SECTION 0B

GENERAL INFORMATION

TABLE OF CONTENTS

Specifications 0B-2
- Technical Data 0B-2
- Vehicle Dimensions and Weights 0B-6
- Standard Bolts Specifications 0B-7

Maintenance and Repair 0B-8
- Maintenance and Lubrication 0B-8
- Normal Vehicle Use 0B-8
- Explanation of Scheduled Maintenance Services 0B-8
- Scheduled Maintenance Charts (Gasoline Engine) 0B-9
- Scheduled Maintenance Charts (Diesel Engine) 0B-11

Owner Inspections and Services 0B-13
- While Operating the Vehicle 0B-13
- At Each Fuel Fill 0B-13
- At Least Twice A Month 0B-13
- At Least Monthly 0B-13
- At Least Twice a Year 0B-13
- Each Time The Oil is Changed 0B-14
- At Least Annually 0B-14
- Recommended Fluids and Lubricants 0B-15

General Description and System Operation 0B-16
- General Repair Instructions 0B-16
- Vehicle Identification Number System 0B-17
- Vehicle Lifting Procedures 0B-20

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SPECIFICATIONS

TECHNICAL DATA

Transaxle Performance

Application	661LA	662NA	662LA	2.0L DOHC	2.3L DOCH	3.2L DOCH
Maximum Speed (Km/h)	140	134	148	154	165	176
Minimum Turning Radius (m)	5.8	5.8	5.8	5.8	5.8	5.8

Performance- Autumatic Transaxle

Application	661LA	662NA	662LA	2.3L DOCH	3.2L DOCH
Maximum Speed (Km/h)	140	137	140	160	170
Minimum Turning Radius (m)	5.8	5.8	5.8	5.8	5.8

Engine

Application	661LA	662NA	662LA	2.0L DOHC	2.3L DOCH	3.2L DOCH
Engine Type	4Cylinder DIESEL	5Cylinder DIESEL	5Cylinder DIESEL	4Cylinder GASOLINE	4Cylinder GASOLINE	6Cylinder GASOLINE
Bore (mm)	89	89	89	89.9	90.9	89.9
Stroke (mm)	92.4	92.4	92.4	78.7	88.4	84
Total Displacement (cc)	2299	2874	2874	1998	2295	3199
Compression Ratio	22:1	22:1	22:1	9.6:1	10.4:1	10:1
Maximum Power (ps/rpm)	101/4000	95/4000	120/4000	135/5500	149/5500	222/5500
Maximum Torque (kg.m/rpm)	21.5/2400	19.6/2400	25.5/2400	19.3/4000	22.4/4000	31.6/3750

Ignition System

Application	2.0L DOHC	2.3L DOHC	2.0L DOHC
Ignition Type	Distributorless Ignition		
Ignition Timing (BOTH)	6° ± 2°	6° ± 2°	8° ± 2°
Ignition Sequence	1-3-4-2	1-3-4-2	1-5-3-6-2-4
Spark Plug Gap (mm)	0.8 ± 0.1	0.8 ± 0.1	0.8 ± 0.1
Spark Plug Maker	Bosch, Chapion, Beru		
Spark Plug Type	F8DC4 (BOSCH) C11YCC (CHAMPION) 14F8DU4 (BERU)		

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Clutch - Manual Type

Application	661LA	662NA	662LA	2.0L DOHC	2.3L DOCH	3.2L DOCH
Type	Single Dry Diaphram					
Outside Diameter (mm)	225	225	240	225	225	240
Inside Diameter (mm)	150	150	150	150	150	155
Thickness	9.2	9.2	9.2	9.2	9.2	9.3
Fluid	Common use :Brake Fluid					

Manual Transmission

Application		661LA	662NA	662LA	2.0L DOHC	2.3L DOCH	3.2L DOCH
Maker		TREMEC	TREMEC	TREMEC	TREMEC	TREMEC	TREMEC
Type or Model		T5	T5	T5	T5	T5	T5
Gear Ratio	: 1st	3.969	3.969	3.969	3.969	3.969	3.969
	2nd	2.341	2.341	2.341	2.341	2.341	2.341
	3rd	1.457	1.457	1.457	1.457	1.457	1.457
	4th	1.000	1.000	1.000	1.000	1.000	1.000
	5th	0.851	0.851	0.851	0.851	0.851	0.851
	Reverse	3.705	3.705	3.705	3.705	3.705	3.705
Final Drive Ratio		4.55	4.55	4.55	4.89	4.55	3.73
Oil Capacity (L)		3.4	3.4	3.4	3.4	3.4	3.4

۰۲۱-۸۸۶۱۰۸۵۸ تلفن شبانه روزی
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Auto Transmission

Application		661LA	662LA	2.3L DOCH	3.2L DOCH
Maker		BTRA	BTRA	BTRA	BTRA
Type or Model		M74 4WD	M74 4WD	M74 4WD	M74 4WD
Gear Ratio	: 1st	2.741	2.741	2.741	2.741
	2nd	1.508	1.508	1.508	1.508
	3rd	1.000	1.000	1.000	1.000
	4th	0.708	0.708	0.708	0.708
	Reverse	2.429	2.429	2.429	2.429
Final Drive Ratio		5.380	4.890	5.860	4.890
Oil Capacity (L)		9	9	9	9

Brake

Application		Specifications
Booster Size	non-ABS	8inch + 9inch
	ABS 5.0	7inch + 8inch
	ABS 5.3	8inch + 9inch
Master Cylinder Diameter (mm)		ϕ 25.4
Booster Ratio		5.6 : 1
Front Brake : Disc Type Rear Brake : Disc Type		Ventilated Solid

Tire and Wheel

Application	Specifications
Standard Tire Size	P235/75 R15, 255/70 R15
Standard Wheel Size	7JJ x 15
Inflation Pressure At Full Lode	
P235 / 75 : Front	30 Psi
Rear	30 Psi
P255 / 75 : Front	30 Psi
Rear	30 Psi

Steering System

Application	Specifications
Gear Type	RACK & PINION
Wheel Alignment:	
Front: Toe-in	0 - 4 mm
Front: Caster	2°30′ ± 30′
Front: Camber	0° ± 30′
Oil Capacity	1L

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Suspension

Application	Specifications
Front Type	Double Wishbone
Rear Type	5 - Link

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Fuel System

Application	Specifications
Fuel Pump Type	Electric Motor Pump
Fuel Capacity	70 L

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Lubricating System

Application	661LA	662NA	662LA	2.0L DOHC	2.3L DOCH	3.2L DOCH
Oil Pump Type	External Gear pump					
Oil Filter Type	Combination (Full & Part)			Full Flow		
Oil Capacity (L) (Including Oil Filter)	8.0	9.0	9.5	7.2	7.5	8.2

Cooling System

Application	661LA	662NA	662LA	2.0L DOHC	2.3L DOCH	3.2L DOCH
Coolant Capacity (L)	9.5 - 10	10.5	10.5 - 11	10.5	10.5	11.3
Radiator Type	Forced Circulation					
Water Pump Type	Centrifugal					

Electric System

Application	661LA	662NA	662LA	2.0L DOHC	2.3L DOCH	3.2L DOCH
Battery (MF)	12V - 90AH					
Generator	75A	75A	75A	75A	115A	115A
Starter	2.2kw	2.2kw	2.2kw	1.2kw	1.2kw	1.7kw

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VEHICLE DIMENSIONS AND WEIGHTS

Vehicle Dimensions

Application	Specifications
Overall Length (mm)	4330
Overall Width (mm)	1841
Overall Height (mm)	1840
Wheel Base (mm)	2840
Tread : Front (mm) Rear (mm)	1510 1520

Vehicle Weights

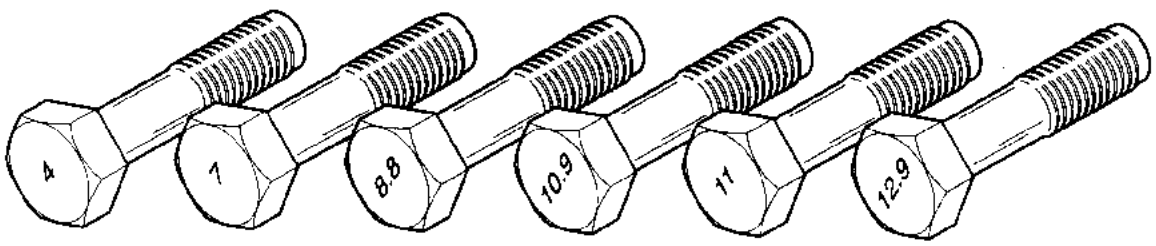
Application	661LA	662NA	662LA	2.0L DOHC	2.3L DOCH	3.2L DOCH
Manual : Curb Weight (kg) Gross Vehicle Weight (kg)	1790 2515	1810 2515	1830 2515	1790 2515	1790 2515	1840 2515
Automatic : Curb Weight (kg) Gross Vehicle Weight (kg)	1810 2515	1815 2515	1850 2515	- -	1810 2515	1860 2515
Passenger Capacity	5	5	5	5	5	5

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STANDARD BOLTS SPECIFICATIONS

Bolt*	Torque (N•m / lb-in)					
	Standard			Limit		
	4T	7T	9T	4T	7T	9T
M3 x 0.5	0.5 N•m (4.5 lb-in)	0.9 N•m (8 lb-in)	1.3 N•m (12 lb-in)	0.7 N•m (6.3 lb-in)	1.2 N•m (11 lb-in)	17 N•m (15 lb-in)
M4 x 0.7	1.2 N•m (11 lb-in)	2.0 N•m (18 lb-in)	3.0 N•m (27 lb-in)	1.6 N•m (14 lb-in)	2.6 N•m (23 lb-in)	4.0 N•m (36 lb-in)
M5 x 0.8	2.4 N•m (22 lb-in)	4.0 N•m (36 lb-in)	5.6 N•m (50 lb-in)	3.1 N•m (28 lb-in)	5.2 N•m (47 lb-in)	7.6 N•m (68 lb-in)
M6 x 1.0	4.0 N•m (36 lb-in)	6.7 N•m (60 lb-in)	9.7 N•m (87 lb-in)	5.4 N•m (49 lb-in)	9.0 N•m (81 lb-in)	12.7 N•m (114 lb-in)
M8 x 1.25	8.6 N•m (77 lb-in)	15.7 N•m (12 lb-in)	22.5 N•m (17 lb-in)	12.7 N•m (9 lb-in)	20.6 N•m (15.2 lb-in)	30.4 N•m (22 lb-in)
M10 x 1.25	18.6 N•m (14 lb-in)	32.3 N•m (24 lb-in)	46.0 N•m (34 lb-in)	25.5 N•m (19 lb-in)	42.1 N•m (31 lb-in)	60.8 N•m (31 lb-in)
M10 x 1.5	18.6 N•m (14 lb-in)	30.4 N•m (22 lb-in)	44.1 N•m (33 lb-in)	24.5 N•m (18 lb-in)	41.2 N•m (30 lb-in)	58.8 N•m (44 lb-in)
M12 x 1.25	34.3 N•m (25lb-in)	56.8 N•m (42 lb-in)	82.3 N•m (61 lb-in)	45.0 N•m (33 lb-in)	75.5 N•m (56 lb-in)	107.8 N•m (80 lb-in)
M12 x 1.75	32.3 N•m (24 lb-in)	53.9 N•m (40 lb-in)	77.4 N•m (57 lb-in)	43.1 N•m (32 lb-in)	71.5 N•m (53 lb-in)	98.0 N•m (73 lb-in)
M14 x 1.5	54.0 N•m (40 lb-in)	89.2 N•m (66 lb-in)	127.4 N•m (94 lb-in)	71.6 N•m (53 lb-in)	117.6 N•m (87 lb-in)	166.6 N•m (123 lb-in)
M16 x 1.5	81.3 N•m (60 lb-in)	107.8 N•m (80 lb-in)	196.0 N•m (145 lb-in)	107.8 N•m (80 lb-in)	186.2 N•m (138 lb-in)	264.6 N•m (196 lb-in)
M18 x 1.5	117.6 N•m (87 lb-in)	196.0 N•m (145 lb-in)	284.2 N•m (210 lb-in)	156.8 N•m (116 lb-in)	264.6 N•m (196 lb-in)	372.4 N•m (276 lb-in)
M20 x 1.5	166.6N•m (123 lb-in)	274.4 N•m (203 lb-in)	392.0 N•m (290 lb-in)	215.6 N•m (160 lb-in)	362.6 N•m (268 lb-in)	519.4 N•m (384 lb-in)
M22 x 0.5	225.4N•m (167 lb-in)	372.4 N•m (276 lb-in)	529.2 N•m (392 lb-in)	294.0 N•m (218 lb-in)	490.0 N•m (362 lb-in)	705.6 N•m (522 lb-in)
M24 x 1.5	284.2 N•m (210 lb-in)	480.2 N•m (355 lb-in)	686.0 N•m (508 lb-in)	382.2 N•m (283 lb-in)	637.0 N•m (471 lb-in)	921.2 N•m (682 lb-in)
M24 x 2.0	274.4 N•m (203 lb-in)	460.6 N•m (341 lb-in)	666.4 N•m (493 lb-in)	372.4 N•m (276 lb-in)	617.4 N•m (457 lb-in)	891.8 N•m (660 lb-in)

* Diameter X pitch in millimeters



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MAINTENANCE AND REPAIR

MAINTENANCE AND LUBRICATION

NORMAL VEHICLE USE

The maintenance instructions contained in the maintenance schedule are based on the assumption that the vehicle will be used for the following reasons:

- To carry passengers and cargo within the limitation of the tire inflation prassure. Refer to “Tire and Wheel” in section 2E.
- To be driven on reasonable road surfaces and within legal operating limits.

EXPLANATION OF SCHEDULED MAINTENANCE SERVICES

The services listed in the maintenance schedule are further explained below. When the following maintenance services are performed, make sure all the parts are replaced and all the necessary repairs are done before driving the vehicle. Always use the proper fluid and lubricants.

Engine Oil and Oil Filter Change

Always use above the API SH grade or recommended engine oil.

Engine Oil Viscosity

Engine oil viscosity (thickness) has an effect on fuel economy and cold weather operation. Lower viscosity engine oils can provide better fuel economy and cold weather performance; however, higher temperature weather conditions require higher viscosity engine oils for satisfactory lubrication. Using oils of any viscosity other than those viscosities recommended could result in engine damage.

Cooling System Service

Drain, flush and refill the system with new coolant. Refer to “Recommended Fluids And Lubricants“ in this section.

Air Cleaner Element Replacement

Clean the air cleaner element every.

- Gasoline Engine : 15,000km (10,000 miles)
- Diesel Engine : 10,000km (6,000 miles)

Replace the air cleaner element every .

- Gasoline Engine : 60,000km (36,000 miles)
- Diesel Engine : 30,000km (18,000 miles)

Replace the air cleaner more often under dusty conditions.

Fuel Filter Replacement

Replace the engine fuel filter every.

- Gasoline Engine : 60,000km (36,000 miles)
- Diesel Engine : 45,000km (24,000 miles)

Spark Plug Replacement

Replace spark plugs with same type.

- Type : BOSCH : F8DC4
  BERU : 14F-8DU4
  Champion : C11YCC
- Gap : 0.8 ± 0.1 mm

Spark Plug Wire Replacement

Clean wires and inspect them for burns, cracks or other damage. Check the wire boot fit at the Distributor and at the spark plugs. Replace the wires as needed.

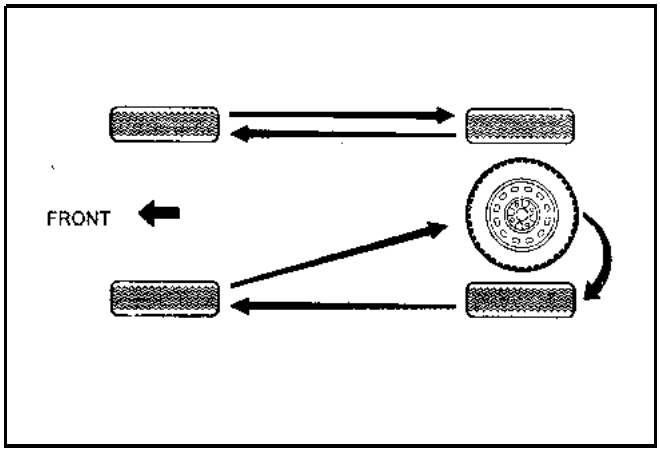
Brake System Service

Check the disc brake pads or the drum brake linings. Check the pad and the lining thickness carefully.

Tire and Wheel Inspection and Rotation

Check the tires for abnormal wear or damage. To equalize wear and obtain maximum tire life, rotate the tires. If irregular or premature wear exists, check the wheel alignment and check for damaged wheels. While the tires and wheels are removed, inspect the brakes.

Tire Rotation (Left-hand Drive Type)



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SCHEDULED MAINTENANCE CHARTS (GASOLINE ENGINE)

Engine

MAINTENANCE ITEM	MAINTENANCE INTERVAL								
	Kilometers or time in months, whichever comes first								
x1,000 km	1	15	30	45	60	75	90	105	120
Months	-	12	24	36	48	60	72	84	96
Drive belt	I	I	I	I	I	I	I	I	I
Engine oil & filter (1) (3)	I	R	R	R	R	R	R	R	R
Cooling system hose & connections	I	I	I	I	I	I	I	I	I
Engine coolant (3)	I	I	I	I	R	I	I	I	R
Fuel filter (2)	-	-	-	-	R	-	-	-	R
Fuel line & connections	I	I	I	I	I	I	I	I	I
Air cleaner (2)	-	I	I	I	R	I	I	I	R
Ignition timing	-	I	I	I	I	I	I	I	I
Spark plugs	-	I	R	I	R	I	R	I	R
Charcoal canister & vapor lines	-	-	-	I	-	-	I	-	-

Chart Symbols:

I - Inspect these items and their related parts. If necessary, correct, clean, replenish, adjust or replace.

R - Replace or change.

(1) If vehicle is operated under severe condition : short distance driving, extensive idling or driving in dusty condition. Change engine oil and the filter every 7,500 km or 6 months, whichever comes first.

(2) More frequent maintenance is required if under dusty driving condition.

(3) Refer to “Recommended fluids and lubricants”.

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Chassis and Body

MAINTENANCE ITEM	MAINTENANCE INTERVAL								
	Kilometers or time in months, whichever comes first								
x1,000 km	1	15	30	45	60	75	90	105	120
Months	-	12	24	36	48	60	72	84	96
Exhaust pipes & mountings	-	I	I	I	I	I	I	I	I
Brake/Clutch fluid (3)(4)	-	I	R	I	R	I	R	I	R
Parking brake/Brake pads F & R (5)	-	I	I	I	I	I	I	I	I
Brake line & connections (including booster)	I	I	I	I	I	I	I	I	I
Manual transmission oil (3)	I	I	I	R	I	I	R	I	I
Clutch & brake pedal free play	-	I	I	I	I	I	I	I	I
Front & Rear Differential Fluid (3)	I	I	I	R	I	I	R	I	I
Transfer case fluid	I	I	I	R	I	I	R	I	I
Automatic transmission fluid (MB W4A040) (6)	I	I	I	R	I	I	I	I	I
Automatic transmission fluid (BTRA M74)	I	I	I	I	I	I	I	I	I
Chassis & underbody bolts & nuts tight/secure	I	I	I	I	I	I	I	I	I
Tire condition & inflation pressure	I	I	I	I	I	I	I	I	I
Wheel alignment (7)	Inspect & adjust when abnormal condition is noted								
Steering wheel & linkage	-	I	I	I	I	I	I	I	I
Power steering fluid & lines* (3)	-	I	I	I	I	I	I	I	I
Drive shaft boots	-	I	I	I	I	I	I	I	I
Seat belts, buckles & anchors	I	I	I	I	I	I	I	I	I
Lubricate locks, hinges & bonnet latch	-	I	I	I	I	I	I	I	I

Chart Symbols:

I - Inspect these items and their related parts. If necessary, correct, clean, replenish, adjust or replace.

R - Replace or change.

(3) Refer to “Recommended fluids and lubricants”.

(4) Change the brake / clutch fluid every 15,000 km if the vehicle is mainly driven under severe conditions:

- Driving in hilly or mountainous terrain, or
- Towing a trailer frequently

(5) More frequent maintenance is required if under severe condition : short distance driving, extensive idling, frequent low - speed operation in stop-and-go traffic or driving in dusty condition.

(6) Change automatic transaxle fluid and filter every 75,000 km if the vehicle is mainly driven under severe conditions.

- In heavy city traffic where the outside temperature regularly reaches 32°C (90°F) or higher, or
- In hilly or mountainous terrain, or
- When doing frequent trailer towing, or
- Uses such as found in taxi, police or delivery service.

(7) If necessary, rotate and balance wheels.

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SCHEDULED MAINTENANCE CHARTS (DIESEL ENGINE)

Engine

MAINTENANCE ITEM	MAINTENANCE INTERVAL										
	Kilometers or time in months, whichever comes first										
x1,000 km	1	10	20	30	40	50	60	70	80	90	100
Months	-	6	12	18	24	30	36	42	48	54	60
Drive belt	I	I	I	I	I	I	I	I	I	I	I
Engine oil & fillter (1) (3)	R	R	R	R	R	R	R	R	R	R	R
Cooling system hose & connections	-	-	I	I	I	I	I	I	I	I	I
Engine coolant (3)	-	-	I	-	-	-	R	-	-	-	I
Fuel filter (2)	-	-	-	-	R	-	-	-	-	R	-
Fuel line & connections	I	I	I	I	I	I	I	I	I	I	I
Glow plug	-	-	I	-	I	-	I	-	R	-	I
Pre - fuel filter	-	I	I	R	I	I	I	I	I	I	I
Air cleaner (2)	-	I	I	I	I	I	R	I	I	R	I
Ignition timing (see NOTE 1)	-	I	I	I	I	I	I	I	I	I	I

NOTE 1 : Injection Timing :
Adjust as required :
- When excessive smoke is visible (black or white)
- Poor performance/economy

Chart Symbols:

I - Inspect these items and their related parts. If necessary, correct, clean, replenish, adjust or replace.

R - Replace or change.

(1) If vehicle is operated under severe condition : short distance driving, extensive idling or driving in dusty condition, change engine oil every 5,000km or 3 months, whichever comes first.

(2) More frequent maintenance is required if under dusty driving conditing.

(3) Refer to “Recommended fluids and lubricants”.

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Chassis and Body

MAINTENANCE ITEM	MAINTENANCE INTERVAL										
	Kilometers or time in months, whichever comes first										
x1,000 km	1	10	20	30	40	50	60	70	80	90	100
Months	-	6	12	18	24	30	36	42	48	54	60
Exhaust pipes & mountings	-	I	I	I	I	I	I	I	I	I	I
Brake/clutch fluid (3) (4)	I	I	I	R	I	I	R	I	I	R	I
Parking brake/Brake pads (F & R) (5)	-	I	I	I	I	I	I	I	I	I	I
Brake line & connections (including booster)	-	I	I	I	I	I	I	I	I	I	I
Manual transmission fluid (3)	-	I	I	I	I	R	I	I	I	I	R
Clutch & brake pedal free play	-	I	I	I	I	I	I	I	I	I	I
F & R Differential fluid (3)	I	I	I	I	I	R	I	I	I	I	R
Transfer case fluid (3)	-	I	I	I	I	R	I	I	I	I	R
Automatic transmission fluid (BTRA M74) (6)	-	I	I	I	I	I	I	I	I	I	I
Chassis & underbody bolts & nuts tight/secure	I	I	I	I	I	I	I	I	I	I	I
Tire condition & inflation pressure	I	I	I	I	I	I	I	I	I	I	I
Wheel alignment (7)	Inspect & adjust when abnormal condition is noted										
Steering wheel & linkage	-	I	I	I	I	I	I	I	I	I	I
Power steering fluid & lines* (3)	-	I	I	I	I	I	I	I	I	I	I
Drive shaft boots	I	I	I	I	I	I	I	I	I	I	I
Seat belts, buckles & anchors	I	I	I	I	I	I	I	I	I	I	I
Lubricate locks, hinges & bonnet latch	I	I	I	I	I	I	I	I	I	I	I

Chart Symbols:

I - Inspect these items and their related parts. If necessary, correct, clean, replenish, adjust or replace.

R - Replace or change.

(3) Refer to “Recommended fluids and lubricants”.

(4) Change the brake / clutch fluid more regularly if the vehicle is mainly driven under severe conditions :

- Driving in hilly or mountainous terrain, or
- Towing a trailer frequently

(5) More frequent maintenance is required if under severe condition : short distance driving, extensive idling, frequent low

- speed operation in stop-and-go traffic or driving in dusty condition.

(6) Change automatic transmission fluid every 70,000 km if the vehicle is mainly driven under severe conditions.

- In heavy city traffic where the outside temperature regularly reaches 32°C (90°F) or higher, or
- In hilly or mountainous terrain, or
- When doing frequent trailer towing, or
- Uses such as found in taxi, police or delivery service.

(7) If necessary, rotate and balance wheels.

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OWNER INSPECTIONS AND SERVICES

WHILE OPERATING THE VEHICLE

Horn Operation

Blow the horn occasionally to make sure it works. Check all the button locations.

Brake System Operation

Be alert for abnormal sounds, increased brake pedal travel or repeated puling to one side when braking. Also, if the brake warning light goes on, or flashes, something may be wrong with part of the brake system.

Exhaust System Operation

Be alert to any changes in the sound of the system or the smell of the fumes. These are signs that the system may be leaking or overheating. Have the system inspected and repaired immediately.

Tires, Wheels and Alignment Operation

Be alert to any vibration of the steering wheel or the seats at normal highway speeds. This may mean a wheel needs to be balanced. Also, a pull right or left on a straight, level road may show the need for a tire pressure adjustment or a wheel alignment.

Steering System Operation

Be alert to changes in the steering action. An inspection is needed when the steering wheel is hard to turn or has too much free play, or is unusual sounds are noticed when turning or parking.

Headlight Aim

Take note of the light pattern occasionally. Adjust the headlights if the beams seem improperly aimed.

AT EACH FUEL FILL

A fluid loss in any (except windshield washer) system may indicate a problem. Have the system inspected and repaired immediately.

Engine Oil Level

Check the oil level and add oil if necessary. The best time to check the engine oil level is when the oil is warm.

1. After stopping the engine, wait a few minutes for the oil to drain back to the oil pan.
2. Pull out the oil level indicator (dip stick).
3. Wipe it clean, and push the oil level indicator back down all the way.
4. Pull out the oil level indicator and look at the oil level on it.
5. Add oil, if needed, to keep the oil level above the lower mark. Avoid overfilling the engine, since this may cause engine damage.
6. Push the indicator all the way back down into the engine after taking the reading.

If you check the oil level when the oil is cold, do not run the engine first. The cold oil will not drain back to the pan fast enough to give a true oil level reading.

Engine Coolant Level and Condition

Check the coolant level in the coolant reservoir tank and add coolant if necessary. Inspect the coolant. Replace dirty or rusty coolant.

Windshield Washer Fluid Level

Check the washer fluid level in the reservoir. Add fluid if necessary.

AT LEAST TWICE A MONTH

Tire And Wheel Inspection and Pressure Check

Check the tire for abnormal wear or damage. Also check for damaged wheels. Check the tire pressure when the tires are cold (check the spare also, unless it is a stowaway). Maintain the recommended pressures. Refer to “Tire and Wheel” is in section 0B.

AT LEAST MONTHLY

Light Operation

Check the operation of the license plate light, the headlights (including the high beams), the parking lights, the fog lights, the taillight, the brake lights, the turn signals, the backup lights and the hazard warning flasher.

Fluid Leak Check

Periodically inspect the surface beneath the vehicle for water, oil, fuel or other fluids, after the vehicle has been parked for a while. Water dripping from the air conditioning system after use is normal. If you notice fuel leaks or fumes, find the cause and correct it at once.

AT LEAST TWICE A YEAR

Power Steering System Reservoir Level

Check the power steering fluid level. Keep the power steering fluid at the proper level. Refer to Section 6A, Power Steering System.

Brake Master Cylinder Reservoir Level

Check the fluid and keep it at the proper level. A low fluid level can indicate worn disc brake pads which may need to be serviced. Check the breather hole in the reservoir cover to be free from dirt and check for an open passage.

Weather- Strip Lubrication

Apply a thin film silicone grease using a clean cloth.

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EACH TIME THE OIL IS CHANGED

Brake System Inspection

This inspection should be done when the wheels are removed for rotation. Inspect the lines and the hoses for proper hookup, binding, leaks, cracks, chafing, etc. Inspect the disc brake pads for wear. Inspect the rotors for surface condition. Inspect other brake parts, the parking brake, etc., at the same time. Inspect the brakes more often if habit or conditions result in frequent braking.

Steering, Suspension and Front Drive Axle Boot And Seal Inspection

Inspect the front and rear suspension and the steering system for damaged, loose or missing parts, signs of wear or lack of lubrication. Inspect the power steering line and the hoses for proper hookup, binding, leaks, cracks, chafing, etc. Clean and inspect the drive axle boot and seals for damage, tears or leakage. Replace the seals if necessary.

Exhaust System Inspection

Inspect the complete system (including the catalytic converter if equipped). Inspect the body near the exhaust system. Look for broken, damaged, missing, or out-of-position parts as well as open seams, holes, loose connections, or other conditions which could cause heat buildup in the floor pan or could let exhaust fumes seep into the trunk or passenger compartment.

Throttle Linkage Inspection

Inspect the throttle linkage for interference or binding, damaged, or missing parts. Lubricate all linkage joints and throttle cable joints, the intermediate throttle shaft bearing, the return spring at throttle valve assembly, and the accelerator pedal sliding face with suitable grease. Check the throttle cable for free movements.

Engine Drive Belts

Inspect all belts for cracks, fraying, wear and proper tension. Adjust or replace the belts as needed.

Hood Latch Operation

When opening the hood, note the operation of the secondary latch. It should keep the hood from opening all the way when the primary latch is released. The hood must close firmly.

AT LEAST ANNUALLY

Lap and Shoulder Belts Condition and Operation

Inspect the belt system including: the webbing, the buckles, the latch plates, the retractor, the guide loops and the anchors.

Movable Head Restraint Operation

On vehicles with movable head restraints, the restraints must stay in the desired position.

Spare Tire and Jack Storage

Be alert to rattles in the rear of the vehicle. The spare tire, all the jacking equipment, and the tools must be securely stowed at all times. Oil the jack ratchet or the screw mechanism after each use.

Key Lock Service

Lubricate the key lock cylinder.

Body Lubrication Service

Lubricate all the body door hinges including the hood, the fuel door, the rear compartment hinges and the latches, the glove box and the console doors, and any folding seat hardware.

Underbody Flushing

Flushing the underbody will remove any corrosive materials used for ice and snow removal and dust control. At least every spring clean the underbody. First, loosen the sediment packed in closed areas of the vehicle. Then flush the underbody with plain water.

Engine Cooling System

Inspect the coolant and freeze protection fluid. If the fluid is dirty or rusty, drain, flush and refill the engine cooling system with new coolant. Keep the coolant at the proper mixture in order to ensure proper freeze protection, corrosion protection and engine operating temperature. Inspect the hoses. Replace the cracked, swollen, or deteriorated hoses. Tighten the clamps. Clean the outside of the radiator and the air conditioning condenser. Wash the filler cap and the neck. Pressure test the cooling system and the cap in order to help ensure proper operation.

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RECOMMENDED FLUIDS AND LUBRICANTS

Usage		Capacity	Fluid/Lubricant
Engine Oil (Change with filter)	3.2L DOHC	8.2 L	Quality class - API ; SH grade or above ACEA ; A2 or A3 MB sheet ; 229.1 Viscosity - MB sheet ; 224.1
	2.3L DOHC	7.5 L	
	662LA	9.5 L	Quality class - API ; CG grade or above ACEA ; B2 or B3 MB sheet ; 228.1, 228.3, 228.5, 229.1 Viscosity - MB sheet ; 224.1
	661LA	8.0 L	
Engine Coolant	3.2L DOHC	11.3 L	ALUTEC P-78
	2.3L DOHC	10.5 L	
	662LA	10.5 - 11.0 L	
	661LA	9.5 - 10.0 L	
Brake / Clutch Fluid		Approx. 0.5L level must be maintained between MAX & MIN level	DOT-3 & SAE J 1703
Power Steering System		1.0 L	ATF DEXRON-II
Parking Brake Cable		As required	Grease
Hood Latch Assembly		As required	Grease
Hood and Door Hinges Fuel Door Hinge Rear Compartment Lid Hinges		As required	Spray type grease
Weatherstrips		As required	Silicone grease

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GENERAL DESCRIPTION AND SYSTEM OPERATION

GENERAL REPAIR INSTRUCTIONS

- If a floor jack is used, the following precautions are recommended.
- Park the vehicle on level ground, “block” the front or rear wheels, set the jack against the frame, raise the vehicle and support it with chassis stands and then perform the service operation.
- Before performing the service operation, disconnect the negative battery cable in order to reduce the chance of cable damaged and burning due to short-cir cuiting.
- Use a cover on the body, the seats and the floor to protect them against damage and contamination.
- Handle brake fluid and antifreeze solution with care as they can cause paint damage.
- The use of proper tools, and the recommended essential and available tools where specified, are important for efficient and reliable performance of the service repairs.
- Use genuine DAEWOO parts.
- Discard used cotter pins, gaskets, O-rings, oil seals, lock washers and self-locking nuts. Prepare new ones for installation. Normal function of these parts cannot be maintained if these parts are reused.
- Keep the disassembled parts neatly in groups to facilitate proper and smooth reassembly.
- Keep attaching bolts and nuts separated, as they vary in hardness and design depending on the position of the installation.
- Clean the parts before inspection or reassembly.
- Also clean the oil parts, etc. Use compressed air to make certain they are free of restrictions.
- Lubricate rotating and sliding faces of parts with oil or grease before installation.
- When necessary, use a sealer on gaskets to prevent leakage.
- Carefully observe all specifications for bolt and nut torques.
- When service operation is completed, make a final check to be sure service was done properly and the problem was corrected.

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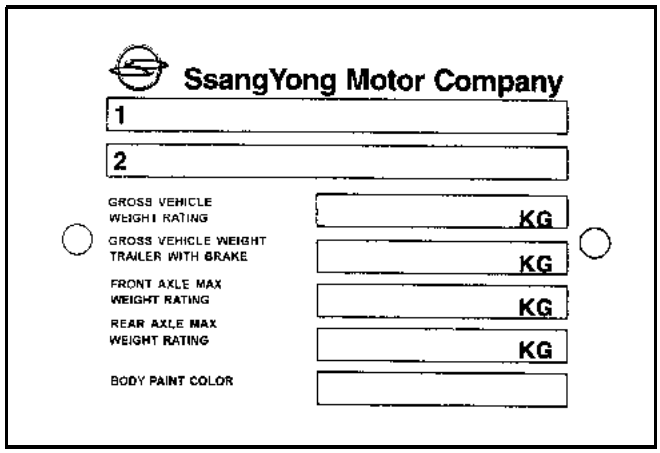
VEHICLE IDENTIFICATION NUMBER SYSTEM



12~17.Production Serial Number
: 000001- 999999
11.Plant Code
P : PyongTaek Plant
10.Model Year
V : 1997
W : 1998
X : 1999
Y : 2000
9. Check Digit
S : All area except North America
8. Engine Type
6 : 2295cc, In-line 4Cylinder, Gasoline (E23)
8 : 1998cc, In-line 4Cylinder, Gasoline (E20)
9 : 3199cc, In-line 6Cylinder, Gasoline (E32)
A : 2299cc, In-line 4Cylinder, Diesel (OM661)
B : 2874cc, In-line 5Cylinder, Diesel (OM662)
7. Restraint System
1 : 3-Point Safety Belt, 2 : 2-Point Safety Belt
6. Trim Level
A : Standard, B : Deluxe, C : Super Deluxe
5. Body Type
2: 3-Door, 4: 3-Door Soft Top
4. Line Models
L : Korando, LHD, R : Korando, RHD
3. Vehicle Type
T : Passenger Car, A : Truck
2. Maker Identification : P
1. Nation : K
*. Symbol according to No.

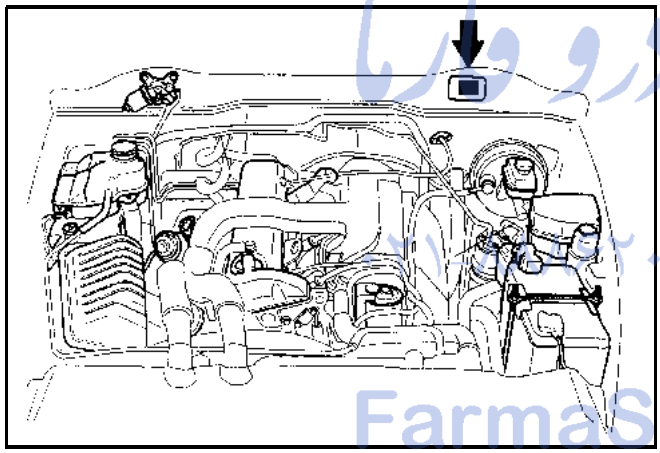
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Manufacturer’s Plate

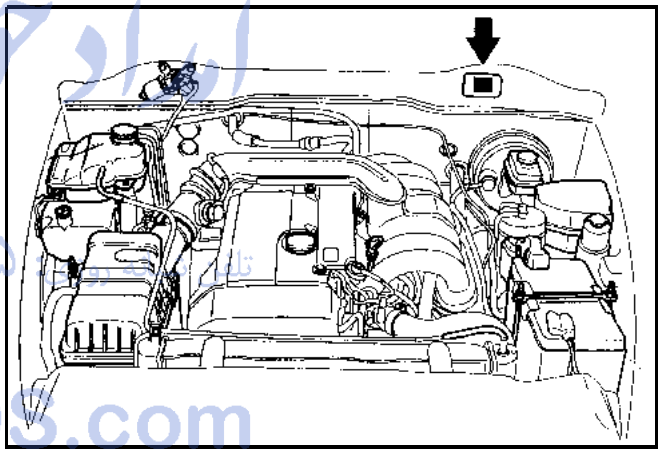


1 Type Approval No.
2 ehicle Identification Number.

Manufacturer’s Plate Location



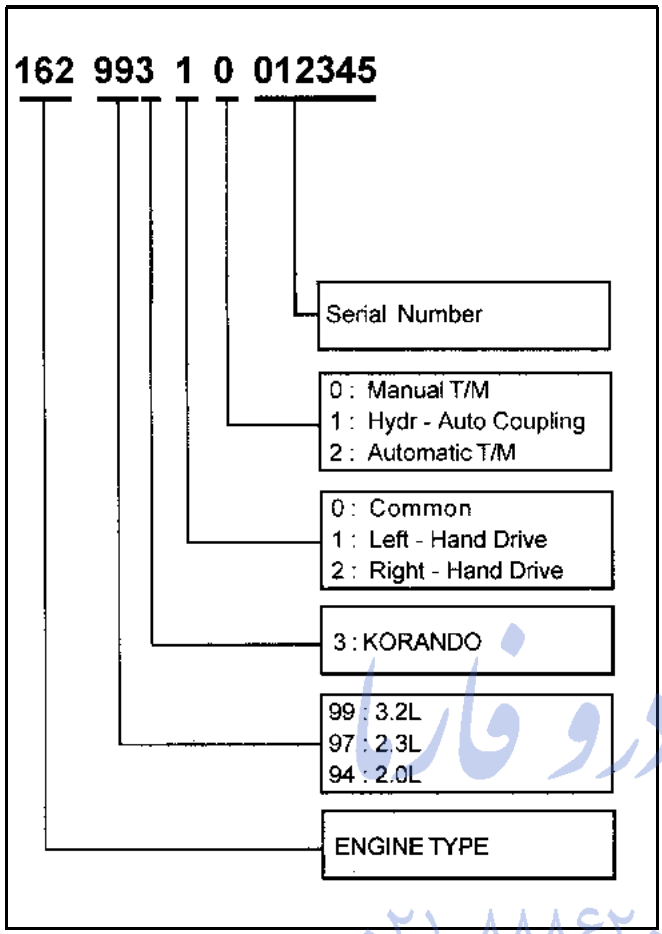
Diesel Engine



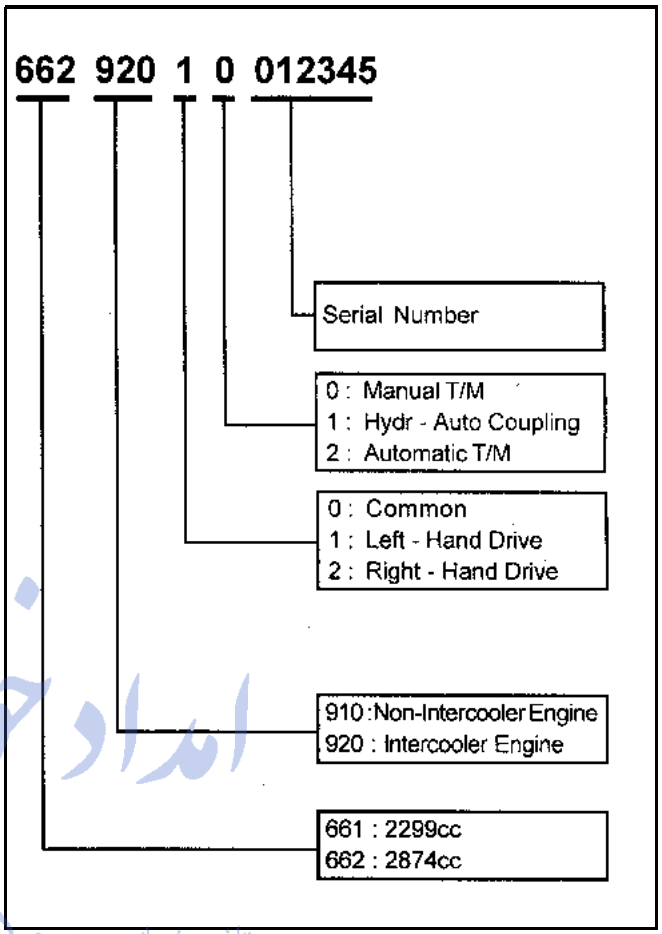
Gasoline Engine

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Gasolind Engine Number

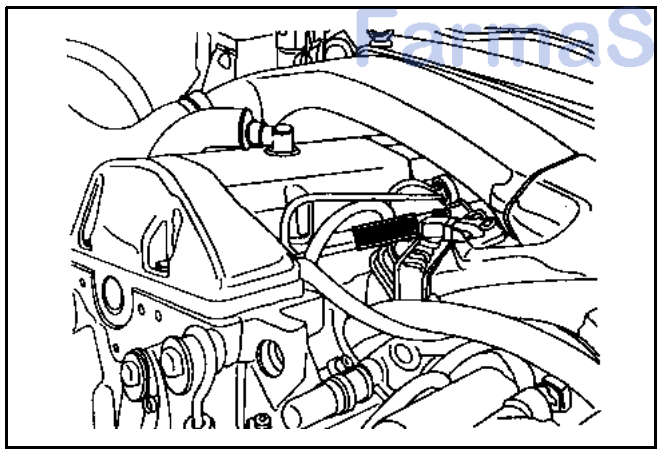


Diesel Engine Number

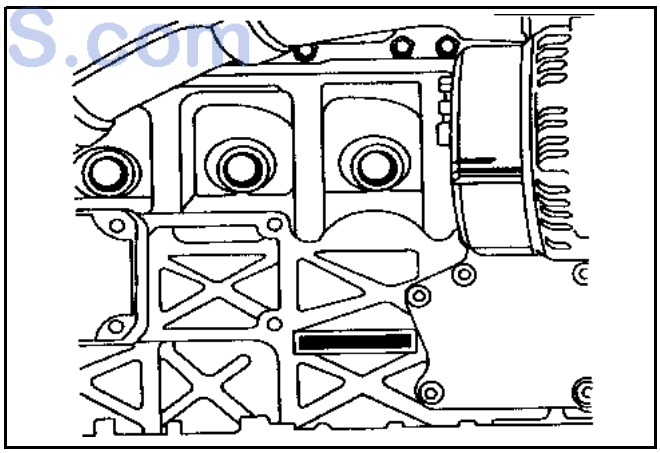


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Engine Number Location



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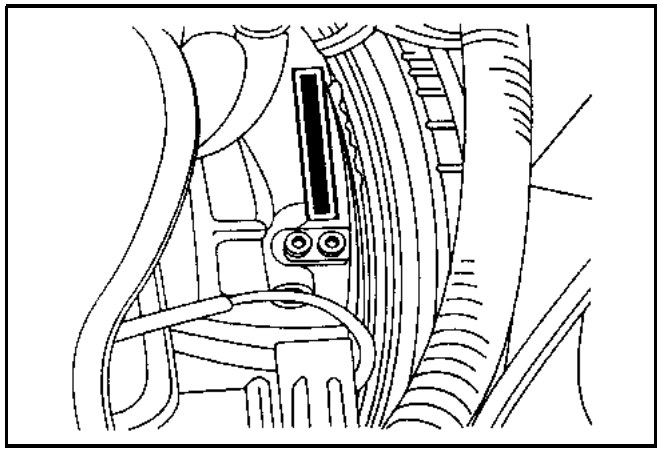


Diesel Engine

The engine number is stamped on the cylinder block in front of injection pump.

IL6 3200 Gasolind Engine

The engine number is stamped on the lower rear side of the alternator.



2300 DOHC Gasolind Engine

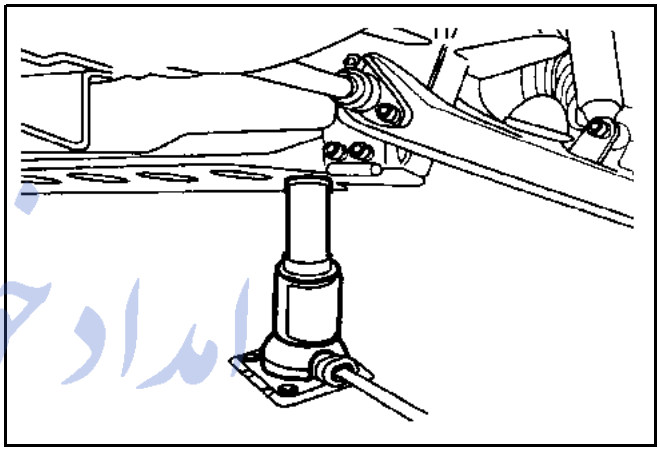
The engine number is stamped on the upper rear left-hand side of the cylinder block.

VEHICLE LIFTING PROCEDURES

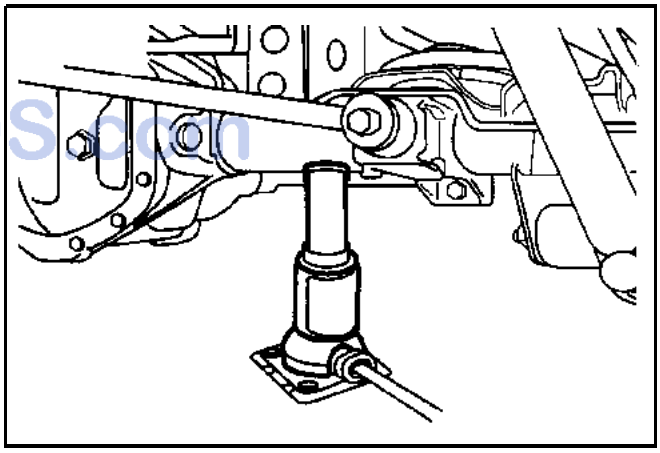
To raise the vehicle, place the lifting equipment only at the points indicated. Failure to use these precise positions may result in permanent vehicle body deformation.

Many dealer service facilities and service stations are equipped with automative hoists that bear upon some parts of the frame in order to lift the vehicle. If any other hoist method is used, take special care to avoid damaging the fuel tank, the filter neck, the exhaust system, or the underbody.

Vehicle Lifting Points



Using Jack
(Rearward of Front Tire)



Using Jack
(Forward of Rear Tire)

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SECTION 1

ENGINE

SECTION 1A1 (M162 ENGINE)

GENERAL ENGINE INFORMATION

TABLE OF CONTENTS

Specifications 1A1-2
Engine Specifications 1A1-2
Component Locator 1A1-3
Front View 1A1-3
Side View 1A1-4
Performance Curve 1A1-5
E32 Engine 1A1-5
Diagnosis 1A1-6
Oil Leak Diagnosis 1A1-6
Engine Cranking at The Front of Crankshaft 1A1-7
Compression Pressure Test 1A1-8
Cylinder Pressure Leakage Test 1A1-10
General Information 1A1-12
Cleanliness and Care 1A1-12
On-Engine Service 1A1-12

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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SPECIFICATIONS

ENGINE SPECIFICATIONS

Application			E32 Engine
Engine Model			M162.990
Displacement (CC)			3199
Cylinder (Bore x Stroke) (mm)			89.9 x 84.0
Fuel Injection / Ignition System			MSE 3.62S
Compression Ratio			10 : 1
Number of Cylinders			6
Camshaft Valve Arrangement			DOHC
Camshaft Drive Type			Chain-Driven
Max. Output (ps/rpm)			222 / 5500
Max. Torque (kg•m/rpm)			31.6 / 3750
Firing Order			1-5-3-6-2-4
Ignition Type			Distributorless Double Ignition
Ignition Timing			BTDC 8° ± 2°
Valve Timing	Intake	Open/Close	ATDC 11° / ABDC 34°
	Exhaust	Open/Close	BBDC 31° / BTDC 14°
Valve Clearance Adjustment			Automatic Control
Idle Speed (rpm)			700 ± 50
Fuel Injection Pressure (kg/cm^2)			3 - 4
Oil Capacity (liter)			8.2
Lubrication Type			Forced by Gear Pump
Oil Filter Type			Full Flow with Paper Filter
Fuel			Unleaded Gasoline

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MSE 3.62S/3.53S (Motorsteuer Elektronik : German)

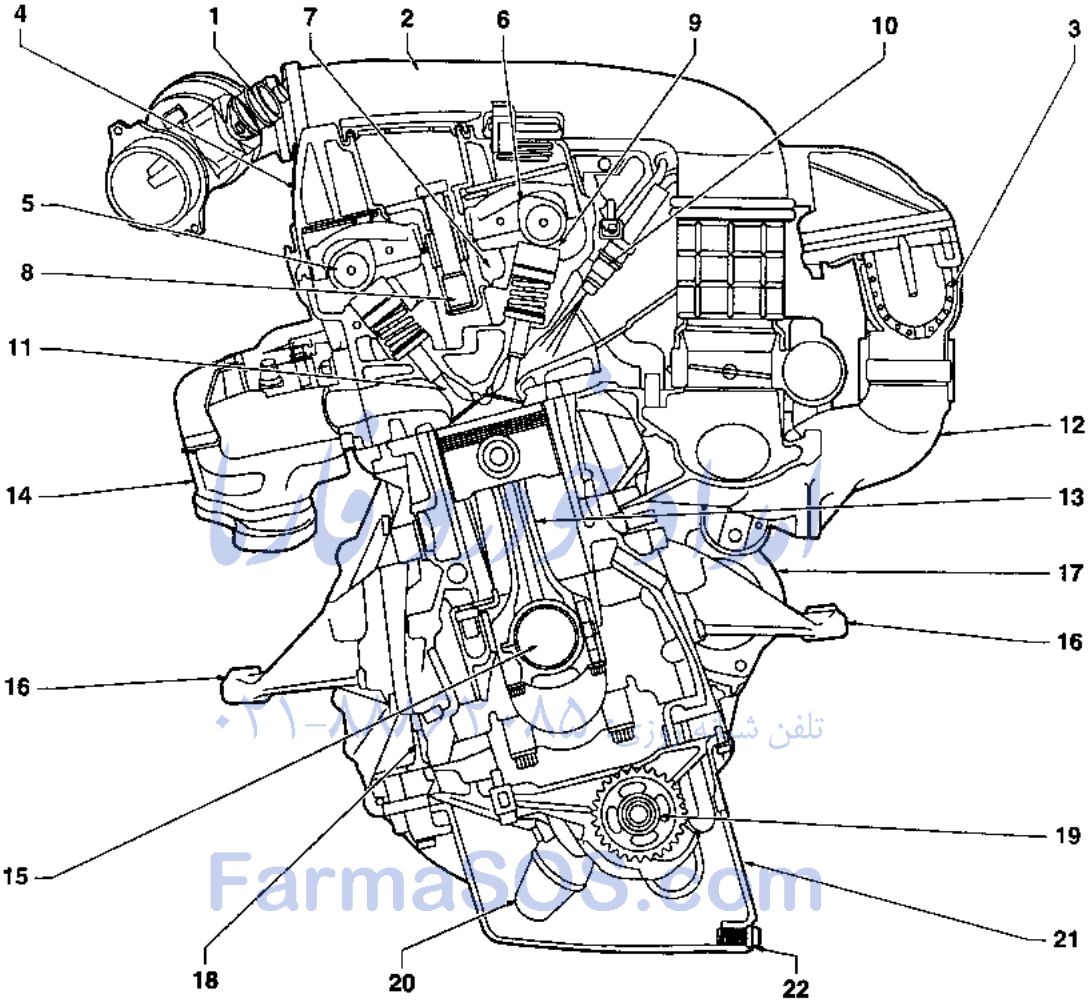
MSE : Engine Control Electronic

3.62S : 6 Cylinder Version

3.53S : 4 Cylinder Version

COMPONENT LOCATOR

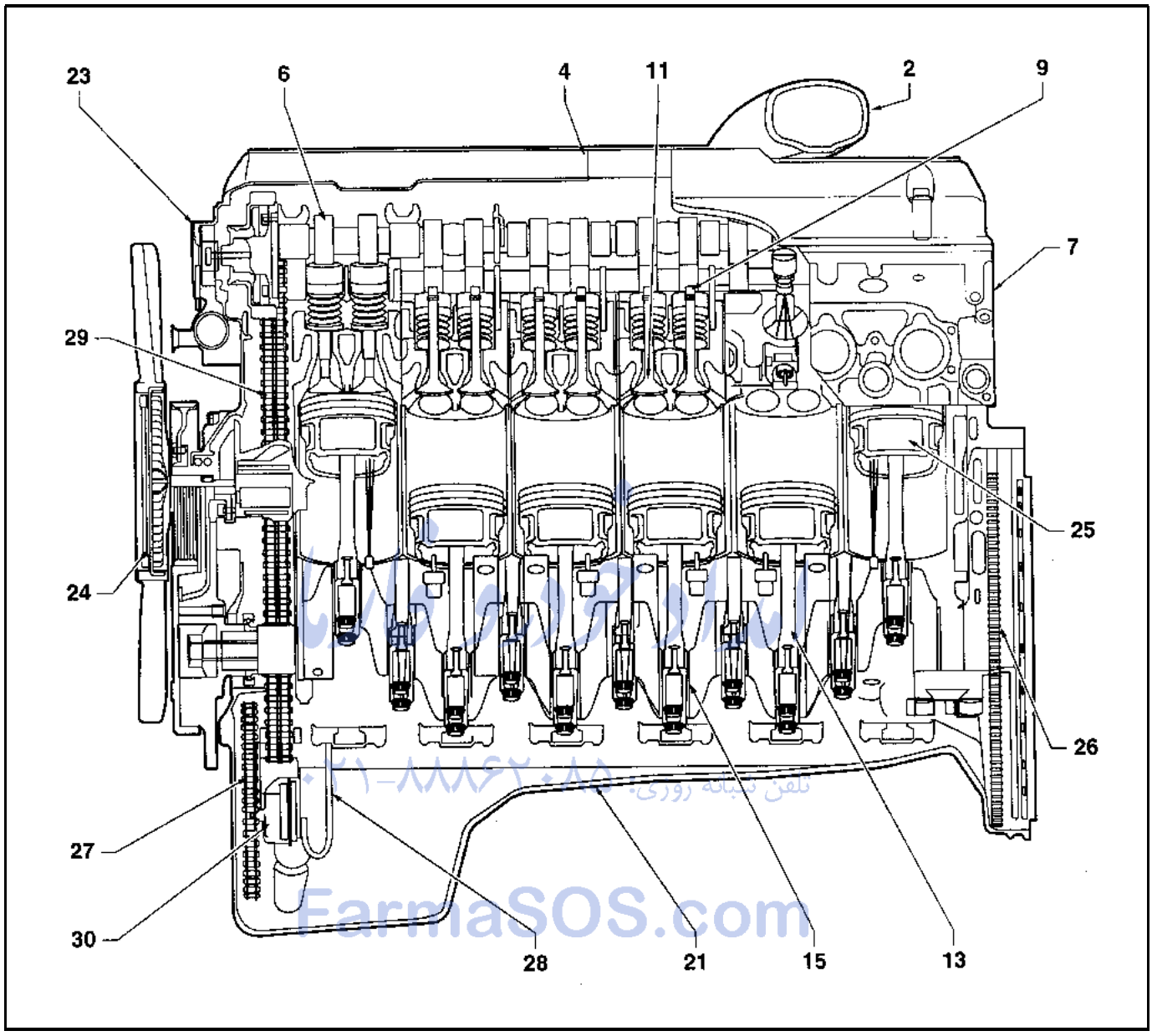
FRONT VIEW



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1 HFM Sensor
2 Intake Air Duct
3 Resonance Flap
4 Cylinder Head Cover
5 Exhaust Camshaft
6 Intake Camshaft
7 Cylinder Head
8 Spark Plug Connector
9 Valve Tappet
10 Injector
11 Exhaust Valve
12 Intake Manifold
13 Connecting Rod
14 Exhaust Manifold
15 Crankshaft
16 Engine Mounting Bracket
17 Starter
18 Crankcase
19 Oil Pump Sprocket
20 Oil Strainer
21 Oil Pan
22 Drain Plug

SIDE VIEW

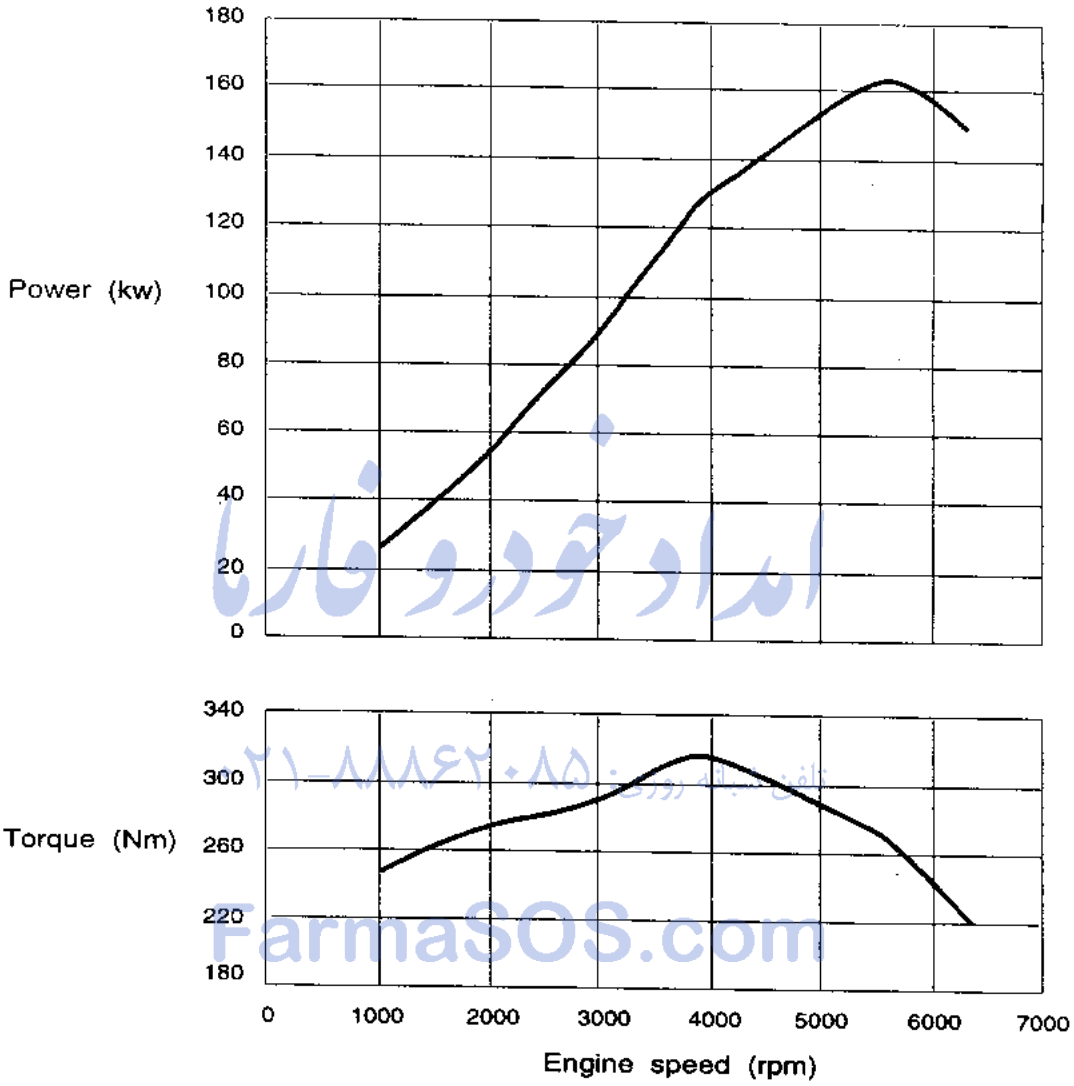


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23 Camshaft Adjuster
24 Cooling Fan and Viscous Clutch
25 Piston
26 Flywheel of Drive Plate
27 Oil Pump Drive Chain
28 Oil Return Pipe
29 Timing Chain
30 Oil Pump

PERFORMANCE CURVE

E32 ENGINE



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DIAGNOSIS

OIL LEAK DIAGNOSIS

Most fluid oil leaks are easily located and repaired by visually finding the leak and replacing or repairing the necessary parts. On some occasions a fluid leak may be difficult to locate or repair. The following procedures may help you in locating and repairing most leaks.

Finding the Leak

1. Identify the fluid. Determine whether it is engine oil, automatic transmission fluid, power steering fluid, etc.
2. Identify where the fluid is leaking from.
   - 2.1 After running the vehicle at normal operating temperature, park the vehicle over a large sheet of paper.
   - 2.2 Wait a few minutes.
   - 2.3 You should be able to find the approximate location of the leak by the drippings on the paper.
3. Visually check around the suspected component. Check around all the gasket mating surfaces for leaks. A mirror is useful for finding leaks in areas that are hard to reach.
4. If the leak still cannot be found, it may be necessary to clean the suspected area with a degreaser, steam or spray solvent.
   - 4.1 Clean the area well.
   - 4.2 Dry the area.
   - 4.3 Operate the vehicle for several miles at normal operating temperature and varying speeds.
   - 4.4 After operating the vehicle, visually check the suspected component.
   - 4.5 If you still cannot locate the leak, try using the powder or black light and dye method.

Powder Method

1. Clean the suspected area.
2. Apply an aerosol-type powder (such as foot powder) to the suspected area.
3. Operate the vehicle under normal operating conditoins.
4. Visually inspect the suspected component. You should be able to trace the leak path over the white powder surface to the source.

Black Light and Dye Method

A dye and light kit is available for finding leaks, Refer to the manufacturer's directions when using the kit.

1. Pour the specified amount of dye into the engine oil fill tube.
2. Operate the vehicle normal operating conditions as directed in the kit.
3. Direct the light toward the suspected area. The dyed fluid will appear as a yellow path leading to the source.

Repairing the Leak

Once the origin of the leak has been pinpointed and traced back to its source, the cause of the leak must be determined n order for it to be repaired properly. If a gasket is replaced, but the sealing flange is bent, the new gasket will not repair the leak. The bent flange must be repaired also. Before attempting to repair a leak, check for the following conditions and correct them as they may cause a leak.

Gaskets

- The fluid level/pressure is too high.
- The crankcase ventilation system is malfunctioning.
- The fasteners are tightened improperly or the threads are dirty or damaged.
- The flanges or the sealing surface is warped.
- There are scratches, burrs or other damage to the sealing surface.
- The gasket is damaged or worn.
- There is cracking or porosity of the component.
- An improper seal was used (where applicable).

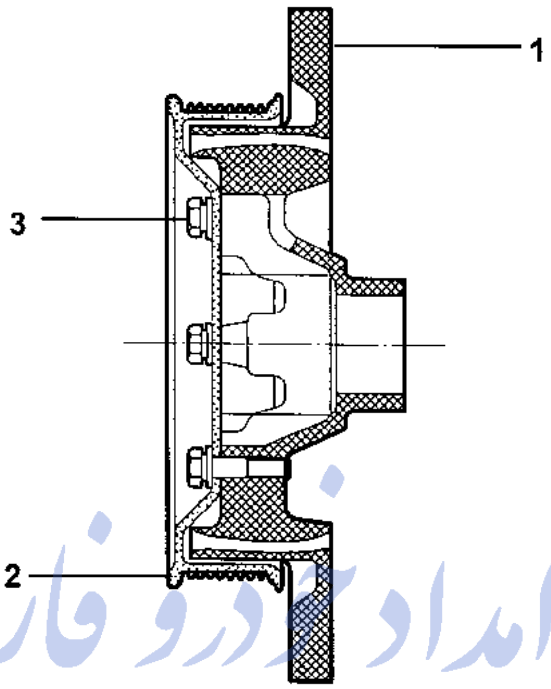
Seals

- The fluid level/pressure is too high.
- The crankcase ventilation system is malfunctioning.
- The seal bore is damaged (scratched, burred or nicked).
- The seal is damaged or worn.
- Improper installation is evident.
- There are cracks in the components.
- The shaft surface is scratched, nicked or damaged.
- A loose or worn bearing is causing excess seal wear.

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ENGINE CRANKING AT THE FRONT OF CRANKSHAFT

Preceding Work: Removal of cooling fan



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1 Vibration Damper Assembly
2 Crankshaft Pulley
3 Bolt ..... 8.6±0.9 N•m

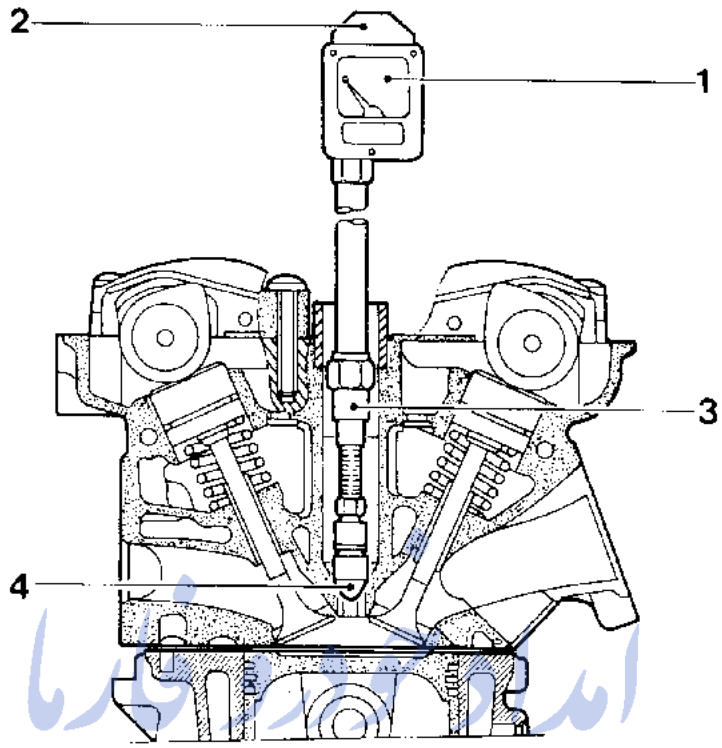
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Notice

- Remove the negative ground cable before proceeding the work.
- Rotate the pulley in normal engine rotating direction when cranking.

COMPRESSION PRESSURE TEST



1 Compression Pressure Tester
2 Diagram Sheet
3 Adaptor
4 Sealing Cone

۰۲۱-۸۸۸۶۲۰۸۵ تلفن شبانه روزی
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Standard Service Data

Compression Ratio		10 : 1
Normal Engine Temperature		80°C
Normal Compression Pressure	General	Min. 10 bar, Max. 14 bar
	Fuel Optimization	Min. 6 bar, Max. 10 bar
Permissible Pressure Difference Between Individual Cylinders		Max. 1.5 bar

Measuring Procedure

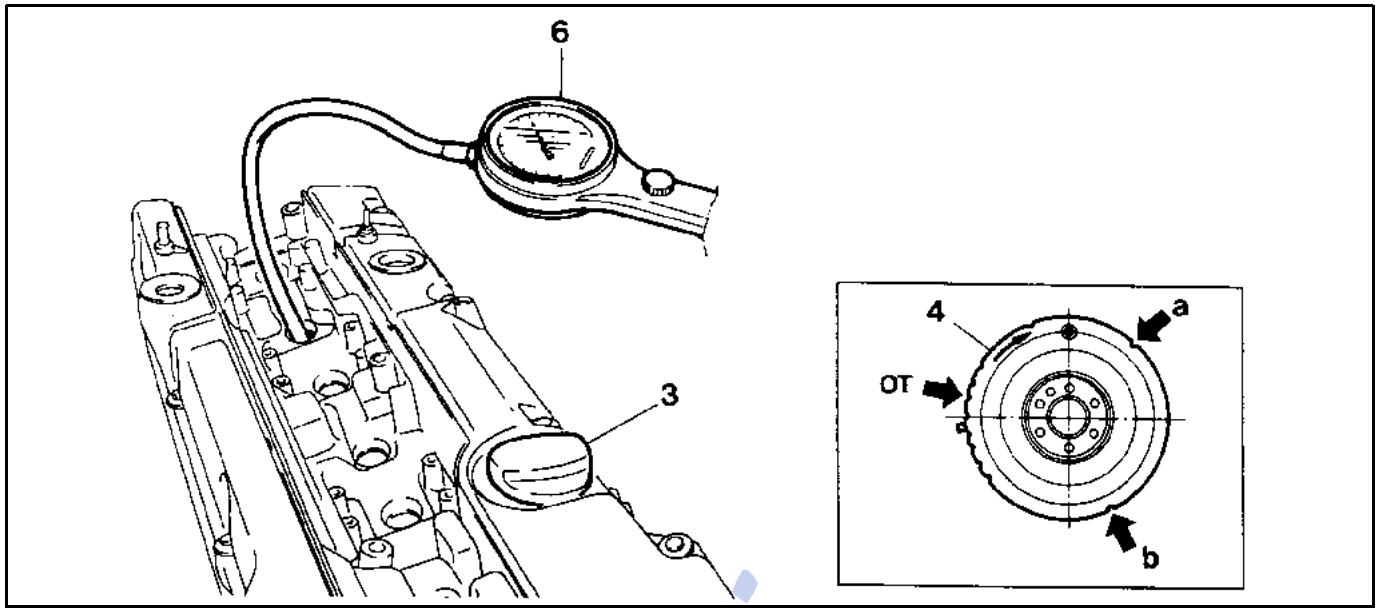
1. Warm the engine up to normal operating temperature.
2. Remove the spark plugs.
3. Place the diagram sheet to compression pressure tester.
4. Connect the adaptor to compression pressure tester and install it into the spark plug hole.
5. Crank the engine approx. eight revolutions by using the start motor.
6. Compare the measurements of compression pressure tester with the specifications.
7. Measure the compression pressure of the other cylinders in the same way.
8. If measured value is not within the specifications, perform the cylinder pressure leakage test.

Notice

- Discharge the combustion residues in the cylinders before testing the compression pressure.
- Apply the parking brake before cranking the engine.

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CYLINDER PRESSURE LEAKAGE TEST



3 Engine Oil Filler Cap
4 Vibration Damper
6 Cylinder Pressure Leakage Tester with Connecting Hose

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Permissible Pressure Leakage

At Whole Engine	Max. 25 %
At Valve and Cylinder Head Gasket	Max. 10 %
At Piston and Piston Ring	Max. 20 %

Cylinder Number By Mark On Vibration Damper At TDC

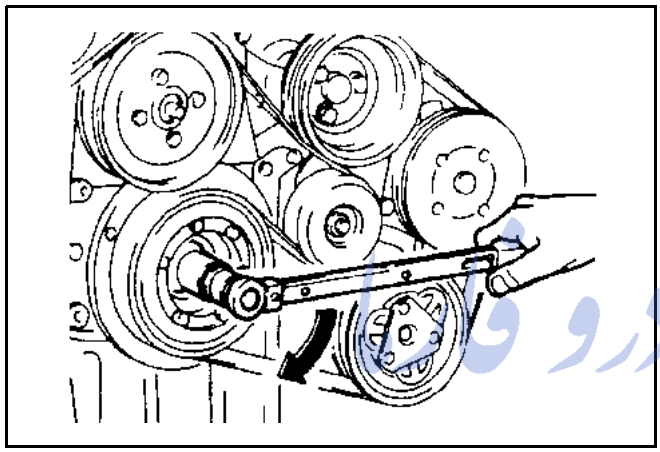
TDC Mark	OT (TDC)	a (120°)	b (240°)
Cylinder Number	1, 6	2, 5	3, 4

Universal Tool

Cylinder Pressure Leakage Tester	Bosch, EFAW 210A Sun, CLT 228

Leakage Test

1. Warm the engine up to normal operating temperature.
2. Disconnect the negative battery cable.
3. Remove the spark plugs.
4. Check the coolant level by opening the coolant surge tank cap and replenish if insufficient.
5. Open the engine oil filler cap.
6. Connect the tester to air pressure line and adjust the scale of tester.
7. Install the connecting hose to spark plug hole.



8. Position the piston of No.1 cylinder at TDC by rotating the crankshaft.

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۰۲۱-۸۸۸۶۲۰۸۵ تلفن شبانه روزی
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9. Connect the connecting hose to tester and measure the leakage volume after blowing up compressed air.

Notice: Measure the leakage volume in the completely opening condition of throttle valve by pulling the acceleration cable.

10. Perform the pressure test according to the firing order.

Notice:

Firing Order : 1 - 5 - 3 - 6 - 2 - 4

11. Compare the leakage pressure with the specifications.

GENERAL INFORMATION

CLEANLINESS AND CARE

An automobile engine is a combination of many machined, honed, polished and lapped surfaces with tolerances that are measured in the ten-thousandths of an inch. When any internal engine parts are serviced, care and cleanliness are important. A liberal coating of enigne oil should be applied to friction areas during assembly, to protect and lubricate the surfaces on initial operation. Proper cleaning and protection of machined surfaces and friction areas is part of the repair procedure. This is considered standard shop practice even if not specifically stated.

Whenever valve train components are removed for service, they should be kept in order. They should be installed in the same locations, and with the same mating surfaces, as when they were removed.

Battery cables should be disconnected before any major work is performed on the engine. Failure to disconnect cables may result in damage to wire harness or other electrical parts.

ON-ENGINE SERVICE

Caution: Disconnect the negative battery cable before removing or installing any electrical unit, or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

Notice: Any time the air cleaner is removed, the intake opening should be covered. This will protect against accidental entrance of foreign material, which could follow the intake passage into the cylinder and cause extensive damage when the engine is started.

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SECTION 1B1

M162 ENGINE MECHANICAL

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

Specifications 1B1-2
Fastener Tightening Specifications 1B1-2
Special Tools 1B1-4
Special Tools Table 1B1-4
Maintenance and Repair 1B1-7
On-Vehicle Service 1B1-7
Engine Assembly 1B1-7
Crankcase Ventilation System 1B1-14
Generator 1B1-16
Engine Mount 1B1-17
Poly V-Belt 1B1-18
Tensioning Device 1B1-20
Poly V-Belt Inspection 1B1-21
Cylinder Head Cover 1B1-24
Cylinder Head Front Cover 1B1-26
Cylinder Head 1B1-28
Timing Gear Case Cover 1B1-31
Crankshaft Sealing Rear Cover 1B1-33
Belt Pulley and Vibration Damper 1B1-35
Crankshaft Front Radial Seal 1B1-38
Crankshaft Rear Radial Seal 1B1-40
Crankshaft 1B1-41
Flywheel / Driven Plate 1B1-47
Camshaft Adjuster 1B1-50
Camshaft Sprocket Bolt 1B1-52
Camshaft 1B1-54
Camshaft Timing Position 1B1-59
Valve Spring 1B1-62
Valve Stem Seal 1B1-66
Chain Tensioner 1B1-67
Timing Chain 1B1-70
Tensioning Rail 1B1-75
Cylinder Head Guide Rail 1B1-76
Crankcase Guide Rail 1B1-77
Crankshaft Sprocket 1B1-78
Piston 1B1-80
Connecting Rod 1B1-83
Piston Ring 1B1-85
Engine Oil Specification 1B1-87
Oil Pan 1B1-88
Engine Oil and Oil Filter Element 1B1-90
Oil Filter 1B1-92
Oil Pump 1B1-94
Oil Pressure Relief Valve 1B1-96
Oil Non-Return Valve 1B1-97
Oil Dipstick Guide Tube 1B1-98
Unit Repair 1B1-99
Oil Gallery in Crankcase 1B1-99
Oil Gallery in Cylinder Head 1B1-101
Core Plugs in Crankcase 1B1-104
Cylinder Bore 1B1-106
Crankcase Mating Surface 1B1-108
Cylinder Head Mating Surface 1B1-110

ایران خودرو فارما
۰۲۱-۸۸۳۴۰۸۵
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SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application		N•m	Lb-Ft	Lb-In
Fuel Feed and Return Line		21 - 25	15 - 18	-
Exhaust Manifold and Pipe		30	22	-
Propeller Shaft to Transmission		81 - 89	60 - 66	-
Engine Mounting Nuts		70	52	-
Generator Carrier Bolts		25	18	-
Tensioning Pulley Bolt		40.5 - 49.5	29.9 - 36.5	-
Steering Pump Bolts		22.5 - 27.5	16.6 - 20.3	-
A/C Bracket Bolts		22.5 - 27.5	16.6 - 20.3	-
Intake Air Duct Mounting Nuts		9 - 11	-	80 - 97
Spark Plug Cover Bolts		9 - 11	-	80 - 97
Cylinder Head Cover Bolts		9 - 11	-	80 - 97
Magnetic Assembly Bolt		9 - 11	-	80 - 97
Cylinder Head Front Cover Bolt		22.5 - 27.5	16.6 - 20.3	-
Cylinder Head Bolts		55 +90° +90°	41 +90° +90°	-
Timing Gear Case Cover Bolts	M8	22.5 - 27.5	16.6 - 20.3	-
	M6	9 - 11	-	80 - 97
Crankshaft Sealing Rear Cover Mounting Bolts		9 - 11	-	80 - 97
Vibration Damper Center Bolt		200 + 20 +90° + 10°	148 + 15 +90° + 10°	-
Connecting Rod Bearing Cap Bolts		40 +90°	30 +90°	-
Flywheel Mounting Bolt		45 + 5 +90° + 10°	33 + 3.7 +90° + 10°	-
Amarture Bolt		35	26	-
Camshaft Adjuster Flange Bolts		18 - 22 60° ± 5°	13 - 16 60° ± 5°	-
Intake Flange Shaft Bolts		18 - 22 60° ± 5°	13 - 16 60° ± 5°	-
Exhaust Camshaft Sprocket Bolts		18 - 22 60° ± 5°	13 - 16 60° ± 5°	-
Camshaft Bearing Cap Bolts		22.5 - 27.5	16.6 - 20.3	-
Chain Tensioner Screw Plug		40	30	-
Chain Tensioner Assembly		72 - 88	53 - 65	-
Oil Pump Sprocket Bolt		29 - 35	21 - 26	-
Tensioning Device Bolts		26 - 32	19 - 24	-
Water Pump Pulley Bolts		22.5 - 27.5	16.6 - 20.3	-
Upper Intake Manifold Bolt		22.5 - 27.5	16.6 - 20.3	-
Lower Intake Mainfold Bolt		22.5 - 27.5	16.6 - 20.3	-
Flange Bolt to Exhaust Mainfold		30	22	-

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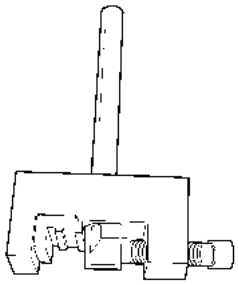
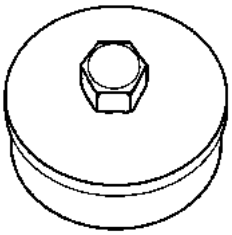
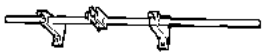
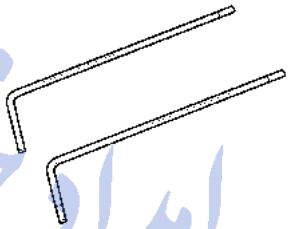
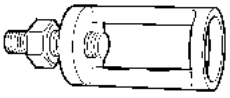
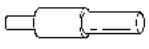
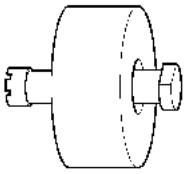
FASTENER TIGHTENING SPECIFICATIONS (Cont'd)

Application		N•m	Lb-Ft	Lb-In
Exhaust Mainfold Nut to Stud Bolt		26 - 34	19 - 25	-
Oil Drain Plug		25	18	-
Oil Filter Cover		25	18	-
Oil Filter Bolt		25	18	-
Oil Pump Drive Sprocket Bolt		29 - 35	21 - 26	-
Oil Pump Mounting Bolt		22.5 - 27.5	16.6 - 20.3	-
Oil Strainer Bracket Bolt		9 - 11	-	89 - 97
Oil Pressure Relief Valve Screw Plug		50	37	-
Oil Dipstick Guide Tube Bolt		9 - 11	-	89 - 97
Oil Gallery Screw Plug		15	11	-
Torque Converter Mounting Bolts		42	31	-
Crankshaft Bearing Cap Bolts		55/+90°	41/+90°	-
Oil Pan Mounting Bolts	M8	25	18	-
	M6	10	-	89

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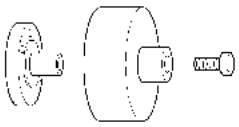
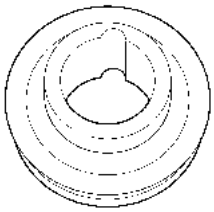
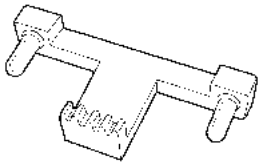
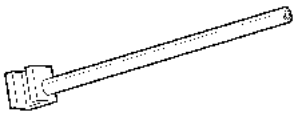
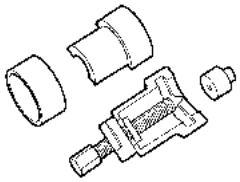
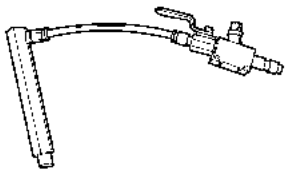
SPECIAL TOOLS

SPECIAL TOOLS TABLE

	**000 589 58 43 00** **Chain Assembly**		**103 589 02 09 00** **Oil Filter Remover**
	**111 589 01 59 00** **Supporting Bar**		**DW110-120** **Holding Pin**
	**111 589 18 61 00** **Lever Pusher**		**111 589 25 63 00** **Thrust Piece**
	**116 589 01 34 00** **Threaded Pin**		**116 589 20 33 00** **Sliding Hammer**

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Special Tools Table (Cont'd)

	**119 589 00 43 00** **Drift**		**601 589 03 43 00** **Crankshaft Rear Seal Installer**
	**601 589 03 14 00** **Crankshaft Front Seal Installer**		**602 589 00 40 00** **Engine Lock**
	**603 589 00 40 00** **Fan Clutch Holder**		**617 589 00 10 00** **Allen Wrench Socket**
	**615 589 01 33 00** **Crankshaft Sprocket Puller**		**DW110 - 090** **Connecting Hose**

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تلفن شبانه روزی: ۰۲۱ ۸۸۸۶۲۰۸۵
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Special Tools Table (Cont'd)

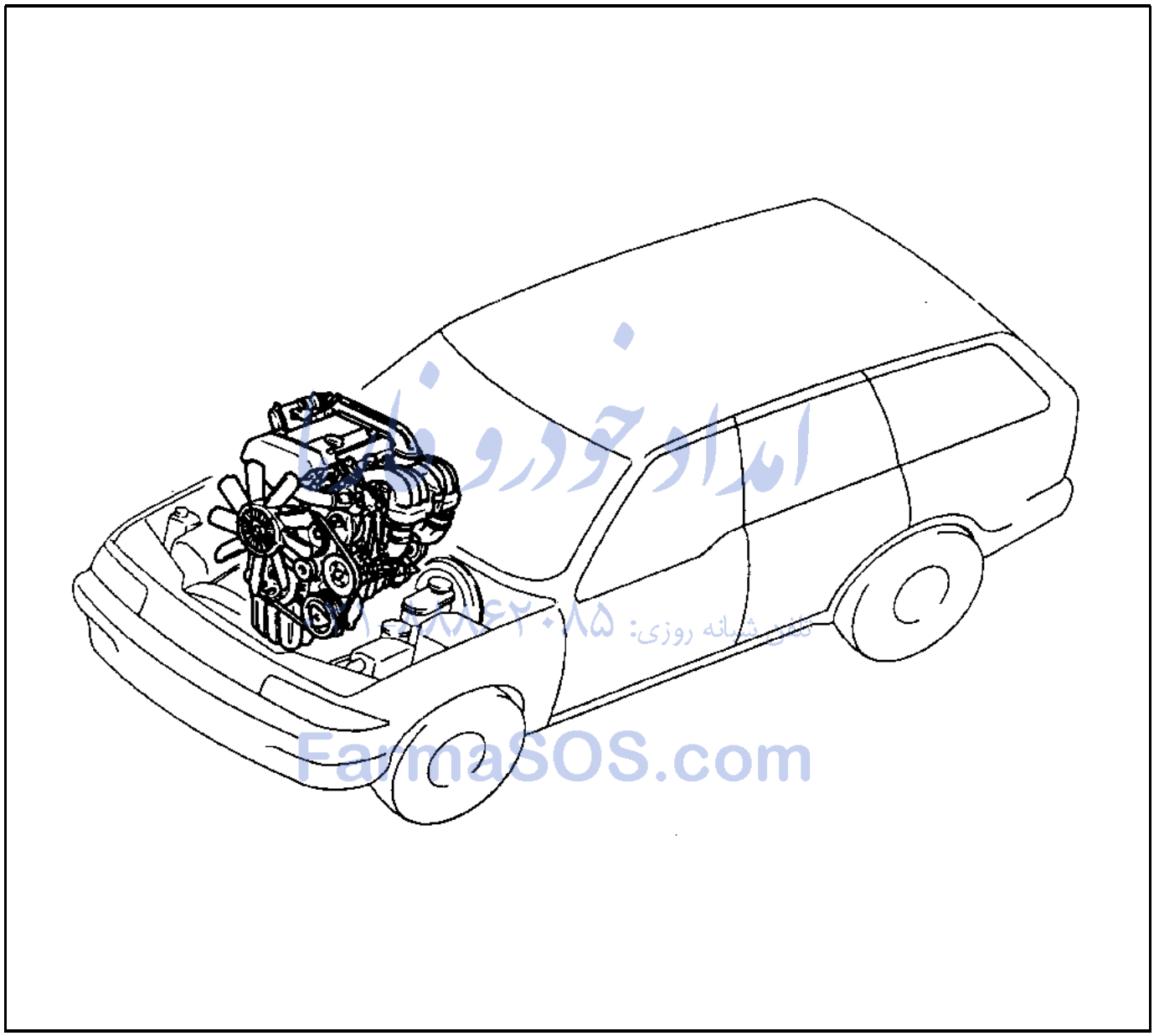
	**DW110 – 100** **Valve Tappet Remover**

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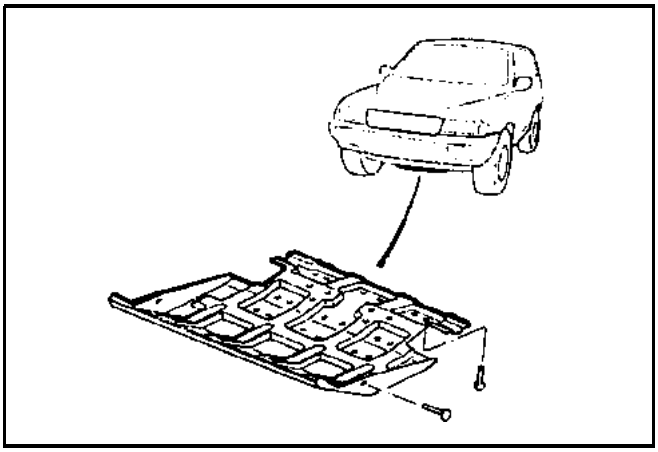
MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

ENGINE ASSEMBLY



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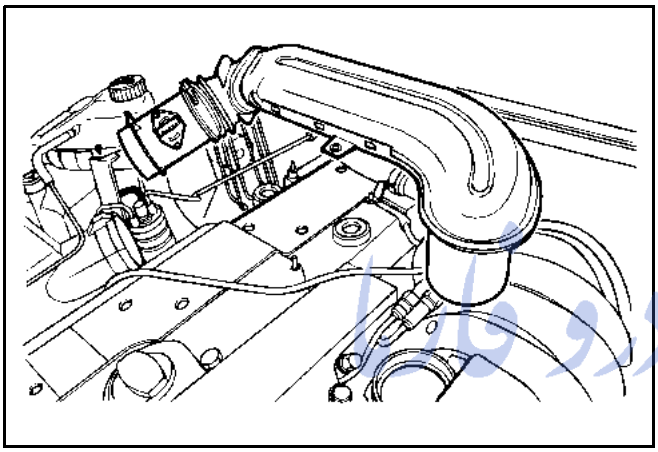


Removal & Installation Procedure

1. Disconnect the negative terminal of battery.
2. Remove the hood.
3. Remove the under cover.

Installation Notice

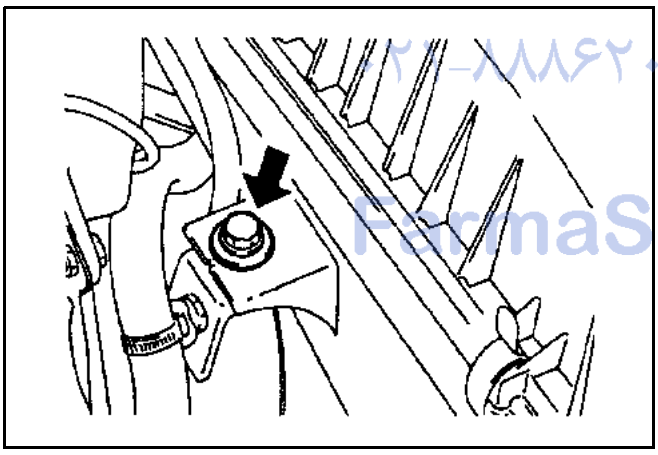
Tightening Torque	28 - 47 N•m (21 - 35 lb-ft)



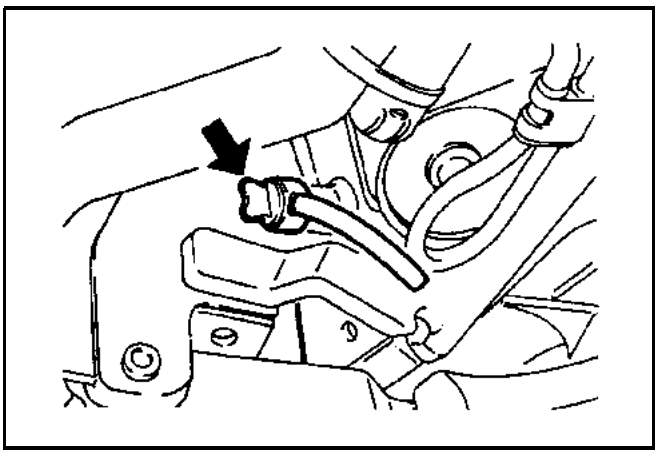
4. Disconnect the mass air flow sensor meter connector.
5. Disconnect the mass air flow sensor meter from the air filter housing.
6. Remove the intake air duct mounting nuts.

Installation Notice

Tightening Torque	9 - 11 N•m (80 - 97 lb-in)



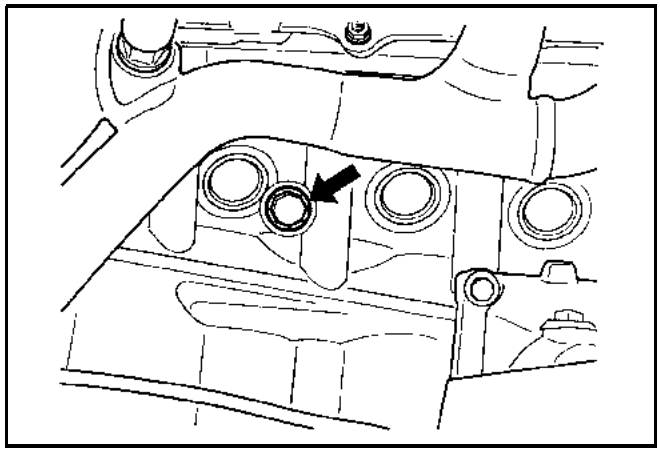
7. Remove the air cleaner cover. Remove the mounting bolts and air cleaner housing and element assembly.



8. Loosen the radiator drain cock and drain the coolant.

Notice: Open the coolant reservoir cap.

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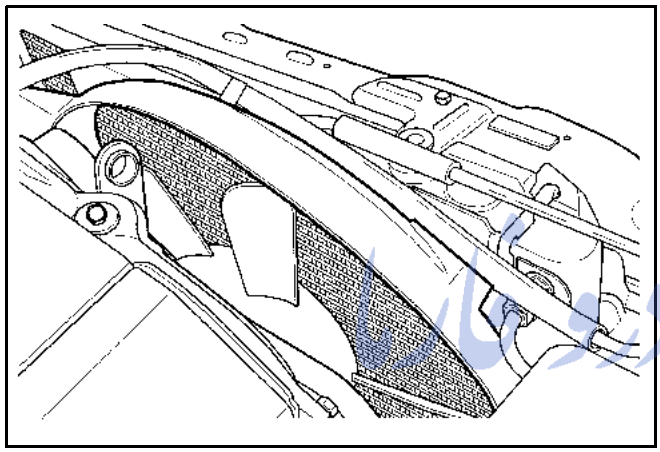


9. Loosen the cylinder block drain plug and then drain the coolant completely.

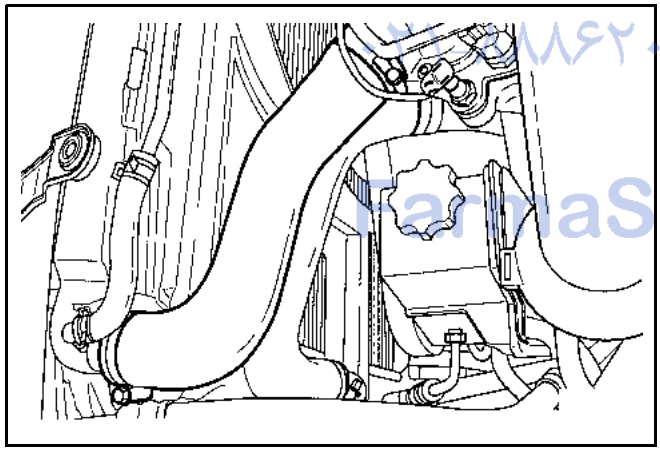
Installation Notice

Tightening Torque	30 N•m (22 lb-ft)

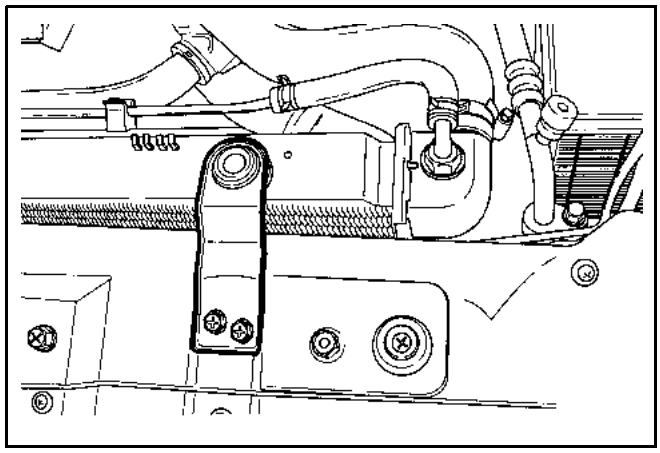
Notice: Replace the seal before installation of the drain plug.



10. Remove the cooling fan shroud. Refer to *Section 1D1, Engine Cooling.*

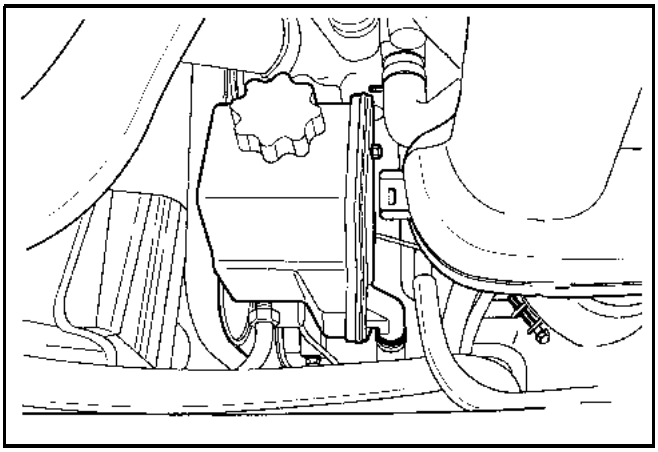


11. Disconnect the each hose from radiator.



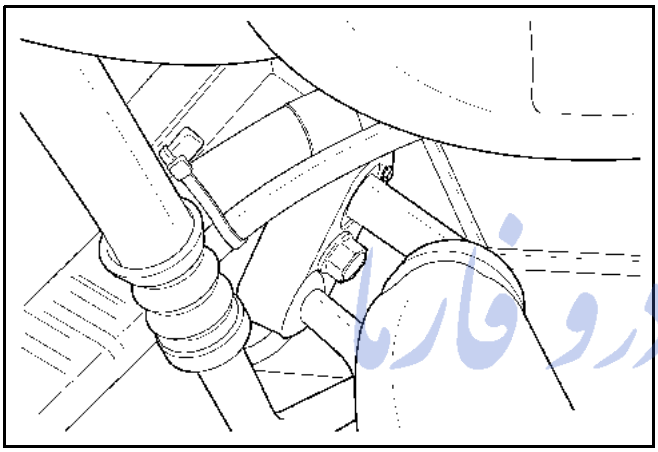
12. Remove the upper mounting bolts of radiator and then remove the radiator.

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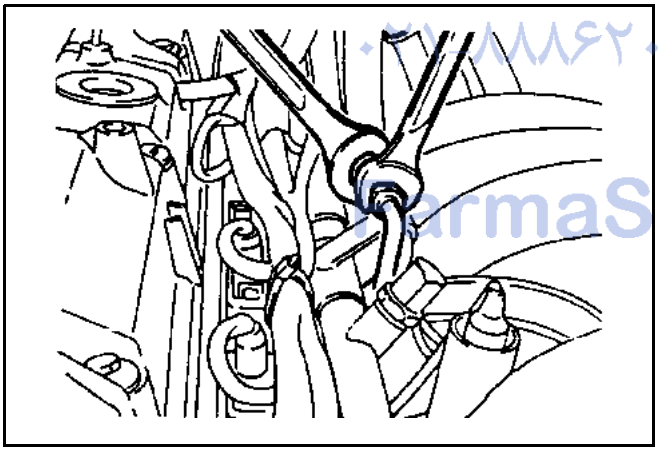


13. Remove the hydraulic pipe of power steering.

Notice: Completely drain the oil.



14. Discharge the refrigerant from A/C system, and disconnect the discharge pipe and suction pipe from the compressor. Refer to *Section 7B, Manual Control Heating, Ventilation, and Air Conditioning System.*

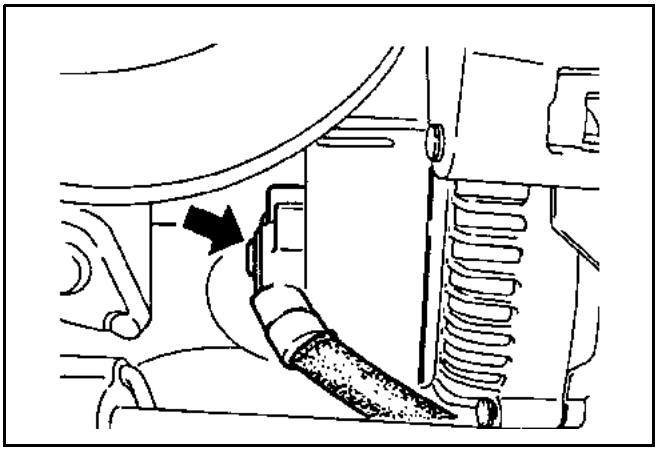


15. Remove the fuel feed and return line.

Notice: Before removing the fuel lines, release the pressure in the fuel system.

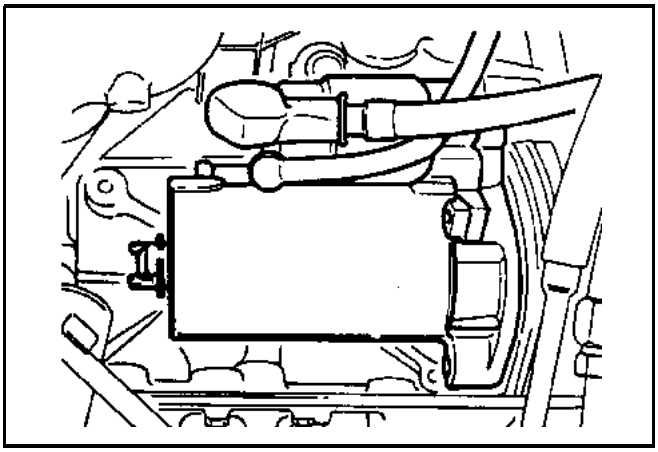
Installation Notice

Tightening Torque	21 – 25 N•m (15 – 18 lb-ft)

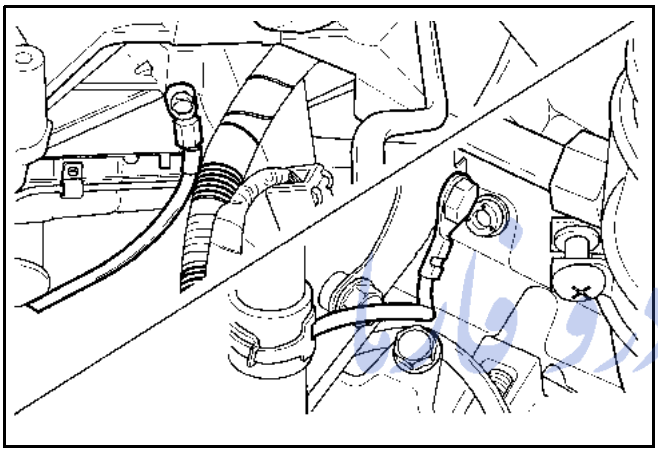


16. Disconnect the terminals from the generator.

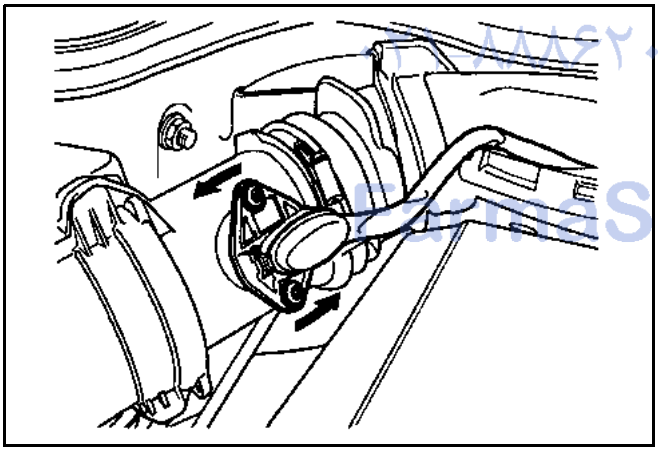
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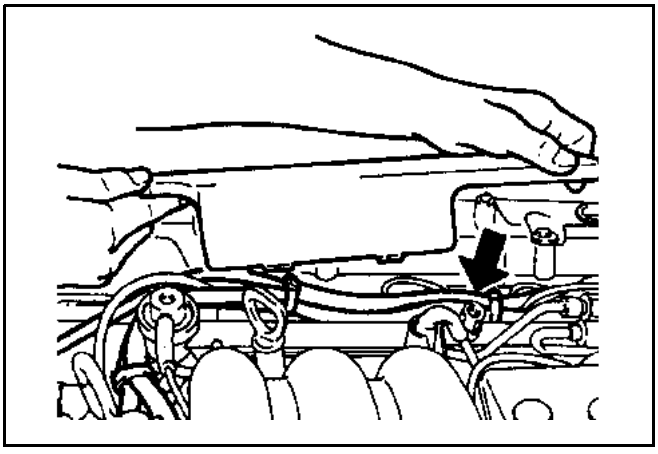
17. Disconnect the terminals from starter motor and remove the starter motor.
18. Disconnect the engine main harness ground.



19. Disconnect the engine ground wire.

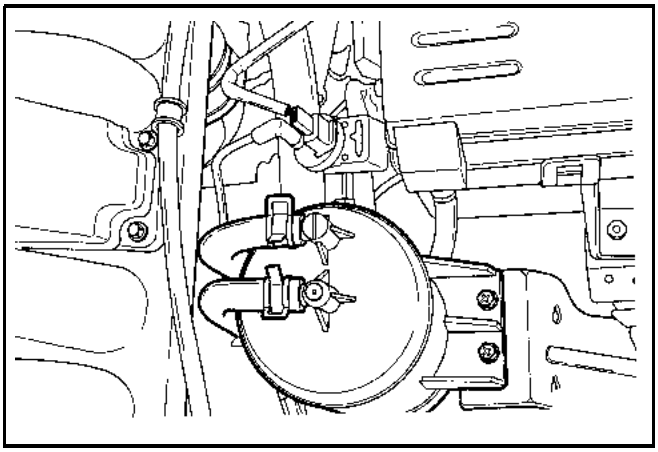


20. Disconnect following sensors connector.
    - HFM sensor.
    - Coolant temperature sensor.
    - 2 knock sensors.
    - Camshaft and crankshaft sensors.

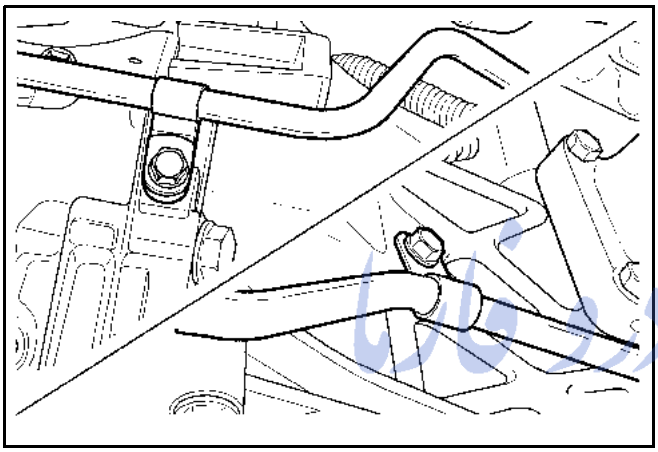


21. After removing the ignition coil cover, disconnect the ignition coil connector.
22. Remove the harness cover and disconnect the 6 injection valve connectors. Disconnect the main harness.

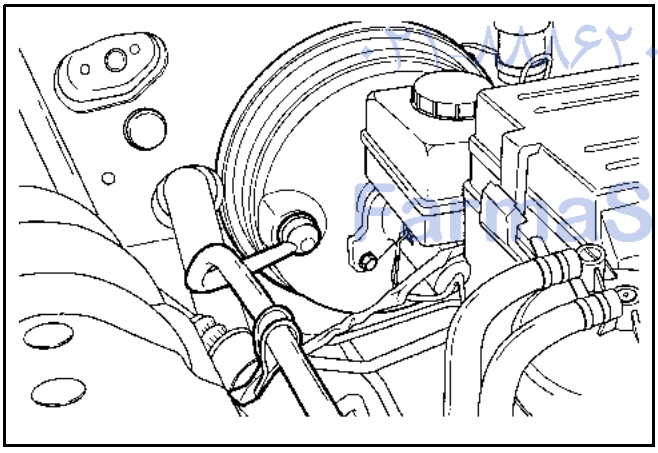
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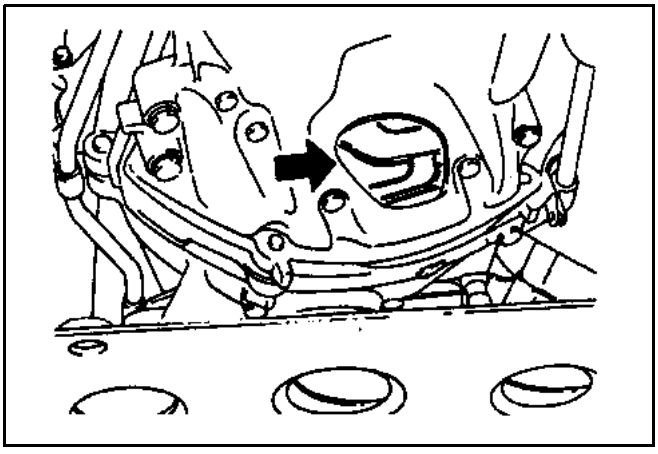
23. Separate the hose toward engine from canister purge solenoid valve.
24. Remove the canister. Refer to *Section 1F1, Engine Control.*



25. Remove the automatic transmission oil cooler line retaining bolts from the automatic transmission side and oil pan side
26. Remove the automatic transmission oil cooler line retaining bolts from engine side and oil pan side.



27. Separate the vacuum hose for brake booster.
28. Separate the other vacuum hoses.

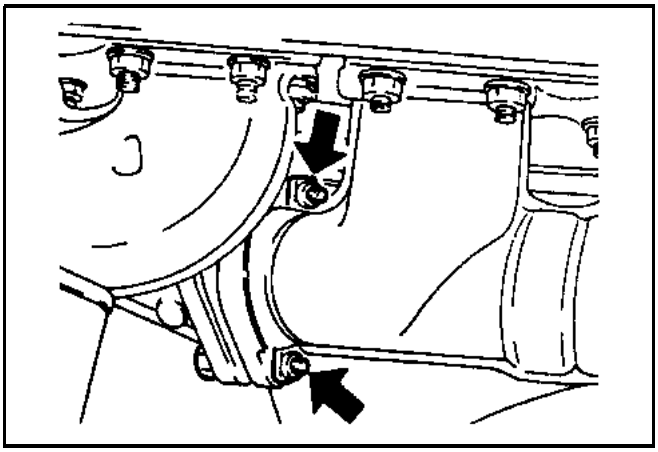


29. By rotating the crankshaft from the front of engine, remove the 6 torque converter mounting bolts from the engine ring gear plate.

Installation Notice

Tightening Torque	42 N•m (31 lb-ft)

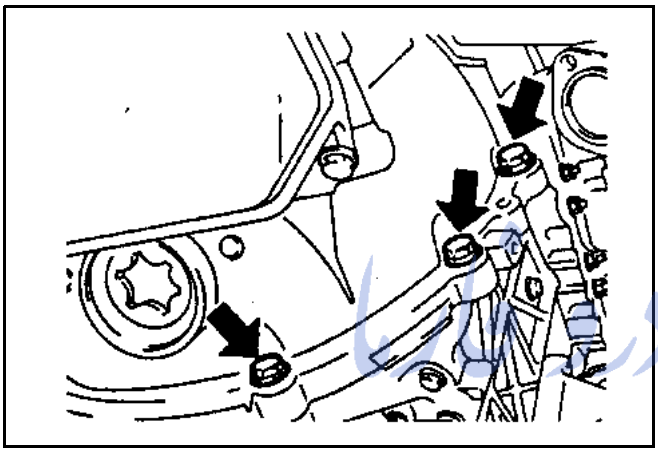
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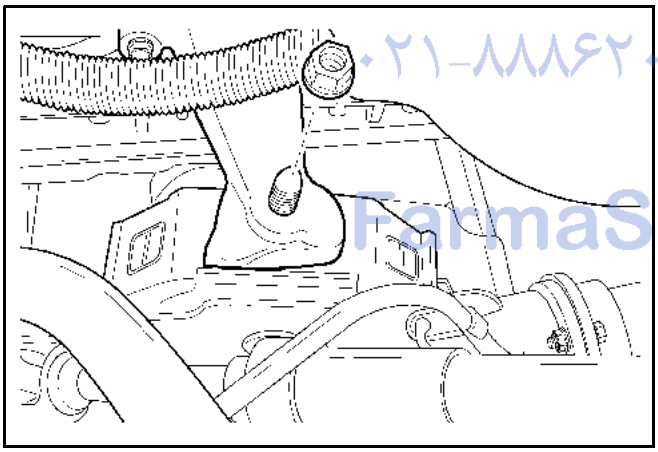
30. Remove the exhaust manifold and exhaust pipe.

Installation Notice

Tightening Torque	30 N•m (22 lb-ft)



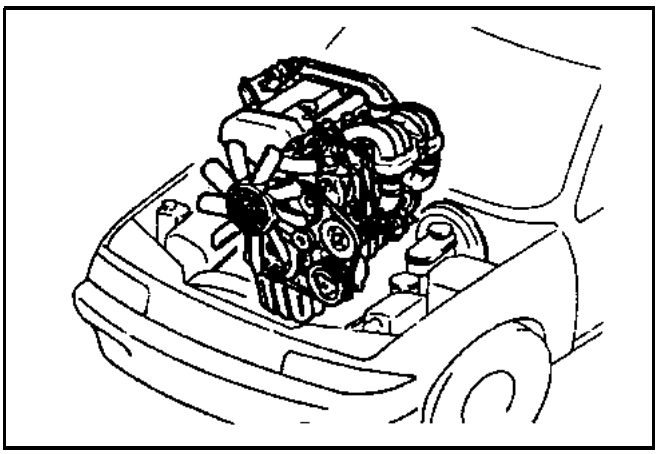
31. Remove the transmission. *Refer to Section 5A, Automatic Transmission.*



32. Install a chain to the bracket of engine, by using a hoist or crane.
33. Remove the engine mount nuts.

Installation Notice

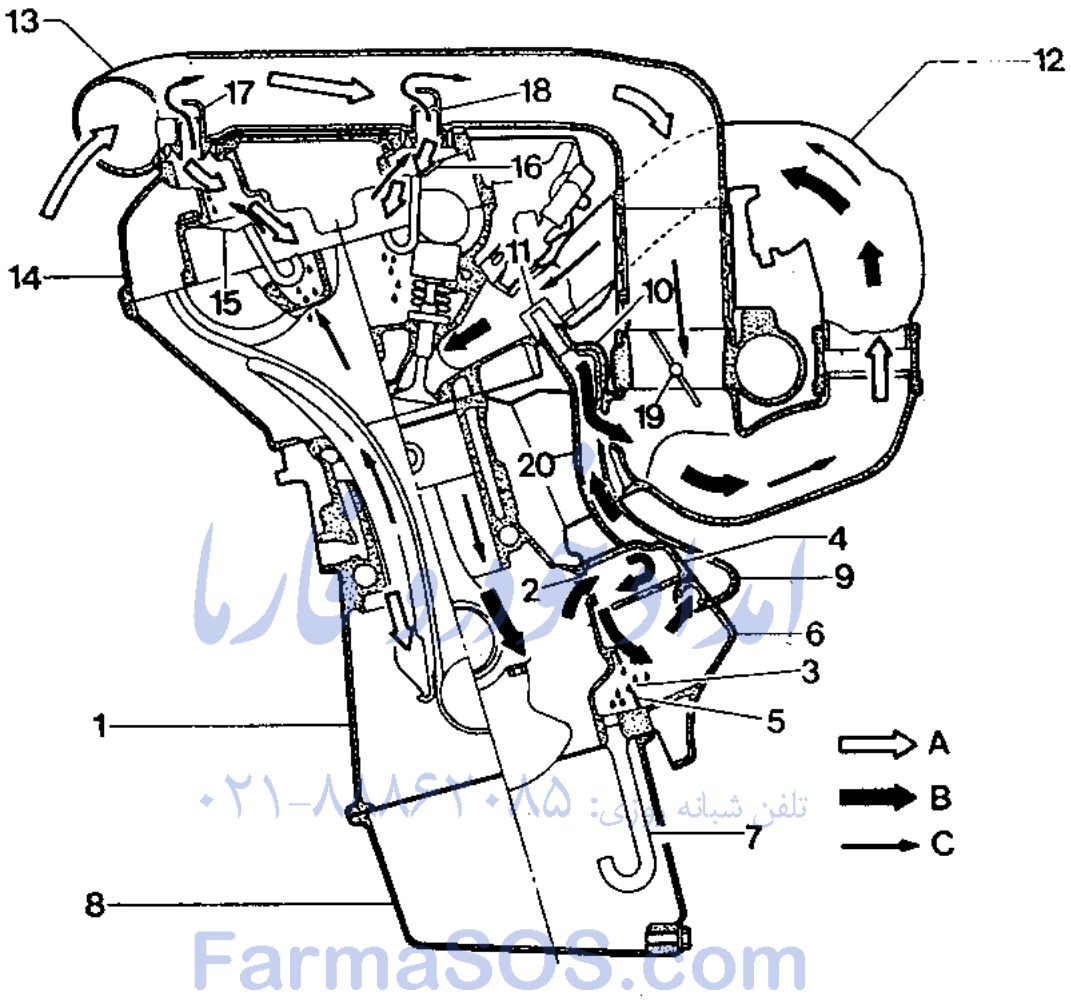
Tightening Torque	70 N•m (52 lb-ft)



34. Carefully separate the engine assembly from the vehicle.
35. Installation should follow the removal procedure in the reverse order.

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CRANKCASE VENTILATION SYSTEM



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1 Crankcase
2 Air Admission Port in Crankcase
3 Oil Drain Port
4 Filter
5 Gasket
6 A/C Bracket
7 Oil Drain Pipe
8 Oil Pan
9 Air Admission Line
10 Vent Line
11 Restriction Hole (Diameter = 2 mm)
12 Intake Manifold
13 Intake Air Duct (Cross Pipe)
14 Cylinder Head Cover
15 Oil Separator
16 Oil Separator
17 Air Admission and Vent Connection
18 Air Admission and Vent Connection
19 Throttle Valve
20 Vent Line

A Fresh Air
B Blowby Gas in Partial Load
C Blowby Gas in Full Load

Operation at Idling and Mid-Load

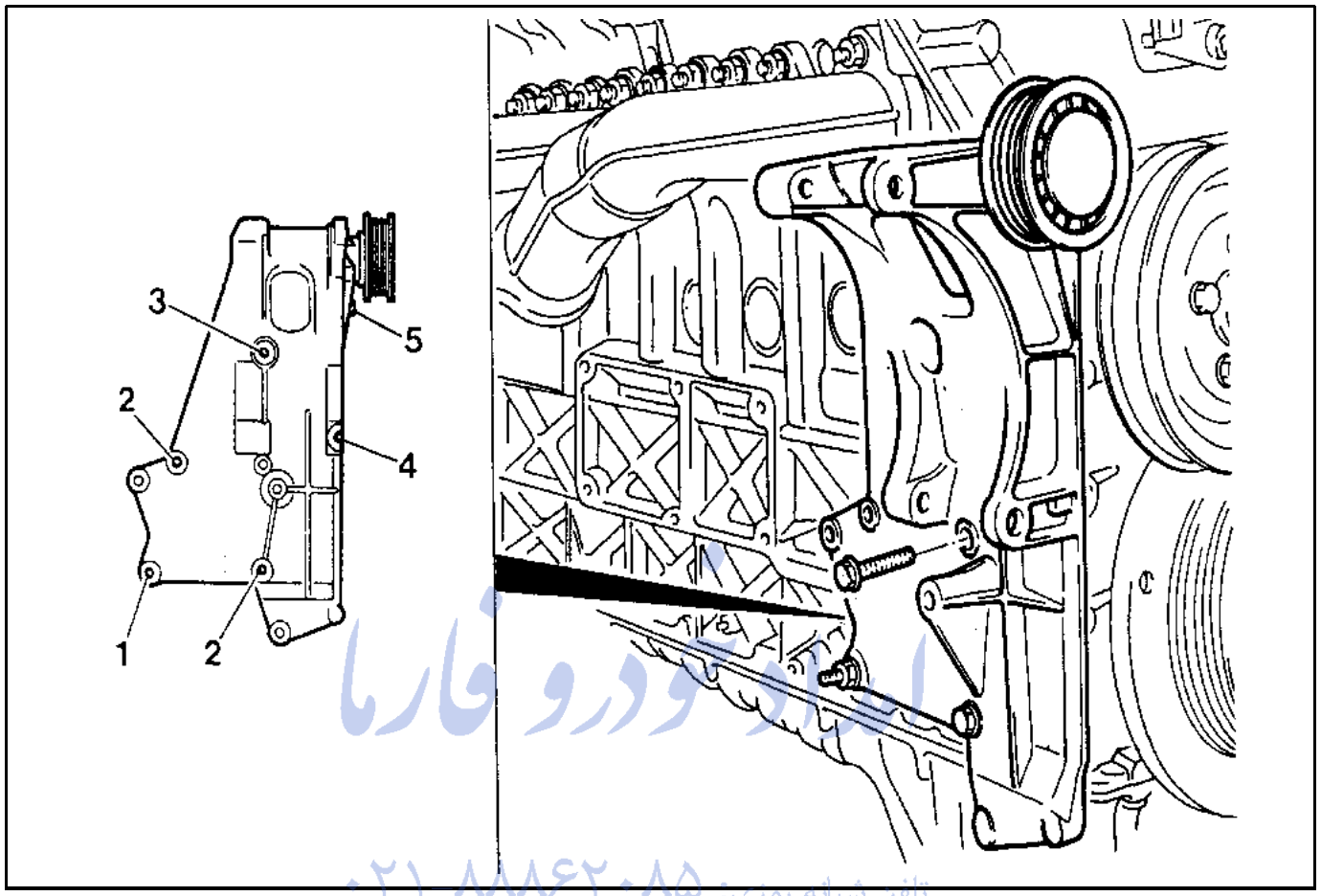
- It show that the throttle valve (19) is closed or very partially opened and the vacuum pressure in intake manifold is high.
  The blowby gas in the crankcase in partial load flows into the intake manifold through the vent line (20) after passing the air conditioner bracket (6) and the filter (4). The air reentered into the intake manifold will be dilluted on the flow through the restriction hole (11) in the vent line (10).
  The circulated engine oil is separated at the air conditioner bracket (6) and then returns into the oil pan through the drain pipe (7).
  The vacuum pressure generated at the crankcase sucks fresh air from intake air line (13) through the air admission and vent connection (17,18).
  The fresh air prevents engine oil from being contaminated and the air admission and vent connection (17,18) is designed to control the rapid pressure changes in intake air line (13).

Operation at Full-Load

- The throttle valve (19) is fully opened.
  All the blowby gases flow into the intake air duct (13) after passing through the oil separator (15,16) of the cylinder head cover (14) when fully loaded. This dilluted air will be supplied to the combustion chamber through the intake manifold (12).

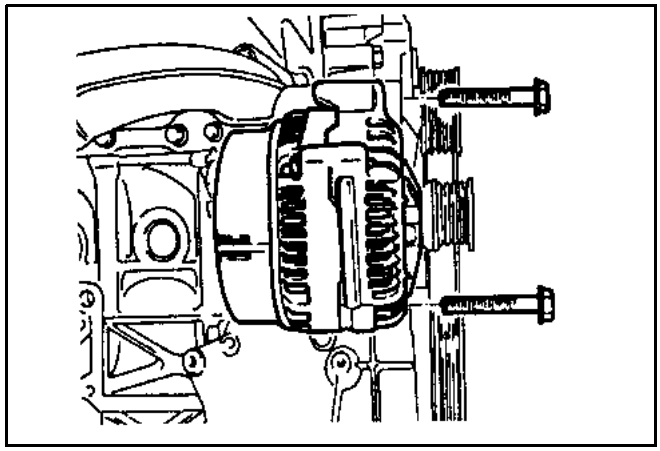
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GENERATOR



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1 Nut (M8) . . . . . 22.5-27.5 N•m (16.6-20.3 lb-ft)
2 Bolt (M8 x 30, 3 pieces)
. . . . . 22.5-27.5 N•m (16.6-20.3 lb-ft)
3 Bolt (M8 x 40, 1 piece)
. . . . . 22.5-27.5 N•m (16.6-20.3 lb-ft)
4 Bolt (M8 x 70, 1 piece)
. . . . . 22.5-27.5 N•m (16.6-20.3 lb-ft)
5 Bolt (M8 x 75, 1 piece)
. . . . . 22.5-27.5 N•m (16.6-20.3 lb-ft)



Removal & Installation Procedure

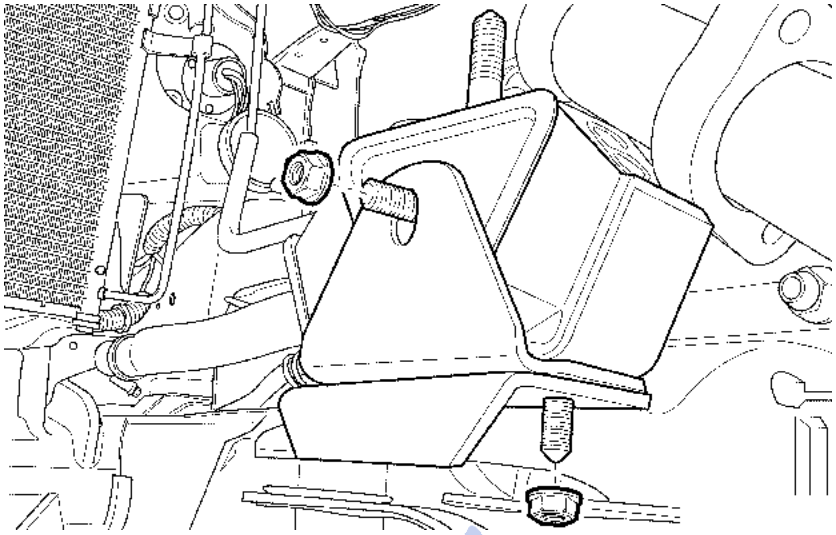
1. Remove the drive belt.
2. Remove the generator.
3. Unscrew the generator carrier bolts and remove the carrier.

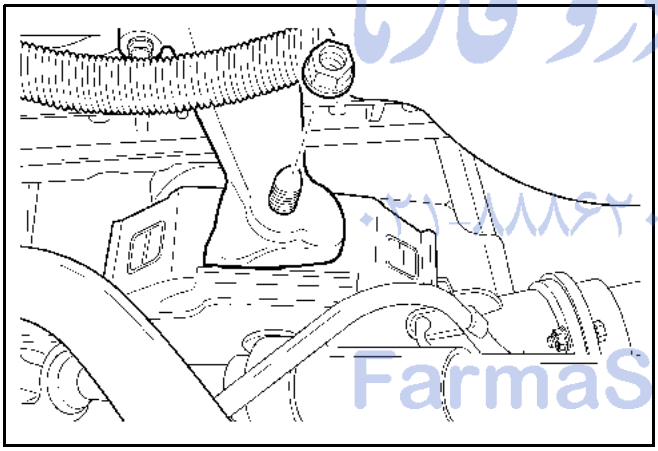
Installation Notice

Tightening Torque	25 N•m (18 lb-ft)

4. Installation should follow the removal procedure in the reverse order.

ENGINE MOUNT





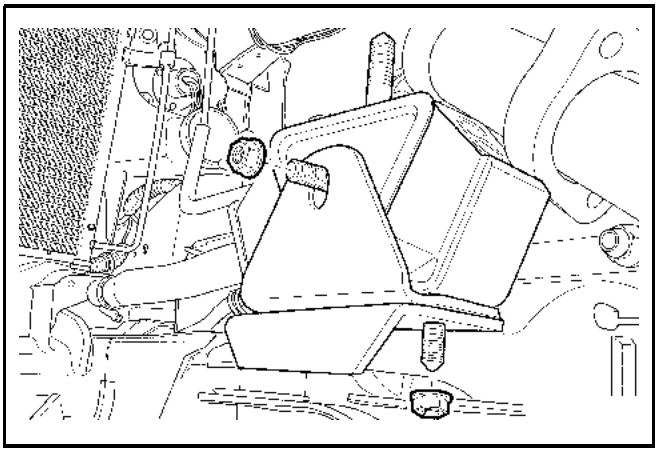
Removal & Installation Procedure

1. Unscrew the upper engine mount nuts and remove the engine.

Installation Notice

Tightening Torque	70 N•m (52 lb-ft)

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2. Unscrew the lower nuts.

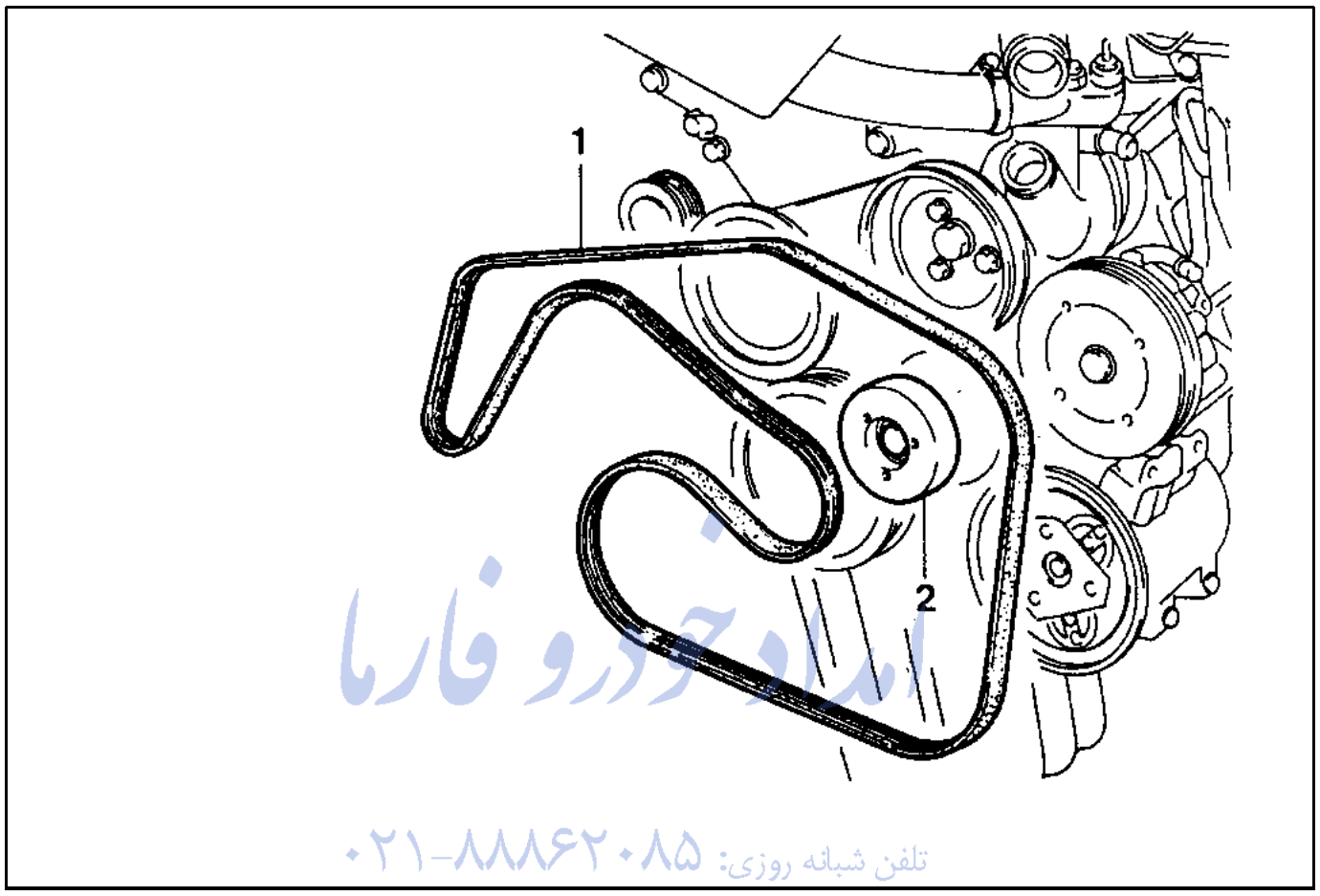
Installation Notice

Tightening Torque	38 N•m (28 lb-ft)

3. Remove the hydraulic engine mounting insulator.
4. Installation should follow the removal procedure in the reverse order.

POLY V - BELT

Preceding Work: Removal of cooling fan

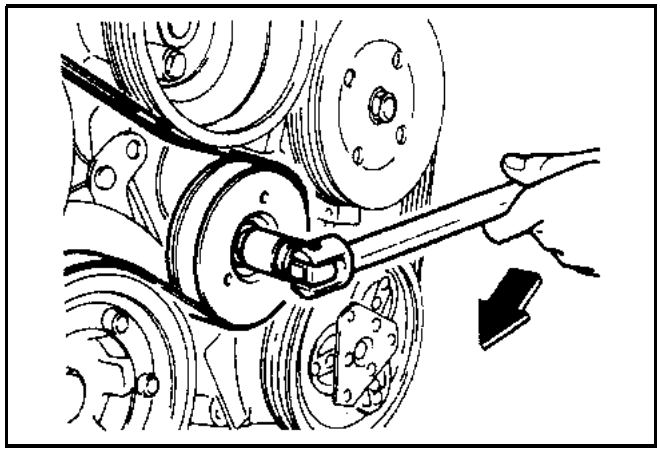


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1 Poly V-belt

2 Belt Tensioning Pulley

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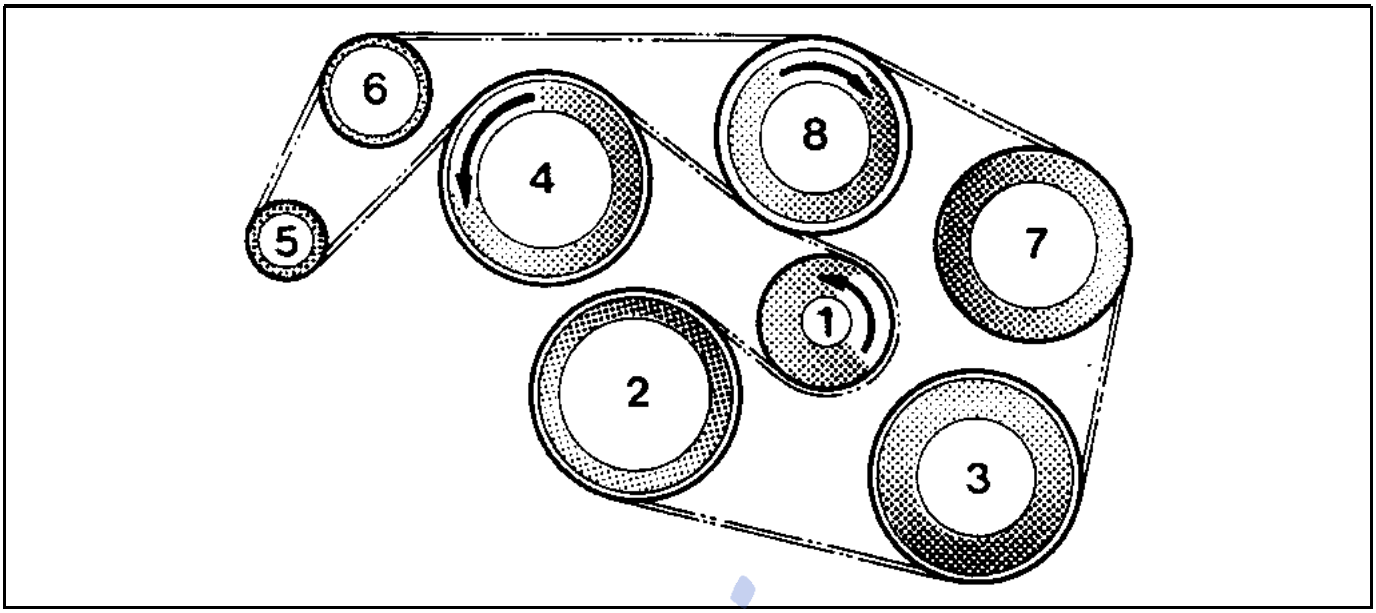
Removal & Installation Procedure

1. Release the belt tension by turning the belt tensioning pulley nut clockwise.
2. Remove the poly v-belt.

Notice: Check the belt for damage and tensioning pulley bearing point for wear and replace them if necessary.

3. Install the belt by turning the nut of tensioning pulley clockwise.

Poly V- Belt Arrangement

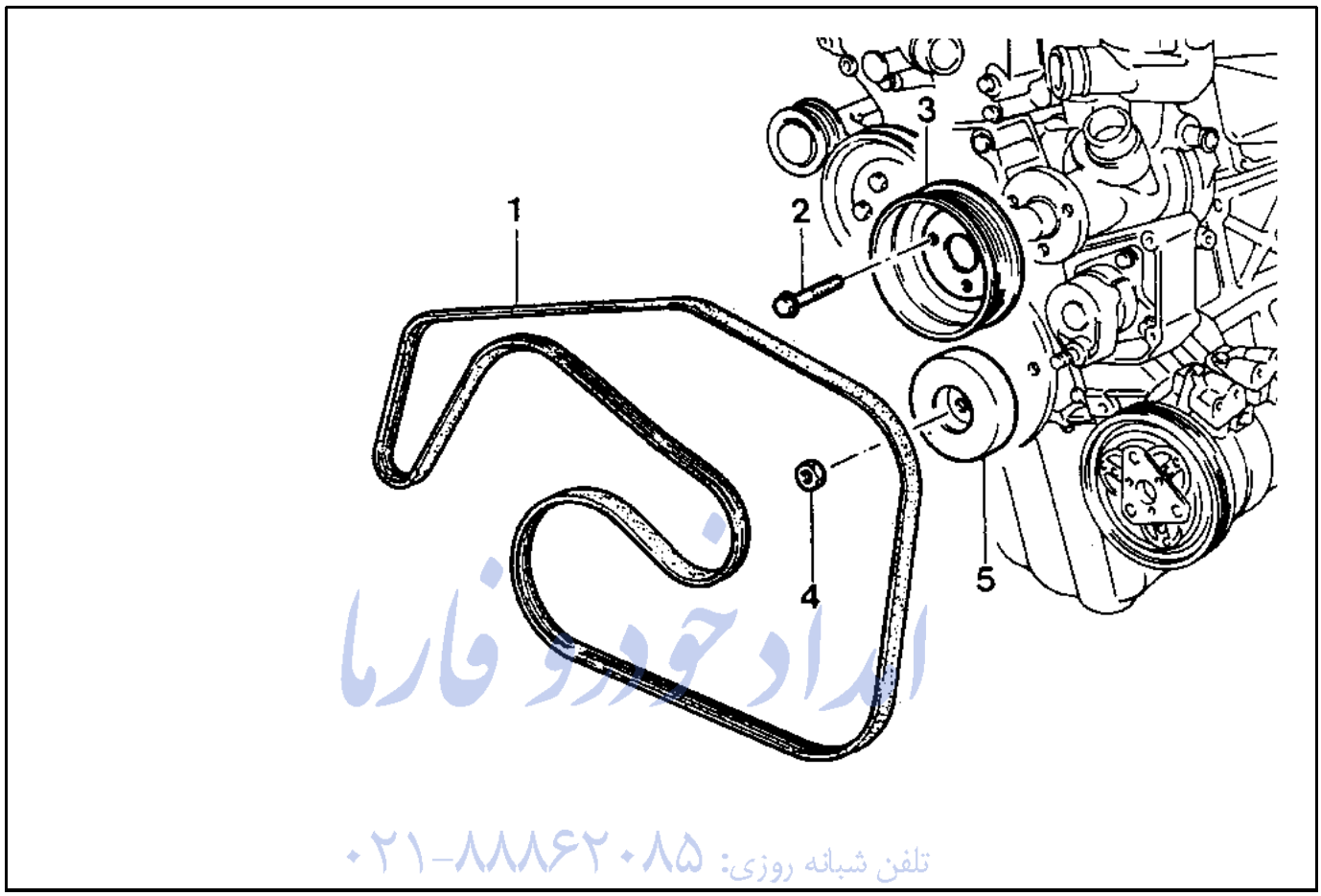


1 Belt Tensioning Pulley
2 Crankshaft Belt Pulley
3 A/C Compressor Pulley
4 Cooling Fan Pulley
5 Generator Pulley
6 Idler
7 Power Steering Pump Pulley
8 Cooling Fan and Water Pump Pulley

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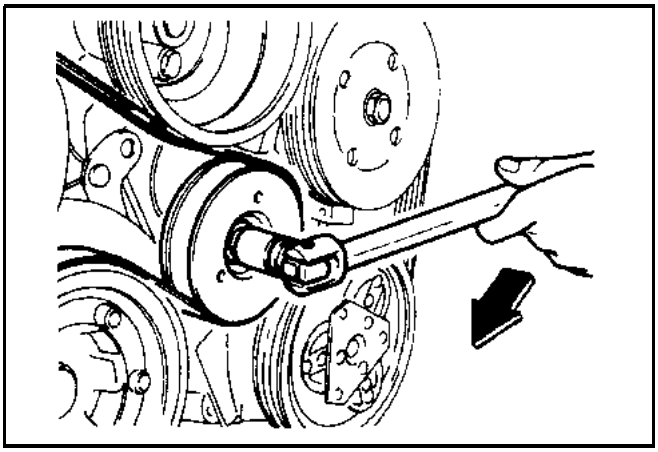
TENSIONING DEVICE

Preceding Work: Removal of poly v-belt



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1 Belt (L = 2245)
2 Bolt Combi (M8 x 14, 3 pieces) + Washer
. . . . . 22.5-27.5 N•m (16.6-20.3 lb-ft)
3 Water Pump Pulley
4 Nut
5 Tensioning Pulley

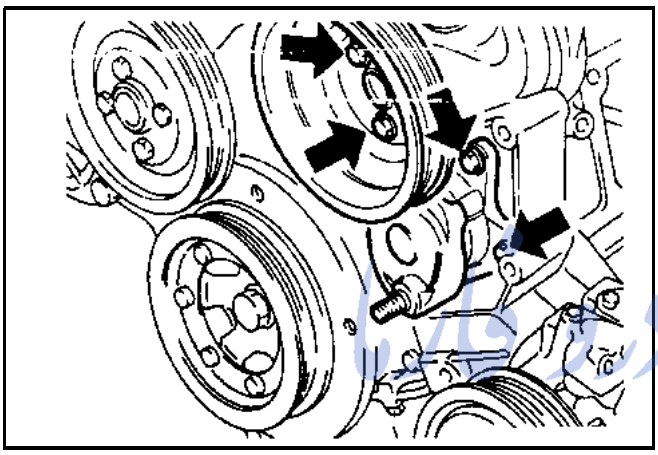


Removal & Installation Procedure

1. Remove the poly v-belt.
2. Remove the tensioning pulley by turning its mounting nut counter clockwise as shown in figure.

Installation Notice

Tightening Torque	40.5 - 49.5 N•m (29.9 - 36.5 lb-ft)



3. Remove the 3 bolts (2) and remove the water pump pulley (arrow).

Installation Notice

Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)

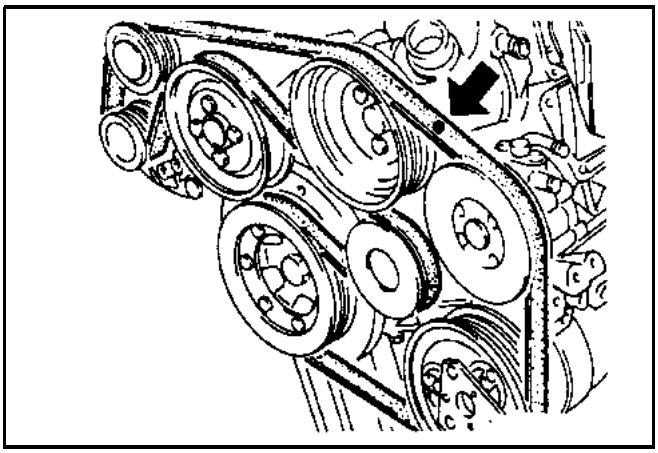
4. Remove the mounting bolts (M8 x 30, 3 pieces) at the tensioning device, and remove the tensioning device (arrow).

Installation Notice

Tightening Torque	26 - 32 N•m (19 - 24 lb-ft)

5. Installation should follow the removal procedure in the reverse order.

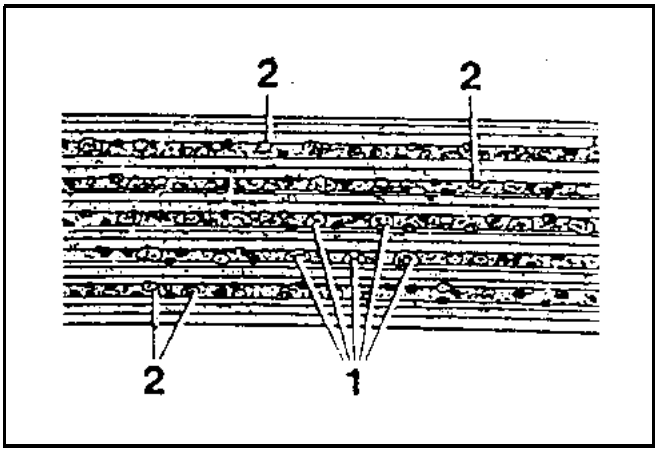
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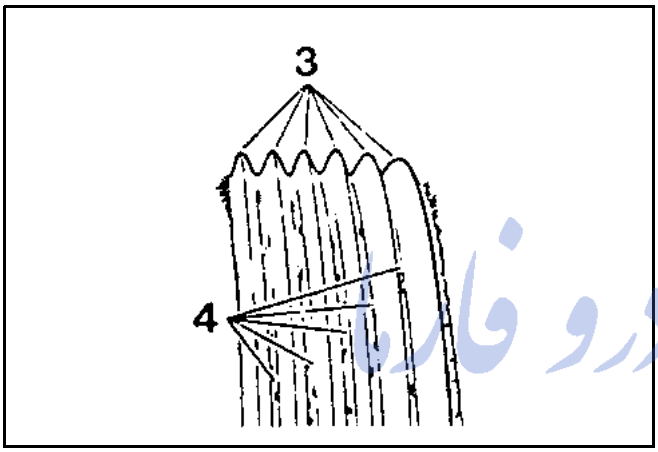
POLY V - BELT INSPECTION

- Make marks on the belt with chalk.
- Rotate the engine and check the belt for damage.

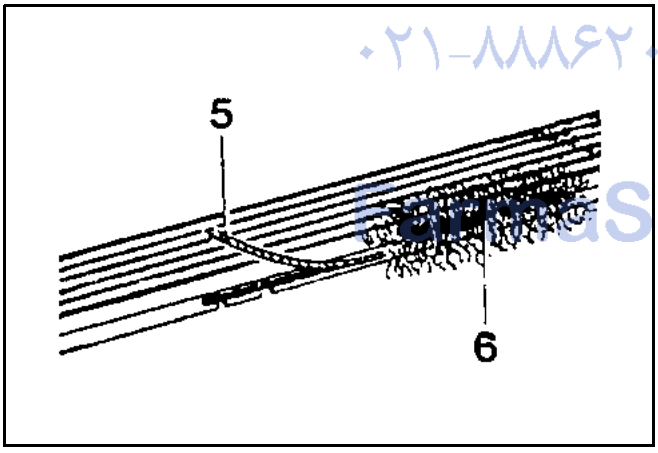
Notice: If one of the following types of damages is found, replace the belt.



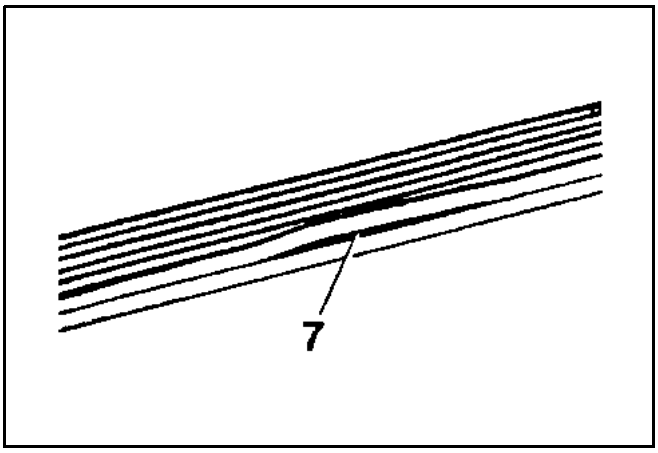
1. Rubber lumps in the base of rib.
2. Dirt or grit ingrained.



3. Pointed rib.
4. Belt cord visible in the base of rib.

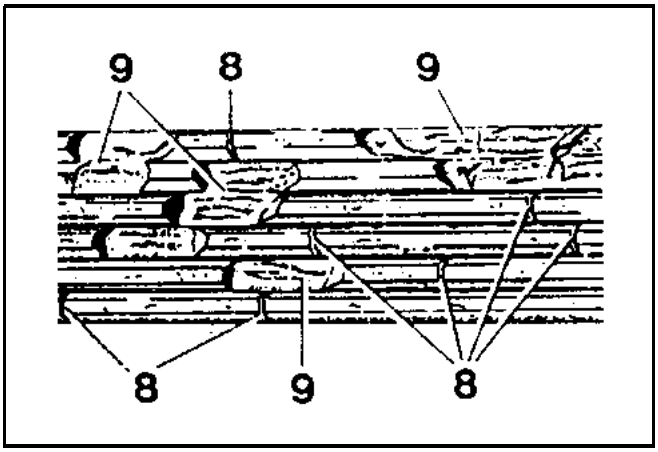


5. Cord torn out at the side.
6. Outer cords frayed.

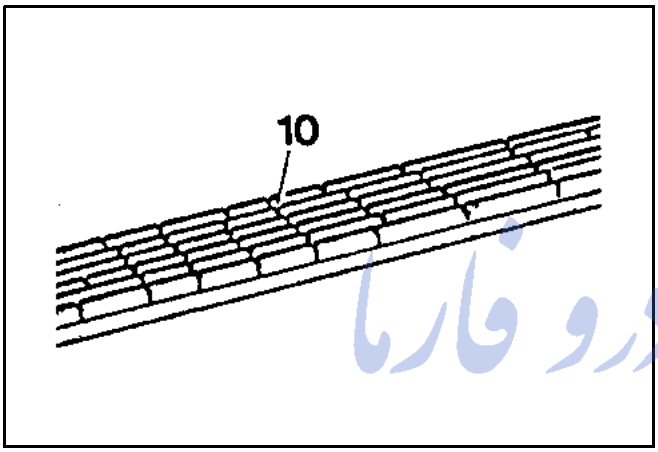


7. Rib detached from the base of belt.

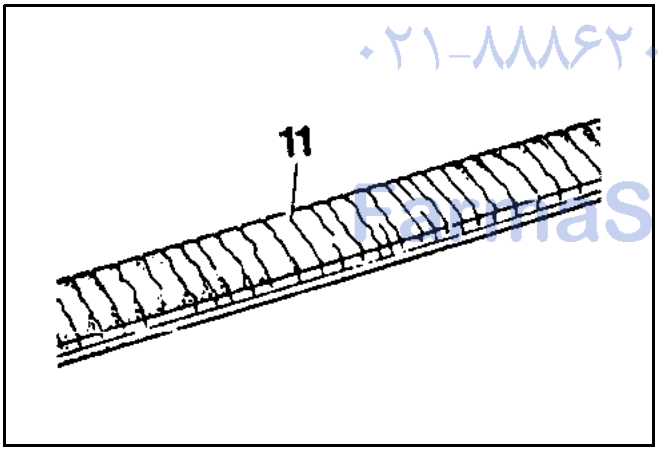
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8. Splits across the rib.
9. Sections of rib torn out.



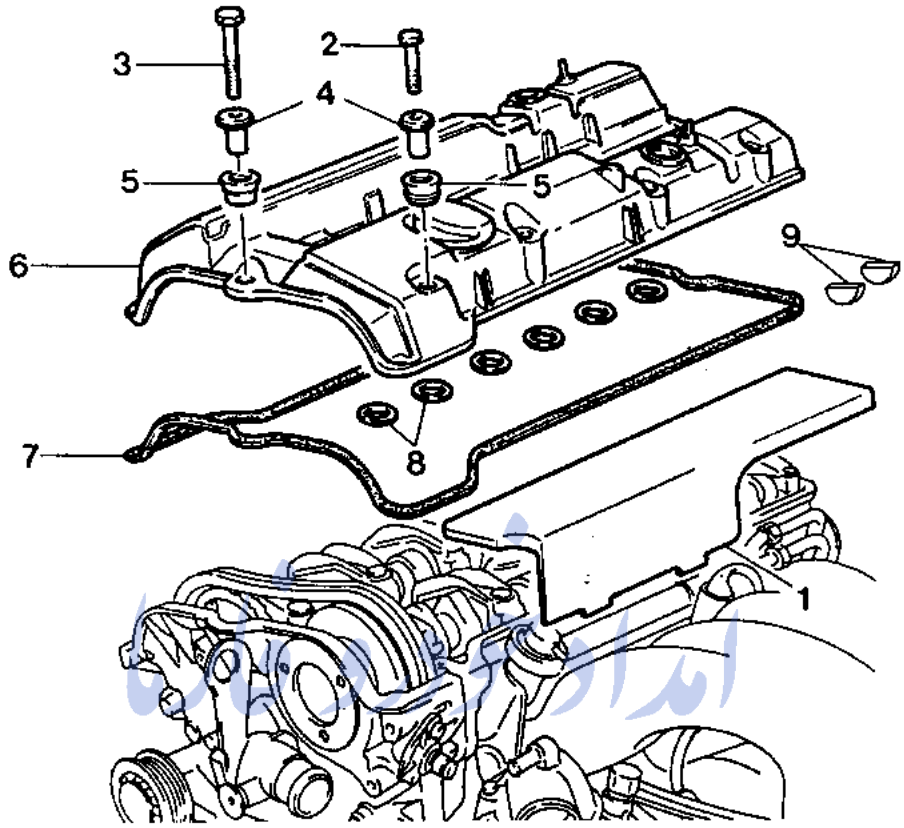
10. Splits across several ribs.



11. Splits across the back of the belt.

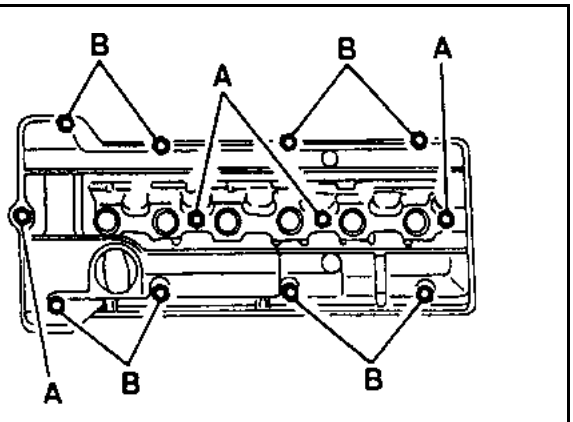
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CYLINDER HEAD COVER



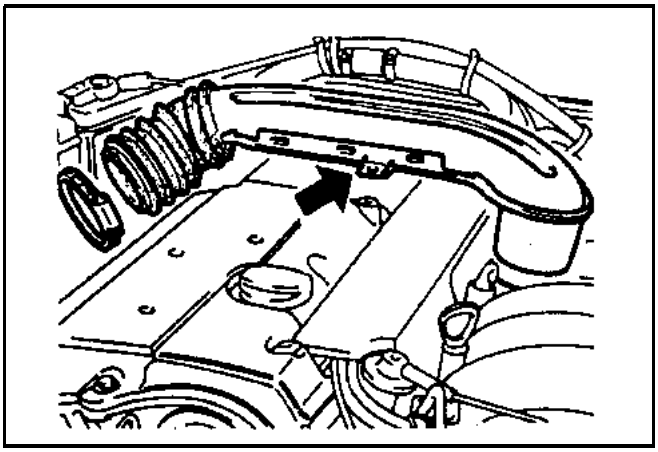
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1 Ignition Cable Dust Cover
2 Bolt (M6 x 65, 8 pieces) ..... 9-11 N•m (80-97 lb-in)
3 Bolt (M6 x 50, 4 pieces) ..... 9-11 N•m (80-97 lb-in)
4 Spacer Sleeve
5 Thrust Piece
6 Cylinder Head Cover
7 Gasket ..... Replace
8 Spart Plug Hole Seal ..... Replace
9 Camshaft Seal ..... Replace



Composition of The Cylinder Head Cover Bolts

A. M6 x 50, 4 Pieces - Bolts + Washers
B. M6 x 65, 8 Pieces - Bolts + Washers

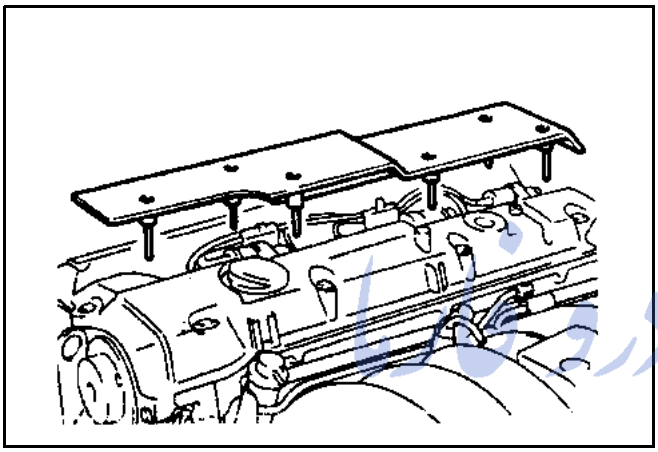


Removal & Installation Procedure

1. Remove the intake air duct.

Installation Notice

Tightening Torque	9 – 11 N•m (80 – 97 lb-in)

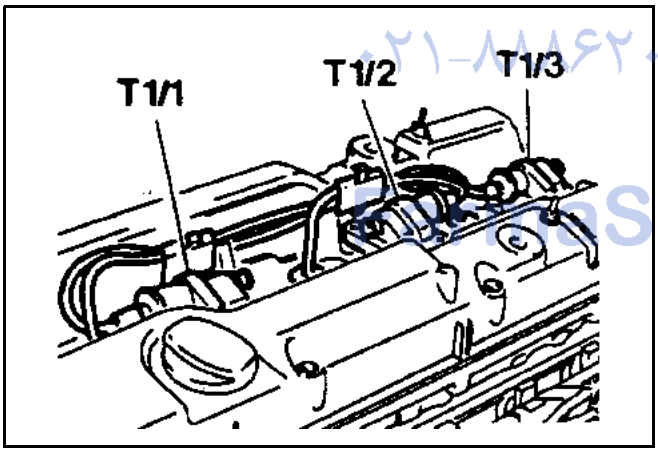


2. Remove the spark plug cover.

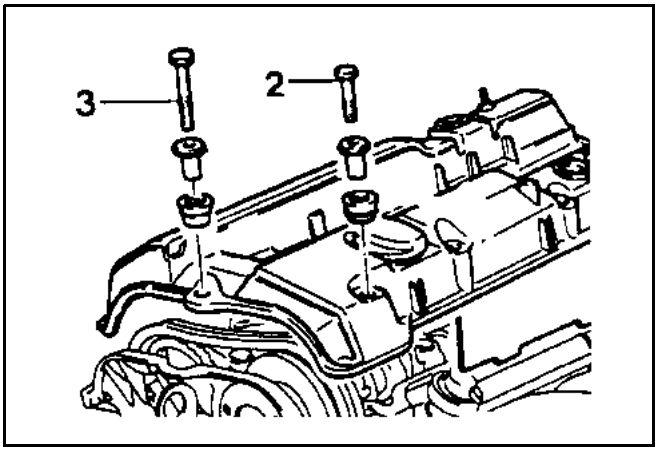
Installation Notice

Tightening Torque	9 – 11 N•m (80 – 97 lb-in)

Notice: Unscrew the seven (M6 x 60) bolts and remove the spark plug cover.



3. Remove the spark plug connector and ignition cable.



4. Unscrew all the bolts (2,3) and remove the head cover and the gasket.

Installation Notice

Tightening Torque	9 – 11 N•m (80 – 97 lb-in)

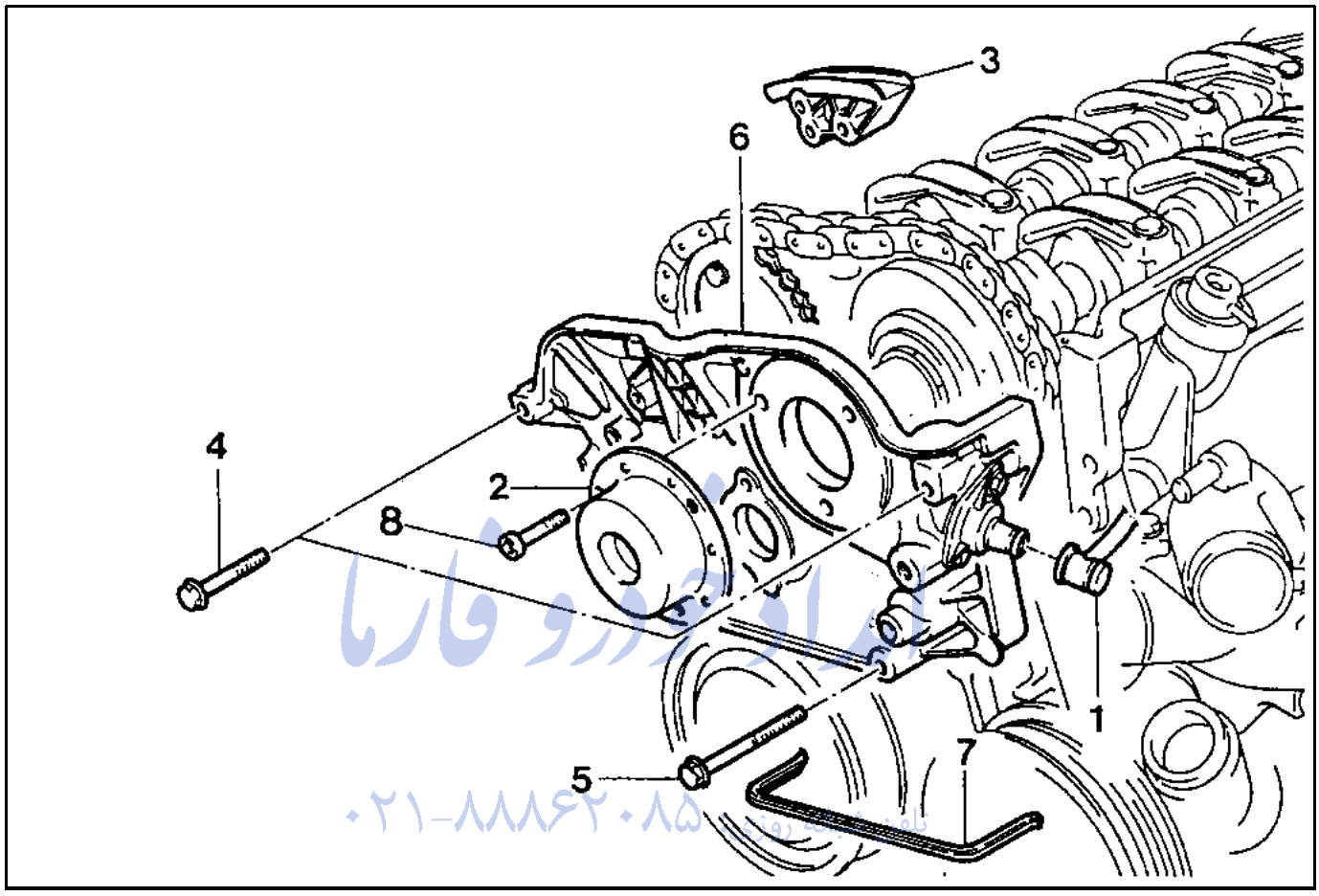
Notice: Replace the gasket with a new one if necessary.

5. Installation should follow the removal procedure in the reverse order.
6. Check for oil leaks by operating the engine.

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CYLINDER HEAD FRONT COVER

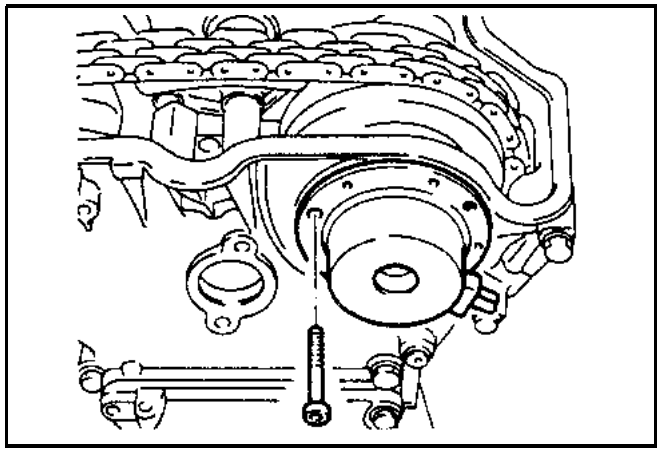
Preceding Work: Removal of cylinder head cover
Removal of coolant connection fitting



۰۲۱-۸۸۸۶۲۰۸۵

1 Camshaft Position Sensor
2 Magnet Assembly
3 Upper Guide Rail
4 Bolt (M6 x 60, 3 pieces)
. . . . . 22.5–27.5 N•m (16.6–20.3 lb-ft)
5 Bolt (M8 x 80, 3 pieces)
. . . . . 22.5–27.5 N•m (16.6–20.3 lb-ft)
6 Front Cover
7 Rubber Gasket . . . . . Replace
8 Bolt (M6 x 16, 3 pieces)
. . . . . 9–11 N•m (80–97 lb-in)

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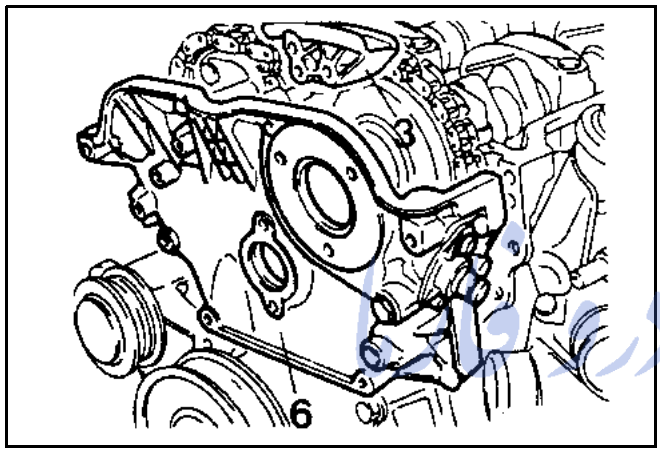


Removal & Installation Procedure

1. Remove the magnet assembly.

Installation Notice

Tightening Torque	9 - 11 N•m (80 - 97 lb-in)



2. Remove the cylinder head front cover (6).

Installation Notice

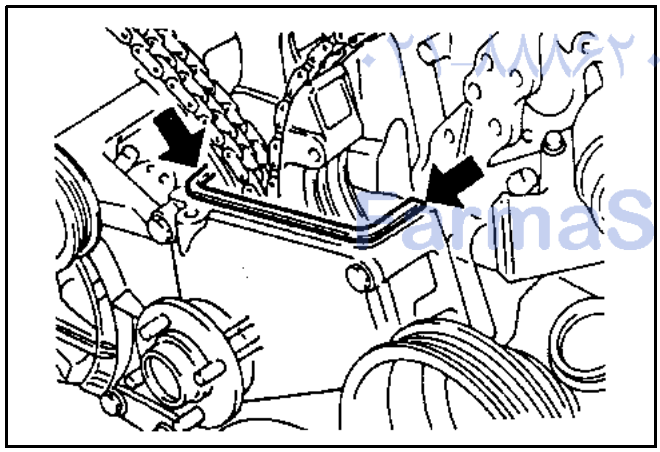
Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)

Apply the sealant at the mating surface of the cylinder head and the front cover.

3. Remove the upper guide rail pin and the guide rail (3).

Installation Notice

Install it while the chain tensioner is loose.



4. Remove the gasket (arrow).

Installation Notice

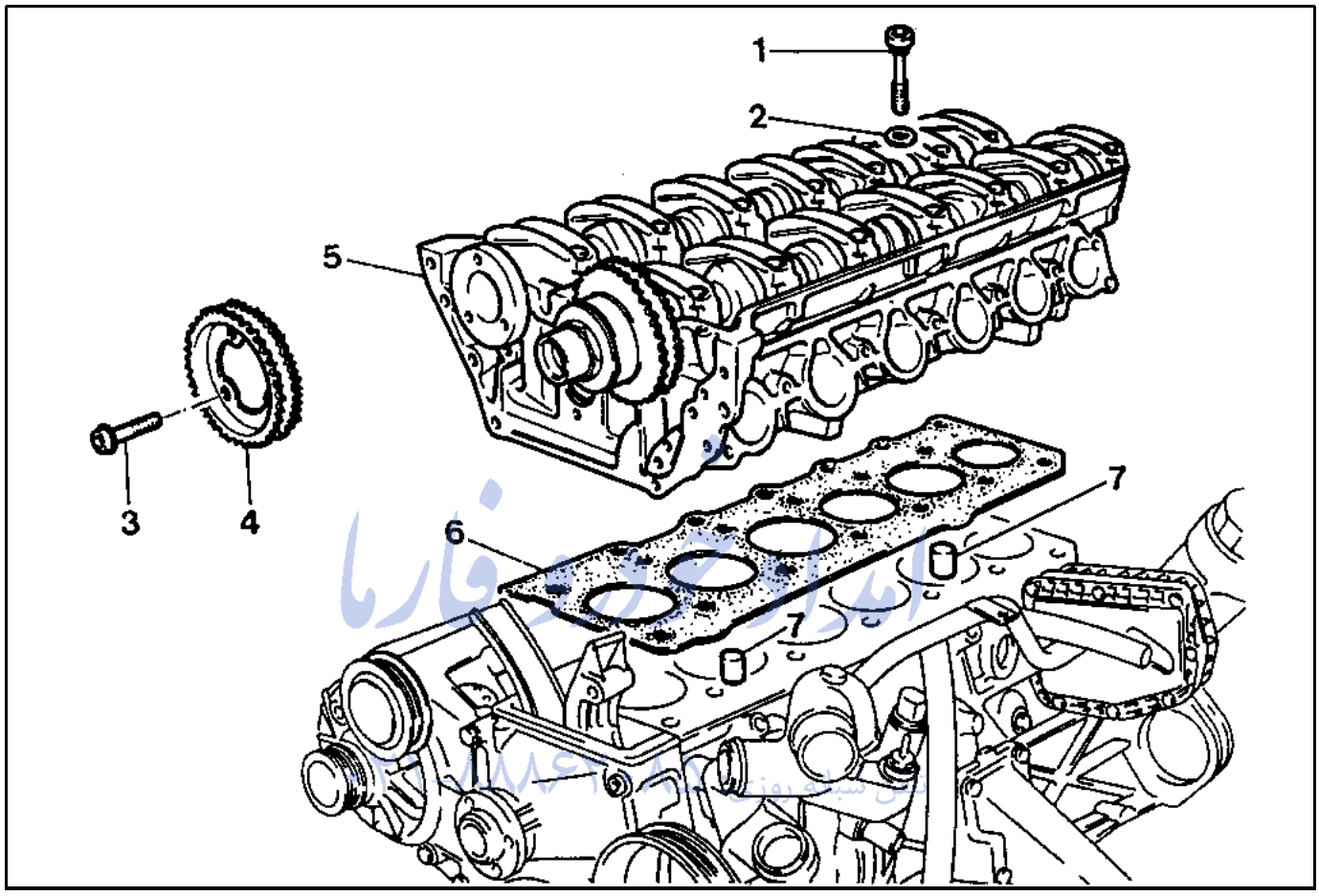
Replace the gasket with new one and apply the sealant.

5. Installation should follow the removal procedure in the reverse order.

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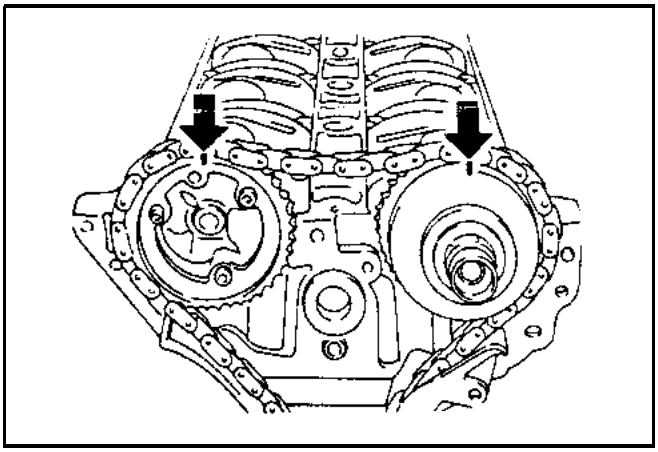
CYLINDER HEAD

Preceding Work: Removal of cylinder head cover
Removal of cylinder head front cover
Removal of upper intake manifold



1 Cylinder Head Bolt (14 pieces)
. . . . . 1st step 55 N•m (41 lb-ft)
2nd step 90°
3rd step 90°
2 Washers (14 pieces)
3 Flange Bolts (3 pieces)
. . . . . 1st step 18–22 N•m (13–16 lb-ft)
2nd step 60° ± 5°
4 Exhaust Camshaft Sprocket
5 Cylinder Head
6 Gasket . . . . . Replace
7 Dowel Sleeve

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Tools Required

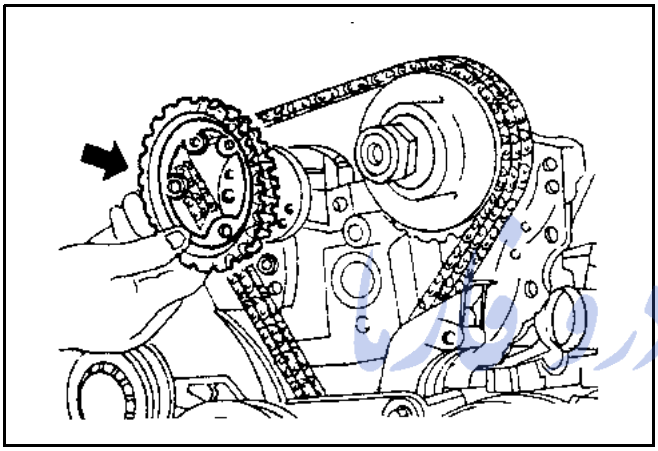
617 589 00 10 00 Allen Wrench Socket
116 589 01 34 00 Threaded Pin
116 589 20 33 00 Sliding Hammer

Removal & Installation Procedure

1. Rotate the crankshaft so that the piston of number 1 cylinder is at TDC.

Notice: Rotate the crankshaft in the normal engine direction.

2. Put the alignment marks (arrows) on the timing chain and camshaft sprocket.
3. Drain the coolant from the crankcase.

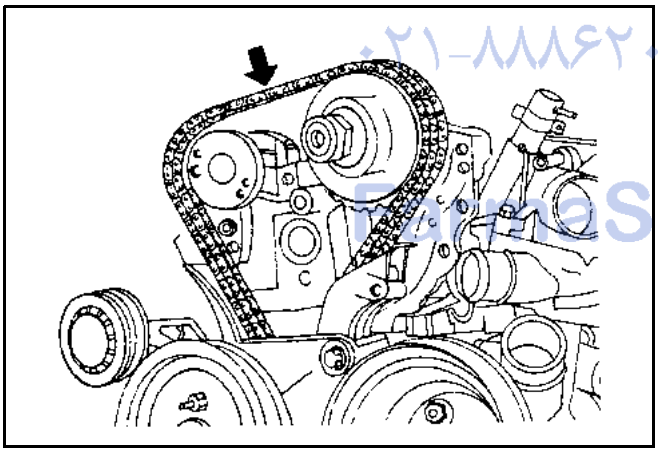


4. Remove the three flange bolts in the exhaust camshaft sprocket.

Installation Notice

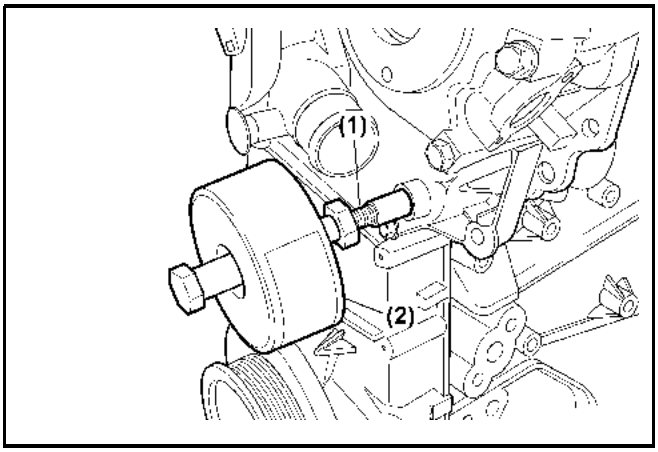
Tightening Torque	1st step: 18 – 22 N•m (13 – 16 lb-ft)
	2nd step: 60° ± 5°

Do not reuse the removed bolts.



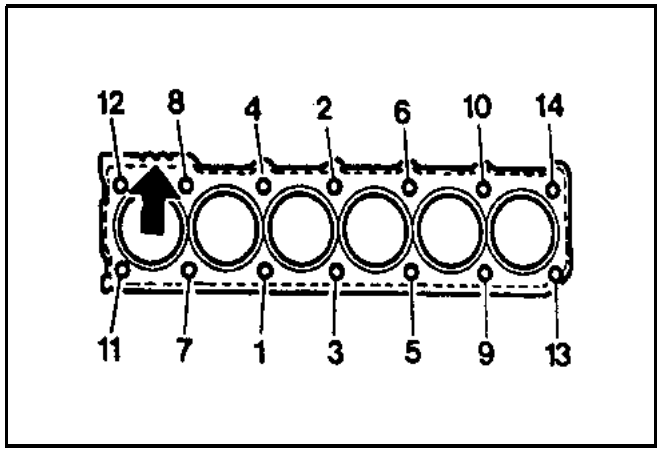
5. Separate the chain from the camshaft sprocket.

Notice: Be careful not to drop the chain into the timing case.



6. Remove the guide rail fixing pin using threaded pin 116 589 01 34 00 (1) and sliding hammer 116 589 33 00 (2).

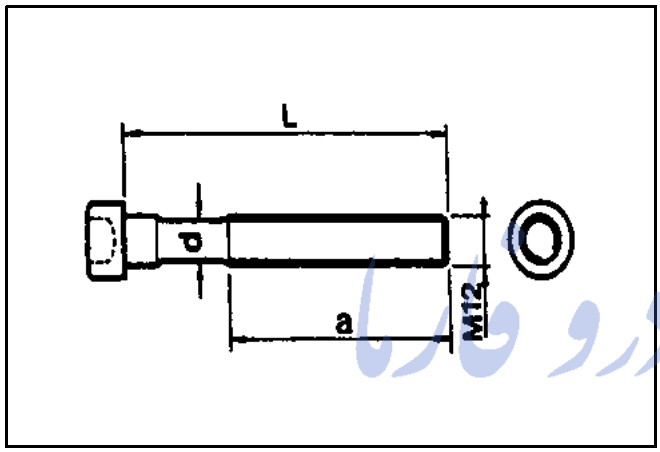
امداد خودرو
۰۲۱-۸۸۸۶۲۰۸۵
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7. Remove the cylinder head bolts in numerical order using allen wrench socket 617 589 00 10 00.

Installation Notice

Tightening Torque	1st step: 55 N•m (41 lb-ft)
	2nd step: 90°
	3rd step: 90°



8. Check the length of the cylinder head bolt.

Installation Notice

Length (L)	New 160 ± 0.8 mm
	Max. 162 ± 0.7 mm

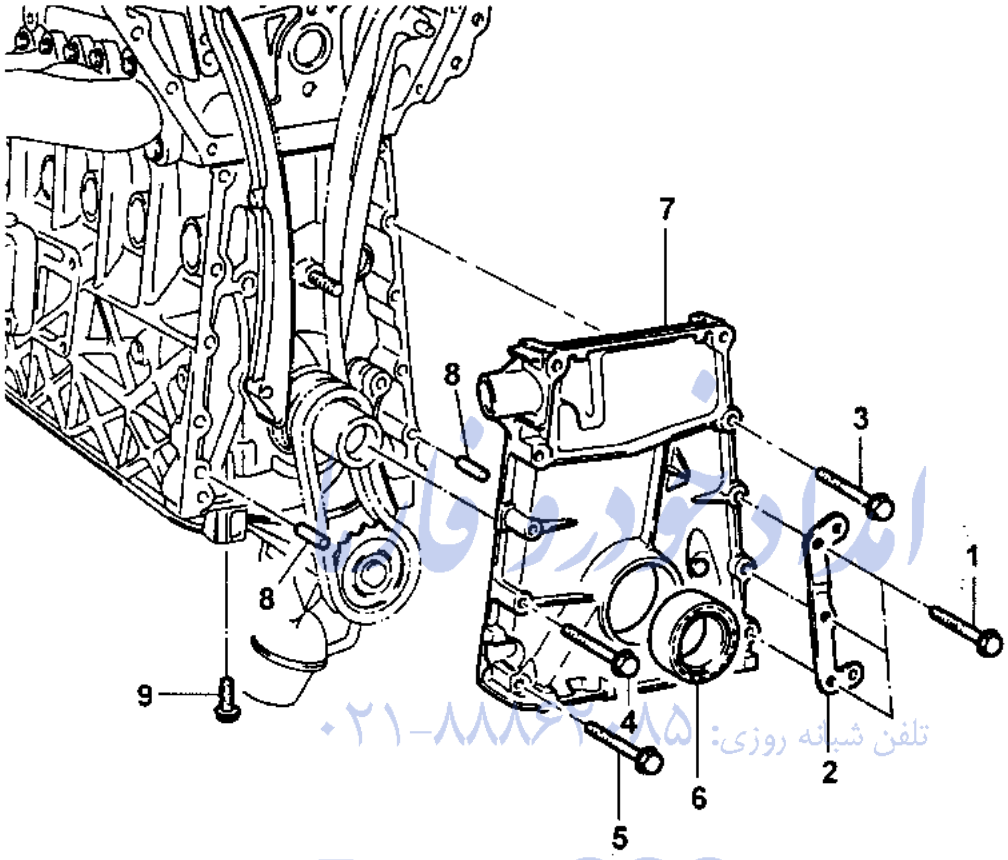
- Replace the bolt if the measured length exceed the max. length.
- Apply the oil to the thread surface of bolt.

9. Carefully remove the cylinder head and check the mating surface.
10. Installation should follow the removal procedure in the reverse order.

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۰۲۱-۸۸۸۶۲۰۸۵ تلفن: شبانه روزی
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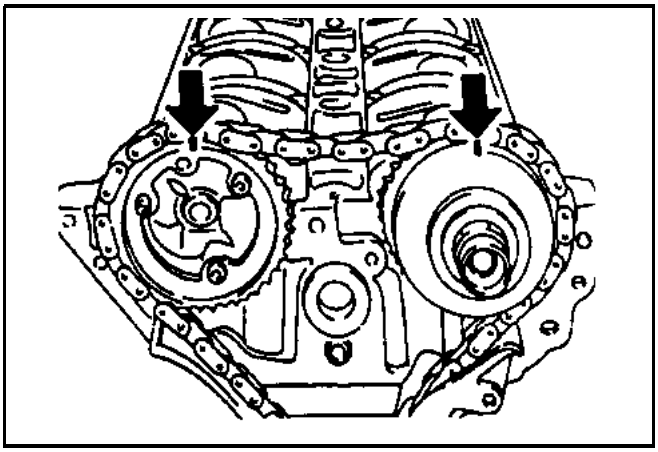
TIMING GEAR CASE COVER

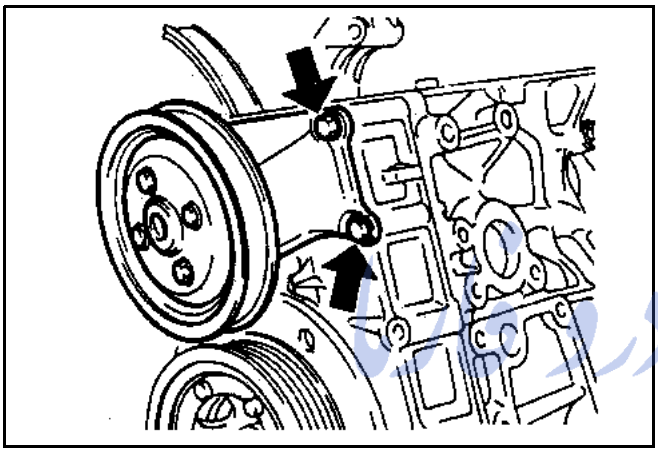
Preceding Work: Removal of cylinder head front cover
Removal of generator bracket
Removal of tensioning device
Removal of belt pulley and vibration damper



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1 Bolt (M8 x 60, 3 pieces)
. . . . . 22.5-27.5 N•m (16.6-20.3 lb-ft)
2 A/C Bracket
3 Bolt (M8 x 65, 3 pieces)
. . . . . 22.5-27.5 N•m (16.6-20.3 lb-ft)
4 Bolt (M8 x 40, 1 piece)
. . . . . 22.5-27.5 N•m (16.6-20.3 lb-ft)
5 Bolt (M8 x 60, 1 piece)
. . . . . 22.5-27.5 N•m (16.6-20.3 lb-ft)
6 Seal
7 Timing Gear Case Cover
8 Roll Pin
9 Bolt (M6 x 22, 6 pieces)
. . . . . 9-11 N•m (80-97 lb-in)





Removal & Installation Procedure

1. Put the alignment marks (arrows) on the timing chain and camshaft sprocket.
2. Unscrew the A/C bracket bolts (1) and remove the bracket.

Installation Notice

Tightening Torque	22.5 – 27.5 N•m (16.6 – 20.3 lb-ft)

3. Remove the cooling fan and the viscous clutch. Unscrew the three bolts from the cooling fan bracket and remove the bracket (arrows).

Installation Notice

Tightening Torque	22.5 – 27.5 N•m (16.6 – 20.3 lb-ft)

4. Remove the timing gear case cover after unscrewing the bolts (3) and (4) from the timing gear case cover and the bolt (9) from the oil pan.

Notice: Be careful not to damage the oil pan gasket.

Installation Notice

Tightening Torque	Bolt (3, 4): 22.5 – 27.5 N•m (16.6 – 20.3 lb-ft)
	Bolt (9): 9 – 11 N•m (80 – 97 lb-in)

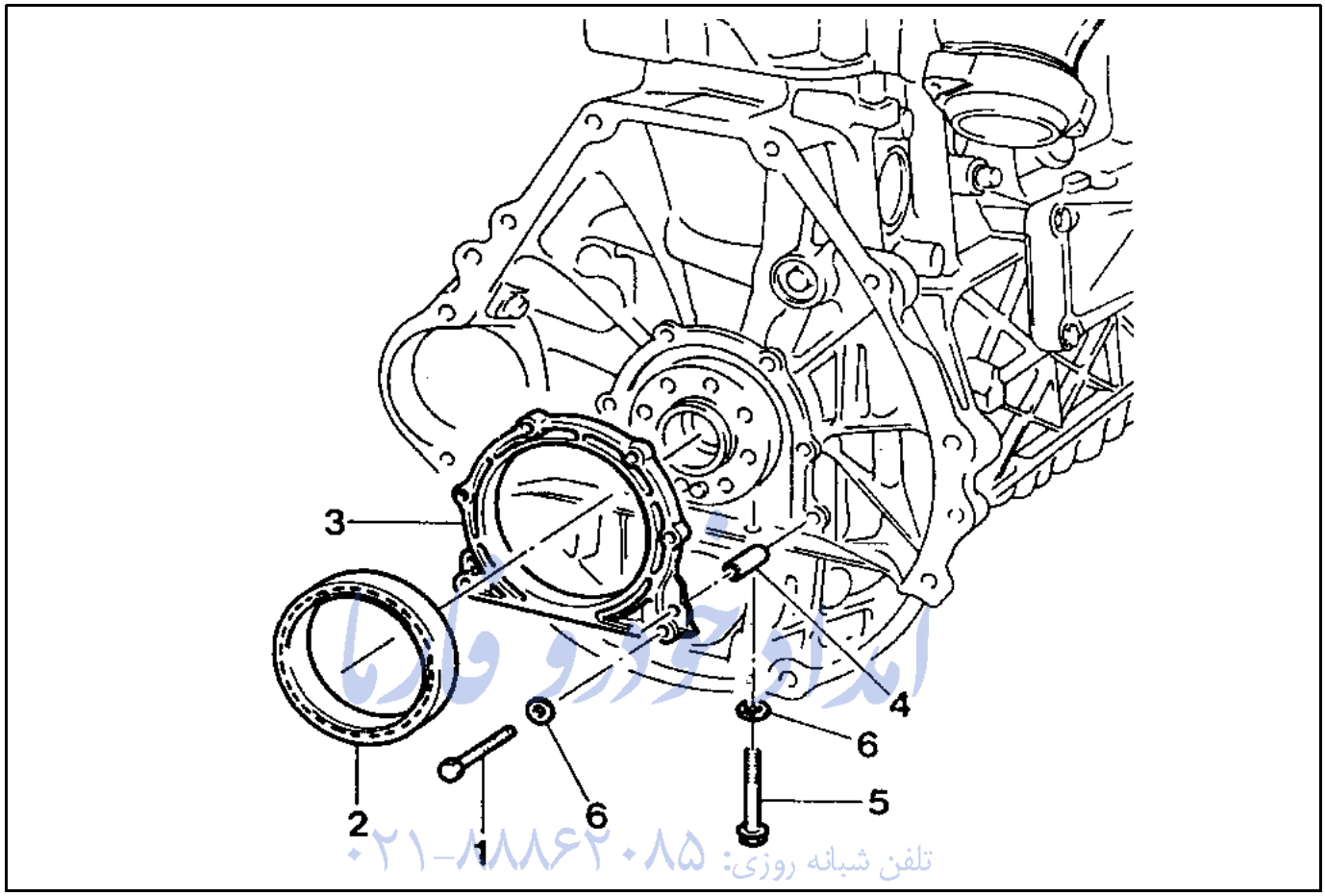
- Apply the sealant after cleaning the timing gear case cover surface.
- Be careful not to stain the oil chamber of chain tensioner with the sealant.

5. Installation should follow the removal procedure in the reverse order.
6. Warm up the engine and check for oil leaks.

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۰۲۱-۸۸۸۶۲۰۸۵
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CRANKSHAFT SEALING REAR COVER

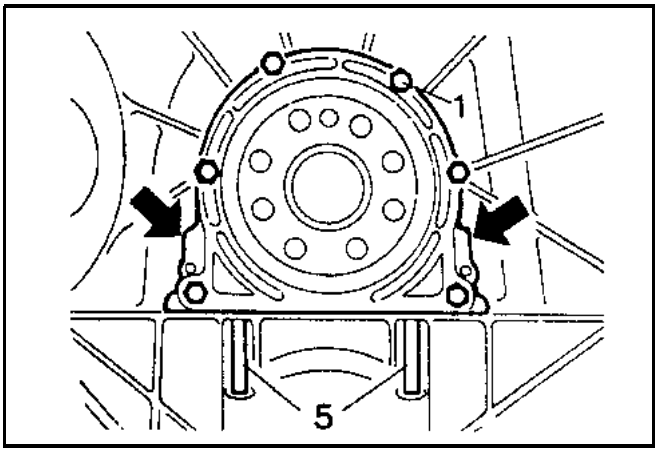
Preceding Work: Removal of the automatic transmission drive plate



تلفن شبانه روزی: ۰۲۱-۸۸۶۲۰۸۵

1 Bolt (M6 x 20, 6 pieces) . . . . . 9-11 N•m (80-97 lb-in)
2 Radial Shaft Seal
3 Rear Cover
4 Sleeve
5 Bolt (M6 x 85, 2 pieces) . . . . . 9-11 N•m (80-97 lb-in)
6 Washer

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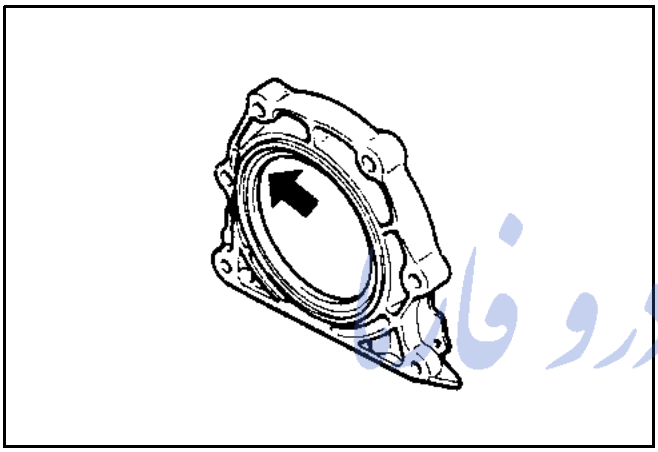
Tools Required

601 589 03 43 00 Crankshaft Rear Seal Installer

Removal & Installation Procedure

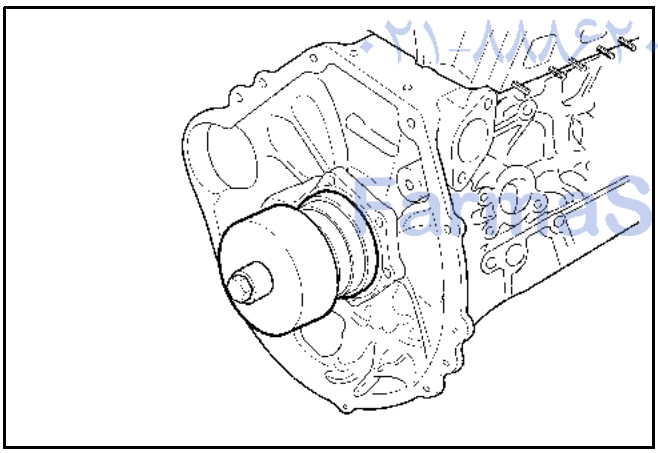
1. Unscrew the bolts (1) and (5) and remove the closing cover by pulling the rear cover lug (arrows).

Notice: Be careful not to damage the oil pan gasket.

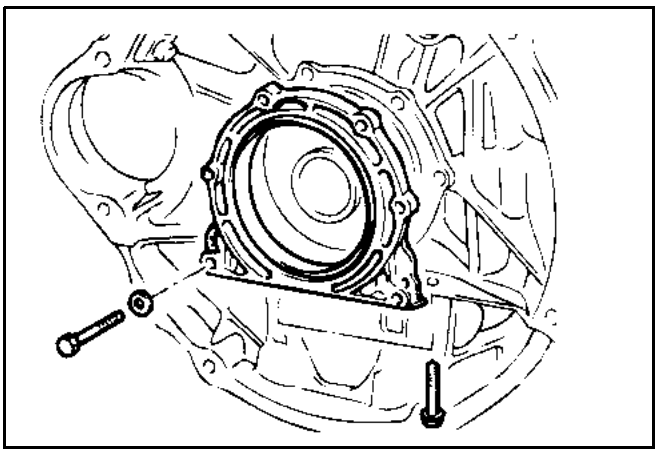


2. Clean the sealing surface of the crankcase and the rear sealing cover.
3. Check the radial shaft seal and replace it if necessary.
4. Apply the Loctite 573 to the rear cover sealing surface.
5. Apply the engine oil to the dust lip of the radial shaft seal.

Notice: Do not use the grease.



6. Install the crankshaft rear radial seal and the crankshaft sealing rear cover, using crankshaft rear seal installer 601 589 03 43 00.



7. Install the crankshaft sealing rear cover mounting bolts and remove the crankshaft rear seal installer 601 589 03 43 00.

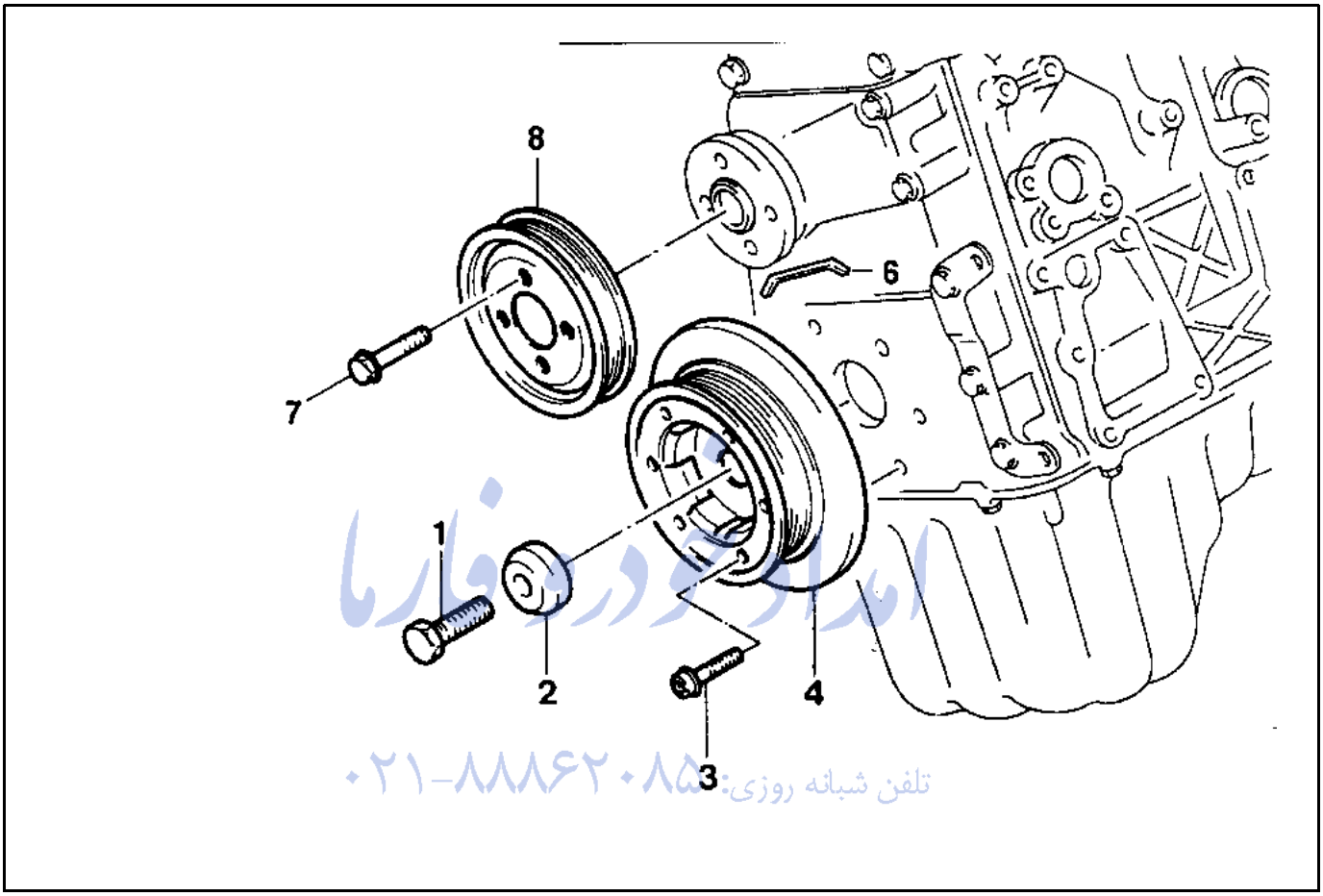
Installation Notice

Tightening Torque	9 – 11 N•m (80 – 97 lb-in)

8. Installation should follow the removal procedure in the reverse order.

BELT PULLEY AND VIBRATION DAMPER

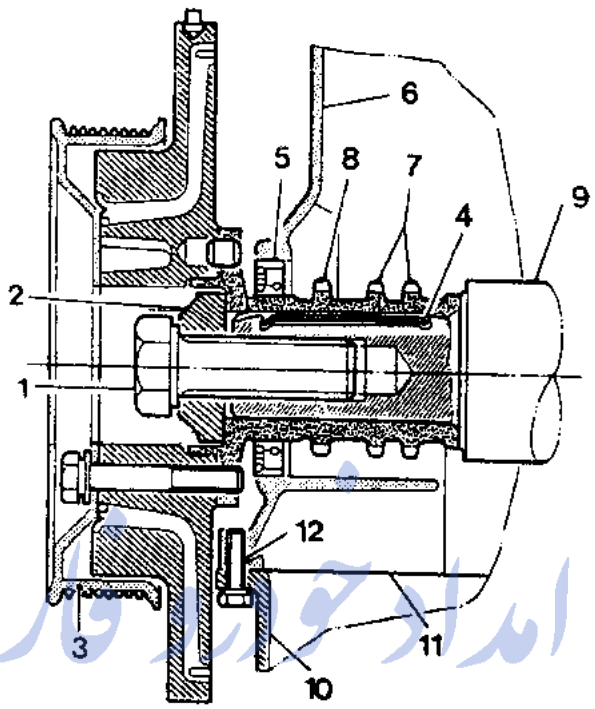
Preceding Work: Removal of cooling fan and viscous clutch
Removal of fan shroud
Removal of drive belt



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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵

1 Vibration Damper Center Bolt (M18 x 50)
. . . . . 1st step 200+20 N•m (148+15 lb-ft)
2nd step 90°+10°
2 Vibration Damper Disk
3 Bolt (M6 x 20, 6 pieces)
. . . . . 7.7-9.5 N•m (68.1-84.1 lb-in)
4 Vibration Damper Assembly
5 Woodruff Key
6 Bolt (M6 x 12, 4 pieces)
. . . . . 9-11 N•m (80-97 lb-in)
7 Cooling Fan Pulley

Components

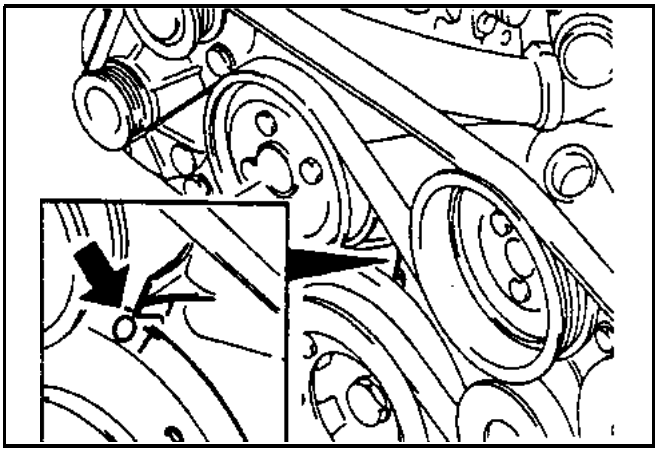


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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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1 Center Bolt (M18 x 50)
2 Center Bolt Washer
3 Vibration Damper and Pulley Assembly
4 Key
5 Crankshaft Front Seal
6 Timing Gear Case Cover
7 Crankshaft Sprocket (Camshaft Driven)
8 Crankshaft Sprocket (Oil pump Driven)
9 Crankshaft
10 Oil Pan
11 Oil Pan Gasket
12 Oil Pan Mounting Bolt (M6 x 22)

Service Data Standard

Permissble Deviation of The Vibration Damper	Radial Runout	0.6 mm
	Axial Runout	0.6 mm

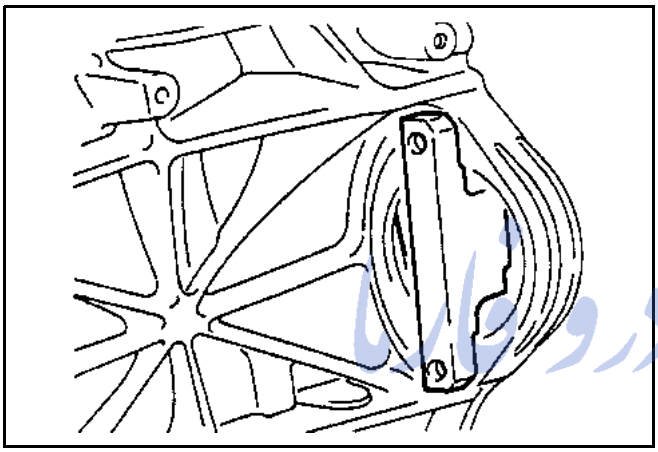


Tools Required

602 589 00 40 00 Engine Lock

Removal & Installation Procedure

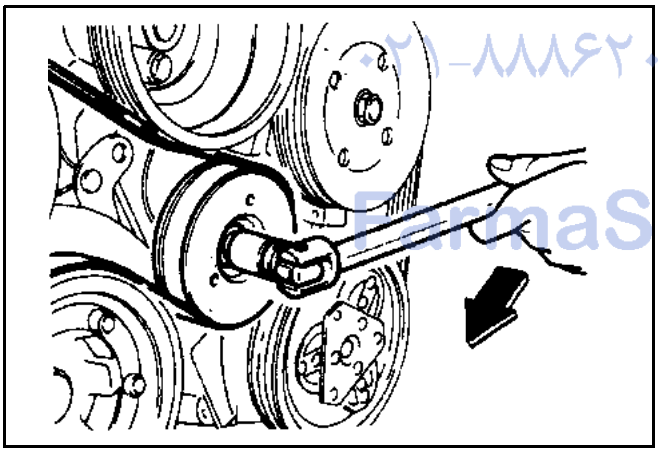
1. Adjust the piston of number 1 cylinder to the TDC.



2. Remove the start motor and install the engine lock 602 589 00 40 00 to the flywheel ring gear.
3. Remove the vibration damper center bolt.

Installation Notice

Tightening Torque	1st step: 200 + 20 N•m (148 + 15 lb-ft)
	2nd step: 90° + 10°



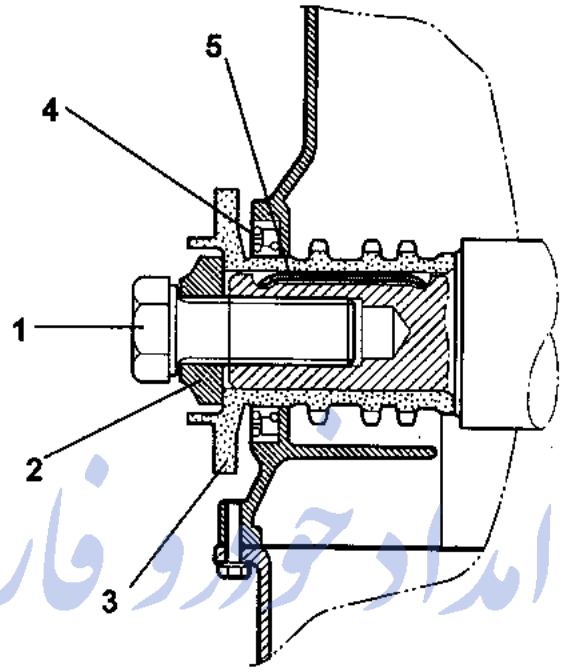
4. Remove the vibration damper assembly using the puller.
5. Installation should follow the removal procedure in the reverse order.

Notice: If possible, don't separate the vibration damper and the pulley.

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۰۲۱-۸۸۸۶۲۰۸۵ تلفن شبانه روزی
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CRANKSHAFT FRONT RADIAL SEAL

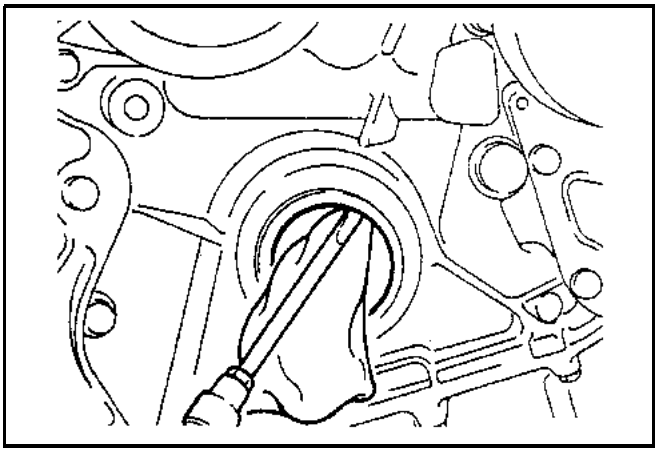
Preceding Work: Removal of belt pulley and vibration damper



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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵

1 Center Bolt (M18 x 50)
. . . . . 1st step 200+20 N•m (148+15 lb-ft)
2nd step 90°+10°
2 Center Bolt Washer
3 Crankshaft Front Seal Installer
4 Crankshaft Front Seal
5 Key

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Tools Required

601 589 03 14 00 Crankshaft Front Seal Installer

Replacement Procedure

1. Remove the radial seal with a screw driver.

Notice: Use a clean cloth not to damage the radial seal mounting hole and the crankshaft.

2. Coat the radial sealing lip with engine oil.
3. Using the crankshaft front seal installer 601 589 03 14 00, assemble the radial seal .
4. Align the sleeve groove and the woodruff key and tighten the center bolt until the center bolt and the damper disk stop in the movement.

Installation Notice

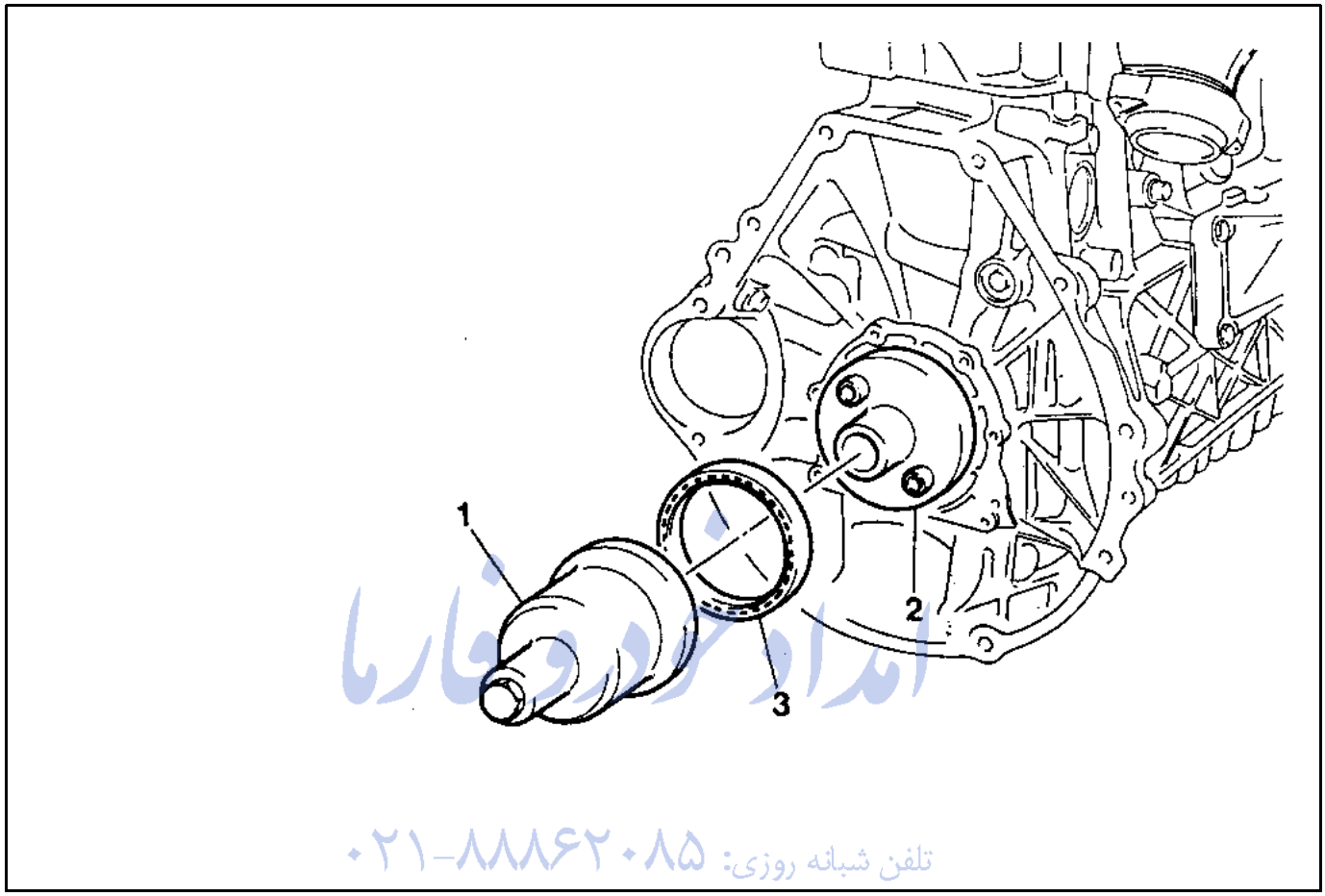
Tightening Torque	1st step: 200 + 20 N•m (148 + 15 lb-ft)
	2nd step: 90° + 10°

5. Remove the crankshaft front seal installer 601 589 03 14 00, and install the belt pulley and the vibration damper.
6. Check for leaks while operating the engine.

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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CRANKSHAFT REAR RADIAL SEAL

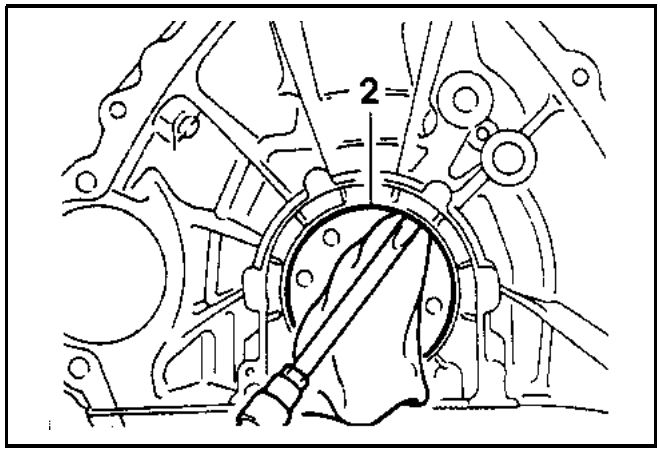
Preceding Work: Removal of flywheel or drive plate



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵

1 Special Tool
2 Special Tool
3 Crankshaft Rear Seal

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Tools Required

601 589 03 43 00 Crankshaft Rear Seal Installer

Replacement Procedure

1. Remove the radial seal with a screw driver.

Notice: Use a clean cloth not to damage the radial seal mounting hole and the crankshaft.

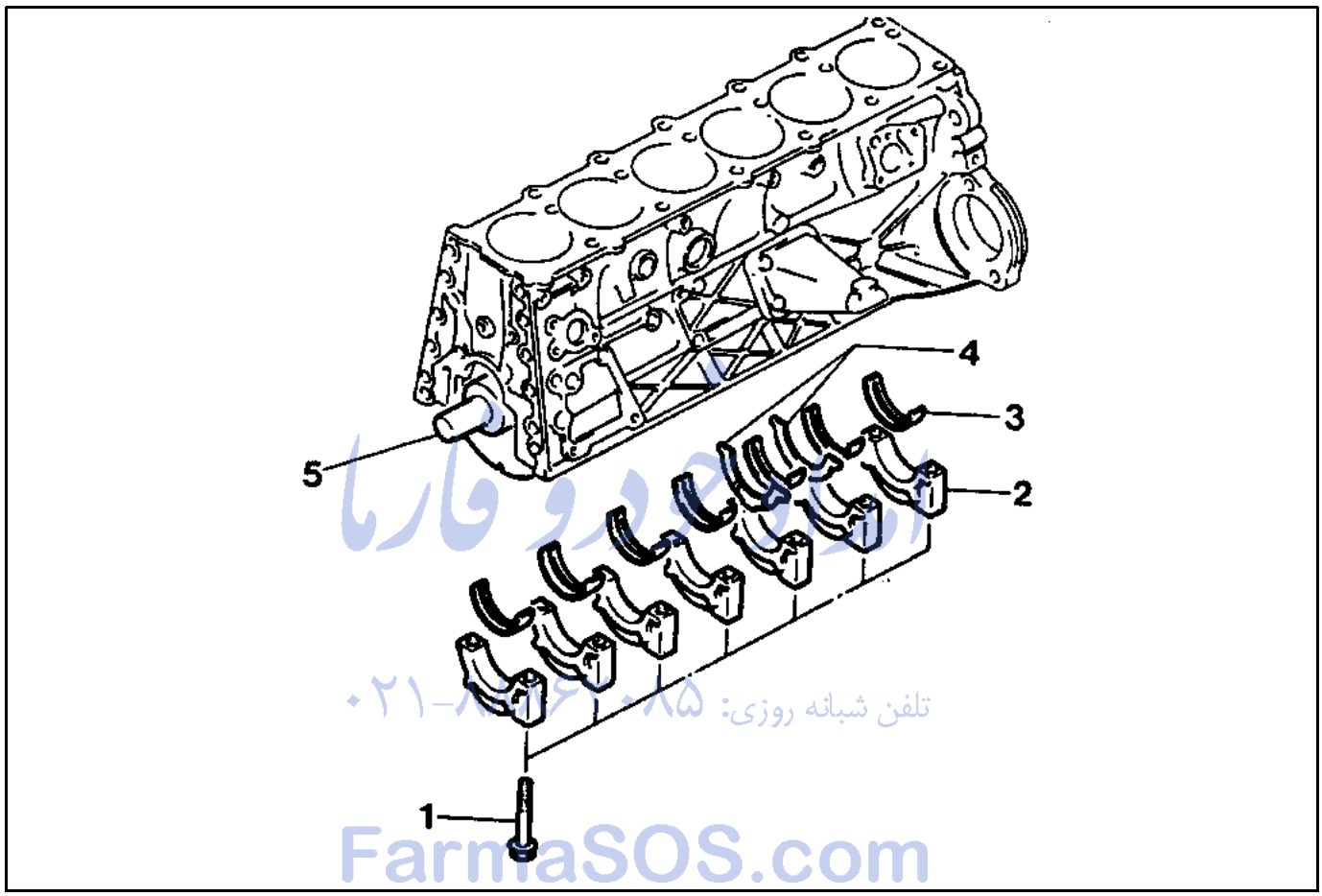
2. Install the special tool (2) to the crankshaft.
3. Apply the engine oil on the special tool (2).

Notice: Do not use the grease.

4. Install the radial seal on the inner parts assembler.
5. Press in the special tool (1) until the radial seal is stopped.
6. Check for leaks while operating the engine.

CRANKSHAFT

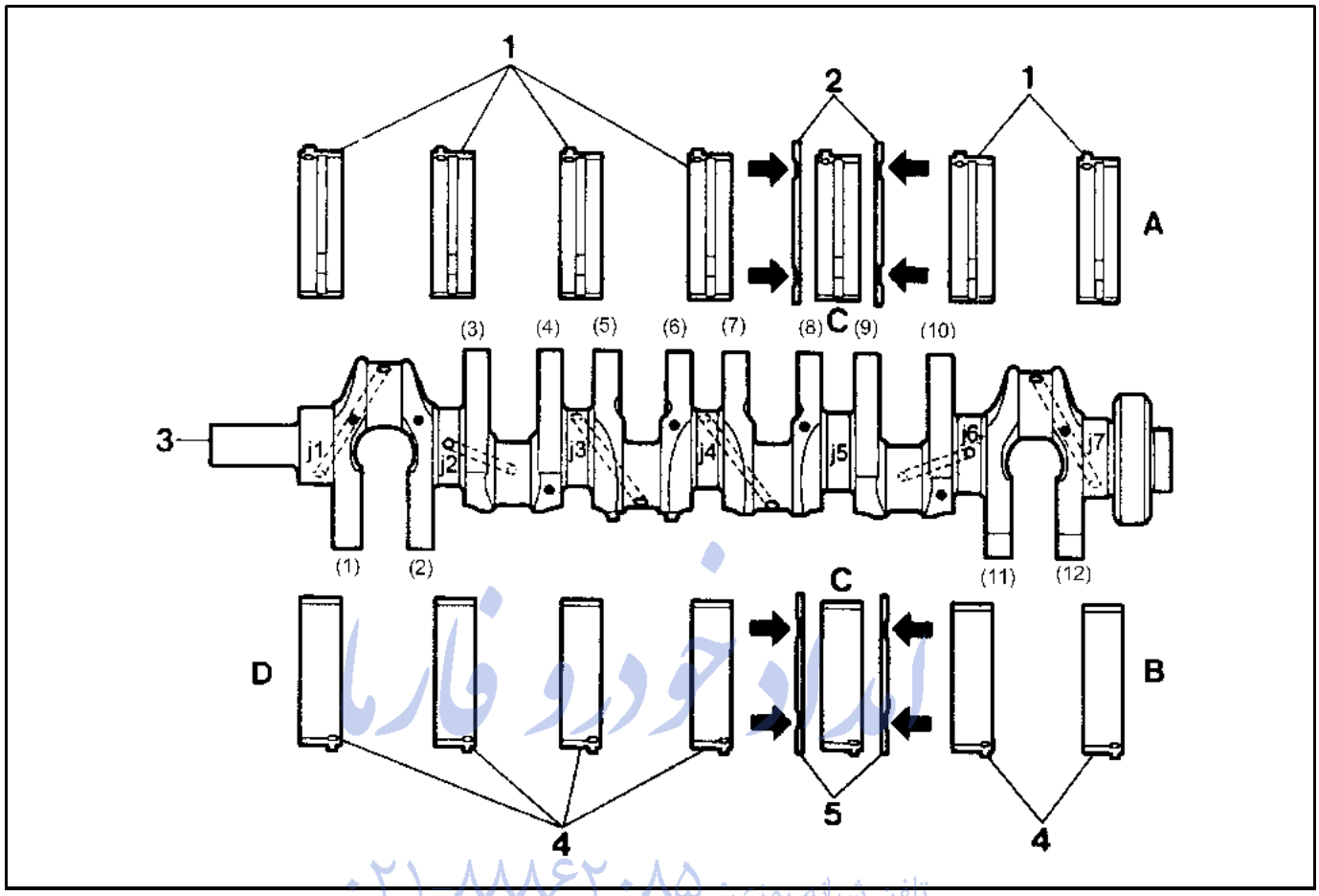
Preceding Work: Removal of engine assembly
Removal of timing gear case cover
Removal of cylinder head
Removal of oil pump
Removal of oil shield



تلفن شبانه روزی: ۰۲۱-۸۸۳۶۱۰۸۵
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1 12-sided Stretch Bolt
. . . . . 55 N•m (41 lb-ft) + 90°, lubricate
2 Crank Shaft Bearing Cap
3 Crank Shaft Low Main Bearing
4 Lower Thrust Bearing
5 Crankshaft

Arrangement of the Thrust Bearing and the Main Bearing



تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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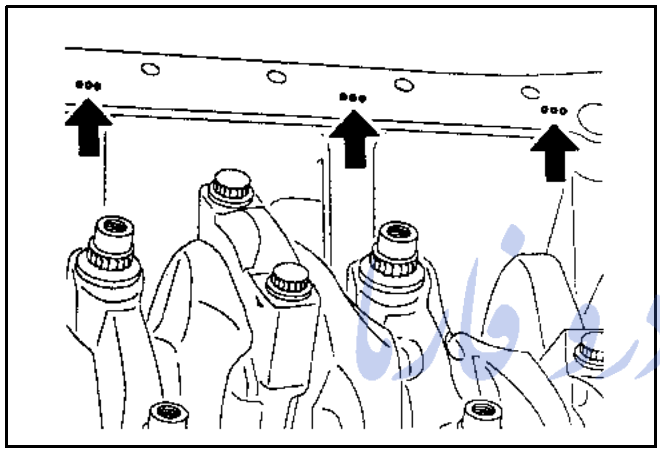
1 Upper Main Bearing
2 Upper Thrust Bearing
3 Crankshaft
4 Lower Main Bearing
5 Lower Thrust Bearing

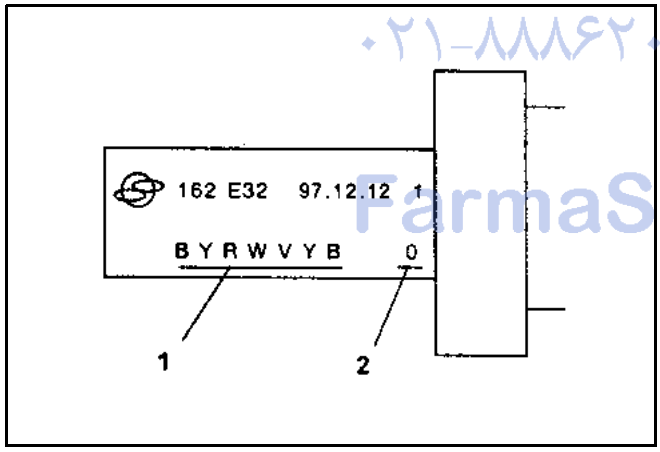
A Crankcase Side
B Bearing Cap Side (Oil Pan Side)
C Axial Fit Bearing (Number 5 Bearing Point)
D Radial Bearing

(1) – (12) Weight Balance/Color Marking Point
j1 – j7 Journal Main Bearing #1 – #7
● Color Dot Marking

The color dot marking are put on the (1), (2), (4), (6), (8), (10), (12) and it indicates the diameter of crankshaft journal by color as below.

Color Dot Marking	Crankshaft Journal Diameter (mm)
Blue	57.960 - 57.965
Yellow	57.955 - 57.960
Red	57.950 - 57.955
White	57.945 - 57.950
Violet	57.940 - 57.945





Selection of Crankshaft Main Bearing

1. Crankcase Side

   There are seven punching marks on the mating surface to oil pan. This mark is correspondent to the bearing distinguished by color. Select the relevant bearing according to the punching mark when repaired.

Punching Mark	Bearing Color Selected
●	Blue
●●	Yellow
●●●	Red

2. Crankshaft Bearing Cap Side

   Select the crankshaft main bearing according to the marking letter on the crankshaft main journal when repaired.

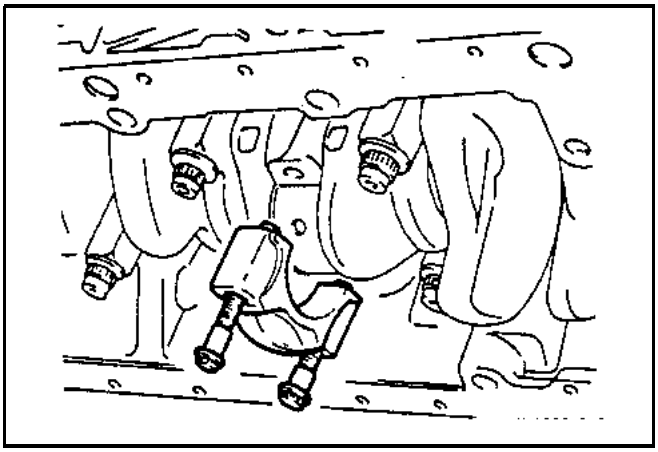
Marking Letter	Bearing Color Selected
B	Blue
Y	Yellow
R	Red
W	White
V	Violet

Service Data

Unit: mm

Crankshaft Standard and Repair Size	Crankshaft Bearing Journal Diameter	Crankshaft Bearing Diameter	Crankshaft Journal Width at fit bearing	Connecting Rod Bearing Journal Diameter	Connecting Rod Bearing Journal Width
Standard size	57.940-57.965	58	24.50-24.533	47.935-47.965	27.958-28.042
1st repair size	57.705-57.715			47.700-47.715	
2nd repair size	57.450-57.465		-	47.450-47.465	-
3rd repair size	57.205-57.215			47.200-47.215	
4th repair size	56.955-56.965			46.950-46.965	

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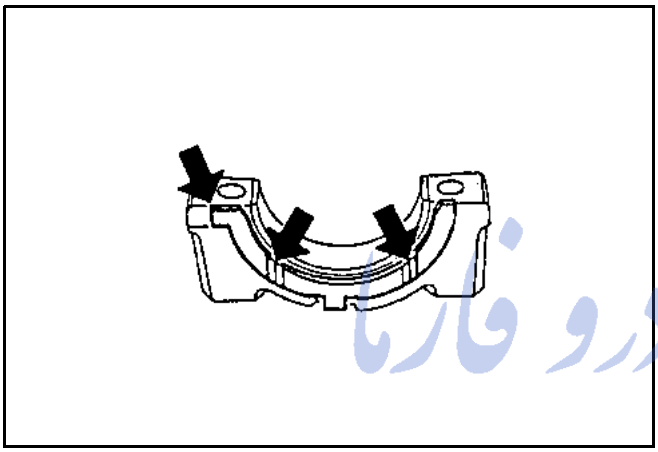
Removal & Installation Procedure

1. Unscrew the connecting rod bearing cap bolt and remove the bearing cap.

Installation Notice

Tightening Torque	40 N•m (30 lb-ft) + 90°

- Make sure that the upper and lower bearing shells do not change each other.
- Coat the bearing shell with engine oil.
- Install the bearing cap according to the consecutive number.



2. Unscrew the crankshaft bearing cap bolts and separate the upper and lower bearing shells and thrust washers.

Installation Notice

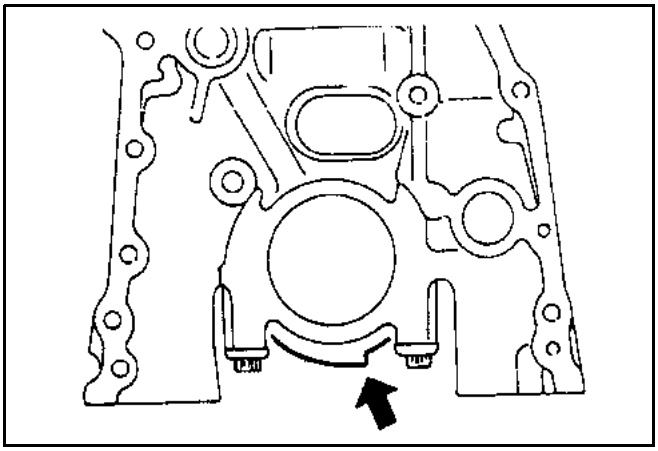
Tightening Torque	55 N•m (41 lb-ft) + 90°

- Remove the bearing cap from front (pulley side) to rear.
- Make sure that the upper and lower bearing shells do not change each other and coat with engine oil.
- The oil grooves (arrows) in the thrust washers must face outward and insert the thrust bearing into the bearing cap.
- There are five kinds of thrust washers by thickness. Select the proper washer when repaired.

Part No. : 601 030 00 62	2.15 mm
Part No. : 601 030 01 62	2.20 mm
Part No. : 601 030 02 62	2.25 mm
Part No. : 601 030 03 62	2.30 mm
Part No. : 601 030 04 62	2.40 mm

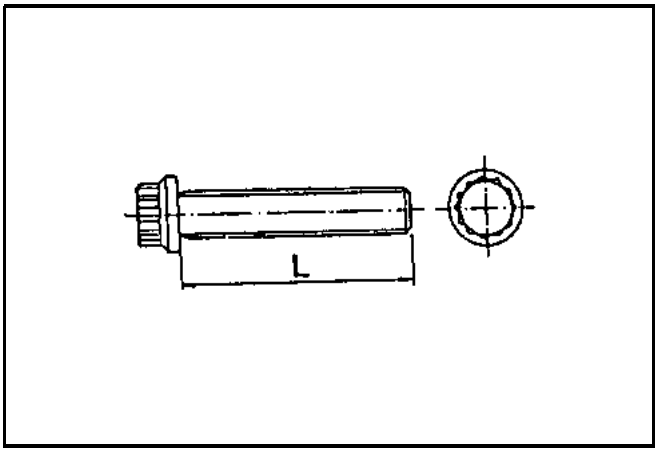
3. Remove the crankshaft.
4. Installation should follow the removal procedure in the reverse order.
5. After completion of the installation, check for the rotating condition of the crankshaft.

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۰۲۱-۸۸۸۶۲۰۸۶
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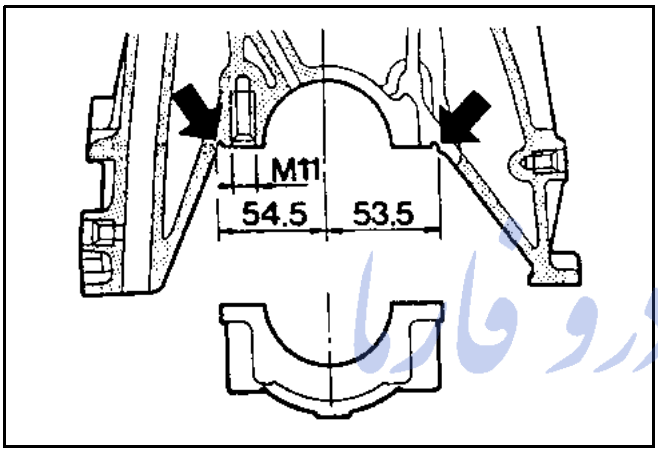
Installation Notice

- Make sure the crankshaft bearing cap properly seated in place in the crankcase side. When perfectly installed, the projected part (arrow) locates in the left side (intake manifold side).
- Assemble so that the projected part of the cap and crankcase face the same direction.



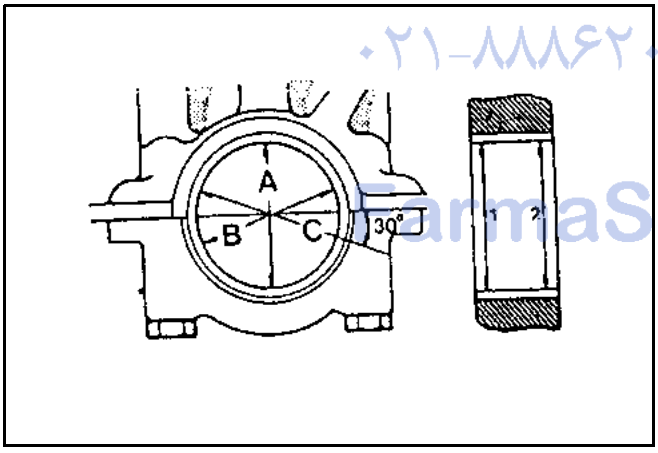
Inspection

1. If the length 'L' of the crankshaft bearing cap bolt exceeds 63.8mm, replace it.



2. Make sure the crankshaft bearing cap is properly seated on the cylinder block (arrows).

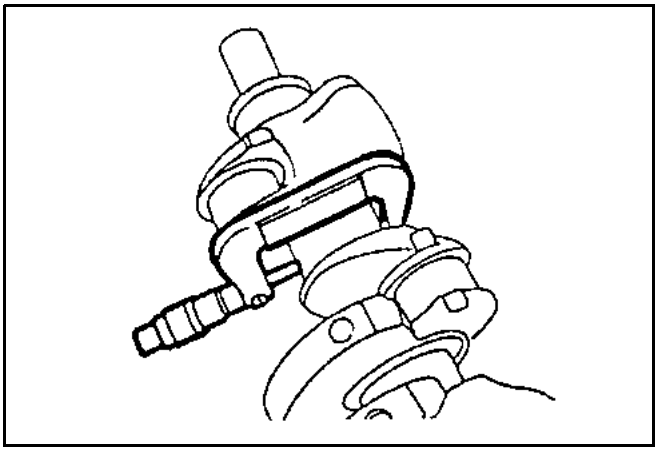
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۰۲۱-۸۸۸۶۲۰۸۵ تلفن شبانه روزی
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3. Measure and record the inner diameter of the crankshaft bearing.

Notice

- Measure at 2 points (1, 2).
- Measure 'A', 'B' and 'C' as shown. If average value of 'B' and 'C' is less than value 'A', then the average value of 'B' and 'C' is actual average value. If average value of 'B' and 'C' is more than value 'A' is actual average value.



4. Measure and record the diameter of the crankshaft bearing journal.

Notice

- Record the mean value when measured at 3 points (A, B, C).
- Measure the inner diameter of bearing and the diameter of journal and if it is out of the standard data, replace the bearing shell.

Service Data Standard (Crankshaft Main Bearing Gap)

Item	Measuring Position	Gap (mm)
Main Bearing Journal (NO. 1, 5, 7)	Radial	Static condition : 0.015 - 0.039 Dynamic condition: 0.031 - 0.051 (Consider the expansion 0.011 - 0.016)
	Axial	0.010 - 0.254
Main Bearing Journal (NO. 3, 4, 6)	Radial	Static condition :0.011 - 0.039 Dynamic condition: 0.031 - 0.051 (Consider the expansion 0.015 - 0.022)
	Axial	0.010 - 0.254

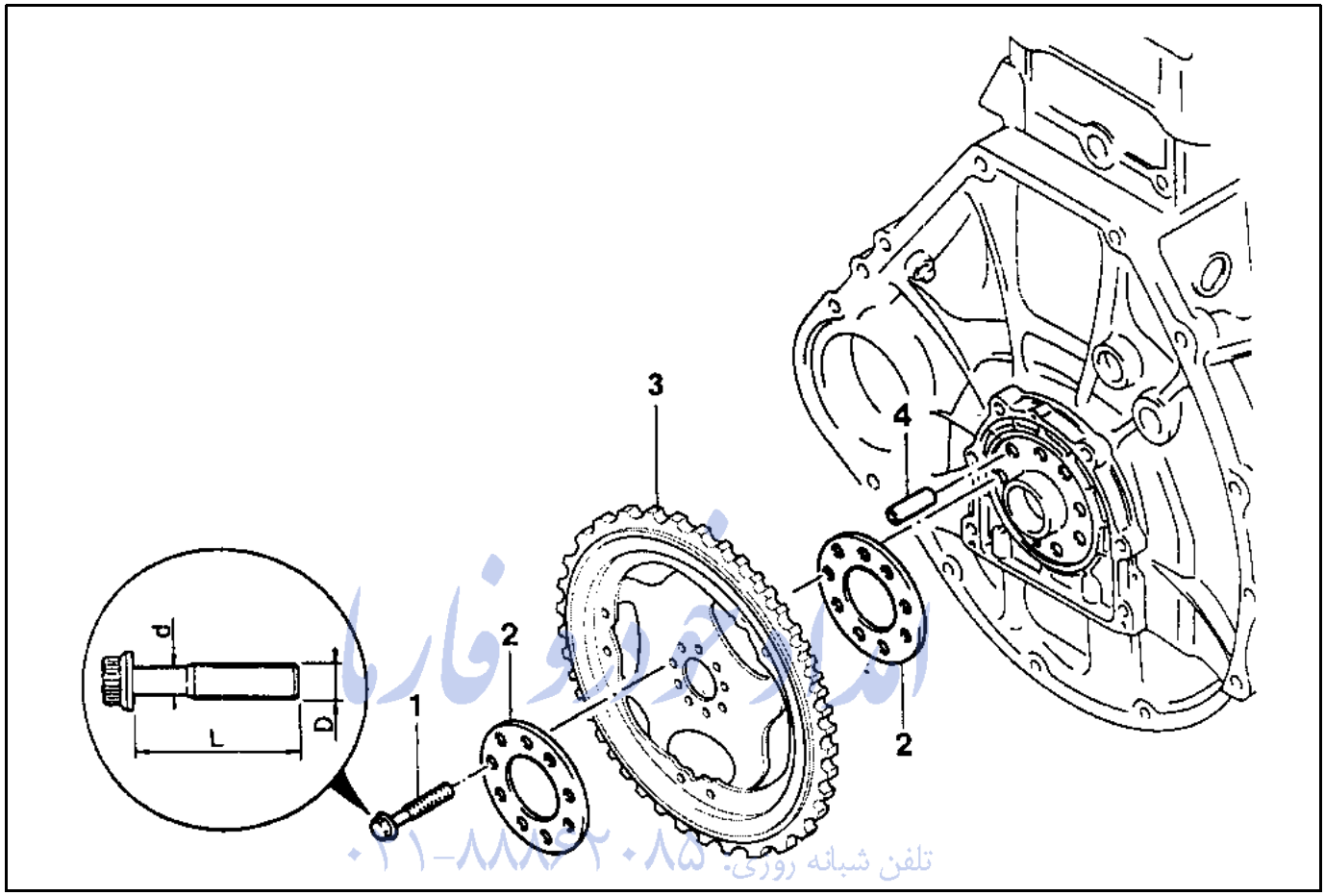
(Connecting Rod Bearing Gap)

Item	Measuring Position	Gap (mm)
Connecting Rod Bearing	Radial	0.030 - 0.050

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FLYWHEEL / DRIVEN PLATE

Preceding Work: Removal of manual or automatic transmission

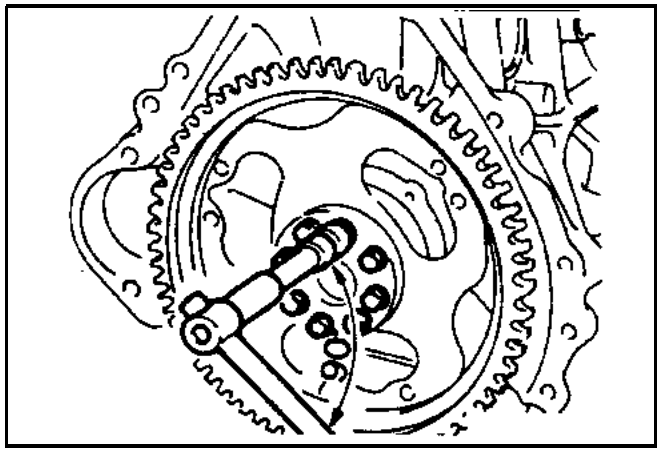


1 Flywheel Mounting Bolt (M10 x 22, 8 pieces)
. . . . . 1st step 45+5 N•m (33+3.7 lb-ft)
2nd step +90° +10°
2 Plate
3 Driven Plate (A/T)
4 Dowel Pin

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Service Data Standard (Stretch Bolt)

Nominal Size	D	-	M x 1.5
Stretch Side Diameter	d	When New	8.5 - 0.2 mm
		Min. Diameter	8.0 mm
Bolt Length	L	When New	21.8 - 22.2 mm
Tightening Torque	1st step 45 + 5 N•m (33 + 3.7 lb-ft), 2nd step 90° + 10°		



Removal & Installation Procedure

1. Unscrew the flywheel mounting bolt.

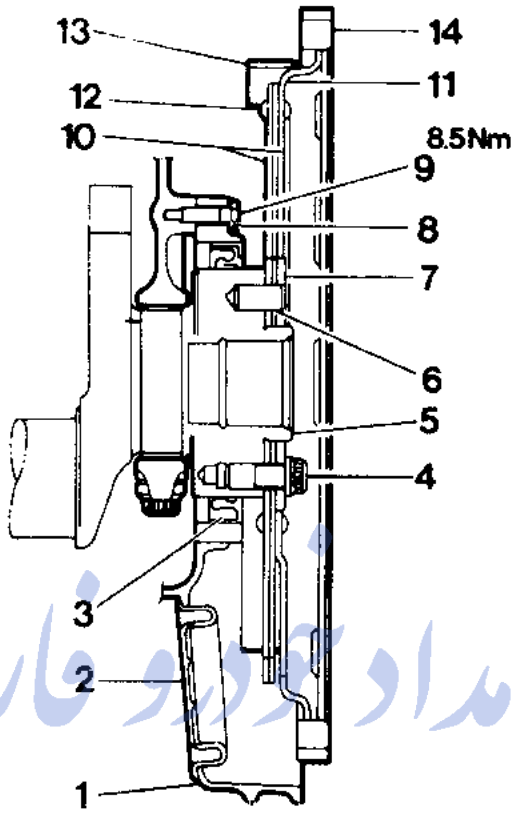
   Installation Notice

Tightening Torque	1st step: 45 + 5 N•m (33 + 3.7 lb-ft)
	2nd step: 90° + 10°

   - Replace the bolt when the stretch side diameter (d) of the flywheel mounting bolt is less than 8.0mm.
   - For the flywheel mounting bolt tightening, keep the socket wrench and Tommy-bar to be 90° and tighten as specified.
2. Remove the flywheel for manual transmission vehicles, or the driven plate (3), and plate (2) for Auto. transmission vehicle.
3. Installation should follow the removal procedure in the reverse order.

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Sectional View

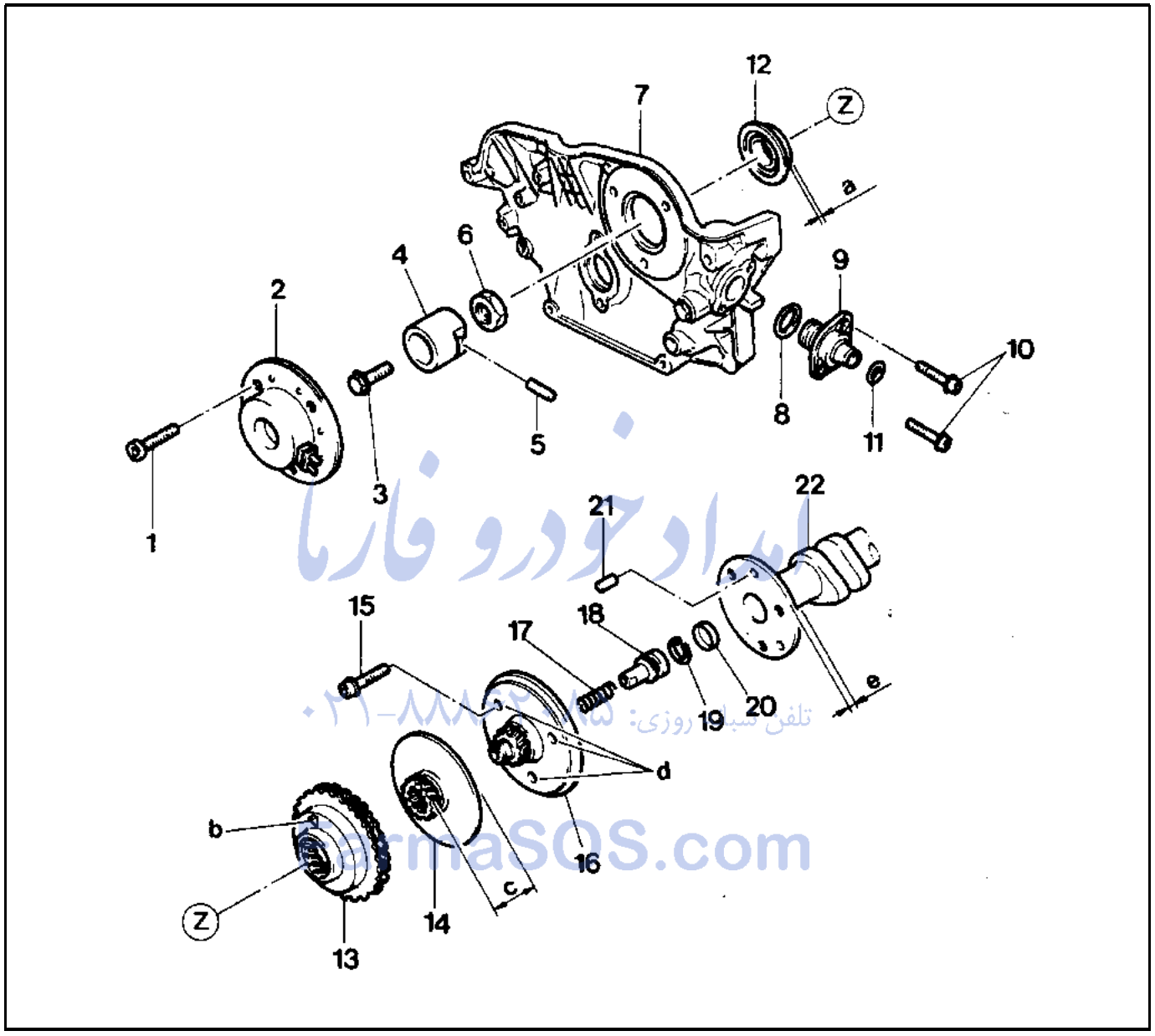


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1 Oil Pan
2 Cover
3 Crankshaft Front Seal
4 Flywheel MTG Bolt
5 Crankshaft
6 Dowel Pin
7 Plate
8 TGCC
9 Bolt
10 Front Drive Plate
11 Rear Drive Plate
12 Rivet
13 Segment
14 Ring Gear

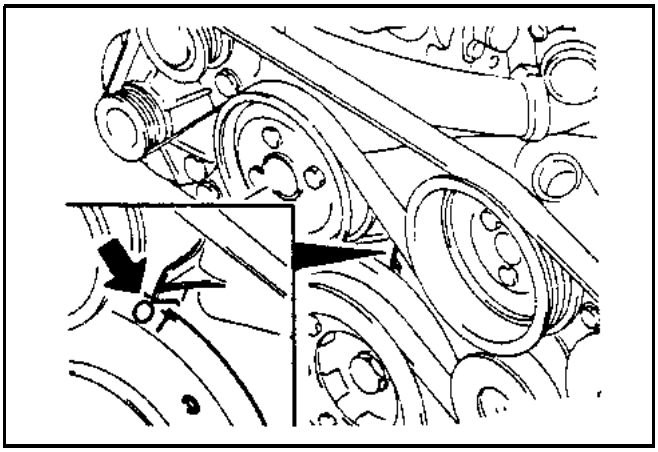
CAMSHAFT ADJUSTER

Preceding Work: Removal of cylinder head cover
Removal of cylinder head front cover



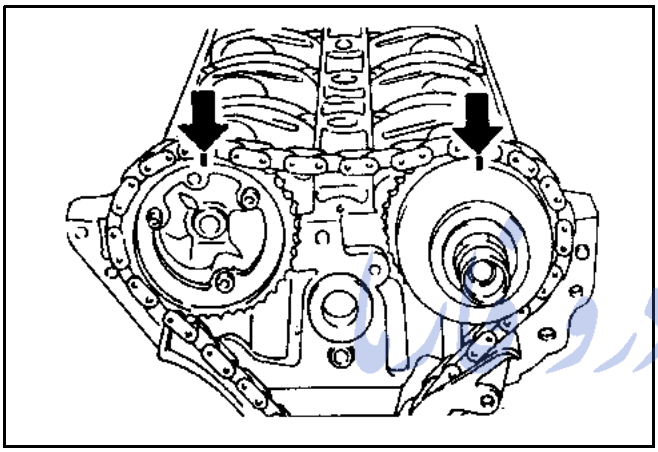
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تلفن شبانه روزی: ۰۲۱-۸۸۸۰۰۰۰
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1 Bolt (M6 x 16, 3 pieces) . . . . . 9-11 N•m (80-97 lb-in)
2 Magnet Assembly (2 Pin Connector)
3 Bolt . . . . . 35 N•m (26 lb-ft)
4 Armature
5 Roll Pin
6 Nut (M20 x 1.5) . . . . . 60-70 N•m (44-52 lb-ft)
7 Front Cover
8 Seal
9 Camshaft Position Sensor
10 Bolt (M6 x 16, 2 pieces) . . . . . 9-11 N•m (80-97 lb-in)
11 Seal
12 Seal Cover
13 Camshaft Sprocket and Position Indicator (b)
14 Adjuster Piston
15 Flange bolt (M7 x 13, 3 pieces) . . . . . 1st step 18-22 N•m (13-16 lb-ft)
2nd step 60° ± 5°
16 Flange Shaft
17 Compression Spring
18 Control Piston
19 Circlip
20 Oil Gallery
21 Pin
22 Intake Camshaft

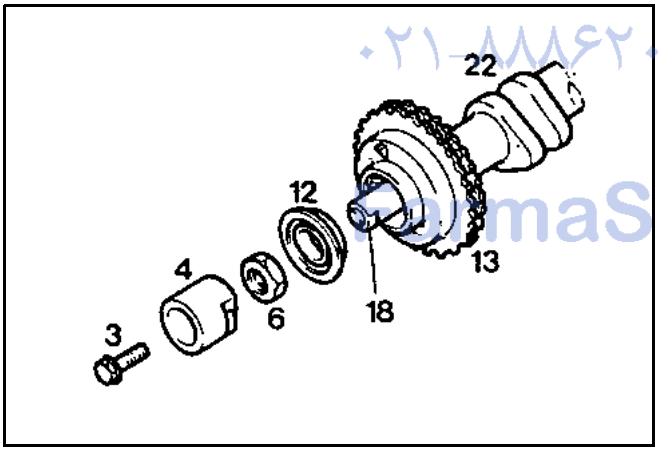


Removal & Installation Procedure

1. Turn the crankshaft to the direction of engine rotation and position the no.1 cylinder piston at TDC which the camshaft is positioned at OT.



2. Remove the cylinder head front cover.
3. Paint the alignment marks (arrows) on the intake and exhaust camshaft sprocket and the timing chain.



3 Bolt
4 Amarture
6 Nut (M20 x 1.5)
12 Seal Cover
13 Camshaft Sprocket
18 Control Piston
22 Intake Camshaft

4. Unscrew the bolt (3) from the armature (4) and remove the armature.

Installation Notice

Tightening Torque	35 N•m (26 lb-ft)

5. Unscrew the nut (6) and remove the ring and seal cover (11).

Installation Notice

Tightening Torque	60 - 70 N•m (44 - 52 lb-ft)

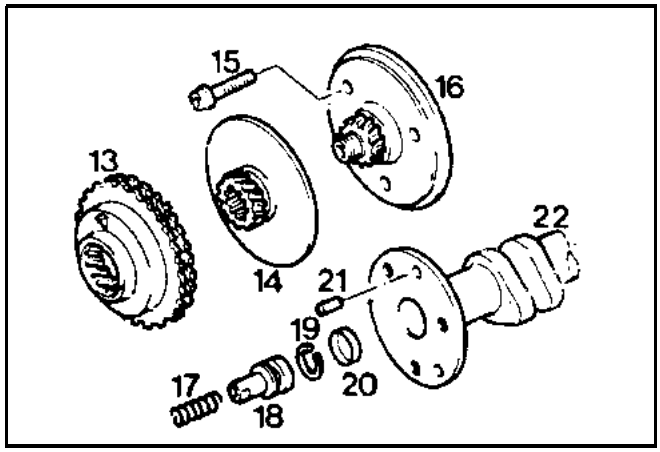
6. Unscrew the sprocket bolt from the exhaust camshaft and remove the sprocket.

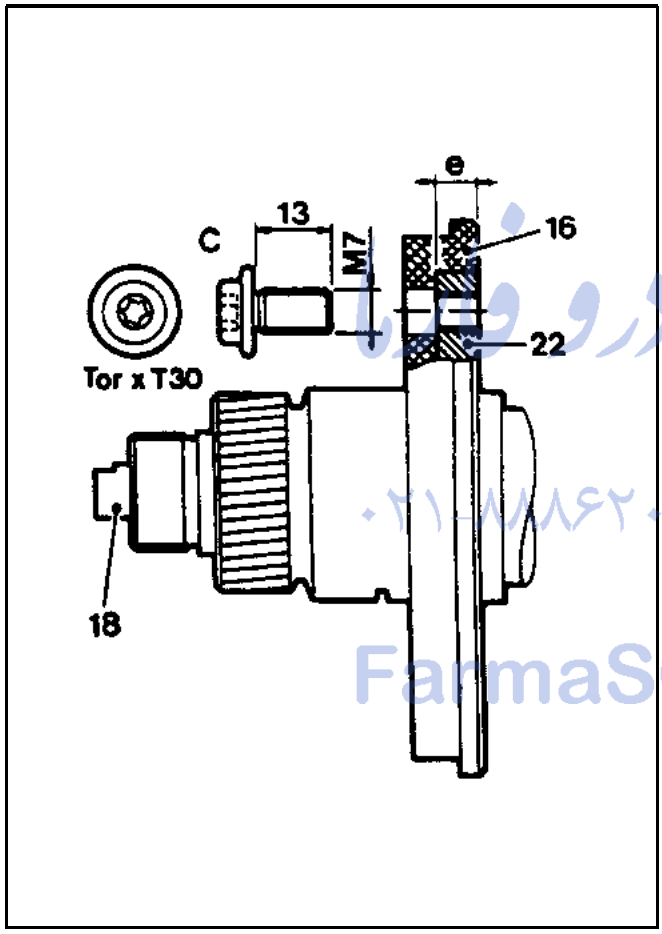
Installation Notice

Tightening Torque	1st step: 18 - 22 N•m (13 - 16 lb-ft)
	2nd step: 60° ± 5°

The sprocket bolt is designed to be used only once, so always replace with new one.

امداد خودرو
۰۲۱-۸۸۴۶۲۰۸۵
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7. Remove the camshaft sprocket (13) and adjust piston (14), and remove the flange shaft (16) from the intake camshaft (22) after removing the bolt (15).

Installation Notice

Tightening Torque	1st step: 18 - 22 N•m (13 - 16 lb-ft)
	2nd step: 60° ± 5°

The sprocket bolt is designed to be used only once, so always replace with new one.

8. Installation should follow the removal procedure in the reverse order.
9. Adjust the camshaft timing.

CAMSHAFT SPROCKET BOLT

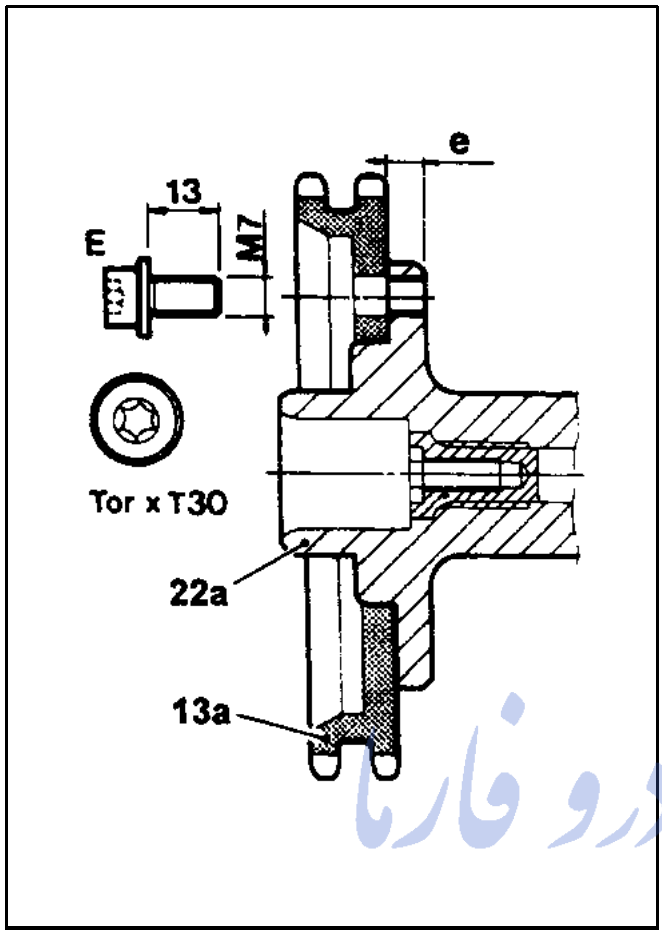
Intake Flange Shaft Bolt

Tightening Torque	1st step: 18 - 22 N•m (13 - 16 lb-ft)
	2nd step: 60° ± 5°

Notice: The sprocket bolts are designed to be used only once, so always replace with new one.

C. M7 x 13 Collar Bolt Torx-T30
e. 6.8 mm
16. Flange Shaft
18. Control Piston
22. Intake Camshaft

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Exhaust Camshaft Sprocket Bolt

Tightening Torque	1st step: 18 - 22 N•m (13 - 16 lb-ft)
	2nd step: 60° ± 5°

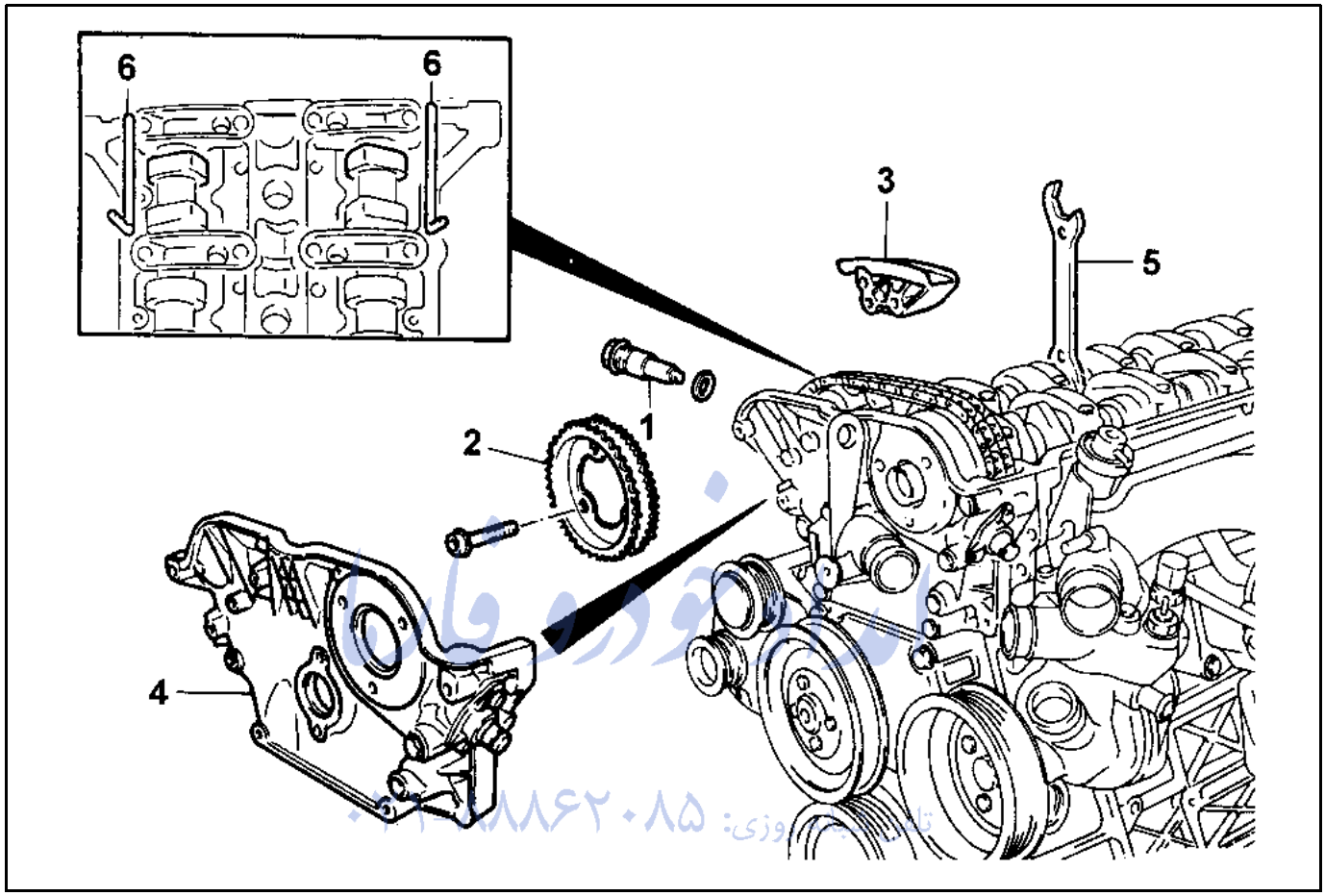
Notice: The sprocket bolts are designed to be used only once, so always replace with new one.

E. M7 x 13 Collar Bolt Torx-T30
e. 6.8 mm
13a. Camshaft Sprocket
22a. Exhaust Camshaft

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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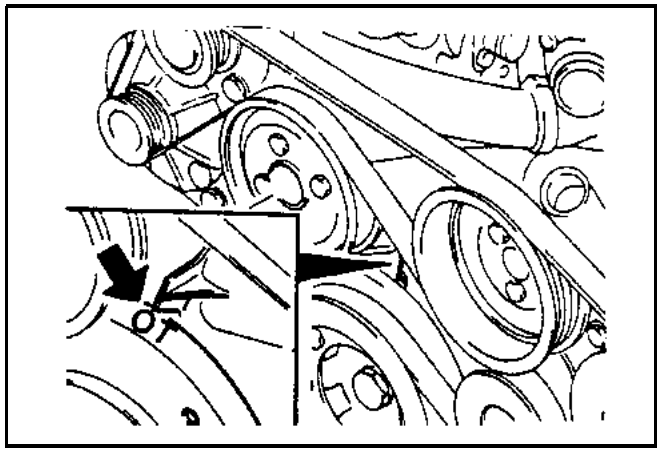
CAMSHAFT TIMING POSITION

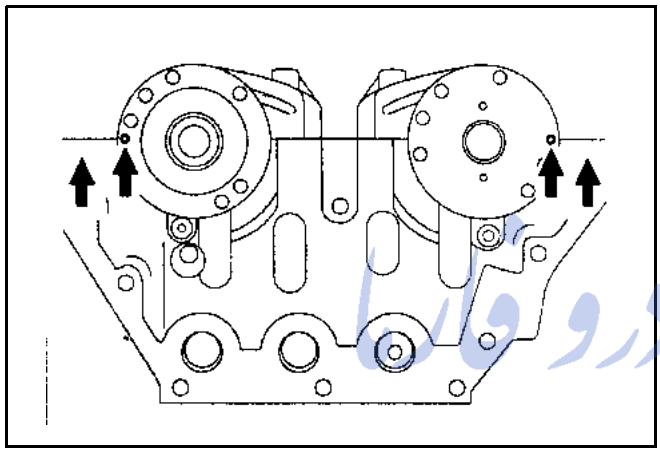
Preceding Work: Removal of cylinder head cover
Removal of cylinder head front cover



1 Chain Tensioner Assembly
2 Exhaust Camshaft Sprocket
3 Upper Guide Rail
4 Cylinder Head Front Cover
5 Wrench
6 Holding Pin DW110-120

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Tools Required

DW110-120 Holding Pin

Inspection

1. Position the No.1 cylinder piston to TDC (OT) by turning the crankshaft.

Notice: When the OT mark on vibration damper is aligned with timing gear case cover, the intake and exhaust cam of cylinder will make the slope to the center and will face up. In this way, the adjustment hole of the intake and exhaust camshaft will match in line with the cylinder head upper end, at 3 o'clock, and 9 o'clock direction each other.

2. Check the timing as below procedure;
   - Check if the camshaft adjustment hole is positioned to 3 o'clock direction at the intake side and to 9 o'clock direction at the exhaust side, respectively and align with the cylinder head mating surface.
   - At this condition, check if the OT mark on vibration damper aligns with the marker on the timing gear case.

امداد خودرو فارما
۰۲۱-۸۸۸۶۲۰۸۵
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Adjustment Procedure

1. Position the No.1 cylinder to BTDC 30° .
2. Remove the chain tensioner.
3. Remove the exhaust camshaft sprocket.
4. Align the intake and exhaust camshaft flange hole with the cylinder head upper surface.
   - Intake Side : 3 o'clock direction
   - Exhaust Side : 9 o'clock direction
5. Align the holes on intake and exhaust camshaft to the hole on cylinder head. Insert the holding pin DW110-120 into the holes.
6. Secure the intake and exhaust camshaft.
7. Position the piston of No.1 cylinder at TDC (OT) by turning the crankshaft.
8. Turn the camshaft adjuster of the intake camshaft to the left as much as possible (cam adjuster 'retarded' position).
9. Install the chain to the intake camshaft sprocket.

Notice: Timing chain must be placed on the guide rail in gear case cover.

10. Install the chain to the exhaust camshaft sprocket and install it to the camshaft.

Installation Notice (Sprocket Bolt)

Tightening Torque	1st step: 18 - 22 N•m (13 - 16 lb-ft)	
	2nd step: 60° ± 5°	

The sprocket bolt is designed to be used only once, so replace with new one.

11. Install the chain tensioner.

Installation Notice

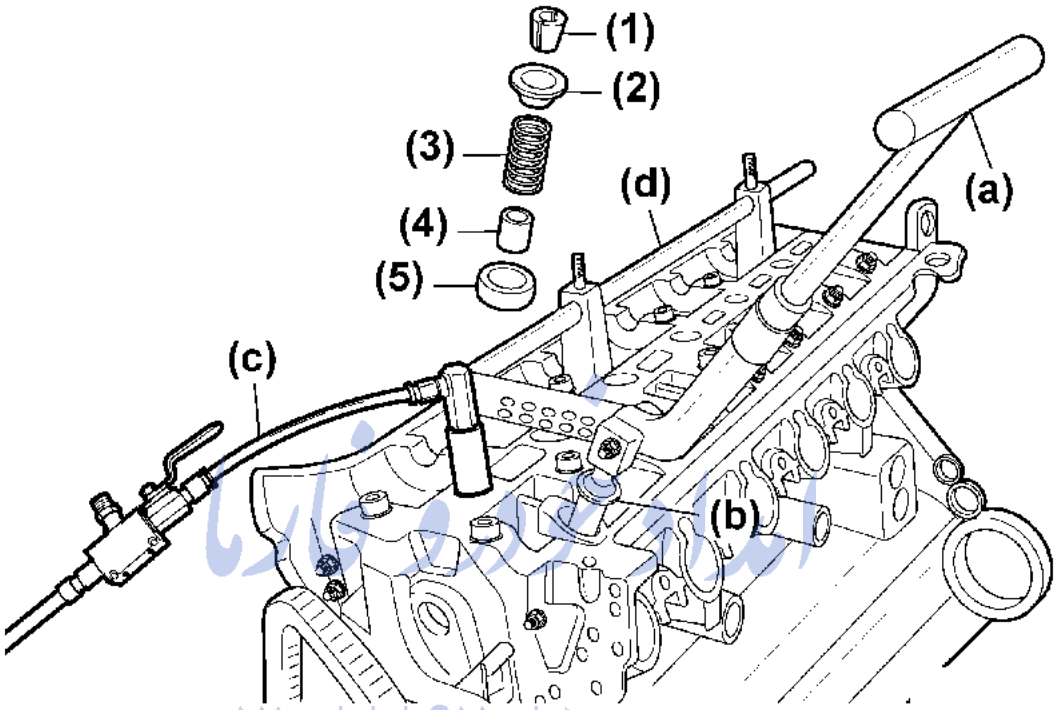
Tightening Torque	Screw Plug	40 N•m (30 lb-ft)
	Tensioner Assembly	72 - 88 N•m (53 - 65 lb-ft)

12. Check the camshaft timing.

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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VALVE SPRING

Preceding Work: Removal of camshaft
Removal of spark plug

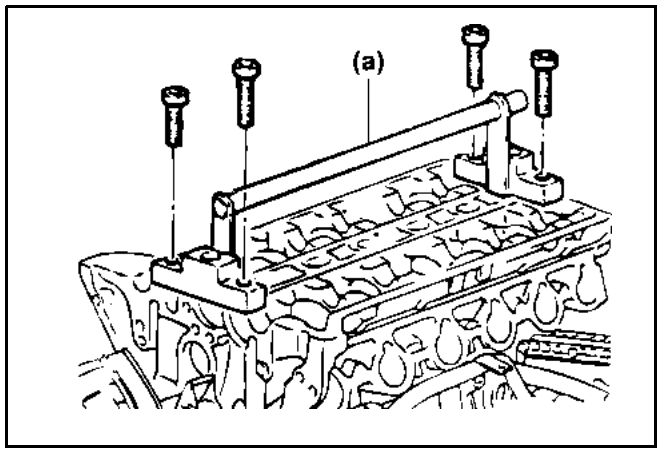


تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵

1 Valve Cotter
2 Valve Spring Retainer
3 Valve Spring
4 Valve Stem Seal
5 Lower Retainer

a Lever Pusher 111 589 18 61 00
b Thrust Piece 111 589 25 63 00
c Connecting Hose DW110-090
d Supporting Bar 111 589 01 59 00

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Tools Required

111 589 01 59 00 Supporting Bar
111 589 18 61 00 Lever Pusher
111 589 25 63 00 Thrust Piece
602 589 00 40 00 Engine Lock
DW110-090 Connecting Hose
DW110-100 Valve Tappet Remover

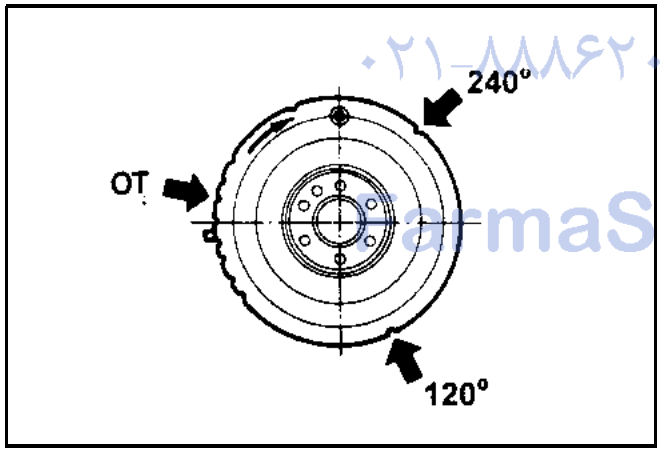
Removal & Installation Procedure

1. Place the supporting bar 111 589 01 59 00 (a) at the camshaft bearing cap and tighten them with the bearing cap bolt.

Installation Notice

Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)

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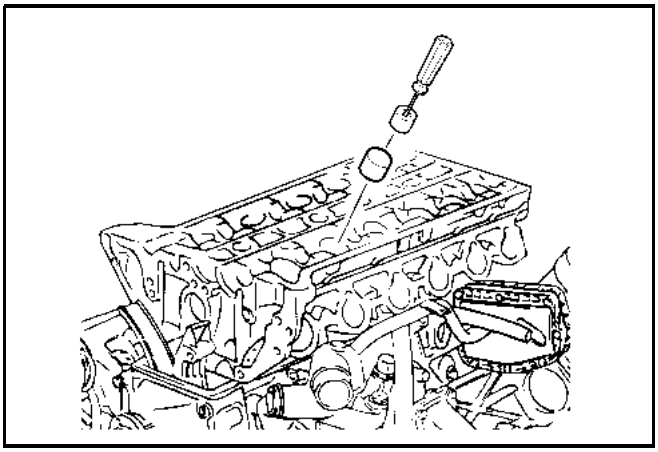
۰۲۱-۸۸۸۶۲۰۸۵ تلفن شبانه روزی:
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2. Turn the crankshaft to position the each cylinder piston at TDC.

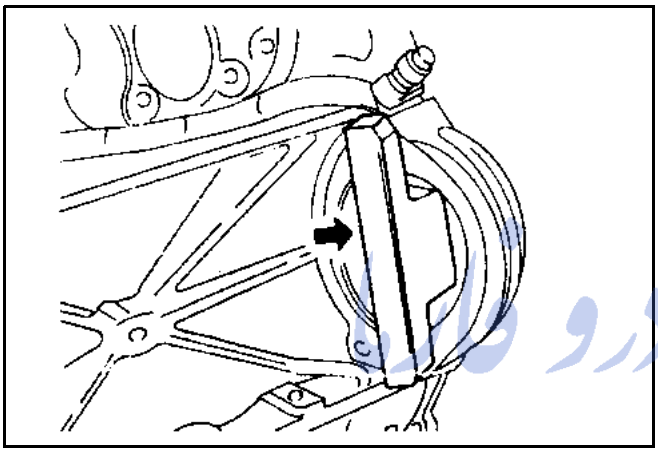
Mark on The Vibration Damper	Cylinder
OT	1, 6
120°	2, 5
240°	3, 4

Notice

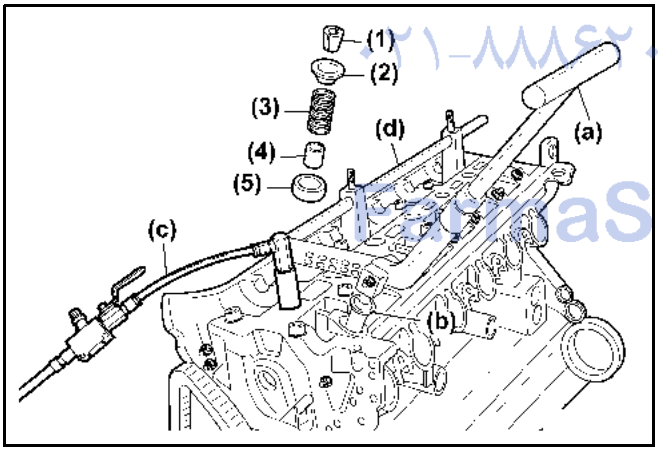
- Remove the valve spring only at TDC.
- Always rotate the crankshaft by holding the chain to prevent from timing chain damage and tangling, and for smooth rotation.



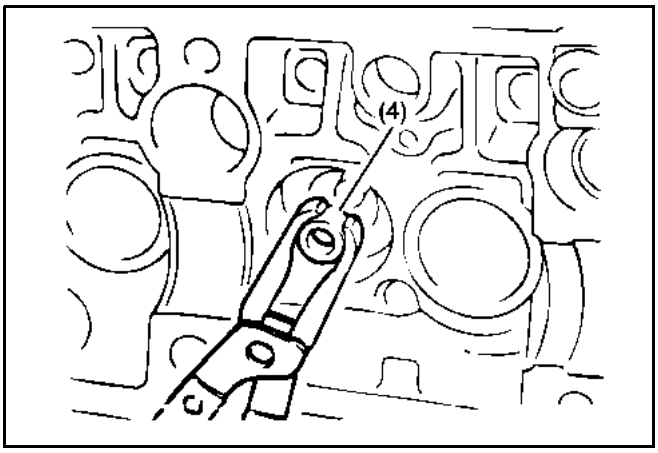
3. Remove the valve tappet using the valve tappet remover DW110-100.
4. Install the connecting hose DW110-090 (c) to the spark plug hole.



5. Install the engine lock 602 589 00 40 00 to the ring gear to prevent the crankshaft from rotating.
6. Blow up with compressed air.



7. Install the supporting bar 111 589 01 59 00 (d) and the lever pusher 111 589 18 61 00 (a).
8. Mount the thrust piece 111 589 25 63 00 (b) vertically to the valve spring retainer (2).
9. Press the valve spring (3) by using the lever pusher 111 589 18 61 00 (a).
10. Remove the valve cotter (1) using the pincette.
11. Remove the upper retainer (2) and the valve spring (3).



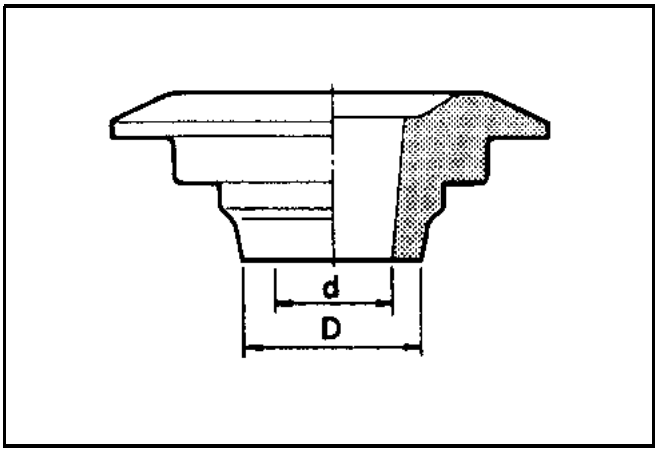
12. Remove the valve stem seal (4) and replace if necessary.

Notice: Check the valve stem seal for damage and replace if necessary.

13. Remove the lower retainer (5).

Notice: Check the retainer for damages and replace with a new one if necessary.

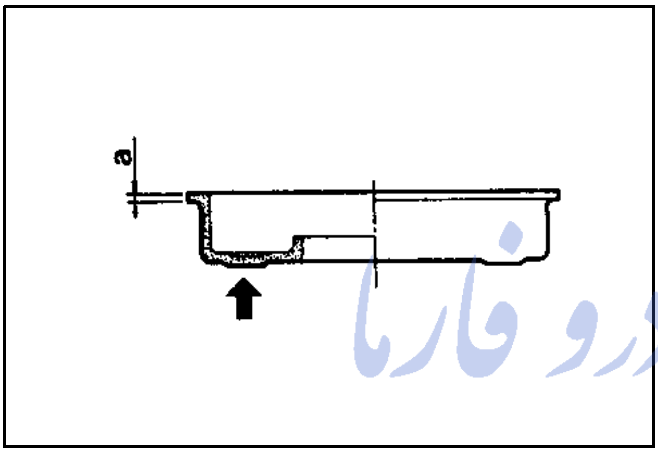
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Test (Upper and Lower Valve Tappet and Valve Cotter)

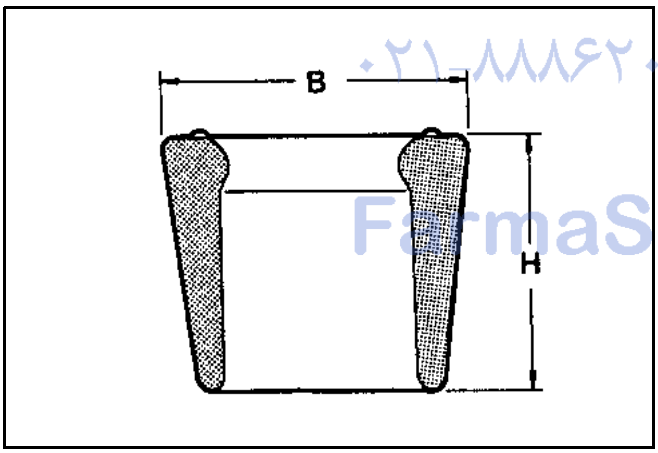
- Upper Valve Spring Retainer

Size (mm)	(d)	8.5
	(D)	12.3



- Lower Valve Spring Retainer

Thickness (mm)	(a)	0.8 - 1.0



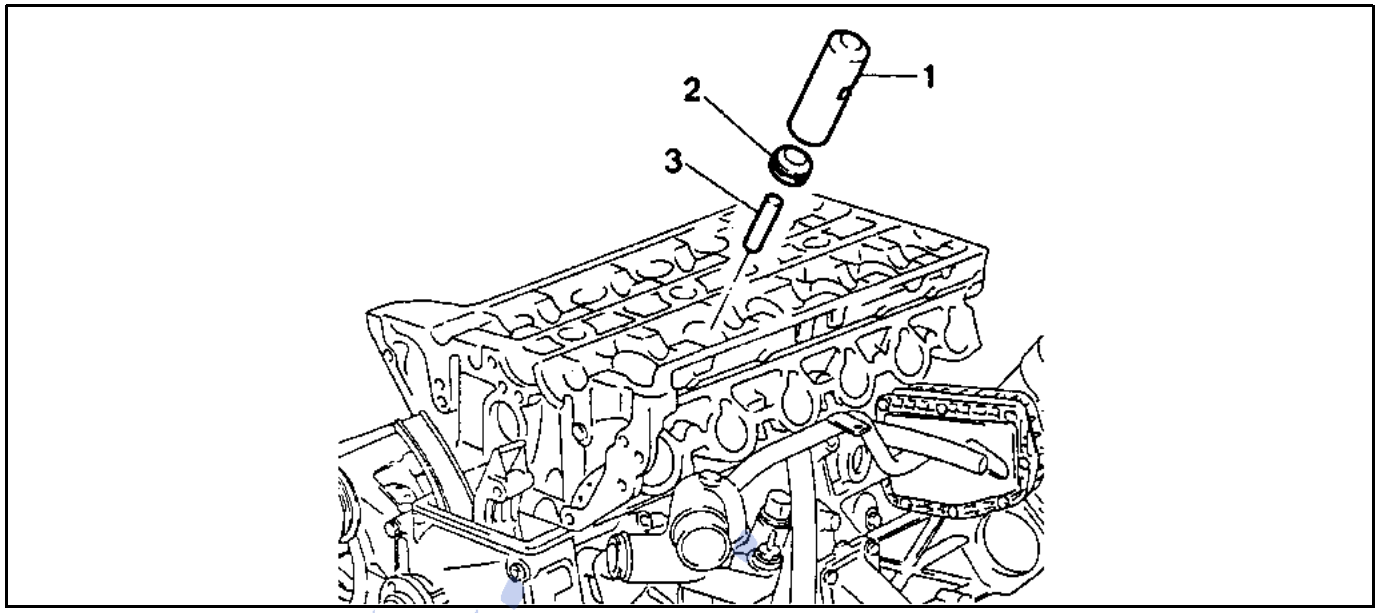
- Valve Cotter

Size (mm)	(B)	9.0
	(H)	9.2 - 9.8

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۰۲۱-۸۸۸۶۲۰۸۵ تلفن شبانه روزی
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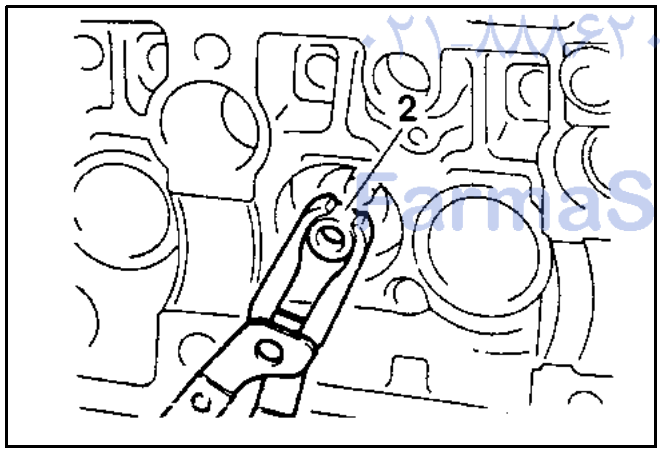
VALVE STEM SEAL

Preceding Work: Removal of valve spring



1 Drift 119 589 00 43 00
2 Valve Stem Seal
3 Protective Sleeve

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Tools Required

119 589 00 43 00 Drift

Replacement Procedure

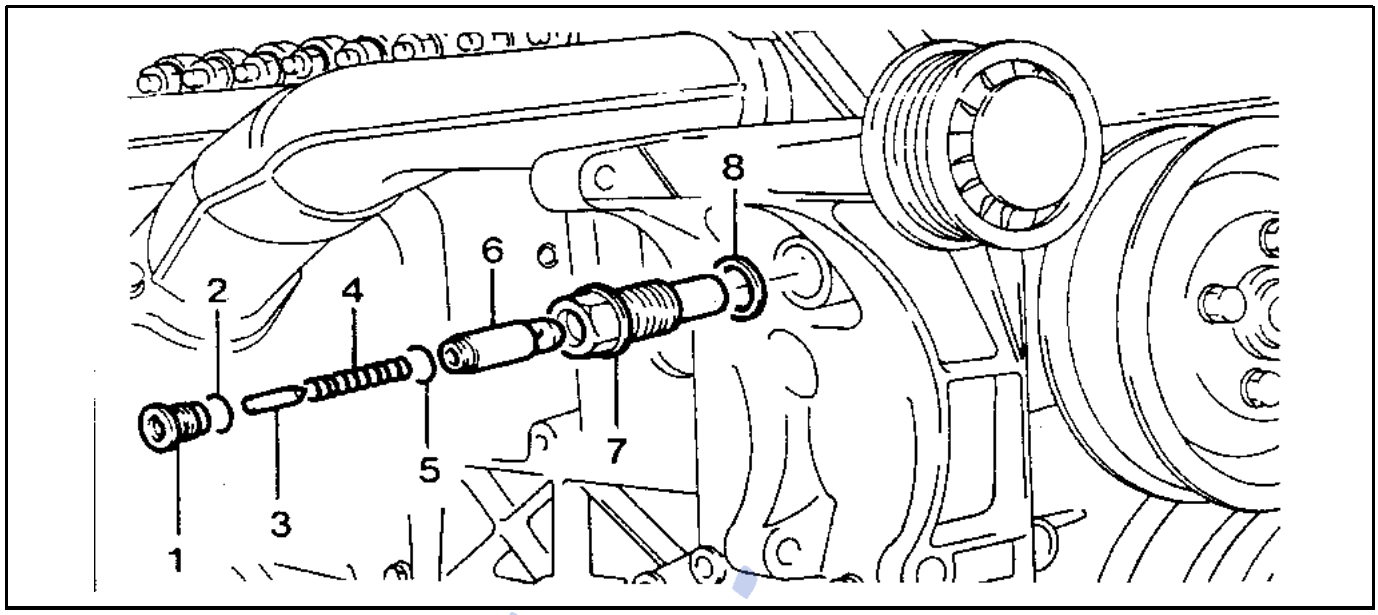
1. Remove the valve stem seal (2) using the pliers.

Notice: Check the valve stem seal for damage and replace if necessary.

2. Coat the valve stem seal with oil and assemble it with the protective sleeve.
3. Insert the valve stem seal by pressing it with the drift 119 589 00 43 00.

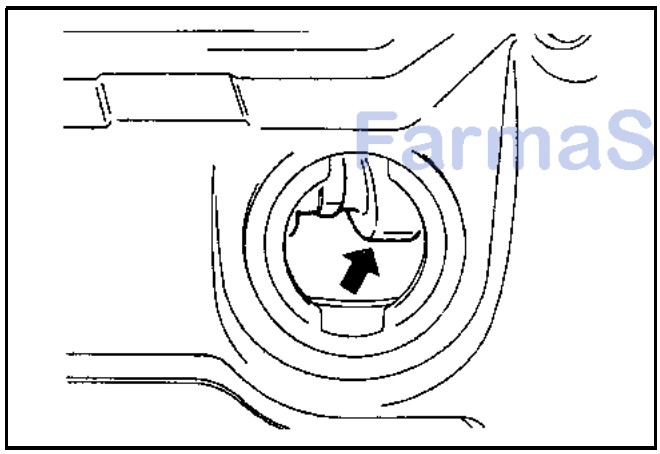
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CHAIN TENSIONER



1 Screw Plug ..... 40 N•m (30 lb-ft)
2 Seal
3 Filler Pin
4 Compression Spring
5 Snap Ring
6 Thrust Pin
7 Chain Tensioner Housing
..... 72-88 N•m (53-65 lb-ft)
8 Seal

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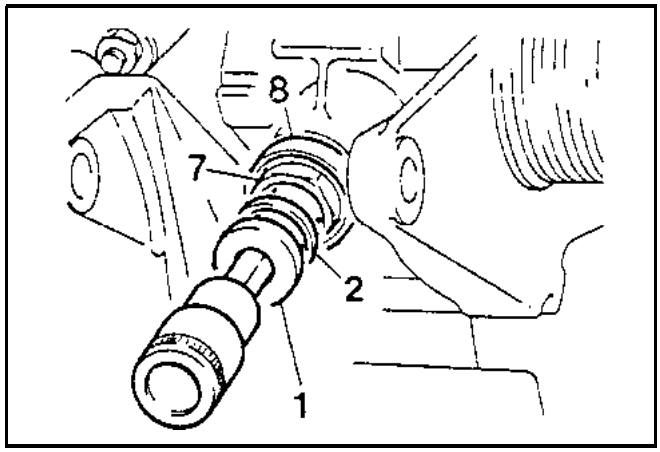
Removal Procedure

1. Position the No.1 cylinder to TDC (OT).

Notice: Remove the oil filler cap at adjustment position, and check whether the intake camshaft cam's lobe (arrow) stays in the upper side.

2. Cover the generator with a clean cloth.
3. Release the tension by unscrewing the screw plug once.

Notice: In case that the tension is reduced by unscrewing the screw plug, reinstall after completely removing the chain tensioner. If the chain tensioner is tightened again without completely reducing its tension, then the detent spring doesn't return to the original position and the tension gets exceeded.

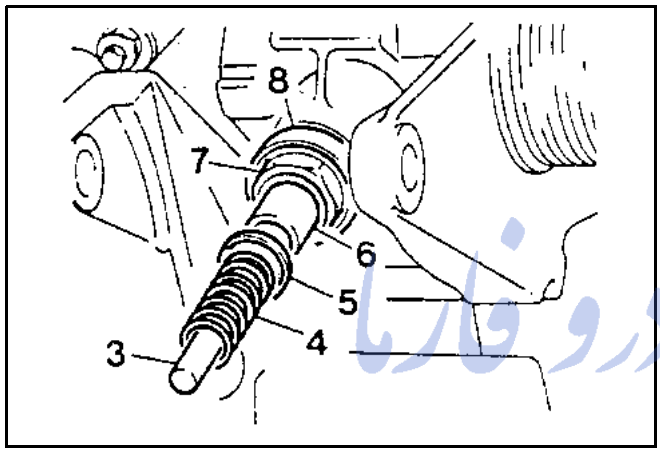


4. Carefully unscrew the screw plug (1), and remove the seal (2).

Notice

- For the removal of screw plug, be careful that it can be jumped out due to the force of compression spring.
- Remove the screw plug only when the seal and compression spring are damaged.

5. Carefully remove the filler pin (3), compression spring (4), snap ring (5), and the thrust pin (6).



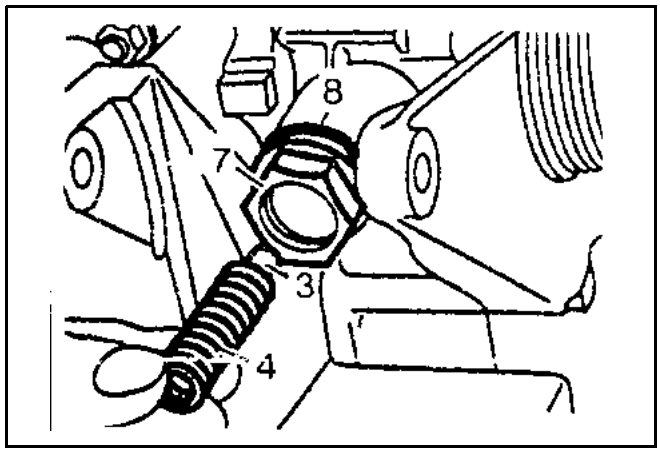
6. Remove the chain tensioner housing (7) and the seal (8).

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۰۲۱-۸۸۸۶۲۰۸۵
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Installation Procedure

1. Connect the thrust pin (6) and the snap ring (5) to the chain tensioner housing (7).

Notice: When connecting the thrust pin, push in the thrust pin far enough so that it doesn't protrude at the chain tensioner housing.

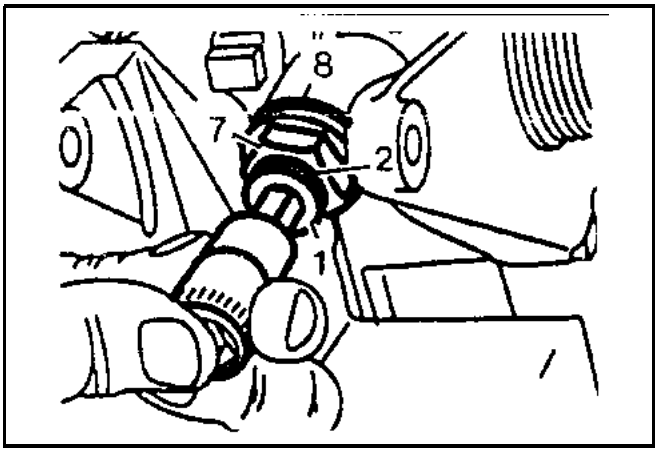


2. Install the chain tensioner housing (7), thrust pin (6), snap ring (5), and the seal (8).

Installation Notice

Tightening Torque	72 – 88 N•m (53 – 65 lb-ft)

3. Insert the compression spring (4) with the filler pin (3) into chain tensioner housing.



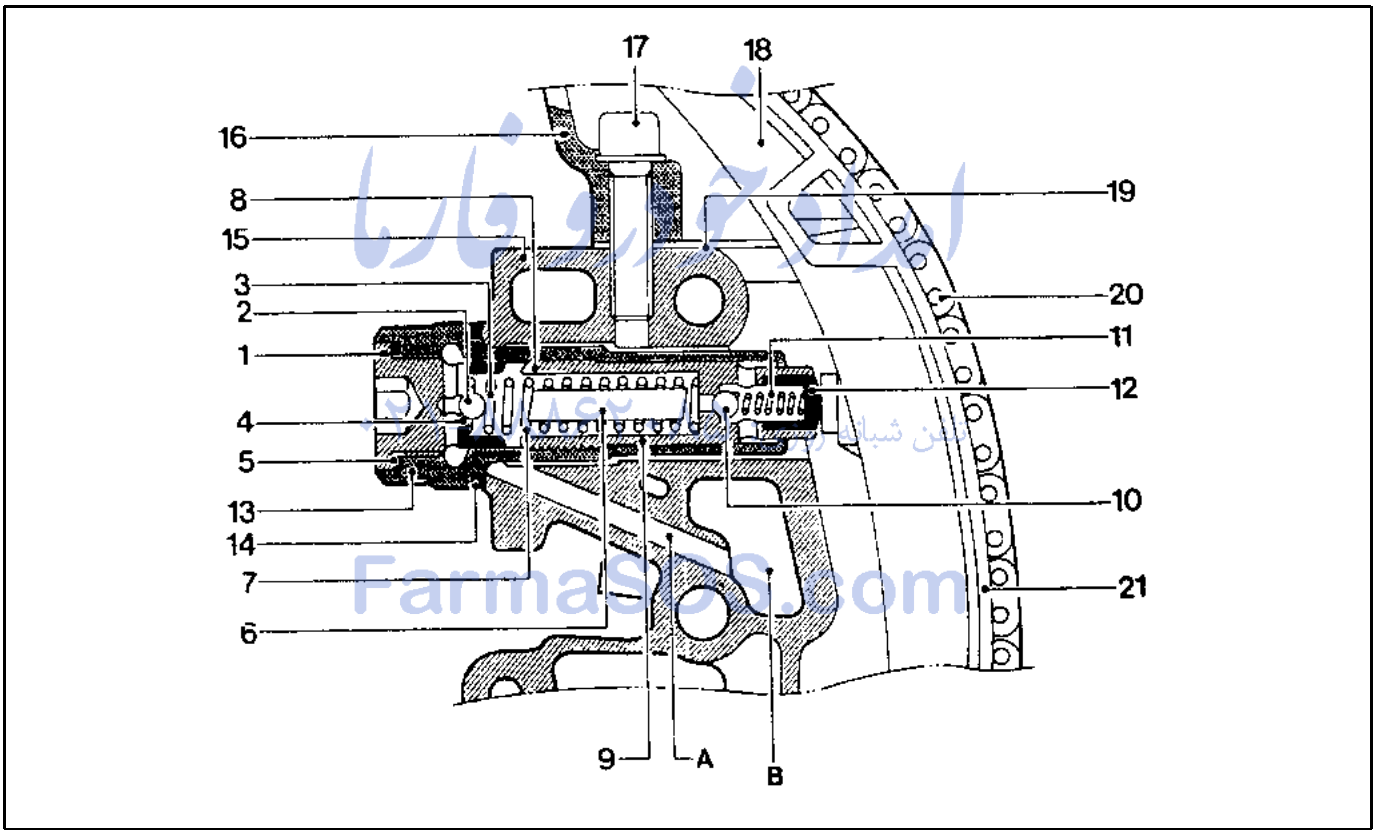
4. Lightly apply the grease to the seal (2) and install the screw plug (1).

Installation Notice

Tightening Torque	40 N•m (30 lb-ft)

5. Check for leaks by operating the engine.

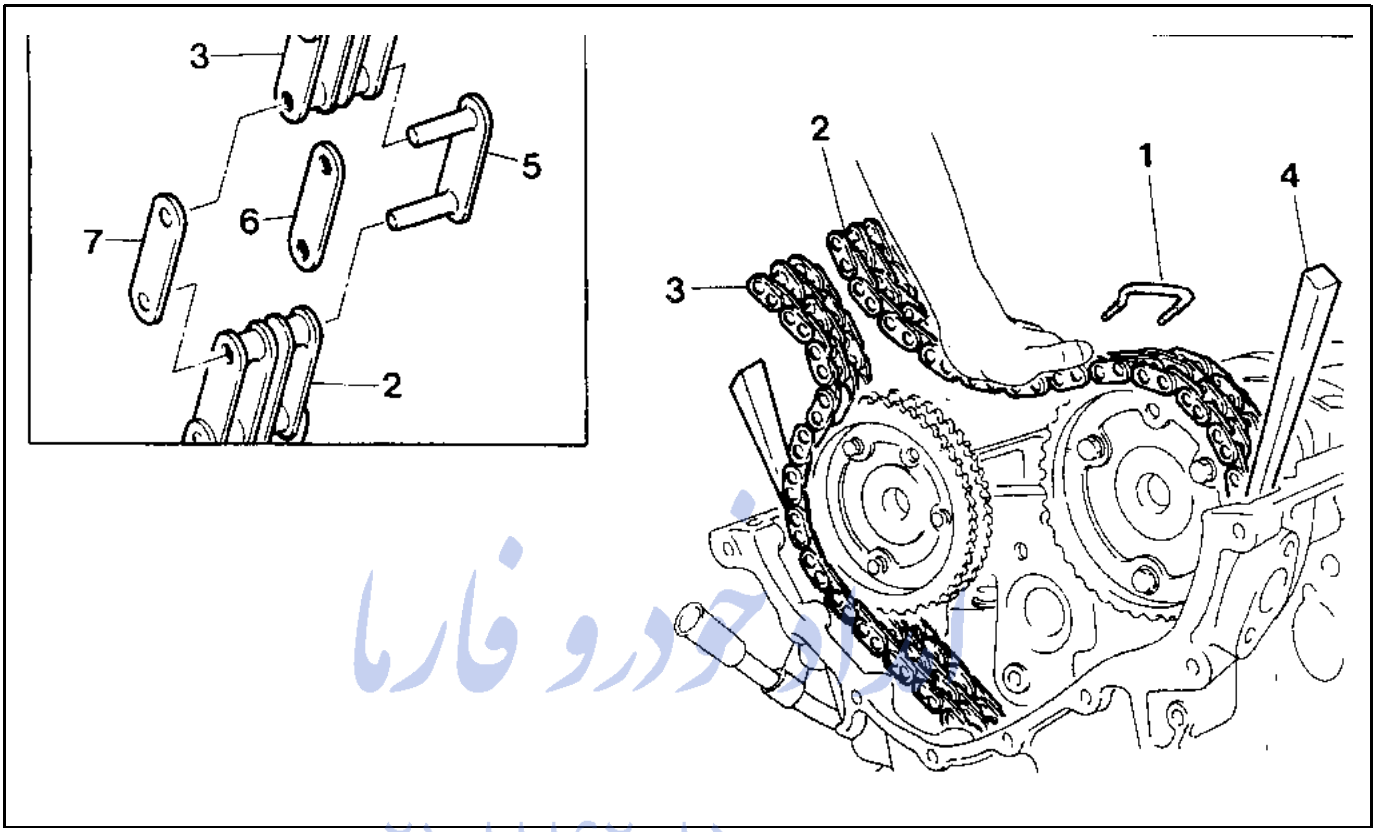
Sectional View



1 Screw Plug
2 Ball (Nonreturn Valve)
3 Compression Spring
4 Ball Guide
5 Seal (Aluminum)
6 Filler Pin
7 Compression Spring
8 Snap Ring
9 Thrust Pin
10 Ball (Nonreturn Valve)
11 Compression Spring
12 Thrust Piece
13 Chain Tensioner Housing
14 Seal
15 Timing Gear Case Cover
16 Cylinder Head
17 Bolt / Washer
18 Tensioning Rail
19 Cylinder Head Gasket
20 Timing Chain
21 Tensioning Rail Base (Sliding Surface)
A Oil Supply Hole
B Chain Tensioner Oil Storage Hole

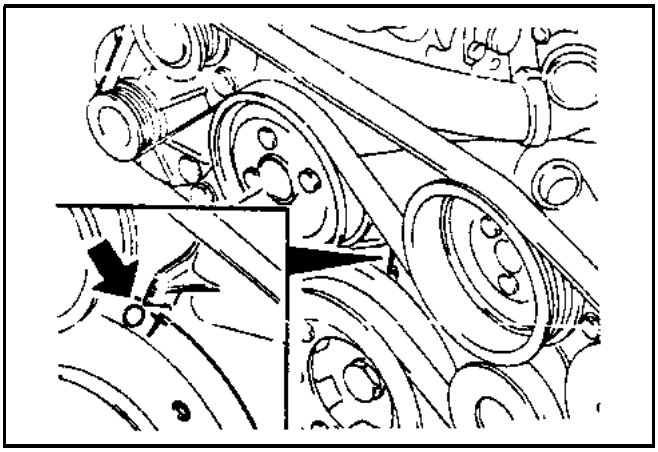
TIMING CHAIN

Preceding Work: Removal of cylinder head cover
Removal of spark plug



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1 Pin
2 New Timing Chain
3 Timing Chain (Used)
4 Wedge
5 Link
6 Center Plate
7 Outer Plate



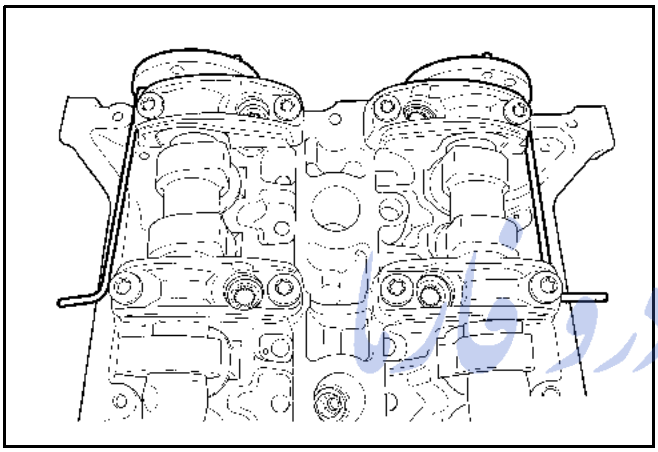
Tools Required

000 589 58 43 00 Chain Assembly

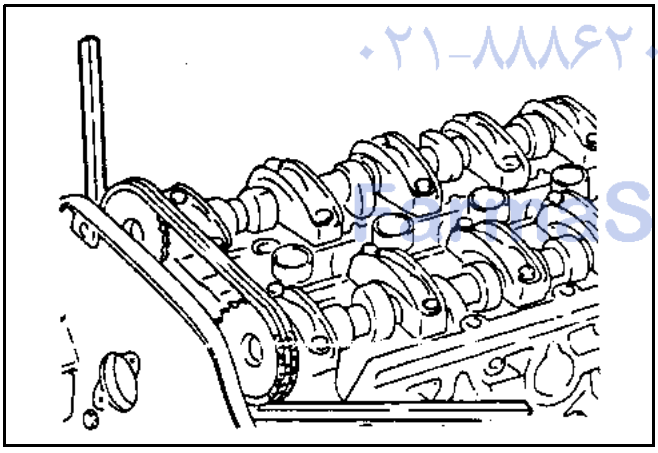
DW110-120 Holding Pin

Replacement Procedure

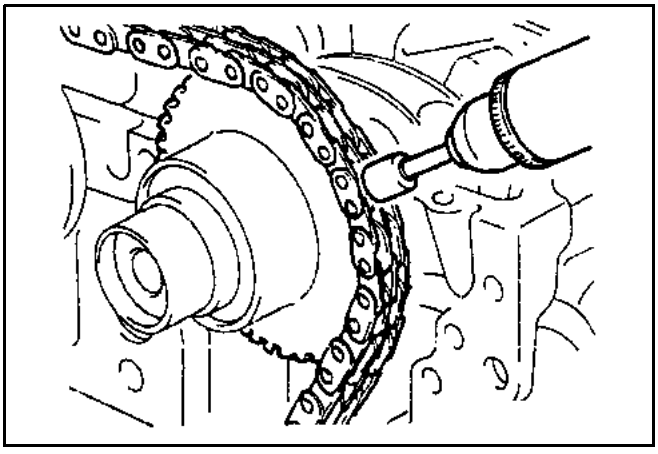
1. Position the No.1 cylinder to TDC (OT).



2. Insert the holding pin DW110-120 to the intake and exhaust camshaft flange not to rotate camshaft.
3. Remove the chain tensioner.

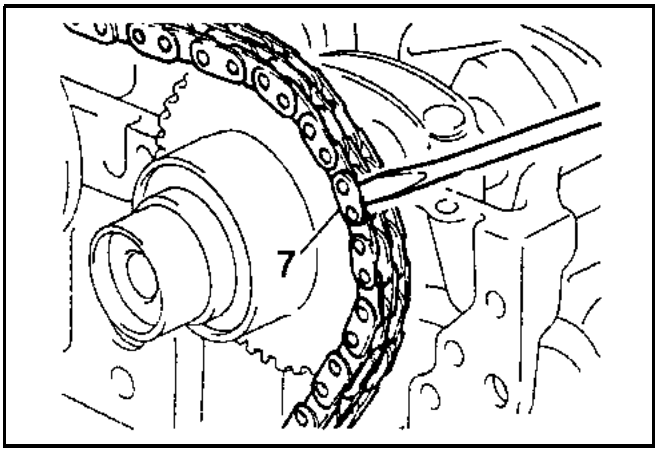


4. Mount the wedges to both sides of the camshaft sprocket as shown in the figure.

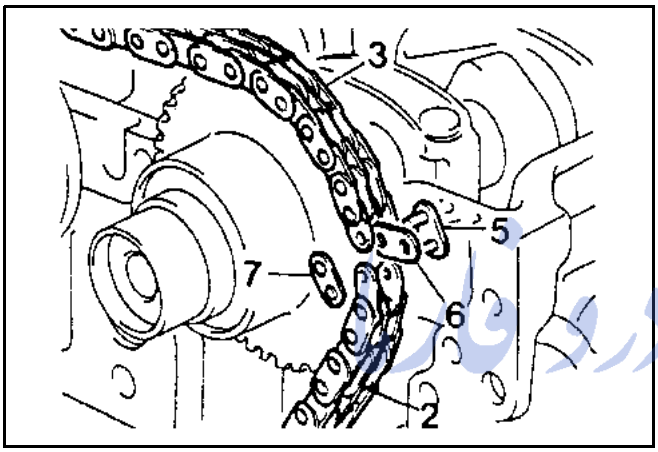


5. Cover the chain housing with a clean cloth, and grind off the timing chain pin from the intake camshaft sprocket with the grinder.

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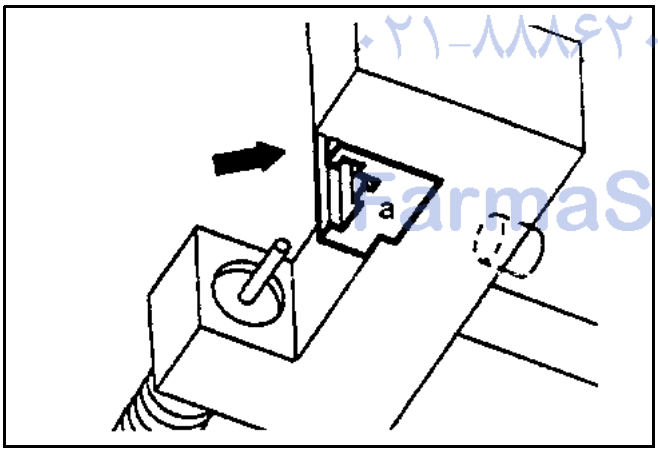
6. Remove the outer plate (7) with the screw driver and remove the link (5).



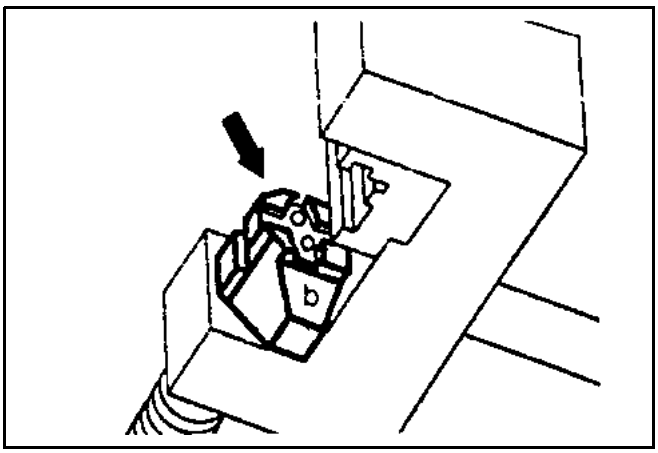
7. Connect the new timing chain (2) to the used timing chain (3) with the link (5), center plate (6, thickness 1.6mm), and the outer plate (7).
8. Rotate the crankshaft in the direction if engine revolution by pressing the new timing chain against the exhaust camshaft sprocket to prevent it to be tangled.

Notice: Be sure to remove the wedge before cranking the engine.

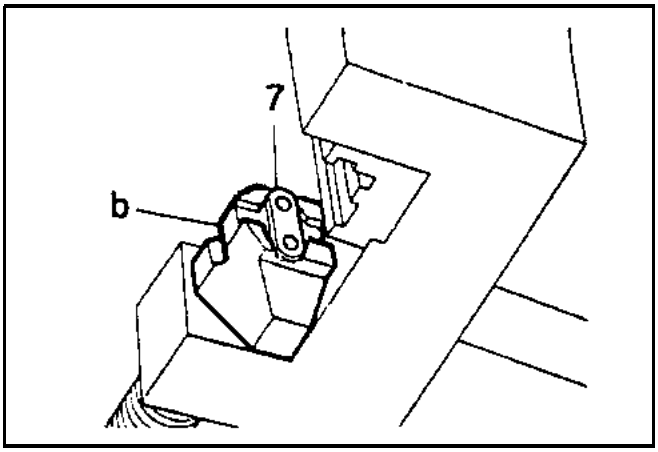
9. Take out the used timing chain out from the chain housing.
10. Connect both separators of the new timing chain with the link (5) and the center plate (6).



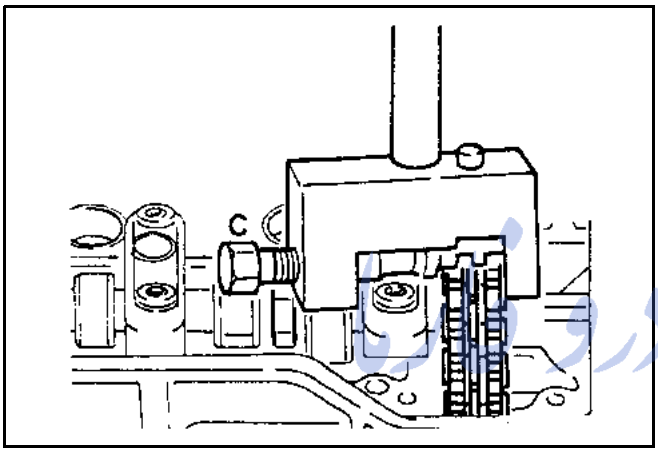
11. Install the jaw (a) and the thrust piece (b) to the chain assembly 000 589 58 43 00 as shown in the figures.



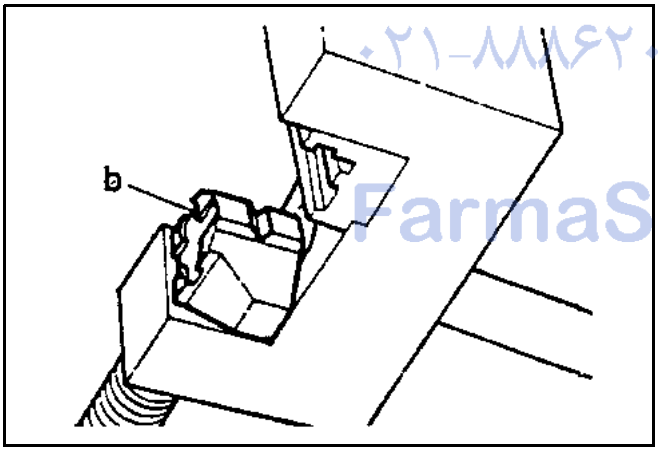
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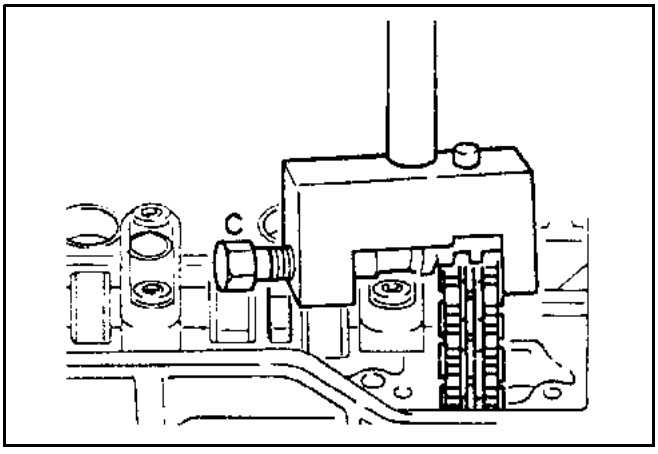
12. Place the outer plate (7, thickness 1.2mm) inside the thrust piece (b).



13. Install the chain assembly 000 589 58 43 00 above the link and tighten the spindle (c) until a block is felt.
14. Place the chain assembly 000 589 58 43 00.



15. Replace the thrust piece (b) as shown in the figure.

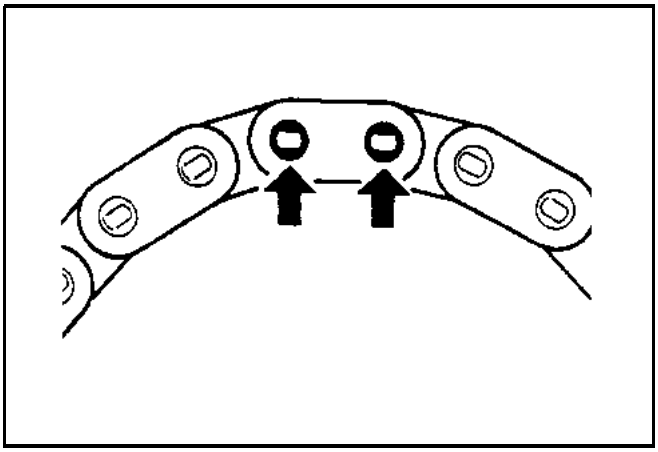


16. Install the chain assembly 000 589 58 43 00 to the link pin and tighten the spindle (c).

Installation Notice

Tightening Torque	30 N•m (22 lb-ft)

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17. Rivet the link pin.
    Check the condition and it again if necessary.
18. Install the chain tensioner.

Installation Notice

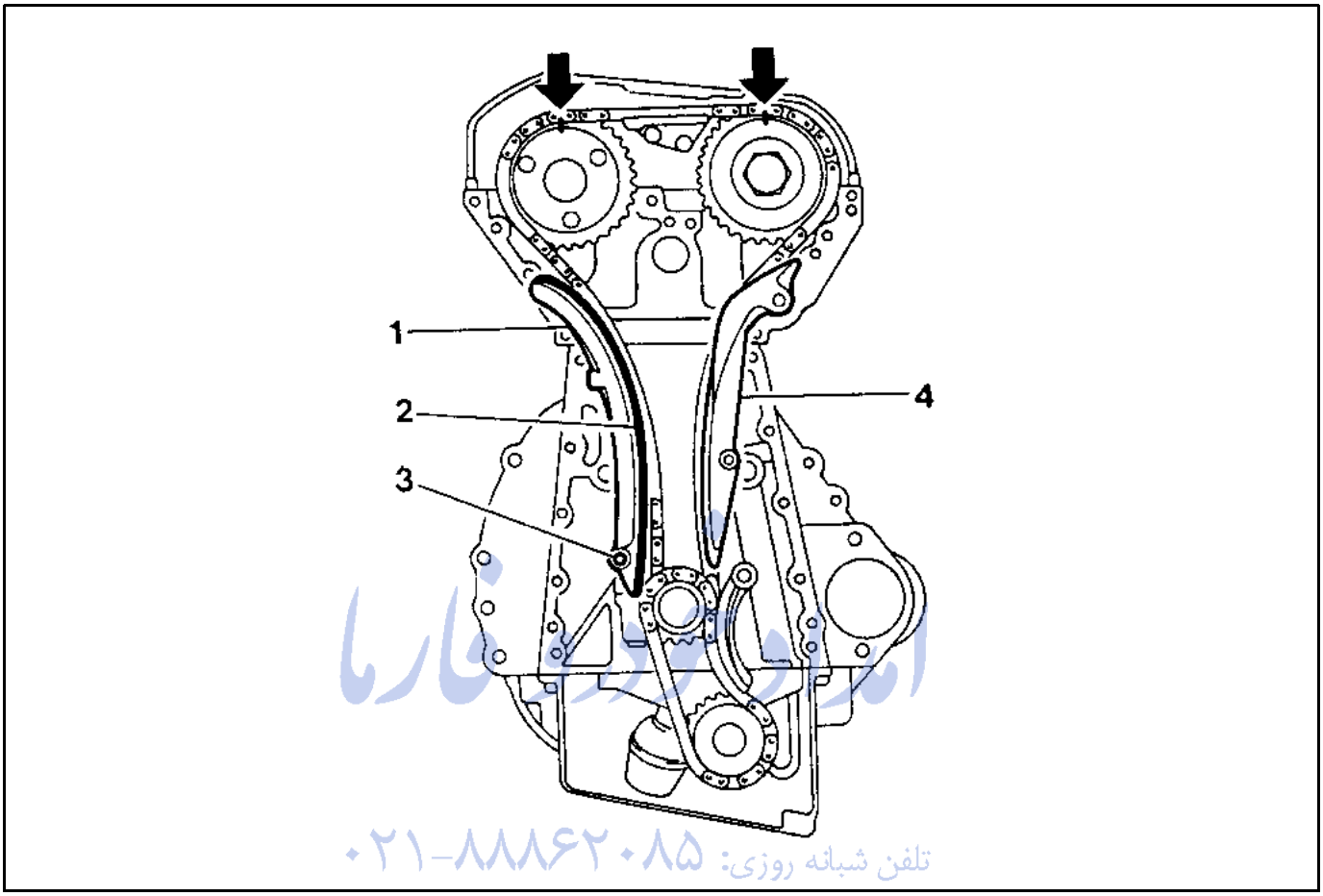
Tightening Torque	Screw Plug	40 N•m (30 lb-ft)
	Tensioner Assembly	72 - 88 N•m (53 - 65 lb-ft)

19. Check the camshaft timing position.

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TENSIONING RAIL

Preceding Work: Removal of timing gear case cover



تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵

1 Tensioning Rail
2 Plastic Guide
3 Tensioning Rail Pin
4 Guide Rail

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Removal & Installation Procedure

1. Put the assembly mark at the camshaft sprocket and the timing chain with the paint (arrow).
2. Remove the exhaust camshaft sprocket.
3. Remove the tensioning rail (1) from the tensioning rail pin (3).

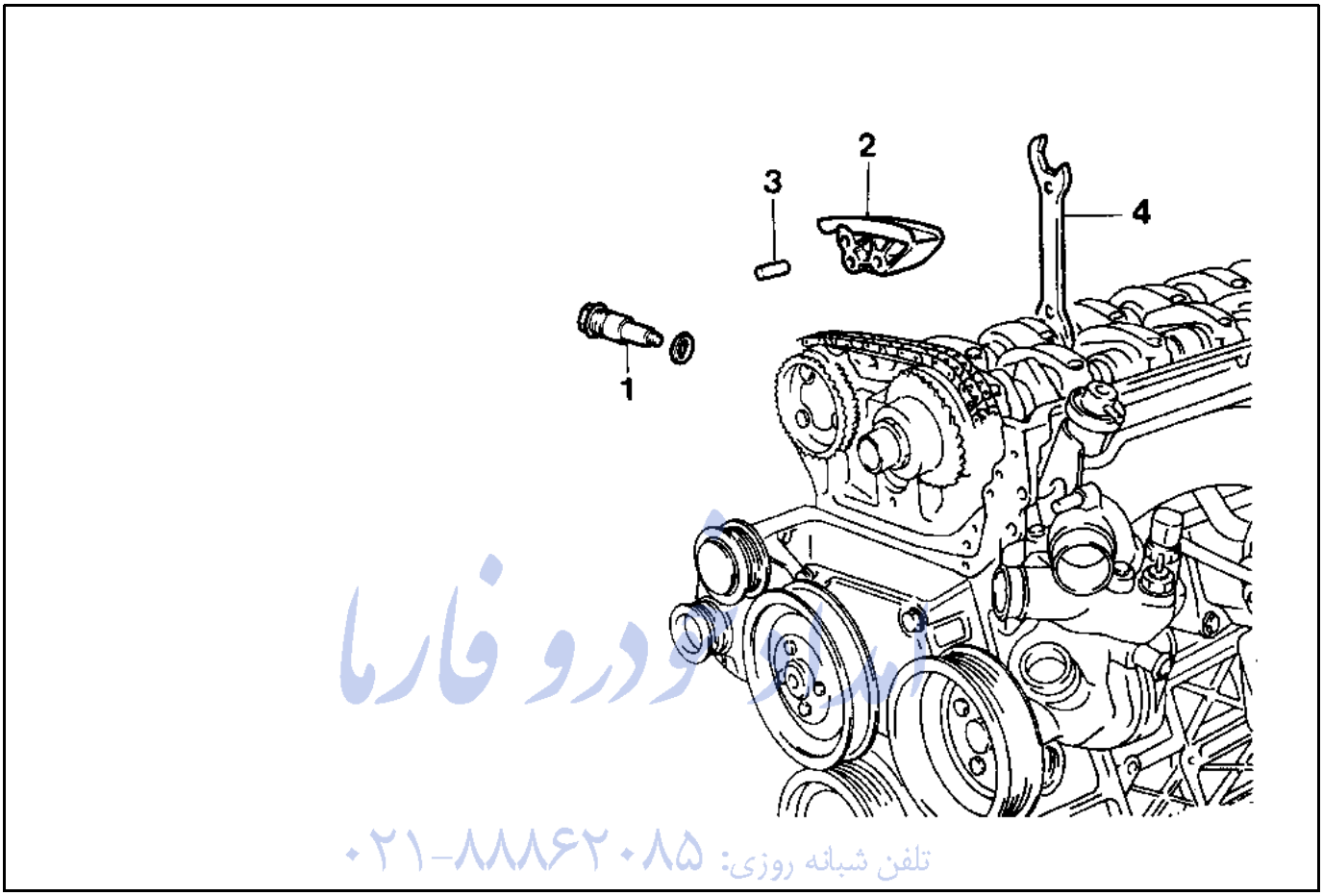
Notice:

- Replace the plastic guide (2) if it is damaged.
- For installation, exactly align the plastic guide (2) with the tensioning rail (1).

4. Installation should follow the removal procedure in the reverse order.
5. Check the camshaft timing position.

CYLINDER HEAD GUIDE RAIL

Preceding Work: Removal of cylinder head front cover



تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵

1 Chain Tensioner
2 Upper Guide Rail
3 Upper Guide Rail Pin
4 Wrench

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Removal & Installation Procedure

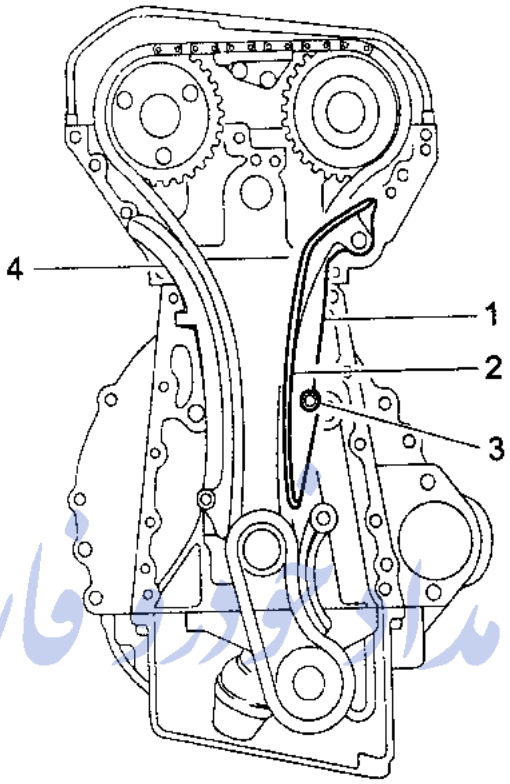
1. Remove the chain tensioner (1).
2. Turn the exhaust camshaft to the camshaft rotating direction using the wrench (4) and loosen the timing chain at upper guide rail (2).
3. Pull out the upper guide rail pin from the guide rail (2).
4. Turn the exhaust camshaft to the opposite direction of rotation using the wrench.
5. Check for damages at the upper sliding rail and replace it if necessary. Install the upper guide rail pin.
6. Install the chain tensioner.

Installation Notice

Tightening Torque	Screw Plug	40 N•m (30 lb-ft)
	Tensioner Assembly	72 - 88 N•m (53 - 65 lb-ft)

CRANKCASE GUIDE RAIL

Preceding Work: Removal of timing gear case cover



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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵

1 Guide Rail
2 Plastic Guide
3 Guide Rail Pin
4 Tensioning Rail

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Removal & Installation Procedure

1. Put the assembly mark at the camshaft sprocket and the timing chain with the paint (arrow).
2. Remove the exhaust camshaft sprocket.
3. Remove the guide rail (1) from the guide rail pin (3).

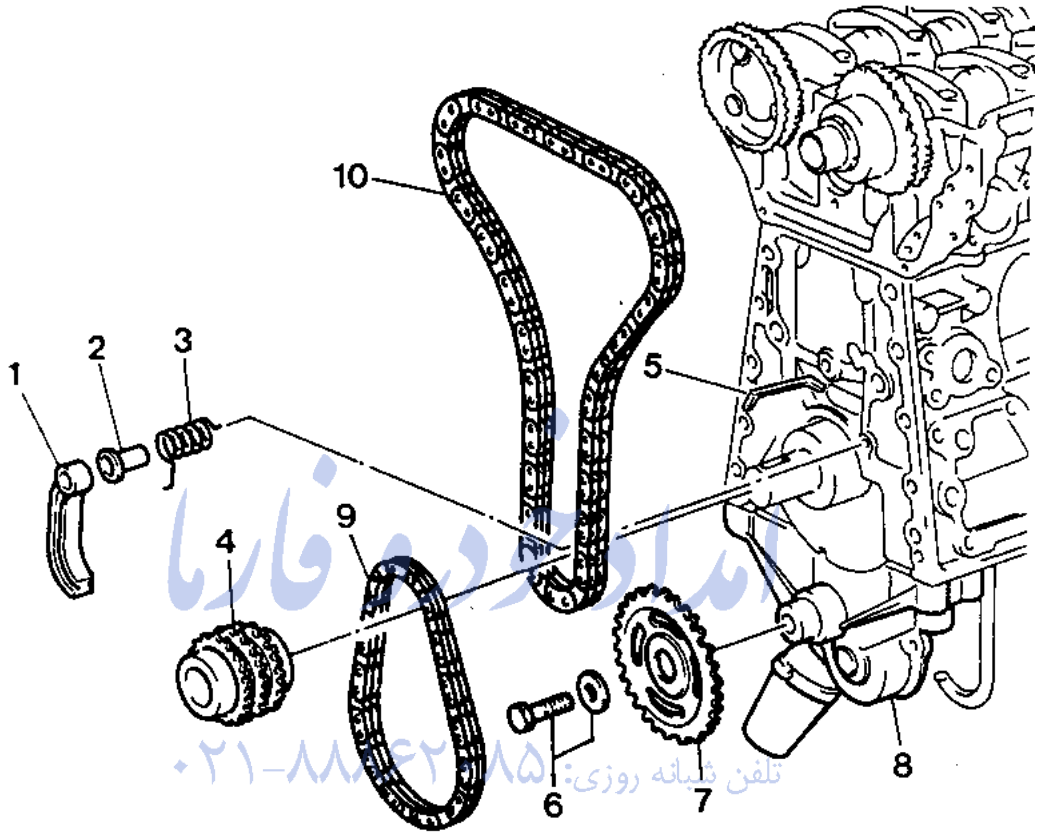
Notice:

- Replace the plastic guide (2) if damaged.
- Connect the plastic guide (2) and the guide rail (1) by aligning them accurately when installing.

4. Installation should follow the removal procedure in the reverse order.
5. Check the camshaft timing position.

CRANKSHAFT SPROCKET

Preceding Work: Removal of oil pan
Removal of tensioning rail
Removal of crank case guide rail

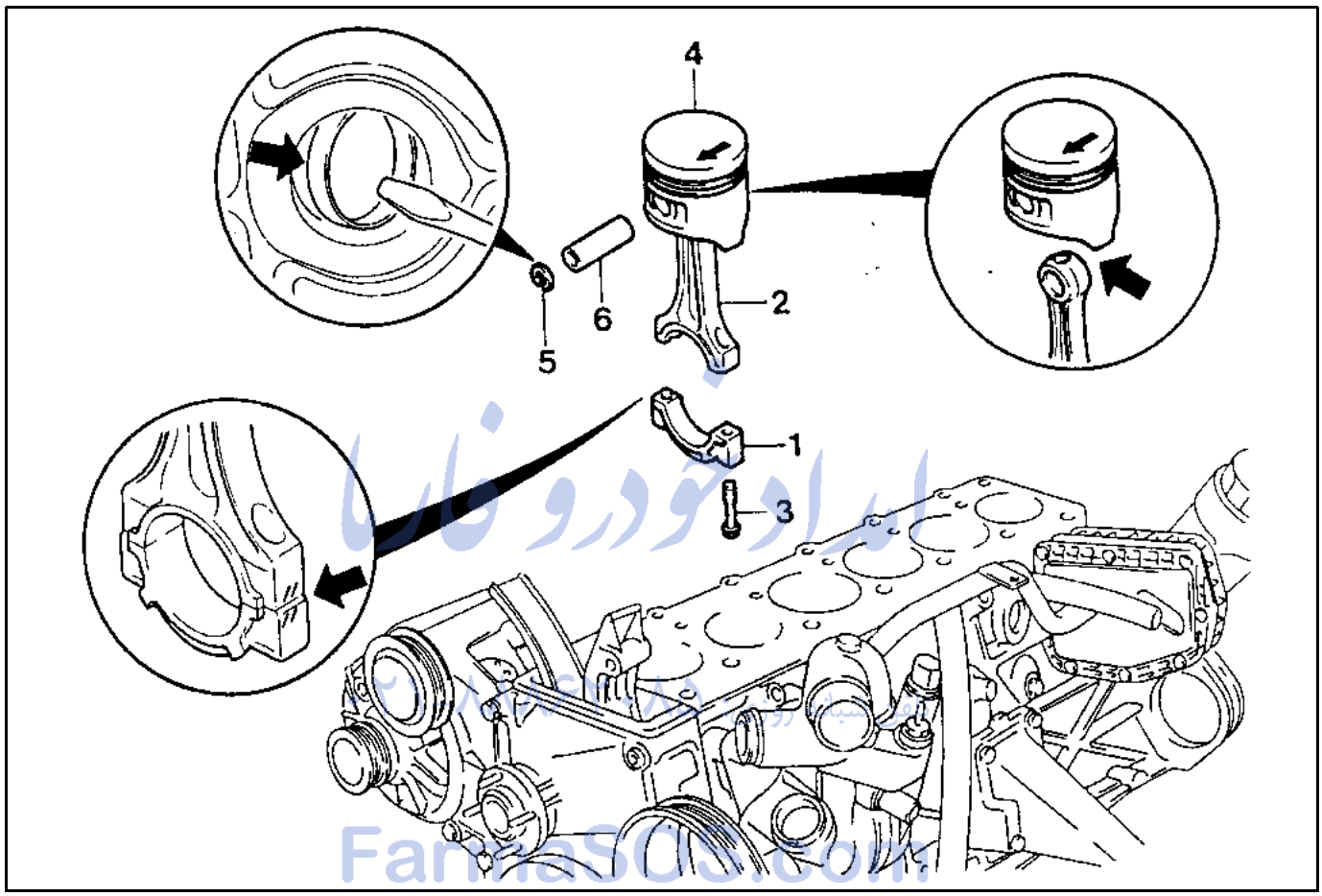


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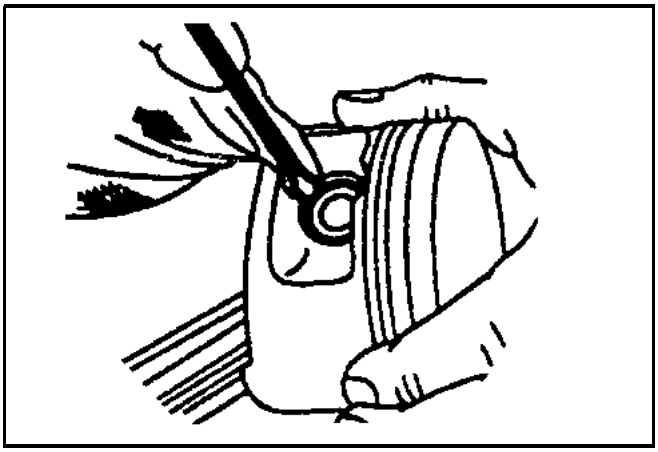
1 Oil Pump Chain Tensioner
2 Oil Pump Chain Bushing
3 Oil Pump Chain Spring
4 Crankshaft Sprocket
5 Key
6 Bolt (M8 x 20, 1 piece) / Washer
..... 29–35 N•m (21–26 lb-ft)
7 Oil Pump Sprocket
8 Oil Pump
9 Oil Pump Roller Chain
10 Timing Chain

PISTON

Preceding Work: Removal of engine
Removal of cylinder head
Removal of oil pan
Removal of oil pump
Removal of baffle plate



1 Connecting Rod Bearing Cap
2 Connecting Rod
3 Connecting Rod Bearing Cap Bolt (M9 x 52, 12 pieces)
. . . . . 1st step 40 N•m (30 lb-ft)
2nd step 90°
4 Piston
5 Snap Ring
6 Piston Pin



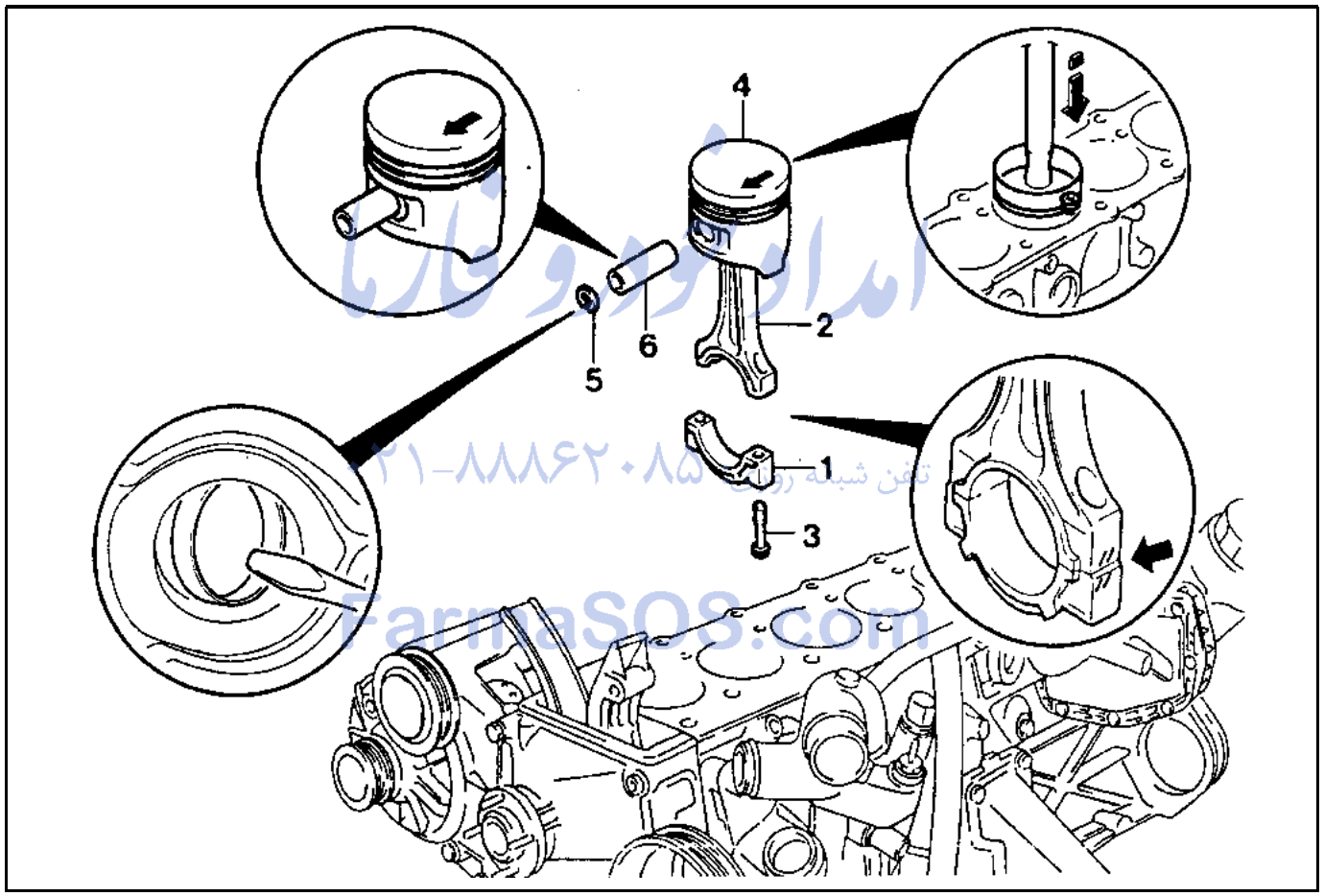
Removal Procedure

1. Unscrew the connecting rod bearing cap bolt (3) and remove the cap.
2. Remove the connecting rod and the piston upward.

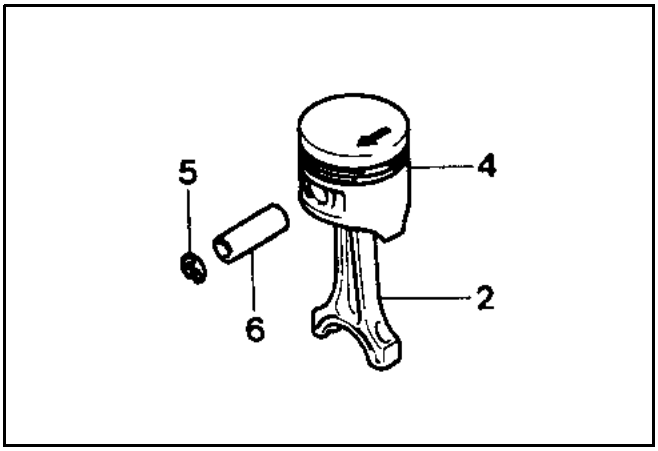
Notice: Make sure that the bearing cap and shell are not changed each other.

3. Remove the snap ring (5) and pull out the piston pin (6).

Notice: Remove the snap ring using a clean cloth as shown in the right picture so that the piston, piston ring, and the snap ring don't get damaged.



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Installation Procedure

1. Check the piston ring gap and apply the engine oil to the piston pin and the connecting rod bushing.
2. Connect the piston and the connecting rod by pressing in the piston pin (6) and install the snap ring to the groove.
3. Clean the cylinder bore, connecting rod bearing journal, connecting rod bearing shell and the piston and coat them with engine oil.
4. Install the piston ring.
5. Install the piston so that the arrow on the piston head faces to the forward of the vehicle.
6. After aligning the connecting rod and the bearing cap mark (// or a number), tighten the bolts.

Installation Notice

Tightening Torque	1st step: 40 N•m (30 lb-ft)
	2nd step: 90°

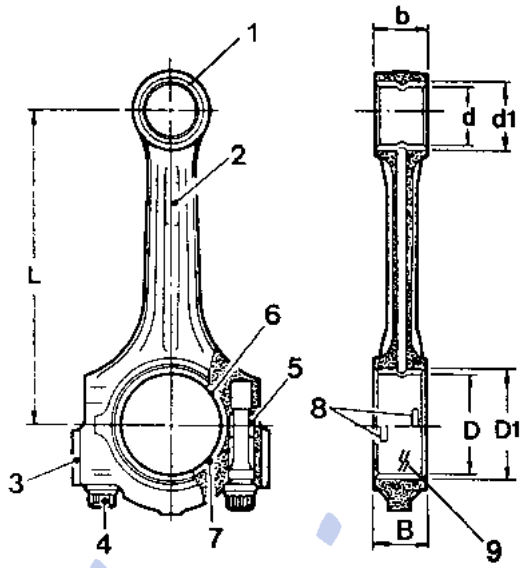
Apply the engine oil to the bearing cap upper and lower bearing shells.

7. Check if the crankshaft rotates without any trouble by rotating it.

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CONNECTING ROD

Preceding Work: Removal of piston



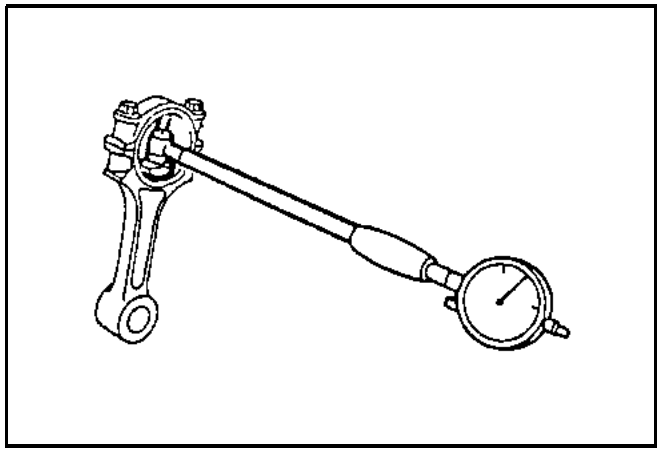
1 Connecting Rod Bushing
2 Oil Gallery
3 Balance Weight
4 Connecting Rod Bearing Cap Bolt (M9 x 52, 12 m pieces)
. . . . . 1st step 40 N•m (30 lb-ft)
2nd step 90°
5 Fit Sleeve
6 Upper Connecting Rod Bearing
7 Lower Connecting Rod Bearing
8 Bearing Shell Lug
9 Marking [Indication(//) or Numbers]

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Service Data Standard

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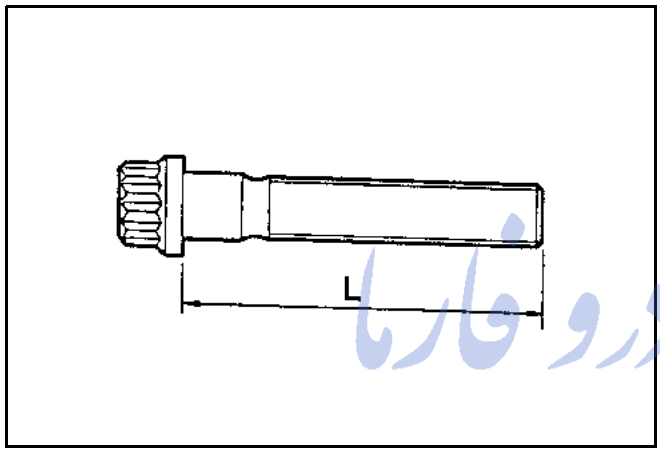
Distance (L) from The Connecting Rod Bearing Bore Center to The Bushing Bore Center	145 ± 0.05 mm
Width of The Connecting Rod (B) at Bearing Bore	21.940 - 22.000 mm
Width of The Connecting Rod (b) at Bushing Bore	21.940 - 22.000 mm
Basic Bore at The Bearing Shell (D1)	51.600 - 51.614 mm
Basic Bore at The Bushing (d1)	24.500 - 24.521 mm
Bushing Inner Diameter (d)	22.007 - 22.013 mm
Clearance Between The Piston Pin and The Bushing	0.007 - 0.018 mm
Peak-to-valley Height of Connecting Rod Bushing on Inside	0.005 mm
Permissible Wwist of Connecting Rod Bearing Bore to Connecting Rod Bushing Bore	0.15 mm
Permissible Deviation of Axial Paralleism of Connecting Rod Bearing Bore to Connecting Rod Bushing Core	0.07 mm
Permissible Deviation of Connecting Rod Bearing Bore from Concentricity	0.01 mm
Permissible Difference of Each Connecting Rod in Weight	0.4 g



Inspection

1. Measure the basic bore of the connecting rod bearing.

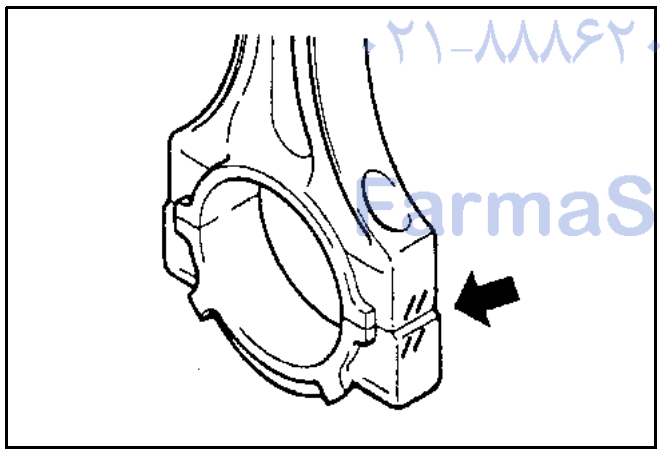
Notice: If the basic bore exceeds the value of 51.614mm, replace the bearing or check the connecting rod.



2. Check connecting rod bolts.

Length When New (L)	51.7 - 52 mm
Max. Length (L)	52.9 mm
Tightening Torque	1st step: 40 N•m (30 lb-ft)
	2nd step: 90°

Notice: If the length exceeds max. length, replace it.



3. Check the assembly mark(indication//or number:arrow) of the connecting rods and the bearing cap when installing.

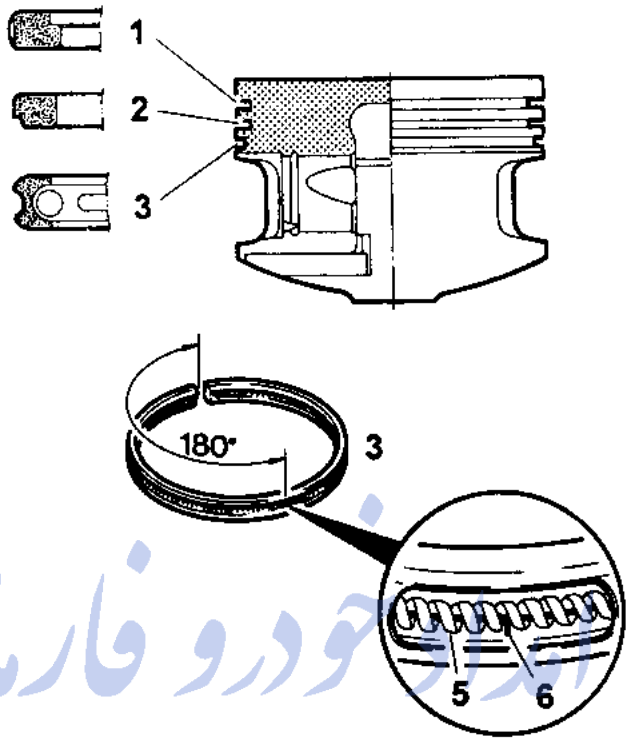
Notice

- Make sure it doesn't exceed over 4g with other connecting rods when replacing the connecting rods.
- Check if the connecting rod and the bearing cap are accurately seated on the groove when replacing the bearing.

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PISTON RING

Preceding Work: Removal of piston



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1 Piston Compression Ring
2 Piston Compression Ring
3 Piston Oil Ring
4 -
5 Coil Spring and Control Ring
6 Hook Spring

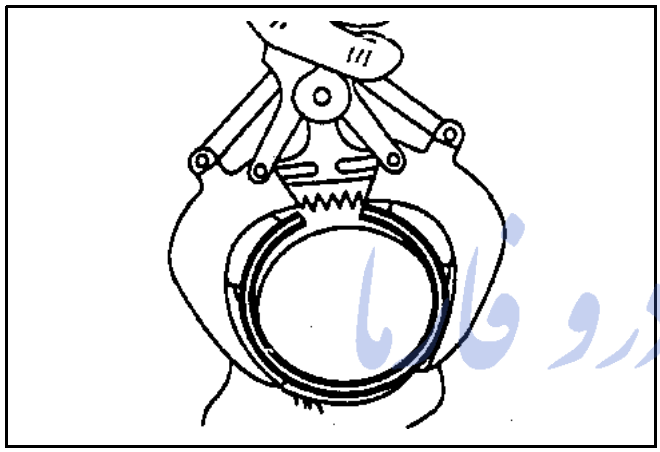
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Replacement Procedure

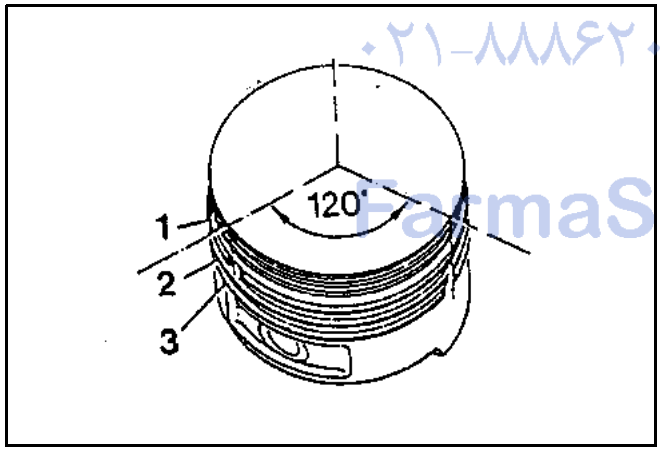
1. Measure the piston ring's gap.

End Gap of The Piston Ring	Groove 1 0.20 - 0.40 mm
	Groove 2 0.20 - 0.40 mm
	Groove 3 0.20 - 0.45 mm
Gap Between The Piston and The Piston Ring	Groove 1 0.015 - 0.050 mm
	Groove 2 0.020 - 0.040 mm
	Groove 3 0.010 - 0.045 mm

Notice: If out of specification, replace the piston ring.



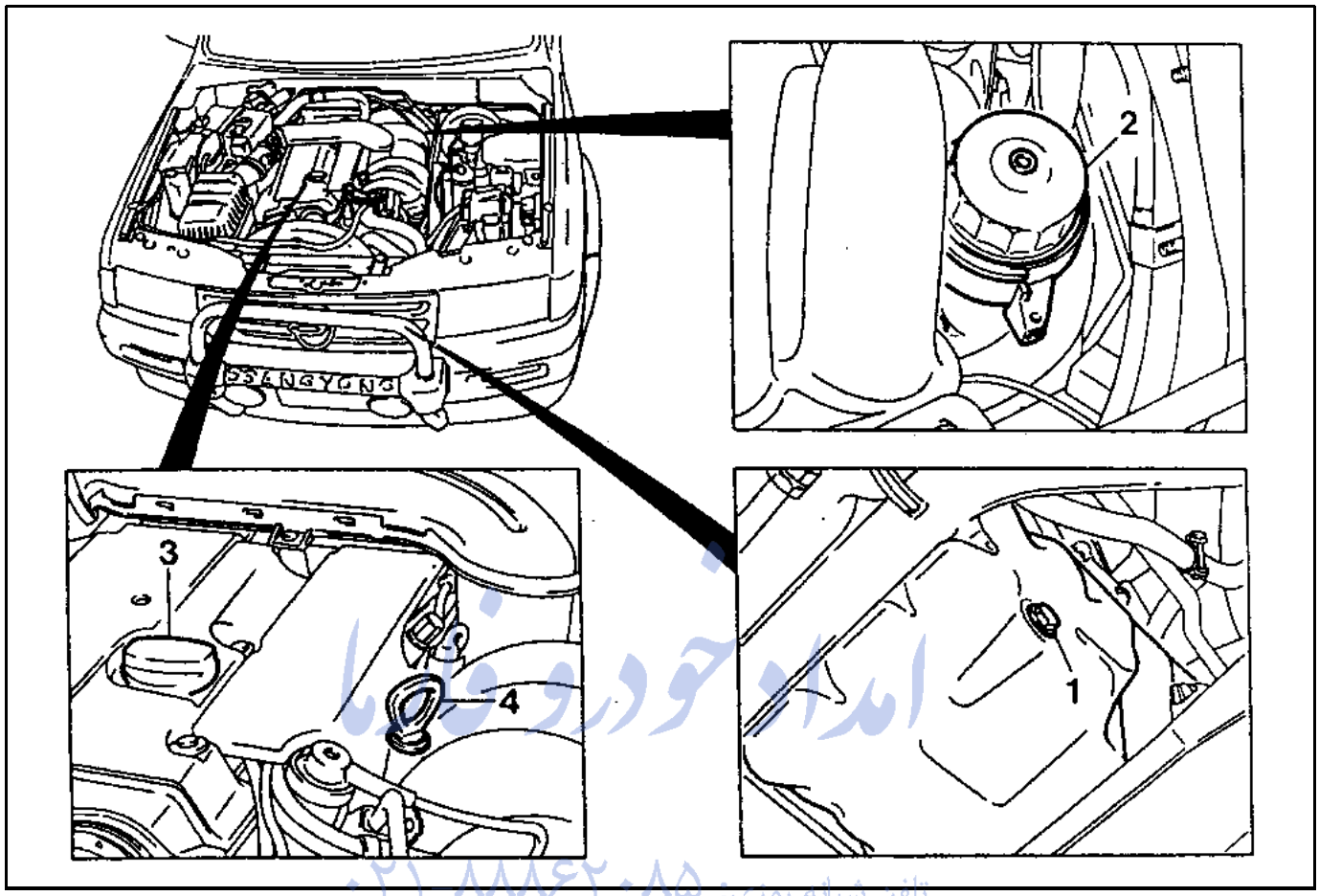
2. Remove the piston ring with a pliers.



3. For installation, position the piston ring to be the 'TOP' mark on the piston ring upward and arrange the piston ring ends to be 120° apart.
4. Adjust the hook spring joint in the oil ring 180° away from the ring end.

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ENGINE OIL SPECIFICATION



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1 Drain Plug . . . . . 25 N•m (18 lb-ft)
2 Oil Filter
3 Engine Oil Filler Cap
4 Dipstick Gauge

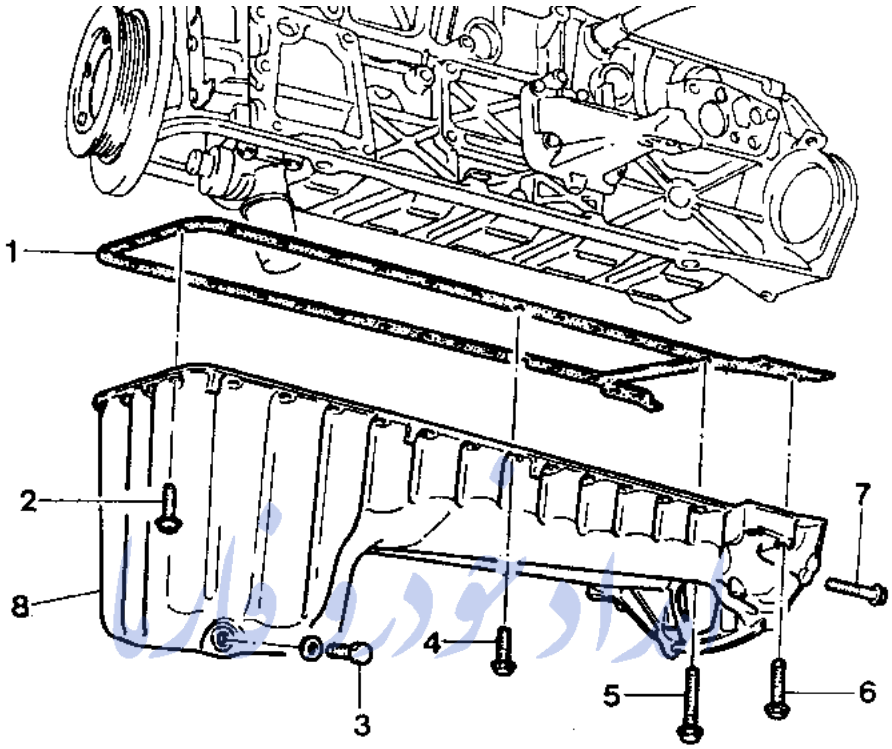
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Specifications

Application	Descrition
Capacity	Min : 6.7L, Max : 8.2L
Quality	• API SH or above grade
	• ACEA : A2 or A3
	• Approved oil by MB Sheet 229.1
Viscosity	• Approved oil by MB Sheet 224.1
Replacement	• Initial at 1000-1500km, Replace every 15000km

OIL PAN

Preceding Work: Removal of front stabilizer
Removal of steering gear box



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1	Gasket ..... Replace	5	Bolt (M6 x 85) ..... 10 N•m (89 lb-in)
2	Bolt (M6 x 22, 6 pieces) ..... 10 N•m (89 lb-in)	6	Bolt (M8 x 40) ..... 25 N•m (18 lb-ft)
3	Drain Plug (M6 x 20) ..... 25 N•m (18 lb-ft)	7	Bolt (M10) ..... 40 N•m (30 lb-ft)
4	Bolt (M6 x 20, 22 pieces) ..... 10 N•m (89 lb-in)	8	Oil Pan

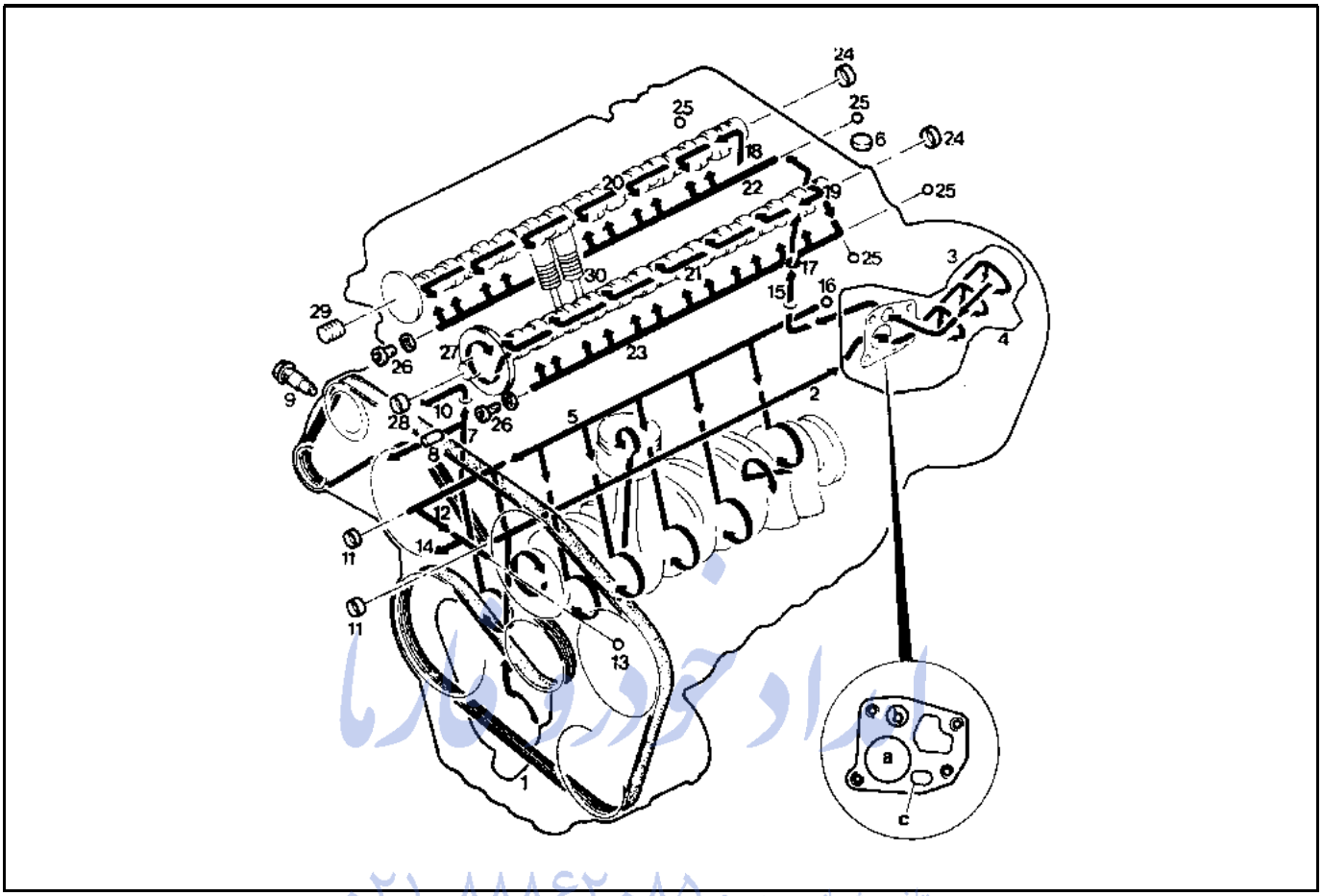
Removal & Installation Procedure

1. Remove the drain plug and drain the oil completely.
2. Unscrew the bolts and remove the oil pan and gasket.

Notice: Arrange the bolts according to each size.

3. Clean the inside of oil pan and sealing surface, then apply the sealant.
4. Replace the gasket with new one.
5. Install the oil pan with gasket, and tighten each bolt in specified torque.
6. Check for oil leaks while running the engine.

Oil Circulation

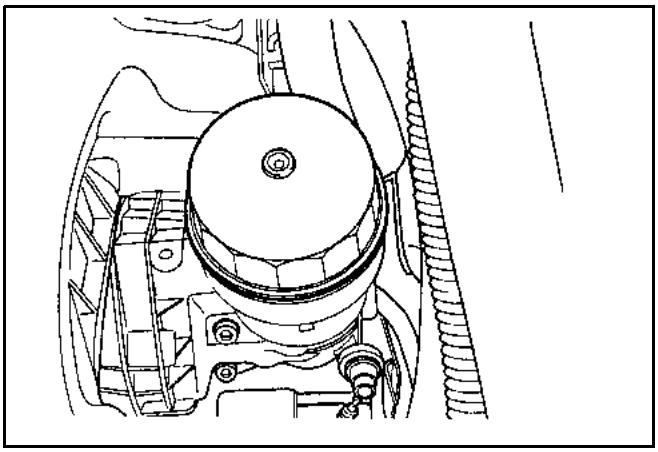


تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵

1 Oil Pump
2 Oil Gallery (to oil filter)
3 Oil Filter
4 Oil Pressure Switch
5 Main Oil Gallery
6 Cylinder Head Closing Cover
7 Oil Gallery (At Chain Tensioner)
8 Oil Non-return Valve
9 Chain Tensioner
10 Vent (Chain Tensioner)
11 Front Closing Cover (ϕ17 mm)
12 Oil Gallery (Perpendicular to The Shaft)
13 Ball (ϕ6 mm)
14 Oil Spray Nozzle (Timing Chain)
15 Oil Gallery (At Cylinder Head)
16 Ball (ϕ15mm)
17 Oil Restriction Inner (ϕ4mm)
18 Oil Supply (To Exhaust Camshaft)
19 Oil Supply (To Intake Camshaft)
20 Oil Supply (To Exhaust Camshaft Bearing)
21 Oil Supply (To Intake Camshaft Bearing)
22 Oil Gallery (Oil Supply to Exhaust Valve Tappet)
23 Oil Gallery (Oil Supply to Exhaust Valve Tappet)
24 Camshaft Closing Cover
25 Ball (ϕ8 mm)
26 Screw Plug
27 Camshaft Adjuster
28 Front Closing Cover (Intake Camshaft)
29 Front Treaded Bushing (Exhaust Camshaft)
30 Valve tappet

a Oil Gallery (From Oil Pump to Oil Filter)
b Main Oil Gallery
c Oil Return Line (Oil Returns to the Oil Pan when Replacing the Filter Element)

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ENGINE OIL AND OIL FILTER ELEMENT

Tools Required

103 589 02 09 00 Oil Filter Remover

Replacement Procedure

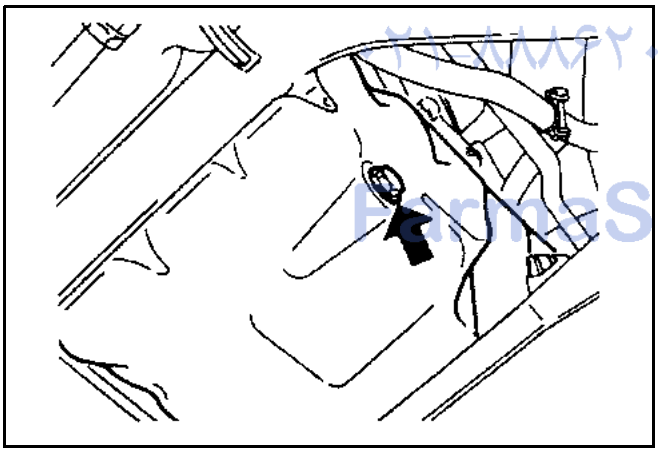
1. Install the oil filter remover 103 589 02 09 00 on the oil filter cover.

Notice: Make the screw cover removable by tightening the bolt at the side of the oil filter remover 103 589 02 09 00.

2. Install the wrench to the upper bolt in the oil filter remover 103 589 02 09 00 and remove the oil cover by turning it.
3. Remove the oil filter element.

Notice: Work with a cloth under the vehicle when removing the oil filter element not to drain the oil.

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4. Remove the drain plug (arrow) and drain the engine oil.

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Notice: Leave the oil filler cap open to ease the engine oil discharge.

5. Tighten the engine oil drain plug after cleaning it.

Installation Notice

Tightening Torque	25 N•m (18 lb-ft)

Replace the seal washer with new one.

6. Replace the O-ring in the oil filter cover with new one.

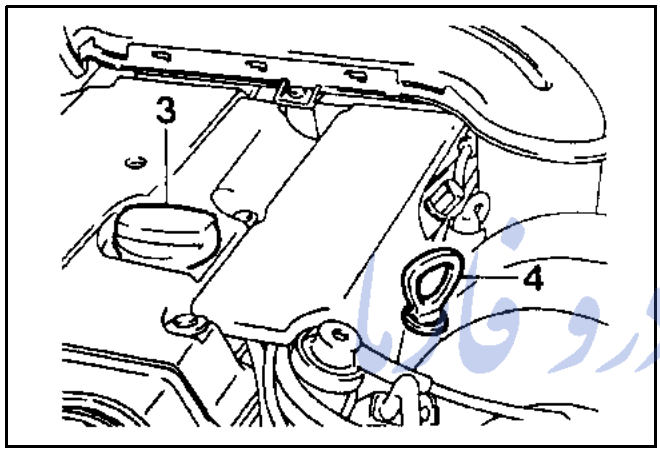
Notice: Apply the engine oil to the O-ring.

7. Insert new oil filter element into the oil filter housing.

8. Temporarily tighten the oil filter cover. Install the oil filter remover 103 589 02 09 00, and then completely tighten it.

Installation Notice

Tightening Torque	25 N•m (18 lb-ft)



9. Fill up engine oil through the engine oil filler opening (3).
10. Check for oil leaks at normal engine temperature after starting the engine.
11. Stop the engine and wait 5 minutes.

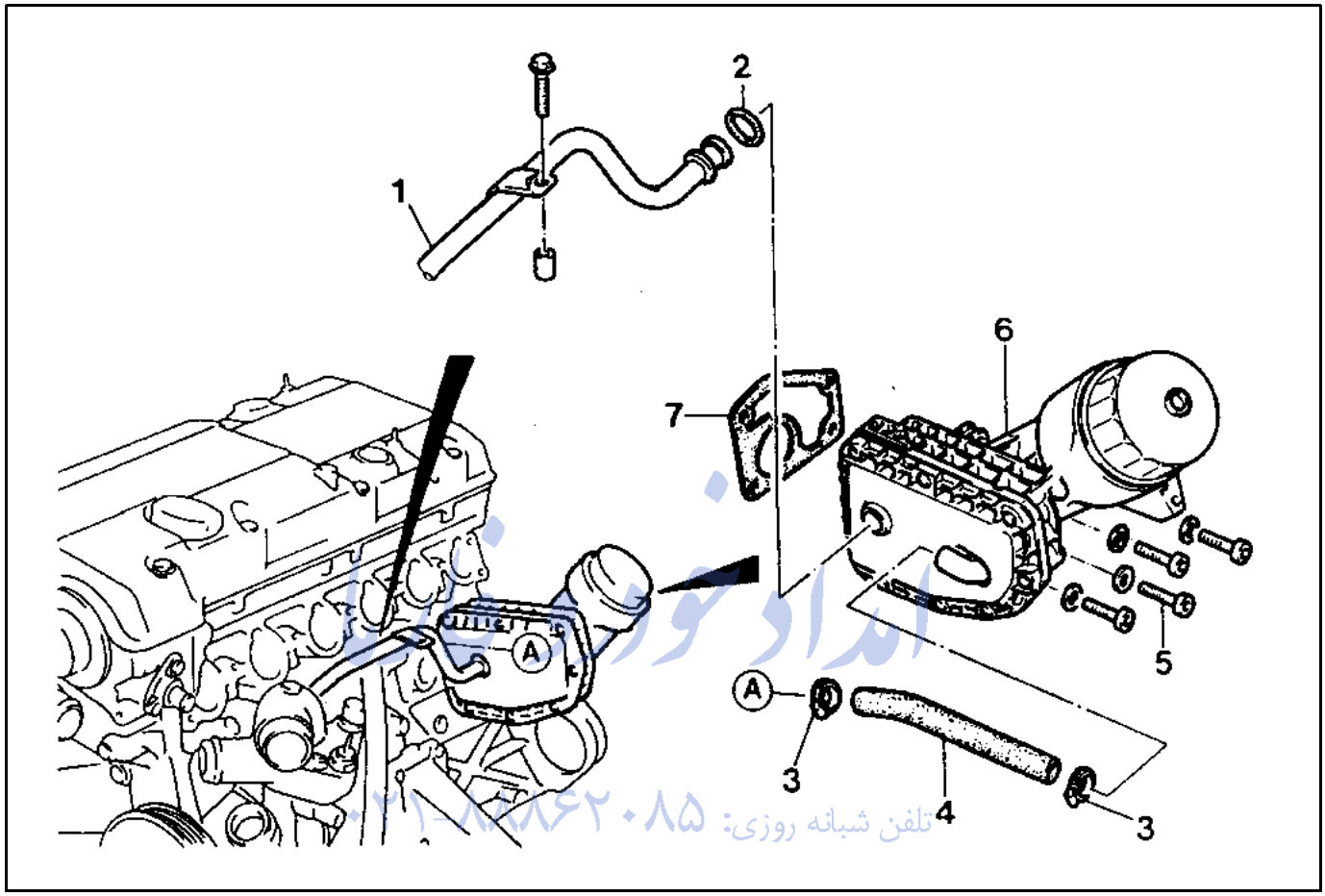
    Check the oil level and fill up as specified if necessary.

3 Oil Filler Cap
4 Dipstick Gauge

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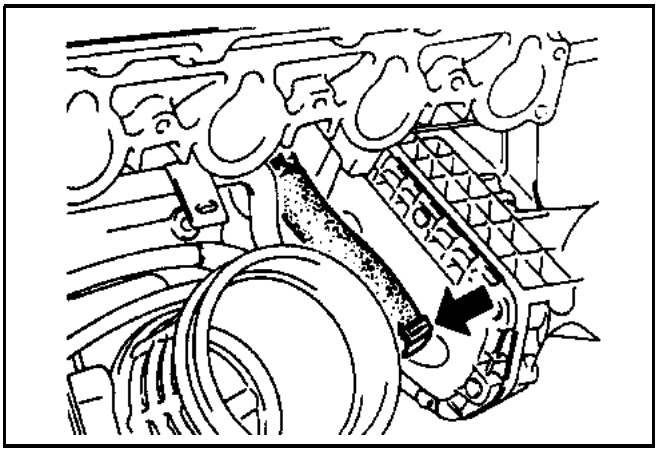
OIL FILTER

Preceding Work: Removal of starter motor
Removal of upper intake manifold



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1 Coolant Line
2 O-ring ..... Replace
3 Clip
4 Hose
5 Bolt ..... 25 N•m (18 lb-ft)
6 Oil Filter
7 Gasket ..... Replace



Removal & Installation Procedure

1. Drain the coolant from the crank case.
2. Remove the each coolant line and hose.
3. Remove the oil filter bolt and then remove the oil filter.

Installation Notice

Tightening Torque	25 N•m (18 lb-ft)

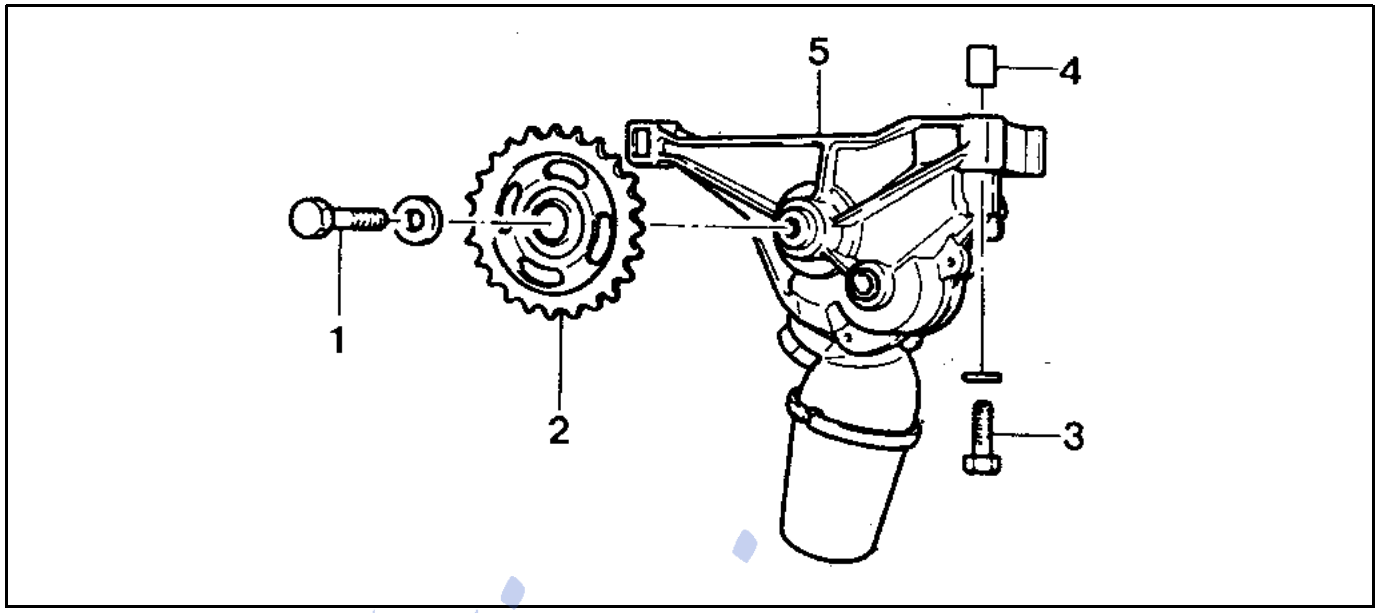
Notice: Replace the oil filter gasket.

4. Installation should follow the removal procedure in the reverse order.
5. Check engine oil level.
6. Run the engine at idle and check the engine for leaks.

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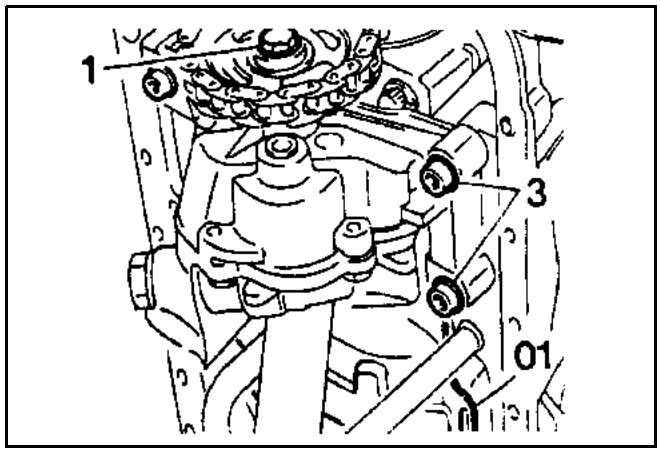
OIL PUMP

Preceding Work: Removal of oil pan



1 Bolt (M8 x 20, 1 piece)
. . . . . 29-35 N•m (21-26 lb-ft)
2 Sprocket (Oil Pump Drive)
3 Bolt (M8 x 35, 3 pieces)
. . . . . 22.5-27.5 N•m (16.6-20.3 lb-ft)
4 Spring Pin
5 Oil Pump

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Removal & Installation Procedure

1. Remove the bolt (1) from the oil pump drive sprocket (2) and separate the gear and the oil pump drive chain.

   Installation Notice

Tightening Torque	29 - 35 N•m (21 - 26 lb-ft)

2. Unscrew the oil pump mounting bolts (3).

   Installation Notice

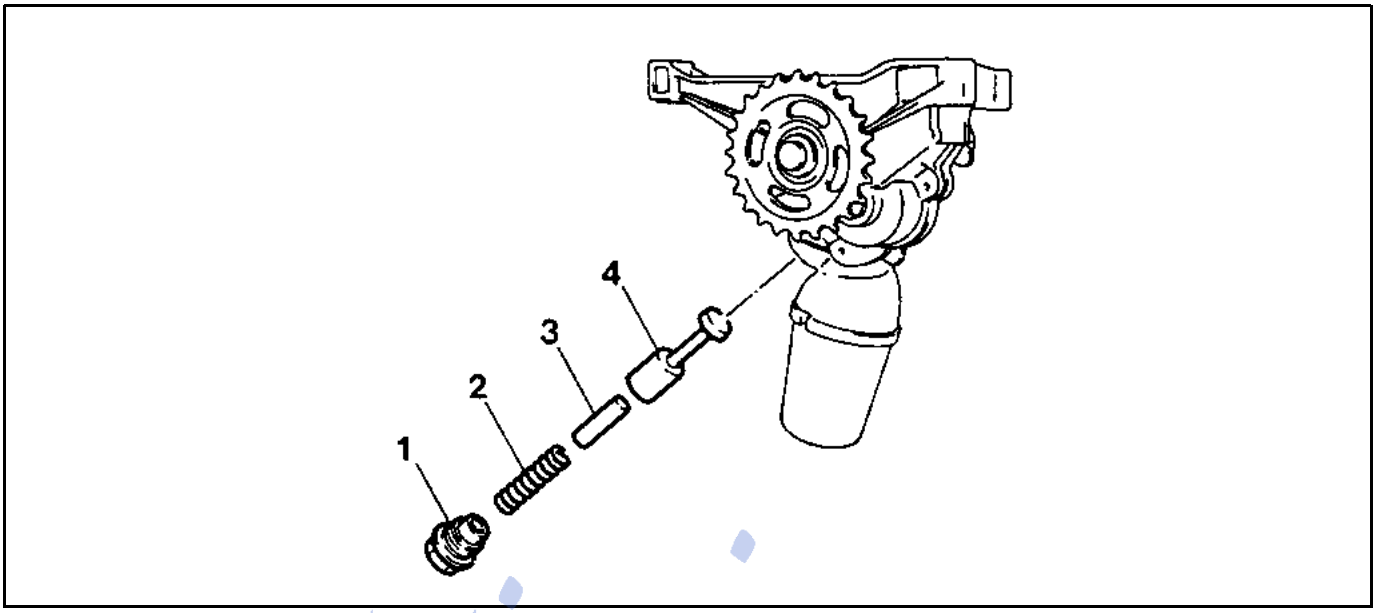
Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)

   Tighten the baffle plate and the oil pump with the two bolts in right side first, and then tighten the other bolt.
3. Remove the oil pump and oil strainer assembly.
4. Replace the strainer in oil pump if necessary.
5. Installation should follow the removal procedure in the reverse order.

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OIL PRESSURE RELIEF VALVE

Preceding Work: Removal of oil pan



1 Screw Plug . . . . . 50 N•m (37 lb-ft)
2 Compression Spring
3 Guide Pin
4 Piston

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Removal & Installation Procedure

1. Remove the screw plug (1).

Installation Notice

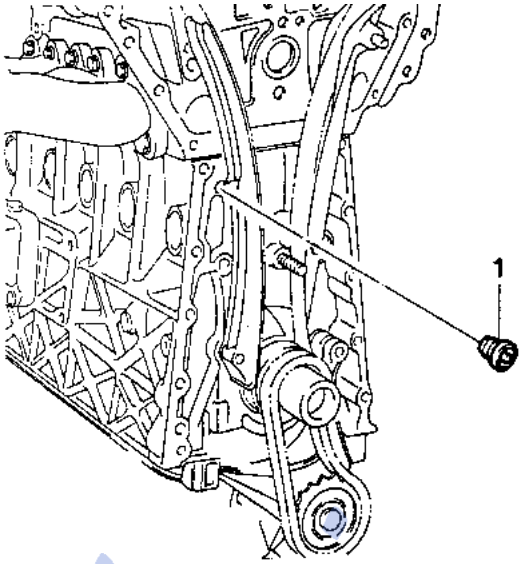
Tightening Torque	50 N•m (37 lb-ft)

2. Remove the spring (2), guide pin (3) and the piston (4).
3. Installation should follow the removal procedure in the reverse order.

Notice: Don't use the seal for the screw plug.

OIL NON-RETURN VALVE

Preceding Work: Removal of timing gear case cover

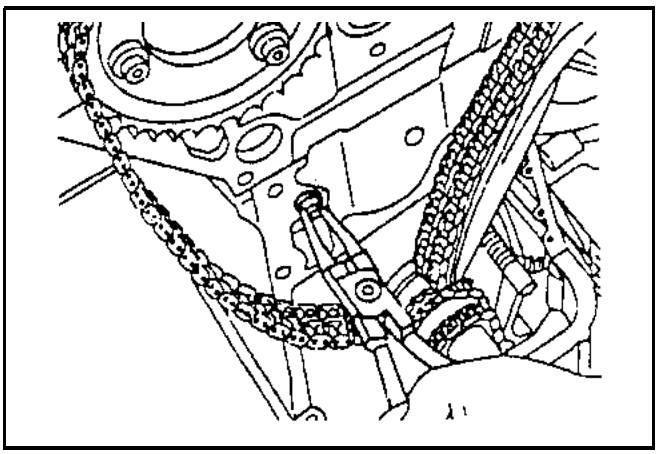


1 Oil Non-return Valve

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۰۲۱-۸۸۸۶۲۰۸۵
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Functions

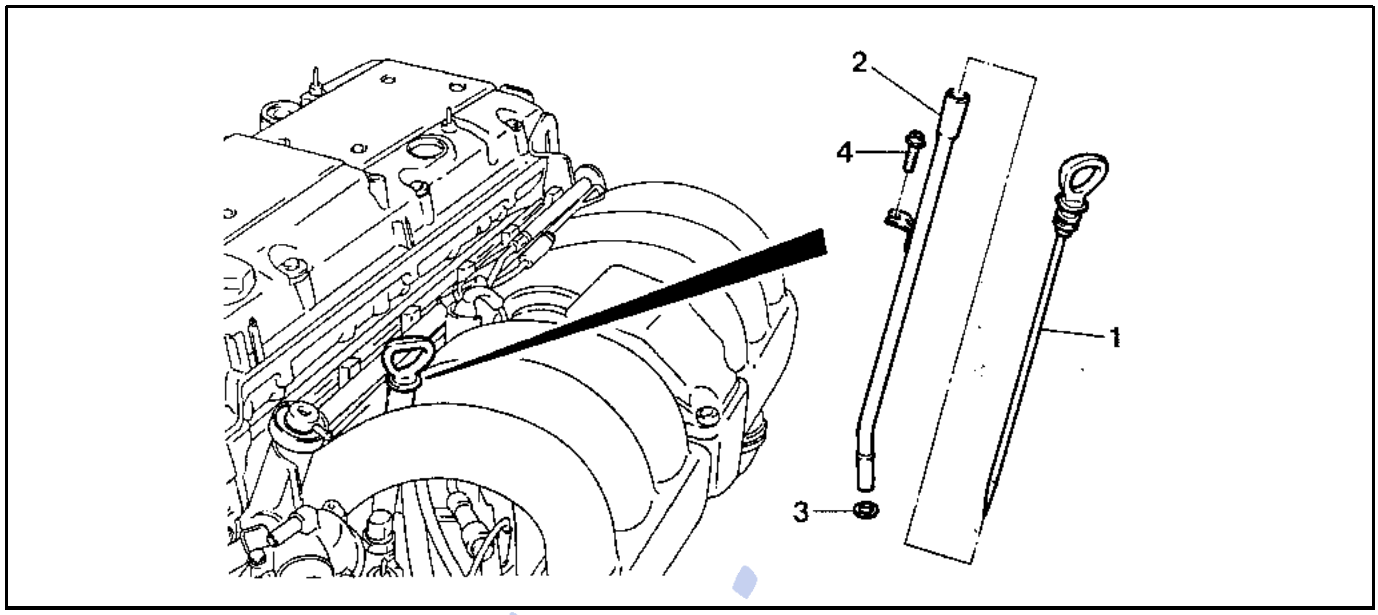
The non-return valve prevents the oil in the chain tensioner from drying up. In other words, it stops oil-returning in order to prevent the oil in the chain tensioner from getting dry. As a result, the chain tensioner can be activated with oil in itself.



Replacement Procedure

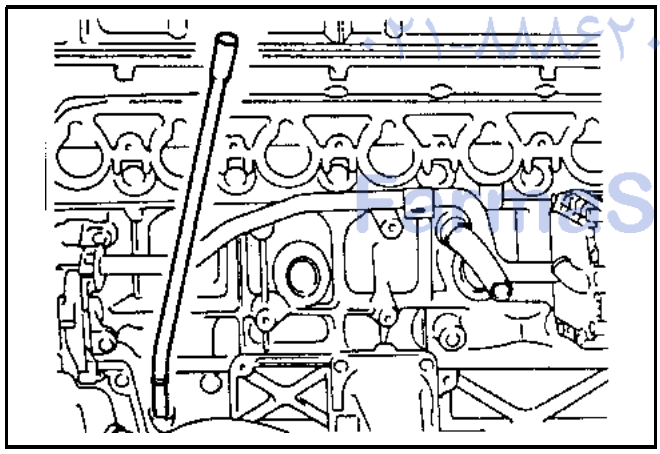
1. Remove the non-return valve using a pliers.
2. Insert new non-return valve with hand.

OIL DIPSTICK GUIDE TUBE



1 Oil Dipstick Level Gauge
2 Oil Dipstick Guide Tube
3 O-ring
4 Bolt (M6 x 12, 1 piece)
. . . . . 9-11 N•m (80-97 lb-in)

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Removal & Installation Procedure

1. Pull out the oil dipstick level gauge (1).
2. Remove the bolt (4) in the upper intake manifold and remove the oil dipstick guide tube.

Installation Notice

Tightening Torque	9 - 11 N•m (80 - 97 lb-in)

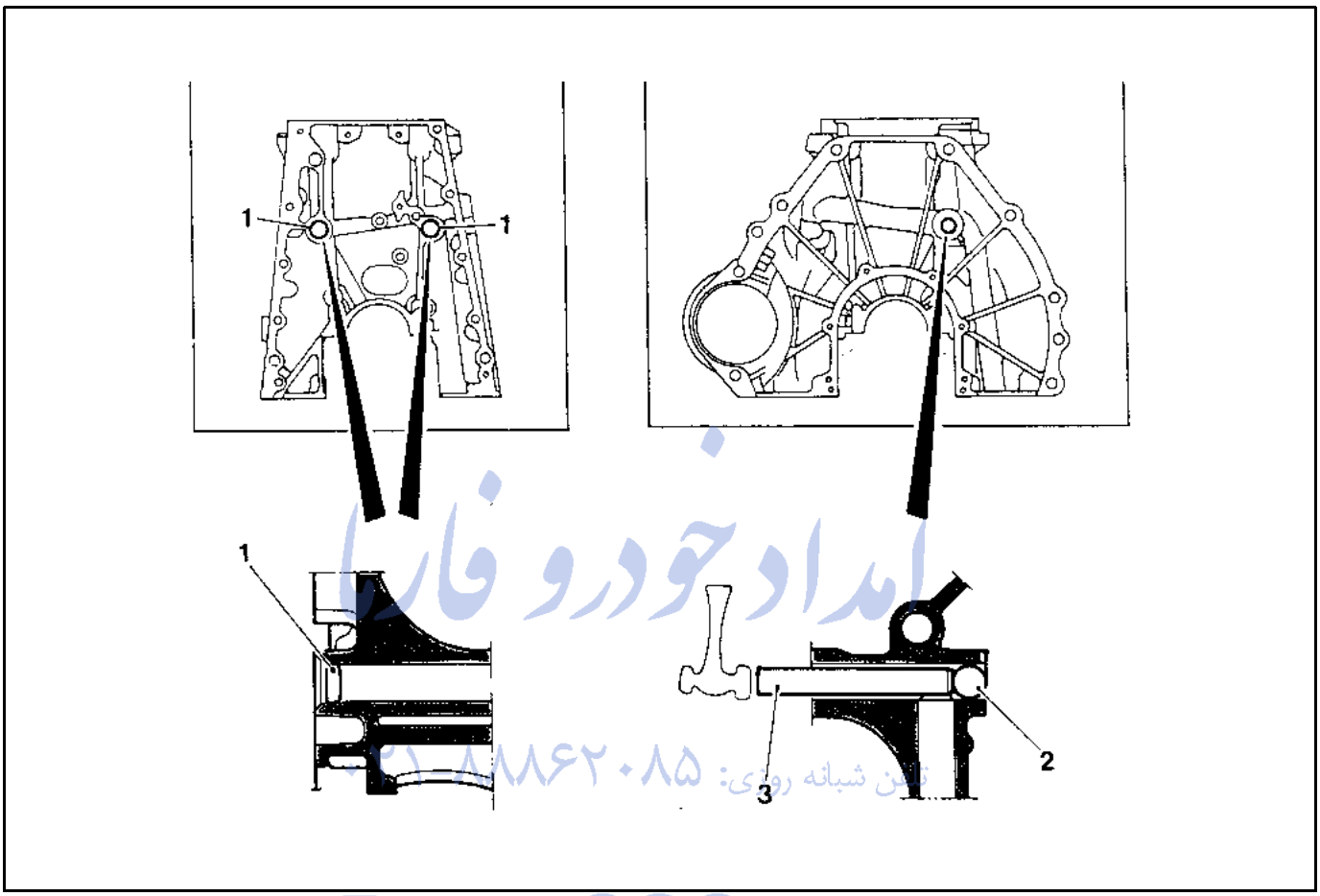
3. Install new O-ring to the dipstick guide tube.
4. Installation should follow the removal procedure in the reverse order.
5. Check for leaks by starting the engine.

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UNIT REPAIR

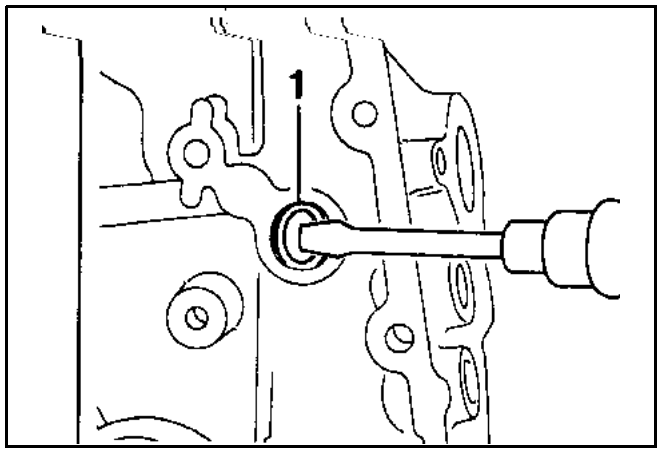
OIL GALLERY IN CRANKCASE

Preceding Work: Removal of crankshaft, removal of oil spray nozzle



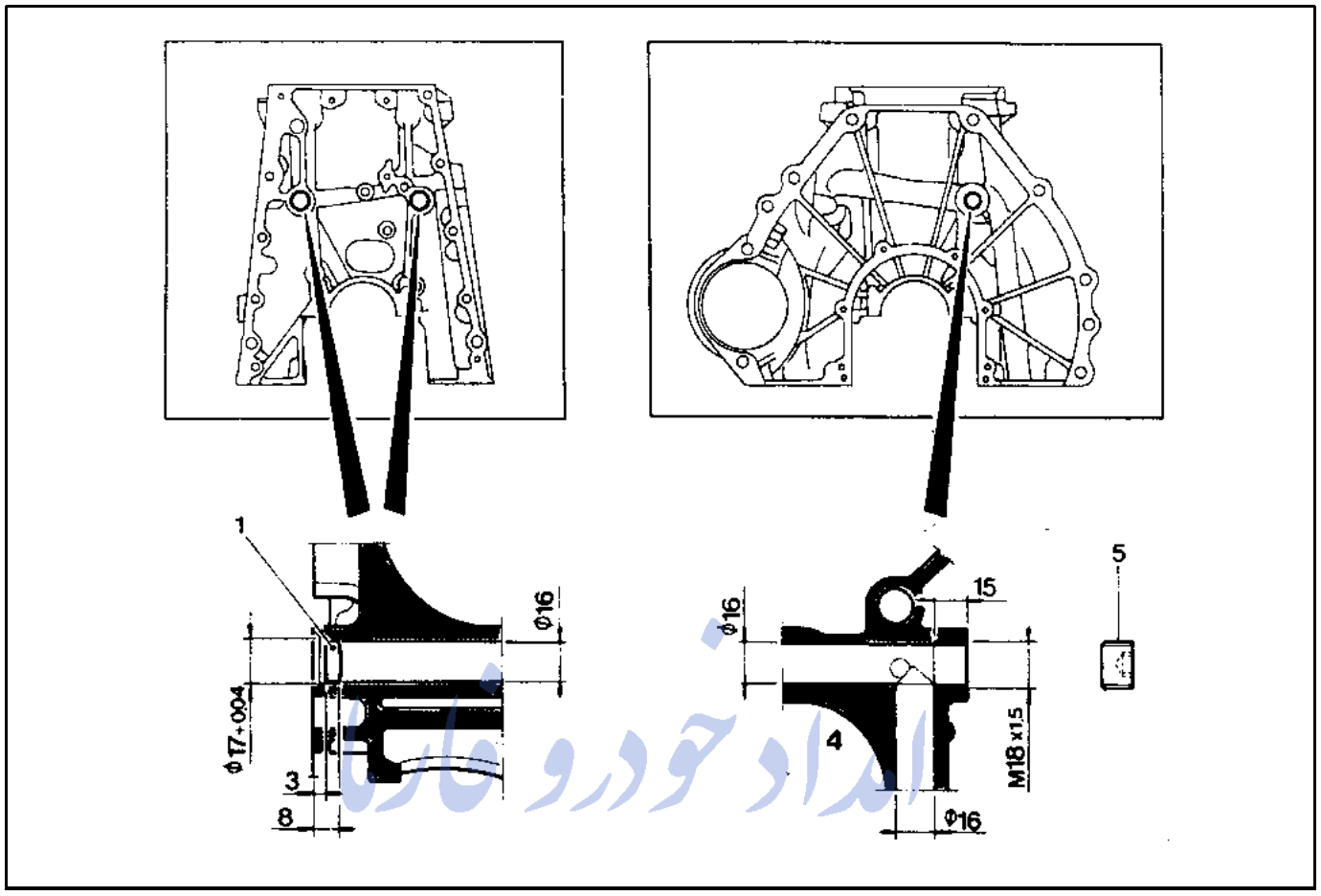
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1 Plug
2 Steel Ball
3 Round Bar ..... ϕ11 x 750 mm



Cleaning Procedure

1. Remove the plug (1) with a screwdriver.
2. Using a round bar (3) and hammer, remove the steel ball (2).
3. Using the compressed air, blow into the oil galleries and clean it off.



1 Plug ..... Replace
2 Main Oil Gallery
3 Screw Plug

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Tools Required

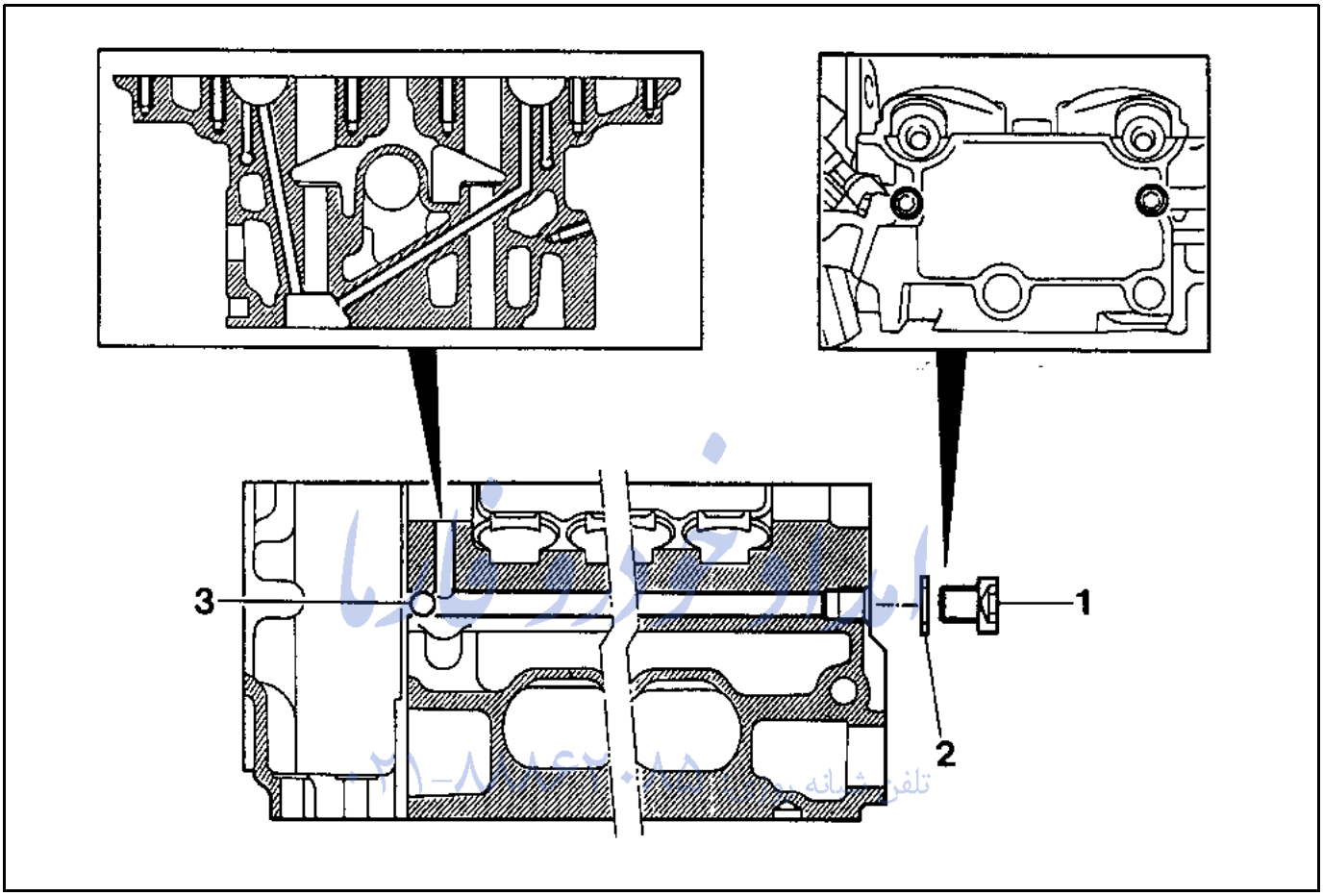
102 589 12 15 00 Drift

Sealing Procedure

1. Enlarge the end of main oil gallery (4) to be diameter of 16mm, depth of 15mm.
2. Using an M16 x 1.5 thread (tap), make the thread at the end of main oil gallery (4).
3. Throughly clean the oil gallery with compressed air and tighten the screw plug (M16 x 1.5) after applying sealing bond on it.
4. Apply Loctite 270 on new plug and tighten to the hole until the drift is stopped after inserting new plug into the drift.

OIL GALLERY IN CYLINDER HEAD

Preceding Work: Removal of cylinder head
Removal of camshaft
Removal of tappet



1 Screw Plug . . . . . 15 N•m (11 lb-ft)
2 Seal
3 Steel Ball (ϕ8mm)

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Cleaning Procedure

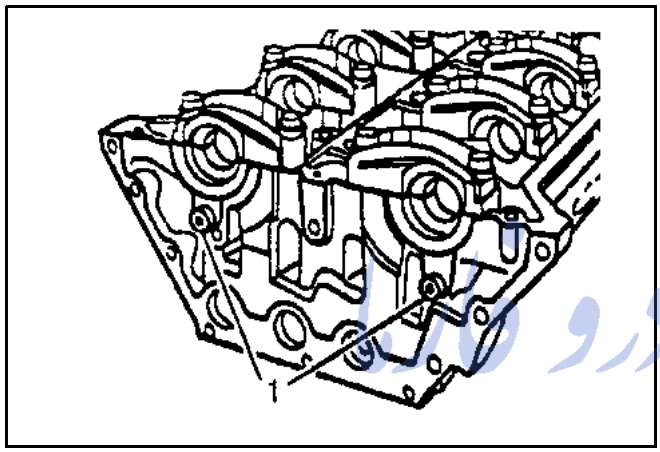
1. Remove the screw plug (1) and the seal (2).

Installation Notice

Tightening Torque	15 N•m (11 lb-ft)

Replace the seal with new one.

2. Clean the oil gallery using the compressed air.

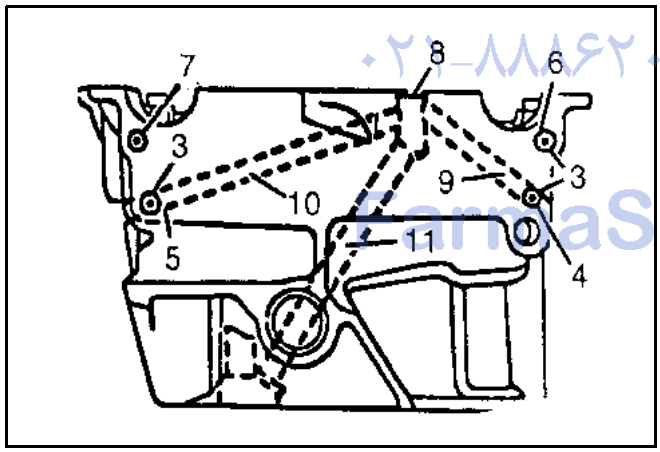


Sealing Procedure

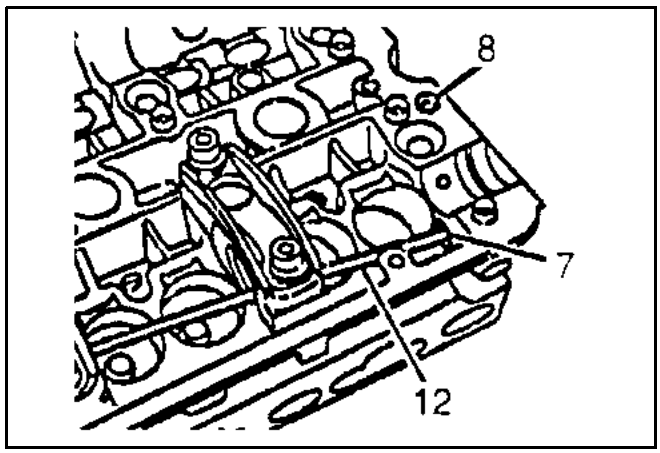
1. Remove the screw plug (1) and the seal.

Installation Notice

Tightening Torque	15 N•m (11 lb-ft)

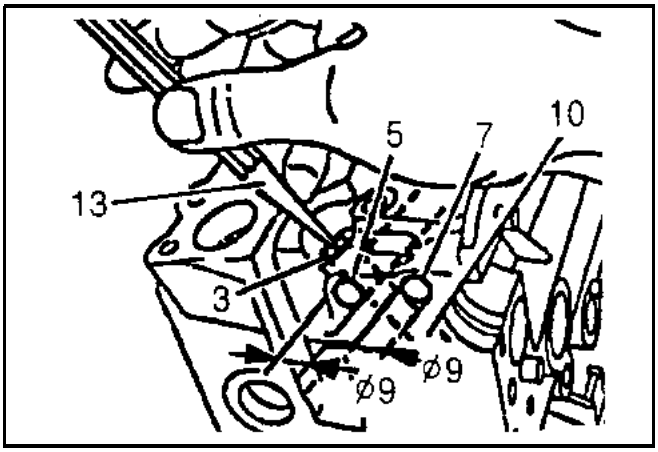


2. Remove the steel ball from the oil gallery (4), (5), (6) and (7) using the round bar (12, ϕ6 x 700 mm).

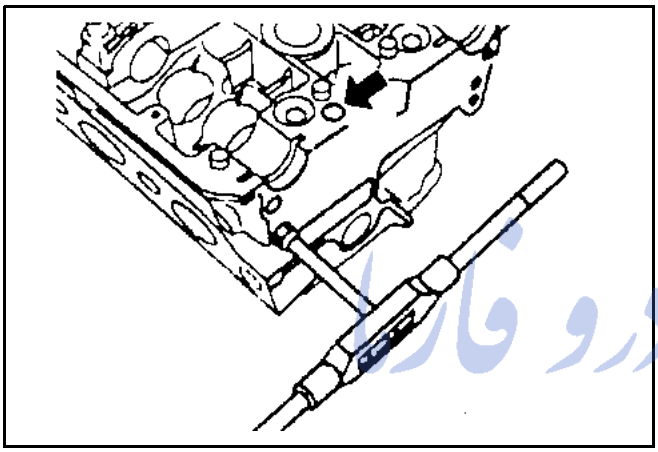


3. Remove the plug (8) using the screw driver.

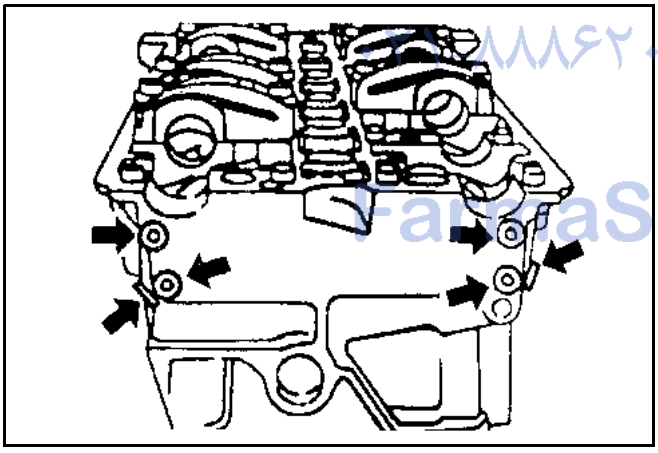
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4. Enlarge the oil gallery at the rear of the cylinder head to be diameter 9mm, depth 8mm.
5. Tap in the steel ball (3) from the side to the oil gallery using the punch (13).
6. Pull out the steel ball (3) using the round bar (12).
7. Enlarge the oil gallery to be diameter 9mm, depth 8mm.



8. Make a screw hole at the oil gallery using M10 x 1 thread.
9. All the oil gallery should be cleaned with the compressed air.
10. Apply the Loctite 270 to new plug and press in using a suitable drift (arrow).

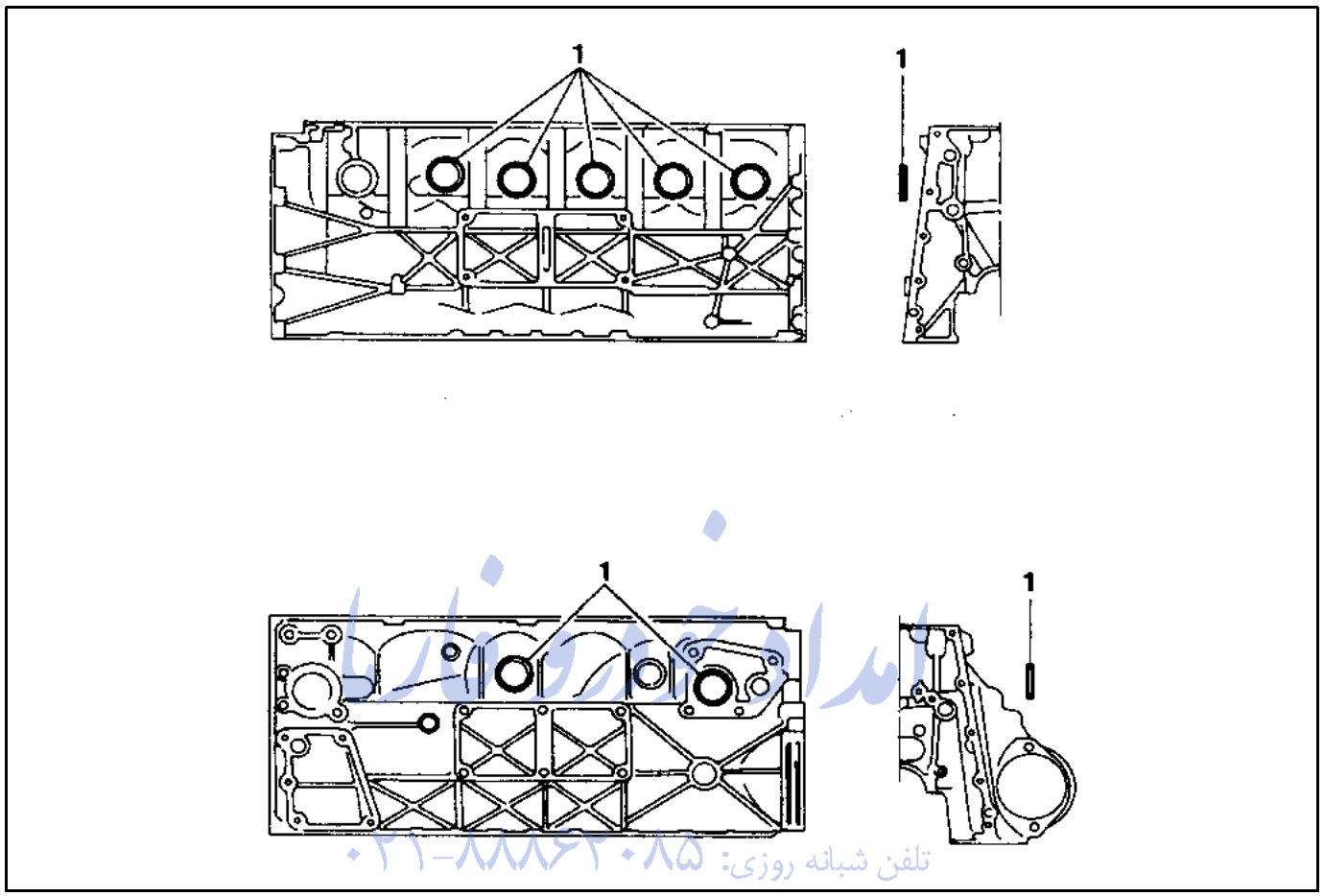


11. Tighten the screw plug with the seal (arrow).

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CORE PLUGS IN CRANKCASE

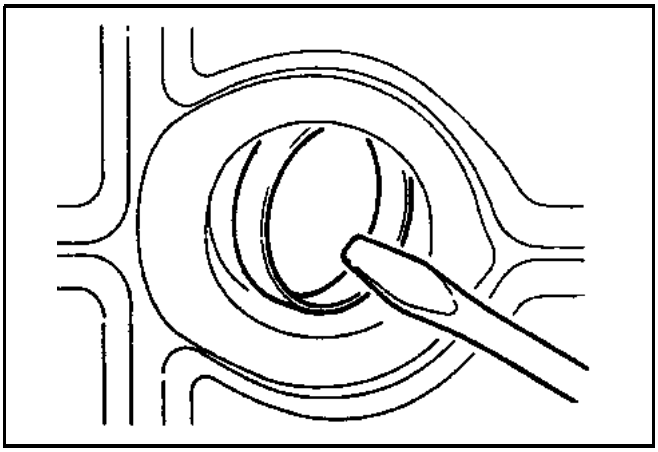
Preceding Work: Draining of the coolant



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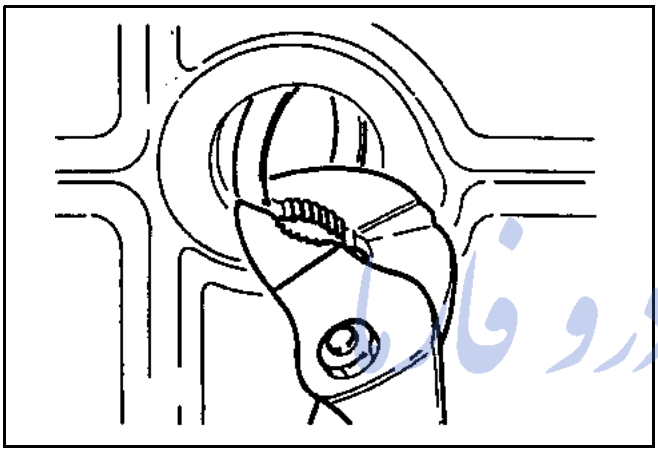
1 Core Plug . . . . . Replace

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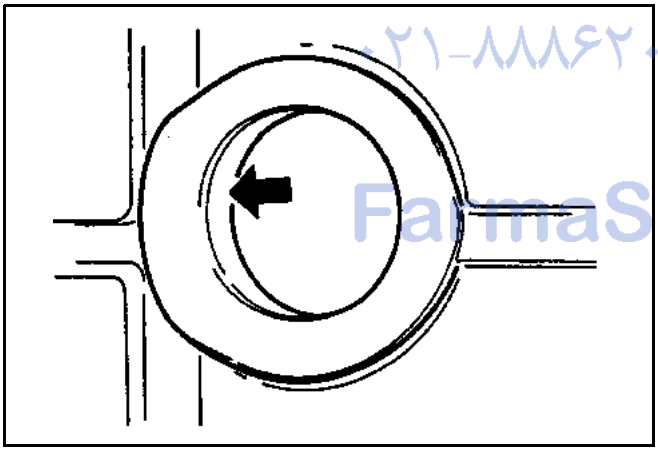


Replacement Procedure

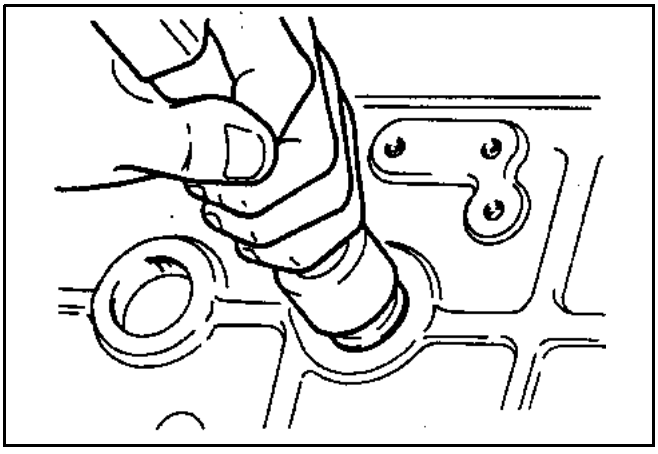
1. Remove the intake and exhaust manifolds.
2. Pull back the core plug until the end of one side comes out using the screw driver.



3. Pull out the plug carefully using a pliers.



4. Clean the sealing surface and apply Loctite 241.



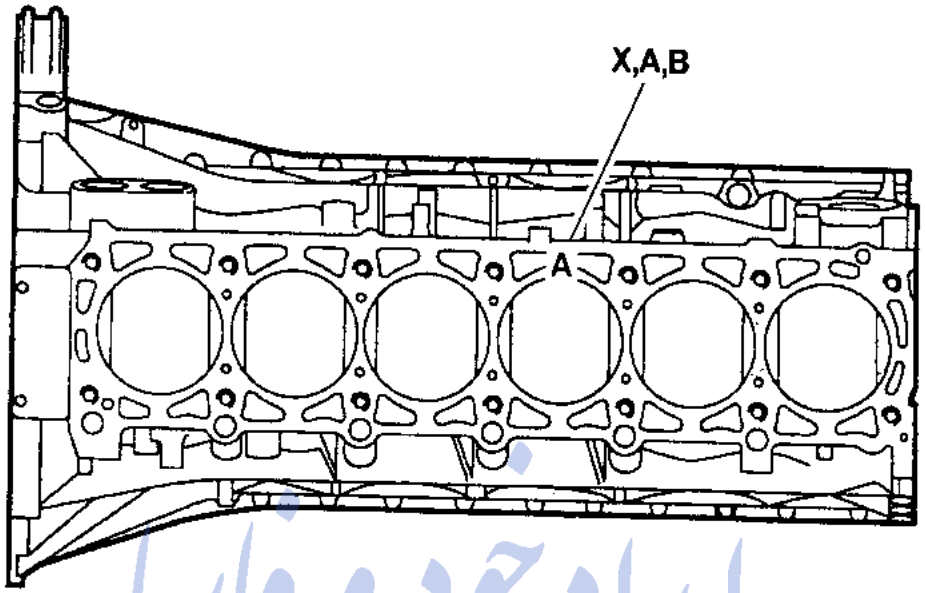
5. Press in new plug using a drift.

Notice: Wait for about 45minutes before filling the coolant so that the Loctite 240 hardens.

6. Warm up the engine and check the coolant for leaks.

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CYLINDER BORE



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Group Code Letter and Cylinder Bore Size

Group Code Letter of Cylinder	Piston Type to be Used	Cylinder Bore Size (mm)
A	A or X	ϕ 89.900 - ϕ 89.906
X	A, X or B	ϕ 89.906 - ϕ 89.912
B	X or B	ϕ 89.912 - ϕ 89.918
X + 5	X + 5	ϕ 89.950 - ϕ 89.968
X + 10	X + 10	ϕ 90.000 - ϕ 90.018

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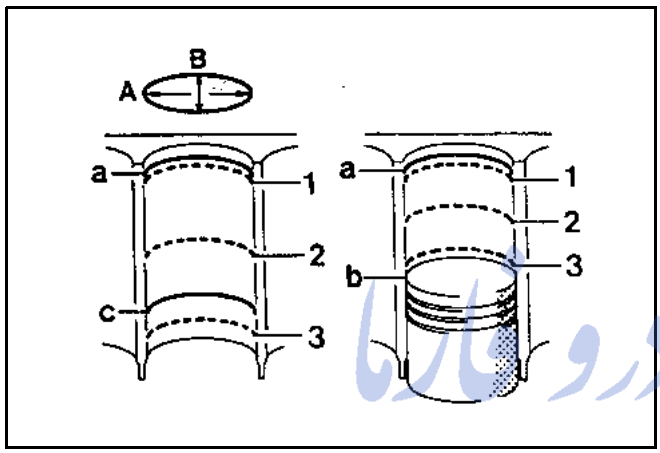
Repair Size

Type	Group Code Letter 1)	Cylinder Bore Size (mm)
Standard Size ϕ 89.9	A	ϕ 89.900 - ϕ 89.906
	X	ϕ 89.906 - ϕ 89.912
	B	ϕ 89.912 - ϕ 89.918
1st Repair Size (Standard Size + 0.25)	A	ϕ 90.150 - ϕ 90.156
	X	ϕ 89.156 - ϕ 90.162
	B	ϕ 90.162 - ϕ 90.168
2nd Repair Size (Standard Size + 0.5)	A	ϕ 90.400 - ϕ 90.406
	X	ϕ 90.406 - ϕ 90.412
	B	ϕ 90.412 - ϕ 90.418

1) The group code letters are carved on the surface of the piston crown and in the mating surface of the crankcase.

Service Data Standard

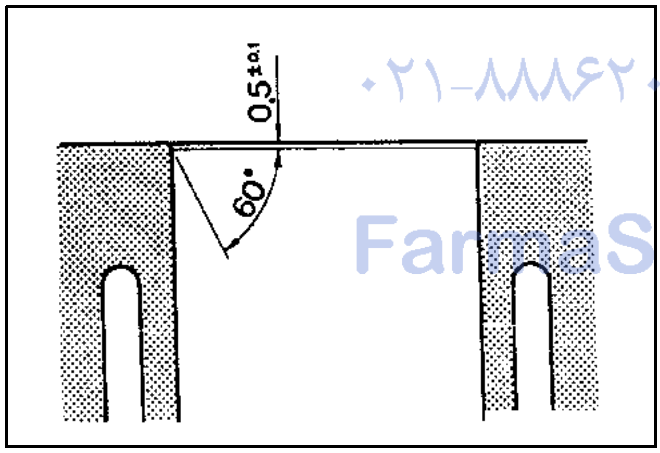
Wear Limit in Longitudinal and Transverse Direction		0.1 mm
Permissible Deviation of Cylinder Out-of-round	When new	0.007 mm
	Wear limit	0.05 mm
Permissible Deviation of Rectangular Cylinder Height (Except Chamfered Area)		0.05 mm
Basic Peak-to-valley Height After Final Honing and Brushing		0.003 - 0.006 mm
Chamfer Angle		60°
Honing Angle		50° ± 10°



Measurement of Cylinder Bore

1. Clean the cylinder wall.
2. Using a internal diameter gauge, measure the bore size in axial and transverse direction at three points (1,2,3).

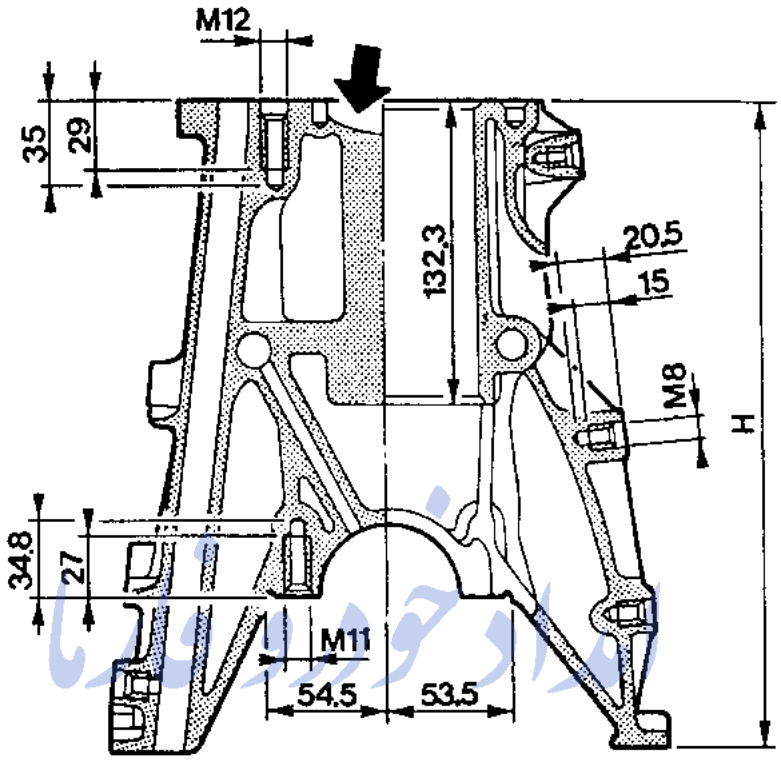
1,2,3. Measuring Points
- A. Axial Direction
- B. Transverse Direction
- a. Location of the No.1 Piston Ring at TDC
- b. Location of the Piston BDC
- c. Location of the Oil Ring at BDC



Chamfer Angle

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CRANKCASE MATING SURFACE

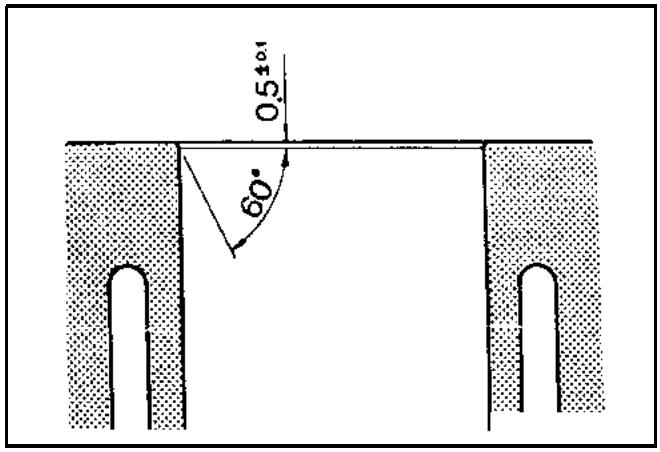


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Service Data Standard

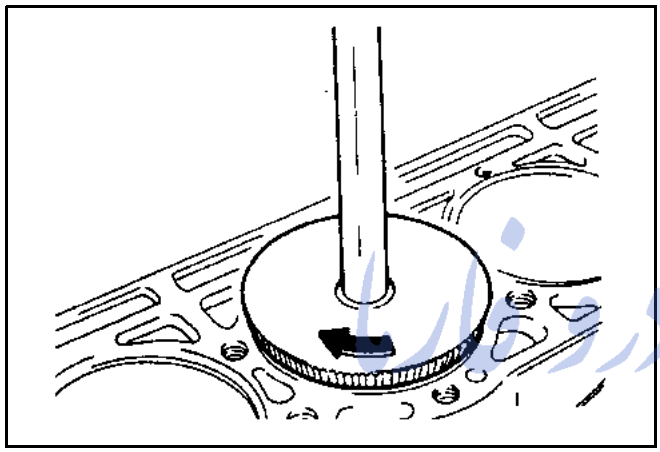
Height of The Crankcase 'H' (When new)		282.25 - 282.35mm
Minimum Height After Milling		281.95mm
Flatness	Crankcase Upper Mating Surface	0.03mm
	Crankcase Lower Mating Surface	0.04mm
Permissible Deviation of Parallelism of The Upper to Lower Mating Surface	Axial Direction	0.1mm
	Transverse Direction	0.05mm
Peak-to-valley Height	Crankcase Upper Mating Surface	0.005 - 0.020mm
	Crankcase Lower Mating Surface	0.025mm

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Chamfering Procedure

1. Chamfer angle : 60°

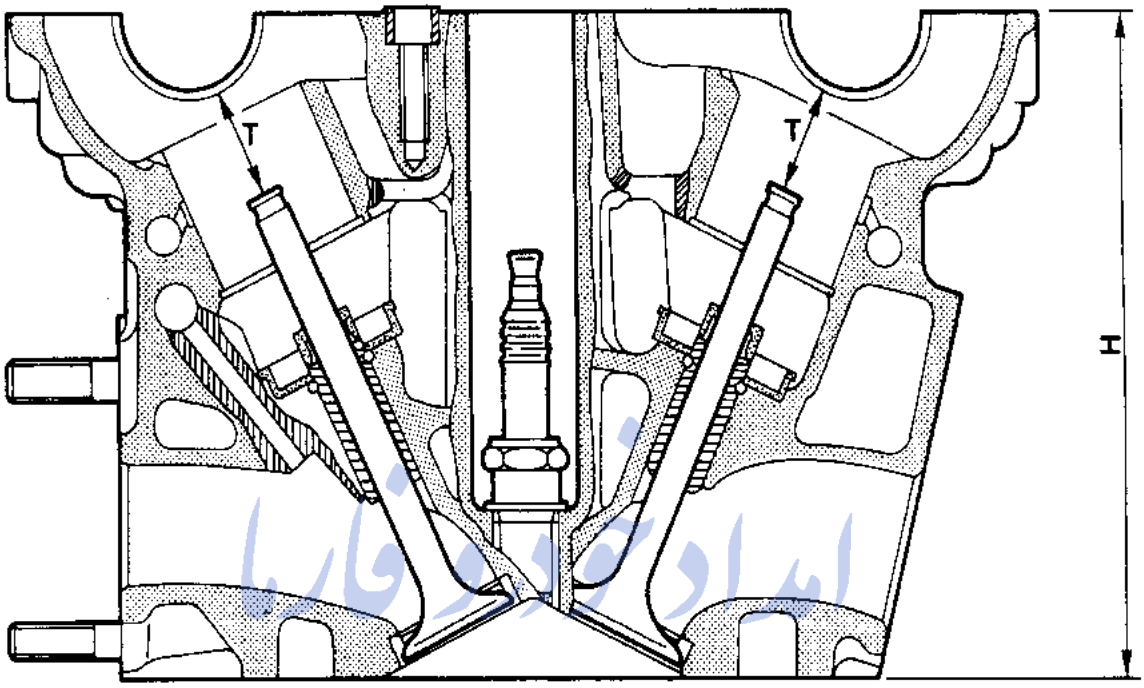


2. Polish the lower chamfered area evenly with a grinder after finishing the chamfering with a suitable tool (e.g., hand milling cutter).

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CYLINDER HEAD MATING SURFACE

Preceding Work: Removal of valves



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Service Data Standard

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Overall Height of Cylinder Head			135.9 - 136.0 mm
Minimum Height After Machining			135.5 mm
Flatness	Axial Direction		0.08 mm
	Transverse Direction		0.0 mm
Distance 'T' (Between Camshaft Bearing and Valve Stem)	Standard Size	Intake	24.21 - 24.75 mm
		Exhaust	22.21 - 22.75 mm
	Repair Size	Intake	23.96 - 24.51 mm
		Exhaust	21.96 - 22.51 mm

Notice: Do not exceed 0.4mm for the milling of the mating surface of crankcase and cylinder head.

SECTION 1D1

M162 ENGINE COOLING

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

Specifications 1D1-2
General Specifications 1D1-2
Fastener Tightening Specifications 1D1-2
Special Tools 1D1-3
Special Tools Table 1D1-3
Diagnosis 1D1-4
System Leakage Test 1D1-4
Maintenance and Repair 1D1-5
On-Vehicle Service 1D1-5
Coolant Drain and Fill Up 1D1-5
Coolant Connection Fitting 1D1-7
Water Pump 1D1-8
Thermostat 1D1-10
Oil Cooler Pipe Line 1D1-11
Cooling Fan and Viscous Clutch 1D1-12
Cooling Fan Shroud 1D1-14
Radiator 1D1-15

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SPECIFICATIONS

GENERAL SPECIFICATIONS

Application		Description
Cooling Type		Water Cooling Forced Circulation
Radiator	Circulation Type	Double Cross Flow
	Radiation Capability	70,000 kcal/h
Dimension(Width x Height x Thickeness)		580 x 482 x 45 mm
Cooling Fan		ϕ 460, Six Blades
Anti-Freeze Agent		ALUTEC - P78
Mixing Ratio of Anti-Freeze Agen with Water (Anti-Freeze Agent : Water)		50 : 50
Coolant Capacity		11.3 L
Reservoir Capacity		3.4 L
Cap Operating Pressure (Reservoir Tank Pressure Cap)		1.4 bar

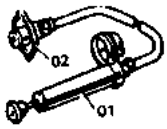
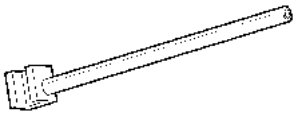
FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Coolant Drain Plug	30	22	-
Engine Hanger Bracket and Coolant Outlet Port Bolt	22.5 - 27.5	16.6 - 20.3	-
Thermostat Cover Bracket Bolts	9 - 11	-	80 - 97
Oil Cooler Pipe Line Bolts	9 - 11	-	80 - 97
Cooling Fan Bolts	9 - 11	-	80 - 97
Viscous Clutch Mounting Bolts	40.5 - 49.5	29.8 - 36.5	-
Automatic Transmission Fluid Cooler Pipe	20	15	-
Cooling Fan Shroud Bolts	3 - 7	-	27 - 62
Automatic Transmission Radiator Tube Assembly Mounting Bolt	7	-	62
Radiator Bracket Mounting Bolts	3 - 7	-	27 - 62

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SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS TABLE

	**124 589 15 21 00** **Tester**		**603 589 00 40 00** **Fan Clutch Holder**

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DIAGNOSIS

SYSTEM LEAKAGE TEST

Tools Required

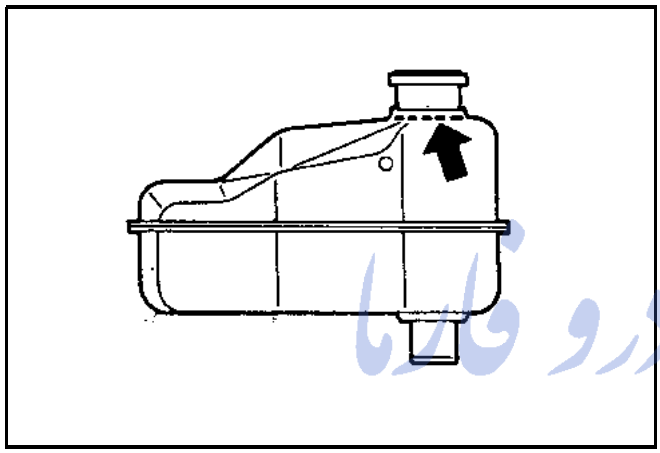
124 589 15 21 00 Tester

Test Procedure

1. Loosen the cap a little and release pressure and remove the cap.

Notice: For the risk of scalding, cap must not be opened unless the coolant temperature is below 90°C.

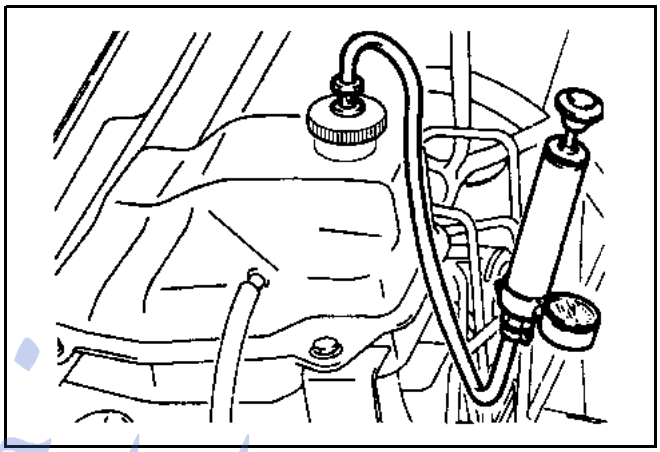
2. Fill coolant up to upper edge (arrow) of reservoir.



3. Connect the special tool to the reservoir filler cap and apply 1.4 bar of pressure.

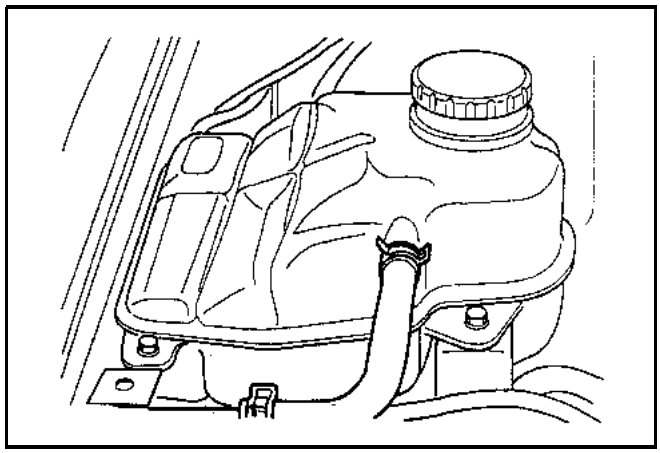
Tester 124 589 15 21 00

4. If the pressure on the tester drops, check leakage at the all coolant hoses and pipes and each connections. Replace or retighten if necessary.



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MAINTENANCE AND REPAIR



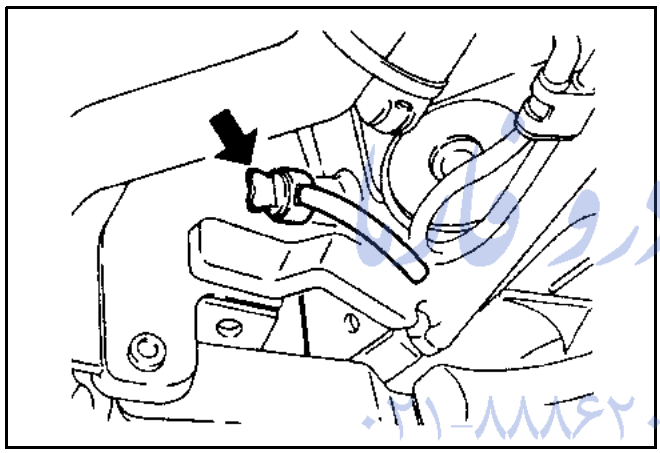
ON-VEHICLE SERVICE

COOLANT DRAIN AND FILL UP

Draning & Filling up Procedure

1. Loosen the cap a little and release pressure and remove the cap.

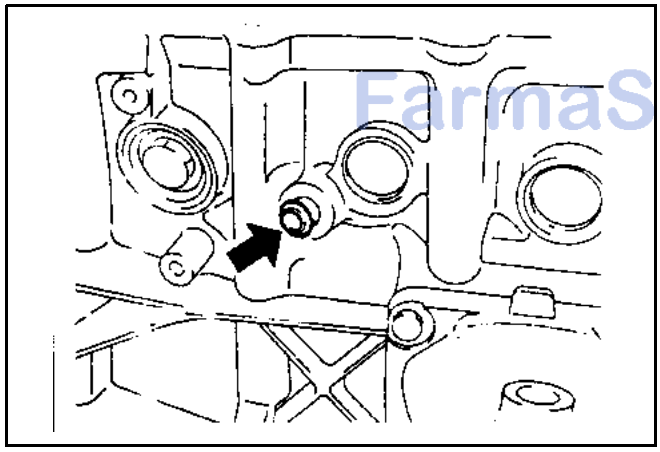
Notice: For the risk of scalding, the cap must not be opened unless the coolant temperature is below 90°C.



2. Loosen the radiator lower drain cock and drain the coolant.

Notice: Collect the coolant by using a proper container.

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3. Drain the coolant from the crankcase by inserting a hose (dia. 14mm) onto the drain bolt on the side of crankcase (exhaust manifold) and by loosening the plug.

Notice

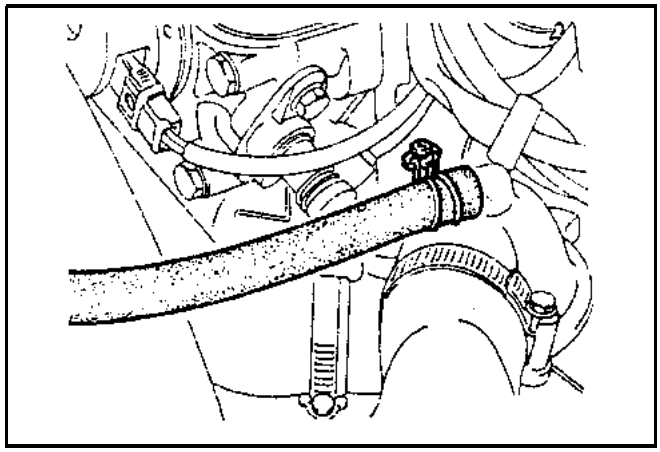
- Just loosen the drain plug to drain the coolant and do not remove the plug completely.
- Collect the coolant by using the proper container.

4. After complete draining of the coolant, remove the hose connector to drain plug and reinstall the drain plug.

Installation Notice

Tightening Torque	30 N•m (22 lb-ft)

5. Tighten the radiator lower drain cock.



6. Remove the de-aeration hose clamp in the coolant pump and remove the de-aeration hose.
7. Fill up the coolant through the coolant reservoir tank.

Notice

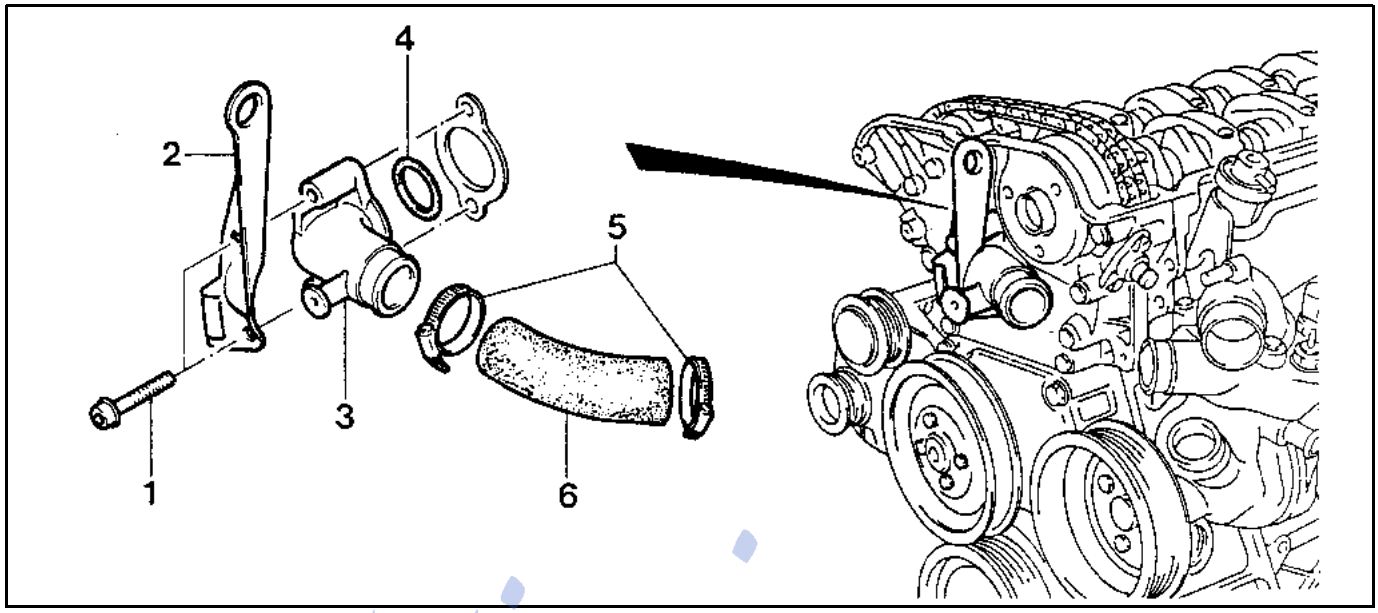
- Match the anti-freeze and the water ratio to 50 : 50.
- Supplement the coolant until the coolant overflows to the deaeration hose.

8. Insert the de-aeration hose and completely tighten the clamp.
9. Check the coolant level in the coolant reservoir tank.
10. Warm up(until thermostat is opened) the engine and recheck the coolant level in the reservoir tank and fill up the coolant if necessary.

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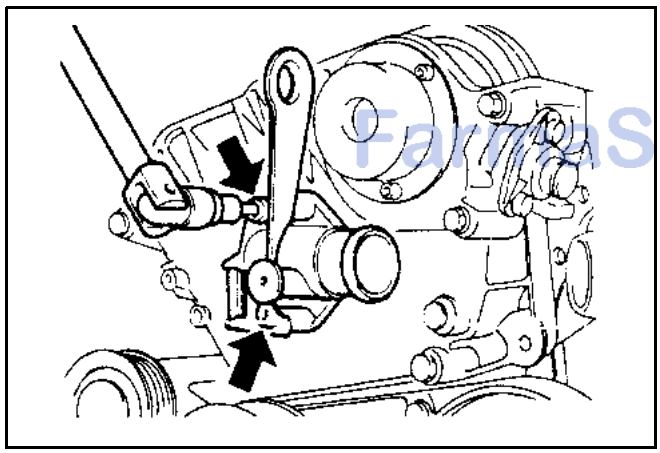
COOLANT CONNECTION FITTING

Preceding Work: Removal of cooling fan shroud



1 Bolt (M8 X 100, 2 pieces)
. . . . . 22.5-27.5 N•m (16.6-20.3 lb-ft)
2 Engine Hanger Bracket
3 Coolant Outlet Port
4 O-ring
5 Hose Mounting Clamp
6 Hose

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Removal & Installation Procedure

1. Drain coolant from the radiator.
2. Remove the hose mounting clamp (5) and disconnect the coolant hose (6).
3. Remove the two bolts (1), the engine hanger bracket (2) and coolant outlet port (3).

Installation Notice

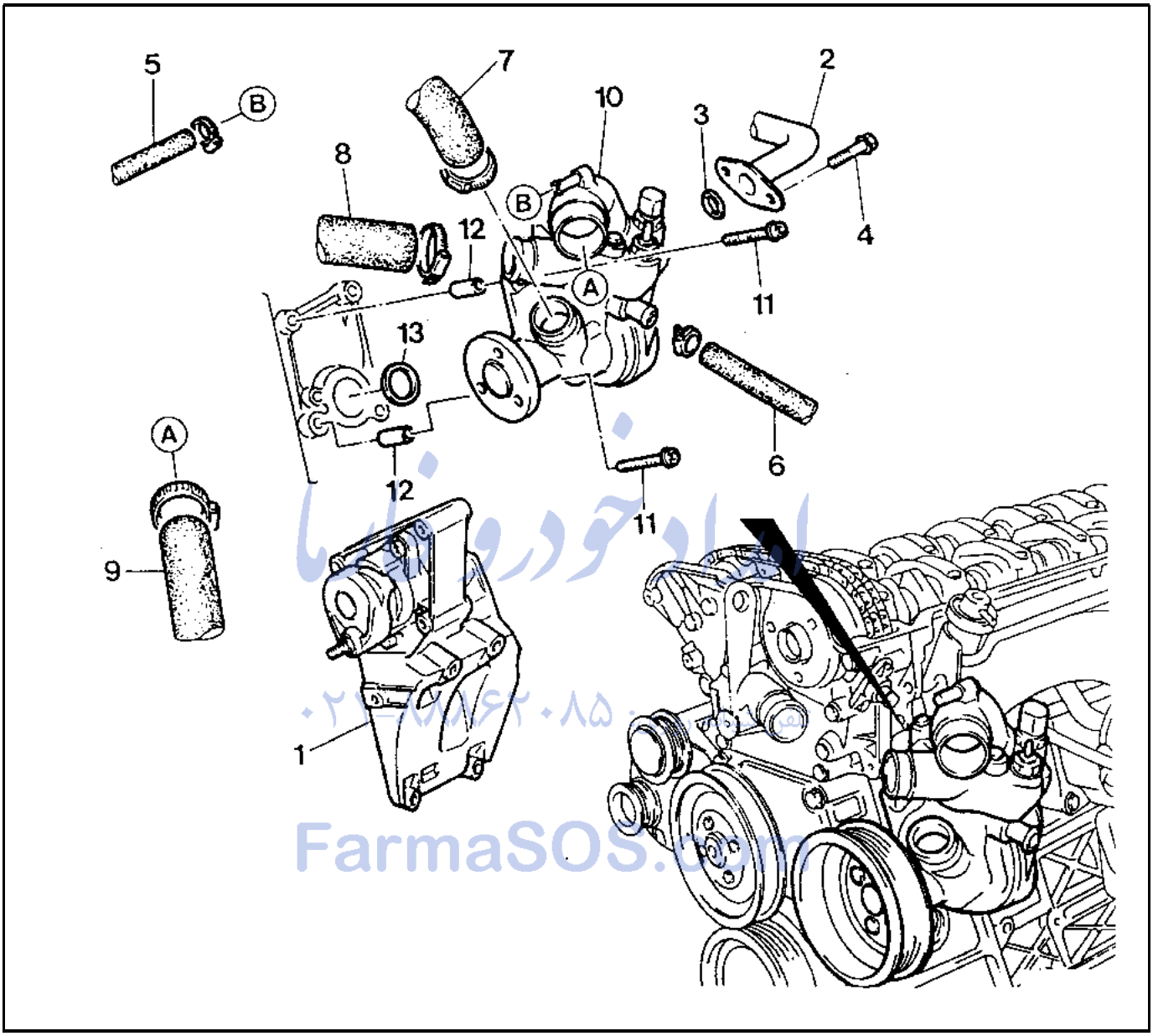
Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)

Replace the O-ring with new one.

4. Installation should follow the removal procedure in the reverse order.
5. Fill up the coolant as specified.
6. Check the leaks in the cooling system.

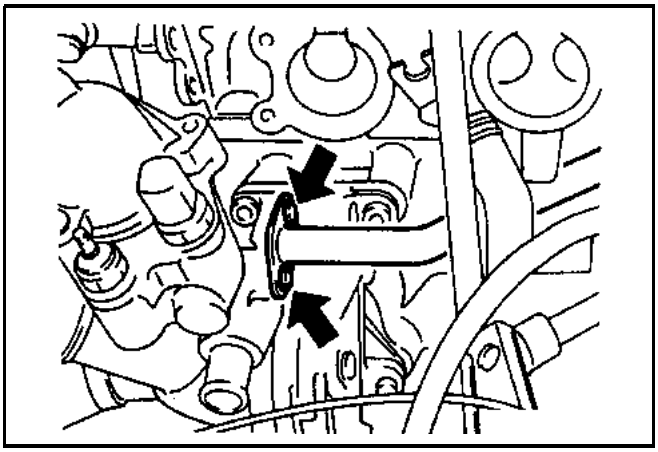
WATER PUMP

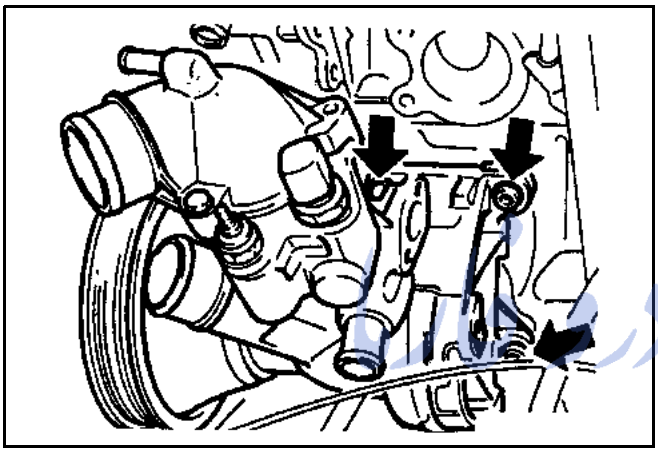
Preceding Work: Removal of V-belt
Removal of air admission housing



1 Air Admission Housing
2 Oil Cooler Pipe Line
3 Seal ..... Replace
4 Bolt ..... 9-11 N•m (80-97 lb-in)
5 Coolant Hose
6 Coolant Hose
7 Outlet Coolant Hose
8 Coolant Hose
9 Inlet Coolant Hose
10 Water Pump
11 Bolt ..... 21 N•m (15 lb-ft)
12 Dowel Sleeve
13 Seal ..... Replace

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Removal & Installation Procedure

1. Drain the coolant.
2. Disconnect the water pump wire connector.
3. Loosen the hose clip and dsconnect all hoses from the water pump.
4. Remove the oil cooler pipe line bolts (4) and then remove the coolant line (2).

   Installation Notice

Tightening Torque	9 - 11 N•m (80 - 97 lb-in)

Notice: Replace the seal (3).

5. Remove the mounting bolts (11) and carefully pull out water pump (10).

   Installation Notice

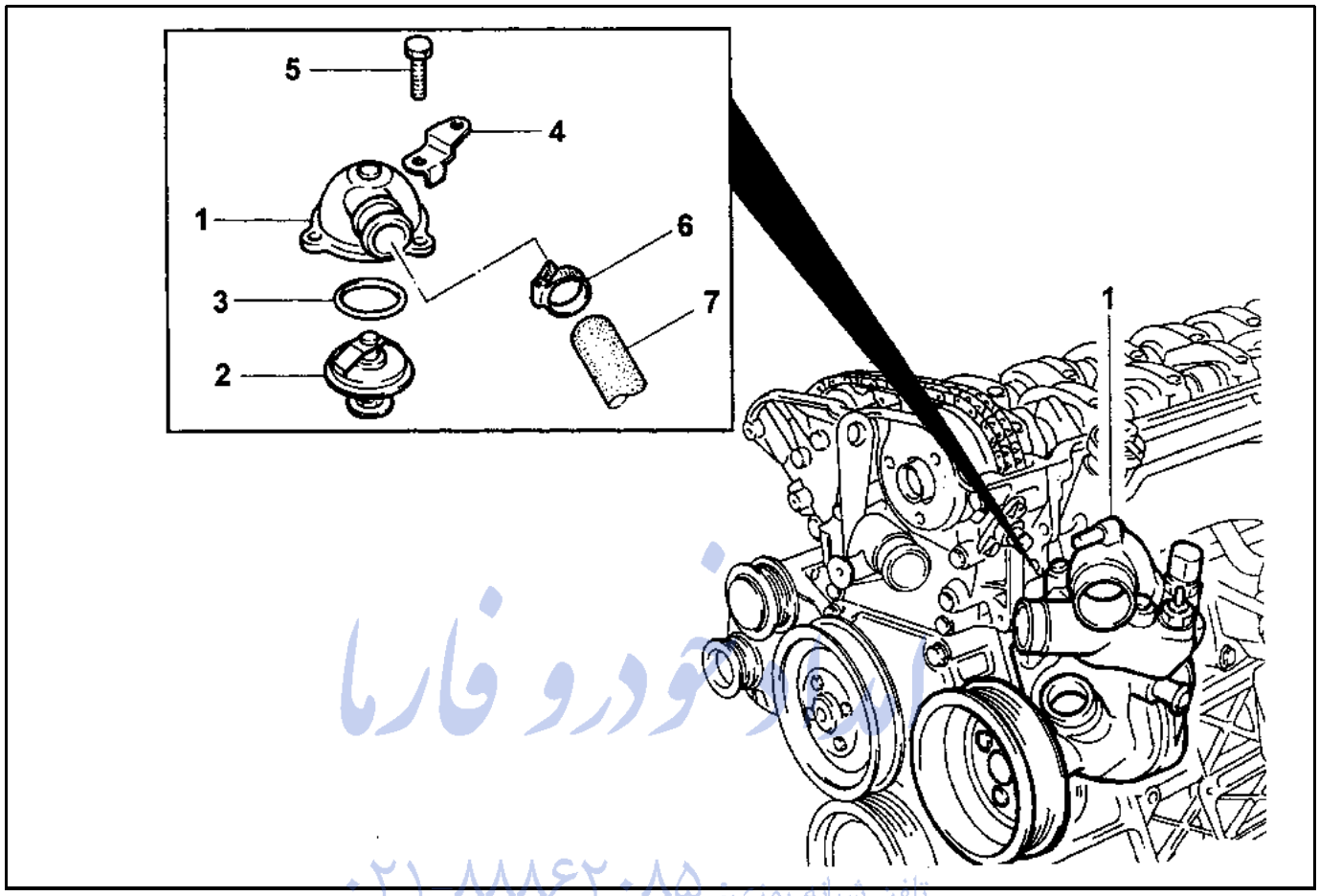
Tightening Torque	21 N•m (15 lb-ft)

Notice: Replace the seal (13).

6. Installation should follow the removal procedure in the reverse order.
7. Fill up coolant.
8. Do coolant system leakage test.

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۰۲۱-۸۸۸۶۲۰۸۵
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THERMOSTAT



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1 Thermostat Cover
2 Thermostat
3 O-ring
4 Thermostat Cover Bracket
5 Bolt (M6 X 25, 3 pieces)
. . . . . 9-11 N•m (80-97 lb-in)
6 Hose Mounting Clamp
7 Heater Hose

Removal & Installation Procedure

1. Drain the coolant from the radiator.
2. Loosen the hose mounting clamp (6) and remove the heater hose (7).
3. Unscrew the three bolts (5) and remove the thermostat cover bracket, thermostat cover and the thermostat in order.

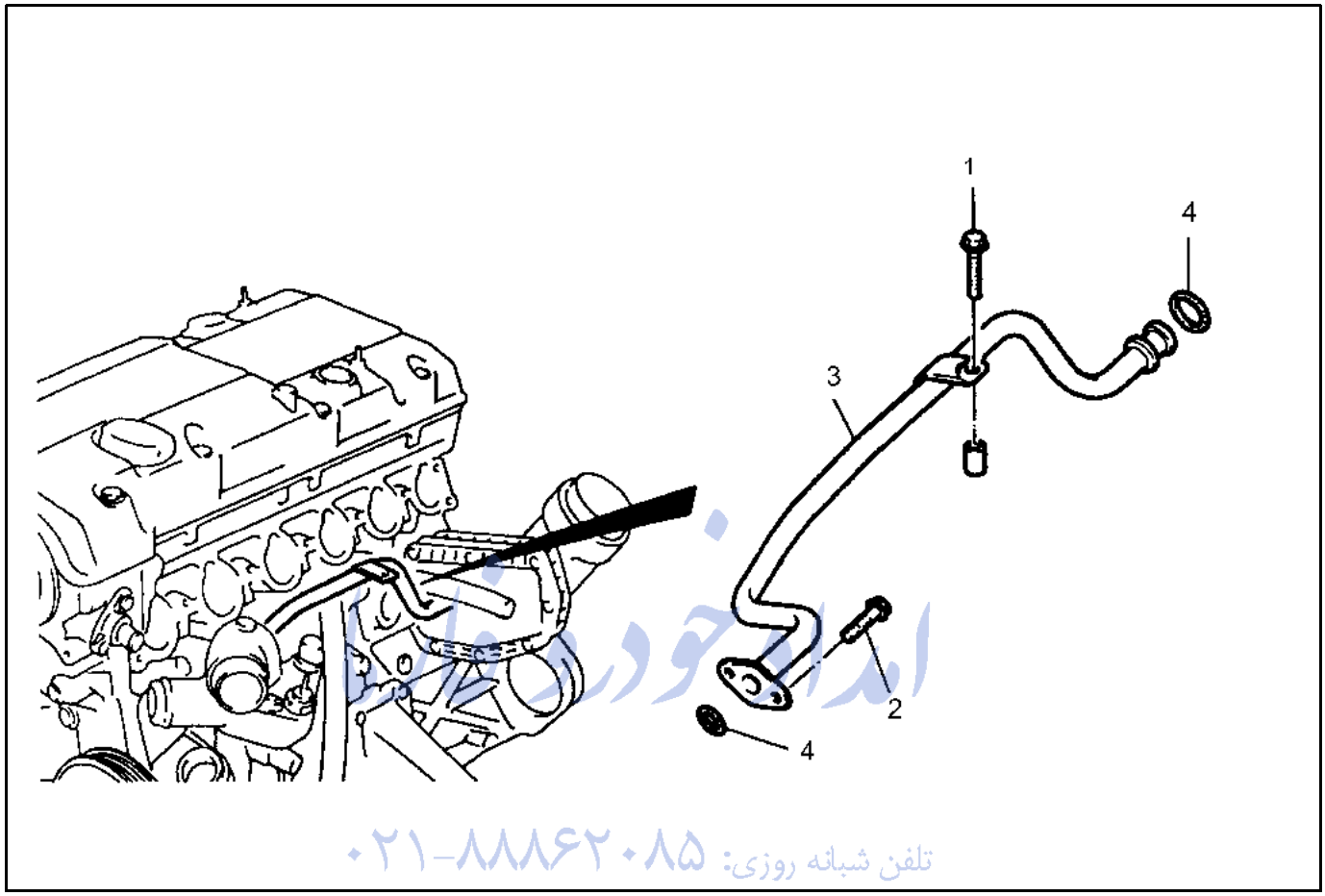
   Installation Notice

Tightening Torque	9 - 11 N•m (80 - 97 lb-in)

   Do not separate the thermostat cover and thermostat.
4. Replace the O-ring if necessary.
5. Check the leakage in the cooling system.

OIL COOLER PIPE LINE

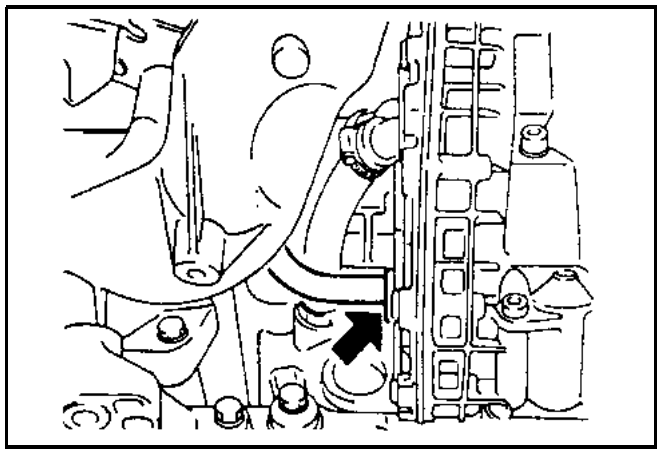
Preceding Work: Removal of intake air duct



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1 Bolt (M6 X 35, 1 piece) ..... 9-11 N•m (80-97 lb-in)
2 Bolt (M6 X 16, 2 pieces) ..... 9-11 N•m (80-97 lb-in)
3 Oil Cooler Pipe Line
4 O-ring ..... Replace

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Removal & Installation Procedure

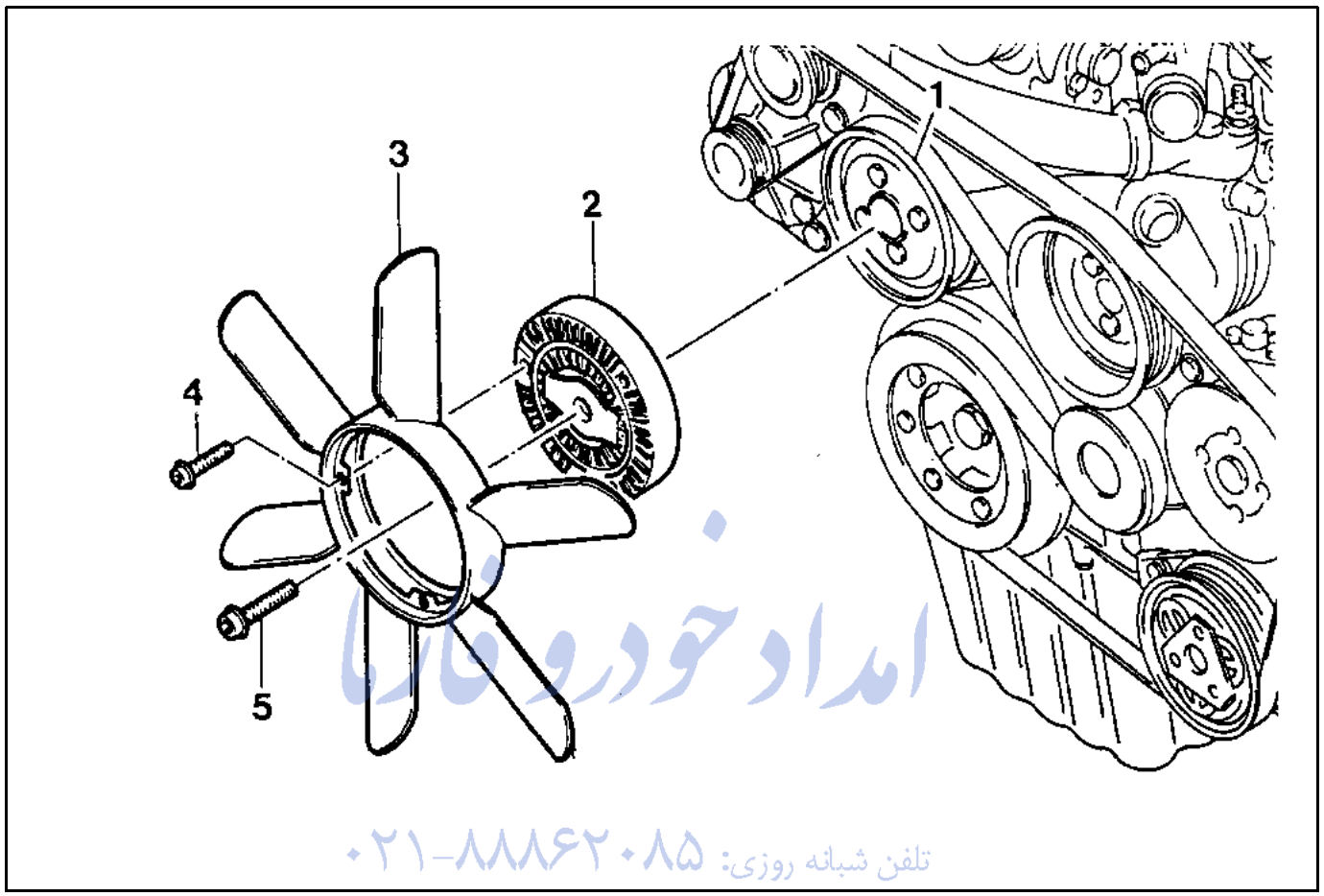
1. Drain the coolant.
2. Unscrew the bolts (1, 2) and remove the oil cooler pipe line (3).
   Replace the O-ring with new one.
   Installation Notice

Tightening Torque	9 - 11 N•m (80 - 97 lb-in)

3. Installation should follow the removal procedure in the reverse order.
4. Fill up the coolant as specified.
5. Check the leaks in the cooling system.

COOLING FAN AND VISCOUS CLUTCH

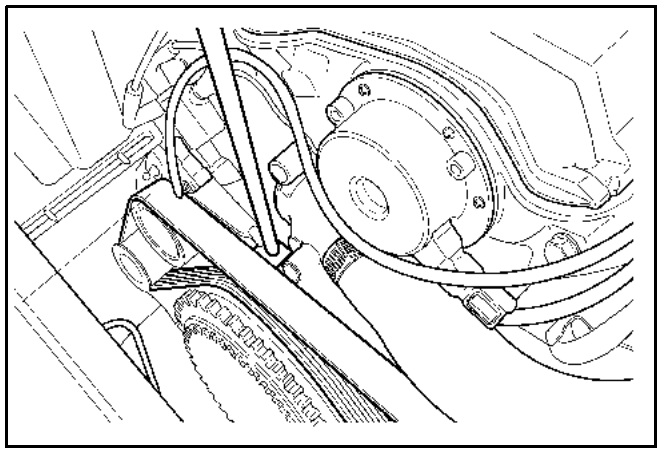
Preceding Work: Removal of cooling fan shroud



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1 Cooling Fan Pulley
2 Viscous Clutch
3 Cooling Fan
4 Bolt (M6 X 12, 4 pieces) . . . . . 9-11 N•m (80-97 lb-in)
5 Bolt (M10 X 45, 1 piece) . . . . . 40.5-49.5 N•m (29.8-36.5 lb-ft)

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Tools Required

603 589 00 40 00 Fan Clutch Holder

1. Remove the engine hanger bracket bolts.

Installation Notice

Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)

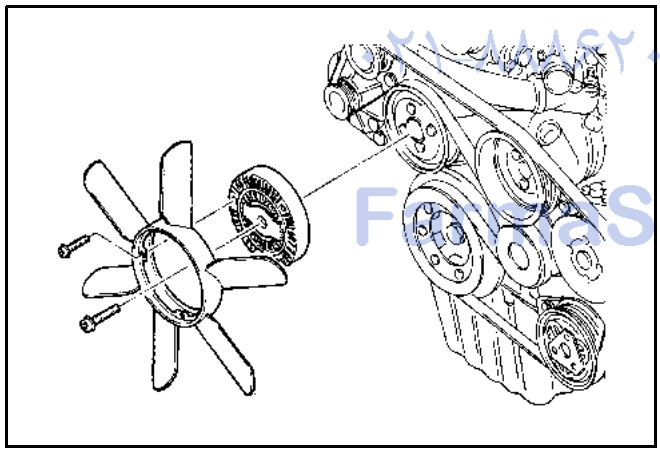
2. Remove the engine hanger bracket.
3. Remove the cooling fan bolts.

Installation Notice

Tightening Torque	9 - 11 N•m (80 - 97 lb-in)

4. Hold the cooling fan pulley using the fan clutch holder 603 589 00 40 00.

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5. Remove the viscous clutch mounting bolts and viscous clutch.

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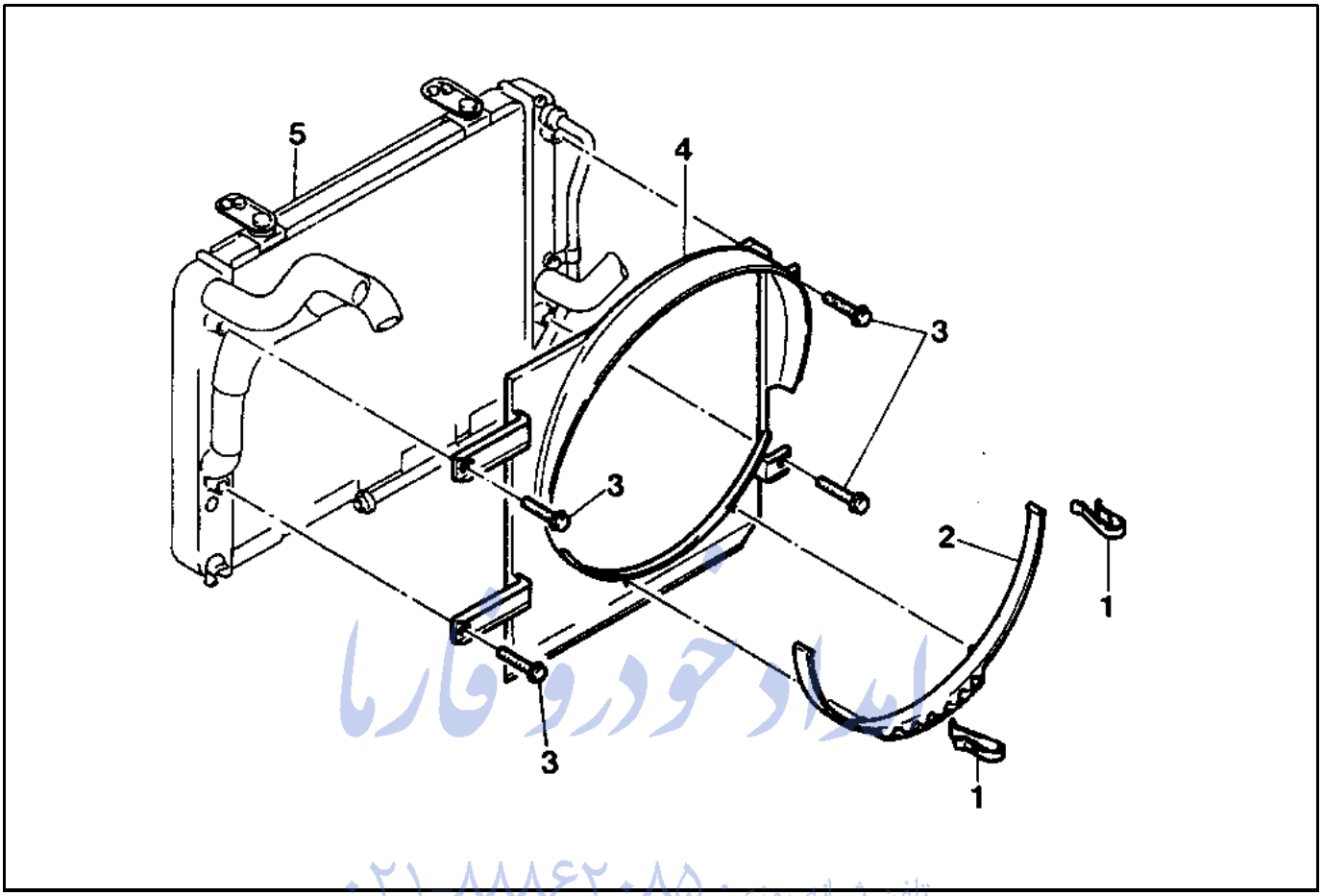
Installation Notice

Tightening Torque	40.5 - 49.5 N•m (29.8 - 36.5 lb-ft)

Important: There are two chambers in the viscous clutch. Be sure to make the viscous clutch stand on the ground not to flow silicone oil into another chamber in the viscous clutch. Do not lay down the clutch.

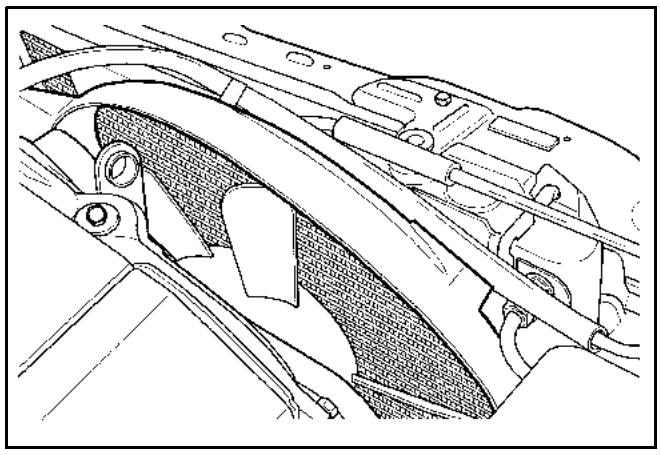
6. Installation should follow the removal procedure in the reverse order.

COOLING FAN SHROUD



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1 Clip
2 Lower Fan Shroud
3 Bolt
4 Fan Shroud Assembly
5 Radiator



Removal & Installation Procedure

1. Pull out the 2 clips (1) from the fan shroud assembly.
2. Remove the lower fan shroud (2).

Notice: For installation, exactly align the lower fan shroud pin into the hole of the fan shroud assembly (4) and insert the clips.

3. Remove the bolts (3) and then remove the cooling fan shroud assembly (4).

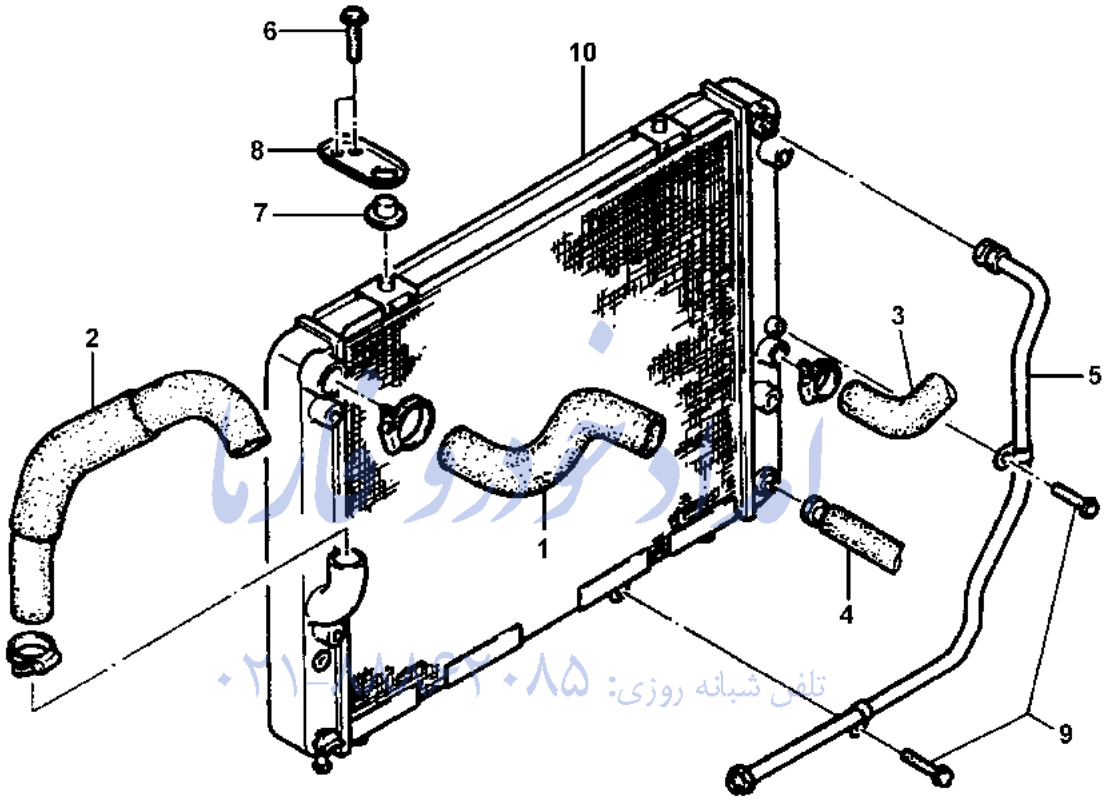
Installation Notice

Tightening Torque	3 – 7 N•m (27 – 62 lb-in)

4. Installation should follow the removal procedure in the reverse order.

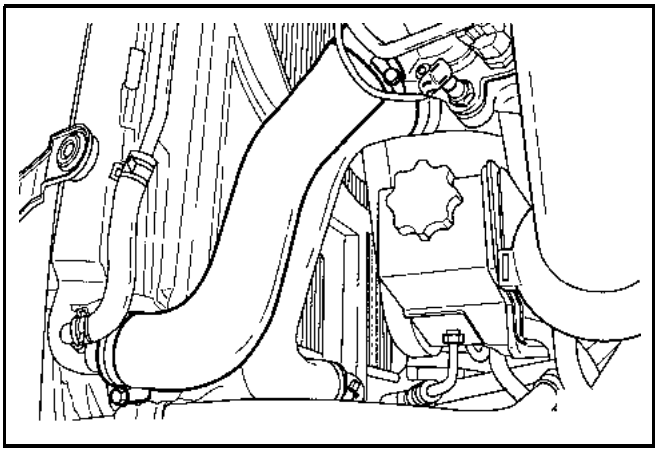
RADIATOR

Preceding Work: Removal of cooling fan shroud



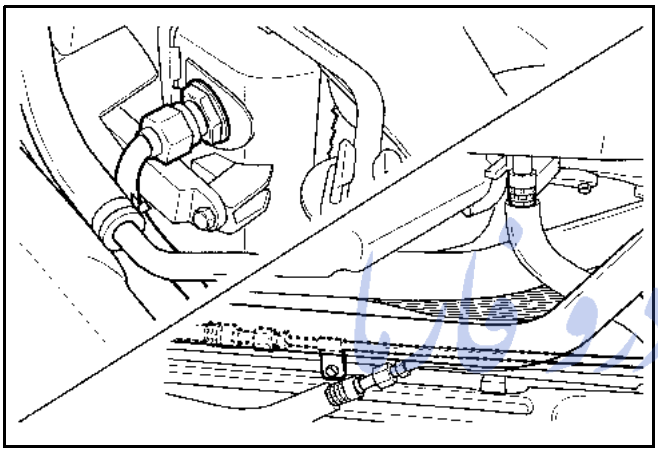
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1 Radiator Inlet Coolant Hose
2 Radiator Outlet Coolant Hose
3 Make Up Coolant Hose
4 Automatic Transmission Oil Cooling Line
5 Automatic Transmission Oil Cooling Line
4 Bolt . . . . . 3-7 N•m (27-62 lb-in)
7 Insulator
8 Stopper
4 Bolt . . . . . 7 N•m (62 lb-in)
10 Radiator



Removal & Installation Procedure

1. Drain coolant from the radiator.
2. Remove the coolant thermo connector from the radiator.
3. Remove the each coolant hoses.



4. Remove the upper and lower automatic transmission fluid cooler pipes from radiator.

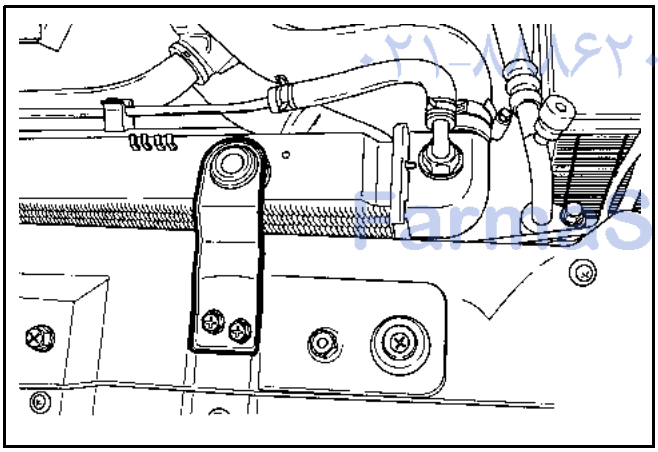
Installation Notice

Tightening Torque	20 N•m (15 lb-ft)

5. Remove the mounting bolt (9) from the automatic transmission radiator tube assembly (5) and then disconnect the tube assembly (5).

Installation Notice

Tightening Torque	7 N•m (62 lb-in)



6. Remove the mounting bolt (6) on the radiator bracket (8) and take off the bracket (8) and insulator (7).

Installation Notice

Tightening Torque	3 – 7 N•m (27 – 62 lb-in)

7. Remove the radiator (10).
8. Check the radiator pin for crack, damage, leakage and bending and replace it if necessary.
9. Installation is reverse order of removal.
10. Check for leakage in the cooling system.

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SECTION 1E1

M162 ENGINE ELECTRICAL

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

Specifications 1E1-2
Generator Specifications 1E1-2
Starting Motor Specifications 1E1-2
Battery Specifications 1E1-2
Fastener Tightening Specifications 1E1-2
Maintenance and Repair 1E1-3
On-Vehicle Service 1E1-3
Generator 1E1-3
Starting Motor 1E1-4
Battery 1E1-5
Spark Plug 1E1-6
Ignition Cable 1E1-8
Unit Repair 1E1-11
Battery 1E1-11

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SPECIFICATIONS

GENERATOR SPECIFICATIONS

Application	Description
Current	115 A
Output Voltage	12 - 14 v
Resistance Between Rotor Core and Slip Ring	∞ Ω

STARTER SPECIFICATIONS

Application	Description
Output Power	1.8 kw
Voltage	12 v

BATTERY SPECIFICATIONS

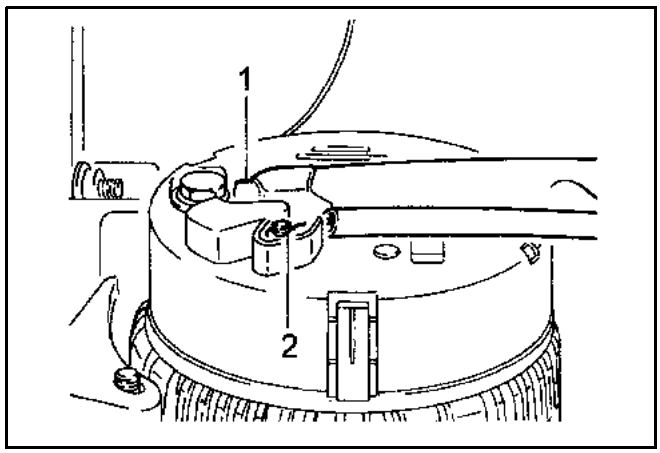
Application	Description
Capacity	90 AH
Max. Tolerance Between Cells	≥ 0.04
Specific Gravity	≥ 1.24

FASTER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Generator Terminal B+Nut	14 - 18	10 - 13	-
Generator Terminal D+Nut	4 - 5	-	35 - 44
Generator Mounting Bolt	25	18	-
Battery Cable Nut on Starting Motor	12 - 15	9 - 11	-
Electric Wire Nut on Starting Motor	6 - 7	-	53 - 62
Starting Motor Mounting Bolt	35 - 48	26 - 35	-
Battery Mounting Bracket Nut	12 - 18	9 - 13	-
Battery Negative Cable	12 - 18	9 - 13	-
Battery Positive Cable	12 - 18	9 - 13	-
Spark Plug Cover Bolt	9 - 11	-	80 - 97
Ignition Cable Bolt	9 - 11	-	80 - 97
Spark plug	20 - 30	15 - 22	-

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MAINTENANCE AND REPAIR



ON-VEHICLE SERVICE

GENERATOR

Preceding Work : Removal of the drivebelt

Removal & Installation Procedure

1. Disconnect the negative battery terminal.
2. Unscrew the nut and disconnect the terminal (1).

Installation Notice

Tightening Torque	14 - 18 N•m (10 - 13 lb-ft)

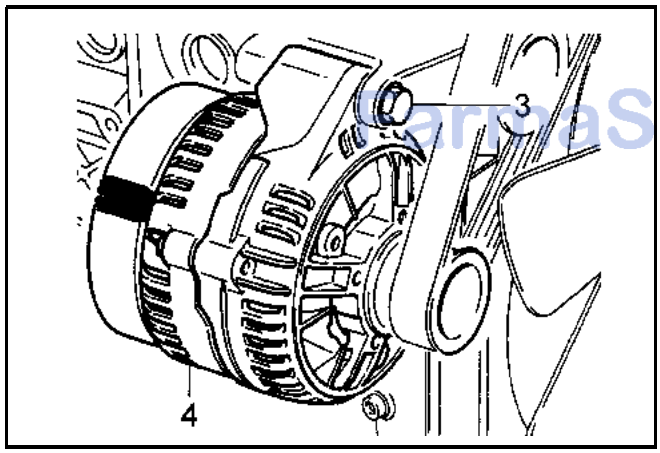
3. Unscrew the nut and disconnect the terminal (2).

Installation Notice

Tightening Torque	4 - 5 N•m (35 - 44 lb-in)

1 Terminal (B+)
2 Terminal (D+)

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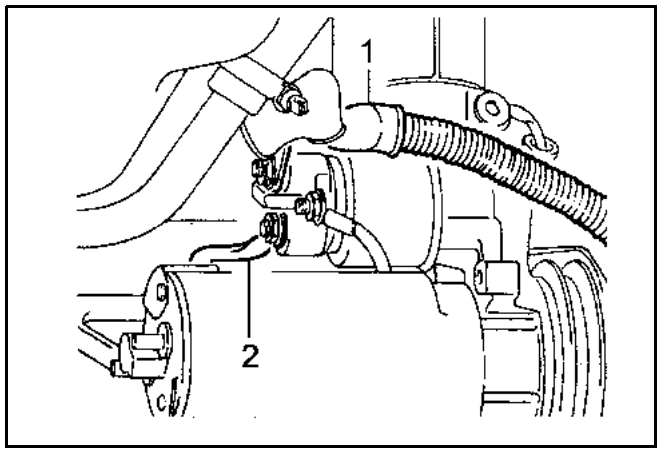
4. Unscrew the generator mounting bolt (3).

Installation Notice

Tightening Torque	25 N•m (18 lb-ft)

5. Remove the generator.
6. Installation should follow the removal procedure in the reverse order.

3 Generator Mounting Bolt
4 Generator



STARTING MOTOR

Removal & Installation Procedure

1. Disconnect the ground cable.
2. Unscrew the nut and disconnect the battery cable(1).

Installation Notice

Tightening Torque	12 - 15 N•m (9 - 11 lb-ft)

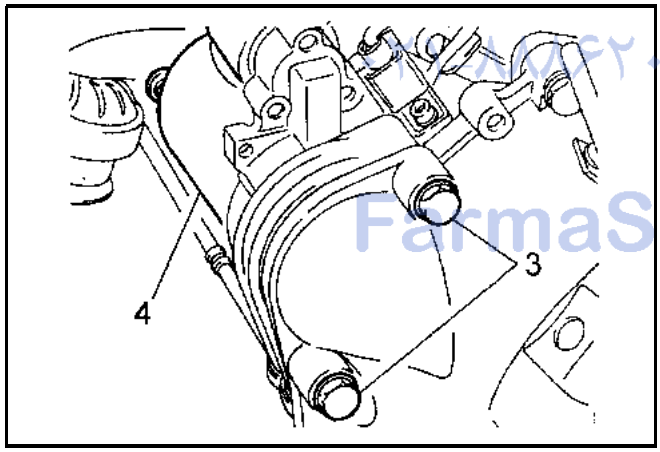
3. Unscrew the nut and disconnect the engine electric wire (2).

Installation Notice

Tightening Torque	6 - 7 N•m (53 - 62 lb-in)

1 Battery Cable
2 Engine Electric Wire

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4. Unscrew the mounting bolts (3) of starting motor.

Installation Notice

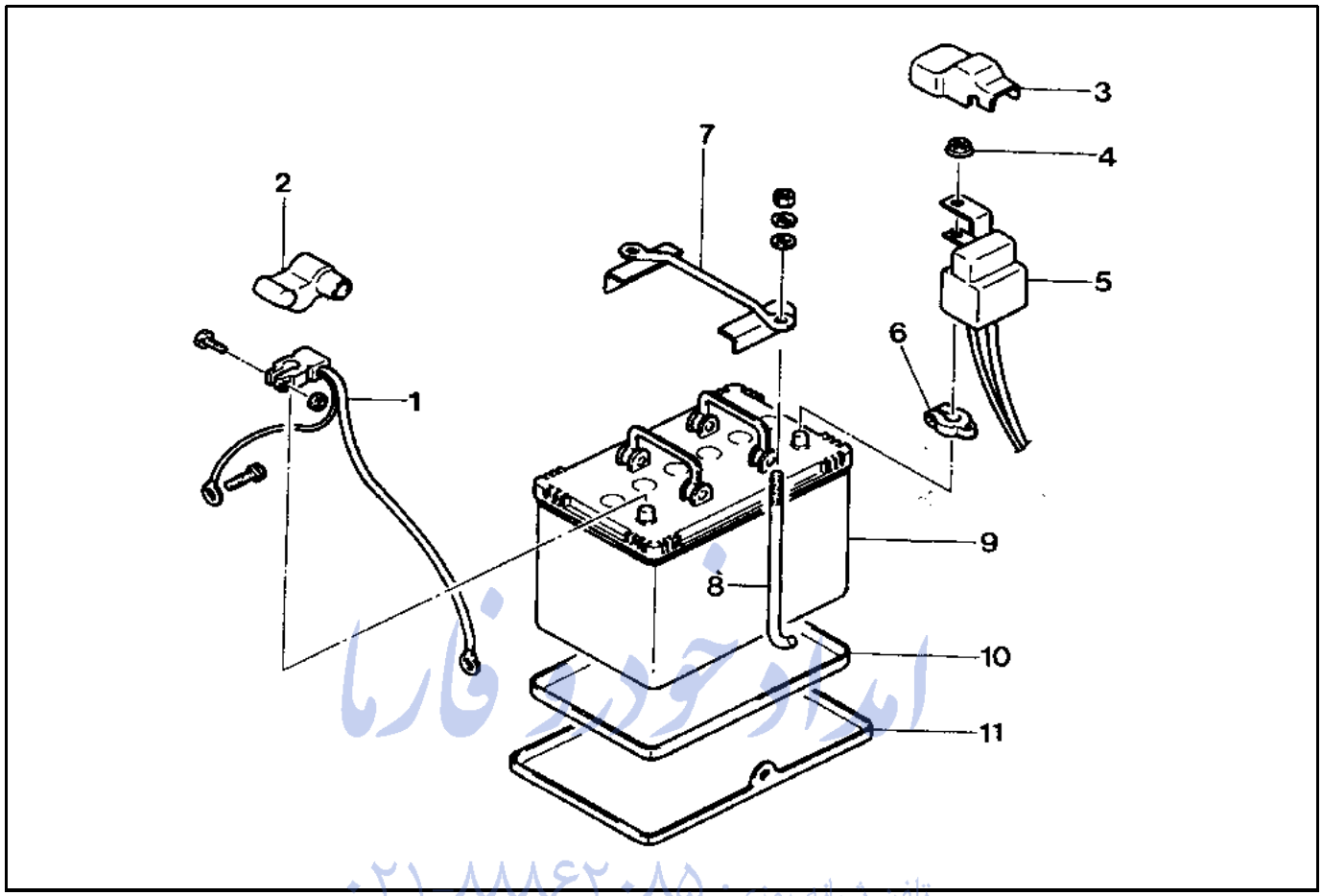
Tightening Torque	35 - 48 N•m (26 - 35 lb-ft)

5. Remove the starting motor.
6. Installation should follow the removal procedure in the reverse order.

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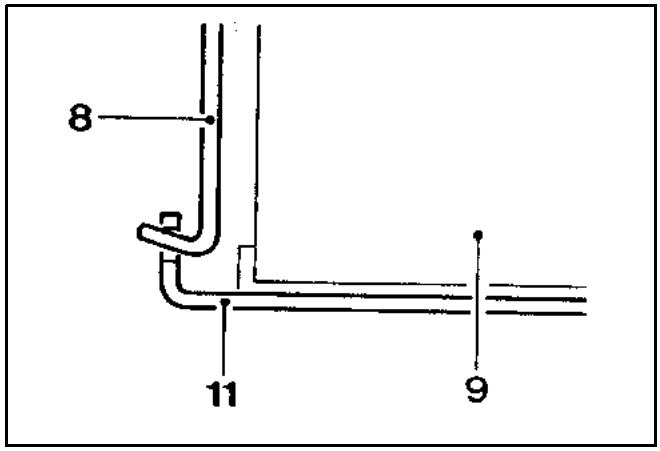
3 Fixing Bolt
4 Starting Motor

BATTERY



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1 Cable Terminal (-)
2 Cable Terminal Cap (-)
3 Cable Terminal Cap (+)
4 Nut
5 Fuseblink Box
6 Terminal (+)
7 Battery holddown Bracket
8 Battery Clamp Bolt
9 Battery
10 Sub Tray
11 Battery Tray



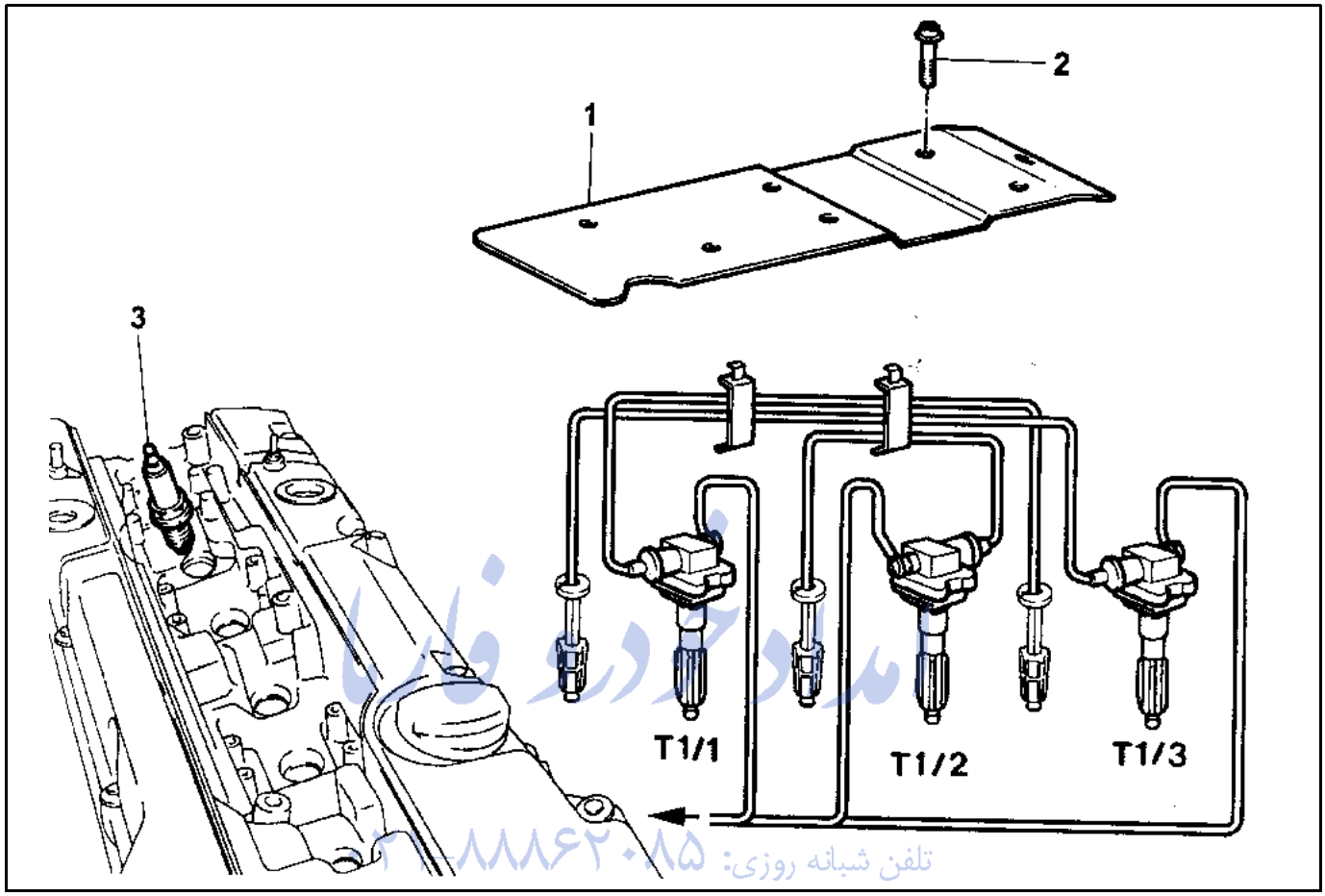
Removal & Installation Procedure

Notice

- Disconnect the battery negative cable first.
- Insert the clamp bolt (8) into the battery tray hole (11) from inside when installing.

SPARK PLUG

Preceding Work: Removal of intake air duct

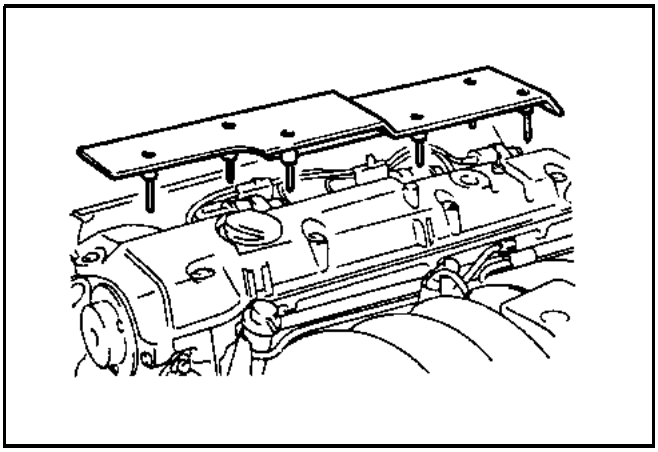


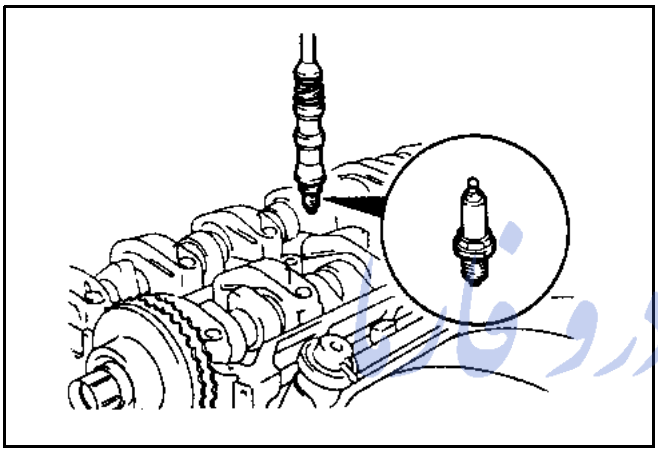
تلفن شبانه روزی: ۰۹۱۲۸۸۶۲۰۸۵

1 Spark Plug Cover
2 Bolt (M6 X 60, 7 pieces)
. . . . . 9-11 N•m (80-97 lb-in)
3 Spark Plug

T1/1 Ignition Coil : Cylinder 2 and 5
T1/2 Ignition Coil : Cylinder 3 and 4
T1/3 Ignition Coil : Cylinder 1 and 6

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Replacement Procedure

1. Remove the seven bolts (2) and remove the spark plug cover.

   Installation Notice

Tightening Torque	9 - 11 N•m (80 - 97 lb-in)

2. Remove the two bolts (M6 X 25) from each ignition cable and remove the ignition cable.

   Installation Notice

Tightening Torque	9 - 11 N•m (80 - 97 lb-in)

3. Remove the spark plug.

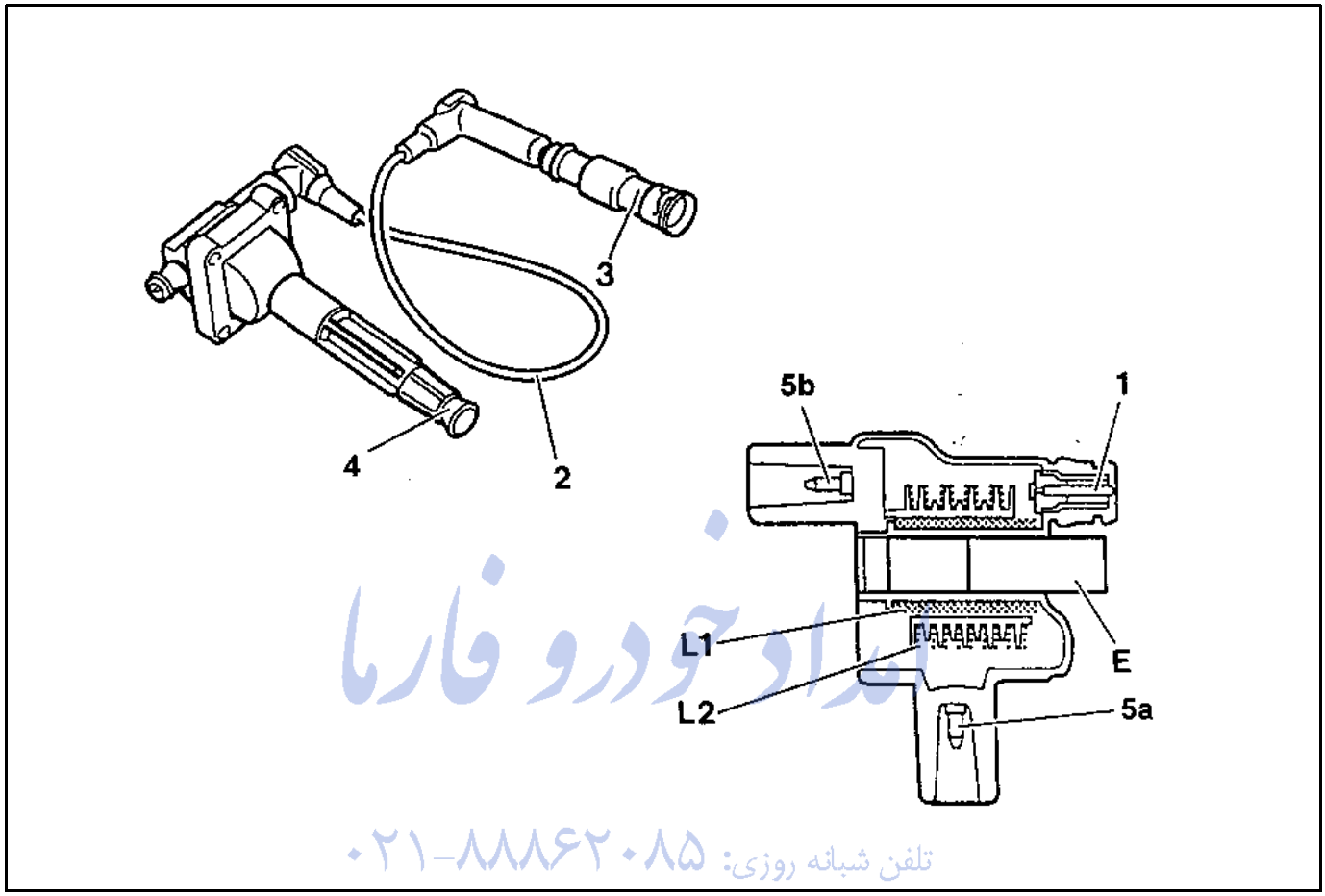
   Installation Notice

Tightening Torque	20 - 30 N•m (15 - 22 lb-ft)

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IGNITION CABLE

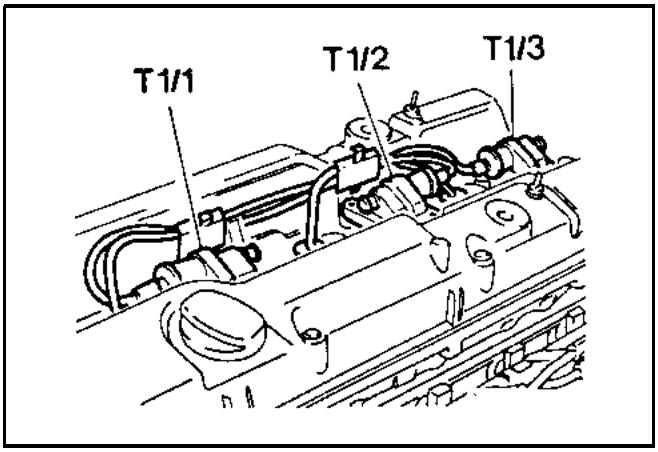
Preceding Work: Removal of intake air duct



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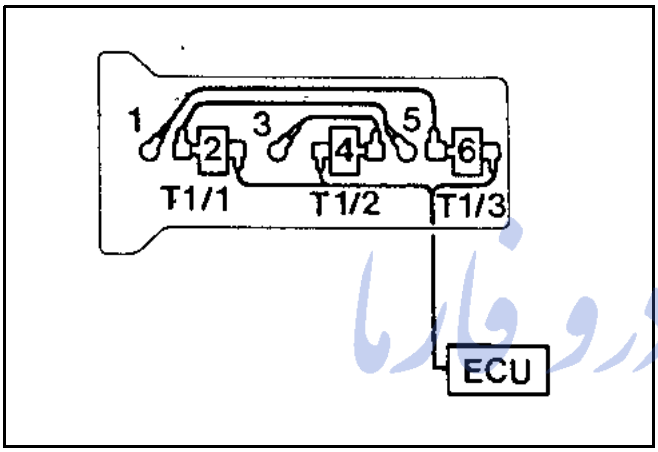
1 Control Cable Connection
2 Ignition Cable
3 Spark Plug Connector
4 Coupling Plug
5a, 5b Secondary Voltage Connection
E Iron Core
L1 Secondary Ignition Coil
L2 Primary Ignition Coil

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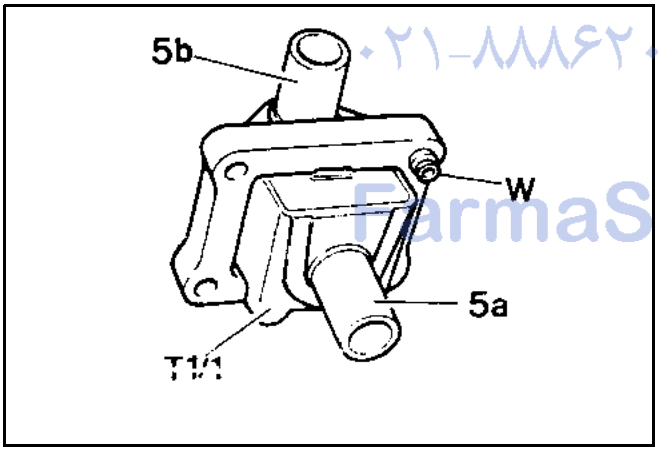


Functions

1. Firing order : 1-5-3-6-2-4
2. The ignition cables are located on the cylinder head cover. Each ignition coil provides the high voltage to two spark plugs simultaneously.
   - T1/1 : cylinder 2 and 5
   - T1/2 : cylinder 3 and 4
   - T1/3 : cylinder 1 and 6



3. The secondary output voltage (5a) is supplied to the No.2 cylinder spark plug through the spark plug connector. The secondary output voltage (5b) is supplied to the No.5 cylinder spark plug through the ignition cable. The guide pin (W) acts as a ground while the ignition cable is operated.



Removal & Installation Procedure

1. Disconnect the negative battery cable (1).
2. Remove the ignition cable connector from the ignition cable.
3. Disconnect the secondary spark plug connectors from the each spark plugs and remove the ignition cable bolt and ignition cable.

Installation Notice

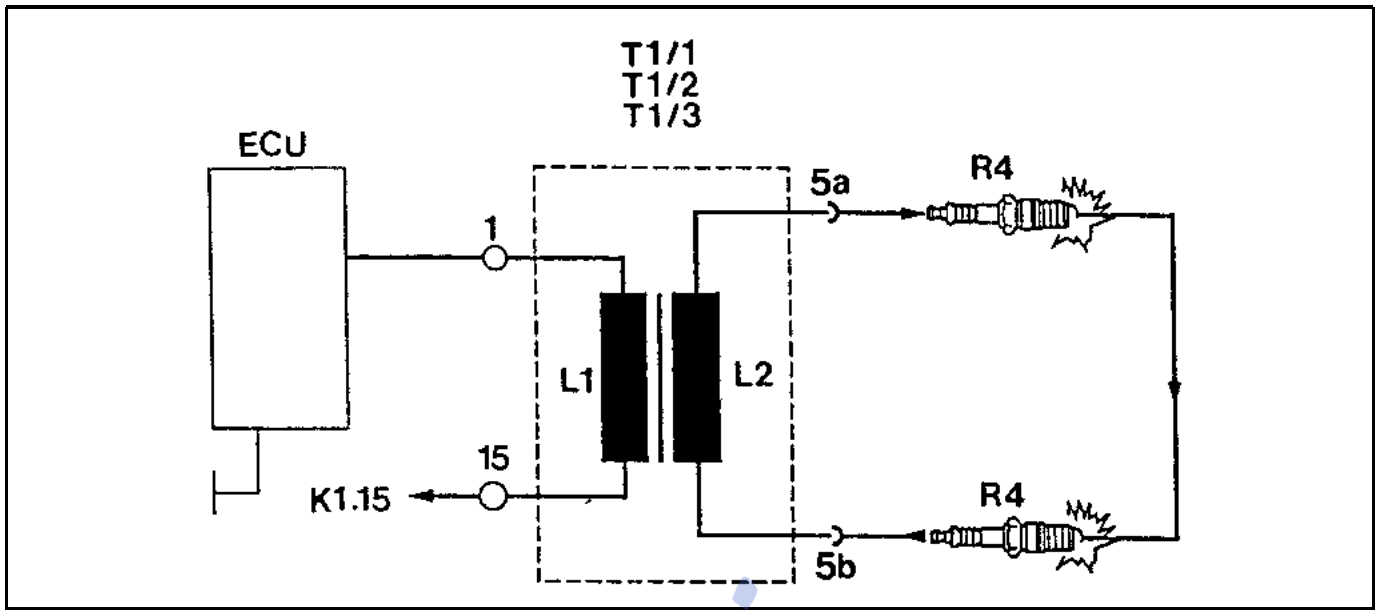
Tightening Torque	9 - 11 N•m (80 - 97 lb-in)

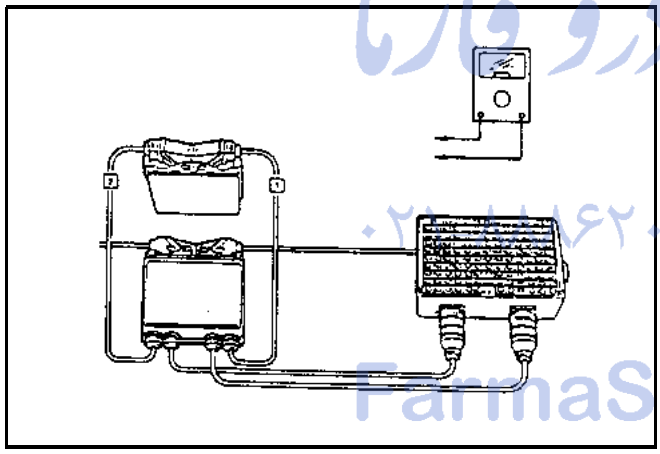
- Make sure that the ignition cables are correctly routed.
- Exactly install the ignition cable guide pin into the vehicle to be grounded.

4. Installation should follow the removal procedure in the reverse order.

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Circuit Diagram





Inspection & Maintenance Procedure (for MSE)

1. While the ignition switch is in 'OFF' position, remove the wiring connectors (1 and 15) from ignition coil and measure the primary resistance between terminal No.1 and No.15.

Specified Value	0.9 - 1.6 Ω (20 °C)

Notice: If out of specified value, replace the ignition coil.

2. During engine cranking, measure primary voltage (T1/1) between ECU terminal No. 71 and No. 69.

Specified Value	200 - 350 V

Notice

- Measure remaining cables.
  - T1/2 : No. 72 and 69.
  - T1/3 : No. 70 and 69.
- If out of specified value, check ignition cable and ECU.

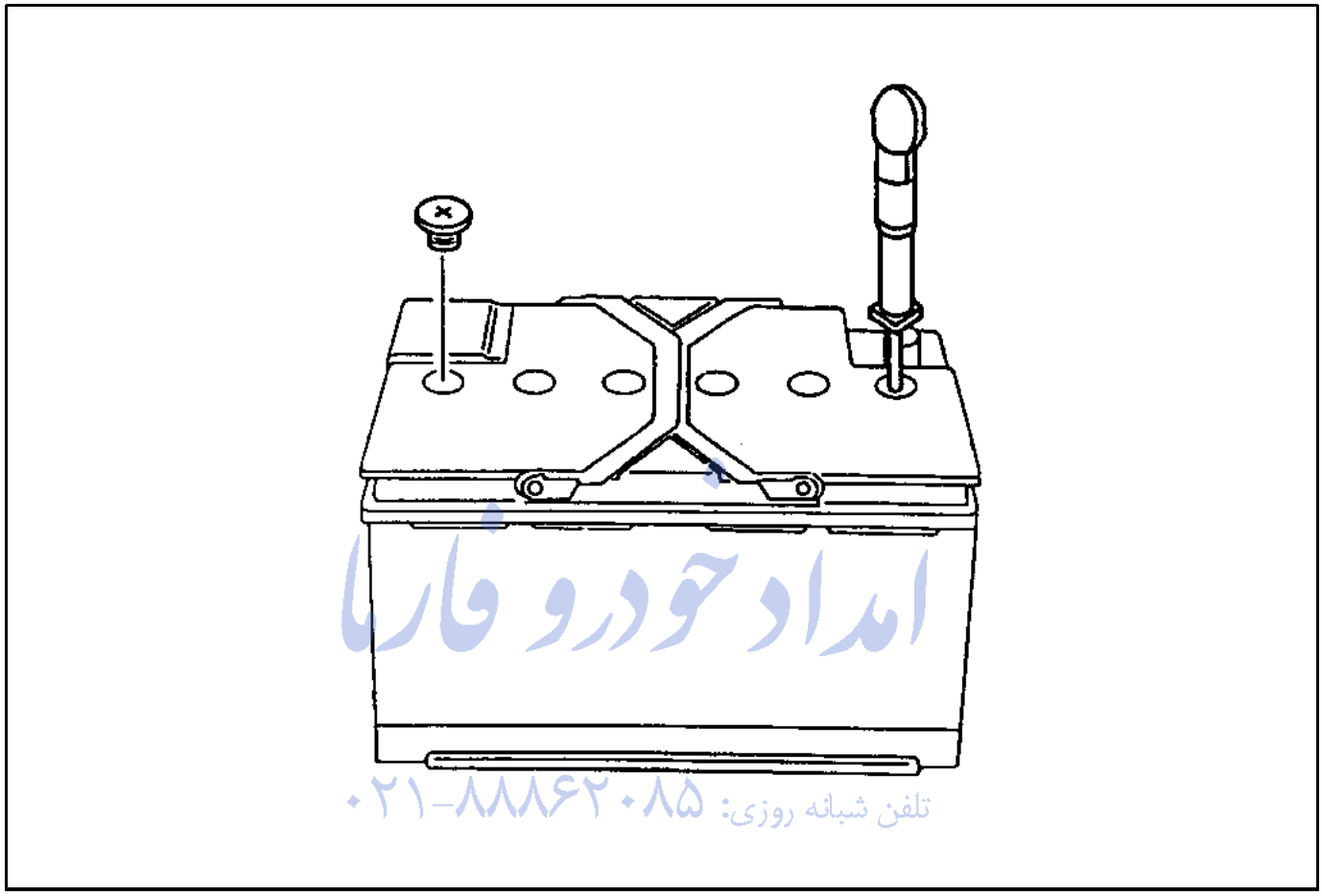
3. Using a multi-tester, measure the secondary coil resistance between 5a and 5b.

Specified Value	6 - 8.5 kΩ

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UNIT REPAIR

BATTERY



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Inspection

Notice

- When charging the battery, do not leave the inflammable objects around it.
- When checking the electrolyte of battery, put on an eye protector and gloves.

1. Inspect the surface of the battery and replace if any defects were found on it.
2. Check if the specific gravity of the electrolyte is within the specified value.

Battery capacity(Ah)	90
Battery specific gravity	≥ 1.24
Max. tolerance between cells	≥ 0.04

Notice

- Replace the battery if the maximum tolerance of the electrolyte between cells is out of the specified value.
- Measure the specific gravity in the approx. 20 °C of ambient temperature.

3. Replenish the electrolyte if necessary.

SECTION 1F1

ENGINE CONTROLS

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

Engine and ECM Problem Check Report 1F1-2
Specifications 1F1-3
Engine Data Display Table 1F1-3
Fastener Tightening Specifications 1F1-4
Fuel System Specification 1F1-5
Temperature vs Resistance 1F1-5
Special Tools and Equipment 1F1-6
Special Tools Table 1F1-6
Schematic and Routing Diagrams 1F1-7
ECM Wiring Diagram (3.2L DOHC - MSE 3.62S) 1F1-7
Diagnosis 1F1-14
Failure Code Diagnosis 1F1-14
Clearing Failure Codes 1F1-14
Failure Codes Table 1F1-14
Ignition System 1F1-18
Ignition Coil 1F1-20
Crankshaft Position (CKP) Sensor 1F1-22
Camshaft Position (CMP) Sensor 1F1-26
Camshaft Actuator 1F1-30
Knock Sensor (KS) 1F1-32
Spark Plug 1F1-34
System Voltage 1F1-38
Ignition Switch 1F1-39
Fuel System 1F1-40
Fuel Pump 1F1-42
Fuel Injector 1F1-46
Purge Control Valve 1F1-50
Fuel Rail 1F1-52
Fuel Pressure Regulator 1F1-54
Induction System 1F1-56
Throttle Valve Actuator 1F1-56
Hot Film Air Mass (HFM) Sensor 1F1-60
Engine Coolant Temperature (ECT) Sensor . 1F1-64
Accelerator Pedal Module 1F1-68
Clutch Switch 1F1-71
Cooling Fan 1F1-72
A/C Compressor Relay 1F1-73
Cruise Control Switch 1F1-74
Traction Control System (TCS) 1F1-75
Resonance Flap 1F1-76
Stop Lamp Switch 1F1-77
Engine RPM 1F1-78
Exhaust System 1F1-79
Catalytic Converter 1F1-79
Oxygen Sensor 1F1-80
Engine Control Module 1F1-86
Serial Data Communication 1F1-88
Internal Failure 1F1-90
Electronic Throttle Controller Safety Malfunction 1F1-92
Immobilizer 1F1-94
Maintenance and Repair 1F1-95
On-Vehicle Service 1F1-95
Discharging the Pressure in Fuel System ... 1F1-95
Fuel Pump 1F1-95
Fuel Filter 1F1-96
Fuel Tank 1F1-97
Fuel Pressure Regulator 1F1-98
Fuel Rail and Injector 1F1-99
Engine Coolant Temperature Sensor 1F1-100
Throttle Body (Integrated with the Actuator) 1F1-101
Hot Film Air Mass (HFM) Sensor 1F1-102
Knock Sensor 1F1-102
Pedal Position Sensor 1F1-103
Oxygen Sensor 1F1-103
Purge Control Valve 1F1-104
Canister 1F1-104
Camshaft Position Sensor 1F1-104
Crankshaft Position Sensor 1F1-105
Engine Control Module 1F1-105

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۰۲۱-۸۸۶۲۰۸۵ تلفن پشتیبانی
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ENGINE AND ECM PROBLEM CHECK REPORT

VEHICLE AND CUSTOMER INFORMATION

Date problem Occurred			
Customer Name		Vehicle Model	
Driver Name		VIN	
Purchase date		Engine Model	
License No.		Mileage	Km miles

MIL INFORMATION

Condition of MIL	□ Remains on □ Sometimes illuminates □ Does not illuminate
DTC inspection (if available)	□ Normal □ Malfunction code(s) (code) □ Freezed frame data ( )

PROBLEM DESCRIPTION

□ Engine Does Not Start	□ No cranking □ No initial combustion □ No complete combustion
□ Hard to Start	□ Slow cranking □ Others
□ Poor Idling	□ Incorrect first Idle □ Abnormal idle rpm □ High (rpm) □ Low (rpm) □ Idling Unstable □ Others
□ Poor Driveability	□ Hesitation □ Back fire □ Muffler explosion (after-burning) □ Surging □ Knocking □ Poor performance □ Other
□ Engine Stall	□ Soon after starting □ After accelerator pedal depressed □ After accelerator pedal released □ During A/C operation □ Shifting from N to D or D to N □ At full steering □ Others
□ Others	

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CONDITION WHEN PROBLEM OCCURS

Problem Frequency	□ Constant □ Intermittent (times per day/month) □ Once only □ Others
Weather	□ Fine □ Cloudy □ Rainy □ Snowy □ Various/Others
Ambient Temperature	□ Hot □ Warm □ Cool □ Cold (approx.____°F/____°C)
Place	□ Highway □ Suburbs □ Inner City □ Uphill □ Downhill □ Rough Road □ Others
Engine Temperature	□ Cold □ Warming Up □ Before warming up □ After warm-up □ Any temp. □ Others
Engine Operation	□ Starting □ Just after starting (min.) □ Idling □ Racing □ Driving □ Constant speed □ Acceleration □ Deceleration □ A/C switch ON/OFF □ Other

SPECIFICATIONS

ENGINE DATA DISPLAY TABLE

Parameter	Unit	Value
Engine Coolant Temp.	°C	greater than 95 °C after warm up
Intake Air Temp.	°C	-40 ~ 130 °C (varies with ambient temp. or engine mode)
Engine RPM	rpm	700 ± 50 (P/N), 600 ± 50 (D)
Regular RPM	rpm	700 ± 50 (P/N), 600 ± 50 (D)
Engine Load	%	18 ~ 25 %
Mass Air Flow Meter	Kg/h	16 ~ 25 Kg/h
Throttle Position Angle	°TA	0 °TA (up to 100 °TA at the wide open throttle)
Spark Advance	°CA	8 °CA (6 ~ 9 °CA)
Indicated Engine Torque	Nm	Varies with engine condition
Injection Time	ms	3 ~ 5 ms
Battery Voltage	V	13.5 ~ 14.1 v (engine running)
Front Axle Speed	Km/h	0 ~ 265 Km/h
Rear Axle Speed	Km/h	0 ~ 265 Km/h
Accel. Pedal Position 1	V	0.4 ~ 4.8 V
Accel. Pedal Position 2	V	0.2 ~ 2.4 V
Throttle Position 1	V	0.3 ~ 4.6 V
Throttle Position 2	V	0.3 ~ 4.6 V
Fuel Integrator		0.8 ~ 1.2
Oxygen Sensor	mv	100 ~ 900 mv
A/C S/W Condition	1=ON/0=OFF	-
Full Load State	1=ON/0=OFF	-
Shift Gear State (A/T)	1=ON/0=OFF	-
A/C Control State	1=ON/0=OFF	-
Clutch Switch (M/T)	1=ON/0=OFF	-
Cam Actuator State	1=ON/0=OFF	-
Knocking Control	1=ON/0=OFF	-
Protect Mission	1=ON/0=OFF	-
Purge Control Valve	1=ON/0=OFF	-
Lambda Function	1=ON/0=OFF	-
Catalyst Heating	1=ON/0=OFF	-
Overrun Fuel Cut	1=ON/0=OFF	-
Full Fuel Cut	1=ON/0=OFF	-
Brake Switch	1=ON/0=OFF	-
Cruise Control Status	1=ON/0=OFF	-

* Condition : Warmed up, idle, P/N or neutral

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FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Camshaft Position Sensor Retaining Bolts	10	-	89
Canister Mounting Bolts	6	-	53
Coolant Temperature Sensor	30	22	-
Crankshaft Position Sensor Retaining Bolt	10	-	89
Engine Control Module (ECM) Mounting Bracket Nuts	10	-	89
Fuel Filter Mounting Bracket Bolt	6	-	53
Fuel Filter Lines	28	21	-
Fuel Pressure Test Connector	25	18	-
Fuel Rail Assembly Bolts	25	18	-
Fuel Return And Supply Lines	23	17	-
Fuel Tank Retaining Nuts	38	28	-
Intake Air Duct Mounting Bolts	9	-	80
Knock Sensor Mounting Bolt	25	18	-
Oxygen Sensor	55	41	-
Pedal Position Censor Mounting Bolts And Nut	6	-	53
Throttle Body Bolts	12	-	106

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FUEL SYSTEM SPECIFICATION

Use Only Unleaded Fuel Rated at 89 Octane or Higher

Fuel quality and additives contained in fuel have a significant effect on power output, drivability, and life of the engine.

Fuel with too low an octane number can cause engine knock.

Caution: Use of fuel with an octane number lower than 89 may damage engine and exhaust system.

Notice: To prevent accidental use of leaded fuel, the nozzles for leaded fuel are larger, and will not fit the fuel filler neck of your vehicle.

Do Not Use Methanol

Fuels containing methanol (wood alcohol) should not be used in vehicle.

This type of fuel can reduce vehicle performance and damage components of the fuel system.

Caution: Use of methanol may damage the fuel system.

Vehicle Fueling from Drums or Storage Containers

For safety reasons (particularly when using noncommercial fueling systems) fuel containers, pumps and hoses must be properly earthed.

Static electricity build up can occur under certain atmospheric and fuel flow conditions if unearthed hoses, particularly plastic, are fitted to the fuel-dispensing pump.

It is therefore recommended that earthed pumps with integrally earthed hoses be used, and that storage containers be properly earthed during all noncommercial fueling operations.

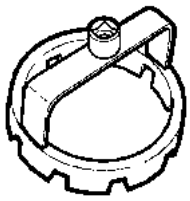
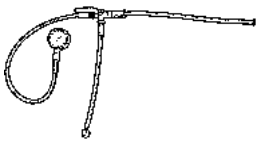
TEMPERATURE VS RESISTANCE

°C	°F	ECT sensor	IAT sensor
		OHMS (Ω)	
Temperature vs Resistance Values (Approximate)			
130	266	88	102
120	248	111.6	127
110	230	143	159
100	212	202	202
90	194	261	261
80	176	340	340
70	158	452	452
60	140	609	609
50	122	835	835
40	113	1166	1166
30	86	1662	1662
20	68	2420	2420
10	50	3604	3604
0	32	5499	5499
-10	14	8609	8609
-20	-4	13850	13850
-30	-22	22960	22960
-40	-40	39260	39260

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SPECIAL TOOLS AND EQUIPMENT

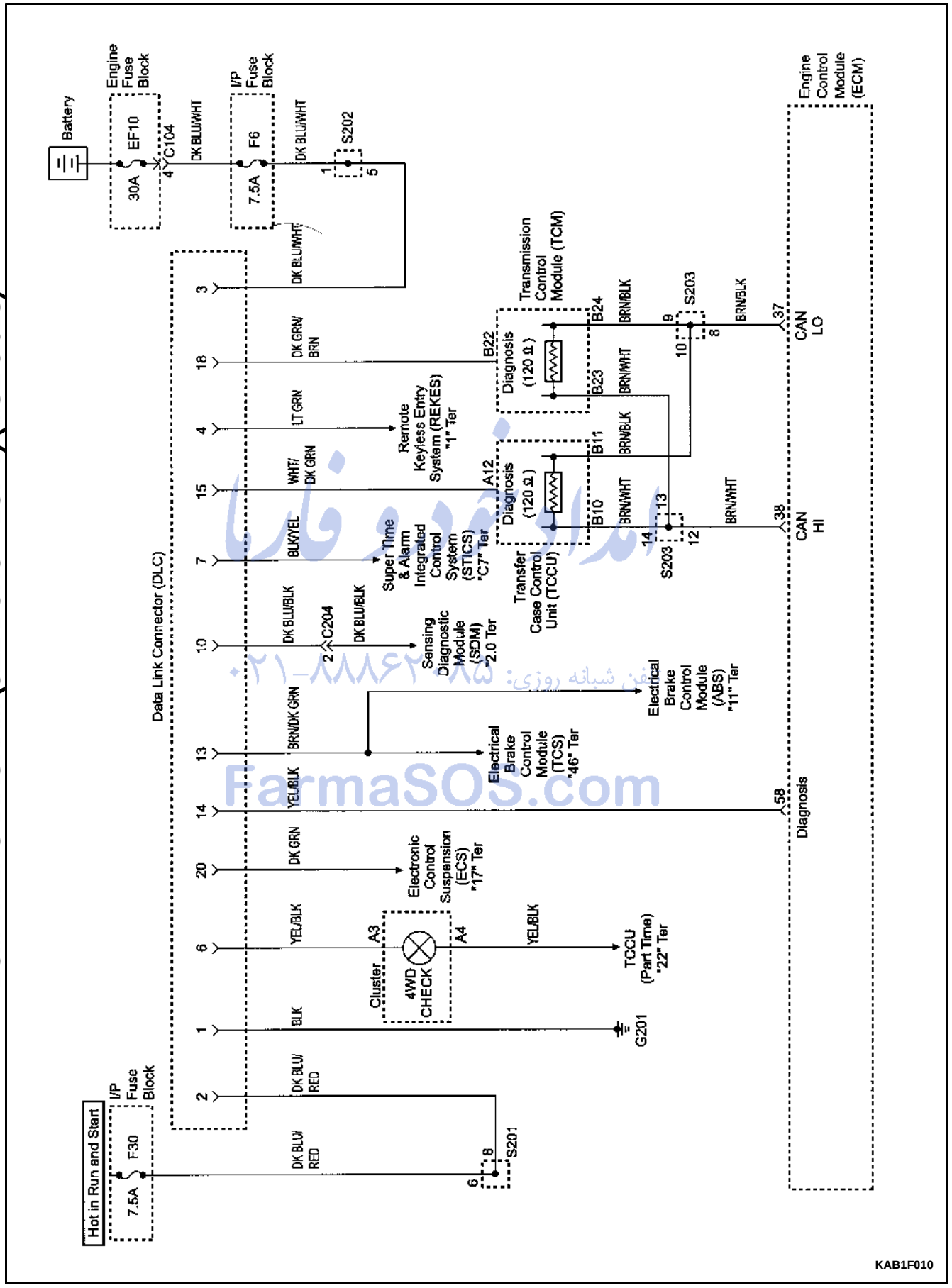
SPECIAL TOOLS TABLE

 YAA1F890	**661 589 00 46 00** **Fuel Tank Cap Wrench**
 KAA1F490	**103 589 00 21 00** **Fuel Pressure Gauge**

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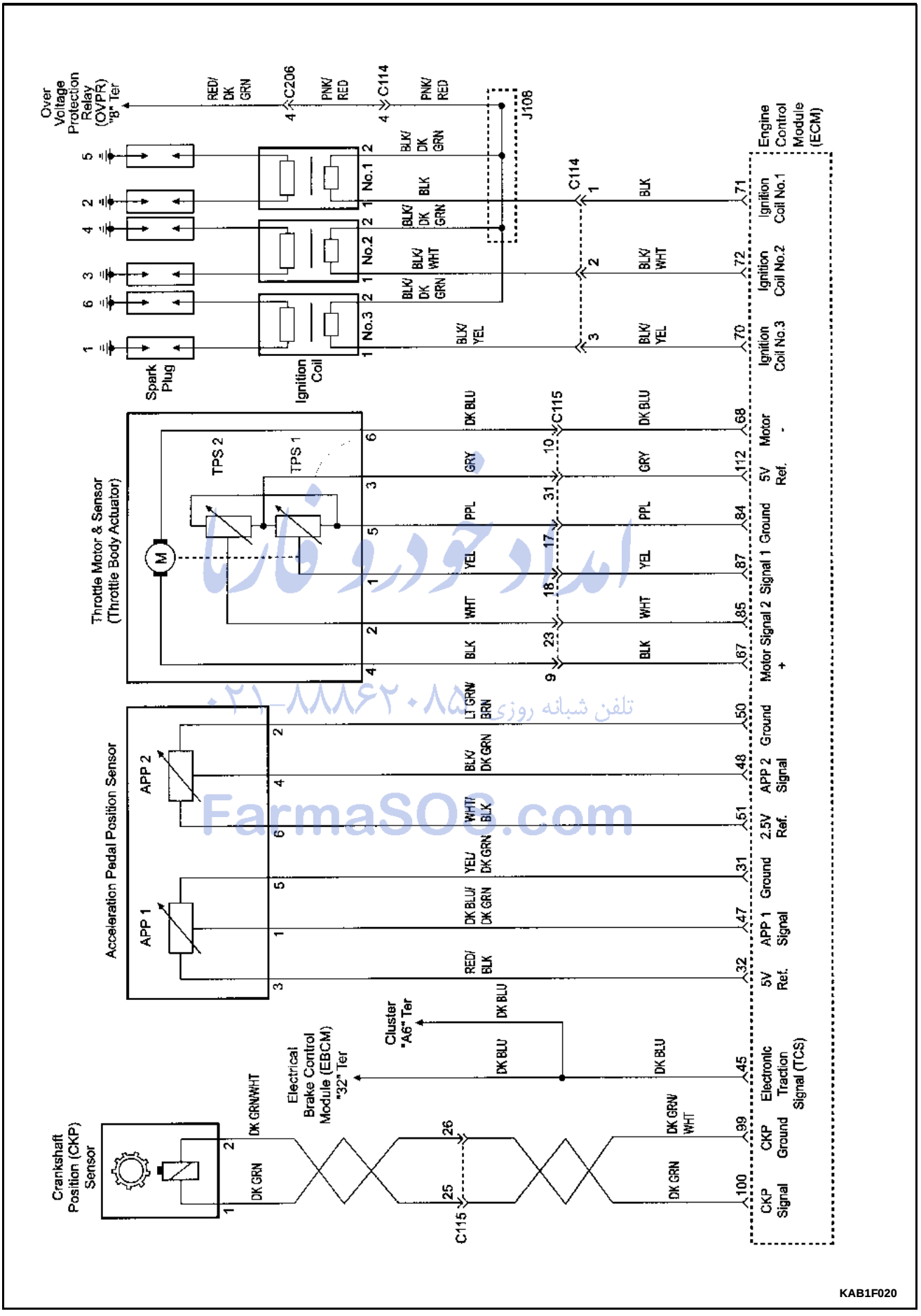
SCHEMATIC AND ROUTING DIAGRAMS

ECM WIRING DIAGRAM (3.2L DOHC – 1OF 7) (MSE 3.62S)



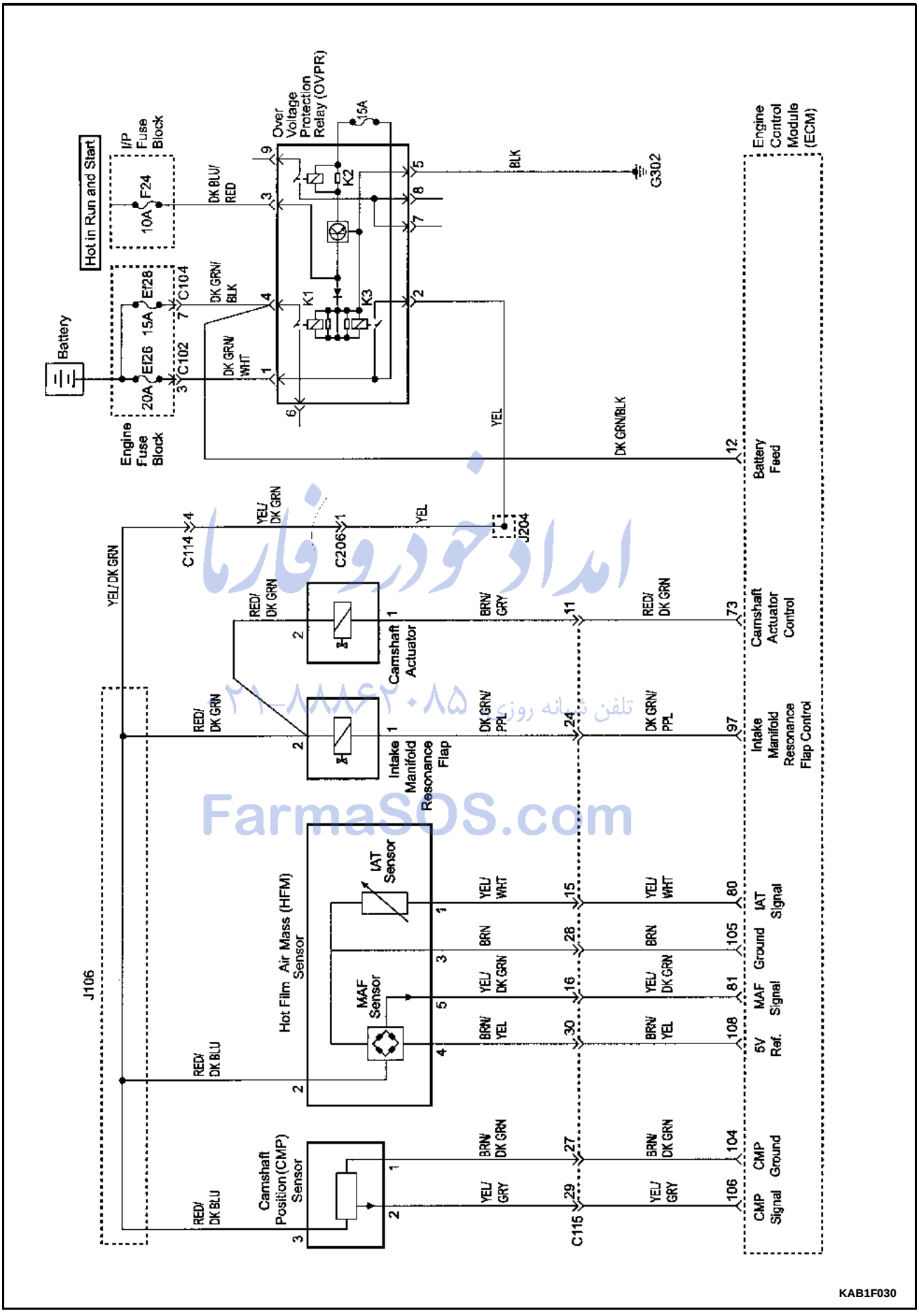
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ECM WIRING DIAGRAM (3.2L DOHC - 2 OF 7) (MSE 3.62S)



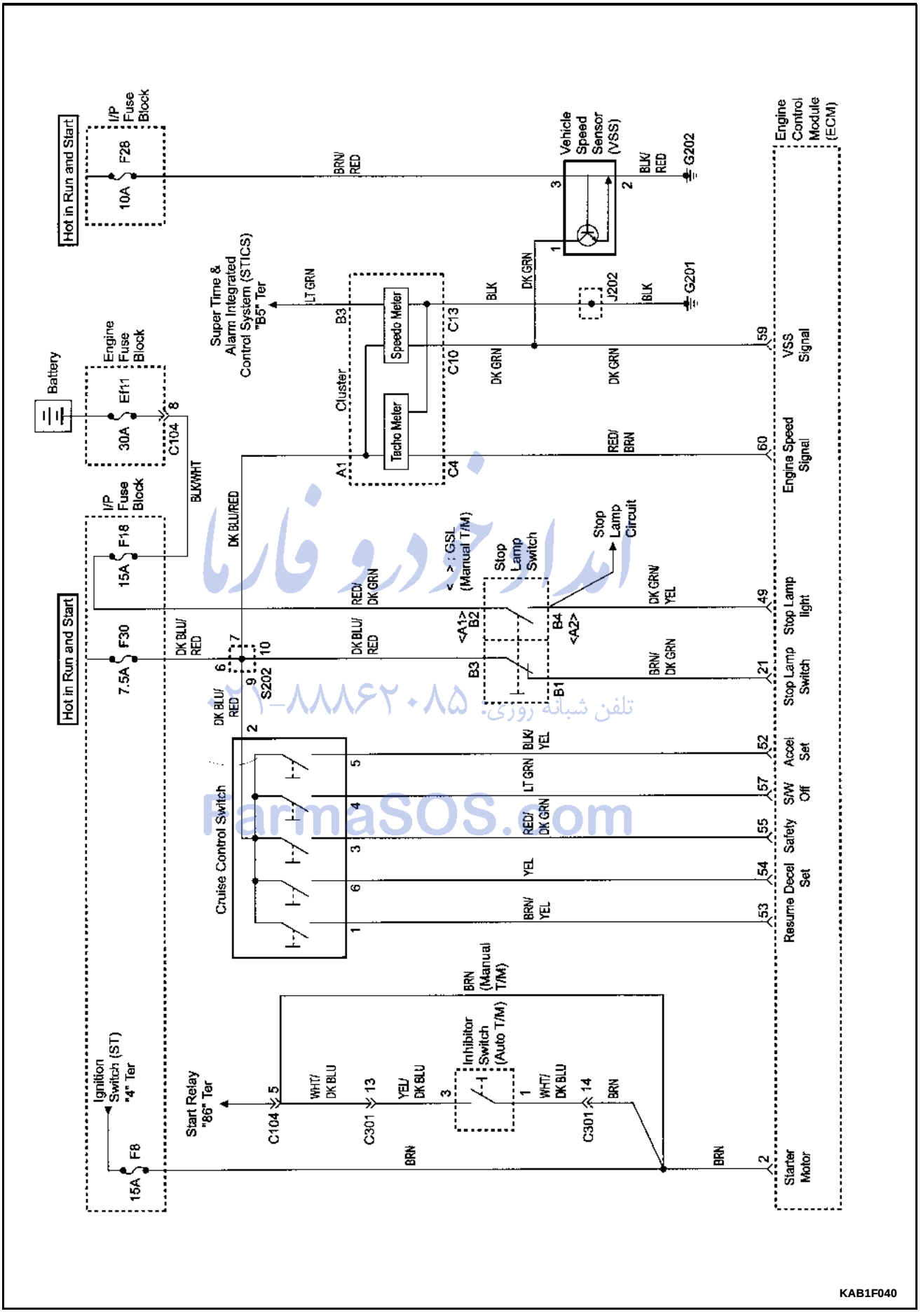
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ECM WIRING DIAGRAM (3.2L DOHC – 3 OF 7) (MSE 3.62S)



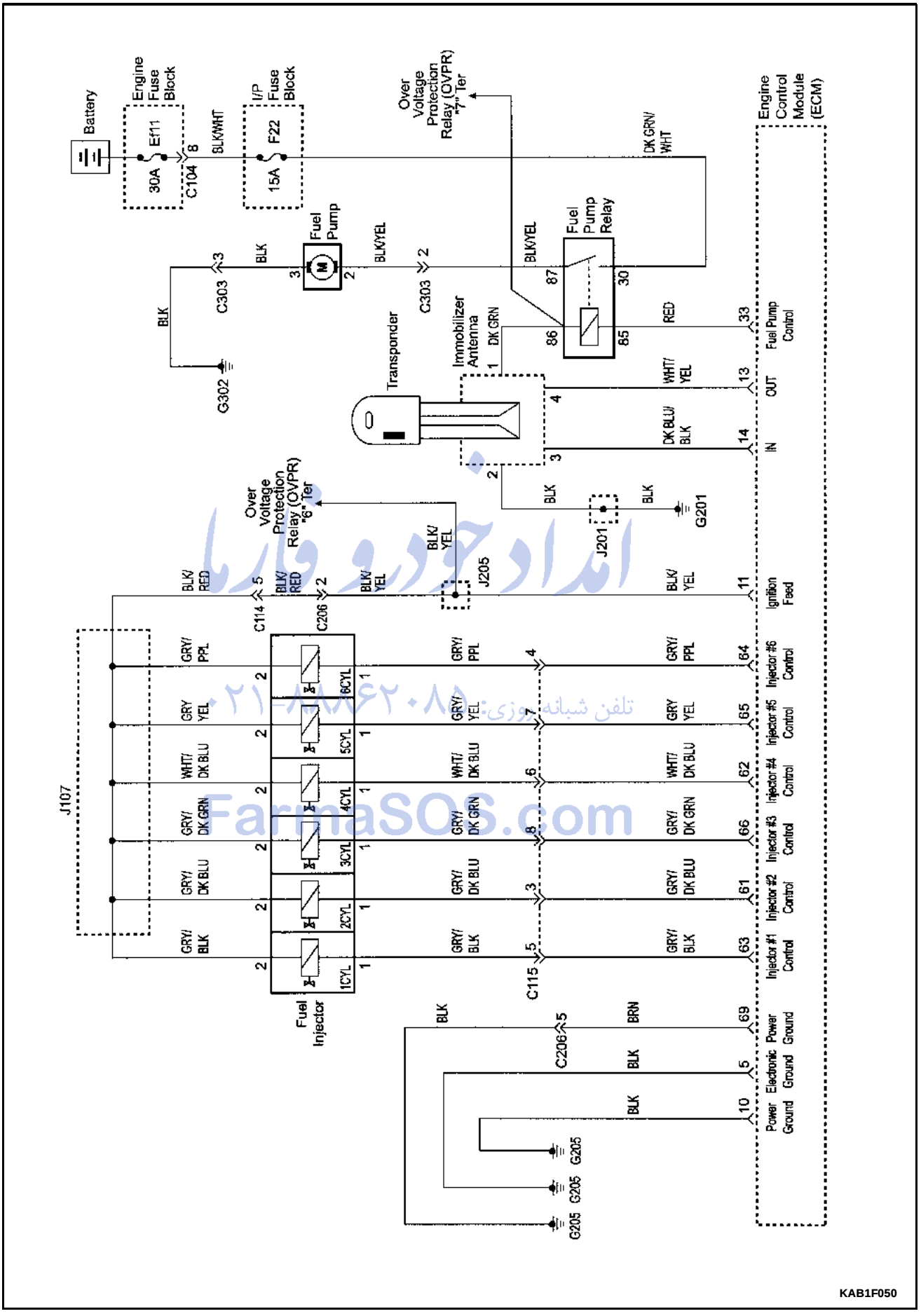
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ECM WIRING DIAGRAM (3.2L DOHC - 4 OF 7) (MSE 3.62S)



DAEWOO MY_2000

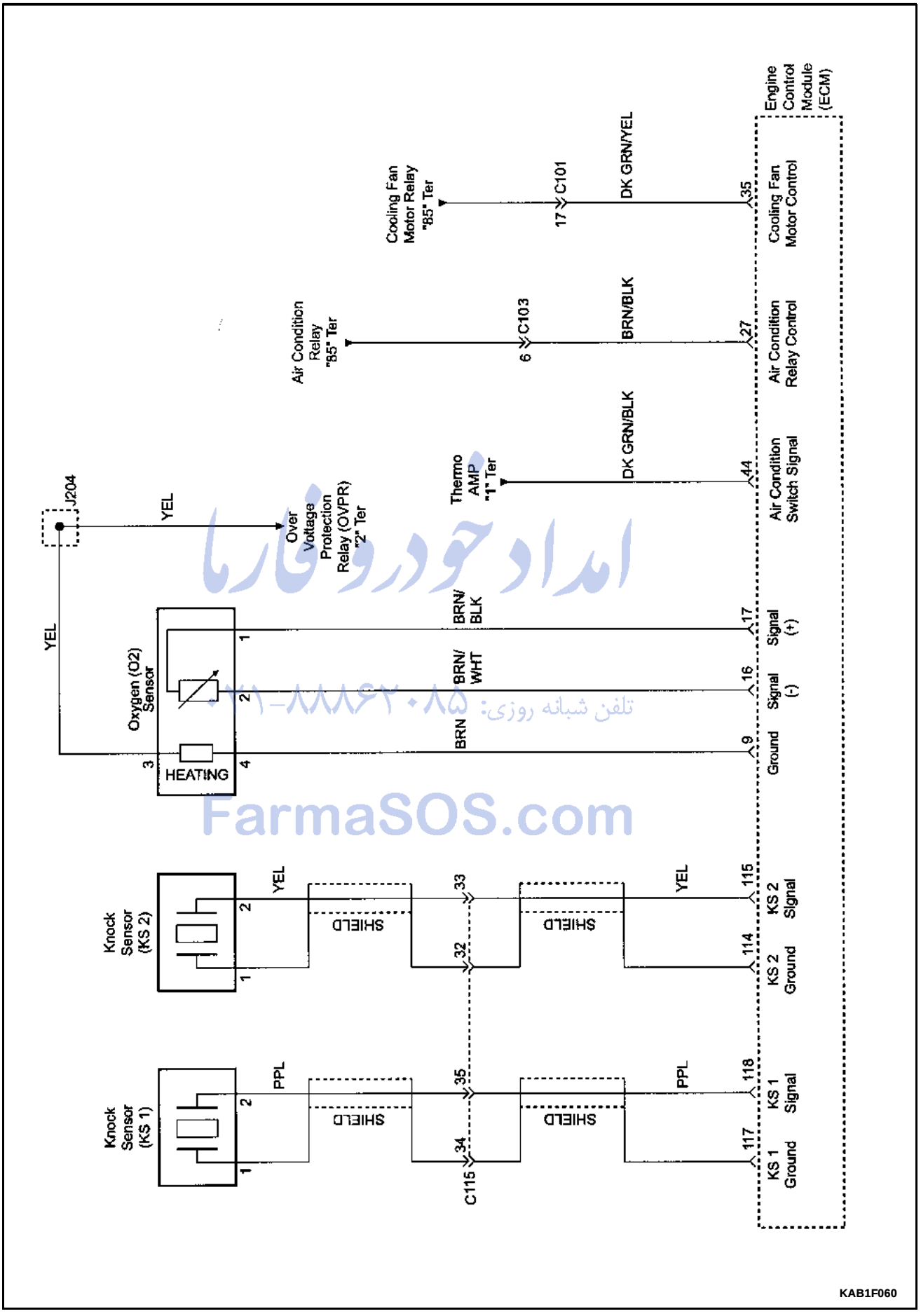
ECM WIRING DIAGRAM (3.2L DOHC – 5 OF 7) (MSE 3.62S)



KAB1F050

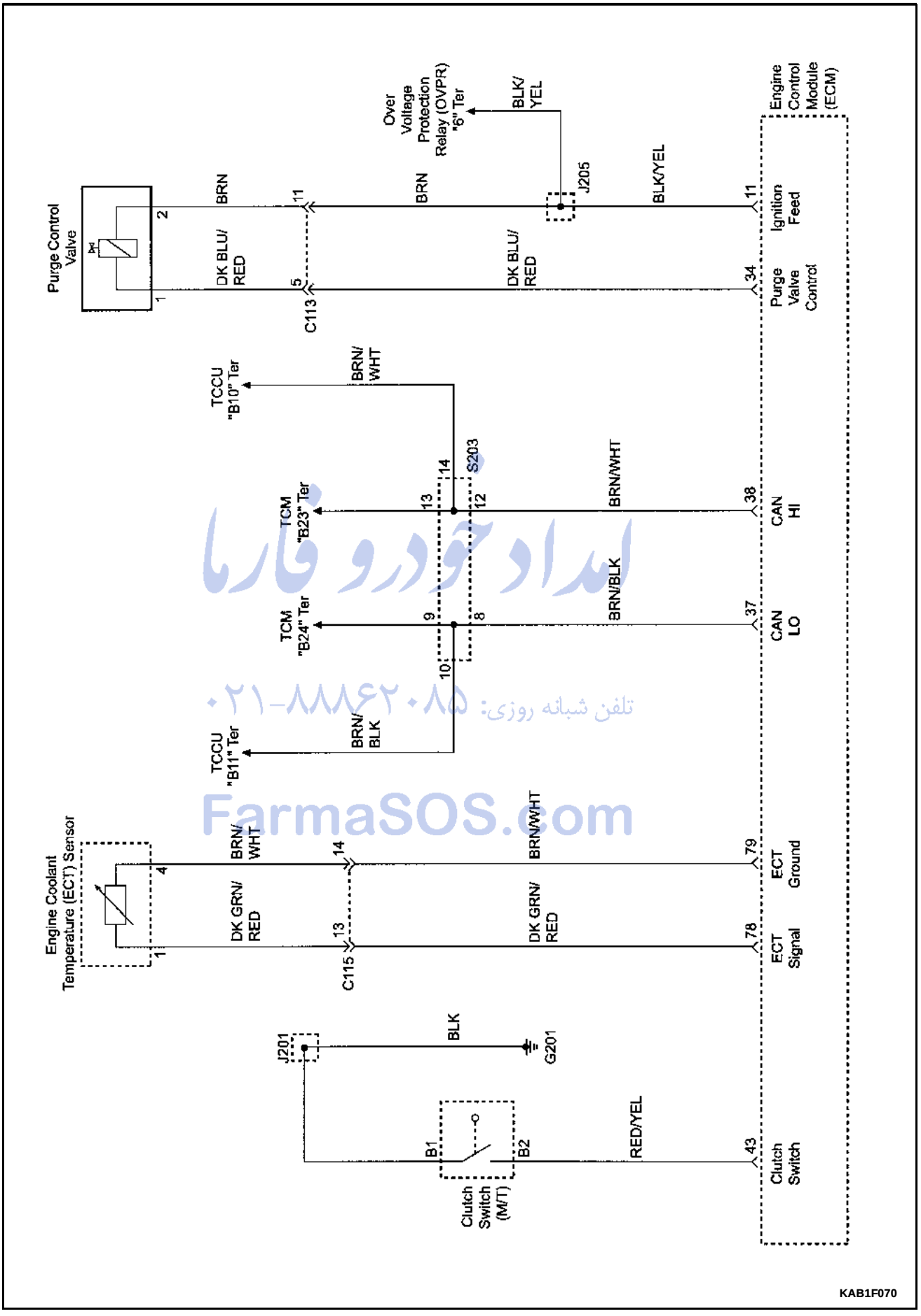
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ECM WIRING DIAGRAM (3.2L DOHC - 6 OF 7) (MSE 3.62S)



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ECM WIRING DIAGRAM (3.2L DOHC - 7 OF 7) (MSE 3.62S)



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DIAGNOSIS

FAILURE CODE DIAGNOSIS

CLEARING FAILURE CODES

Notice: To prevent Engine Control Module (ECM) damage, the key must be OFF when disconnecting or reconnecting the power to the ECM (for example battery cable, ECM pigtail connector, ECM fuse, jumper cables, etc.)

Parameters listed in the table may not be exactly the same as your reading due to the type of instrument or other factors. If a failure code is displayed during the “TROUBLE CODE” in scan tool check mode, check the circuit for the code listed in the table below. For details of each code, turn to the page referred to under the “See Page” for the respective “Failure Code” in the below table.

Failure codes should be cleared after repairs have been completed.

FAILURE CODES TABLE

Failure code	See Page	Description
00	1F1-66	Engine coolant temperature sensor low voltage
01	1F1-66	Engine coolant temperature sensor high voltage
02	1F1-66	Engine coolant temperature sensor plausibility
03	1F1-62	Intake air temperature sensor low voltage
04	1F1-62	Intake air temperature sensor high voltage
05	1F1-62	Intake air temperature sensor plausibility
06	1F1-66	Engine coolant temperature insufficient for closed loop fuel control
08	1F1-38	System voltage too low
09	1F1-62	Mass air flow sensor plausibility
10	1F1-62	Mass air flow sensor low voltage
11	1F1-62	Mass air flow sensor high voltage
17	1F1-23	Crankshaft position sensor signal failure (no engine revolution signal)
18	1F1-23	Crankshaft position sensor signal failure (rpm > max. value)
19	1F1-27	Camshaft position senosr signal : No.1 cylinder recognition failure
20	1F1-23	Crankshaft position sensor signal failure (gap recognition failure)
21	1F1-90	Transmission coding failure
23	1F1-88	CAN communication failure : ASR/MSR
24	1F1-88	CAN communication failure : ABS
25	1F1-94	Communication with transponder missing
26	1F1-88	CAN communication failure : TCU (A/T only)
27	1F1-88	CAN communication failure : TOD (E32 only)
29	1F1-89	CAN communication failure : ID 200h not plausible
30	1F1-89	CAN communication failure : ID 208h not plausible
31	1F1-89	CAN communication failure : communication initialization failure
32	1F1-78	Engine rpm output circuit short circuit to battery
33	1F1-78	Engine rpm output circuit short circuit to ground or open
34	1F1-43	Fuel pump relay short circuit to battery
35	1F1-43	Fuel pump relay short circuit to ground or open

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FAILURE CODES TABLE (Cont'd)

Failure code	See Page	Description
40	1F1-51	Purge control valve short circuit to battery
41	1F1-51	Purge control valve short circuit to ground or open
44	1F1-72	Cooling fan (HI) relay short circuit to power
45	1F1-72	Cooling fan (HI) relay short circuit to ground or open
54	1F1-51	Purge control circuit malfunction
56	1F1-33	No.1 knock sensor signal failure
57	1F1-33	No.2 knock sensor signal failure
58	1F1-27	Camshaft position sensor signal : No.1 cylinder synchronization failure
59	1F1-89	CAN communication failure : MSR data transmission not plausible
60	1F1-89	CAN communication failure : ASR data transmission not plausible
62	1F1-71	Clutch switch defective
64	1F1-21	No ignition voltage output (No.1 ignition coil)
65	1F1-21	No ignition voltage output (No.2 ignition coil)
66	1F1-21	No ignition voltage output (No.3 ignition coil)
67	1F1-23	Crankshaft position sensor adaptation failure
68	1F1-35	Random/Multiple Misfire
71	1F1-39	Starter signal recognition failure
72	1F1-47	No.1 injector short circuit to battery
73	1F1-47	No.1 injector short circuit to ground or open
74	1F1-47	No.2 injector short circuit to battery
75	1F1-47	No.2 injector short circuit to ground or open
76	1F1-47	No.3 injector short circuit to battery
77	1F1-48	No.3 injector short circuit to ground or open
78	1F1-48	No.4 injector short circuit to battery
79	1F1-48	No.4 injector short circuit to ground or open
80	1F1-82	Oxygen sensor high voltage
81	1F1-83	Bank 1 system short term fuel trim adaptation below lean threshold
82	1F1-82	Oxygen sensor no activity detected
83	1F1-82	Oxygen sensor not lean after overrun fuel shut-off
84	1F1-82	Oxygen sensor slow response
85	1F1-82	Oxygen sensor heater failure
86	1F1-82	Oxygen sensor heater short circuit to battery
87	1F1-82	Oxygen sensor heater short circuit to ground or open
89	1F1-82	Oxygen sensor low voltage
93	1F1-83	Bank 1 system short term fuel trim adaptation above rich threshold
96	1F1-83	Bank 1 system short term fuel trim at rich stop
97	1F1-83	Bank 1 system short term fuel trim at lean stop
98	1F1-83	Bank 1 system idle adaptation failure (above rich threshold)
99	1F1-83	Bank 1 system idle adaptation failure (below lean threshold)
100	1F1-83	Bank 1 system learning control failure (rich, low load)
101	1F1-83	Bank 1 system learning control failure (lean, low load)
102	1F1-83	Bank 1 system learning control failure (rich, high load)

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FAILURE CODES TABLE (Cont'd)

Failure code	See Page	Description
103	1F1-83	Bank 1 system learning control failure (lean, high load)
104	1F1-57	Throttle position sensor 1 low voltage
105	1F1-57	Throttle position sensor 1 high voltage
108	1F1-57	Throttle position sensor 2 low voltage
109	1F1-57	Throttle position sensor 2 high voltage
110	1F1-92	Throttle actuator learning data fault
116	1F1-57	Throttle actuator learning control failure
117	1F1-92	Exceed fuel-cut safety time
119	1F1-57	Throttle valve return spring failure
120	1F1-92	Cruise control interruption memory failure
121	1F1-57	Throttle actuator failure
122	1F1-69	Accelerator pedal position sensor signal failure
123	1F1-57	Different Mass air flow sensor signal with throttle position sensor
125	1F1-57	Both throttle position sensors failure
126	1F1-58	Throttle position sensor 1 not plausible with throttle position sensor 2
127	1F1-58	High permanent throttle signal
129	1F1-74	Cruise control "OFF" due to message counter failure
130	1F1-74	Vehicle speed signal failure
131	1F1-74	Vehicle speed signal failure
132	1F1-74	Cruise control lever failure
133	1F1-74	Cruise control acceleration failure
134	1F1-74	Cruise control deceleration failure
135	1F1-77	Stop lamp switch failure
136	1F1-90	ECU failure (RAM)
137	1F1-90	ECU failure (EPROM)
138	1F1-92	Call monitoring
139	1F1-92	Servo motor control output interruption memory failure
140	1F1-92	Servo motor open/short
141	1F1-94	Unprogramed ECU with immobilizer
142	1F1-90	Uncoded/unprogramed ECU
143	1F1-90	ECU failure (EEPROM/Flash-EPROM checksum failure)
144	1F1-90	ECU failure (coding ID checksum failure)
145	1F1-90	ECU failure (coding checksum failure)
146	1F1-90	ECU failure (programing checksum failure)
150	1F1-75	TCS input signal short circuit to battery
151	1F1-75	TCS input signal short circuit to ground or open
160	1F1-69	Accelerator pedal position sensor 1 low voltage
161	1F1-69	Accelerator pedal position sensor 1 high voltage
162	1F1-69	Accelerator pedal position sensor 2 low voltage
163	1F1-69	Accelerator pedal position sensor 2 high voltage
164	1F1-69	Accelerator pedal position sensor 1 not plausible with pedal position sensor 2

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FAILURE CODES TABLE (Cont'd)

Failure code	See Page	Description
167	1F1-69	Both setpoint accelerator pedal position sensor defective
185	1F1-58	Mass air flow sensor and throttle position sensor failure
186	1F1-92	ECU failure (incompatible CPU)
187	1F1-92	ECU failure (CPUs communication failure)
188	1F1-92	ECU failure (CPU 2 configuration failure)
189	1F1-92	ECU failure (CPU 2 fault)
190	1F1-92	ECU failure (CPU run time failure between CPUs)
192	1F1-48	No.5 injector short circuit to battery
193	1F1-48	No.5 injector short circuit to ground or open
194	1F1-48	No.6 injector short circuit to battery
195	1F1-48	No.6 injector short circuit to ground or open
198	1F1-76	Resonance flap short circuit to battery
199	1F1-76	Resonance flap short circuit to ground or open
226	1F1-31	Camshaft actuator short circuit to battery
227	1F1-31	Camshaft actuator short circuit to ground or open
228	1F1-73	A/C compressor relay short circuit to battery
229	1F1-73	A/C compressor relay short circuit to ground or open
231	1F1-92	ECU failure (CPU 2 cruise control message counter failure)
232	1F1-92	Over decceleration limit (CPU 2)
233	1F1-92	Over acceleration limit (CPU 2)
234	1F1-92	Cruise control lever dual operation (CPU 2)
235	1F1-92	Cruise control lever safety terminal failure (CPU 2)
236	1F1-92	Unusual pedal position variation (CPU 2)
237	1F1-92	Unusual throttle position variation (CPU 2)
238	1F1-92	Unusual throttle controller monitor data comparison fault (CPU 2)
239	1F1-93	Unusual accelerator pedal position sensor comparison fault (CPU 2)
240	1F1-93	Throttle potentiometer comparision fault (CPU 2)
241	1F1-93	Unusual CPU communication (CPU 2)
242	1F1-93	Unusual CPU configuration (CPU 2)
243	1F1-93	A/D converter failure (CPU 2)
244	1F1-93	Accelerator pedal position sensor setpoint fault between CPU 1 and CPU 2
245	1F1-93	Position controller setpoint fault between CPU 1 and CPU 2
246	1F1-93	MSR setpoint fault between CPU 1 and CPU 2
247	1F1-93	Idle control setpoint fault between CPU 1 and CPU 2
248	1F1-93	A/D converter overflow (CPU 2)
249	1F1-93	ROM fault (CPU 2)
250	1F1-93	RAM fault (CPU 2)
251	1F1-93	Cycle monitor fault (CPU 2)

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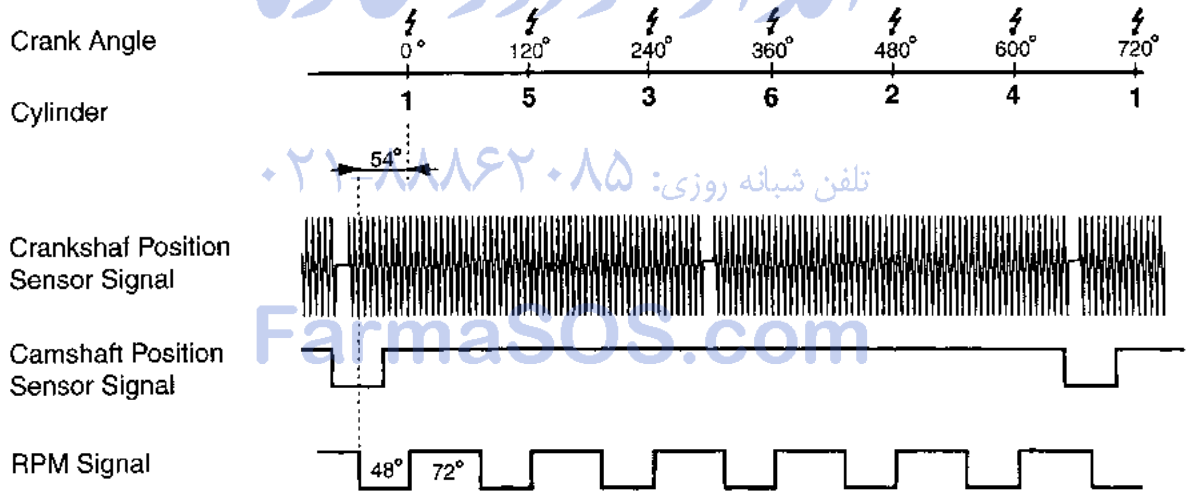
IGNITION SYSTEM

This ignition system does not use a conventional distributor and coil. It uses a crankshaft position sensor input to the Engine Control Module (ECM). The ECM then determines Electronic Spark Timing (EST) and triggers the electronic ignition system ignition coil.

This type of distributorless ignition system uses a “waste spark” method of spark distribution. Each cylinder is paired with the cylinder that is opposite it (1-6 or 2-5 or 3-4). The spark occurs simultaneously in the cylinder coming up on the compression stroke and in the cylinder coming up on the exhaust stroke. The cylinder on the exhaust stroke requires very little of the available energy to fire the spark plug. The remaining energy is available to the spark plug in the cylinder on the compression stroke.

These systems use the EST signal from the ECM to control the EST. The ECM uses the following information:

- Engine load (mass air flow sensor).
- Engine temperature.
- Intake air temperature.
- Crankshaft position.
- Engine speed (rpm).



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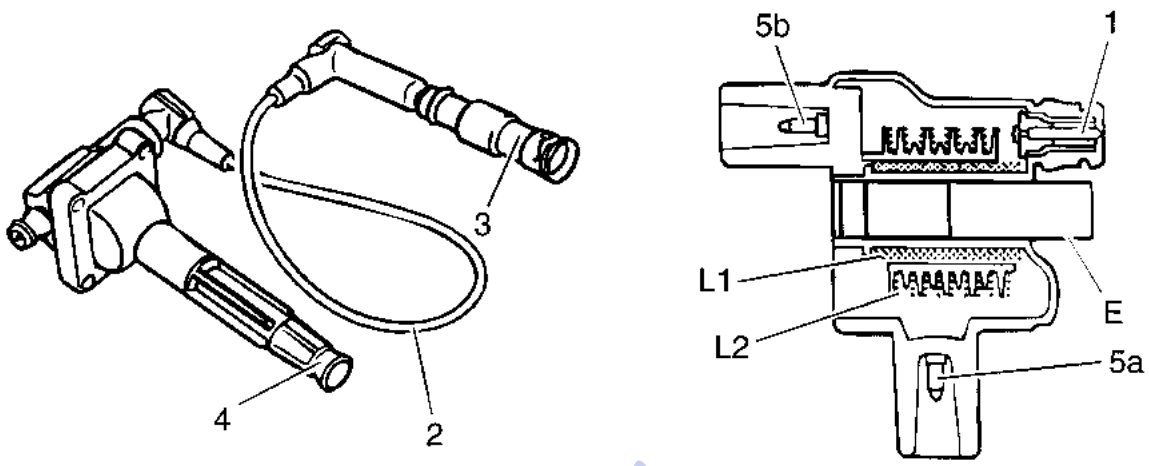
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IGNITION COIL



1. Control Cable Connection
2. Ignition Cable
3. Spark Plug Connector
4. Coupling Plug

5a, 5b. Secondary Voltage Connection
E. Iron Core
L1. Secondary Ignition Coil
L2. Primary Ignition Coil

YAA1F240

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The Electronic Ignition (EI) system ignition coil is located on the cylinder head cover. The double ended coils receive the signal for the Engine Control Module (ECM) which controls the spark advance.

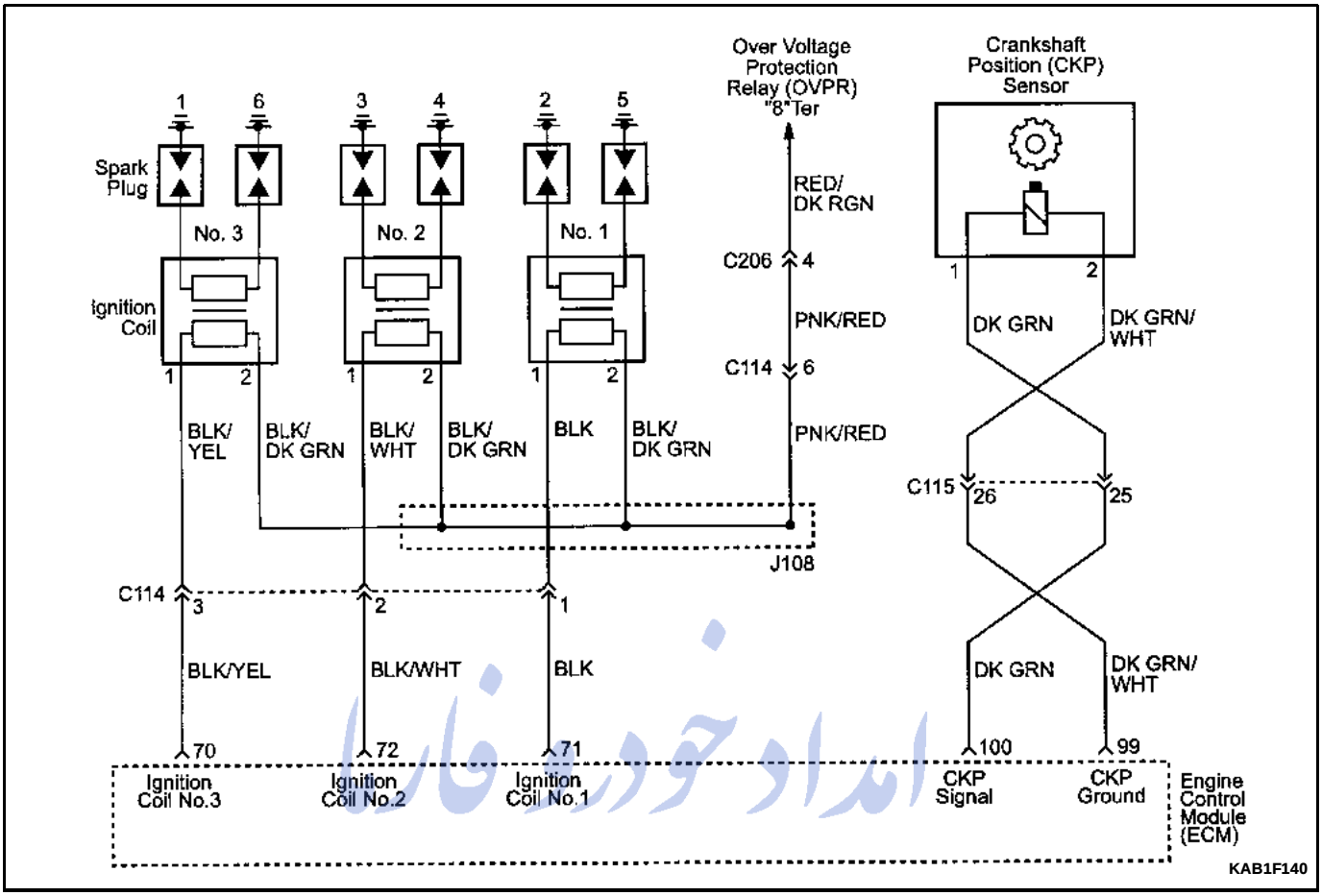
Each EI system ignition coil provides the high voltage to two spark plugs simultaneously;

T1/1: cylinder 2 and 5

T1/2: cylinder 3 and 4

T1/3: cylinder 1 and 6

The EI system ignition coil is not serviceable and must be replaced as an assembly.



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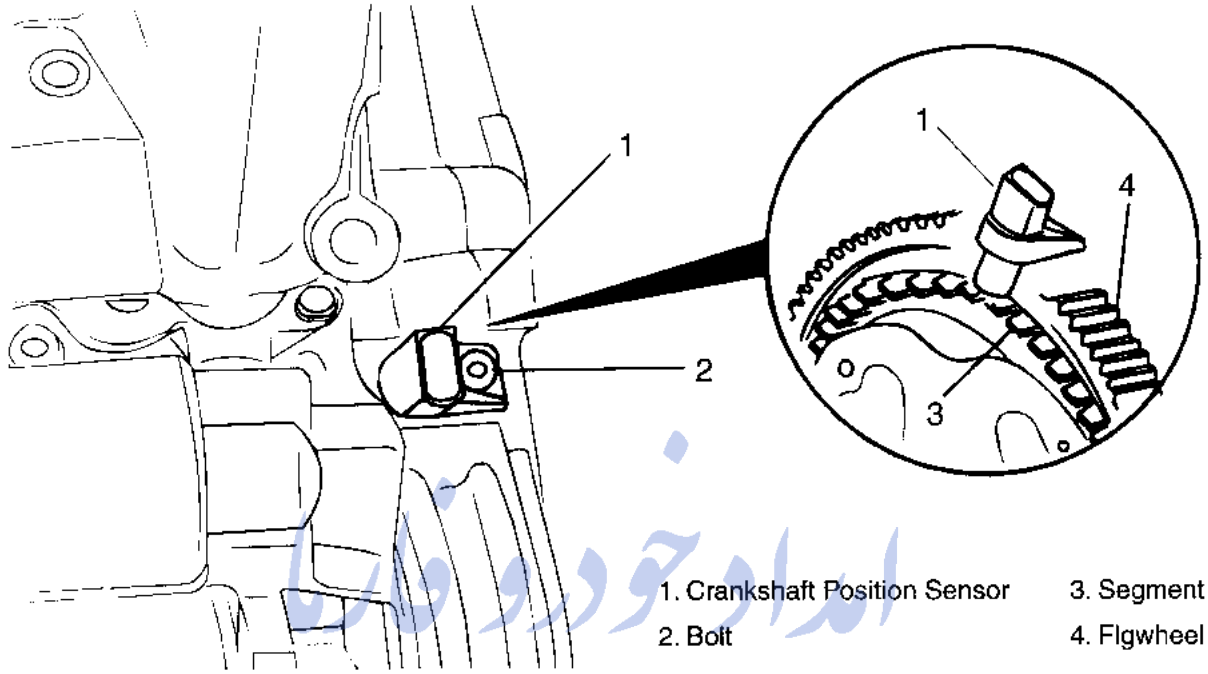
Failure Code	Description	Trouble Area	Maintenance Hint
64	No ignition voltage output (No. 1 ignition coil)	Malfunction of ignition circuit Primary current values or secondary short circuit	• Inspection the ECM pin 70 (71 and 72) about short circuit or open with bad contact • Inspection the power source to ignition coil • Inspection the ignition coil, high tension cords etc. • Inspection the spark plug (wet, cracks, wear, improper gap, burned electrodes, heavy deposit) • Inspection the ECM
65	No ignition voltage output (No. 2 ignition coil)		
66	No ignition voltage output (No. 3 ignition coil)		

Circuit Description

The Electronic Ignition (EI) system uses a waste spark method of spark distribution. The Crankshaft Position (CKP) sensor sends reference pulses to the ECM. The ECM then triggers the EI system ignition coils. Once the ECM triggers the EI system ignition coils both of the connected spark plugs fire at the same time. One cylinder is on its compression stroke at the same time that the other is on the exhaust stroke, resulting in lower energy needed to fire the spark plug in the cylinder on its exhaust stroke.

This leaves the remainder of the high voltage to be used to fire the spark plug in the cylinder on its compression stroke. Since the CKP sensor is in a fixed position, timing adjustments are not possible or needed.

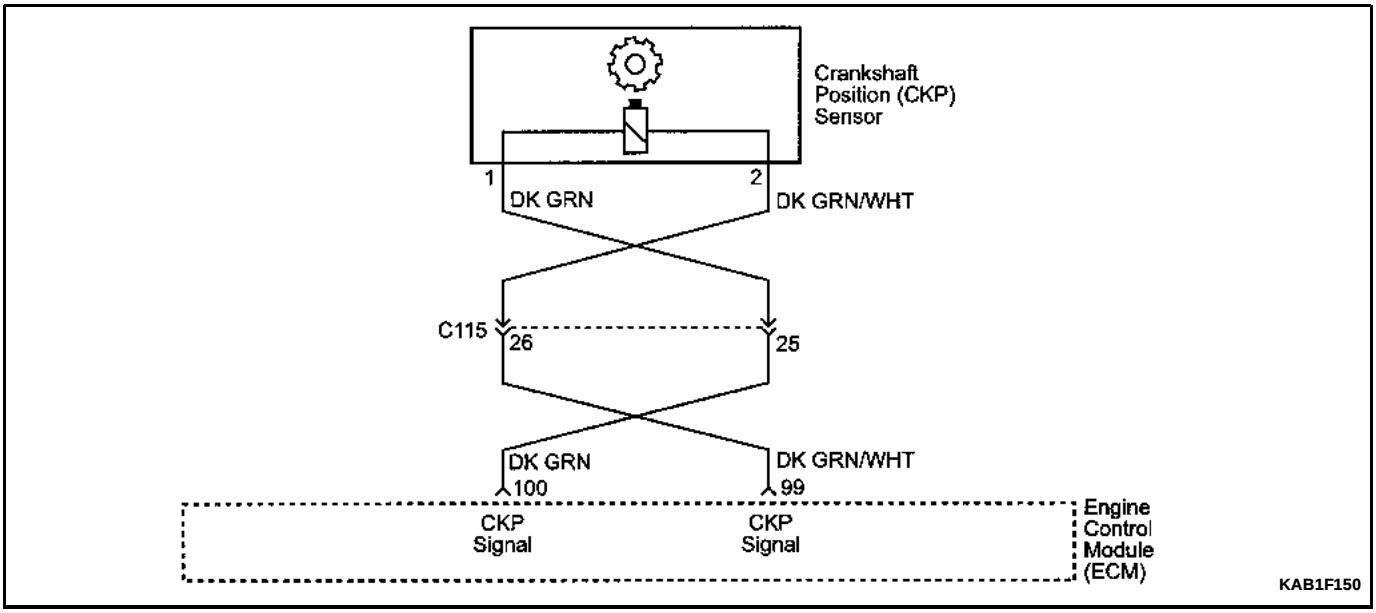
CRANKSHAFT POSITION (CKP) SENSOR



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This Electronic Ignition (EI) system uses inductive or pick up type magnetic Crankshaft Position (CKP) sensor. The CKP sensor is located in the opposite side of the crankshaft pulley and triggers the pick-up wheel teeth which is equipped 60-2 teeth with a gap of 2 teeth at 360 degree spacing. This sensor protrudes through its mount to within 1.1 ± 0.14 mm.

The output of the sensor is a sinusoidal signal. Each tooth of the pick-up 60 - 2 wheel generates a positive half wave. The Engine Control Module (ECM) uses this sensor signal to generate timed ignition and injection pulses that it sends to the ignition coils and to the fuel injectors.



Failure Code	Description	Trouble Area	Maintenance Hint
17	Crankshaft position sensor signal failure (no engine revolution signal)	Even through cam position recognition is normal, no crankshaft position signal recognition	• Monitoring the actual rpm through or scan tool • Inspection the ECM pin 100, 99 about short circuit with bad contact • Inspection the CKP sensor • Inspection the air gap between sensor and drive plate • Inspection the drive plate (teeth condition) • Inspection the ECM
18	Crankshaft position sensor signal failure (rpm > max. value)	When more than applicable revolution values or implausible to 60 – 2 teeth	
20	Crankshaft position sensor signal failure (gap recognition failure)	When implausible recognition of cam and crank angle signal or intermittent sensing the signal or error count of undetected gap.	
67	Crankshaft position sensor adaptation failure	When faulty crank angle sensor adaption	

Circuit Description

The 58X reference signal is produced by the CKP sensor. During one crankshaft revolution, 58 crankshaft pulses will be produced. The ECM uses the 58X reference signal to calculate engine rpm and CKP. The ECM constantly monitors the number of pulses on the 58X reference circuit and compares them to the number of Camshaft Position (CMP) signal pulses being received. If the ECM receives and incorrect number of pulses on the 58X reference circuit, this failure code will set.

Crankshaft Position Sensor Resistance Inspection

1. Disconnect the coupling “E” of ECM while the ignition switch is in “OFF” position.
2. Measure the resistance between the coupling terminal pin No. 99 and No. 100 using a multimeter.

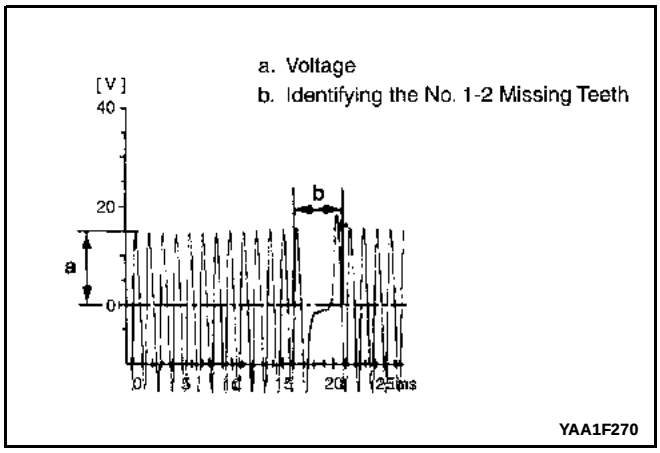
Specified Value	1,050 ~ 1,400 Ω

Notice: Measure the insulator resistance of the CKP sensor if out of the specified value.

Crankshaft Position Sensor Output Wave Inspection

1. Measure the output wave between the ECM terminals No. 99 and No. 100 using the scan tool or the oscilloscope while engine cranking (start motor activated).

Notice: Check the segment or crankshaft position sensor and air gap if cannot get the output wave as shown in the figure.



Crankshaft Position Sensor Insulator Resistance Inspection

1. Disconnect the coupling from ECM while the ignition switch is in “OFF” position.
2. Measure the resistance between the coupling terminal pin No. 100 and No. 69 using a multimeter.

Specified Value	> 20 kΩ

Notice: Measure the check and ground terminal of the CKP sensor if out of the specified value.

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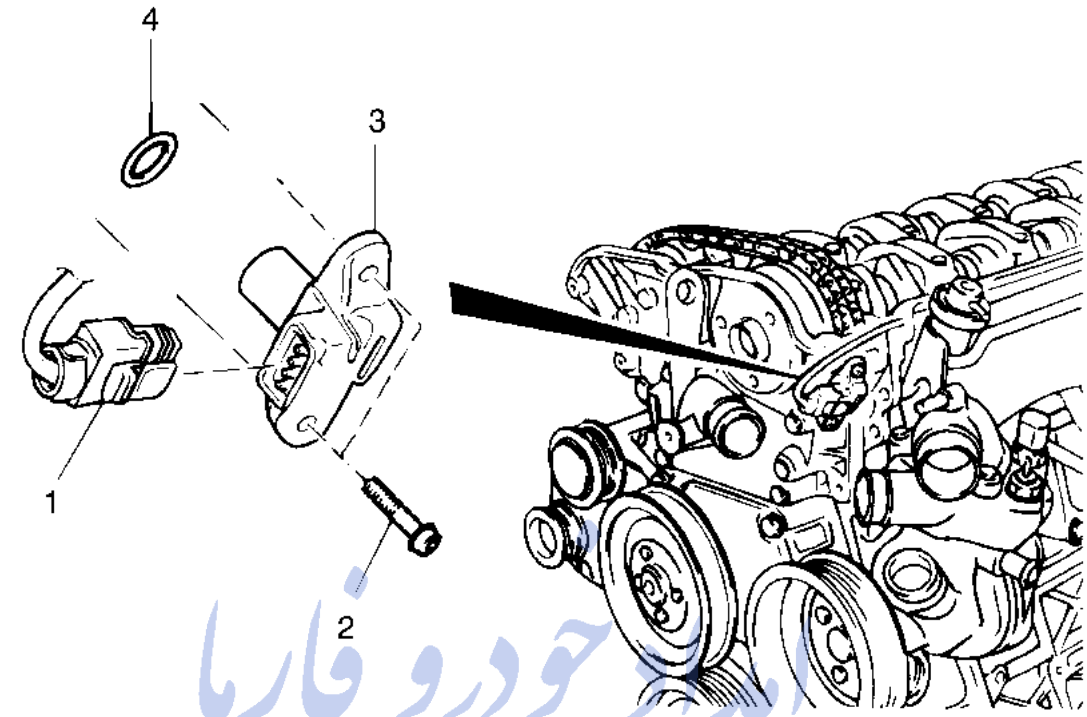
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CAMSHAFT POSITION (CMP) SENSOR

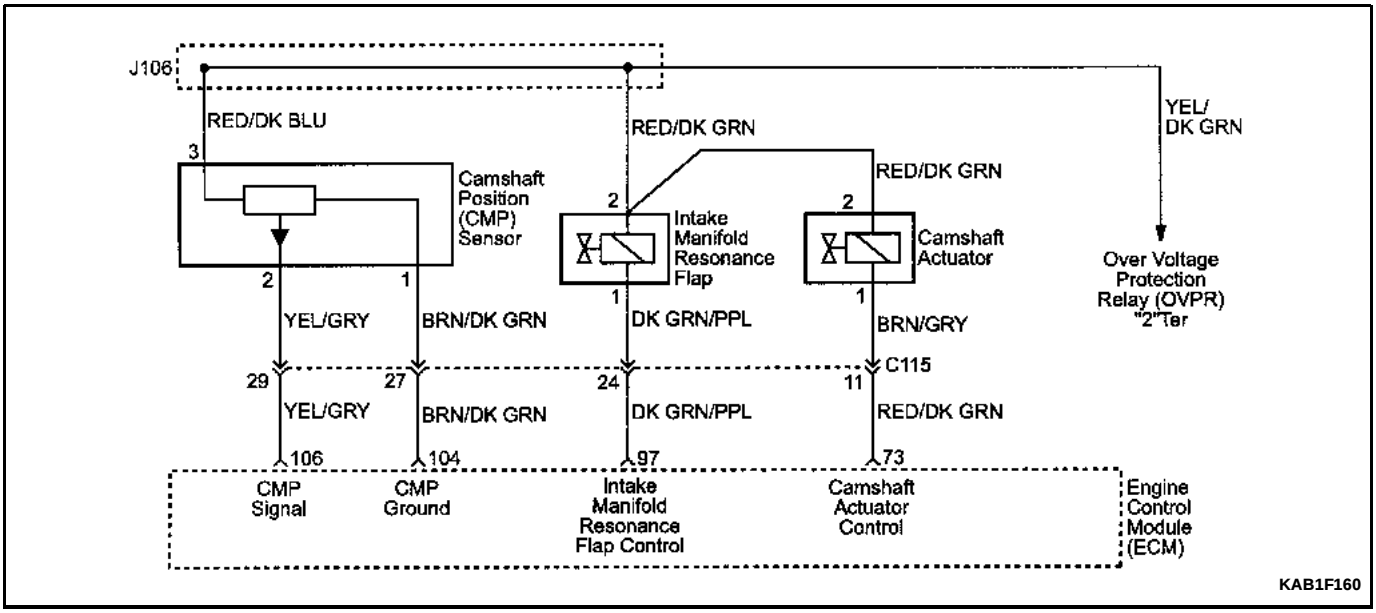


1. Camshaft Position Sensor Connector
2. Bolt
3. Camshaft Position Sensor
4. O-ring

YAA1F280

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The Camshaft Position (CMP) sensor sends a CMP signal to the Engine Control Module (ECM). The ECM uses this signal as a “synchronized pulse” to trigger the injectors in the proper sequence. The ECM uses the CMP signal to indicate the position of the #1 piston during its power stroke. This allows the ECM to calculate true sequential fuel injection mode of operation.



Failure Code	Description	Trouble Area	Maintenance Hint
19	Camshaft position sensor signal : No. 1 cylinder recognition failure	When no cam recognition signal during TN 24 counts more. (maintain the constant low or high level)	• Inspection the source voltage of CMP sensor • Inspection the ECM pin 106, 104 about short circuit or open with bad contact • Inspection the CMP sensor • Inspection the damage of sensor or sprocket • Inspection the ECM
58	Camshaft position sensor signal : No. 1 cylinder synchronization failure	When synchronization fault of cylinder 1 (TDC recognition)	

Circuit Description

The CMP sensor sends a cam position signal to the ECM. If the cam position signal is lost while the engine is running, the fuel injection system shifts to a calculated sequential fuel injection mode based on the last fuel injection pulse, and the engine continuous to run.

Camshaft Position Sensor Signal Voltage Inspection

1. Measure the voltage between the ECM terminal No. 11 and No. 106 while the engine speed is at idle.

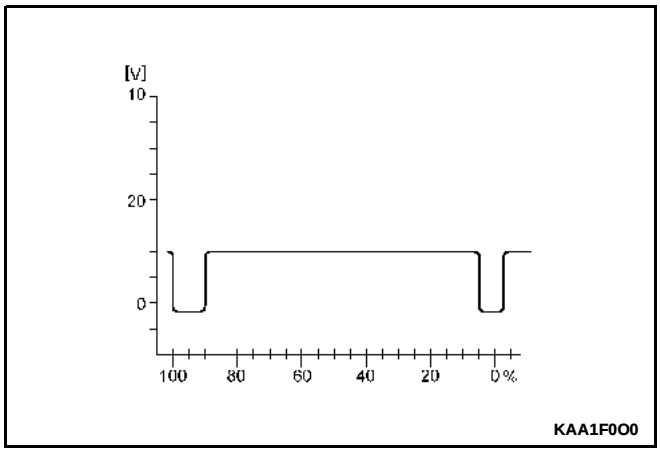
Specified Value	1.2 ~ 1.7 v

Notice: The signal voltage will be changed in the range of 1.2 ~ 1.7 v.

Camshaft Position Sensor Output Wave Inspection

1. Measure the output wave between the ECM terminals No. 104 and No. 106 using the scan tool or the oscilloscope while engine speed is at idle.

Notice: Replace the CAM sensor if cannot get the output wave as shown in the figure.



Camkshaft Position Sensor Power Supply Inspection

1. Disconnect the CMP sensor Connector.
2. Measure the resistance between the No. 1 and No. 3 pin of the CMP sensor connector while the ignition switch is in “ON” position.

Specified Value	11 ~ 14 v

Notice: If the measured value is not within the specified value, check the cable.

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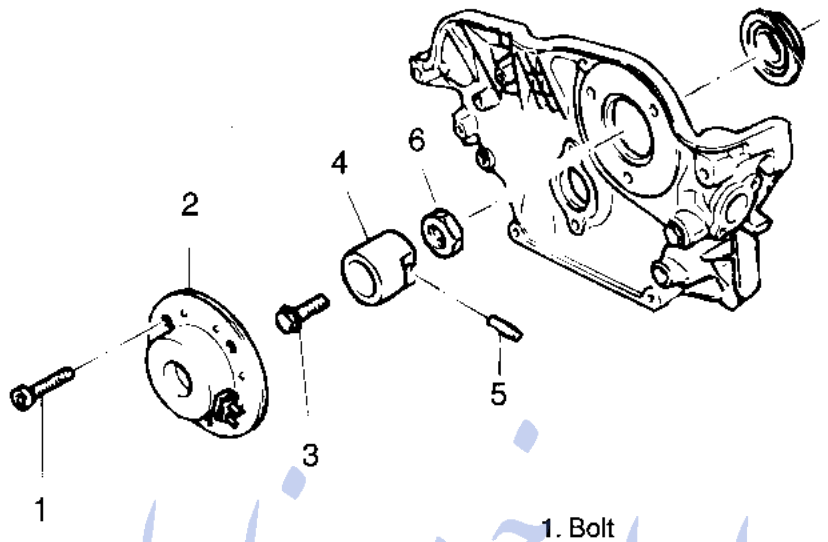
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CAMSHAFT ACTUATOR



1. Bolt
2. Camshaft Actuator
3. Bolt
4. Armature
5. Roll Pin
6. Nut

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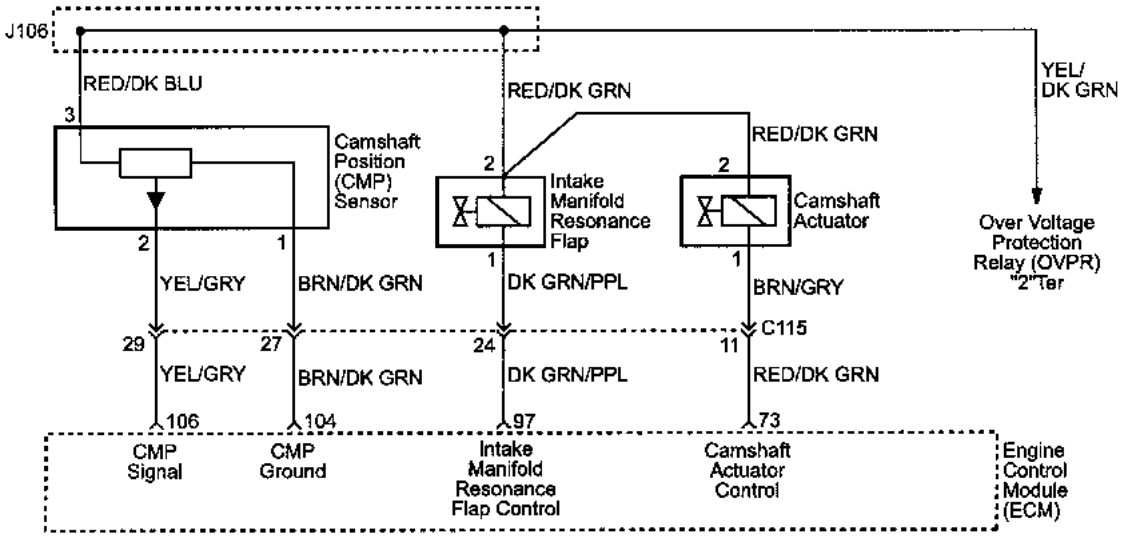
When the engine is running, the camshaft actuator rotates the intake camshaft hydraulically and mechanically relative to the camshaft sprocket by 32° crank angle to the “advanced” position and back to the “retard” position.

The camshaft actuator is actuated electro-mechanically by the Engine Control Module (ECM). The positioning time of apporx. 1 second is dependent on the engine oil pressure at the camshaft actuator and on the oil viscosity and oil temperature, respectively.

The camshaft indicator on the camshaft sprocket provides the camshaft rotational speed to the position sensor as an input parameter for the engine ignition control unit.

Operation Condition of Camshaft Actuator

Engine RPM	Camshaft Position	Effect
Engine stop	Retard	-
0 ~ 1,500 rpm	Retard	Idle speed is improved Blow-by gas is decreased Valve overlap is decreased
1,500 ~ 4,300 rpm	Advanced	Torque is increased Fuel loss is decreased NOx is decreased
Above 4,300 rpm	Retard	Engine overrun is prohibited



Failure Code	Description	Trouble Area	Maintenance Hint
226	Camshaft actuator short circuit to battery	When malfunction of cam phasing control	• Monitoring the actual operational status through scan tool • Inspection the ECM pin 73 about short circuit or open • Inspection the power source short circuit or open to cam actuator • Inspection the magnet and hardware • Inspection the ECM
227	Camshaft actuator short circuit to ground or open		

۰۲۱-۸۸۸۶۲۰۸۵ پاسخگوی شبانه روزی

Camshaft Actuator Current Consumption Inspection

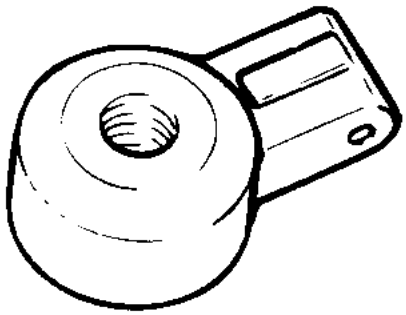
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1. Run the engine to reach the coolant temperature above 70 °C.
2. Increase the engine rpm up to 2000 rpm
3. Measure the current between the No. 1 and No. 2 pin of the camshaft actuator connector.

Specified Value	1 ~ 1.5 A

Notice: If the measured value is not within the specified value, check the cable.

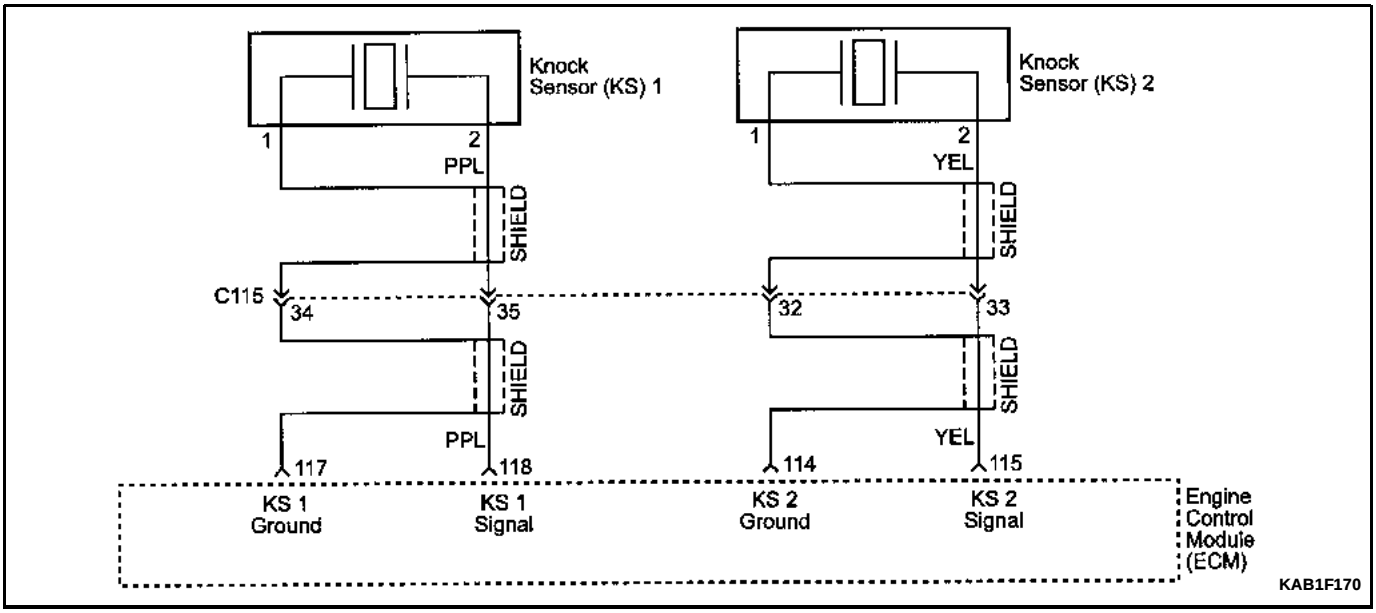
KNOCK SENSOR (KS)



YAA1F320

The Knock Sensor (KS) detects abnormal knocking in the engine. The two KS are mounted in the engine block near the cylinders. The sensors produce an output voltage which increases with the severity of the knock. This signal is sent to the Engine Control Module (ECM) via a shielded cable. The ECM then adjusts the ignition timing to reduce the spark knock.

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Failure Code	Description	Trouble Area	Maintenance Hint
56	No. 1 knock sensor signal failure	When recognition in more than control gain threshold at normal operational condition of other system during over 75 and 3,000 rpm running area (cylinder 1, 2, 3)	• Inspection the ECM pin 118, 117 about short circuit or open with bad contact • Inspection the KS 1 malfunction • Inspection the ECM
57	No. 2 knock sensor signal failure	When recognition in more than control gain threshold at normal operational condition of other system during over 75 and 3,000 rpm running area (cylinder 4, 5, 6)	• Inspection the ECM pin 115, 114 about short circuit or open with bad contact • Inspection the KS 2 malfunction • Inspection the ECM

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Circuit Description

The KS system is used to detect engine detonation, allowing the ECM to retard the ignition control spark timing based on the KS signal being received. The KS signal's amplitude and frequency depend upon the amount of knock being experienced. The ECM monitors the KS signal and can diagnose the KS sensor and circuitry.

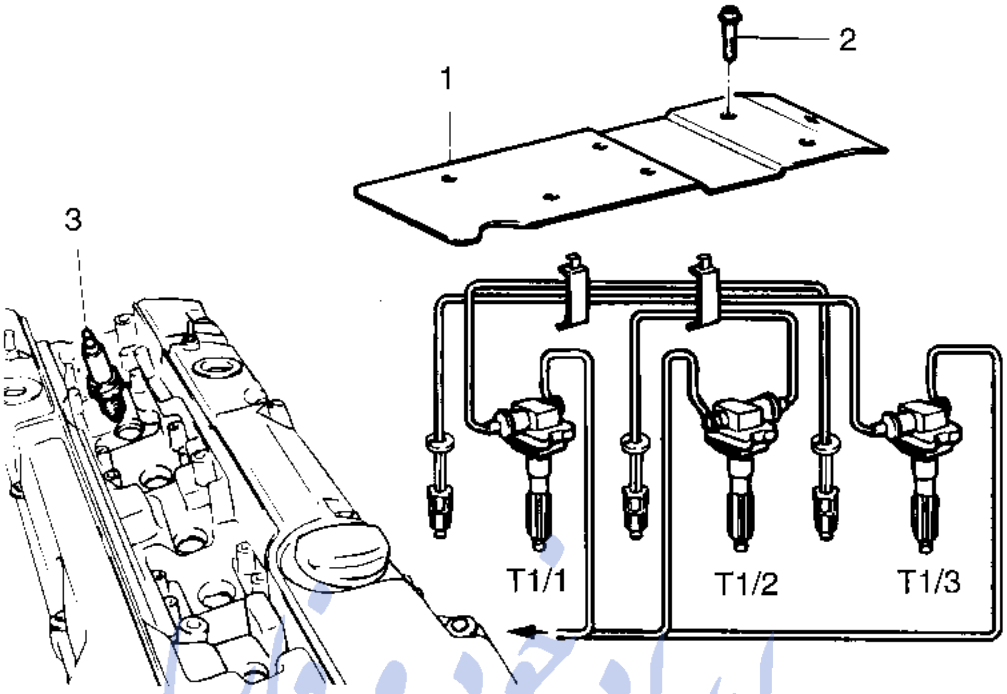
Knock Sensor Resistance Inspection

1. Disconnect the coupling from ECM while the ignition switch is in "OFF" position.
2. Measure the resistance between the coupling terminal pin No. 118 and No. 117 and terminal pin No. 115 and No. 114 using a multimeter.

Specified Value	> 10 MΩ

Notice: Replace the KS if the measured values is out of the specified values. Check the connector and wire connection between ECM and the KS if the measured values are normal.

SPARK PLUG

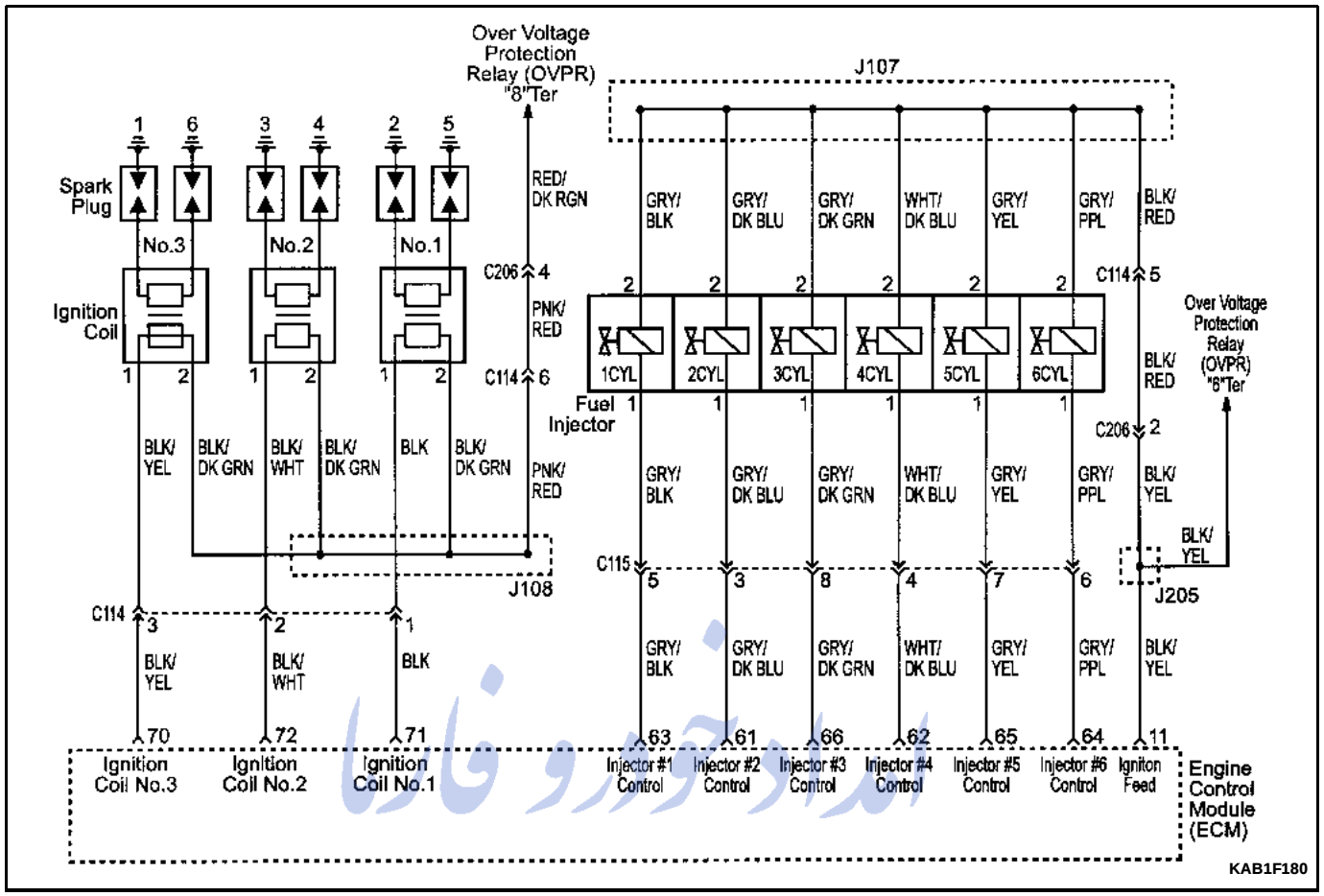


1. Ignition Coil Cable Cover
2. Bolt
3. Spark Plug

T 1/1 Ignition Coil : Cylinder 2 and 5
T 1/2 Ignition Coil : Cylinder 3 and 4
T 1/3 Ignition Coil : Cylinder 1 and 6

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Failure Code	Description	Trouble Area	Maintenance Hint
68	Random / Multiple Misfire	When detection misfire of multiple cylinder for source of over the emission threshold or catalyst damage	• Inspection the ignition system • Inspection the injection system • Inspection the fuel pressure • Inspection the compression pressure • Inspection the valve timing or clearance • Inspection the air flow sensor • Inspection the crankshaft position sensor and air gap • Inspection the engine wiring system • Inspection the Engine Control Module (ECM)

Circuit Description

The ECM monitors the crankshaft and camshaft positions to detect if the engine is misfiring. The ECM looks for a quick drop in crankshaft speed. Misfire multiple cylinder is monitored by engine roughness measuring. The actual roughness value is compared with the actual (emission and catalyst damage) threshold.

Spark Plug Cable Resistance Inspection

1. Turn the ignition switch “OFF” position.
2. Disconnect the spark plug cables Refer to *Section 1E1, Engine electrical.*
3. Measure the spark plug resistance using a multimeter.

Specified Value	1.8 ~ 2.2 kΩ

Notice: Replace the spark plug cable if the measured values is out of the specified values.

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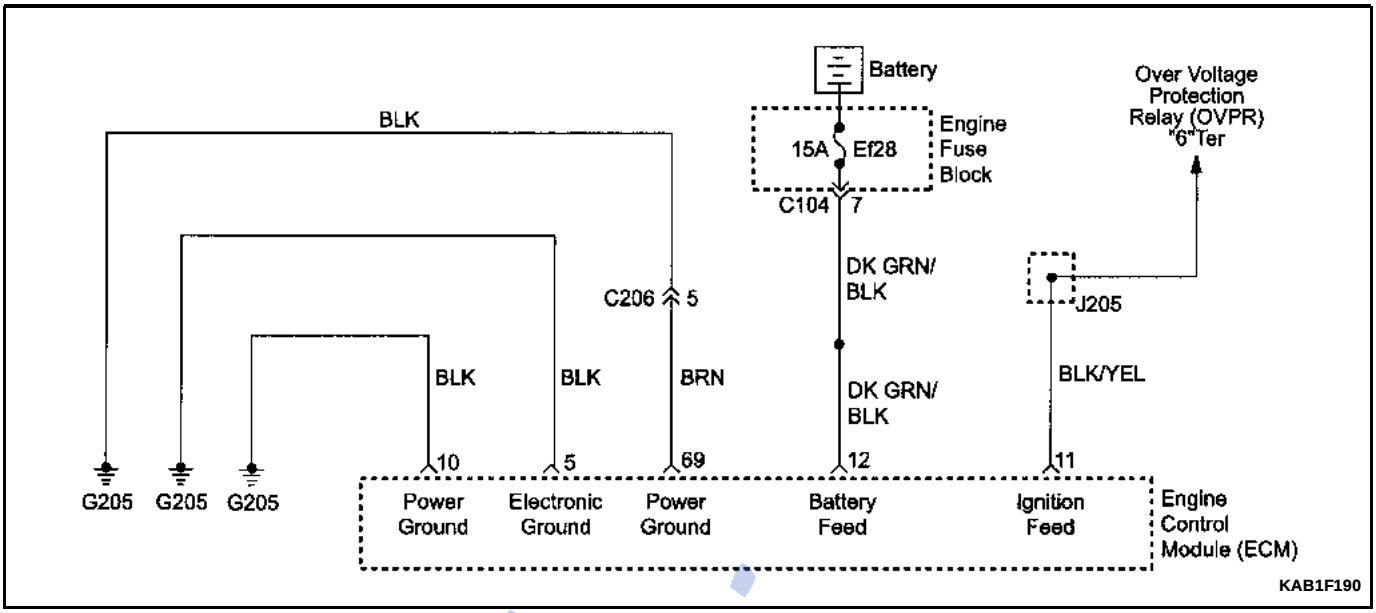
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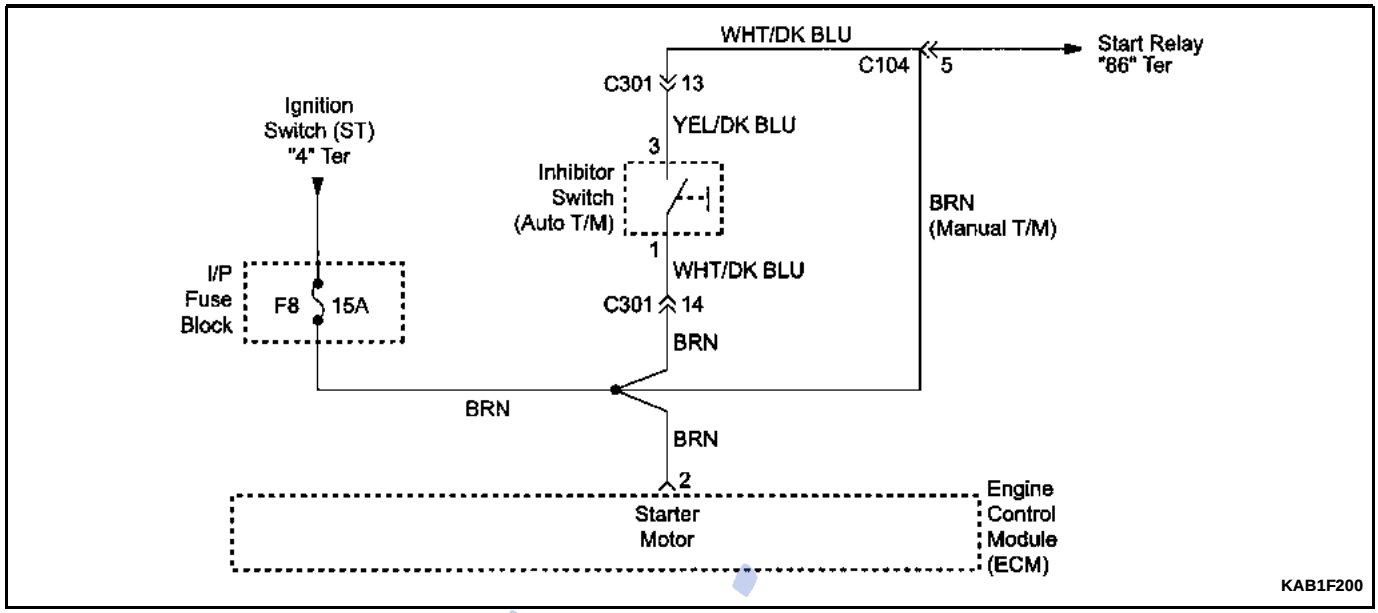
SYSTEM VOLTAGE



Failure Code	Description	Trouble Area	Maintenance Hint
08	System voltage too low	Malfunction in recognition of system source voltage. Less than minimum 8 volts in 2,000 rpm below, or less than 10 volts in 2,000 rpm above.	• Monitoring the actual battery voltages through the scan tool • Inspection the Engine Control Module (ECM) pin 12, 11, 10, 5 about short circuit or open with bad contact • Inspection the over voltage protection relay • Inspection the battery • Inspection ECM

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IGNITION SWITCH



Failure Code	Description	Trouble Area	Maintenance Hint
71	Starter signal recognition failure	When not detection of starter signal	• Inspection the Engine Control Module (ECM) pin 2 circuit short or open with bad contact • Inspection ECM

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FUEL SYSTEM

The function of the fuel metering system is to deliver the correct amount of fuel to the engine under all operating conditions. The fuel is delivered to the engine by the individual fuel injectors mounted into the intake manifold near each cylinder.

The main fuel control sensors are the Mass Air Flow (MAF) sensor and the oxygen (O2) sensors.

The MAF sensor monitors the mass flow of the air being drawn into the engine. An electrically heated element is mounted in the intake air stream, where it is cooled by the flow of incoming air. Engine Control Module (ECM) modulates the flow of heating current to maintain the temperature differential between the heated film and the intake air at a constant level. The amount of heating current required to maintain the temperature thus provides an index for the mass air flow. This concept automatically compensates for variations in air density, as this is one of the factors that determines the amount of warmth that the surrounding air absorbs from the heated element. MAF sensor is located between the air filter and the throttle valve.

Under high fuel demands, the MAF sensor reads a high mass flow condition, such as wide open throttle. The ECM uses this information to enrich the mixture, thus increasing the fuel injector on-time, to provide the correct amount of fuel. When decelerating, the mass flow decreases. This mass flow change is sensed by the MAF sensor and read by the ECM, which then decreases the fuel injector on-time due to the low fuel demand conditions.

The O2 sensors are located in the exhaust pipe before catalytic converter. The O2 sensors indicate to the ECM the amount of oxygen in the exhaust gas, and the ECM changes the air/fuel ratio to the engine by controlling the fuel injectors. The best air/fuel ratio to minimize exhaust emissions is 14.7 to 1, which allows the catalytic converter to operate most efficiently. Because of the constant measuring and adjusting of the air/fuel ratio, the fuel injection system is called a “closed loop” system.

The ECM uses voltage inputs from several sensors to determine how much fuel to provide to the engine. The fuel is delivered under one of several conditions, called “modes”.

Starting Mode

When the ignition is turned ON, the ECM turns the fuel pump relay on for 1 second. The fuel pump then builds fuel pressure. The ECM also checks the Engine Coolant Temperature (ECT) sensor and the Throttle Position (TP) sensor and determines the proper air/fuel ratio for starting the engine. This ranges from 1.5 to 1 at -36 °C (-33 °F) coolant temperature to 14.7 to 1 at 94 °C (201 °F) coolant temperature. The ECM controls the amount of fuel delivered in the starting mode by changing how long the fuel injector is turned on and off. This is done by “pulsing” the fuel injectors for very short times.

Run Mode

The run mode has two conditions called “open loop” and “closed loop”.

Open Loop

When the engine is first started and it is above 690 rpm, the system goes into “open loop” operation. In “open loop”, the ECM ignores the signal from the HO2S and calculates the air/fuel ratio based on inputs from the ECT sensor and the MAF sensor. The ECM stays in “open loop” until the following conditions are met:

- The O2 has a varying voltage output, showing that it is hot enough to operate properly.
- The ECT sensor is above a specified temperature (22.5 °C).
- A specific amount of time has elapsed after starting the engine.

Closed Loop

The specific values for the above conditions vary with different engines and are stored in the Electronically Erasable Programmable Read-Only Memory (EEPROM). When these conditions are met, the system goes into “closed loop” operation. In “closed loop”, the ECM calculates the air/fuel ratio (fuel injector on-time) based on the signals from the O2 sensors. This allows the air/fuel ratio to stay very close to 14.7 to 1.

Acceleration Mode

The ECM responds to rapid changes in throttle position and airflow and provides extra fuel.

Deceleration Mode

The ECM responds to changes in throttle position and airflow and reduces the amount of fuel. When deceleration is very fast, the ECM can cut off fuel completely for short periods of time.

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Battery Voltage Correction Mode

When battery voltage is low, the ECM can compensate for a weak spark delivered by the ignition module by using the following methods:

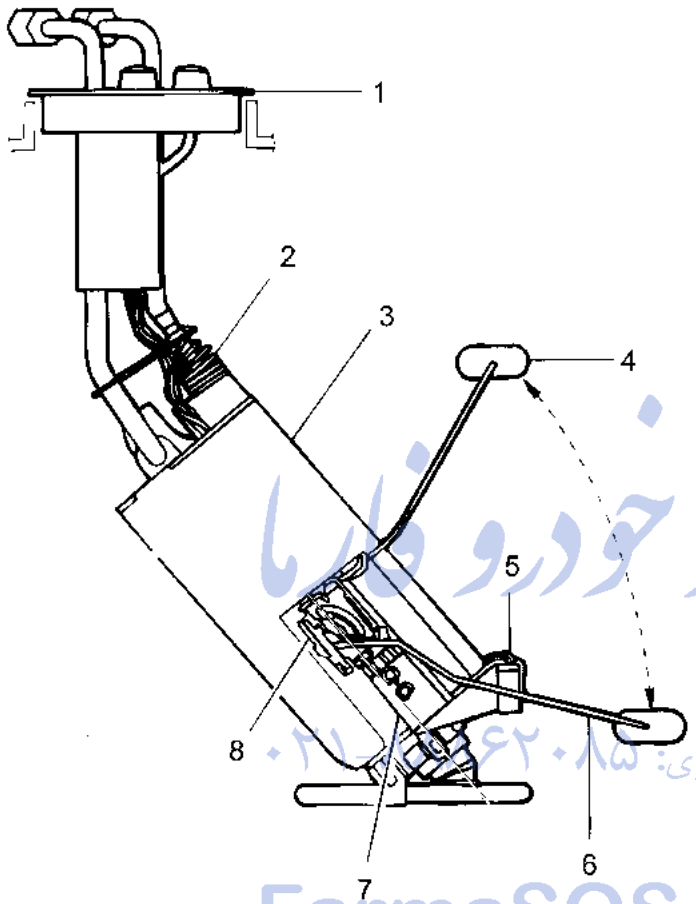
- Increasing the fuel injector pulse width.
- Increasing the idle speed rpm.
- Increasing the ignition dwell time.

Fuel Cut- Off Mode

No fuel is delivered by the fuel injectors when the ignition is off. This prevents dieseling or engine run-on. Also, the fuel is not delivered if there are no reference pulses received from the CKP sensor. This prevents flooding.

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FUEL PUMP



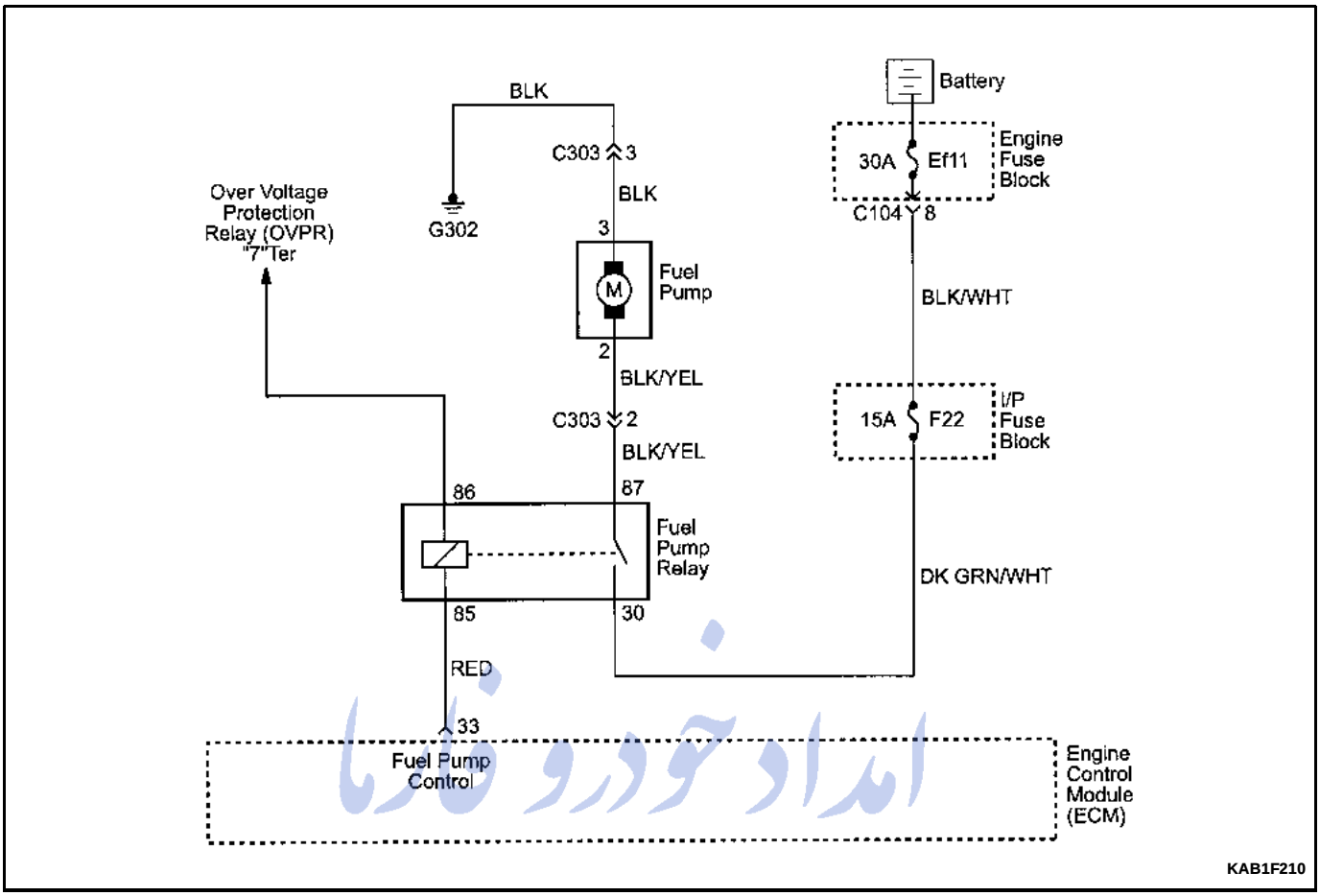
1. Flange and Harness Assembly
2. Spring
3. Fuel Pump
4. Float
5. Thermistor
6. Float Arm
7. Thermistor Housing
8. Resistor Card and Wiper

YAA1F380

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Requirements for Fuel Pump

Item	Specified Value	Item	Specified Value
System Pressure	3.8 bar	Minimum Delivery at 8V	30 Litre/Hr
Maximum Pressure	8.5 bar (12 V)	Operating Voltage	8 V
Minimum Pressure	5.0 bar (12 V)	Maximum Allowable Current	7.5 A
Nominal Voltage	12 V	Ambient Temperature	-30 ~ +70 °C
Minimum Amount of Fuel Supply	114 Liter/Hr (12 V, 3.8 bar, -30 ~ +70 °C)	Maximum Amount of Fuel Supply	165 Liter/Hr (12V, 3.8 bar, -30 ~ +70 °C)



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۰۲۱-۸۸۸۶۲۰۸۵ تلفن شبانه روزی:
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Failure Code	Description	Trouble Area	Maintenance Hint
34	Fuel pump relay short circuit to battery	When short circuit to power source	• Inspection the Engine Control Module (ECM) pin 33 about short circuit or open with bad contact • Inspection the fuel pump relay • Inspection the ECM
35	Fuel pump relay short circuit to ground or open	When short circuit to ground or open	

Circuit Description

When the ignition switch is turned ON, the ECM will activate the pump relay and run the in-tank fuel pump. The fuel pump will operate as long as the engine is cranking or running and the ECM is receiving ignition reference pulses.

If there are no reference pulses, the ECM will shut off the fuel pump within 2 seconds after the ignition switch is turned ON, engine stopped or engine stalled.

Fuel Pump Relay Inspection

Measure the voltage between the ECM terminal No. 33 and Ground.

Ignition Switch : ON	0 v (for 1 ~ 2 sec.)
Cranking	0 v

Measure the Fuel Delivery from the Fuel Pump

1. Disconnect the return pipe from fuel distributor and insert the appropriate hose into it.
2. Place the hose end into the beaker with the minimum capacity of 1 Liter
3. Turn the ignition switch to “ON” position.
4. Connect the terminal No. 33 and No. 5 of ECM with a service wire.
5. Measure the fuel delivery from the fuel pump

Specified Value	1 Liter/max. 35 sec.

Notice: Check the fuel filter and fuel line when the fuel delivery is not within specified value.

Measure the Current Consumption of Fuel Pump

1. Remove the fuel pump relay from fuse and relay box in trunk, and turn the ignition switch to “ON” position.
2. Using a multimeter, measure the current consumption by connecting the terminal No. 30 and No. 87 of the fuel pump relay connector.

Specified Value	5 ~ 9 A

Notice: Replace the fuel pump relay if the measured value is over 9 A.

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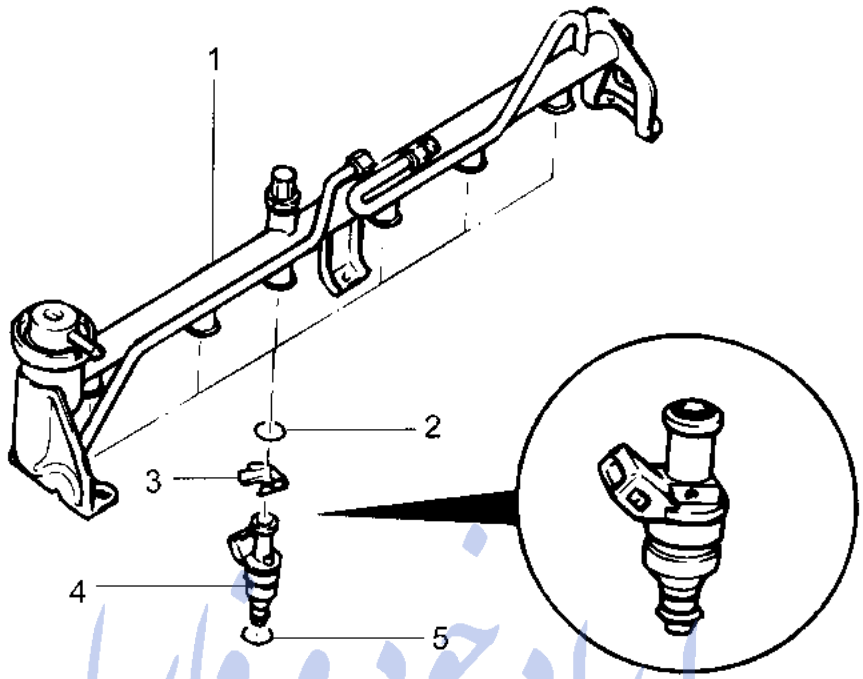
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FUEL INJECTOR



1. Fuel Rail
2. O - Ring
3. Injector Bracket
4. Injector
5. O - Ring

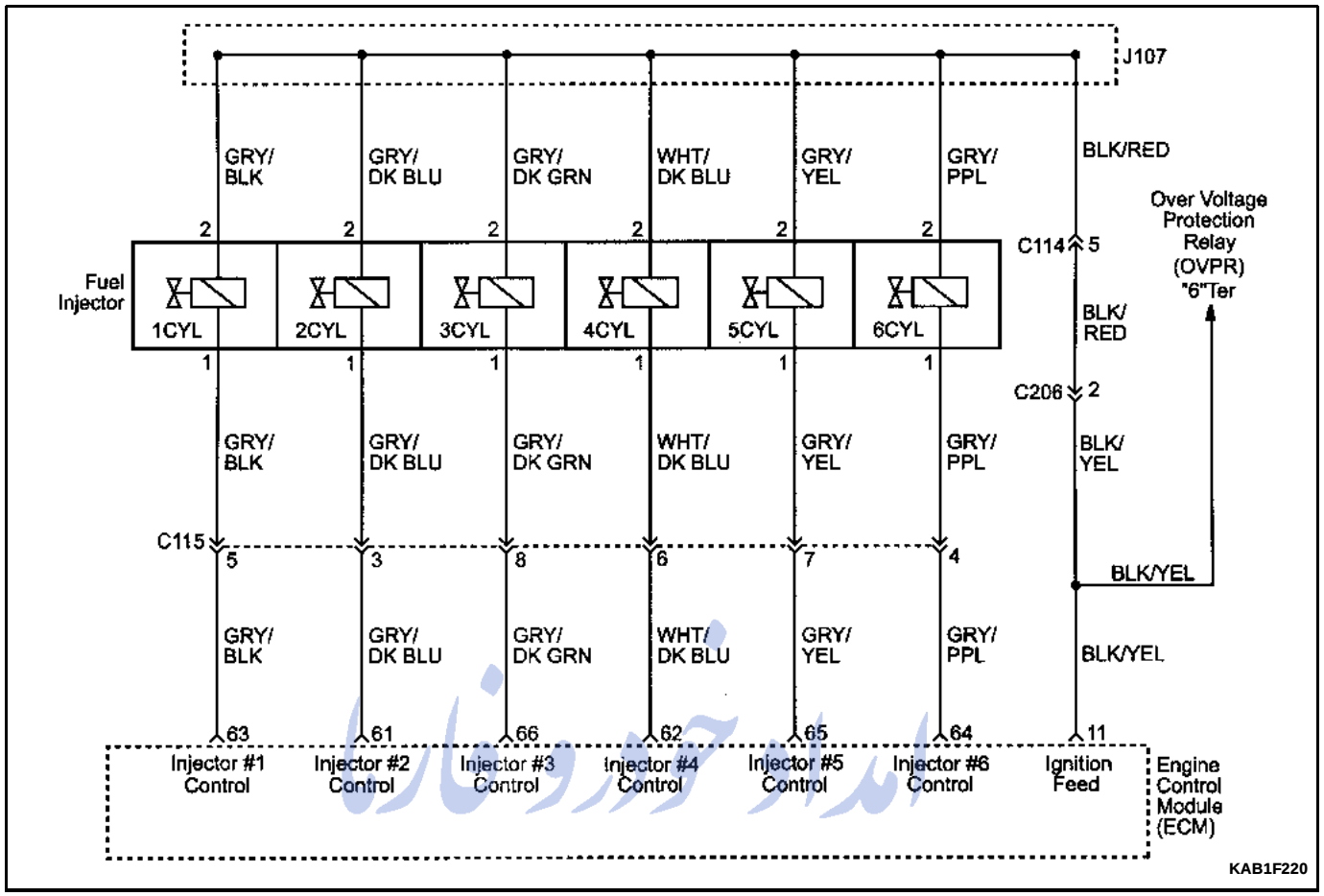
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The Multipoint Fuel Injection (MFI) assembly is a solenoid-operated device controlled by the Engine Control Module (ECM) that meters pressurized fuel to an each individual cylinder. The injector sprays the fuel, in precise quantities at a point in time determined by the ECM, directly toward the cylinder intake valve. ECM energizes the fuel injector solenoid to lift the needle valve and to flow the fuel through the orifice. This injector's discharge orifice is calibrated to meet the effective fuel atomization necessary for both ensuring the maximum homogeneity in the air-fuel mixture and holding the condensation along the walls of the intake tract to a minimum.

Fuel enters the top feed injector from above and flows through its vertical axis. The lower end extends into the intake valve. Fuel from the tip is directed at the intake valve, causing it to become further atomized and vaporized before entering the combustion chamber.

A fuel injector which is stuck partially open would cause a loss of fuel pressure after the engine is shut down. Also, an extended crank time would be noticed on some engines. Dieseling could also occur because some fuel could be delivered to the engine after the ignition is turned off.

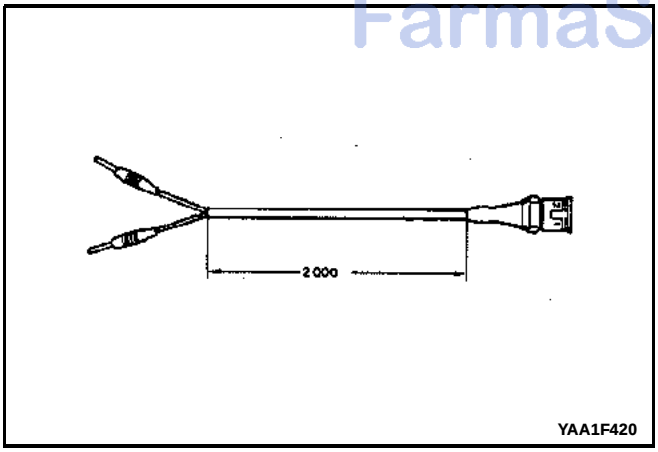


۰۲۱-۸۸۸۶۲۰۸۵ تلفن شبانه روزی:
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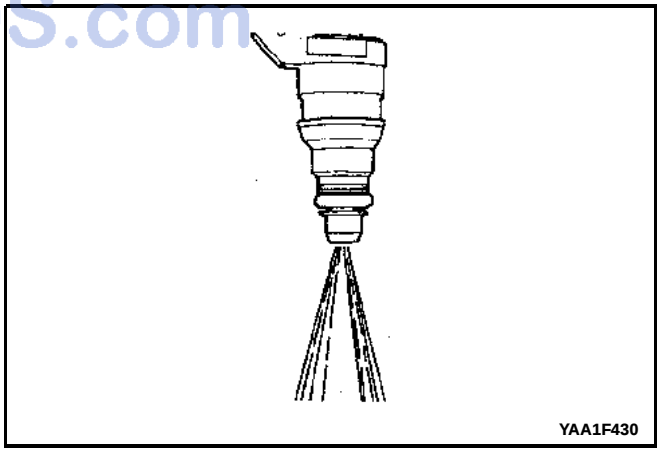
Failure Code	Description	Trouble Area	Maintenance Hint
72	No. 1 injector short circuit to battery	When malfunction of injector circuit Injector #1 short circuit to power	• Inspection the power to injector #1 or bad contact • Inspection the injector • Inspection the ECM
73	No. 1 injector short circuit to ground or open	When malfunction of injector circuit Injector #1 short circuit to ground or open	• Inspection the ECM pin 63 about short circuit or open with bad contact • Inspection the injector • Inspection the ECM
74	No. 2 injector short circuit to battery	When malfunction of injector circuit Injector #2 short circuit to power	• Inspection the power to injector #2 or bad contact • Inspection the injector • Inspection the ECM
75	No. 2 injector short circuit to ground or open	When malfunction of injector circuit Injector #2 short circuit to ground or open	• Inspection the ECM pin 61 about short circuit or open with bad contact • Inspection the injector • Inspection the ECM
76	No. 3 injector short circuit to battery	When malfunction of injector circuit Injector #3 short circuit to power	• Inspection the power to injector #3 or bad contact • Inspection the injector • Inspection the ECM

Failure Code	Description	Trouble Area	Maintenance Hint
77	No. 3 injector short circuit to ground or open	When malfunction of injector circuit Injector #3 short circuit to ground or open	• Inspection the ECM pin 66 about short circuit or open with bad contact • Inspection the injector • Inspection the ECM
78	No. 4 injector short circuit to battery	When malfunction of injector circuit Injector #4 short circuit to power	• Inspection the power to injector #4 or bad contact • Inspection the injector • Inspection the ECM
79	No. 4 injector short circuit to ground or open	When malfunction of injector circuit Injector #4 short circuit to ground or open	• Inspection the ECM pin 62 about short circuit or open with bad contact • Inspection the injector • Inspection the ECM
192	No. 5 injector short circuit to battery	When malfunction of injector circuit Injector #5 short circuit to power	• Inspection the power to injector #5 or bad contact • Inspection the injector • Inspection the ECM
193	No. 5 injector short circuit to ground or open	When malfunction of injector circuit Injector #5 short circuit to ground or open	• Inspection the ECM pin 65 about short circuit or open with bad contact • Inspection the injector • Inspection the ECM
194	No. 6 injector short circuit to battery	When malfunction of injector circuit Injector #6 short circuit to power	• Inspection the power to injector #6 or bad contact • Inspection the injector • Inspection the ECM
195	No. 6 injector short circuit to ground or open	When malfunction of injector circuit Injector #6 short circuit to ground or open	• Inspection the ECM pin 64 about short circuit or open with bad contact • Inspection the injector • Inspection the ECM

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YAA1F420


YAA1F430

Injector Spray Pattern Check

1. Turn the ignition switch OFF.
2. Remove the fuel injector connectors.
3. Remove the fuel distributor and injector with a unit. At this time, do not remove the supply and return line.

Notice: Prepare the beaker for taking the fuel.

4. Connect the shop made cable to the injector with a firing order.
5. Connect the other end of shop made cable to the positive battery cable and negative battery cable.
6. Turn the ignition switch ON.
7. Check the injector for normal spray pattern as shown in the figure. Check injector for leaks or later drop

Injector Resistance Inspection

1. Turn the ignition switch OFF.
2. Remove the fuel injector connectors.
3. Measure the fuel injector coil resistance using a multimeter.

Specified Value	14 ~ 17 Ω

Notice: Replace the fuel injector if the measured value is out of the specified values. Check the connector and wire connection between the ECM and the injector if the measured values are normal.

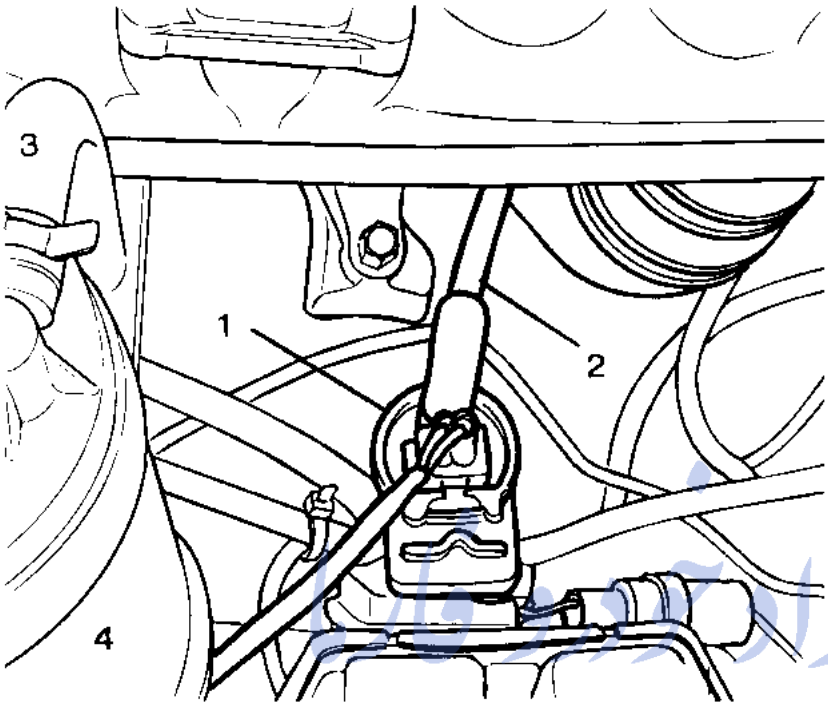
Injector Pulse Width Inspection

1. Turn the ignition switch OFF.
2. Install the scan tool.
3. Turn the ignition switch ON.
4. Monitor the “INJECTION TIME” with a scan tool.

Cranking	8.0 ms
Engine Idle	3 ~ 5 ms
Wide Open Throttle (WOT)	14 ms

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PURGE CONTROL VALVE



1. Purge Control Valve
2. Line to Engine
3. Line to Canister
4. Canister

YAA1F440

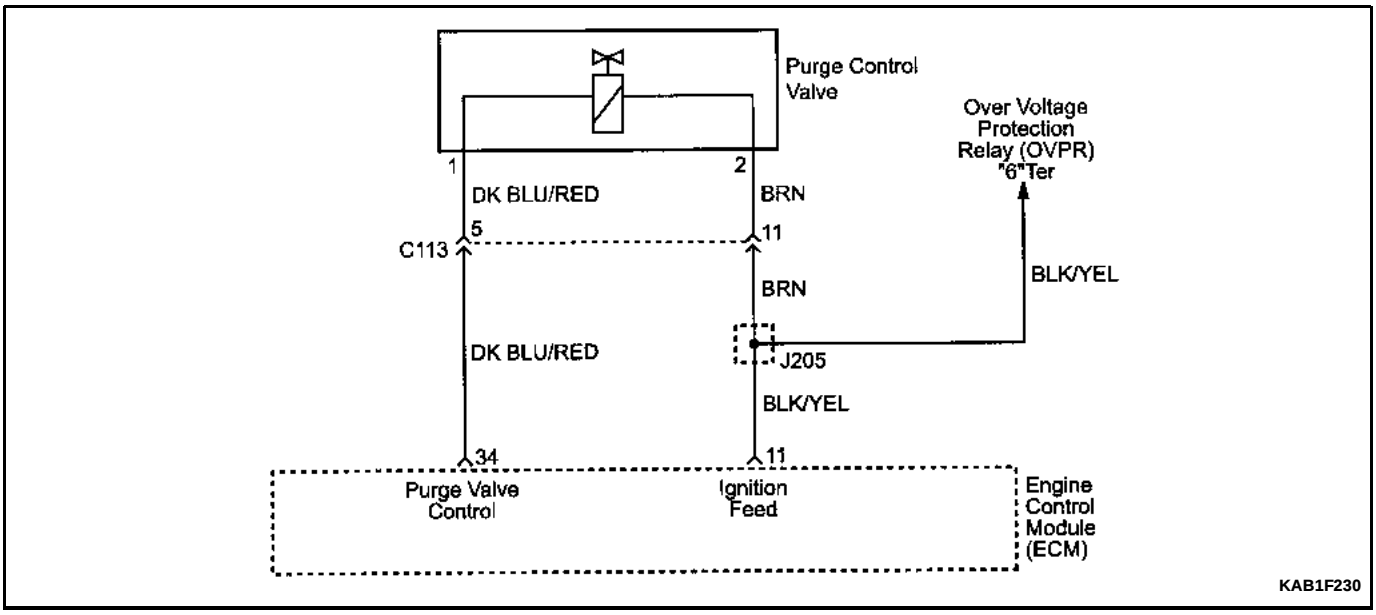
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The fuel vaporization control system is installed to inhibit the fuel vaporized gas from discharging into the atmosphere. The fuel vaporized gas that is accumulated in the canister abstracts through the purge control valve purification during the engine combustion (except the decreasing mode) and coolant temperature of over 80°C. For this reason, the Engine Control Module (ECM) transacts the engine speed, air inflow quantity, coolant temperature, and intake temperature.

The purge control valve is activated by the ECM frequency according with the engine rotating speed to adjust the purification rate. The purification rate is determined by the continuous valve opening interval.

The purge control valve is activated by the ECM for the following conditions:

- Coolant temperature of over 80 °C
- Engine speed of over 1,000 rpm
- 2 minutes after starting
- When the fuel cut-off mode is not activated

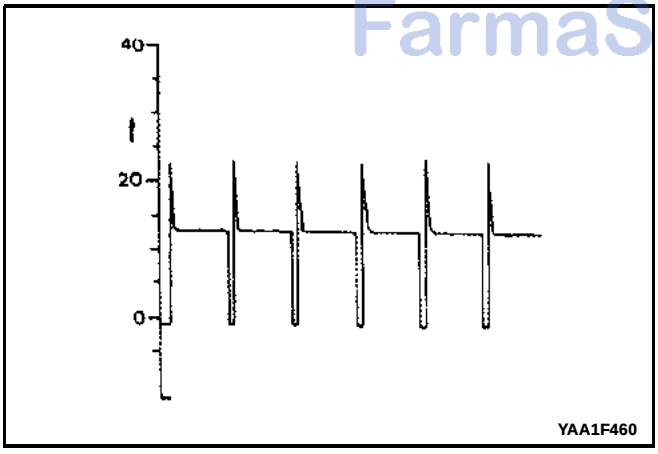


Failure Code	Description	Trouble Area	Maintenance Hint
40	Purge control valve short circuit to battery	When short circuit to power source	• Inspection the ECM pin 34 about short circuit or open with bad contact • Inspection the source power of valve • Inspection the purge control solenoid vale • Inspection the ECM
41	Purge control valve short circuit to ground or open	When short circuit to ground or open	
54	Purge control circuit malfunction	When malfunction of purge control : not work	

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Test

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1. Maintain the normal temperature and idling state by operating the engine.
2. Connect the ECM terminal No. 11 and No. 34 and check for normal operation through the output waves using oscilloscope.

Notice: Test during purge control valve operation after the minimum of 1 minute after the engine turned on.

3. Connect the ECM terminal No. 34 and No.10 and check for current consumption during the ignition switch ON.

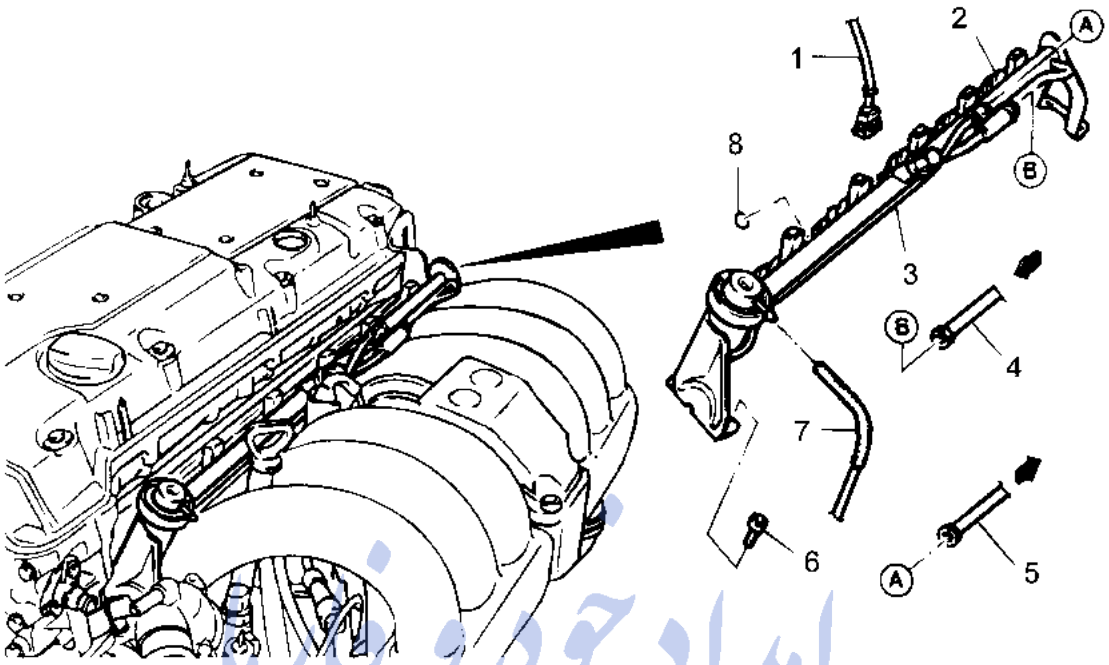
Specified Value	0.3 ~ 0.5 A

4. Remove the line to canister and measure the pressure with the vacuum pressure gauge.

Specified Value	> 500 mbar (after approx. 1 min.) purge control valve operates at this time

Notice: Test while at normal temperature and at idling state by operating the engine.

FUEL RAIL



1. Injector Connector
2. Injector
3. Fuel Rail
4. Fuel Supply Line
5. Fuel Return Line
6. Bolt
7. Vacuum Hose
8. O - Ring

YAA1F470

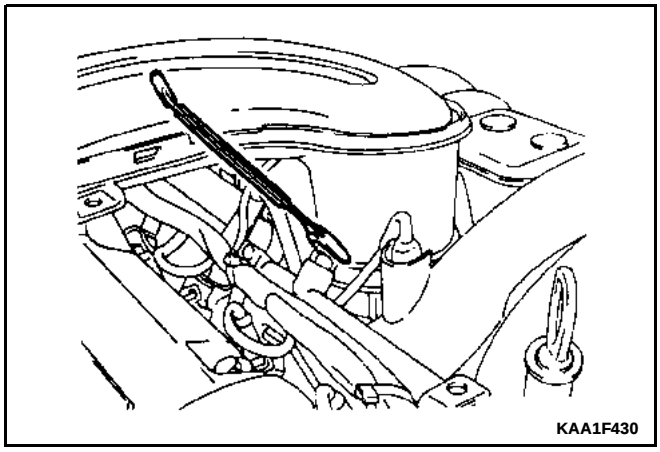
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Fuel Pressure Test

Tools Required

103 589 00 21 00 Fuel Pressure Gauge

1. Turn the ignition switch to “OFF” position.
2. Remove the fuel pressure test connector.


KAA1F430

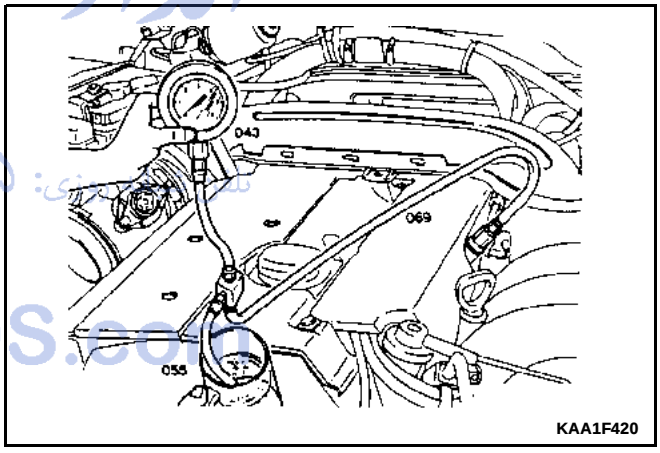
3. Connect the fuel pressure gauge to the fuel pressure test connector.
4. Test the fuel pressure at idling by operating the engine using the fuel pressure gauge 103 589 00 21 00.

Vacuum Hose Connected (bar)	3.2~3.6
Vacuum Hose Disconnected (bar)	3.7~4.2

5. Replace the pressure regulator diaphragm if out of the specification.

Internal Leakage Test

1. Connect the fuel pressure gauge 103 589 00 21 00 to the fuel pressure test connector.



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2. Stop the engine for approximately 30 minutes and then check the fuel pressure changes.

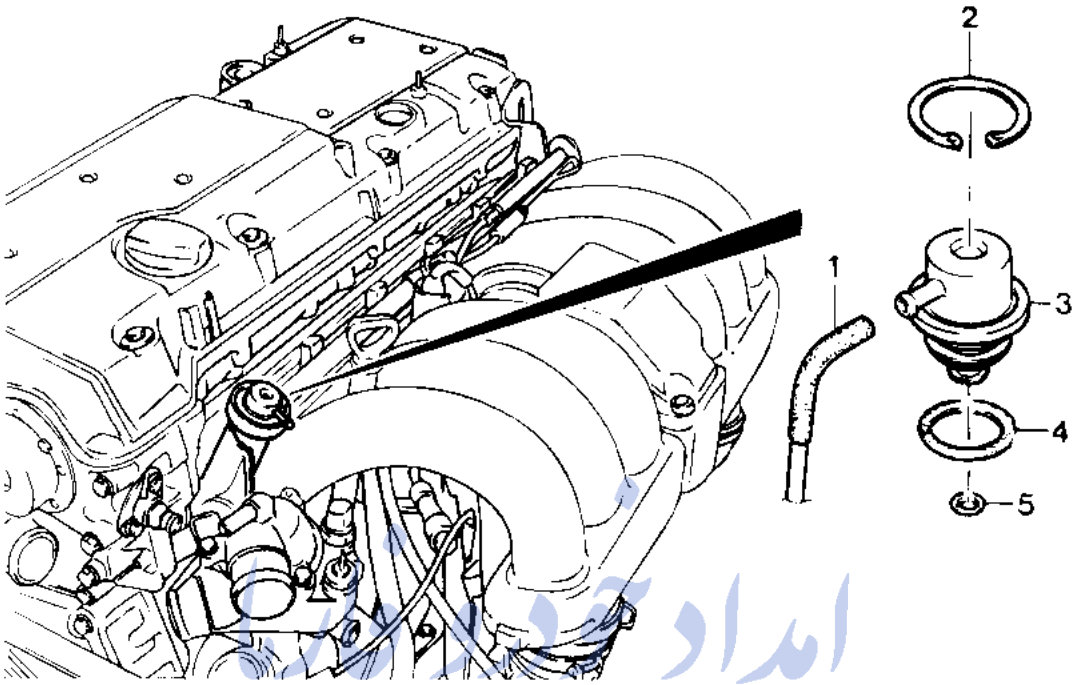
Pressure change	
Fuel pressure drops slowly	• Fuel leakage at the injector • Faulty fuel pressure regulator’s diaphragm and O-ring
Fuel pressure drops rapidly	• Faulty check valve in the fuel pump

3. If there is no change in fuel pressure and maintain the following pressure over 30minutes, it is normal.

Fuel pressure (bar)	≥ 2.5

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۰۲۱-۸۸۸۶۲۰۸۵
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FUEL PRESSURE REGULATOR



1. Vacuum Hose
2. Circlip
3. Fuel Pressure Regulator
4. O - Ring
5. O - Ring

YAA1F480

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Function of the Fuel Pressure Regulator

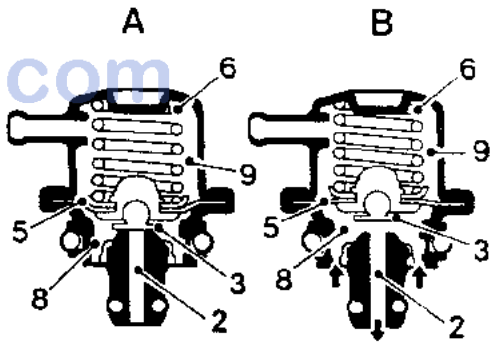
The fuel pressure regulator maintains the fuel pressure in the fuel line with the pressure of 3.2 bars to 3.8 bars according to the intake manifold pressure. This operating pressure cannot be changed, and the fuel injection volume will be only determined by the injection time. Over supplied fuel returns to the fuel tank through the return line.

<Operating at full load>

There is no negative pressure applied to the spring chamber (9) during the full load, and it is separated from the fuel chamber (8) by the diaphragm (5).

When the fuel pressure goes up, the diaphragm forces the compression spring (6) in the direction of compression . At this moment, the valve (3) sticks to the diaphragm by the fuel pressure, and the fuel return line (2) opens. The fuel over supplied returns to the fuel tank through the return line.

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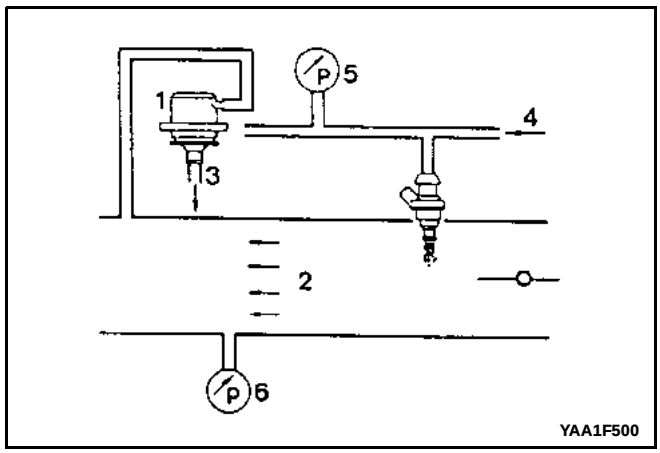


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2. Fuel return line
3. Valve
5. Diaphragm
6. Compression Spring
8. Fuel Chamber
9. Spring Chamber

A. Valves Closed
B. Valves Opened

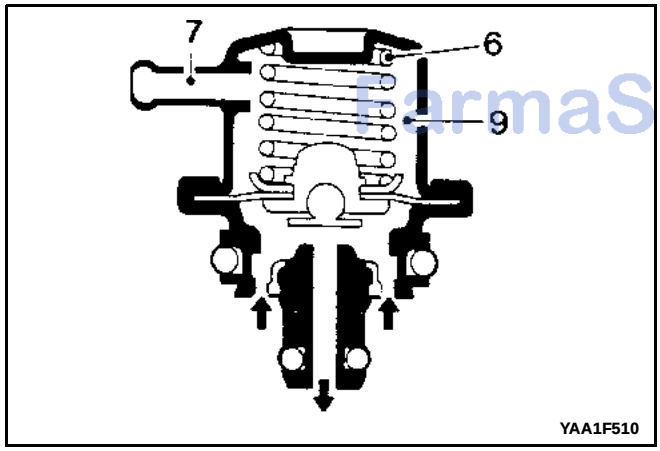
The pressure difference between the fuel pressure and the intake manifold is about 3.8 bars during the full load.



1. Fuel Pressure Regulator
2. Intake Manifold
3. Fuel Return (to fuel tank)
4. Fuel Supply (from fuel pump)
5. Fuel Pressure (approx. 3.8 bars)
6. Intake Manifold Negative Pressure (0 bar)

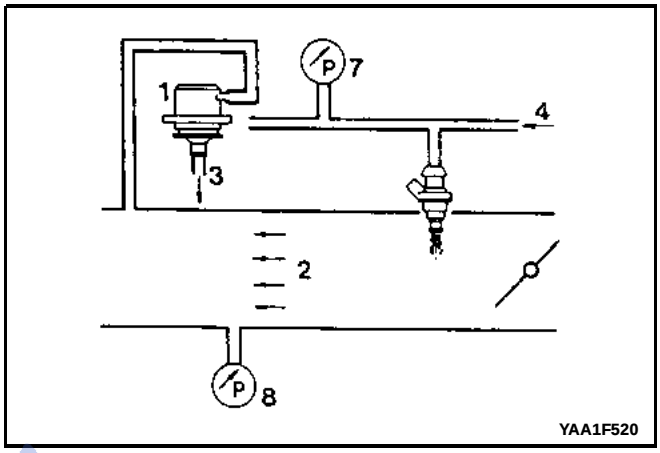
<Operating at Idle and partial load>

The spring chamber (9) is connected to the intake manifold with the vacuum hose at the intake pipe connection (7). The negative pressure generated in the intake manifold activates the diaphragm, and thus the fuel pressure gets reduced to the rate of the operating extent of the diaphragm by the intake manifold's negative pressure.



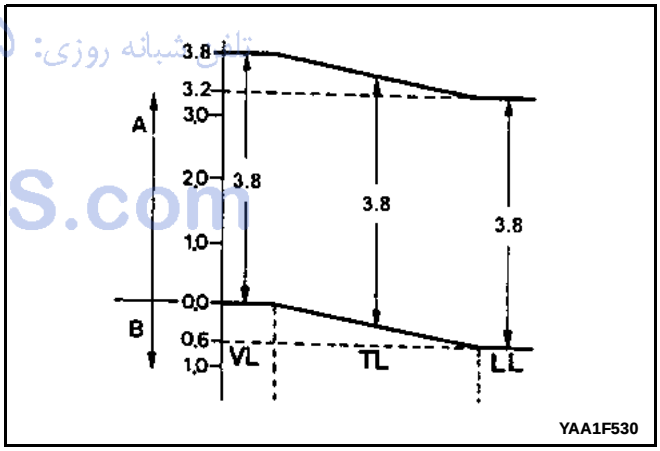
Consequently, the fuel pressure in the fuel distributor changes by the intake manifold's negative pressure, and the injector's fuel pressure gets reduced independently to the throttle valve's position. Thus, the fuel injection volume can only be determined according to the injector's injecting duration.

The pressure difference between the fuel pressure and the intake manifold is approx. 3.2 bars during idling.



1. Fuel Pressure Regulator
2. Intake Manifold
3. Fuel Return (to fuel tank)
4. Fuel Supply (from fuel pump)
7. Fuel Pressure (approx. 3.2 bars)
8. Intake Manifold Negative Pressure (0.6 bars)

<Fuel Pressure Diagram>

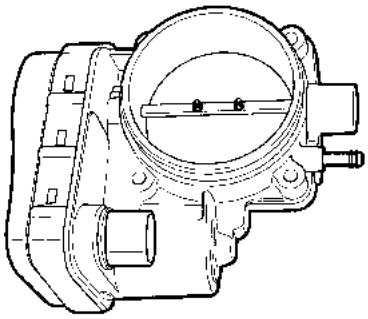


A. Fuel pressure
B. Intake Manifold Negative Pressure
LL. Idling
TL. Partial load
VL. Full load

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INDUCTION SYSTEM

THROTTLE VALVE ACTUATOR



YAA1F540

The throttle actuator is actuated by the Engine Control Module (ECM) according to the position of the accelerator pedal position.

It has two potentiometers which signal the position of the throttle valve to the ECM to enable it to recognize the various engine load states.

Ignition “Off”

In the de-energized states the throttle valve position is determined to be spring capsule.

Ignition “On”

When the ignition S/W on the servo motor in the throttle actuator is operated by the ECM. The throttle valve adopts a position in line with the coolant temperature.

Closed position

In the closed throttle position, the servo motor controls engine speed by operating the throttle valve further (greater mixture) or closing it further (reduced mixture), depending on coolant temperature and engine load. When this is done, the throttle valve can be closed further by the servo motor overcoming the force of the spring capsule (mechanical end stop). If the actuator is de-energized, the throttle valve is resting against the spring capsule.

Consequently, the throttle valve opening is a constant 10-12° approximately.

At no load, this produces an engine speed of about 1,800 rpm

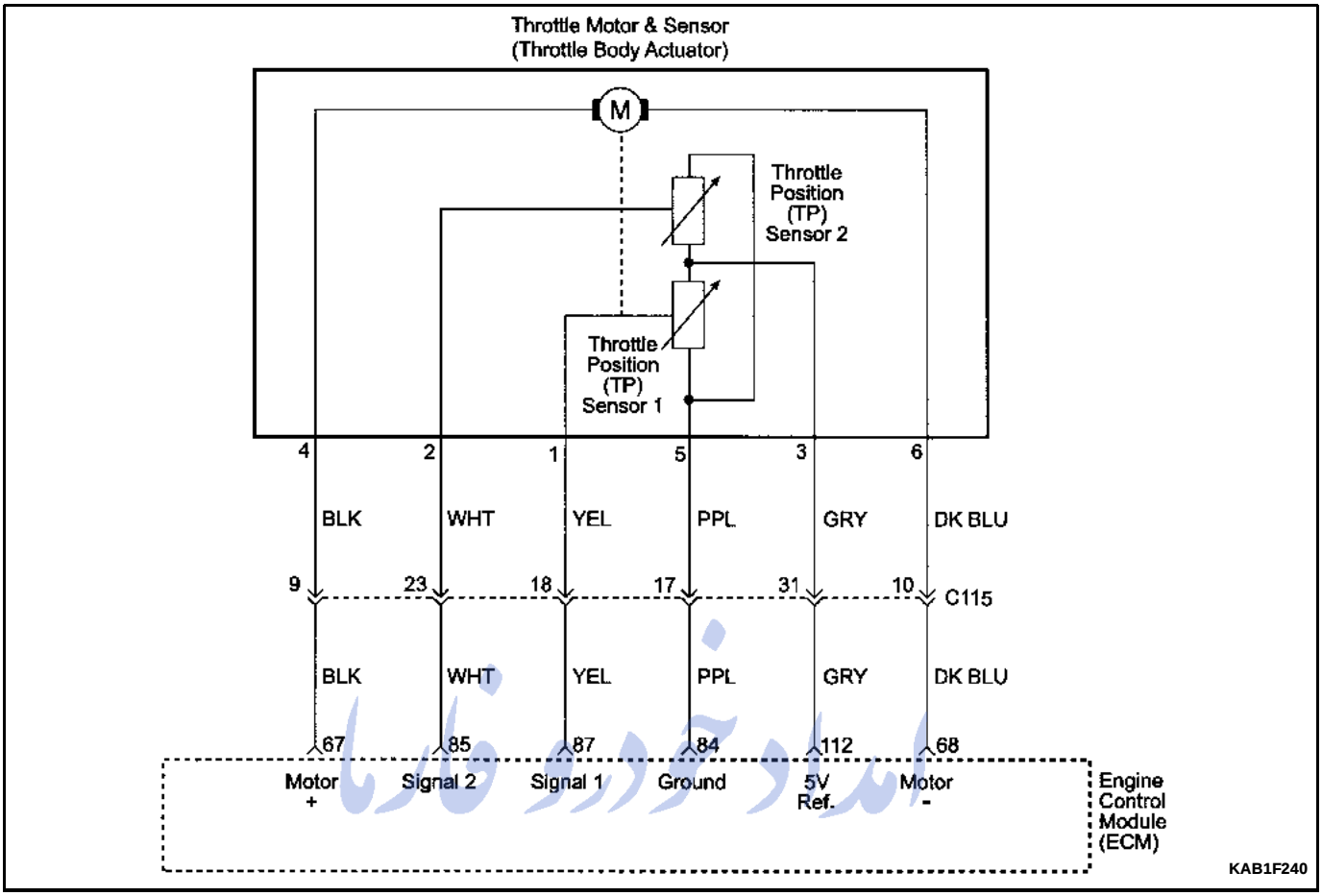
Driving

When driving (part/full throttle), the servo motor controls the throttle valve in line with the various load states and according to the input signals from the pedal value sensor according to the input signals from the pedal value sensor according to the position of the accelerator pedal.

The function of the EA (electronic accelerator) in the ECM determines the opening angle of the throttle valve through the throttle actuator. Further functions are;

- Idle speed control
- Cruise control
- Reducing engine torque for ASR/ABS operation
- Electronic accelerator emergency running
- Storing faults
- Data transfer through CAN

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Failure Code	Description	Trouble Area	Maintenance Hint
104	Throttle position sensor 1 low voltage	TPS 1 short circuit to ground or open	• Monitoring the actual values through scan tool • Inspection the ECM pin 84, 85, 87, 112, 67, 68 about short circuit or open with bad contact • Inspection the throttle valve actuator • Inspection the ECM
105	Throttle position sensor 1 high voltage	TPS 1 short circuit to power	
108	Throttle position sensor 2 low voltage	TPS 2 short circuit to ground or open	
109	Throttle position sensor 2 high voltage	TPS 2 short circuit to power	
116	Throttle actuator learning control failure	When actuator adaption fluctuation or not meet the condition	
119	Throttle valve return spring failure	When return spring defective of actuator	
121	Throttle actuator failure	When supply voltage of the actuator short circuit to power	
123	Different mass air flow sensor signal with throttle position sensor	When shut down of output driver	
125	Both throttle position sensor failure	When defective of both potentiometers	

Failure Code	Description	Trouble Area	Maintenance Hint
126	Throttle position sensor 1 not plausible with Throttle position sensor 2	When difference between TPS 1 and TPS 2	• Monitoring the actual values through scan tool • Inspection the ECM pin 84, 85, 87, 112, 67, 68 about short circuit or open with bad contact • Inspection the throttle valve actuator • Inspection the ECM
127	High permanent throttle signal	When failure of wiring harness or actuator	
185	Mass air flow sensor and throttle position sensor failure	When difference between MAF and TPS signal	

Circuit Description

The ECM supplies a 5 volt reference signal and a ground to the TP sensor. The TP sensor sends a voltage signal back to the ECM relative to the throttle plate opening. The voltage signal will vary from approximately 0.3 ~ 0.9 volts at closed throttle, to over 4.0 ~ 4.6 volts at Wide Open Throttle (WOT).

The TP sensors serve for engine load control according to the drive pedal command. Load adjustments independent of the drive pedal command can be implemented; such functions are, for instance, idle control, speed control, drive slip control, load shock damping, and similar functions.

When the actuator current fails, the throttle valve is returned to emergency operating position by a spring. The throttle valve position, thereby the actuator drive position checkback is provided by two potentiometers. The motor positions the throttle valve against the return spring force. Motor and return spring are two separate energy sources. Each of them is able to position the throttle valve in emergency position alone. Throttle valve position checkback and monitoring is provided by two actual value potentiometers connected to the engine control electronics.

Throttle Actuator Inspection

1. Turn the ignition switch to “ON” position.
2. Measure the TPS 1 signal voltage at the ECM pin No. 87 and TPS 2 signal voltage at the ECM pin No. 85.

	Pedal Position	Specified Value
TPS 1	Closed	0.3 ~ 0.9 v
	Opened	4.0 ~ 4.6 v
TPS 2	Closed	4.0 ~ 4.6 v
	Opened	0.3 ~ 0.9 v

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Throttle Actuator DC Motor Inspection

1. Turn the ignition switch to “ON” position.
2. Measure the signal voltage between the ECM pin No. 67 and No. 68.

Application		Specified Value
Engine Status	Ignition “ON”	0.8 ~ 2.3 v
	Idling	1.0 ~ 2.5 v (Coolant temperature is over 70°C)

Throttle Actuator DC Motor Resistance

1. Turn the ignition switch to “OFF” position.
2. Measure the resistance between the ECM pin No. 67 and No. 68.

Specified Value	< 10 Ω

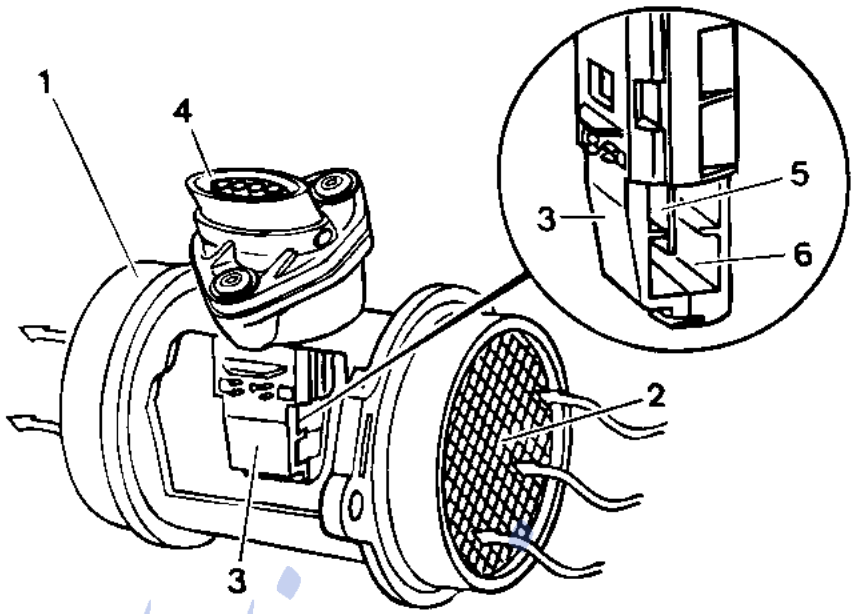
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HOT FILM AIR MASS (HFM) SENSOR



1. Housing
2. Protector Net
3. Electronic Housing
4. Connector
5. Hot Film Air Mass Sensor
6. Measuring Port

YAA1F570

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The Hot Film Air Mass (HFM) sensor with recognition of flow direction related to pulsating flow is designed for recording load on Engine Control Module (ECM) by measuring the output voltage proportional to the reference voltage of the ECM.

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Mass Air Flow Sensor

Mass Air Flow (MAF) is a thermal flow meter whose sensor element with its temperature sensors and heating area is exposed to the MAF to be measured. A heating area located in the center of a thin membrane is controlled to an over-temperature by a heating resistor and a temperature sensor of this membrane. And the value of over-temperature depends on the temperature of the in-flowing air.

Two temperature sensors on upstream and downstream of the heating area show the same temperature without incoming flow. With incoming flow, upstream part is cooled down but downstream temperature retains its temperature more or less due to the air heated up in the heating area. This temperature difference in quantity and direction depends on the direction of the incoming flow.

ECM modulates the flow of heating current to maintain the temperature differential between the heated film and the intake air at a constant level. The amount of heating current required to maintain the temperature thus provides an index for the MAF. This concept automatically compensates for variations in air density, as this is one of the factors that determines the amount of warmth that the surrounding air absorbs from the heated element. MAF sensor is located between the air filter and the throttle valve.

Under high fuel demands, the MAF sensor reads a high mass flow condition, such as Wide Open Throttle (WOT). The ECM uses this information to enrich the mixture, thus increasing the fuel injector on-time, to provide the correct amount of fuel. When decelerating, the mass flow decreases. This mass flow change is sensed by the MAF sensor and read by the ECM, which then decreases the fuel injector on-time due to the low fuel demand conditions.

To facilitate the installation of the HFM in the intake passage, lubricating agents may be used. However, when lubricants are used care must be taken to ensure that they do not enter the flow passage and cannot be sucked in with the air flow.

The following tables show the relationship between MAF and output voltage.

Mass Air Flow (kg/h)	Voltage (v)	Mass Air Flow (kg/h)	Voltage (v)
0	0.95 ~ 1.05	250	3.51
10	1.28	370	3.93
15	1.41	480	4.23
30	1.71	640	4.56
60	2.16	800	4.82
120	2.76		

Intake Air Temperature

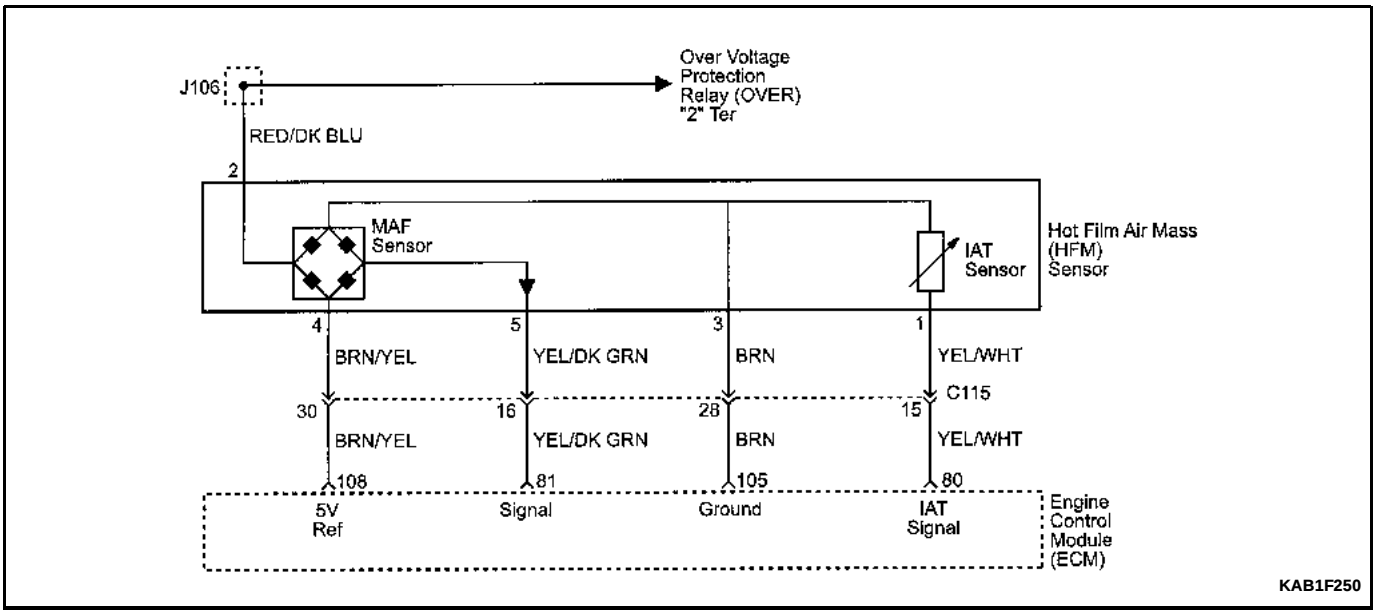
The Intake Air Temperature (IAT) sensor is a part of Hot Film Air Mass (HFM) sensor and is a thermistor, a resistor which changes value based on the temperature of the air entering the engine. Low temperature produces a high resistance, while high temperature causes a low resistance as the following table.

The ECM provides 5 volts to the IAT sensor through a resistor in the ECM and measures the change in voltage to determine the IAT. The voltage will be high when the manifold air is cold and low when the air is hot. The ECM knows the intake IAT by measuring the voltage.

The IAT sensor is also used to control spark timing when the manifold air is cold.

Temp. (°C)	R min. (Ω)	R nom. (Ω)	R max. (Ω)
-40	35140	39260	43760
-20	12660	13850	15120
0	5119	5499	5829
20	2290	2420	2551
40	1096	1166	1238
60	565	609	654
80	312	340	370
100	184	202	222
120	114	127	141
130	91	102	114

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Failure Code	Description	Trouble Area	Maintenance Hint
03	Intake air temperature sensor low voltage	IAT sensor short circuit to ground or open	• Monitoring the actual air temperature through scan tool • Inspection the ECM pin 80, 79 about short circuit or open with bad contact • Inspection the IAT sensor (integrated in HFM sensor) • Inspection the ECM
04	Intake air temperature sensor high voltage	IAT sensor short circuit to power	
05	Intake air temperature sensor plausibility	Malfunction in recognition of IAT When functional problem	
09	Mass air flow sensor plausibility	Malfunction in recognition of MAF When air mass not plausible	• Monitoring the actual air mass flow through scan tool • Inspection the ECM pin 81, 105 about short circuit or open with bad contact • Inspection the MAF sensor (integrated in HFM sensor) • Inspection the ECM
10	Mass air flow sensor low voltage	MAF sensor short circuit to ground or open	
11	Mass air flow sensor high voltage	MAF sensor short circuit to power	

Circuit Description

The heated element on the MAF is a platinum film resistor (heater). It is located on a ceramic plate together with the other elements in the bridge circuit. The temperature sensitive resistor (flow sensor) also included in the bridge. The separation of heater and flow sensor facilitates design of the control circuitry. Saw cuts are employed to ensure thermal decoupling between the heating element and the intake air temperature (IAT) sensor. The complete control circuitry is located on a single layer. The voltage at the heater provides the index for the mass air flow. The MAF's electronic circuitry then converts the voltage to a level suitable for processing in the ECM. This device does not need a burn off process to maintain its measuring precision over an extended period. In recognition of the fact that most deposits collect on the sensor element's leading edge, the essential thermal transfer elements are located downstream on the ceramic layer. The sensor element is also design to ensure that deposits will not influence the flow pattern around the sensor.

The IAT sensor uses a thermistor to control the signal voltage to the ECM. The ECM supplies 5 volt reference and a ground to the sensor. When the air is cold, the resistance is high; therefore the IAT signal voltage will be high. If the intake air is warm, resistance is low; therefore the IAT signal voltage will be low.

Mass Air Flow Sensor Input Voltage Inspection

1. Turn the ignition switch to “ON” position.
2. Measure the signal voltage between the ECM pin No. 103 and No. 104.

Application		Specified Value
Engine Status	Ignition “ON”	0.9 ~ 1.1 v
	Idling	1.3 ~ 1.7 v (Coolant temperature is over 70°C)

Notice: If the measured value is not within the specified value, the possible cause may be in cable or MAF sensor in itself. Perform the 5 volt power supply inspection procedures.

Mass Air Flow Sensor 5 volt Power Supply Inspection

1. Turn the ignition switch to “OFF” position.
2. Disconnect the HFM sensor connector.
3. Turn the ignition switch to “ON” position.
4. Measure the voltage between the ECM pin No. 108 and MAF sensor connecter terminal No. 3.

Specified Value	4.7 ~ 5.2 v

Notice: If the measured value is not within the specified value, the possible cause may be in cable or ECM coupling.

5. Measure the voltage between the ECM pin No. 105 and MAF sensor connecter terminal No. 4.

Specified Value	4.7 ~ 5.2 v

Notice: If the measured value is not within the specified value, the possible cause may be in cable or ECM coupling.

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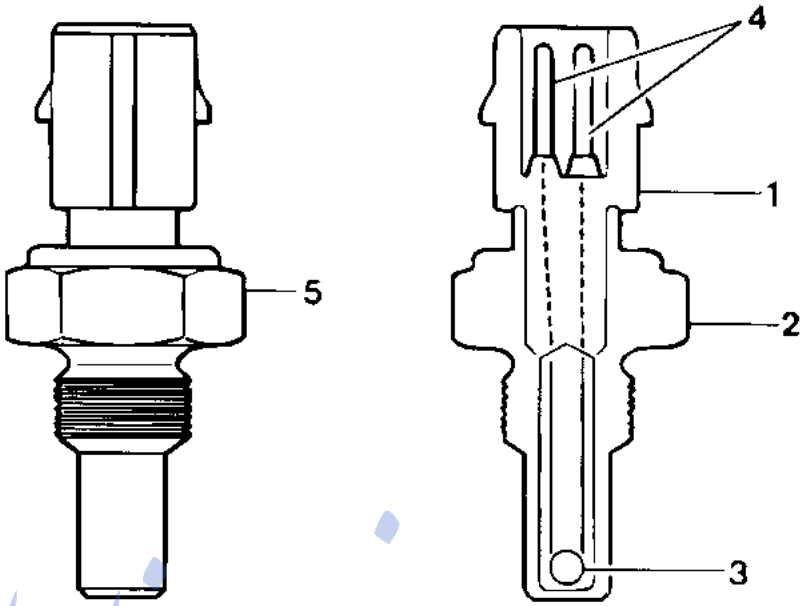
Mass Air Flow Sensor 12 volt Power Supply Inspection

1. Turn the ignition switch to “OFF” position.
2. Disconnect the HFM sensor connector.
3. Turn the ignition switch to “ON” position.
4. Measure the voltage between the ECM pin No. 105 and MAF sensor connecter terminal No. 2.

Specified Value	11 ~ 14 v

Notice: If the measured value is not within the specified value, the possible cause may be in cable or Over Voltage Protection Relay (OVPR).

ENGINE COOLANT TEMPERATURE (ECT) SENSOR



1. Artificial Resin Housing
2. Metal Housing
3. NTC (Negative Temperature Coefficient) Resistor
4. Connector
5. Engine Coolant Temperature Sensor

YAA1F590

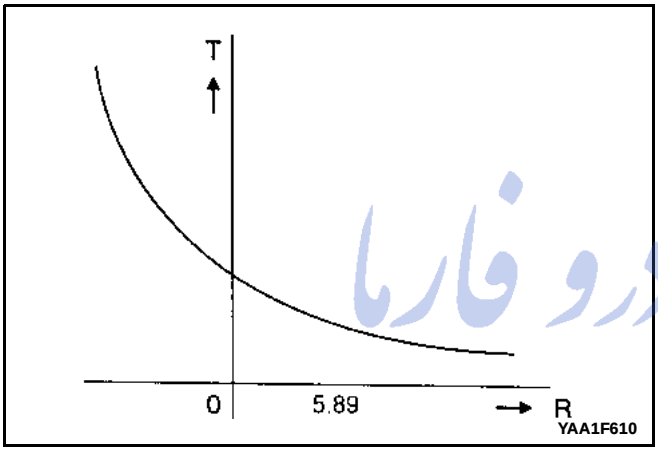
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Engine Coolant Temperature (ECT) sensor detects coolant temperature and supplies information to the ECM. It is composed of metal housing with two NTC resistor, 4 pin connector. The ECM provides a 5 volt signal to the ECT sensor through a dropping resistor. When the engine is cold, the ECT sensor provides high resistance, which the ECM detects as a high signal voltage. As the engine warms up, the sensor resistance becomes lower, and the signal voltage drops. At normal engine operating temperature, the ECT signal will measure about 1.5 to 2.0 volts.

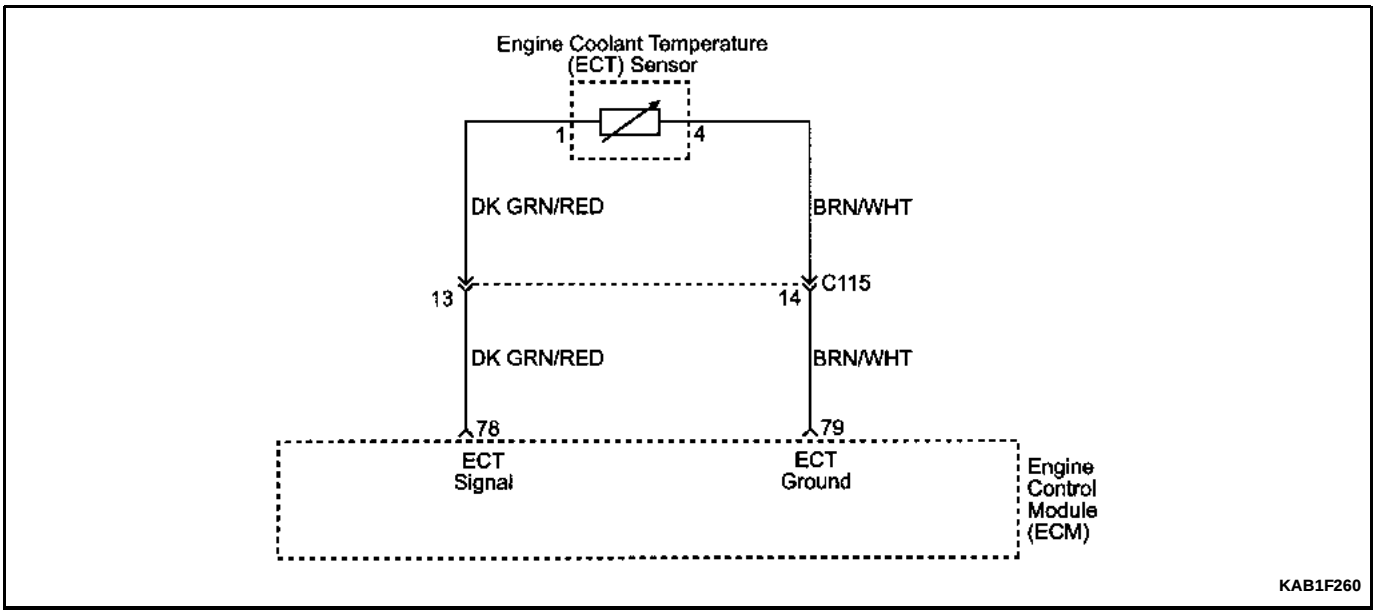
The ECM uses information about coolant temperature to make the necessary calculations for:

- Fuel delivery
- Ignition control
- Knock sensor system
- Idle speed
- Torque converter clutch application
- Canister purge
- Cooling fan operation
- Others

Temperature (°C)	Resistance (Ω)	Voltage (V)	Temperature (°C)	Resistance (Ω)	Voltage (V)
-40	48,550	4.90	60	594	1.86
-30	27,000	4.82	70	434	1.51
-20	15,570	4.70	80	322	1.22
-10	9,450	4.52	90	243	0.98
0	5,890	4.43	100	185	0.78
10	3,790	3.96	110	143	0.63
20	2,500	3.57	120	111.6	0.50
30	1,692	3.14	130	88	0.40
40	1,170	2.70	140	71.2	0.33
50	826	2.26	-	-	-



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Failure Code	Description	Trouble Area	Maintenance Hint
00	Engine coolant temperature sensor low voltage	ECT sensor short circuit to ground or open	• Monitoring the actual coolant temperature through scan tool • Inspection the ECM pin 78, 79 about short circuit or open with bad contact • Inspection the ECT sensor • Inspection the ECM
01	Engine coolant temperature sensor high voltage	ECT sensor short circuit to power	
02	Engine coolant temperature sensor plausibility	Malfunction in recognition of ECT When drop to about 50°C below after warm up	
06	Engine coolant temperature insufficient for closed loop fuel control	Malfunction in recognition of ECT When minimum temperature for lambda control after warm up	

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Circuit Description

The ECT sensor uses a thermistor to control the signal voltage to the ECM. The ECM supplies a voltage on the signal circuit to the sensor. When the engine coolant is cold, the resistance is high; therefore the ECT signal voltage will be high

Engine Coolant Temperature Sensor Inspection

1. Turn the ignition switch to “ON” position.
2. Measure the voltage between the ECM pin No. 78 and No. 79.

Temperature (°C)	Specified Value (V)
20	3.57
80	1.22
100	0.78

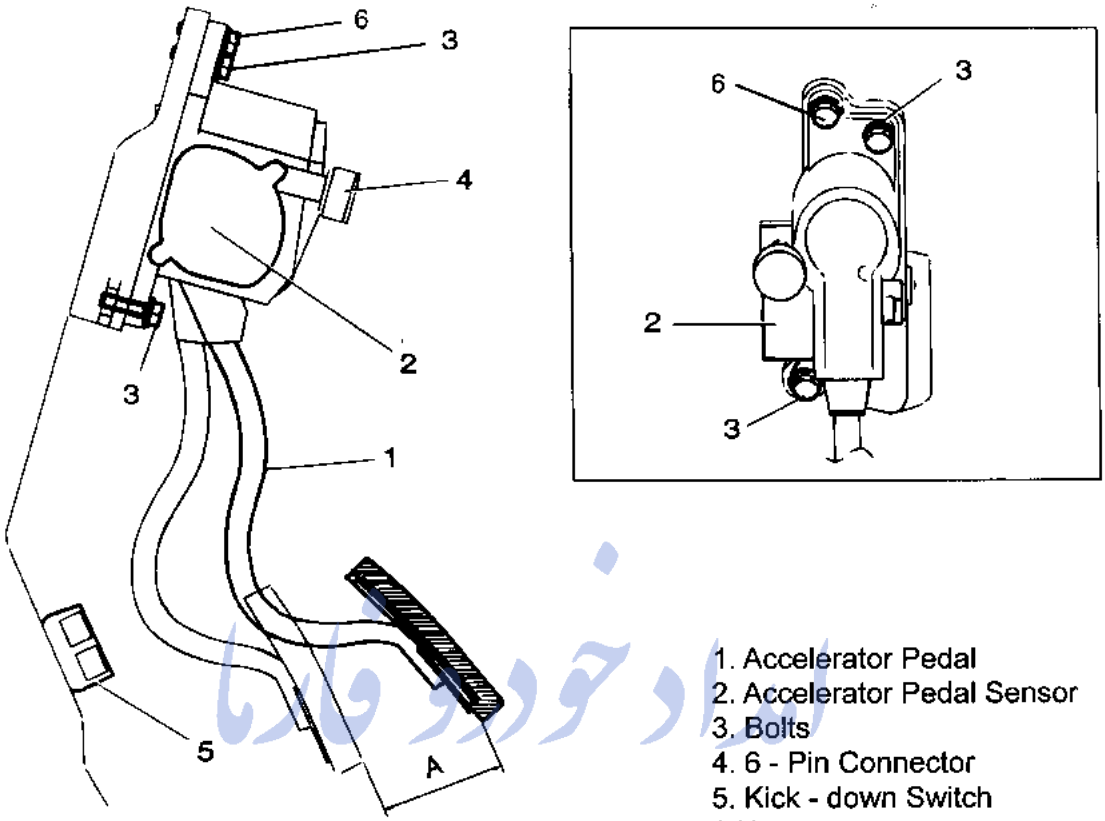
3. Turn the ignition switch to “OFF” position.
4. Disconnect the ECT sensor connector.
5. Turn the ignition switch to “ON” position.
6. Measure the resistance between the ECT sensor terminal pin No. 1 and No. 4.

Temperature (°C)	Specified Value (Ω)
20	2,500
80	322
100	185

Notice: Replace wiring and coolant temperature sensor if out of specified value.

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ACCELERATOR PEDAL MODULE



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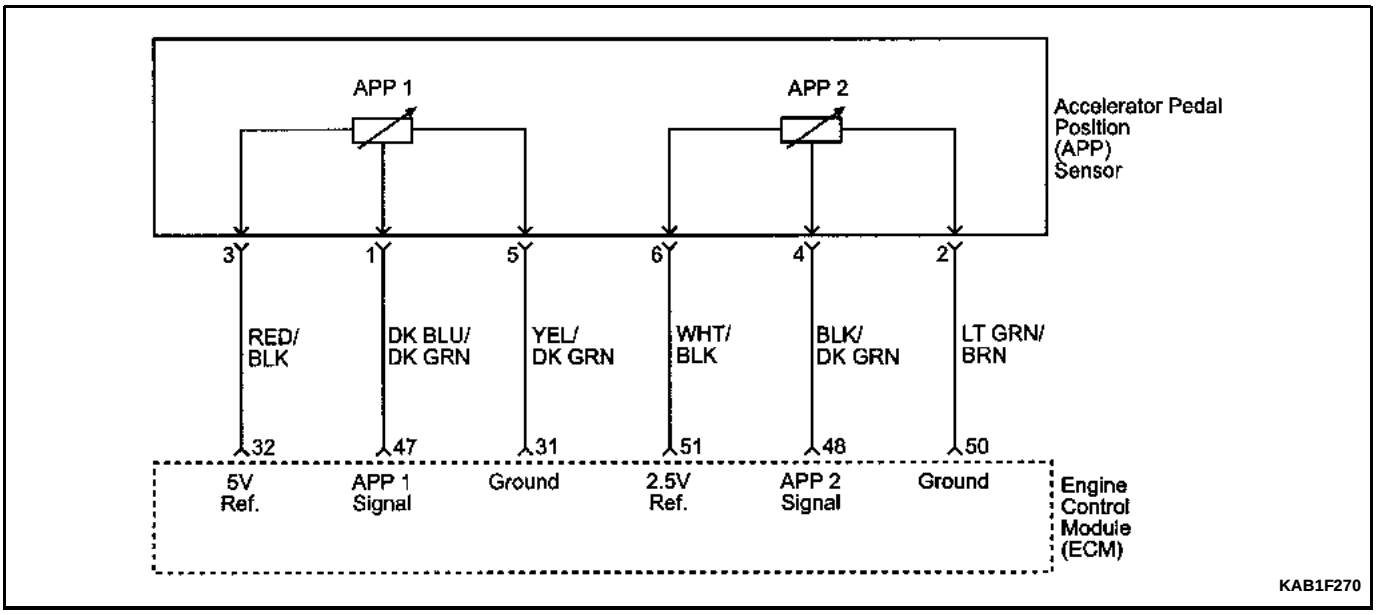
The Acceleration Pedal Position (APP) sensor is mounted on the accelerator pedal assembly. The sensor is actually two individual APP sensors and one housing. This sensor works with the Throttle Position (TP) sensor to provide input to the Engine Control Module (ECM) regarding driver requested accelerator pedal and throttle angle at the throttle body.

When the APP sensor is defected:

When the APP 1 or APP 2 sensor is defected condition, the engine is still running at idle condition but, the accelerator pedal reaction is not response correctly and also, the engine rpm will be reacted to 4,000 rpm slowly. If the APP 1 sensor is out of order, the APP 2 sensor will be conducted with signal as a default signal but, the throttle valve opening is limited 60% and delayed opening speed.

When the TP sensor or servo motor is defected:

When the TP 1, 2 sensor or servo motor is defected condition, the throttle valve will be closed to the spring capsule by spring force, at this condition, the throttle valve will open 10° ~ 20° and engine rpm will be controlled by ECM will opening (On/Off) time of injector. The engine rpm will be maintaining 900 rpm (at idle) to 1,800 according to the engine load.



Failure Code	Description	Trouble Area	Maintenance Hint
122	Acceleration pedal position sensor signal failure	When malfunction of APP Sensor	• Monitoring the actual values through scan tool • Inspection the ECM pin 31, 47, 32, 48, 59, 51 about short circuit or open with bad contact • Inspection the APP sensor • Inspection the ECM
160	Acceleration pedal position 1 sensor low voltage	APP 1 sensor short circuit to ground or open	
161	Acceleration pedal position sensor 1 high voltage	APP 1 sensor short circuit to power	
162	Acceleration pedal position sensor 2 low voltage	APP 2 sensor short circuit to ground or open	
163	Acceleration pedal position sensor 2 high voltage	APP 2 sensor short circuit to power	
164	Accelerator pedal position sensor 1 not plausible with accelerator pedal position sensor 2	When difference between APP 1 sensor and APP 2 sensor	
167	Both setpoint Accelerator pedal position sensor defective	When defective of both APP sensor	

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Circuit Description

The ECM supplies a 5 or 2.5 volt reference signal and a ground to the APP sensor 1 or 2. The ECM calculates on these signal lines. The APP sensor output changes as the accelerator pedal is moved. The output of the APP 1 and APP 2 sensor are low, about 0.4 ~ 0.7 volts and 0.2 ~ 0.35 volts respectively at the closed throttle position. As pushing the accelerator pedal, the output increases so that the output voltages will be about 4.3 ~ 4.8 volts and 2.1 ~ 2.4 volts individually when accelerating fully with the kick down, at Wide Open Throttle (WOT).

Acceleration Pedal Position Sensor 1 Inspection

1. Turn the ignition switch to “ON” position.
2. Measure the signal voltage between the ECM pin No. 47 and No. 31 while operating the accelerator pedal as following conditions.
   - Not depress the pedal (closed throttle position)
   - Fully depress the pedal (full throttle with kick down)

Condition of Throttle Valve	Specified Value (V)
Closed Throttle Valve	0.3 ~ 0.7
Fully Depressed Throttle Valve	4.3 ~ 4.8

Notice: If measured value is not within the specified value, check the pedal valve sensor and the supply voltage to APP 1 sensor.

Acceleration Pedal Position Sensor 2 Inspection

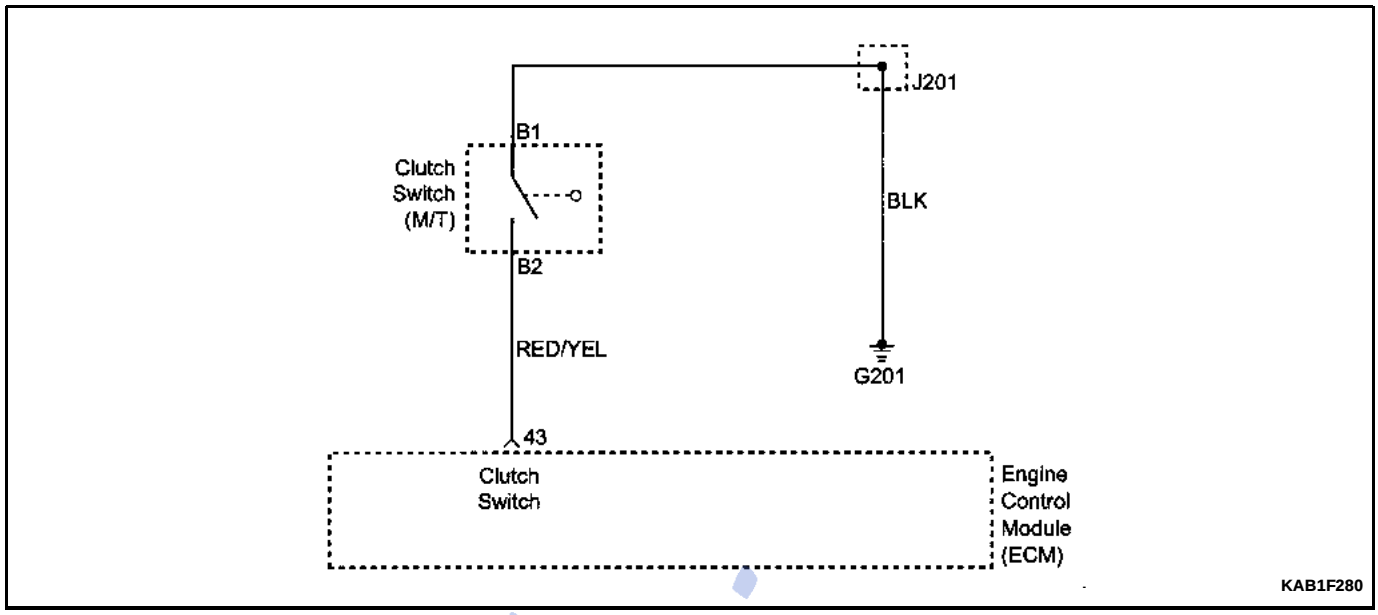
1. Turn the ignition switch to “ON” position.
2. Measure the signal voltage between the ECM pin No. 48 and No. 50 while operating the accelerator pedal as following conditions.
   - Not depress the pedal (closed throttle position)
   - Fully depress the pedal (full throttle with kick down)

Condition of Throttle Valve	Specified Value (V)
Closed Throttle Valve	0.1 ~ 0.4
Fully Depressed Throttle Valve	2.1 ~ 2.5

Notice: If measured value is not within the specified value, check the pedal valve sensor and the supply voltage to APP sensor 2.

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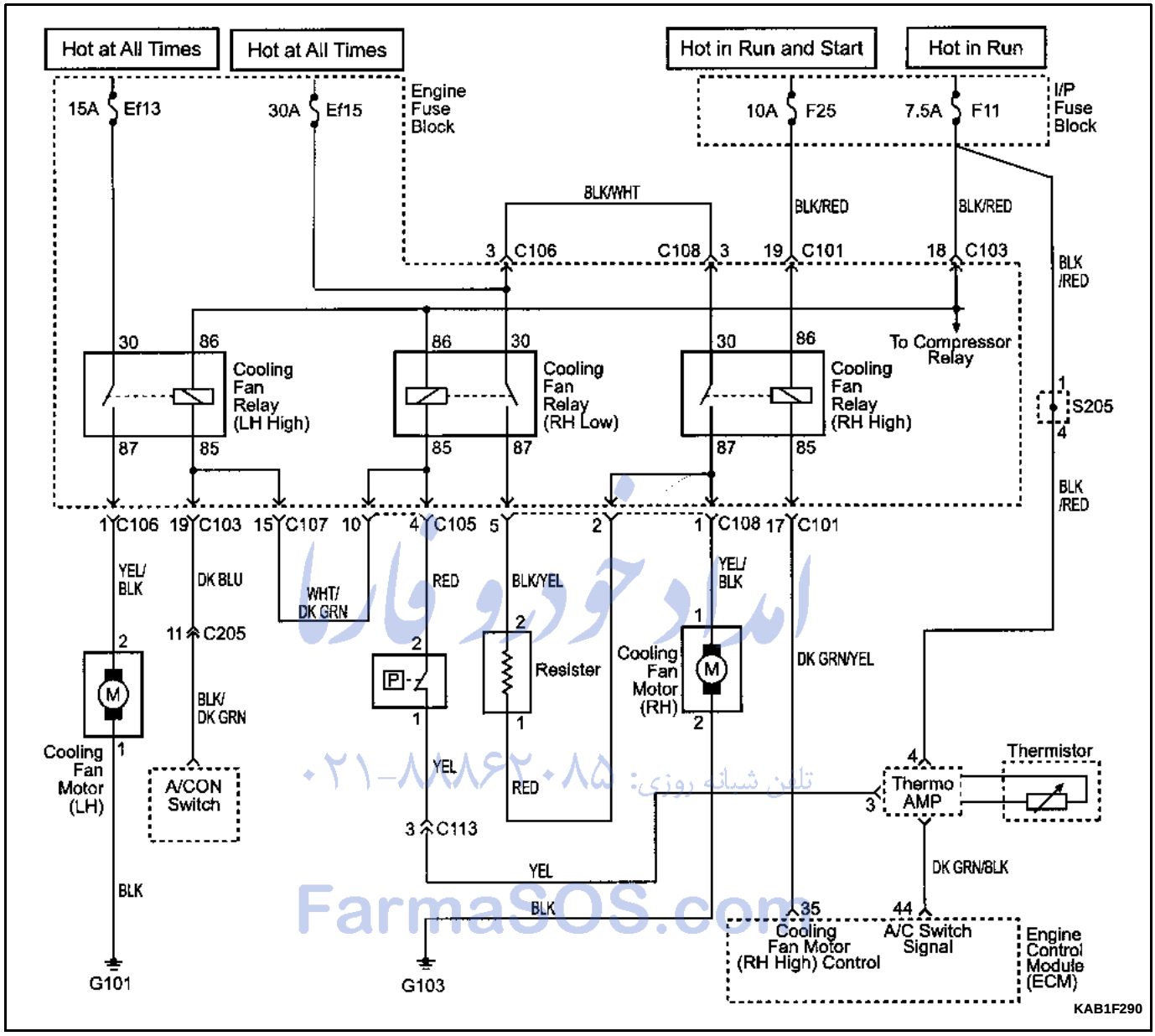
CLUTCH SWITCH



Failure Code	Description	Trouble Area	Maintenance Hint
62	Clutch switch defective	When malfunction of clutch switch	• Inspection the Engine Control Module (ECM) pin 43 about shout circuit or open • Inspection the clutch switch • Inspection the ECM

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COOLING FAN



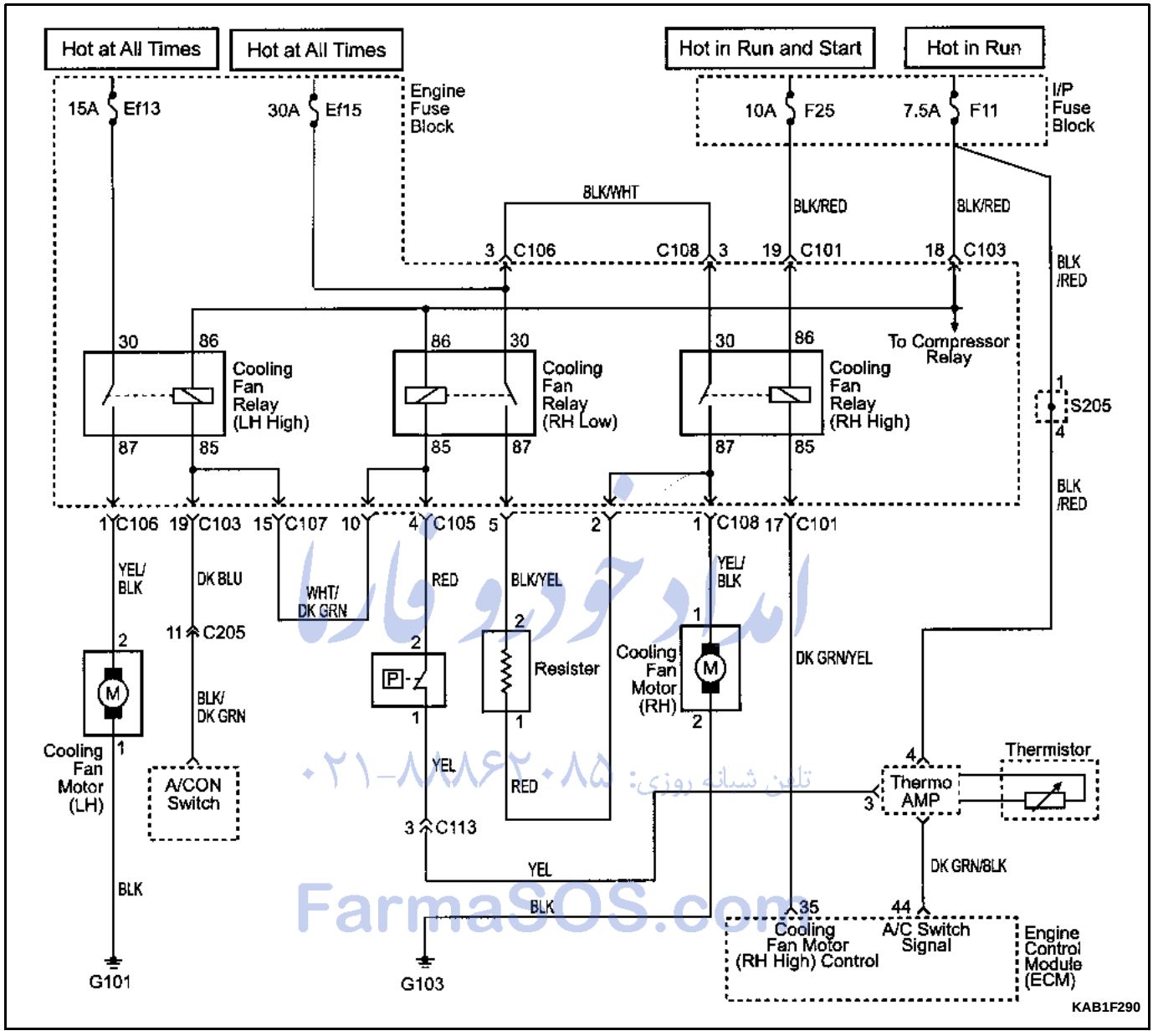
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Failure Code	Description	Trouble Area	Maintenance Hint
44	Cooling fan (HI) relay short circuit to power	Cooling fan short circuit to power	• Inspection the Engine Control Module (ECM) pin 35 about short circuit or open with bad contact • Inspection the power source • Inspection the cooling fan • Inspection the ECM
45	Cooling fan (HI) relay short circuit to ground or open	Cooling fan short circuit to ground or open	

Circuit Description

Ignition voltage is supplied directly to the cooling fan relay coil. The ECM controls the relay by grounding the control circuit. When the ECM is commanding a command ON, the voltage of the control circuit should be low (near 0 volt). When the ECM is commanding the control circuit should be high (near battery voltage). If the fault detection circuit senses a voltage other than what is expected, the fault line status will change causing the fault code to set.

A/C COMPRESSOR RELAY



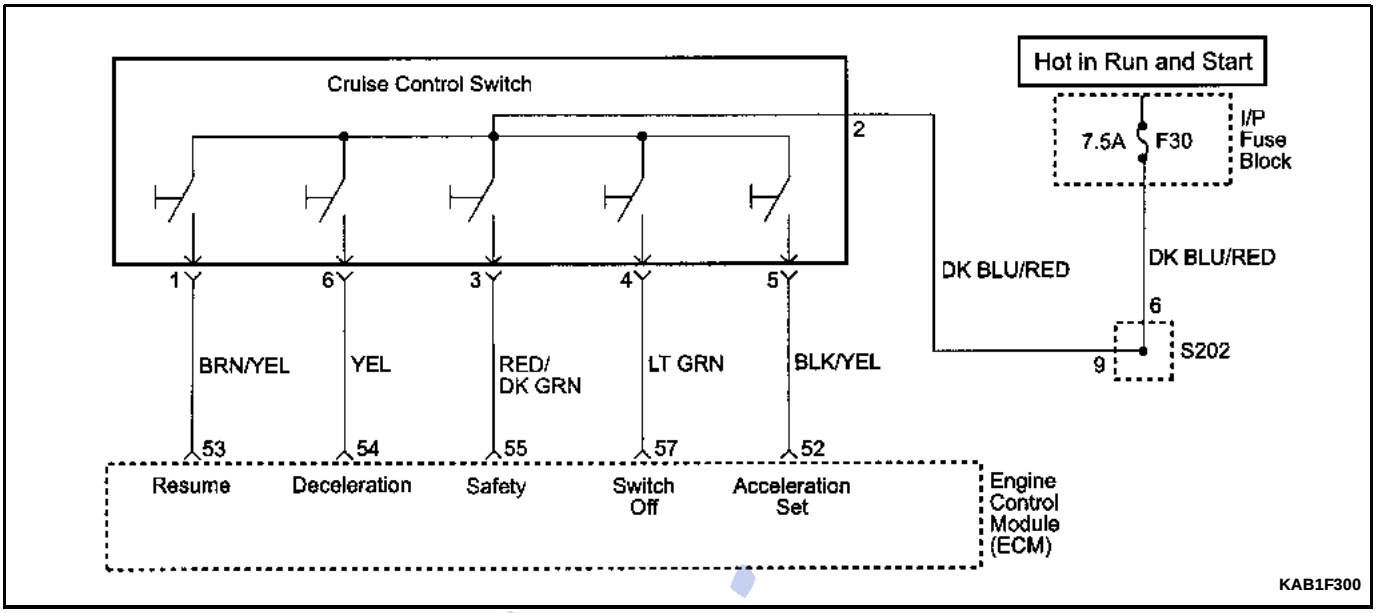
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Failure Code	Description	Trouble Area	Maintenance Hint
228	A/C compressor relay short circuit to battery	When malfunction of A/C compressor control	• Monitoring the actual operation through scan tool • Inspection the Engine Control Module (ECM) pin 44 about short circuit or open with bad contact • Inspection the relay short circuit or open • Inspection the ECM
229	A/c compressor relay short circuit to ground or open		

Circuit Description

When the ECM detects that A/C has been requested, the ECM will activated the A/C clutch relay. When the relay has been activated, voltage should be present at both the A/C clutch relay and A/C switch circuit at ECM.

CRUISE CONTROL SWITCH



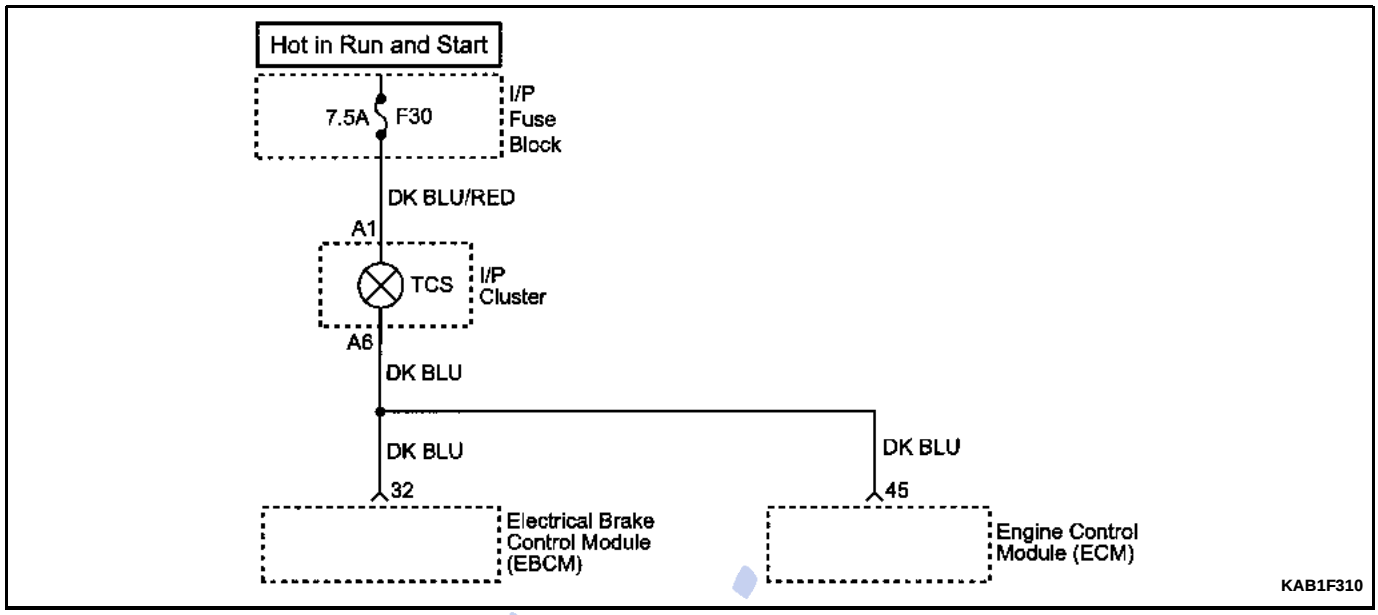
Failure Code	Description	Trouble Area	Maintenance Hint
129	Cruise control "OFF" due to message counter failure	Cruise control system Message counter fault	• Monitoring the actual recognition status and vehicle speed signal through scan tool • Inspection the Engine Control Module (ECM) pin 52, 53, 54, 55, 57 about short circuit or open with bad contact • Inspection the CAN and ABS • Inspection the cruise control lever switch • Inspection the ECM
130	Vehicle speed signal failure	When malfunction of auto-cruise system Implausible condition of vehicle speed signal.	
131	Vehicle speed signal failure		
132	Cruise control lever failure	Cruise control lever defective	
133	Cruise control acceleration failure	Cruise control system Implausible condition of acceleration signal	
134	Cruise control deceleration failure	Cruise control system Implausible condition of deceleration signal	

Circuit Description

Cruise control is an automatic speed control system that maintain a desired driving speed without using the accelerator pedal. The vehicle speed must be greater than 40 km/h to engage cruise control.

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TRACTION CONTROL SYSTEM (TCS)



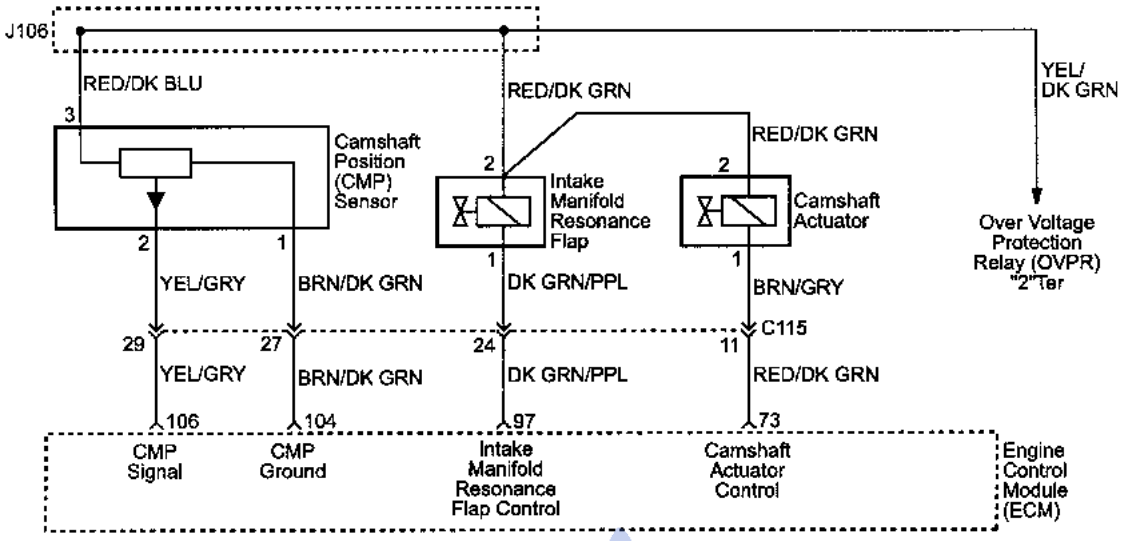
Failure Code	Description	Trouble Area	Maintenance Hint
150	TCS input signal short circuit to battery	TCS short circuit to power	• Inspection the Engine Control Module (ECM) pin 45 about short circuit or open with bad contact • Inspection the TCS lamp of I/P cluster. • Inspection the ECM
151	TCS input signal short circuit to ground or open	TCS short circuit to ground or open	

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Circuit Description

Battery voltage is supplied to the TCS warning lamp with the ignition in ON and START. The warning lamp can be activated only by the Electrical Brake Control Module (EBCM) internally supplying ground to terminal 32. If the TCS input circuit is open or short, this failure code will be set.

RESONANCE FLAP



Failure Code	Description	Trouble Area	Maintenance Hint
198	Resonance flap short circuit to battery	Resonance flap short circuit to power	• Monitoring the actual operational status and vehicle speed signal through scan tool • Inspection the Engine Control Module (ECM) pin 97 about short circuit or open with bad contact • Inspection the power source short circuit or open to resonance flap • Inspection the resonance flap solenoid and hardware • Inspection the ECM
199	Resonance flap short circuit to ground or open	Resonance flap short circuit to ground or open	

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۰۲۱-۸۸۸۶۲۰۸۵ تلفن شبانه روزی
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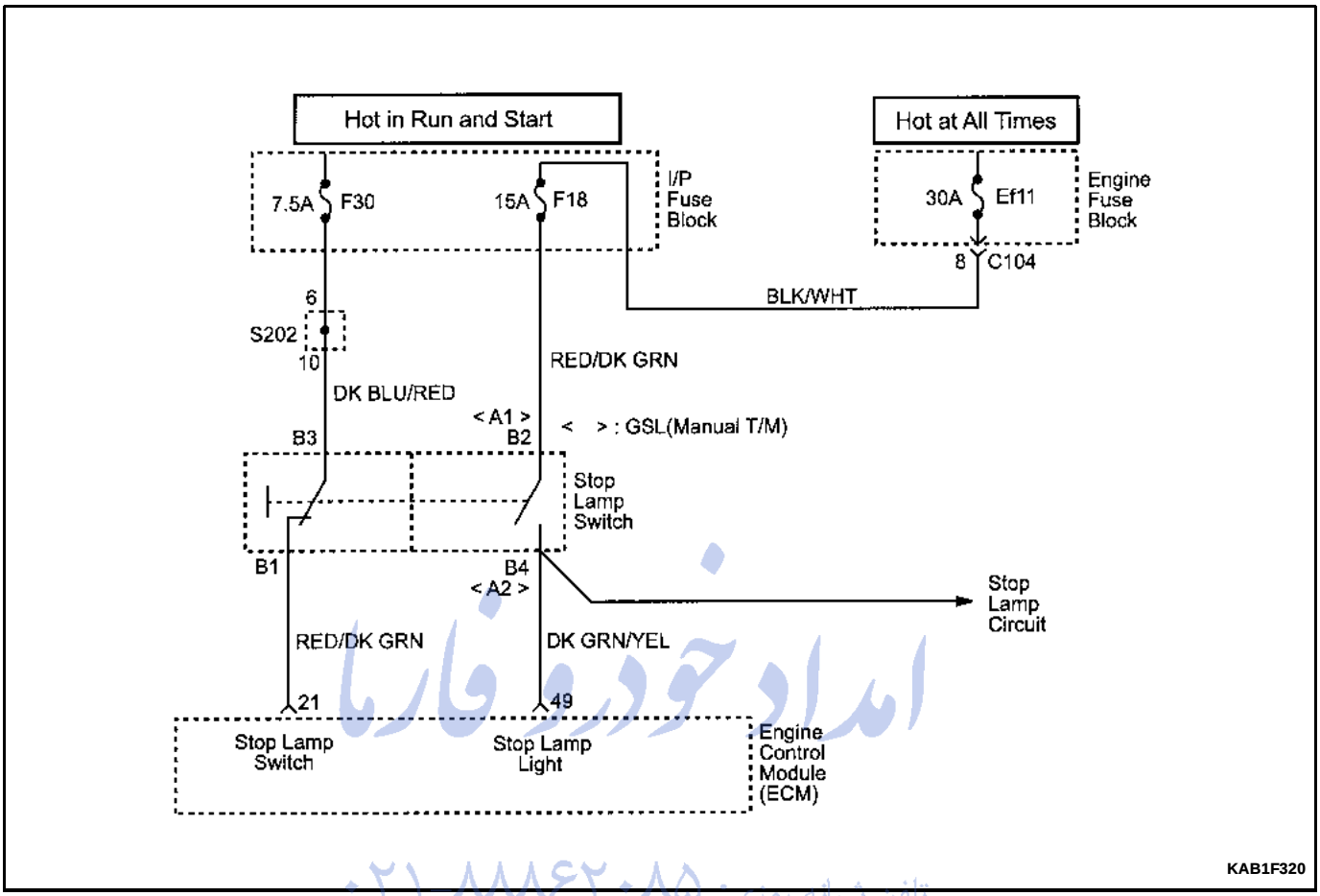
Circuit Description

A pneumatically actuated resonance flap is located on the intake manifold, and will be opened and closed by load, which operates resonance flap according to engine and controlled by ECM and rpm.

Resonance flap is closed at idle/partial load (less than 3,800/rpm). The switch valve will be adjusted by ECM and resonance flap will be closed. By increasing air flow passage through dividing intake air flow toward both air collection housing. This leads to a significant increase in the torque in the lower speed range.

Resonance flap is open at full load (over 3,800/rpm). The switch valve will not be adjusted by ECM and resonance flap will be open. The collected air in the air collection housing will not be divided and intake air passage will be shorten.

STOP LAMP SWITCH



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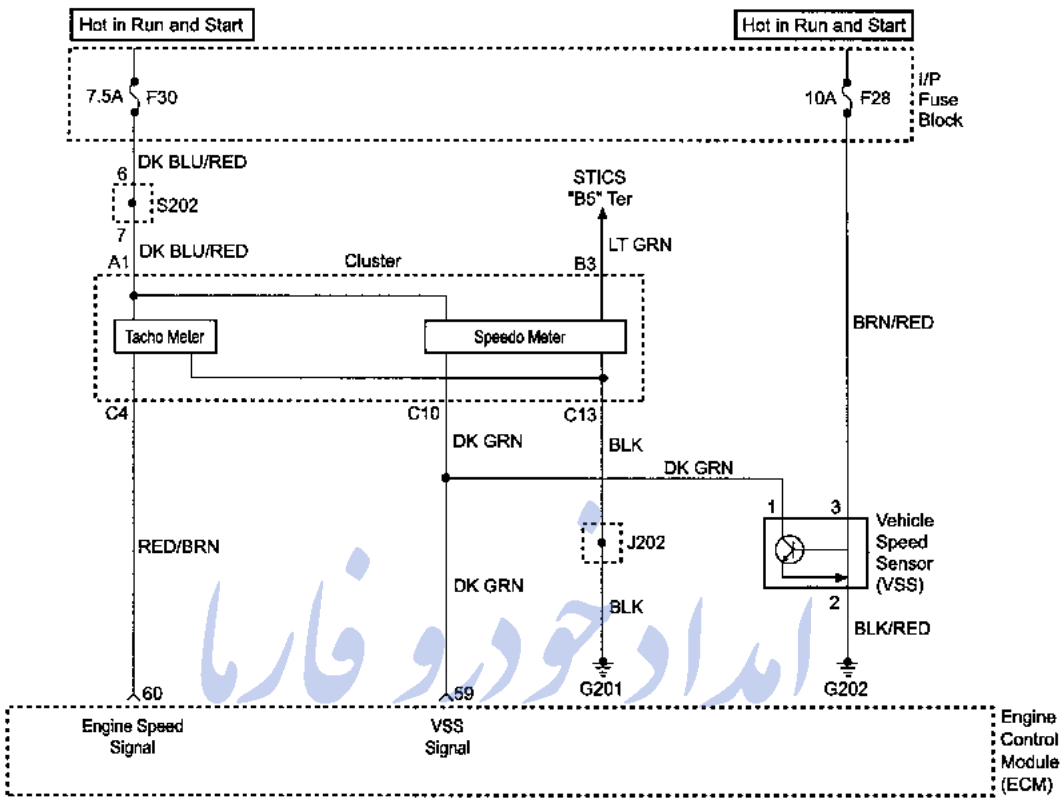
Failure Code	Description	Trouble Area	Maintenance Hint
135	Stop lamp switch failure	When malfunction of stop lamp switch – implausible condition of stop lamp signal input	• Monitoring the actual operational status and vehicle speed signal through scan tool • Inspection the Engine Control Module (ECM) pin 49 about short circuit or open with bad contact • Inspection the contact condition of stop lamp switch • Inspection the ECM

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Circuit Description

The stop lamp switch is normally opened. When the ignition switch ON and brake ON, the battery voltage is supplied to the ECM. A scan tool should display ON when brake pedal is depressed and should read OFF with brake pedal released.

ENGINE RPM



KAB1F330

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Failure Code	Description	Trouble Area	Maintenance Hint
32	Engine rpm output circuit short circuit to battery	When short circuit to battery	• Monitoring the actual rpm in cluster • Inspection the Engine Control Module (ECM) pin 60 about short circuit or open • Inspection the cluster panel board circuit • Inspection the ECM
33	Engine rpm output circuit short circuit to ground or open	When short circuit to ground or open	

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EXHAUST SYSTEM

CATALYTIC CONVERTER

The purpose of the catalytic converter is to convert the three pollutants of carbon monoxide (CO), hydrocarbons (HC) and oxides of nitrogen (NOx) contained in the exhaust of gasoline engines, into the harmless compounds of water (H2O), carbon dioxide (CO2) and nitrogen (N2).

The catalytic converter contains a catalyst, a word coming from the Greek and which designates the element essential for catalyst which triggers chemical reactions without itself being consumed.

These catalysts in the 3-way catalytic converter are the rare metals platinum (Pt) and rhodium (Rh).

The catalytic converter consists essentially of three main elements. The exhaust gases flow through the catalytic converter and, in so doing, coming into contact with rare metals (Pt and Rh).

The following chemical reaction are produced.

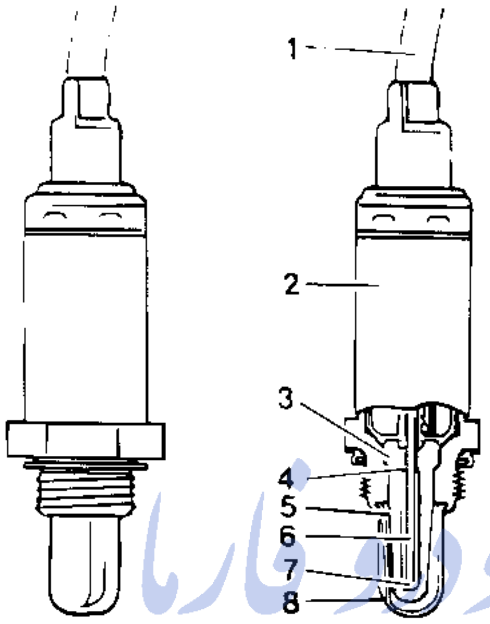
$CO + O2 \rightarrow CO2$

$HC + O2 \rightarrow CO2 + H2O$

$NOx \rightarrow N2 + O2$

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OXYGEN SENSOR



1. Electrical Wire
2. Oxygen Sensor Housing
3. Sensor Ceramic
4. Eletrode (Internal)
5. Eletrode (External)
6. Heating Coil
7. Open Space
8. Protector Tube

YAA1F650

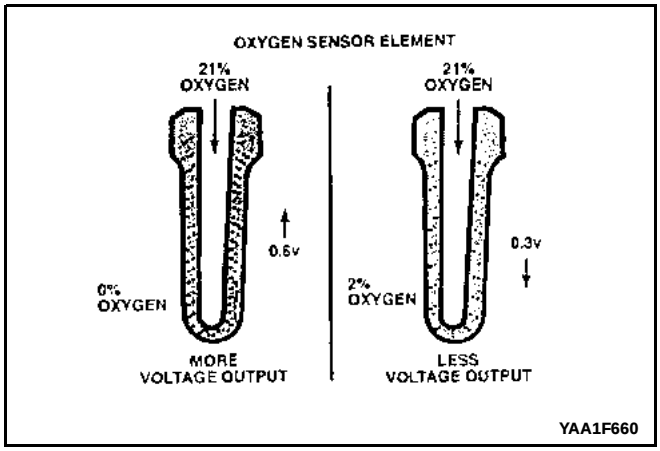
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵

The oxygen sensor is unique among the engine control sensors because is acts like a battery and is able to generate its own low voltage signal. It is located the exhaust system and monitors the amount of oxygen in the exhaust stream and provides feedback to the Engine Control Module (ECM).

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The electrically heated oxygen sensor warms up quickly and remains hot, even at idle when the exhaust manifold may cool down.

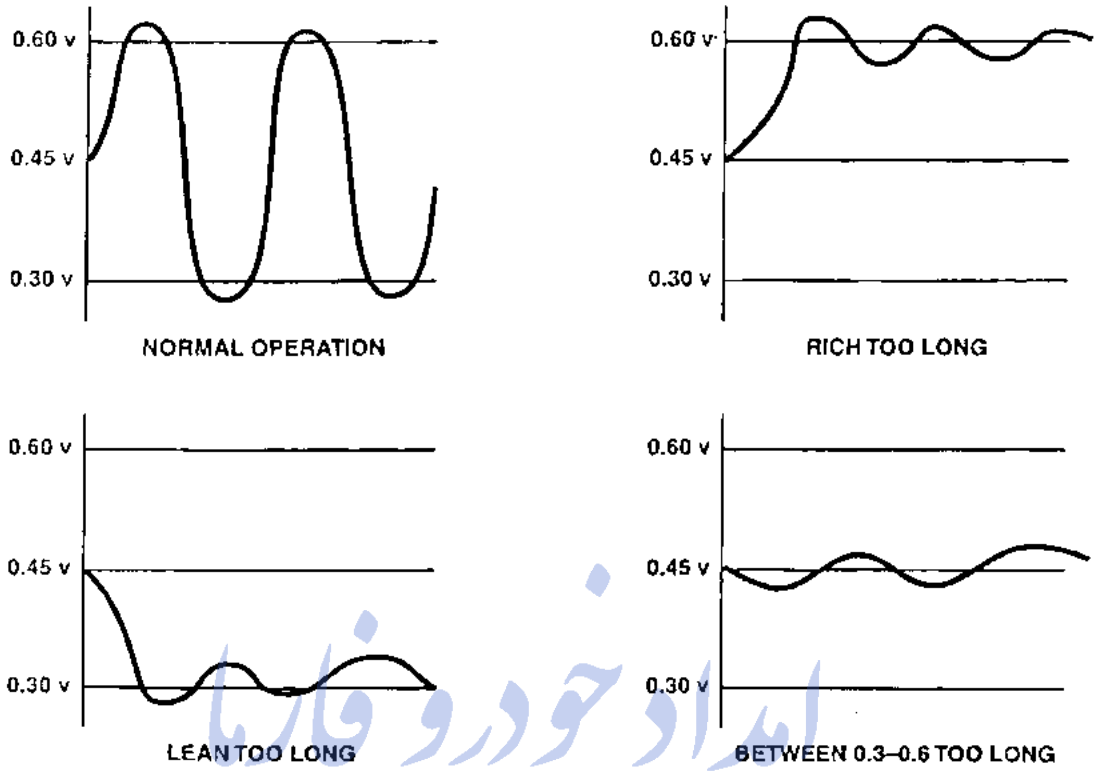
The ECM applies a reference voltage of 450 mv to the oxygen sensor, the ECM compares this reference voltage with the voltage generated by oxygen sensor. The amount of voltage the oxygen sensor generates is proportionate to the difference between the amount of oxygen in the outside air and the exhaust gases. The atmosphere contains about 21% oxygen. The exhaust from a rich air/fuel ratio contains almost no oxygen. With a large difference between the amounts of oxygen containing the two surface, the sensor generates less voltage. When the exhaust gas is rich (below 14.7:1), the voltage output is high, above 450 mv. When the exhaust gas is lean (above 14.7:1 air/fuel ratio), the sensor's voltage output is low, below 450 mv.



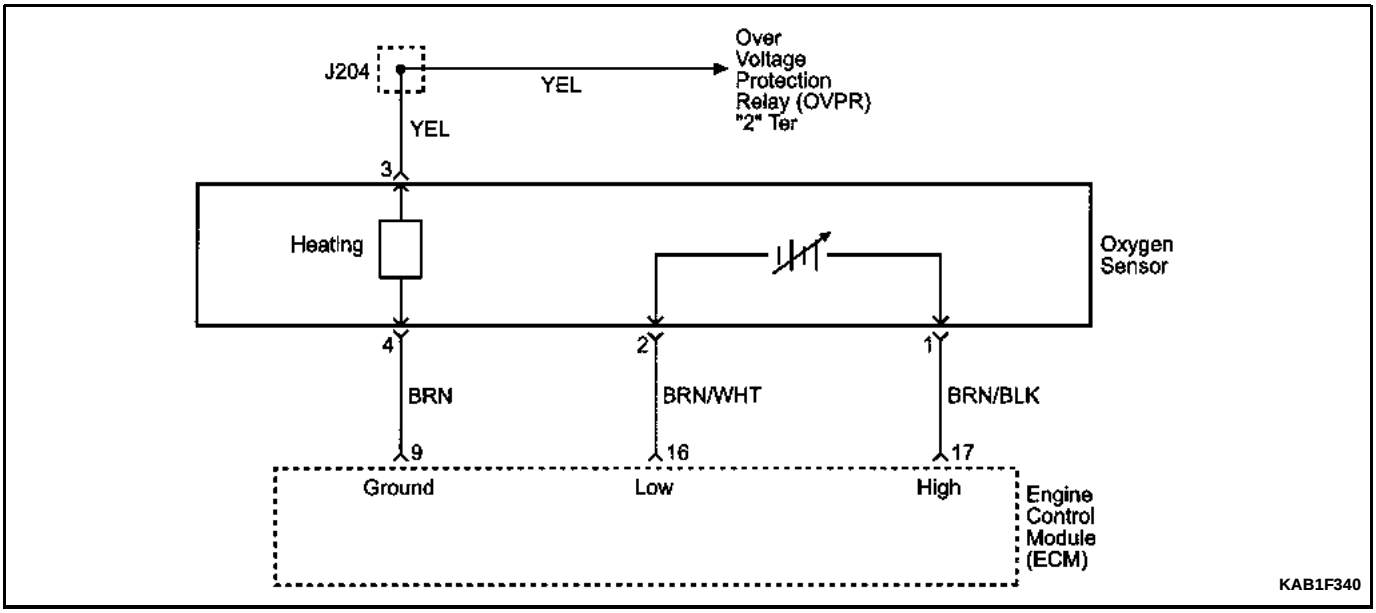
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The ECM uses oxygen sensor information for:

- Open loop / closed loop criteria
- Ideal air / fuel ratio



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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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Failure Code	Description	Trouble Area	Maintenance Hint
80	Oxygen sensor high voltage	When recognition the output that more than nominal threshold, malfunction of sensing voltage.	• Monitoring the actual output signal through scan tool • Inspection the ECM pin 16, 17 about short circuit or open with bad contact • Inspection the oxygen sensor • Inspection the ECM
89	Oxygen sensor low voltage	When recognition the output that more than nominal threshold, malfunction of sensing voltage.	
82	Oxygen sensor no activity detected	When recognition the output that not active the sensor etc.	
83	Oxygen sensor not lean after overrun fuel shut-off	When recognition the output that no lean signal after overrun fuel shut-off	
84	Oxygen sensor slow response	When slow response of sensor signal	
85	Oxygen sensor heater failure	When recognition the heating circuit	• Monitoring the heating status through scan tool • Inspection the ECM pin 9 about short circuit or open with bad contact • Inspection the heating power source • Inspection the heating circuit of oxygen sensor • Inspection the ECM
86	Oxygen sensor heater short circuit to battery	When recognition the heating currents that more or less than set values (less than 0.2 A or more than 2 A)	
87	Oxygen sensor heater short circuit to ground or open	When recognition the heating voltages than less than set values (less than 2 v)	

امداد خودرو ۰۲۱-۸۸۶۳۰۰۸۵ FarmaCOS.com

Failure Code	Description	Trouble Area	Maintenance Hint
81	Bank 1 system short term fuel trim adaptation below lean threshold	When recognition the value less than nominal control threshold, it means that when big deviation in control range of adaptation values through fuel and air mixture formation	• Inspection the intake air leakage • Inspection the injection quantities with injector block or leakage • Inspection the exhaust leakage • Inspection the ECM
93	Bank 1 system short term fuel trim adaptation above rich threshold	When recognition the value more than nominal control threshold, it means that when big deviation in control range of adaptation values through fuel and air mixture formation	
96	Bank 1 system short term fuel trim at rich stop	When recognition the short term fuel trim that more than nominal threshold	
97	Bank1 system short term fuel trim at lean stop	When recognition the short term fuel trim that less than nominal threshold	
98	Bank 1 system idle adaptation failure (above rich threshold)	When recognition the long term fuel trim exceeds rich threshold	
99	Bank 1 system idle adaptation failure (below rich threshold)	When recognition the long term fuel trim exceeds lean threshold	
100	Bank 1 system learning control failure (rich, low load)	When recognition the long term fuel trim exceeds rich threshold	
101	Bank 1 system learning control failure (lean, low load)	When recognition the long term fuel trim exceeds lean threshold	
102	Bank 1 system learning control failure (rich, high load)	When recognition the long term fuel trim exceeds rich threshold	
103	Bank 1 system learning control failure (rich, low load)	When recognition the long term fuel trim exceeds lean threshold	

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Circuit Description

In order to control emissions, a catalytic converter is used to covert harmful emissions into harmless water vapor and carbon dioxide. The ECM has the ability to monitor this process by using a oxygen sensor. The oxygen sensor produces and output signal which indicates the storage capacity of the catalyst. This in turn indicates the catalyst's ability to convert exhaust emission effectively. If the oxygen sensor pigtail wiring, connector, or terminal is damaged. Do not attempt to repair the wiring, connector, or terminals. In order for the sensor to function properly, it must have a clean air reference provided to it. This clean air reference is obtained by way of the oxygen sensor wire(s). Any attempt to repair the wires, connector, or terminal and degrade the oxygen sensor performance.

Oxygen Sensor Signal Voltage Inspection

1. Maintain the engine speed is at idle while the coolant temperature is over 80 °C.
2. Measure the oxygen sensor signal voltage between the ECM terminal No. 16 and No. 17.

Specified Value	- 0.2 ~ 1.0 v

Notice: If the measured value is not within the specified value, the possible cause may be in cable, oxygen sensor or ECM

Oxygen Sensor Heating Voltage Inspection

1. Maintain the engine speed is at idle while the coolant temperature is over 80°C.
2. Measure the oxygen sensor signal voltage between the ECM terminal No. 11 and No. 9.

Specified Value	11 ~ 14 v

Notice: If the measured value is not within the specified value, the possible cause may be in cable, oxygen sensor or ECM

Oxygen sensor Heating Current Consumption Inspection

1. Turn the ignition switch to “ON” position.
2. Measure the oxygen sensor heating current consumption between the ECM terminal No. 9 and No. 5.

Specified Value	0.2 ~ 2.0 A

Notice: If the measured value is not within the specified value, the possible cause may be in cable, oxygen sensor or ECM

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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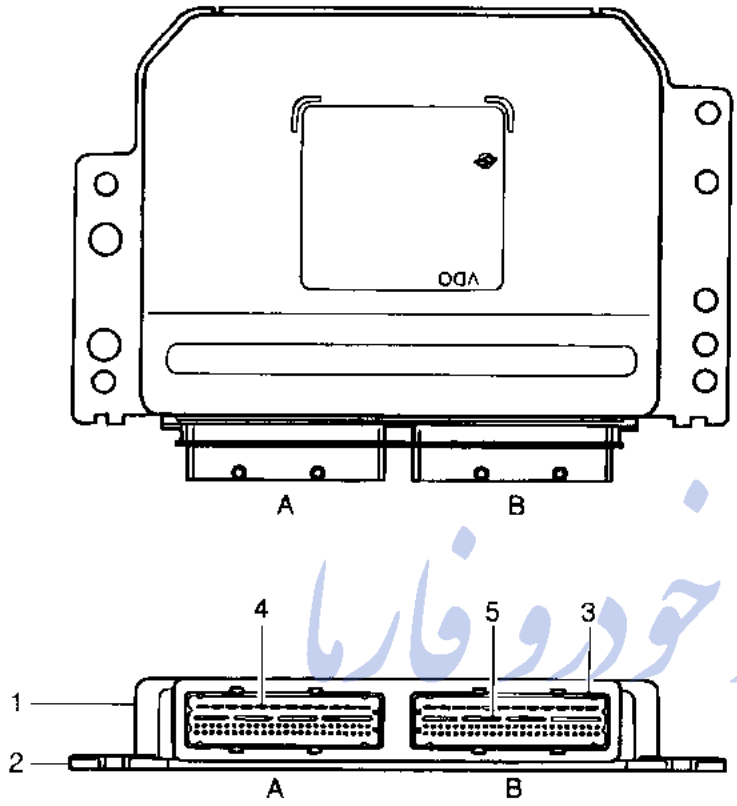
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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵

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ENGINE CONTROL MODULE



1. Cover
2. Plate
3. Connector
4. Flat Pin
   Vehicle Side : No. 1 - 12
   Engine Side : No. 61 - 72
5. Pin
   Vehicle Side : No. 13 - 60
   Engine Side : No. 73 - 120

A. Vehicle Side Connector : Black
B. Engine Side Connector : Gray

YAA1F830

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The Engine Control Module (ECM), located inside the right side kick panel, is the control center of the fuel injection system. It constantly looks at the information from various sensors and controls the systems that affect the vehicle's performance. Engine rpm and air mass are used to measure the air intake quantity resulting in fuel injection metering. The ECM also performs the diagnostic functions of the system. It can recognize operational problems, store failure code(s) which identify the problem areas to aid the technician in making repairs.

There are no serviceable parts in the ECM. The calibrations are stored in the ECM in the Programmable Read Only Memory (PROM).

The ECM supplies either 5 or 12 volts to power the sensors or switches. This is done through resistance in the ECM which are so high in value that a test light will not come ON when connected to the circuit. In some cases, even an ordinary shop voltmeter will not give and accurate reading because its resistance is too low. You must use a digital voltmeter with a 10 Mohm input impedance to get accurate voltage readings. The ECM controls output circuits such as the ignition coils, the fuel injectors, the fuel pump relay, the intake manifold resonance flap, the camshaft actuator, the canister purge valve, etc., by controlling the ground circuit.

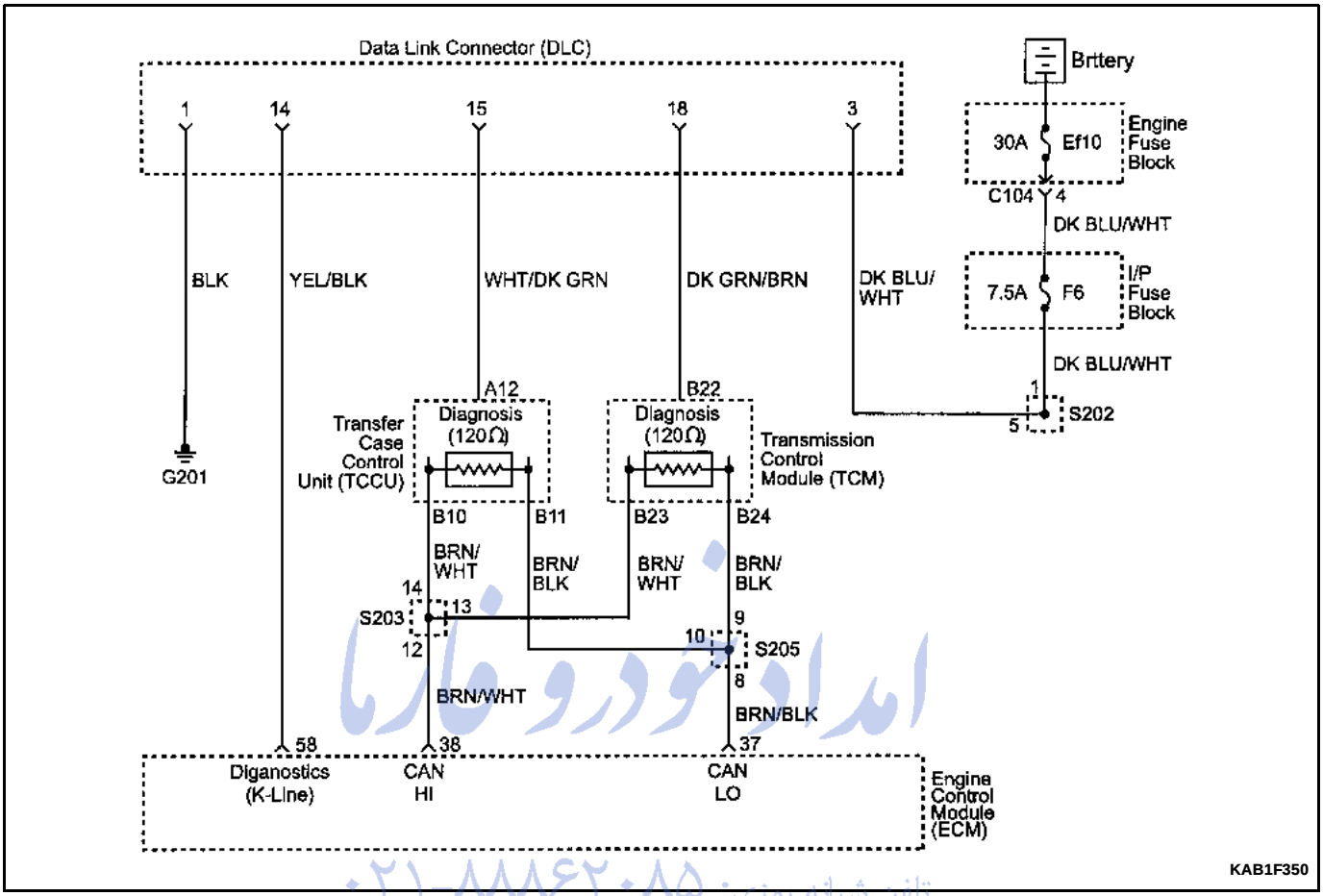
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SERIAL DATA COMMUNICATION



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Failure Code	Description	Trouble Area	Maintenance Hint
23	CAN communication failure: ASR/MSR	When CAN signal message missing or implausibility for ASR/MSR unit or not initialized condition	• Inspection the ASR unit with CAN connection • Inspection the Engine Control Module (ECM) pin 38, 37 about short circuit or open with bad contact • Inspection the ECM
24	CAN communication failure: ABS	When CAN signal message missing or implausibility for ABS unit or not initialized condition	• Inspection the ABS unit with CAN connection • Inspection the ECM pin 38, 37 about short circuit or open with bad contact • Inspection the ECM
26	CAN communication failure: TCU (A/T only)	When CAN signal message missing or implausibility for TCU unit or not initialized condition	• Inspection the TCM unit with CAN connection • Inspection the ECM pin 38, 37 about short circuit or open with bad contact • Inspection the ECM
27	CAN communication failure: TOD (E32 only)	When CAN signal message missing or implausibility for TOD unit or not initialized condition	• Inspection the TOD unit with CAN connection • Inspection the ECM pin 38, 37 about short circuit or open with bad contact • Inspection the ECM

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Failure Code	Description	Trouble Area	Maintenance Hint
29	CAN communication failure: ID 200h not plausible	When CAN signal message missing or implausibility for ABS/ABD unit or not initialized condition	• Inspection the ABS/ABD unit with CAN connection • Inspection the ECM pin 38, 37 about short circuit or open with bad contact • Inspection the ECM
30	CAN communication failure: ID 208h not plausible	When CAN signal message missing or implausibility for ABS/ABD unit or not initialized condition	• Inspection the ABS/ABD unit with CAN connection • Inspection the ECM pin 38, 37 about short circuit or open with bad contact • Inspection the ECM
31	CAN communication failure: communication initialization failure	When CAN signal message missing or implausibility for each unit (ABS, ASR, TCM, TOD etc.) or not initialized condition	• Inspection the each control unit with CAN connection • Inspection the ECM pin 38, 37 about short circuit or open with bad contact • Inspection the ECM
59	CAN communication failure: MSR data transmission not plausible	When CAN signal message missing or implausibility for MSR unit or not initialized condition	• Inspection the MSR unit with CAN connection • Inspection the Engine Control Module (ECM) pin 38, 37 about short circuit or open with bad contact • Inspection the ECM
60	CAN communication failure: ASR data transmission not plausible	When CAN signal message missing or implausibility for ASR unit or not initialized condition	• Inspection the ASR unit with CAN connection • Inspection the Engine Control Module (ECM) pin 38, 37 about short circuit or open with bad contact • Inspection the ECM

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Circuit Description

The provision for communicating with the ECM is the Data Link Connector (DLC). It is located in the instrument panel fuse block. The DLC is used to connect the scan tool. Battery power and ground is supplied for the scan tool through the DLC. CAN line is used to communicate with the other module such as the Transmission Control Module (TCM) and Transfer Case Control Unit (TCCU).

Keyword 2000 Serial Data Communications

Each bit of information can have one of two lengths: long or short. This allows vehicle wiring to be reduced by transmitting and receiving multiple signals over a singles wire. The message carried on KWP 2000 data streams are also prioritized. If two messages attempt to establish communications on the data line at the same time, only the message with higher priority will must wait.

INTERNAL FAILURE

Failure Code	Description	Trouble Area	Maintenance Hint
21	Transmission coding failure	When faulty of variant coding of transmission	• Inspection the coding condition through scan tool • Inspection the Engine Control Module (ECM) • Inspection the CAN line • Inspection the TCM
136	ECM failure (RAM)	When malfunction of random access memory - ECM internal error	• Inspection the ECM
142	Uncoded/ unprogramed ECM	When malfunction of ECM coding-required ECM encoding	• Fulfill the ECM variant coding
137	ECM failure (EPROM)	When malfunction of ECM internal	• Inspection the ECM
143	ECM failure (EEPROM/Flash-EPPOM checksum failure)		
144	ECM failure (coding ID checksum failure)		
145	ECM failure (coding checksum failure)		
146	ECM failure (programming checksum failure)		

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ELECTRONIC THROTTLE CONTROLLER SAFETY MALFUNCTION

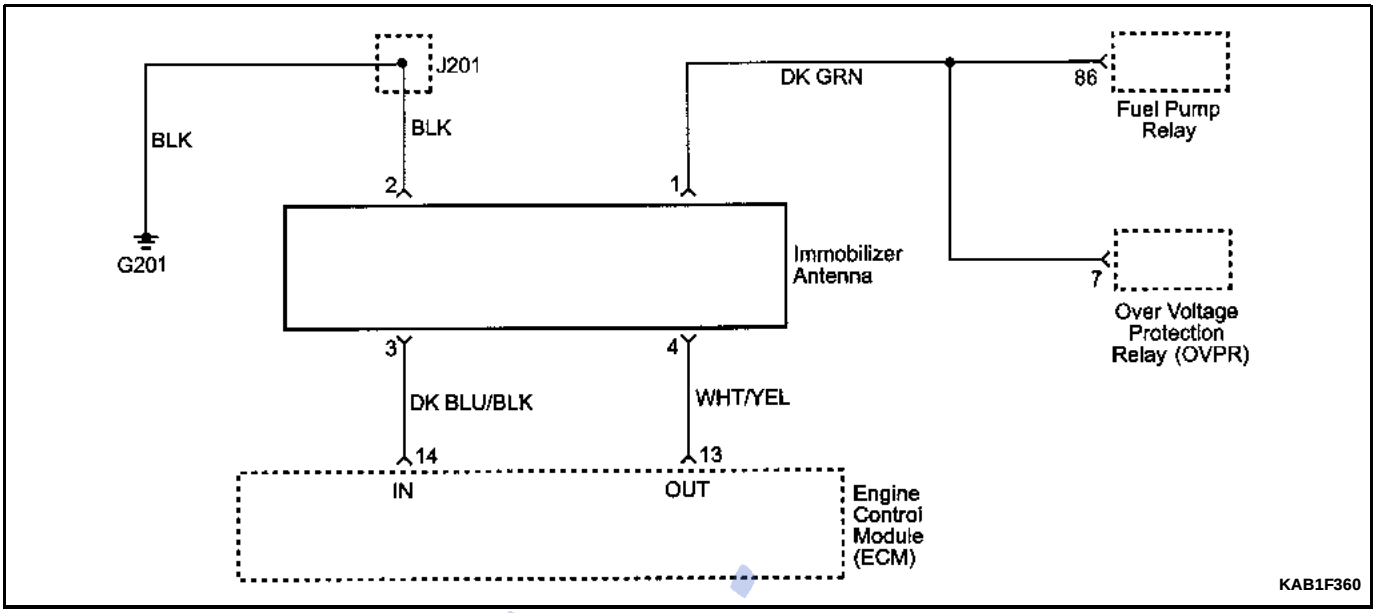
Failure Code	Description	Trouble Area	Maintenance Hint
110	Throttle actuator learning data fault	System internal failure	• Inspection the Engine Control Module (ECM)
117	Exceed fuel-cut safety time		
120	Cruise control interruption memory failure		
138	Call Monitoring		
139	Servo motor control output interruption memory failure		
140	Servo motor open/short		
186	ECM failure (incompatible CPU)		
187	ECM failure (CPUs communication failure)		
188	ECM failure (CPU 2 configuration failure)		
189	ECM failure (CPU 2 fault)		
190	ECM failure (CPU run time failure between CPUs)		
231	ECM failure (CPU 2 cruise control message counter failure)		
232	Over deceleration limit (CPU 2)		
233	Over acceleration limit (CPU 2)		
234	Cruise control lever dual operation (CPU 2)		
235	Cruise control lever safety terminal failure (CPU 2)		
236	Unusual pedal position variation (CPU 2)		
237	Unusual throttle position variation (CPU 2)		
238	Unusual throttle controller monitoring data comparison fault (CPU 2)		

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Failure Code	Description	Trouble Area	Maintenance Hint
239	Unusual accelerator pedal position sensor comparison fault (CPU 2)	System internal failure	• Inspection the Engine Control Module (ECM)
240	Throttle potentiometer comparison fault (CPU 2)		
241	Unusual CPU communication (CPU 2)		
242	Unusual CPU configuration (CPU 2)		
243	A/D converter failure (CPU 2)		
244	Accelerator pedal position sensor setpoint fault between CPU 1 and CPU 2		
245	Position controller setpoint fault between CPU 1 and CPU 2		
246	MSR setpoint fault between CPU 1 and CPU 2		
247	Idle control setpoint fault between CPU 1 and CPU 2		
248	A/D converter overflow (CPU 2)		
249	ROM fault (CPU 2)		
250	RAM fault (CPU 2)		
251	Cycle monitor fault (CPU 2)		

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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IMMOBILIZER



Failure Code	Description	Trouble Area	Maintenance Hint
25	Communication with transponder missing	When missing the transponder signal	• Inspection the Engine Control Module (ECM) pin 13, 14 about short circuit or open with bad contact • Inspection the power source or ground short circuit or open of immobilizer unit • Inspection the transponder condition (broken etc.) • Inspection the ECM
141	Unprogramed ECM with immobilizer	When malfunction of immobilizer Required immobilizer encoding, no paired condition of immobilizer even through start trial	• Fulfill the immobilizer pairing

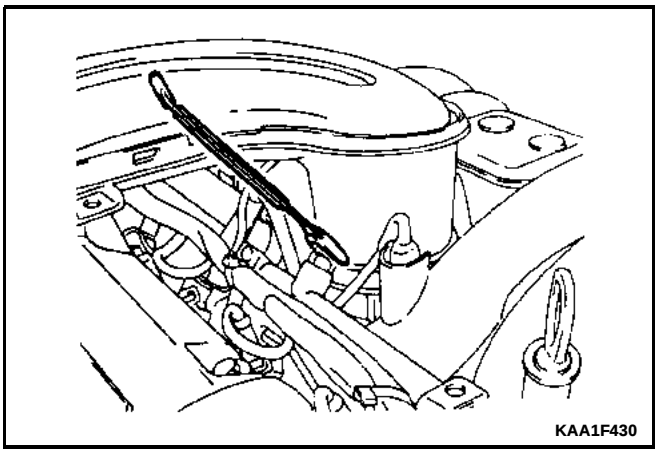
Circuit Description

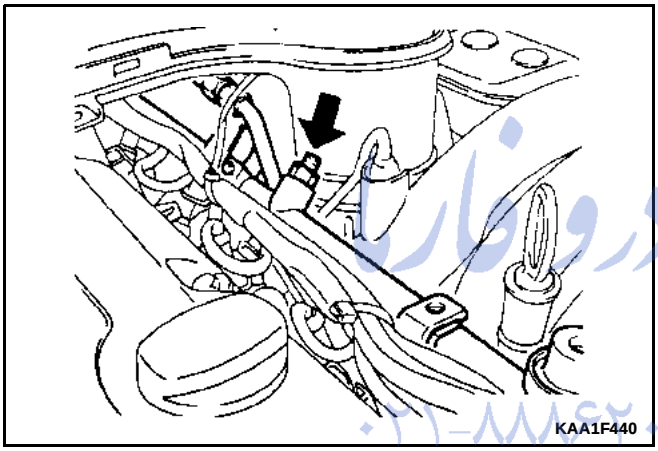
Immobilizer is a device disabling vehicle ignition unless a specific key is used and designed to help prevent vehicle theft.

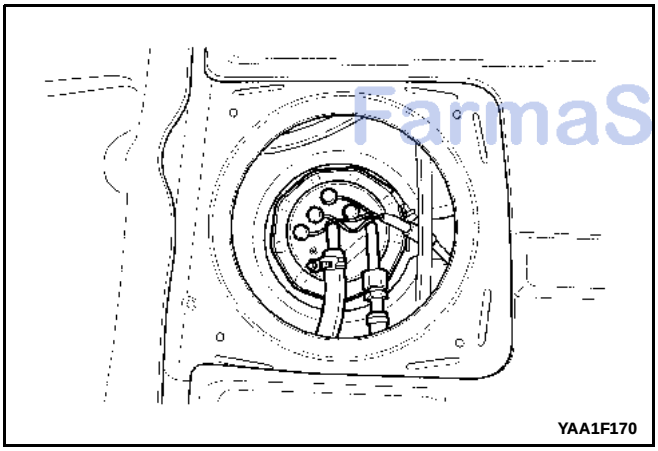
Immobilizer is comprised of two devices, a key with encoded transponder and ECM with the same encoding of the transponder. When a key is inserted into the hole to start vehicle and turned to ON, the ECM reads and decodes the transponder code and, if the same, starts the engine, it is called immobilizer. It means immobilizer system disables starting by stopping fuel supply if the code in the transponder does not match the code stored in ECM each other.

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MAINTENANCE AND REPAIR


KAA1F430


KAA1F440


YAA1F170

ON VEHICLE SERVICE

DISCHARGING THE PRESSURE IN FUEL SYSTEM

Removal and Installation Procedure

1. Remove the fuel pressure test connector.

Installation Notice

Tightening Torque	25 N•m (18 lb-ft)

2. Remove the fuel pressure in fuel system by pressing the service valve with a clean, pointy tool.

Notice: Place a cloth so that the fuel doesn't stain around.

3. Installation should follow the removal procedure in the reverse order.

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FUEL PUMP

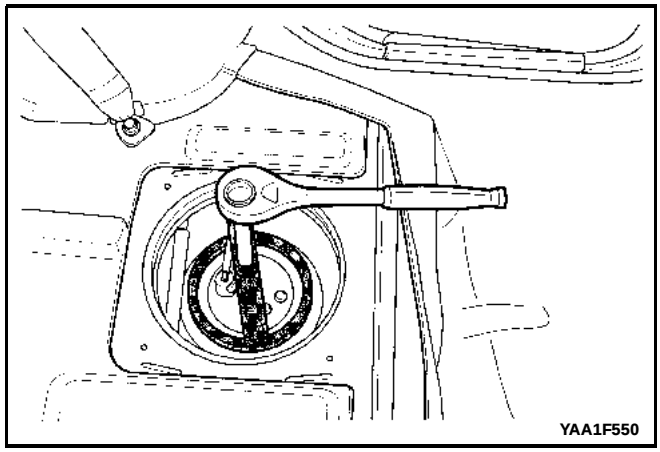
Tools Required

661 589 00 46 00 Fuel Tank Cap Wrench

Removal and Installation Procedure

Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

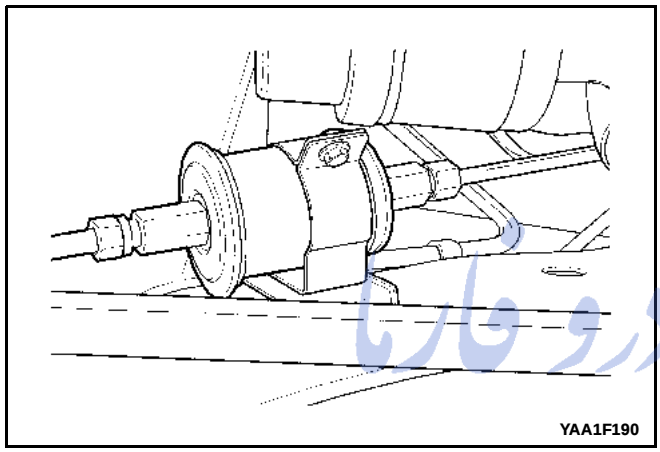
1. Relieve the fuel system pressure. Refer to "Discharging the Pressure in Fuel System" in this section.
2. Disconnect the negative battery cable.
3. Put aside the floor carpet to remove the fuel pump access cover.
4. Remove the fuel pump access cover.
5. Remove the fuel pump wiring connectors.
6. Disconnect the fuel supply and return pipes.
7. Remove the fuel pump locking cap band.


YAA1F550

8. Using the fuel tank cap wrench 661 589 00 46 00, remove the locking cap.
9. Remove the pump from the fuel tank.

Notice: Check the condition of the seal and replace if necessary. Drain the fuel before removing the pump.

10. Perform an operational check of the fuel pump.
11. Installation should follow the removal procedure in the reverse order.


YAA1F190

FUEL FILTER

Removal and Installation Procedure

1. Disconnect the negative battery cable.

Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

2. Relieve the fuel system pressure. Refer to “Discharging the Pressure in Fuel System” in this section.
3. Disconnect the fuel lines from the fuel filter.

Installation Notice

Tightening Torque	28 N•m (21 lb-ft)

4. Remove the fuel filter mounting bracket bolt .

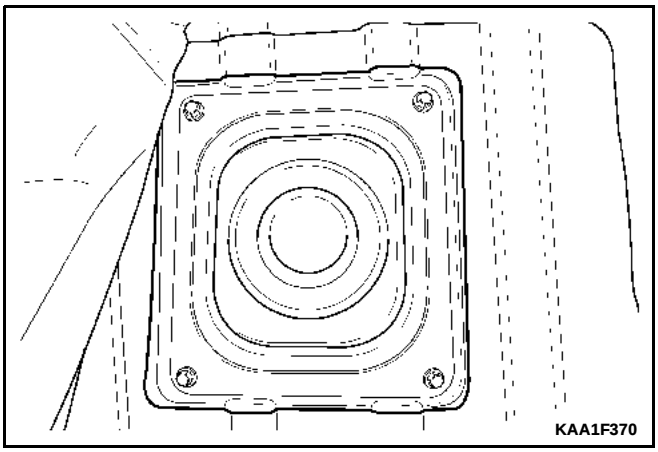
Installation Notice

Tightening Torque	6 N•m (53 lb-in)

Notice: Place the fuel pump pad. There may be a corrosion due to the contact between the fuel filter and the bracket.

5. Remove the fuel filter.
6. Install the fuel filter.
7. Perform a leak test of the fuel filter.
8. Installation should follow the removal procedure in the reverse order.

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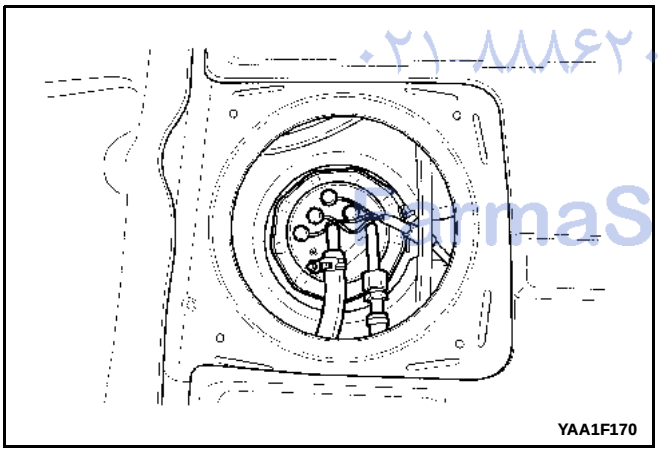
FUEL TANK

Removal and Installation Procedure

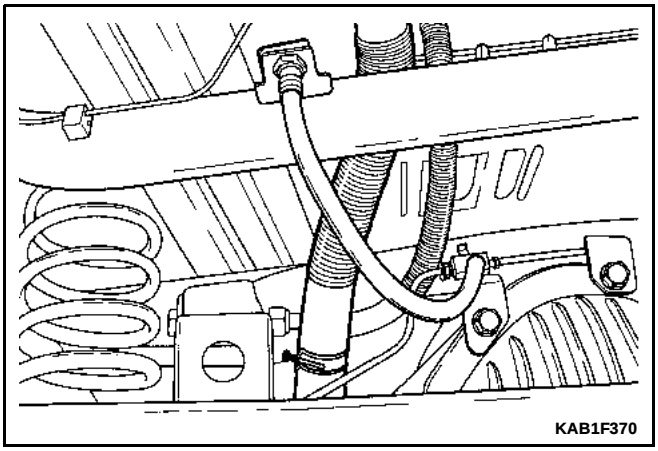
Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

1. Relieve the fuel pressure. Refer to “Discharging the Pressure in Fuel System” in this section.
2. Disconnect the negative battery cable.
3. Drain the fuel tank.
4. Put aside the floor carpet to remove the fuel pump access cover.
5. Remove the fuel pump access cover.

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6. Disconnect the return line.
7. Disconnect the supply line.
8. Disconnect the fuel tank-to-canister hose from the fuel tank.
9. Disconnect the fuel pump wiring connector.

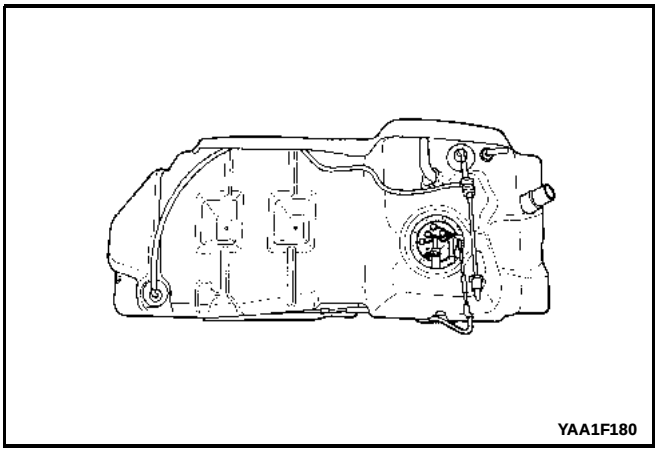

KAB1F370

10. Disconnect the fuel filler hose and air vent hose from the fuel tank.
11. Support the fuel tank.
12. Remove the fuel tank retaining nuts.

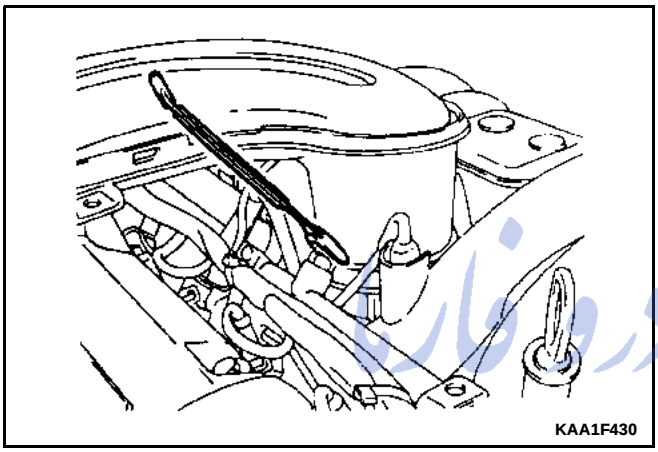
Installation Notice

Tightening Torque	38 N•m (28 lb-ft)

13. Carefully lower the fuel tank.


YAA1F180

14. Turn the roll over valves counterclockwise at an angle of 90 degrees.
15. Turn the lock ring counterclockwise.
16. Remove and discard the gasket.
17. Installation should follow the removal procedure in the reverse order.


KAA1F430

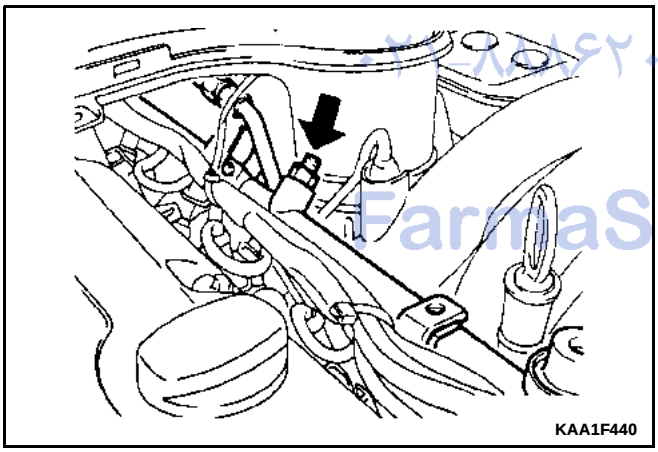
FUEL PRESSURE REGULATOR

Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Remove the fuel pressure test connector.

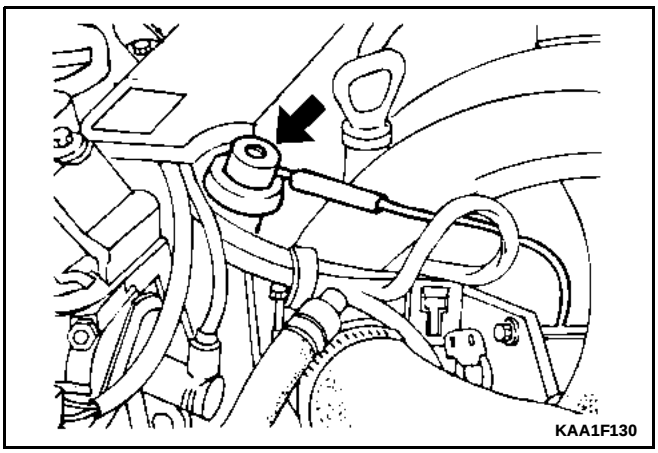
Installation Notice

Tightening Torque	25 N•m (18 lb-ft)


KAA1F440

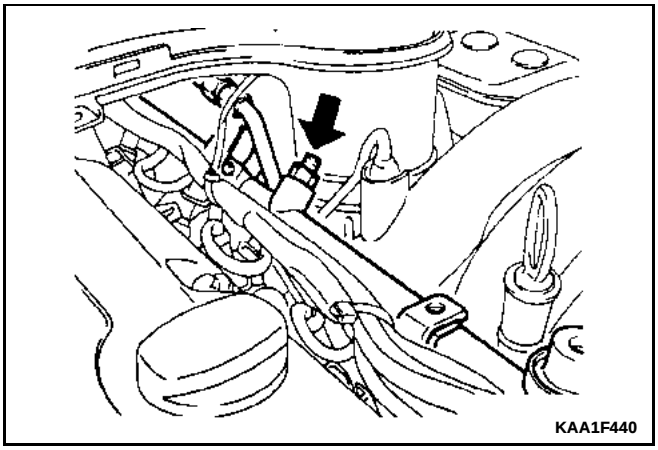
Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

3. Relieve the fuel pressure in fuel supply system by pressing the service valve.


KAA1F130

4. Disconnect the vacuum hose.
5. Disconnect the circlip and remove the fuel pressure regulator.
6. Apply the oil to O-ring lightly and then replace it.
7. Perform a leak test of the fuel pressure regulator with the engine off and the ignition on.
8. Installation should follow the removal procedure in the reverse order.

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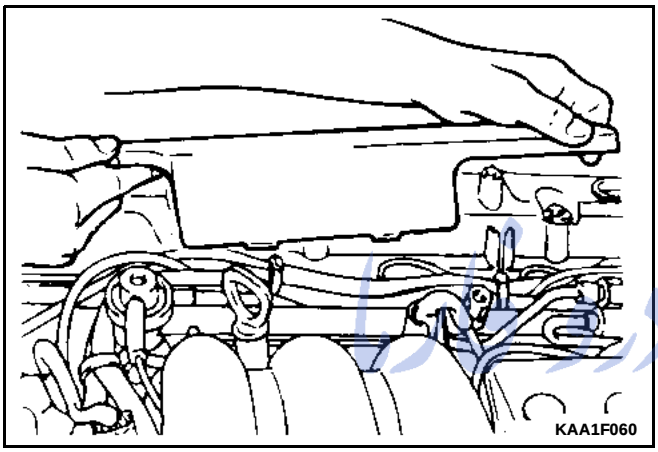

KAA1F440

FUEL RAIL AND INJECTORS

Removal and Installation Procedure

Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

1. Discharge the fuel pressure from the fuel pressure test connector.
2. Disconnect the negative battery cable.
3. Disconnect the vacuum hose from the fuel pressure regulator.

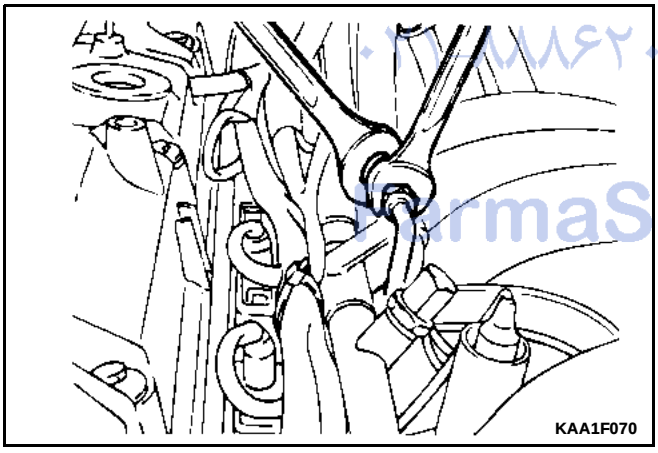

KAA1F060

4. Remove the cable guide.
5. Disconnect the Hot Film Air Mass (HFM) sensor connector.
6. Remove the intake air duct mounting bolts.

Installation Notice

Tightening Torque	9 N•m (80 lb-in)

7. Remove the intake air duct clamps.
8. Remove the intake air duct.


KAA1F070

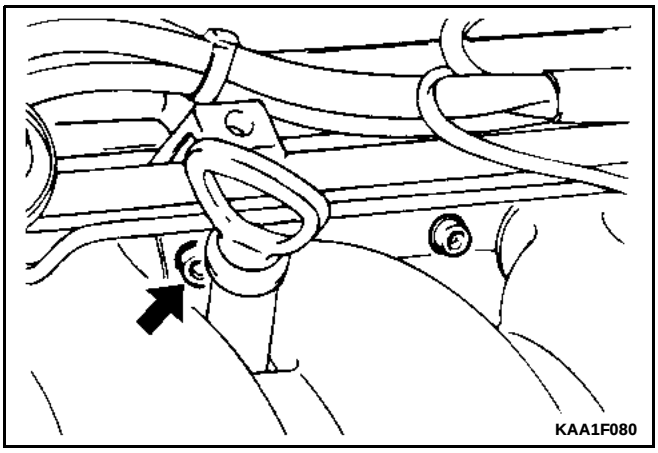
9. Remove the fuel return and supply line.

Notice: For removal, cover around parts with cloths not to be stained by fuel. In case of checking the injector only, do not remove the fuel return and supply line.

Installation Notice

Tightening Torque	23 N•m (17 lb-ft)

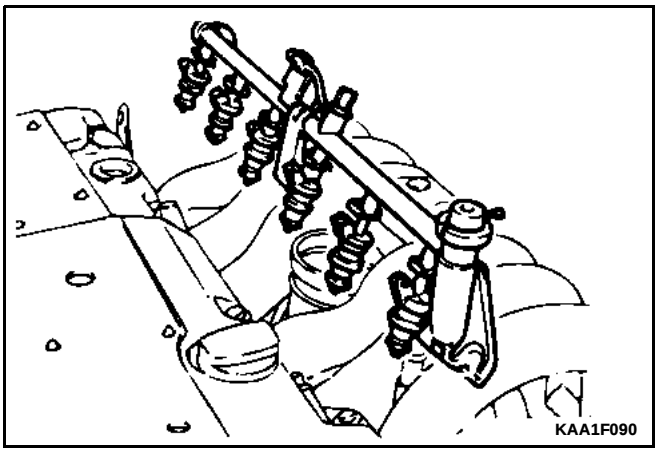
10. Remove the six injector connectors.


KAA1F080

11. Remove the two left and two right bolts and one center bolt of the fuel rail assembly from the intake manifold.

Installation Notice

Tightening Torque	25 N•m (18 lb-ft)

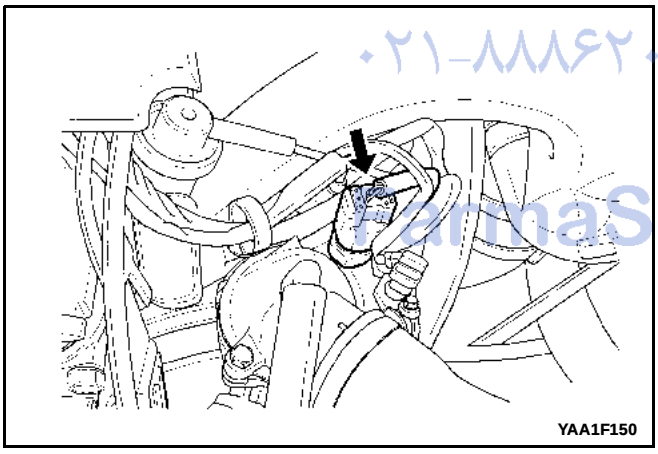

KAA1F090

Notice: Before removal, the fuel rail assembly may be cleaned with a spray-type cleaner, following package instructions. Do not immerse the fuel rails in liquid cleaning solvent. Use care in removing the fuel rail assembly to prevent damage to the electrical connectors and injector spray tips. Prevent dirt and other contaminants from entering open lines and passages. Fittings should be capped and holes plugged during service.

Important: If an injector becomes separated from the rail and remains in the cylinder head, replace the injector O-ring seals and the retaining clip.

12. Remove the injectors and the fuel rail carefully.
13. Remove the fuel injector retainer clips.
14. Remove the fuel injectors by pulling them down and out.
15. Discard the fuel injector O-rings.
16. Lubricate the new fuel injector O-rings with engine oil. Install the new O-rings on the fuel injectors.
17. Perform a leak check of the fuel rail and fuel injectors.
18. Installation should follow the removal procedure in the reverse order.

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YAA1F150

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ENGINE COOLANT TEMPERATURE SENSOR

Removal and Installation Procedure

1. Relieve the coolant system pressure.
2. Disconnect the negative battery cable.
3. Disconnect the engine coolant temperature sensor connector.

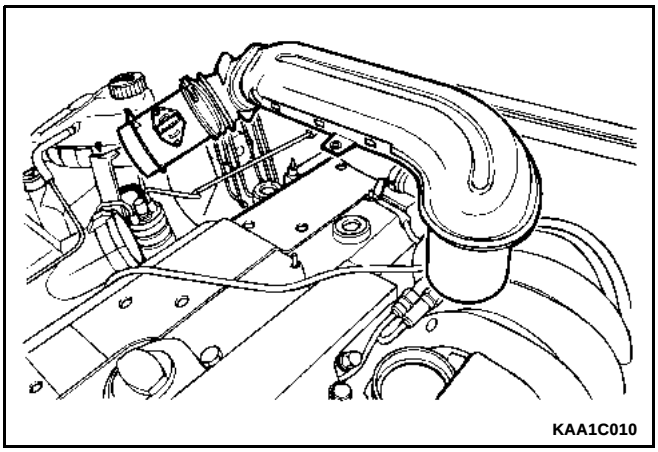
Notice: Take care when handling the engine coolant temperature sensor. Damage to the sensor will affect the proper operation of the fuel injection system.

4. Remove the engine coolant temperature sensor from the pump hosing.

Installation Notice

Tightening Torque	30 N•m (22 lb-ft)

5. Installation should follow the removal procedure in the reverse order.


KAA1C010

THROTTLE BODY (INTEGRATED WITH THE ACTUATOR)

Removal and Installation Procedure

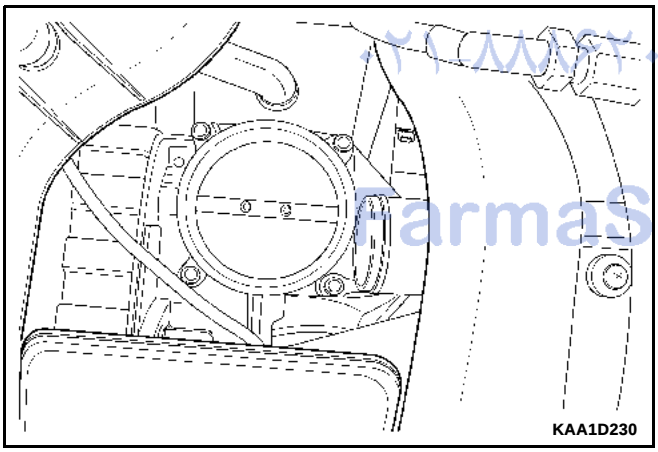
1. Disconnect the negative battery cable.
2. Disconnect the mass air flow sensor connector.
3. Disconnect the mass air flow sensor from the air filter housing.
4. Remove the intake air duct mounting bolts.

Installation Notice

Tightening Torque	9 N•m (80 lb-in)

5. Remove the air inlet housing clamps.
6. Remove the inlet air housing.

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KAA1D230

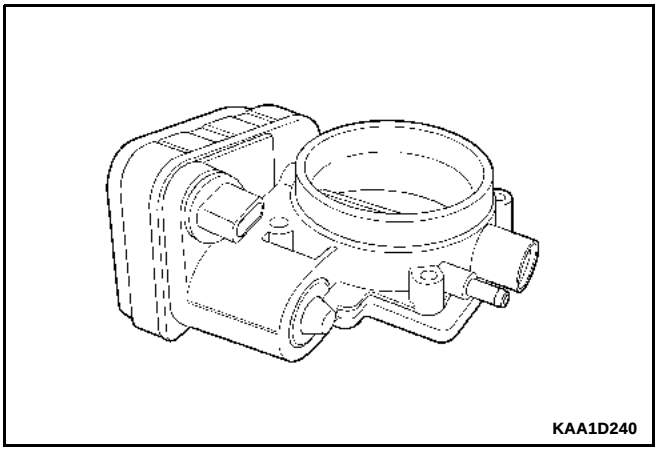
7. Disconnect the throttle body electrical connector.
8. Remove the throttle body bolts.

Installation Notice

Tightening Torque	12 N•m (106 lb-in)

9. Remove the vacuum hose.

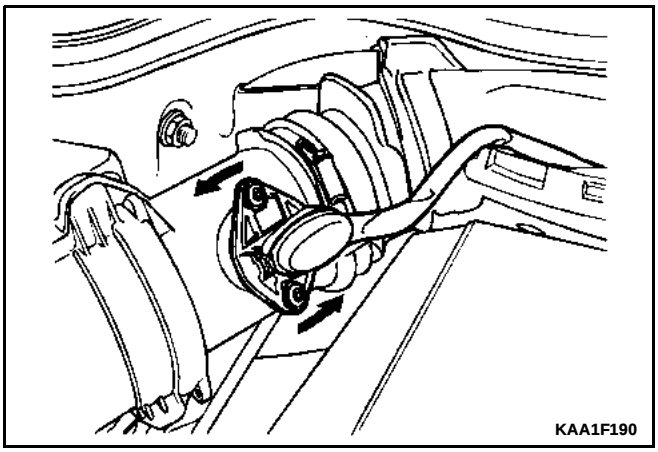
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KAA1D240

10. Remove the throttle body and discard the gasket.

Important: Use care in cleaning old gasket material. Sharp tools may damage sealing surfaces.

11. Installation should follow the removal procedure in the reverse order.


KAA1F190

HOT FILM AIR MASS (HFM) SENSOR

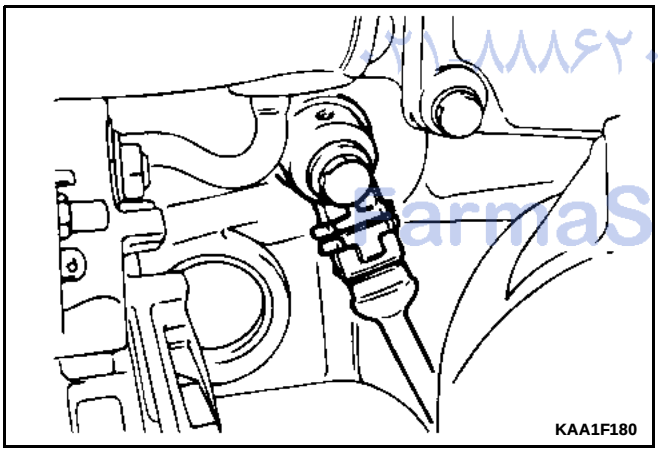
Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Disconnect the Hot Film Air Mass (HFM) sensor electrical connector.
3. Remove the HFM sensor retaining screws.
4. Turn the HFM sensor coupling in the direction shown in the figure in the left so that it gets separated from the contact surface.

Notice: Make sure the HFM sensor coupling connects completely with the contact surface installation.

5. Remove the HFM sensor.
6. Installation should follow the removal procedure in the reverse order.

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KNOCK SENSOR

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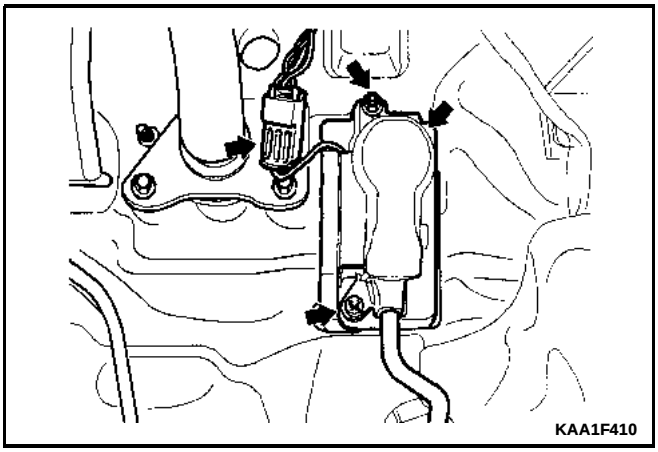
Removal and installation Procedure

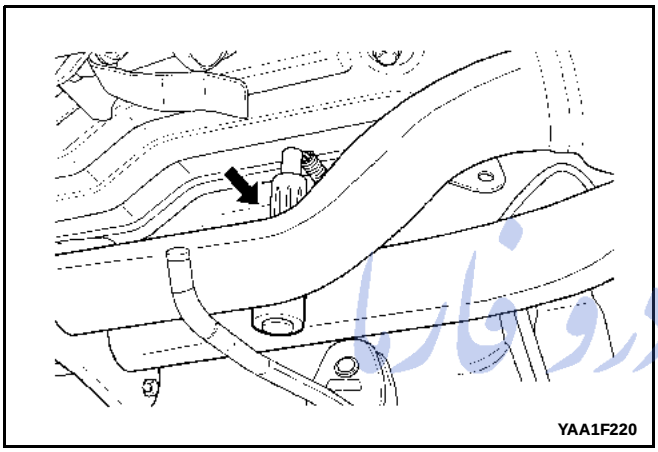
1. Disconnect the negative battery cable.
2. Disconnect the knock sensor electrical connector from the intake manifold bracket.
3. Remove the knock sensor mounting bolt from the knock sensor installed on the cylinder block.

Installation Notice

Tightening Torque	25 N•m (18 lb-ft)

4. Remove the knock sensor.
5. Installation should follow the removal procedure in the reverse order.


KAA1F410


YAA1F220

PEDAL POSITION SENSOR

Removal and installation Procedure

1. Disconnect the negative battery cable.
2. Disconnect the pedal position sensor connector.
3. Unscrew the bolts and nut.

Installation Notice

Tightening Torque	6 N•m (53 lb-in)

4. Remove the pedal and sensor assembly.
5. Installation should follow the removal procedure in the reverse order.

OXYGEN SENSOR

Removal and Installation Procedure

1. Disconnect the negative battery cable.

Notice: The oxygen sensor uses a permanently attached pigtail and connector. This pigtail should not be removed from the oxygen sensor. Damage or removal of the pigtail or the connector could affect proper operation of the oxygen sensor. Do not drop the oxygen sensor.

2. Disconnect the electrical connector.
3. Carefully remove the oxygen sensor from the exhaust pipe.

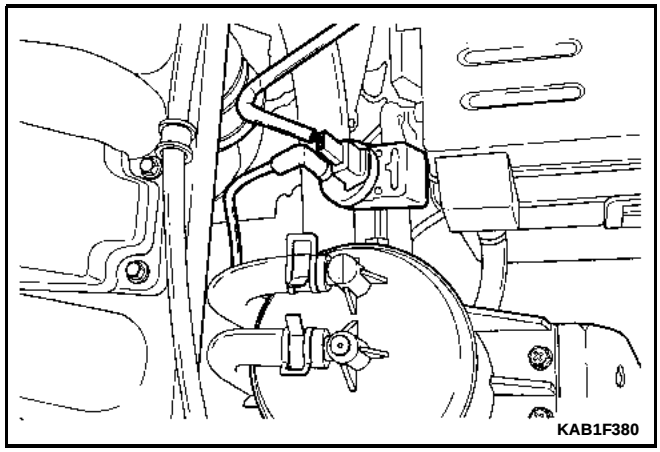
Installation Notice

Tightening Torque	55 N•m (41 lb-ft)

Important: A special anti-seize compound is used on the oxygen sensor threads. This compound consists of a liquid graphite and glass beads. The graphite will burn away, but the glass beads will remain, making the sensor easier to remove. New or serviced sensors will already have the compound applied to the threads. If a sensor is removed from any engine and is to be reinstalled, the threads must have an anti-seize compound applied before reinstallation.

4. Coat the threads of the oxygen sensor with an anti-seize compound, if needed.
5. Installation should follow the removal procedure in the reverse order.

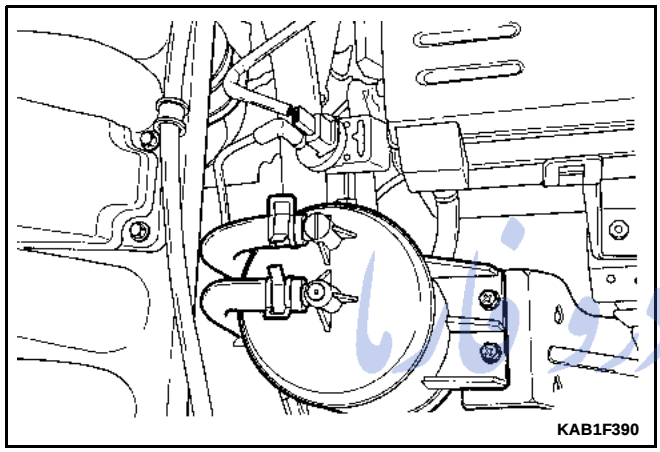
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KAB1F380

PURGE CONTROL VALVE

Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Disconnect the purge control valve connector.
3. Disconnect the throttle body-to-purge control valve hose from the purge control valve.
4. Disconnect the canister-to-purge control valve hose from the purge control valve.
5. Remove the purge control valve.
6. Installation should follow the removal procedure in the reverse order.

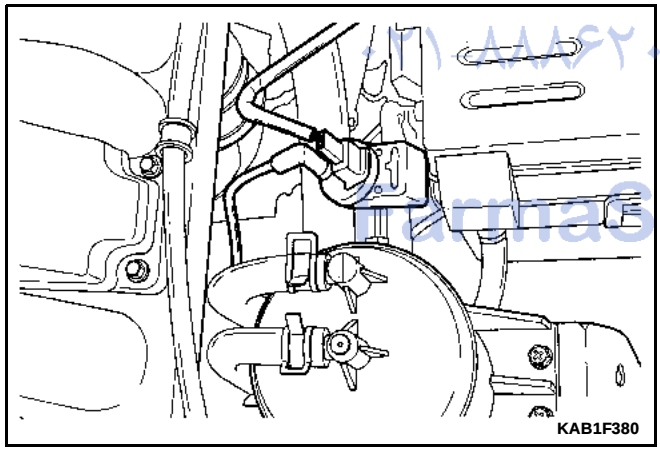

KAB1F390

CANISTER

Removal and Installation Procedure

Caution: Canister and vacuum hoses contain fuel vapors. Do not smoke in the area or permit an open flame.

1. Disconnect the fuel tank-to-canister hose form the canister.
2. Disconnect the canister-to-purge control valve hose form the canister.

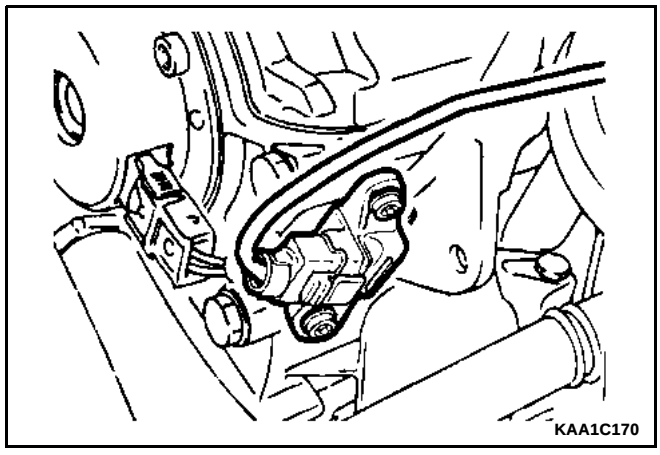

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3. Remove the canister mounting bolts.

Installation Notice

Tightening Torque	6 N•m (53 lb-in)

4. Remove the canister.
5. Installation should follow the removal procedure in the reverse order.


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CAMSHAFT POSITION SENSOR

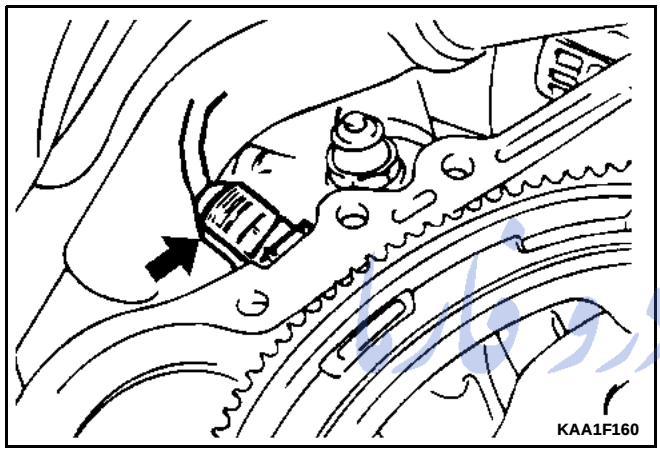
Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Disconnect the electrical connector from the cam-shaft position sensor.
3. Remove the camshaft position sensor retaining bolt.

Installation Notice

Tightening Torque	10 N•m (89 lb-in)

4. Check the O-ring for damage and replace it if necessary.
5. Installation should follow the removal procedure in the reverse order.



CRANKSHAFT POSITION SENSOR

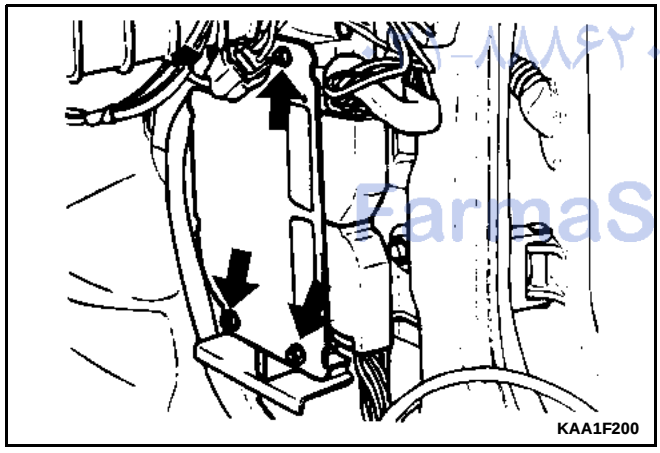
Removal and installation Procedure

1. Disconnect the negative battery cable.
2. Disconnect the electrical connector at the crankshaft position sensor.
3. Remove the crankshaft position sensor retaining bolt.

Installation Notice

Tightening Torque	10 N•m (89 lb-in)

4. Installation should follow the removal procedure in the reverse order.



ENGINE CONTROL MODULE

Removal and installation Procedure

1. Disconnect the negative battery cable.
2. Remove the cowl side trim form passenger side. Refer to *Section 9G, Interior trim.*
3. Remove the four securing nuts for the Engine Control Module (ECM) from the mounting bracket.

Installation Notice

Tightening Torque	10 N•m (89 lb-in)

4. Pull out the ECM from the bracket.
5. Disconnect the vehicle side coupling.
6. Installation should follow the removal procedure in the reverse order.

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SECTION 1G1

M162 ENGINE INTAKE & EXHAUST

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

Specifications 1G1-2
Fastener Tightening Specifications 1G1-2
Maintenance and Repair 1G1-3
On-Vehicle Service 1G1-3
Air Cleaner 1G1-3
Intake Air Duct 1G1-5
Intake Manifold 1G1-7
Resonance Flap 1G1-9
Exhaust Manifold 1G1-11

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SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

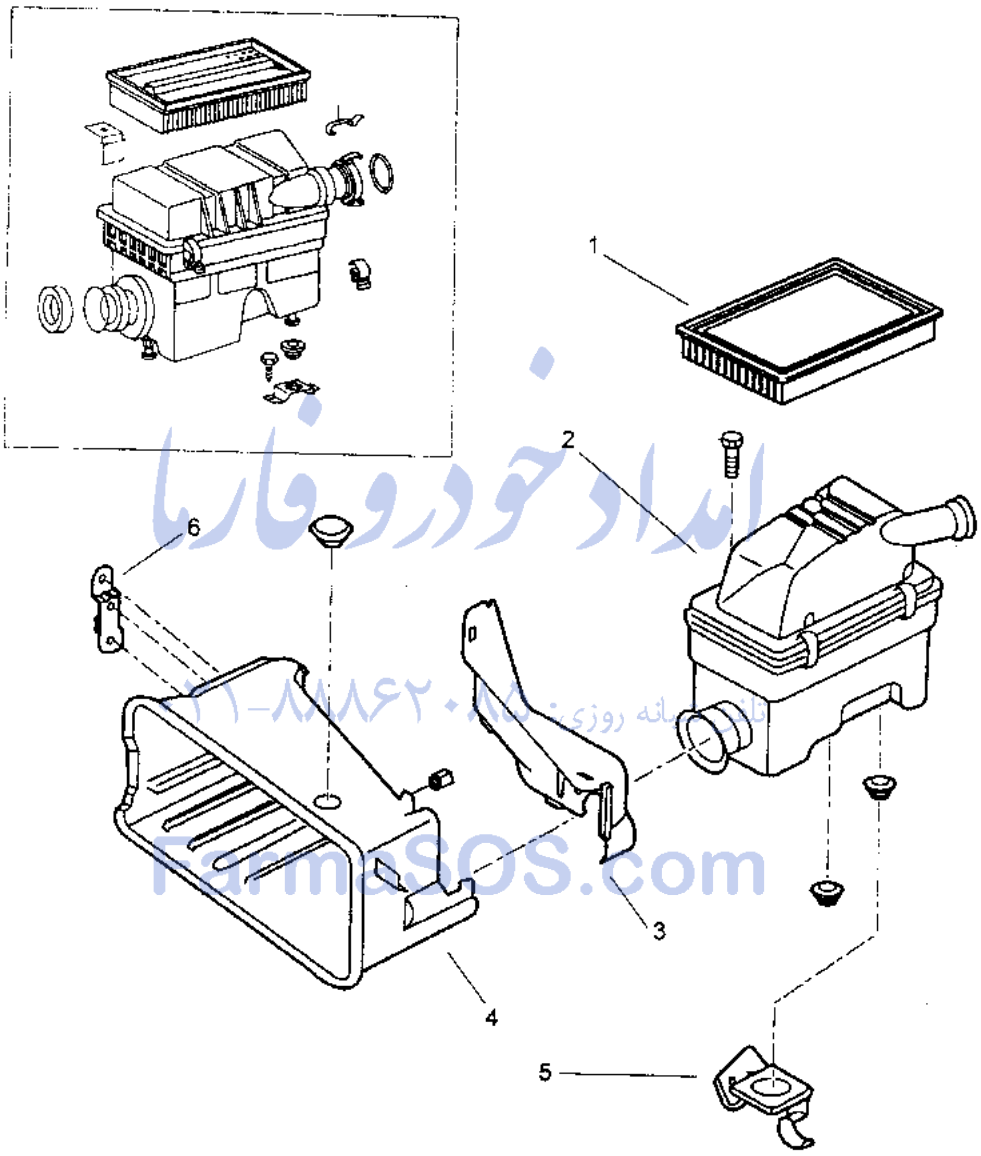
Application	N•m	Lb-Ft	Lb-In
Air Cleaner Mounting Bolt	22.5 - 27.5	16.6 - 20.3	-
Exhaust Flange Bolt	30	22	-
Exhaust Manifold Nuts	36 - 44	27 - 33	-
Exhaust Pipe-To-Catalytic Converter Flange Nuts	28 - 47	21 - 35	-
Front Muffler Pipe-To-Catalytic Converter Flange Nuts	28 - 47	21 - 35	-
Lower Intake Manifold Mounting Bolt	22.5 - 27.5	16.6 - 20.3	-
Rear Muffler Pipe Flange-To-Front Muffler Pipe Flange Nuts	28 - 47	21 - 35	-
Resonance Flap Retaining Bolts	9 - 11	-	80 - 97
Upper Intake Manifold Mounting Bolt	22.5 - 27.5	16.6 - 20.3	-

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MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

AIR CLEANER



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1 Element Assembly
2 Cleaner Assembly-Air
3 Shield Cover-Air Intake
4 Shield Assembly-Air Intake
5 Braket Assembly-Air Cleaner Mounting
6 Braket Assembly-Shield Surport

Removal and Installation Procedure

1. Disconnect the HFM sensor and the air cleaner by prying up the clamp.
2. Remove the air cleaner mounting bolt.

   Installation Notice

Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)

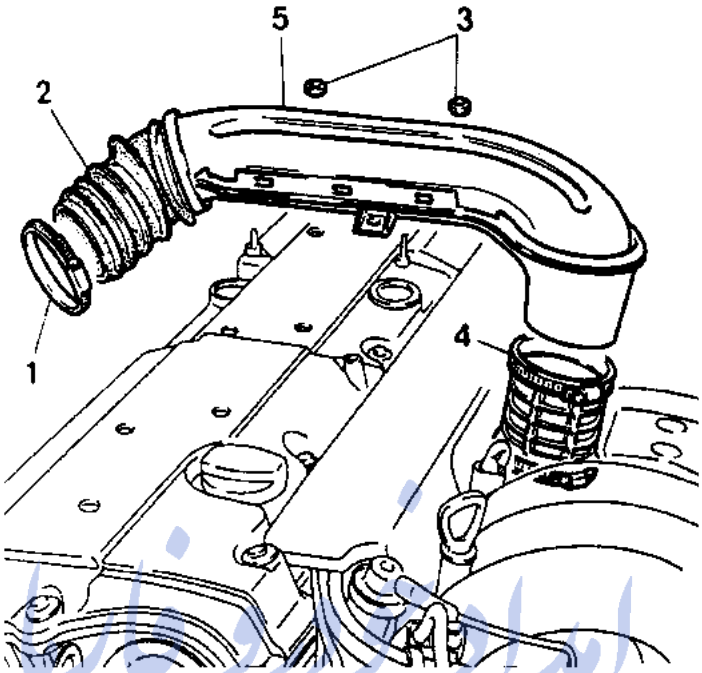
3. Remove air intake shield upper cover, and then remove the air cleaner from rubber bearing on bracket.

Notice: For installation, exactly seat the air cleaner into the rubber bearing.

4. Installation should follow the removal procedure in the reverse order.

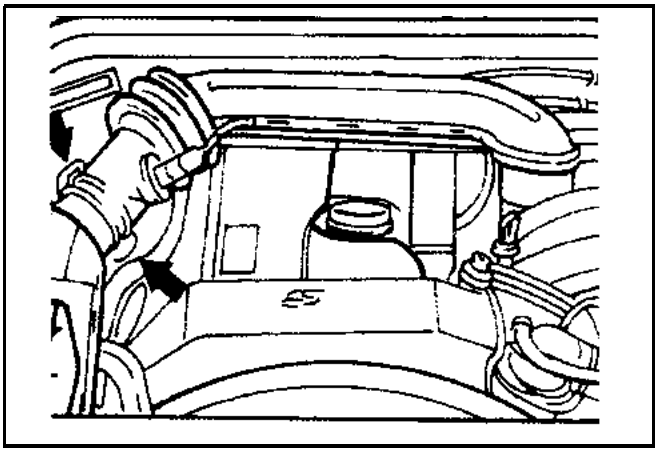
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INTAKE AIR DUCT



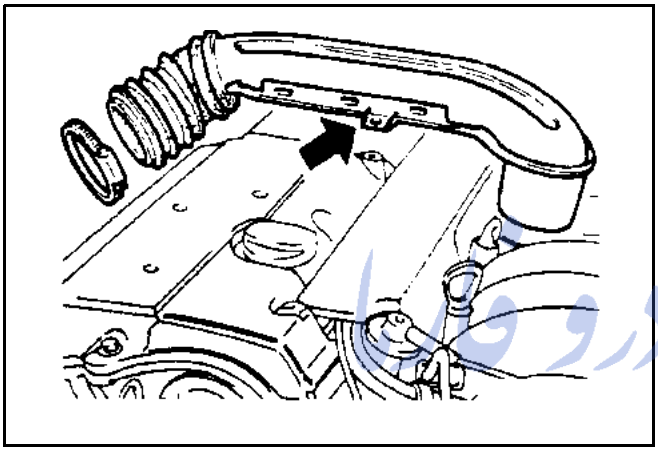
1 Clamp
2 Sleeve
3 Nut
4 Clamp
5 Intake Air Duct

۰۲۱-۸۸۸۶۲۰۸۵
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Removal & Installation Procedure

1. Remove the clamp (1) and disconnect the HFM sensor.
2. Remove the nut (3) (arrow).



3. Remove the clamp (4).
4. Remove the intake air duct (5) carefully.

Installation Notice

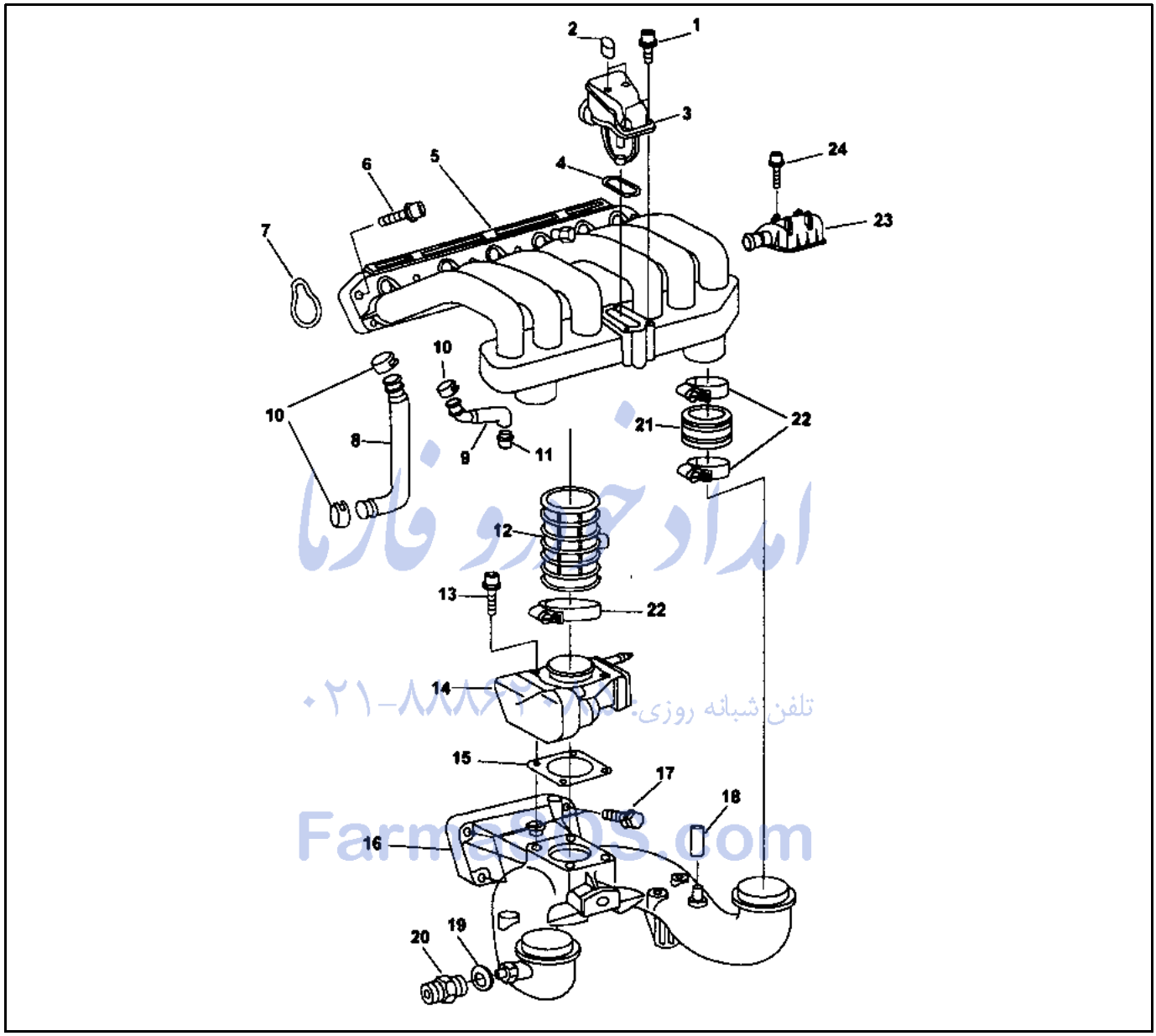
Exactly seat the pin of intake air duct onto the crankcase ventilation rubber mount.

5. Installation should follow the removal procedure in the reverse order.

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INTAKE MANIFOLD

Preceding Work: Removal of fuel rail
Removal of battery
Removal of canister



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1 Bolt (M6 X 40, 4 pieces) . . . . . 9-11 N•m (80-97 lb-in)
2 Softcap
3 Resonance Flap
4 Gasket . . . . . Replace
5 Upper Intake Manifold
6 Bolt (M8 x 50, 9 pieces) . . . . . 22.5-27.5 N•m (16.6-20.3 lb-ft)
7 Gasket . . . . . Replace
8 Blow-by Hose
9 Blow-by Hose
10 Clamp
11 Blow-by Nipple
12 Inlet Air Housing
13 Bolt (M6 x 40, 4 pieces) . . . . . 9-11 N•m (80-97 lb-in)
14 Throttle Body - Electric
15 Gasket . . . . . Replace
16 Lower Intake Manifold
17 Bolt (M8 x 40, 4 pieces) . . . . . 22.5-27.5 N•m (16.6-20.3 lb-ft)
18 Nipple . . . . . Replace
19 Seal Ring
20 Connection House
21 Clamp
22 Noise Damper Assembly
23 Tapping Screw

Removal & Installation Procedure

- **Upper Intake Manifold**

1. Disconnect the vacuum hose (8,9).
2. Loosen the clip (22).
3. Disconnect the resonance flap connector.
4. Remove the upper intake manifold (5) after unscrewing the bolt (6).

Installation Notice

Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)

Notice: Check the gasket and replace it if necessary.

5. Installation should follow the removal procedure in the reverse order.

- **Lower Intake Manifold**

Preceding work : removal of upper intake manifold

1. Remove the hose of brake booster vacuum line and idle speed connector.
2. Disconnect the hot water inlet pipe from the bottom of lower intake manifold.
3. Unscrew the bolt (17) and remove the lower intake manifold (16).

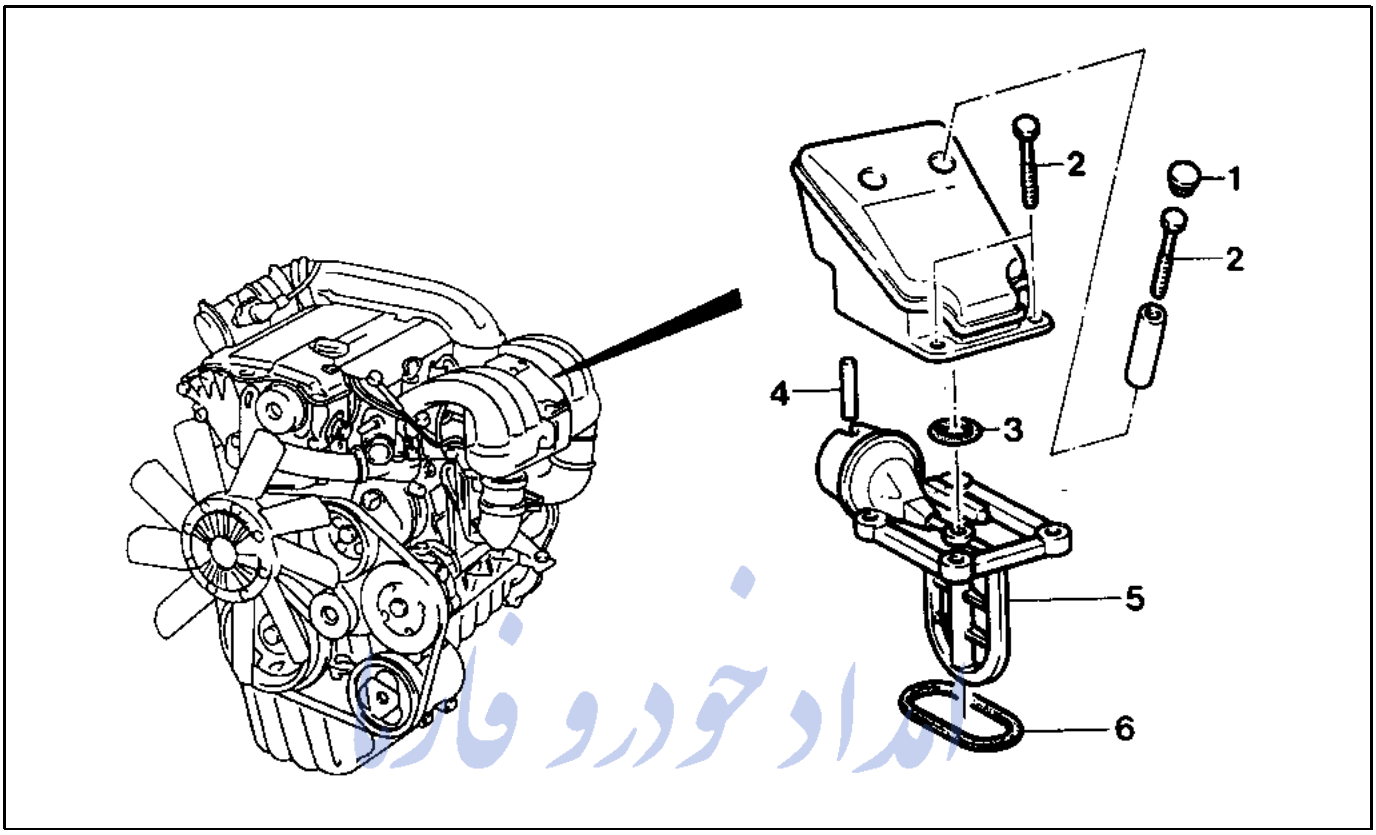
Installation Notice

Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)

4. Start the engine and check for leaks at each connection part.

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RESONANCE FLAP



1 Soft Cap (2)
2 Bolt (M6 x 25, 4 pieces) ..... 9-11 N•m (80-97 lb-in)
3 O-ring
4 Vacuum Hose
5 Resonance Flap
6 Gasket ..... Replace

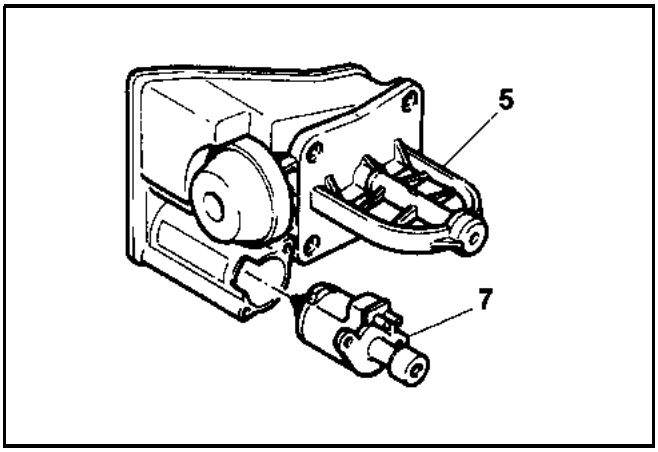
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Removal & Installation Procedure

1. Remove the 2 soft caps (1).
2. Remove the upper resonance flap coupling after removing 4 bolts (2).

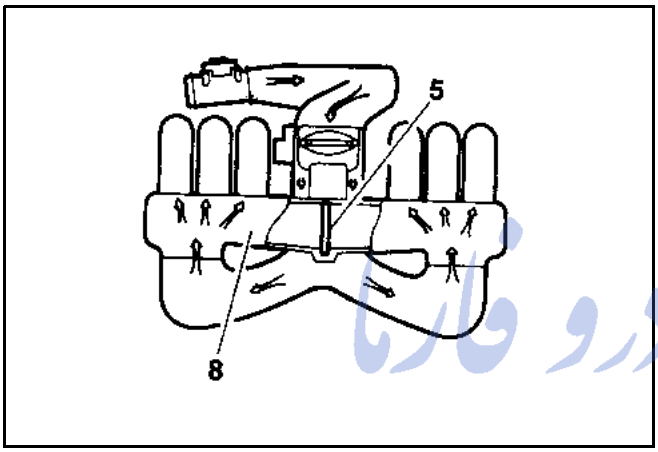
Notice: Connect carefully the vacuum hose (4) for installation.

3. Check the O-ring (3) and replace it if necessary.
4. Remove the lower resonance flap (5).
5. Replace the gasket (6).
6. Installation should follow the removal procedure in the reverse order.



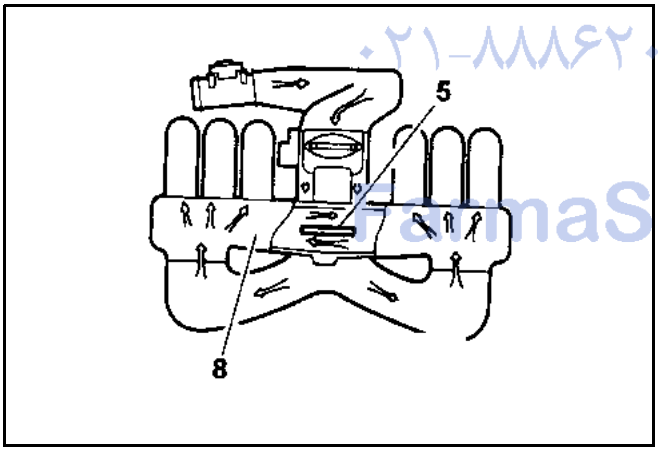
Function Description

A pneumatically actuated resonance flap (5) is located on the intake manifold, and will be opened and closed by load, which operates resonance flap according to engine and controlled by ECU and rpm.



1. Resonance flap closed (at idle/partial load : less than 3,800/rpm)

The switch valve (7) will be adjusted by ECU and resonance flap will be closed. By increasing air flow passage through dividing intaking air flow toward both air collection housing (8). This leads to a signficant increase in the torque in the lower speed range.



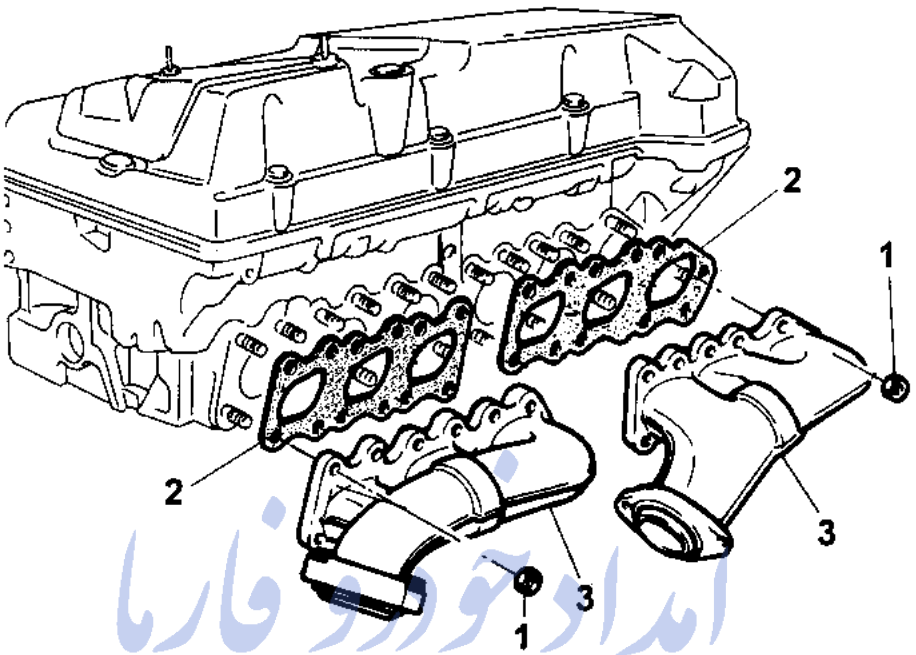
2. Resonance flap open (at full load:over 3,800/rpm)

The switch valve (7) will not be adjusted by ECU and resonance flap (5) will be open. The colllected air in the air collection housing (8) will not be divided and intaking air passage will be shorten.

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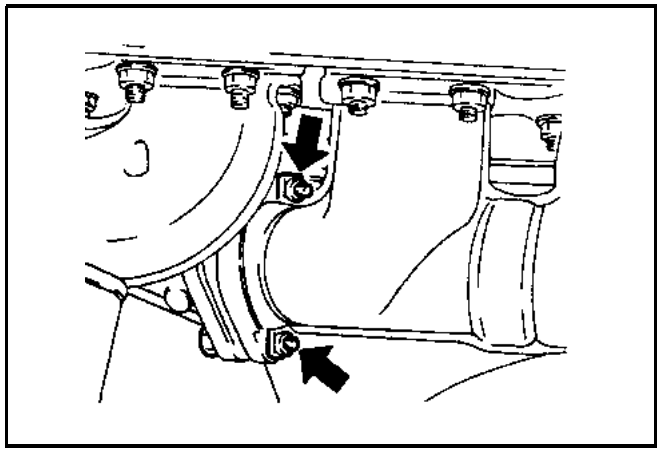
EXHAUST MANIFOLD

Preceding Work: Removal of air cleaner



1 Nut . . . . . 36-44 N•m (27-33 lb-ft)
2 Gasket . . . . . Replace
3 Exhaust Manifold

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Removal & Installation Procedure

1. Remove the flange bolt from the exhaust manifold, and disconnect the front exhaust pipe.

   Installation Notice

Tightening Torque	30 N•m (22 lb-ft)

Notice: Check for nut damages and replace the nut if necessary.

2. Remove the 23 nuts (1) from the stud bolt, and remove the exhaust manifold.

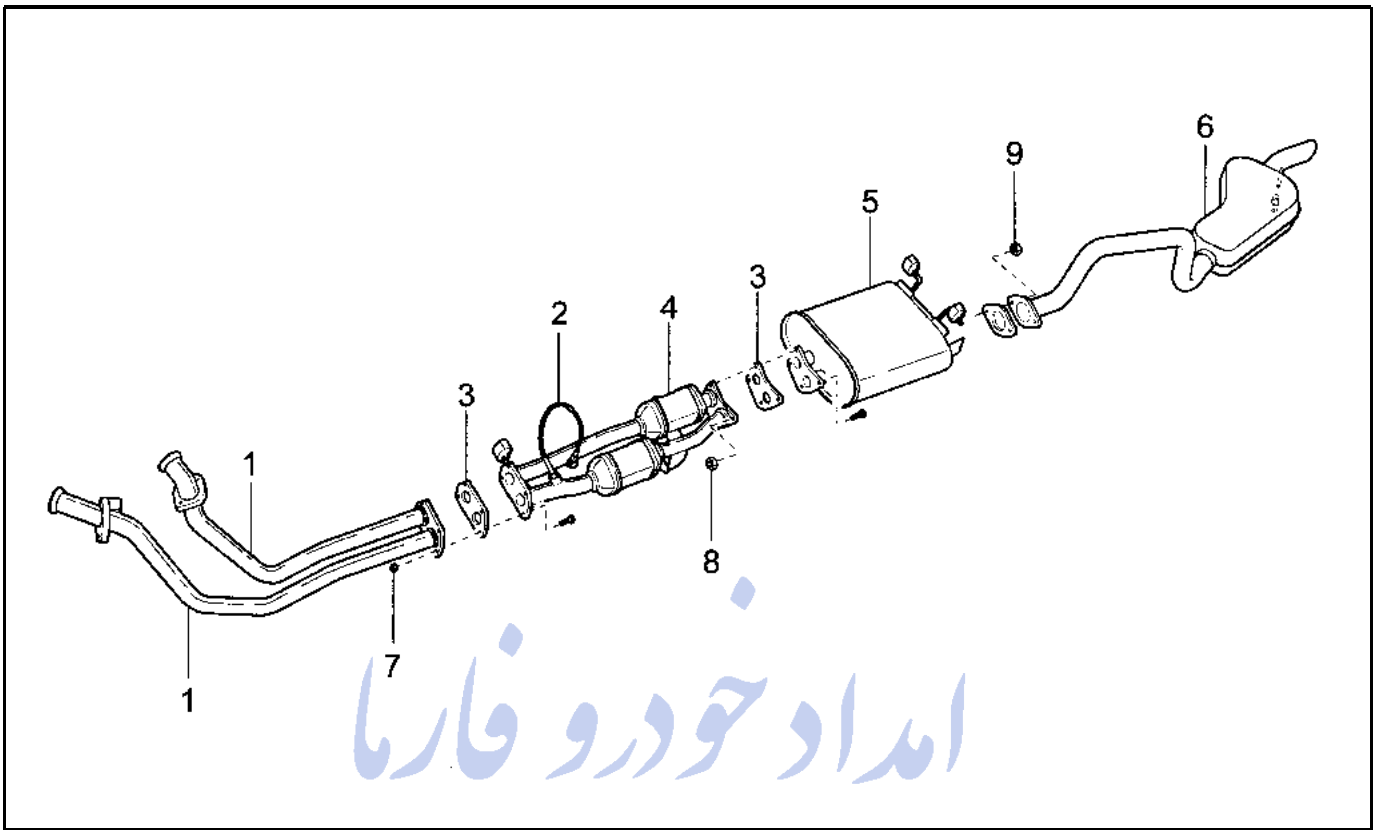
   Installation Notice

Tightening Torque	36 - 44 N•m (27 - 33 lb-ft)

3. Replace the gasket (2).
4. Installation is reverse order of the removal.

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Removal and Installation of Exhaust System



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1 Exhaust Pipe
2 Oxygen Sensor
3 Gasket
4 Catalytic Converter
5 Front Muffler
6 Rear Muffler
7 Exhaust Pipe-to-Catalytic Converter Flange Nuts ..... 28-47 N•m (21-35 lb-ft)
8 Front Muffler Pipe-to-Catalytic Converter Flange Nuts ..... 28-47 N•m (21-35 lb-ft)
9 Rear Muffler Pipe Flange-to-Front Muffler Pipe Flange Nuts ... 28-47 N•m (21-35 lb-ft)

SECTION 1

ENGINE

SECTION 1A2 (M161 ENGINE)

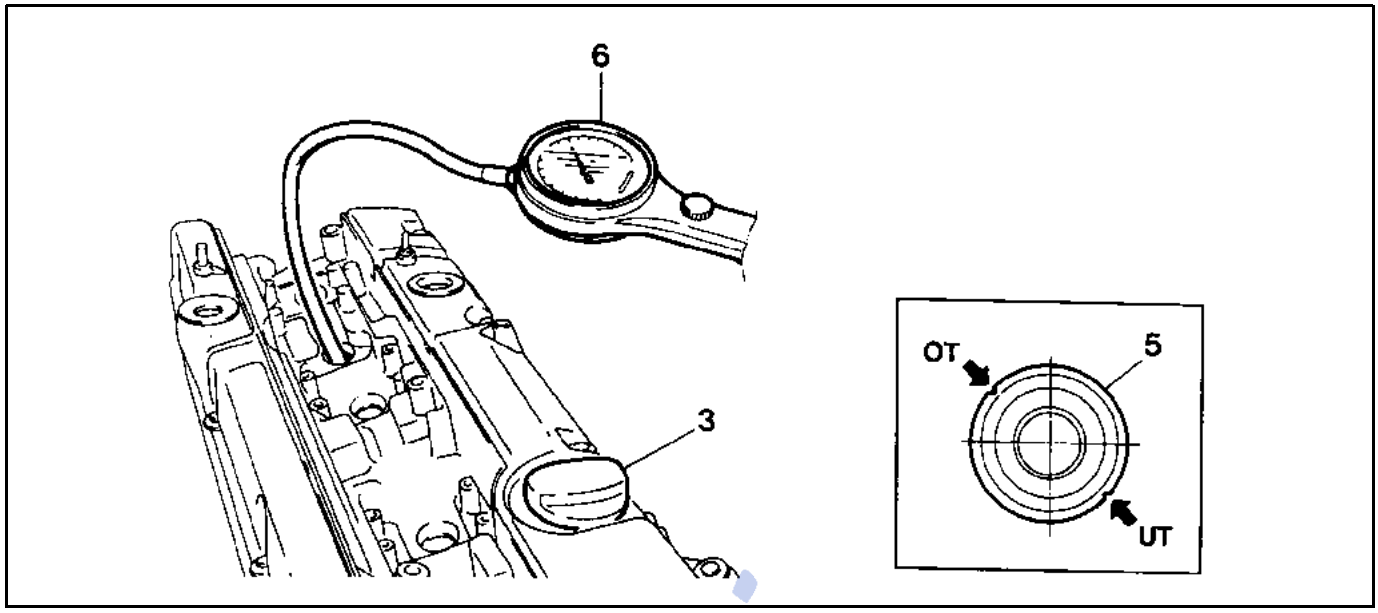
GENERAL ENGINE INFORMATION

TABLE OF CONTENTS

Specifications 1A2-2
Engine Specifications 1A2-2
Component Locator 1A2-3
Front View 1A2-3
Side View 1A2-4
Performance Curve 1A2-5
E23 Engine 1A2-5
E20 Engine 1A2-6
Diagnosis 1A2-7
Oil Leak Diagnosis 1A2-7
Engine Cranking At The Front of Crankshaft 1A2-8
Compression Pressure Test 1A2-9
Cylinder Pressure Leakage Test 1A2-11
General Information 1A2-13
Cleanliness and Care 1A2-13
On-Engine Service 1A2-13

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CYLINDER PRESSURE LEAKAGE TEST



3 Engine Oil Filler Cap
5 Vibration Damper
6 Cylinder Pressure Leakage Tester with Connecting Hose

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Permissible Pressure Leakage

At Whole Engine	Max. 25 %
At Valve and Cylinder Head Gasket	Max. 10 %
At Piston and Piston Ring	Max. 20 %

Cylinder Number By Mark On Vibration Damper At TDC

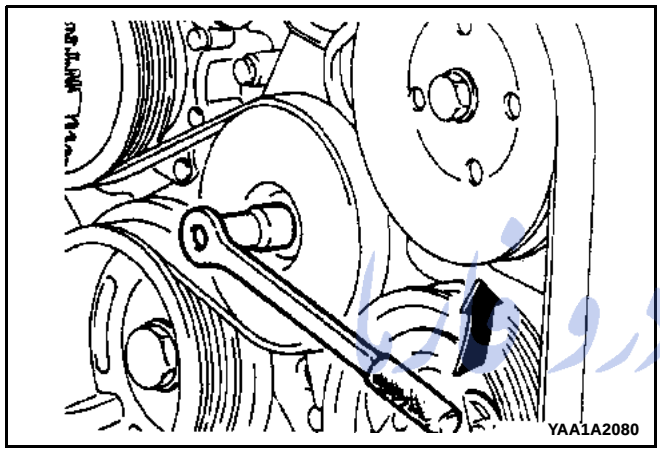
TDC Mark	OT (TDC)	UT (BDC : 180°)
Cylinder Number	1, 4	2, 3

Universal Tool

Cylinder Pressure Leakage Tester	Bosch, EFAW 210A Sun, CLT 228

Leakage Test

1. Warm the engine up to normal operating temperature.
2. Disconnect the negative battery cable.
3. Remove the spark plugs.
4. Check the coolant level by opening the coolant surge tank cap and replenish if insufficient.
5. Open the engine oil filler cap.
6. Connect the tester to air pressure line and adjust the scale of tester.
7. Install the connecting hose to spark plug hole.



8. Position the piston of No.1 cylinder at TDC by rotating the crankshaft.

9. Connect the connecting hose to tester and measure the leakage volume after blowing up compressed air.

Notice: Measure the leakage volume in the completely opening condition of throttle valve by pulling the acceleration cable.

10. Perform the pressure test according to the firing order.

Notice: Firing Order : 1 - 3 - 4 - 2

11. Compare the leakage pressure with the specifications.

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GENERAL INFORMATION

CLEANLINESS AND CARE

An automobile engine is a combination of many machined, honed, polished and lapped surfaces with tolerances that are measured in the ten-thousandths of an inch. When any internal engine parts are serviced, care and cleanliness are important. A liberal coating of enigne oil should be applied to friction areas during assembly, to protect and lubricate the surfaces on initial operation. Proper cleaning and protection of machined surfaces and friction areas is part of the repair procedure. This is considered standard shop practice even if not specifically stated.

Whenever valve train components are removed for service, they should be kept in order. They should be installed in the same locations, and with the same mating surfaces, as when they were removed.

Battery cables should be disconnected before any major work is performed on the engine. Failure to disconnect cables may result in damage to wire harness or other electrical parts.

ON-ENGINE SERVICE

Caution: Disconnect the negative battery cable before removing or installing any electrical unit, or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

Notice: Any time the air cleaner is removed, the intake opening should be covered. This will protect against accidental entrance of foreign material, which could follow the intake passage into the cylinder and cause extensive damage when the engine is started.

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SPECIFICATIONS

ENGINE SPECIFICATIONS

Application			E23 Engine	E20 Engine
Engine Model			M161.970	M161.940
Displacement (CC)			2295	1998
Cylinder (Bore x Stroke) (mm)			90.9 x 88.4	89.9 x 78.7
Fuel Injection / Ignition System			MSE 3.53S	←
Compression Ratio			10.4:1	9.6:1
Number of Cylinders			4	←
Camshaft Valve Arrangement			DOHC	←
Camshaft Drive Type			Chain-Driven	←
Max. Output (ps/rpm)			149 / 5500	135 / 5500
Max. Torque (kg•m/rpm)			22.4 / 4000	19.3 / 4000
Firing Order			1-3-4-2	←
Ignition Type			Distributorless	←
Ignition Timing			BTDC 6° ± 2°	←
Valve Timing	Intake	Open/Close	ATDC 19.25° / ABDC 28.76°	ATDC 13.15° / ABDC 13.57°
	Exhaust	Open/Close	BBDC 20.62° / BTDC 15.08°	BBDC 16.58° / BTDC 17.05°
Valve Clearance Adjustment			Automatic Control	←
Idle Speed (rpm)			750 ± 50	←
Fuel Injection Pressure (kg/cm^2)			3.2 - 4.2	←
Oil Capacity (liter)			7.5	←
Lubrication Type			Forced by Gear Pump	←
Oil Filter Type			Full Flow with Paper Filter	←
Fuel			Unleaded Gasoline	←

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MSE 3.62S/3.53S (Motorsteuer Elektronik : German)

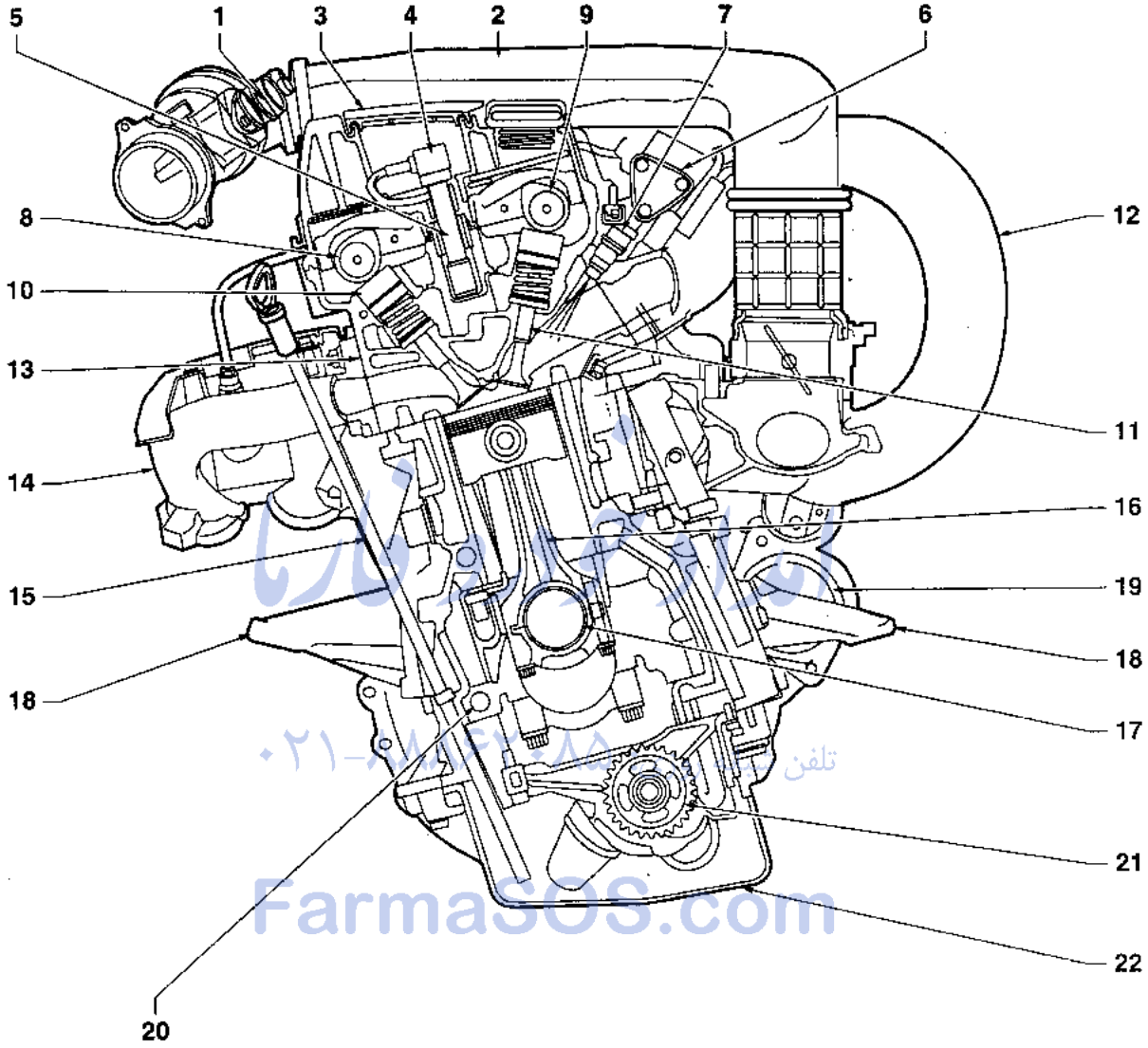
MSE : Engine Control Electronic

3.62S : 6 cylinder version

3.53S : 4 cylinder version

COMPONENT LOCATOR

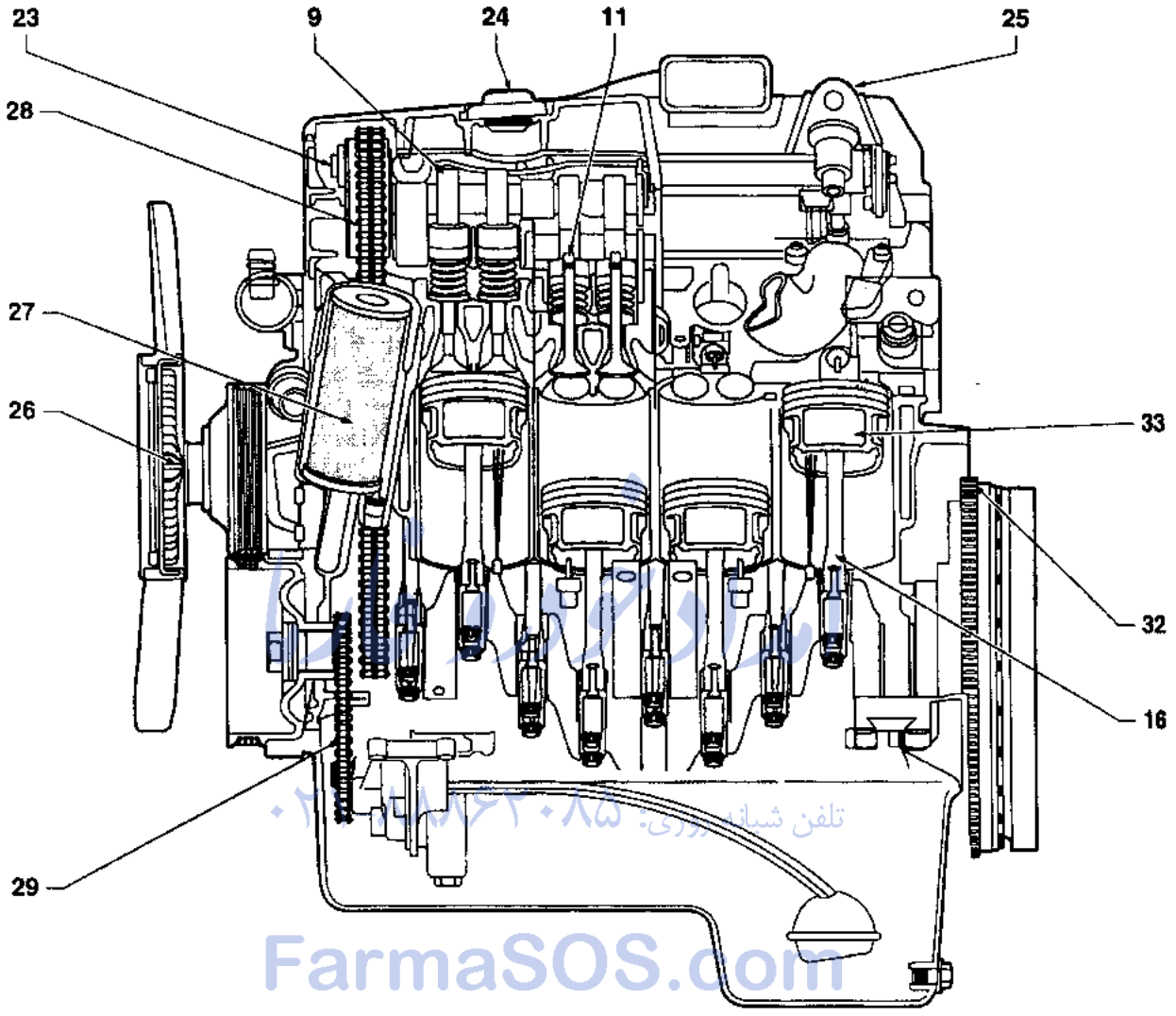
FRONT VIEW



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1 HFM Sensor
2 Intake Air Duct
3 Cylinder Head Cover
4 Ignition Coil
5 Spark Plug Connector
6 Fuel Distributor
7 Injector
8 Exhaust Camshaft
9 Intake Camshaft
10 Valve Tappet
11 Intake Valve
12 Intake Manifold
13 Cylinder Head
14 Exhaust Manifold
15 Dipstick Guide Tube and Gauge
16 Connecting Rod
17 Crankshaft
18 Engine Mounting Bracket
19 Starter
20 Crankcase
21 Oil Pump Sprocket
22 Oil Pan

SIDE VIEW

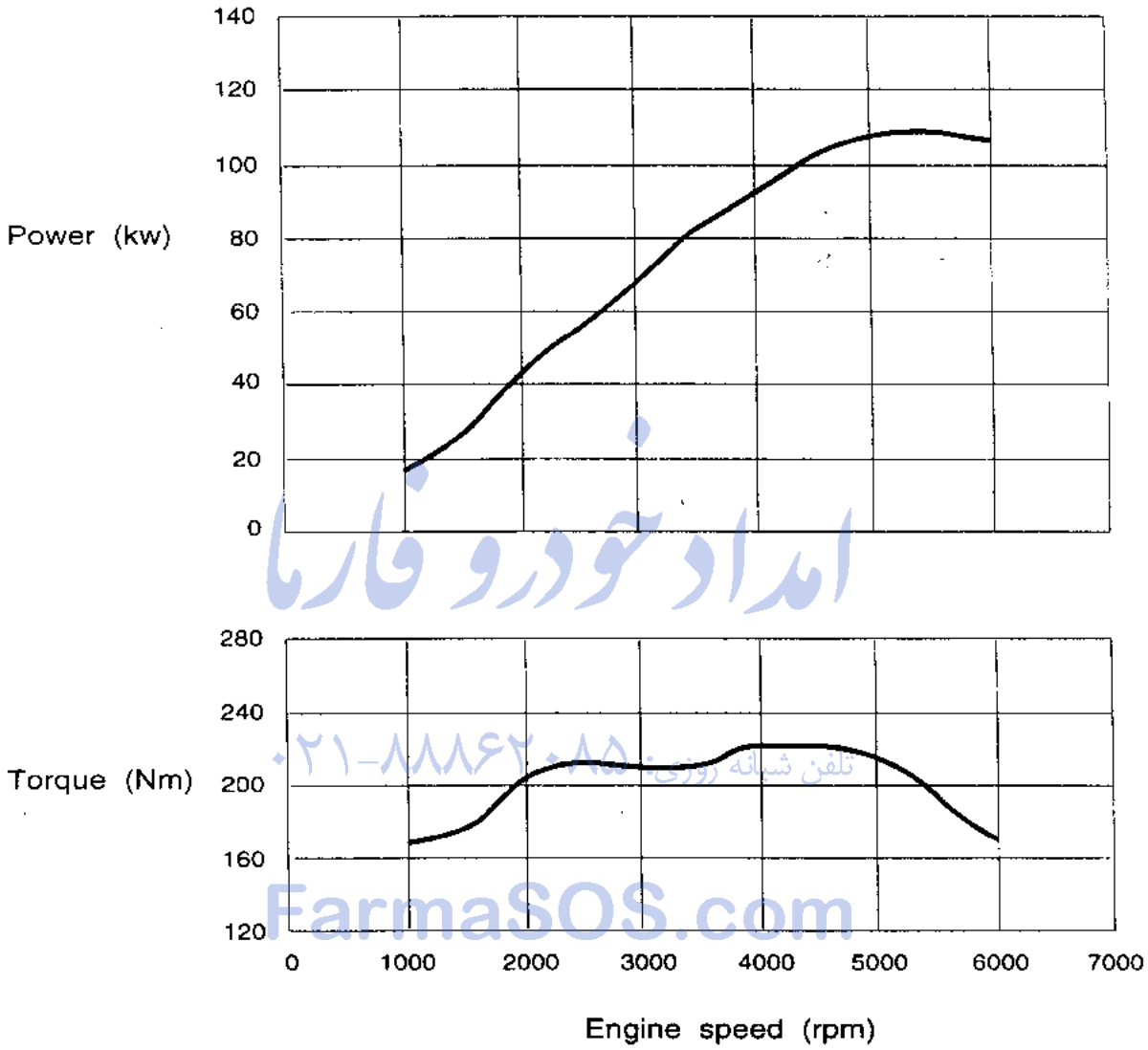


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23 Camshaft Adjuster
24 Oil Filler Cap
25 Engine Hanger Bracket
26 Cooling Fan and Viscous Clutch
27 Oil Filter
28 Timing Chain
29 Oil Pump Drive Chain
30 Oil Strainer
31 Oil Pump
32 Ring Gear and Flywheel of Drive Plate
33 Piston

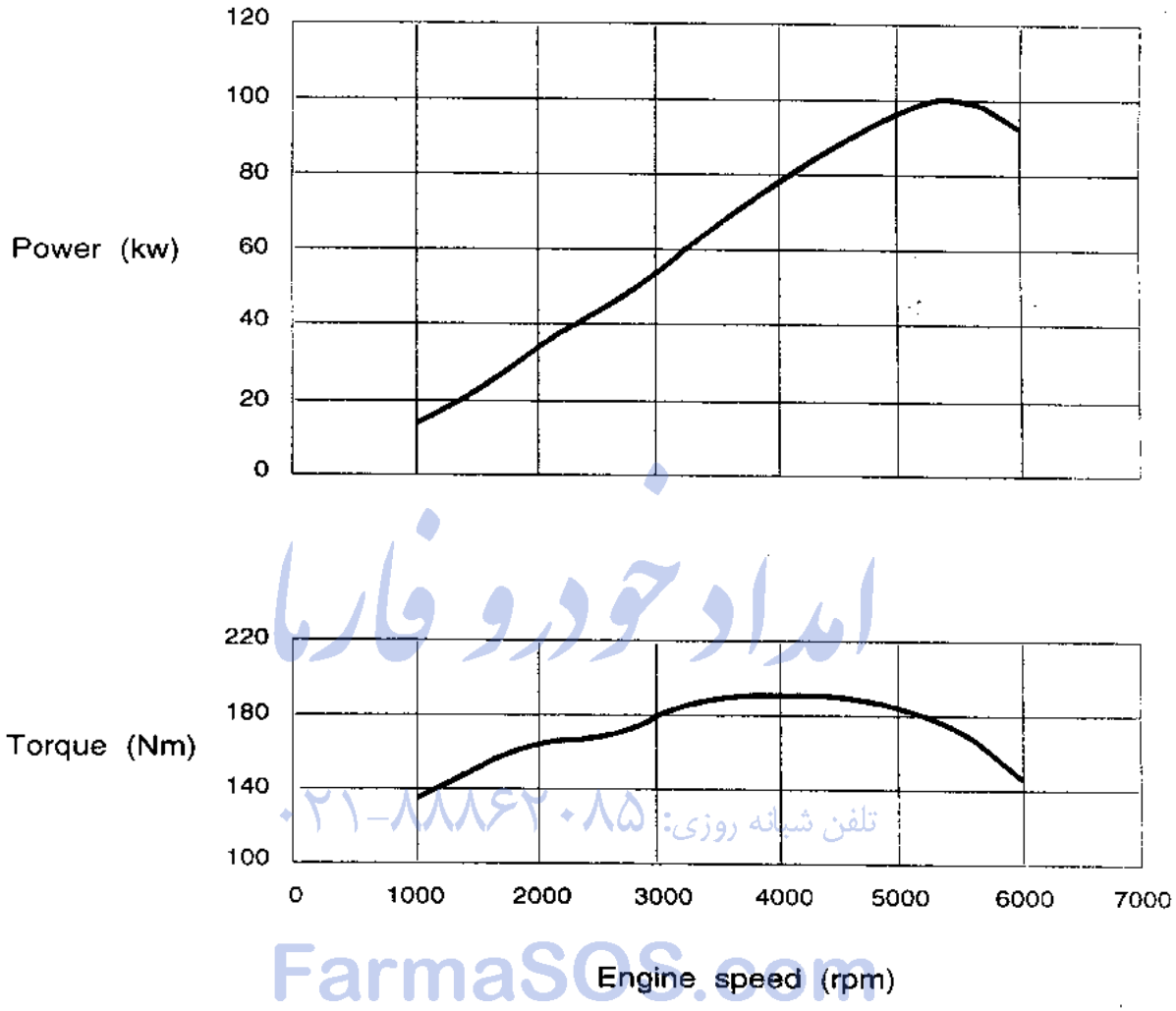
PERFORMANCE CURVE

E32 ENGINE



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E20 ENGINE



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DIAGNOSIS

OIL LEAK DIAGNOSIS

Most fluid oil leaks are easily located and repaired by visually finding the leak and replacing or repairing the necessary parts. On some occasions a fluid leak may be difficult to locate or repair. The following procedures may help you in locating and repairing most leaks.

Finding the Leak

1. Identify the fluid. Determine whether it is engine oil, automatic transmission fluid, power steering fluid, etc.
2. Identify where the fluid is leaking from.
   - 2.1 After running the vehicle at normal operating temperature, park the vehicle over a large sheet of paper.
   - 2.2 Wait a few minutes.
   - 2.3 You should be able to find the approximate location of the leak by the drippings on the paper.
3. Visually check around the suspected component. Check around all the gasket mating surfaces for leaks. A mirror is useful for finding leaks in areas that are hard to reach.
4. If the leak still cannot be found, it may be necessary to clean the suspected area with a degreaser, steam or spray solvent.
   - 4.1 Clean the area well.
   - 4.2 Dry the area.
   - 4.3 Operate the vehicle for several miles at normal operating temperature and varying speeds.
   - 4.4 After operating the vehicle, visually check the suspected component.
   - 4.5 If you still cannot locate the leak, try using the powder or black light and dye method.

Powder Method

1. Clean the suspected area.
2. Apply an aerosol-type powder (such as foot powder) to the suspected area.
3. Operate the vehicle under normal operating conditoins.
4. Visually inspect the suspected component. You should be able to trace the leak path over the white powder surface to the source.

Black Light and Dye Method

A dye and light kit is available for finding leaks, Refer to the manufacturer's directions when using the kit.

1. Pour the specified amount of dye into the engine oil fill tube.
2. Operate the vehicle normal operating conditions as directed in the kit.
3. Direct the light toward the suspected area. The dyed fluid will appear as a yellow path leading to the source.

Repairing the Leak

Once the origin of the leak has been pinpointed and traced back to its source, the cause of the leak must be determined n order for it to be repaired properly. If a gasket is replaced, but the sealing flange is bent, the new gasket will not repair the leak. The bent flange must be repaired also. Before attempting to repair a leak, check for the following conditions and correct them as they may cause a leak.

Gaskets

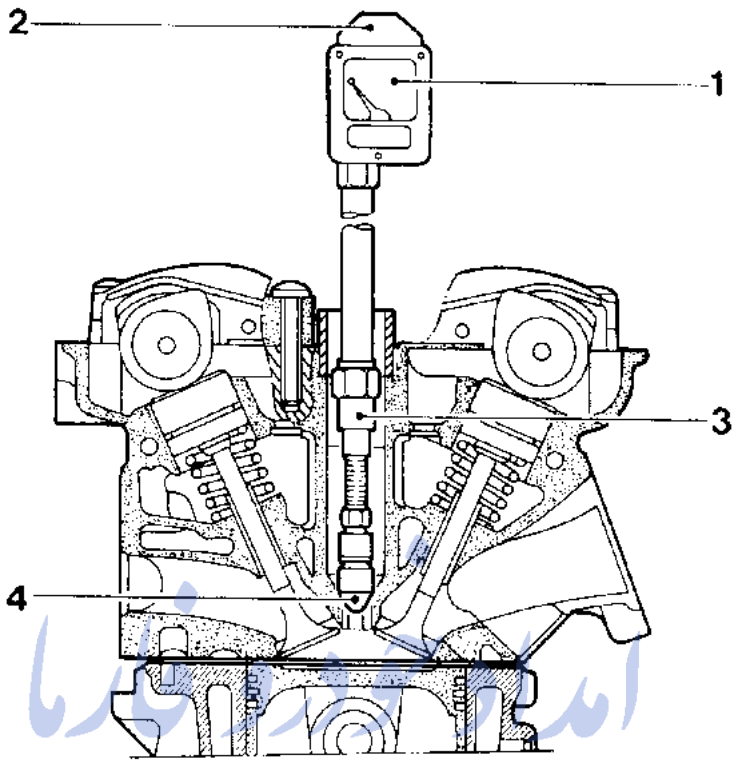
- The fluid level/pressure is too high.
- The crankcase ventilation system is malfunctioning.
- The fasteners are tightened improperly or the threads are dirty or damaged.
- The flanges or the sealing surface is warped.
- There are scratches, burrs or other damage to the sealing surface.
- The gasket is damaged or worn.
- There is cracking or porosity of the component.
- An improper seal was used (where applicable).

Seals

- The fluid level/pressure is too high.
- The crankcase ventilation system is malfunctioning.
- The seal bore is damaged (scratched, burred or nicked).
- The seal is damaged or worn.
- Improper installation is evident.
- There are cracks in the components.
- The shaft surface is scratched, nicked or damaged.
- A loose or worn bearing is causing excess seal wear.

۰۲۱-۸۸۸۶۲۰۸۵
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COMPRESSION PRESSURE TEST



1 Compression Pressure Tester
2 Diagram Sheet
3 Adaptor
4 Sealing Cone

۰۲۱-۸۸۸۶۲۰۸۵ تلفن شبانه روزی
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Standard Service Data

Compression Ratio		10.4, 9.6
Normal Engine Temperature		80°C
Normal Compression Pressure	E23 Engine(e = 10.4)	Min. 11 bar, Max. 15 bar
	E20 Engine(e = 9.6)	Min. 10.5 bar, Max. 14 bar
Permissible Pressure Difference Between Individual Cylinders		Max. 1.5 bar

Measuring Procedure

1. Warm the engine up to normal operating temperature.
2. Remove the spark plugs.
3. Place the diagram sheet to compression pressure tester.
4. Connect the adaptor to compression pressure tester and install it into the spark plug hole.
5. Crank the engine approx. eight revolutions by using the start motor.
6. Compare the measurements of compression pressure tester with the specifications.
7. Measure the compression pressure of the other cylinders in the same way.
8. If measured value is not within the specifications, perform the cylinder pressure leakage test.

Notice

- Discharge the combustion residues in the cylinders before testing the compression pressure.
- Apply the parking brake before cranking the engine.

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SECTION 1B2

M161 ENGINE MECHANICAL

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

Specifications 1B2-2
Fastener Tightening Specifications 1B2-2
Special Tools 1B2-4
Special Tools Table 1B2-4
Maintenance and Repair 1B2-7
On-Vehicle Service 1B2-7
Engine Assembly 1B2-7
Crankcase Ventilation System 1B2-14
Generator 1B2-18
Engine Mount 1B2-19
Poly V-Belt 1B2-20
Tensioning Device 1B2-22
Tensioning Device Shock Absorber 1B2-23
Poly V-Belt Inspection 1B2-24
Cylinder Head Cover 1B2-26
Cylinder Head Front Cover 1B2-28
Cylinder Head 1B2-30
Timing Gear Case Cover 1B2-34
Crankshaft Sealing Rear Cover 1B2-37
Belt Pulley and Vibration Damper 1B2-39
Crankshaft Front Radial Seal 1B2-42
Crankshaft Rear Radial Seal 1B2-44
Crankshaft 1B2-45
Flywheel / Driven Plate 1B2-51
Camshaft Adjuster 1B2-54
Camshaft Sprocket Bolt 1B2-57
Camshaft 1B2-58
Camshaft Timing Position 1B2-61
Valve Spring 1B2-63
Valve Stem Seal 1B2-67
Chain Tensioner 1B2-68
Timing Chain 1B2-72
Tensioning Rail 1B2-77
Cylinder Head Guide Rail 1B2-78
Crankcase Guide Rail 1B2-80
Crankshaft Sprocket 1B2-81
Piston 1B2-83
Connecting Rod 1B2-86
Piston Ring 1B2-88
Oil Pan 1B2-90
Engine Oil and Oil Filter Element 1B2-92
Oil Pump 1B2-95
Oil Pressure Relief Valve 1B2-97
Oil Non-Return Valve 1B2-98
Oil Dipstick Guide Tube 1B2-99
Unit Repair 1B2-100
Core Plugs in Crankcase 1B2-100
Cylinder Bore 1B2-102
Crankcase Mating Surface 1B2-104
Cylinder Head Mating Surface 1B2-106

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تلفن شبانه روزی ۰۲۱-۸۸۳۶۰۸۵
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SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application		N•m	Lb-Ft	Lb-In
Fuel Feed and Return Line		21 - 25	15 - 18	-
Exhaust Manifold and Pipe		30	22	-
Engine Mounting Nuts		70	52	-
Generator Carrier Bolts		25	18	-
Tensioning Pulley Bolt		40.5 - 49.5	29.9 - 36.5	-
Steering Pump Bolts		22.5 - 27.5	16.6 - 20.3	-
A/C Bracket Bolts		22.5 - 27.5	16.6 - 20.3	-
Intake Air Duct Mounting Nuts		9 - 11	-	80 - 97
Spark Plug Cover Bolts		9 - 11	-	80 - 97
Cylinder Head Cover Bolts		9 - 11	-	80 - 97
Magnetic Assembly Bolt		9 - 11	-	80 - 97
Cylinder Head Front Cover Bolts	M8	22.5 - 27.5	16.6 - 20.3	-
	M6	9 - 11	-	80 - 97
Cylinder Head Bolts		55 +90° +90°	41 +90° +90°	-
Timing Gear Case Cover Bolts		22.5 - 27.5	16.6 - 20.3	-
Crankshaft Sealing Rear Cover Mounting Bolts		9 - 11	-	80 - 97
Vibration Damper Center Bolt		200 + 20 +90° + 10°	148 + 15 +90° + 10°	-
Connecting Rod Bearing Cap Bolts		40 +90°	30 +90°	-
Flywheel Mounting Bolt		45 + 5 +90° + 10°	33 + 3.7 +90° + 10°	-
Amarture Bolt in Flywheel		35	26	-
Camshaft Adjuster Flange Bolts		18 - 22 60° ± 5°	13 - 16 60° ± 5°	-
Intake Flange Shaft Bolts		18 - 22 60° ± 5°	13 - 16 60° ± 5°	-
Exhaust Camshaft Sprocket Bolts		18 - 22 60° ± 5°	13 - 16 60° ± 5°	-
Camshaft Bearing Cap Bolts		22.5 - 27.5	16.6 - 20.3	-
Chain Tensioner Screw Plug		40	30	-
Chain Tensioner Assembly		72 - 88	53 - 65	-
Oil Pump Sprocket Bolt		29 - 35	21 - 26	-
Tensioning Device Bolts		26 - 32	19 - 24	-
Water Pump Pulley		22.5 - 27.5	16.6 - 20.3	-
Upper Intake Manifold Bolt		22.5 - 27.5	16.6 - 20.3	-
Lower Intake Mainfold Bolt		22.5 - 27.5	16.6 - 20.3	-
Flange Bolt to Exhaust Mainfold		30	22	-

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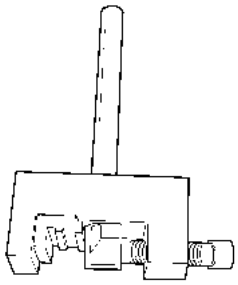
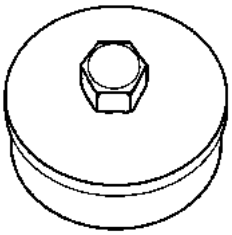
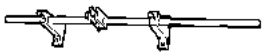
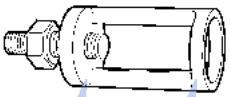
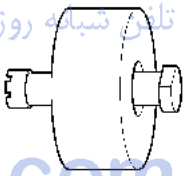
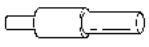
FASTENER TIGHTENING SPECIFICATIONS (Cont'd)

Application	N•m	Lb-Ft	Lb-In
Exhaust Mainfold Nut to Stud Bolt	26 - 34	19 - 25	-
Oil Drain Plug	25	18	-
Oil Filter Cover	25	18	-
Oil Filter Bolt	22.5 - 27.5	16.6 - 20.3	-
Oil Pump Drive Sprocket Bolt	29 - 35	21 - 26	-
Oil Pump Mounting Bolt	22.5 - 27.5	16.6 - 20.3	-
Oil Strainer Bracket Bolt	9 - 11	-	80 - 97
Oil Pressure Relief Valve Screw Plug	50	37	-
Oil Dipstick Guide Tube Bolt	9 - 11	-	80 - 97
Oil Gallery Screw Plug	15	11	-
Shock Absorber Bolts	22.5 - 27.5	16.6 - 20.3	-
Crankshaft Bearing Cap Bolts	55/+90°	41/+90°	-
Torque Converter Mounting Bracket Bolts	42	31	-

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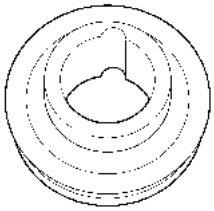
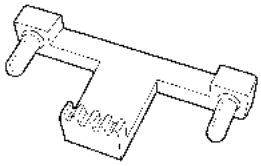
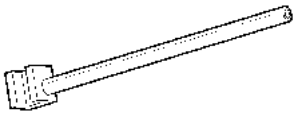
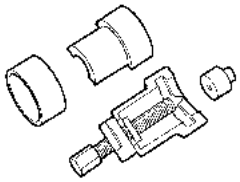
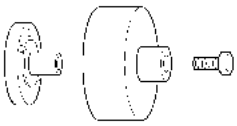
SPECIAL TOOLS

SPECIAL TOOLS TABLE

	**000 589 58 43 00** **Chain Assembly**		**103 589 02 09 00** **Oil Filter Remover**
	**111 589 01 59 00** **Supporting Bar**		**111 589 25 63 00** **Thrust Piece**
	**111 589 18 61 00** **Lever Pusher**		**116 589 20 33 00** **Sliding Hammer**
	**116 589 01 34 00** **Threaded Pin**		**119 589 00 43 00** **Drift**

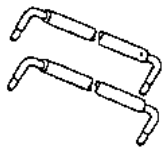
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Special Tools Table (Cont'd)

	**601 589 03 14 00** **Crankshaft Front Seal Installer**		**602 589 00 40 00** **Engine Lock**
	**603 589 00 40 00** **Fan Clutch Holder**		**617 589 00 10 00** **Allen Wrench Socket**
	**615 589 01 33 00** **Crankshaft Sprocket Puller**		**DW110 - 090** **Connecting Hose**
	**601 589 03 43 00** **Crankshaft Rear Seal Installer**		**DW110 - 100** **Valve Tappet Remover**

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Special Tools Table (Cont'd)

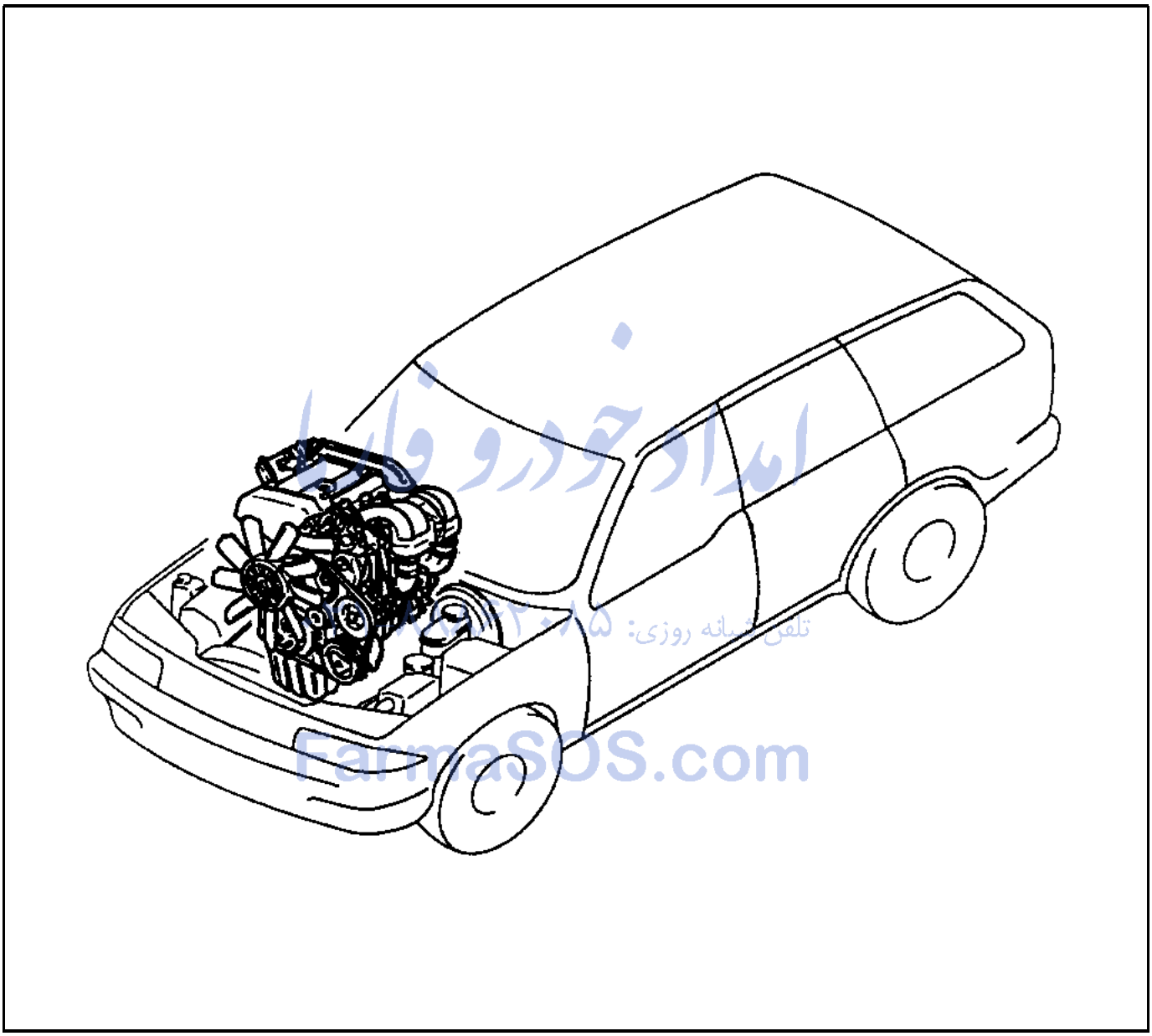
	**111 589 03 15 00** **Holding Pin**

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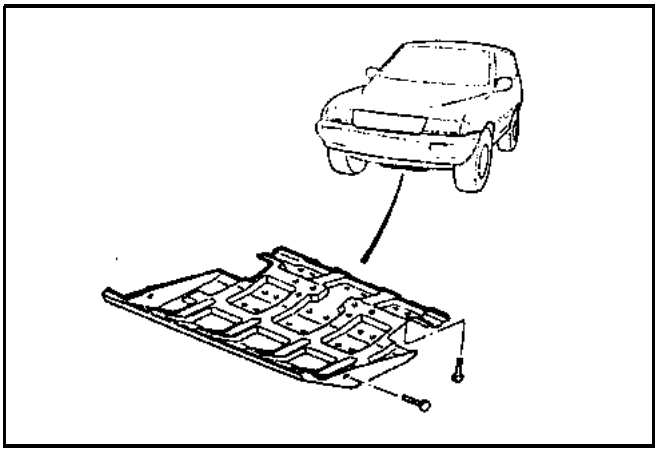
MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

ENGINE ASSEMBLY



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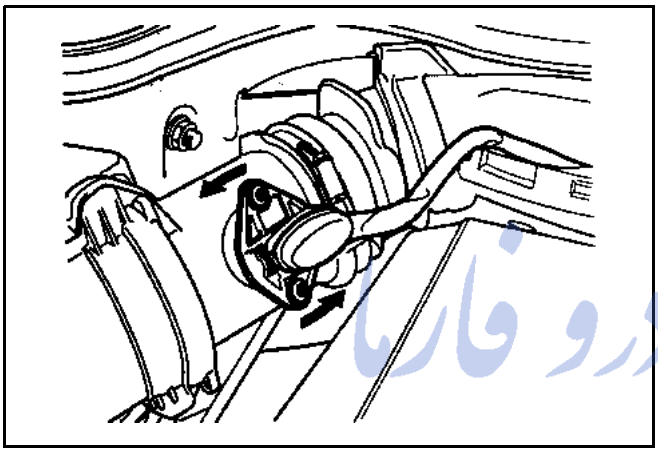


Removal & Installation Procedure

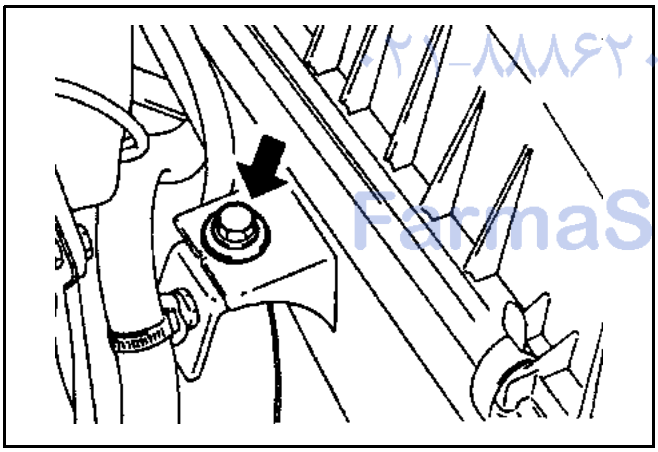
1. Disconnect the negative terminal of battery.
2. Remove the hood.
3. Remove the under cover.

Installation Notice

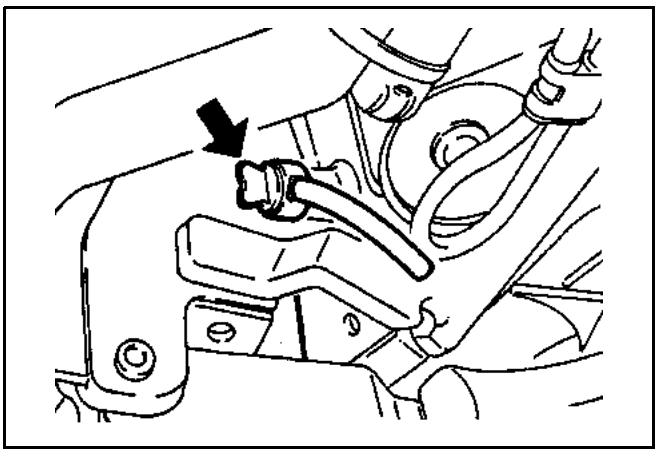
Tightening Torque	28 - 47 N•m (21 - 35 lb-ft)



4. Disconnect the coupling of HFM sensor and remove the air cleaner cross pipe.



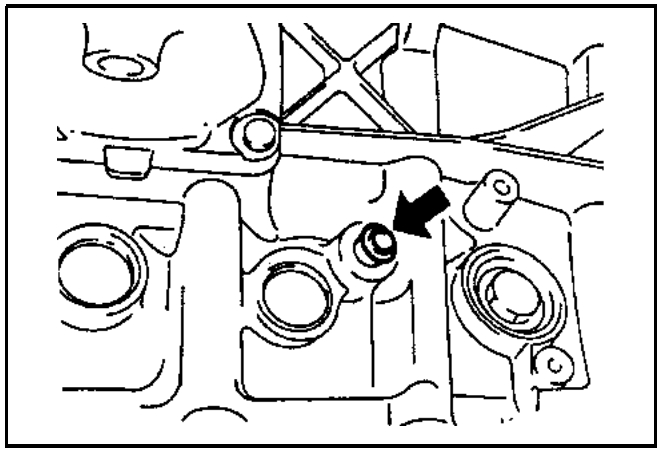
5. Remove the air cleaner cover. Remove the mounting bolts and air cleaner housing and element assembly.



6. Loosen the radiator drain cock and drain the coolant.

Notice: Open the coolant reservoir cap.

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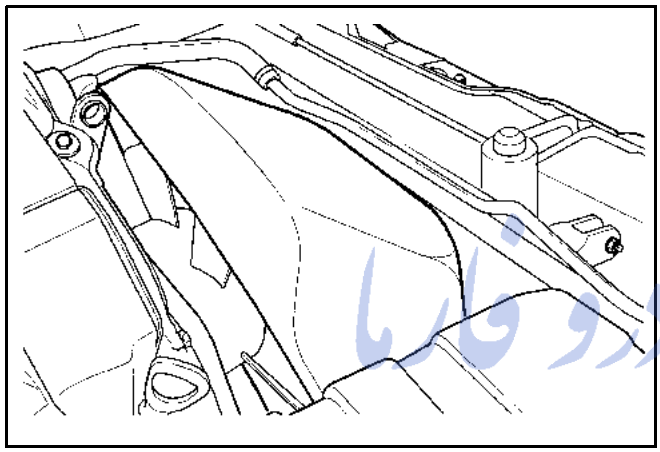


7. Loosen the cylinder block drain plug and then drain the coolant completely.

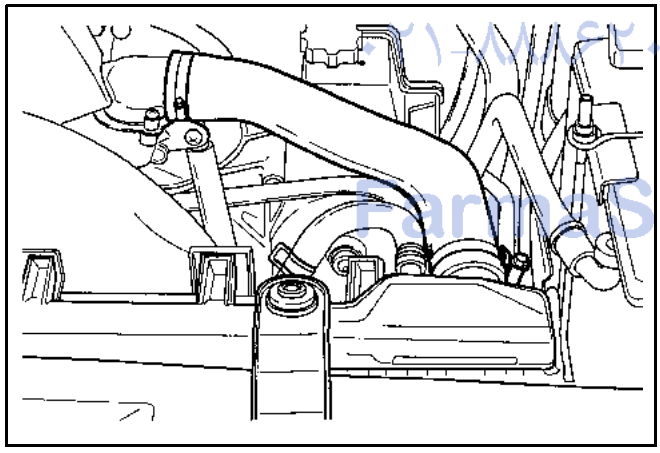
Installation Notice

Tightening Torque	30 N•m (22 lb-ft)

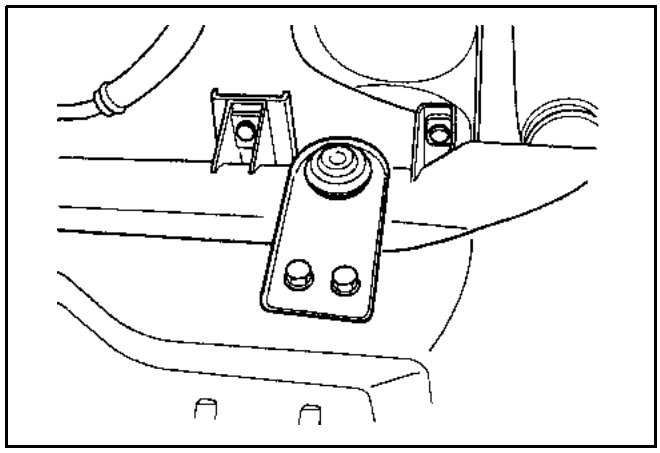
Notice: Replace the seal before installation of the drain plug.



8. Remove the cooling fan shroud. Refer to *Section 1D2, Engine Cooling.*

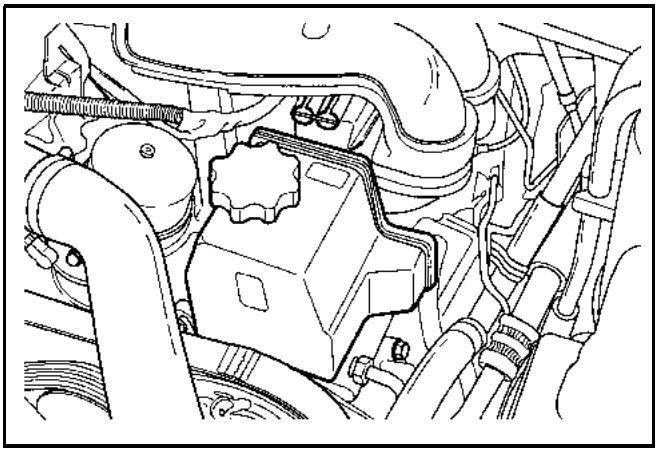


9. Disconnect the each hose from radiator.



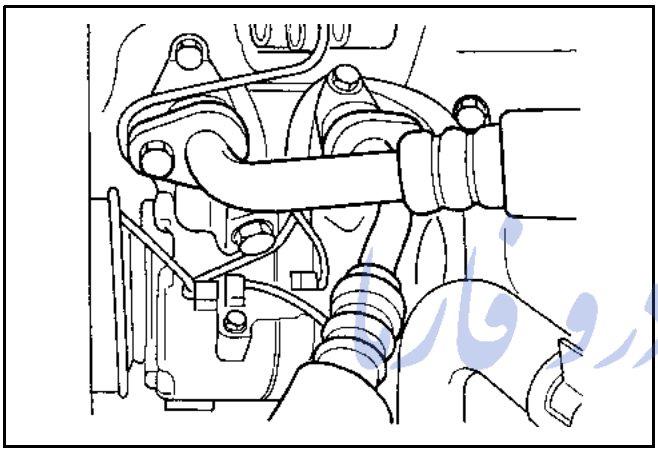
10. Remove the upper mounting bolts of radiator and then remove the radiator.

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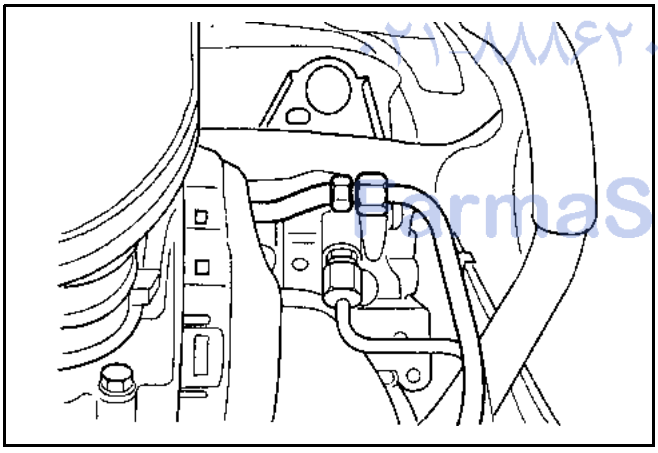


11. Remove the hydraulic pipe of power steering.

Notice: Completely drain the oil.



12. Discharge the refrigerant from A/C system, and disconnect the discharge pipe and suction pipe from the compressor.

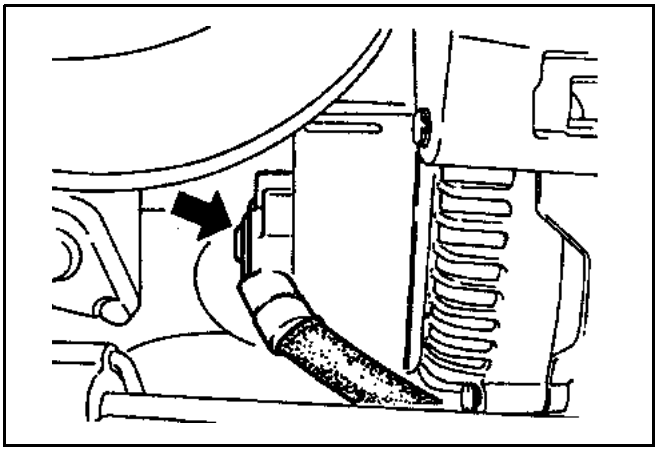


13. Remove the fuel feed and return line.

Notice: Before removing the fuel lines, release the pressure in the fuel system.

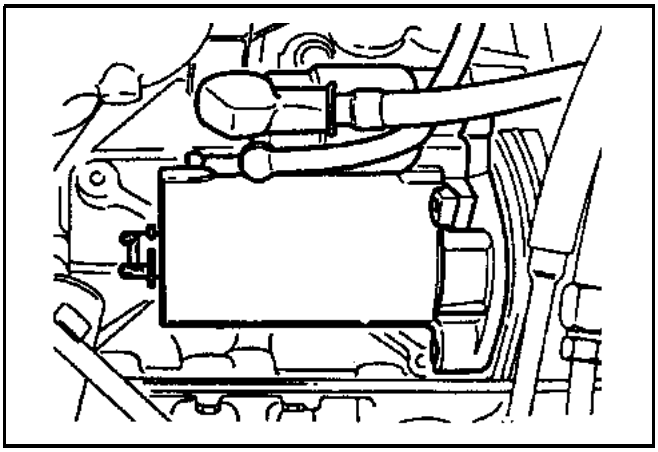
Installation Notice

Tightening Torque	21 – 25 N•m (15 – 18 lb-ft)

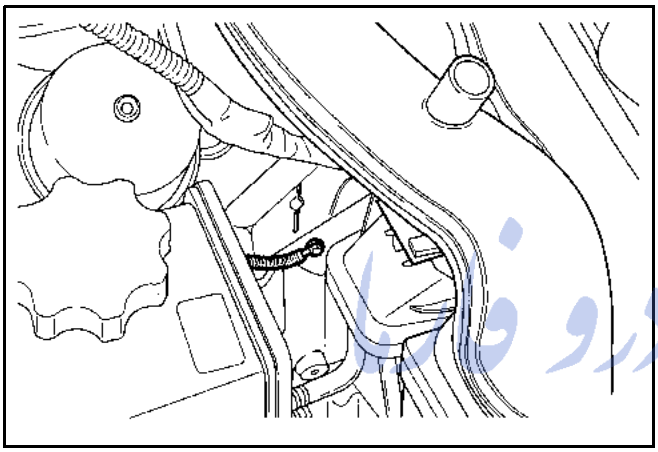


14. Disconnect the terminals from the generator.

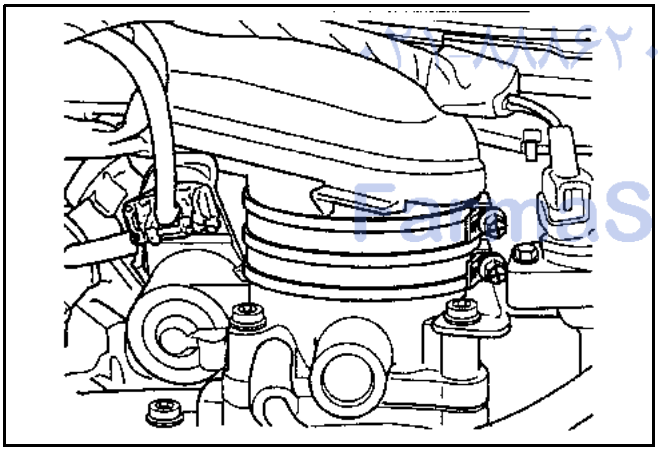
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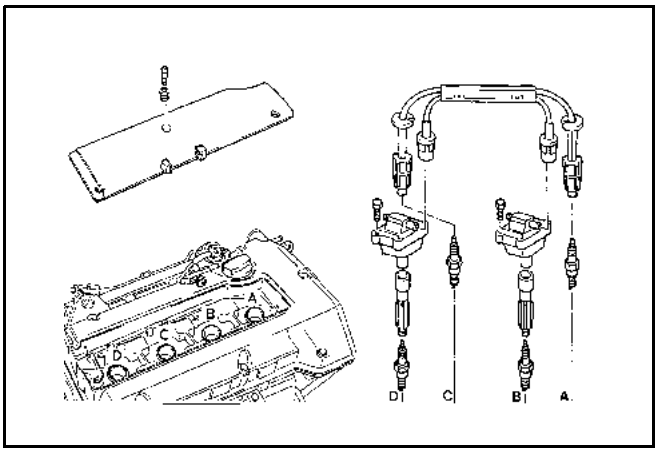
15. Disconnect the terminals from starter motor and remove the starter motor.
16. Disconnect the engine main harness ground.



17. Disconnect the engine ground wire.

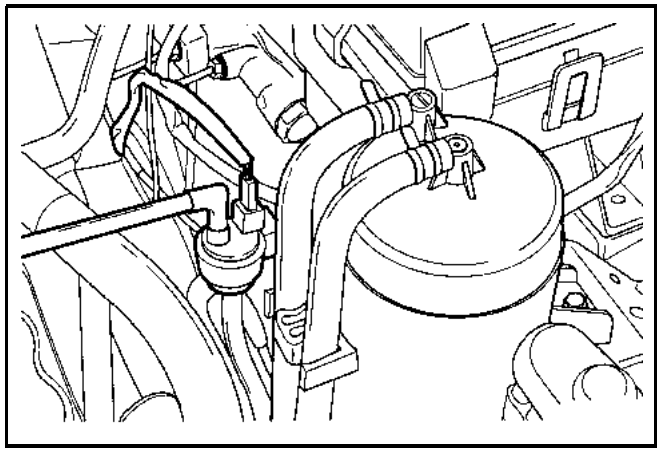


18. Disconnect following sensors connector.
    - HFM sensor.
    - Coolant temperature sensor.
    - Knock sensor.
    - Camshaft and crankshaft sensors.

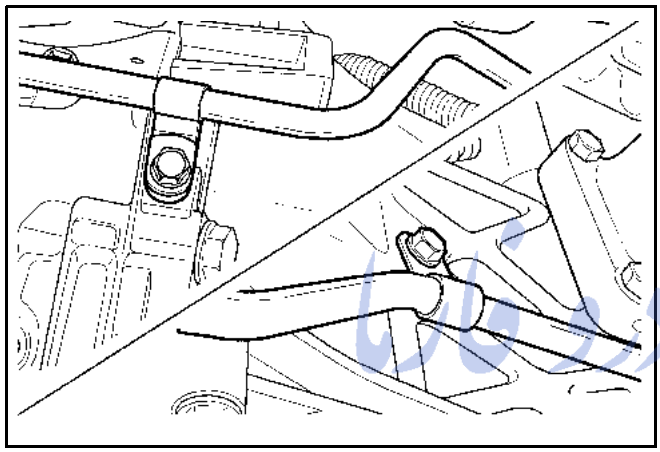


19. After removing the ignition coil cover, disconnect the ignition coil connector.
20. Remove the harness cover and disconnect the 4 injection valve connectors. Disconnect the main harness.

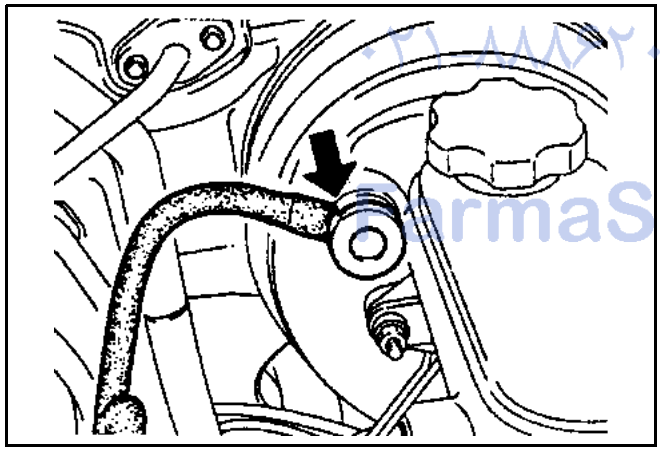
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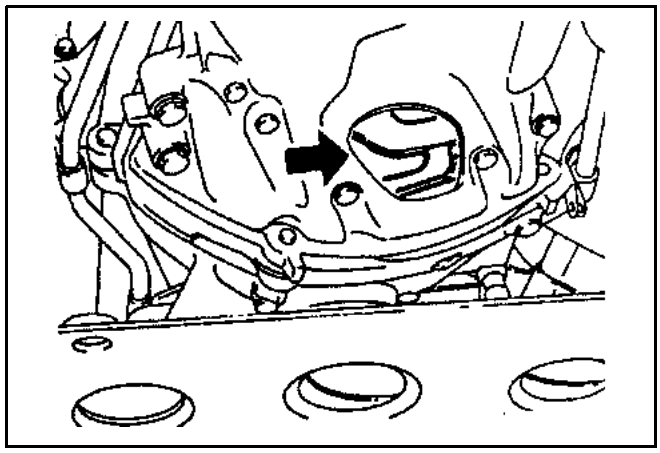
21. Separate the hose toward engine from canister purge solenoid valve and canister. Refer to *Section 1F2, Engine Control.*



22. Remove the automatic transmission oil cooler line retaining bolts from the automatic transmission side and oil pan side.
23. Remove the automatic transmission oil cooler line retaining bolts from engine side and oil pan side.



24. Separate the vacuum hose for brake booster.
25. Separate the other vacuum hoses.

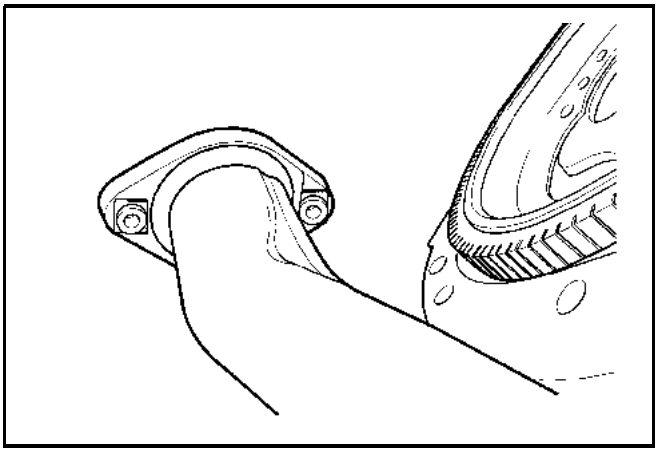


26. By rotating the crankshaft from the front of engine, remove the 6 torque converter mounting bolts from the engine ring gear plate.

Installation Notice

Tightening Torque	42 N•m (31 lb-ft)

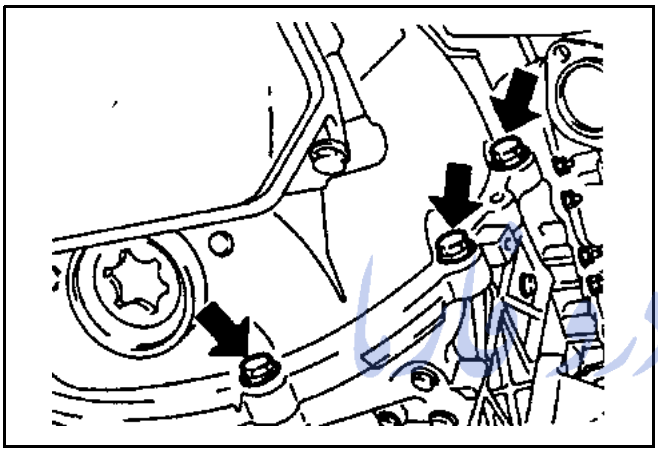
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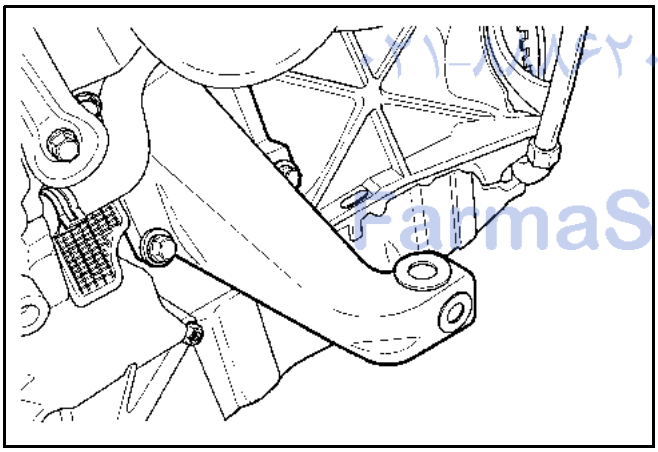
27. Remove the exhaust manifold and exhaust pipe.

Installation Notice

Tightening Torque	30 N•m (22 lb-ft)



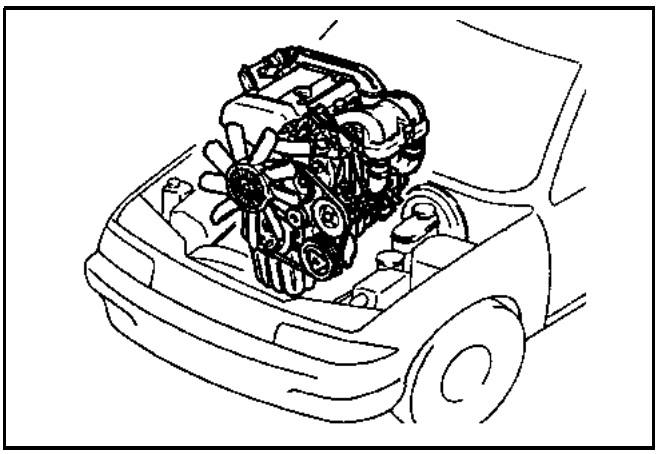
28. Remove the transmission. Refer to *Section 5A, Automatic Transmission.*



29. Install a chain to the bracket of engine, by using a hoist or crane.
30. Remove the engine mount nuts.

Installation Notice

Tightening Torque	70 N•m (52 lb-ft)

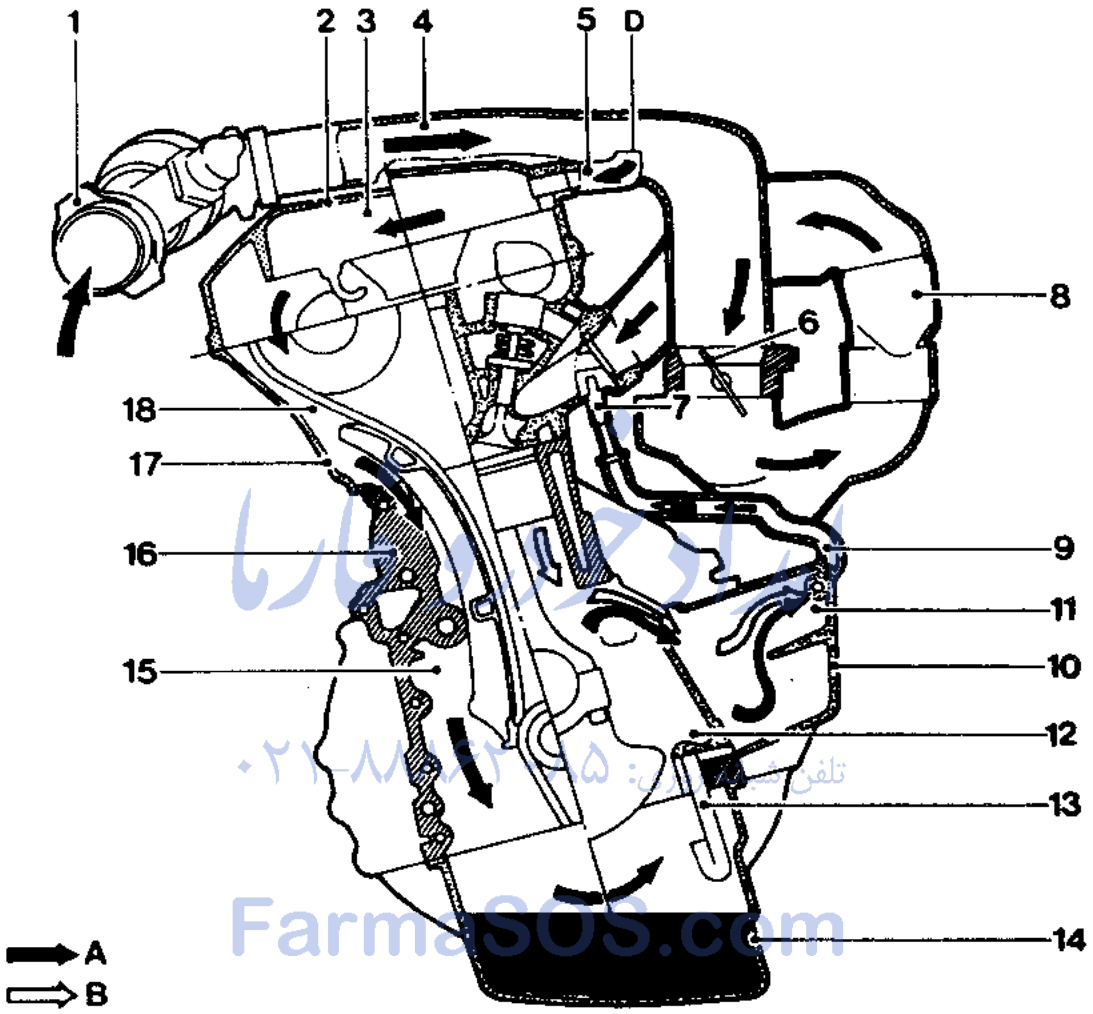


31. Carefully separate the engine assembly from the vehicle.
32. Installation should follow the removal procedure in the reverse order.

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CRANKCASE VENTILATION SYSTEM

Operation at Idling and Mid-Load



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1 HFM Sensor
2 Cylinder Head Cover
3 Oil Spearation Chamber (Full-Load or Over Mid-Load)
4 Intake Air Duct (Cross Pipe)
5 Vent Line (Full-Load or Over Mid-Load)
6 Throttle Valve
7 Restrictor, Diameter 1.1mm (Mid-Load at Idling)
8 Intake Manifold
9 Vent Line (Mid-Load at Idling)
10 Air Conditioner Bracket
11 Oil Separation Chamber (Mid-Load at Idling)
12 Crank Chamber
13 Oil Return Pipe
14 Oil Pan
15 Timing Gear Case Cover
16 Crankcase
17 Chain Housing

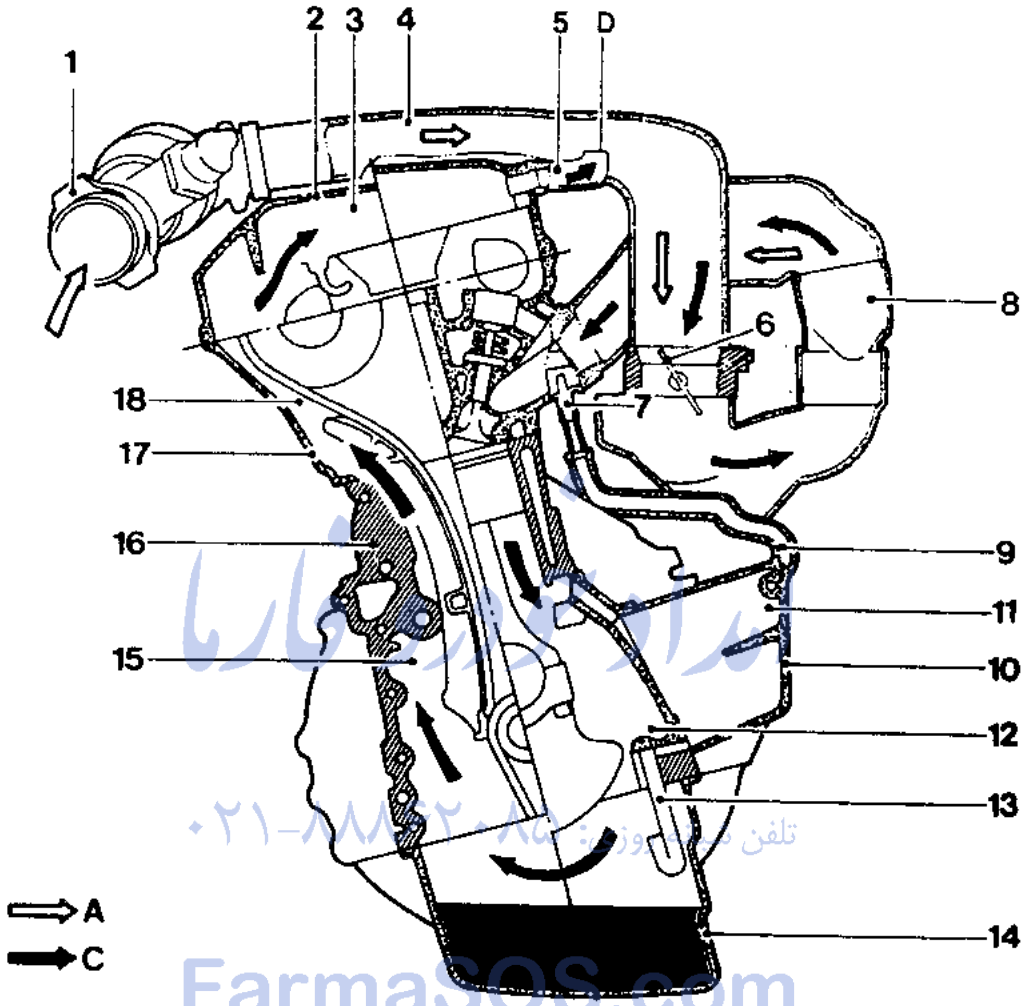
A Fresh Air
B Blow-by Gas
D Vent Connection

Operation at Idling and Mid-Load

- The throttle valve (6) is closed or very partially opened, and the vacuum pressure in intake manifold is high.
  The blow-by gas and the fresh air that is additionally supplied through the vent connection (D) in the crankcase in partial load gets supplied to the combustion chamber from the crank chamber (12) through the oil separation chamber (11), air-conditioner bracket (10), vent line (9), and restrictor (7) mounted to the cylinder head.
  The circulated engine oil returns to the oil pan through the oil return pipe (13) at the bottom of oil separation chamber (11).
  The fresh air gets supplied to the crank chamber (12) through the HFM sensor (1), intake air duct (4), vent line (5), oil separation chamber (3), chain housing (17), and the timing gear case cover (15).
  The additional supply of the fresh air is needed to prevent from forming the residues of the engine oil.

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Operation When Full-Load at Partial Load



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1 HFM Sensor
2 Cylinder Head Cover
3 Oil Spearation Chamber (Full-Load or Over Mid-Load)
4 Intake Air Duct (Cross Pipe)
5 Vent Line (Full-Load or Over Mid-Load)
6 Throttle Valve
7 Restrictor, Diameter 1.1mm (Mid-Load at Idling)
8 Intake Manifold
9 Vent Line (Mid-Load at Idling)
10 Air Conditioner Bracket
11 Oil Separation Chamber (Mid-Load at Idling)
12 Crank Chamber
13 Oil Return Pipe
14 Oil Pan
15 Timing Gear Case Cover
16 Crankcase
17 Chain Housing

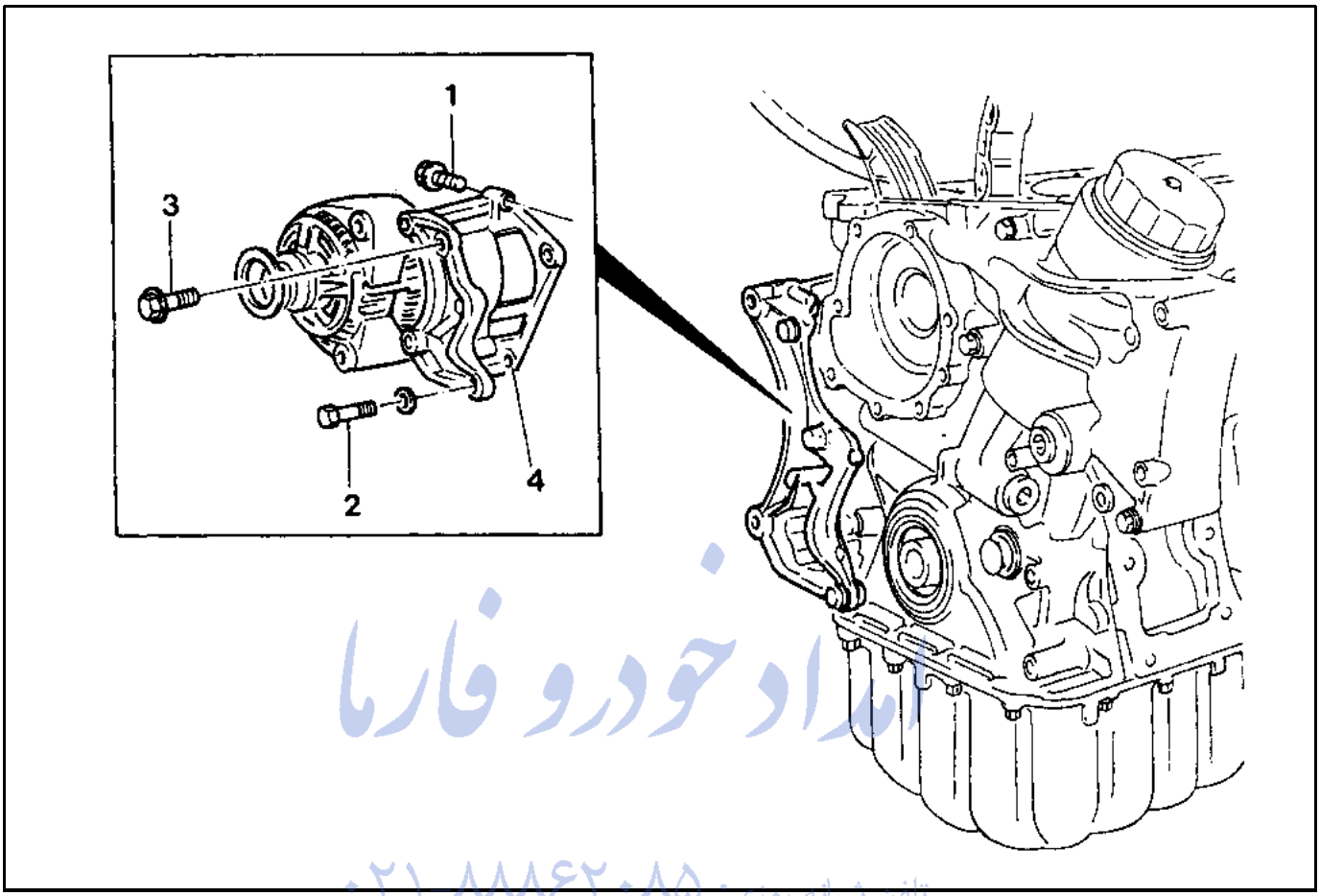
A Fresh Air
C Blow-by Gas
D Vent Connection

Operation When Full- Load at Partial Load

- The throttle valve (6) is partially opened or fully opened.
  The air flows very rapidly through the vent line (5) s connection (D) and the intake air duct when full-load at partial load.
  Consequently, most of the low-by gases are supplied to the combustion chamber through the timing gear case cover (15), chain housing (17), oil separation chamber (3), vent line (5), throttle valve (6), and intake manifold (8).

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GENERATOR



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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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1 Bolt (M8 X 40, 3 pieces)
. . . . . 22.5-27.5 N•m (16.6-20.3 lb-ft)
2 Bolt (M8 X 70, 2 pieces)
. . . . . 22.5-27.5 N•m (16.6-20.3 lb-ft)
3 Bolt (M8 X 85, 1 piece)
. . . . . 22.5-27.5 N•m (16.6-20.3 lb-ft)
4 Generator Bracket

Removal & Installation Procedure

1. Disconnect the negative battery cable.
2. Remove the drive belt.
3. Remove the generator.
4. Unscrew the generator carrier bolts and remove the carrier.

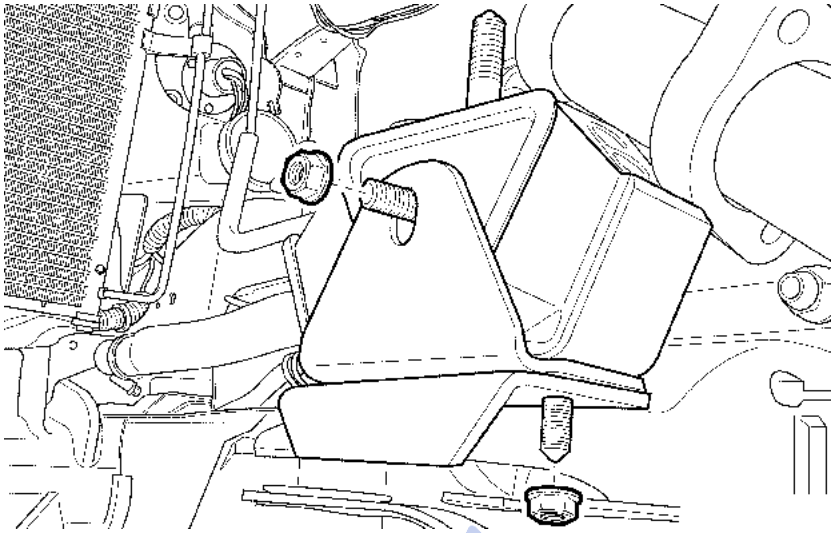
Installation Notice

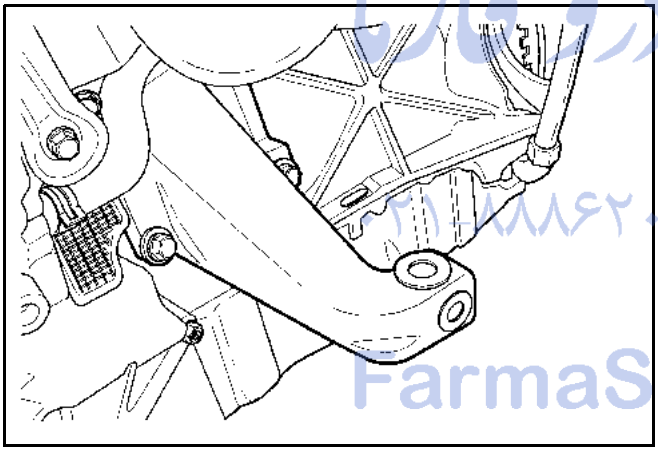
Tightening Torque	25 N•m (18 lb-ft)

Notice: Apply 3 Nm of torque when mounting the bolt (1) ; apply 25 Nm of torque when mounting the bolts (2), and (3) ; and then tighten the bolt (1) with 25 Nm of torque.

5. Installation should follow the removal procedure in the reverse order.

ENGINE MOUNT





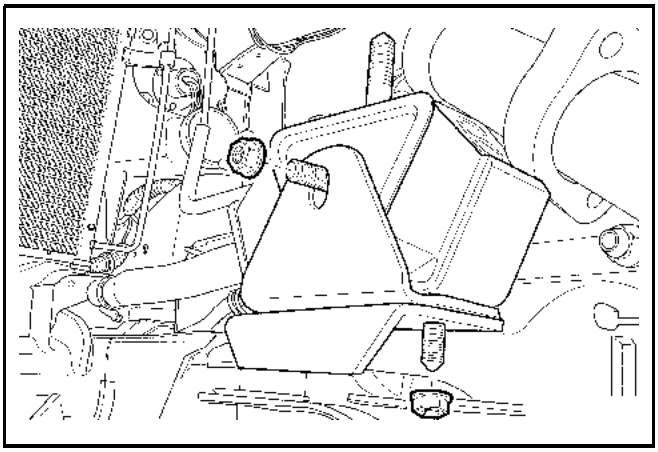
Removal & Installation Procedure

1. Unscrew the upper engine mount nuts and remove the engine.

Installation Notice

Tightening Torque	70 N•m (52 lb-ft)

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2. Unscrew the lower nuts.

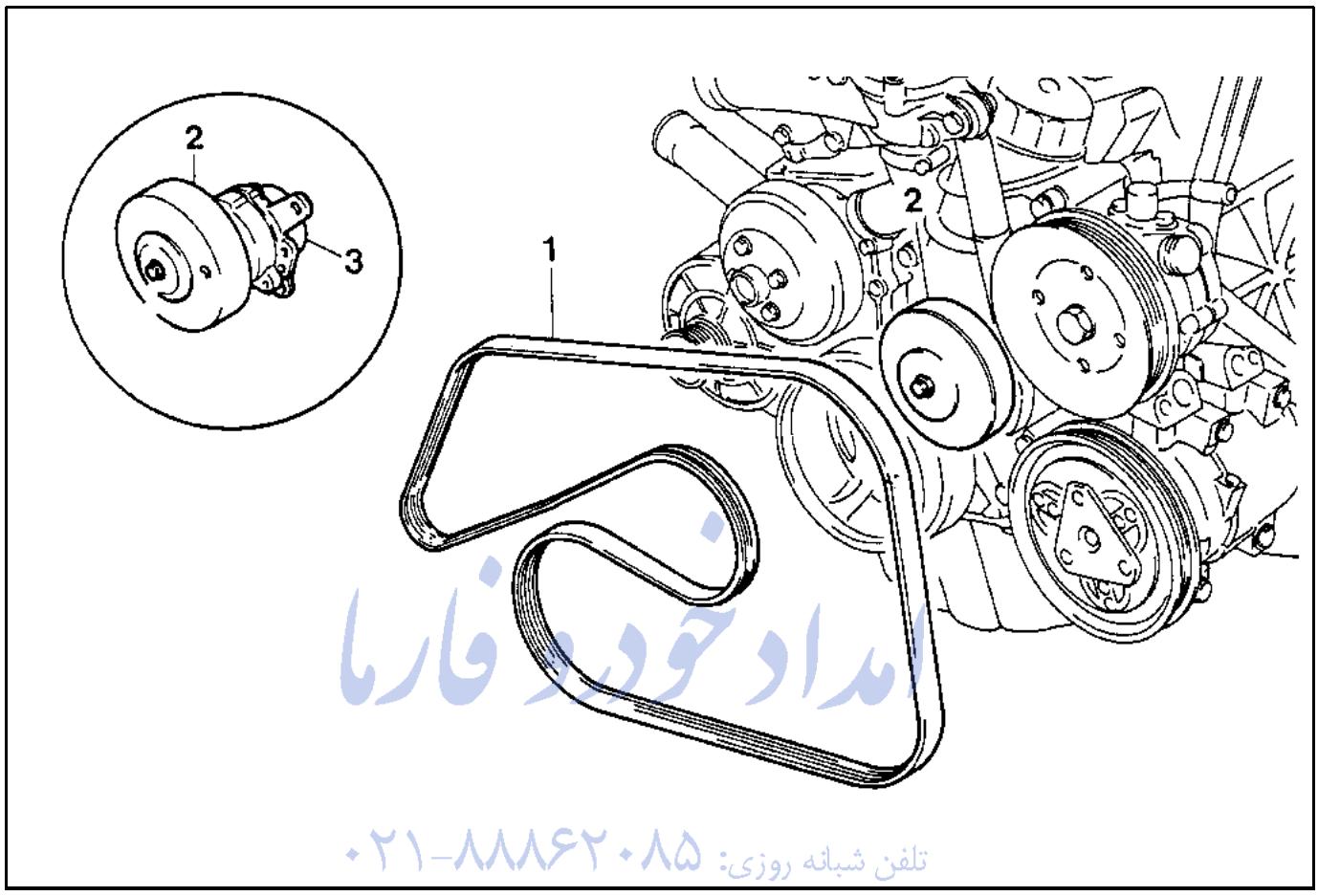
Installation Notice

Tightening Torque	38 N•m (28 lb-ft)

3. Remove the hydraulic engine mounting insulator.
4. Installation should follow the removal procedure in the reverse order.

POLY V - BELT

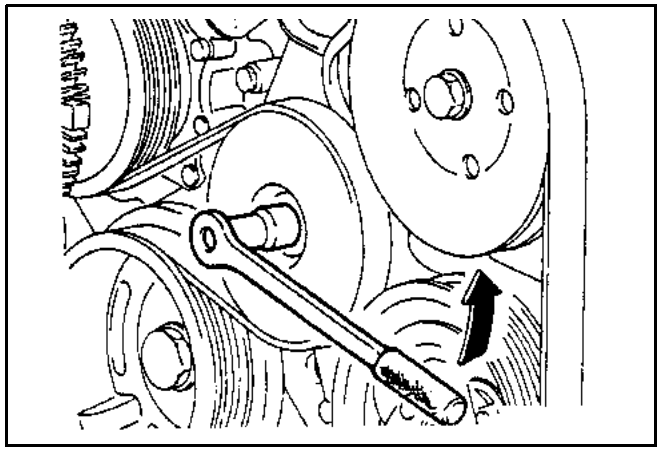
Preceding Work: Removal of cooling fan



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1 Poly V-belt (2,155 mm)
2 Belt Tensioning Pulley
3 Belt Tensioner

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Removal & Installation Procedure

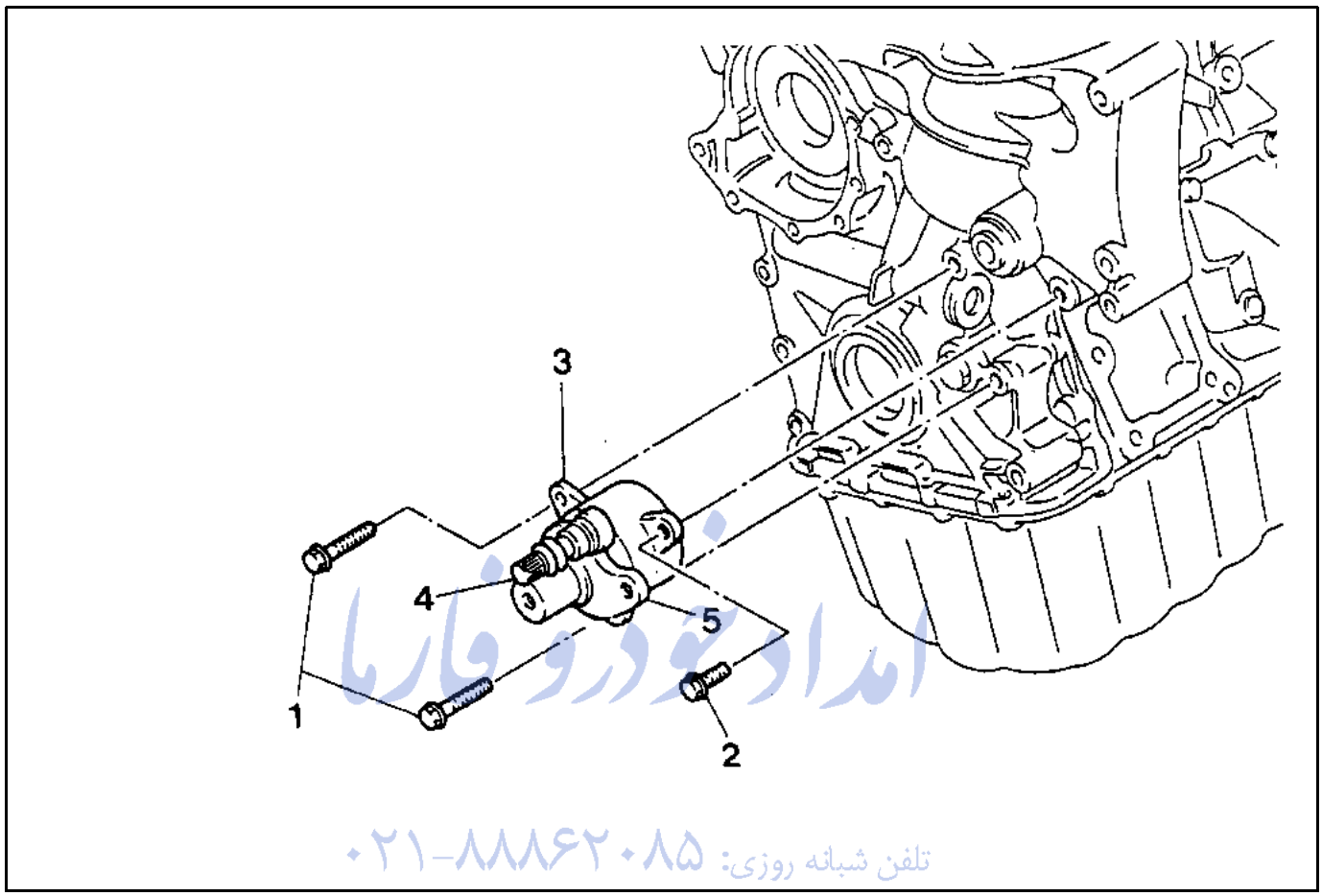
1. Release the belt tension by turning the stud on the cap with 12 sided wrench or spanner counterclockwise.
2. Remove the poly v-belt.

Notice: Check the belt for damage and tensioning pulley bearing point for wear and replace them if necessary.

3. Install the belt after prying the tensioning pulley.

TENSIONING DEVICE

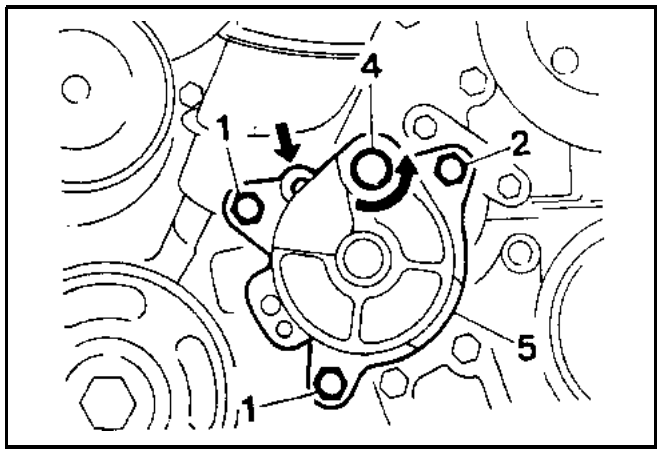
Preceding Work: Removal of tensioning device shock absorber



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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵

1 Bolt (M8 x 75, 2 pieces) + Washer . . . . . 22.5-27.5 N•m (16.6-20.3 lb-ft)
2 Bolt (M8 x 25, 1 pieces) + Washer . . . . . 22.5-27.5 N•m (16.6-20.3 lb-ft)
3 Tensioning Device
4 Stud bolt
5 Tensioning Arm

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Removal & Installation Procedure

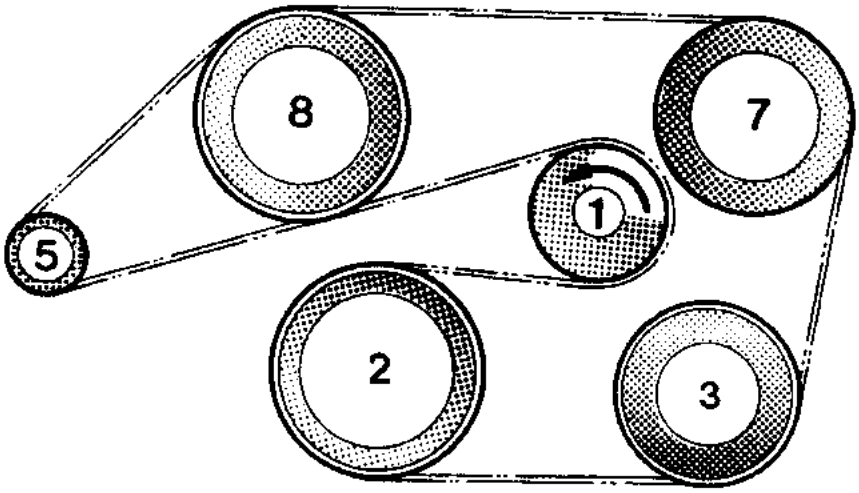
1. Turn the stud bolt to counterclockwise.
2. Insert the pin (111 589 01 15 00) into the hole in tensioning arm.
3. Unscrew the bolts (1, 2) and remove the tensioning device.

Installation Notice

Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)

4. Installation should follow the removal procedure in the reverse order.

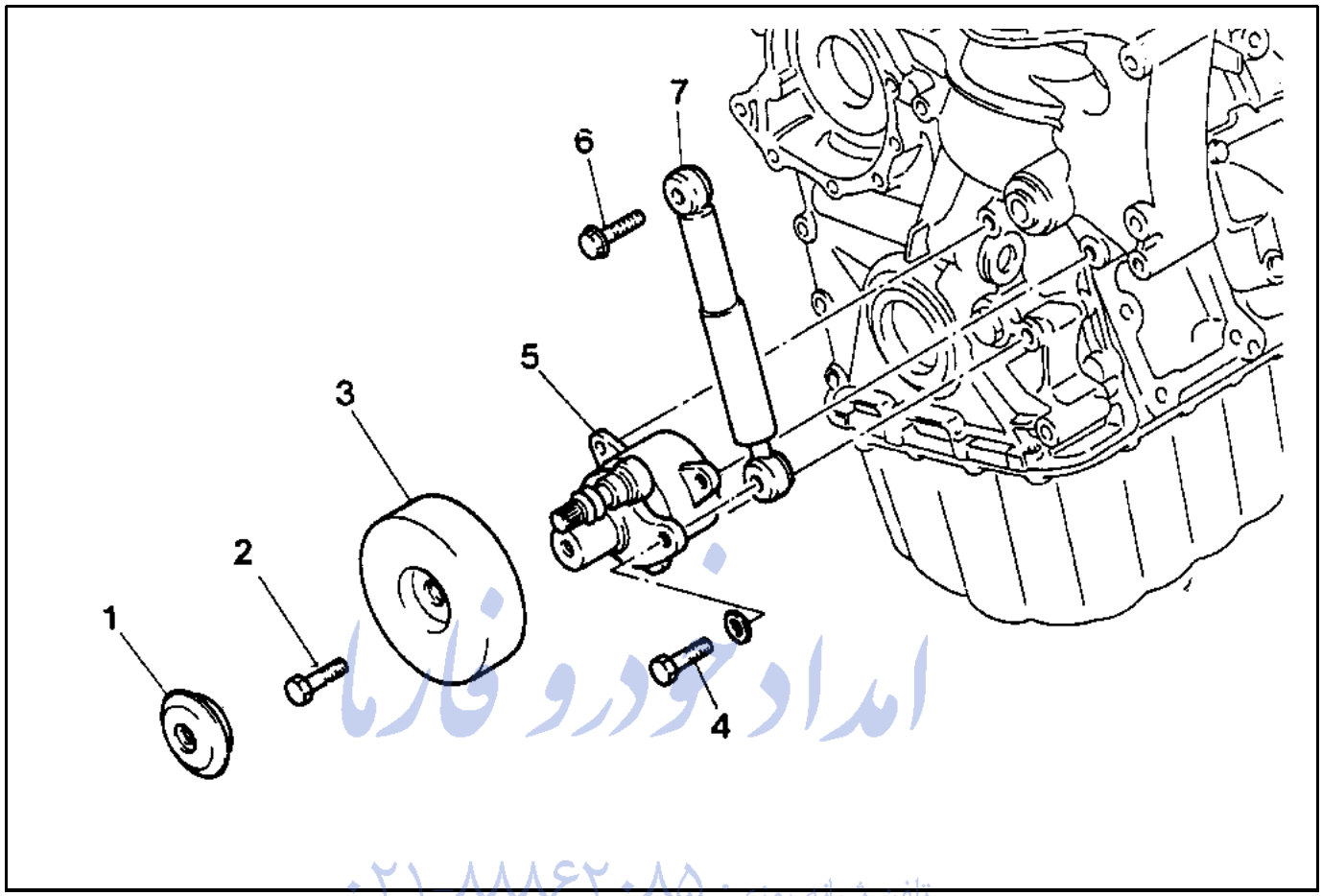
Poly V- Belt Arrangement



1 Belt Tensioning Pulley
2 Crankshaft Belt Pulley
3 A/C Compressor Pulley
5 Generator Pulley
7 Power Steering Pump Pulley
8 Water Pump Pulley

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TENSIONING DEVICE SHOCK ABSORBER



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1 End Cover
2 Bolt . . . . . 40.5-49.5 N•m (29.9-36.5 lb-ft)
3 Tensioning Pulley
4 Bolt (M8 X 25) + Washer
. . . . . 22.5-27.5 N•m (16.6-20.3 lb-ft)
5 Tensioning Device
6 Bolt (M8 X 35) + Washer
. . . . . 22.5-27.5 N•m (16.6-20.3 lb-ft)
7 Shock Absorber

Removal & Installation Procedure

1. Remove the end cover (1).
2. Remove the bolt (2) and remove the tensioning pulley (3).

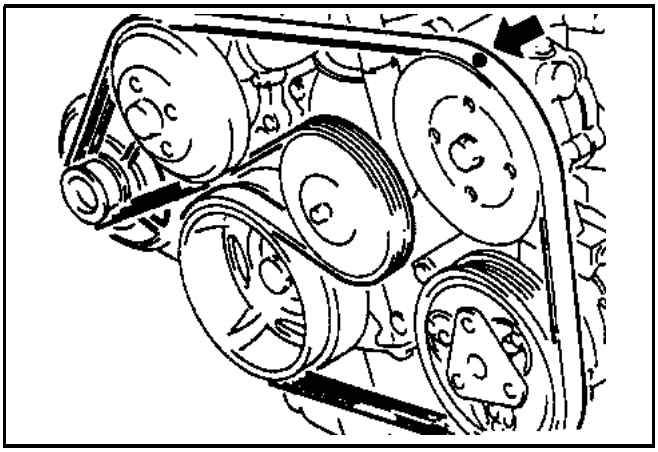
Installation Notice

Tightening Torque	40.5 - 49.5 N•m (29.9 - 36.5 lb-ft)

3. Unscrew the bolts (4,6) and remove the shock absorber (7).

Installation Notice

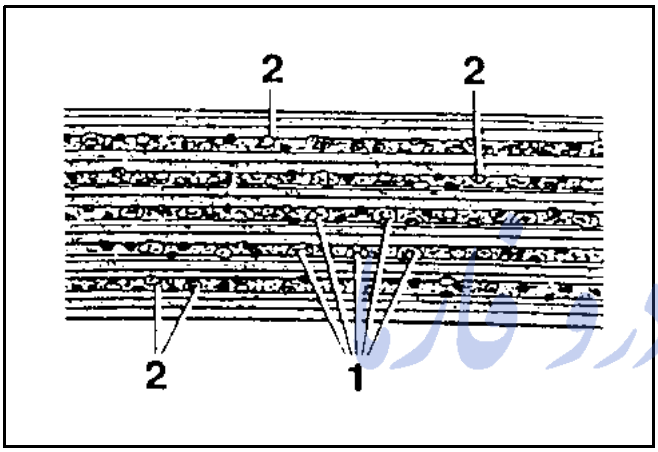
Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)



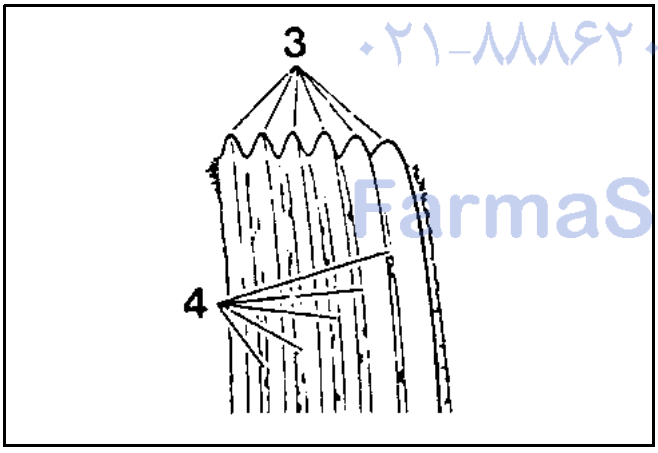
POLY V-BELT INSPECTION

- Make marks on the belt with chalk.
- Rotate the engine and check the belt for damage.

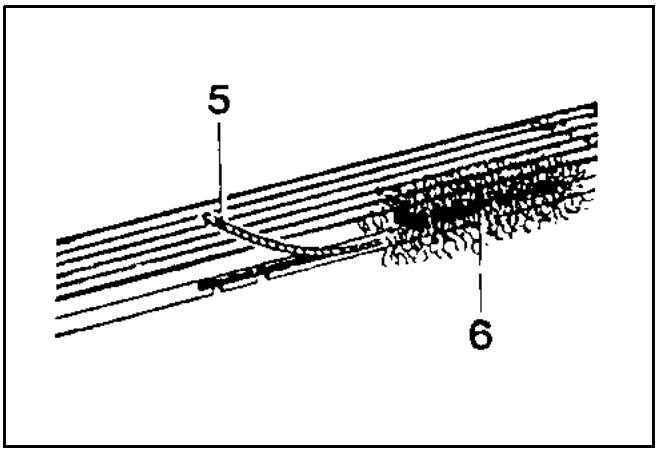
Notice: If one of the following types of damages is found, replace the belt.



1. Rubber lumps in the base of rib.
2. Dirt or grit ingrained.

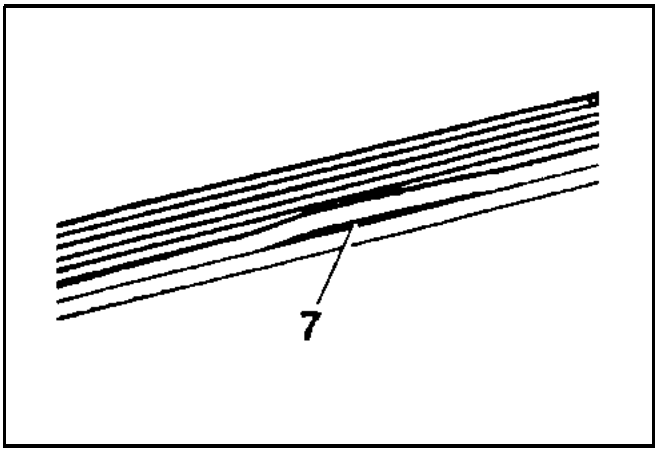


3. Pointed rib.
4. Belt cord visible in the base of rib.

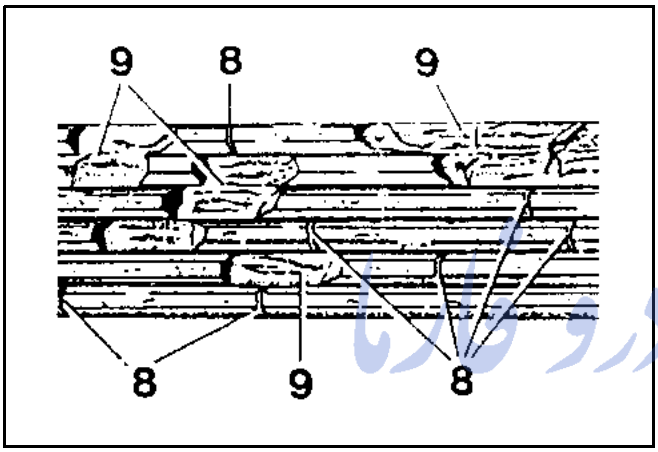


5. Cord torn out at the side.
6. Outer cords frayed.

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۰۲۱-۸۸۸۶۲۰۸۵
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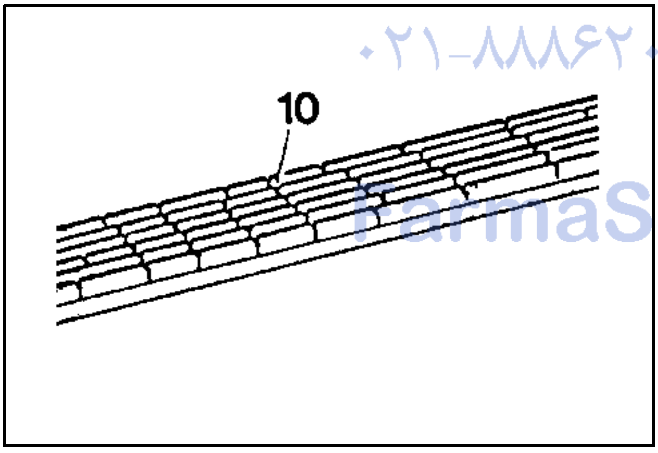


7. Rib detached from the base of belt.

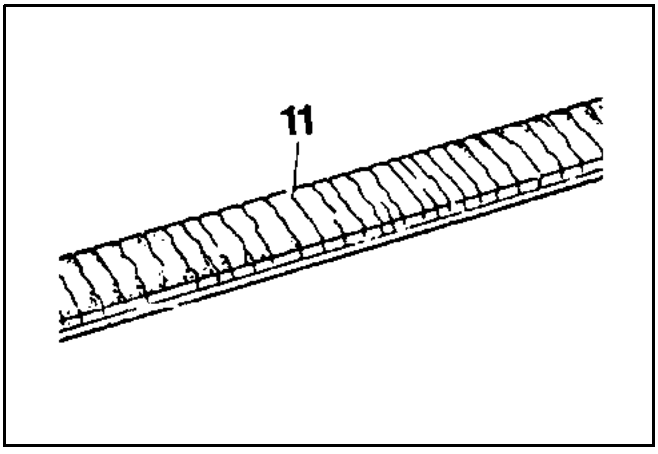


8. Splits across the rib.
9. Sections of rib torn out.

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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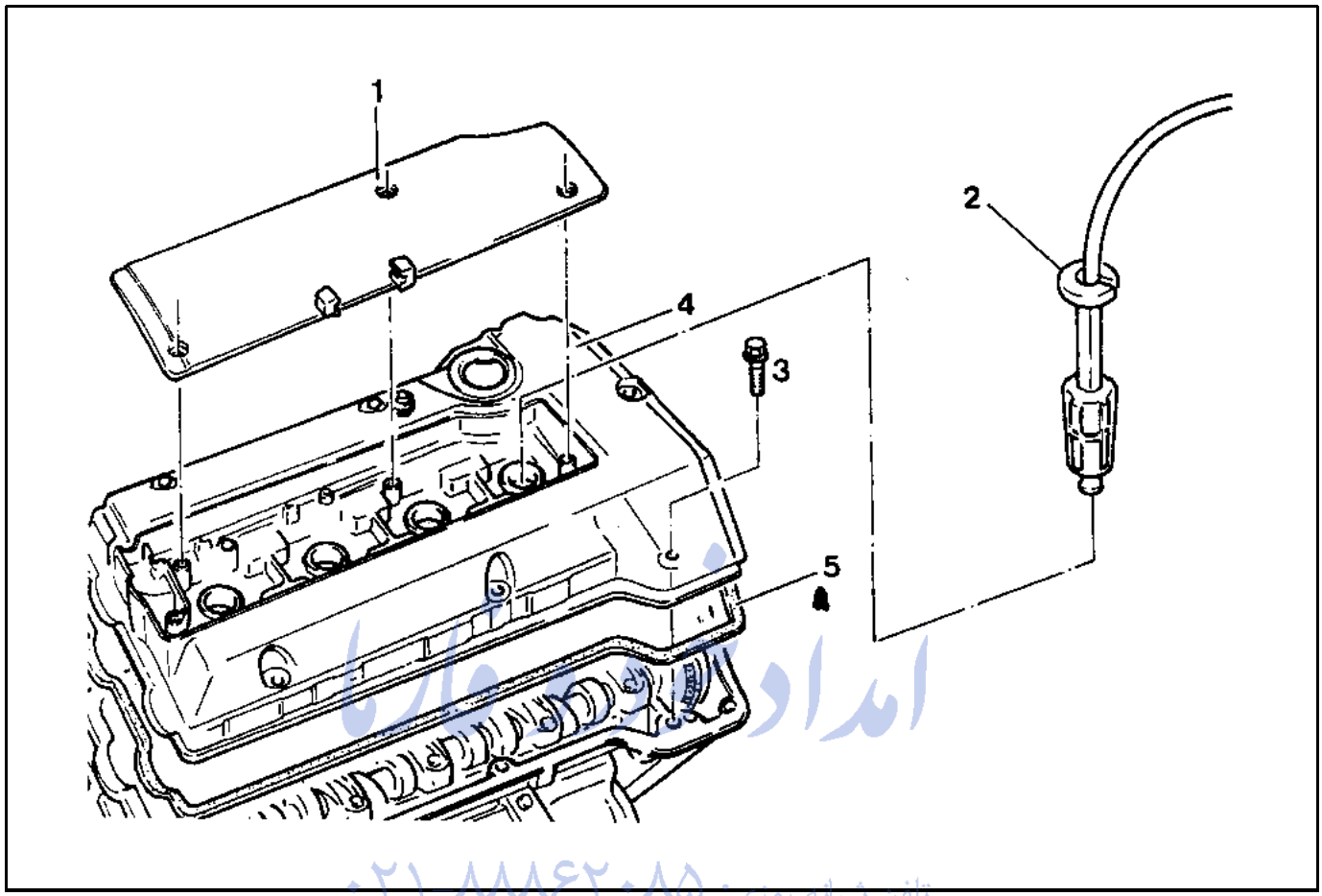


10. Splits across several ribs.



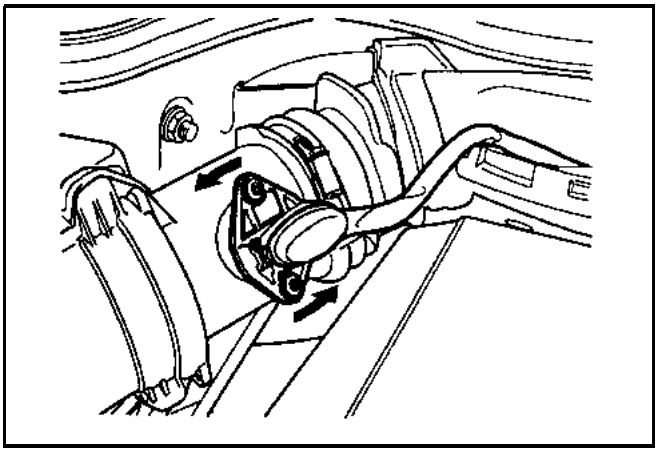
11. Splits across the back of the belt.

CYLINDER HEAD COVER



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1 Spark Plug Cover
2 Spark Plug Connector
3 Bolt (M6 X 45 : 4 pieces, M6 X 60 : 6 pieces) . . . . . 9-11 N•m (80-97 lb-in)
4 Cylinder Head Cover
5 Gasket . . . . . Replace

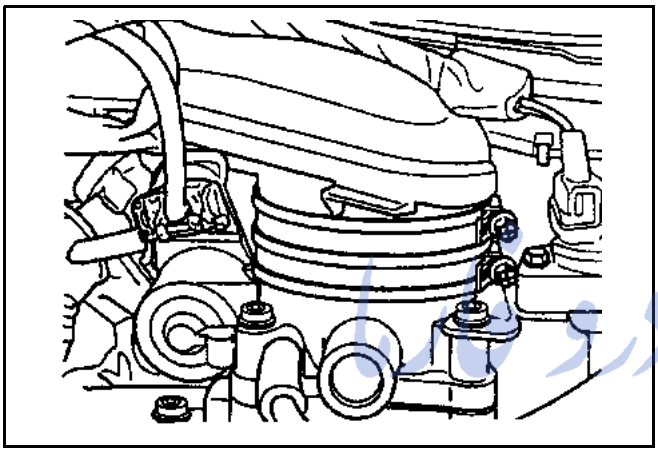


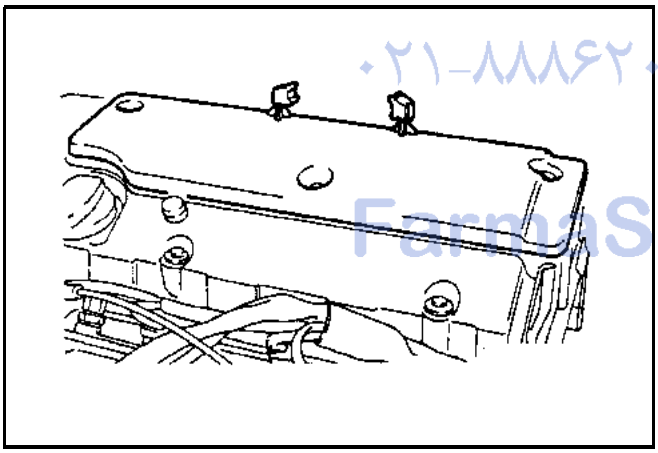
Removal & Installation Procedure

1. Remove the intake air duct.

Installation Notice

Tightening Torque	9 - 11 N•m (80 - 97 lb-in)



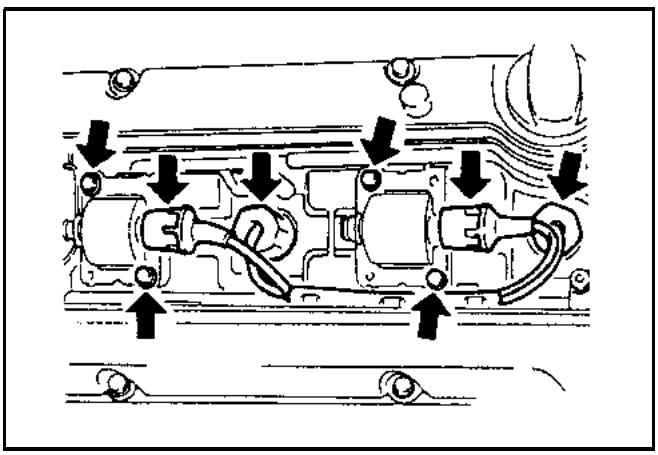


2. Remove the spark plug cover.

Installation Notice

Tightening Torque	9 - 11 N•m (80 - 97 lb-in)

Notice: Release 3 screws from the spark plug cover and remove the cover for M161 Engine coil.



3. Remove the spark plug connector and ignition cable.
4. Unscrew the bolts (3) and remove the head cover and the gasket.

Installation Notice

Tightening Torque	9 - 11 N•m (80 - 97 lb-in)

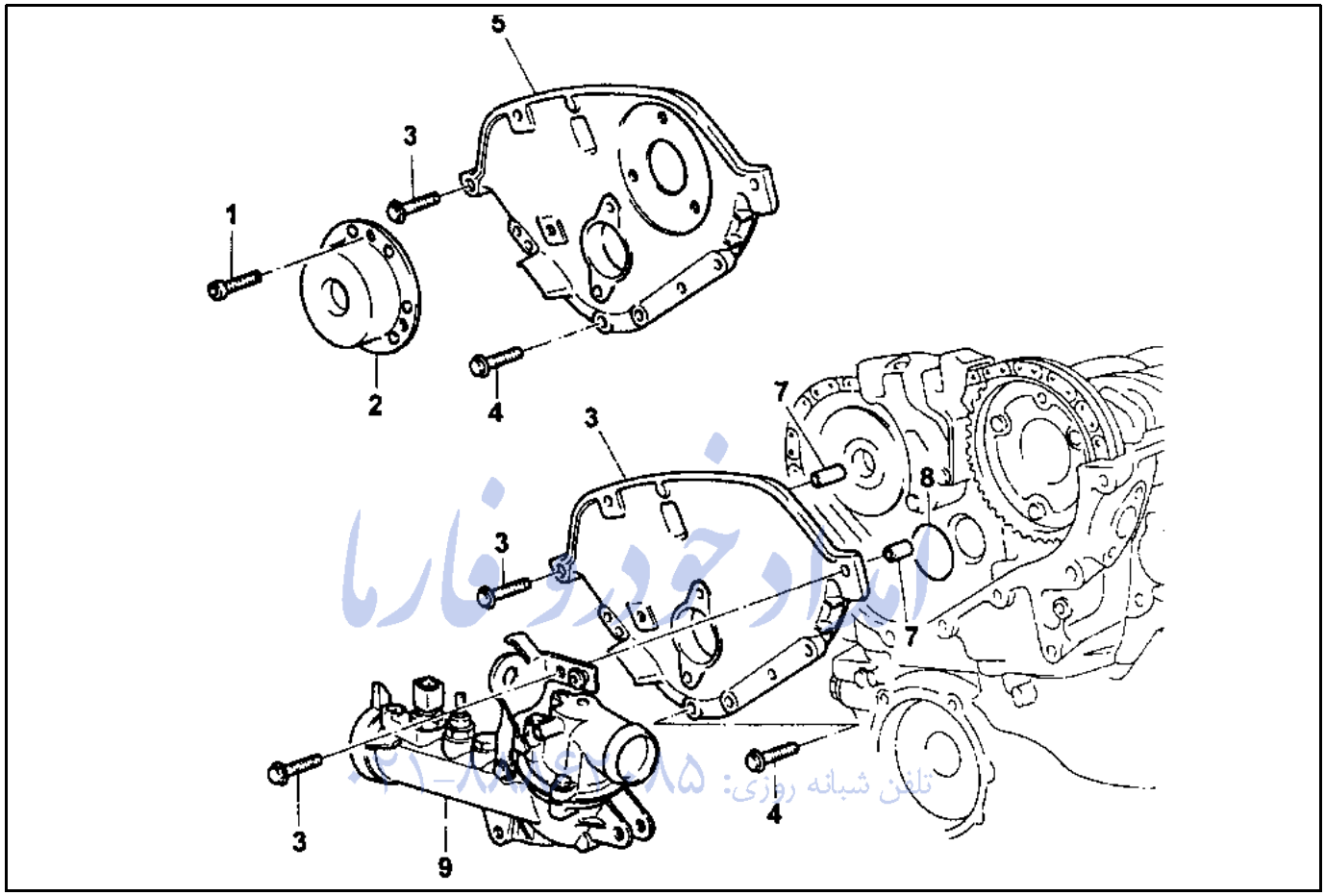
Notice: Replace the gasket with a new one if necessary.

5. Installation should follow the removal procedure in the reverse order.
6. Check for oil leaks by operating the engine.

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۰۲۱-۸۸۸۶۲۰۸۵
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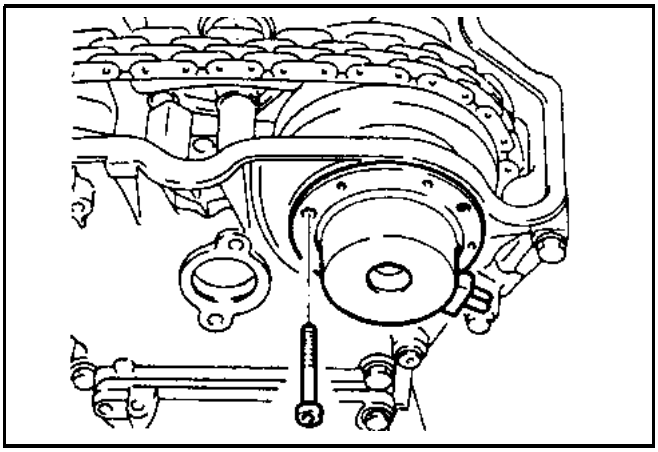
CYLINDER HEAD FRONT COVER

Preceding Work: Removal of cylinder head cover
Removal of thermostat housing assembly
Removal of engine hanger bracket



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1 Bolt (M6 X 16, 3 pieces) . . . . . 9-11 N•m (80-97 lb-in)
2 Camshaft Adjuster
3 Bolt (M8 X 35, 2 pieces) . . . . . 22.5-27.5 N•m (16.6-20.3 lb-ft)
4 Bolt (M6 X 22, 6 pieces) . . . . . 9-11 N•m (80-97 lb-in)
5 Front Cover (E23 : M161.973)
6 Front Cover (E20 : M161.943)
7 Sleeve
8 O-ring . . . . . Replace
9 Thermostat Housing

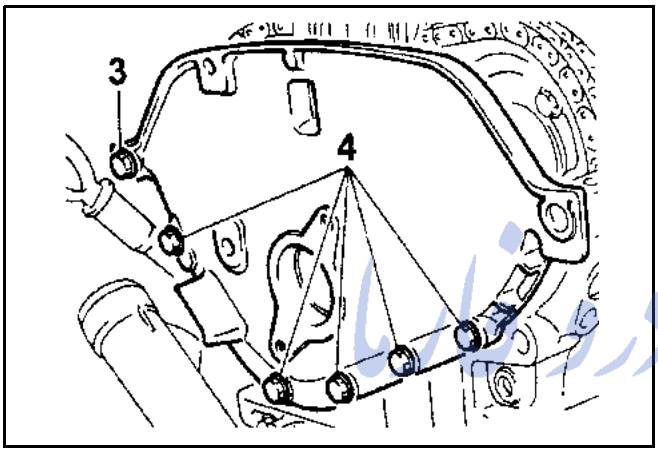


Removal & Installation Procedure

1. Disconnect the camshaft adjuster connector and remove the camshaft adjuster (E23 engine only).

Installation Notice

Tightening Torque	9 - 11 N•m (80 - 97 lb-in)



2. Remove the cylinder head front cover.

Installation Notice

Tightening Torque (3)	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)
Tightening Torque (4)	9 - 11 N•m (80 - 97 lb-in)

Apply the sealant at the mating surface of the cylinder head and the front cover.

3. Remove the O-ring.

Installation Notice

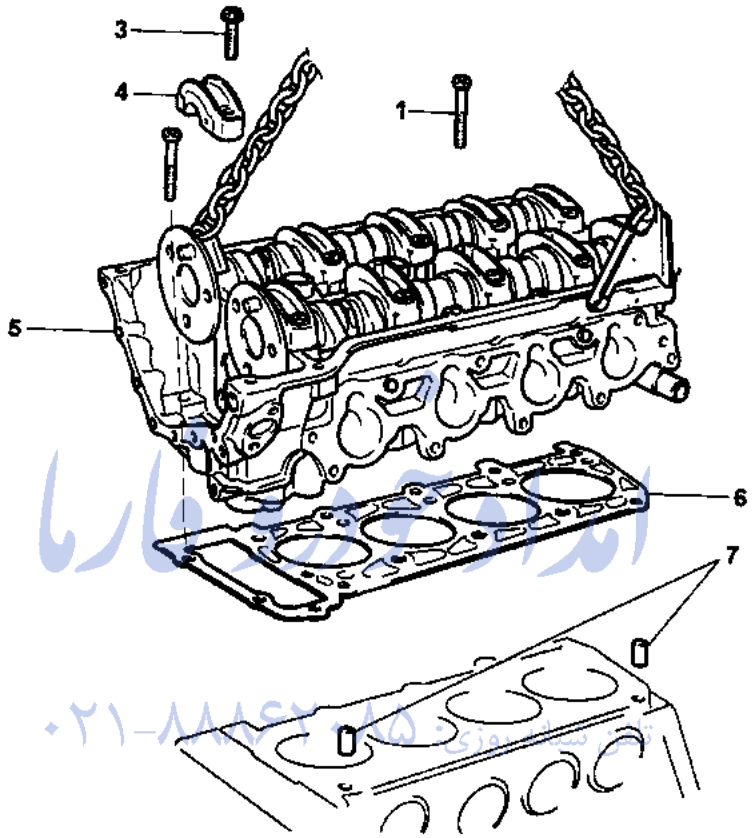
Replace the O-ring with new one and apply the sealant.

4. Installation should follow the removal procedure in the reverse order.

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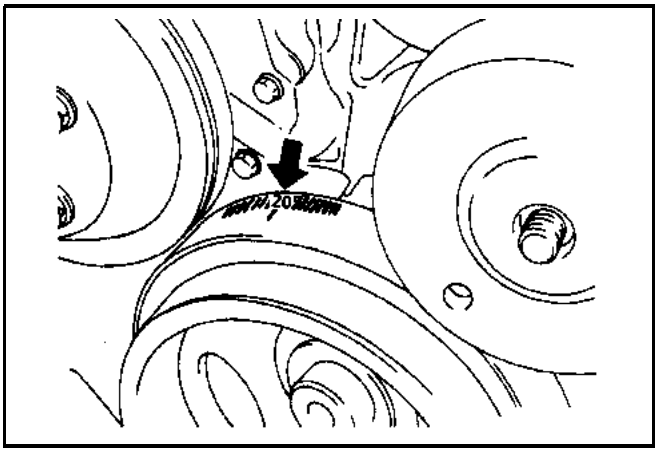
CYLINDER HEAD

Preceding Work: Removal of cylinder head cover
Removal of cylinder head front cover
Removal of intake manifold
Removal of cylinder head lower line (intake manifold side)



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1 Cylinder Head Bolt (M12 X 100, 10 pieces)
. . . . . 1st step 55 N•m (41 lb-ft)
2nd step 90° rotation added
3rd step 90° rotation added
3 Bolt (M8 X 35, 4 pieces)
. . . . . 22.5-27.5 N•m (16.6-20.3 lb-ft)
4 Camshaft Bearing cap
5 Cylinder Head
6 Gasket . . . . . Replace
7 Dowel Sleeve . . . . . Note

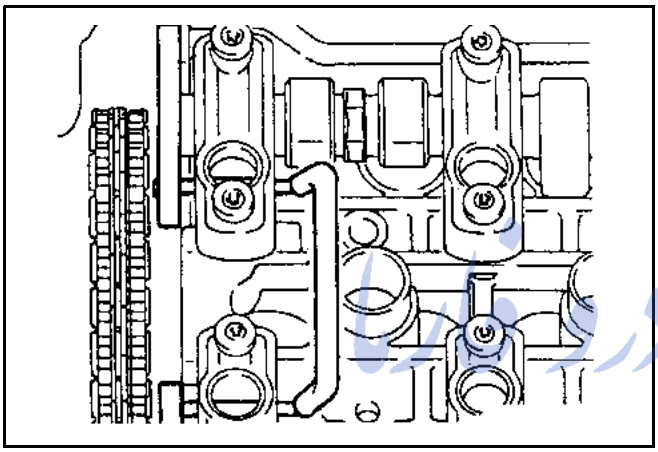


Tools Required

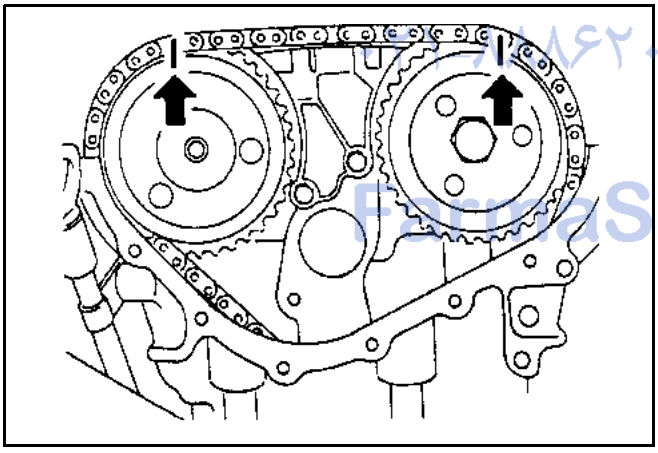
617 589 00 10 00 Allen Wrench Socket
116 589 20 33 00 Sliding Hammer
116 589 01 34 00 Threaded Pin
111 589 03 15 00 Holding Pin

Removal & Installation Procedure

1. Rotate the crankshaft so that the piston of number 1 cylinder is at ATDC 20.



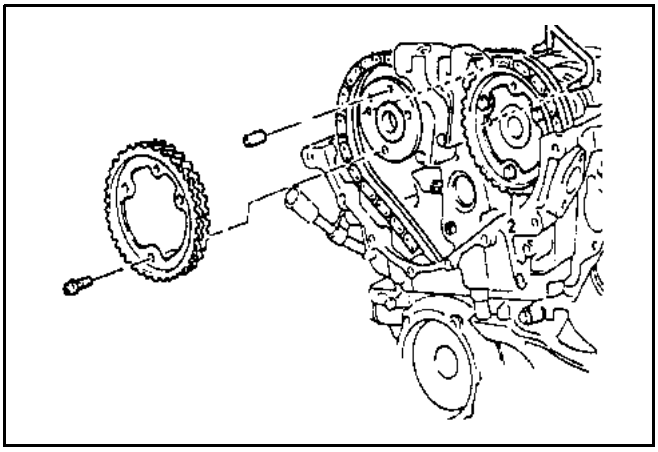
2. Put the holding pin 111 589 03 15 00 into the camshaft bearing cap (number 1, 6).



3. Put the alignment marks (arrows) on the timing chain and camshaft sprocket.
4. Remove the chain tensioner.

Installation Notice

Tightening Torque	72 - 88 N•m (53 - 65 lb-ft)



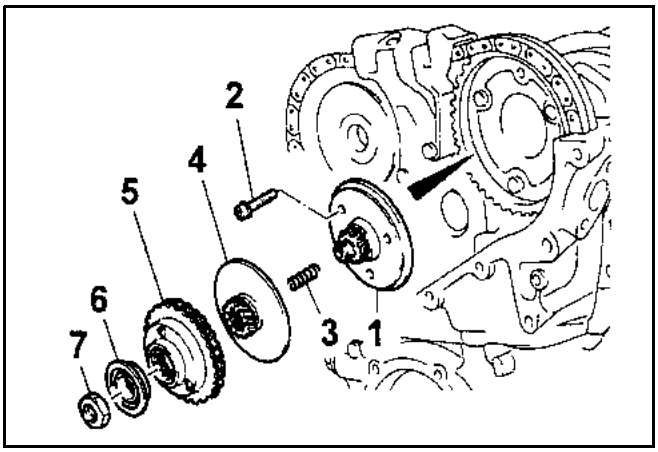
5. Remove the exhaust camshaft sprocket.

Installation Notice

Tightening Torque	1st step: 18 - 22 N•m (13 - 16 lb-ft)
	2nd step: 60° ± 5°

Notice: The flange bolt is designed to be used only once, so always replace with new one.

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6. Remove the intake camshaft sprocket (E20 engine).
7. Remove the camshaft adjuster (E23, M161.970 engine).

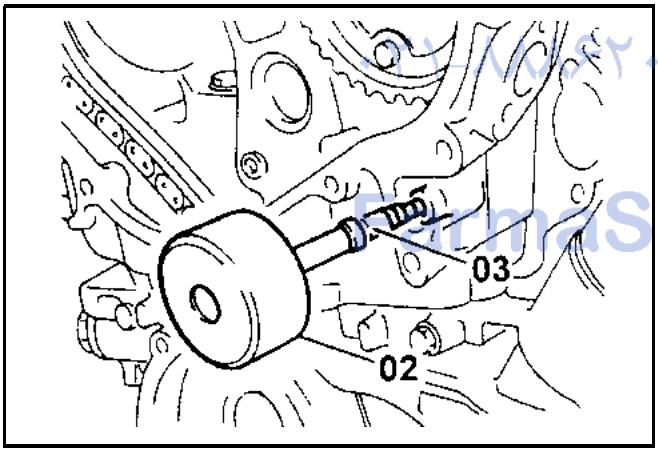
Installation Notice (Flange Bolt)

Tightening Torque	1st step: 18 – 22 N•m (13 – 16 lb-ft)
	2nd step: 60° ± 5°

Notice: The flange bolt is designed to be used only once, so always replace with new one.

1 Flange Shaft
2 Flange Bolt
3 Compression Spring
4 Adjust Piston
5 Camshaft Sprocket
6 Seal Cover
7 Nut

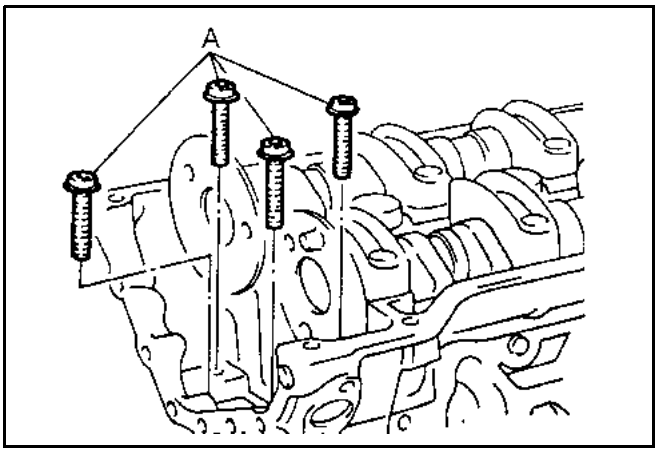
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8. Remove the guide rail pin using the sliding hammer 116 589 20 33 00 (02) and the threaded pin 116 589 01 34 00 (03).

Notice: Apply the sealant on guide rail pin when installation.

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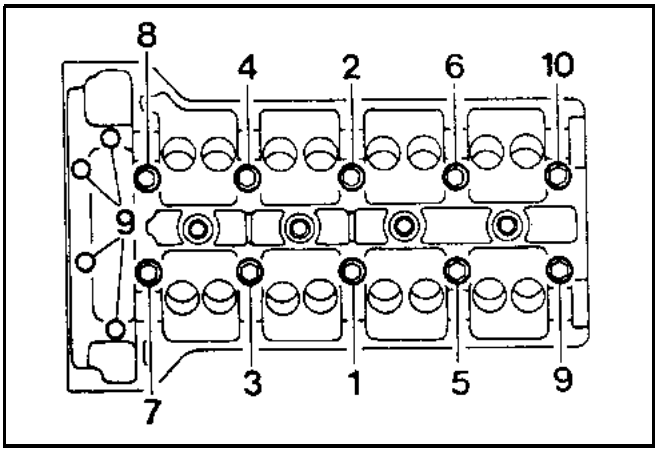


9. Unscrew the bolts (A).

Installation Notice

Tightening Torque	22.5 – 27.5 N•m (16.6 – 20.3 lb-ft)

Bolt (A) : (M8 X 35, 4 pieces)



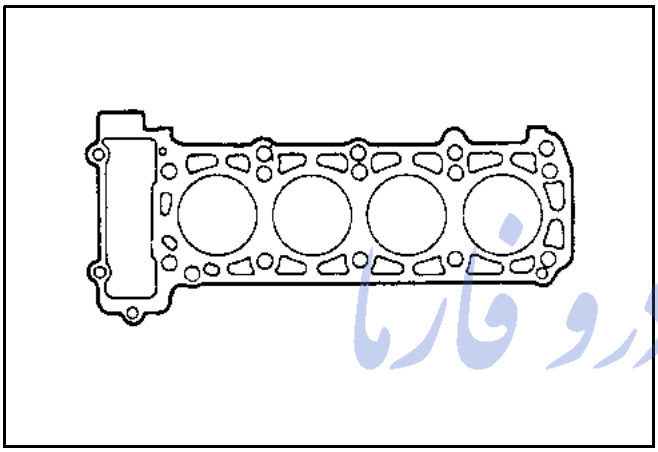
10. Remove the cylinder head bolts in the reverse order of the numerics (No.10 → No.1) using allen wrench socket 617 589 00 10 00.

Installation Notice

Tighten the bolts as numerical order with specified torque (No.1 → No.10).

Tightening Torque	1st step: 55 N•m (41 lb-ft)
	2nd step: + 90°
	3rd step: + 90°

Notice: Operate during engine cooling.

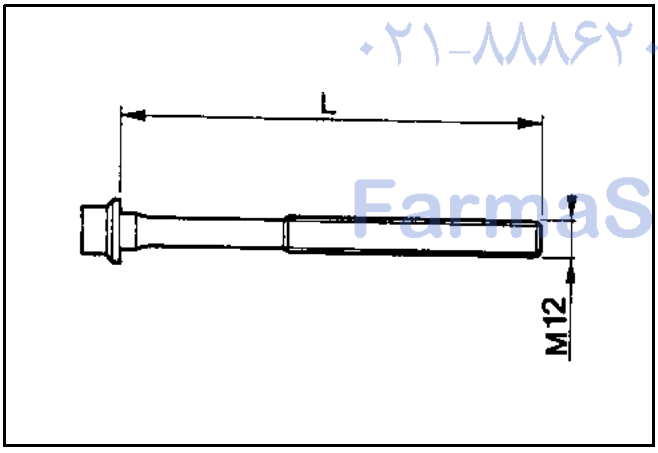


11. Remove the No. 1 bearing cap of the exhaust camshaft.

Installation Notice

Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)

12. Carefully remove the cylinder head.
13. Check the cylinder head mating surface and clean the crankcase head bolt mounting hole.
14. Replace the cylinder head gasket with new one.



15. Check the length of the cylinder head bolt.

Installation Notice

Length (L)	When New 100 mm
	Max. Length 105 mm

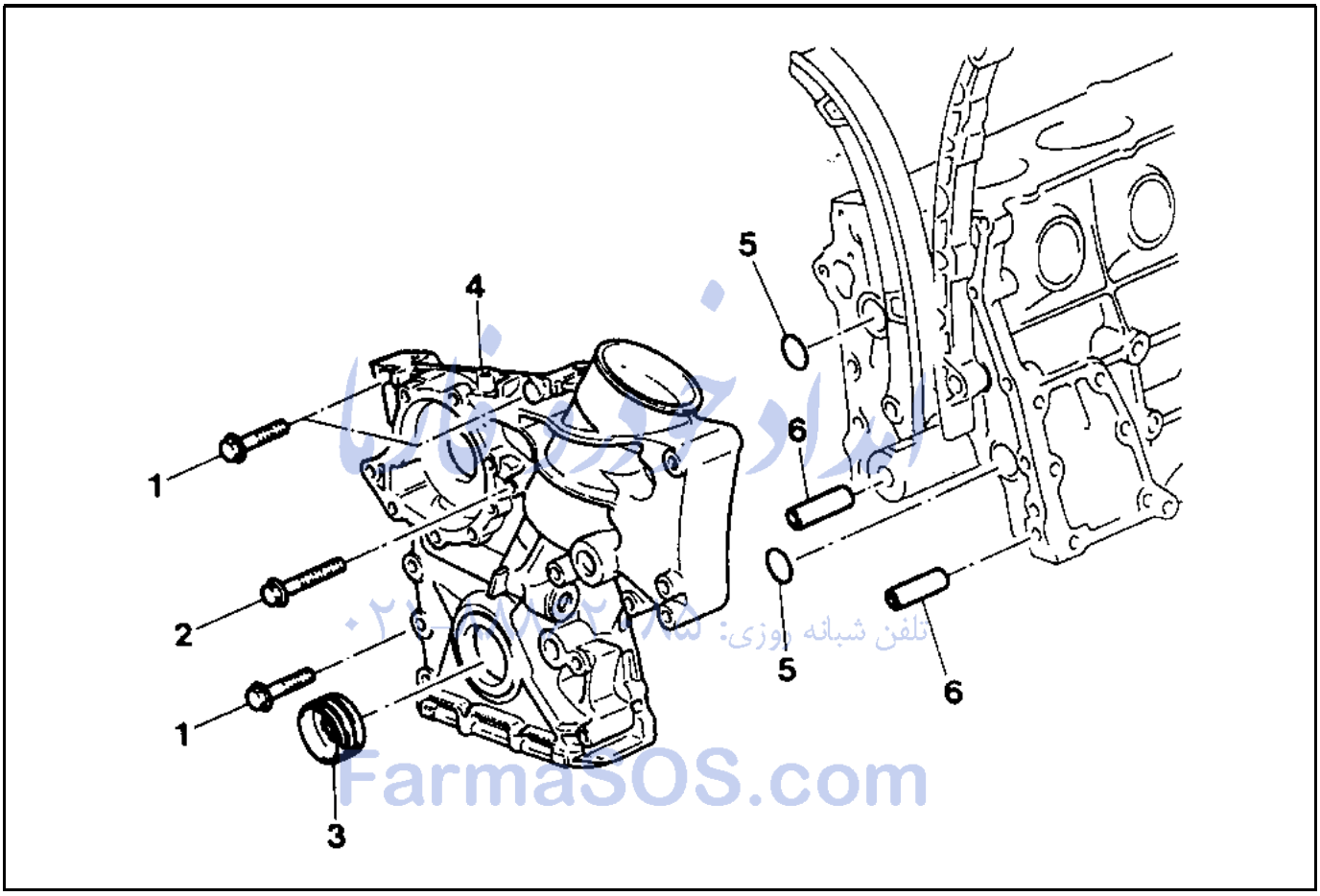
Notice: Replace the bolt if the measured length exceed the max. length.

16. Installation should follow the removal procedure in the reverse order.

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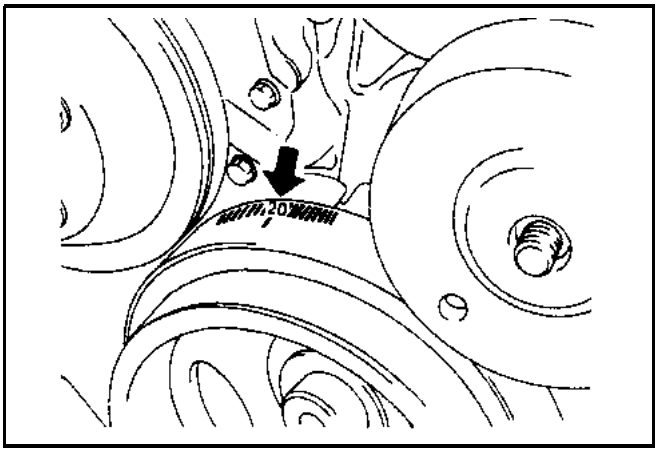
TIMING GEAR CASE COVER

Preceding Work: Removal of viscous clutch
Removal of cylinder head front cover
Removal of tensioning device
Removal of water pump
Removal of oil filter element
Removal of oil pan
Removal of generator bracket



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1 Bolt (M8 X 60, 3 pieces)
. . . . . 22.5-27.5 N•m (16.6-20.3 lb-ft)
2 Bolt (M8 X 75, 1 piece)
. . . . . 22.5-27.5 N•m (16.6-20.3 lb-ft)
3 Seal
4 Timing gear case cover
5 O-ring
6 Sleeve



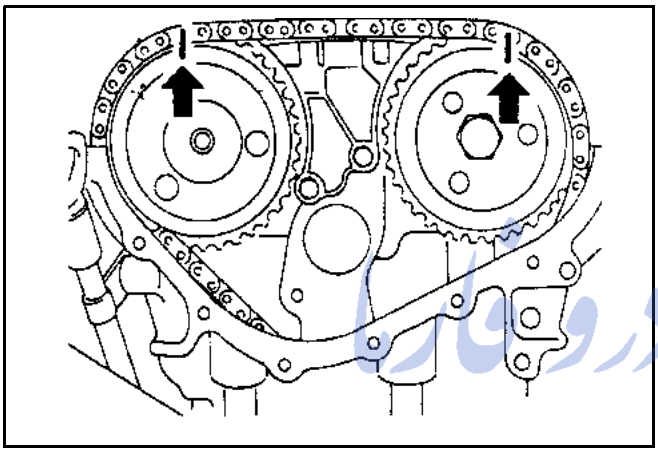
Tools Required

116 589 20 33 00 Sliding Hammer

116 589 01 34 00 Threaded Pin

Removal & Installation Procedure

1. Remove the power steering belt pulley and A/C compressor bracket.
2. Remove the oil line from power steering pump.
3. Rotate the crankshaft so that the piston of number, cylinder is at ATDC20°.



4. Put the alignment marks (arrows) on the timing chain and camshaft sprocket.
5. Remove the chain tensioner.

Installation Notice

Tightening Torque	72 - 88 N•m (53 - 65 lb-ft)

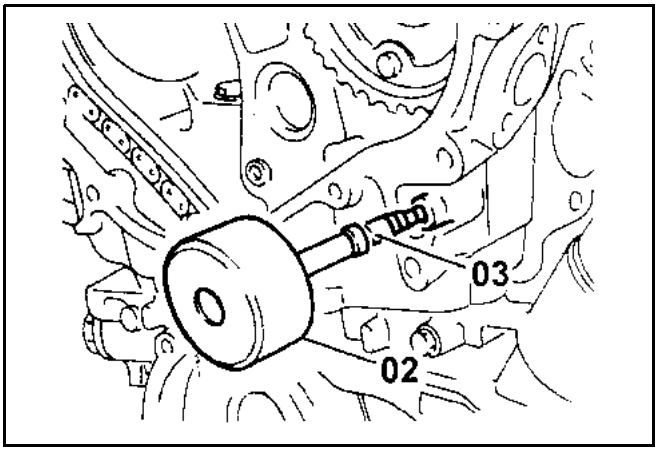
6. Remove the intake and exhaust camshaft sprocket (remove the camshaft adjuster assembly in E23 engine).

Installation Notice

Tightening Torque	1st step: 18 - 22 N•m (13 - 16 lb-ft)
	2nd step: 60° ± 5°

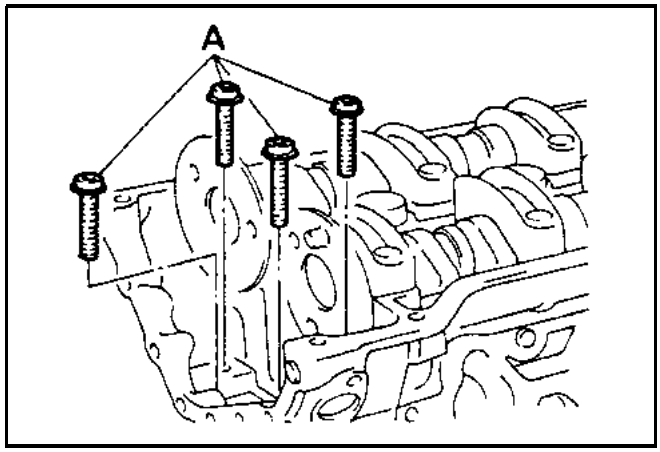
Notice: The flange bolt is designed to be used only once, so always replace with new one.

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7. Remove the guide rail pin using the sliding hammer 116 589 20 33 00 (02) and the threaded pin 116 589 01 34 00 (03).

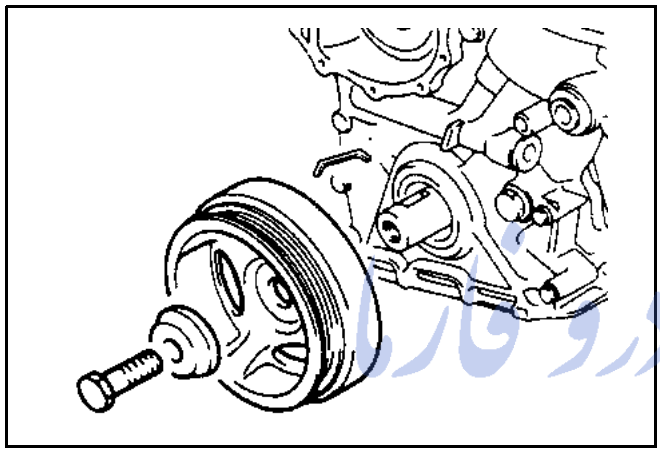
Notice: Apply the sealant on guide rail pin when installation.



8. Unscrew the bolts (A).

Installation Notice

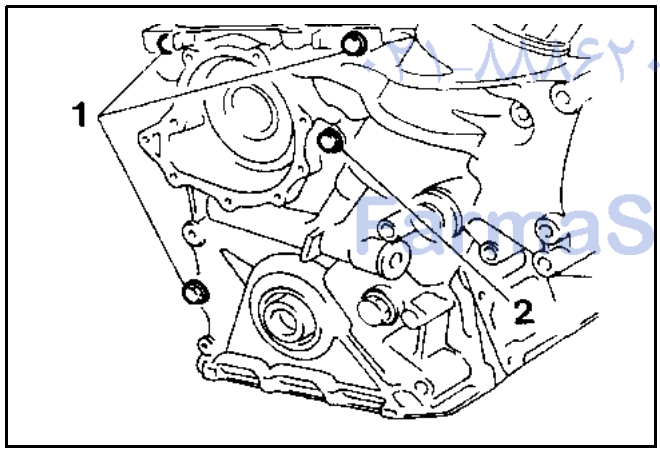
Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)



9. Remove the belt pulley and vibration damper.

Installation Notice (Center Bolt)

Tightening Torque	1st step: 200 + 20N•m (148 + 15 lb-ft)
	2nd step: 90° + 10°



10. Unscrew the bolts (1, 2) on timing gear case cover and remove the timing gear case cover.

Installation Notice

Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)

Notice: Be careful not to damage the cylinder head gasket.

11. Remove the radial shaft seal.

Notice: Installation note replace the seal with new one.

12. Clean the timing gear case cover and crankcase sealing surface.
13. Replace the O-ring with new one and apply the sealant on the sealing surface.

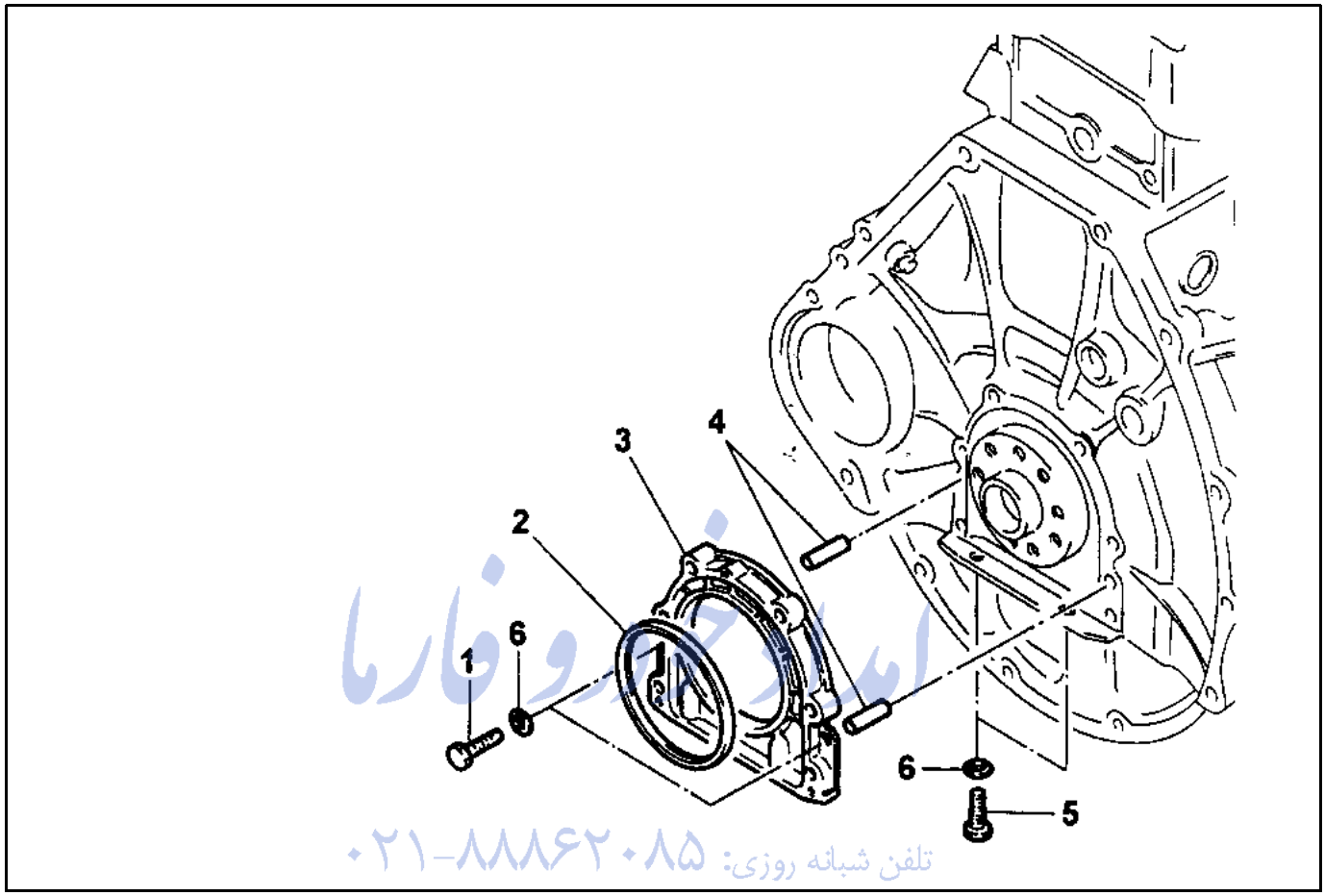
Notice: Be careful not to stain the oil chamber of chain tensioner with the sealant.

14. Installation should follow the removal precedure in the reverse order.
15. Warm up the engine and check for oil leaks.

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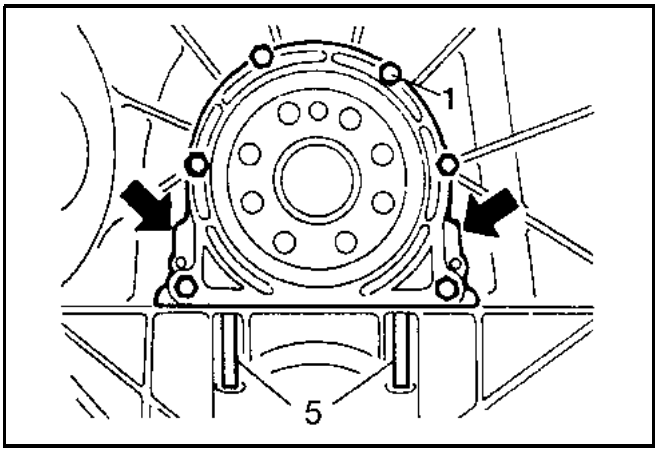
CRANKSHAFT SEALING REAR COVER

Preceding Work: Removal of the automatic transmission drive plate or flywheel



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1 Bolt (M6 x 20, 6 pieces) . . . . . 9-11 N•m (80-97 lb-in)
2 Radial Shaft Seal
3 Rear Cover
4 Sleeve
5 Bolt (M6 x 85, 2 pieces) . . . . . 9-11 N•m (80-97 lb-in)
6 Washer



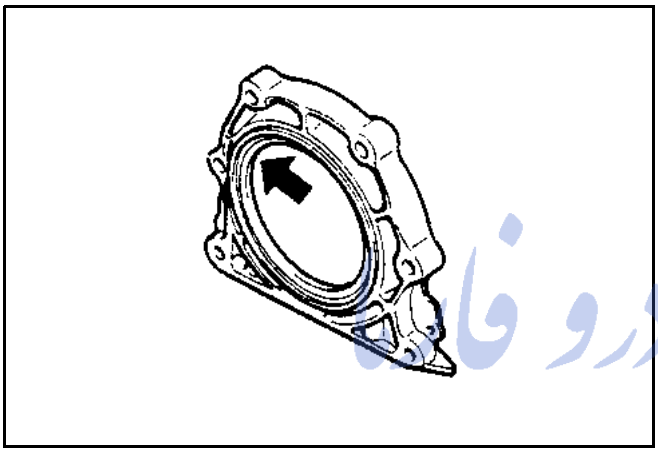
Tools Required

601 589 03 43 00 Crankshaft Rear Seal Installer

Removal & Installation Procedure

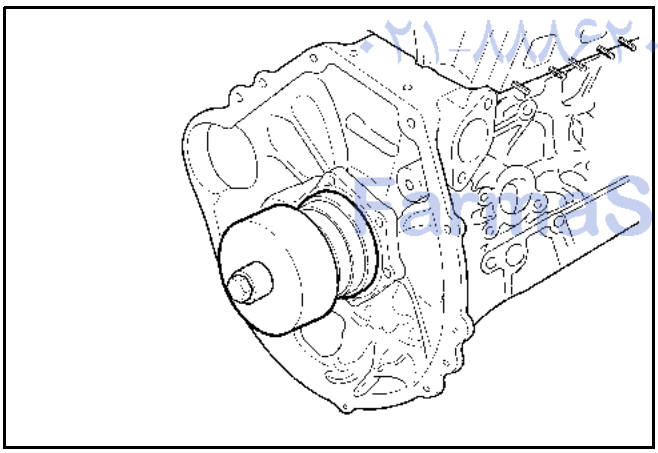
1. Unscrew the bolts (1) and (5) and remove the closing cover by pulling the rear cover lug (arrows).

Notice: Be careful not to damage the oil pan gasket.

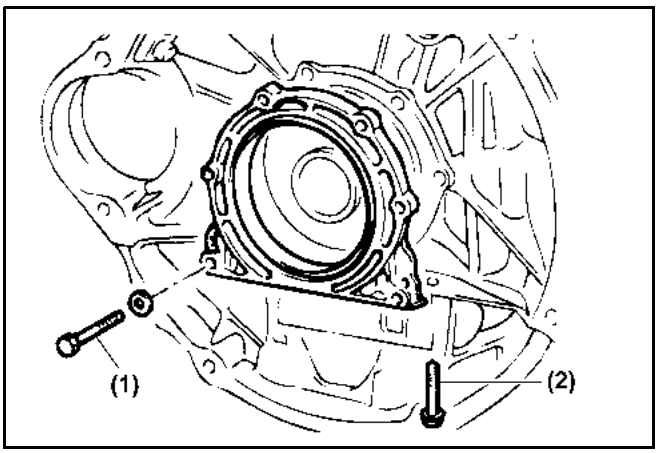


2. Clean the sealing surface of the crankcase and the rear sealing cover.
3. Check the radial shaft seal and replace it if necessary.
4. Apply the Loctite 573 to the rear cover sealing surface.
5. Apply the engine oil to the dust lip of the radial shaft seal.

Notice: Do not use the grease.



6. Install the crankshaft rear radial seal and the crankshaft sealing rear cover, using crankshaft rear seal installer 601 589 03 43 00.



7. Install the crankshaft sealing rear cover mounting bolts and remove the crankshaft rear seal installer 601 589 03 43 00.

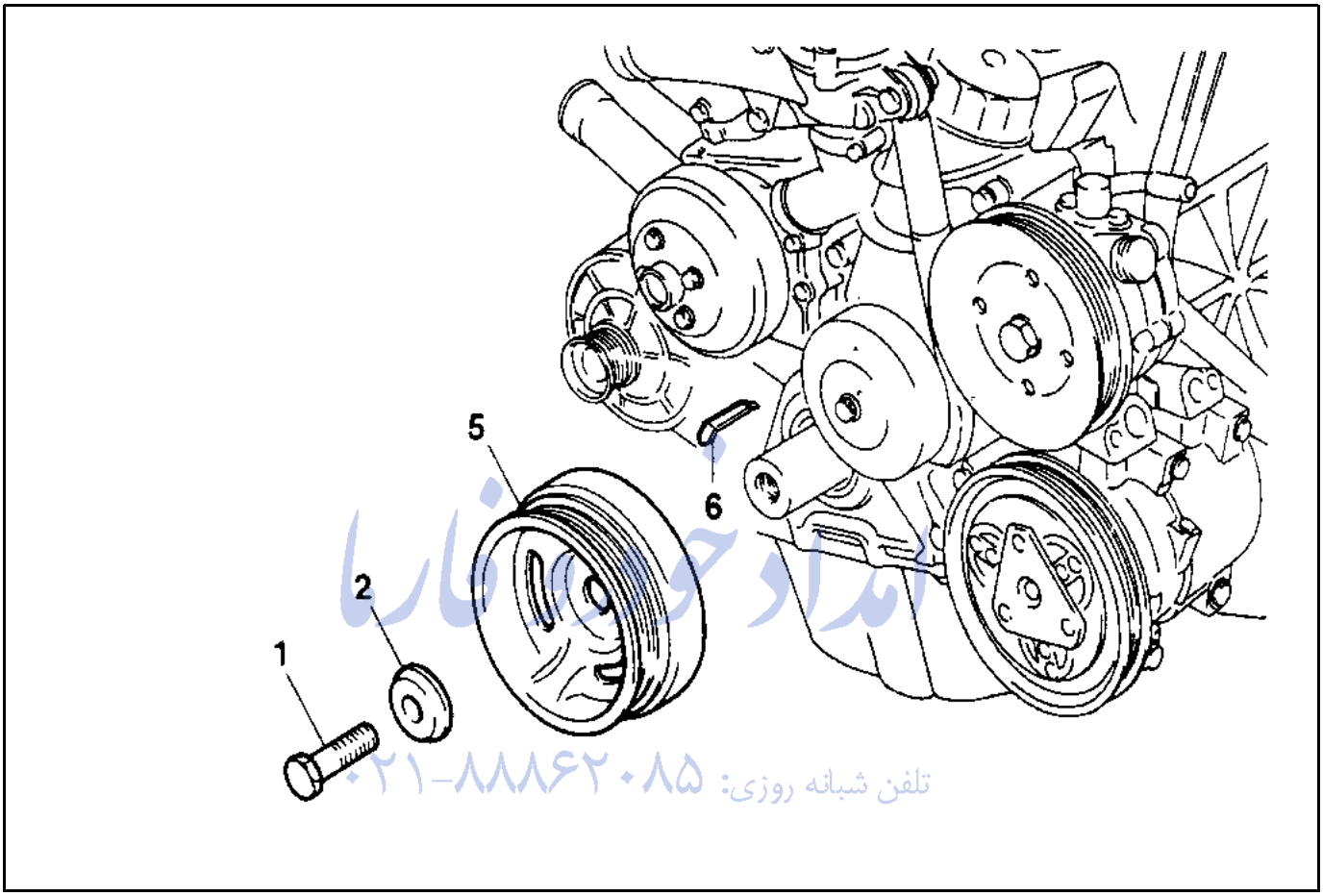
Installation Notice

Tightening Torque	9 – 11 N•m (80 – 97 lb-in)

8. Installation should follow the removal procedure in the reverse order.

BELT PULLEY AND VIBRATION DAMPER

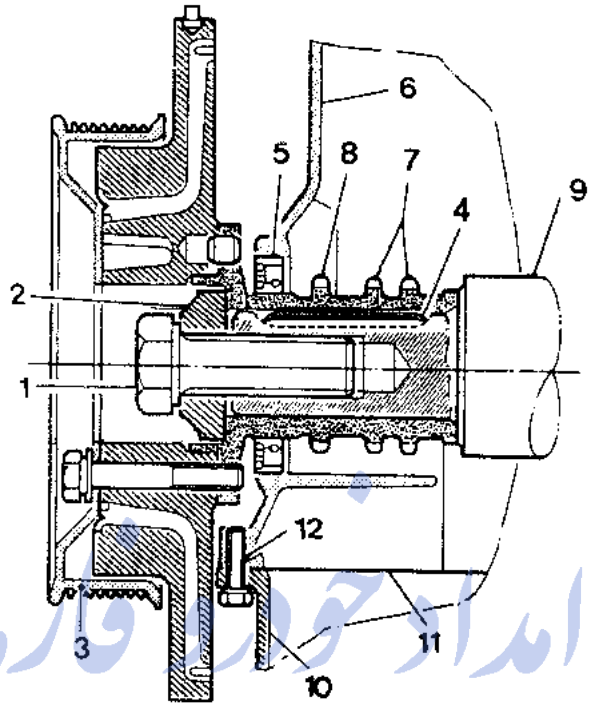
Preceding Work: Removal of cooling fan and viscous clutch
Removal of fan shroud
Removal of drive belt



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1 Vibration Damper Center
. . . . . 1st step 200+20 N•m (148+15 lb-ft)
2nd step 90°+10° rotation added
2 Vibration Damper Disk
5 Vibration Damper Assembly
6 Key

Components

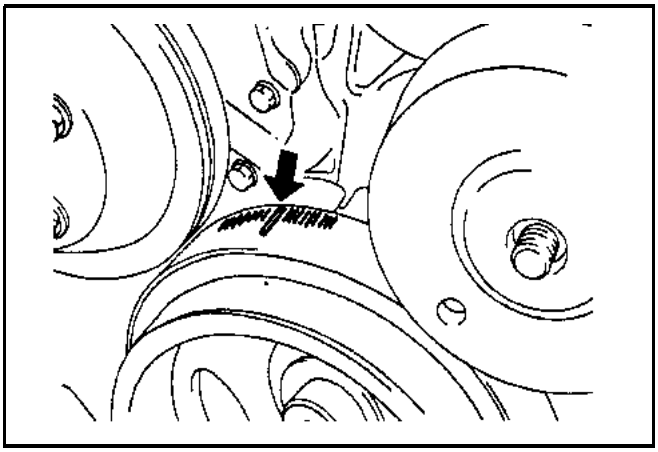


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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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1 Center Bolt (M18 x 50)
2 Center Bolt Washer
3 Vibration Damper and Pulley Assembly
4 Key
5 Crankshaft Front Seal
6 Timing Gear Case Cover
7 Crankshaft Sprocket (Camshaft Driven)
8 Crankshaft Sprocket (Oil pump Driven)
9 Crankshaft
10 Oil Pan
11 Oil Pan Gasket
12 Oil Pan Mounting Bolt (M6 x 22)

Service Data Standard

Permissble Deviation of The Vibration Damper	Radial Runout	0.6 mm
	Axial Runout	0.6 mm

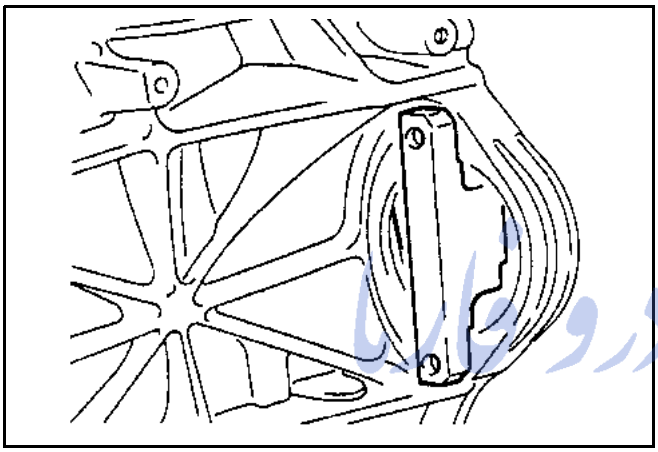


Tools Required

602 589 00 40 00 Engine Lock

Removal & Installation Procedure

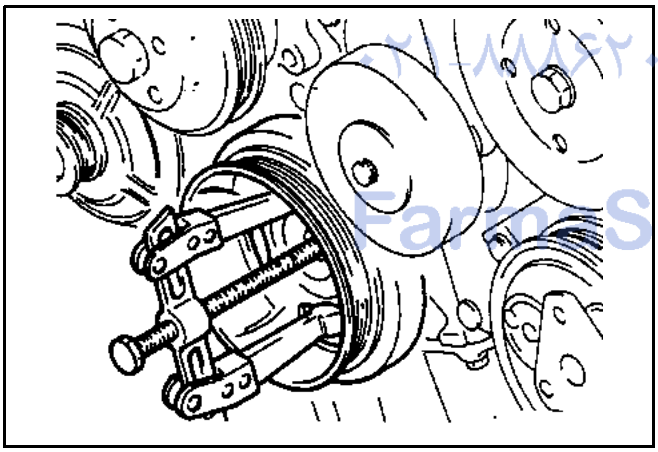
1. Adjust the piston of number 1 cylinder to the TDC.



2. Remove the start motor and install the engine lock 602 589 00 40 00 to the flywheel ring gear.
3. Remove the vibration damper center bolt.

Installation Notice

Tightening Torque	1st step: 200 + 20 N•m (148 + 15 lb-ft)
	2nd step: 90° + 10°



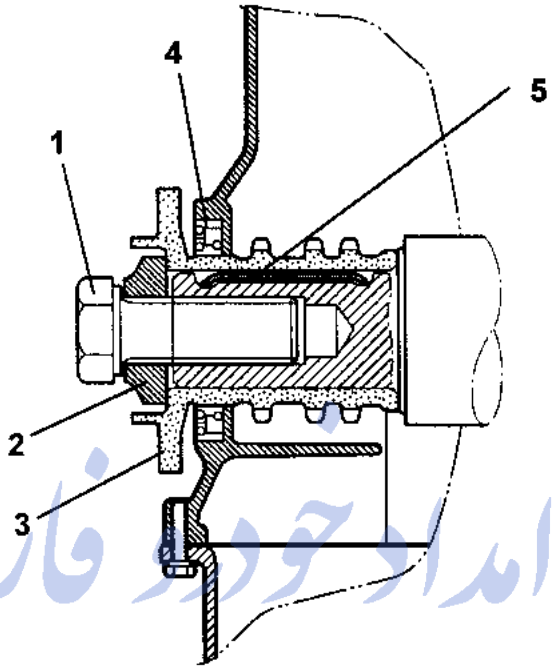
4. Remove the vibration damper assembly using the puller.
5. Installation should follow the removal procedure in the reverse order.

Notice: If possible, don't separate the vibration damper and the pulley.

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CRANKSHAFT FRONT RADIAL SEAL

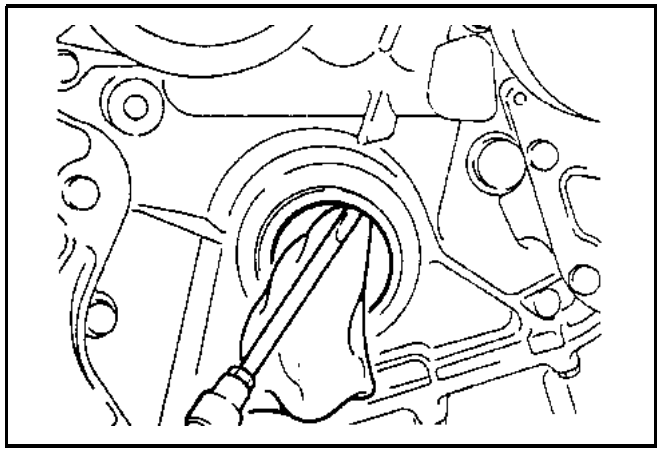
Preceding Work: Removal of belt pulley and vibration damper



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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵

1 Center Bolt (M18 x 50)
. . . . . 1st step 200+20 N•m (148+15 lb-ft)
2nd step 90°+10°
2 Center Bolt Washer
3 Crankshaft Front Seal Installer
4 Crankshaft Front Seal
5 Key

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Tools Required

601 589 03 14 00 Crankshaft Front Seal Installer

Replacement Procedure

1. Remove the radial seal with a screw driver.

Notice: Use a clean cloth not to damage the radial seal mounting hole and the crankshaft.

2. Coat the radial sealing lip with engine oil.
3. Using the crankshaft front seal installer 601 589 03 14 00, assemble the radial seal .
4. Align the sleeve groove and the woodruff key and tighten the center bolt until the center bolt and the damper disk stop in the movement.

Installation Notice

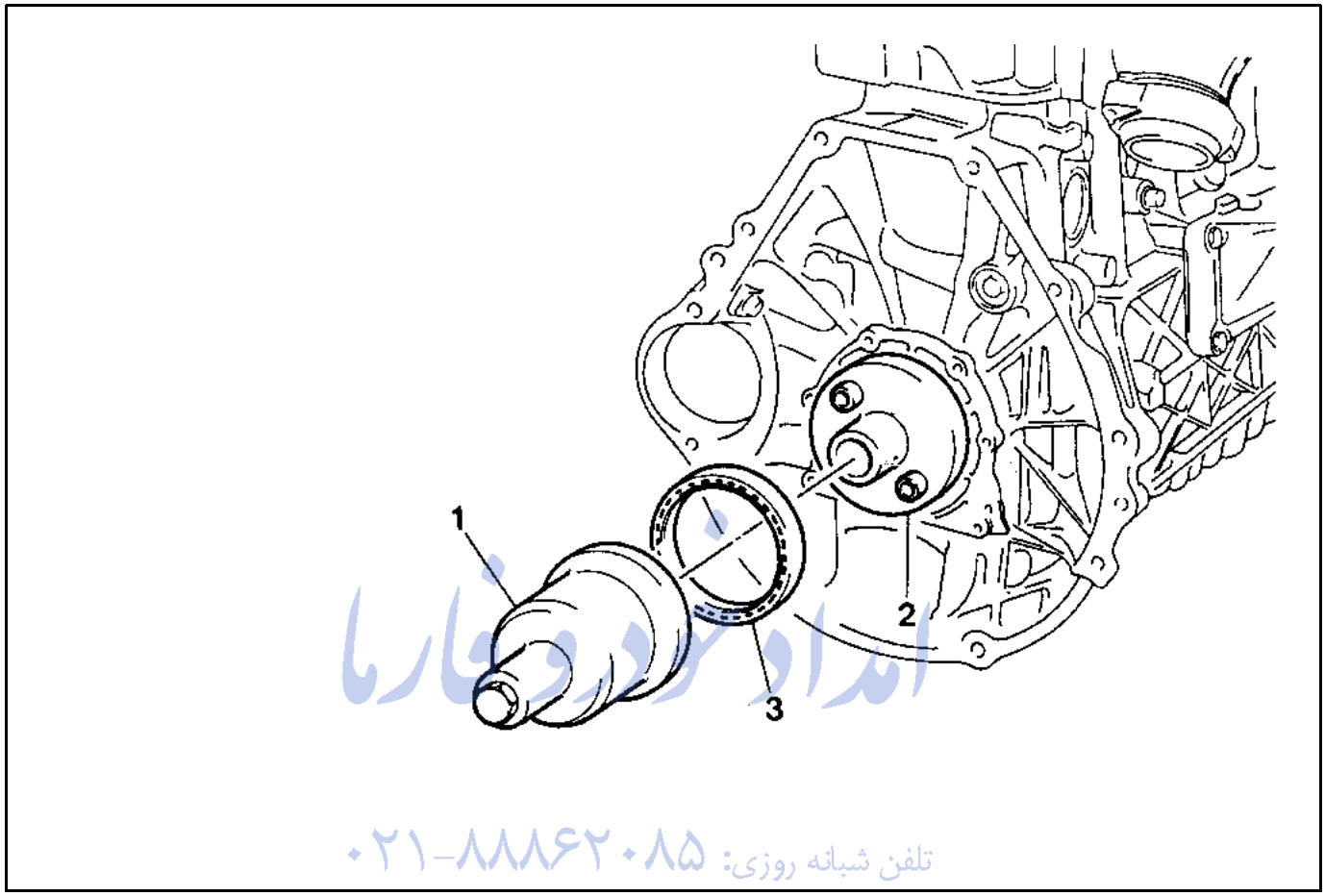
Tightening Torque	1st step: 200 + 20 N•m (148 + 15 lb-ft)
	2nd step: 90° + 10°

5. Remove the crankshaft front seal installer 601 589 03 14 00, and install the belt pulley and the vibration damper.
6. Check for leaks while operating the engine.

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CRANKSHAFT REAR RADIAL SEAL

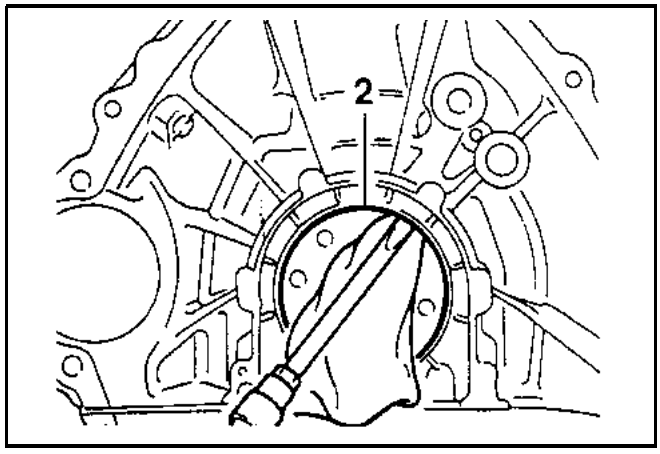
Preceding Work: Removal of flywheel or drive plate



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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵

1 Special Tool
2 Special Tool
3 Crankshaft Rear Seal

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Tools Required

601 589 03 43 00 Crankshaft Rear Seal Installer

Replacement Procedure

1. Remove the radial seal with a screw driver.

Notice: Use a clean cloth not to damage the radial seal mounting hole and the crankshaft.

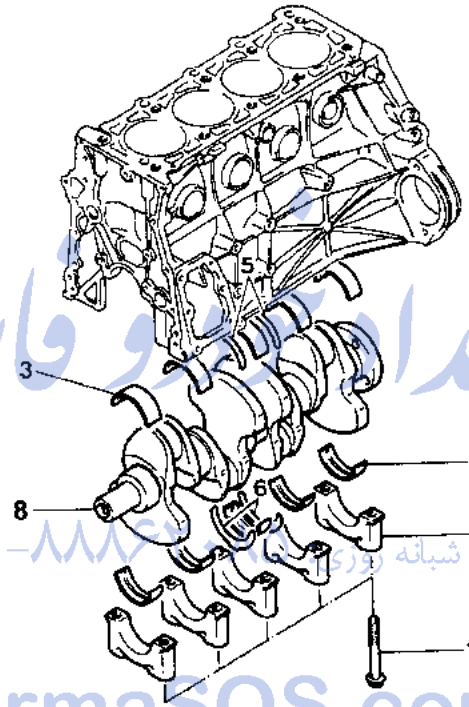
2. Install the special tool (2) to the crankshaft.
3. Apply the engine oil on the special tool (2).

Notice: Do not use the grease.

4. Install the radial seal on the inner parts assembler.
5. Press in the special tool (1) until the radial seal is stopped.
6. Check for leaks while operating the engine.

CRANKSHAFT

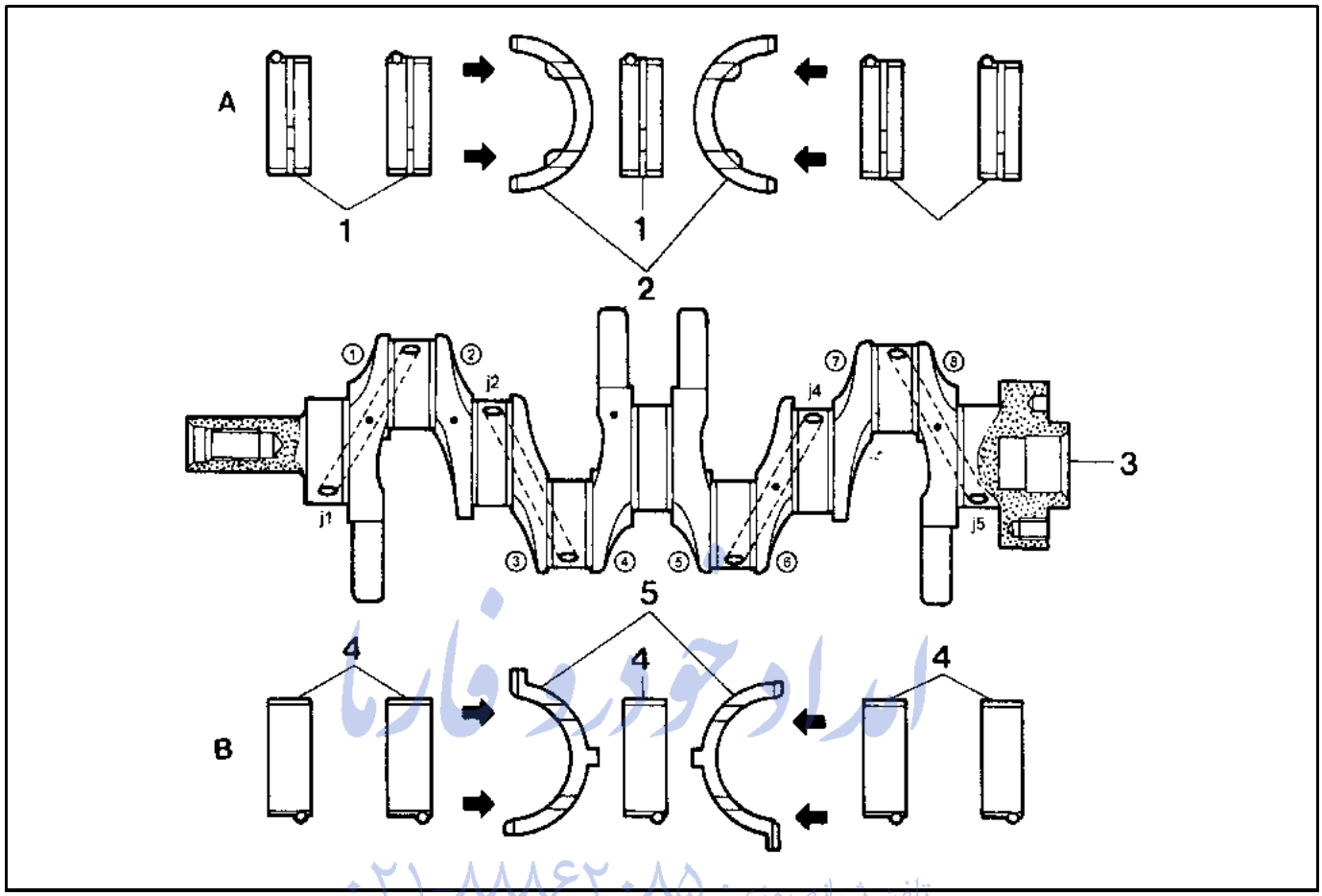
Preceding Work: Removal of engine
Removal of cylinder head
Removal of timing gear case cover
Removal of crankcase sealing rear cover
Removal of oil pan
Removal of baffle plate
Removal of oil pump



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1 Bearing Cap Bolt (M8 X 55-10 pieces)
. . . . . 1st step 55 N•m (41 lb-ft)
2nd step 90° rotation added
2 Bearing Cap
3 Upper Main Bearing
4 Lower Main Bearing
5 Upper Thrust Bearing
6 Lower Thrust Bearing
8 Crankshaft

Arrangement of the Thrust Bearing and the Main Bearing



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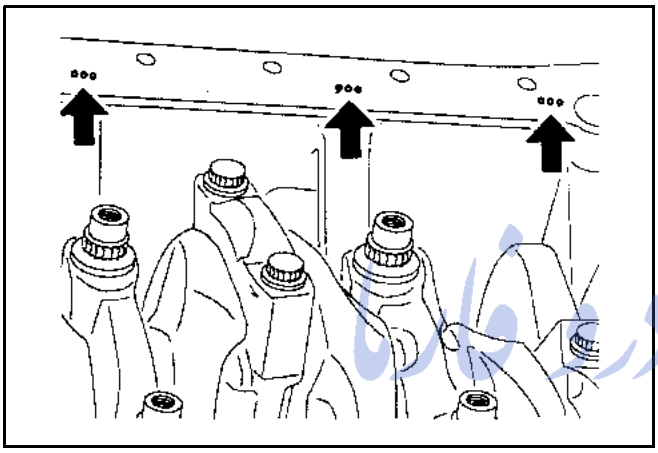
1 Upper Main Bearing
2 Upper Thrust Bearing
3 Crankshaft
4 Lower Main Bearing
5 Lower Thrust Bearing

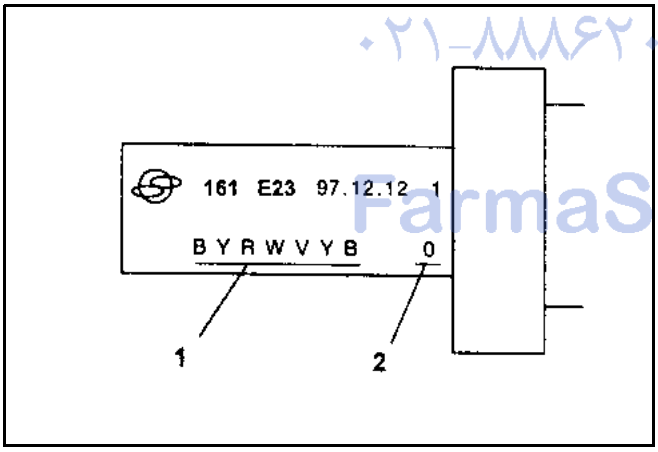
A Crankcase Side
B Bearing Cap Side (Oil Pan Side)

(1) – (8) Weight Balance/Color Marking Point
j1 – j5 Journal Main Bearing #1 – #5
● Color Dot Marking

The color dot marking are put on the (1), (2), (4), (6), (8), and it indicates the diameter of crankshaft journal by color as below.

Color Dot Marking	Crankshaft Journal Diameter (mm)
Blue	57.960 - 57.965
Yellow	57.955 - 57.960
Red	57.950 - 57.955
White	57.945 - 57.950
Violet	57.940 - 57.945





Selection of Crankshaft Main Bearing

1. Crankcase Side

   There are seven punching marks on the mating surface to oil pan. This mark is correspondent to the bearing distinguished by color. Select the relevant bearing according to the punching mark when repaired.

Punching Mark	Bearing Color Selected
●	Blue
●●	Yellow
●●●	Red

2. Crankshaft Bearing Cap Side

   Select the crankshaft main bearing according to the marking letter on the crankshaft main journal when repaired.

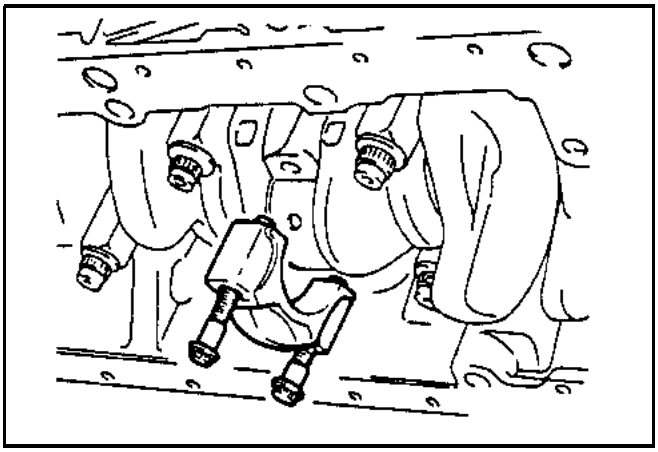
Marking Letter	Bearing Color Selected
B	Blue
Y	Yellow
R	Red
W	White
V	Violet

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Service Data

Unit: mm

Crankshaft Standard and Repair Size	Crankshaft Bearing Journal Diameter	Crankshaft Bearing Diameter	Crankshaft Journal Width at fit bearing	Connecting Rod Bearing Journal Diameter	Connecting Rod Bearing Journal Width
Standard size	57.940-57.965	58	24.50-24.533	47.935-47.965	27.958-28.042
1st repair size	57.705-57.715	-	-	47.700-47.715	-
2nd repair size	57.450-57.465			47.450-47.465	
3rd repair size	57.205-57.215			47.200-47.215	
4th repair size	56.955-56.965			46.950-46.965	



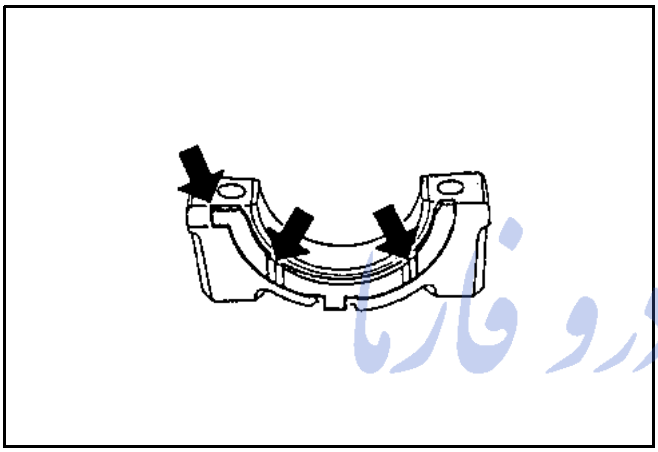
Removal & Installation Procedure

1. Unscrew the connecting rod bearing cap bolt and remove the bearing cap.

Installation Notice

Tightening Torque	40 N•m (30 lb-ft) + 90°

- Make sure that the upper and lower bearing shells do not change each other.
- Coat the bearing shell with engine oil.
- Install the bearing cap according to the consecutive number.



2. Unscrew the crankshaft bearing cap bolts and separate the upper and lower bearing shells and thrust washers.

Installation Notice

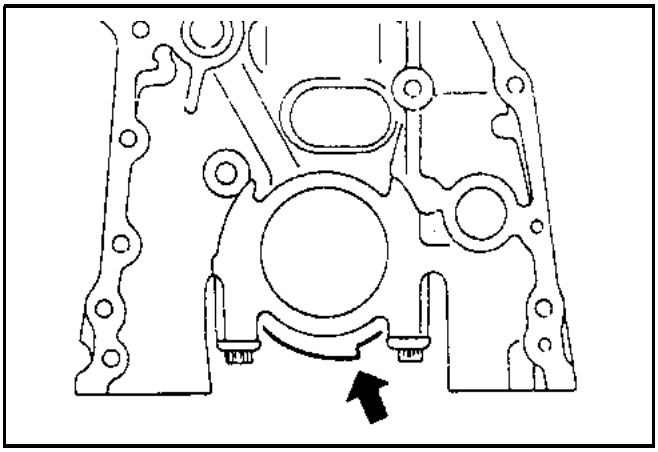
Tightening Torque	55 N•m (41 lb-ft) + 90°

- Remove the bearing cap from front (pulley side) to rear.
- Make sure that the upper and lower bearing shells do not change each other and coat with engine oil.
- The oil grooves (arrows) in the thrust washers must face outward and insert the thrust bearing into the bearing cap.
- There are five kinds of thrust washers by thickness. Select the proper washer when repaired.

Part No. : 601 030 00 62 2.15 mm
Part No. : 601 030 01 62 2.20 mm
Part No. : 601 030 02 62 2.25 mm
Part No. : 601 030 03 62 2.30 mm
Part No. : 601 030 04 62 2.40 mm

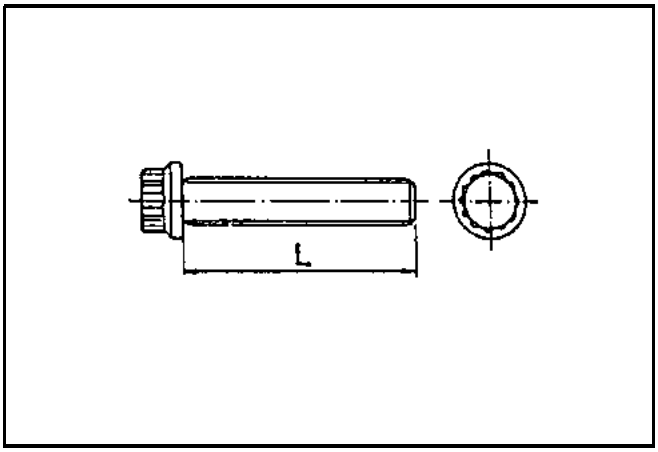
3. Remove the crankshaft.
4. Installation should follow the removal procedure in the reverse order.
5. After completion of the installation, check for the rotating condition of the crankshaft.

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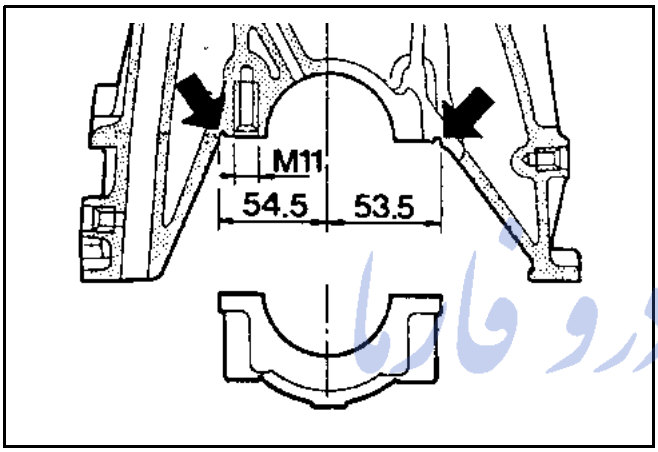
Installation Notice

- Make sure the crankshaft bearing cap properly seated in place in the crankcase side. When perfectly installed, the projected part (arrow) locates in the left side (intake manifold side).
- Assemble so that the projected part of the cap and crankcase face the same direction.



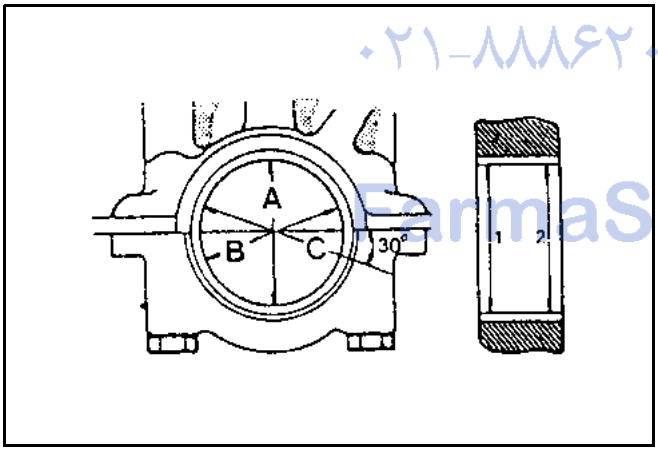
Inspection

1. If the length 'L' of the crankshaft bearing cap bolt exceeds 63.8mm, replace it.



2. Make sure the crankshaft bearing cap is properly seated on the cylinder block (arrows).

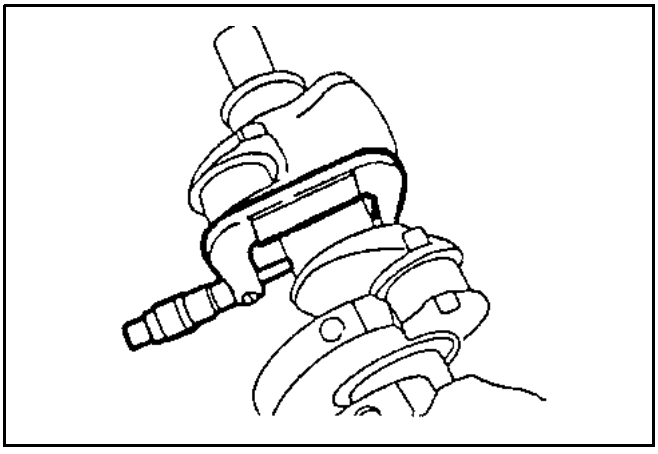
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3. Measure and record the inner diameter of the crankshaft bearing.

Notice

- Measure at 2 points (1, 2).
- Measure 'A', 'B' and 'C' as shown. If average value of 'B' and 'C' is less than value 'A', then the average value of 'B' and 'C' is actual average value. If average value of 'B' and 'C' is more than value 'A' is actual average value.



4. Measure and record the diameter of the crankshaft bearing journal.

Notice

- Record the mean value when measured at 3 points (A, B, C).
- Measure the inner diameter of bearing and the diameter of journal and if it is out of the standard data, replace the bearing shell.

Service Data Standard (Crankshaft Main Bearing Gap)

Item	Measuring Position	Gap (mm)
Main Bearing Journal (NO. 1, 5, 7)	Radial	Static condition : 0.015 - 0.039 Dynamic condition: 0.031 - 0.051 (Consider the expansion 0.011 - 0.016)
	Axial	0.010 - 0.254

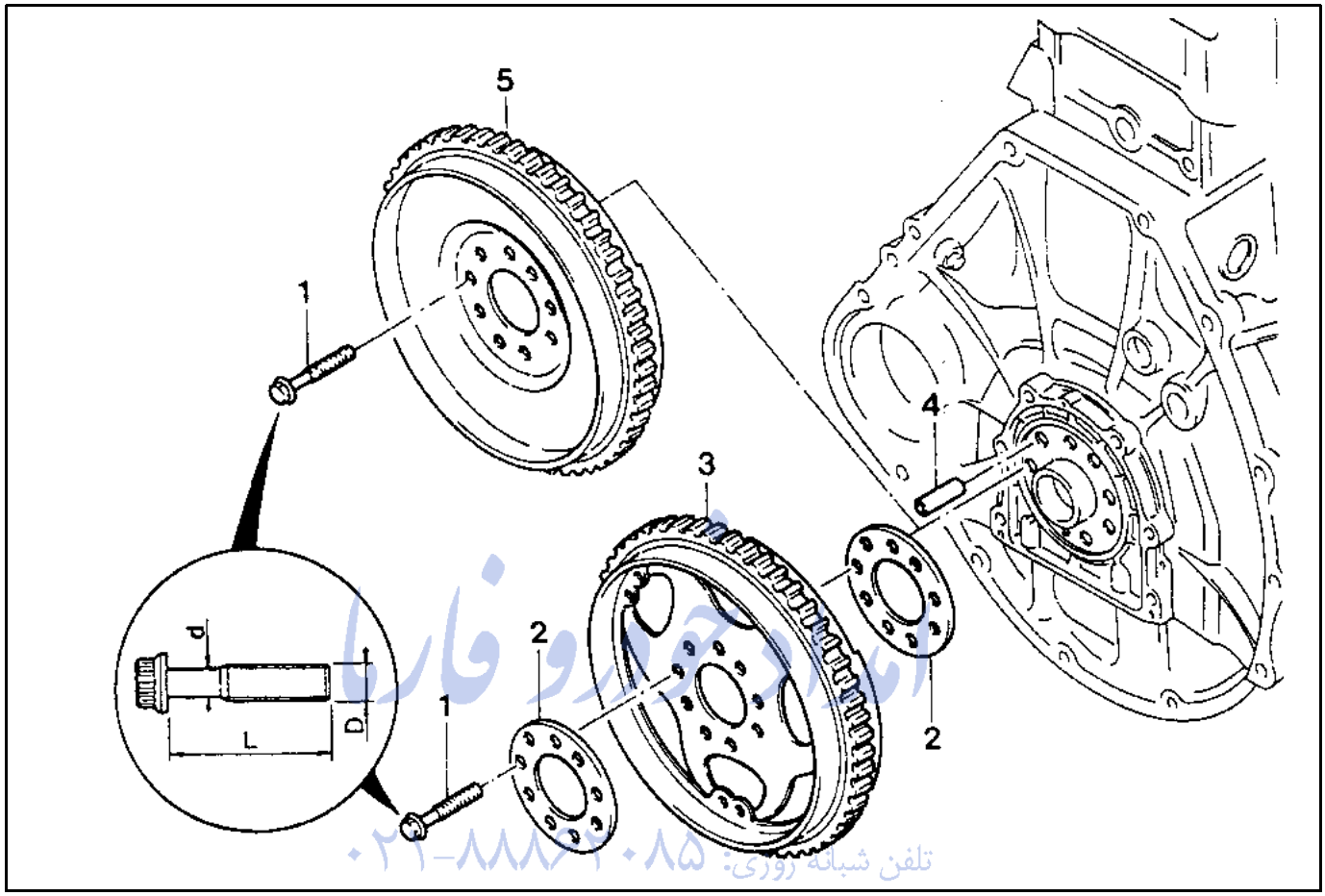
(Connecting Rod Bearing Gap)

Item	Measuring Position	Gap (mm)
Connecting Rod Bearing	Radial	0.020 - 0.065

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FLYWHEEL / DRIVEN PLATE

Preceding Work: Removal of manual or automatic transmission



1 Flywheel Mounting Bolt (M10 x 22, 8 pieces)
. . . . . 1st step 45+5 N•m (33+3.7 lb-ft)
2nd step 90°+10°
2 Plate
3 Driven Plate (A/T)
4 Dowel Pin
5 Flywheel (M/T)

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Service Data Standard (Stretch Bolt)

Nominal Size	D	-	M x 1.5
Stretch Side Diameter	d	When New	8.5 - 0.2 mm
		Min. Diameter	8.0 mm
Bolt Length	L	When New	21.8 - 22.2 mm
Tightening Torque	1st step 45 + 5 N•m (33 + 3.7 lb-ft), 2nd step 90° + 10°		

Removal & Installation Procedure

1. Unscrew the flywheel mounting bolt.

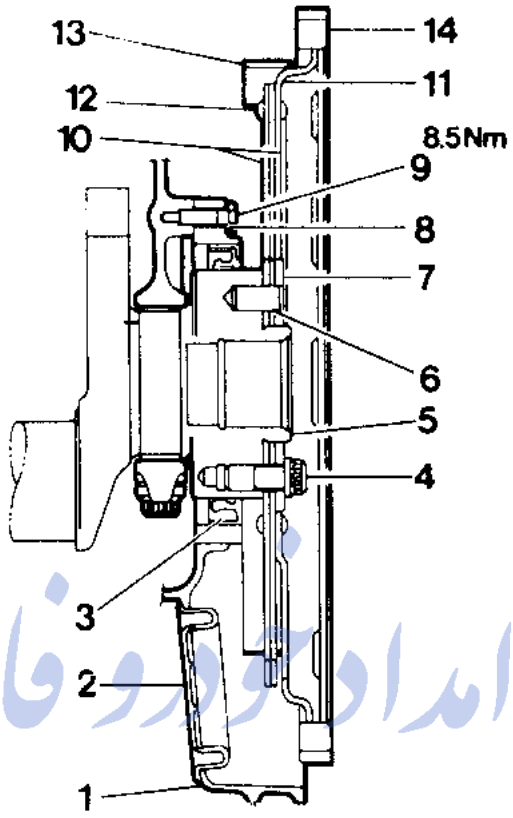
   Installation Notice

Tightening Torque	1st step: 45 + 5 N•m (33 + 3.7 lb-ft)
	2nd step: 90° + 10°

   - Replace the bolt when the stretch side diameter (d) of the flywheel mounting bolt is less than 8.0mm.
   - For the flywheel mounting bolt tightening, keep the socket wrench and Tommy-bar to be 90° and tighten as specified.
2. Remove the flywheel for manual transmission vehicles, or the driven plate (3), and plate (2) for Auto. transmission vehicle.
3. Installation should follow the removal procedure in the reverse order.

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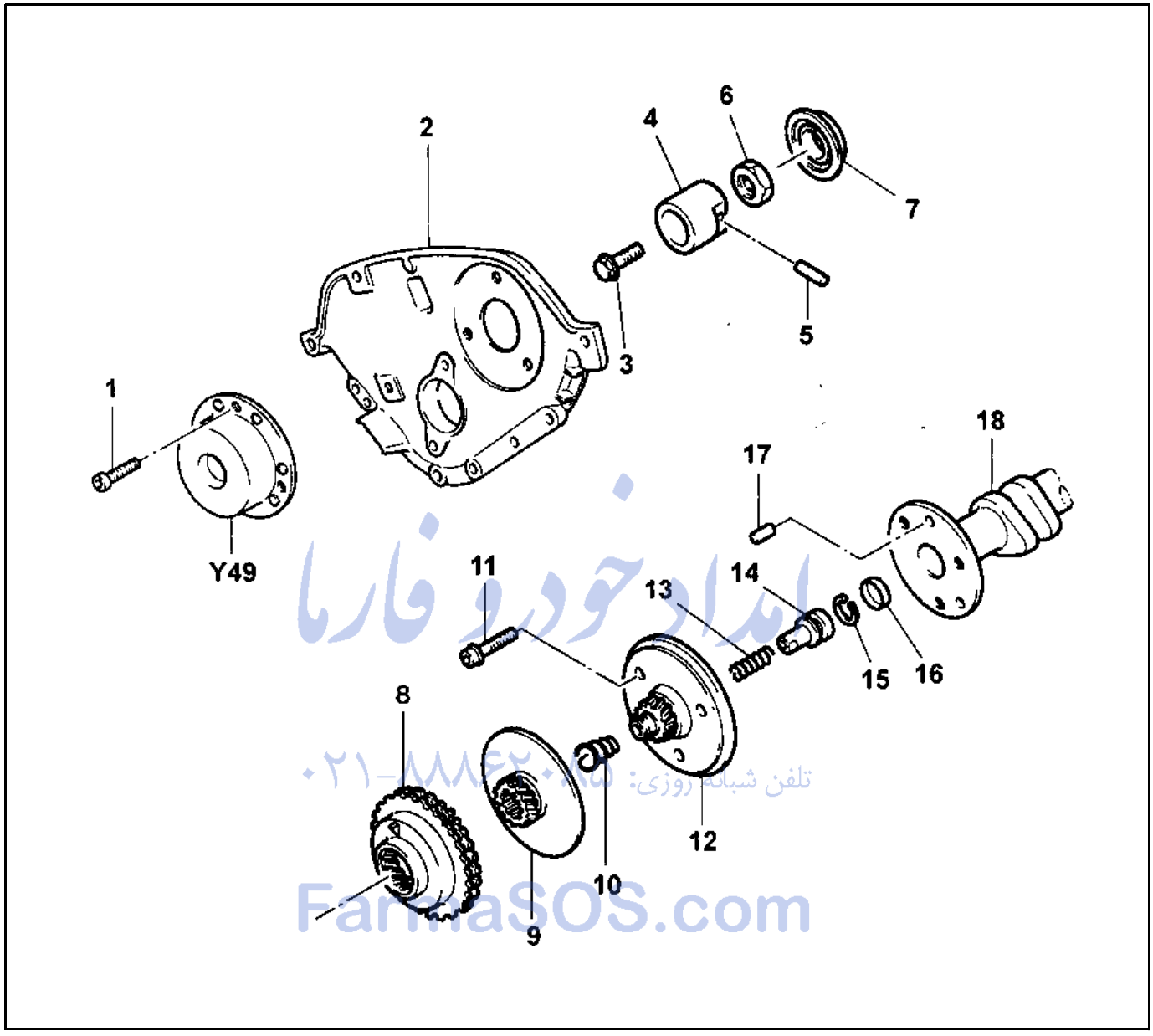
Sectional View



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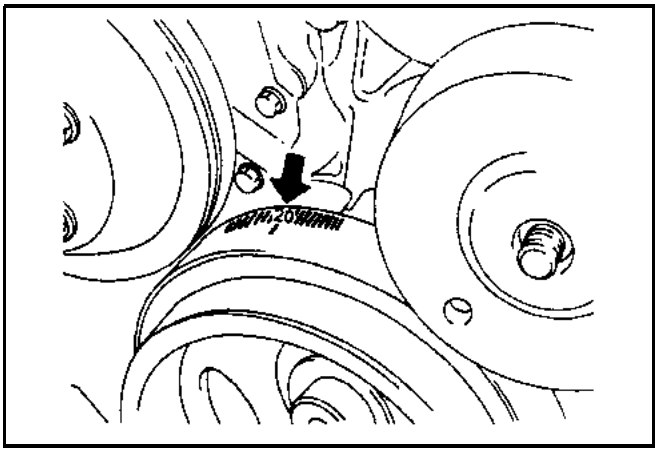
1 Oil Pan
2 Cover
3 Radial Seal
4 Bolt
5 Crankshaft
6 Dowel Pin
7 Washer (Thickness : 3.5 mm)
8 Washer
9 Bolt
10 Front Drive Plate
11 Rear Drive Plate
12 Rivet
13 Segment
14 Ring Gear

CAMSHAFT ADJUSTER



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1 Bolt (M6 X 16, 3 pieces) . . . . . 9-11 N•m (80-97 lb-in)
2 Cylinder Head Front Cover
3 Bolt . . . . . 35 N•m (26 lb-ft)
4 Armature
5 Roll Pin
6 Nut (M20 X 1.5) . . . . . 60-70 N•m (44-52 lb-ft)
7 Seal Cover
8 Camshaft Sprocket
9 Adjust Piston
10 Conical Spring
11 Flange Bolt (M7 X 13, 3 pieces) . . . . . 1st Step 18-22 N•m (13-16 lb-ft) 2nd Step 60° ± 5° Rotation Added
12 Flange Shaft
13 Compression Spring
14 Control Piston
15 Circlip
16 Oil Gallery
17 Straight Pin
18 Intake Camshaft
Y49 Magnetic Actuator (2-pin connector)

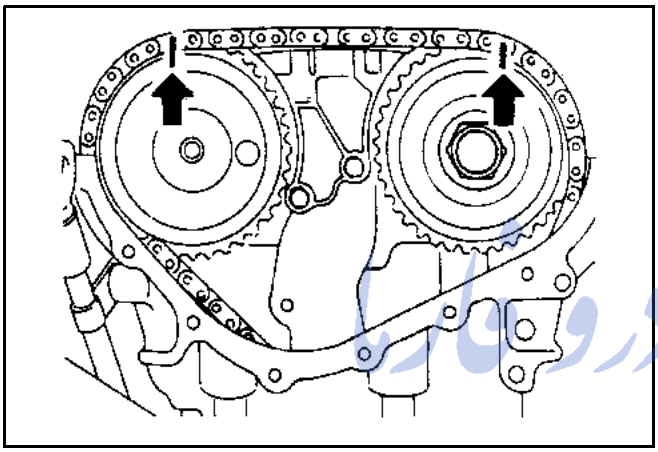


Removal & Installation Procedure

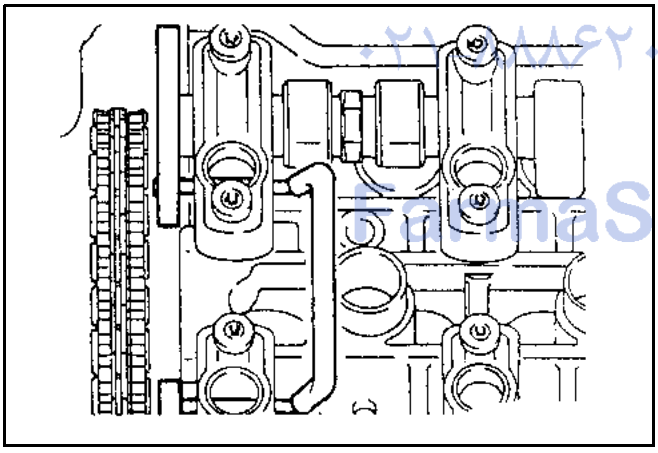
1. Turn the crankshaft and position the no.1 cylinder piston at ATDC 20°.

Notice: Turn the crankshaft in the direction of engine rotation.

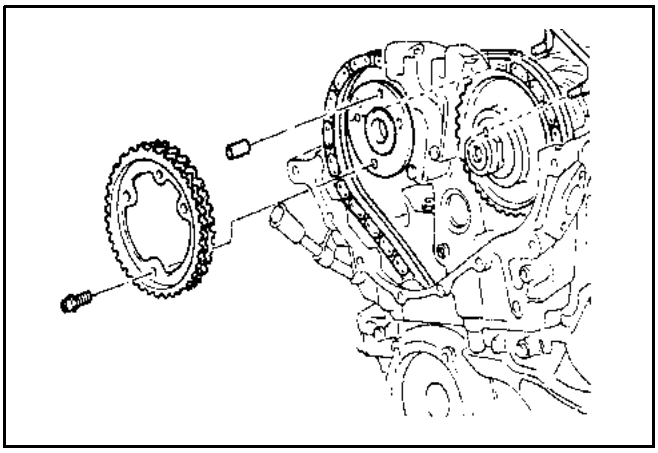
2. Remove the cylinder head front cover.



3. Put the alignment marks (arrows) on the camshaft sprocket and the timing chain.



4. Insert the holding pin 111 589 03 15 00 into the no.1 and no.6 bearing cap hole on camshaft to secure intake and exhaust camshaft.
5. Remove the chain tensioner.



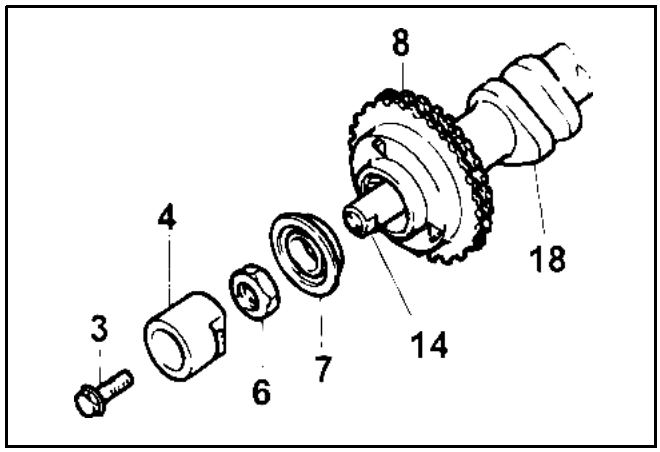
6. Unscrew the exhaust sprocket bolt and remove the exhaust camshaft sprocket.

Installation Notice

Tightening Torque	1st step: 18 - 22 N•m (13 - 16 lb-ft)
	2nd step: 60° ± 5°

Notice: The flange bolt is designed to be used only once, so always replace with new one.

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7. Unscrew the bolt (3) from the armature (4) and remove the roll pin, and remove the armature.

Installation Notice

Tightening Torque	35 N•m (26 lb-ft)

8. Unscrew the nut (6) and remove the seal cover (7).

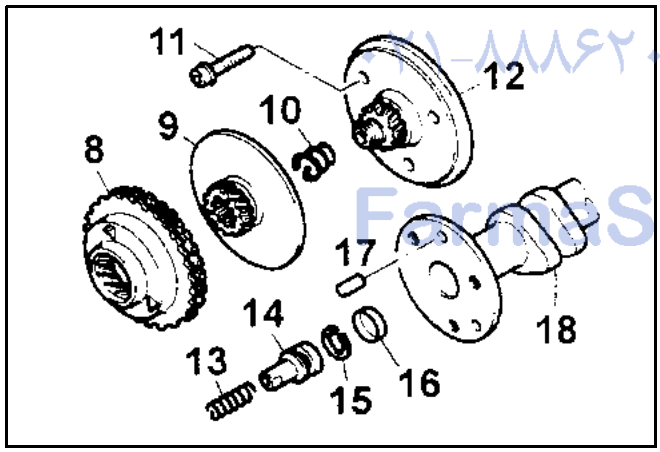
Installation Notice

Tightening Torque	60 - 70 N•m (44 - 52 lb-ft)

Notice: Put the locking slot of nut toward armarture.

9. Take off the timing chain from intake camshaft sprocket.

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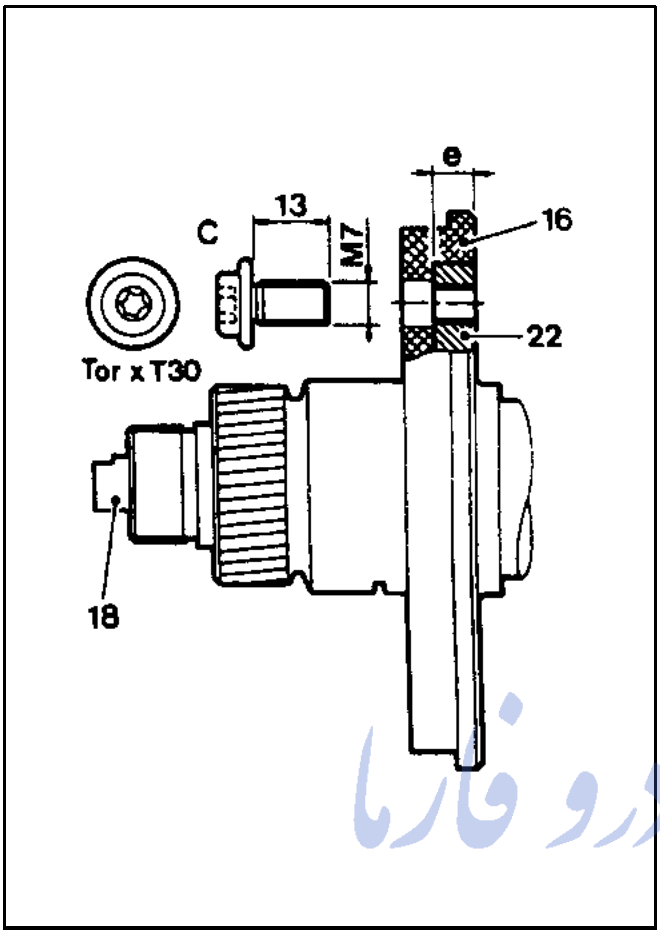
10. Remove the adjuster piston (9) and conical spring (10) from intake camshaft sprocket.
11. Unscrew the bolt (11) and remove the flange shaft.

Installation Notice

Tightening Torque	1st step: 18 - 22 N•m (13 - 16 lb-ft)
	2nd step: 60° ± 5°

Notice: The flange bolt is designed to be used only once, so always replace with new one.

12. Installation should follow the removal procedure in the reverse order.
13. Check and adjust the camshaft timing.



CAMSHAFT SPROCKET BOLT

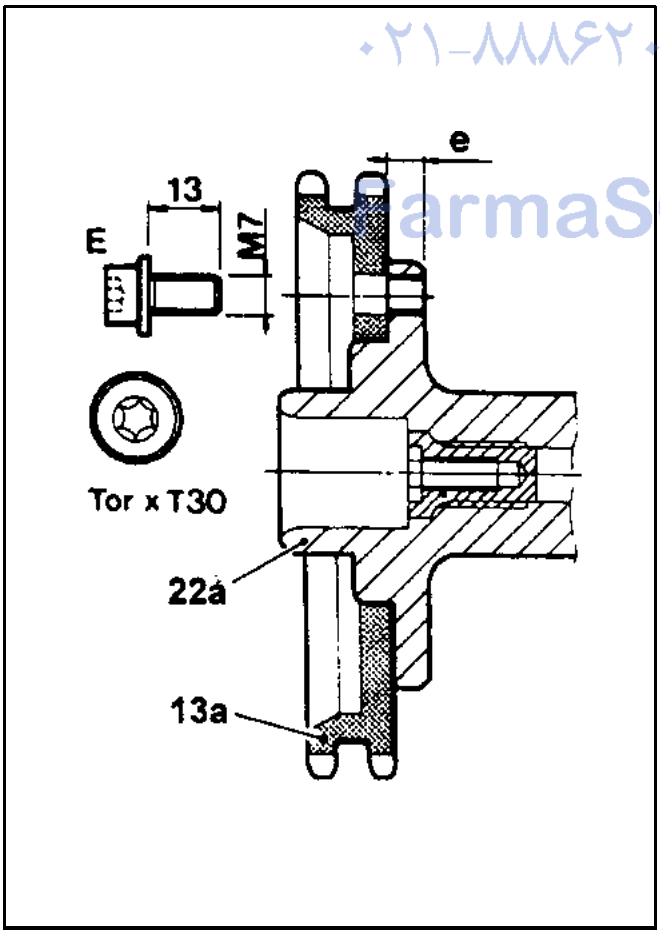
Intake Flange Shaft Bolt

Tightening Torque	1st step: 18 - 22 N•m (13 - 16 lb-ft)
	2nd step: 60° ± 5°

Notice: The sprocket bolts are designed to be used only once, so always replace with new one.

C. M7 x 13 Collar Bolt Torx-T30
e. 6.8 mm
16. Flange Shaft
18. Control Piston
22. Intake Camshaft

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Exhaust Camshaft Sprocket Bolt

۰۲۱-۸۸۸۶۲۰۸۵ تلفن شبانه روزی
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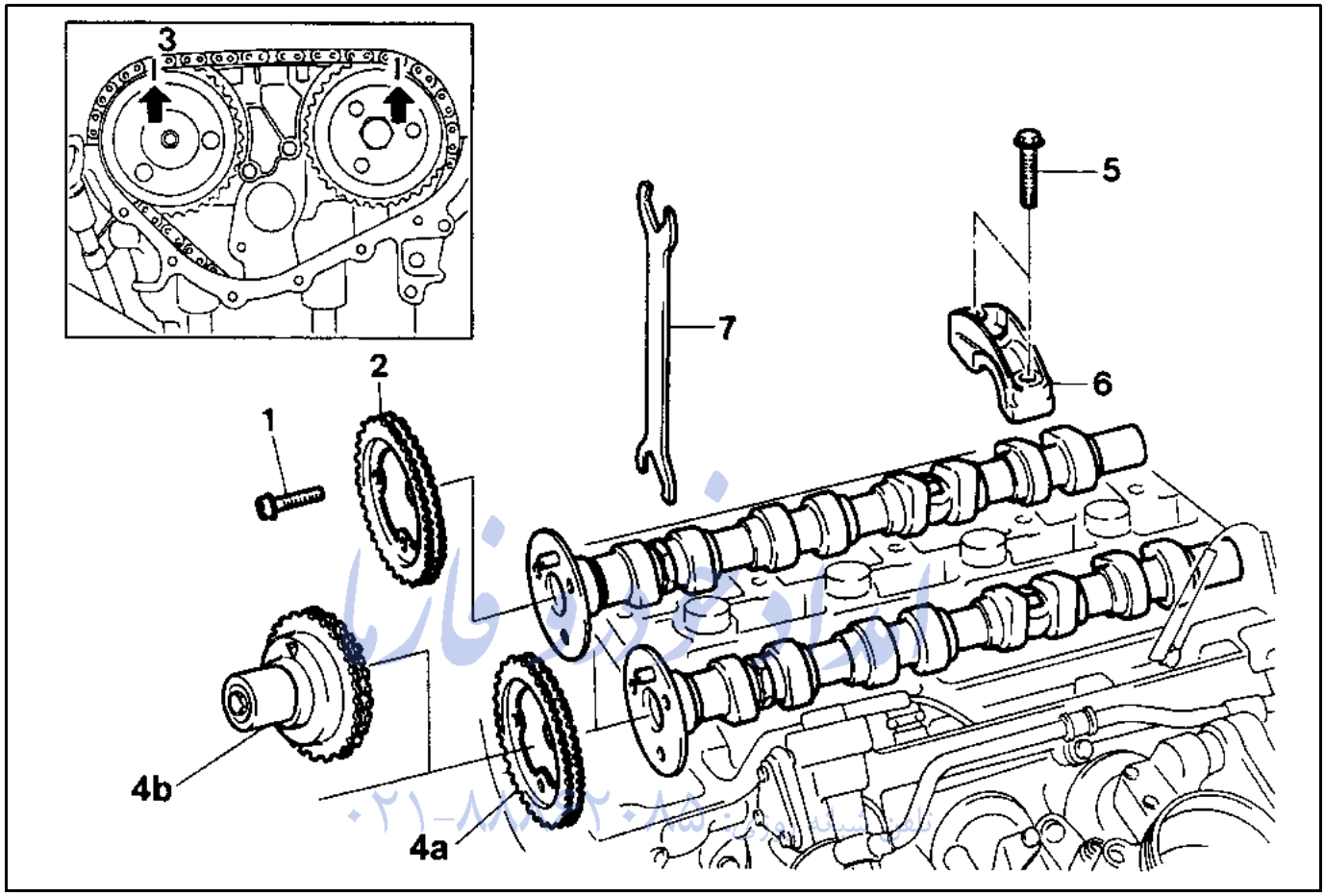
Tightening Torque	1st step: 18 - 22 N•m (13 - 16 lb-ft)
	2nd step: 60° ± 5°

Notice: The sprocket bolts are designed to be used only once, so always replace with new one.

E. M7 x 13 Collar Bolt Torx-T30
e. 6.8 mm
13a. Camshaft Sprocket
22a. Exhaust Camshaft

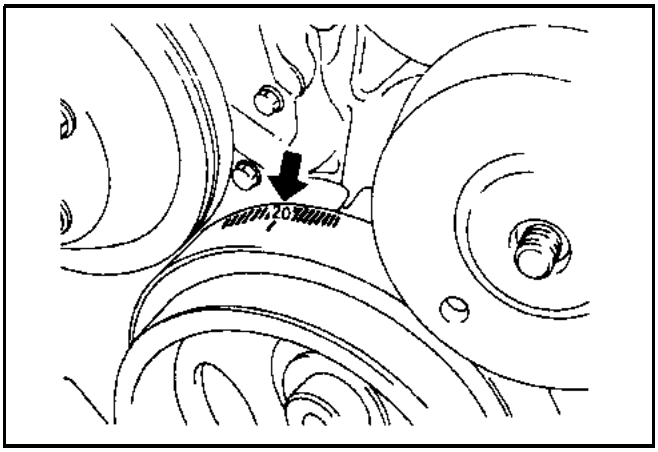
CAMSHAFT

Preceding Work: Removal of cylinder head cover
Removal of camshaft adjust actuator and cylinder head front cover



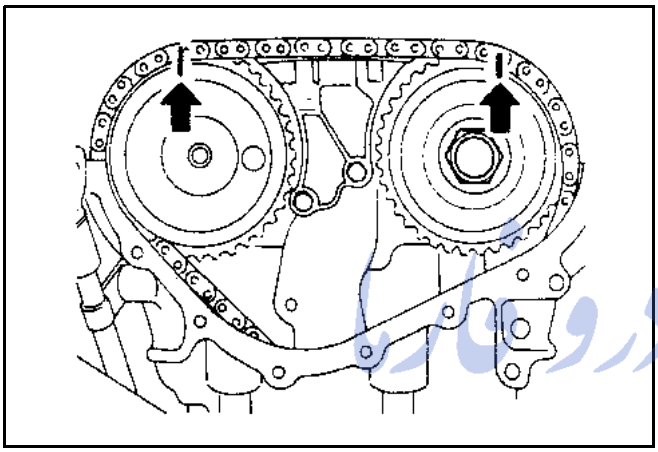
1 Bolt (M7 X 13, 3 pieces)
. . . . . 1st Step 18-22 N•m (13-16 lb-ft)
2nd Step 60° ± 5° Rotation Added
2 Exhaust Camshaft Sprocket
3 Timing Chain
4a Intake Camshaft Spocket (E20)
4b Camshaft Adjuster and Camshaft Sprocket (E23)
5 Bearing Cap Bolt (20 pieces)
. . . . . 22.5-27.5 N•m (16.6-20.3 lb-ft)
6 Camshaft Bearing Cap
7 Wrench

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Removal & Installation Procedure

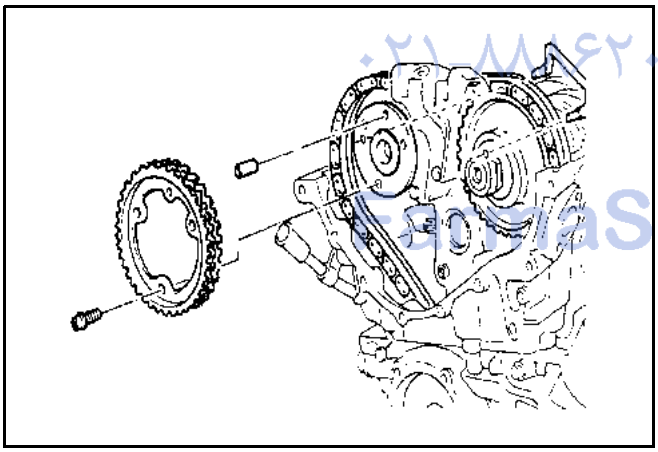
1. Turn the crankshaft and position the no.1 cylinder piston at ATDC20°.



2. Put the alignment marks (arrows) on the camshaft sprocket and the timing chain.
3. Remove the chain tensioner.

Installation Notice

Tightening Torque	Screw Plug	40 N•m (30 lb-ft)
	Tensioner Assembly	72 - 88 N•m (53 - 65 lb-ft)



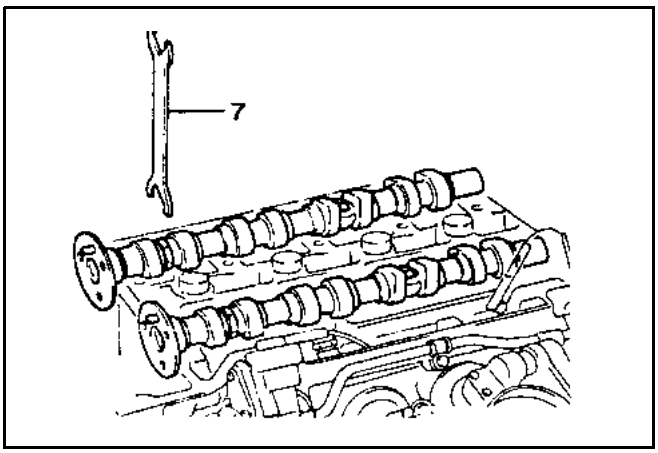
4. Remove the exhaust camshaft sprocket.

Notice

Tightening Torque	1st step: 18 - 22 N•m (13 - 16 lb-ft)
	2nd step: 60° ± 5°

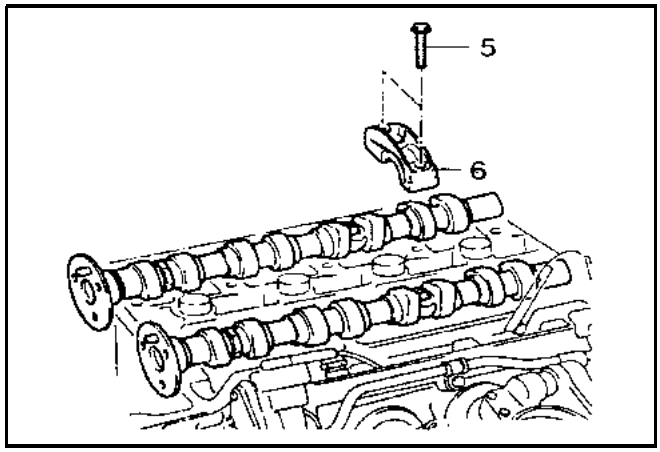
Notice: The sprocket bolt is designed to be used only once, so always replace with new one.

5. Take off the timing chain from intake camshaft sprocket, and secure it not to fall down into the timing gear case.



6. Using the wrench (7), turn the camshaft until there is no resistence in camshaft bearing area.

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تلفن شبانه روزی ۰۲۱-۸۸۴۶۲۰۸۵
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7. Remove the bearing cap, and remove the intake and the exhaust camshaft.

Installation Notice

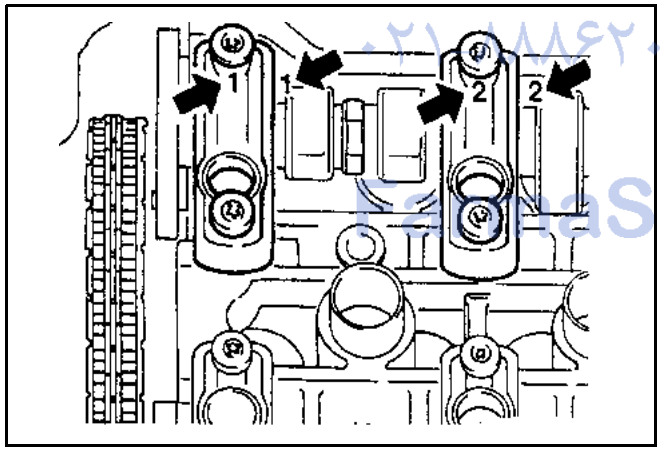
Tightening Torque	22.5 – 27.5 N•m (16.6 – 20.3 lb-ft)

Notice: Check the numbers on the bearing cap not to be mixed up.

8. Apply the engine oil on the valve tappet and camshaft bearing.
9. Installation should follow the removal procedure in the reverse order.

Notice:

- Base circle of cam should cantact with the valve tappet.
- Install the camshaft bearing caps according to the numbers on the cylinder head cast and bearing cap.

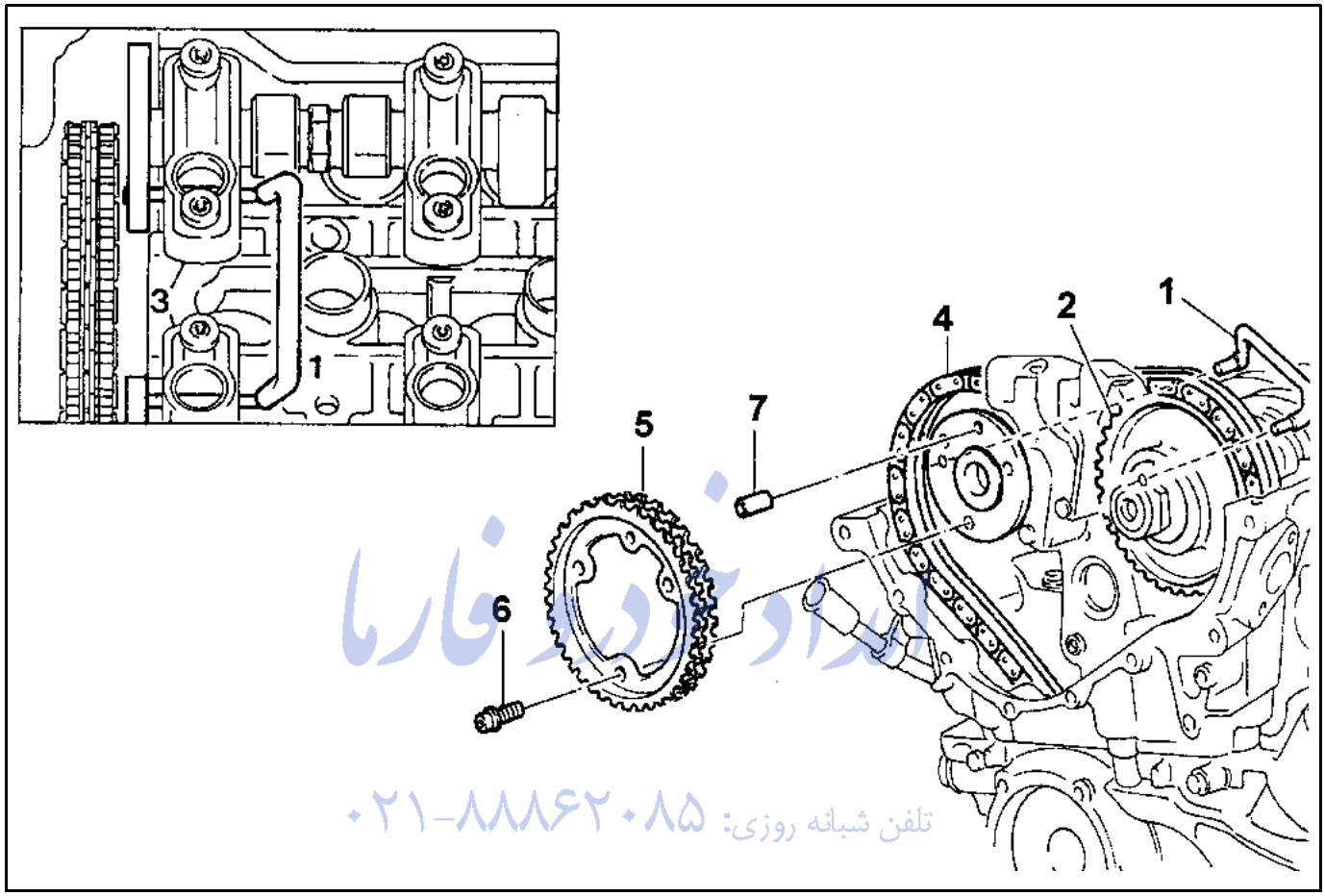


10. Check the camshaft timing position.

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تلفن شبانه روزی: ۰۲۱-۸۸۴۶۲۰۸۵
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CAMSHAFT TIMING POSITION

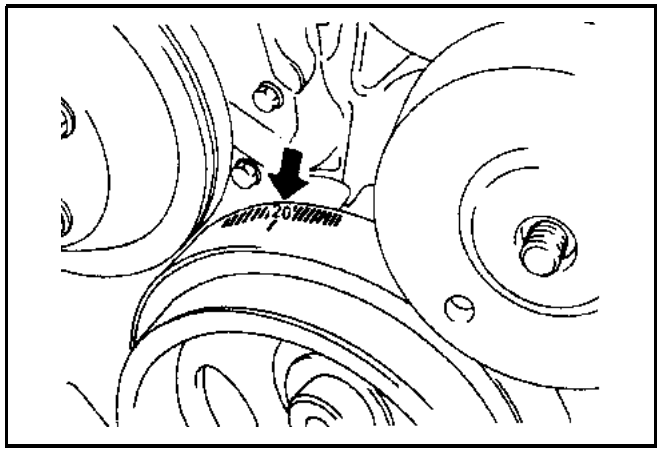
Preceding Work: Removal of cylinder head cover
Removal of cylinder head front cover

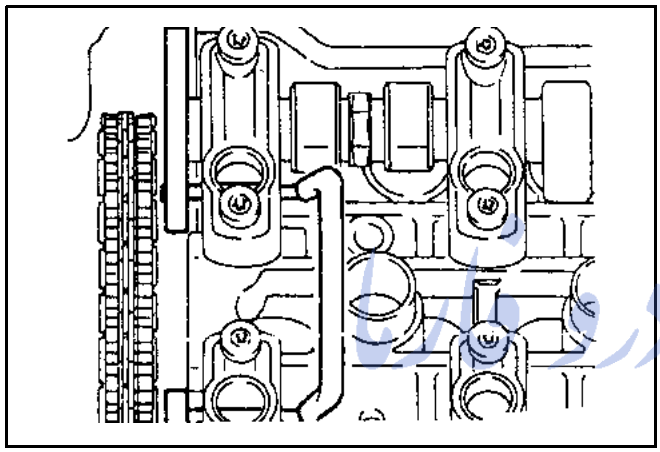


تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵

1 Holding Pin 111 589 03 15 00
2 Intake Camshaft Sprocket
3 Camshaft Bearing Cap
4 Timing Chain
5 Exhaust Camshaft Sprocket
6 Bolt (M7 X 13, 3 pieces) ..... 1st step 18-22 N•m (13-16 lb-ft)
2nd step 60° ± 5° rotation added
7 Strate Pin

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Tools Required

111 589 03 15 00 Holding Pin

Inspection Procedure

1. Position the NO.1 cylinder piston to ATDC 20° by turning the crankshaft.

Notice: When the ATDC 20° mark on vibration damper is aligned with timing gear case cover, the intake and exhaust cam of cylinder will make the slope to the center and will face up. In this way, the insert hole in NO.1 and NO.4 camshaft bearing cap will match in line with the flange hole for camshaft sprocket.

2. Check the timing as below procedure;
   - Check if the holding pin 111 589 03 15 00 can be inserted into the NO.1 and NO.4 bearing cap hole.
   - At this condition, check if the ATDC 20° mark on vibration damper aligns with the marker on the timing gear case.

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۰۲۱-۸۸۸۶۲۰۸۵
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Adjustment Procedure

1. Position the NO.1 cylinder to ATDC 20°.
2. Remove the chain tensioner.
3. Remove the exhaust camshaft sprocket.
4. Adjust the timing position with inserting the holding pin 111 589 03 15 00 into the NO.1 and NO.4 camshaft bearing cap hole and flange hole while rotating the camshaft by using wrench.
5. Install the chain to the intake camshaft sprocket.
6. Install the chain to the exhaust camshaft sprocket and tighten the bolt.

Installation Notice

Tightening Torque	1st step: 18 – 22 N•m (13 – 16 lb-ft)	
	2nd step: 60° ± 5°	

The sprocket bolt is designed to be used only once, so replace with new one.

7. Install the chain tensioner.

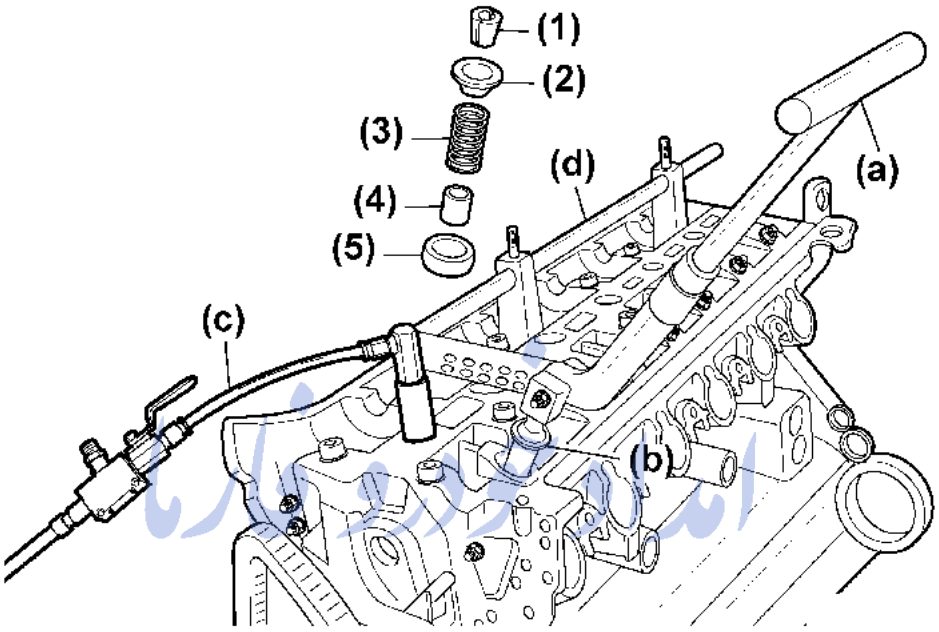
Installation Notice

Tightening Torque	Screw Plug	40 N•m (30 lb-ft)
	Tensioner Assembly	72 – 88 N•m (53 – 65 lb-ft)

8. Check the camshaft timing.

VALVE SPRING

Preceding Work: Removal of camshaft
Removal of spark plug

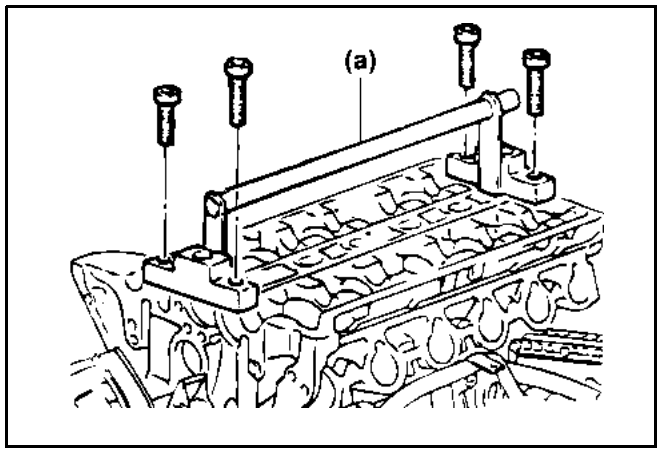


تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵

1 Valve Cotter
2 Valve Spring Retainer
3 Valve Spring
4 Valve Stem Seal
5 Lower Retainer

a Lever Pusher 111 589 18 61 00
b Thrust Piece 111 589 25 63 00
c Connecting Hose DW110-090
d Supporting Bar 111 589 01 59 00

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Tools Required

111 589 01 59 00 Supporting Bar
111 589 18 61 00 Lever Pusher
111 589 25 63 00 Thrust Piece
602 589 00 40 00 Engine Lock
DW110-090 Connecting Hose
DW110-100 Valve Tappet Remover

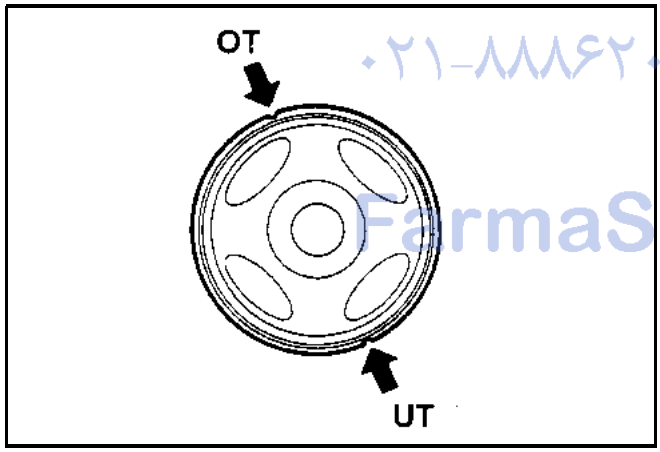
Removal & Installation Procedure

1. Place the supporting bar 111 589 01 59 00 (a) at the camshaft bearing cap and tighten them with the bearing cap bolt.

Installation Notice

Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)

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۰۲۱-۸۸۸۶۲۰۸۵ تلفن شبانه روزی:
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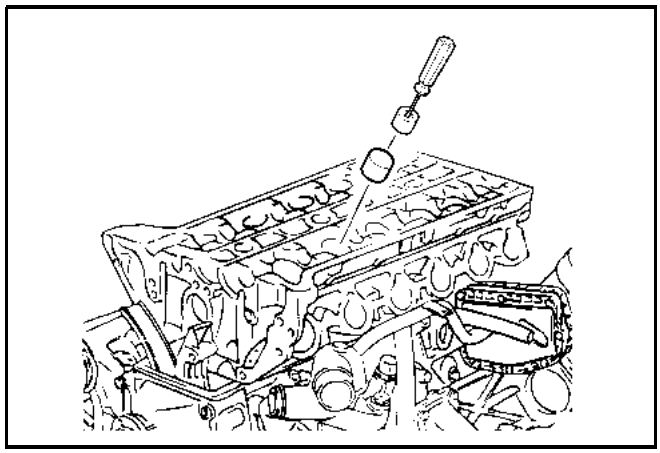


2. Turn the crankshaft to position the each cylinder piston at TDC.

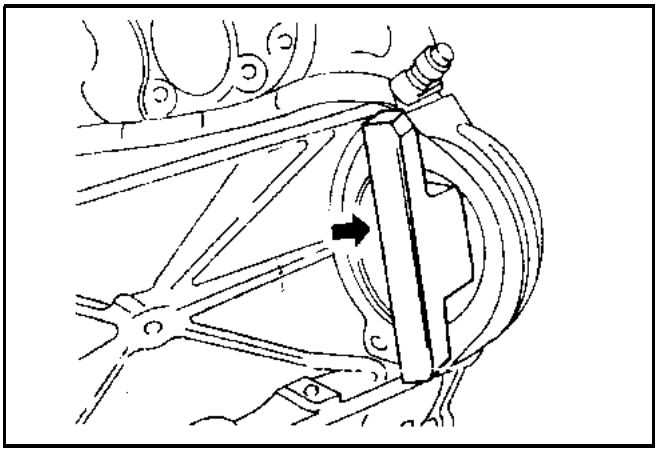
Mark on The Vibration Damper	Cylinder
OT	1, 4
UT	2, 3

Notice

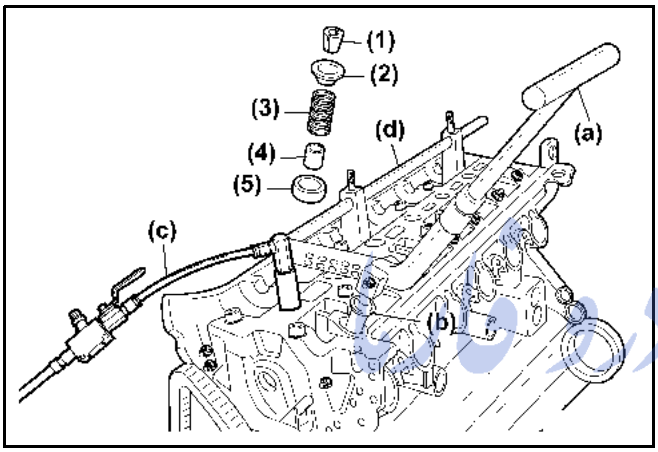
- Remove the valve spring only at TDC.
- Always rotate the crankshaft by holding the chain to prevent from timing chain damage and tangling, and for smooth rotation.



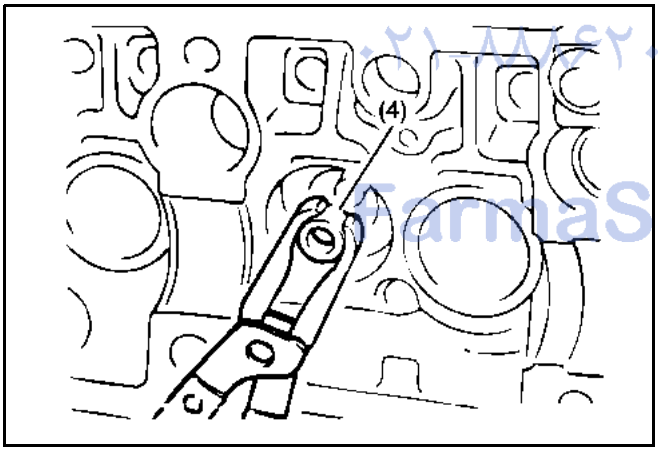
3. Remove the valve tappet using the valve tappet remover DW110-100.
4. Install the connecting hose DW110-090 (c) to the spark plug hole.



5. Install the engine lock 602 589 00 40 00 to the ring gear to prevent the crankshaft from rotating.
6. Blow up with compressed air.



7. Install the supporting bar 111 589 01 59 00 (d) and the lever pusher 111 589 18 61 00 (a).
8. Mount the thrust piece 111 589 25 63 00 (b) vertically to the valve spring retainer (2).
9. Press the valve spring (3) by using the lever pusher 111 589 18 61 00 (a).
10. Remove the valve cotter (1) using the pincette.
11. Remove the upper retainer (2) and the valve spring (3).



12. Remove the valve stem seal (4) and replace if necessary.

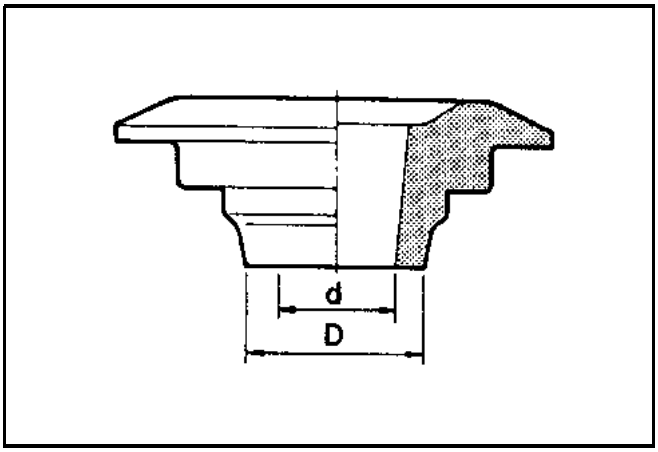
Notice: Check the valve stem seal for damage and replace if necessary.

13. Remove the lower retainer (5).

Notice: Check the retainer for damages and replace with a new one if necessary.

14. Installation should follow the removal procedure in the reverse order.

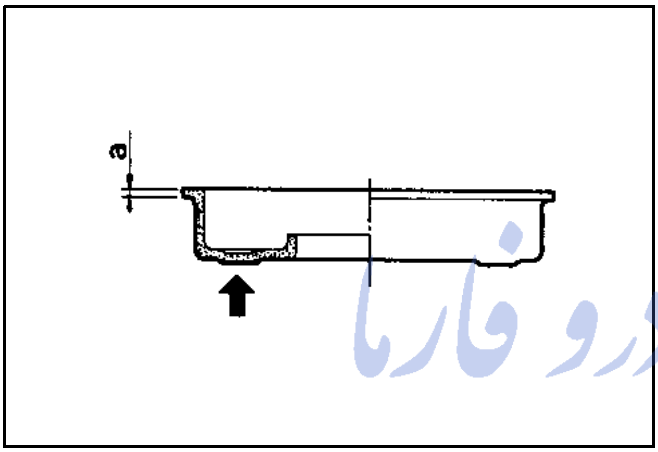
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تلفن شبانه روزی: ۰۲۱-۸۸۴۲۰۸۵
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Test (Upper and Lower Valve Tappet and Valve Cotter)

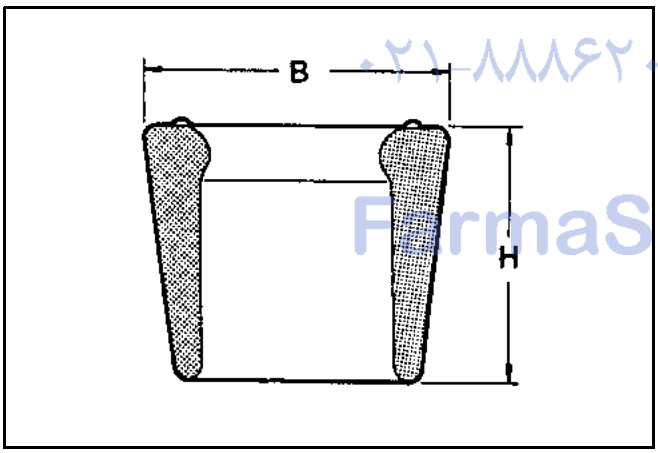
- Upper Valve Spring Retainer

Size (mm)	(d)	8.5
	(D)	12.3



- Lower Valve Spring Retainer

Thickness (mm)	(a)	0.8 - 1.0



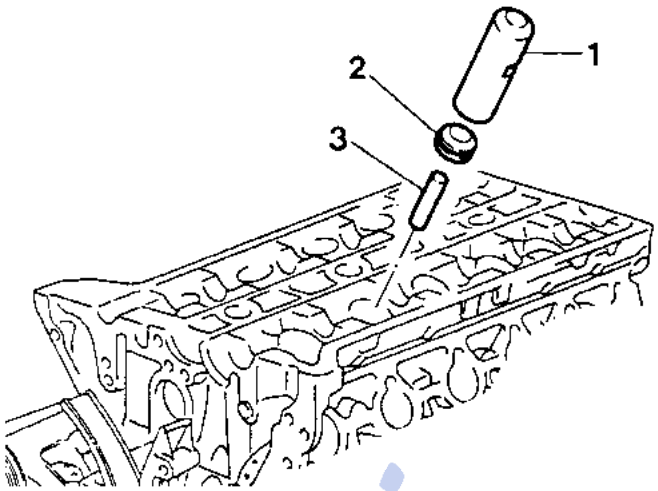
- Valve Cotter

Size (mm)	(B)	9.0
	(H)	9.2 - 9.8

امداد خودرو فارما
۰۲۱-۸۸۸۶۲۰۸۵ تلفن شبانه روزی
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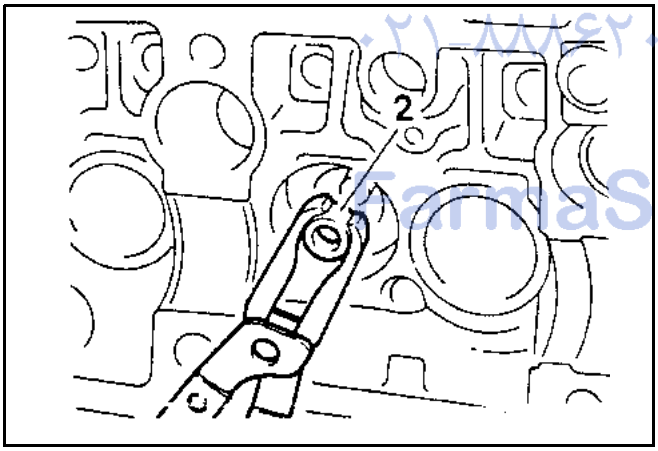
VALVE STEM SEAL

Preceding Work: Removal of valve spring



1 Drift 119 589 00 43 00
2 Valve Stem Seal
3 Protective Sleeve

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Tools Required

119 589 00 43 00 Drift

Replacement Procedure

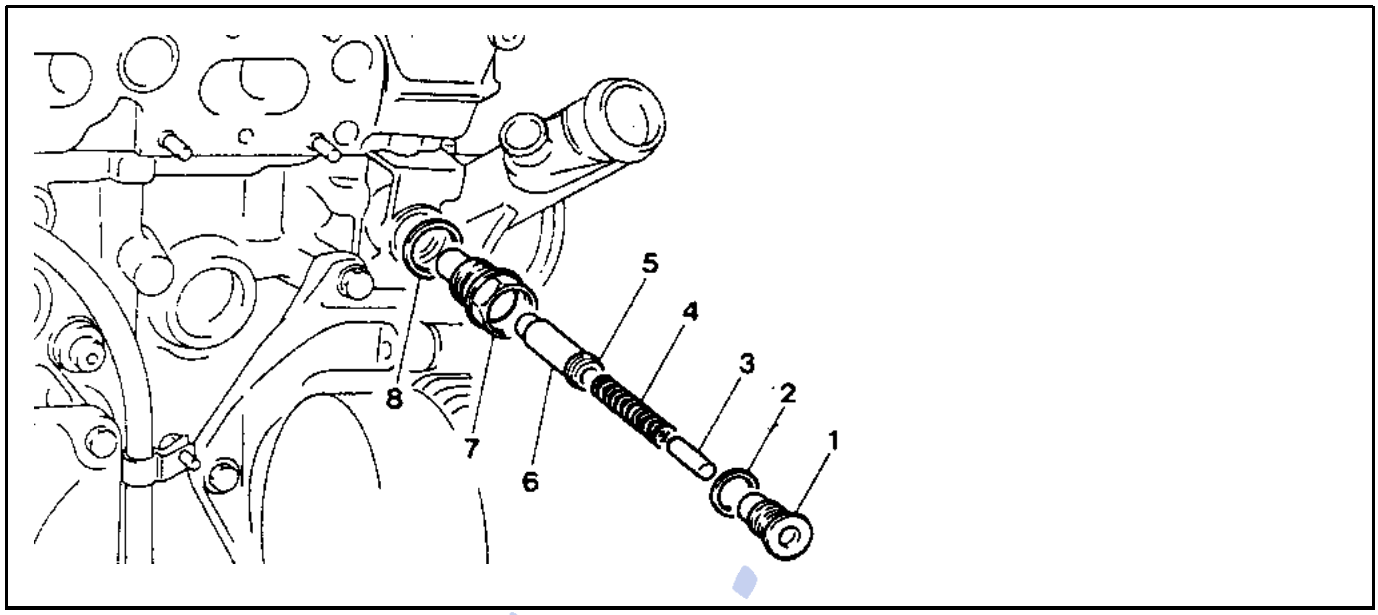
1. Remove the valve stem seal (2) using the pliers.

Notice: Check the valve stem seal for damage and replace if necessary.

2. Coat the valve stem seal with oil and assemble it with the protective sleeve.
3. Insert the valve stem seal by pressing it with the drift 119 589 00 43 00.

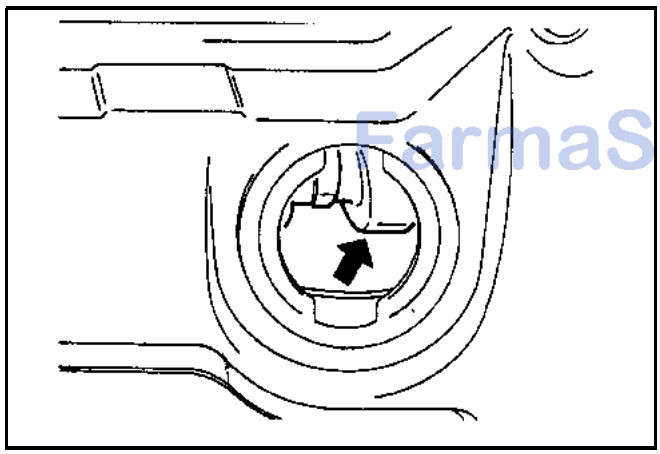
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CHAIN TENSIONER



1 Screw Plug . . . . . 40 N•m (30 lb-ft)
2 Seal
3 Filler Pin
4 Compression Spring
5 Snap Ring
6 Thrust Pin
7 Chain Tensioner Housing
. . . . . 72-88 N•m (53-65 lb-ft)
8 Seal

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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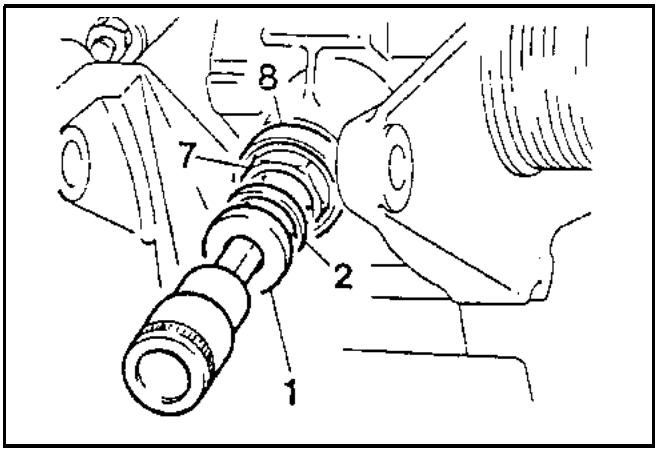
Removal Procedure

1. Position the number 1 cylinder to ATDC 20°.

Notice: Remove the oil filler cap at adjustment position, and check whether the intake camshaft cam's lobe (arrow) stays in the upper side.

2. Cover the generator with a clean cloth.
3. Release the tension by unscrewing the screw plug once.

Notice: In case that the tension is reduced by unscrewing the screw plug, reinstall after completely removing the chain tensioner. If the chain tensioner is tightened again without completely reducing its tension, then the snap ring doesn't return to the original position and the tension gets exceeded.

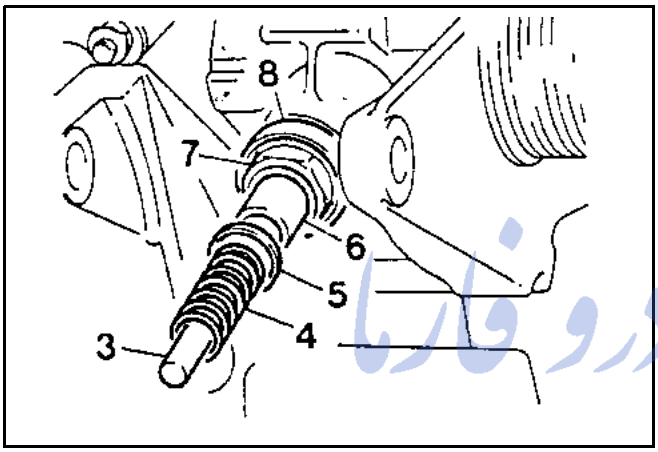


4. Carefully unscrew the screw plug (1), and remove the seal (2).

Notice

- For the removal of screw plug, be careful that it can be jumped out due to the force of compression spring.
- Remove the screw plug only when the seal and compression spring are damaged.

5. Carefully remove the filler pin (3), compression spring (4), snap ring (5), and the thrust pin (6).



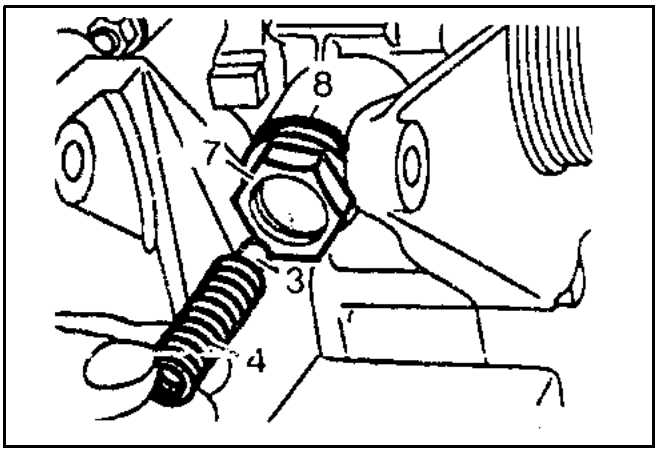
6. Remove the chain tensioner housing (7) and the seal (8).

امداد خودرو فارما
۰۲۱-۸۸۸۶۲۰۸۵
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Installation Procedure

1. Connect the thrust pin (6) and the snap ring (5) to the chain tensioner housing (7).

Notice: When connecting the thrust pin, push in the thrust pin far enough so that it doesn't protrude at the chain tensioner housing.

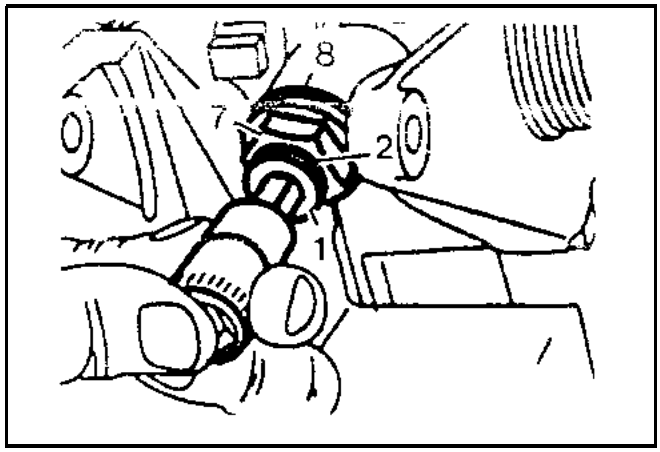


2. Install the chain tensioner housing (7), thrust pin (6), snap ring (5), and the seal (8).

Installation Notice

Tightening Torque	72 - 88 N•m (53 - 65 lb-ft)

3. Insert the compression spring (4) with the filler pin (3) into chain tensioner housing.



4. Lightly apply the grease to the seal (2) and install the screw plug (1).

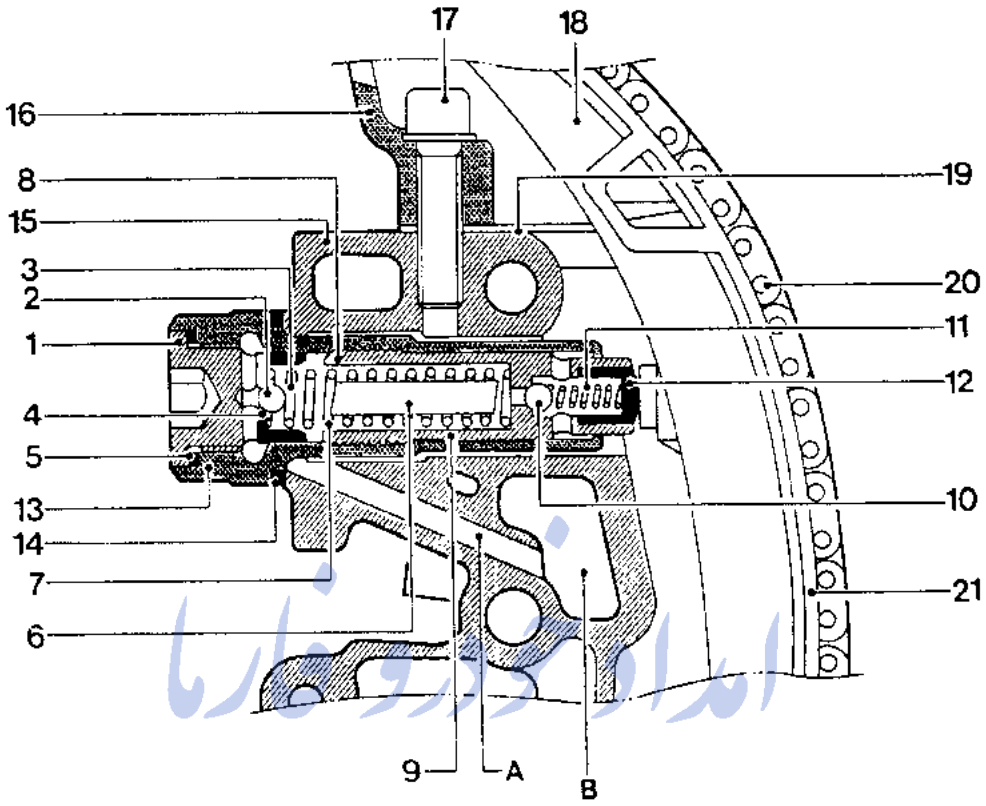
   Installation Notice

Tightening Torque	40 N•m (30 lb-ft)

5. Check for leaks by operating the engine.

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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Sectional View



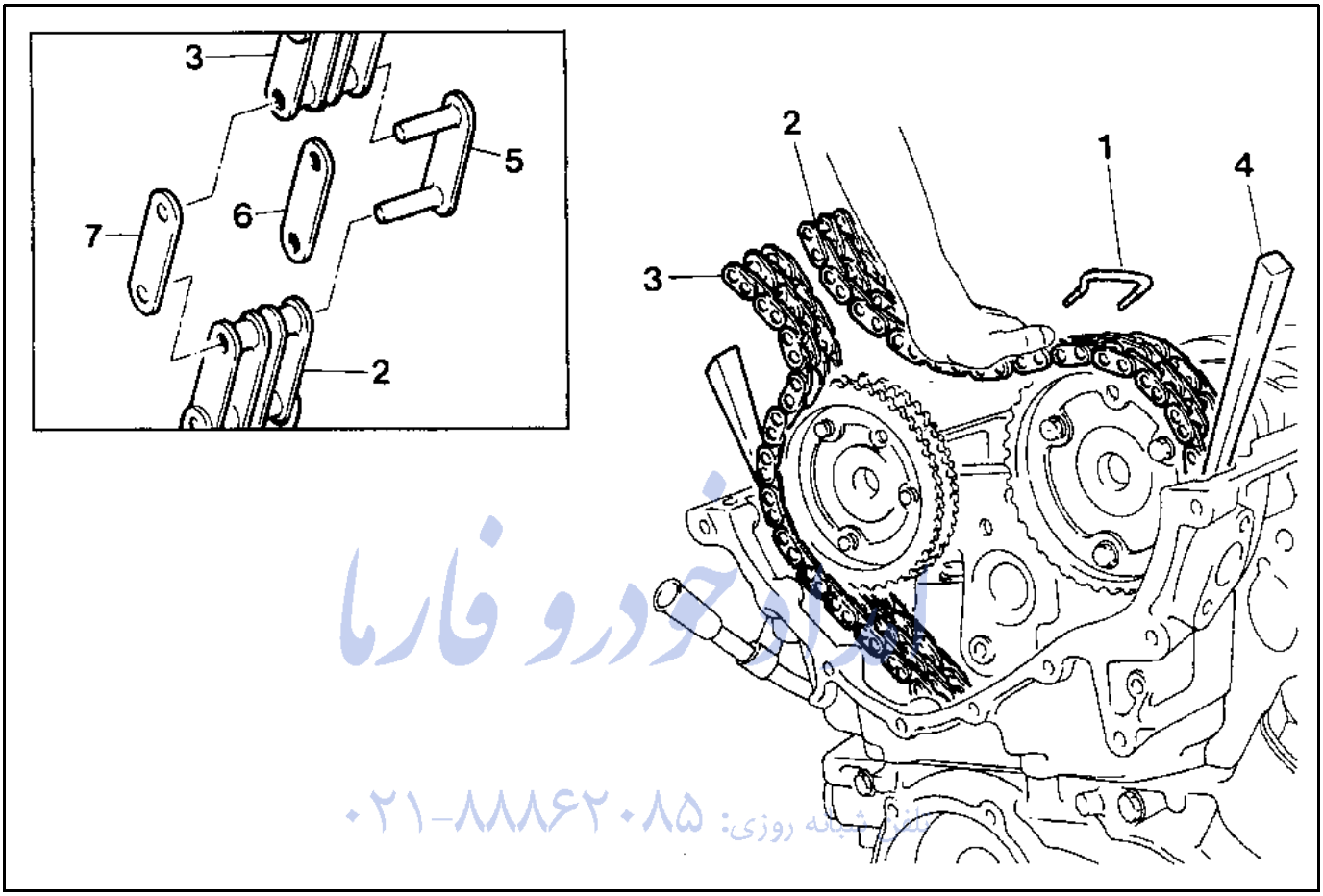
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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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1 Screw Plug
2 Ball (Nonreturn Valve)
3 Compression Spring
4 Ball Guide
5 Seal (Aluminum)
6 Filler Pin
7 Compression Spring
8 Snap Ring
9 Thrust Pin
10 Ball (Nonreturn Valve)
11 Compression Spring
12 Thrust Piece
13 Chain Tensioner Housing
14 Seal
15 Timing Gear Case Cover
16 Cylinder Head
17 Bolt / Washer
18 Tensioning Rail
19 Cylinder Head Gasket
20 Timing Chain
21 Tensioning Rail Base (Sliding Surface)

A Oil Supply Hole
B Chain Tensioner Oil Storage Hole

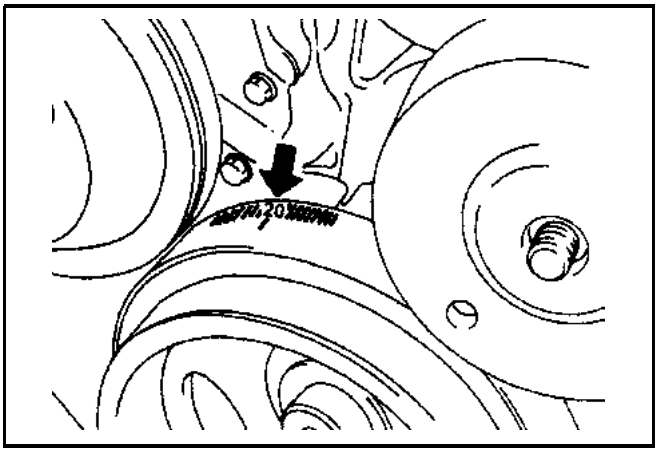
TIMING CHAIN

Preceding Work: Removal of cylinder head cover
Removal of spark plug



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1 Pin
2 New Timing Chain
3 Timing Chain (Used)
4 Wedge
5 Link
6 Center Plate
7 Outer Plate



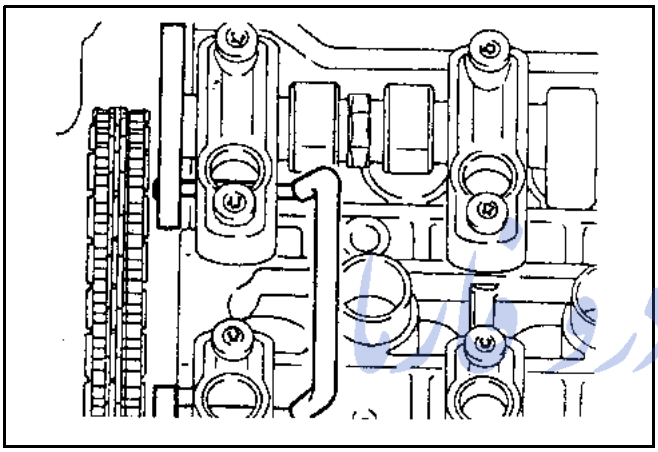
Tools Required

000 589 58 43 00 Chain Assembly

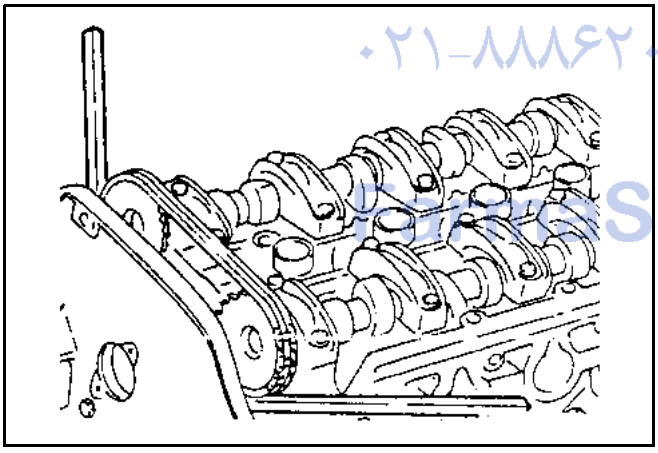
111 589 03 15 00 Holding Pin

Replacement Procedure

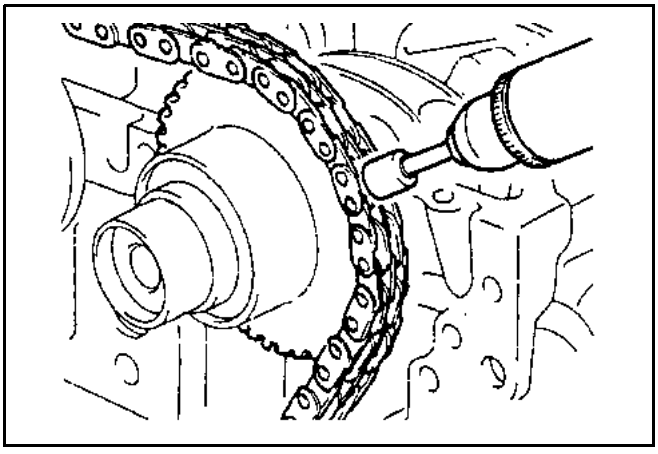
1. Position the NO.1 cylinder to ATDC 20°.



2. Insert the holding pin 111 589 03 15 00 to the intake and exhaust camshaft flange not to rotate camshaft.
3. Remove the chain tensioner.

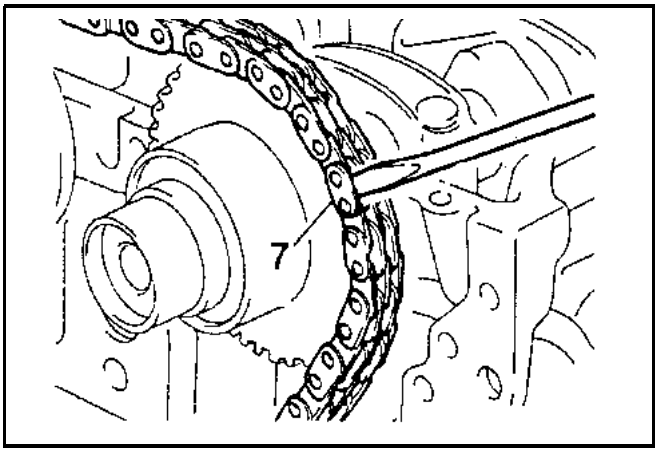


4. Mount the wedges to both sides of the camshaft sprocket as shown in the figure.

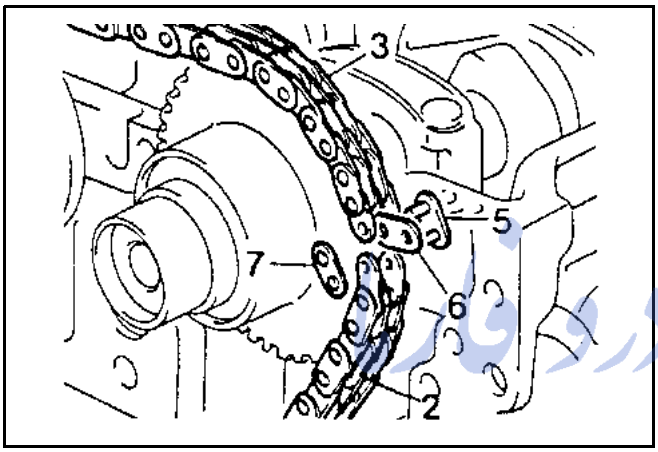


5. Cover the chain housing with a clean cloth, and grind off the timing chain pin from the intake camshaft sprocket with the grinder.

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۰۲۱-۸۸۸۶۲۰۸۵ تلفن شبانه روزی
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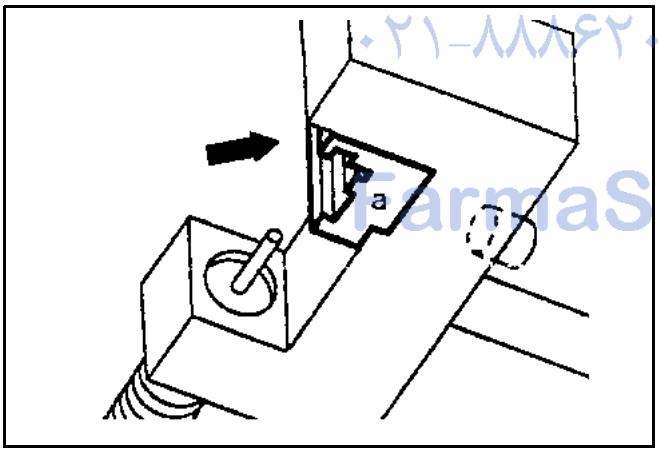
6. Remove the outer plate (7) with the screw driver and remove the link (5).



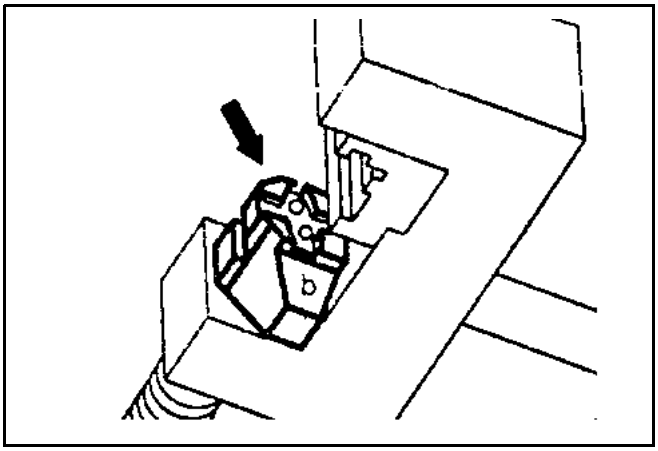
7. Connect the new timing chain (2) to the used timing chain (3) with the link (5), center plate (6, thickness 1.6mm), and the outer plate (7).
8. Rotate the crankshaft in the direction if engine revolution by pressing the new timing chain against the exhaust camshaft sprocket to prevent it to be tangled.

Notice: Be sure to remove the wedge before cranking the engine.

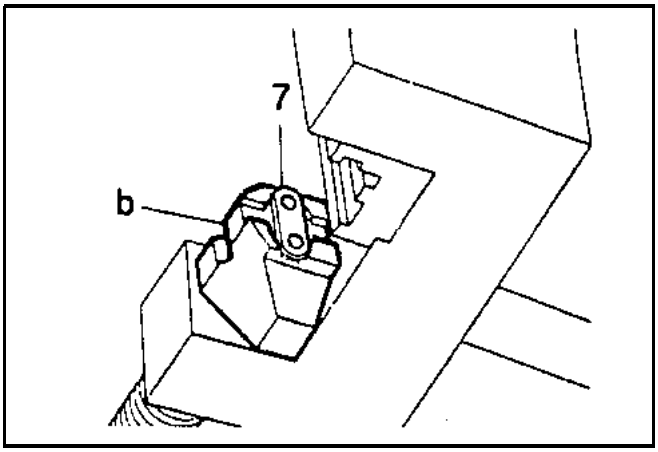
9. Take out the used timing chain out from the chain housing.
10. Connect both separators of the new timing chain with the link (5) and the center plate (6).



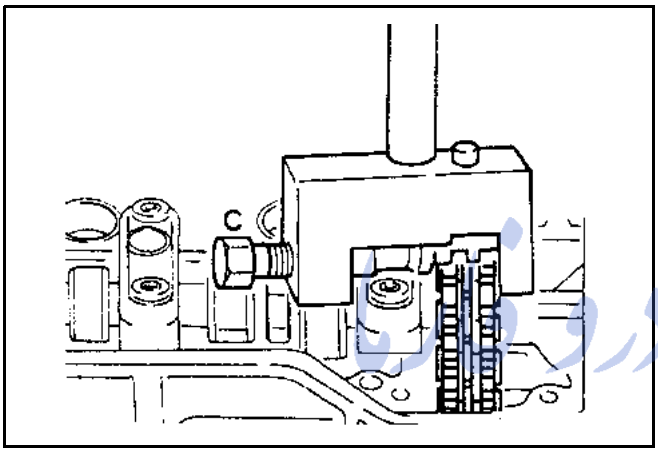
11. Install the jaw (a) and the thrust piece (b) to the assembly tool as shown in the figures.



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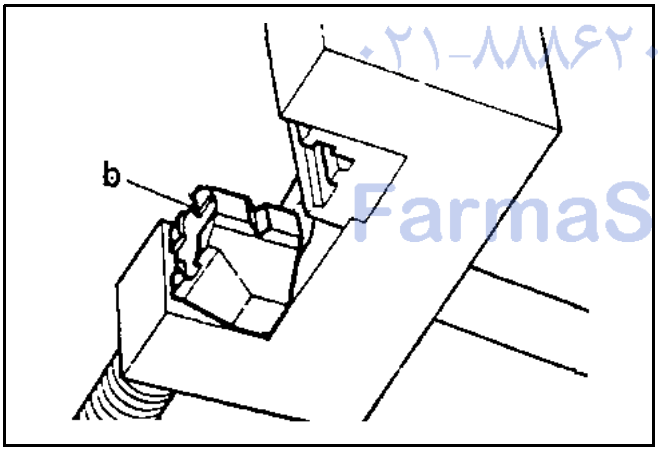


12. Place the outer plate (7, thickness 1.2mm) inside the thrust piece (b).

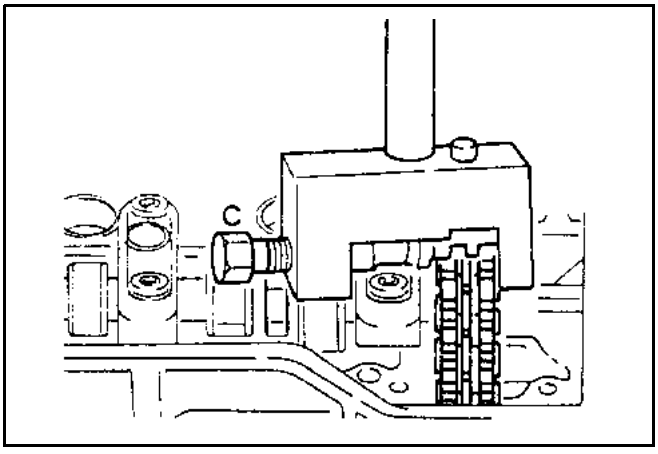


13. Install the chain assembly 000 589 58 43 00 above the link and tighten the spindle (c) until a block is felt.
14. Place the chain assembly 000 589 58 43 00.

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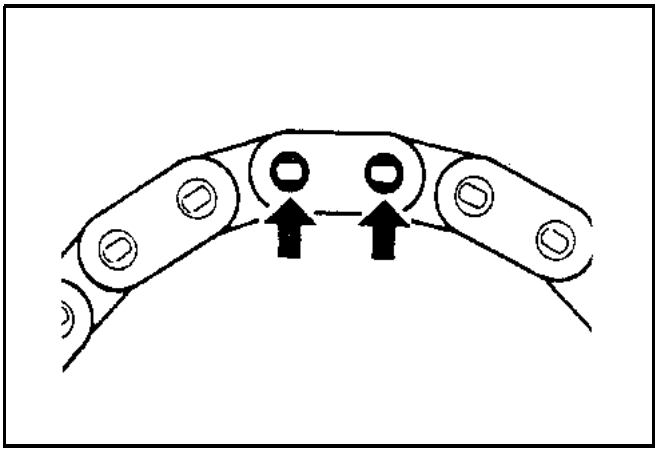
15. Replace the thrust piece (b) as shown in the figure.



16. Install the chain assembly 000 589 58 43 00 to the link pin and tighten the spindle (c).

Installation Notice

Tightening Torque	30 N•m (22 lb-ft)



17. Rivet the link pin.
    Check the condition and it again if necessary.
18. Install the chain tensioner.

Installation Notice

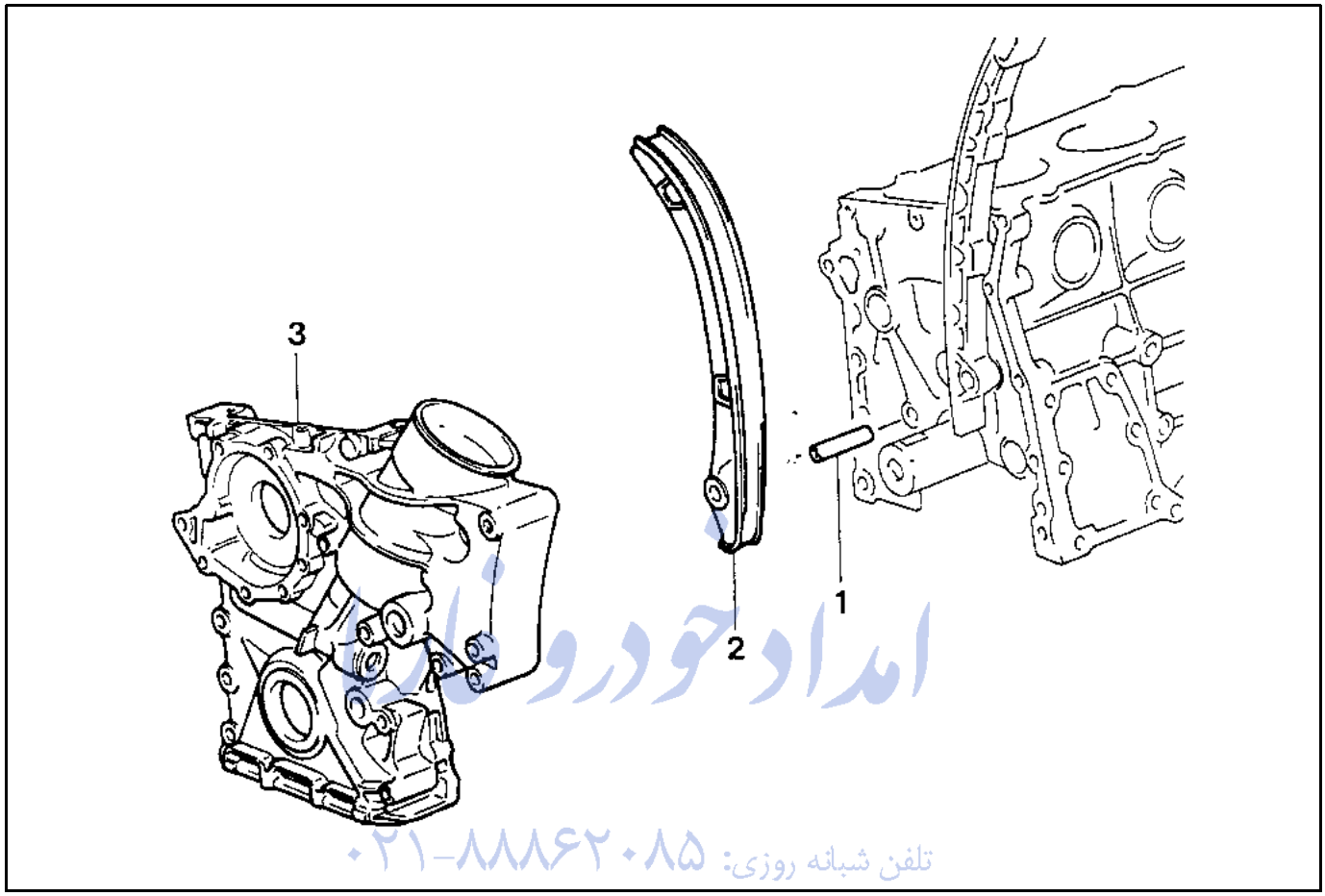
Tightening Torque	Screw Plug	40 N•m (30 lb-ft)
	Tensioner Assembly	72 - 88 N•m (53 - 65 lb-ft)

19. Check the camshaft timing position.

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TENSIONING RAIL

Preceding Work: Removal of cylinder head



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1 Sliding Rail Pin
2 Sliding Rail
3 Timing Gear Case Cover

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Removal & Installation Procedure

1. Remove the timing gear case cover (3).

Notice: Be careful not to damage the gasket.

2. Remove the sliding rail (1) from the sliding rail pin (2).

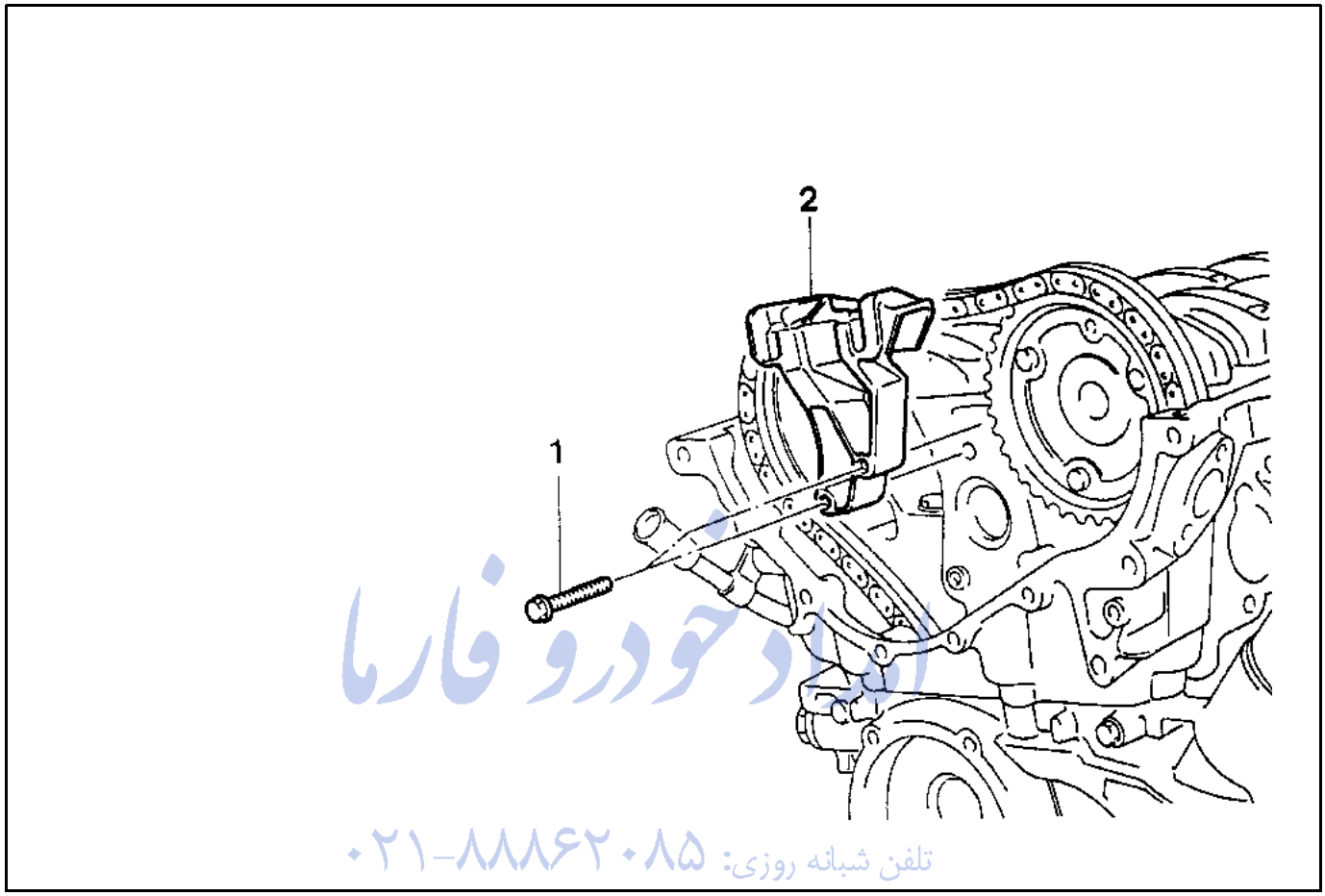
Notice

- Replace the plastic guide (2) if it is damaged.
- For installation, exactly align the plastic guide (2) with the sliding rail (1).

3. Installation should follow the removal procedure in the reverse order.

CYLINDER HEAD GUIDE RAIL

Preceding Work: Removal of cylinder head front cover

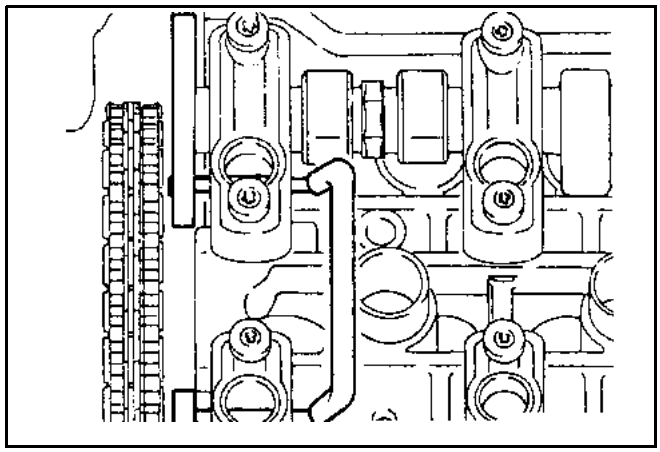


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1 Bolt (M6 X 45, 2 pieces) ..... 9-11 N•m (80-97 lb-in)

2 Guide Rail

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Tools Required

111 589 03 15 00 Holding Pin

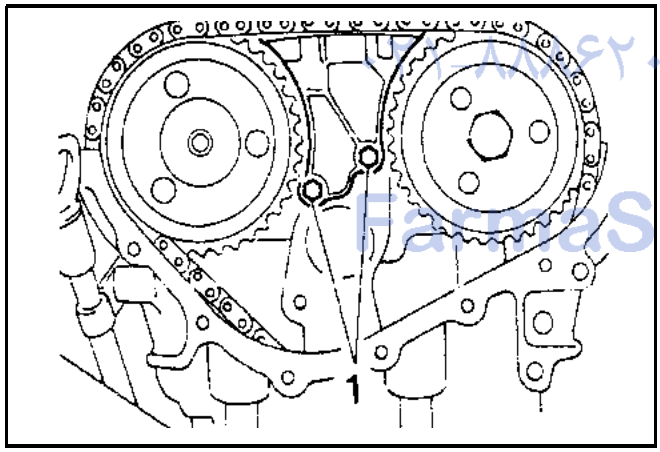
Removal & Installation Procedure

1. Position the number 1 cylinder to ATDC20° guide rail.
2. Install the holding pin 111 589 03 15 00 into the no.1 and no.6 bearing cap hole.
3. Remove the chain tensioner.

Installation Notice

Tightening Torque	Screw Plug	40 N•m (30 lb-ft)
	Tensioner Assembly	72 - 88 N•m (53 - 65 lb-ft)

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4. Unscrew the bolt (1) and remove the guide rail.

Installation Notice

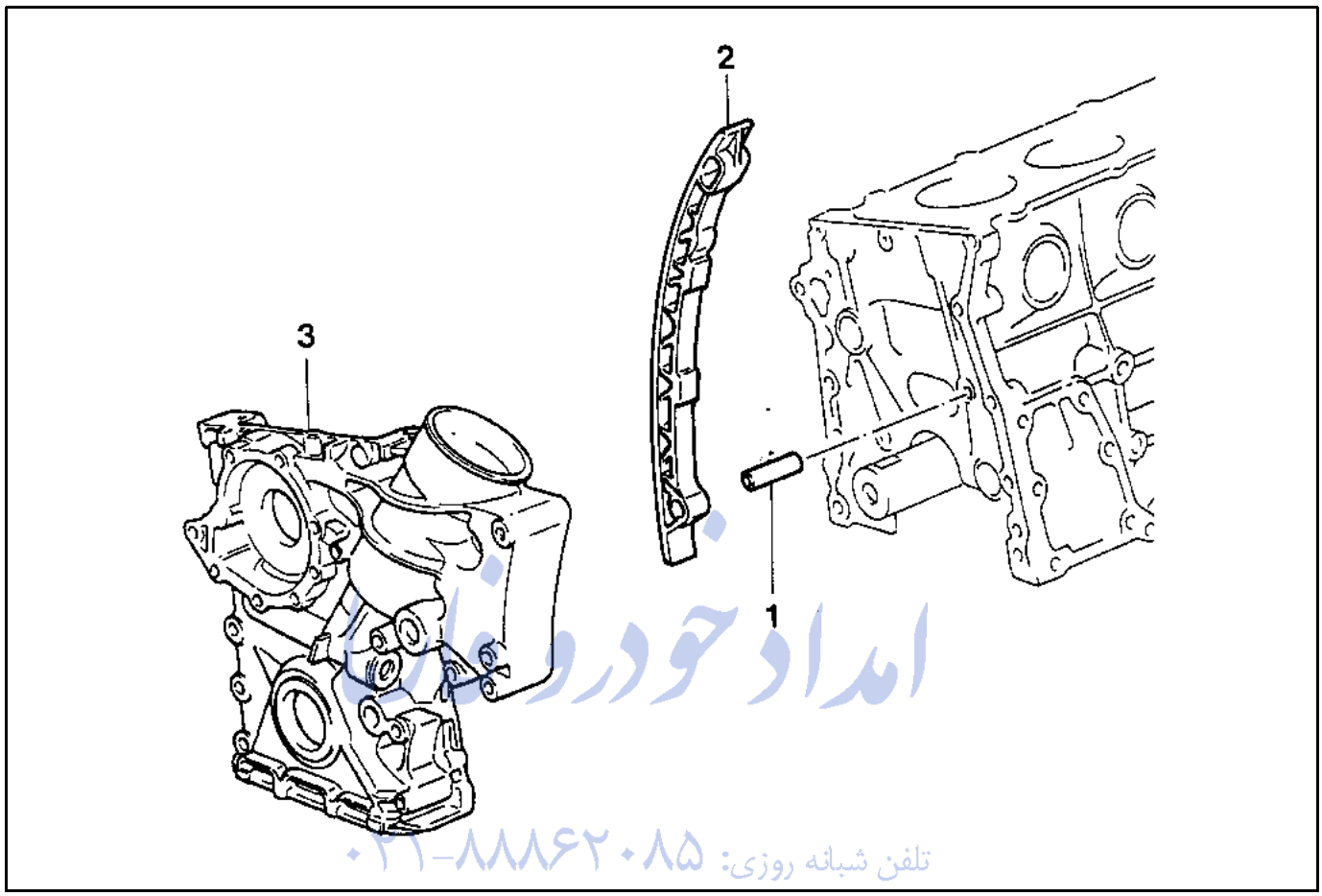
Tightening Torque	9 - 11 N•m (80 - 97 lb-in)

5. Installation should follow the removal procedure in the reverse order.

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CRANKCASE GUIDE RAIL

Preceding Work: Removal of timing gear case cover



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1 Guide Rail Pin
2 Guide Rail
3 Timing Gear Case Cover

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Removal & Installation Procedure

1. Remove the timing gear case cover (3).

Notice: Be careful not to damage the gasket when removing/installing the timing gear case cover.

2. Remove the guide rail (2) from the guide rail pin (1).

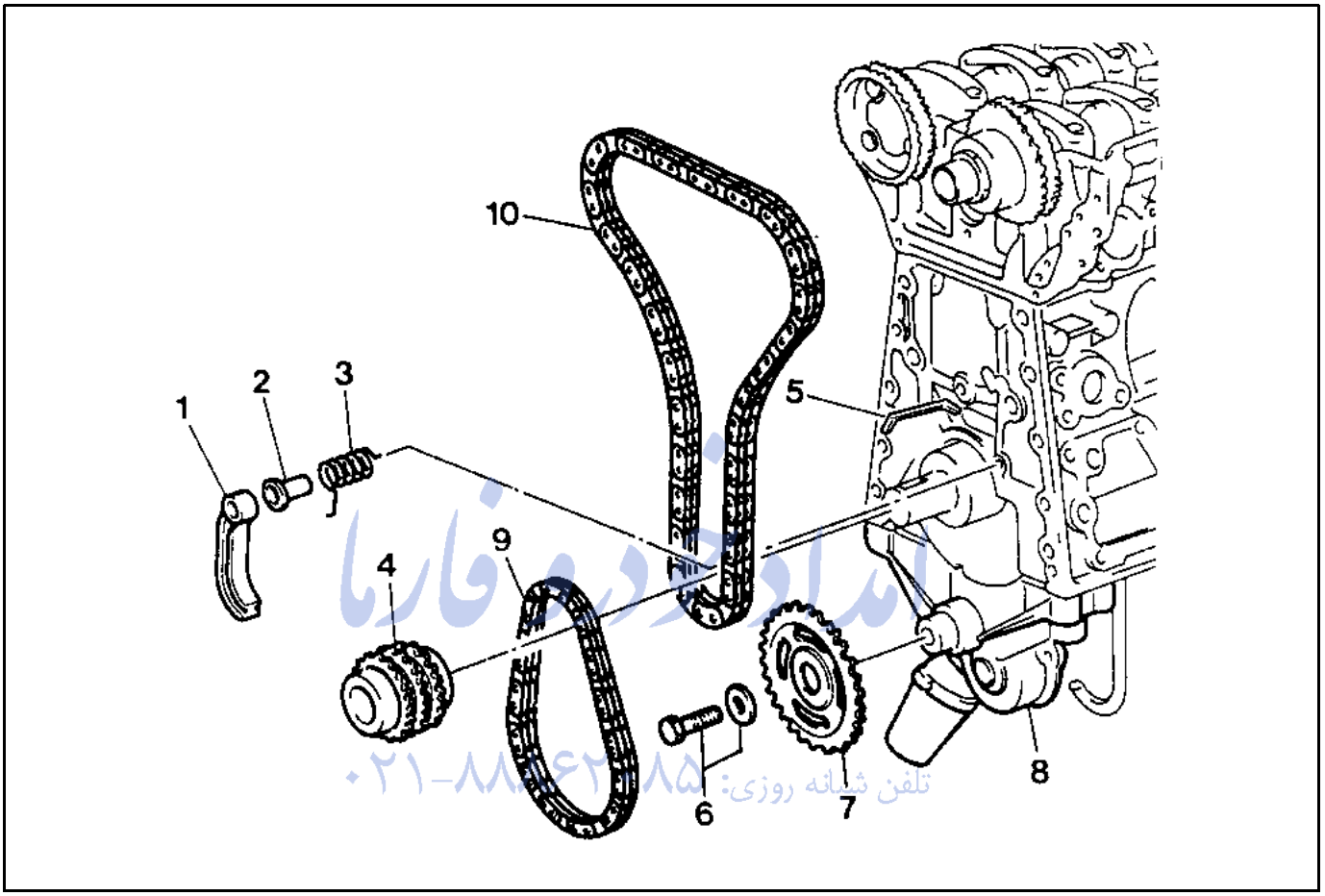
Notice:

- Replace the plastic guide (2) if damaged.
- Connect the plastic guide (2) and the guide rail (1) by aligning them accurately when installing.

3. Installation should follow the removal procedure in the reverse order.

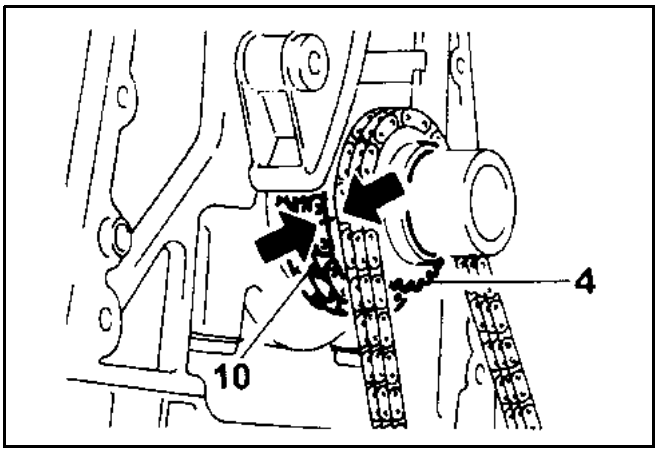
CRANKSHAFT SPROCKET

Preceding Work: Removal of oil pan
Removal of tensioning rail
Removal of crank case guide rail



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1 Oil Pump Chain Tensioner
2 Oil Pump Chain Bushing
3 Oil Pump Chain Spring
4 Crankshaft Sprocket
5 Key
6 Bolt (M8 x 20, 1 piece) / Washer ..... 29-35 N•m (21-26 lb-ft)
7 Oil Pump Sprocket
8 Oil Pump
9 Oil Pump Roller Chain
10 Timing Chain



Tools Required

615 589 01 33 00 Crankshaft Sprocket Puller

Removal & Installation Procedure

1. Put the assembly mark at the crankshaft sprocket (4) and the timing chain (10) with the paint (arrow).

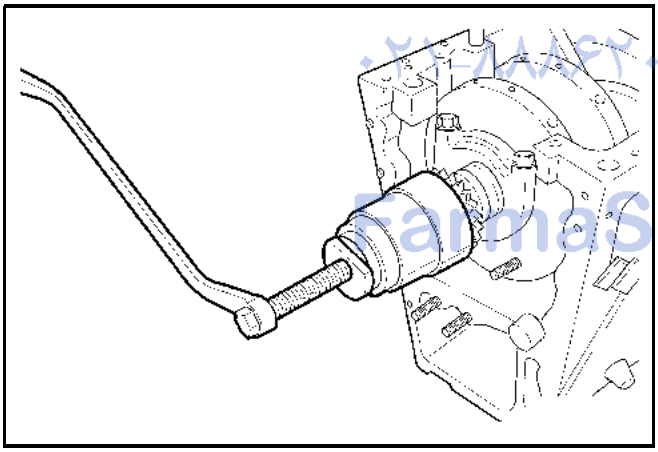
   Installation Notice

   Align the assembly marks on crankshaft sprocket and timing chain. Also, align the assembly marks on camshaft sprocket and timing chain when installing.
2. Unscrew the bolt (6) and remove the oil pump sprocket (7) from the oil pump.

   Installation Notice

Tightening Torque	29 - 35 N•m (21 - 26 lb-ft)

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3. Remove the oil pump roller chain (9).
4. Remove the oil pump chain tensioner (1), oil pump chain bushing (3), and the oil pump chain spring (2).
5. Remove the crankshaft sprocket (4) using crankshaft sprocket puller 615 589 01 33 00.

Notice:

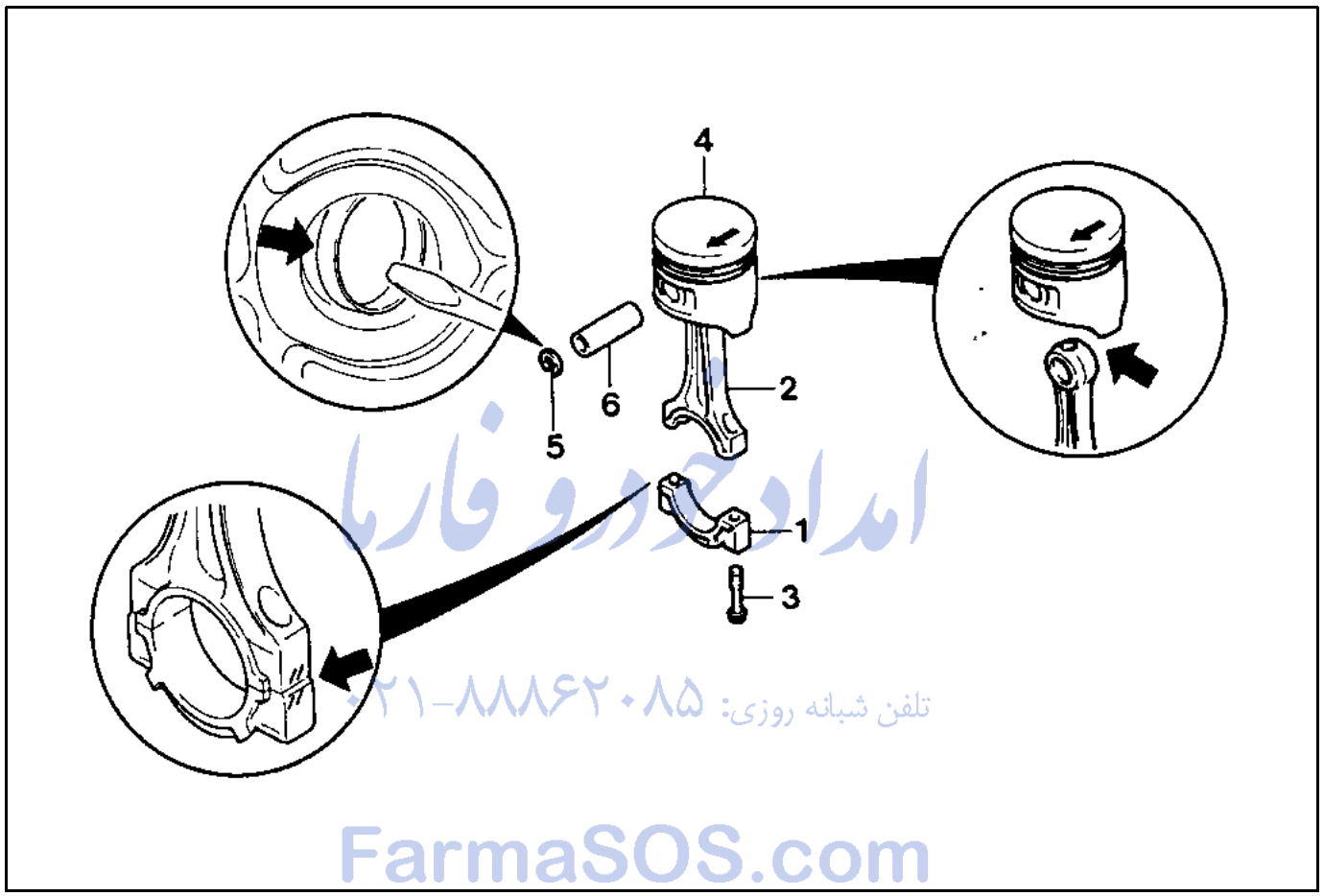
- Make sure not to lose the crankshaft pulley key (5) when removing.
- Install the crankshaft sprocket (4) after warming it up.

6. Installation should follow the removal procedure in the reverse order.

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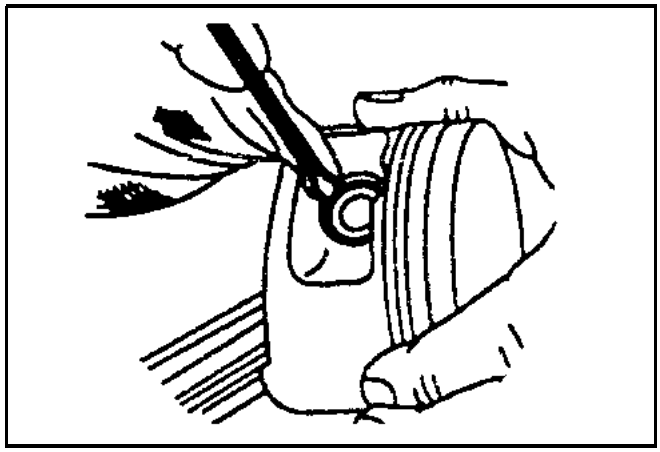
PISTON

Preceding Work: Removal of engine
Removal of cylinder head
Removal of oil pan
Removal of oil pump
Removal of baffle plate



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1 Connecting Rod Bearing Cap
2 Connecting Rod
3 Connecting Rod Bolt (M9 x 52, 8 pieces)
. . . . . 1st step 40 N•m (30 lb-ft)
2nd step 90°
4 Piston
5 Snap Ring
6 Piston Pin



Removal Procedure

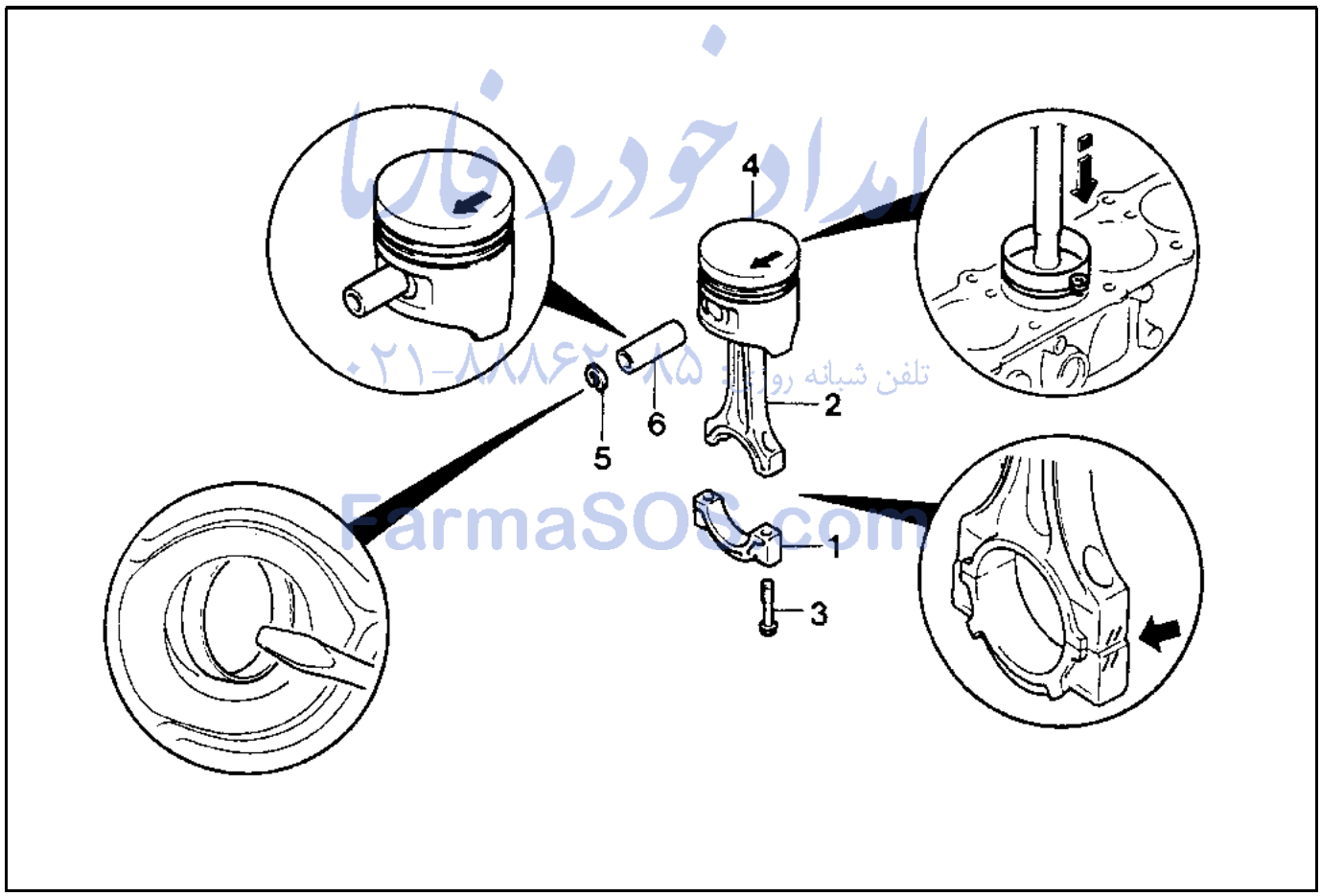
1. Unscrew the connecting rod bolt (3) and remove the cap.
2. Remove the connecting rod and the piston upward.

Notice: Make sure that the bearing cap and shell are not changed each other.

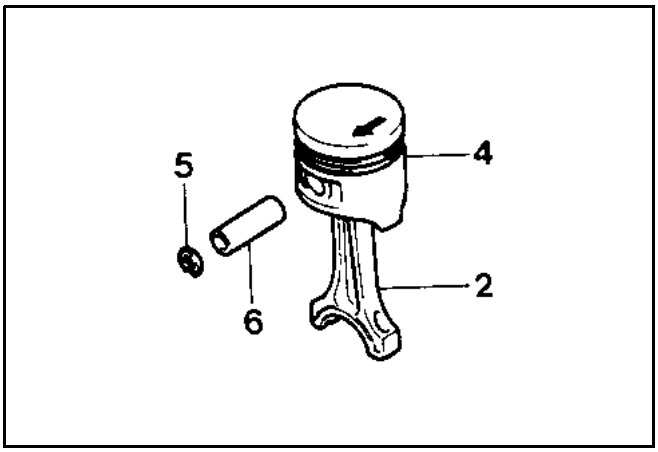
3. Remove the snap ring (5) and pull out the piston pin (6).

Notice: Remove the snap ring using a clean cloth as shown in the right picture so that the piston, piston ring, and the snap ring don't get damaged.

Installation Procedure



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1. Check the piston ring gap and apply the engine oil to the piston pin and the connecting rod bushing.
2. Connect the piston and the connecting rod by pressing in the piston pin (6) and install the snap ring to the groove.
3. Clean the cylinder bore, connecting rod bearing journal, connecting rod bearing shell and the piston and coat them with engine oil.
4. Install the piston ring.
5. Install the piston so that the arrow on the piston head faces to the forward of the vehicle.
6. After aligning the connecting rod and the bearing cap mark (// or a number), tighten the bolts.

Installation Notice

Tightening Torque	1st step: 40 N•m (30 lb-ft)
	2nd step: 90°

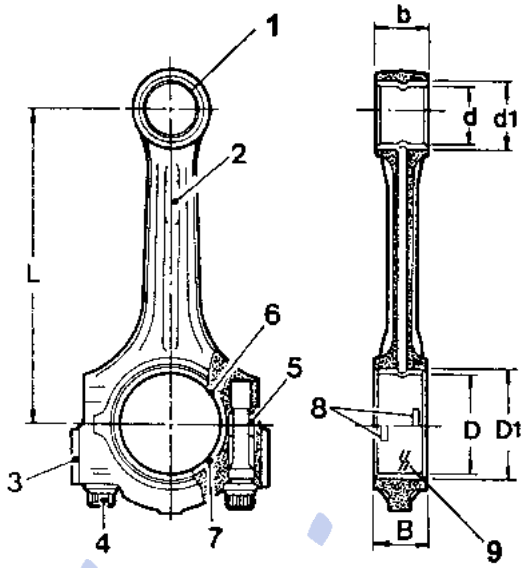
Apply the engine oil to the bearing cap upper and lower bearing shells.

7. Check if the crankshaft rotates without any trouble by rotating it.

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CONNECTING ROD

Preceding Work: Removal of piston

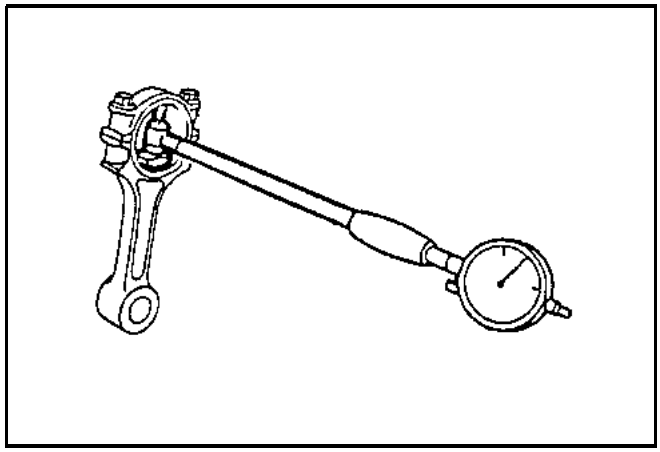


1 Connecting Rod Bushing
2 Oil Gallery
3 Balance Weight
4 Connecting Rod Bearing Cap Bolt (M9 x 52, 8 pieces)
. . . . . 1st step 40 N•m (30 lb-ft)
2nd step 90°
5 Fit Sleeve
6 Upper Connecting Rod Bearing
7 Lower Connecting Rod Bearing
8 Bearing Shell Lug
9 Marking [Indication (//) or Numbers]

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Service Data Standard

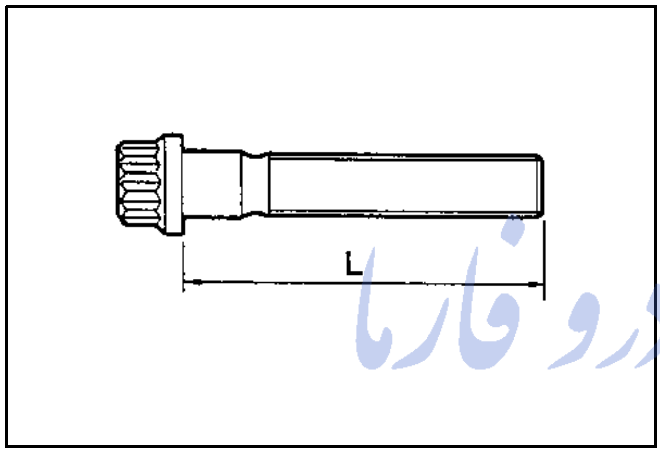
Distance (L) from The Connecting Rod Bearing to Bushing Bore Center	E20 : 154 mm E23 : 149 ± 0.05 mm
Width of The Connecting Rod (B) at Bearing Bore	21.940 - 22.000 mm
Width of The Connecting Rod (b) at Bushing Bore	21.940 - 22.000 mm
Basic Bore at The Bearing Shell (D1)	51.600 - 51.614 mm
Basic Bore at The Bushing (d1)	24.500 - 24.521 mm
Bushing Inner Diameter (d)	22.007 - 22.013 mm
Clearance Between The Piston Pin and The Bushing	0.007 - 0.018 mm
Peak-to-valley Height of Connecting Rod Bushing on Inside	0.005 mm
Permissible Wwist of Connecting Rod Bearing Bore to Connecting Rod Bushing Bore	0.1/100 mm
Permissible Deviation of Axial Paralleism of Connecting Rod Bearing Bore to Connecting Rod Bushing Bore	0.045/100 mm
Permissible Deviation of Axial Paralleism of Connecting Rod Bearing Bore from Concentricity	0.01 mm
Permissible Difference of Each Connecting Rod in Weight	0.4 g



Inspection

1. Measure the basic bore of the connecting rod bearing.

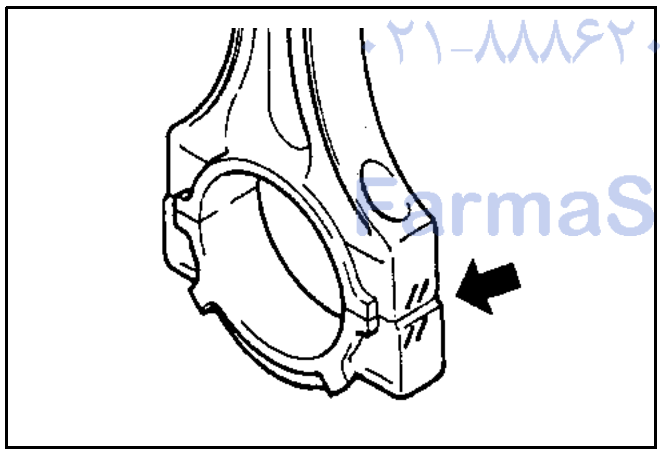
Notice: If the basic bore exceeds the value of 51.614mm, replace the bearing or check the connecting rod.



2. Check connecting rod bolts.

Length When New (L)	51.7 - 52 mm
Max. Length (L)	52.9 mm
Tightening Torque	1st step: 40 N•m (30 lb-ft)
	2nd step: 90°

Notice: If the length exceeds max. length, replace it.



3. Check the assembly mark (indication//or number:arrow) of the connecting rods and the bearing cap when installing.

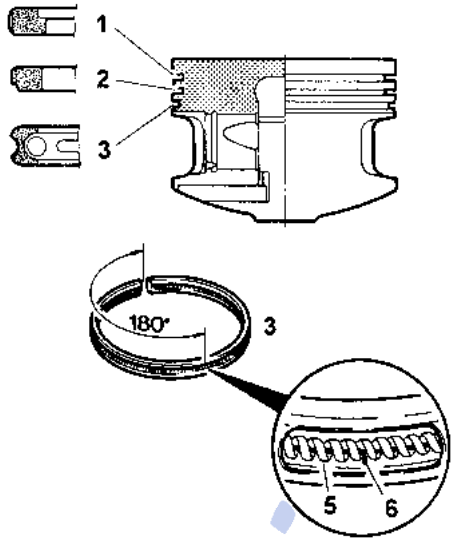
Notice

- Make sure it doesn't exceed over 4g with other connecting rods when replacing the connecting rods.
- Check if the connecting rod and the bearing cap are accurately seated on the groove when replacing the bearing.

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PISTON RING

Preceding Work: Removal of piston



1 Piston Compression Ring (Top Ring)
2 Piston Compression Ring (2nd Ring)
3 Piston Oil Ring
4 -
5 Spacer
6 Side Rail

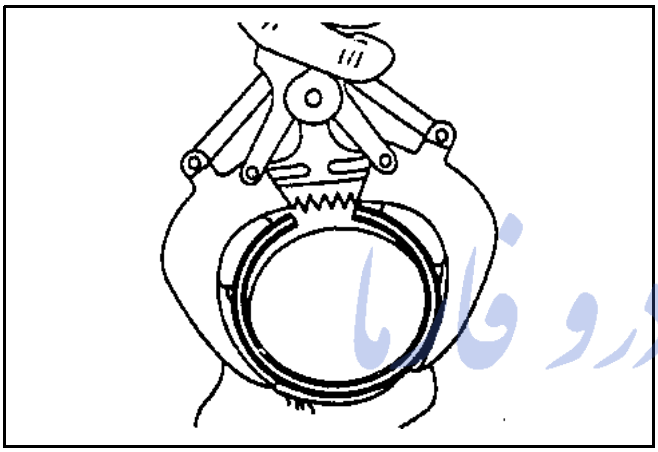
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Replacement Procedure

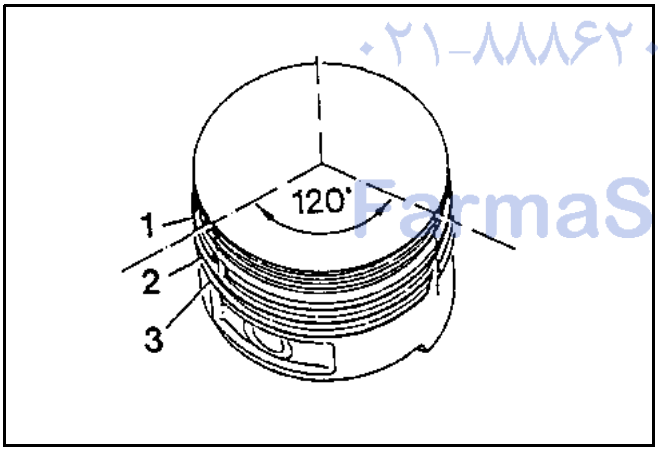
1. Measure the piston ring's gap.

End Gap of The Piston Ring	Groove 1 0.20 - 0.40 mm
	Groove 2 0.20 - 0.40 mm
	Groove 3 0.20 - 0.45 mm
Gap Between The Piston and The Piston Ring	Groove 1 0.028 - 0.060 mm
	Groove 2 0.010 - 0.045 mm
	Groove 3 0.010 - 0.045 mm

Notice: If out of specification, replace the piston ring.



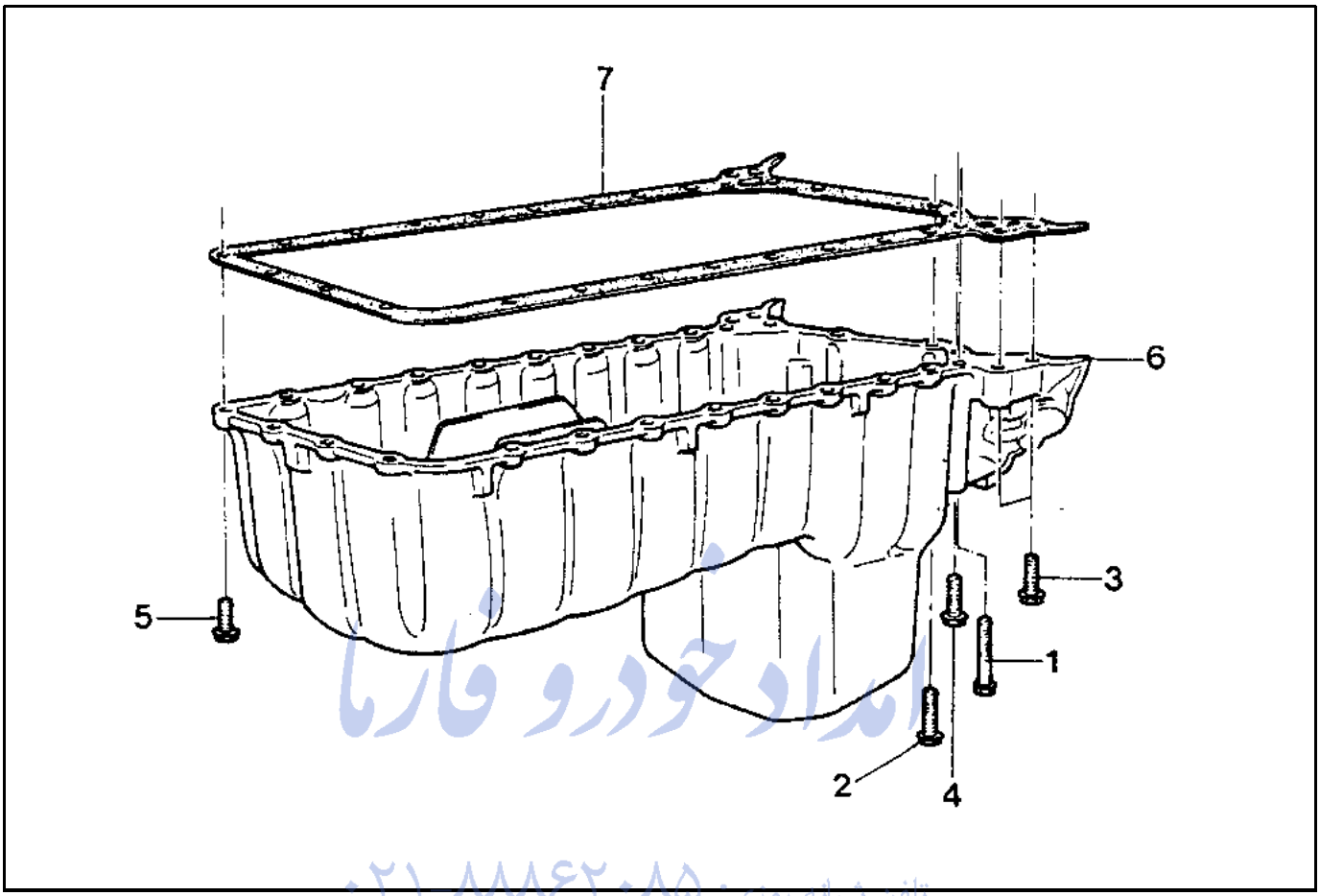
2. Remove the piston ring with a pliers.



3. For installation, position the piston ring to be the 'TOP' mark on the piston ring upward and arrange the piston ring ends to be 120° apart.
4. Adjust the hook spring joint in the oil ring 180° away from the ring end.

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OIL PAN



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1 Bolt
2 Bolt
3 Bolt
4 Bolt
5 Bolt
6 Oil Pan
7 Gasket

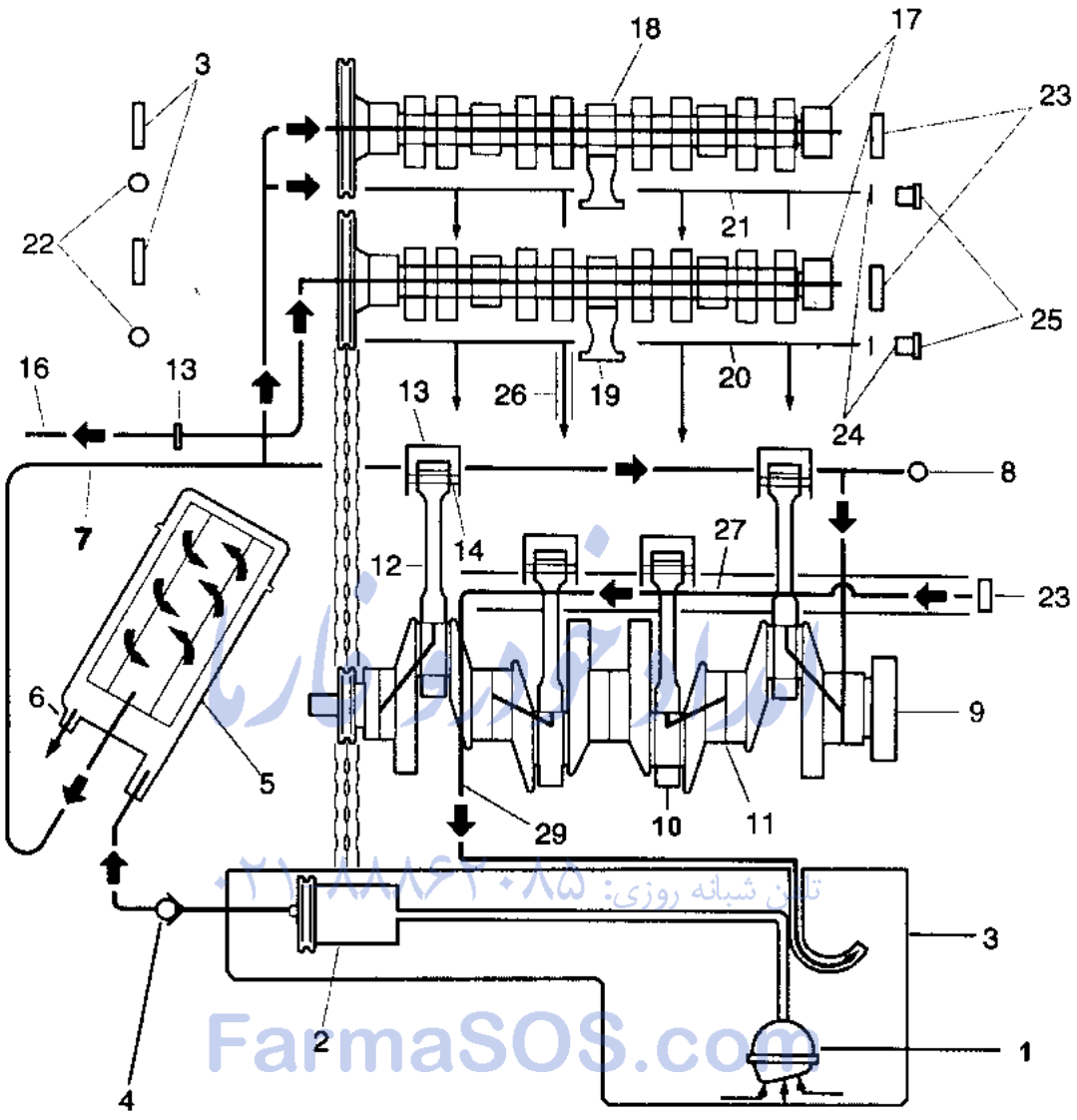
Removal & Installation Procedure

1. Remove the drain plug and drain the oil completely.
2. Unscrew the bolts and remove the oil pan and gasket.

Notice: Arrange the bolts according to each size.

3. Clean the inside of oil pan and sealing surface, then apply the sealant.
4. Replace the gasket with new one.
5. Install the oil pan with gasket, and tighten each bolt in specified torque.
6. Check for oil leaks while running the engine.

Oil Circulation

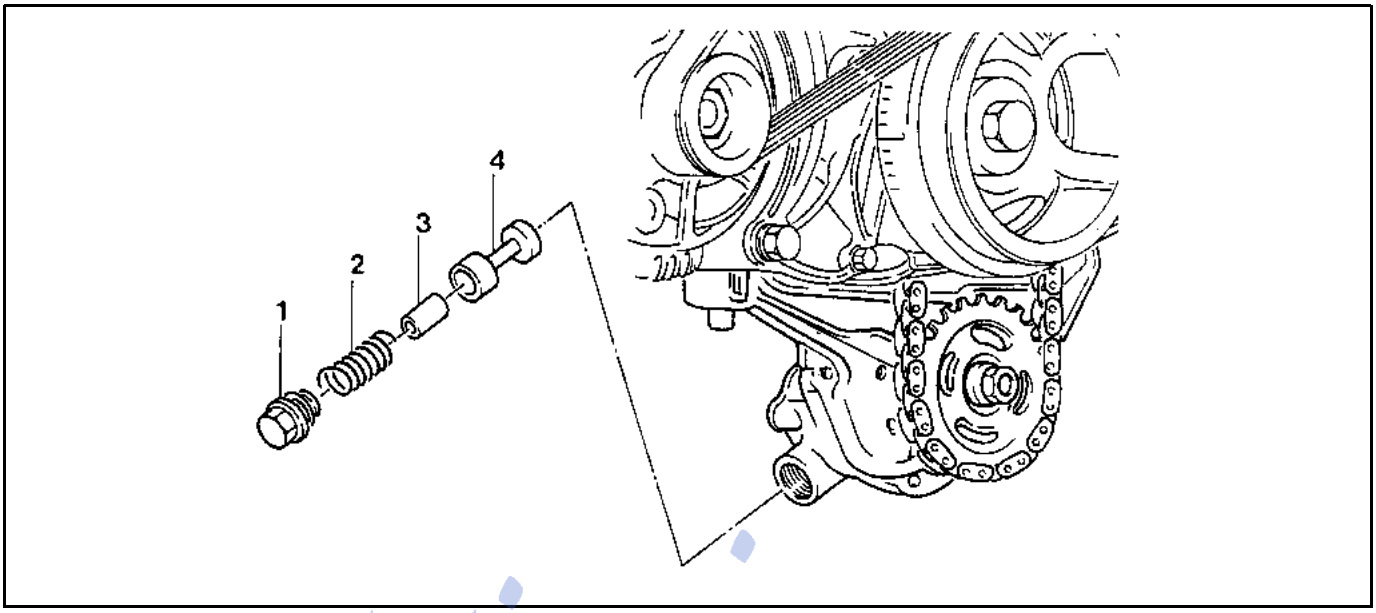


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1 Oil Strainer
2 Oil Pump
3 Oil Pan
4 Oil Non-Return Valve
5 Oil Filter
6 Oil Filter Bypass Valve
7 Main Oil Gallery
8 Closing Ball (ϕ 15mm)
9 Crankshaft
10 Connecting Rod Bearing
11 Crankshaft Bearing
12 Connecting Rod
13 Piston
14 Oil Spray (Piston Crown Area)
15 Non-Return Valve (Crankcase)
16 Oil Supply (To Chain Tensioner)
17 Camshaft
18 Cam Bearing
19 Valve
20 Oil Gallery (Supply Oil to Intake Tappet)
21 Oil Gallery (Supply Oil to Exhaust Tappet)
22 Ball (ϕ 8mm)
23 Camshaft Plug
24 Seal
25 Screw Plug
26 Oil Return Gallery (Cylinder Head and Crankcase)
27 Oil Return Gallery (Crankcase)
28 End Cover (ϕ 20mm)
29 Oil Return Pipe

OIL PRESSURE RELIEF VALVE

Preceding Work: Removal of oil pan



1 Screw Plug . . . . . 50 N•m (37 lb-ft)
2 Compression Spring
3 Guide Pin
4 Piston

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Removal & Installation Procedure

1. Remove the screw plug (1).

Installation Notice

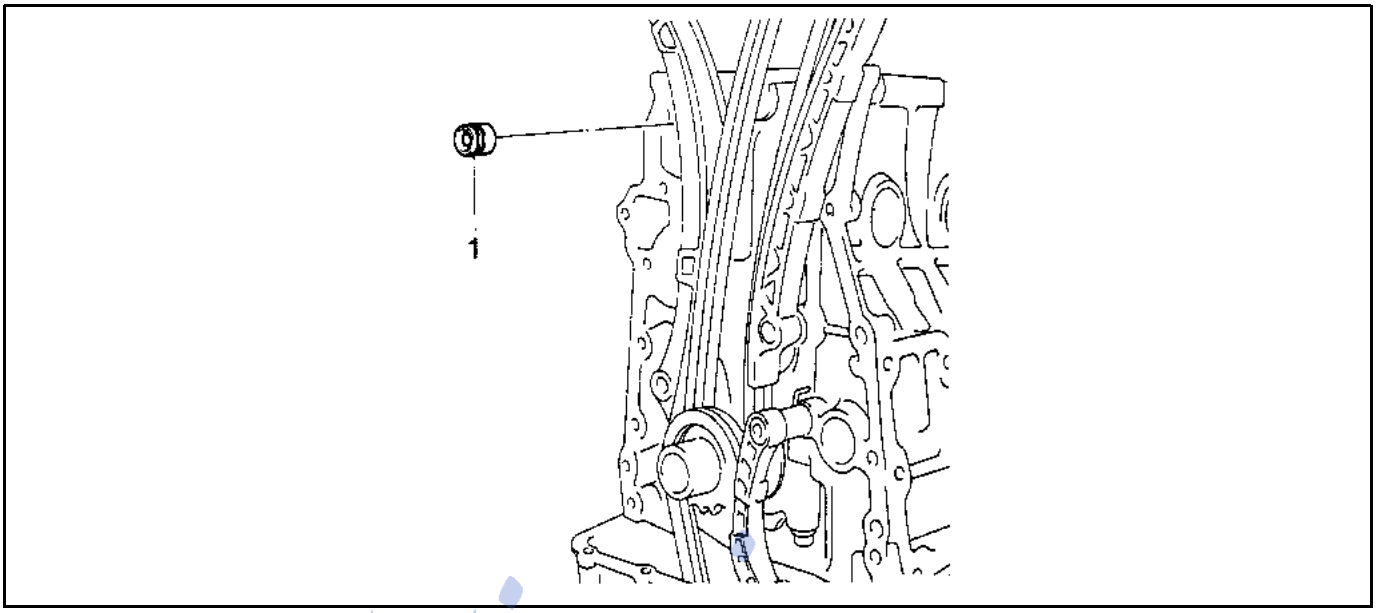
Tightening Torque	50 N•m (37 lb-ft)

2. Remove the spring (2), guide pin (3) and the piston (4).
3. Installation should follow the removal procedure in the reverse order.

Notice: Don't use the seal for the screw plug.

OIL NON-RETURN VALVE

Preceding Work: Removal of timing gear case cover

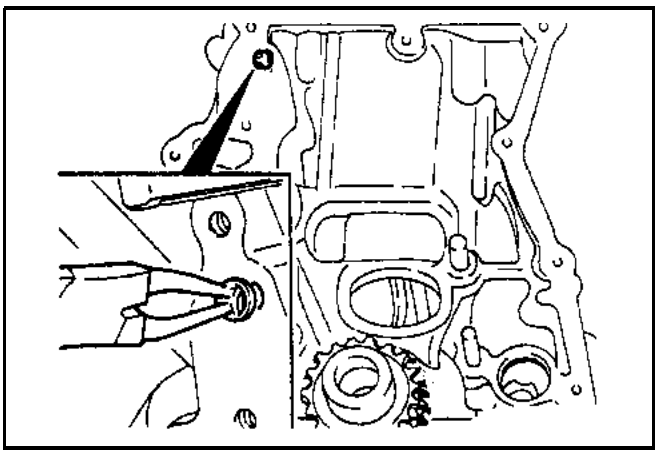


1 Oil Non-return Valve

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Functions

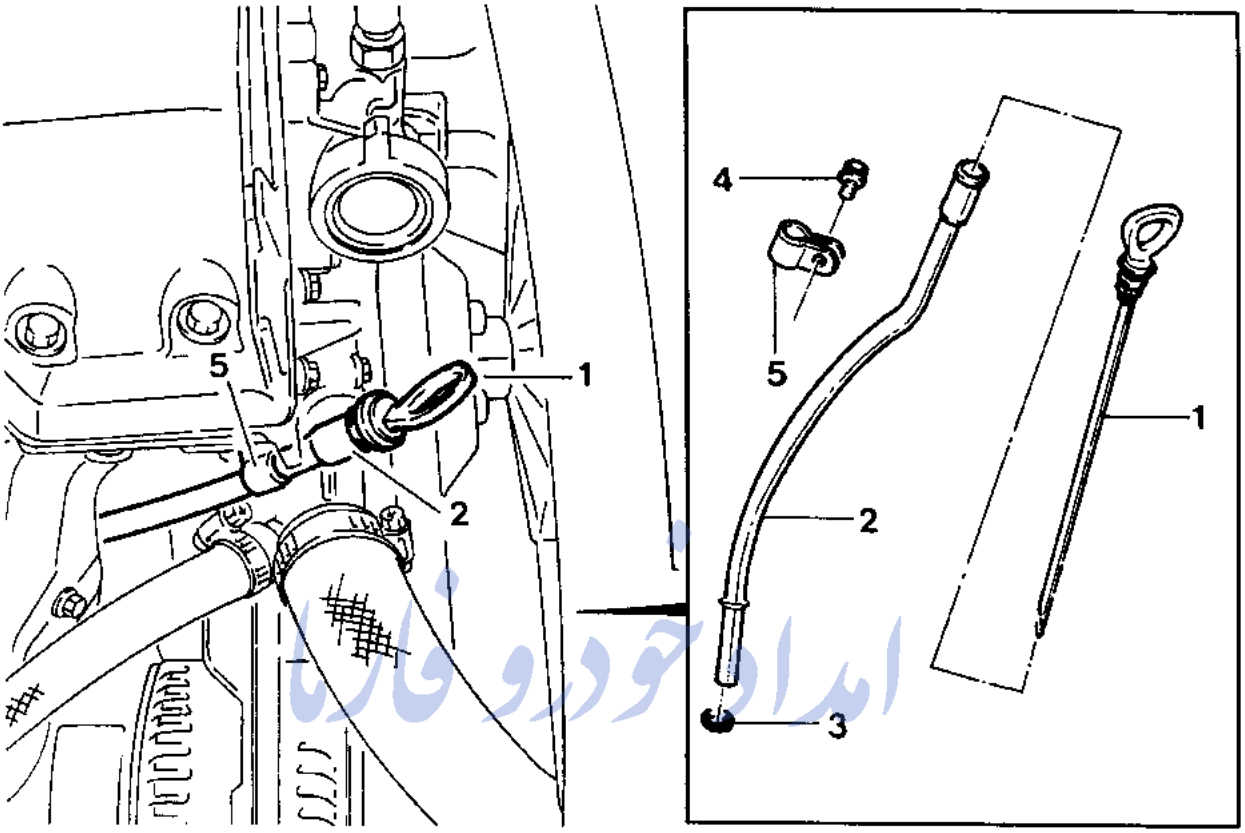
The non-return valve prevents the oil in the chain tensioner from drying up. In other words, it stops oil-returning in order to prevent the oil in the chain tensioner from getting dry. As a result, the chain tensioner can be activated with oil in itself.



Replacement Procedure

1. Remove the non-return valve using a pliers.
2. Insert new non-return valve with hand.

OIL DIPSTICK GUIDE TUBE



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1 Oil Dipstick Level Gauge
2 Oil Dipstick Guide Tube
3 O-ring
4 Bolt (M6 X 16, 1 piece)
. . . . . 9-11 N•m (80-97 lb-in)
5 Clamp

Removal & Installation Procedure

1. Pull out the oil dipstick level gauge (1).
2. Unscrew the bolt (4) and remove the oil dipstick guide tube (2).

Installation Notice

Tightening Torque	9 - 11 N•m (80 - 97 lb-in)

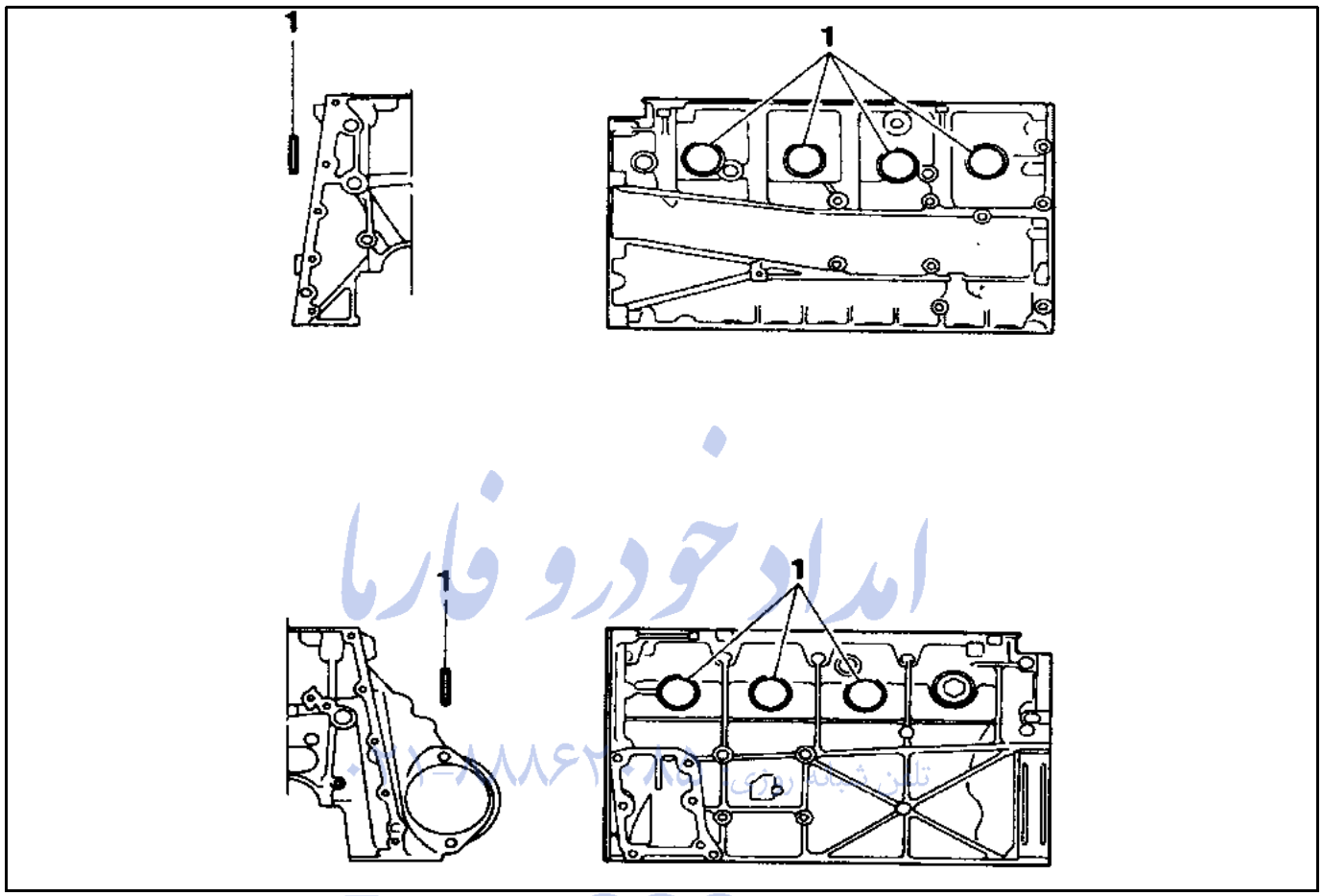
It is very hard to remove the oil dipstick guide tube without special tool. If it is not necessary, do not remove the guide tube.

3. Installation should follow the removal procedure in the reverse order.
4. Check for leaks by starting the engine.

UNIT REPAIR

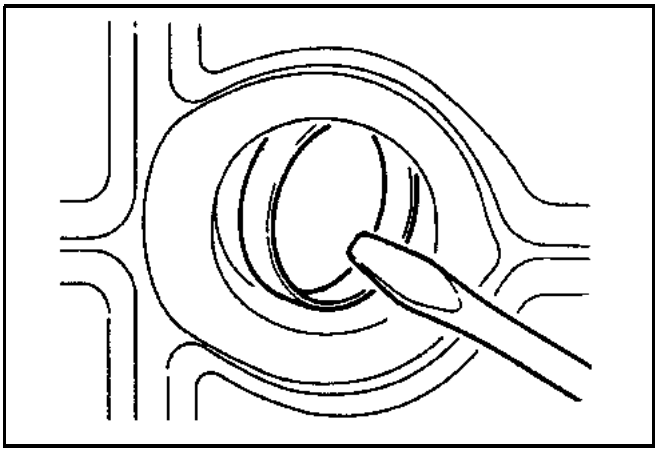
CORE PLUGS IN CRANKCASE

Preceding Work: Draining of the coolant



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1 Core Plug ..... Replace

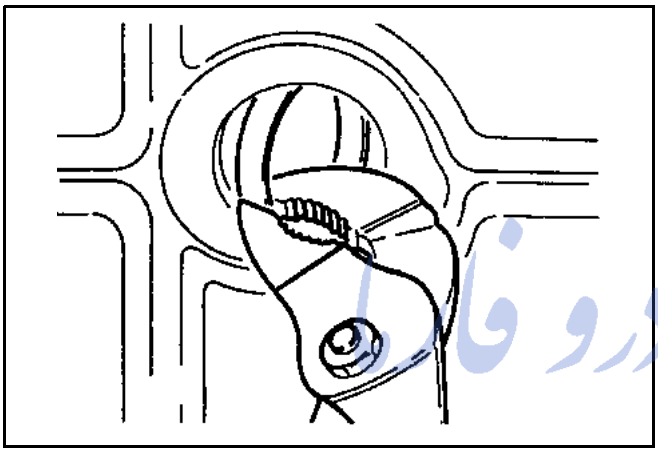


Tools Required

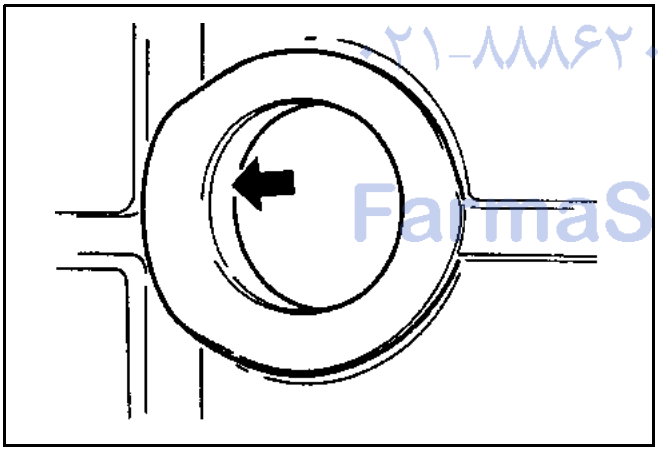
102 589 00 15 00 Drift

Replacement Procedure

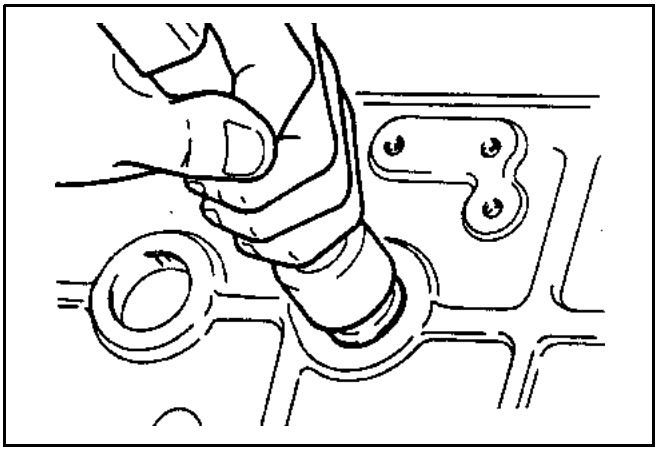
1. Remove the intake and exhaust manifolds.
2. Pull back the core plug until the end of one side comes out using the screw driver.



3. Pull out the plug carefully using a pliers.



4. Clean the sealing surface and apply Loctite 241.



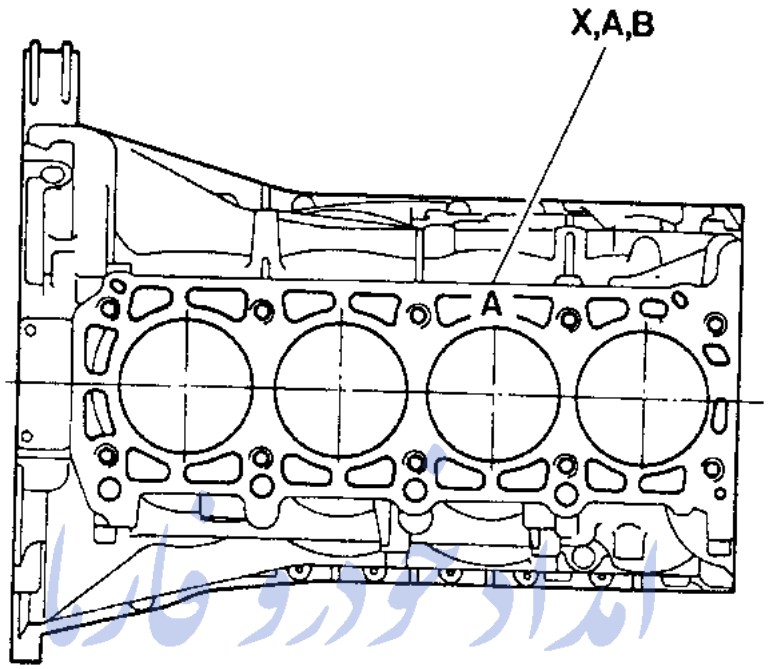
5. Press in new plug using a drift.

Notice: Wait for about 45minutes before filling the coolant so that the Loctite 241 hardens.

6. Warm up the engine and check the coolant for leaks.

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CYLINDER BORE



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Group Code Letter and Cylinder Bore Size

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Engine	Group Code Letter of Cylinder	Piston Type to be Used	Cylinder Bore Size (mm)
E23	A	A or X	ϕ 90.906 - ϕ 90.912
	X	A, X or B	ϕ 90.906 - ϕ 90.912
	B	X or B	ϕ 90.912 - ϕ 90.918
	X + 5	X + 5	ϕ 90.950 - ϕ 90.968
	X + 10	X + 10	ϕ 91.000 - ϕ 91.018
E20	A	A or X	ϕ 89.900 - ϕ 90.906
	X	A, X or B	ϕ 89.906 - ϕ 89.912
	B	X or B	ϕ 89.912 - ϕ 89.918
	X + 5	X + 5	ϕ 89.950 - ϕ 89.968
	X + 10	X + 10	ϕ 90.000 - ϕ 90.018

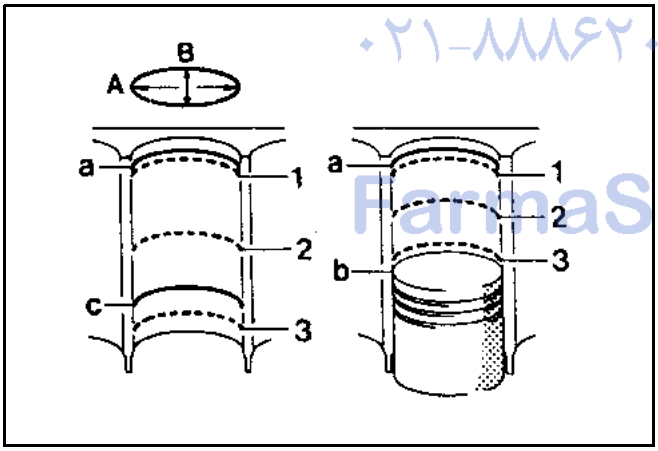
Group Code Letter of Cylinder	Group Code Letter 1)	Cylinder Bore Size (mm)
Standard Size E20 : ϕ 89.9 E23 : ϕ 90.9	A	ϕ 89.900 - ϕ 89.906
	X	ϕ 89.906 - ϕ 89.912
	B	ϕ 89.912 - ϕ 89.918
1st Repair Size (Standard Size + 0.25)	A	ϕ 90.150 - ϕ 90.156
	X	ϕ 89.156 - ϕ 90.162
	B	ϕ 90.162 - ϕ 90.168
2nd Repair Size (Standard Size + 0.5)	A	ϕ 90.400 - ϕ 90.406
	X	ϕ 90.406 - ϕ 90.412
	B	ϕ 90.412 - ϕ 90.418

1) The group code letters are carved on the surface of the piston crown and in the mating surface of the crankcase.

Service Data Standard

Wear Limit in Longitudinal and Transverse Direction		0.1 mm
Permissible Deviation of Cylinder Out-of-round	When new	0.007 mm
	Wear limit	0.05 mm
Permissible Deviation of Rectangular Cylinder Height (Except Chamfered Area)		0.05 mm
Basic Peak-to-valley Height After Final Honing and Brushing		0.003 - 0.006 mm
Chamfer Angle		75°
Honing Angle		50° ± 10°

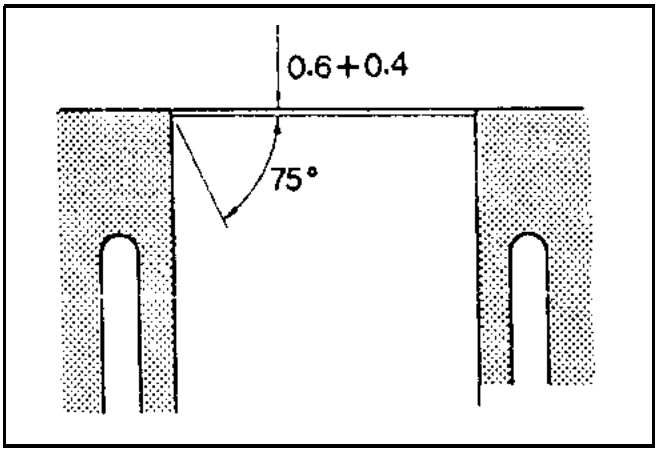
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Measurement of Cylinder Bore

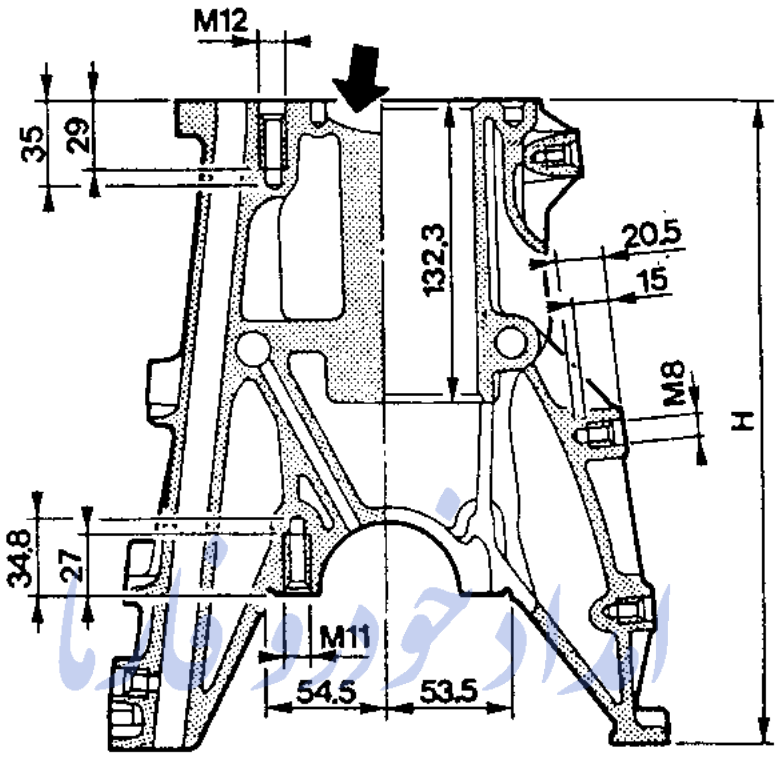
1. Clean the cylinder wall.
2. Using a internal diameter gauge, measure the bore size in axial and transverse direction at three points (1,2,3).

1, 2, 3 Measuring Points
A. Axial Direction
B. Transverse Direction
a. Location of the No.1 Piston Ring at TDC
b. Location of the Piston BDC
c. Location of the Oil Ring at BDC



Chamfer Angle

CRANKCASE MATING SURFACE

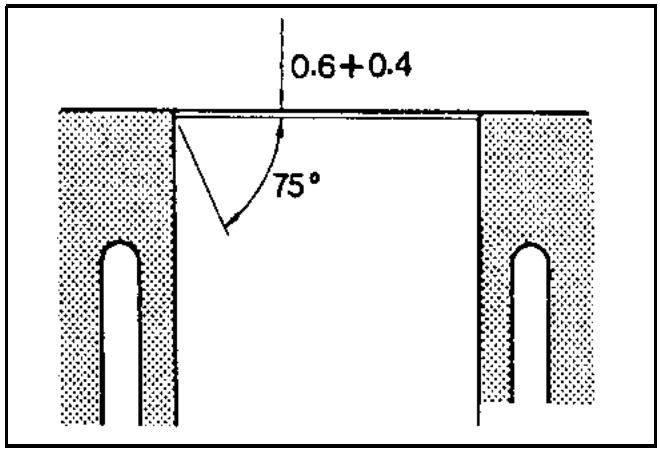


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Service Data Standard

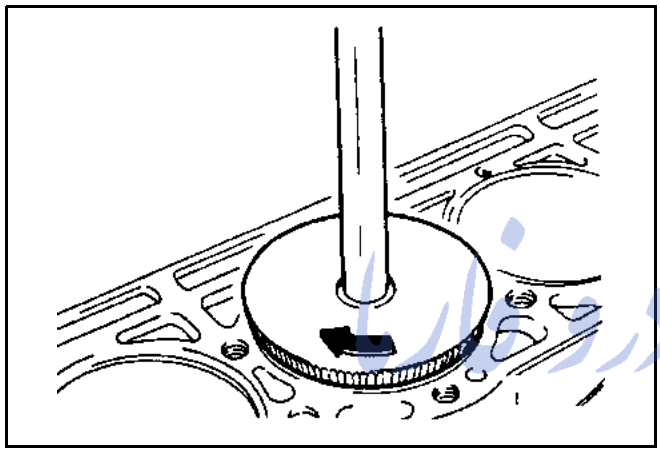
Height of The Crankcase 'H' (When new)		289.35 - 289.45 mm
Minimum Height After Milling		289.05 mm
Flatness	Crankcase Upper Mating Surface	0.03 mm
	Crankcase Lower Mating Surface	0.04 mm
Permissible Deviation of Parallelism of The Upper to Lower Mating Surface	Axial Direction	0.1 mm
	Transverse Direction	0.05 mm
Peak-to-valley Height	Crankcase Upper Mating Surface	0.012 - 0.009 mm
	Crankcase Lower Mating Surface	0.025 - 0.020 mm

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Chamfering Procedure

1. Chamfer angle : 75°

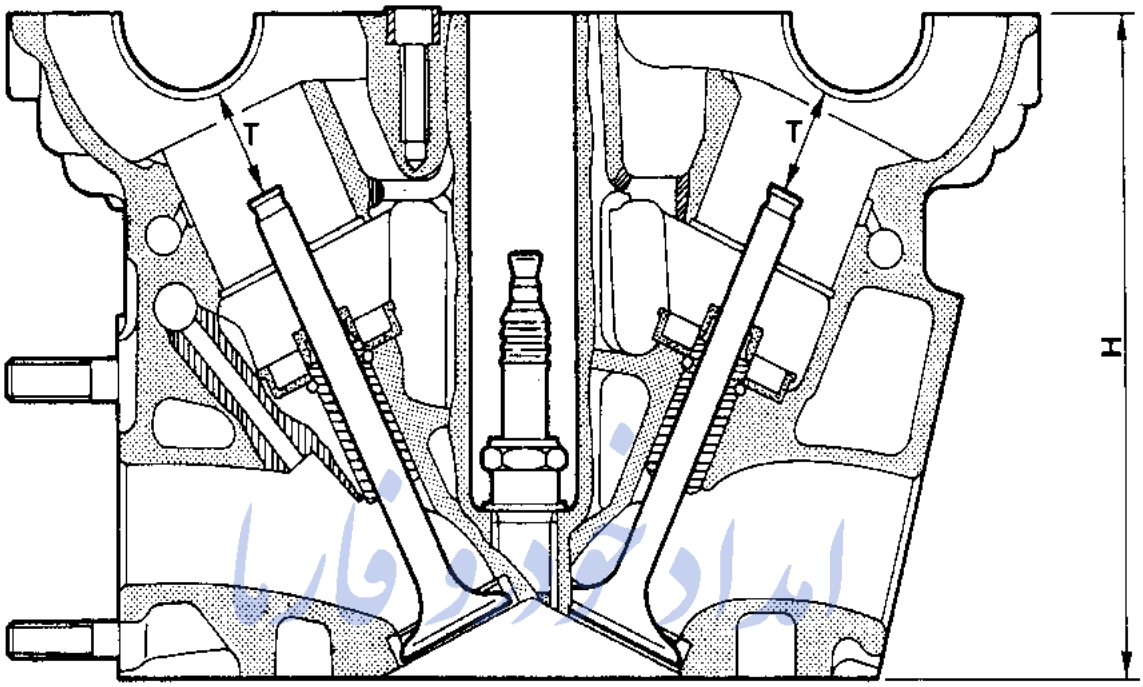


2. Polish the lower chamfered area evenly with a grinder after finishing the chamfering with a suitable tool (e.g., hand milling cutter).

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CYLINDER HEAD MATING SURFACE

Preceding Work: Removal of valves



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Service Data Standard

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Overall Height of Cylinder Head			135.9 - 136.0 mm
Minimum Height After Machining			135.5 mm
Flatness	Axial Direction		0.08 mm
	Transverse Direction		0.0 mm
Distance 'T' (Between Camshaft Bearing and Valve Stem)	Standard Size	Intake	24.21 - 24.75 mm
		Exhaust	22.21 - 22.75 mm
	Repair Size	Intake	23.96 - 24.51 mm
		Exhaust	21.96 - 22.51 mm

Notice: Do not exceed 0.4mm for the milling of the mating surface of crankcase and cylinder head.

Measurement of Mating Surfac

1. Measure the height (H) of the cylinder head *(refer to Service data standard).*
2. Check the mating surface of the cylinder head.
3. Mill the sharp edge of the combustion chamber.
4. Re-measure the height (H) of the cylinder head.
5. Seal the intake and exhaust valves.
6. Measure the dimension (T) between the camshaft bearing and the valve system *(refer to Service data standard).*
7. Mill the cylinder head valve seat *(refer to Service data standard).*

Universal Tool

Surface Grinding Machine	Sceledum, Type RTY Roaro Schio/Italy

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SECTION 1D2

M161 ENGINE COOLING

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

Specifications 1D2-2
General Specifications 1D2-2
Fastener Tightening Specifications 1D2-2
Special Tools 1D2-3
Special Tools Table 1D2-3
Diagnosis 1D2-4
System Leakage Test 1D2-4
Maintenance and Repair 1D2-5
On-Vehicle Service 1D2-5
Coolant Drain and Fill Up 1D2-5
Cooling Fan and Viscous Clutch 1D2-7
Water Pump 1D2-9
Thermostat 1D2-11
Thermostat Housing Assembly 1D2-12
Removal and Installation of Cooling Fan Shroud 1D2-14
Removal and Installation of Radiator 1D2-15

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SPECIFICATIONS

GENERAL SPECIFICATIONS

Application		Description
Cooling Type		Water Cooling Forced Circulation
Radiator	Circulation Type	Down Flow
	Radiation	61,500 kcal/h
	Capability	58,000 kcal/h
Dimension (Width x Height x Thickeness)		680 x 415 x 25 mm
		680 x 415 x 28 mm
Cooling Fan		ϕ 460, 9 Blades
Anti-Freeze Agent		ALUTEC-P78, Dragon Power Coolant A
Mixing Ratio of Anti-Freeze Agen with Water (Anti-Freeze Agent : Water)		50 : 50
Coolant Capacity		10.5 L
Reservoir Capacity		3.4 L
Cap Operating Pressure (Reservoir Tank Pressure Cap)		1.4 bar

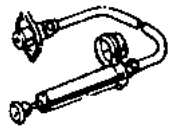
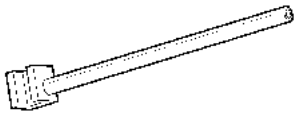
FASTENER TIGHTENING SPECIFICATIONS

Application		N•m	Lb-Ft	Lb-In
Coolant Drain Plug		30	22	-
Engine Hanger Bracket and Coolant Outlet Port Bolt		22.5 - 27.5	16.6 - 20.3	-
Thermostat Cover Bracket Bolt		9 - 11	-	80 - 97
Oil Cooler Pipe Line Bolt		9 - 11	-	80 - 97
Cooling Fan Bolt		9 - 11	-	80 - 97
Viscous Clutch		40.5 - 49.5	29.8 - 36.5	-
Automatic Transmission Fluid Cooler Pipe		20	15	-
Cooling Fan Shroud Bolts		3 - 7	-	27 - 62
Water Pump Pulley Retaining Bolts		9 - 11	-	80 - 97
Water Pump Housing Bolts	M6	9 - 11	-	80 - 97
	M8	22.5 - 27.5	16.6 - 20.3	-
Radiator Bracket Mounting Bolts		3 - 7	-	27 - 62

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SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS TABLE

	**124 589 15 21 00** **Tester**		**603 589 00 40 00** **Fan Clutch Holder**
	**111 589 02 01 00** **Open End Wrench**		**111 589 00 40 00** **Open End Wrench**

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DIAGNOSIS

SYSTEM LEAKAGE TEST

Tools Required

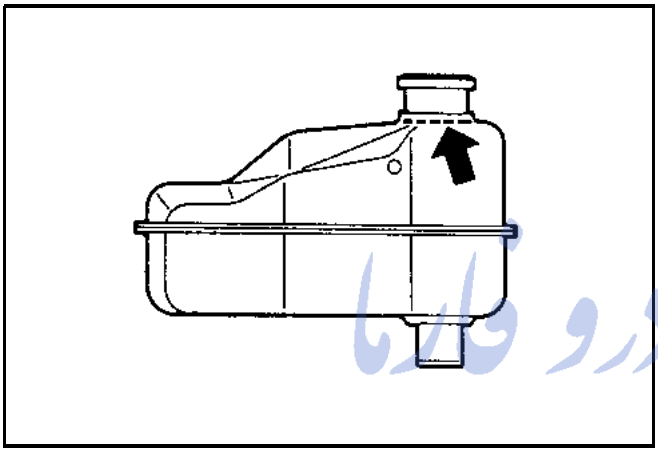
124 589 15 21 00 Tester

Test Procedure

1. Loosen the cap a little and release pressure and remove the cap.

Notice: For the risk of scalding, cap must not be opened unless the coolant temperature is below 90°C.

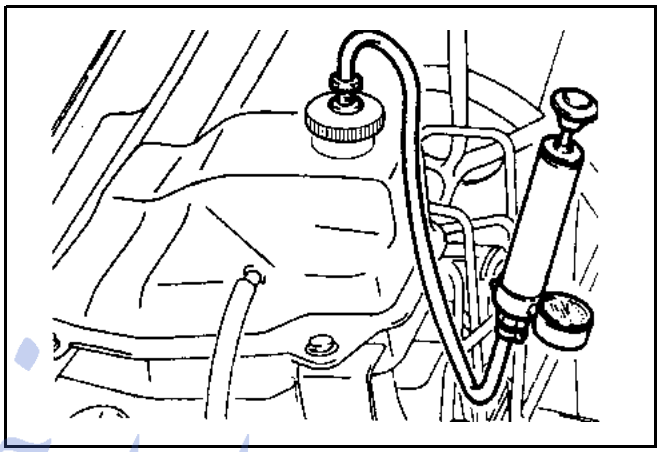
2. Fill coolant up to upper edge (arrow) of reservoir.



3. Connect the special tool to the reservoir filler cap and apply 1.4 bar of pressure.

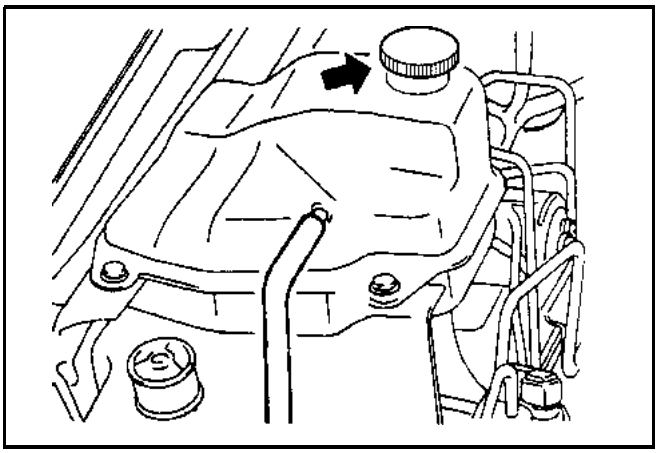
Tester 124 589 15 21 00

4. If the pressure on the tester drops, check leakage at the all coolant hoses and pipes and each connections. Replace or retighten if necessary.



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MAINTENANCE AND REPAIR



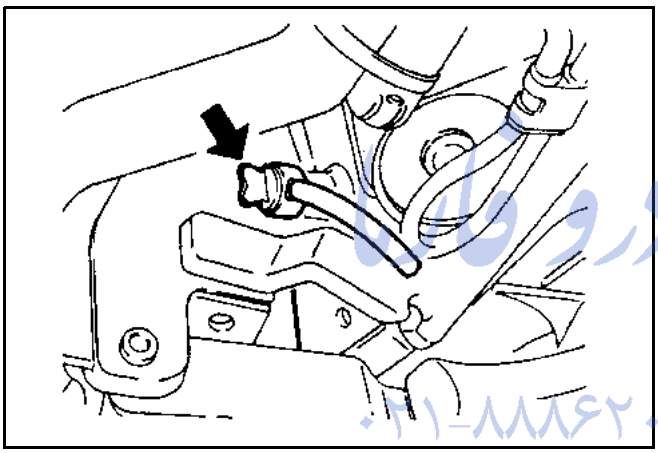
ON-VEHICLE SERVICE

COOLANT DRAIN AND FILL UP

Draning & Filling up Procedure

1. Loosen the cap a little and release pressure and remove the cap.

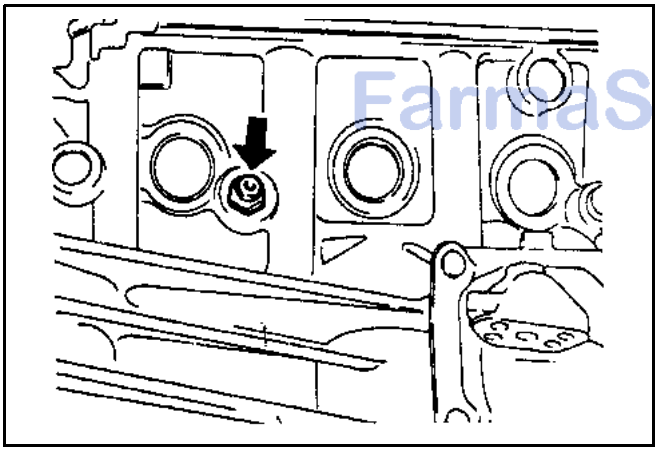
Notice: For the risk of scalding, the cap must not be opened unless the coolant temperature is below 90°C.



2. Loosen the radiator lower drain cock and drain the coolant.

Notice: Collect the coolant by using a proper container.

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3. Drain the coolant from the crankcase by inserting a hose (dia. 14mm) onto the drain bolt on the side of crankcase (exhaust manifold) and by loosening the plug.

Notice

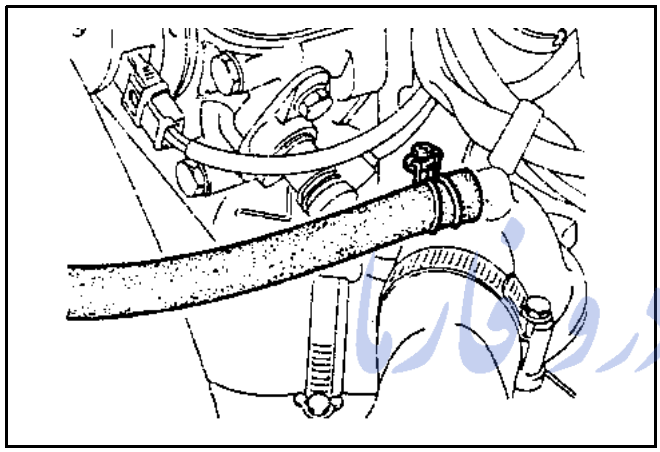
- Just loosen the drain plug to drain the coolant and do not remove the plug completely.
- Collect the coolant by using the proper container.

4. After complete draining of the coolant, remove the hose connector to drain plug and reinstall the drain plug.

Installation Notice

Tightening Torque	30 N•m (22 lb-ft)

5. Tighten the radiator lower drain cock.



6. Remove the de-aeration hose clamp in the water pump and remove the de-aeration hose.
7. Fill up the coolant through the coolant reservoir tank.

Notice

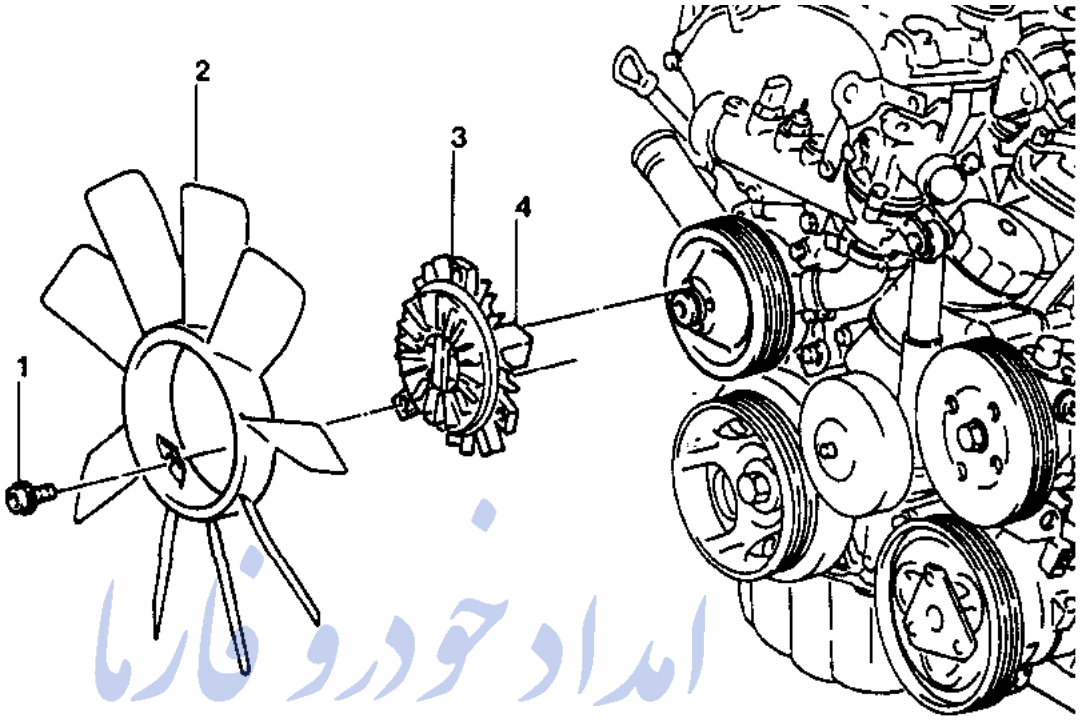
- Match the anti-freeze and the water ratio to 50 : 50.
- Supplement the coolant until the coolant overflows to the deaeration hose.

8. Insert the de-aeration hose and completely tighten the clamp.
9. Check the coolant level in the coolant reservoir tank.
10. Warm up(until thermostat is opened) the engine and recheck the coolant level in the reservoir tank and fill up the coolant if necessary.

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COOLING FAN AND VISCOUS CLUTCH

Preceding Work: Removal of cooling fan shroud



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1 Bolt (M6 X 14, 3 piece) . . . . . 9-11 N•m (80-97 lb-in)
2 Cooling Fan
3 Viscous Clutch
4 Union Nut (Left Threaded Screw) . . . . . 40.5-49.5 N•m (29.8-36.5 lb-ft)

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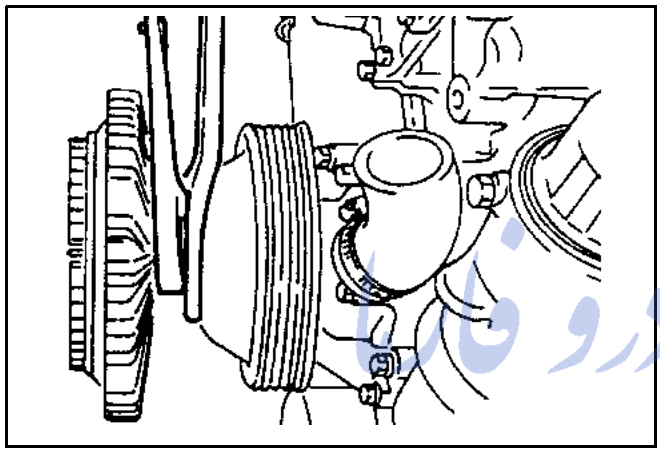
Tools Required

111 589 02 01 00 Open End Wrench

111 589 00 40 00 Open End Wrench

Removal & Installation Procedure

1. Install the holder (special tool : 111 589 00 40 00) to the bolt at the pulley as shown in the right figure to hold the pulley.



2. Remove the viscous clutch using an open end wrench (special tool : 111 589 02 01 00).

Installation Notice

Tightening Torque	40.5 – 49.5 N•m (29.8 – 36.5 lb-ft)

Notice: The union nut is left threaded screw.

3. Remove the 3 bolts (1) from the viscous clutch and remove the cooling fan and the viscous clutch.

Installation Notice

Tightening Torque	9 – 11 N•m (80 – 97 lb-in)

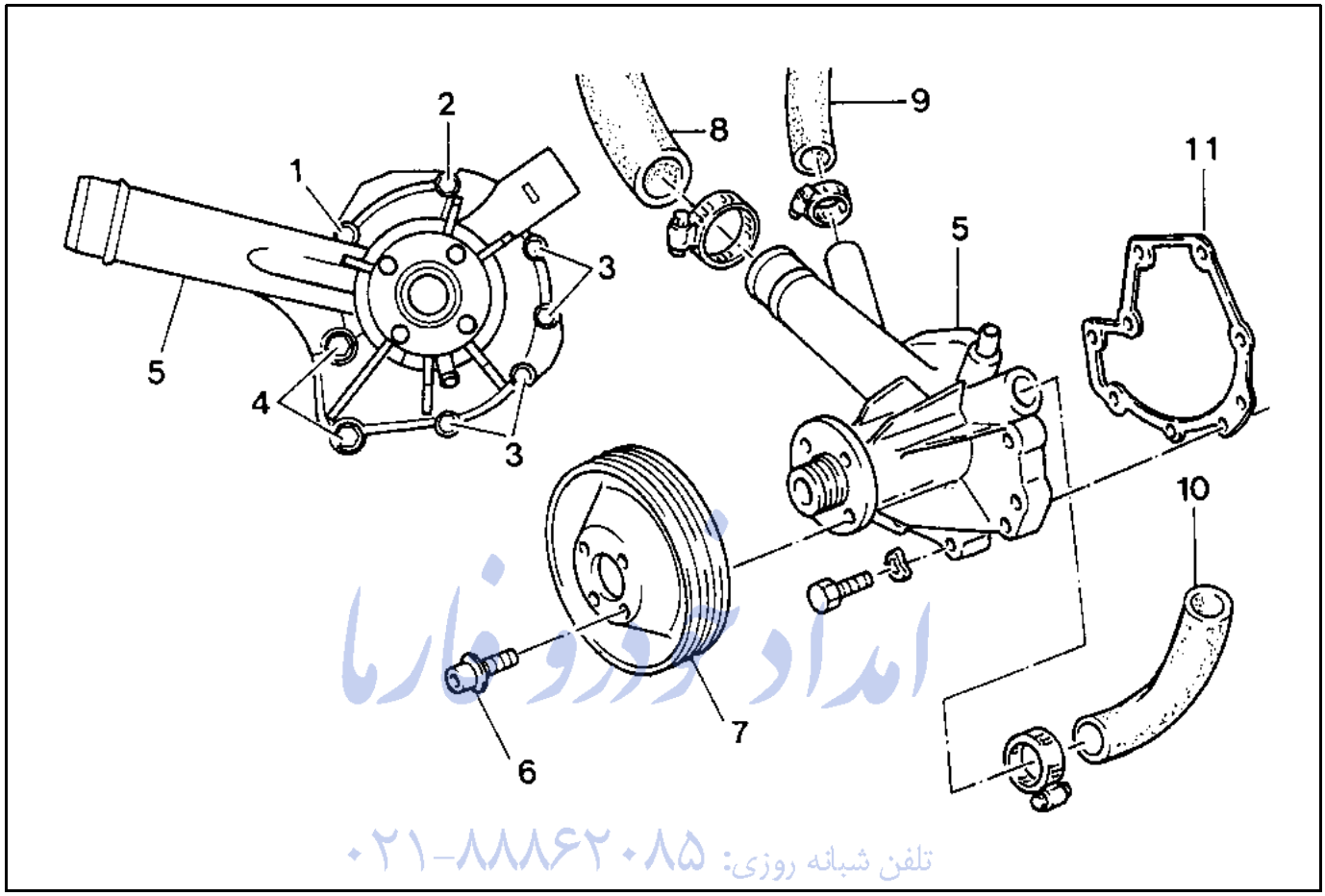
Notice: You may change the procedure (2) and (3) if necessary.

4. Installation should follow the removal procedure in the reverse order.

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WATER PUMP

Preceding Work: Removal of viscous clutch



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1 Bolt (M6 X 45, 1 piece) . . . . . 9-11 N•m (80-97 lb-in)
2 Bolt (M6 X 95, 1 piece) . . . . . 9-11 N•m (80-97 lb-in)
3 Bolt (M6 X 25, 4 piece) . . . . . 9-11 N•m (80-97 lb-in)
4 Bolt (M8 X 85, 2 piece) . . . . . 22.5-27.5 N•m (16.6-20.3 lb-ft)
5 Water Pump Housing
6 Bolt (M6 X 16, 4 piece) . . . . . 9-11 N•m (80-97 lb-in)
7 Water Pump Pulley
8 Coolant Inlet Hose
9 Heater Hose
10 Coolant Bypass Hose
11 Gasket

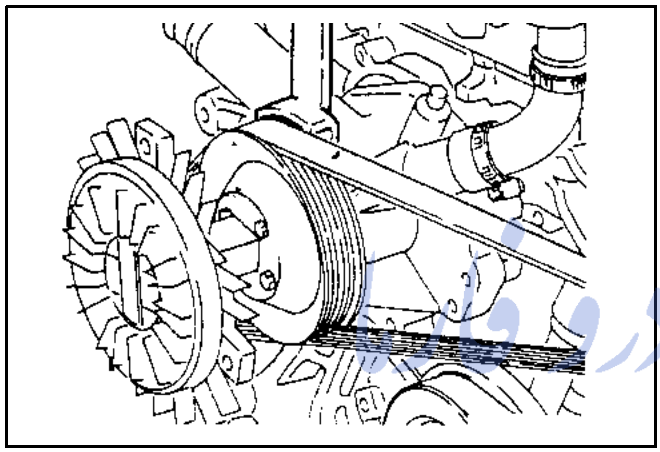
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Tools Required

124 589 15 21 00 Tester

Removal & Installation Procedure

1. Drain the coolant.
2. Disconnect the coolant hoses (8, 9, 10).
3. Take off the drive belt.

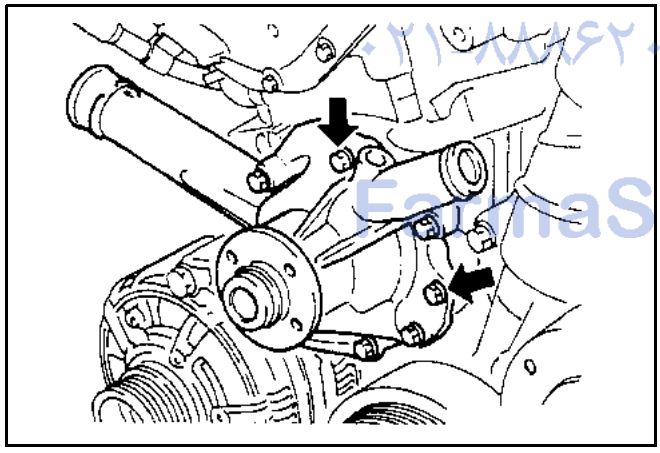


4. Unscrew the four bolts (6) from water pump pulley and remove the pulley (7).

Installation Notice

Tightening Torque	9 - 11 N•m (80 - 97 lb-in)

Notice: Hold the pulley with fan clutch holder 603 589 00 40 00 while removing the pulley.



5. Unscrew the bolts (1, 2, 3, 4) from water pump housing (5) and remove the water pump.

Installation Notice

Tightening Torque	(1, 2, 3)	9 - 11 N•m (80 - 97 lb-in)
	(4)	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)

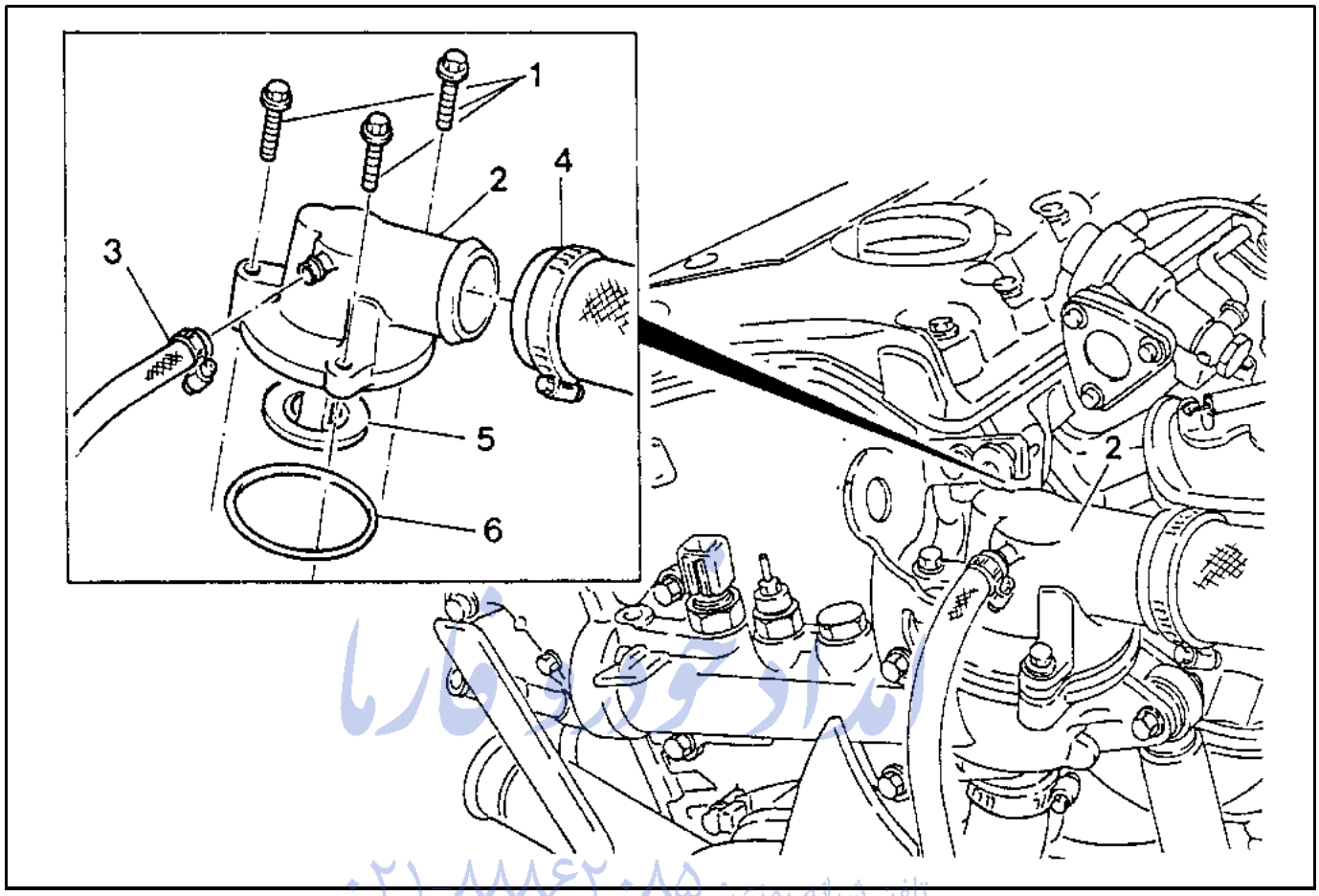
6. Clean the sealing surface.
7. Replace the gasket with new one.

Notice: Apply the sealant when the sealing surface of water pump housing and coolant mounting area is clean.

8. Installation should follow the removal procedure in the reverse order.
9. Check for leaks by starting the engine.

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THERMOSTAT



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1 Bolt (M6 X 25, 3 pieces)
. . . . . 9-11 N•m (80-97 lb-in)
2 Thermostat Cover
3 De-aeration Hose
4 Coolant Outlet Hose
5 Thermostat
6 O-ring

Removal & Installation Procedure

1. Drain the coolant from the radiator.
2. Loosen the hose mounting clip and remove the coolant hose (3, 4).
3. Unscrew the three bolts (1) and remove the thermostat cover assembly from thermostat housing.

Installation Notice

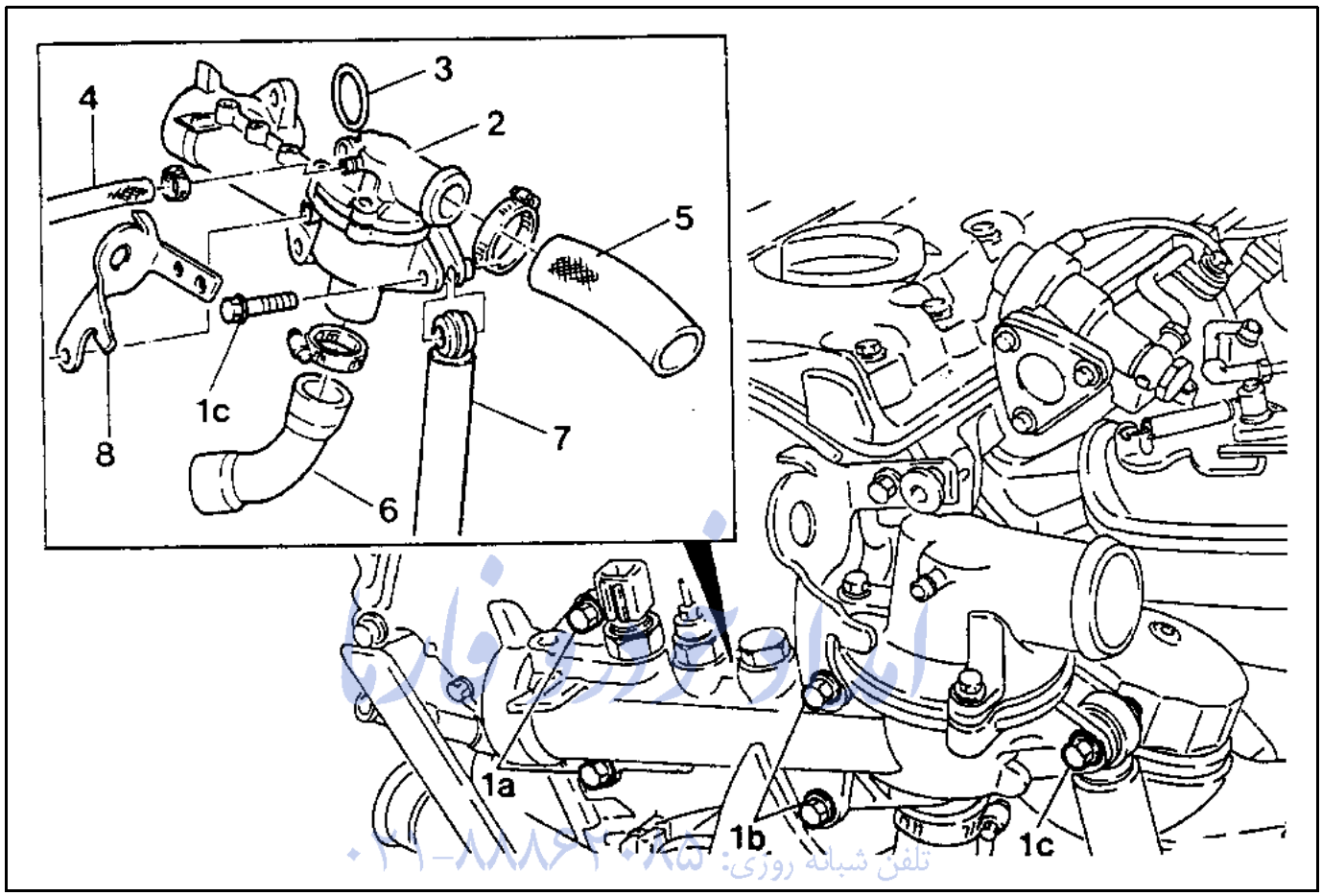
Tightening Torque	9 - 11 N•m (80 - 97 lb-in)

Do not separate the thermostat cover and thermostat.

4. Replace the O-ring if necessary.
5. Check the leakage in the cooling system.

THERMOSTAT HOUSING ASSEMBLY

Preceding Work: Removal of viscous clutch



1a Bolt (M6 X 95, 2 pieces)
. . . . . 9-11 N•m (80-97 lb-in)
1b Bolt (M8 X 75, 2 pieces)
. . . . . 22.5-27.5 N•m (16.6-20.3 lb-ft)
1c Bolt (M8 X 35, 1 piece)
. . . . . 22.5-27.5 N•m (16.6-20.3 lb-ft)
2 Thermostat Housing Assembly
3 O-ring
4 De-aeration Hose
5 Coolant Outlet Hose
6 Coolant Bypass Hose
7 Tensioning Device Shock Absorber
8 Engine Hanger Brocket

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Removal & Installation Procedure

1. Drain the coolant.
2. Remove the de-aeration hose (4), coolant outlet hose (5) and coolant bypass hose (6).
3. Disconnect the coolant temperature sensor connector.
4. Unscrew the bolt (1c) and pry off the tensioning device shock absorber (7).

Installation Notice

Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)

5. Unscrow the bolts (1a, 1b) and remove the engine hanger bracket and thermostat housing.

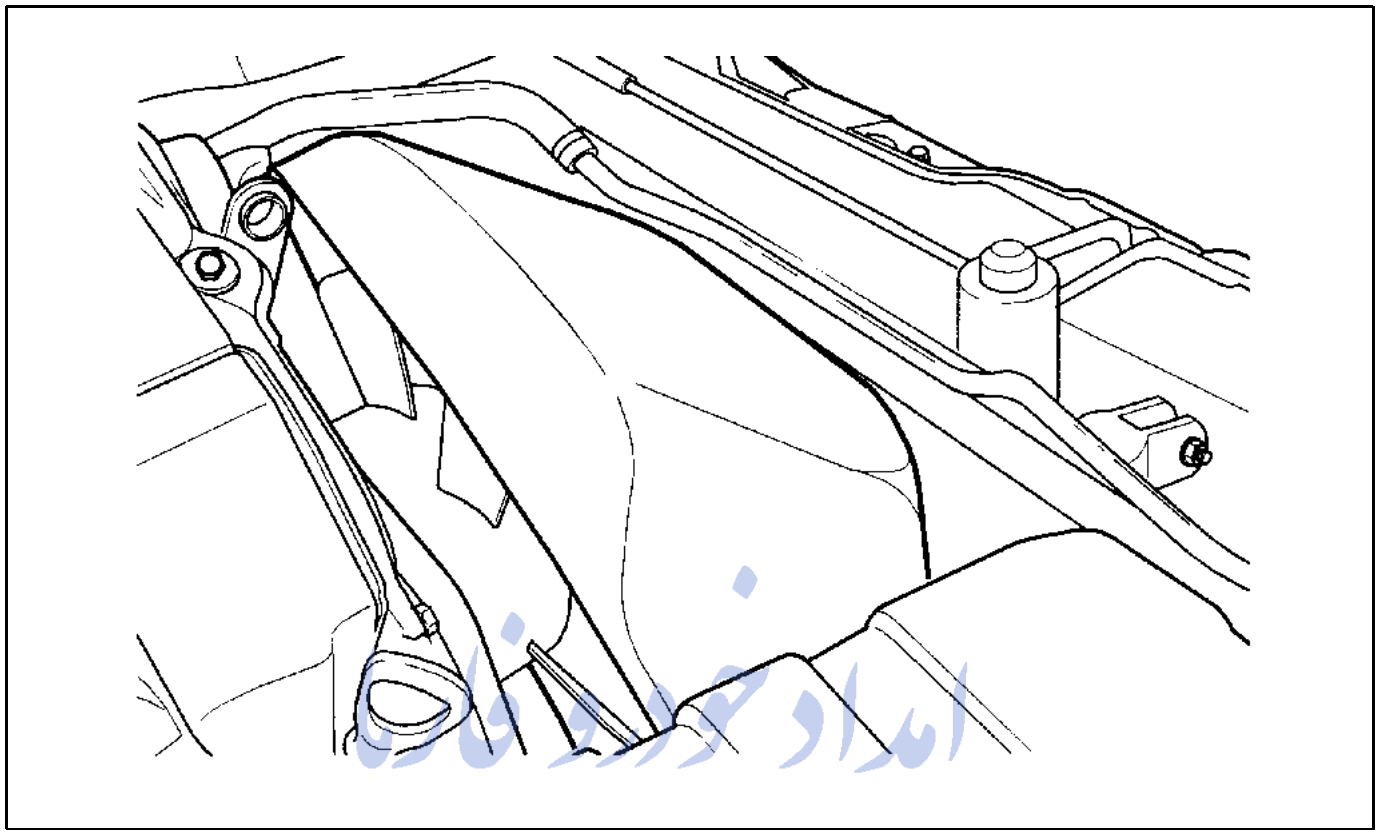
Installation Notice

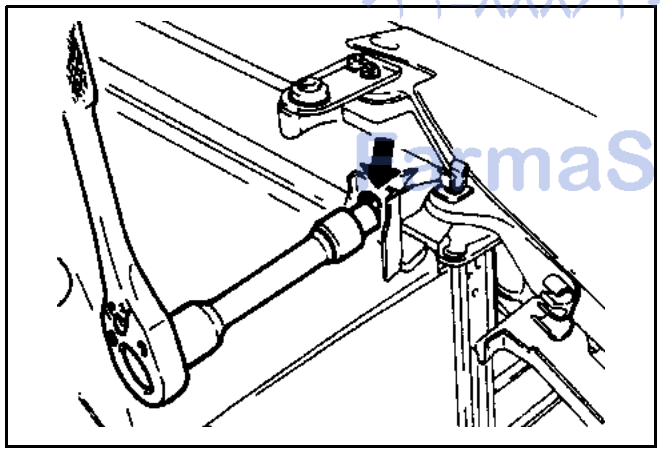
Tightening Torque	(1a)	9 - 11 N•m (80 - 97 lb-in)
	(1b)	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)

6. Replace the O-ring with new one.
7. Installation should follow the removal procedure in the reverse order.
8. Check for leaks in cooling system.

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FAN SHROUD





Removal & Installation Procedure

1. Unscrew two bolts from cooling fan shroud and remove the shroud.

Installation Notice

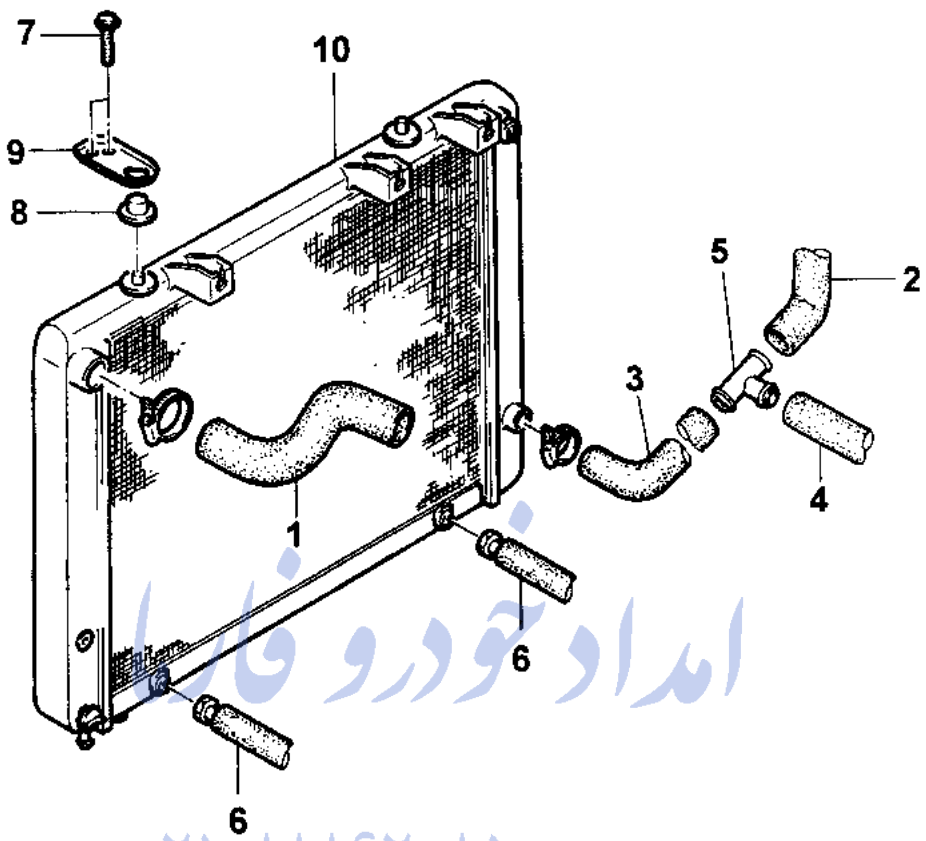
Tightening Torque	3 – 7 N•m (27 – 62 lb-in)

2. Installation should follow the removal procedure in the reverse order.

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REMOVAL AND INSTALLATION OF RADIATOR

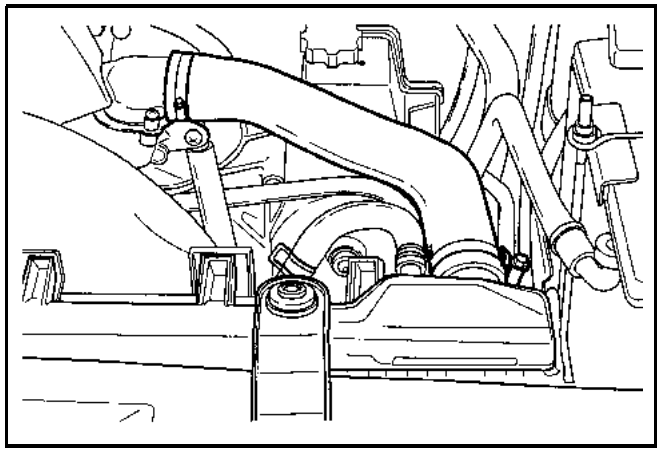
Preceding Work: Removal of cooling fan shroud

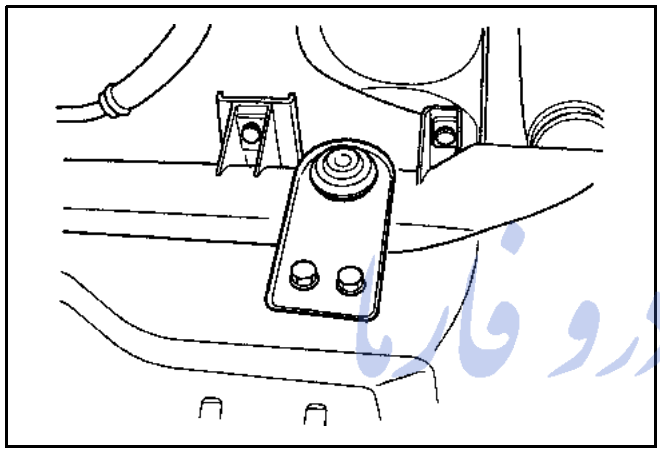


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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵

1 Inlet Hose
2 Hose (to Engine)
3 Hose (to 3-way Connector)
4 Make-up Hose (to Coolant Reservoir)
5 3-way Connector
6 Automatic Transmission Oil Cooling Hose (A/T Equippend Vehicle)
7 Bolt (M6 X 20, 4 pieces) ..... 3-7 N•m (27-62 lb-in)
8 Insulator
9 Radiator Bracket
10 Radiator

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Removal & Installation Procedure

1. Drain coolant from the radiator.
2. Remove the coolant thermo connector from the radiator.
3. Remove the each coolant hoses.
4. Remove the automatic transmission fluid cooler pipes from radiator.

Installation Notice

Tightening Torque	20 N•m (15 lb-ft)

5. Remove all the bolts (7) from the radiator bracket (9) and remove the bracket (9) and insulator (8).

Installation Notice

Tightening Torque	3 - 7 N•m (27 - 62 lb-in)

6. Remove the radiator (10).
7. Check the radiator pin for crack, damage, leakage and bending and replace it if necessary.
8. Installation is reverse order of removal.
9. Check for leakage in the cooling system.

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SECTION 1E2

M161 ENGINE ELECTRICAL

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

Specifications 1E2-2
Generator Specifications 1E2-2
Starting Motor Specifications 1E2-2
Battery Specifications 1E2-2
Fastener Tightening Specifications 1E2-2
Maintenance and Repair 1E2-3
On-Vehicle Service 1E2-3
Generator 1E2-3
Starting Motor 1E2-4
Battery 1E2-5
Spark Plug 1E2-6
Ignition Cable 1E2-8
Unit Repair 1E2-11
Battery 1E2-11

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SPECIFICATIONS

GENERATOR SPECIFICATIONS

Application	Description
Current	115 A
Output Voltage	12 - 14 v
Resistance Between Rotor Core and Slip Ring	∞ Ω

STARTER SPECIFICATIONS

Application	Description
Output Power	1.2 kw
Voltage	12 v

BATTERY SPECIFICATIONS

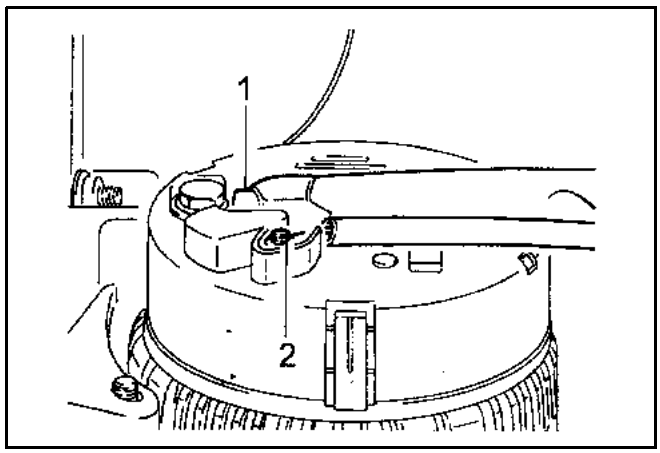
Application	Description
Capacity	90 AH
Max. Tolerance Between Cells	≥ 0.04
Specific Gravity	≥ 1.24

FASTER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Generator Terminal B+Nut	14 - 18	10 - 13	-
Generator Terminal D+Nut	4 - 5	-	35 - 44
Generator Mounting Bolt	25	18	-
Battery Cable Nut on Starting Motor	12 - 15	9 - 11	-
Electric Wire Nut on Starting Motor	6 - 7	-	53 - 62
Starting Motor Mounting Bolt	35 - 48	26 - 35	-
Battery Mounting Bracket Nut	12 - 18	9 - 13	-
Battery Negative Cable	12 - 18	9 - 13	-
Battery Positive Cable	12 - 18	9 - 13	-
Spark plug Cover Bolt	9 - 11	-	80 - 97
Ignition Cable Bolt	9 - 11	-	80 - 97
Spark plug	20 - 30	15 - 22	-

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MAINTENANCE AND REPAIR



ON-VEHICE SERVICE

GENERATOR

Preceding Work : Removal of the drivebelt

Removal & Installation Procedure

1. Disconnect the negative battery terminal.
2. Unscrew the nut and disconnect the terminal (1).

Installation Notice

Tightening Torque	14 - 18 N•m (10 - 13 lb-ft)

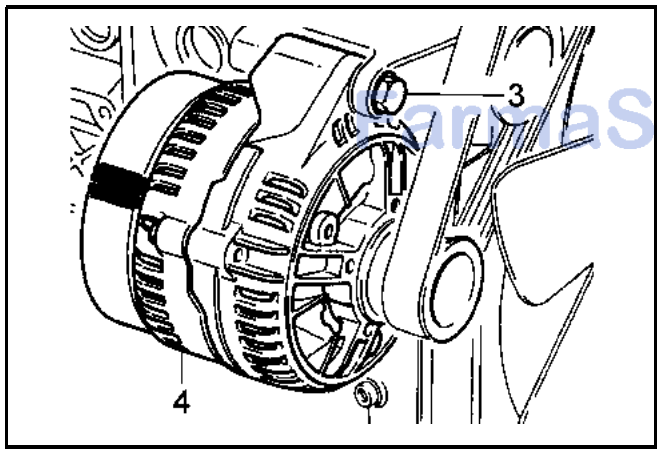
3. Unscrew the nut and disconnect the terminal (2).

Installation Notice

Tightening Torque	4 - 5 N•m (35 - 44 lb-in)

1 Terminal (B+)
2 Terminal (D+)

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4. Unscrew the generator mounting bolt (3).

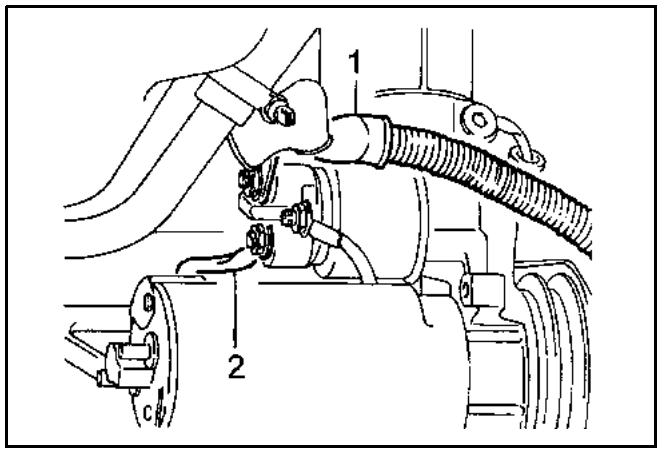
Installation Notice

Tightening Torque	25 N•m (18 lb-ft)

5. Remove the generator.
6. Installation should follow the removal procedure in the reverse order.

3 Generator Mounting Bolt
4 Generator

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STARTING MOTOR

Removal & Installation Procedure

1. Disconnect the ground cable.
2. Unscrew the nut and disconnect the battery cable (1).

Installation Notice

Tightening Torque	12 – 15 N•m (9 – 11 lb-ft)

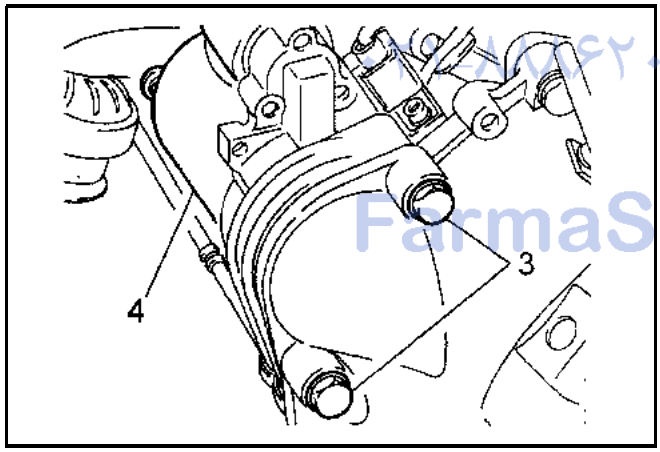
3. Unscrew the nut and disconnect the engine electric wire (2).

Installation Notice

Tightening Torque	6 – 7 N•m (53 – 62 lb-in)

1 Battery Cable
2 Engine Electric Wire

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4. Unscrew the mounting bolts (3) of starting motor.

Installation Notice

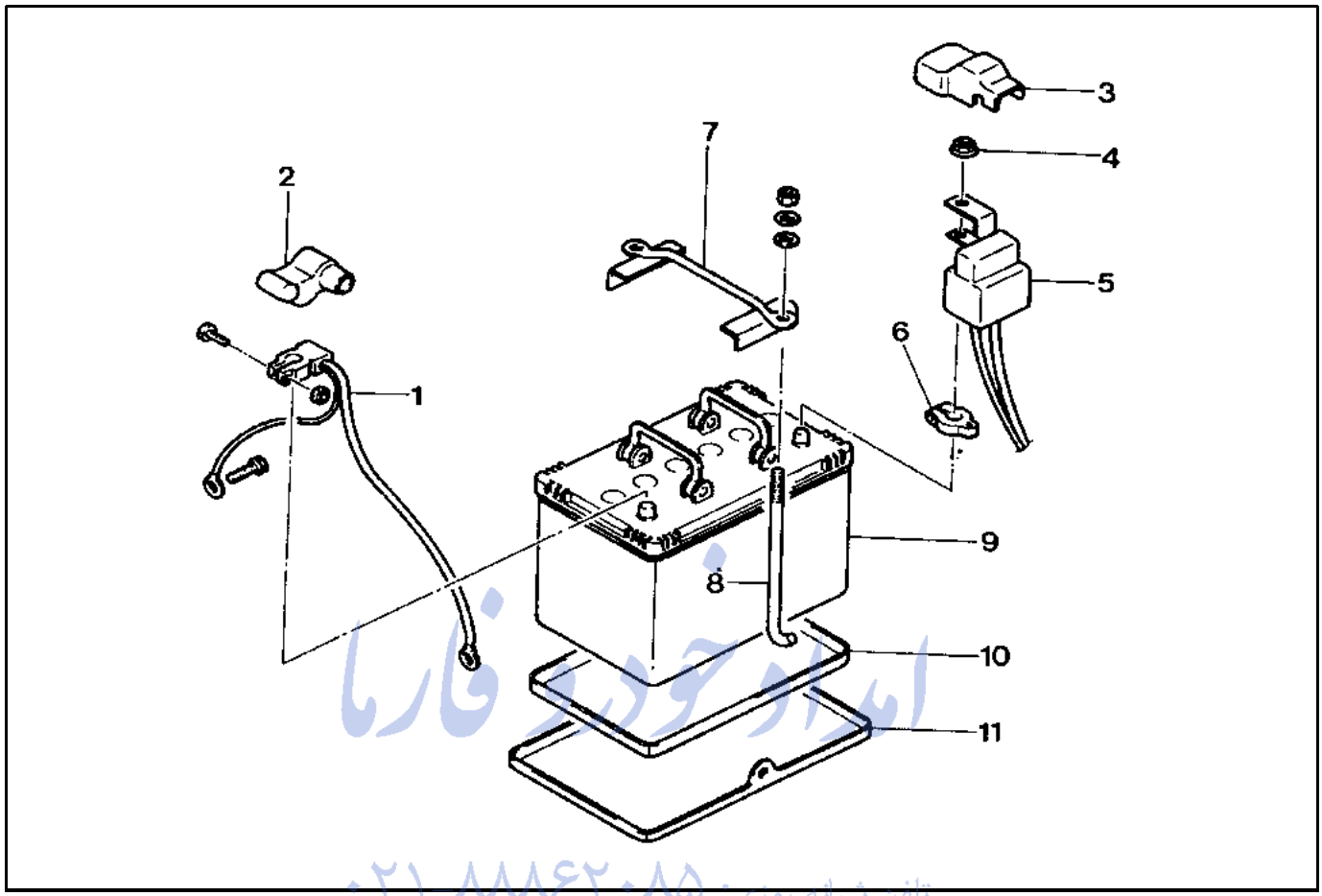
Tightening Torque	35 – 48 N•m (26 – 35 lb-ft)

5. Remove the starting motor.
6. Installation should follow the removal procedure in the reverse order.

3 Fixing Bolt
4 Starting Motor

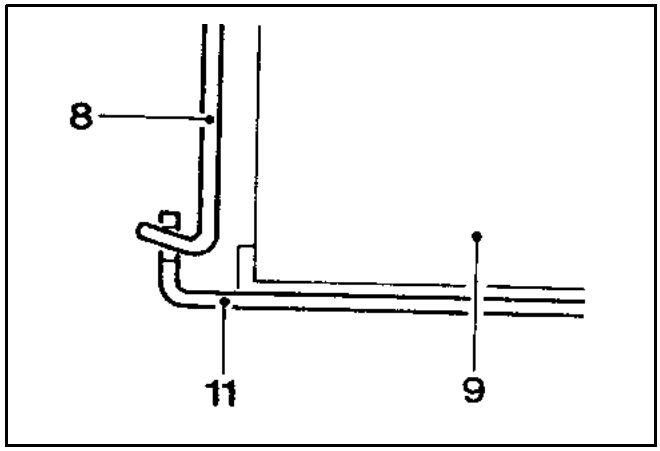
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BATTERY



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1 Cable Terminal (-)
2 Cable Terminal Cap (-)
3 Cable Terminal Cap (+)
4 Nut
5 Fuseblink Box
6 Terminal (+)
7 Battery holddown Bracket
8 Battery Clamp Bolt
9 Battery
10 Sub Tray
11 Battery Tray



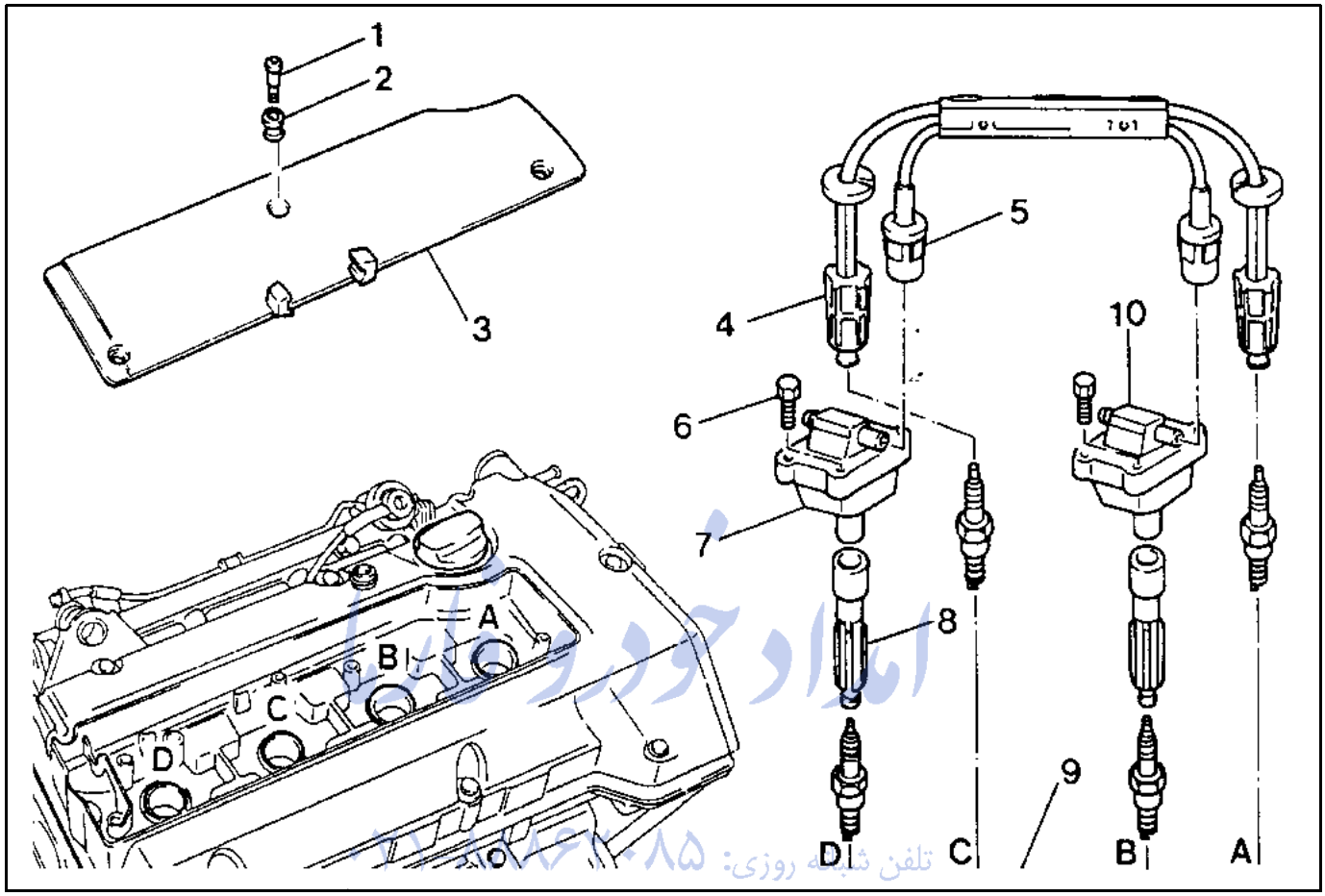
Removal & Installation Procedure

Notice

- Disconnect the battery negative cable first.
- Insert the clamp bolt (8) into the battery tray hole (11) from inside when installing.

SPARK PLUG

Preceding Work: Removal of intake air duct



1 Screw (3 pieces) . . . . . 9-11 N•m (80-97 lb-in)
2 Adaptor (3 pieces)
3 Ignition Coil Cable Cover
4 Spark Plug Connector
5 Ignition Coil Connector
6 Bolts (M6 X 25, 4 pieces)
. . . . . 9-11 N•m (80-97 lb-in)
7 Ignition Coil (T1/1)
8 Coupling Plug
9 Spark Plug . . . . . 20-30 N•m (15-22 lb-ft)
10 Ignition Coil (T1/2)

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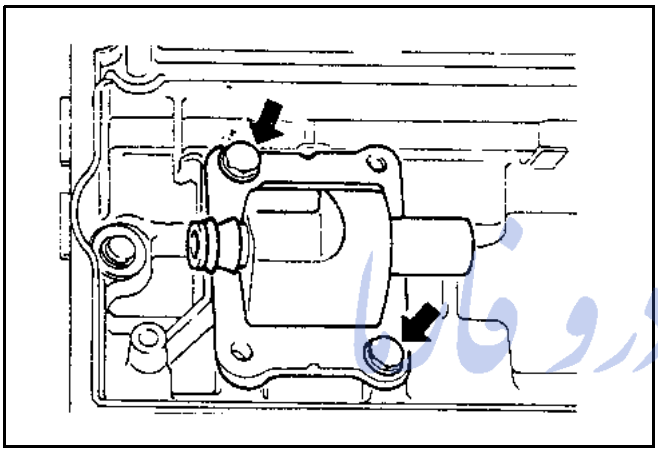
Replacement Procedure

1. Unscrew the three screws(1) and remove the spark plug cable cover.

   Installation Notice

Tightening Torque	9 - 11 N•m (80 - 97 lb-in)

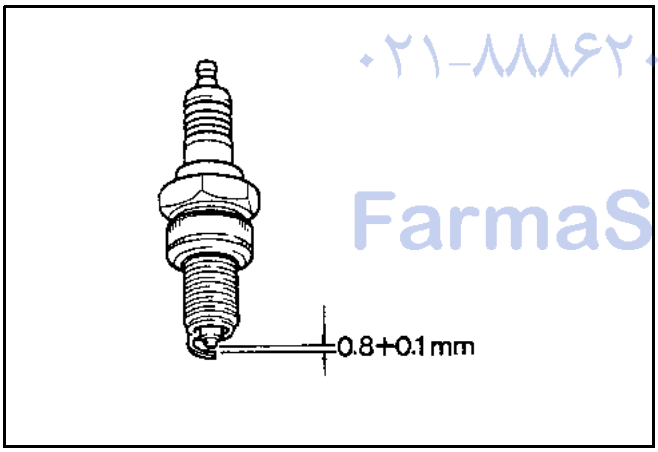
2. Disconnect the cable from ignition coil and spark plug.



3. Unscrew two bolts(M6 X 25) from each ignition coil and remove the ignition coil(arrow).

   Installation Notice

Tightening Torque	9 - 11 N•m (80 - 97 lb-in)



4. Remove the spark plug .

   Installation Notice

Tightening Torque	20 - 30 N•m (15 - 22 lb-ft)
Clearance	0.8 + 0.1 mm

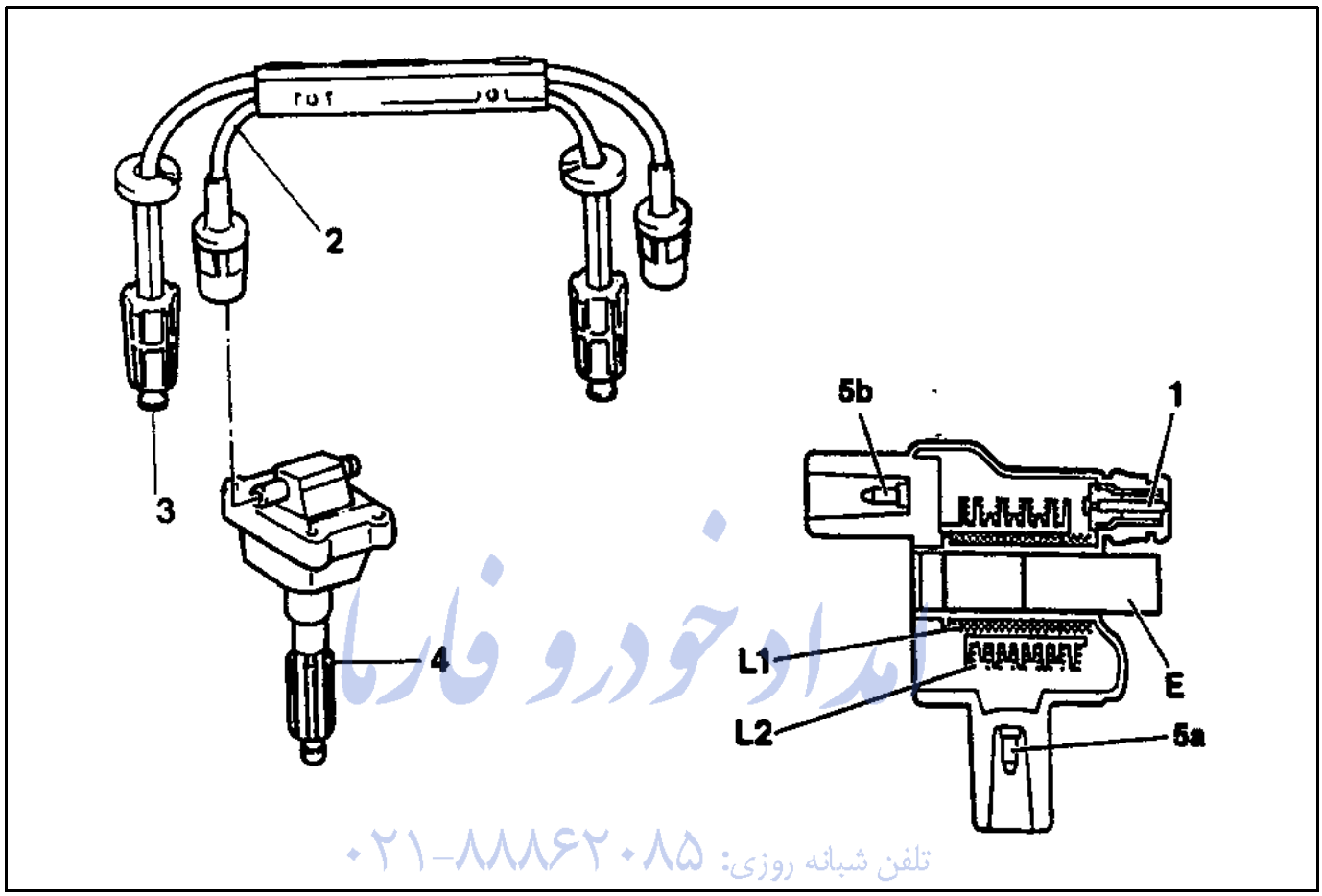
Notice:

- Tighten the spark plug with specified torque.
- Install the ignition coil to number 2 and 4 cylinder, and connect the cable to number 1, 4 and 2, 3 cylinder.
  - T1/1 : cylinder 1 and 4
  - T1/2 : cylinder 2 and 3

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IGNITION CABLE

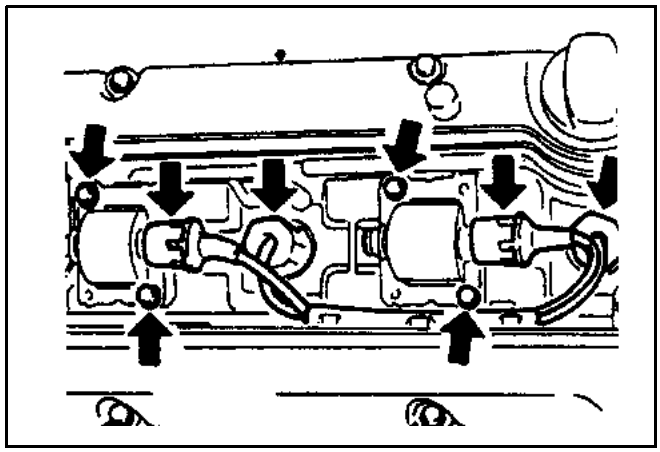
Preceding Work: Removal of intake air duct



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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵

1 Control Cable Connection
2 Ignition Cable
3 Spark Plug Connector
4 Coupling Plug
5a, 5b Secondary Voltage Connection
E Iron Core
L1 Secondary Ignition Coil
L2 Primary Ignition Coil

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Removal & Installation Procedure

1. Disconnect the battery negative cable.
2. Unscrew the 3 screws and remove the ignition cable duct cover.

Installation Notice

Tightening Torque	9 - 11 N•m (80 - 97 lb-in)

3. Seperate the cable from the ignition cable and the spark plug.
4. Remove the 2 bolts from each ignition cable and remove the ignition cables.

Installation Notice

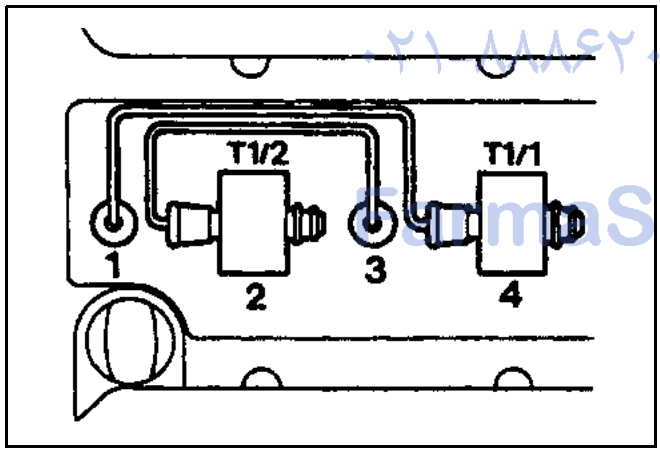
Tightening Torque	9 - 11 N•m (80 - 97 lb-in)

Install the ignition cable to the cylinder 2 and 4 and connect the cable from 1 to 4, and from 2 to 3.

- T1/1 : Cylinder 1 and 4
- T1/2 : Cylinder 2 and 3

5. Installation should follow the removal procedure in the reverse order.

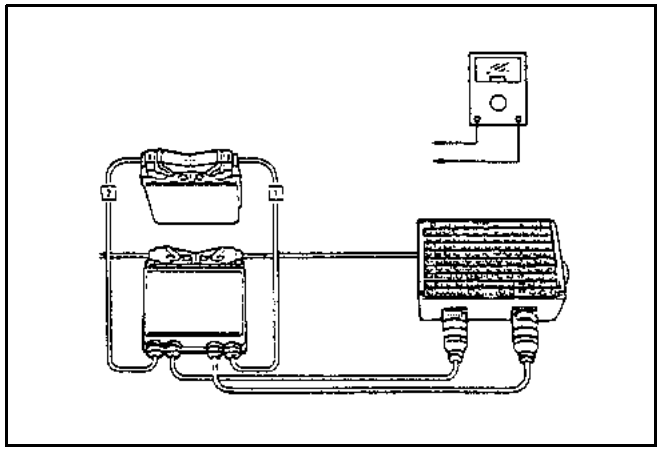
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۰۲۱-۸۸۸۴۲۰۸۵
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Ignition Cable and Cable Lay-out

1. Firing Order : 1-3-4-2
2. T1/1 : Connect the cylinder 1 + 4
3. T1/2 : Connect the cylinder 2 + 3



Inspection & Maintenance (for E2.3 MSE)

1. Measure the primary resistance between the cable terminals 1 and 15 after removing the ignition cable wiring connector (1 and 15) with ignition switch OFF.

Notice: Replace the ignition coil if out of the specified resistance.

Specified Value	0.9 - 1.6 Ω

2. Measure the primary voltage(T1/1) between the ECU terminals No.72 and No.69 during the engine cranking (starter motor activated).

Specified Value	200 - 350 v

- T1/2 : between No.71 and No.69

Notice: Check the ignition cable and the ECU if out of the specified value.

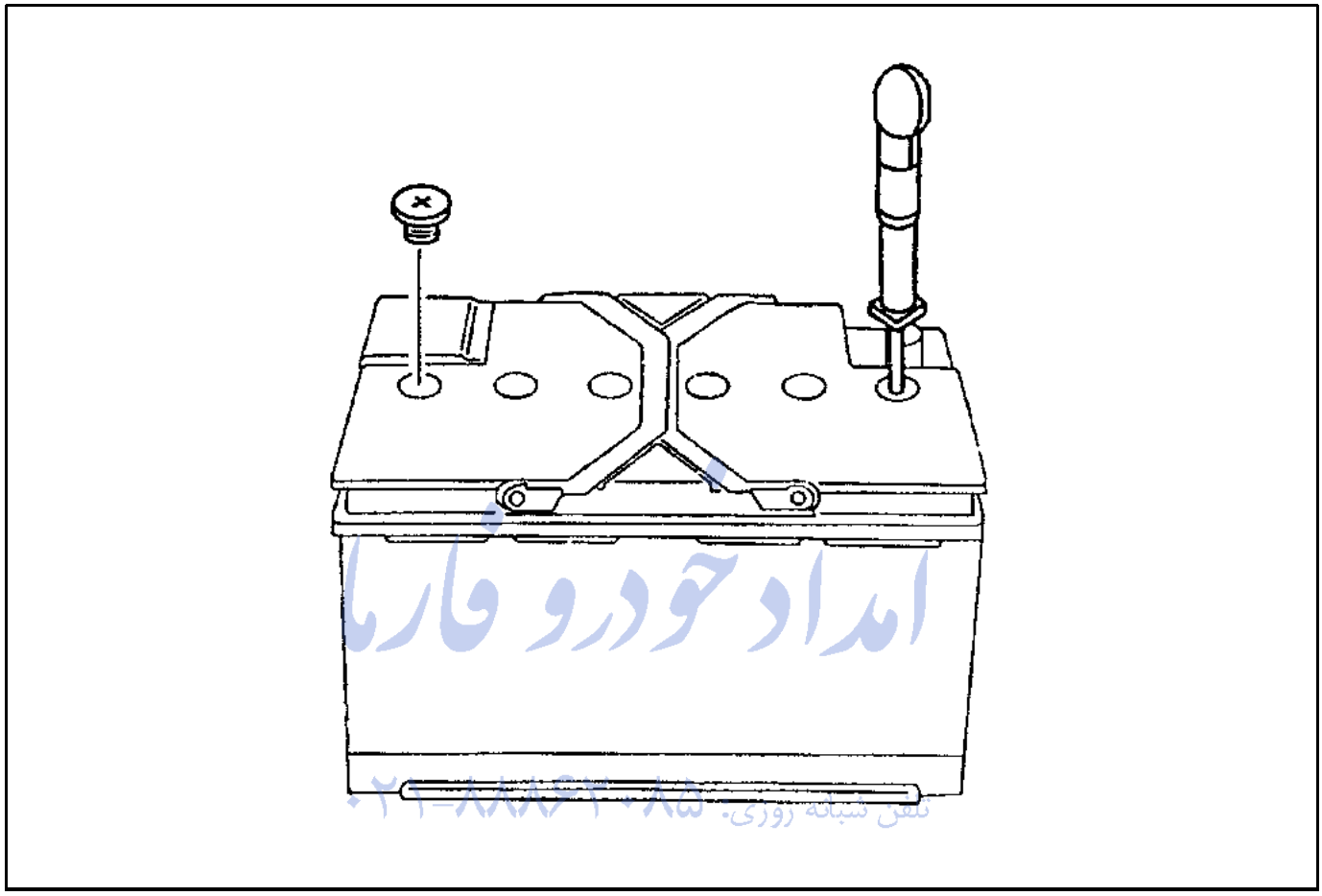
3. Measure the secondary cable resistance between the ignition coil 5a and 5b using a multimeter.

Specified Value	6 - 8.5 kΩ

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UNIT REPAIR

BATTERY



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Inspection

Notice

- When charging the battery, do not leave the inflammable objects around it.
- When checking the electrolyte of battery, put on an eye protector and gloves.

1. Inspect the surface of the battery and replace if any defects were found on it.
2. Check if the specific gravity of the electrolyte is within the specified value.

Battery capacity(Ah)	90
Battery specific gravity	≥ 1.24
Max. tolerance between cells	≥ 0.04

Notice

- Replace the battery if the maximum tolerance of the electrolyte between cells is out of the specified value.
- Measure the specific gravity in the approx. 20 °C of ambient temperature

3. Replenish the electrolyte if necessary.

SECTION 1F2

ENGINE CONTROLS

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

Engine and ECM Problem Check Report 1F2-2
Specifications 1F2-3
Engine Data Display Table 1F2-3
Fastener Tightening Specifications 1F2-4
Fuel System Specification 1F2-5
Temperature vs Resistance 1F2-5
Special Tools and Equipment 1F2-6
Special Tools Table 1F2-6
Schematic and Routing Diagrams 1F2-7
ECM Wiring Diagram (2.3L DOHC - MSE 3.53S) 1F2-7
Diagnosis 1F2-14
Failure Code Diagnosis 1F2-14
Clearing Failure Codes 1F2-14
Failure Codes Table 1F2-14
Ignition System 1F2-18
Ignition Coil 1F2-20
Crankshaft Position (CKP) Sensor 1F2-22
Camshaft Position (CMP) Sensor 1F2-26
Camshaft Actuator 1F2-30
Knock Sensor (KS) 1F2-32
Spark Plug 1F2-34
System Voltage 1F2-38
Ignition Switch 1F2-39
Fuel System 1F2-40
Fuel Pump 1F2-42
Fuel Injector 1F2-46
Purge Control Valve 1F2-50
Fuel Rail 1F2-52
Fuel Pressure Regulator 1F2-54
Induction System 1F2-56
Throttle Valve Actuator 1F2-56
Hot Film Air Mass (HFM) Sensor 1F2-60
Engine Coolant Temperature (ECT) Sensor . 1F2-64
Accelerator Pedal Module 1F2-68
Cooling Fan 1F2-72
A/C Compressor Relay 1F2-73
Cruise Control Switch 1F2-74
Traction Control System (TCS) 1F2-75
Stop Lamp Switch 1F2-76
Engine RPM 1F2-77
Exhaust System 1F2-78
Catalytic Converter 1F2-78
Oxygen Sensor 1F2-80
Engine Control Module 1F2-86
Serial Data Communication 1F2-88
Internal Failure 1F2-90
Electronic Throttle Controller Safety Malfunction 1F2-92
Immobilizer 1F2-94
Maintenance and Repair 1F2-95
On-Vehicle Service 1F2-95
Discharging the Pressure in Fuel System ... 1F2-95
Fuel Pump 1F2-95
Fuel Filter 1F2-96
Fuel Tank 1F2-97
Fuel Pressure Regulator 1F2-98
Fuel Rail and Injector 1F2-99
Engine Coolant Temperature Sensor 1F2-100
Throttle Body (Integrated with the Actuator) 1F2-101
Hot Film Air Mass (HFM) Sensor 1F2-102
Knock Sensor 1F2-102
Pedal Position Sensor 1F2-103
Oxygen Sensor 1F2-103
Purge Control Valve 1F2-104
Canister 1F2-104
Camshaft Position Sensor 1F2-104
Crankshaft Position Sensor 1F2-105
Engine Control Module 1F2-105

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ENGINE AND ECM PROBLEM CHECK REPORT

VEHICLE AND CUSTOMER INFORMATION

Date problem Occurred			
Customer Name		Vehicle Model	
Driver Name		VIN	
Purchase date		Engine Model	
License No.		Mileage	Km miles

MIL INFORMATION

Condition of MIL	□ Remains on □ Sometimes illuminates □ Does not illuminate
DTC inspection (if available)	□ Normal □ Malfunction code(s) (code) □ Freezed frame data ( )

PROBLEM DESCRIPTION

□ Engine Does Not Start	□ No cranking □ No initial combustion □ No complete combustion
□ Hard to Start	□ Slow cranking □ Others
□ Poor Idling	□ Incorrect first Idle □ Abnormal idle rpm □ High (rpm) □ Low (rpm) □ Idling Unstable □ Others
□ Poor Driveability	□ Hesitation □ Back fire □ Muffler explosion (after-burning) □ Surging □ Knocking □ Poor performance □ Other
□ Engine Stall	□ Soon after starting □ After accelerator pedal depressed □ After accelerator pedal released □ During A/C operation □ Shifting from N to D or D to N □ At full steering □ Others
□ Others	

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CONDITION WHEN PROBLEM OCCURS

Problem Frequency	□ Constant □ Intermittent (times per day/month) □ Once only □ Others
Weather	□ Fine □ Cloudy □ Rainy □ Snowy □ Various/Others
Ambient Temperature	□ Hot □ Warm □ Cool □ Cold (approx.____°F/____°C)
Place	□ Highway □ Suburbs □ Inner City □ Uphill □ Downhill □ Rough Road □ Others
Engine Temperature	□ Cold □ Warming Up □ Before warming up □ After warm-up □ Any temp. □ Others
Engine Operation	□ Starting □ Just after starting (min.) □ Idling □ Racing □ Driving □ Constant speed □ Acceleration □ Deceleration □ A/C switch ON/OFF □ Other

SPECIFICATIONS

ENGINE DATA DISPLAY TABLE

Parameter	Unit	Value
Engine Coolant Temp.	°C	greater than 95 °C after warm up
Intake Air Temp.	°C	-40 ~ 130 °C (varies with ambient temp. or engine mode)
Engine RPM	rpm	700 ± 50 (P/N), 600 ± 50 (D)
Regular RPM	rpm	700 ± 50 (P/N), 600 ± 50 (D)
Engine Load	%	18 ~ 25 %
Mass Air Flow Meter	Kg/h	16 ~ 25 Kg/h
Throttle Position Angle	°TA	0 °TA (up to 100 °TA at the wide open throttle)
Spark Advance	°CA	8 °CA (6 ~ 9 °CA)
Indicated Engine Torque	Nm	Varies with engine condition
Injection Time	ms	3 ~ 5 ms
Battery Voltage	V	13.5 ~ 14.1 v (engine running)
Front Axle Speed	Km/h	0 ~ 265 Km/h
Rear Axle Speed	Km/h	0 ~ 265 Km/h
Accel. Pedal Position 1	V	0.4 ~ 4.8 V
Accel. Pedal Position 2	V	0.2 ~ 2.4 V
Throttle Position 1	V	0.3 ~ 4.6 V
Throttle Position 2	V	0.3 ~ 4.6 V
Fuel Integrator		0.8 ~ 1.2
Oxygen Sensor	mv	100 ~ 900 mv
A/C S/W Condition	1=ON/0=OFF	-
Full Load State	1=ON/0=OFF	-
Shift Gear State (A/T)	1=ON/0=OFF	-
A/C Control State	1=ON/0=OFF	-
Clutch Switch (M/T)	1=ON/0=OFF	-
Cam Actuator State	1=ON/0=OFF	-
Knocking Control	1=ON/0=OFF	-
Protect Mission	1=ON/0=OFF	-
Purge Control Valve	1=ON/0=OFF	-
Lambda Function	1=ON/0=OFF	-
Catalyst Heating	1=ON/0=OFF	-
Overrun Fuel Cut	1=ON/0=OFF	-
Full Fuel Cut	1=ON/0=OFF	-
Brake Switch	1=ON/0=OFF	-
Cruise Control Status	1=ON/0=OFF	-

* Condition : Warmed up, idle, P/N or neutral

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FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Camshaft Position Sensor Retaining Bolts	10	-	89
Canister Mounting Bolts	6	-	53
Coolant Temperature Sensor	30	22	-
Crankshaft Position Sensor Retaining Bolt	10	-	89
Engine Control Module (ECM) Mounting Bracket Nuts	10	-	89
Fuel Filter Mounting Bracket Bolt	6	-	53
Fuel Filter Lines	28	21	-
Fuel Pressure Test Connector	25	18	-
Fuel Rail Assembly Bolts	25	18	-
Fuel Return And Supply Lines	23	17	-
Fuel Tank Retaining Nuts	38	28	-
Knock Sensor Mounting Bolt	25	18	-
Oxygen Sensor	55	41	-
Pedal Position Censor Mounting Bolts And Nut	6	-	53
Throttle Body Bolts	12	-	106

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FUEL SYSTEM SPECIFICATION

Use Only Unleaded Fuel Rated at 89 Octane or Higher

Fuel quality and additives contained in fuel have a significant effect on power output, drivability, and life of the engine.

Fuel with too low an octane number can cause engine knock.

Caution: Use of fuel with an octane number lower than 89 may damage engine and exhaust system.

Notice: To prevent accidental use of leaded fuel, the nozzles for leaded fuel are larger, and will not fit the fuel filler neck of your vehicle.

Do Not Use Methanol

Fuels containing methanol (wood alcohol) should not be used in vehicle.

This type of fuel can reduce vehicle performance and damage components of the fuel system.

Caution: Use of methanol may damage the fuel system.

Vehicle Fueling from Drums or Storage Containers

For safety reasons (particularly when using noncommercial fueling systems) fuel containers, pumps and hoses must be properly earthed.

Static electricity build up can occur under certain atmospheric and fuel flow conditions if unearthed hoses, particularly plastic, are fitted to the fuel-dispensing pump.

It is therefore recommended that earthed pumps with integrally earthed hoses be used, and that storage containers be properly earthed during all noncommercial fueling operations.

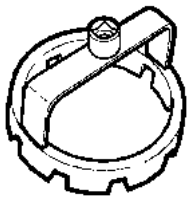
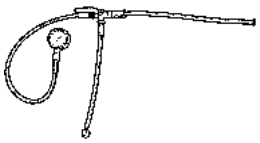
TEMPERATURE VS RESISTANCE

°C	°F	ECT sensor	IAT sensor
		OHMS (Ω)	
Temperature vs Resistance Values (Approximate)			
130	266	88	102
120	248	111.6	127
110	230	143	159
100	212	202	202
90	194	261	261
80	176	340	340
70	158	452	452
60	140	609	609
50	122	835	835
40	113	1166	1166
30	86	1662	1662
20	68	2420	2420
10	50	3604	3604
0	32	5499	5499
-10	14	8609	8609
-20	-4	13850	13850
-30	-22	22960	22960
-40	-40	39260	39260

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SPECIAL TOOLS AND EQUIPMENT

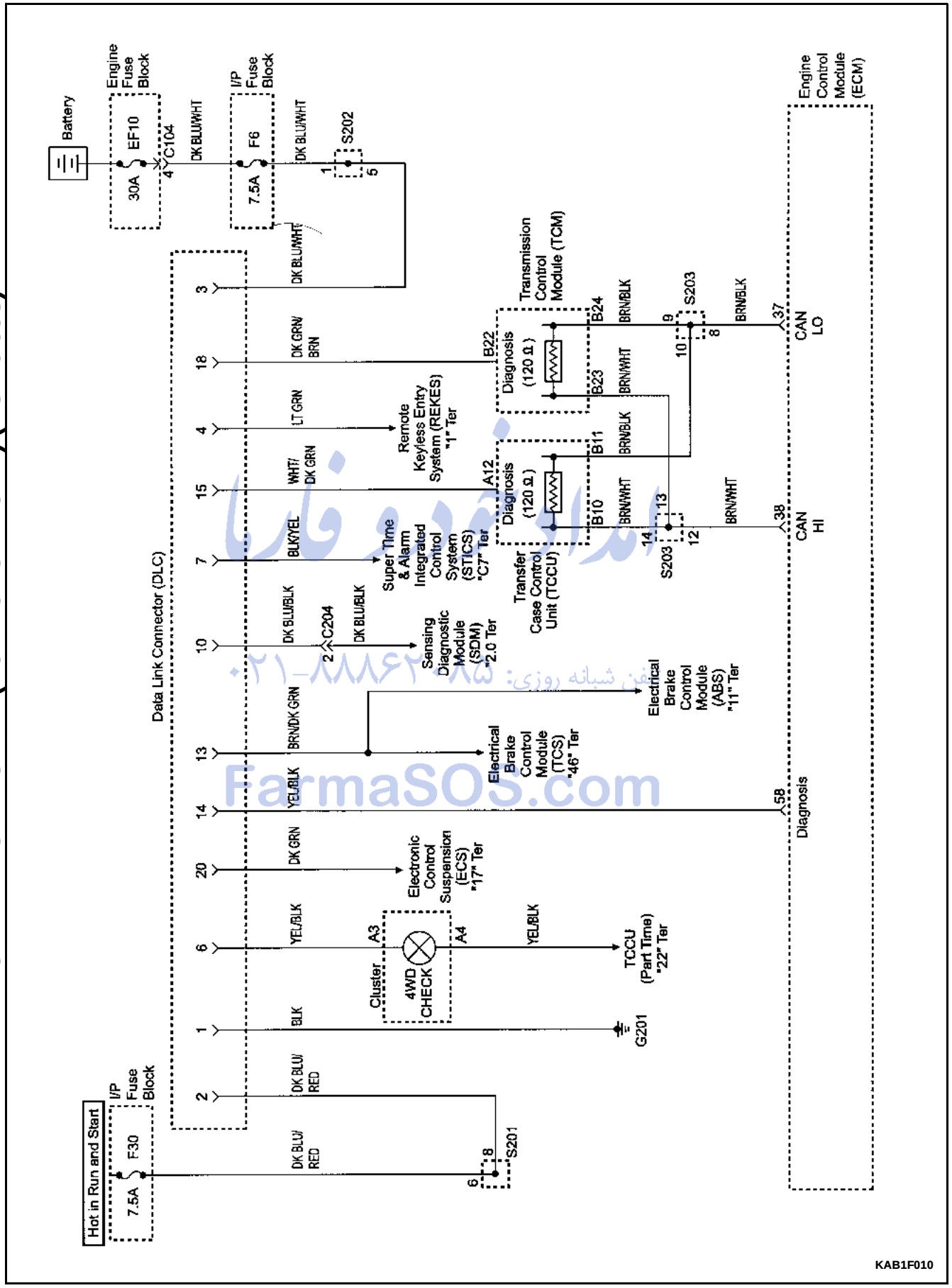
SPECIAL TOOLS TABLE

 YAA1F890	**661 589 00 46 00** **Fuel Tank Cap Wrench**
 KAA1F490	**103 589 00 21 00** **Fuel Pressure Gauge**

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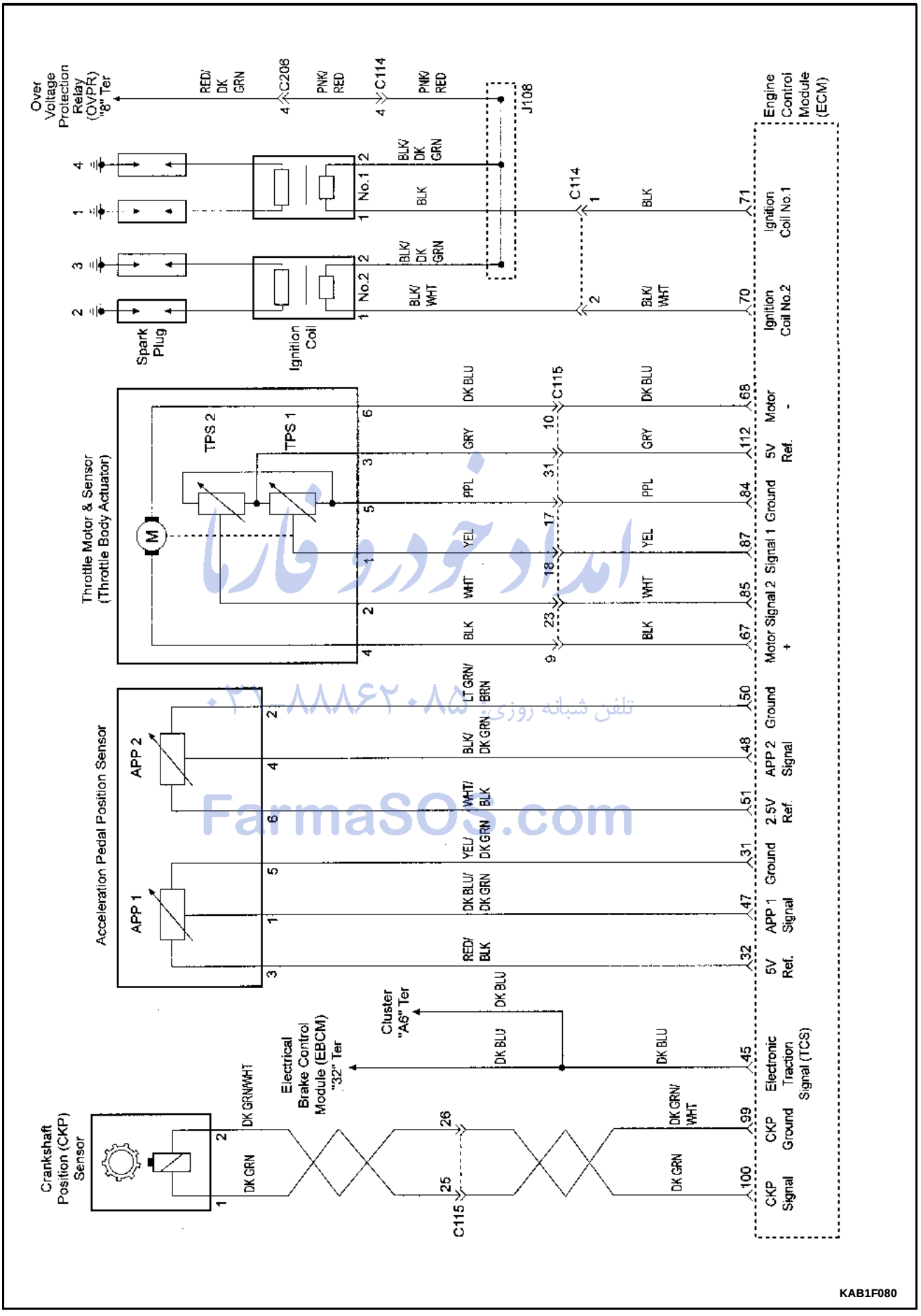
SCHEMATIC AND ROUTING DIAGRAMS

ECM WIRING DIAGRAM (2.3L DOHC – 1OF 7) (MSE 3.53S)



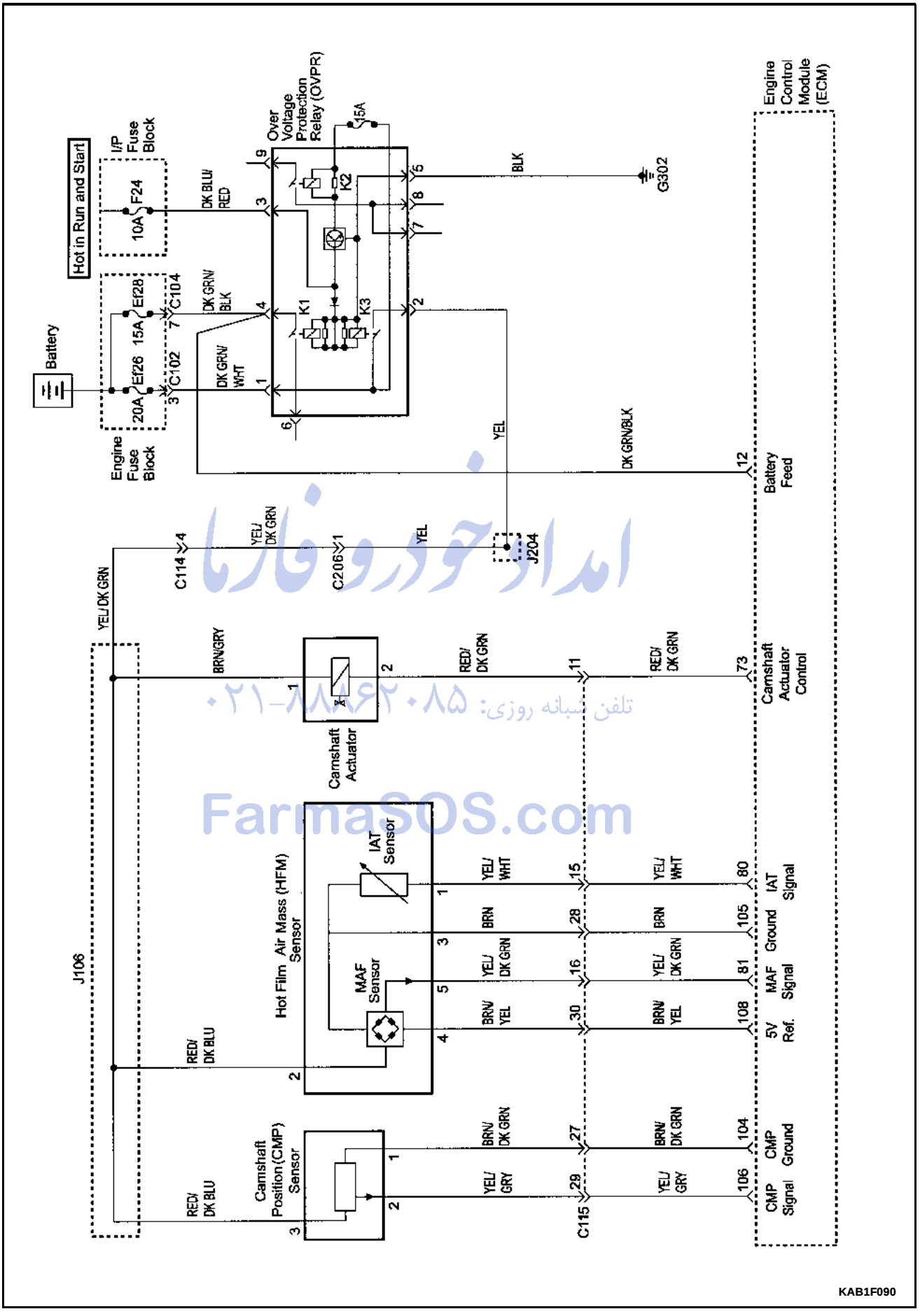
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ECM WIRING DIAGRAM (2.3L DOHC - 2 OF 7) (MSE 3.53S)



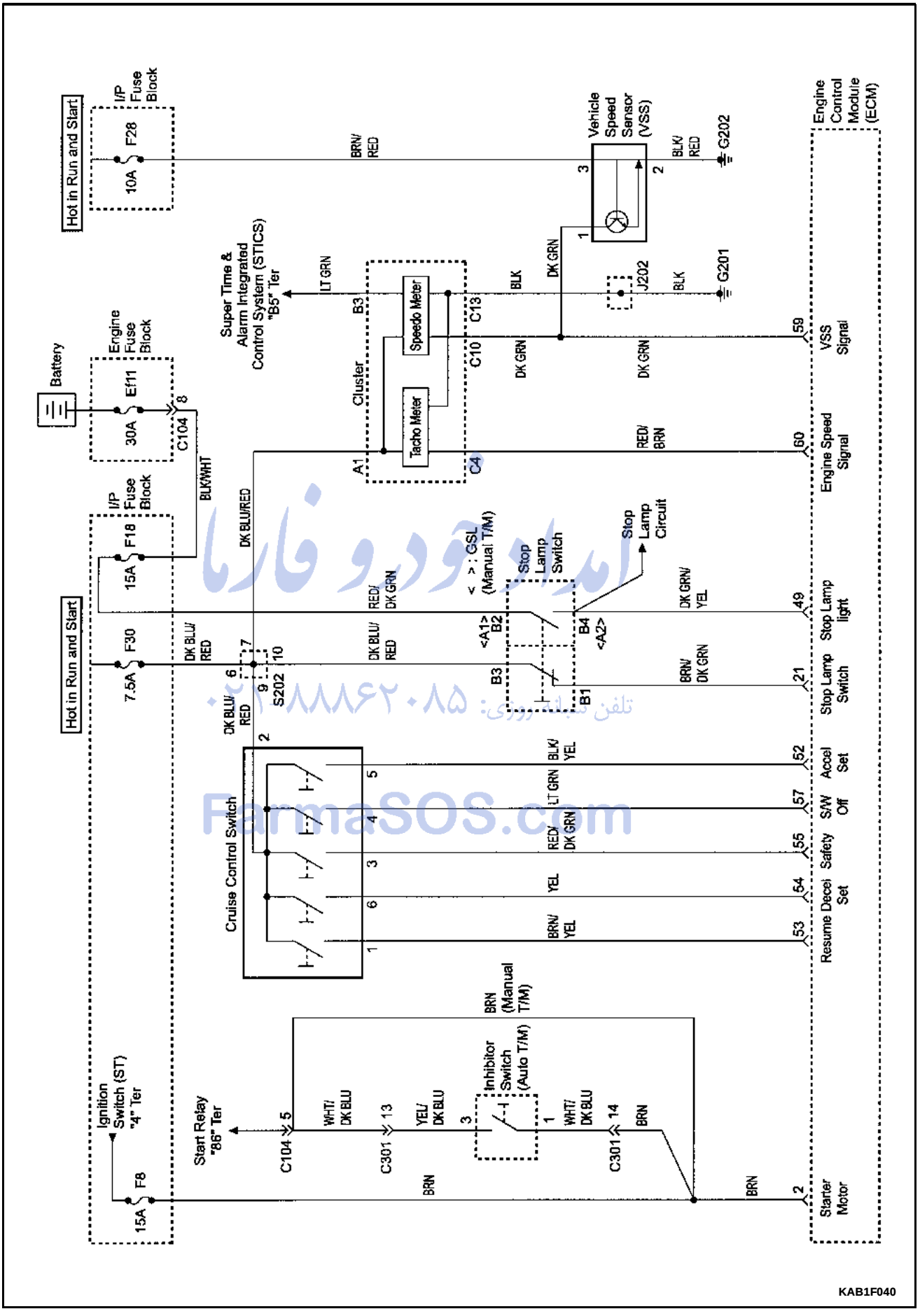
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ECM WIRING DIAGRAM (2.3L DOHC - 3 OF 7) (MSE 3.53S)



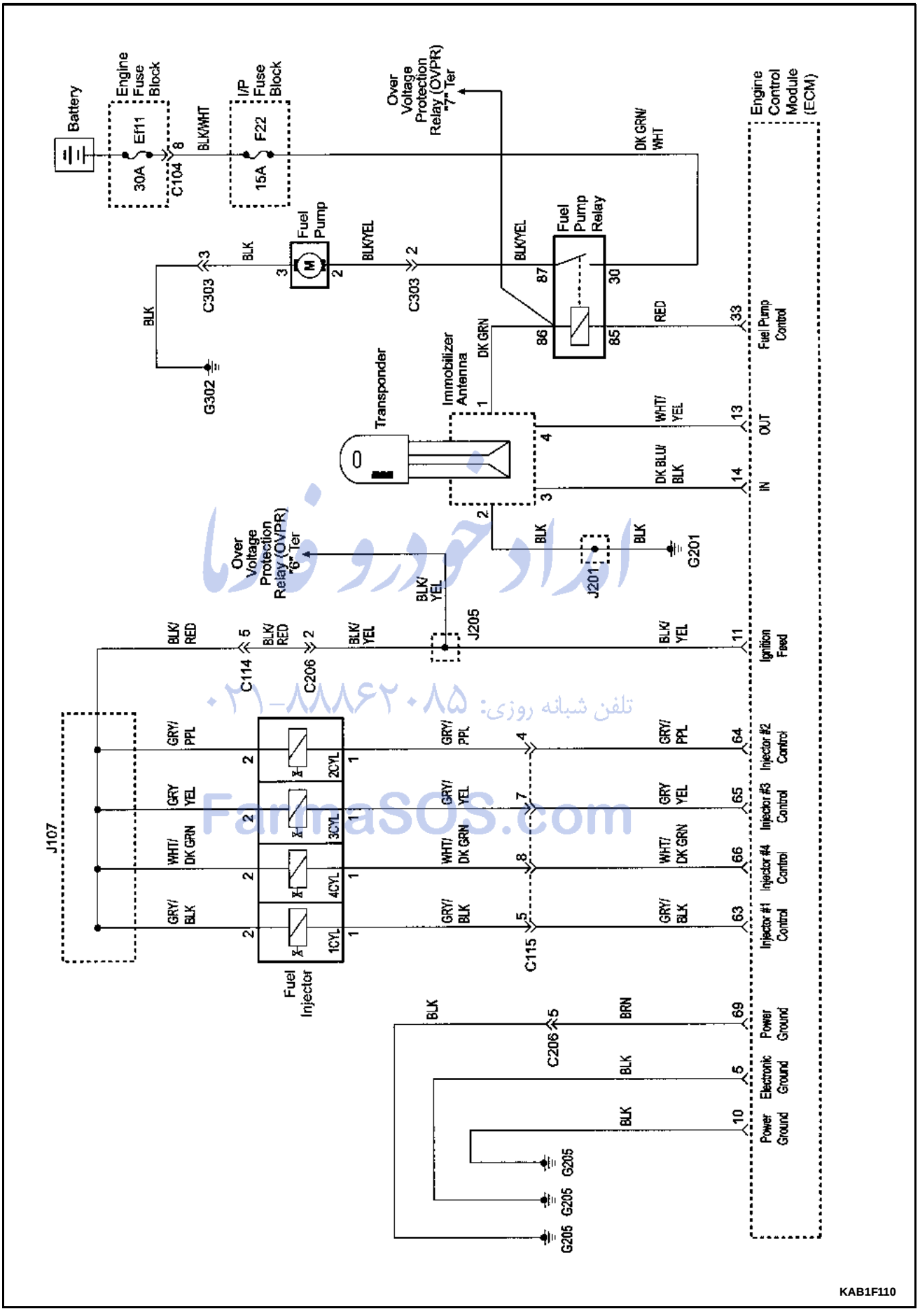
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ECM WIRING DIAGRAM (2.3L DOHC - 4 OF 7) (MSE 3.53S)



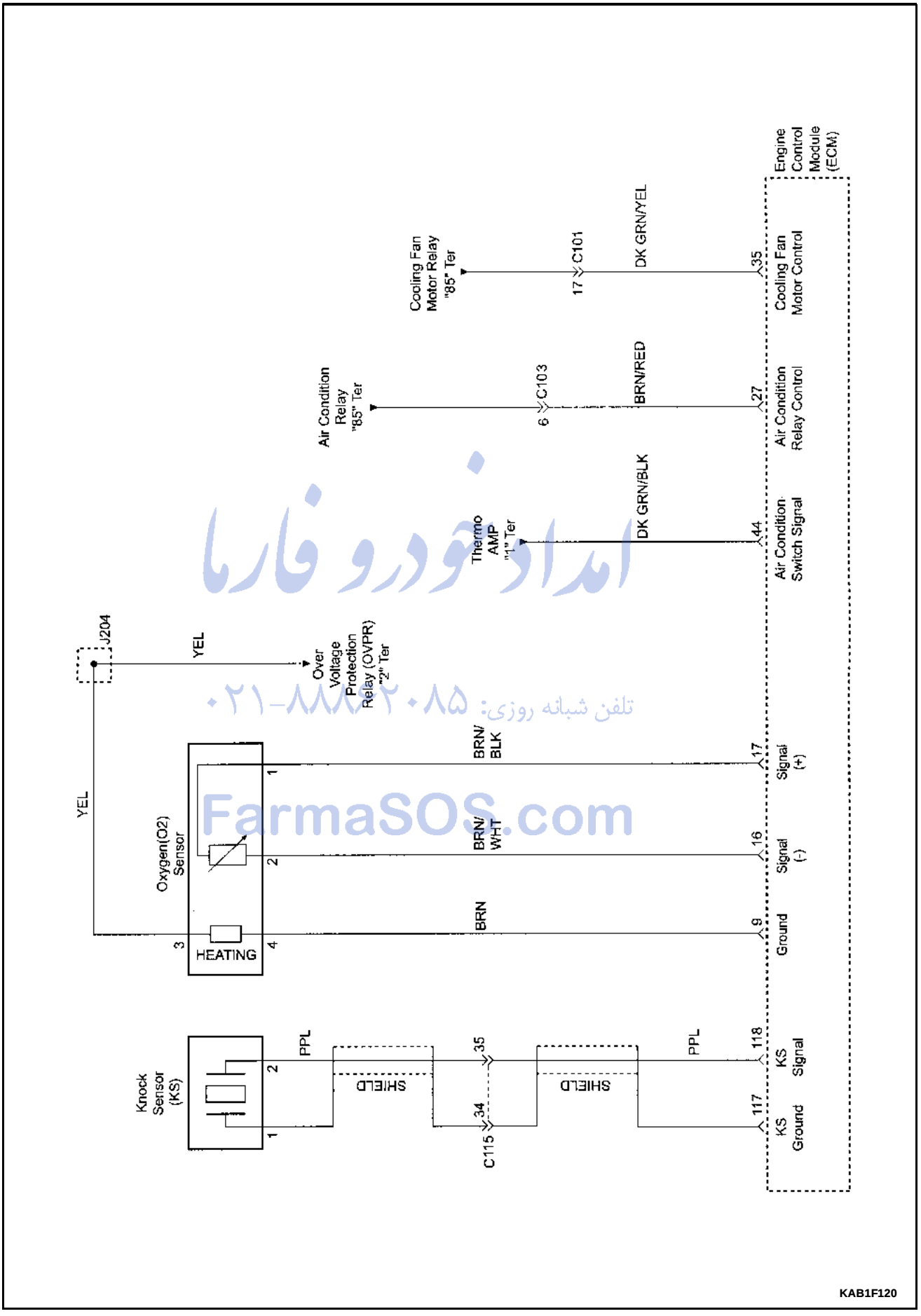
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ECM WIRING DIAGRAM (2.3L DOHC - 5 OF 7) (MSE 3.53S)



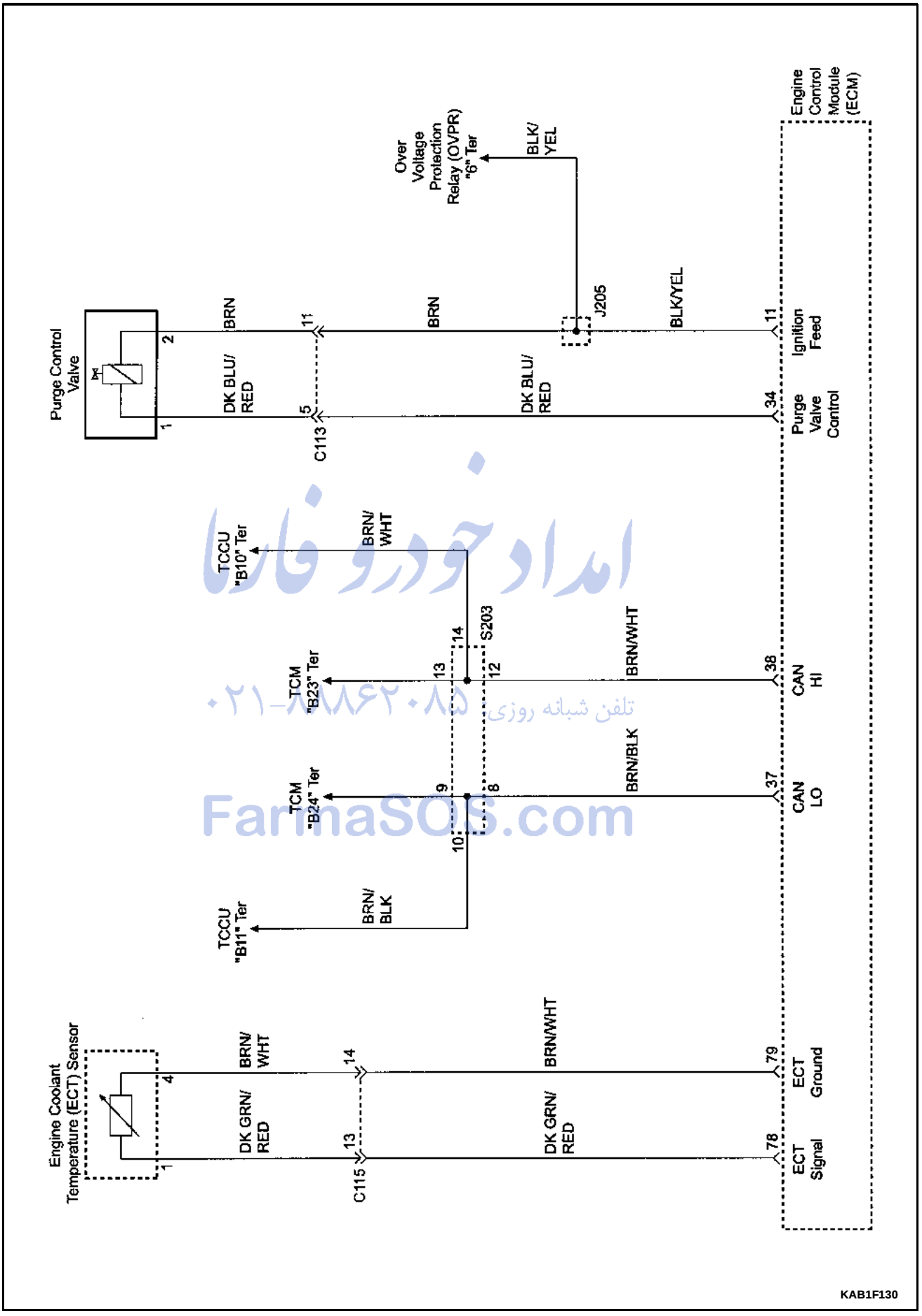
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ECM WIRING DIAGRAM (2.3L DOHC - 6 OF 7) (MSE 3.53S)



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ECM WIRING DIAGRAM (2.3L DOHC - 7 OF 7) (MSE 3.53S)



KAB1F130

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DIAGNOSIS

FAILURE CODE DIAGNOSIS

CLEARING FAILURE CODES

Notice: To prevent Engine Control Module (ECM) damage, the key must be OFF when disconnecting or reconnecting the power to the ECM (for example battery cable, ECM pigtail connector, ECM fuse, jumper cables, etc.)

Parameters listed in the table may not be exactly the same as your reading due to the type of instrument or other factors. If a failure code is displayed during the “TROUBLE CODE” in scan tool check mode, check the circuit for the code listed in the table below. For details of each code, turn to the page referred to under the “See Page” for the respective “Failure Code” in the below table.

Failure codes should be cleared after repairs have been completed.

FAILURE CODES TABLE

Failure code	See Page	Description
00	1F2-66	Engine coolant temperature sensor low voltage
01	1F2-66	Engine coolant temperature sensor high voltage
02	1F2-66	Engine coolant temperature sensor plausibility
03	1F2-62	Intake air temperature sensor low voltage
04	1F2-62	Intake air temperature sensor high voltage
05	1F2-62	Intake air temperature sensor plausibility
06	1F2-66	Engine coolant temperature insufficient for closed loop fuel control
08	1F2-38	System voltage too low
09	1F2-62	Mass air flow sensor plausibility
10	1F2-62	Mass air flow sensor low voltage
11	1F2-62	Mass air flow sensor high voltage
17	1F2-23	Crankshaft position sensor signal failure (no engine revolution signal)
18	1F2-23	Crankshaft position sensor signal failure (rpm > max. value)
19	1F2-27	Camshaft position senosr signal : No.1 cylinder recognition failure
20	1F2-23	Crankshaft position sensor signal failure (gap recognition failure)
21	1F2-90	Transmission coding failure
23	1F2-88	CAN communication failure : ASR/MSR
24	1F2-88	CAN communication failure : ABS
25	1F2-94	Communication with transponder missing
26	1F2-88	CAN communication failure : TCU (A/T only)
29	1F2-89	CAN communication failure : ID 200h not plausible
30	1F2-89	CAN communication failure : ID 208h not plausible
31	1F2-89	CAN communication failure : communication initialization failure
32	1F2-77	Engine rpm output circuit short circuit to battery
33	1F2-77	Engine rpm output circuit short circuit to ground or open
34	1F2-43	Fuel pump relay short circuit to battery
35	1F2-43	Fuel pump relay short circuit to ground or open

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FAILURE CODES TABLE (Cont'd)

Failure code	See Page	Description
40	1F2-51	Purge control valve short circuit to battery
41	1F2-51	Purge control valve short circuit to ground or open
44	1F2-72	Cooling fan (HI) relay short circuit to power
45	1F2-72	Cooling fan (HI) relay short circuit to ground or open
54	1F2-51	Purge control circuit malfunction
56	1F2-33	No.1 knock sensor signal failure
58	1F2-27	Camshaft position sensor signal : No.1 cylinder synchronization failure
59	1F2-89	CAN communication failure : MSR data transmission not plausible
60	1F2-89	CAN communication failure : ASR data transmission not plausible
64	1F2-21	No ignition voltage output (No.1 ignition coil)
65	1F2-21	No ignition voltage output (No.2 ignition coil)
67	1F2-23	Crankshaft position sensor adaptation failure
68	1F2-35	Random/Multiple Misfire
71	1F2-39	Starter signal recognition failure
72	1F2-47	No.1 injector short circuit to battery
73	1F2-47	No.1 injector short circuit to ground or open
74	1F2-47	No.2 injector short circuit to battery
75	1F2-47	No.2 injector short circuit to ground or open
76	1F2-47	No.3 injector short circuit to battery
77	1F2-48	No.3 injector short circuit to ground or open
78	1F2-48	No.4 injector short circuit to battery
79	1F2-48	No.4 injector short circuit to ground or open
80	1F2-82	Oxygen sensor high voltage
81	1F2-83	Bank 1 system short term fuel trim adaptation below lean threshold
82	1F2-82	Oxygen sensor no activity detected
83	1F2-82	Oxygen sensor not lean after overrun fuel shut-off
84	1F2-82	Oxygen sensor slow response
85	1F2-82	Oxygen sensor heater failure
86	1F2-82	Oxygen sensor heater short circuit to battery
87	1F2-82	Oxygen sensor heater short circuit to ground or open
89	1F2-82	Oxygen sensor low voltage
93	1F2-83	Bank 1 system short term fuel trim adaptation above rich threshold
96	1F2-83	Bank 1 system short term fuel trim at rich stop
97	1F2-83	Bank 1 system short term fuel trim at lean stop
98	1F2-83	Bank 1 system idle adaptation failure (above rich threshold)
99	1F2-83	Bank 1 system idle adaptation failure (below lean threshold)
100	1F2-83	Bank 1 system learning control failure (rich, low load)
101	1F2-83	Bank 1 system learning control failure (lean, low load)
102	1F2-83	Bank 1 system learning control failure (rich, high load)

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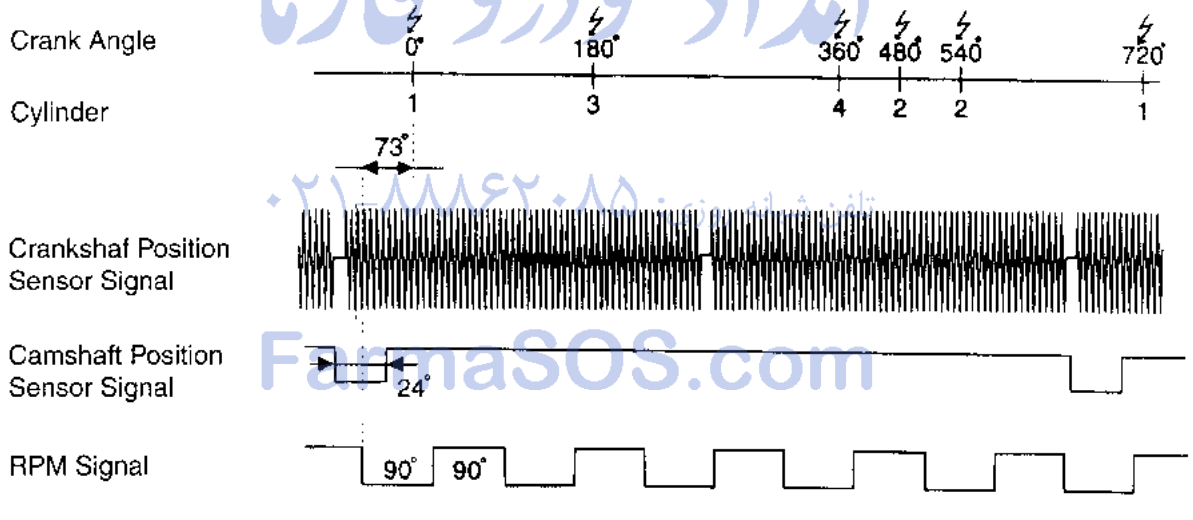
IGNITION SYSTEM

This ignition system does not use a conventional distributor and coil. It uses a crankshaft position sensor input to the Engine Control Module (ECM). The ECM then determines Electronic Spark Timing (EST) and triggers the electronic ignition system ignition coil.

This type of distributorless ignition system uses a “waste spark” method of spark distribution. Each cylinder is paired with the cylinder that is opposite it (2-3 or 1-4). The spark occurs simultaneously in the cylinder coming up on the compression stroke and in the cylinder coming up on the exhaust stroke. The cylinder on the exhaust stroke requires very little of the available energy to fire the spark plug. The remaining energy is available to the spark plug in the cylinder on the compression stroke.

These systems use the EST signal from the ECM to control the EST. The ECM uses the following information:

- Engine load (mass air flow sensor).
- Engine temperature.
- Intake air temperature.
- Crankshaft position.
- Engine speed (rpm).



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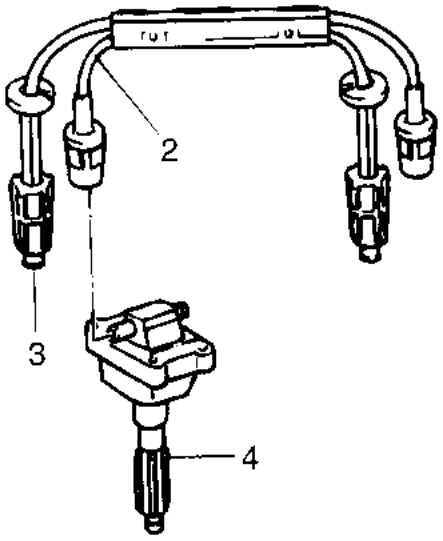
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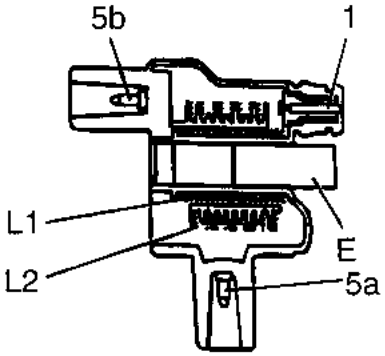
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IGNITION COIL





1. Control Cable Connection
2. Ignition Cable
3. Spark Plug Connector
4. Coupling Plug

5a, 5b. Secondary Voltage Connection
E. Iron Core
L1. Secondary Ignition Coil
L2. Primary Ignition Coil

YAA1F920

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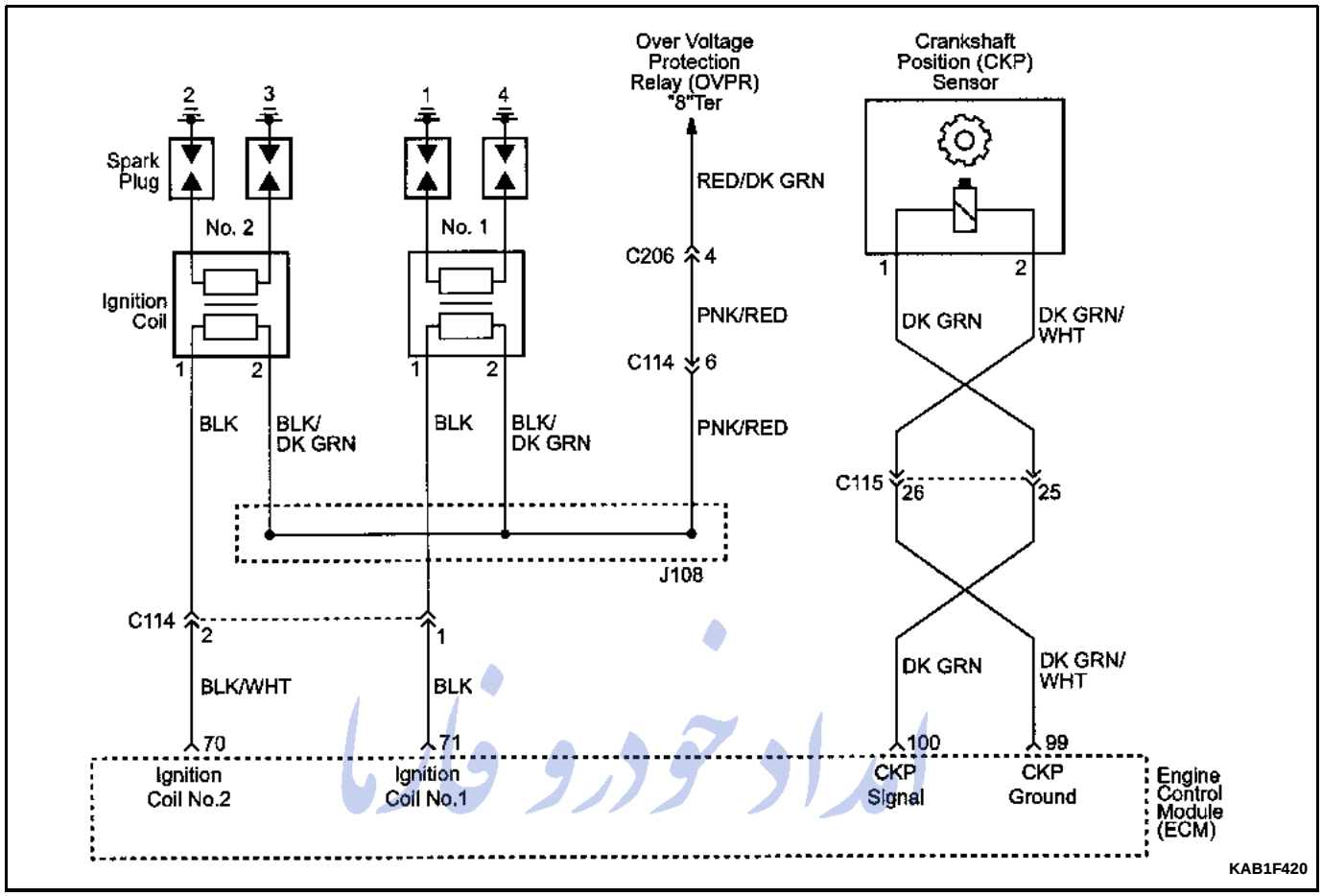
The Electronic Ignition (EI) system ignition coil is located on the cylinder head cover. The double ended coils receive the signal for the Engine Control Module (ECM) which controls the spark advance.

Each EI system ignition coil provides the high voltage to two spark plugs simultaneously;

T1/1: cylinder 1 and 4

T1/2: cylinder 2 and 3

The EI system ignition coil is not serviceable and must be replaced as an assembly.



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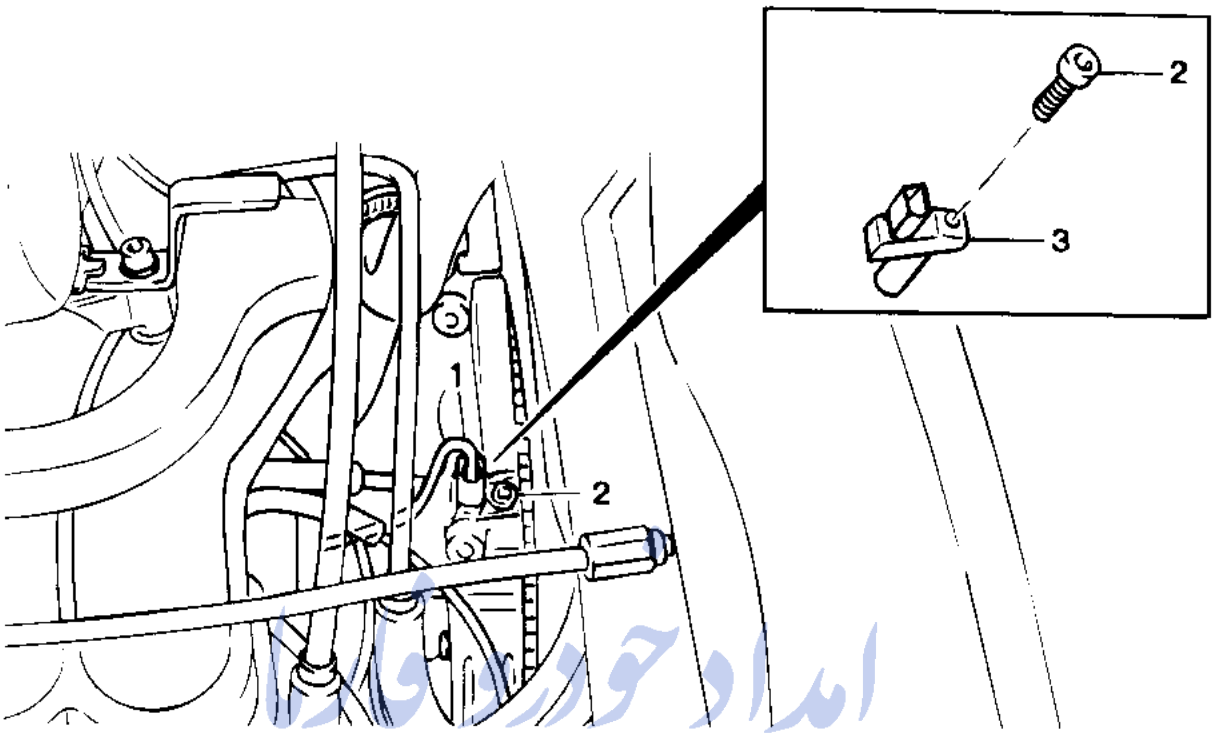
Failure Code	Description	Trouble Area	Maintenance Hint
64	No ignition voltage output (No. 1 ignition coil)	Malfunction of ignition circuit Primary current values or secondary short circuit	• Inspection the ECM pin 70 and 71 about short circuit or open with bad contact • Inspection the power source to ignition coil • Inspection the ignition coil, high tension cords etc. • Inspection the spark plug (wet, cracks, wear, improper gap, burned electrodes, heavy deposit) • Inspection the ECM
65	No ignition voltage output (No. 2 ignition coil)		

Circuit Description

The Electronic Ignition (EI) system uses a waste spark method of spark distribution. The Crankshaft Position (CKP) sensor sends reference pulses to the ECM. The ECM then triggers the EI system ignition coils. Once the ECM triggers the EI system ignition coils both of the connected spark plugs fire at the same time. One cylinder is on its compression stroke at the same time that the other is on the exhaust stroke, resulting in lower energy needed to fire the spark plug in the cylinder on its exhaust stroke.

This leaves the remainder of the high voltage to be used to fire the spark plug in the cylinder on its compression stroke. Since the CKP sensor is in a fixed position, timing adjustments are not possible or needed.

CRANKSHAFT POSITION (CKP) SENSOR



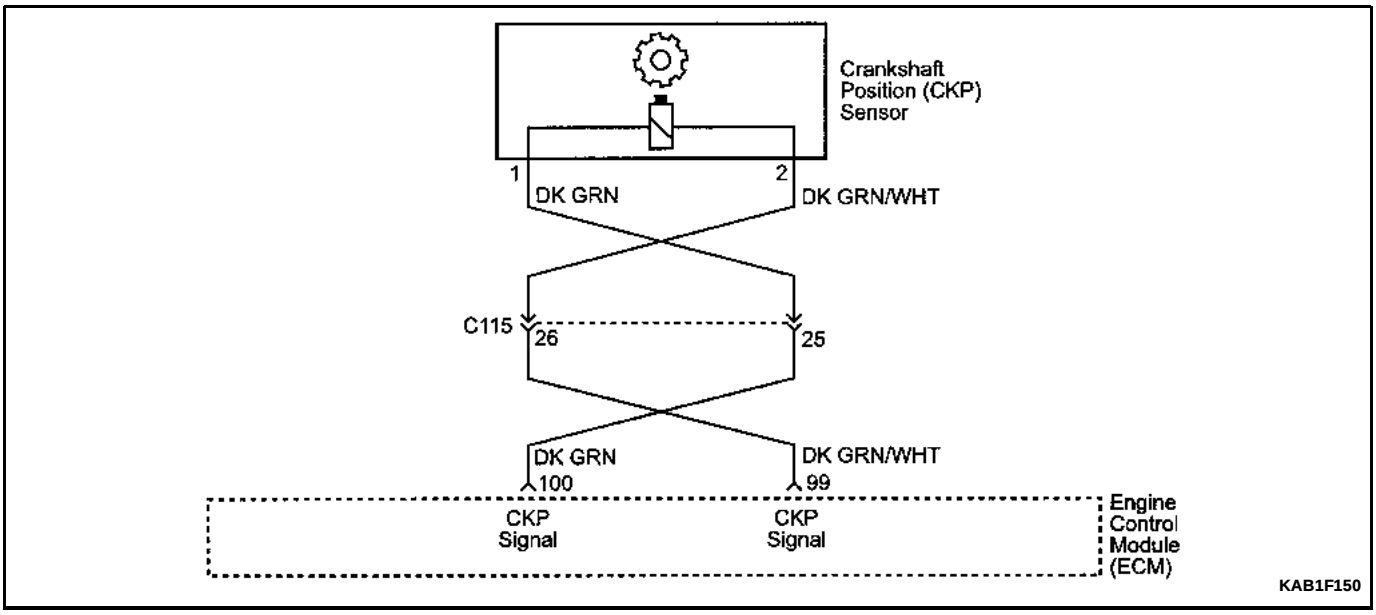
1. Crankshaft Position Sensor Connector
2. Bolt
3. Crankshaft Position Sensor

YAA1F940

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This Electronic Ignition (EI) system uses inductive or pick up type magnetic Crankshaft Position (CKP) sensor. The CKP sensor is located in the opposite side of the crankshaft pulley and triggers the pick-up wheel teeth which is equipped 60-2 teeth with a gap of 2 teeth at 360 degree spacing. This sensor protrudes through its mount to within 1.1 ± 0.14 mm.

The output of the sensor is a sinusoidal signal. Each tooth of the pick-up 60 - 2 wheel generates a positive half wave. The Engine Control Module (ECM) uses this sensor signal to generate timed ignition and injection pulses that it sends to the ignition coils and to the fuel injectors.



Failure Code	Description	Trouble Area	Maintenance Hint
17	Crankshaft position sensor signal failure (no engine revolution signal)	Even through cam position recognition is normal, no crankshaft position signal recognition.	• Monitoring the actual rpm through or scan tool • Inspection the ECM pin 100, 99 about short circuit with bad contact • Inspection the CKP sensor • Inspection the air gap between sensor and drive plate • Inspection the drive plate (teeth condition) • Inspection the ECM
18	Crankshaft position sensor signal failure (rpm > max. value)	When more than applicable revolution values or implausible to 60 – 2 teeth.	
20	Crankshaft position sensor signal failure (gap recognition failure)	When implausible recognition of cam and crank angle signal or intermittent sensing the signal or error count of undetected gap.	
67	Crankshaft position sensor adaptation failure	When faulty crank angle sensor adaption.	

Circuit Description

The 58X reference signal is produced by the CKP sensor. During one crankshaft revolution, 58 crankshaft pulses will be produced. The ECM uses the 58X reference signal to calculate engine rpm and CKP. The ECM constantly monitors the number of pulses on the 58X reference circuit and compares them to the number of Camshaft Position (CMP) signal pulses being received. If the ECM receives and incorrect number of pulses on the 58X reference circuit, this failure code will set.

Crankshaft Position Sensor Resistance Inspection

1. Disconnect the coupling “E” of ECM while the ignition switch is in “OFF” position.
2. Measure the resistance between the coupling terminal pin No. 99 and No. 100 using a multimeter.

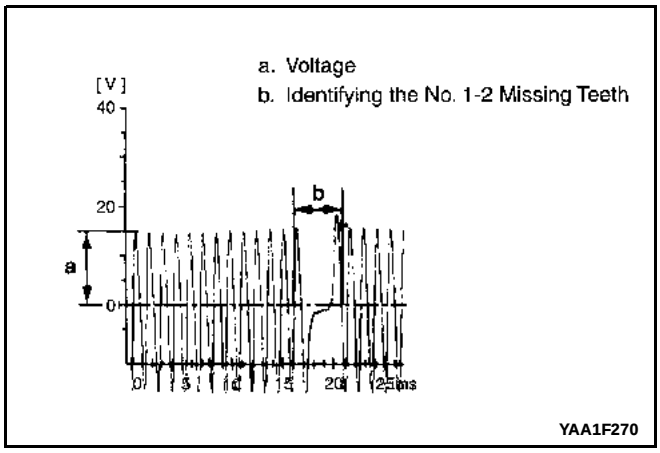
Specified Value	1,050 ~ 1,400 Ω

Notice: Measure the insulator resistance of the CKP sensor if out of the specified value.

Crankshaft Position Sensor Output Wave Inspection

1. Measure the output wave between the ECM terminals No. 99 and No. 100 using the scan tool or the oscilloscope while engine cranking (start motor activated).

Notice: Check the segment or crankshaft position sensor and air gap if cannot get the output wave as shown in the figure.



Crankshaft Position Sensor Insulator Resistance Inspection

1. Disconnect the coupling from ECM while the ignition switch is in “OFF” position.
2. Measure the resistance between the coupling terminal pin No. 100 and No. 69 using a multimeter.

Specified Value	> 20 kΩ

Notice: Measure the check and ground terminal of the CKP sensor if out of the specified value.

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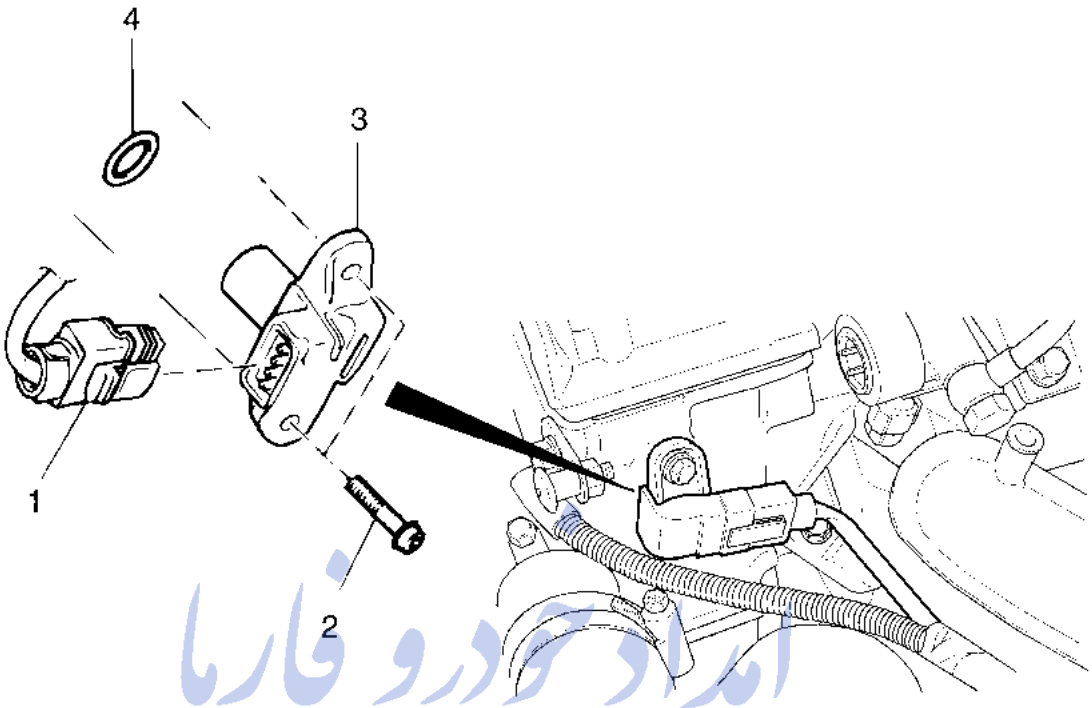
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CAMSHAFT POSITION (CMP) SENSOR

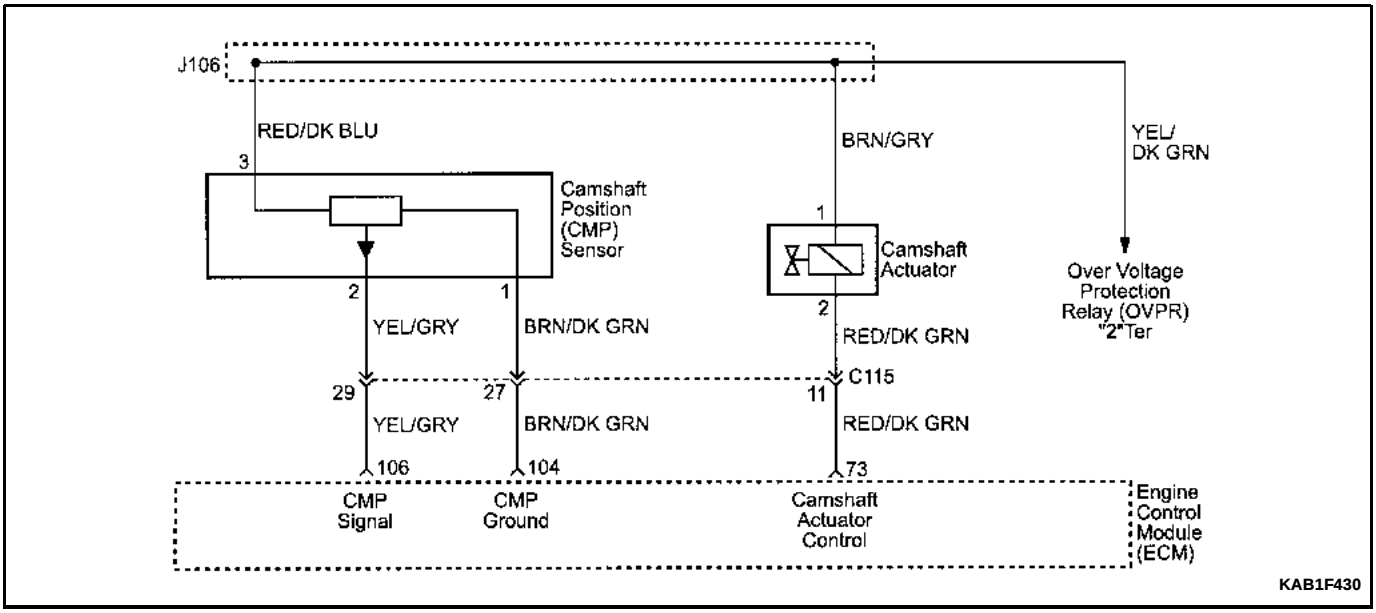


1. Camshaft Position Sensor Connector
2. Bolt
3. Camshaft Position Sensor
4. O-ring

YAA1F950

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The Camshaft Position (CMP) sensor sends a CMP signal to the Engine Control Module (ECM). The ECM uses this signal as a “synchronized pulse” to trigger the injectors in the proper sequence. The ECM uses the CMP signal to indicate the position of the #1 piston during its power stroke. This allows the ECM to calculate true sequential fuel injection mode of operation.



Failure Code	Description	Trouble Area	Maintenance Hint
19	Camshaft position sensor signal : No. 1 cylinder recognition failure	When no cam recognition signal during TN 24 counts more. (maintain the constant low or high level)	• Inspection the source voltage of CMP sensor • Inspection the ECM pin 106, 104 about short circuit or open with bad contact • Inspection the CMP sensor • Inspection the damage of sensor or sprocket • Inspection the ECM
58	Camshaft position sensor signal : No. 1 cylinder synchronization failure	When synchronization fault of cylinder 1 (TDC recognition)	

Circuit Description

The CMP sensor sends a cam position signal to the ECM. If the cam position signal is lost while the engine is running, the fuel injection system shifts to a calculated sequential fuel injection mode based on the last fuel injection pulse, and the engine continuous to run.

Camshaft Position Sensor Signal Voltage Inspection

1. Measure the voltage between the ECM terminal No. 11 and No. 106 while the engine speed is at idle.

Specified Value	1.2 ~ 1.7 v

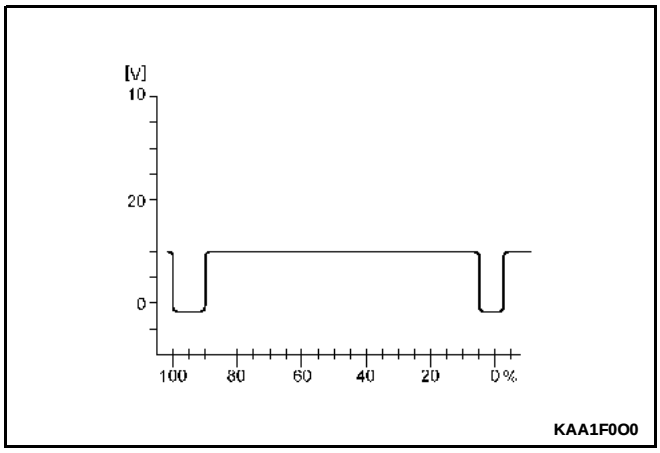
Notice: The signal voltage will be changed in the range of 1.2 ~ 1.7 v.

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Camshaft Position Sensor Output Wave Inspection

1. Measure the output wave between the ECM terminals No. 104 and No. 106 using the scan tool or the oscilloscope while engine speed is at idle.

Notice: Replace the CAM sensor if cannot get the output wave as shown in the figure.



Camkshaft Position Sensor Power Supply Inspection

1. Disconnect the CMP sensor Connector.
2. Measure the resistance between the No. 1 and No. 3 pin of the CMP sensor connector while the ignition switch is in “ON” position.

Specified Value	11 ~ 14 v

Notice: If the measured value is not within the specified value, check the cable.

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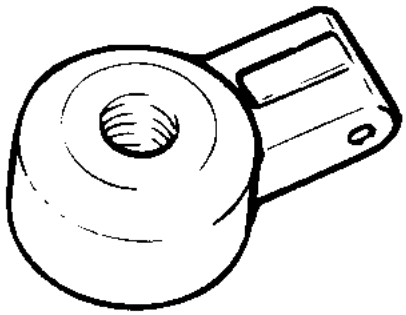
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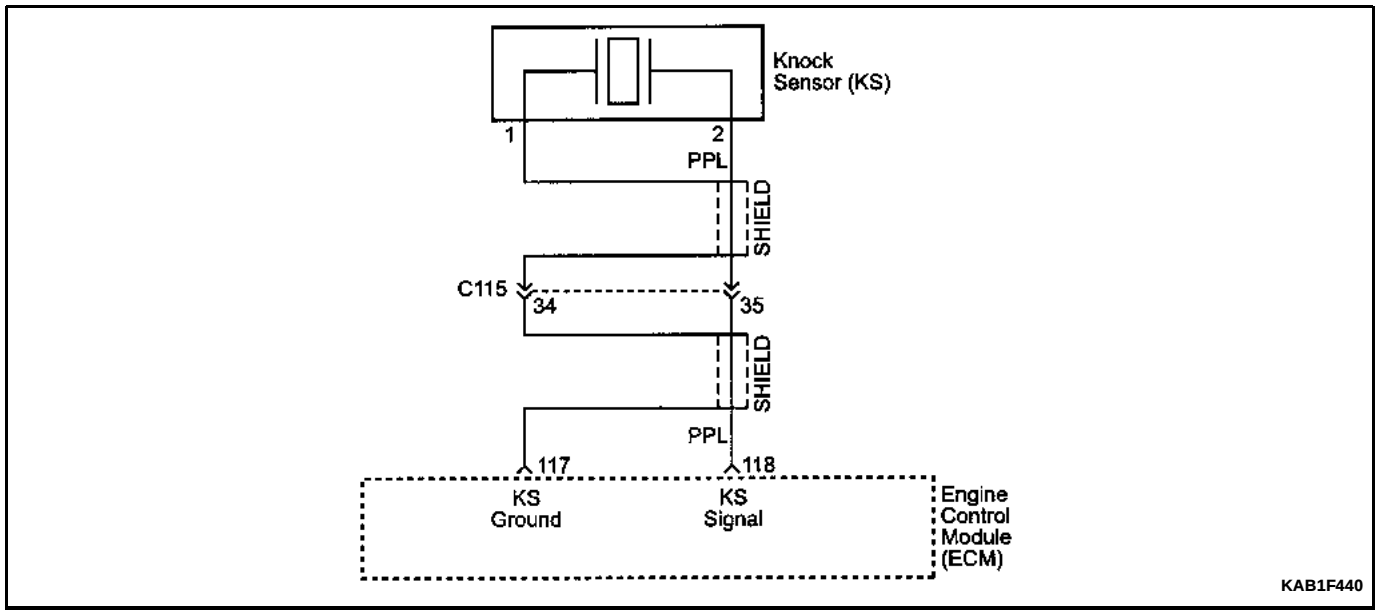
KNOCK SENSOR (KS)



YAA1F320

The Knock Sensor (KS) detects abnormal knocking in the engine. The two KS are mounted in the engine block near the cylinders. The sensors produce an output voltage which increases with the severity of the knock. This signal is sent to the Engine Control Module (ECM) via a shielded cable. The ECM then adjusts the ignition timing to reduce the spark knock.

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Failure Code	Description	Trouble Area	Maintenance Hint
56	No. 1 knock sensor signal failure	When recognition in more than control gain threshold at normal operational condition of other system during over 75 and 3,000 rpm running area (cylinder 1, 2, 3, 4)	• Inspection the ECM pin 118, 117 about short circuit or open with bad contact • Inspection the KS 1 malfunction • Inspection the ECM

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Circuit Description

The KS system is used to detect engine detonation, allowing the ECM to retard the ignition control spark timing based on the KS signal being received. The KS signal's amplitude and frequency depend upon the amount of knock being experienced. The ECM monitors the KS signal and can diagnose the KS sensor and circuitry.

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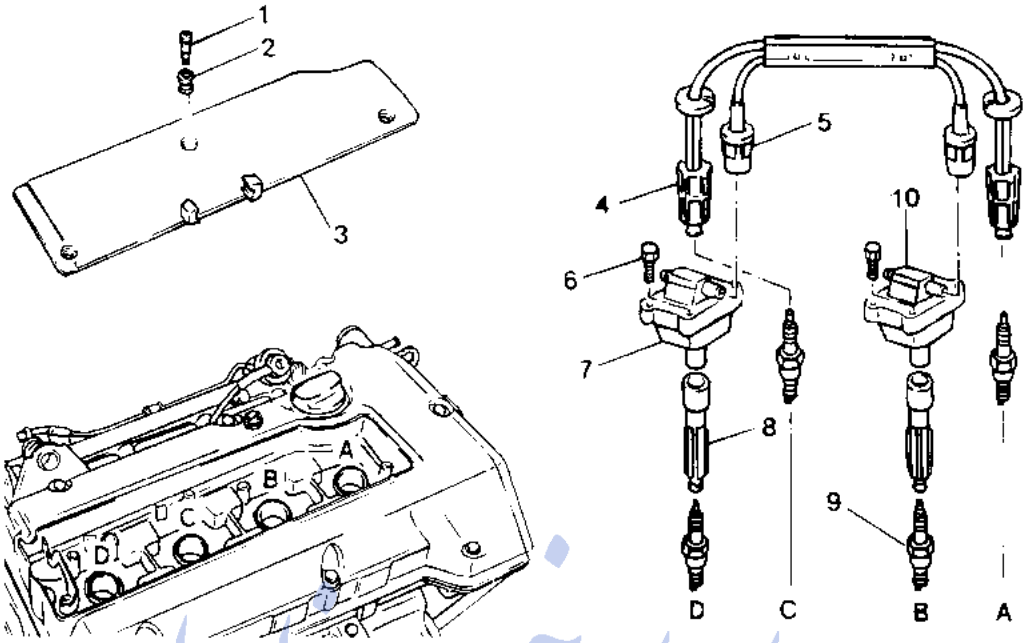
Knock Sensor Resistance Inspection

1. Disconnect the coupling from ECM while the ignition switch is in "OFF" position.
2. Measure the resistance between the coupling terminal pin No. 118 and No. 117 using a multimeter.

Specified Value	> 10 MΩ

Notice: Replace the KS if the measured values is out of the specified values. Check the connector and wire connection between ECM and the KS if the measured values are normal.

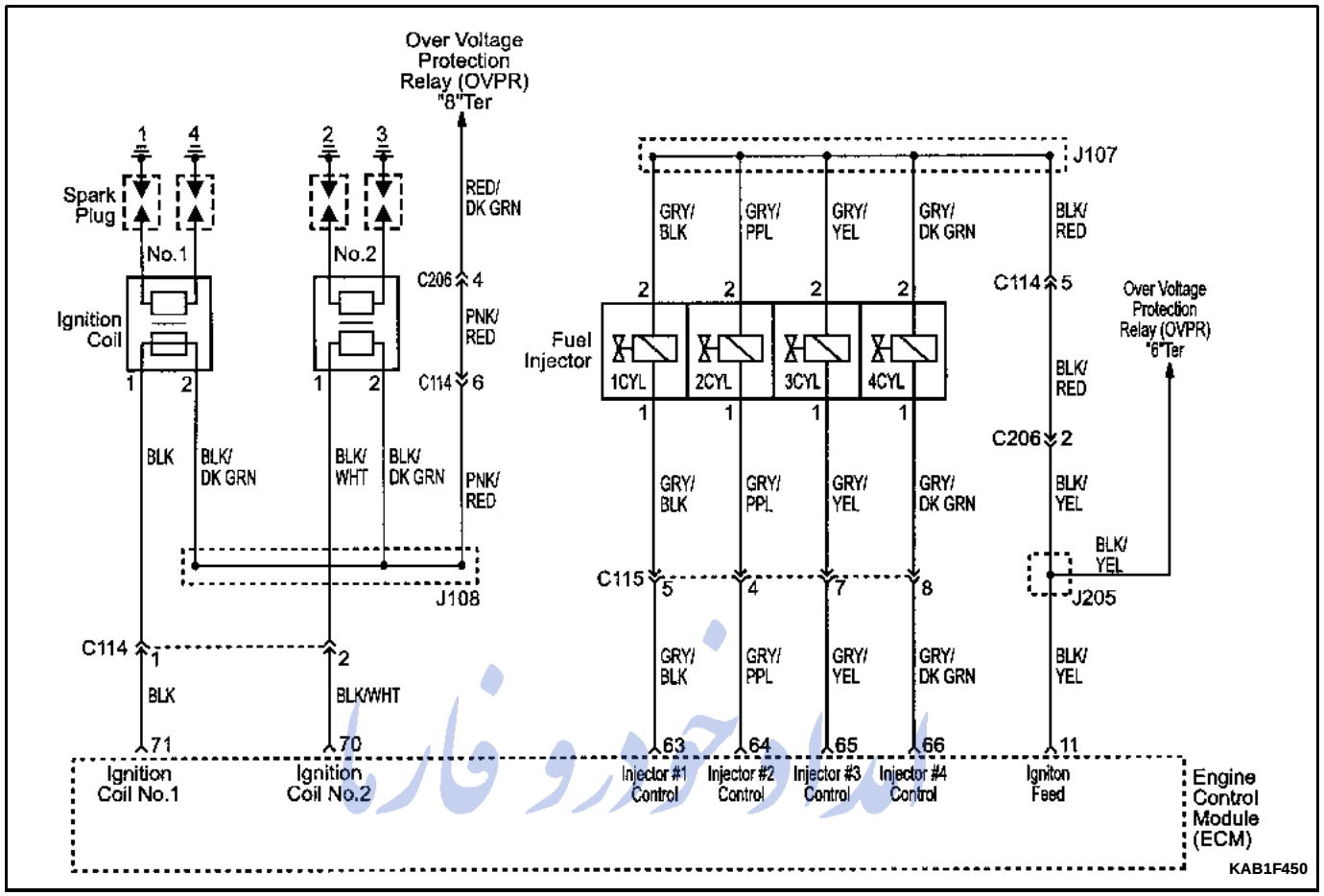
SPARK PLUG



1. Screw
2. Adaptor
3. Ignition Coil Cable Cover
4. Spark Plug Connector
5. Ignition Coil Connector
6. Bolts
7. Ignition Coil (T 1/1)
8. Coupling Plug
9. Spark Plug
10. Ignition Coil (T 1/2)

YAA1F990

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Failure Code	Description	Trouble Area	Maintenance Hint
68	Random / Multiple Misfire	When detection misfire of multiple cylinder for source of over the emission threshold or catalyst damage	• Inspection the ignition system • Inspection the injection system • Inspection the fuel pressure • Inspection the compression pressure • Inspection the valve timing or clearance • Inspection the air flow sensor • Inspection the crankshaft position sensor and air gap • Inspection the engine wiring system • Inspection the Engine Control Module (ECM)

Circuit Description

The ECM monitors the crankshaft and camshaft positions to detect if the engine is misfiring. The ECM looks for a quick drop in crankshaft speed. Misfire multiple cylinder is monitored by engine roughness measuring. The actual roughness value is compared with the actual (emission and catalyst damage) threshold.

Spark Plug Cable Resistance Inspection

1. Turn the ignition switch “OFF” position.
2. Disconnect the spark plug cables Refer to *Section 1E1, Engine electrical.*
3. Measure the spark plug resistance using a multimeter.

Specified Value	1.8 ~ 2.2 kΩ

Notice: Replace the spark plug cable if the measured values is out of the specified values.

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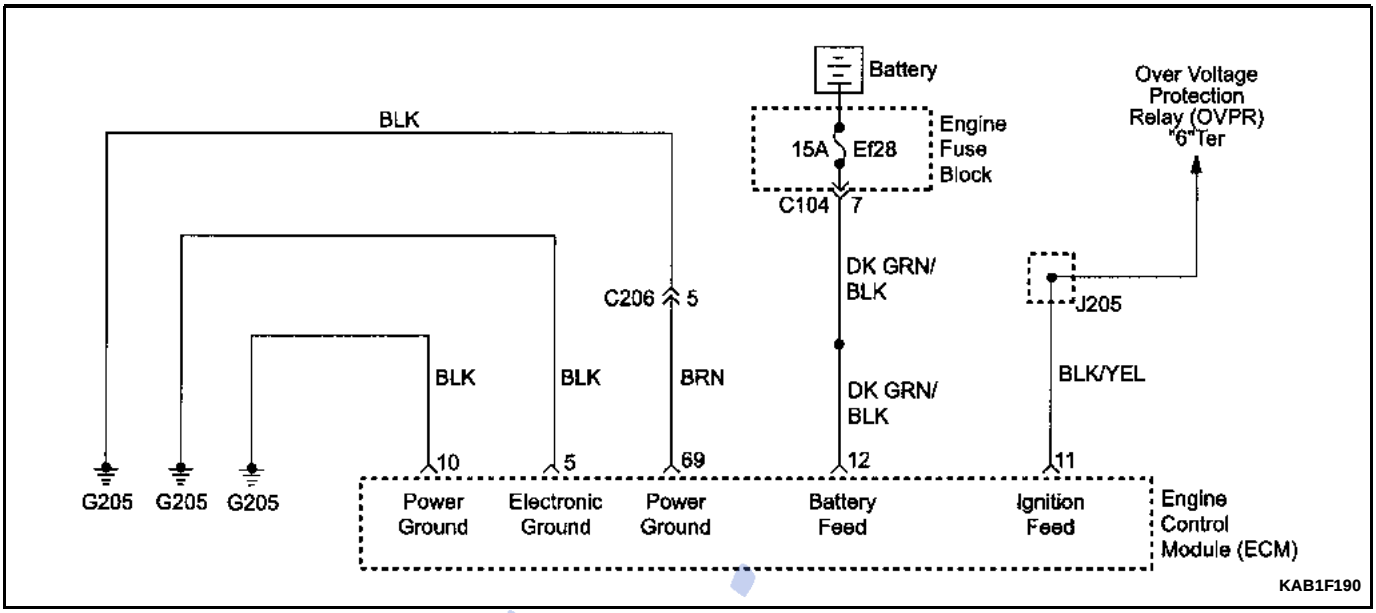
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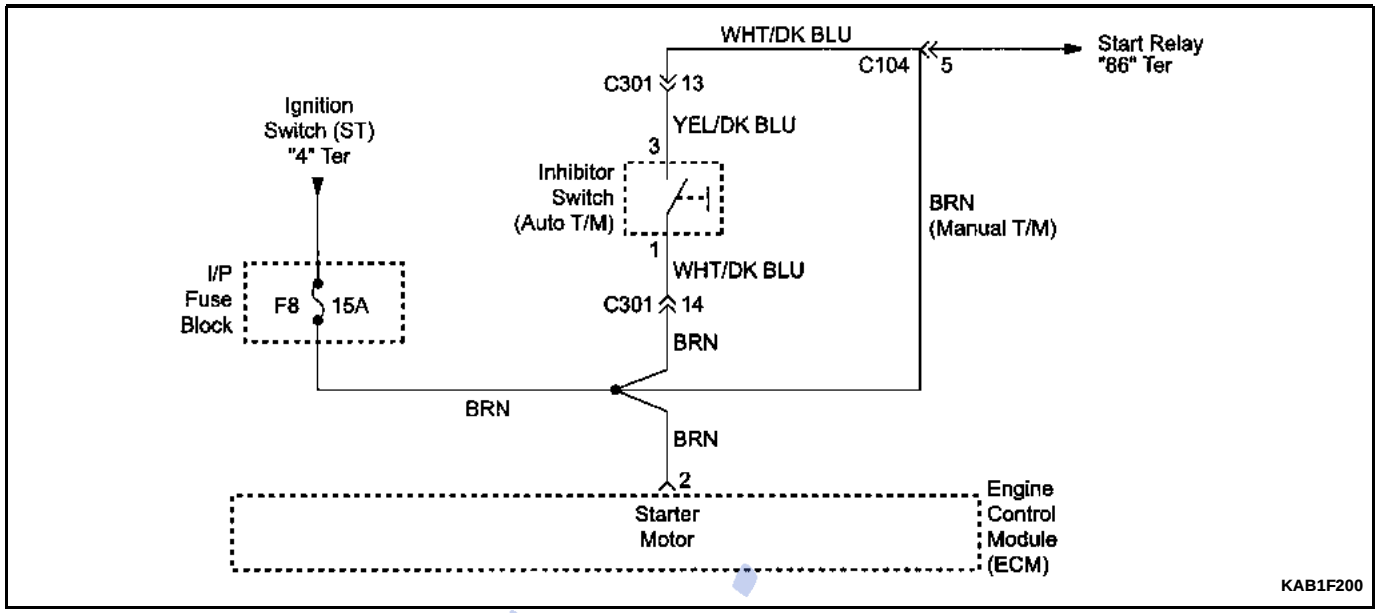
SYSTEM VOLTAGE



Failure Code	Description	Trouble Area	Maintenance Hint
08	System voltage too low	Malfunction in recognition of system source voltage. Less than minimum 8 volts in 2,000 rpm below, or less than 10 volts in 2,000 rpm above.	• Monitoring the actual battery voltages through the scan tool • Inspection the Engine Control Module (ECM) pin 12, 11, 10, 5 about short circuit or open with bad contact • Inspection the over voltage protection relay • Inspection the battery • Inspection ECM

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IGNITION SWITCH



Failure Code	Description	Trouble Area	Maintenance Hint
71	Starter signal recognition failure	When not detection of starter signal	• Inspection the Engine Control Module (ECM) pin 2 circuit short or open with bad contact • Inspection ECM

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FUEL SYSTEM

The function of the fuel metering system is to deliver the correct amount of fuel to the engine under all operating conditions. The fuel is delivered to the engine by the individual fuel injectors mounted into the intake manifold near each cylinder.

The main fuel control sensors are the Mass Air Flow (MAF) sensor and the oxygen (O2) sensors.

The MAF sensor monitors the mass flow of the air being drawn into the engine. An electrically heated element is mounted in the intake air stream, where it is cooled by the flow of incoming air. Engine Control Module (ECM) modulates the flow of heating current to maintain the temperature differential between the heated film and the intake air at a constant level. The amount of heating current required to maintain the temperature thus provides an index for the mass air flow. This concept automatically compensates for variations in air density, as this is one of the factors that determines the amount of warmth that the surrounding air absorbs from the heated element. MAF sensor is located between the air filter and the throttle valve.

Under high fuel demands, the MAF sensor reads a high mass flow condition, such as wide open throttle. The ECM uses this information to enrich the mixture, thus increasing the fuel injector on-time, to provide the correct amount of fuel. When decelerating, the mass flow decreases. This mass flow change is sensed by the MAF sensor and read by the ECM, which then decreases the fuel injector on-time due to the low fuel demand conditions.

The O2 sensors are located in the exhaust pipe before catalytic converter. The O2 sensors indicate to the ECM the amount of oxygen in the exhaust gas, and the ECM changes the air/fuel ratio to the engine by controlling the fuel injectors. The best air/fuel ratio to minimize exhaust emissions is 14.7 to 1, which allows the catalytic converter to operate most efficiently. Because of the constant measuring and adjusting of the air/fuel ratio, the fuel injection system is called a “closed loop” system.

The ECM uses voltage inputs from several sensors to determine how much fuel to provide to the engine. The fuel is delivered under one of several conditions, called “modes”.

Starting Mode

When the ignition is turned ON, the ECM turns the fuel pump relay on for 1 second. The fuel pump then builds fuel pressure. The ECM also checks the Engine Coolant Temperature (ECT) sensor and the Throttle Position (TP) sensor and determines the proper air/fuel ratio for starting the engine. This ranges from 1.5 to 1 at -36 °C (-33 °F) coolant temperature to 14.7 to 1 at 94 °C (201 °F) coolant temperature. The ECM controls the amount of fuel delivered in the starting mode by changing how long the fuel injector is turned on and off. This is done by “pulsing” the fuel injectors for very short times.

Run Mode

The run mode has two conditions called “open loop” and “closed loop”.

Open Loop

When the engine is first started and it is above 690 rpm, the system goes into “open loop” operation. In “open loop”, the ECM ignores the signal from the HO2S and calculates the air/fuel ratio based on inputs from the ECT sensor and the MAF sensor. The ECM stays in “open loop” until the following conditions are met:

- The O2 has a varying voltage output, showing that it is hot enough to operate properly.
- The ECT sensor is above a specified temperature (22.5 °C).
- A specific amount of time has elapsed after starting the engine.

Closed Loop

The specific values for the above conditions vary with different engines and are stored in the Electronically Erasable Programmable Read-Only Memory (EEPROM). When these conditions are met, the system goes into “closed loop” operation. In “closed loop”, the ECM calculates the air/fuel ratio (fuel injector on-time) based on the signals from the O2 sensors. This allows the air/fuel ratio to stay very close to 14.7 to 1.

Acceleration Mode

The ECM responds to rapid changes in throttle position and airflow and provides extra fuel.

Deceleration Mode

The ECM responds to changes in throttle position and airflow and reduces the amount of fuel. When deceleration is very fast, the ECM can cut off fuel completely for short periods of time.

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Battery Voltage Correction Mode

When battery voltage is low, the ECM can compensate for a weak spark delivered by the ignition module by using the following methods:

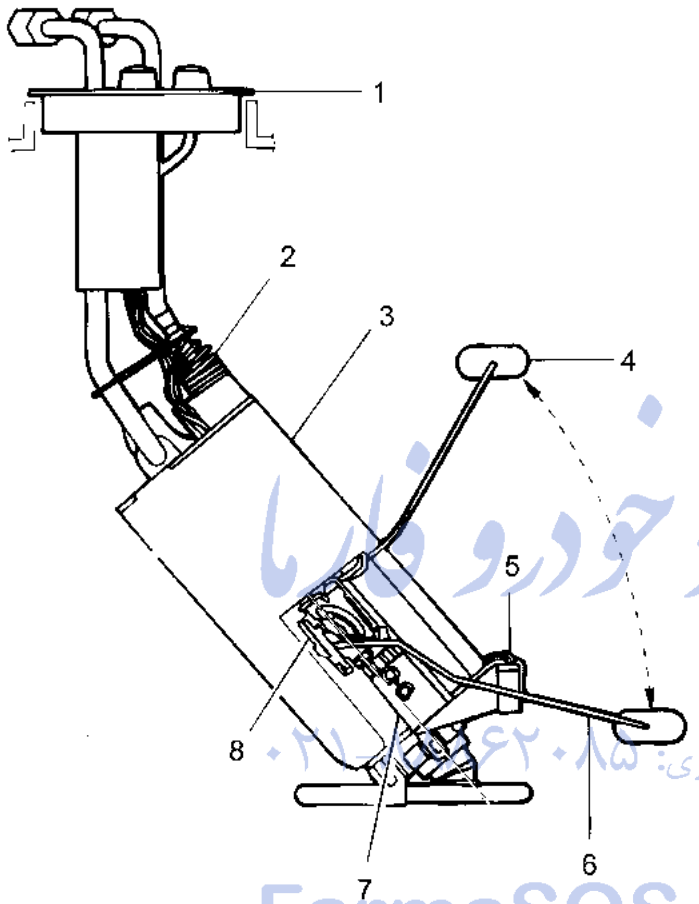
- Increasing the fuel injector pulse width.
- Increasing the idle speed rpm.
- Increasing the ignition dwell time.

Fuel Cut- Off Mode

No fuel is delivered by the fuel injectors when the ignition is off. This prevents dieseling or engine run-on. Also, the fuel is not delivered if there are no reference pulses received from the CKP sensor. This prevents flooding.

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FUEL PUMP



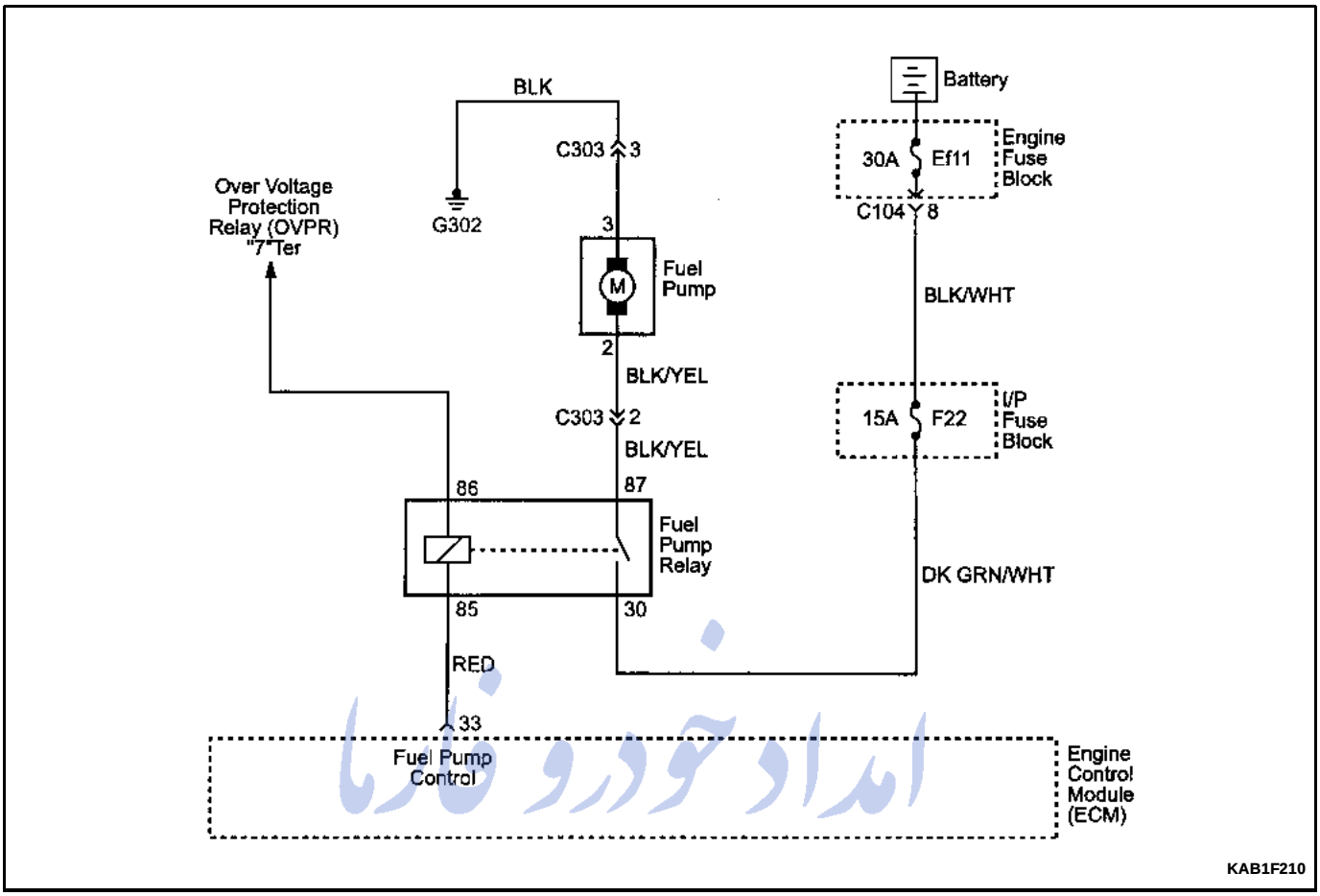
1. Flange and Harness Assembly
2. Spring
3. Fuel Pump
4. Float
5. Thermistor
6. Float Arm
7. Thermistor Housing
8. Resistor Card and Wiper

YAA1F380

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Requirements for Fuel Pump

Item	Specified Value	Item	Specified Value
System Pressure	3.8 bar	Minimum Delivery at 8V	30 Litre/Hr
Maximum Pressure	8.5 bar (12 V)	Operating Voltage	8 V
Minimum Pressure	5.0 bar (12 V)	Maximum Allowable Current	7.5 A
Nominal Voltage	12 V	Ambient Temperature	-30 ~ +70 °C
Minimum Amount of Fuel Supply	114 Liter/Hr (12 V, 3.8 bar, -30 ~ +70 °C)	Maximum Amount of Fuel Supply	165 Liter/Hr (12V, 3.8 bar, -30 ~ +70 °C)



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Failure Code	Description	Trouble Area	Maintenance Hint
34	Fuel pump relay short circuit to battery	When short circuit to power source	• Inspection the Engine Control Module (ECM) pin 33 about short circuit or open with bad contact • Inspection the fuel pump relay • Inspection the ECM
35	Fuel pump relay short circuit to ground or open	When short circuit to ground or open	

Circuit Description

When the ignition switch is turned ON, the ECM will activate the pump relay and run the in-tank fuel pump. The fuel pump will operate as long as the engine is cranking or running and the ECM is receiving ignition reference pulses.

If there are no reference pulses, the ECM will shut off the fuel pump within 2 seconds after the ignition switch is turned ON, engine stopped or engine stalled.

Fuel Pump Relay Inspection

Measure the voltage between the ECM terminal No. 33 and Ground.

Ignition Switch : ON	0 v (for 1 ~ 2 sec.)
Cranking	0 v

Measure the Fuel Delivery from the Fuel Pump

1. Disconnect the return pipe from fuel distributor and insert the appropriate hose into it.
2. Place the hose end into the beaker with the minimum capacity of 1 Liter
3. Turn the ignition switch to “ON” position.
4. Connect the terminal No. 33 and No. 5 of ECM with a service wire.
5. Measure the fuel delivery from the fuel pump

Specified Value	1 Liter/max. 35 sec.

Notice: Check the fuel filter and fuel line when the fuel delivery is not within specified value.

Measure the Current Consumption of Fuel Pump

1. Remove the fuel pump relay from fuse and relay box in trunk, and turn the ignition switch to “ON” position.
2. Using a multimeter, measure the current consumption by connecting the terminal No. 30 and No. 87 of the fuel pump relay connector.

Specified Value	5 ~ 9 A

Notice: Replace the fuel pump relay if the measured value is over 9 A.

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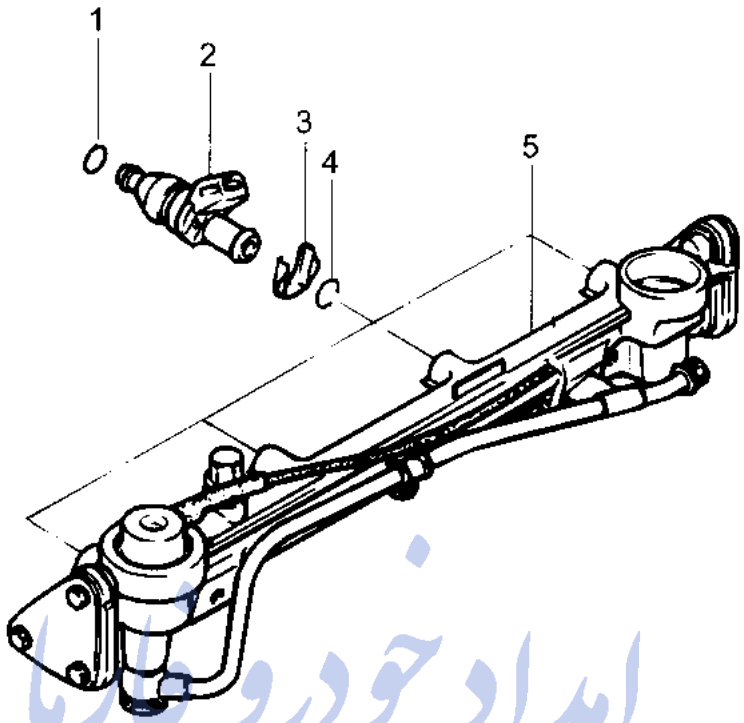
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FUEL INJECTOR



1. O - Ring
2. Injector
3. Injector Bracket
4. O - Ring
5. Fuel Rail

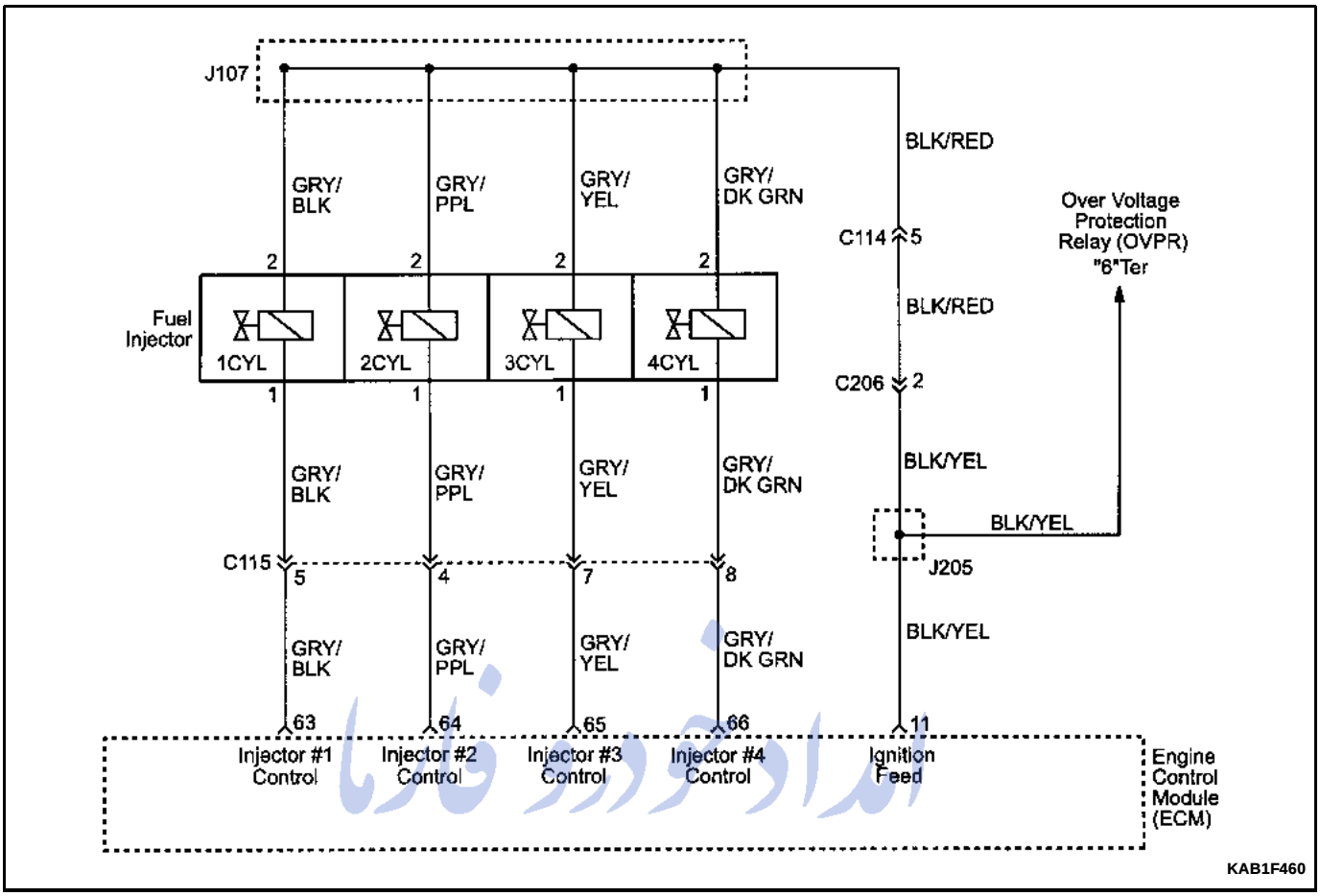
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امداد خودرو ملارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
Farmar98.com

The Multipoint Fuel Injection (MFI) assembly is a solenoid-operated device controlled by the Engine Control Module (ECM) that meters pressurized fuel to an each individual cylinder. The injector sprays the fuel, in precise quantities at a point in time determined by the ECM, directly toward the cylinder intake valve. ECM energizes the fuel injector solenoid to lift the needle valve and to flow the fuel through the orifice. This injector's discharge orifice is calibrated to meet the effective fuel atomization necessary for both ensuring the maximum homogeneity in the air-fuel mixture and holding the condensation along the walls of the intake tract to a minimum.

Fuel enters the top feed injector from above and flows through its vertical axis. The lower end extends into the intake valve. Fuel from the tip is directed at the intake valve, causing it to become further atomized and vaporized before entering the combustion chamber.

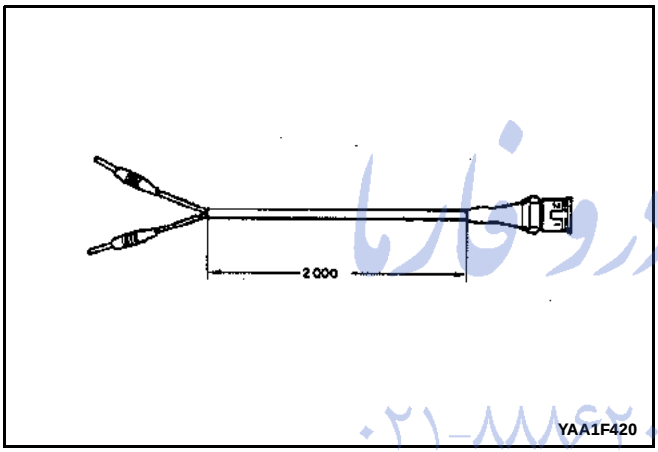
A fuel injector which is stuck partially open would cause a loss of fuel pressure after the engine is shut down. Also, an extended crank time would be noticed on some engines. Dieseling could also occur because some fuel could be delivered to the engine after the ignition is turned off.

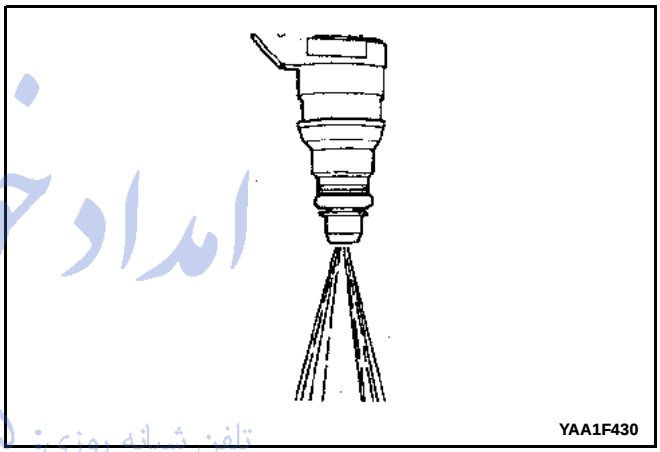


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Farda303.com

Failure Code	Description	Trouble Area	Maintenance Hint
72	No. 1 injector short circuit to battery	When malfunction of injector circuit Injector #1 short circuit to power	• Inspection the power to injector #1 or bad contact • Inspection the injector • Inspection the ECM
73	No. 1 injector short circuit to ground or open	When malfunction of injector circuit Injector #1 short circuit to ground or open	• Inspection the ECM pin 63 about short circuit or open with bad contact • Inspection the injector • Inspection the ECM
74	No. 2 injector short circuit to battery	When malfunction of injector circuit Injector #2 short circuit to power	• Inspection the power to injector #2 or bad contact • Inspection the injector • Inspection the ECM
75	No. 2 injector short circuit to ground or open	When malfunction of injector circuit Injector #2 short circuit to ground or open	• Inspection the ECM pin 64 about short circuit or open with bad contact • Inspection the injector • Inspection the ECM
76	No. 3 injector short circuit to battery	When malfunction of injector circuit Injector #3 short circuit to power	• Inspection the power to injector #3 or bad contact • Inspection the injector • Inspection the ECM

Failure Code	Description	Trouble Area	Maintenance Hint
77	No. 3 injector short circuit to ground or open	When malfunction of injector circuit Injector #3 short circuit to ground or open	• Inspection the ECM pin 65 about short circuit or open with bad contact • Inspection the injector • Inspection the ECM
78	No. 4 injector short circuit to battery	When malfunction of injector circuit Injector #4 short circuit to power	• Inspection the power to injector #4 or bad contact • Inspection the injector • Inspection the ECM
79	No. 4 injector short circuit to ground or open	When malfunction of injector circuit Injector #4 short circuit to ground or open	• Inspection the ECM pin 66 about short circuit or open with bad contact • Inspection the injector • Inspection the ECM





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Injector Spray Pattern Check

1. Turn the ignition switch OFF.
2. Remove the fuel injector connectors.
3. Remove the fuel distributor and injector with a unit. At this time, do not remove the supply and return line.

Notice: Prepare the beaker for taking the fuel.

4. Connect the shop made cable to the injector with a firing order.
5. Connect the other end of shop made cable to the positive battery cable and negative battery cable.
6. Turn the ignition switch ON.
7. Check the injector for normal spray pattern as shown in the figure. Check injector for leaks or later drop

Injector Resistance Inspection

1. Turn the ignition switch OFF.
2. Remove the fuel injector connectors.
3. Measure the fuel injector coil resistance using a multimeter.

Specified Value	14 ~ 17 Ω

Notice: Replace the fuel injector if the measured value is out of the specified values. Check the connector and wire connection between the ECM and the injector if the measured values are normal.

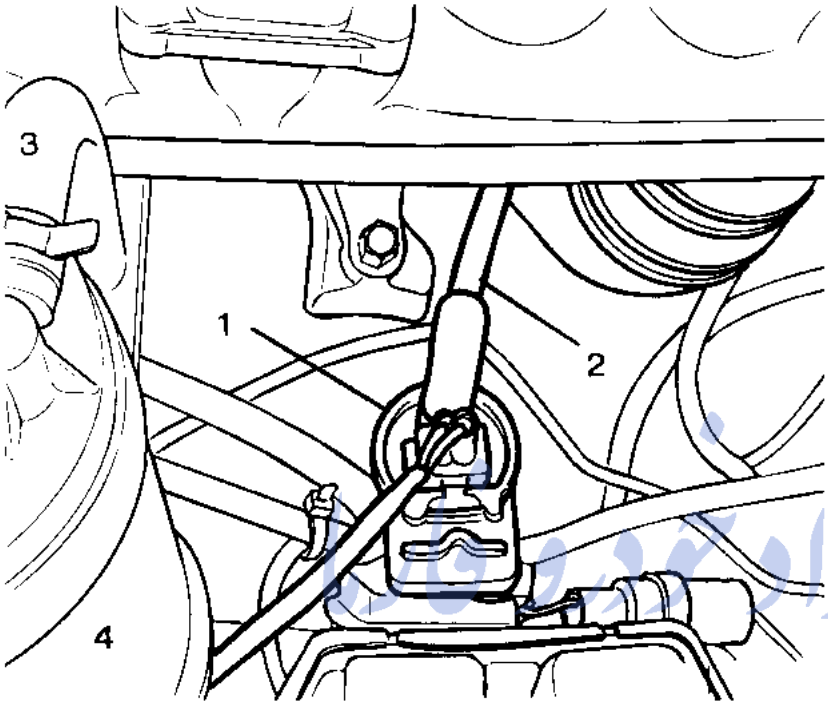
Injector Pulse Width Inspection

1. Turn the ignition switch OFF.
2. Install the scan tool.
3. Turn the ignition switch ON.
4. Monitor the “INJECTION TIME” with a scan tool.

Cranking	8.0 ms
Engine Idle	3 ~ 5 ms
Wide Open Throttle (WOT)	14 ms

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PURGE CONTROL VALVE



1. Purge Control Valve
2. Line to Engine
3. Line to Canister
4. Canister

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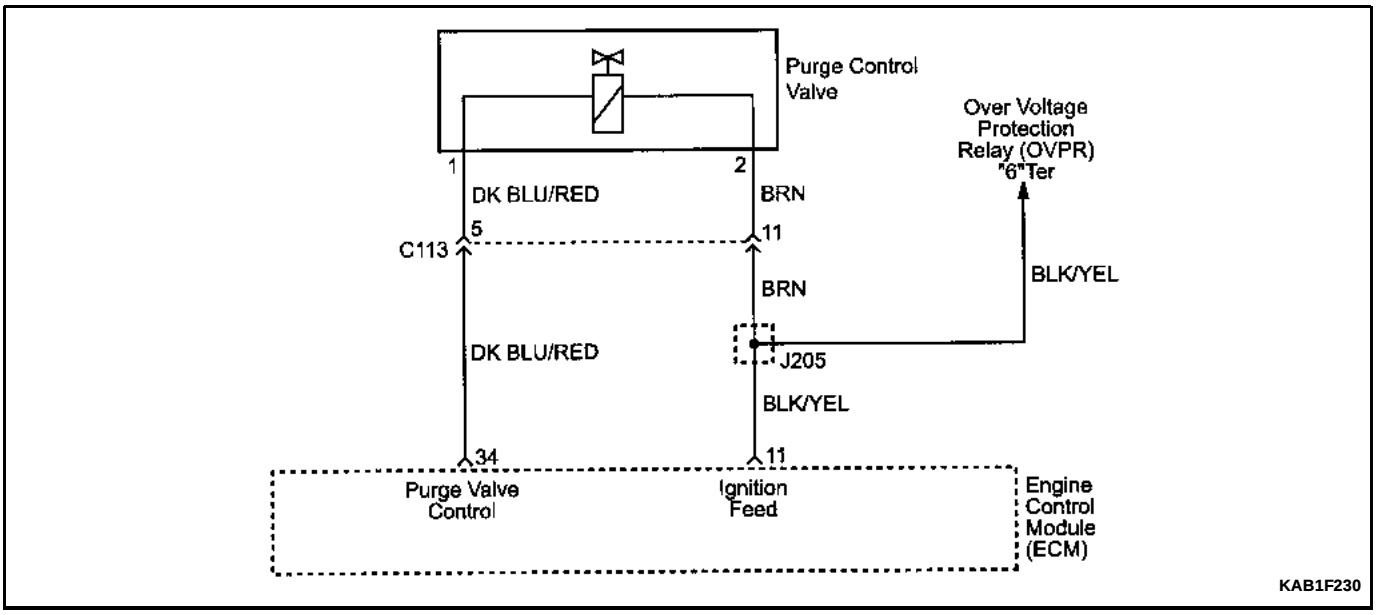
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The fuel vaporization control system is installed to inhibit the fuel vaporized gas from discharging into the atmosphere. The fuel vaporized gas that is accumulated in the canister abstracts through the purge control valve purification during the engine combustion (except the decreasing mode) and coolant temperature of over 80°C. For this reason, the Engine Control Module (ECM) transacts the engine speed, air inflow quantity, coolant temperature, and intake temperature.

The purge control valve is activated by the ECM frequency according with the engine rotating speed to adjust the purification rate. The purification rate is determined by the continuous valve opening interval.

The purge control valve is activated by the ECM for the following conditions:

- Coolant temperature of over 80 °C
- Engine speed of over 1,000 rpm
- 2 minutes after starting
- When the fuel cut-off mode is not activated

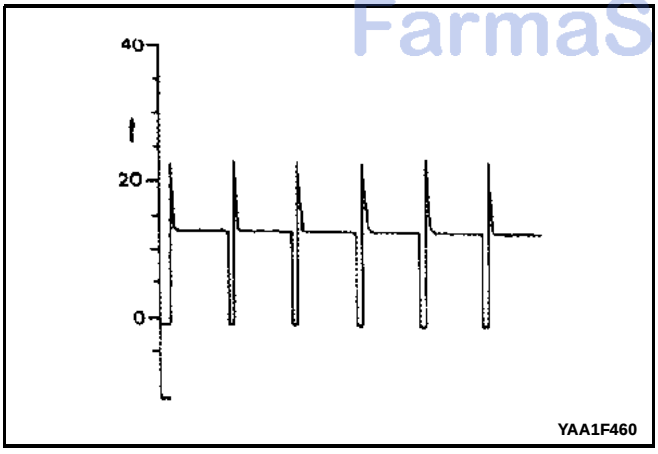


Failure Code	Description	Trouble Area	Maintenance Hint
40	Purge control valve short circuit to battery	When short circuit to power source	• Inspection the ECM pin 34 about short circuit or open with bad contact • Inspection the source power of valve • Inspection the purge control solenoid vale • Inspection the ECM
41	Purge control valve short circuit to ground or open	When short circuit to ground or open	
54	Purge control circuit malfunction	When malfunction of purge control : not work	

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Test

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1. Maintain the normal temperature and idling state by operating the engine.
2. Connect the ECM terminal No. 11 and No. 34 and check for normal operation through the output waves using oscilloscope.

Notice: Test during purge control valve operation after the minimum of 1 minute after the engine turned on.

3. Connect the ECM terminal No. 34 and No.10 and check for current consumption during the ignition switch ON.

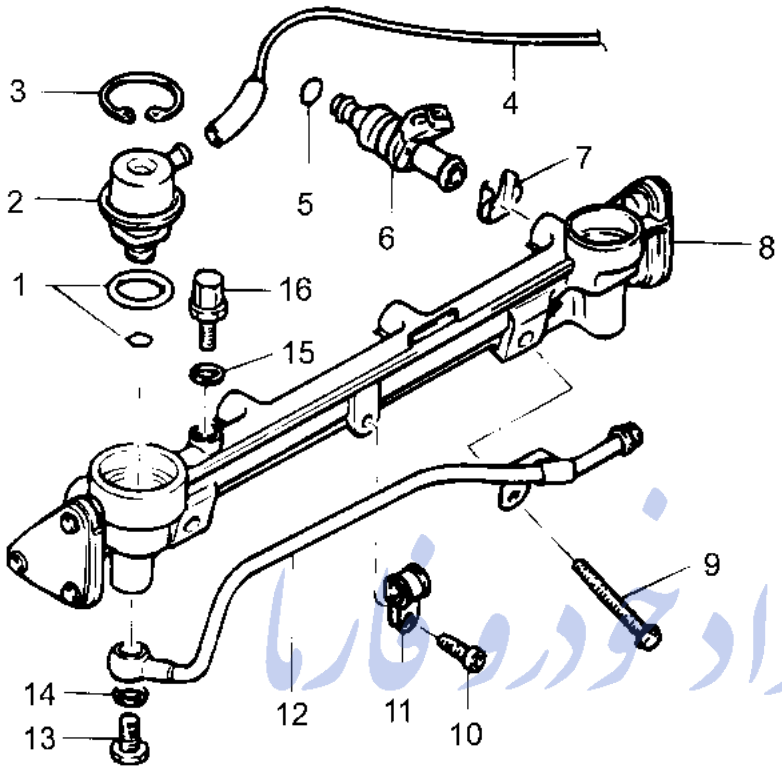
Specified Value	0.3 ~ 0.5 A

4. Remove the line to canister and measure the pressure with the vacuum pressure gauge.

Specified Value	> 500 mbar (after approx. 1 min.) purge control valve operates at this time

Notice: Test while at normal temperature and at idling state by operating the engine.

FUEL RAIL



1. O - Ring
2. Fuel Pressure Regulator
3. Circlip
4. Vacuum Hose
5. O - Ring
6. Injector
7. Injector Bracket
8. Fuel Rail
9. Combination Bolt
10. Bolt
11. Clamp
12. Fuel Return Line
13. Hollow Bolt
14. Seal Ring
15. Seal Ring
16. Fuel Pressure Test Connector

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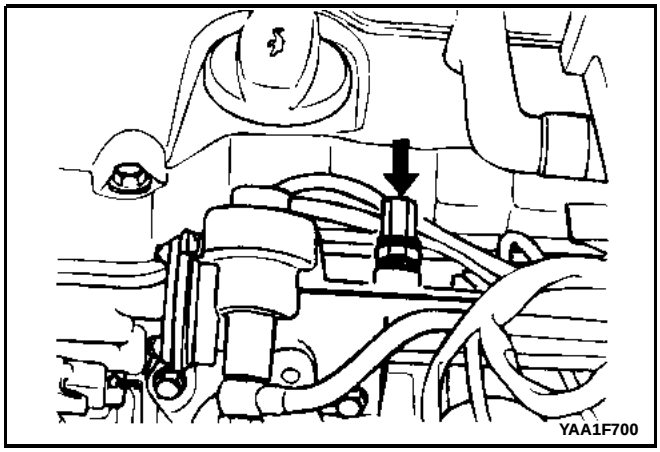
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Fuel Pressure Test

Tools Required

103 589 00 21 00 Fuel Pressure Gauge

1. Turn the ignition switch to “OFF” position.
2. Remove the fuel pressure test connector.



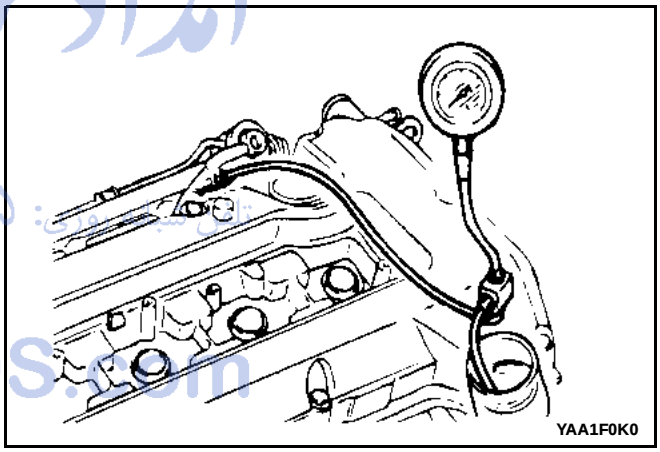
3. Connect the fuel pressure gauge to the fuel pressure test connector.
4. Test the fuel pressure at idling by operating the engine using the fuel pressure gauge 103 589 00 21 00.

Vacuum Hose Connected (bar)	3.2~3.6
Vacuum Hose Disconnected (bar)	3.7~4.2

5. Replace the pressure regulator diaphragm if out of the specification.

Internal Leakage Test

1. Connect the fuel pressure gauge 103 589 00 21 00 to the fuel pressure test connector.



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۰۲۱-۸۸۸۶۲۰۸۵
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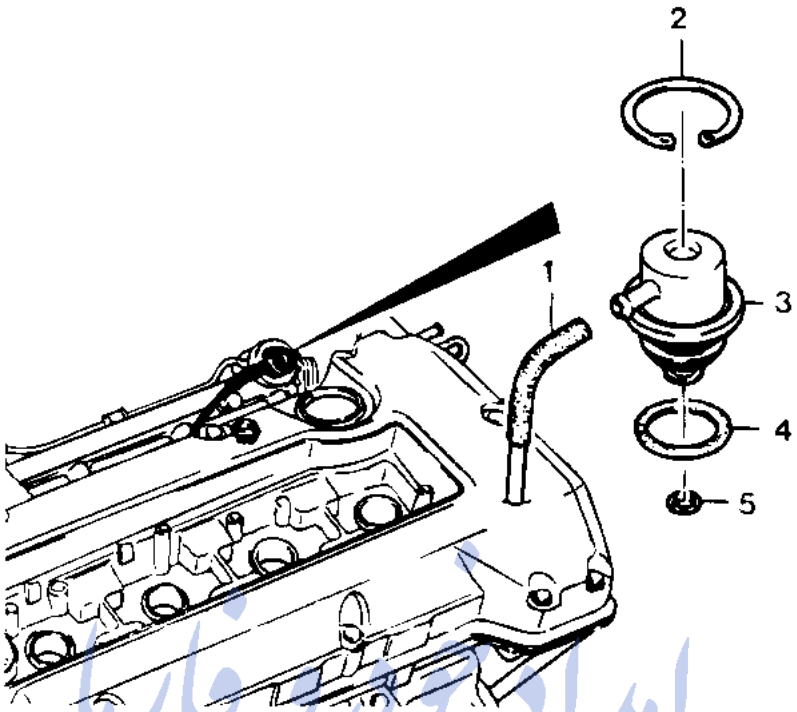
2. Stop the engine for approximately 30 minutes and then check the fuel pressure changes.

Pressure change	
Fuel pressure drops slowly	• Fuel leakage at the injector • Faulty fuel pressure regulator’s diaphragm and O-ring
Fuel pressure drops rapidly	• Faulty check valve in the fuel pump

3. If there is no change in fuel pressure and maintain the following pressure over 30minutes, it is normal.

Fuel pressure (bar)	≥ 2.5

FUEL PRESSURE REGULATOR



1. Vacuum Hose
2. Circlip
3. Fuel Pressure Regulator
4. O - Ring
5. O - Ring

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Function of the Fuel Pressure Regulator

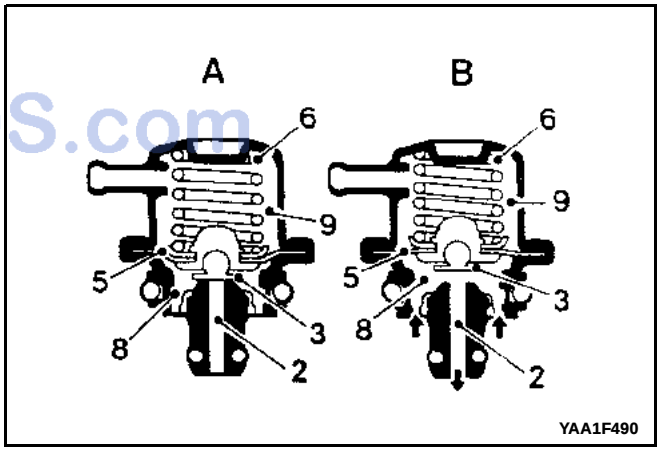
The fuel pressure regulator maintains the fuel pressure in the fuel line with the pressure of 3.2 bars to 3.8 bars according to the intake manifold pressure. This operating pressure cannot be changed, and the fuel injection volume will be only determined by the injection time. Over supplied fuel returns to the fuel tank through the return line.

<Operating at full load>

There is no negative pressure applied to the spring chamber (9) during the full load, and it is separated from the fuel chamber (8) by the diaphragm (5).

When the fuel pressure goes up, the diaphragm forces the compression spring (6) in the direction of compression . At this moment, the valve (3) sticks to the diaphragm by the fuel pressure, and the fuel return line (2) opens. The fuel over supplied returns to the fuel tank through the return line.

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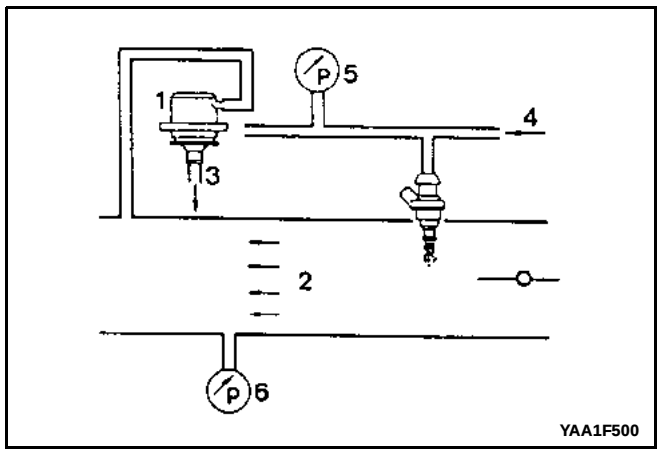


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2. Fuel return line
3. Valve
5. Diaphragm
6. Compression Spring
8. Fuel Chamber
9. Spring Chamber

A. Valves Closed
B. Valves Opened

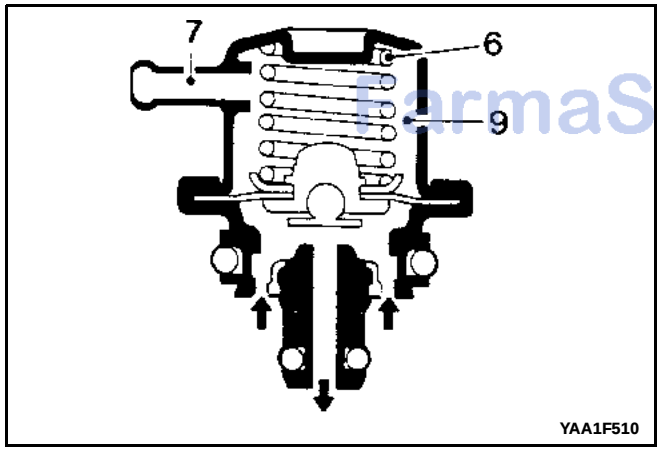
The pressure difference between the fuel pressure and the intake manifold is about 3.8 bars during the full load.



1. Fuel Pressure Regulator
2. Intake Manifold
3. Fuel Return (to fuel tank)
4. Fuel Supply (from fuel pump)
5. Fuel Pressure (approx. 3.8 bars)
6. Intake Manifold Negative Pressure (0 bar)

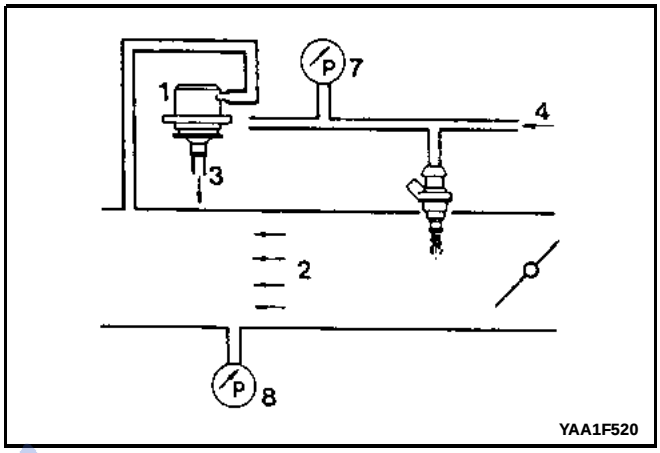
<Operating at Idle and partial load>

The spring chamber (9) is connected to the intake manifold with the vacuum hose at the intake pipe connection (7). The negative pressure generated in the intake manifold activates the diaphragm, and thus the fuel pressure gets reduced to the rate of the operating extent of the diaphragm by the intake manifold's negative pressure.



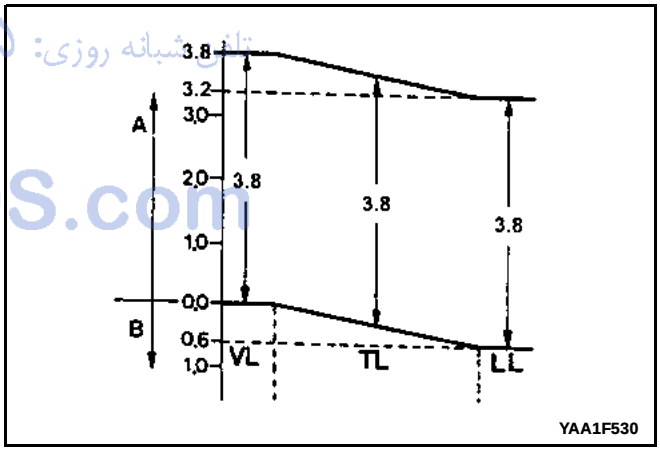
Consequently, the fuel pressure in the fuel distributor changes by the intake manifold's negative pressure, and the injector's fuel pressure gets reduced independently to the throttle valve's position. Thus, the fuel injection volume can only be determined according to the injector's injecting duration.

The pressure difference between the fuel pressure and the intake manifold is approx. 3.2 bars during idling.



1. Fuel Pressure Regulator
2. Intake Manifold
3. Fuel Return (to fuel tank)
4. Fuel Supply (from fuel pump)
7. Fuel Pressure (approx. 3.2 bars)
8. Intake Manifold Negative Pressure (0.6 bars)

<Fuel Pressure Diagram>

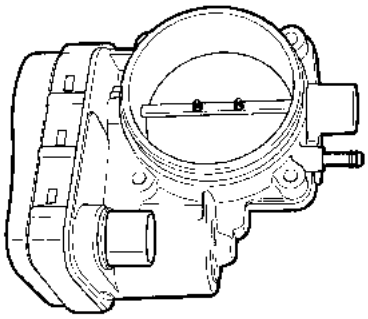


A. Fuel pressure
B. Intake Manifold Negative Pressure
LL. Idling
TL. Partial load
VL. Full load

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INDUCTION SYSTEM

THROTTLE VALVE ACTUATOR



YAA1F540

The throttle actuator is actuated by the Engine Control Module (ECM) according to the position of the accelerator pedal position.

It has two potentiometers which signal the position of the throttle valve to the ECM to enable it to recognize the various engine load states.

Ignition “Off”

In the de-energized states the throttle valve position is determined to be spring capsule.

Ignition “On”

When the ignition S/W on the servo motor in the throttle actuator is operated by the ECM. The throttle valve adopts a position in line with the coolant temperature.

Closed position

In the closed throttle position, the servo motor controls engine speed by operating the throttle valve further (greater mixture) or closing it further (reduced mixture), depending on coolant temperature and engine load. When this is done, the throttle valve can be closed further by the servo motor overcoming the force of the spring capsule (mechanical end stop). If the actuator is de-energized, the throttle valve is resting against the spring capsule.

Consequently, the throttle valve opening is a constant 10-12° approximately.

At no load, this produces an engine speed of about 1,800 rpm

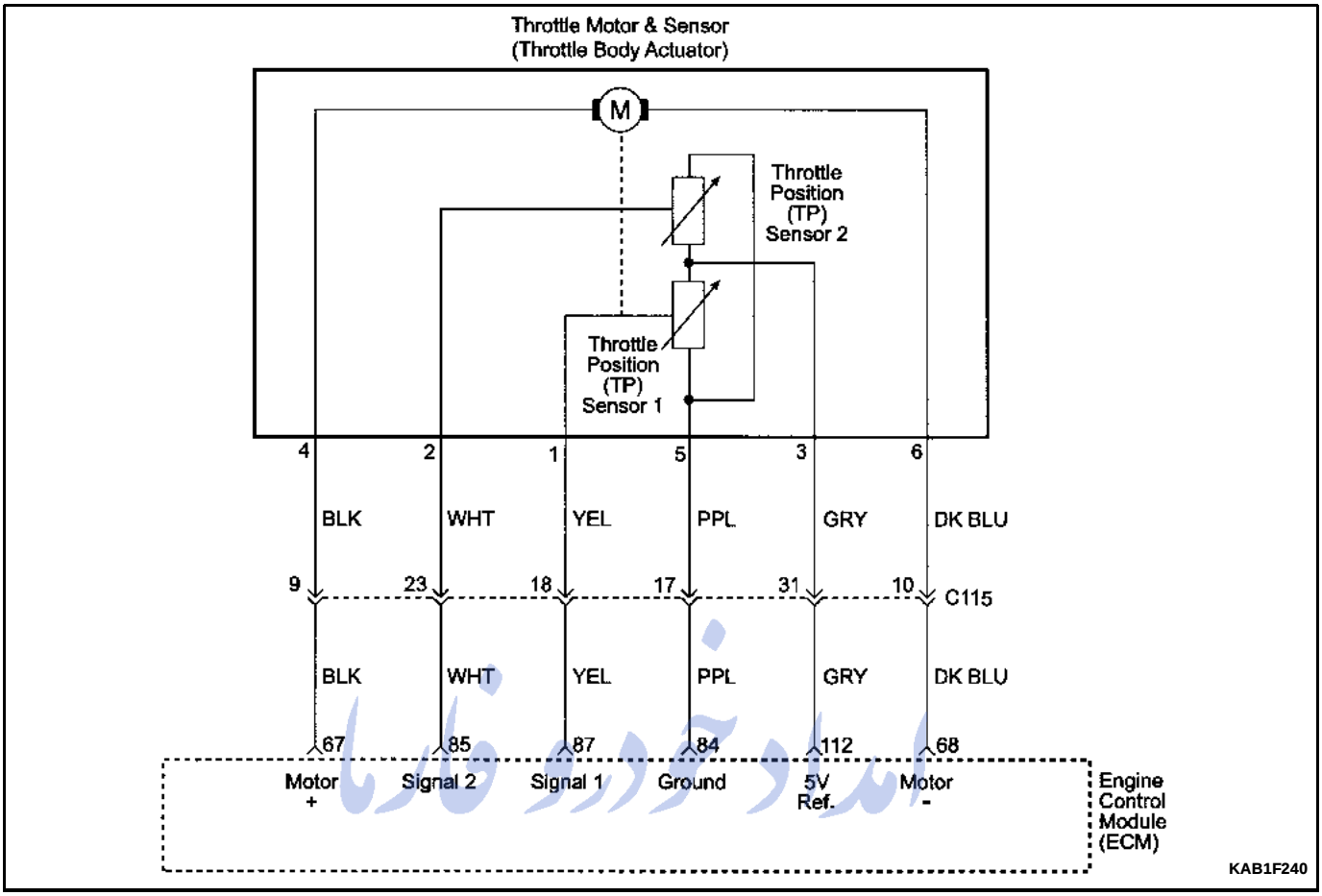
Driving

When driving (part/full throttle), the servo motor controls the throttle valve in line with the various load states and according to the input signals from the pedal value sensor according to the input signals from the pedal value sensor according to the position of the accelerator pedal.

The function of the EA (electronic accelerator) in the ECM determines the opening angle of the throttle valve through the throttle actuator. Further functions are;

- Idle speed control
- Cruise control
- Reducing engine torque for ASR/ABS operation
- Electronic accelerator emergency running
- Storing faults
- Data transfer through CAN

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Failure Code	Description	Trouble Area	Maintenance Hint
104	Throttle position sensor 1 low voltage	TPS 1 short circuit to ground or open	• Monitoring the actual values through scan tool • Inspection the ECM pin 84, 85, 87, 112, 67, 68 about short circuit or open with bad contact • Inspection the throttle valve actuator • Inspection the ECM
105	Throttle position sensor 1 high voltage	TPS 1 short circuit to power	
108	Throttle position sensor 2 low voltage	TPS 2 short circuit to ground or open	
109	Throttle position sensor 2 high voltage	TPS 2 short circuit to power	
116	Throttle actuator learning control failure	When actuator adaption fluctuation or not meet the condition	
119	Throttle valve return spring failure	When return spring defective of actuator	
121	Throttle actuator failure	When supply voltage of the actuator short circuit to power	
123	Different mass air flow sensor signal with throttle position sensor	When shut down of output driver	
125	Both throttle position sensor failure	When defective of both potentiometers	

Failure Code	Description	Trouble Area	Maintenance Hint
126	Throttle position sensor 1 not plausible with Throttle position sensor 2	When difference between TPS 1 and TPS 2	• Monitoring the actual values through scan tool • Inspection the ECM pin 84, 85, 87, 112, 67, 68 about short circuit or open with bad contact • Inspection the throttle valve actuator • Inspection the ECM
127	High permanent throttle signal	When failure of wiring harness or actuator	
185	Mass air flow sensor and throttle position sensor failure	When difference between MAF and TPS signal	

Circuit Description

The ECM supplies a 5 volt reference signal and a ground to the TP sensor. The TP sensor sends a voltage signal back to the ECM relative to the throttle plate opening. The voltage signal will vary from approximately 0.3 ~ 0.9 volts at closed throttle, to over 4.0 ~ 4.6 volts at Wide Open Throttle (WOT).

The TP sensors serve for engine load control according to the drive pedal command. Load adjustments independent of the drive pedal command can be implemented; such functions are, for instance, idle control, speed control, drive slip control, load shock damping, and similar functions.

When the actuator current fails, the throttle valve is returned to emergency operating position by a spring. The throttle valve position, thereby the actuator drive position checkback is provided by two potentiometers. The motor positions the throttle valve against the return spring force. Motor and return spring are two separate energy sources. Each of them is able to position the throttle valve in emergency position alone. Throttle valve position checkback and monitoring is provided by two actual value potentiometers connected to the engine control electronics.

Throttle Actuator Inspection

1. Turn the ignition switch to “ON” position.
2. Measure the TPS 1 signal voltage at the ECM pin No. 87 and TPS 2 signal voltage at the ECM pin No. 85.

	Pedal Position	Specified Value
TPS 1	Closed	0.3 ~ 0.9 v
	Opened	4.0 ~ 4.6 v
TPS 2	Closed	4.0 ~ 4.6 v
	Opened	0.3 ~ 0.9 v

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Throttle Actuator DC Motor Inspection

1. Turn the ignition switch to “ON” position.
2. Measure the signal voltage between the ECM pin No. 67 and No. 68.

Application		Specified Value
Engine Status	Ignition “ON”	0.8 ~ 2.3 v
	Idling	1.0 ~ 2.5 v (Coolant temperature is over 70°C)

Throttle Actuator DC Motor Resistance

1. Turn the ignition switch to “OFF” position.
2. Measure the resistance between the ECM pin No. 67 and No. 68.

Specified Value	< 10 Ω

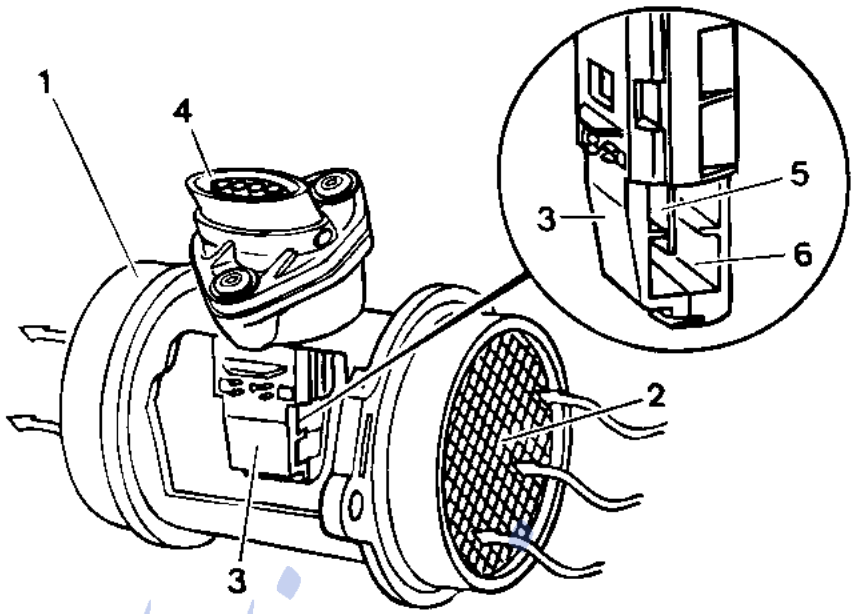
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HOT FILM AIR MASS (HFM) SENSOR



1. Housing
2. Protector Net
3. Electronic Housing
4. Connector
5. Hot Film Air Mass Sensor
6. Measuring Port

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The Hot Film Air Mass (HFM) sensor with recognition of flow direction related to pulsating flow is designed for recording load on Engine Control Module (ECM) by measuring the output voltage proportional to the reference voltage of the ECM.

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Mass Air Flow Sensor

Mass Air Flow (MAF) is a thermal flow meter whose sensor element with its temperature sensors and heating area is exposed to the MAF to be measured. A heating area located in the center of a thin membrane is controlled to an over-temperature by a heating resistor and a temperature sensor of this membrane. And the value of over-temperature depends on the temperature of the in-flowing air.

Two temperature sensors on upstream and downstream of the heating area show the same temperature without incoming flow. With incoming flow, upstream part is cooled down but downstream temperature retains its temperature more or less due to the air heated up in the heating area. This temperature difference in quantity and direction depends on the direction of the incoming flow.

ECM modulates the flow of heating current to maintain the temperature differential between the heated film and the intake air at a constant level. The amount of heating current required to maintain the temperature thus provides an index for the MAF. This concept automatically compensates for variations in air density, as this is one of the factors that determines the amount of warmth that the surrounding air absorbs from the heated element. MAF sensor is located between the air filter and the throttle valve.

Under high fuel demands, the MAF sensor reads a high mass flow condition, such as Wide Open Throttle (WOT). The ECM uses this information to enrich the mixture, thus increasing the fuel injector on-time, to provide the correct amount of fuel. When decelerating, the mass flow decreases. This mass flow change is sensed by the MAF sensor and read by the ECM, which then decreases the fuel injector on-time due to the low fuel demand conditions.

To facilitate the installation of the HFM in the intake passage, lubricating agents may be used. However, when lubricants are used care must be taken to ensure that they do not enter the flow passage and cannot be sucked in with the air flow.

The following tables show the relationship between MAF and output voltage.

Mass Air Flow (kg/h)	Voltage (v)	Mass Air Flow (kg/h)	Voltage (v)
0	0.95 ~ 1.05	250	3.51
10	1.28	370	3.93
15	1.41	480	4.23
30	1.71	640	4.56
60	2.16	800	4.82
120	2.76		

Intake Air Temperature

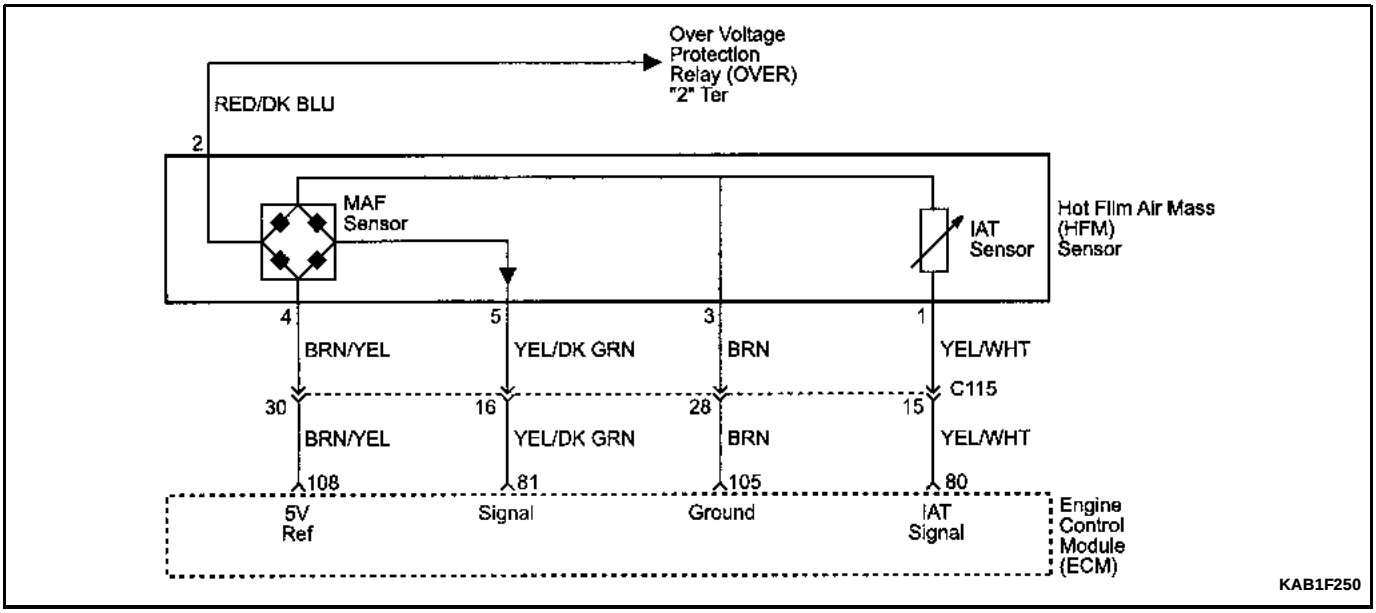
The Intake Air Temperature (IAT) sensor is a part of Hot Film Air Mass (HFM) sensor and is a thermistor, a resistor which changes value based on the temperature of the air entering the engine. Low temperature produces a high resistance, while high temperature causes a low resistance as the following table.

The ECM provides 5 volts to the IAT sensor through a resistor in the ECM and measures the change in voltage to determine the IAT. The voltage will be high when the manifold air is cold and low when the air is hot. The ECM knows the intake IAT by measuring the voltage.

The IAT sensor is also used to control spark timing when the manifold air is cold.

Temp. (°C)	R min. (Ω)	R nom. (Ω)	R max. (Ω)
-40	35140	39260	43760
-20	12660	13850	15120
0	5119	5499	5829
20	2290	2420	2551
40	1096	1166	1238
60	565	609	654
80	312	340	370
100	184	202	222
120	114	127	141
130	91	102	114

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Failure Code	Description	Trouble Area	Maintenance Hint
03	Intake air temperature sensor low voltage	IAT sensor short circuit to ground or open	• Monitoring the actual air temperature through scan tool • Inspection the ECM pin 80, 79 about short circuit or open with bad contact • Inspection the IAT sensor (integrated in HFM sensor) • Inspection the ECM
04	Intake air temperature sensor high voltage	IAT sensor short circuit to power	
05	Intake air temperature sensor plausibility	Malfunction in recognition of IAT When functional problem	
09	Mass air flow sensor plausibility	Malfunction in recognition of MAF When air mass not plausible	• Monitoring the actual air mass flow through scan tool • Inspection the ECM pin 81, 105 about short circuit or open with bad contact • Inspection the MAF sensor (integrated in HFM sensor) • Inspection the ECM
10	Mass air flow sensor low voltage	MAF sensor short circuit to ground or open	
11	Mass air flow sensor high voltage	MAF sensor short circuit to power	

Circuit Description

The heated element on the MAF is a platinum film resistor (heater). It is located on a ceramic plate together with the other elements in the bridge circuit. The temperature sensitive resistor (flow sensor) also included in the bridge. The separation of heater and flow sensor facilitates design of the control circuitry. Saw cuts are employed to ensure thermal decoupling between the heating element and the intake air temperature (IAT) sensor. The complete control circuitry is located on a single layer. The voltage at the heater provides the index for the mass air flow. The MAF's electronic circuitry then converts the voltage to a level suitable for processing in the ECM. This device does not need a burn off process to maintain its measuring precision over an extended period. In recognition of the fact that most deposits collect on the sensor element's leading edge, the essential thermal transfer elements are located downstream on the ceramic layer. The sensor element is also design to ensure that deposits will not influence the flow pattern around the sensor.

The IAT sensor uses a thermistor to control the signal voltage to the ECM. The ECM supplies 5 volt reference and a ground to the sensor. When the air is cold, the resistance is high; therefore the IAT signal voltage will be high. If the intake air is warm, resistance is low; therefore the IAT signal voltage will be low.

Mass Air Flow Sensor Input Voltage Inspection

1. Turn the ignition switch to “ON” position.
2. Measure the signal voltage between the ECM pin No. 103 and No. 104.

Application		Specified Value
Engine Status	Ignition “ON”	0.9 ~ 1.1 v
	Idling	1.3 ~ 1.7 v (Coolant temperature is over 70°C)

Notice: If the measured value is not within the specified value, the possible cause may be in cable or MAF sensor in itself. Perform the 5 volt power supply inspection procedures.

Mass Air Flow Sensor 5 volt Power Supply Inspection

1. Turn the ignition switch to “OFF” position.
2. Disconnect the HFM sensor connector.
3. Turn the ignition switch to “ON” position.
4. Measure the voltage between the ECM pin No. 108 and MAF sensor connecter terminal No. 3.

Specified Value	4.7 ~ 5.2 v

Notice: If the measured value is not within the specified value, the possible cause may be in cable or ECM coupling.

5. Measure the voltage between the ECM pin No. 105 and MAF sensor connecter terminal No. 4.

Specified Value	4.7 ~ 5.2 v

Notice: If the measured value is not within the specified value, the possible cause may be in cable or ECM coupling.

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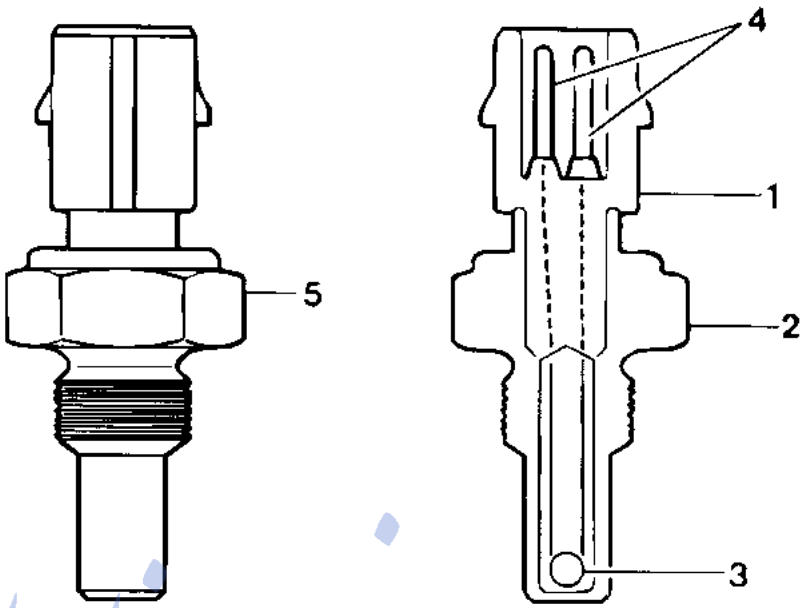
Mass Air Flow Sensor 12 volt Power Supply Inspection

1. Turn the ignition switch to “OFF” position.
2. Disconnect the HFM sensor connector.
3. Turn the ignition switch to “ON” position.
4. Measure the voltage between the ECM pin No. 105 and MAF sensor connecter terminal No. 2.

Specified Value	11 ~ 14 v

Notice: If the measured value is not within the specified value, the possible cause may be in cable or Over Voltage Protection Relay (OVPR).

ENGINE COOLANT TEMPERATURE (ECT) SENSOR



1. Artificial Resin Housing
2. Metal Housing
3. NTC (Negative Temperature Coefficient) Resistor
4. Connector
5. Engine Coolant Temperature Sensor

YAA1F590

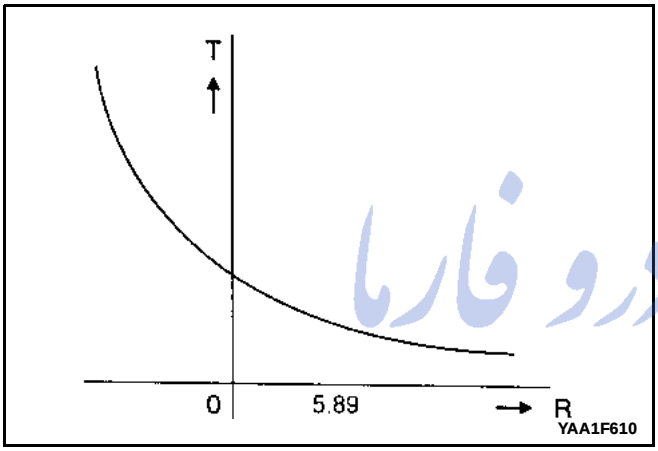
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Engine Coolant Temperature (ECT) sensor detects coolant temperature and supplies information to the ECM. It is composed of metal housing with two NTC resistor, 4 pin connector. The ECM provides a 5 volt signal to the ECT sensor through a dropping resistor. When the engine is cold, the ECT sensor provides high resistance, which the ECM detects as a high signal voltage. As the engine warms up, the sensor resistance becomes lower, and the signal voltage drops. At normal engine operating temperature, the ECT signal will measure about 1.5 to 2.0 volts.

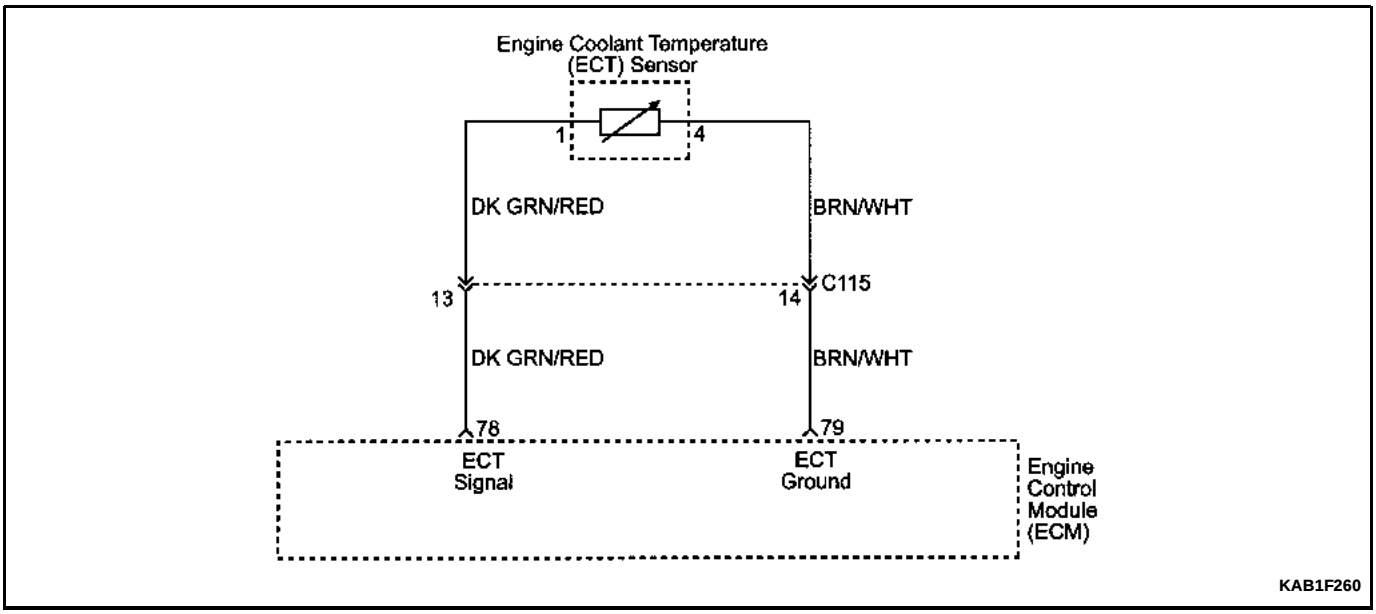
The ECM uses information about coolant temperature to make the necessary calculations for:

- Fuel delivery
- Ignition control
- Knock sensor system
- Idle speed
- Torque converter clutch application
- Canister purge
- Cooling fan operation
- Others

Temperature (°C)	Resistance (Ω)	Voltage (V)	Temperature (°C)	Resistance (Ω)	Voltage (V)
-40	48,550	4.90	60	594	1.86
-30	27,000	4.82	70	434	1.51
-20	15,570	4.70	80	322	1.22
-10	9,450	4.52	90	243	0.98
0	5,890	4.43	100	185	0.78
10	3,790	3.96	110	143	0.63
20	2,500	3.57	120	111.6	0.50
30	1,692	3.14	130	88	0.40
40	1,170	2.70	140	71.2	0.33
50	826	2.26	-	-	-



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Failure Code	Description	Trouble Area	Maintenance Hint
00	Engine coolant temperature sensor low voltage	ECT sensor short circuit to ground or open	• Monitoring the actual coolant temperature through scan tool • Inspection the ECM pin 78, 79 about short circuit or open with bad contact • Inspection the ECT sensor • Inspection the ECM
01	Engine coolant temperature sensor high voltage	ECT sensor short circuit to power	
02	Engine coolant temperature sensor plausibility	Malfunction in recognition of ECT When drop to about 50°C below after warm up	
06	Engine coolant temperature insufficient for closed loop fuel control	Malfunction in recognition of ECT When minimum temperature for lambda control after warm up	

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Circuit Description

The ECT sensor uses a thermistor to control the signal voltage to the ECM. The ECM supplies a voltage on the signal circuit to the sensor. When the engine coolant is cold, the resistance is high; therefore the ECT signal voltage will be high

Engine Coolant Temperature Sensor Inspection

1. Turn the ignition switch to “ON” position.
2. Measure the voltage between the ECM pin No. 78 and No. 79.

Temperature (°C)	Specified Value (V)
20	3.57
80	1.22
100	0.78

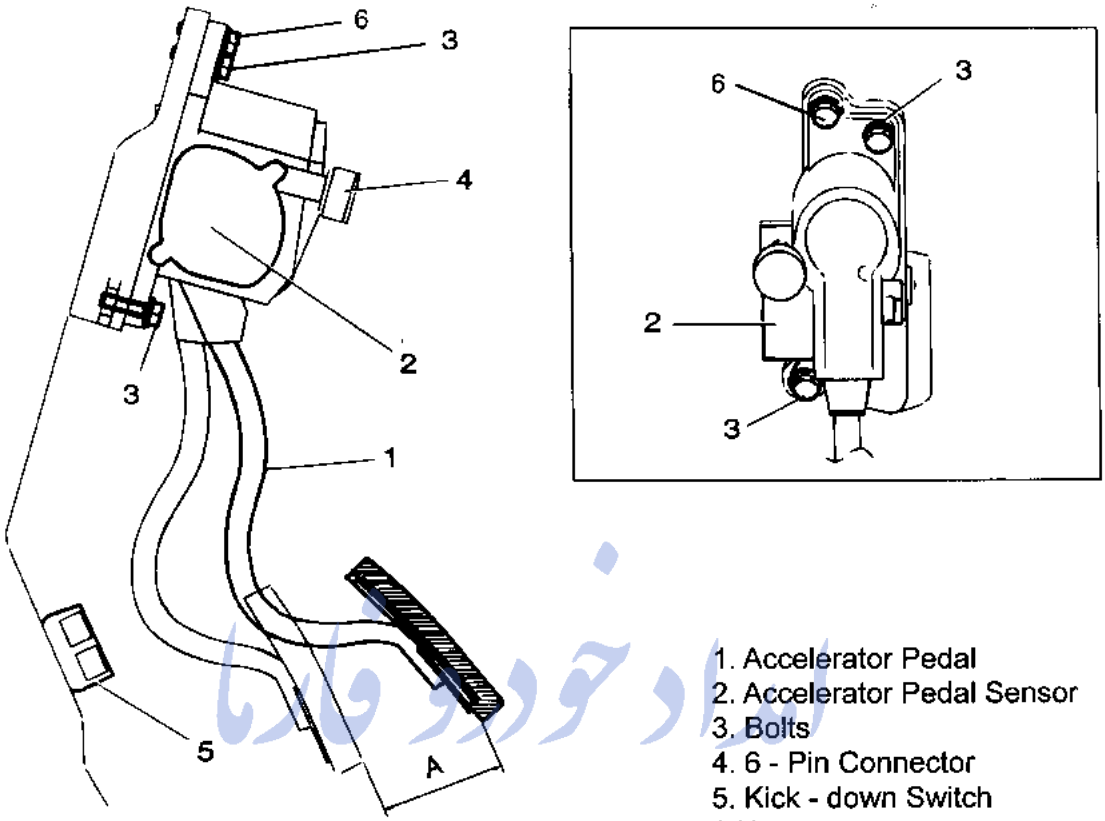
3. Turn the ignition switch to “OFF” position.
4. Disconnect the ECT sensor connector.
5. Turn the ignition switch to “ON” position.
6. Measure the resistance between the ECT sensor terminal pin No. 1 and No. 4.

Temperature (°C)	Specified Value (Ω)
20	2,500
80	322
100	185

Notice: Replace wiring and coolant temperature sensor if out of specified value.

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ACCELERATOR PEDAL MODULE



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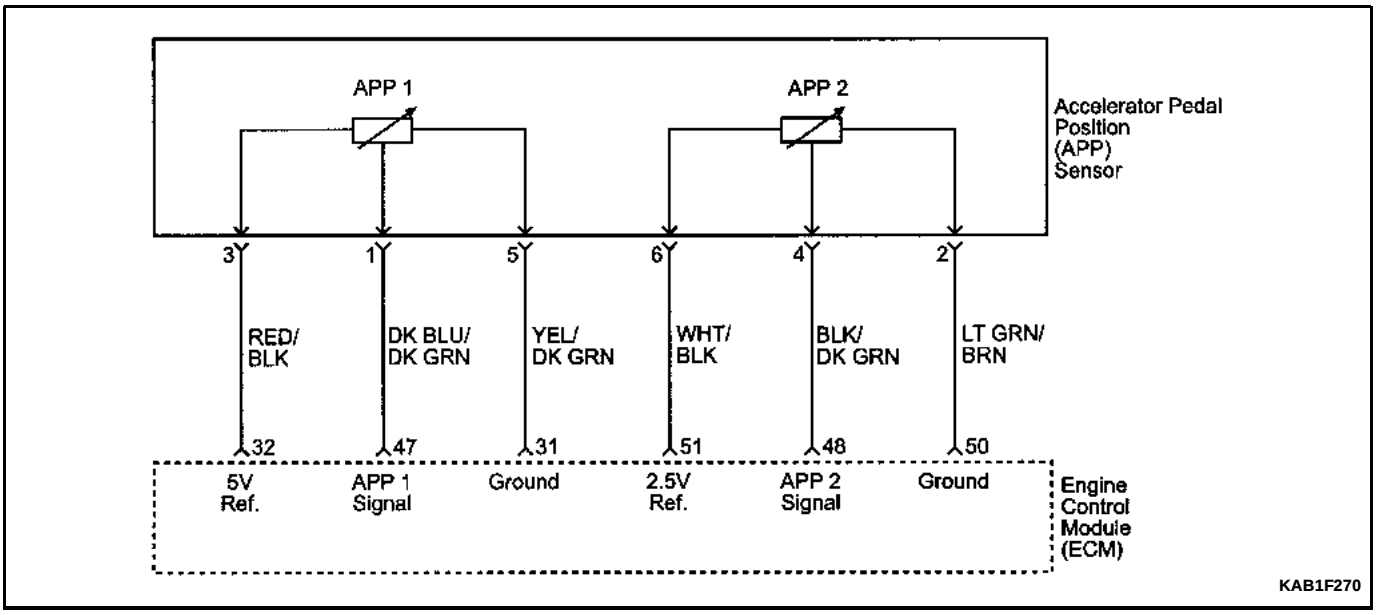
The Acceleration Pedal Position (APP) sensor is mounted on the accelerator pedal assembly. The sensor is actually two individual APP sensors and one housing. This sensor works with the Throttle Position (TP) sensor to provide input to the Engine Control Module (ECM) regarding driver requested accelerator pedal and throttle angle at the throttle body.

When the APP sensor is defected:

When the APP 1 or APP 2 sensor is defected condition, the engine is still running at idle condition but, the accelerator pedal reaction is not response correctly and also, the engine rpm will be reacted to 4,000 rpm slowly. If the APP 1 sensor is out of order, the APP 2 sensor will be conducted with signal as a default signal but, the throttle valve opening is limited 60% and delayed opening speed.

When the TP sensor or servo motor is defected:

When the TP 1, 2 sensor or servo motor is defected condition, the throttle valve will be closed to the spring capsule by spring force, at this condition, the throttle valve will open 10° ~ 20° and engine rpm will be controlled by ECM will opening (On/Off) time of injector. The engine rpm will be maintaining 900 rpm (at idle) to 1,800 according to the engine load.



Failure Code	Description	Trouble Area	Maintenance Hint
122	Acceleration pedal position sensor signal failure	When malfunction of APP Sensor	• Monitoring the actual values through scan tool • Inspection the ECM pin 31, 47, 32, 48, 59, 51 about short circuit or open with bad contact • Inspection the APP sensor • Inspection the ECM
160	Acceleration pedal position 1 sensor low voltage	APP 1 sensor short circuit to ground or open	
161	Acceleration pedal position sensor 1 high voltage	APP 1 sensor short circuit to power	
162	Acceleration pedal position sensor 2 low voltage	APP 2 sensor short circuit to ground or open	
163	Acceleration pedal position sensor 2 high voltage	APP 2 sensor short circuit to power	
164	Accelerator pedal position sensor 1 not plausible with accelerator pedal position sensor 2	When difference between APP 1 sensor and APP 2 sensor	
167	Both setpoint Accelerator pedal position sensor defective	When defective of both APP sensor	

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Circuit Description

The ECM supplies a 5 or 2.5 volt reference signal and a ground to the APP sensor 1 or 2. The ECM calculates on these signal lines. The APP sensor output changes as the accelerator pedal is moved. The output of the APP 1 and APP 2 sensor are low, about 0.4 ~ 0.7 volts and 0.2 ~ 0.35 volts respectively at the closed throttle position. As pushing the accelerator pedal, the output increases so that the output voltages will be about 4.3 ~ 4.8 volts and 2.1 ~ 2.4 volts individually when accelerating fully with the kick down, at Wide Open Throttle (WOT).

Acceleration Pedal Position Sensor 1 Inspection

1. Turn the ignition switch to “ON” position.
2. Measure the signal voltage between the ECM pin No. 47 and No. 31 while operating the accelerator pedal as following conditions.
   - Not depress the pedal (closed throttle position)
   - Fully depress the pedal (full throttle with kick down)

Condition of Throttle Valve	Specified Value (V)
Closed Throttle Valve	0.3 ~ 0.7
Fully Depressed Throttle Valve	4.3 ~ 4.8

Notice: If measured value is not within the specified value, check the pedal valve sensor and the supply voltage to APP 1 sensor.

Acceleration Pedal Position Sensor 2 Inspection

1. Turn the ignition switch to “ON” position.
2. Measure the signal voltage between the ECM pin No. 48 and No. 50 while operating the accelerator pedal as following conditions.
   - Not depress the pedal (closed throttle position)
   - Fully depress the pedal (full throttle with kick down)

Condition of Throttle Valve	Specified Value (V)
Closed Throttle Valve	0.1 ~ 0.4
Fully Depressed Throttle Valve	2.1 ~ 2.5

Notice: If measured value is not within the specified value, check the pedal valve sensor and the supply voltage to APP sensor 2.

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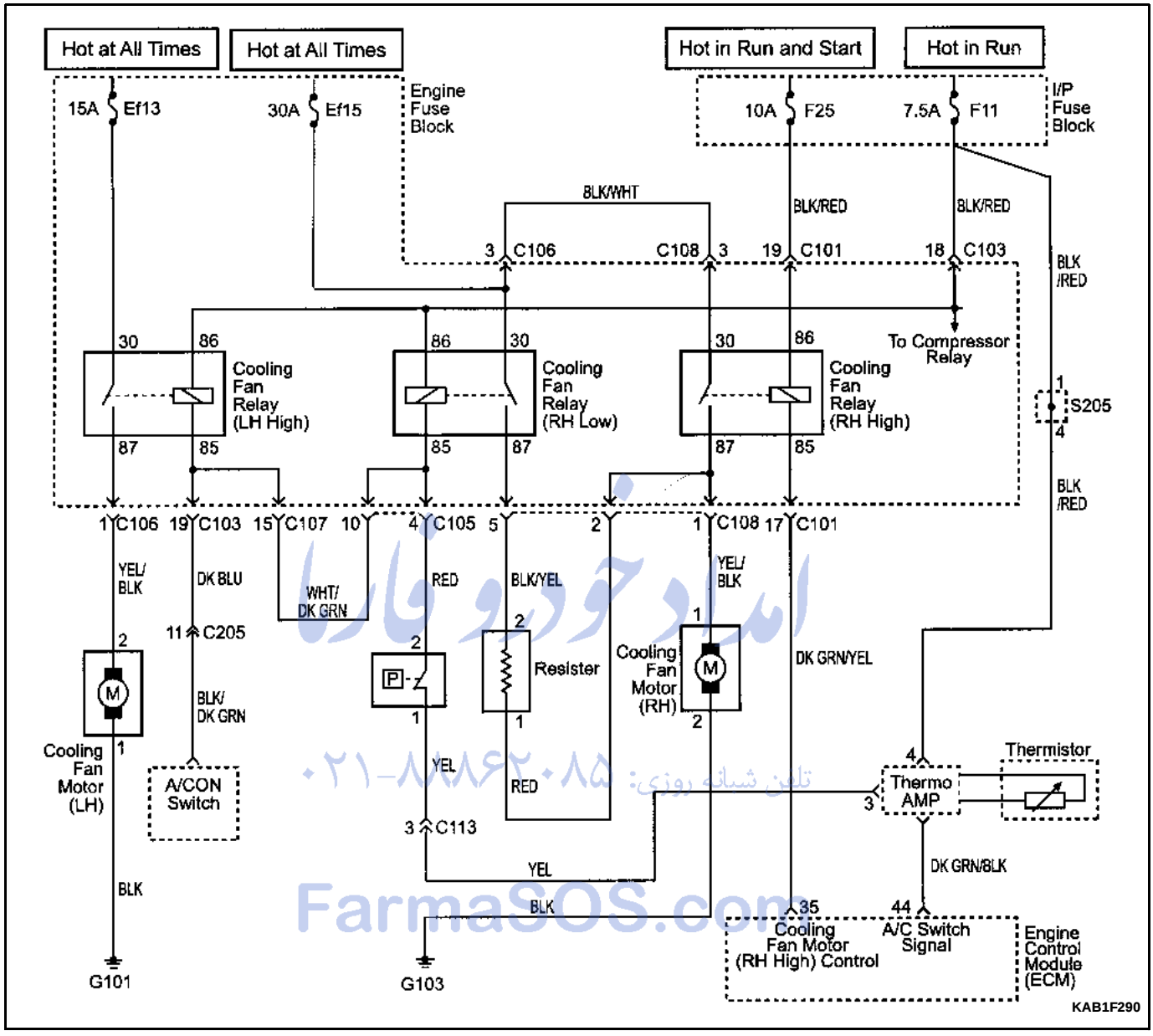
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COOLING FAN

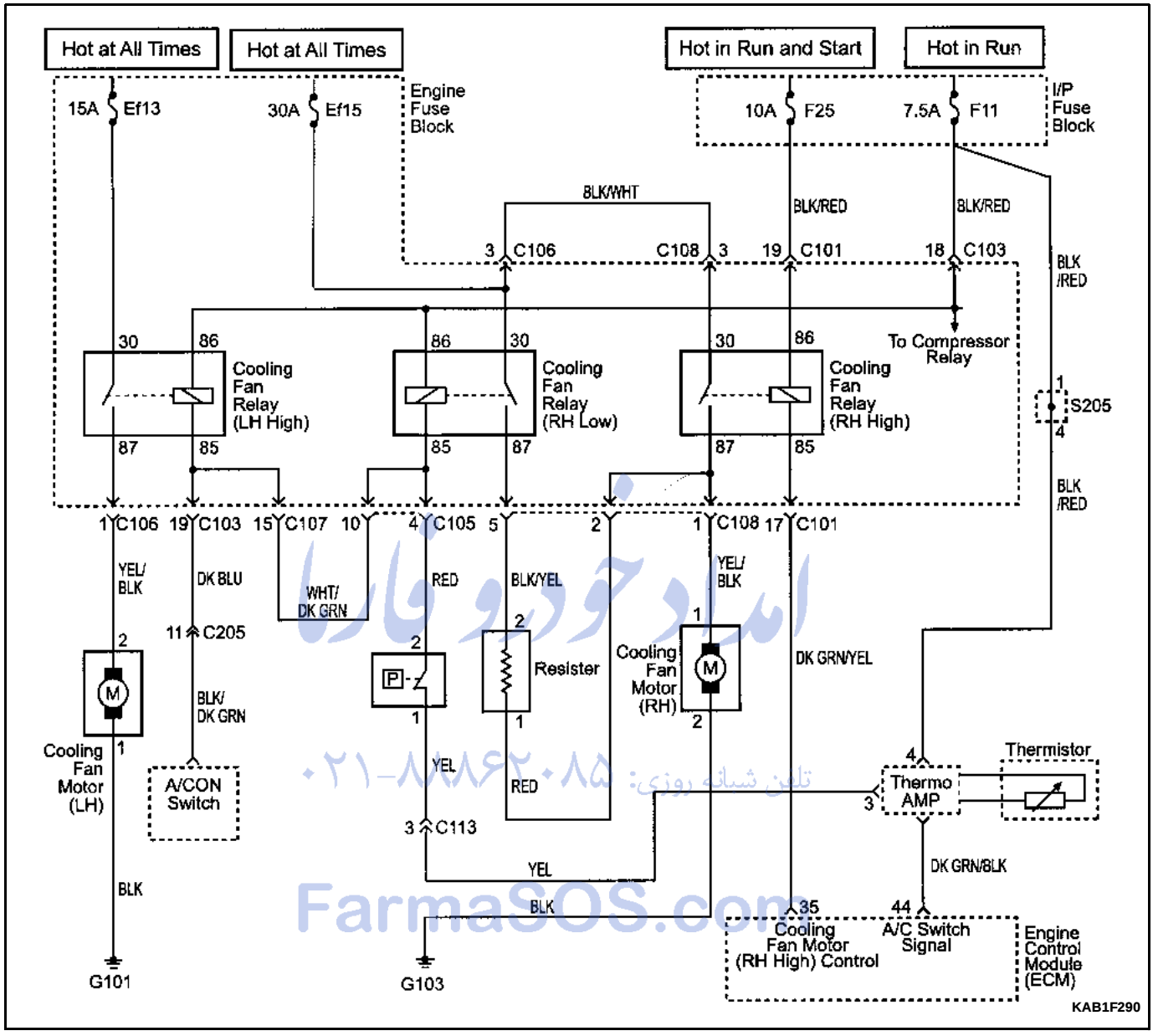


Failure Code	Description	Trouble Area	Maintenance Hint
44	Cooling fan (HI) relay short circuit to power	Cooling fan short circuit to power	• Inspection the Engine Control Module (ECM) pin 35 about short circuit or open with bad contact • Inspection the power source • Inspection the cooling fan • Inspection the ECM
45	Cooling fan (HI) relay short circuit to ground or open	Cooling fan short circuit to ground or open	

Circuit Description

Ignition voltage is supplied directly to the cooling fan relay coil. The ECM controls the relay by grounding the control circuit. When the ECM is commanding a command ON, the voltage of the control circuit should be low (near 0 volt). When the ECM is commanding the control circuit should be high (near battery voltage). If the fault detection circuit senses a voltage other than what is expected, the fault line status will change causing the fault code to set.

A/C COMPRESSOR RELAY



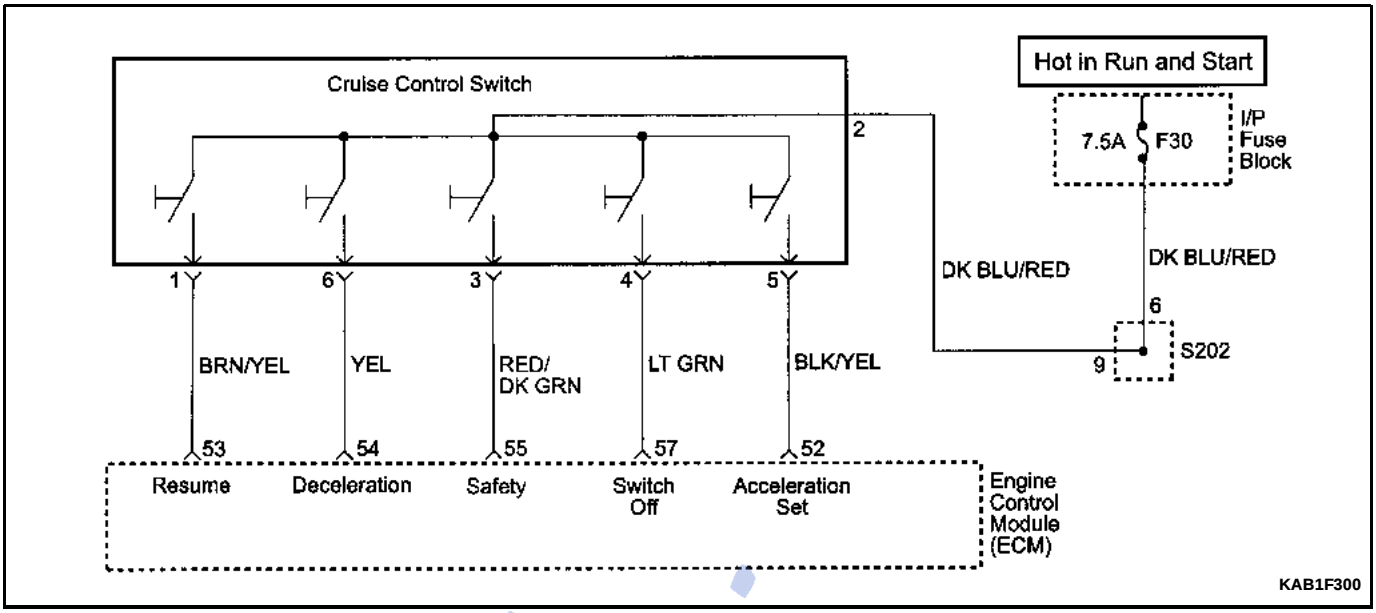
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Failure Code	Description	Trouble Area	Maintenance Hint
228	A/C compressor relay short circuit to battery	When malfunction of A/C compressor control	• Monitoring the actual operation through scan tool • Inspection the Engine Control Module (ECM) pin 44 about short circuit or open with bad contact • Inspection the relay short circuit or open • Inspection the ECM
229	A/c compressor relay short circuit to ground or open		

Circuit Description

When the ECM detects that A/C has been requested, the ECM will activated the A/C clutch relay. When the relay has been activated, voltage should be present at both the A/C clutch relay and A/C switch circuit at ECM.

CRUISE CONTROL SWITCH



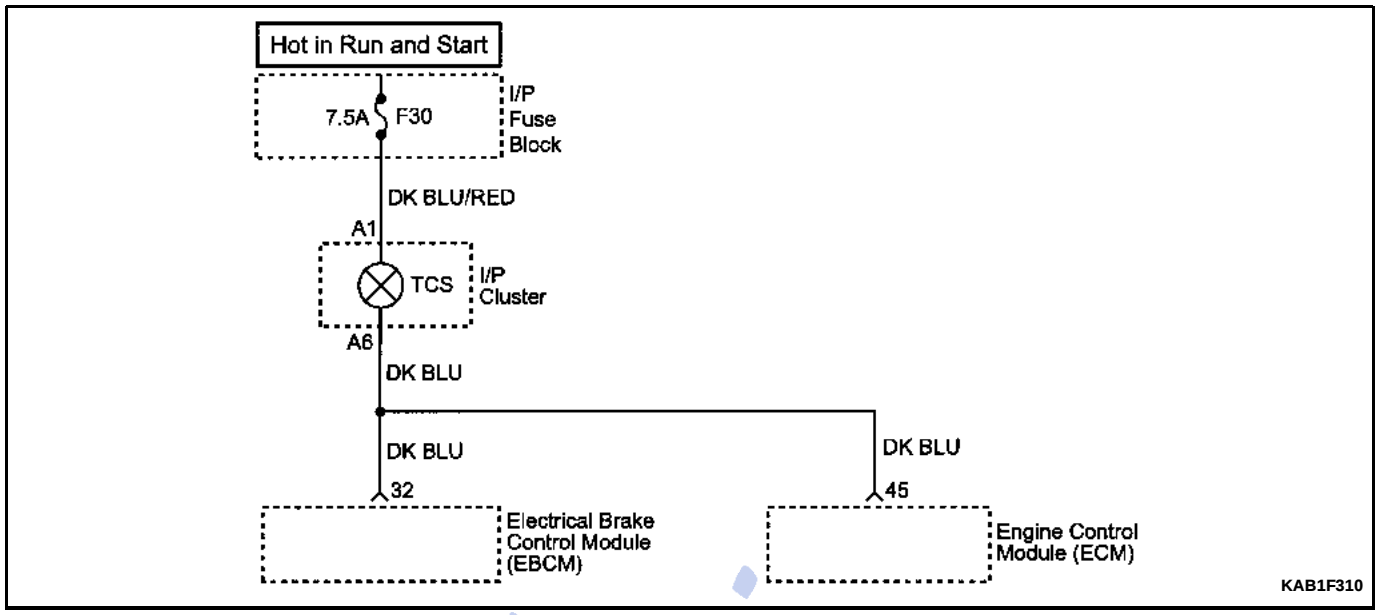
Failure Code	Description	Trouble Area	Maintenance Hint
129	Cruise control "OFF" due to message counter failure	Cruise control system Message counter fault	• Monitoring the actual recognition status and vehicle speed signal through scan tool • Inspection the Engine Control Module (ECM) pin 52, 53, 54, 55, 57 about short circuit or open with bad contact • Inspection the CAN and ABS • Inspection the cruise control lever switch • Inspection the ECM
130	Vehicle speed signal failure	When malfunction of auto-cruise system Implausible condition of vehicle speed signal.	
131	Vehicle speed signal failure		
132	Cruise control lever failure	Cruise control lever defective	
133	Cruise control acceleration failure	Cruise control system Implausible condition of acceleration signal	
134	Cruise control deceleration failure	Cruise control system Implausible condition of deceleration signal	

Circuit Description

Cruise control is an automatic speed control system that maintain a desired driving speed without using the accelerator pedal. The vehicle speed must be greater than 40 km/h to engage cruise control.

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TRACTION CONTROL SYSTEM (TCS)



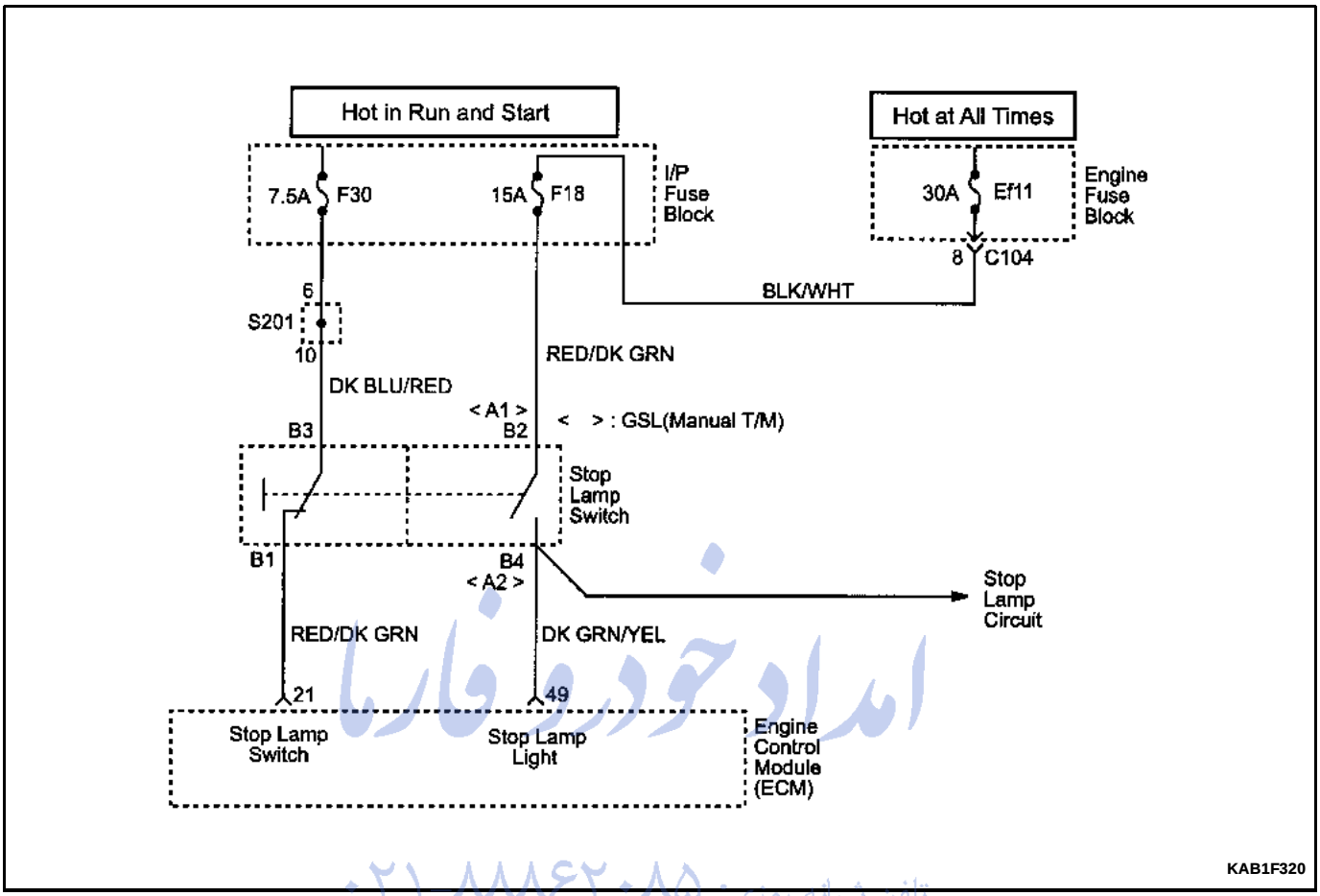
Failure Code	Description	Trouble Area	Maintenance Hint
150	TCS input signal short circuit to battery	TCS short circuit to power	• Inspection the Engine Control Module (ECM) pin 45 about short circuit or open with bad contact • Inspection the TCS lamp of I/P cluster. • Inspection the ECM
151	TCS input signal short circuit to ground or open	TCS short circuit to ground or open	

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Circuit Description

Battery voltage is supplied to the TCS warning lamp with the ignition in ON and START. The warning lamp can be activated only by the Electrical Brake Control Module (EBCM) internally supplying ground to terminal 32. If the TCS input circuit is open or short, this failure code will be set.

STOP LAMP SWITCH



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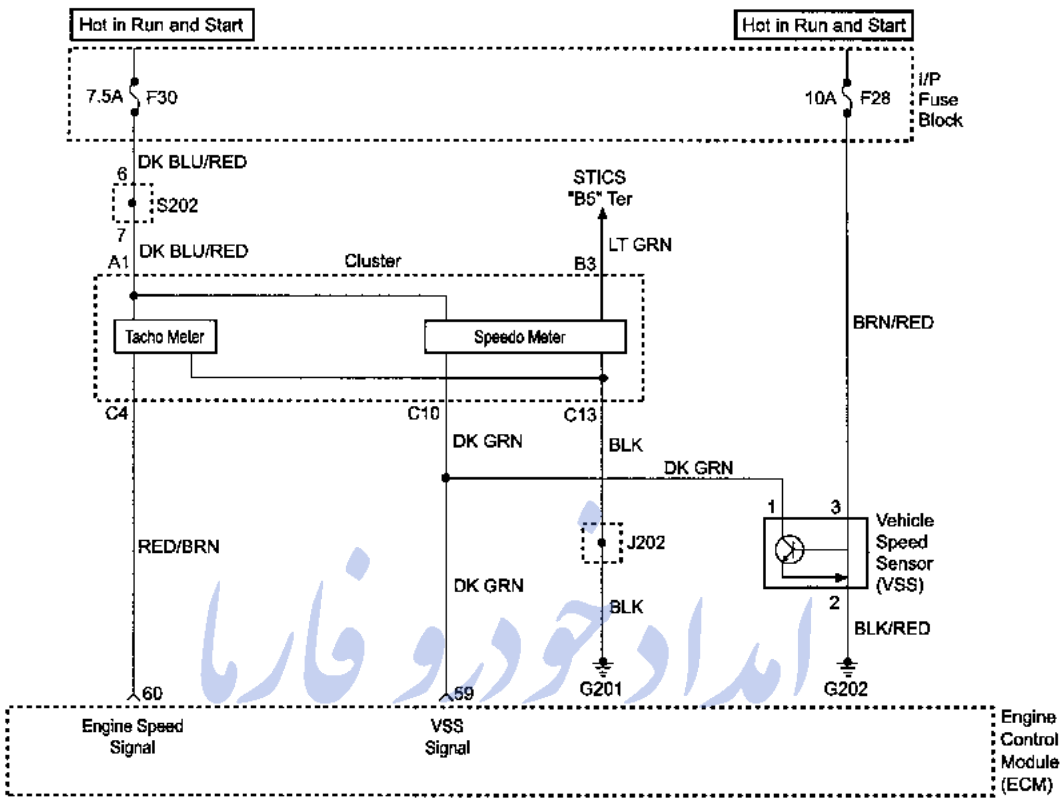
Failure Code	Description	Trouble Area	Maintenance Hint
135	Stop lamp switch failure	When malfunction of stop lamp switch – implausible condition of stop lamp signal input	• Monitoring the actual operational status and vehicle speed signal through scan tool • Inspection the Engine Control Module (ECM) pin 49 about short circuit or open with bad contact • Inspection the contact condition of stop lamp switch • Inspection the ECM

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Circuit Description

The stop lamp switch is normally opened. When the ignition switch ON and brake ON, the battery voltage is supplied to the ECM. A scan tool should display ON when brake pedal is depressed and should read OFF with brake pedal released.

ENGINE RPM



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Failure Code	Description	Trouble Area	Maintenance Hint
32	Engine rpm output circuit short circuit to battery	When short circuit to battery	• Monitoring the actual rpm in cluster • Inspection the Engine Control Module (ECM) pin 60 about short circuit or open • Inspection the cluster panel board circuit • Inspection the ECM
33	Engine rpm output circuit short circuit to ground or open	When short circuit to ground or open	

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EXHAUST SYSTEM

CATALYTIC CONVERTER

The purpose of the catalytic converter is to convert the three pollutants of carbon monoxide (CO), hydrocarbons (HC) and oxides of nitrogen (NOx) contained in the exhaust of gasoline engines, into the harmless compounds of water (H2O), carbon dioxide (CO2) and nitrogen (N2).

The catalytic converter contains a catalyst, a word coming from the Greek and which designates the element essential for catalyst which triggers chemical reactions without itself being consumed.

These catalysts in the 3-way catalytic converter are the rare metals platinum (Pt) and rhodium (Rh).

The catalytic converter consists essentially of three main elements. The exhaust gases flow through the catalytic converter and, in so doing, coming into contact with rare metals (Pt and Rh).

The following chemical reaction are produced.

$CO + O2 \rightarrow CO2$

$HC + O2 \rightarrow CO2 + H2O$

$NOx \rightarrow N2 + O2$

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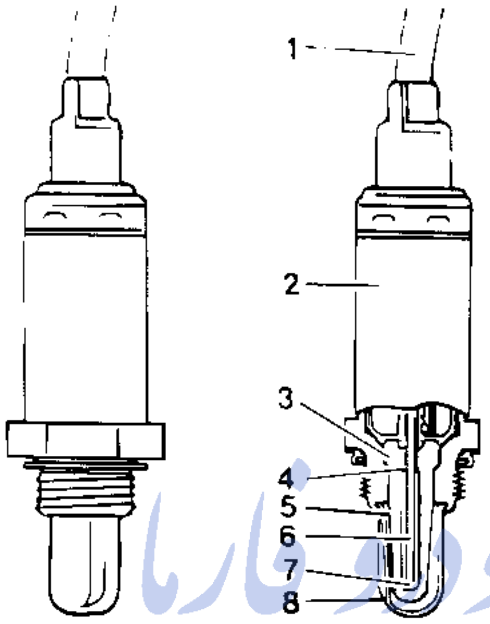
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OXYGEN SENSOR



1. Electrical Wire
2. Oxygen Sensor Housing
3. Sensor Ceramic
4. Eletrode (Internal)
5. Eletrode (External)
6. Heating Coil
7. Open Space
8. Protector Tube

YAA1F650

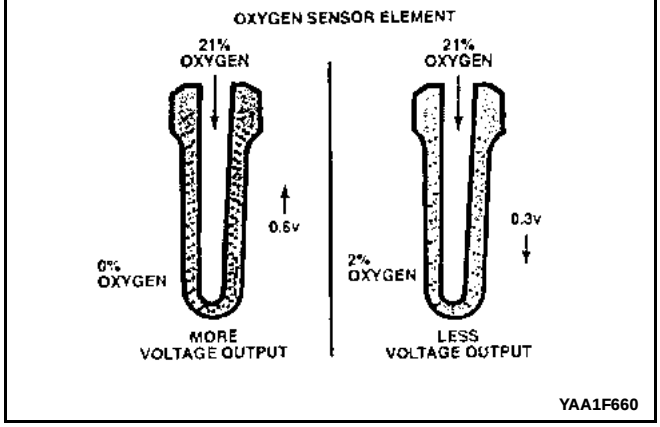
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The oxygen sensor is unique among the engine control sensors because is acts like a battery and is able to generate its own low voltage signal. It is located the exhaust system and monitors the amount of oxygen in the exhaust stream and provides feedback to the Engine Control Module (ECM).

The electrically heated oxygen sensor warms up quickly and remains hot, even at idle when the exhaust manifold may cool down.

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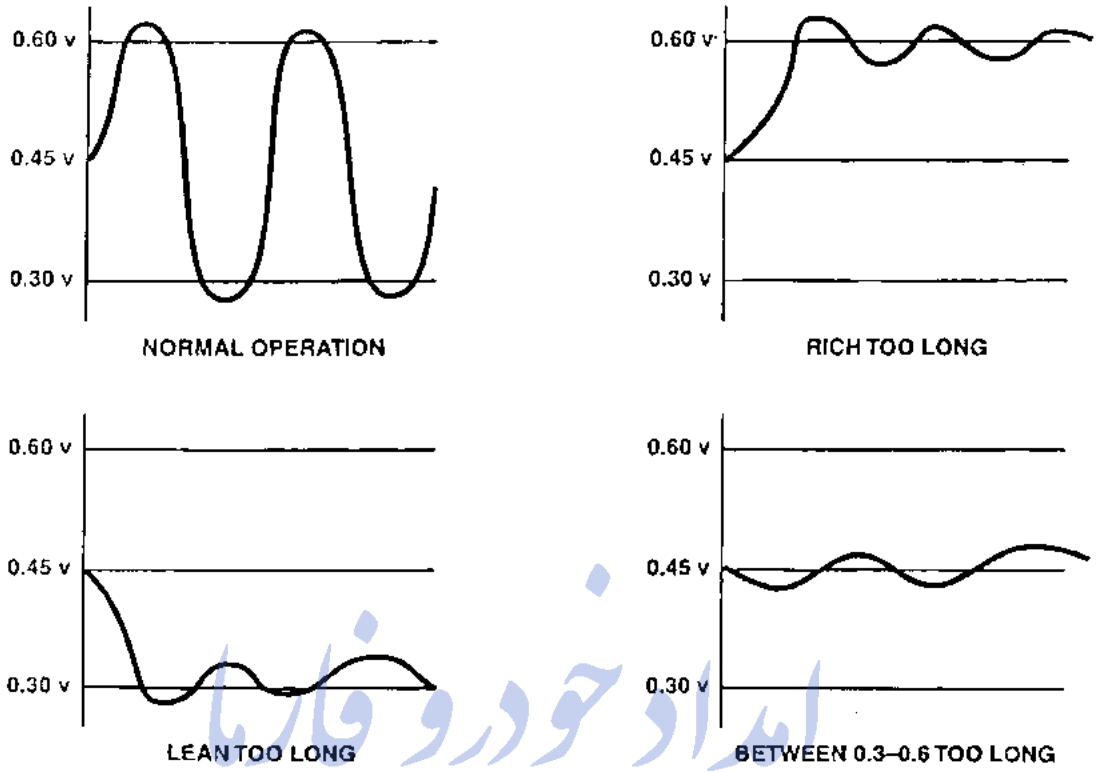
The ECM applies a reference voltage of 450 mv to the oxygen sensor, the ECM compares this reference voltage with the voltage generated by oxygen sensor. The amount of voltage the oxygen sensor generates is proportionate to the difference between the amount of oxygen in the outside air and the exhaust gases. The atmosphere contains about 21% oxygen. The exhaust from a rich air/fuel ratio contains almost no oxygen. With a large difference between the amounts of oxygen containing the two surface, the sensor generates less voltage. When the exhaust gas is rich (below 14.7:1), the voltage output is high, above 450 mv. When the exhaust gas is lean (above 14.7:1 air/fuel ratio), the sensor's voltage output is low, below 450 mv.



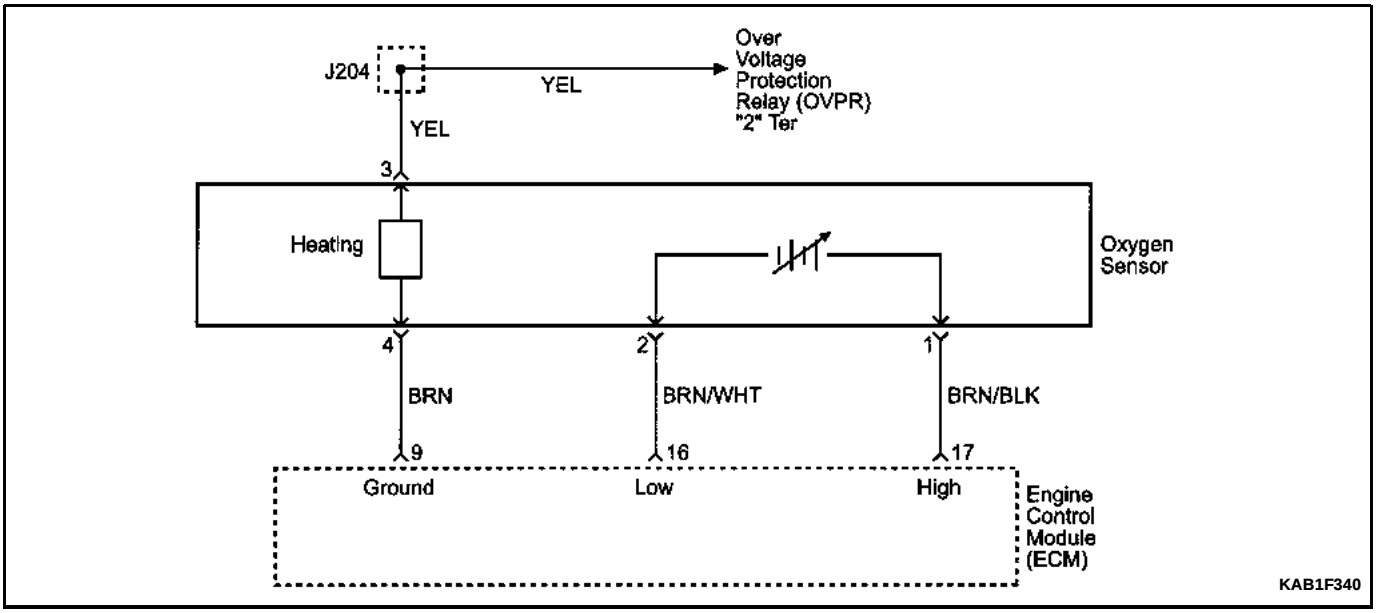
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The ECM uses oxygen sensor information for:

- Open loop / closed loop criteria
- Ideal air / fuel ratio



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Failure Code	Description	Trouble Area	Maintenance Hint
80	Oxygen sensor high voltage	When recognition the output that more than nominal threshold, malfunction of sensing voltage.	• Monitoring the actual output signal through scan tool • Inspection the ECM pin 16, 17 about short circuit or open with bad contact • Inspection the oxygen sensor • Inspection the ECM
89	Oxygen sensor low voltage	When recognition the output that more than nominal threshold, malfunction of sensing voltage.	
82	Oxygen sensor no activity detected	When recognition the output that not active the sensor etc.	
83	Oxygen sensor not lean after overrun fuel shut-off	When recognition the output that no lean signal after overrun fuel shut-off	
84	Oxygen sensor slow response	When slow response of sensor signal	
85	Oxygen sensor heater failure	When recognition the heating circuit	• Monitoring the heating status through scan tool • Inspection the ECM pin 9 about short circuit or open with bad contact • Inspection the heating power source • Inspection the heating circuit of oxygen sensor • Inspection the ECM
86	Oxygen sensor heater short circuit to battery	When recognition the heating currents that more or less than set values (less than 0.2 A or more than 2 A)	
87	Oxygen sensor heater short circuit to ground or open	When recognition the heating voltages than less than set values (less than 2 v)	

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Failure Code	Description	Trouble Area	Maintenance Hint
81	Bank 1 system short term fuel trim adaptation below lean threshold	When recognition the value less than nominal control threshold, it means that when big deviation in control range of adaptation values through fuel and air mixture formation	• Inspection the intake air leakage • Inspection the injection quantities with injector block or leakage • Inspection the exhaust leakage • Inspection the ECM
93	Bank 1 system short term fuel trim adaptation above rich threshold	When recognition the value more than nominal control threshold, it means that when big deviation in control range of adaptation values through fuel and air mixture formation	
96	Bank 1 system short term fuel trim at rich stop	When recognition the short term fuel trim that more than nominal threshold	
97	Bank1 system short term fuel trim at lean stop	When recognition the short term fuel trim that less than nominal threshold	
98	Bank 1 system idle adaptation failure (above rich threshold)	When recognition the long term fuel trim exceeds rich threshold	
99	Bank 1 system idle adaptation failure (below rich threshold)	When recognition the long term fuel trim exceeds lean threshold	
100	Bank 1 system learning control failure (rich, low load)	When recognition the long term fuel trim exceeds rich threshold	
101	Bank 1 system learning control failure (lean, low load)	When recognition the long term fuel trim exceeds lean threshold	
102	Bank 1 system learning control failure (rich, high load)	When recognition the long term fuel trim exceeds rich threshold	
103	Bank 1 system learning control failure (rich, low load)	When recognition the long term fuel trim exceeds lean threshold	

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Circuit Description

In order to control emissions, a catalytic converter is used to covert harmful emissions into harmless water vapor and carbon dioxide. The ECM has the ability to monitor this process by using a oxygen sensor. The oxygen sensor produces and output signal which indicates the storage capacity of the catalyst. This in turn indicates the catalyst's ability to convert exhaust emission effectively. If the oxygen sensor pigtail wiring, connector, or terminal is damaged. Do not attempt to repair the wiring, connector, or terminals. In order for the sensor to function properly, it must have a clean air reference provided to it. This clean air reference is obtained by way of the oxygen sensor wire(s). Any attempt to repair the wires, connector, or terminal and degrade the oxygen sensor performance.

Oxygen Sensor Signal Voltage Inspection

1. Maintain the engine speed is at idle while the coolant temperature is over 80 °C.
2. Measure the oxygen sensor signal voltage between the ECM terminal No. 16 and No. 17.

Specified Value	- 0.2 ~ 1.0 v

Notice: If the measured value is not within the specified value, the possible cause may be in cable, oxygen sensor or ECM

Oxygen Sensor Heating Voltage Inspection

1. Maintain the engine speed is at idle while the coolant temperature is over 80°C.
2. Measure the oxygen sensor signal voltage between the ECM terminal No. 11 and No. 9.

Specified Value	11 ~ 14 v

Notice: If the measured value is not within the specified value, the possible cause may be in cable, oxygen sensor or ECM

Oxygen sensor Heating Current Consumption Inspection

1. Turn the ignition switch to “ON” position.
2. Measure the oxygen sensor heating current consumption between the ECM terminal No. 9 and No. 5.

Specified Value	0.2 ~ 2.0 A

Notice: If the measured value is not within the specified value, the possible cause may be in cable, oxygen sensor or ECM

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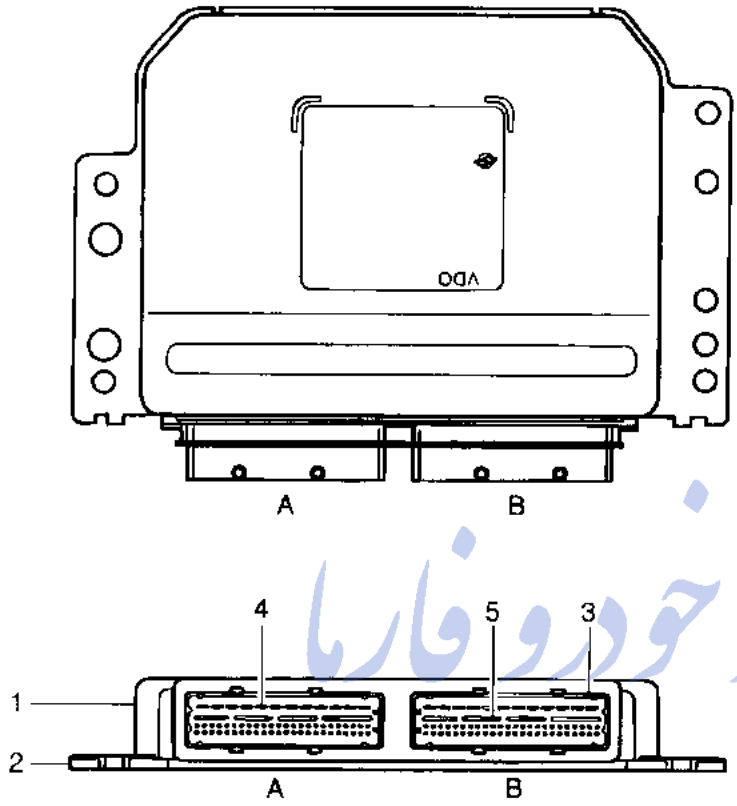
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ENGINE CONTROL MODULE



1. Cover
2. Plate
3. Connector
4. Flat Pin
   Vehicle Side : No. 1 - 12
   Engine Side : No. 61 - 72
5. Pin
   Vehicle Side : No. 13 - 60
   Engine Side : No. 73 - 120

A. Vehicle Side Connector : Black
B. Engine Side Connector : Gray

YAA1F830

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The Engine Control Module (ECM), located inside the right side kick panel, is the control center of the fuel injection system. It constantly looks at the information from various sensors and controls the systems that affect the vehicle's performance. Engine rpm and air mass are used to measure the air intake quantity resulting in fuel injection metering. The ECM also performs the diagnostic functions of the system. It can recognize operational problems, store failure code(s) which identify the problem areas to aid the technician in making repairs.

There are no serviceable parts in the ECM. The calibrations are stored in the ECM in the Programmable Read Only Memory (PROM).

The ECM supplies either 5 or 12 volts to power the sensors or switches. This is done through resistance in the ECM which are so high in value that a test light will not come ON when connected to the circuit. In some cases, even an ordinary shop voltmeter will not give and accurate reading because its resistance is too low. You must use a digital voltmeter with a 10 Mohm input impedance to get accurate voltage readings. The ECM controls output circuits such as the ignition coils, the fuel injectors, the fuel pump relay, the camshaft actuator, the canister purge valve, etc., by controlling the ground circuit.

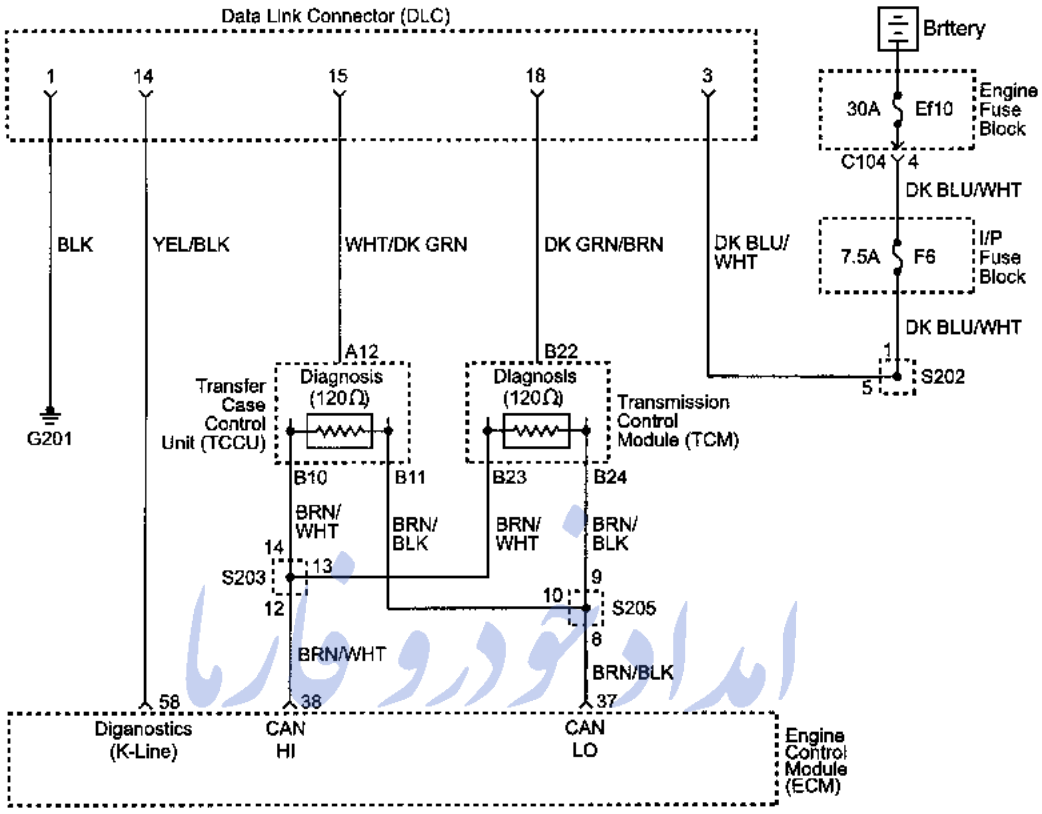
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SERIAL DATA COMMUNICATION



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Failure Code	Description	Trouble Area	Maintenance Hint
23	CAN communication failure: ASR/MSR	When CAN signal message missing or implausibility for ASR/MSR unit or not initialized condition	• Inspection the ASR unit with CAN connection • Inspection the Engine Control Module (ECM) pin 38, 37 about short circuit or open with bad contact • Inspection the ECM
24	CAN communication failure: ABS	When CAN signal message missing or implausibility for ABS unit or not initialized condition	• Inspection the ABS unit with CAN connection • Inspection the ECM pin 38, 37 about short circuit or open with bad contact • Inspection the ECM
26	CAN communication failure: TCU (A/T only)	When CAN signal message missing or implausibility for TCU unit or not initialized condition	• Inspection the TCM unit with CAN connection • Inspection the ECM pin 38, 37 about short circuit or open with bad contact • Inspection the ECM

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Failure Code	Description	Trouble Area	Maintenance Hint
29	CAN communication failure: ID 200h not plausible	When CAN signal message missing or implausibility for ABS/ABD unit or not initialized condition	• Inspection the ABS/ABD unit with CAN connection • Inspection the ECM pin 38, 37 about short circuit or open with bad contact • Inspection the ECM
30	CAN communication failure: ID 208h not plausible	When CAN signal message missing or implausibility for ABS/ABD unit or not initialized condition	• Inspection the ABS/ABD unit with CAN connection • Inspection the ECM pin 38, 37 about short circuit or open with bad contact • Inspection the ECM
31	CAN communication failure: communication initialization failure	When CAN signal message missing or implausibility for each unit (ABS, ASR, TCM, TOD etc.) or not initialized condition	• Inspection the each control unit with CAN connection • Inspection the ECM pin 38, 37 about short circuit or open with bad contact • Inspection the ECM
59	CAN communication failure: MSR data transmission not plausible	When CAN signal message missing or implausibility for MSR unit or not initialized condition	• Inspection the MSR unit with CAN connection • Inspection the Engine Control Module (ECM) pin 38, 37 about short circuit or open with bad contact • Inspection the ECM
60	CAN communication failure: ASR data transmission not plausible	When CAN signal message missing or implausibility for ASR unit or not initialized condition	• Inspection the ASR unit with CAN connection • Inspection the Engine Control Module (ECM) pin 38, 37 about short circuit or open with bad contact • Inspection the ECM

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Circuit Description

The provision for communicating with the ECM is the Data Link Connector (DLC). It is located in the instrument panel fuse block. The DLC is used to connect the scan tool. Battery power and ground is supplied for the scan tool through the DLC. CAN line is used to communicate with the other module such as the Transmission Control Module (TCM) and Transfer Case Control Unit (TCCU).

Keyword 2000 Serial Data Communications

Each bit of information can have one of two lengths: long or short. This allows vehicle wiring to be reduced by transmitting and receiving multiple signals over a singles wire. The message carried on KWP 2000 data streams are also prioritized. If two messages attempt to establish communications on the data line at the same time, only the message with higher priority will must wait.

INTERNAL FAILURE

Failure Code	Description	Trouble Area	Maintenance Hint
21	Transmission coding failure	When faulty of variant coding of transmission	• Inspection the coding condition through scan tool • Inspection the Engine Control Module (ECM) • Inspection the CAN line • Inspection the TCM
136	ECM failure (RAM)	When malfunction of random access memory - ECM internal error	• Inspection the ECM
142	Uncoded/ unprogramed ECM	When malfunction of ECM coding-required ECM encoding	• Fulfill the ECM variant coding
137	ECM failure (EPROM)	When malfunction of ECM internal	• Inspection the ECM
143	ECM failure (EEPROM/Flash-EPPOM checksum failure)		
144	ECM failure (coding ID checksum failure)		
145	ECM failure (coding checksum failure)		
146	ECM failure (programming checksum failure)		

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ELECTRONIC THROTTLE CONTROLLER SAFETY MALFUNCTION

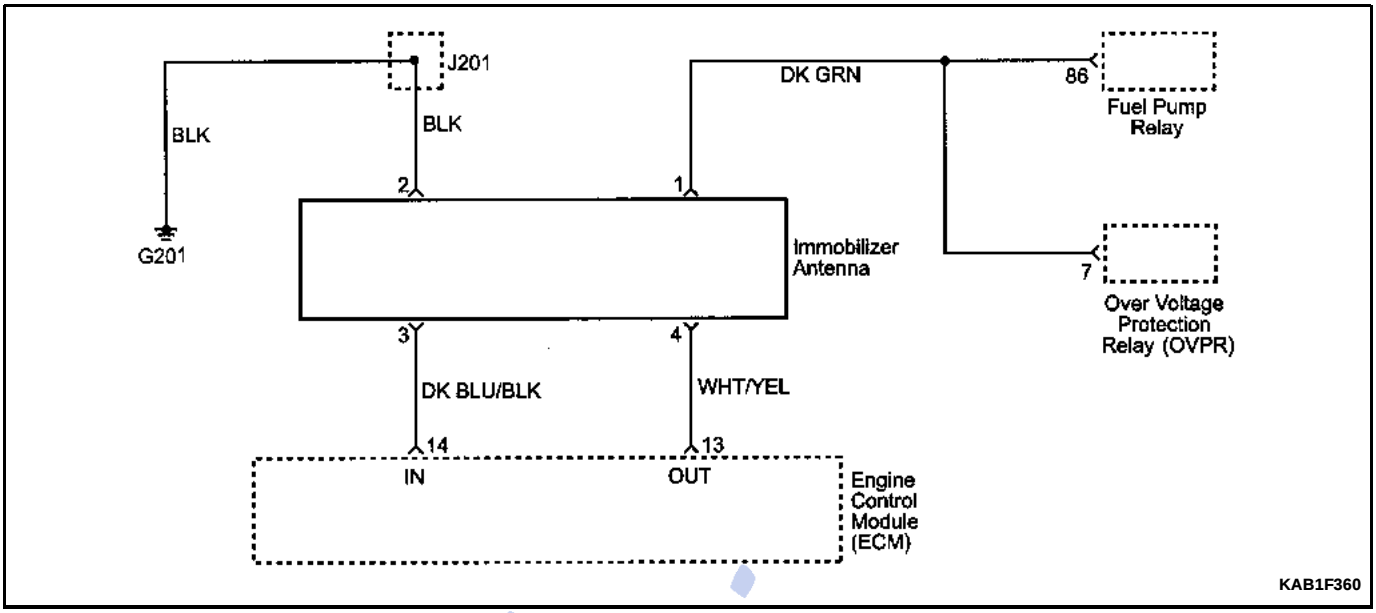
Failure Code	Description	Trouble Area	Maintenance Hint
110	Throttle actuator learning data fault	System internal failure	• Inspection the Engine Control Module (ECM)
110	Exceed fuel-cut safety time		
120	Cruise control interruption memory failure		
138	Call Monitoring		
139	Servo motor control output interruption memory failure		
140	Servo motor open/short		
186	ECM failure (incompatible CPU)		
187	ECM failure (CPUs communication failure)		
188	ECM failure (CPU 2 configuration failure)		
189	ECM failure (CPU 2 fault)		
190	ECM failure (CPU run time failure between CPUs)		
231	ECM failure (CPU 2 cruise control message counter failure)		
232	Over deceleration limit (CPU 2)		
233	Over acceleration limit (CPU 2)		
234	Cruise control lever dual operation (CPU 2)		
235	Cruise control lever safety terminal failure (CPU 2)		
236	Unusual pedal position variation (CPU 2)		
237	Unusual throttle position variation (CPU 2)		
238	Unusual throttle controller monitoring data comparison fault (CPU 2)		

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Failure Code	Description	Trouble Area	Maintenance Hint
239	Unusual accelerator pedal position sensor comparison fault (CPU 2)	System internal failure	• Inspection the Engine Control Module (ECM)
240	Throttle potentiometer comparison fault (CPU 2)		
241	Unusual CPU communication (CPU 2)		
242	Unusual CPU configuration (CPU 2)		
243	A/D converter failure (CPU 2)		
244	Accelerator pedal position sensor setpoint fault between CPU 1 and CPU 2		
245	Position controller setpoint fault between CPU 1 and CPU 2		
246	MSR setpoint fault between CPU 1 and CPU 2		
247	Idle control setpoint fault between CPU 1 and CPU 2		
248	A/D converter overflow (CPU 2)		
249	ROM fault (CPU 2)		
250	RAM fault (CPU 2)		
251	Cycle monitor fault (CPU 2)		

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IMMOBILIZER



Failure Code	Description	Trouble Area	Maintenance Hint
25	Communication with transponder missing	When missing the transponder signal	• Inspection the Engine Control Module (ECM) pin 13, 14 about short circuit or open with bad contact • Inspection the power source or ground short circuit or open of immobilizer unit • Inspection the transponder condition (broken etc.) • Inspection the ECM
141	Unprogramed ECM with immobilizer	When malfunction of immobilizer Required immobilizer encoding, no paired condition of immobilizer even through start trial	• Fulfill the immobilizer pairing

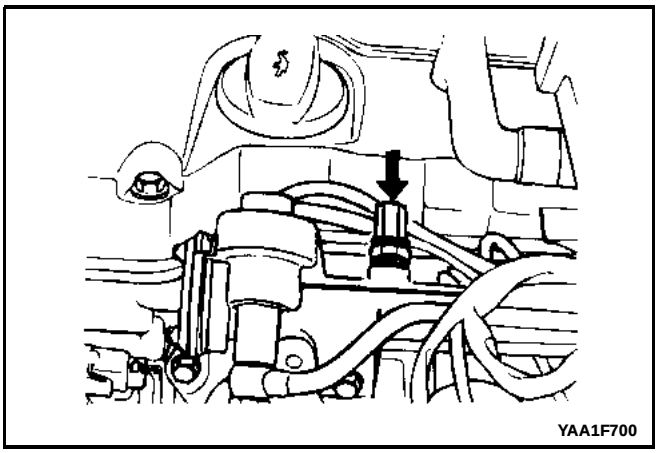
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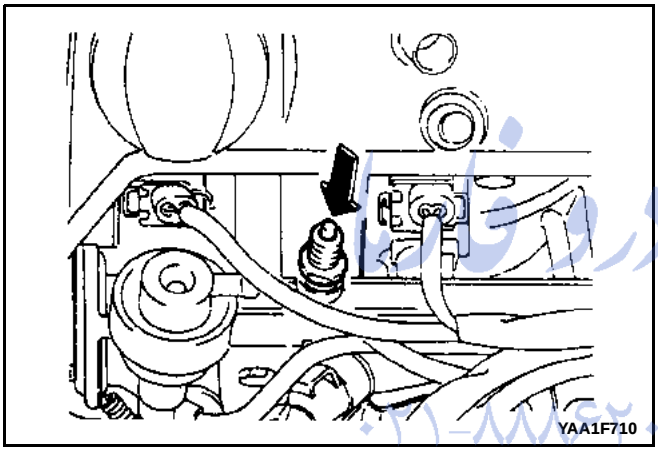
Circuit Description

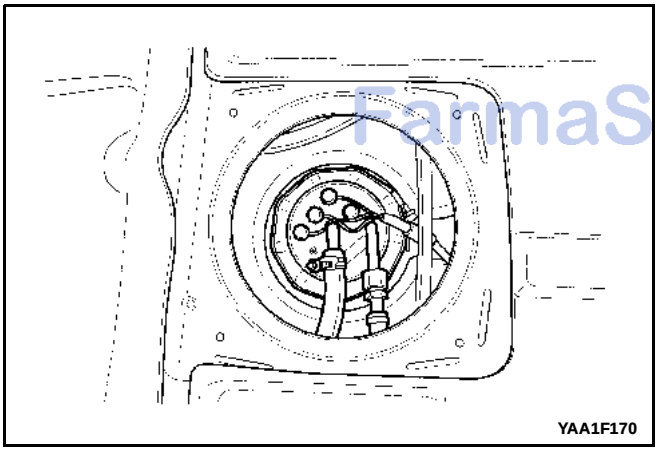
Immobilizer is a device disabling vehicle ignition unless a specific key is used and designed to help prevent vehicle theft.

Immobilizer is comprised of two devices, a key with encoded transponder and ECM with the same encoding of the transponder. When a key is inserted into the hole to start vehicle and turned to ON, the ECM reads and decodes the transponder code and, if the same, starts the engine, it is called immobilizer. It means immobilizer system disables starting by stopping fuel supply if the code in the transponder does not match the code stored in ECM each other.

MAINTENANCE AND REPAIR


YAA1F700


YAA1F710


YAA1F170

ON VEHICLE SERVICE

DISCHARGING THE PRESSURE IN FUEL SYSTEM

Removal and Installation Procedure

1. Remove the fuel pressure test connector.

Installation Notice

Tightening Torque	25 N•m (18 lb-ft)

2. Remove the fuel pressure in fuel system by pressing the service valve with a clean, pointy tool.

Notice: Place a cloth so that the fuel doesn't stain around.

3. Installation should follow the removal procedure in the reverse order.

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FUEL PUMP

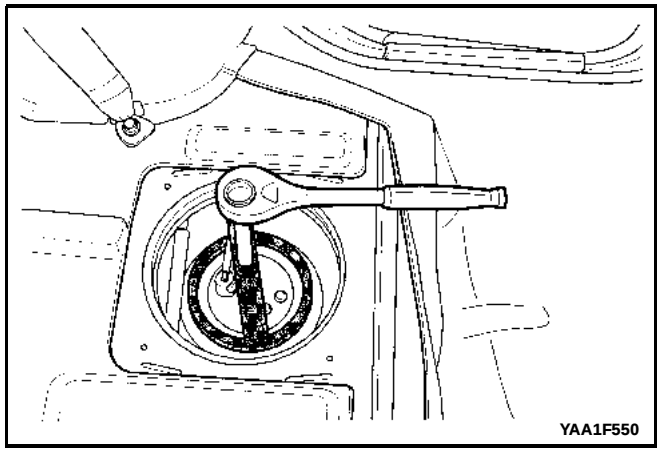
Tools Required

661 589 00 46 00 Fuel Tank Cap Wrench

Removal and Installation Procedure

Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

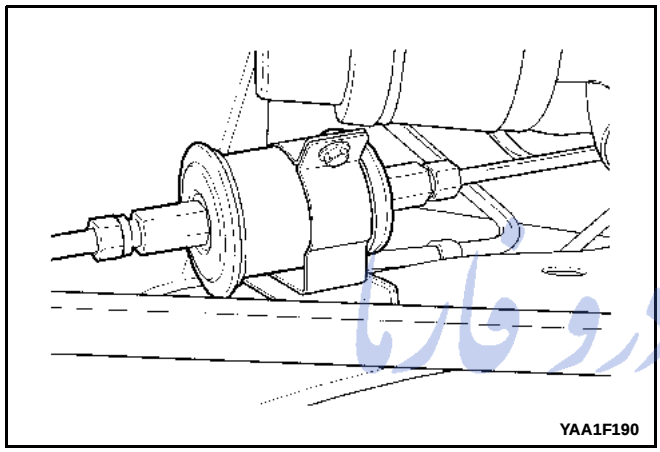
1. Relieve the fuel system pressure. Refer to "Discharging the Pressure in Fuel System" in this section.
2. Disconnect the negative battery cable.
3. Put aside the floor carpet to remove the fuel pump access cover.
4. Remove the fuel pump access cover.
5. Remove the fuel pump wiring connectors.
6. Disconnect the fuel supply and return pipes.
7. Remove the fuel pump locking cap band.


YAA1F550

8. Using the fuel tank cap wrench 661 589 00 46 00, remove the locking cap.
9. Remove the pump from the fuel tank.

Notice: Check the condition of the seal and replace if necessary. Drain the fuel before removing the pump.

10. Perform an operational check of the fuel pump.
11. Installation should follow the removal procedure in the reverse order.


YAA1F190

FUEL FILTER

Removal and Installation Procedure

1. Disconnect the negative battery cable.

Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

2. Relieve the fuel system pressure. Refer to “Discharging the Pressure in Fuel System” in this section.
3. Disconnect the fuel lines from the fuel filter.

Installation Notice

Tightening Torque	28 N•m (21 lb-ft)

4. Remove the fuel filter mounting bracket bolt .

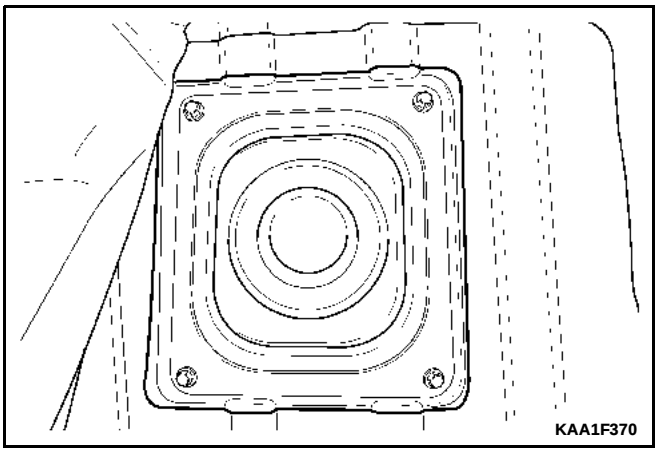
Installation Notice

Tightening Torque	6 N•m (53 lb-in)

Notice: Place the fuel pump pad. There may be a corrosion due to the contact between the fuel filter and the bracket.

5. Remove the fuel filter.
6. Install the fuel filter.
7. Perform a leak test of the fuel filter.
8. Installation should follow the removal procedure in the reverse order.

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KAA1F370

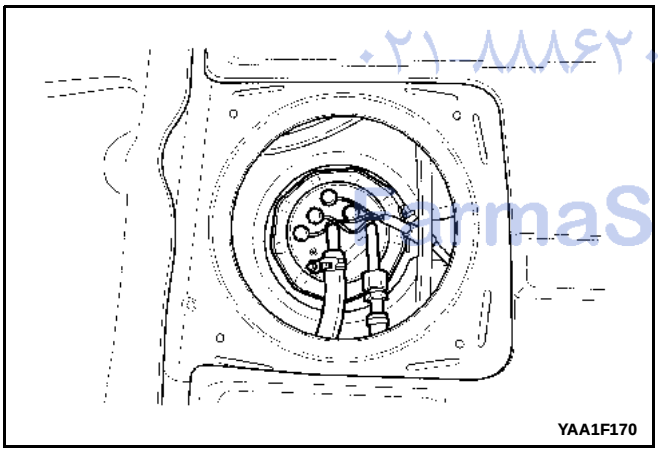
FUEL TANK

Removal and Installation Procedure

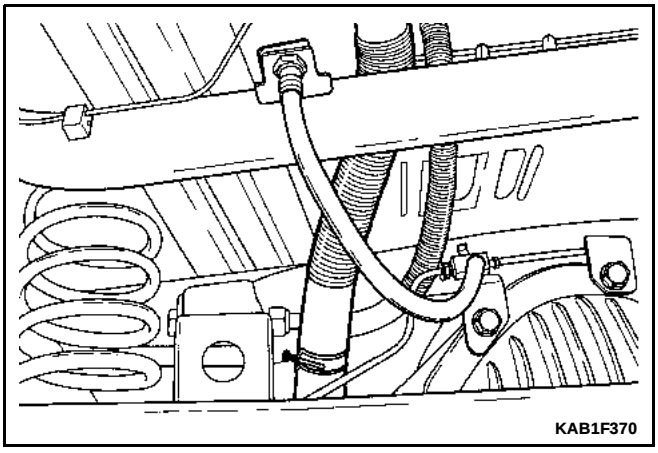
Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

1. Relieve the fuel pressure. Refer to “Discharging the Pressure in Fuel System” in this section.
2. Disconnect the negative battery cable.
3. Drain the fuel tank.
4. Put aside the floor carpet to remove the fuel pump access cover.
5. Remove the fuel pump access cover.

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YAA1F170

6. Disconnect the return line.
7. Disconnect the supply line.
8. Disconnect the fuel tank-to-canister hose from the fuel tank.
9. Disconnect the fuel pump wiring connector.

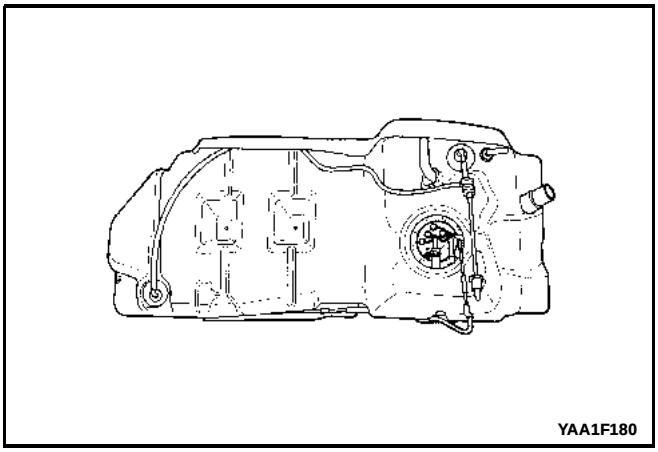

KAB1F370

10. Disconnect the fuel filler hose and air vent hose from the fuel tank.
11. Support the fuel tank.
12. Remove the fuel tank retaining nuts.

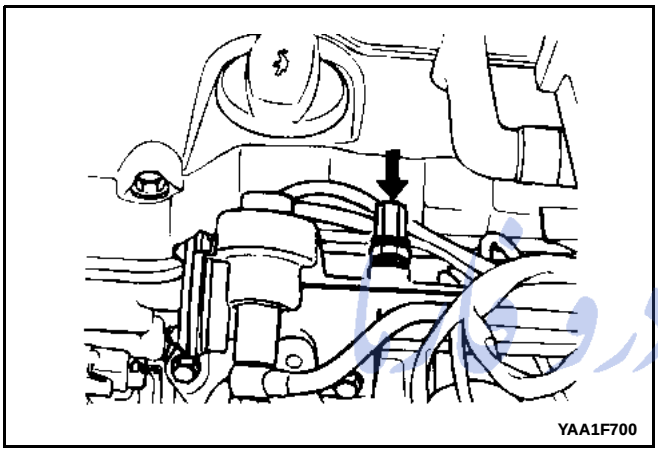
Installation Notice

Tightening Torque	38 N•m (28 lb-ft)

13. Carefully lower the fuel tank.


YAA1F180

14. Turn the roll over valves counterclockwise at an angle of 90 degrees.
15. Turn the lock ring counterclockwise.
16. Remove and discard the gasket.
17. Installation should follow the removal procedure in the reverse order.


YAA1F700

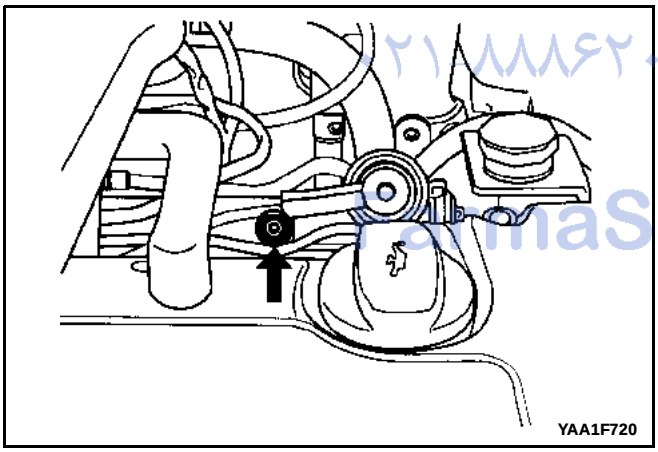
FUEL PRESSURE REGULATOR

Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Remove the fuel pressure test connector.

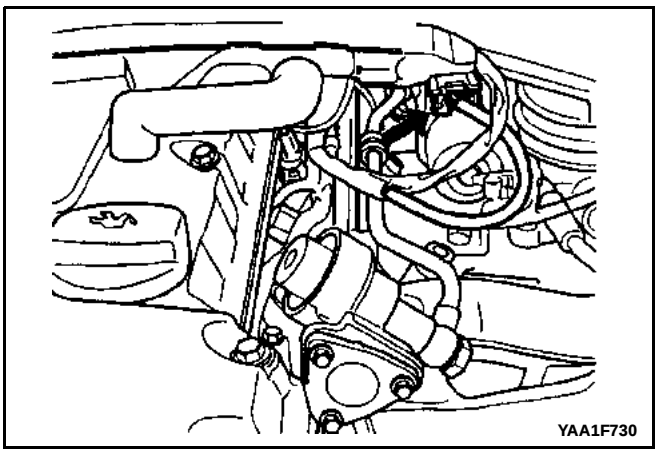
Installation Notice

Tightening Torque	25 N•m (18 lb-ft)


YAA1F720

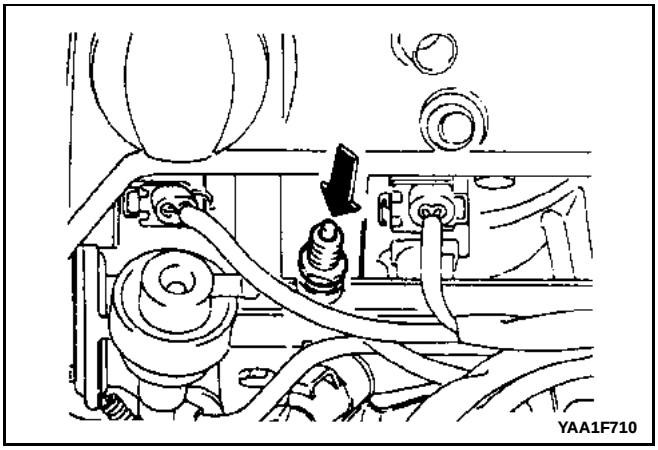
Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

3. Relieve the fuel pressure in fuel supply system by pressing the service valve.


YAA1F730

4. Disconnect the vacuum hose.
5. Disconnect the circlip and remove the fuel pressure regulator.
6. Apply the oil to O-ring lightly and then replace it.
7. Perform a leak test of the fuel pressure regulator with the engine off and the ignition on.
8. Installation should follow the removal procedure in the reverse order.

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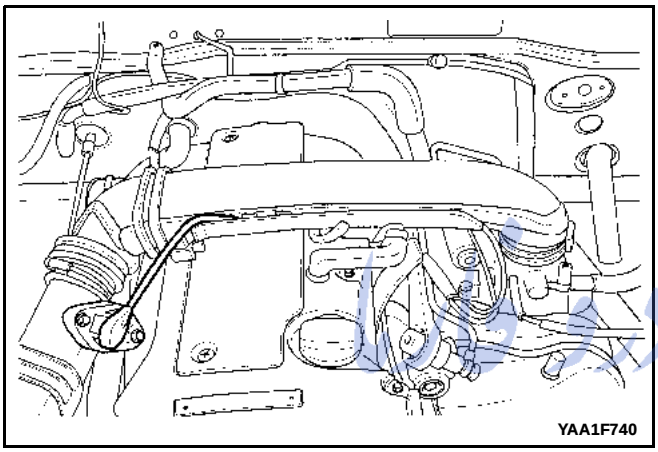

YAA1F710

FUEL RAIL AND INJECTORS

Removal and Installation Procedure

Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

1. Discharge the fuel pressure from the fuel pressure test connector.
2. Disconnect the negative battery cable.
3. Disconnect the vacuum hose from the fuel pressure regulator.

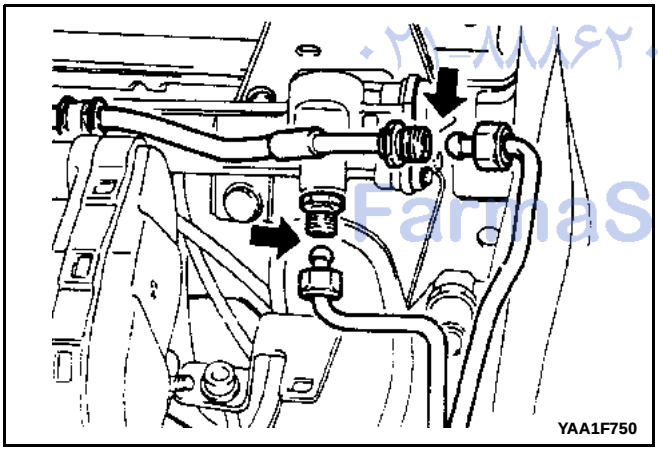

YAA1F740

4. Remove the cable guide.
5. Disconnect the Hot Film Air Mass (HFM) sensor connector.
6. Remove the intake air duct mounting bolts.

Installation Notice

Tightening Torque	9 N•m (80 lb-in)

7. Remove the intake air duct clamps.
8. Remove the intake air duct.


YAA1F750

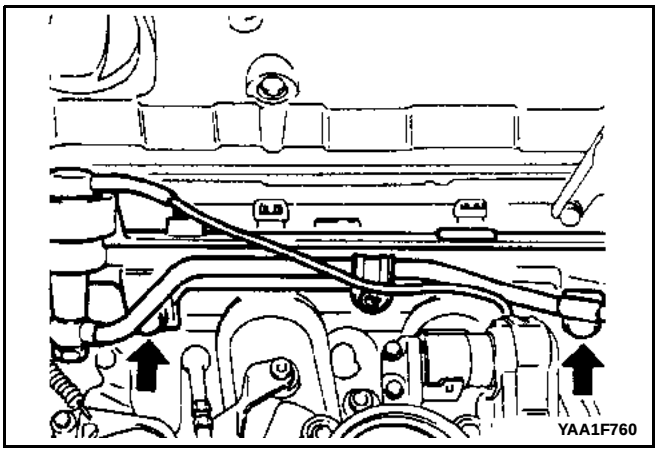
9. Remove the fuel return and supply line.

Notice: For removal, cover around parts with cloths not to be stained by fuel. In case of checking the injector only, do not remove the fuel return and supply line.

Installation Notice

Tightening Torque	23 N•m (17 lb-ft)

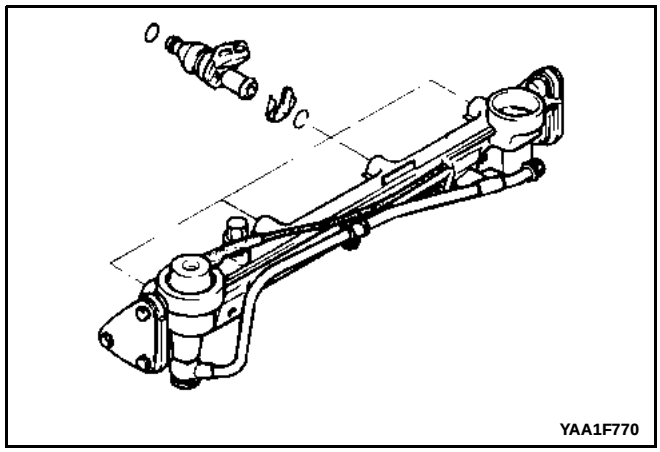
10. Remove the six injector connectors.


YAA1F760

11. Remove the two left and two right bolts and one center bolt of the fuel rail assembly from the intake manifold.

Installation Notice

Tightening Torque	25 N•m (18 lb-ft)

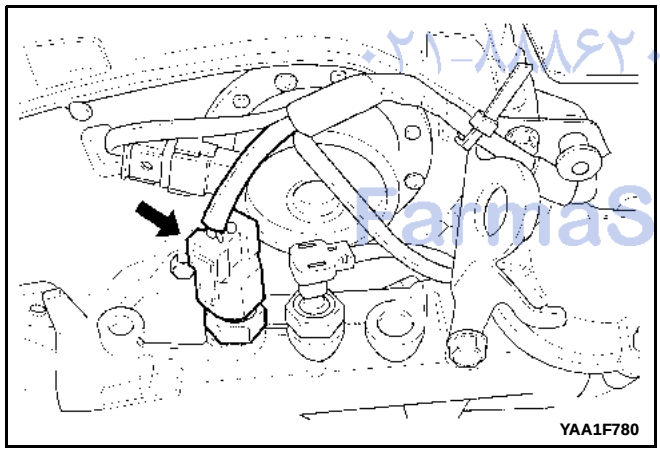

YAA1F770

Notice: Before removal, the fuel rail assembly may be cleaned with a spray-type cleaner, following package instructions. Do not immerse the fuel rails in liquid cleaning solvent. Use care in removing the fuel rail assembly to prevent damage to the electrical connectors and injector spray tips. Prevent dirt and other contaminants from entering open lines and passages. Fittings should be capped and holes plugged during service.

Important: If an injector becomes separated from the rail and remains in the cylinder head, replace the injector O-ring seals and the retaining clip.

12. Remove the injectors and the fuel rail carefully.
13. Remove the fuel injector retainer clips.
14. Remove the fuel injectors by pulling them down and out.
15. Discard the fuel injector O-rings.
16. Lubricate the new fuel injector O-rings with engine oil. Install the new O-rings on the fuel injectors.
17. Perform a leak check of the fuel rail and fuel injectors.
18. Installation should follow the removal procedure in the reverse order.

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YAA1F780

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ENGINE COOLANT TEMPERATURE SENSOR

Removal and Installation Procedure

1. Relieve the coolant system pressure.
2. Disconnect the negative battery cable.
3. Disconnect the engine coolant temperature sensor connector.

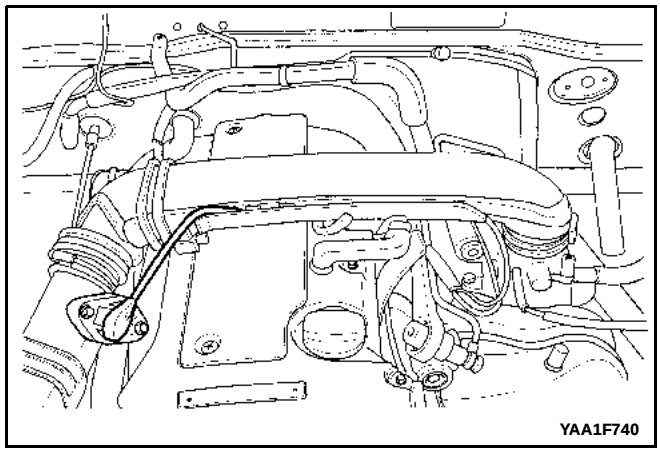
Notice: Take care when handling the engine coolant temperature sensor. Damage to the sensor will affect the proper operation of the fuel injection system.

4. Remove the engine coolant temperature sensor from the pump hosing.

Installation Notice

Tightening Torque	30 N•m (22 lb-ft)

5. Installation should follow the removal procedure in the reverse order.


YAA1F740

THROTTLE BODY (INTEGRATED WITH THE ACTUATOR)

Removal and Installation Procedure

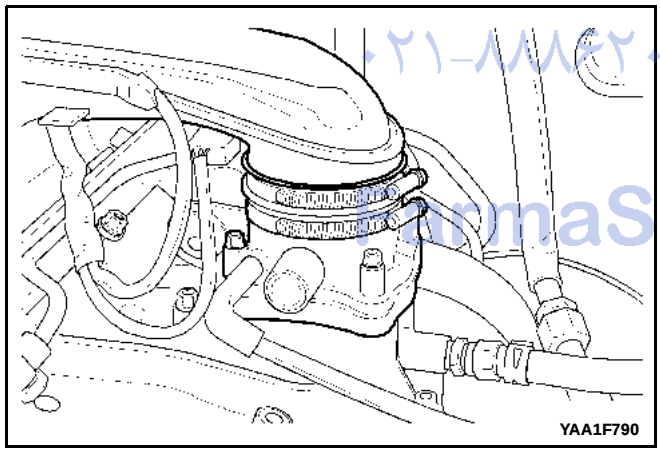
1. Disconnect the negative battery cable.
2. Disconnect the mass air flow sensor connector.
3. Disconnect the mass air flow sensor from the air filter housing.
4. Remove the intake air duct mounting bolts.

Installation Notice

Tightening Torque	9 N•m (80 lb-in)

5. Remove the air inlet housing clamps.
6. Remove the inlet air housing.

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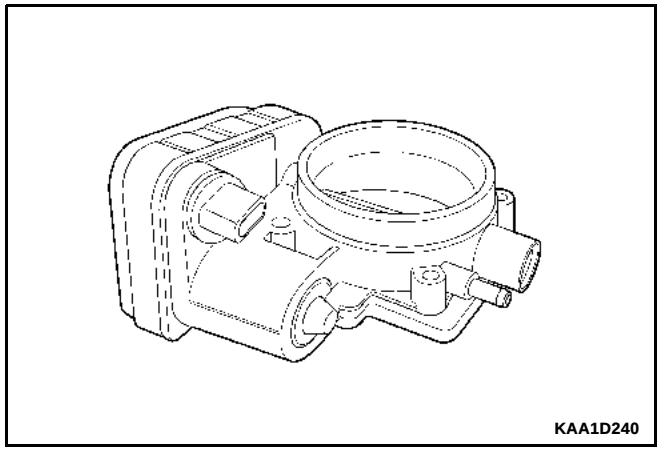
7. Disconnect the throttle body electrical connector.
8. Remove the throttle body bolts.

Installation Notice

Tightening Torque	12 N•m (106 lb-in)

9. Remove the vacuum hose.

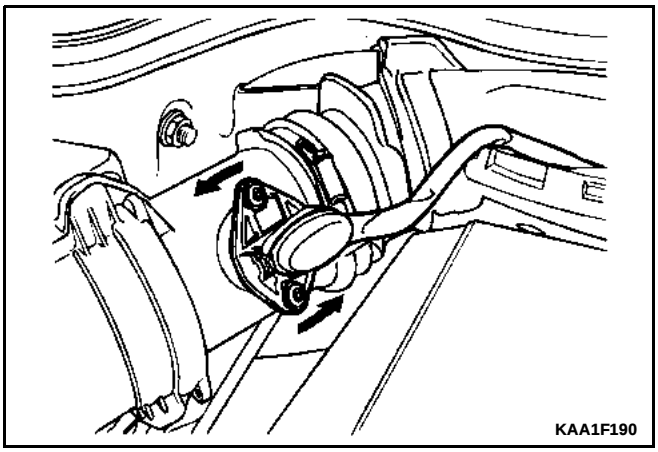
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KAA1D240

10. Remove the throttle body and discard the gasket.

Important: Use care in cleaning old gasket material. Sharp tools may damage sealing surfaces.

11. Installation should follow the removal procedure in the reverse order.


KAA1F190

HOT FILM AIR MASS (HFM) SENSOR

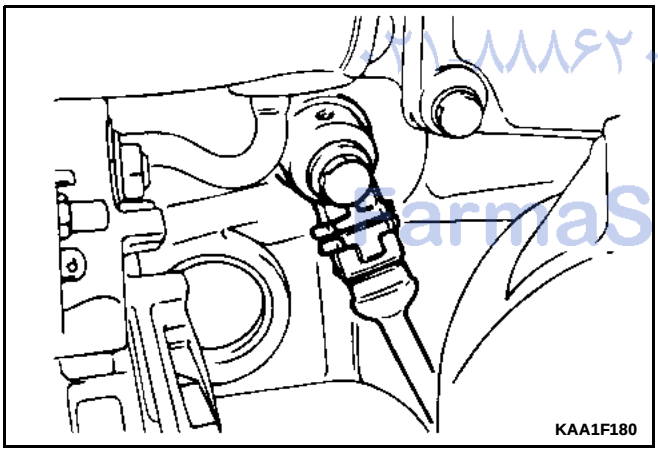
Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Disconnect the Hot Film Air Mass (HFM) sensor electrical connector.
3. Remove the HFM sensor retaining screws.
4. Turn the HFM sensor coupling in the direction shown in the figure in the left so that it gets separated from the contact surface.

Notice: Make sure the HFM sensor coupling connects completely with the contact surface installation.

5. Remove the HFM sensor.
6. Installation should follow the removal procedure in the reverse order.

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KNOCK SENSOR

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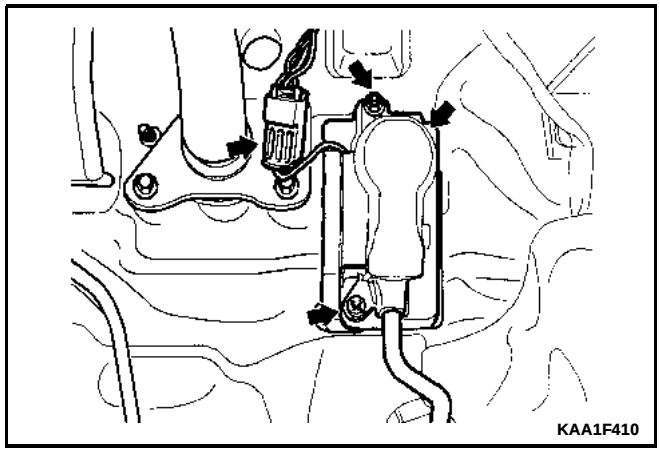
Removal and installation Procedure

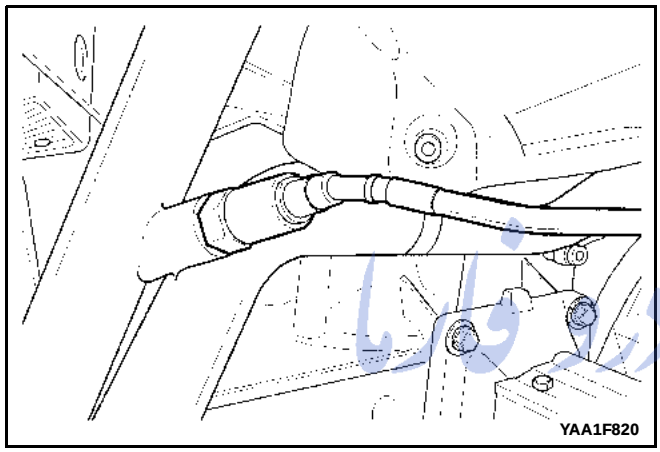
1. Disconnect the negative battery cable.
2. Disconnect the knock sensor electrical connector from the intake manifold bracket.
3. Remove the knock sensor mounting bolt from the knock sensor installed on the cylinder block.

Installation Notice

Tightening Torque	25 N•m (18 lb-ft)

4. Remove the knock sensor.
5. Installation should follow the removal procedure in the reverse order.


KAA1F410


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PEDAL POSITION SENSOR

Removal and installation Procedure

1. Disconnect the negative battery cable.
2. Disconnect the pedal position sensor connector.
3. Unscrew the bolts and nut.

Installation Notice

Tightening Torque	6 N•m (53 lb-in)

4. Remove the pedal and sensor assembly.
5. Installation should follow the removal procedure in the reverse order.

OXYGEN SENSOR

Removal and Installation Procedure

1. Disconnect the negative battery cable.

Notice: The oxygen sensor uses a permanently attached pigtail and connector. This pigtail should not be removed from the oxygen sensor. Damage or removal of the pigtail or the connector could affect proper operation of the oxygen sensor. Do not drop the oxygen sensor.

2. Disconnect the electrical connector.
3. Carefully remove the oxygen sensor from the exhaust pipe.

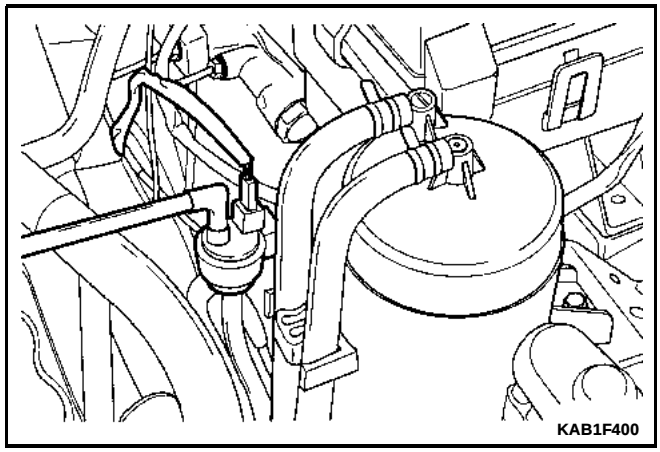
Installation Notice

Tightening Torque	55 N•m (41 lb-ft)

Important: A special anti-seize compound is used on the oxygen sensor threads. This compound consists of a liquid graphite and glass beads. The graphite will burn away, but the glass beads will remain, making the sensor easier to remove. New or serviced sensors will already have the compound applied to the threads. If a sensor is removed from any engine and is to be reinstalled, the threads must have an anti-seize compound applied before reinstallation.

4. Coat the threads of the oxygen sensor with an anti-seize compound, if needed.
5. Installation should follow the removal procedure in the reverse order.

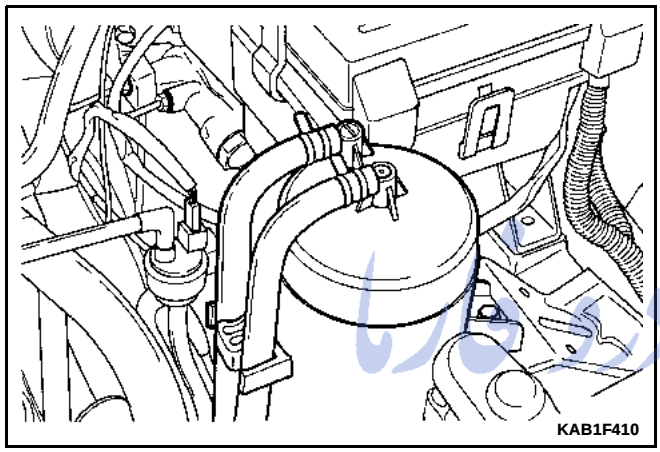
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PURGE CONTROL VALVE

Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Disconnect the purge control valve connector.
3. Disconnect the throttle body-to-purge control valve hose from the purge control valve.
4. Disconnect the canister-to-purge control valve hose from the purge control valve.
5. Remove the purge control valve.
6. Installation should follow the removal provedure in the reverse order.

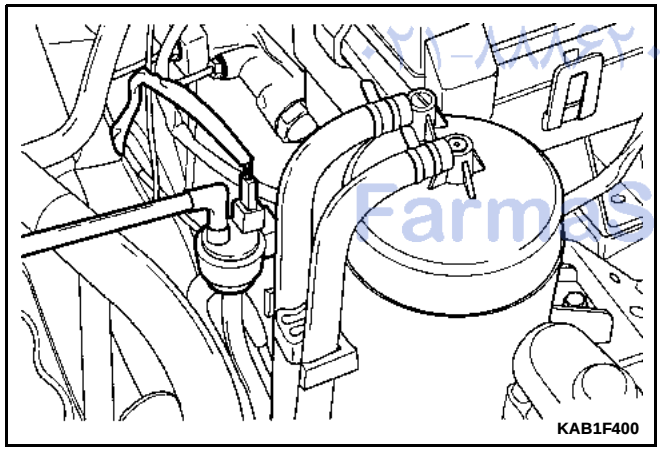

KAB1F410

CANISTER

Removal and Installation Procedure

Caution: Canister and vacuum hoses contain fuel vapors. Do not smoke in the area or permit an open flame.

1. Disconnect the fuel tank-to-canister hose form the canister.
2. Disconnect the canister-to-purge control valve hose form the canister.

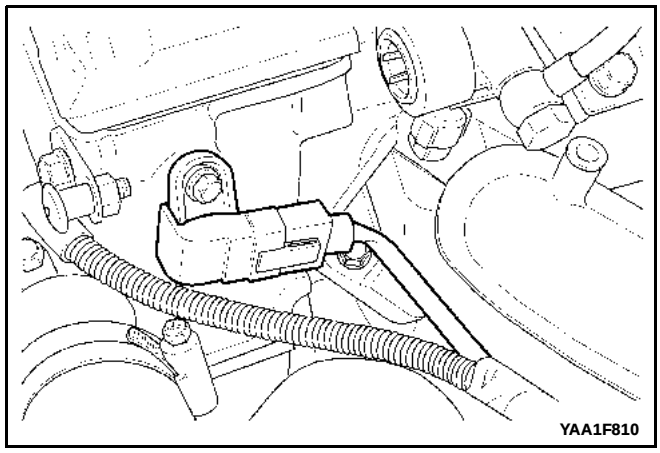

KAB1F400

3. Remove the canister mounting bolts.

Installation Notice

Tightening Torque	6 N•m (53 lb-in)

4. Remove the canister.
5. Installation should follow the removal procedure in the reverse order.


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CAMSHAFT POSITION SENSOR

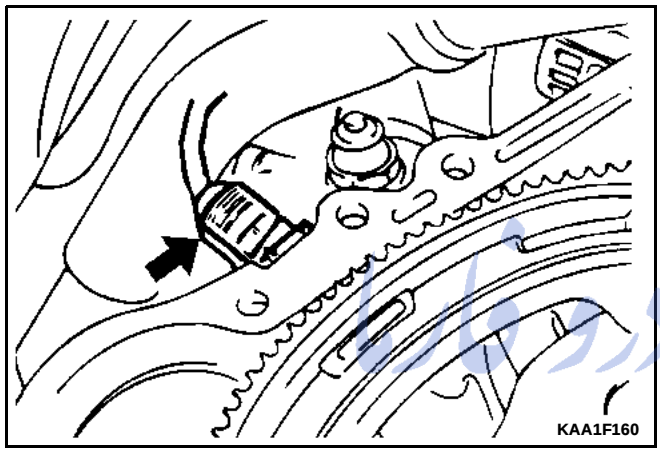
Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Disconnect the electrical connector from the cam-shaft position sensor.
3. Remove the camshaft position sensor retaining bolt.

Installation Notice

Tightening Torque	10 N•m (89 lb-in)

4. Check the O-ring for damage and replace it if necessary.
5. Installation should follow the removal procedure in the reverse order.



CRANKSHAFT POSITION SENSOR

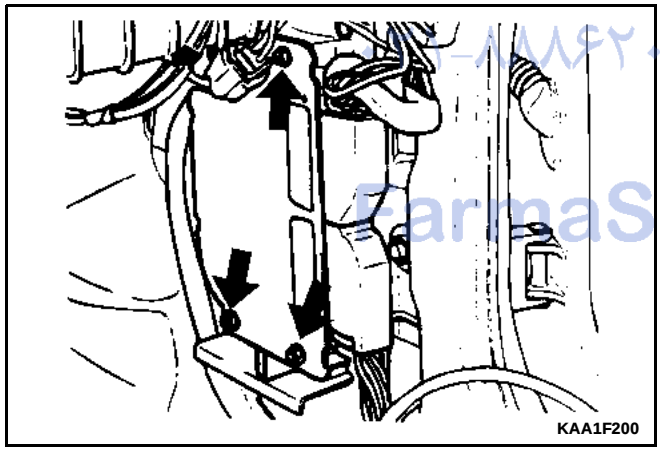
Removal and installation Procedure

1. Disconnect the negative battery cable.
2. Disconnect the electrical connector at the crankshaft position sensor.
3. Remove the crankshaft position sensor retaining bolt.

Installation Notice

Tightening Torque	10 N•m (89 lb-in)

4. Installation should follow the removal procedure in the reverse order.



ENGINE CONTROL MODULE

Removal and installation Procedure

1. Disconnect the negative battery cable.
2. Remove the cowl side trim form passenger side. Refer to *Section 9G, Interior trim.*
3. Remove the four securing nuts for the Engine Control Module (ECM) from the mounting bracket.

Installation Notice

Tightening Torque	10 N•m (89 lb-in)

4. Pull out the ECM from the bracket.
5. Disconnect the vehicle side coupling.
6. Installation should follow the removal procedure in the reverse order.

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SECTION 1G2

M161 ENGINE INTAKE & EXHAUST

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

Specifications 1G2-2
Fastener Tightening Specifications 1G2-2
Maintenance and Repair 1G2-3
On-Vehicle Service 1G2-3
Air Cleaner 1G2-3
Air Intake Shield 1G2-5
Intake Air Duct 1G2-6
Intake Manifold 1G2-8
Exhaust Manifold 1G2-10
Removal and Installation of Exhaust System 1G2-12

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SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

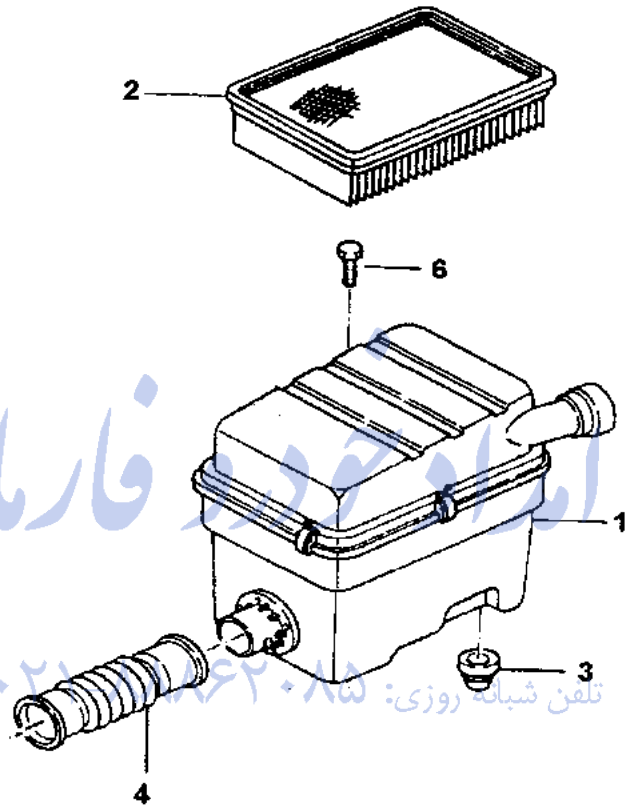
Application	N•m	Lb-Ft	Lb-In
Air Cleaner Mounting Bolt	22.5 - 27.5	16.6 - 20.3	-
Intake Manifold Mounting Bolts	22.5 - 27.5	16.6 - 20.3	-
Idle Regulator and Intermediate Flange Bolts	22.5 - 27.5	16.6 - 20.3	-
Supporting Assembly Bolts	22.5 - 27.5	16.6 - 20.3	-
Oxygen Sensor	55	41	-
Connection Piece	36 - 44	27 - 33	-
Exhaust Pipe Flange Bolts	30	22	-
Exhaust Manifold Nuts	31.5 - 38.5	23.2 - 28.4	-
Exhaust Pipe-to-Catalytic Converter Flange Nuts	28 - 47	21 - 35	-
Front Muffler Pipe-to-Catalytic Converter Flange Nuts	28 - 47	21 - 35	-
Rear Muffler Pipe Flange-to -Front Muffler Pipe Flange Nuts	28 - 47	21 - 35	-

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MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

AIR CLEANER



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1 Air Cleaner Assembly
2 Element Assembly
3 Insulator
4 Air Duct Hose
6 Bolt (M8 x 30) . . . . . 22.5-27.5 N•m

Removal and Installation Procedure

1. Disconnect the HFM sensor and the air cleaner by prying up the clamp.
2. Remove the air cleaner mounting bolt.

   Installation Notice

Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)

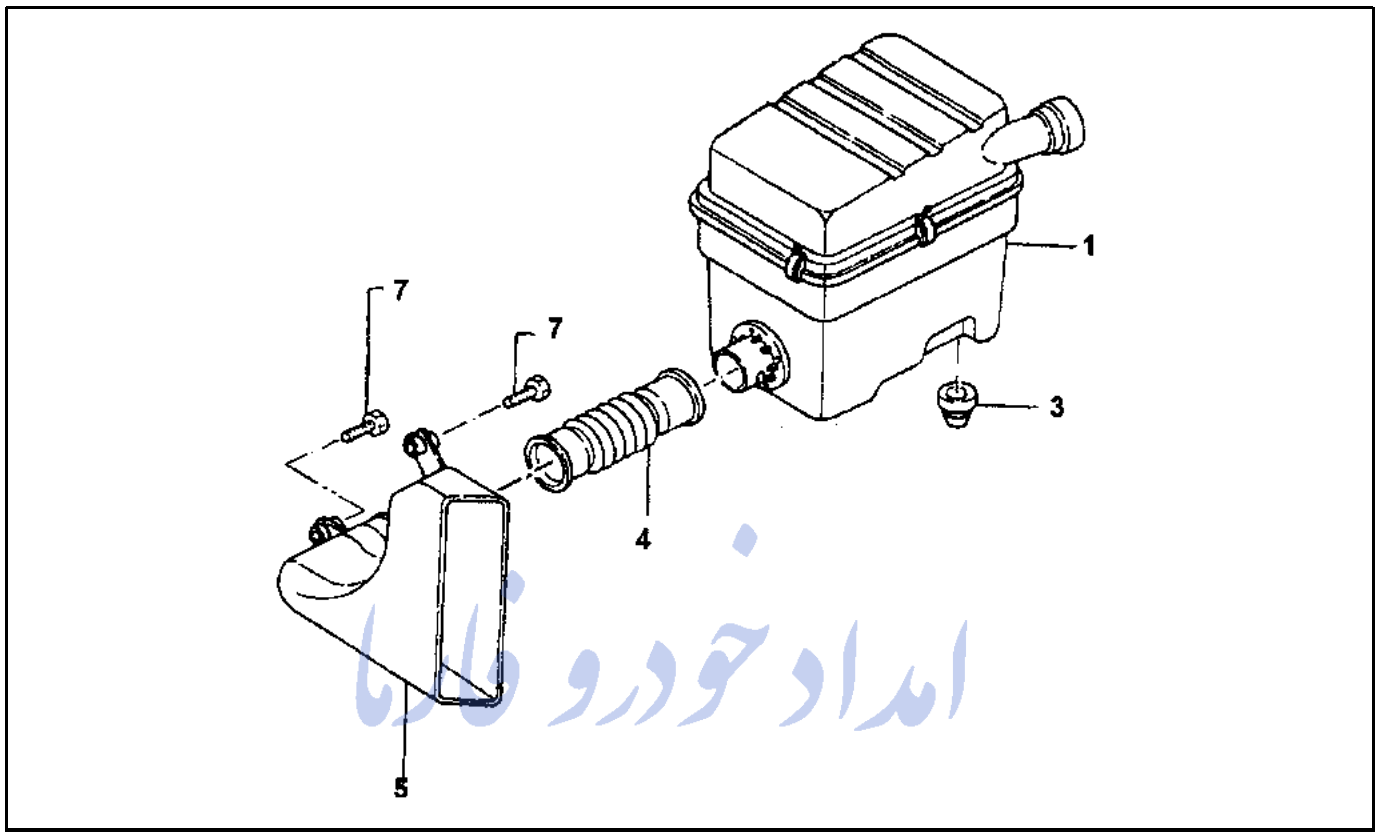
3. Remove air intake shield upper cover, and then remove the air cleaner from rubber bearing on bracket.

Notice: For installation, exactly seat the air cleaner into the rubber bearing.

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AIR INTAKE SHIELD

Preceding Work: Removal of air cleaner



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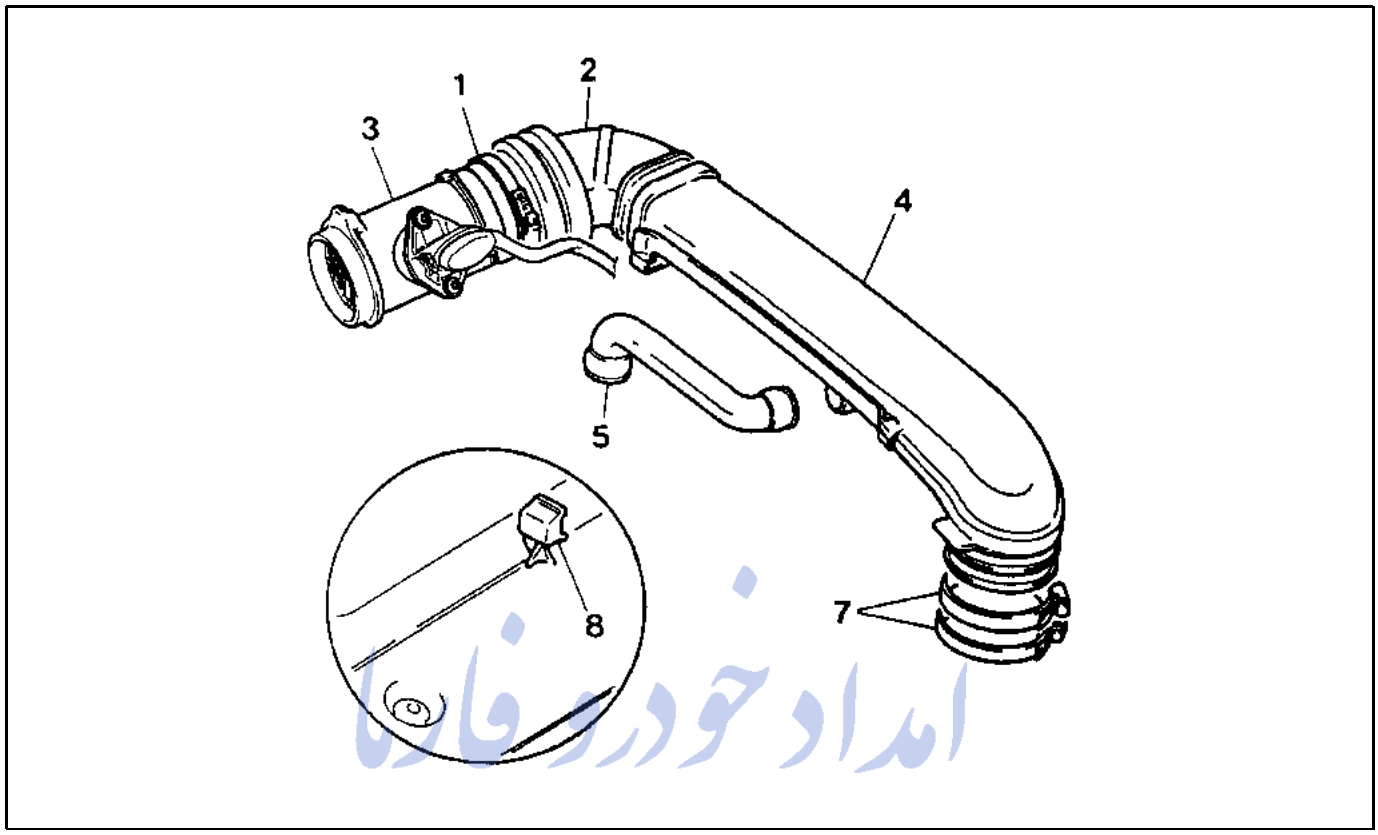
1 Air Cleaner Assembly
3 Insulator
4 Air Duct Hose
5 Air Inlet Duct
7 Bolt (M6 x 35) . . . . . 9-11 N•m

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Removal & Installation Procedure

1. Remove the upper cover (3) from the air intake shield (5) upper mounting pin.
2. Remove the bolts (4 and 6).
3. Remove the air intake shield (5).
4. Installation should follow the removal procedure in the reverse order.

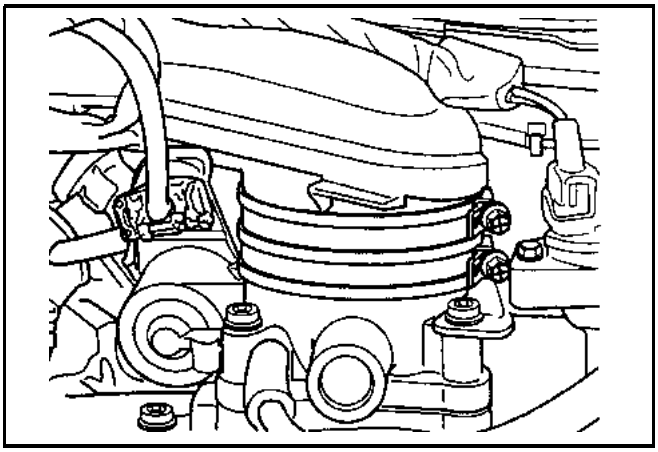
INTAKE AIR DUCT



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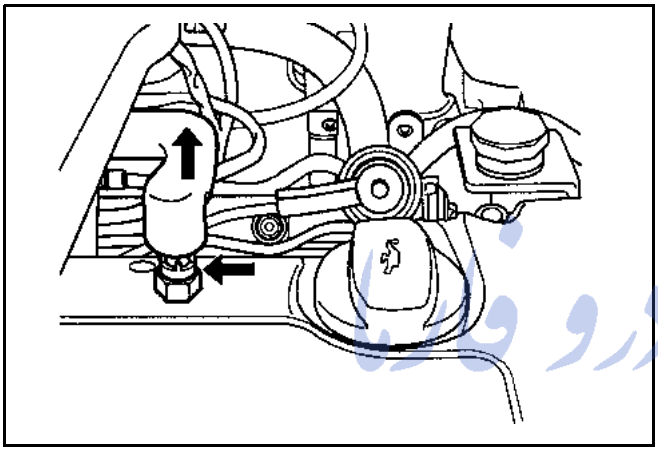
1 Clamp
2 Sleeve
3 HFM Sensor
4 Intake Air Duct
5 Blow-by Hose
7 Clamp(2 pieces)
8 Intake Air Duct Mounting Bracket

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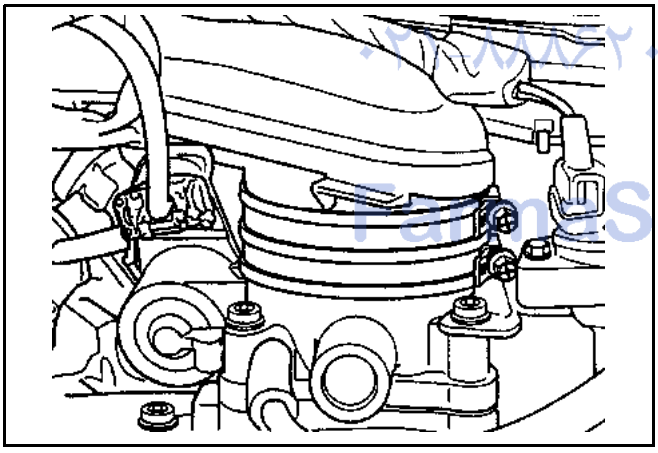


Removal & Installation Procedure

1. Release the clamp (1) and intake air duct.



2. Remove the Blow-by hose (5) (arrow).



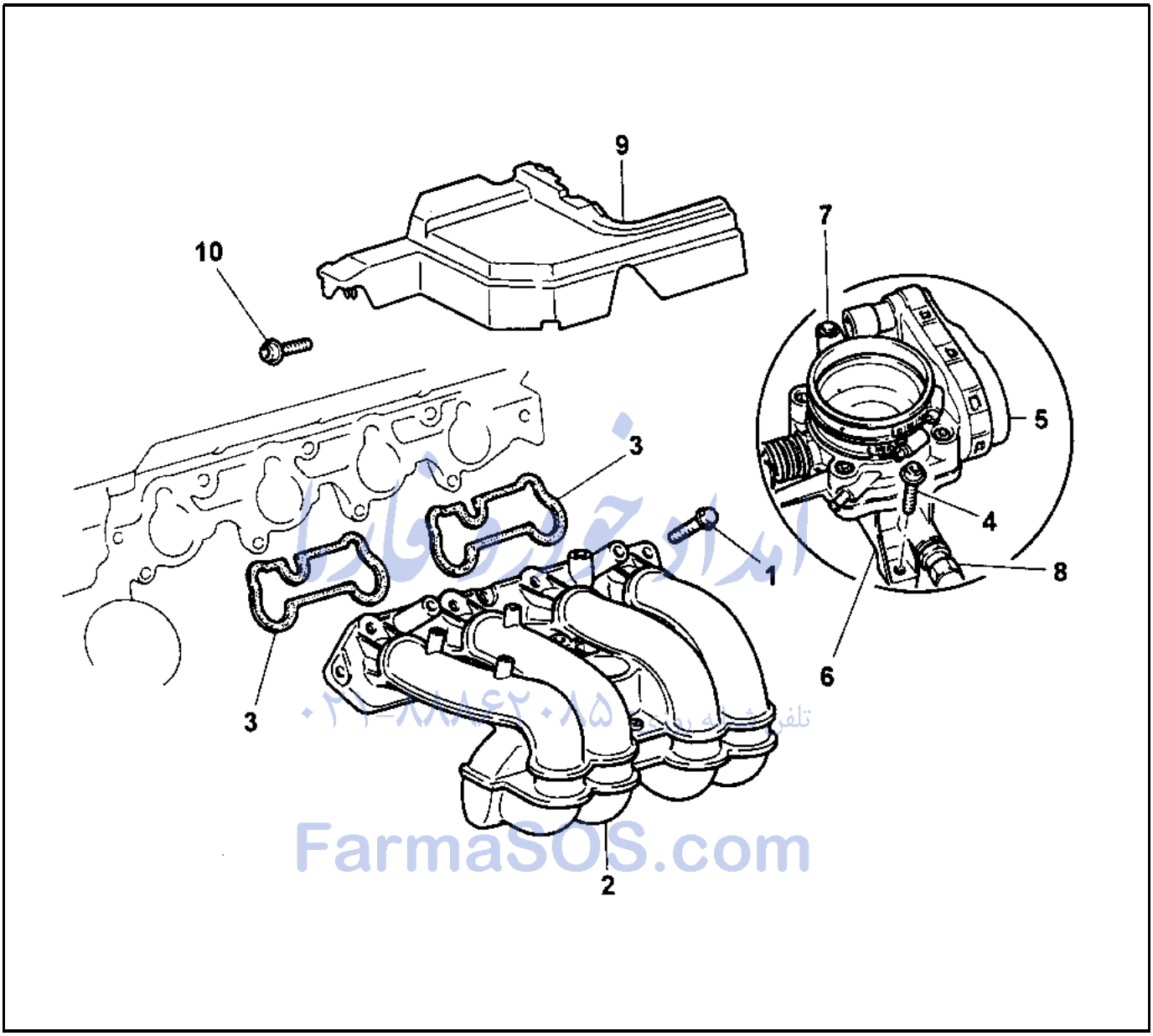
3. Release the clamp (7) and remove the intake air duct.

Notice: Completely fit the intake air duct with the mounting bracket (8).

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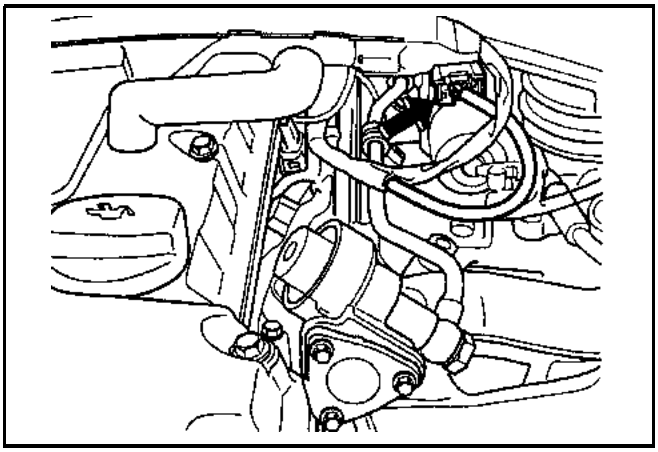
INTAKE MANIFOLD

Preceding Work: Removal of intake air duct
Removal of fuel distributor and injector valve



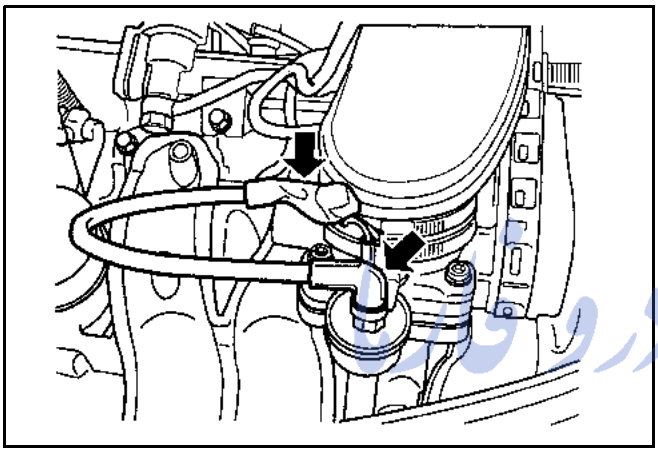
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1 Bolt (M6 X 40, 6 pieces)
. . . . . 22.5-27.5 N•m (16.6-20.3 lb-ft)
2 Intake Manifold
3 Gasket (2 pieces) . . . . . Replace
4 Bolt (M8 X 40, 3 pieces)
. . . . . 22.5-27.5 N•m (16.6-20.3 lb-ft)
5 Idle Regulator
6 Intermediate Flange
7 Bolt (M6 X 35, 4 pieces)
. . . . . 9-11 N•m (80-97 lb-in)
8 Connection Piece With Seal Ring
. . . . . 36-44 N•m (27-33 lb-ft)



Removal & Installation Procedure

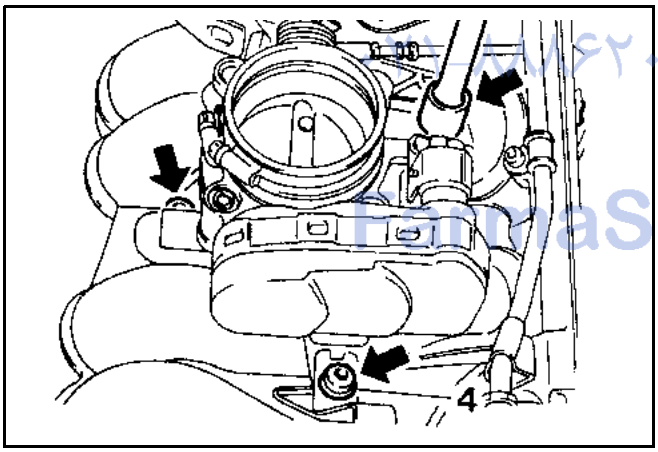
1. Disconnect the battery ground cable.
2. Remove idle speed control plug connector (arrow).



3. Disconnect the brake booster vacuum line and other vacuum lines.
4. Disconnect the rod from bearing bracket assembly and remove the connection piece (8).

Installation Notice

Tightening Torque	36 - 44 N•m (27 - 33 lb-ft)



5. Unscrew the three bolts (4) and remove the idle regulator and intermediate flange (6).

Installation Notice

Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)

6. Unscrew the two bolts (M8 X 16) and remove the support assembly.

Installation Notice

Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)

7. Unscrew the intake manifold mounting bolts (1) and remove the intake manifold and gasket.

Installation Notice

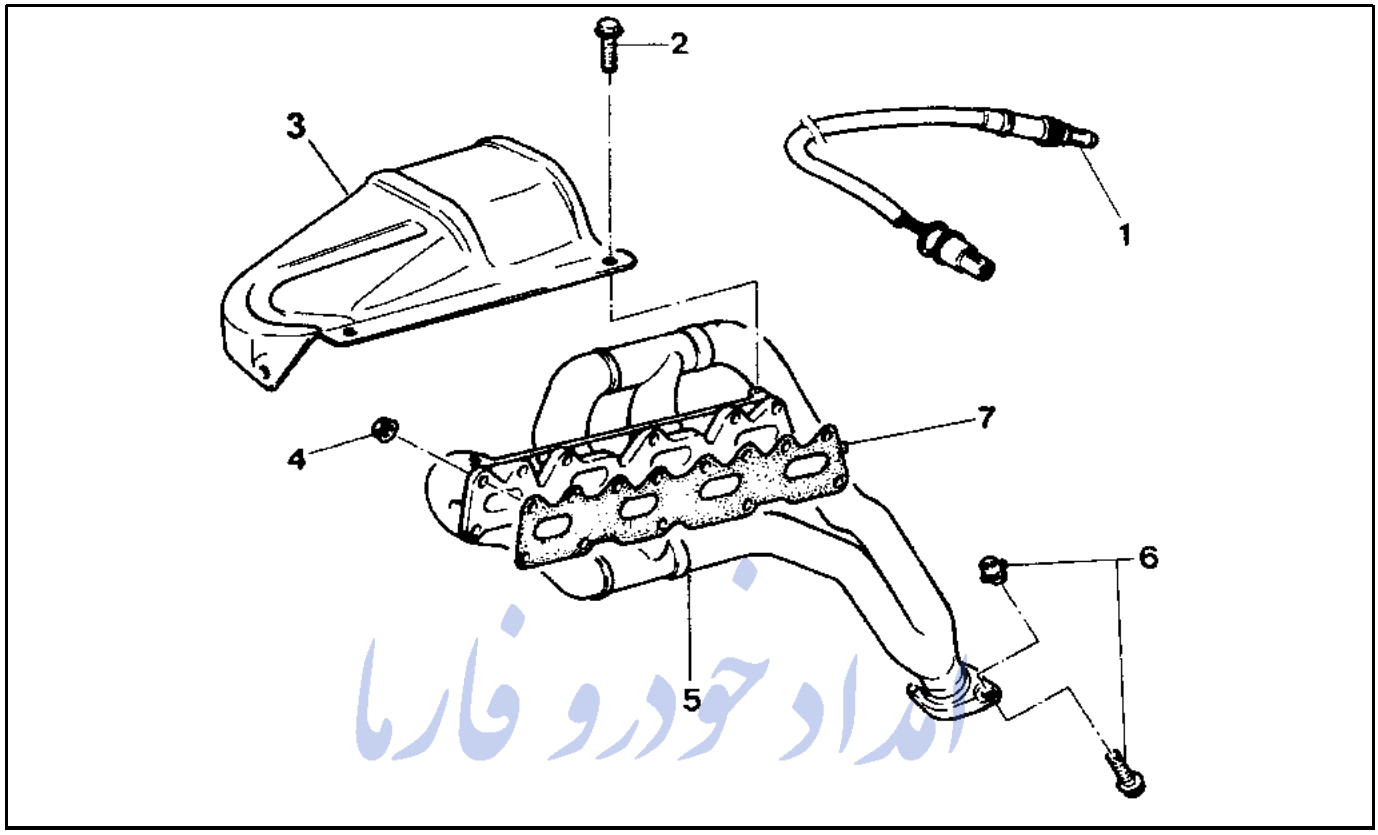
Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)

Notice: Replace the gasket with new one.

8. Installation should follow the removal procedure in the reverse order.
9. Start the engine and check for leaks in each connection.

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EXHAUST MANIFOLD



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1 Oxygen Sensor . . . . . 55 N•m (41 lb-ft)
2 Bolt (4 pieces) . . . . . 9–11 N•m (80–97 lb-in)
3 Upper Cover
4 Nut (11 pieces)
. . . . . 31.5–38.5 N•m (23.2–28.4 lb-ft)
5 Exhaust Manifold
6 Flange Bolt & Exhaust Pipe
Mounting Nut . . . . . 30 N•m (22 lb-ft)
7 Gasket . . . . . Replace

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Removal & Installation Procedure

1. Remove the oxygen sensor if necessary.

   Installation Notice

Tightening Torque	55 N•m (41 lb-ft)

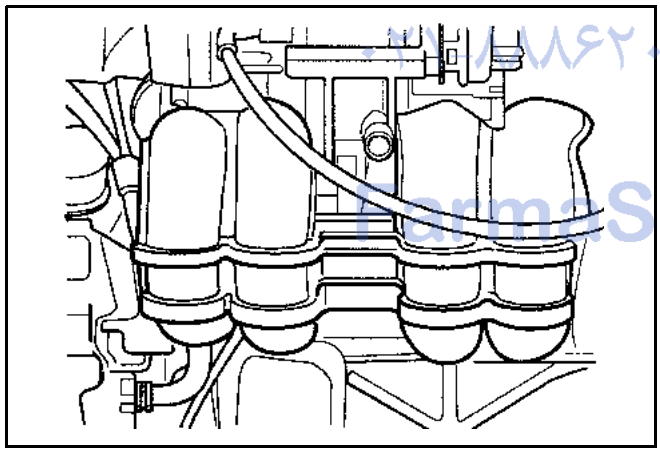
2. Unscrew the bolt (2) and remove the exhaust manifold upper cover (3).
3. Unscrew the flange bolt (6) of front exhaust pipe and separate the front exhaust pipe.

   Installation Notice

Tightening Torque	30 N•m (22 lb-ft)

Notice: Check the exhaust pipe mounting nut, and replace it with new one if necessary.

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4. Unscrew the eleven nuts (4) and remove the exhaust manifold (5) and gasket (7).

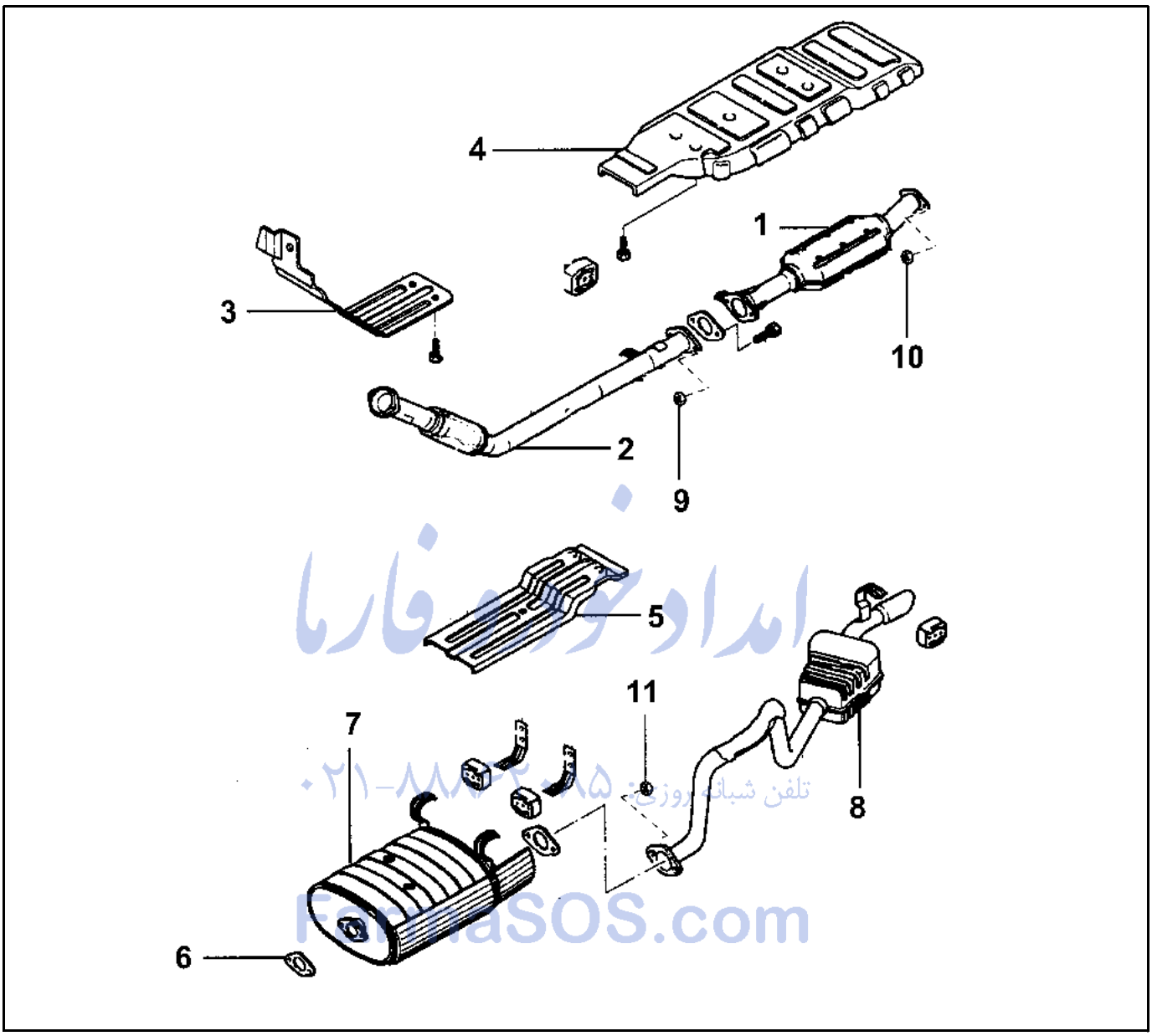
   Installation Notice

Tightening Torque	31.5 - 38.5 N•m (23.2 - 28.4 lb-ft)

5. Replace the gasket (7) with new one.
6. Installation should follow the removal procedure in the reverse order.

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Removal and Installation of Exhaust System



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1 Catalytic Converter
2 Exhaust Pipe
3 Heat Protector Dash
4 Heat Protector Front Floor
5 Hear Protector Rear Floor
6 Gasket
7 Front Muffler
8 Rear Muffler
9 Exhaust Pipe-to-Catalytic Converter Flange Nuts . . . . . 28-47 N•m (21-35 lb-ft)
10 Front Muffler Pipe-to-Catalytic Converter Flange Nuts . . . . . 28-47 N•m (21-35 lb-ft)
11 Rear Muffler Pipe Flange-to-Front Muffler Pipe Flange Nuts . . . . . 28-47 N•m (21-35 lb-ft)

SECTION 1

ENGINE

SECTION 1A3 (OM600 ENGINE)

GENERAL ENGINE INFORMATION

TABLE OF CONTENTS

Specifications 1A3-1
Engine Specifications 1A3-1
Sectional View 1A3-3
OM662LA Engine 1A3-3
OM661LA Engine 1A3-5
Performance Curve 1A3-7
OM662LA Engine 1A3-7
OM661LA Engine 1A3-8
Special Tools 1A3-9
Special Tools Table 1A3-9
Diagnosis 1A3-10
Oil Leak Diagnosis 1A3-10
Compression Pressure Test 1A3-11
Cylinder Pressure Leakage Test 1A3-13
General Information 1A3-15
Cleanliness and Care 1A3-15
On-Engine Service 1A3-15

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SPECIFICATIONS

ENGINE SPECIFICATIONS

Application			OM662LA	OM661LA
Engine Type			Four-Stroke Diesel	Four-Stroke Diesel
Displacement (CC)			2874	2299
Cylinder (Bore x Stroke) (mm)			89 x 92.4	89 x 92.4
Fuel Injection / Ignition System			PES 5 M55 C320 RS 168	PES 5 M55 C320 RS 167
Compression Ratio			22 :1	22 :1
Number of Cylinders			5	4
Camshaft Valve Arrangement			SOHC	SOHC
Camshaft Drive Type			Chain-Drive	Chain-Drive
Max. Output (ps/rpm)			120 / 4000	101 / 4000
Max. Torque (kg•m/rpm)			25.5 / 4000	21.5 / 2400
Firing Order			1-2-4-5-3	1-3-4-2
Injection Timing			BTDC 18° ± 10°	BTDC 18° ± 10°
Valve Timing (at 2mm lift)	Intake	Open/Close	ATDC 11.33° / ABDC 17°	ATDC 11.33° / ABDC 17°
	Exhaust	Open/Close	BBDC 28° / BTDC 15.25°	BBDC 28° / BTDC 15.25°
Valve Clearance Adjustment			Automatic Control	Automatic Control

ENGINE SPECIFICATIONS (Cont'd)

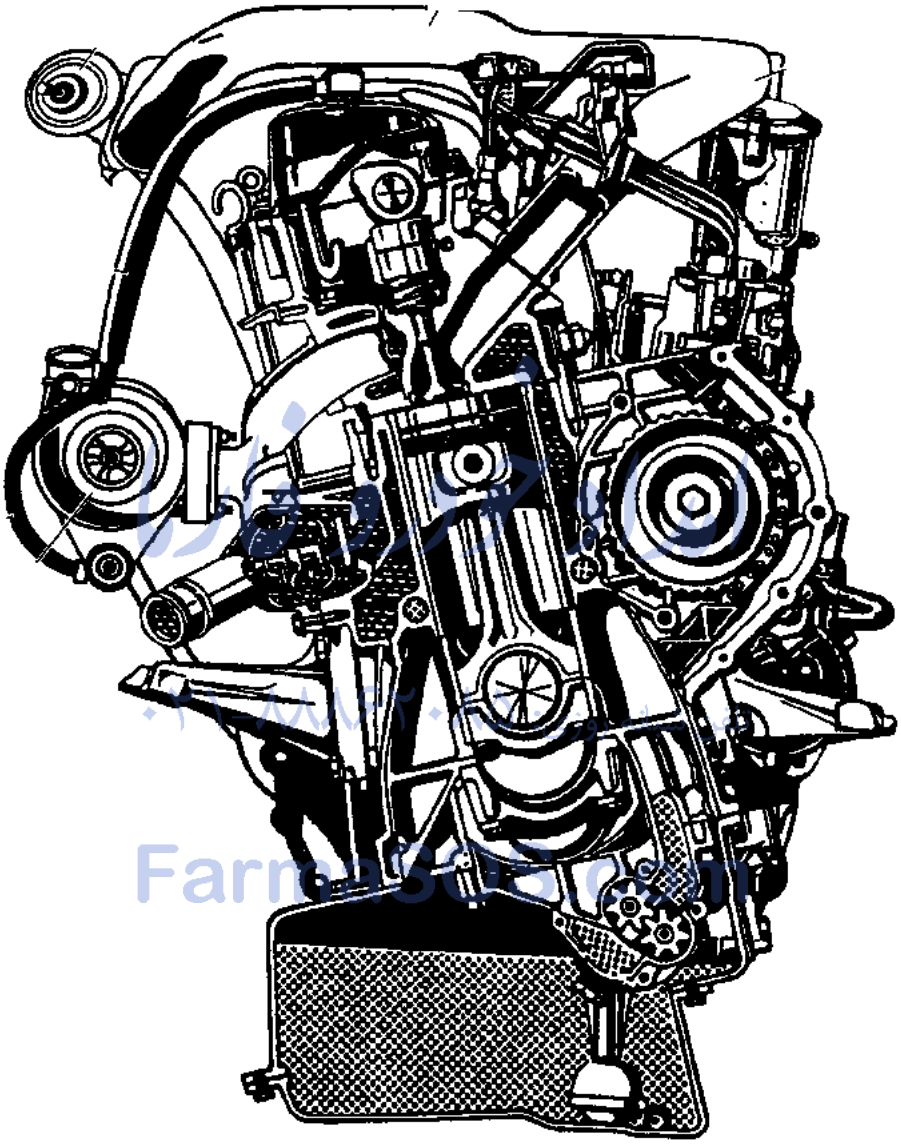
Application	OM662LA	OM661LA
Idle Speed (rpm)	720 - 820	750 - 850
Fuel Injection Pressure (bar)	135 - 143	135 - 143
Oil Capacity (liter)	8.0 - 9.5	6.5 - 8.0
Lubrication Type	Forced by Gear Pump	Forced by Gear Pump
Oil Filter Type	Combined Full-Flow and Partial Flow Filter	Combined Full-Flow and Partial Flow Filter
Fuel	Diesel	Diesel

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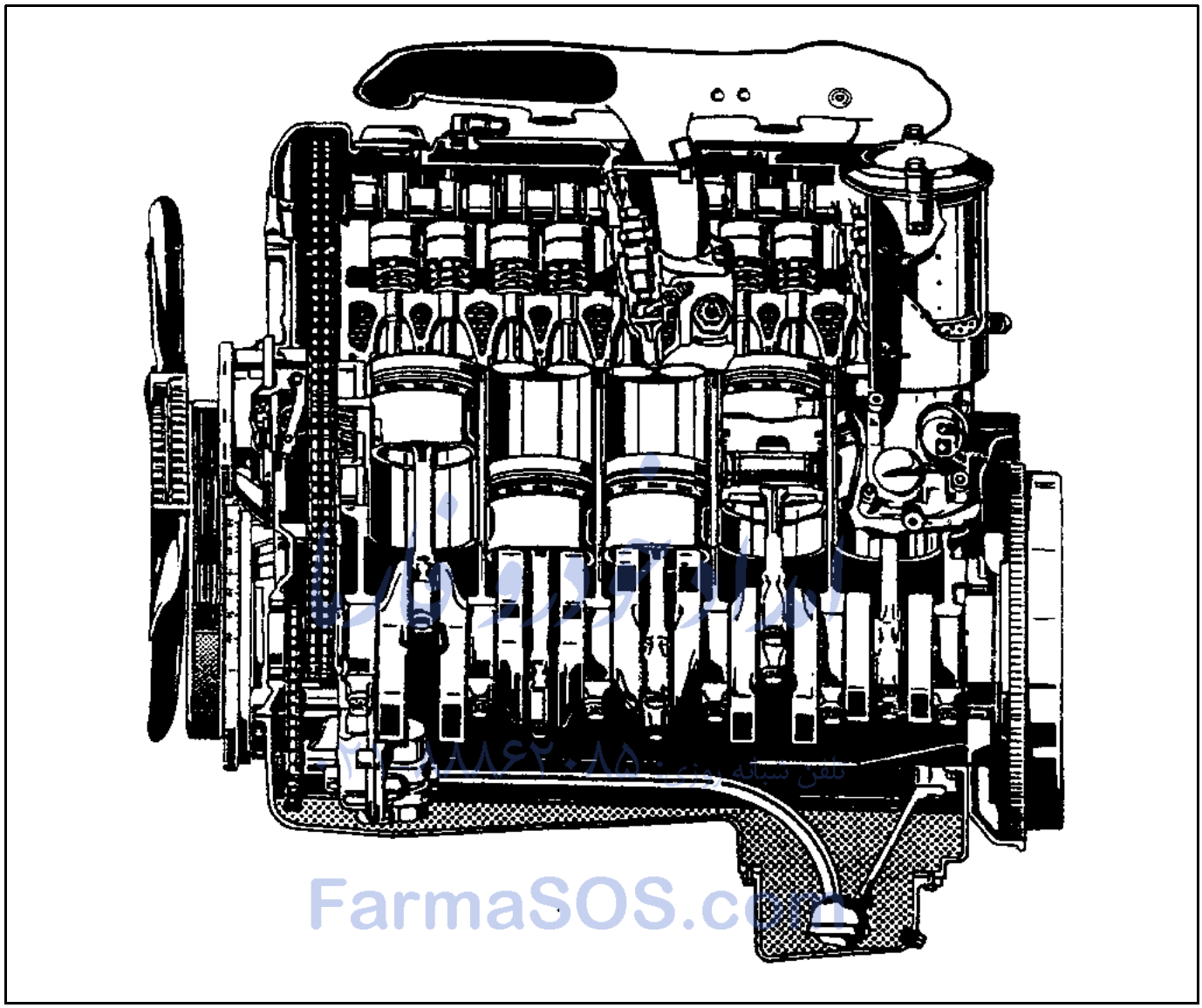
SECTIONAL VIEW

OM662LA ENGINE

Front View



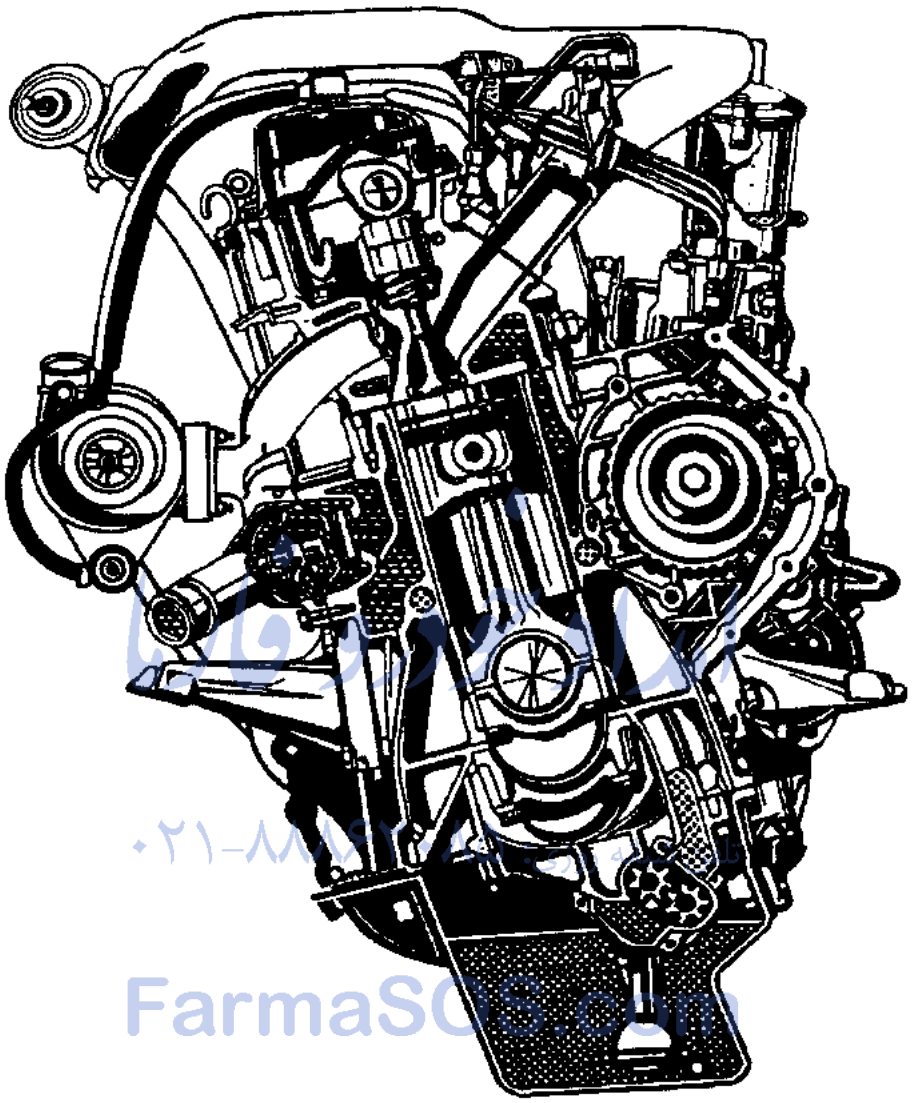
Side View



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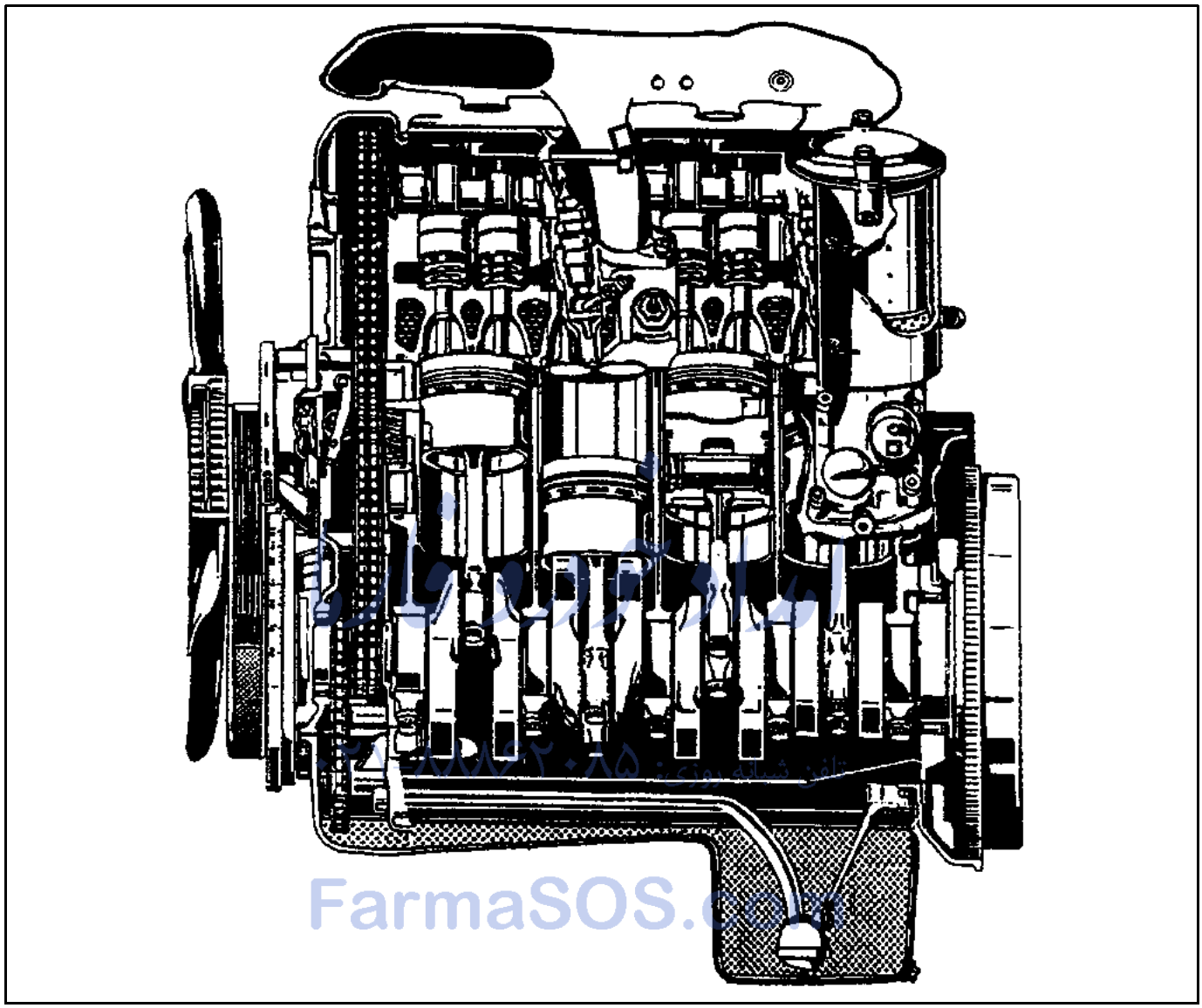
OM661LA ENGINE

Front View



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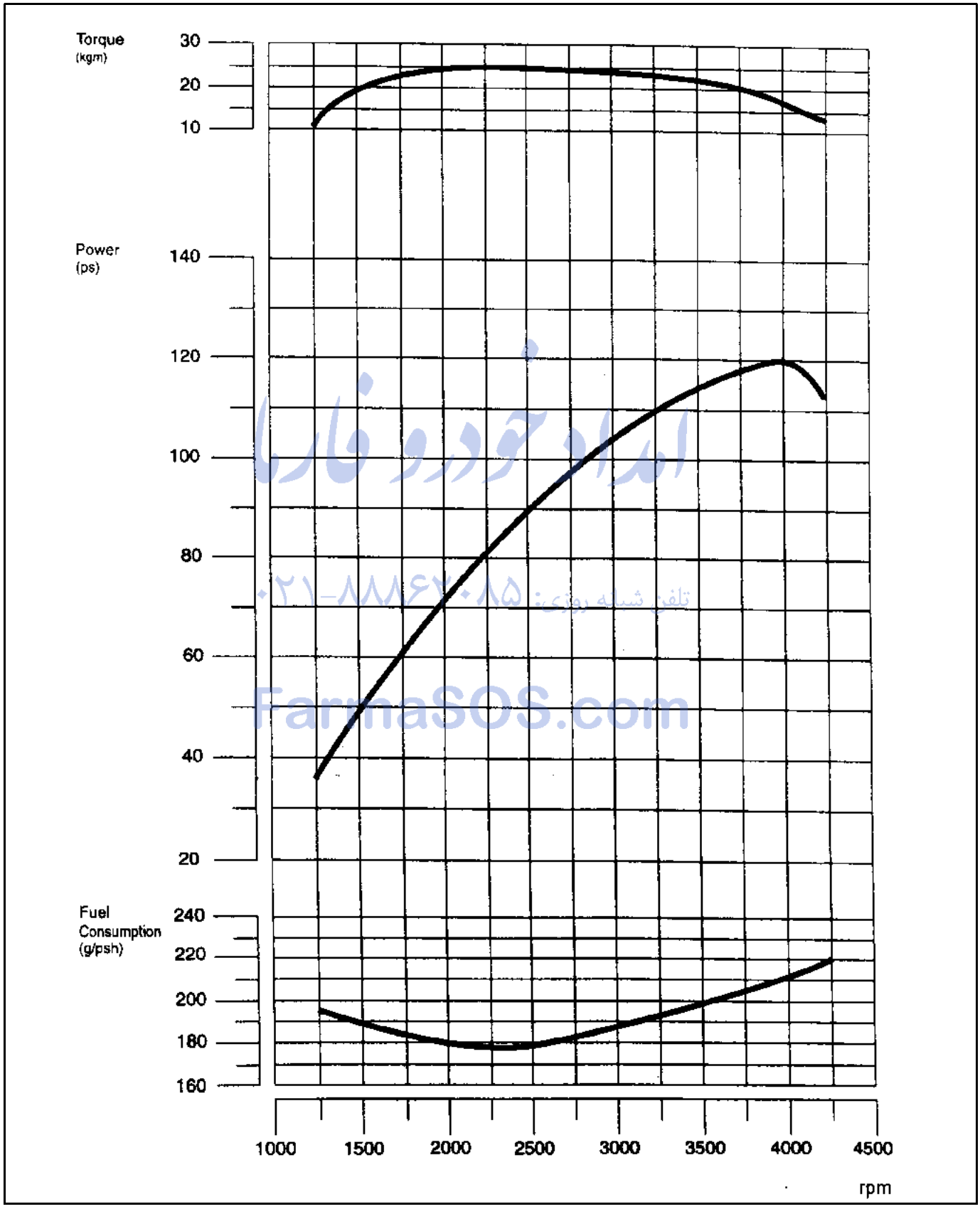
Side View



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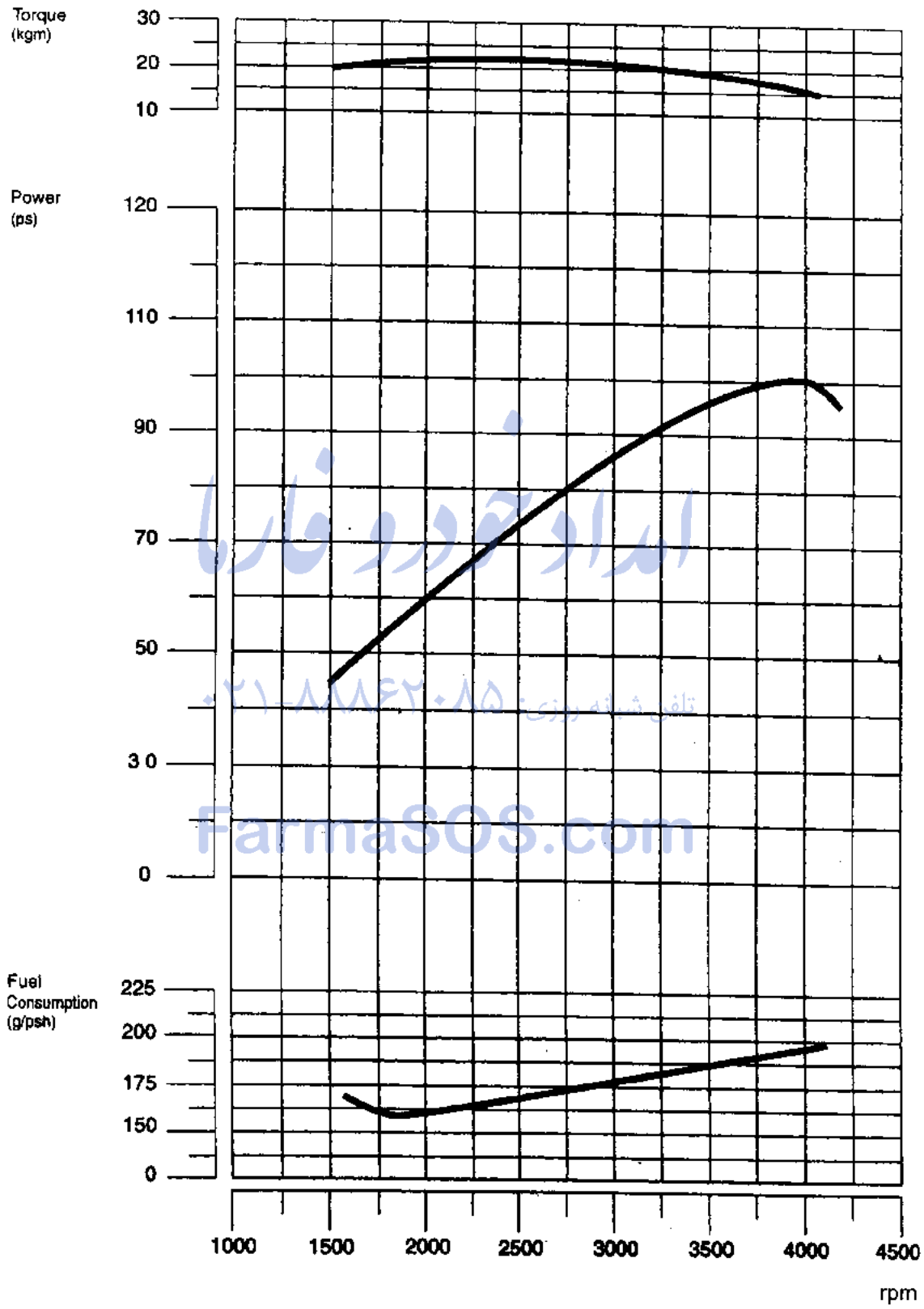
PERFORMANCE CURVE

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SPECIAL TOOLS

SPECIAL TOOLS TABLE

	**000 589 10 99 01** **Torque Wrench**		**601 589 65 09 00** **Socket**
	**001 589 76 21 00** **Compression Pressure Tester**		**001 589 73 21 00** **Hand Vacuum Pump**

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DIAGNOSIS

OIL LEAK DIAGNOSIS

Most fluid oil leaks are easily located and repaired by visually finding the leak and replacing or repairing the necessary parts. On some occasions a fluid leak may be difficult to locate or repair. The following procedures may help you in locating and repairing most leaks.

Finding the Leak

1. Identify the fluid. Determine whether it is engine oil, automatic transmission fluid, power steering fluid, etc.
2. Identify where the fluid is leaking from.
   - 2.1 After running the vehicle at normal operating temperature, park the vehicle over a large sheet of paper.
   - 2.2 Wait a few minutes.
   - 2.3 You should be able to find the approximate location of the leak by the drippings on the paper.
3. Visually check around the suspected component. Check around all the gasket mating surfaces for leaks. A mirror is useful for finding leaks in areas that are hard to reach.
4. If the leak still cannot be found, it may be necessary to clean the suspected area with a degreaser, steam or spray solvent.
   - 4.1 Clean the area well.
   - 4.2 Dry the area.
   - 4.3 Operate the vehicle for several miles at normal operating temperature and varying speeds.
   - 4.4 After operating the vehicle, visually check the suspected component.
   - 4.5 If you still cannot locate the leak, try using the powder or black light and dye method.

Powder Method

1. Clean the suspected area.
2. Apply an aerosol-type powder (such as foot powder) to the suspected area.
3. Operate the vehicle under normal operating conditions.
4. Visually inspect the suspected component. You should be able to trace the leak path over the white powder surface to the source.

Black Light and Dye Method

A dye and light kit is available for finding leaks, Refer to the manufacturer's directions when using the kit.

1. Pour the specified amount of dye into the engine oil fill tube.
2. Operate the vehicle normal operating conditions as directed in the kit.
3. Direct the light toward the suspected area. The dyed fluid will appear as a yellow path leading to the source.

Repairing the Leak

Once the origin of the leak has been pinpointed and traced back to its source, the cause of the leak must be determined n order for it to be repaired properly. If a gasket is replaced, but the sealing flange is bent, the new gasket will not repair the leak. The bent flange must be repaired also. Before attempting to repair a leak, check for the following conditions and correct them as they may cause a leak.

Gaskets

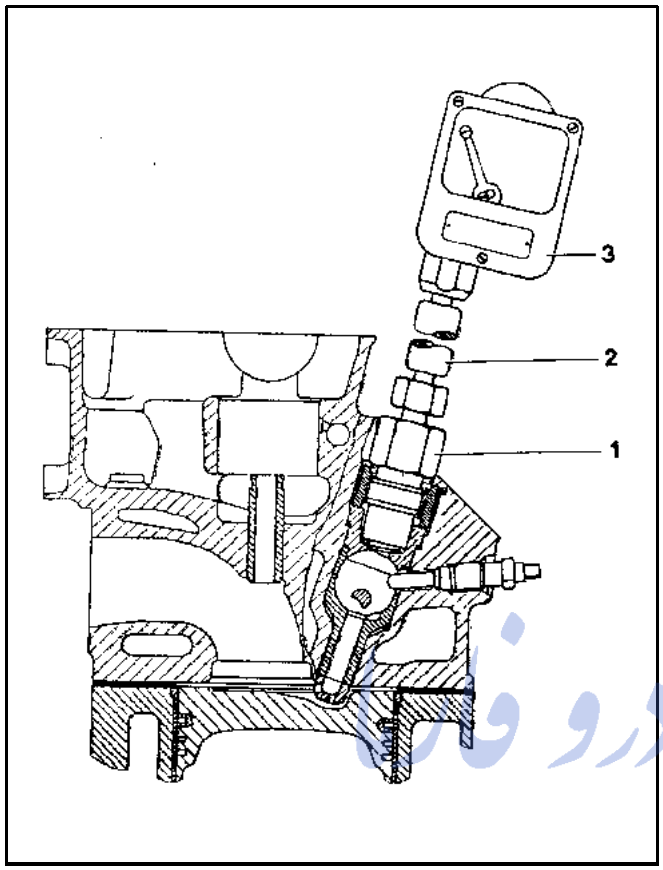
- The fluid level/pressure is too high.
- The crankcase ventilation system is malfunctioning.
- The fasteners are tightened improperly or the threads are dirty or damaged.
- The flanges or the sealing surface is warped.
- There are scratches, burrs or other damage to the sealing surface.
- The gasket is damaged or worn.
- There is cracking or porosity of the component.
- An improper seal was used (where applicable).

Seals

- The fluid level/pressure is too high.
- The crankcase ventilation system is malfunctioning.
- The seal bore is damaged (scratched, burred or nicked).
- The seal is damaged or worn.
- Improper installation is evident.
- There are cracks in the components.
- The shaft surface is scratched, nicked or damaged.
- A loose or worn bearing is causing excess seal wear.

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COMPRESSION PRESSURE TEST



1 Test Adapter
2 Flexible Connector
3 Compression Pressure Recorder

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Service Data

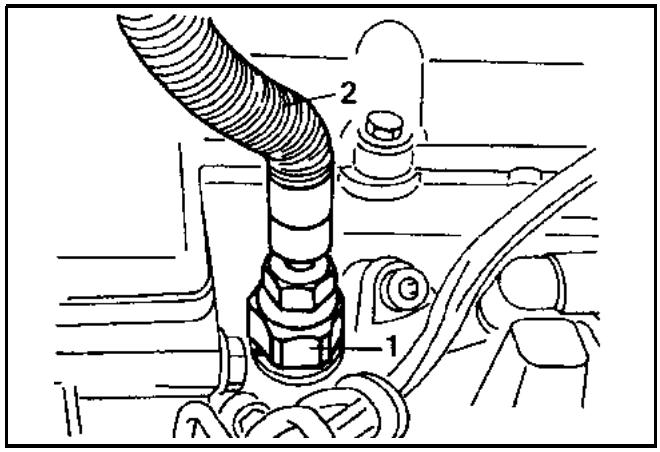
Normal Compression Pressure	28bar
Minimum Compression Pressure	Approx.18bar
Permissible Pressure Difference Between Individual Cylinders	Max. 3bar

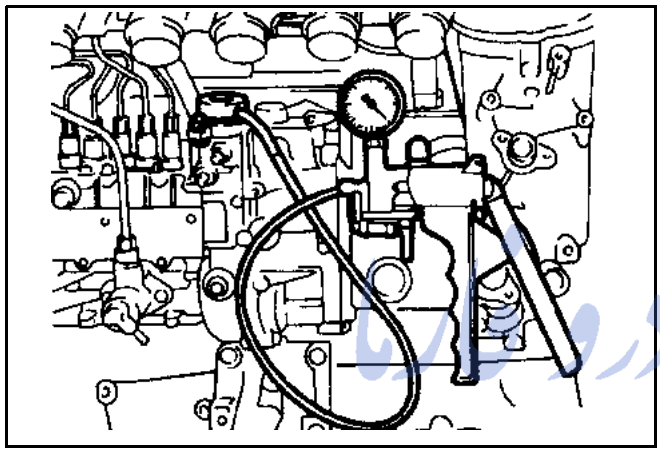
●Engine at normal operating temperature of 80°C

Tools Required

000 589 65 09 00 Socket

001 589 73 21 00 Hand Vacuum Pump





Compression Pressure Measurement

Notice

Ensure that no gear is engaged and that the vehicle is protected from rolling.

1. Run the engine to be the coolant temperature 80°C.
2. Remove the fuel injection nozzle.

Socket Wrench Insert 001 589 65 09 00

3. Install the test adapter (1) and connect the flexible connector (2) to the compression pressure recorder.

Compression Pressure Recorder 001 589 76 21 00

4. Disconnect the vacuum line from the stop unit and connect the hand vacuum pump to the stop unit.
5. Pump the hand vacuum pump and make the fuel injection pump in stop position.

Operating Pressure	Approx. 500bar

Hand Vacuum Pump 001 589 73 21 00

6. Using a starter motor, crank the engine 8 revolutions.
7. Measure the remaining cylinder compression pressure in the same manner and compare it with service data.

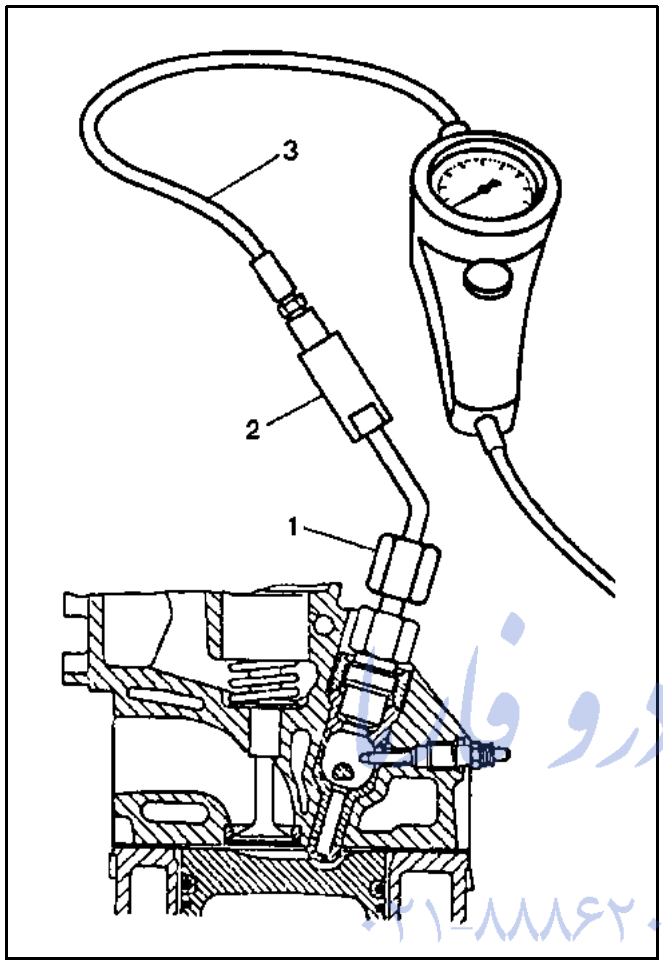
Notice

If out of standard, do cylinder pressure leakage test.

8. Remove the compression pressure recorder.
9. Install the fuel injection nozzle.

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CYLINDER PRESSURE LEAKAGE TEST



1 Connector
2 Connection Piece
3 Connection Hose

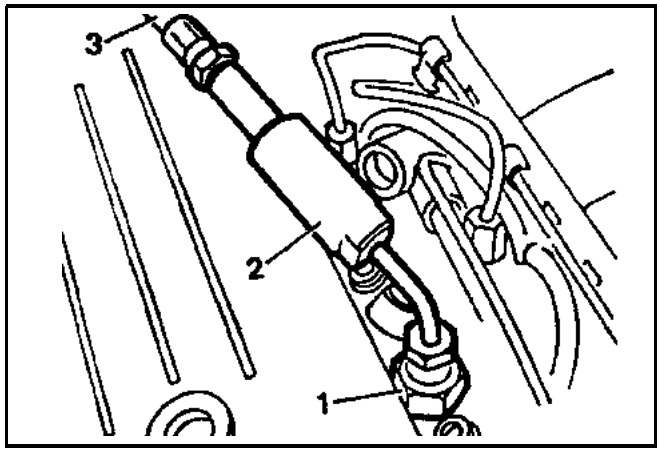
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Permissible Pressure Leakage (Engine at Normal Operating Temperature of 80°C)

At Whole Engine	Max. 25 %
At Valve and Cylinder Head Gasket	Max. 10 %
At Piston and Piston Ring	Max. 20 %

Commercial Tools

Cylinder Pressure Leakage tester	BOSCH, EFAW 210 A or SUN CLT 228
Connection Piece	BOSCH order no. 1 687 010 016



Leakage Test

1. Run the engine to be the coolant temperature 80°C.
2. Remove the fuel injection nozzle.
3. Open the coolant subtank cap.
4. Check the coolant level and replenish if necessary.
5. Open the oil filler cap.
6. Remove the air cleaner cover and element.
7. Position the piston at TDC.
8. Install the connector (1) and connection piece (2).
9. Calibrate the tester and connect the connection hose (3)
10. Pressurize with compressed air and compare the pressure changes with permissible pressure leakage.
11. If permissible pressure leakage is out of standard, check followings :
    - Intake and exhaust lines.
    - Sounds in oil filler area.
    - Air bubbles in radiator coolant.
12. Do pressure leakage test for the remaining cylinders according to the firing order.
    - OM 662LA Engine : 1-2-4-5-3
    - OM 661LA Engine : 1-3-4-2
13. Remove the tester.
14. Close the coolant pressure cap and oil filler cap.
15. Install the air cleaner element and cover.
16. Install the fuel injection nozzle.

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GENERAL INFORMATION

CLEANLINESS AND CARE

An automobile engine is a combination of many machined, honed, polished and lapped surfaces with tolerances that are measured in the ten-thousanths of an inch. When any internal engine parts are serviced, care and cleanliness are important. A liberal coating of enigne oil should be applied to friction areas during assembly, to protect and lubricate the surfaces on initial operation. Proper cleaning and protection of machined surfaces and friction areas is part fo the repair procedure. This is considered standard shop practice even if not specifically stated.

Whenever valve train components are removed for service, they should be kept in order. They should be installed in the same locations, and with the same mating surfaces, as when they were removed.

Battery cables should be disconnected before any major work is performed on the engine. Failure to disconnect cables may result in damage to wire harness or other electrical parts.

ON-ENGINE SERVICE

Caution: Disconnect the negative battery cable before removing or installing any electrical unit, or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

Notice: Any time the air cleaner is removed, the intake opening should be covered. This will protect against accidental entrance of foreign material, which could follow the intake passage into the cylinder and cause extensive damage when the engine is started.

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SECTION 1B3

OM600 ENGINE MECHANICAL

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

Specifications 1B3-2
Fastener Tightening Specifications 1B3-2
Special Tools 1B3-4
Special Tools Table 1B3-4
Maintenance and Repair 1B3-12
On-Vehicle Service 1B3-12
Engine Assembly 1B3-12
Poly V-Belt 1B3-21
Tensioning Device 1B3-23
Poly V-Belt Alignment & Inspection 1B3-26
Prechamber 1B3-29
Milling of Prechamber Sealing Surface 1B3-32
TDC (TDC Sensor Bracket) Setting 1B3-35
Cylinder Head 1B3-37
Timing Case Cover 1B3-63
Crankshaft End Cover 1B3-71
Vibration Damper and Hub 1B3-74
Crankshaft Front Radial Seal 1B3-80
Crankshaft Ball Bearing 1B3-82
Crankshaft 1B3-83
Flywheel 1B3-93
Machining of Flywheel 1B3-97
Flywheel Ring Gear 1B3-98
Hydraulic Valve Clearance Compensation
Element Check 1B3-101
Valve Tappets 1B3-103
Valve Spring Check 1B3-105
Valve Springs (Cylinder Head Removed) .. 1B3-106
Valve Springs (Cylinder Head Installed) ... 1B3-109
Valve Stem Seals 1B3-112
Check and Replacement of Valve Guides .. 1B3-116
Valve Seat Rings 1B3-122
Check and Machining of Valves 1B3-127
Machining of Valve Seat 1B3-132
Camshaft Timing Test 1B3-137
Camshaft 1B3-139
Chain Tensioner 1B3-145
Timing Chain 1B3-147
Tensioning Rail 1B3-151
Cylinder Head Guide Rail 1B3-152
Timing Case Cover Guide Rail 1B3-156
Crankshaft Sprocket 1B3-158
Piston 1B3-163
Oil Filter 1B3-169
Oil Pan 1B3-171
Oil Spray Nozzle 1B3-174
Oil Pump 1B3-175
Unit Repair 1B3-177
Cylinder Head Pressure Leakage Test 1B3-177
Facing Cylinder Head Mating Surface 1B3-178
Replacement of Crankcase Core Plug 1B3-180
Facing Crankcase Contacting Surface 1B3-182
Oil Gallery Steel Ball 1B3-183
Cylinder Bore Measurement 1B3-187

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SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Engine Assembly

Application	N•m	Lb-Ft	Lb-In
Skid Plate Bolt	28 - 47	21 -35	-
Drain Plug Bolt	30	22	-
Coolong Fan Shroud Bolt	3 - 7	-	27 - 62
Control Linkage Nut	8 - 18	6 - 13	-
Clutch Linkage Cylinder Nut	20 - 34	15 - 25	-
Exhaust Manifold Bolt	30	22	-
Propeller Shaft Bolt & Nut (Axle)	70 - 80	52 - 59	-
Propeller Shaft Bolt & Nut (T/C)	81 - 89	60 - 66	-
Engine Mounting Nut	50 - 75	37 - 55	-

Crankshaft Assembly

Application	N•m	Lb-Ft	Lb-In
Cooling Fan Belt Pulley Bolt	10	-	89
Socket Bolt	23	17	-
Tighten The Bolt	200 / 90°	148 / 90°	-
End Cover Bolt	10	-	89
Crankshaft Bearing Cap Bolt	55 / 90°	41 / 90°	-
Ball Bearing	45 / 90°	33 / 90°	-
Camshaft Sprocket Bolt	25 / 90°	18 / 90°	-
Oil Pump Sprocket Bolt	25	18	-

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Piston

Application	N•m	Lb-Ft	Lb-In
Connecting Rod Bolt	35 / 90°	26 / 90°	-

Flywheel

Application	N•m	Lb-Ft	Lb-In
12-Sided Stretch Bolt	45 / 90°	33 / 90°	-

Cylinder Head

Application	N•m	Lb-Ft	Lb-In
Prechamber Threaded Ring	130	96	-
Cylinder Head Cover Bolt	10	-	89
Fuel Injsction Pipe Nut	18	13	-
Socket Bolt	25	18	-
Fuel Filter Pipe Bolt	25	18	-
Idle Pulley Bolt	23	17	-
Damper Bolt	21	15	-
Camshaft Bearing Cap Bolt	25	18	-
Camshaft Sprocket Bolt	25 / 90°	18 / 90°	-
Exhaust Pipe Bolt& Nut	25	18	-
Chain Tensioner	80	59	-
Injection Nozzle	40	30	-
Intake Manifold Not	25	18	-
Injection Nozzle Pipe Not	18	13	-
Oil Dipstick Tube Bolt	10	-	89
Screw Plug M18 x 15	50	37	-

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Cam Support & Shaft

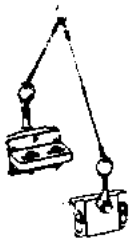
Application	N•m	Lb-Ft	Lb-In
Stud Bolt	12	-	106
Exhaust Manifold Not	25	18	-
CamShaft Bearing Cap Bolt	25	18	-
12-Sided Bolt (M11)	25 / 90°	18 / 90°	-

۰۲۱-۸۸۴۲۰۸۵ تلفن شبانه روزی
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Timing Cover

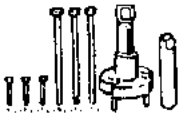
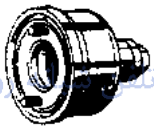
Application	N•m	Lb-Ft	Lb-In
Oil Pan Bolt-Socket Bolt	10	-	89
Oil Pan Bolt-M6	10	-	89
Oil Pan Bolt-M23	23	17	-
Belt Pulley Bolt	32	24	-
Guide Pulley Bolt	4	-	35
Guide Pulley Bracket Nut	23	17	-
Chain Tensioner	80	59	-
Tesioning Lever Bolt	23	17	-

SPECIAL TOOLS TABLE (Cont'd)

	**116 589 03 07 00** **T Type Socket Wrench**		**115 589 34 63 00**
	**601 589 00 10 00** **Cylinder Head Bolt 102**		**602 589 00 25 00**
	**102 589 12 15 00** **(ϕ17) Drift**		**102 589 00 15 00** **(ϕ34) Drift**
	**617 589 10 21 00** **RI Sensor**		**601 589 05 14 00** **Assembly Cage**

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SPECIAL TOOLS TABLE (Cont'd)

	**601 589 08 15 00** **Drift**		**103 589 00 33 00** **Puller**
	**001 589 53 21 00** **Dial Gauge**		**601 589 03 14 00** **Sleeve**
	**601 589 07 21 00** **Depth Gauge**		**601 589 03 43 00** **Oil Seal Assembler**
	**667 589 01 21 00** **Fixing Device**		**366 589 00 21 05** **Extension**

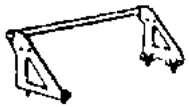
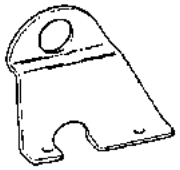
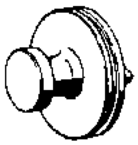
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SPECIAL TOOLS TABLE (Cont'd)

	**363 589 02 21 00** **Dial Gauge Holder**		**116 589 07 15 00** **Drift**
	**000 589 33 33 00** **Counter Support**		**000 589 04 14 00** **Tensioning Strap**
	**000 589 25 33 00** **Internal Extractor**		**102 589 03 40 00** **Magnetic Bar**
	**102 589 05 33 00** **Puller**		**601 589 01 59 00** **Assembling Board**

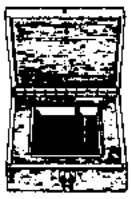
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SPECIAL TOOLS TABLE (Cont'd)

	**601 589 02 59 00** **Supporting Bridge**		**667 584 02 63 00** **Supporting Bar**
	**667 589 00 31 00** **Press Lever**		**104 589 00 37 00** **Pliers**
	**116 589 06 63 00** **Magnetic Finger**		**601 589 02 43 00** **Drift**
	**603 589 01 40 00** **Holding Wheel**		**000 589 10 68 00** **Cylinder Brush**

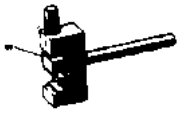
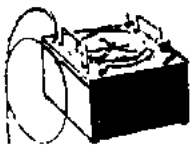
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تلفن همراه روزی: ۰۹۱۵ ۲۰۸۵ ۰۲۱
FarmaSOS.com

SPECIAL TOOLS TABLE (Cont'd)

	**601 589 02 23 00** **Go/No Go Gauge**		**601 589 05 15 00** **Drift (for Intake)**
	**105 589 03 15 00** **Drift (for Intake)**		**601 589 06 15 00** **Drift (for Exhaust)**
	**103 589 02 15 00** **Drift (for Exhaust)**		**000 589 10 53 00** **Reamer (for Exhaust)**
	**346 589 00 63 00** **Super Cooling Box**		**000 589 21 53 00** **Reamer (for Intake)**

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تلفن شبانه روزی: ۰۲۱ ۸۸۸۶۲۰۸۵
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SPECIAL TOOLS TABLE (Cont'd)

	001 589 32 21 00 Dial Gauge		124 589 15 21 00 Tester
	001 589 53 21 00 Dial Gauge		667 589 02 21 00 TDC Pulse Generator
	000 589 58 43 00 Chain Assembling Device		501 589 73 21 00 Vacuum Pump
	201 589 13 21 00 Vacuum Tester		617 589 04 21 00 Tester

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تلفن پشتیبانی: ۰۲۱-۸۸۸۶۳۰۸۵
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SPECIAL TOOLS TABLE (Cont'd)

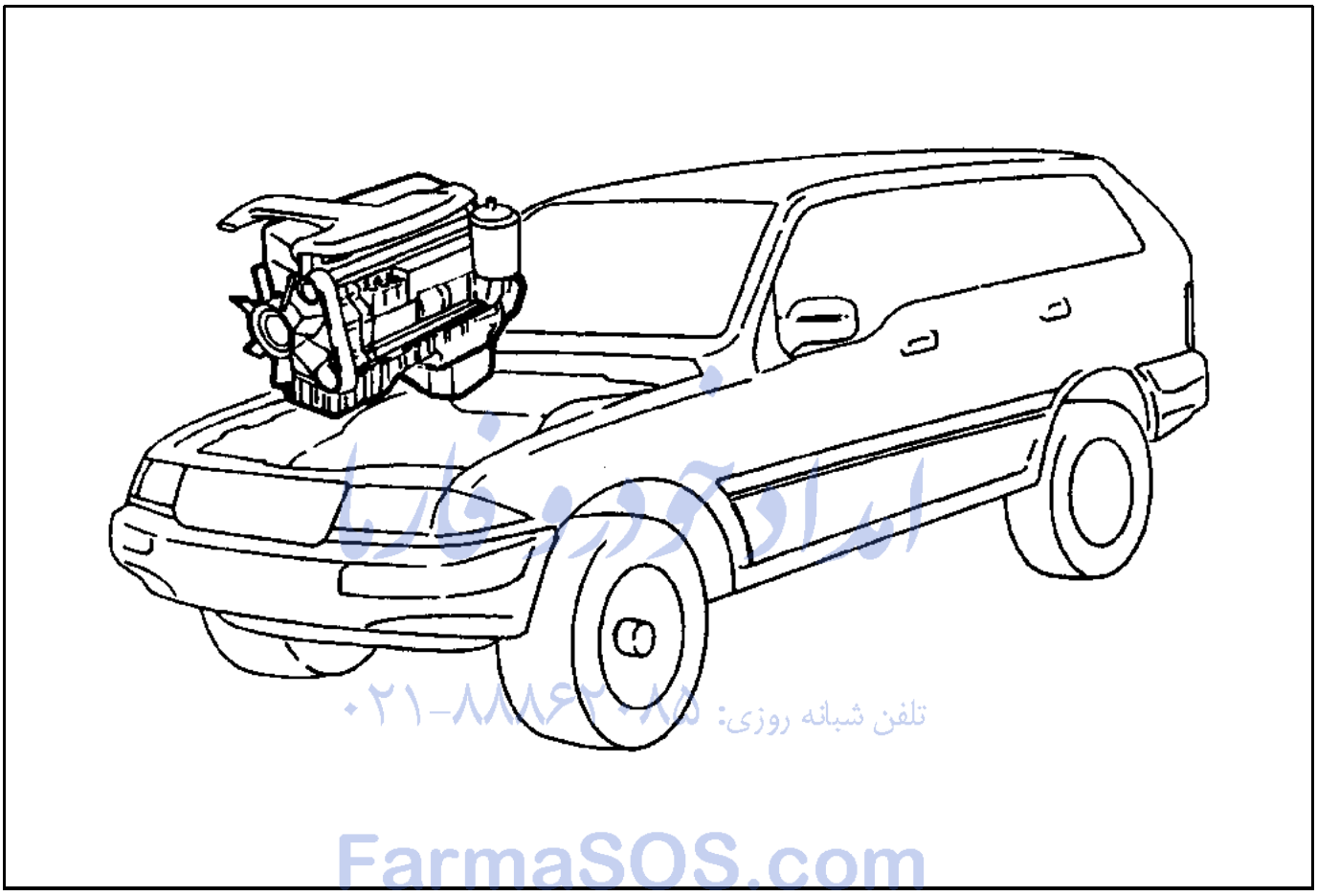
	**000 589 14 21 00** **Tester**		**601 589 00 08 00** **Flange**
	**001 589 65 09 00** **Serration Wrench**		**116 589 02 34 00** **Thread Bolt**
	**000 589 00 68 00** **Cleaning Set**		**667 589 04 63 00** **Retaining Plate**
	**601 589 05 21 00** **Looking Screw**		**617 589 08 21 00** **Position Sensor**

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تلفن پاسخگویی: ۰۲۱ ۸۸۴۶۲۰۸۵
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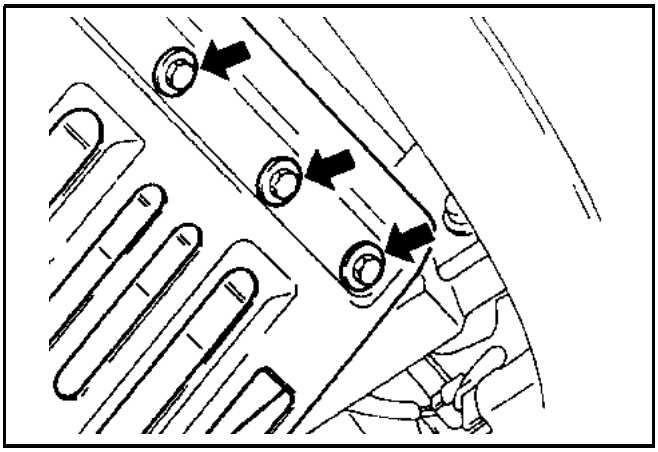
MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

ENGINE ASSEMBLY



ایران آفرود فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۳۰۸۵
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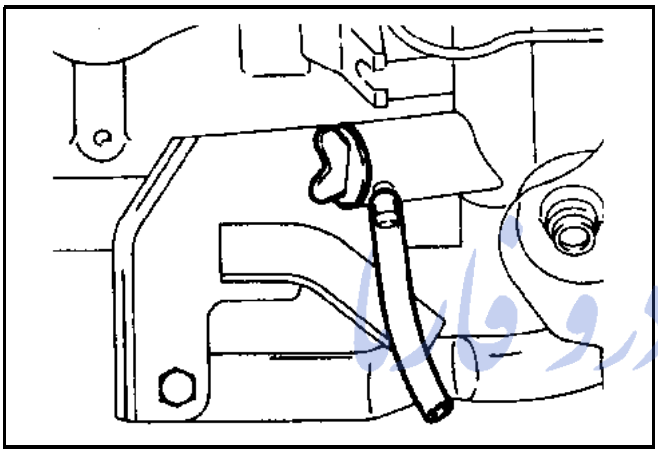


Removal & Installation Procedure

1. Disconnect the negative terminal of battery.
2. Remove the hood.
3. Remove the skid plate.

Installation Notice

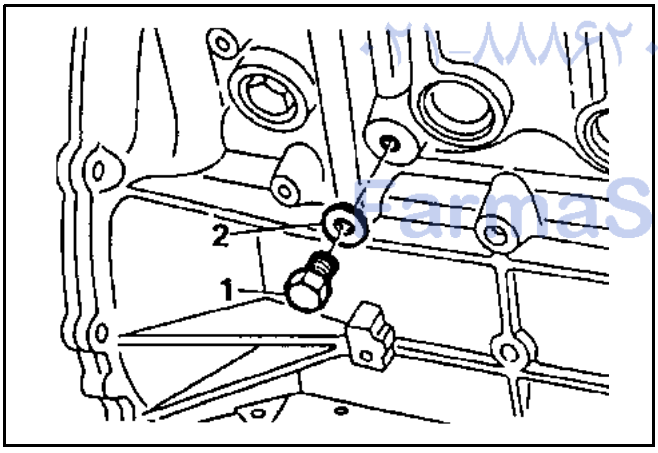
Tightening Torque	28-47 N·m (21-35 lb-ft)



4. Remove the radiator drain cock and drain the coolant.

Notice

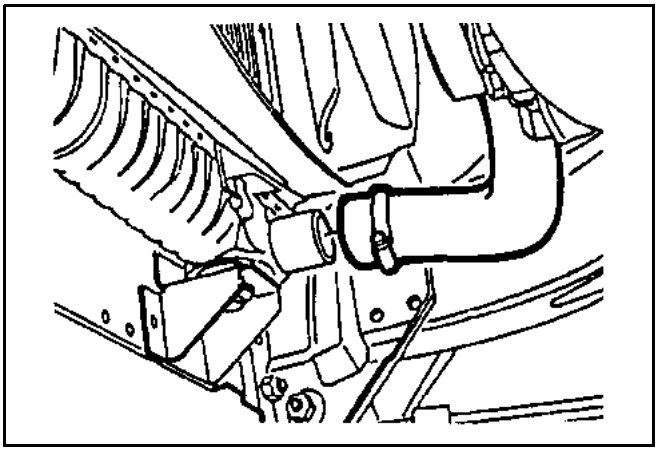
Open the coolant reservoir tank cap.



5. Remove the drain plug (1) and seal (2) from the cylinder block and drain the coolant completely.
6. After draining, replace the seal and reinstall the drain plug.

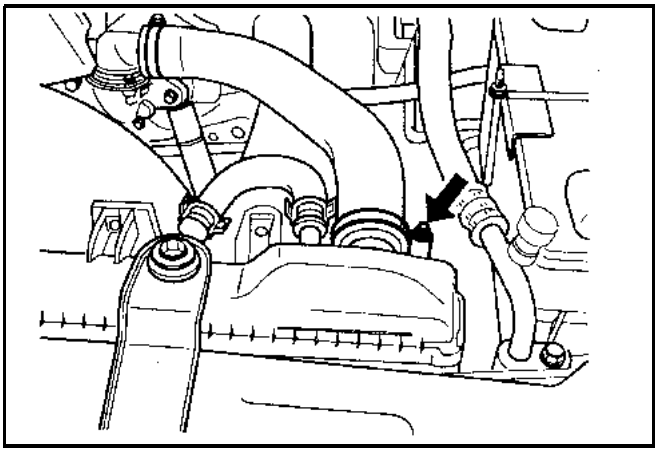
Installation Notice

Tightening Torque	30 N·m (22 lb-ft)

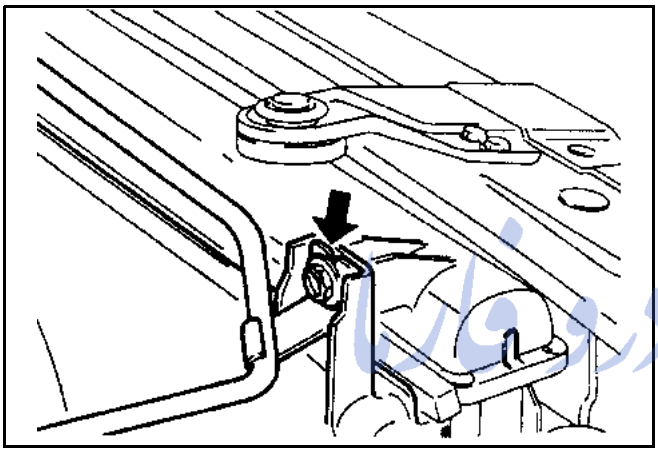


7. Disconnect the lower coolant hose from the radiator.

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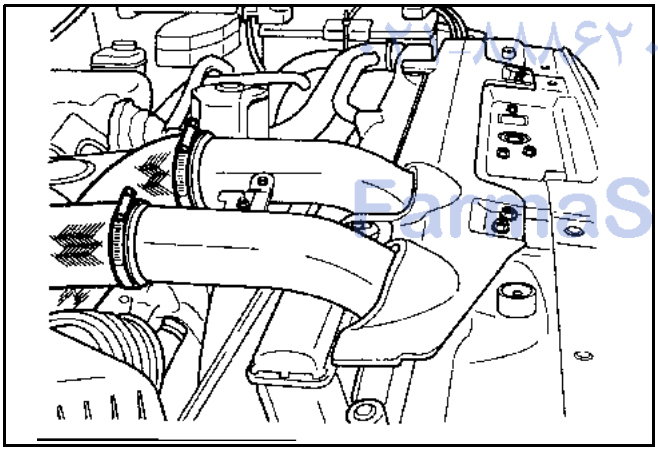
8. Disconnect the upper coolant hose from the radiator.



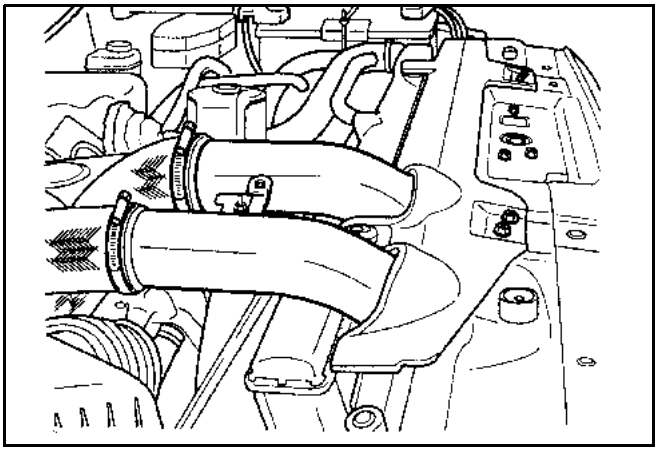
9. Loosen the bolt and remove the coolant pipe and cooling fan shroud.

Installation Notice

Tightening Torque	3 -7 N·m (27-62 lb-in)

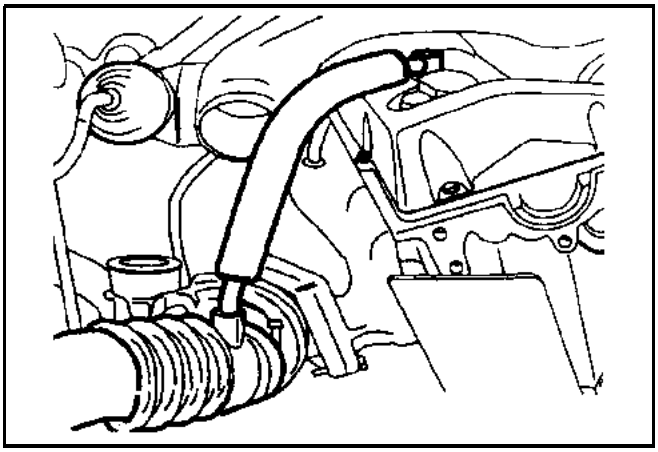


10. Remove the hoses (air intake to intercooler, intercooler to intake duct).

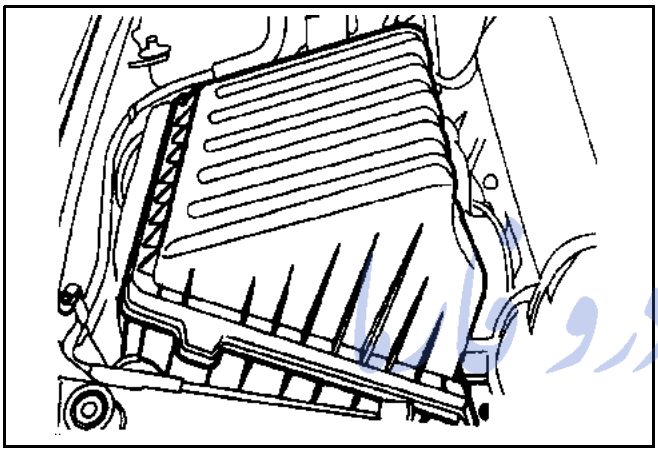


11. Remove the pipes connected to intercooler.

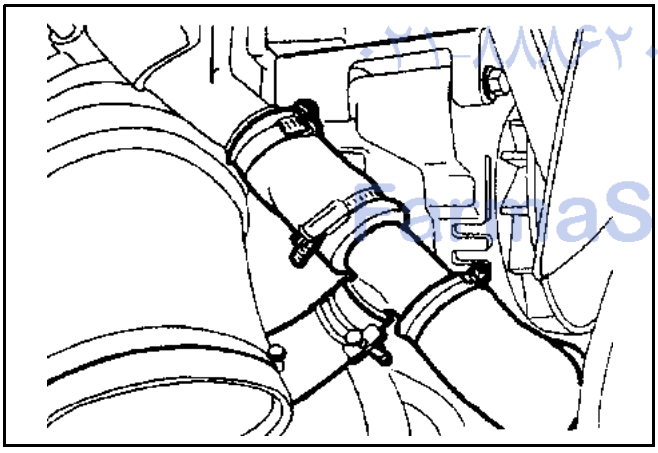
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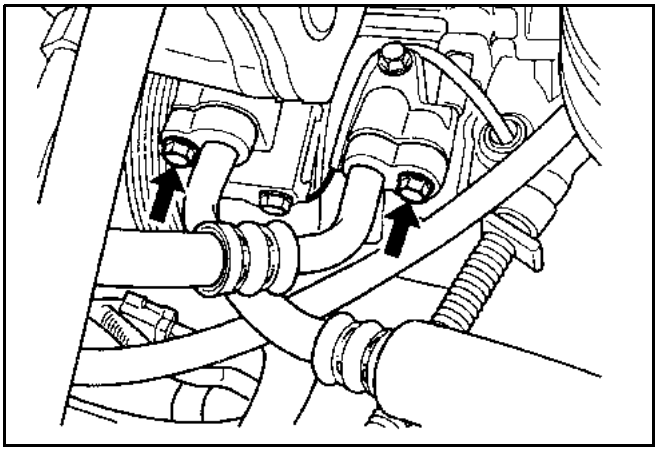
12. Remove the hose(air cleaner to turbocharger) with blow by hose.



13. Disconnect the air cleaner intake hose and remove the air cleaner cover and element.



14. Disconnect the coolant hose from the water inlet.

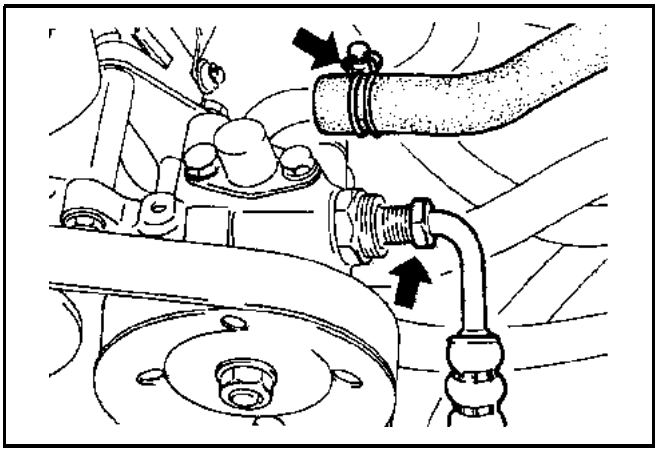


15. Remove the air-conditioner lines from the compressor.

Notice

Evacuate the refrigerant before removal.

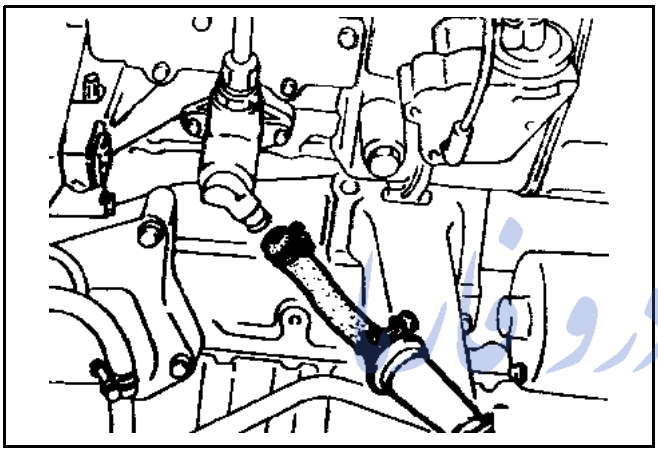
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تلفن شبانه روزی: ۰۲۱-۸۸۳۴۲۰۸۵
IranSOS.com



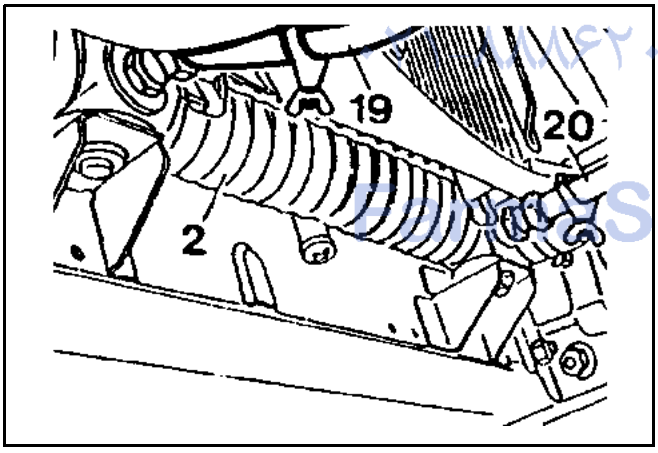
16. Remove the power steering pump lines.

Notice

Completely drain the fluid.

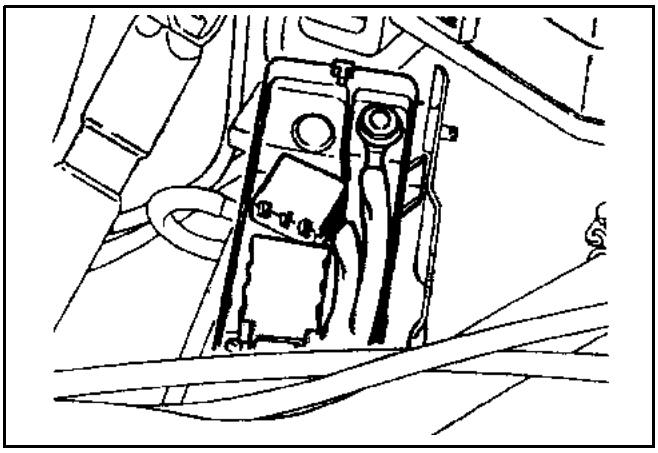


17. Disconnect the fuel feed line with prefilter from the feed pump on injection pump.



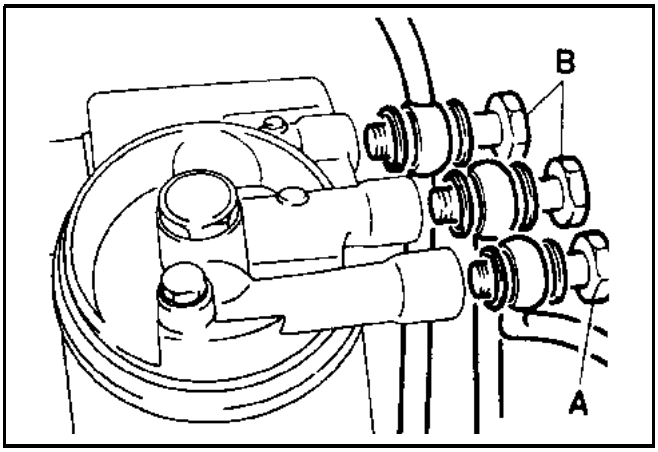
18. Vehicle with automatic transmission.

Remove the hydraulic lines (19, 20) from oil cooler (2).

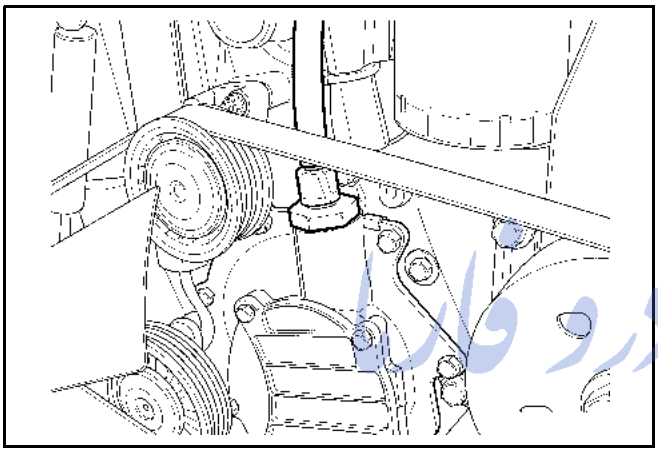


19. Disconnect the engine harness.
20. Disconnect the preheating time relay cable.

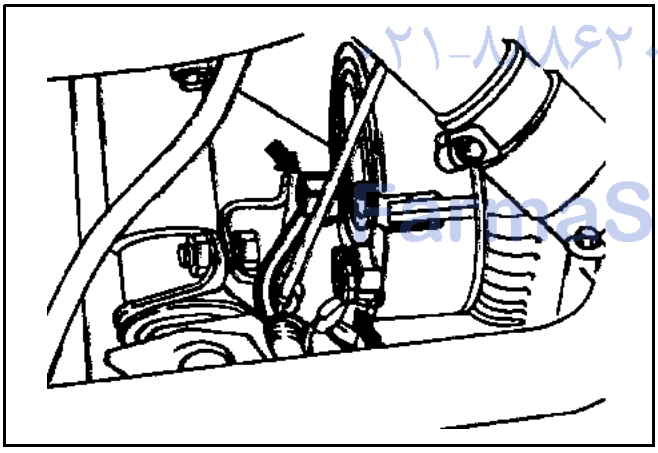
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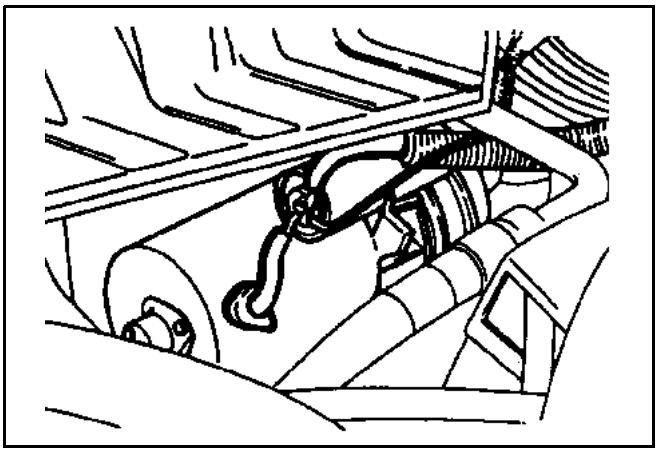
21. Remove the fuel lines from the fuel filter and cover the filter with plug.



22. Disconnect the brake booster hose from vacuum pump.
23. Disconnect the other vacuum lines.

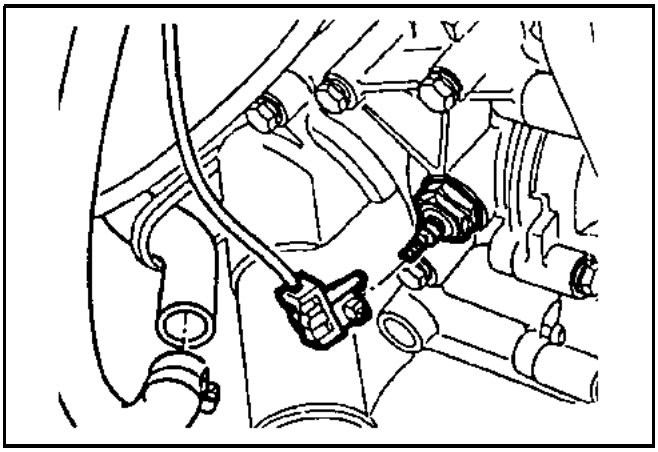


24. Disconnect the ground cable.
25. Disconnect the generator wires.

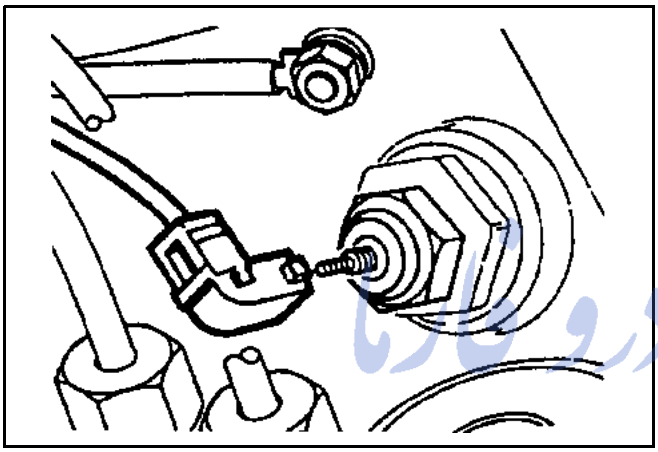


26. Disconnect the starter motor wires and remove the starter motor.

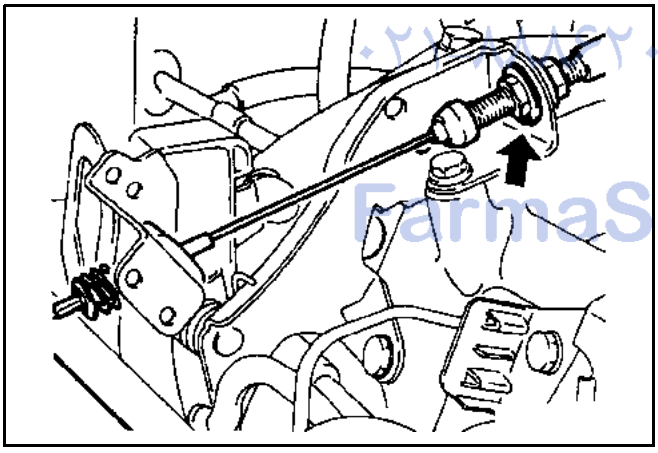
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27. Disconnect the preheating time relay sensor plug.



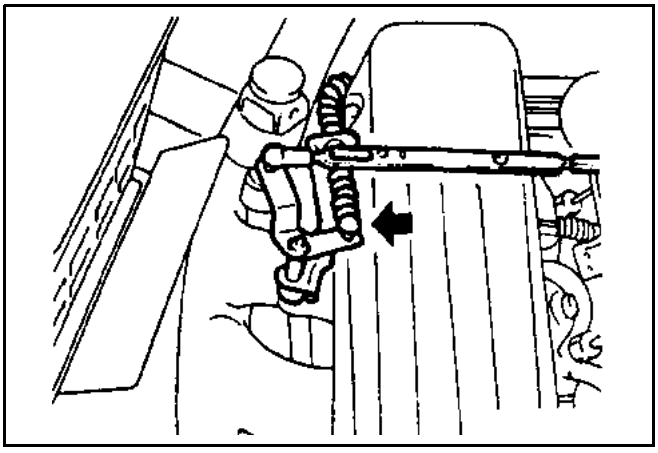
28. Disconnect the coolant temperature sensor plug.



29. Disconnect the accelerator cable from the control linkage.

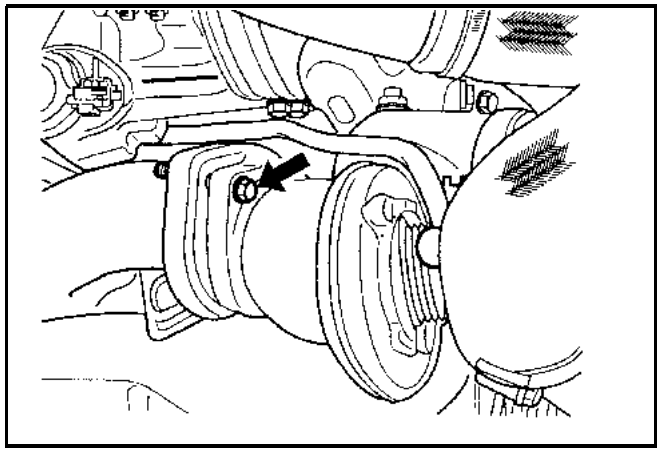
Installation Notice

Tightening Torque	8 - 18 N·m (6 - 13 lb-ft)



30. Loosen the connection of control pressure cable (an arrow) used in auto transmisson.

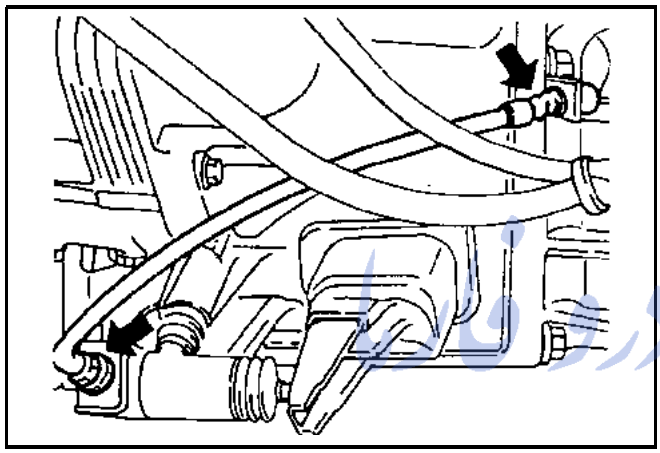
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31. Separate the exhaust pipe flange from the turbo charger.

Installation Notice

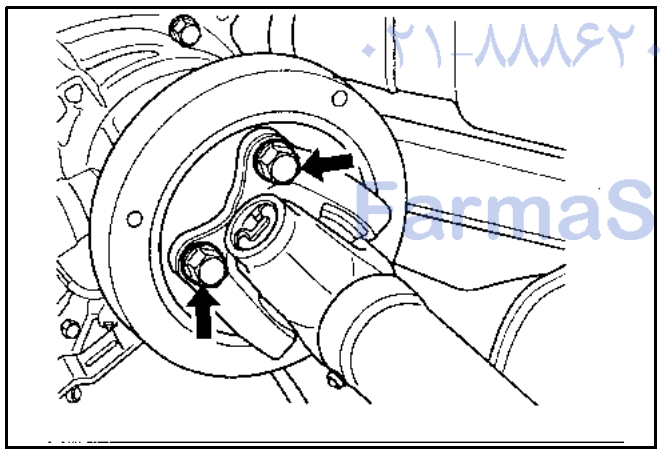
Tightening Torque	30 N·m (22 lb-ft)



32. Loosen the installing bolt of clutch release cylinder and remove the clutch release cylinder.

Installation Notice

Tightening Torque	20-34 N·m (15-25 lb-ft)



33. Disconnect the exhaust pipe flange from the exhaust manifold.

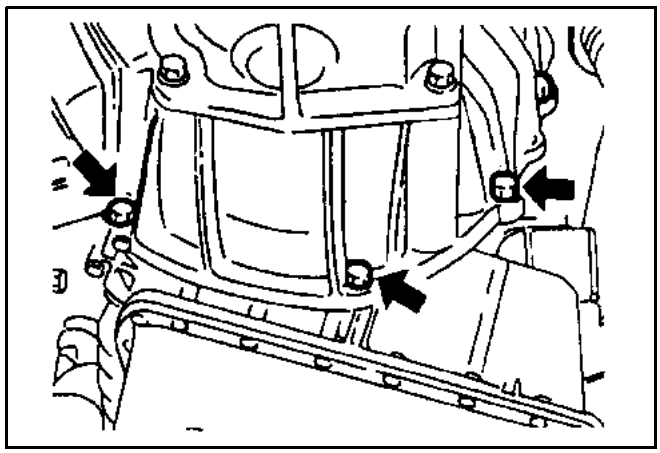
Installation Notice

Tightening Torque	30 N·m (22 lb-ft)

34. Remove the propeller shaft from the transmission.

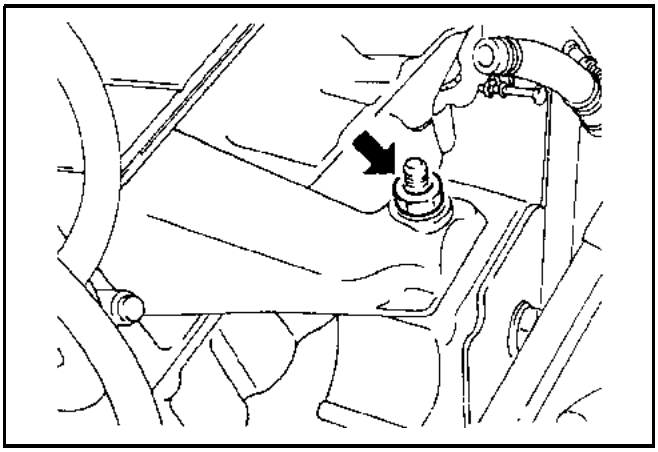
Installation Notice

Tightening Torque	Axle 70-80 N·m (52-59 lb-ft)
	T/C 81-89 N·m (60-66 lb-ft)



35. Remove the shift control cable.
36. Remove the transmission.

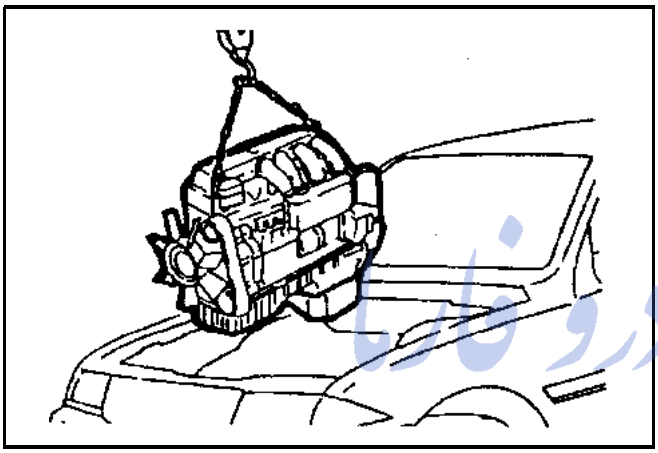
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37. Loosen the engine mounting bracket nut.

Installation Notice

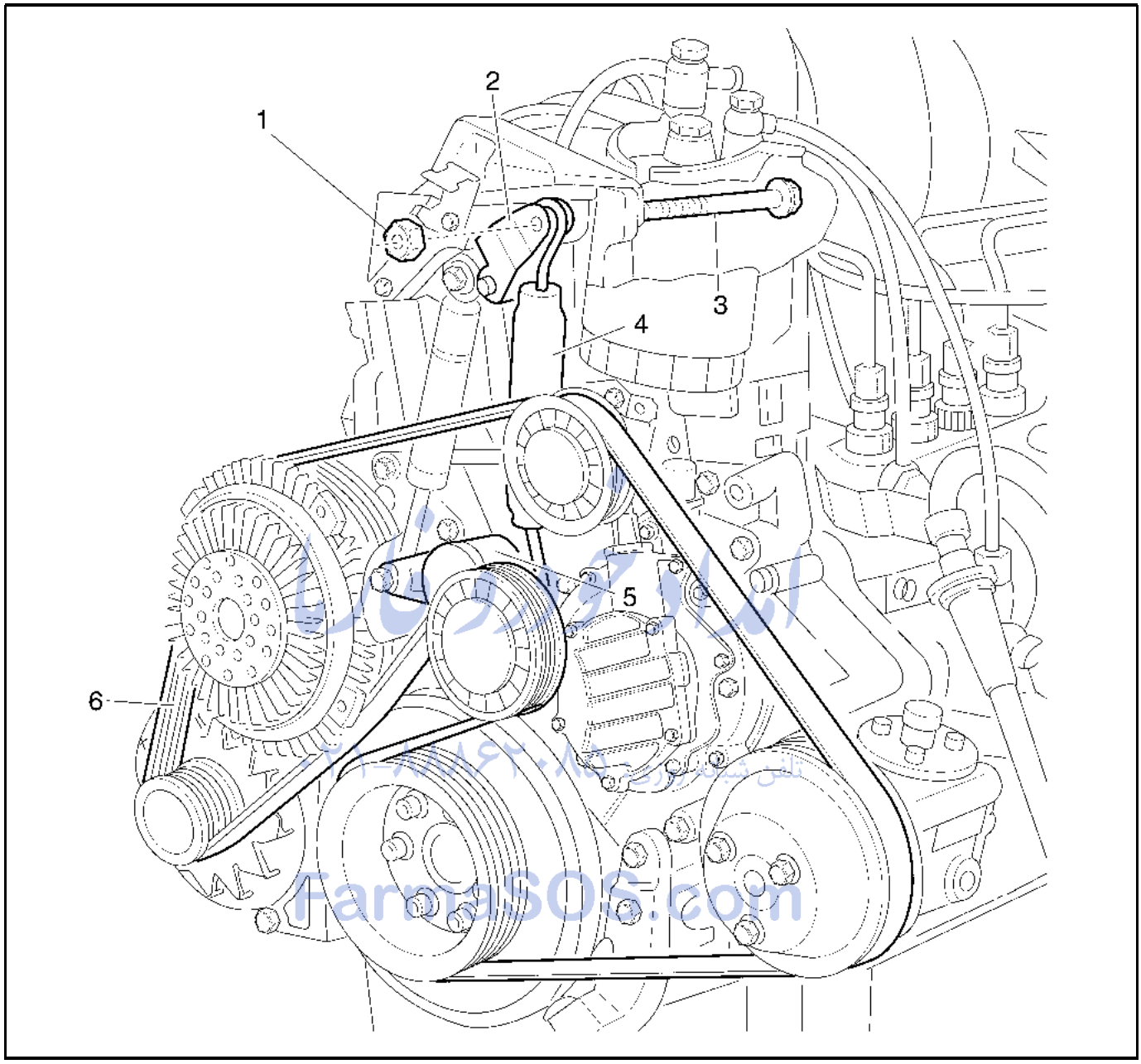
Tightening Torque	50-75 N·m (37-55 lb-ft)



38. Remove the engine assembly from the vehicle by using a hoist or crane.
39. Installation should follow the removal procedure in the reverse order.

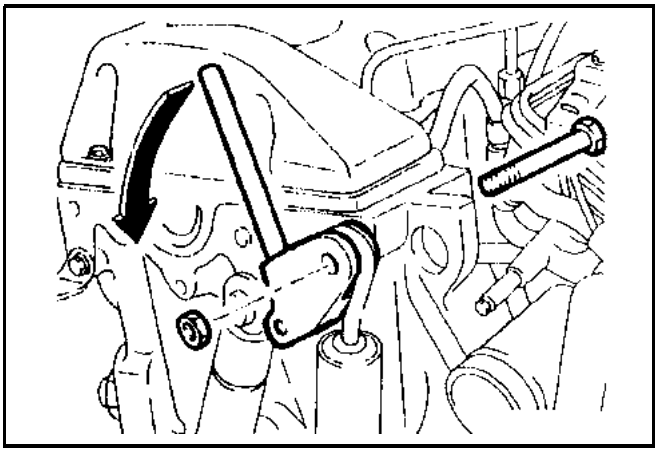
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POLY V-BELT



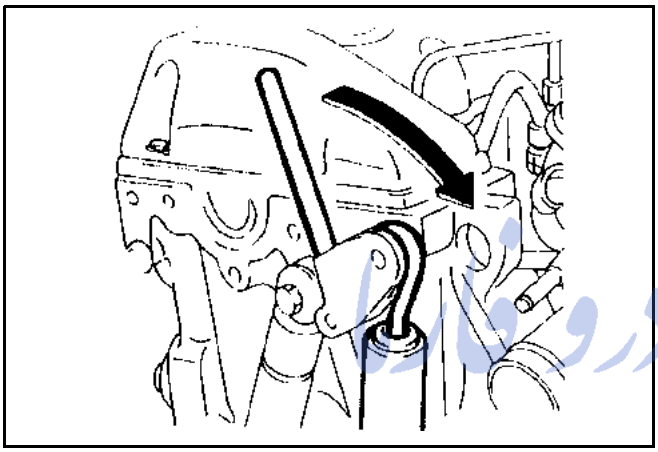
1 Nut . . . . . 23N·m (17 lb-ft)
2 Tensioning Lever
3 Bolt
4 Spring
5 Tensioning Lever
6 Poly V-Belt

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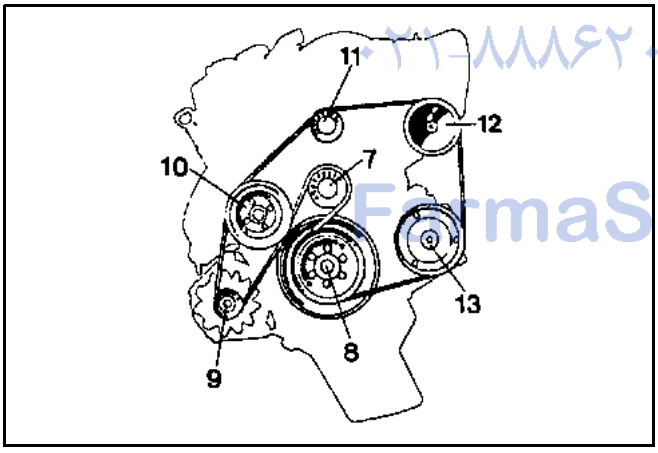


Removal & Installation Procedure

1. Remove the nut.
2. Push the tensioning lever in direction of arrow with a rod (F12' 180mm) and pull out the bolt to the rear.



3. Push back the tensioning lever (arrow direction) to release the spring tension and remove the belt.



4. Install the poly V-belt beginning at the tensioning pulley (7).

7 Tensioning Pulley
8 Crankshaft
9 Generator
10 Water Pump
11 Guide Pulley
12 Power Steering Pump
13 Aircon. Compressor

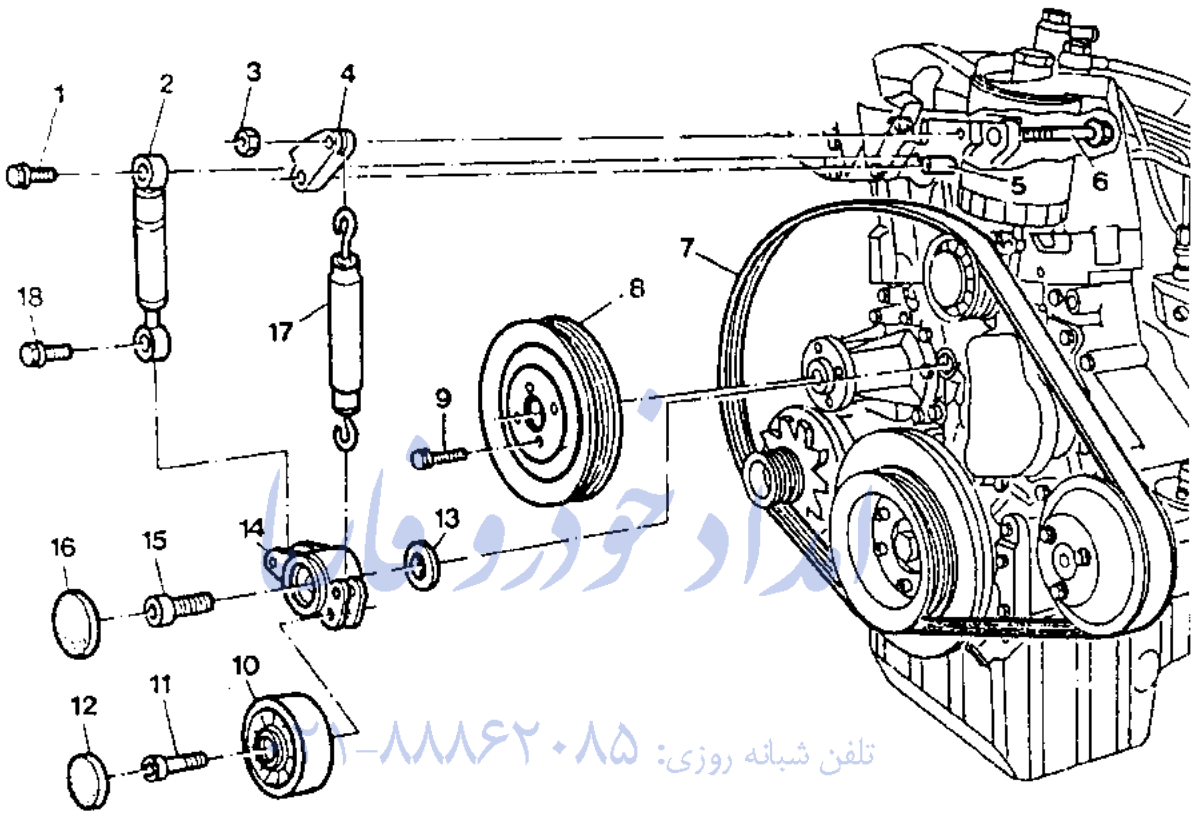
Length of Belt

Length (L)	With Air Conditioner	2,100 mm
Length (L)	Without Air Conditioner	2,040 mm

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تلفن شبانه روزی: ۰۳۱-۸۸۸۶۲۰۸۵
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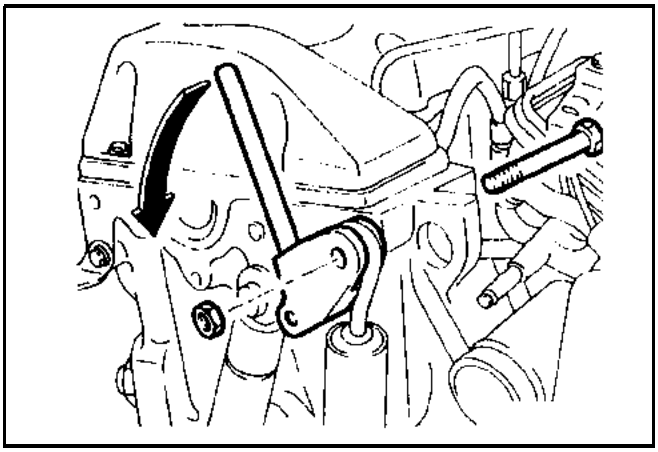
TENSIONING DEVICE

Preceding Work : Removal of cooling fan



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1 Bolt ..... 21N·m (15 lb-ft)
2 Damper
3 Nut ..... 21N·m (15 lb-ft)
4 Tensioning Lever
5 Guide Rail Pin
6 Bolt
7 Poly V-Belt
8 Belt Pulley
9 Bolt ..... 10N·m (89 lb-in)
10 Tensioning Pulley
11 Socket Bolt ..... 29N·m (21 lb-ft)
12 Closing Cover
13 Washer
14 Tensioning Lever
15 Fit Bolt ..... 100N·m (74 lb-ft)
16 Closing Cover
17 Spring
18 Bolt ..... 20N·m (15 lb-ft)



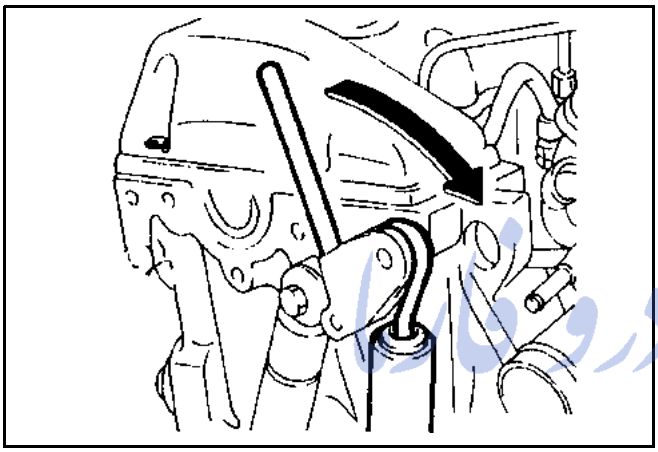
Removal & Installation Procedure

1. Remove the nut.

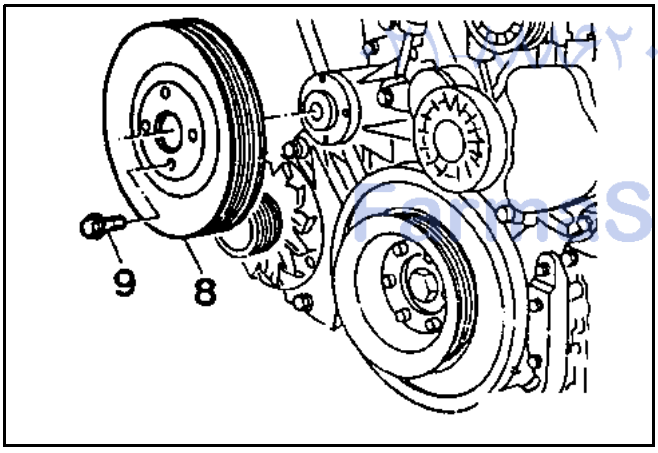
   Installation Notice

Tightening Torque	10 N·m (89 lb-in)

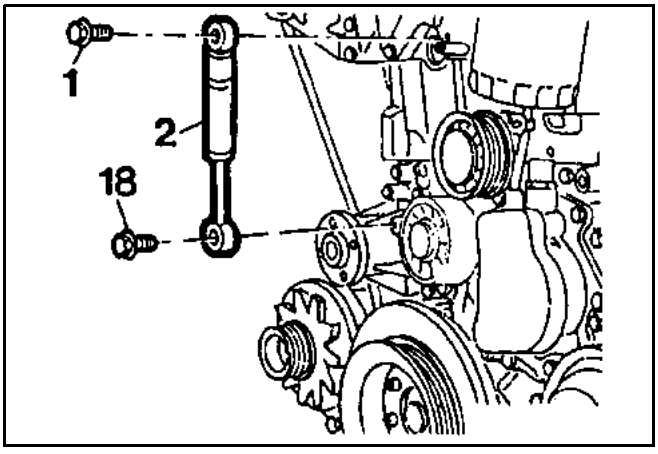
2. Push the tensioning lever in direction of arrow with a rod (F12' 180mm) and push out the bolt to the rear.



3. Push back the tensioning lever to release the spring tension and remove the belt.



4. Remove the bolt (9) and then remove the belt pulley (8).

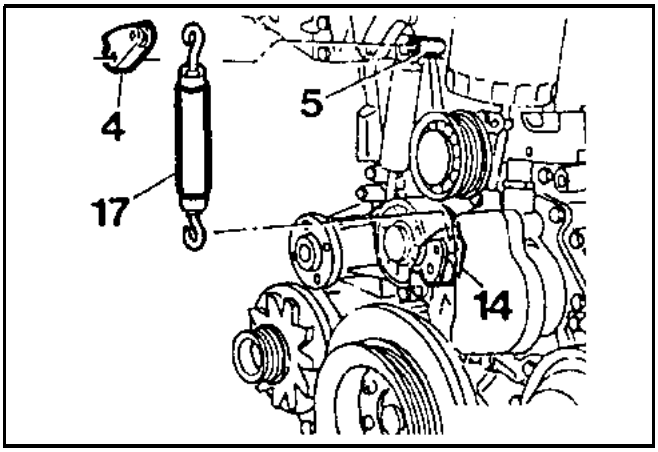


5. Remove the bolt (1, 18) and take off the damper (2).

   Notice

   Pay attention to installation position of the damper.

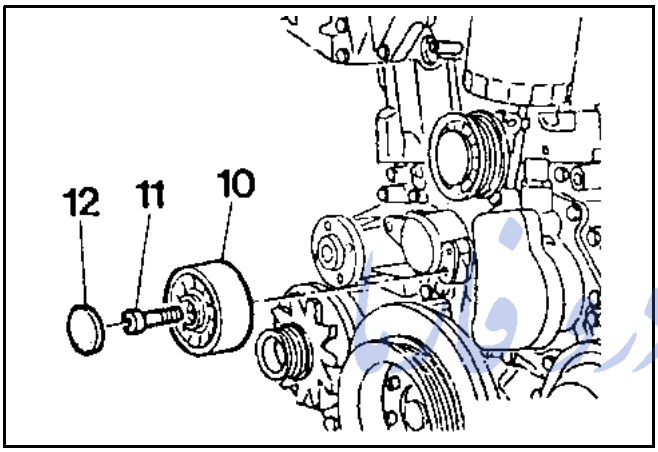
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6. Pull off the tensioning lever (4) from guide rail pin.
7. Remove the spring (17).

Installation Notice

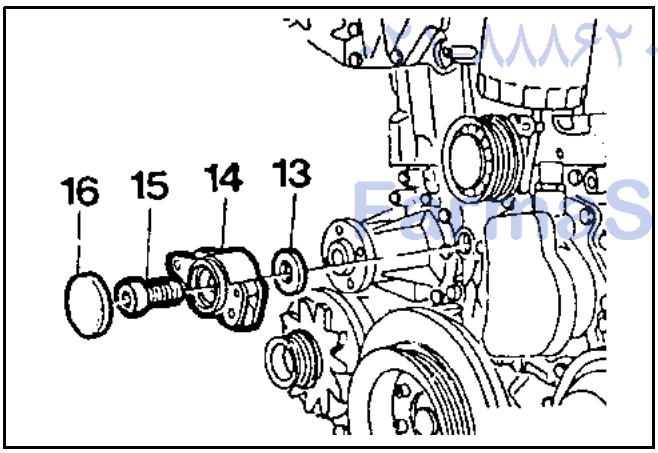
Insert spring (17) with color coding (blue/violet) facing up.



8. Pry off the closing cover (12) and remove the socket bolt (11) and then remove the tensioning pulley (10).

Installation Notice

Tightening Torque	29 N·m (21 lb-ft)



9. Pry off the closing cover (16) and remove the fit bolt (15).
10. Remove the tensioning lever (14) and washer (13).
11. Clean thread in the timing case cover and fit bolt.

Installation Notice

Apply Loctite on thread of fit bolt.

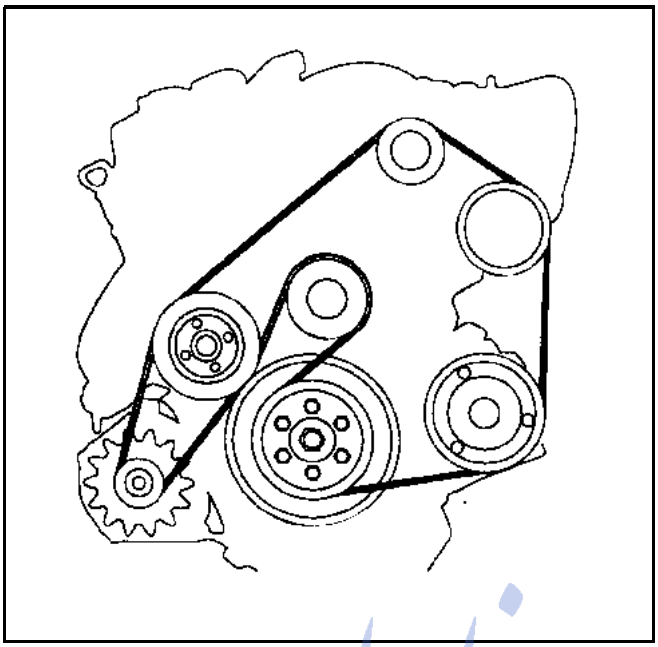
Tightening Torque	100 N·m (74 lb-ft)

12. Installation should follow the removal procedure in the reverse order.

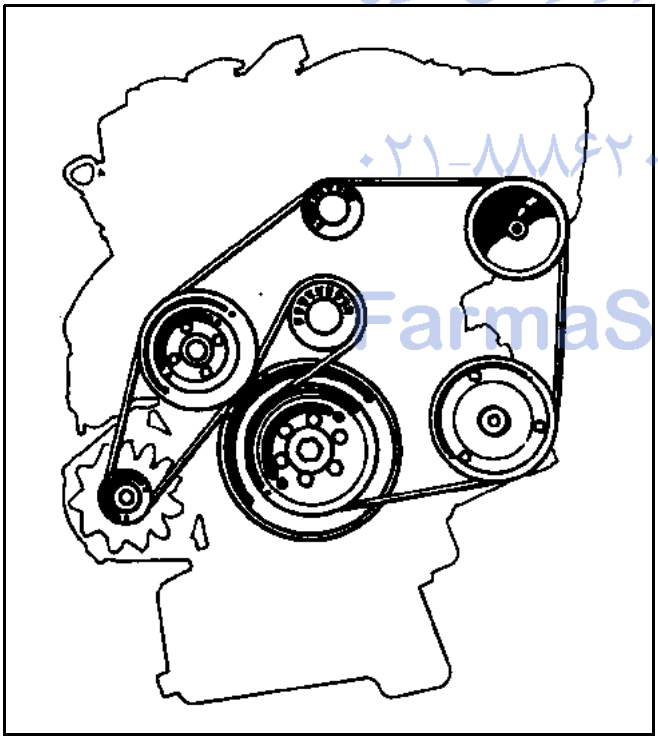
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POLY V-BELT ALIGNMENT & INSPECTION

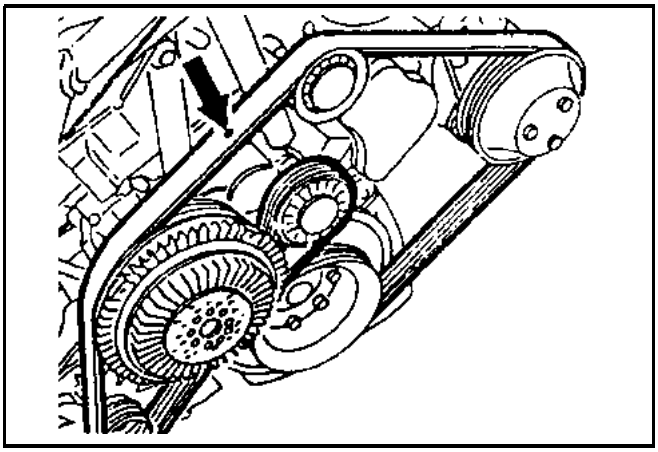
Without Air Conditioner



With Air Conditioner



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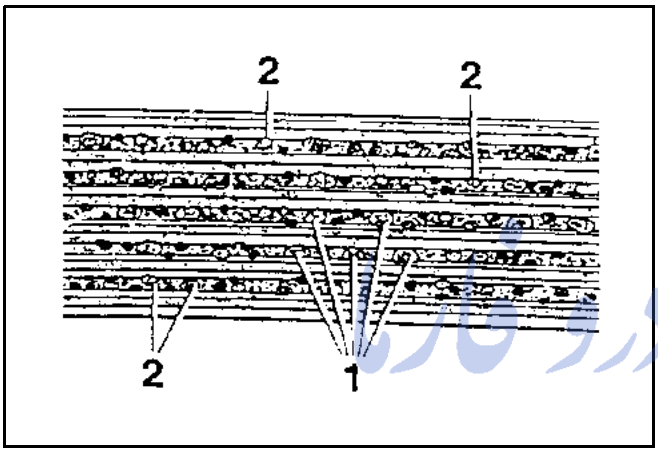


Inspection Procedure

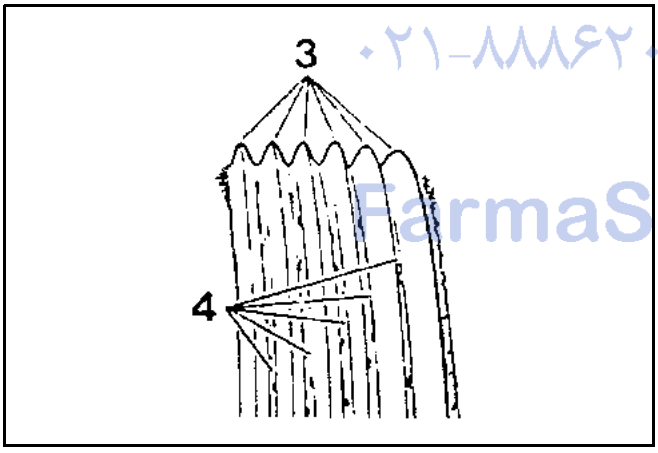
- Mark poly V-belt at a clearly visible point with chalk.
- Rotate the engine and check the belt.

Notice

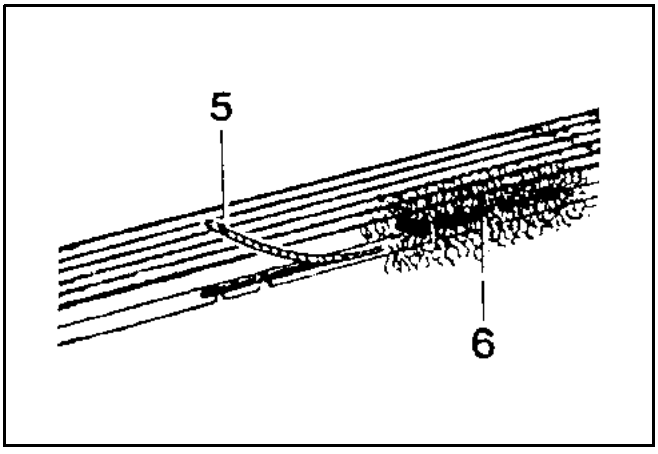
If one of the following types of damage is found, replace the belt.



1. Rubber lumps in the base of rips.
2. Dirt or grit ingrained.

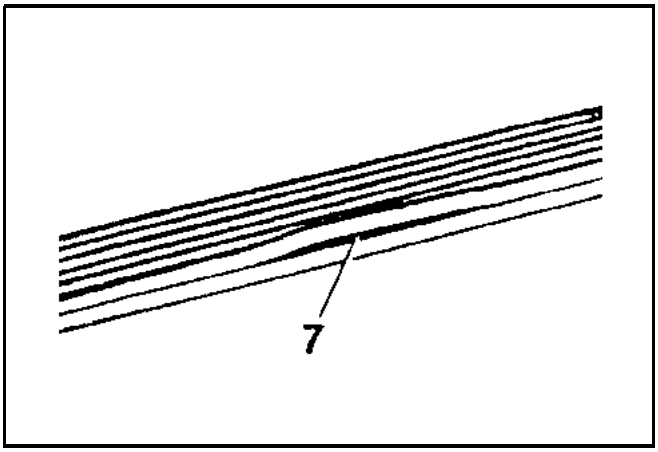


3. Pointed rips.
4. Belt cord visible in the base of rips.

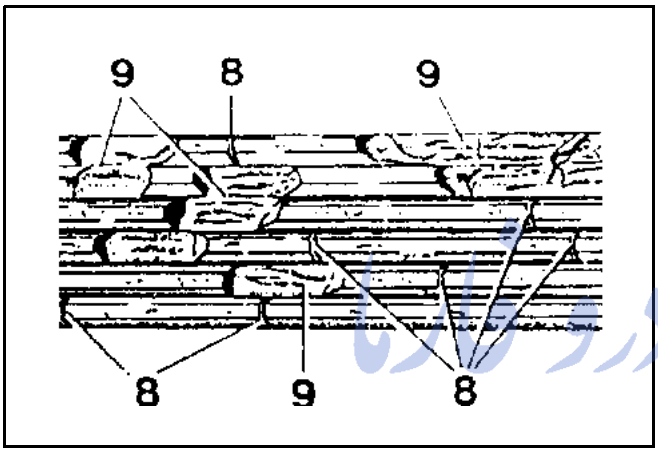


5. Cord torn out at the side.
6. Outer cords frayed.

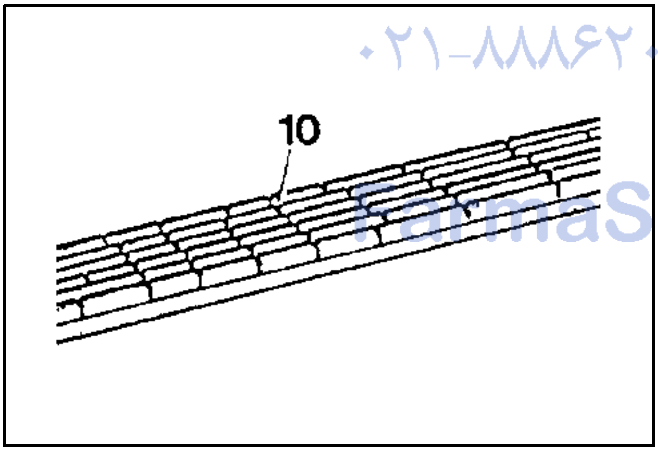
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۰۲۱-۸۸۸۶۲۰۸۵
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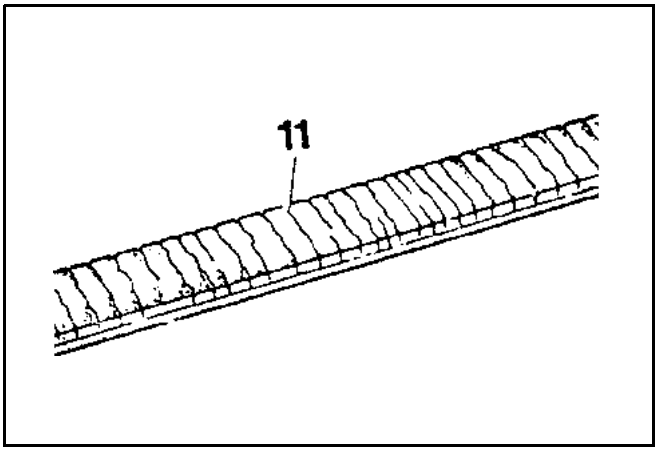
7. Belt detached from the base of rip.



8. Splits across the rips.
9. Sections of rip torn out.



10. Splits across several rips.

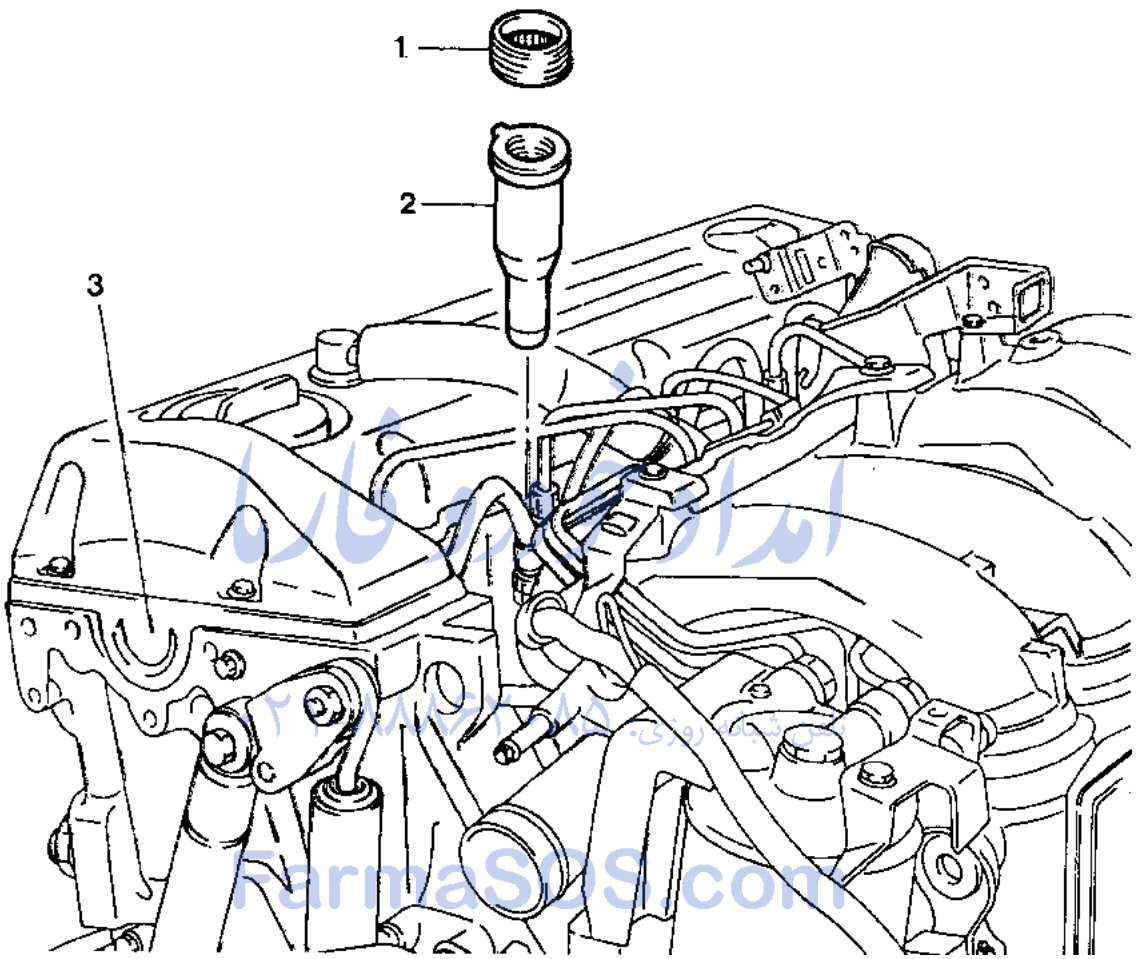


11. Splits across the back.

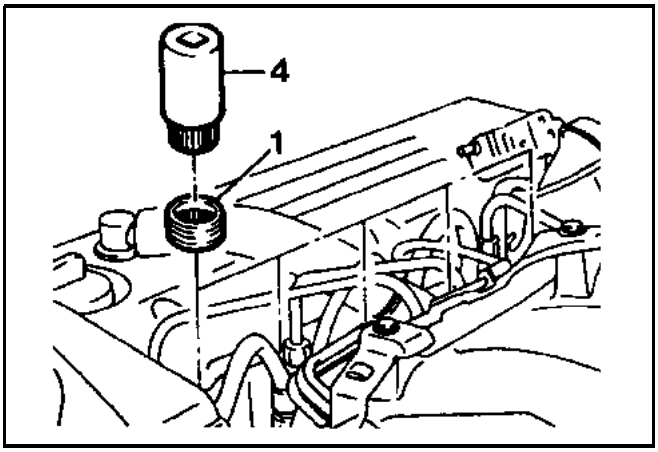
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PRECHAMBER

Preceding Work : Removal of glow plug
Removal of fuel injection nozzle



1 Threaded Ring . . . . . 130 N·m (96 lb-ft)
2 Prechamber
3 Cylinder Head



Tools Required

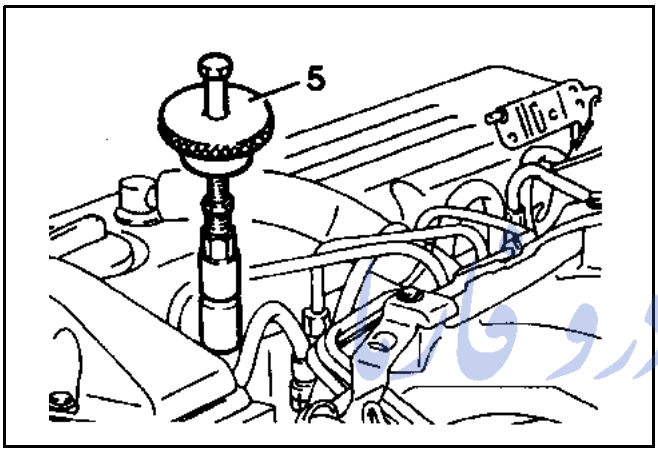
603 589 00 09 00 Serration Wrench

667 589 03 63 00 Sliding Hammer

Removal & Installation Procedure

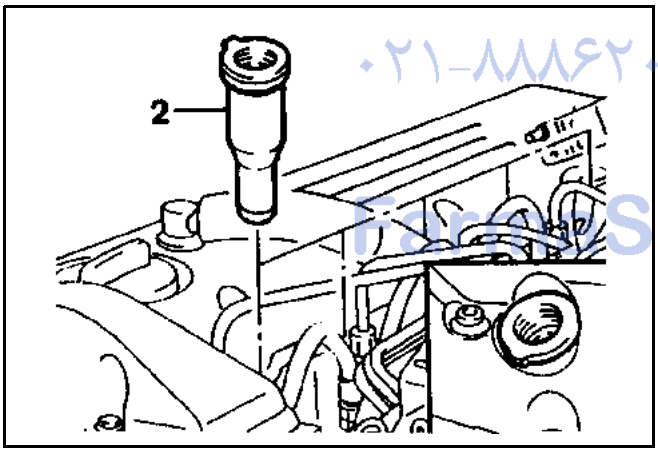
1. Using the serration wrench (4), remove the threaded ring (1).

Serration Wrench 603 589 00 09 00



2. Install the sliding hammer into the prechamber.

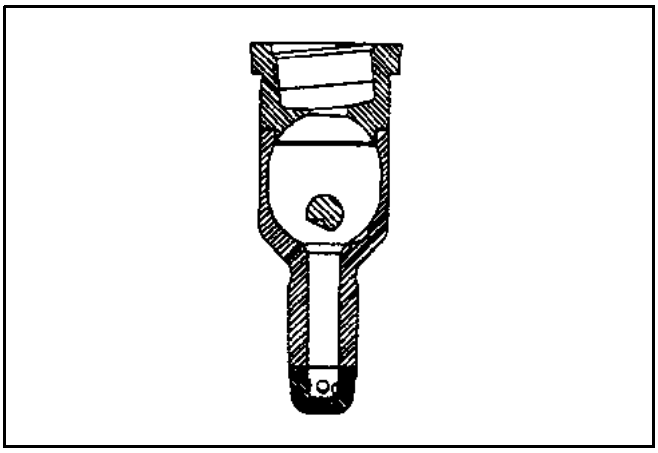
Sliding Hammer 667 589 03 63 00



3. Remove the perchamber (2).

Notice

After removing the prechamber, cover over the bores with clean rag.

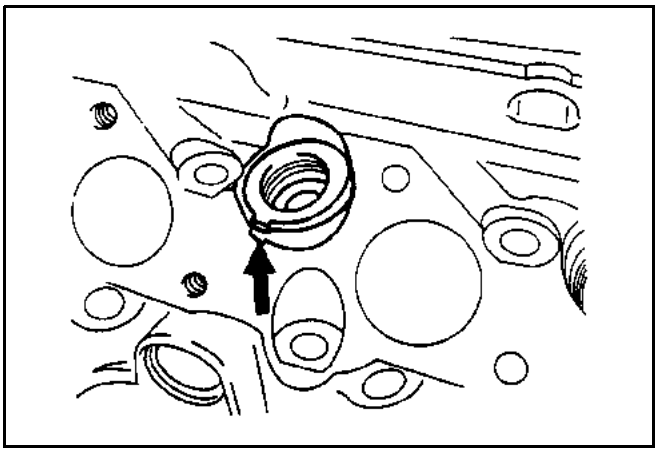


4. Inspect the prechamber.

Notice

If the prechamber seats in the cylinder head are leaking or if the prechambers are replaced, the sealing surfaces in the cylinder head must be remachined.

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Assembly Procedure

Notice

In case the prechambers are reused, inspect the prechambers thoroughly, if the ball pin by heat and fire is broken, it can not be used.

1. Clean the sealing surface of the prechamber.
2. Insert the prechamber into the cylinder head at the same time aligning the cam on the collar of the pre-chambers with the slots in the cylinder head.

Notice

If the spacer rings are fitted to the prechambers, the spacer rings should be replaced with rings of the same thickness.

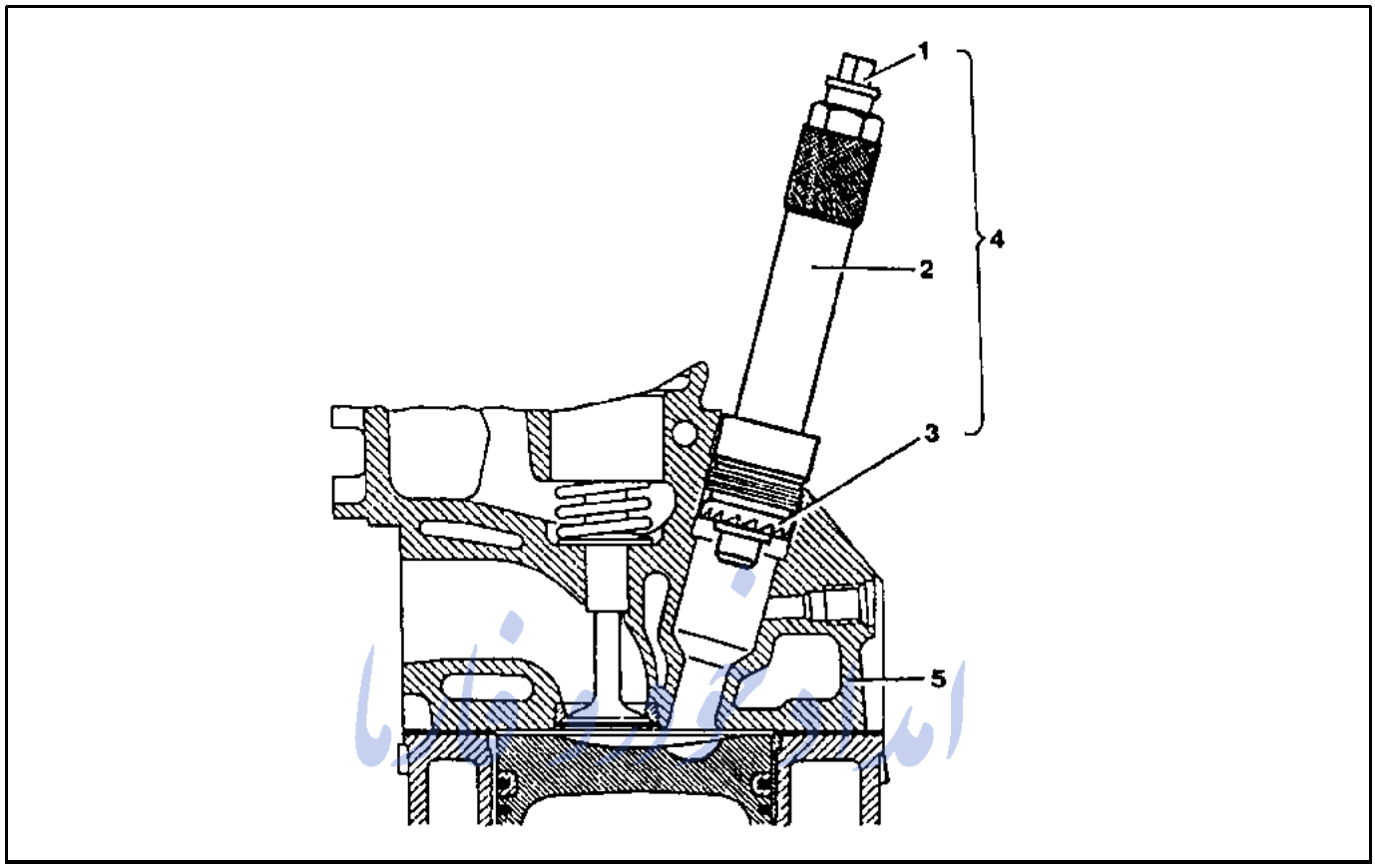
Thickness of Spacer Ring	0.3, 0.6, 1.0 mm

3. Coat the threaded ring with oil and assemble the ring by using the serration wrench.

Tightening Torque	130 N·m (96 lb-ft)

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MILLING OF PRECHAMBER SEALING SURFACE



۰۲۱-۸۸۸۶۲۰۸۵

1 Drift
2 Sleeve
3 Milling Cutter
4 Counter Sink (Special Tool - 601 589 00 66)
5 Cylinder Head

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Tools Required

601 589 00 66 00 Counter Sink

667 589 00 23 00 Height Gauge

Milling of the Prechamber Sealing Surface

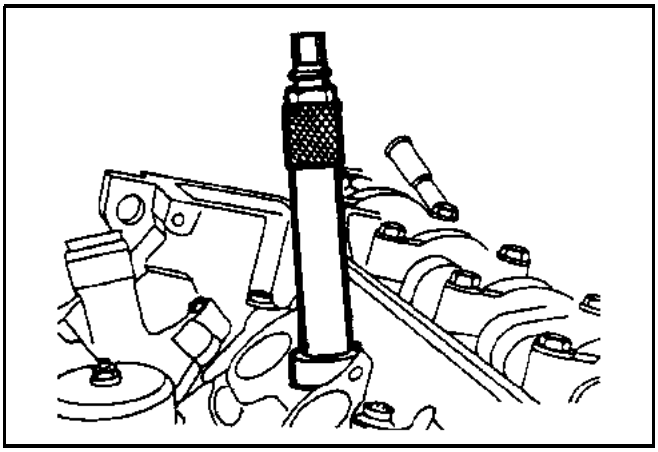
Notice

The prechamber sealing surface may only be remachined once with the cylinder head fitted. It is essential to adhere to the specified projection 'C' of the prechamber of 7.6 - 8.1mm.

This ensures that the required clearance exists between prechamber and piston crown with the piston in TDC. For this reason, spacer rings should be inserted on remachined sealing surfaces.

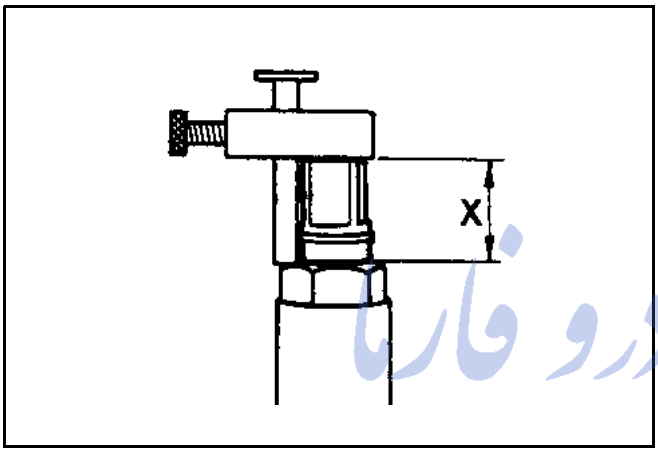
Thickness of spacers	0.3, 0.6, 1.0 mm

If a spacer ring is already fitted, or a marking is made on the cylinder head, the cylinder head must be removed and size 'C' measured if further remachining is necessary on a prechamber sealing surface.



1. Remove the injection nozzle.
2. Remove the prechamber.
3. Cover the prechamber bore to avoid any chips dropping into the combustion chamber.
4. Remove the protective sleeve from the countersink and rotate the countersink into the prechamber bore to be machined as far as the stop.

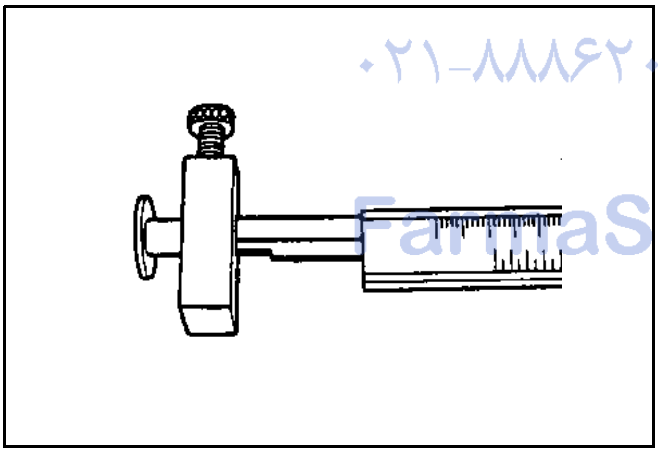
Counter Sink 601 589 00 66 00



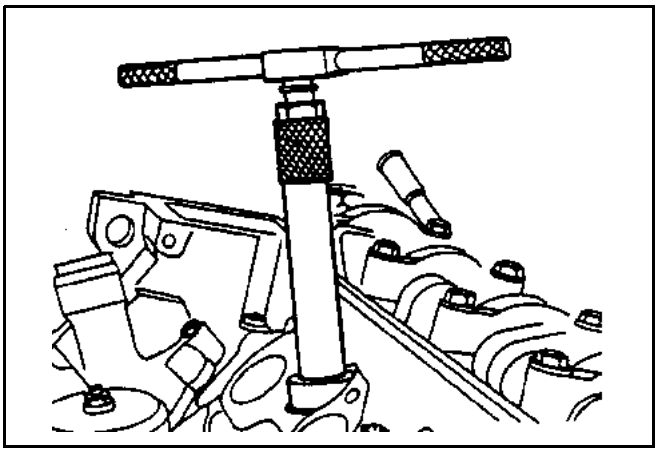
5. Maintain size 'X' from the top edge of mandrel to the top edge of the sleeve with the gauge.

Height Gauge 667 589 00 23 00

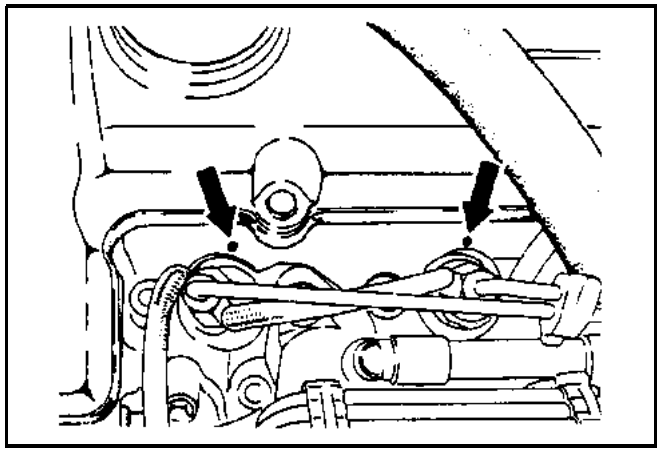
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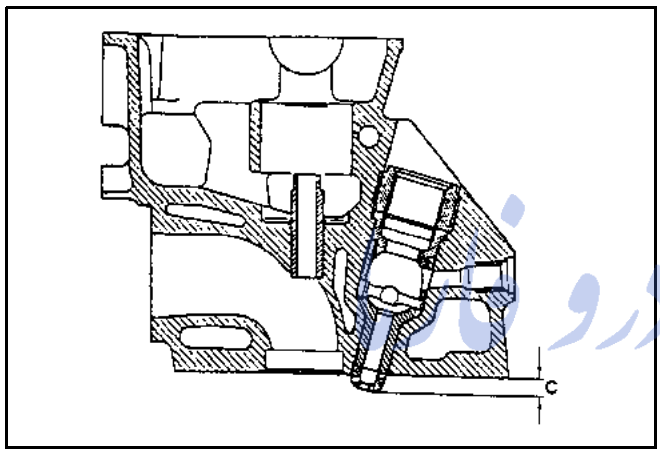


6. Measure the 'X' by using a vernier caliper.



7. Mount the turning tool onto the countersink tool and rotate to the right approx. 5 revolutions by applying slight pressure.





8. Remeasure size 'X' and compare it with the first measurement and determine the thickness of spacer ring.

   Ex

Size before machining	25.7 mm
Size after machining	25.5 mm

   The spacer ring should be selected so that it is at least 0.1mm and not more than 0.3mm thicker than the measured on the sealing surface. In this example, the necessary thickness of spacer ring should be within 0.3 ~ 0.5mm and the thickness of spacer ring to be installed is 0.3mm.

9. Remove the countersink tool and clean the chips.

Notice

If the sealing surface is not completely flat, remachine the sealing surface.

10. Remove rag from the prechamber bore and crank the engine with starter motor to threw out any chips which may have got into the combustion chamber.
11. Insert the proper spacer ring into the prechamber sealing surface.
12. Punch a mark on the cylinder head above the prechamber sealing surface which has been machined.
13. Install the prechambers.

Notice

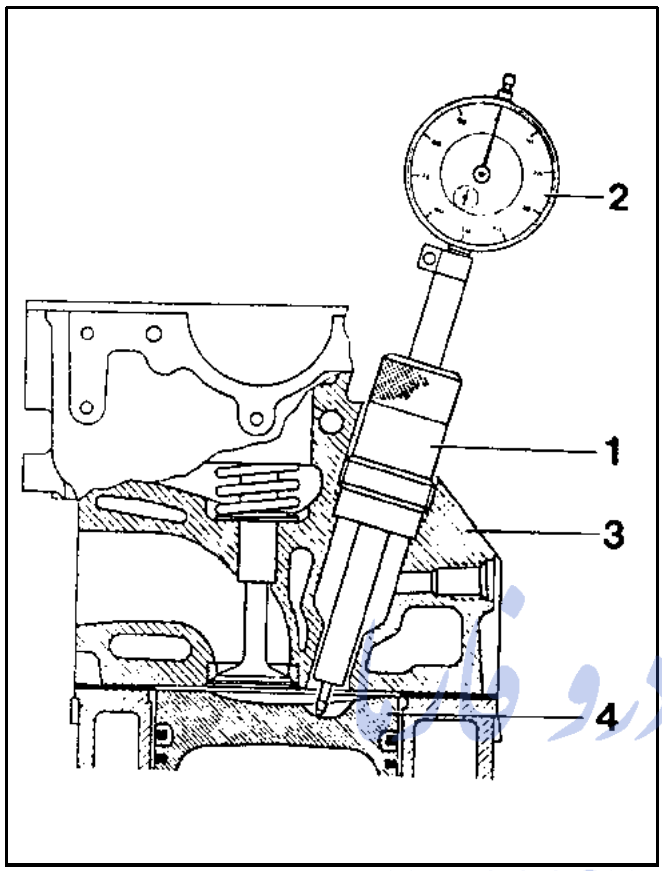
If the cylinder head is removed, the projection 'C' is measured in place of size 'X' and the appropriate size of spacer ring selected.

Normal Projection (c)	7.6 - 8.1mm

۰۲۱-۸۸۸۶۲۰۸۵
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TDC (TDC SENSOR BRACKET) SETTING

Preceding Work : Removal of No.1 cylinder prechamber



1 Measuring Device
2 Dial Gauge
3 Cylinder Head
4 Piston ..... Set at TDC

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Tools Service

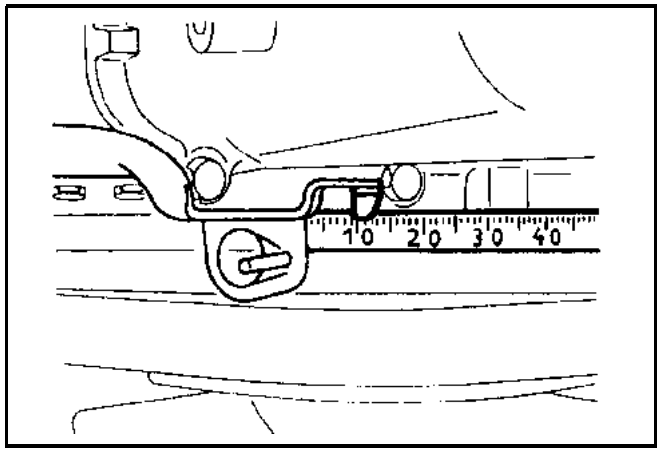
001 589 32 21 00 Dial Gauge
601 589 07 21 00 Depth Gauge
667 589 01 21 00 Fixing Device

Notice

- The TDC sensor bracket must be adjusted in case of followings.
- When replacing the TDC sensor bracket.
- When replacing the crankshaft, the hub or the vibration damper.
- IWhen replacing or installing the timing case cover.
- After engine overhauling.

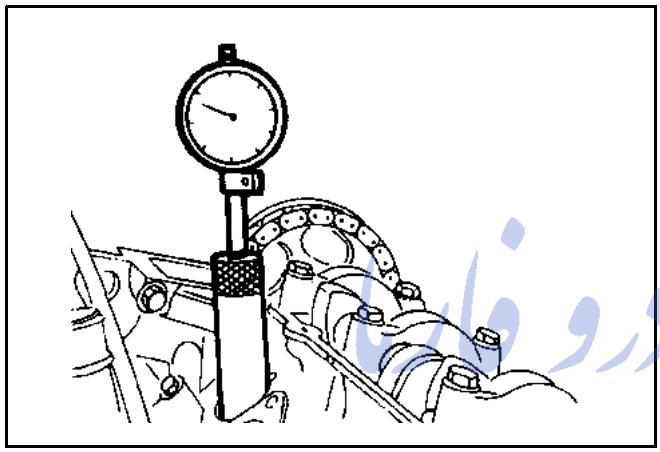
* If the cylinder head is removed, the measuring pin of the dial gauge can be positioned on the piston crown.

This is done by placing the magnetic dial holder on the mating surface of the crankcase.



Setting (with cylinder head installed)

1. Remove the prechamber of No. 1 cylinder.
2. Position the piston of No.1 cylinder at BTDC 10.



3. Install the measuring device into the prechamber bore and position the dial gauge with a preload of 5mm.

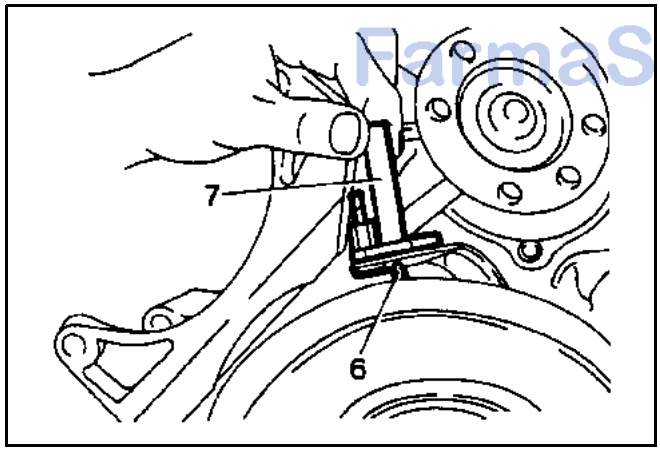
Dial Gauge 001 589 53 21 00
Depth Gauge 601 589 07 21 00

4. Slowly rotate the crankshaft in the direction of engine rotation until the large pointer on the dial gauge stops (TDC position).

Notice

The position of TDC is when the large pointer on the dial gauge is stopped before moving back.

5. Remove the reinstall the measuring device and position the dial gauge scale at '0'.
6. Slowly rotate the crankshaft in the direction of engine rotation until the dial gauge has moved back (counterclockwise) by 3.65mm.



7. Insert fixing device into the sensor bracket.

Notice

The pin on the vibration damper must engage into the slot of the fixing device.

Fixing Device 667 589 01 21 00

8. If the pin does not engage, adjust the setting of the sensor bracket by removing and tightening of the sensor bracket bolts.

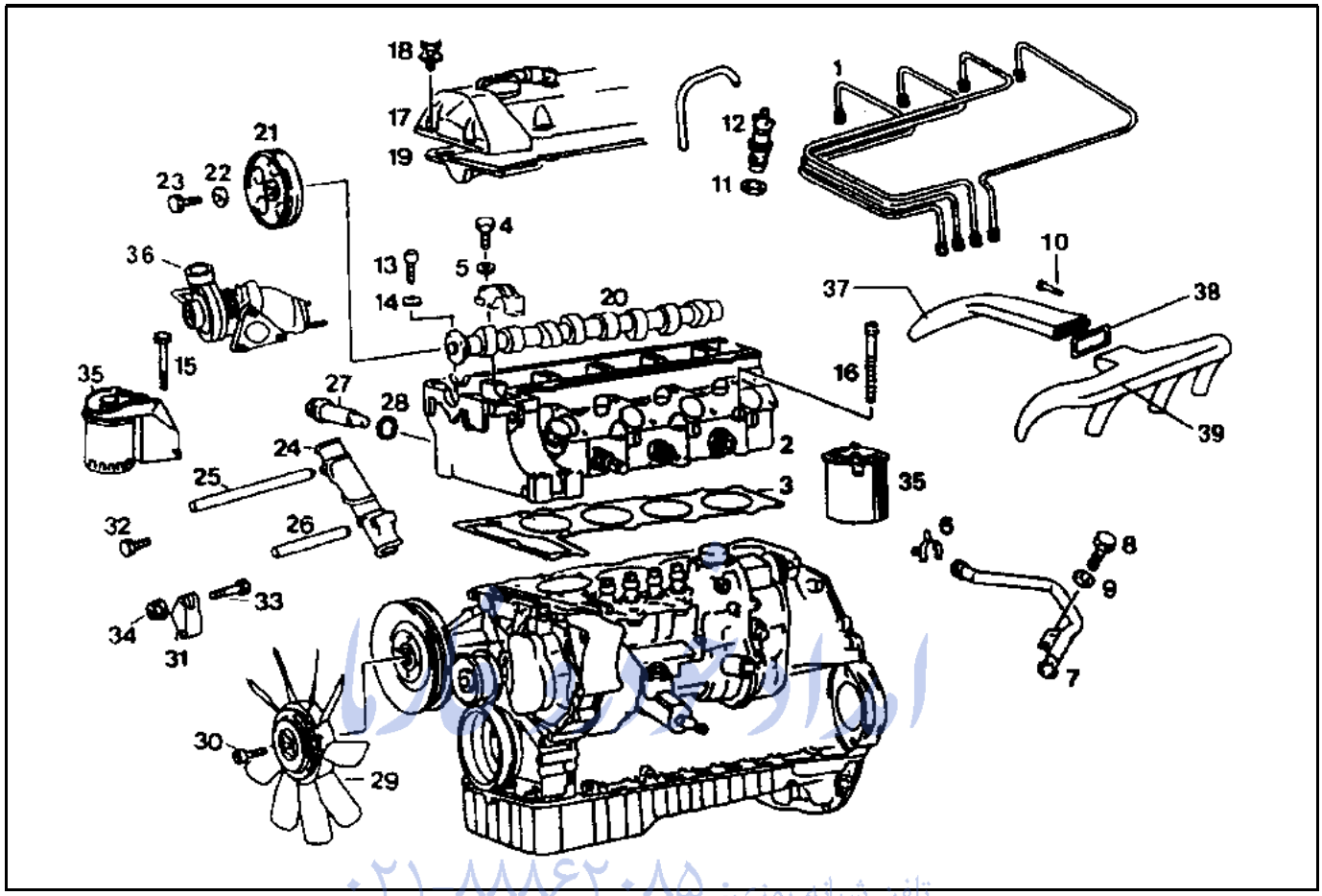
Tightening Torque	10 N·m (89 lb-in)

Notice

The timing mark on the damper must be positioned at ATDC 20.

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CYLINDER HEAD



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1 Fuel Injection Pipe . . . . . 18N·m (13 lb-ft)
2 Cylinder Head
3 Gasket . . . . . Replace
4 Bolt . . . . . 25N·m (18 lb-ft)
5 Washer
6 Clamp
7 Heater Feed Pipe
8 Bolt
9 Washer
10 Bolt
11 Nozzle Washer . . . . . Replace
12 Fuel Injection Nozzle 35-40 N·m(26-30 lb-ft)
13 Hexagon Socket Bolt . . . . . 25 N·m (18 lb-ft)
14 Washer
15 Bolt . . . . . 25 N·m (18 lb-ft)
16 Cylinder Head Bolt . . . . . See Table
17 Cylinder Head Cover
18 Bolt . . . . . 10 N·m (89 lb-in)
19 Gasket
20 Camshaft
21 Camshaft Drive Sprocket . . . . . Replace
22 Washer
23 Bolt(12-Sided) . . . . . 25N·m (18 lb-ft) + 90°
24 Sliding Rail
25 Sliding Rail Pin
26 Sliding Rail Pin
27 Chain Tensioner . . . . . 80 N·m (59 lb-ft)
28 Gasket . . . . . Replace
29 Cooling Fan . . . . . Check
30 Hexagon Socket Bolt . . . . . 45 N·m (33 lb-ft)
31 Tensioning Lever
32 Bolt . . . . . 25 N·m (18 lb-ft)
33 Bolt
34 Nut . . . . . 23 N·m (17 lb-ft)
35 Fuel Filter
36 Turbo Charger
37 Intake Duct
38 Gasket . . . . . Replace
39 Intake Manifold

Tightening Torque

Cylinder Bolts (12-sided socket head) (Engine cold)	stage 1	10 N·m (89 lb-in)
	stage 2	35 N·m (26 lb-ft)
	stage 3	180°
M8 Cylinder Head Bolts		25 N·m (18 lb-ft)

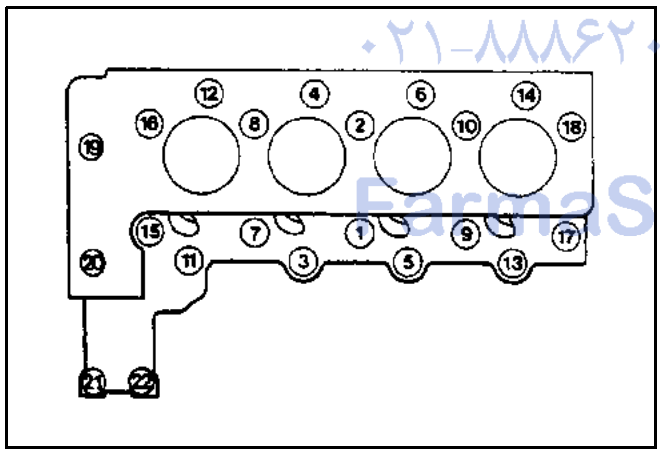
Tools Required

000 589 77 03 00 Box Wrench Insert
001 589 65 09 00 Socket Wrench Insert
102 589 03 40 00 Magnetic Bar
116 589 02 34 00 Threaded Pin
116 589 03 07 00 T Type Socket Wrench
116 589 20 33 00 Sliding Hammer
601 589 00 10 00 Cylinder Head Bolt Wrench
602 589 00 40 00 Engine Lock
603 589 00 40 00 Counter Holder

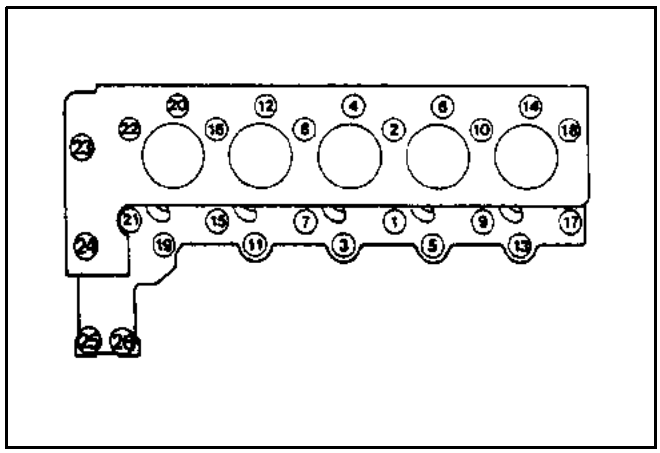
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۰۲۱-۸۸۸۶۲۰۸۵ تلفن شبانه روزی
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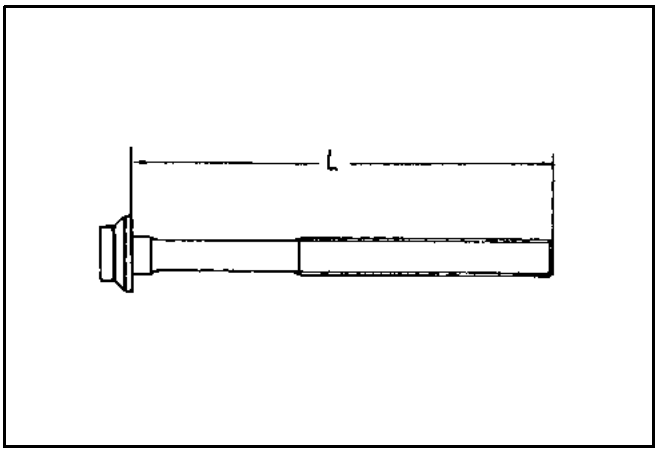
Tightening Sequence for Cylinder Head Bolts

OM 662LA Engine



OM 661LA Engine





Notice

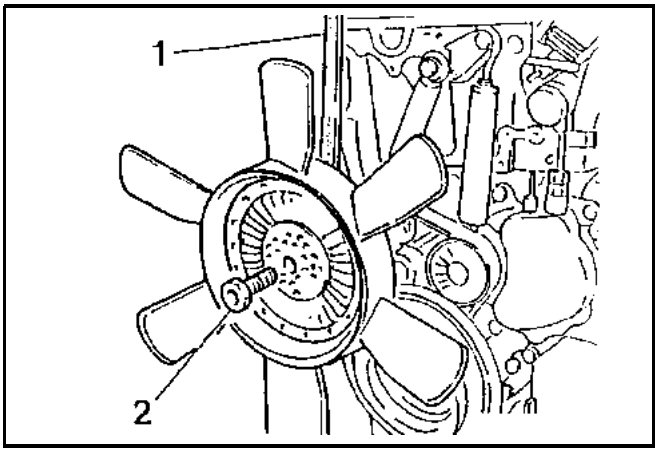
The cylinder head may only be removed when the engine has cooled down. The cylinder head is removed together with the exhaust manifold. As the cylinder head bolts undergo a permanent tightening. They require to be replaced if they exceed the maximum lengthes indicated in the table.

Thread Dia	Length(L) When New	Max. Length(L)
M10	80mm	82mm
M10	120mm	104mm
M10	115mm	117mm

The twelve-sided socket head bolts are tightened with each stages of torque and torque angle.

It is not necessary to retighten the cylinder head bolts at the 1000~1500km inspection or after 1000~1500km of repairs.

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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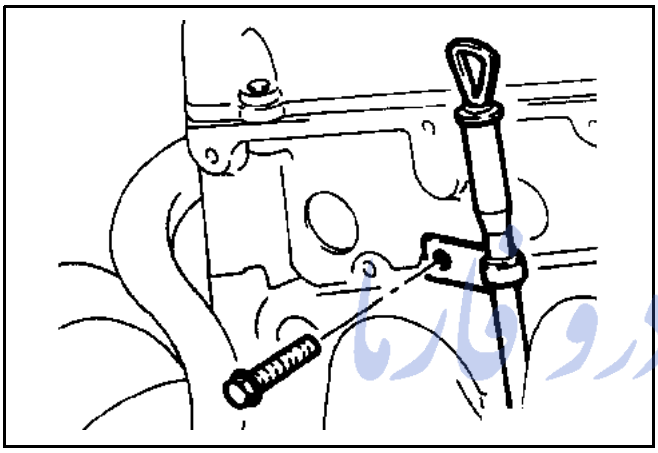
Disassembly Procedure

1. Completely drain the coolant from the radiator and cylinder block.
2. Remove the cooling fan shroud.
3. Hold the fan with counter holder and remove the bolt and then remove the cooling fan.

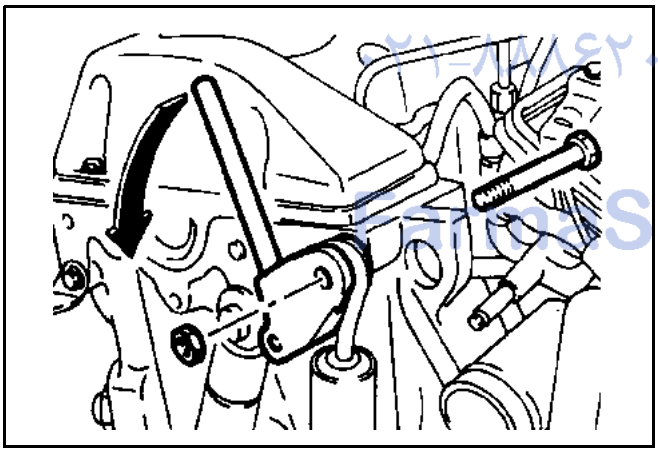
   Notice

   Keep the fan in vertical position.

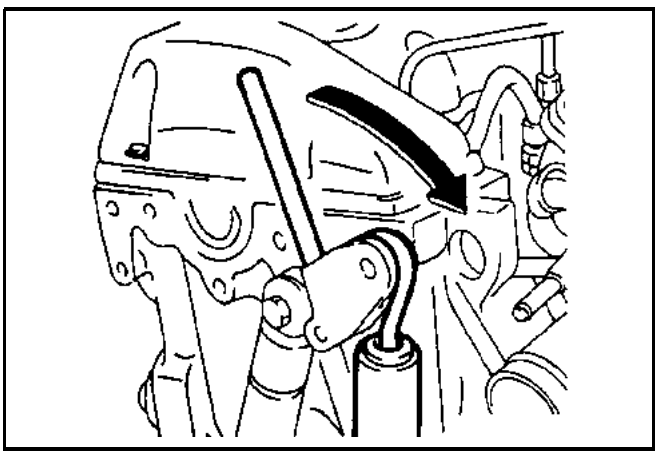
Counter Holder 603 589 00 40 00



4. Remove the bracket oil dipstick tube.

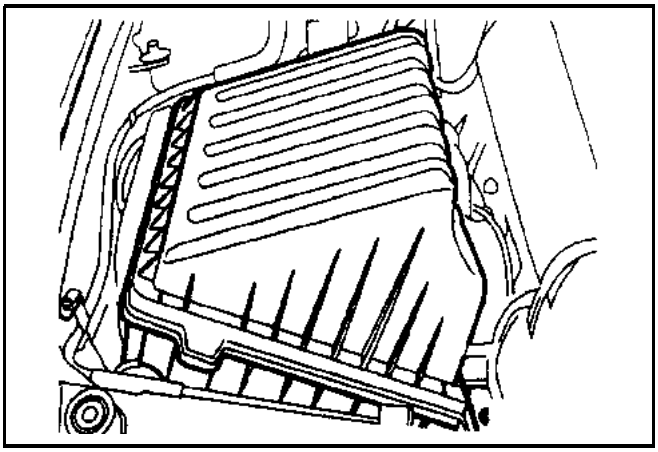


5. Remove the nut.
6. Remove the nut on the tensioning lever and insert the rod(F12' 180mm). By pushing the rod to the arrow direction, pull back the bolt.



7. Push the tensioning lever to the opposite direction to release the spring tension and remove the poly V-belt.

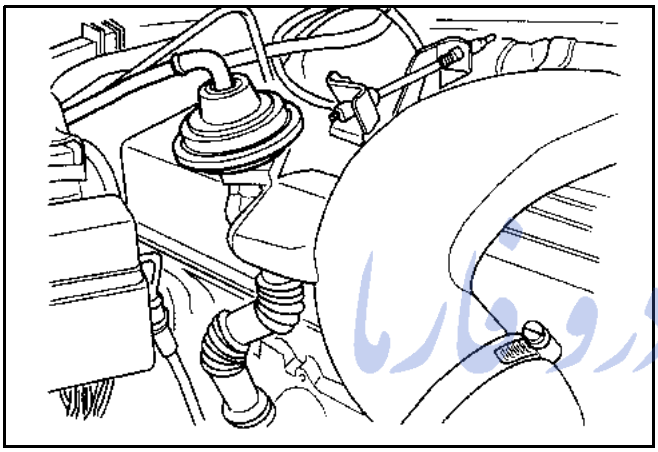
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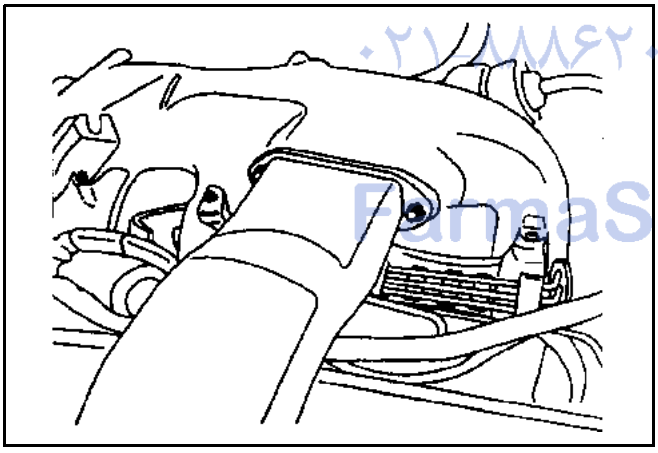
8. Remove the air cleaner cover and element and then remove the air cleaner housing.
9. Remove the oil return hose and plug.

Notice

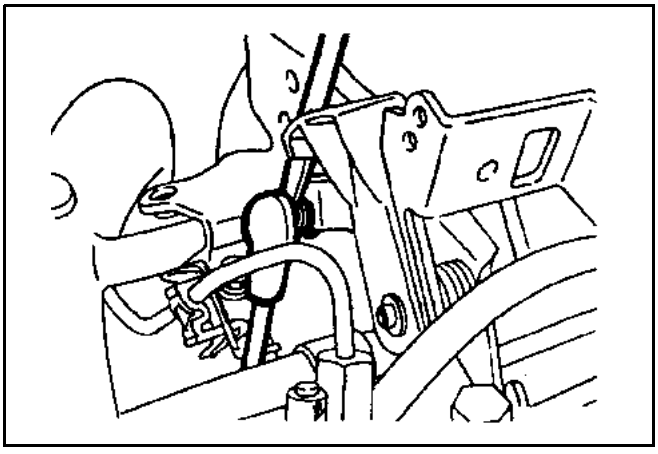
Cover them to prevent chips from coming into.



10. Unscrew the EGR pipe mounting bolts onto the exhaust manifold.
11. Remove the duct bracket from the cylinder head.

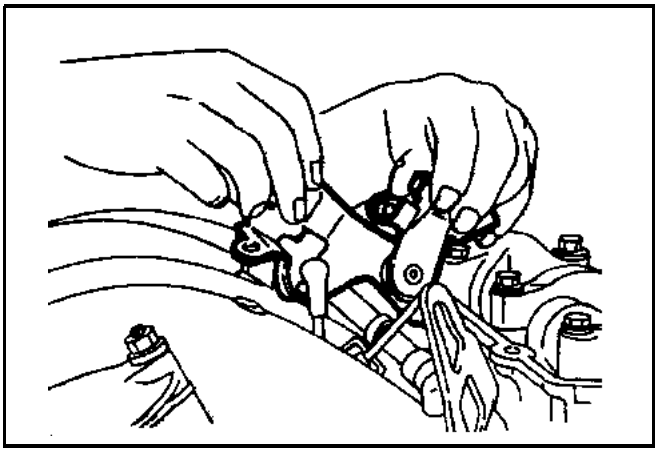


12. Unscrew the intake duct mounting bolts onto the intake manifold.

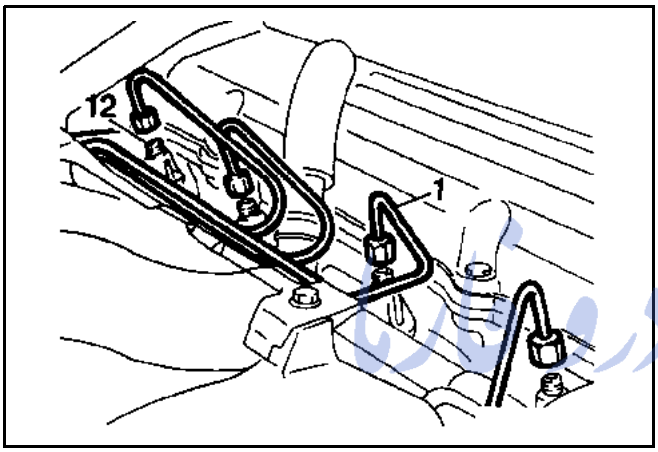


13. Separate the connecting rod from the control lever.

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تلفن شبانه روزی: ۰۲۷۳۸۸۴۲۰۸۵
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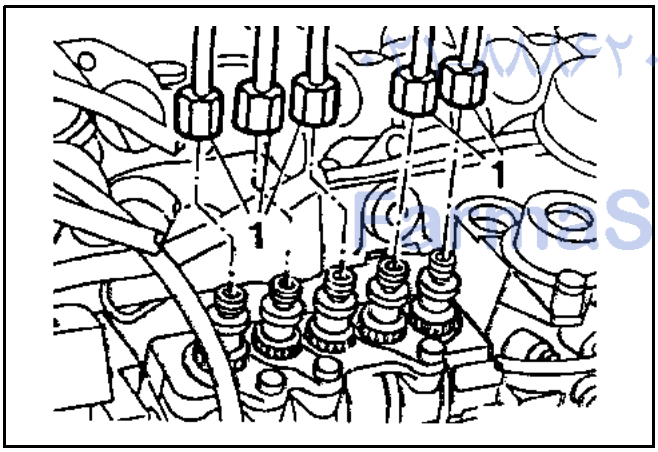


14. Pull out the accelerator control linkage.



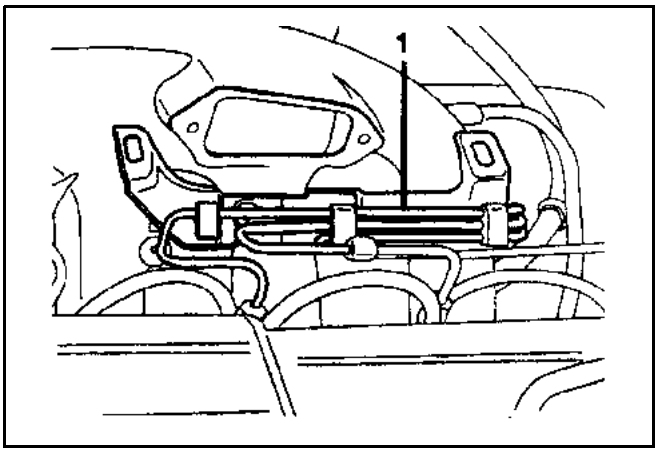
15. Remove the fuel injection line(1) from the fuel injection nozzle(12).

Box Wrench Inset 000 589 77 03 00



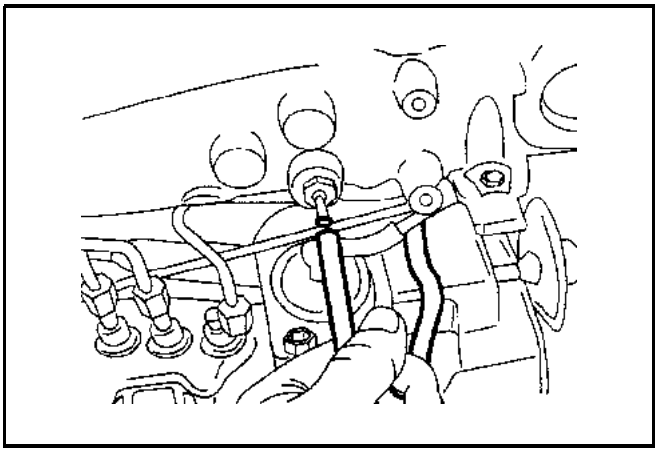
16. Remove the fuel injection line from the fuel injection pump.

Box Wrench Insert 000 589 77 03 00

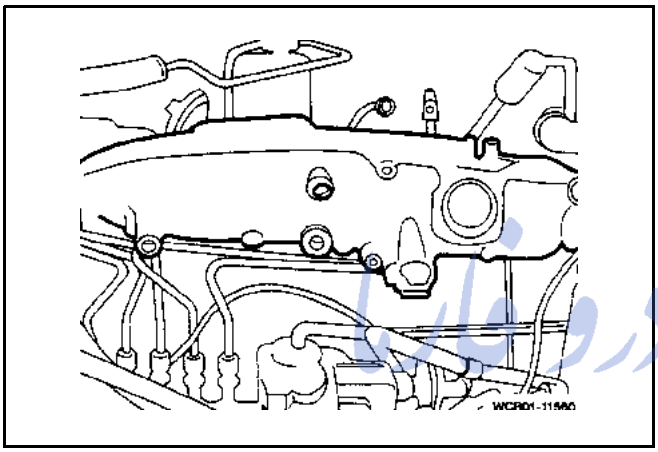


17. Remove the bracket mounting bolts and then remove the fuel injection line(1).

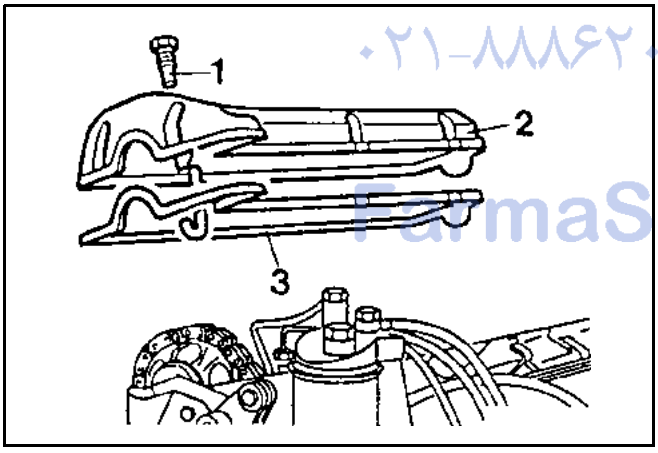
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تلفن شبانه روزی: ۰۹۱۲۰۲۰۲۸۵
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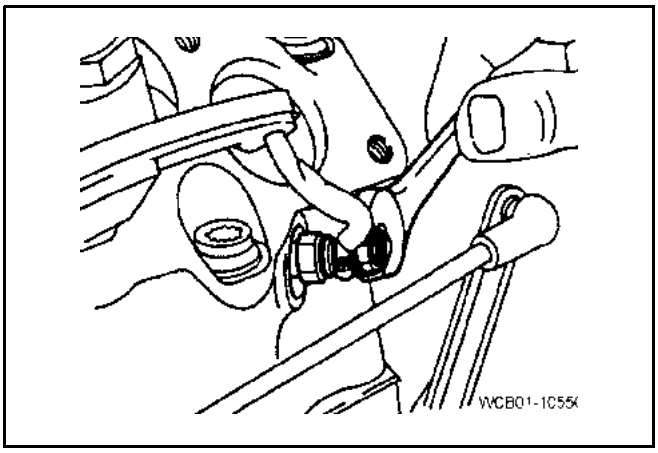
18. Disconnect the booster hose connected to intake manifold.



19. Remove the intake manifold and gasket.

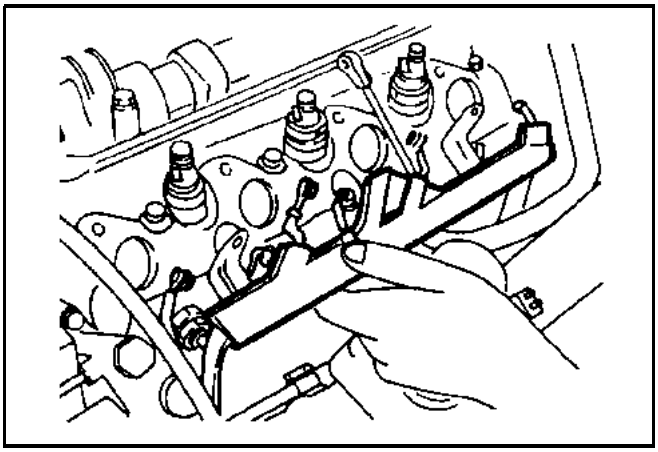


20. Remove the cylinder head cover and gasket with the blow-by gas hose.

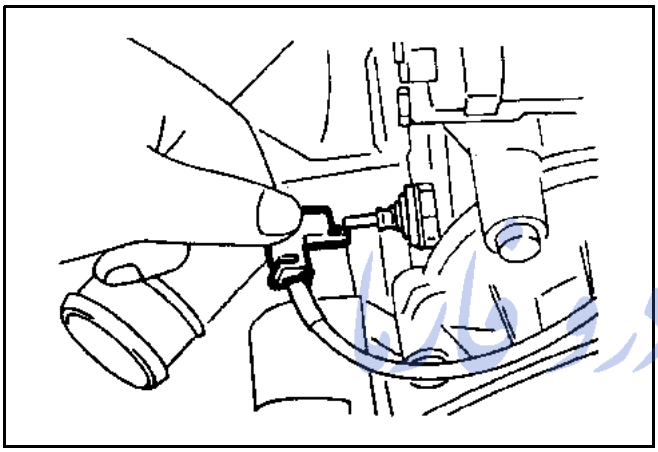


21. Disconnect the glow plug cables.

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۰۲۱-۸۸۸۶۲۰۸۵ طفل شبانه روزی
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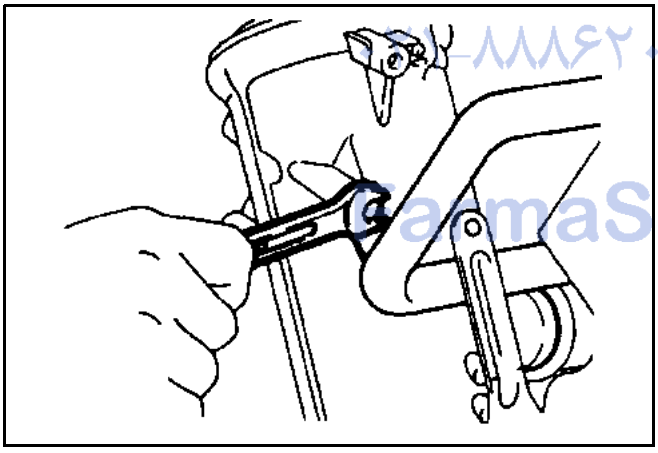


22. Remove the cable channel.

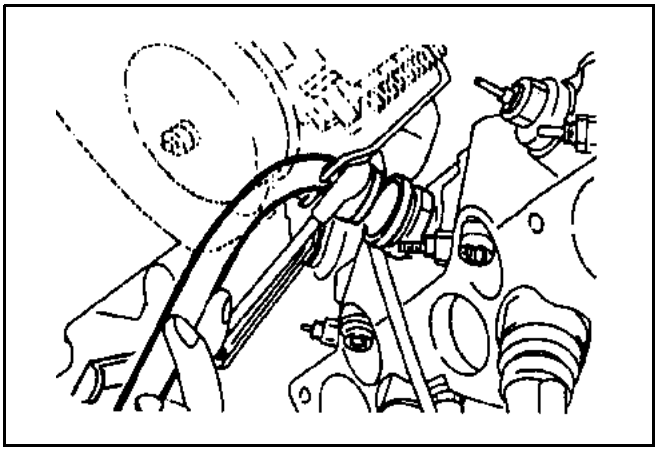


23 .Disconnect the cables from the glow plug sensor and coolant temperature sensor.

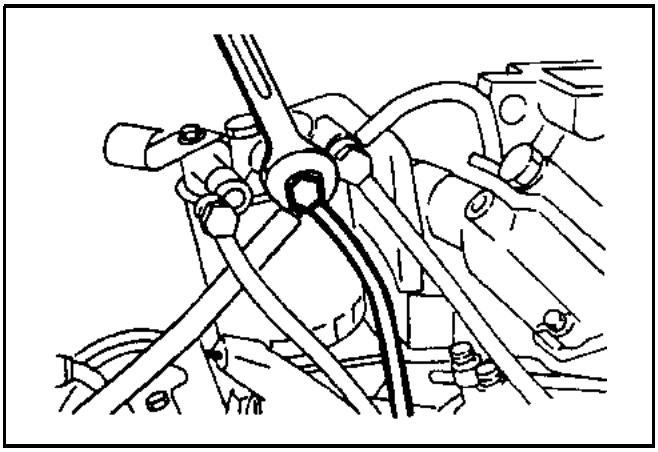
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تلفن شبانه روزی: ۸۸۸۶۲۰۸۵
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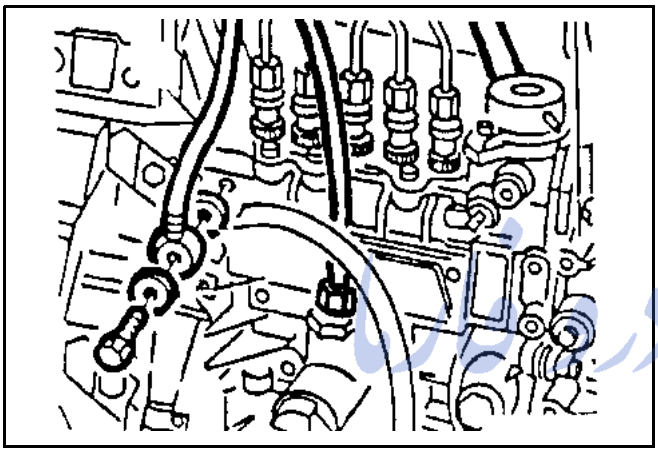
24. Remove the heater pipe bracket from the oil filter.



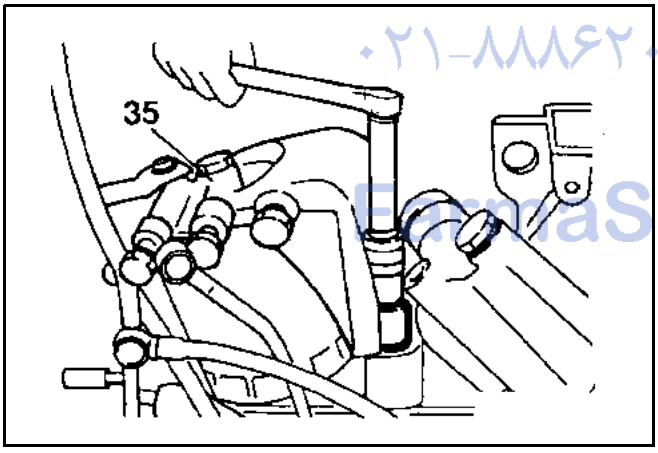
25. Pry off the clamp and push the heater feed pipe forward and then pull out the pipe.



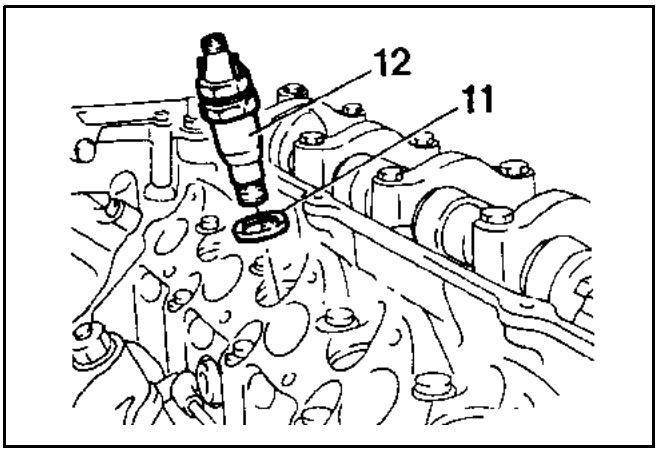
26. Disconnect the fuel lines from the fuel filter.



27. Disconnect the fuel lines from the injection pump.



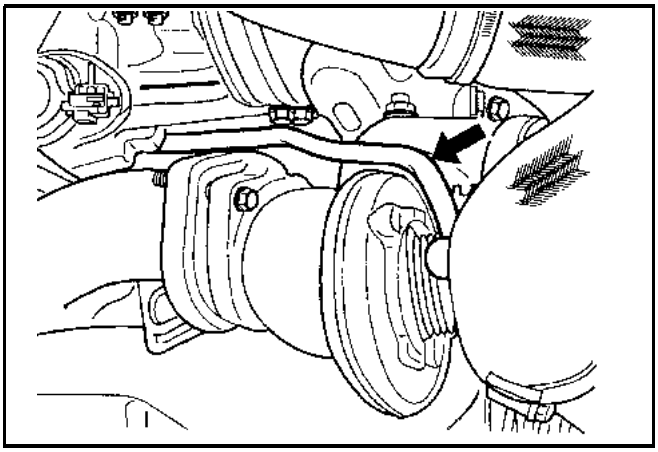
28. Remove the fuel filter(35).



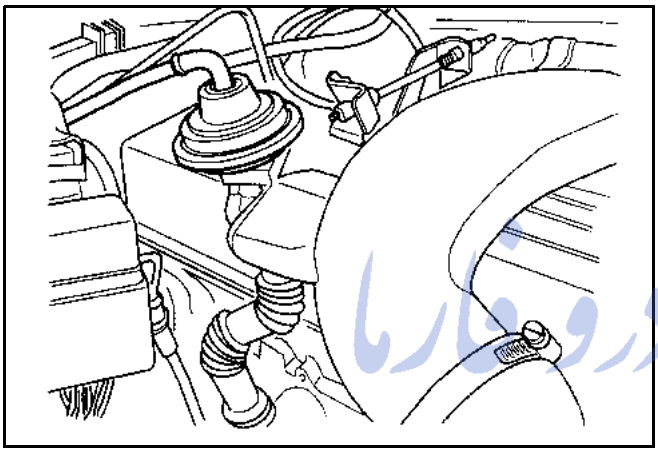
29. Remove the fuel injection nozzle(12) and nozzle washer(11).

Socket Wrench Insert 001 589 65 09 00

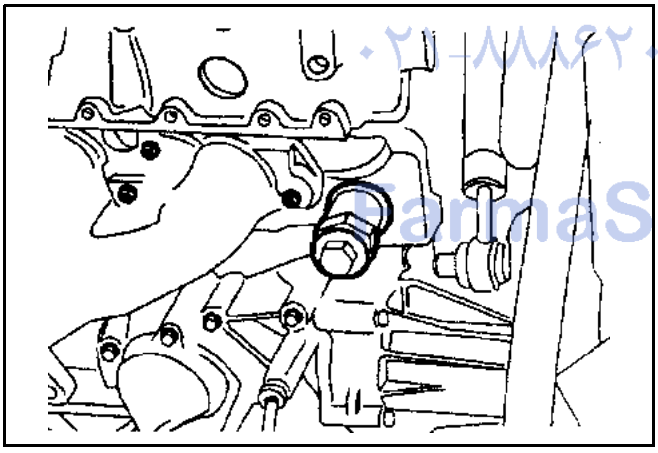
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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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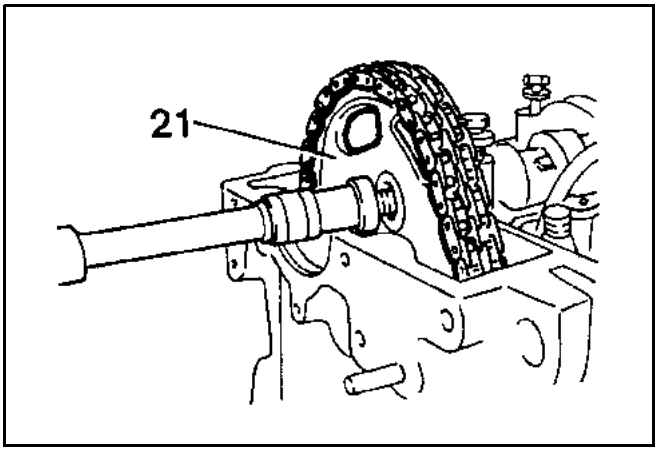
34. Remove the turbocharger.



35. Remove the exhaust manifold and gasket.



36. Remove the chain tensioner and seal.



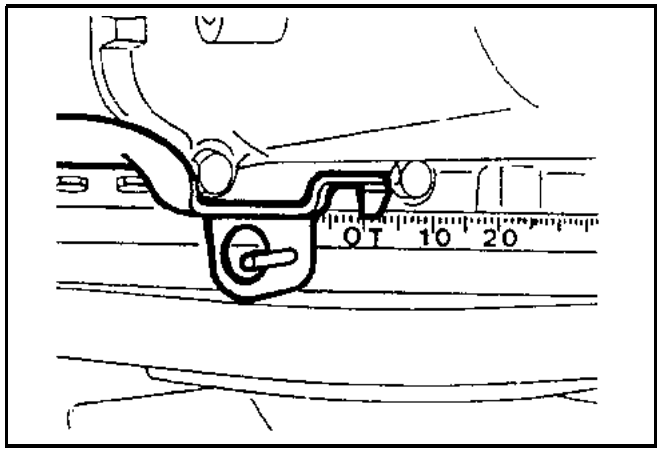
37. Remove the bolt and separate the drive sprocket (21).

Notice

During removal, be careful not to drop the sprocket and chain into the timing case.

Carefully pull off the chain and then pull out the sprocket.

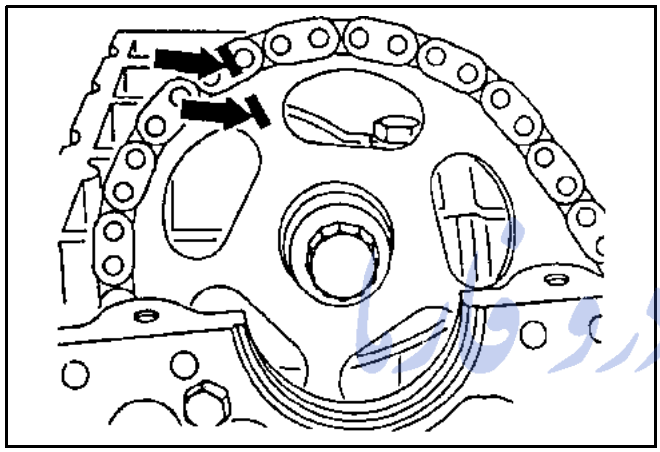
امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۴۲۰۸۵
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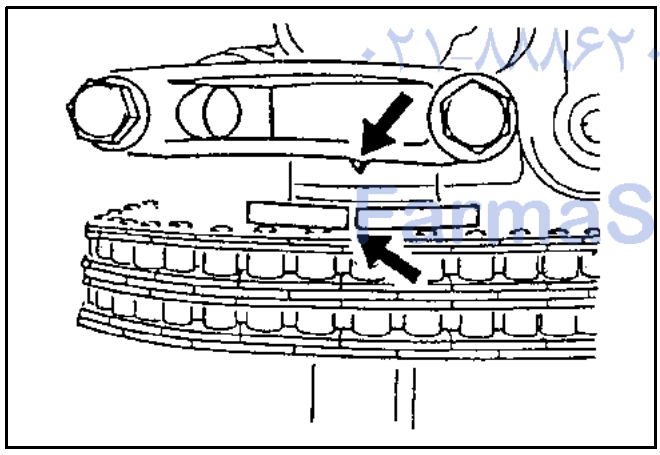
30. Rotate the crankshaft and set the no.1 cylinder at TDC.

Notice

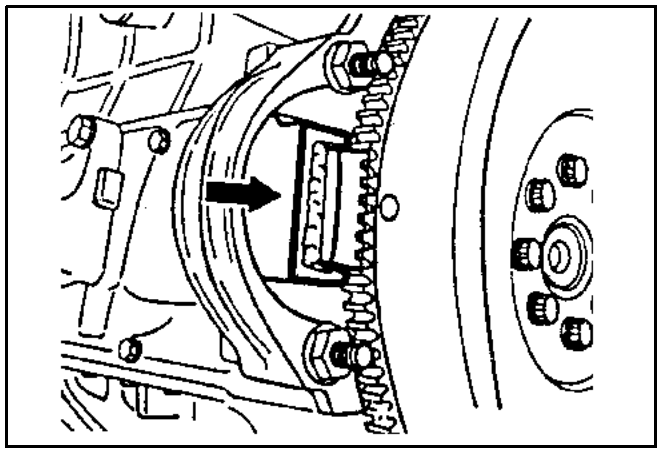
Do not rotate the crankshaft to the opposite direction of engine revolution.



31. Place alignment marks on the camshaft gear and timing chain.



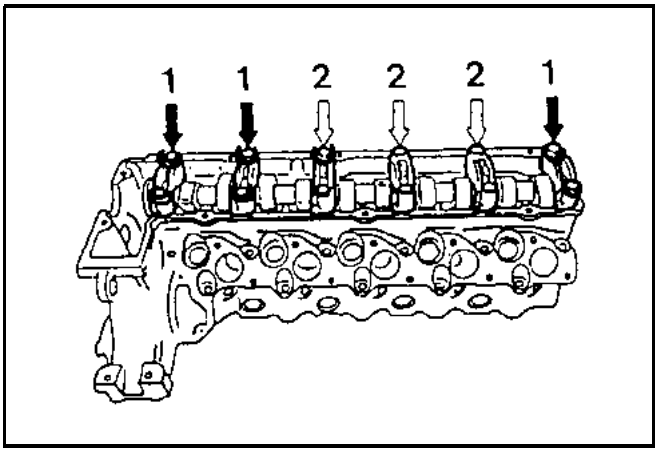
32. Ensure that the camshaft and the bearing cap marking are aligned.



33. Remove the starter motor and install the engine lock onto the flywheel ring gear.

Engine Lock 602 589 00 40 00

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تلفن شبانه روزی: ۰۲۷۸۸۶۲۰۸۵
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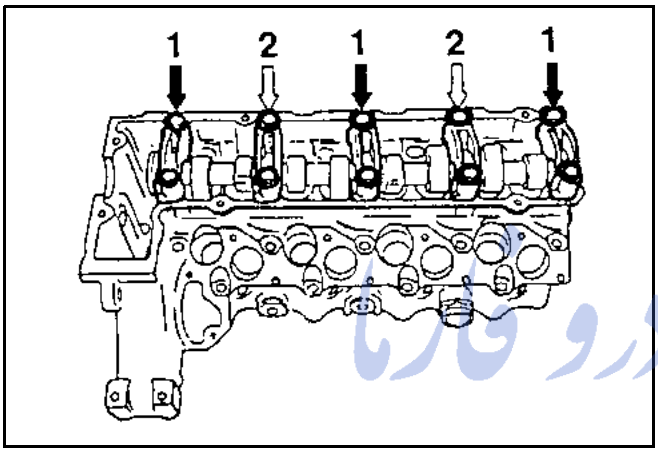


38. Remove the camshaft bearing cap bolts according to the numerical sequence.

Notice

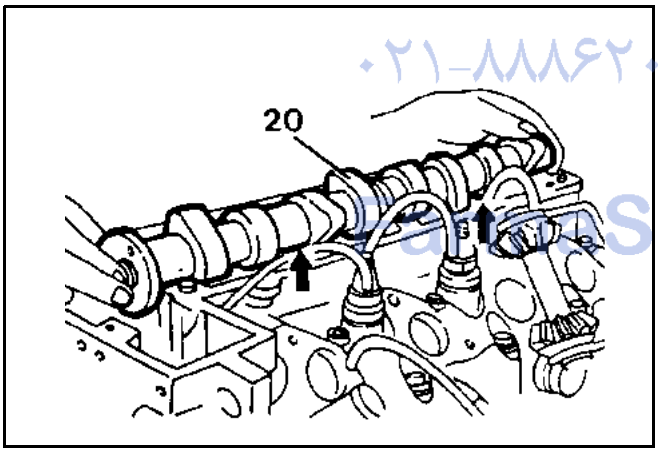
Remove the No.1 bolts first and then remove the No. 2 bolts. Do not remove the bolts at a time completely but remove them step by step evenly or camshaft can be seriously damaged.

OM662LA



OM661LA

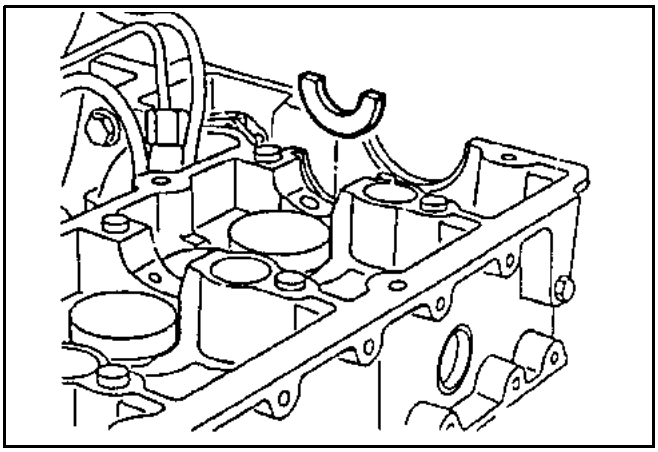
امداد خودرو فارنا
۰۲۱-۸۸۸۶۲۰۸۵ تلفن شبانه روزی:
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39. Remove the bearing caps and then pull out the camshaft(20) upward.

Notice

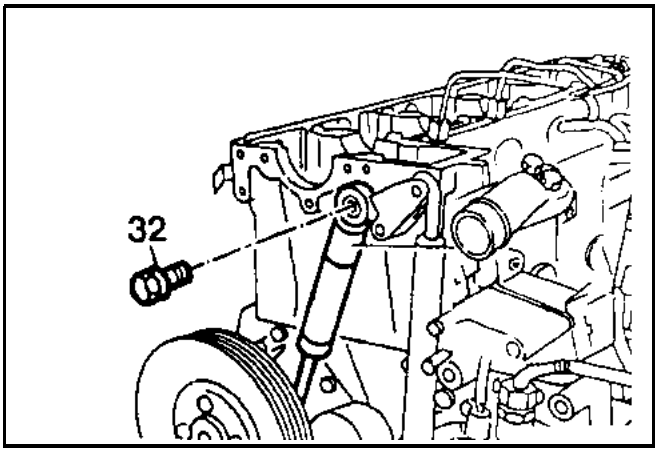
Be careful not to miss the locking washer.



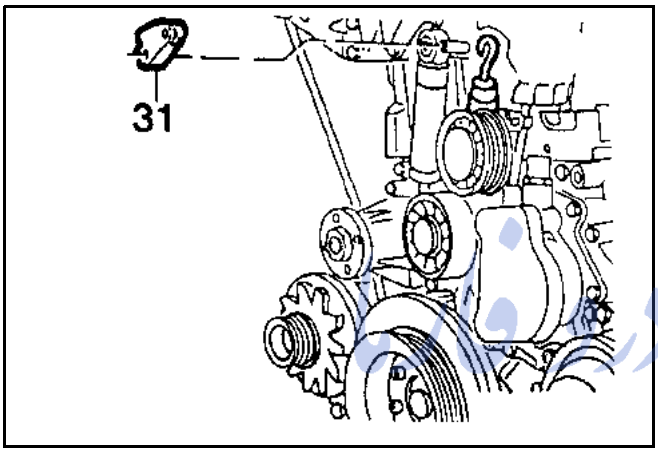
40. Remove the locking washer.

Notice

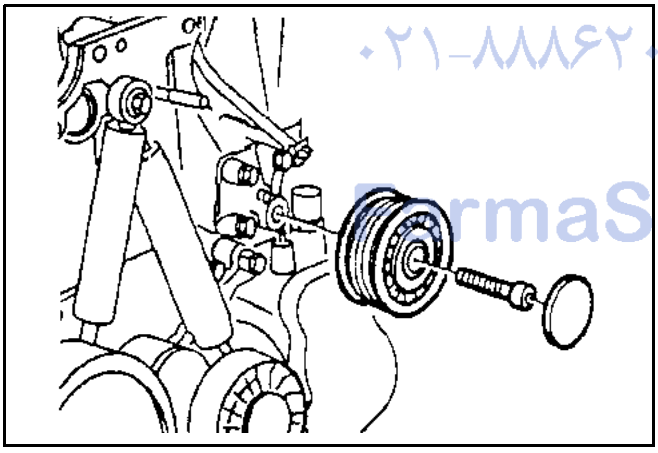
Check the locking washer and replace if necessary.



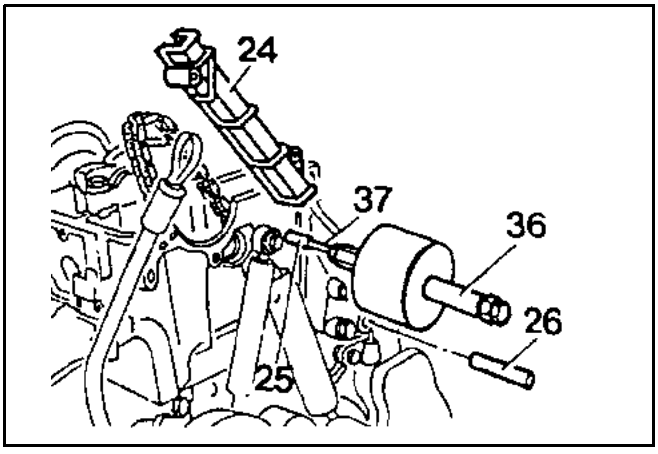
41. Remove the bolt(32).



42. Separate the spring and pull out the tensioning lever(31).



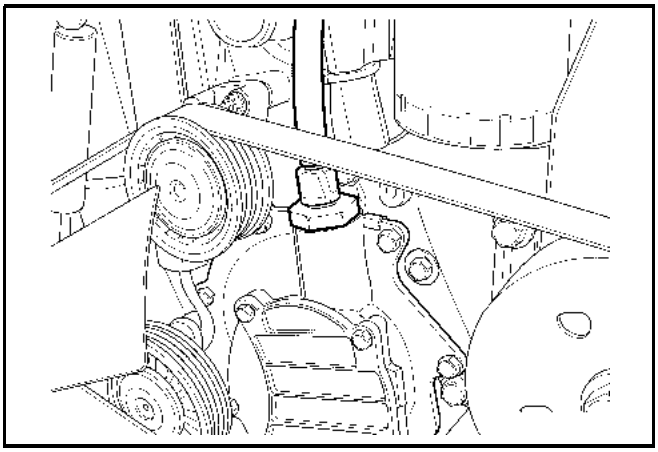
43. Pry off the closing cover. Remove the bolt and then remove the idle pulley.



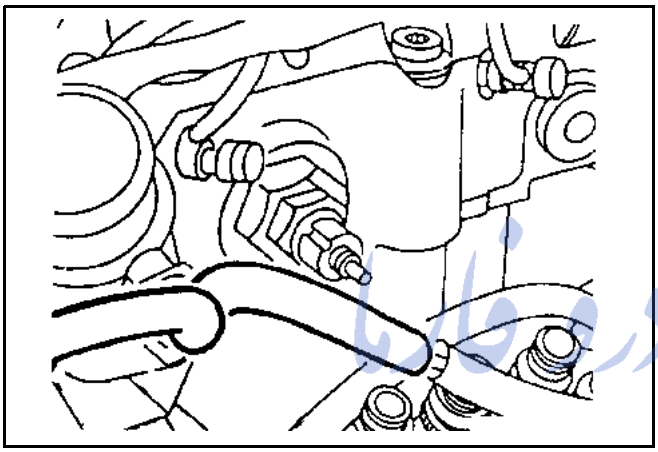
44. Using the sliding hammer(36) and the threaded pin(37), pull out the sliding rail pins(25, 26) and remove the sliding rail(24).

Sliding Hammer 116 589 20 33 00
Threaded Pin 116 589 02 34 00

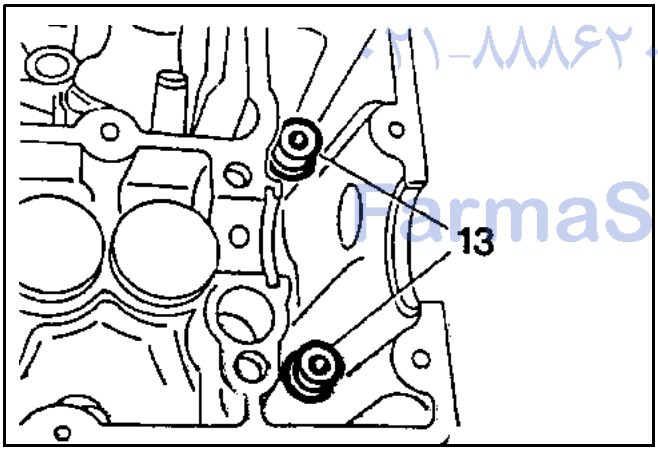
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۰۲۱-۸۸۸۶۲۰۸۵ : تلفن شبانه روزی
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45. Remove the vacuum line from the vacuum pump.

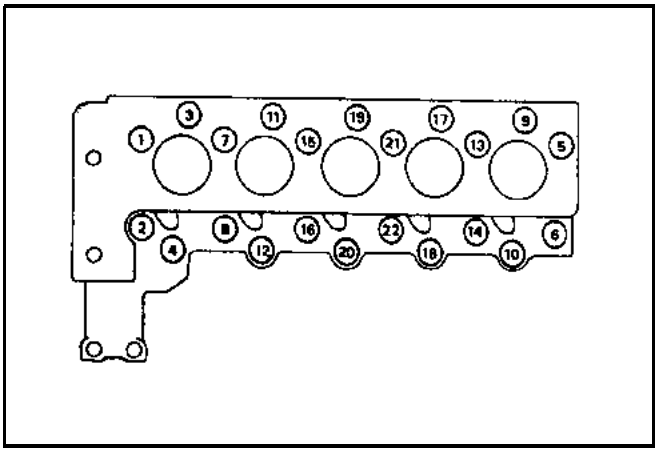


46. Disconnect the vacuum pipe from thermo valve.



47. Remove the socket bolts(13) of the chain box.

T Type Socket Wrench 116 589 03 07 00
Magnetic Bar 102 589 03 40 00

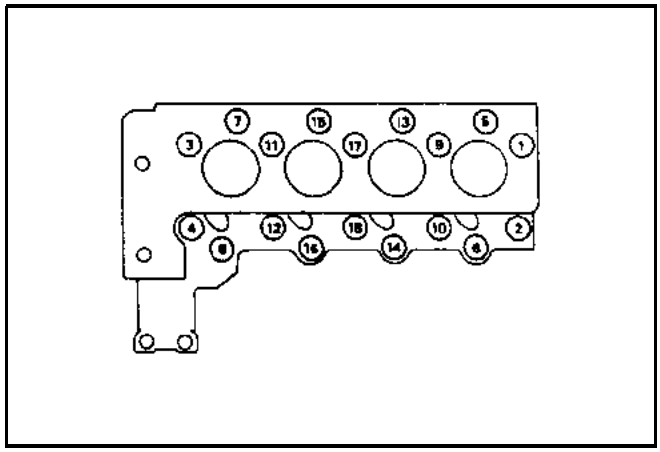


48. Remove the cylinder head bolts in numerical sequence.

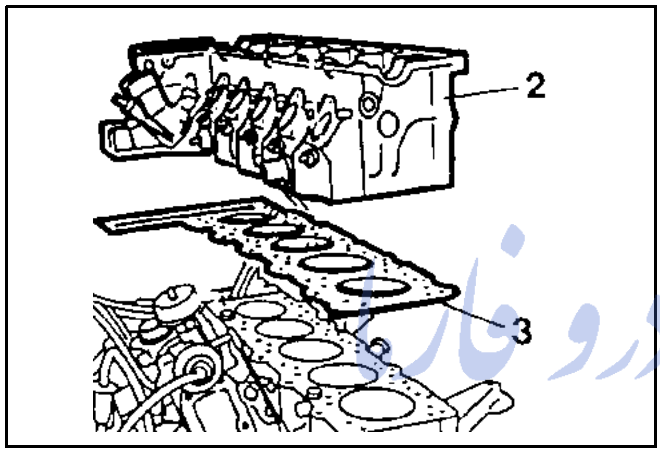
Cylinder Head Bolt Wrench 601 589 00 10 00

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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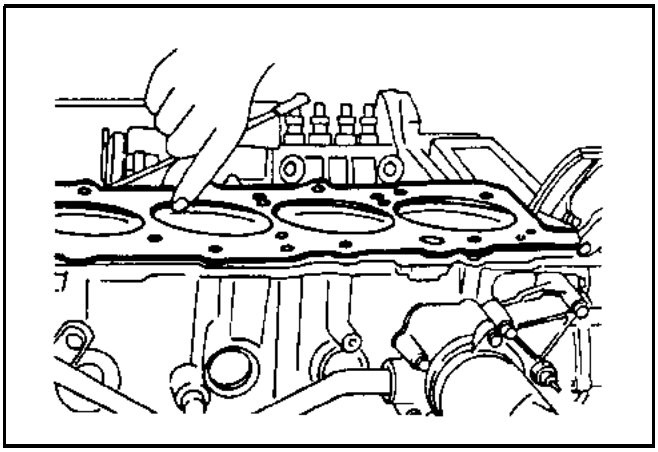


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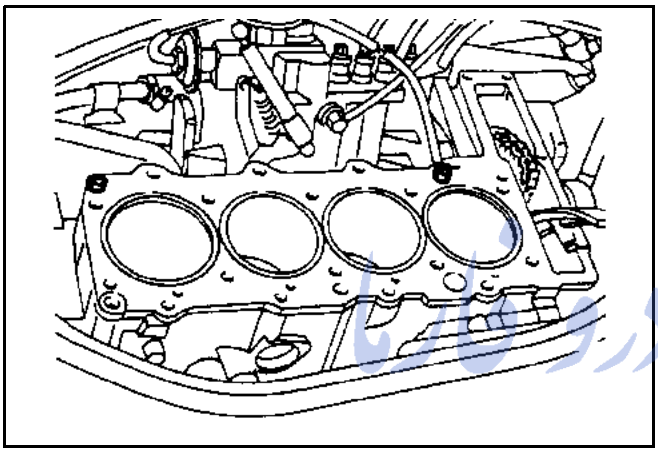
49. Remove the cylinder head(2) and gasket(3).

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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Assembly Procedure

1. Replace the cylinder head gasket.

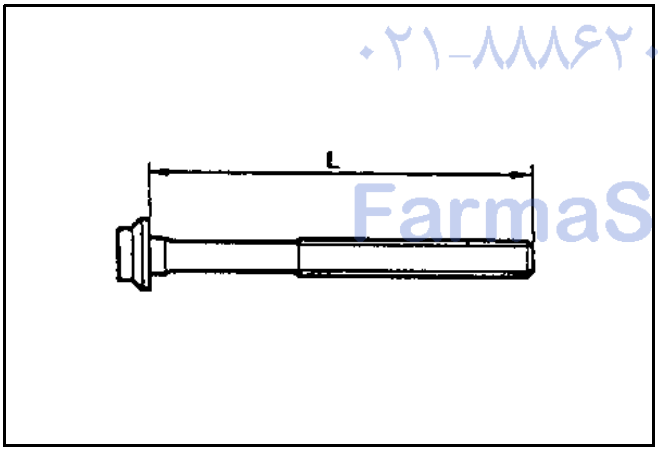


2. Install the cylinder head onto the crankcase.

   Notice

   Align the cylinder head holes with the guide pins.

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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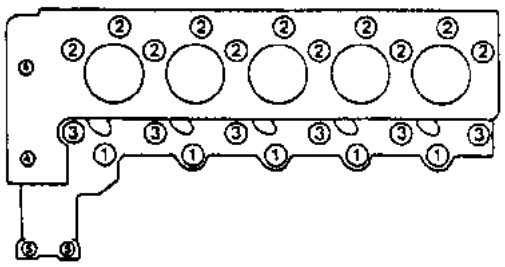
3. Measure the length(L) of cylinder head bolts.

   Notice

   If the max. length is exceeded, replace the bolts.

Thread Dia.	Length (L) When New	Max. Limit (L)
M10	80mm	82mm
M10	120mm	104mm
M10	115mm	117mm

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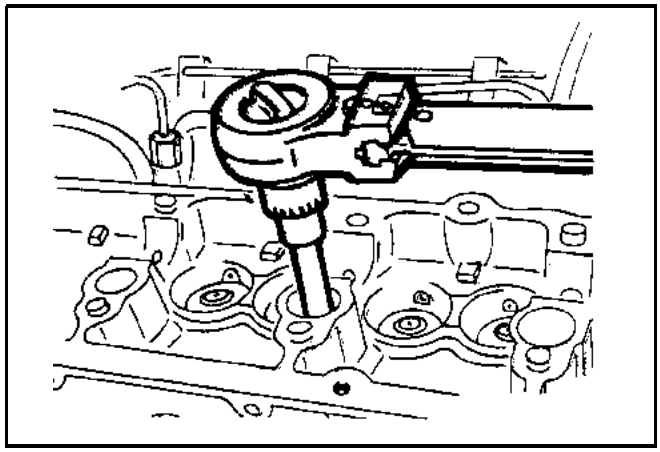


4. Coat the head contact surface of bolts and thread with oil and insert them as shown.

   - Cylinder head bolts arrangement

   Bore

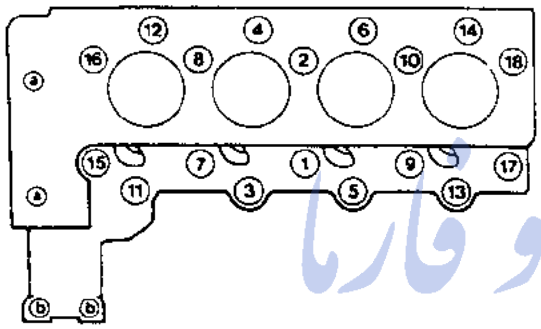
   1 ..... M10 x 80
   2 ..... M10 x 102
   3 ..... M10 x 115
   4 ..... M 8 x 50
   5 ..... M 8 x 80



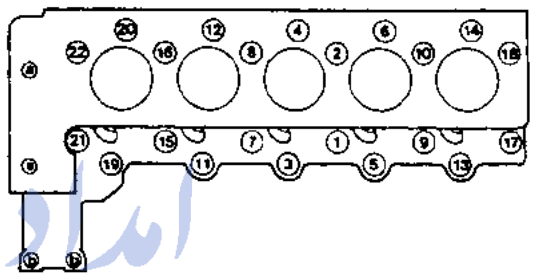
5. Tighten the cylinder head bolts to specified torque and torque angle.

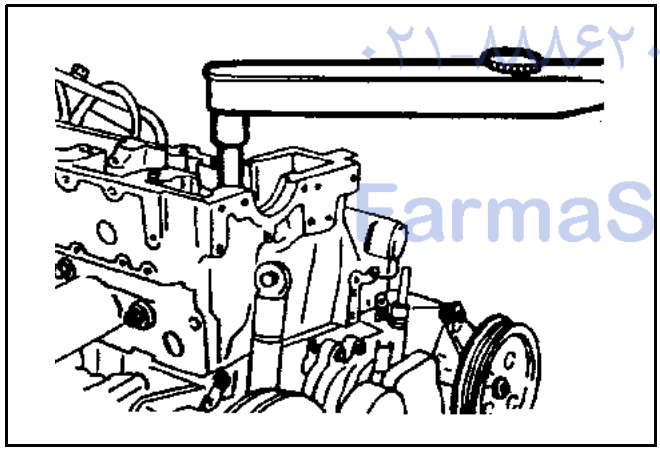
Stage 1	15 N·m (11 lb-ft)
Stage 2	35 N·m (26 lb-ft)
Torque angle	90°
Wait for	10 minutes
Torque angle	90°

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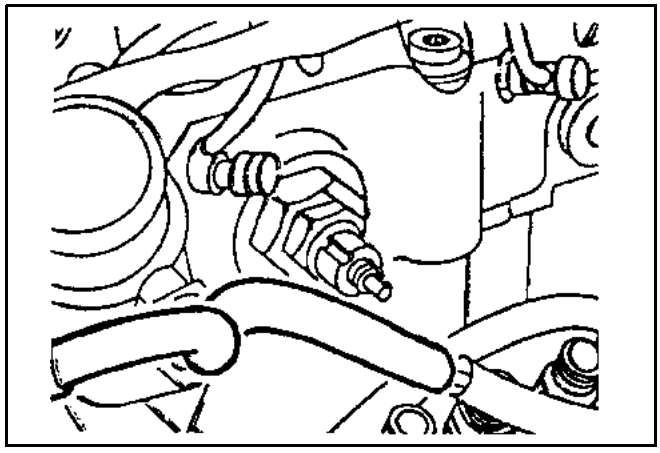
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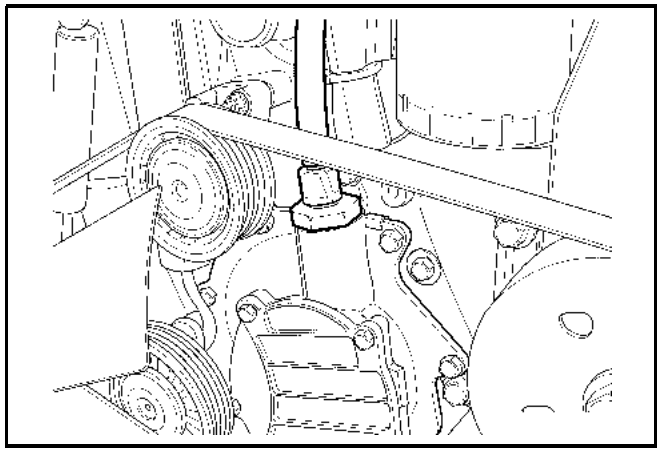
6. Install the socket bolts in the chain box.

Tightening Torque	25 N·m (18 lb-ft)

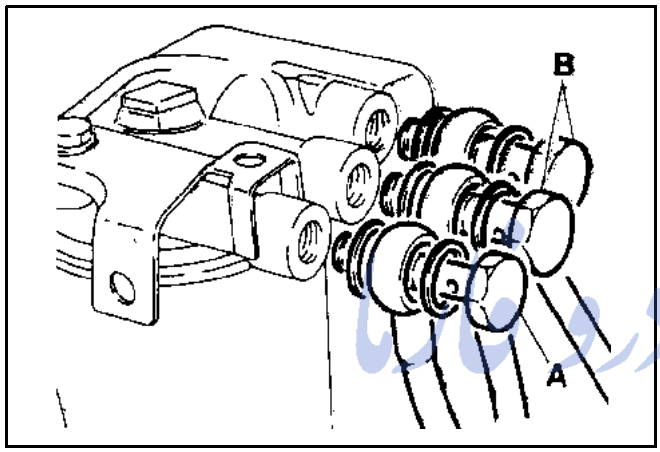


7. Connect the vacuum pipe to the thermo valve.

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8. Connect the vacuum lines to the vacuum pump.

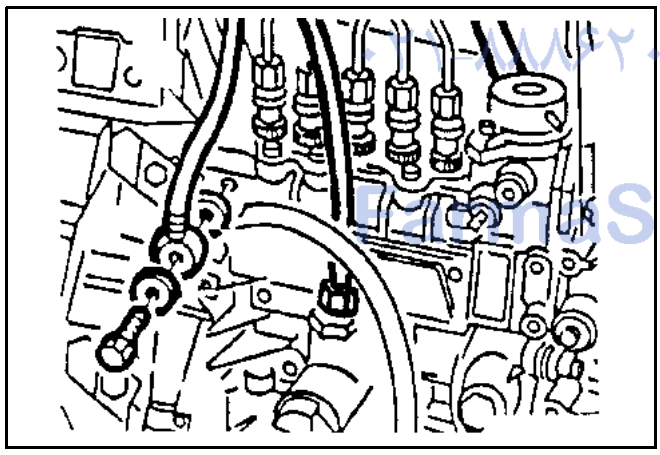


9. Install the fuel filter and connect the pipe.

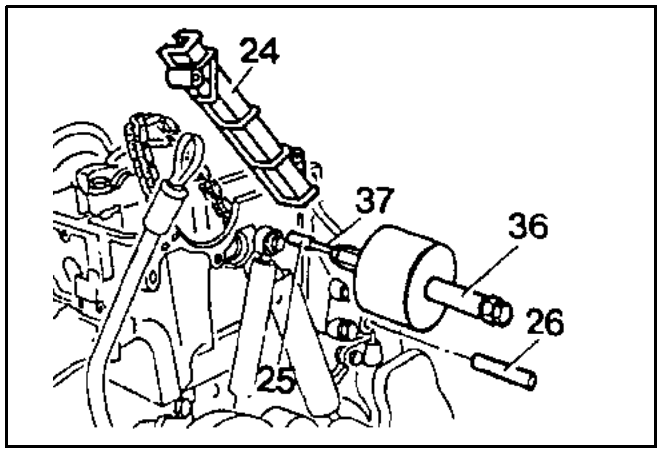
Tightening Torque	25 N·m (18 lb-ft)

Notice

Be careful not to be confused the connections and hoses.



10. Connect the fuel pipe to the injection pump.



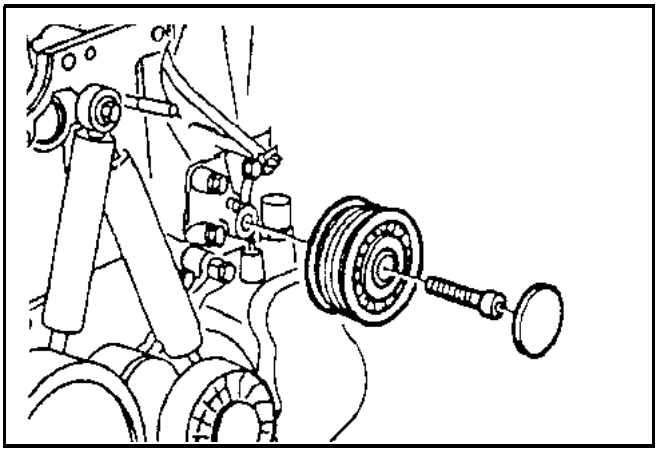
11. Install the sliding rail(24) and insert the sliding rail pins(25, 26).

Notice

Apply sealing compound on the each collar of the sliding rail pins.

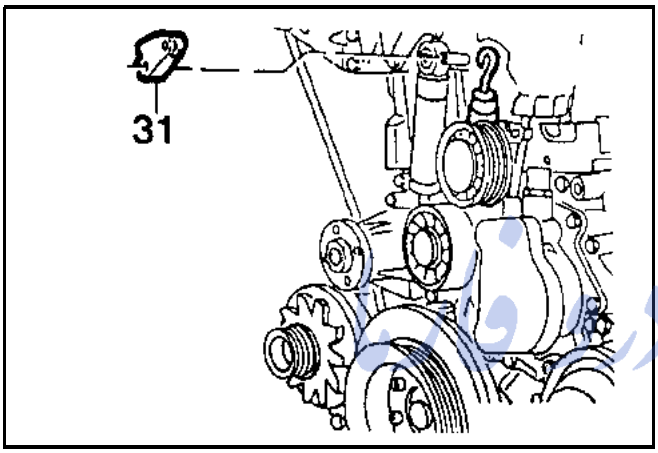
Sliding Hammer 116 589 20 33 00
Threaded Pin 116 589 02 34 00

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تلفن شبانه روزی: ۰۹۱۲۰۳۸۲۰۸۵
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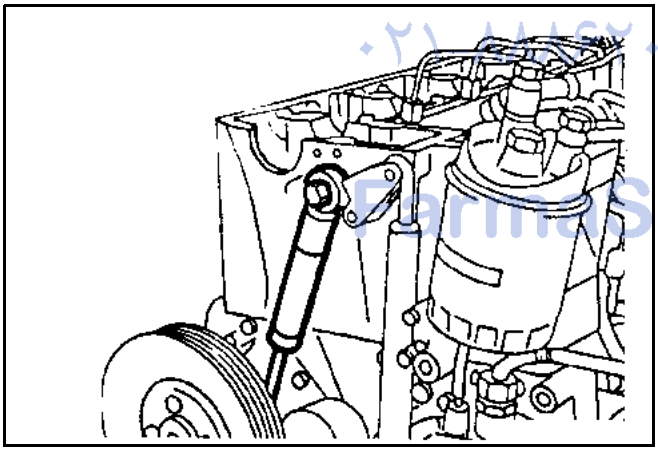


12. Install the idle pulley and fit the closing cover.

Tightening Torque	25 N·m (18 lb-ft)



13. Insert the tensioning lever(31) and install the spring.

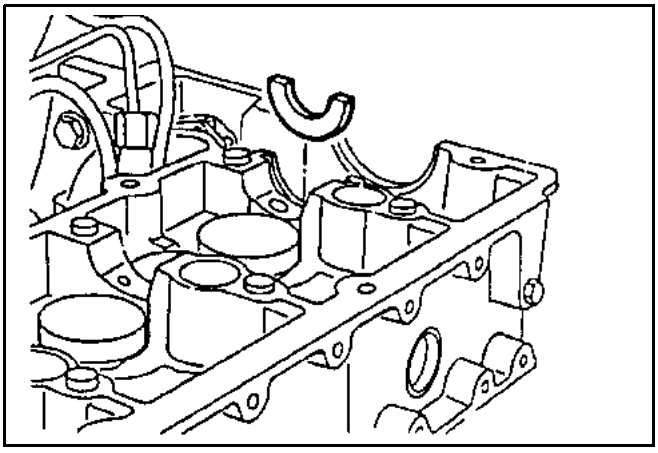


14. Install the damper.

Tightening Torque	23 N·m (17 lb-ft)

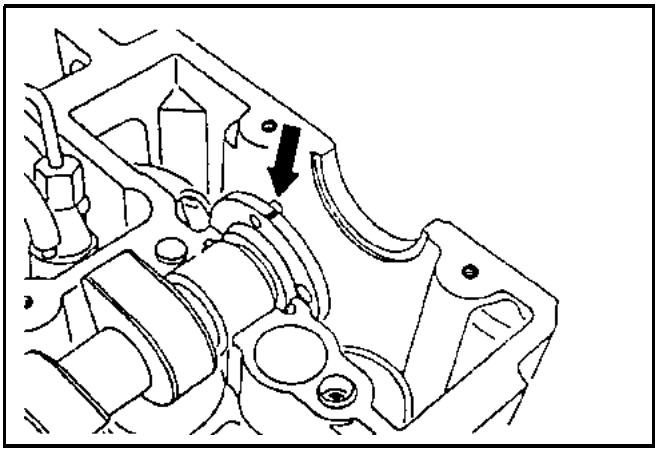
Notice

Insert the tensioning lever bolts onto the mounting hole.



15. Insert the locking washer.
16. Inspect the valve tappet and check that the tappet moves smoothly.

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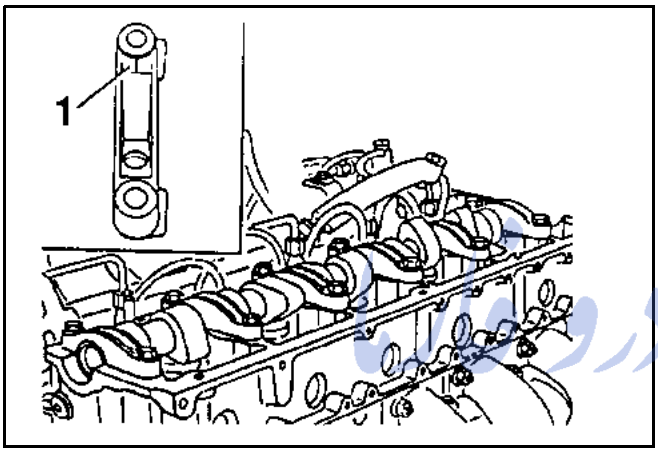


17. Coat the camshaft with oil and install the camshaft on the cylinder head to be TDC mark(arrow) upward.
18. Measure the axial end play of the camshaft.

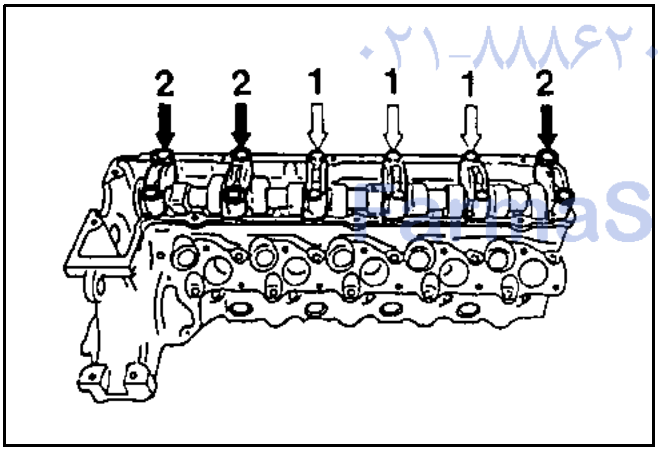
End Play	0.06 - 0.21mm

Notice

If out of standard, adjust it with the proper thickness of locking washer.



19. Install the bearing caps on the camshaft according to the number on the caps.



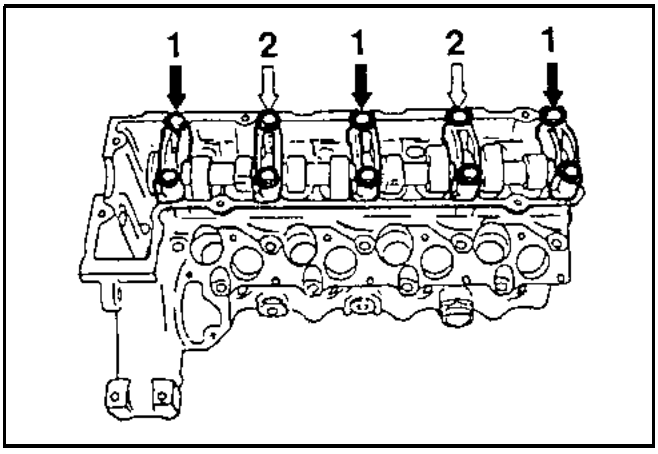
20. Tighten the bearing cap bolts according to the numerical sequence.

Tightening Torque	25 N·m (18 lb-ft)

Notice

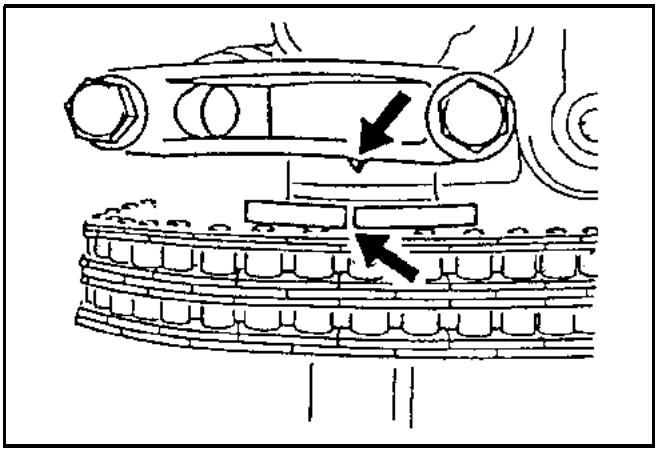
Tighten the No. 1 bolts(light arrow) first and then tighten the No. 2 bolts(dark arrow) stage by stage.

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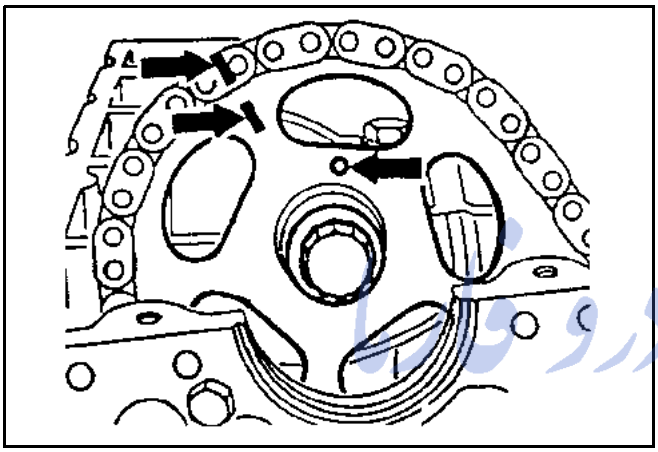
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۰۲۱-۸۸۸۶۲۰۸۵
IranSOS.com



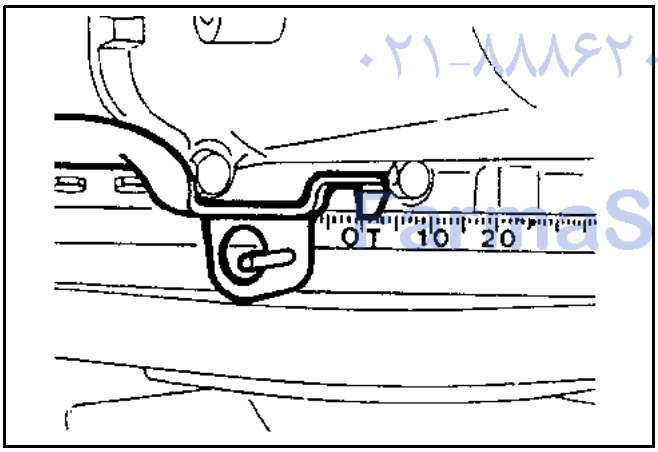
21. Position the camshaft on marking and install the camshaft sprocket.

Notice

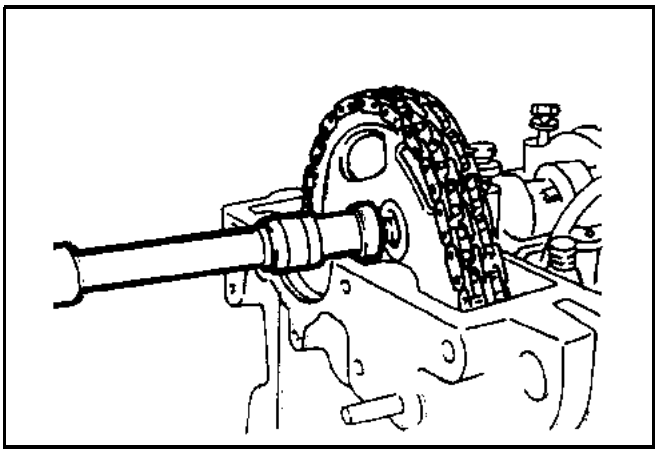
Align the alignment marks on the chain and sprocket.



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۰۲۱-۸۸۸۶۲۰۸۵ تلفن شبانه روزی:
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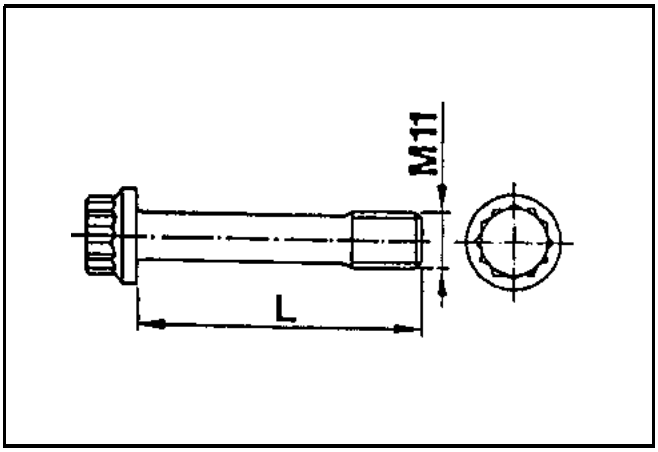


22. Check the TDC position of the crankshaft.



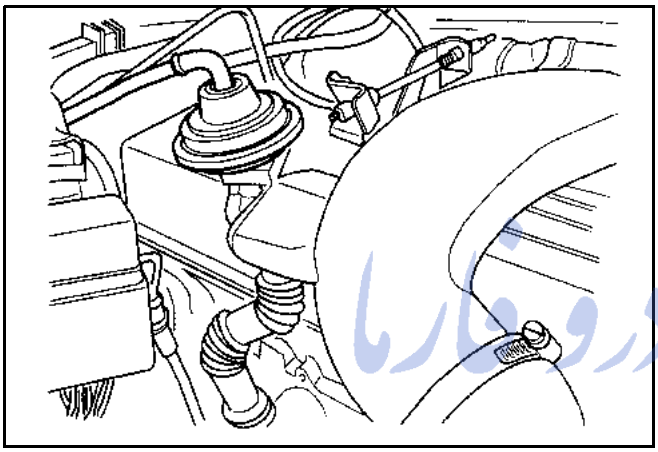
23. Install the camshaft sprocket bolt.

Tightening Torque	25 N·m (18 lb-ft) + 90°

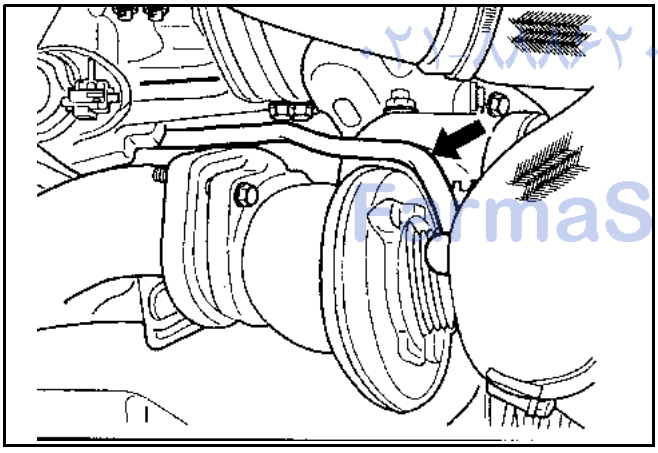


Notice

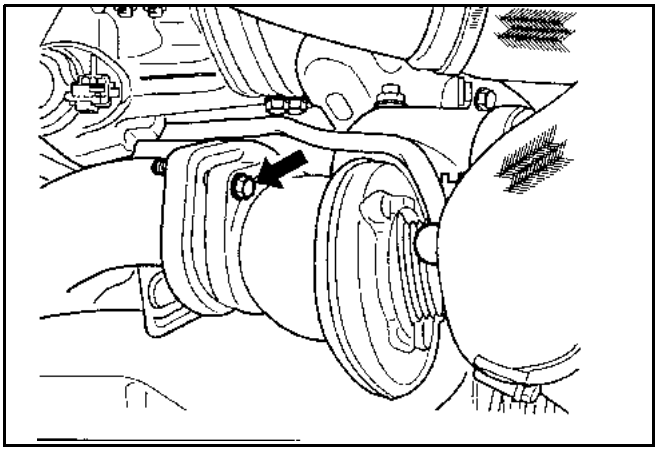
Measure the max. length 'L' and replace the bolt if it exceeds 53.6mm.



24. Install the exhaust manifold and gasket.



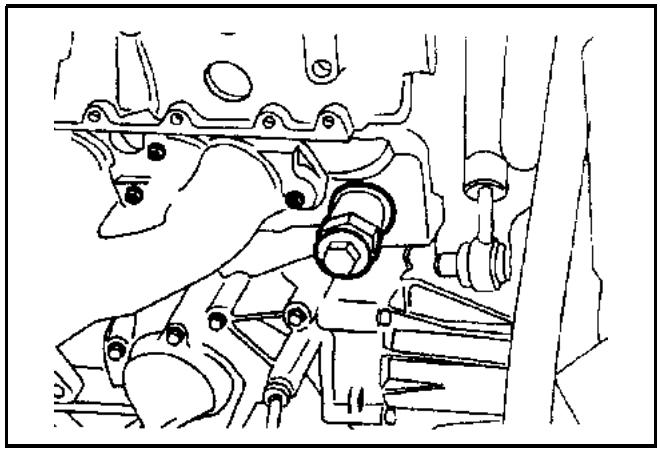
25. Install the turbocharger.



26. Install the exhaust pipe onto the turbocharger.

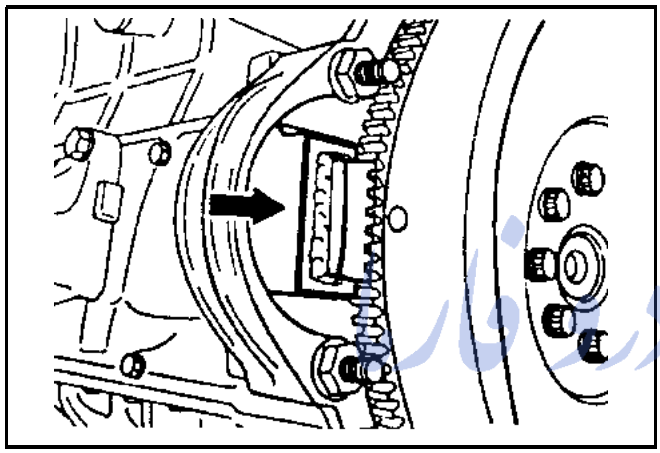
Tightening Torque	25 N·m (18 lb-ft)

امداد خودرو فارما
تلفن شبانه روزی: ۰۲۷۳۸۸۴۲۰۸۵
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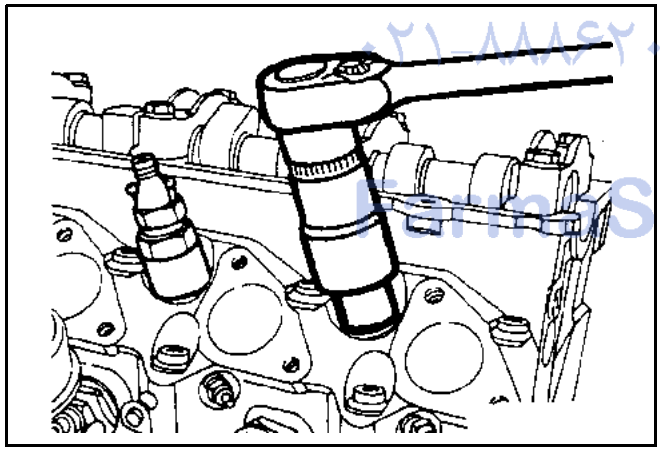


27. Replace the seal and then install the chain tensioner.

Tightening Torque	80 N·m (59 lb-ft)

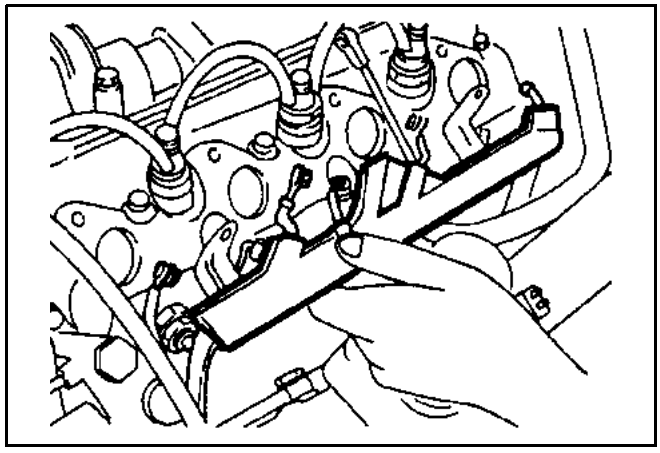


28. Remove the engine lock.



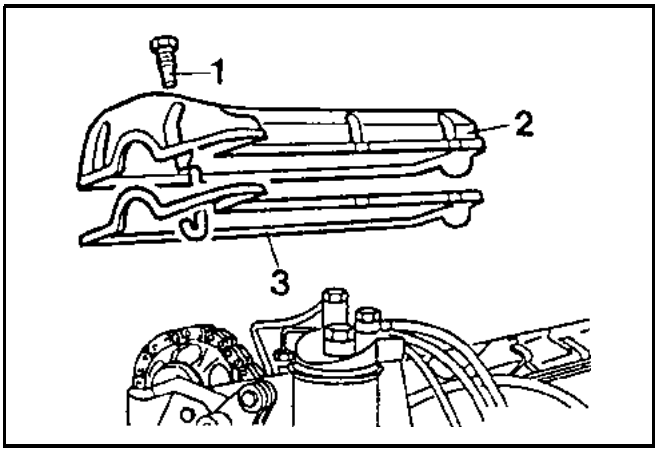
29. Insert the nozzle washer into the hole to face round part downward.
30. Install the fuel injection nozzle.

Tightening Torque	40 N·m (30 lb-ft)



31. Connect the fuel hose.
32. Install the cable channel and connect the cables to glow plugs.

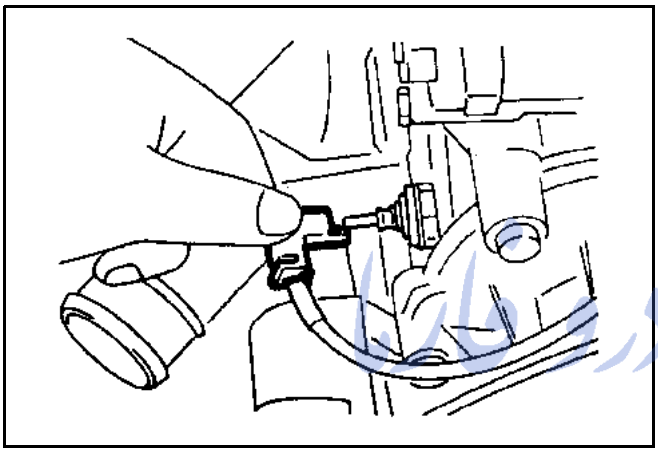
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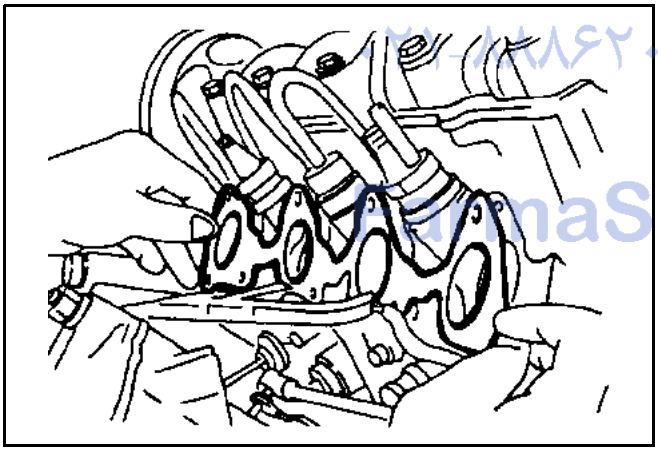
33. Replace the gasket and install the cylinder head cover.

Tightening Torque	10 N·m (89 lb-in)

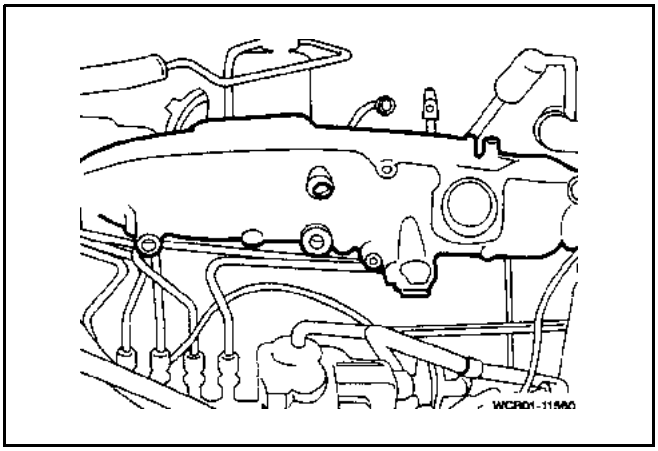
34. Install the blow-by hose.



35. Connect the wires to the coolant temperature sensor and the glow plug sensor.



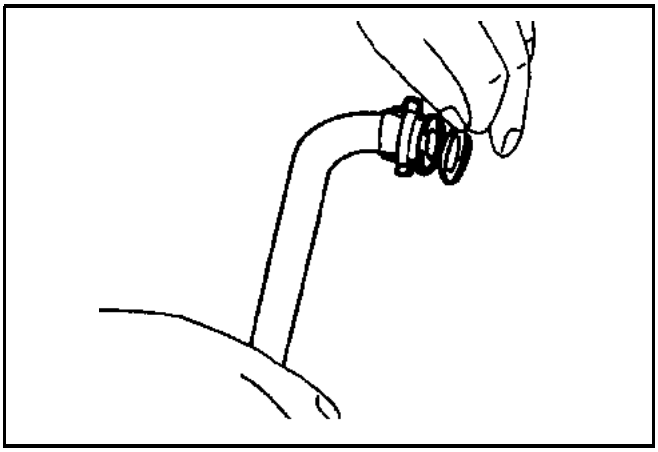
36. Replace the intake manifold gasket.



37. Install the intake manifold.

Tightening Torque	25 N·m (18 lb-ft)

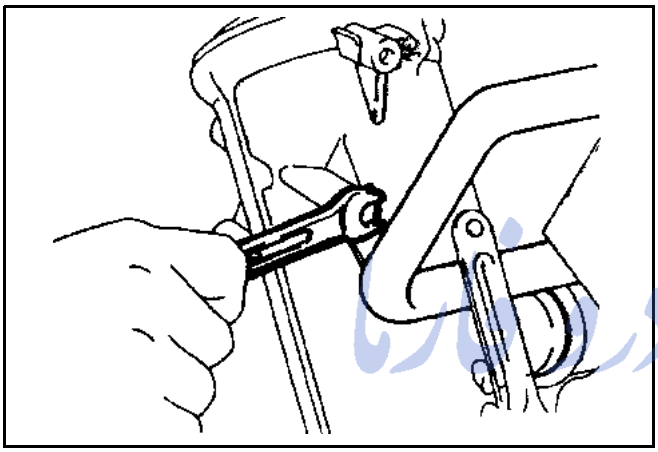
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تلفن شبانه روزی: ۰۲۱-۸۸۶۲۰۸۵
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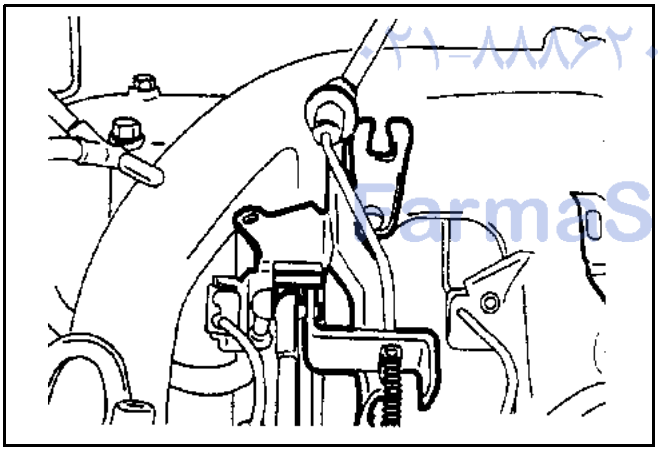
38. Replace the O-ring of heater feed pipe and install it to the cylinder head.

Notice

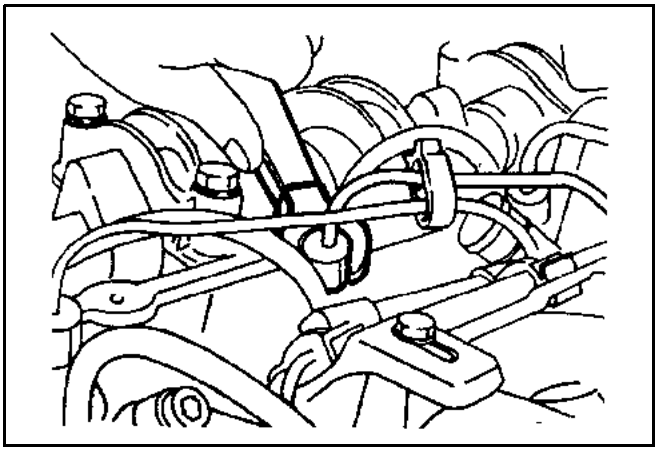
For installation, clean the hole.



39. Install the bracket of heater feed pipe to the oil filter.



40. Install the fuel pipe and the accelerator control linkage.

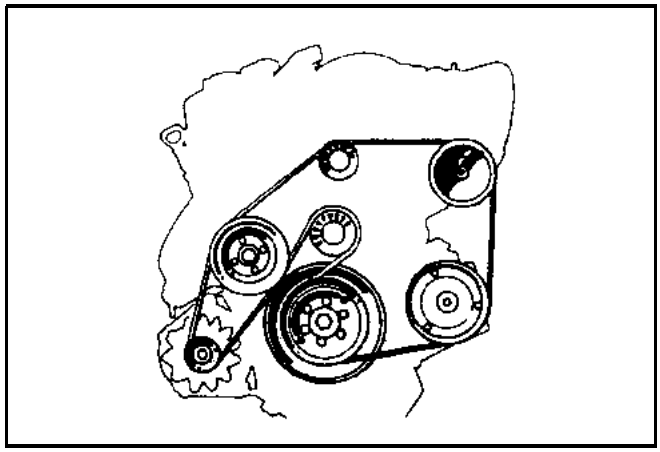


41. Connect the fuel lines to the injection nozzles and to the injection pump.

Tightening Torque	18 N·m (13 lb-ft)

Box Wrench Insert 000 589 77 03 00

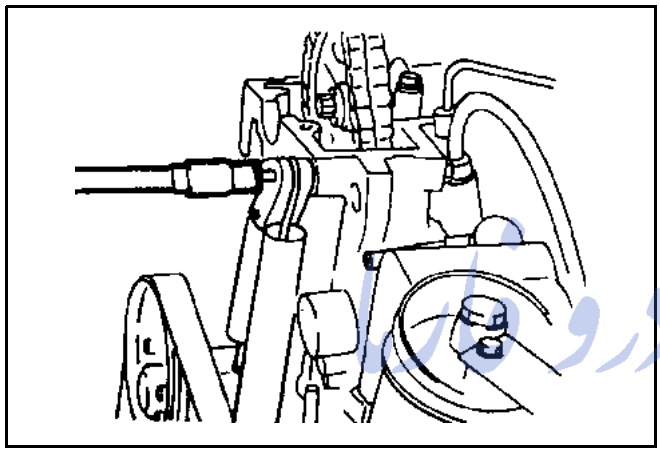
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42. Install the poly V-belt.

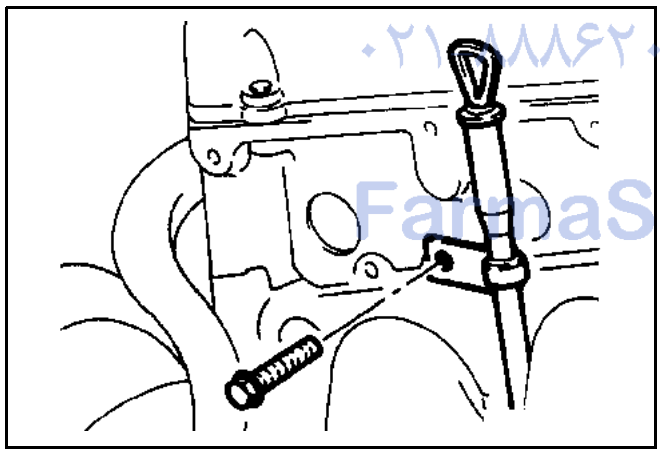
Notice

Be careful not to contaminate the belt.



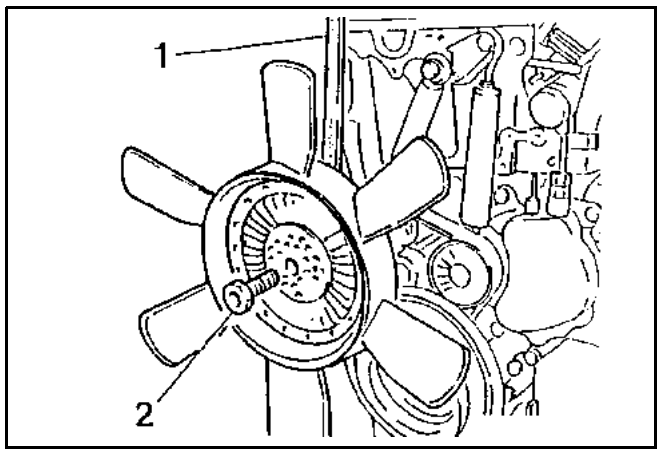
43. By inserting a rod into the tensioning lever upper hole and pulling the rod, install the bolt and then tighten the nut.

Tightening Torque	23 N·m (17 lb-ft)



44. Install the oil dipstick tube bracket.

Tightening Torque	10 N·m (89 lb-in)

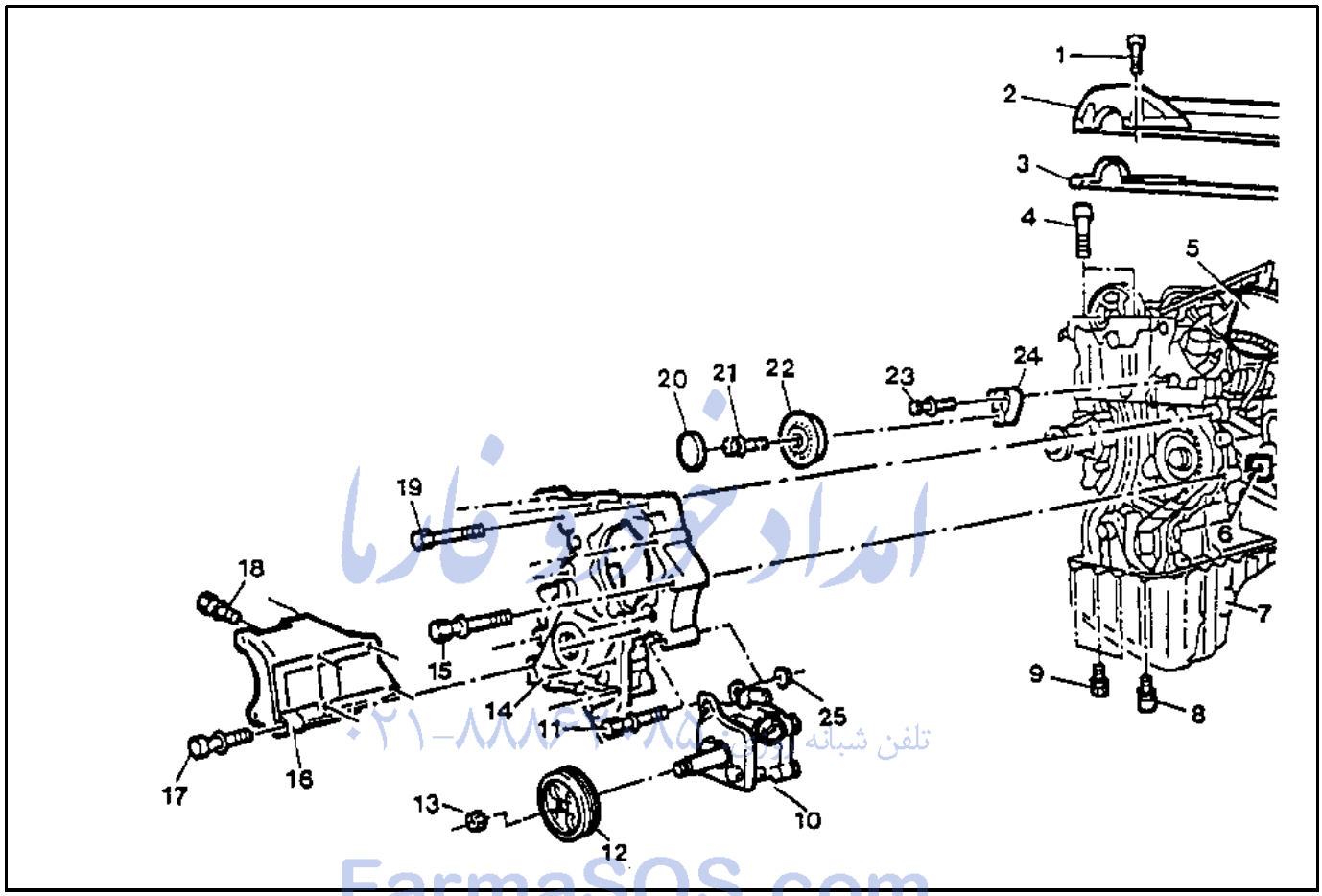


45. Hold the cooling fan with the counter holder and tighten the bolt.

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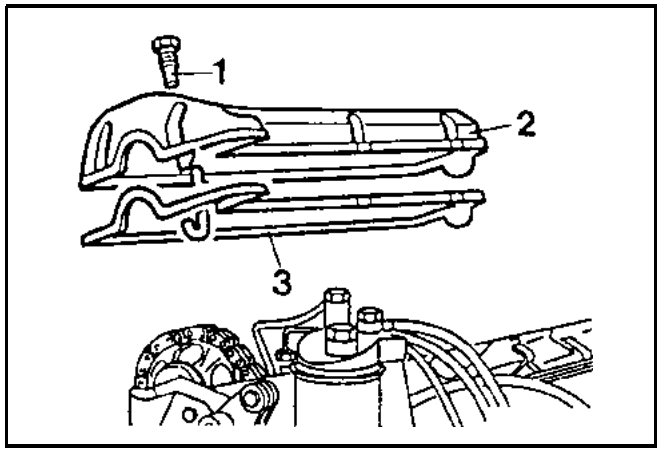
TIMING CASE COVER

Preceding Work : Removal of the cooling fan
Rmoval of the V-belt tensioning device
Removal of the vibration damper and hub
Removal of the generator



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1	Bolt	10N·m (89 lb-in)	
2	Cylinder Head Cover		
3	Gasket	Replace	
4	Socket Bolt	25N·m (18 lb-ft)	
5	Fuel Filter		
6	Square Nut		
7	Oil Pan		
8	Socket Bolt	10N·m (89 lb-in)	
9	Bolt	M6 : 10N·m (89 lb-in) M8 : 23N·m (17 lb-ft)	
10	Power Steering Pump		
11	Bolt		
12	Belt Pulley		
13	Bolt	32N·m (24 lb-ft)	
14	Timing Case Cover		
15	Bolt	23N·m (17 lb-ft)	
16	Generator Bracket		
17	Bolt	45N·m (33 lb-ft)	
18	Bolt	25N·m (18 lb-ft)	
19	Bolt	10N·m (89 lb-in)	
20	Closing Cover		
21	Socket Bolt	23N·m (17 lb-ft)	
22	Guide Pulley		
23	Bolt	9N·m (80 lb-in)	
24	Guide Pulley Bracket		
25	Nut	23N·m (17 lb-ft)	

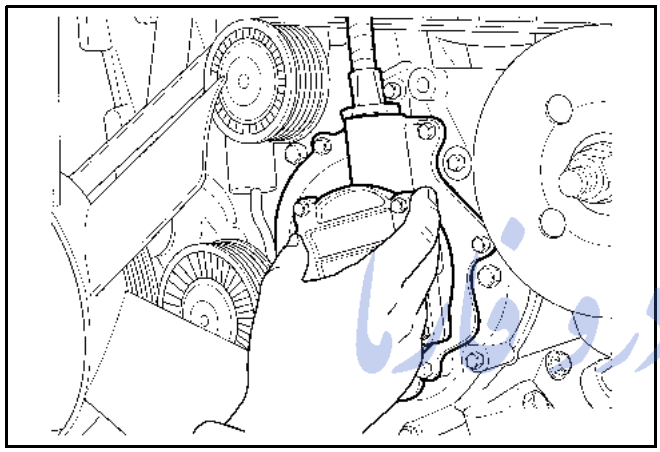


Tools Required

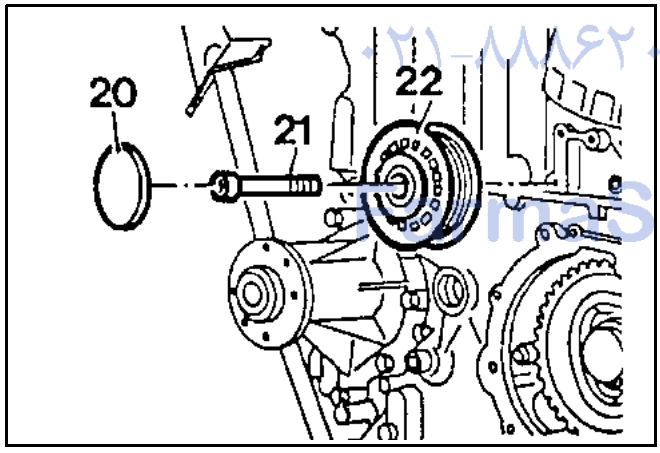
116 589 03 07 00 Socket Wrench

Removal Procedure

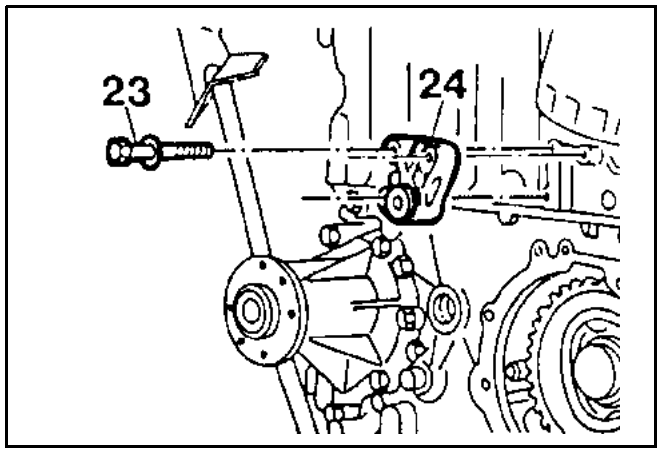
1. Remove the fan clutch and cooling fan belt pulley.
2. Drain the engine oil completely.
3. Remove the oil dipstick tube bracket bolts.
4. Remove the crankshaft pulley.
5. Loosen the bolt (1) and then remove the cylinder head cover (2) and gasket.



6. Remove the vacuum pump.

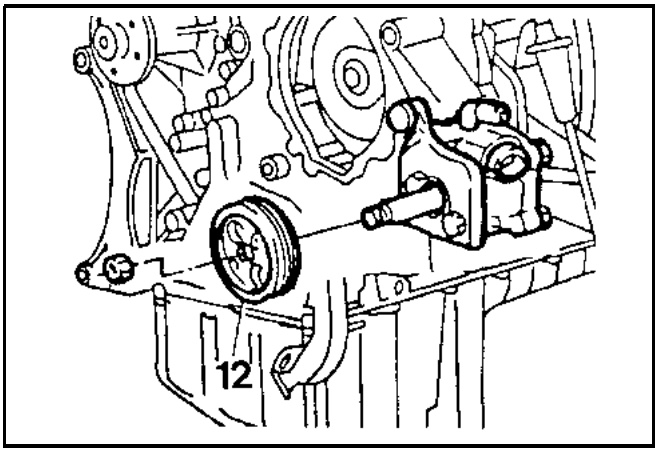


7. Detach the closing cover (20). Remove the bolts(21) and then remove the guide pulley (22).



8. Remove the guide pulley bracket (24).

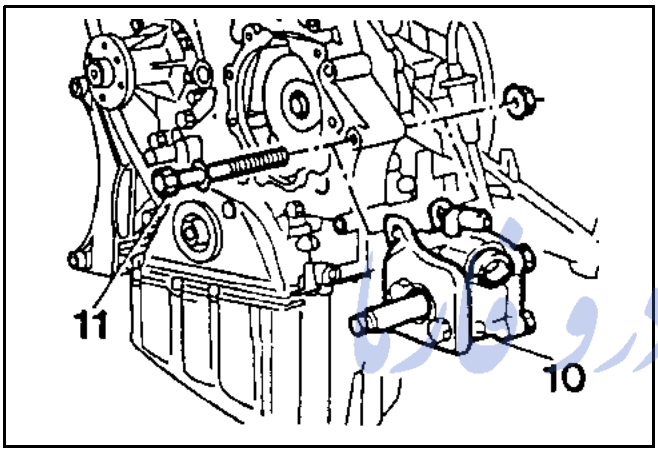
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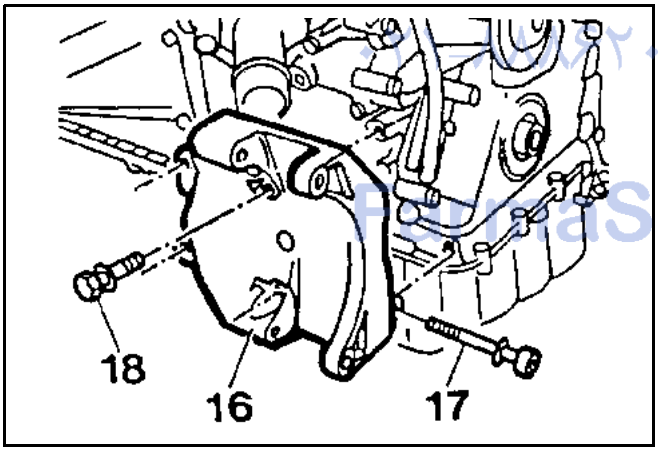
9. Disconnect the pipes of power steering pump and remove the belt pulley.

   Notice

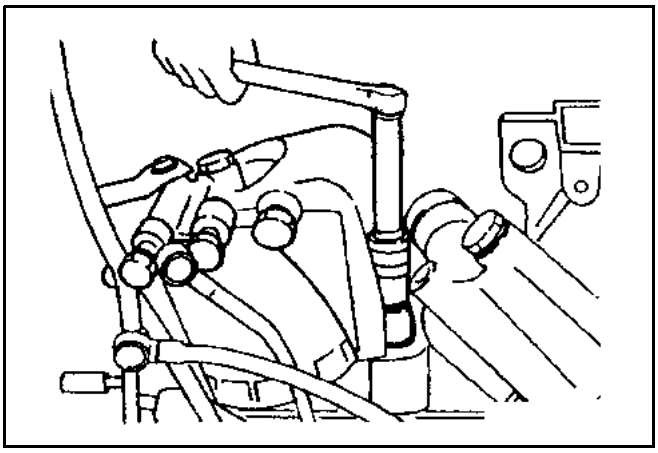
   Be careful not to lose the key.



10. Remove the nut and pull out the bolt and then remove the power steering pump.

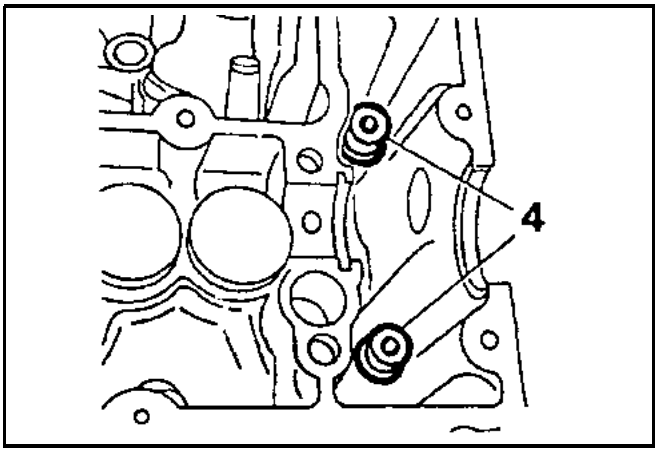


11. Remove the generator bracket (16).



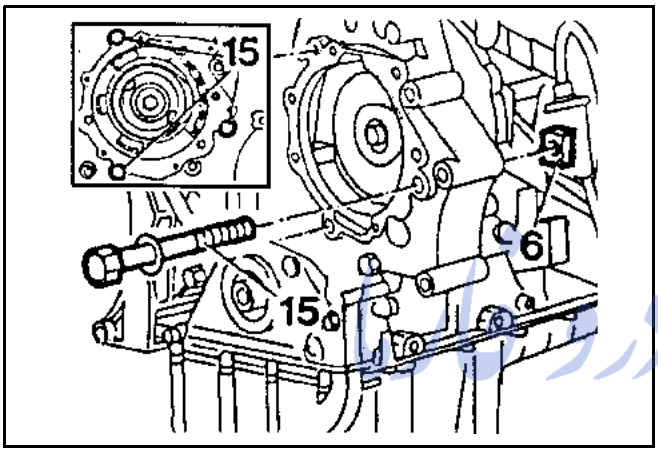
12. Remove the fuel filter.

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تلفن شبانه روزی: ۰۹۱۲۰۲۰۲۸۵
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13. Remove the camshaft.
14. Remove the socket bolts(4) in the chain box.

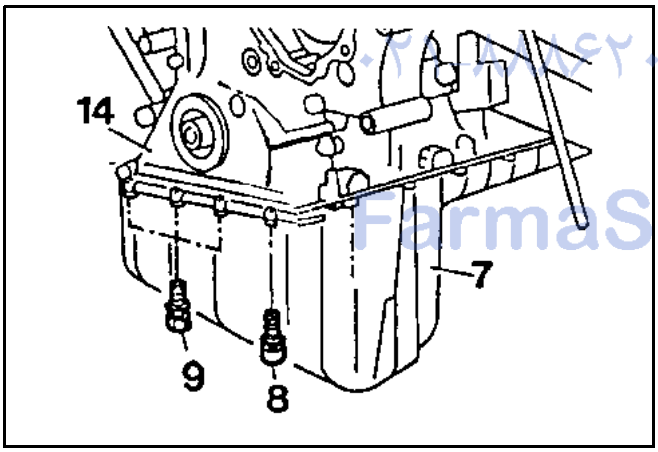
Socket Wrench 115 589 03 07 00



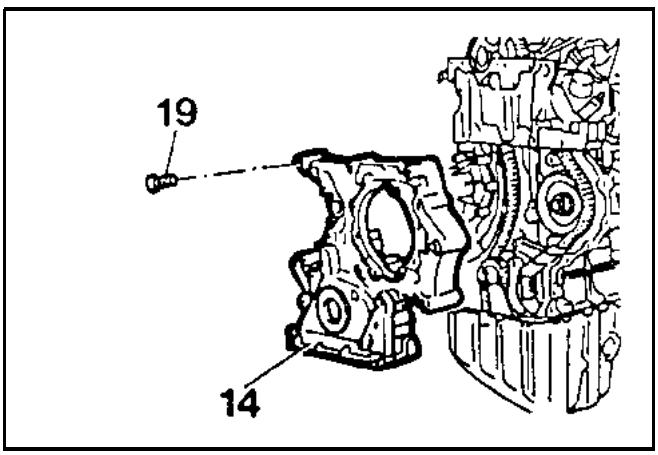
15. Remove the injection pump.

Notice

See the “Removal of fuel injection pump”.



16. Remove the oil pan bolts (8, 9) in the area of the timing case cover (14).
17. Slightly loosen the remaining oil pan bolts.

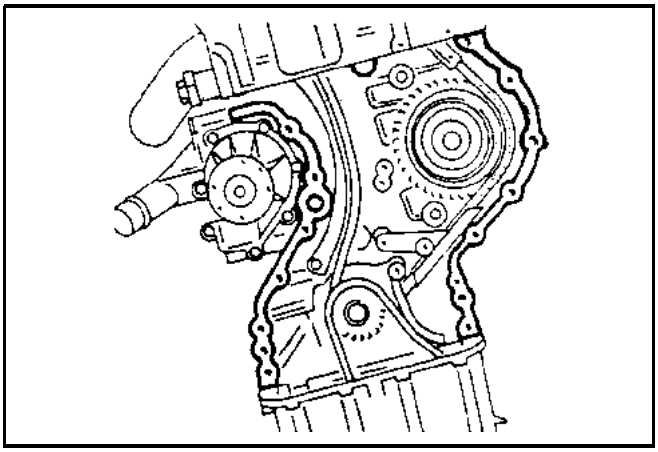


18. Remove the timing case cover (19) bolts and then remove the timing case cover (14).

Notice

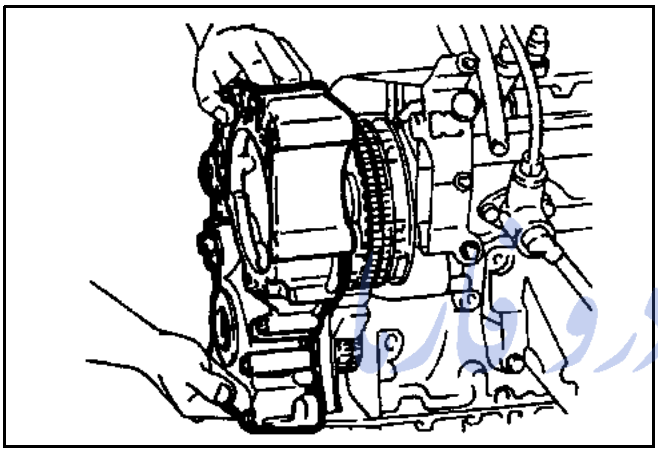
Be careful not to damage the cylinder head gasket or oil pan gasket.

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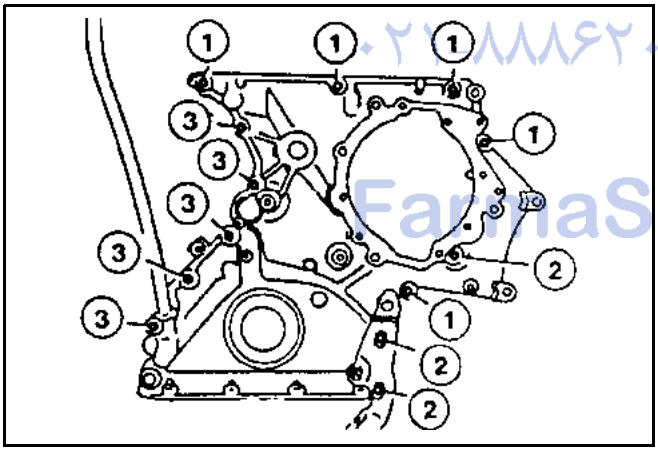
Installation Procedure

1. Thoroughly clean the sealing surface and apply sealant.



2. Install the timing case cover.

Tightening Torque	10 N·m (89 lb-in)



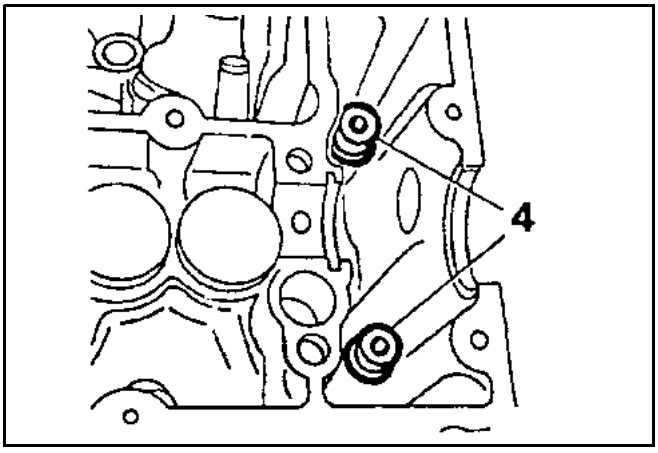
Notice

Bolts arrangement

1.M6 x 60

2.M6 x 70

3.M6 x 40



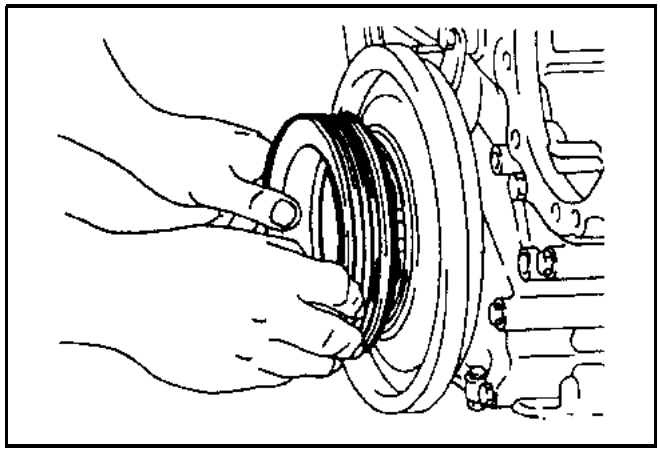
3. Tighten the socket bolts in the chain box.

Tightening Torque	23 N·m (17 lb-ft)

4. Tighten the oil pan bolts.

Tightening Torque	Socket bolt	10 N·m (89 lb-in)
	M6 bolt	10 N·m (89 lb-in)
	M8 bolt	23 N·m (17 lb-ft)

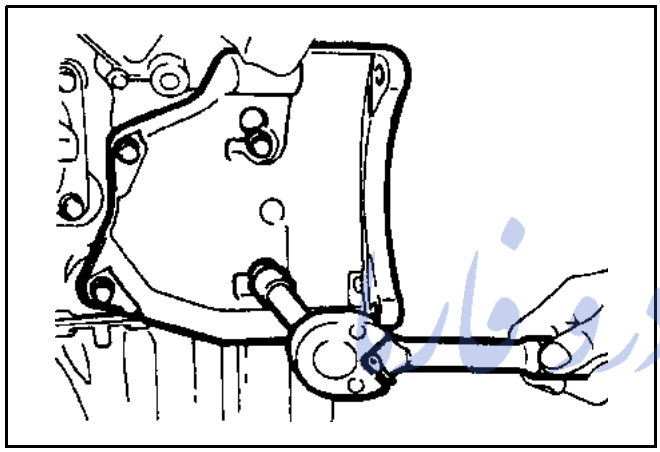
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5. Install the flange, vibration damper and crankshaft belt pulley.

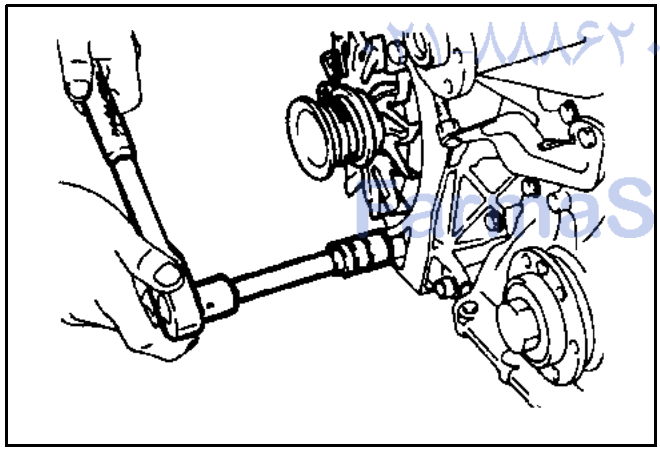
Notice

Replace front radial seal if necessary.



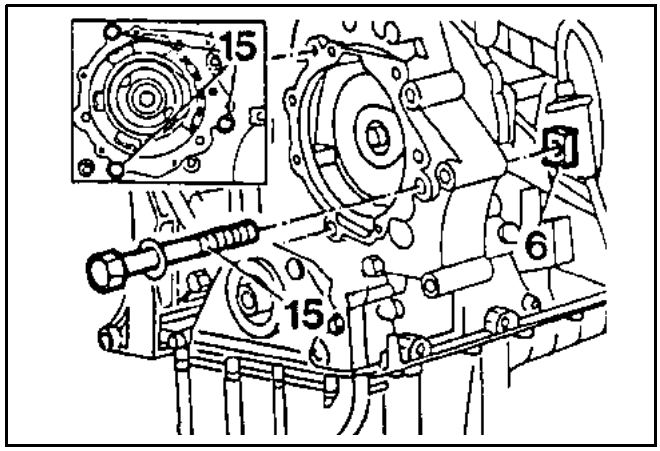
6. Install the generator bracket.

Tightening Torque	Front	25 N·m (18 lb-ft)
	Side	25 N·m (18 lb-ft)



7. Install the generator.

Tightening Torque	Upper - 25 N·m (18 lb-ft)
	Low - 25 N·m (18 lb-ft)



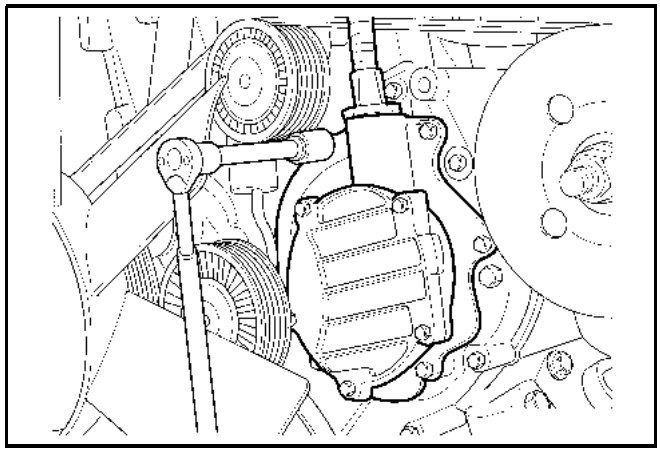
8. Install the cylinder head cover.

Tightening Torque	10 N·m (89 lb-in)

9. Tighten the injection pump mounting bolts.

Tightening Torque	23 N·m (17 lb-ft)

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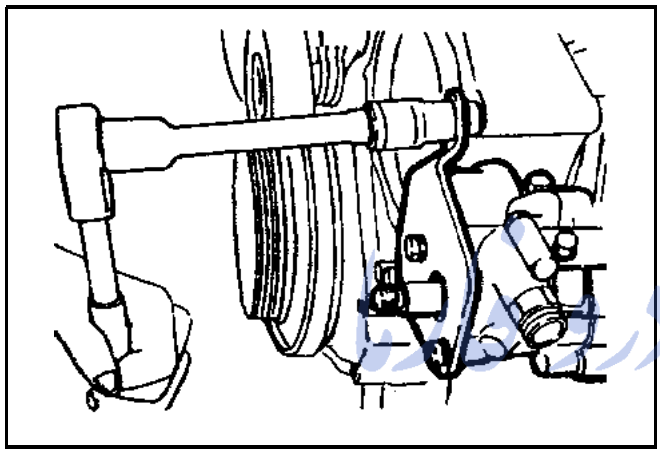


10. Install the fuel filter.

Tightening Torque	25 N·m (18 lb-ft)

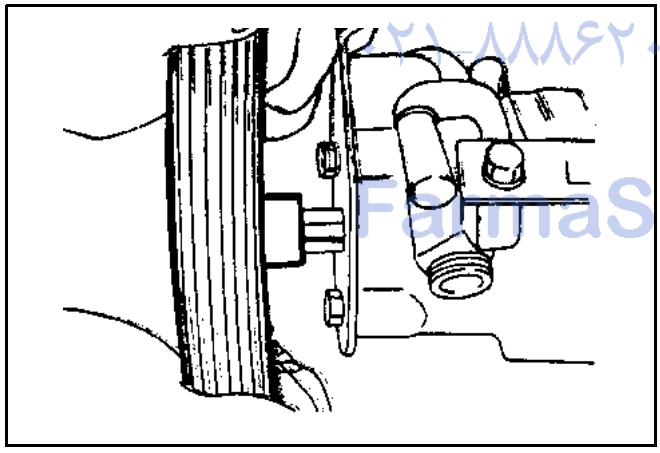
11. Install the vacuum pump.

Tightening Torque	10 N·m (89 lb-in)



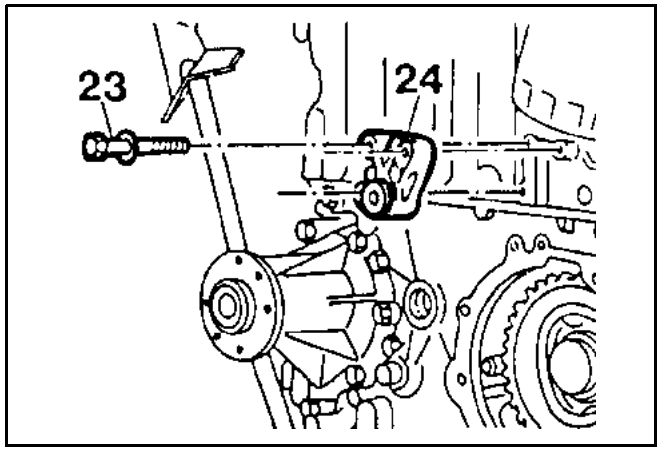
12. Install the power steering pump.

Tightening Torque	23 N·m (17 lb-ft)



13. Install the power steering pump pulley

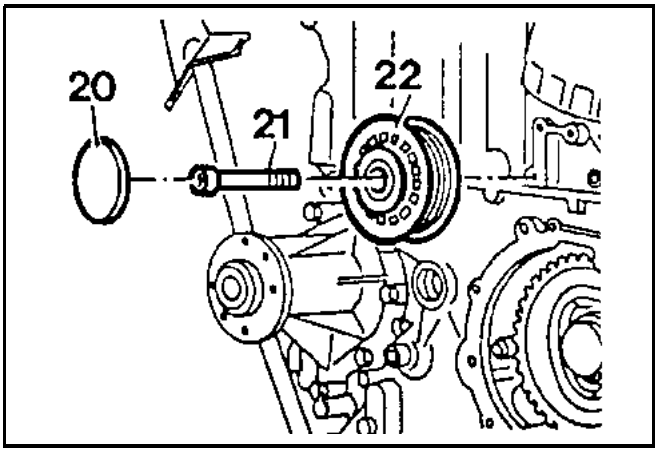
Tightening Torque	32 N·m (24 lb-ft)



14. Install the guide pulley bracket

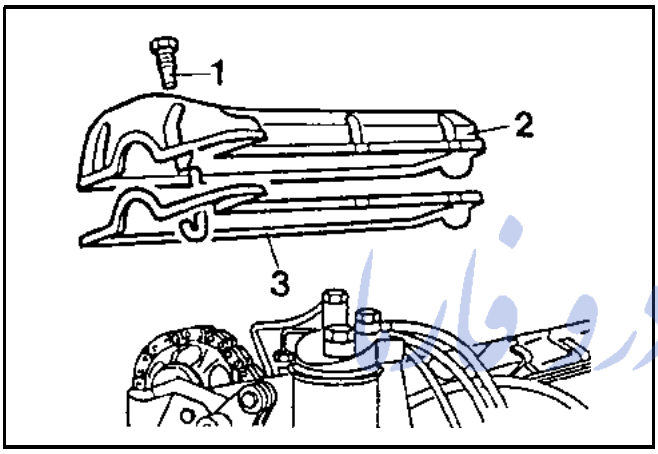
Tightening Torque	9 N·m (80 lb-in)

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15. Install the guide pulley (22) and fit the closing cover (20).

Tightening Torque	23 N·m (17 lb-ft)



16. Replace the gasket (3) and install the cylinder head cover (2).

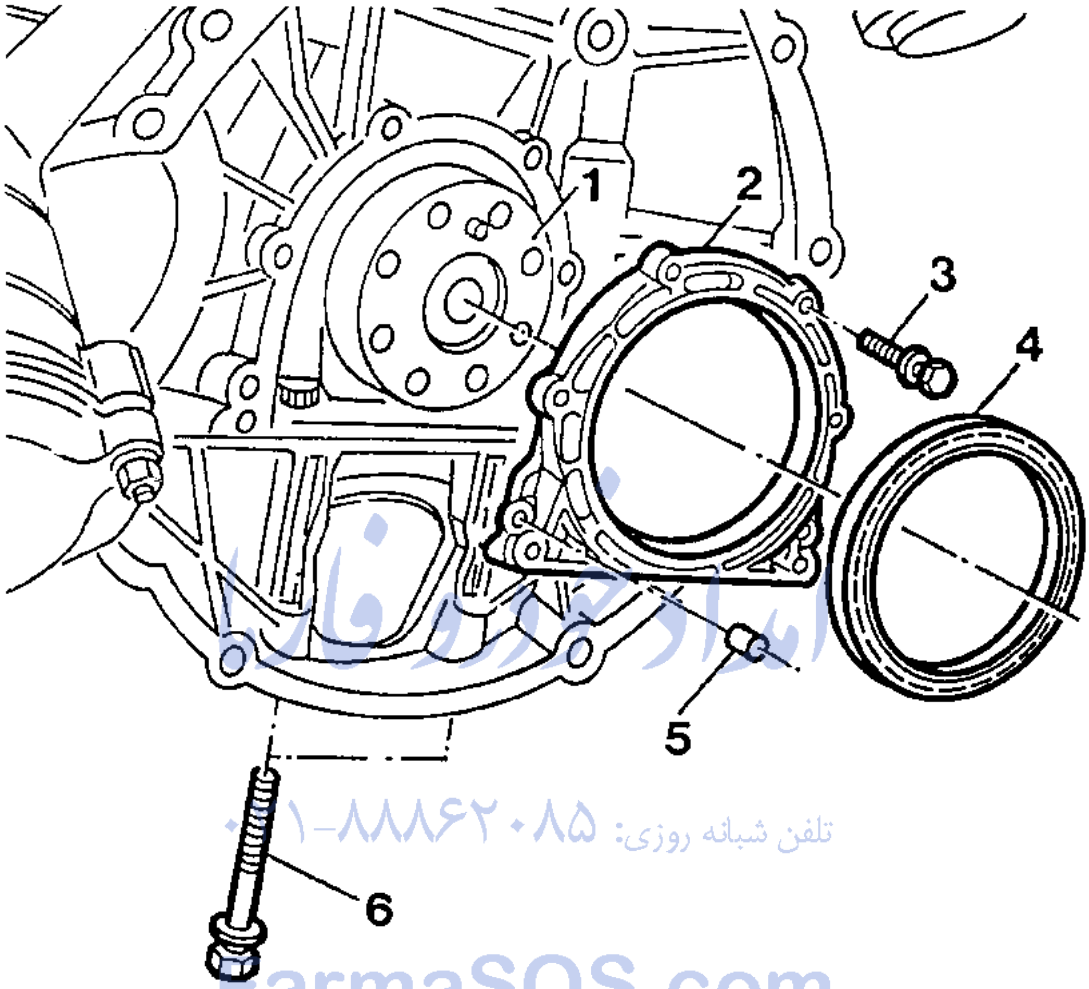
Tightening Torque	10 N·m (89 lb-in)

17. Install the cooling fan belt pulley and fan clutch.
18. Install the belt tensioning device and then install the belt.
19. Install the cooling fan.
20. Fill the engine oil and check oil leaks by running the engine.

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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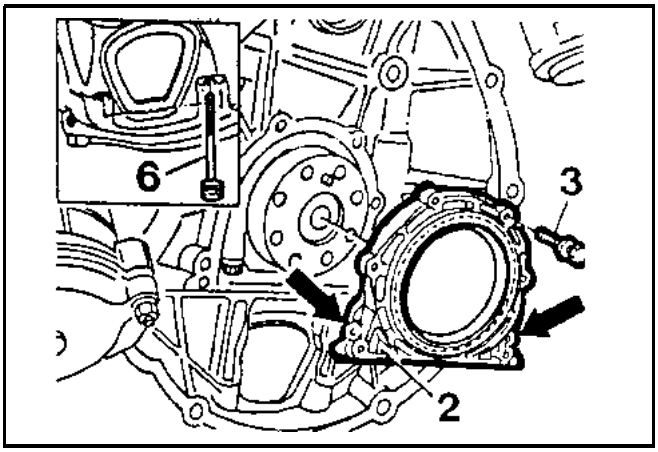
CRANKSHAFT END COVER

Preceding Work : Removal of flywheel and driven plate.



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1 Crankshaft Flange
2 End Cover . . . . . Clean, Loctite 573
3 Bolt . . . . . 10N·m, Loctite 573
4 Radial Seal . . . . . Replace
5 Dowel Sleeve
6 Bolt . . . . . 10N·m (89 lb-in), Loctite 573



Tools Required

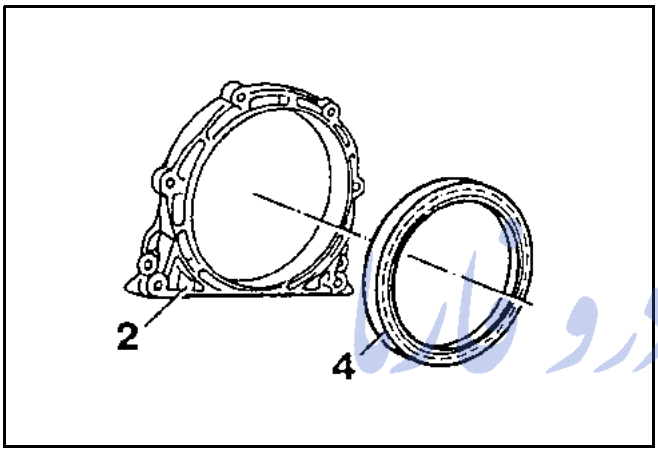
601 589 03 43 00 Oil Seal Assmbler

Removal Procedure

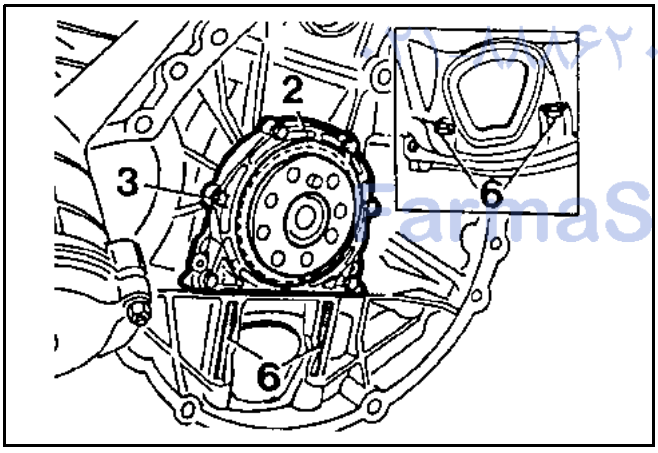
1. Remove the bolts (3, 6) from end cover, By pulling out the lugs (arrow), remove the cover.

   Notice

   Be careful not to damage the oil pan gasket.



2. Remove the radial seal (4) with care not to damage the sealing surface.



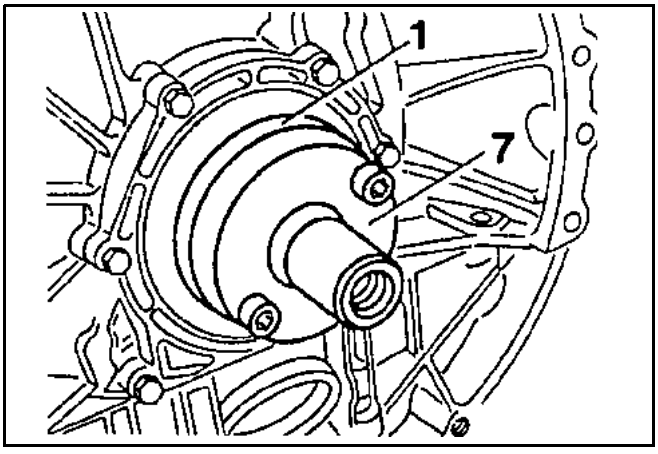
Installation Procedure

1. Thoroughly clean the sealing surface of end cover and apply Loctite 573.
2. Clean the groove of radial seal.
3. Apply Loctite 573 on the bolts and install the end cover.

Tightening Torque	10 N·m (89 lb-in)

   Notice

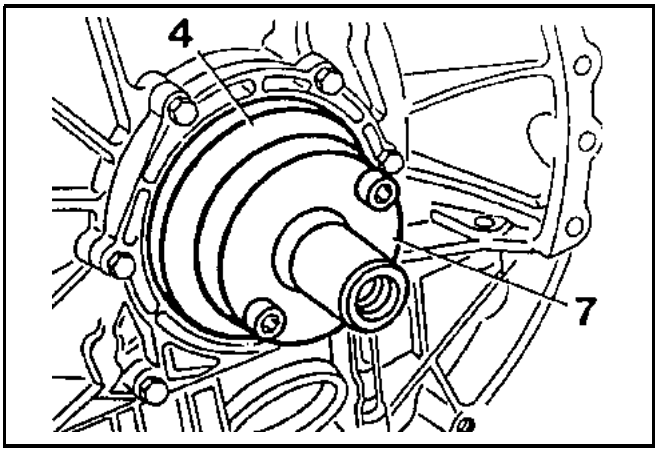
   Be careful not to damage the oil pan gasket.



4. Install the inner oil seal assembler to the crankshaft flange.

Oil Seal Assembler 601 589 03 43 00

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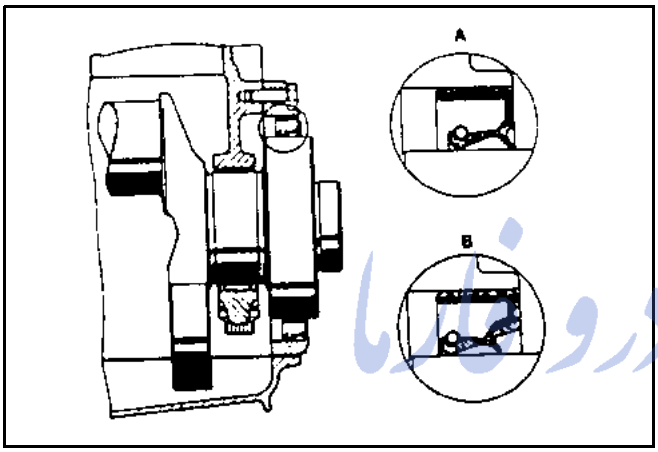


5. Coat a little oil on the sealing lip of new radial seal and contacting surface.

Notice

Don't use grease.

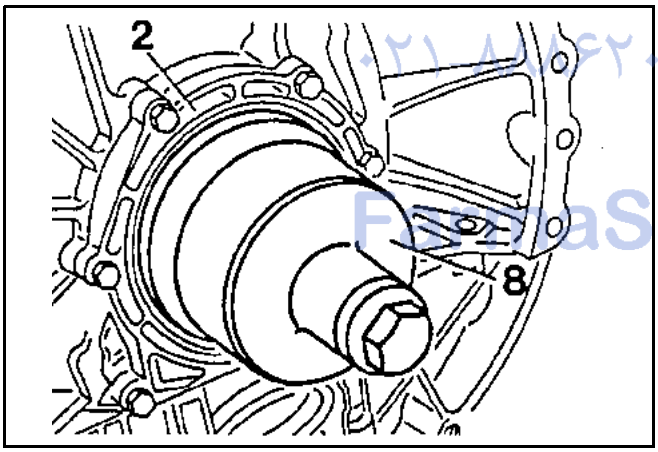
6. Insert the new radial seal (4) onto the oil seal assembler (7).



Notice

The sealing lip of the repair radial seal is offset to the inside by 3mm to ensure that it does not run in any groove which the standard radial seal may have left on the crankshaft flange.

A Standard Radial Seal
B Repair Radial Seal



7. Install the outer oil seal assembler on he seal and by tightening the bolts, press the radial seal into the end cover as far as the stop.

Notice

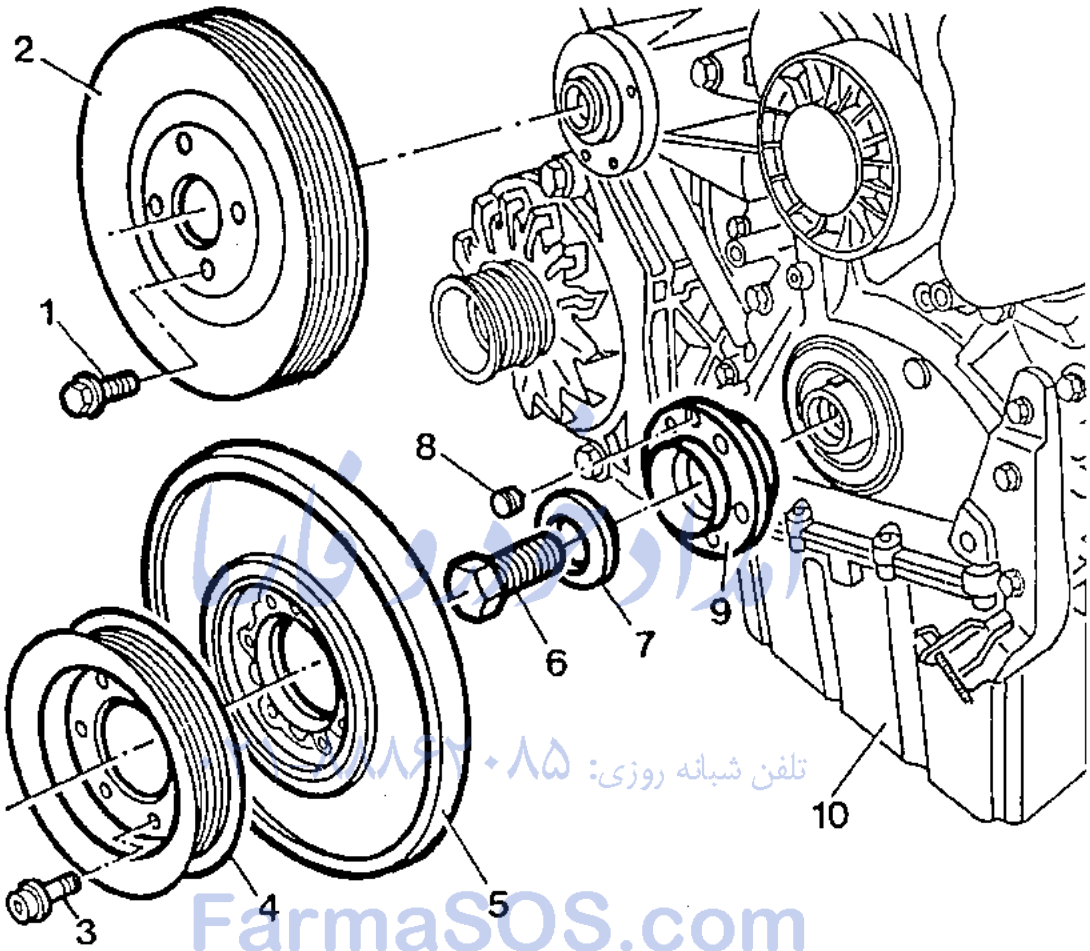
The seal must be positioned exactly at right angles in the end cover to ensure that it provides a proper seal.

Oil Seal Assembler 601 589 03 43 00

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VIBRATION DAMPER AND HUB

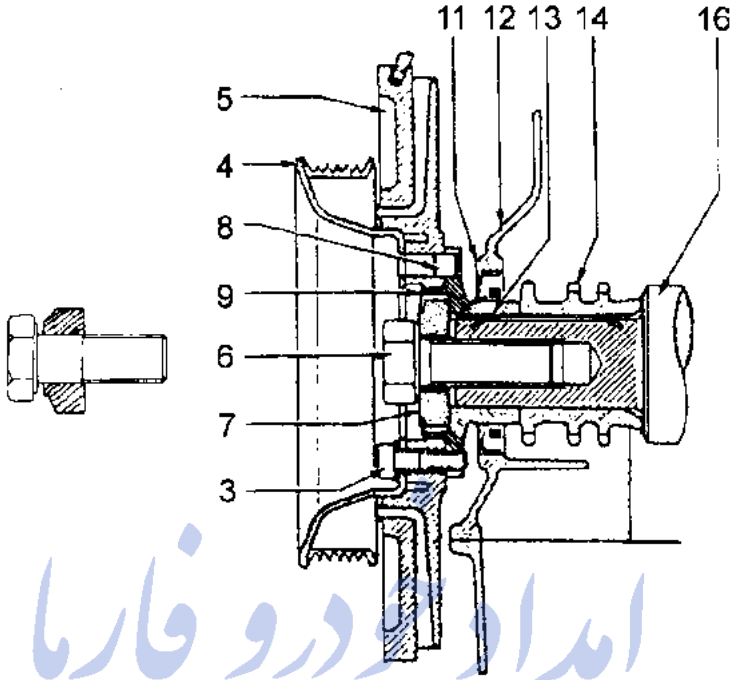
Preceding Work : Removal of the cooling fan
Removal of poly V-belt



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1 Bolt ..... 10N·m (89 lb-in)
2 Cooling Fan Belt Pulley
3 Socket Bolt ..... 23N·m (17 lb-ft)
4 Crankshaft Belt Pulley
5 Vibration Damper
6 Bolt ..... 200N·m (148 lb-ft) + 90°
7 Washer
8 Straight Pin
9 Hub
10 Oil Pan

Sectional View



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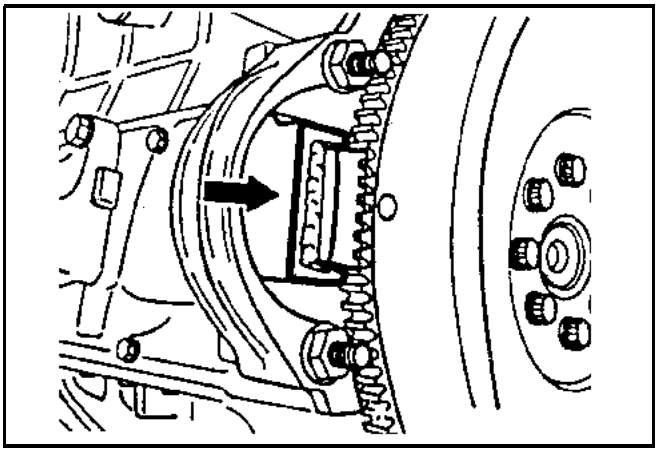
3 Socket Bolt
4 Crankshaft Belt Pulley
5 Vibration Damper
6 Bolt
7 Washer
8 Straight Pin
9 Hub
11 Radial Seal
12 Timing Gear Case Cover
13 Key
14 Crankshaft Sprocket
16 Crankshaft

Notice

The mounting position of vibration damper is fixed by straight pin (8).

Tools Required

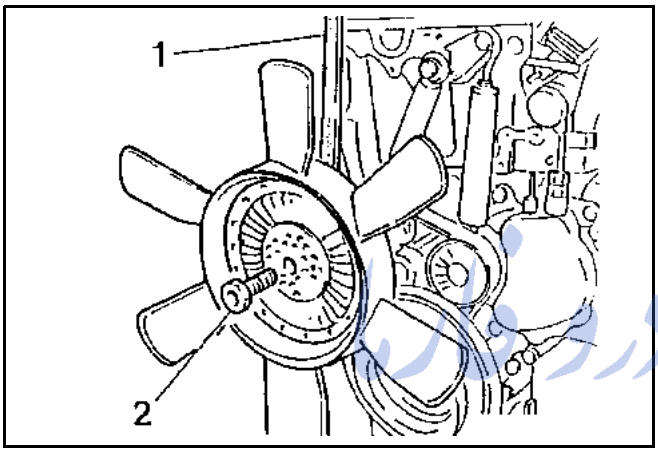
602 589 00 40 00 Engine Lock
103 589 00 30 00 Puller



Removal Procedure

1. Remove the starter motor and install the engine lock into the wheel ring gear.

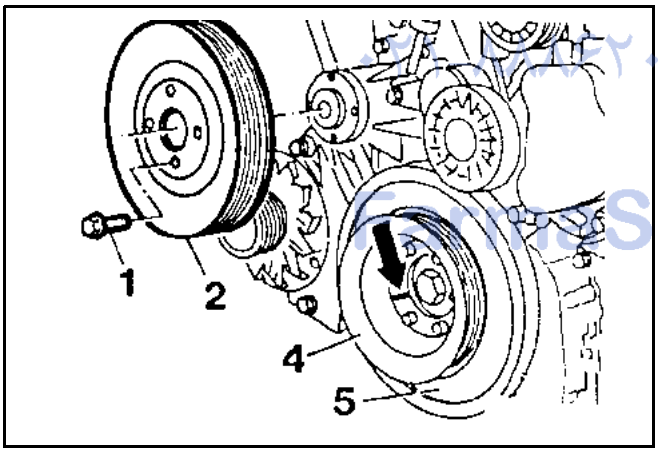
Engine Lock 602 589 00 40 00



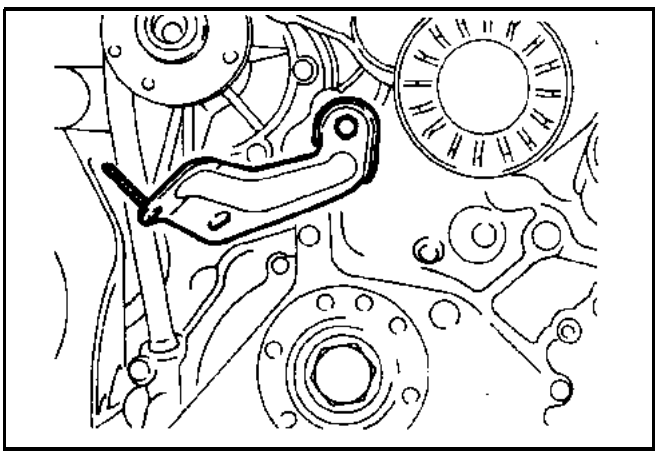
2. Remove the poly V-belt.
3. Remove the cooling fan.

Notice

Keep the fan in vertical position.



4. Remove the cooling fan belt pulley (2).
5. Place alignment marks (arrow) on the vibration damper (5) and crankshaft belt pulley (4).

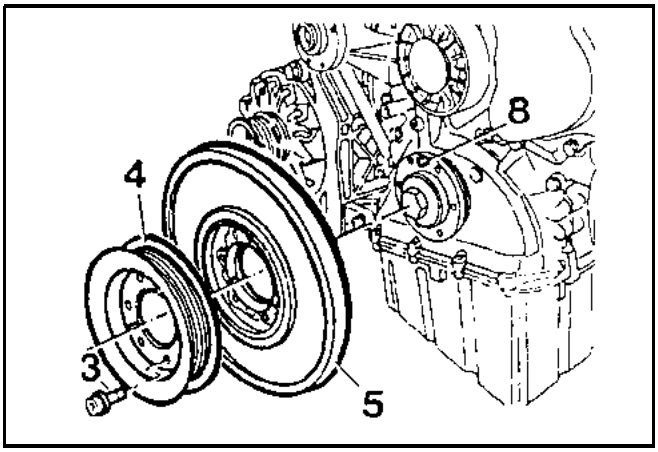


6. Remove the timing sensor bracket.

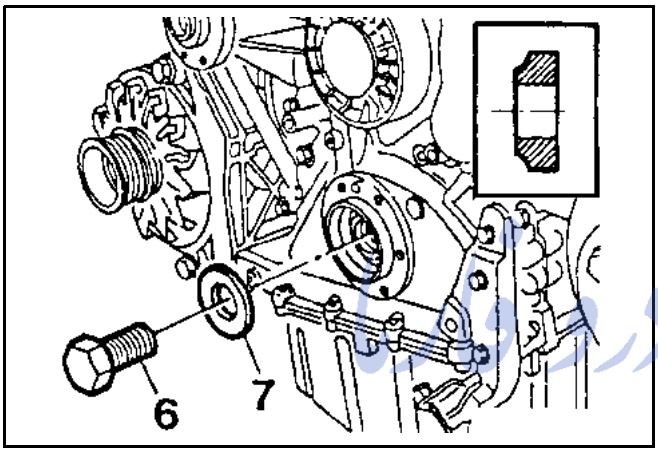
Notice

Remove if necessary.

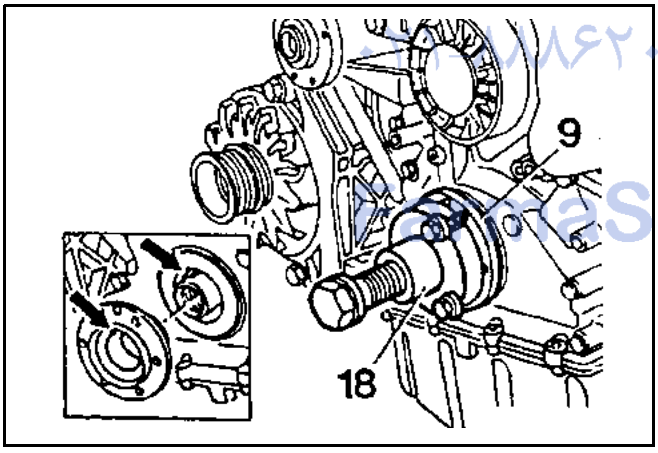
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7. Remove the socket bolts (3) and then remove the belt pulley (4) and vibration damper (5).



8. Remove the washer and bolt.

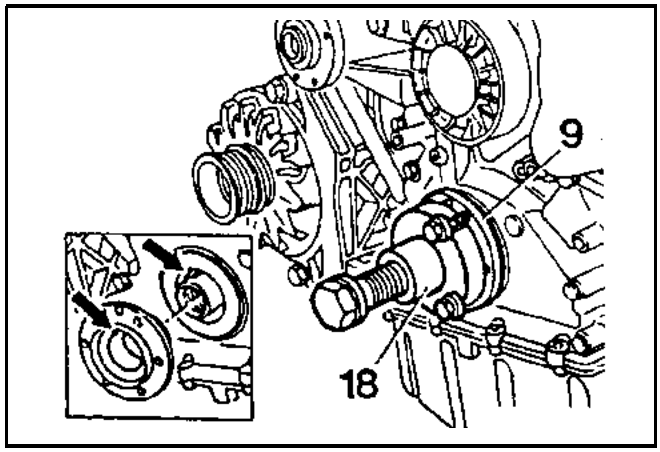


9. Remove the hub by using a puller.

Puller 103 589 00 33 00

10. Replace the radial seal.

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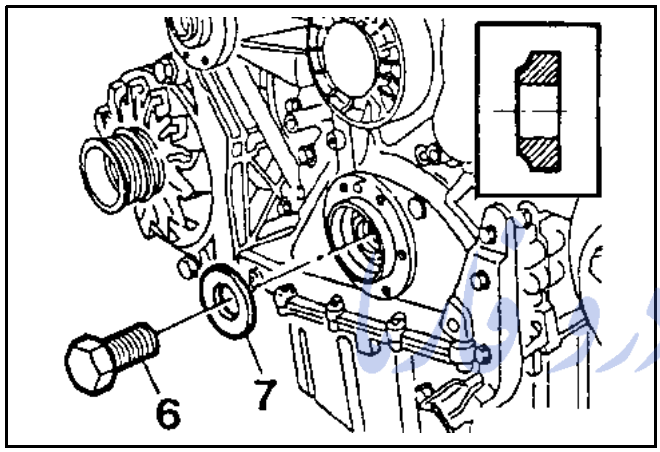


Installation Procedure

1. Install the hub.

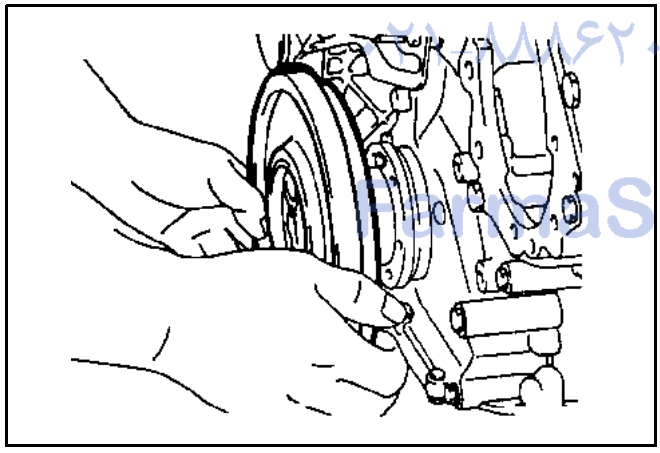
Notice

Exactly align the woodruff key and the groove of hub (arrow).



2. Install the washer (7) and tighten the bolt (6).

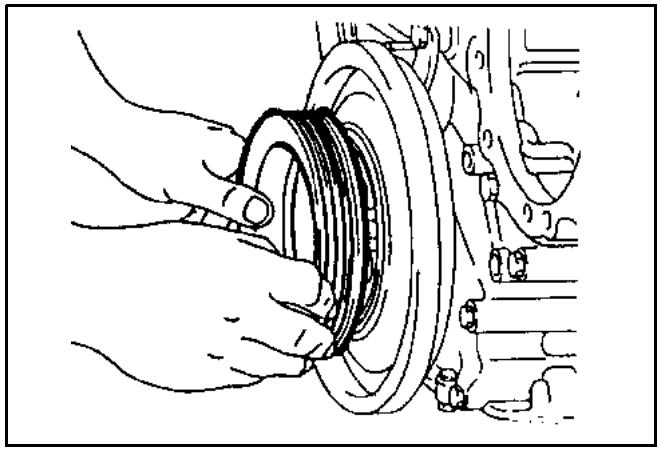
Washer (new) :1 EA	200 N·m (148 lb-ft) + 90°



3. Install the vibration damper.

Notice

Exactly align and insert onto the straight pin.



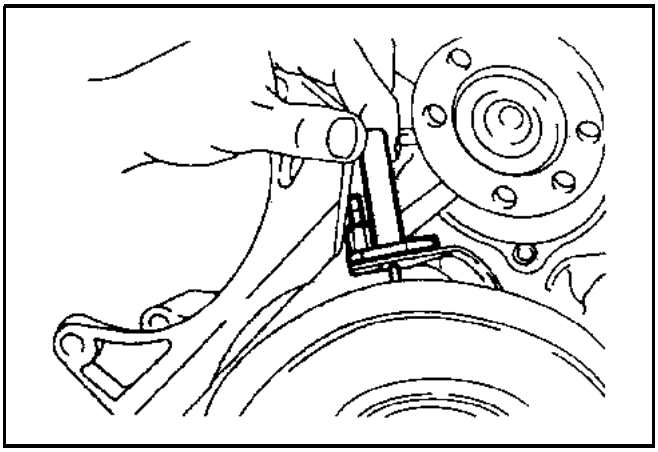
4. Install the belt pulley.

Tightening Torque	25 N·m (18 lb-ft)

Notice

Align the alignment marks.

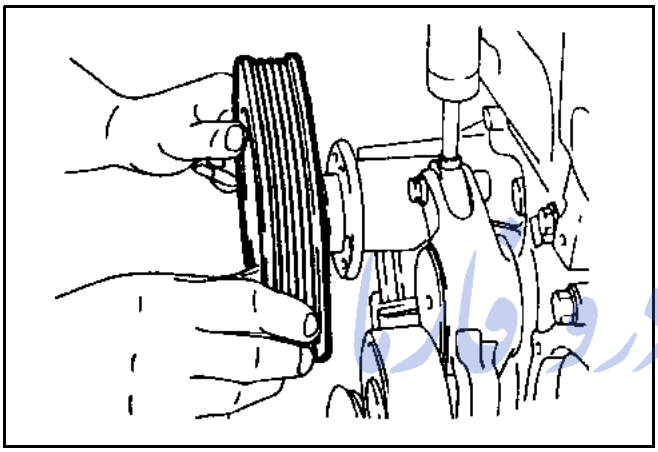
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5. Install the timing sensor bracket.

Notice

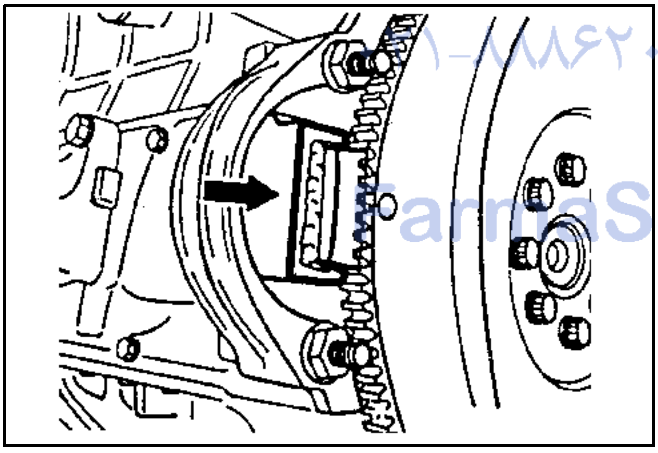
See the 'TDC setting'.



6. Install the cooling fan pulley.

Tightening Torque	10 N·m (89 lb-in)

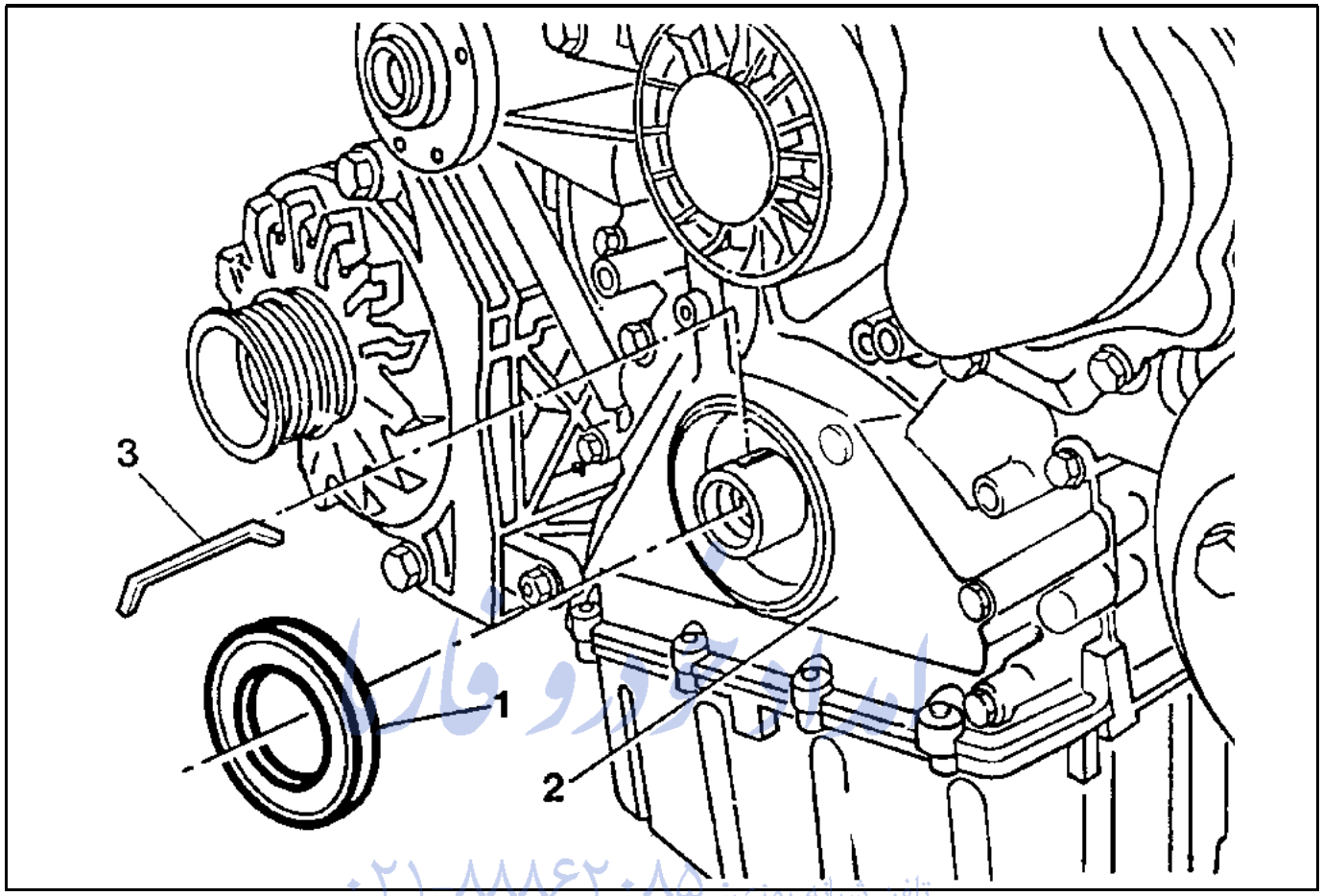
7. Install the cooling fan.
8. Install the fan belt.



9. Remove the engine lock.

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CRANKSHAFT FRONT RADIAL SEAL



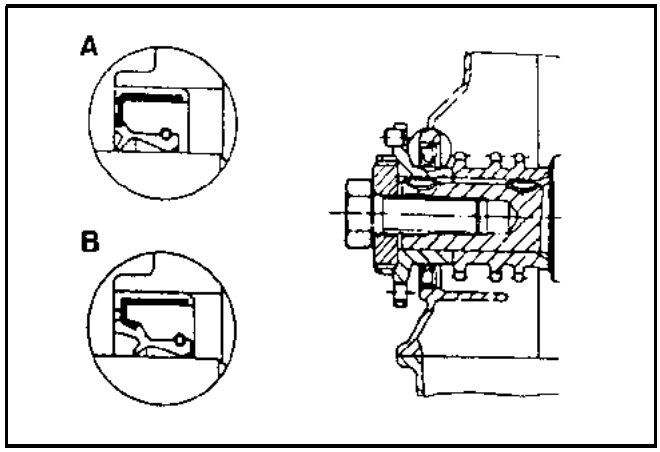
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1 Radial Seal
2 Timing Case Cover
3 Woodruff Key

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Tools Required

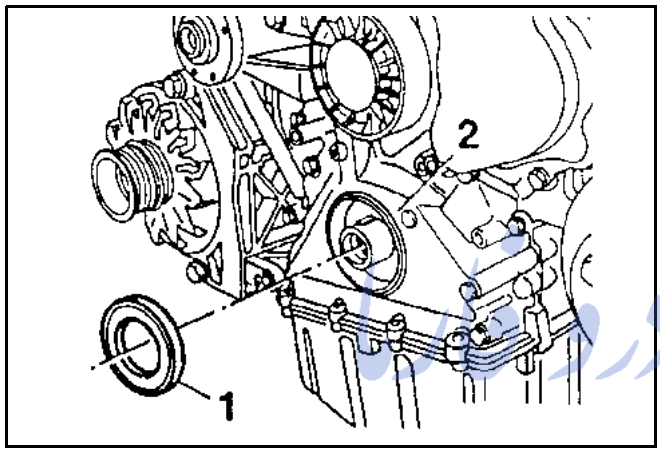
601 589 03 14 00 Sleeve



Notice

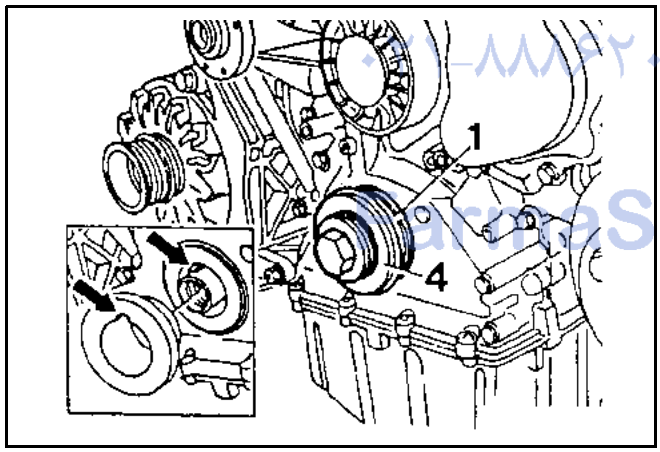
The sealing lip of the repair radial seal is offset to the inside by 2mm to ensure that is does not run in any groove which the standard radial seal may have left on the crankshaft flange.

A Standard Radial Seal
B Repair Radial Seal



Replacement Procedure

1. Pull out the radial seal (1) and be careful not to damage the sealing surface of timing case cover.
2. Thoroughly clean the mounting bore of the radial seal.



3. Coat a little oil on the sealing lip of new radial (1) and contact surface.

Notice

Don't use grease.

4. Install the radial seal (1) by using a sleeve (4).

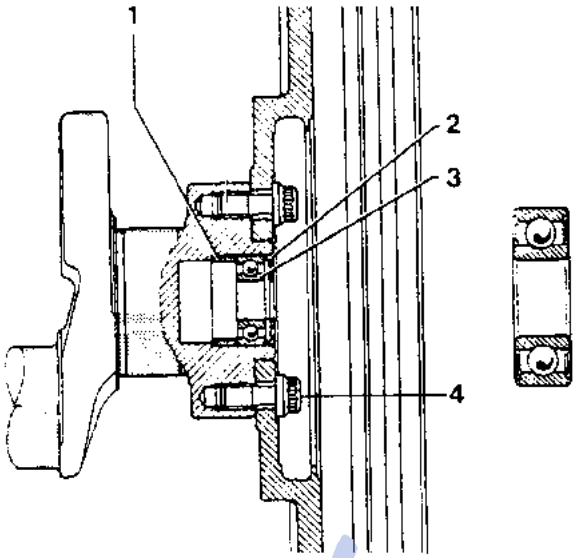
Notice

Align the groove of sleeve and woodruff key(arrow).

Sleeve 601 589 03 14 00

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CRANKSHAFT BALL BEARING



1 Spacer
2 Cover . . . . . Replace
3 Ball Bearing
4 Bolt . . . . . 45N·m (33 lb-ft)+ 90°

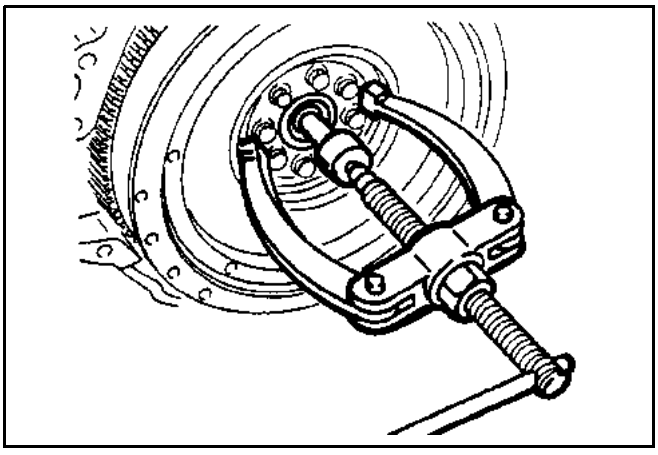
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Notice

Manual transmission only.

Tools Required

000 589 33 33 00 Counter Support
000 589 25 33 00 Internal Extractor



Removal & Installation Procedure

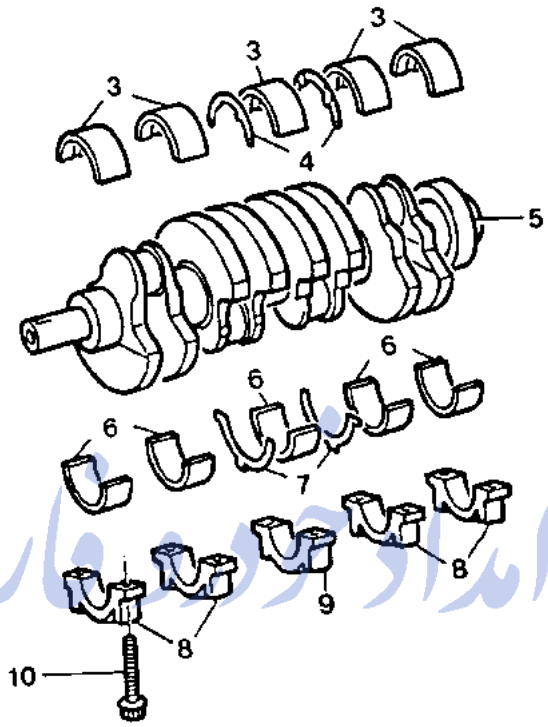
1. Remove the manual transmission.
2. Using a puller, pull out the locking ring and ball bearing together.

Counter Support 000 589 33 33 00
Internal Extractor 000 589 25 33 00

3. Apply Loctite 241 on the new ball bearing and then insert the ball bearing to be stopped at the spacer ring by using a proper mandrel.

CRANKSHAFT

Preceding Work : Removal of the end cover
Removal of the piston
Removal of the crankshaft sprocket



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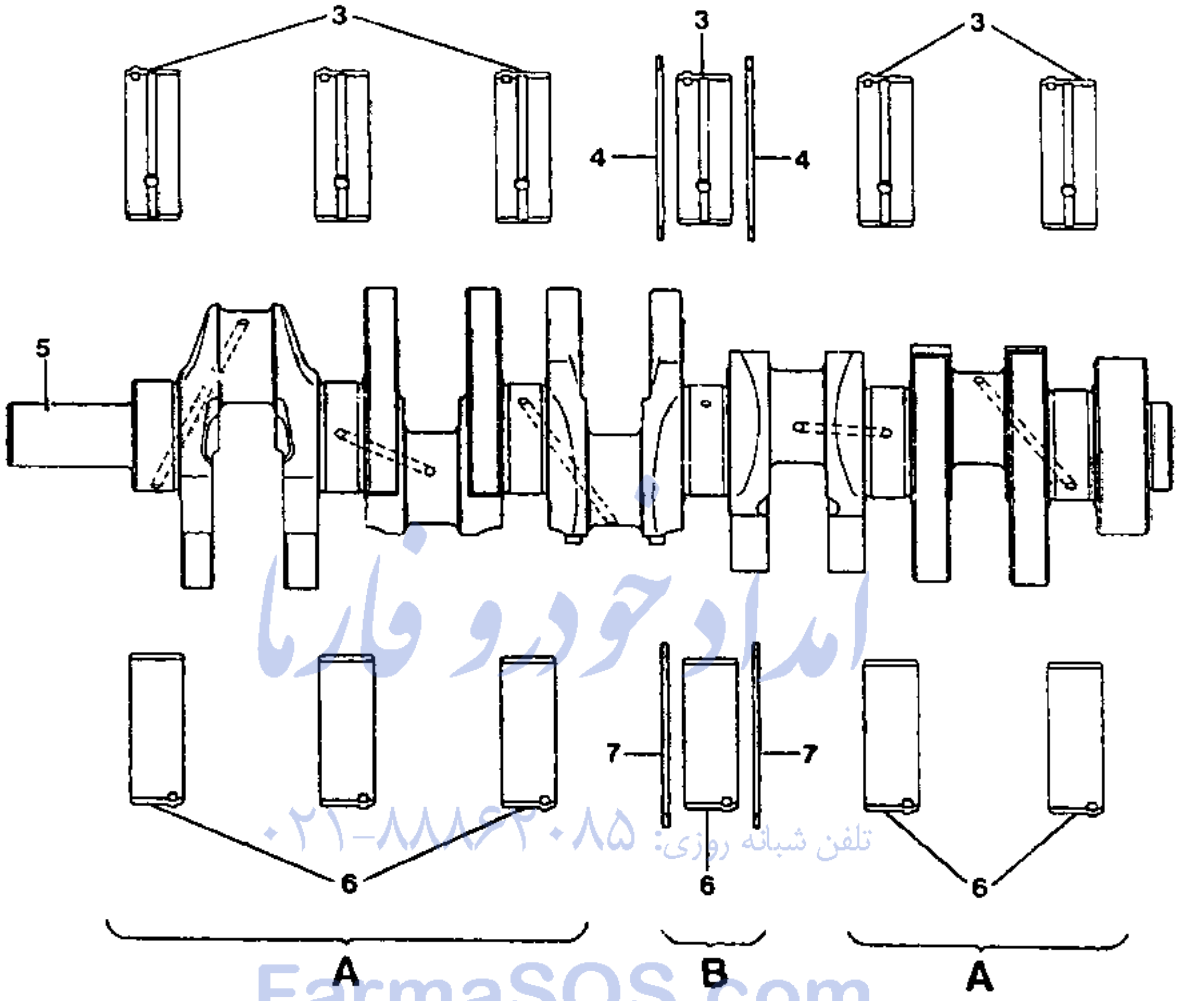
3 Crankshaft Main Bearing Shells (Upper)
4 Trust Bearings (Upper)
5 Crankshaft
6 Crankshaft Main Bearing Shells (Lower)
7 Thrust Bearings (Lower)
8 Crankshaft Bearing Cap
9 Crankshaft Bearing Cap (Fit Bearing)
10 12-sided Stretch Bolts : 55N·m (41 lb-ft)+90°

Tools Required

001 589 53 21 00 Dial Gauge
363 589 02 21 00 Dial Gauge Holder
366 589 00 21 05 Extension

Thrust Washer and Bearing Arrangement

OM662LA Engine



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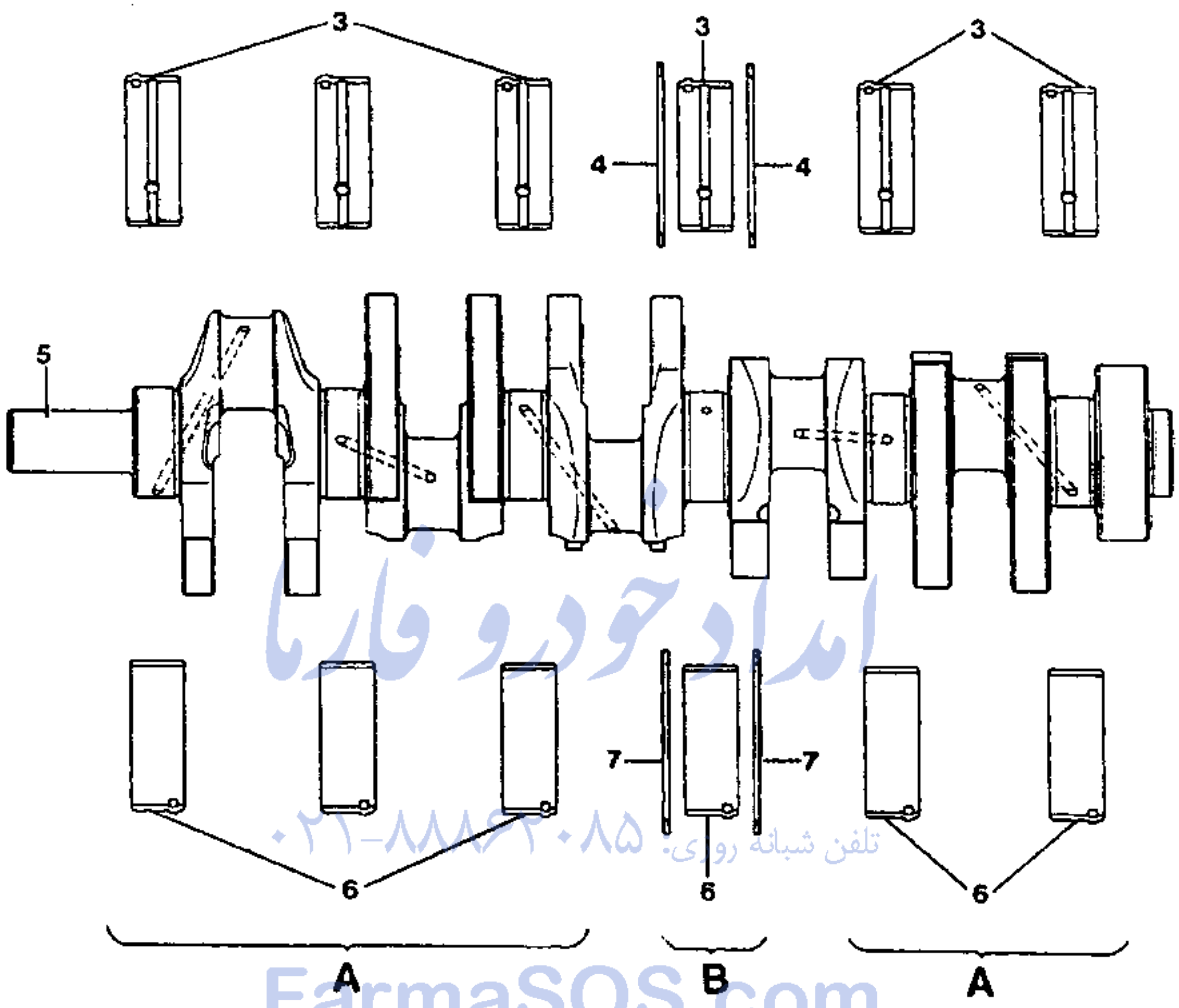
3 Crankshaft Main Bearing Shells (Upper)
4 Thrust Bearings (Upper)
5 Crankshaft
6 Crankshaft Main Bearing Shells (Lower)
7 Thrust Bearings (Lower)

A Radial Bearings
B Radial and Axial Bearings (Thrust Bearing)

Notice

The gaps between the bearing shell and bore and between the bearing shell and journal are different each other. Refer to service data.

OM661LA Engine



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3 Crankshaft Main Bearing Shells (Upper)
4 Thrust Bearings (Upper)
5 Crankshaft
6 Crankshaft Main Bearing Shells (Lower)
7 Thrust Bearings (Lower)

A Radial Bearings
B Radial and Axial Bearings (Thrust Bearing)

Notice

The gaps between the bearing shell and bore and between the bearing shell and journal are different each other. Refer to service data.

Crankshaft Standard and Repair Sizes

mm

	Crankshaft bearing journal diameter	Thrust bearing journal width	Thrust bearing journal diameter
Standard size	50.950 - 57.965	24.500 - 24.533	47.950 - 47.965
		24.600 - 24.633	
Repair size 1	57.500 - 57.715	24.700 - 24.733	47.700 - 47.715
Repair size 2	57.450 - 57.465	24.900 - 24.933	47.450 - 47.650
Repair size 3	57.200 - 57.215	25.000 - 25.033	47.200 - 47.215
Repair size 4	56.950 - 56.965	-	46.950 - 46.965

Bearing Clearances

mm

		Thrust bearing	Crankshaft bearing
Radial clearance	New	0.027 - 0.051	0.026 - 0.068
	Limit	Max. 0.070	Max. 0.080
Axlal clearances	New	0.100- 0.254	-
	Limit	Max. 0.300	-

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Matching Fit Bearing Journal Width to Thrust Bearings

mm

Fit bearing journal width	Thrust bearing thickness
24.500 - 24.533	2.15
24.600 - 24.633	2.20
24.700 - 24.733	2.25
24.900 - 24.933	2.35
25.000 - 25.033	2.40

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Notice

- Measure crankshaft axial clearance and adjust with proper thrust Bearing.
- The same thickness of washer must be installed on both sides of the fit bearing.

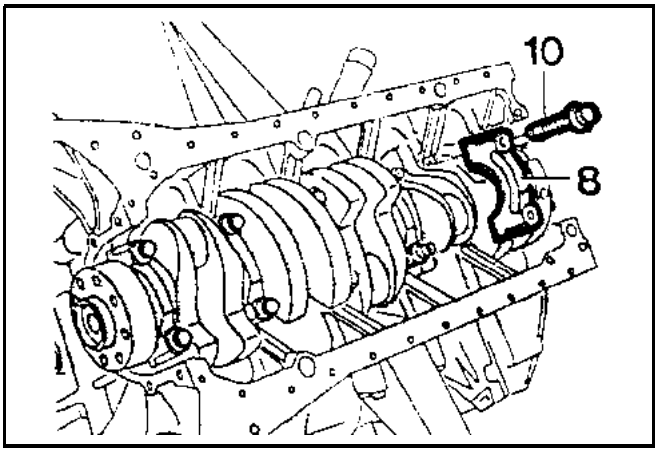
Matching Crankshaft Bearing Shells to Basic Bearing Bore in Crankshaft

Marking of basic bearing bore in lower parting surface	Color code of relevant crankshaft bearing shell
1 punch mark or blue	Blue or white-blue
2 punch marks or yellow	Yellow or white-yellow
3 punch marks or red	Red or white-red

Matching Crankshaft Bearing Shells to Basic Bearing Journal of Crankshaft

Marking of bearing journals on crank webs	Color code of relevant crankshaft bearing shell
Blue or white-blue	Blue or white-blue
Yellow or white-blue	Yellow or white-yellow
Red or white-blue	Red or white-red

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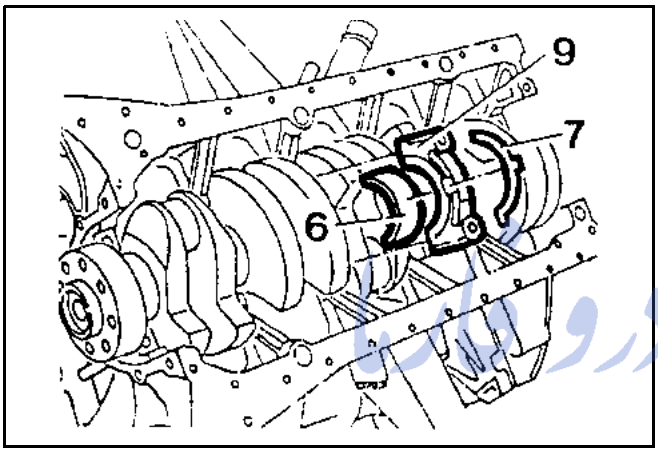


Removal & Installation Procedure

1. Remove the bearing cab bolt.
2. Remove the bearing caps (8).

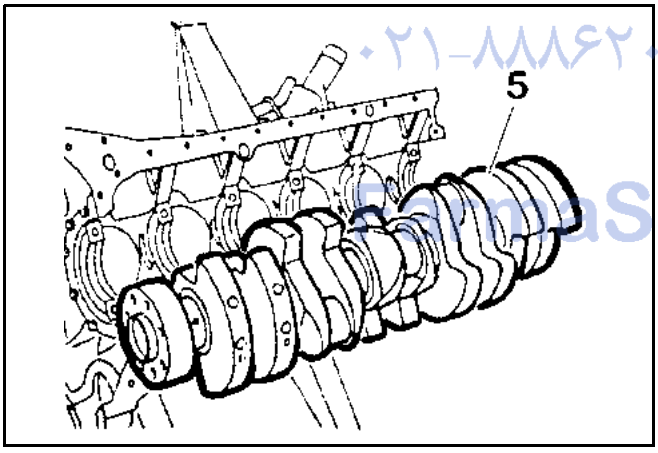
Notice

The crankshaft bearing caps are marked with stamped numbers. Remove the bearing cap from the vibration damper side.

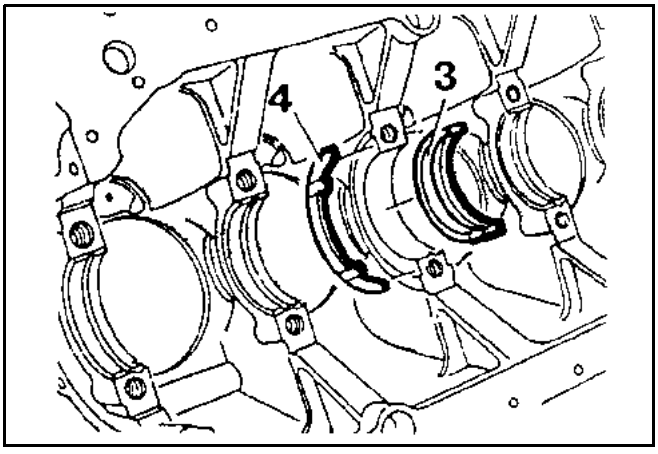


3. Remove the crankshaft bearing caps (9) and lower thrust bearings (7).
4. Remove the lower thrust bearings (6) from the bearing cap (9).

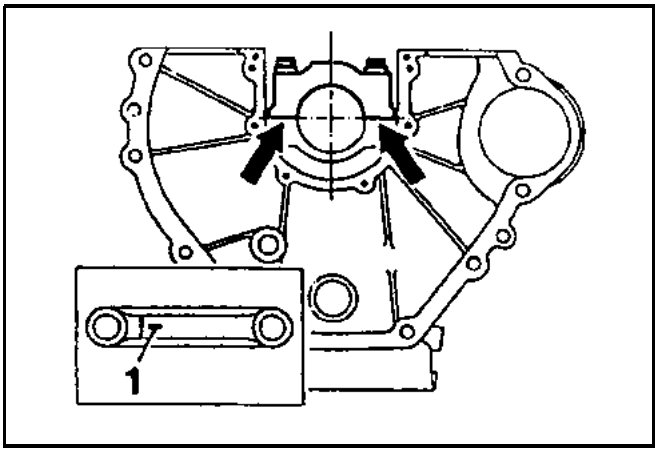
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5. Remove the crankshaft (5).



6. Remove the upper thrust bearings(4).
7. Remove the upper bearing shells (3) from crankcase.



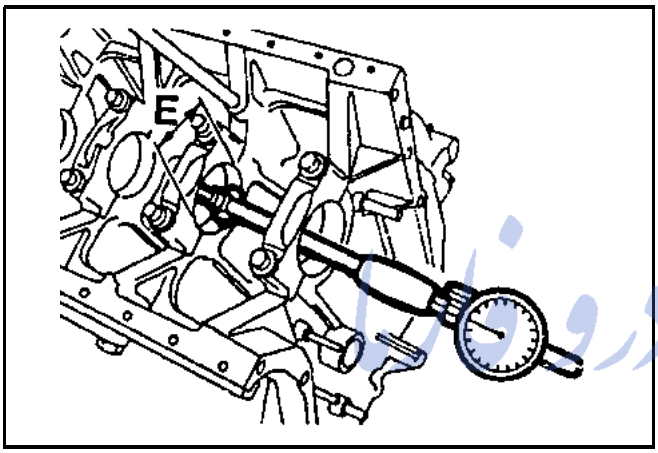
8. Thoroughly clean the oil gallery.
9. Select a proper new bearing shells with reference to table.
10. Coat the new bearing shells with oil and insert into the crankcase and into the crankshaft bearing caps.

Notice

Do not mix up upper and lower crankshaft bearing shells.

11. Install the bearing caps according to marking and tighten the 12-sided stretch bolts.

Tightening Torque	35-40 N·m (26-30 lb-ft)



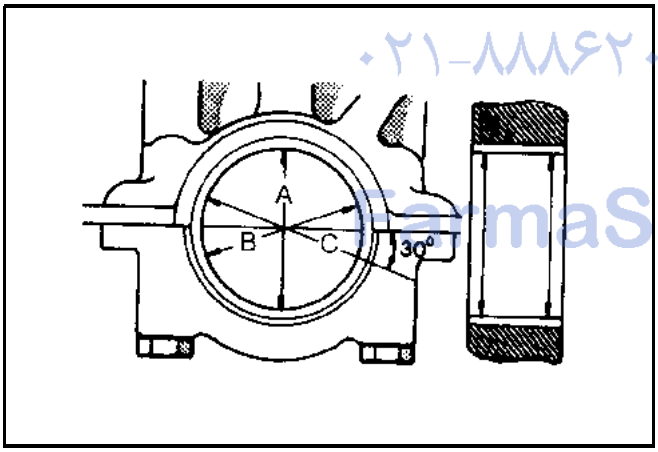
Notice

No. 1 is vibration damper side.

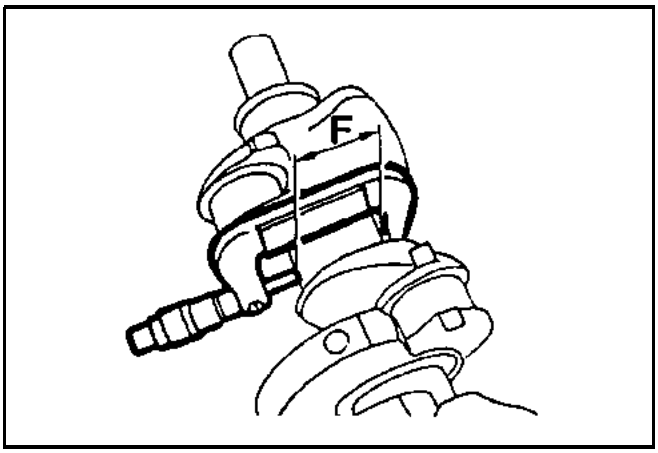
12. Measure crankshaft bearing diameters (E).

Extension 366 589 00 21 05

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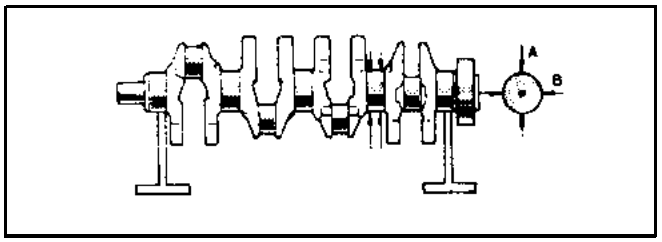
13. Measure at 3 points (A, B and C) and if the average value of B and C is less than A's value, the average value of B and C is the mean value and if more than A's value, A's value is the mean value.



14. Measure crankshaft bearing journal diameter (F).

Notice

When measured in A and B, the runout should not exceed 0.010mm.



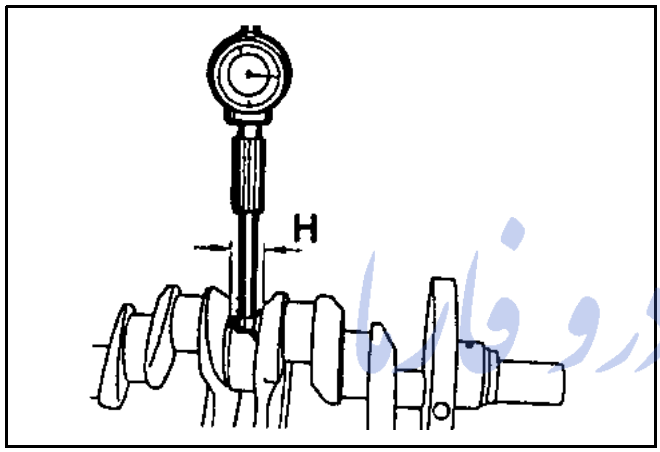
15. Measure radial clearance of crankshaft bearing (G).

Clearance 'G'	0.027 - 0.051mm

Notice

If 'G' is out of standard, replace the bearing shells and adjust the radial clearance of crankshaft bearing.

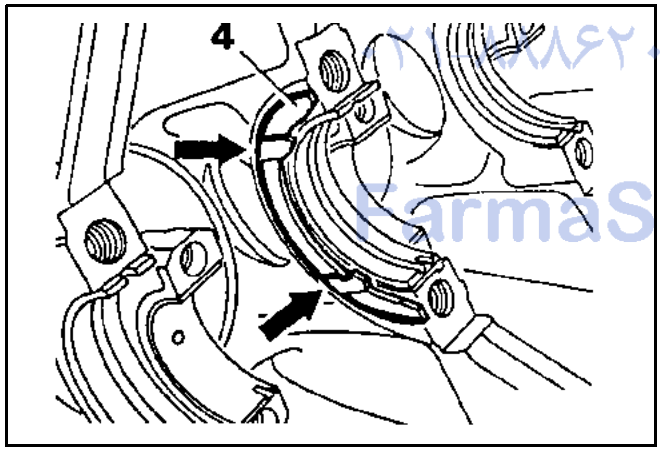
Example) Measured value 'E' = 57.700mm
Measured value 'F' = 57.659mm
Clearance 'G' = 0.041mm



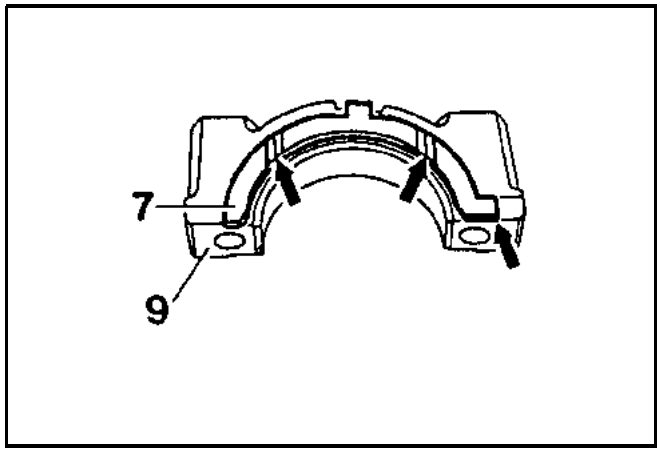
16. Remove the crankshaft bearing cap.
17. Measure width of thrust bearing journal (H) and adjust with proper thrust bearings (see table).

Notice

- The same thickness of thrust washers should be installed on both sides of the thrust bearing.



18. Coat the upper thrust bearing (4) with oil and insert into the crankcase so that the oil grooves are facing the crank webs (arrow).

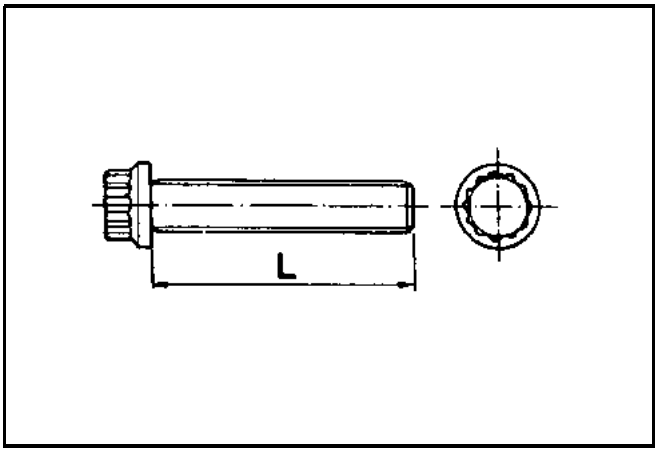


19. Coat the lower thrust bearing (7) with oil and insert into the crankshaft bearing cap so that the oil grooves are facing the crank webs (arrow).

Notice

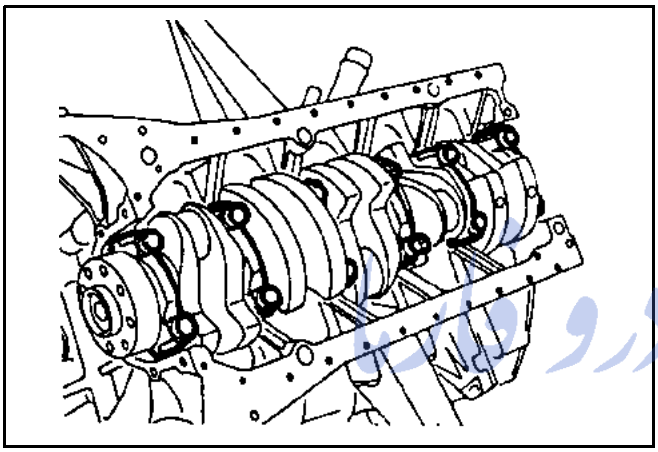
The retaining lugs should be positioned in the grooves (arrow).

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Notice

If the max. length of bolts(L) exceed 63.8mm, replace them.

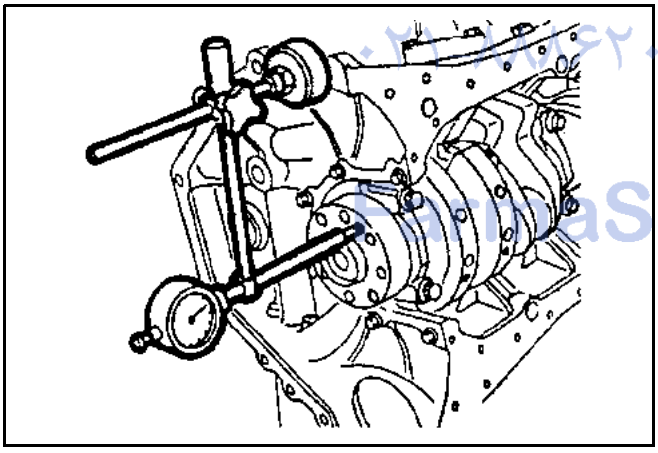


19. Coat the new crankshaft with engine oil and place it on the crankcase.
20. Install the crankshaft bearing caps according to marking and tighten the bolts.

Tightening Torque	55 N·m (41 lb-ft) + 90°

Notice

Install from No. 1 cap.



22. Rotate the crankshaft with hand and check whether it rotates smoothly.
23. Measure crankshaft bearing axial clearance.

Clearance	0.100 - 0.245 mm

Notice

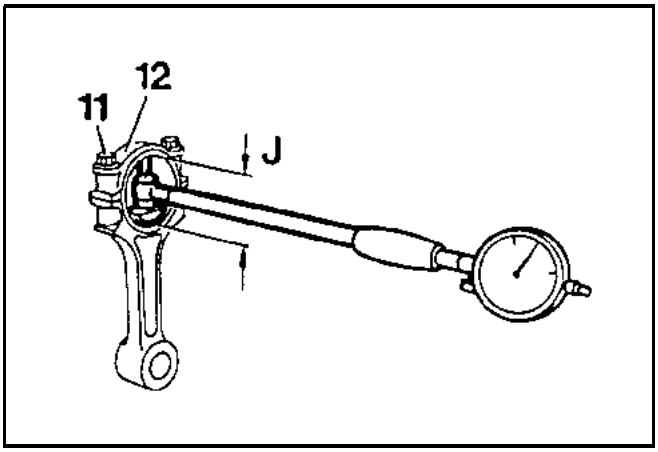
If the clearance is out of standard, adjust the axial clearance of crankshaft bearing by replacing the thrust washers.

Dial Gauge 001 589 53 21 00
Dial Gauge Holder 363 589 02 21 00

Notice

The same thickness of thrust washers should be installed on both sides of the thrust bearing.

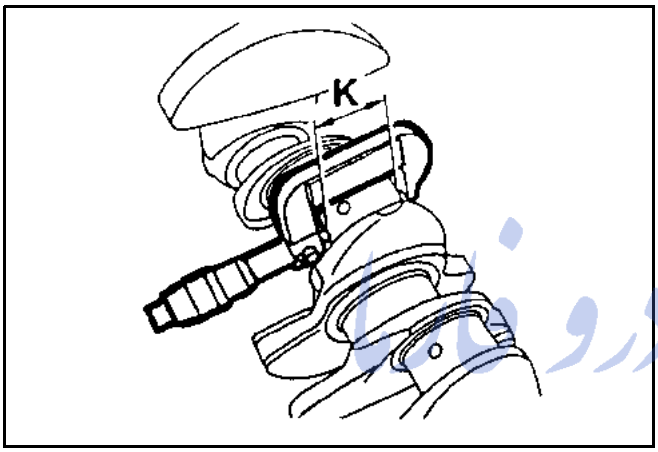
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24. Insert the new connecting rod bearing shells into the connecting rod and connecting rod bearing cap and tighten the 12-sided stretch bolts (11).

Tightening Torque	40 N·m (30 lb-ft) + 90°

25. Measure inner diameter of connecting rod bearing.



26. Measure connecting rod bearing journal diameter (K).

Notice

Refer to measurement of the crankshaft bearing journal diameter.

27. Measure the radial clearance (L) of the connecting rod bearing.

Example) Measured value 'J' = 47.700mm
Measured value 'K' = 47.653mm
Clearance 'L' = 0.047mm

Radial Clearance 'L'	0.026 - 0.068mm

Notice

If the clearance is out of standard, adjust the radial clearance of connecting rod bearing by replacing the connecting rod bearing shells.

28. Remove the connecting rod bearing cap.
29. Install the piston.
30. Rotate the crankshaft by hand and check whether it rotates smoothly.
31. If the bearings are damaged,
    - replace the oil presser relief valve.
    - clean the oil pump and oil filter housing carefully and replace the hose if necessary.

Notice

After assembling the engine, check the camshaft timing, adjust the start of fuel injection and check the TDC sensor bracket setting.

32. Fill oil and run the engine and then check the oil pressure and oil level.

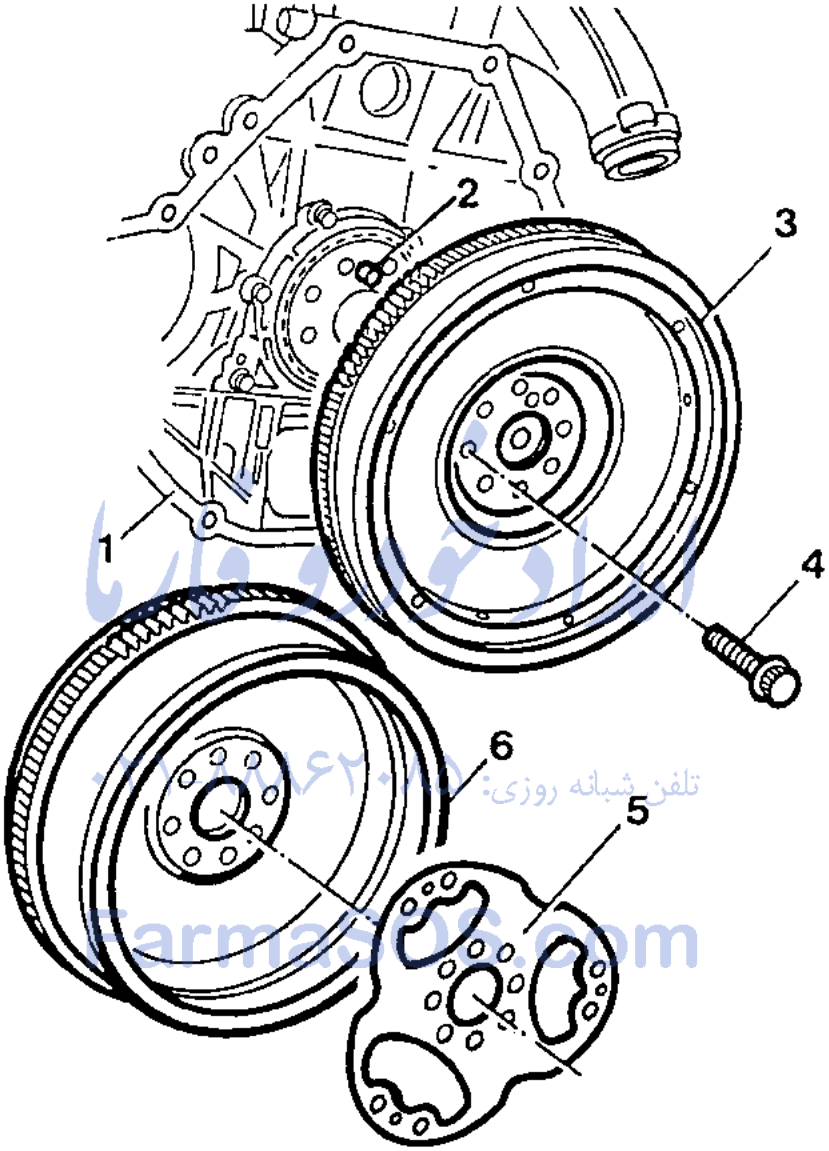
Notice

Install the original oil filter element and then change the engine oil and oil filter element after 1,000 - 1,500km.

ایراد خودرو
۰۲۱-۸۸۸۶۲۰۸۵
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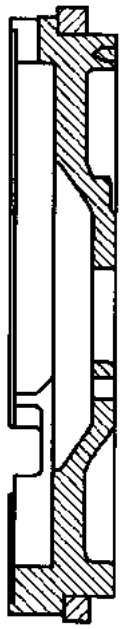
FLYWHEEL

Preceding Work : Removal of transmission
Removal of the clutch



1 Oil Pan
2 Straight Pin
3 Flywheel
4 12-Sided Stretch Bolt
. . . . . Check, 45N·m (33 lb-ft)+90°
5 Drive Plate (Automatic Transmission)
6 Flywheel (Automatic Transmission)

OM662LA

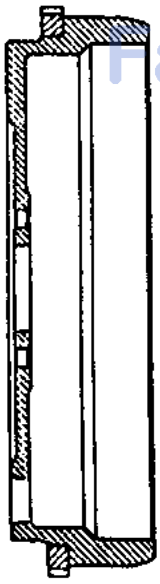


OM661LA

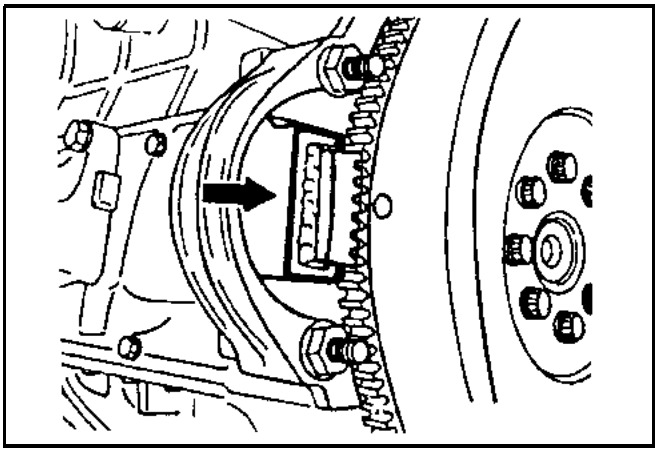


- Manual transmission flywheel

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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- Automatic transmission flywheel



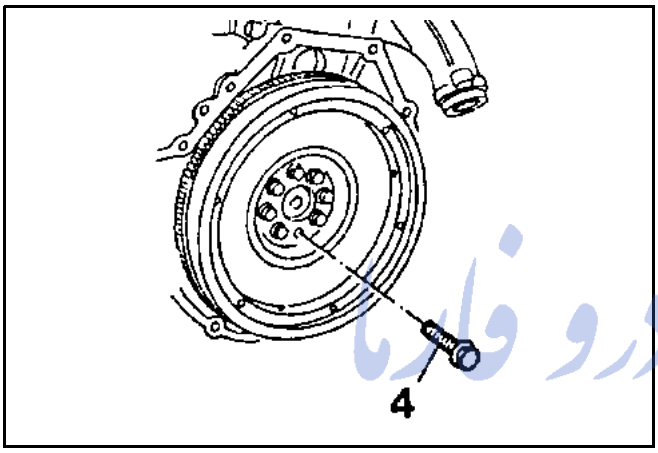
Tools Required

602 589 00 40 00 Engine Lock

Removal & Installation Procedure

1. Install the engine lock.

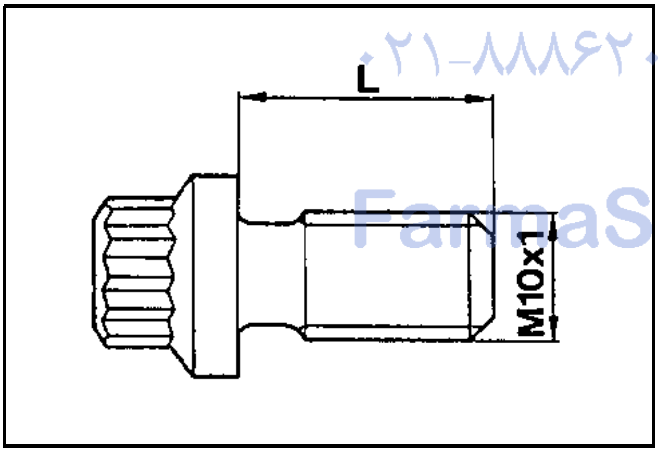
Engine Lock 602 589 02 40 00



2. Remove the 12-sided stretch bolts (4).

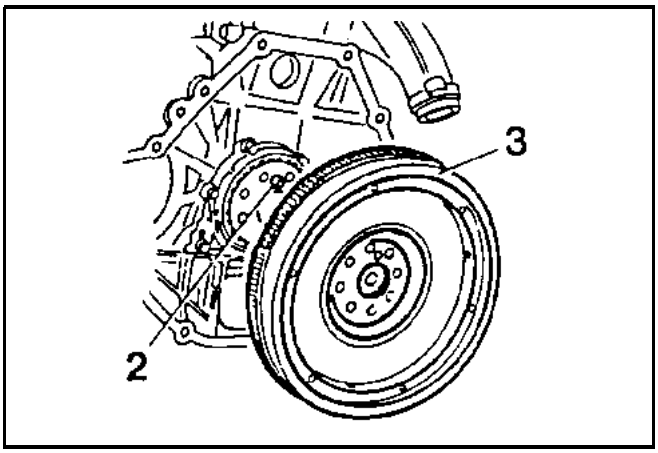
Installation Notice

Tightening Torque	45 N·m (33 lb-ft) + 90°



Notice

If the length 'L' of bolts exceeds 22.5mm, replace the bolts.

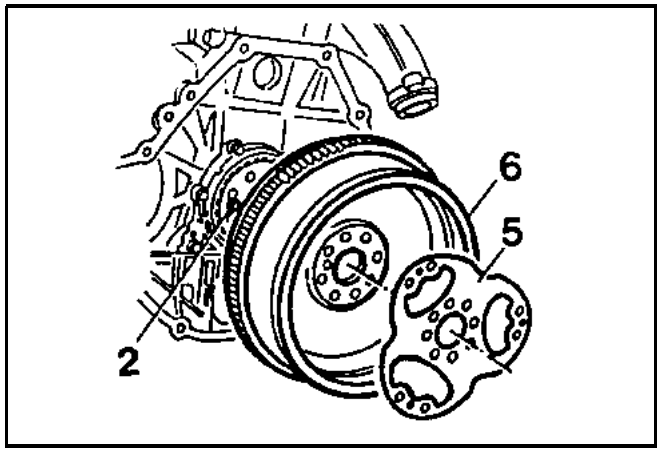


3. Remove the flywheel (3), if equipped with manual transmission.

Installation Notice

Correctly align the position of dowel pin (2).

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۰۲۱-۸۸۸۶۲۰۸۵
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4. Remove the flywheel (6) and driven plate (5), if equipped with automatic transmission.

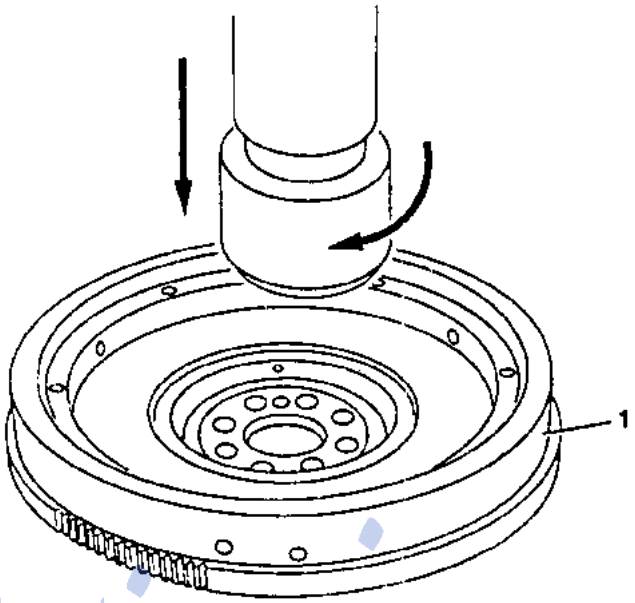
   Installation Notice

   Correctly align the position of dowel pin (2).

5. Installation should follow the removal procedure in the reverse order.

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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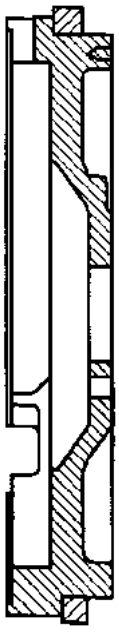
MACHINING OF FLYWHEEL



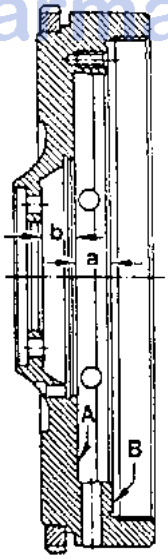
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1 Flywheel

OM662LA



OM661LA



تلفن شبانه روزی: ۰۲۱-۸۸۶۲۰۸۵
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Machining of Flywheel

Notice

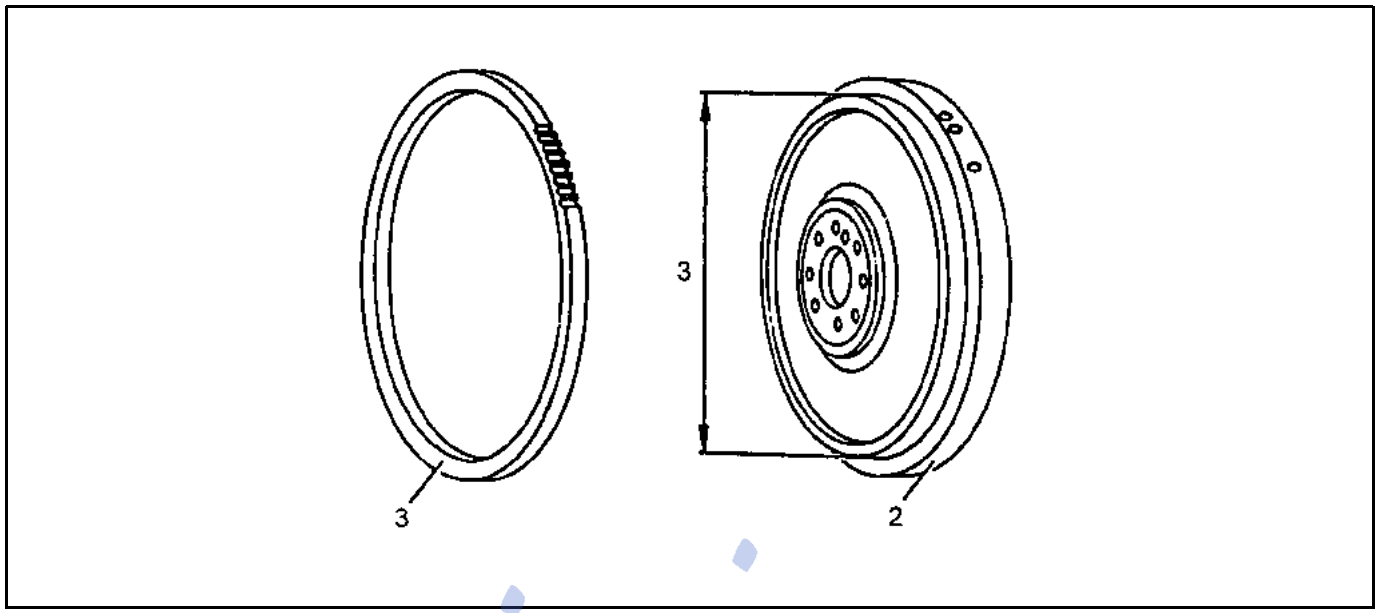
Flywheels which have scorch marks, scoring or cracks in the clutch surface should be machined by grinding or precision-turning. If the scores or cracks are severe than permissible specifications, replace the flywheel.

Distance 'a'	19.3 - 19.5 mm	
Distance 'b'	New	16.6 mm
	Repair up to	15.6 mm
Max. axial runout		0.05 mm

- When machining the clutch surface 'A', the mounting surface (B) for the clutch pressure plate should also be machined in accordance with 'A' to keep the distance 'a'.
- Do not machine under 'b' value.
- When machining, fix the flywheel exactly not to exceed the standard runout.

FLYWHEEL RING GEAR

Preceding Work : Removal of flywheel



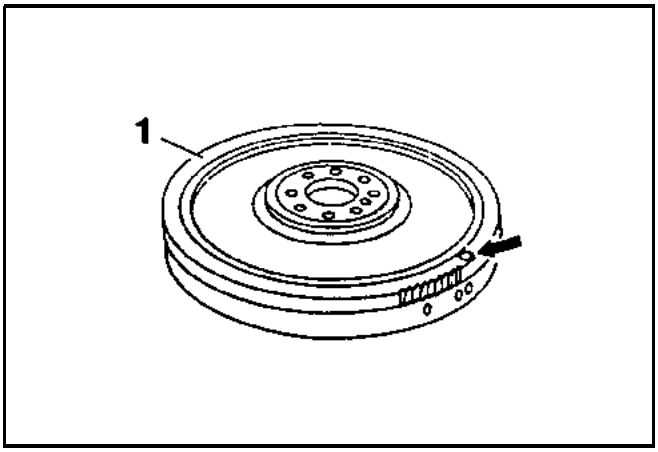
1 Ring Gear
2 Flywheel
3 Centering Collar Diameter

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵

Tools Required

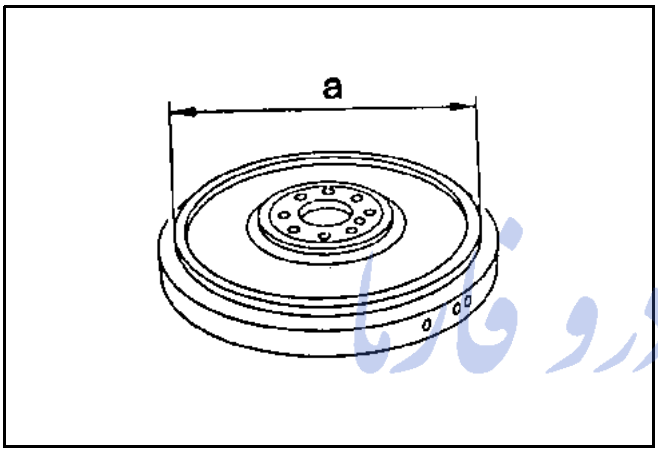
001 589 53 21 00 Dial Gauge
363 589 02 21 00 Dial Gauge Holder

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Replacement Procedure

1. Drill a hole into the ring gear (1) (arrow) and snap with a chisel.
2. Thoroughly clean the collar surfaces of ring gear.



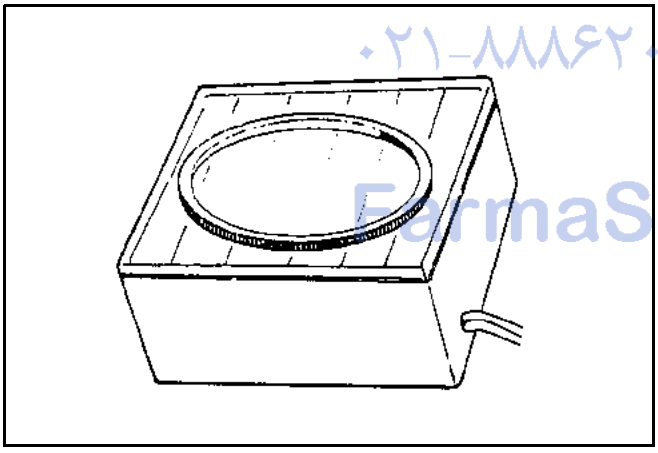
3. Measure diameter (a) of centering collar.

Diameter 'a'	275 + 0.5mm

Notice

If out of standard, replace the flywheel.

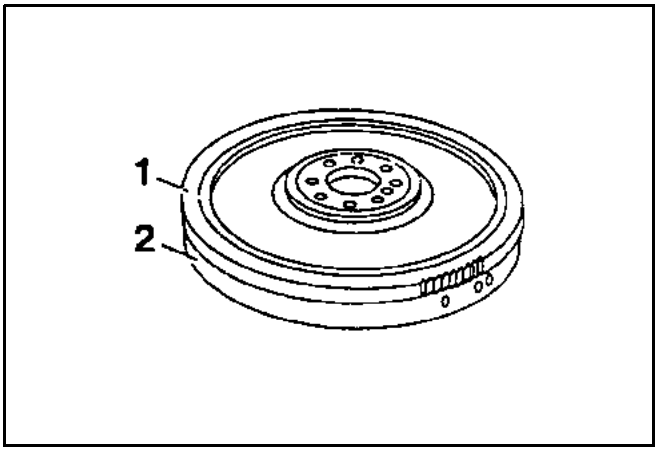
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۰۲۱-۸۸۸۶۲۰۸۵ تلفن شبانه روزی
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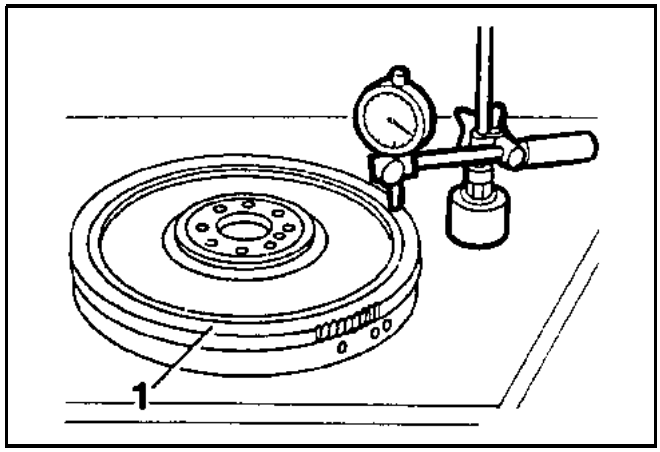
4. Heat up the new ring gear up to 220°C by using a heating device.

Notice

Use temperature measuring chalk.



5. Install the new ring gear (1) onto the flywheel by using a drift.



6. Measure axial runout of ring gear (1) on a surface plate.

Limit	Max. 0.4mm

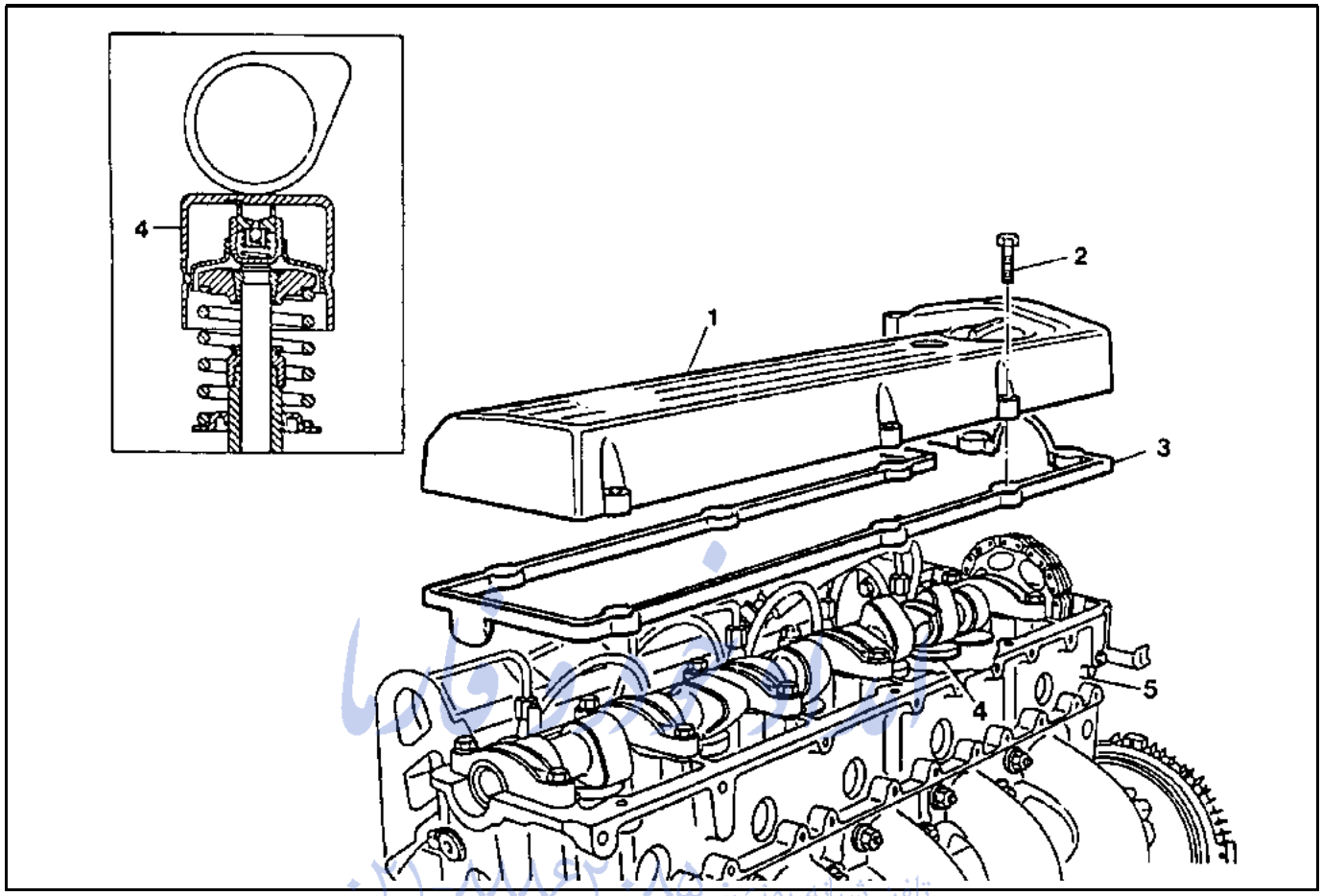
Notice

For correct measurement, put the flywheel on the flat measuring board.

Dial Gauge 001 589 53 21 00
Dial Gauge Holder 363 589 02 21 00

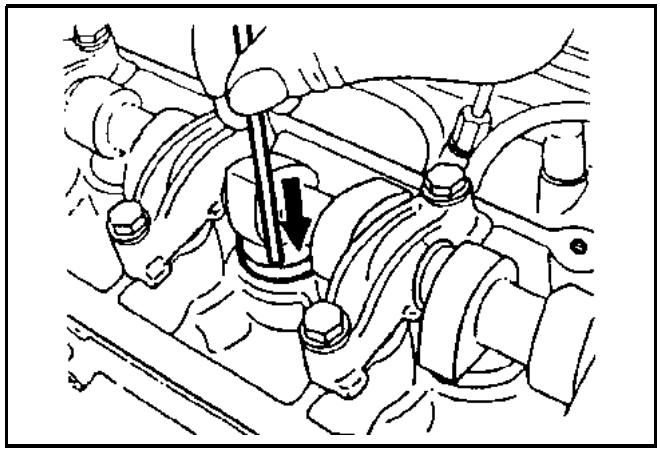
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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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HYDRAULIC VALVE CLEARANCE COMPENSATION ELEMENT CHECK



1 Cylinder Head Cover
2 Bolt ..... 10N·m (89 lb-in)
3 Gasket ..... Replace
4 Valve Tappet
5 Cylinder Head

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Checking

Notice

The noise which continues short time during short travel (frequent starting of the engine) or engine starting after a long time storage is normal operating conditions. So, it does not need to be repaired. Determine the malfunctions in valve clearance compensation device with noise through following tests. If defective, replace as respectively.

1. Run the engine at more than 3000rpm for approx. 4 minutes.
2. Stop the engine. After 5minutes, check the engine oil level and adjust if necessary.
3. Remove the cylinder head cover.
4. Check the valve tappets at TDC position of each cylinders.
5. Using a drift, lightly press the valve tappet and measure clearance between the cam and valve tappet.

Notice

If the clearance exceeds 0.4mm, replace the valve tappet.

6. If a valve tappet moves down too far in comparison to the others, replace the valve tappet.
7. Rotate the engine and check the remaining valve tappets.

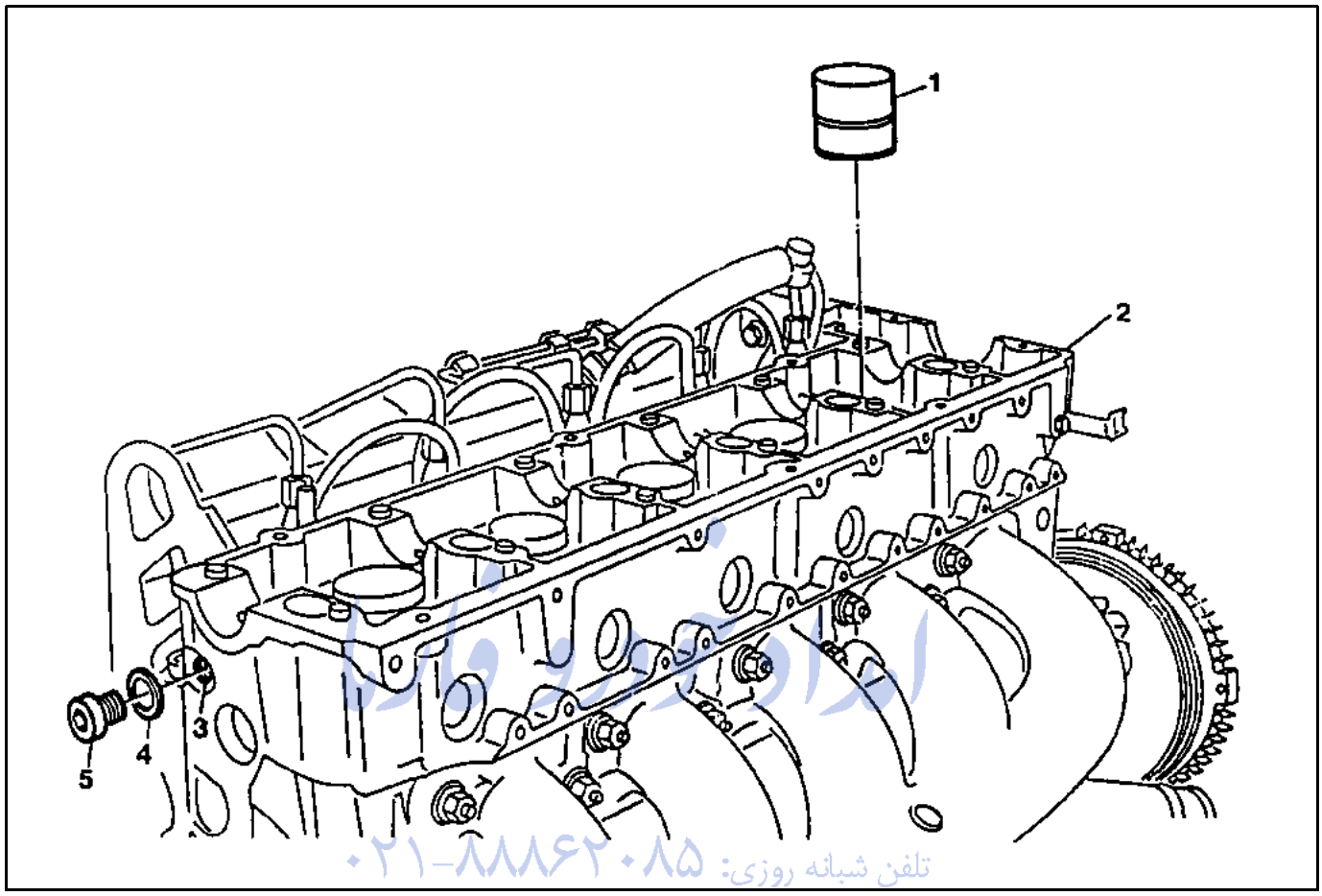
Notice

- Unnecessary rotation of the engine will damage the valve tappets.
- Do not rotate the engine by using the camshaft sprocket bolt or to the opposite direction of the engine rotation.

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VALVE TAPPETS

Preceding Work : Removal of camshaft



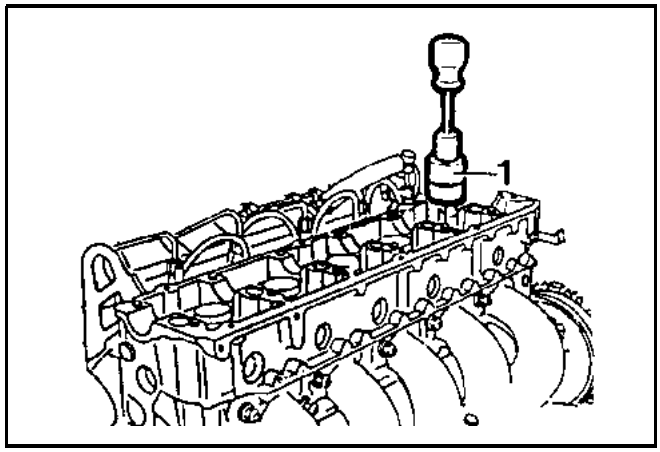
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵

1 Valve Tappet
2 Cylinder Head
3 Oil Gallery
4 Seal . . . . . Replace
5 Screw Plug

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Tools Required

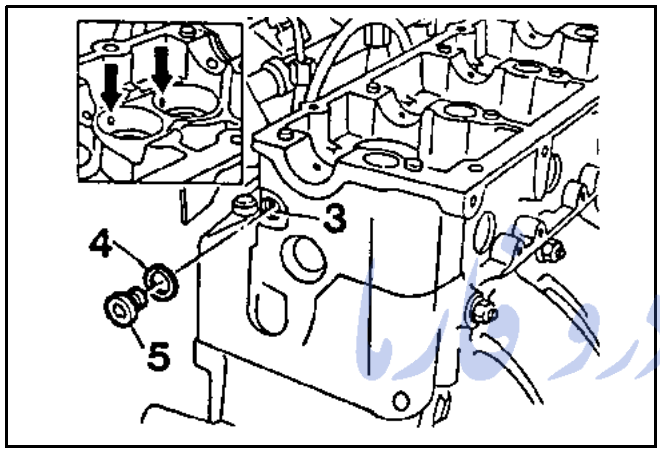
102 589 03 40 00 Magnetic Bar



Replacement Procedure

1. Pull out the valve tappet (1).

Magnetic Bar 102 589 03 40 00



2. Remove the plug (5) and blow compressed air into the oil gallery (3). At this time, check that the outlet bores(arrow) at the seat of the valve tappet are clear.
3. Replace the seal (4) and tighten the plug (5).
4. Insert the new valve tappet.

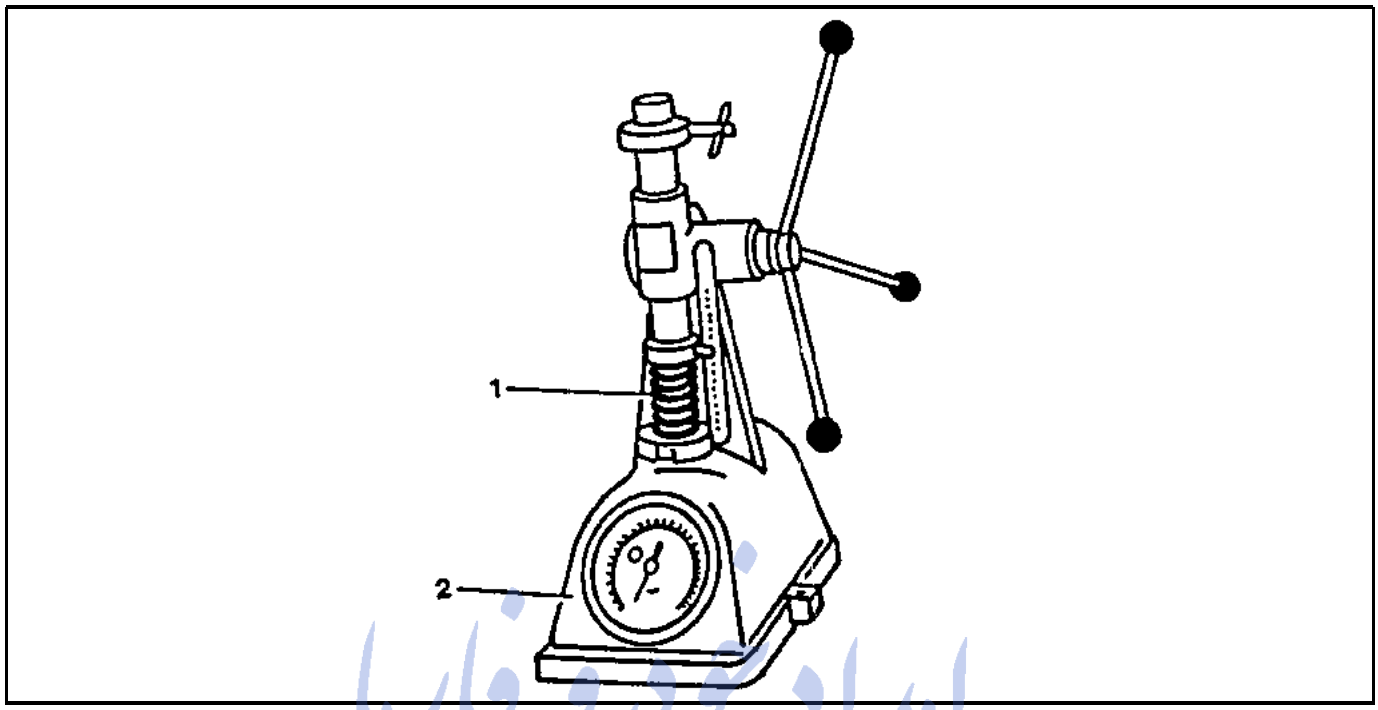
Notice

Coat the valve tappet with oil.

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VALVE SPRINGS CHECK

Preceding Work : Removal of valve spring



1 Valve Spring

2 Spring Scale

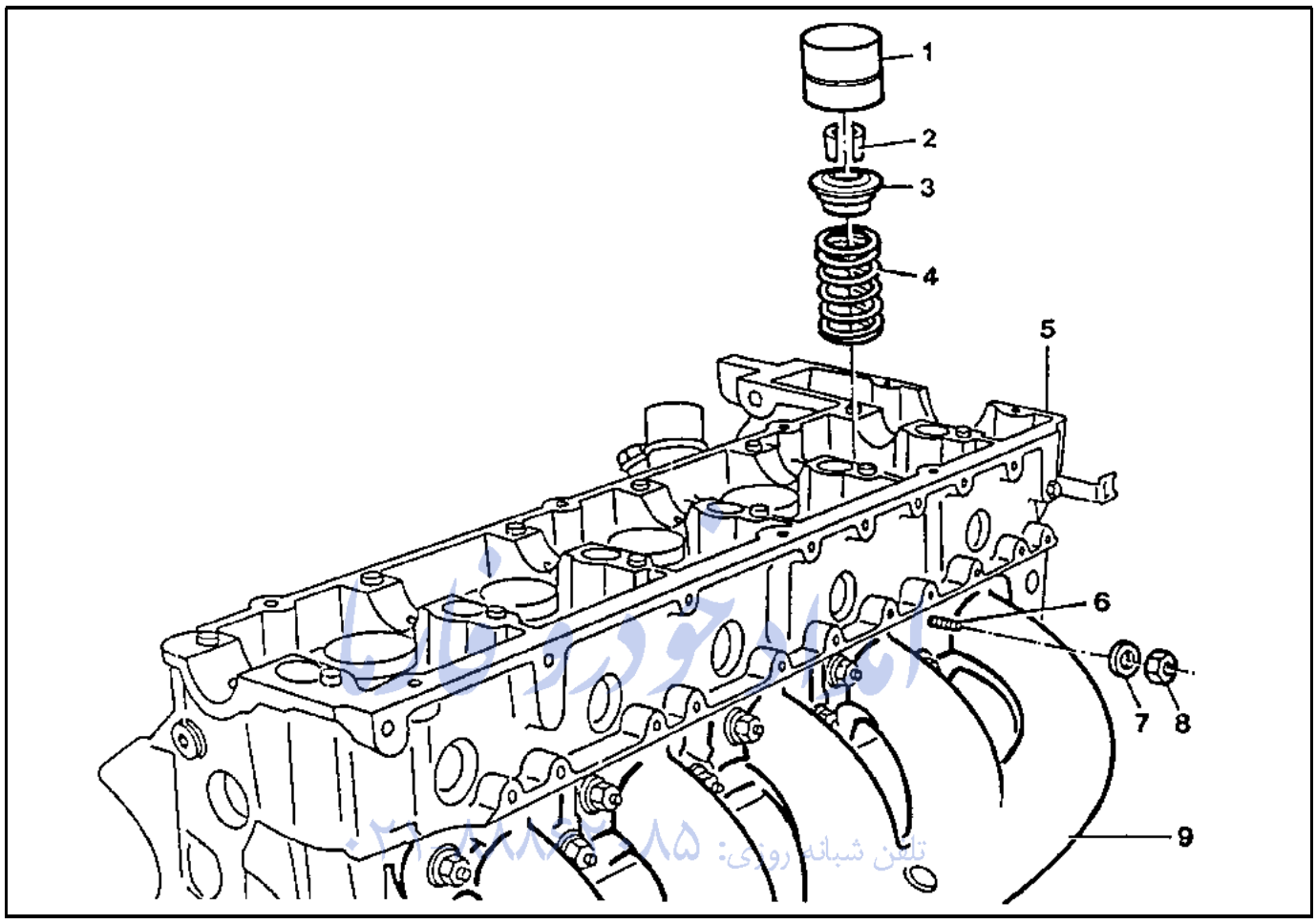
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Service Data

Outer diameter	Wire diameter	Free length	At preloaded		
			Length	Tension (new)	Limit
33.1 mm	4.20 mm	50.0 mm	27 mm	680 - 740 N	612 N

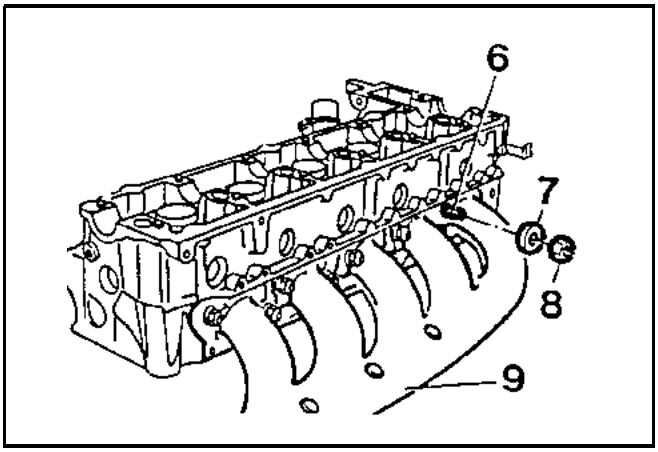
VALVE SPRINGS (CYLINDER HEAD REMOVED)

Cylinder Head Removed



1 Valve Tappet
2 Valve Cotters
3 Spring Retainer
4 Valve Spring .... Check, replace if necessary
5 Cylinder Head
6 Stud Bolt ..... 12N·m (106 lb-in)
7 Washer
8 Nut ..... Replace, 25N·m (18 lb-ft)
9 Exhaust Manifold

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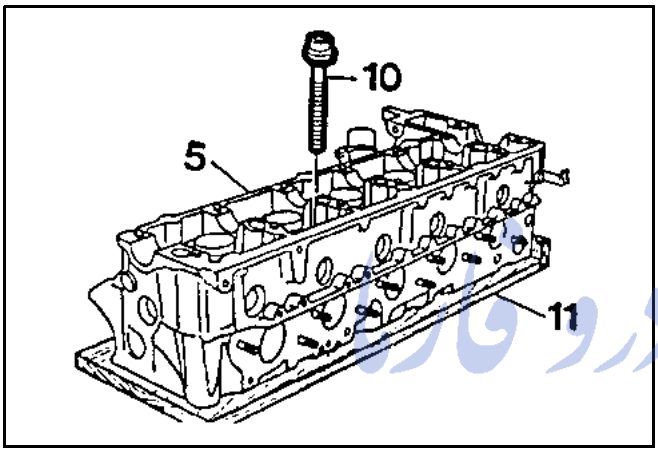


Tools Required

102 589 03 40 00 Magnetic Bar
116 589 06 63 00 Magnetic Finger
601 589 01 59 00 Assembling Board
601 589 02 59 00 Supporting Bridge
667 589 00 31 00 Press Lever

Removal & Installation Procedure

1. Remove the nuts (8) uniformly and then remove the washer (7), exhaust manifold (9) and gasket.



Installation Notice

Check the stud bolt (6) for damage and replace if necessary.

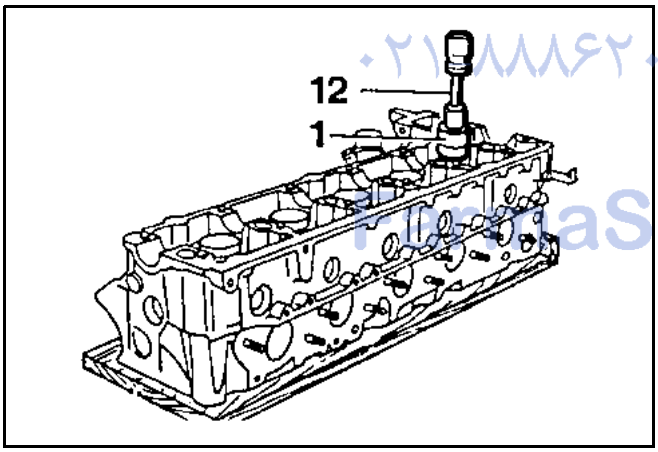
Tightening Torque	12 N·m (106 lb-in)

Replace the gasket and tighten the nuts (8).

Tightening Torque	25 N·m (18 lb-ft)

2. Install the assembling board (11) to the cylinder head with 4 cylinder head blots (10).

Assembling Board 601 589 01 59 00

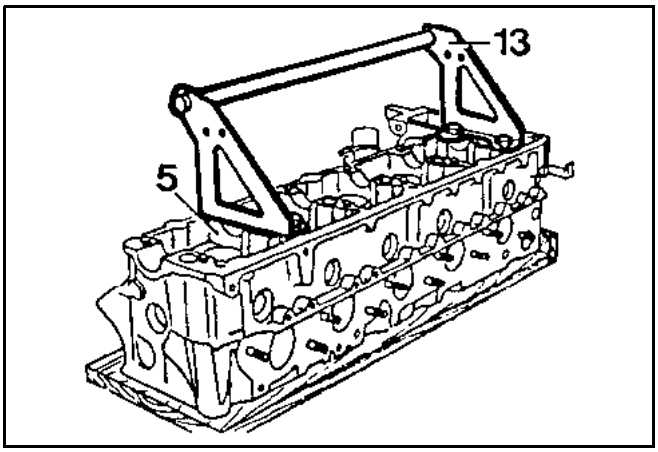


3. Pull out the valve tappet (1) with magnetic bar (12).

Notice

Place the valve tappets upside down (open end upward).

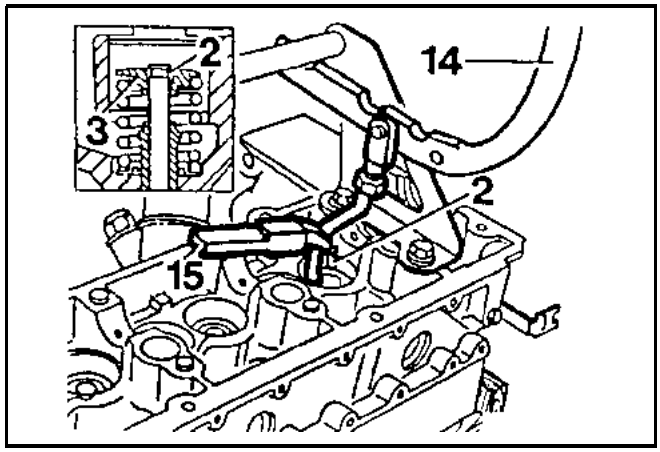
Magnetic Bar 102 589 03 40 00



4. Install the supporting bridge (13) on the cylinder head (5).

Supporting Bridge 601 589 02 59 00

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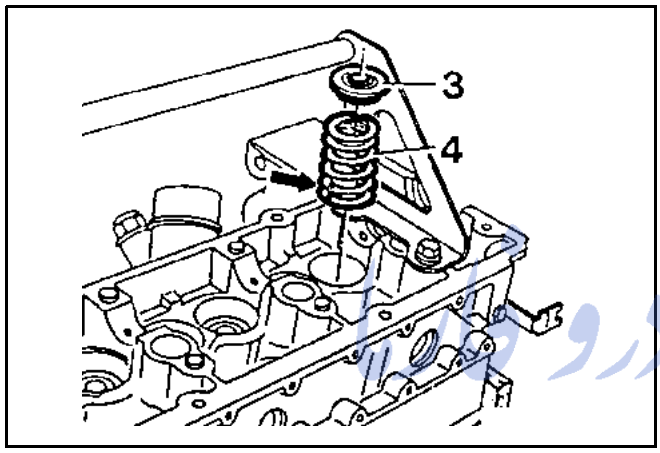


5. Using the press lever (14), press the spring retainer downward and remove the valve cotters (2) with magnetic finger (15).

Notice

Be careful not to damage guide bore of the valve tappet.

Press Lever 667 589 00 31 00
Magnetic Finger 116 589 06 63 00



6. Remove the spring retainer (3) and spring (4).

Installation Notice

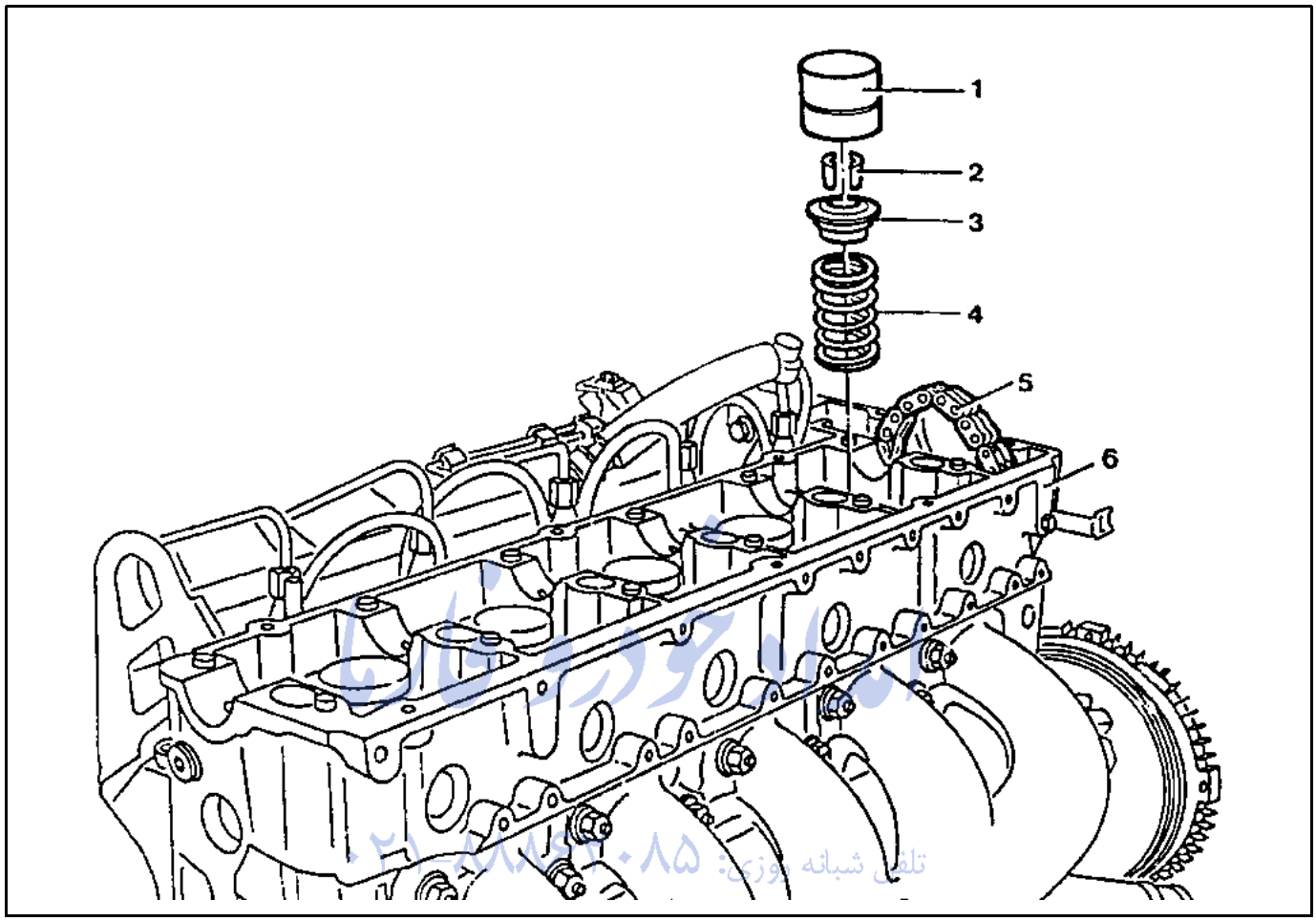
Install the valve spring with the color coding (arrow) facing down.

7. Check the valve spring and replace if necessary.
8. Installation should follow the removal procedure in the reverse order.

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VALVE SPRINGS (CYLINDER HEAD INSTALLED)

Preceding Work : Removal of camshaft



1 Valve Tappet
2 Valve Cotters
3 Spring Retainer
4 Valve Spring . . . . Check, replace if necessary
5 Timing Chain
6 Cylinder Head

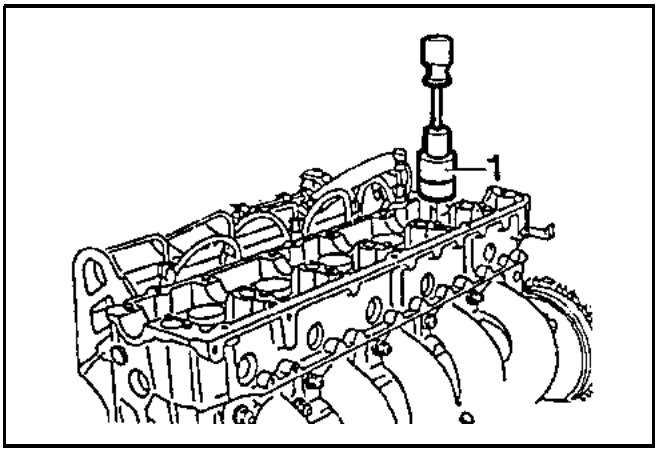
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Notice

Remove the valve springs only when the piston is at TDC.

Tools Required

102 589 03 40 00 Magnetic Bar
116 589 06 63 00 Magnetic Finger
603 589 01 40 00 Holding Wheel
667 589 00 31 00 Press Lever
667 589 02 63 00 Supporting Bar



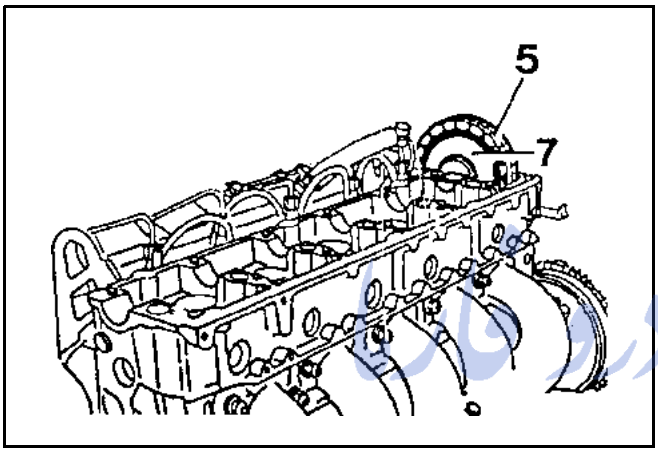
Removal & Installation Procedure

1. Remove the valve tappet (1) with magentic lifter.

   Notice

   Place the valve tappets upside down (open end upward)

Magentic Liter 102 589 03 40 00

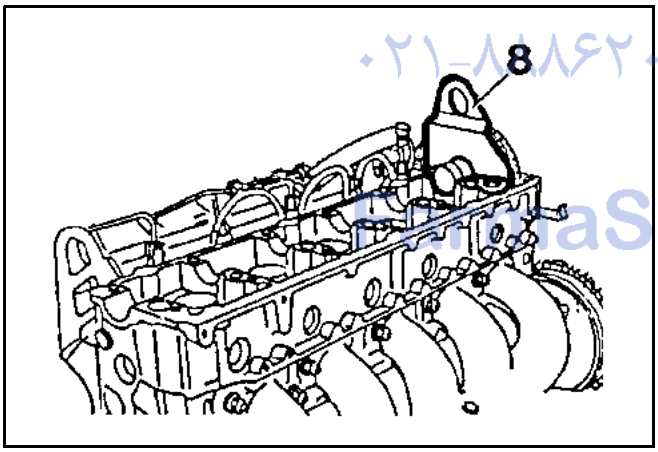


2. Install the holding wheel (7) into the timing chain of camshaft sprocket piston.

Holding Wheel 603 589 01 40 00

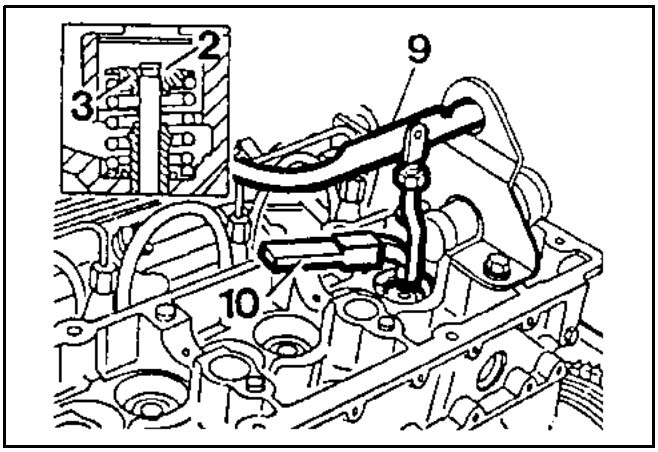
3. Position the piston of relevant cylinder at TDC.

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4. Install the supporting bar (8).

Supporting Bar 667 589 02 63 00

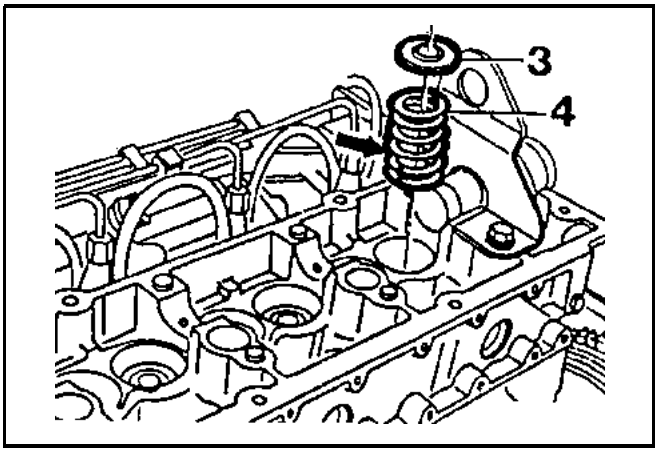


5. Using the press lever (9), press the spring retainer(3) downward and remove the valve cotters (2) with magnetic finger (10).

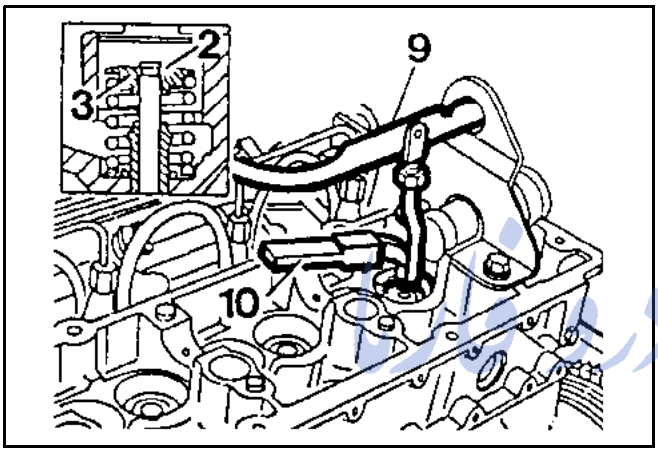
   Notice

   Be careful not to damage guide bore of the valve tappet.

Press Lever 667 589 00 31 00
Magnetic Finger 116 589 06 63 00

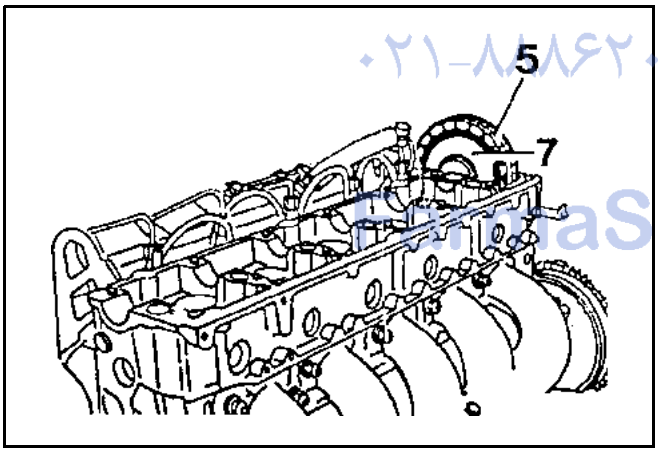


6. Remove the spring retainer(3) and spring (4).
7. Check the valve spring and replace if necessary.
8. Insert valve spring (4) with the color coding (arrow) facing down and insert valve spring Retainer(3).



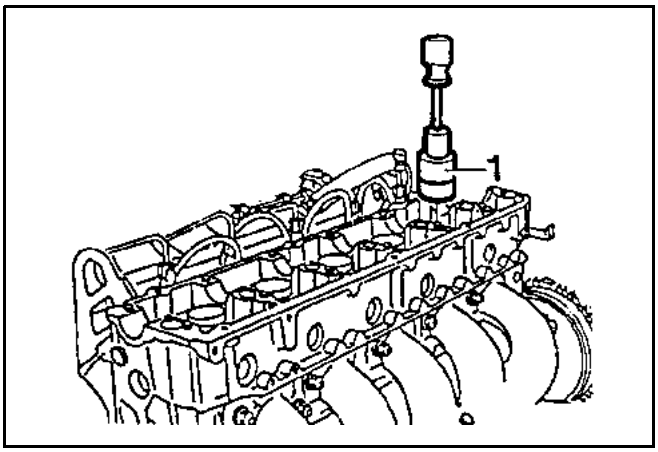
9. By press the spring retainer(3) with press lever (90), install the valve cotters with magnetic finger (10).

Press Lever 667 589 00 31 00
Magnetic Finger 116 589 06 63 00



10. Remove the supporting bar.
11. Remove the holding wheel (7) from the timing chain (5).

Holding Wheel 603 589 01 40 00



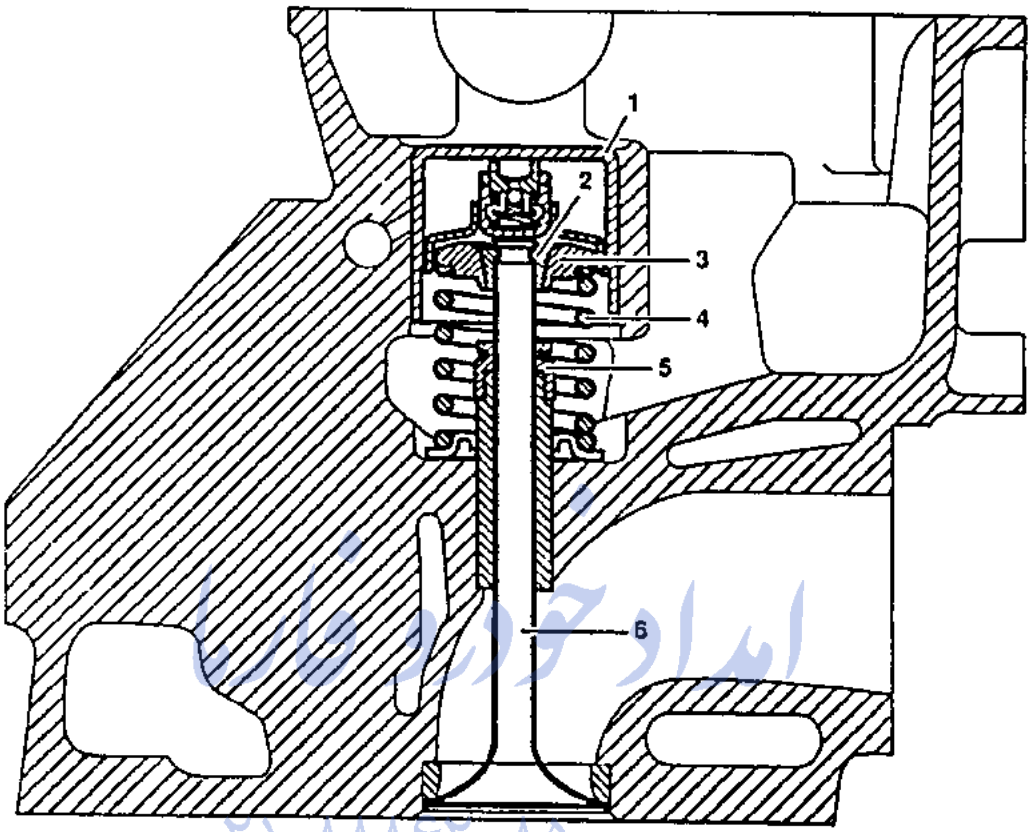
13. Coat the valve tappet with oil and install it.

Magnetic Bar 102 589 03 40 00

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VALVE STEM SEALS

Preceding Work : Removal of camshaft



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1 Valve Tappet
2 Valve Cotters
3 Spring Retainer
4 Valve Spring . . . . Check, replace if necessary
5 Valve Stem Seal
6 Valve

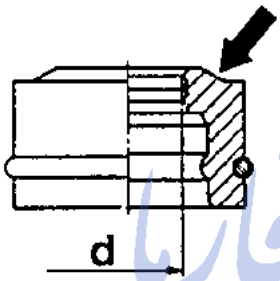
Notice

Remove the valve stem seals when the piston is positioned at TDC.

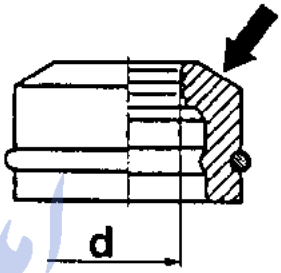
Tools Required

667 589 00 31 00 Press Lever
104 589 00 37 00 Pliers
102 589 03 40 00 Magnetic Lifter
603 589 01 40 00 Holding Wheel
601 589 02 43 00 Drift
116 589 06 63 00 Magnetic Finger
667 589 02 63 00 Supporting Bar

A: Intake valve stem seal

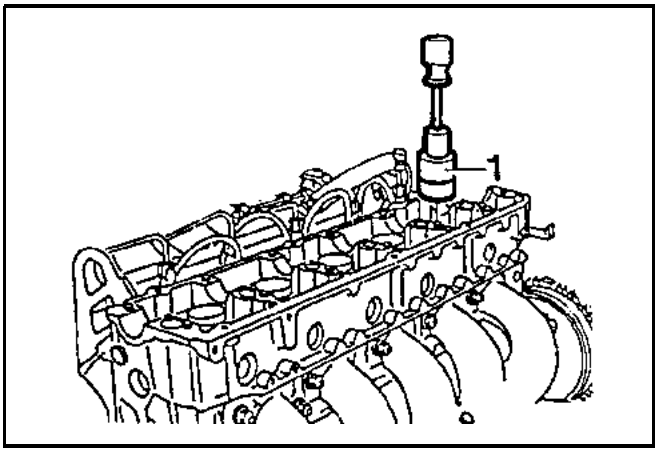


B: Exhaust valve stem seal



	Intake valve stem seal	Exhaust valve stem seal
Chamfer	Offset	All round
Inner diameter 'd'	7.3 mm	8.2 mm
Color	Brown	Green
Wire ring	Black	Yellow

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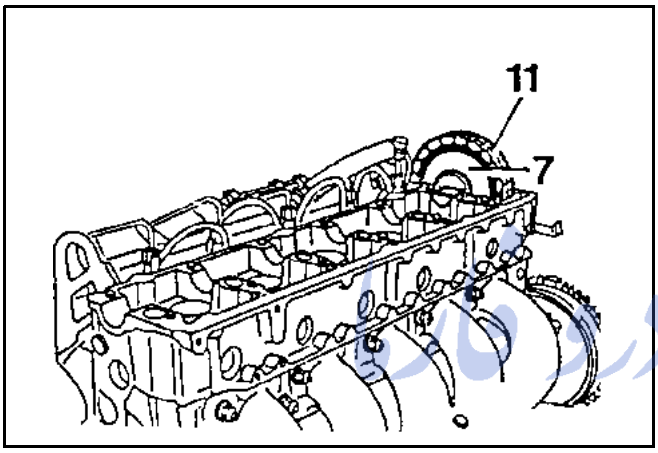
Replacement Procedure

1. Remove the valve tappet (1) with magnetic lifter.

   Notice

   Place the valve tappets upside down (open end upward).

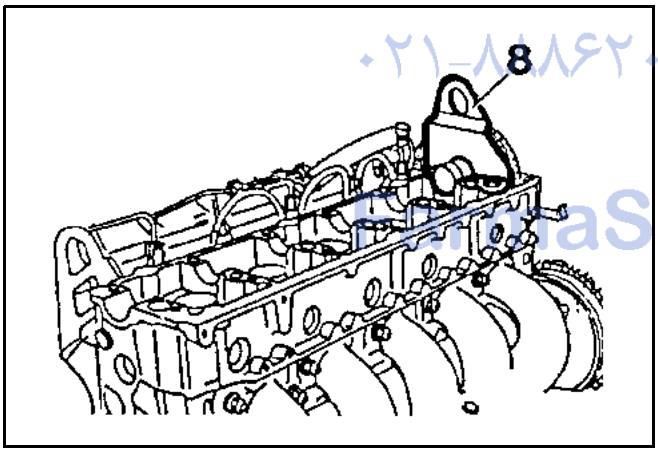
Magnetic Lifter 102 589 03 40 00



2. Install the holding wheel (7) into the timing chain (11).

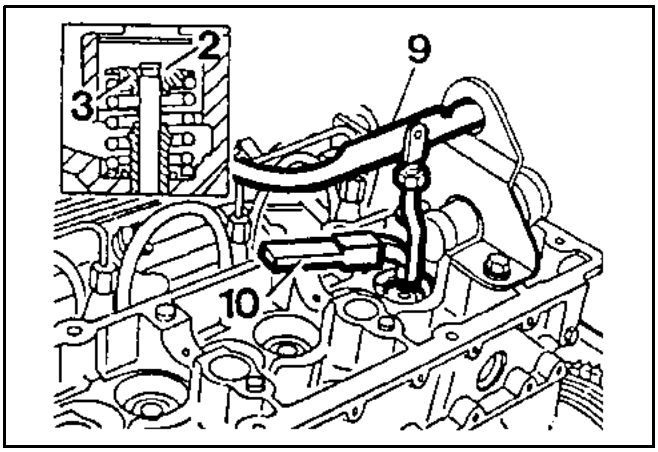
Holding Wheel 603 589 01 40 00

3. Position the piston of relevant cylinder at TDC.



4. Install the supporting bar (8).

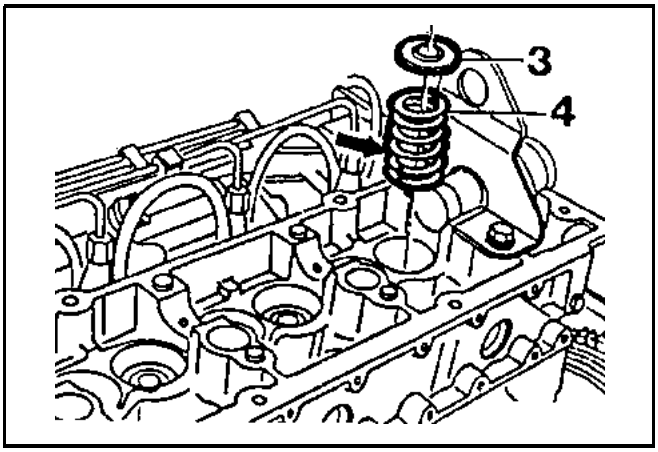
Supporting Bar 667 589 02 63 00



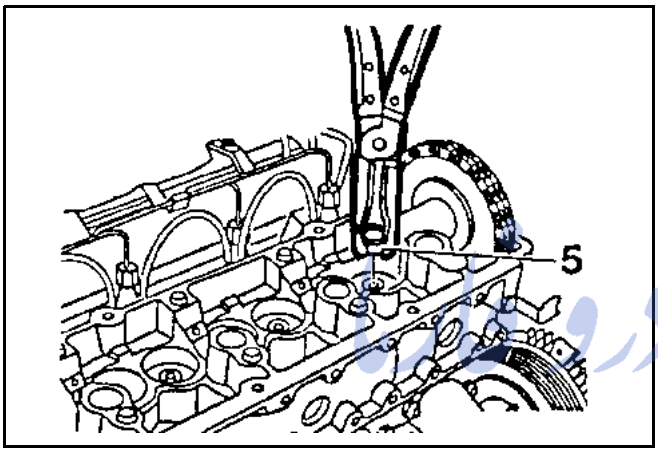
5. Using press lever (9), press the spring retainer(3) downward and remove the valve collets with magnetic finger (10).

Press Lever 667 589 00 31 00
Magnetic Finger 116 589 06 63 00

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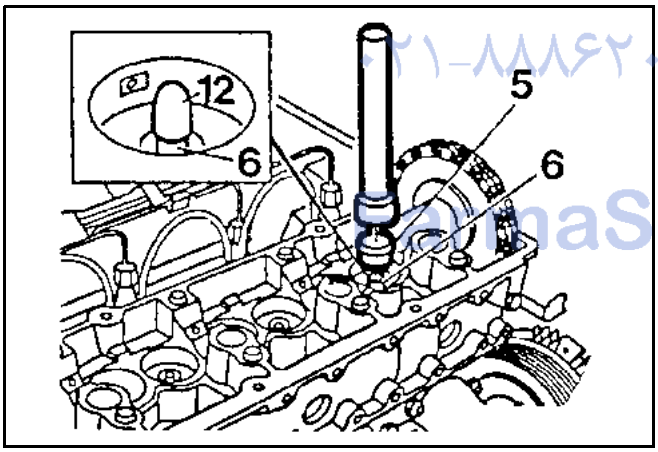


6. Remove the spring retainer(3) and valve spring (4).



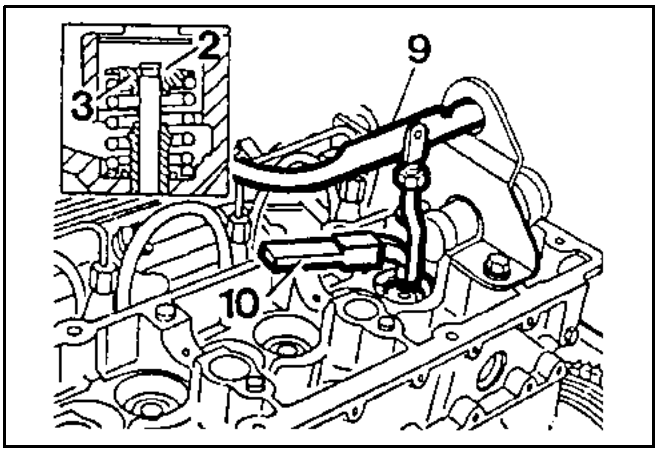
7. Remove the valve stem seal (5).

Pliers 104 589 00 37 00



8. Insert the cap (12) onto the valve (6) and install the new valve stem seal (5) and then remover the cap.

Drift 601 589 02 43 00



9. By pressing the spring seat with press lever (9), install the valve cotters(2) with magnetic finger (10).

Notice

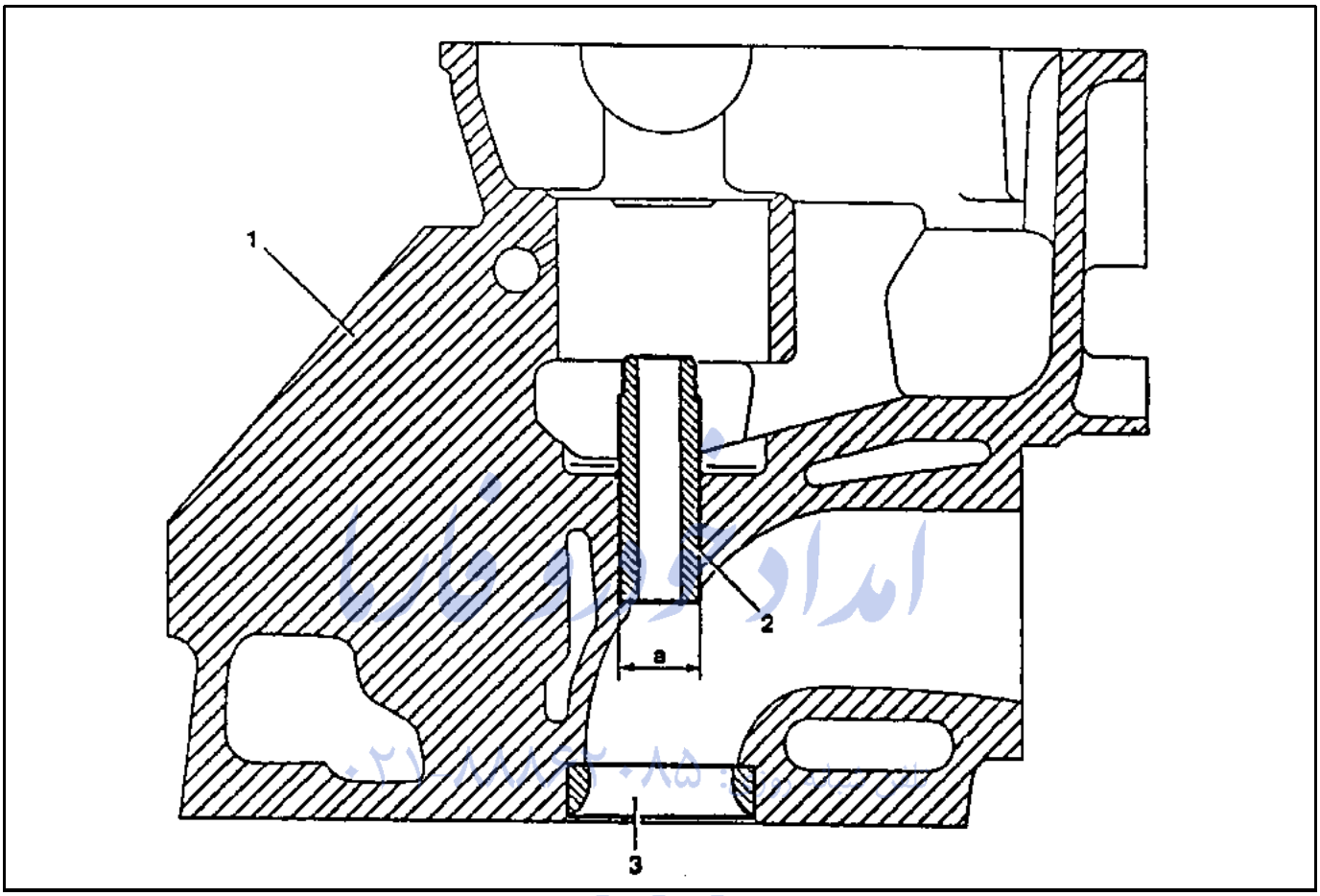
Be careful not to damage guide bore of the valve tappet.

Press Lever 667 589 00 31 00
Magnetic Finger 116 589 06 63 00

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CHECK AND REPLACEMENT OF VALVE GUIDES

Preceding Work : Removal of cylinder head
Removal of valve spring
Removal of valve

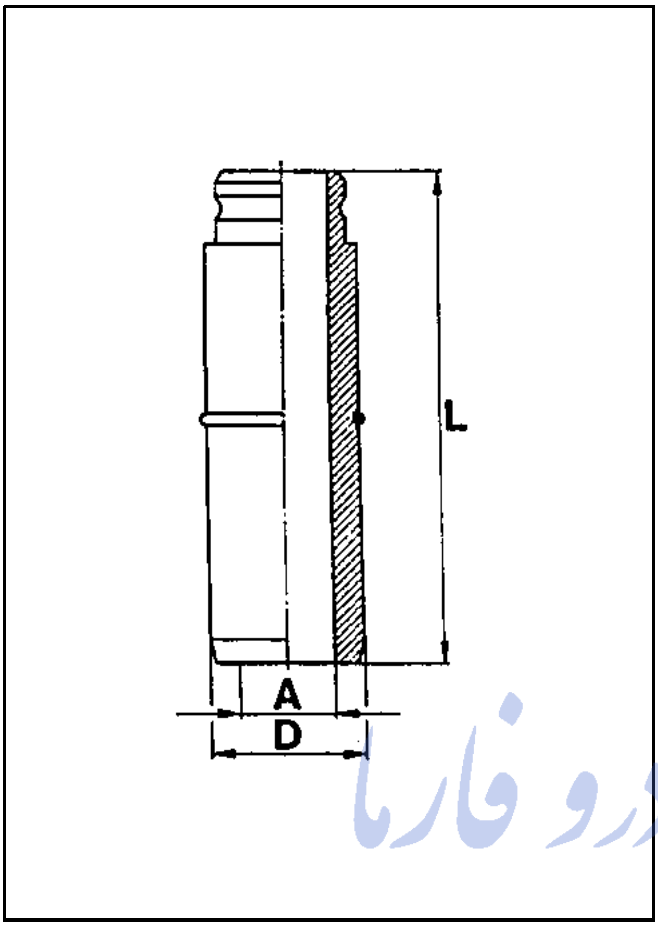


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1 Cylinder Head
2 Valve Guide
3 Valve Seat Ring
a Basic Bore Diameter

Service Ddata

	Item	Outer Diameter 'D'	Color Code	Basic Bore Diameter 'a'	Overlap 'D' - 'a'	Valve Guide Inner Diameter 'A'	Length 'L'
Intake	Repair size 1	14.251	Red	14.200 - 14.211	0.029 - 0.051	8.000 -8.030	39.5
	Repair size 2	14.440 - 14.451	White	14.400 - 14.411			
Exhaust	Repair size 1	14.240 -14. 251	Red	14.200 - 14.211	0.029 - 0.051	9.000 -9.050	37.7
	Repair size 2	14.440- 14.451	White	14.400 - 14.411			



Notice

Measure center (arrow) of the valve guide and if the inner diameter 'A' exceeds standard value, replace the guide.

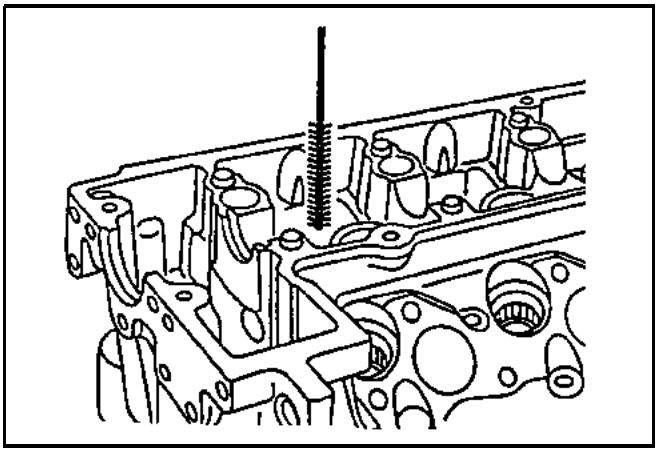
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Tools Required

000 589 10 53 00 Reamer (for Exhaust)
000 589 10 68 00 Cylinder Brush
000 589 21 53 00 Reamer (for Intake)
102 589 00 23 00 GO / NO GO Gauge (for Intake)
103 589 02 15 00 Drift (for Exhaust)
103 589 03 15 00 Drift (for Intake)
117 589 03 25 00 GO / NO GO Gauge (for Exhaust)
346 589 00 63 00 Super Cooling Box
601 589 02 23 00 GO/NO GO Gauge
601 589 05 15 00 Drift (for Intake)
601 589 06 15 00 Drift (for Exhaust)

Matching Valve Seat - Broaching Tools - Guide Sleeves

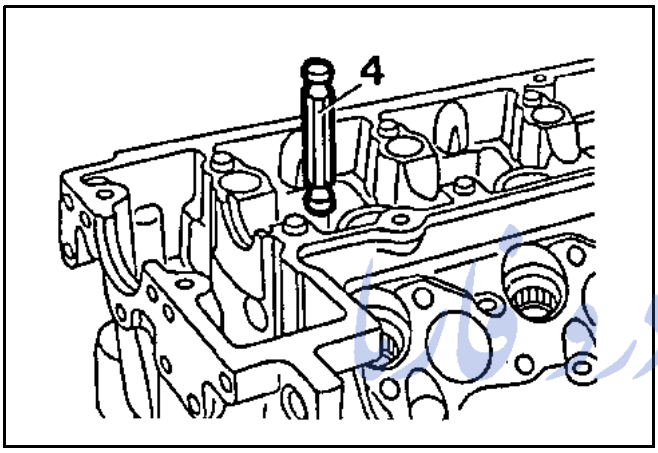
Valve Seat	Broaching Tool No.	Guide Sleeve Tool No.	Guide Sleeve Side
Intake	115 589 00 53 00 (14.2 mm)	102 589 00 63 00	B
Exhaust		102 589 08 63 00	B
Intake	115 589 01 53 00 (14.4 mm)	601 589 15 63 00	A
Exhaust			B



Checking

1. Thoroughly clean the valve guide bore using a cylinder brush.

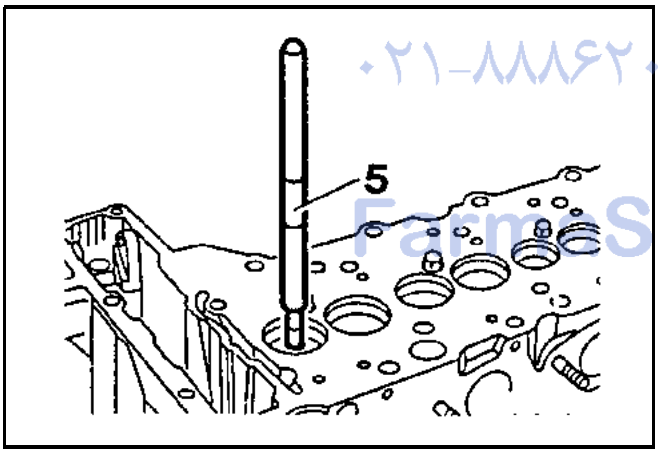
Cylinder Brush 000 589 10 68 00



2. Insert the GO/NO GO gauge into the valve guide bore. If the NO GO side is inserted fully, replace the valve guide (Intake 8mm, Exhaust 9mm).

GO/NO GO Gauge 601 589 02 23 00

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Replacement Procedure

1. Drive out the valve guide (2) by using a drift (5).

   Notice

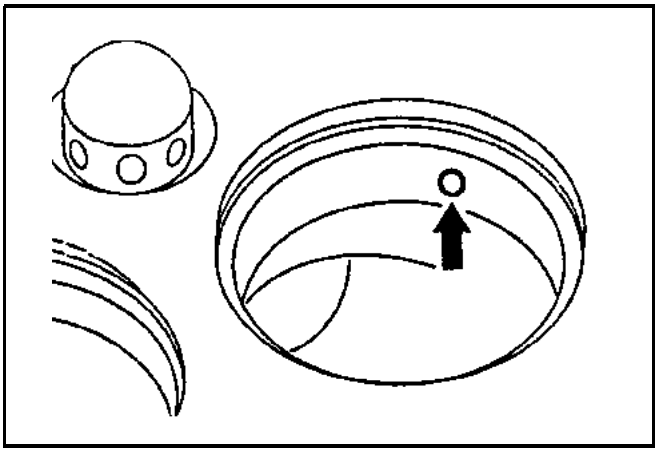
   The valve guide must be driven out upward of the cylinder head.

Drift (for Intake) 103 589 03 15 00
Drift (for Exhaust) 103 589 02 15 00

2. Thoroughly clean the basic bore by using a cylinder brush.

Cylinder Brush 000 589 10 68 00

3. Check the basic bore in cylinder head for scoring marks and ream to next repair size if necessary.

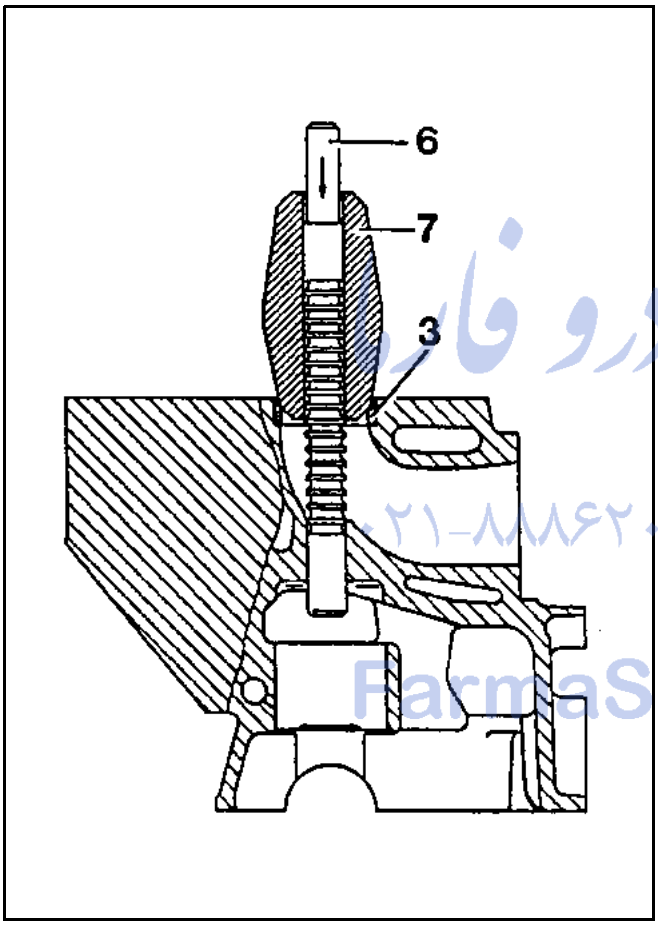


4. Reaming basic bore in cylinder head (repair size).
   - Thoroughly remove carbon deposits in cylinder head.

Notice

Particularly remove the insides of the valve seat rings.

   - Remove the elevation (arrow) of intake valve seat rings.



   - Select correct broaching tool and guide sleeve (refer to the table).

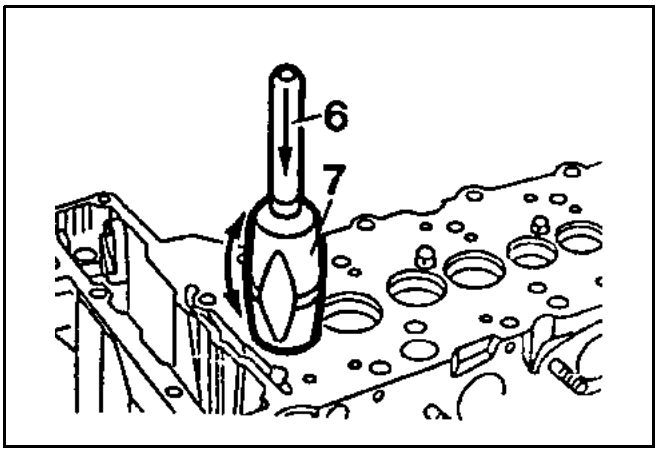
Notice

Before broaching work, the broaching tool must be cleared of swarf with a stiff plastic brush.

   - Lubricate the basic bore, guide sleeve and broaching tool with petroleum.
   - Push broaching tool (6) in broaching direction (arrow) into the guide sleeve (7) far enough so that the first cut of the broaching tool is positioned in the basic bore when guide sleeve is fitted onto the valve seat ring (3).

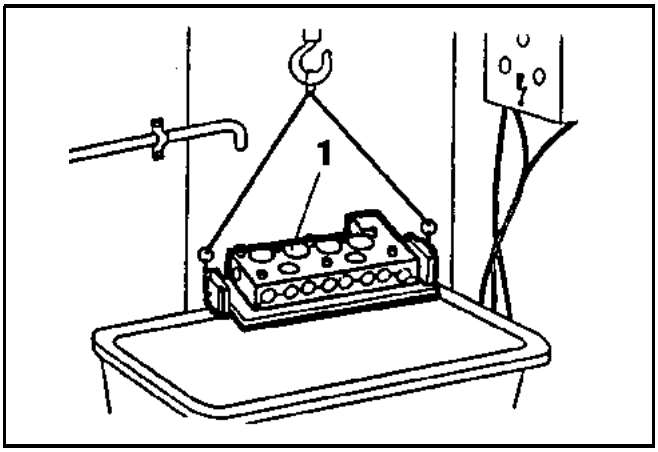
6. Broaching tool
7. Guide sleeve

See the 'standard data'

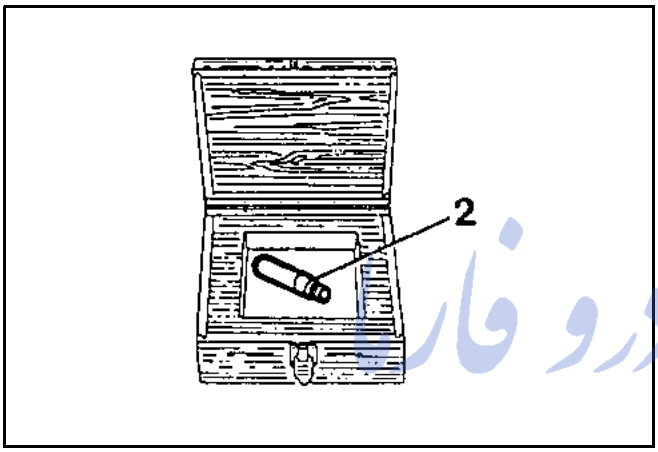


   - Center the guide sleeve (7) in the valve seat ring (3) by turning.
   - Knock through the broaching tool (6) with a plastic hammer (approx. 25g). and aluminum drift.

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5. Heat the cylinder head (1) in a wear tank to approx. 80°C.



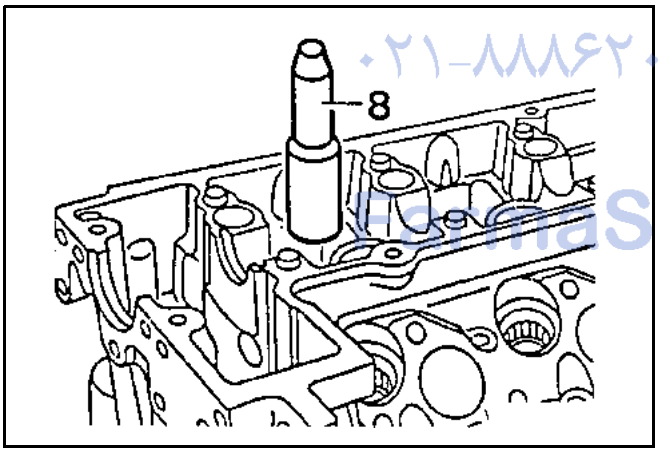
6. Cool down the new valve guide (2) with liquid nitrogen.

Notice

Do not touch the cooled valve guide by hand.

Super Cooling box 346 589 00 63 00

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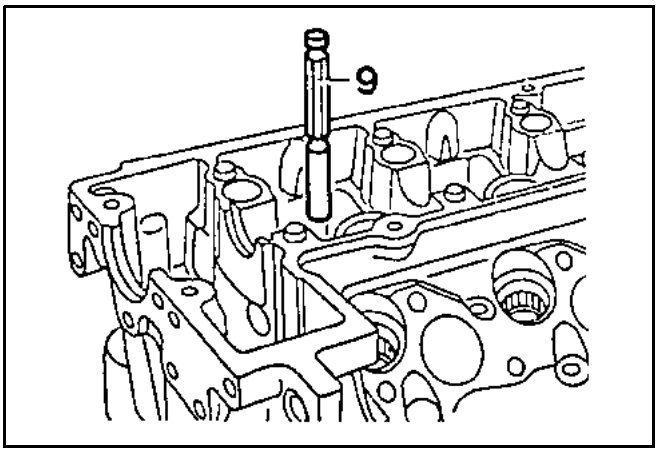


7. Drive in new valve guide with drift (8) until the wire ring makes contact.

Notice

The valve guide must be driven in from the cylinder head cover.

Drift (for Intake) 601 589 05 15 00
Drift (for Exhaust) 601 589 06 15 00



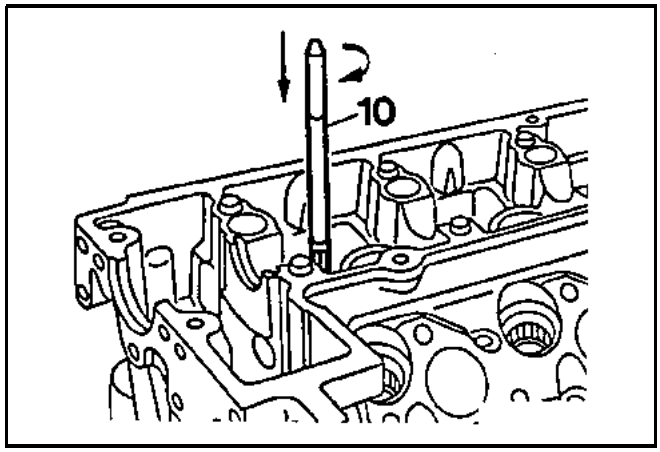
8. Check the valve guide bore with GO / NO GO gauge (9).

The GO side (marked '0') should just still drop. If the GO side cannot be inserted, the bore of valve guide should be reamed.

Notice

Perform the check only on cooled down cylinder head.

GO / NO GO Gauge (for Intake) 102 589 00 23 00
GO / NO GO Gauge (for Exhaust) 117 589 03 23 00



9. If necessary, ream the valve guide bore evenly.

   Notice

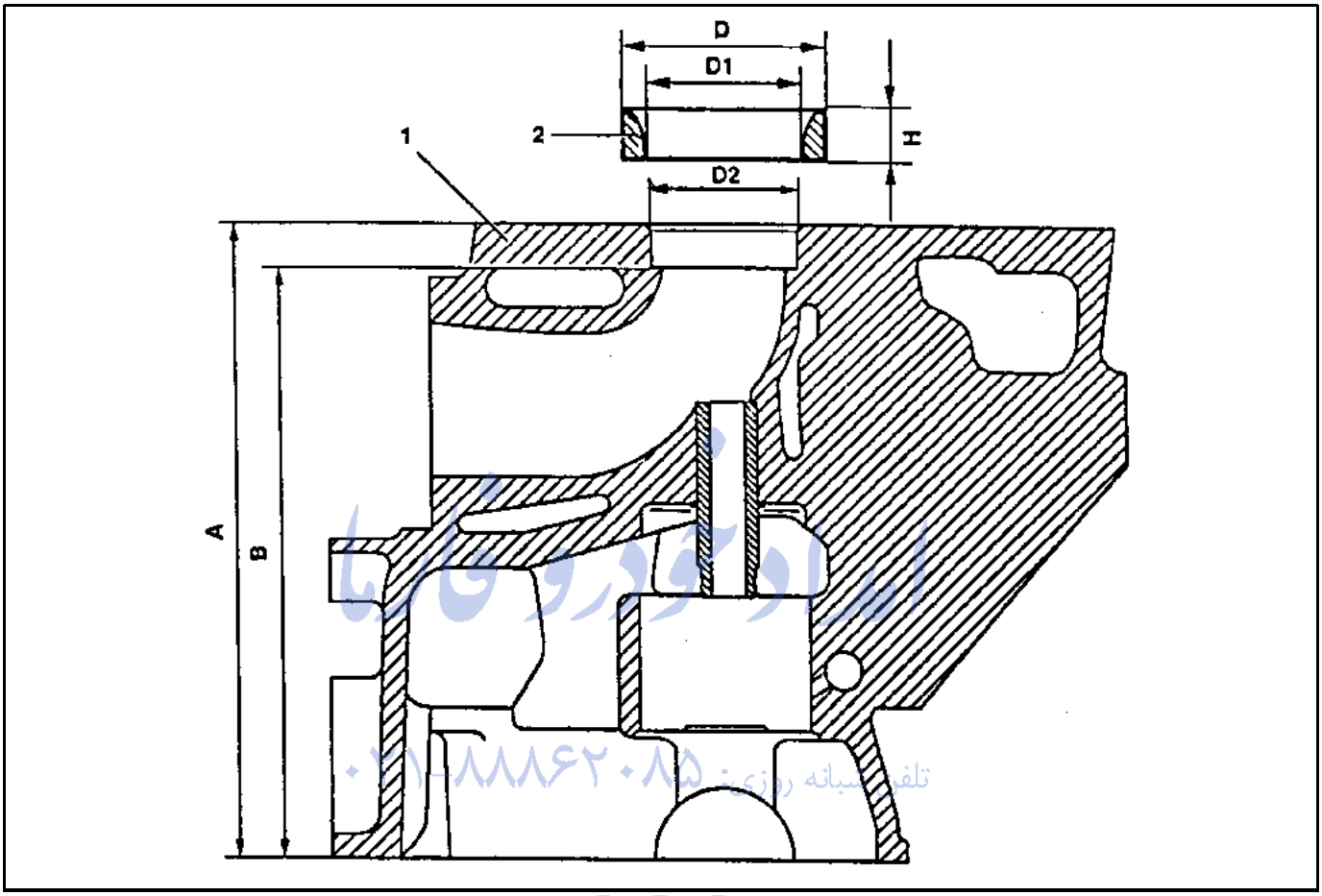
   Never turn the reamer against the direction of rotation.

Reamer (for Exhaust) 000 589 10 53 00
Reamer (for Intake) 000 589 21 53 00

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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VALVE SEAT RINGS

Preceding Work : Removal of valve
Checking of valve guide, replace if necessary
Removal of prechamber



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1 Cylinder Head
2 Valve Seat Ring
3 Valve Guide
A Height (Cylinder Head Upper / Lower Surface)
B Height (cylinder Head Cover Surface - Seat of Valve Seat Ring)
D Valve Seat Ring Outer Diameter
D1 Valve Seat Ring Inner Diameter
D2 Basic Bore Diameter
H Height of Valve Seat Ring

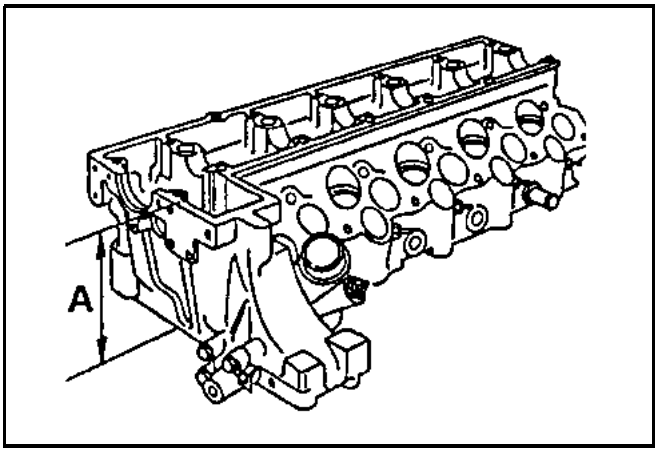
Service Ddata

Item	Intake	Exhaust
D2	40.000 - 40.016 mm	37.000 - 37.016 mm
D	40.084 - 40.100 mm	37.084 - 37.100 mm
D1	33.400 - 33.600 mm	30.400 - 30.600 mm
H	6.955 - 7.045 mm	6.955 - 7.045 mm
Overlap U=D-D2	0.068 - 0.100 mm	0.068 - 0.100 mm
B	133.4 mm	133.4 mm
A	142.5 mm	142.5 mm

Commercial Tools

Cylinder Head Clamping Device	Hunger D-8000 München 70 Type Ventilknecht K2000 Order No. 221 00 100
Valve Seat Turning Tool	Hunger D-8000 München 70 Type VDS 1A Order No. 236 03 308
Ring Seat Turning Tool	Hunger D-8000 München 70 Type RDS 1 Order No. 219 00 100
Pneumatic Removal / Installation Device (Drift : 8mm, 9mm, 14mm)	Hunger D-8000 München 70 Type PVM 1
Tensioning Head	Hunger D-8000 München 70 Order No. 250 15 250
Cutting Tool for Recessing Grooves	Hunger D-8000 München 70 Order No. 217 93 601
Test Set for Valves	Hunger D-8000 München 70 Order No. 216 69 210
Internal Dial Gauge (Range : 25 - 60mm)	Mahr D-7300 Esslingen Order No. 844
External Micrometer (Range : 25 - 60mm)	Mahr D-7300 Esslingen Order No. 40 S
Electrically Heated Water Tank	Otto Dürr D-7123 Sachsenherm - Ochsenbach

امداد خودرو فارما
۰۲۱-۸۸۸۶۲۰۸۵ پاسخگوی ۲۴ ساعته روزی
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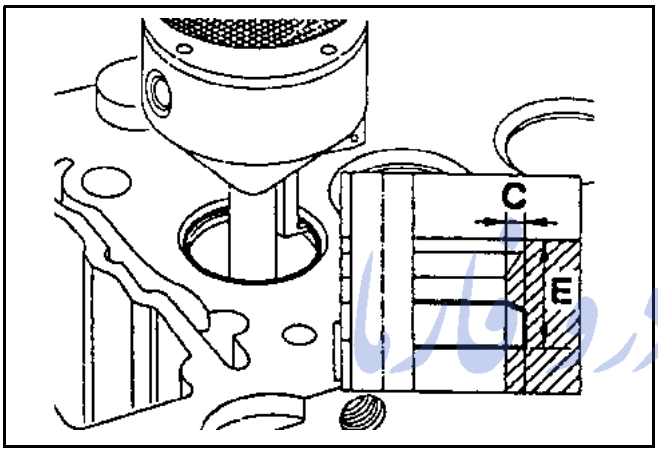


Removal Procedure

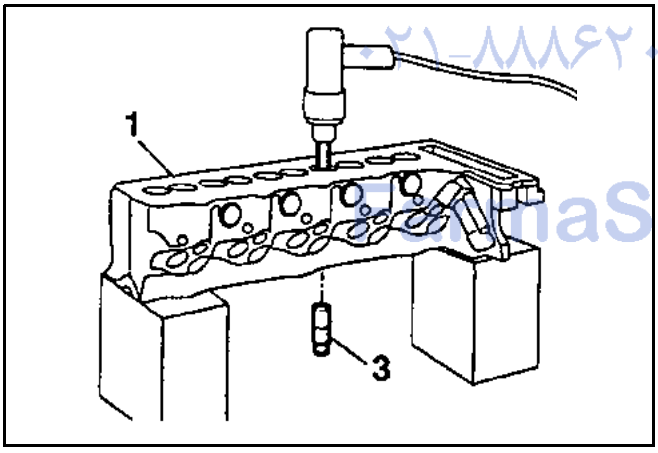
1. Measure dimension 'A'.

Limit	142.5 mm

2. Clamp the cylinder head with clamping device.

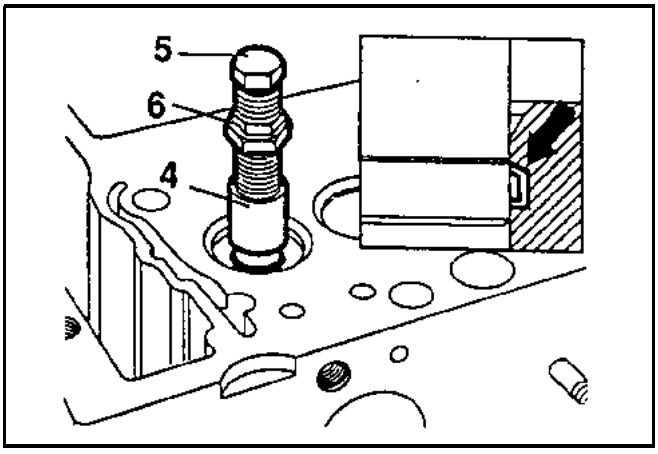


3. Cut groove into the valve seat ring so that dimension 'C' is approx. 2mm and dimension 'E' is approx. 6mm.



4. Remove the cylinder head from the clamping device and place it onto wooden blocks.
5. Remove the valve guide (3).

Drift (Intake) 8mm
Drift (Exhaust) 9mm

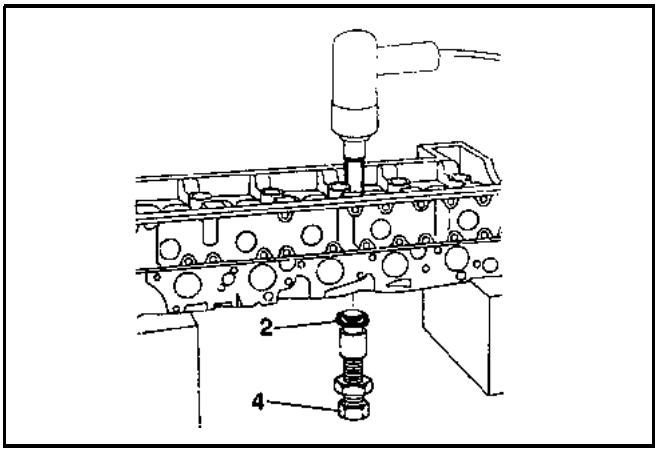


6. Insert the tensioning head (4) and extracted wedges (arrow) by turning the bolt (5).

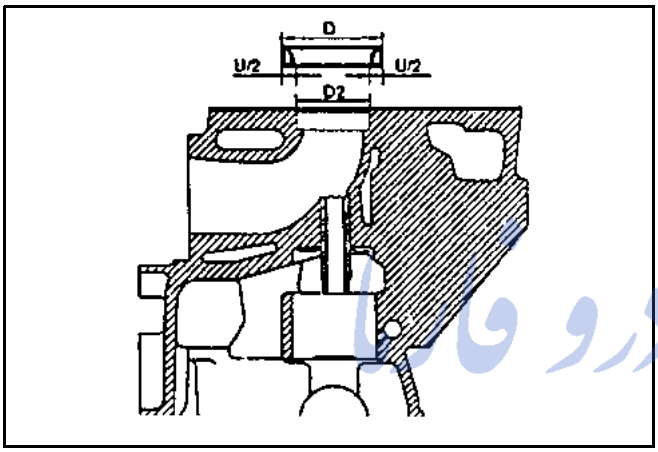
   Notice

   Carefully tighten the bolt (5) otherwise the valve seat ring in the cylinder headwill be excessively tensioned.
7. Lock the bolt (5) with nut (6).

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8. Turn over the cylinder head.
9. Remove the tensioning head (4) and valve seat ring (2) with drift (14mm) and removal tool.
10. Clean the basic bore of valve seat ring.

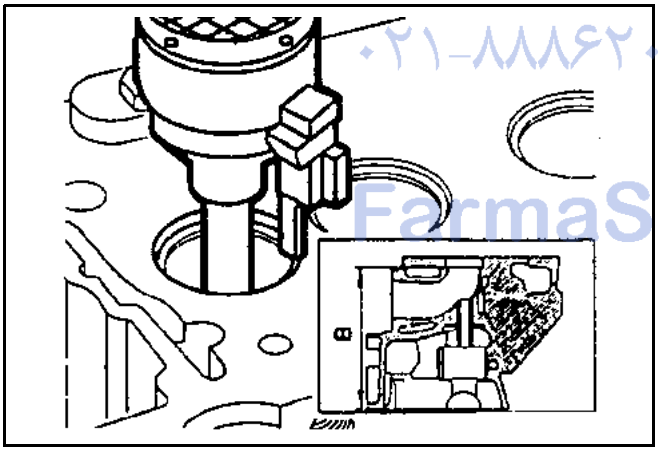


11. Measure the basic bore diameter (D2) and outer diameter (D) of the new valve seat ring (standard size).
12. Calculate the overlap value 'U' (D - D2).

Overlap Value 'U'	0.068 - 0.100 mm

Example) Measured value D = 37.100mm
Measured value D2 = 37.010mm
Overlap value 'U' = 0.090mm

If overlap value 'U' is out of standard, machine the basic bore for the valve seat ring.



13. Clamp the cylinder head with clamping device.
14. Machining basic bore for valve seat ring (repair size).

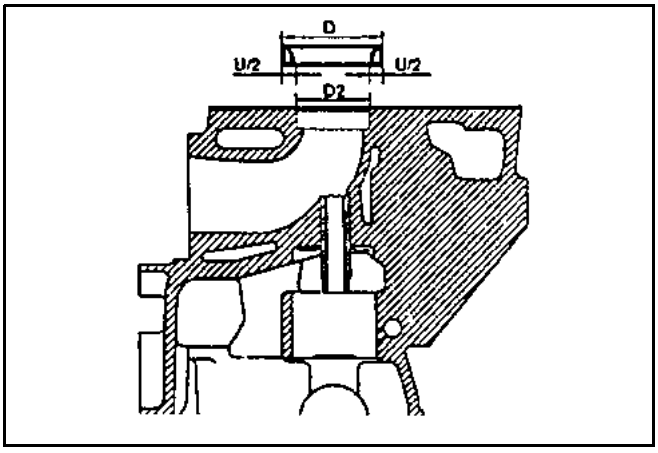
Notice

Maintain minimum value of 'B'.

- Machine the basic bore.

Limit

Max. D2	Intake	40.516 mm
	Exhaust	37.516 mm
Min.B		133.4 mm



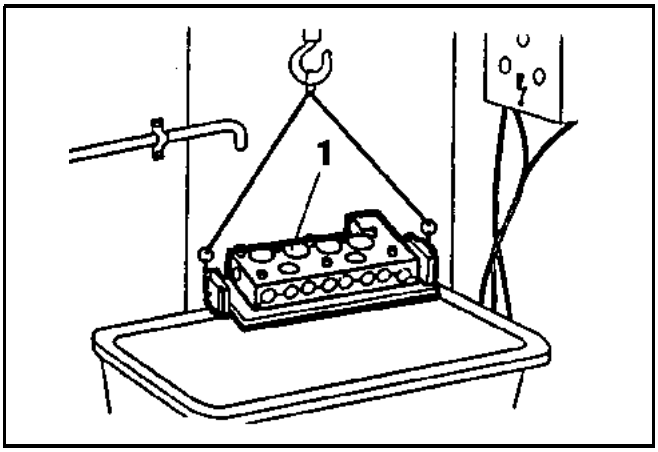
- Measure machined basic bore and outer diameter 'D' of valve seat ring (repair size).
- Measure the overlap 'U'.

Overlap 'U' (D-D2)	0.068 - 0.100 mm

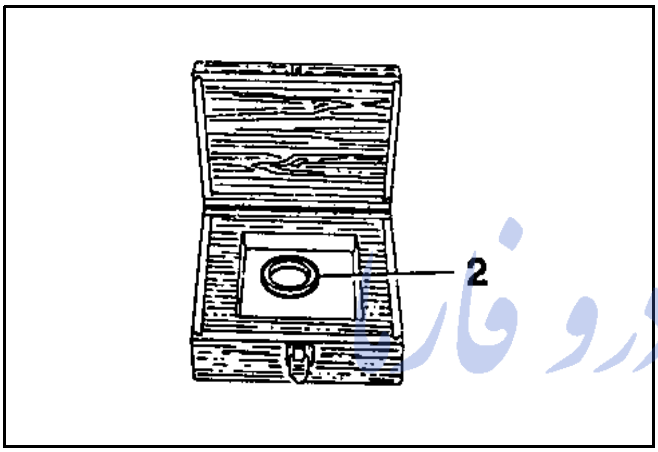
Example) Measured value D = 37.600mm
Measured value D2 = 37.480mm
Overlap value 'U' = 0.120mm

The basic diameter D2 must be machined by 0.020mm in order to get the required overlap value.

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15. Hang the cylinder head (1) to the lifting device and heat in a water tank to approx. 80°C.



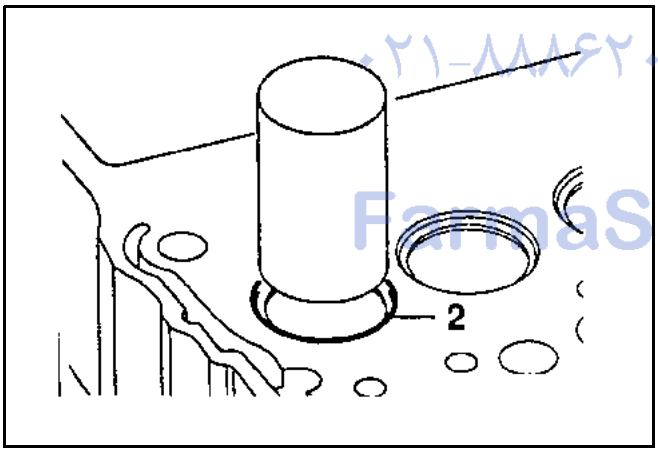
16. Cool down new valve seat ring (2) into the cooling box with liquidnitrogen.

Notice

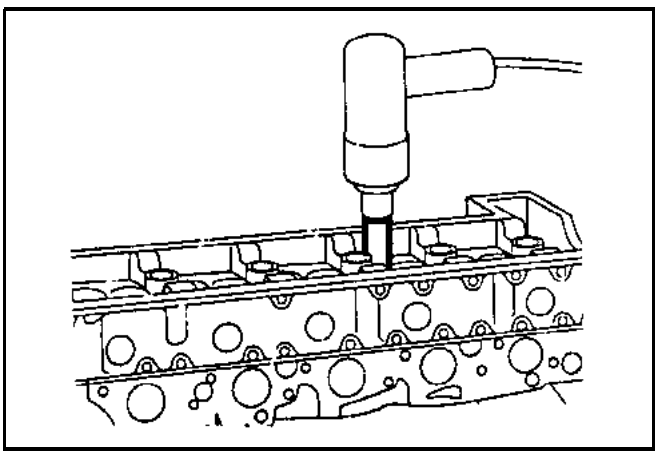
Do not touch the cooled valve seat rings with hand.

Super Cooling Box 345 589 00 63 00

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17. Drive in new valve seat ring (2) with a proper wooden drift.



18. Install the valve guide (3) with a proper drift and assembling tool.

Notice

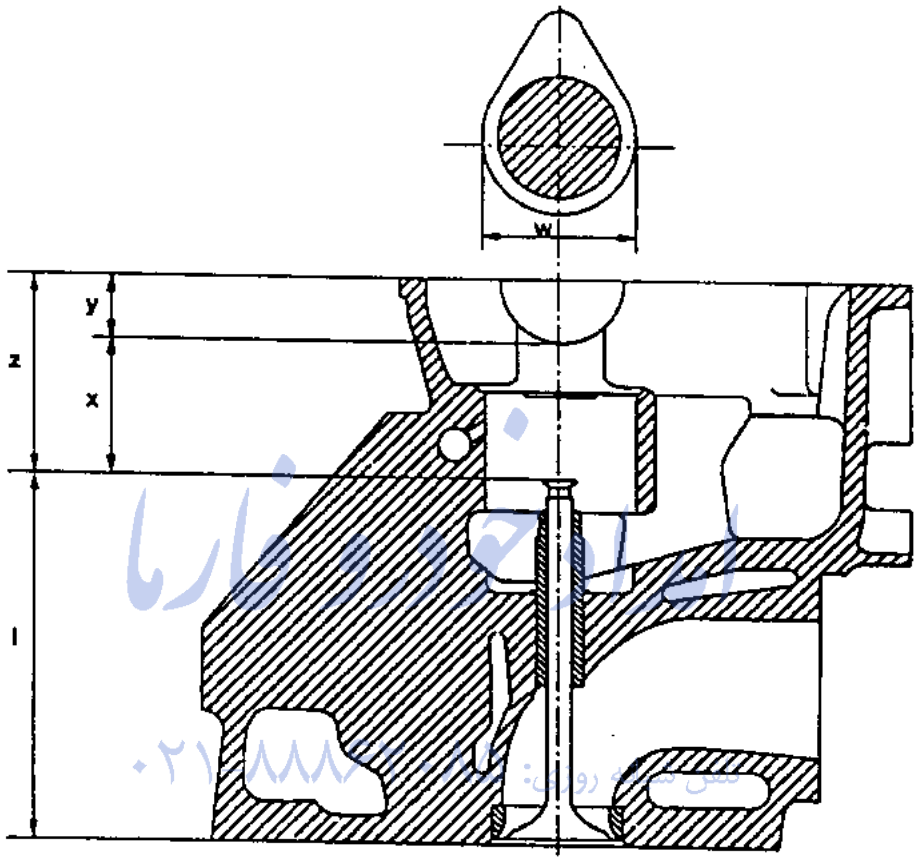
The valve guide must be driven in from the cylinder head cover.

Drift (Intake) 8mm
Drift (Exhaust) 9mm

19. Machine the valve seats.

CHECK AND MACHINING OF VALVES

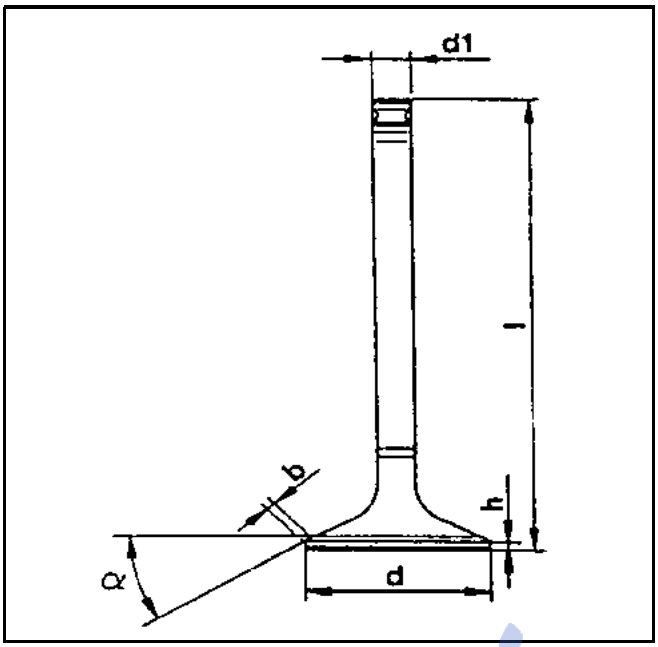
Preceding Work : Removal of cylinder head
Removal of the vale spring
Removal of the valve



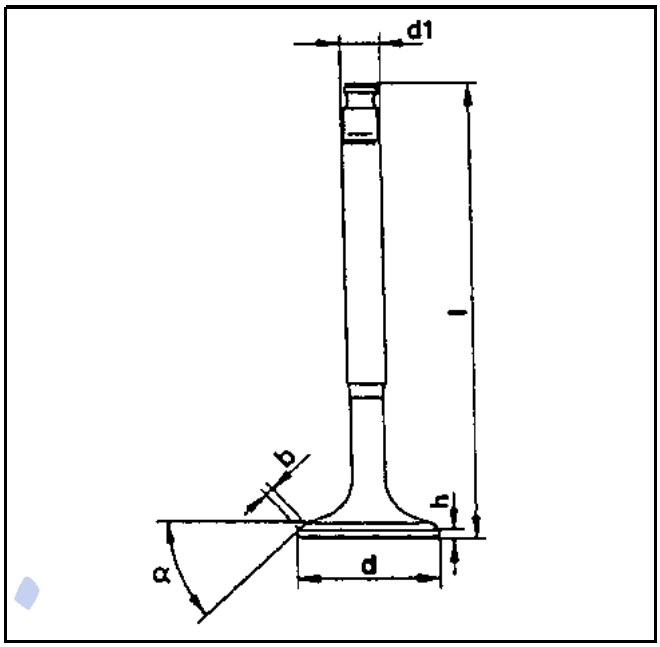
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l Valve Length
W Camshaft Cam Basic Diameter
X Distance (Camshaft Basic Bore - Valve Stem)
Y Half Camshaft Basic Bore Diameter
Z Distance (Cylinder Head Cover Parting Surface - Valve Stem)

Intake Valve



Exhaust Valve

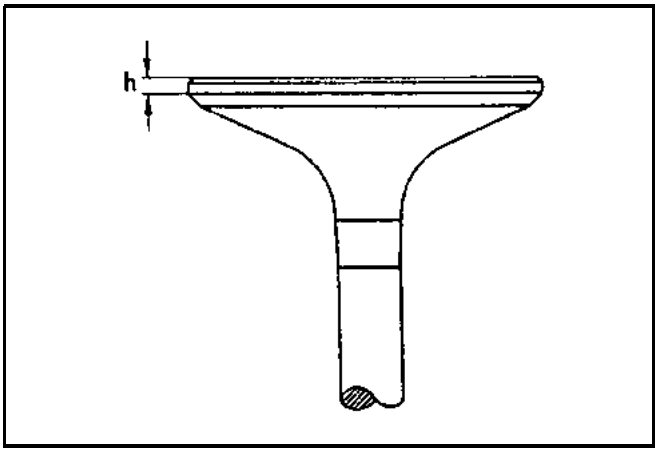


Item		Intake Valve	Exhaust Valve
Valve Disc Diameter 'd'		37.90 - 38.10 mm	34.90 - 35.10 mm
Valve Disc Height 'h'		1.7 mm	1.7 mm
Setting Angle "α" or machining the Valve		45°	45°
Valve Stem Diameter 'd1'		7.955 - 7.970 mm	9.945 - 9.960 mm
Valve Length 'l'	Standard	106.20 - 106.60 mm	106.20 - 106.60 mm
	Repair	105.30 - 105.70 mm	105.30 - 105.70 mm
Max. Permis Sible Runout at Valve Stem and Valve Seat		0.03 mm	0.03 mm

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Matching Valves

	Camshaft Cam Basic Dia. W = 38.0 ± 0.2 mm	Camshaft Cam Basic Dia. W = 36.6 ± 0.2 mm	Valve to be Used
Size (x)	19.5 - 20.3 mm	19.5 - 20.1 mm	Use machined valve, if needed new repair valve l = 105.5 ± 0.2mm
Size (x)	20.4 - 21.4 mm	20.2 - 21.2 mm	Reuse valve
Size (x)	21.4 - 21.97 mm	21.2 - 21.97 mm	Use standard size valve l = 106.4 ± 0.2mm



Tools Required

001 589 32 21 00 Dial Gauge

Commercial Tool

Valve corn grinding machine

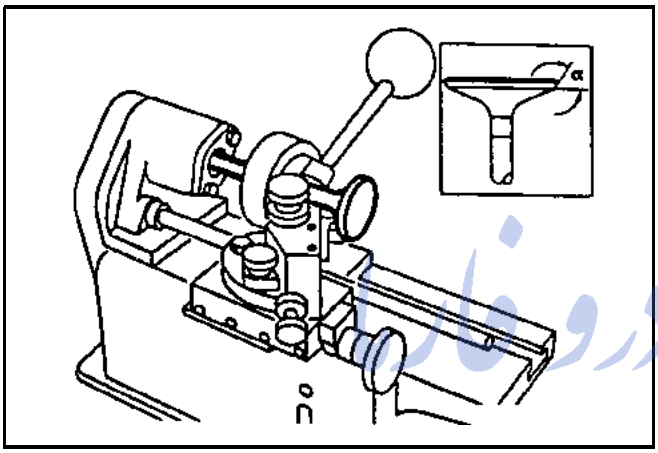
Checking and Machining

1. Clean the valves and do visual check.

   Valves with wobbled valve disc, with worn or scored valve stem should be replaced.

2. Measure valve disc height 'h'.

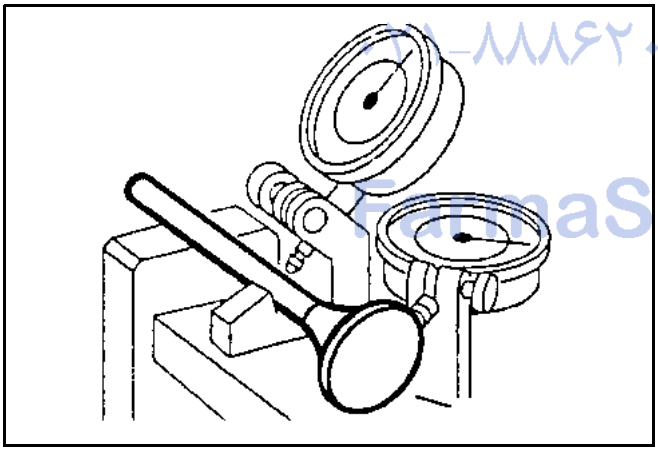
Service data	Intake	1.7 ± 0.15 mm
	Exhaust	1.7 ± 0.15 mm



3. Machine the valve.

   Notice

   Pay attention to setting angle 'a'.

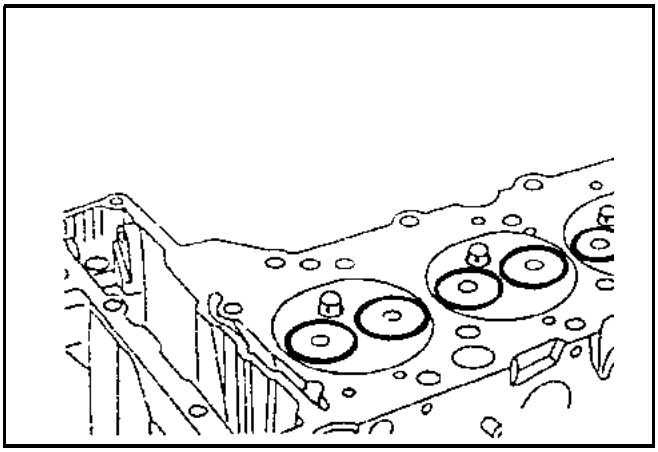


4. Measure radial runout between valve stem and valve seat.

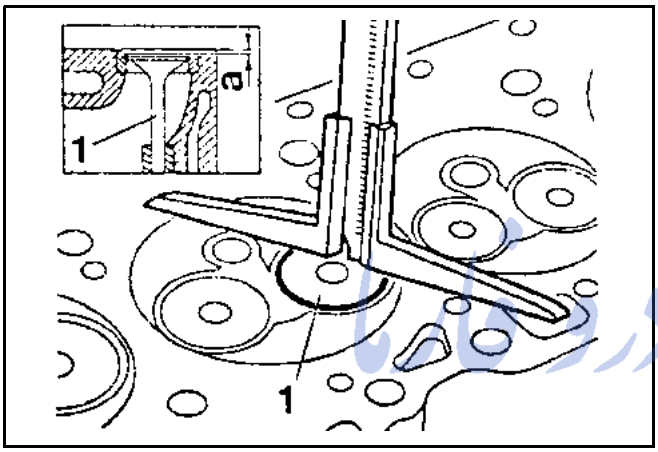
Limit	Max. 0.03 mm

Dial Gauge 001 589 32 21 00

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5. Clean the vales, valve seats and valve guides.
6. Coat the valve stem with oil and insert it into valve guide.



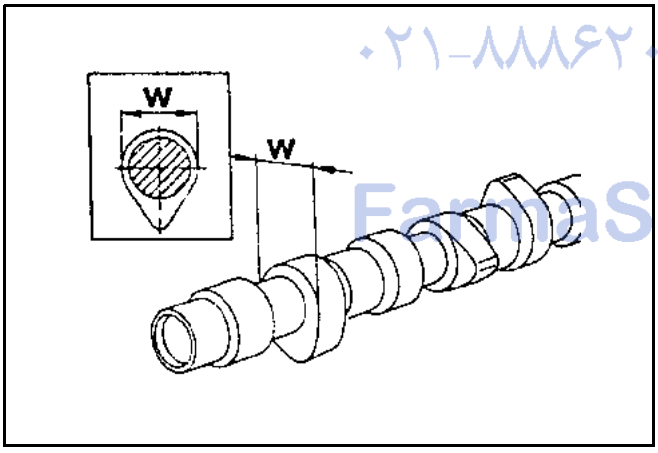
7. Insert the valves (1) into the valve guides according to marking.
8. Measure amount by which the valve arrears 'a'.

Arrears 'a'	0.1 - 0.7 mm

Notice

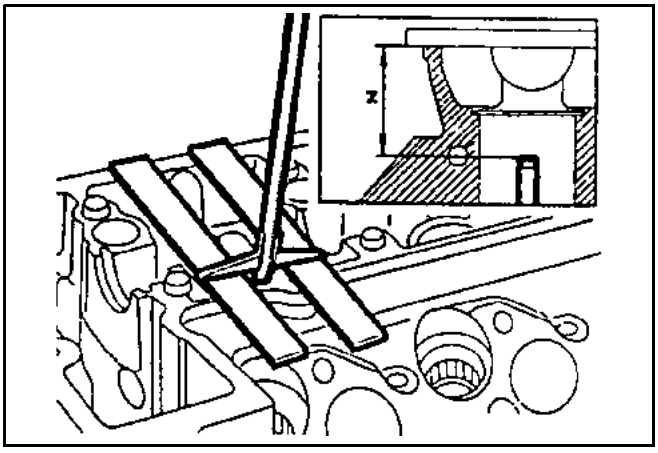
If out of standard, replace the valve seat ring.

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9. Measure camshaft cam basic diameter (w).

Diameter 'w'	38 ± 0.2 mm or 37.6 ± 0.2 mm



10. Measure distance 'z' (cylinder head cover parting surface - valve stem).

11. The distance 'x' (camshaft basic bore - valve stem).
    'x' = 'z' - 'y'.
    Determine the valve to use according to this measurement (See 'matching valves')

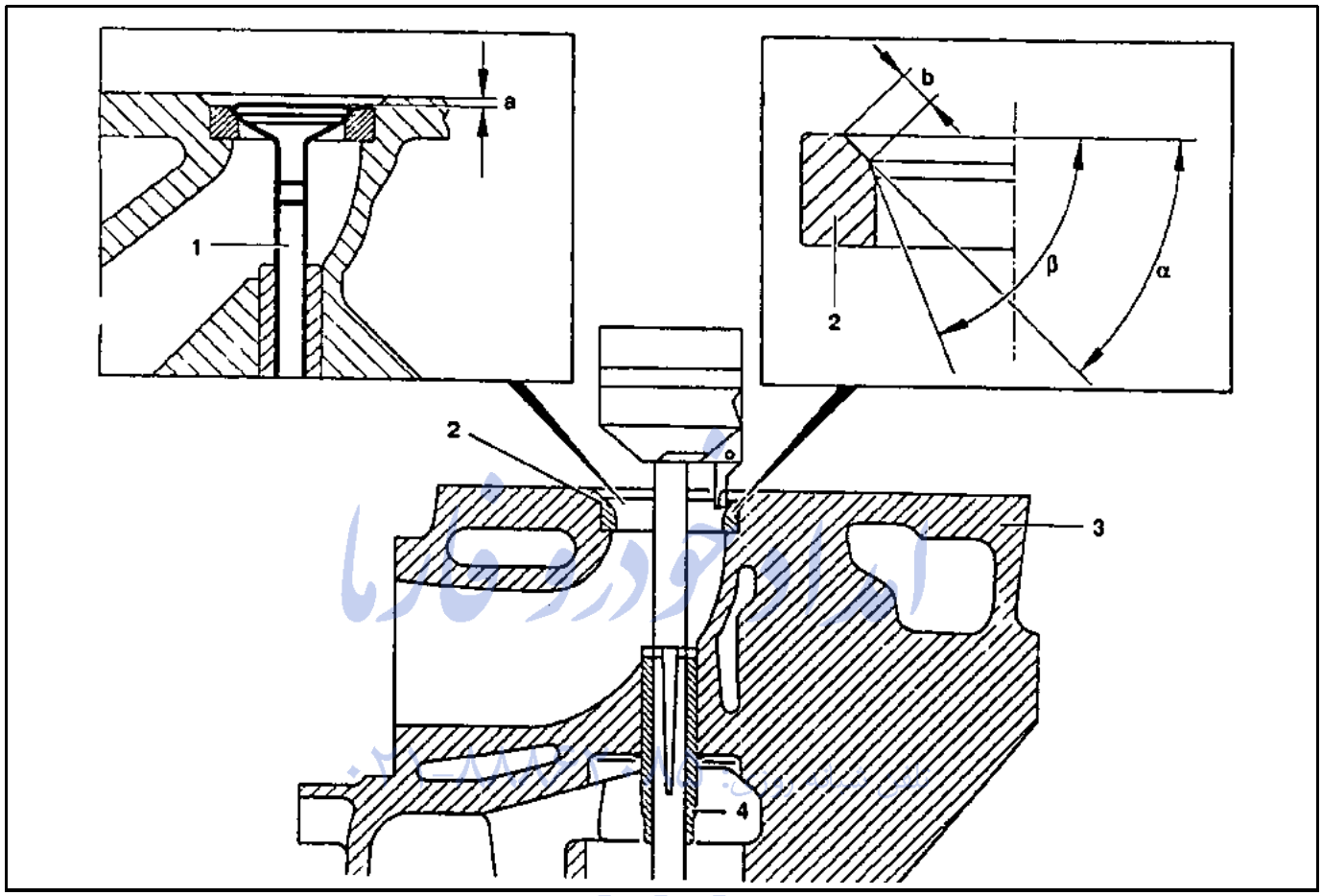
    Example) Measured value 'w'= 38.2 mm
    Measured value 'z' = 36.5 mm
    Value 'y' = 15.5 mm

    'x' = 36.5 - 15.5 = 21.0mm
    In this case according to 'Matching valves' table, the installed valve may be used.

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MACHINING OF VALVE SEAT

Preceding Work : Removal of prechamber
Removal and inspection of valve, replace if necessary
Inspection of valve guide, replace if necessary



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1 Valve
2 Valve Seat Ring
3 Cylinder Head
4 Valve Guide

a Valve Seat Angle
b Valve Seat Free Angle

Service Data

Item		Intake	Exhaust
Valve Arrears 'a'		0.1 - 0.7 mm	0.1 - 0.7 mm
Valve Seat Width 'b'		1.2 - 1.7 mm	1.5 - 2.0 mm
Valve Seat Angle 'α'		45°	45°
Valve Seat Free Angle 'β'		65°	65°
Permissible Radial Runout		0.03 mm	0.03 mm
Valve Length 'l'	Standard	106.20 - 106.60 mm	106.20 - 106.60 mm
	Repair	105.30 - 105.70 mm	105.30 - 105.70 mm

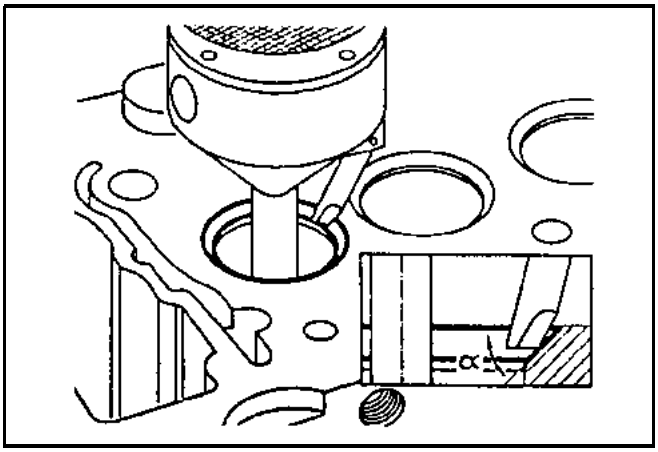
Matching Valves

	Camshaft Cam Basic Dia. W = 38.0 ± 0.2 mm	Camshaft Cam Basic Dia. W = 36.6 ± 0.2 mm	Valve to be Used
Size (x)	19.5 - 20.3 mm	19.5 - 20.1 mm	Use machined valve, if needed new repair valve l = 105.5 ± 0.2mm
Size (x)	20.4 - 21.4 mm	20.2 - 21.2 mm	Reuse valve
Size (x)	21.4 - 21.97 mm	21.2 - 21.97 mm	Use standard size valve l = 106.4 ± 0.2mm

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Commercial Tools

Cylinder Head Clamping Device	Hunger D-8000 München 70 Type Ventilknecht K2000 Order No. 221 00 100
Valve Seat Turning Tool	Hunger D-8000 München 70 Type VDS 1A Order No. 236 03 308
Test Set for Valves	Hunger D-8000 München 70 Order No. 217 93 601

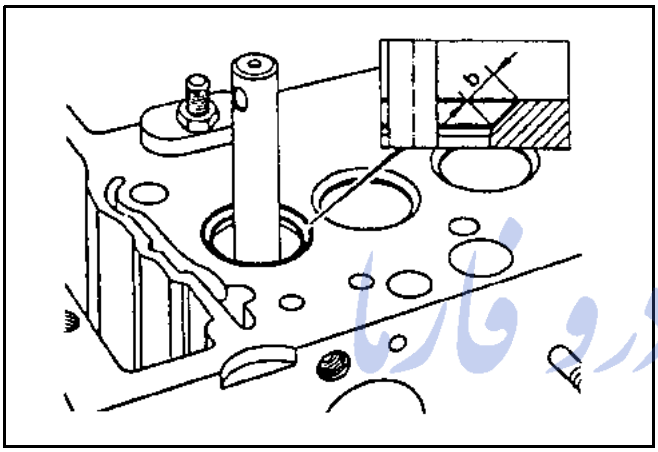


Machining Procedure

Valve machining is required :

- When the valve is leaking.
- When replacing the valve.
- When replacing the valve guide.
- When replacing the valve seat or valve seat ring.

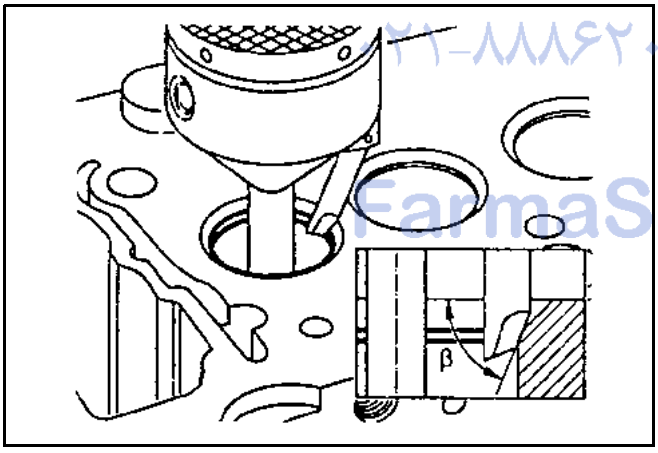
1. Machine the valve seat (a=45°).



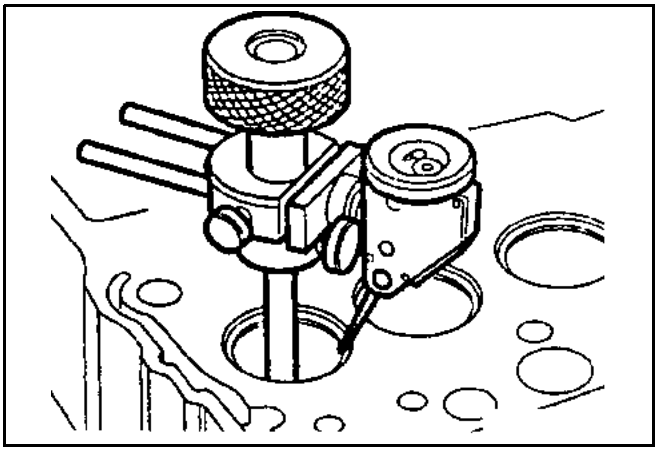
2. Measure valve seat width 'b'.

Valve seat width 'b'	Intake	1.2 - 1.7 mm
	Exhaust	1.5 - 2.0 mm

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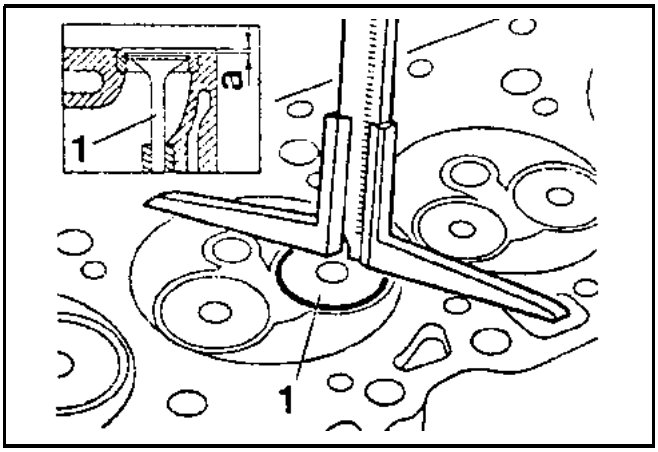


3. If the specification is exceeded, the valve seat width has to be corrected at the lower free angle of 'β'=65□.



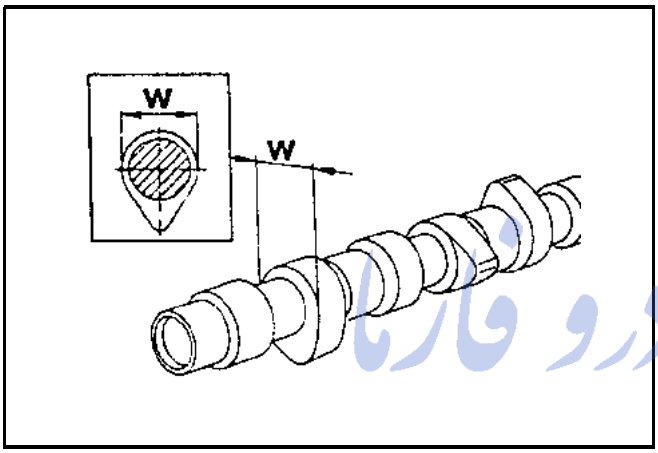
4. Measure radial runout.

Runout	Max. 0.03mm



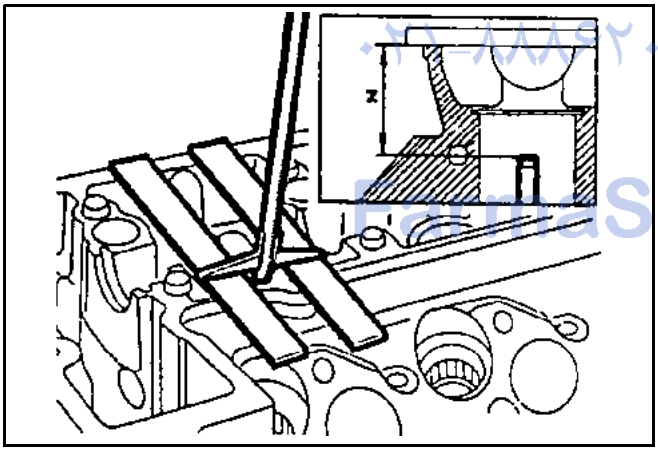
5. Insert the valve (1) into the valve guide according to marking and measure amount by which the valve arrears 'a'.

Arrears 'a'	0.1 - 0.7mm



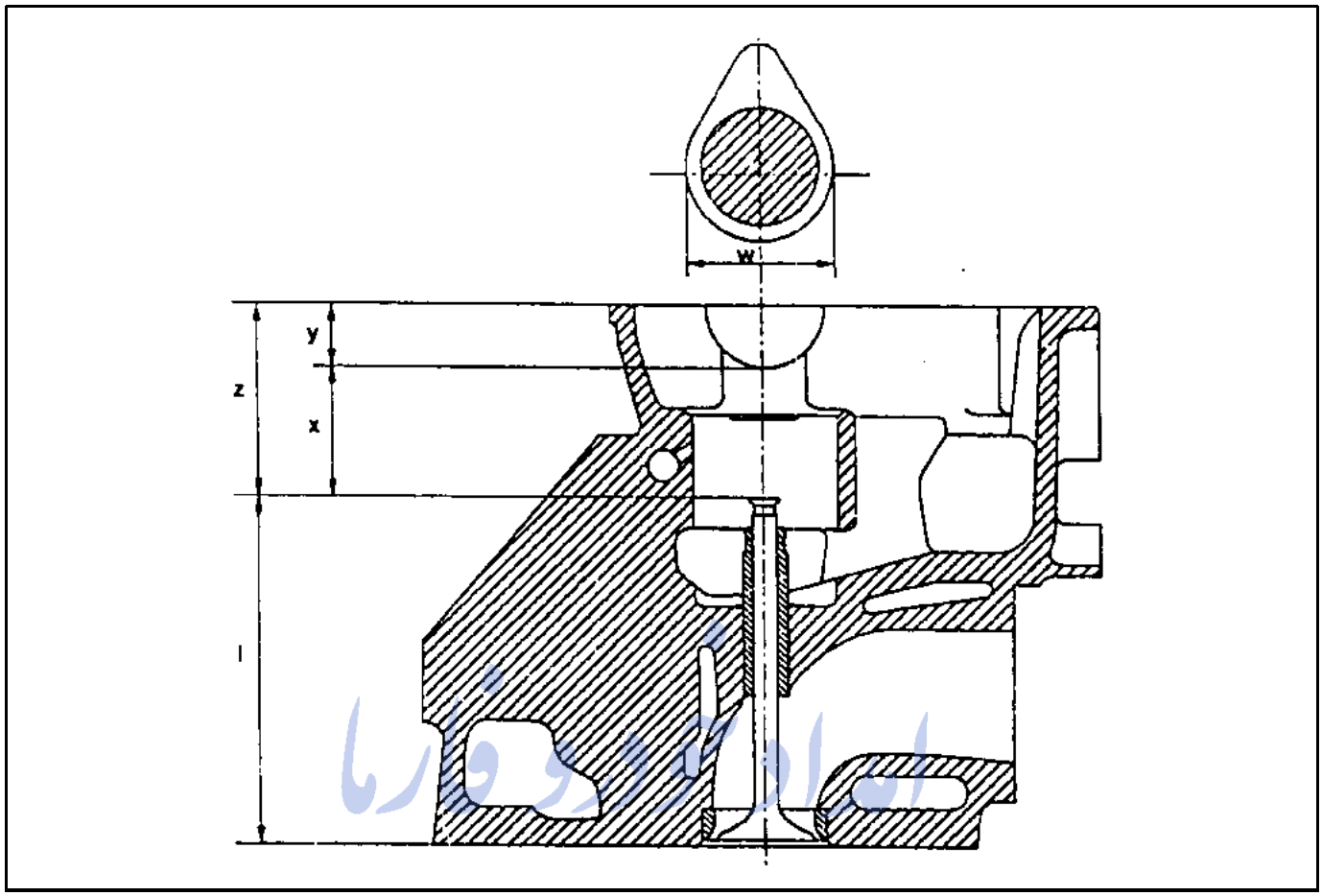
6. Measure camshaft cam basic circle diameter (w).

Diameter 'w'	38 ± 0.2mm or 37.6 ± 0.2mm



7. Measure distance 'z' (cylinder head cover parting surface - valve stem).

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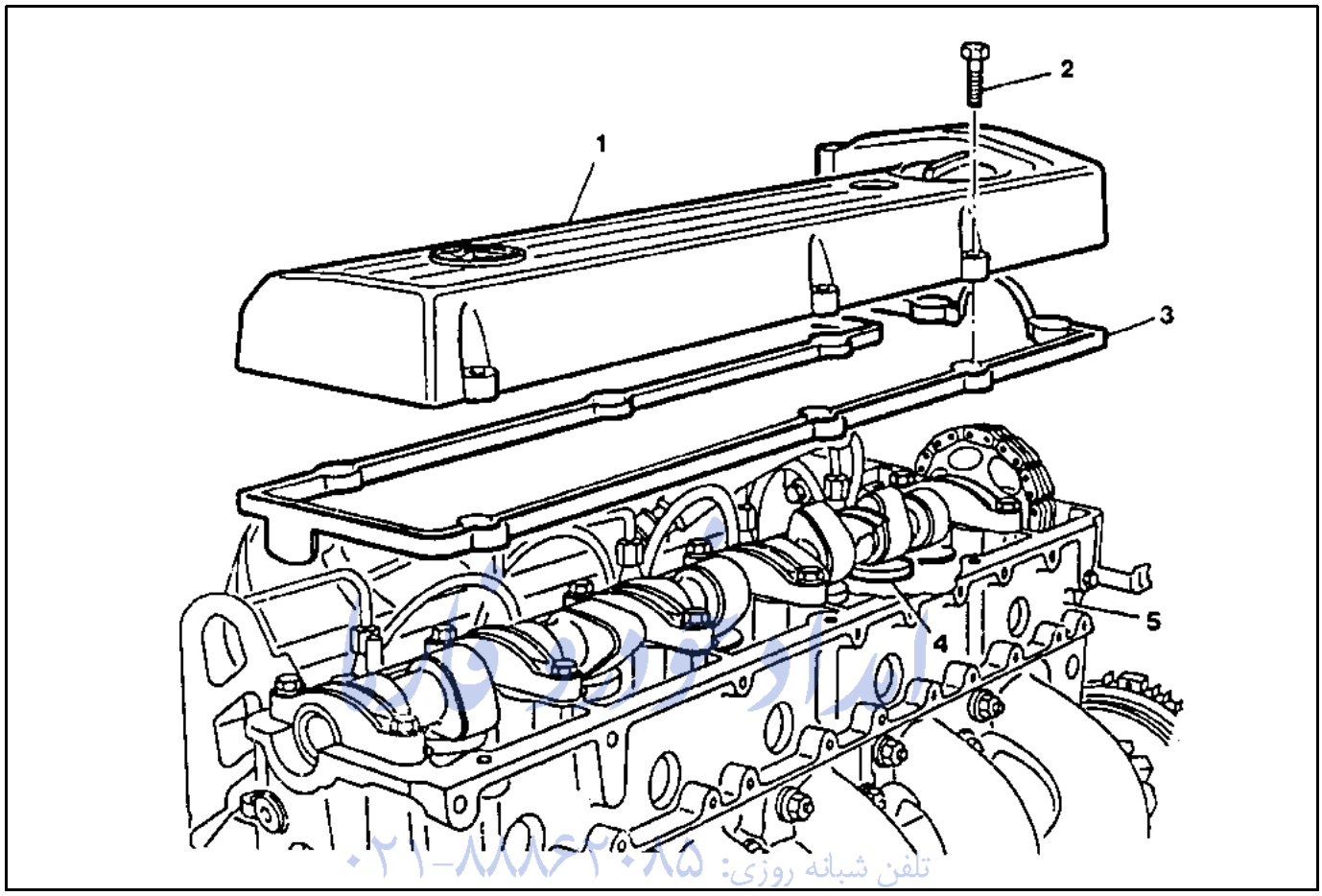
l Length of Valve
w Camshaft Cam Basic Circle Diameter
x Distance (Camshaft basic bore - valve stem)
y Half Camshaft Basic Bore Diameter
z Distance (Cylinder head cover parting surface - valve stem)

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8. Measure 'x' (Camshaft basic bore - valve stem).
   'x' = 'z' - 'y'
9. Determine the valve to be used.
   (See 'Matching valves')
   Example) Measured value 'w' = 38.2 mm
   Measured value 'z' = 36.5 mm
   Value 'y' = 15.5 mm
   'x' = 36.5 - 15.5 = 21.0 mm
   In the case of a camshaft cam basic circle diameter 'w' = 38.2mm and a distance 'x' = 21.0mm, the installed valve may be used.

CAMSHAFT TIMING TEST

Preceding Work : Removal of glow plug



تلفن شبانه روزی: ۰۲۱-۸۸۶۲۰۸۵

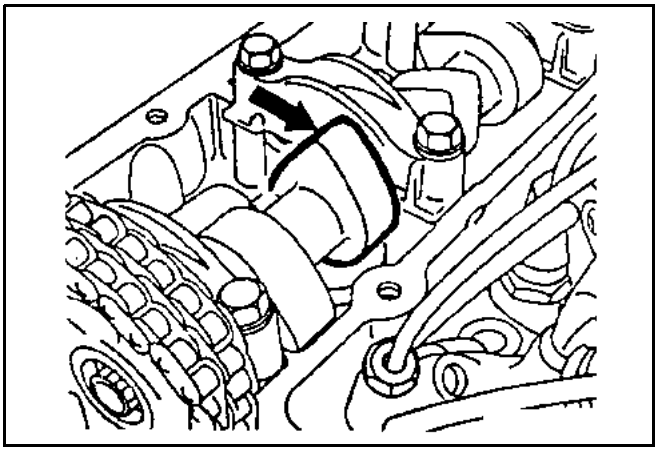
1 Cylinder Head Cover
2 Bolt . . . . . 10N·m (89 lb-in)
3 Gasket . . . . . Replace
4 Valve Tappet
5 Cylinder Head

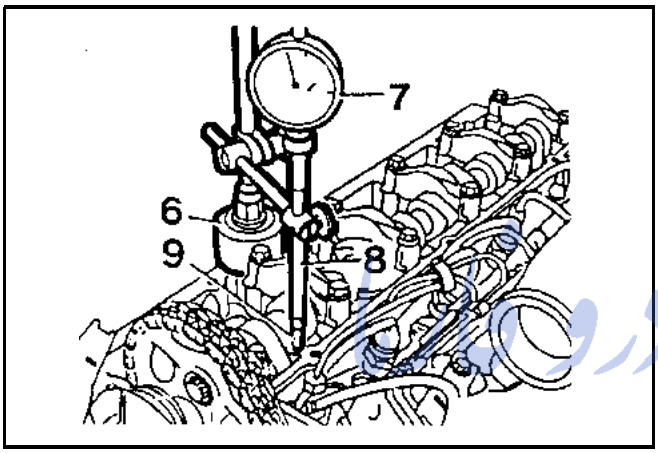
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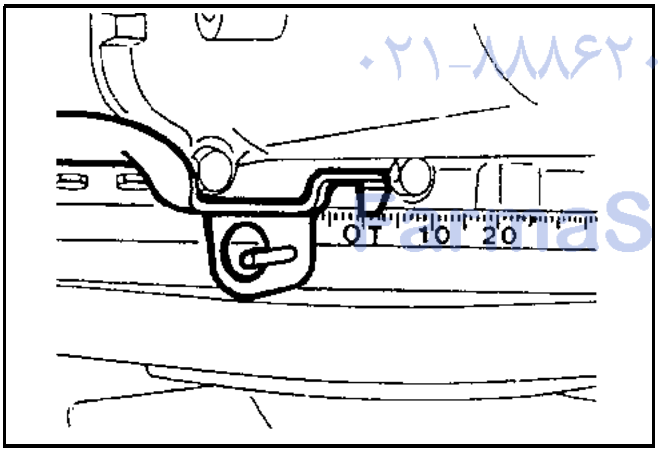
Timing

Condition of camshaft	Intake valve		Exhaust valve	
	Open	Close	Open	Close
New	ATDC 11.33°	ABDC 17°	BBDC 28°	BTDC 15.25°
After approx. 20,000km	ATDC 12°	ABDC 18°	BBDC 27°	BTDC 14°

* At 2mm of valve lifting stroke.







Tools Required

001 589 53 21 00 Dial Gauge

363 589 02 21 00 Dial Gauge Holder

366 589 00 21 05 Extension

Measurement Procedure

1. Remove the cylinder head cover.
2. Rotate the engine in the direction of engine rotation until the intake valve of NO.1 cylinder is completely closed. The cam lobe faces up (arrow).

   Notice

   Do not rotate the engine at the bolt of the crankshaft sprocket. Do not rotate the engine in the opposite direction of engine rotation. If do, this will cause serious measuring errors.
3. Install the dial gauge holder and dial gauge (7) with the extension (8) to the cylinder head and position the tracer pin (9) onto the valve tappet (intake valve of cylinder NO.1) with a preload of min. 3mm.

   Notice

   The tracer pin should be positioned exactly vertical.

Dial gauge Holder 363 589 02 21 00
Dial Gauge 001 589 53 21 00
Extension 366 589 00 21 05

4. Set the dial gauge to '0'.
5. Rotate the engine further in direction of rotation until the dial gauge has moved back by 2mm (valve lift) to 1mm.
6. Check the timing.

New	ATDC 11.33°
After approx. 20,000km	ATDC 12°

   Notice

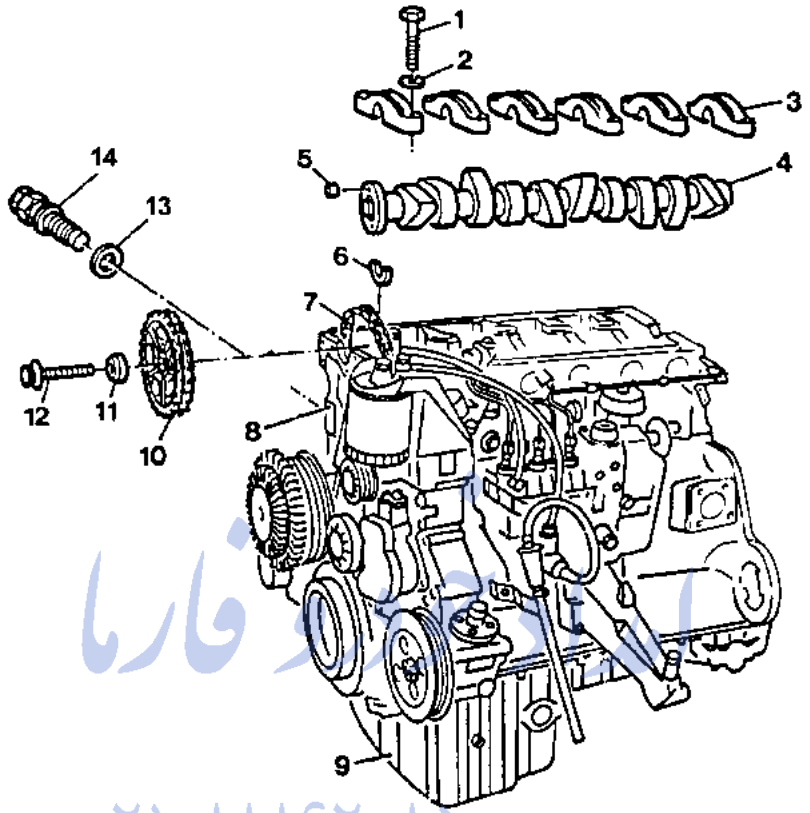
   If timing is out standard, the camshaft should be checked for wear and the timing chain for stretch. If a difference of more than 4° exists, the timing chain should be replaced.
7. Replace the gasket and install the cylinder head cover.

Tightening Torque	10 N·m (89 lb-in)

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۰۲۱-۸۸۸۶۲۰۸۵
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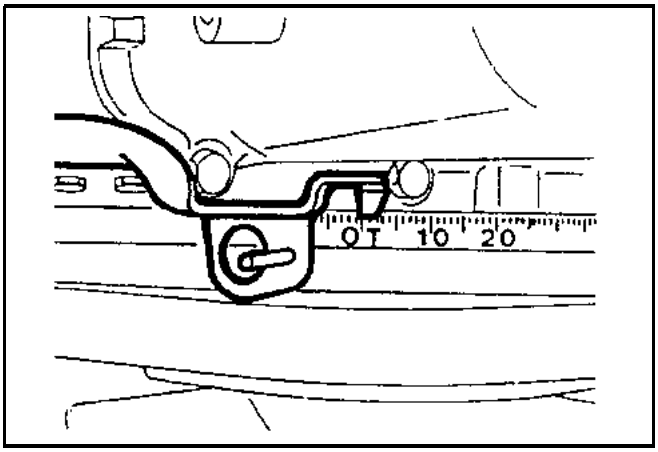
CAMSHAFT

Preceding Work : Removal of cylinder head cover



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1 Bolt . . . . . 25N·m (18 lb-ft)
2 Washer
3 Camshaft Bearing Cap
4 Camshaft
5 Dowel Pin
6 Locking Washer
7 Timing Chain
8 Cylinder Head
9 Oil Pan
10 Camshaft Sprocket
11 Washer
12 12-Sided Bolt (M11)
. . . . . Check, 25N·m (18 lb-ft)+90°
13 Gasket . . . . . Replace
14 Chain Tensioner . . . . . 80N·m (59 lb-ft)



Tools Required

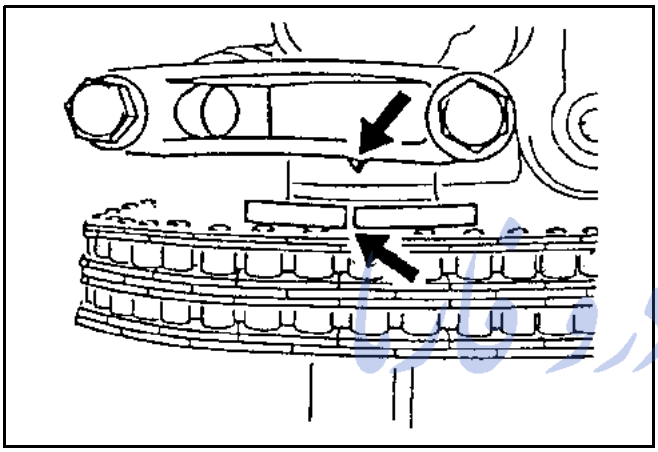
602 589 00 40 00 Engine Lock

Removal Procedure

1. Rotate the crankshaft and position the piston of no.1 cylinder at TDC.

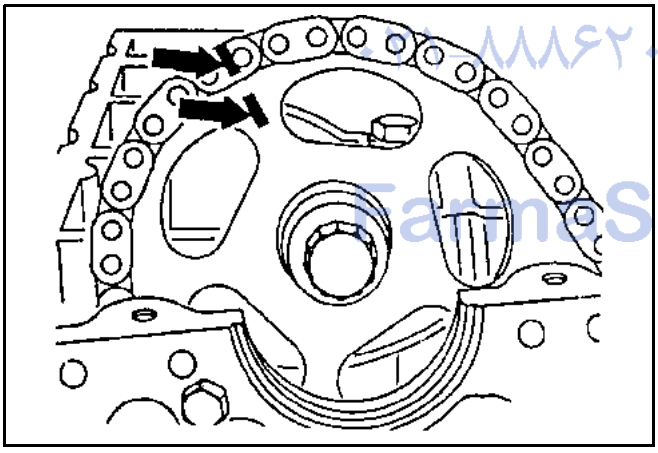
   Notice

   Do not rotate the crankshaft in the opposite direction of engine rotation.

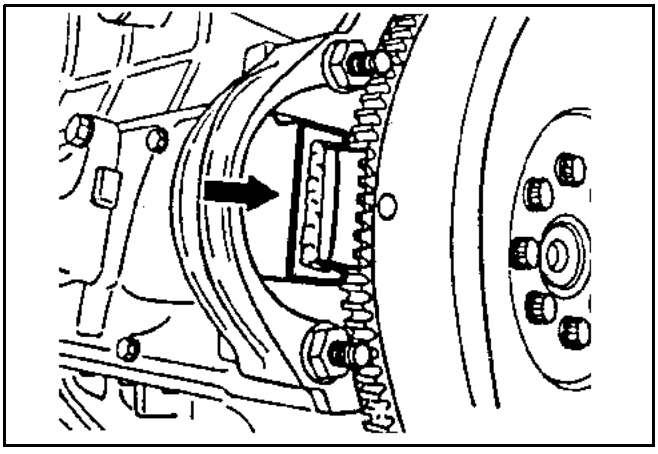


In this position, the markings of the camshaft/camshaft bearing cap (arrow) must be aligned.

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تلفن شبانه روزی: ۰۸۵-۸۸۴۶۲۰۸۵
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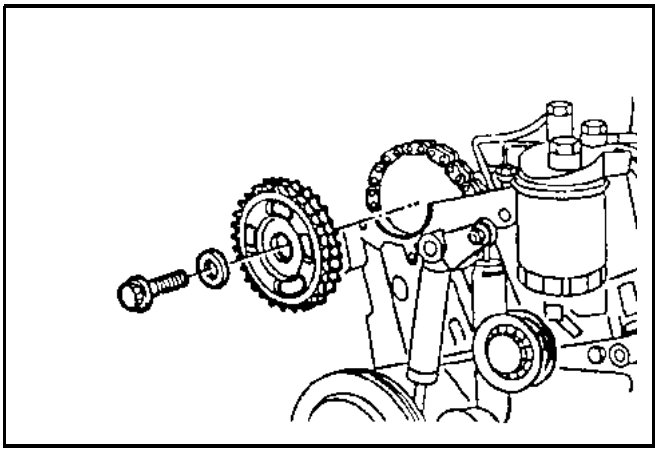


2. Place alignment marks on the camshaft sprocket and timing chain.



3. Remove the starter motor and install the engine lock.

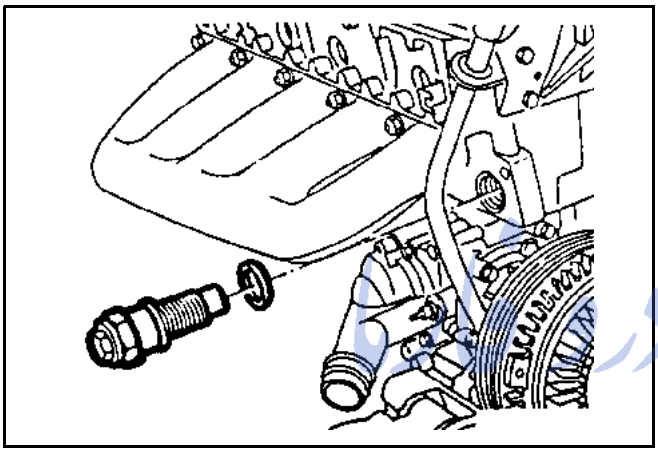
Engine Lock 602 589 00 40 00



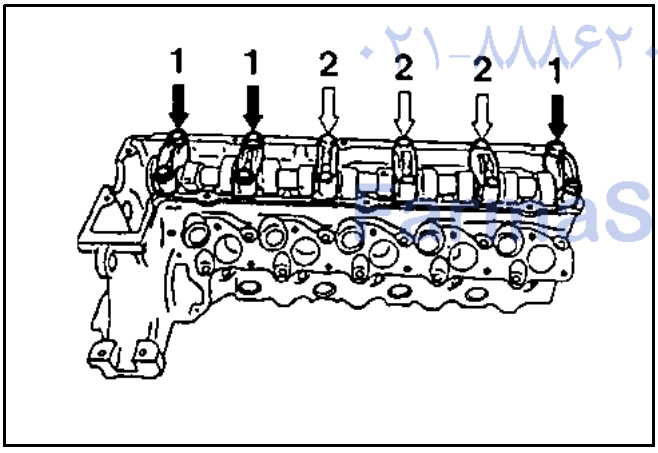
4. Remove the bolt and then remove the camshaft sprocket.

Notice

During removal, be careful not to drop the sprocket with chain. Remove the chain carefully and then pull out the sprocket.



5. Remove the chain tensioner.

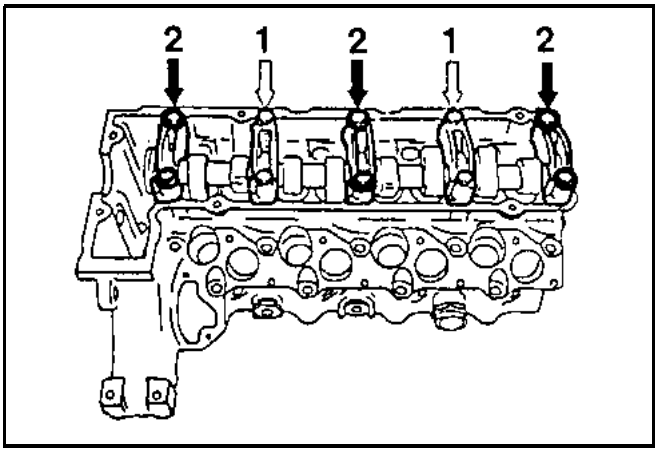


6. Remove the camshaft bearing cap bolts according to the removal order.

Notice

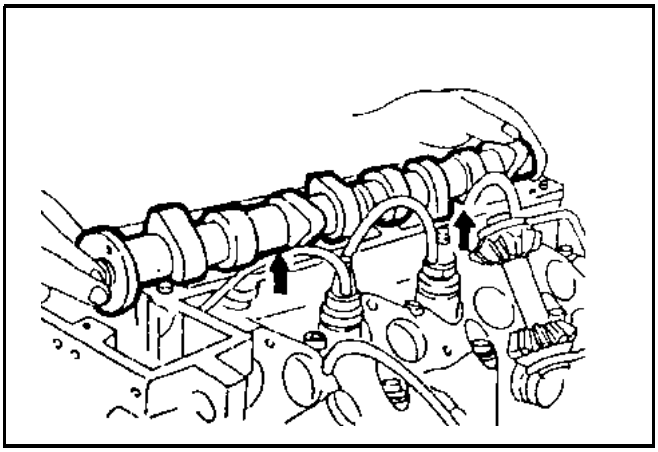
Remove the camshaft bearing cap bolts of 1(dark arrow) first and then remove the bolts of 2 (light arrow) one revolution in stages until the counter-pressure is released. In order to avoid damaging the camshaft, it is essential to adhere to the removal order for the camshaft bearing caps.

OM 662LA



OM 661LA

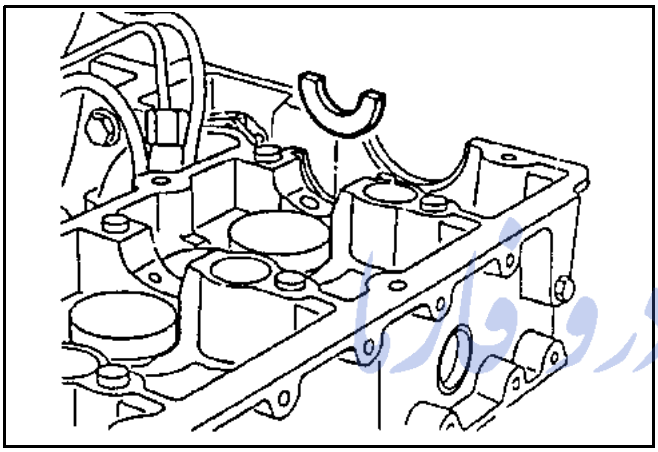
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7. Remove the camshaft bearing cap.
8. Pull off the camshaft.

Notice

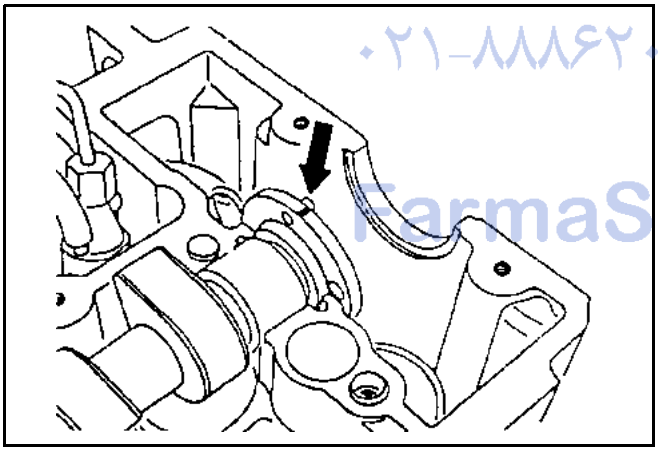
Be careful not to miss front locking washer.



9. Pull out the locking washer.

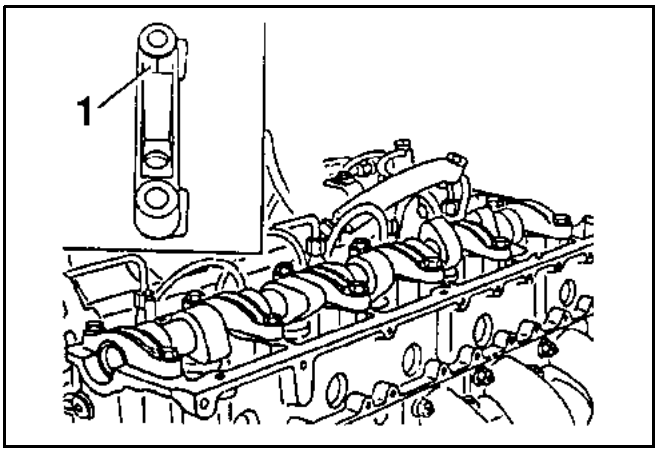
Notice

Check the condition of locking washer and replace if necessary.



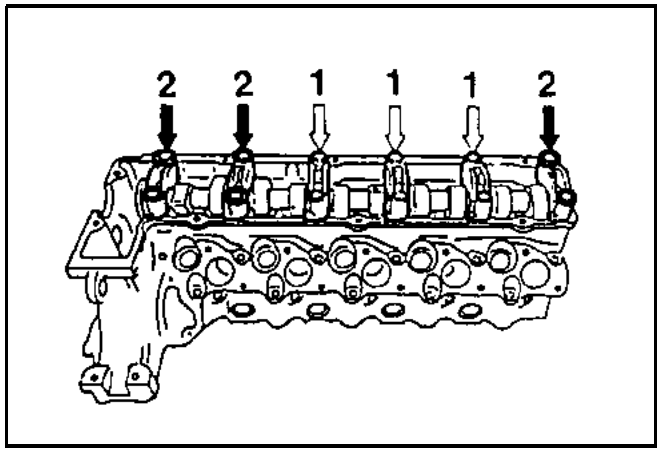
Installation Procedure

1. Insert the locking washer.
2. Check the valve tappet and ensure that tappet moves smoothly.
3. Coat the camshaft with oil and install the camshaft onto the cylinder head so that the TDC marking (arrow) is positioned upward vertically.



4. Install the camshaft bearing caps according to markings(1, 2, 3 etc.).

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۰۲۱-۸۸۸۶۲۰۸۵
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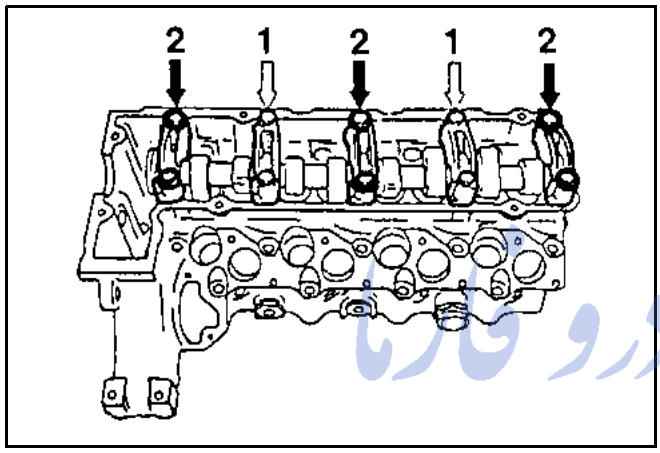
5. Tighten the camshaft bearing cap bolts acccording to installation order.

Tightening Torque	25 N·m (18 lb-ft)

Notice

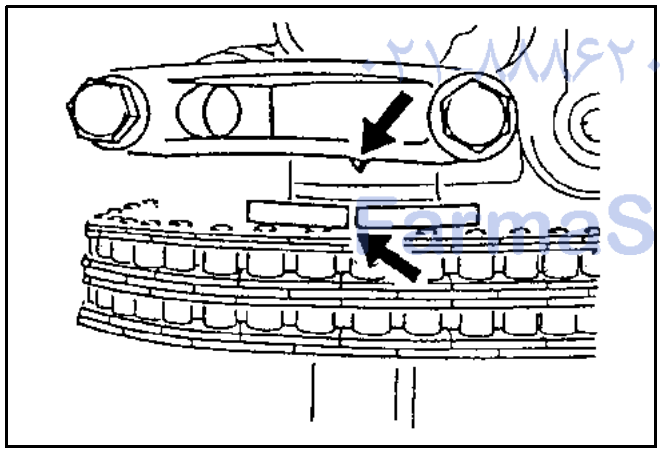
Tighten the No. 1 bolts (light arrow) by one revolution in stages first and then tighten the No.2 bolts (dark arrow).

OM 662LA



OM 661LA

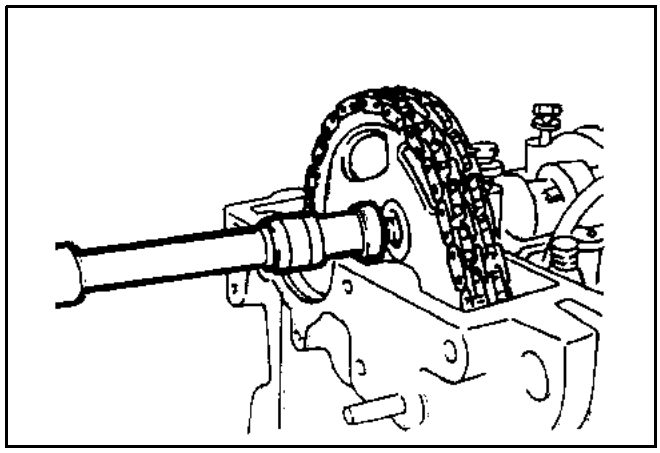
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تلفن شبانه روزی: ۰۲۱۸۸۸۶۲۰۸۵
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6. Install the camshaft sprocket to be aligned the markings of the camshaft / camshaft bearing cap (arrow).

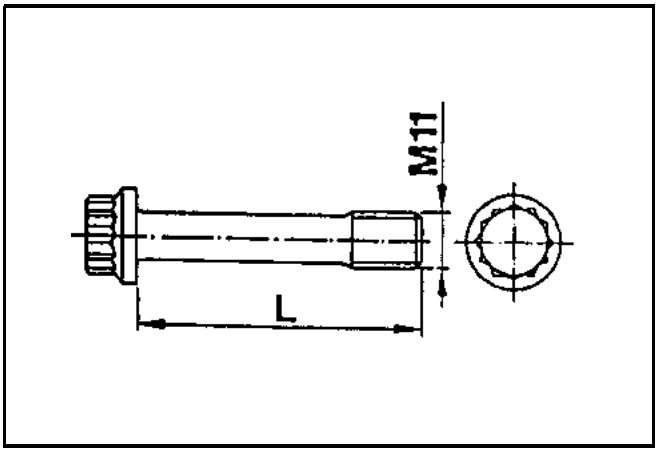
Notice

Align the alignment marks on the timing chain and sprocket.



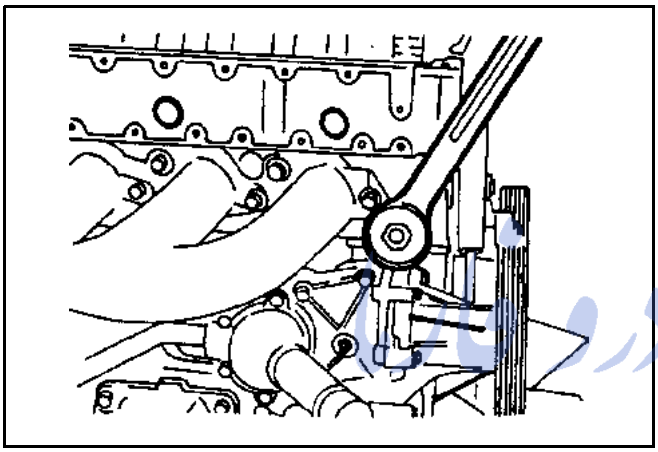
7. Tighten the camshaft sprocket bolt.

Tightening Torque	25 N·m (18 lb-ft) + 90°



Notice

If max. length 'L' of the 12-sided bolt exceeds 53.6mm, replace it.



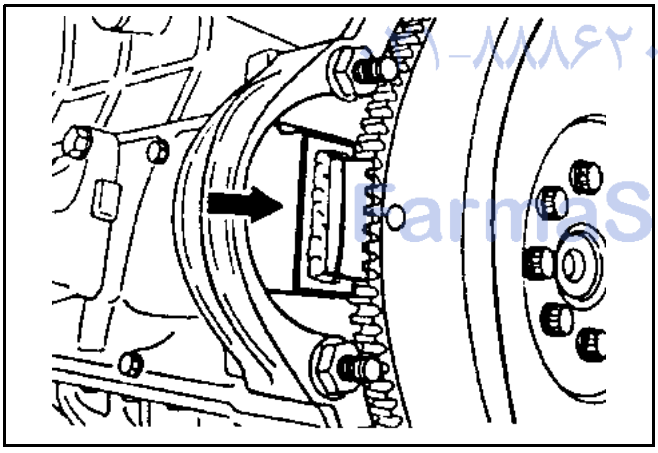
8. Install the chain tensioner.

Tightening Torque	80 N·m (59 lb-ft)

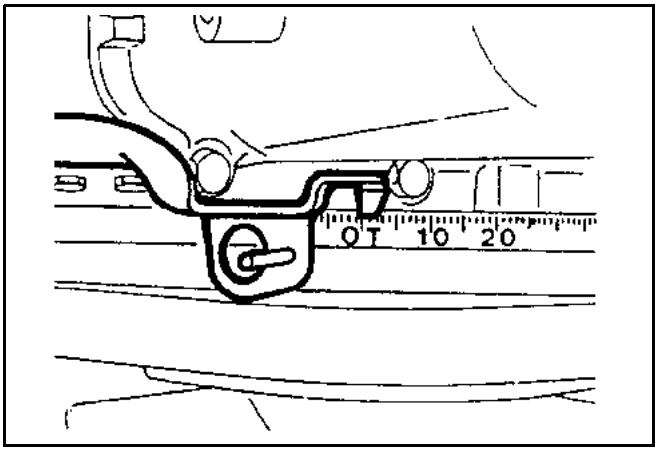
Notice

Replace the seal.

Before installation, by pumping in the oil approx. 10 times, fill the oil.



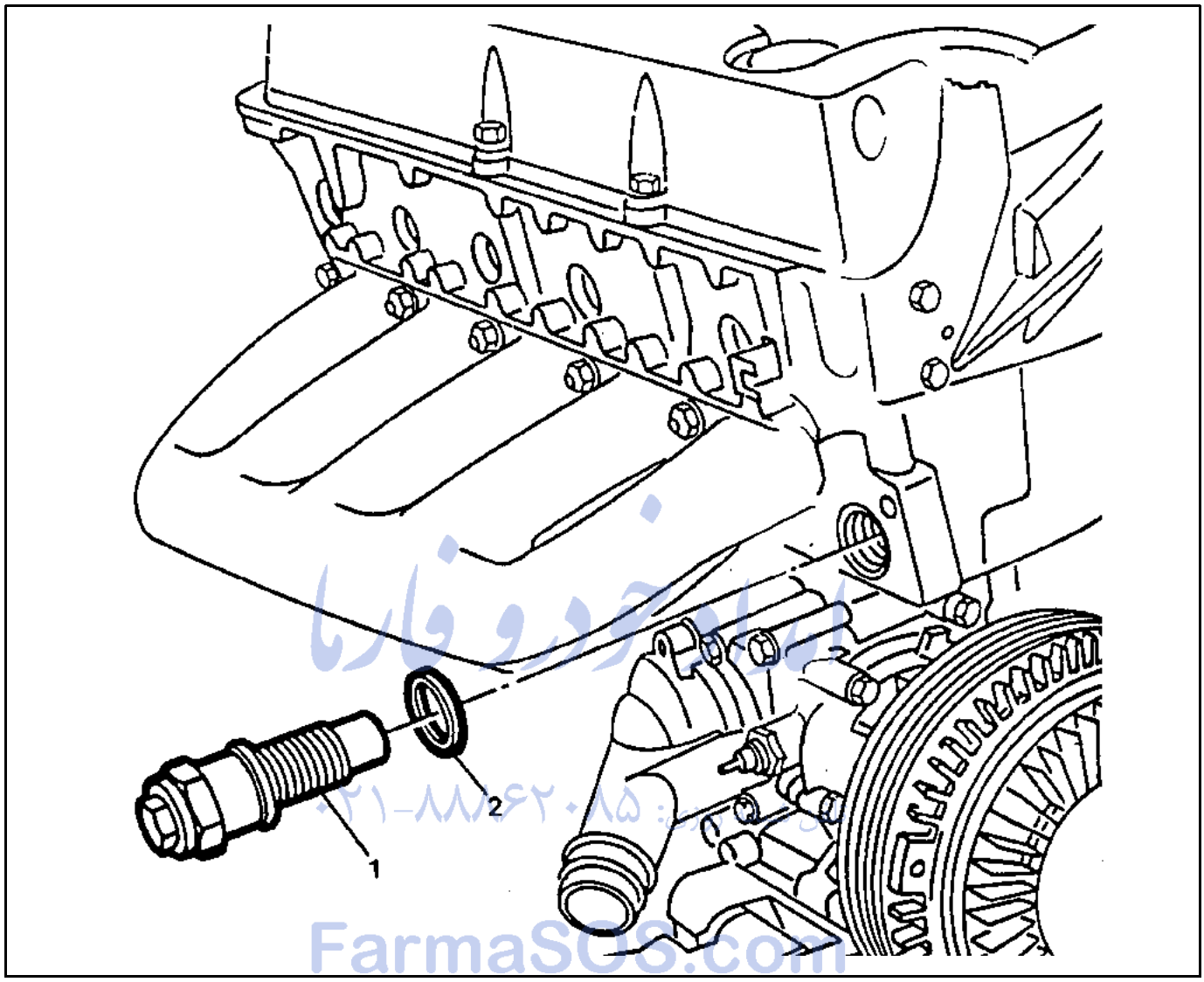
9. Remove the engine lock.



10. Check the TDC marking of OT on the crankshaft.

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تلفن شبانه روزی: ۸۸۸۶۲۰۸۵-۰۲۱
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CHAIN TENSIONER



1 Chain Tensioner . . . . . 80N·m (59 lb-ft)

2 Seal . . . . . Replace

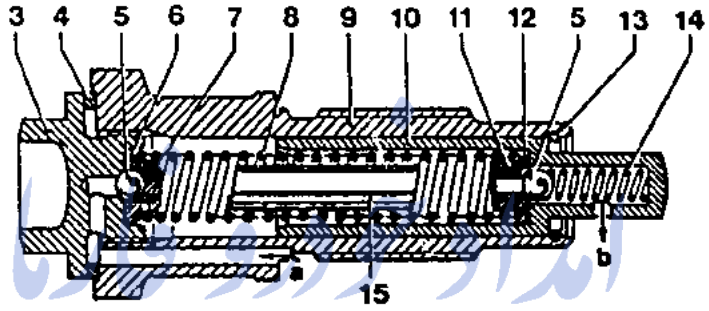
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Notice

Always install the chain tensioner to be filled with oil.

Place the chain tensioner in engine oil up to over the collar on the hexagon headwith the thrust pin facing up. Slowly push down the thrust pin as far as the stop 7~10 times with the aid of a press or a column drill

Faulty chain tensioners should be replaced completely.



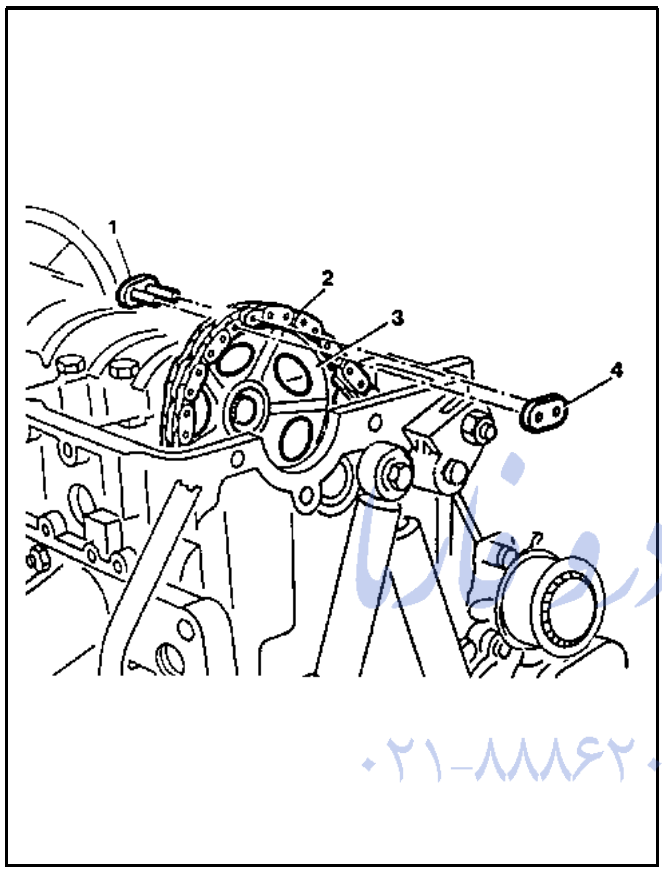
3 Screw Plug
4 Aluminum Gasket
5 Ball
6 Ball Guide
7 Compression Spring
8 Compression Spring
9 Housing
10 Thrust Pin
11 Valve Disc
12 O-Ring
13 Snap Ring
14 Compression Spring
15 Filler

A Feed Bore from Cylinder Head
B To Oil Pan

۰۲۱-۸۸۸۶۲۰۸۵ تلفن شماره گیری
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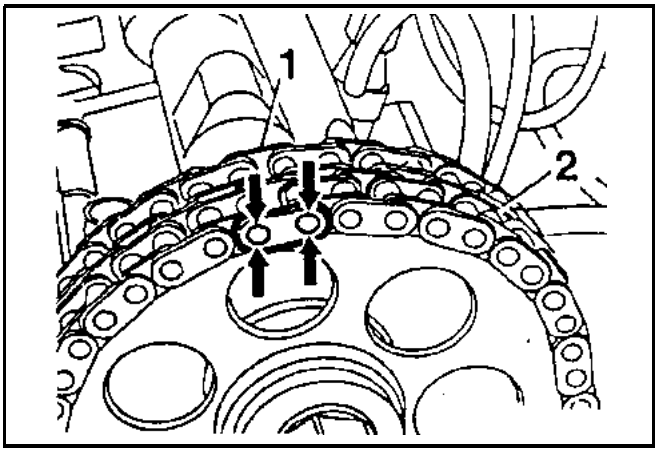
TIMING CHAIN

Preceding Work : Removal of glow plug
Removal of chain tensioner
Removal of cooling fan
Removal of cylinder head cover



1 Chain Link
2 Timing Chain
3 Camshaft Sprocket
4 Outer Plate

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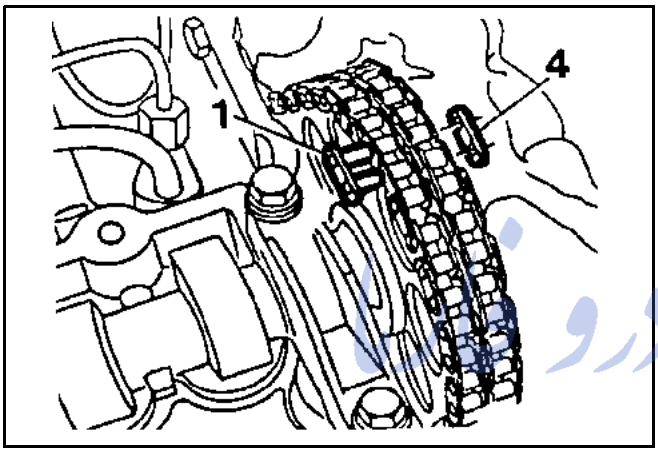


Tools Required

000 589 58 43 00 Chain Assembling Device

Replacement Procedure

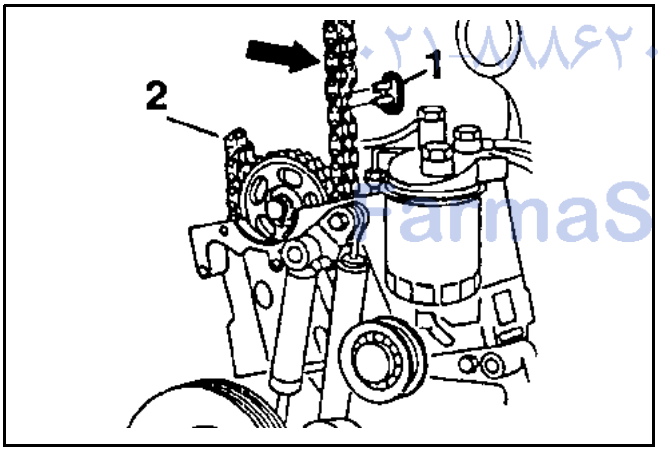
1. Cover over the chain box with cleaning rag and grind off both chain pins (arrow) at a chain link (1) of the timing chain.



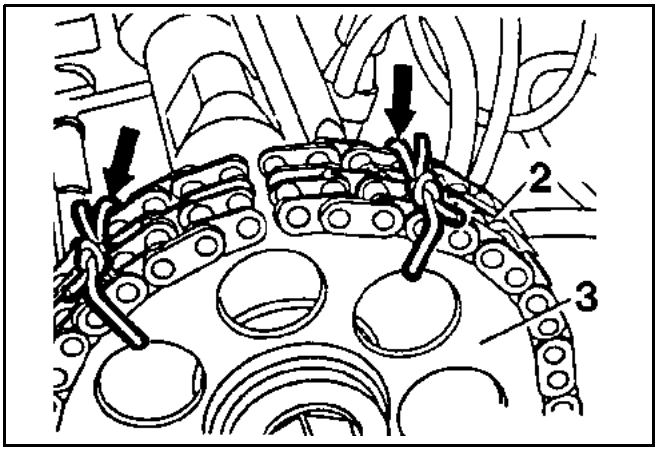
2. Remove the outer plate (4) and chain link (1).

   Notice

   Ensure that the ends of the timing chain do not drop into the chain box.

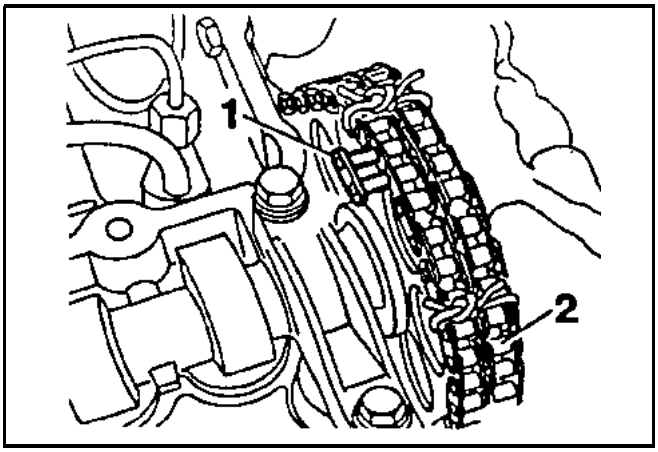


3. Loosen the chain tension with approx. 4 turns.
4. Connect the new timing chain (arrow) with chain link (1) to the old timing chain (2).

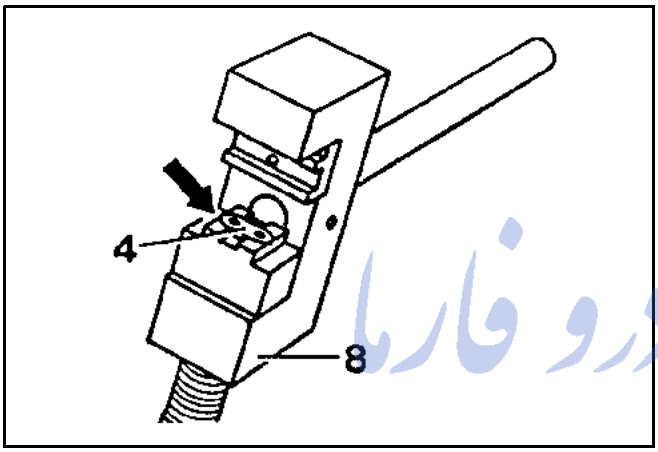


5. By rotating the crankshaft in the of engine rotation, pull out the old timing chain with installing the new timing chain.
6. Remove the old timing chain and hold the ends of the new timing chain to camshaft sprocket (3) with wire (arrow).

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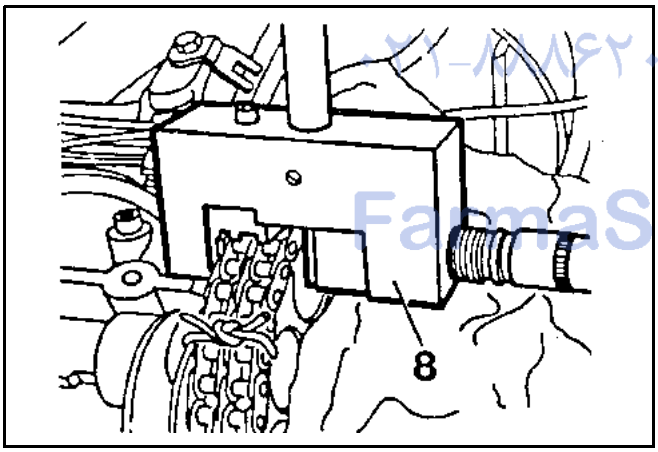
7. Insert the new chain link (1) to connect the chain.



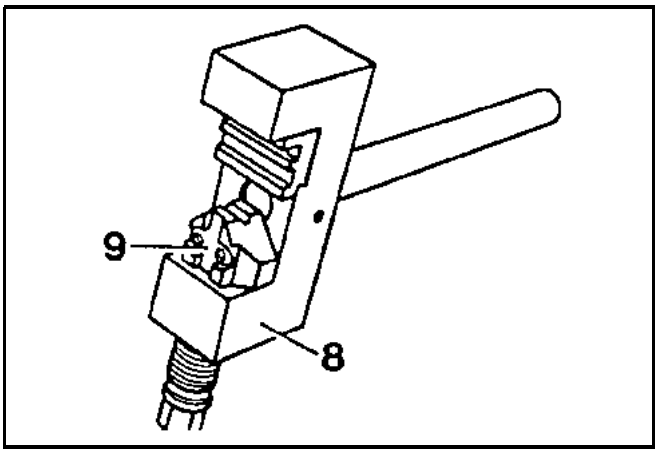
8. Insert the new outer plate (4) into the fitting tool (8) and then the outer plate will be held by a magnet.

Chain Assembling Device 000 589 58 43 00

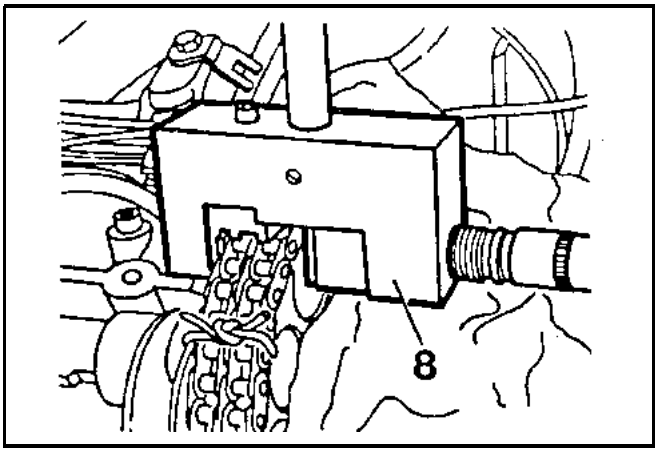
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تلفن شبانه روزی: ۰۲۱-۸۸۳۴۶۲۰۸۵
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9. Place the fitting tool (8) onto the chain link and press the outer plate on as far as the stop.

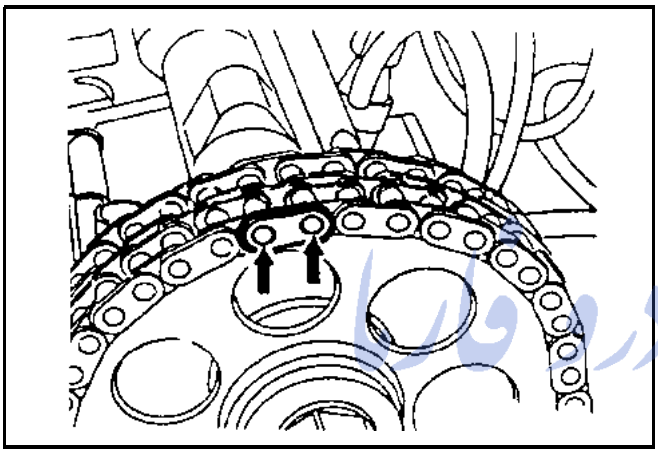


10. Switch over the die (9) of the fitting tool (8).



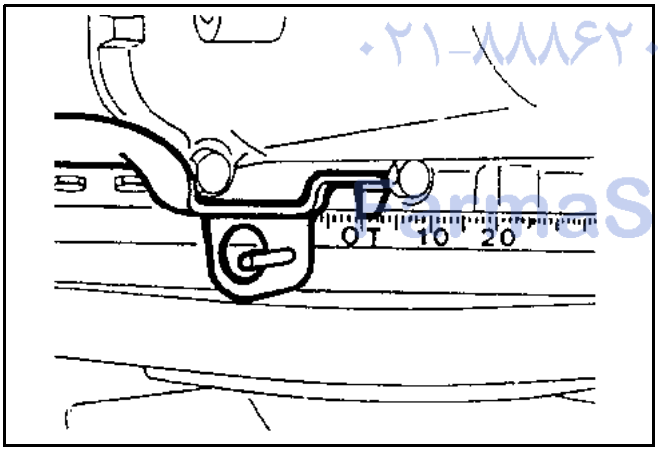
11. Place the fitting tool (8) onto the chain link and rivet the chain pins one by one.

Tightening Torque	35-40 N·m (26-30 lb-ft)

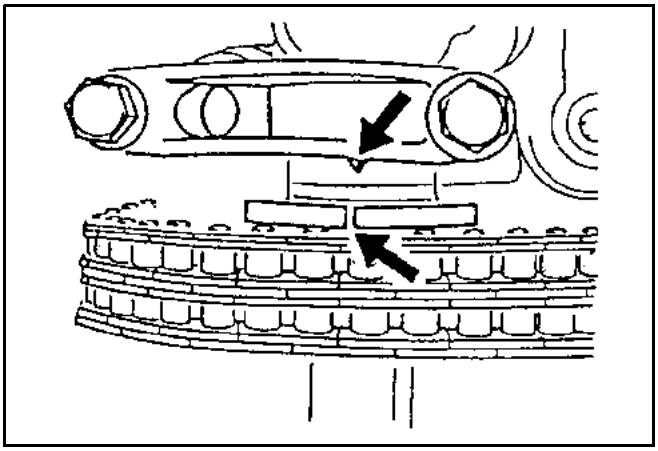


12. Check the riveting of chain pins and re-rivet if necessary.
13. Remove the wire.

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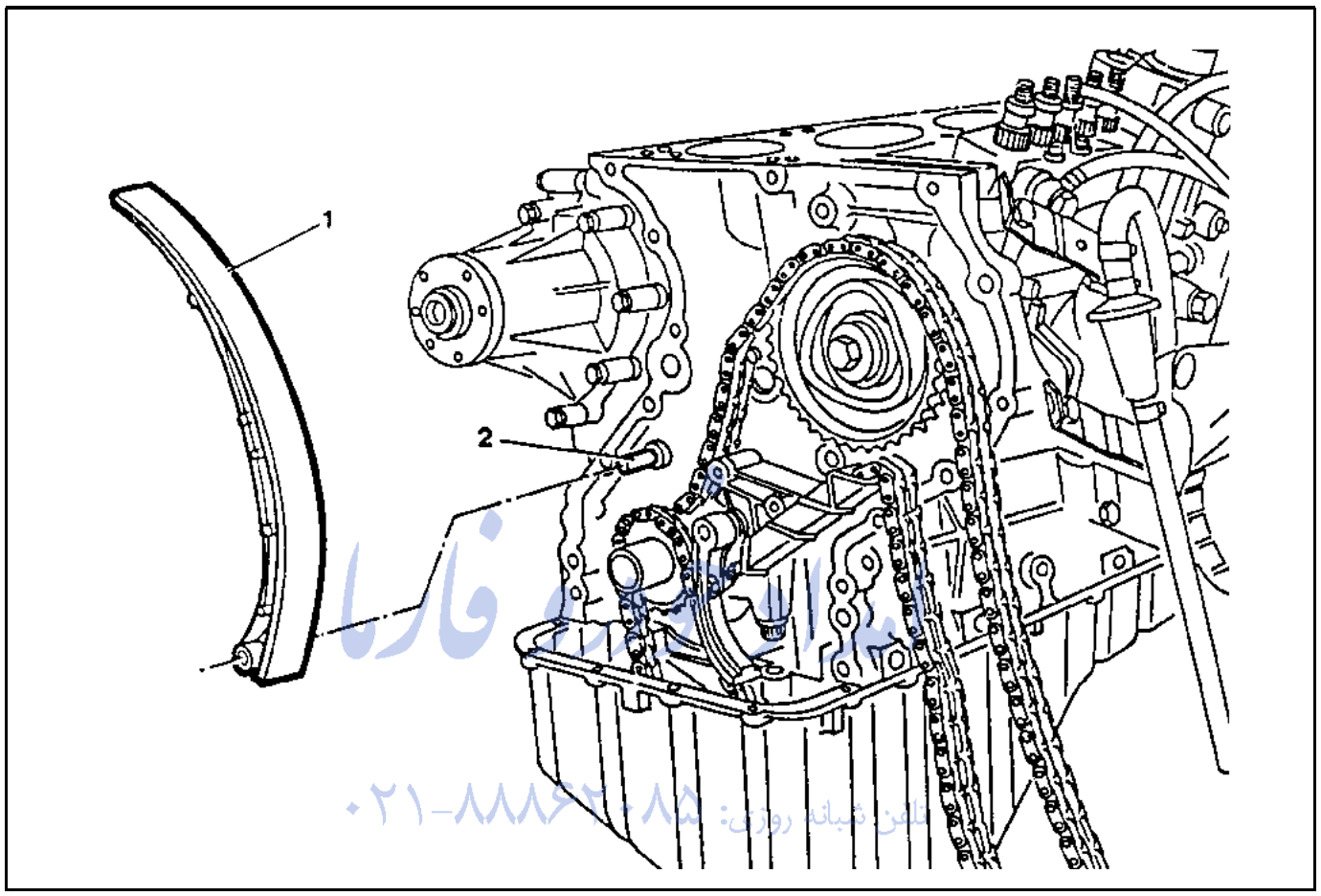
14. Position the no.1 cylinder at TDC.



In this position, the marking on camshaft / camshaft bearing cap (arrow) must also be aligned. If the markings are not aligned, the timing chain must be re-set and the injection pump timing has to be set.

TENSIONING RAIL

Preceding Work : Removal of cylinder head
Removal of timing case cover



1 Tensioning Rail
2 Bearing Pin

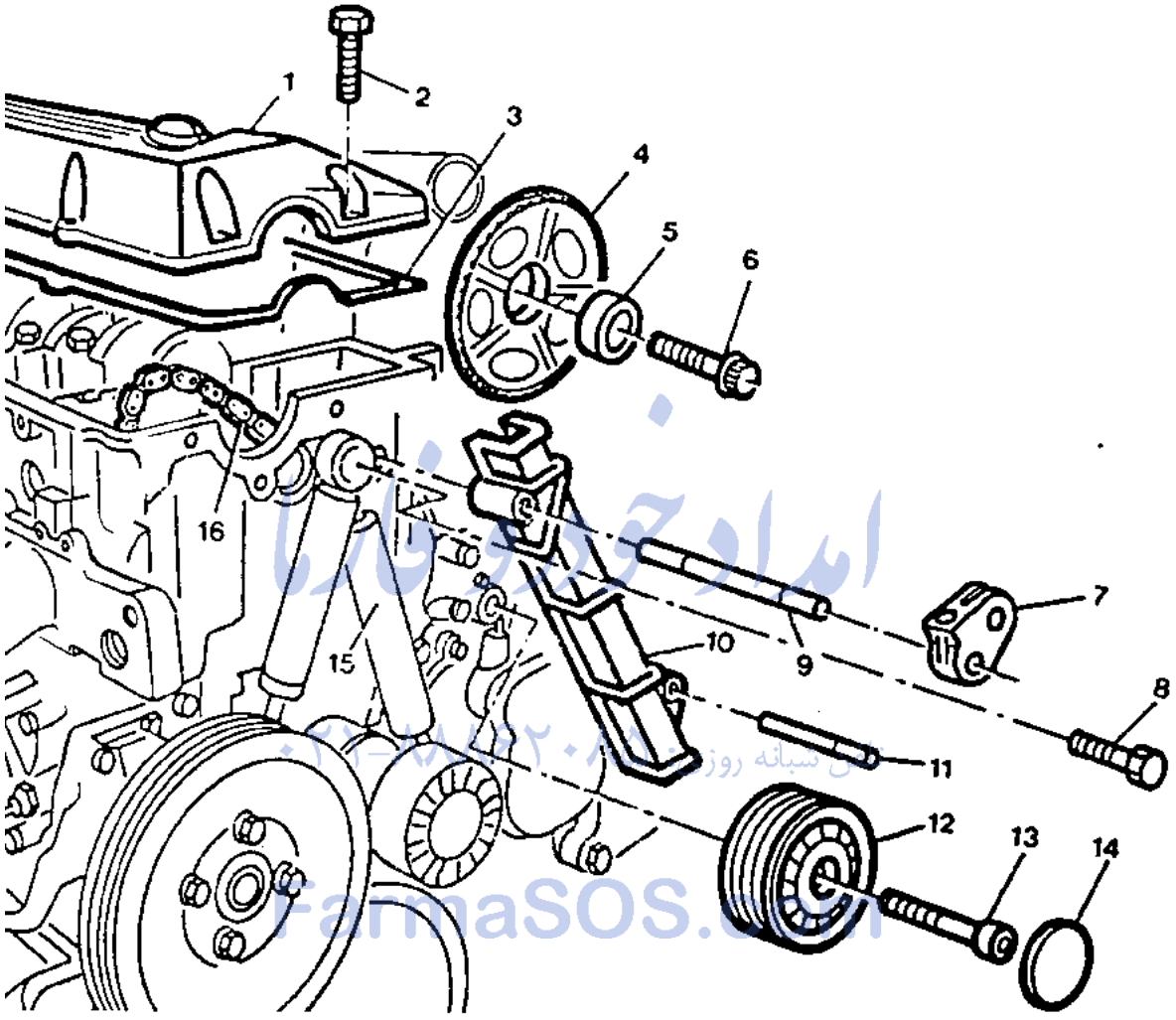
FarmaSOS.com

Notice

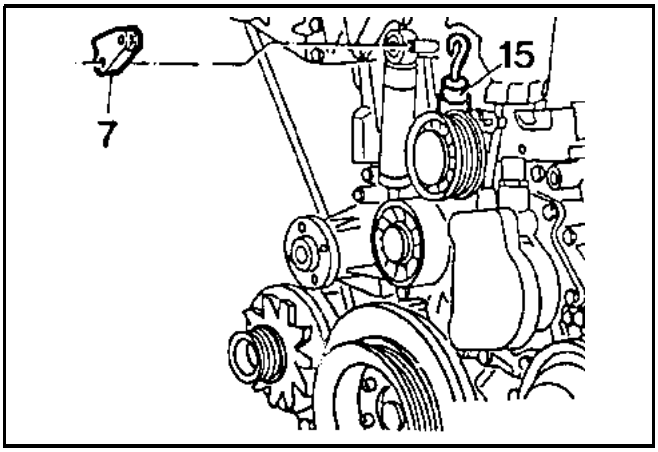
The plastic coating of the tensioning rail can not be replaced.

CYLINDER HEAD GUIDE RAIL

Preceding Work : Removal of the cooling fan
Removal of poly V-belt
Removal of chain tensioner



1 Cylinder Head Cover
2 Bolt . . . . . 10N·m (89 lb-in)
3 Gasket . . . . . Replace
4 Camshaft Sprocket
5 Washer
6 12-Sided Bolt (M11)
. . . . . Inspect, 25N·m (18 lb-ft)+90°
7 Tensioning Lever
8 Bolt . . . . . 23N·m (17 lb-ft)
9 Bearing Pin . . . . . Sealing Compound
10 Guide Rail
11 Bearing Pin
12 Guide Pulley
13 Socket Bolt . . . . . 23N·m (17 lb-ft)
14 Closing Cover
15 Spring
16 Timing Chain



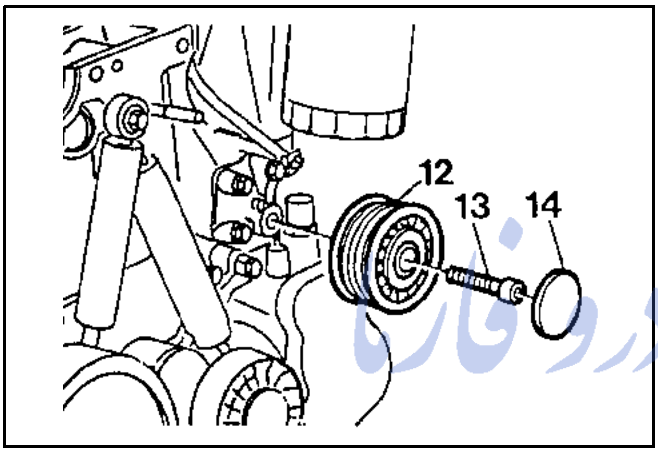
Tools Required

115 589 02 34 00 Sliding Hammer

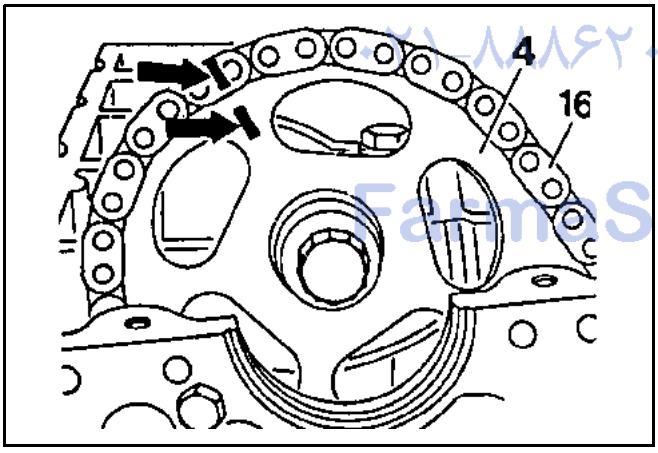
116 589 20 33 00 Threaded Pin

Removal Procedure

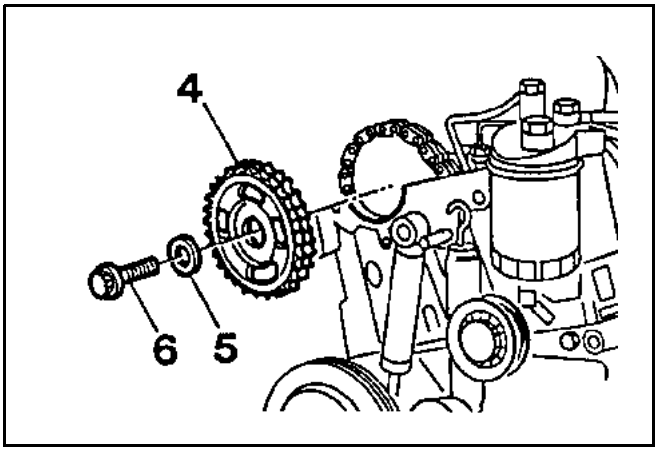
1. Removal the cylinder head cover.
2. Pull off the tensioning lever (7) and remove from the spring (15).



3. Pry off the closing cover (14) and remove the bolt (13) and then remove the guide pulley (12).

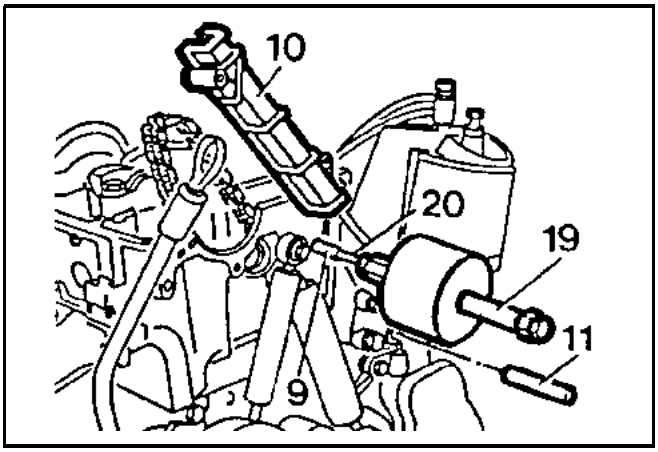


4. Place alignment marks (arrow) on the timing chain (16) and camshaft sprocket (4).



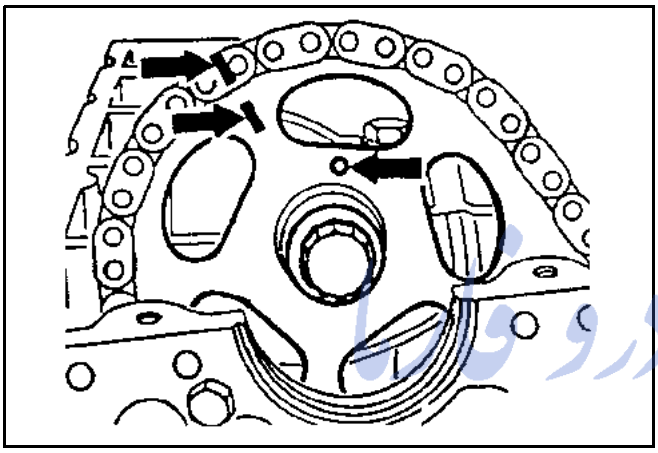
5. Remove the camshaft sprocket.

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6. Pull out the bearing pins (9, 11) with sliding hammer and remove the guide rail 10.

Sliding Hammer 116 589 20 33 00
Threaded Pin 116 589 02 34 00

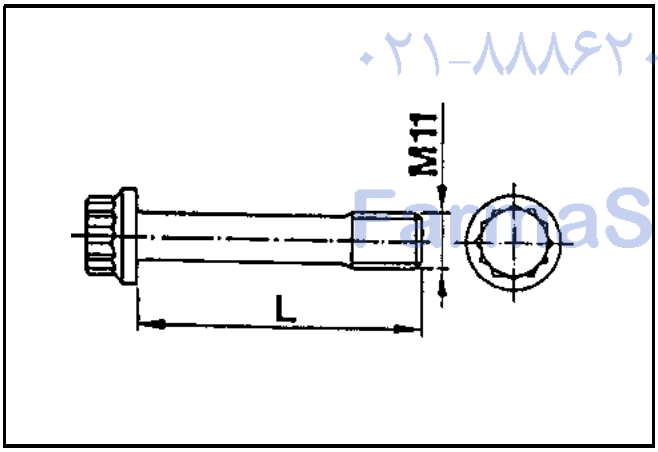


Installation Procedure

1. Apply collar of both bearing pins with sealing compound.
2. Position the guide rail and insert the bearing pins.
3. Install the camshaft sprocket.

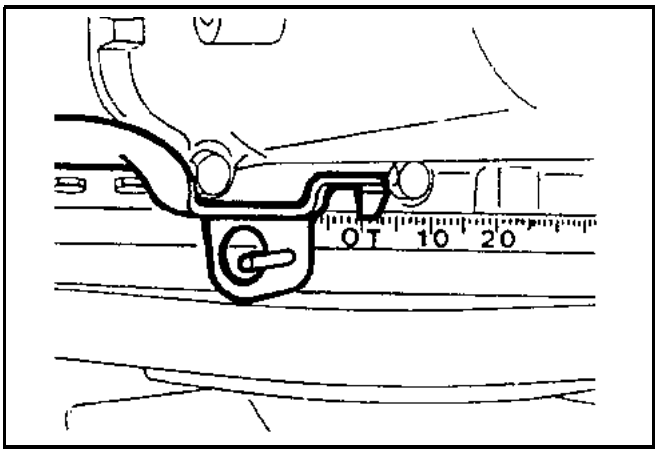
Tightening Torque	10 N·m (89 lb-in)

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۰۲۱-۸۸۸۶۲۰۸۵
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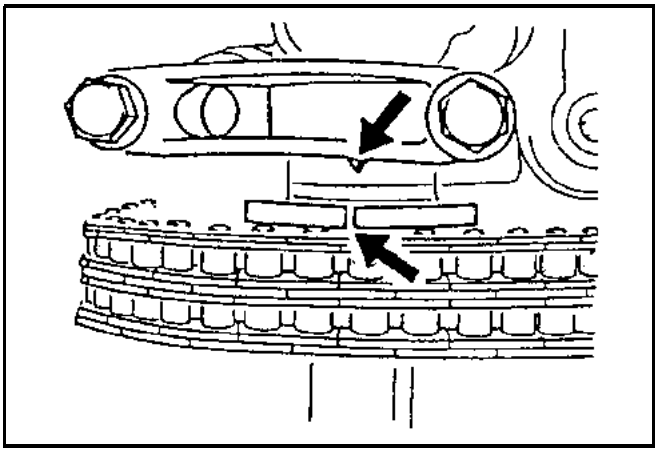


Notice

If the max. length 'L' of the 12-sided bolt exceeds 53.6mm, replace it.



4. Position the no. 1 cylinder at the TDC of OT.



In this position, the marking on the camshaft / camshaft bearing cap (arrow) must also be aligned.

5. Install the guide pulley (12).

Tightening Torque	23 N·m (17 lb-ft)

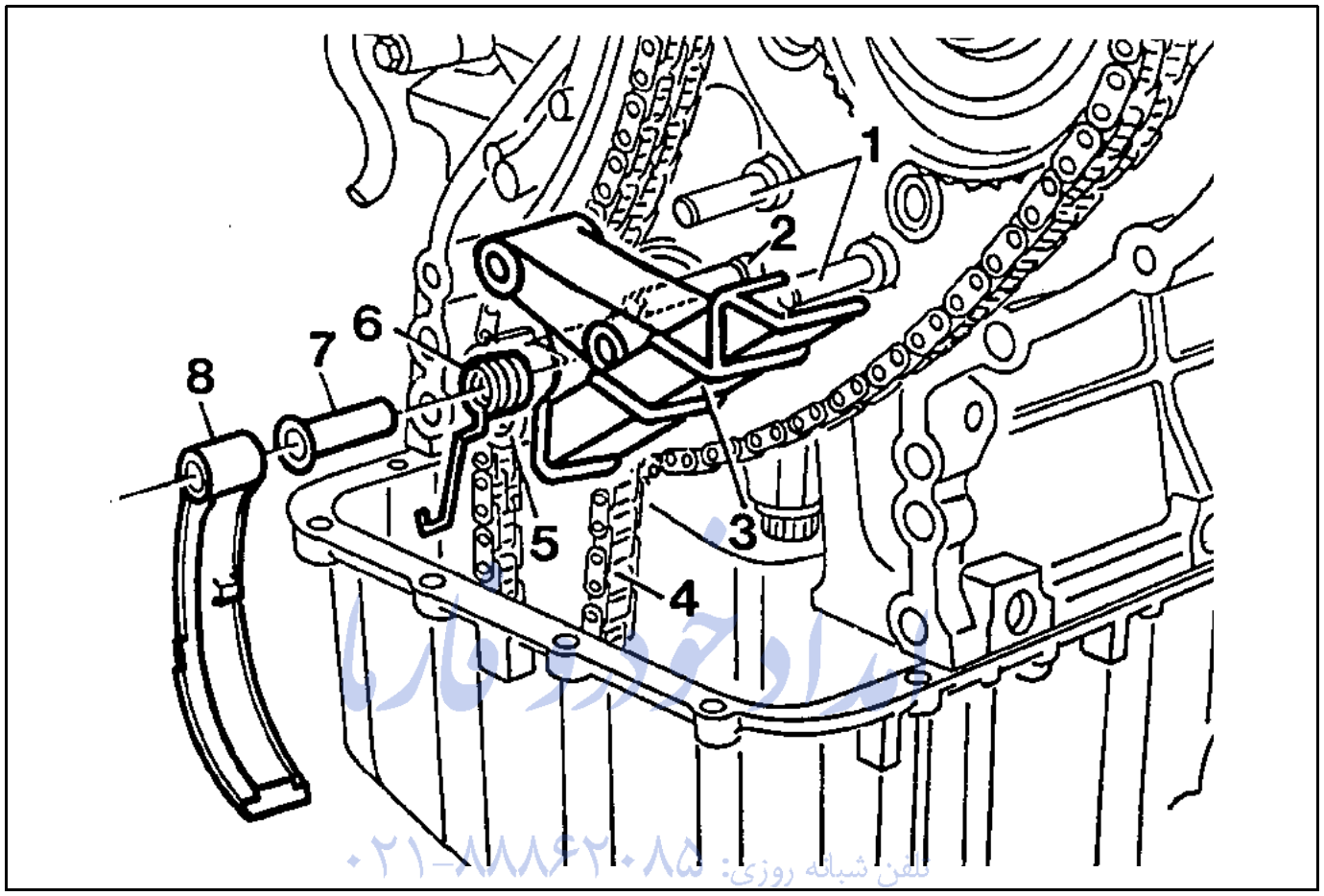
6. Attach the tensioning lever (7) to the spring (15) and install.
7. Replace the gasket and install the cylinder head cover.

Tightening Torque	10 N·m (89 lb-in)

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TIMING CASE COVER GUIDE RAIL

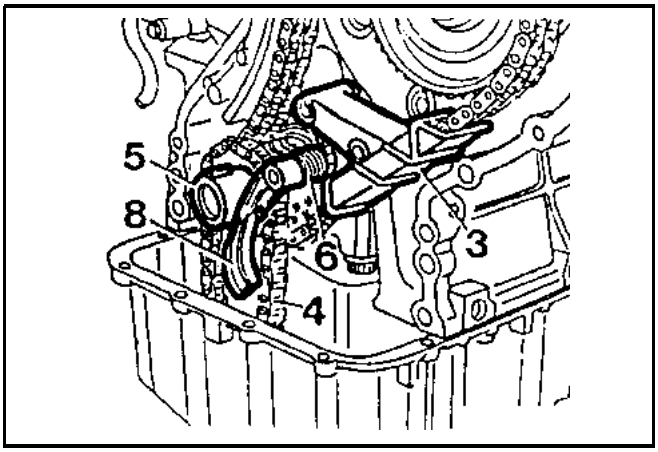
Preceding Work : Removal of cylinder head cover



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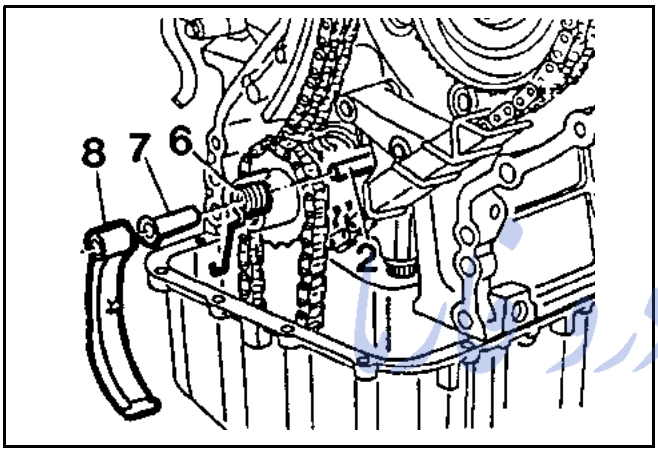
1 Bearing Pin
2 Bearing Pin
3 Guide Rail
4 Oil Pump Chain
5 Crankshaft
6 Spring
7 Bushing
8 Tensioning Lever

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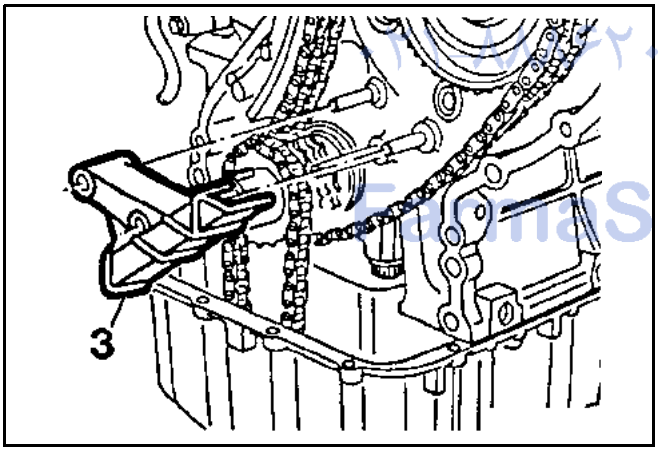


Removal Procedure

1. Pull out the tensioning lever (8) together with the spring (6) and guide rail (3) far enough until the tensioning lever has moved passed the oil pump chain (4) and is resting against the crankshaft (5)

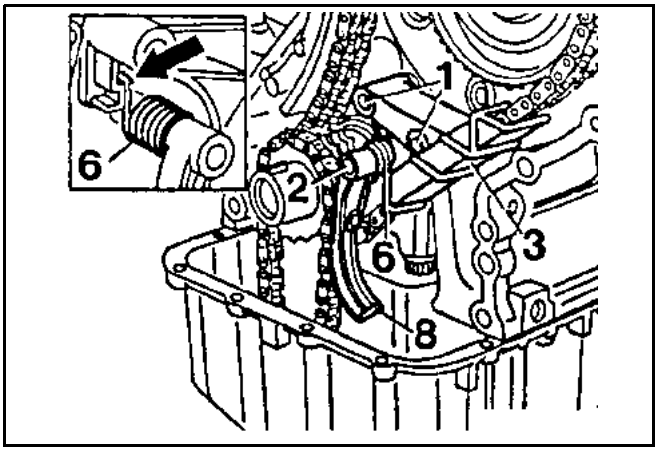


2. Pull the tensioning lever (8) off the bearing pin (2) and carefully remove the spring (6). Remove the tensioning lever (8) together with the spring (6) and bushing (7).



3. Remove the guide rail (3).

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Installation Procedure

1. Install the guide rail (3). Attach the spring (6) to the guide rail and to the tensioning lever (8).

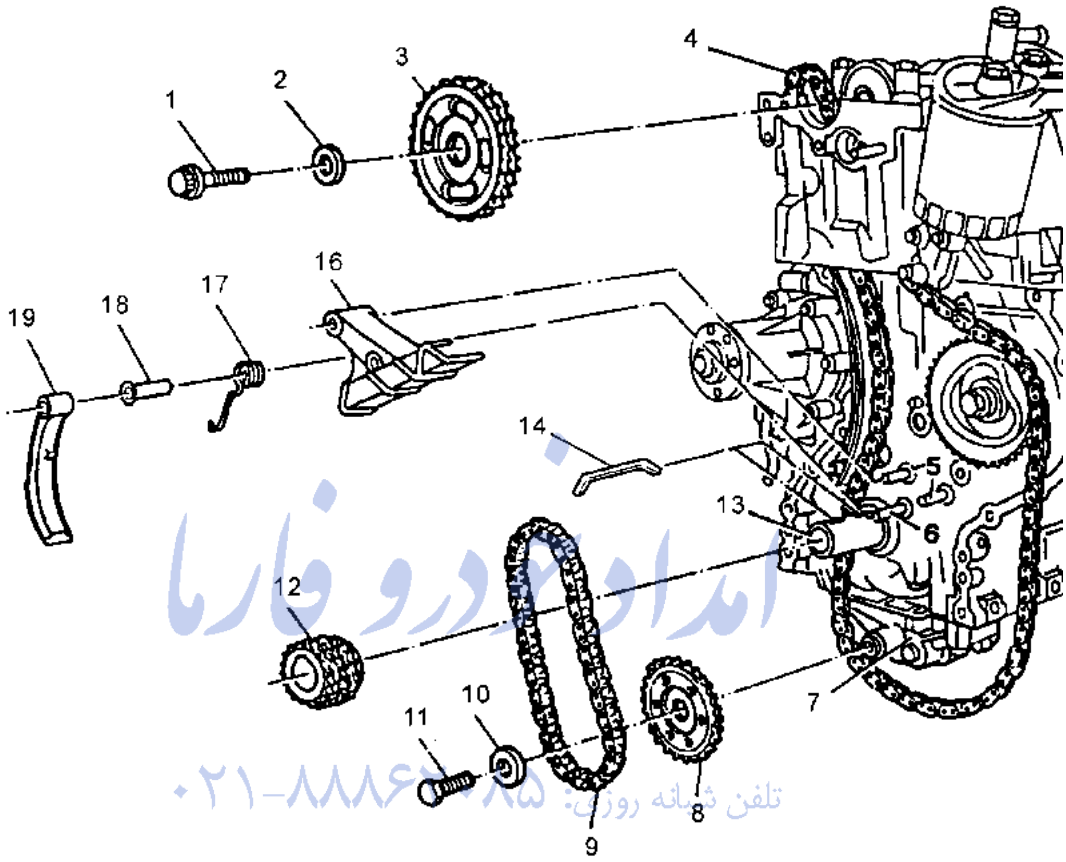
   Notice

   Ensure that the spring is correctly located in the guide rail (arrow).

2. Push the guide rail, spring, bushing and tensioning lever together onto the bearing pin (1, 2).

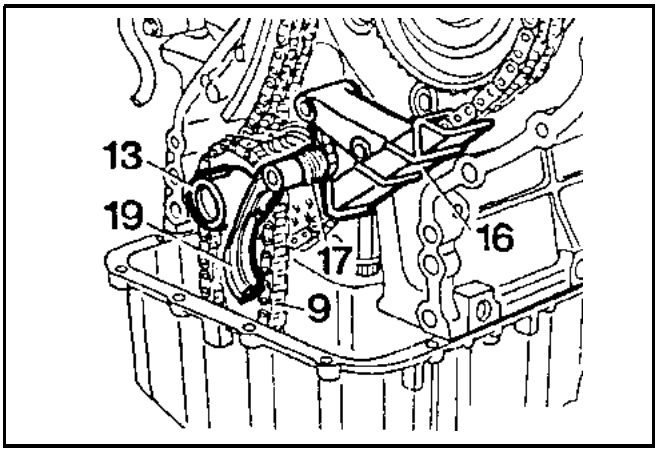
CRANKSHAFT SPROCKET

Preceding Work : Removal of oil pan
Removal of timing case cover



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1 12-Sided Stretch Bolt (M11) . . . . . Check, 25N·m (18 lb-ft)+90°
2 Washer
3 Camshaft Sprocket
4 Timing Chain
5 Bearing Pin
6 Bearing Pin
7 Oil Pump
8 Oil Pump Sprocket
9 Oil Pump Chain
10 Washer
11 Bolt . . . . . 25N·m (18 lb-ft)
12 Crankshaft Sprocket
13 Crankshaft
15 Key
16 Guide Rail
17 Spring
18 Bushing
19 Tensioning Lever



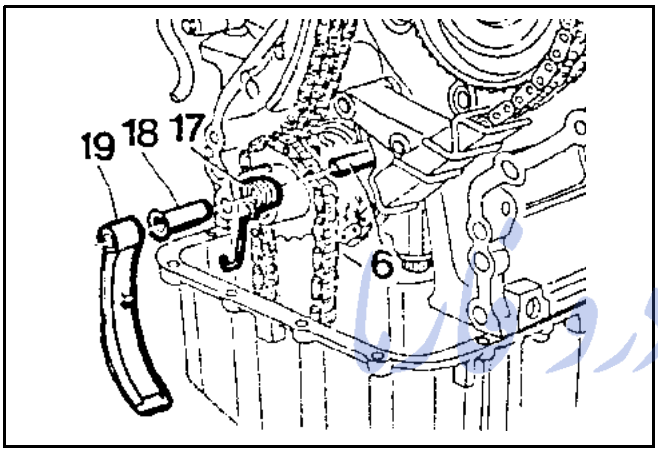
Special Tools

116 589 07 15 00 Drift

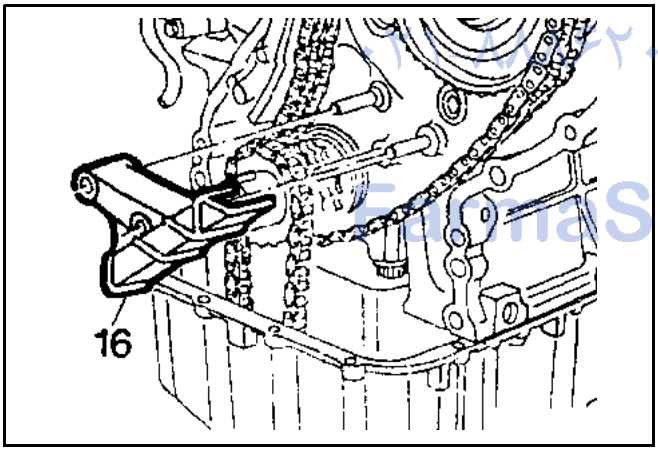
102 589 05 33 00 Puller

Removal Procedure

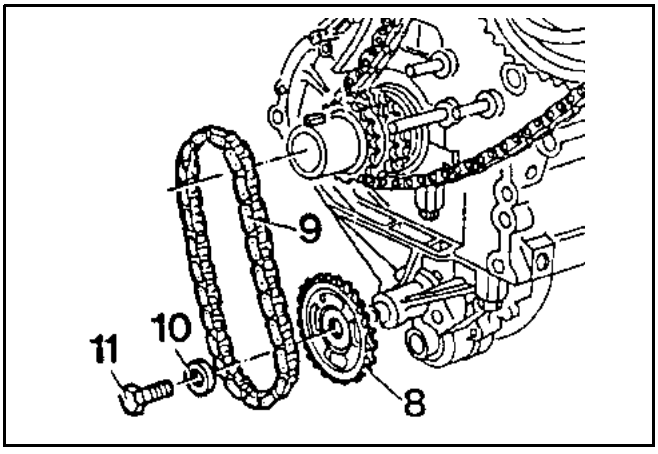
1. Pull out the tensioning lever (19) together with the spring (17) and guide rail (16) far enough until the tensioning lever has passed the oil pump chain (9) and is resting against the crankshaft (13).



2. Pull out tensioning lever (19), spring (17) and bushing (18) from the bearing pin (6).

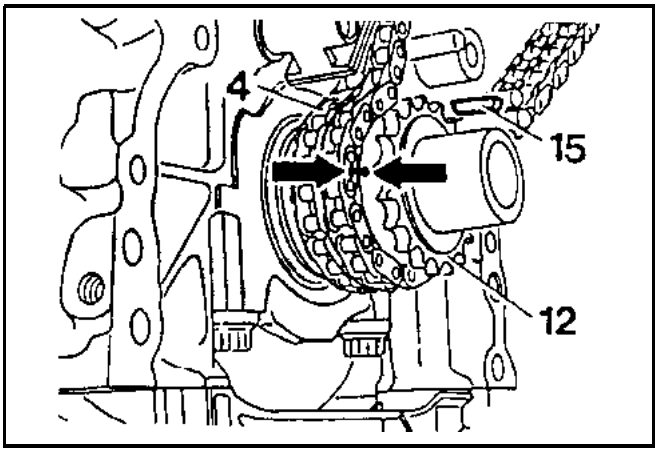


3. Pull out the guide rail (16).

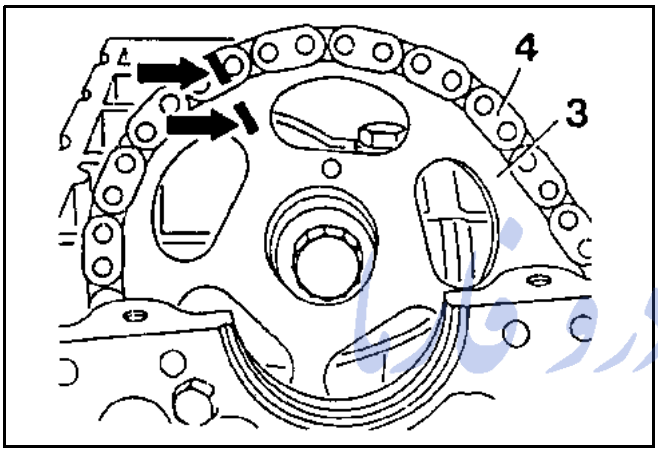


4. Remove the bolt(11) and then remove the washer (10), oil pump chin (9) and sprocket (8).

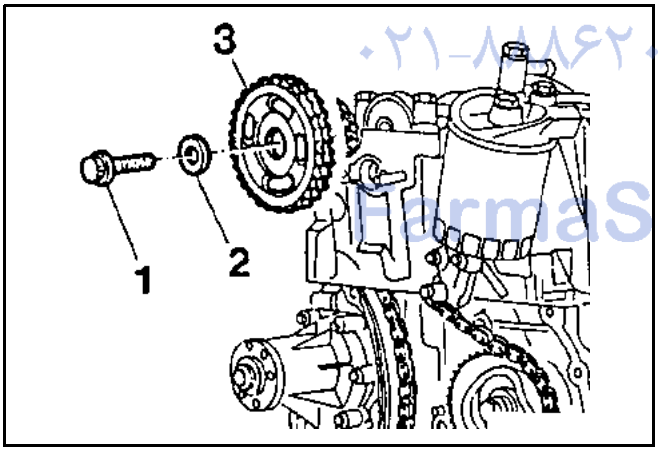
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EmdadSOS.com



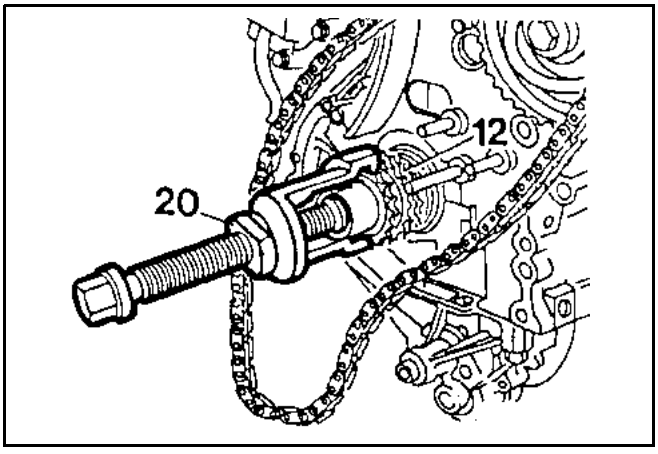
5. Place alignment marks (arrow) on the timing chain (4) and crankshaft sprocket (12).
6. Remove the woodruff key(15).



7. Place alignment marks (arrow) on the timing chain (4) and camshaft sprocket (3).



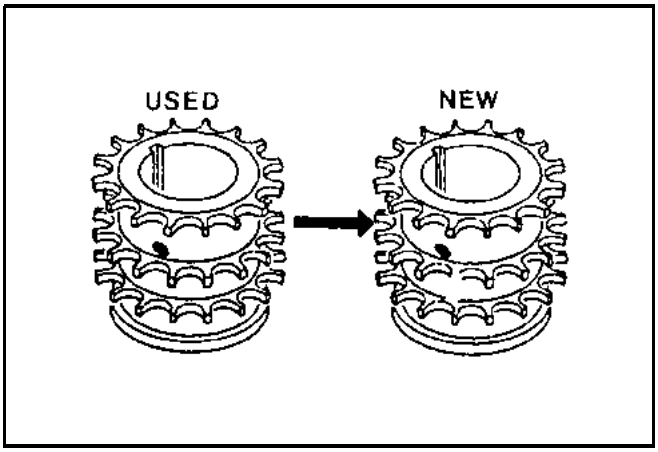
8. Remove the chain tensioner.
9. Remove the bolt (1) and then remove the washer (2) and camshaft sprocket (3).



10. Remove the crankshaft sprocket (12) by using a puller (20).

Puller 102 589 05 33 00

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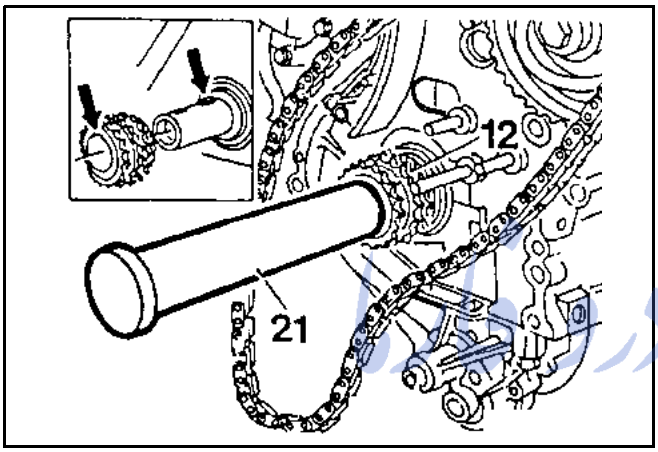


Installation Procedure

1. Put the same alignment mark on the new crankshaft sprocket as in the old sprocket.

   Notice

   Check the timing chain, camshaft sprocket, injection pump timing sprocket, oil pump chain and oil pump sprocket for wear and replace if necessary.

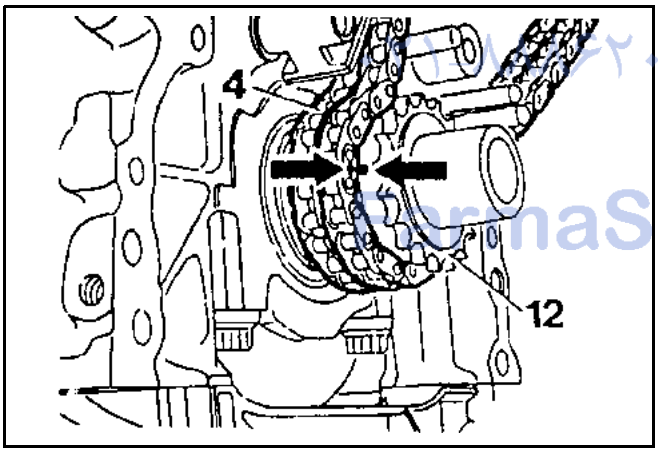


2. Install the new crankshaft sprocket (12) by using a drift (21).

   Notice

   Align the groove of sprocket and woodruff key (arrow) exactly.

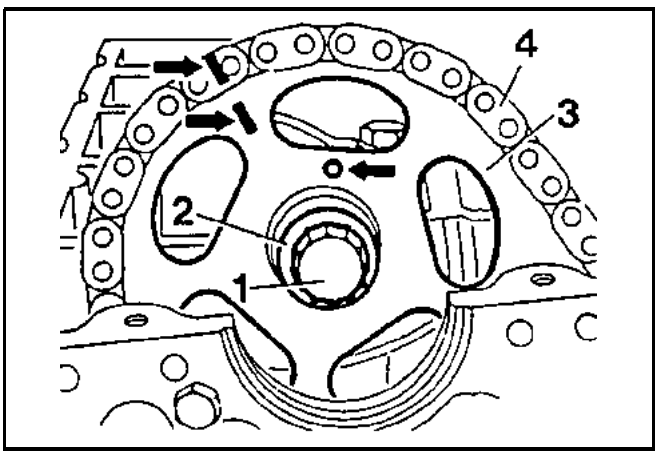
Drift 116 589 07 15 00



3. Fit the timing chain (4) on the crankshaft sprocket (12).

   Notice

   Align the alignment marks (arrow) on the chain and sprocket.



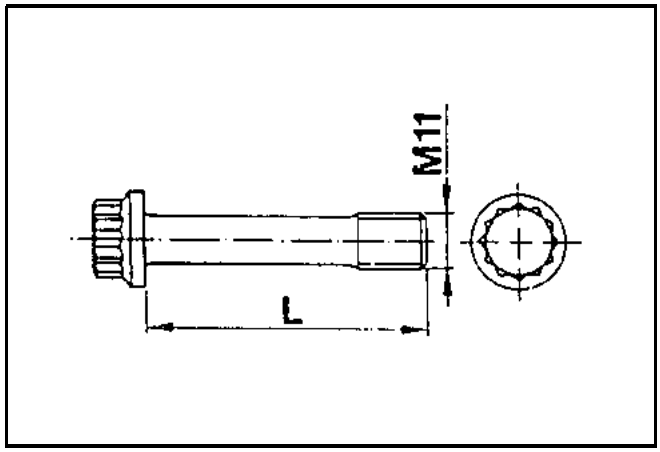
4. Install the camshaft sprocket (3).

Tightening Torque	25 N·m (18 lb-ft) + 90°

   Notice

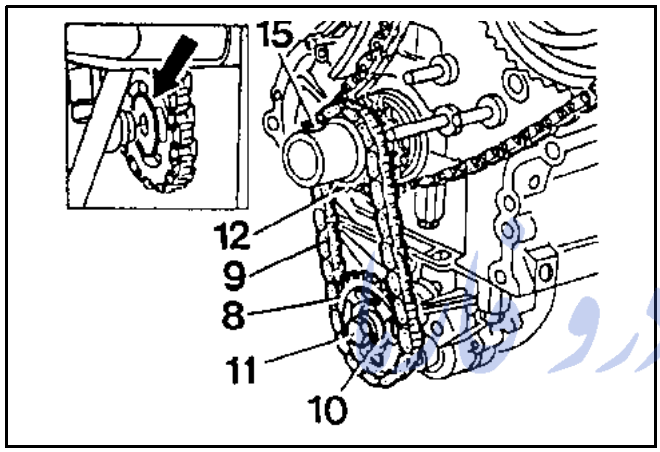
   Pay attention on the alignment marks and dowel pin (arrow).

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Notice

If the max. length 'L' of the stretch bolt exceeds 53.6mm, replace it.

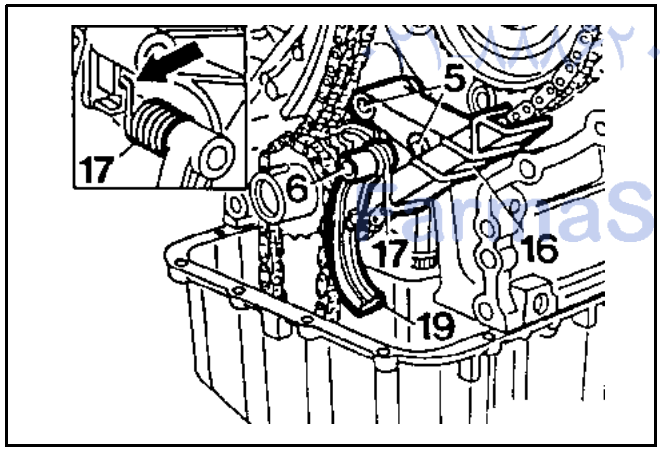


5. Fit the oil pump chain (9) on the crankshaft sprocket (12) and insert the oil pump sprocket (8) into the oil pump chain and then install it on the oil pump.

Notice

The curved side of the oil pump sprocket should face the oil pump.

6. Insert the woodruff key (15).



7. Install the guide rail (16). Attach the spring (17) to guide rail and to tensioning lever together onto the bearing pins (5,6).

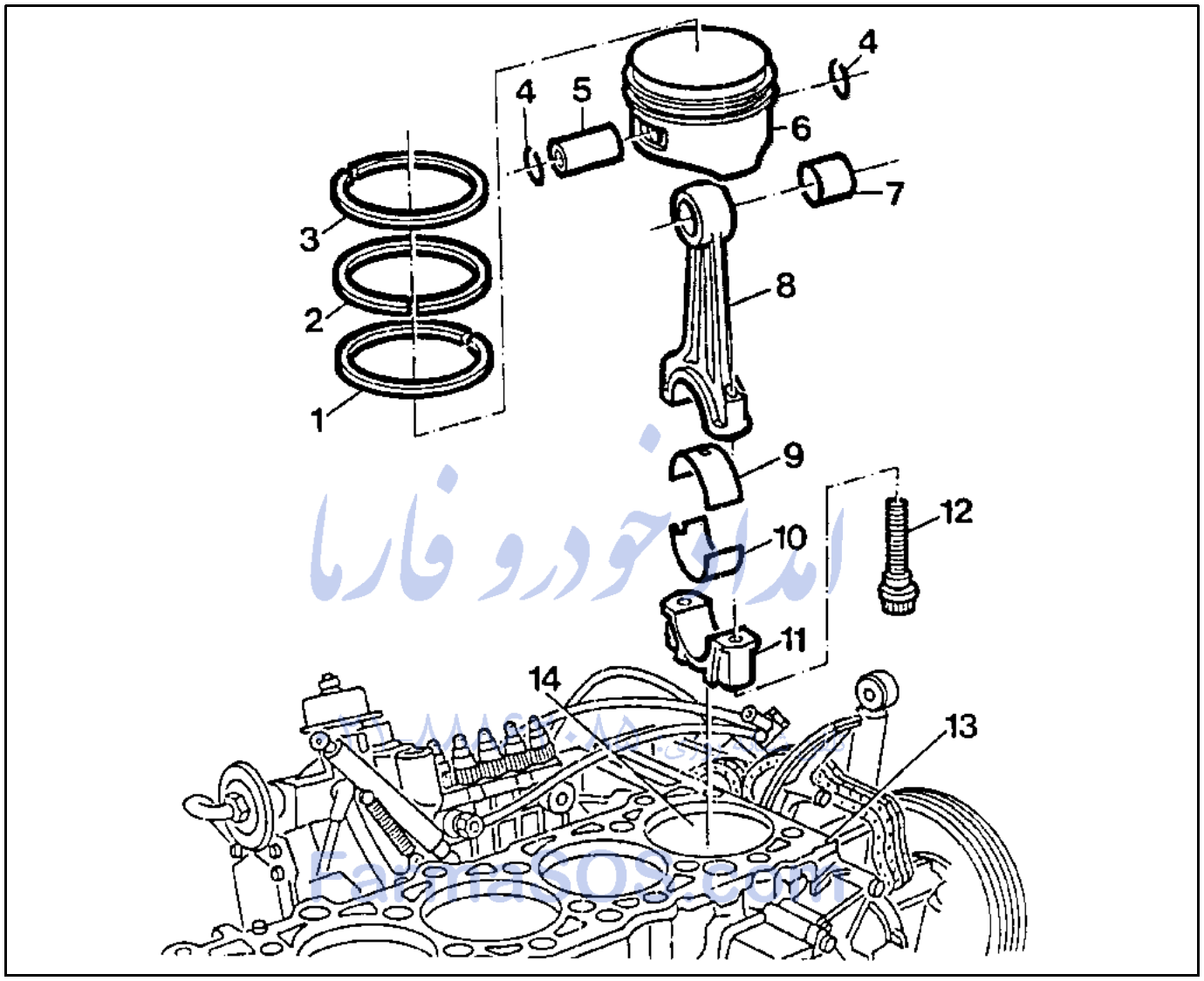
Notice

Ensure that the spring is correctly located in the guide rail (arrow).

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PISTON

Preceding Work : Removal of cylinder head
Removal of the oil pump



1 Oil Ring
2 2nd Ring
3 Top Ring
4 Snap Ring . . . . . Replace
5 Piston Pin
6 Piston
7 Connecting Rod Bushing . . . . . Check
8 Connecting Rod
9 Connecting Rod Upper Bearing Shell
10 Connecting Rod Lower Bearing Shell
11 Connecting Rod Bearing Cap
12 Connecting Rod Bolt . . . 35N·m (26 lb-ft)+90°
13 Crankcase
14 Cylinder Bore

Notice

There are two kinds of connecting rods (for machining) and they are different in weight approx. 15g. When replacing the connecting rod, measure its weight and ensure that a engine has the same weight of connecting rods. If not, there would be a unbalancing of engine.

Service Data

Piston clearance	Max. 0.12 mm
Piston crown protrusion in TDC position	0.735 - 0.965 mm
Connecting rod bushing diameter	26.012 - 26.018 mm

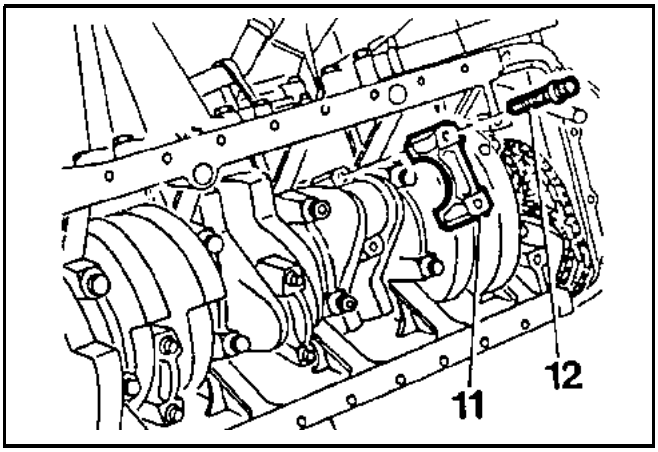
Connecting Rod Bolt Dimensions

Thread	M9 x 1
Stretch shaft(C) diameter (new)	$7.4^{-0.1}$mm
Minimum stretch shaft diameter (C)	7.1 mm
Length(L)(new)	$52^{-0.3}$ mm

Tools Required

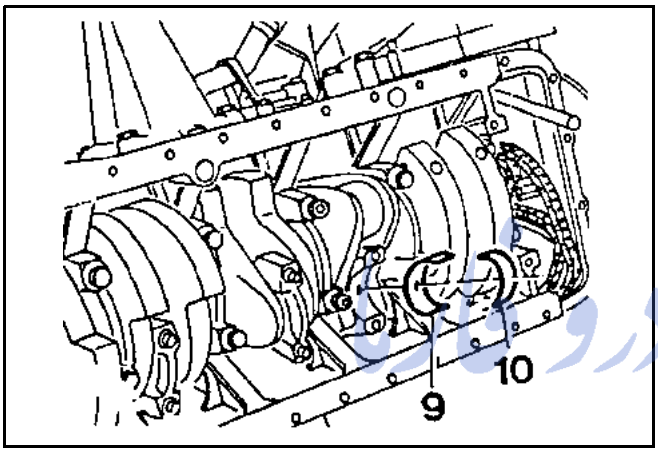
000 589 04 14 00 Tensioning Strap
001 589 53 21 00 Dial Gauge
363 589 02 21 00 Dial Gauge Holder

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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Removal Procedure

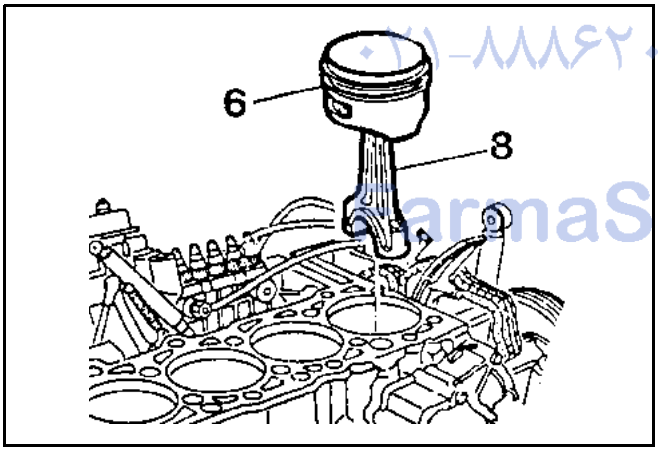
1. Remove combustion residues from the cylinder bores.
2. Remove the connecting rod bolts (12) and then remove the connecting rod bearing caps(11).



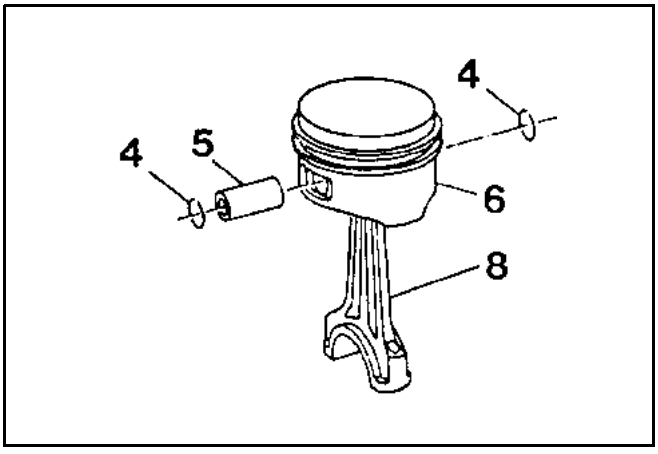
3. Remove the connecting rod bearing shells (9, 10).

   Notice

   Be careful not mix the bearing caps and shells each other.

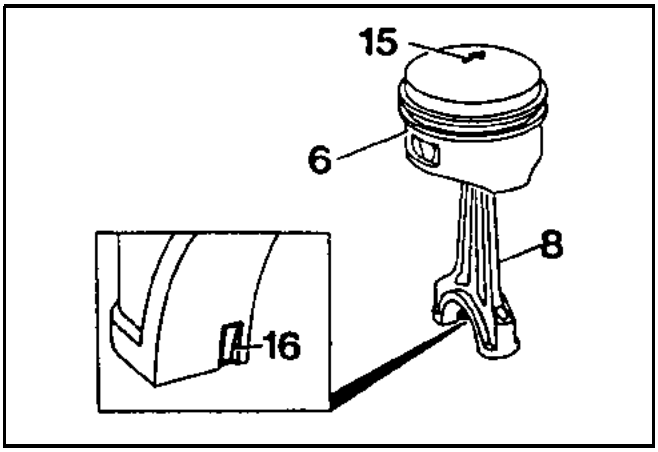


4. Remove the piston (6) and connecting rod (8).



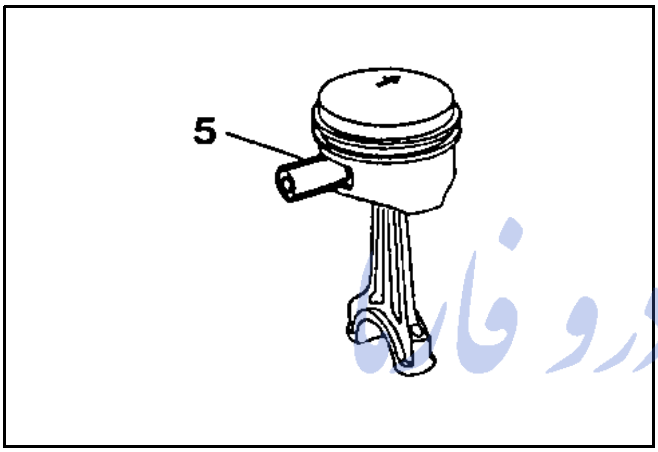
5. Remove the snap ring (4) and pull out the piston pin (5).
6. Separate the piston and connecting rod.

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تلفن شبانه روزی: ۰۷۱-۸۸۸۶۲۰۸۵
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Installation Procedure

1. Fit the piston onto the connecting rod so that the arrow (15) and the locking slot (16) are facing in direction of the vehicle.

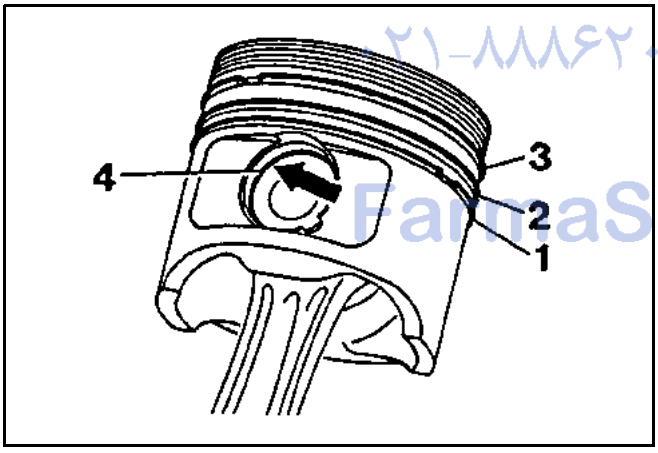


2. Coat the piston pin (15) with engine oil and insert it by hand.

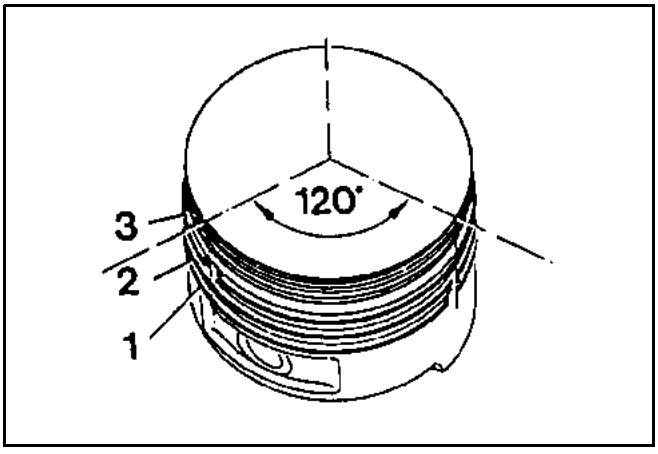
   Notice

   Do not heat up the piston.

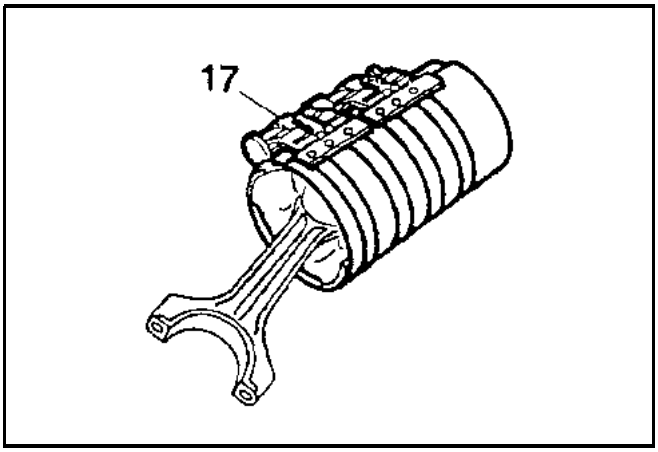
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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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3. Install the new snap ring (4) into the grooves (arrow).
4. Check the piston rings (1, 2, 3) and replace them if necessary.

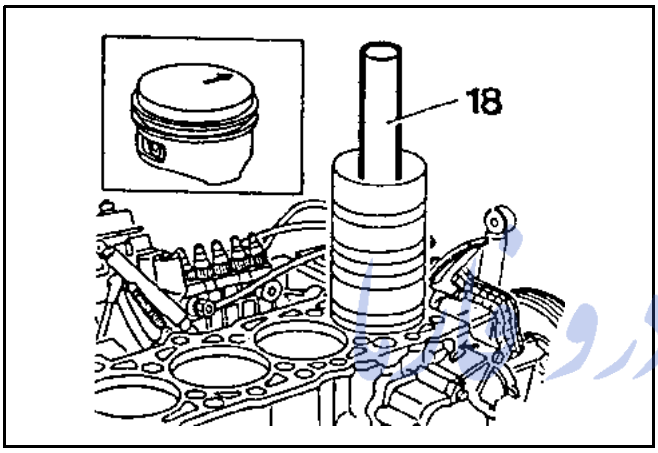


5. Install and arrange the piston rings to be evenly 120° from each ends gap.



6. Coat the cylinder bore, connecting rod bearing journal, connecting rod bearing shell and piston with oil.
7. Compress the piston rings with a tensioning strap (7).

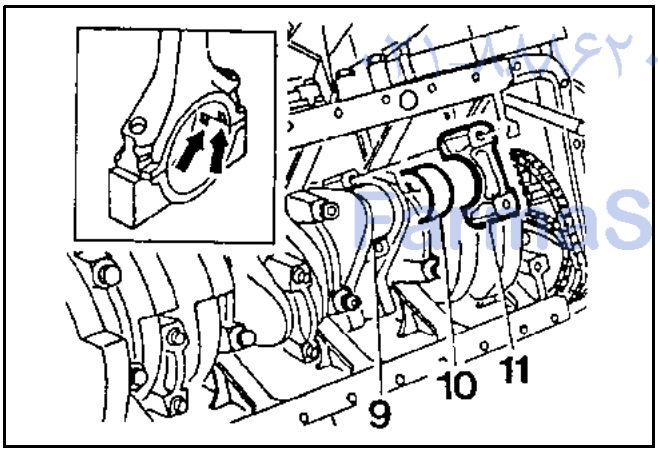
Tensioning Strap 000 589 04 14 00



8. Insert the piston assembly into the cylinder with a wooden stick (18).

Notice

The arrow on the piston crown must point toward the front of vehicle.



9. Insert the connecting rod bearing shells (9, 10).

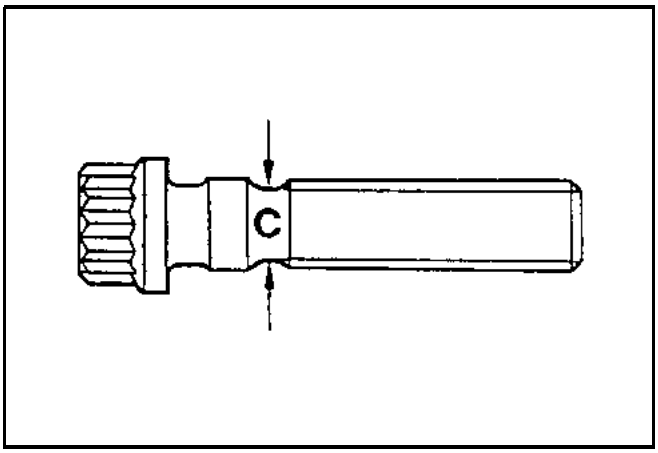
Notice

Be careful of the difference in upper and lower bearing shells and not to be changed.

10. Position the connecting rod bearings caps.

Notice

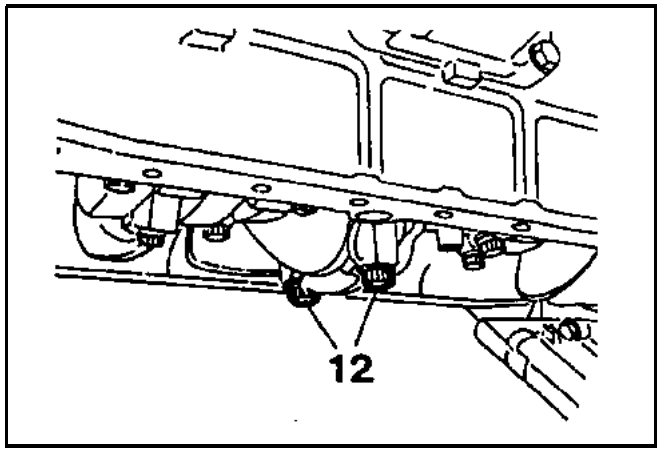
Position so that the retaining lugs are on the same side of the connecting rod bearing(arrow).



11. Measure stretch shaft diameter (C) of the connecting rod bolts.

Limit 'C'	7.1mm

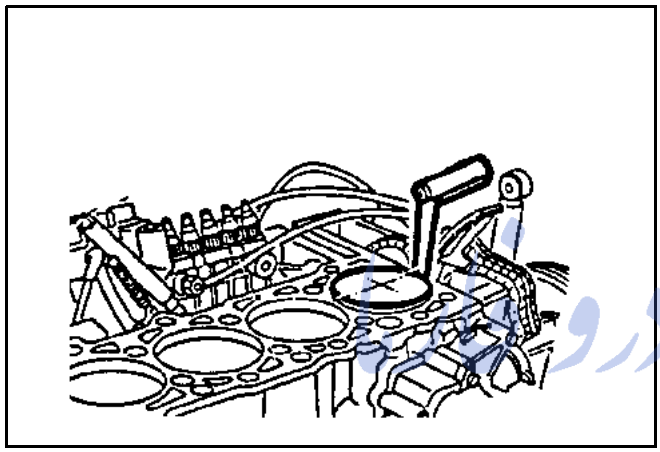
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تلفن شبانه روزی: ۰۸۵-۳۲۶۲۰۸۴۸
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12. Coat the bolts (12) with oil and then tighten the bolts.

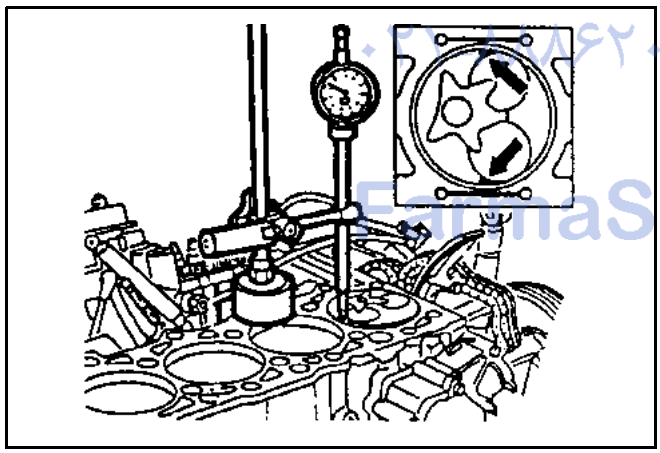
Tightening Torque	40 N·m (30 lb-ft) + 90°

13. Rotate the crankshaft and check axial clearance between the connecting rod and crankshaft.



14. Measure clearance between the piston crown and cylinder

Standard	Max. 0.12mm



15. Position the piston at TDC and measure the distance between the piston crown and the crankcase surface.

Standard	Max. 0.965 mm

Notice

Measure at points marked.

Dial Gauge 001 589 00 53 21
Dial Gauge Holder 363 589 02 21 00

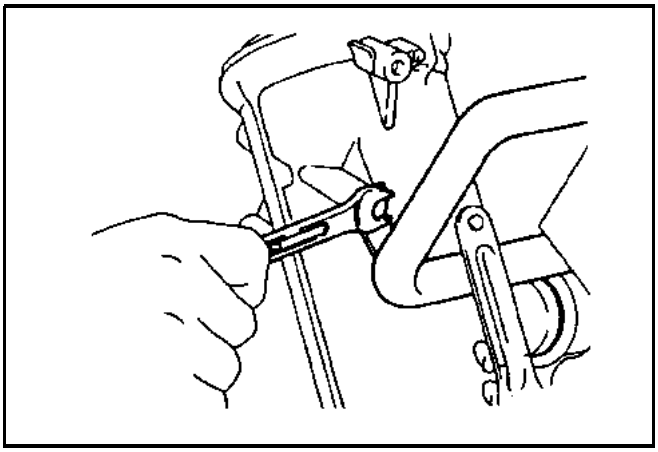
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OIL FILTER



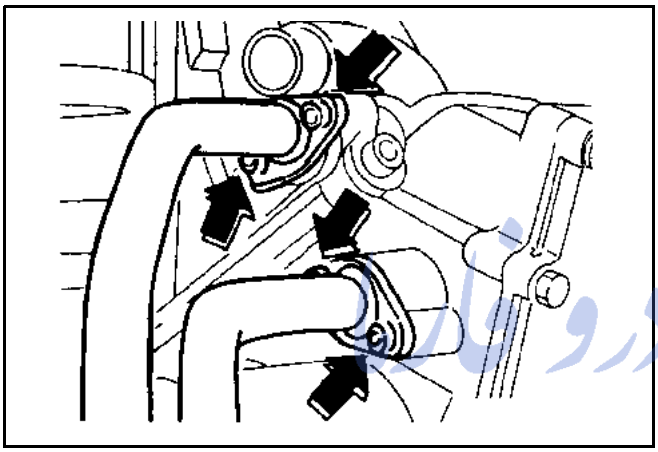
ایران خودرو فارما
تلفن شبانه روزی: ۰۲۱۸۸۸۲۰۱۵
FarmaSOS.com

1 Nut . . . . . 25 N·m (18 lb-ft)
2 Oil Filter . . . . . Cover
3 O-Ring . . . . . Replace
4 Oil Filter . . . . . Element Replace If necessary
5 Oil Filter Housing
6 Bolt (M8) . . . . . 10 N·m (89 lb-in)
7 Oil Pressure Switch
8 Gasket
9 Bolt . . . . . 25 N·m (18 lb-ft)

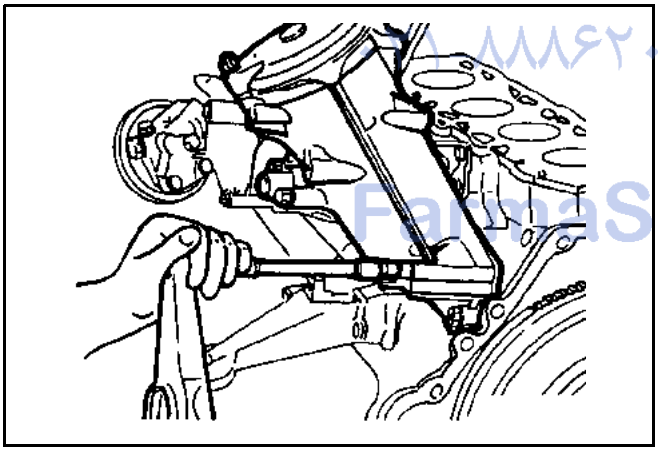


Remeval & Installation Procedure

1. Remove the oil filter cover and then drain the oil.



2. Remove the oil pressure switch line.

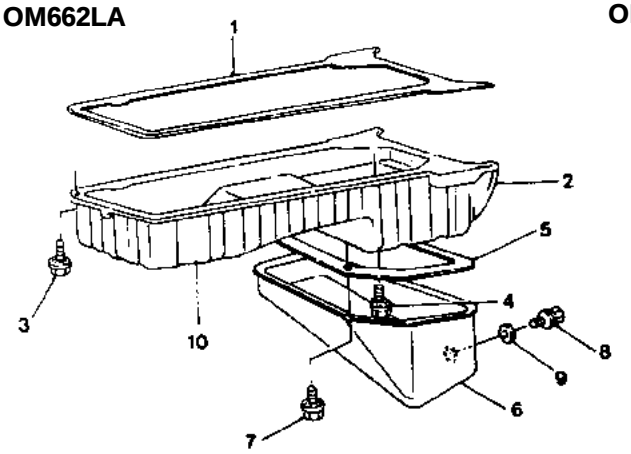


3. Remove the oil filter housing.
4. Clean the sealing surface.
5. Installation should follow the removal procedure in the reverse order.

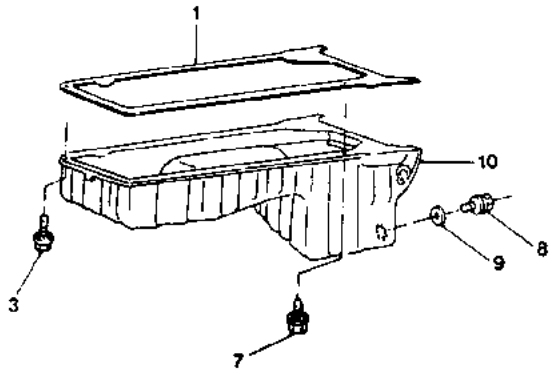
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OIL PAN

OM662LA



OM661LA



1 Gasket . . . . . Replace
2 Upper Oil Pan
3 Combination Bolt . . . . . 10 N·m (89 lb-in)
4 Combination Bolt . . . . . 10 N·m (89 lb-in)
5 Gasket . . . . . Replace
6 Lower Oil Pan
7 Combination Bolt . . . . . 25 N·m (18 lb-ft)
8 Drain Plug . . . . . 25 N·m (18 lb-ft)
9 Washer Seal . . . . . Replace
10 Oil Pan

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*Remove and install as numerical sequence.

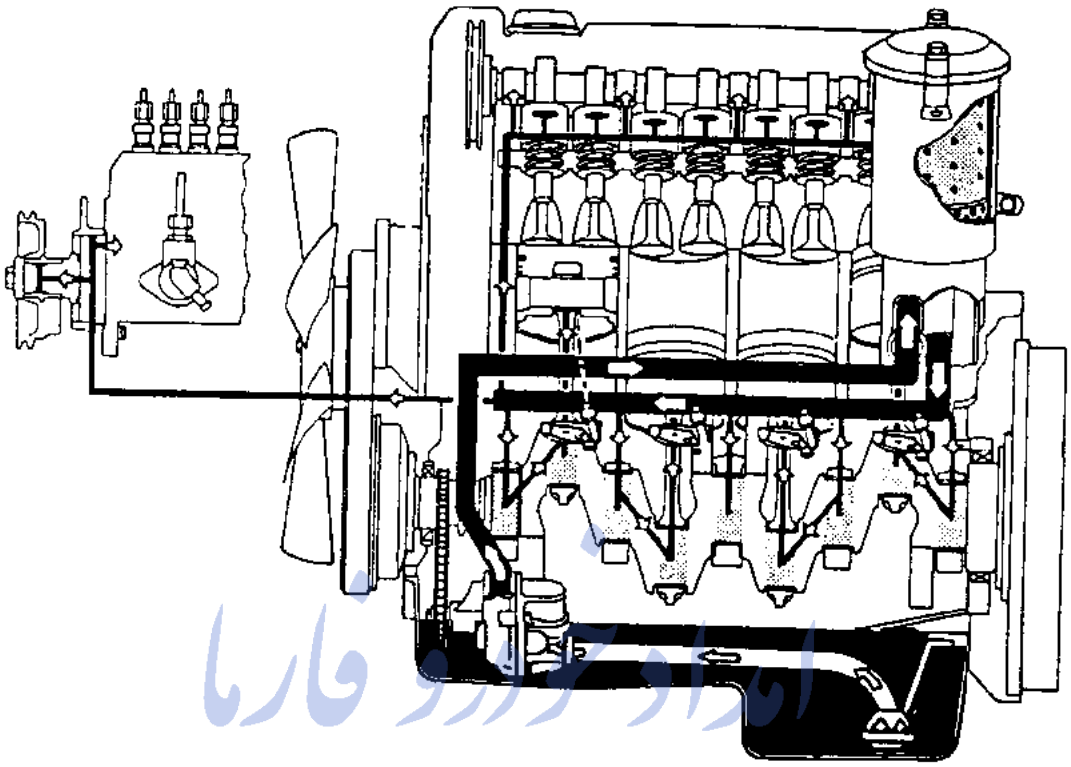
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵

Notice

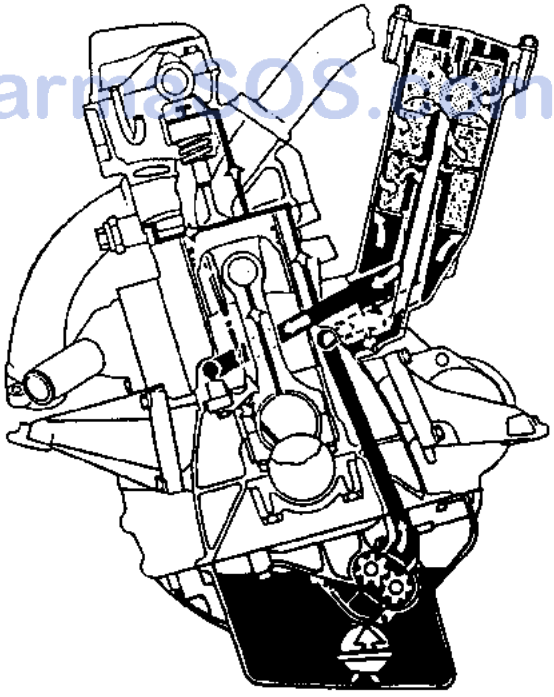
Replace the washer seal with new one.

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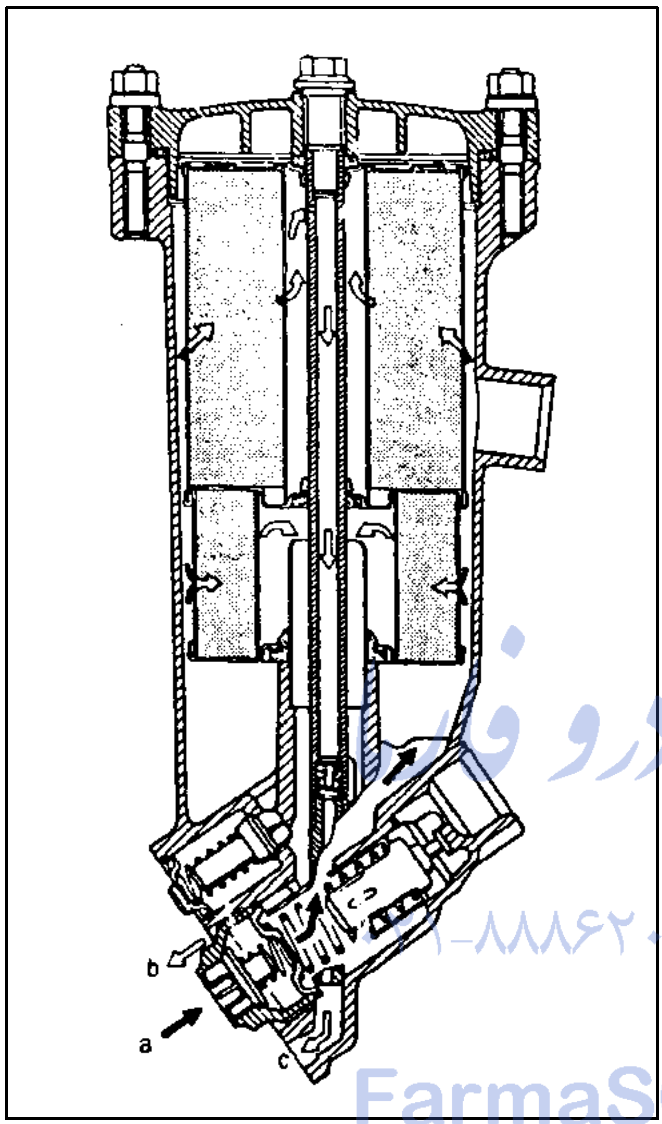
Oil Circulation



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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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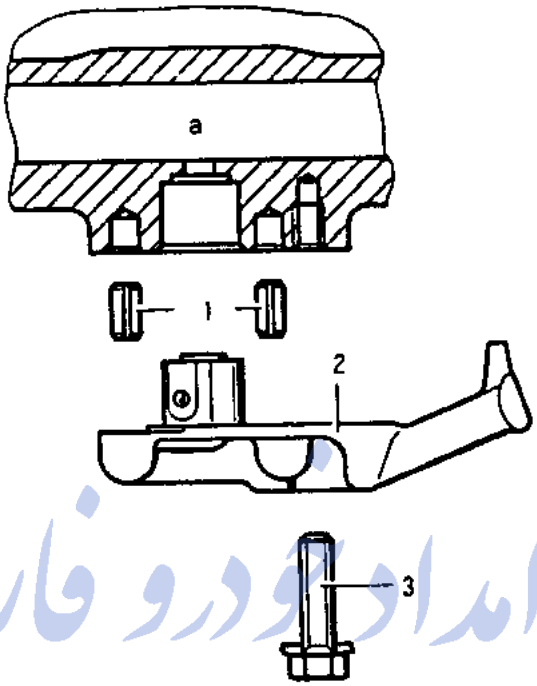
Oil Filter



a From Oil Pump
b To Main Oil Gallery
c To Oil Pan

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تلفن شبانه روزی: ۸۸۸۶۲۰۸۵-۰۲۱
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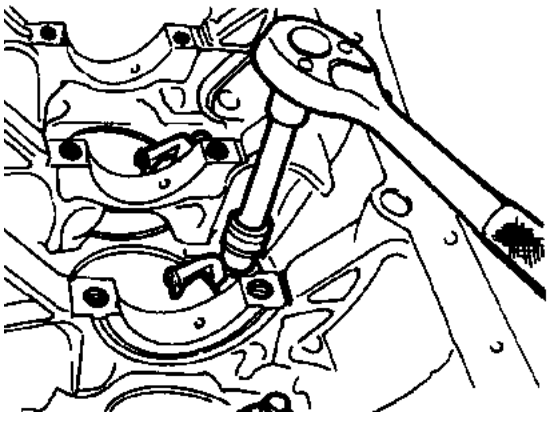
OIL SPRAY NOZZLE



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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵

1 Fitting Sleeve
2 Oil Spray Nozzle
3 Combination Bolt . . . . . 10 N·m (89 lb-in)
A Oil Duct

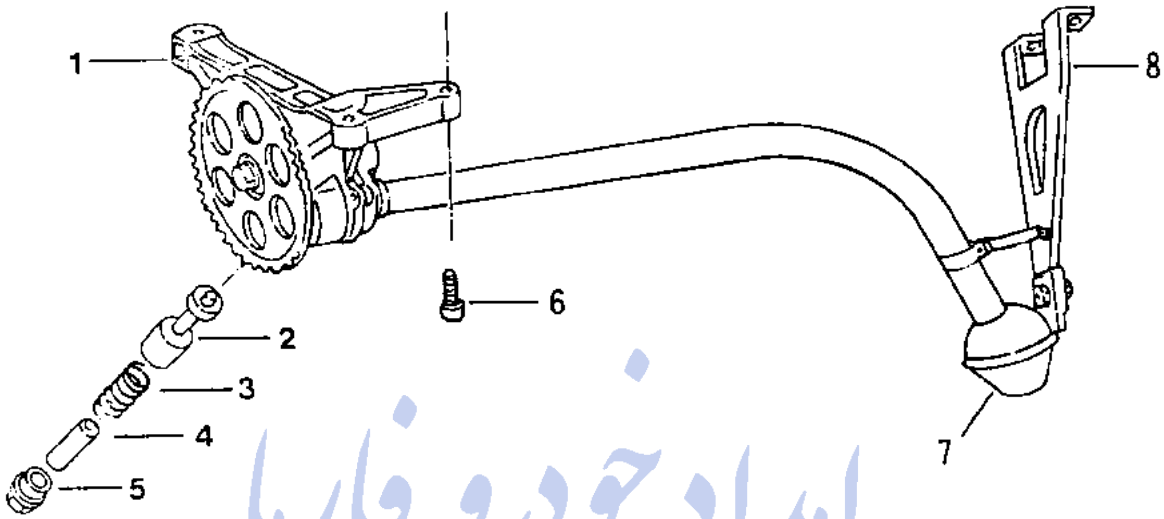
FarmaSOS.com



Disassembly Procedure

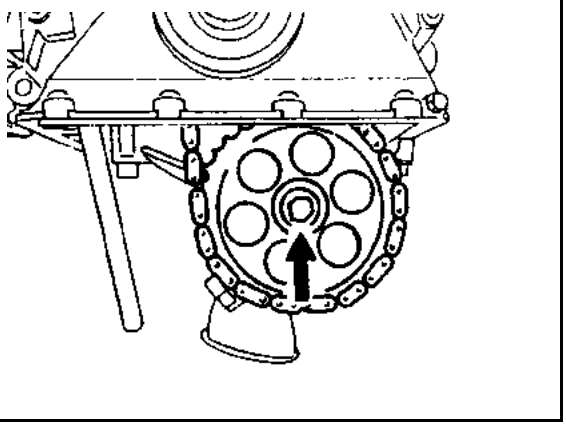
1. Remove oil pan or crankshaft.
2. Loose the bolt and then remove the nozzle.

OIL PUMP



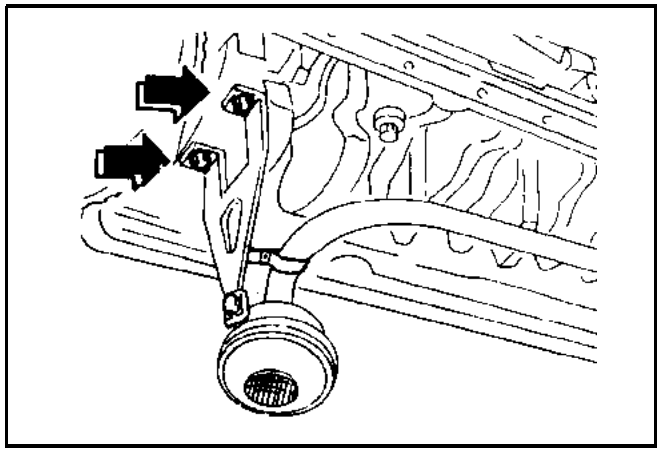
امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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1 Oil Pump
2 Piston
3 Pressure Spring
4 Guide Pin
5 Screw Plug . . . . . 50 N·m (37 lb-ft)
6 Combination Bolt . . . . . 25 N·m (18 lb-ft)
7 Oil Strainer
8 Bracket



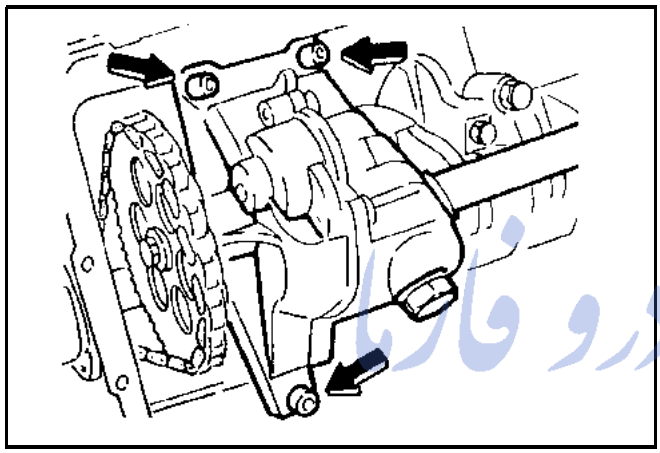
Disassembly Procedure

1. Remove the oil pan.
2. Unscrew the mounting bolt of spracket.

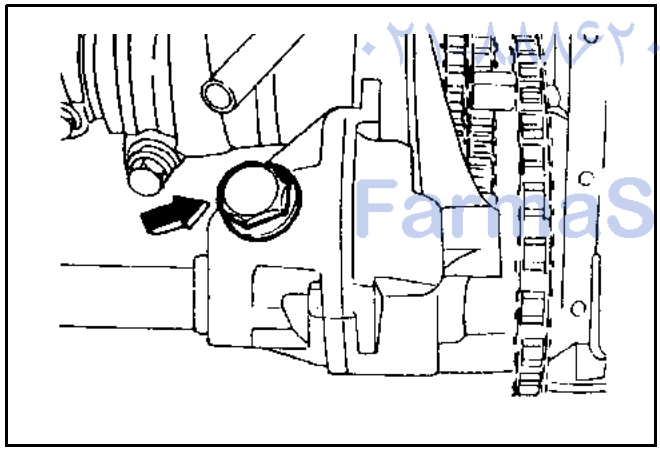


3. Unscrew the oil strainer bracket bolt.

Tightening Torque	10 N·m (89 lb-in)



4. Remove the oil pump.



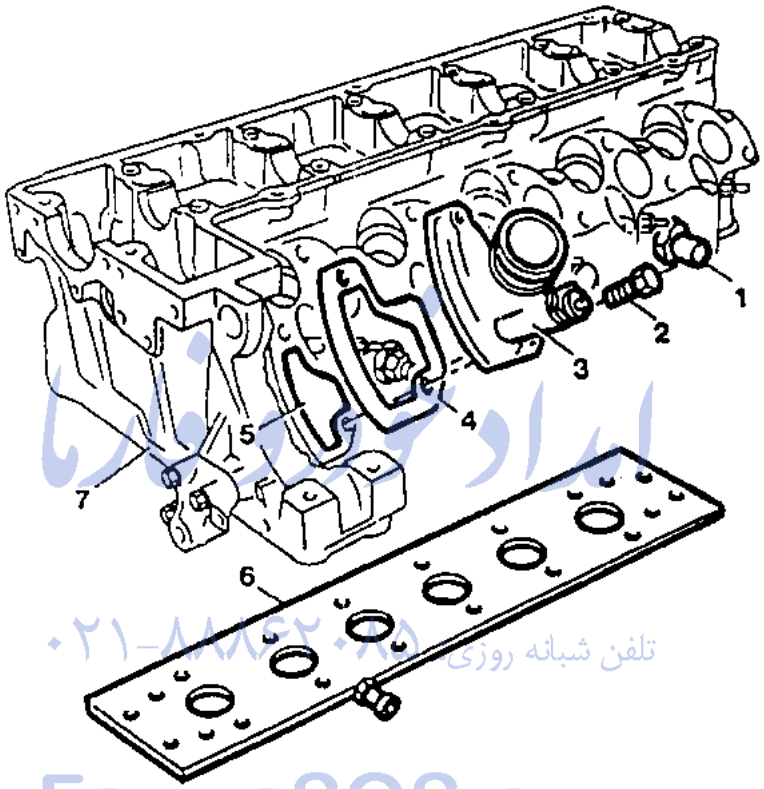
5. Unscrew the screw plug and remove the relief valve.
6. Installation should follow the removal procedure in the reverse order.

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UNIT REPAIR

CYLINDER HEAD PRESSURE LEAKAGE TEST

Preceding Work : Removal of the cylinder head
Removal of the exhaust manifold
Removal of the valve



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1 Feed Pipe
2 Bolt
3 Return Connection
4 Gasket ..... Replace
5 Coolant Gallery ..... Sealing
6 Pressure Measuring Plate ..... Completely tight to the cylinder head
7 Cylinder Head .....
Immerse with pressure measuring plate into warm water of approx. 60°C and pressurize with compressed air of 2 bar.

Notice

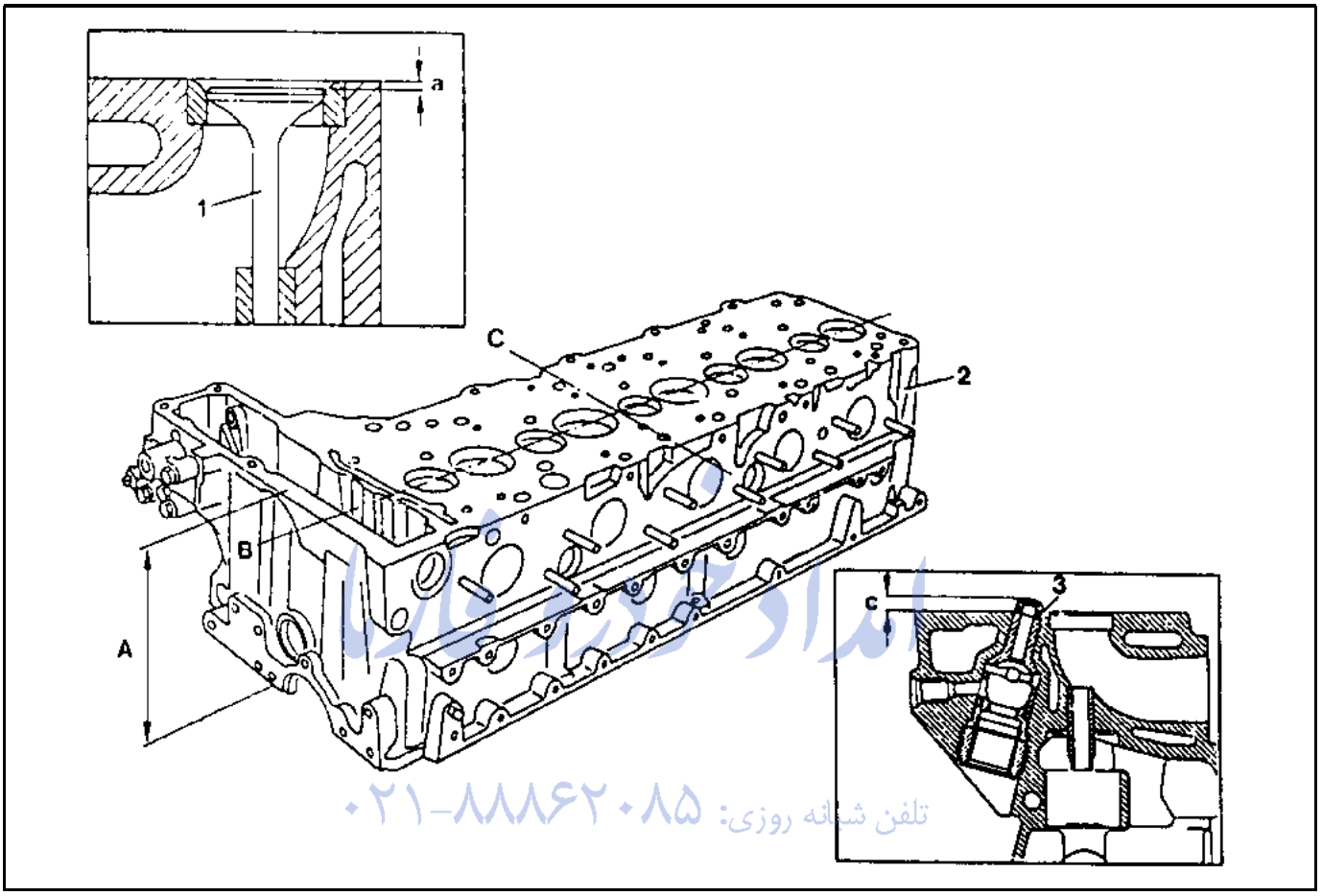
If air bubbles are seen, replace the cylinder head.

Tools Required

115 589 34 63 00 Pressure Measuring Plate
601 589 00 25 00 Suspension Device

FACING CYLINDER HEAD MATING SURFACE

Preceding Work : Removal of prechamber
Cylinder head pressure leakage test

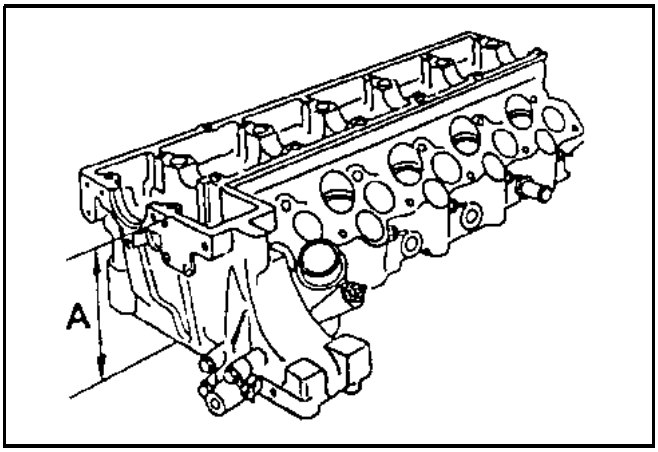


تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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1 Valve
2 Cylinder Head
3 Prechamber
A Height of Cylinder Head
B Longitudinal Direction
C Transverse Direction
a Valve Arrears
b Prechamber Protrusion

Service Data

Height 'A' (cylinder head surface - cylinder head cover surface)		142.9 - 143.1 mm
Minimum height after machining		142.5 mm
Permissible unevenness of parting surface	In longitudinal direction	0.08 mm
	In transverse direction	0.0 mm
Permissible variation of parallelism (longitud. Direction)		Max. 0.1 mm
Peak-to-valley height		0.0017 mm
Valve arrears 'a'	Intake valve	0.1 - 0.7 mm
	Exhaust valve	0.1 - 0.7 mm
Prechamber protrusion		7.6 - 8.1 mm



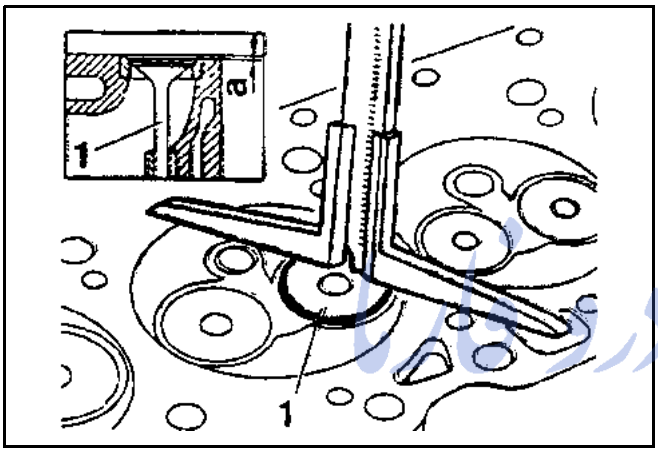
Measurement Procedure

1. Measure height 'A'.

Limit	142.5 mm

Notice

If the height is less than 142.5mm, replace the cylinder head.

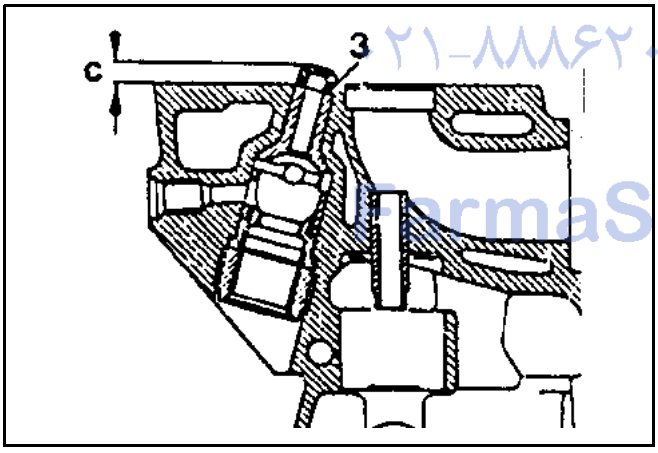


2. Insert the valve (1) and measure valve arrears 'a'.

Valve Arrears 'a'	0.1 - 0.7 mm

Notice

If out of standard, machine the valve seat.



3. Install the prechamber and measure protrusion 'C'.

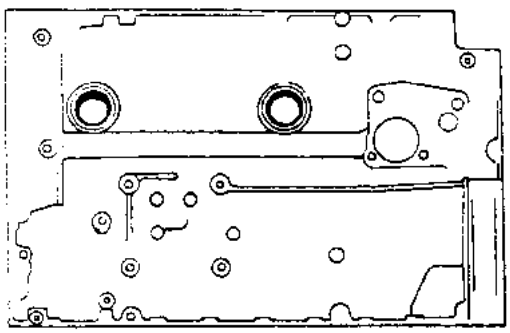
Protrusion 'C'	7.6 - 8.1mm

4. Assemble the engine and check the valve timing.

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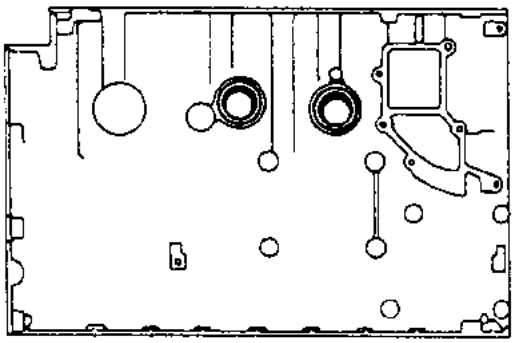
REPLACEMENT OF CRANKCASE CORE PLUG

Left



Core plug ϕ34mm
OM661LA - 2EA
OM662LA - 3EA

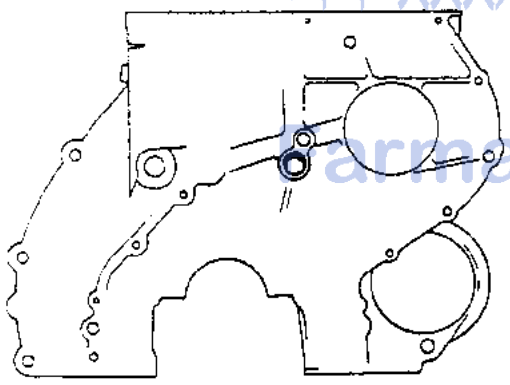
Right



Core plug ϕ34mm
OM661LA - 2EA
OM662LA - 3EA

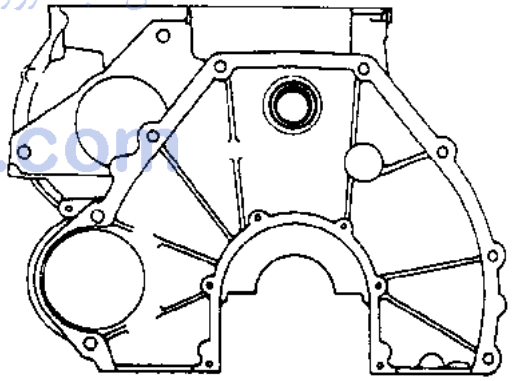
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Left

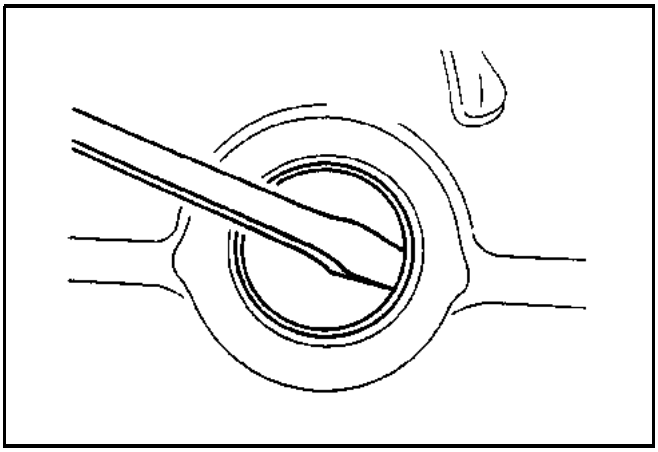


Core plug ϕ17mm
OM661LA - 1EA
OM662LA - 1EA

Right



Core plug ϕ34mm
OM661LA - 1EA
OM662LA - 1EA



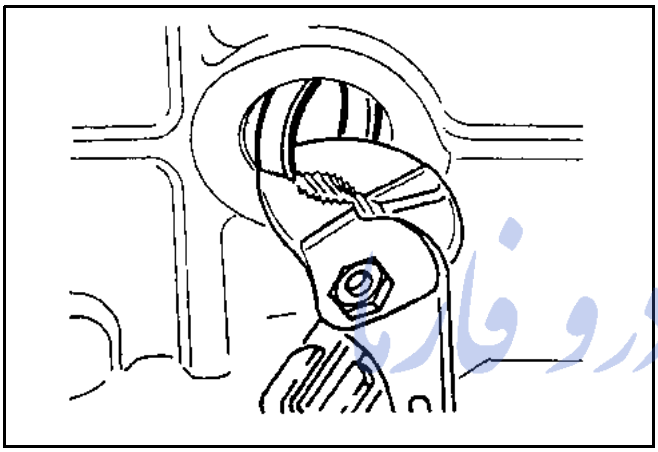
Tools Required

102 589 00 15 00 Drift

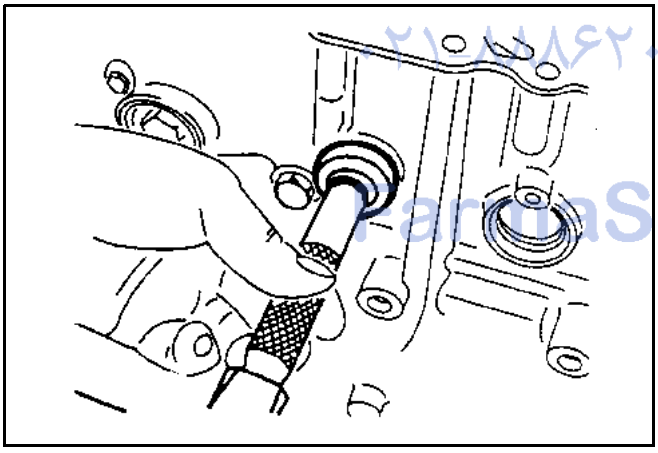
102 589 12 15 00 Drift

Replacement Procedure

1. Completely drain the coolant.
2. Remove any parts which impede access.
   (Example : transmission, injection pump)
3. Place the screwdriver to the deepdrawn edge of the core plug and pull forward and then rotate 90°.



4. Pull out the core plug with pliers.



5. Thoroughly clean the sealing surface and apply Loctite 241.
6. Install the new core plug by using a drift.

Drift 102 589 00 15 00 (F34)
Drift 102 589 12 15 00 (F17)

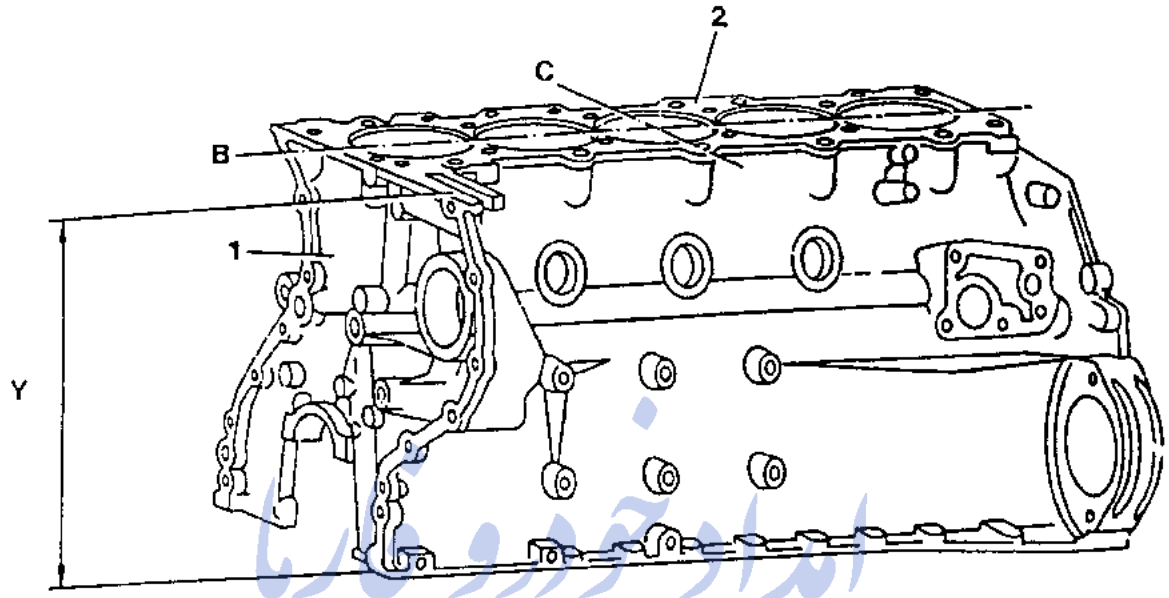
7. Install the removed parts and fill the coolant.

   Notice

   The adhesive must be allowed to harden for about 45 minutes before filling of coolant.
8. Warm up the engine and check the coolant for leaks.

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FACING CRANKCASE CONTACTING SURFACE



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1 Crankcase
2 Crankcase Contacting Surface

Y Height (crankcase upper surface - crankcase lower surface)

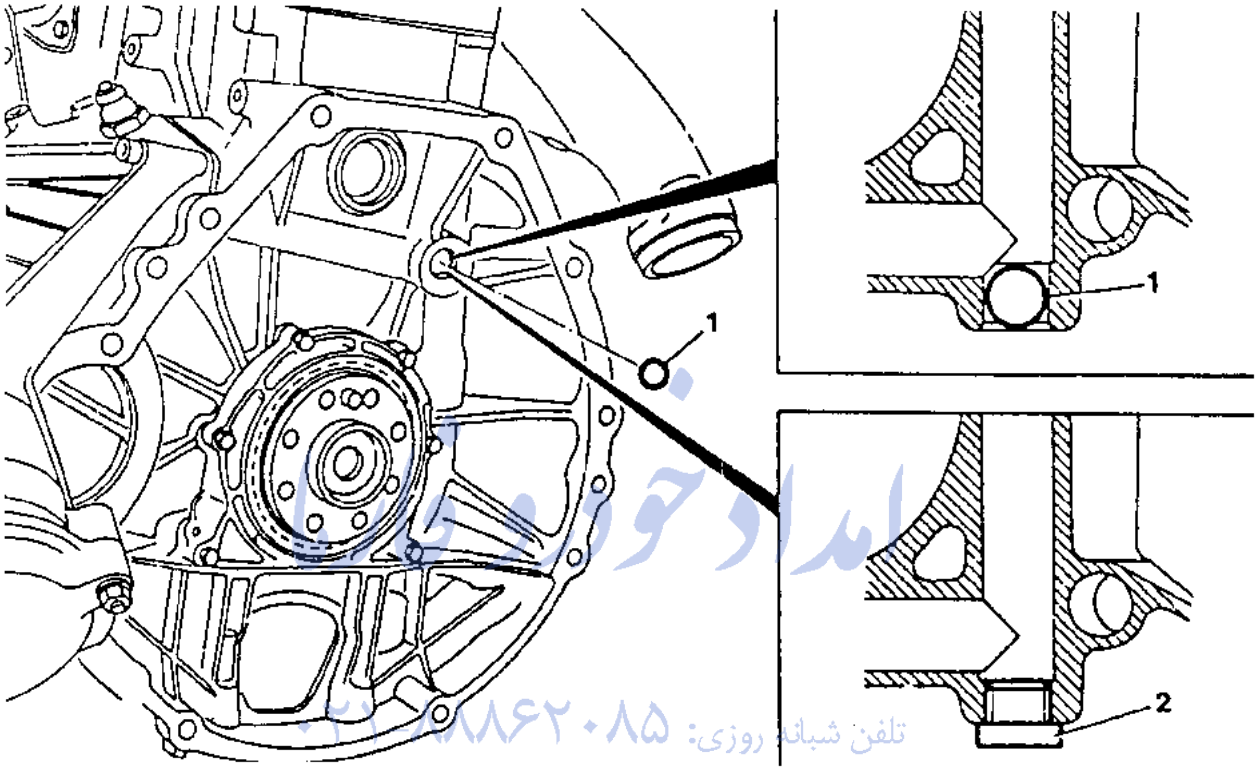
B Longitudinal Direction
C Transverse Direction
H Chamfer Height
b Chamfer Angle

Service Data

Height 'Y'		Min. 299.62 mm
Permissible unevenness of contacting surface	In longitudinal direction (B)	0.06 mm
	In transverse direction (C)	0.06 mm
Permissible roughness upper contacting surface		0.0006 - 0.0016 mm
Permissible variation of parallelism of crankcase upper surface to lower surface in longitudinal direction		0.05 mm
Piston protrusion at TDC to crankcase upper surface	Max.	0.965 mm
	Min.	0.735 mm

OIL GALLERY STEEL BALL

Preceding Work : Removal of cooling fan
Removal of the water pump housing
Removal of the flywheel and driven plate

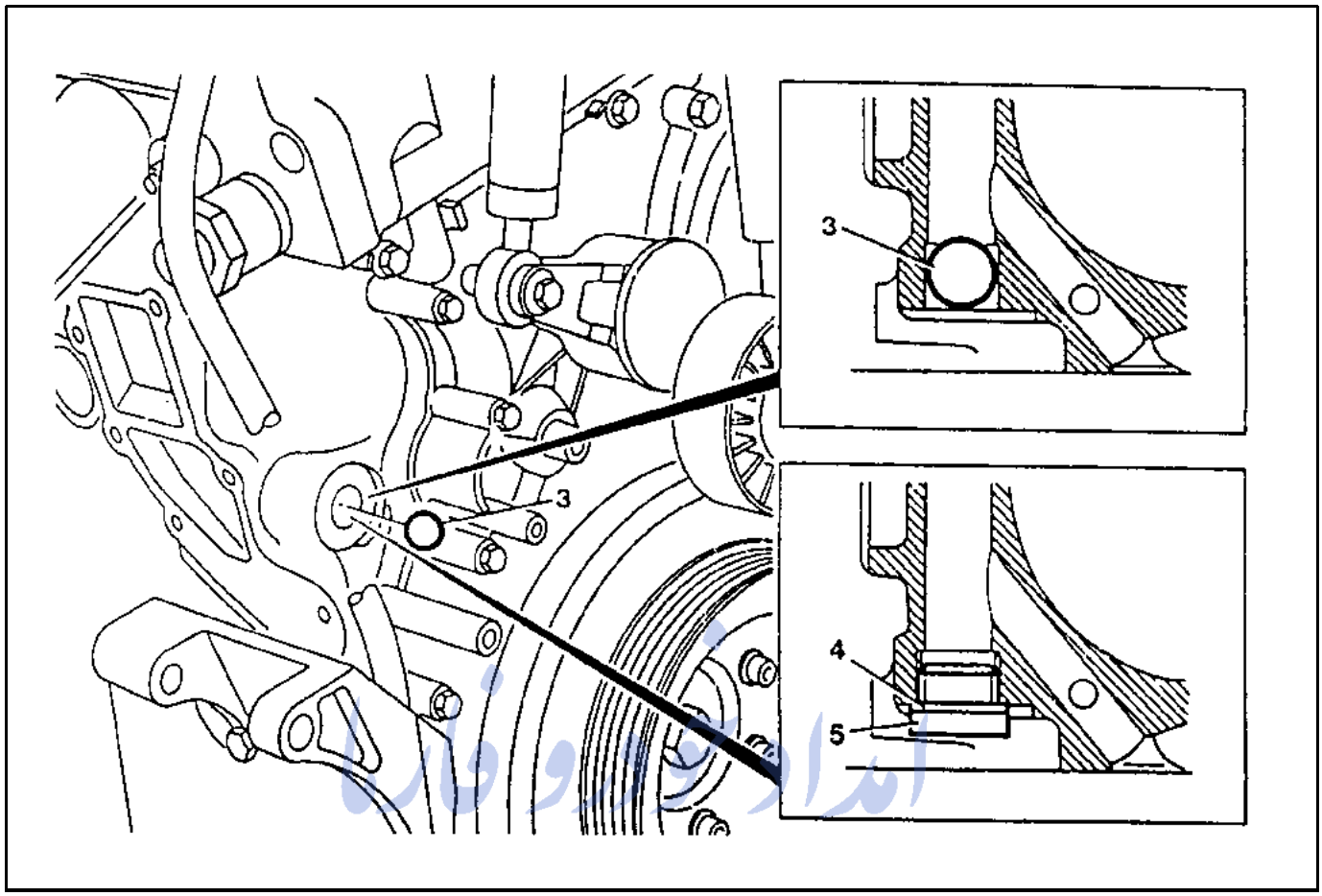


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1 Steel Ball . . . . . ϕ15mm 2 Screw Plug . . . . . Loctite 241, 50N·m

Notice

The screw plug (2) has to be installed as a repair solution if the steel ball (1) is leaking.



3 Steel Ball ϕ17mm
4 Seal
5 Screw Plug . . . . . 50N·m (37 lb-ft)

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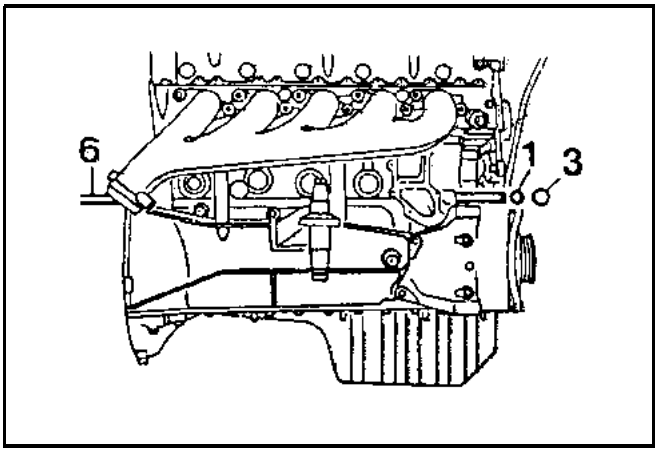
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Notice

The seal (4) and screw plug (5) have to be installed as a repair solution if the steel ball (3) is leaking.

Tools Required

601 589 08 15 00 Drift



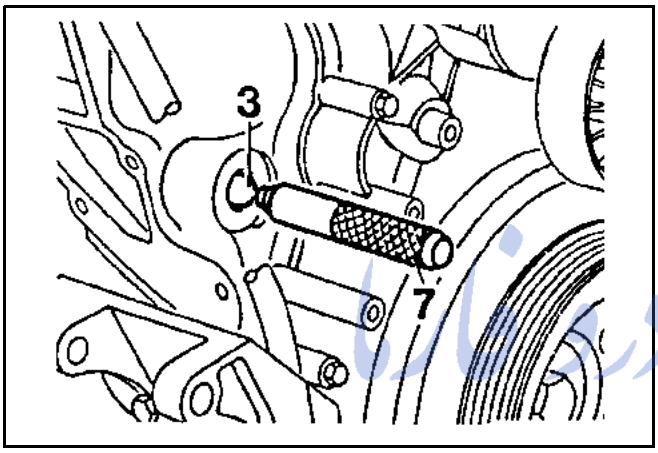
Removal & Installation Procedure

1. Remove the timing case cover.
2. By inserting a round bar (6) approx. 0.7m from the back to the front side through the oil gallery, knock out the steel balls (1,3).

   Notice

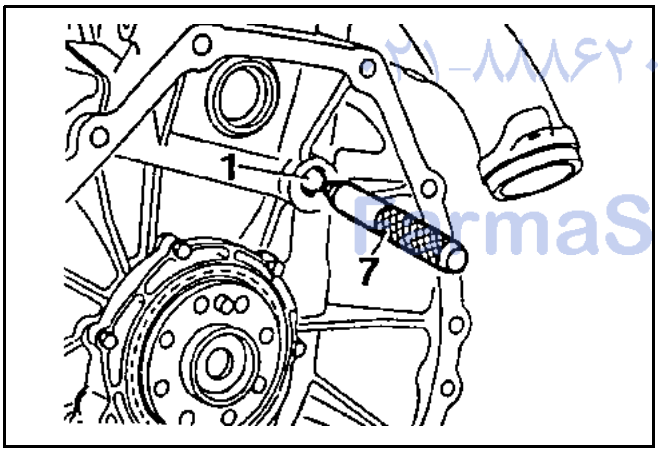
   Be careful not to damage the bores of the steel balls.

6 Shop-made tool



3. Thoroughly clean the bores of steel balls.
4. Place the steel ball (3) onto the drift (7) with a little grease and position to the bore and then tap until the drift stops.

Drift 601 589 08 15 00

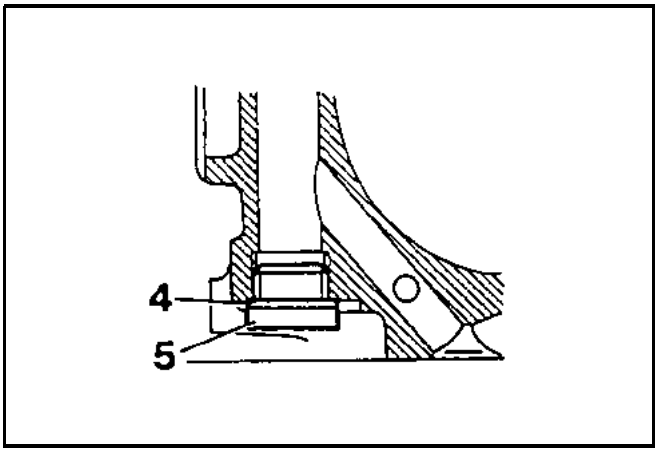


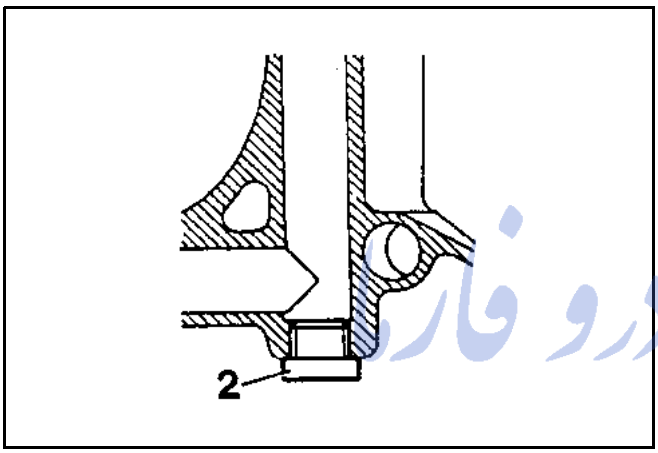
5. Place the steel ball (1) onto the drift (7) with a little grease and position to the bore and then tap until the drift stops.

Drift 601 589 08 1500

6. Warm up the engine and check the oil for leaks.

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Installation of Screw Plug

Notice

If steel ball leaks again, install the screw plug.

1. Remove the steel ball.
2. Tap thread into the bores of the oil gallery.

Notice

Front bore : M18′ 1.5, depth 10mm

Rear bore : M16′ 1.5, depth 14mm

3. Thoroughly clean the oil gallery.
4. Tighten the front plug (5) with seal (4).

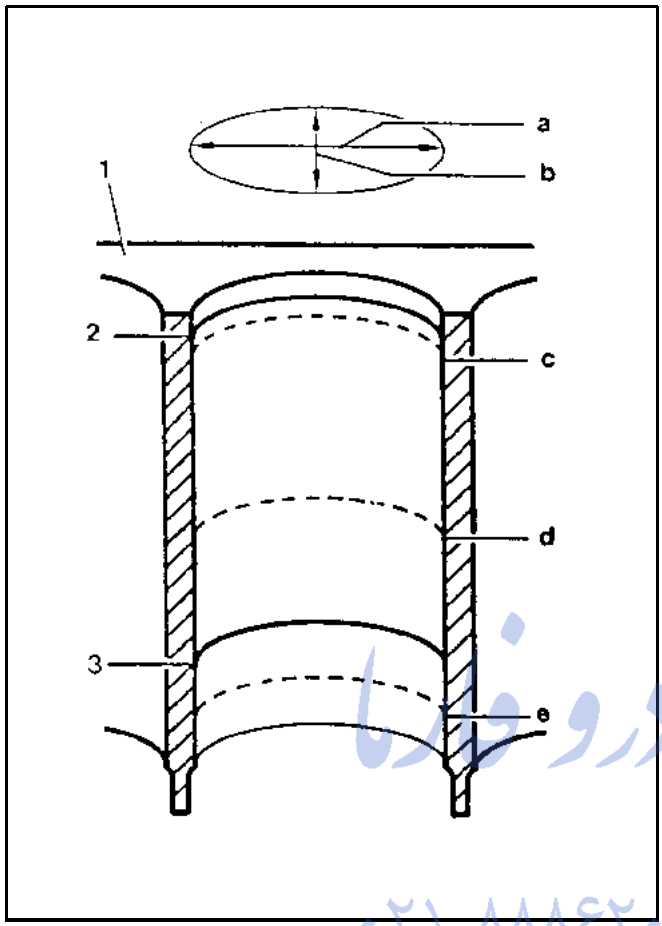
Tightening Torque	50 N·m (37 lb-ft)

5. Apply Loctite 241 and then tighten the rear plug (2).

Tightening Torque	50 N·m (37 lb-ft)

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CYLINDER BORE MEASUREMENT



a Longitudinal Direction
b Transverse Direction
c, d, e. Measuring Point

1 Crankcase Contacting Surface
2 TDC of 1st Piston Ring
4 BDC of Ring

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Service Data

Standard size	Code letter 'A'	89.000 - 89.006mm
	Code letter 'X'	89.006 - 89.012mm
	Code letter 'B'	89.012 - 89.018mm
Wear limit in direction of travel and in transverse direction		Max. 0.20mm
	When new	0.01mm
Permissible deviation of cylinder shape	Wear limit	0.05mm
Honing angle		50° ± 10°

SECTION 1D3

OM600 ENGINE COOLING

Caution: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

Specifications 1D3-1
General Specifications 1D3-1
Fastener Tightening Specifications 1D3-1
Diagnosis 1D3-2
Cooling Circulation 1D3-2
Thermostat Operation 1D3-3
Cooling System Leakage Test 1D3-4
Maintenance and Repair 1D3-5
On-Vehicle Service 1D3-5
Drain and Filling of Coolant 1D3-5
Water Pump 1D3-6
Water Pump Housing 1D3-8
Cooling Fan Clutch 1D3-10
Radiator 1D3-12
Cooling Sub-System 1D3-14
Thermostat 1D3-16

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SPECIFICATIONS

GENERAL SPECIFICATIONS

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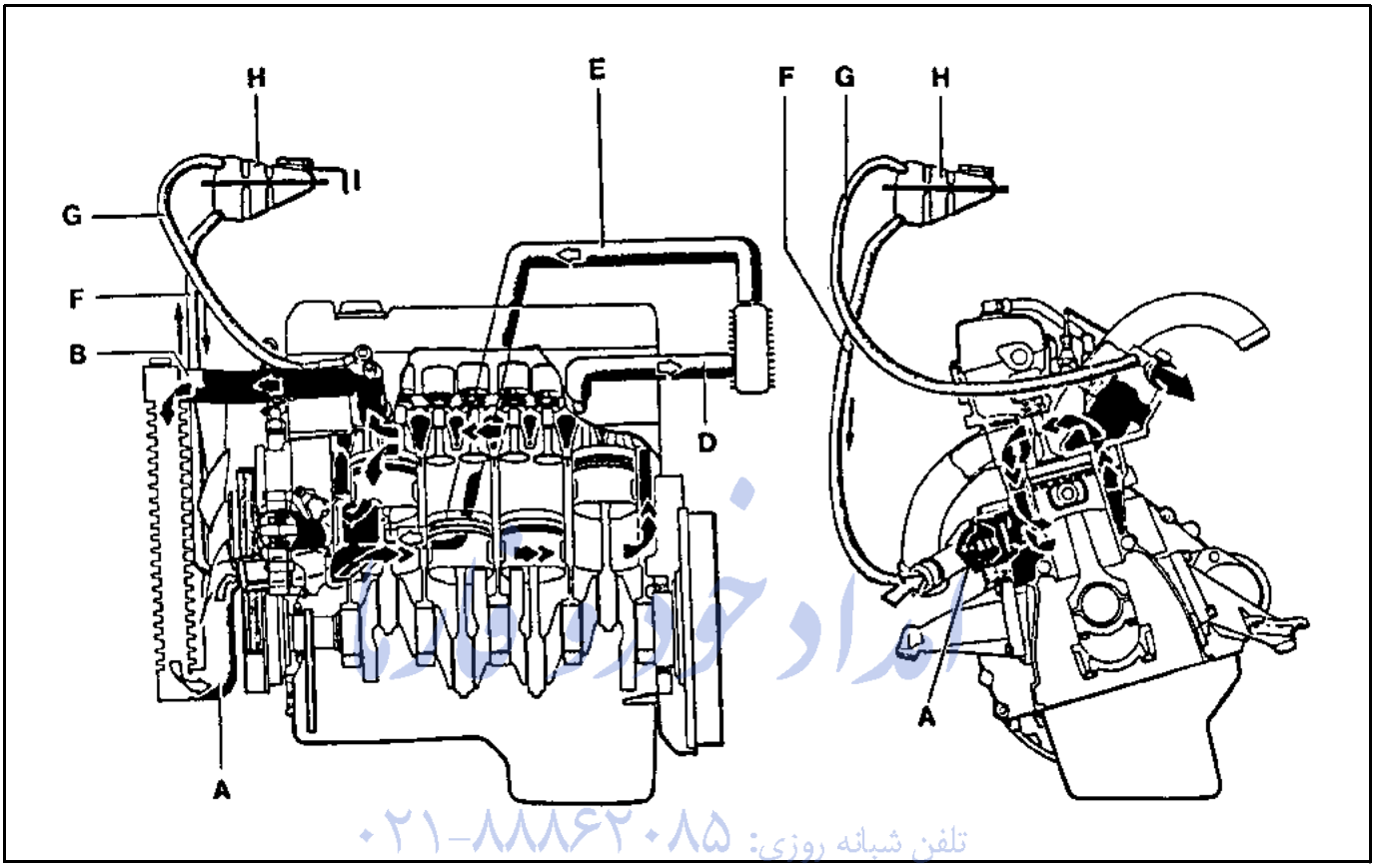
Application		Description
Coolant		ALUTEC P-78
Mixing Ratio (Water: anticorrosion)		50 : 50
Capacity	662LA	10.5L - 11L
	661LA	9.5L - 10L

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Water Pump Bolt	10	-	89
Belt Pulley Bolt	10	-	89
Water Pump Housing Return Pipe Bolt	10	-	89
Thermostat Bolt	10	-	89
Cooling Fan Clutch Socket Bolt (Center)	45	33	-
Cooling Fan Clutch Socket Bolt (Side)	10	-	89
Radiator Bolt	3 - 7	-	27 - 62
Coolant Sub-tank Bolt	3 - 7	-	27 - 62

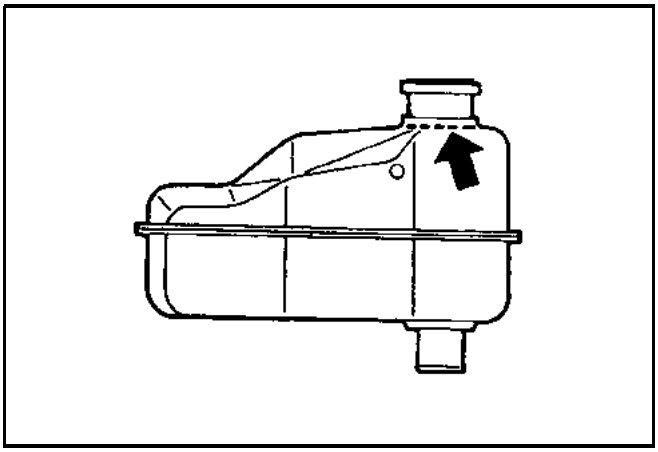
DIAGNOSIS

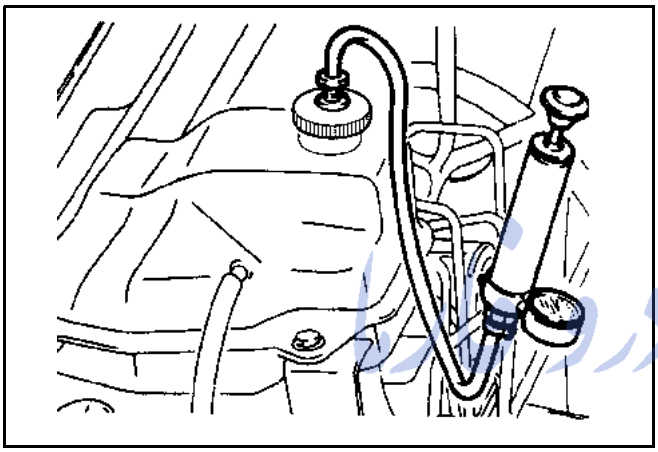
COOLING CIRCULATION



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A Thermostat
B Radiator
D From Heater
E Hose
G Deaeration Line
H Reservoir





COOLING SYSTEM LEAKAGE TEST

Tools Required

124 589 15 21 00 Tester

Test

1. Loosen the pressure cap by 1 notch and remove the cap after.

   Notice

   Do not remove radiator cap when coolant is above 90°C.

2. Add the coolant to the arrow mark of coolant reservoir.

3. Connect the special tool to the injector of reservoir and apply 1.4bar pressure.

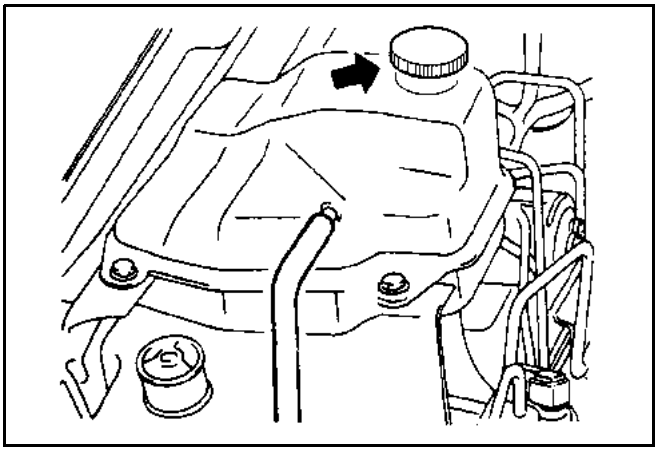
Tester 124 589 15 21 00

4. If the pressure on the tester drops, check the hose, pipe and leakage and, replace or retighten.

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MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE



DRAIN AND FILLING OF COOLANT

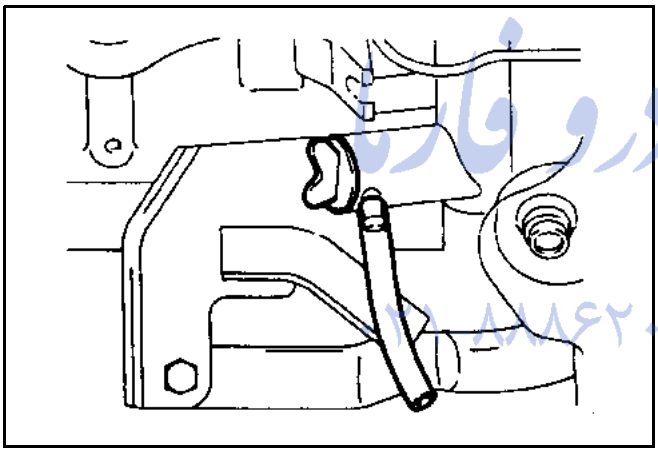
Preceding Work : Removal of skid plate

Drain / Filling

1. Loosen the pressure cap of reservoir by 1 notch and remove pressure and then loosen the cap.

   Notice

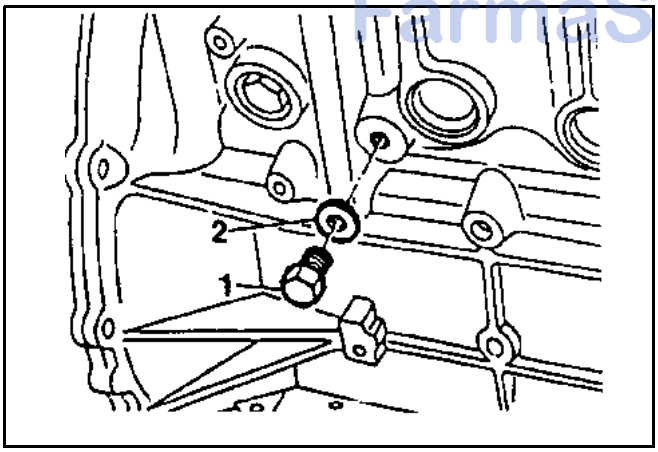
   Do not remove radiator cap when coolant is above 90°C.



2. Open the drain plug and drain the coolant.

   Notice

   Collect the coolant by using the proper bottle.



3. Remove the drain plug(1) and seal(2) of cylinder block and drain the coolant.
4. Replace the seal to new one and tighten the drain plug.

   Installation Notice

Tightening Torque	30 N·m (22 lb-ft)

5. Tighten the drain plug of the lower radiator.
6. Fill the coolant through coolant reservoir-tank.

   Notice

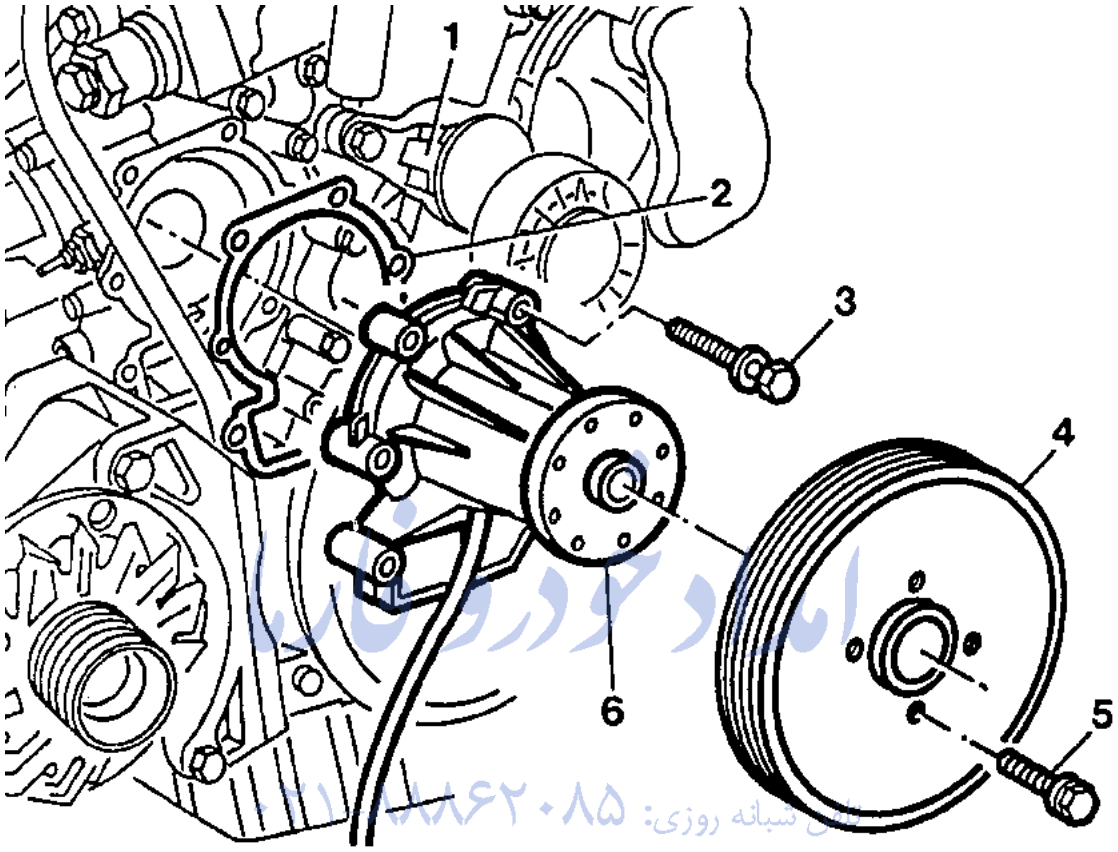
   - A proportion of 50% by volume of water / anticorrosion must be ensured.

7. After engine is running at idle speed, check the level of coolant. If necessary, add enough specified coolant.

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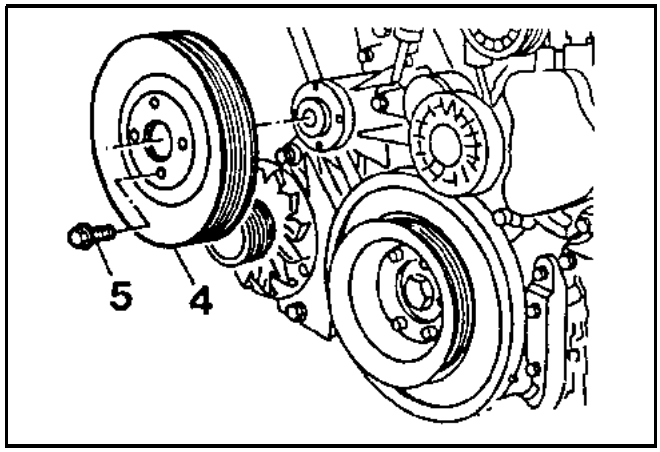
WATER PUMP

Preceding Work : Removal of cooling fan
Removal of V-belt



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1 Tensioning Lever
2 Gasket . . . . . Replace
3 Bolt . . . . . 10 N·m (89 lb-in)
4 Belt Pulley
5 Bolt . . . . . 10 N·m (89 lb-in)
6 Water Pump

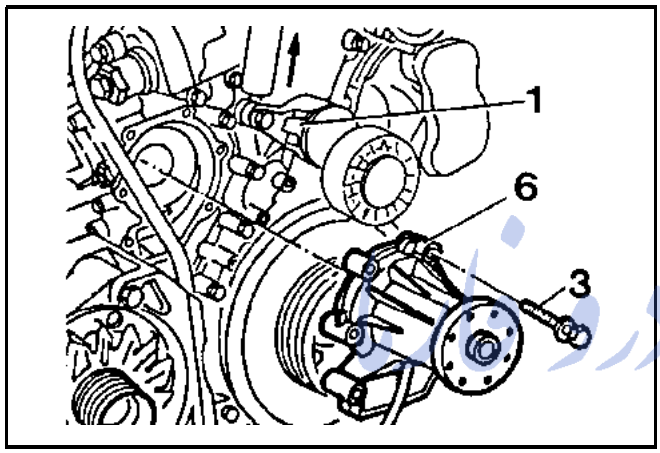


Removal & Installation Procedure

1. Loose the bolts(5) and remove the pulley (4).

Installation Notice

Tightening Torque	10 N·m (89 lb-in)



2. Loose the bolts (3).

Installation Notice

Tightening Torque	10 N·m (89 lb-in)

3. Pull the tensioning lever(1) to the arrow direction.
4. Remove the water pump(6).

Notice

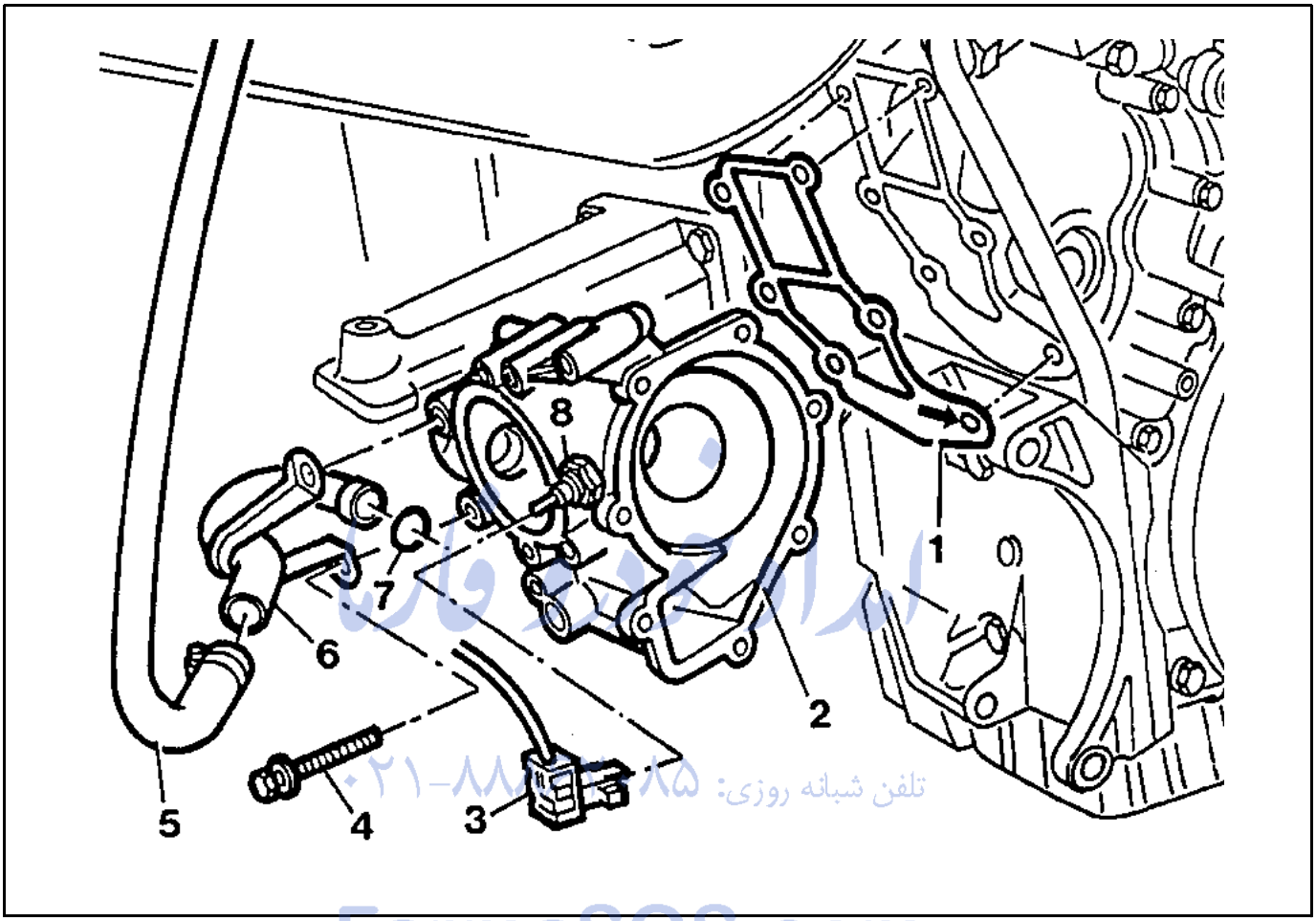
Clean gasket residues on the sealing surface of water pump and replace the gasket.

5. Installation should follow the removal procedure in the reverse order.

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WATER PUMP HOUSING

Preceding Work : Removal of water pump
Removal of thermostat
Removal of generator

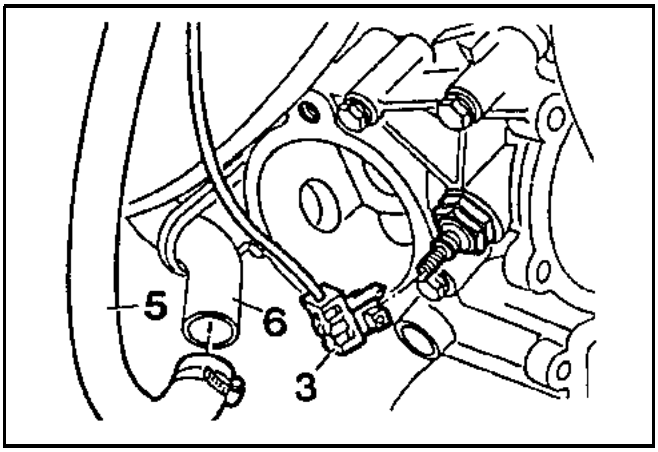


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1 Gasket ..... Replace
2 Water Pump Housing
3 Connector
4 Bolt ..... 10 N·m (89 lb-in)
5 Coolant Hose
6 Return Pipe
7 O-Ring
8 Temperature Sensor

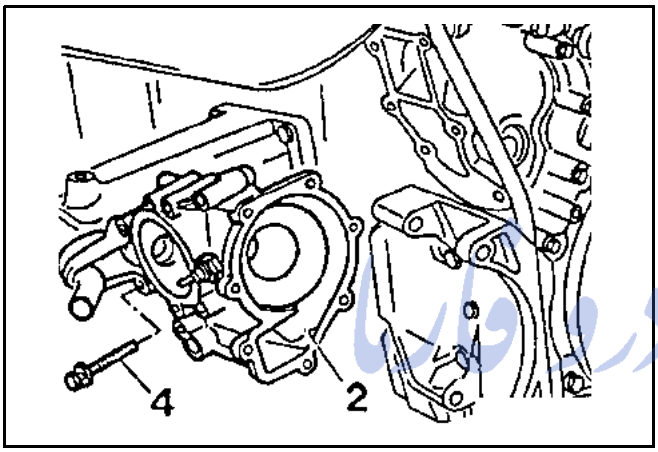
Notice

The bolt on the arrow should be installed last.



Removal & Installation Procedure

1. Disconnect the connector(3).
2. Separate the coolant hose (5) and return pipe(6).



3. Remove the bolts(4) evenly.

Installation Notice

Tightening Torque	10 N·m (89 lb-in)

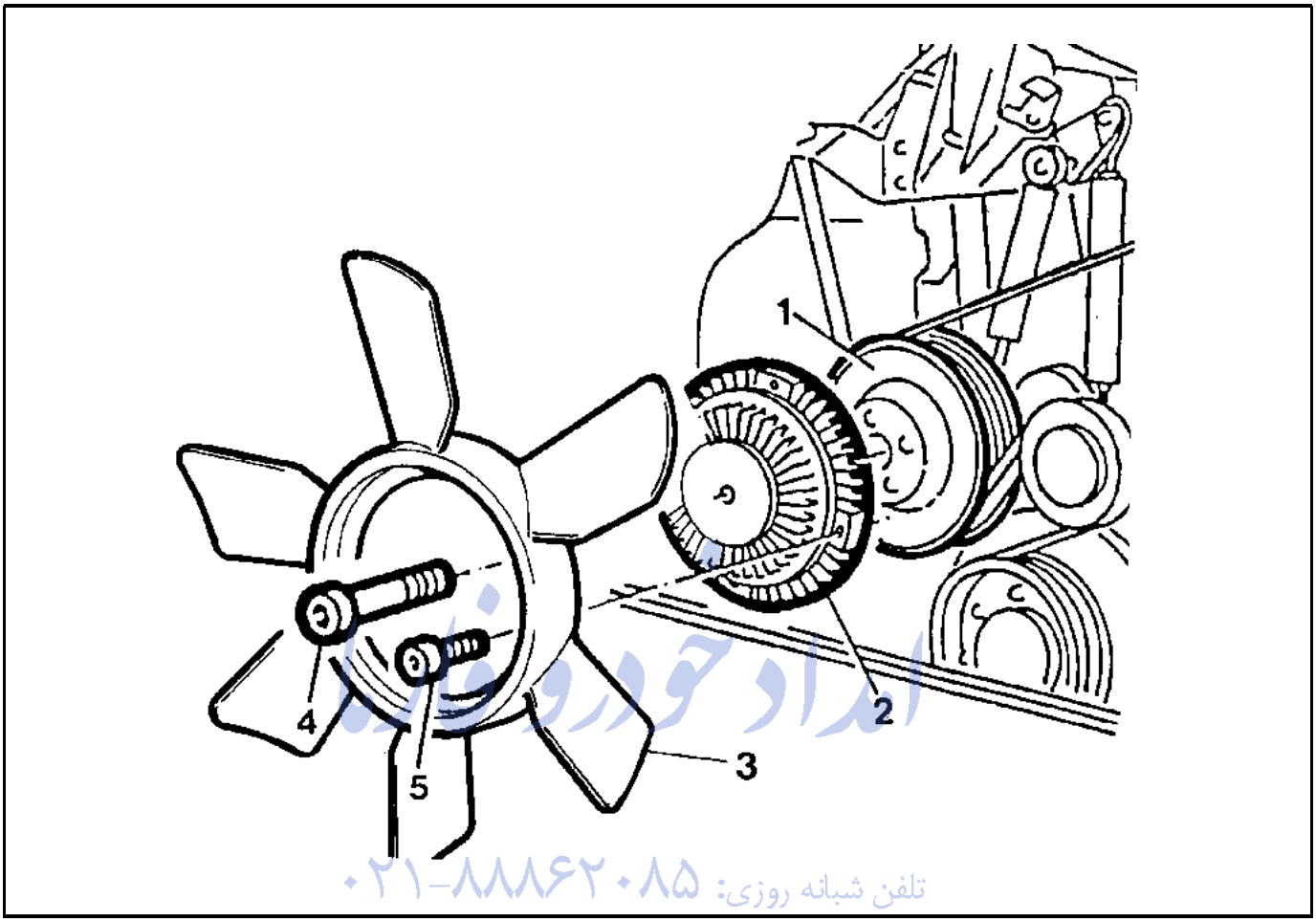
Notice

Clean gasket residues on the sealing surface of water pump and replace the gasket.

4. Remove the water pump housing(2).
5. Installation should follow the removal procedure in the reverse order.

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COOLING FAN CLUTCH

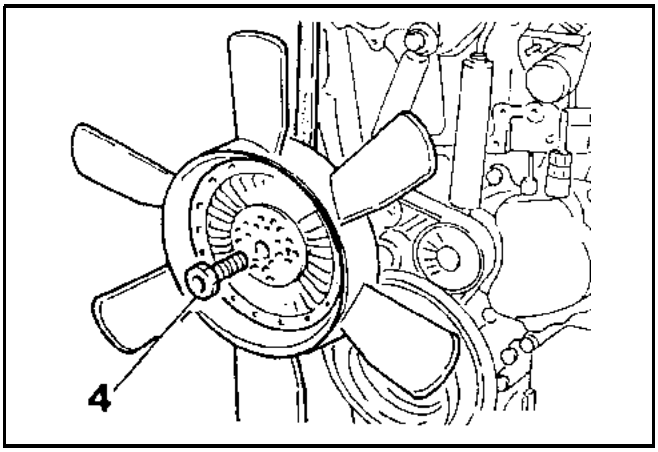


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1 Belt Pulley
2 Cooling Fan Clutch
3 Cooling Fan
4 Socket Bolt . . . . . 45 N·m (33 lb-ft)
5 Socket Bolt . . . . . 10 N·m (89 lb-in)

Tools Required

603 589 00 40 00 Counter Holder



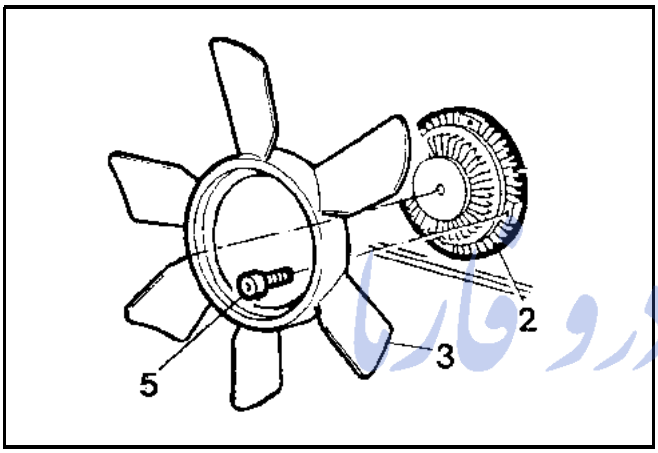
Removal & Installation Procedure

1. Hold the bolt pulley with counter holder and remove the bolt(4).

Counter Holder 603 589 00 40 00

Installation Notice

Tightening Torque	45 N·m (33 lb-ft)



2. Remove the socket bolt(5) and then remove the cooling fan(3) and fan clutch(2).

Notice

Keep the fan clutch vertically.

Installation Notice

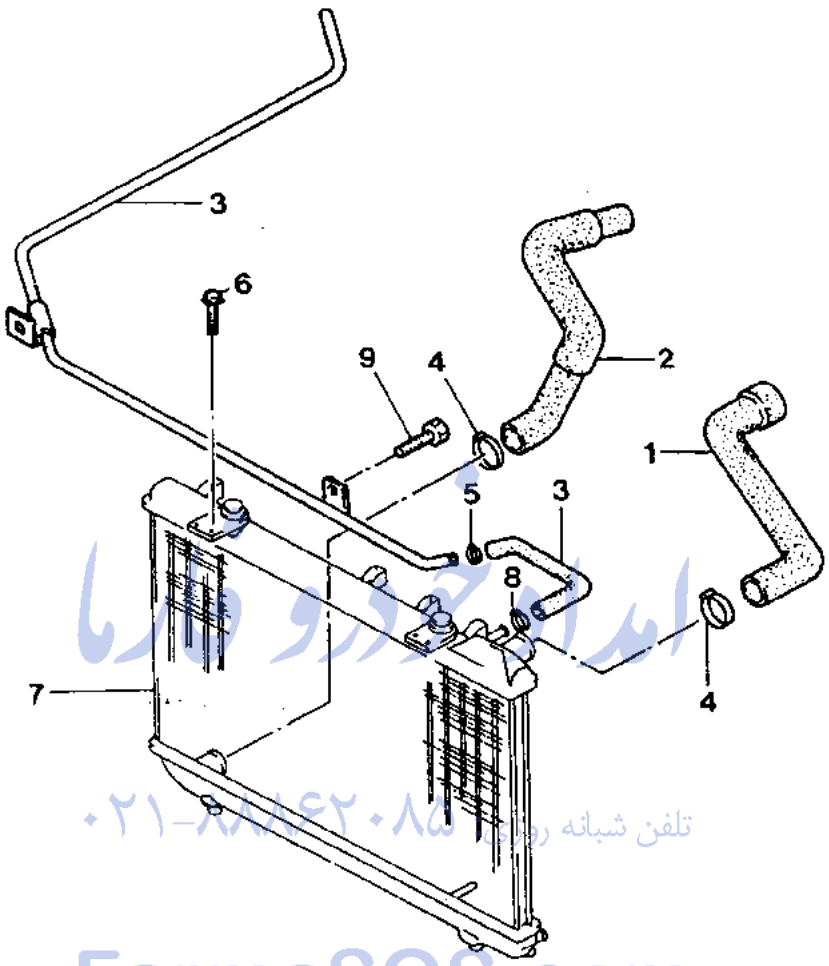
Tightening Torque	10 N·m (89 lb-in)

3. Installation should follow the removal procedure in the reverse order.

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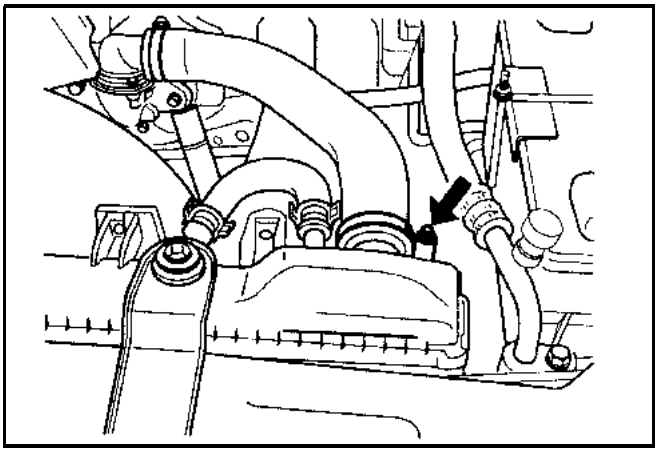
RADIATOR

Preceding : Removal of cooling fan shroud



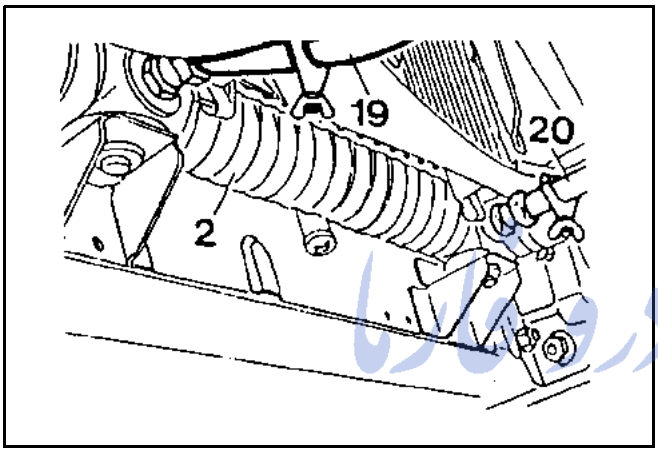
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تلفن شبانه روزی ۰۲۱-۸۸۸۴۲۰۸۵
FarmaSOS.com

1 Radiator Inlet Hose ..... OM662LA : 220mm
..... OM661LA : 321mm
2 Radiator outlet Hose
3 Radiator Deaeration Tube & Hose
4 Clamp
5 Spring Clamp
6 Bolt ..... 3-7 N·m (27-62 lb-in)
7 Radiator
8 Spring Clamp
9 Bolt ..... 3-7 N·m (27-62 lb-in)



Removal & Installation Procedure

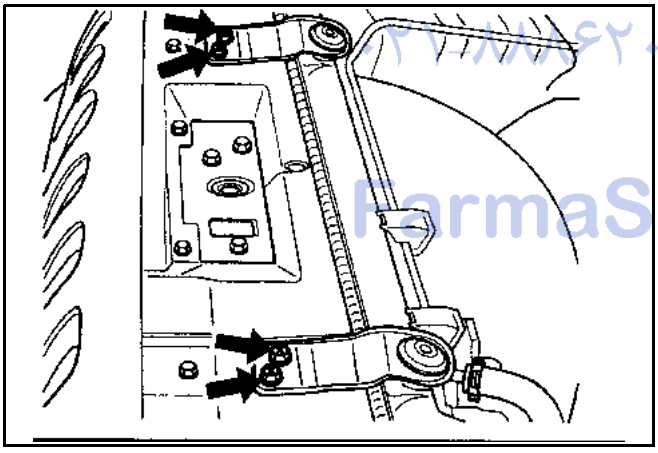
1. Drain coolant from the radiator.
2. Remove the coolant thermoswich connector from radiator.
3. Remove the each coolant hose.



4. Remove the auto T/M oil cooling hose and cooling line.

Installation Notice

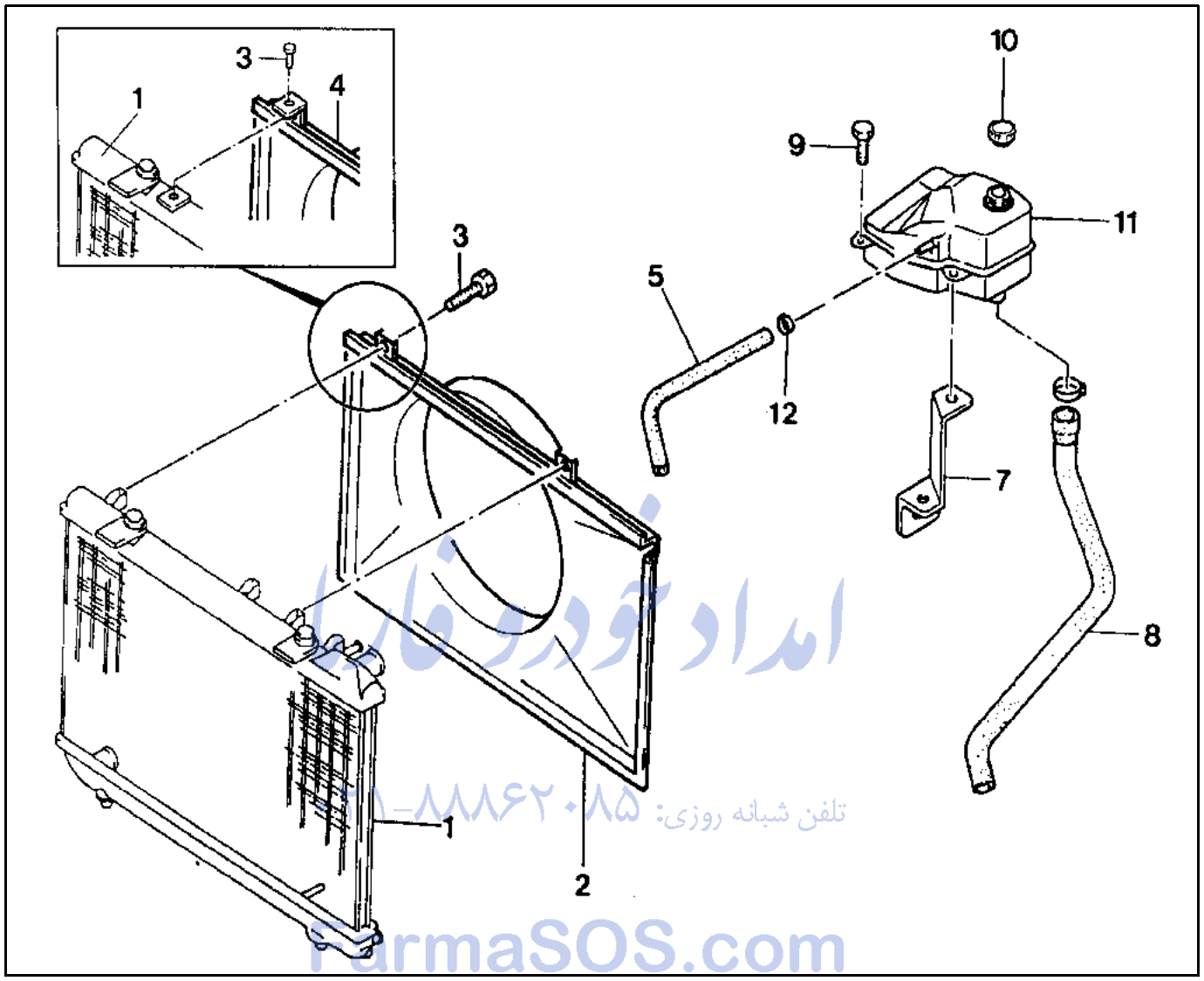
Tightening Torque	Hose : 29-40N·m (21-30 lb-ft)
	Tube : 25-35N·m (18-26 lb-ft)



5. Loosen the radiator upper mounting bolt and remove the mounting stopper and insulator.
6. Remove the radiator.
7. Check the radiator pin for crack, leakage and bending and replace it if necessany.
8. Installation should follow the removal procedure in the reverse order.

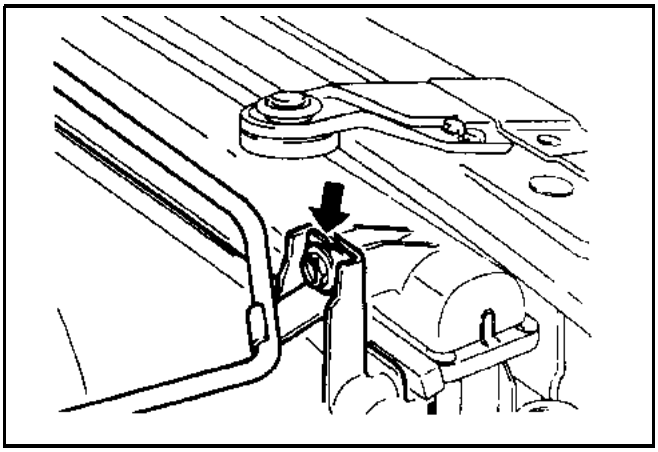
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COOLING SUB-SYSTEM



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1 Radiator
2 Cooling Fan Shroud
3 Bolt . . . . . 3-7 N·m (27-62 lb-in)
4 Cooling Fan Shroud
5 Radiator Deaeration Hose
7 Mounting Bracket
8 Make-up Cooling Hose
9 Bolt . . . . . 3-7 N·m (27-62 lb-in)
10 Cooling Reservoir-tank Cap
11 Cooling Reservoir-tank



Removal & Installation Procedure

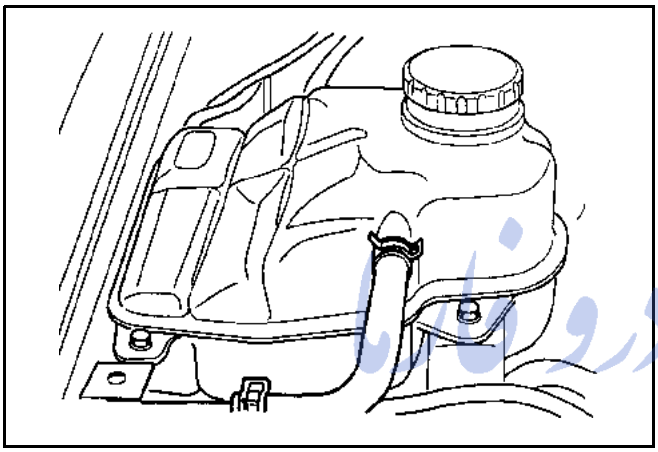
Cooling Fan Shroud

1. Remove the radiator deaeration hose and tube.

Installation Notice

Tightening Torque	3-7 N·m (27-62 lb-in)

2. Check the shroud.
3. Installation should follow the removal procedure in the reverse order.

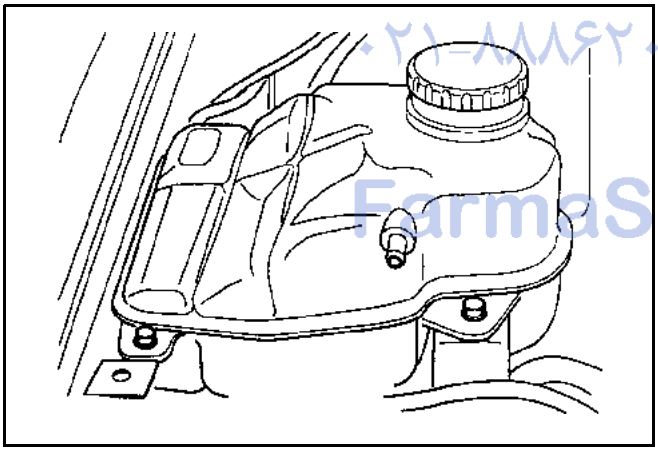


Coolant Sub-Tank

1. Drain the coolant from radiator.
2. Remove the each hose.
3. Loosen the mounting bolt of sub-tank and remove the coolant sub-tank.

Installation Notice

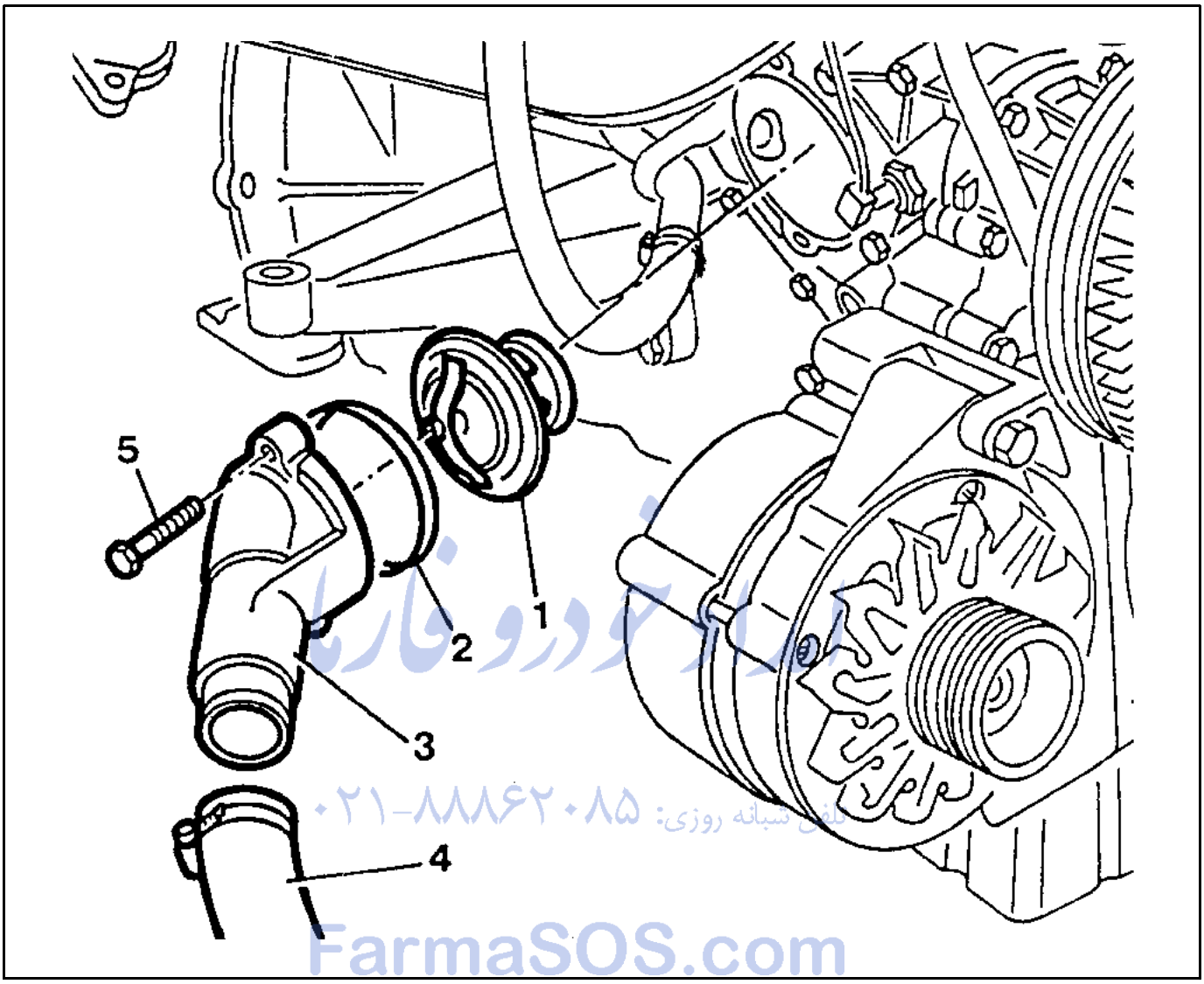
Tightening Torque	3-7 N·m (27-62 lb-in)



4. Installation should follow the removal procedure in the reverse order.

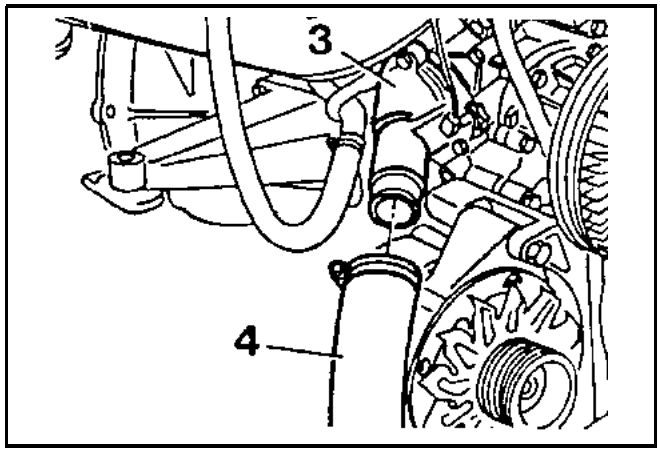
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THERMOSTAT



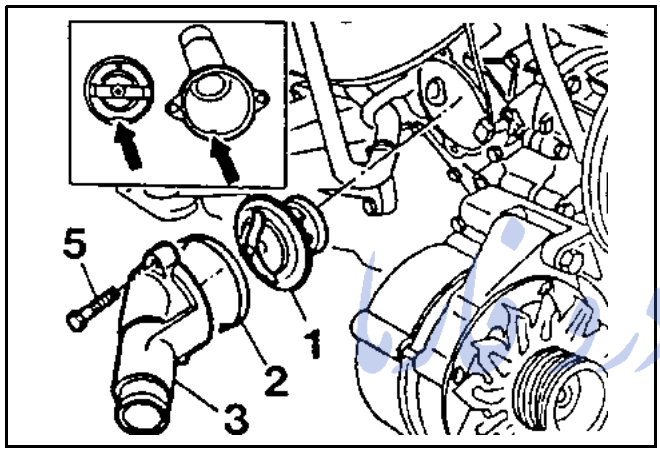
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1 Thermostat
2 Seal . . . . . Replace
3 Thermostat Housing Cover
4 Coolant Hose
5 Bolt . . . . . 10N·m (89 lb-in)



Removal & Installation Procedure

1. Drain the coolant completely.
2. Disconnect the coolant hose(4) from the thermostat housing cover(3).



3. Remove the bolts(5) and then remove the thermostat(1) and housing cover(3)

   Installation Notice

   Align the groove on thermostat and the housing cover rib(arrow).

Tightening Torque	10 N·m (89 lb-in)

   Notice

   Replace the seal(2).
4. Installation should follow the removal procedure in the reverse order.

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SECTION 1E3

OM600 ENGINE ELECTRICAL

Caution: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

Specifications 1E3-1
General Specifications 1E3-1
Maintenance and Repair 1E3-2
On-Vehicle Service 1E3-2
Glow Plug 1E3-2
Generator 1E3-6
Starter Motor 1E3-8

SPECIFICATIONS

GENERAL SPECIFICATIONS

Application	Description
Generator	12V - 75A
Starter	12V - 2.2kW
Glow Plug	11.5V

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SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Engine Assembly

Application	N•m	Lb-Ft	Lb-In
Skid Plate Bolt	28 - 47	21 -35	-
Drain Plug Bolt	30	22	-
Coolong Fan Shroud Bolt	3 - 7	-	27 - 62
Control Linkage Nut	8 - 18	6 - 13	-
Clutch Linkage Cylinder Nut	20 - 34	15 - 25	-
Exhaust Manifold Bolt	30	22	-
Propeller Shaft Bolt & Nut (Axle)	70 - 80	52 - 59	-
Propeller Shaft Bolt & Nut (T/C)	81 - 89	60 - 66	-
Engine Mounting Nut	50 - 75	37 - 55	-

Crankshaft Assembly

Application	N•m	Lb-Ft	Lb-In
Cooling Fan Belt Pulley Bolt	10	-	89
Socket Bolt	23	17	-
Tighten The Bolt	200 / 90°	148 / 90°	-
End Cover Bolt	10	-	89
Crankshaft Bearing Cap Bolt	55 / 90°	41 / 90°	-
Ball Bearing	45 / 90°	33 / 90°	-
Camshaft Sprocket Bolt	25 / 90°	18 / 90°	-
Oil Pump Sprocket Bolt	25	18	-

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Piston

Application	N•m	Lb-Ft	Lb-In
Connecting Rod Bolt	35 / 90°	26 / 90°	-

Flywheel

Application	N•m	Lb-Ft	Lb-In
12-Sided Stretch Bolt	45 / 90°	33 / 90°	-

Cylinder Head

Application	N•m	Lb-Ft	Lb-In
Prechamber Threaded Ring	130	96	-
Cylinder Head Cover Bolt	10	-	89
Fuel Injsction Pipe Nut	18	13	-
Socket Bolt	25	18	-
Fuel Filter Pipe Bolt	25	18	-
Idle Pulley Bolt	23	17	-
Damper Bolt	21	15	-
Camshaft Bearing Cap Bolt	25	18	-
Camshaft Sprocket Bolt	25 / 90°	18 / 90°	-
Exhaust Pipe Bolt& Nut	25	18	-
Chain Tensioner	80	59	-
Injection Nozzle	40	30	-
Intake Manifold Not	25	18	-
Injection Nozzle Pipe Not	18	13	-
Oil Dipstick Tube Bolt	10	-	89
Screw Plug M18 x 15	50	37	-

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Cam Support & Shaft

Application	N•m	Lb-Ft	Lb-In
Stud Bolt	12	-	106
Exhaust Manifold Not	25	18	-
CamShaft Bearing Cap Bolt	25	18	-
12-Sided Bolt (M11)	25 / 90°	18 / 90°	-

۰۲۱-۸۸۴۲۰۸۵ تلفن شبانه روزی
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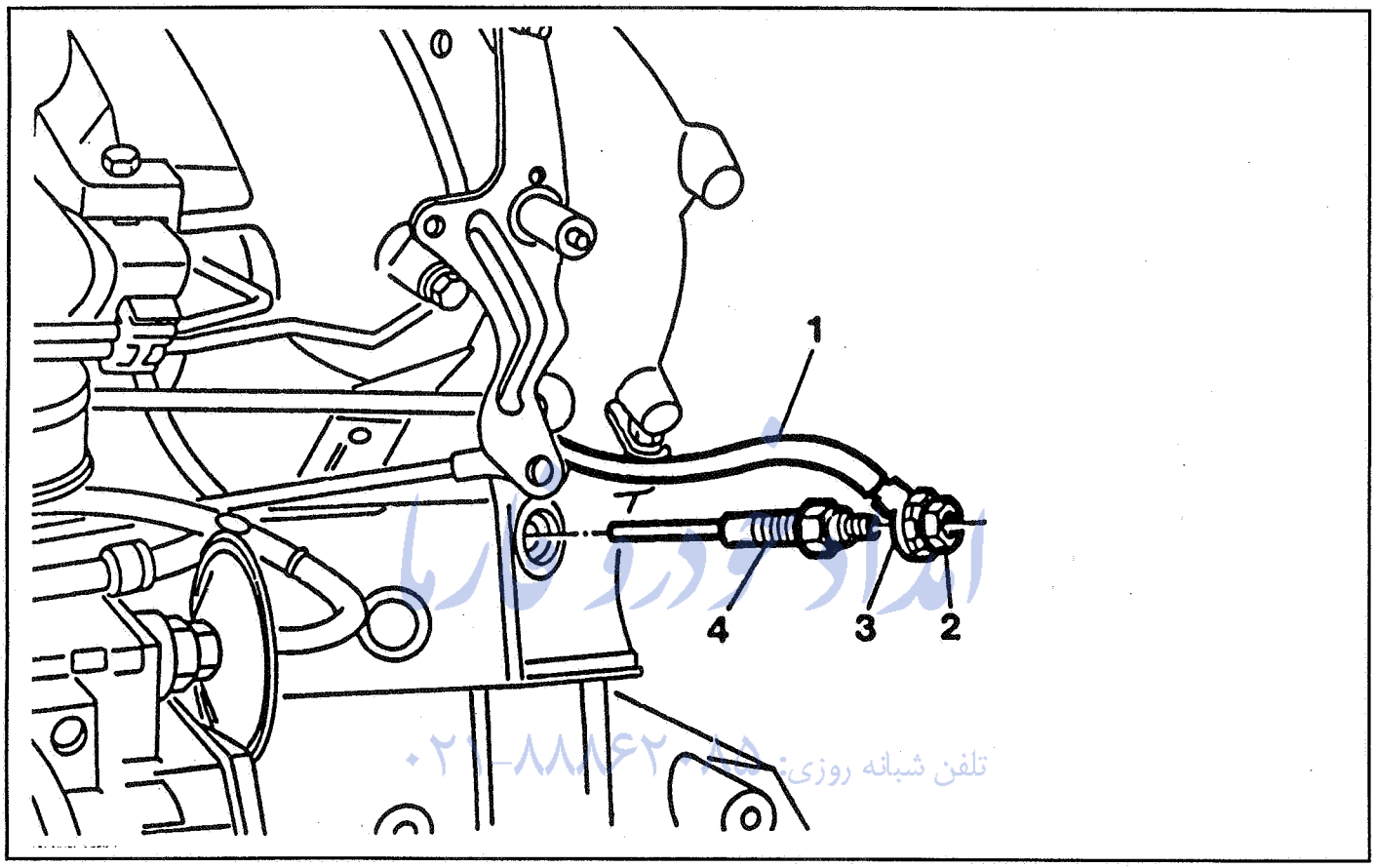
Timing Cover

Application	N•m	Lb-Ft	Lb-In
Oil Pan Bolt-Socket Bolt	10	-	89
Oil Pan Bolt-M6	10	-	89
Oil Pan Bolt-M23	23	17	-
Belt Pulley Bolt	32	24	-
Guide Pulley Bolt	4	-	35
Guide Pulley Bracket Nut	23	17	-
Chain Tensioner	80	59	-
Tesioning Lever Bolt	23	17	-

MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

GLOW PLUG



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1 Wiring Harness
2 Nut ..... 4 Nm
3 Wire Terminal
4 Glow Plug

Preheating System

General information

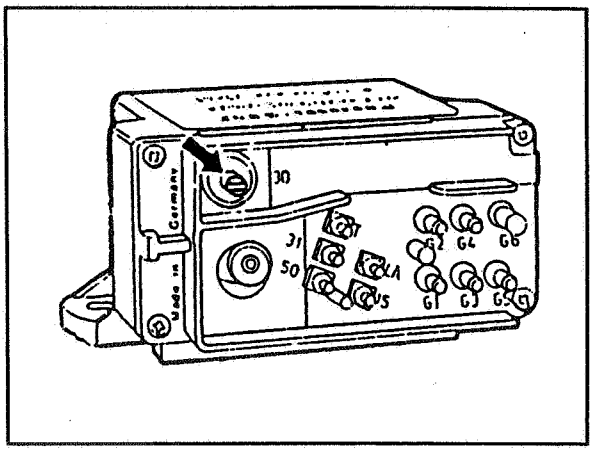
The preheating system consists of control, coolant temperature sensor and glow plugs.

- Control relay - preheating time.
- Coolant temperature sensor.
- Glow plug.

1. Preheating time - control relay.

   Control relay functions as followings :

   - Switching of preheating current.
   - Indication of preheating finish.
   - Control of preheating sequence.
   - Indication of fault.



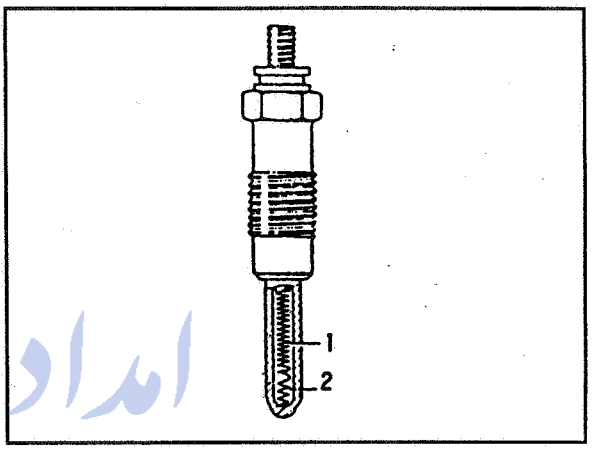
2. Coolant temperature sensor.

   Coolant temperature sensor senses coolant's temperature and signals it to the preheating relay continuously.

3. Glow plug

   The glow plug parts are housing with M12 ´ 1.25 thread and heating pin in housing. It is connected in a parallel circuit with the specified voltage of 11.5V.

   The heating element has a heating coil and a control coil and they are connected in series.



1. Control Coil
2. Heater Coil

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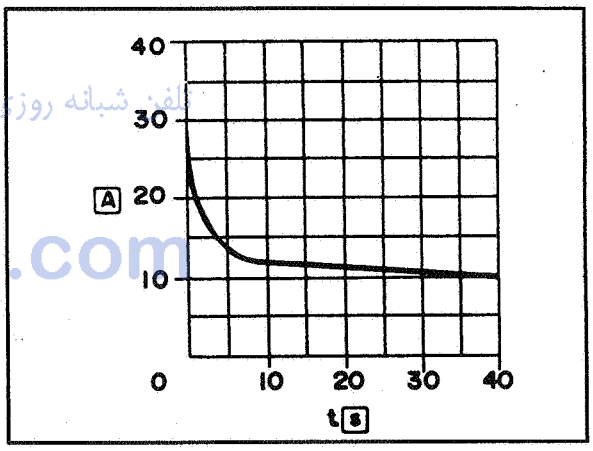
4. Current and temperature of glow plug

   - Current of glow plug

     While the preheating system operates, current of about 30A flows in each glow plug and temperature of heating coil rises very fast.

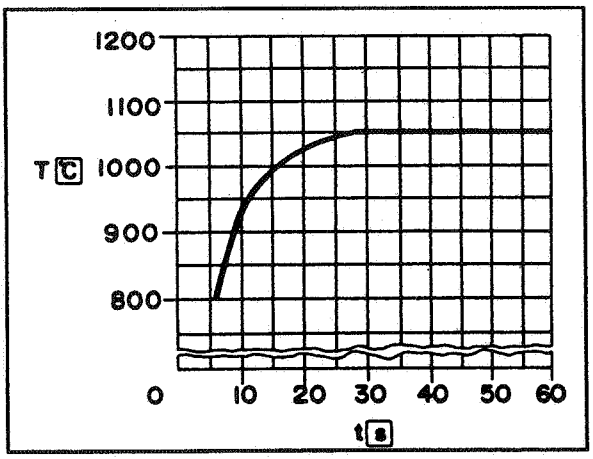
     Due to the rise of temperature, the resistance of control coil increases therefore the current is controlled to about 8~15A and that protects the glow plug from over-heating.

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   - Temperature of glow plug

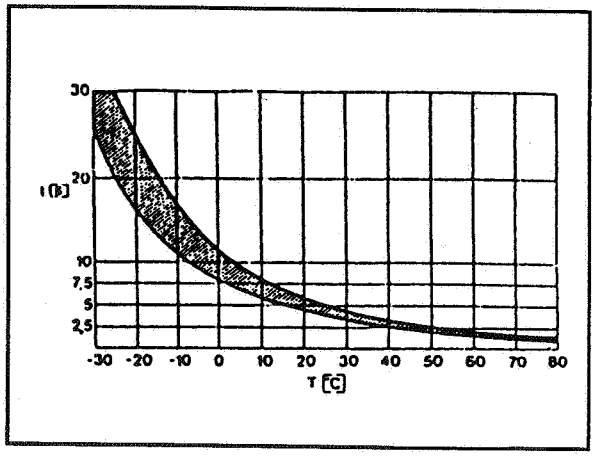
     The temperature of the glow plug reaches up to 900°C after about 9 seconds and up to 1,050°C after 30 seconds.



Preheating System Operation

1. Preheating before start.

   Preheating time is different by coolant temperature and it is on until the glow indicator light goes off.



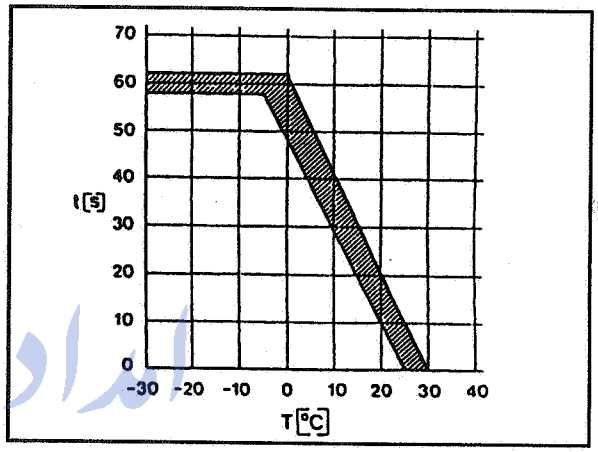
2. Preheating after start.

   Preheating continues for max. 60 seconds to rise in characteristic of warming-up on engine after starting too.

3. Monitoring on glow plug.

   Glow plugs are monitored by low current by the micro processor in control relay respectively while running the engine.

   If glow indicator comes on after starting for about one minute, it indicates on or several plugs are faulty.

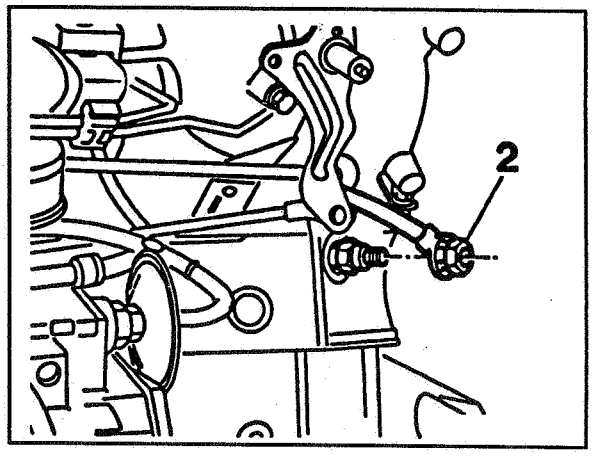


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	Problem	Possible Cause
1	Glow indicator does not come on in preheating time and comes on after starting the engine.	- One or several glow are faulty
2	Glow indicator does not come on while preheating and after starting engine.	- Faulty glow indicator - Faulty circuit of glow indicator - Faulty control relay
3	Glow indicator does not come on and engine's starting is difficult or does not start at all.	- Circuits short in one or several glow plugs - Faulty preheating circuits - Faulty control relay
4	Glow indicator comes on after starting for about one minute.	- One or several glow plugs are faulty

Removal & Installation Procedure

1. Disconnect the negative terminal of battery.
2. Remove the nut (2).

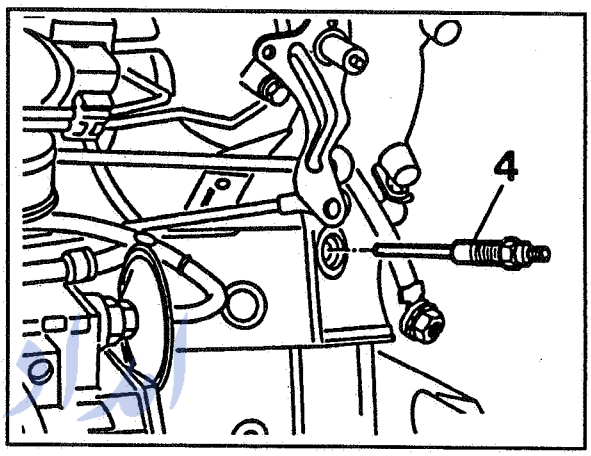


3. Remove the glow plug (4).
4. Install the glow plug (4).

Tightening Torque	20 Nm

5. Tighten the nut (2).

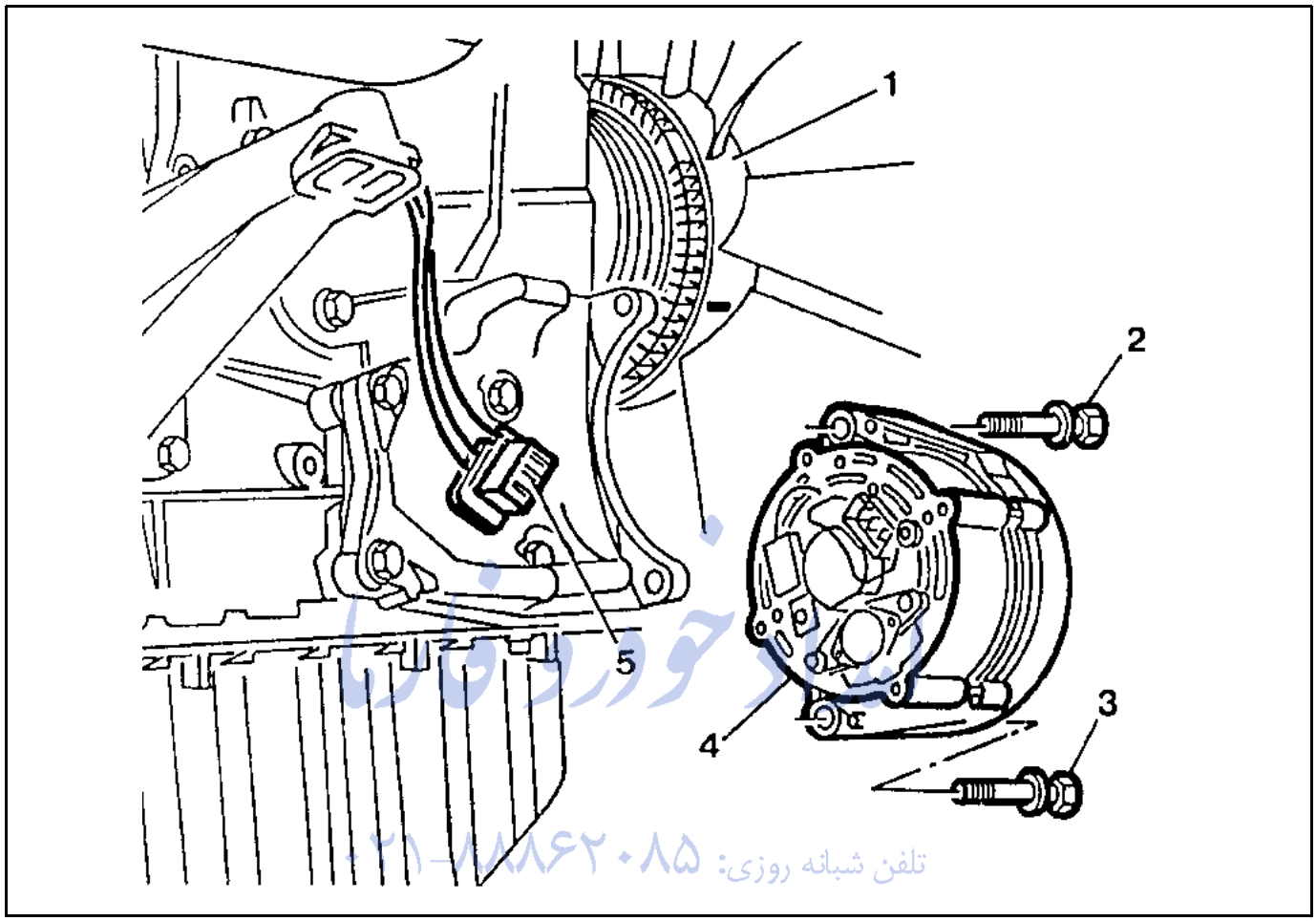
Tightening Torque	4 Nm



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GENERATOR

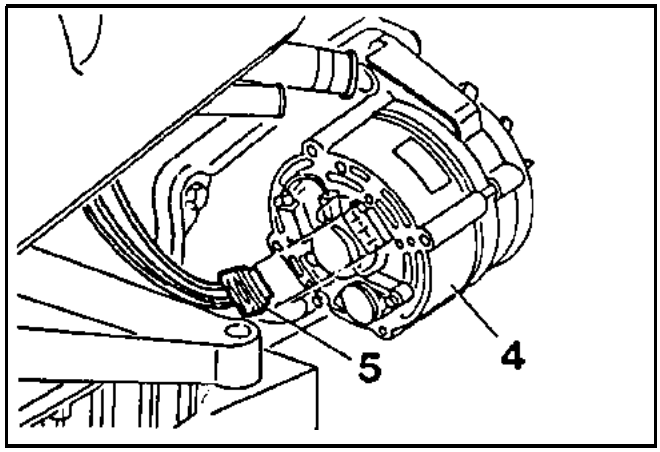
Preceding Work : Removal of poly V-belt



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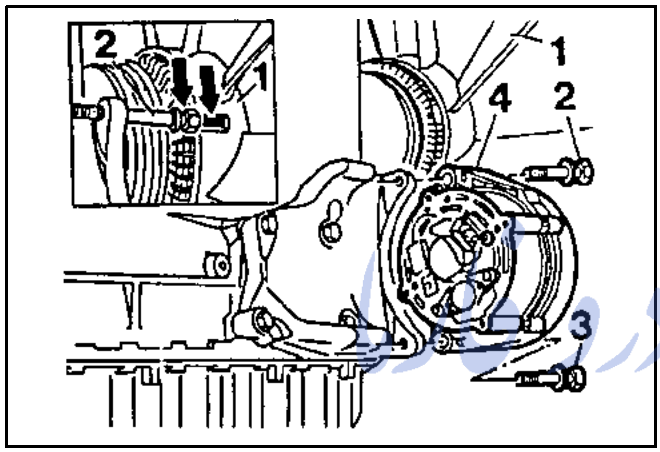
1 Cooling Fan
2 Bolt . . . . . 45 N·m (33 lb-ft)
3 Bolt . . . . . 45 N·m (33 lb-ft)
4 Generator
5 Plug Connection

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Removal & Installation Procedure

1. Disconnect the negative terminal of the battery.
2. Disconnect the plug connection (5).



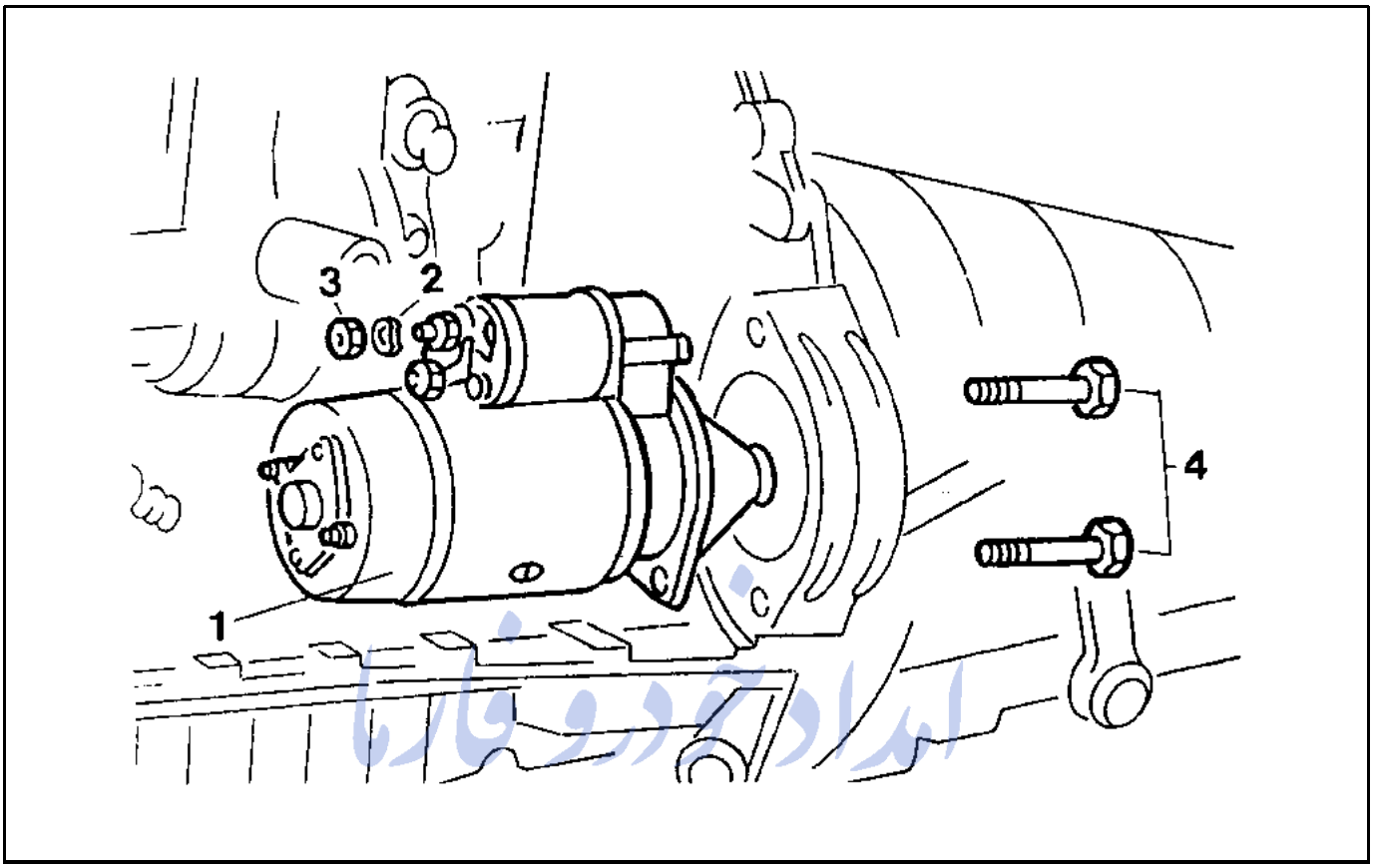
3. OM 662 Engine
   Align the groove of cooling fan with bolt (2) (arrow).
4. Remove the bolts (2, 3) and take out the alternator.

Tightening Torque	45 N·m (33 lb-ft)

5. Installation should follow the removal procedure in the reverse order.

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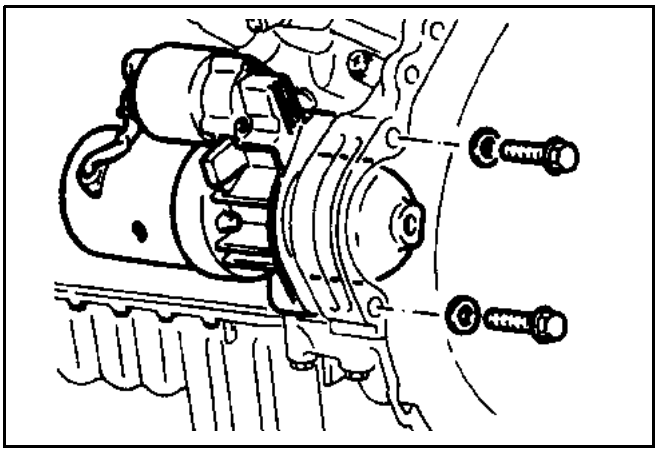
STARTER MOTOR



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1	Starter Motor	3 Nut	15 N·m (11 lb-ft)
2	Washer	4 Bolt	48 N·m (35 lb-ft)

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Removal & Installation Procedure

1. Disconnect the battery terminals.
2. Disconnect the starter motor cable harnesses.
3. Remove the bolts and then remove the starter motor.
4. Installation should follow the removal procedure in the reverse order.

SECTION 1F3

OM600 ENGINE CONTROLS

Caution: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

Specifications 1F3-1
Fastener Tightening Specifications 1F3-1
Maintenance and Repair 1F3-2
On-Vehicle Service 1F3-2
Fuel System 1F3-2
Fuel Injection Pump Coding 1F3-3
Fuel Tank 1F3-4
Vacuum Control System Test 1F3-5
Vacuum Pump Test 1F3-10
Vacuum Pump 1F3-12
Vacuum Unit Replacement 1F3-14
Idle Speed Adjustment 1F3-15
Fuel Pump Test 1F3-17
Fuel Pump 1F3-20
Injection Nozzle Test 1F3-21
Injection Nozzles 1F3-24
Injection Nozzle Repair 1F3-26
Removal and Installation of Injection Timing Device 1F3-29
Injection Timing Device 1F3-34
Start of Delivery Test (Position Sensor, RIV Method) 1F3-36
Fuel Injection Pump 1F3-45

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SPECIFICATIONS

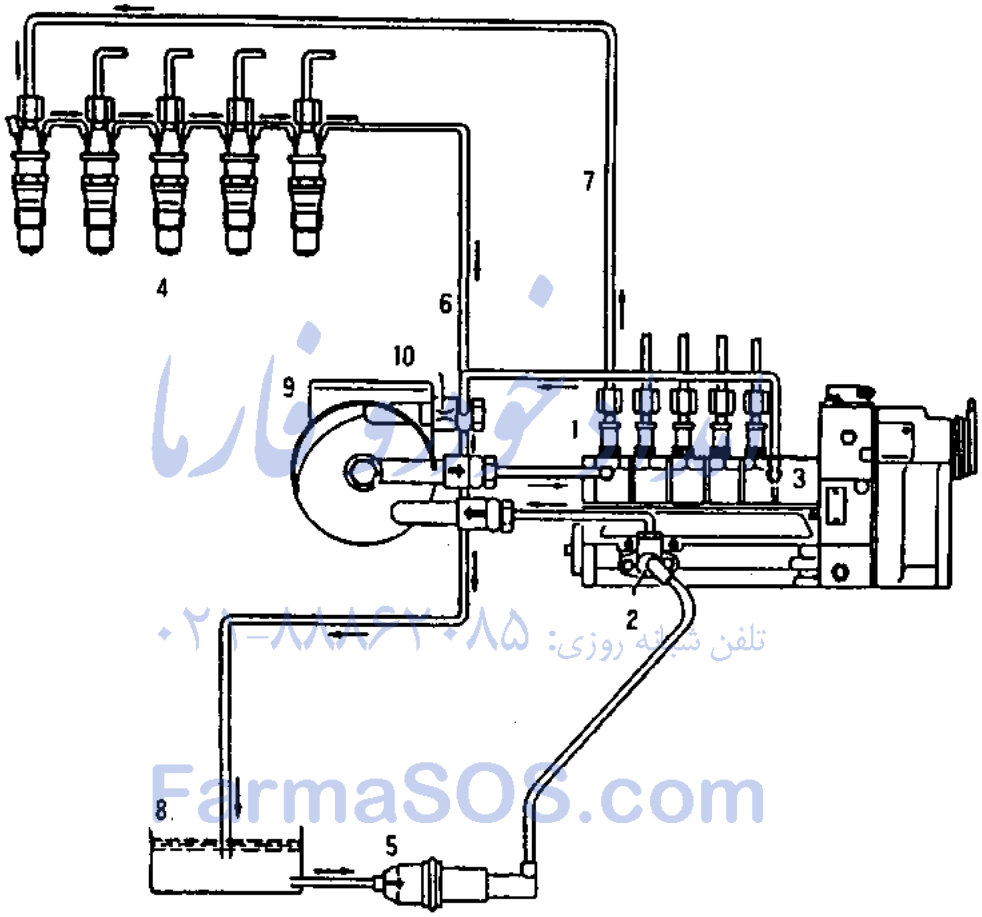
FASTENER TIGHTENING SPECIFICATIONS

Application	N·m	Lb-Ft	Lb-In
Fuel Tank Mounting Nut	28 - 47	21 - 35	-
Fuel Pump Pressure Line	13	10	-
Fuel Injection Nozzle	35 - 40	26 - 30	-
Fuel Injection Pipe	18	13	-
Nozzle Tensioning Nut	80	59	-
Screw Plug	30	22	-
Left-Hand Thread Bolt	46	34	-

MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

FUEL SYSTEM



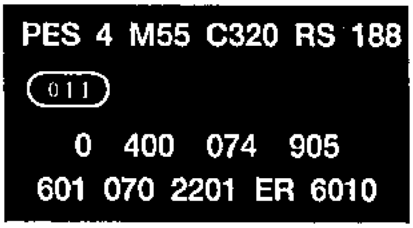
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1 Fuel Injection Pump
2 Fuel Feed Pump
3 Overflow Valve
4 Injection Nozzle
5 Pre-filter
6 Fuel Retrun Hose
7 Injection Line
8 Fuel Tank
9 Fuel Filter
10 Choke Orifice

FUEL INJECTION PUMP CODING

Model Code

OM661 LA Engine	PES 4M 55C 320 RS 167
OM662 LA Engine	PES 5M 55C 320 RS 168



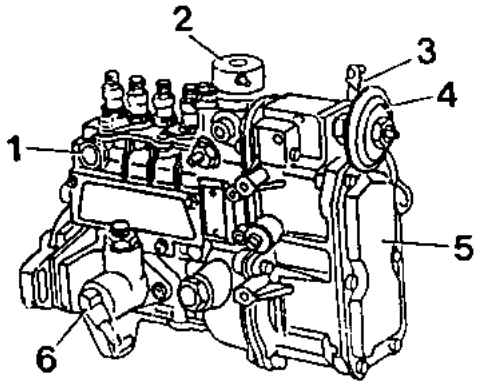
Fuel Injection Pump Code

Example) PES 5M 55C 320 RS 168

P	Pump
E	Self-Driven
S	End Flange Mounting
5	Number of Cylinders (5EA)
M	Pump Size
55	Element Diameter
C	Modification Letter
320	Assembly Number
R	Direction of Rotation (clockwise)
S188	Special Version

RSF	**Governor**
R	Governor
S	Coil Spring
F	Drive Governor

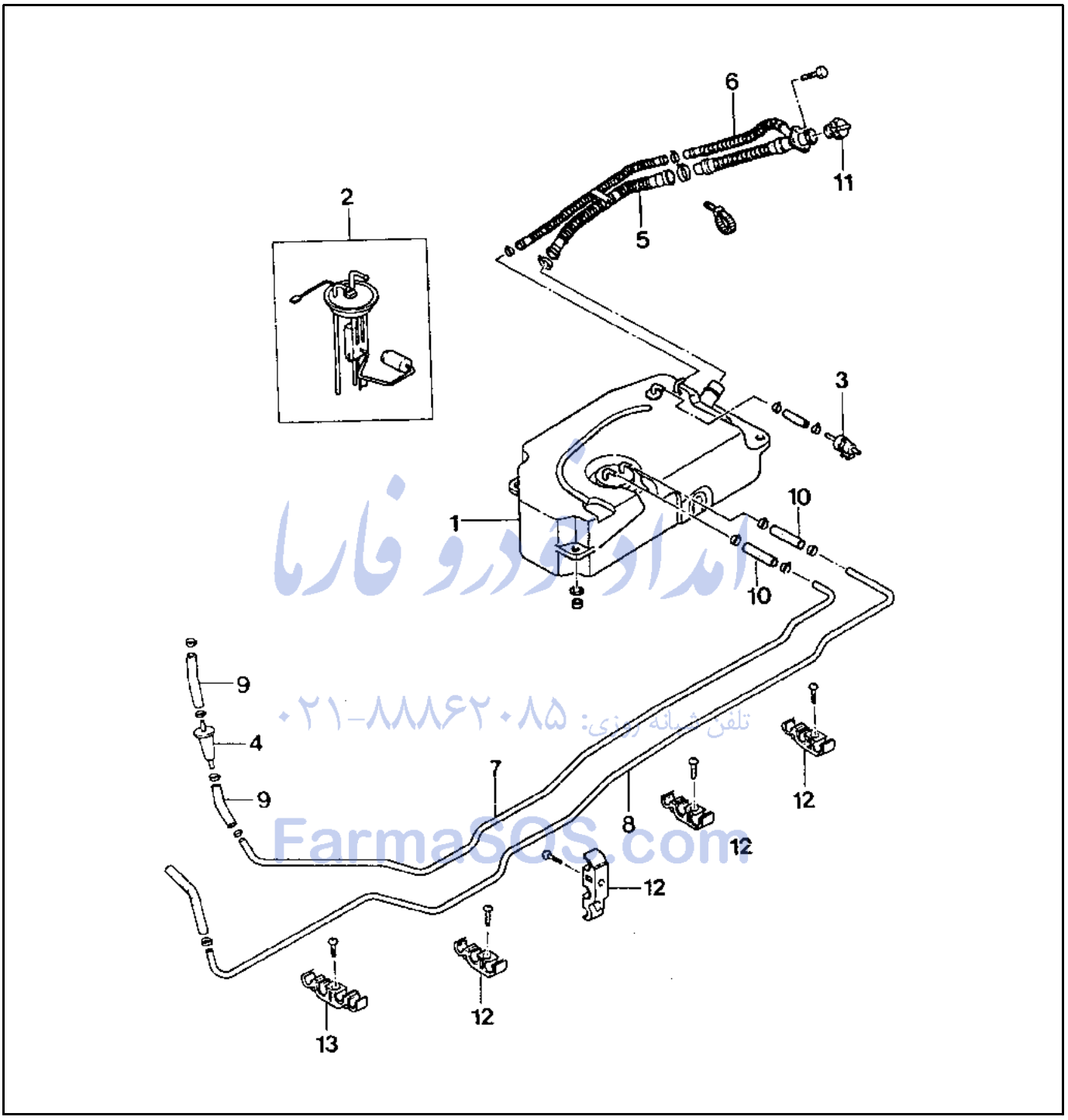
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Component Location

1. Fuel Injection Pump
2. Vacuum Unit (Stop Unit)
3. Control Lever
4. PLA Vacuum Unit (Idle Speed Adjustment)
5. Governor
6. Fuel Pump

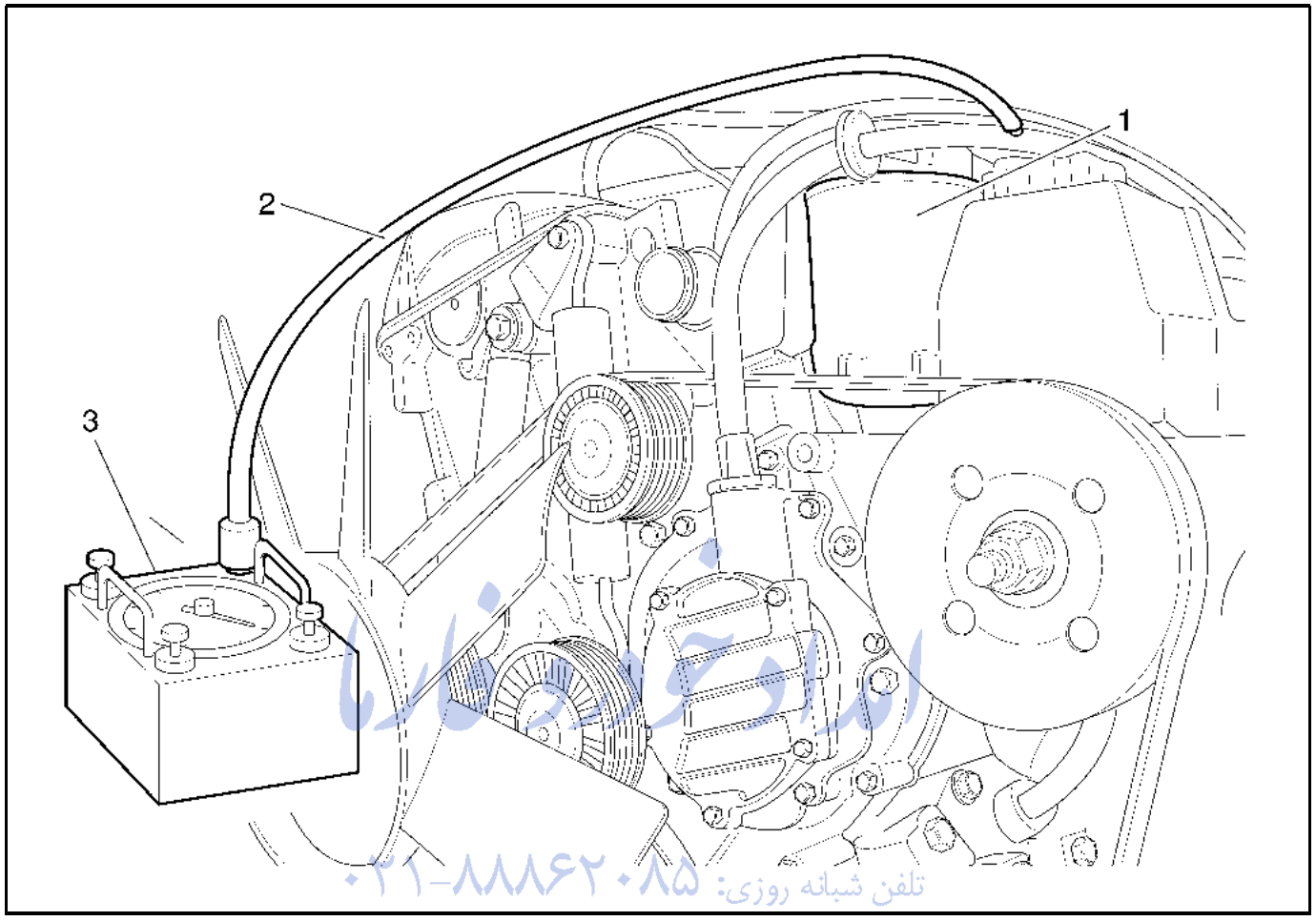
FUEL TANK



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۰۲۱-۸۸۸۶۲۰۸۵ تلفن شبانه روزی:
FarmaSOS.com

1 Fuel Tank
2 The Sender of Fuel Tank
3 2-way Check Valve
4 Pre Filter
5 Front Fuel Filler Neck
6 Rear Fuel Filler Neck
7 Fuel Supply Tube
8 Fuel Return Tube
9 Filter Hose
10 Fuel Tank Hose
11 Fuel Filler Cap
12 Clip
13 Clip

VACUUM PUMP TEST

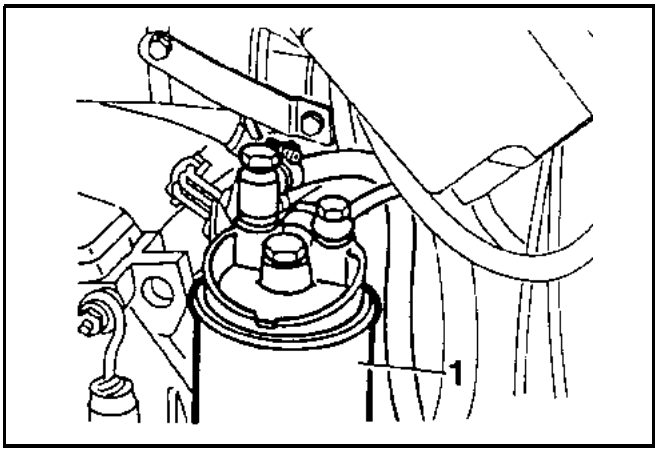


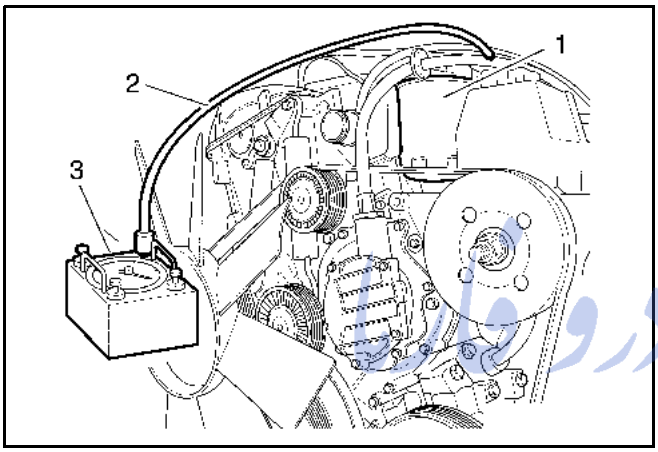
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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1 Fuel Filter
2 Ancillaries Connection
3 Vacuum Tester

Tools Required

201 589 13 21 00 Vacuum Tester





Test Procedure

1. Remove the fuel filter (1) and keep the filter not to be damaged from running engine.
2. Remove the vacuum line from ancillaries connection (2).
3. Connect the vacuum tester (3) to the ancillaries connection (2).

Vacuum Tester 201 589 13 21 00

4. Run the engine at idle and check vacuum pressure after 30 sec.

Standard	> 70 mbar

Notice

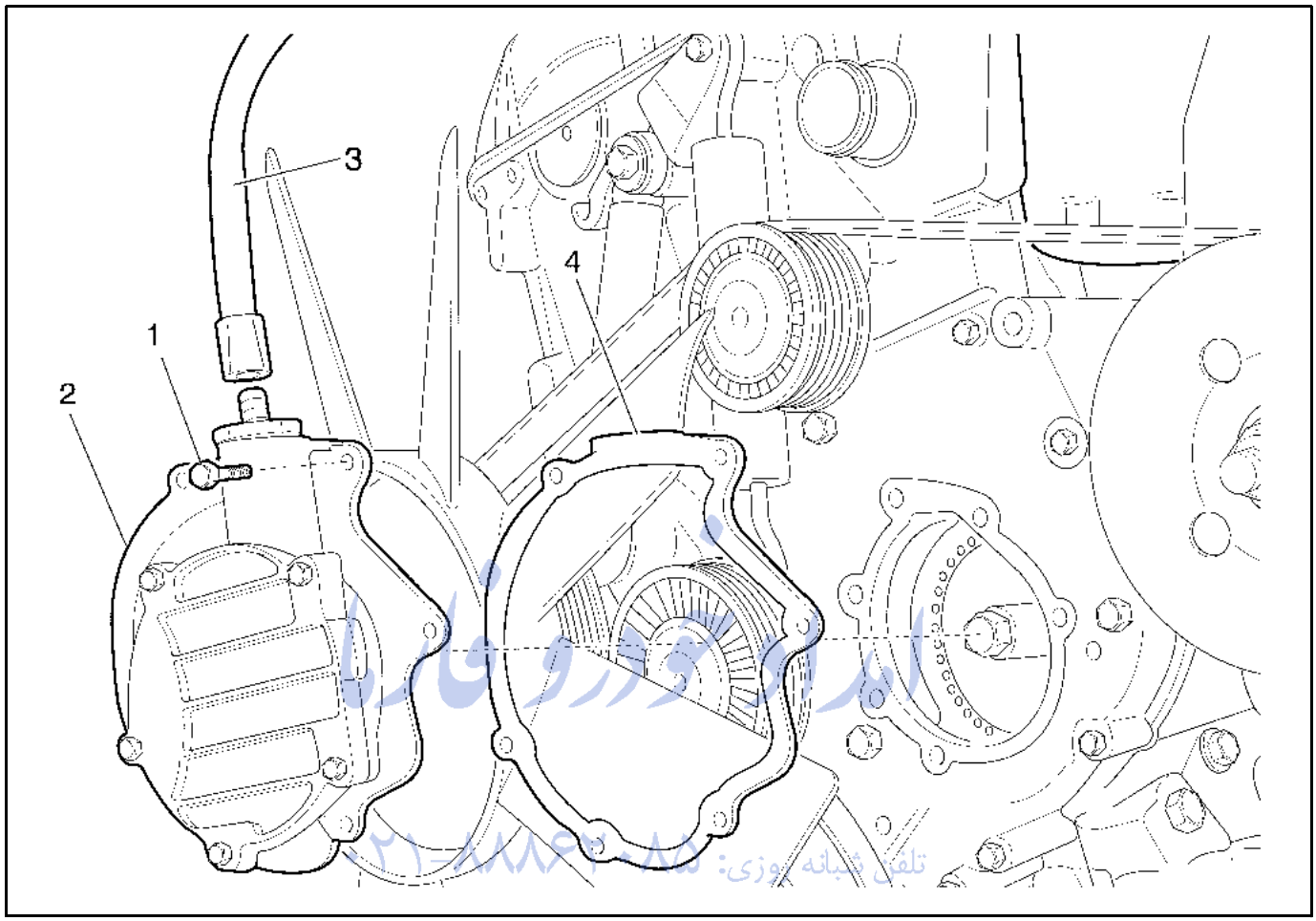
If out of standard, replace the vacuum pump.

5. Remove the vacuum tester.
6. Connect the vacuum line to the ancillaries connection.
7. Install the fuel filter.

۰۲۱-۸۸۸۶۲۰۸۵
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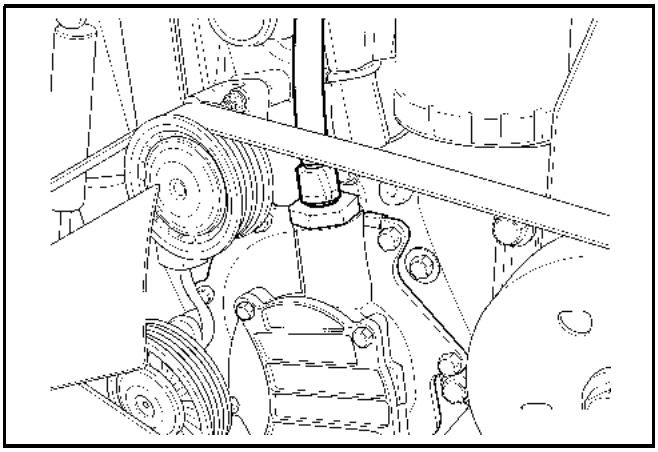
VACUUM PUMP

Preceding Work : Remove the poly V-belt



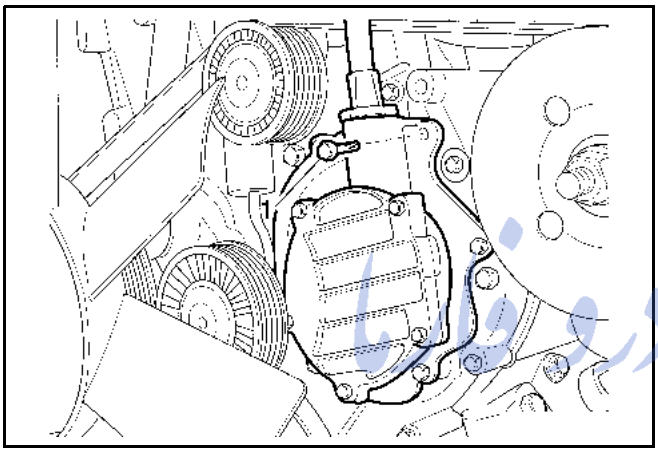
1 Bolt ..... 10N·m (89 lb-in)
2 Vacuum Pump
3 Vacuum Line
4 Gasket ..... Replace

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Removal & Installation Procedure

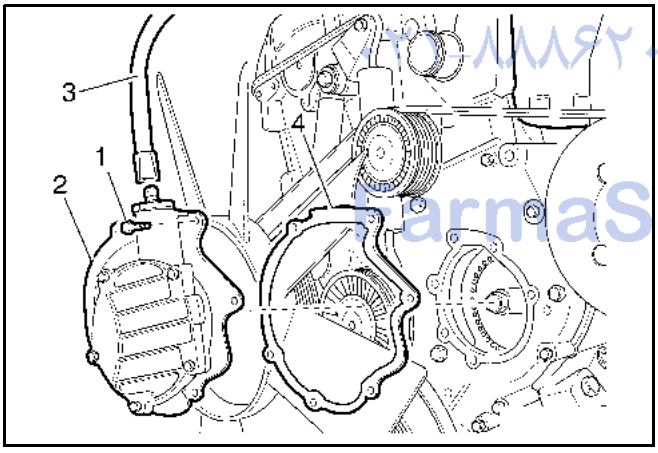
1. Remove the vacuum line.



2. Remove the bolts (1) evenly.

Notice

If necessary, rotate the engine until the pressure on the tappet of the vacuum pump is released.



3. Remove the vacuum pump (2).
4. Install the vacuum pump (2).

Tightening Torque	10 N·m (89 lb-in)

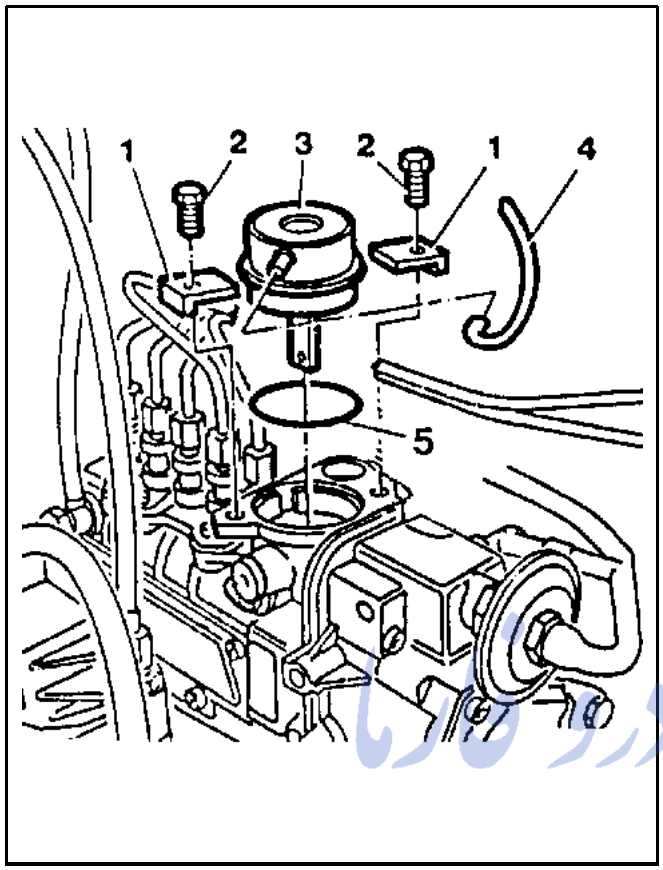
Notice

Clean the gasket residues of sealing surface of vacuum pump and replace the gasket(4).

5. Connect the vacuum line.

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VACUUM UNIT REPLACEMENT



1 Bracket
2 Bolt
3 Vacuum Unit
4 Vacuum Line
5 Seal . . . . . Replace

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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IDLE SPEED ADJUSTMENT

Service Data

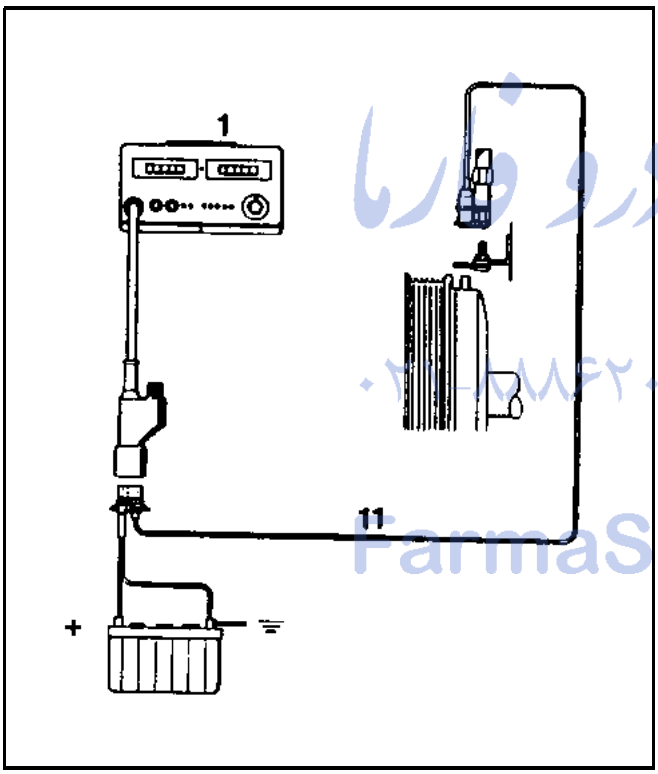
Engine	Idle Speed
OM661LA Engine	750 - 850 rpm
OM662LA Engine	720 - 820 rpm

Tools Required

667 589 00 21 00 TDC Pulse Generato

Commercial Tool

Digital Tester	e.g. Bosch, MOT 001.03
	Sun, DIT 9000

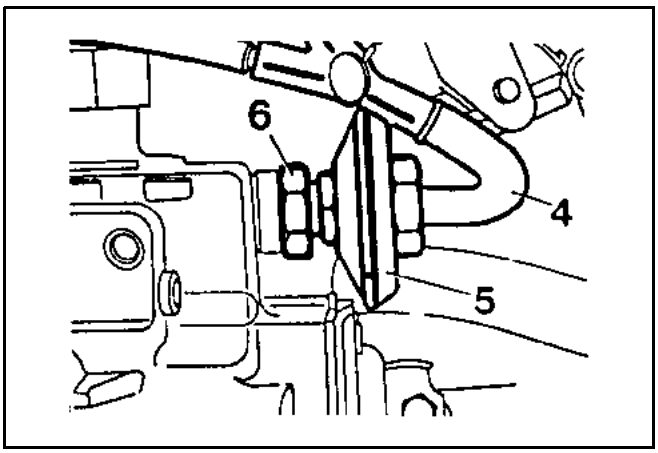


Adjustment Procedure

1. Connect the digital tester (1) and TDC pulse sender unit (11).
2. Run the engine and warm up the coolant to 60~80°C.

TDC pulse generator 667 589 02 21 00

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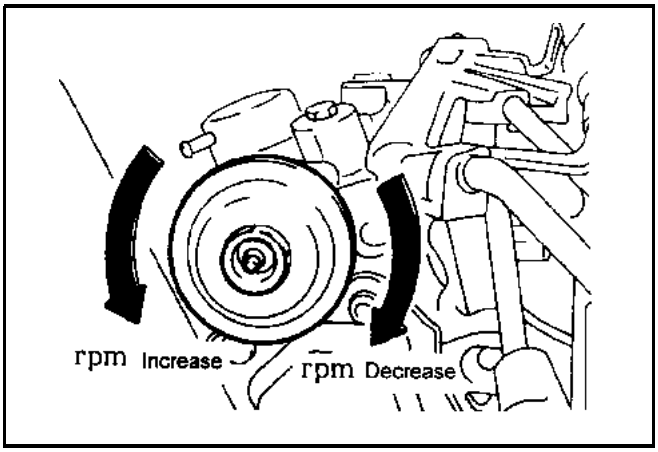


3. Disconnect the vacuum hose (4) from the PLA unit to check idle speed with tester.
4. Check idle speed with tester.

OM 661LA Engine	750 - 850rpm
OM 662LA Engine	720 - 820rpm

Notice

To adjust idle speed, loosen the locking nut (6) of PLA unit.

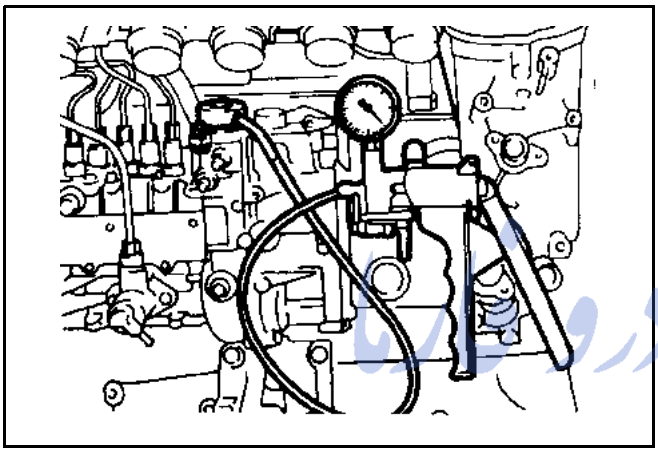


5. Ensure not to damage the idle spring in the governor and adjust idle speed by turning the PLA unit (5) slowly.

Clockwise	RPM Decrease
Counterclockwise	RPM Increase

Notice

Do not rotate the PLA unit over 1/2 turn from the position marking. If do, idle spring in the governor will be severely damaged.



6. After adjustment, tighten the locking nut and place the position marking with different color of paint.

Notice

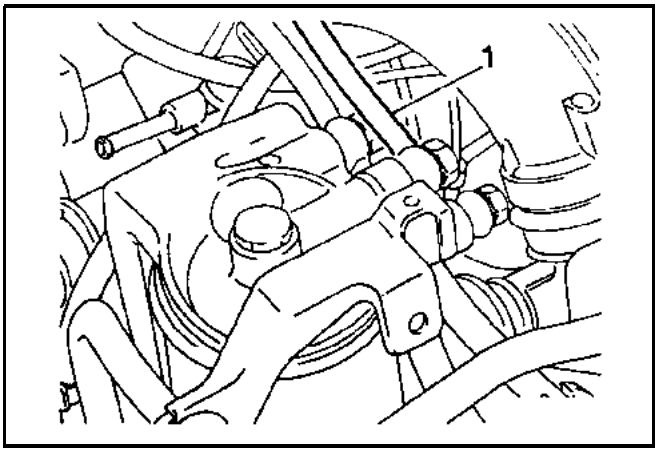
If there are no changes in idle speed with PLA unit adjustment, perform the service at a BOSCH Service Center.

7. Connect the vacuum pump to the PLA vacuum unit and build up vacuum approx. 500mbar. If engine rpm increases by approx. 100rpm, It is normal.

Vacuum Pump 001 589 73 21 00

8. Connect the vacuum line (4).
9. Switch on all ancillaries and check the idle speed.

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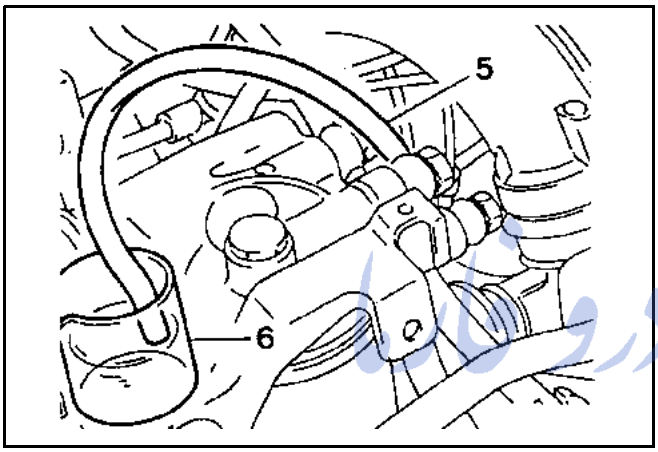
FUEL PUMP TEST

Notice

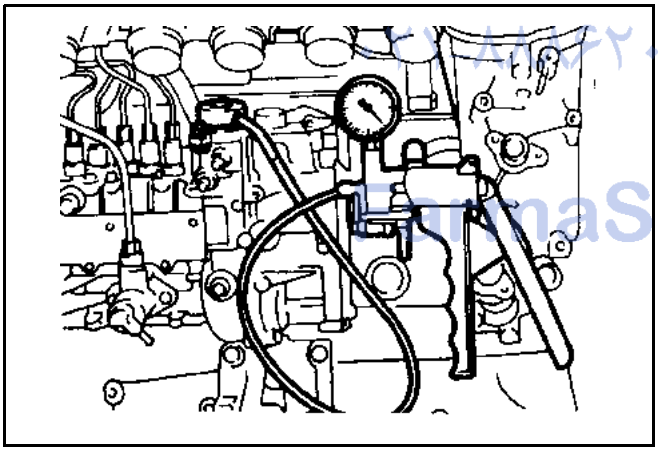
Before test, replace the fuel filter cartridge and fuel pre-filter.

Fuel Feed Test

1. Disconnect the fuel return line (1) and seal up it with plug.



2. Insert the plastic hose (5) and put the end into the measuring beaker (6).

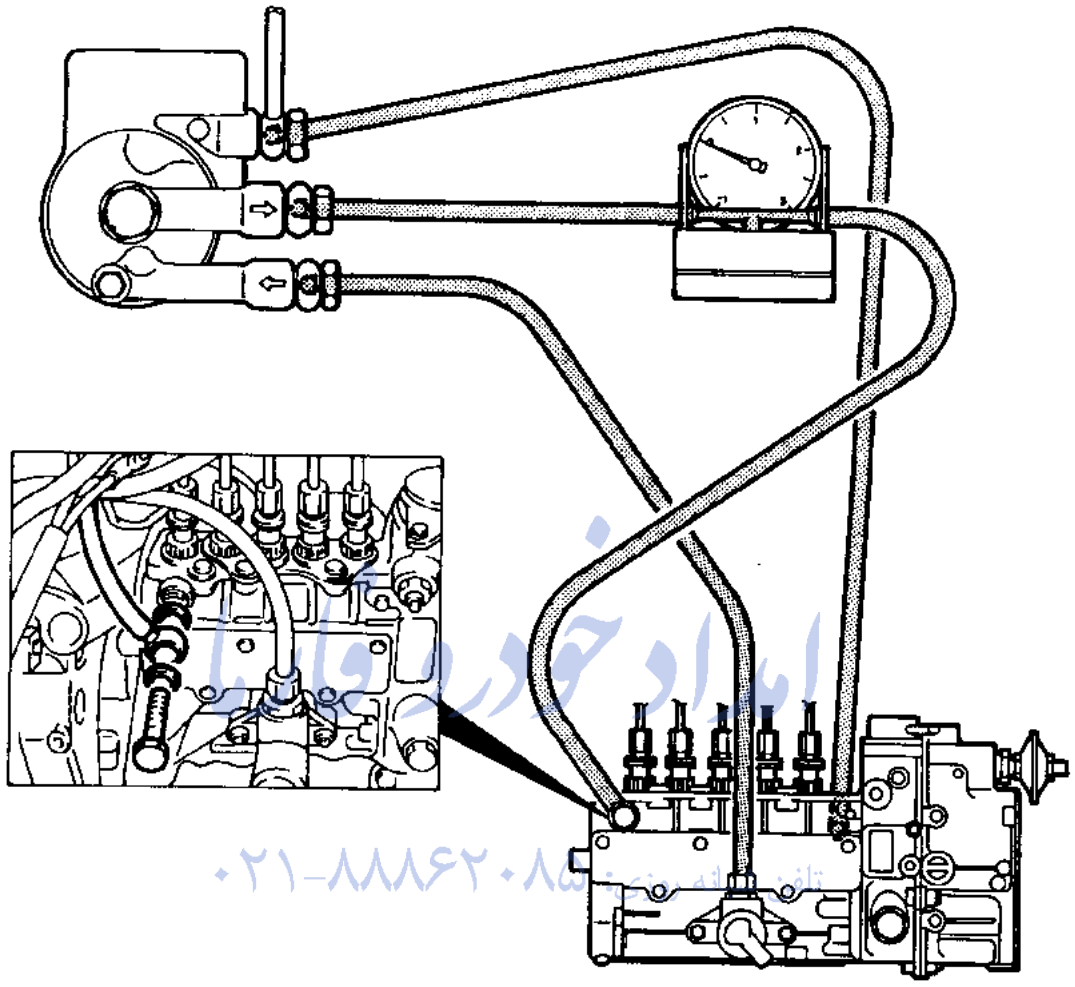


3. Disconnect the vacuum line (4) from vacuum unit (engine stop) (5) and connect the vacuum pump (7) to the vacuum unit.
4. To avoid the engine starting, build up vacuum (approx. 500 mbar).
5. Operate the starter motor for exactly 30 seconds and measure fuel volume in the beaker.

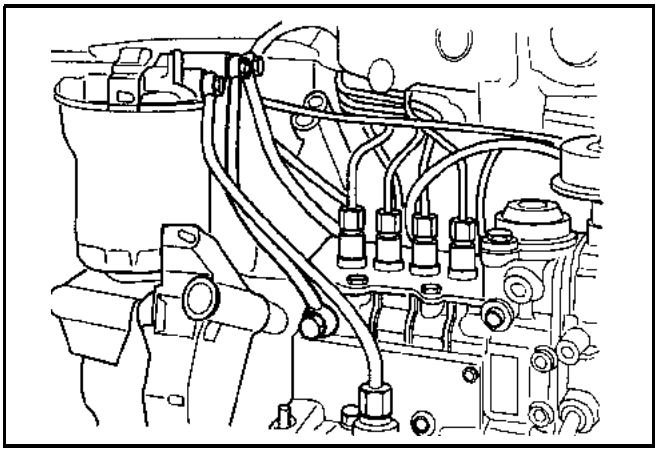
Min. volume	150cm^3 for 30 seconds

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SamaSOS.com

Fuel Pressure Test



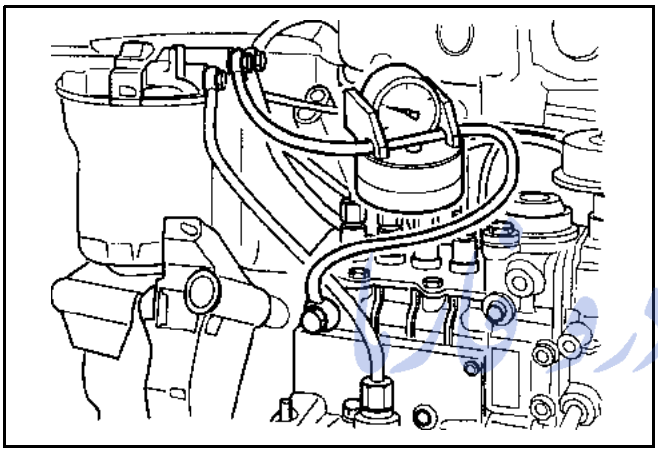
۰۲۱-۸۸۸۶۲۰۸۵
FarmaSOS.com



Tools Required

617 589 04 21 00 Tester

1. Disconnect the fuel line (2) from the fuel filter.
2. Remove the banjo bolt (4) from the fuel injection pump and remove the seals (3) and fuel line (2).
3. Connect the tester (5).



4. Start the engine and read off the fuel pressure on tester (5).

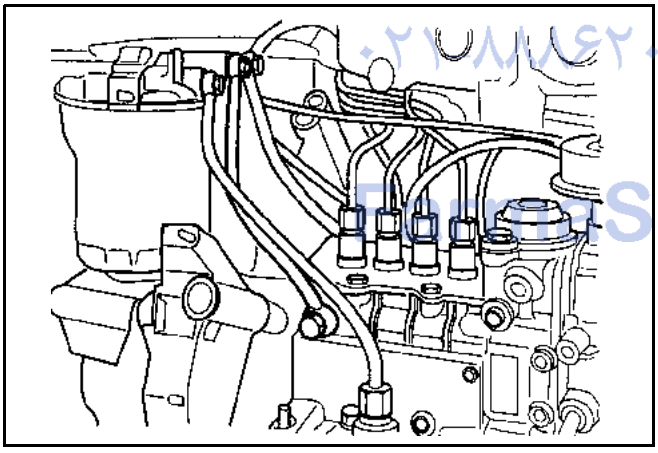
Notice

At Idle Speed	> 0.3bar
At Full load	> 0.5bar

If out of standard, replace the fuel feed pump.

Tester 617 589 04 21 00

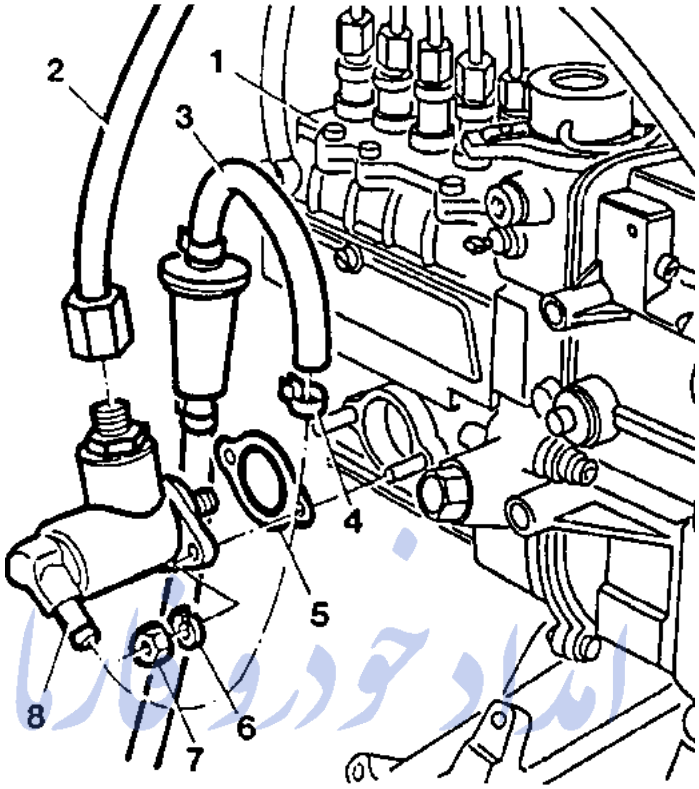
5. Stop the engine.



6. Remove the tester.
7. Replace the seal and connect the fuel line (2).

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PeugeotSOS.com

FUEL PUMP

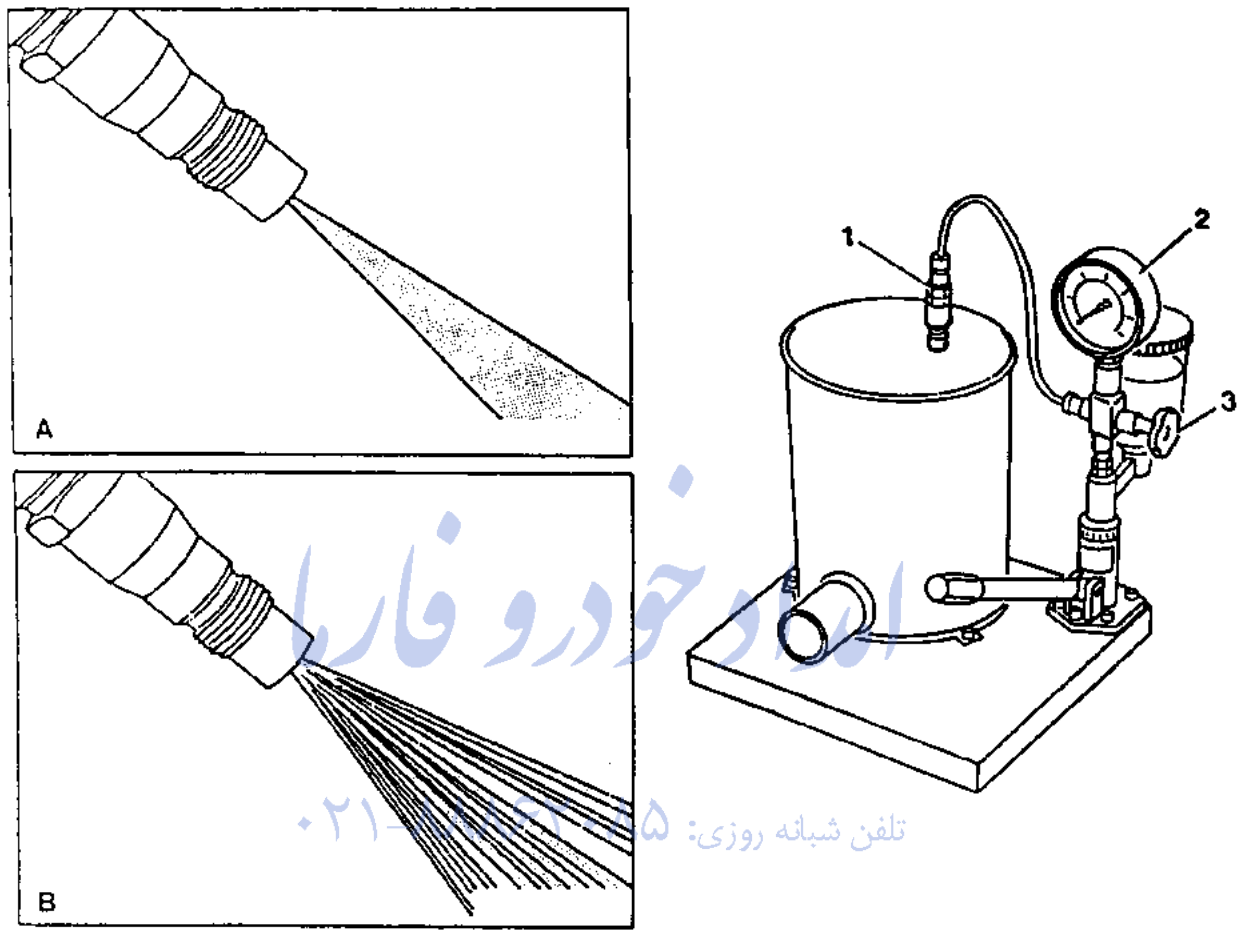


1 Fuel Injection Pump
2 Pressure Line . . . . . 13N·m (10 lb-ft)
3 Suction Line
4 Hose Clip . . . . . Replace
5 Gasket . . . . . Replace
6 Spring Lock Washer
7 Hexagon Nuts
8 Fuel Pump

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۰۲۱-۸۸۸۶۲۰۸۵ تلفن شبانه روزی
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INJECTION NOZZLE TEST

Preceding Work : Removal of fuel injection nozzle

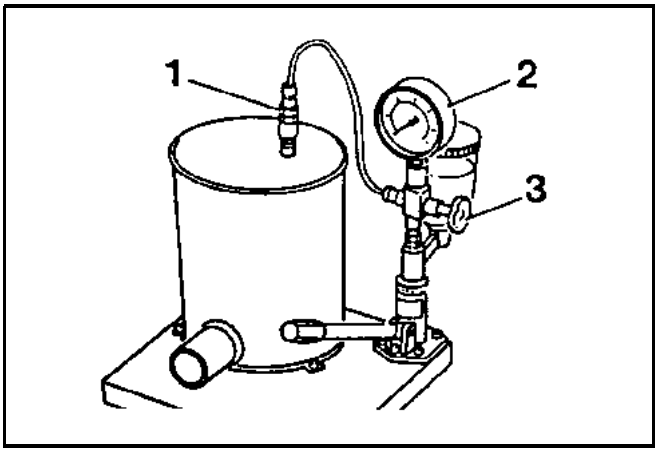


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1 Fuel Injection Nozzle .... New : 115-125 bar
Used : min. 100bar

2 Tester
3 Valve

A Closed Spray = good
B Stringy Spray = poor



Tools Required

000 589 14 27 00 Tester

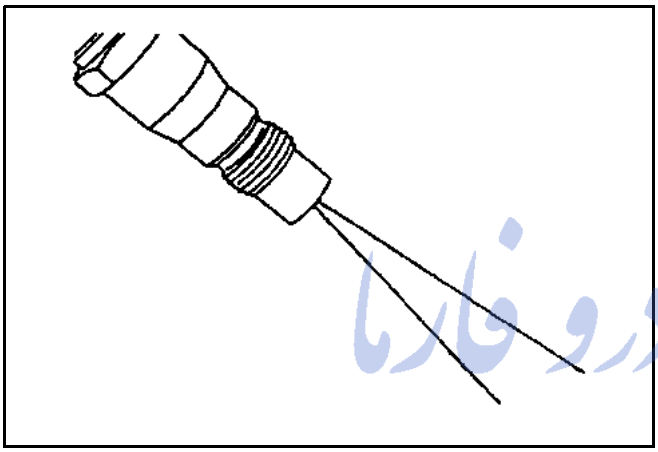
Notice

When testing the injection nozzle, do not place your hand into the spray of a nozzle. The spray will penetrate deep into the skin and destroy the tissue.

1. Connect the fuel injection nozzle to the tester (2).

Tester 000 589 14 27 00

2. Close the valve (3) and pump 5 times strongly.



3. Chatter test :

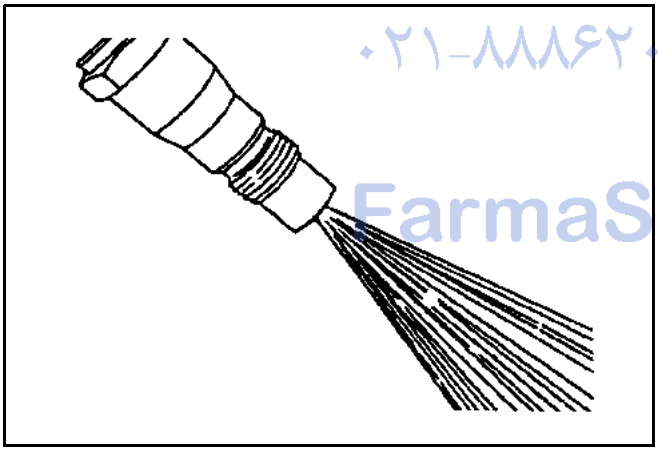
   Slowly operate the hand lever at tester (approx. 1 stroke per second). The nozzlemust spray with a gentle chattering.

4. Spray pattern test :

   Operate the hand lever at tester rapidly (approx. 2~3 strokes per second).

   - Good

     The spray pattern shows closed and well atomized.

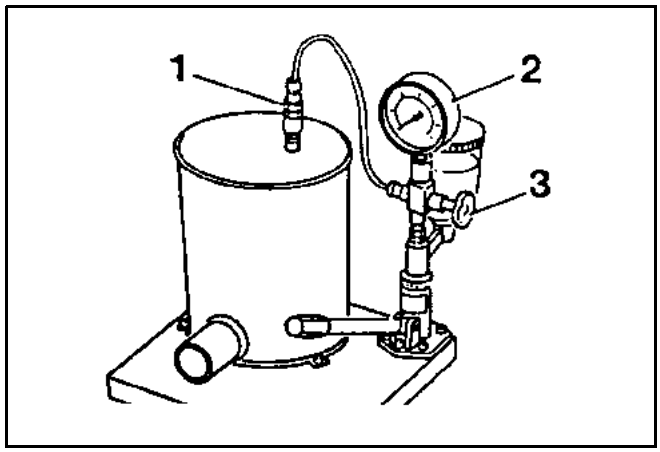


   - Poor

     The spray pattern shows split, too wide and stringy.

     (Repair the fuel injection nozzle)

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5. Opening pressure test :

   Open the valve (3) and slowly operate the hand lever at tester (approx. 1 stroke / second) and measure opening pressure.

New Nozzle	115 - 125bar
Used Nozzle	Min. 100bar
Difference Between Nozzles	Max. 5bar

Notice

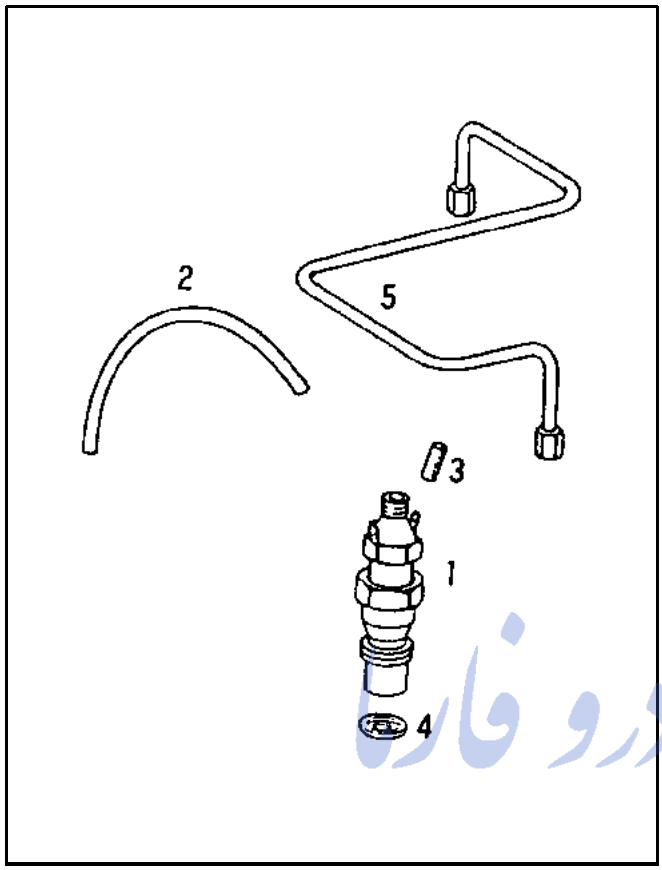
If out of standard, repair the injection nozzle.

6. Leak test

   Slowly operate the hand lever at the tester until get a pressure of approx. 90bar. Maintain this pressure for more than 20 seconds and within this period no drop of fuel should build up at the nozzle tip.

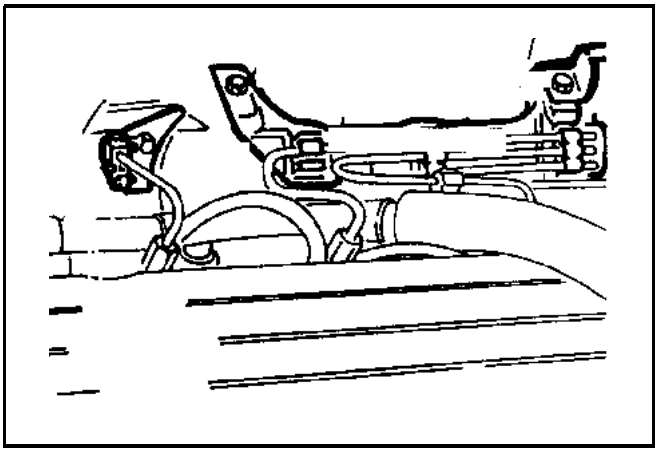
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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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INJECTION NOZZLES



1 Fuel Injection Nozzle . 35-40N·m(26-30 lb-ft)
2 Fuel Return Hose
3 Plug
4 Nozzle Washer . . . . . Replace
5 Fuel Injection Pipe . . . . . 18N·m (13 lb-ft)

ایران خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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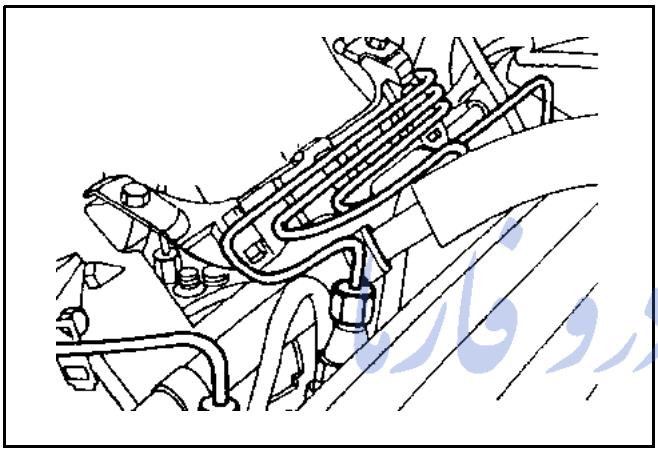


Tools Required

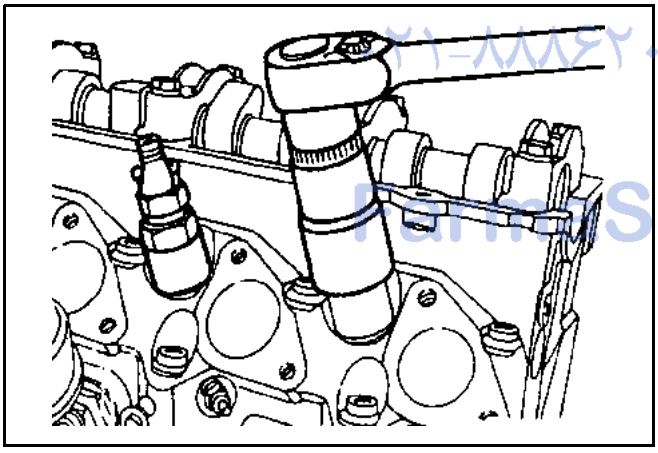
001 589 65 09 00 Serration Wrench

Removal & Installation Procedure

1. Remove the plastic clip from the injection pipe
2. Remove the fuel return hose.



3. Disconnect the injection pipes from the injection nozzles and push them to theside.



4. Remove the fuel injection nozzle.

Serration Wrench 001 589 65 09 00

Notice

Replace the washers.

5. Installation should follow the removal procedure in the reverse order.

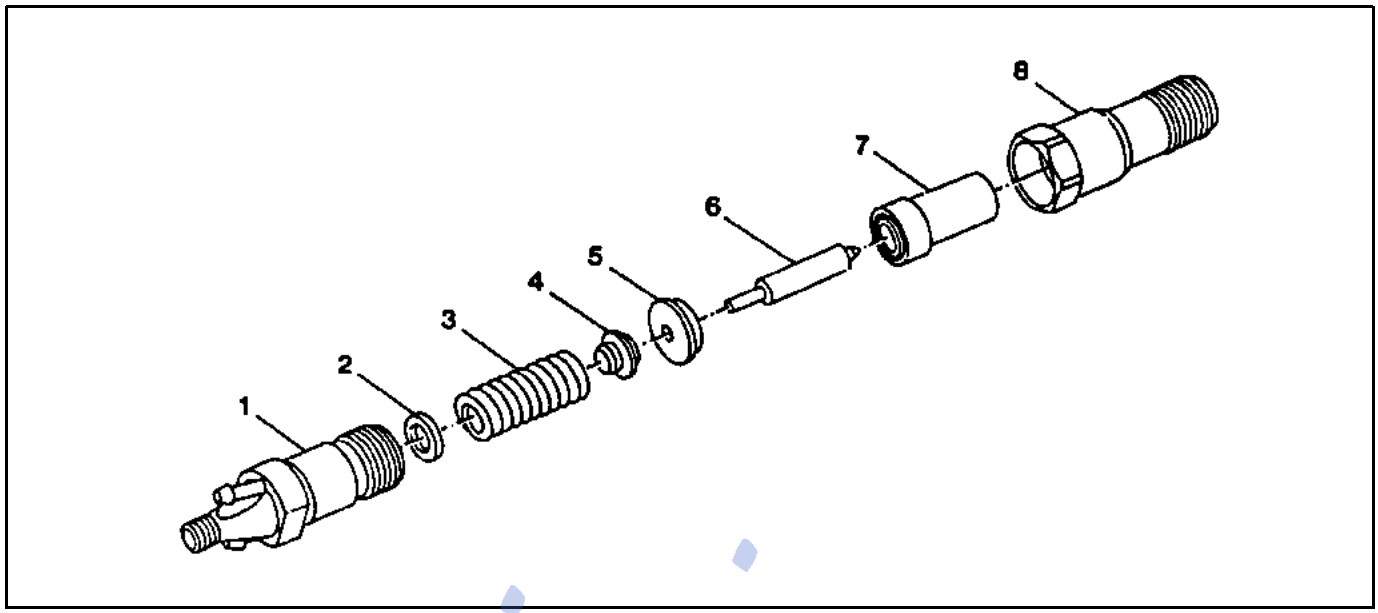
Notice

Pay attention to the installation position of new nozzle washer and tightening torque.

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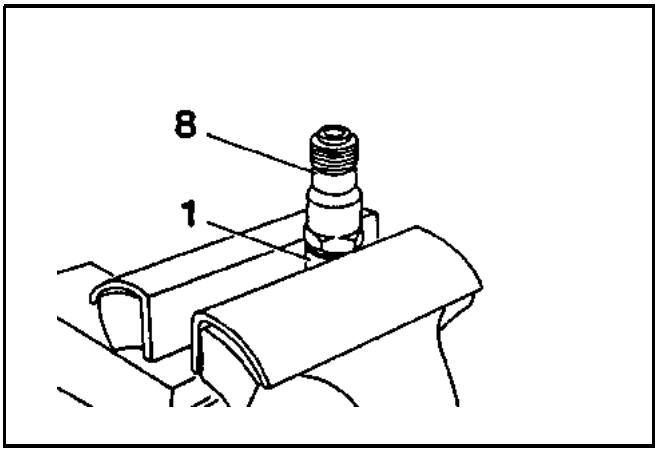
INJECTION NOZZLE REPAIR

Preceding Work : Removal of fuel injection nozzle



1 Nozzle Holder
2 Steel Washer
3 Compression Spring
4 Thrust Pin
5 Intermediate Disc
6 Nozzle Needle
7 Nozzle Body
8 Nozzle Tensioning Nut ..... 80 N·m (59 lb-ft)

ایران خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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Tools Required

001 589 65 09 00 Socket Wrench Insert

000 589 00 68 00 Cleaning Set

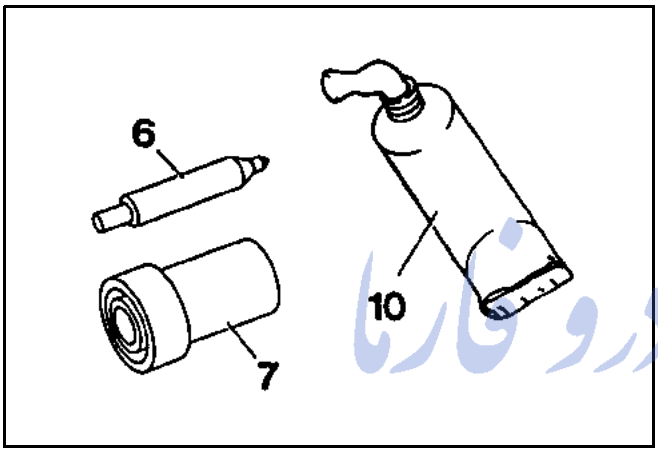
Repair Procedure

1. Clamp the nozzle holder (1) in a vice and remove the nozzle tensioning nut (8).

   Notice

   Use protective jaws for clamping.

2. Disassemble the fuel injection nozzle.

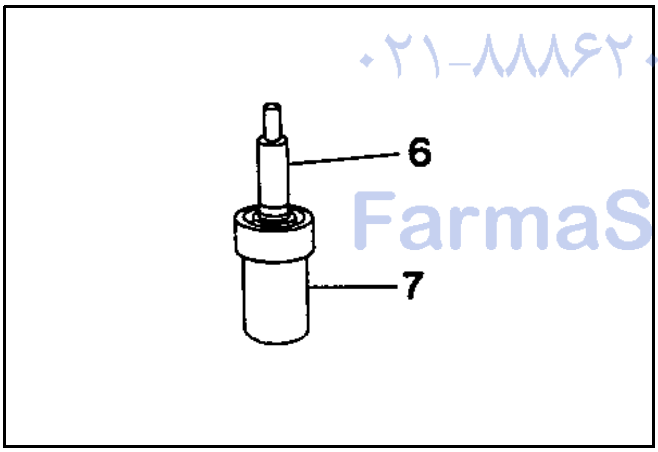


Socket Wrench Insert 001 589 65 09 00

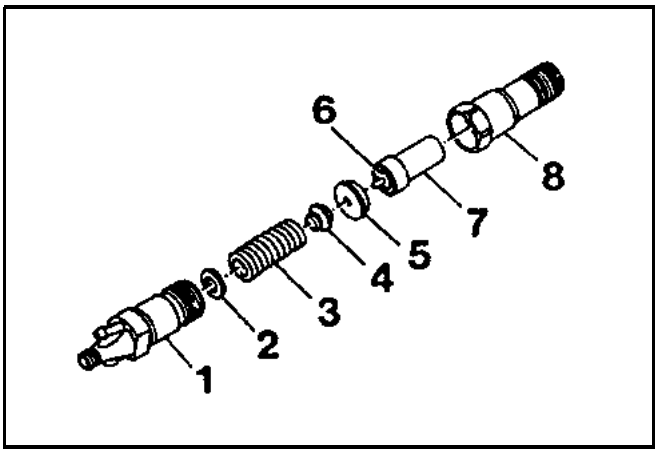
3. Clean the nozzle needle (6) and nozzle body (7) with an abradant.
4. Clean the nozzle seat with cleaning cutter.

Cleaning Set 000 589 00 68 00

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۰۲۱-۸۸۸۶۲۰۸۵
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5. Immerse nozzle needle (6) and nozzle body (7) in filtered diesel fuel. When the nozzle body is held vertical, the weight of the nozzle needle must cause it to slide down toward the nozzle needle seat.



6. Assemble the injection nozzle so that the tip of the thrust (4) pin is facing toward the nozzle holder.

Tightening Torque	80 N·m (59 lb-ft)

Notice

Nozzle needle (6) and nozzle body (7) should always be replaced as a pair.

7. Check the fuel injection nozzle and adjust opening pressure if necessary.

   Opening pressure adjustment

   Disassemble the fuel injection nozzle and replace the steel washer (2).

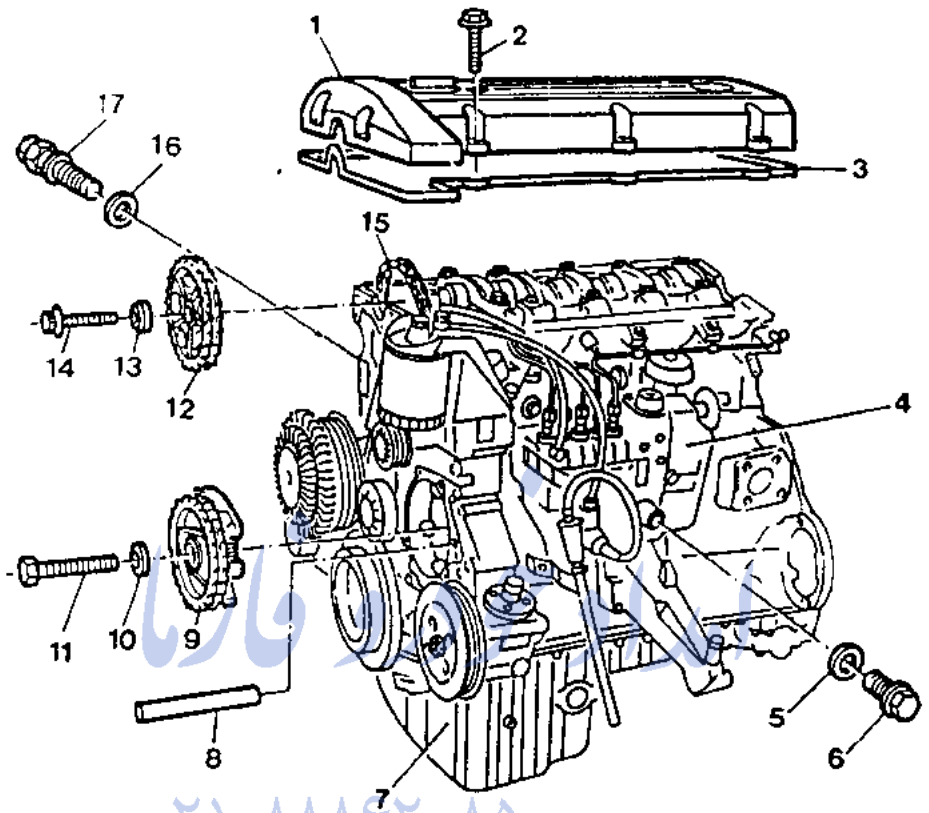
   Notice

   Each 0.05mm thickness of the washer results in a pressure difference of approx. 3bar.

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REMOVAL AND INSTALLATION OF INJECTION TIMING DEVICE

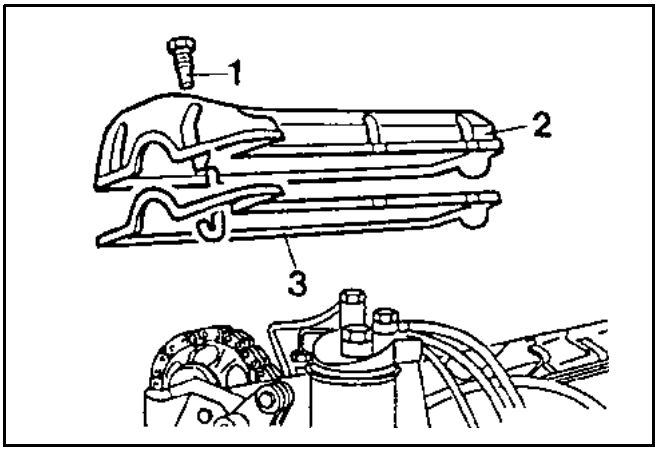
Preceding Work : Removal of vacuum pump



تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵

1 Cylinder Head Cover
2 Bolt . . . . . 10N·m (89 lb-in)
3 Gasket . . . . . Replace
4 Fuel Injection Pump
5 Seal . . . . . Replace
6 Screw Plug . . . . . 30N·m (22 lb-ft)
7 Oil Pan
8 Locking Pin
9 Injection Timing Device
10 Washer
11 Bolt (Left-Hand Thread) . . . . 46N·m (34 lb-ft)
12 Camshaft Sprocket
13 Washer
14 12-Sided Stretch Bolt
. . . . . Check, 25N·m (18 lb-ft) +90°
15 Timing Chain
16 Seal
17 Chain Tensioner . . . . . 80N·m (59 lb-ft)

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Tools Required

601 589 00 08 00	Flange
601 589 05 21 00	Locking Screw
116 589 20 33 00	Sliding Hammer
116 589 02 34 00	Threaded Bolt
667 589 04 63 00	Retaining Plate

Removal & Installation Procedure

1. Remove the bolts (2) and then remove the cylinder head cover (1) and gasket (3).

Installation Notice

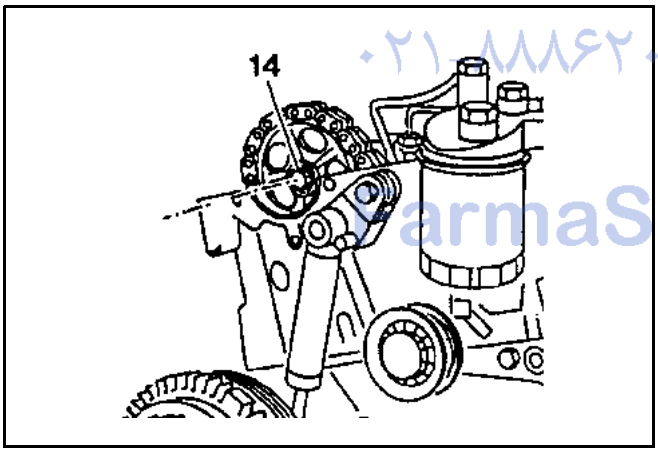
Tightening Torque	10 N·m (89 lb-in)

Notice

Replace the gasket.

Rotate the engine 1 revolution by hand and check TDC marking of the crankshaft and camshaft.

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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2. Loosen the camshaft sprocket bolt (14).

Notice

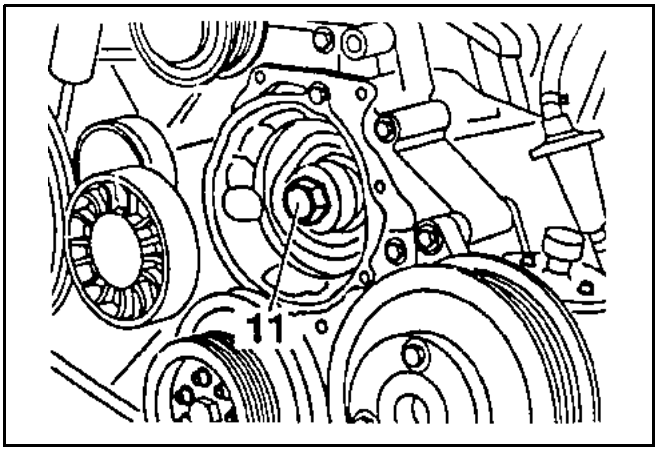
Do not remove the bolt.

Installation Notice

Tightening Torque	25N·m (18 lb-ft) + 90°

Notice

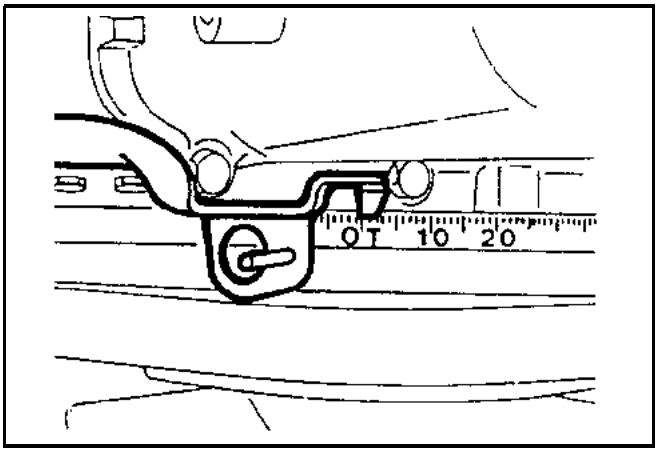
If max. length of bolt exceeds 53.6mm, replace it.



3. Loosen the bolt (11) (left-hand thread).

Notice

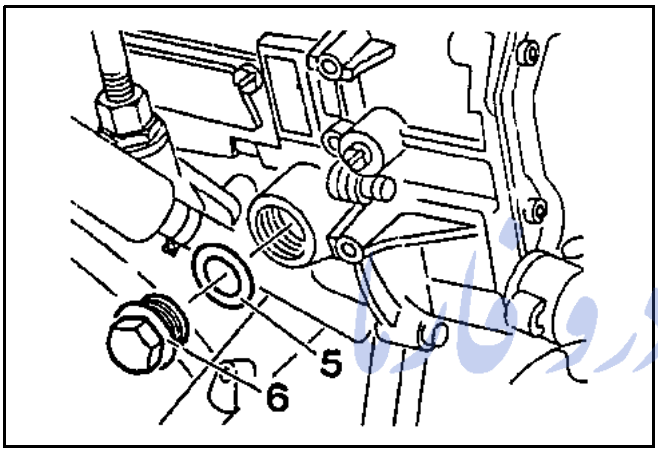
Do not remove the bolt.



4. Position the no.1 cylinder at ATDC 15°.

Notice

Do not rotate the engine with camshaft sprocket bolt or opposite direction of the engine rotation.



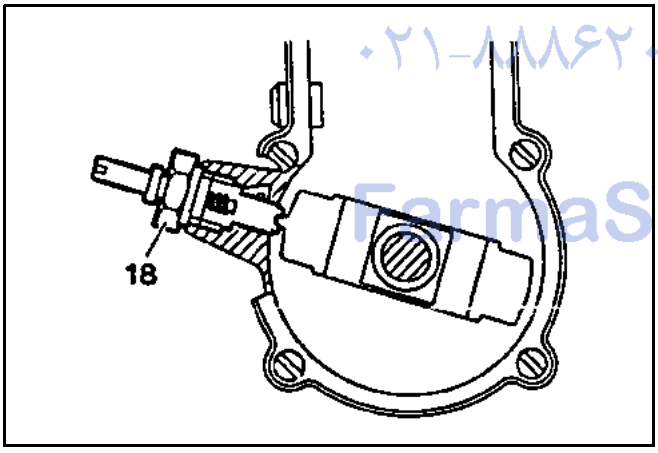
5. Remove the plug (6) and seal (5) from the fuel injection pump and collect oil in a suitable vessel.

Installation Notice

Tightening Torque	30 N·m (22 lb-ft)

Notice

Replace the seal.

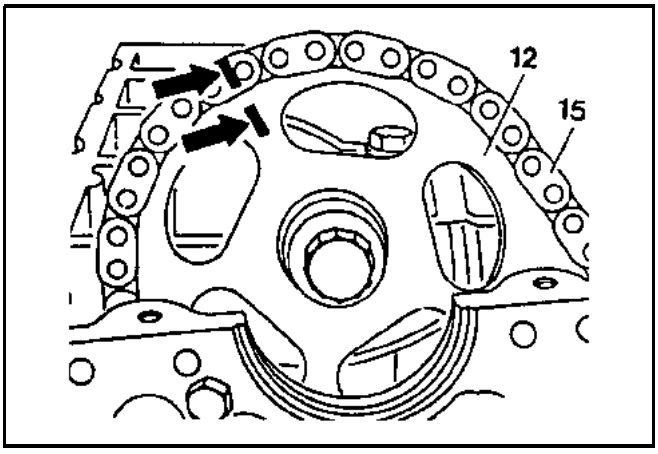


6. Install the locking screw (18) into the injection pump.

Notice

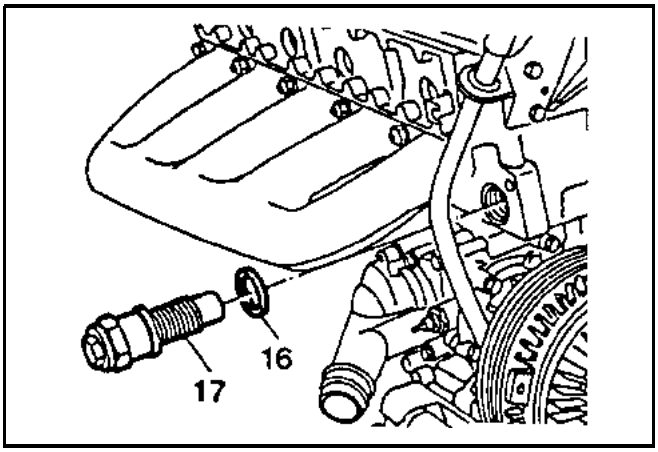
Before tightening the bolts for the injection timing device and the camshaft sprocket, always remove the locking screw from the injection pump and reinstall the plug.

Locking Screw 601 589 05 21 00



7. Place alignment marks (arrow) on the timing chain (12) and camshaft sprocket (15).

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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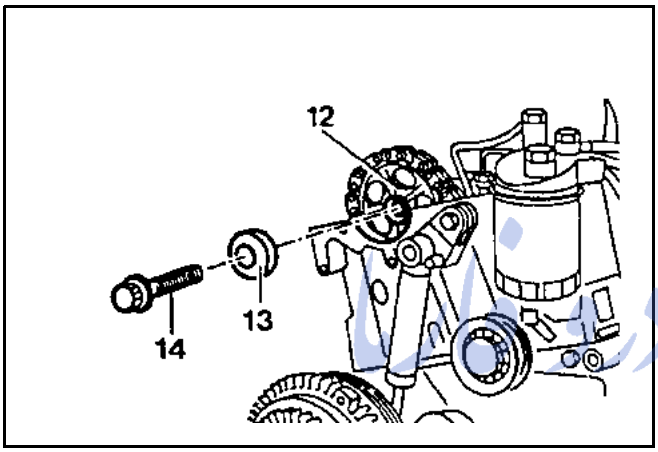
8. Remove the chain tensioner (17).

Installation Notice

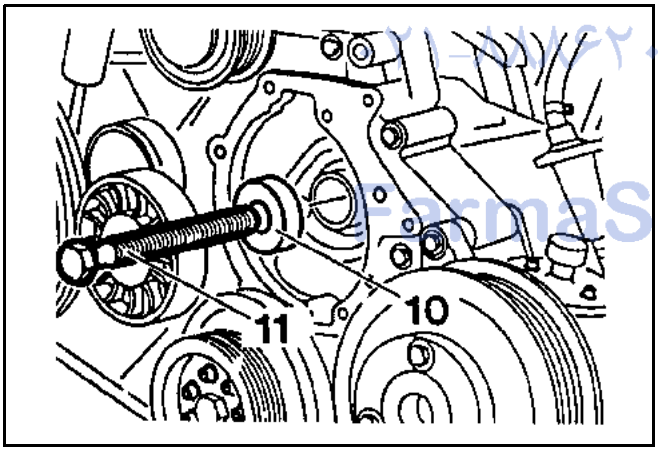
Tightening Torque	80 N·m (59 lb-ft)

Notice

Replace the seal (16).



9. Pull out the 12-sided stretch bolt (14) and washer and remove thecamshaft sprocket (12).



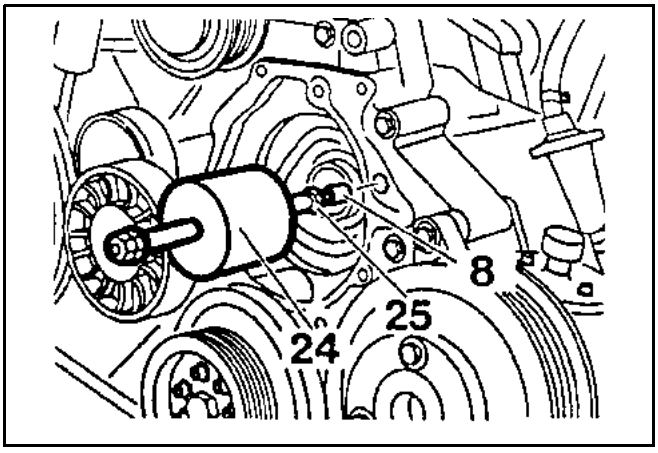
10. Pull out the bolt (11) and washer (10).

Notice

Be careful that the bolt is left-hand thread.

Installation Notice

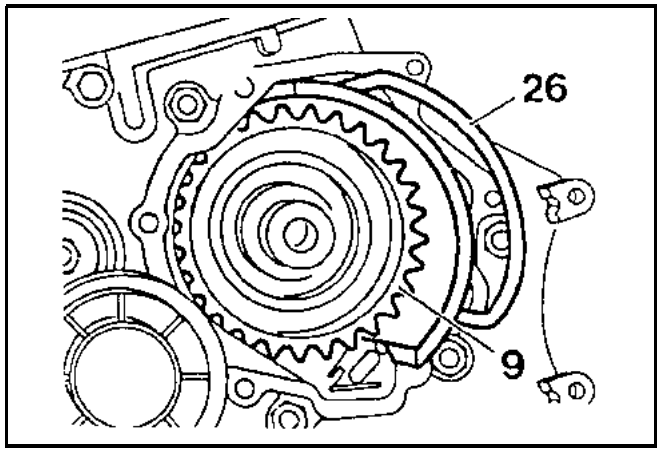
Tightening Torque	46 N·m (34 lb-ft)



11. Using special tool (24, 25), remove the locking pin (8).

Sliding Hammer 116 589 20 33 00
Threaded Bolt 116 589 02 34 00

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12. Push back the timing chain with retaining plate (26) and remove the injection timing device (9).

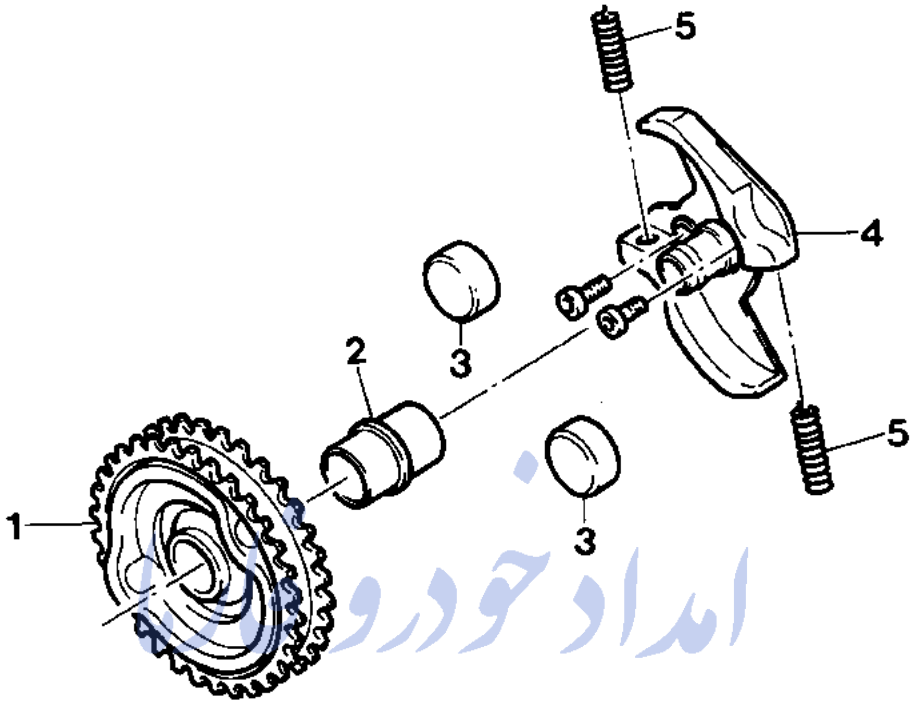
Retaining Plate 667 589 04 63 00

13. Installation should follow the removal procedure in the reverse order.
14. After assembling the engine, check start of delivery and adjust if necessary.

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INJECTION TIMING DEVICE

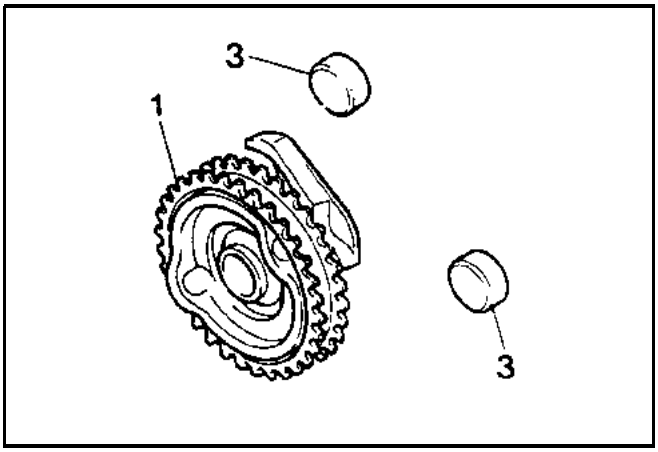
Preceding Work : Removal of injection timing device



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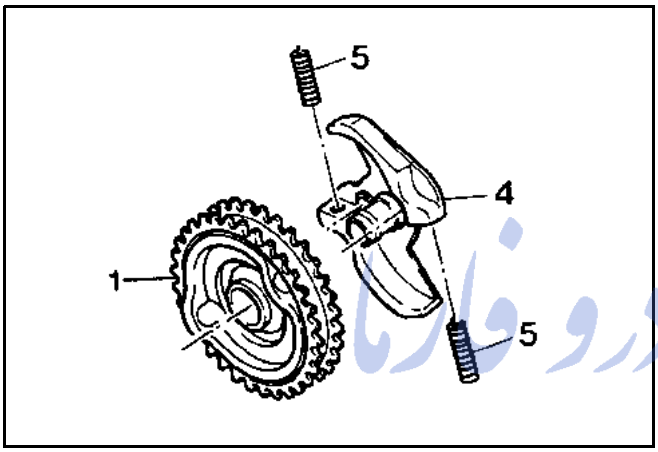
1 Cam Sprocket ..... Check
2 Bushing ..... Check
3 Governor Weights
4 Segment Flange and Drive Hub
5 Compression Springs

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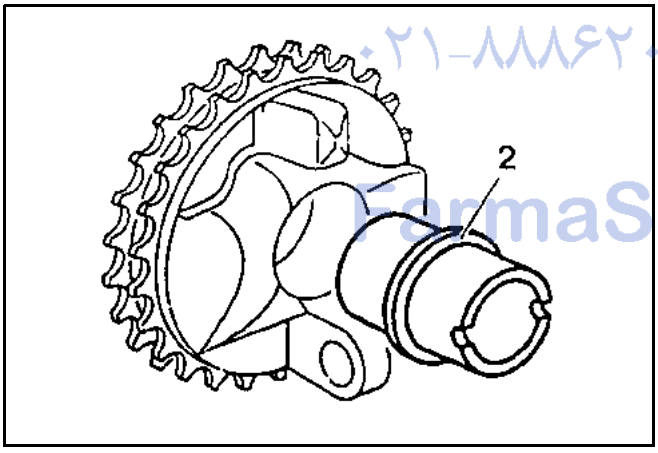


Disassembly & Assembly

1. Remove the governor weights (3).



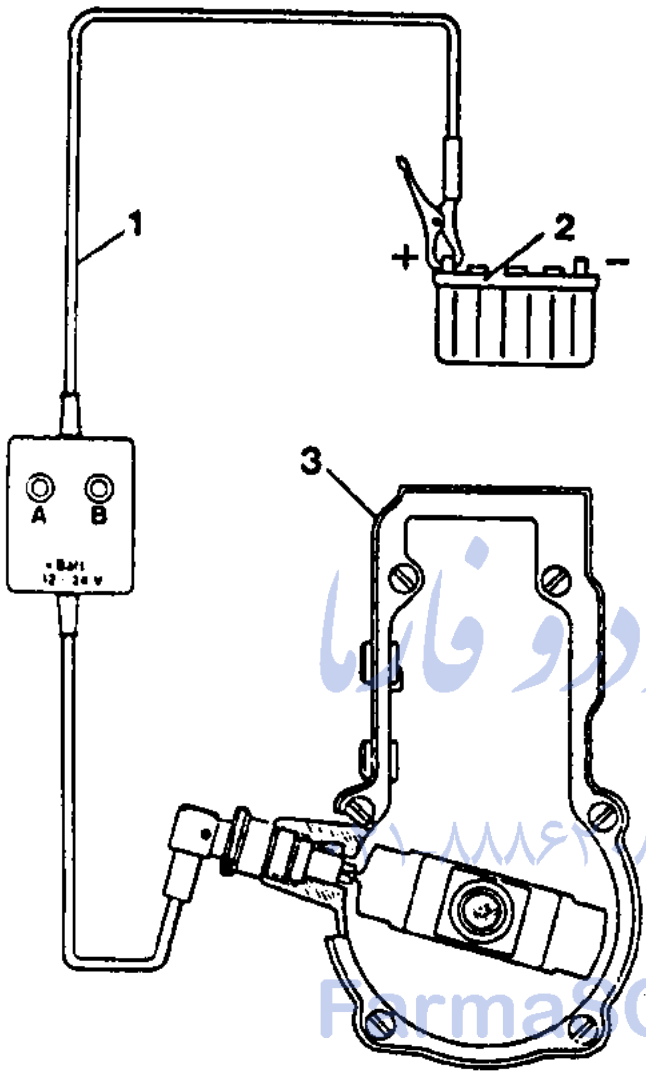
2. Pull out the compression springs (5) and cam sprocket (1) from the segment flange (4).

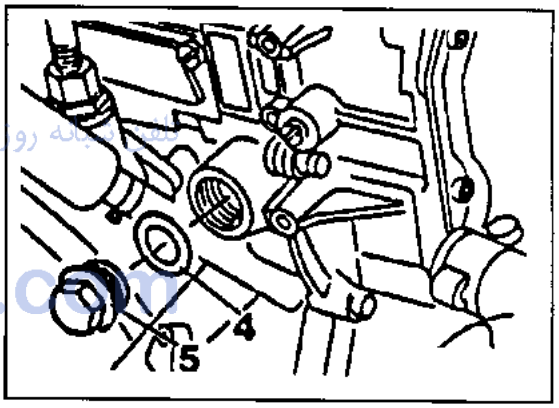


3. Knock out the bushing with a proper drift.
4. Installation should follow the removal procedure in the reverse order.

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۰۲۱-۸۸۸۶۲۰۸۵
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START OF DELIVERY TEST (POSITION SENSOR, RIV METHOD)



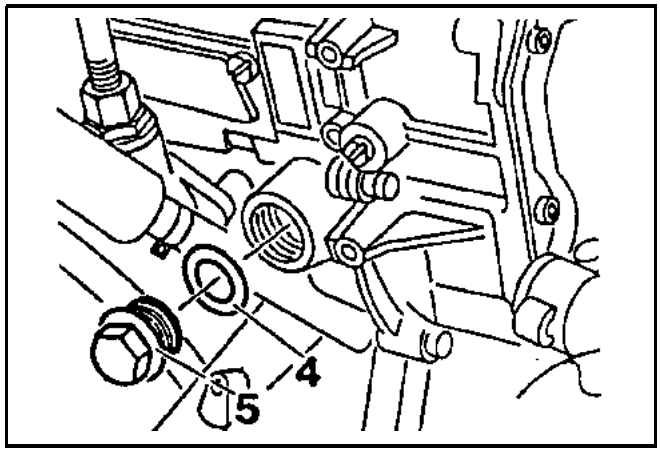


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1 Position Sensor
2 Battery
3 Fuel Injection Pump
4 Seal . . . . . Replace
5 Screw Plug . . . . . 30N·m (22 lb-ft)

Service Data

Start of Delivery (RIV)	ATDC 14° - 16°

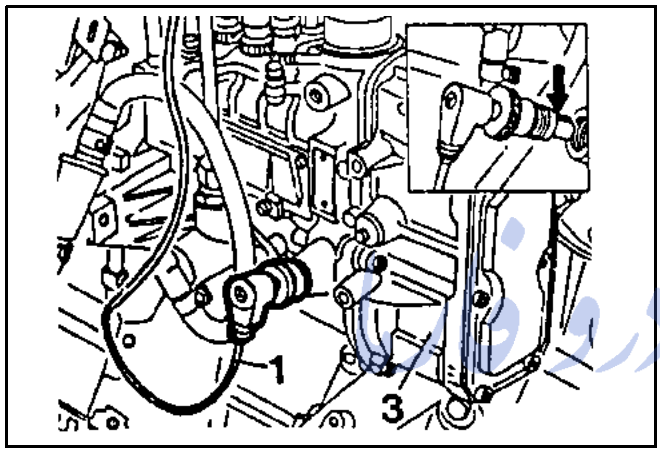


Tools Required

617 589 08 21 00 Position Sensor

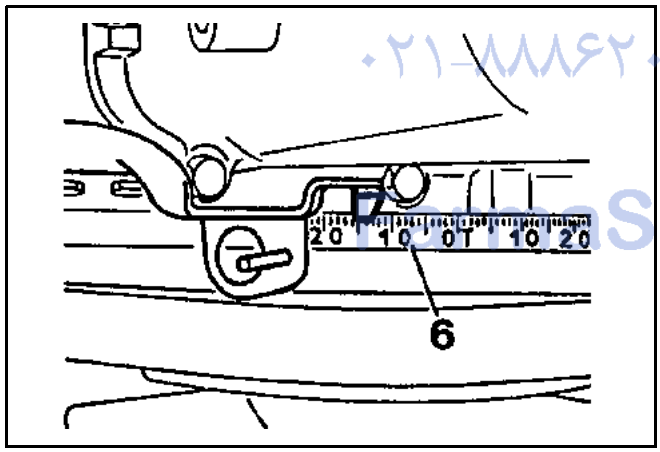
Test Procedure

1. Remove the screw plug (5) and seal (4) and collect oil in a suitable vessel.



2. Install the position sensor (1) into the governor housing of the injection pump to be the guide pin of the position sensor facing up.
3. Connect the battery terminal of position sensor (1) to positive terminal (+) of battery.

Position Sensor 617 589 08 21 00



4. Rotate the crankshaft by hand (in direction of engine rotation) until the lamp 'B' lights up. Rotate the crankshaft carefully further until both lamps 'A and B' come on. In this position, check the RI value on the crankshaft vibration damper.

Specification	ATDC 14° - 16°

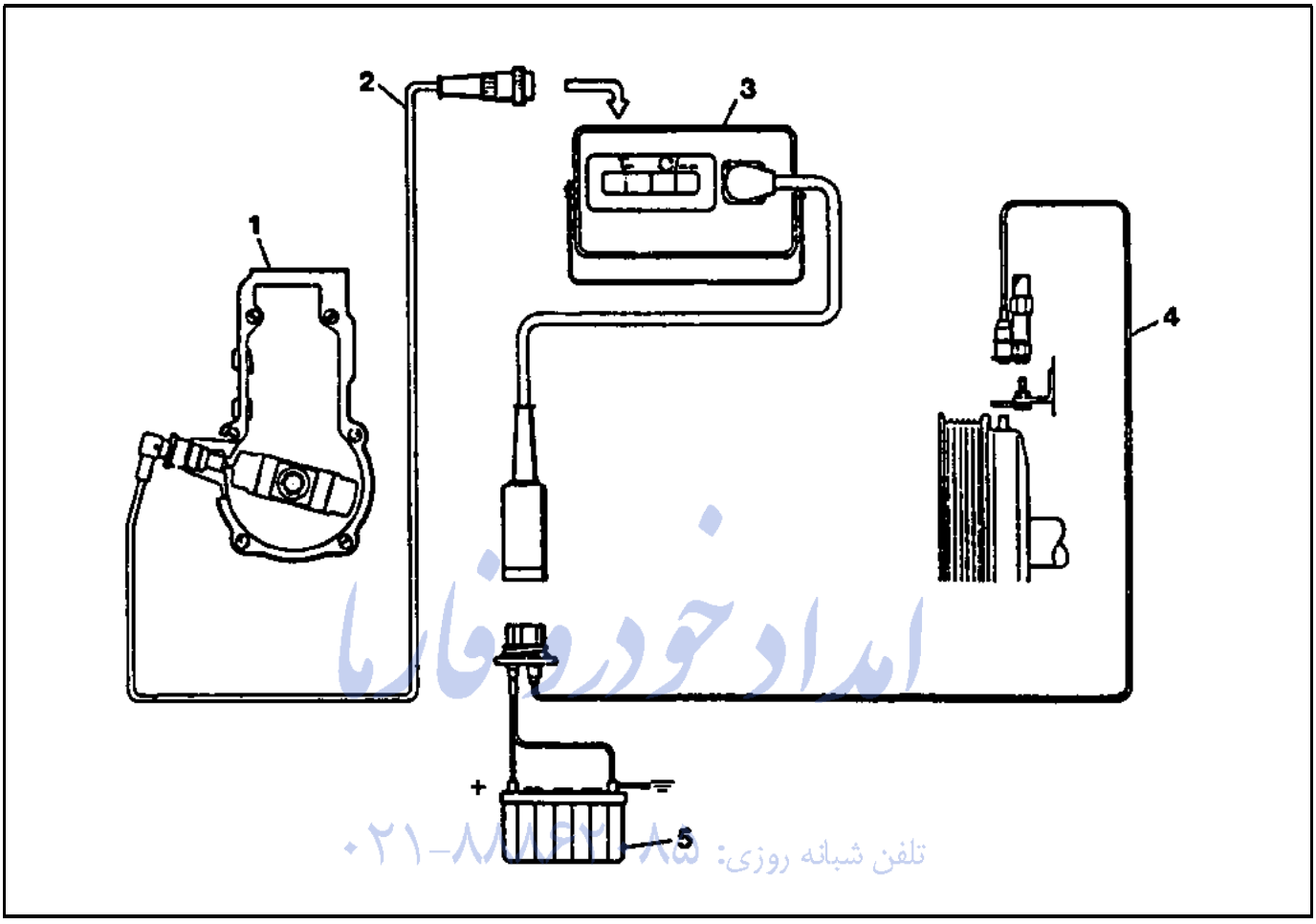
Notice

If only lamp 'A' lights up, repeat the test and if out of specification, adjust start of delivery.

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Digital Tester, RIV Method

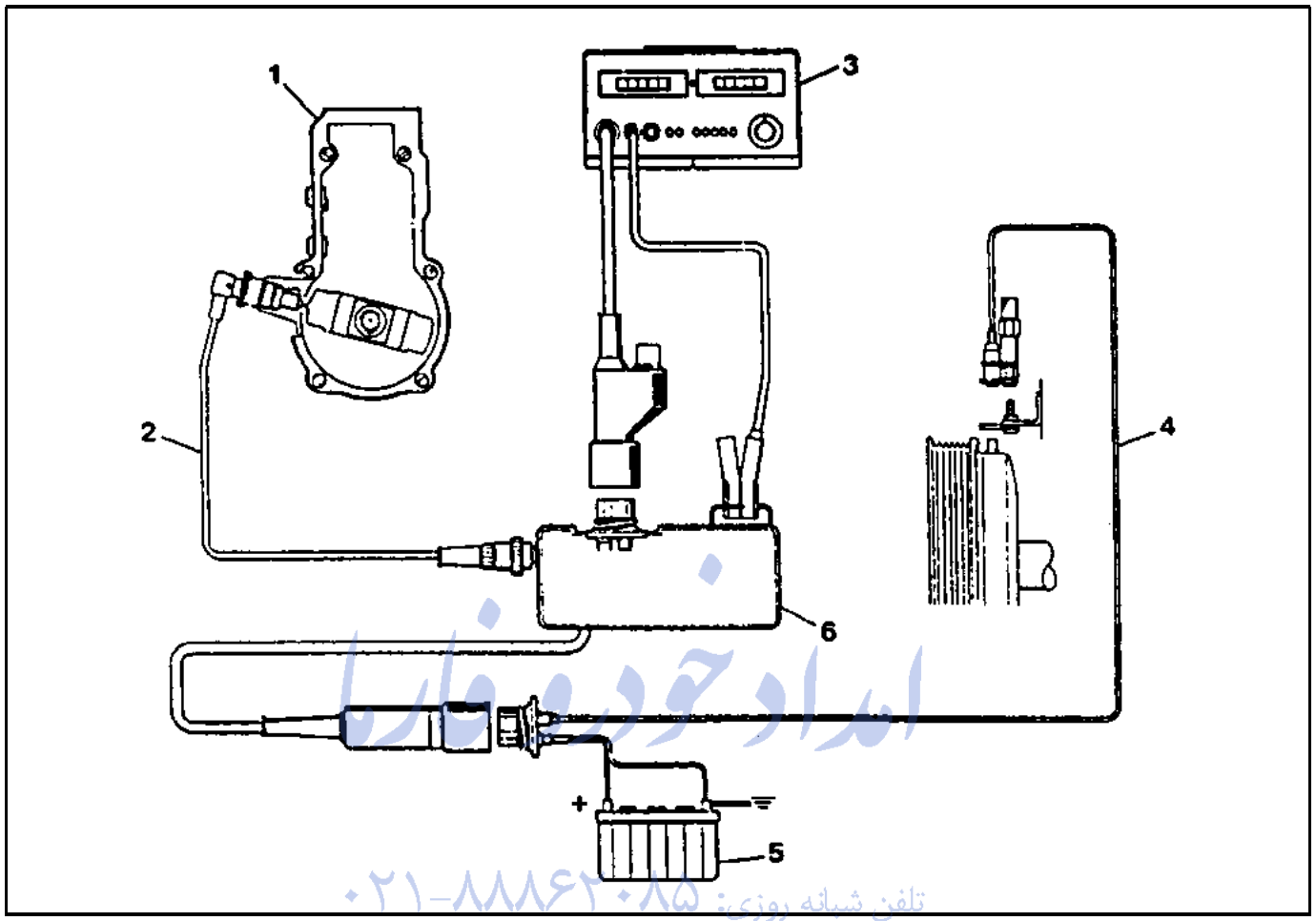
(Connection Diagram for Testers Without Adapter)



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تلفن شبانه روزی: ۰۲۱-۸۸۶۲۰۸۵۵
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1 Fuel Injection Pump
2 RI Sensor
3 Digital Tester
4 TDC Pulse Sender Unit
5 Battery

(Connection Diagram for Testers With Adapter)



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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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1 Fuel Injection Pump
2 RI Sensor
3 Digital Tester
4 TDC Pulse Sender Unit
5 Battery
6 RI Pulse Generator

Service Data

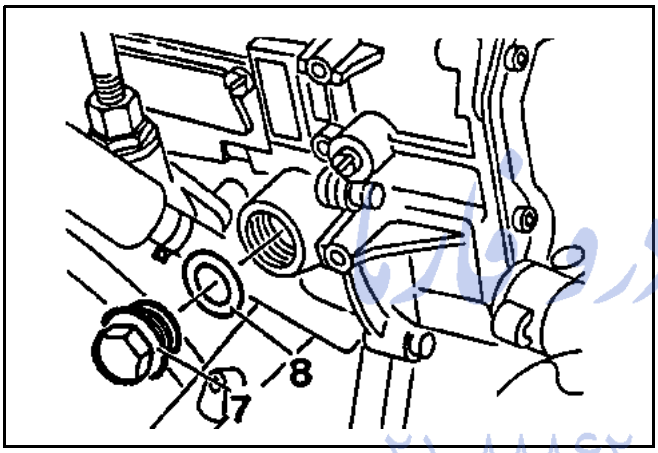
Start of Delivery (RIV)	ATDC 14° - 16°
Idle Speed	OM661LA : 720 - 820 rpm, OM662LA : 750 - 850 rpm

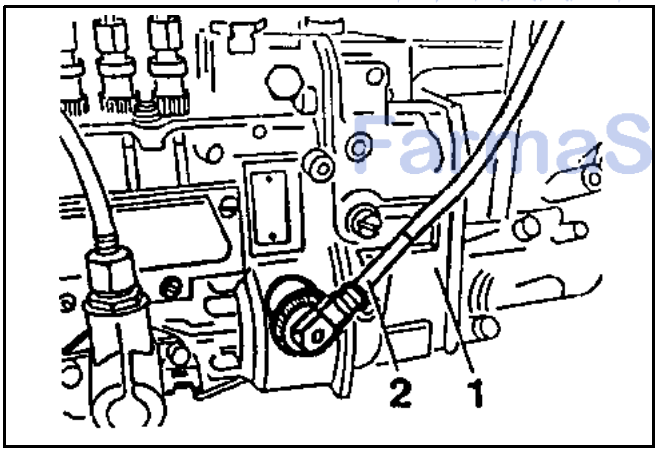
Tools Required

617 589 09 21 00 RI Sensor
617 589 10 21 00 Timing Tester
667 589 00 21 00 TDC Pulse Generator

Commercial Tools

Item		Tools
Digigal Tester	With Pulse Generator	Bosch, MOT 001.03
		Hartmann & Braun, EOMT3
	Without Pulse Generator	Bosch, ETD 019.00
		Sun, DIT 9000
		ALV, Diesel - Tester 875





Test Procedure

1. Remove the screw plug (7) and seal (8) collect oil in a suitable vessel.

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2. Install the RI sensor into the governor housing of injection pump (1).

RI Sensor 617 589 10 21 00

3. Connect the digital tester and TDC pulse sender unit according to connection diagram.
4. Run the engine at idle speed and check the RI value on the digital tester

RI value	ATDC 14° - 16°

Notice

If out of standard, adjust the start of delivery.

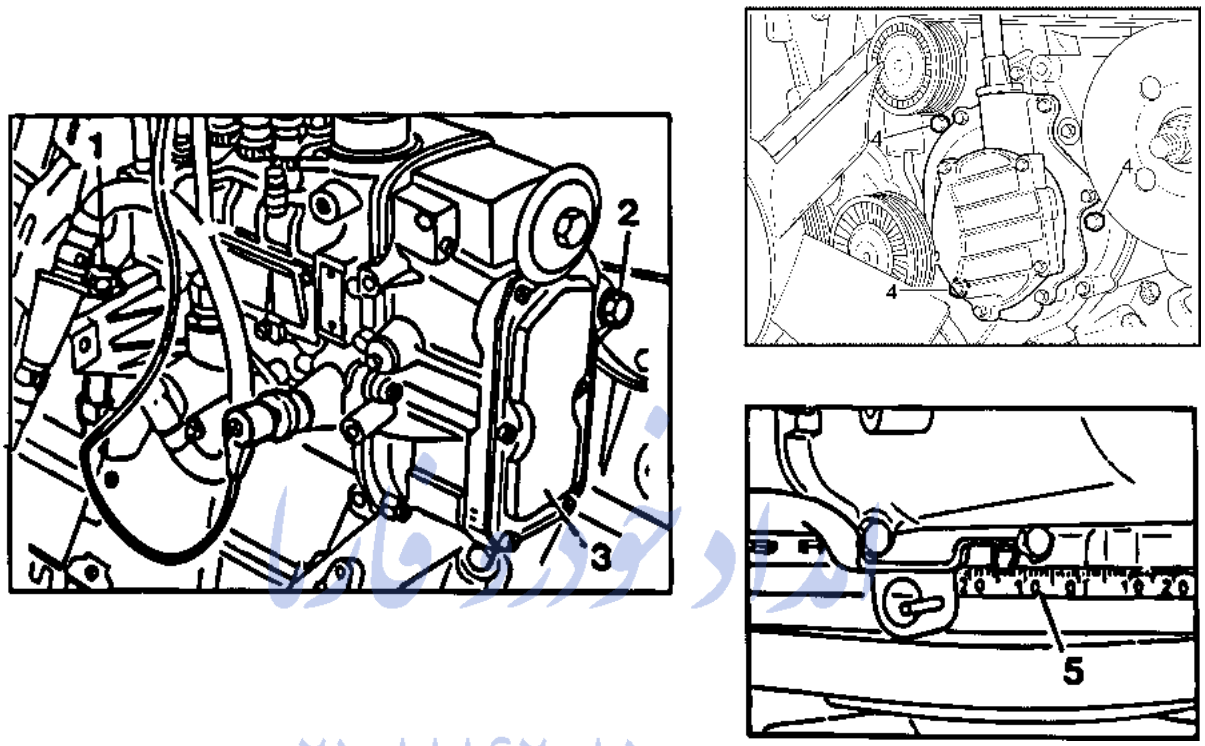
5. Stop the engine.
6. Remove the RI sensor, digital tester and TDC pulse sender unit.
7. Replace the seal and tighten the plug.
8. Check engine oil level and adjust if necessary.

Tightening Torque	30 N·m (22 lb-ft)

After Testing

Preceding Work : Start of delivery test

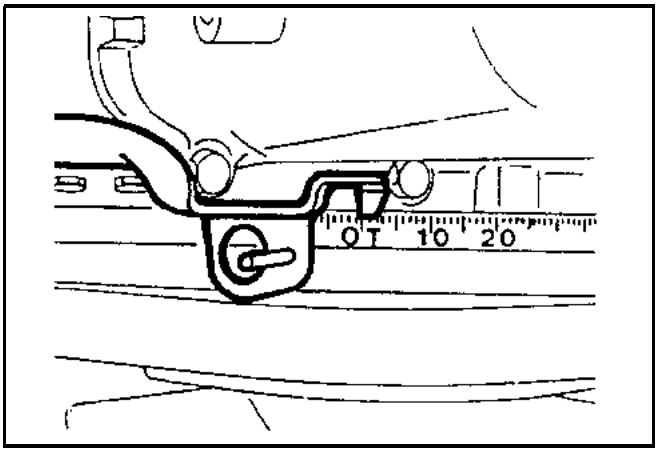
Position Sensor (RIV method)



تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵

1 Adjusting Screw
2 Bolt . . . . . 23N·m (17 lb-ft)
3 Fuel Injection Pump
4 Bolt . . . . . 23N·m (17 lb-ft)
5 Scale . . RI start of delivery = 14° - 16° ATDC

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Tools Required

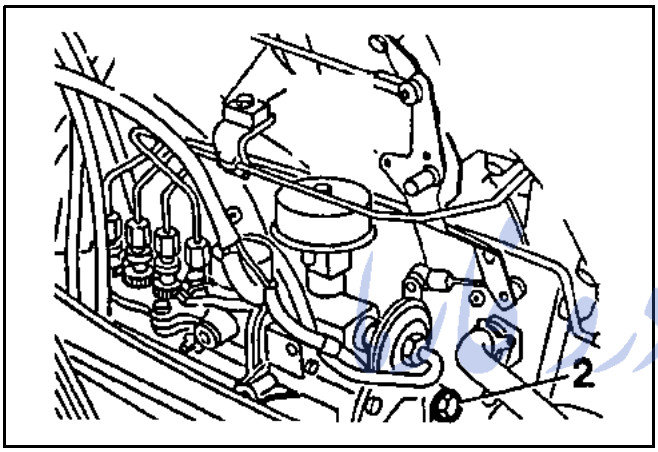
617 589 08 21 00 Position Sensor

Adjustment Procedure

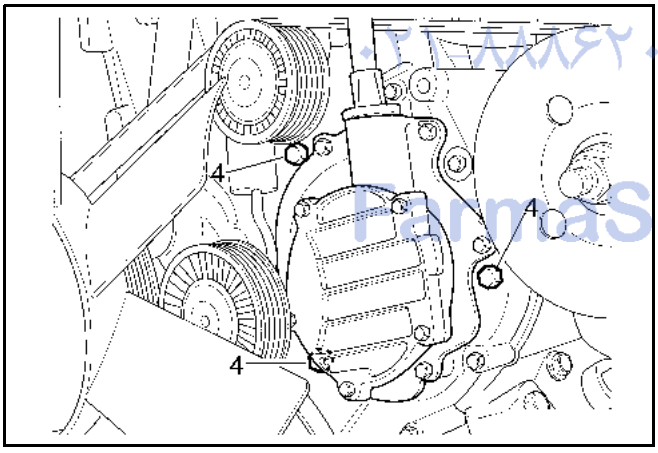
1. Position the No. 1 cylinder at ATDC 15°

   Notice

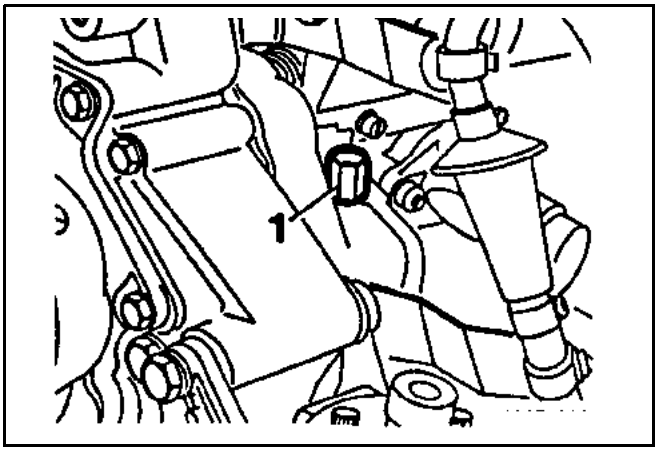
   Do not rotate the engine in opposite direction of engine rotation.



2. Remove the bolt (2) at the supporting bracket.



3. Remove the bolt (4).



4. Turn the adjusting screw (1) until both lamps 'A' + 'B' on the position sensor light up.

To the right	Start of delivery retarded
To the left	Start of delivery advanced

Notice

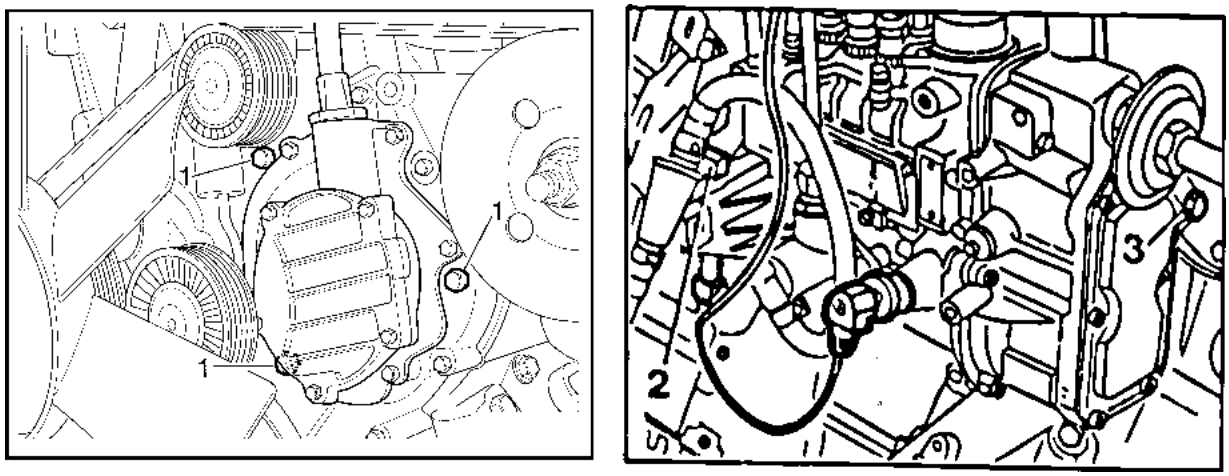
If the adjustment range is not adequate, remove the injection pump and reinstall.

Position Sensor 617 589 08 21 00

5. After adjusting, retighten all the bolt to the specified torque.

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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Digital tester (RIV Method)



1 Bolt ..... 23N·m (17 lb-ft)
2 Adjusting
Screw To the right : start of delivery retarded
To the left : start of delivery advanced
3 Bolt ..... 23N·m (17 lb-ft)

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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Service Data

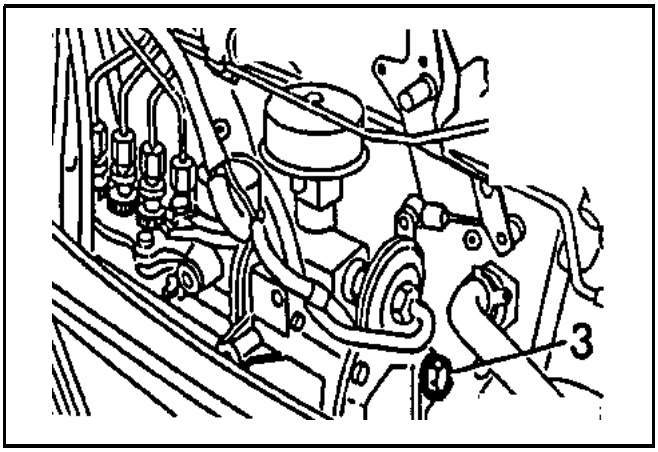
Start of Delivery (RIV)	ATDC 14° - 16°
Ldling Speed	OM661LA : 720 - 820 rpm, OM662LA : 750 - 850 rpm

Tools Required

617 589 09 21 00 RI Sensor
617 589 10 21 00 Timing Tester
667 589 00 21 00 TDC Pulse Generator

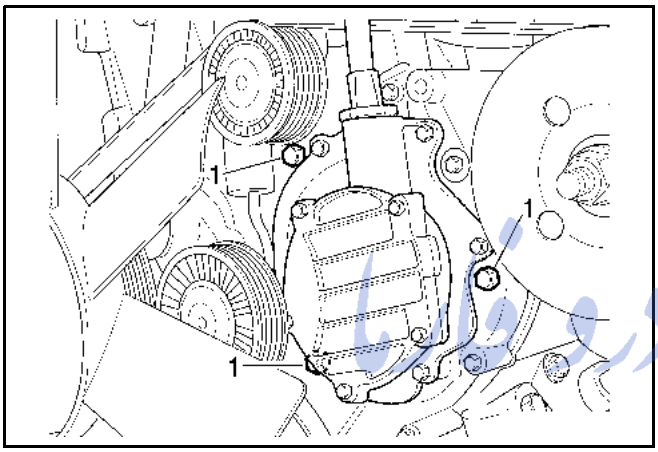
Commercial Tools

Item		Tools
Digital Tester	With Pulse Generator	Bosch, MOT 001.03
		Hartmann & Braun, EOMT3
	Without Pulse Generator	Bosch, ETD 019.00
		Sun, DIT 9000
		ALV, Diesel - Tester 875

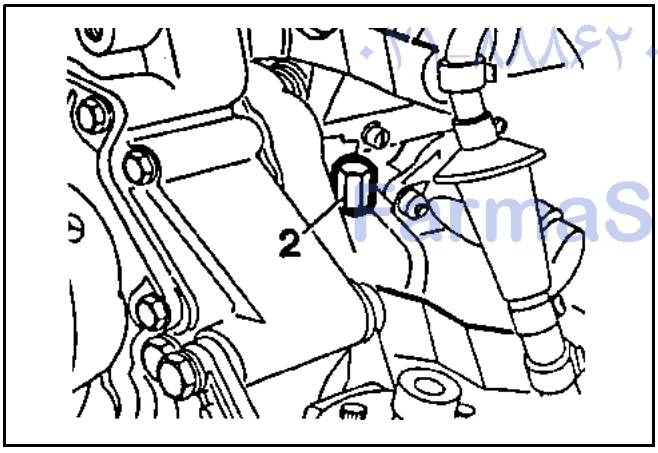


Adjustment Procedure

1. Remove the bolt (3) at the supporting bracket.



2. Remove the bolts (1) at the timing case cover.



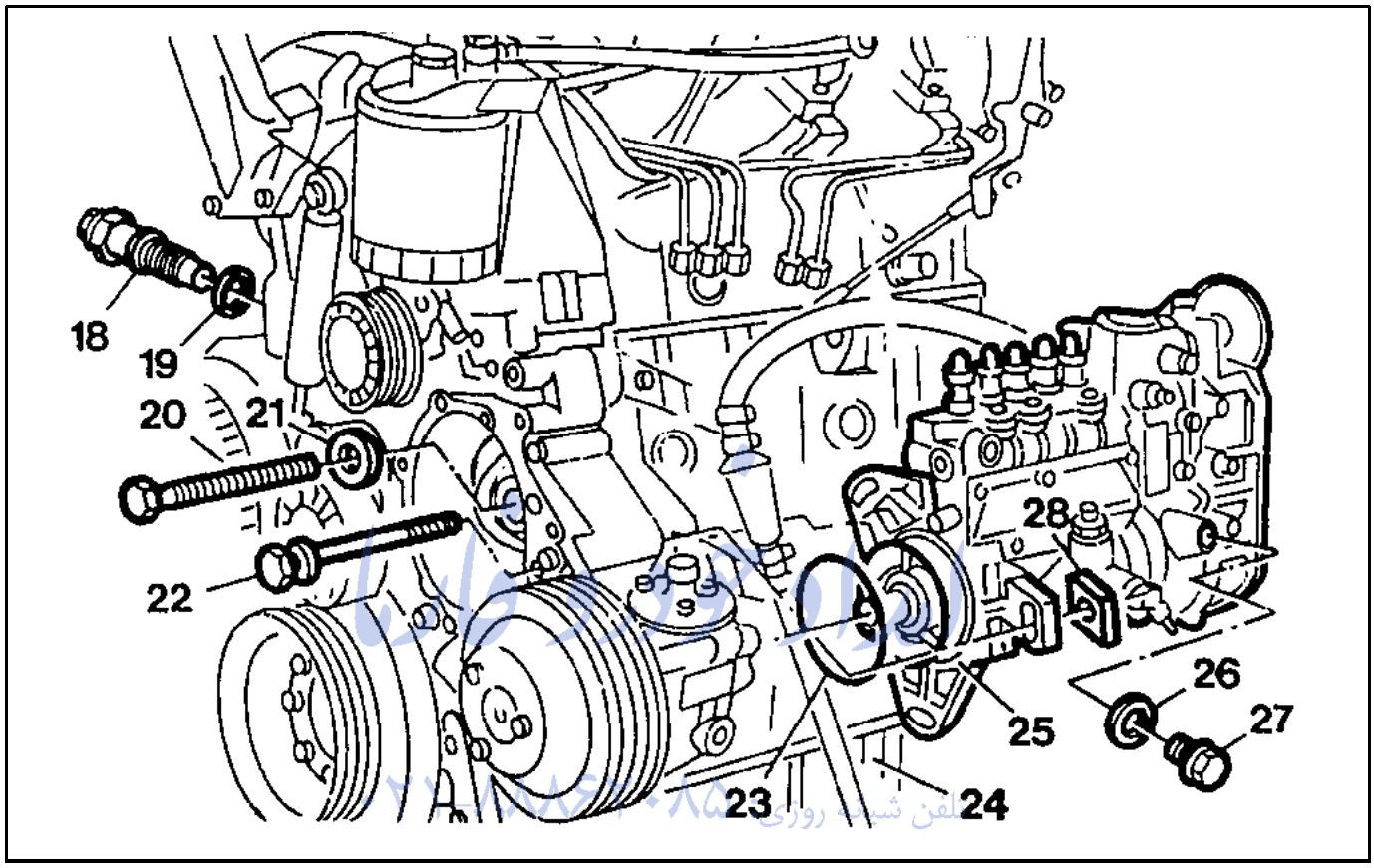
3. Run the engine at idle speed.
4. Turn the adjusting screw (2) until the specification (15° ± 1° ATDC) is indicated on the digital tester.

To the Right	Start of Delivery Retarded
To the Left	Start of Delivery Advanced

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FUEL INJECTION PUMP

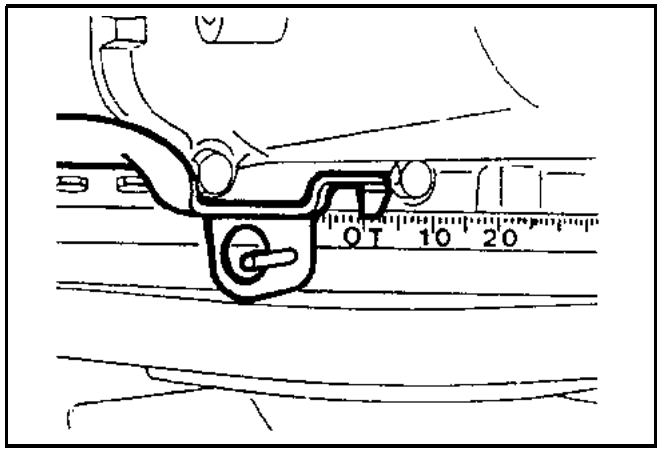
Preceding Work : Removal of vacuum pump
Removal of air cleaner housing
Removal of intake manifold



18 Chain Tensioner . . . . . 80N·m (59 lb-ft)
19 Seal . . . . . Replace
20 Bolt(Left-Hand Thread) . . . . . 46N·m (34 lb-ft)
21 Washer
22 Bolt . . . . . 23N·m (17 lb-ft)
23 Seal . . . . . Replace
24 Oil Pan
25 Fuel Injection Pump
26 Seal . . . . . Replace
27 Screw Plug . . . . . 30N·m (22 lb-ft)
28 Square Nut

Tools Required

000 589 77 03 00 Box Wrench Insert
601 589 00 08 00 Flange
601 589 05 21 00 Locking Screw
601 589 05 14 00 Assembly CageRemoval

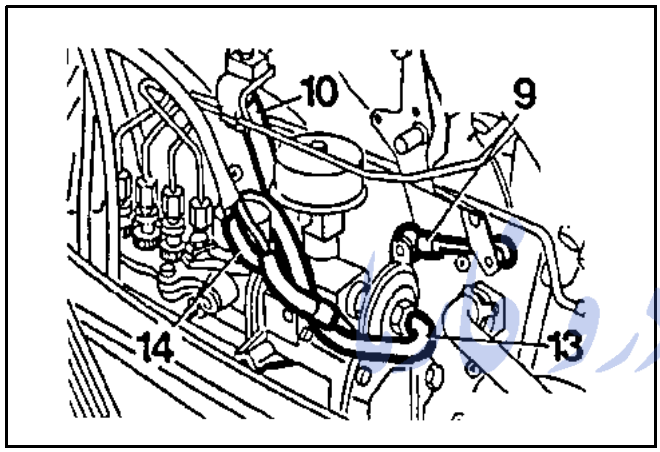


Removal Procedure

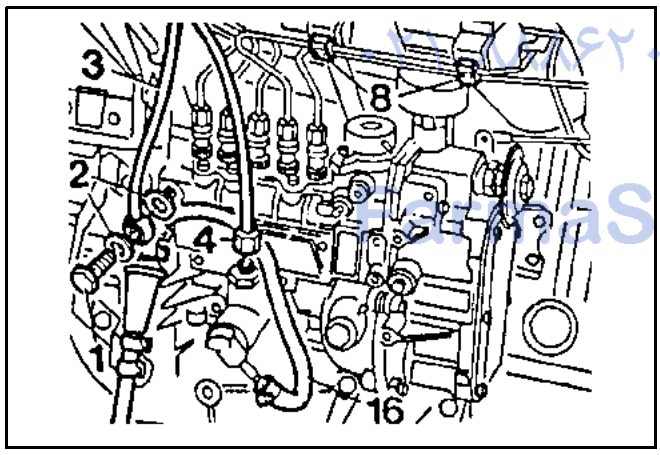
1. Position then no.1 cylinder at 15° ATDC.

   Notice

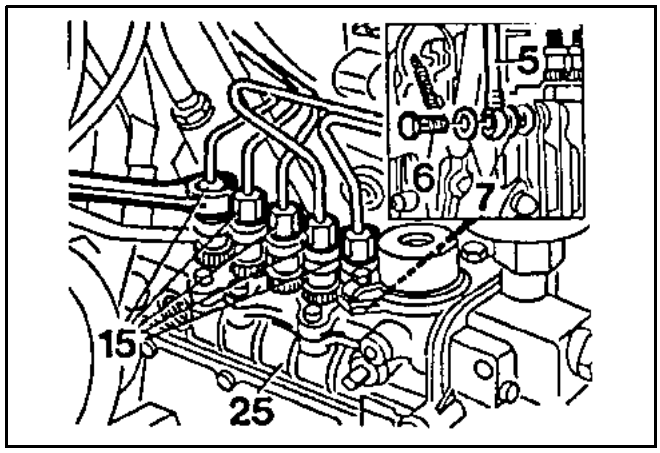
   Do not rotate the engine in opposition direction of engine rotation.



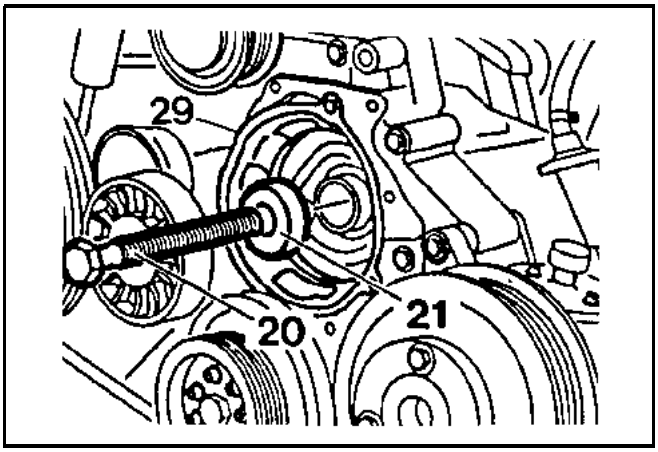
2. Remove the connecting rod (9).
3. Disconnect the vacuum lines (13, 14).
4. Remove the accelerator control damper (10).
   (Manual transmission vehicle)



5. Remove the suction line (16) and pressure line (4).
6. Remove the banjo bolt (1) and then remove the seal (2) and fuel line (3).
7. Remove the plastic clip (8) on the injection line.



8. Disconnect the injection lines (15) from the injection pump (25).
9. Remove the banjo bolt (1) and then remove the seal (7) and return line (5).

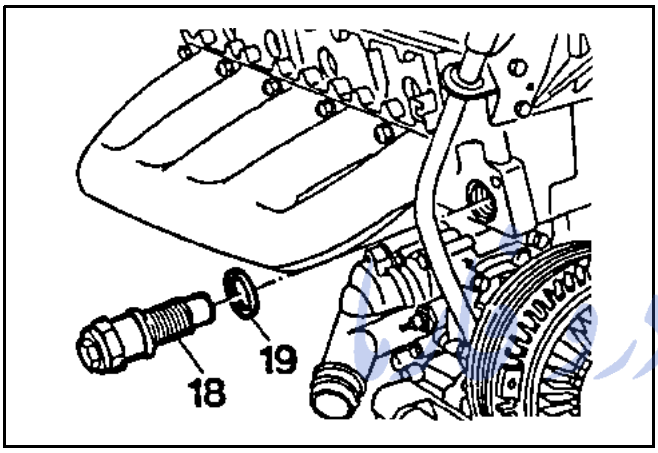


10. Install the assembly cage (29) and remove the bolt (20) and pull off the washer (21).

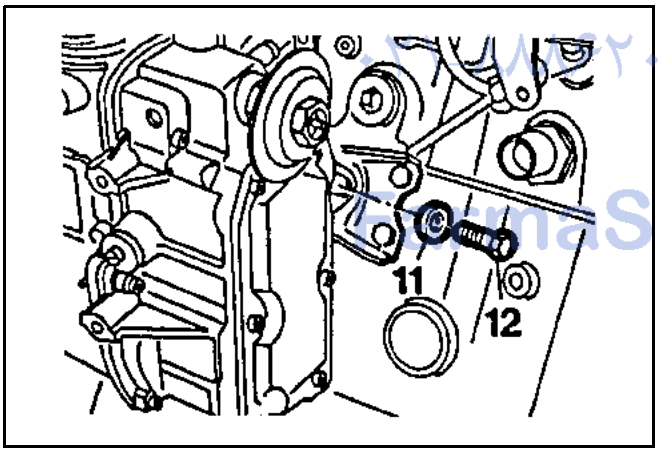
Notice

Be careful that the bolt (20) is left hand thread.

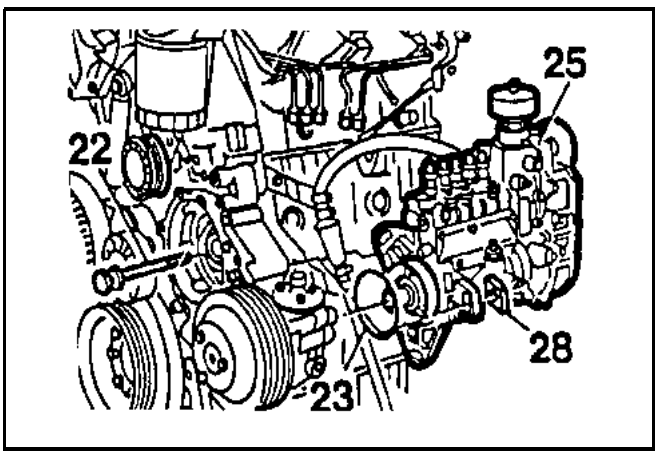
Assembly Cage 601 589 05 14 00



11. Remove the chain tensioner (18) and seal (19).

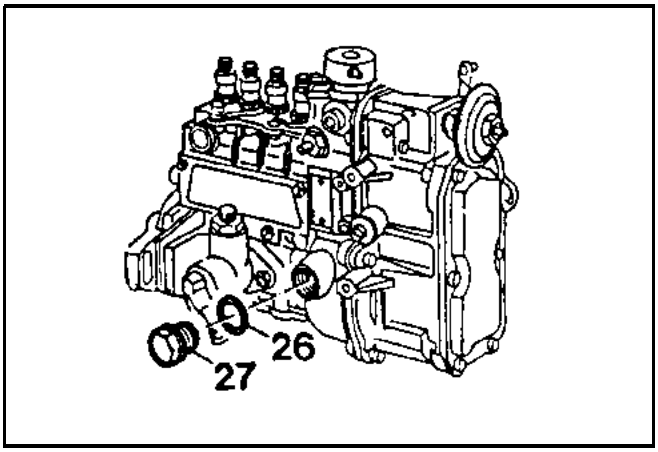


12. Remove the bolt (12) and pull off the washer (11).



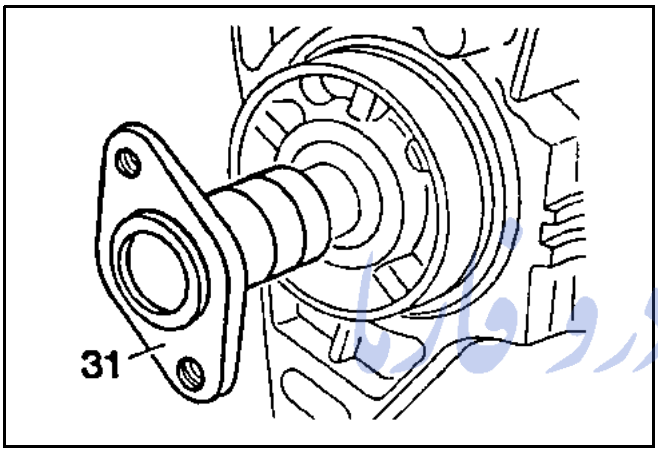
13. Remove the bolt (22) and pull off the square nut (28).
14. Pull out the fuel injection pump (25) and seal (23).

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Installation Procedure

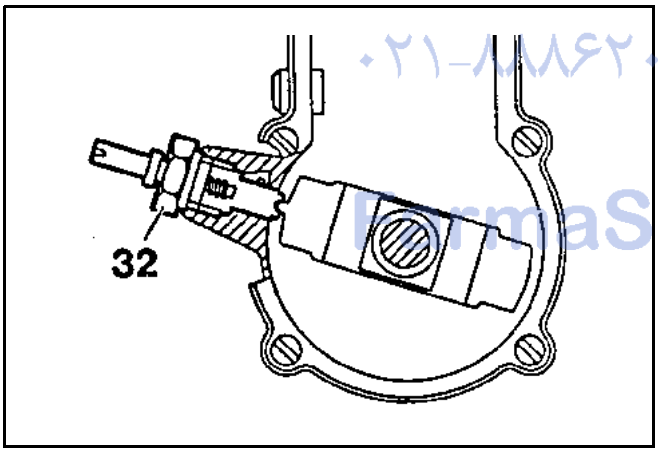
1. Remove the screw plug (27) and seal (26) and collect oil in a vessel.



2. Insert flange (31) onto the injection pump camshaft and turn until the cam of the governor is visible in the hole.

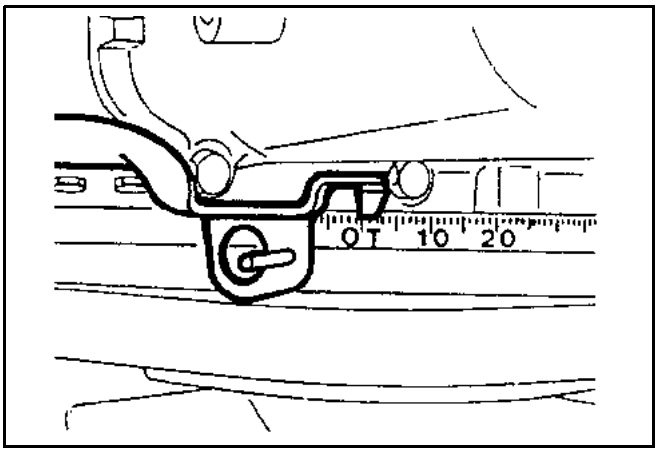
Flange 601 589 00 08 00

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۰۲۱-۸۸۸۶۲۰۸۵ تلفن شبانه روزی:
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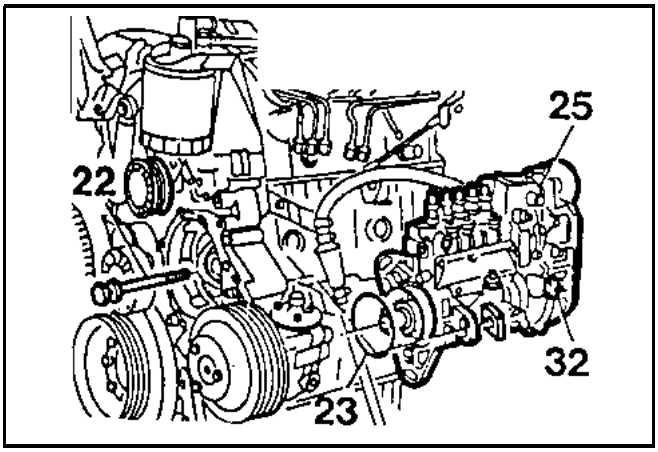


3. Tighten the locking screw.

Locking Screw 601 589 05 21 00



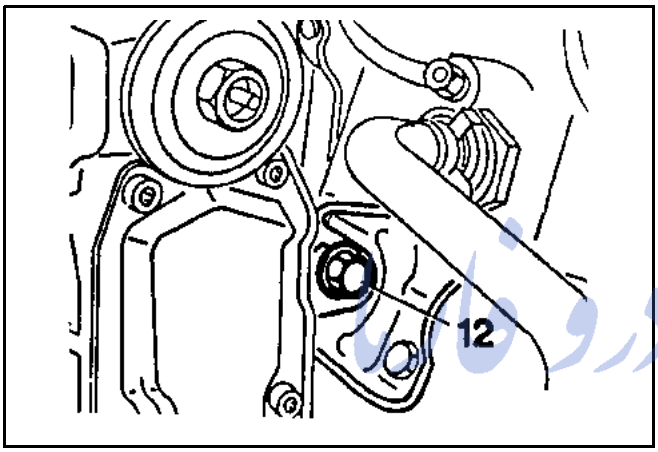
4. Ensure that the No.1 cylinder is positioned at ATDC 15°.



5. Coat the new seal (23) with engine oil and install it.
6. Insert the fuel injection pump (25) and tighten the bolts (22).

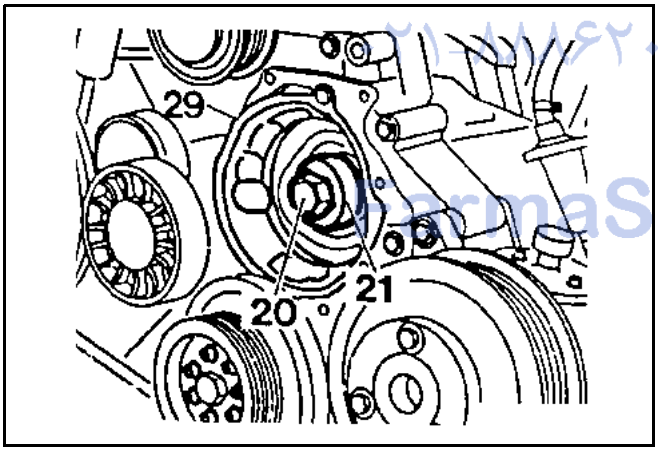
Tightening Torque	23 N·m (17 lb-ft)

7. Remove the locking screw (32).



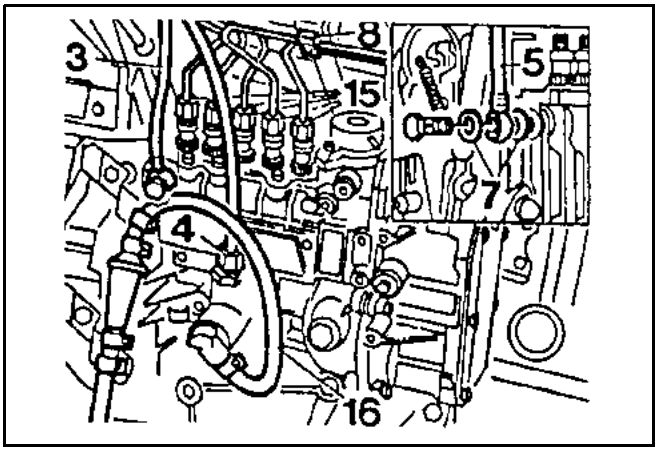
8. Tighten the bolt(12).

Tightening Torque	23 N·m (17 lb-ft)



9. Insert the washer (21) and tighten the bolts (20) and then remove the assembly cage (29).

Tightening Torque	46 N·m (34 lb-ft)



10. Connect the fuel pipes.

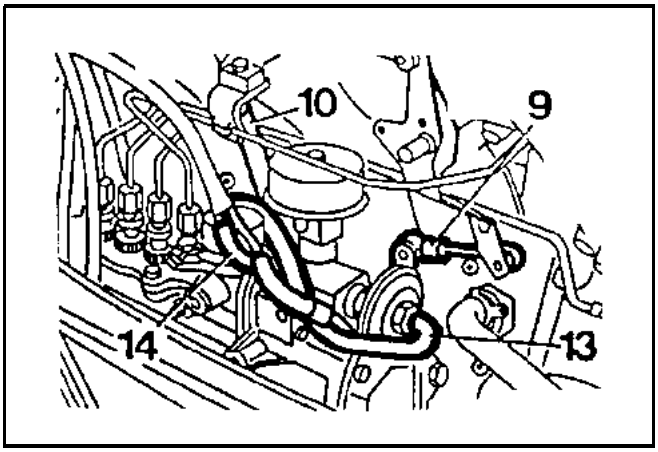
Return Line	46 N·m (34 lb-ft)
Fuel Injection Line	18 N·m (13 lb-ft)
Fuel feed Line	13 N·m (10 lb-ft)
Suction and Pressure Line	13 N·m (10 lb-ft)

Notice

Replace the seal.

Box Wrench Insert 000 589 77 03 00

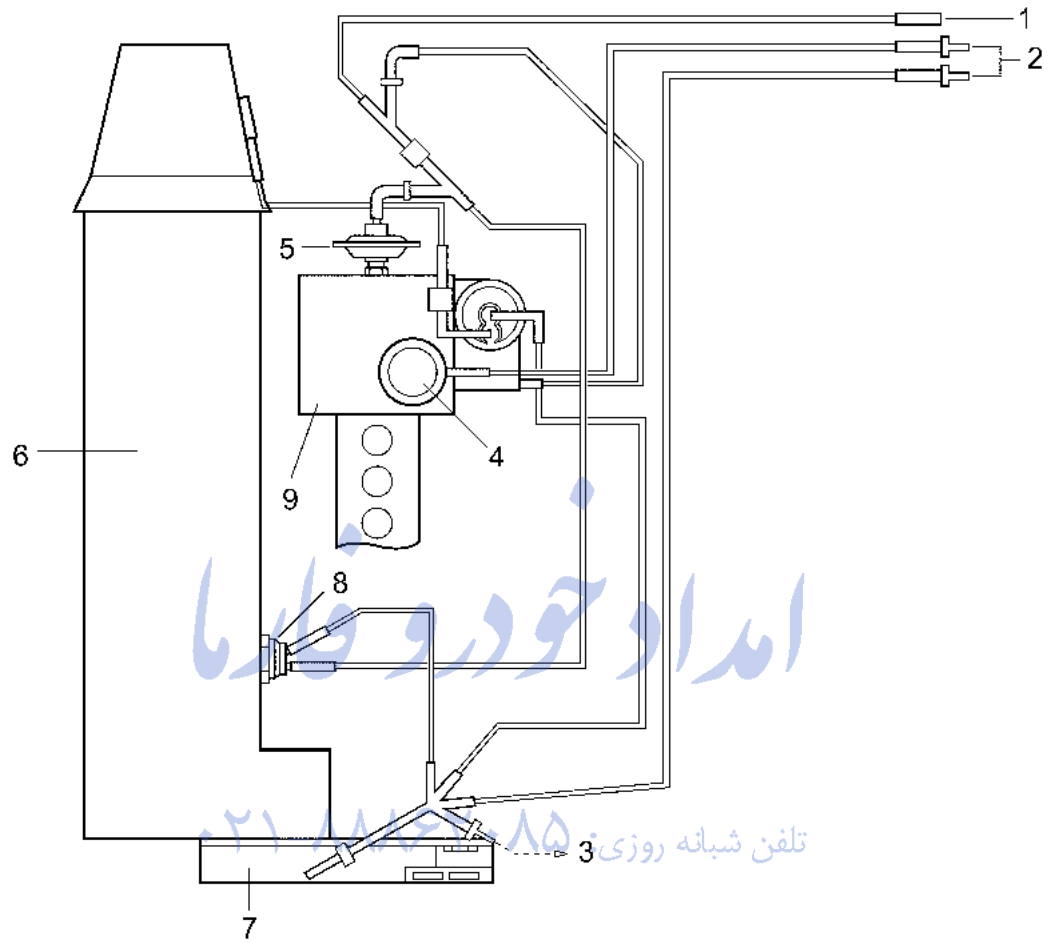
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11. Assemble the plastic clip (8).
12. Connect the vacuum line (13, 14).
13. Connect the connecting rod (9).
14. Connect the accelerator control damper (10). (Manual transmission vehicle)
15. Install the chain tensioner.
16. Install the vacuum pump.
17. Check the start of delivery.
18. Adjust the idle speed.

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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VACUUM CONTROL SYSTEM TEST



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1 Ventilation (To Passenger Compartment)
2 Engine Cut-Off Valve (Ignition Key Switch)
3 Auto-locking Hub Solenoid Valve
4 Engine Stop Valve Unit
5 PLA Vacuum Unit (Idle Speed Adjustment)
6 Engine
7 Vacuum Pump
8 30° Thermovalve
9 Fuel Injection Pump

Test Data

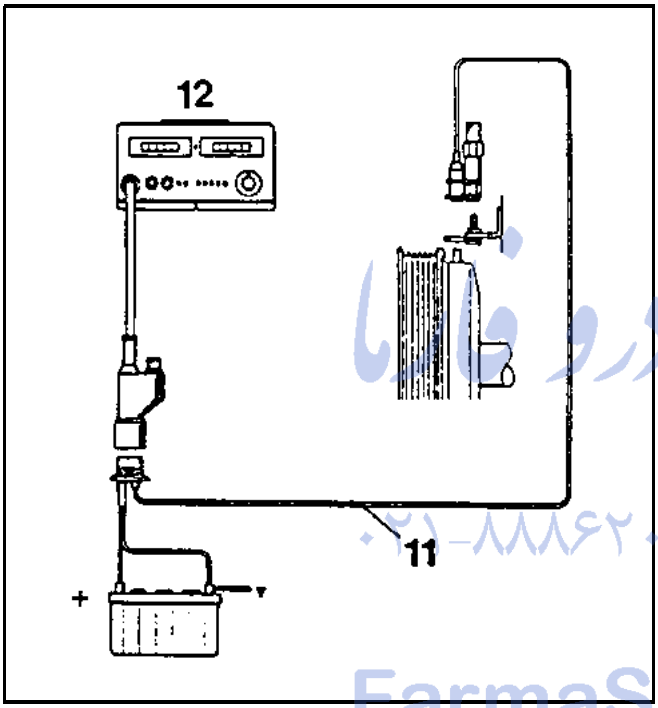
Idle Speed Increase	At least 100 rpm at approx. 500mbr
Permissible Pressure Drop of System	400 - 500mbar approx. 1 min.

Tools Required

001 589 73 21 00 Vacuum Pump
201 589 13 21 00 Vacuum Tester
667 589 00 21 00 TDC pulse generator

Commercial Tools

Digital tester	e.g. Bosch MOT 001.03 Sun DIT 9000
Temperature measuring instrument with test probe WB24	e.g. Ahlborn, Therm 2263-2 Eichenfeldstrabe 1 - 3 D-8150 Holzkirchen

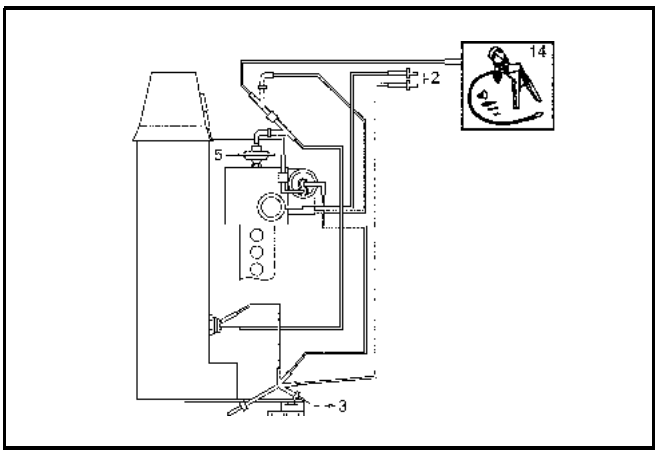


Tester Connection

11 TDC Pulse Sender Unit
12 Digital Tester

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Test step 1



Connect vacuum pump (14) with Y adapter to PLA vacuum unit (5). Run engine at idle speed.

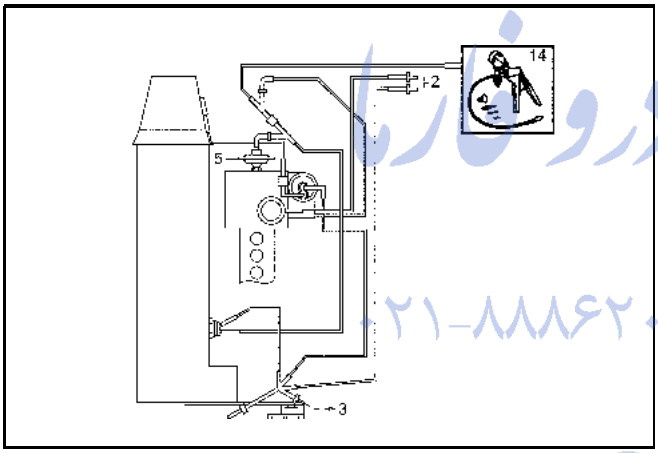
Vacuum ≧ 500 mbar

YES

NO

Lines and connections leaking. Faulty PLA vacuum unit.

(Remove the connection hose from vacuum pump)



Connect vacuum pump (14) direct to PLA vacuum unit (5) and pressurize with vacuum.

Vacuum is built up and idle speed increases approx. 150-200 rpm

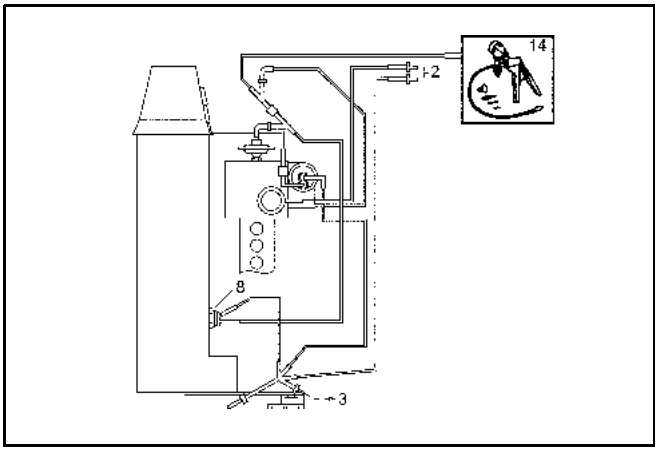
YES

NO

Faulty PLA vacuum unit

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(Coolant Temperature 30°C)



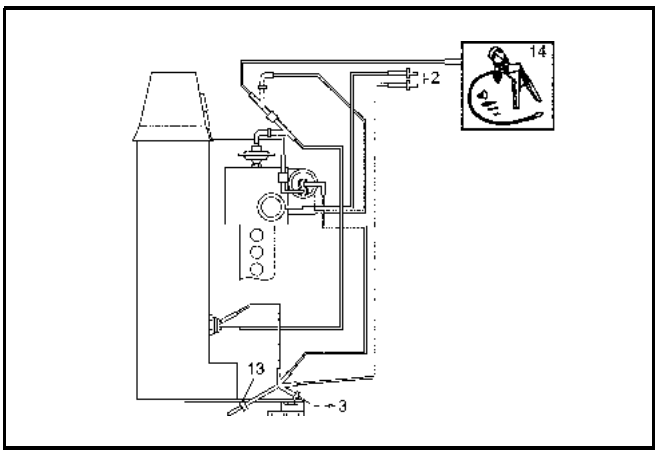
Stop the engine Seal the air admission line with plug. Connect the vacuum pump to line to thermovalve and pressurize the line with vacuum.

Vacuum is built up.

YES

NO

Lines and connections leaking. Faulty thermovalve.



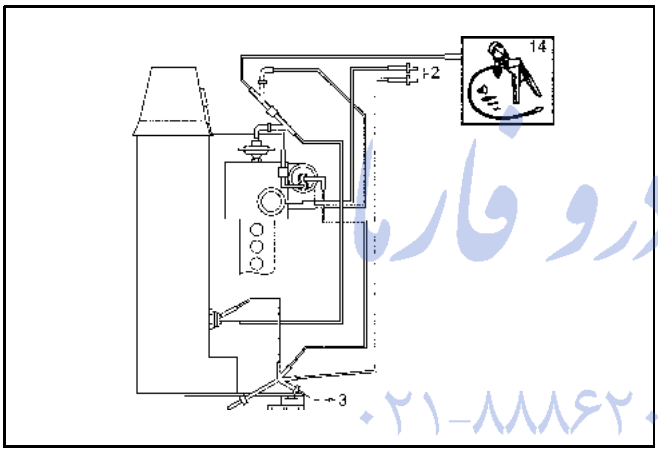
Detach line downstream of air admission filter (13).

Vacuum drops

YES

NO

Faulty thermovalve



Fit the line onto air admission filter. Built up vacuum with vacuum pump. Detach the plug from air admission line.

Vacuum drops

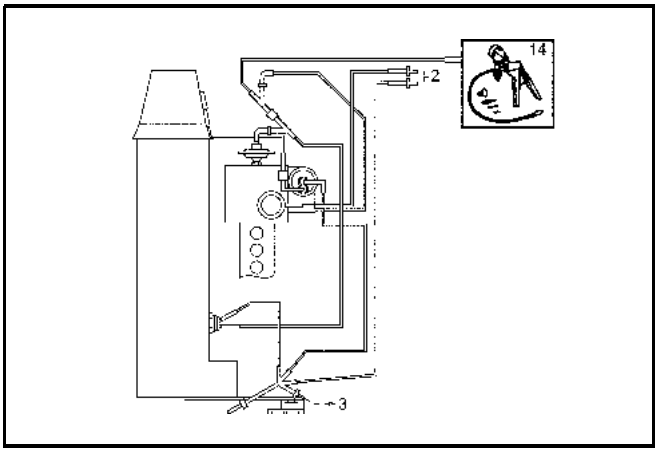
YES

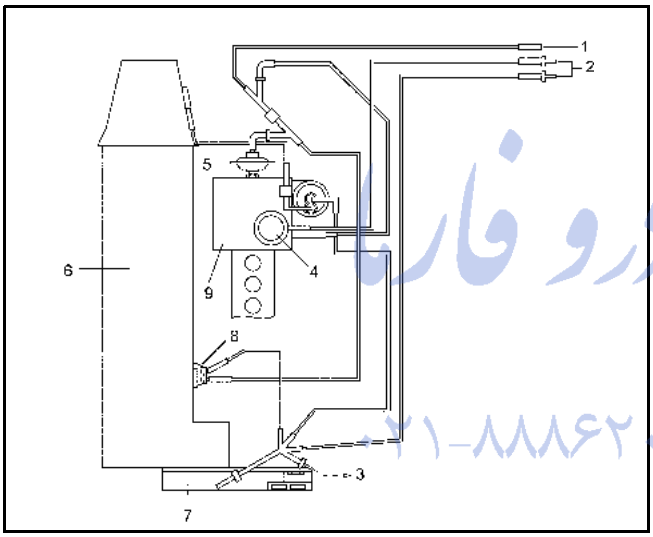
NO

Faulty filter with restriction.

Go to test step 2

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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Test step 2

Connect vacuum pump(14) with Y adapter to PLA vacuum unit(5). Run the engine at idle speed.

Vacuum drops to '0' at approx. 30°C of the thermovalve.

YES

NO

Faulty thermovalve.
Defective filter with restriction.

Stop the engine. Detach the filter with restriction.

Filter with restriction is clear.

YES

NO

Defective filter with restriction.

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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SECTION 2A

SUSPENSION DIAGNOSIS

TABLE OF CONTENTS

Diagnosis 2A-2
General Diagnosis 2A-2
Hub and Bearing 2A-7

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DIAGNOSIS

GENERAL DIAGNOSIS

Problems in the steering, the suspension, the tires, and the wheels involve several systems. Consider all systems when diagnosing a complaint. Some problems, such as abnormal or excessive tire wear and scuffed tires, may be the result of hard driving. Always road test the vehicle first. If possible, do this road test with the customer.

Proceed with the following preliminary checks. Correct any substandard conditions.

Preliminary Checks

Checks	Action
Inspect the tires for improper pressure and uneven wear.	Inflate the tires to the proper pressure.
Inspect the joint from the steering column to the steering gear for loose connections or wear.	Tighten the intermediate shaft pinch bolts. Replace the intermediate shaft, as needed.
Inspect the front and the rear suspension, the steering gear, and the linkage for loose or damaged parts.	Tighten the front and the rear suspension. Tighten the steering gear mounting bracket bolts. Tighten the intermediate shaft pinch bolts. Replace the front and the rear suspension, as needed. Replace the steering gear, as needed. Replace the intermediate shaft, as needed.
Inspect for out-of-round tires.	Perform a free runout test. Match-mount the tires.
Inspect for out-of-balance tires, bent wheels, and worn or loose wheel bearings.	Balance the wheels. Replace the wheels. Replace the wheel bearings.
Check the power steering pump serpentine belt tension.	Tighten the power steering pump serpentine belt.
Inspect the power steering system for leaks. Also, check the power steering fluid level.	Repair any leaks. Perform a power steering system test. Add power steering fluid, as needed.

Car Lead/Pull

Checks	Action
Inspect for mismatched or uneven tires.	Replace the tires.
Inspect for a broken or a sagging spring.	Replace the spring.
Inspect for a radial tire lateral force.	Check the wheel alignment. Switch the tire and the wheel assemblies. Replace the tires, as needed.
Check the front-wheel alignment.	Align the front wheels.
Inspect for an off-center steering gear.	Reseat the pinion valve assembly. Replace the pinion valve assembly, as needed.
Inspect for front-brake dragging.	Adjust the front brakes.

Scuffed Tires

Checks	Action
Inspect for incorrect toe on the front and the rear wheels.	Adjust the toe on the front and the rear wheels.
Inspect for a twisted or a bent suspension arm.	Replace the suspension arm.

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Abnormal or Excessive Tire Wear

Checks	Action
Check the front-wheel and the rear-wheel alignment.	Align the front and the rear wheels.
Inspect for excessive toe on the front and the rear wheels.	Adjust the toe on the front and the rear wheels.
Inspect for a broken or a sagging spring.	Replace the spring.
Inspect for out-of-balance tires.	Balance the tires.
Check for a failure to rotate tires.	Rotate the tires. Replace the tires, as needed.
Check for an overloaded vehicle.	Maintain the proper load weight.
Inspect for low tire inflation.	Inflate the tires to the proper pressure.

Wheel Tramp

Checks	Action
Inspect for an out-of-balance tire or wheel.	Balance the tire or the wheel.

Shimmy, Shake, or Vibration

Checks	Action
Inspect for an out-of-balance tire or wheel.	Balance the tire or the wheel.
Inspect for excessive wheel hub runout.	Measure the hub flange runout. Replace the hub, as needed.
Inspect for excessive brake rotor imbalance.	Adjust the brakes. Replace the brake rotor, as needed.
Inspect for worn tie rod ends.	Replace the outer tie rods.
Inspect for wheel trim imbalance.	Balance the wheel.
Inspect for a worn lower ball joint.	Replace the lower ball joint.
Inspect for excessive wheel runout.	Measure the wheel runout. Replace the wheel, as needed.
Inspect for excessive loaded radial runout on the tire and the wheel assembly.	Match-mount the tire and the wheel assembly.

امداد خودرو فارما
۰۲۱-۸۸۸۶۲۰۸۵
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Hard Steering

Checks	Action
Check the steering gear preload adjustment.	Perform a rack bearing preload adjustment.
Check the hydraulic system. Test the power steering system pressure with a gauge.	Replace the seals and the hoses, as needed.
Inspect for binding or catching in the steering gear.	Lubricate the steering gear. Repair or replace the steering gear, as needed.
Inspect for a loose steering gear mounting.	Tighten the steering gear mounting bracket nuts and the bolts.

Too Much Playin Steering

Checks	Action
Inspect for worn or loose front wheel bearings.	Replace the front wheel bearings.
Inspect for a loose steering gear mounting.	Tighten the steering gear mounting bracket nuts and the bolts.
Inspect the joint from the column to the steering gear for loose connections or wear.	Tighten the intermediate shaft pinch bolts. Replace the intermediate shaft, as needed.
Check the steering gear preload adjustment.	Perform a rack bearing preload adjustment.

Poor Returnability

Checks	Action
Inspect for lack of lubrication of the ball joints and the tie rod ends.	Replace the ball joints and the outer tie rods.
Inspect for binding in the ball joints.	Replace the ball joint.
Inspect for binding in the steering column.	Lubricate the steering column. Replace the steering column as needed.
Check the front-wheel alignment.	Align the front wheels.
Check the steering gear preload adjustment.	Perform a rack bearing preload adjustment.
Inspect for a sticking valve.	Lubricate the pinion valve assembly. Replace the pinion valve assembly, as needed.
Inspect for binding in the intermediate shaft on the steering gear.	Replace the intermediate shaft.

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تلفن شبانه روزی ۰۲۱-۸۸۴۶۲۰۸۵
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Abnormal Noise, Front Suspension

Checks	Action
Inspect for a lack of lubrication of the ball joints and the tie rod ends.	Replace the ball joints and the outer tie rods.
Inspect for damaged suspension components.	Replace the damaged suspension components.
Inspect for worn control arm bushings or tie rod ends.	Replace the control arm bushings or the tie rods.
Inspect for a loose stabilizer link.	Tighten the stabilizer link.
Inspect for loose wheel nuts.	Tighten the wheel nuts.
Inspect for loose suspension bolts or nuts.	Tighten the suspension bolts or the nuts.

Abnormal or Excessive Tire Wear

Checks	Action
Inspect for mismatched or uneven tires.	Replace the tires.
Inspect for lack of lubrication of the ball joints and the tie rod ends.	Replace the ball joints and the outer tie rods.
Inspect for worn dampeners.	Replace the dampeners.
Inspect for a loose stabilizer link.	Tighten the stabilizer link.
Inspect for a broken or a sagging spring.	Replace the spring.
Check the steering gear preload adjustment.	Perform a rack bearing preload adjustment.
Check the front-wheel and the rear-wheel alignment.	Align the front and the rear wheels.

Erratic Steering when Braking

Checks	Action
Inspect for worn or loose front wheel bearings.	Replace the front wheel bearings.
Inspect for a broken or a sagging spring.	Replace the spring.
Inspect for a leaking wheel cylinder or caliper.	Replace the wheel cylinder or the caliper.
Inspect for warped rotors.	Replace the rotors.
Inspect for an incorrect or an uneven caster.	If the caster is beyond specifications, check the frame and repair it, as needed.

Low or Uneven Trim Height

Checks	Action
Inspect for a broken or a sagging spring.	Replace the spring.
Check for an overloaded vehicle.	Maintain the proper load weight.
Inspect for an incorrect or weak spring.	Replace the spring.

Ride Too Soft

Checks	Action
Inspect for worn dampeners.	Replace the dampeners.
Inspect for a broken or a sagging spring.	Replace the spring.

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Ride Too Harsh

Checks	Action
Inspect for incorrect dampeners.	Replace the dampeners.
Inspect for an incorrect spring.	Replace the spring.

تلفن شبانه روزی: ۸۸۸۶۲۰۸۵-۲۱
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Body Leans or Sways in Corners

Checks	Action
Inspect for a loose stabilizer link.	Tighten the stabilizer link.
Check for an overloaded vehicle.	Maintain the proper load weight.
Inspect for a broken or a sagging spring.	Replace the spring.

Suspension Bottoms

Checks	Action
Inspect for worn dampeners.	Replace the dampeners.
Check for an overloaded vehicle.	Maintain the proper load weight.
Inspect for a broken or a sagging spring.	Replace the spring.

Steering Wheel Kickback

Checks	Action
Inspect for air in the power steering system.	Purge the power steering system of air.
Inspect for a loose steering gear mounting.	Tighten the steering gear mounting bracket nuts and the bolts.
Inspect the joint from the column to the steering gear for loose connections or wear.	Tighten the intermediate shaft pinch bolts. Replace the intermediate shaft, as needed.
Inspect for loose tie rod ends.	Tighten the tie rod ends. Replace the outer tie rods, as needed.
Inspect for loose or worn front wheel bearings.	Replace the front wheel bearings.

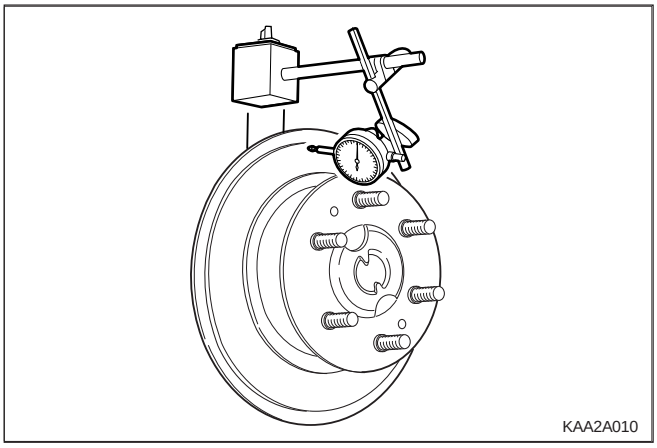
Steering Wheel Surges or Jerks

Checks	Action
Check the hydraulic system. Test the power steering system pressure with a gauge.	Replace the seals and the hoses, as needed.
Inspect for a sluggish steering gear valve.	Clean the pinion valve assembly. Replace the pinion valve assembly, as needed.
Inspect for a loose power steering pump serpentine belt.	Adjust the power steering pump serpentine belt.

Cupped Tires

Checks	Action
Check the front-wheel and the rear-wheel alignment.	Align the front and the rear wheels.
Inspect for worn dampeners.	Replace the dampeners.
Inspect for worn or loose wheel bearings.	Replace the wheel bearings.
Inspect for excessive tire or wheel runout.	Match-mount the tires. Replace the tires, as needed. Replace the wheels, as needed.
Inspect for a worn ball joint.	Replace the ball joint.
Check the steering gear preload adjustment.	Perform a rack bearing preload adjustment.

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HUB AND BEARING

Perform the following test to check for looseness in the hub and bearing assembly:

1. Raise and suitably support the vehicle.
2. Remove the rear wheel. Refer to *Section 2E, Tires and Wheels*.
3. Remove the caliper and the disc brake rotor. Refer to *Section 4E, Rear Disc Brakes*.
4. Mount a dial indicator set with a magnetic base to a stationary part of the vehicle.
5. Push and pull the wheel hub by hand. If the wheel hub movement exceeds 0.03 mm (0.001 inch), replace the hub and bearing assembly. Refer to *Section 2D, Rear Suspension*.
6. Install the caliper and the disc brake rotor. Refer to *Section 4E, Rear Disc Brakes*.
7. Install the rear wheel. Refer to *Section 2E, Tires and Wheels*.
8. Lower the vehicle.

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SECTION 2B

WHEEL ALIGNMENT

TABLE OF CONTENTS

Description and Operation 2B-2

Four Wheel Alignment 2B-2

Toe-in 2B-2

Caster 2B-2

Camber 2B-2

Diagnostic Information and Procedures 2B-3

Tire Diagnosis 2B-3

Radial Tire Lead/Pull 2B-4

Vibration Diagnosis 2B-6

Vehicle Height 2B-7

Front Toe-in Adjustment 2B-7

Front Camber Check 2B-8

Front Caster Check 2B-8

Specifications 2B-9

Wheel Alignment Specifications 2B-9

Fastener Tightening Specifications 2B-9

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵

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DESCRIPTION AND OPERATION

FOUR WHEEL ALIGNMENT

The first responsibility of engineering is to design safe steering and suspension systems. Each component must be strong enough to withstand and absorb extreme punishment. Both the steering system and the front and the rear suspension must function geometrically with the body mass.

The steering and the suspension systems require that the front wheels self-return and that the tire rolling effort and the road friction be held to a negligible force in order to allow the customer to direct the vehicle with the least effort and the most comfort.

A complete wheel alignment check should include measurements of the rear toe and camber.

Four-wheel alignment assures that all four wheels will be running in precisely the same direction.

When the vehicle is geometrically aligned, fuel economy and tire life are at their peak, and steering and perfor mance are maximized.

TOE-IN

Toe-in is the turning in of the tires, while toe-out is the turning out of the tires from the geometric centerline or thrust line. The toe ensures parallel rolling of the wheels.

The toe serves to offset the small deflections of the wheel support system which occur when the vehicle is rolling forward. The specified toe angle is the setting which achieves 0 degrees of toe when the vehicle is moving.

Incorrect toe-in or toe-out will cause tire wear and re duced fuel economy. As the individual steering and sus-pension components wear from vehicle mileage, additional toe will be needed to compensate for the wear.

Always correct the toe dimension last.

CASTER

Caster is the tilting of the uppermost point of the steering axis either forward or backward from the vertical when viewed from the side of the vehicle. A backward tilt is positive, and a forward tilt is negative. Caster influences directional control of the steering but does not affect tire wear. Weak springs or overloading a vehicle will affect caster. One wheel with more positive caster will pull toward the center of the car. This condition will cause the car to move or lean toward the side with the least amount of positive caster. Caster is measured in degrees.

CAMBER

Camber is the tilting of the top of the tire from the vertical when viewed from the front of the vehicle. When the tires tilt outward, the camber is positive. When the tires tilt inward, the camber is negative. The camber angle is measured in degrees from the vertical. Camber in-fluences both directional control and tire wear.

If the vehicle has too much positive camber, the outside shoulder of the tire will wear. If the vehicle has too much negative camber, the inside shoulder of the tire will wear.

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DIAGNOSTIC INFORMATION AND PROCEDURES

TIRE DIAGNOSIS

Irregular and Premature Wear

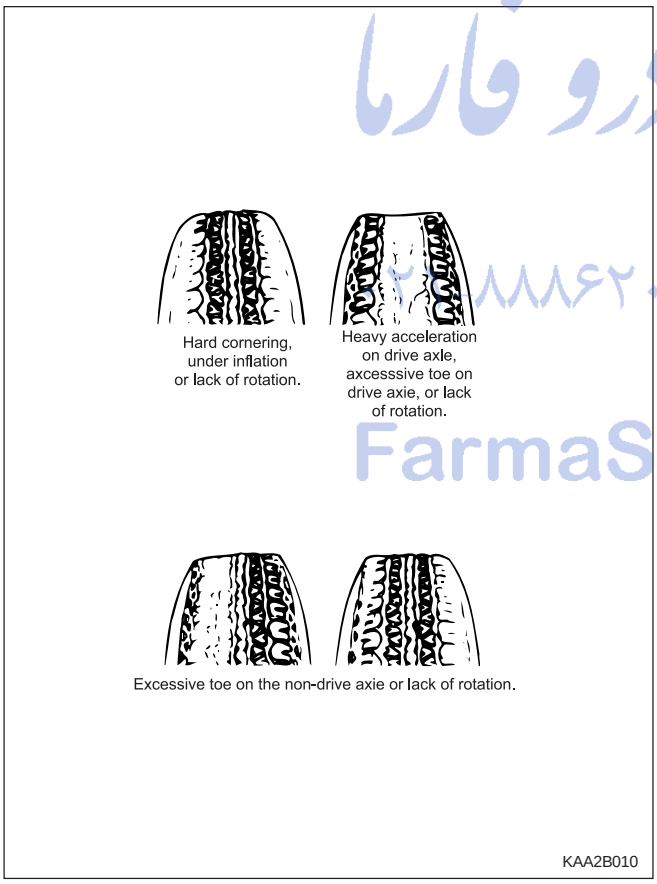
Irregular and premature tire wear has many causes. Some of them are incorrect inflation pressures, lack of regular rotation, poor driving habits, or improper wheel alignment.

Rotate the tires if :

- The front tire wear is different from the rear.
- The left and right front tire wear is unequal.
- The left and right rear tire wear is unequal.

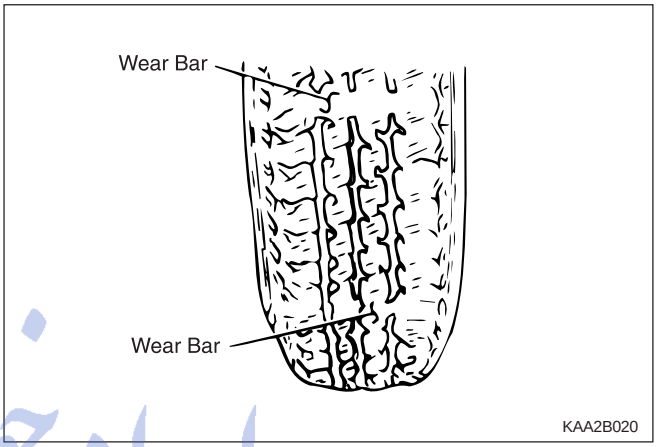
Check wheel alignment if :

- The left and right front tire wear is unequal.
- The wear is uneven across the tread of either front tire.
- The front tire treads are scuffed with “feather” edges on the side of the tread ribs or blocks.



Tread Wear Indicators

The original equipment tires have built-in tread wear in dicators to show when the tires need replacement. These indicators appear as bands when the tire tread depth becomes shallow. Tire replacement is recom mended when the indicators appear in three or more grooves at six locations.



Radial Tire Waddle

Waddle is side-to-side movement at the front or rear of the vehicle. It is caused by the steel belt not being straight within the tire, or by excessive lateral runout of the tire or wheel.

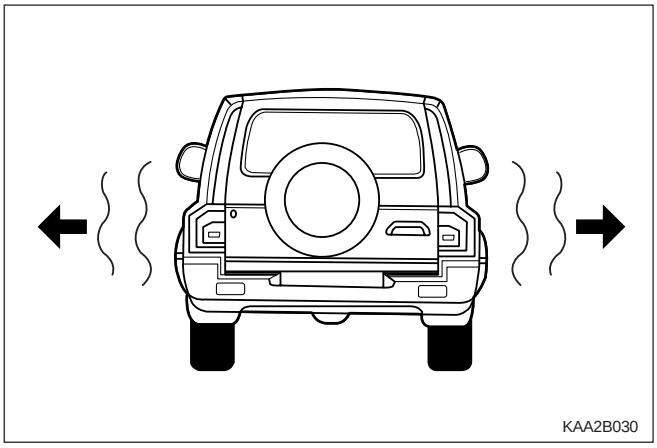
The vehicle must be road tested to determine which end of the vehicle has the faulty tire. The rear end of the vehicle will shake from side to side or “waddle” if the waddle tire is on the rear of the vehicle. From the driver’s seat, it feels as though someone is pushing on the side of the vehicle.

If the faulty tire is on the front of the vehicle, the waddle is more visual. The front sheet meld appears to be moving back and forth, and the drivers seat feels like the pivot point in the vehicle.

Waddle can be diagnosed using the method of substituting known good tire and wheel assemblies on the problem vehicle.

1. Road test the vehicle to determine if the waddle is coming from the front or the rear of the vehicle.
2. Install good tires and wheels from a similar vehicle in place of those on the offending end of the problem vehicle. If the source of the waddle is not obvious, change the rear tires.
3. Road test the vehicle. If there is improvement, install the original tires to find the offending tire. If there is no a straight improvement, install good tires in place of all four offending tires.

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RADIAL TIRE LEAD/PULL

Lead/pull is the deviation of the vehicle from a straight path on a level road with no pressure on the steering wheel. Lead is usually caused by:

- Incorrect alignment.
- Uneven brake adjustment.
- Tire construction.

The way in which a tire is built can produce lead/pull in the vehicle. Off-center belts on radial tires can cause the tire to develop a side force while the vehicle rolls straight down the road. If one side of the tire has even a little larger diameter than the diameter of the other side, the tire will tend to roll to one side. Unequal diameters will cause the tire to develop a side force which can produce vehicle lead/pull.

The radial lead/pull diagnosis chart should be used to determine whether the problem originates from an alignment problem or from the tires. Part of the lead diagnosis procedure calls for tire rotation that is different from the proper tire rotation pattern. If a medium-to high-mileage tire is moved to the other side of the vehicle, be sure to check for ride roughness. Rear tires will not cause lead/pull.

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RadialTire Lead/Pull Diagnosis Chart

Step	Action	Value(s)	Yes	No
1	1. Perform wheel alignment preliminary inspection. 2. Check the brakes for dragging. 3. Road test the vehicle. Does the vehicle lead/pull?	-	Go to Step 2	System OK
2	1. Cross switch the front tire and wheel assemblies. 2. Road test the vehicle. Does the vehicle lead/pull?	-	Go to Step 3	System OK
3	Check the front wheel alignment. Is the alignment within specifications?	-	Go to Step 4	Adjust alignment
4	Compare the front camber and front caster to specifications. Are they within specifications?	-	Go to Step 7	Go to Step 5
5	Check the vehicle frame. Is the frame bent?	-	Go to Step 6	Go to Step 1
6	Straighten the frame. Is the repair complete?	-	Go to Step 3	-
7	1. The probable cause is the tires. 2. Switch the left front tire and wheel assembly with the left rear tire and wheel assembly. 3. Road test the vehicle. Does the vehicle still lead/pull?	-	Go to Step 9	Go to Step 8
8	Switch the left front tire and wheel assembly with the left rear tire and wheel assembly and replace the left front tire. Does the repair complete?	-	System OK	Go to Step 1
9	1. Switch the right front tire and wheel assembly with the right rear tire and wheel assembly. 2. Road test the vehicle. Does the vehicle still lead/pull?	-	Go to Step 1	Go to Step 10
10	Switch the right front tire and wheel assembly with the right rear tire and wheel assembly and replace the right front tire. Is the repair complete?	-	System OK	Go to Step 1

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VIBRATION DIAGNOSIS

Wheel imbalance causes most highway speed vibration problems. A vibration can remain after dynamic balancing because:

- A tire is out of round
- A rim is out of round
- A tire stiffness variation exists

Measuring tire and wheel free runout will uncover only part of the problem. All three causes, known as loaded radial runout, must be checked using method of substituting known good tire and wheel assemblies on the problem vehicle.

Tire Balancing

Balance is the easiest procedure to perform and should be done first if the vibration occurs at high speeds. Do an off-vehicle, two-plane dynamic balance first to correct any imbalance in the tire and wheel assembly.

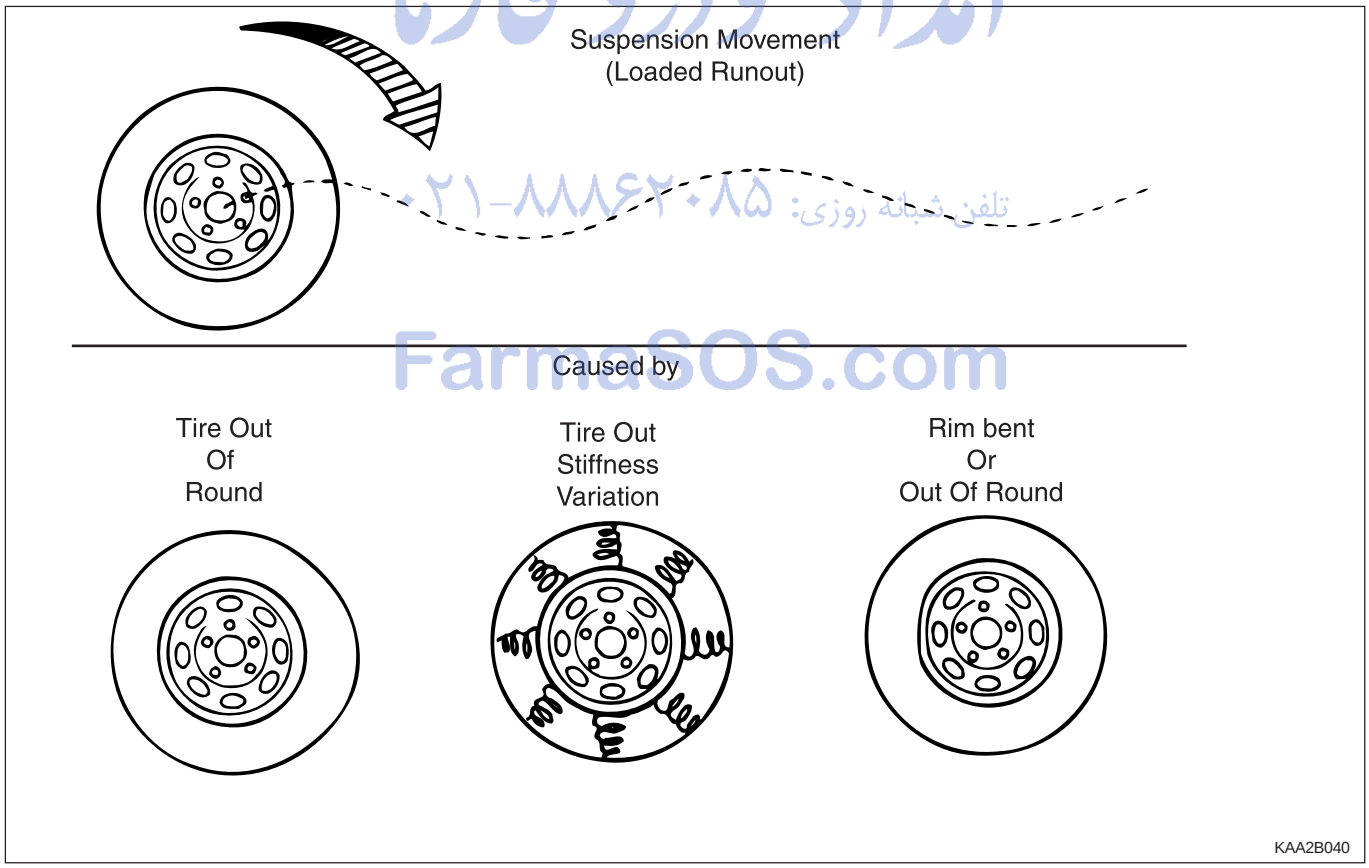
An on-vehicle finish balance will correct any brake drum, rotor, or wheel cover imbalance, If balancing does not correct the high-speed vibration, or if the vibration occurs at low speeds, runout is the probable cause.

Preliminary Checks

Prior to performing any work, always road test the car and perform a careful visual inspection for:

- Obvious tire and wheel runout.
- Obvious drive axle runout.
- Improper tire inflation.
- Incorrect trim height.
- Bent or damaged wheels.
- Debris build-up on the tire or the wheel.
- Irregular or excessive tire wear.
- Improper tire bead seating on the rim,
- Imperfections in the tires, including: tread deformations, separations, or bulges from impact damage. Slight sidewall indentations are normal and will not affect ride quality.

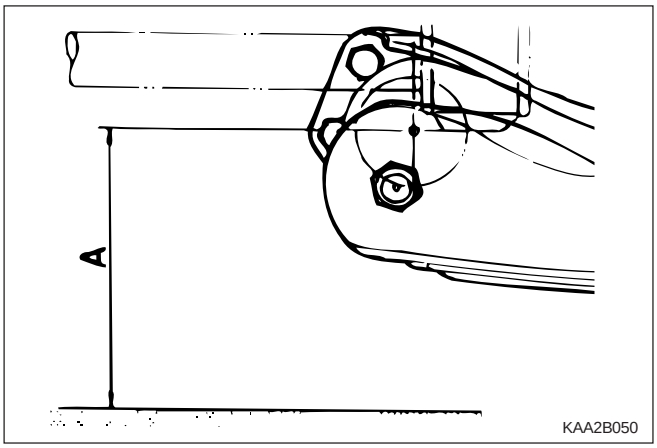
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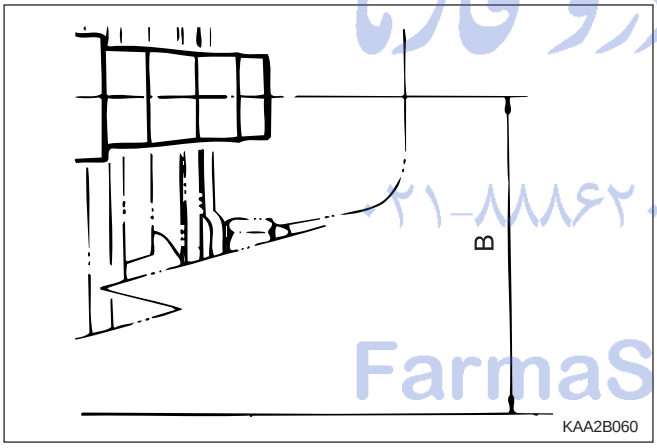
VEHICLE HEIGHT

Adjustment Procedure

1. Check the tire for proper inflation.
2. Measure 'A' from the center of the lower arm rear mounting bolt end to the ground.



3. Measure 'B' from the center of the steering knuckle shaft to the ground.

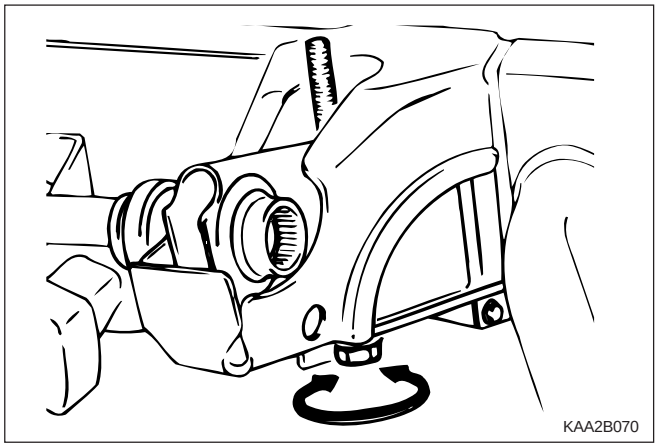


4. If the difference between 'A' and 'B' is not within specification, adjust vehicle height using torsion bar height control bolt.

Adjustment Notice

Specification	B - A	31 - 36 mm (1.22 - 1.42 inch)

Notice: Before wheel alignment, adjust vehicle height adjustment first.



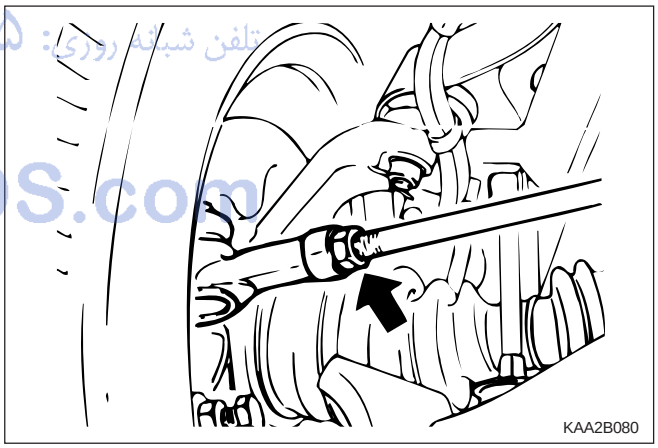
FRONT TOE-IN ADJUSTMENT

Adjustment Procedure

1. Disconnect the outer tie rods from the knuckle assemblies. Refer to *Section 6C, Power Steering Gear.*
2. Loosen the front toe adjusting nut.

Notice: In this adjustment, the right and the left tie rods must be equal in length, or the tires will wear unevenly.

3. Turn the right and the left outer tie rods to align the toe to the proper specifications. Refer to "Wheel Alignment Specifications" in this section.



4. Hold the outer tie rod and tighten the front toe adjusting nut.

Adjustment Notice

Tightening Torque	73 N•m (54 lb-ft)

5. Reconnect the outer tie rods to the knuckle assemblies. Refer to *Section 6C, Power Steering Gear.*

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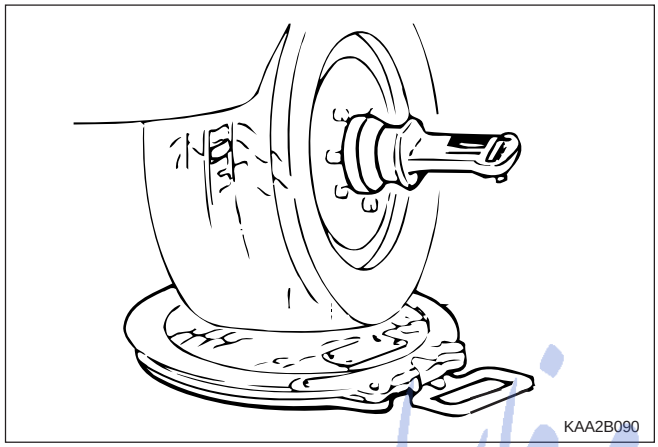
FRONT CAMBER CHECK

Adjustment Procedure

1. Remove the free wheel hub.
2. Measure camber with a wheel alignment equipment.

Adjustment Notice

Specification	0° ± 30′

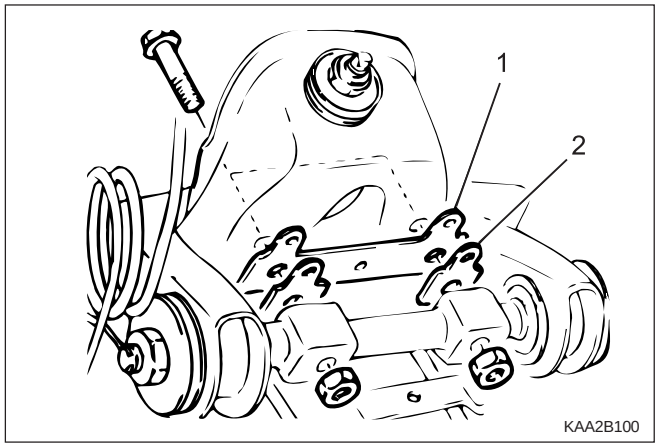


3. If camber measurements are not within specification, adjust it by increasing or decreasing the number of adjusting shims inserted between the upper arm shaft and cross bracket.

Adjustment Notice

Adjusting Shims	Increasing 1EA	Decreasing 1EA
1.6 Large	+19′	-19′
3.2 Large	+38′	-38′

Notice: Difference between the left and right should be adjusted within 30′.



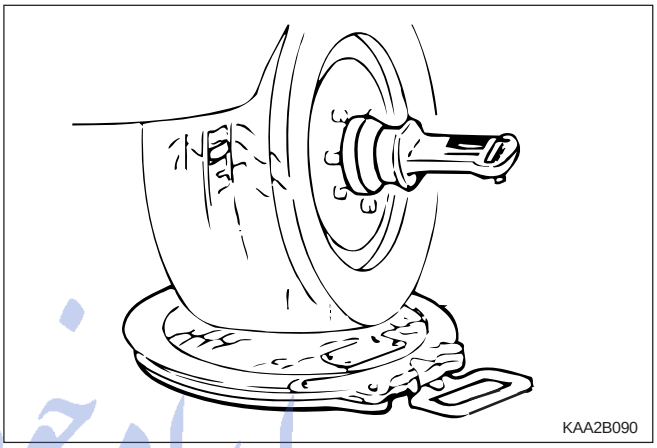
FRONT CASTER CHECK

Adjustment Procedure

1. Remove the free wheel hub.
2. Measure caster with a wheel alignment equipment and a turning radius gauge.

Adjustment Notice

Specification	2°30′ ± 30′

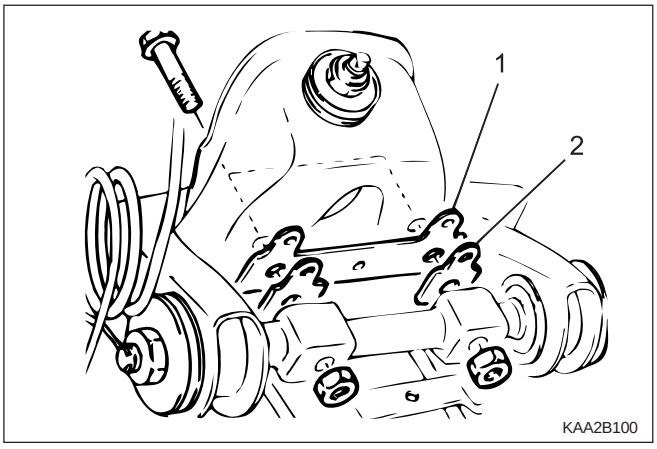


3. If caster measurements are not within specification, adjust it by increasing 1EA (rear) or decreasing 1EA (front).

Adjustment Notice

Adjusting Shims		Increasing 1EA	Decreasing 1EA
Front	0.4 Small	-11′	+11′
	1.6 Small	-43′	+43′
Rear	0.4 Small	+11′	-11′
	1.6 Small	+43′	-43′

Notice: Difference between the left and right should be adjusted within 30′.



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SPECIFICATIONS

WHEEL ALIGNMENT SPECIFICATIONS

Application	Front	Rear
Camber	0° ± 30′	-
Caster	2°30′ ± 30′	-
King Pin Inclination	12°30′	-
Toe-in (No load)	0 - 4 mm	-

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Front Toe Adjusting Nut	73	54	-

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SECTION 2C

FRONT SUSPENSION

TABLE OF CONTENTS

Components Locator 2C-2

Diagnostic Information and Procedures 2C-3

Ball Joint Inspection 2C-3

Repair Instructions 2C-4

On-Vehice Service 2C-4

Front Hub Bearing Assembly 2C-4

Front Stabilizer 2C-5

Stabilizer Link 2C-6

Torsion Bar 2C-7

Lower Control Arm 2C-7

Upper Control Arm 2C-8

Front Shock Absorber 2C-9

Lower Ball Joint 2C-10

Upper Ball Joint 2C-10

Knuckle Assembly 2C-11

Crossmember 2C-12

Unit Repair 2C-14

Hub and Bearing 2C-14

Specifications 2C-16

Fastener Tightening Specifications 2C-16

Special Tools and Equipment 2C-17

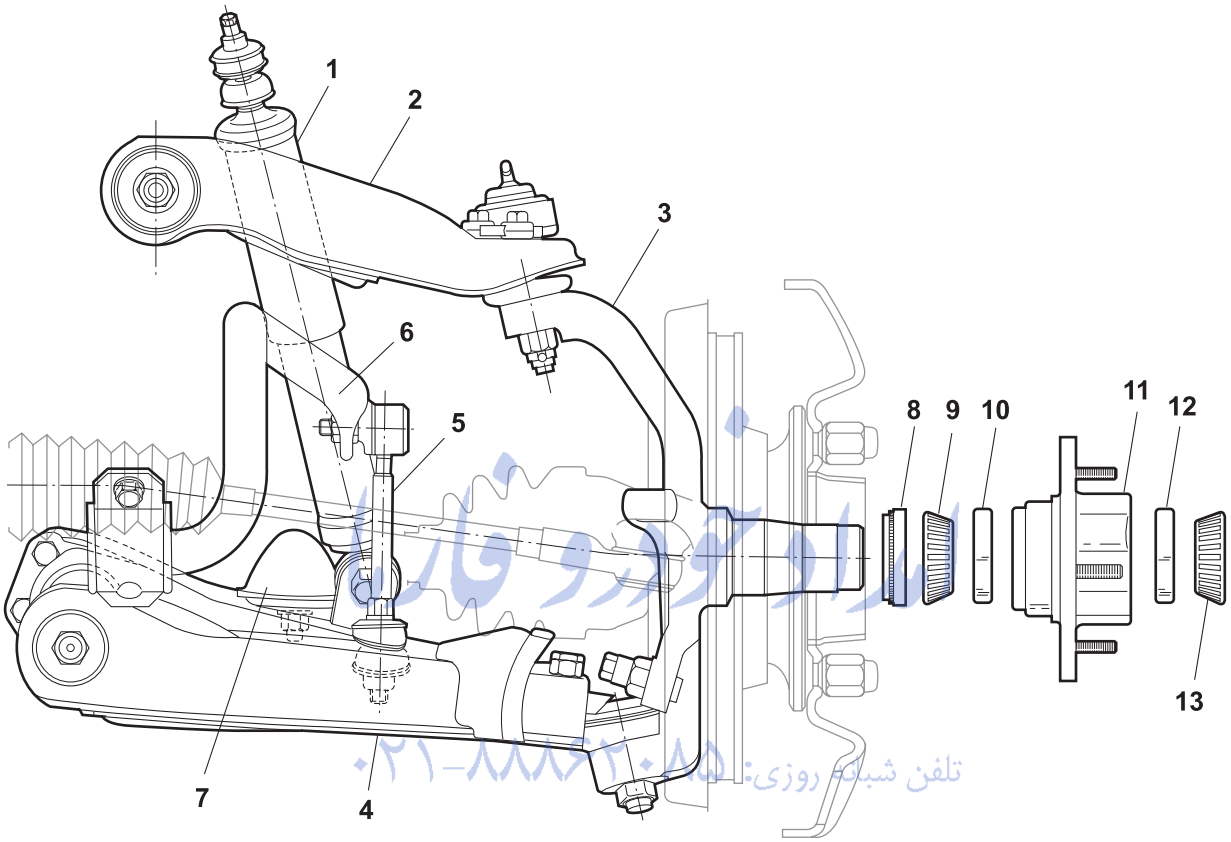
Special Tools Table 2C-17

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COMPONENTS LOCATOR



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1 Front Shock Absorber
2 Upper Control Arm
3 Knuckle
4 Low Control Arm
5 Stabilizer Link
6 Stabilizer
7 Suspension Bumper
8 Hub Inner Seal
9 Hub Inner Bearing
10 Hub Inner Bearing Race
11 Hub
12 Hub Outer Bearing Race
13 Hub Outer Bearing

DIAGNOSTIC INFORMATION AND PROCEDURES

BALL JOINT INSPECTION

Ball Joint Inspection

1. Raise the front of the vehicle to allow the front suspension to hang free.
2. Grasp the tire at the top and the bottom.
3. Move the top of the tire in an in-and-out motion.
4. Look for any horizontal movement of the knuckle relative to the control arm.
5. Ball joints must be replaced under the following conditions:
   - The joint is loose.
   - The ball seal is cut.
   - The ball stud is disconnected from the knuckle.
   - The ball stud is loose at the knuckle.
   - The ball stud can be twisted in its socket with finger pressure.

Ball Stud Inspection

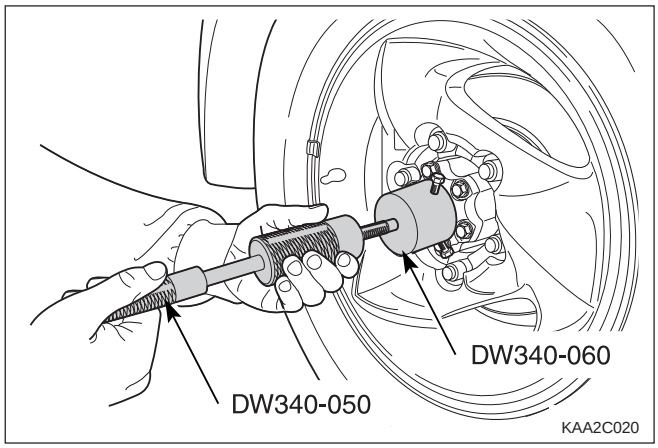
Make sure to check the tightness of the ball stud in the knuckle boss during each inspection of the ball joint. One way to inspect the ball stud for wear is to shake the wheel and feel for movement of the stud end at the knuckle boss.

Another way to inspect the ball stud for wear is to check the fastener torque at the pinch nut. A loose nut can indicate a stressed stud orahole in theknuckle boss.

Worn of damaged ball joints and knuckles must be replaced.

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REPAIR INSTRUCTIONS



ON-VEHICE SERVICE

FRONT HUB BEARING ASSEMBLY

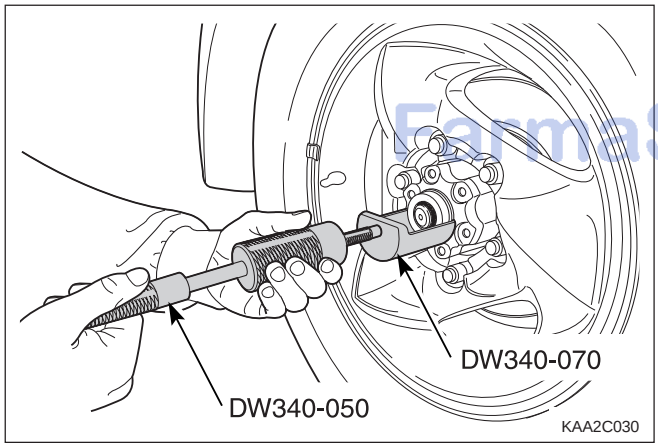
Tools Required

DW340-050	Sliding Hammer
DW340-060	Front Hub Cap Remover/Installer
DW340-070	Front Hub Flange Remover
661 589 01 07 00	Front Hub Adjusting Nut Remover/ nstaller

Removal and Installation Procedure

1. Raise and suitably support the vehicle.
2. Remove the front wheels. Refer to *Section 2E, Tires and Wheels*.
3. Remove the caliper assembly. Refer to *Section 4D, Front Disc Brakes*.
4. Remove the hub cap with front hub cap remover/ Installer DW340-060 and sliding hammer DW340-050.

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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5. Remove the hub flange bolts.

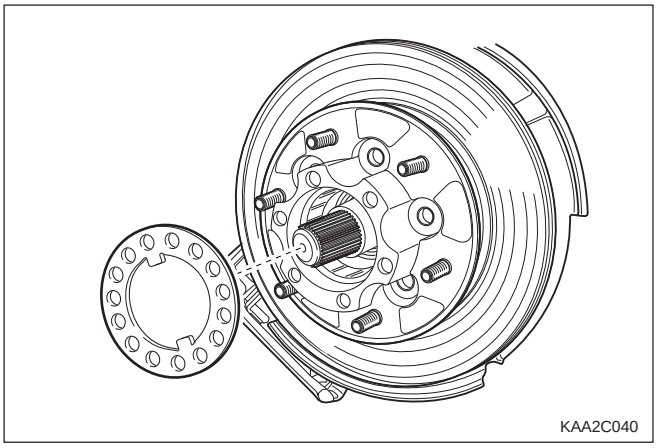
Installation Notice

Tightening Torque	55 N•m (41 lb-ft)

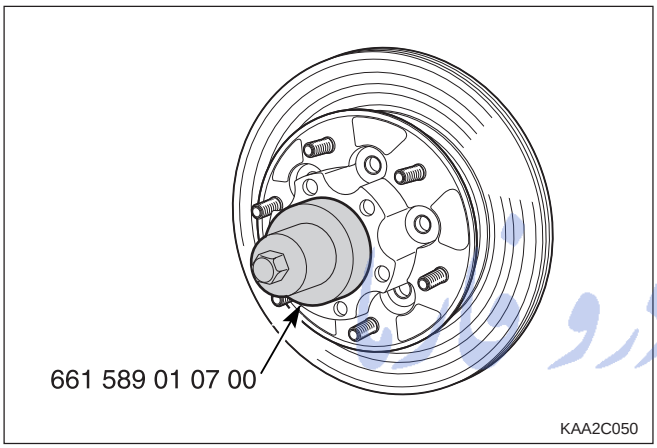
6. Remove the snap ring and hub flange with front hub flange remover DW340-070 and sliding hammer DW340-050.

Notice:

- When installing, coat the hub flange surface with Loctitte.


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7. Remove the hub adjust locking washer.



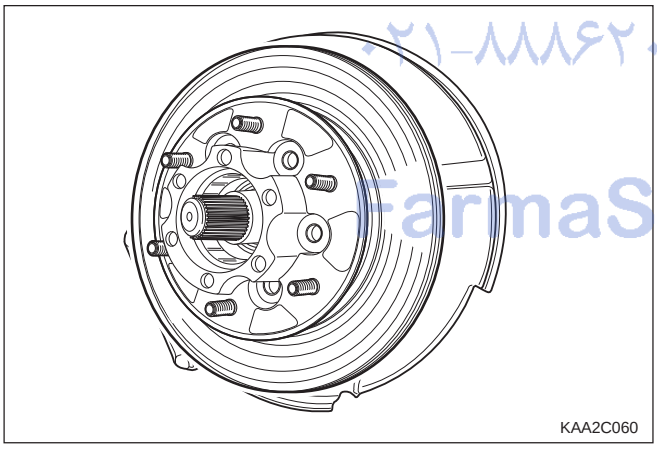
KAA2C050

8. Remove the hub adjusting nut with front hub adjusting nutremover/installer 661589 01 07 00.

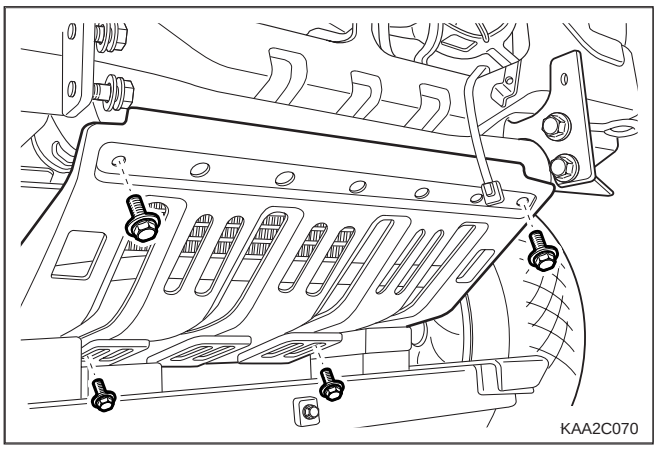
Installation Notice

Tightening Torque	15 N•m (11 lb-ft)

- When installing, adjust the clearance between the hub adjusting nut and hub not to exceed 0.2 mm (0.008 inch) using the shim.


KAA2C060

9. Remove the hub bearing assembly.
10. Installation should follow the removal procedure in the reverse order.


KAA2C070

FRONT STABILIZER

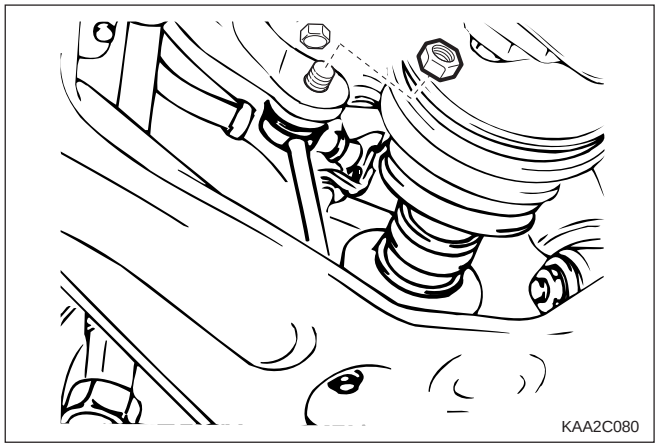
Removal and Installation Procedure

1. Raise and suitably support the vehicle.
2. Remove the lower cover.

Installation Notice

Tightening Torque	35 N•m (26 lb-ft)

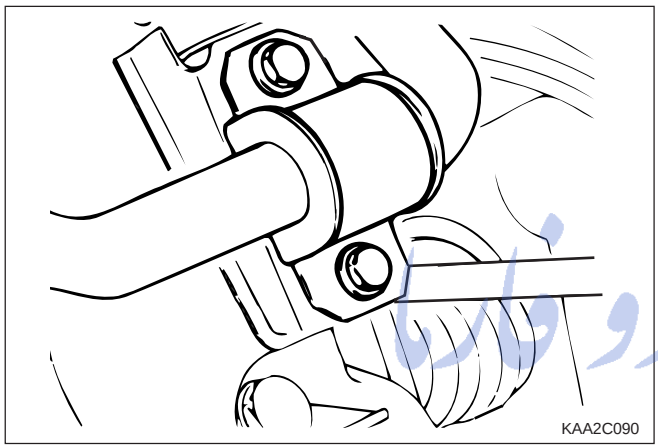
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KAA2C080

3. Remove the front stabilizer-to-stabilizer link nuts.

Installation Notice

Tightening Torque	70 N•m (52 lb-ft)


KAA2C090

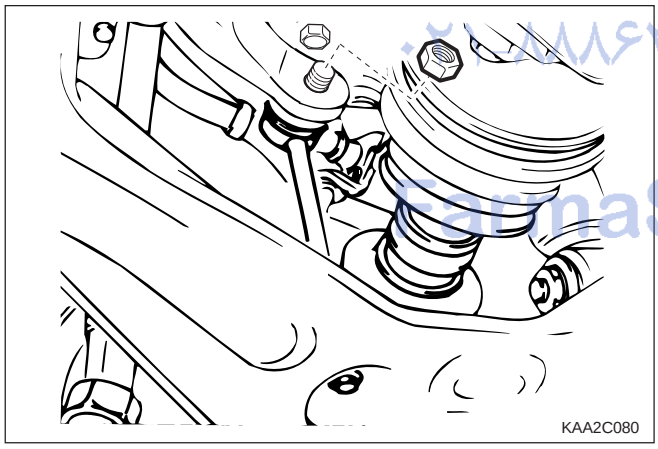
4. Remove the front stabilizer mounting bolts.

Installation Notice

Tightening Torque	38 N•m (28 lb-ft)

5. Installation should follow the removal procedure in the reverse order.

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تلفن شبانه روزی: ۰۸۵-۳۲۳۸۴۶۲۰
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KAA2C080

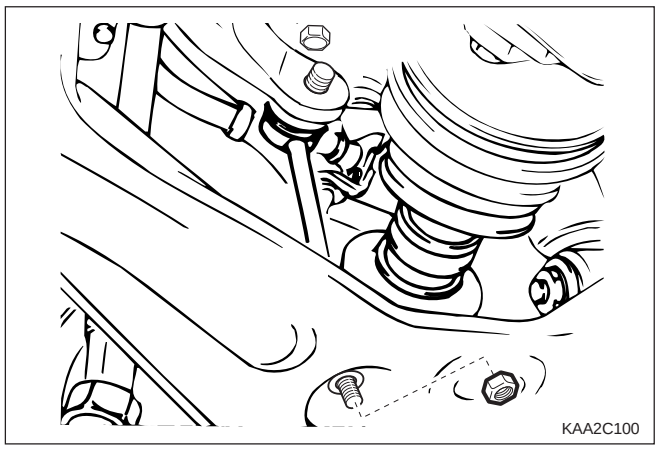
STABILIZER LINK

Removal and Installation Procedure

1. Raise and suitably support the vehicle.
2. Remove the front stabilizer-to-stabilizer link nuts.

Installation Notice

Tightening Torque	70 N•m (52 lb-ft)


KAA2C100

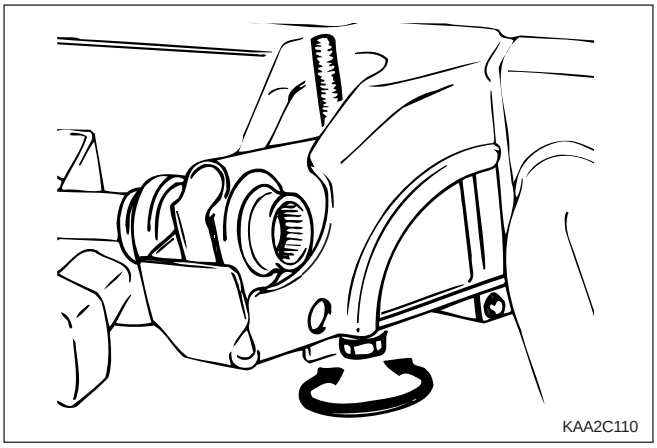
3. Remove the stabilizer link-to-lower control arm nuts.
4. Remove the stabilizer link.

Installation Notice

Tightening Torque	19 N•m (14 lb-ft)

- The distance between the end of the nut and the end of the stabilizer link should be 10 - 12 mm (0.39 - 0.47 inch) at the connection of the stabilizer link and lower control arm.

5. Installation should follow the removal procedure in the reverse order.


KAA2C110

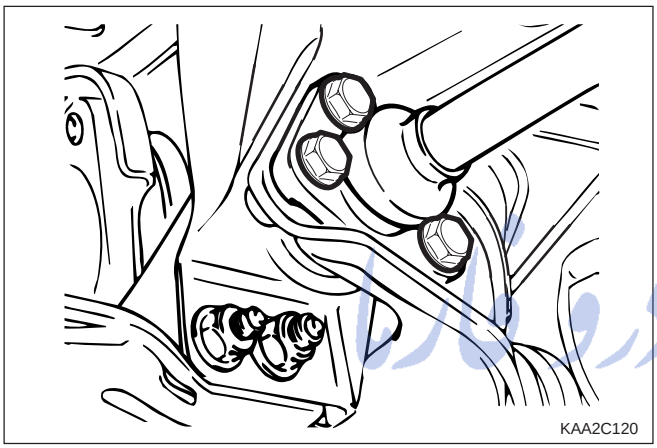
TORSION BAR

Removal and Installation Procedure

1. Raise and suitably support the vehicle.
2. Remove the height control bolt.

Notice:

- Install the torsion bar and adjust the distance be tween the end of the height control blot and piece end of the bolt to be 50 - 55 mm (1.97 - 2.17 inch). Adjust the vehicle height.


KAA2C120

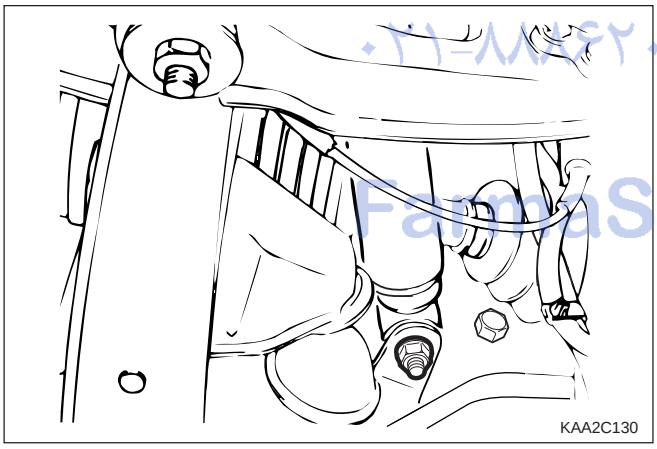
3. Remove the torsion bar fixing nuts and bolts and then withdraw the torsion bar.

Installation Notice

Tightening Torque	M10	50 N•m (37 lb-ft)
	M12	70 N•m (52 lb-ft)

- Check and adjust the wheel alignment.

4. Installation should follow the removal procedure in the reverse order.


KAA2C130

LOWER CONTROL ARM

Tools Required

661 589 13 33 00 Ball Joint Remover

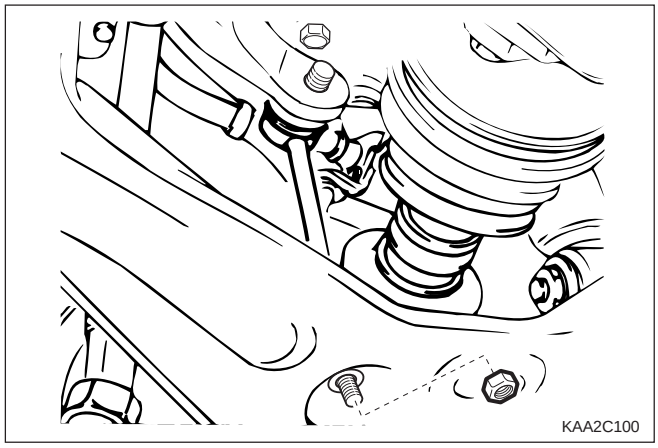
Removal and Installation Procedure

1. Raise and suitably support the vehicle.
2. Remove the front wheels. Refer to *Section 2E, Tires and Wheels*.
3. Remove the torsion bar. Refer to “Torsion Bar” in this section.
4. Remove the front shock absorber lower mounting bolt and nut.

Installation Notice

Tightening Torque	70 N•m (52 lb-ft)

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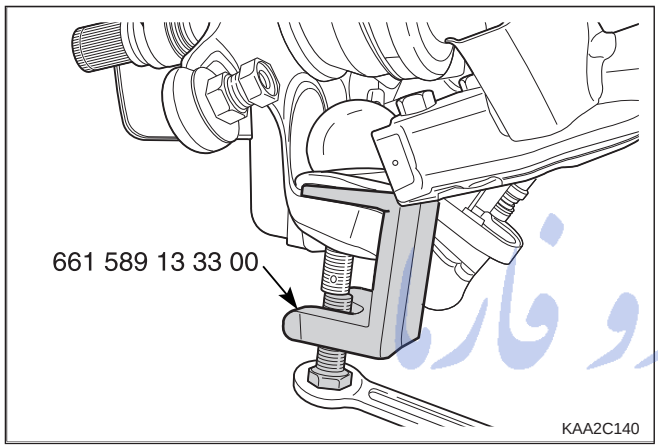


5. Remove the stabilizer link-to-lower control arm nut.

Installation Notice

Tightening Torque	19 N•m (14 lb-ft)

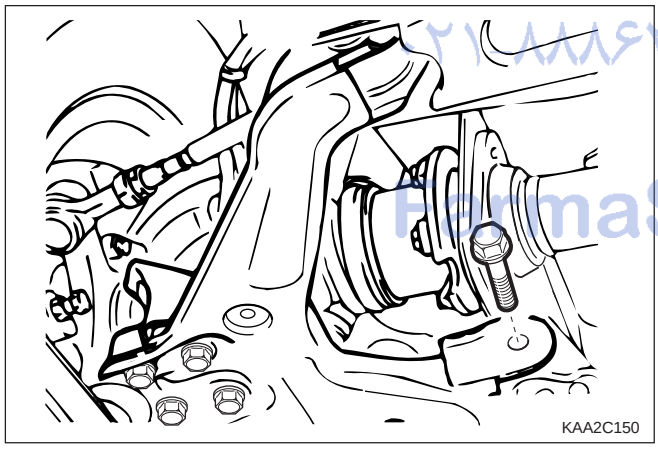
- The distance between the end of the nut and the end of the stabilizer link should be 10 - 12 mm (0.39 - 0.47 inch) at the connection of the stabilizer link and lower control arm.



6. Remove the lower ball joint using the ball joint remover 661 589 13 33 00.

Installation Notice

Tightening Torque	150 N•m (111 lb-ft)

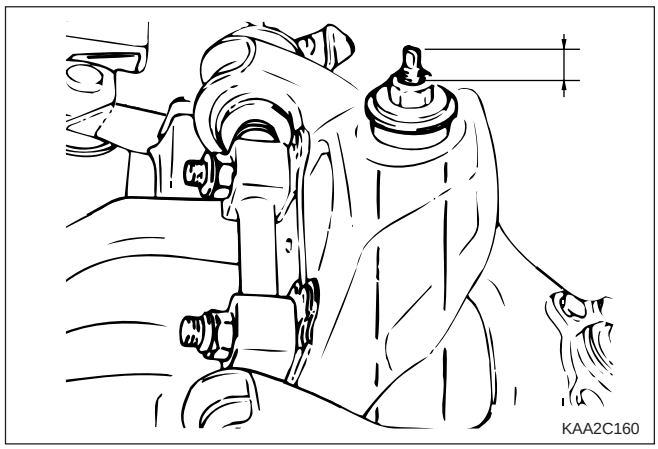


7. Remove the lower control arm mounting bolts.

Installation Notice

Tightening Torque	120 N•m (89 lb-ft)

8. Installation should follow the removal procedure in the reverse order.



UPPER CONTROL ARM

Tools Required

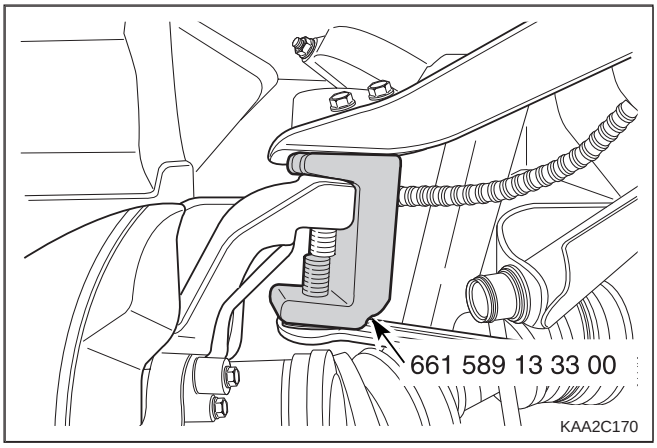
661589 13 33 00 BallJointRemover

Removal and Installation Procedure

1. Raise and suitably support the vehicle.
2. Remove the front wheels. Refer to *Section 2E, Tires and Wheels*.
3. Remove the front shock absorber upper mounting nut.

Notice:

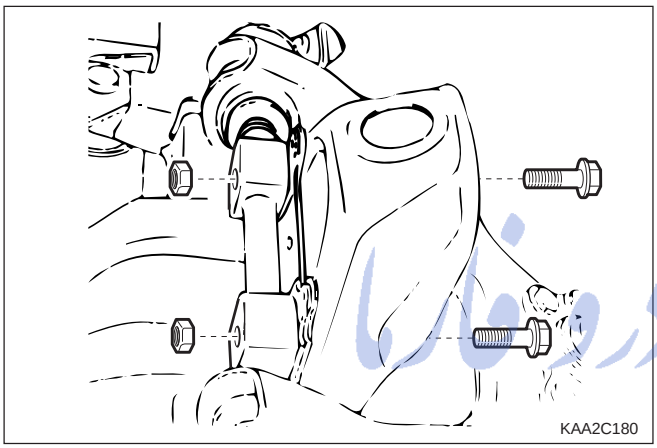
- The distance between the nut end and the screw end is 6 - 9 mm (0.24 - 0.35 inch).



4. Remove the upper ball joint using the ball joint remover 661 589 13 33 00.

Installation Notice

Tightening Torque	115 N•m (85 lb-ft)



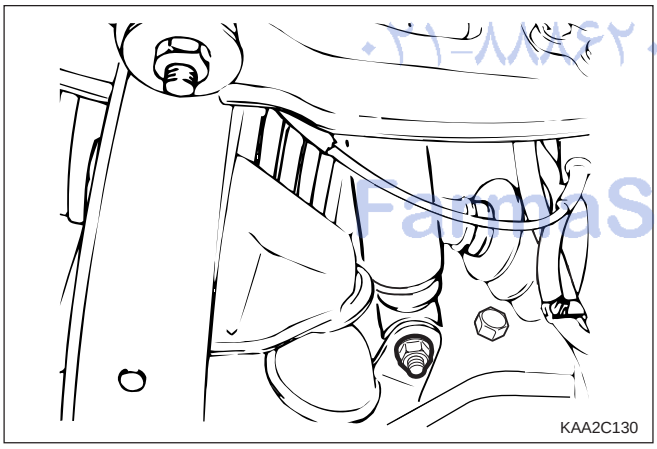
5. Remove the fulcrum pin mounting bolts and nuts and remove the upper control arm.

Removal Notice

Tightening Torque	130 N•m (96 lb-ft)

- Be careful not to damage or lose the adjusting shims.
- Check and adjust the wheel alignment.

6. Installation should follow the removal procedure in the reverse order.



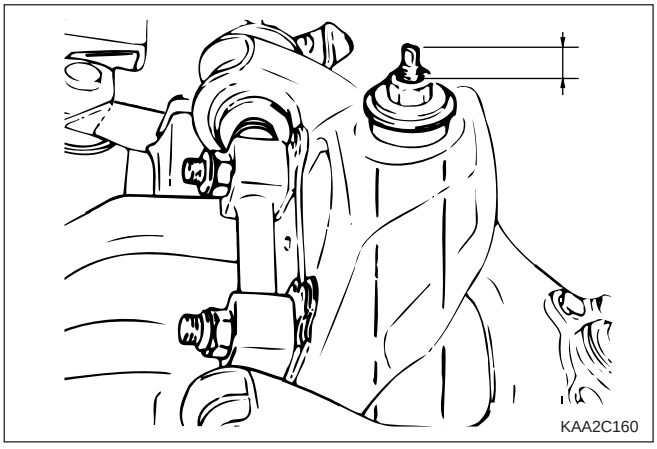
FRONT SHOCK ABSORBER

Removal and Installation Procedure

1. Raise and suitably support the vehicle.
2. Remove the front wheels. Refer to *Section 2E, Tires and Wheels*.
3. Remove the front shock absorber lower mounting bolt and nut.

Removal Notice

Tightening Torque	70 N•m (52 lb-ft)



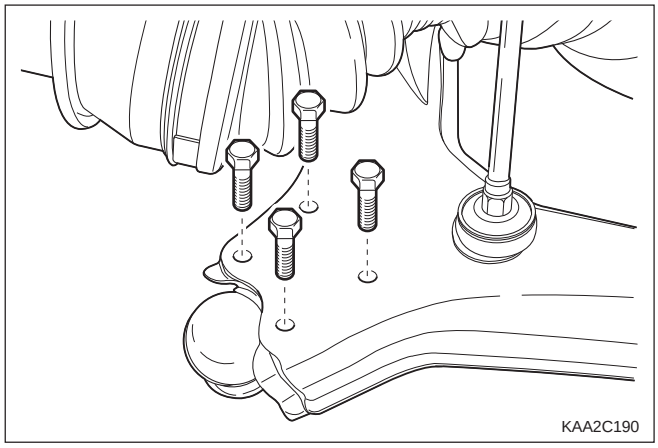
4. Remove the front shock absorber upper mounting nut.

Notice:

- The distance between the nut end and the screw end is 6 - 9 mm (0.24 - 0.35 inch).

5. Installation should follow the removal procedure in the reverse order.

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KAA2C190

LOWER BALL JOINT

Removal and Installation Procedure

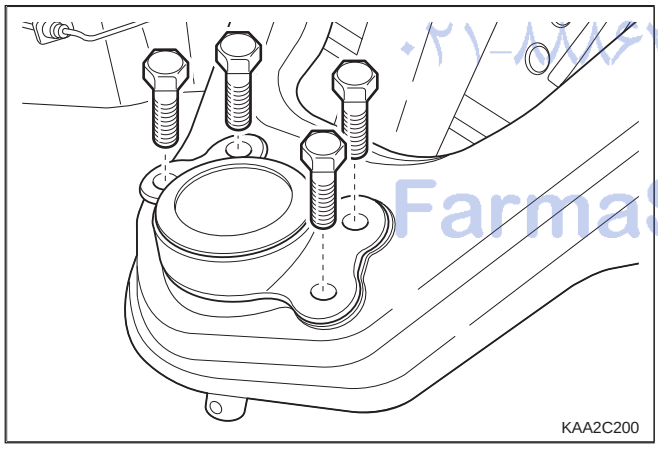
1. Raise and suitably support the vehicle.
2. Remove the front wheels. Refer to *Section 2E, Tires and Wheels*.
3. Remove the knuckle assembly. Refer to “Knuckle Assembly” in this section.
4. Remove the lower ball joint.

Installation Notice

Tightening Torque	70 N•m (52 lb-ft)

5. Installation should follow the removal procedure in the reverse order.

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KAA2C200

UPPER BALL JOINT

۰۲۱-۸۸۶۲۰۸۵ تلفن شبانه روزی
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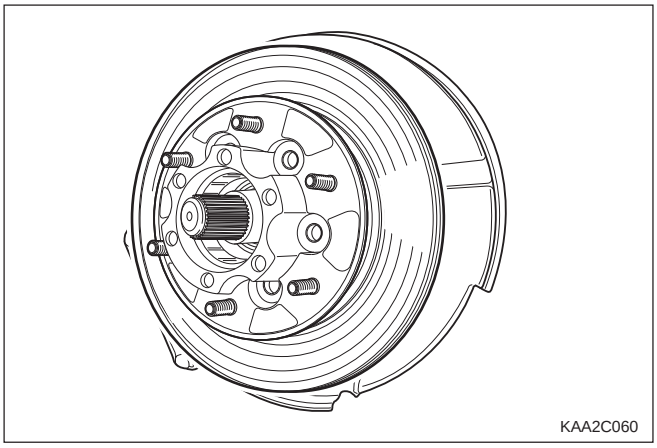
Removal and Installation Procedure

1. Raise and suitably support the vehicle.
2. Remove the front wheels. Refer to *Section 2E, Tires and Wheels*.
3. Remove the knuckle assembly. Refer to “Knuckle Assembly” in this section.
4. Remove the upper ball joint.

Installation Notice

Tightening Torque	130 N•m (96 lb-ft)

5. Installation should follow the removal procedure in the reverse order.


KAA2C060

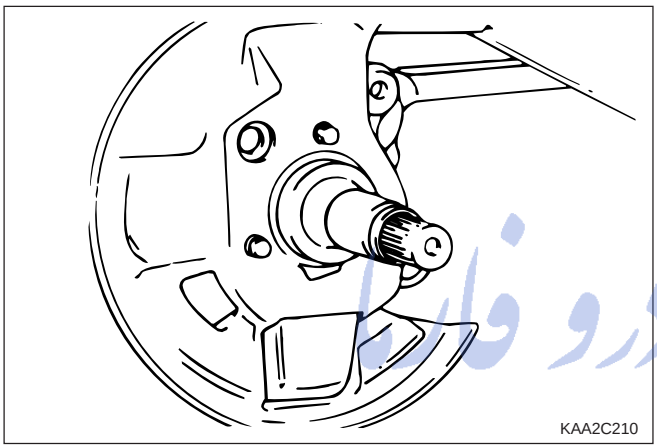
KNUCKLE ASSEMBLY

Tools Required

661589 13 33 00 BallJointRemover

Removal and Installation Procedure

1. Raise and suitably support the vehicle.
2. Remove the front wheels. Refer to *Section 2E, Tires and Wheels*.
3. Remove the caliper assembly. Refer to *Section 4D, Front Disc Brakes*.
4. Remove the front hub bearing assembly. Refer to "Front hub bearing assembly" in this section.

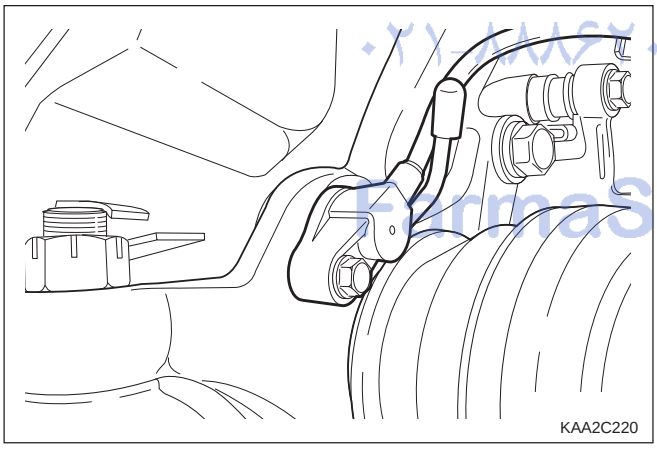

KAA2C210

5. Remove the splash shield mounting bolts.

Installation Notice

Tightening Torque	6 N•m (53 lb-in)

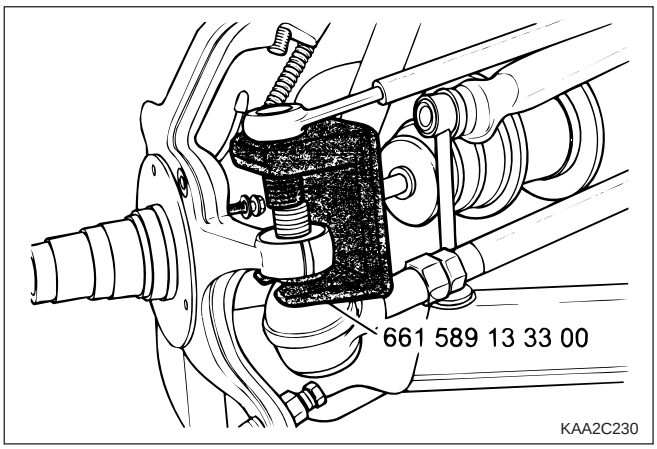
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۰۲۱-۸۸۸۶۲۰۸۵ تلفن پشتیبانی
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KAA2C220

6. Remove the front wheel speed sensor.

Installation Notice

Tightening Torque	5 N•m (33 lb-in)

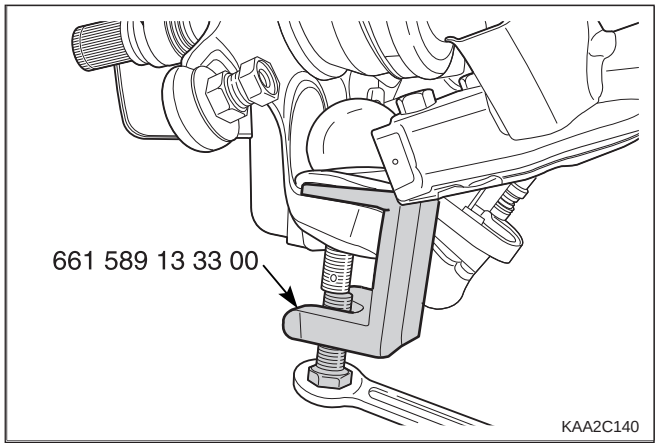


KAA2C230

7. Remove the outer tie rod nuts and disconnect the tie rod ends from the knuckle using the ball joint remover 661 589 13 33 00.

Installation Notice

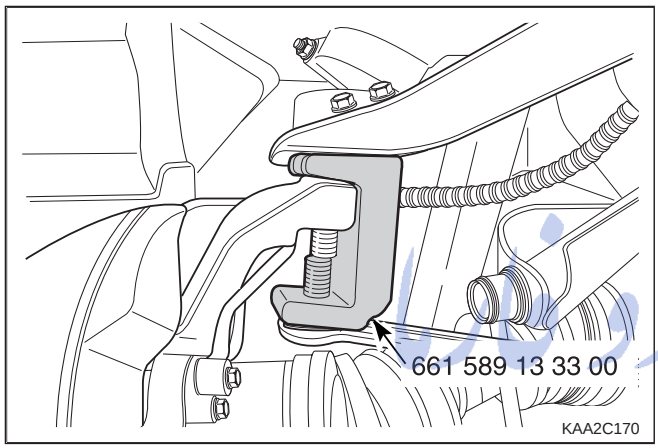
Tightening Torque	40 N•m (30 lb-ft)



8. Remove the lower ball joint using the ball joint remover 661 589 13 33 00.

Installation Notice

Tightening Torque	150 N•m (111 lb-ft)

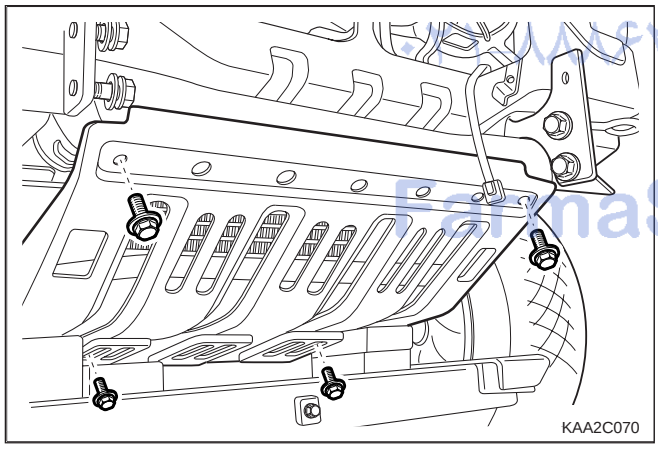


9. Remove the upper ball joint using the ball joint remover 661 589 13 33 00.

Installation Notice

Tightening Torque	115 N•m (85 lb-ft)

10. Remove the knuckle assembly.
11. Installation should follow the removal procedure in the reverse order.



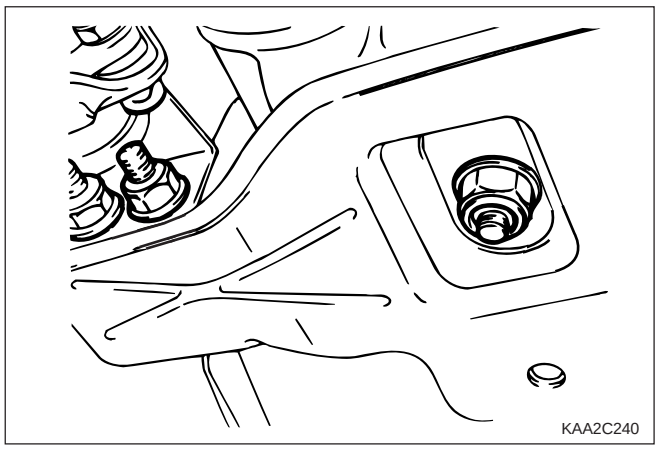
CROSSMEMBER

Removal and Installation Procedure

1. Raise and suitably support the vehicle.
2. Remove the lower cover.

Installation Notice

Tightening Torque	35 N•m (26 lb-ft)

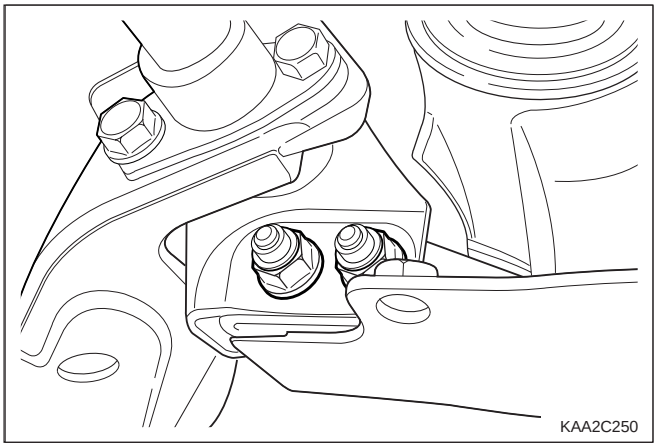


3. Remove the front axle housing mounting nuts from the crossmember.

Installation Notice

Tightening Torque	118 N•m (87 lb-ft)

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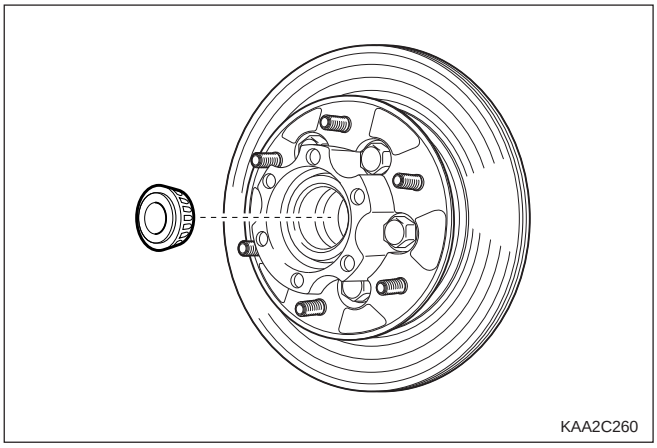
4. Remove the crossmember mounting bolts and nuts.

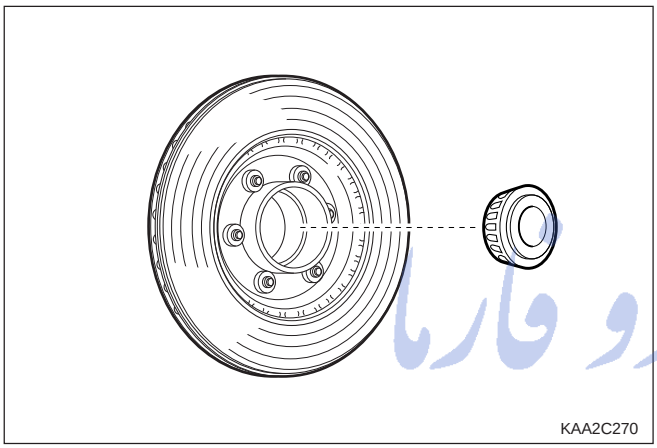
Installation Notice

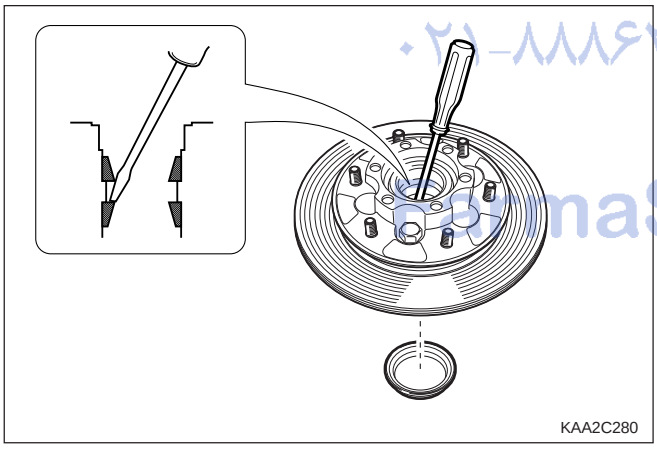
Tightening Torque	78 N•m (58 lb-ft)

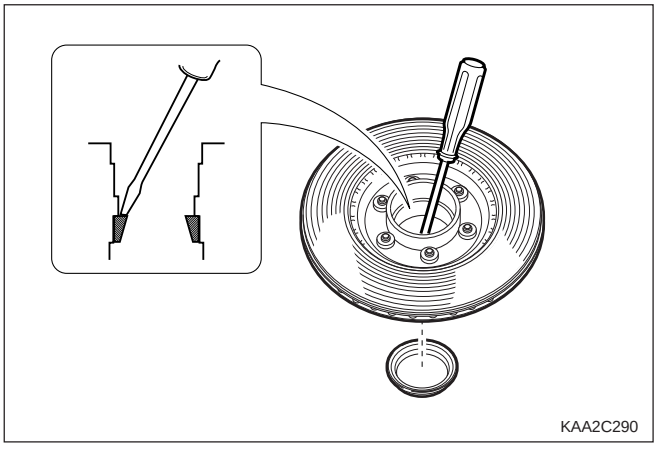
5. Remove the crossmember
6. Installation should follow the removal procedure in the reverse order.

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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KAA2C260


KAA2C270


KAA2C280


KAA2C290

UNIT REPAIR

HUB AND BEARING

Tools Required

DW340-021-01 Handle

DW340-021-02 Front Inner Bearing Race Installer

DW340-021-03 Front Outer Bearing Race Installer

Disassembly and Assembly Procedure

1. Remove the front hub and bearing assembly. Refer to “Front Hub Bearing Assembly” in this section.
2. Remove the outer bearing
3. Remove the inner seal.

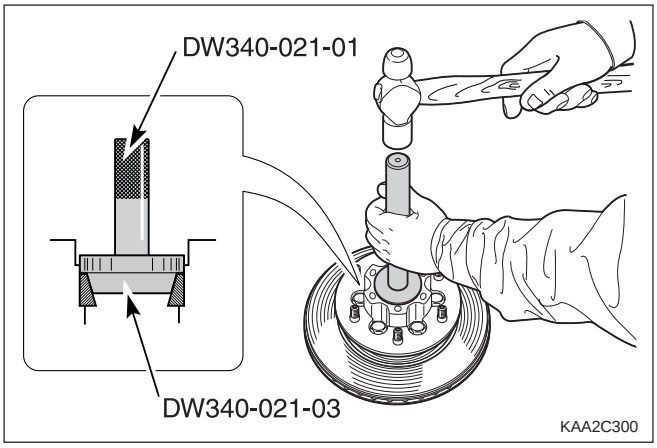
   Notice:

   - The inner seal must be discard and replaced with new parts.
4. Remove the inner bearing.

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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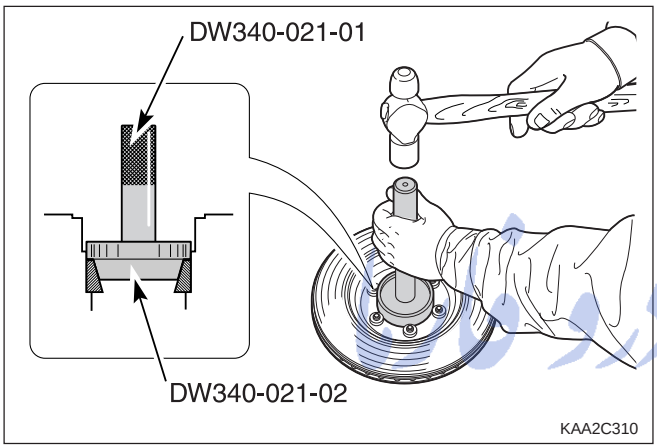
5. Remove the inner bearing race.

6. Remove the outer bearing race.



Notice:

- Install the outer bearing race using the front outer bearing race installer DW340-021-03 and handle DW340-021-01.



- Install the inner bearing race using the front inner bearing race installer DW340-021-02 and handle DW 340-021-01.

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SPECIFICATIONS

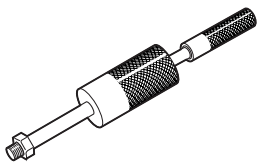
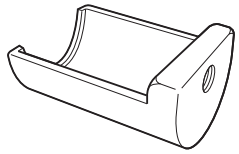
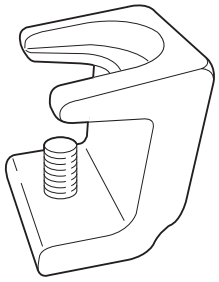
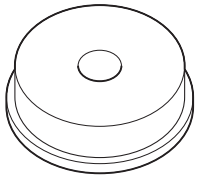
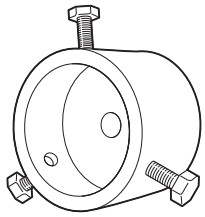
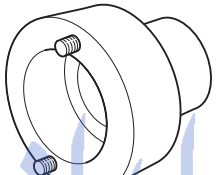
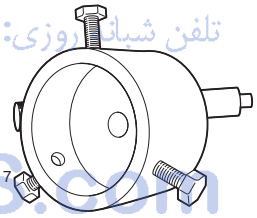
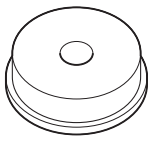
FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Crossmember Mounting Bolts	78	58	-
Front Axle Housing Mounting Nuts	118	87	-
Front Stabilizer-to-Stabilizer Link Nuts	70	52	-
Front Stabilizer Mounting Bolts	38	28	-
Front Shock Absorber Lower Mounting Nut	70	52	-
Fulcrum Pin Mounting Bolts and Nuts	130	96	-
Front Wheel Speed Sensor Bolt	5	-	35
Hub Flange Bolts	55	41	-
Hub Adjusting Nut	15	11	-
Lower Cover Bolts	35	26	-
Lower Ball Joint Nut	150	85	-
Lower Ball Joint Mounting Bolts	70	52	-
Lower Control Arm Mounting Bolts	120	89	-
Outer Tie Rod Nuts	40	30	-
Splash shield Mounting Bolts	6	-	53
Stabilizer Link-to-Lower Control Arm Nuts	19	14	-
Torsion Bar Fixing Nuts	50/70	37/52	-
Upper Ball Joint Nut and Bolts	115	85	-
Upper Ball Joint Mounting Bolts	130	96	-

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SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS TABLE

 KAA2C320	**DW 340-050** **Sliding Hammer** **Front Hub Cap**
 KAA2C330	**DW 340-070** **Front Hub Flange** **Remover**
 KAA2C340	**661 589 13 33 00** **Ball Joint Remover**
 KAA2C350	**DW 340-021-02** **Front Inner Bearing** **Race Installer**
 KAA2C360	**DW 340-060** **Front Hub Cap** **Remover/Installer**
 KAA2C370	**661 589 01 07 00** **Front Hub Adjusting** **Nut Remover/Installer**
 KAA2C380	**DW 340-021-01** **Handle**
 KAA2C390	**DW 340-021-03** **Front Outer Bearing** **Race Installer**

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SECTION 2D

REAR SUSPENSION

TABLE OF CONTENTS

Components Locator 2D-2

Diagnostic Information and Procedures 2D-3

Excessive Friction Check 2D-3

Repair Instructions 2D-4

On-Vehicle Service 2D-4

Rear Stabilizer 2D-4

Rear Stabilizer Link 2D-4

Rear Shock Absorber 2D-5

Lower Trailing Link 2D-5

Upper Trailing Link 2D-6

Rear Coil Spring 2D-6

Lateral Rod 2D-7

Specifications 2D-8

Fastener Tightening Specifications 2D-8

Special Tools and Equipment 2D-9

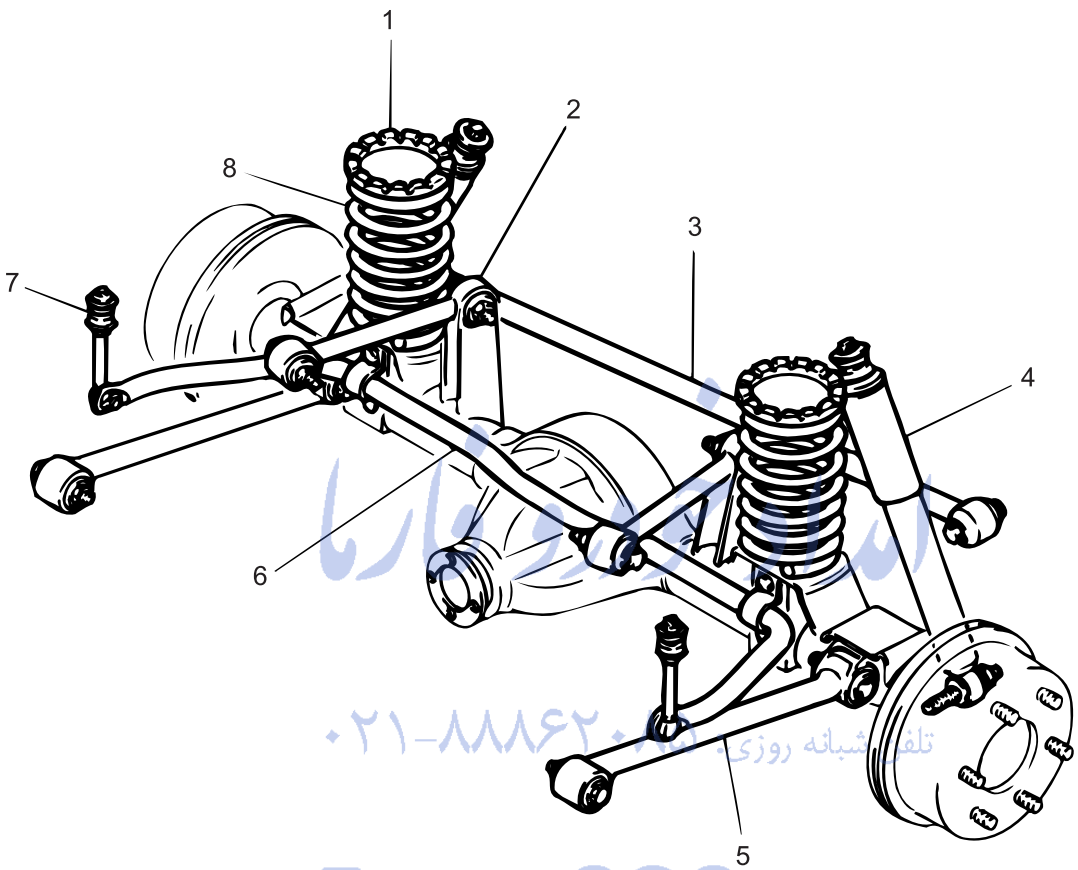
Special Tools Table 2D-9

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COMPONENT LOCATOR



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KAA2D010

1 Rear Coil Spring Seat
2 Upper Trailing Link
3 Lateral Rod
4 Rear Shock Absorber
5 Lower Trailing Link
6 Rear Stabilizer
7 Rear Stabilizer Link
8 Rear Coil Spring

DIAGNOSTIC INFORMATION AND PROCEDURES

EXCESSIVE FRICTION CHECK

Ball Joint Inspection

Check excessive friction in the rear suspension as follows:

1. With the aid of a helper, lift up on the rear bumper and raise the vehicle as high as possible. Slow release the bumper and allow the car to assume normal trim height.
2. Measure the distance from the floor to the center of the bumper.
3. Push down on the bumper, release slowly, and allow the car to assume normal trim height.
4. Measure the distance from the floor to the center of the bumper.

The distance between the two measurements should be less than 12.7 mm (0.50 inch). If the difference exceeds this limit, inspect the control arms for damage or wear.

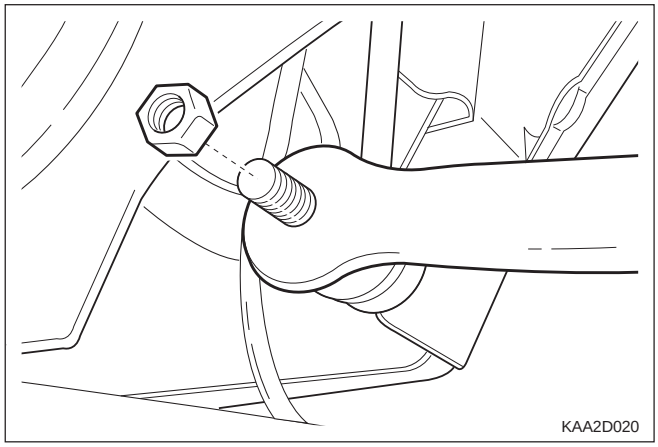
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REPAIR INSTRUCTIONS

ON-VEHICLE SERVICE

REAR STABILIZER

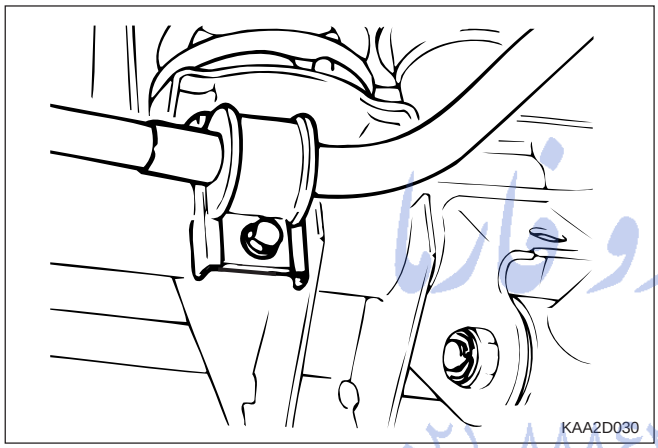
Removal and Installation Procedure


KAA2D020

1. Raise and suitably support the vehicle.
2. Remove the rear stabilizer-to-rear stabilizer link nut.

Installation Notice

Tightening Torque	70 N•m (52 lb-ft)


KAA2D030

3. Remove the rear stabilizer mounting bolts.

Installation Notice

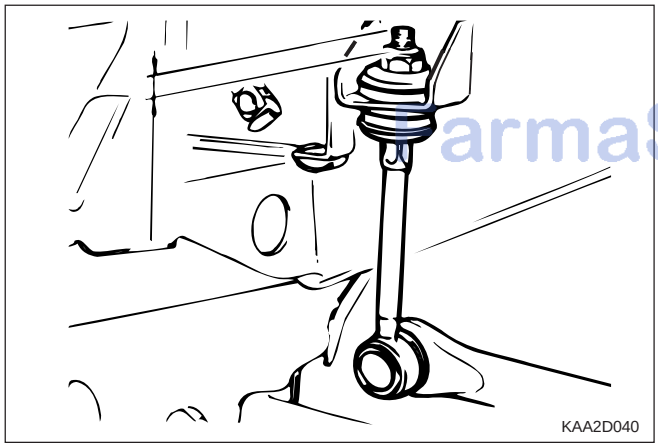
Tightening Torque	38 N•m (28 lb-ft)

4. Installation should follow the removal procedure in the reverse order.

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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REAR STABILIZER LINK

Removal and Installation Procedure

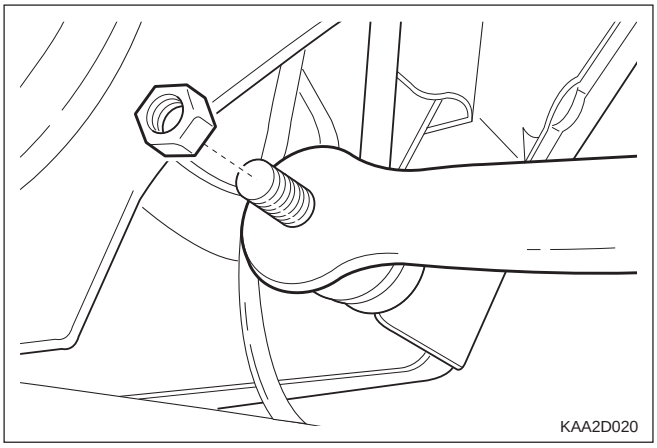

KAA2D040

1. Raise and suitably support the vehicle.
2. Remove the rear stabilizer link-to-body frame nut.

Installation Notice

Tightening Torque	38 N•m (28 lb-ft)

- The distance between the end of the nut and the end of the rear stabilizer link should be 10 - 13 mm (0.39 - 0.51 inch) at the connection of the rear stabilizer link and body.

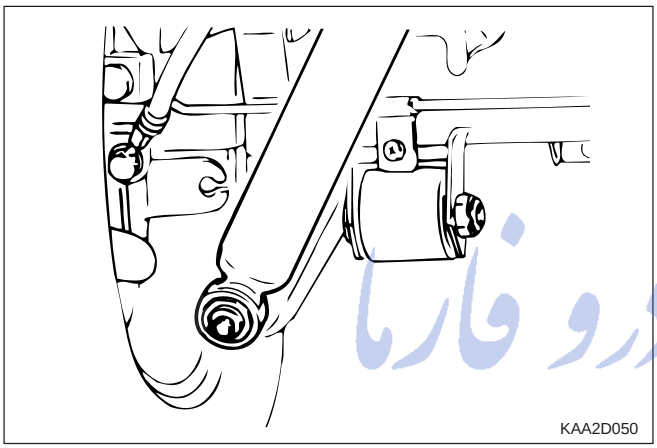


3. Remove the rear stabilizer-to-rear stabilizer link nut.

Installation Notice

Tightening Torque	70 N•m (52 lb-ft)

4. Installation should follow the removal procedure in the reverse order.



REAR SHOCK ABSORBER

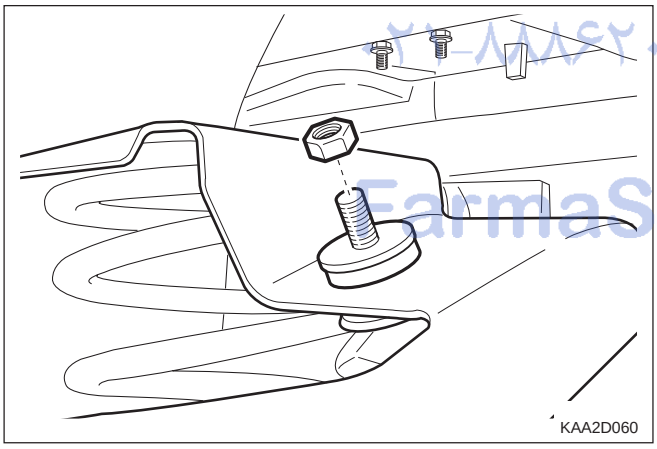
Removal and Installation Procedure

1. Raise and suitably support the vehicle.
2. Remove the rear shock absorber lower mounting nut.

Installation Notice

Tightening Torque	38 N•m (43 lb-ft)

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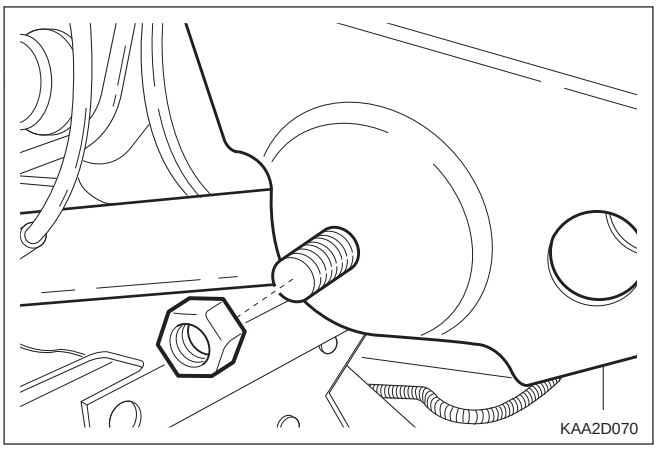


3. Remove the rear shock absorber upper mounting nut.

Installation Notice

Tightening Torque	38 N•m (28 lb-ft)

4. Installation should follow the removal procedure in the reverse order.



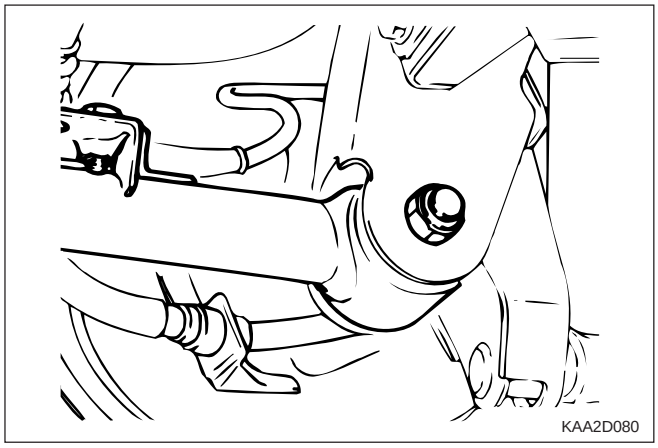
LOWER TRAILING LINK

Removal and Installation Procedure

1. Raise and suitably support the vehicle.
2. Remove the lower trailing link-to-body frame nut.

Installation Notice

Tightening Torque	165 N•m (122 lb-ft)

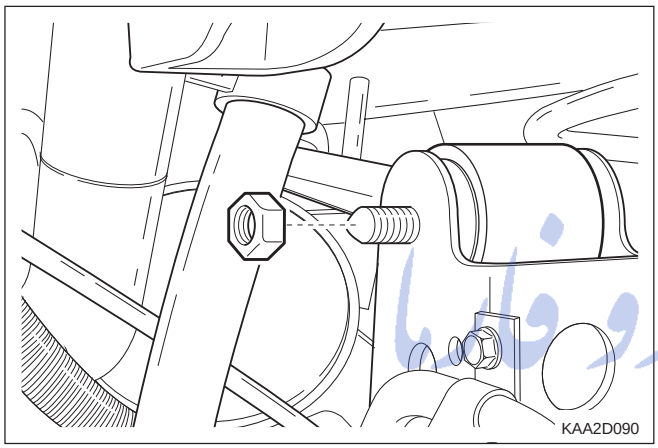

KAA2D080

3. Remove the lower trailing link-to-rear axle nut.

Installation Notice

Tightening Torque	165 N•m (122 lb-ft)

4. Installation should follow the removal procedure in the reverse order.


KAA2D090

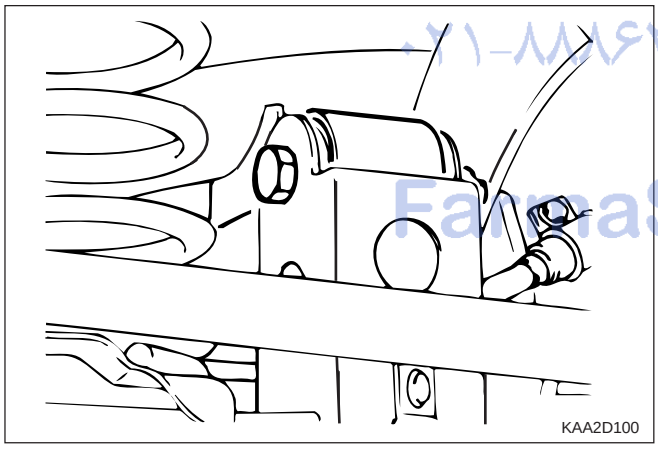
UPPER TRAILING LINK

Removal and Installation Procedure

1. Raise and suitably support the vehicle.
2. Remove the upper trailing link-to-body frame nut.

Installation Notice

Tightening Torque	165 N•m (122 lb-ft)

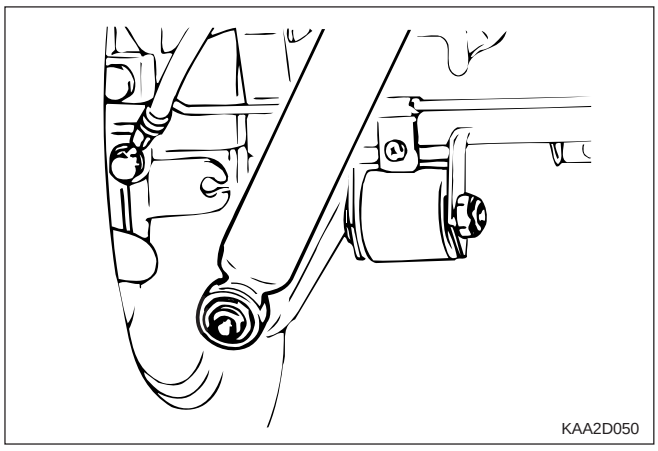

KAA2D100

3. Remove the upper trailing link-to-rear axle nut.

Installation Notice

Tightening Torque	165 N•m (122 lb-ft)

4. Installation should follow the removal procedure in the reverse order.


KAA2D050

REAR COIL SPRING

Tools Required

661589 12 33 00 RearSpringCompressor

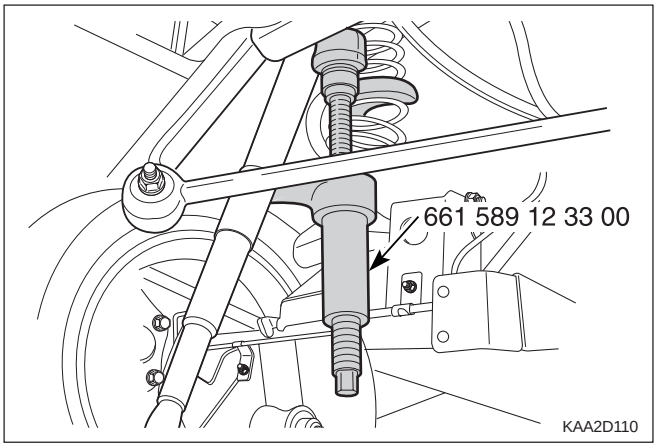
Removal and Installation Procedure

1. Raise and suitably support the vehicle.
2. Remove the rear shock absorber lower mounting nuts.

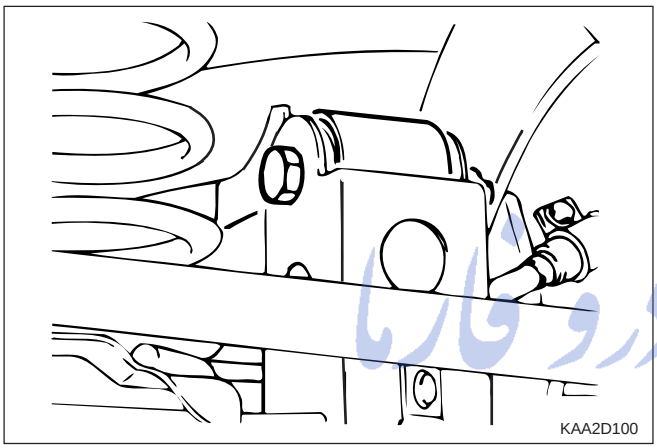
Installation Notice

Tightening Torque	58 N•m (43 lb-ft)

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3. Compress the rear coil springs completely using the rear spring compressor 661 589 12 33 00.



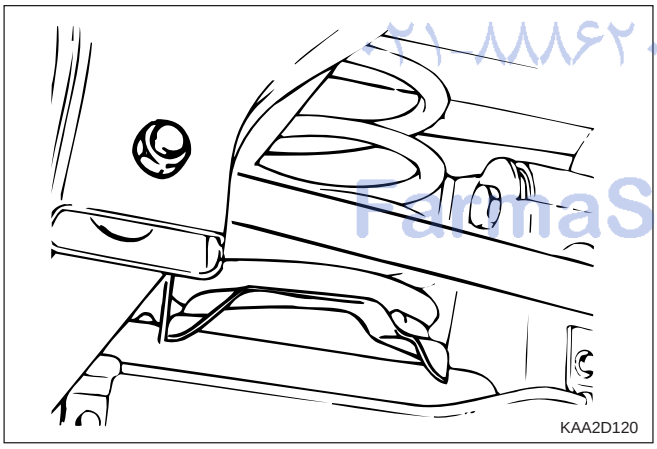
4. Remove the upper trailing link-to-rear axle nuts.

Installation Notice

Tightening Torque	165 N•m (122 lb-ft)

5. Remove the rear coil spring.
6. Installation should follow the removal procedure in the reverse order.

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LATERAL ROD

Removal and Installation Procedure

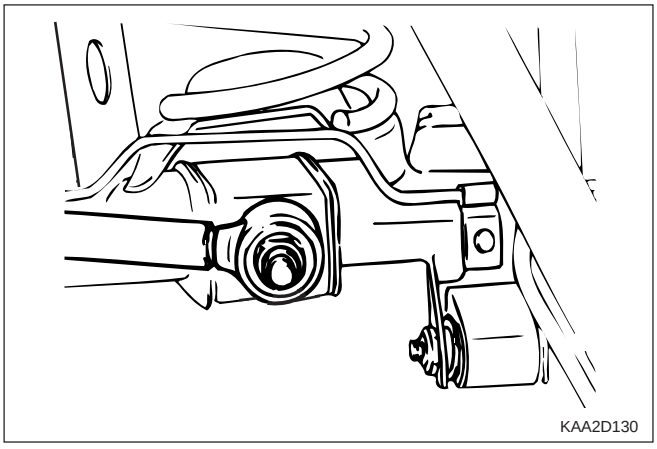
1. Raise and suitably support the vehicle.
2. Remove the lateral rod-to-body frame nut.

Removal Notice:

- Completely press the coil springs.

Installation Notice

Tightening Torque	165 N•m (122 lb-ft)



3. Remove the lateral rod-to-rear axle nut.

Installation Notice

Tightening Torque	165 N•m (122 lb-ft)

4. Installation should follow the removal procedure in the reverse order.

SPECIFICATIONS

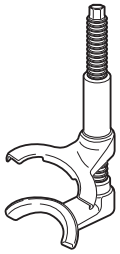
FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Lateral Rod-to-Body Frame Nut	165	122	-
Lateral Rod-to-Rear Axle Nut	165	122	-
Lower Trailing Link-to-Rear Axle Nut	165	122	-
Lower Trailing Link-to-Body Frame Nut	165	122	-
Rear Stabilizer-to-Rear Stabilizer Link Nut	70	52	-
Rear Stabilizer Mounting Bolts	38	28	-
Rear Stabilizer Link-to-Body Frame Nut	38	28	-
Rear Shock Absorber Lower Mounting Nut	58	43	-
Rear Shock Absorber Upper Mounting Nut	38	28	-
Upper Trailing Link-to-Body Frame Nut	165	122	-
Upper Trailing Link-to-Rear Axle Nut	165	122	-

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SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS TABLE

 KAA2D140	**661 589 12 33 00** **Rear Spring Compressor**

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SECTION 2E

TIRES AND WHEELS

TABLE OF CONTENTS

Description and Operation 2E-2
- Tire and Wheel Balancing 2E-2
- Tire Chain Usage 2E-3
- Replacement Tires 2E-3
- All Season Tires 2E-3
- Passenger Metric Sized Tires 2E-3
- Tire Label 2E-4
- Spare Tire 2E-4
- Wheels 2E-4
- Inflation of Tires 2E-4

Diagnostic Information and Procedures 2E-5
- Wheel Runout 2E-5

Maintenance and Repair 2E-6

On-Vehicle Service 2E-6
- Wheel 2E-6
- On-Vehicle Balancing 2E-7

Unit Repair 2E-8
- Alloy Wheel Porosity 2E-8
- Alloy Wheel Refinishing 2E-8
- Off-Vehicle Balancing 2E-9
- Correcting Non-Uniform Tires 2E-9
- Tire and Wheel Match-Mounting 2E-9
- Tire Mounting and Dismounting 2E-9

Specifications 2E-10
- Tire Size and Pressure Specifications 2E-10
- Inflation Pressure Conversion Specifications 2E-10
- Fastener Tightening Specifications 2E-10

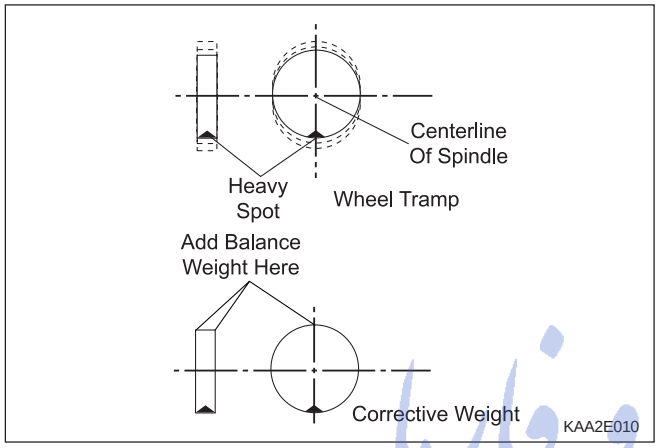
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DESCRIPTION AND OPERATION

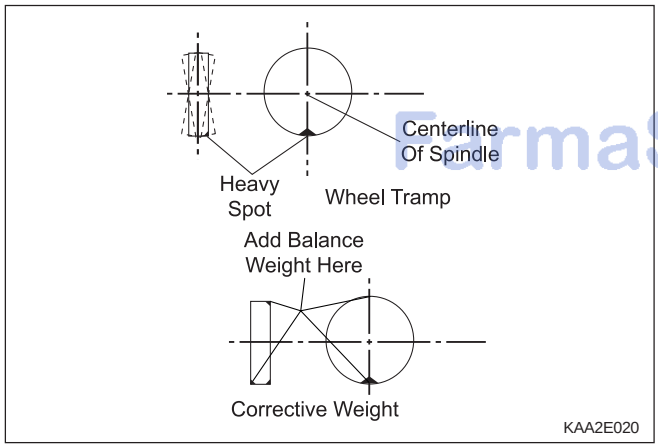
TIRE AND WHEEL BALANCING

There are two types of tire and wheel balancing: static and dynamic.

Static balance is the equal distribution of weight around the wheel. Assemblies that are statically unbalanced cause a bouncing action called wheel tramp. This condition may eventually cause uneven tire wear.



Dynamic balance is the equal distribution of weight on each side of the centerline so that when the assembly spins there is no tendency for it to move from side to side. Assemblies that are dynamically unbalanced may cause wheel shimmy.

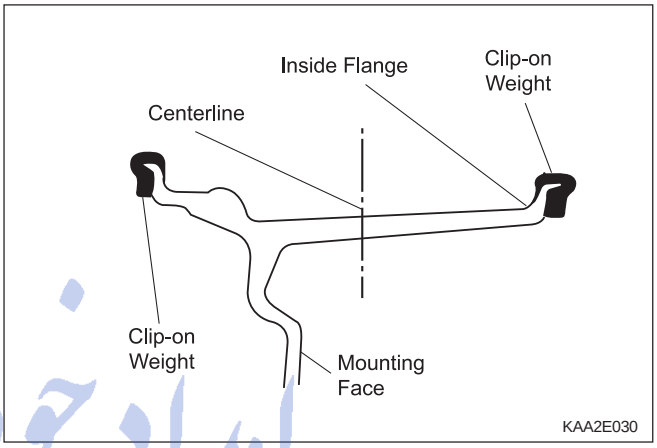


General Balance Precautions

Remove all deposits of foreign material from the inside of the wheel.

Caution: Remove stones from the tread in order to avoid operator injury during spin balancing.

Inspect the tire for any damage. Balance the tire according to the equipment manufacturer's recommendations.



Wheel Weights

If more than 85 grams (3.0 ounces) are needed to static balance the wheel, split the wheel weights as equally as possible between the inboard and the outboard flanges.

Balancing the assemblies with factory alloy wheels requires the use of special nylon-coated, clip-on wheel weights. These weights are designed to fit over the thicker rim flange of the alloy wheel. Install these weights with a plastictipped hammer.

Adhesive wheel weights are also available. Use the following procedure to install adhesive wheel weights.

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TIRE CHAIN USAGE

Due to limited tire-to-body clearance on certain vehicles, recommendations for tire chain use are published in the Owner's Manual. When tire chains need to be used, most current Ssangyong vehicles require SAE Class "S" tire chains. These may also be designated as 1100 Series, type PL tire chains. These chains are specifically designed to limit the "fly off" effect which occurs when the wheel rotates.

Be sure that only fine-link chains are used which do not add more than 15 mm (0.590 inch), including the lock, to the tread surface and the inner sides of the tires. Manufacturers of tire chains have a specific chain size for each tire size to ensure a proper fit when the chain is installed. Be sure to purchase the correct chains for the tires on which they are to be used. Use rubber adjusters to take up any slack or clearance in loose chains.

Use of chains may adversely affect vehicle handling. When tire chains are installed, follow these precautions:

- Adjust speed to road conditions.
- Avoid sharp turns.
- Avoid locked-wheel braking.

To prevent chain damage to the vehicle, install the chains on the front tires as tightly as possible. Tighten them again after driving 0.4 to 0.8 kilometer (0.3 to 0.5 mile). The use of chains on the rear tires is not recommended because they may contact the vehicle and possibly damage it. If chains must be used on the rear tires, be sure there is sufficient clearance between the chains and the body. Do not exceed 70 km/h (45 mph) or the chain manufacturer's speed limit, if lower. Avoid large bumps, potholes, severe turns and any other maneuvers which could cause the tires to bounce. Follow any other instructions of the chain manufacturer which do not disagree with the above instructions.

REPLACEMENT TIRES

A tire performance criteria (TPC) specification number is molded in the sidewall near the tire size of all original equipment tires. This specification number assures that the tire meets performance standards for traction, en durance, dimensions, noise, handling and rolling resistance. Usually a specific TPC number is assigned to each tire size.

Caution: Do not mix different types of tires on the same vehicle such as radial, bias and bias-belted tires except in emergencies, because vehicle handling may be seriously affected and may result in loss of control.

Use only replacement tires with the same size, load range, and construction as the original. The use of any other tire size or construction type may seriously affect ride, handling, speedometer/odometer calibration, vehicle ground clearance, and tire clearance to the body and the chassis. This does not apply to the spare tire furnished with the vehicle.

It is recommended that new tires be installed in pairs on the same axle.

If it is necessary to replace only one tire, pair it with the tire having the most tread to equalize the braking action. Although they may appear different in tread design, tires built by different manufacturers with identical TPC specifications may be used on the same vehicle.

ALL SEASON TIRES

Most vehicles are now equipped with steel-belted all season radial tires as standard equipment. These tires qualify as snow tires, with a 37 percent higher average rating for snow traction than the non-all season radial tires previously used. Other performance areas, such as wet traction, rolling resistance, tread life, and air retention, have also been improved. This was done by improvements in both tread design and tread compounds. These tires are identified by an "M + S" molded in the tire sidewall following the size number. The suffix "MS" is also molded in the sidewall after the TPC specification number.

The optional handling tires used on some vehicles are not all season tires. These will not have the "MS" marking after the tire size or the TPC specification number.

PASSENGER METRIC SIZED TIRES

All Daewoo vehicles now use passenger (P) metric sized tires. P-metric tires are available in two load ranges: standard load (35 psi maximum) and extra load (41 psi maximum). Most passenger vehicle tires are standard load.

Most P-metric tire sizes do not have exact corresponding alphanumeric tire sizes. For example, a P175/70R13 is not exactly equal in size and load-carrying capacity to an FR70-13. For this reason, replacement tires should be of the same TPC specification number as the originals. If P-metric tires must be replaced with other sizes, consult a tire dealer. Tire companies can best recommend the closest match of alphanumeric to P-metric sizes within their own tire lines.

The metric term for measuring tire inflation pressure is the kilopascal (kPa). Tire pressure may be printed in both kPa and psi. One psi equals 6.895 kPa.

See the tire label or refer to "Tire Size and Pressure Specifications" in this section for tire inflation pressures.

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TIRE LABEL

The tire label is permanently located on the rear face of the driver's door and should be referred to for tire information. It lists the maximum vehicle load, the tire size (including the spare tire), and the cold inflation pressure (including the spare tire).

SPARE TIRE

This vehicle comes equipped with a full-sized spare tire and wheel.

The temporary spare tire is designed for emergency use only. The original tire should be repaired or replaced at the first opportunity and reinstall.

WHEELS

Wheels must be replaced if they are bent, dented, have excessive lateral or radial runout, leak air through welds, have elongated bolt holes, or if the wheel bolts won't stay tight or are heavily rusted. Wheels with excessive runout may cause vehicle vibration. Replacement wheels must be equivalent to the original equipment wheels in load capacity, diameter, rim width, offset, and mounting configuration. A wheel of improper size or type may affect wheel and bearing life, brake cooling, speedometer/odometer calibration, vehicle ground clearance, and tire clearance to the body and the chassis. The wheel offset is 49 ± 1 (1.93 ± 0.04 inches). Steel wheels may be identified by a two- or three-letter code stamped into the rim near the valve stem. Alloy wheels should have the code, the part number, and the manufacturer ID cast into the back side.

INFLATION OF TIRES

The pressure recommended for any vehicle line is carefully calculated to give a satisfactory ride, handling, tread life, and load-carrying capacity.

Tire pressure should be checked monthly or before any extended trip. Check the tires when they are cold, after the vehicle has sat for 3 hours or more or has been driven less than 1 mile. Set the tire pressure to the specifications on the tire label located on the rear face of the drive r 's door. Tire inflation pressure is also given under "Tire Size and Pressure Specifications" in this section.

Valve caps or extensions should be on the valves to keep dust and water out.

For sustained driving at speeds up to 140 km/h (85 mph), inflate the tires to the pressure recommended on the tire. Sustained driving at speeds faster than 140 km/h (85 mph), even if permitted by law, is not advised unless the vehicle has special high-speed tires available from many tire dealers. Tire pressures may increase as much as 41 kPa (6 psi) when the tires are hot.

Higher than recommended tire pressure can cause

- Hard ride.
- Tire bruising or damage.
- Rapid tread wear at the center of the tire.

Lower than recommended pressure can cause

- Tire squeal on turns.
- Hard steering.
- Rapid and uneven wear on the edges of the tread.
- Tire rim bruises and rupture.
- Tire cord breakage.
- High tire temperatures.

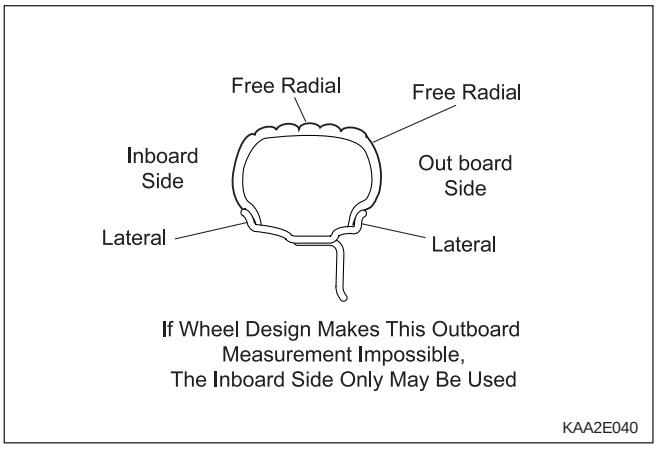
Unequal tire pressures on same axle can cause

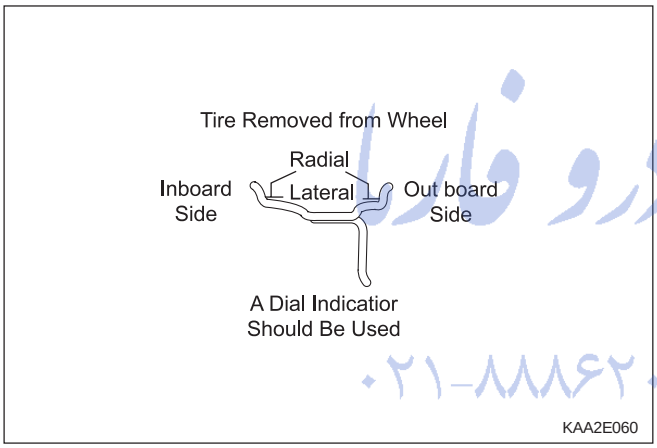
- Uneven braking.
- Steering lead.
- Reduced handling.
- Swerve on acceleration.
- Torque steer.

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DIAGNOSTIC INFORMATION AND PROCEDURES

WHEEL RUNOUT





Measure wheel runout with an accurate dial indicator. Measurement may be taken with the wheels either on or off the vehicle, using an accurate mounting surface such as a wheel balancer. Measurements may be taken with or without the tire mounted on the wheel.

Measure dial runout and lateral runout on both the inboard and the outboard rim flanges. With the dial indicator firmly seated next to the wheel and tire assembly, slowly rotate the wheel one revolution and record the indicator reading. If any measurement exceeds the following specifications and there is a vibration that wheel balancing will not correct, replace the wheel. Discardany indicator readings due to welds, paint runs, or scratches.

Steel Wheels

- Radial runout : 0.8 mm (0.03 inch)
- Lateral runout : 1.0 mm (0.04 inch)

Alloy Wheels

- Radial runout : 0.5 mm (0.02 inch)
- Lateral runout : 0.5 mm (0.02 inch)

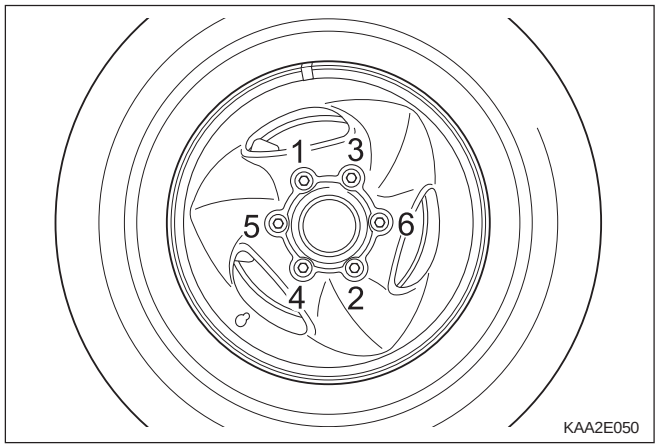
Measure free radial runout on the center of the tire tread. The tread can be taped to present a smooth surface. Measurement free runout on the outboard side of the tire nearest to the tread.

Steel and Alloy Wheels

- Free radial runout : 1.5 mm (0.06 inch)
- Free lateral runout : 1.5 mm (0.06 inch)

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MAINTENANCE AND REPAIR



ON-VEHICLE SERVICE

WHEEL

Removal Procedure

1. Remove the hub cap.
2. Loosen the wheel nuts.
3. Raise and suitably support the vehicle.
4. Remove the wheel nuts.

   Notice: Never use heat to loosen a tight wheel. It can shorten the life of the wheel, the wheel nuts, and the wheel bearings. Excessive force, such as hammering the wheel or tire, can also cause damage and is not recommended. Slight tapping of the wheel sidewall with one's hand or with a rubber mallet is acceptable.

5. Remove the wheel and tire assembly.

Difficulty in removing the wheels from the vehicle can be due to foreign material or to a tight fit between the wheel centerhole and the hub or the rotor. These wheels can be removed by

1. Retightening the wheel nuts on the affected wheel and then loosening the wheel nuts by two turns.
2. Lowering the vehicle and rocking it from side to side as hard as possible, using one or more person's body weight to loosen the wheel.
3. Raising the vehicle and removing the wheel.

Caution: Do not allow the penetrating oil to get on the vertical surfaces between the wheel and the drum (or rotor) because penetrating oil in this area could cause the wheel to work loose as the vehicle is driven, resulting in loss of control and an injury accident.

Penetrating oil is not effective in removing tight wheels. If it is used, however, apply it sparingly and only to the wheel's centerhole area.

Installation Procedure

Notice: Before installing the wheels, remove any build-up of corrosion on the wheel mounting surface and the rotor mounting surface by scraping and brushing them with a wire brush. Installing the wheels without good metal-to-metal contact at the mounting surfaces can cause the wheel nuts to loosen, which can later allow a wheel to come off while the vehicle is moving. Wheel bolts must be tightened in sequence and to the proper torque to avoid bending the wheel or the rotor.

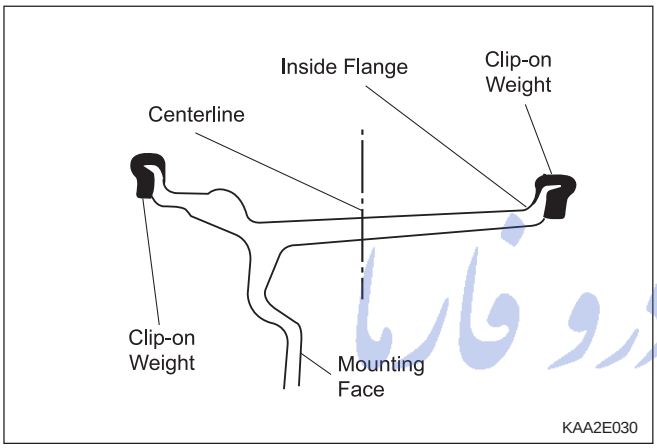
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1. Mount the wheel and tire assembly.
2. Install the wheel nuts in the sequence shown. Do not tighten the wheel nuts .

Installation Notice

Tightening Torque	120 N•m (89 lb-ft)

3. Lower the vehicle.
4. Install the wheel cover.



ON-VEHICLE BALANCING

On-vehicle balancing will help correct vibrations due to brake drum, rotor, and wheel cover imbalances.

Notice: Do not allow the front suspension to hang free. When the drive axle is run at an extreme angle, extra vibrations can occur, as well as damage to seals and joints.

1. During on-vehicle balancing, do not remove the bal-ance weights from the off-vehicle dynamic balance.
2. If more than 28.4 grams (1 ounce) of additional weight is required, split the weight between the inner and the outer rim flanges.

Caution: Do not spin the drive wheels faster than 55 km/h (35 mph) as indicated by the speedometer. This limit is necessary because the speedometer indicates only one-half of the actual wheel speed when one drive wheel is spinning and the other drive wheel is stopped. Personal injury and damage may result from high-speed spinning.

3. Spin the driven tire and wheel assemblies using the engine.

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SPECIFICATIONS

TIRE SIZE AND PRESSURE SPECIFICATIONS

Inflation Pressure at Full Load

Engine	Tires	Wheel	Front		Rear	
			kPa	psi	kPa	psi
E32	P235/75R15	7.0 JJx15	205	30	205	30
E32	P255/65R16	7.0 JJx16	205	30	205	30
	P255/70R15	7.0 JJx15	205	30	205	30

INFLATION PRESSURE CONVERSION SPECIFICATIONS

kPa	psi	kPa	psi	kPa	psi
140	20	185	27	235	34
145	21	190	28	240	35
155	22	200	29	250	36
160	23	205	30	275	40
165	24	215	31	310	45
170	25	220	32	345	50
180	26	230	33	380	55

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Wheel Nut (Alloy Wheel)	120	89	-

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SECTION 3A

FRONT AXLE

TABLE OF CONTENTS

Specifications 3A-2
General Specifications 3A-2
Fastener Tightening Specifications 3A-2
Component Locator 3A-3
Front Axle Assembly 3A-3
Auto-Locking Hub 3A-4
Maintnance and Repair 3A-5
On-Vehicle Service 3A-5
Vacuum Line 3A-5
Steering Knuckle and Drive Shaft 3A-7
Front Axle Assembly 3A-12
Unit Repair 3A-16
Axle Housing 3A-16
Outer Joint Seal 3A-23
Inner Tripot Seal 3A-24
Special Tools and Equipment 3A-25
Special Tools Table 3A-25

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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SPECIFICATIONS

GENERAL SPECIFICATIONS

Application			Description
Drive Shaft Type			CV Joint
Axle Housing Type			Build - up
Differential Type			Conventional
Differential Gear			Hypoid Gear
Reduction Ratio	661LA	M/T	4.56
		A/T	5.38
	662LA	M/T	4.27
		A/T	4.89
	E23	M/T	4.55
		A/T	5.86
	E32	M/T	3.73
		A/T	4.89
Oil Capacity			1.3 L
Oil Specification			SEA 80W/90, API GL - 5

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FASTENER TIGHTENING SPECIFICATIONS

Steering Knuckle and Drive Shaft

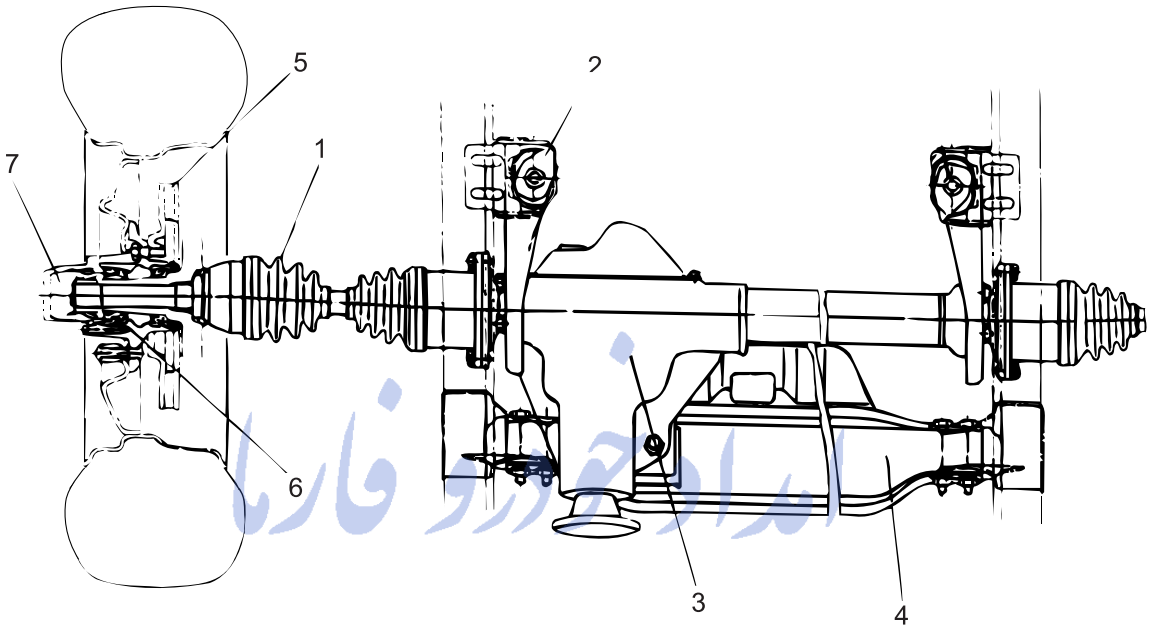
۰۲۱-۸۸۴۶۲۰۰۰ داخلی شبانه روزی

Application	N•m	Lb-Ft	Lb-In
Drive Shaft Cover Bolt	50 - 60	36.8 - 44.2	-
Drive Shaft to Front Axle Inner Shaft	25 - 35	18.4 - 25.8	-
Hub Flange Bolt	70 - 90	51.6 - 66.3	-
Hub Nut	15	11.0	-
Locking Hub Washer Screw	2 - 4	-	17.7 - 35.4
Wheel Speed Sensor	85 - 105	62.7 - 77.4	-

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COMPONENT LOCATOR

FRONT AXLE ASSEMBLY



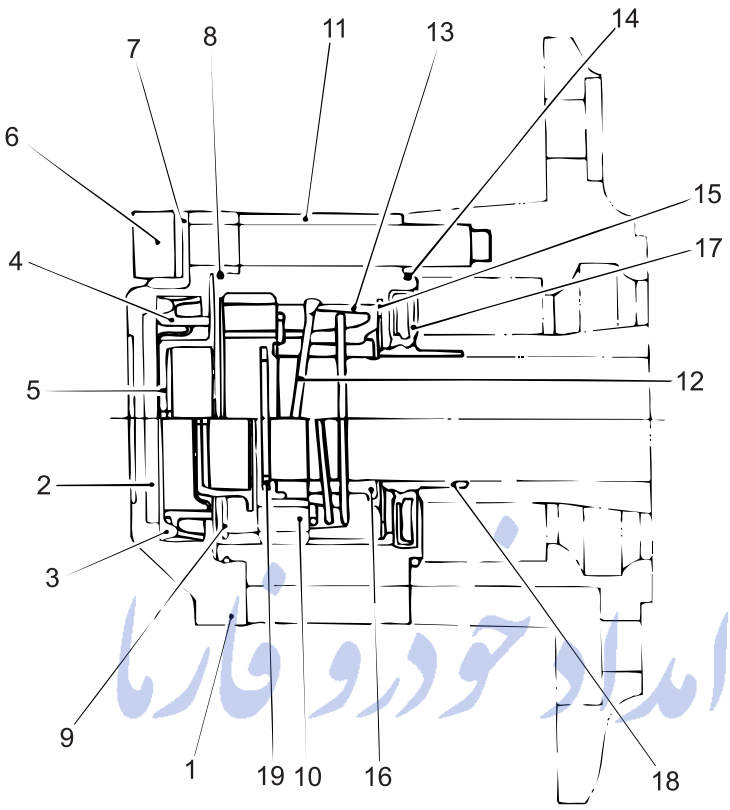
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1 Drive Shaft
2 Axle Housing Mounting Bolt
3 Axle Housing
4 Cross Member
5 Brake Disc
6 Hub-Wheel
7 Locking Hub

AUTO-LOCKING HUB



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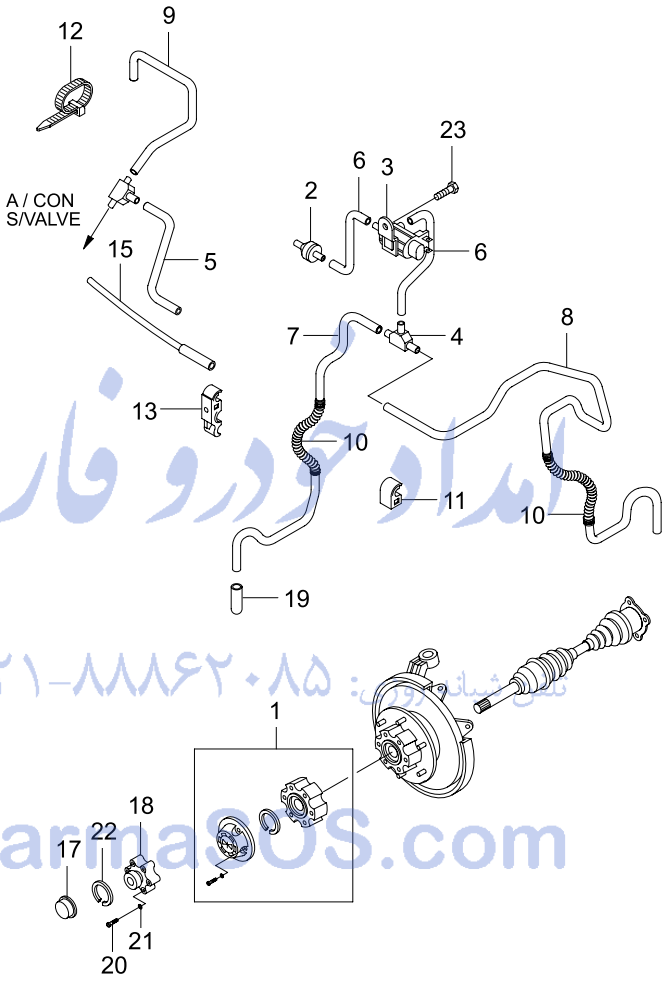
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1 Cap
2 Filter
3 Vacuum Diaphragm
4 Diaphragm Retainer
5 Piston
6 Bolt (M10)
7 Lock Washer
8 O-ring
9 Retaining Ring
10 Clutch Ring
11 Body
12 Return Spring
13 Bearing
14 O-ring
15 Retaining Ring
16 Inner Drive Gear
17 Oil Seal
18 Oil Seal Race
19 Axle Retaining Ring

MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

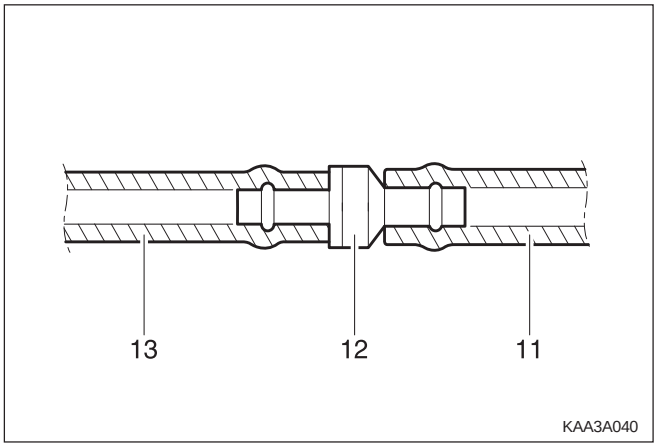
VACUUM LINE



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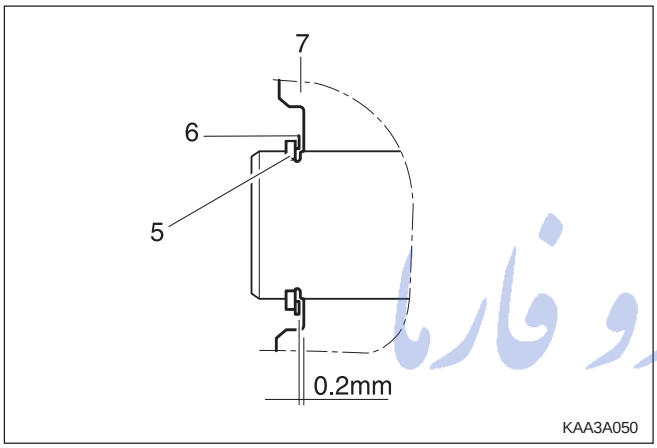
1 Hub A-Auto Vac Locking
2 Valve-Check
3 Valve A-Solenoid
4 Connector
5 House-Vcuum
6 Hose-Vacuum
7 Hose-Vacuum
8 Hose-Vacuum
9 Hose
10 Tube-corruagated
11 Clip
12 Band
13 Clip
14 Bolt
15 Tube A-Vacuum
16 Clip-L/Hub Hose MTG
17 Cap-Hub Flange FRT
18 Flange-Hub FRT
19 Cap
20 Bolt
21 Washer
22 Ring-Retainer
23 Bolt



Removal & Installation Procedure

1. Be careful not to change the valve when connecting the check valve and each hose.
2. Adjust the clearance between the retainer ring (5) and locking hub (7) using the shim(6).

   Notice: Shim thickness : 0.1, 0.2, 0.3, 0.5, 1.0 mm



3. Tighten the auto locking hub cap bolt to the specified torque and order.

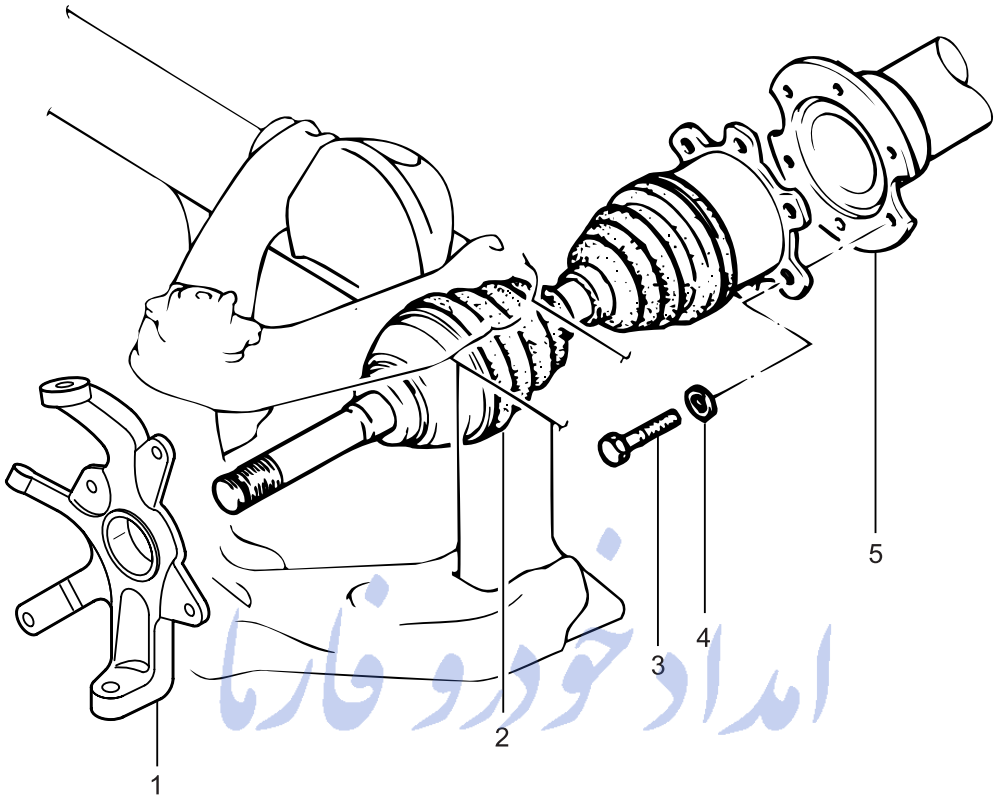
Normal	Max. 0.2 mm

Installation Notice

Tightening Torque	50 - 60 N•m (37 - 44 lb-ft)

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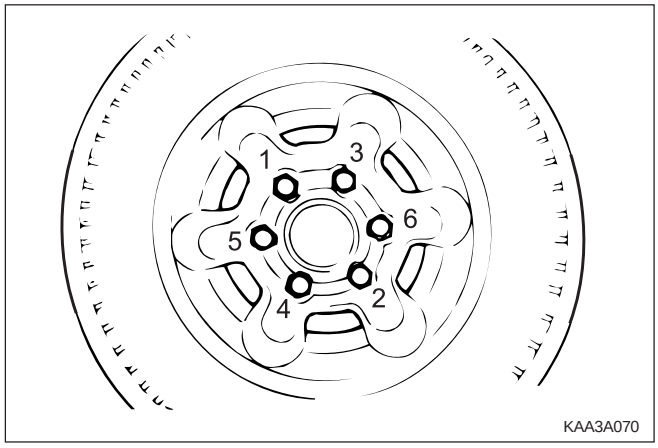
STEERING KNUCKLE AND DRIVE SHAFT



KAA3A060

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1 Front Axle Inner Shaft
2 Front Axle Drive Shaft
3 Spring Washer
4 Bolt ..... 45 - 60 N•m (33 - 44 lb-ft)
5 Steering Knuckle

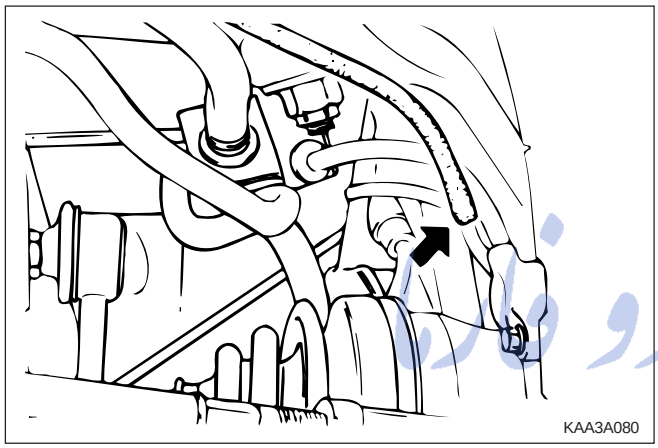


Removal & Installation Procedure

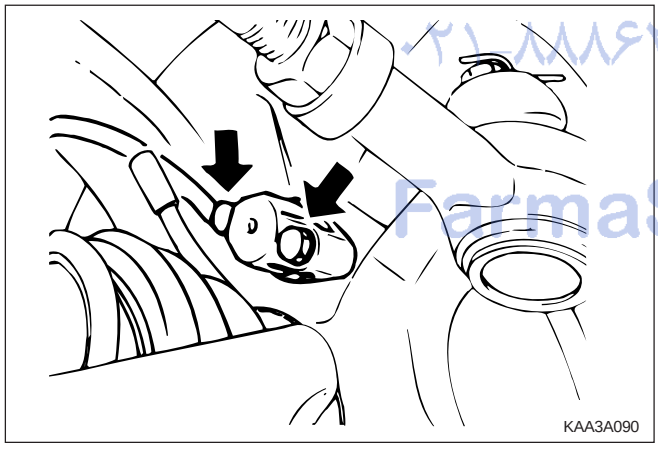
1. Remove the tire.

Installation Notice

Tightening Torque	Steel Wheel	80 - 120 N•m (59 - 89 lb-ft)
	Aluminum Wheel	110 - 130 N•m (81 - 96 lb-ft)



2. Remove the autolocking hub vacuum hose.

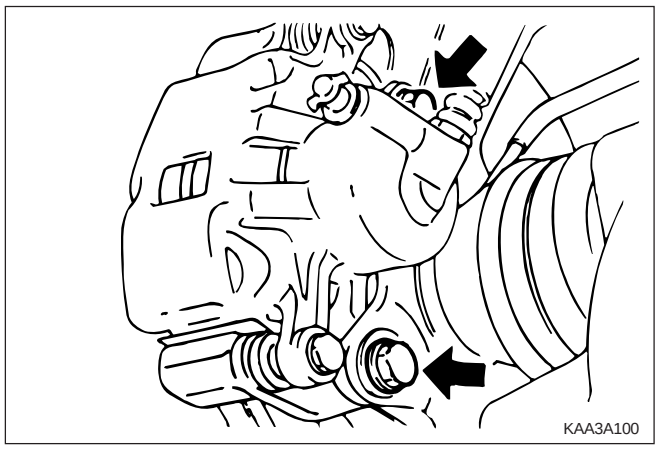


3. With ABS

Remove the wheel speed sensor from the steering knuckle.

Installation Notice

Tightening Torque	6 - 8 N•m (53 - 71 lb-in)



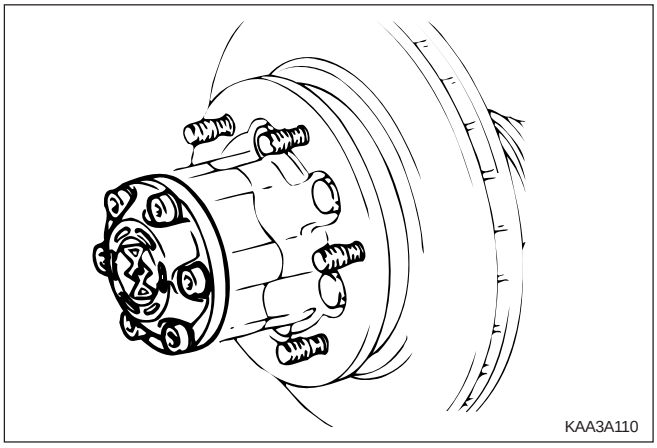
4. Remove the mounting bolts and pull off the caliper assembly.

Installation Notice

Tightening Torque	Hose Bolt	25 - 35 N•m (18 - 26 lb-ft)
	Mounting Bolt	85 - 105 N•m (63 - 77 lb-ft)

Notice: Be careful not to damage the brake hose.

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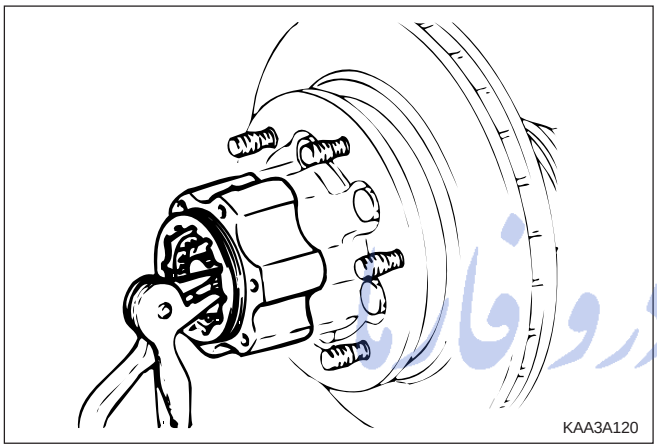


5. With part time transfer case.

5-1. Remove the cover mounting bolts and pull off the cover.

Installation Notice

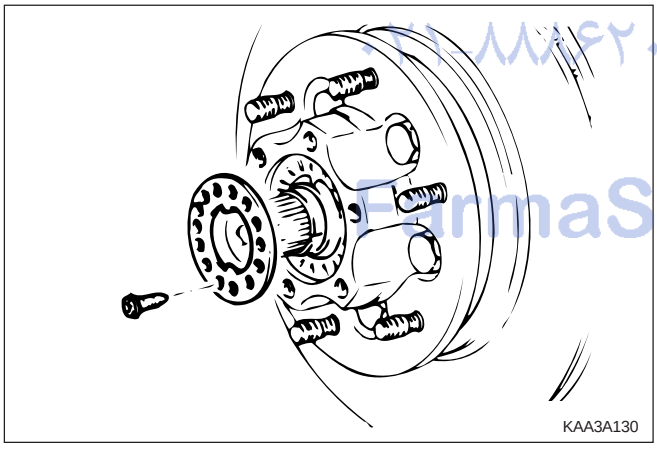
Tightening Torque	50 - 60 N•m (37 - 44 lb-ft)



5-2. Remove the snap ring of the drive shaft and pull off the hub body.

Notice: For assembly, adjust the clearance between the snap ring and hub not to exceed 0.2 mm (Shim thickness : 0.1, 0.2, 0.3, 0.5, 1.0 mm).

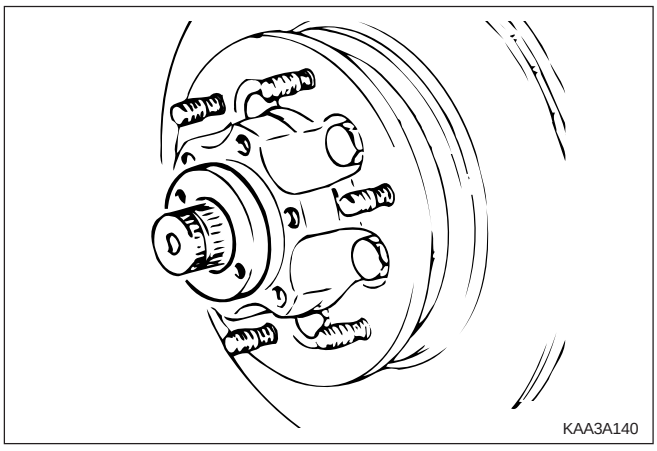
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5-3. Remove the screws and pull off the locking hub washer.

Installation Notice

Tightening Torque	2 - 4 N•m (18 - 35 lb-in)



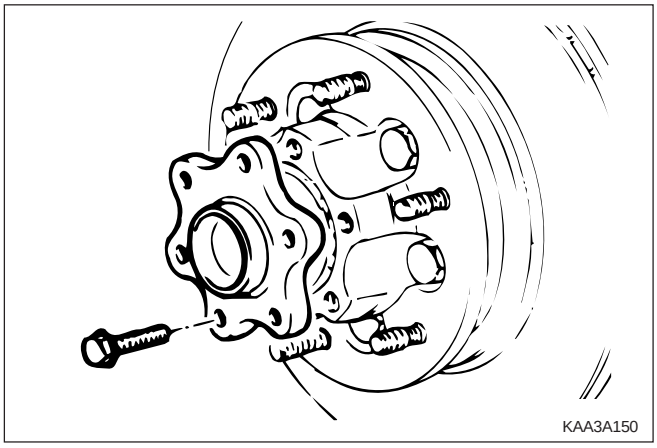
6. With full time transfer case

6-1. Detach the hub cap with screw driver and remove the snap ring on drive shaft.

Installation Notice

Tightening Torque	15 N•m (11 lb-ft)

Notice: For assembly, adjust the clearance between the snap ring and hub not to exceed 0.2 mm (Shim thickness : 0.1, 0.2, 0.3, 0.5, 1.0 mm).

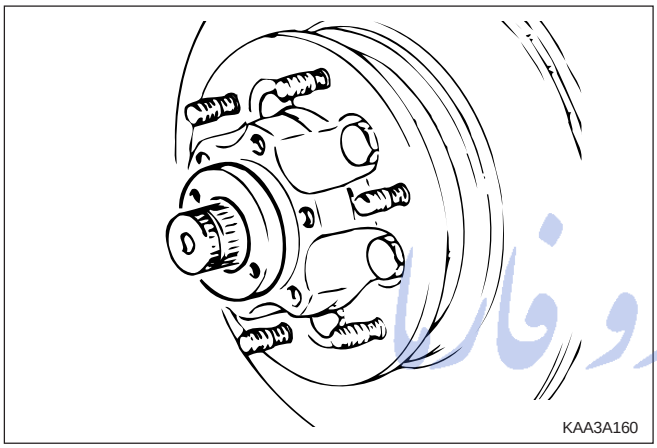

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6-2. Unscrew the bolts and remove hub flange.

Installation Notice

Tightening Torque	70 - 90 N•m (52 - 66 lb-ft)

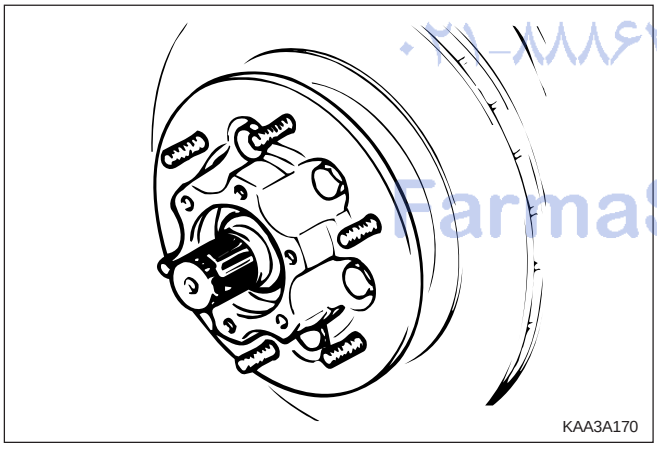
Before installation, apply loctite on the mating surface.


KAA3A160

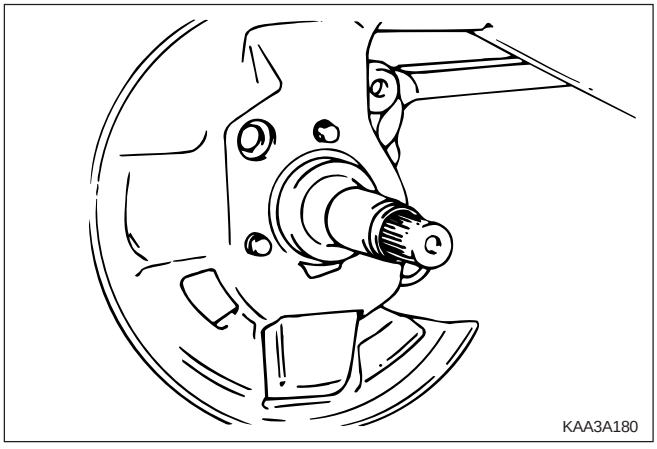
7. Remove the hub nut with special tool.

Tightening Torque	15 N•m (11 lb-ft)

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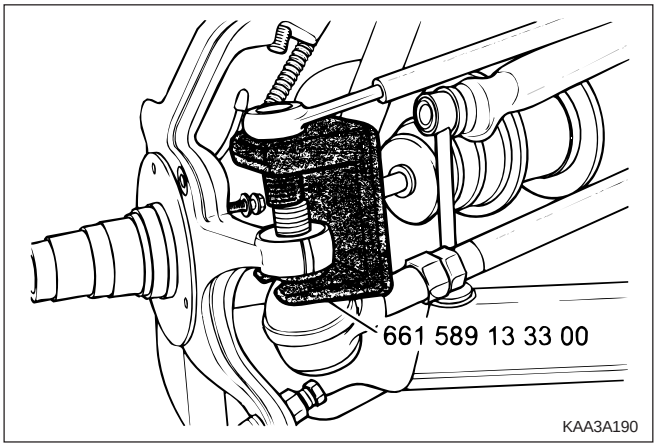
8. Remove the hub and disk assembly.


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9. Remove the disk brake dust shield.

Installation Notice

Tightening Torque	4 - 6 N•m (35 - 53 lb-in)

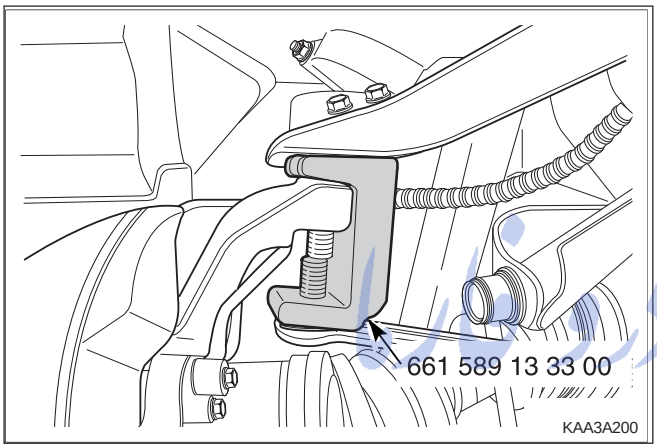


10. Remove the cotter pin and slotted nut and then remove the steering knuckle arm and tie-rod.

Installation Notice

Tightening Torque	40 N•m (30 lb-ft)

Replace the cotter pin with new one.

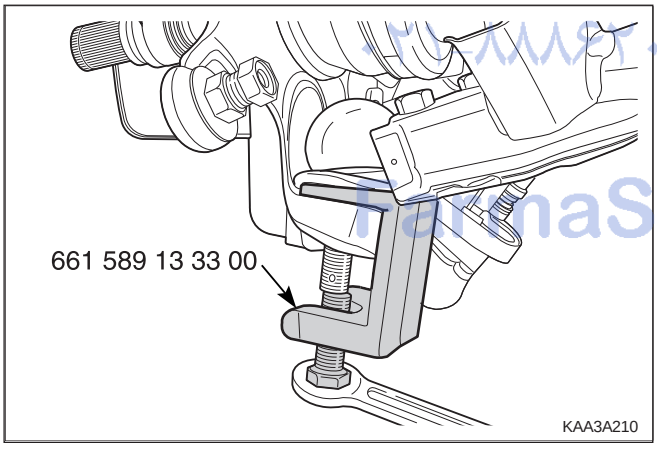


11. Remove the cotter pin and nut from the steering knuckle arm and upper arm ball joint connection.

Installation Notice

Tightening Torque	115 N•m (85 lb-ft)

Replace the cotter pin with new one.

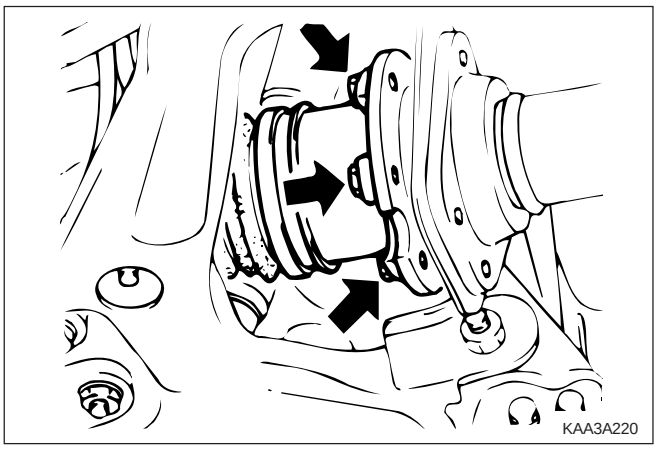


12. Remove the cotter pin and nut from the steering knuckle arm and lower and lower arm boll joint connection.

Installation Notice

Tightening Torque	150 N•m (111 lb-ft)

13. Carefully remove the knuckle arm.



14. Remove the drive shaft mounting bolts and remove the drive shaft.

Installation Notice

Tightening Torque	4.6 - 60 kgf•m

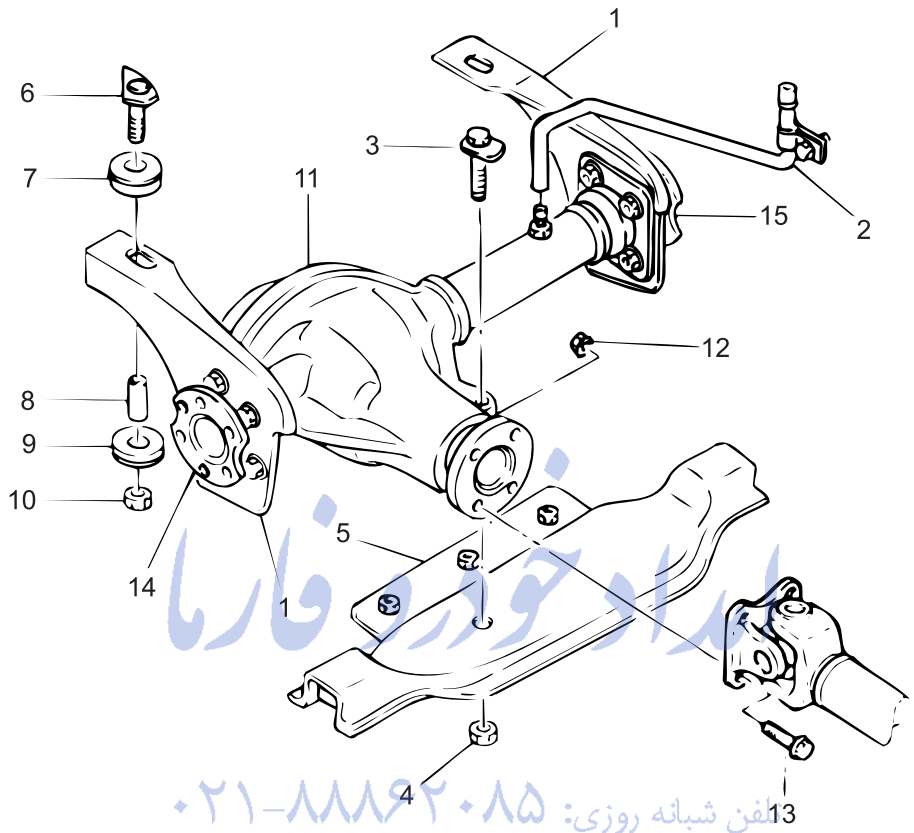
Observe the tighening torque and sequence.

15. Installation should follow the removal precedure in the reverse order.

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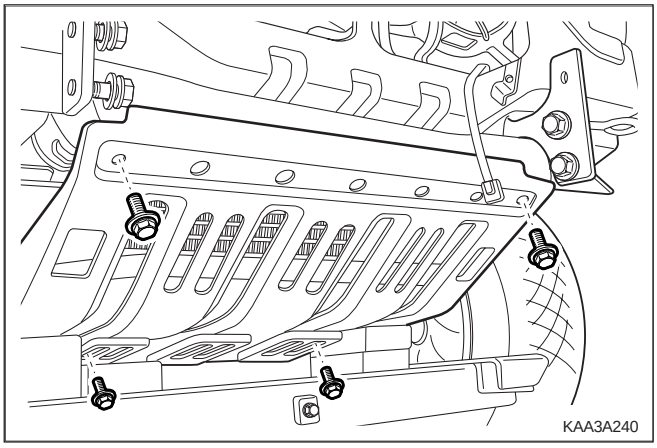
FRONT AXLE ASSEMBLY

Preceding Work : Removal of the front axle drive shaft
Removla of the steering gear box



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1 Axle Mounting Bracket
2 Breather Hose
3 Bolt (Rear)
4 Nut ..... 95 - 142 N•m (70 - 105 lb-ft)
5 Cross Member
6 Bolt (Front)
7 Bushing
8 Spacer
9 Bushing
10 Nut ..... 95 - 142 N•m (70 - 105 lb-ft)
11 Front Axle Assembly
12 Nut ..... 70 - 80 N•m(52 - 59 lb-ft)
13 Bolt
14 Inner Axle Shaft (LH)
15 Inner Axle Shaft (RH)



Tools Required

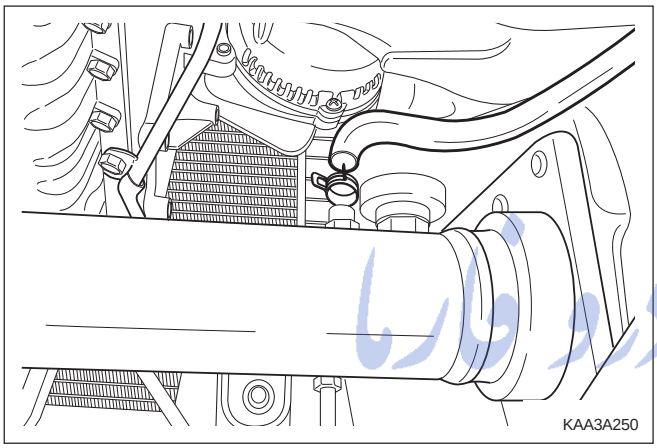
DW340-80 Front Axle Support

Removal and Installation Procedure

1. Raise and suitably support the vehicle.
2. Remove the lower cover.

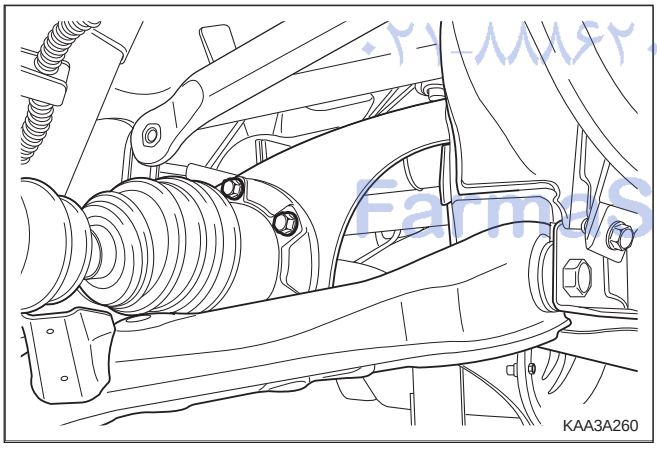
Installation Notice

Tightening Torque	35 N•m (26 lb-ft)



3. Remove the rack and pinion assembly. Refer to *Section 6C, Power Steering Gear.*
4. Remove the front axle bleeder hose.

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۰۲۱-۸۸۸۶۲۰۸۵ تلفن همراه فارما
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5. Remove the front drive shaft-to-front axle assemblybolts.

Installation Notice

Tightening Torque	4.5 - 6.0 kgf•m



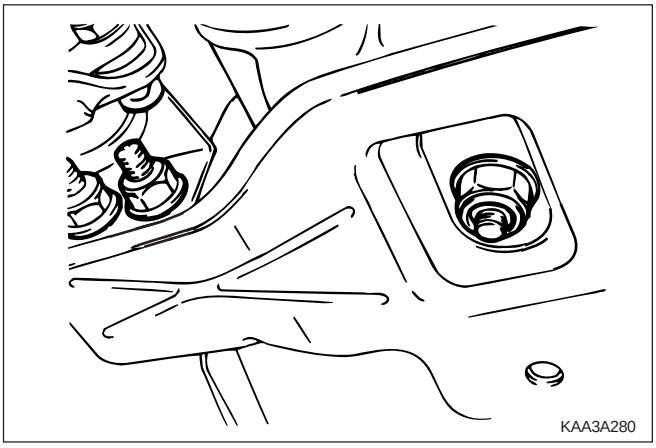
6. Remove the front propeller shaft-to-front axle bolts.

Removal Notice

- Make alignment marks on the front propeller shaft and front axle housing.

Installation Notice

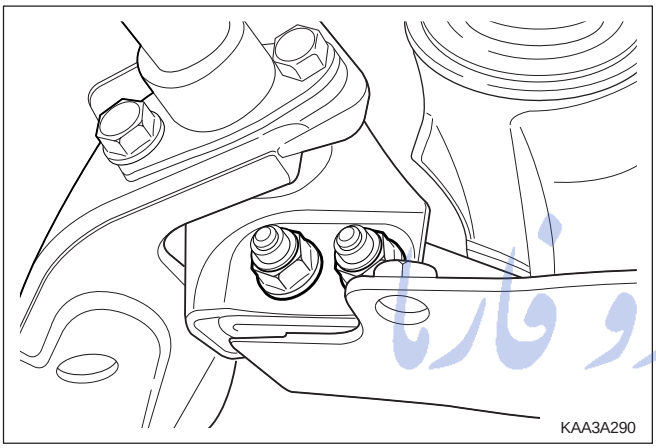
Tightening Torque	7.0 - 8.5 kgf•m



7. Remove the front axle housing mounting nuts from the crossmember.

Installation Notice

Tightening Torque	118 N•m (87 lb-ft)

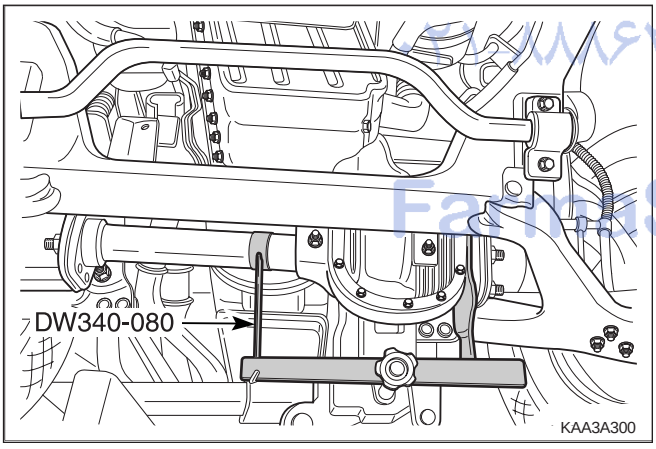


8. Remove the lower ball joint using the ball joint remover 661 589 13 33 00.

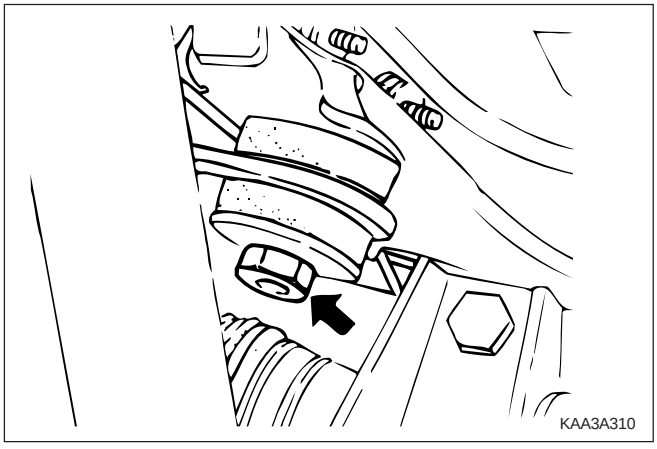
Installation Notice

Tightening Torque	78 N•m (58 lb-f t)

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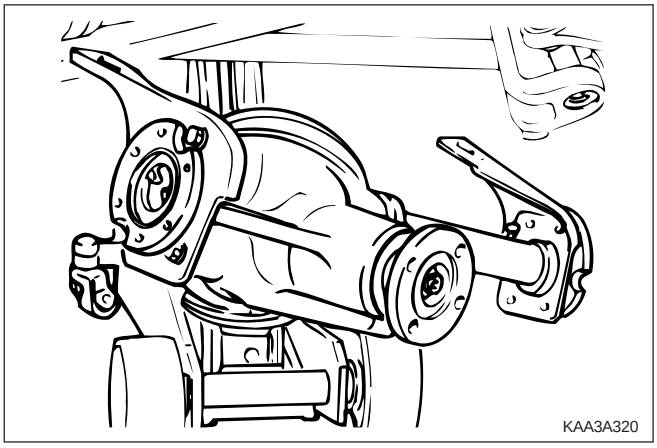
9. Support the front axle housing with front axle support DW340-080.



10. Remove the front axle mounting bracket nuts.

Installation Notice

Tightening Torque	9.5 - 14.2 kgf•m



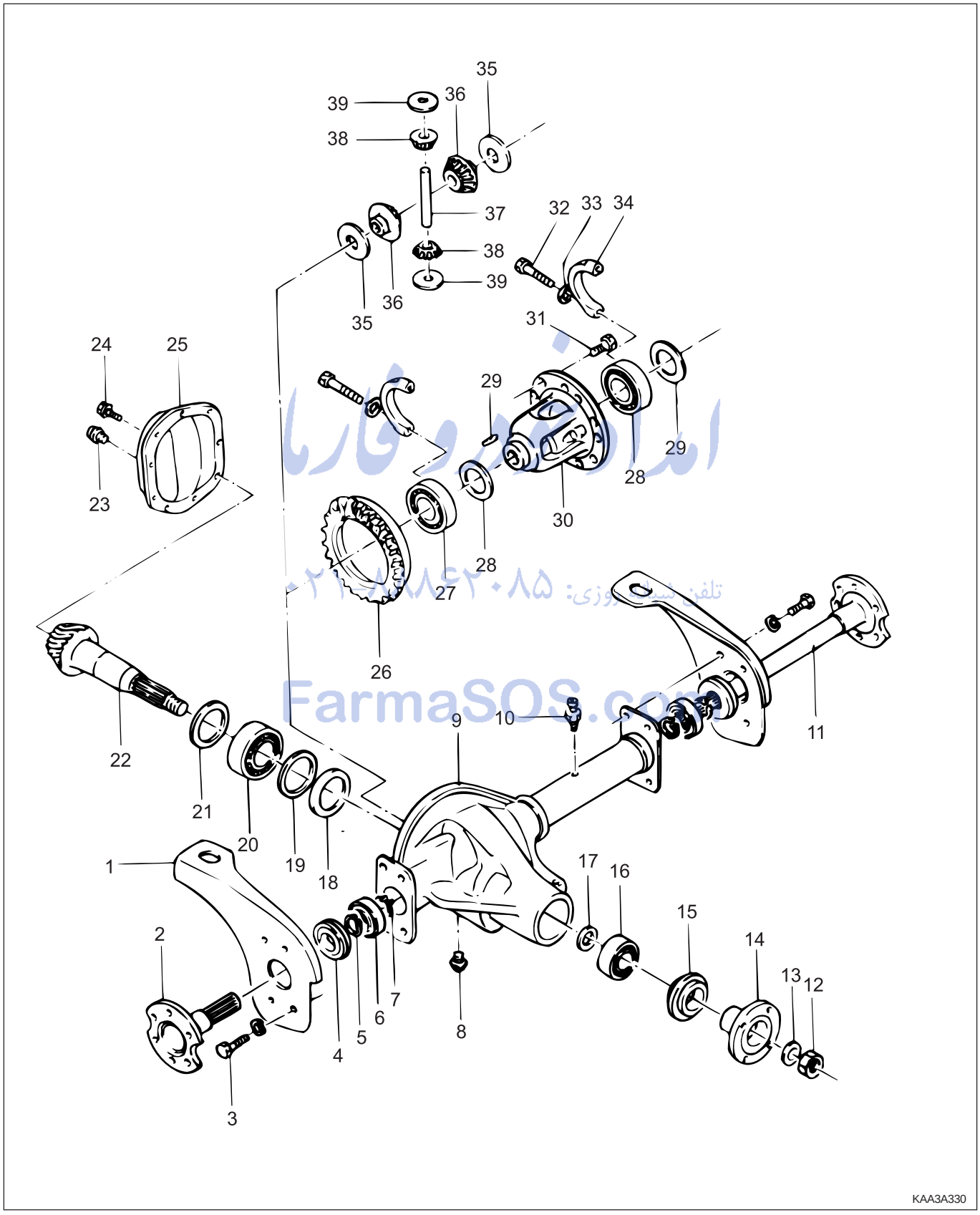
11. Lowering the jack carefully, remove the front axle assembly.
12. Installation should follow the removal procedure in the reverse order.

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UNIT REPAIR

AXLE HOUSING

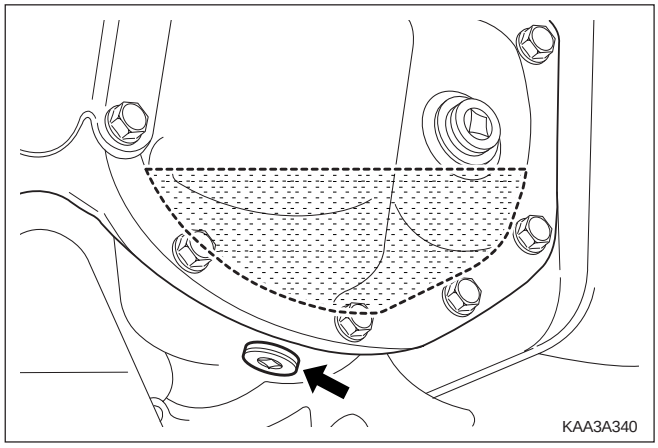
Preceding Work : Removal of the axle housing



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1 Front Axle Housing Mounting Bracket
2 Inner Shaft (Left)
3 Bolt ..... 55 - 65 N•m (41 - 48 lb-ft)
4 Oil Seal .....
..... Replace, Apply Grease to the Sealing Rib
5 Snap Ring
6 Bearing
7 Snap Ring
8 Oil Drain Plug ..... 28 - 41 N•m (21 - 30 lb-ft)
9 Front Axle Housing
10 Breather Nipple
11 Inner Shaft (Right)
12 Pinion Lock Nut .. 240 - 310 N•m (177 - 229 lb-ft)
13 Washer
14 Companion Flange
15 Oil Seal .....
..... Replace, Apply Grease to the Sealing Rib
16 Bearing
17 Shim
18 Bearing Baffle
19 Shim
20 Bearing
21 Oil Slinger
22 Drive Pinion
23 Oil Filler Plug ..... 28 - 41 N•m (21 - 30 lb-ft)
24 Bolt ..... 39 - 46 N•m (29 - 34 lb-ft)
25 Axle Housing Cover .....
..... Apply Liquid Gasket to the Contact Surface
26 Ring Gear
27 Bearing
28 Shim
29 Shaft Lock Pin
30 Differential Case
31 Bolt ..... 75 - 90 N•m (55 - 66 lb-ft)
32 Bolt ..... 48 - 69 N•m (35 - 51 lb-ft)
33 Washer
34 Bearing Cap
35 Thrust Washer
36 Side Gear
37 Differential Shaft
38 Differential Pinion
39 Thrust Washer

امداد خودرو فارما
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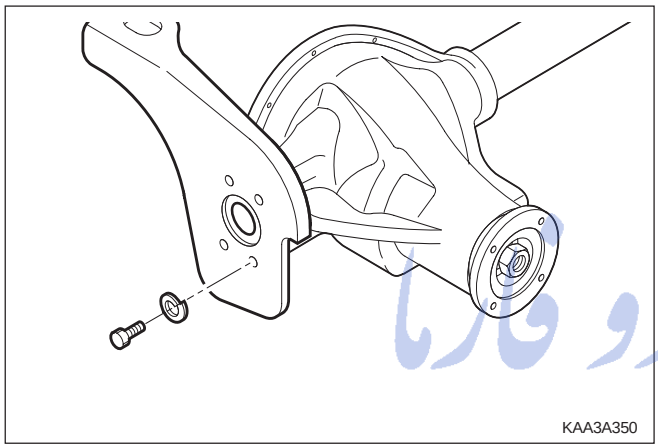


Disassembly Procedure

1. Remove the drain plug and drain the oil. Reinstall the drain plug.

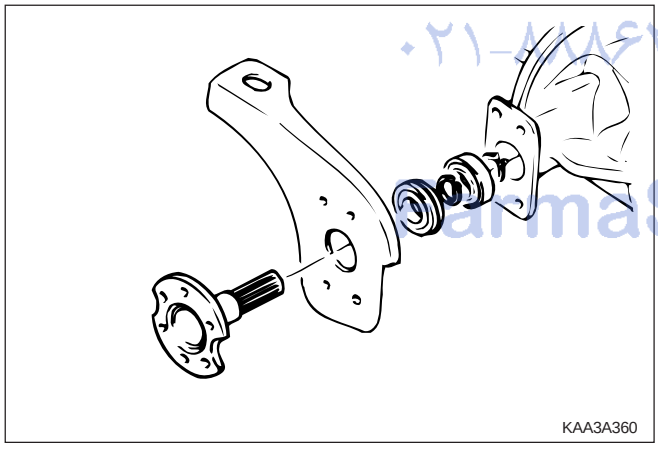
   Installation Notice

Tightening Torque	2.8 - 4.2 kgf•m

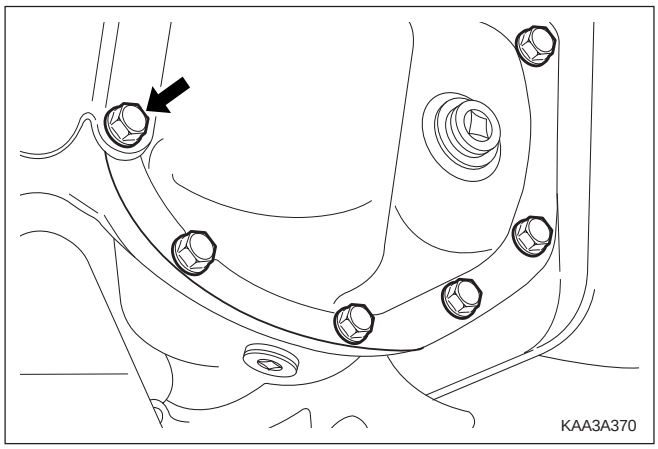


2. Unscrew the axle housing and housing mounting bracket bolts and remove the bracket and inner shaft assembly.

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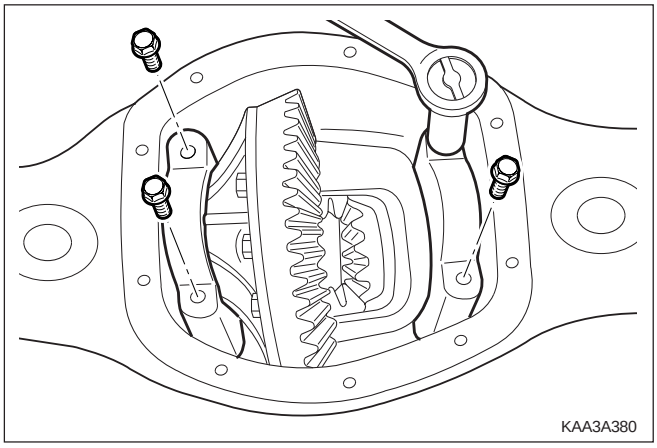


3. Remove the bearing fixing snap ring of the inner shaft and pull out the bearing. Separate the inner shaft and the mounting bracket.



4. Remove the axle housing cover.

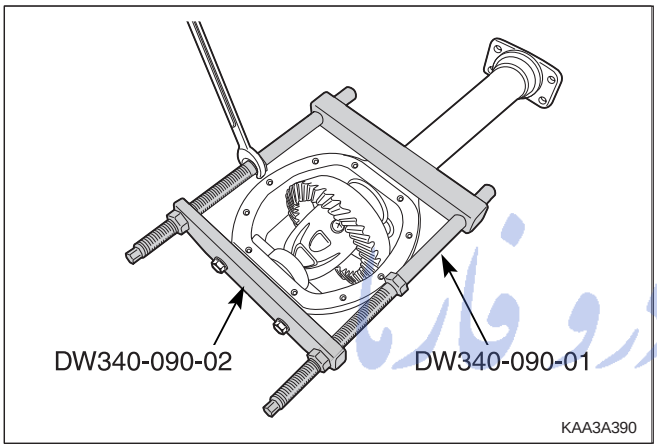
   Notice: Clean the cover and housing contact surfaces.



5. Unscrew the bearing cap bolts and remove the bearing caps. Pull out the differential carrier assembly.

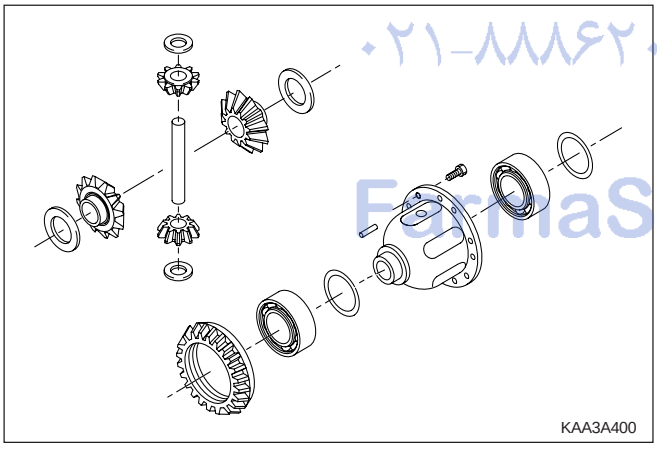
   Notice:

   - Place alignment marks on the bearing cap not to change the caps before removal. When pulling out the differential carrier assembly, be careful not to damage the axle housing.
   - When adding fluid or making a complete fuid change, always use front axle housing.

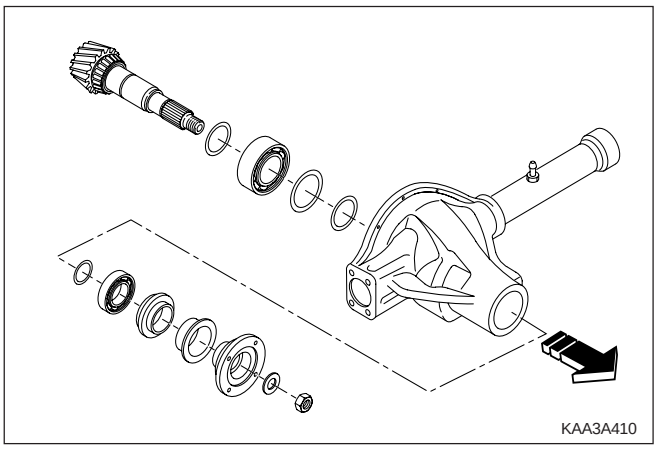


6. Pull out the differential assembly using the differential assembly remover/installer DW340-090-01 and front differental assembly/installer DW340-090-02.

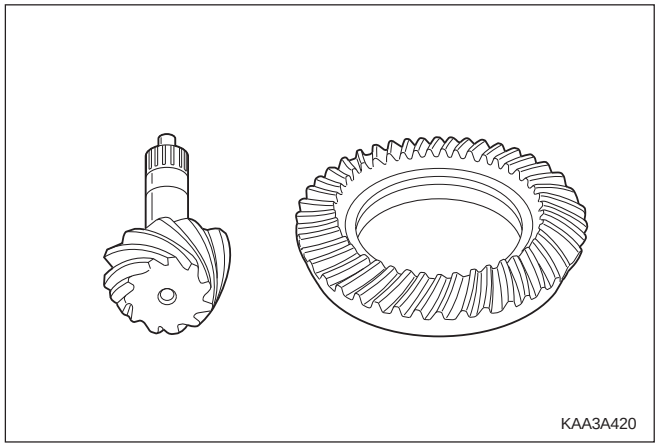
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7. Disassemble the parts of the differential carrier assembly.

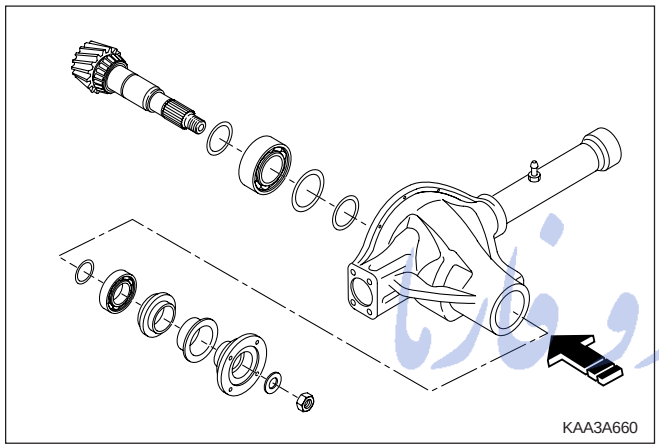


8. Remove the drive pinion lock nut. Disassemble the parts of the drive pinion.



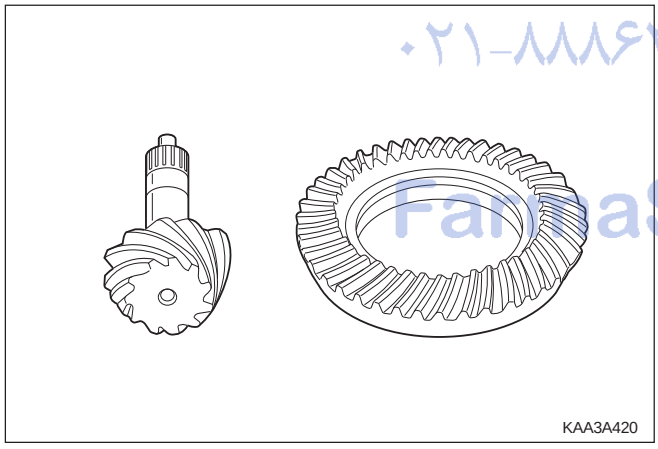
Assembly Procedure

1. Clean the all parts and check the followings :
   - Check the ring gear and drive pinion for wear and damage. If damaged, replace it as a set.
   - Check the bearing for sticks, wear, noise and turning resistance.
   - Check the side gear, pinion, pinion shaft and thrust washer for wear and damage.
   - Check the differential carrier for crack and wear (bearing contact surface). Check the gear case for crack.



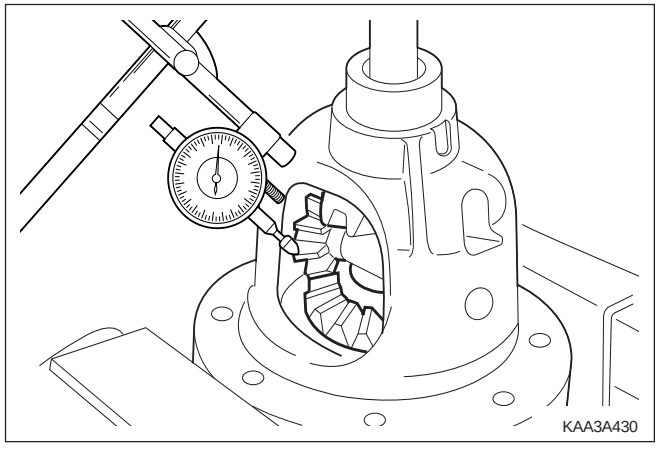
2. Assemble the parts of the drive pinion.

Tightening Torque of the Lock Nut	240 - 310 N•m (177 - 229 lb-ft)



3. Assemble the parts of the differential carrier.

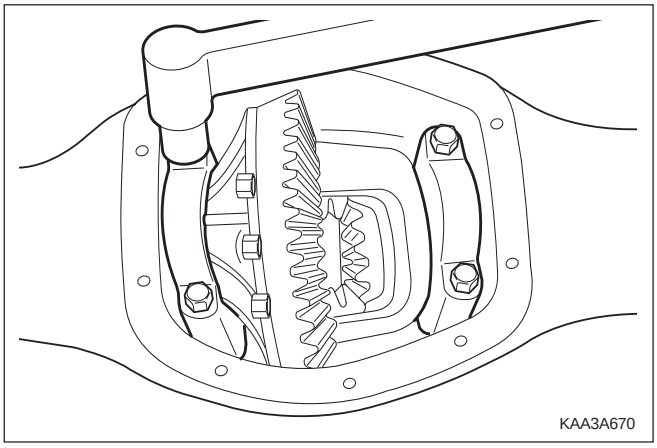
Tightening Torque of the Ring Gear Bolts	75 - 90 N•m (55 - 66 lb-ft)



4. Measure backlash of the side gear and pinion.

Standard	0.025 mm

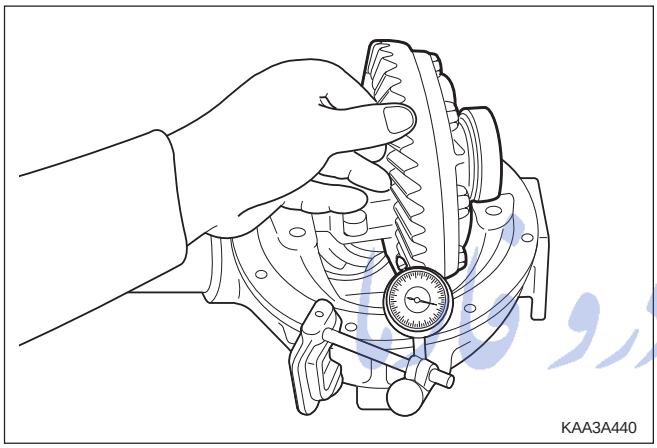
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5. Install the differential carrier assembly into the axle housing.

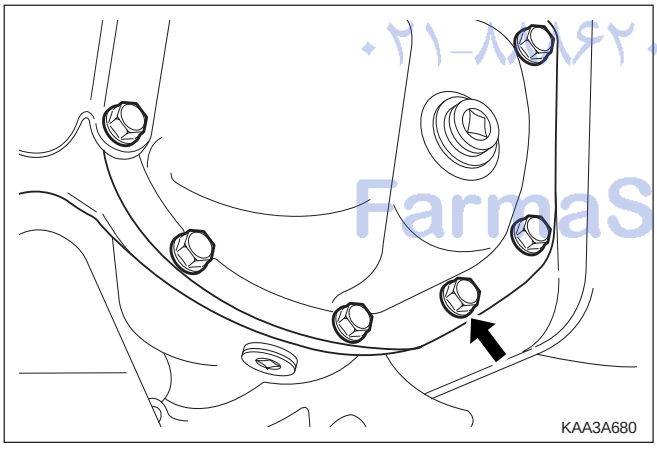
Tightening Torque of the Bearing Cap Bolts	4.8 - 6.9 kgf•m

Notice: Be careful not to change the caps. Be sure to keep the original position of the caps.



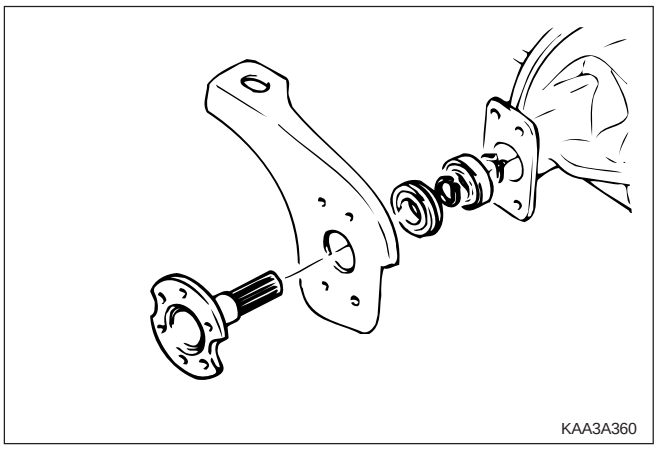
6. Measure backlash of the drive pinion and ring gear.

Specified Value	0.165 mm



7. Install the axle housing cover.

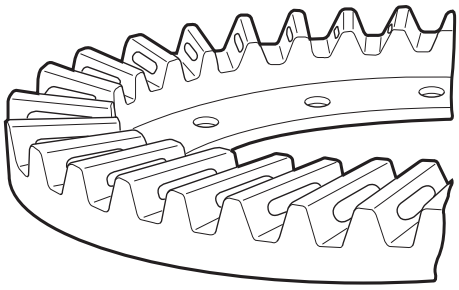
Tightening Torque	3.9 - 4.6 kgf•m



8. Assemble the parts of the front axle shaft and housing mounting bracket.

Notice: Apply grease to the oil seal rib.

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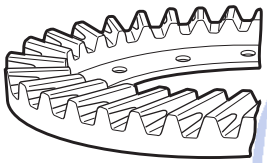
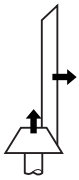
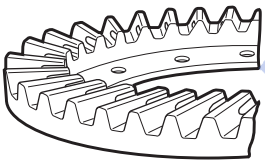
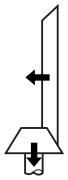
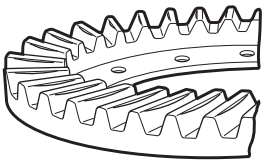
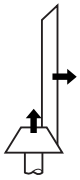
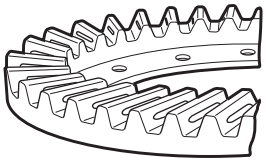
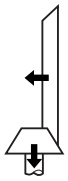

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Inspection of Ring Gear Tooth Contact Pattern

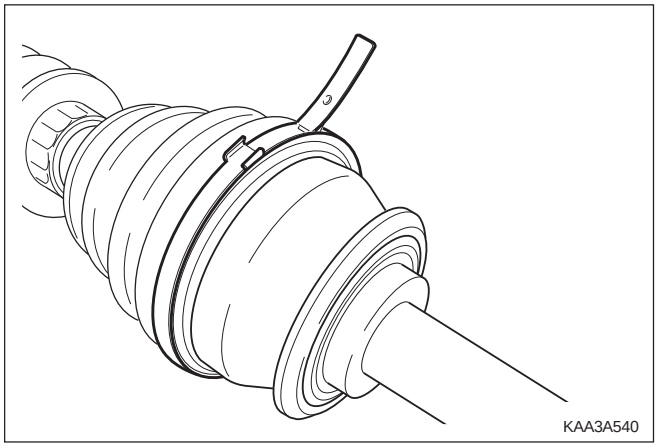
Normal Contact

Apply gear-marking compound (Prussian blue / red lead) on the ring gear teeth. Rotate the ring gear and check the tooth contact pattern.

Abnormal Contact

Tooth contact pattern	Possible cause	Remedy
1. Heel contact  KAA3A460	Excessive backlash (little) • Noise can be occurred	Adjust backlash (Drecrease backlash) • Select proper shim(s) to move the drive pinion toward the ring gear (toward toe)  KAA3A500
2. Toe contact  KAA3A470	Insufficient backlash (little) • Tooth can be damaged or broken under heavy load	Adjust backlash (Increase backlash) • Select proper shim(s) to move the drive pinion against the ring gear (toward heel)  KAA3A510
3. Face contact  KAA3A480	Excessive backlash (much) • Drive pinion shaft is apart from the ring gear • Noise can be occurred	Adjust backlash (Increase pinion shim) • Move the drive pinion toward the ring gear (toward center of ring gear)  KAA3A520
4. Flank contact  KAA3A490	Insufficient backlash (much) • Gear contacts on the low flank • Gear can be damaged or worn • Noise can be occurred	Adjust backlash (Decrease pinion shim) • Move the ring gear toward the drive pinion (toward ring gear center line)  KAA3A530

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۰۲۱-۸۸۳۲۰۸۵ (خط شبانه روزی)
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KAA3A540

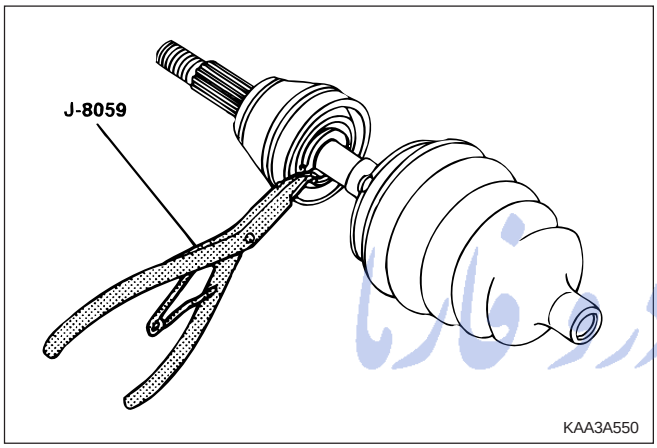
OUTER JOINT SEAL

Tools Required

J-8059 Snap Ring Plier

Disassembly and Assembly Procedure

1. Remove the front drive shaft from the vehicle. Refer to “Front Drive Shaft” in this section.
2. Remove the large seal retaining clamp.
3. Remove the small seal retaining clamp.



KAA3A550

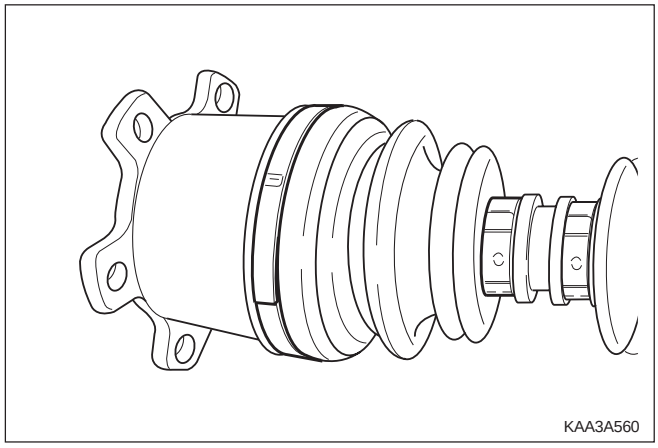
4. Degrease the joint.

   Installation Notice:

   - Fill the joint seal with 135 to 155 g (4.76 to 5.46 ounces) of the recommended grease. Repack the joint with 135 to 155 g (4.76 to 5.46 ounces) of the recommended grease.
5. Spread the snap ring using the snap ring plier J-8059 and remove the outer joint from the front drive shaft.

   Caution: Do not disassembly the outer joint assembly. Parts are match fit and cannot be serviced separately. Improper reassembly will adversely affect both performance and safety.
6. Remove the seal from the joint assembly.

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KAA3A560

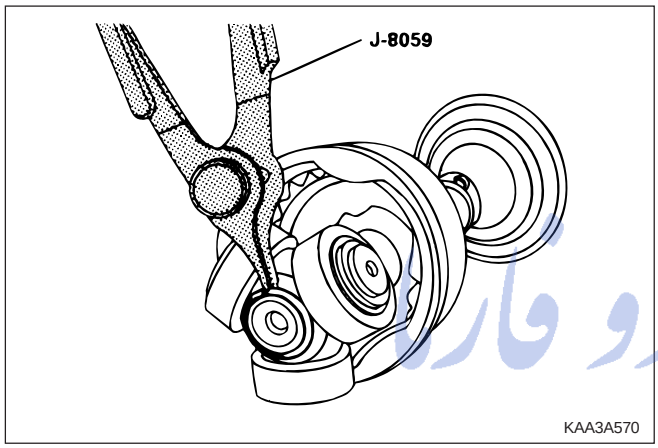
INNER TRIPOT SEAL

Tools Required

J-8059 Snap Ring Plier

Disassembly and Assembly Procedure

1. Remove the front drive shaft from the vehicle. Refer to “Front Drive Shaft” in this section.
2. Remove the large seal retaining clamp.
3. Remove the small seal retaining clamp.

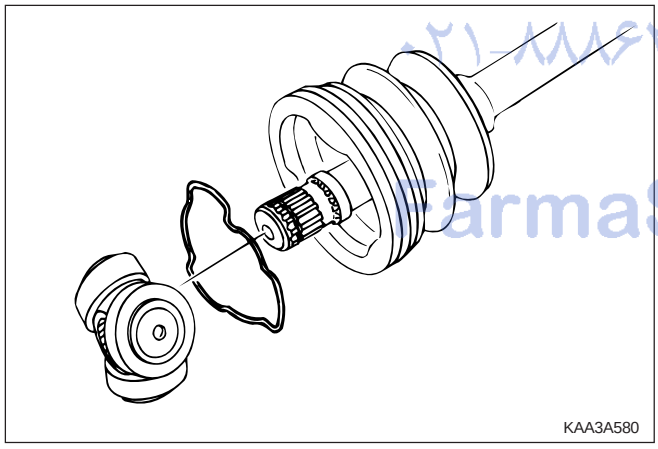


KAA3A570

4. Degrease the tripot assembly.

   Installation Notice

   - Fill the tripot housing with 185 to 205 g (6.53 to 7.23 ounces) of the recommended grease. Repack the tripot with 185 to 205 g (6.53 to 7.23 ounces) of the recommended grease.
5. Remove the shaft retaining ring using the snap ring plier J-8059.

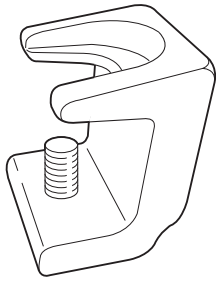
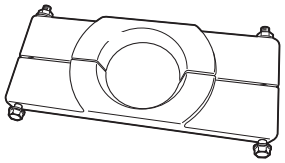
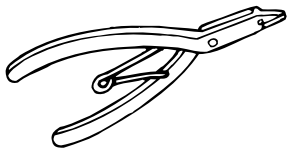
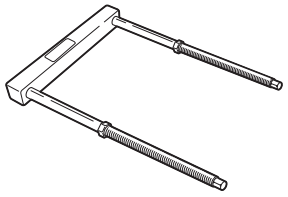
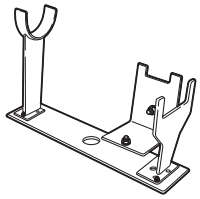
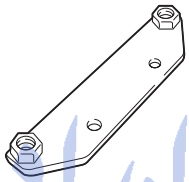

KAA3A580

6. Remove the tripot and the tripot joint retaining ring from the front drive shaft.
7. Remove the tripot joint seal from the front drive shaft.

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SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS TABLE

 KAA3A590	**661 589 13 33 00** **Ball Joint Remover**
 KAA3A600	**661 589 18 33 00** **Axle Bearing Puller Plate**
 KAA3A610	**J-8059** **Snap Ring Plier**
 KAA3A620	**DW340-090-01** **Differential Assembly Remover/Installer**
 KAA3A630	**DW340-080** **Front Axle Support**
 KAA3A640	**DW340-090-02** **Front Differential Assembly Remover/Installer**
 KAA3A650	**DW340-100** **Front Axle Bearing Remover**

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SECTION 3C

PROPELLER SHAFT

TABLE OF CONTENTS

Components Locator 3C-2

Diagnostic Information and Procedures 3C-3

Propeller Shaft 3C-3

Repair Instructions 3C-4

On-Vehicle Service 3C-4

Front Propeller Shaft 3C-4

Rear Propeller Shaft 3C-4

Unit Repair 3C-6

Propeller Shaft 3C-6

Specifications 3C-7

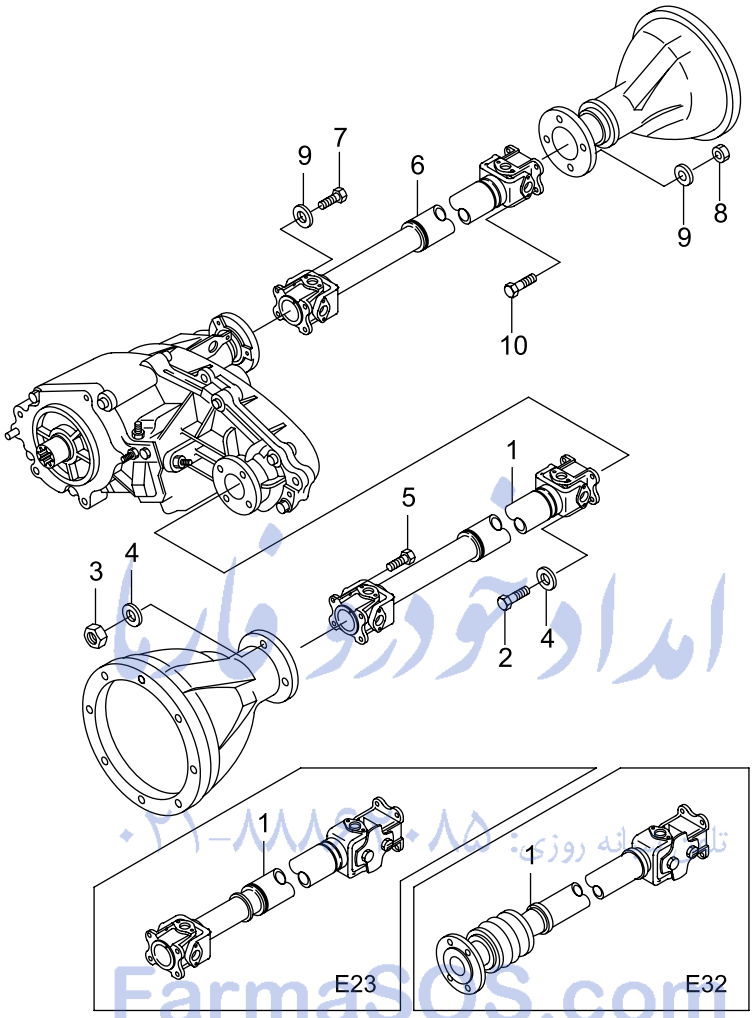
Fastener Tightening Specifications 3C-7

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COMPONENT LOCATOR



KAA3C010

1 Front Propeller Shaft
2 Bolt
3 Nut
4 Washer
5 Bolt
6 Rear Propeller Shaft
7 Bolt
8 Nut
9 Washer
10 Bolt

DIAGNOSTIC INFORMATION AND PROCEDURES

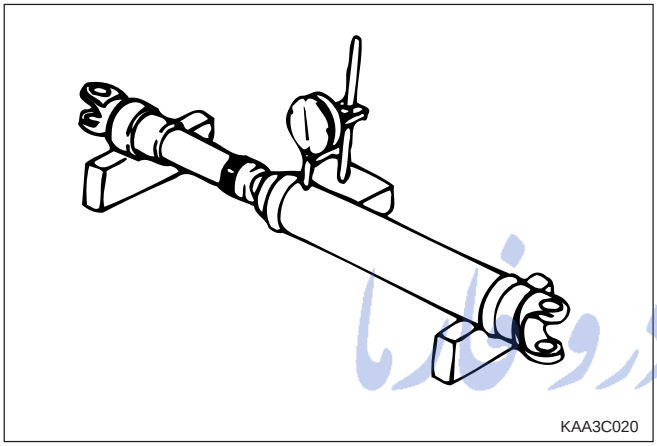
PROPELLER SHAFT

Inspection Procedure

1. Visually check the propeller shaft.
2. Using a dial indicator, measure propeller shaft runout by turning the shaft. If runout exceeds limit, replace the propeller shaft or correct it.

Adjustment Notice

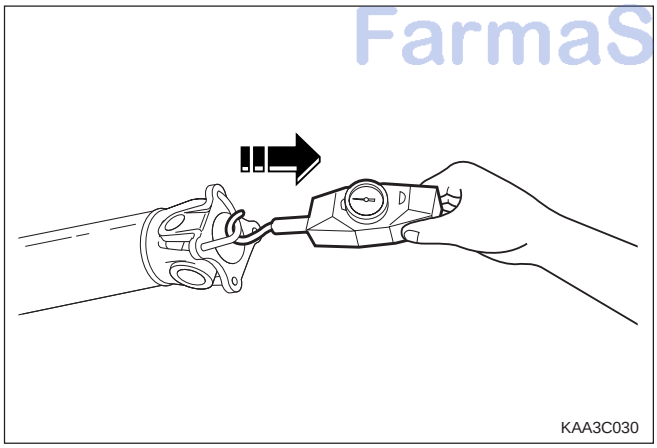
Specification	0.4 mm (0.016 inch)


KAA3C020

3. Measure the universal joint starting torque.

Adjustment Notice

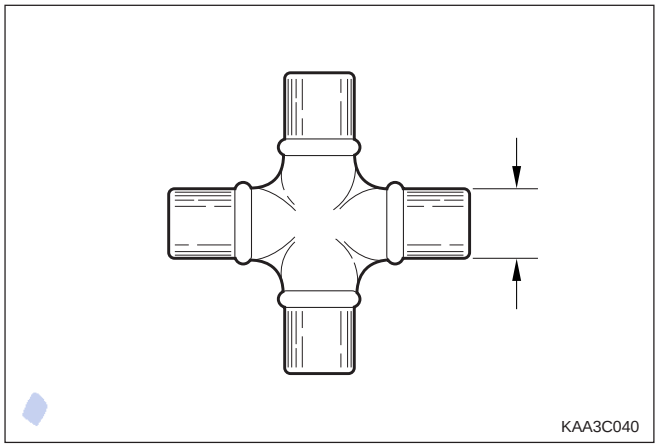
Specification	0.54 N•m (4.78 lb-in)


KAA3C030

4. Measure the spider outer diameter.

Adjustment Notice

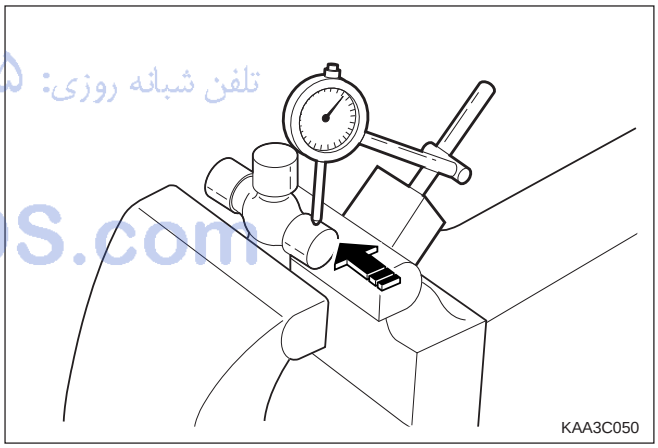
Specification	16.668 mm (0.656 inch)


KAA3C040

4. Measure the spider outer diameter.

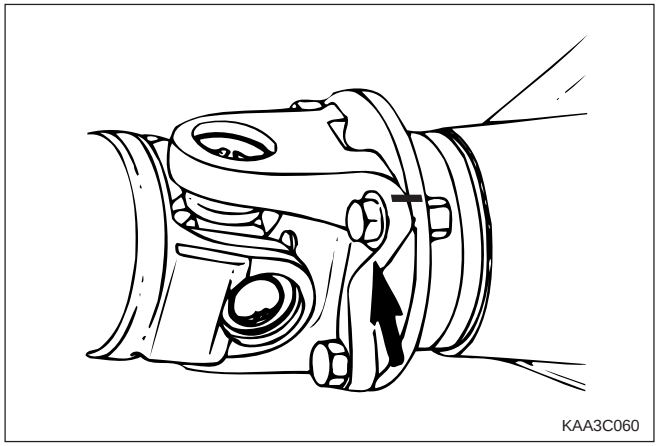
Adjustment Notice

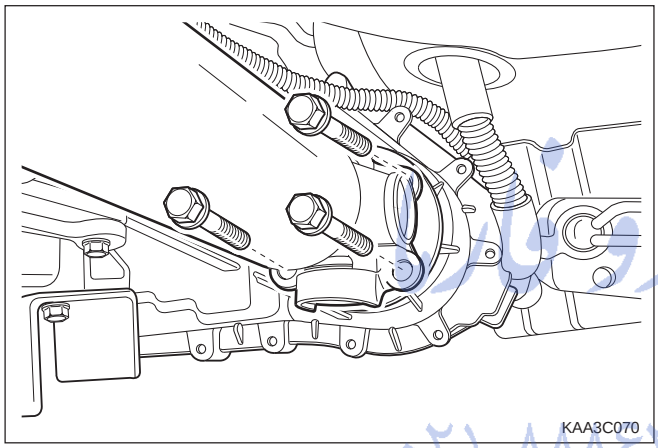
Specification	0.064 mm (0.0025 inch)

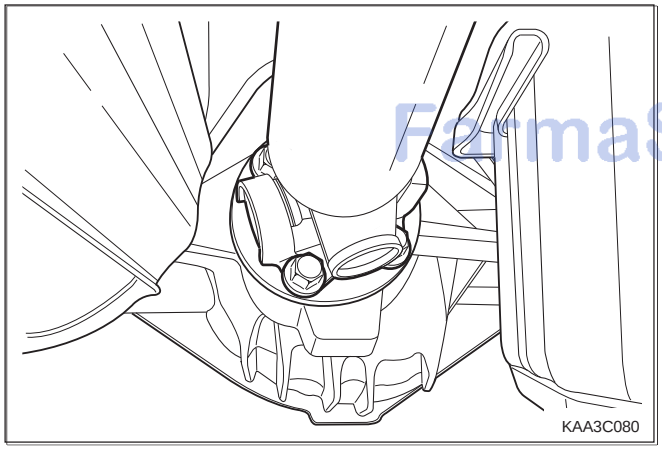

KAA3C050

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REPAIR INSTRUCTIONS


KAA3C060


KAA3C070


KAA3C080

ON-VEHICLE SERVICE

FRONT PROPELLER SHAFT

Removal and Installation Procedure

1. Raise and suitably support the vehicle.
2. Remove the front propeller shaft-to-front axle assembly bolts.

Installation Notice

Tightening Torque	7.0 - 8.5 kg•m

- Make alignment marks on the front propeller shaft and front axle housing.

3. Remove the front propeller shaft-to-transfer case bolts.

Installation Notice

Tightening Torque	8.1 - 8.9 kg•m

4. Remove the front propeller shaft.
5. Installation should follow the removal procedure in the reverse order.

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REAR PROPELLER SHAFT

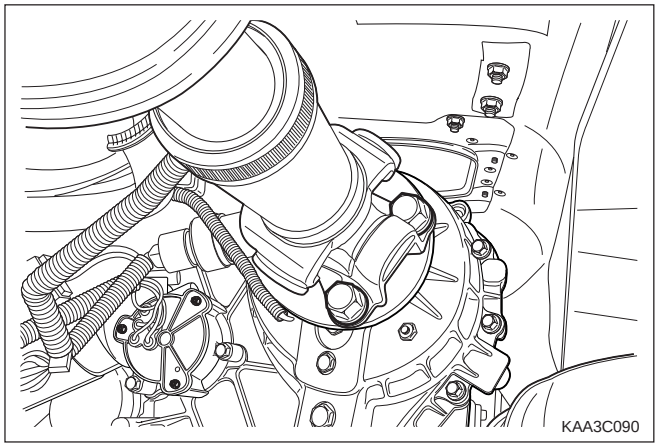
Removal and Installation Procedure

1. Raise and suitably support the vehicle.
2. Remove the rear propeller shaft-to-rear axle assembly bolts.

Installation Notice

Tightening Torque	7.0 - 8.5 kg•m

- Make alignment marks on the rear propeller shaft and rear axle housing.



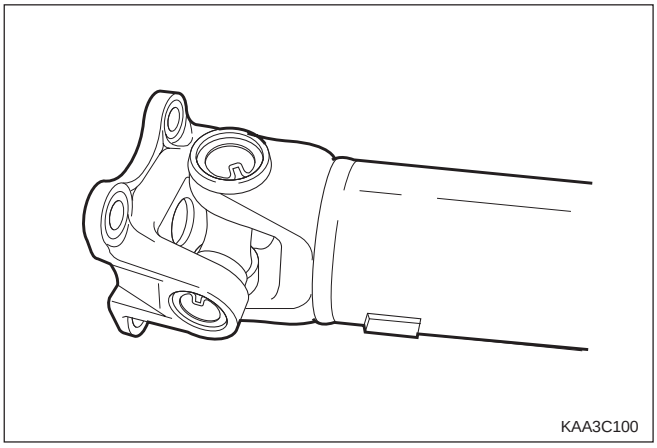
3. Remove the rear propeller shaft-to-transfer case bolts.

Installation Notice

Tightening Torque	8.1 - 8.9 kg•m

4. Remove the rear propeller shaft.
5. Installation should follow the removal procedure in the reverse order.

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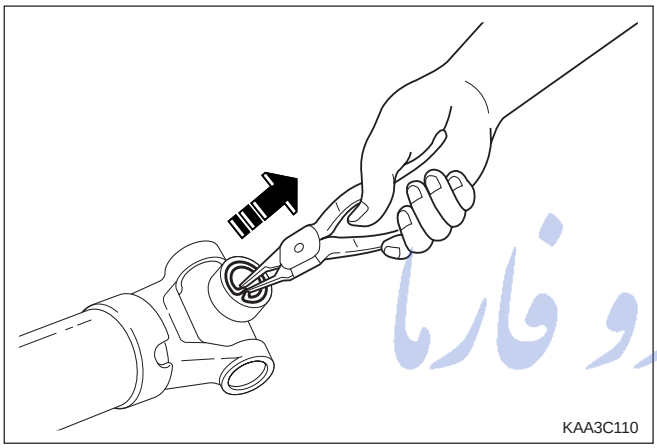

KAA3C100

UNIT REPAIR

PROPELLER SHAFT

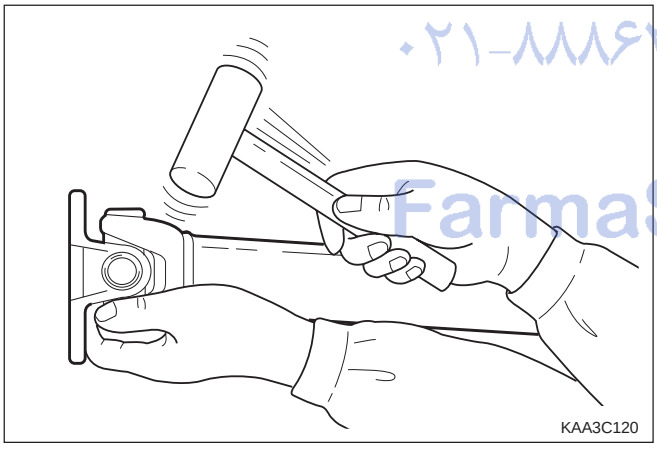
Removal and Installation Procedure

1. Remove the front propeller shaft. Refer to “Front Propeller Shaft” in this section.
2. Place alignment marks before removing the spider.

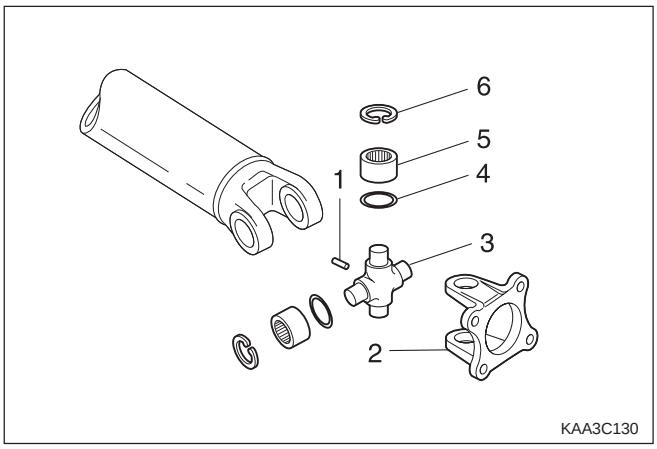

KAA3C110

3. Using a snap ring pliers, remove the snap ring.

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KAA3C120

4. Slightly tapping the yoke shoulder using a brass hammer, remove the bearing. Remove the remaining bearings in the same way.



KAA3C130

5. Disassemble the universal joint parts.

Installation Notice:

- Clean the disassembled parts and replace them if damaged.
- Apply grease to the inner of the bearing cap of the needle roller bearing and assemble the needle roller.

Grease	EP#2

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Front Propeller Shaft-to-Front Axle Assembly	75 - 85	55	-
Front Propeller Shaft-to-Transfer Bolts	81 - 89	63	-
Rear Propeller Shaft-to-Rear Axle Assembly	70 - 85	55	-
Rear Propeller Shaft-to-Transfer Bolts	81 - 89	63	-

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SECTION 3D

REAR AXLE

TABLE OF CONTENTS

General Description and Operation 3D-2
Specifications 3D-2
Fastener Tightening Specifications 3D-2
Diagnostic Information and Procedures 3D-3
Component Locator 3D-4
Rear Axle Assembly 3D-4
Cross Sectional View 3D-5
Rear Axle Shaft Assembly 3D-6
Maintenance and Repair 3D-8
On-Vehicle Service 3D-8
Axle Shaft Assembly (With Disc Brake) 3D-8
Axle Shaft Assembly (With Drum Brake) 3D-11
Rear Axle Housing 3D-13
Unit Repair 3D-18
Axle Assembly 3D-18
Differential Gear Assembly 3D-20
Drive Shaft 3D-25
Special Tools and Equipment 3D-26
Special Tools Table 3D-26

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GENERAL DESCRIPTION AND OPERATION

SPECIFICATIONS

Axle Shaft Type		Semi-floating
Axle Housing Type		Build up
Differential	Type	Conventional Type
	Gear	Hypoid Gear
Reduction Ratio	Gasoline + M/T	3.73
	Diesel + M/T	4.27
	Gasoline + A/T	4.56
	Diesel + A/T	4.89
Oil	Capacity	1.9 ℓ
	Specification	SAE 80W/90 or API GL-5

FASTENER TIGHTENING SPECIFICATIONS

Application		N•m	Lb-Ft	Lb-In
Disc Brake	Flange fixing Bolt	50 - 65	37 - 48	-
	Dust shield Bolt	4 - 8	35 - 71	-
	Caliper Bolt	85 - 105	63 - 77	-
Drum Brake	Fixing Nut	50 - 65	37 - 48	-
Rod Bolt		150 - 180	111 - 133	-
Shock absorber Bolt		30 - 45	22 - 23	-
Stabilizer bar cap bolt		30 - 45	22 - 23	-
Upper arm nut		150 - 180	111 - 133	-
Lower arm nut		150 - 180	111 - 133	-
Propeller shaft fixing bolt		70 - 80	52 - 59	-
LCRV Mounting Bolt		12 - 23	9 - 17	-
Air Breather Hose Bolt		6 - 8	53 - 71	-
Brake oil pipe (M10)		1 - 19	11 - 14	-

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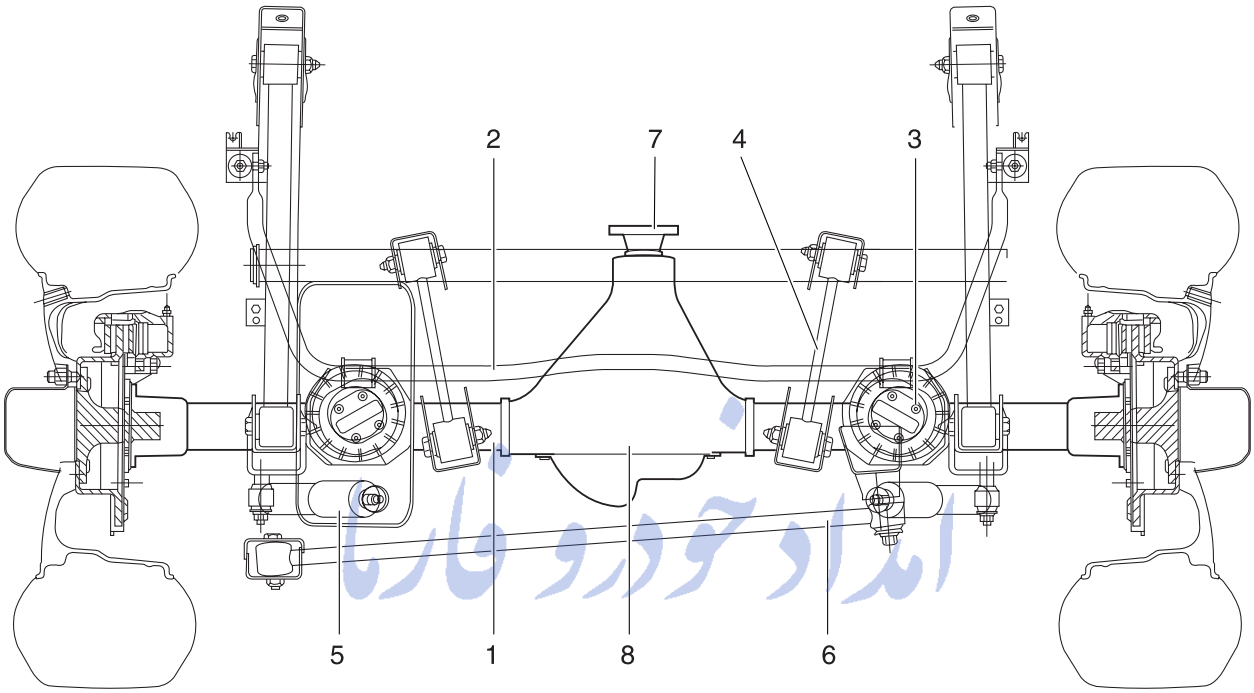
DIAGNOSTIC INFORMATION AND PROCEDURES

Phenomena	Checks	Action
Noise (During Straight Driving)	Lack of Oil	Replenish
	Low Viscosity of Oil	Replace
	Inferior Oil	Replace
	Excessive Backlash of Ring Gears	Adjust
	Worn or Damaged Tooth of Ring and Pinion Gear	Replace
	Worn or Damaged Tooth of Drive Pinion Gear	Replace
	Wear of Side Bearing and Side Gear Spline	Replace
	Bending of Axle Housing	Replace
	Distortion of Differential Case	Replace
	Wear of Pinion Shaft	Replace
	Incorrect Drive Pinion Preload.	Adjust
	Incorrect Contact of Ring Gear and Pinion	Reassembly
Oil Leakage	Excessive Oil	Adjust
	Fault Seal of Carrier Contact Surface	Correct
	Axle Housing Crack	Replace
	Worn or Damaged Oil Seal	Replace
Noise (During Turning)	Worn or Damaged Tooth of Pinion or Side Gear	Replace
	Wear of Pinion Shaft	Replace
	Excessive Backlash of Pinion Gear and Side Gear	Replace
	Excessive End-Play of Rear Axle Shaft	Adjust
	Incorrect Contact of Side Gear and Differential Case	Replace
	Axle Housing Crack	Replace
	Distortion or Poor Installation of Drive pinion Oil Seal	Replace
	Damaged of Torn Drive Pinion Oil Seal	Replace
	Loosened Bearing Collar	Replace
	Worn or Damaged Universal Joint	Replace
	Worn or damaged Axle Shaft Bearing	Replace
Heating	Lock of Oil	Replenish
	Insufficient Backlash of Gears	Adjust
	Excessive Preload of Bearing	Adjust

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COMPONENT LOCATOR

REAR AXLE ASSEMBLY



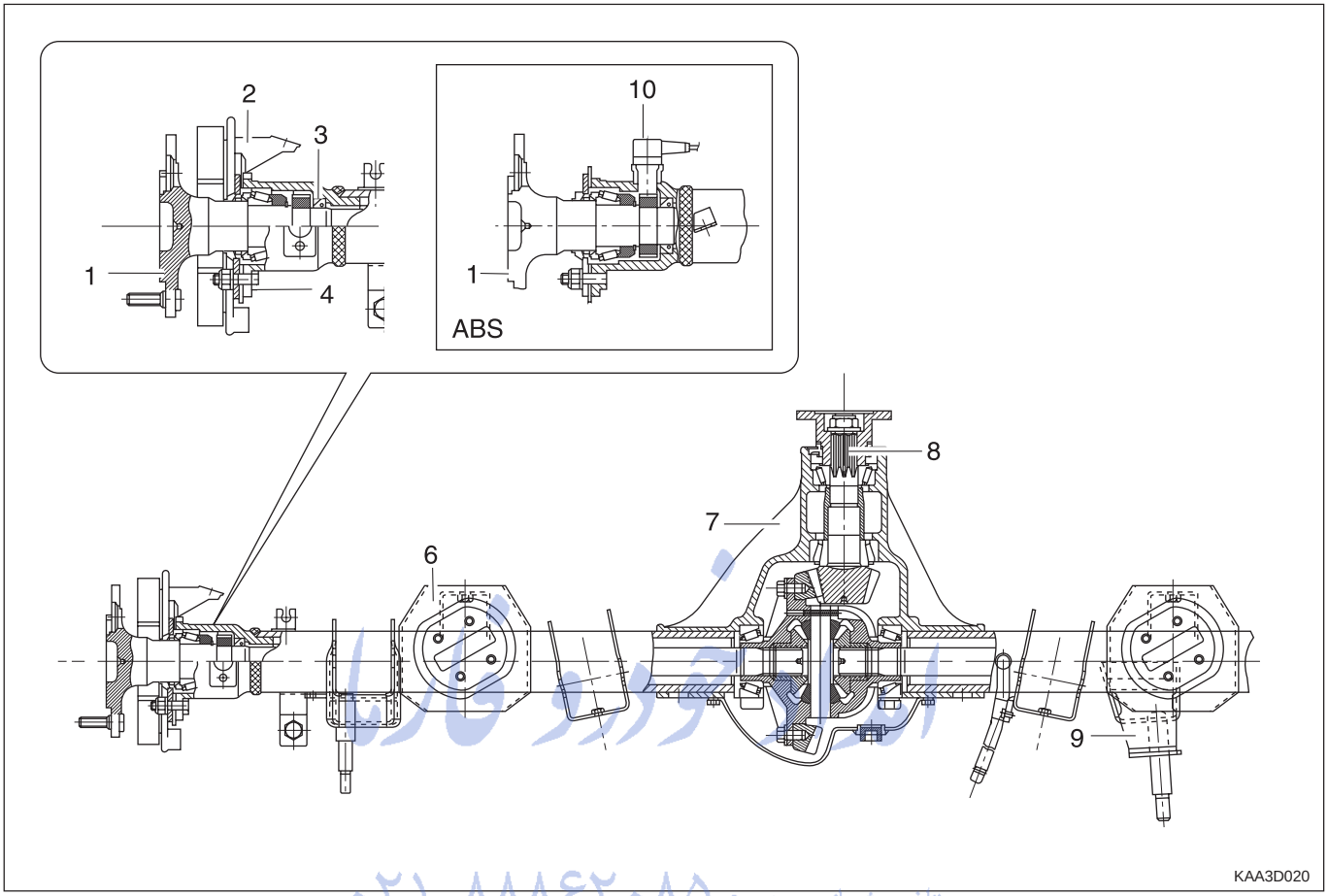
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KAA3D010

1 Axle Shaft/Tube
2 Stabilizer Bar
3 Spring Seat & Spring
4 Upper Arm
5 Shock Absorber
6 Lateral Rod
7 Input Shaft
8 Axle Housing

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CROSS SECTIONAL VIEW

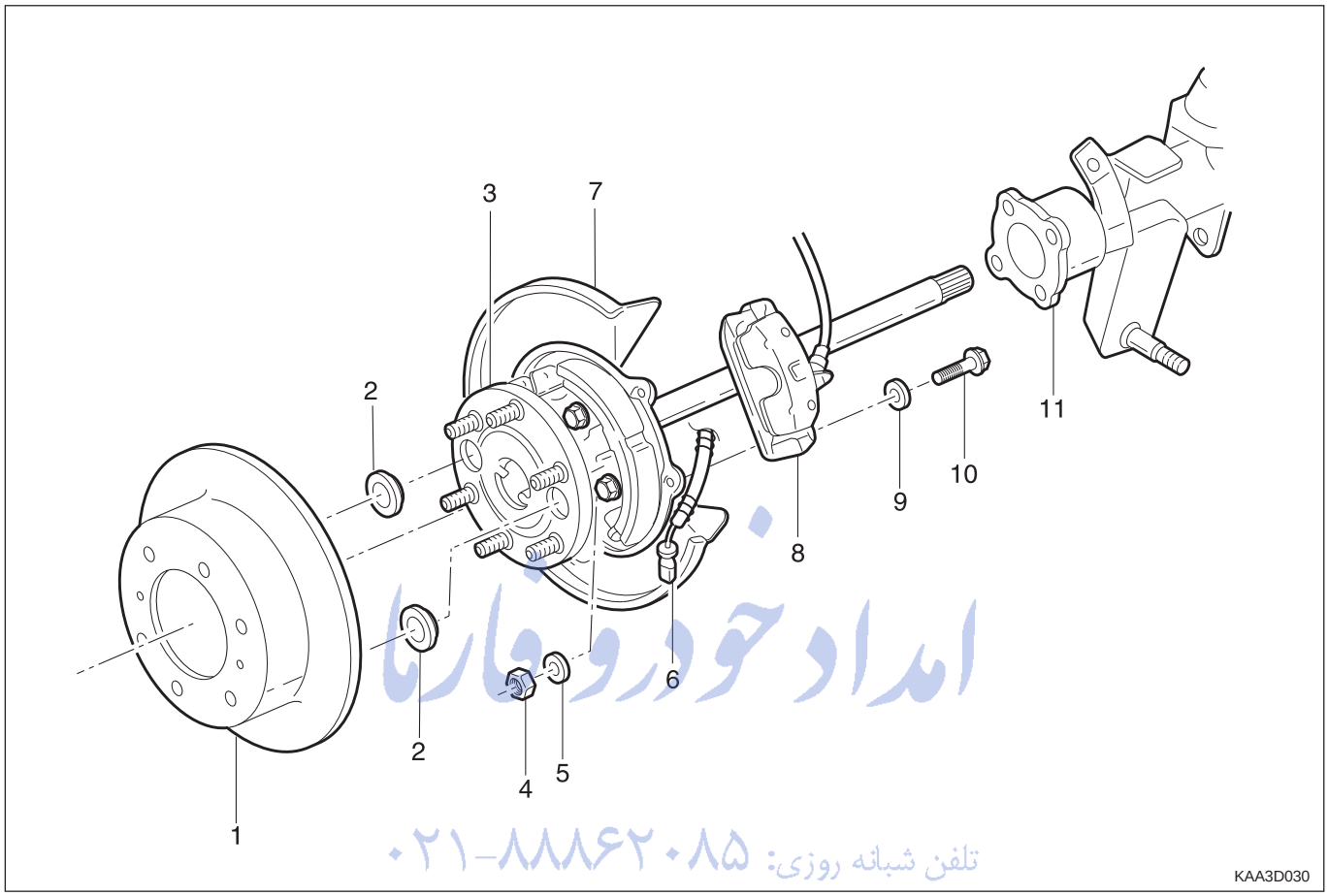


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1 Rear Axle Shaft Assembly
2 Bracket Assembly
3 Hub Oil Seal
4 Bolt
5 Axle Shaft Tube
6 Coil Spring Seat (Lower)
7 Caliper Assembly
8 Input Shaft/Flange
9 Rod Mounting Bracket
10 Wheel Speed Sensor

REAR AXLE SHAFT ASSEMBLY

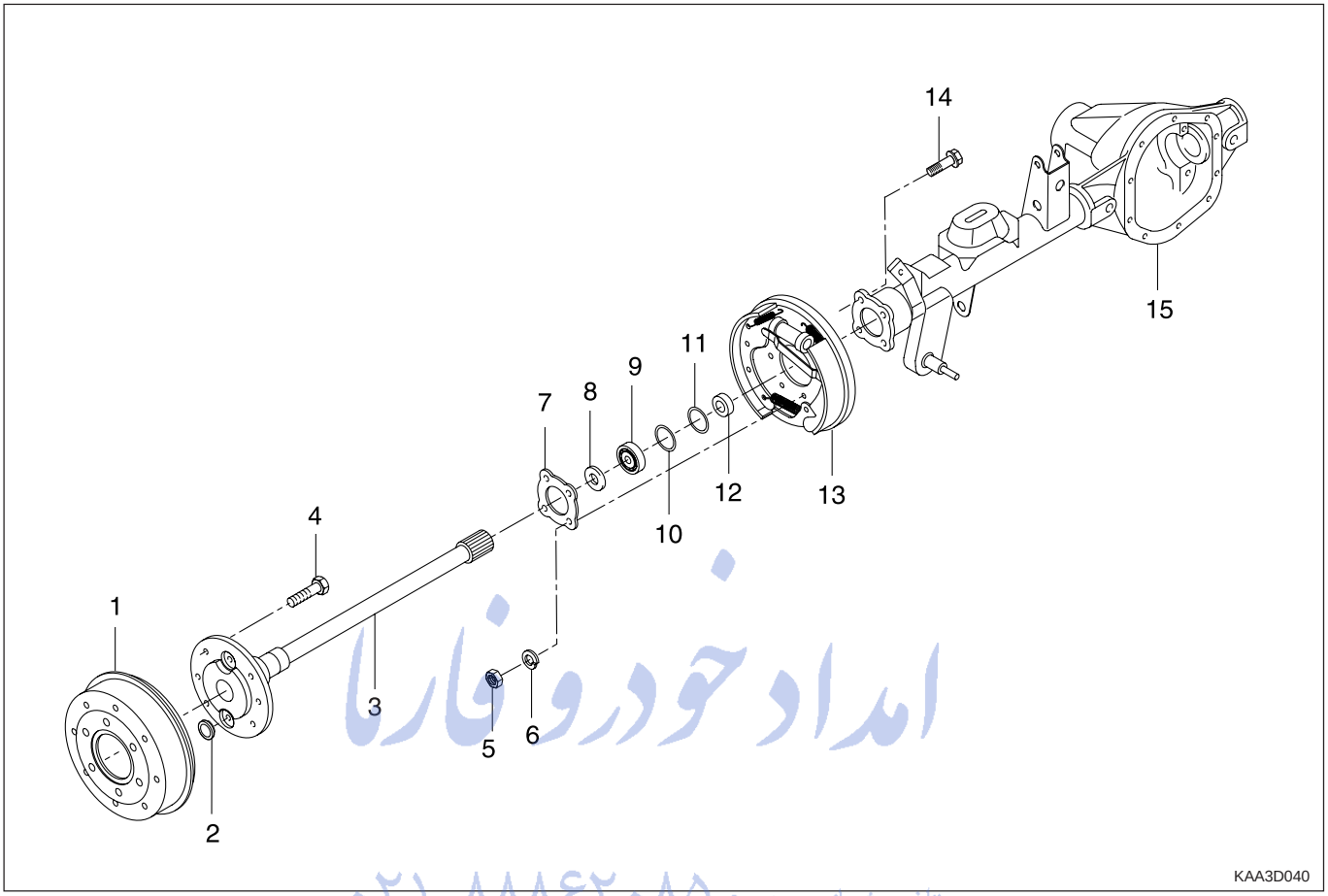
With disc brake



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1 Brake Disc
2 Plug
3 Rear Axle Shaft
4 Nut
5 Washer
6 Parking Brake Cable
7 Parking Brake Lining & Back Plate Assembly
8 Brake Caliper Assembly
9 Spring Washer
10 Bolt
11 Rear Axle Housing

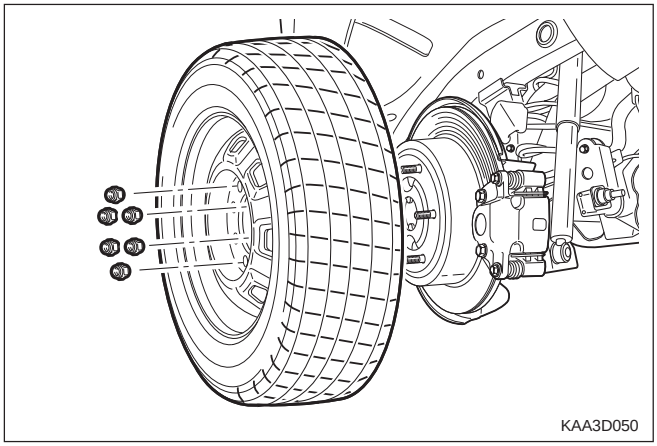
With drum brake



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1 Brake Drum
2 Plug
3 Rear Axle Shaft
4 Wheel Bolt
5 Nut
6 Washer
7 Retainer Plate
8 Oil Seal
9 Bearing
10 Snap Ring
11 Snap Ring
12 Oil Seal
13 Brake Shoe & Back Plate Assembly
14 Bolt
15 Rear Axle Housing

MAINTENANCE AND REPAIR

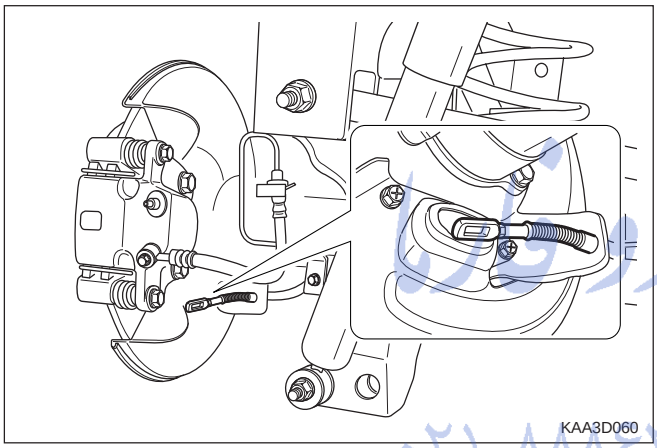

KAA3D050

ON-VEHICLE SERVICE

AXLE SHAFT ASSEMBLY (WITH DISC BRAKE)

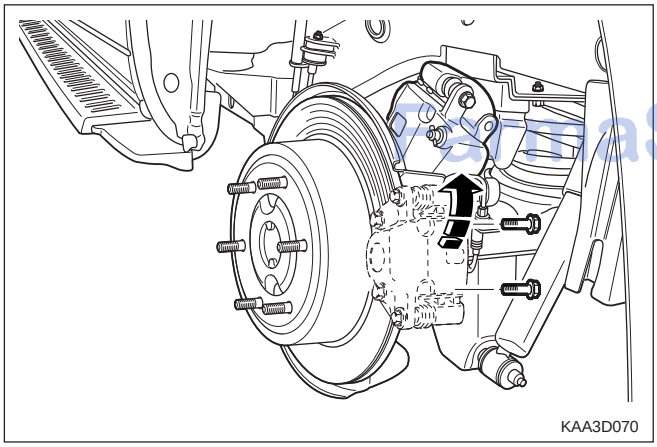
Removal

1. Remove the tire.


KAA3D060

2. Release the parking brake.
3. Remove the fixing pin of parking brake.
4. After detaching the parking brake lever, detach the cable.

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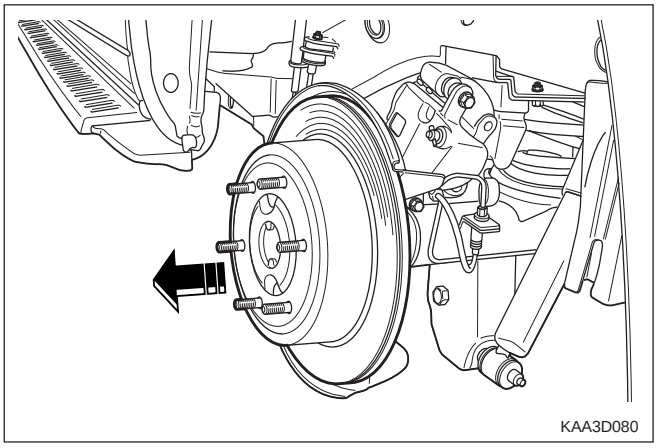

KAA3D070

5. Remove the two fixing bolt of brake caliper.

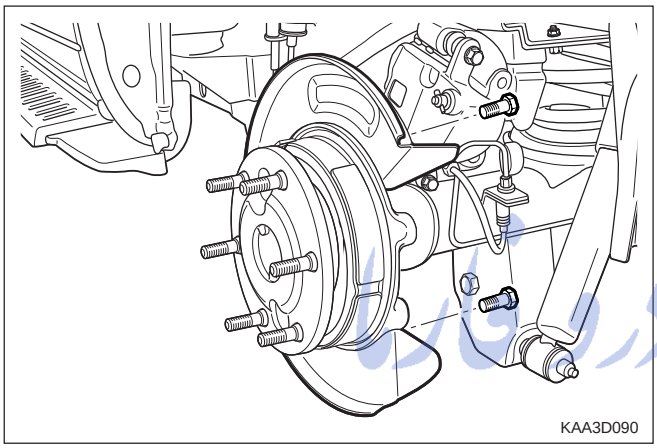
   Notice: Be careful not to damage the brake oil hose.

6. Remove the brake caliper assembly.

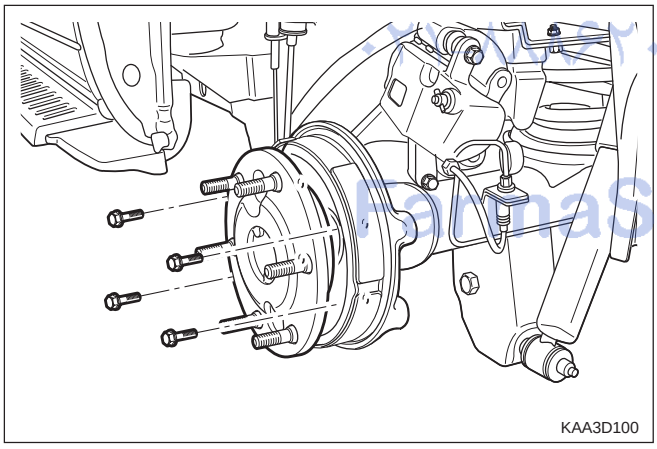
   Notice: If replacing the brake pad only, remove the upper fixing bolt of caliper pad and lower it.


KAA3D080

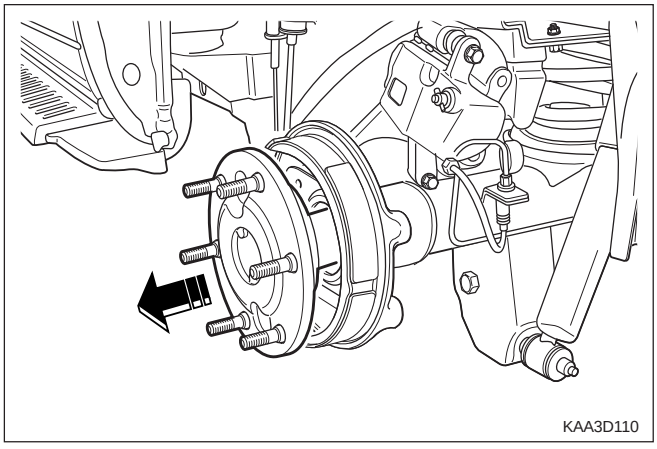
7. Remove the brake disc.


KAA3D090

8. Remove the four fixing bolt of dust shield cover and then pull out the dust shield cover.

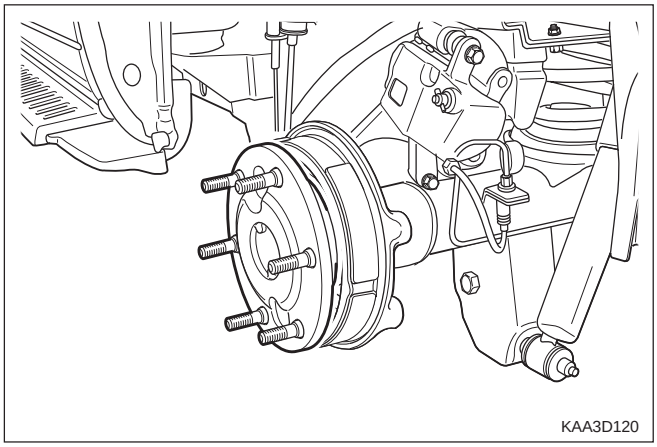

KAA3D100

9. Remove the two plastic plug in the axle shaft flange.
10. Remove the four fixing bolts & washers of axle housing flange from the retainer plate.


KAA3D110

11. Remove the rear axle drive shaft.

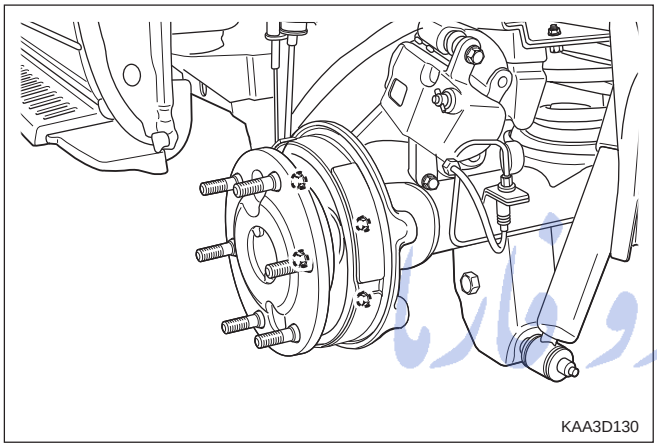
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KAA3D120

Installation

Clean the detached axle shaft, check the damage or wear.

1. After checking the spline & shaft of rear axle shaft, assemble the shaft into the rear axle housing.

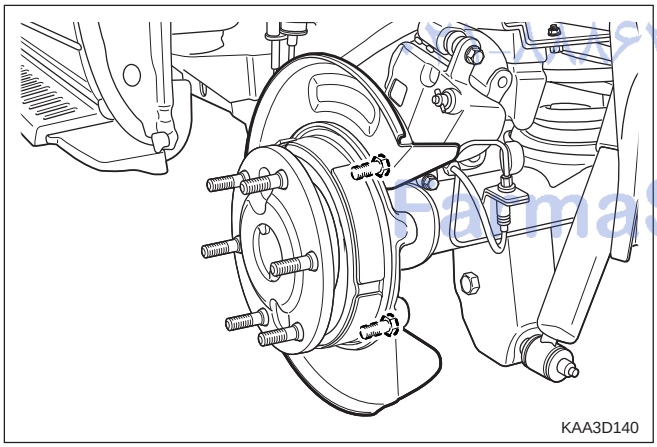

KAA3D130

2. Tighten the flange fixing bolts and washers with the retainer plate.

Installation Notice

Tightening Torque	50 - 65 N•m (37 - 48 lb-ft)

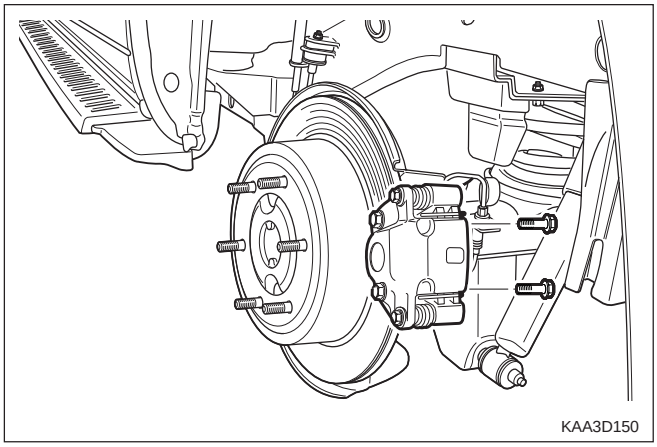
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KAA3D140

3. Assemble the plastic plug n the rear axle flange and install the dust shield.

Installation Notice

Tightening Torque	4 - 8 N•m (35 - 71 lb-in)

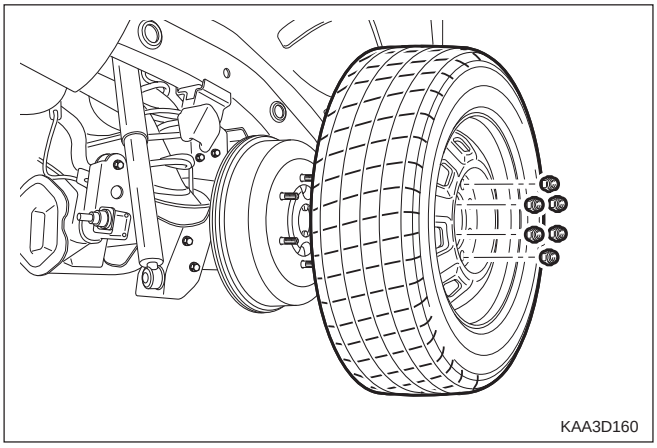

KAA3D150

4. Install the brake disc and caliper assembly.

Installation Notice

Tightening torque	85 - 105 N•m

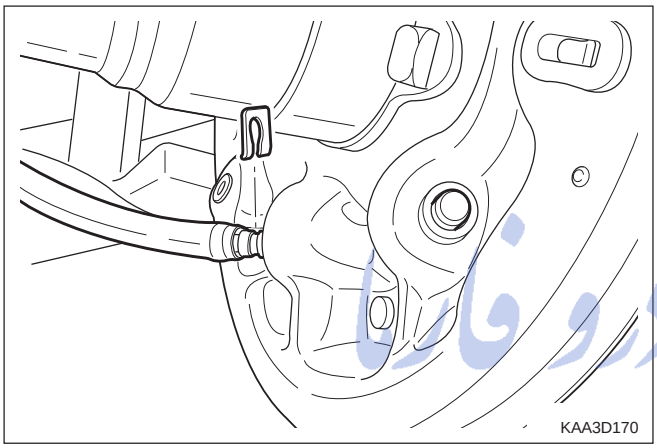
5. Install the parking brake cable and tire.


KAA3D160

AXLE SHAFT ASSEMBLY (WITH DRUM BRAKE)

Removal

1. Release the parking brake.
2. Remove the tire.

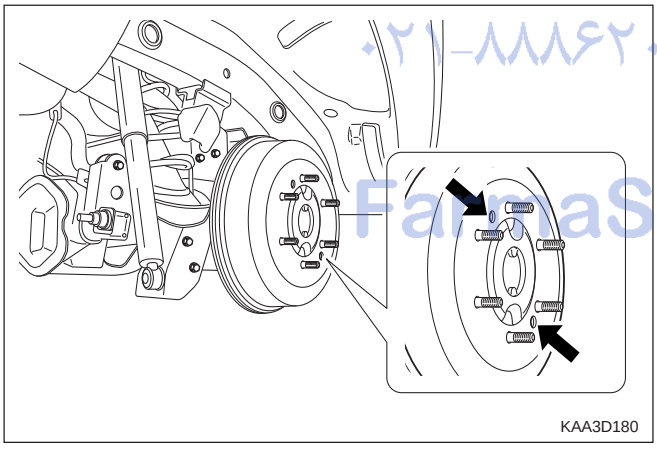

KAA3D170

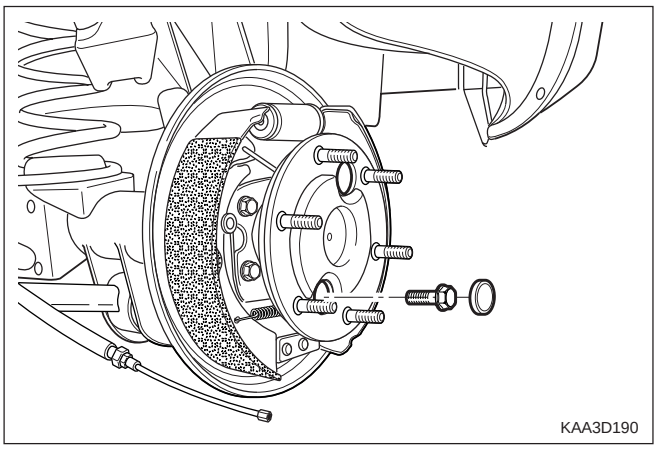
3. Remove the brake drum.

   Notice: Insert the bolt into the service hole, while tightening the both side bolts uniformly, remove the brake drum.

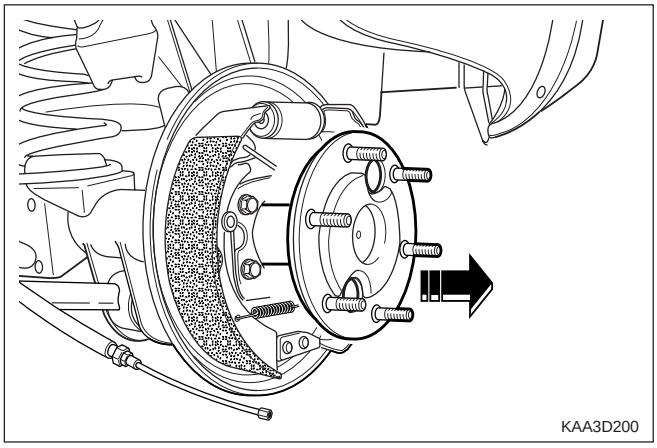
4. Remove the fixing pin of parking brake.
5. After detaching the cover of parking brake, disconnect the cable.

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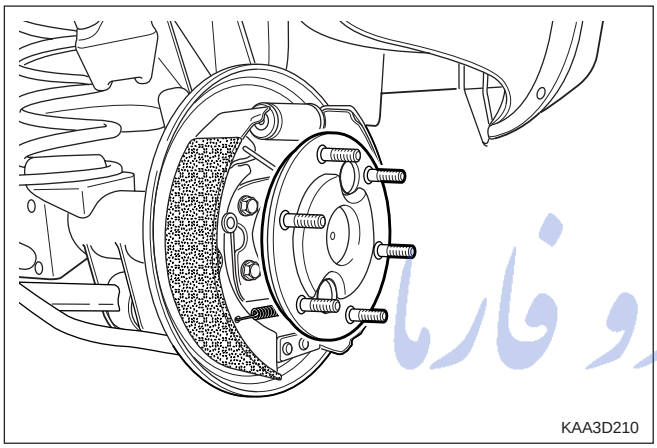

KAA3D180


KAA3D190

6. After pulling out the two plastic plug of axle shaft flange, remove the fixing nuts of inner bracket.


KAA3D200

7. Remove the axle shaft.

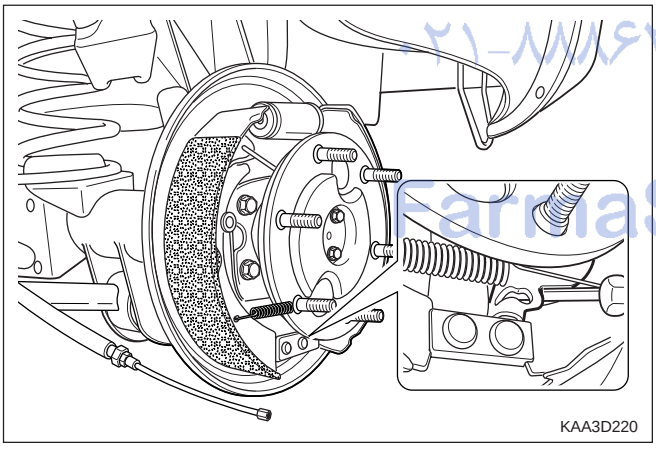

KAA3D210

Installation

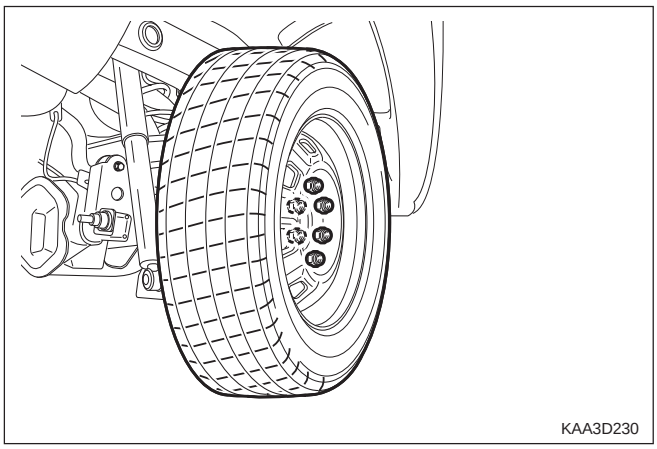
1. Check the rear axle shaft.
2. Insert the rear axle shaft into the axle housing and tighten the fixing nuts of axle shaft flange.

Installation Notice

Tightening Torque	50 - 65 N•m (37 - 47 lb-ft)

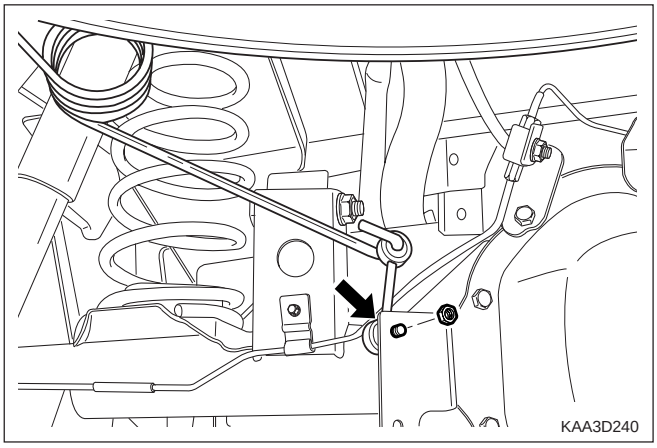

KAA3D220

3. Connect the brake cable and install the brake drum.


KAA3D230

4. Install the tire and test the braking force.

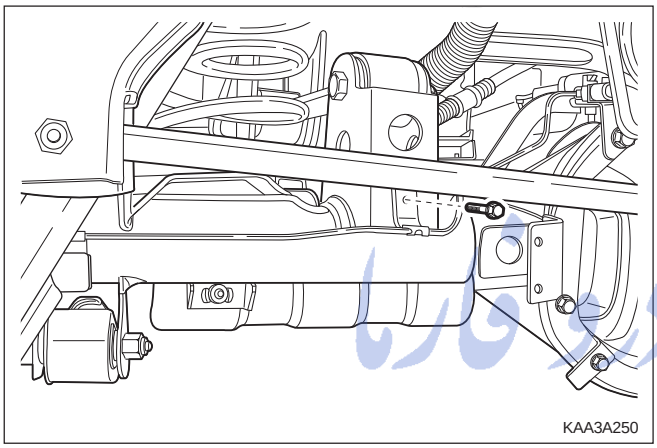
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REAR AXLE HOUSING

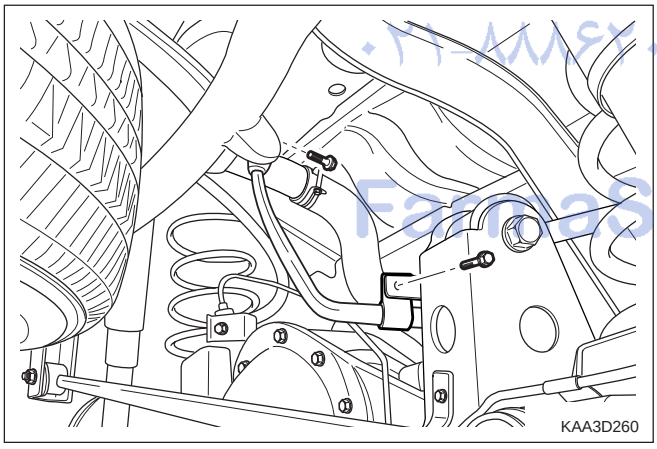
Removal

1. Remove the tire.
2. Remove the connecting rod of LCRV assembly & fixing nut of axle housing bracket.

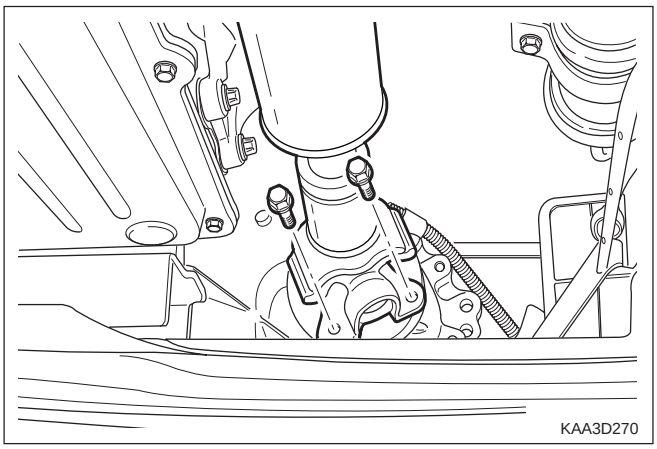


3. Disconnect the brake oil hose & oil line (pipe)
   - Brake pipe nut.
   - Brake pipe mounting clip
   - 3-way connector
   - Brake pipe assembly

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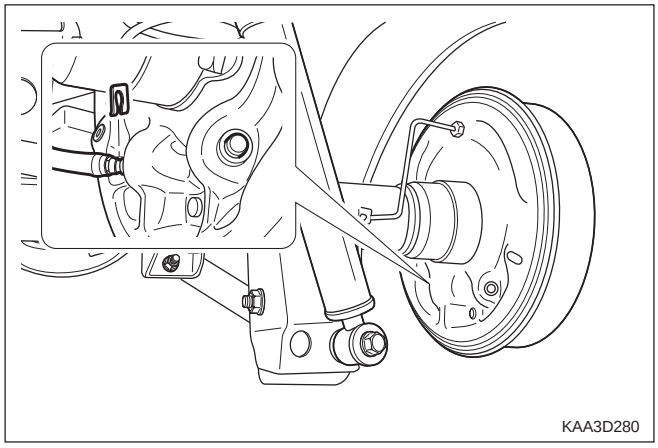


4. Detach the air breather.

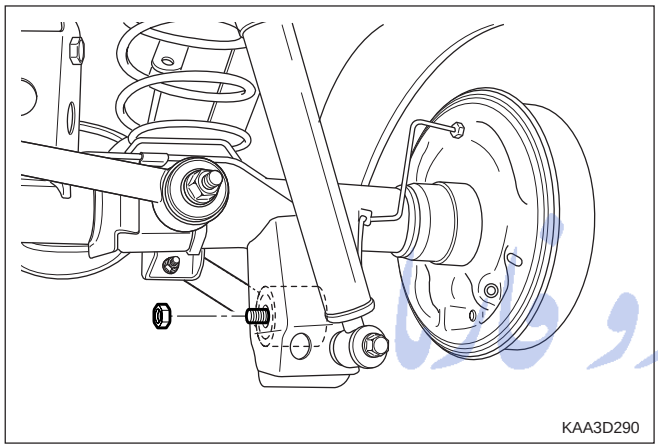


5. Remove the propeller shaft from rear axle input shaft.

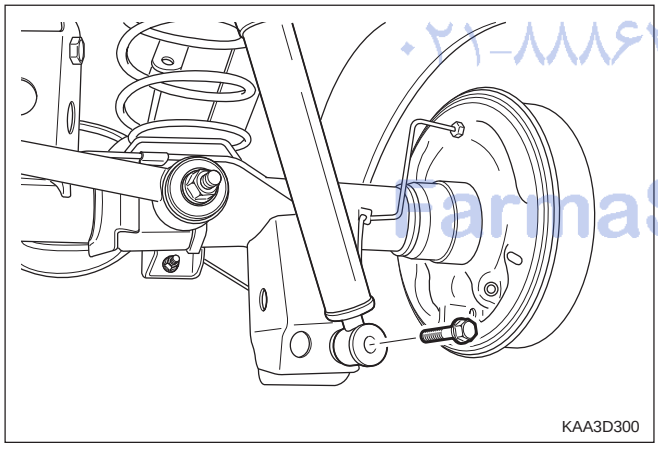
   Notice: Do alignment marks before removing.


KAA3D280

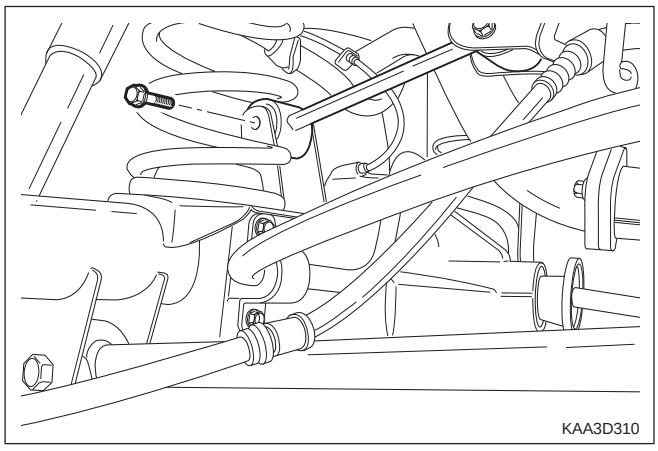
6. Pull out the fixing pin of parking brake.
7. After removing the parking brake lever, pull out the cable.


KAA3D290

8. Remove the lower arm mounting nuts and remove the lower arm from the axle housing.

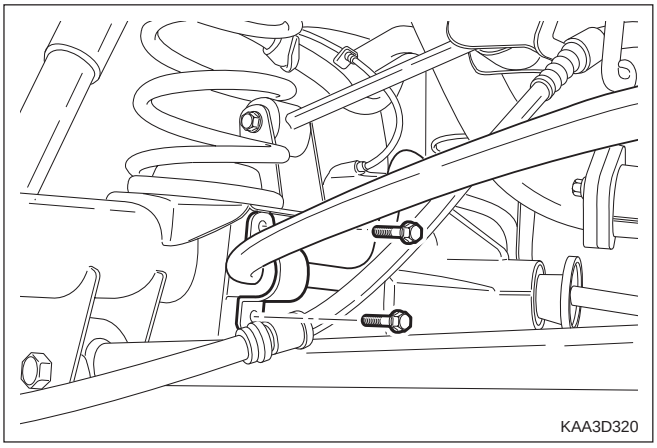

KAA3D300

9. Detach the lower mounting of shock absorber from the axle housing.

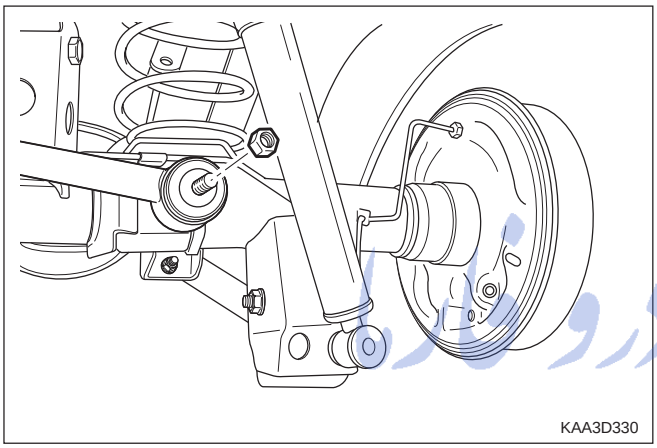

KAA3D310

10. Remove the upper arm mounting nuts and remove the upper arm from the axle housing.

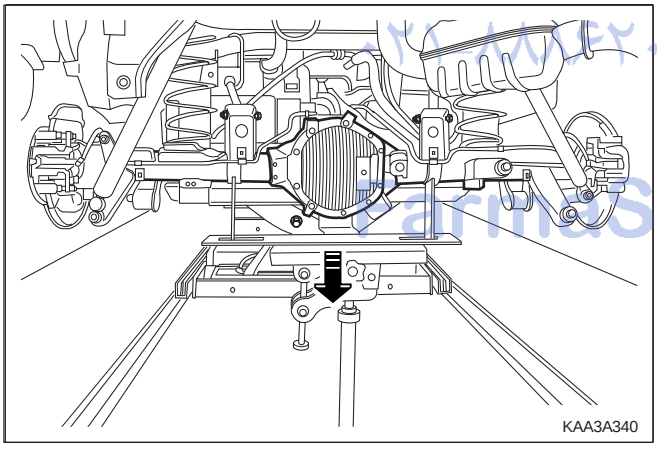
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KAA3D320

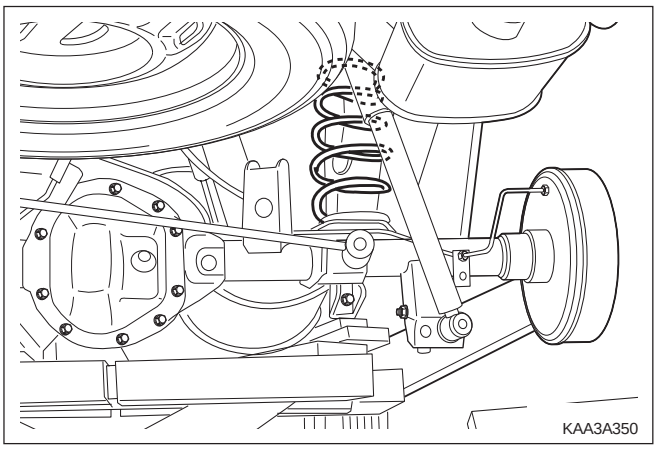
11. Remove the stabilizer bar.


KAA3D330

12. Remove the lateral rod mounting nut and detach the lateral rod from the axle housing.


KAA3A340

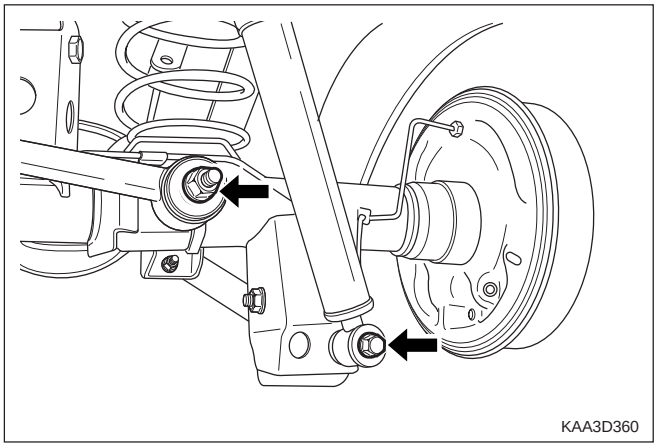
13. Lowering the axle slowly, remove the coil spring & spring seat.
14. Lower the axle housing by using the safety jack.


KAA3A350

Installation

1. Placing the rear axle housing on the assembly position, install both coil springs.

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KAA3D360

2. Install the lateral rod in axle hosing.

   Notice: Do not tighten the nuts completely.

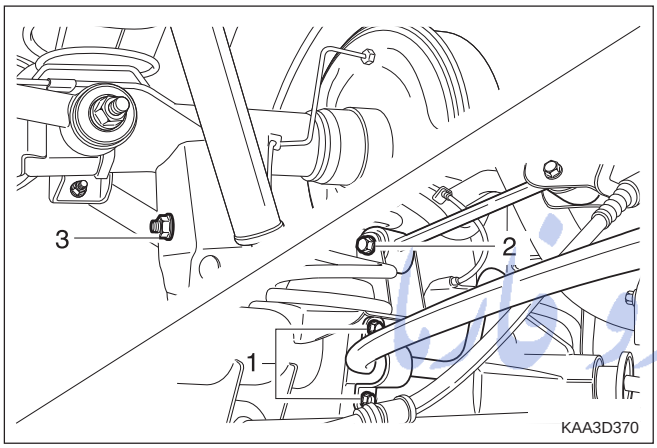
   Installation Notice

Tightening Torque	150 - 180 N•m

3. Install the shock absorber in axle housing.

   Installation Notice

Tightening Torque	30 - 45 N•m (22 - 33 lb-ft)

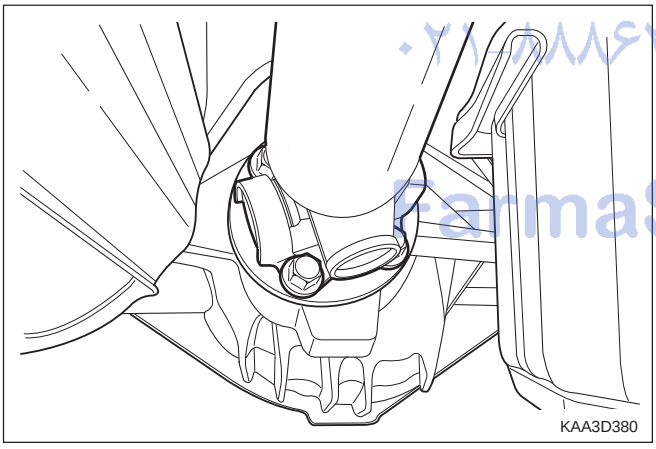


KAA3D370

4. Install the stabilizer bar and upper/lower arm in axle housing

   Installation Notice

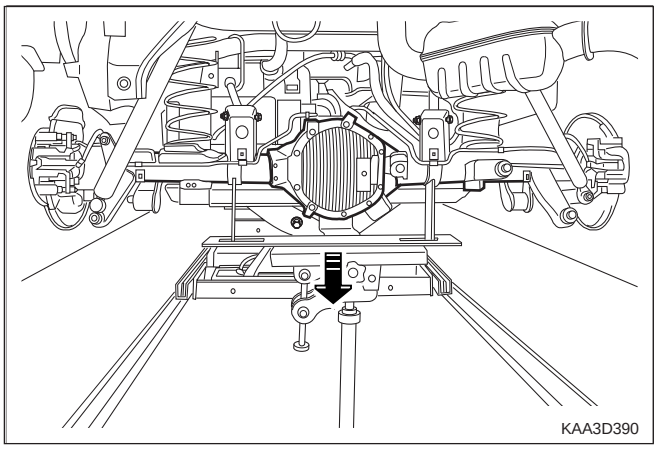
Stabilizer bar cap bolt	30 - 45 N•m (22 - 33 lb-ft)
Upper arm nut	150 - 180 N•m (111 - 133 lb-ft)
Lower arm nut	150 - 180 N•m (111 - 133 lb-ft)


KAA3D380

5. Install the propeller shaft of rear axle side and tighten above the fixing bolts/nuts.

   Installation Notice

Tightening Torque	70 - 80 N•m (52 - 59 lb-ft)


KAA3D390

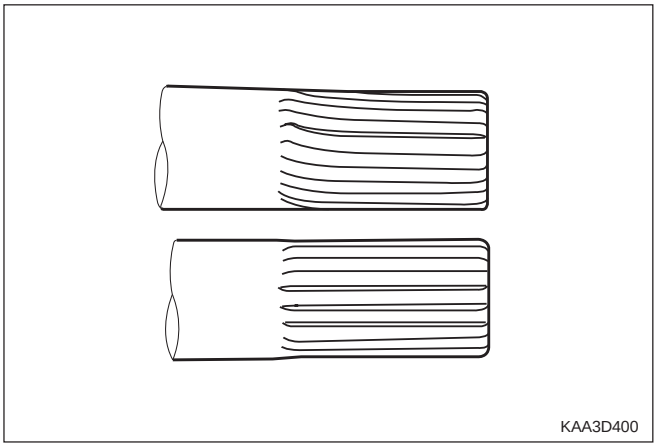
6. Install the brake cable, air bleeder hose, oil pipe, LCRV unit in rear axle assembly with assembled completely.

   Installation Notice

LCRV Mounting Bolt	12 - 23 N•m (9 - 17 lb-ft)
Air Breather Hose Bolt	6 - 8 N•m (53 - 71 lb-in)
Brake Oil Pipe (M10)	15 - 19 N•m (11 - 14 lb-ft)

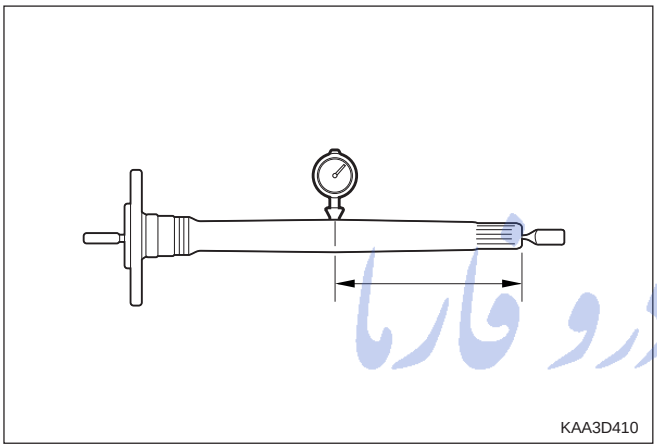
7. Bleeding the air in brake, install the tire.

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KAA3D400

Inspection

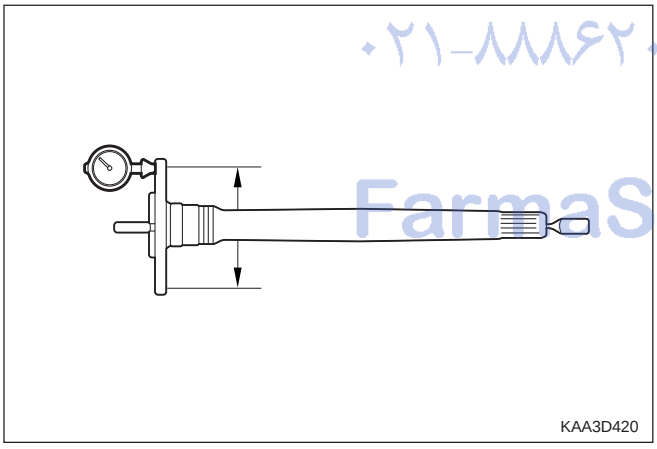
1. Check the shaft spline for the wear and damage.


KAA3D410

2. Measure the run-out of shaft.

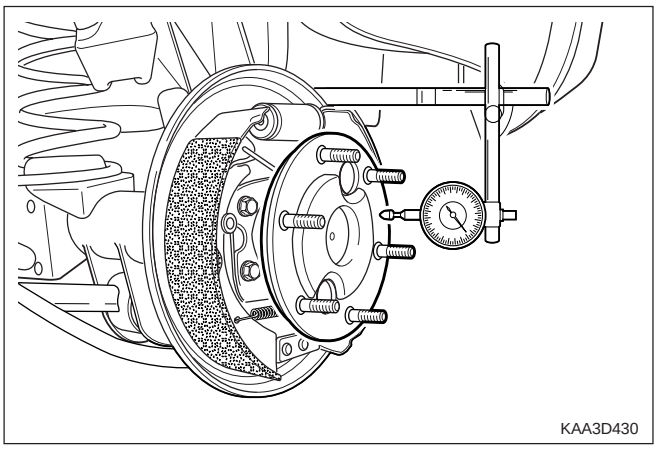
Specified value	Within 1.0 mm

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KAA3D420

3. Measure the run-out of shaft flange.

Specified value	Within 0.13 mm

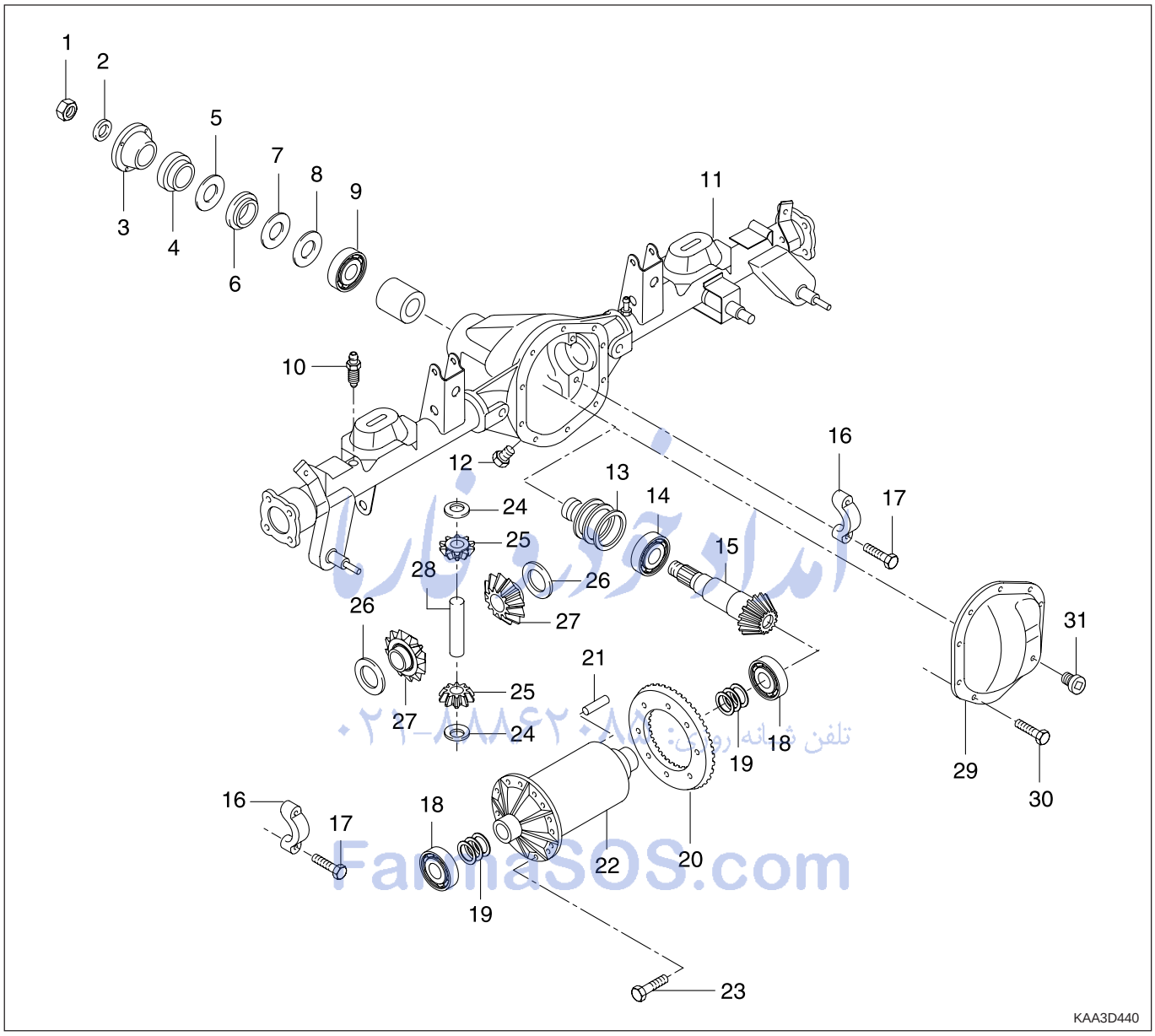

KAA3D430

4. Install the axle shaft and measure the clearance of shaft direction.

Specified value	Within 0.38 mm

UNIT REPAIR

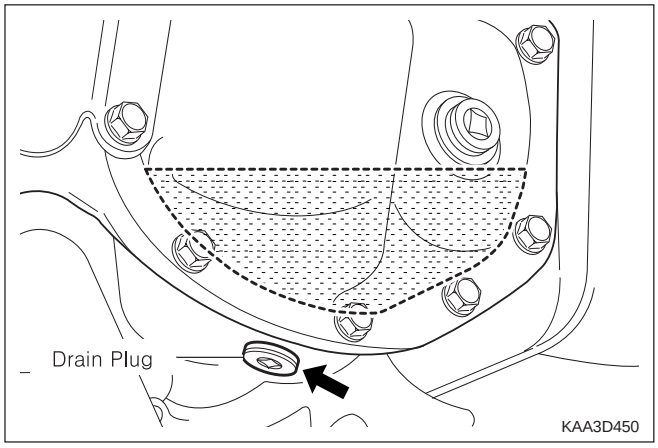
AXLE ASSEMBLY



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1 Drive Pinion Lock Nut
..... 240 - 310 N•m (177 - 229 lb-ft)
2 Washer
3 Companion Flange
4 Pinion Oil Seal
5 Bearing Slinger
6 Bearing
7 Shim
8 Shim
9 Bearing Cup
10 Breather Nipple
11 Rear Axle Housing
12 Oil Drain Plug..... 28 - 42 N•m (21 - 31 lb-ft)
13 Shim
14 Bearing
15 Drive Pinion
16 Bearing Cap
17 Bolt..... 87 - 124 N•m (64 - 94 lb-ft)
18 Bearing
19 Shim
20 Ring Gear
21 Shaft Lock Pin
22 Differential Case
23 Ring Gear Mounting Bolt
..... 75 - 90 N•m (55 - 66 lb-ft)
24 Thrust Washer
25 Differential Pinion
26 Thrust Washer
27 Side Gear
28 Differential Shaft
29 Housing Cover
30 Bolt..... 38 - 46 N•m (28 - 34 lb-ft)
31 Oil Filler Plug ..... 28 - 42 N•m (21 - 31 lb-ft)

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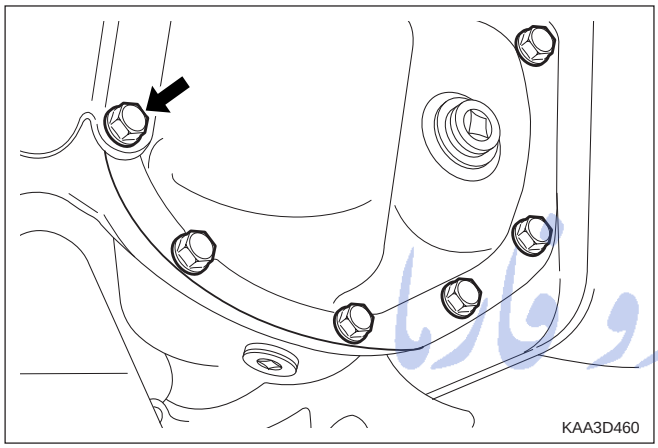
DIFFERENTIAL GEAR ASSEMBLY

Disassembly

1. Remove the drain plug and drain oil. Reinstall the drain plug.

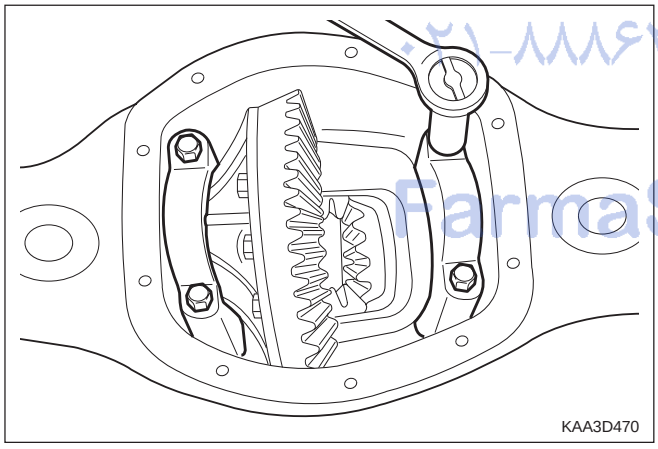
   Installation Notice

Tightening Torque	28 - 42 N•m (21 - 31 lb-ft)



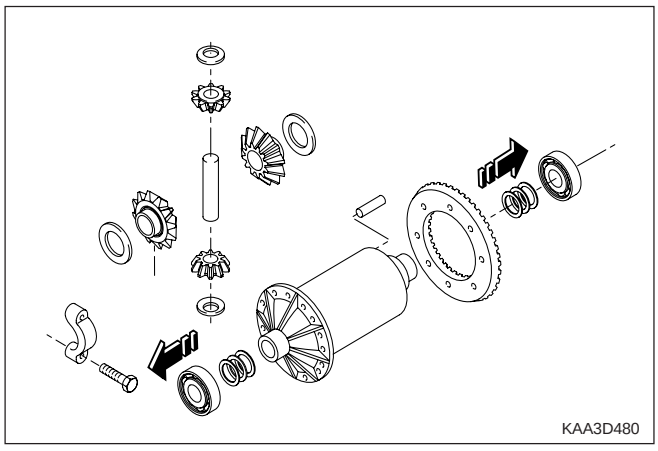
2. Remove the axle housing cover.

   Notice: Clean the cover and housing contact surface.



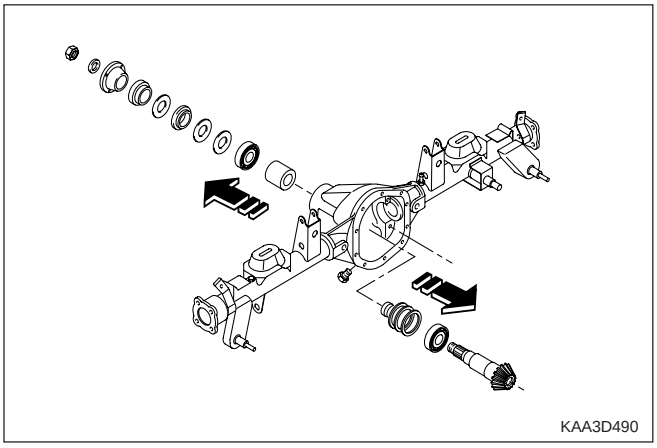
3. Remove the bearing cap bolts and remove the bearing cap. Pull out the differential carrier assembly.

   Notice: Do alignment marks on the bearing cap not to change the caps before removal. When pulling out, be careful to damage the axle housing.



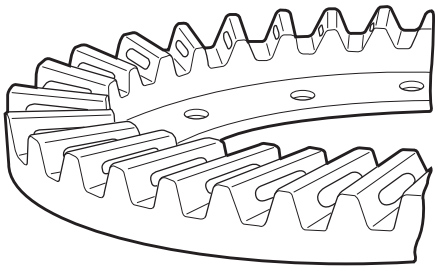
4. Disassemble the parts of differential carrier assembly.

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5. Remove the drive pinion lock nut. Disassemble the parts of drive pinion

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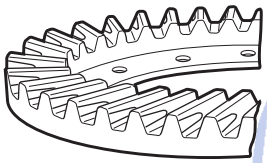
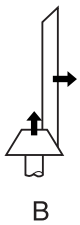
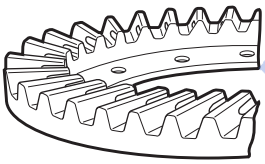
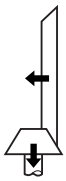
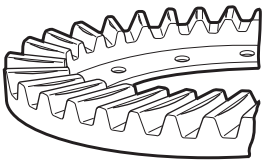
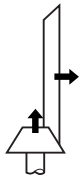
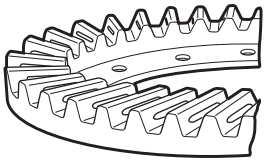
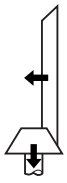

KAA3D500

Inspection of Ring Gear Tooth Contact Pattern

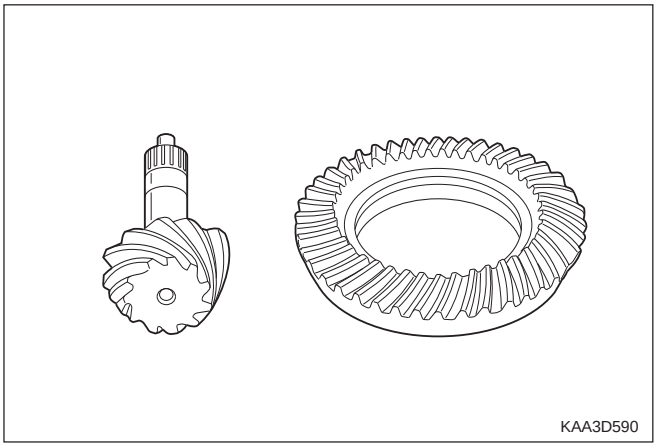
1. Normal Contact

   Apply gear-marking compound (prussian blue/red lead) on the ring rear teeth. Rotate the ring gear and check the to the contact pattern.

2. Abnormal contact

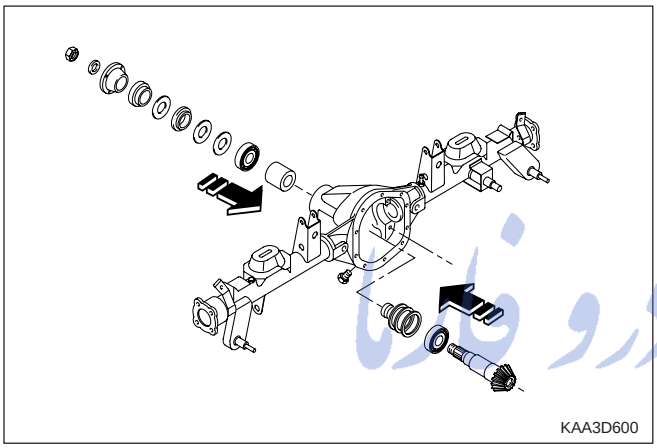
Tooth contact pattern	Possible cause	Remedy
1. Heel contact  A KAA3D510	Excessive backlash • Noise can be occurred	Adjust backlash (Drecrease backlash) • Select proper shin to move the drive pinion toward the ring gear (toward toe)  B KAA3D520
2. Toe contact  A KAA3D530	Insufficient backlash • Tooth can be damaged or broken under heavy load	Adjust backlash (Increase backlash) • Select proper shim to move the drive pinion against the ring gear (toward heel)  B KAA3D540
3. Face contact  A KAA3D550	Excessive backlash • Drive pinion shaft is apart from the ring gear • Noise can be occurred	Adjust backlash (Increase pinion shim) • Move the drive pinion toward the ring gear (toward center of ring gear)  B KAA3D560
4. Flank contact  A KAA3D570	Insufficient backlash • Gear contacts on the low flank • Gear can be damaged or worn • Noise can be occurred	Adjust backlash (Decrease pinion shim) • Move the ring gear toward the drive pinion (toward ring gear center line)  B KAA3D580

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Assembly

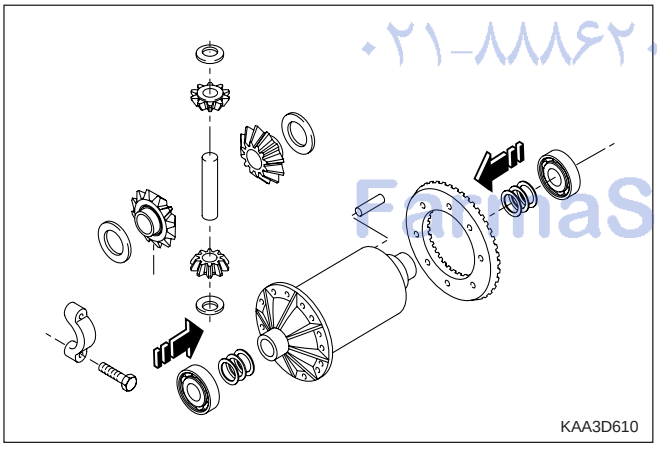
1. Clean all parts and check the followings.
   - Check the ring gear, drive pinion for wear and damage. If damaged, replace it as a set.
   - Check the bearing for sticks, wear, noise and turning resistance.
   - Check the side gear, pinion, pinion shaft and thrust washer for wear and damage.
   - Check the differential carrier for crack and wear (bearing contact surface). Check the gear case for crack.


KAA3D600

2. Assemble the drive pinion assembly to the axle housing and then tighten the pinion lock nut.

   Installation Notice

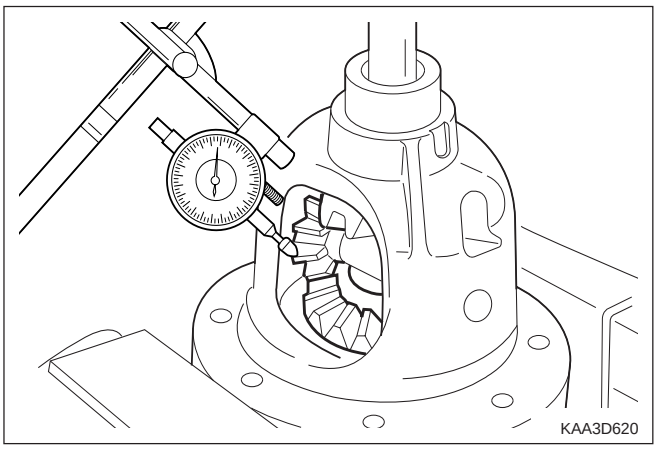
Tightening torque	240 - 310 N•m


KAA3D610

3. Assemble the differential carrier assembly. Align the ring gear to the mark of differential carrier, tighten the fixing bolts.

   Installation Notice

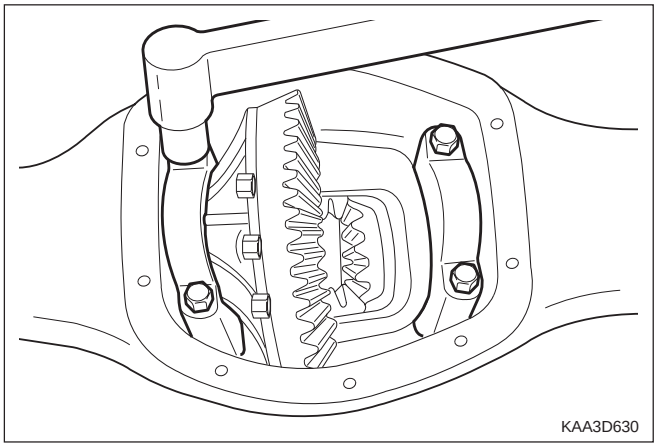
Tightening Torque	75 - 90 N•m (55 - 66 lb-ft)


KAA3D620

4. Measure the backlash of side gear and pinion gear.

Specified value	0 - 0.5 mm

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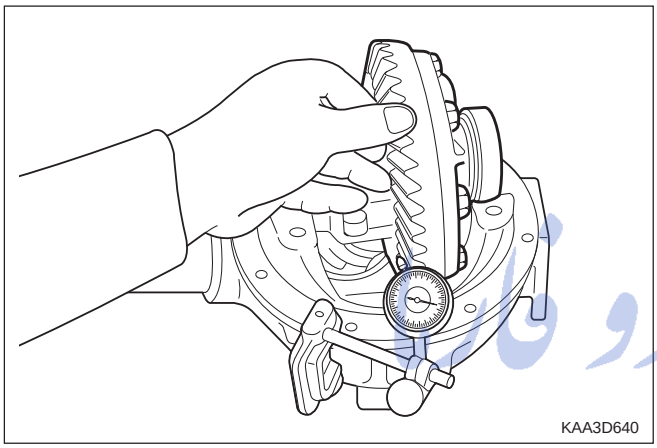

KAA3D630

5. Install the differential carrier assembly into the axle housing. Set up the bearing cap and then tighten the cap bolts.

Installation Notice

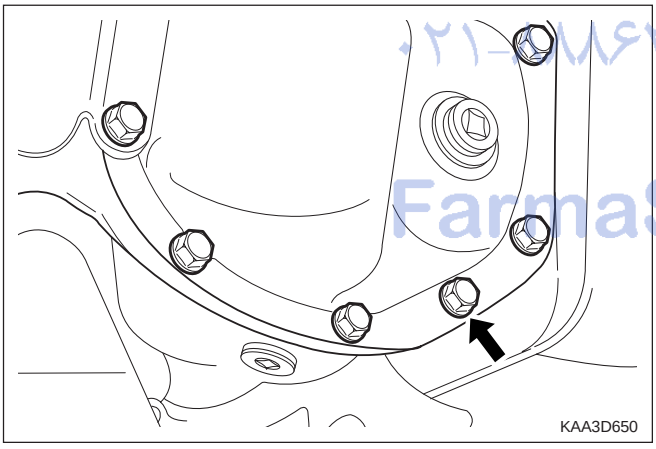
Tightening Torque	48 - 69 N•m (35 - 51 lb-ft)

Notice: Be careful not to change the caps. Be sure to keep the original position of the caps.


KAA3D640

6. Measure the backlash of drive pinion and ring gear.

Specified value	0.13 - 0.20 mm

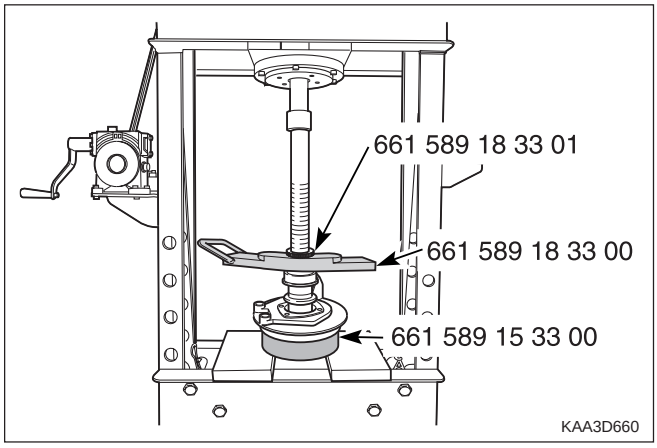

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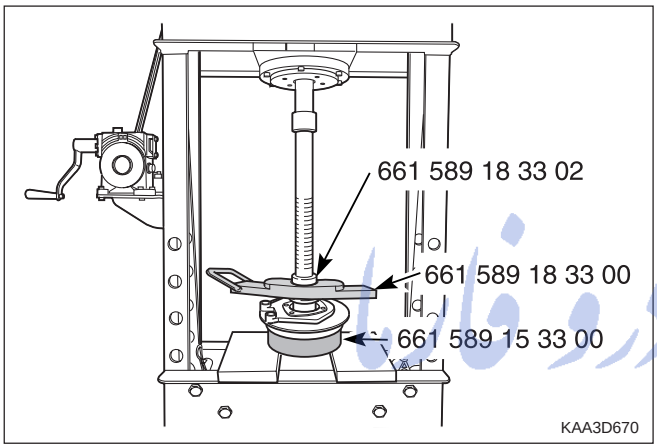
7. Install the axle housing cover. Tighten the fixing bolts.

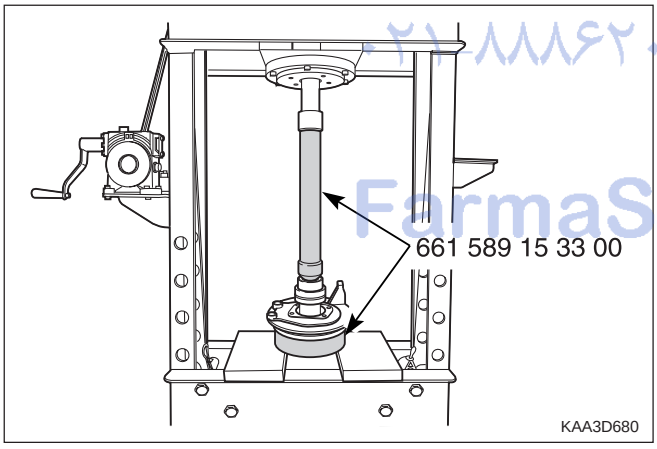
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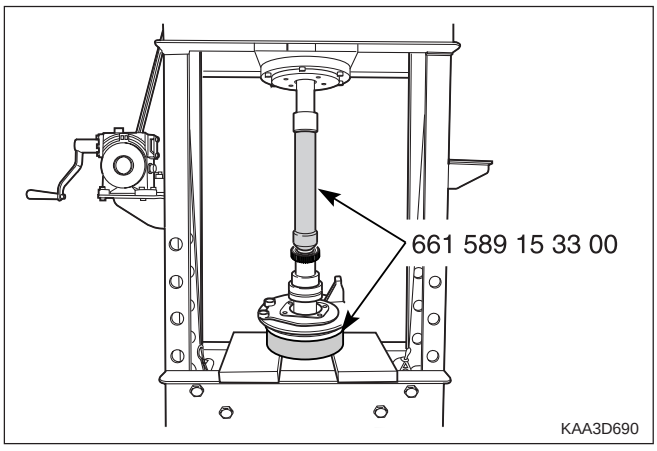
Tightening Torque	39 - 46 N•m (29 - 34 lb-ft)

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DRIVE SHAFT

Tools Required

661 589 15 33 00 Rear Hub Bearing Installer
661589 18 33 00 Axle Bearing Puller Plate
661 589 18 33 01 Rear Axle Bearing Remover
661 589 18 33 02 Rear Axle Oil Seal Remover

Disassembly Procedure

1. Remove the rear drive shaft from the vehicle. Refer to “Rear Drive Shaft” in this section.
2. Remove the toothed ring using the axle bearing puller plate 661 589 18 33 00 and rear axle bearing remover 661 589 18 33 01 by press.
3. Remove the rear drive shaft oil seal bearing using the axle bearing puller plate 661 589 18 33 00 and rear axle oil seal remover 661 589 18 33 02 by press.
4. Remove the rear disc brake rotor shield.

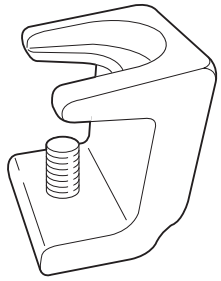
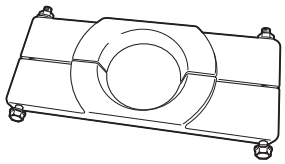
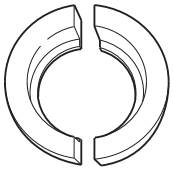
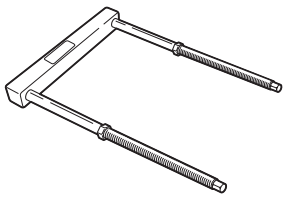
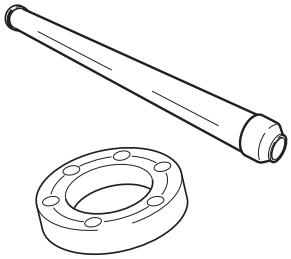
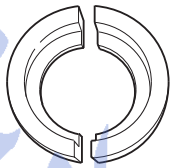
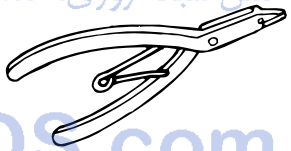
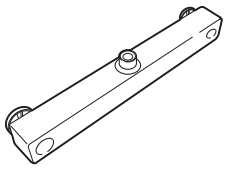
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Assembly Procedure

1. Install the rear disc brake rotor shield.
2. Install the rear drive shaft bearing oil seal using the rear hub bearing installer 661 589 15 33 00 by press.
3. Install the retainer drive shaft bearing using the rear hub bearing installer 661 589 15 33 00 by press.
4. Install the rear drive shaft. Refer to “Rear Drive Shaft” in this section.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS TABLE

 KAA3D700	**661 589 13 33 00** **Ball Joint Remover**
 KAA3D710	**661 589 18 33 00** **Axle Bearing Puller Plate**
 KAA3D720	**661 589 18 33 02** **Rear Axle Oil Seal Remover**
 KAA3D730	**DW340-090-01** **Differential Assembly Remover/Installer**
 KAA3D740	**661 589 15 33 00** **Rear Hub Bearing Installer**
 KAA3D750	**661 589 18 33 01** **Rear Axle Bearing Remover**
 KAA3D760	**J-8059** **Snap Ring Plier**
 KAA3D770	**DW340-090-03** **Rear Differential Assembly Remover/Installer**

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SECTION 4A

HYDRAULIC BRAKES

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

Description and Operation 4A-2

General Description 4A-2

Diagnostic Information and Procedures 4A-3

Brake System Testing 4A-3

Brake Hose Inspection 4A-3

Brake Warning Lamp Circuit Description 4A-4

Brake Warning Lamp Diagnosis 4A-5

LCRV (Load Conscious Reducing Valve) 4A-8

Repair Instructions 4A-10

On-Vehicle Service 4A-10

Manual Bleeding The Brakes 4A-10

Front Brake Hose 4A-13

Rear Brake Hose 4A-13

Stoplamp Switch 4A-14

Brake Pedal 4A-14

Specifications 4A-15

General Specification 4A-15

Fastener Tightening Specifications 4A-16

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DESCRIPTION AND OPERATION

GENERAL DESCRIPTION

Brake fluid should meet the DOT 4 specification. Use only clear fluid from a sealed container.

Fluid that is exposed to the air will absorb moisture. Water in the brake fluid will cause the fluid to boil and the rubber components to deteriorate.

Thoroughly clean the master cylinder reservoir cap before removing it. Do not let any dirt or foreign material fall into the fluid reservoir.

There is a brake fluid level switch under the master cylinder reservoir.

When the fluid level is low, the BRAKE lamp in the instrument cluster will turn on.

The correct brake fluid level is marked on the both side of the brake fluid reservoir. If the fluid level is below the MIN indicator mark, check the hydraulic brake system for leaks. Fix any leaks. Then refill the reservoir to the MAX indicator mark.

The hydraulic brake system is parallel split on Antilock Brake Systems. This means the left front and left rear brakes are on one hydraulic circuit and the right front and right rear are on the other.

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DIAGNOSTIC INFORMATION AND PROCEDURES

BRAKE SYSTEM TESTING

Brakes should be tested on a dry, clean, reasonably smooth and level roadway. A true test of brake performance cannot be made if the roadway is wet, greasy, or covered with loose dirt which can cause tires not to grip the road unequally. Testing also will be inaccurate on a crowned roadway because the wheels tend to bounce.

Test the brakes at different vehicle speeds with both light-and heavy-pedal pressure; however, avoid locking the brakes and sliding the tires. Locked brakes and slid-ing tires do not indicate brake efficiency since heavily braked but turning wheels will stop the vehicle in less distance than locked brakes. More tire-to-road friction is present with a heavily braked, turning tire than with a sliding tire.

Because of the high deceleration capability, a firmer pedal may be felt at higher deceleration levels.

There are three major external conditions that affect brake performance:

- Tires having unequal contact and grip of the road will cause unequal braking. Tires must be equally inflated, and the tread pattern of the right and the left tires must be approximately equal.
- Unequal loading of the vehicle can affect the brake performance since the most heavily loaded wheels require more braking power, and thus more braking effort, than the others.
- Misalignment of the wheels, particularly conditions of excessive camber and caster, will cause the brakes to pull to one side.

To check for brake fluid leaks, hold constant foot pressure on the pedal with the engine running at idle and the shift lever in NEUTRAL. If the pedal gradually falls away with the constant pressure, the hydraulic system may be leaking. Perform a visual check to confirm any suspected leaks.

Check the master cylinder fluid level. While a slight drop in the reservoir level results from normal lining wear, an abnormally low level indicates a leak in the system. The hydraulic system may be leaking either internally or externally. Refer to the procedure below to check the master cylinder. The system may appear to pass this test while still having a slight leak. If the fluid level is normal, check the vacuum booster pushrod length. If an incorrect pushrod length is found, adjust or replace the rod.

Check the master cylinder using the following proce dure:

- Check for a cracked master cylinder casting or a brake fluid leak around the master cylinder. Leaks are indicated only if there is at least one drop of fluid. A damp condition is not abnormal.
- Check for a binding pedal linkage and for an incorrect pushrod length. If both of these parts are in satisfactory condition, disassemble the master cylinder and check for an elongated or swollen primary cylinder or piston seals. If swollen seals are found, substandard or contaminated brake fluid should be suspected. If contaminated brake fluid is found, all the components should be disassembled and cleaned, and all the rubber components should be replaced. All of the pipes must also be flushed.

Improper brake fluid, or mineral oil or water in the fluid, may cause the brake fluid to boil or cause deterioration of the rubber components. If the primary piston cups in the master cylinder are swollen, the rubber parts have deteriorated.

If deterioration of the rubber is evident, disassemble all the hydraulic parts and wash the parts with alcohol. Dry these parts with compressed air before reassembly to keep the alcohol out of the system. Replace all the rubber parts in the system, including the hoses. When working on the brake mechanisms, check for fluid on the linings. If excessive fluid is found, replace the linings.

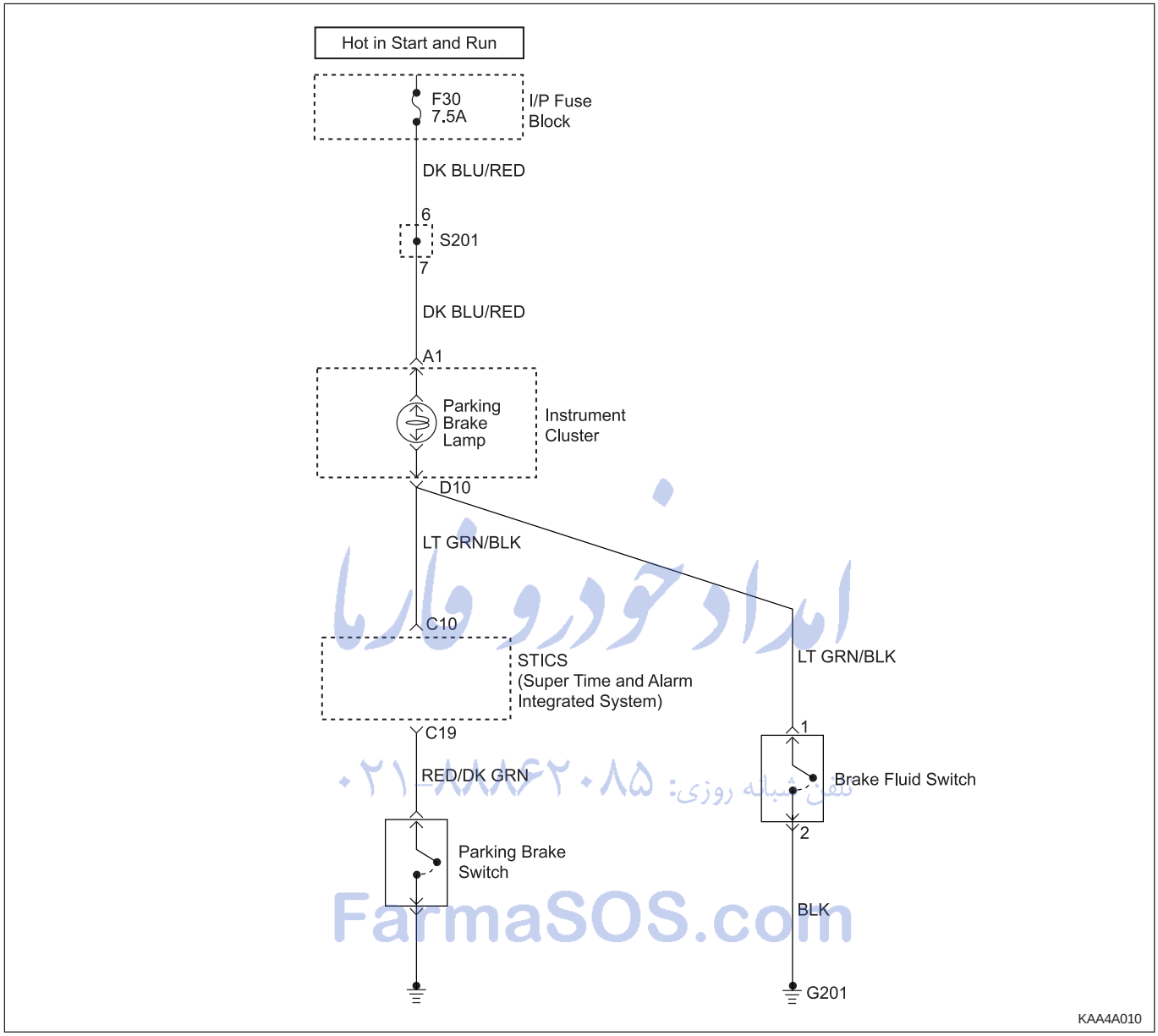
If the master cylinder piston seals are in satisfactory condition, check for leaks or excessive heat conditions. If these conditions are not found, drain the fluid, flush the master cylinder with brake fluid, refill the master cylinder, and bleed the system.

BRAKE HOSE INSPECTION

The hydraulic brake hoses should be inspected at least twice a year. The brake hose assembly should be checked for road hazard damage, cracks, chafing of the outer cover, and for leaks or blisters. Inspect the hoses for proper routing and mounting. A brake hose that rubs on a suspension component will wear and eventually fail. A light and a mirror may be needed for an adequate inspection. If any of the above conditions are observed on the brake hose, adjust or replace the hose as necessary.

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BRAKE WARNING LAMP CIRCUIT DESCRIPTION



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Diagnostic Aids

The BRAKE lamp glows brightly when the ignition is ON and either the parking brake lever switch or the brake fluid level switch is closed.

If neither switch is closed, the BRAKE lamp receives a ground through the generator, and it glows dimly when the ignition is ON and the engine is off. When the engine starts, the generator creates voltage. With voltage on both sides of the lamp, the lamp turns off.

Test Description

The numbers below refer to steps in the diagnostic table.

1. This step begins the test sequence for a BRAKE warning lamp that stays on when the engine is running.
2. This step begins the test sequence for a BRAKE warning lamp that never turns on.

BRAKE WARNING LAMP DIAGNOSIS

Step	Action	Value(s)	Yes	NO
1	Start the engine and leave it running. Does the BRAKE warning lamp stay on?	-	Go To Step 2	Go To Step 12
2	With the engine running, release the parking brake. Is the BRAKE warning lamp off?	-	System OK	Go To Step 3
3	Check the brake fluid level. Is the fluid level OK?	-	Go To Step 5	Go To Step 4
4	1. Fill the brake fluid reservoir with clean DOT-3 hydraulic fluid. 2. Check the cap on the fluid reservoir. 3. Start the engine and leave it running. Is the BRAKE warning lamp on?	-	Go To Step 5	System OK
5	Disconnect the wiring harness connector from the brake fluid level switch. Is the BRAKE warning lamp on?	-	Go To Step 7	Go To Step 6
6	Replace the brake fluid lever switch. Is the repair complete?	-	System OK	-
7	1. Connect the brake fluid level switch. 2. Disconnect the parking brake lever switch. 3. Start the engine and leave it running. Is the BRAKE warning lamp on?	-	Go To Step 9	Go To Step 8
8	Replace the parking brake lever switch. Is the repair complete?	-	System OK	-
9	1. Connect the parking brake lever switch. 2. Disconnect the STICS (Super Time and Alarm Integrated System). 3. Start the engine and leave it running. Is the BRAKE warning lamp on?	-	Go To Step 11	Go To Step 10
10	Replace the STICS. Is the repair complete?	-	System OK	-
11	Repair the short circuit in the instrument wiring harness between terminal D10 of the instrument cluster and ground. Is the repair complete?	-	System OK	-
12	1. Disconnect the electrical connector from the fluid level switch. 2. Connect a jumper wire between ground and terminal 1 of the fluid level switch harness connector. Does the BRAKE warning lamp turn on?	-	Go To Step 13	Go To Step 15
13	1. Disconnect the electrical connector from the fluid level switch. 2. Connect a jump wire between terminals 1 and 2 of the fluid level switch harness connector. Does the BRAKE warning lamp turn on?	-	Go To Step 14	Go To Step 15
14	1. Replace the brake fluid level switch. 2 The switch can be removed and replaced without draining the brake fluid from the reservoir. Is the repair complete?	-	System OK	-

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BRAKE LAMP WARNING CIRCUIT (Cont'd)

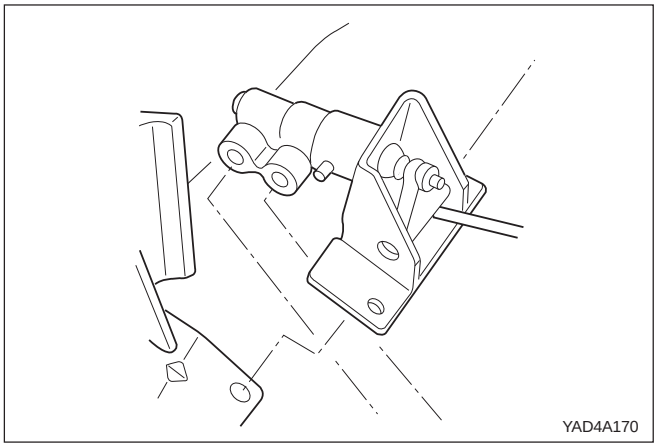
Step	Action	Value	Yes	NO
15	1. Turn the ignition ON. 2. Apply the parking brake. Does the BRAKE warning lamp turn on?	-	Go To Step 31	Go To Step 16
16	Check fuse F30. Is fuse F30 blown?	-	Go To Step 17	Go To Step 18
17	Check for a short circuit and repair it, if necessary. Replace fuse F30.	-	System OK	-
18	1. Turn the ignition ON. 2. Check the voltage at F30. Is the voltage equal to the specified value?	11 - 14 v	Go To Step 20	Go To Step 19
19	Repair the power supply to fuse F30. Is the repair complete?	-	System OK	-
20	1. Disconnect terminal A1 of the instrument cluster. 2. Turn the ignition ON. 3. Use a voltmeter to check the voltage at terminal A1. Is the voltage equal to the specified value?	11 - 14 v	Go To Step 22	Go To Step 21
21	Repair the open circuit between terminal A1 of the instrument cluster and fuse F30. Is the repair complete?	-	System OK	-
22	1. Reconnect terminal A1 of the instrument cluster. Turn the ignition ON. 2. Use a voltmeter to backprobe terminal D10 of the instrument cluster. Is the voltage equal to the specified value?	11 - 14 v	Go To Step 26	Go To Step 23
23	1. Remove the BRAKE warning lamp from its socket. 2. Test the Brake warning lamp. Is the BRAKEwarning lamp OK?	-	Go To Step 24	Go To Step 25
24	Replace the instrument cluster. Is the repair complete?	-	System OK	-
25	Replace the BRAKE warning lamp. Is the repair complete?	-	System OK	-
26	1. Disconnect terminal C10 of the STICS. 2. Connect a jumper wire between terminal C10 and ground. 3. Turn the ignition ON. Is the BRAKE warning lamp on?	-	Go To Step 27	Go To Step 28
27	Replace the STICS. Is the repair complete?	-	System OK	-
28	1. Disconnect the STICS connector. 2. Connect a jump wire between terminal C19 and ground. 3. Turn the ignition ON. Is the BRAKE warning lamp on?	-	Go To Step 29	Go To Step 30
29	Replace the brake warning lamp switch. Is the repair complete?	-	System OK	-
30	Repair the open circuit between the brake warning lamp switch and terminal C19 of the STICS	-	System OK	-

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BRAKE LAMP WARNING CIRCUIT (Cont'd)

Step	Action	Value(s)	Yes	NO
31	1. Disconnect the brake fluid level switch. 2. Use an ohmmeter to check the resistance between terminal 2 of the switch connector and ground. Is the resistance equal to the specified value?	≈ 0 Ω	Go To Step 32	Go To Step 33
32	Repair the open circuit between ground and the brake fluid level switch. Is the repair complete?	-	System OK	-
33	Repair the open circuit between terminal 1 of the brake fluid level switch and terminal D10 of the instrument cluster. Is the repair complete?	-	System OK	-

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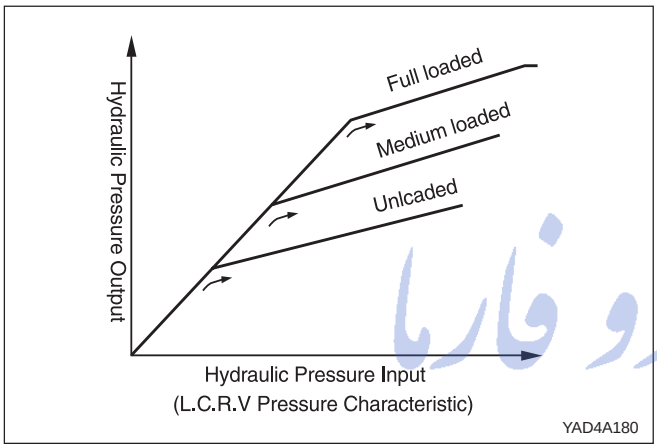

YAD4A170

LCRV (LOAD CONSCIOUS REDUCING VALVE)

LCRV consists of sensing part and hydraulic control part.

1. Sensing Part

   It detects the changes of vehicle height caused by vehicle load. It consists of load sensing spring and control lever which change according to vehicle load.

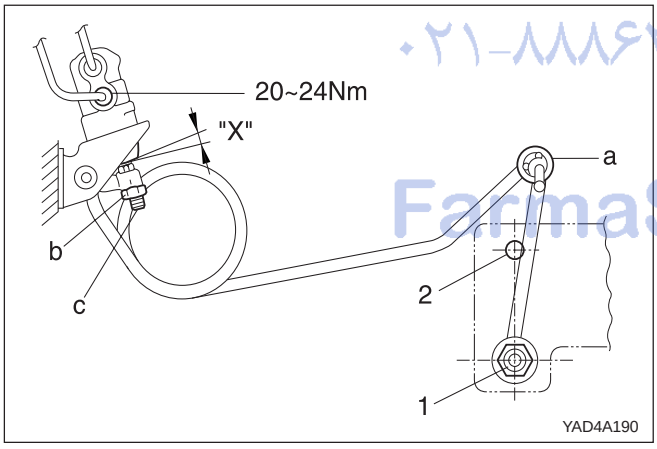


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2. Hydraulic Control Part

   It consists of valve stem devices which controls hydraulic pressure according to load detected by sensing part.

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Setting Method

1. Install the connecting rod (a) to the No.1 hole.
2. Adjust the clearance “X” to be 0mm and tighten the bolt (c) using the lock nut (b).

Installation Notice

Tightening Torque	14 - 18 N•m (10 - 13 lb-ft)

3. Remove the connecting rod (a) from the No.1 hole and reinstall it to the No.2 hole.

Installation Notice

Tightening Torque	14 - 18 N•m (10 - 13 lb-ft)

4. Place alignment marks between the lock nut (b) and adjusting screw (c) after the valve setting.
5. LCRV setting should be performed with unloaded vehicle condition.

Inspection

When it occurs the malfunction in the LCRV, the sensor spring, valve body assembly, rear axle or rear spring may be replaced. For these replacement, the following inspection should perform;

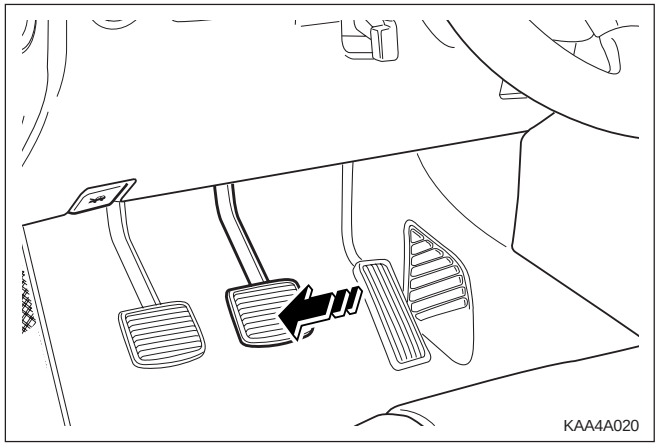
Symptom	Possible Cause	Action
Poor Braking Performance	Air in Brake System	Bleeding
	Poor Adjustment of Sensor Spring	Adjust
	Damaged Sensor Spring	Replace
	Fluid Leaking from LCRV	Replace
Rear Wheels Lock Early	Poor Adjustment of Sensor Spring	Adjust
	Internal Fluid Leaking of LCRV	Replace

Notice:

- Fluid leaking from LCRV results from poor valve open/close or sealing wear caused by the foreign materials in the LCRV.
- When you change or repair the LCRV, it may affect the braking performance. Thus, ensure to use the approved part.

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REPAIR INSTRUCTIONS



ON-VEHICLE SERVICE

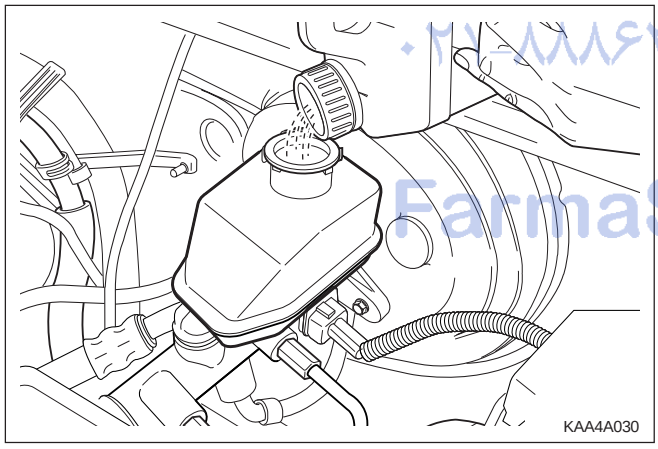
MANUAL BLEEDING THE BRAKES

Removal and Installation Procedure

Important: Manual bleeding of the hydraulic modulator is not possible. If air enters the antilock brake hydraulic modulator, or if an unfilled modulator is installed, use the scan tool to bleed air out of the brake system. Replacement modulators are shipped already filled and bled. In normal on-vehicle service procedures involving the modulator, such as the procedure to replace the electronic brake control module, air will not enter the modulator. In such cases, use the bleeding procedure in this section.

1. Remove the booster reserve by applying the brakes several times with the engine off, until all the reserve is depleted.

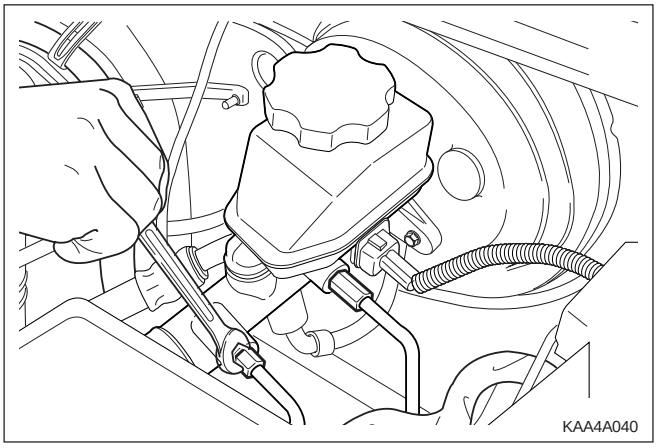
   Important: If no air is suspected to be in the master cylinder, begin the bleeding procedure at Step 12. If it is suspected that air is in the master cylinder bore, then the master cylinder must be bled, beginning with step 2.



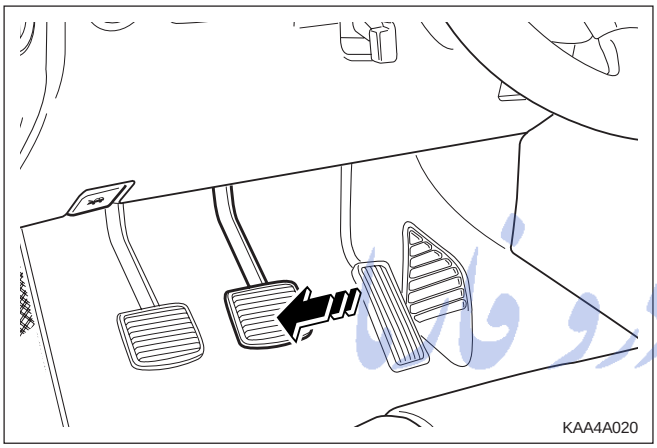
Notice: Keep brake fluid away from painted surfaces because brake fluid will damage the paint finish.

2. Fill the master cylinder reservoir with brake fluid. Keep the master cylinder reservoir at least one-half full during the bleeding operation.

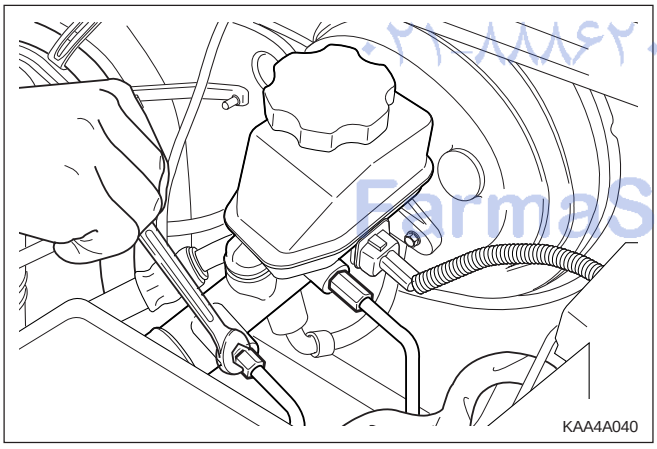
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3. Disconnect the brake line at the front of the master cylinder.
4. Allow the brake fluid to fill the master cylinder until it begins to flow from the port.
5. Reconnect the brake line at the front of the master cylinder.


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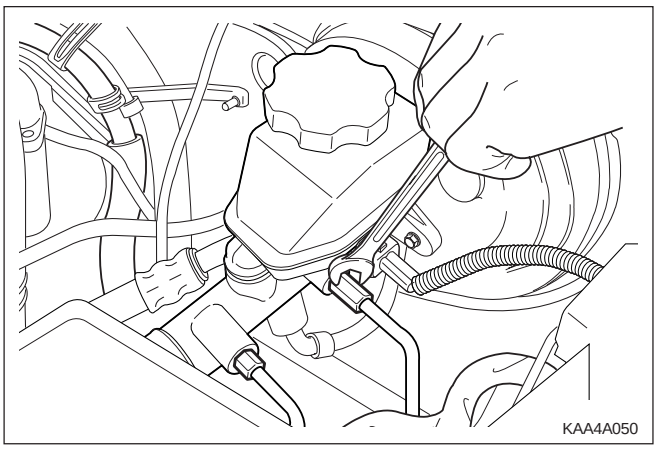
6. Slowly push and hold the brake pedal.


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7. While the brake pedal is pushed down, loosen the brake fitting at the front of the master cylinder to purge the air from the cylinder.
8. Slightly tighten the brake fitting. Then release the brake pedal slowly. Wait 15 seconds before continuing with the next step.
9. Repeat Steps 6-8 until all of the air is removed from the master cylinder bore.
10. Tighten the brake line fitting.

Installation Notice

Tightening Torque	22 N•m (16 lb-ft)

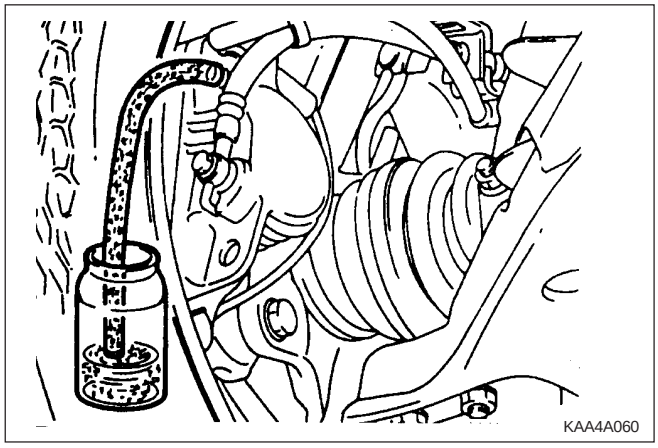

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11. After the air has been bled at the front connection, bleed the master cylinder at the rear connection using the same sequence as with the top connection.

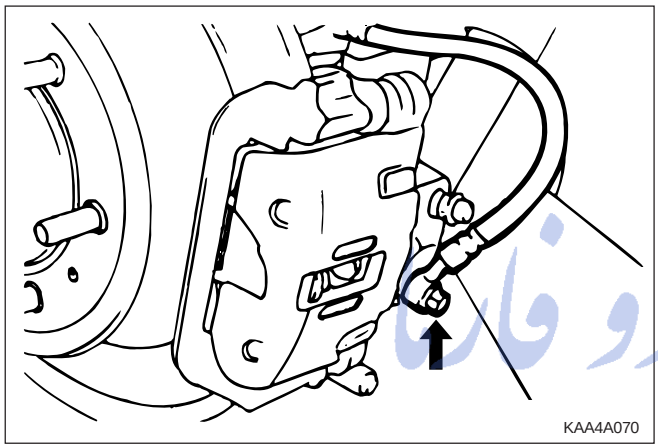
Installation Notice

Tightening Torque	17 N•m (13 lb-ft)

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KAA4A060

12. Attach a transparent tube over the rear bleeder valve at the right rear caliper. Allow the tube to hang submerged in the brake fluid in a transparent container. (After the right rear caliper is bled in the following steps, use this procedure at the left front, the left rear and the right front bleeder valves.)


KAA4A070

13. Slowly push and hold the brake pedal. Avoid rapid pumping of the brake pedal.
14. While the brake pedal is pushed down, loosen the bleeder valve to purge the air from the caliper.
15. After the air bubbles have escaped into the container of brake fluid, slightly tighten the rear bleeder valve.
16. Slowly release the brake pedal. Wait 15 seconds before proceeding with the next step.

    Notice: Keep brake fluid away from painted surfaces because brake fluid will damage the paint finish.

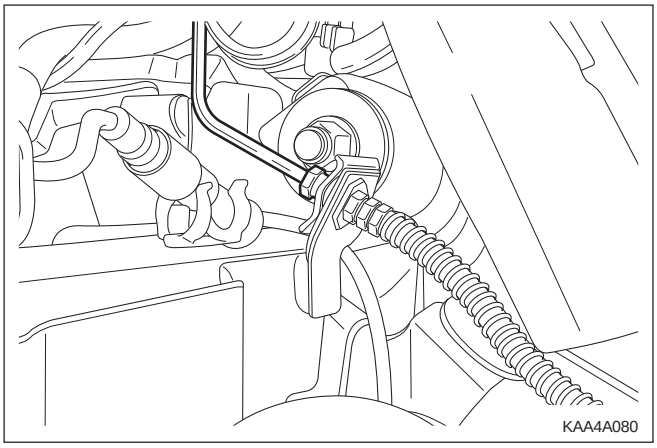
17. Repeat Steps 13 - 16 until all of the air is removed. You will know all of the air is removed when no bubbles appear in the container when the bleeder valve is loosened. Keep the master cylinder reser voir at least one-half full during the bleeding operation.
18. Tighten the front bleeder valve.

Installation Notice

Tightening Torque	10 N•m (89 lb-ft)

19. Bleed the remaining calipers in the following order : left rear, right front, and left front. Use the procedure in Steps 12 - 17.
20. After all calipers have been bled, check the brake pedal for sponginess. If the brake pedal is not firm, repeat the entire bleeding procedure to correct this condition.

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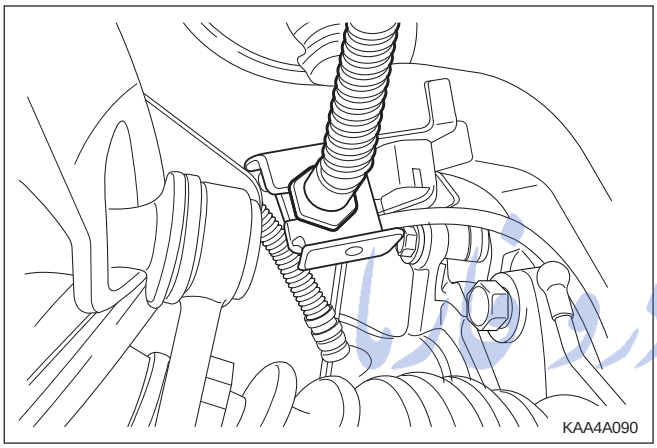
FRONT BRAKE HOSE

Removal and Installation Procedure

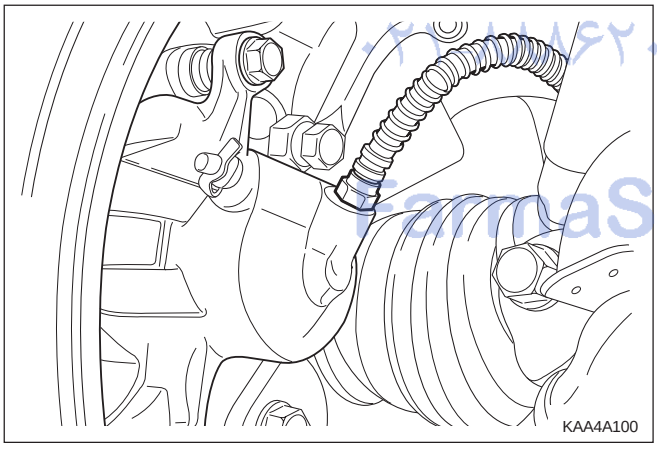
1. Raise and suitably support the vehicle.
2. Disconnect the brake line from the brake hose sup port bracket on the front frame on each side of the vehicle and remove the retainer.

Installation Notice

Tightening Torque	17 N•m (13 lb-ft)


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3. Remove the brake hose from the brake hose support bracket on the upper control arm.


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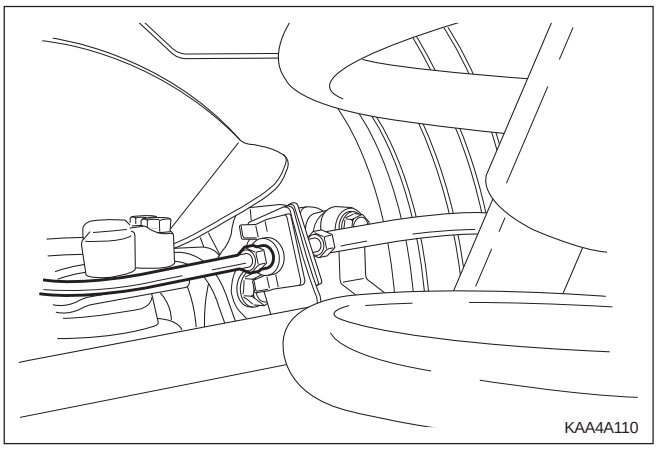
4. Remove the front brake hose-to-front caliper assembly bolt.
5. Remove the ring seals and the disc brake hose.

Installation Notice

Tightening Torque	30 N•m (22 lb-ft)

- Bleed the brake system. Refer to “Manual Bleeding the Brakes” in this section.
- Check the brake system for leaks.

6. Installation should follow the removal procedure in the reverse order.


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REAR BRAKE HOSE

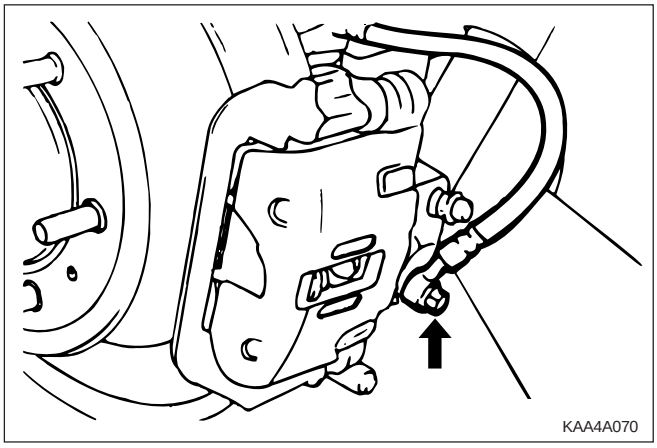
Removal and Installation Procedure

1. Raise and suitably support the vehicle.
2. Disconnect the brake line from the disc brake hose at the rear axle bracket on each side of the vehicle.

Installation Notice

Tightening Torque	17 N•m (13 lb-ft)

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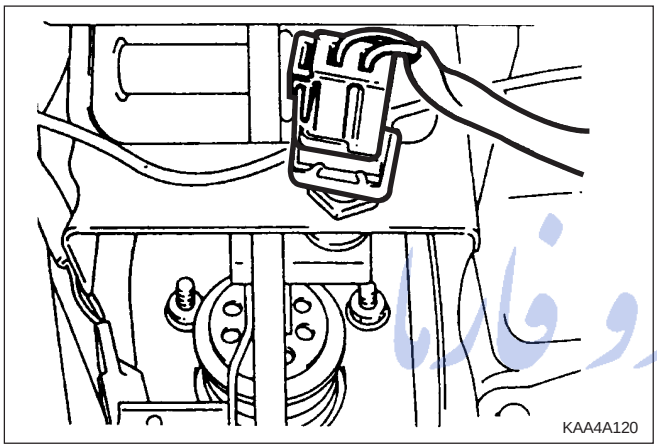
3. Remove the rear bleeder valve from the caliper as sembly.

Installation Notice

Tightening Torque	10 N•m (89 lb-ft)

- Bleed the brake system. Refer to “Manual Bleeding the Brakes” in this section.
- Check the brake system for leaks.

4. Installation should follow the removal procedure in the reverse order.

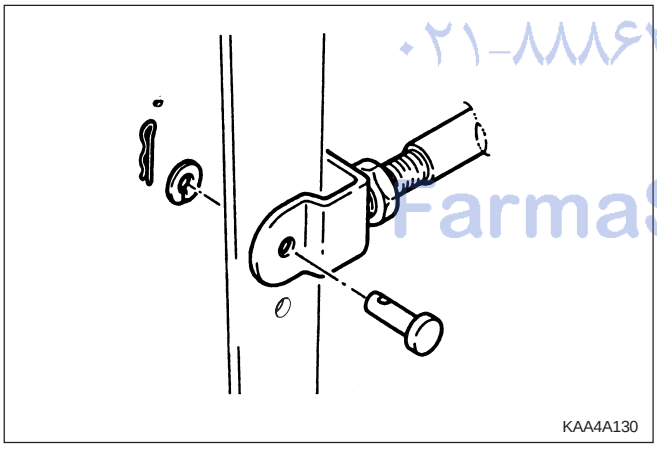

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STOPLAMP SWITCH

Removal and Installation Procedure

1. Remove the stoplamp switch connector.
2. Remove the stoplamp switch.
3. Installation should follow the removal procedure in the reverse order.

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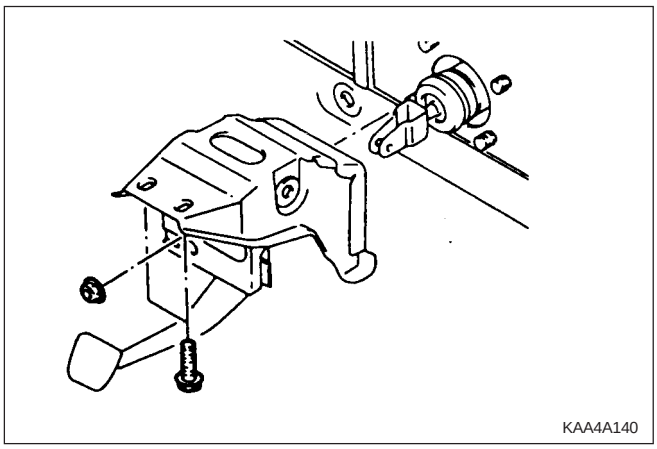
BRAKE PEDAL

Removal and Installation Procedure

1. Remove the stoplamp switch connector.
2. Remove the clevis pin and disconnect the brake booster pushrod.

Installation Notice:

- Install in the upper hole.
- Install the snap pin fully in the hole of clevis pin.
- Apply the grease around the hold of clevis pin.


KAA4A140

3. Remove the brake pedal mounting nut and remove the brake pedal assembly.

Installation Notice

Tightening Torque	13 N•m (10 lb-ft)

4. Installation should follow the removal procedure in the reverse order.

SPECIFICATIONS

GENERAL SPECIFICATION

Application	Description
Capacity	0.7 ℓ (0.7 qt)
Lublicant	DOT 4

Application	E32	
	mm	in
Front Disc Brake Rotor		
Type	Ventialated	
Diameter	278.30	10.96
Thickness (New)	24.00	0.95
Discard Thickness	22.00	0.87
Thickness Variation	0.013	0.0005
Lateral Runout (Installed)	0.03	0.001
Light Scoring of the Rotor Surface	0.40	0.002
Rear Disc Brake Rotor		
Type	Solid	
Diameter	299.00	11. 77
Thickness (New)	10.40	0.41
Discard Thickness	8.50	0.33
Thickness Variation	0.013	0.0005
Lateral Runout (Installed)	0.03	0.001
Booster		
Dual	-	8″ & 9″
Ratio	7 : 1	-
Master Cylinder		
Bore Diameter (Nominal)	25.40	1.00
Caliper		
Minimum Piston Diameter (Front)	60.00	2.36
Minimum Piston Diameter (Rear)	38.00 (42.9)	1.50
Pad and lining		
Front		
Thickness (New)	10.00	0.39
Minimum Discard Thickness	2.00	0.08
Rear (Disc)		
Thickness (New)	9.50	0.39
Minimum Discard Thickness	1.50	0.06

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FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Brake Pedal Mounting Nut	13	10	-
Brake Lind Fitting	17	13	-
Front Bleeder Valve	10	-	89
Front Brake Hose-to-Front Caliper Assembly Bolt	30	22	-
Rear Bleeder Valve	10	-	89

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SECTION 4B

MASTER CYLINDER

TABLE OF CONTENTS

Description and Operation 4B-2

General Description 4B-2

Component Locator 4B-3

Repair Instructions 4B-4

On-Vehicle Service 4B-4

Brake Oil Level Switch 4B-4

Brake Fluid Reservoir 4B-4

Master Cylinder 4B-5

Specifications 4B-8

Fastener Tightening Specifications 4B-8

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DESCRIPTION AND OPERATION

GENERAL DESCRIPTION

The master cylinder is designed for use in a parallel split system. One front and one parallel to rear brakes are served by the primary piston. The opposite front and rear brakes are served by the secondary piston. The master cylinder incorporates the functions of the standard dual master cylinder, plus a low fluid level indicator. The brake fluid level switch is attached under the body of the plastic brake master cylinder reservoir.

Notice: Do not use lubricated shop air on the brake parts, because oil will damage the rubber components.

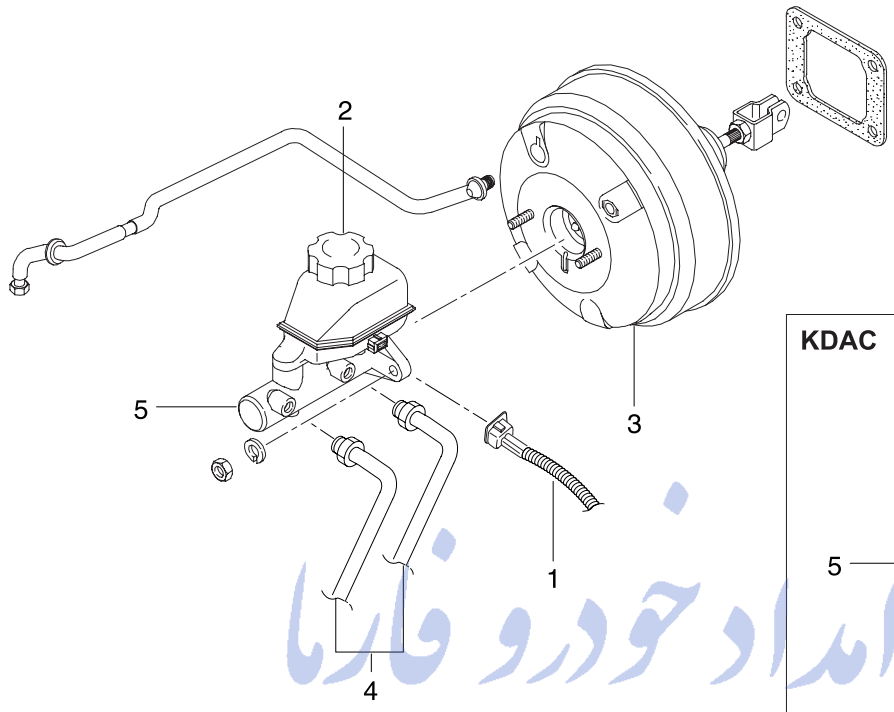
Important:

- Replace all the components included in the repair kits used to service the master cylinder.
- Lubricate the rubber parts with clean brake fluid to ease assembly.
- If any hydraulic component is removed or disconnected, it may be necessary to bleed all or part of the brake system. Refer to *Section 4F, Antilock Brake System* and *Traction Control System*.
- The torque values specified are for dry, unlubricated fasteners.
- Perform all service operations on a clean bench, free from all traces of mineral oil.

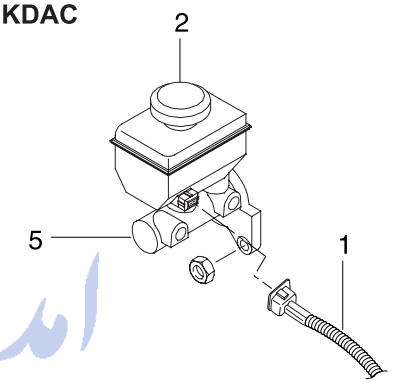
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COMPONENT LOCATOR

MANDO



KDAC

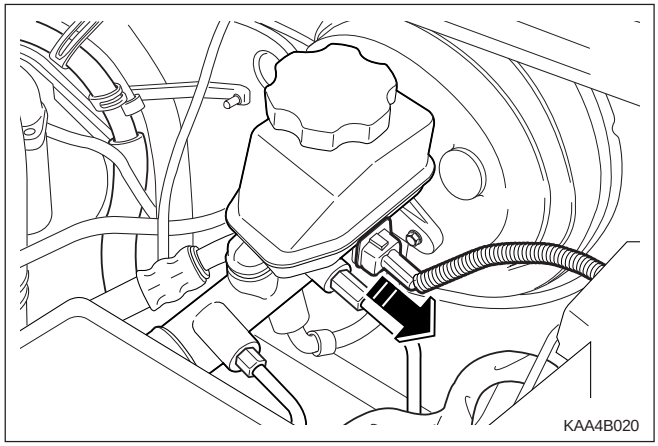


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1 Brake Fluid Level Switch Connector
2 Brake Fluid Reservoir
3 Power Booster
4 Brake Lines (Master Cylinder-to-Hydraulic Modulator)
5 Master Cylinder

REPAIR INSTRUCTIONS

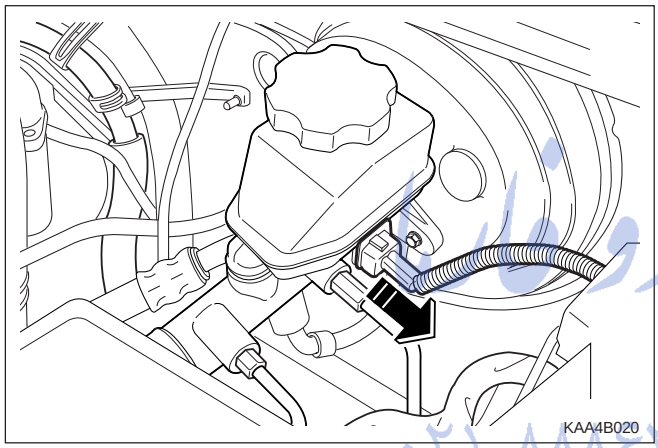


ON-VEHICLE SERVICE

BRAKE OIL LEVEL SWITCH

Removal and Installation Procedure

1. Disconnect the brake fluid level switch connector.
2. Disconnect the switch wiring connector.
3. Disconnect the switch from the brake oil tank.
4. Installation should follow the removal procedure in the reverse order.



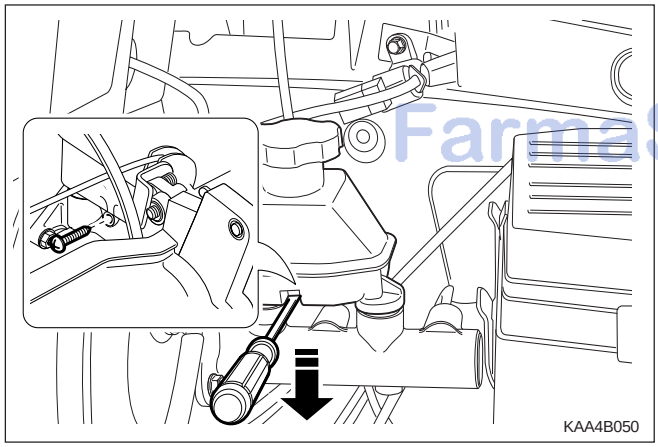
BRAKE FLUID RESERVOIR

Removal and Installation Procedure

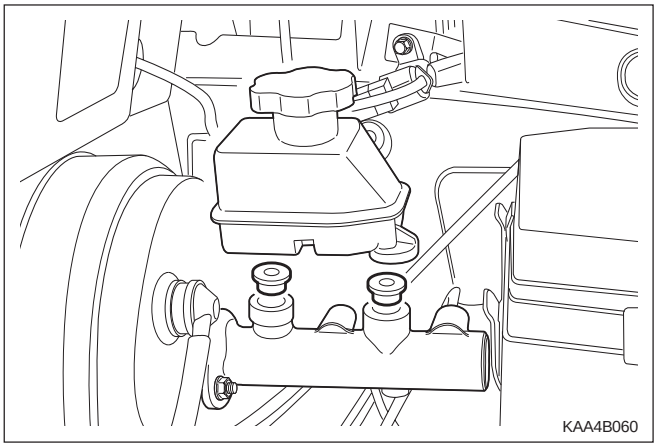
Important: Remove the brake fluid reservoir only when it must be replaced because of damage or leaks.

1. Disconnect the brake fluid level switch connector.
2. Drain the brake fluid.

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3. Remove the brake fluid reservoir fromthe master cylinder body by tilting the reservoir and pulling it up-ward.

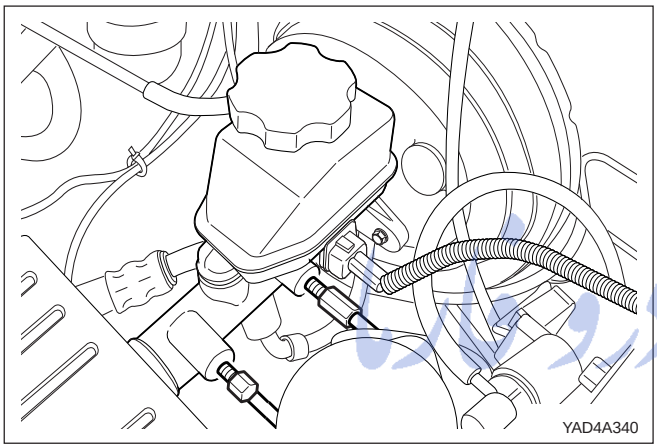


4. Remove and discard the brake fluid reservoir seals from the master cylinder body.

   Installation Notice:

   - Lubricate the new brake fluid reservoir seals with clean brake fluid.
   - After the installation, bleed the brake system. Refer to *Section 4F, Antilock Brake System and Traction Control System*.

5. Installation should follow the removal procedure in the reverse order.



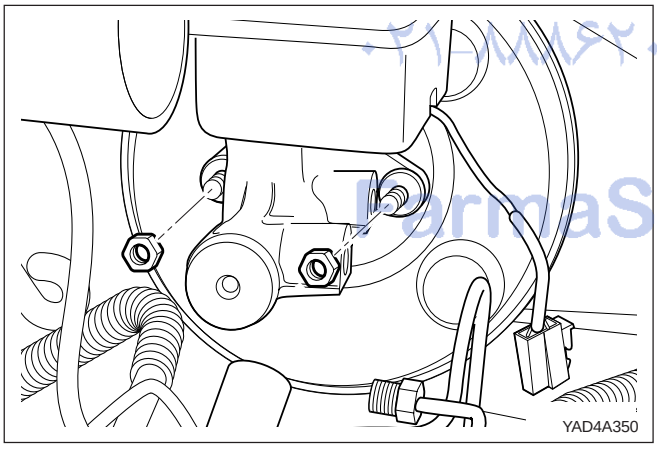
MASTER CYLINDER

Removal Procedure

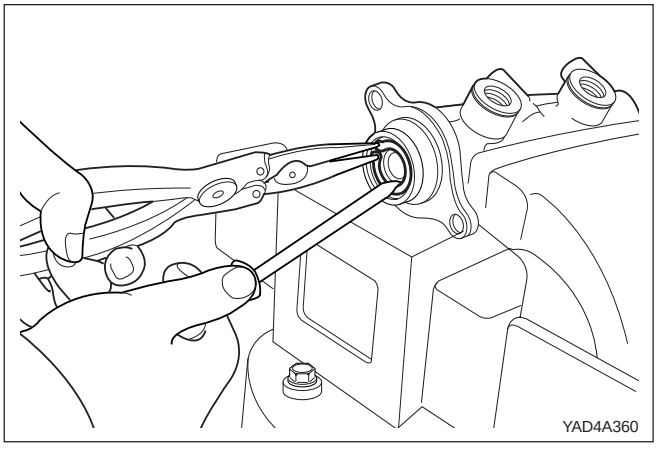
1. Disconnect the brake lines from the master cylinder.

   Notice: The brake fluid may damage paintwork, if spillage onto paintwork, wash with cold water immediately.

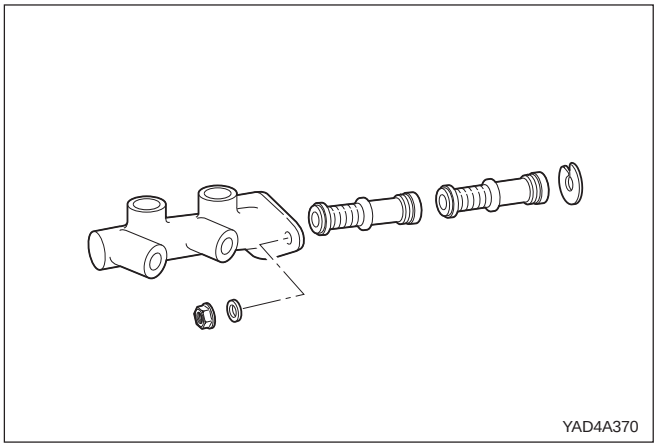
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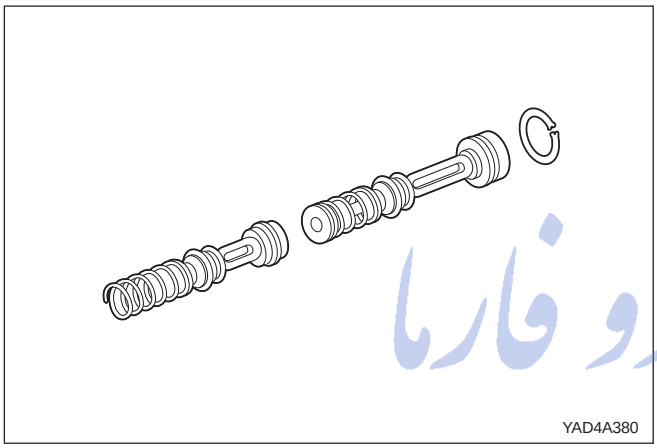
2. Loosen the mounting nut of the master cylinder and remove the master cylinder from the power booster.



3. Remove the master cylinder.
   - Retain the master cylinder in the vice and remove the retainer ring from the master cylinder using the snap ring plier.



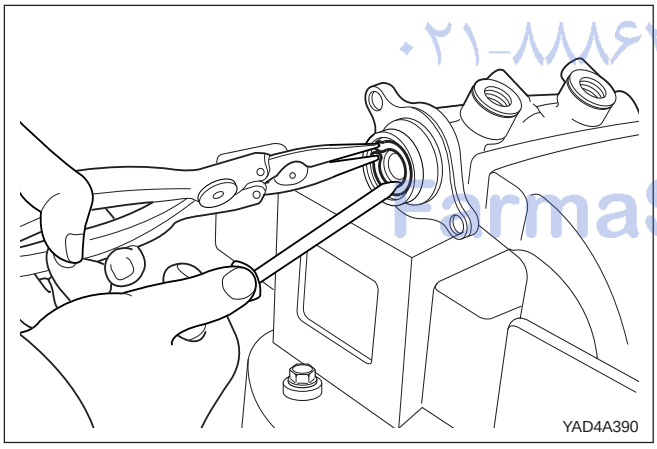
- Remove the 1st piston and 2nd piston assembly from the master cylinder assembly.



- Check the cylinder for excessive wear.

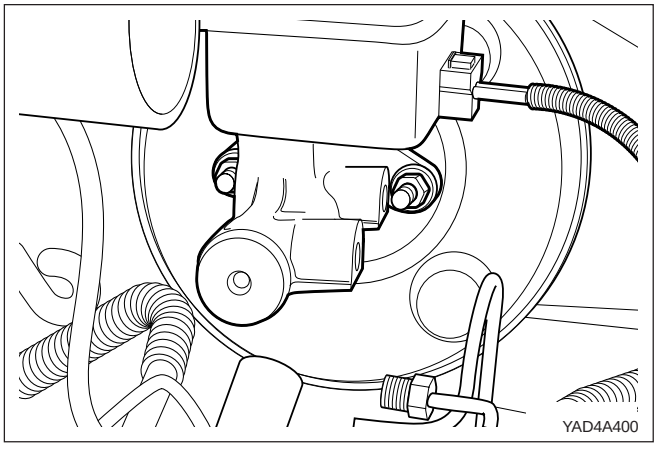
  Notice:
  - Replace the cylinder assembly when there occurs any damage or wear in the cylinder.
  - Clean the contaminated oil of the assembly.
- Install the 1st piston and 2nd piston assembly from the master cylinder assembly.

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Installation Procedure

1. Install the retainer ring using the snap ring plier.



2. Install the master cylinder into the booster.

   Installation Notice

Tightening Torque	8 - 12 N•m (71 - 106 lb-in)

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Brake Lines Fitting (M10)	17	13	-
Brake Lines Fitting (M12)	22	16	-
Master Cylinder Mounting Nunts	25	18	-

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SECTION 4C

POWER BOOSTER

TABLE OF CONTENTS

Description and Operation 4C-2

General Description 4C-2

Component Locator 4C-3

Diagnostic Information and Procedures 4C-4

Power Booster Functional Check 4C-4

Repair Instructions 4C-5

On-Vehicle Service 4C-5

Power Booster Assembly 4C-5

Vacuum Hose 4C-6

Specifications 4C-7

General Specification 4C-7

Fastener Tightening Specifications 4C-7

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DESCRIPTION AND OPERATION

GENERAL DESCRIPTION

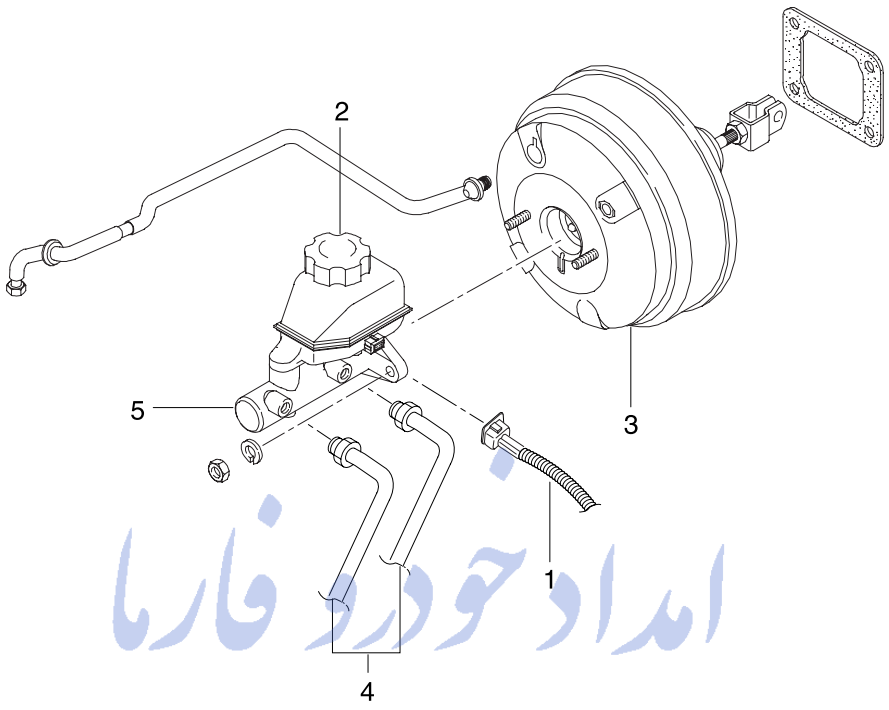
The power booster is a double-diaphragm, vacuum-sus pended unit. In normal operating mode, with the service brakes in the release position, a vacuum-suspended booster operates with a vacuum on both sides of its diaphragm. When the brakes are applied, air at atmospheric pressure is admitted to one side of the diaphragm to provide the power assist.

When the brakes are released, atmospheric air is shut off from that side of the diaphragm. The air is then drawn from the booster through the vacuum check valve by the vacuum source.

Important: If any hydraulic component is removed or disconnected, it may be necessary to bleed all or part of the brake system. Refer to *Section 4F, Antilock Brake System and Traction Control System*.

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COMPONENT LOCATOR



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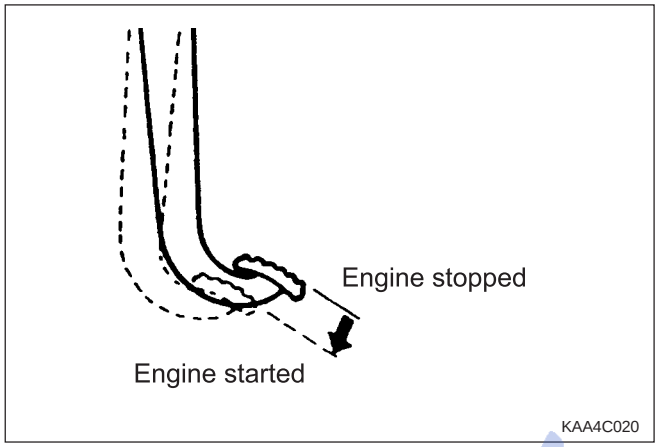
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1 Brake Fluid Level Switch Connector
2 Brake Fluid Reservoir
3 Power Booster
4 Brake Lines (Master Cylinder-to-Hydraulic Modulator)
5 Master Cylinder

DIAGNOSTIC INFORMATION AND PROCEDURES

POWER BOOSTER FUNCTIONAL CHECK

1. With the engine stopped, eliminate vacuum in the booster by pumping the brake pedal several times.

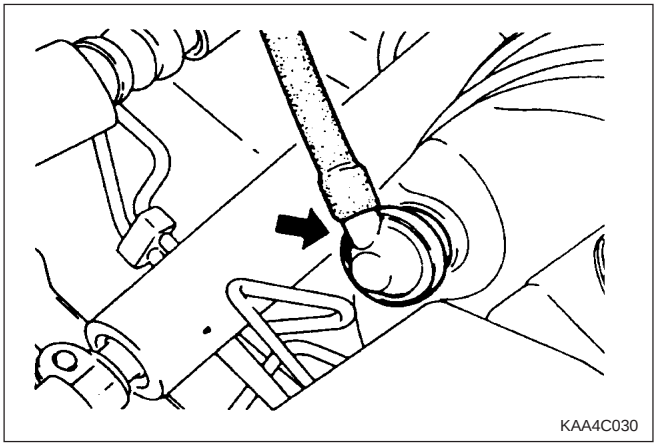


2. Push the pedal down and hold in this position.
3. Start the engine.
4. The booster is OK if the pedal drops further because of extra force produced.

If the brake pedal does not drop, the vacuum system (vacuum hoses, check valve, etc.) is probably defective and should be checked. If no defect is revealed by checking the vacuum system, the defect is in the booster itself.

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REPAIR INSTRUCTIONS

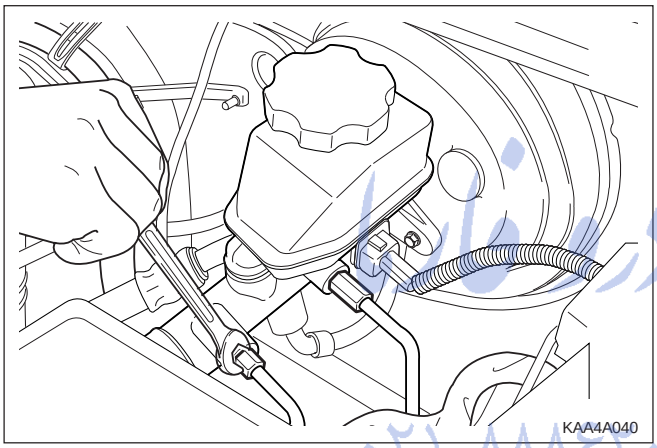

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ON-VEHICLE SERVICE

POWER BOOSTER ASSEMBLY

Removal and Installation Procedure

1. Remove the master cylinder. Refer to *Section 4B, Master Cylinder*.
2. Remove the vacuum hose from the booster.

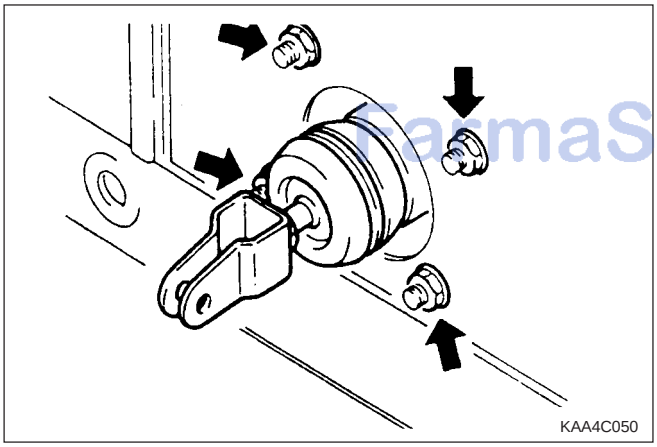

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3. Remove the clevis pin and disconnect the pedal and brake booster push rod.

Installation Notice:

- Apply the grease around the hole of clevis pin.

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4. Remove the power booster mounting nuts and remove the booster from the dash panel.

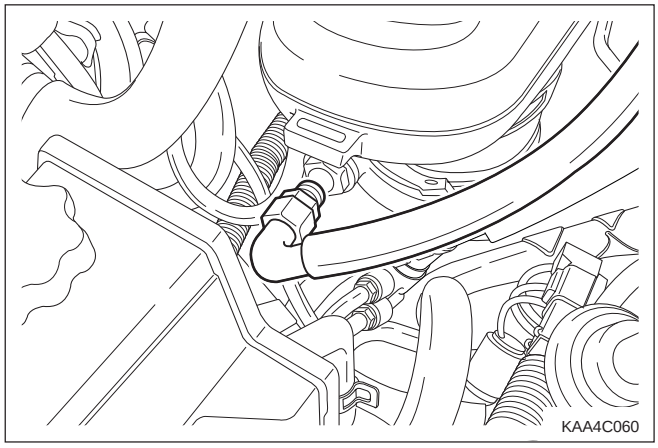
Installation Notice

Tightening Torque	17 N•m (13 lb-ft)

- Install the new gasket.

5. Installation should follow the removal procedure in the reverse order.

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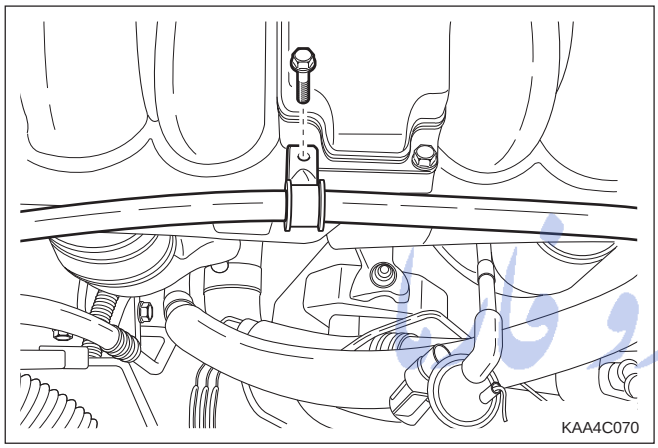
VACUUM HOSE

Removal and Installation Procedure

1. Remove the vacuum hose connection bolt to the intake manifold.

Installation Notice

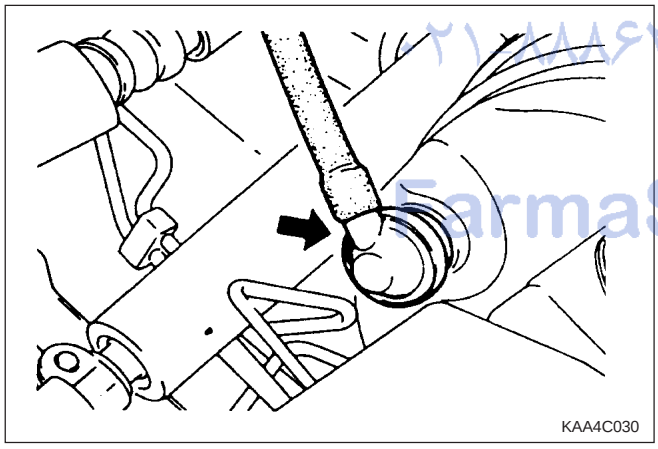
Tightening Torque	40 N•m (30 lb-ft)



2. Remove the vacuum hose retaining bolt located on the intake manifold.

Installation Notice

Tightening Torque	13 N•m (10 lb-ft)



3. Remove the vacuum hose from the booster.
4. Installation should follow the removal procedure in the reverse order.

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SPECIFICATIONS

GENERAL SPECIFICATION

Application	Description
Type	Vacuum Assisted
Retio	5.6 : 1

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Power Booster Mounting Nuts	13	10	-
Vacuum Hose Connection Bolt	40	30	-
Vacuum Hose Retaining Bolt	13	10	-

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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SECTION 4D

FRONT BRAKES

TABLE OF CONTENTS

Description and Operation 4D-2
General Description 4D-2
Brake Caliper 4D-2
Brake Pads 4D-2
Brake Rotor 4D-2
Component Locator 4D-3
Front Brake Assembly 4D-3
Caliper Assembly 4D-4
Diagnostic Information and Procedures 4D-5
Pad Inspection 4D-5
Front Disc Brake Rotor Inspection 4D-5
Repair Instructions 4D-6
On-Vehicle Service 4D-6
Brake Pads 4D-6
Front Disc Brake Rotor 4D-6
Caliper Assembly 4D-7
Splash Shield 4D-7
Unit Repair 4D-8
Brake Caliper 4D-8
Specifications 4D-10
Fastener Tightening Specifications 4D-10

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DESCRIPTION AND OPERATION

GENERAL DESCRIPTION

When the brakes are applied, fluid pressure is sent to each brake caliper. The pressure at the caliper is exerted equally against the caliper piston. The pressure applied to the piston is transmitted directly to the inboard brake pad. This forces the pad against the inner surface of the brake rotor. At the same time, fluid pressure within the caliper piston bore forces the caliper to slide inward on its guide pins. This action brings the outboard pad into contact with the outer surface of the brake rotor. This pressure on both sides of the brake rotor causes friction, bringing the vehicle to a stop.

BRAKE CALIPER

The caliper has a single bore and is mounted to the steering knuckle with two mounting bolts. Hydraulic pressure, created by applying the brake pedal, is converted by the caliper to a stopping force. This force acts equally against the piston and the bottom of the caliper bore to move the piston outward and to slide the caliper inward, resulting in a clamping action on the rotor. This clamping action forces the linings against the rotor, creating friction to stop the vehicle.

Important:

- Replace all components included in the repair kits used to service the caliper.
- Lubricate the rubber parts with clean brake fluid to ease assembly.
- Do not use lubricated shop air on brake parts, as damage to the rubber components may result.
- If any hydraulic component is removed or disconnected, it may be necessary to bleed all or part of the brake system. Refer to *Section 4F, Antilock Brake System And Traction Control System*.
- Replace the pads in axle sets only.
- The torque values specified are for dry, unlubricated fasteners.
- Perform the service operations on a clean bench, free from all oily material.

BRAKE PADS

There are two brake pads mounted to each caliper, one inboard and one outboard. As front disc brake pad wear, master cylinder reservoir brake fluid level will drop. Fluid level should be checked after replacing pads.

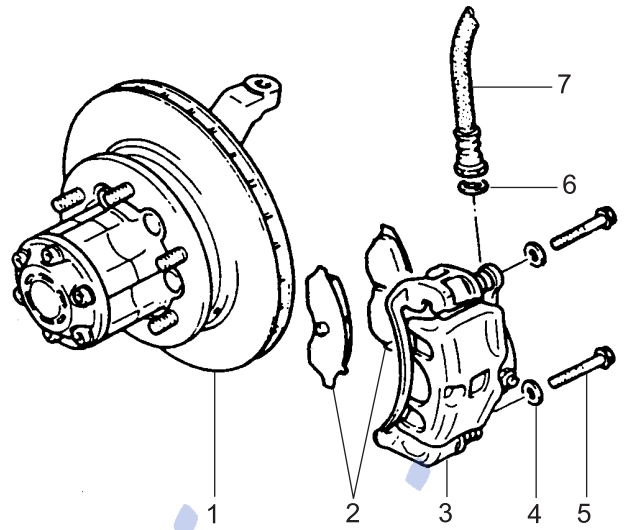
BRAKE ROTOR

Each front disc brake rotor is vented to help cool it during and after brake applications.

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COMPONENT LOCATOR

FRONT BRAKE ASSEMBLY



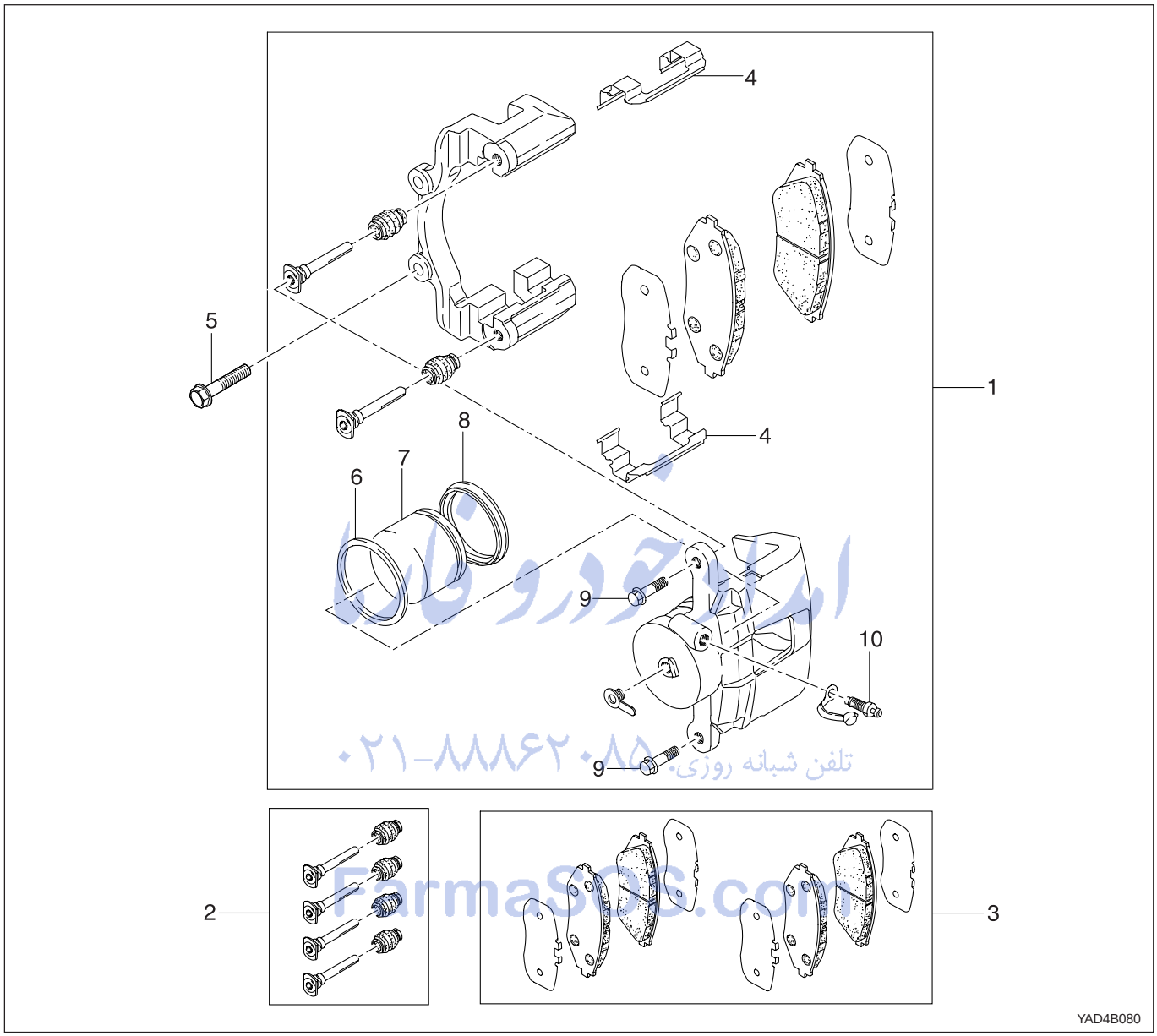
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1 Front Disc Brake Assembly
2 Brake Pad
3 Caliper Assembly
4 Washer
5 Caliper Guide Bolt
6 Gasket
7 Front Brake Hose

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CALIPER ASSEMBLY

Front Caliper Brake



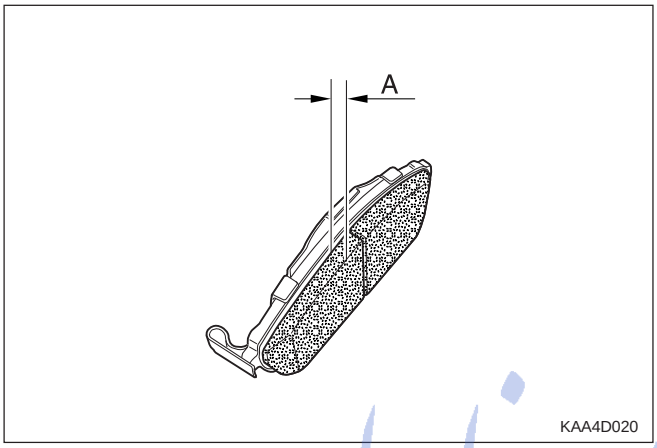
۰۲۱-۸۸۸۶۲۰۸۵ تلفن شبانه روزی
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1 Brake Caliper Assembly
2 Guide Rod Set
3 Brake Pad
4 Brake Pad Spring
5 Caliper Mounting Bolt
6 Piston Seal
7 Piston
8 Piston Boot
9 Caliper Guide Rod Bolt
10 Bleeder Screw

DIAGNOSTIC INFORMATION AND PROCEDURES

PAD INSPECTION

1. Raise and suitably support the vehicle.
2. Remove the front wheel. Refer to *Section 2E, Tires and Wheels.*
3. Visually check the linings for minimum thickness and wear.



4. Measure the thickness.

   Important: The minimum discard thickness of the lining is 2 mm (0.08 inch).

5. Install the pads in axle sets only.
6. Install the rear wheels. Refer to *Section 2E, Tires and Wheels*.
7. Lower the vehicle.

FRONT DISC BRAKE ROTOR INSPECTION

Thickness variation can be checked by measuring the thickness of the rotor at four or more points around the circumference of the rotor. All measurements must be made at the same distance in from the edge of the rotor.

A rotor that varied by more than 0.013 mm (0.0005 inch) can cause pedal pulsations and/or front end vibration during brake applications. A rotor that does not meet these specifications should be refinished to specifications or replaced.

During manufacturing, the brake rotor and the tolerances of the braking surface regarding flatness, thickness variation, and lateral runout are held very close. The maintenance of close tolerances on the shape of the braking surfaces is necessary to prevent brake roughness.

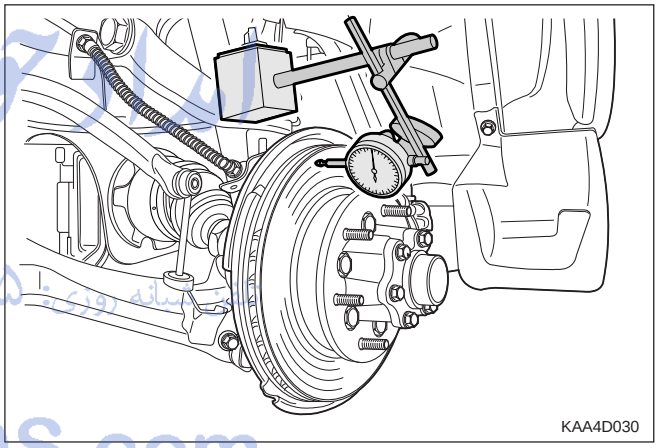
In addition to these tolerances, the surface finish must be held to a specified range. The control of the braking surface finish is necessary to avoid pulls and erratic performance and to extend lining life.

Light scoring of the rotor surfaces not exceeding 0.4 mm (0.016 inch) in depth, which may result from normal use, is not detrimental to brake operation.

Using a commercially available dial indicator, check lateral runout as follows:

Notice: Permissible lateral runout is a maximum 0.07 mm (0.003 inch). If lateral runout exceeds the specification, ensure that there is no dirt between the rotor and the hub and that contact surfaces are smooth and free from burrs.

1. Position the transaxle in NEUTRAL.
2. Remove the rotor. Refer to “Rotor” in this section.
3. Fasten the brake rotor to the wheel hub with two wheel nuts. Refer to *Section 2E, Tires and Wheels.*



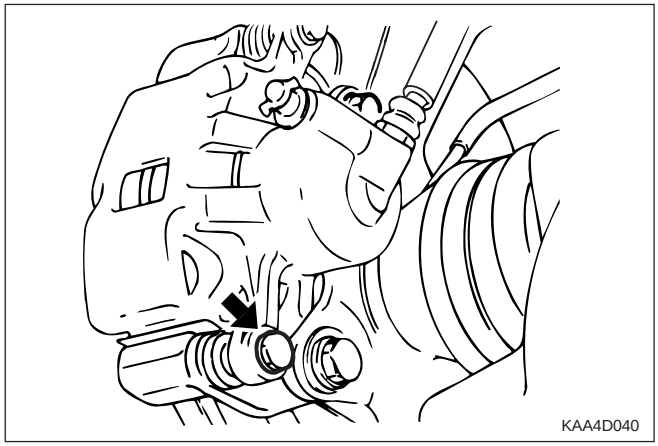
4. Fasten a dial indicator to the brake caliper.
5. Set the gauge probe tip to approximately 10 mm (0.394 inch) from the outer edge of the brake rotor, perpendicular to the disc and under slight preload.
6. Remove the dial indicator and the wheel nuts that connect the rotor to the hub.

   Important: Since accurate control of the tolerances is necessary for proper performance of the disc brakes, refinishing of the rotor should be done only with precision equipment.

7. Refinish the rotor, if required, with precision equipment. Discard the rotor if it fails to meet the above specifications after refinishing.
8. Install the rotor. Refer to “Rotor” in this section.

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REPAIR INSTRUCTIONS


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ON-VEHICLE SERVICE

BRAKE PADS

Removal and Installation Procedure

1. Raise and suitably support the vehicle.
2. Remove the front wheels. Refer to *Section 2E, Tires and Wheels*.
3. Remove the caliper guide lower bolt.

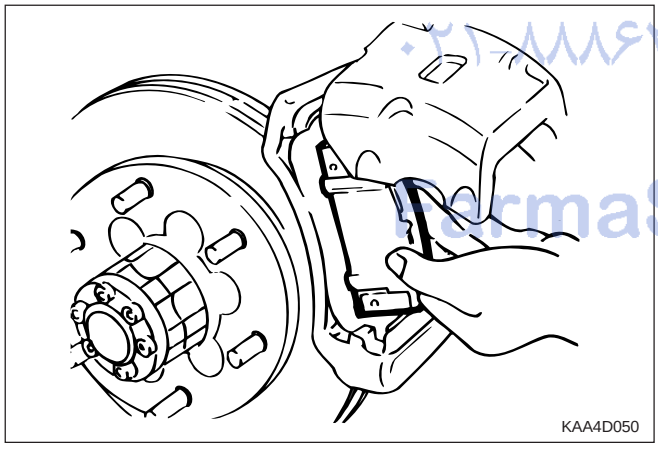
   Important: Caliper assembly removal is not necessary to service the brake pad.

Installation Notice

Tightening Torque	31 N•m (23 lb-ft)

- Take care not to damage the piston seal when the retaining frame is pulled down.

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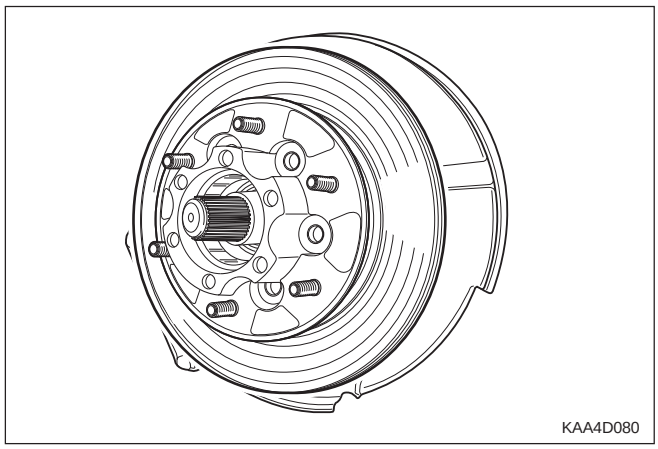
4. Remove the brake pads.

Installation Notice:

- Measure the minimum brake pad thickness. Refer to “Lining Inspection” in this section.
- Always change the all pads on one wheel at a time.

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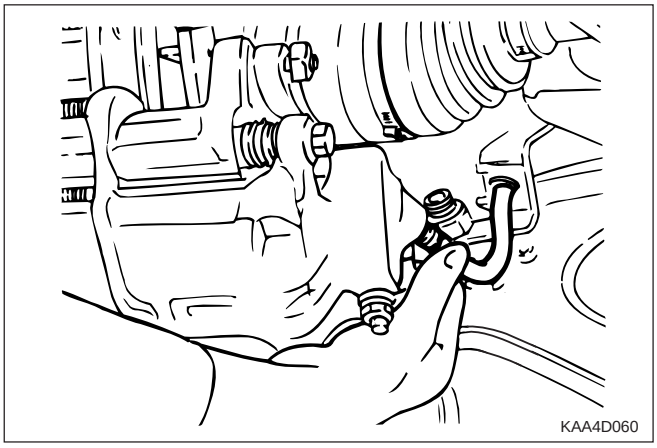
5. Installation should follow the removal procedure in the reverse order.

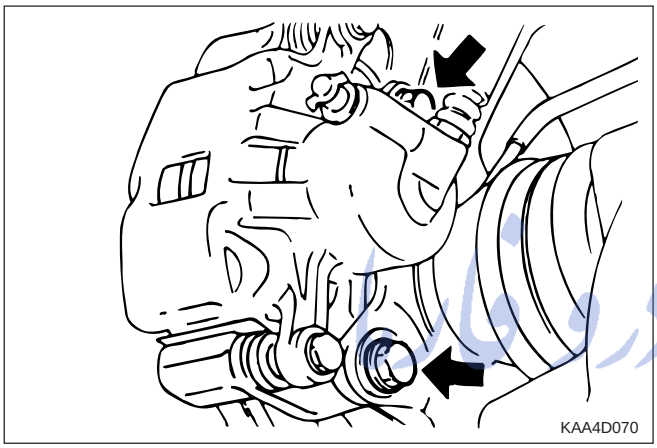

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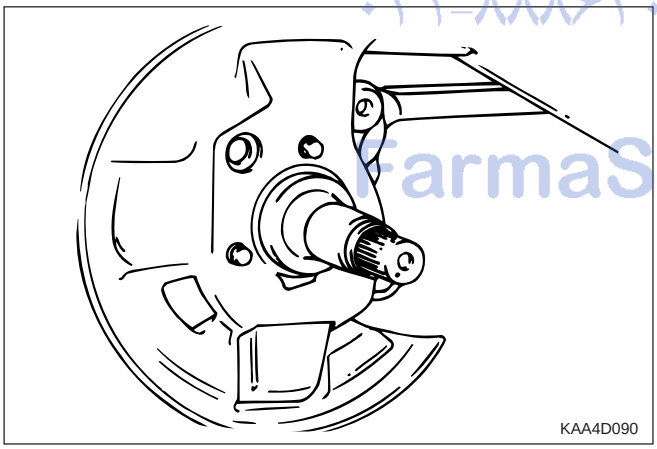
FRONT DISC BRAKE ROTOR

Removal and Installation Procedure

1. Raise and suitably support the vehicle.
2. Remove the front wheels. Refer to *Section 2E, Tires and Wheels*.
3. Remove the hub bearing assembly. Refer to *Section 2C, Front Suspension*.
4. Remove the front disc brake rotor.
5. Installation should follow the removal procedure in the reverse order.


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KAA4D070


KAA4D090

CALIPER ASSEMBLY

Removal and Installation Procedure

1. Raise and suitably support the vehicle.
2. Remove the front wheels. Refer to *Section 2E, Tires and Wheels*.
3. Remove the brake hose mounting nut and disconnect the hose. Plug the openings in the caliper and the brake hose to prevent fluid loss and contamination.

Installation Notice

Tightening Torque	30 N•m (22 lb-ft)

4. Remove the caliper mounting bolts and then remove the caliper assembly.

Installation Notice

Tightening Torque	95 N•m (70 lb-ft)

- Bleed the caliper. Refer to *Section 4A, Hydraulic Brakes*.

Notice: do not move the vehicle until a firm pedal is obtained or improper braking action will result.

- Repeatedly press the brake pedal to bring the pads in contact with the rotor.

5. Installation should follow the removal procedure in the reverse order.

SPLASH SHIELD

Removal and Installation Procedure

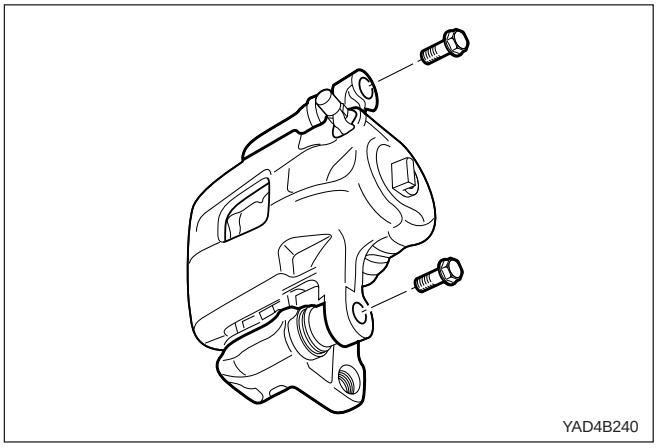
1. Raise and suitably support the vehicle.
2. Remove the front wheels. Refer to *Section 2E, Tires and Wheels*.
3. Remove the hub bearing assembly. Refer to *Section 2C, Front Suspension*.
4. Remove the front disc brake rotor. Refer to “Front Disc Brake Rotor” in this section.
5. Remove the splash shield bolt.

Installation Notice

Tightening Torque	6 N•m (53 lb-ft)

6. Installation should follow the removal procedure in the reverse order.

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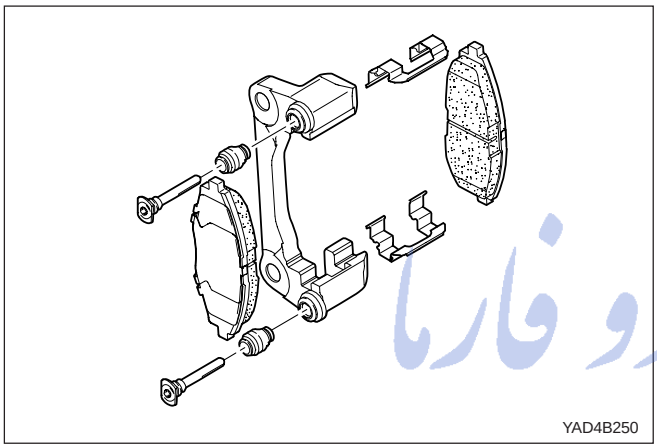

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UNIT REPAIR

BRAKE CALIPER

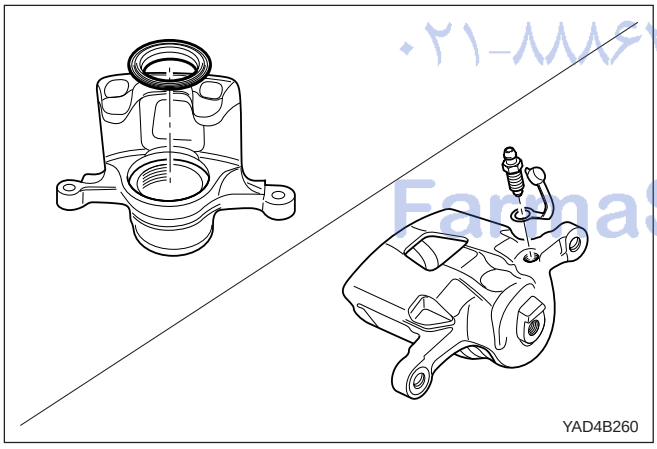
Disassembly Procedure

1. Remove the caliper assembly.
2. Separate the cylinder assembly and carrier.
   - Remove the guide rod bolt.
   - Separate the cylinder assembly and carrier.

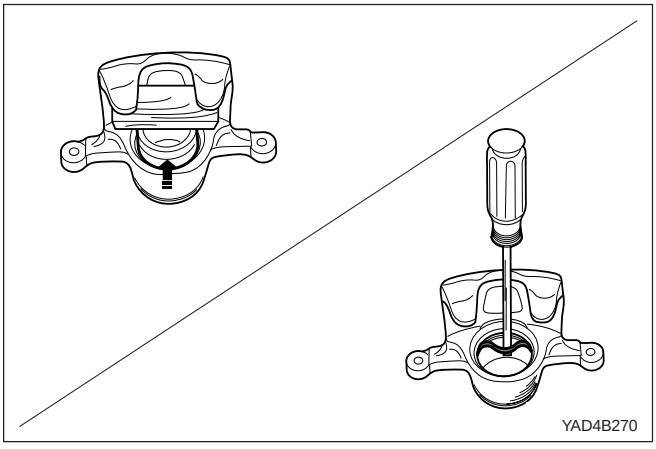

YAD4B250

3. Disassemble the carrier.
   - Remove the pad.
   - Remove the spring.
   - Remove the guide rod and the boot.

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۰۲۱-۸۸۸۶۲۰۸۵
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YAD4B260

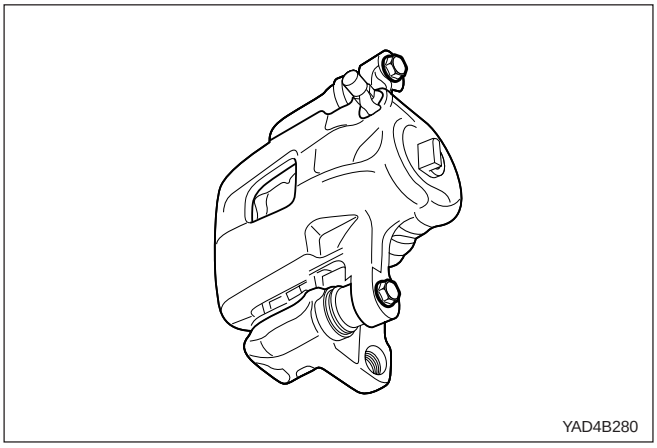
4. Remove the cylinder assembly.
   - Remove the bleeder plug.
   - Remove the bleeder plug cap.
   - Remove the piston boot.


YAD4B270

- Using the compressed air, blow out the piston from housing.

  Notice: Do not face in the direction of removing.

- Remove the piston.
- Remove the piston seal.


YAD4B280

Assembly Procedure

1. Installation should follow the removal procedure in the reverse order.

   Notice: Clean all the parts in denatured alcohol or brake fluid. Dry the parts with unlubricated compressed air and blow out all the passages in the housing and the bleeder valve.

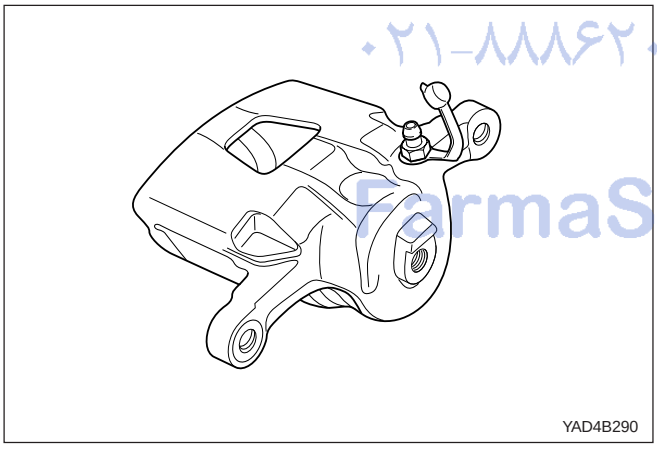
   Apply the brake fluid on the surface of the piston and cylinder.

2. Fasten the guide rod bolt as specified torque.

   Installation Notice

Tightening Torque	22 - 32 N•m (16 - 24 lb-ft)

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۰۲۱-۸۸۸۶۲۰۸۵
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YAD4B290

3. Fasten the bleeder screw as specified torque.

   Installation Notice

Tightening Torque	7 - 13 N•m (62 - 115 lb-in)

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Brake Hose Mounting Nut	30	22	-
Caliper Guide Lower Bolt	31	23	-
Caliper Mounting Bolts	95	70	-
Splash Shield Bolts	6	-	53

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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SECTION 4E

REAR BRAKES

TABLE OF CONTENTS

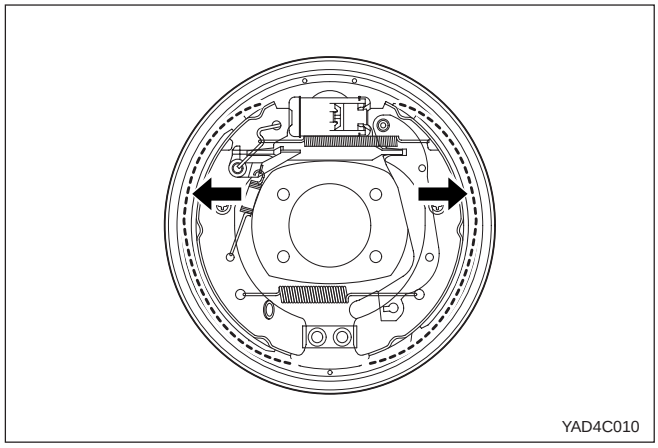
Description and Operation 4E-2
Drum Brake 4E-2
Disc Brake 4E-3
Service Specifications 4E-4
Diagnostic Information and Procedures 4E-5
Inspection 4E-6
Drum Brake Type 4E-6
Disc Brake Type 4E-6
Cross Sectional View 4E-8
Drum Brake (KDAC) 4E-8
Disc Brake 4E-9
Component Locator 4E-10
Drum Brake 4E-10
Disc Brake 4E-11
Rerair Instructions 4E-12
On-Vehicle Service 4E-12
Disc Brake Assembly 4E-12
Drum Brake Assembly 4E-17
Unit Repair 4E-22
Wheel Cylinder 4E-22
Parking Brake Lever 4E-23
Specifications 4E-24
Fastener Tightening Specifications 4E-24

امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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DESCRIPTION AND OPERATION

DRUM BRAKE

This drum brake assembly is a leading/trailing shoe design.



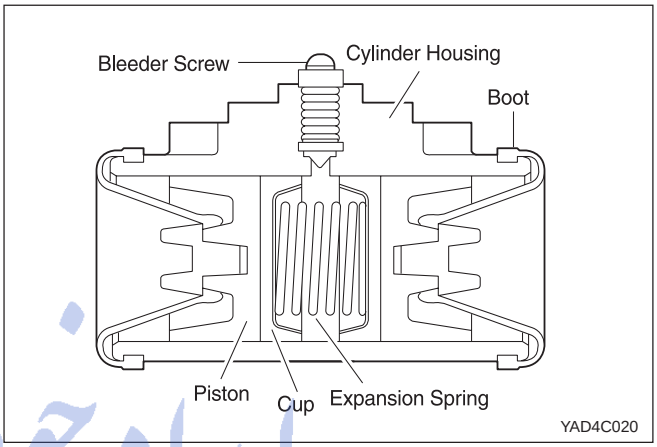
Both brake shoes are held against the wheel cylinder pistons by the lower return spring and the fixed anchor plate near the lower return spring. When the brakes are applied, the wheel cylinder pistons move both shoes out to contact the drum. With forward wheel rotation, the forward brake shoe will wrap into the drum and become selt-energized. With reverse wheel rotation, brake shoes is transferred to the anchor plate through the braking plate to the axle flange. Adjustment is automatic and occurs on any service brake application. Do not switch the position of shoes that have been in service, as this may render the self-adjustment feature inoperative and result in increased pedal travel.

The brake drum must have high abrasion resistance, heatproof, high stiffness, fatigue stiffness and strength enough not to make any deformation. The temperature of the drum surface comes up to 500 - 700 °C on brake operation by the friction with the lining. When the temperature of the drum surface continues to keep high, the friction coefficient goes down and the ‘fade development’ occurs. When the brake is applied often on the hill, any accident may be occur.

Wheel Cylinder

Both wheel cylinder diameters are same in order to balance the friction forces of both shoes.

The hydraulic pressure from the master cylinder is provided to the wheel cylinder and the piston in the wheel cylinder allows to push both shoes toward the drum resulted in generating the braking force.



1 Cylinder Housing	1 Cylinder Housing
2 Boot	2 Boot
3 Spring	3 Spring
4 Piston Cup	4 Piston Cup
5 Piston	5 Piston
6 Air Bleeder	6 Air Bleeder

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Brake Lining

The brake lining is installed with the brake shoe and pushed toward the drum for applying the brake pedal. Thus, lining must have high-heat tolerance, abrasion resistance and high friction coefficient.

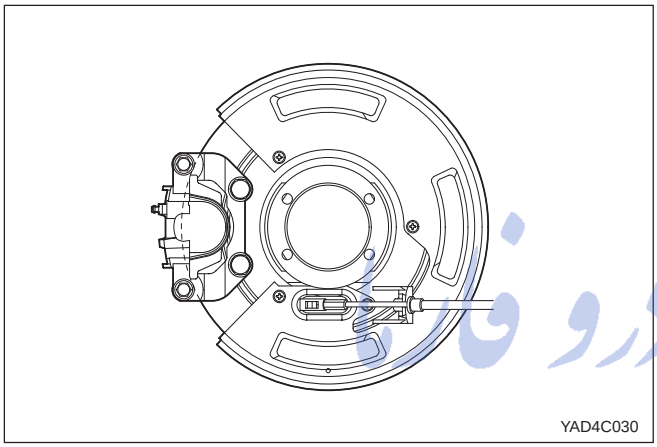
Brake Lining and Drum Clearance Automatic Control System

If the lining’s wear is excessive, the piston moves to long distance and the pedal travel increases. The clearance between the drum and the brake lining should be adjusted.

Generally the drum brake must be adjusted regularly and thus the clearance automatic control system enables to adjust the clearance between the brake lining and the drum resulting from brake lining wear.

DISC BRAKE

The disc brake uses at front wheel generally and recently has been using at rear wheel. The floating type caliper disc brake installed by this vehicle installs only brake cylinder per caliper at one side. When the master cylinder generates the hydraulic pressure, the piston pushes the pad in order to compress to the disc and at this time, the caliper is moved by this reaction resulted in pushing the pad at the other side to compress to the disc. Because the brake disc contacts atmospheric conditions and effect on good radiation, the braking variation keeps uniform forces, the uneven braking may not be generated on high speed driving.



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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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SERVICE SPECIFICATIONS

Application	Drum Brake	Disc Brake	
		MANDO	Delphi Korea
Drum I.D.	ϕ 254 mm	-	-
Shoe Type	Leading and Trailing	-	-
Lining Width x Length x Thickness	55 x 243 x 4.7 mm	-	-
Wheel Cylinder I.D.	ϕ 23.81 mm	-	-
Caliper Cylinder I.D.	-	ϕ 42.9 mm	ϕ 42 mm
Brake Pad Thickness	-	10 mm	10 mm
Disc Thickness	-	10.4 mm	10.4 mm

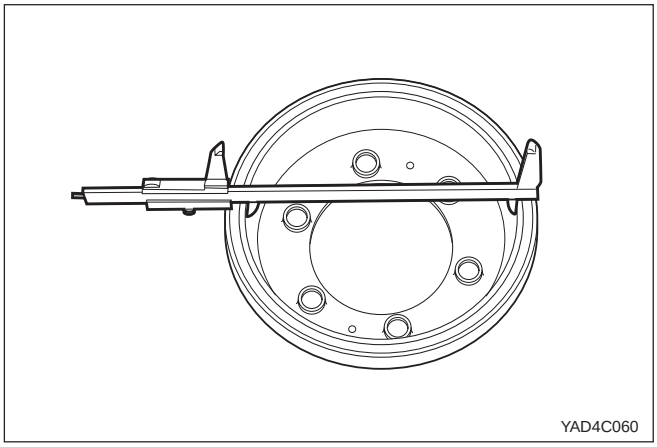
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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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DIAGNOSTIC INFORMATION AND PROCEDURES

Symptom	Possible Cause	Action
Poor Braking	Lining Wear, Hardening	Replace
	Oil or Water Contamination on the Lining	Replace or Repair
	Inoperative Wheel Cylinder	Replace
	Inoperative Clearance Automatic Control System	Repair
Uneven Braking	Lining Wear, Hardening	Adjust
	Oil or Water Contamination on the Lining	Replace or Repair
	Inoperative Wheel Cylinder	Replace
	Inoperative Clearance Automatic Control System	Repair
Dragging Brake	Damage of the Brake Shoe Return Spring	Replace
	Inoperative Wheel Cylinder Returning	Replace
Excessive Pedal Travel	Lining Wear	Replace
	Inoperative Clearance Automatic Control System	Repair
Noise and Vibration When Brake Applied	Lining Wear, Hardening	Replace
	Foreign Material Inside Drum	Clean
	Loosen the Brake Plate Bolt	Tighten
	Drum Deformation or Surface Damage	Replace
Inoperative Parking Brake	Lining Wear, Hardening	Replace
	Oil Contamination on the Lining	Replace
	Inoperative Clearance Automatic Control System	Repair

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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INSPECTION

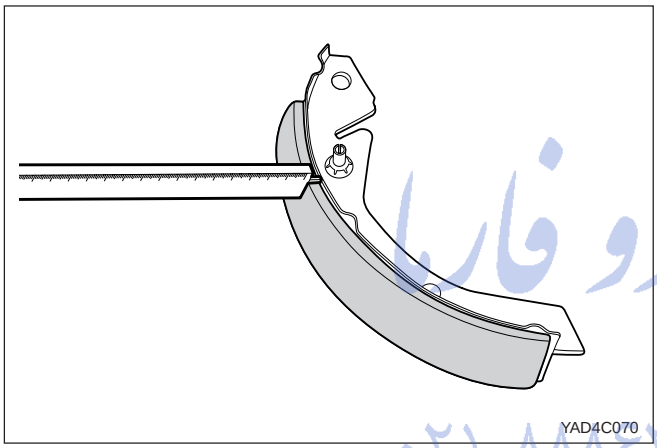

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DRUM BRAKE TYPE

1. Inspect the drum for crack or damage or deformation.
2. Measure the inside diameter.

Inside Diameter	Wear Limit
ϕ 254 mm	ϕ 255.5 mm

- Measure two more position.


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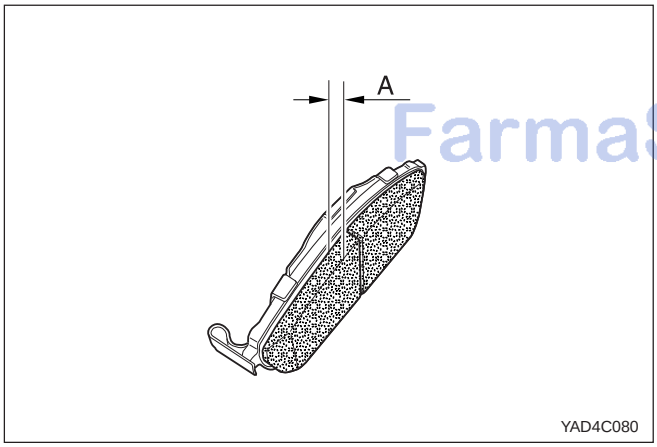
Brake Lining

1. Inspect the surface hardening or excessive wear of the lining. Inspect the lining for stain with oil.
2. Measure the lining thickness.

Wear Limit	1 mm

- If the measured value is below the limit value, replace the brake lining.

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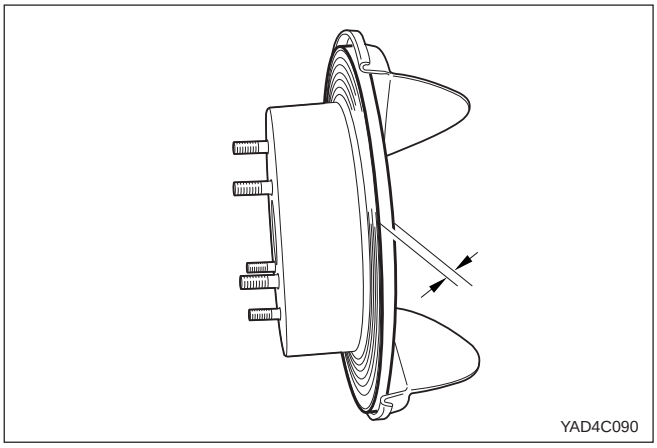
YAD4C080

DISC BRAKE TYPE

Pad Thickness

1. Remove the front wheel.
2. If the measured value is below the limit value, replace the pad.

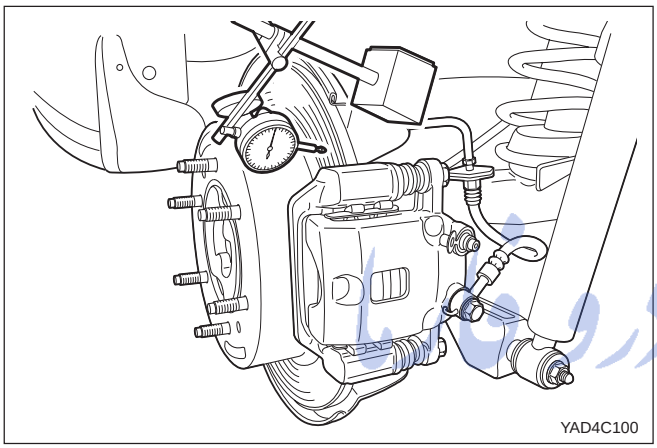
Wear Limit	2 mm


YAD4C090

Brake Disc Thickness

1. Measure the thickness of the rotor at four or more points around the circumference of the disc.
2. If the thickness of the brake disc is below the specified value, replace the brake disc.

Disc Thickness Limit	8.5 mm


YAD4C100

Brake Disc Run Out

1. Set a dial indicator to the brake disc side and measure the run out by rotating the disc.

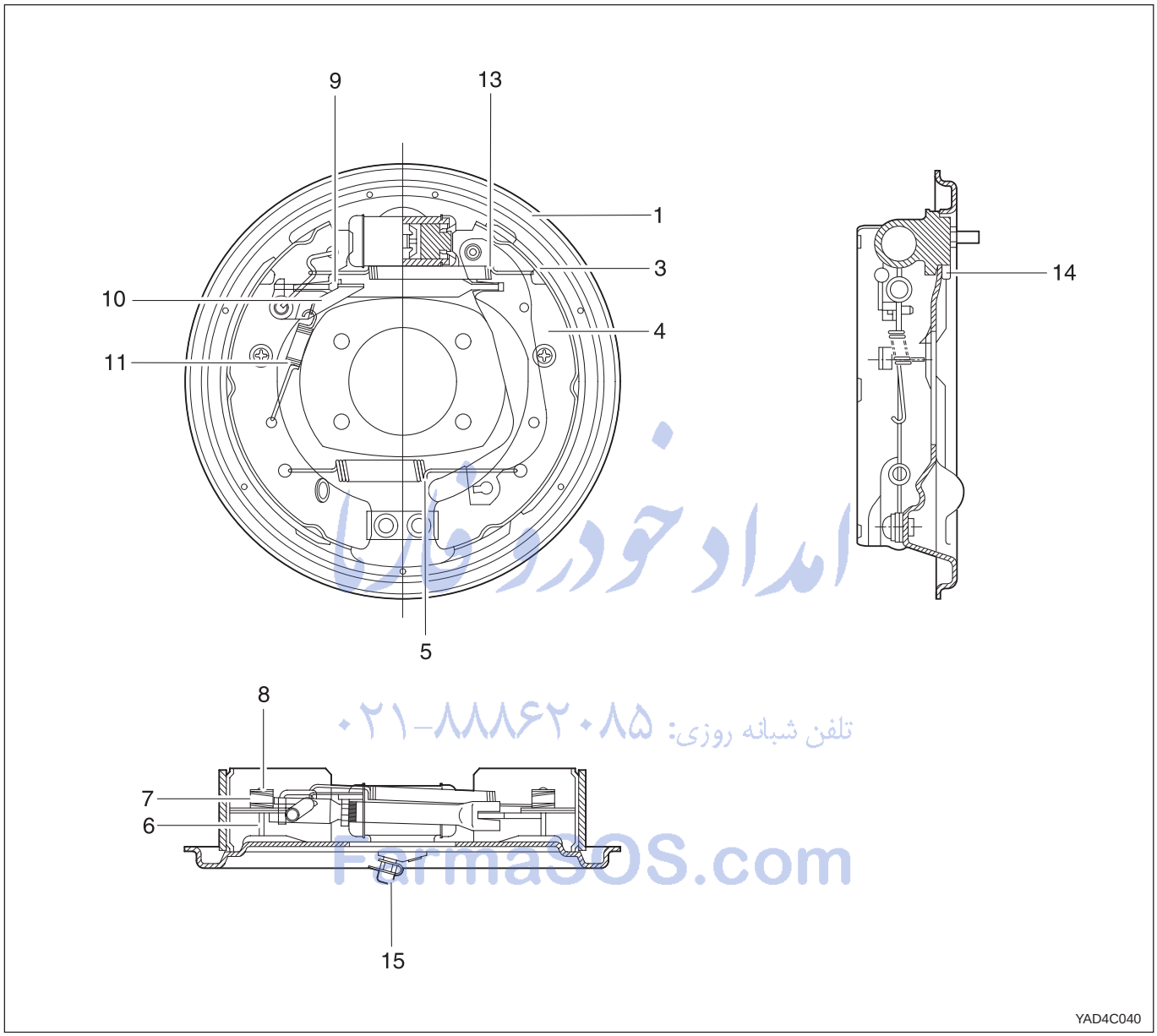
Run Out Limit	On-Vehicle	Max. 0.07 mm
	Disc only	Max. 0.03 mm

2. If lateral run out exceeds the specification, replace the brake disc to prevent the pedal's vibration at braking.

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CROSS SECTIONAL VIEW

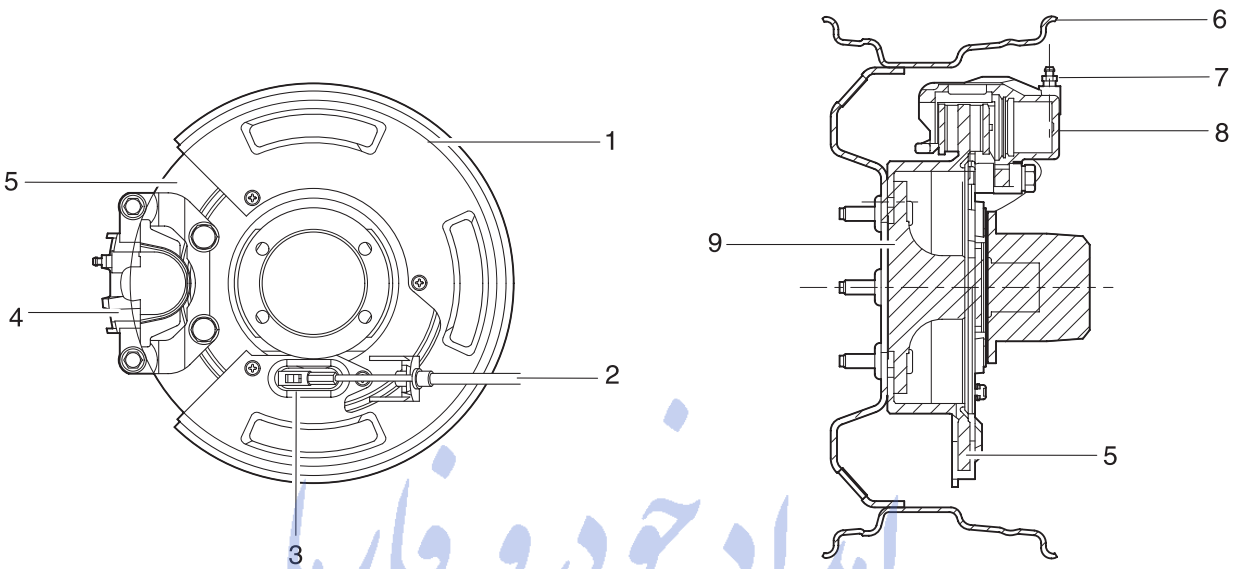
DRUM BRAKE (KDAC)



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1 Backing Plate
2 Wheel Cylinder
3 Brake Shoe Lining
4 Brake Shoe
5 Lower Return Spring (Lower Shoe Spring)
6 Retainer Spring Pin
7 Compression Spring
8 Retainer Spring Plate
9 Adjuster Assembly
10 Adjuster Lever
11 Return Spring (Adjuster)
13 Upper Return Spring (Upper Shoe Spring)
14 Bolt
15 Air Bleeder Nipple

DISC BRAKE

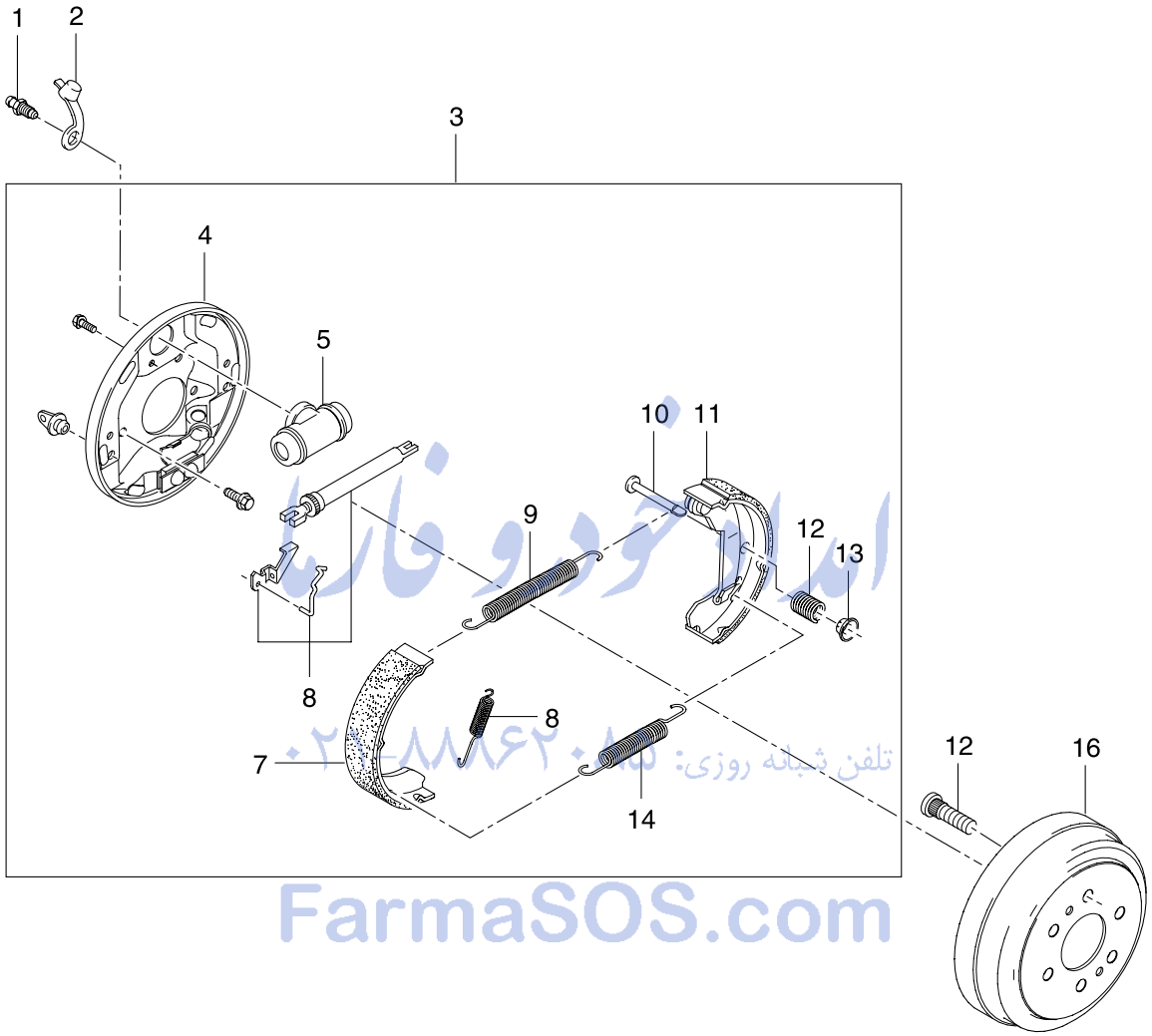


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1 Backing Plate
2 Parking Cable
3 Parking Cable Lever
4 Caliper Assembly
5 Disc
6 Wheel
7 Air Bleeder Nipple
9 Shaft Assembly

COMPONENT LOCATOR

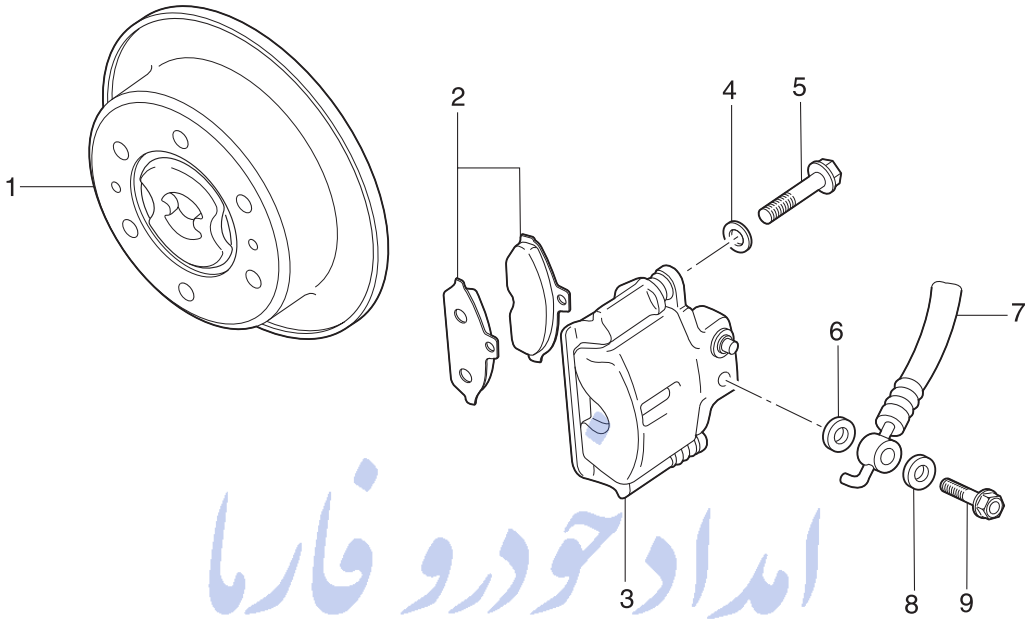
DRUM BRAKE



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1 Bleeder Screw
2 Bleeder Screw Cap
3 Rear Brake Assembly
4 Rear Brake Plate
5 Wheel Cylinder
6 Strut Assembly (Clearance Automatic Control System)
7 Brake Leading Shoe
8 Middle Return Spring
9 Upper Return Spring
10 Brake Shoe Retaining Spring Pin
11 Trailing Shoe
12 Brake Shoe Retaining Spring
13 Brake Shoe Retaining Spring Cap
14 Lower Return Spring
15 Hub Bolt
16 Rear Brake Drum

DISC BRAKE

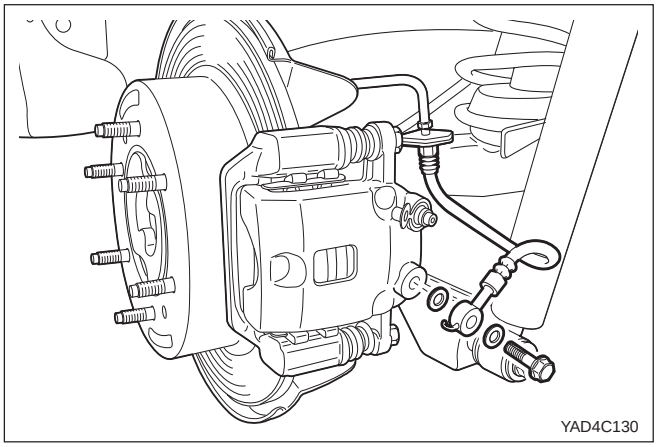


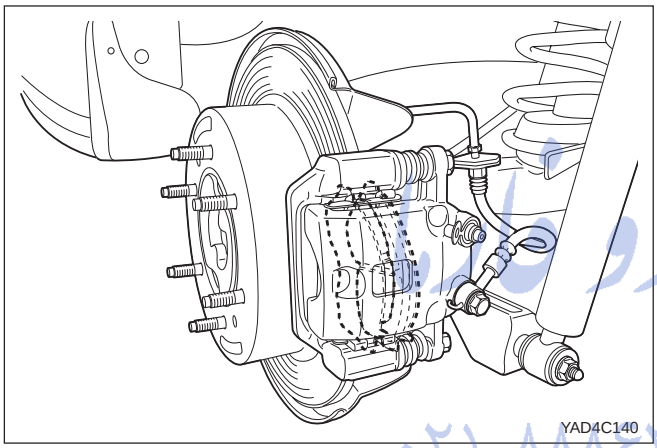
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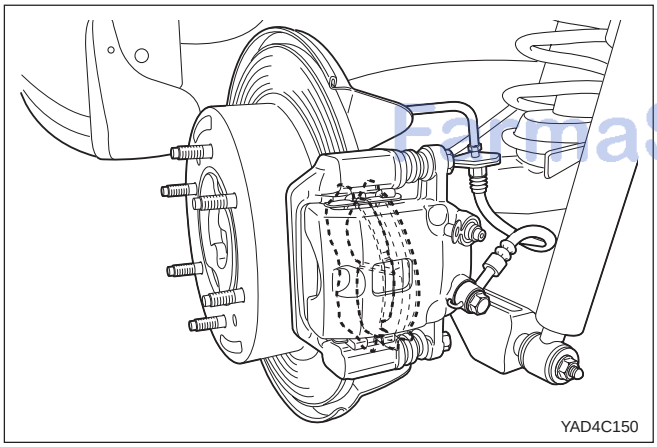
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1	Rear brake disc assembly	6	Gasket ..... Replace
2	Brake pad	7	Brake hose
3	Brake caliper	8	Gasket ..... Replace
4	Gasket ..... Replace	9	Hose bolt ..... 8 - 18 N•m
5	Bolt ..... 20 N•m (15 lb-ft)		

RERAIR INSTRUCTIONS


YAD4C130


YAD4C140


YAD4C150

ON-VEHICLE SERVICE

DISC BRAKE ASSEMBLY

Removal Procedure

1. Remove the rear wheel.

   Notice:
   - Park the vehicle on the flat ground and fix the vehicle not to move it.
   - Release the parking brake.
   - Position the transmission in NEUTRAL.

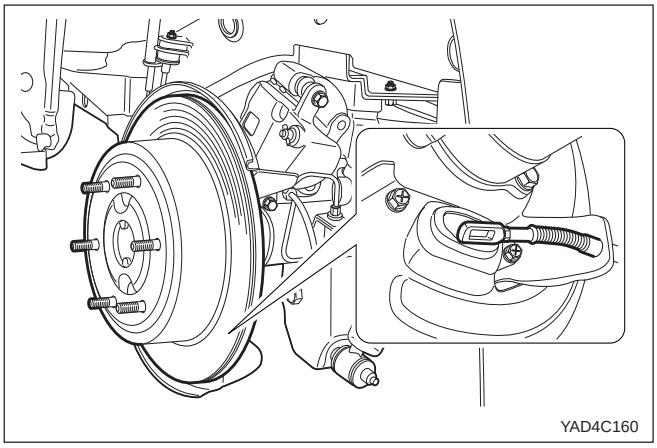
2. Remove the brake hose from the rear brake caliper.

   Notice: Be carefully to prevent the brake fluid loss and contamination.

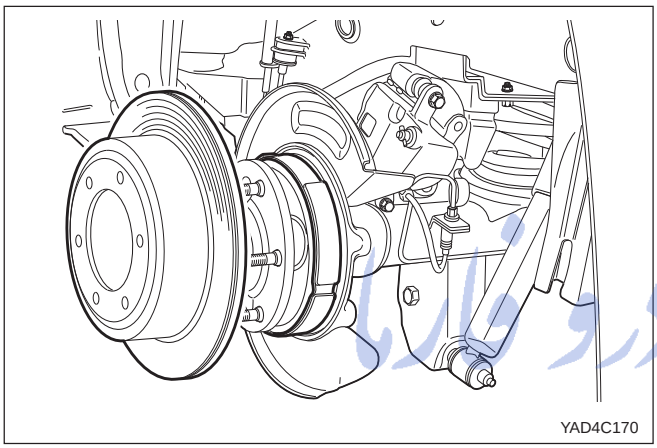
3. Remove the caliper cylinder mounting bolt and remove the disc pad and the cylinder.

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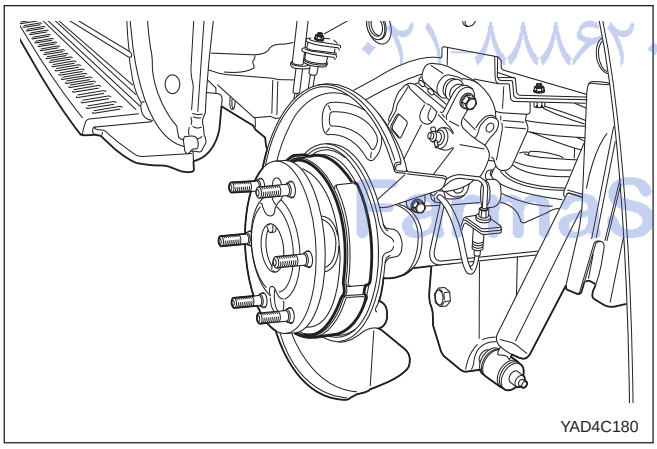
4. Remove the caliper mounting bolt and remove the caliper assembly.



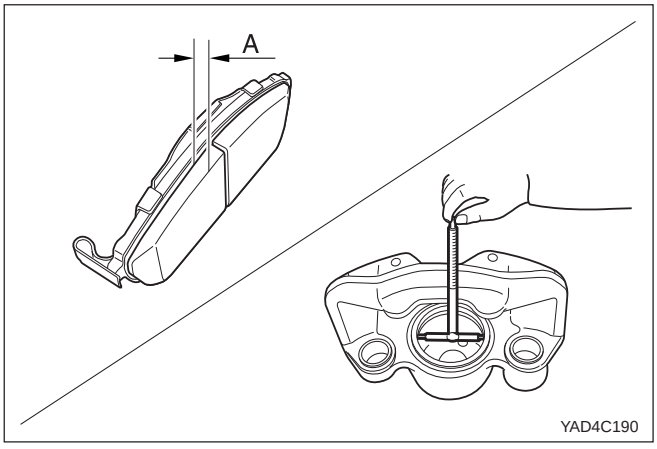
5. Disconnect the parking brake cable from the parking brake lever.



6. Remove the brake disc.



7. Using the rubber hammer, hit to separate the parking brake lining lightly and move the lining upward.



Inspection

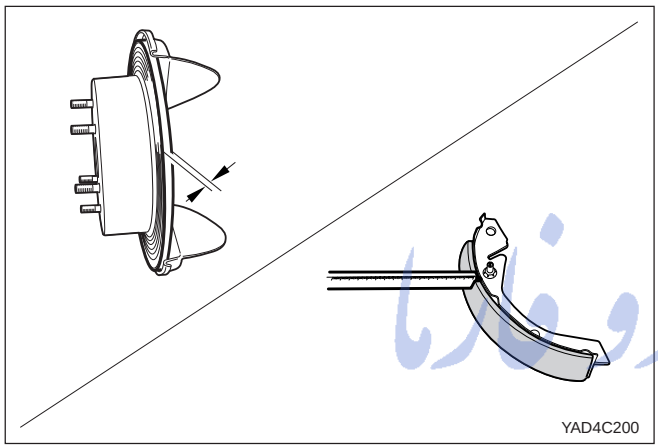
1. Clean the dissembled parts and visually check the followings;
   - Wear, rust and damage on the cylinder and piston
   - Damage, crack on the caliper body and damage, wear on the guide pin
   - Pad uneven wear and oil contamination
   - Boot's damage and tear

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2. Inspect the brake pad thickness.

Pad Thickness	Max wear Limit
10 mm	2 mm

Notice: If the thickness of both pads is not same, replace both pads at the same time.

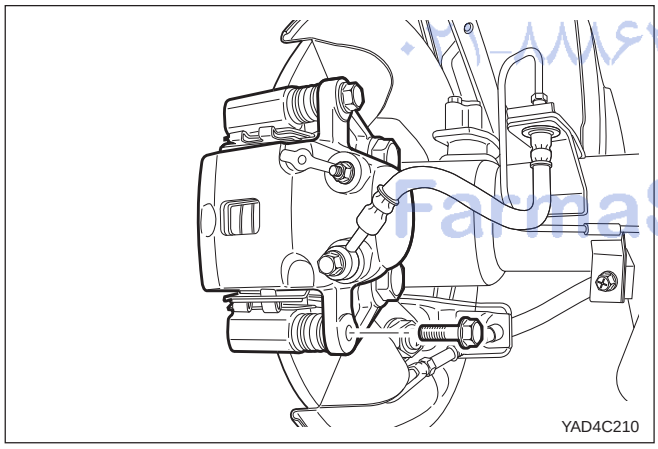


3. Inspect the disc thickness.

Pad Thickness	Max wear Limit
10.4 mm	8.5 mm

4. Inspect the disc plate's scratch and deformation.

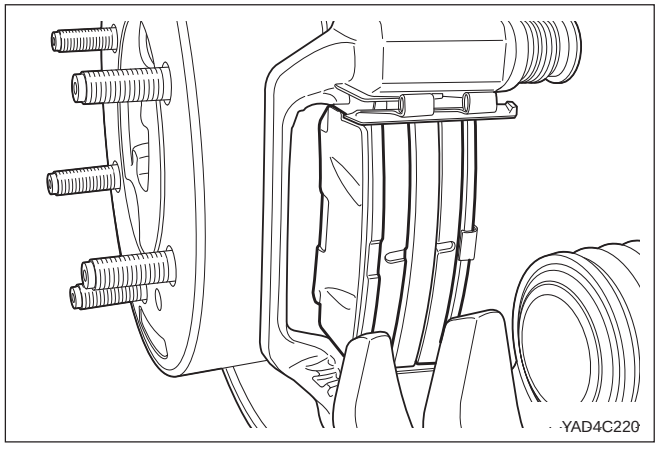
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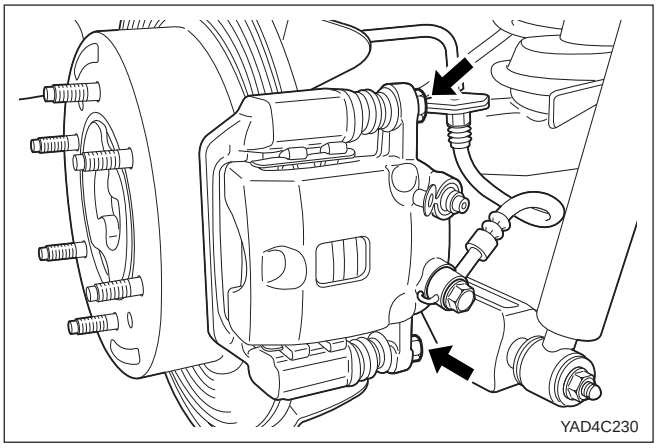
Brake Pad

1. Remove the cylinder mounting bolt (lower) at the brake caliper.
2. Raise and fix the caliper assembly at the proper position not to cause any damage in the hoses or others.

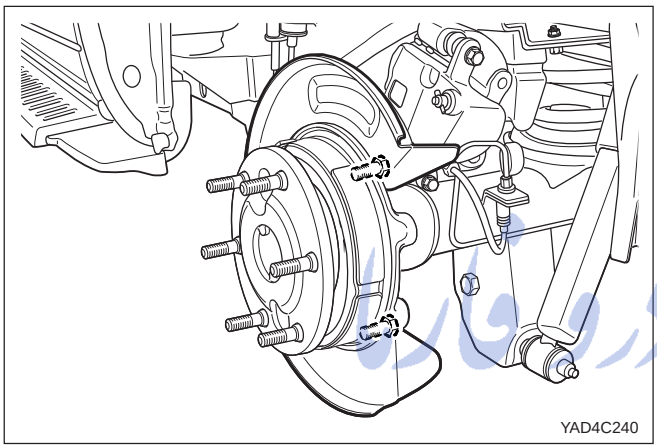
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3. Remove the brake pad and replace the new pad.


YAD4C230

4. Install the caliper cylinder assembly and tighten the retaining bolt.


YAD4C240

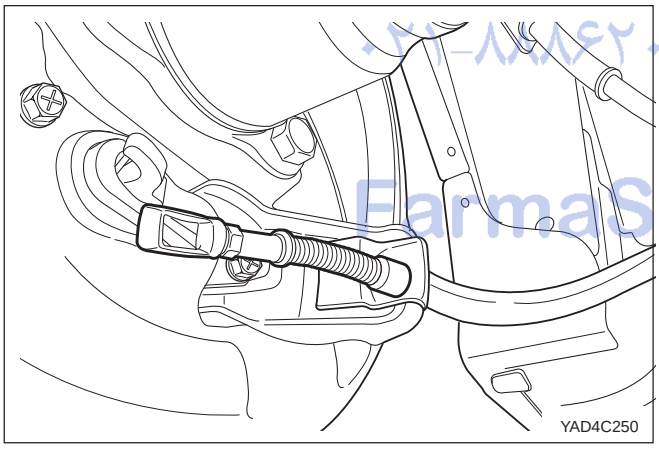
Installation Procedure

1. Install the brake lining between the backing plate and the flange.

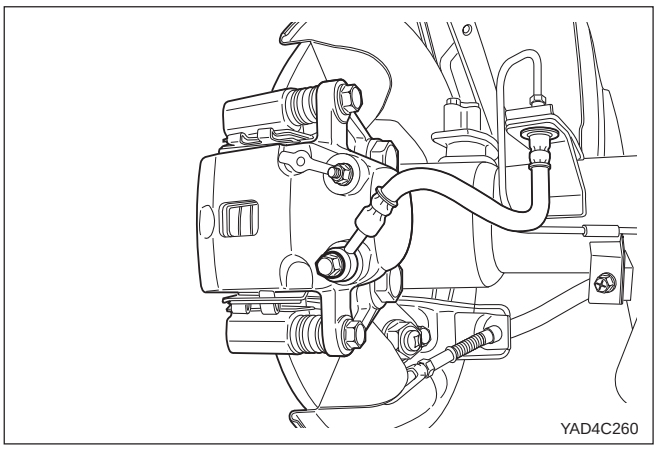
Installation Notice

Tightening Torque	4 - 8 N•m (35 - 71 lb-in)

Notice: Apply a certain amount of grease on the parking brake lining surface.


YAD4C250

2. Install the brake disc and connect the parking brake cable to the lever.

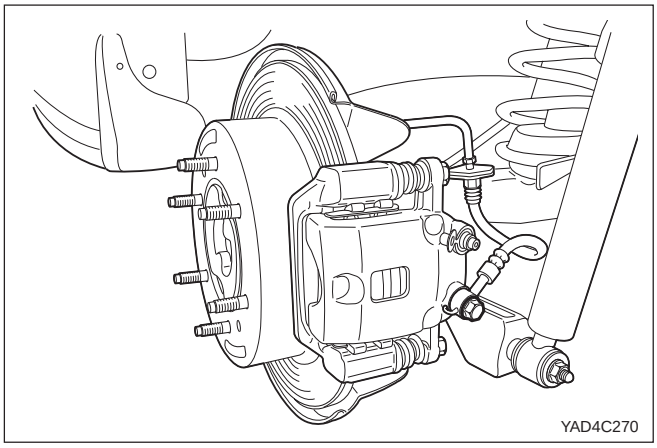

YAD4C260

3. Install the caliper to the brake disc.

Installation Notice

Tightening Torque	4 - 8 N•m (35 - 71 lb-in)

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4. Install the brake hose.

   Notice: The washer should be replaced new part.

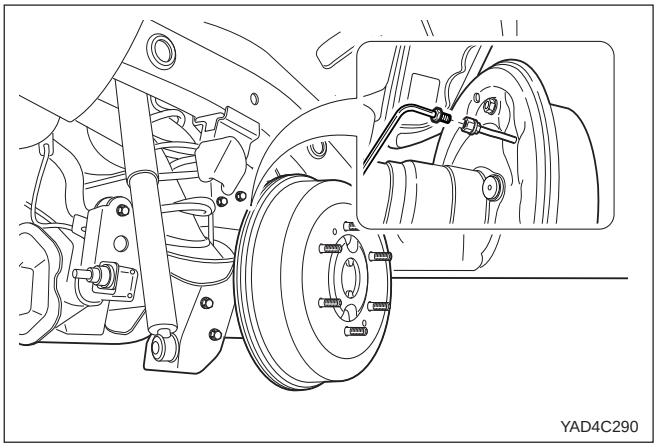
5. Tighten the air bleeder screw.

   Installation Notice

Tightening Torque	7 - 13 N•m (62 - 115 lb-in)

6. Bleed the brake system after replacement.

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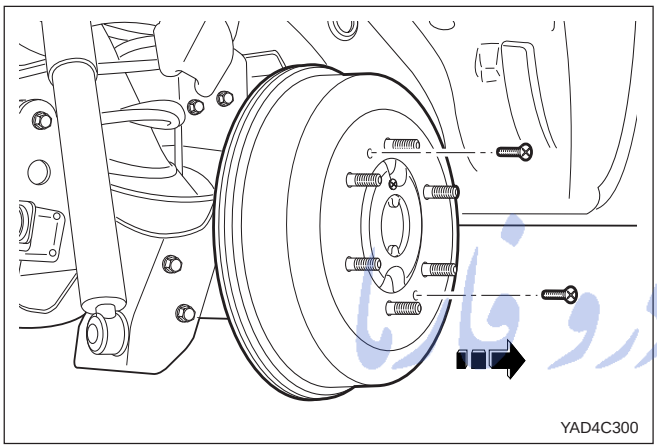

YAD4C290

DRUM BRAKE ASSEMBLY

1. Remove the tires

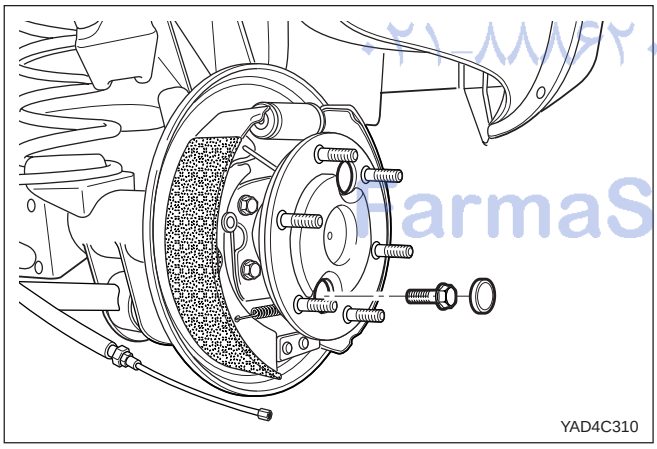
   Notice:
   - Park the vehicle on the flat ground and fix the vehicle not to move it.
   - Position the transmission in NEUTRAL.
2. Disconnect the brake pipe from the rear brake.

   Notice: Be carefully to prevent the brake fluid loss and contamination.

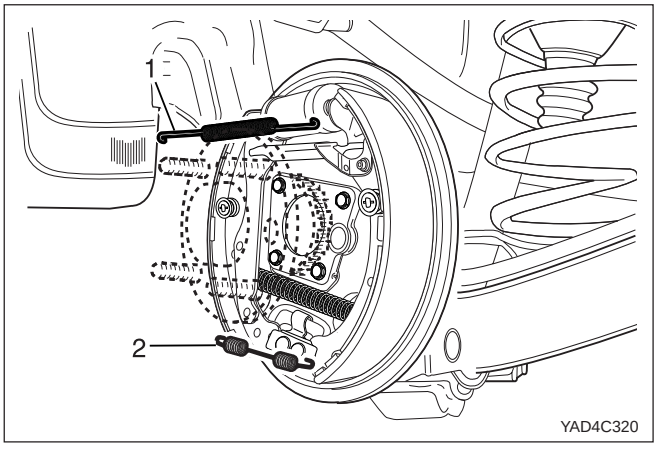

YAD4C300

3. Insert the bolt (M8) to the service hole of the brake drum and remove the brake drum.

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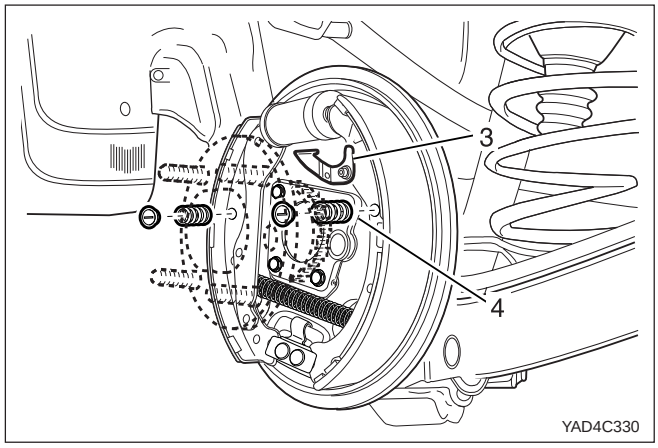

YAD4C310

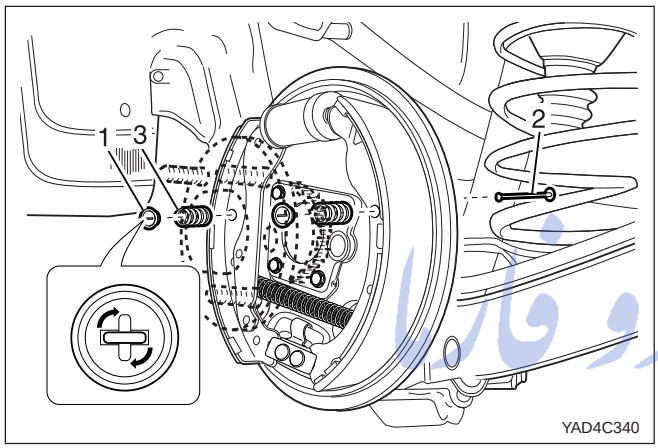
4. Remove the service hole plug of the axle shaft.



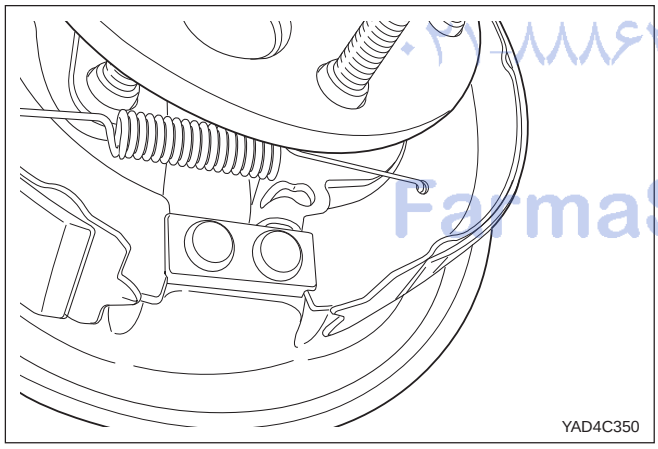
YAD4C320

5. Remove the return spring.
   (1) Disconnect the upper return spring.
   (2) Disconnect the lower return spring.
   (3) Disconnect the lever spring.
   (4) Disconnect the adjuster lever from the adjuster.

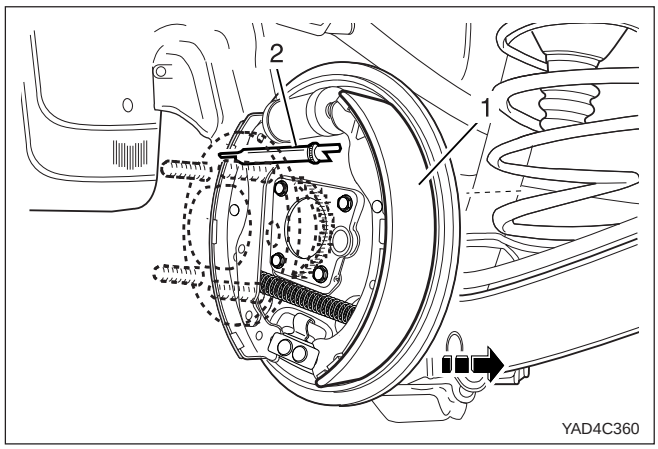




6. Rotate the lining shoe hold down-washer in the plug hole of the axle shaft flange and disconnect the pin and the spring.

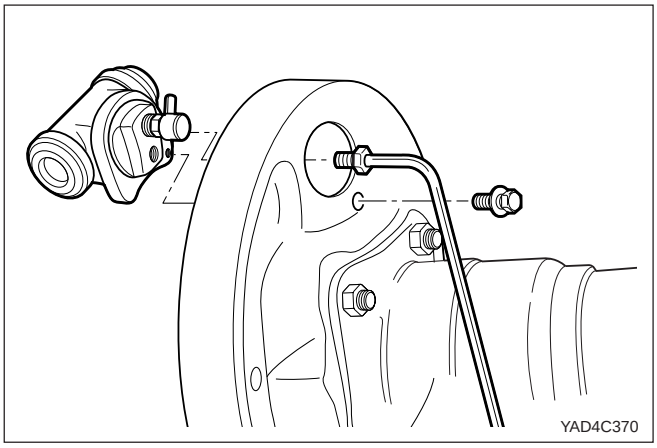


7. Disconnect the parking cable from the parking lever.

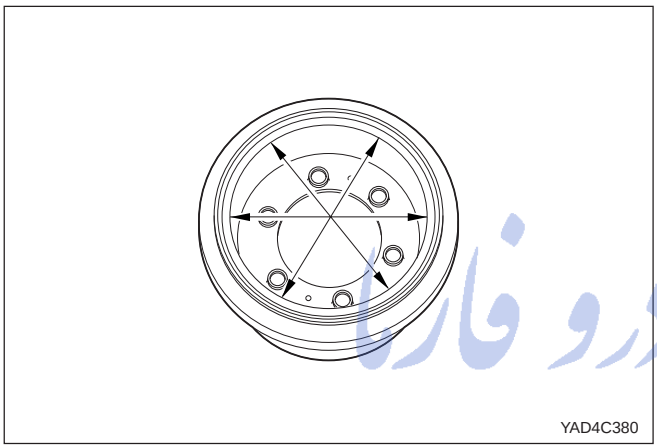


8. Disconnect the brake lining and adjuster lever.

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9. Remove the wheel cylinder mounting bolt and remove the wheel cylinder.

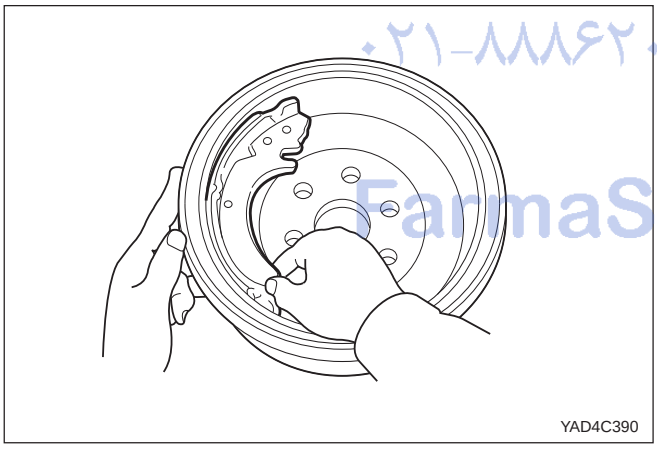


Inspection

1. Measure the inside diameter of the brake drum and replace as needed.

I.D.	Wear Limit
ϕ 254 mm	ϕ 255.5 mm

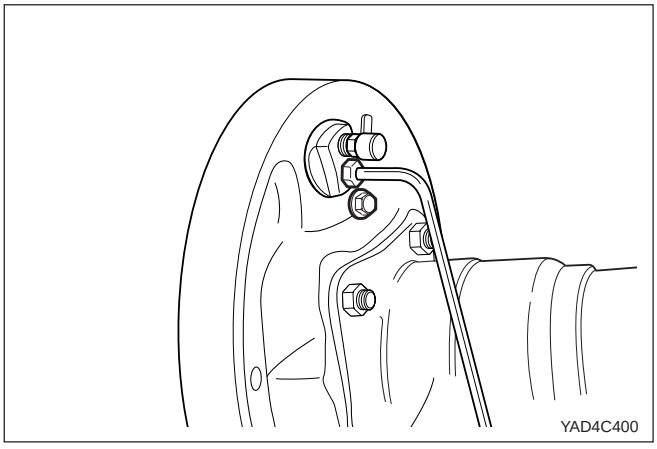
Notice: Measure two more position.



2. Inspect the surface between the lining and brake.

   Mark the brake drum inside using chalk and scrub the shoe & lining assembly. If there is excessive contact problem, replace the shoe & lining assembly or the brake drum.

   Notice: Clean any chalk mark after inspection complete.



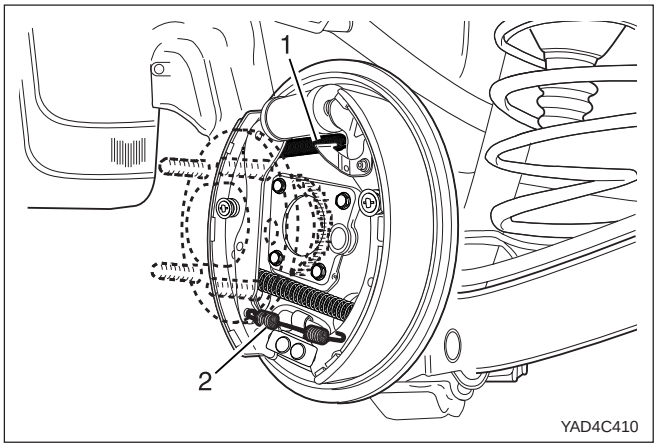
Installation Procedure

1. Install the wheel cylinder to the backing plate.

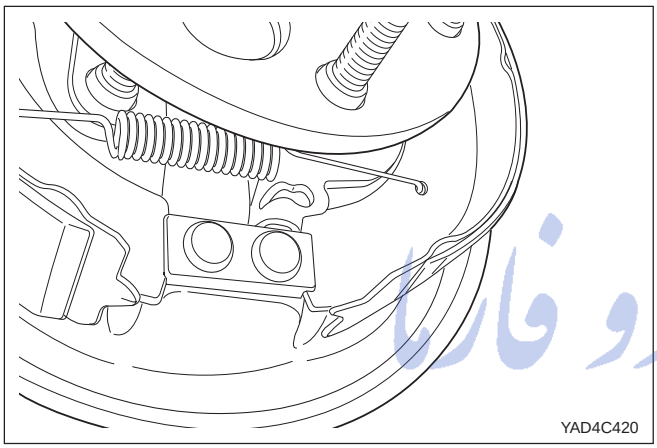
   Installation Notice

Tightening Torque	8 - 12 N•m (71 - 106 lb-in)

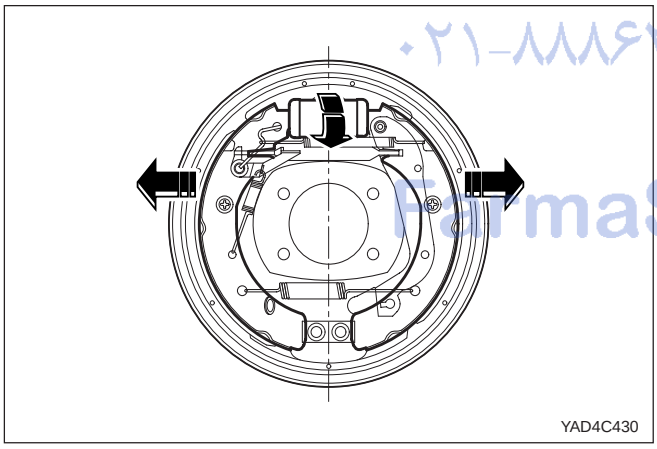
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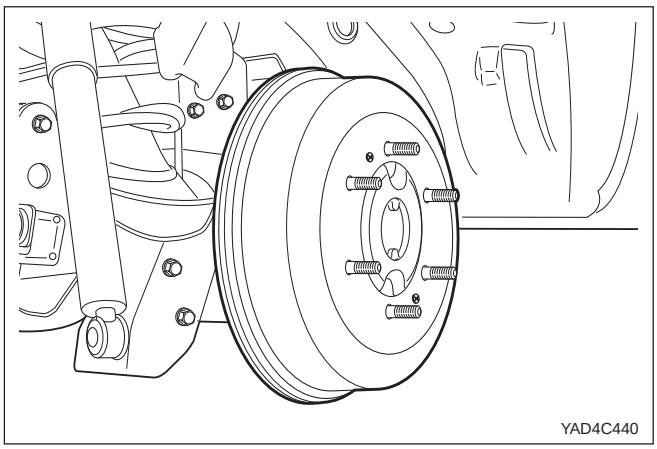
2. Install both brake linings between the wheel cylinder and the bottom anchor plate. And then install adjuster and each return spring.



3. Connect the parking cable.



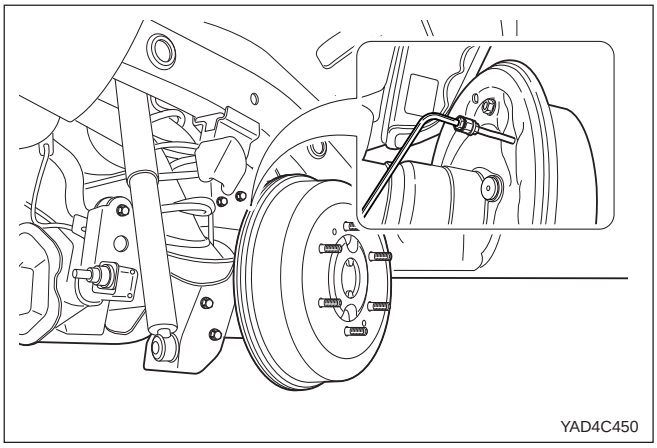
4. The outside diameter of the lining set to ϕ 253.08 - ϕ 253.50 mm by rotating the adjuster screw.



5. Install the plate and drum to the axle shaft sequently.
6. Check that the brake drum is rotated properly by hand.

   Notice: Adjust the adjuster screw as needed.

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YAD4C450

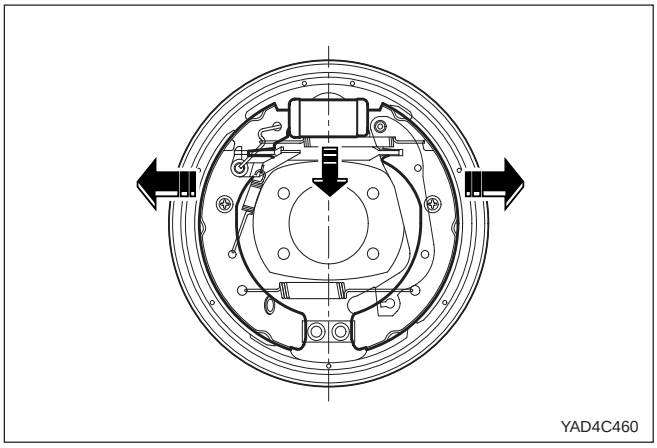
7. Connect the brake pipe to the wheel cylinder.

Installation Notice

Tightening Torque	15 - 19 N•m (11 - 14 lb-ft)

8. Bleed the brake system and verify the parking brake operation.
   Install the tire.

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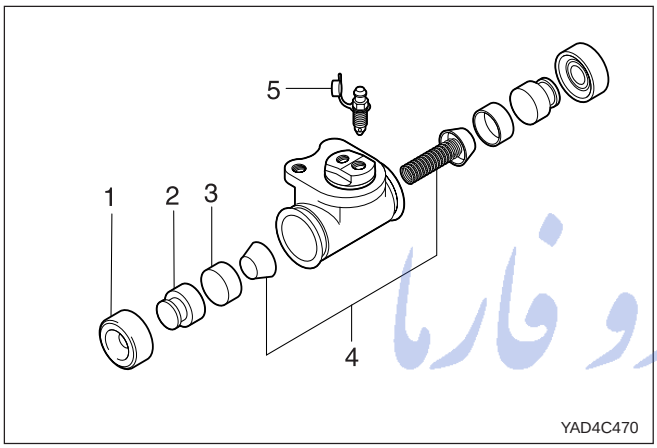

YAD4C460

UNIT REPAIR

WHEEL CYLINDER

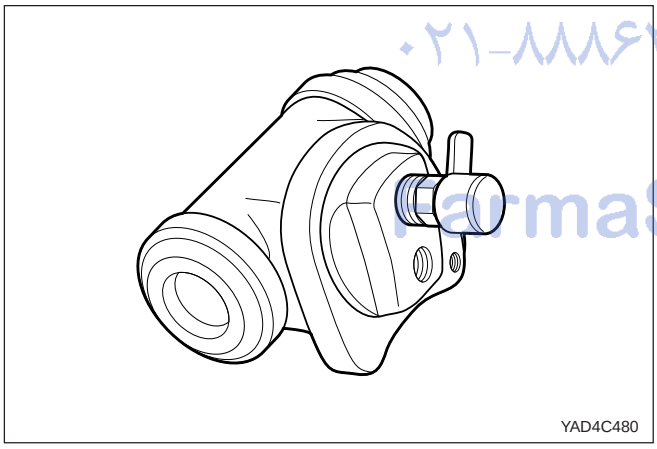
Disassembly Procedure

1. Remove the upper brake return spring and remove the wheel cylinder with pulling the upper lining outside.



YAD4C470

2. Disassembly the wheel cylinder assembly.
   - Remove the dust boot and do not reuse them (1).
   - Remove the piston (2).
   - Remove the piston cup and do not reuse it (3).
   - Remove the spring assembly (4).
   - Remove the bleeder screw (5).
3. Clean all the parts with the denatured alcohol. Dry the parts with unlubricated compressed air.

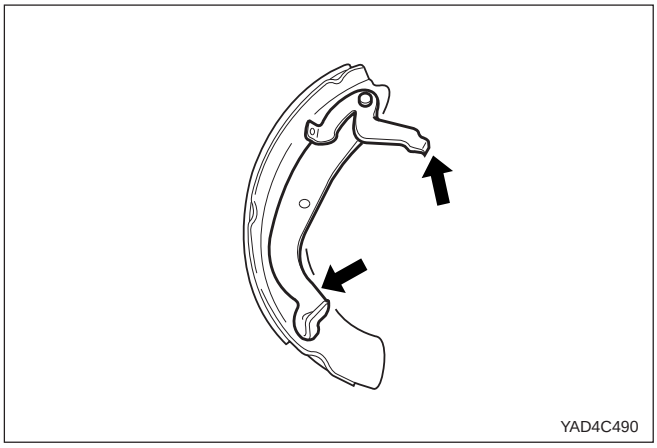

YAD4C480

4. Installation should follow the removal procedure in the reverse order.
5. Tighten the bleeder screw and wheel cylinder as specified torque.

Bleeder Screw	7 - 10 N•m (62 - 89 lb-in)
Wheel Cylinder Mounting Bolt	8 - 12 N•m (71 - 106 lb-in)

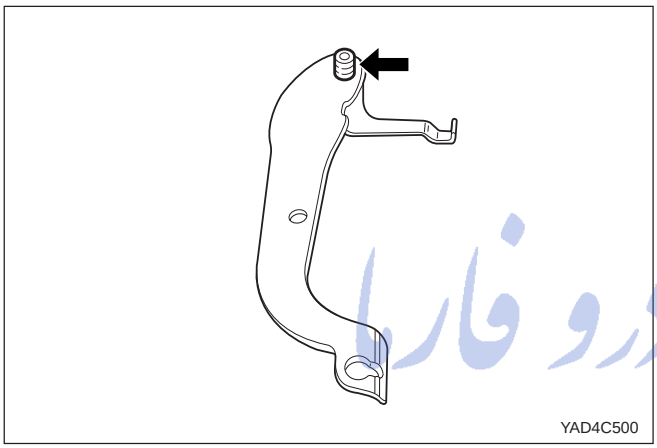
Notice: Lubricate the new seals, the piston, the piston cup and the wheel cylinder bore with clean brake fluid before assembly.

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YAD4C490

PARKING BRAKE LEVER

1. Disconnect the parking brake lever and the adjuster lever from the lining.


YAD4C500

2. Pull out the lever pin (arrow) and Disconnect the the parking brake lever and the adjuster lever.
3. Installation should follow the removal procedure in the reverse order.

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SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Brake Hose Bolt	19	14	-
Caliper Guide Bolt	27	20	-
Caliper Mounting Bolts	95	70	-
Splash Shield-to-Knuckle Bolts	6	-	53

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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SECTION 4F

ANTILOCK BRAKE SYSTEM AND TRACTION CONTROL SYSTEM

TABLE OF CONTENTS

General Description and System Opertion 4F-3

Basic Knowledge Required 4F-3

ABS System Components 4F-3

Traction Control System (TCS) Description 4F-3

EBD System 4F-5

EBD Failure Matrix 4F-6

Tires and ABS/TCS 4F-7

Hydraulic Circuit 4F-8

ABS 5.3 ..... 4F-8

ABS/TCS 5.3 ..... 4F-11

Component Locator 4F-14

ABS, ABS/TCS 5.3 ..... 4F-14

Diagnosis 4F-15

Diagnostic Circuit Check 4F-15

ABS Indicator Lamp Inoperative 4F-18

Traction Control System (TCS) Indicator Lamp Inoperative 4F-22

EBD Indicator Lamp Inoperative 4F-26

Power Supply to Control Module, No DTCs Stored 4F-30

ABS Indicator Lamp Illuminated Continuously, No DTCs Stored 4F-34

Self-Diagnostics 4F-36

Displaying DTCs 4F-36

Clearing DTCs 4F-36

Intermittents and Poor Connections 4F-36

DTC 03 - Left Front Wheel Speed Sensor Fault ... 4F-38

DTC 07 - Left Front Wheel Speed Sensor Continuity Fault 4F-40

DTC 04 - Right Front Wheel Speed Sensor Fault 4F-42

DTC 08 - Right Front Wheel Speed Sensor Continuity Fault 4F-44

DTC 05 - Left Rear Wheel Speed Sensor Fault 4F-46

DTC 09 - Left Rear Wheel Speed Sensor Continuity Fault 4F-48

DTC 06 - Right Rear Wheel Speed Sensor Fault . 4F-50

DTC 10 - Right Rear Wheel Speed Sensor Continuity Fault 4F-52

DTC 11 - Wheel Speed Sensor Frequency Error .. 4F-54

DTC 42 - Acceleration Sensor Fault 4F-58

DTC 43 - Acceleration Sensor Continuity Fault 4F-60

DTC 13/14 - Left Front Inlet and Outlet Valve Solenoid Fault 4F-62

DTC 15/16 - Right Front Inlet and Outlet Valve Solenoid Fault 4F-64

DTC 17/18 - Left Rear Inlet and Outlet Valve Solenoid Fault 4F-66

DTC 19/20 - Right Rear Inlet and Outlet Valve Solenoid Fault 4F-68

DTC 21/22 - Left Rear Prime Line and Traction Control System (TCS) Pilot Valve Fault 4F-70

DTC 23/24 - Right Rear Prime Line and Traction Control System (TCS) Pilot Valve Fault 4F-72

DTC 12 - Valve Relay Circuit Fault 4F-74

DTC 24 - Pump Motor or Pump Motor Relay Fault 4E-76

DTC 27 - Stoplamp Switch Fault 4E-80

DTC 28 - Low Voltage Fault 4E-84

DTC 02 - ABS Control Module Internal Fault 4E-88

Scheatic and Routing Diagrams 4E-90

ABS Circuit (Without TCS): Gasoline 4E-90

ABS/TCS Circuit: Gasoline 4E-91

ABS/ABD (Automatic Brake Differential Lock): Diesel 4E-93

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۰۲۱-۸۸۸۲۰۸۵
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EBCM Connection Fact View 4E-95
EBCM Connector 4E-95
Hydraulic Modulator Connector 4E-96
Repair Instructions 4E-99
On-Vehicle Service 4E-99
Service Precautions 4E-99
ABS 5.3 Assembly 4E-100
ABS/TCS Unit 4E-100
Front Wheel Speed Sensor 4E-101
Rear Wheel Speed Sensor 4E-101
Acceleration Sensor 4E-102
System Fuse 4E-102
Indicators 4E-102
Unit Repair 4E-103
ABS Front Tooth Wheel 4E-103
Special Tools and Equipment 4E-104
Special Tools Table 4E-104

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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GENERAL DESCRIPTION AND SYSTEM OPERATION

BASIC KNOWLEDGE REQUIRED

Before using this section, it is important that you have a basic knowledge of the following items. Without this knowledge, it will be difficult to use the diagnostic procedures contained in this section.

- **Basic Electrical Circuits** - You should understand the basic theory of electricity and know the meaning of voltage, current (amps), and resistance (ohms). You should understand what happens in a circuit with an open or shorted wire. You should be able to read and understand a wiring diagram.
- **Use of Circuit Testing Tools** - You should know how to use a test light and how to bypass components to test circuits using fused jumper wires. You should be familiar with a digital multimeter. You should be able to measure voltage, resistance, and current, and be familiar with the controls and how to use them correctly.

ABS SYSTEM COMPONENTS

The ABS 5.3 Antilock Braking System (ABS) consists of a conventional hydraulic brake system plus antilock components. The conventional brake system includes a vacuum booster, master cylinder, front disc brakes, rear disc brakes, interconnecting hydraulic brake pipes and hoses, brake fluid level switch and the BRAKE indicator.

The ABS components include a hydraulic unit, an electronic brake control module (EBCM), two system fuses,

four wheel speed sensors (one at each wheel), interconnecting wiring, the ABS indicator, the EBD indicator and the TCS indicator. See “ABS Component Locator” in this section for the general layout of this system.

The hydraulic unit with the attached EBCM is located between the surge tank and the bulkhead on the left side of the vehicle.

The basic hydraulic unit configuration consists of hydraulic check valves, two solenoid valves for each wheel, a hydraulic pump, and two accumulators. The hydraulic unit controls hydraulic pressure to the front calipers and rear calipers by modulating hydraulic pressure to prevent wheel lockup.

Units equipped with TCS add two more valves for each drive wheel for the purpose of applying the brake to a wheel that is slipping. This is done with pressure from the hydraulic pump in the unit. There is also a TCS indicator lamp on the instrument panel to alert the driver to the fact that the TCS system is active. The components identified in the drawing are those added to the basic ABS 5.3 system to provide traction control.

Nothing in the hydraulic unit or the EBCM is serviceable.

In the event of any failure, the entire ABS unit with attached EBCM must be replaced. For more information, refer to “Base Braking Mode” and “Antilock Braking Mode” in this section.

TRACTION CONTROL SYSTEM (TCS) DESCRIPTION

General Information

The traction control system (TCS) is a traction system by means of brake intervention only, available in a low speed range (< 60kph).

It workes on µ - split roads with sidewise different friction coefficients.

The spinning driven wheel is braked and the drive torque can be transferred to the wheel on the high-µ side. During TCS active, the TCS information lamp is blinking.

The temperature of the brakes is calculated by a mathematical model and TCS is switched passive if the calculated temperature is greater than a threshold value (500 °C).

TCS is permitted again, when the calculated temperature is less than 350 °C.

Control Algorithm

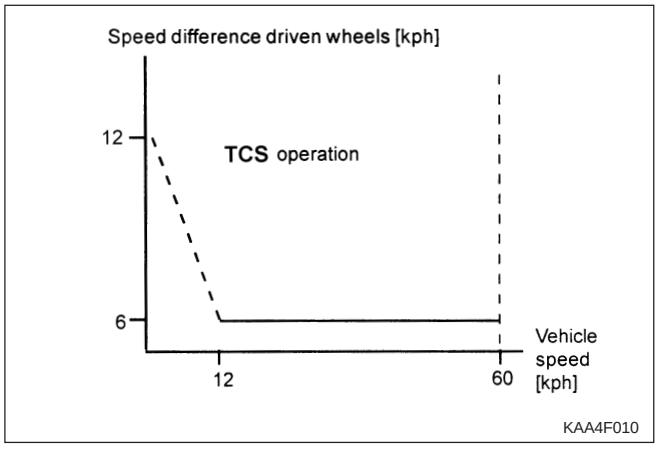
The input signals for the control algorithm are the filtered wheel speed signals from the ABS speed processing.

With the speed difference of the driven wheels, the control deviation is calculated.

If the control deviation exceeds a certain threshold value, the wheel with the greater slip is braked actively.

The threshold value depends on the vehicle speed:

It is reduced with increasing vehicle speed down to a constant value.



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Pressure Modulation

Depending on the control deviation and the wheel acceleration of the spinning wheel, pressure increase, hold and decrease are made.

The pressure modulation is done with the conventional control with the valves. Prime valve, pilot valve, inlet valve and outlet valve according to the following table:

	Increase	Hold	Decrease
Prime Valve	Open	Open	Open
Pilot Valve	Closed	Closed	Closed
Inlet Valve	Open	Closed	Closed
Outlet Valve	Closed	Closed	Open

Speed Range

TCS is available in the speed range ≤ 60 kph.

Above 60 kph vehicle speed, TCS is passive.

It is possible to initiate TCS operation up to a vehicle speed of 55 kph.

Temperature Model

TCS operation is a high thermal load for the brakes.

To avoid any damages at the brakes, the disk temperature is calculated with a mathematical model for each driven wheel separately. After ignition on, the calculation starts with 30°C and then three different phases are evaluated separately and added:

TCS operation, braking and coling phase.

If the temperature is highter than 500°C, TCS is disabled for this wheel.

It is permitted again, if the model has calculated down the 350°C.

Lamp Concepts

The system is equipped with an TCS information lamp, which is blinking during TCS operation.

The activation of the EBD, TCS warning lamp and the TCS info lamp issummarized in thefollowing table:

	Ignition ON	ABS Operation	TCS Operation	System Failure (EBD, ABS or TCS are Not Distinguished)	TCS Passive Due to Temperature Model
ABS Warning Lamp	2 second on for lamp check	OFF	OFF	ON	OFF
TCS Info Lamp	2 second on for lamp check	OFF	Blinking (FLASHING)	OFF	ON
EBD Warning Lamp	2 second on for lamp check	EBD operation/OFF	OFF	ON	OFF

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EBD (ELECTRONIC BRAKE FORCE DISTRIBUTION) SYSTEM

System Description

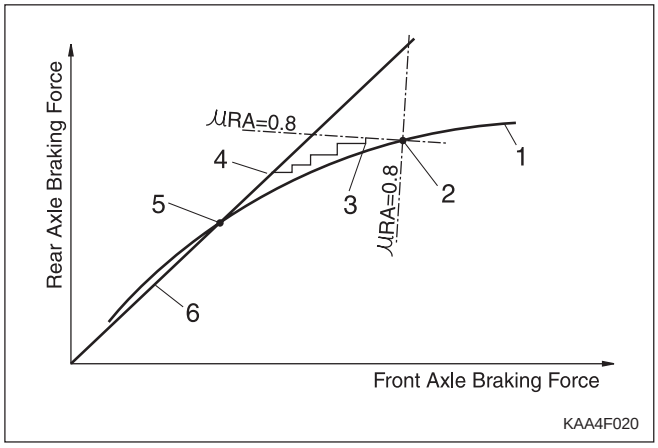
As an add-on logic to the ABS base algorithm, EBD works in a range in which the intervention thresholds for ABS control are not reached yet.

EBD ensures that the rear wheels are sensitively monitored for slip with respect to the front axle. If slip is detected, the inlet valves for the rear wheels are switched to pressure hold to prevent a further increase in pressure at the rear-wheel breaks, thus electronically reproducing a pressure-reduction function at the rear-wheel brakes.

ABS features an enhanced algorithm which includes control of the brake force distribution between the front and rear axles. This is called Electronic Brake Distribution. In an unloading car condition the brake efficiency is comparable to the conventional system but for a fully loaden vehicle the efficiency of the EBD system is higher due to the better use of rear axle braking capability.

The Benefits of EBD

- Elimination of conventional proportioning valve EBD utilizes the existing rear axle wheel speed sensor to monitor rear wheel slip.
- Based on many variables in algorithm a pressure hold, increase and/or decrease pulsetrain may be triggered at the rear wheels insuring vehicle stability.
- Vehicle approaches the ideal brake force distribution (front to rear).
- Constant brake force distribution during vehicle lifetime.
- EBD function is monitored via ABS safety logic (conventional proportioning valves are not monitorable).
- “Keep alive” function.



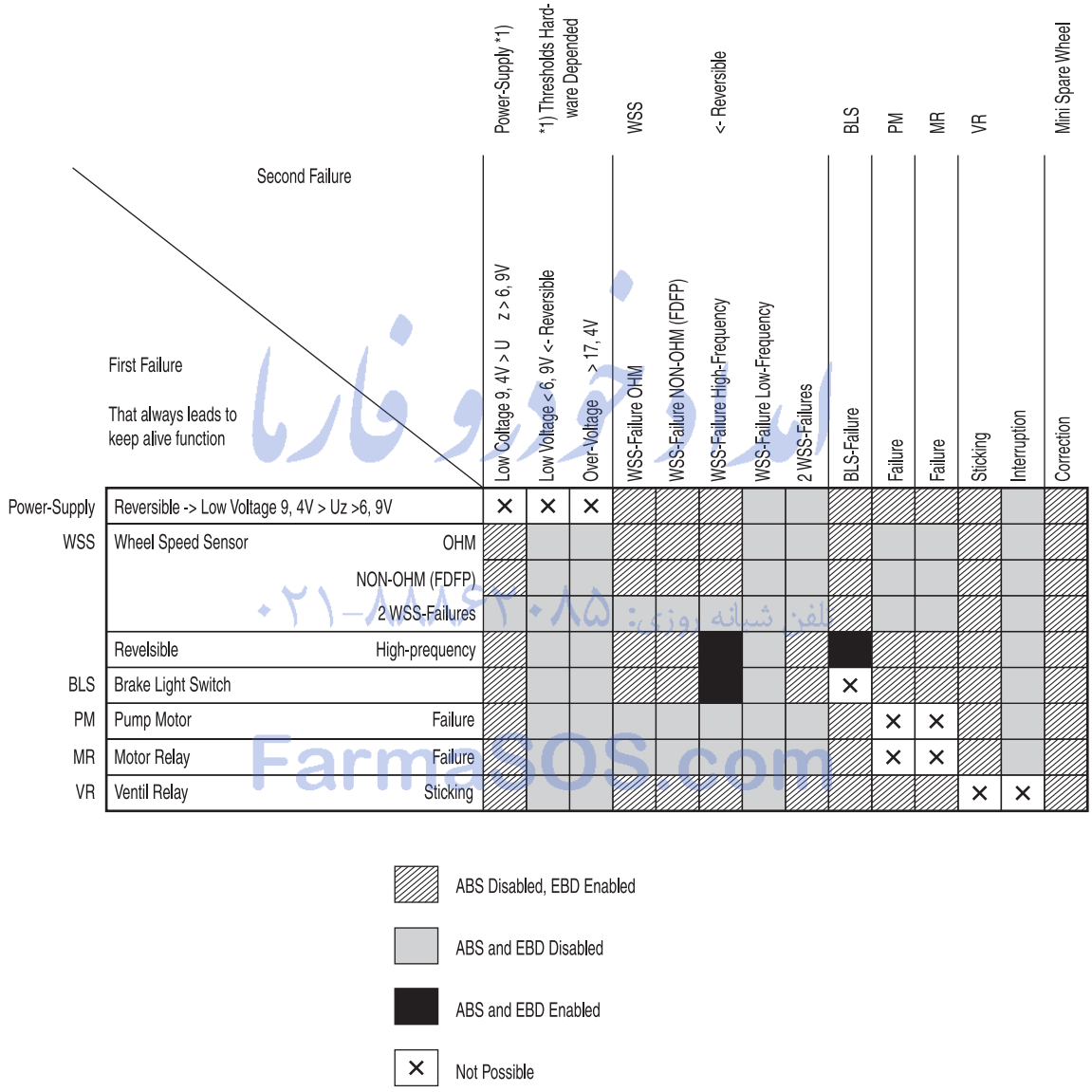
Service Precautions

Observe the following general precautions during any ABS/TCS service. Failure to adhere to these precautions may result in ABS/TCS system damage.

1. Disconnect the EBCM harness connector before performing the electric welding procedures.
2. Carefully note the routing of the ABS/TCS wiring and wring components during removal. The ABS/TCS components are extremely sensitive to EMI (eletromagnetic interference). Proper mounting is critical during component service.
3. Disconnect the EBCM connector with the ignition OFF.
4. Do not hang the suspension components from the wheel speed sensor cables. The cables may be damaged.
5. Do not use petroleum based fluids in the master cylinder. Do not use any containers previously used for petroleum based fluids. Petroleum causes swelling and distortion of the rubber components in the hydraulic brake system, resulting in water entering the system and lowering the fluid boiling point.

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EBD (Electronic Brake-Force Distribution) FAILURE MATRIX



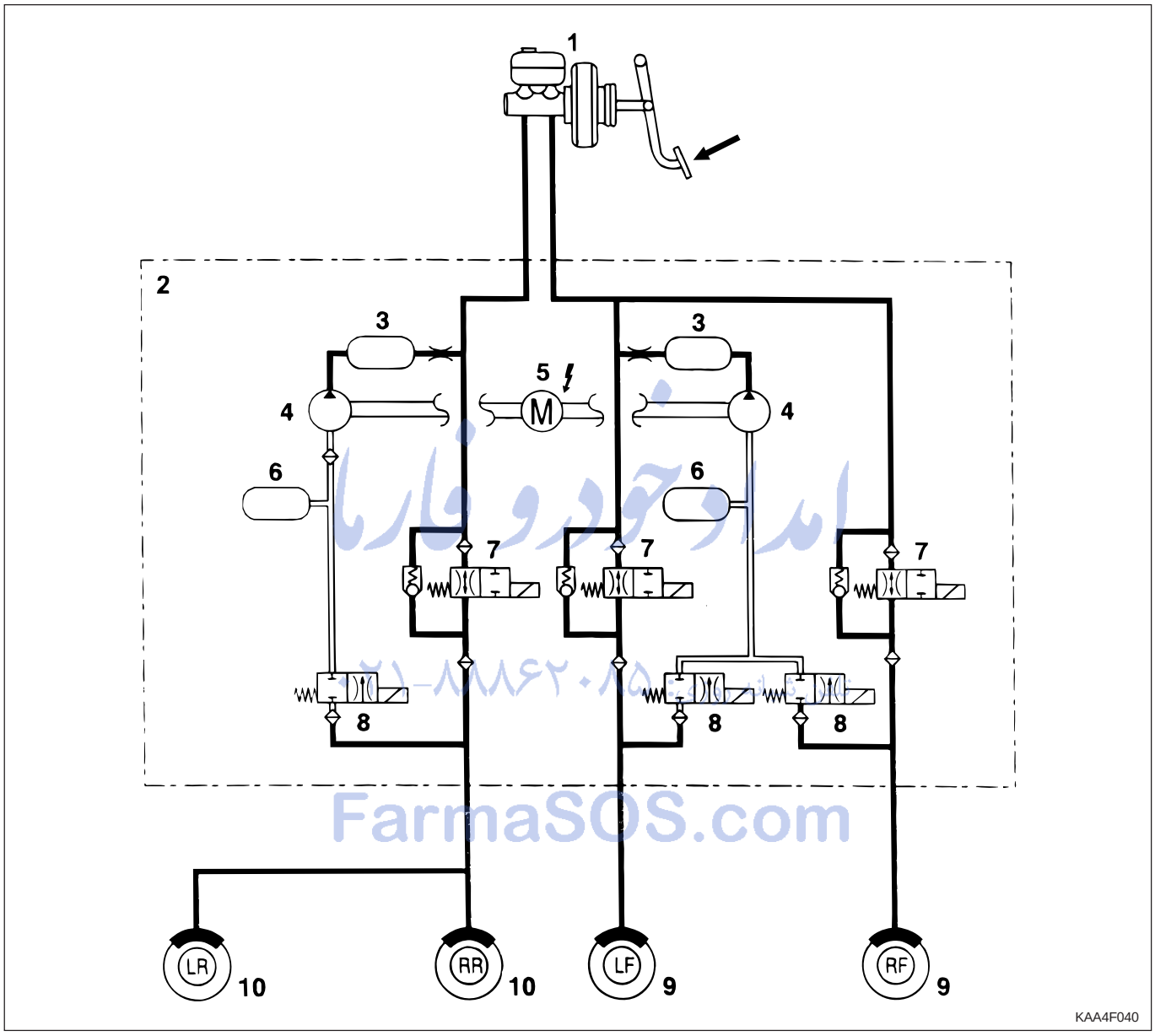
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HYDRAULIC CIRCUIT

ABS 5.3

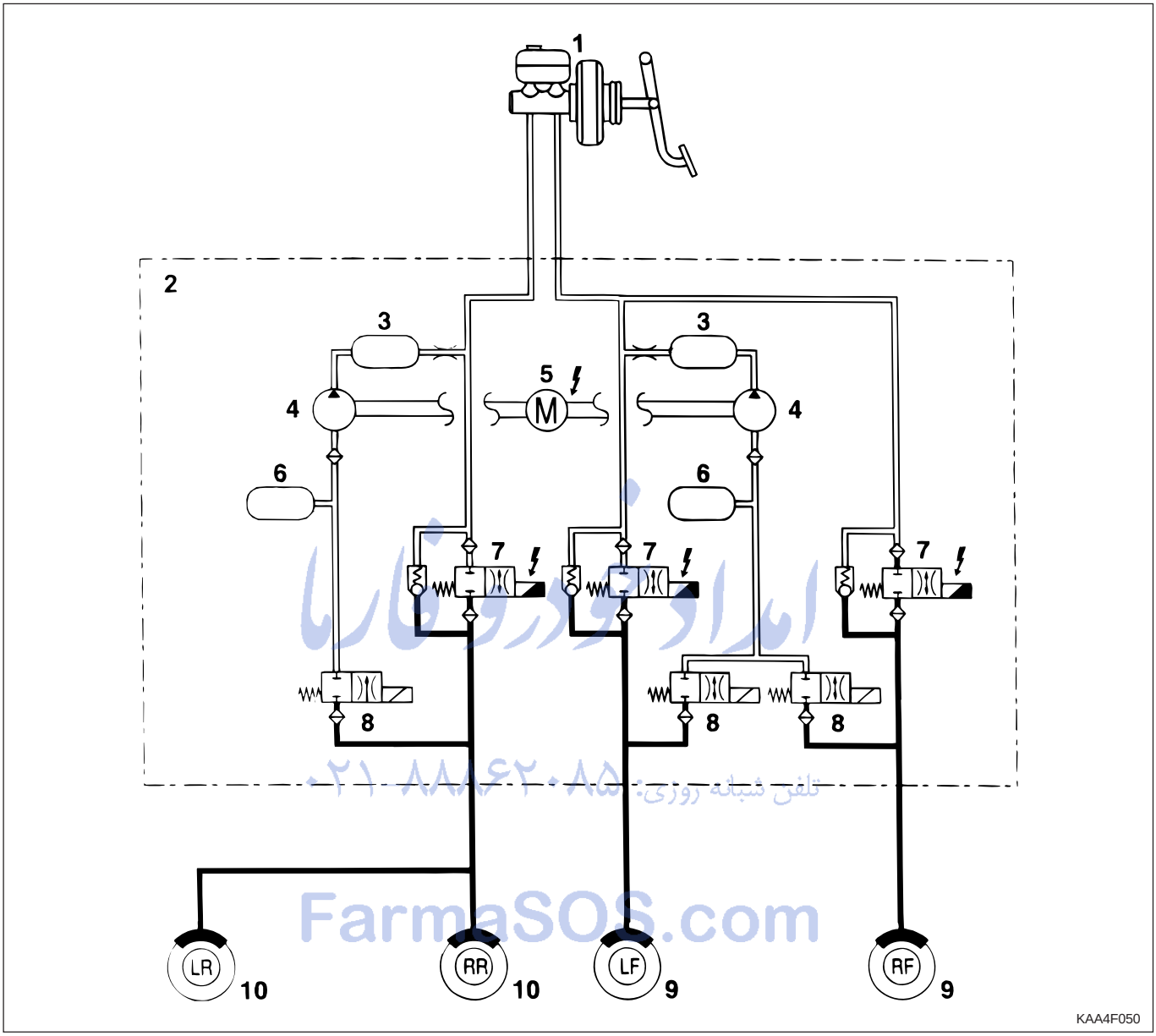
Pressure Increased



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1 Master Cylinder
2 Hydraulic Modulator
3 Damper
4 Pump
5 Pump Motor
6 Accumulator
7 Inlet Valve for Each Wheel
8 Outlet Valve for Each Wheel
9 Front Wheel
10 Rear Wheel

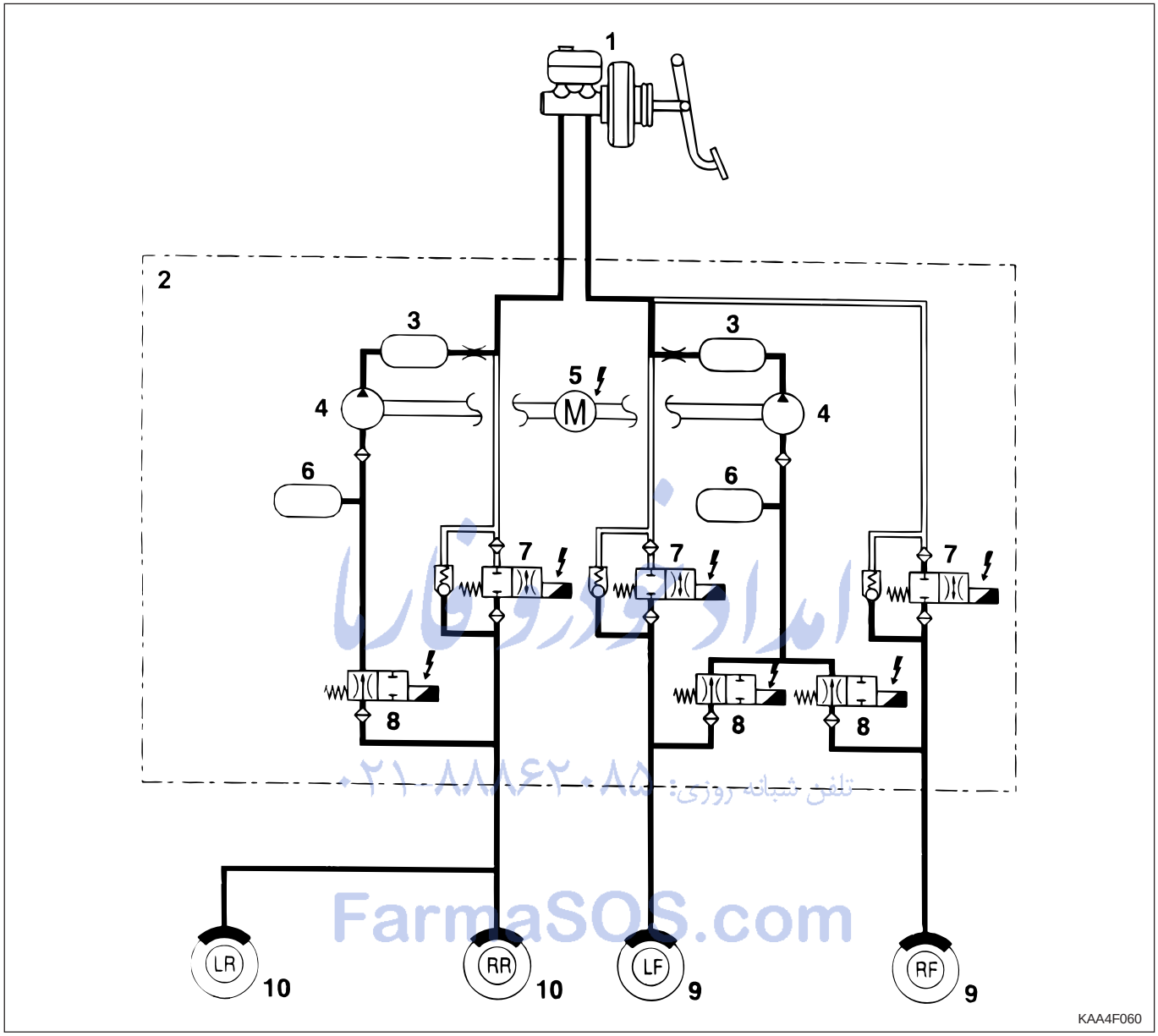
Pressure Maintained



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1 Master Cylinder
2 Hydraulic Modulator
3 Damper
4 Pump
5 Pump Motor
6 Accumulator
7 Inlet Valve for Each Wheel
8 Outlet Valve for Each Wheel
9 Front Wheel
10 Rear Wheel

Pressure Maintained

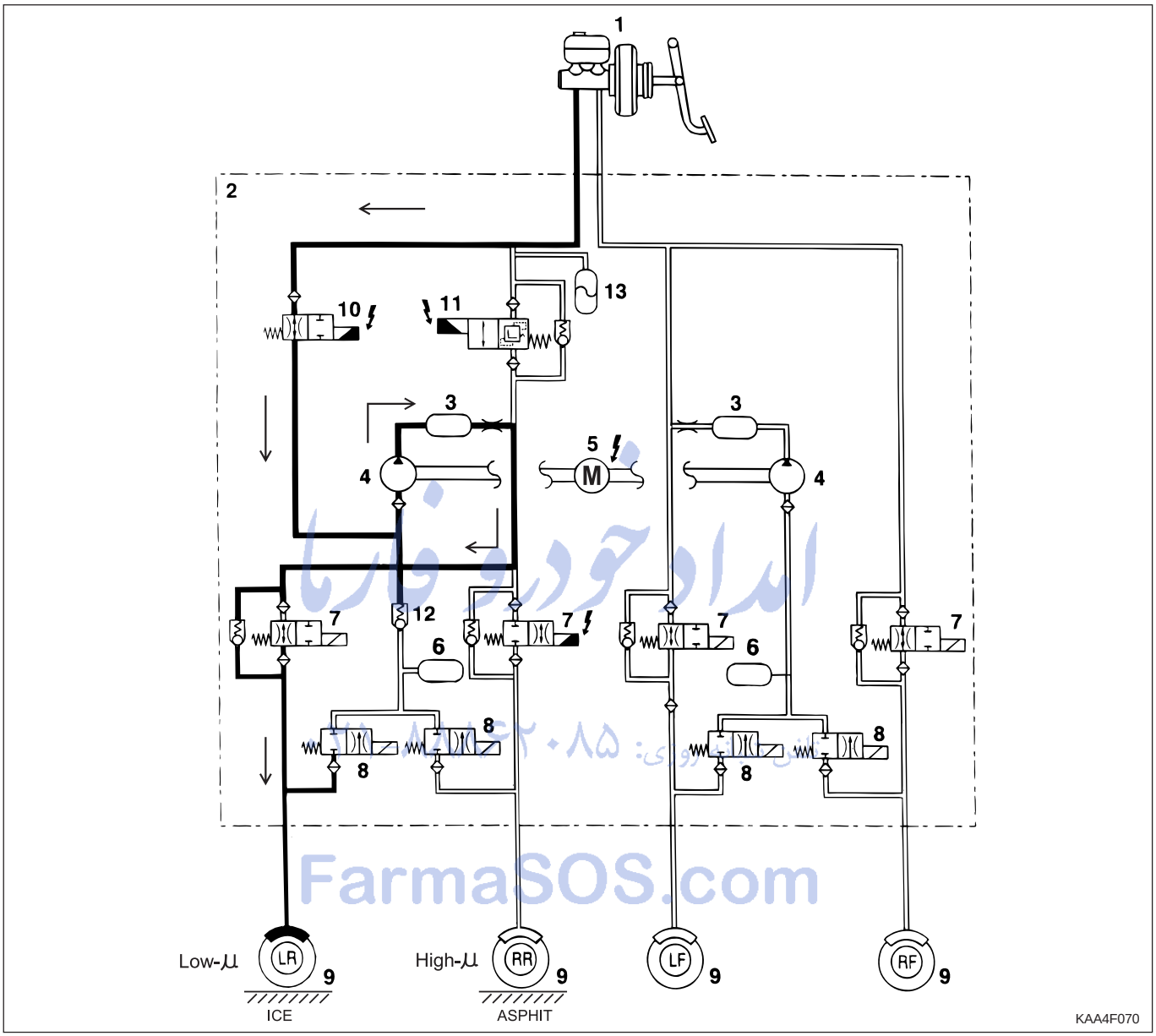


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1 Master Cylinder
2 Hydraulic Modulator
3 Damper
4 Pump
5 Pump Motor
6 Accumulator
7 Inlet Valve for Each Wheel
8 Outlet Valve for Each Wheel
9 Front Wheel
10 Rear Wheel

ABS/TCS 5.3

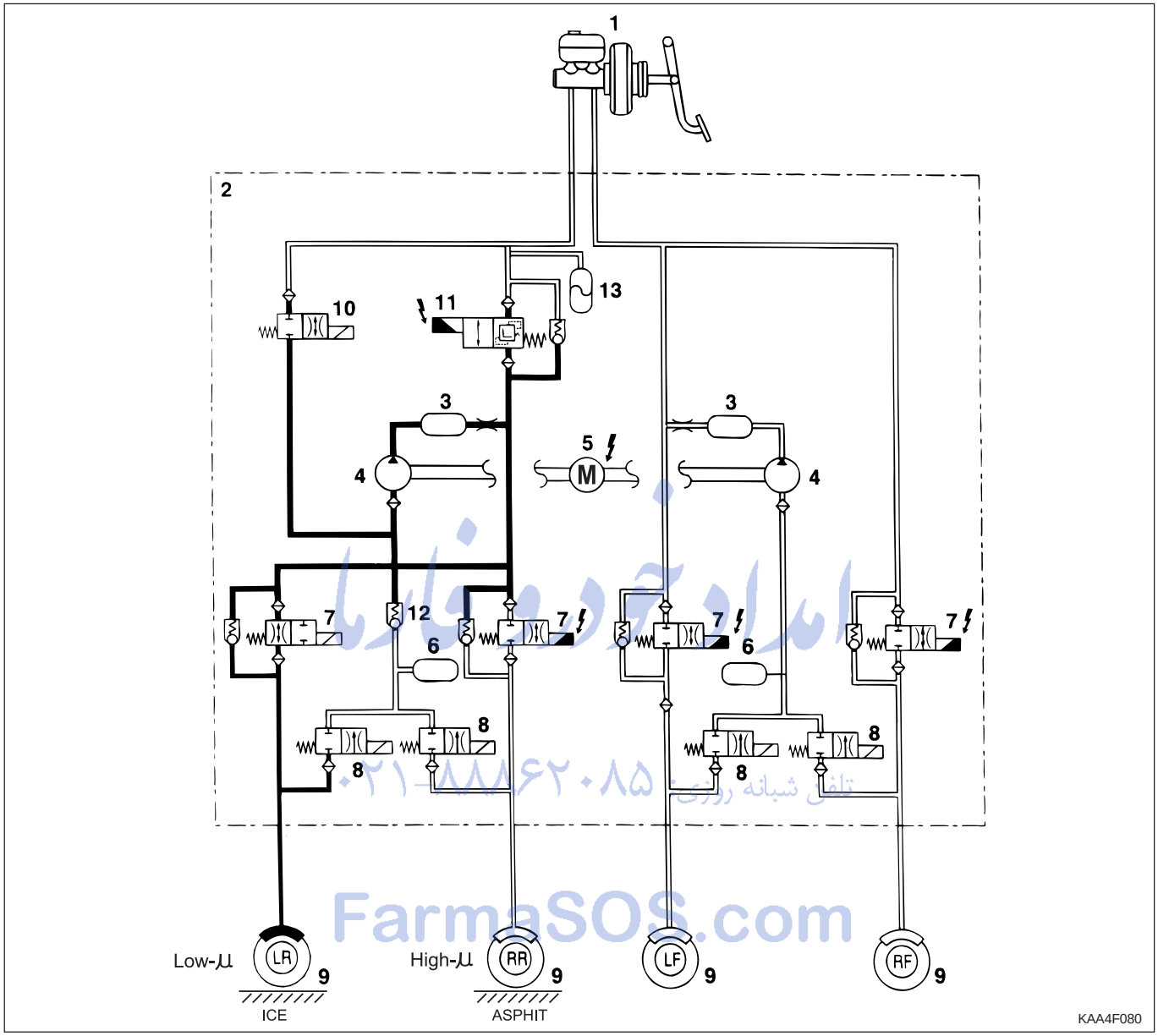
Pressure Increased



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1 Master Cylinder
2 Hydraulic Modulator
3 Damper
4 Pump
5 Pump Motor
6 Accumulator
7 Inlet Valve for Each Wheel
8 Outlet Valve for Each Wheel
9 Wheel
10 Prime Valve
11 Pilot Valve
12 Check Valve
13 ISD (Integrated Suction Damper)

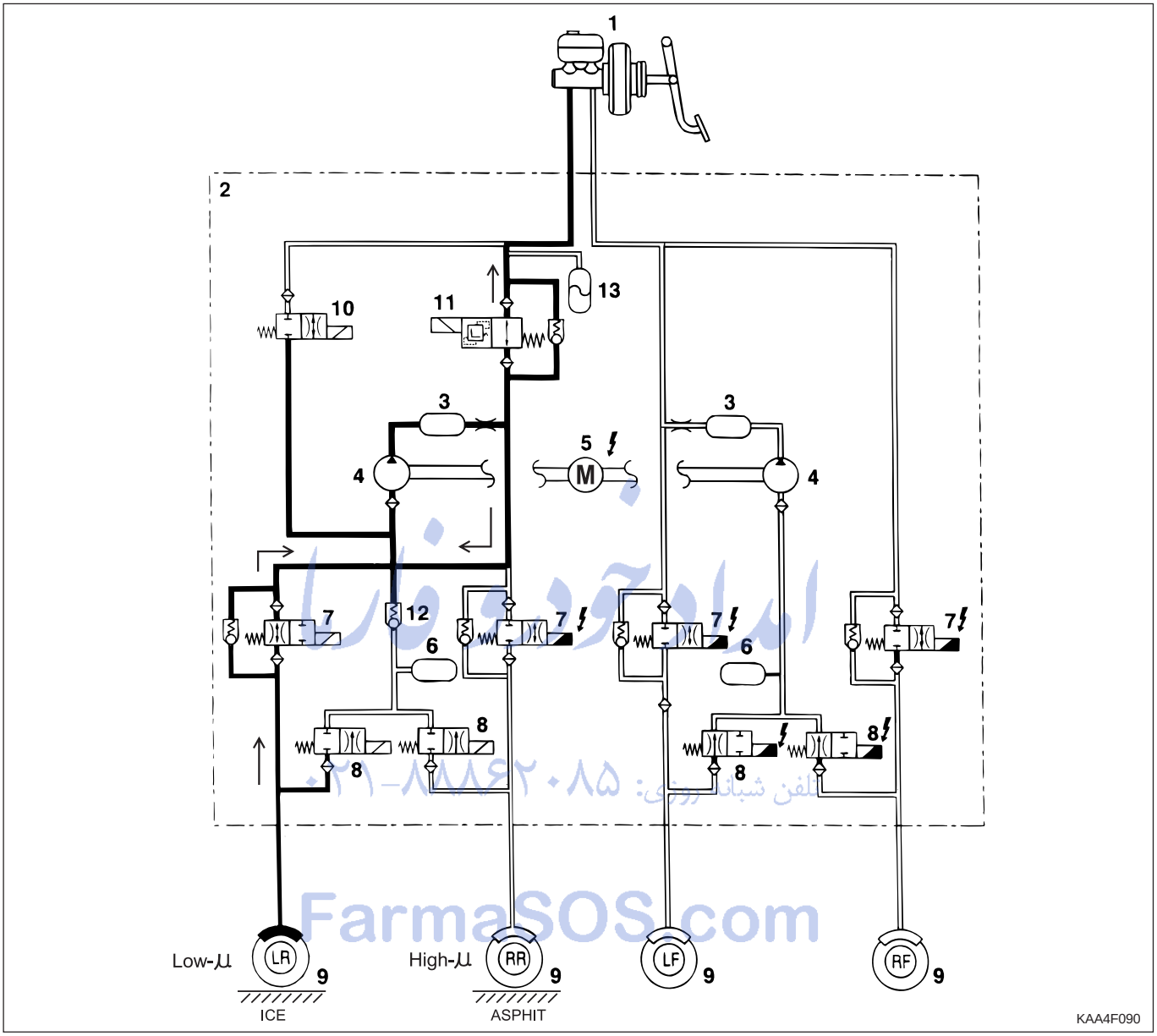
Pressure Maintained



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1 Master Cylinder
2 Hydraulic Modulator
3 Damper
4 Pump
5 Pump Motor
6 Accumulator
7 Inlet Valve for Each Wheel
8 Outlet Valve for Each Wheel
9 Wheel
10 Prime Valve
11 Pilot Valve
12 Check Valve
13 ISD (Integrated Suction Damper)

Pressure Decreased

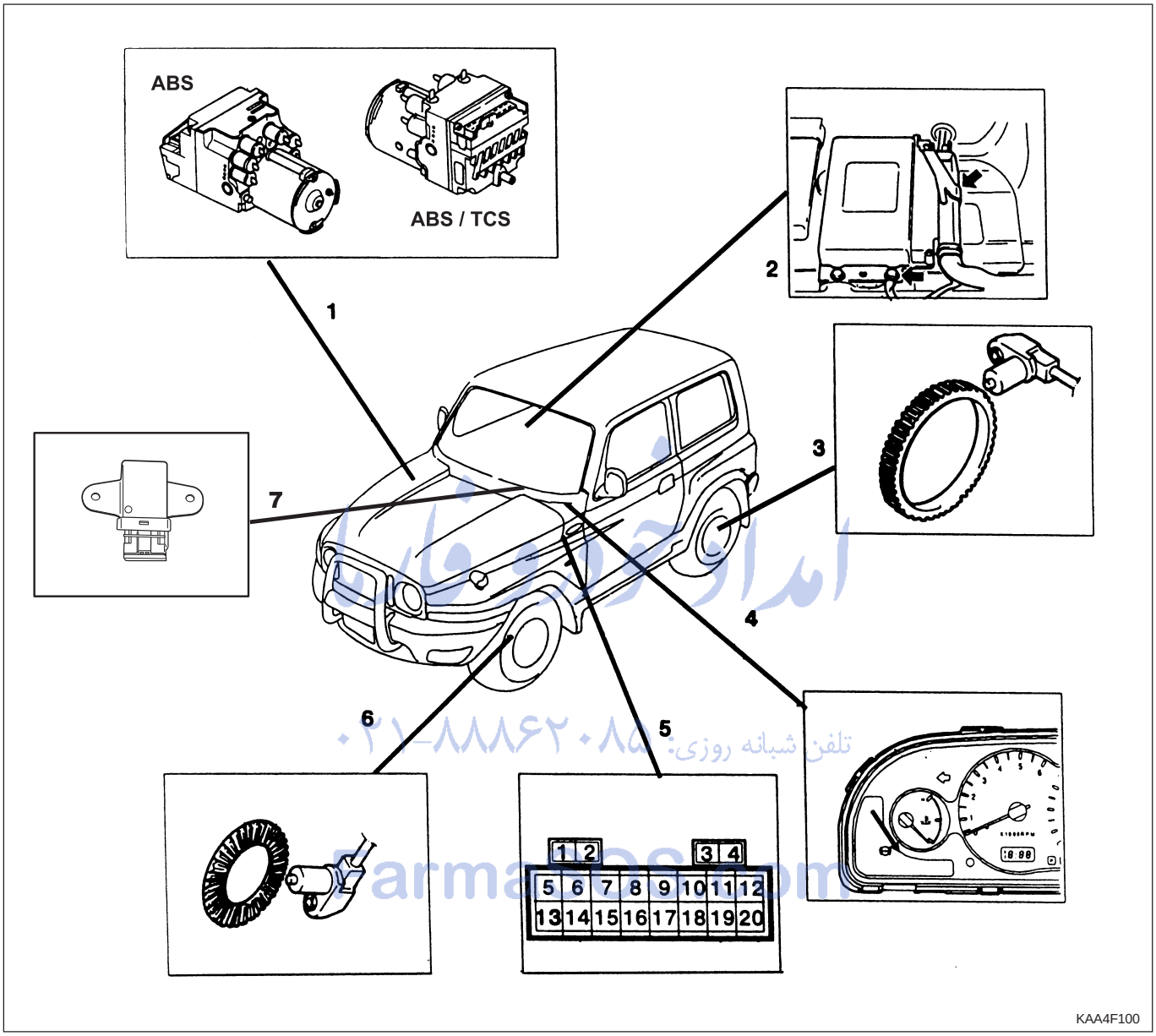


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1 Master Cylinder
2 Hydraulic Modulator
3 Damper
4 Pump
5 Pump Motor
6 Accumulator
7 Inlet Valve for Each Wheel
8 Outlet Valve for Each Wheel
9 Wheel
10 Prime Valve
11 Pilot Valve
12 Check Valve
13 ISD (Integrated Suction Damper)

COMPONENT LOCATOR

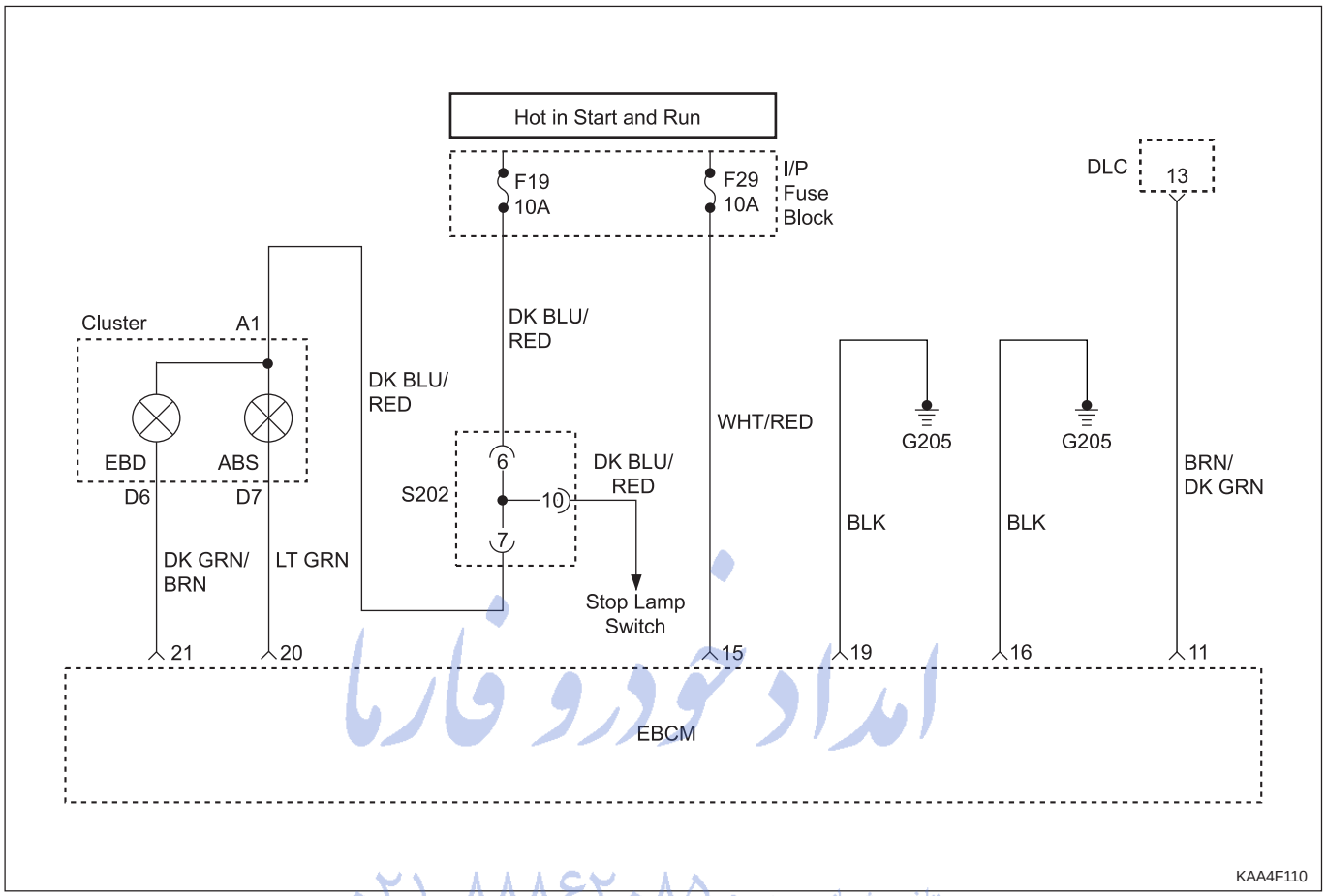
ABS, ABS/TCS 5.3



1 ABS/TCS Hydraulic Unit (with EBCM in case of ABS only)
2 ABS/TCS EBCM Unit (in case of TCS)
3 Rear Wheel Speed Sensor
4 ABS Warning Indicator Light
5 Diagnosis Connector
6 Front Wheel Speed Sensor
7 Acceleration Sensor

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DIAGNOSIS



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DIAGNOSTIC CIRCUIT CHECK

The Diagnostic Circuit Check is an organized approach to identifying a problem created by an antilock brake system (ABS) malfunction. If must be the starting point for any ABS complaint diagnosis because it directs the service technician to the next logical step in diagnosing the complaint.

Diagnostic Process

Perform the following steps in order when servicing the ABS/TCS system. Failure to do so may result in the loss of important diagnostic data and may lead to difficulties and time-consuming diagnosis procedures.

1. Perform the tests of the table below.
2. Perform a road test if directed by the table.
   - Test drive the vehicle while using the snapshot feature of the scan tool.
   - Perform normal acceleration, stopping, and turning maneuvers.
   - If this does not reproduce the malfunction, perform an ABS stop or TCS maneuver on a low friction surface such as gravel.
3. Clear the diagnostic trouble codes (DTCs) after all system malfunctions have been corrected.

Diagnostic Circuit Check

Step	Action	Value(s)	Yes	No
1	1. Install the scan tool. 2. Turn ignition switch to ON. 3. Select the Data List mode. Is the scan tool receiving data from the electronic brake control module (EBCM)?	-	Go to Step 2	Go to Step 7
2	Check the display. Are there any current DTCs displayed?	-	Refer to the applicable DTC table	Go to Step 3
3	1. Turn the ignition to LOCK for 10 seconds. 2. Turn the ignition to ON and observe the ABS indicator. Does the indicator light for 2 seconds and then go off?	-	Go to Step 5	Go to Step 4
4	Check the ABS indicator. Did the ABS indicator turn on and stay on?	-	Go to “ABS Indicator Lamp Illuminated Constantly”	Go to “ABS Indicator Lamp Inoperative
5	Check whether the vehicle is equipped with traction control. Is the vehicle equipped with traction control?	-	Go to Step 6	Go to Step 13
6	1. Turn the ignition to LOCK for 10 seconds. 2. Turn the ignition to ON and observe the TCS indicator. Does the indicator light for 2 seconds and then go off?	-	Go to Step 13	Go to “Traction Control System Indicator Lamp Inoperative”
7	1. Turn the ignition to LOCK. 2. Disconnect the EBCM harness connector. 3. Turn the ignition to ON. 4. Use a digital voltmeter (DVM) to measure the voltage from ground to terminal 1 and 50 of the EBCM harness connector. Is the voltage equal to the specified value?	11 - 14 v	Go to Step 8	Go to “Power Supply to Control Module, No DTCs Stored
8	1. Turn the ignition to LOCK. 2. Use a DVM to measure the resistance from the EBCM harness connector, terminals 28 and 29 to ground. Is the resistance equal to the specified value?	≈ 0 Ω	Go to Step 10	Go to Step 9
9	Repair the open in the circuit that failed. Is the repair complete?	-	System OK	-
10	Use a DVM to measure the resistance between terminal 46 of the EBCM harness connector and terminal 8 of the data link connector (DLC). Is the resistance below the specified value?	2 Ω	Go to Step 11	Go to Step 12
11	Replace the ABS unit. Is the repair complete?	-	System OK	-
12	Repair the open or high resistance in circuit BrG between terminal 11 of the EBCM harness connector and terminal 13 of the DLC. Is the repair complete?	-	Go to Step 1	-
13	Perform the road test described above. Are any DTCs set?	-	Go to the table for the DTC	System OK

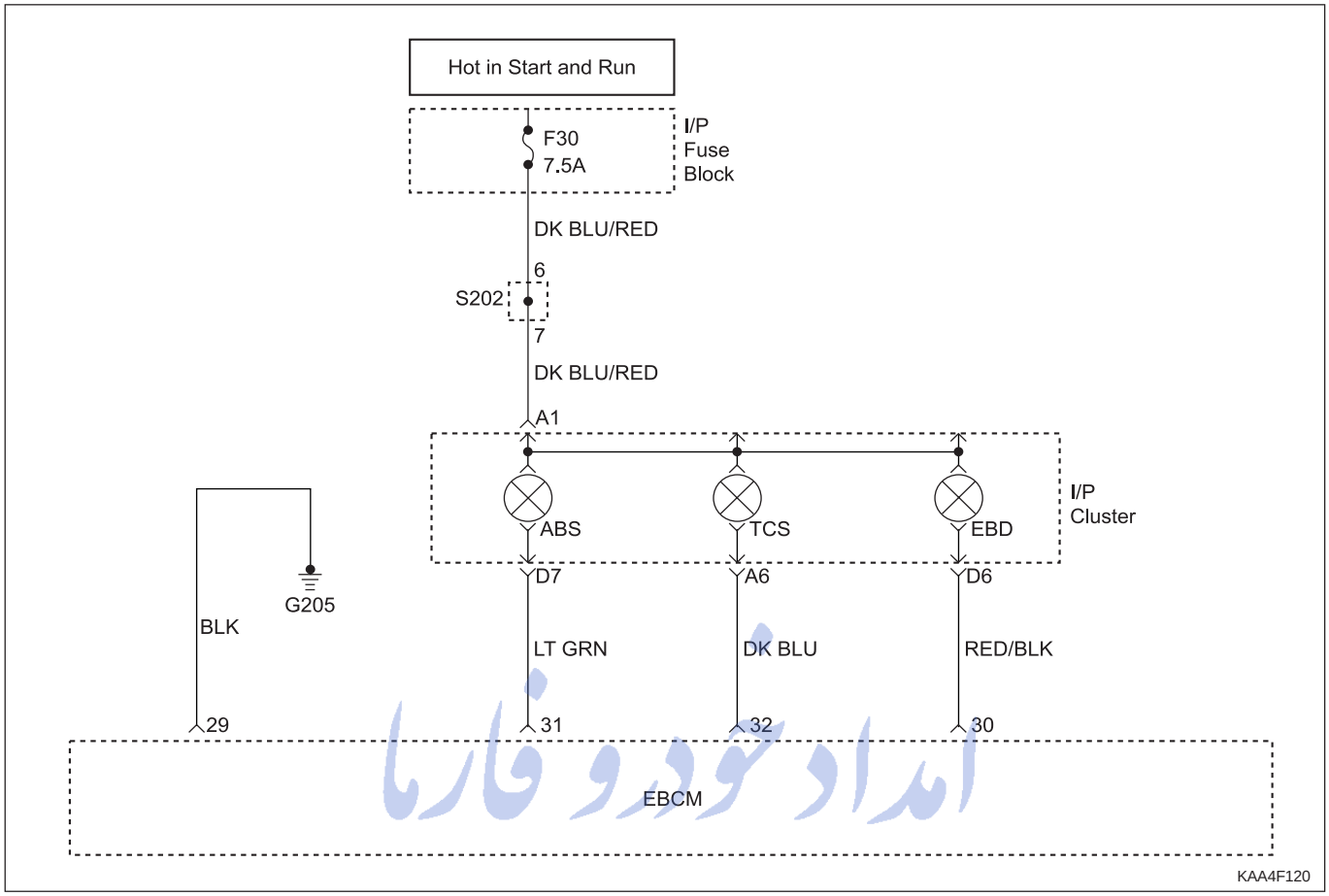
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ABS INDICATOR LAMP INOPERATIVE

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Circuit Description

Battery voltage is supplied to the ABS warning lamp with the ignition switch in the ON or START positions. The warning lamp can be activated only by the ABS control module internally supplying ground to terminal 20 or by the shorting bar in the ABS module connector if the connector is disconnected from the module.

Diagnosis

This procedure checks for a problem in the wiring, a faulty ground, a voltage supply problem, a burned out indicator lamp, or a contact problem in a connector.

Cause(s)

- A fuse has blown.
- The indicator lamp has burned out.
- There is a corroded or broken connector terminal.
- There is a faulty ground connection.
- There is a broken wire in a wiring harness.
- The EBCM is faulty.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This test checks for any DTCs that may cause the ABS indicator lamp to be inoperative.
2. This test verifies an inoperative lamp condition.
3. This test checks for voltage on the lamp circuit.
4. This begins a series of tests of the circuit from the indicator lamp to the EBCM and ground.

19. This begins a series of tests of the voltage supply circuits that power the indicator lamp.

ABS Indicator Lamp Inoperative

Step	Action	Value(s)	Yes	No
1	Install the scan tool and check for any DTCs. Is any DTC set?	-	Go to the chart for the DTC	Go to Step 2
2	1. Turn the ignition to LOCK. 2. Disconnect the scan tool. 3. Turn the ignition to ON. 4. Observe the ABS indicator lamp. Does the lamp illuminate for about 2 seconds, then turn off?	-	Go to “Intermittents and Poo Connections”	Go to Step 3
3	With the ignition still ON, observe the oil pressure lamp. Is the oil pressure lamp illuminated?	-	Go to Step 4	Go to Step 19
4	1. Turn the ignition to LOCK. 2. Disconnect the connector from the electronic brake control module (EBCM). 3. Turn the ignition switch to ON. Does the ABS indicator illuminate?	-	Go to Step 5	Go to Step 8
5	1. Turn the ignition to LOCK. 2. Examine terminals 19 and 31 at the EBCM connector on both the ABS wiring harness and on the EBCM. Is there a poor connection at any of these terminals?	-	Go to Step 6	Go to Step 7
6	Repair the faulty terminals or replace the ABS unit, as required. Is the repair complete?	-	System OK	-
7	Replace the ABS unit. Is the repair complete?	-	System OK	-
8	1. Turn the ignition to LOCK. 2. Disconnect the wire from the negative battery terminal. 3. Measure the resistance between the negative battery wire, which is attached to ground, and the shorting bar in the EBCM connector. Is the resistance equal to the specified value?	≈ 0 Ω	Go to Step 10	Go to Step 9
9	Repair the open or high resistance in the circuit from EBCM connector, terminal 19 to ground G205. Is the repair complete?	-	System OK	-
10	1. Remove the I/P cluster. 2. Remove and check the ABS indicator bulb. Is the bulb burned out?	-	Go to Step 11	Go to Step 12
11	1. Replace the ABS indicator bulb. 2. Install the I/P cluster. Is the repair complete?	-	System OK	-
12	Check the continuity at the I/P cluster connector terminal D7. Is the continuity equal to the specified value?	≈ 0 Ω	Go to Step 14	Go to Step 13
13	Repair the contact at the I/P cluster connector terminal D7. Is the repair complete?	-	System OK	-

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ABS Indicator Lamp Inoperative (Cont'd)

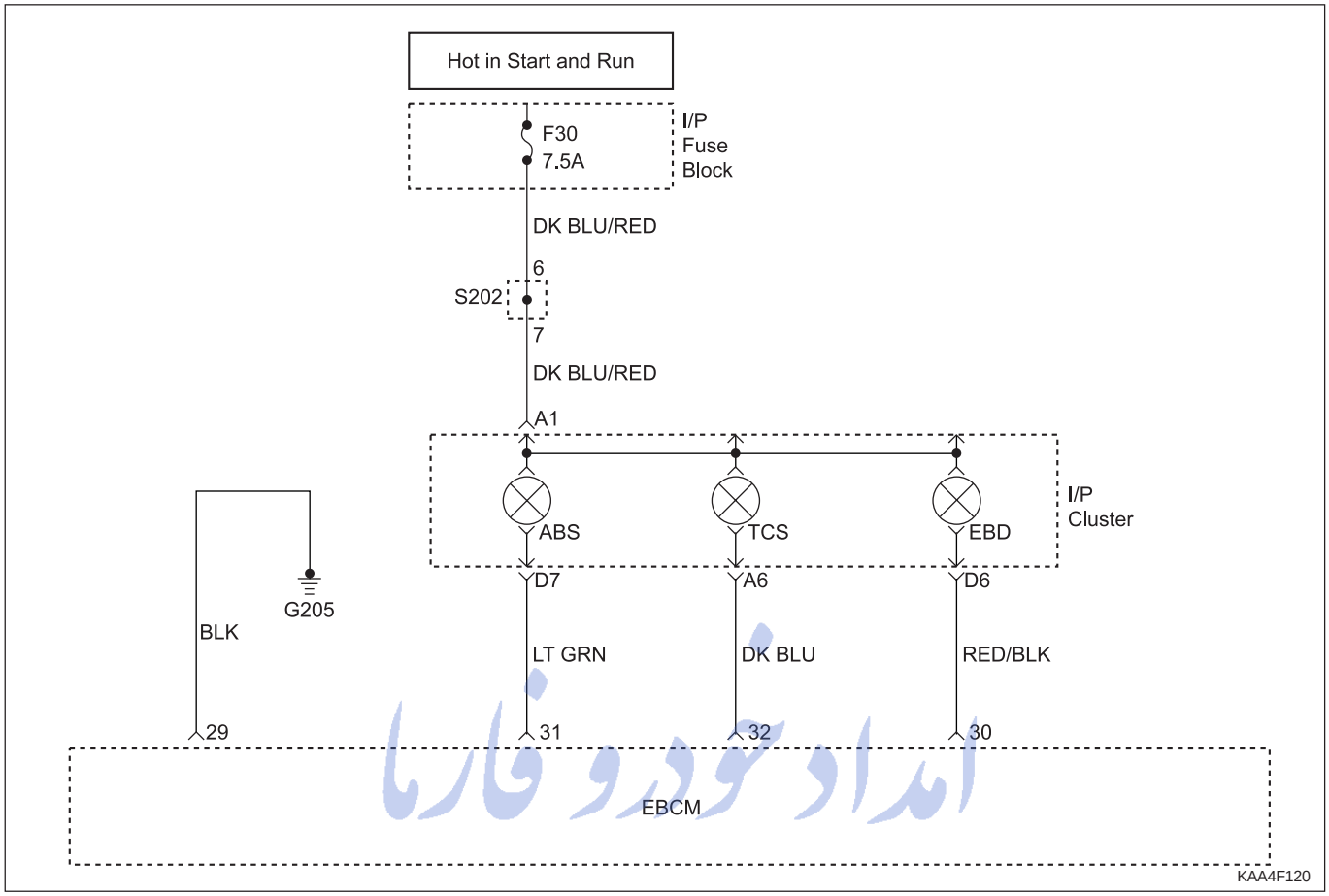
Step	Action	Value(s)	Yes	No
14	Check the wiring harnesses and the connectors in circuit Lg from the I/P cluster terminal D7 to terminal 31 of the EBCM connector. Is the voltage equal to the specified value?	∞	Go to Step 15	Go to Step 16
15	Repair the open or high resistance found. Is the repair complete?	-	System OK	-
16	Check for continuity between terminal 19 of the EBCM connector and ground G205. Is the the continuity equal to the specified value?	≈ 0 Ω	Go to Step 17	Go to Step 18
17	Replace the ABS unit. Is the repair complete?	-	System OK	-
18	Repair the continuity problem between terminal 19 of the EBCM connector and ground G205. Is the repair complete?	-	System OK	-
19	1. Turn the ignition to LOCK. 2. Check fuse F30 in the I/P fuse block. Is fuse F30 blown?	-	Go to Step 20	Go to Step 21
20	Replace fuse F30. Is the repair complete?	-	System OK	-
21	1. Turn the ignition on. 2. Check the voltage at fuse F30. Is the voltage equal to the specified value?	11 - 14 v	Go to Step 22	Go to Step 23
22	Repair the power supply to fuse F30. Is the repair complete?	-	System OK	-
23	1. Remove the instrument cluster. 2. Check the circuit PNK from fuse F30 to terminal A1 of the I/P cluster connector. 3. Repair any open or high resistance found in a wiring harness, splice pack, or connector. Is the repair complete?	-	System OK	-

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TRACTION CONTROL SYSTEM (TCS) INDICATOR LAMP INOPERATIVE

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Circuit Description

Battery voltage is supplied to the TCS warning lamp with the ignition in ON or START. The warning lamp can be activated only by the ABS control module internally supplying ground to terminal 32.

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Diagnosis

This procedure checks for a problem in the wiring, a faulty ground, a voltage supply problem, a burned out indicator lamp, or a contact problem in a connector.

Cause(s)

- A fuse has blown.
- The indicator lamp has burned out.
- There is a corroded or broken connector terminal.
- There is a faulty ground connection.
- There is a broken wire in a wiring harness.
- The EBCM is faulty.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This test checks for any DTCs that may cause the TCS indicator lamp to be inoperative.
2. This test verifies an inoperative lamp condition.
3. This test checks for voltage on the lamp circuit.
4. This begins a series of tests of the circuit from the indicator lamp to the EBCM and ground.

19. This begins a series of tests of the voltage supply circuits that power the indicator lamp.

Traction Control System (TCS) Indicator Lamp Inoperative

Step	Action	Value(s)	Yes	No
1	Install the scan tool and check for any DTCs. Is any DTC set?	-	Go to the chart for the DTC	Go to Step 2
2	1. Turn the ignition to LOCK. 2. Disconnect the scan tool. 3. Turn the ignition to ON. 4. Observe the TCS indicator lamp. Does the lamp illuminate for about 2 seconds, then turn off?	-	Go to “Intermittents and Poor Connections”	Go to Step 3
3	With the ignition still ON, observe the oil pressure lamp. Is the oil pressure lamp illuminated?	-	Go to Step 4	Go to Step 19
4	1. Turn the ignition to LOCK. 2. Disconnect the connector from the EBCM. 3. Connect a jumper from terminal 32 to the grounding bar in the connector. 4. Turn the ignition to ON. Does the TCS indicator illuminate?	-	Go to Step 5	Go to Step 8
5	1. Turn the ignition to LOCK. 2. Examine terminals 19 and 32 at the EBCM connector on both the ABS wiring harness and on the EBCM. Is there a poor connection at any of these terminals?	-	Go to Step 6	Go to Step 7
6	Repair the faulty terminals or replace the ABS unit, as required. Is the repair complete?	-	System OK	-
7	Replace the ABS unit. Is the repair complete?	-	System OK	-
8	1. Turn the ignition to LOCK. 2. Disconnect the wire from the negative battery terminal. 3. Measure the resistance between the negative battery wire, which is attached to ground, and the shorting bar in the EBCM connector. Is the resistance equal to the specified value?	≈ 0 Ω	Go to Step 10	Go to Step 9
9	Repair the open or high resistance in the circuit from EBCM connector, terminal 29 to ground G303. Is the repair complete?	-	System OK	-
10	1. Remove the I/P cluster. 2. Remove and check the TCS indicator bulb. Is the bulb burned out?	-	Go to Step 11	Go to Step 12
11	1. Replace the TCS indicator bulb. 2. Replace the I/P cluster. Is the repair complete?	-	System OK	-
12	Check continuity at the I/P cluster connector terminal A6. Is the continuity equal to the specified value?	≈ 0 Ω	Go to Step 14	Go to Step 13
13	Repair the contact at the I/P cluster connector terminal A6. Is the repair complate?	-	System OK	-

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Traction Control System (TCS) Indicator Lamp Inoperative (Cont'd)

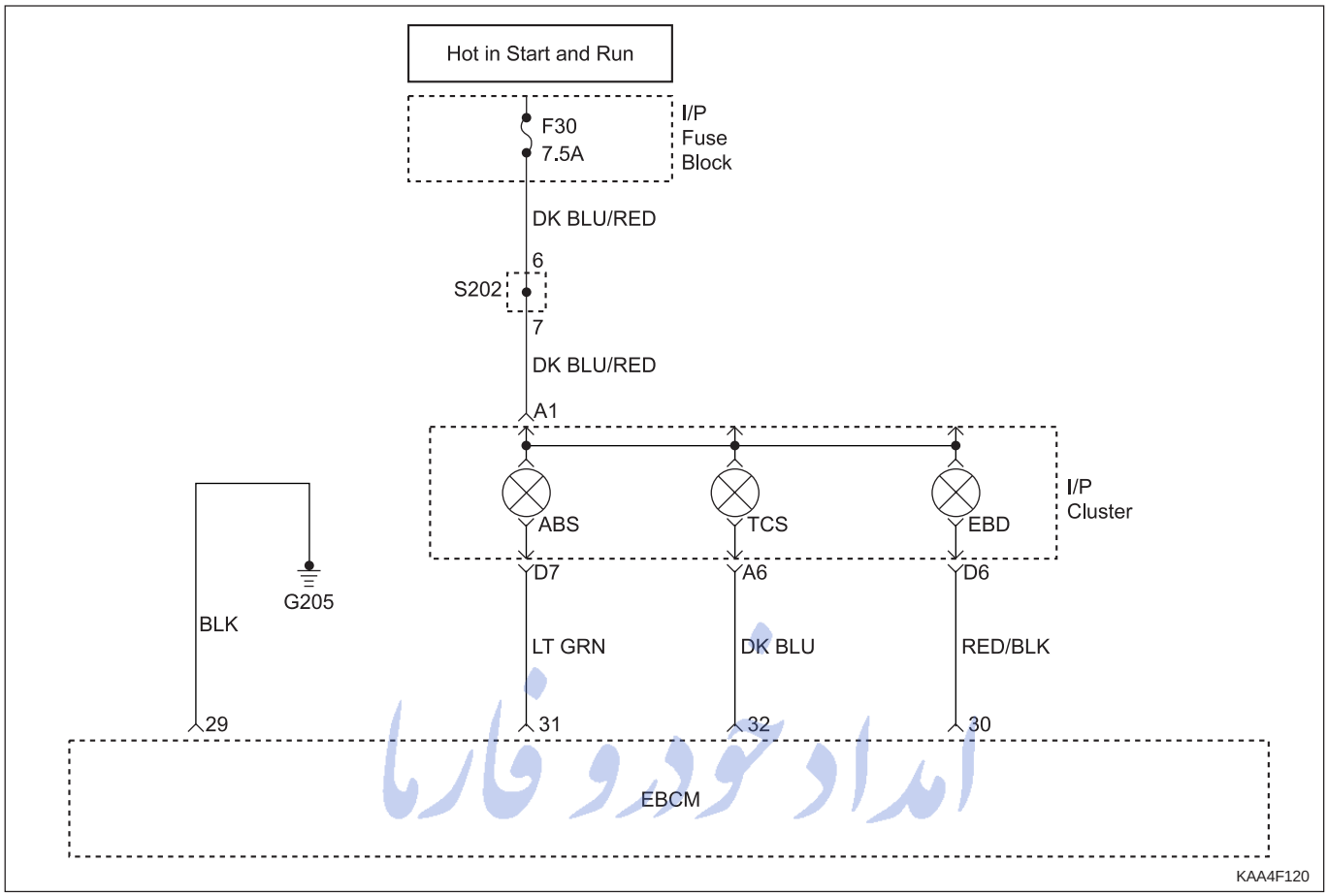
Step	Action	Value(s)	Yes	No
14	Check the wiring harnesses and connectors in circuit DK BLU from the I/P cluster terminal A6 to terminal 32 of the EBCM connector. Is the voltage equal to the specified value?	≈ 0 Ω	Go to Step 15	Go to Step 16
15	Repair the open or high resistance. Is the repair complete?	-	System OK	-
16	Check for continuity between terminal 19 of the ABS connector and ground G205. Is the continuity equal to the specified value?	≈ 0 Ω	Go to Step 17	Go to Step 18
17	Replace the ABS unit. Is the repair complete?	-	System OK	-
18	Repair the continuity between terminal 19 of the EBCM connector and ground G205. Is the repair complete?	-	System OK	-
19	1. Turn the ignition to LOCK. 2. Check fuse F30 in the I/P fuse block. Is fuse F30 blown?	-	Go to Step 20	Go to Step 21
20	Replace fuse F30. Is the repair complete?	-	System OK	-
21	1. Turn the ignition ON. 2. Check the voltage at fuse F30. Is the voltage equal to the specifies value?	11 - 14v	Go to Step 22	Go to Step 23
22	Repair the power supply to fuse F30. Is the repair complete?	-	System OK	
23	1. Remove the I/P cluster. 2. Check circuit LR from fuse F30 to terminal A1 of the I/P cluster connector. 3. Repair any open or high resistance found in a wiring harness, a splice pack, or a connector. Is the repair complete?	-	System OK	-

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ELECTRONIC BRAKE-FORCE DISTRIBUTION SYSTEM (EBD) INDICATOR LAMP INOPERATIVE

Circuit Description

Battery voltage is supplied to the EBD warning lamp with the ignition in ON or START. The warning lamp can be activated only by the ABS control module internally supplying ground to terminal 30.

Diagnosis

This procedure checks for a problem in the wiring, a faulty ground, a voltage supply problem, a burned out indicator lamp, or a contact problem in a connector.

Cause(s)

- A fuse has blown.
- The indicator lamp has burned out.
- There is a corroded or broken connector terminal.
- There is a faulty ground connection.
- There is a broken wire in a wiring harness.
- The EBCM is faulty.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This test checks for any DTCs that may cause the EBD indicator lamp to be inoperative.
2. This test verifies an inoperative lamp condition.
3. This test checks for voltage on the lamp circuit.
4. This begins a series of tests of the circuit from the indicator lamp to the EBCM and ground.

19. This begins a series of tests of the voltage supply circuits that power the indicator lamp.

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Traction Control System (TCS) Indicator Lamp Inoperative

Step	Action	Value(s)	Yes	No
1	Install the scan tool and check for any DTCs. Is any DTC set?	-	Go to the chart for the DTC	Go to Step 2
2	1. Turn the ignition to LOCK. 2. Disconnect the scan tool. 3. Turn the ignition to ON. 4. Observe the EBD indicator lamp. Does the lamp illuminate for about 2 seconds, then turn off?	-	Go to “Intermittents and Poor Connections”	Go to Step 3
3	With the ignition still ON, observe the oil pressure lamp. Is the oil pressure lamp illuminated?	-	Go to Step 4	Go to Step 19
4	1. Turn the ignition to LOCK. 2. Disconnect the connector from the EBCM. 3. Connect a jumper from terminal 30 to the grounding bar in the connector. 4. Turn the ignition to ON. Does the EBD indicator illuminate?	-	Go to Step 5	Go to Step 8
5	1. Turn the ignition to LOCK. 2. Examine terminals 19 and 30 at the EBCM connector on both the ABS wiring harness and on the EBCM. Is there a poor connection at any of these terminals?	-	Go to Step 6	Go to Step 7
6	Repair the faulty terminals or replace the ABS unit, as required. Is the repair complete?	-	System OK	-
7	Replace the ABS unit. Is the repair complete?	-	System OK	-
8	1. Turn the ignition to LOCK. 2. Disconnect the wire from the negative battery terminal. 3. Measure the resistance between the negative battery wire, which is attached to ground, and the shorting bar in the EBCM connector. Is the resistance equal to the specified value?	≈ 0 Ω	Go to Step 10	Go to Step 9
9	Repair the open or high resistance in the circuit from EBCM connector, terminal 19 to ground G205. Is the repair complete?	-	System OK	-
10	1. Remove the I/P cluster. 2. Remove and check the TCS indicator bulb. Is the bulb burned out?	-	Go to Step 11	Go to Step 12
11	1. Replace the EBD indicator bulb. 2. Replace the I/P cluster. Is the repair complete?	-	System OK	-
12	Check continuity at the I/P cluster connector terminal D6. Is the continuity equal to the specified value?	≈ 0 Ω	Go to Step 14	Go to Step 13
13	Repair the contact at the I/P cluster connector terminal D6 Is the repair complate?	-	System OK	-

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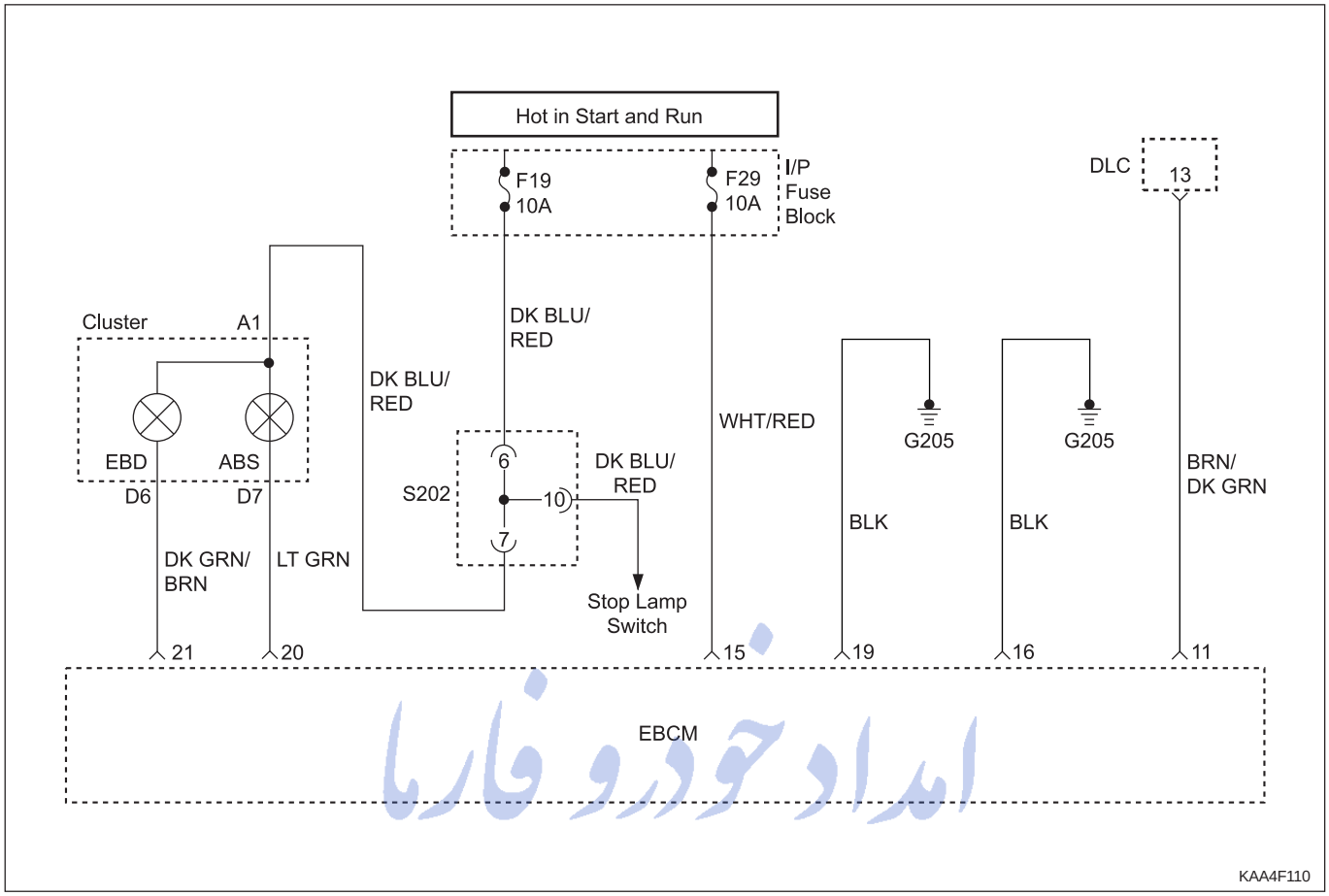
Electronic Brake-Force Distribution System (EBD) Indicator Lamp Inoperative

Step	Action	Value(s)	Yes	No
14	Check the wiring harnesses and connectors in circuit from the I/P cluster terminal D6 to terminal 30 of the EBCM connector. Is the voltage equal to the specified value?	∞	Go to Step 15	Go to Step 16
15	Repair the open or high resistance. Is the repair complete?	-	System OK	-
16	Check for continuity between terminal 19 of the ABS connector and ground G205. Is the continuity equal to the specified value?	≈ 0 Ω	Go to Step 17	Go to Step 18
17	Replace the ABS unit. Is the repair complete?	-	System OK	-
18	Repair the continuity between terminal 19 of the EBCM connector and ground G205. Is the repair complete?	-	System OK	-
19	1. Turn the ignition to LOCK. 2. Check fuse F30 in the I/P fuse block. Is fuse F30 blown?	-	Go to Step 20	Go to Step 21
20	Replace fuse F30. Is the repair complete?	-	System OK	-
21	1. Turn the ignition ON. 2. Check the voltage at fuse F30. Is the voltage equal to the specifies value?	11 - 14v	Go to Step 22	Go to Step 23
22	Repair the power supply to fuse F30. Is the repair complete?	-	System OK	-
23	1. Remove the I/P cluster. 2. Check circuit LR from fuse F30 to terminal A1 of the I/P cluster connector. 3. Repair any open or high resistance found in a wiring harness, a splice pack, or a connector. Is the repair complete?	-	System OK	-

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POWER SUPPLY TO CONTROL MODULE, NO DTCS STORED

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Circuit Description

Battery voltage is supplied to the electronic brake control module (EBCM) through fuse F19 and F29 in the I/P fuse block, to terminal 50 and 1 of the EBCM connector. The voltage is present when the ignition switch is in ON or START.

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Diagnosis

This test checks for battery output, proper grounding, blown fuses, a faulty ignition switch, and problems in the circuitry.

Cause(s)

- The battery is defective.
- There is a defective ground connection.
- A connector is damaged.
- A wire is broken or shorted.
- A fuse is blown.
- The ignition switch is malfunctioning.

Fail Action

ABS action is disabled during the period of low voltage, and the ABS warning lamp is ON for the remainder of the ignition cycle.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This step determines whether there is voltage at the battery and the high current source.
7. This step checks for voltage at the ignition 1 source.

Diagnostic Aids

It is very important to perform a thorough inspection of the wiring and the connectors. Failure to do so may result in misdiagnosis, causing part replacement with a re-appearance of the malfunction.

Power Supply to Control Module, No DTCs Stored

Step	Action	Value(s)	Yes	No
1	Check the voltage at the battery. Is the voltage equal to the specified value?	11 - 14v	Go to Step 3	Go to Step 2
2	Charge or replace the battery, as required. Is the repair complete?	-	System OK	-
3	Check fuse F30 in the I/P fuse block. Is the fuse blown?	-	Go to Step 4	Go to Step 8
4	1. Replace fuse F30. 2. Turn the ignition to ON. Does the fuse blow again?	-	Go to Step 6	Go to Step 5
5	Check the ABS function. Is the repair complete?	-	System OK	-
6	1. Turn the ignition to OFF. 2. Remove fuse F30. 3. Disconnect the ABS connector from the EBCM. 4. Measure the resistance to ground at terminals 20 and 21. Does the ohmmeter show the specified value?	≈ 0 Ω	Go to Step 7	Go to Step 25
7	Repair the short to ground in circuit WR between F19 and the ABS harness EBCM connector. Is the repair complete?	-	System OK	-
8	1. Turn the ignition to ON. 2. Check the voltage at fuse F29. Is the voltage equal to the specified value?	11 - 14v	Go to Step 10	Go to Step 9
9	Repair the power supply to fuse F29. Is the repair complete?	-	System OK	-
10	Check fuse F29 in the I/P fuse block. Is the fuse F29 blown?	-	Go to Step 14	Go to Step 18
11	1. Replace fuse F29. 2. Turn the ignition to ON. Does the fuse blow again?	-	Go to Step 13	Go to Step 12
12	Check the ABS function. Is the repair complete?	-	System OK	-
13	1. Turn the ignition to OFF. 2. Remove fuse F29. 3. Disconnect the ABS connector from the EBCM. 4. Measure the resistance between ground and terminal 1. Is the resistance equal to the specified value?	≈ 0 Ω	Go to Step 22	Go to Step 14
14	Repair the short to ground in circuit WR fuse F29 of the I/P fuse block and terminal 1 of the ABS garness EBCM connector. Is the repair complete?	-	System OK	-

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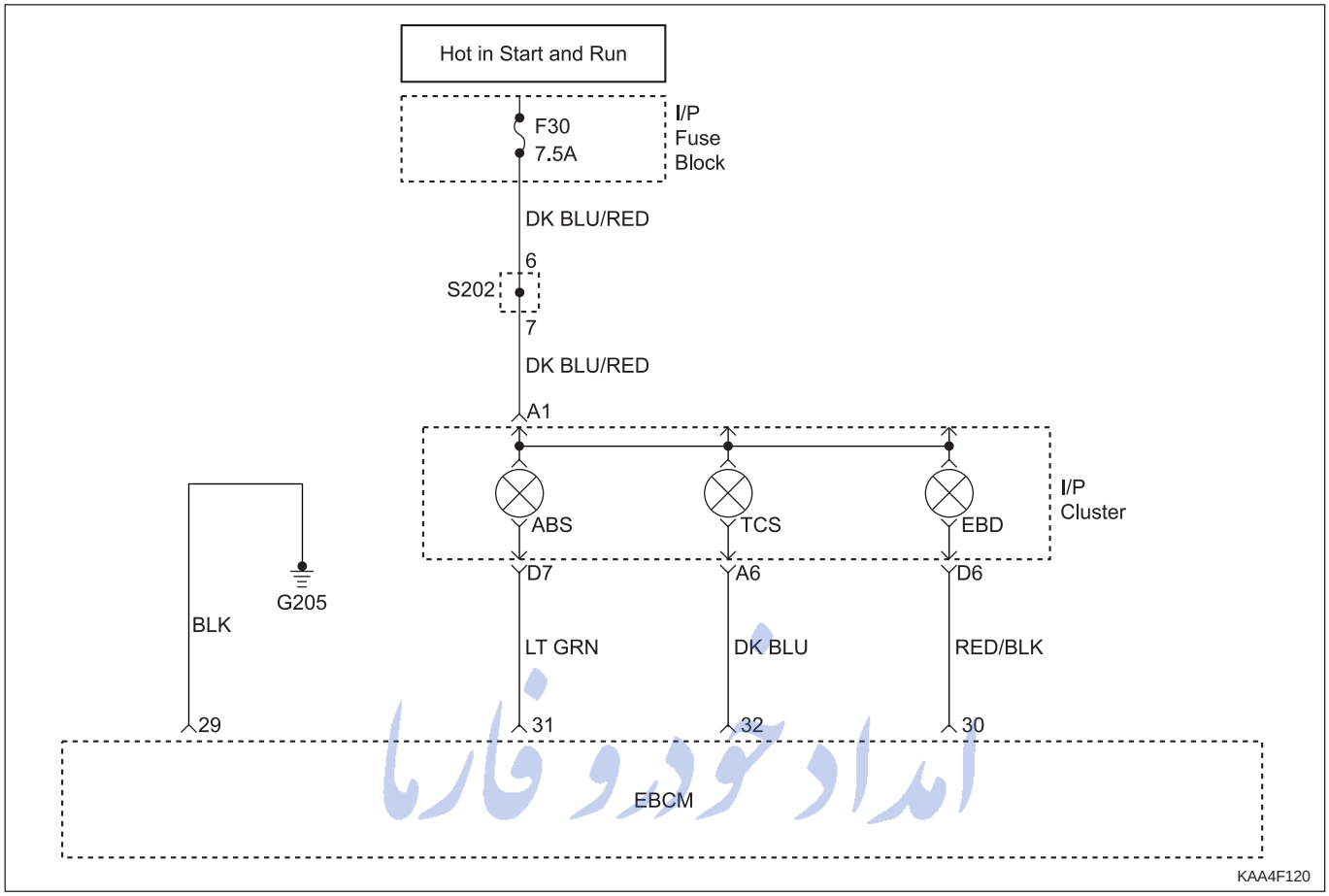
Power Supply to Control Module, No DTCs Stored (Cont'd)

Step	Action	Value(s)	Yes	No
15	1. Disconnect the EBCM connector from the EBCM. 2. Turn the ignition to ON. 3. Check for the presence of battery voltage between ground and terminal 20 and 21. Is the voltage equal to the specified value?	11 - 14v	Go to Step 17	Go to Step 16
16	1. Turn the ignition switch to OFF. 2. Trace the RW wires between terminal 20 and 21 of the EBCM connector to fuse F30 of the I/P fuse block. 3. Repair the open in this circuit. Is the repair complete?	-	System OK	-
17	Check the voltage between ground and terminal 1 of the EBCM connector. Is the voltage equal to the specified value?	11 - 14v	Go to Step 19	Go to Step 18
18	1. Turn the ignition switch to OFF. 2. Repair the circuit RW between terminal 1 of the ABS harness EBCM connector to fuse F29 in the I/P fuse block. Is the repair complete?	-	System OK	-
19	1. Turn the ignition to OFF. 2. Check the resistance between ground and terminals 16 and 19 of the EBCM connector. Is the resistance equal to the specified value?	≈ 0 Ω	Go to Step 20	Go to Step 23
20	Examine terminals 20, 21, 1, 19 and 16 of the EBCM connector. Is there a defective terminal?	-	Go to Step 21	Go to Step 22
21	Repair the defective terminal or replace the connector or wiring harness, as required. Is the repair complete?	-	System OK	-
22	Replace the ABS unit. Is the repair complete?	-	System OK	-
23	Repair the defective ground connection. Is the repair complete?	-	System OK	-

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ABS INDICATOR LAMP ILLUMINATED CONTINUOUSLY, NO DTCS STORED

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Circuit Description

Battery voltage is supplied to the ABS warning lamp with the ignition in ON or START. The warning lamp should be activated only by the ABS control module internally supplying ground to terminal 31.

Diagnosis

This procedure checks for a short to ground in the wiring or a defective electronic brake control module (EBCM).

Cause(s)

- There is a short to ground in the circuit between the cluster terminal D7 and the EBCM terminal 31.
- The EBCM is faulty.

ABS INDICATOR LAMP ILLUMINATED CONTINUOUSLY, NO DTCS STORED

Step	Action	Value(s)	Yes	No
1	Check the EBCM connector. Is it connected properly?	-	Go to Step 3	Go to Step 2
2	Connect the EBCM connector. Is the repair complete?	-	System OK	-
3	1. Disconnect the EBCM connector. 2. Turn the ignition to ON. 3. Use an insulated tool to push the shorting bar in the connector away from terminal 31. Does the ABS indicator lamp go out?	-	Go to Step 4	Go to Step 5
4	Replace the ABS unit. Is the repair complete?	-	System OK	-
5	Repair the short to ground in circuit Lg between I/P cluster connector D7 and terminal 31 EBCM. Is the repair complete?	-	System OK	-

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SELF-DIAGNOSTICS

Important: The electronic brake control module (EBCM) turns the valve relay off when a diagnostic trouble code (DTC) is set. The scan tool will indicate that the valve relay is off when it is used to monitor the data list. This is normal and should not be considered a mal-function.

The EBCM performs system self-diagnostics and can detect and often isolate system malfunctions. When it detects a malfunction, the EBCM sets a DTC that repre sents the malfunction, turns on the ABS and/or the TCS indicators in most instances, and may disable the ABS and/or the TCS functions, as necessary, for the duration of the ignition cycle.

Once each ignition cycle, the EBCM performs an auto-matic test when the vehicle reaches 2.75 km/h (1.7 mph). In the course of this test, the system cycles each valve solenoid and the pump motor, along with the necessary relays, to check component operation. If the EBCM detects any malfunctions, it will set a DTC as described above.

DISPLAYING DTCs

Tools Required

Scan Tool

DTCs can be read through the use of the scan tool.

CLEARING DTCs

Tools Required

Scan Tool

The diagnostic trouble codes (DTCs) in the electronic brake control module (EBCM) memory are erased in one of two ways:

- Use the scan tool “Clear DTCs” selection.
- After 249 DTC-free ignition cycles.

These two methods are detailed below. Be sure to verify the proper system operation and, the absence of DTCs when the clearing procedure is completed.

The EBCM will not permit DTC clearing until all DTCs have been displayed. Also, DTCs cannot be cleared by disconnecting the EBCM, disconnecting the battery cables, or turning the ignition switch to LOCK.

Scan Tool Method

The scan tool can clear ABS/TCS system DTCs using the mass storage cartridge.

1. Install the scan tool and the mass storage cartridge.
2. Select “Fault Memory”.
3. Select “Clear Fault Memory”.

Clearing the fault memory cannot reset a valve relay which was shut down when the fault was recognized. Changes are possible only after the fault has been elimi-nated and the next ignition cycle has begun.

Ignition Cycle Default

A DTC is erased from memory after 249 ignition cycles without any reappearance of that malfunction.

INTERMITTENTS AND POOR CONNECTIONS

As with most electronic systems, intermittent malfunc tions may be difficult to diagnose accurately. The follow-ing is a method to try to isolate an intermittent malfunction, especially in wheel speed circuitry.

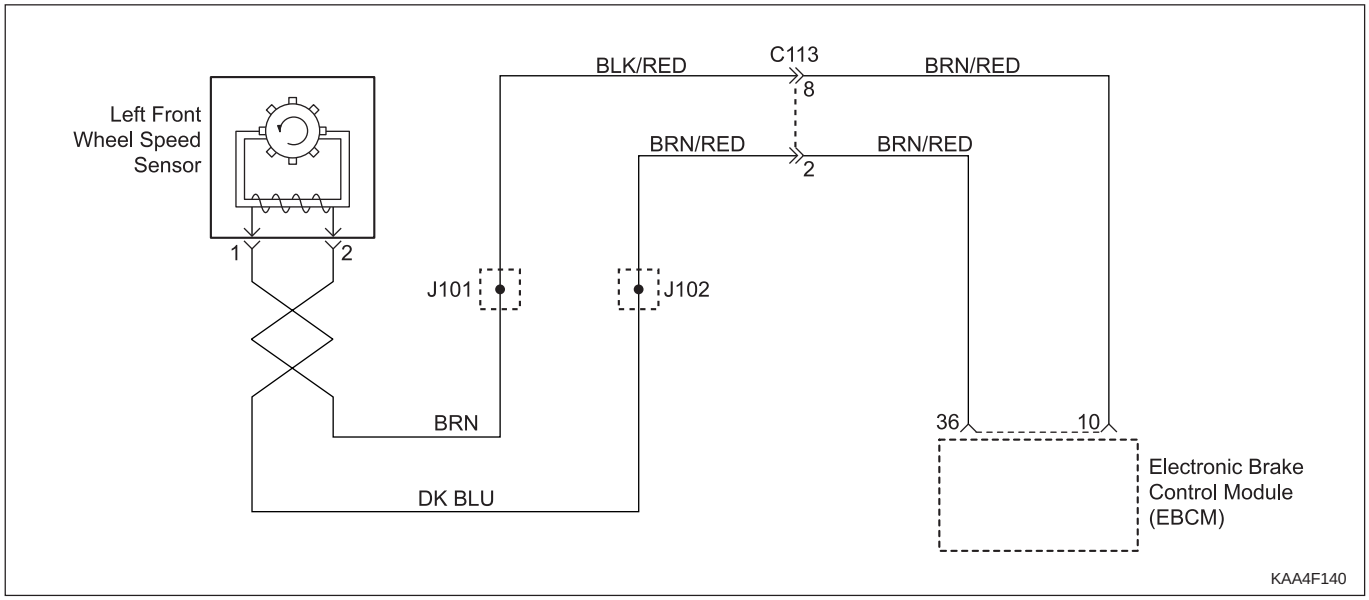
If an ABS malfunction occurs, the ABS indicator will illuminate during the ignition cycle in which the malfunction was detected. If it is an intermittent problem which seems to have corrected itself (ABS indicator OFF), a history DTC will be stored. Also stored will be the history data of the DTC at the time the malfunction occurred. Use the scan tool modular diagnostic system to read ABS history data.

Most intermittents are caused by faulty electrical con nections or wiring, although a sticking relay or solenoid can occasionally be at fault.

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DIAGNOSTIC TROUBLE CODE (DTC) 03
LEFT FRONT WHEEL SPEED SENSOR FAULT

Circuit Description

The toothed wheel generates a voltage pulse as it moves past the sensor. Each tooth-gap-tooth series on the wheel generates the pulses. The electronic brake control module (EBCM) uses the frequency of these pulses to determine the wheel speed. The voltage generated depends on the air gap between the sensor and the toothed wheel, and on the wheel speed.

Diagnosis

This procedure checks for a malfunctioning wheel speed sensor, a short to ground or to voltage in the wiring, or a contact problem in a connector.

Cause(s)

- The wheel speed sensor is defective.
- There is a problem in the wiring.
- There is a problem with a connector.

Fail Action

ABS action is disabled, and the ABS warning lamp is ON.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This step begins an examination for a defective wheel speed sensor.
6. This step tests the wiring for a short to voltage.
8. This step tests the wiring for a short to ground.
10. This step tests for an open or a high resistance in the wiring.

Diagnostic Aids

Be sure that the speed sensor wiring is properly routed and retained. This will help to prevent false signals due to the pickup of electrical noise.

It is very important to perform a thorough inspection of the wiring and the connectors. Failure to inspect the wiring and the connectors carefully and completely may result in misdiagnosis, causing part replacement with the reappearance of the malfunction.

Use the scan tool to monitor wheel speeds during a road test. Watch the wheel speeds being displayed on the scan tool to see if any of the readings are unusual, such as one sensor varying in speed from the other three, a signal going intermittently high or low, etc. If this does not identify the intermittent, wet the speed sensor harness on the underside of the vehicle and perform a road test, monitoring wheel speeds with the scan tool.

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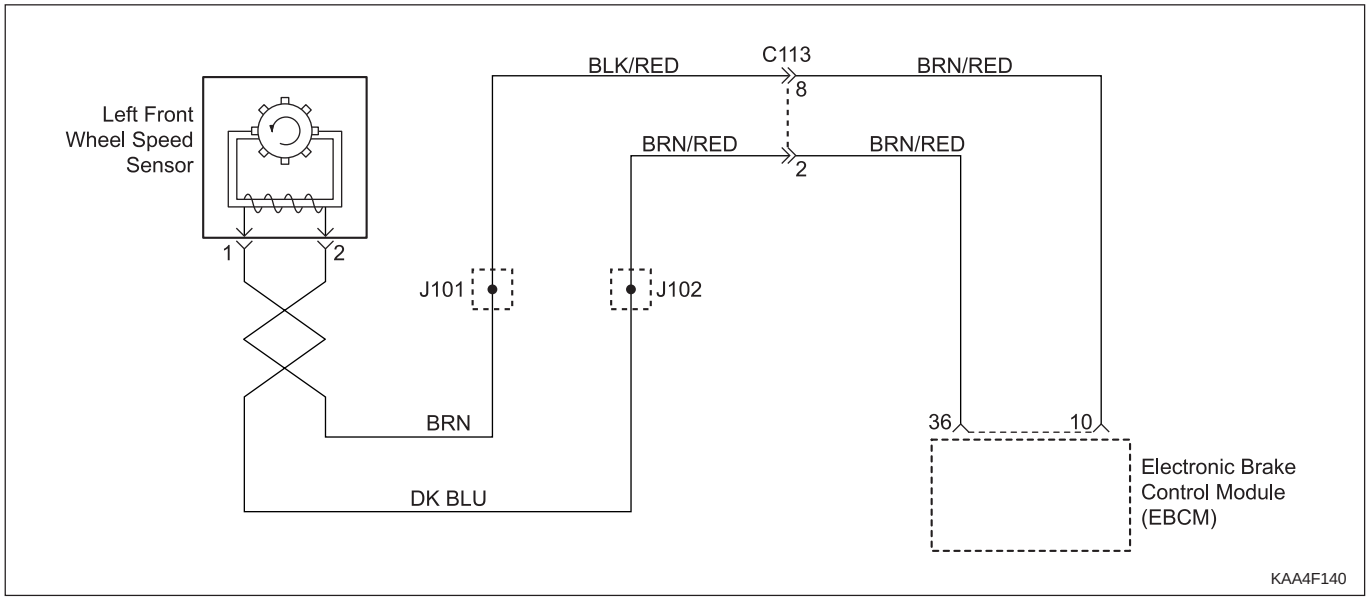
DTC 03 - Left Front Wheel Speed Sensor Fault

Step	Action	Value(s)	Yes	No
1	Examine the wheel speed sensor. Are there any signs of physical damage?	-	Go to Step 3	Go to Step 2

DTC 03 - Left Front Wheel Speed Sensor Fault (Cont'd)

Step	Action	Value(s)	Yes	No
2	1. Turn the ignition to LOCK. 2. Disconnect the left rear wheel speed sensor connector. 3. Use a digital voltmeter (DVM) to measure resistance between the sensor terminals. Is the resistance within the specified value at approximately 25-C (77-F)?	1280 - 1920 Ω	Go to Step 4	Go to Step 3
3	Replace the wheel speed sensor. Is the repair complete?	-	System OK	-
4	1. Switch the DVM to the ac millivolt range. 2. Measure the voltage output between the wheel speed sensor terminals while rotating the wheel about 1 revolution per second. Is the output within the specified value?	≈ 70 mv	Go to Step 6	Go to Step 5
5	Replace the speed sensor or the toothed wheel, as required. Is the repair complete?	-	System OK	-
6	1. Disconnect the harness from the EBCM. 2. Connect a DVM between ground and one terminal of the wheel speed connector. 3. Turn the ignition to ON. 4. Repeat the above test for the other terminal of the wheel speed connector. Is the voltage for either of these terminals within the specified value?	>1v	Go to Step 7	Go to Step 8
7	Repair the short to voltage in the affected circuit. Is the repair complete?	-	System OK	-
8	1. Turn the ignition to LOCK. 2. Measure the resistance to ground from terminal at the harness EBCM connector. 3. Measure the resistance to ground from terminal 36 at the harness EBCM connector. Is the resistance at either circuit less than the specified value?	∞	Go to Step 9	Go to Step 10
9	Repair the short to ground in the affected circuit. Is the repair complete?	-	System OK	-
10	1. Measure the resistance between terminal 10 at the harness EBCM connector and the harness wheel speed sensor connector. 2. Measure the resistance between terminal 36 at the harness EBCM connector and the harness wheel speed sensor connector. Is the resistance on either circuit within the specified value?	>5 Ω	Go to Step 11	Go to Step 12
11	Repair the open or the high resistance in the affected circuit, as required. Be sure to check terminals 2 and 8 of connector C113 and junction J101 and J102. Is the repair complete?	-	System OK	-
12	Replace the ABS unit. Is the repair complete?	-	System OK	-

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DIAGNOSTIC TROUBLE CODE (DTC) 07
LEFT FRONT WHEEL SPEED SENSOR CONTINUITY FAULT

Circuit Description

The toothed wheel generates a voltage pulse as it moves past the sensor. Each tooth-gap-tooth series on the wheel generates the pulses. The electronic brake control module (EBCM) uses the frequency of these pulses to determine the wheel speed. The voltage generated depends on the air gap between the sensor and the toothed wheel, and on the wheel speed.

Diagnosis

This procedure checks for a malfunctioning wheel speed sensor, a short to ground or to voltage in the wiring, or a contact problem in a connector.

Cause(s)

- The wheel speed sensor is defective.
- There is a problem in the wiring.
- There is a problem with a connector.

Fail Action

ABS action is disabled, and the ABS warning lamp is ON.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This step begins an examination for a defective wheel speed sensor.
4. This step tests the wiring for a short to voltage.
6. This step tests the wiring for a short to ground.
8. This step tests for an open or high resistance in the wiring.

Diagnostic Aids

Be sure that the speed sensor wiring is properly routed and retained. This will help to prevent false signals due to the pickup of electrical noise.

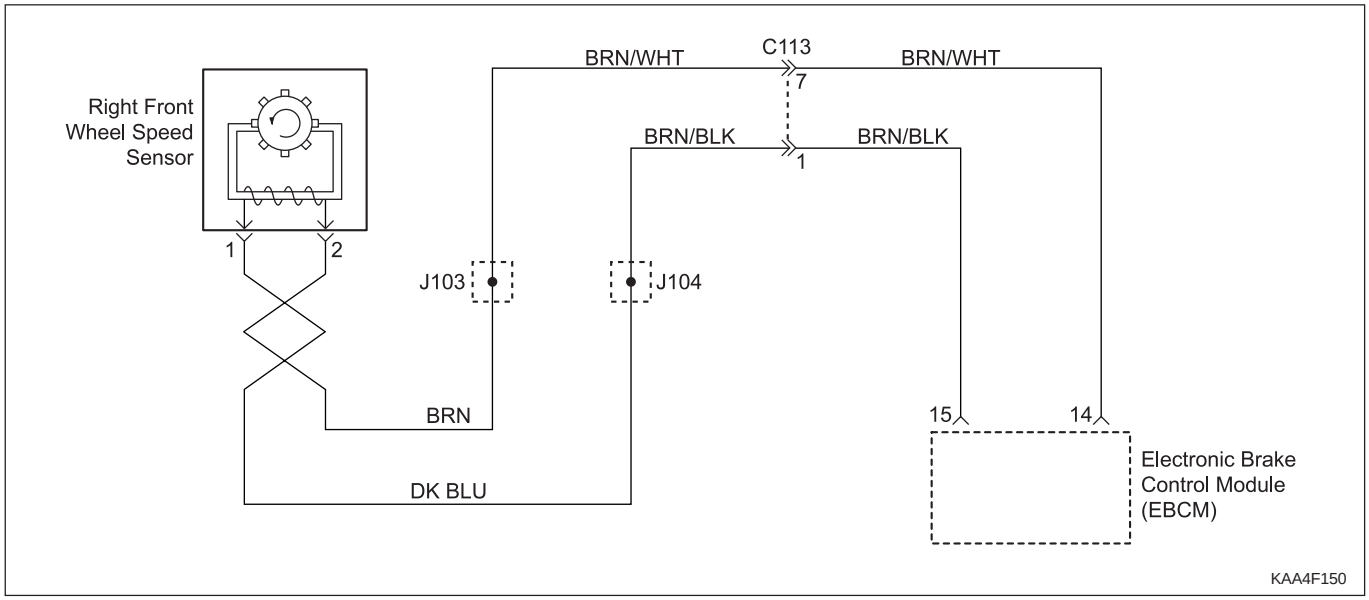
It is very important to perform a thorough inspection of the wiring and the connectors. Failure to inspect the wiring and the connectors carefully and completely may result in misdiagnosis, causing part replacement with the reappearance of the malfunction.

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DTC 07 - Left Front Wheel Speed Sensor Continuity Fault

Step	Action	Value(s)	Yes	No
1	Examine the wheel speed sensor. Are there any signs of physical damage?	-	Go to Step 3	Go to Step 2
2	1. Turn the ignition to LOCK. 2. Disconnect the left rear wheel speed sensor connector. 3. Use a digital voltmeter (DVM) to measure resistance between the sensor terminals. Is the resistance within the specified value at approximately 25-C (77-F)?	1280 - 1920 Ω	Go to Step 4	Go to Step 3
3	Replace the wheel speed sensor. Is the repair complete?	-	System OK	-
4	1. Disconnect the harness from the EBCM. 2. Connect a DVM between ground and one terminal of the wheel speed connector. 3. Turn the ignition to ON. 4. Repeat the above test for the other terminal of the wheel speed connector. Is the voltage for either of these terminals within the specified value?	>1v	Go to Step 5	Go to Step 6
5	Repair the short to voltage in the affected circuit. Is the repair complete?	-	System OK	-
6	1. Turn the ignition to LOCK. 2. Measure the resistance to ground from terminal 10 at the harness EBCM connector. 3. Measure the resistance to ground from terminal 36 at the harness EBCM connector. Is the resistance at either circuit less than the specified value?	∞	Go to Step 7	Go to Step 8
7	Repair the short to ground in the affected circuit. Is the repair complete?	-	System OK	-
8	1. Measure the resistance between terminal 10 at the harness EBCM connector and the harness wheel speed sensor connector. 2. Measure the resistance between terminal 36 at the harness EBCM connector and the harness wheel speed sensor connector. Is the resistance on either circuit within the specified value?	>5 Ω	Go to Step 9	Go to Step 10
9	Repair the open or high resistance in the affected circuit as required. Be sure to check terminals 2 and 8 of connector C113 and junction J101 and J102. Is the repair complete?	-	System OK	-
10	Replace the ABS unit. Is the repair complete?	-	System OK	-

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DIAGNOSTIC TROUBLE CODE (DTC) 04
RIGHT FRONT WHEEL SPEED SENSOR FAULT

Circuit Description

The toothed wheel generates a voltage pulse as it moves past the sensor. Each tooth-gap-tooth series on the wheel generates the pulses. The electronic brake control module (EBCM) uses the frequency of these pulses to determine the wheel speed. The voltage generated depends on the air gap between the sensor and the toothed wheel, and on the wheel speed.

Diagnosis

This procedure checks for a malfunctioning wheel speed sensor, a short to ground or to voltage in the wiring, or a contact problem in a connector.

Cause(s)

- The wheel speed sensor is defective.
- There is a problem in the wiring.
- There is a problem with a connector.

Fail Action

ABS action is disabled, and the ABS warning lamp is ON.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This step begins an examination for a defective wheel speed sensor.
6. This step tests the wiring for a short to voltage.
8. This step tests the wiring for a short to ground.
10. This step tests for an open or high resistance in the wiring.

Diagnostic Aids

Be sure that the speed sensor wiring is properly routed and retained. This will help to prevent false signals due to the pickup of electrical noise.

It is very important to perform a thorough inspection of the wiring and the connectors. Failure to inspect the wiring and the connectors carefully and completely may result in misdiagnosis, causing part replacement with the reappearance of the malfunction.

Use the scan tool to monitor wheel speeds during a road test. Watch the wheel speeds being displayed on the scan tool to see if any of the readings are unusual, such as one sensor varying in speed from the other three, a signal going intermittently high or low, etc. If this does not identify the intermittent, wet the speed sensor harness on the underside of the vehicle and perform a road test, monitoring wheel speeds with the scan tool.

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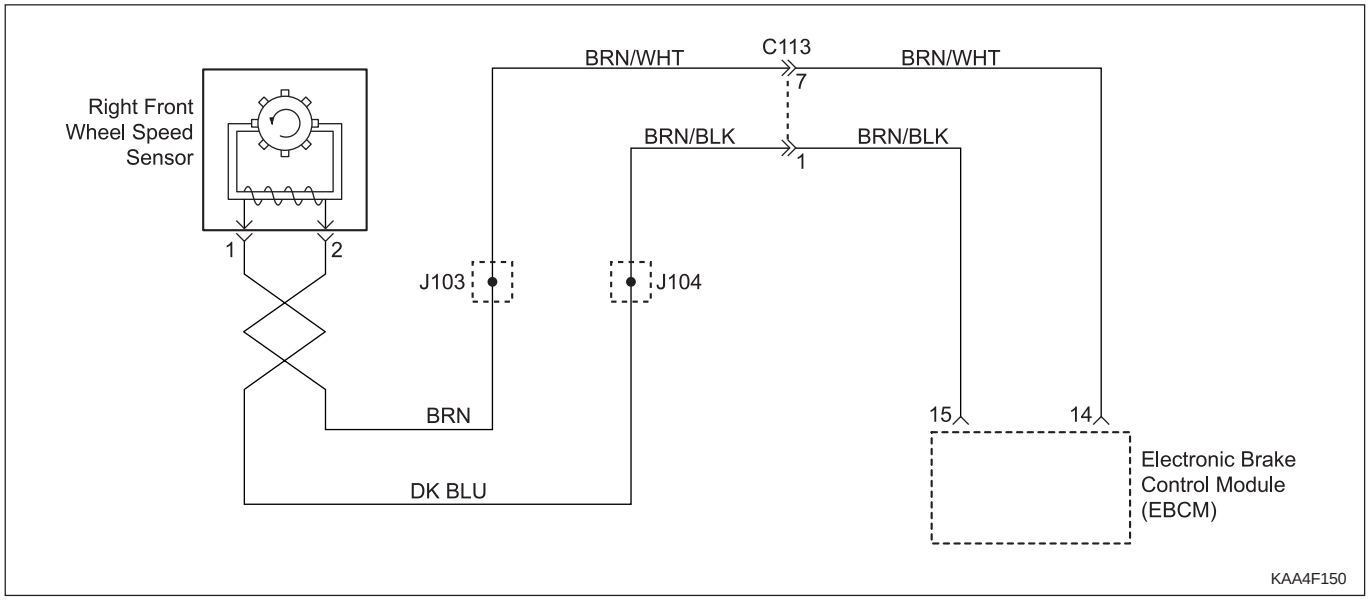
DTC 04 - Right Front Wheel Speed Sensor Fault

Step	Action	Value(s)	Yes	No
1	Examine the wheel speed sensor. Are there any signs of physical damage?	-	Go to Step 3	Go to Step 2

DTC 04 - Right Front Wheel Speed Sensor Fault (Cont'd)

Step	Action	Value(s)	Yes	No
2	1. Turn the ignition to LOCK. 2. Disconnect the left rear wheel speed sensor connector. 3. Use a digital voltmeter (DVM) to measure resistance between the sensor terminals. Is the resistance within the specified value at approximately 25-C (77-F)?	1280 - 1920 Ω	Go to Step 4	Go to Step 3
3	Replace the wheel speed sensor. Is the repair complete?	-	System OK	-
4	1. Switch the DVM to the ac millivolt range. 2. Measure the voltage output between the wheel speed sensor terminals while rotating the wheel about 1 revolution per second. Is the output within the specified value?	≈ 70 mv	Go to Step 6	Go to Step 5
5	Replace the speed sensor or the toothed wheel, as required. Is the repair complete?	-	System OK	-
6	1. Disconnect the harness from the EBCM. 2. Connect a DVM between ground and one terminal of the wheel speed connector. 3. Turn the ignition to ON. 4. Repeat the above test for the other terminal of the wheel speed connector. Is the voltage for either of these terminals within the specified value?	>1v	Go to Step 7	Go to Step 8
7	Repair the short to voltage in the affected circuit. Is the repair complete?	-	System OK	-
8	1. Turn the ignition to LOCK. 2. Measure the resistance to ground from terminal 14 at the harness EBCM connector. 3. Measure the resistance to ground from terminal 15 at the harness EBCM connector. Is the resistance at either circuit less than the specified value?	∞	Go to Step 9	Go to Step 10
9	Repair the short to ground in the affected circuit. Is the repair complete?	-	System OK	-
10	1. Measure the resistance between terminal 14 at the harness EBCM connector and the harness wheel speed sensor connector. 2. Measure the resistance between terminal 15 at the harness EBCM connector and the harness wheel speed sensor connector. Is the resistance on either circuit within the specified value?	>5 Ω	Go to Step 11	Go to Step 12
11	Repair the open or the high resistance in the affected circuit, as required. Be sure to check terminals 7 and 1 of connector C113 and junction J103 and J104. Is the repair complete?	-	System OK	-
12	Replace the ABS unit. Is the repair complete?	-	System OK	-

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DIAGNOSTIC TROUBLE CODE (DTC) 08
RIGHT FRONT WHEEL SPEED SENSOR CONTINUITY FAULT

Circuit Description

The toothed wheel generates a voltage pulse as it moves past the sensor. Each tooth-gap-tooth series on the wheel generates the pulses. The electronic brake control module (EBCM) uses the frequency of these pulses to determine the wheel speed. The voltage generated depends on the air gap between the sensor and the toothed wheel, and on the wheel speed.

Diagnosis

This procedure checks for a malfunctioning wheel speed sensor, a short to ground or to voltage in the wiring, or a contact problem in a connector.

Cause(s)

- The wheel speed sensor is defective.
- There is a problem in the wiring.
- There is a problem with a connector.

Fail Action

ABS action is disabled, and the ABS warning lamp is ON.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This step begins an examination for a defective wheel speed sensor.
4. This step tests the wiring for a short to voltage.
6. This step tests the wiring for a short to ground.
8. This step tests for an open or a high resistance in the wiring.

Diagnostic Aids

Be sure that the speed sensor wiring is properly routed and retained. This will help to prevent false signals due to the pickup of electrical noise.

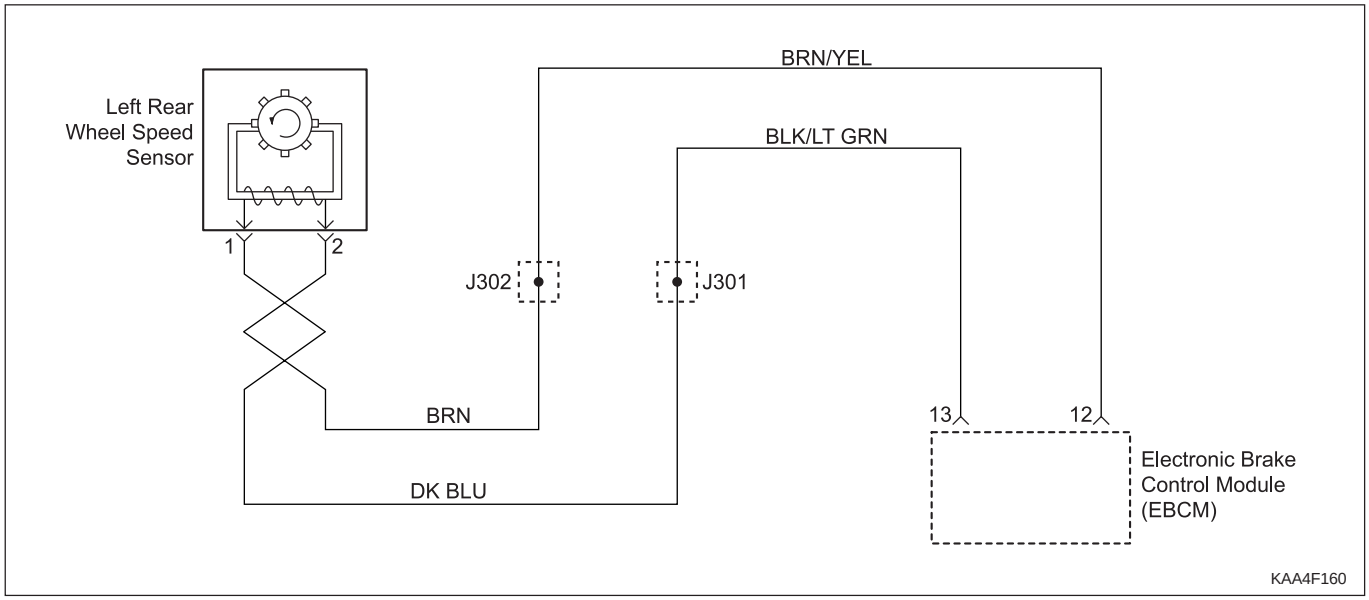
It is very important to perform a thorough inspection of the wiring and the connectors. Failure to inspect the wiring and the connectors carefully and completely may result in misdiagnosis, causing part replacement with the reappearance of the malfunction.

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DTC 08 - Right Front Wheel Speed Sensor Continuity Fault

Step	Action	Value(s)	Yes	No
1	Examine the wheel speed sensor. Are there any signs of physical damage?	-	Go to Step 3	Go to Step 2
2	1. Turn the ignition to LOCK. 2. Disconnect the left rear wheel speed sensor connector. 3. Use a digital voltmeter (DVM) to measure resistance between the sensor terminals. Is the resistance within the specified value at approximately 25-C (77-F)?	1280 - 1920 Ω	Go to Step 4	Go to Step 3
3	Replace the wheel speed sensor. Is the repair complete?	-	System OK	-
4	1. Disconnect the harness from the EBCM. 2. Connect a DVM between ground and one terminal of the wheel speed connector. 3. Turn the ignition to ON. 4. Repeat the above test for the other terminal of the wheel speed connector. Is the voltage for either of these terminals within the specified value?	>1v	Go to Step 5	Go to Step 6
5	Repair the short to voltage in the affected circuit. Is the repair complete?	-	System OK	-
6	1. Turn the ignition to LOCK. 2. Measure the resistance to ground from terminal 14 at the harness EBCM connector. 3. Measure the resistance to ground from terminal 15 at the harness EBCM connector. Is the resistance at either circuit less than the specified value?	∞	Go to Step 7	Go to Step 8
7	Repair the short to ground in the affected circuit. Is the repair complete?	-	System OK	-
8	1. Measure the resistance between terminal 14 at the harness EBCM connector and the harness wheel speed sensor connector. 2. Measure the resistance between terminal 15 at the harness EBCM connector and the harness wheel speed sensor connector. Is the resistance on either circuit within the specified value?	>5 Ω	Go to Step 9	Go to Step 10
9	Repair the open or high resistance in the affected circuit as required. Be sure to check terminals 1 and 7 of connector C113 and junction J103 and J104. Is the repair complete?	-	System OK	-
10	Replace the ABS unit. Is the repair complete?	-	System OK	-

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DIAGNOSTIC TROUBLE CODE (DTC) 05
LEFT REAR WHEEL SPEED SENSOR FAULT

Circuit Description

The toothed wheel generates a voltage pulse as it moves past the sensor. Each tooth-gap-tooth series on the wheel generates the pulses. The electronic brake control module (EBCM) uses the frequency of these pulses to determine the wheel speed. The voltage generated depends on the air gap between the sensor and the toothed wheel, and on the wheel speed.

Diagnosis

This procedure checks for a malfunctioning wheel speed sensor, a short to ground or to voltage in the wiring, or a contact problem in a connector.

Cause(s)

- The wheel speed sensor is defective or discon nected.
- There is a problem in the wiring.
- There is a problem with a connector.

Fail Action

ABS action is disabled, and the ABS warning lamp is ON.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This step begins an examination for a defective wheel speed sensor.
4. This step tests the wiring for a short to voltage.
6. This step tests the wiring for a short to ground.
8. This step tests for an open or a high resistance in the wiring.

Diagnostic Aids

Be sure that the speed sensor wiring is properly routed and retained. This will help to prevent false signals due to the pickup of electrical noise.

It is very important to perform a thorough inspection of the wiring and the connectors. Failure to inspect the wiring and the connectors carefully and completely may result in misdiagnosis, causing part replacement with the reappearance of the malfunction.

Use the scan tool to monitor wheel speeds during a road test. Watch the wheel speeds being displayed on the scan tool to see if any of the readings are unusual, such as one sensor varying in speed from the other three, a signal going intermittently high or low, etc. If this does not identify the intermittent, wet the speed sensor harness on the underside of the vehicle and perform a road test, monitoring the wheel speeds with the scan tool.

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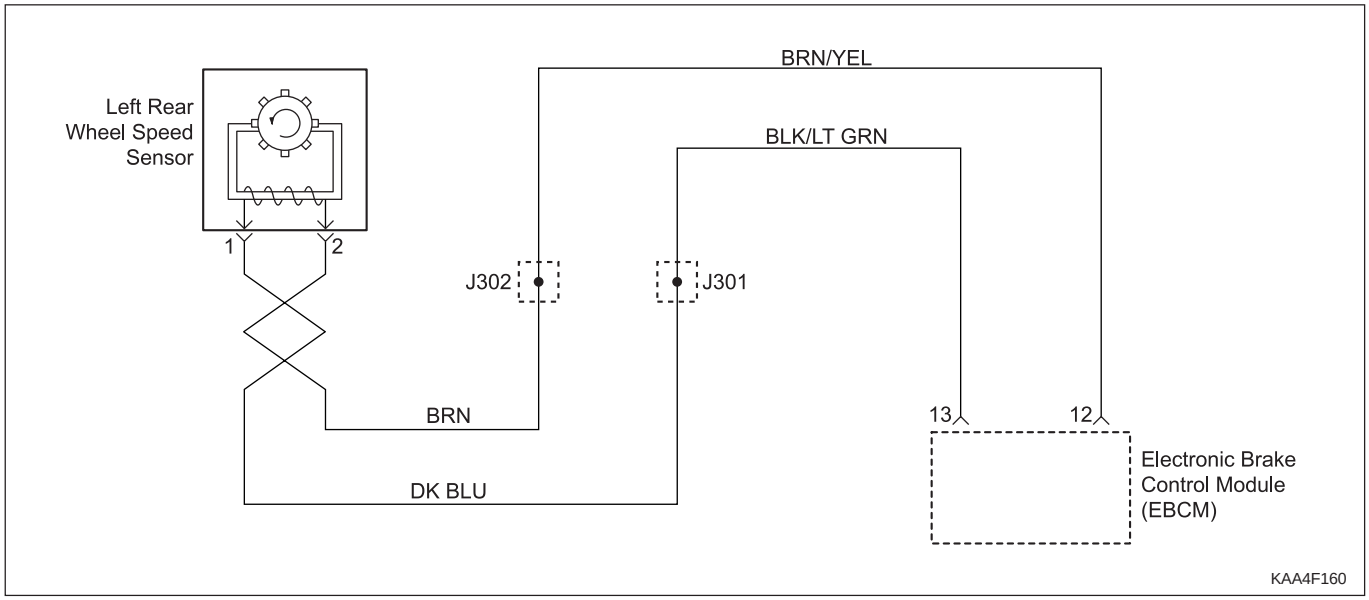
DTC 05 - Left Rear Wheel Speed Sensor Fault

Step	Action	Value(s)	Yes	No
1	Examine the wheel speed sensor. Are there any signs of physical damage?	-	Go to Step 3	Go to Step 2

DTC 05 - Left Rear Wheel Speed Sensor Fault (Cont'd)

Step	Action	Value(s)	Yes	No
2	1. Turn the ignition to LOCK. 2. Disconnect the left rear wheel speed sensor connector. 3. Use a digital voltmeter (DVM) to measure resistance between the sensor terminals. Is the resistance within the specified value at approximately 25-C (77-F)?	1280 - 1920 Ω	Go to Step 4	Go to Step 3
3	Replace the wheel speed sensor. Is the repair complete?	-	System OK	-
4	1. Switch the DVM to the ac millivolt range. 2. Measure the voltage output between the wheel speed sensor terminals while rotating the wheel about 1 revolution per second. Is the output within the specified value?	≈ 70 mv	Go to Step 6	Go to Step 5
5	Replace the speed sensor or the toothed wheel, as required. Is the repair complete?	-	System OK	-
6	1. Disconnect the harness from the EBCM. 2. Connect a DVM between ground and one terminal of the wheel speed connector. 3. Turn the ignition to ON. 4. Repeat the above test for the other terminal of the wheel speed connector. Is the voltage for either of these terminals within the specified value?	>1v	Go to Step 7	Go to Step 8
7	Repair the short to voltage in the affected circuit. Is the repair complete?	-	System OK	-
8	1. Turn the ignition to LOCK. 2. Measure the resistance to ground from terminal 12 at the harness EBCM connector. 3. Measure the resistance to ground from terminal 13 at the harness EBCM connector. Is the resistance at either circuit less than the specified value?	∞	Go to Step 9	Go to Step 10
9	Repair the short to ground in the affected circuit. Is the repair complete?	-	System OK	-
10	1. Measure the resistance between terminal 12 at the harness EBCM connector and the harness wheel speed sensor connector. 2. Measure the resistance between terminal 13 at the harness EBCM connector and the harness wheel speed sensor connector. Is the resistance on either circuit within the specified value?	>5 Ω	Go to Step 11	Go to Step 12
11	Repair the open or the high resistance in the affected circuit, as required. Be sure to check junction J301 and J302. Is the repair complete?	-	System OK	-
12	Replace the ABS unit. Is the repair complete?	-	System OK	-

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DIAGNOSTIC TROUBLE CODE (DTC) 09
LEFT REAR WHEEL SPEED SENSOR CONTINUITY FAULT

Circuit Description

The toothed wheel generates a voltage pulse as it moves past the sensor. Each tooth-gap-tooth series on the wheel generates the pulses. The electronic brake control module (EBCM) uses the frequency of these pulses to determine the wheel speed. The voltage generated depends on the air gap between the sensor and the toothed wheel, and on the wheel speed.

Diagnosis

This procedure checks for a malfunctioning wheel speed sensor, a short to ground or to voltage in the wiring, or a contact problem in a connector.

Cause(s)

- The wheel speed sensor is defective.
- There is a problem in the wiring.
- There is a problem with a connector.

Fail Action

ABS action is disabled, and the ABS warning lamp is ON.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This step begins an examination for a defective wheel speed sensor.
4. This step tests the wiring for a short to voltage.
6. This step tests the wiring for a short to ground.
8. This step tests for an open or a high resistance in the wiring.

Diagnostic Aids

Be sure that the speed sensor wiring is properly routed and retained. This will help to prevent false signals due to the pickup of electrical noise.

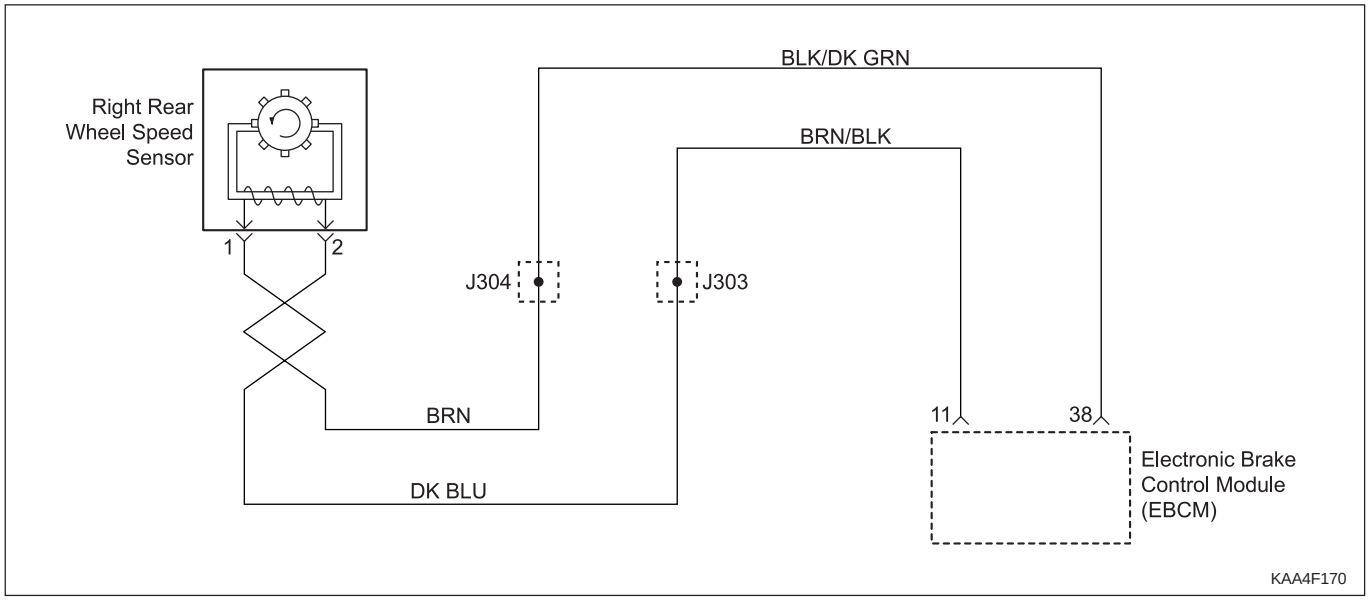
It is very important to perform a thorough inspection of the wiring and the connectors. Failure to inspect the wiring and the connectors carefully and completely may result in misdiagnosis, causing part replacement with the reappearance of the malfunction.

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DTC 09 - Rear Front Wheel Speed Sensor Continuity Fault

Step	Action	Value(s)	Yes	No
1	Examine the wheel speed sensor. Are there any signs of physical damage?	-	Go to Step 3	Go to Step 2
2	1. Turn the ignition to LOCK. 2. Disconnect the left rear wheel speed sensor connector. 3. Use a digital voltmeter (DVM) to measure resistance between the sensor terminals. Is the resistance within the specified value at approximately 25-C (77-F)?	1280 - 1920 Ω	Go to Step 4	Go to Step 3
3	Replace the wheel speed sensor. Is the repair complete?	-	System OK	-
4	1. Disconnect the harness from the EBCM. 2. Connect a DVM between ground and one terminal of the wheel speed connector. 3. Turn the ignition to ON. 4. Repeat the above test for the other terminal of the wheel speed connector. Is the voltage for either of these terminals within the specified value?	>1v	Go to Step 5	Go to Step 6
5	Repair the short to voltage in the affected circuit. Is the repair complete?	-	System OK	-
6	1. Turn the ignition to LOCK. 2. Measure the resistance to ground from terminal 12 at the harness EBCM connector. 3. Measure the resistance to ground from terminal 13 at the harness EBCM connector. Is the resistance at either circuit less than the specified value?	∞	Go to Step 7	Go to Step 8
7	Repair the short to ground in the affected circuit. Is the repair complete?	-	System OK	-
8	1. Measure the resistance between terminal 12 at the harness EBCM connector and the harness wheel speed sensor connector. 2. Measure the resistance between terminal 13 at the harness EBCM connector and the harness wheel speed sensor connector. Is the resistance on either circuit within the specified value?	>5 Ω	Go to Step 9	Go to Step 10
9	Repair the open or high resistance in the affected circuit as required. Be sure to check junction J301 and J302. Is the repair complete?	-	System OK	-
10	Replace the ABS unit. Is the repair complete?	-	System OK	-

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DIAGNOSTIC TROUBLE CODE (DTC) 06
RIGHT REAR WHEEL SPEED SENSOR FAULT

Circuit Description

The toothed wheel generates a voltage pulse as it moves past the sensor. Each tooth-gap-tooth series on the wheel generates the pulses. The electronic brake control module (EBCM) uses the frequency of these pulses to determine the wheel speed. The voltage generated depends on the air gap between the sensor and the toothed wheel, and on the wheel speed.

Diagnosis

This procedure checks for a malfunctioning wheel speed sensor, a short to ground or to voltage in the wiring, or a contact problem in a connector.

Cause(s)

- The wheel speed sensor is defective or disconnected.
- There is a problem in the wiring.
- There is a problem with a connector.

Fail Action

ABS action is disabled, and the ABS warning lamp is ON.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This step begins an examination for a defective wheel speed sensor.
6. This step tests the wiring for a short to voltage.
8. This step tests the wiring for a short to ground.
10. This step tests for an open or high resistance in the wiring.

Diagnostic Aids

Be sure that the speed sensor wiring is properly routed and retained. This will help to prevent false signals due to the pickup of electrical noise.

It is very important to perform a thorough inspection of the wiring and the connectors. Failure to inspect the wiring and the connectors carefully and completely may result in misdiagnosis, causing part replacement with the reappearance of the malfunction.

You can use the scan tool to monitor wheel speeds during a road test. Watch the wheel speeds being displayed on the scan tool to see if any of the readings is unusual, such as one sensor varying in speed from the other three, a signal going intermittently high or low, etc. If this does not identify the intermittent, wet the speed sensor harness on the underside of the vehicle and perform a road test, monitoring the wheel speeds with the scan tool.

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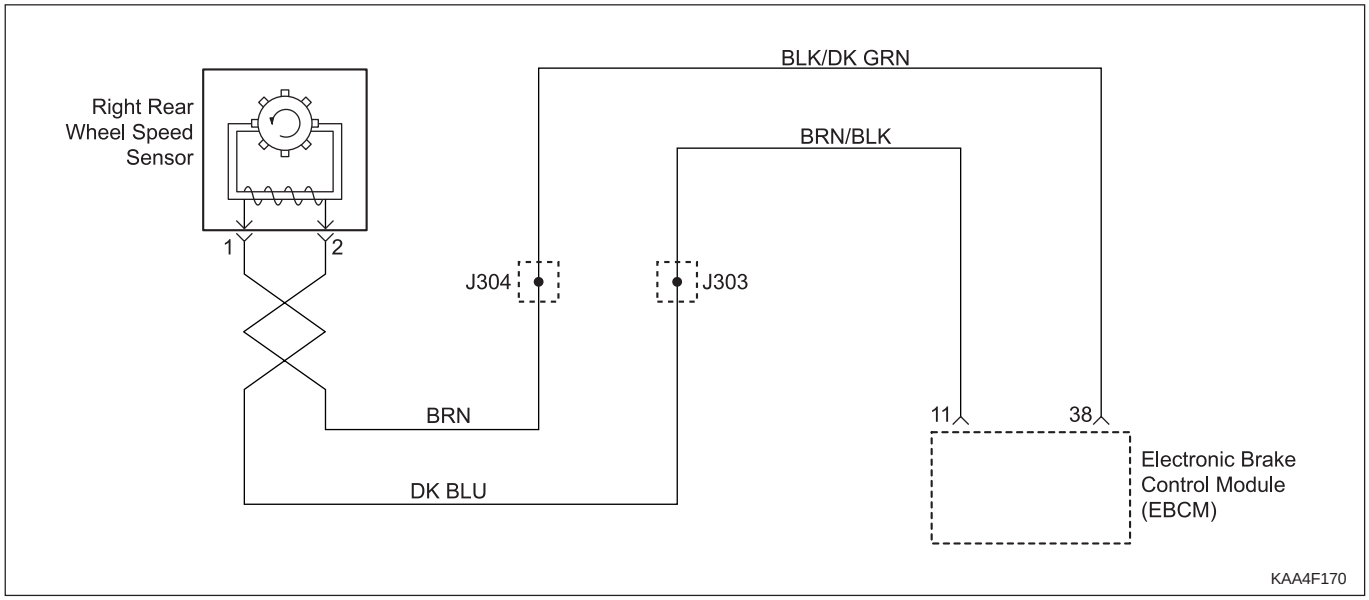
DTC 06 - Right Rear Wheel Speed Sensor Fault

Step	Action	Value(s)	Yes	No
1	Examine the wheel speed sensor. Are there any signs of physical damage?	-	Go to Step 3	Go to Step 2

DTC 05 - Left Rear Wheel Speed Sensor Fault (Cont'd)

Step	Action	Value(s)	Yes	No
2	1. Turn the ignition to LOCK. 2. Disconnect the left rear wheel speed sensor connector. 3. Use a digital voltmeter (DVM) to measure resistance between the sensor terminals. Is the resistance within the specified value at approximately 25-C (77-F)?	1280 - 1920 Ω	Go to Step 4	Go to Step 3
3	Replace the wheel speed sensor. Is the repair complete?	-	System OK	-
4	1. Switch the DVM to the ac millivolt range. 2. Measure the voltage output between the wheel speed sensor terminals while rotating the wheel about 1 revolution per second. Is the output within the specified value?	≈ 70 mv	Go to Step 6	Go to Step 5
5	Replace the speed sensor or the toothed wheel, as required. Is the repair complete?	-	System OK	-
6	1. Disconnect the harness from the EBCM. 2. Connect a DVM between ground and one terminal of the wheel speed connector. 3. Turn the ignition to ON. 4. Repeat the above test for the other terminal of the wheel speed connector. Is the voltage for either of these terminals within the specified value?	>1v	Go to Step 7	Go to Step 8
7	Repair the short to voltage in the affected circuit. Is the repair complete?	-	System OK	-
8	1. Turn the ignition to LOCK. 2. Measure the resistance to ground from terminal 38 at the harness EBCM connector. 3. Measure the resistance to ground from terminal 11 at the harness EBCM connector. Is the resistance at either circuit less than the specified value?	∞	Go to Step 9	Go to Step 10
9	Repair the short to ground in the affected circuit. Is the repair complete?	-	System OK	-
10	1. Measure the resistance between terminal 38 at the harness EBCM connector and the harness wheel speed sensor connector. 2. Measure the resistance between terminal 11 at the harness EBCM connector and the harness wheel speed sensor connector. Is the resistance on either circuit within the specified value?	>5 Ω	Go to Step 11	Go to Step 12
11	Repair the open or the high resistance in the affected circuit, as required. Be sure to check junction J303 and J304. Is the repair complete?	-	System OK	-
12	Replace the ABS unit. Is the repair complete?	-	System OK	-

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DIAGNOSTIC TROUBLE CODE (DTC) 10
RIGHT REAR WHEEL SPEED SENSOR CONTINUITY FAULT

Circuit Description

The toothed wheel generates a voltage pulse as it moves past the sensor. Each tooth-gap-tooth series on the wheel generates the pulses. The electronic brake control module (EBCM) uses the frequency of these pulses to determine the wheel speed. The voltage generated depends on the air gap between the sensor and the toothed wheel, and on the wheel speed.

Diagnosis

This procedure checks for a malfunctioning wheel speed sensor, a short to ground or to voltage in the wiring, or a contact problem in a connector.

Cause(s)

- The wheel speed sensor is defective or disconnected.
- There is a problem in the wiring.
- There is a problem with a connector.

Fail Action

ABS action is disabled, and the ABS warning lamp is ON.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This step begins an examination for a defective wheel speed sensor.
4. This step tests the wiring for a short to voltage.
6. This step tests the wiring for a short to ground.
8. This step tests for an open or a high resistance in the wiring.

Diagnostic Aids

Be sure that the speed sensor wiring is properly routed and retained. This will help to prevent false signals due to the pickup of electrical noise.

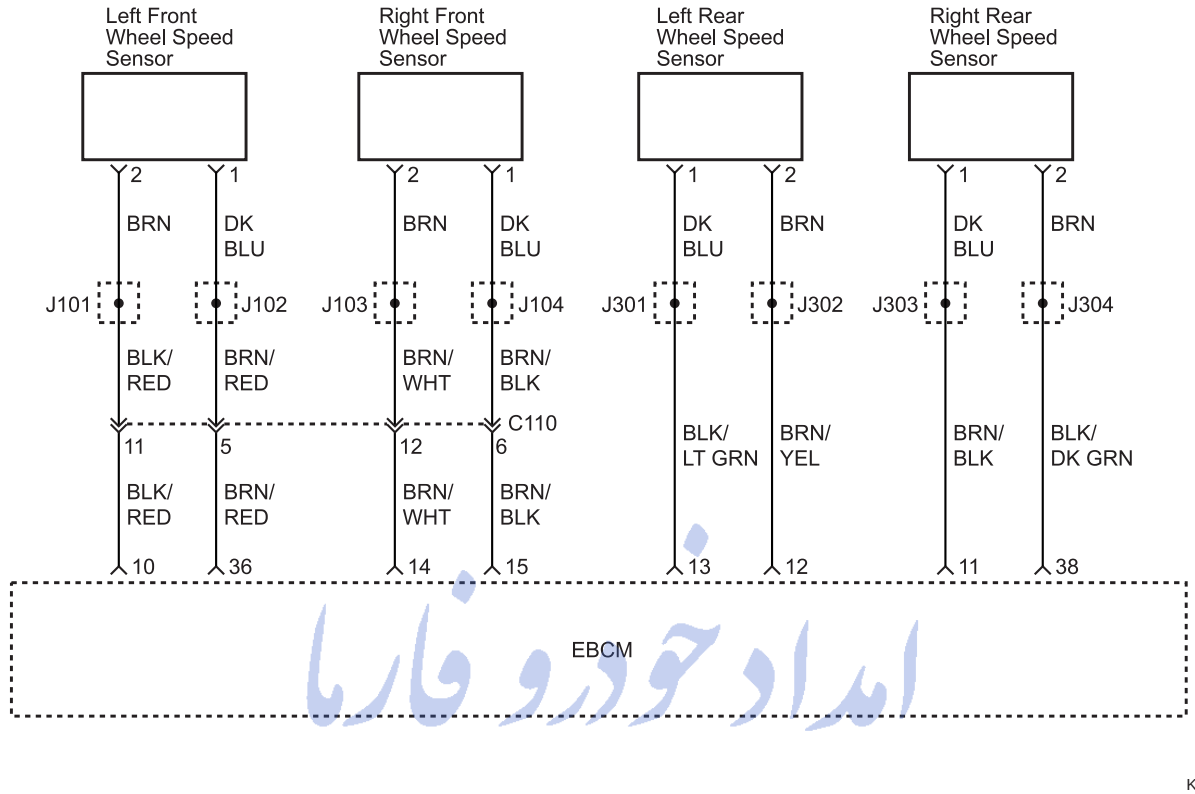
It is very important to perform a thorough inspection of the wiring and the connectors. Failure to inspect the wiring and the connectors carefully and completely may result in misdiagnosis, causing part replacement with the reappearance of the malfunction.

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DTC 10 - Right Rear Wheel Speed Sensor Continuity Fault

Step	Action	Value(s)	Yes	No
1	Examine the wheel speed sensor. Are there any signs of physical damage?	-	Go to Step 3	Go to Step 2
2	1. Turn the ignition to LOCK. 2. Disconnect the left rear wheel speed sensor connector. 3. Use a digital voltmeter (DVM) to measure resistance between the sensor terminals. Is the resistance within the specified value at approximately 25-C (77-F)?	1280 - 1920 Ω	Go to Step 4	Go to Step 3
3	Replace the wheel speed sensor. Is the repair complete?	-	System OK	-
4	1. Disconnect the harness from the EBCM. 2. Connect a DVM between ground and one terminal of the wheel speed connector. 3. Turn the ignition to ON. 4. Repeat the above test for the other terminal of the wheel speed connector. Is the voltage for either of these terminals within the specified value?	>1v	Go to Step 5	Go to Step 6
5	Repair the short to voltage in the affected circuit. Is the repair complete?	-	System OK	-
6	1. Turn the ignition to LOCK. 2. Measure the resistance to ground from terminal 38 at the harness EBCM connector. 3. Measure the resistance to ground from terminal 11 at the harness EBCM connector. Is the resistance at either circuit less than the specified value?	∞	Go to Step 7	Go to Step 8
7	Repair the short to ground in the affected circuit. Is the repair complete?	-	System OK	-
8	1. Measure the resistance between terminal 38 at the harness EBCM connector and the harness wheel speed sensor connector. 2. Measure the resistance between terminal 11 at the harness EBCM connector and the harness wheel speed sensor connector. Is the resistance on either circuit within the specified value?	>5 Ω	Go to Step 9	Go to Step 10
9	Repair the open or high resistance in the affected circuit as required. Be sure to check junction J303 and J304. Is the repair complete?	-	System OK	-
10	Replace the ABS unit. Is the repair complete?	-	System OK	-

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تلفن شبانه روزی: ۰۹۱۲۸۶۲۰۸۵
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DIAGNOSTIC TROUBLE CODE (DTC) 11 WHEEL SPEED SENSOR FREQUENCY ERROR

Circuit Description

The toothed wheel generates a voltage pulse as it moves past the wheel speed sensor. Each tooth-gap-tooth series on the wheel generates the pulses. The electronic brake control module (EBCM) uses the frequency of these pulses to determine wheel speed. The voltage generated depends on the air gap between the wheel speed sensor and the toothed wheel, and on the wheel speed.

Diagnosis

This DTC will set when the EBCM cannot identify which wheel speed sensor is causing the malfunction. It is nec-essary to check all wheel speed sensors and associated wiring to determine the cause of the DTC.

Cause(s)

- Incorrect number of teeth on the toothed wheel.
- Damaged or broken teeth on the toothed wheel.
- Discontinuity or short in speed wheel speed sensor wiring.

Fail Action

Antilock brake system (ABS) action is disabled and the ABS warning lamp is ON.

Test Description

The number(s) below refer to Step(s) on the diagnostic table.

1. This step begins the examination of the front wheel speed sensor sensors.
3. This step checks for a problem with one of the front toothed rings.
5. This step checks the front wheel speed sensors.
7. This step checks for shorts in a front wheel speed sensor harness.
9. This step checks for opens in a front wheel speed sensor harness.
11. This step begins a check of the rear wheel speed sensors.
13. This step checks for a problem with one of the rear toothed rings.
15. This step checks the rear wheel speed sensors.
17. This step checks for shorts in a rear wheel speed sensor harness.
19. This step checks for opens in a rear wheel speed sensor harness.

Diagnostic Aids

DTC 11 may be set by running the scan tool auto test if the throttle angle readings are not updating while in the data list mode. If this is the case, clear the DTCs, disconnect the scan tool, and road test the vehicle to at least 25 km/h (15 mph) to see if the DTC resets.

Check the toothed wheels for any large grooves, gouges, marks, etc. that might influence the tooth's signal at the wheel speed sensor. Also, check for a buildup of foreign material in the gaps between the teeth in the toothed wheel, as this material may cause this malfunction.

A badly worn hub/bearing assembly may cause this malfunction. The wheel speed sensor-to-toothed wheel air gap may change excessively due to bearing play.

If an improper rear hub assembly or front outer constant velocity joint is installed, one with a toothed wheel containing the incorrect number of teeth, this DTC can set. Be sure that all the toothed wheels have 52 teeth.

DTC 11 - Wheel Speed Sensor Frequency Error

Step	Action	Value(s)	Yes	No
1	Visually inspect the wiring for the front wheel speed sensors. Is there any damage?	-	Go to Step 2	Go to Step 3
2	Repair or replace components, as required. Is the repair complete?	-	System OK	-
3	Check that the correct outer constant velocity (CV) joints are installed on the vehicle. They should have speed rings with 52 teeth. Is one of these incorrect?	-	Go to Step 4	Go to Step 5
5	Replace the incorrect outer CV joint with the proper unit. Is the repair complete?	-	System OK	-
6	1. Disconnect the wheel speed sensor harnesses from the wheel speed sensor connectors. 2. Measure the wheel speed sensor resistance at the wheel speed sensor connector terminals. Does the resistance fall within the specified values for both wheel speed sensors?	1280 - 1920 Ω	Go to Step 7	Go to Step 6
7	Replace the faulty wheel speed sensor. Is the repair complete?	-	System OK	-
8	1. Disconnect the ABS control module connector. 2. Check each wheel speed sensor harness for a short circuit between its wires with a digital ohmmeter attached to the two terminals at the harness side of the wheel speed sensor connector. 3. Also check each wheel speed sensor harness wire for a short to ground from the connector terminals. Is there any short circuit in either wheel speed sensor harness?	-	Go to Step 9	Go to Step 9
9	Repair the short circuit in the wiring or from a wiring harness to ground. Is the repair complete?	-	System OK	-

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DTC 11 - Wheel Speed Sensor Frequency Error (Cont'd)

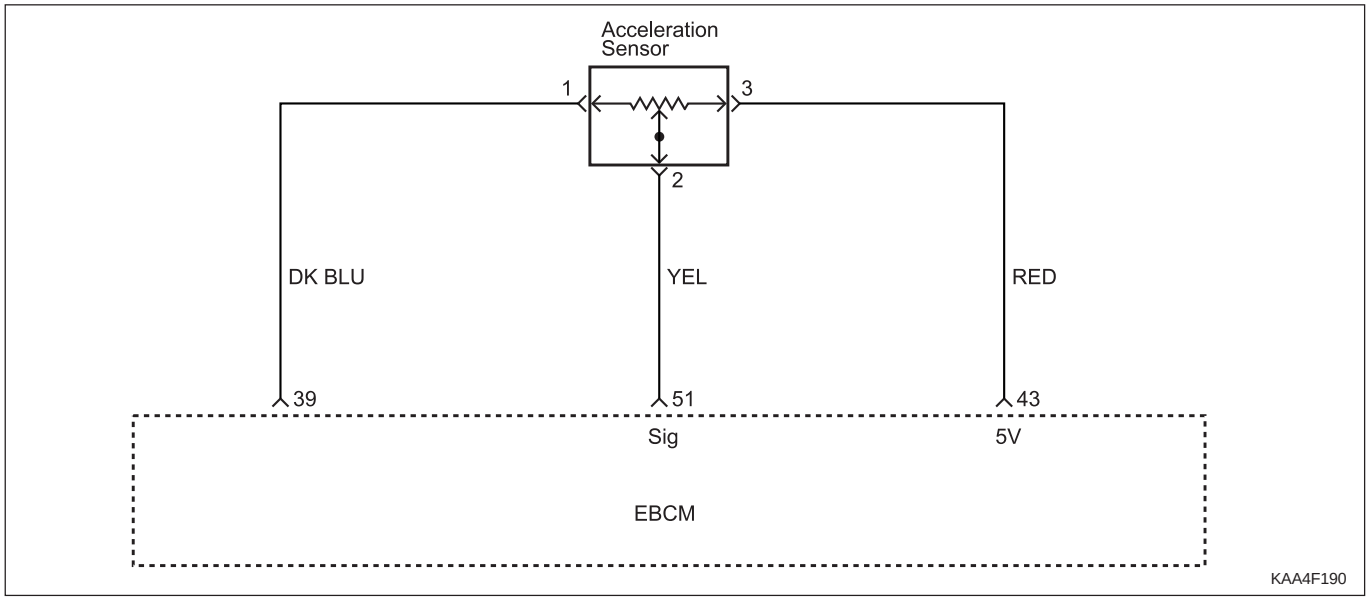
Step	Action	Value(s)	Yes	No
9	Check the continuity of the wiring in both front wheel speed sensor circuits between the EBCM connector and the wheel speed sensor connector on each side of the vehicle. • The left side uses terminals 10 and 36 at the EBCM connector. • The right side uses terminals 14 and 15 at the EBCM connector. Is continuity good for both harnesses?	-	Go to Step 11	Go to Step 10
10	Repair the discontinuity found in the front wheel speed sensor harness or connectior C113. Is the repair complete?	-	System OK	-
11	1. Visually inspect the wiring for the rear wheel speed sensors. 2. Check that the wheel speed sensors are properly mounted and that the retaining bolts are properly tightened. Is there any damage?	-	Go to Step 12	Go to Step 13
12	Repair or replace the components, as required. Is the repair complete?	-	System OK	-
13	Remove each wheel speed sensor from the rear axle and inspect the toothed ring through the wheel speed sensor mounting holes. • Make sure that the toothed ring has 52 teeth. • Check for any damaged or missing teeth. • Check that the ring is properly positioned under the wheel speed sensor. Is there any damage or other fault with either speed ring?	-	Go to Step 14	Go to Step 15
14	Replace the rear wheel hub with the proper unit. Is the repair complete?	-	System OK	-
15	1. Disconnect the rear wheel speed sensor harnesses from the wheel speed sensor connectors. 2. Measure the wheel speed sensor resistance at the wheel speed sensor connector terminals. Does the resistance fall within the specified values for both wheel speed sensors?	1280 - 1920 Ω	Go to Step 17	Go to Step 16
16	Replace the faulty wheel speed sensor. Is the repair complete?	-	System OK	-

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تلفن شبانه روزی: ۰۸۵-۳۲۲۶۸۸۸۶
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DTC 11 - Wheel Speed Sensor Frequency Error (Cont'd)

Step	Action	Value(s)	Yes	No
17	1. The ABS control module connector should still be disconnected. Disconnect it now if it is not. 2. Check each wheel speed sensor harness for a short circuit between its wires with a digital ohmmeter attached to the two terminals at the harness side of the wheel speed sensor connector. 3. Also, check each wheel speed sensor harness wire for a short to ground from the connector terminals. Is there any short circuit in either wheel speed sensor harness?	-	Go to Step 18	Go to Step 19
18	Repair the short circuit in the wiring or from a wire to ground. Is the repair complete?	-	System OK	-
19	Check the continuity of the wiring in both rear wheel speed sensor circuits between the EBCM connector and the wheel speed sensor connector on each side of the vehicle. • The left side uses terminals 12 and 13 at the EBCM connector. • The right side uses terminals 11 and 38 at the EBCM connector. Is continuity good for both harnesses?	-	Go to Step 21	Go to Step 20
20	Repair the discontinuity found in the rear wheel speed sensor harness. Is the repair complete?	-	System OK	-
21	Replace the ABS unit. Is the repair complete?	-	System OK	-

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DIAGNOSTIC TROUBLE CODE (DTC) 42
ACCELERATION SENSOR FAULT

Circuit Description

The acceleration sensor provides a voltage signal that changes in relation to the acceleration of vehicle. The signal voltage will vary from about 1.95 to 3.45 volt. The electronic brake control module (EBCM) monitor a signal voltage of deceleration in the vehicle.

Diagnosis

This procedure checks for a malfunctioning acceleration sensor, a short to ground or to voltage in the wiring, or a contact problem in a connector.

Cause

- The vertical acceleration sensor is defective or dis connected
- There is a problem in the wiring
- There is a problem with a connector
- Wrong installed vertical acceleration sensor

Fail Action

ABS action is disabled, and the ABS warning lamp is ON.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. This step checks for the voltage reference from the EBCM.
5. This step checks for the voltage signal from the acceleration sensor.

Diagnostic Aids

Be sure that the acceleration sensor wiring is properly routed and retained.

It is very important to perform a thorough inspection of the wiring and the connectors carefully and completely may result in misdiagnosis, causing part replacement with the reappearance of the malfunction.

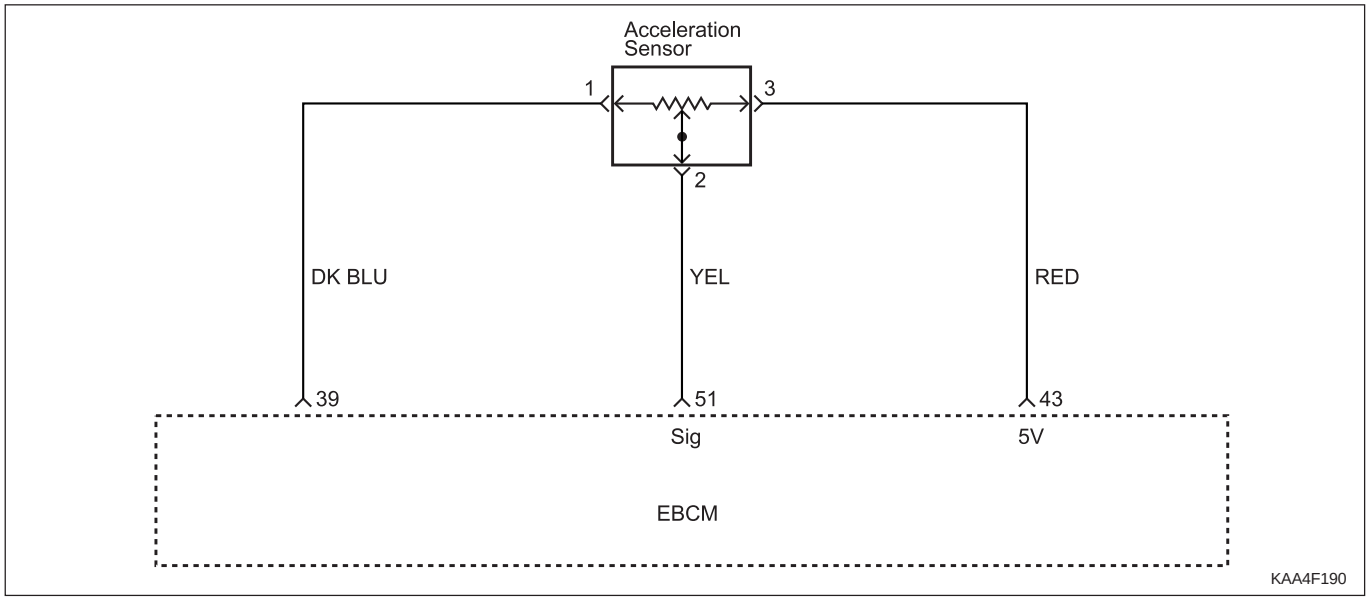
You can use the scan tool to monitor acceleration sensor during a road test. Watch the acceleration sensor being displayed on the scan tool to see if any of the reading is unusual.

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DTC 42 - Acceleration Sensor Fault

Step	Action	Value(s)	Yes	No
1	Examine the acceleration sensor. Are there any signs of physical damage?	-	Go to Step 3	Go to Step 2
2	1. Turn the ignition switch to ON. 2. Use a digital voltmeter (DVM) to measure the voltage between terminal 39 and 43 of EBCM. Is the voltage within the specified value?	4.75 - 5.25 v	Go to Step 5	Go to Step 4
3	Replace the acceleration sensor. Is the repair complete?	-	System OK	-
4	Repair the open in the affected circuit or replace the acceleration sensor, if necessary. Is the repair complete?	-	System OK	-
5	1. Place the acceleration sensor horizontally and let the acceleration sensor 2. Turn the ignition switch to ON. 3. Use a digital voltmeter (DVM) to measure the voltage between terminal 39 and 51 of EBCM. Is the voltage within the specified value?	1.95 - 3.45 v	Go to Step 7	Go to Step 6
6	Repair the open in the affected circuit or replace the acceleration sensor, if necessary. Is the repair complete?	-	System OK	-
7	Replace the ABS unit. Is the repair complete?	-	System OK	-

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DIAGNOSTIC TROUBLE CODE (DTC) 43
ACCELERATION SENSOR CONTINUITY FAULT

Circuit Description

The acceleration sensor provides a voltage signal that changes in relation to the acceleration of vehicle. The signal voltage will vary from about 1.95 to 3.45 volt. The electronic brake control module (EBCM) monitor a signal voltage of deceleration in the vehicle.

Diagnosis

This procedure checks for a malfunctioning acceleration sensor, a short to ground or to voltage in the wiring, or a contact problem in a connector.

Cause

- The vertical acceleration sensor is defective or dis connected
- There is a problem in the wiring
- There is a problem with a connector
- Wrong installed vertical acceleration sensor

Fail Action

ABS action is disabled, and the ABS warning lamp is ON.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. This step checks for the voltage reference from the EBCM.
5. This step checks for the voltage signal from the acceleration sensor.

Diagnostic Aids

Be sure that the acceleration sensor wiring is properly routed and retained.

It is very important to perform a thorough inspection of the wiring and the connectors carefully and completely may result in misdiagnosis, causing part replacement with the reappearance of the malfunction.

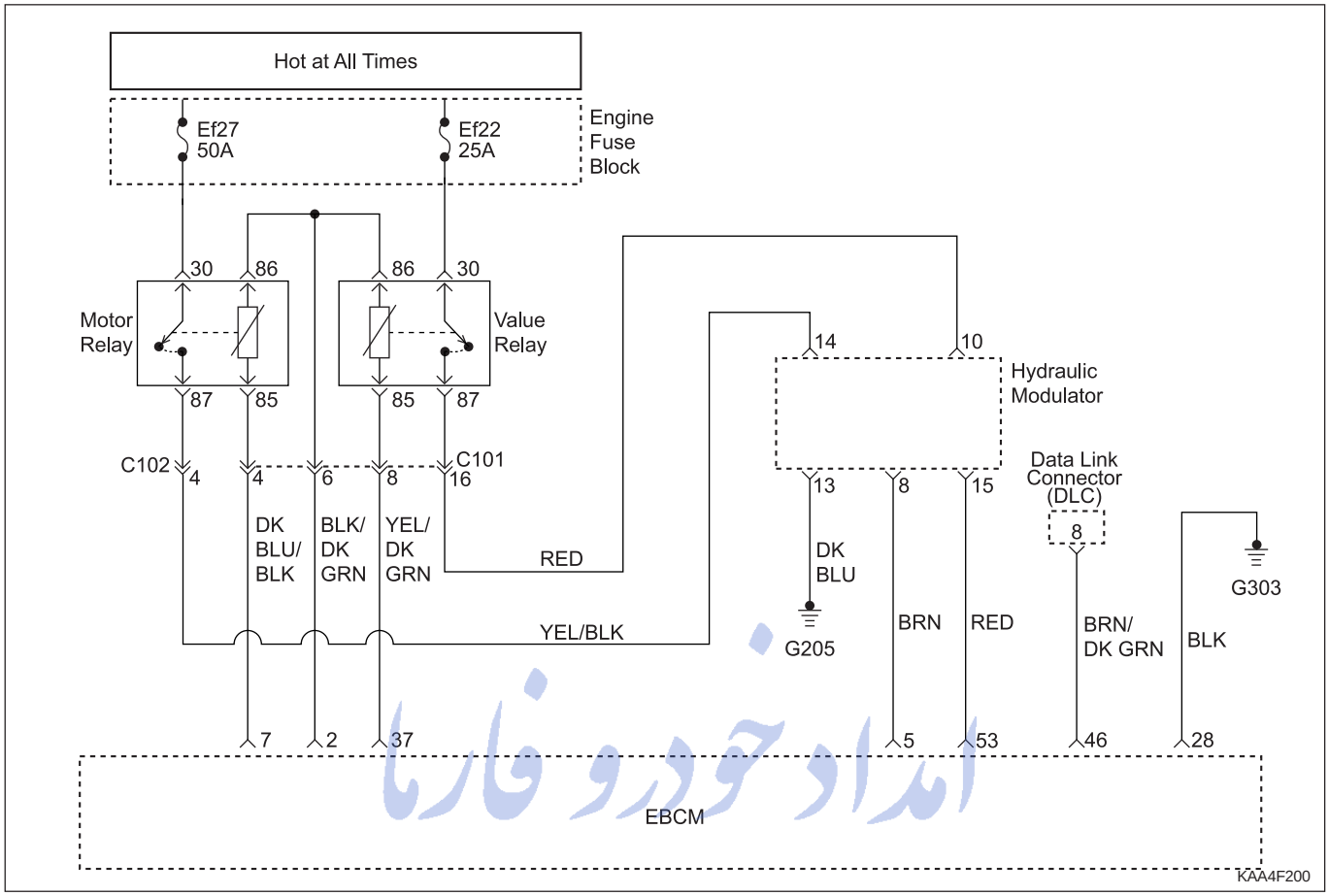
You can use the scan tool to monitor acceleration sensor during a road test. Watch the acceleration sensor being displayed on the scan tool to see if any of the reading is unusual.

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DTC 43 - Acceleration Sensor Continuity Fault

Step	Action	Value(s)	Yes	No
1	Examine the acceleration sensor. Are there any signs of physical damage?	-	Go to Step 3	Go to Step 2
2	1. Turn the ignition switch to ON. 2. Use a digital voltmeter (DVM) to measure the voltage between terminal 39 and 43 of EBCM. Is the voltage within the specified value?	4.75 - 5.25 v	Go to Step 5	Go to Step 4
3	Replace the acceleration sensor. Is the repair complete?	-	System OK	-
4	Repair the open in the affected circuit or replace the acceleration sensor, if necessary. Is the repair complete?	-	System OK	-
5	1. Place the acceleration sensor horizontally and let the acceleration sensor 2. Turn the ignition switch to ON. 3. Use a digital voltmeter (DVM) to measure the voltage between terminal 39 and 51 of EBCM. Is the voltage within the specified value?	1.95 - 3.45 v	Go to Step 7	Go to Step 6
6	Repair the open in the affected circuit or replace the acceleration sensor, if necessary. Is the repair complete?	-	System OK	-
7	Replace the ABS unit. Is the repair complete?	-	System OK	-

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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DIAGNOSTIC TROUBLE CODE (DTC) 13/14
LEFT FRONT INLET AND OUTLET VALVE SOLENOID FAULT

Circuit Description

The solenoid valve coil circuits are supplied with power from the battery when the valve relay is energized. Switched ground is provided by the electronic brake control module (EBCM) to each coil.

Diagnosis

This procedure checks whether the left front inlet and outlet valves are functioning.

Cause(s)

- A valve has failed.
- A solenoid coil is open or shorted.

Fail Action

ABS is disabled, and the ABS warning lamp is turned ON for the remainder of the ignition cycle. If the failure is intermittent, the EBCM will enable the system at the next ignition cycle and set a history DTC.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

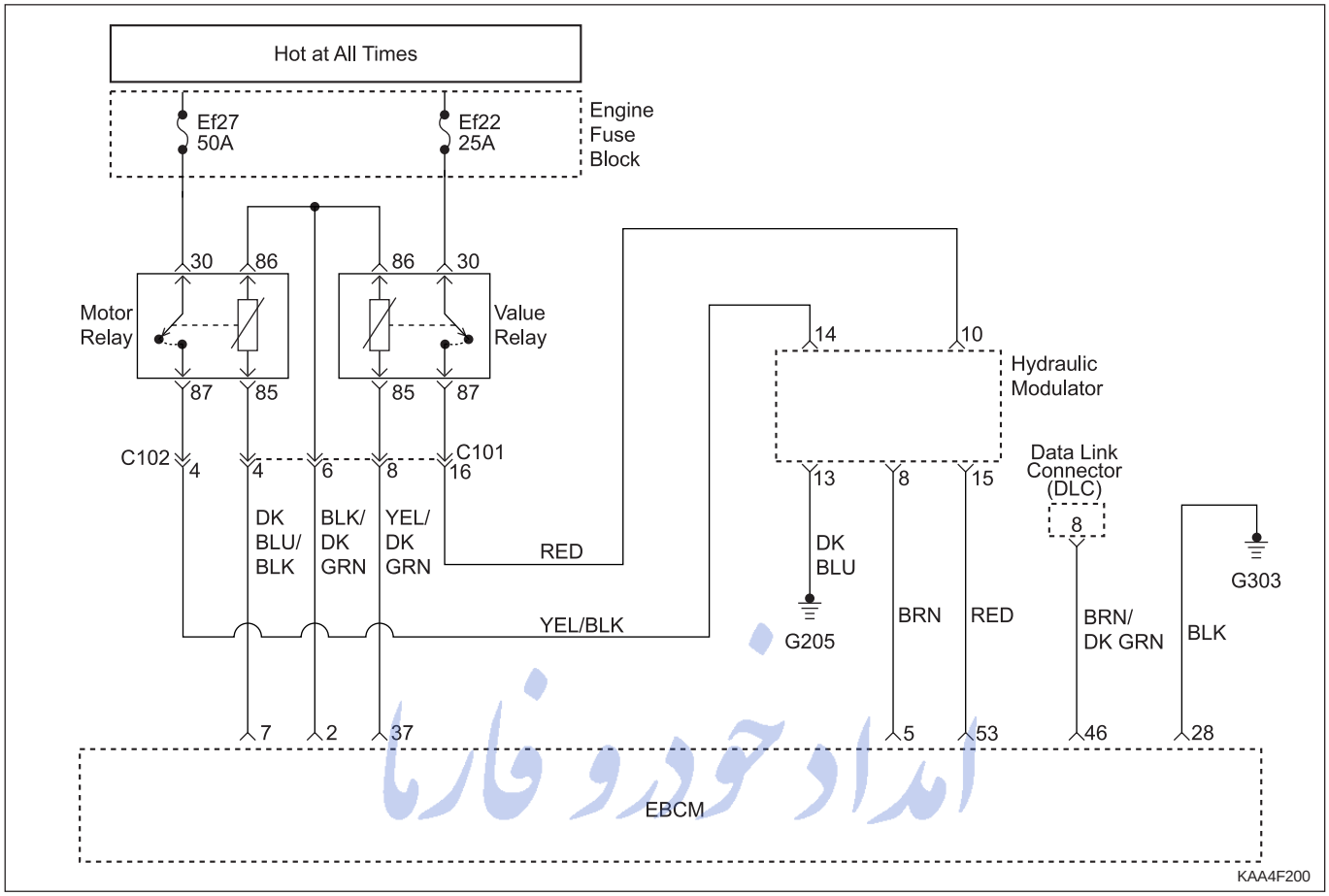
1. This step begins the test of the inlet valve.
3. This step tests the outlet valve.

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DTC 13/14 - Left Front Inlet and Outlet Valve Solenoid Fault

Step	Action	Value(s)	Yes	No
1	1. Raise and suitably support the vehicle at the corner being tested. 2. Turn the ignition to ON. 3. Install the scan tool to the data link connector (DLC) and select “Wheel front left” to begin the solenoid tests at that wheel. This will test both the inlet and the outlet valves. 4. When the scan tool indicates “Pressure hold”, press and hold the brake pedal until the end of the test. 5. Have an assistant attempt to rotate the wheel. Can the wheel be rotated?	-	Go to Step 2	Go to Step 6
2	1. Maintain pressure on the brake pedal. 2. When the scan tool indicates “Pressure increase”, have an assistant attempt to rotate the wheel again. Can the wheel be rotated now?	-	Go to Step 6	Go to Step 3
3	1. Maintain pressure on the brake pedal. 2. When the scan tool indicates “Pressure release on”, have an assistant attempt to rotate the wheel again. Can the wheel be rotated?	-	Go to Step 7	Go to Step 6
4	1. Release brake pedal pressure when the scan tool indicates “Pressure release off”. 2. Clear all DTCs. 3. Road test the vehicle. Does the DTC set again?	-	Go to Step 6	Go to Step 5
5	1. Check the wiring harness and connector terminals for an intermittent problem. 2. Repair any problem found. Is the repair complete?	-	System OK	-
6	Replace the ABS unit. Is the repair complete?	-	System OK	-

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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DIAGNOSTIC TROUBLE CODE (DTC) 15/16
RIGHT FRONT INLET AND OUTLET VALVE SOLENOID FAULT

Circuit Description

The solenoid valve coil circuits are supplied with power from the battery when the valve relay is energized. Switched ground is provided by the electronic brake control module (EBCM) to each coil.

Diagnosis

This procedure checks whether the right front inlet and outlet valves are functioning.

Cause(s)

- A valve has failed.
- A solenoid coil is open or shorted.

Fail Action

ABS is disabled, and the ABS warning lamp is turned ON for the remainder of the ignition cycle. If the failure is intermittent, the EBCM will enable the system at the next ignition cycle and set a history DTC.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

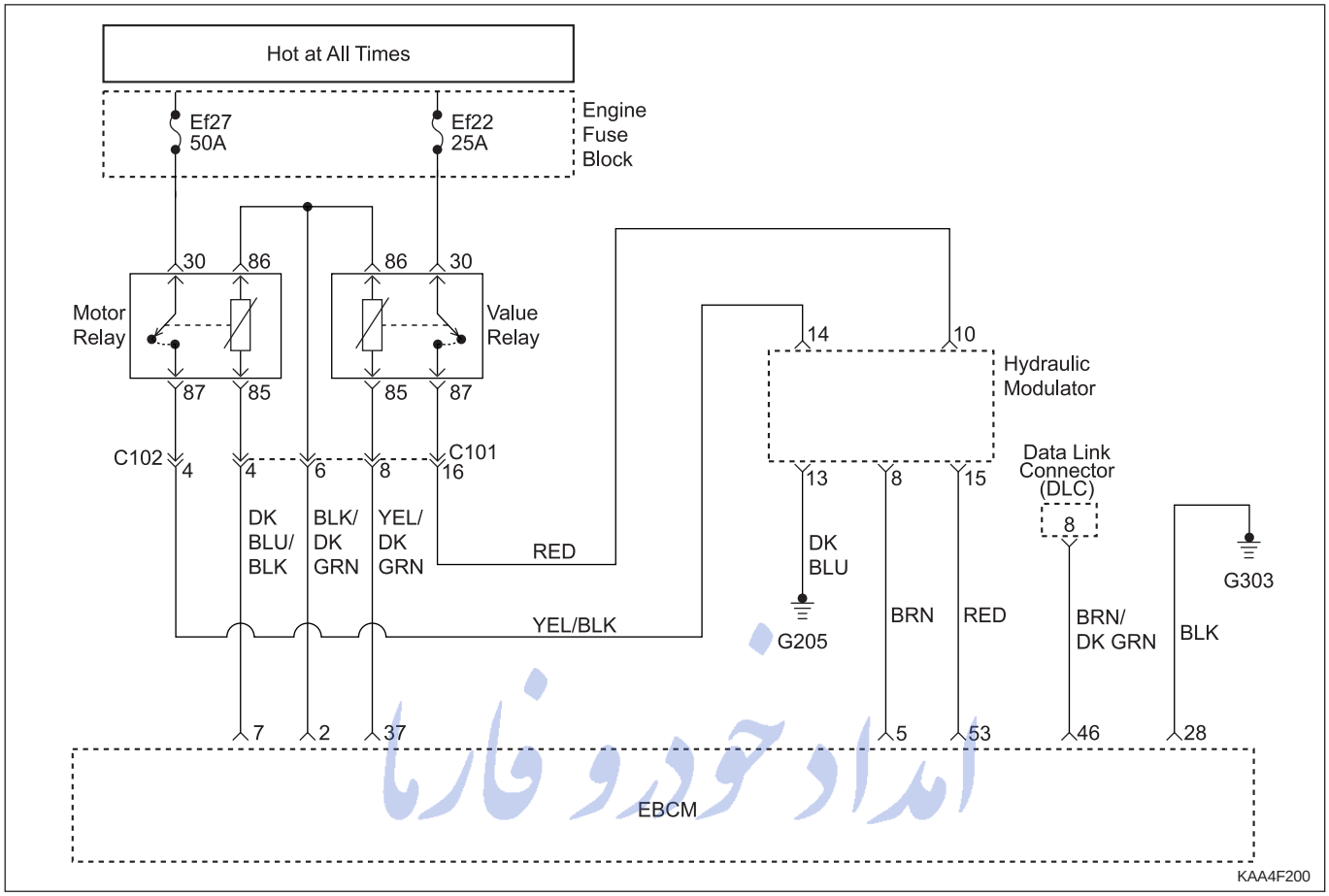
1. This begins the test of the inlet valve.
3. This tests the outlet valve.

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DTC 15/16 - Right Front Inlet and Outlet Valve Solenoid Fault

Step	Action	Value(s)	Yes	No
1	1. Raise and suitably support the vehicle at the corner being tested. 2. Turn the ignition to ON. 3. Install the scan tool to the data link connector (DLC) and select “Wheel front right” to begin the solenoid tests at that wheel. This will test both the inlet and the outlet valves. 4. When the scan tool indicates “Pressure hold”, press and hold the brake pedal until the end of the test. 5. Have an assistant attempt to rotate the wheel. Can the wheel be rotated?	-	Go to Step 2	Go to Step 6
2	1. Maintain pressure on the brake pedal. 2. When the scan tool indicates “Pressure increase”, have an assistant attempt to rotate the wheel again. Can the wheel be rotated now?	-	Go to Step 6	Go to Step 3
3	1. Maintain pressure on the brake pedal. 2. When the scan tool indicates “Pressure release on”, have an assistant attempt to rotate the wheel again. Can the wheel be rotated?	-	Go to Step 7	Go to Step 6
4	1. Release brake pedal pressure when the scan tool indicates “Pressure release off”. 2. Clear all DTCs. 3. Road test the vehicle. Does the DTC set again?	-	Go to Step 6	Go to Step 5
5	1. Check the wiring harness and connector terminals for an intermittent problem. 2. Repair any problem found. Is the repair complete?	-	System OK	-
6	Replace the ABS unit. Is the repair complete?	-	System OK	-

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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DIAGNOSTIC TROUBLE CODE (DTC) 17/18
LEFT REAR INLET AND OUTLET VALVE SOLENOID FAULT

Circuit Description

The solenoid valve coil circuits are supplied with power from the battery when the valve relay is energized. Switched ground is provided by the electronic brake control module (EBCM) to each coil.

Diagnosis

This procedure checks whether the left rear inlet and outlet valves are functioning.

Cause(s)

- A valve has failed.
- A solenoid coil is open or shorted.

Fail Action

ABS is disabled, and the ABS warning lamp is turned ON for the remainder of the ignition cycle. If the failure is intermittent, the EBCM will enable the system at the next ignition cycle and set a history DTC.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

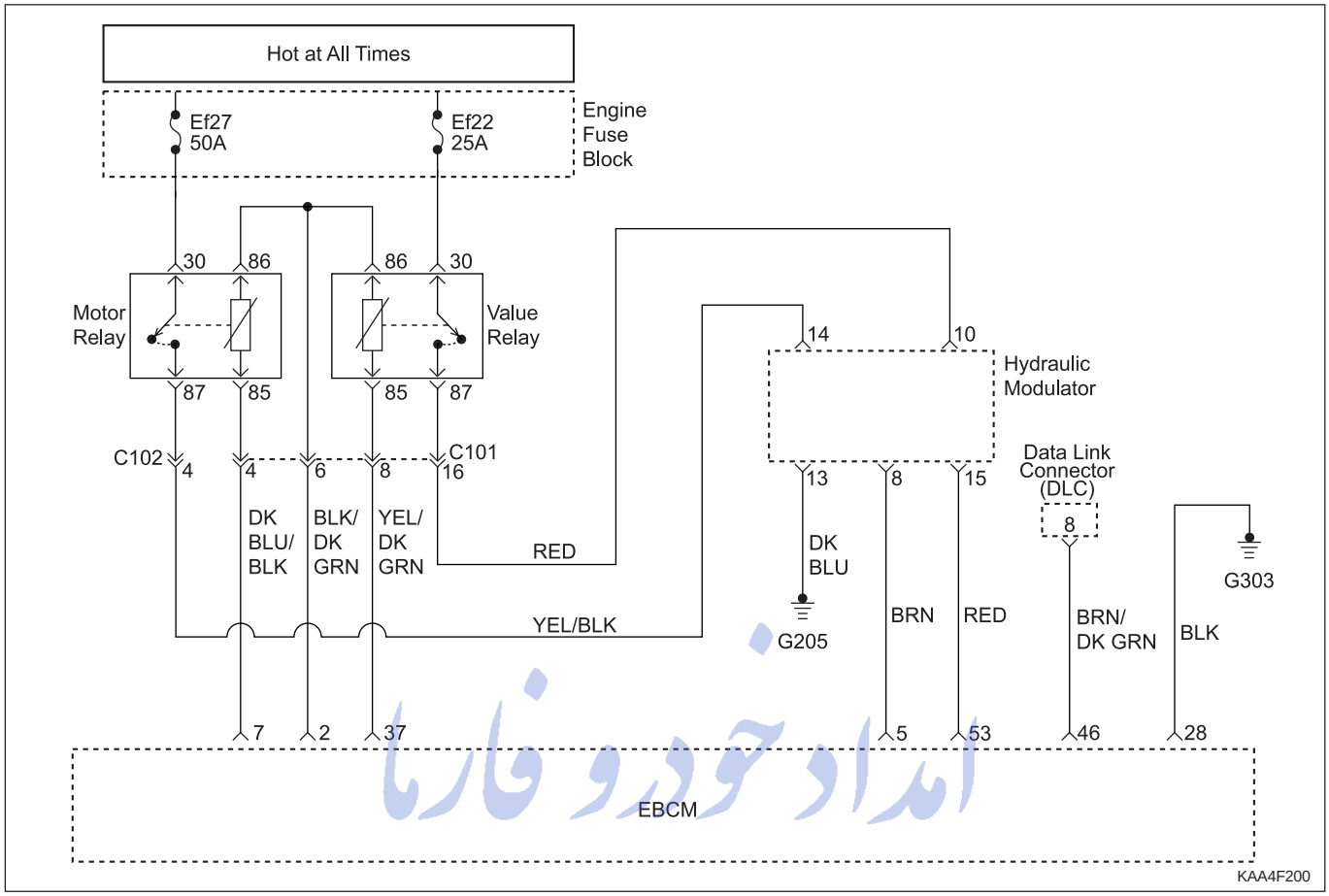
1. This begins the test of the inlet valve.
3. his tests the outlet valve.

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DTC 17/18 - Left Front Inlet and Outlet Valve Solenoid Fault

Step	Action	Value(s)	Yes	No
1	1. Raise and suitably support the vehicle. 2. Turn the ignition to ON. 3. Install the scan tool to the data link connector (DLC) and select “Wheel front right” to begin the solenoid tests at that wheel. This will test both the inlet and the outlet valves. 4. When the scan tool indicates “Pressure hold”, press and hold the brake pedal until the end of the test. 5. Have an assistant attempt to rotate the wheel. Can the wheel be rotated?	-	Go to Step 2	Go to Step 6
2	1. Maintain pressure on the brake pedal. 2. When the scan tool indicates “Pressure increase”, have an assistant attempt to rotate the wheel again. Can the wheel be rotated now?	-	Go to Step 6	Go to Step 3
3	1. Maintain pressure on the brake pedal. 2. When the scan tool indicates “Pressure release on”, have an assistant attempt to rotate the wheel again. Can the wheel be rotated?	-	Go to Step 7	Go to Step 6
4	1. Release brake pedal pressure when the scan tool indicates “Pressure release off”. 2. Clear all DTCs. 3. Road test the vehicle. Does the DTC set again?	-	Go to Step 6	Go to Step 5
5	1. Check the wiring harness and connector terminals for an intermittent problem. 2. Repair any problem found. Is the repair complete?	-	System OK	-
6	Replace the ABS unit. Is the repair complete?	-	System OK	-

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تلفن شبانه روزی: ۰۲۱-۸۸۴۶۲۰۸۵
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DIAGNOSTIC TROUBLE COED (DTC) 19/20 - RIGHT REAR INLET AND OUTLET VALVE SOLENOID FAULT

Circuit Description

The solenoid valve coil circuits are supplied with power from the battery when the valve relay is energized. Switched ground is provided by the electronic brake control module (EBCM) to each coil.

Diagnosis

This procedure checks whether the right rear inlet and outlet valves are functioning.

Cause(s)

- A valve has failed.
- A solenoid coil is open or shorted.

Action Taken When the DTC Sets

ABS is disabled, and the ABS warning lamp is turned ON for the remainder of the ignition cycle. If the failure is intermittent, the EBCM will enable the system at the next ignition cycle and set a history DTC.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

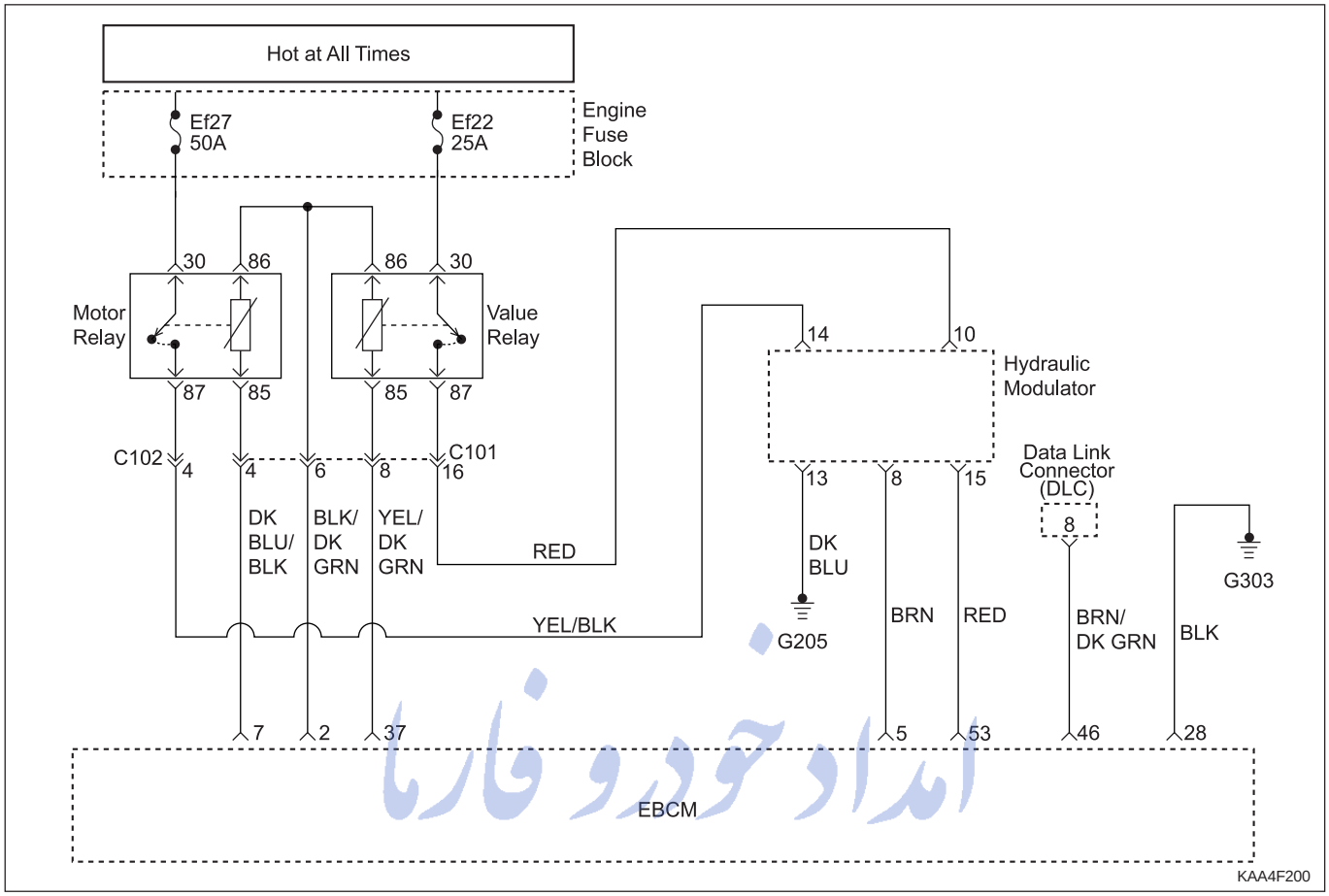
1. This begins the test of the inlet valve
3. This tests the outlet valve.

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DTC 19/20 - Right Rear Inlet and Outlet Valve Solenoid Fault

Step	Action	Value	Yes	No
1	1. Raise and suitably support the vehicle. 2. Turn the ignition to ON. 3. Install the scan tool to the data link connector (DLC) and select “Wheel rear right” to begin the solenoid tests at that wheel. This will test both the inlet and the outlet valves. 4. When the scan tool indicates “Pressure hold”, press and hold the brake pedal until the end of the test. 5. Have an assistant attempt to rotate the wheel. Can the wheel be rotated?	-	Go to Step 2	Go to Step 6
2	1. Maintain pressure on the brake pedal. 2. When the scan tool indicates “Pressure increase”, have an assistant attempt to rotate the wheel again. Can the wheel be rotated now?	-	Go to Step 6	Go to Step 3
3	1. Maintain pressure on the brake pedal. 2. When the scan tool indicates “Pressure release on”, have an assistant attempt to rotate the wheel again. Can the wheel be rotated?	-	Go to Step 4	Go to Step 6
4	1. Release brake pedal pressure when the scan tool indicates “Pressure release off”. 2. Clear all DTCs. 3. Road test the vehicle. Does the DTC set again?	-	Go to Step 6	Go to Step 5
5	1. Check the wiring harness and connector terminals for an intermittent problem. 2. Repair any problem found. Is the repair complete?	-	System OK	-
6	Replace the ABS unit. Is the repair complete?	-	System OK	-

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تلفن شبانه روزی: ۰۲۱-۸۸۴۶۲۰۸۵
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DIAGNOSTIC TROUBLE CODE (DTC) 21/22 LEFT REAR PRIME LINE AND TRACTION CONTROL SYSTEM (TCS) PILOT VALVE FAULT

Circuit Description

The solenoid valve coil circuits are supplied with power from the battery when the valve relay is energized. Switched ground is provided by the electronic brake control module (EBCM) to each coil.

Diagnosis

This procedure checks whether the left rear TCS valves are functioning.

Cause(s)

- A solenoid coil is open or shorted.

Fail Action

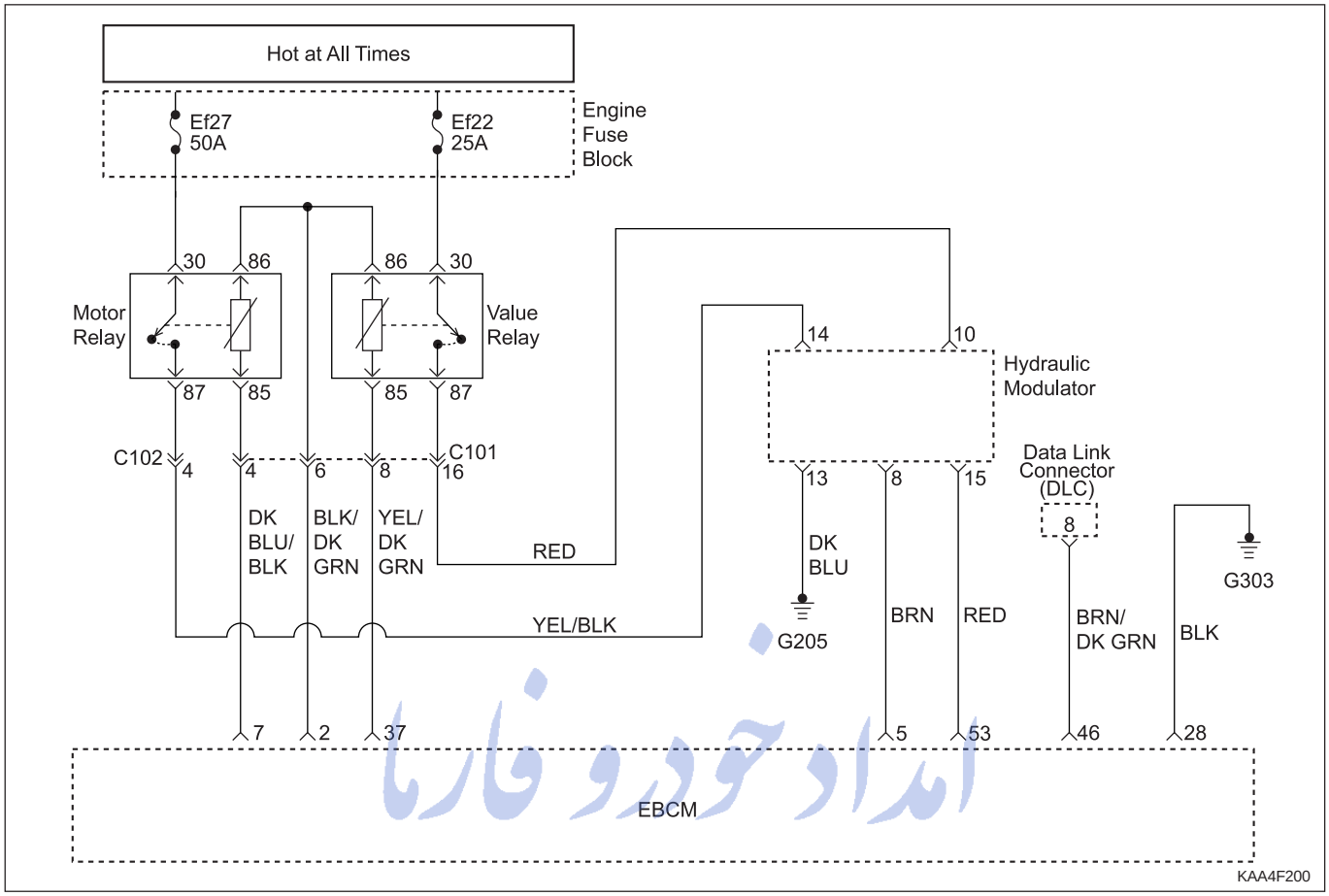
Antilock brake system (ABS) is disabled, and the ABS warning lamp is turned ON for the remainder of the ignition cycle. If the failure is intermittent, the EBCM will enable the system at the next ignition cycle and set a history DTC.

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DTC 21/22 - Left Rear Prime Line and TCS Pilot Valve Fault

Step	Action	Value(s)	Yes	No
1	1. Raise and suitably support the vehicle at the corner being tested. 2. Turn the ignition to ON. **Important:** Do not step on the brake pedal at any time during this test. 3. Install the scan tool to the data link connector (DLC). 4. Select the TCS function and “Wheel rear left” to begin the solenoid tests at that wheel. This will test both the prime and pilot valves. 5. When the scan tool indicates a pressure increase, attempt to rotate the wheel. Can the wheel be rotated?	-	Go to Step 6	Go to Step 2
2	When the scan tool indicates that the prime valve was turned OFF, attempt to rotate the wheel again. Can the wheel be rotated now?	-	Go to Step 6	Go to Step 3
3	When the scan tool indicates that the pilot valve and the pump motor were switched OFF, attempt to rotate the wheel again. Can the wheel be rotated?	-	Go to Step 4	Go to Step 6
4	1. Clear all the DTCs. 2. Road test the vehicle. Does the DTC set again?	-	Go to Step 6	Go to Step 5
5	1. Check the wiring harness and connector terminals for an intermittent problem. 2. Repair any problem found. Is the repair complete?	-	System OK	-
6	Replace the ABS unit. Is the repair complete?	-	System OK	-

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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DIAGNOSTIC TROUBLE CODE (DTC) 23/24 RIGHT REAR PRIME LINE AND TRACTION CONTROL SYSTEM (TCS) PILOT VALVE FAULT

Circuit Description

The solenoid valve coil circuits are supplied with power from the battery when the valve relay is energized. Switched ground is provided by the electronic brake control module (EBCM) to each coil.

Diagnosis

This procedure checks whether the right rear TCS valves are functioning.

Cause(s)

- A solenoid coil is open or shorted.

Fail Action

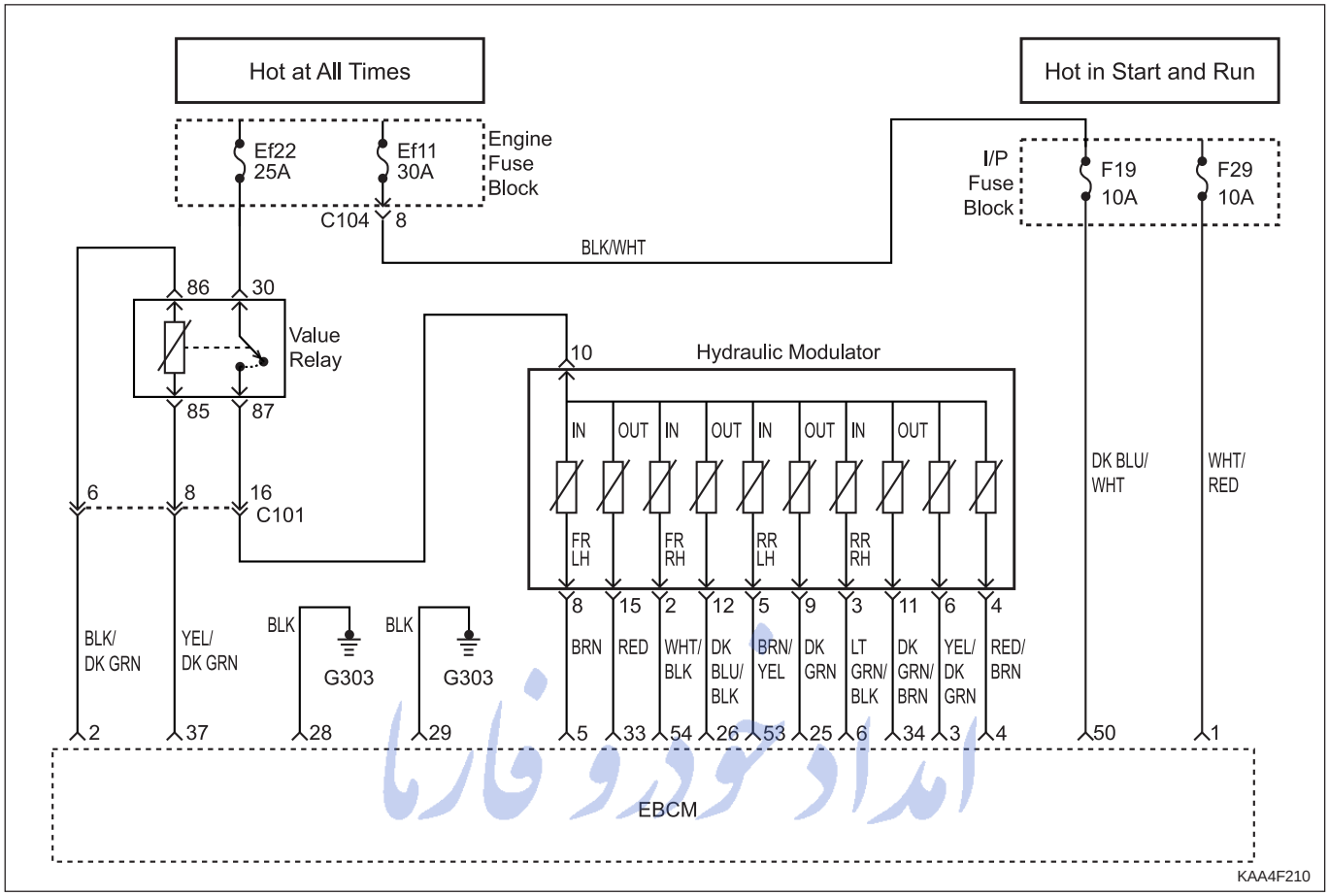
Antilock brake system (ABS) is disabled, and the ABS warning lamp is turned ON for the remainder of the ignition cycle. If the failure is intermittent, the EBCM will enable the system at the next ignition cycle and set a history DTC.

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DTC 23/24 - Right Rear Prime Line and TCS Pilot Valve Fault

Step	Action	Value(s)	Yes	No
1	1. Raise and suitably support the vehicle at the corner being tested. 2. Turn the ignition to ON. **Important:** Do not step on the brake pedal at any time during this test. 3. Install the scan tool to the data link connector (DLC). 4. Select the TCS function and “Wheel rear right” to begin the solenoid tests at that wheel. This will test both the prime and pilot valves. 5. When the scan tool indicates a pressure increase, attempt to rotate the wheel. Can the wheel be rotated?	-	Go to Step 6	Go to Step 2
2	When the scan tool indicates that the prime valve was turned OFF, attempt to rotate the wheel again. Can the wheel be rotated now?	-	Go to Step 6	Go to Step 3
3	When the scan tool indicates that the pilot valve and the pump motor were switched OFF, attempt to rotate the wheel again. Can the wheel be rotated?	-	Go to Step 4	Go to Step 6
4	1. Clear all the DTCs. 2. Road test the vehicle. Does the DTC set again?	-	Go to Step 6	Go to Step 5
5	1. Check the wiring harness and connector terminals for an intermittent problem. 2. Repair any problem found. Is the repair complete?	-	System OK	-
6	Replace the ABS unit. Is the repair complete?	-	System OK	-

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تلفن شبانه روزی: ۰۹۱۲-۸۸۸۶۲۰۸۵
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DIAGNOSTIC TROUBLE CODE (DTC) 12 VALVE RELAY CIRCUIT FAULT

Circuit Description

When the ABS is active, the valve relay provides voltage to actuate the solenoid valves. The valves do not use this voltage unless the ABS control module provides the ground for each solenoid coil.

DTC 12 will set if the valve relay voltage is low or if the relay supply line is at 12 volts when the ABS control module is not requesting it. This DTC will also set if the ABS control module detects three or more solenoid valve circuits are open or shorted during the self-test.

Diagnosis

This procedure checks whether there is a poor ground connection for the electronic brake control module (EBCM).

Cause(s)

- A connector terminal is corroded.
- The wiring harness is damaged.
- The ground terminal is not conducting properly.
- The valve relay is defective.
- The EBCM is defective.

Fail Action

ABS/TCS is disabled, and the ABS warning lamp is turned ON for the remainder of the ignition cycle. If the failure is intermittent, the control module will enable the system at the next ignition cycle and set a history DTC 12.

Diagnostic Aids

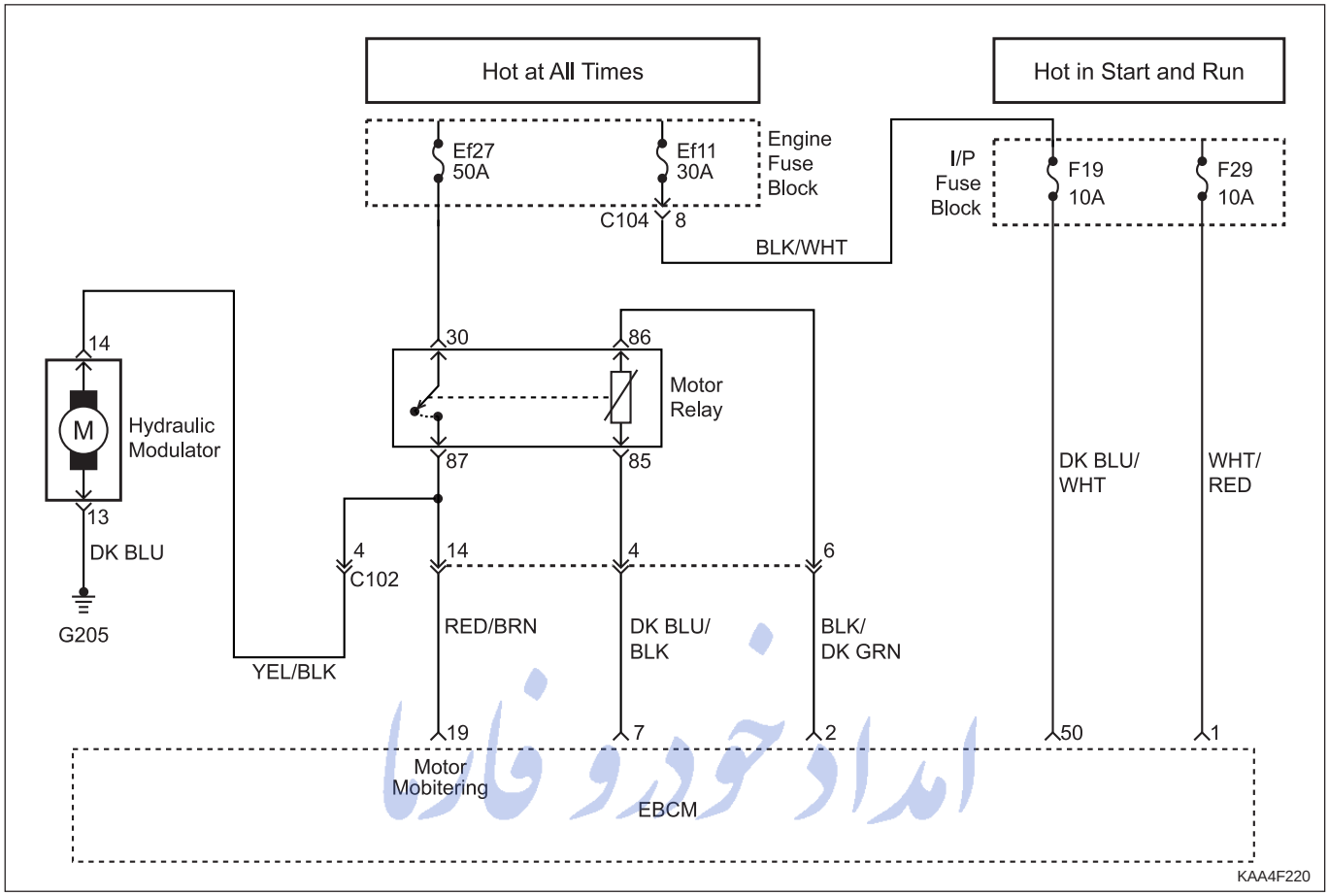
It is very important to perform a thorough inspection of the wiring and the connectors. Failure to do so may re sult in misdiagnosis, causing part replacement with the reappearance of the malfunction.

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DTC 12 - Valve Relay Circuit Fault

Step	Action	Value(s)	Yes	No
1	1. Use a scan tool to clear all DTCs. 2. Road test the vehicle. Does DTC 12 set again?	-	Go to Step 3	Go to Step 2
2	1. Check all system wiring harness connectors and terminals, especially the electronic brake control module(EBCM), for any problem that could cause an intermittent condition. 2. Repair any intermittent problem found. Is the repair complete?	-	System OK	-
3	Check fuse EF 22. Is fuse EF22 blown?	-	Go to Step 4	Go to Step 5
4	1. Check for a short circuit and repair it, if necessary. 2. Replace fuse EF 21. Is the repair complete?	-	System OK	-
5	1. Disconnect the valve relay. 2. Check the resistance between the valve relay connector terminal 86 and terminal 2 of EBCM. Is the resistance equal to the specified value?	≈ 0 Ω	Go to Step 7	Go to Step 6
6	Repair the open circuit between the valve relay connector terminal 86 and terminal 2 of EBCM. Is the repair complete?	-	System OK	-
7	Check the resistance between the valve relay connector terminal 85 and terminal 37 of EBCM. Is the resistance equal to the specified value?	≈ 0 Ω	Go to Step 9	Go to Step 8
8	Repair the open circuit between the valve relay connector terminal 85 and terminal 37 of EBCM. Is the repair complete?	-	System OK	-
9	Check the voltage between the valve relay connector terminal 30 and ground. Is the voltage equal to the specified value?	11 - 14v	Go to Step 11	Go to Step 10
10	Repair the open circuit between the valve relay connector terminal 30 and fuse EF21. Is the repair complete?	-	System OK	-
11	Check the resistance between the valve relay connector terminal 87 and terminal 10 of hydraulic modulator. Is the resistance equal to the specified value?	≈ 0 Ω	Go to Step 13	Go to Step 12
12	Replace the valve relay. Is the repair complete?	-	System OK	-
13	1. Disconnect the EBCM. 2. Check the resistance between terminal 28 and 29 of EBCM and ground G303. Is the resistance equal to the specified value?	≈ 0 Ω	Go to Step 15	Go to Step 14
14	Repair the open circuit between the valve relay connector terminal 87 and terminal 14 of hydraulic modulator. Is the repair complete?	-	System OK	-
15	Replace the ABS unit. Is the repair complete?	-	System OK	-

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تلفن شبانه روزی: ۰۹۱۷۶۴۶۰۸۵
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DIAGNOSTIC TROUBLE CODE (DTC) 24
PUMP MOTOR OR PUMP MOTOR RELAY FAULT

Circuit Description

When the electronic brake control module (EBCM) grounds the pump motor relay, it closes and provides battery voltage to the pump motor. The EBCM senses the voltage applied to the pump motor to verify motor operation.

Diagnosis

This DTC sets when the EBCM detects B+ without mo tor relay activation or if the EBCM does not detect B+ after motor relay activation.

Cause(s)

- There is a faulty terminal in the pump motor connector.
- There is a faulty terminal in EBCM connector.
- There is a problem in the ABS wiring harness.
- There is high resistance in the chassis ground.
- The EBCM is defective.
- There is a problem in the wiring from the pump motor connector to the motor.

Fail Action

ABS is disabled, and the ABS warning lamp is ON.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

2. This step checks for poor connection.
5. This step checks for the motor relay.
13. This step checks for the hydraulic modulator.

Diagnostic Aids

It is very important to perform a thorough inspection of the wiring and the connectors. Failure to do so may result in misdiagnosis, causing part replacement with the reappearance of the malfunction.

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DTC 24 - Pump Motor or Pump Motor Relay Fault

Step	Action	Value(s)	Yes	No
1	1. Use a scan tool to clear all DTCs. 2. Road test the vehicle. Does DTC 24 set again?	-	Go to Step 3	Go to Step 2
2	1. Check all system wiring harness connectors and terminals, especially the electronic brake control module(EBCM), for any problem that could cause an intermittent condition. 2. Repair any intermittent problem found. Is the repair complete?	-	System OK	-
3	Check fuse EF 27. Is fuse EF27 blown?	-	Go to Step 4	Go to Step 5
4	1. Check for a short circuit and repair it, if necessary. 2. Replace fuse EF 27. Is the repair complete?	-	System OK	-
5	1. Disconnect the motor relay. 2. Check the resistance between the motor relay connector terminal 86 and terminal 2 of EBCM. Is the resistance equal to the specified value?	≈ 0 Ω	Go to Step 7	Go to Step 6
6	Repair the open circuit between the motor relay connector terminal 86 and terminal 2 of EBCM. Is the repair complete?	-	System OK	-
7	Check the resistance between the motor relay connector terminal 85 and terminal 7 of EBCM. Is the resistance equal to the specified value?	≈ 0 Ω	Go to Step 9	Go to Step 8
8	Repair the open circuit between the motor relay connector terminal 85 and terminal 7 of EBCM. Is the repair complete?	-	System OK	-
9	Check the voltage between the motor relay connector terminal 30 and ground. Is the voltage equal to the specified value?	11 - 14v	Go to Step 11	Go to Step 10
10	Repair the open circuit between the motor relay connector terminal 30 and fuse EF27. Is the repair complete?	-	System OK	-
11	Check the resistance between the motor relay connector terminal 87 and terminal 19 of EBCM. Is the resistance equal to the specified value?	≈ 0 Ω	Go to Step 13	Go to Step 12
12	Replace the motor relay. Is the repair complete?	-	System OK	-
13	1. Disconnect the hydraulic modulator. 2. Check the resistance between the motor relay connector terminal 87 and terminal 14 of hydraulic modulator. Is the resistance equal to the specified value?	≈ 0 Ω	Go to Step 15	Go to Step 14
14	1. Repair the open circuit between the motor relay connector terminal 87 and terminal 14 of hydraulic modulator. 2. Road test the vehicle. Does DTC 24 clear?	-	System OK	Go to Step 14

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تلفن شبانه روزی: ۸۵ ۰۲۱ ۷۷۱۸۶۵۲۵
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DTC 24 - Pump Motor or Pump Motor Relay Fault (Cont'd)

Step	Action	Value(s)	Yes	No
15	1. Disconnect the hydraulic modulator. 2. Check the resistance between the motor connector terminal 13 and ground G205. Is the resistance equal to the specified value?	≈ 0 Ω	Go to Step 6	Go to Step 16
16	Repair the open circuit between the motor relay connector terminal 13 and ground G205. Is the repair complete?	-	System OK	-
17	1. Replace the hydraulic modulator. 2. Road test the vehicle. Does DTC 24 clear?	-	System OK	Go to Step 18
18	Replace the ABS unit. Is the repair complete?	-	System OK	-

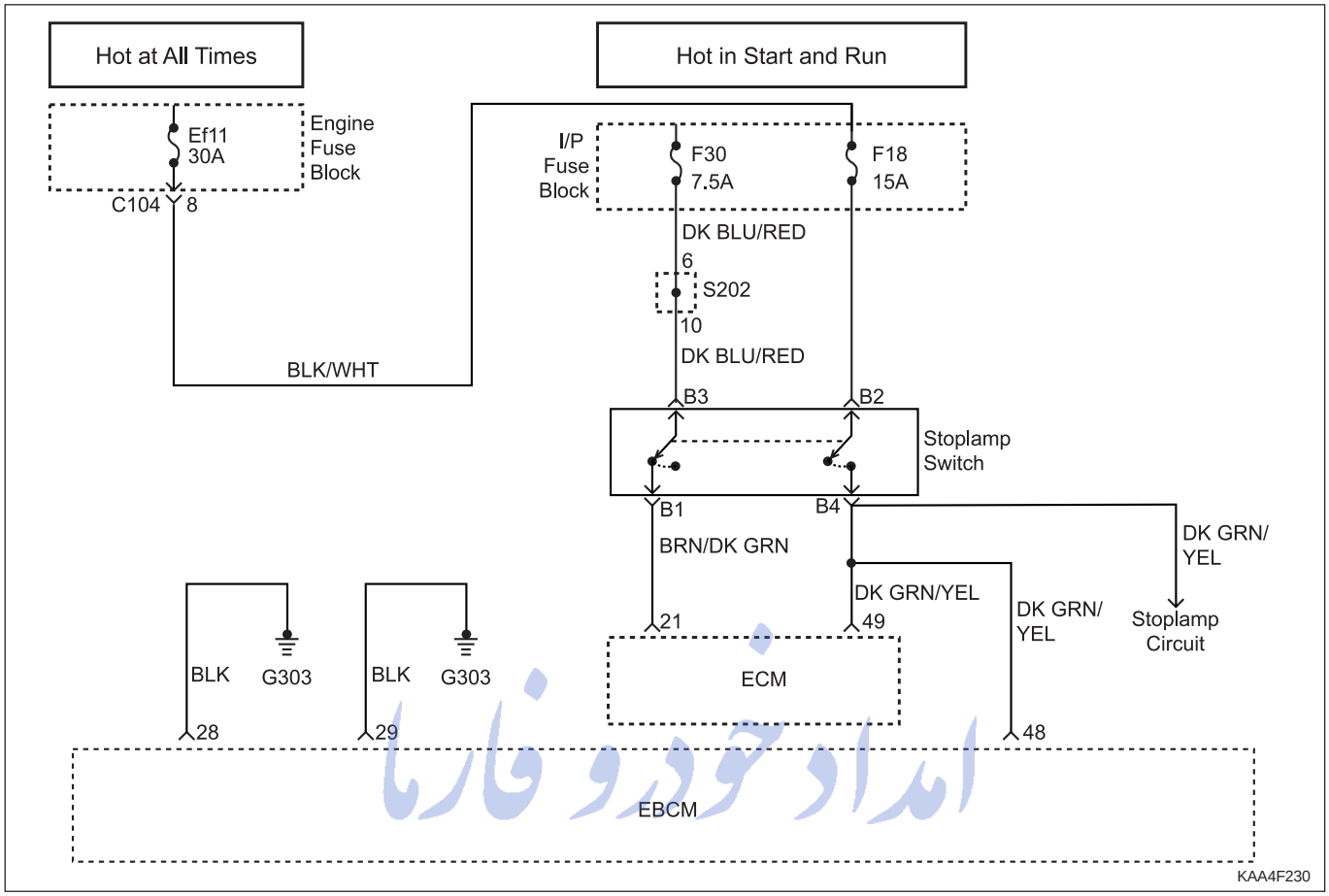
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DIAGNOSTIC TROUBLE CODE (DTC) 27
STOPLAMP SWITCH FAULT

Circuit Description

When the brake pedal is pressed, the contacts on the brake light switch close to illuminate the brake lights. Battery voltage is also applied to terminal 48 of the elec-tronic brake control module (EBCM), which signals the ABS controller that the brakes are applied and ABS may be needed. Without this, signals from a wheel speed sensor that may indicate the need for ABS intervention are questionable. When the brake pedal is not pressed, the EBCM terminal 48 is grounded through the stoplamps.

Diagnosis

This procedure will check whether there is no output or constant output from the stoplamp switch and will deter-mine the cause as a faulty switch or a problem in the circuitry.

Cause(s)

- The ground connection or the positive connection at the EBCM has failed.
- There is an open, short to ground, or short to positive in the vehicle wiring.
- The stoplamp switch has failed.

Fail Action

The system records a DTC 27. ABS operation is not dis-abled.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

12. This step begins the process of troubleshooting stoplamps that are always on.

Diagnostic Aids

Inspect the wiring and the connectors carefully and thoroughly. Failure to do so could result in misdiagnosis, causing part replacement with the reappearance of the malfunction.

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DTC 27 - Stoplamp Switch Fault

Step	Action	Value(s)	Yes	No
1	Observe the stoplamps when the brakes are applied. Do the stoplamps turn on?	-	Go to Step 12	Go to Step 2
2	Check fuse EF11. Is fuse EF11 blown?	-	Go to Step 3	Go to Step 4
3	1. Check for a short circuit and repair it, if necessary. 2. Replace fuse EF11 Is the repair complete?	-	System OK	-
4	Check the voltage at fuse EF11. Is the voltage equal to the specified value?	11 - 14v	Go to Step 6	Go to Step 5
5	Repair the power supply circuit for fuse EF11. Is the repair complete?	-	System OK	-
6	Check the voltage at fuse F18. Is fuse F18 blown?	-	Go to Step 7	Go to Step 8
7	1. Check for a short circuit between terminal 8 of connector C104 and fuse F18 in the I/P fuse block and repair it, if necessary. 2. Replace fuse F18. Is the repair complete?	-	System OK	-
8	Check the voltage at terminal B2 of the stoplamps switch. Is the voltage equal to the specified value?	11 - 14v	Go to Step 10	Go to Step 9
9	Repair the open circuit between fuse F18 and terminal B2 of the stoplamp switch. Is the repair complete?	-	System OK	-
10	With the brakes applied, check the voltage at terminal B4 of the stoplamp switch. Is the voltage equal to the specified value?	11 - 14v	Go to Step 12	Go to Step 11
11	Replace the stoplamp switch. Is the repair complete?	-	System OK	-
12	1. Disconnect the electronic brake control module (EBCM) connector. 2. Visually inspect the EBCM and its connector for damaged pins or terminals. Are there any damaged pins or terminals?	-	Go to Step 13	Go to Step 14
13	Repair the damaged pins or terminals. Is the repair complete?	-	System OK	-
14	1. With the EBCM connector disconnected, applied the brake. 2. Check the voltage at terminal 48 of the EBCM. Is the voltage equal to the specified value?	11 - 14v	Go to Step 16	Go to Step 15
15	Repair the open circuit between the B4 of the stoplamp switch and terminal 48 of the EBCM connector. Is the repair complete?	-	System OK	-

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DTC 27 - Stoplamp Switch Fault (Cont'd)

Step	Action	Value(s)	Yes	No
16	With the EBCM disconnected, use an ohmmeter to measure the resistance between ground and terminal 28 of the EBCM connector. Is the resistance equal to the specified value?	≈ 0 Ω	Go to Step 18	Go to Step 17
17	Repair the open circuit between ground and terminal 48 of the EBCM. Is the repair complete?	-	System OK	-
18	Replace the ABS unit. Is the repair complete?	-	System OK	-

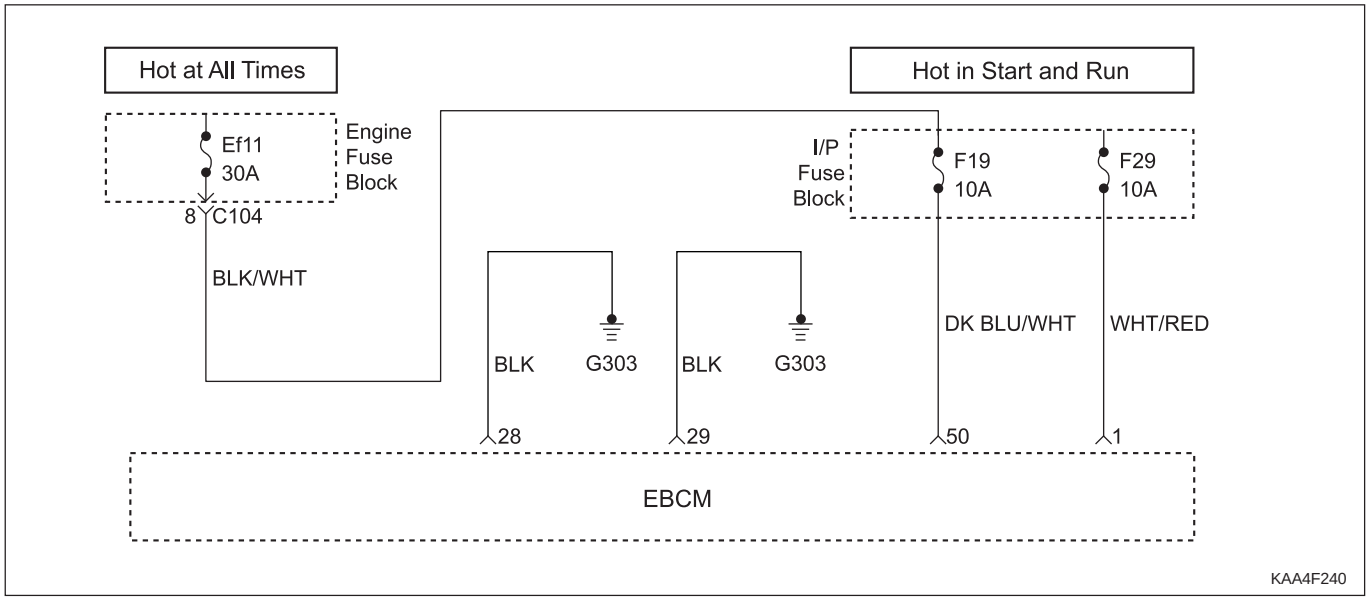
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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵

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DIAGNOSTIC TROUBLE CODE (DTC) 28 LOW VOLTAGE FAULT

Circuit Description

Proper operation of the electronic brake control module (EBCM) requires a certain minimum voltage. The EBCM monitors the ignition feed circuit to determine if the voltage falls below a minimum level.

Diagnosis

This test checks for battery output, proper grounding, blown fuses, faulty ignition switch, and problems in the circuitry.

Cause(s)

- The battery is defective.
- There is a defective ground connection.
- A connector is damaged.
- A wire is broken or shorted.
- A fuse is blown.
- The ignition switch is malfunctioning.

Fail Action

ABS action is disabled during the period of low voltage, and the ABS warning lamp is ON for the remainder of the ignition cycle. If the failure is intermittent, the EBCM will enable the system at the next ignition cycle and set a history DTC 28.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This step determines whether there is voltage at the battery and at the high current source.
7. This step checks for voltage at the ignition 1 source.
15. This step begins the check for voltage at the EBCM end of the ABS harness.

Diagnostic Aids

It is very important to perform a thorough inspection of the wiring and the connectors. Failure to do so may result in misdiagnosis, causing part replacement with the reappearance of the malfunction.

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DTC 28 - Low Voltage Fault

Step	Action	Value(s)	Yes	No
1	Check the voltage at the battery. Is the voltage within the specified value?	11 - 14v	Go to Step 3	Go to Step 2
2	Charge or replace the battery, as required. Is the repair complete?	-	System OK	-
3	Check fuse EF11 in the engine fuse block. Is the fuse blown?	-	Go to Step 4	Go to Step 7

DTC 28 - Low Voltage Fault (Cont'd)

Step	Action	Value(s)	Yes	No
4	1. Replace fuse EF11. 2. Turn the ignition to ON. Does the fuse blow again?	-	Go to Step 5	Go to Step 6
5	1. Turn the ignition to OFF. 2. Trace the BLK/WHT wires in the ABS wiring harness from terminal 8 of C104 at the engine fuse block to F19 in the I/P fuse block. 3. Repair any short circuit found along this path. Is the repair complete?	-	System OK	-
6	1. Turn the ignition to OFF. 2. Install the scan tool. 3. Clear all DTCs. 4. Road test the vehicle. Does DTC 28 reset?	-	System OK	-
7	Check fuse F19 in the I/P fuse block. Is the fuse blown?	-	Go to Step 8	Go to Step 11
8	1. Replace fuse F19. 2. Turn the ignition to ON. Does the fuse blow again?	-	Go to Step 9	Go to Step 10
9	1. Turn the ignition to OFF. 2. Trace the WHT/RED wires in the ABS Wiring harness from fuse F19 to terminal 50 of the EBCM connector. 3. Repair any short circuit found along this path. Is the repair complete?	-	System OK	-
10	1. Turn the ignition to OFF. 2. Install the scan tool. 3. Clear all DTCs. 4. Rood test the vehicle. Does DTC 28 reset?	-	System OK	-
11	Check fuse F29 in the I/P fuse block. Is fuse F29 blown?	-	Go to Step 12	Go to Step 15
12	1. Replace fuse F29. 2. Turn the ignition to ON. Does fuse F29 blow again?	-	Go to Step 13	Go to Step 14
13	1. Turn the ignition to OFF. 2. Trace the WHT/RED wire from fuse F19 to terminal 1 of the EBCM connector. 3. Repair any short circuit found along this path. Is the repair complete?	-	System OK	-

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DTC 28 - Low Voltage Fault (Cont'd)

Step	Action	Value(s)	Yes	No
14	1. Turn the ignition to OFF. 2. Install the scan tool. 3. Clear all DTCs. 4. Road test the vehicle. Does DTC 28 reset?	-	System OK	-
15	1. Disconnect the EBCM connector from the EBCM. 2. Turn the ignition to ON. 3. Check the voltage between ground and terminal 1, and between ground and terminal 50. Is the voltage within the specified value?	11 - 14v	Go to Step 17	Go to Step 16
16	1. Turn the ignition to OFF. 2. Trace the WHT/RED wires between terminals 1 and 50 of the EBCM connector to fuse F19 and F29 in the I/P fuse block. 3. Repair the open in this circuit. Is the repair complete?	-	System OK	-
17	1. Turn the ignition ON. 2. Check the voltage at fuse F19. Is the voltage within the specified value?	11 - 14v	Go to Step 19	Go to Step 18
18	Repair the power supply circuit for fuse F19. Is the repair complete?	-	System OK	-
19	1. Turn the ignition ON. 2. Check the voltage at fuse F29. Is the voltage within the specified value?	11 - 14v	Go to Step 21	Go to Step 18
20	Repair the power supply circuit for Fuse 29. Is the repair complete?	-	System OK	-
21	1. Turn the ignition to OFF. 2. Check the resistance between ground and terminals 28 and 29 of the ABS harness EBCM connector. Is the resistance equal to the specified value?	≈ 0 Ω	Go to Step 22	Go to Step 20
22	Examine terminals 1, 28, 29, and 50 of the EBCM connector. Is there a defective terminal?	-	Go to Step 23	-
23	Repair the defective terminal or replace the connector or wiring harness, as required. Is the repair complete?	-	System OK	Go to Step 24
24	Repair the defective ground connection. Is the repair complete?	-	System OK	Go to Step 25
25	1. Install the scan tool. 2. Clear all DTCs. 3. Road test the vehicle. Does DTC 28 set again?	-	Go to Step 26	-
26	Replace the ABS unit. Is the repair complete?	-	System OK	-
27	1. Examine the wiring harness and connectors for causes of intermittent problems. 2. Repair any intermittent problem found. Is the repair complete?	-	System OK	-

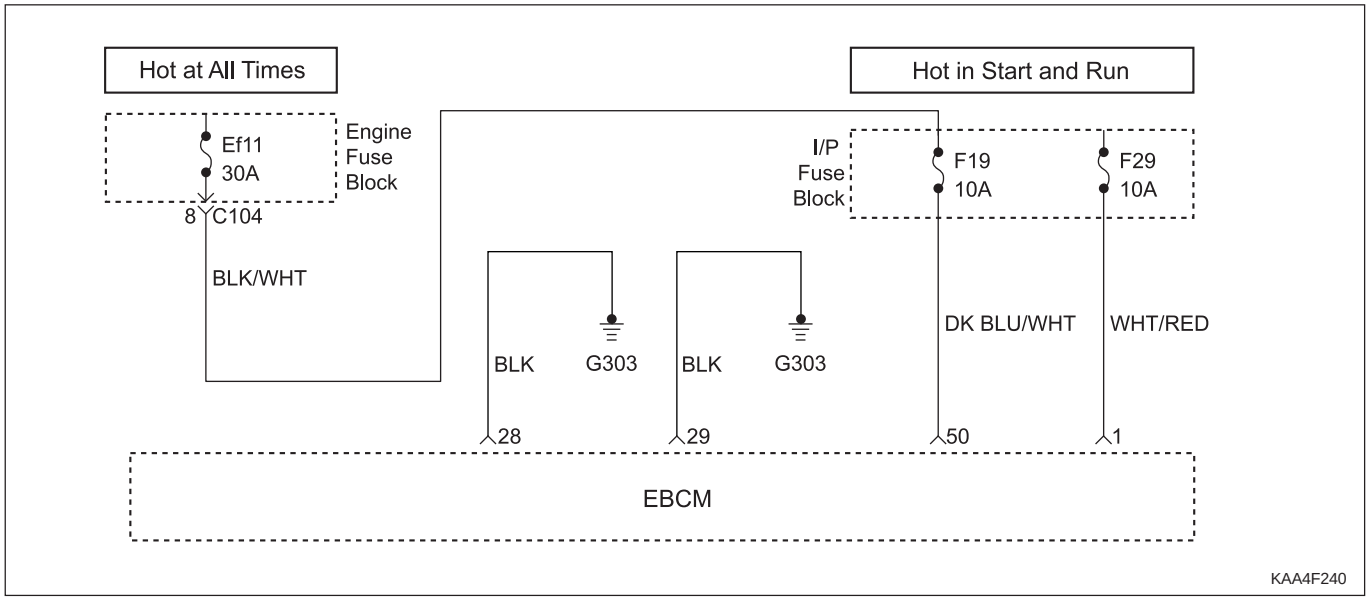
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DIAGNOSTIC TROUBLE CODE (DTC) 02
ABS CONTROL MODULE INTERNAL FAULT

Circuit Description

The ABS control module performs various diagnostic checks on itself. If it finds a problem, it sets DTC 02.

Diagnosis

This procedure checks whether there is a poor ground connection for the electronic brake control module (EBCM).

Cause(s)

- A connector terminal is corroded.
- The EBCM is malfunctioning.

Fail Action

ABS is disabled, and the ABS warning lamp is turned ON. If the failure is intermittent, the control module will enable the system at the next ignition cycle and will store a history DTC 02.

Test Description

The number(s) below refer to step(s) on the diagnostic table.

3. This step begins the testing for a poor voltage or ground connection.

Diagnostic Aids

It is very important to perform a thorough inspection of the wiring and the connectors. Failure to inspect the wiring and the connectors carefully and completely may result in misdiagnosis, causing part replacement with the reappearance of the malfunction.

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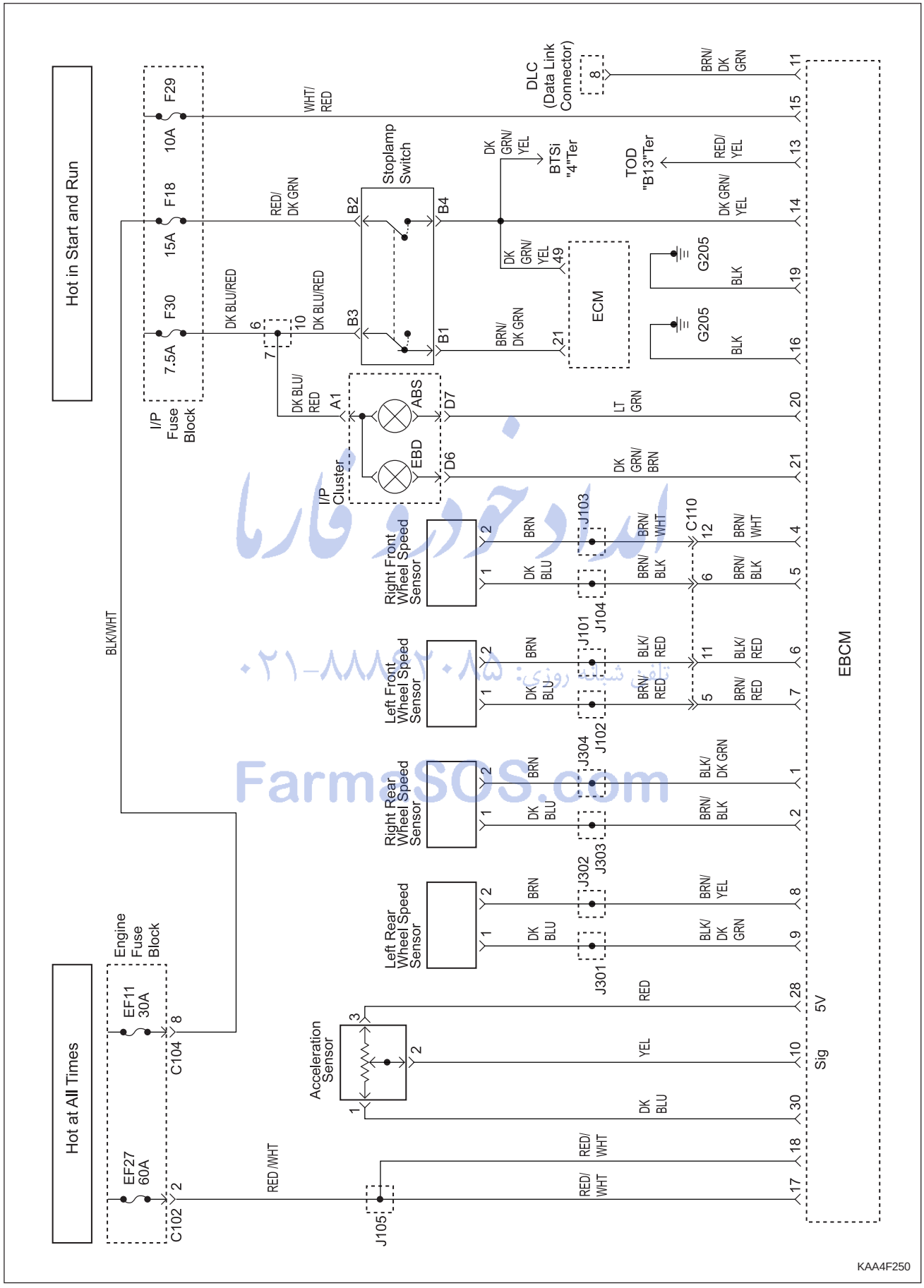
DTC 02 - ABS Control Module Internal Fault

Step	Action	Value(s)	Yes	No
1	Use the scan tool to determine if any other DTCs are set. Are other DTCs set?	-	Go to the tables for the other DTCs	Go to Step 2
2	Clear all DTCs and road test the vehicle. Does DTC 02 set again?	-	Go to Step 4	Go to Step 3
3	1. Check all wiring harness connectors and terminals, especially those at the EBCM, for any condition that could cause an intermittent. 2. Repair any problems found. Is the repair complete?	-	System OK	-
4	1. Turn the ignition to OFF. 2. Disconnect the EBCM connector. 3. Turn the ignition to ON. 4. Measure the voltage between ground and terminals 50 and 1 of the EBCM harness connector. Is the voltage equal to the specified value?	11 - 14v	Go to Step 6	Go to Step 5
5	1. Check the voltage supply and the ground connections to the EBCM. 2. Repair any open or high resistance found. Is the repair complete?	-	System OK	-
6	Check the EBCM connector for any damaged terminals. Are there any problems?	-	Go to Step 7	Go to Step 8
7	Repair any connector problem found. Is the repair complete?	-	System OK	-
8	Clear all DTCs and road test the vehicle. Does DTC 02 set again?	-	Go to Step 9	System OK
9	Replace the ABS unit. Is the repair complete?	-	System OK	-

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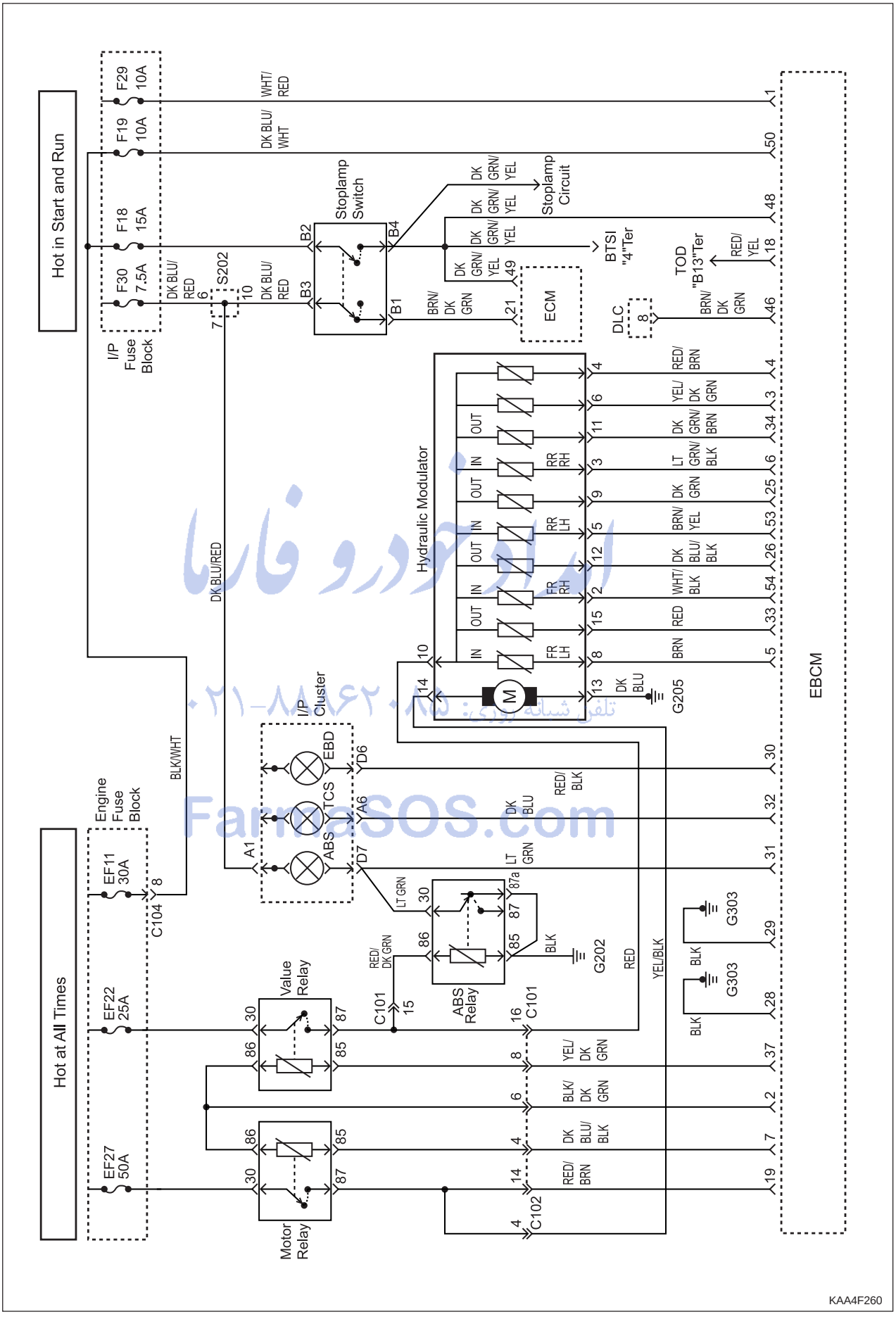
SCHEMATIC AND ROUTING DIAGRAMS

ABS CIRCUIT (WITHOUT TCS): GASOLINE



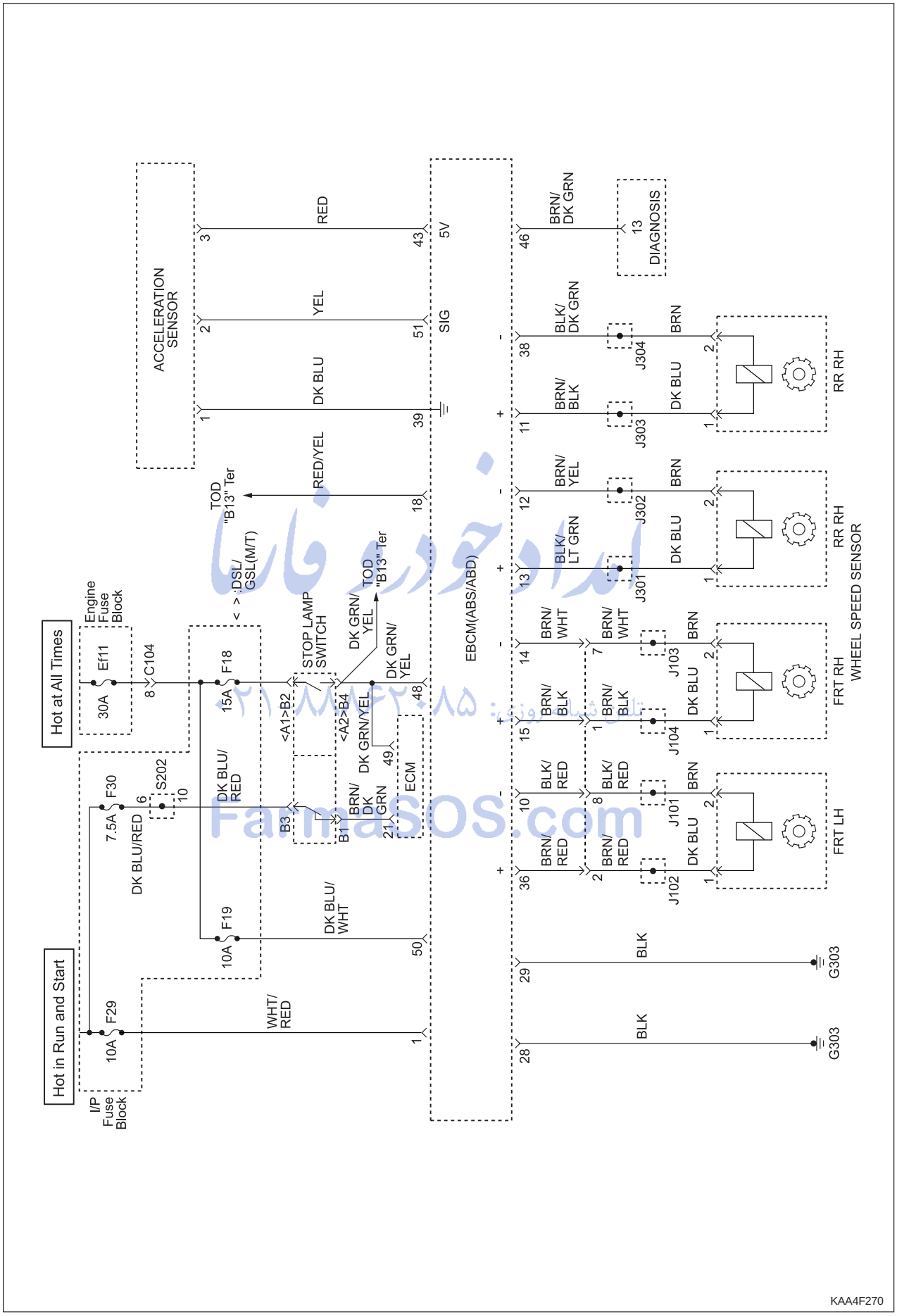
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ABS / TCS CIRCUIT (1 OF 2): GASOLINE - INDICATOR, RELAY (ABD, MOTOR, VALVE), HYDRAULIC MODULATOR



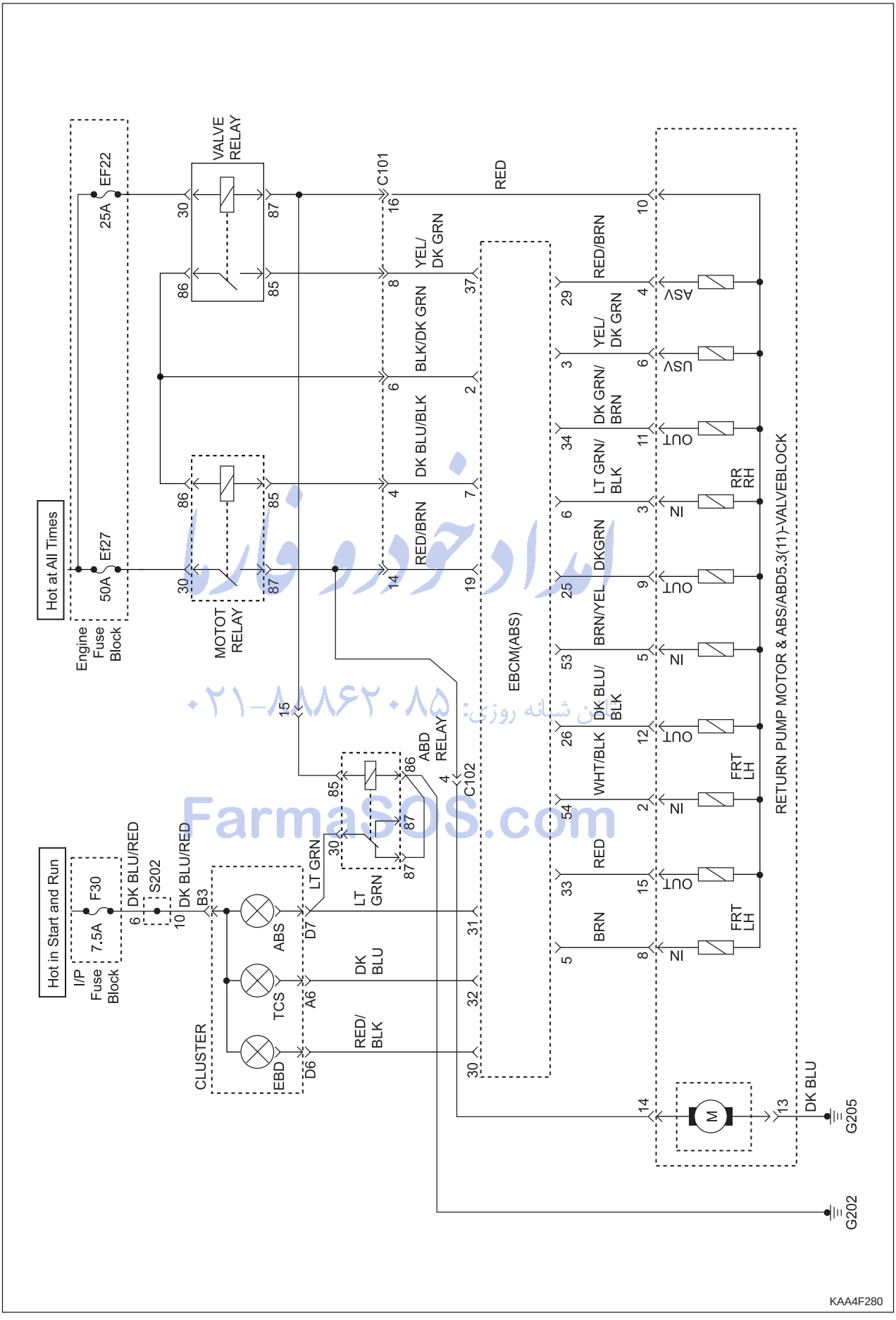
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ABS / TCS CIRCUIT (2 OF 2): GASOLINE - STOP LAMP SWITCH, DECELERATION SENSOR, WHEEL SPEED SENSOR DIAGNOSIS



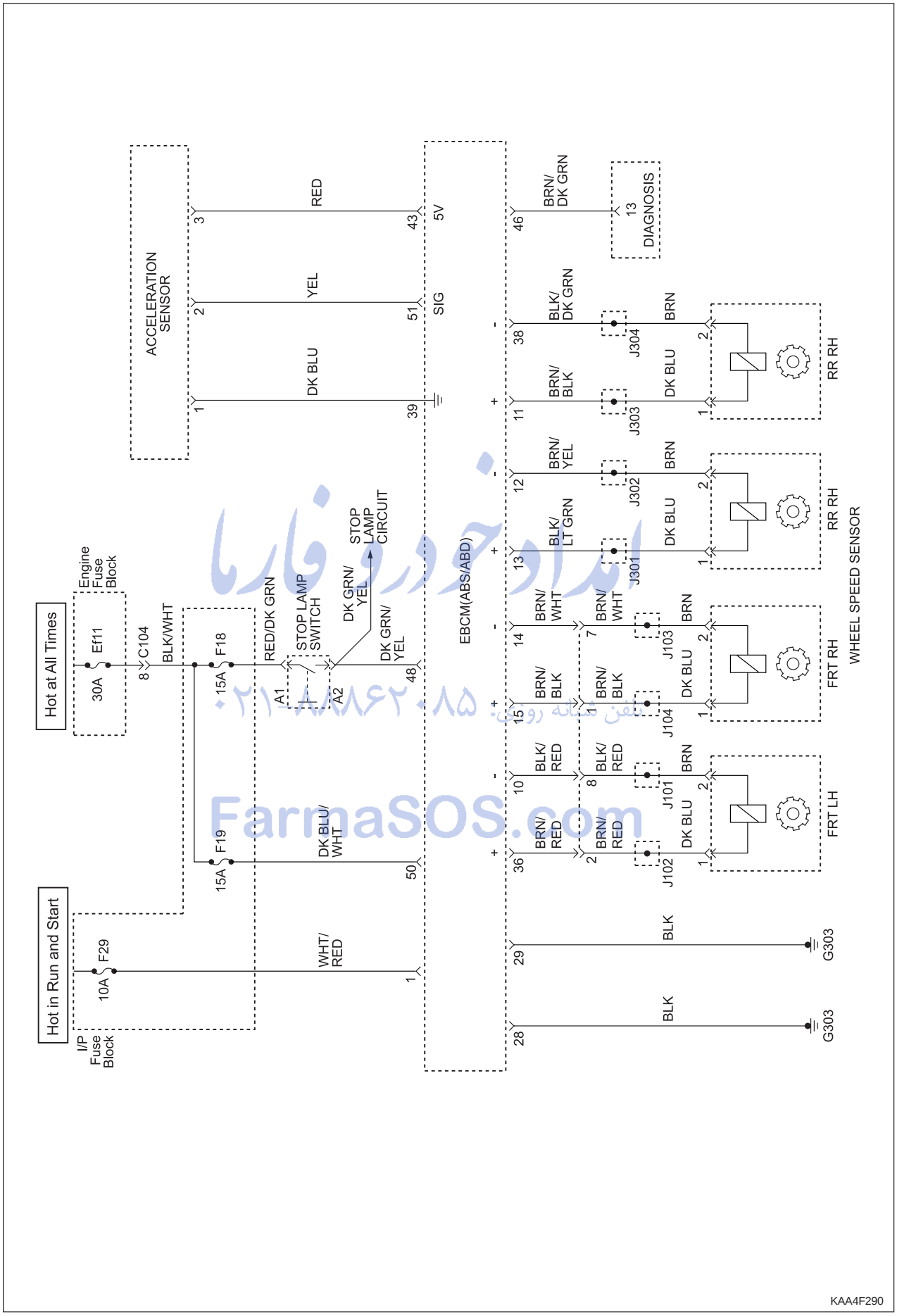
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ABS / ABD (AUTOMATIC BRAKE DIFFERENTIAL LOCK): DIESEL - INDICATOR, RELAY (ABD, MOTOR, VALVE) HYDRAULIC MODULATOR



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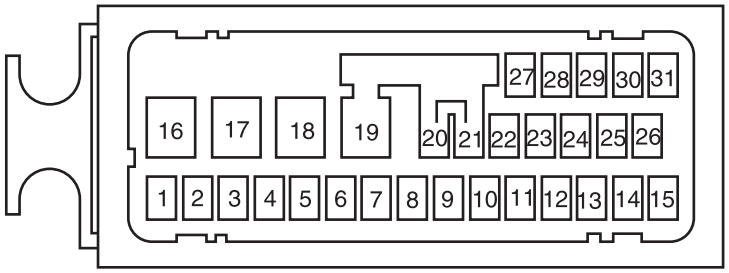
ABS / ABD (AUTOMATIC BRAKE DIFFERENTIAL LOCK): DIESEL - STOPLAMP SWITCH, ACCELERATION SENSOR, WHEEL SPEED SENSOR DIAGNOSIS



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EBCM CONNECTION FACE VIEW (WITHOUT TRACTION CONTROL SYSTEM)

EBCM CONNECTOR



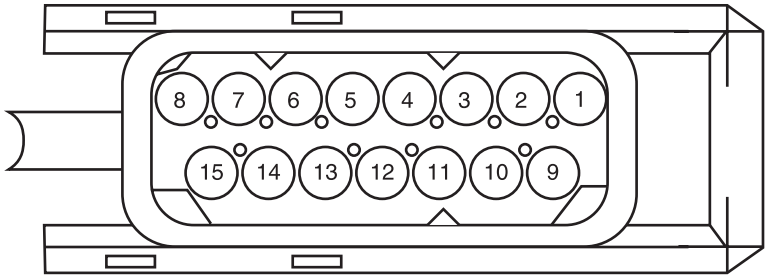
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Pin	Color	Circuit
1	BLK/DK GRN	Right Rear Ground
2	BRN/BLK	Right Rear Sensor
3	-	Not Used
4	BRN/WHT	Right Front Ground
5	BRN/BLK	Right Front Sensor
6	BLK/RED	Left Front Ground
7	BRN/RED	Left Front Sensor
8	BRN/YEL	Left Rear Ground
9	BLK/DK GRN	Left Rear Sensor
10	YEL	Acceleration Sensor Signal Voltage
11	BRN/DK GRN	Data Link Connector
12	-	Not Used
13	RED/YEL	Torque On Demand
14	DK GRN/YEL	Stoplamp Switch
15	WHT/RED	Ignition
16	BLK	Ground

Pin	Color	Circuit
17	RED/WHT	Battery
18	RED/WHT	Battery
19	-	Ground
20	BLK	ABS Warning Lamp
21	LT GRN	EBD Warning Lamp
22	DK GRN/BRN	Not Used
23	-	Not Used
24	-	Not Used
25	-	Not Used
26	-	Not Used
27	-	Not Used
28	RED	Acceleration Sensor Supply Voltage
29	-	Not Used
30	DK BLU	Acceleration Sensor Ground
31	-	Not Used

HYDRAULIC MODULATOR CONNECTOR

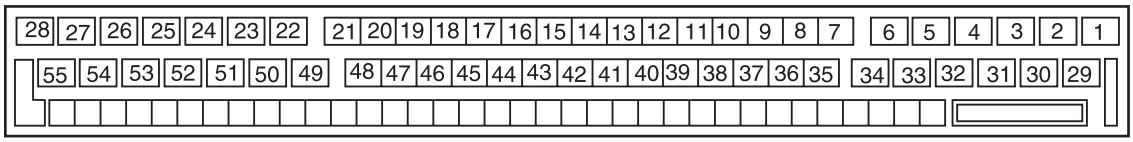


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Pin	Color	Circuit
1	-	Not Used
2	WHT/BLK	Right Front Inlet Valve
3	LT GRN/BLK	Right Rear Inlet Valve
4	RED/BRN	Prime Valve
5	BRN/YEL	Left Rear Inlet Valve
6	YEL/DK GRN	Pilot Valve
7	–	Not Used
8	BRN	Left Front Inlet Valve

Pin	Color	Circuit
9	DK GRN	Left Rear Outlet Valve
10	RED	Valve Relay
11	DK GRN/BRN	Right Rear Outlet Valve
12	DK BLU/BLK	Right Front Inlet Valve
13	DK BLU	Motor Ground
14	YEL/BLK	Motor Relay
15	RED	Left Front Outlet Valve

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۲۱-۸۸۸۶۲۰۸۵
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Pin	Color	Circuit
1	WHT/RED	Ignition
2	BLK/DK GRN	Relay Supply Voltage
3	YEL/DK GRN	Pilot Valve
4	RED/BRN	Prime Valve
5	BRN	Left Front Inlet Valve
6	LT GRN/BLK	Right Rear Inlet Valve
7	DK BLU/BLK	Motor Relay Actuation
8	-	Not Used
9	-	Not Used
10	BLK/RED	Left Front Ground
11	BRN/BLK	Right Rear Sensor
12	BRN/YEL	Left Rear Ground
13	BLK/LT GRN	Left Rear Sensor
14	BRN/WHT	Right Front Ground
15	BRN/BLK	Right Front Sensor
16	-	Not Used
17	-	Not Used
18	RED/YEL	Torque On Demand
19	RED/BRN	Motor Monitoring
20	-	Not Used
21	-	Not Used
22	-	Not Used
23	-	Not Used
24	-	Not Used
25	DK GRN	Left Rear Outlet Valve
26	DK BLU/BLK	Right Front Inlet Valve
27	-	Not Used

Pin	Color	Circuit
28	BLK	Ground
29	BLK	Ground
30	RED/BLK	EBD Warning Lamp
31	LT GRN	ABS Warning Lamp
32	DK BLU	TCS Warning Lamp
33	RED	Left Front Outlet Valve
34	DK GRN/BRN	Right Rear Outlet Valve
35	-	Not Used
36	BRN/RED	Left Front Sensor
37	YEL/DK GRN	Valve Relay Actuation
38	BLK/DK GRN	Right Rear Ground
39	DK BLU	Acceleration Sensor Ground
40	-	Not Used
41	-	Not Used
42	-	Not Used
43	RED	Acceleration Sensor Supply Voltage
44	-	Not Used
45	-	Not Used
46	BRN/DK GRN	Data Link Connector
47	-	Not Used
48	DK GRN/YEL	Stoplamp Switch
49	-	Not Used
50	DK BLU/WHT	Battery
51	YEL	Acceleration Sensor Signal Voltage

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Pin	Color	Circuit
52	-	Not Used
53	BRN/YEL	Left Rear Inlet Valve
54	WHT/BLK	Right Front Inlet Valve
	-	Not Used

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REPAIR INSTRUCTIONS

ON-VEHICLE SERVICE

SERVICE PRECAUTIONS

Caution: Brake Fluid may irritate eyes and skin. In case of contact, take the following actions:

- Eye contact - rinse thoroughly with water.
- Skin contact - wash with soap and water.
- Ingestion - consult a physician immediately.

Caution: To help avoid personal injury due to poor braking. DO NOT Tap into the vehicle's brake system to operate a trailer brake system.

Notice: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for is not available, a fastener of equal size and strength (or stronger) may be used. Fasteners that are not reused, and those requiring thread-locking compound will be called out. The correct torque values must be used when installing fasteners that require them. If the above procedures are not followed, parts or system damage could result.

Notice: Use only DOT-3 equivalent hydraulic brake fluid. The use of DOT-5 (silicone) brake fluid is not recommended. Reduced brake performance or durability may result.

Notice: Avoid spilling brake fluid on any the vehicle's painted surfaces, wiring, cables or electrical connectors. Brake fluid will damage paint and electrical connections. If any fluid is spilled on the vehicle, flush the area with water to lessen the damage.

Electronic System Service Precautions

Take care to avoid electronic brake control module (EBCM) circuit overloading. In testing for opens or shorts, do not ground or apply voltage to any circuit unless instructed to do so by the diagnostic procedure.

Test circuits only with a high-impedance multi-meter. Never remove or apply power to any control module with the ignition switch in the ON position. Always turn the ignition to the OFF position before removing or connecting battery cables, fuses or connectors.

General Service Precautions

Disconnect the EBCM connector before performing any vehicle welding work using an electric arc welder.

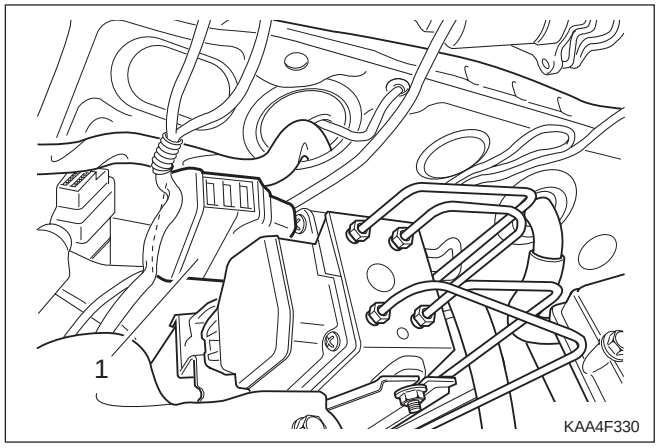
Do not attempt to disassemble any component designated as nonserviceable. The hydraulic modulator and the EBCM can be separated from each other and replaced separately but cannot be serviced. They have no replaceable parts, and there is no replaceable parts, and there is no access to the components they contain.

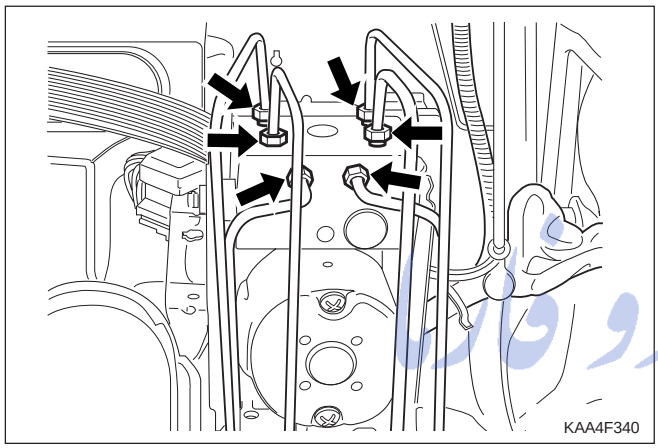
Bleeding System

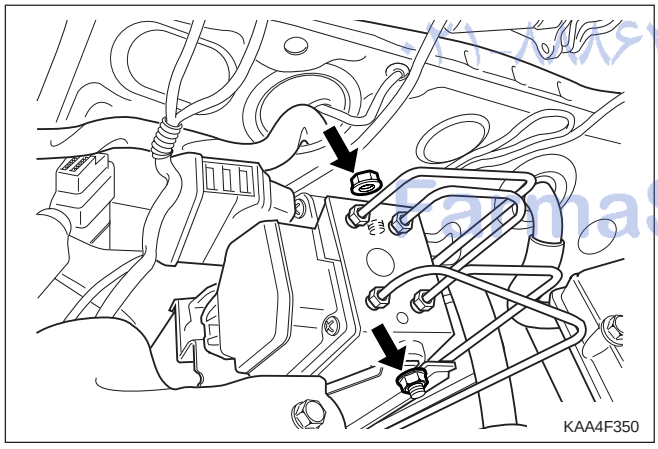
Replacement modulators are shipped already filled and bled. In normal procedures requiring removal of the modulator, such as to replace the EBCM, air will not enter the modulator, and normal bleeding will be all that is needed.

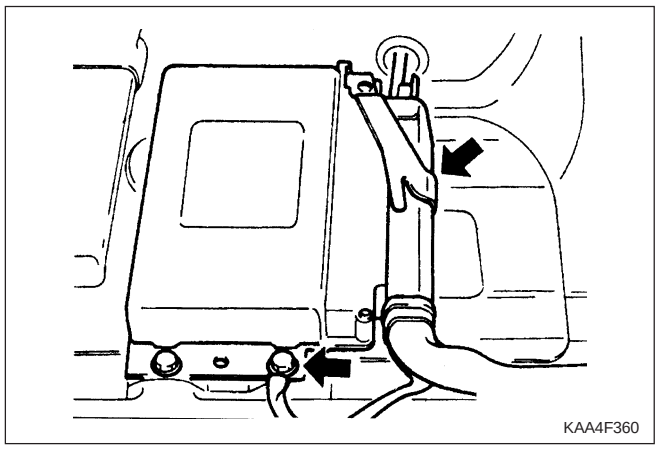
If air enters the hydraulic modulator, or if an unfilled modulator is installed, use the brake bleeding program in the scan tool to bleed the modulator. Manual bleeding of the hydraulic modulator is not possible.

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ABS 5.3 ASSEMBLY

Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Disconnect the 15 or 31-pin ABS wiring harness connector from its socket on the EBCM.
3. Cover the connector and the socket with shop cloths to protect them from brake fluid.

   Notice: Take care not to allow air into the hydraulic modulator. If air gets into the hydraulic unit, it will require a bleeding procedure using a scan tool programmed for the ABS 5.3 system. As long as no air enters the hydraulic unit, a simple bleeding procedure is all the system will require.

4. Remove the brake pipes from the hydraulic modula tor.

Installation Notice

Tightening Torque	14 N•m (124 lb-in)

5. Loosen the mounting nuts on the hydraulic unit.
6. Move the brake pipes aside far enough to allow for lifting the ABS 5.3 unit out of the mounting bracket.
7. Cap the brake pipes.

Installation Notice

Tightening Torque	6 N•m (53 lb-in)

- Bleed the hydraulic system. Refer to *Section 4A, Hydraulic Brakes*.

8. Installation should follow the removal procedure in the reverse order.

ABS/TCS UNIT

Removal and Installation Procedure

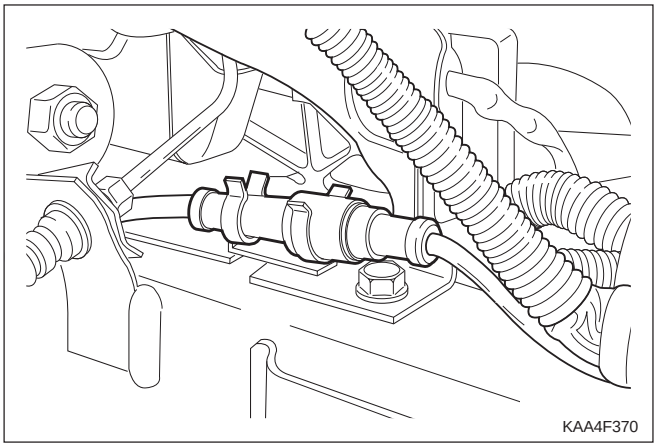
1. Disconnect the negative battery cable.
2. Disconnect the ABS/TCS wiring harness connector from its socket on the ABS/TCS unit.
3. Remove the ABS/TCS unit mounting bolts.

Installation Notice

Tightening Torque	7 N•m (62 lb-in)

4. Installation should follow the removal procedure in the reverse order.

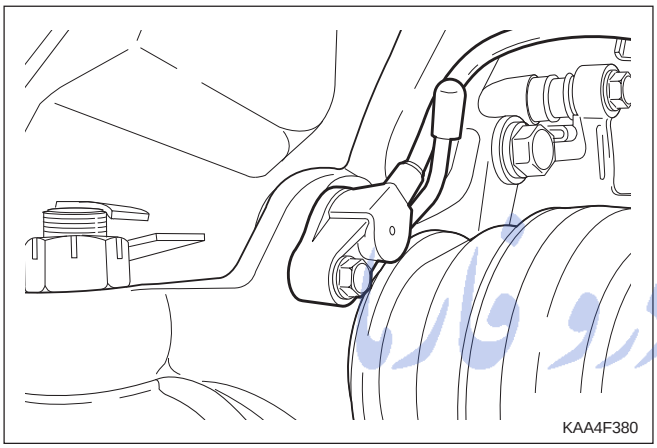
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KAA4F370

FRONT WHEEL SPEED SENSOR

Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Disconnect the front wheel speed sensor electrical connector.


KAA4F380

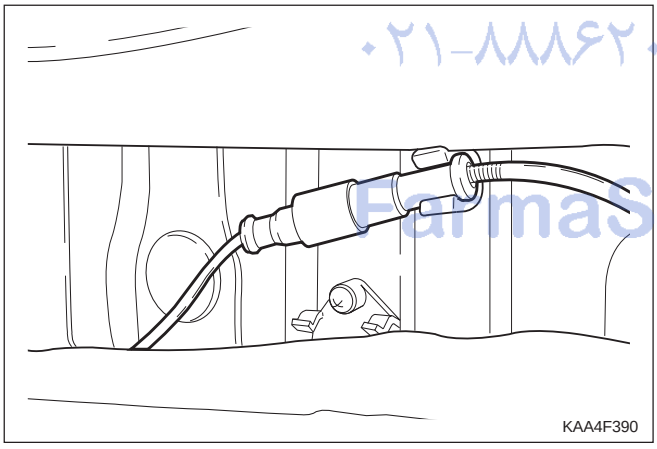
3. Raise and suitably support the vehicle.
4. Turn the steering wheel to expose the front wheel speed sensor. It is located at the rear of the steering knuckle near tie rod end.
5. Remove the bolt and the front wheel speed sensor from the steering knuckle.

Installation Notice

Tightening Torque	7 N•m (62 lb-in)

6. Installation should follow the removal procedure in the reverse order.

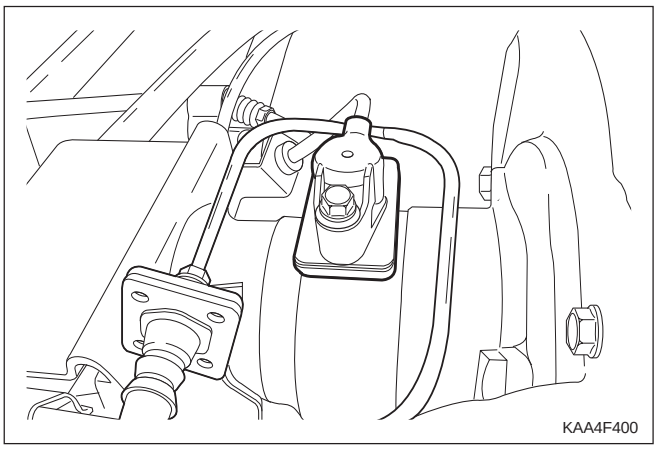
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KAA4F390

REAR WHEEL SPEED SENSOR

Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Disconnect the rear wheel speed sensor electrical connector. It is located under the rear seat.

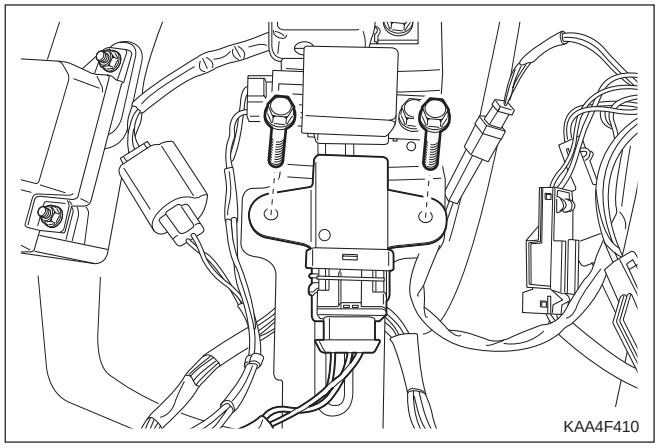

KAA4F400

3. Raise and suitably support the vehicle.
4. Remove the rear wheel speed sensor.

Installation Notice

Tightening Torque	7 N•m (62 lb-in)

5. Installation should follow the removal procedure in the reverse order.



ACCELERATION SENSOR

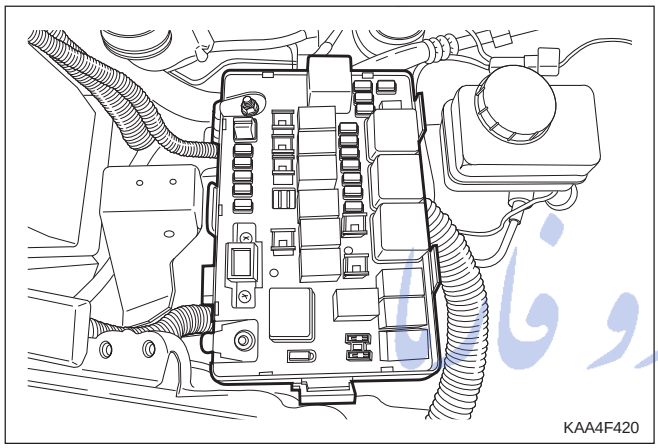
Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Disconnect the acceleration sensor connector. It is located at the rear of audio system.
3. Remove the acceleration sensor mounting bolts.

Installation Notice

Tightening Torque	7 N•m (62 lb-in)

4. Installation should follow the removal procedure in the reverse order.



SYSTEM FUSE

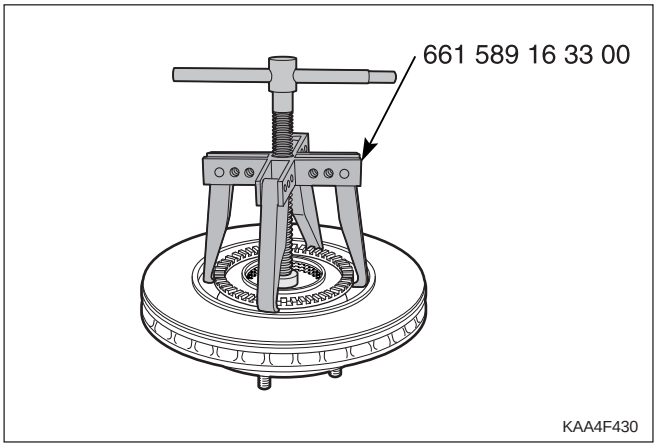
Removal and Installation Procedure

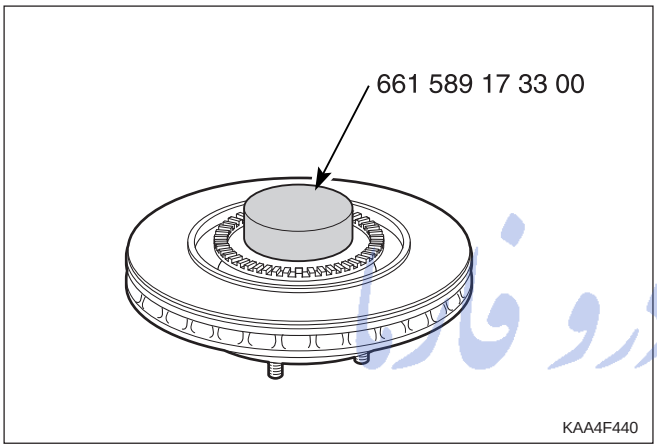
The ABS/TCS system fuse, EF11, is located in the engine fuse block. Counting from the battery toward the surge tank, it is the first system fuse in the row.

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INDICATORS

The indicator lamps ABS and EBD and TCS are part of the instrument cluster. Refer to *Section 9E, instrumentation/ Driver information*, for removal and replacement details.





UNIT REPAIR

ABS FRONT TOOTH WHEEL

Tools Required

661 589 16 33 00 ABS Tooth Wheel Puller

Removal Procedure

1. Remove the disc brake rotor. Refer to *Section 4D, Front Disc Brakes*.
2. Remove the ABS front toothed wheel using the ABS tooth wheel puller 661 589 16 33 00.

Tools Required

661 589 17 33 00 ABS Tooth Wheel Installer

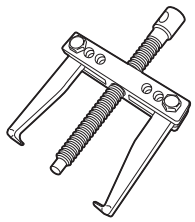
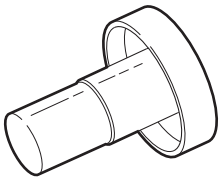
Installation Procedure

1. Install the ABS front toothed wheel using the ABS tooth wheel installer 661 589 17 33 00.

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SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS TABLE

 KAA4F450	**661 589 16 33 00** **ABS Tooth Wheel Puller**
 KAA4F460	**661 589 17 33 00** **ABS Tooth Wheel Installer**

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SECTION 4G

PARKING BRAKE

TABLE OF CONTENTS

Description and Operation 4G-2

Brake Caliper 4G-2

Component Locator 4G-3

Repair Instructions 4G-4

On-Vehicle Service 4G-4

Parking Brake Adjustment - Rear Disc Brakes 4G-4

Parking Brake Lever 4G-5

Parking Brake Cable 4G-6

Specifications 4G-7

Fastener Tightening Specifications 4G-7

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DESCRIPTION AND OPERATION

BRAKE CALIPER

This braking system uses a BRAKE warning light located in the instrument panel cluster.

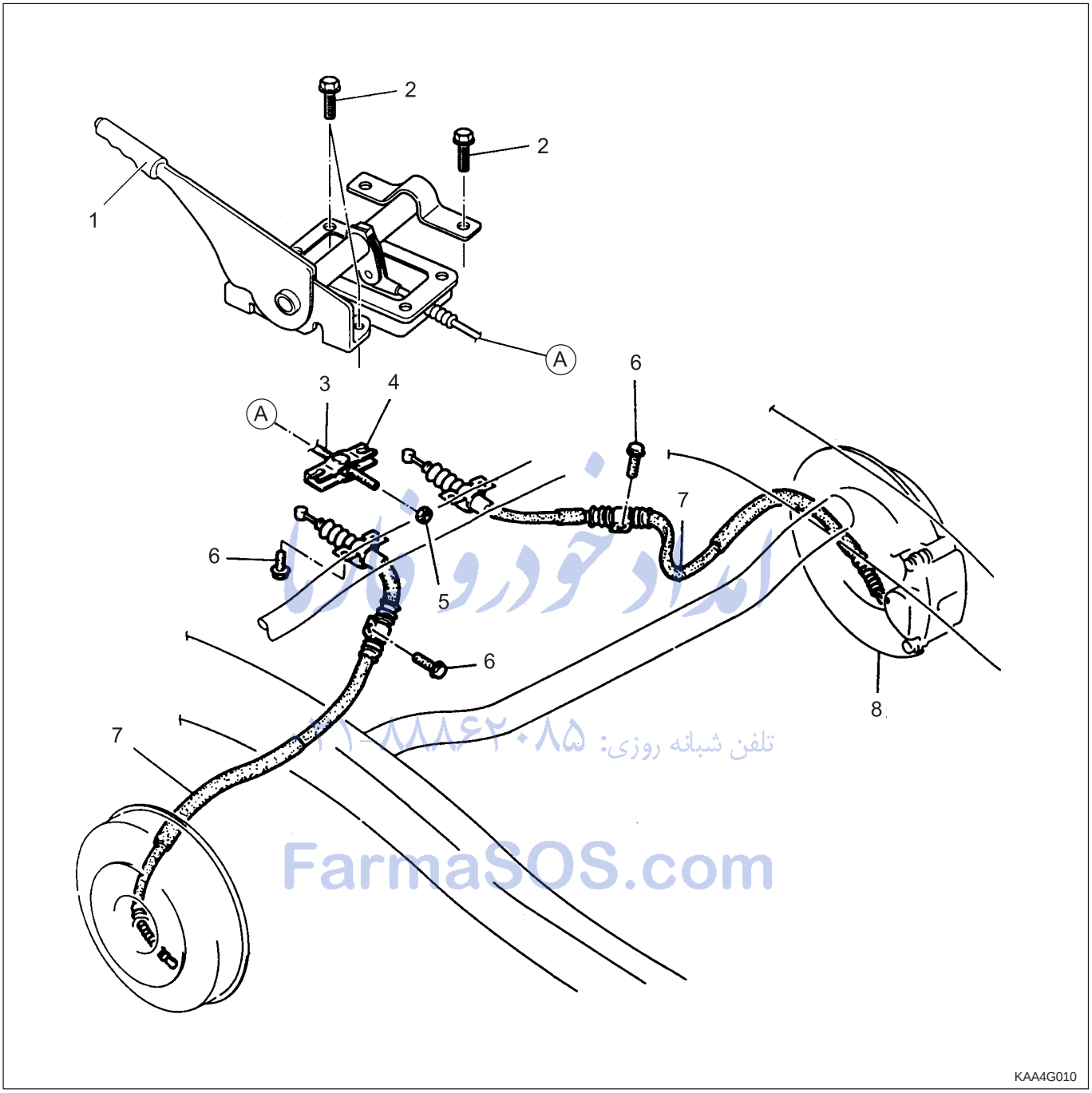
The following conditions will activate the BRAKE lamp:

- The parking brake is applied when the ignition is ON. The lamp will turn off when the parking brake is released.
- The fluid level is below the minimum mark in the master cylinder reservoir. The lamp will turn off when the fluid level is above the minimum.
- As a test of the lamp circuit, the BRAKE lamp will glow dimly when the ignition is ON, even if the parking brake is off and fluid level is above the minimum. The lamp will turn off when the engine is started. When the brake is firmly applied, the parking brake should hold the vehicle with ample pedal travel remaining.

Check for frayed cables, rust, etc. or any condition that may inhibit present (or future) free movement of the parking brake lever assembly.

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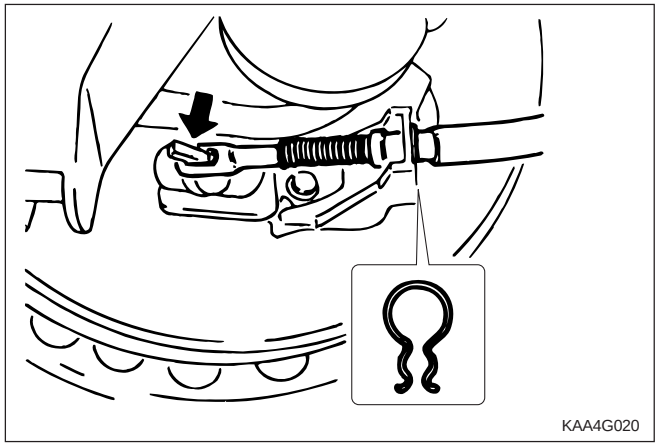
COMPONENT LOCATOR



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1 Parking Brake Lever
2 Parking Brake Lever Mounting Bolt
3 Front Parking Brake Cable
4 Equalizer
5 Adjuster Nut
6 Rear Parking Brake Cable Securing Bolt
7 Rear Parking Brake Cable
8 Rear Disc Brake Rotor

REPAIR INSTRUCTIONS


KAA4G020

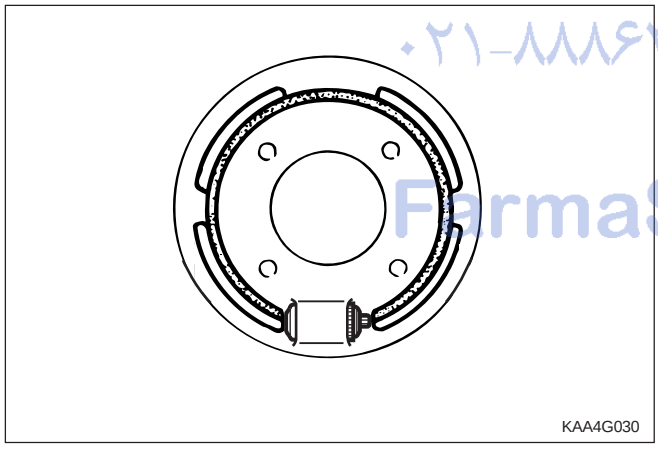
ON-VEHICLE SERVICE

PARKING BRAKE ADJUSTMENT - REAR DISC BRAKES

Adjustment Procedure

1. Release the parking brake.
2. Raise and suitably support the vehicle.
3. Remove the rear wheels. Refer to *Section 2E, Tires and Wheels*.
4. Remove the rear caliper and rotor assemblies. Refer to *Section 4E, Rear Disc Brakes.*
5. Disconnect the rear parking brake cable from the backplate operating lever on each side of the vehicle.

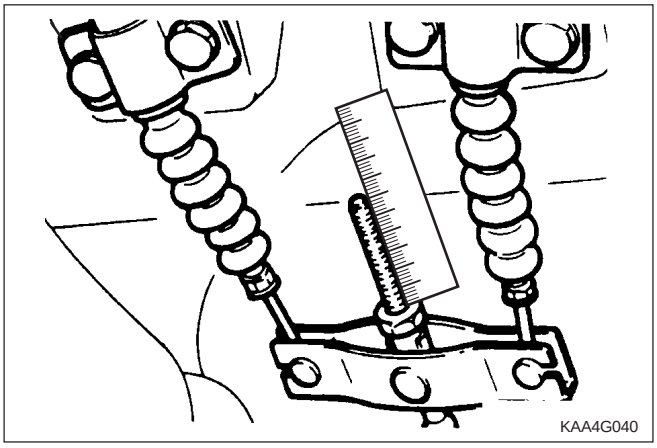
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KAA4G030

6. Inspect and replace any parts of doubtful strength or quality because of discoloration from heat or stress.

Notice:

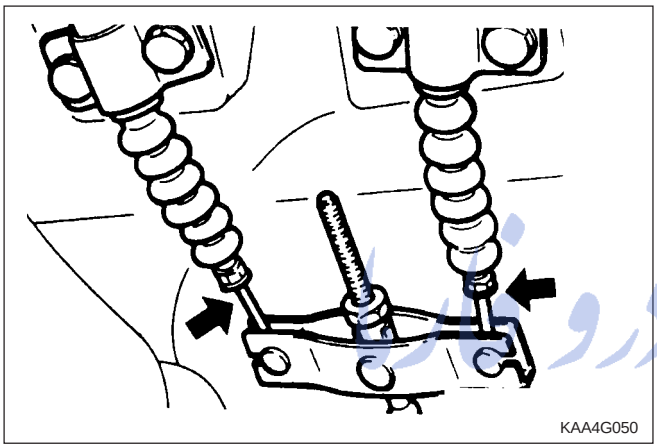
- In the vehicle cabin, pull on the parking brake handle and stop after hearing two clicks.
- Turn the rear wheel by hand until the wheel begins to drag.
- Release the parking brake.
- Turn the rear wheel by hand to check drag and readjust the cable, if necessary.
- Repeat the process for the other rear wheel and lower vehicle.


KAA4G040

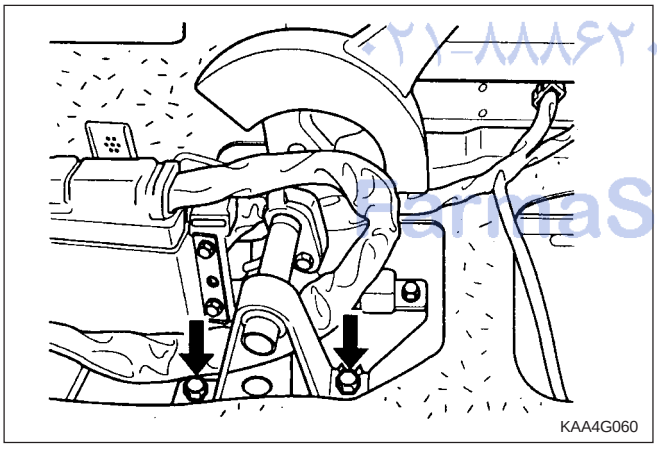
PARKING BRAKE LEVER

Removal and Installation Procedure

1. Release the parking brake.
2. Raise and suitably support the vehicle.
3. Measure the thread length from the end of the pull rod to the hex nut.


KAA4G050

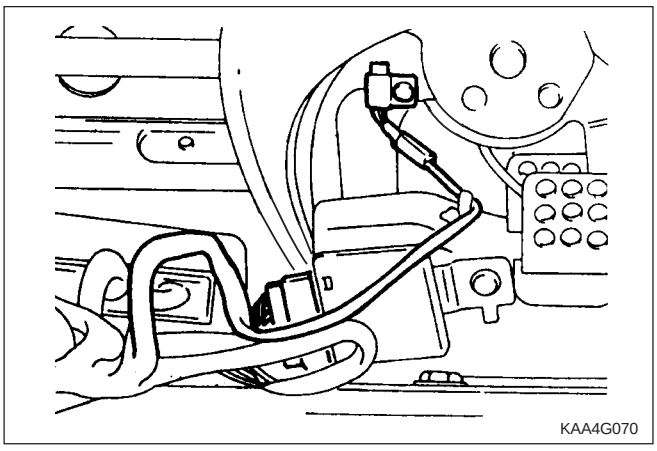
4. Remove the parking brake cable ends from the equalizer and remove the boot.


KAA4G060

5. Lower the vehicle.
6. Remove the parking brake/gearshift console hood. Refer to *Section 9G, Interior Trim.*
7. Remove the parking brake lever mounting bolts and washers which secure the complete parking brake lever assembly to the underbody.

Installation Notice

Tightening Torque	18 N•m (13 lb-ft)

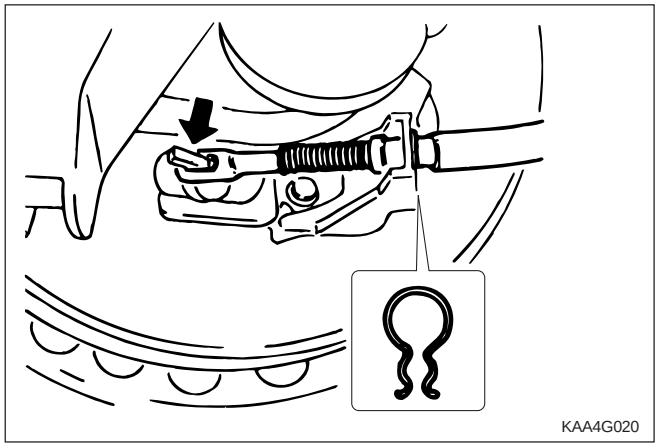

KAA4G070

8. Disconnect the parking brake switch and remove the clip. If necessary, remove the parking brake switch attached to the parking brake lever assembly by a small screw, and remove the switch.
9. Remove the parking brake lever assembly.

Notice:

- The parking brake switch should be replaced if the BRAKE warning light in the instrument panel cluster did not glow when the parking brake was applied with the ignition switch ON.

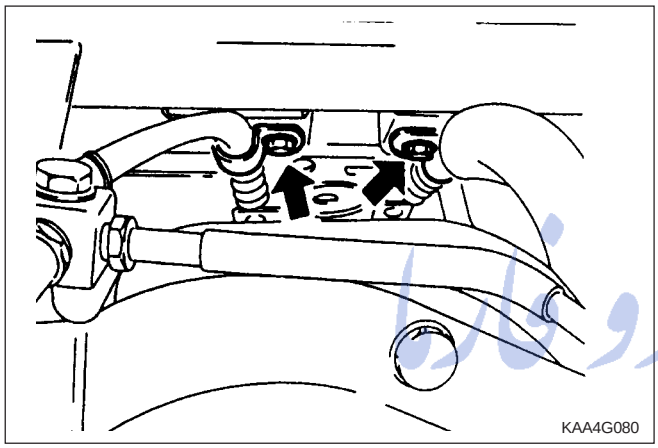
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PARKING BRAKE CABLE

Removal and Installation Procedure

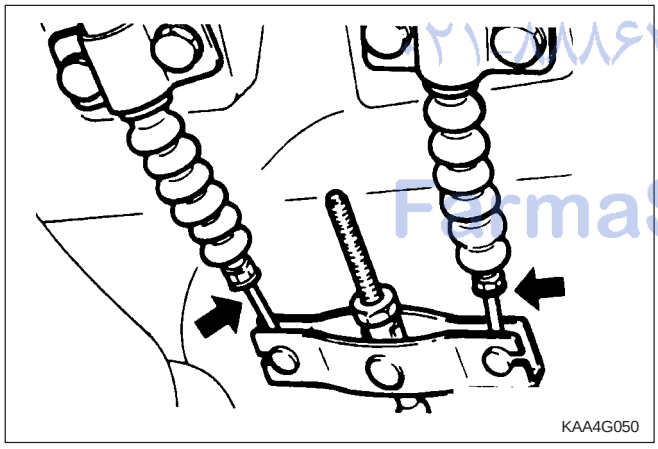
1. Release the parking brake.
2. Raise and suitably support the vehicle.
3. Remove the clip that holds the cable into the rear knuckle assembly.



5. Remove the bolts securing the parking brake cable to a holding bracket attached to the trailing link brackets on both the driver and passenger sides of the vehicle.

Installation Notice

Tightening Torque	9 N•m (80 lb-in)



6. Remove the parking brake cable ends from the equalizer.

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SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Parking Brake Lever Mounting Bolts	18	13	-
Rear Parking Brake Cable Securing Bolts	9	-	80

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SECTION 5A

AUTOMATIC TRANSMISSION

***CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless* otherwise noted.**

TABLE OF CONTENTS

Description and Operation 5A-2
BTRA M74 4WD Automatic Transmission 5A-2
Operators Interfaces 5A-2
Control Systems 5A-3
Electronic Control System 5A-3
Hydraulic Control System 5A-9
Hydraulic Control Circuit 5A-10
Power Train System 5A-14
Power Flows 5A-18
Park and Neutral 5A-20
Reverse 5A-22
Manual 1 . . . . . 5A-24
Drive 1 . . . . . 5A-26
Drive 2 and Manual 2 . . . . . 5A-28
Drive 3 and Manual 3 . . . . . 5A-30
Drive 3 Lock Up and Manual 3 Lock Up 5A-32
Drive 4 (Overdrive) 5A-34
Drive 4 Lock Up 5A-36
Diagnostic Information and Procedures 5A-38
Diagnosis 5A-38
Basic Knowledge Required 5A-38
Functional Check Procedure 5A-38
Transmission Fluid Level Service Procedure . . . 5A-38
Fluid Leak Diagnosis and Repair 5A-39
Electrical / Garage Shift Test 5A-40
Road Test Procedure 5A-40
Electronic Adjustments 5A-40
Symptom Diagnosis 5A-41
Drive Faults 5A-41
Faulty Shift Pattern 5A-42
Shift Quality Faults 5A-44
After Teardown Faults 5A-46
Trouble Code Diagnosis - Gasoline Vehicle . . 5A-48
TCM Diagnostic System Overview 5A-48
Clearing Trouble Codes 5A-48
Diagnostic Trouble Codes 5A-48
Trouble Code Diagnosis - Diesel Vehicle 5A-50
TCM Diagnostic System Overview 5A-50
Clearing Trouble Codes 5A-50
Diagnostic Trouble Codes 5A-50
Repair Instructions 5A-157
On-Vehicle Service 5A-157
Transmission 5A-157
Unit Repair 5A-160
Rebuild Warnings 5A-160
Disassembly Procedure 5A-161
Assembly Procedure 5A-171
Front and Rear Band Adjustment 5A-199
Gear Shift Control Lever 5A-202
Kickdown Switch 5A-202
Specifications 5A-203
General Specification 5A-203
Fastener Tightening Specifications 5A-205
Schematic and Routing Diagrams 5A-206
TCM Wiring Diagrams (Gasoline Engine) 5A-206
TCM Wiring Diagrams (Diesel Engine) 5A-208
Connector End View 5A-210
Special Tools and Equipment 5A-211
Special Tools Table 5A-211

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DESCRIPTION AND OPERATION

BTRA M74 4WD AUTOMATIC TRANSMISSION

The BTR Automotive Model 74 Four Speed Automatic Transmission is an electronically controlled overdrive four speed unit with a lock-up torque converter. The lock-up torque converter results in lower engine speeds at cruise and eliminates unnecessary slippage. These features benefit the customer through improved fuel economy and noise reduction.

	Max. Power (kW)	Configuration
320	160	260 mm Torque Converter-Wide Ratio Gear Set Splined Output for Transfer Case

Of primary significance is the Transmission Control Module (TCM) which is a microprocessor based control system.

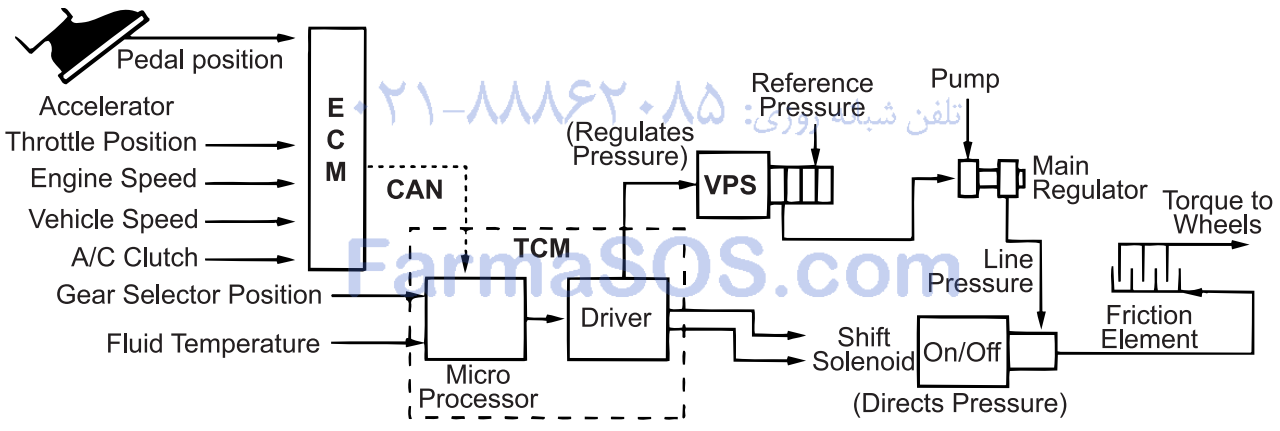
The TCM utilizes throttle position, rate of throttle opening, engine speed, vehicle speed, transmission fluid temperature, gear selector position and mode selector inputs, and in some applications a Kickdown Switch to control all shift feel and shift schedule aspects.

The TCM drives a single proportional solenoid multiplexed to three regulator valves to control all shift feel aspects. The output pressure of this solenoid is controlled as a function of transmission fluid temperature to maintain consistent shift feel throughout the operating range.

Shift scheduling is highly flexible, and several independent schedules are programmed depending on the vehicle.

Typically the NORMAL schedule is used to maximize fuel economy and driveability, and a POWER schedule is used to maximize performance. WINTER schedule is used to facilitate starting in second gear.

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OPERATORS INTERFACES

There are three operator interfaces as the following;

- Gear Shift Control Lever
- Driving Mode Selector
- Indicator Light

Gear Shift Control lever

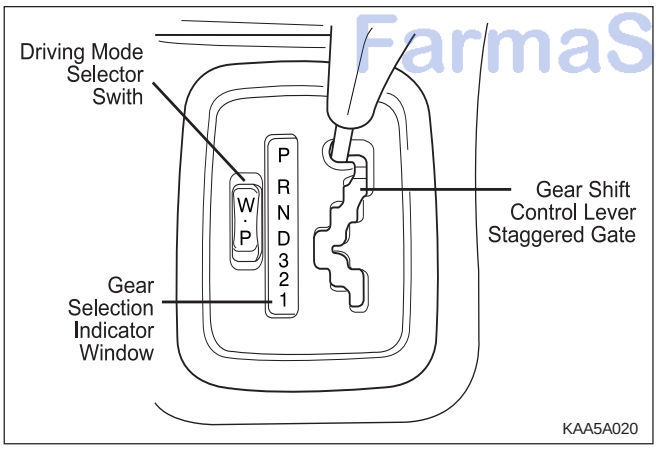
The transmission uses a conventional shift control lever. The gear shift control lever can be moved from one position to another within the staggered configuration of the shift control lever gate to positively indicate the gear selection.

- P - Park position prevents the vehicle from rolling either forward or backward by locking the transmission output shaft. The inhibitor switch allows the engine to be started. For safety reasons, the parking should be used in addition to the park position. Do not select the Park position until the vehicle comes to a complete stop because it mechanically locks the output shaft.
- R - Reverse allows the vehicle to be operated in a rearward direction. The inhibitor switch enables reverse lamp operation.

- N - Neutral allows the engine to be started and operated while driving the vehicle. The inhibitor switch allows the engine to be started. There is no power transferred through the transmission in Neutral. But the final drive is not locked by the parking pawl, so thewheels are free to rotate.
- D - Overdrive range is used for all normal driving conditions. 4th gear (overdrive gear) reduces the fuel consumption and the engine noise. Engine braking is applied with reduced throttle.

  First to second (1 → 2), first to third (1 → 3), second to third (2 → 3), second to fourth (2 → 4), third to fourth (3 → 4), fourth to third (4 → 3), fourth to second (4 → 2), third to second (3 → 2), third to first (3 → 1) and second to first (2 → 1) shifts are all available as a function of vehicle speed, throttle position and the time change rate of the throttle position.

  Downshifts are available for safe passing by depress-ing the accelerator. Lockup clutch may be enabled in 3rd and 4th gears depending on vehicle type.
- 3 - Manual 3 provides three gear ratios (first through third) and prevents the transmission from operating in 4th gear. 3rd gear is used when driving on long hill roads or in heavy city traffic. Downshifts are available by depressing the accelerator.
- 2 - Manual 2 provides two gear ratios (first and second). It is used to provide more power when climbing hills or engine braking when driving down a steep hill or starting off on slippery roads.
- 1 - Manual 1 is used to provide the maximum engine braking when driving down the severe gradients.



Driving Mode Selector

The driving mode selector consists of a driving mode selector switch and indicator light. The driving mode selector is located on the center console and allows the driver to select the driving mode.

The driving modes available to be selected vary with vehicle types. Typically the driver should have the option to select among NORMAL, POWER and WINTER modes.

When NORMAL mode is selected upshifts will occur to maximize fuel economy. When POWER mode is selected, upshifts will occur to give maximum performance and the POWER mode indicator light is switched ON.

When WINTER mode is selected, starting in second gear is facilitated, the WINTER mode indicator light is switched ON and the POWER mode indicator light is switched OFF.

Indicator Light

The indicator light is located on the instrument panel.

- Auto shift indicator light comes ON when the ignition switch ON and shows the gear shift control lever position.
- POWER mode indicator light comes ON when the POWER mode is selected and when the kickdown switch is depressed.
- WINTER mode indicator light comes ON when the WINTER mode is selected.

CONTROL SYSTEMS

BTRA M74 4WD automatic transmission consists of two control systems. One is the electronic control system that monitors vehicle parameters and adjusts the transmission performance. Another is the hydraulic control system that implements the commands of the electronic control system commands.

ELECTRONIC CONTROL SYSTEM

The electronic control system comprises of sensors, a TCM and seven solenoids. The TCM reads the inputs and activates the outputs according to values stored in Read Only Memory (ROM).

The TCM controls the hydraulic control system. This control is via the hydraulic valve body, which contains seven electromagnetic solenoids. Six of the seven solenoids are used to control the line pressure, operate the shift valves and the torque converter lock-up clutch, and to turn ON and OFF the two regulator valves that control the shift feel.

The seventh solenoid is the proportional or Variable Pressure Solenoid (VPS) which works with the two regulator valves to control shift feel.

Transmission Control Module (TCM)

The TCM is an in-vehicle micro-processor based transmission management system. It is mounted under the driver's side front seat in the vehicle cabin.

The TCM contains:

- Processing logic circuits which include a central microprocessor controller and a back-up memory system.
- Input circuits.

- Output circuits which control external devices such as the Variable Pressure Solenoid (VPS) driver, On/Off solenoid drivers, a diagnostics output and the driving mode indicator light.

Processing Logic

Shift schedule and calibration information is stored in an Erasable Programmable Read Only Memory (EPROM).

Throttle input calibration constants and the diagnostics information are stored in Electrically Erasable Programmable Read Only Memory (EEPROM) that retains the memory even when power to the TCM is disconnected. TCM continuously monitors the input values and uses these, via the shift schedule, to determine the required gear state. At the same time it monitors, via the solenoid outputs, the current gear state, whenever the input conditions change such that the required gear state is different to the current gear state, the TCM initiates a gear shift to bring the two states back into line.

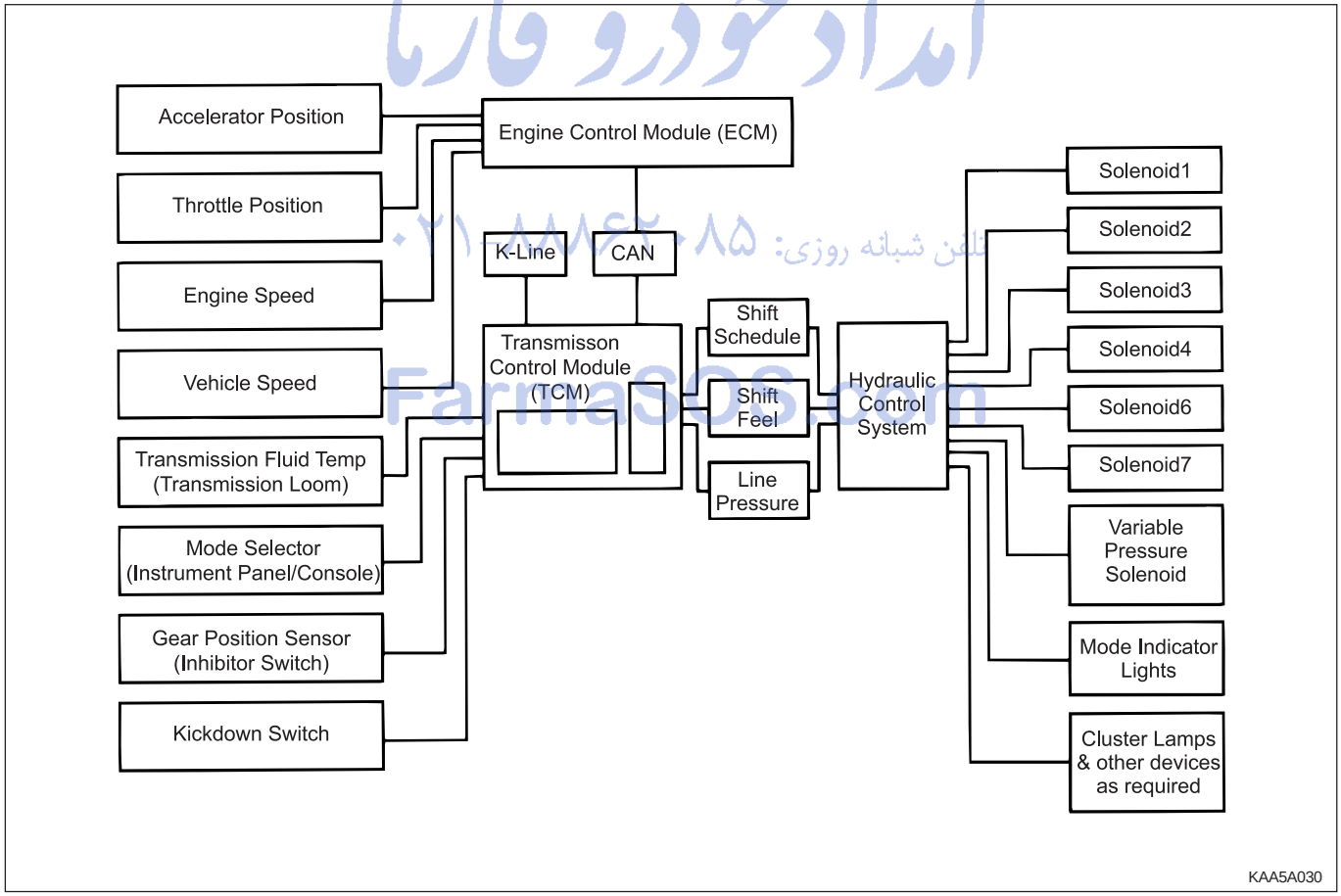
Once the TCM has determined the type of gearshift required the TCM accesses the shift logic, estimates the engine torque output, adjusts the variable pressure solenoid ramp pressure then executes the shift.

The TCM continuously monitors every input and output circuit for short or open circuits and operating range.

When a failure or abnormal operation is detected the TCM records the condition code in the diagnostics memory and implements a Limp Home Mode (LHM).

The actual limp home mode used depends upon the failure detected with the object to maintain maximum drive-ability without damaging the transmission. In general input failures are handled by providing a default value. Output failures, which are capable of damaging the transmission, result in full limp mode giving only third or fourth gear and reverse. For further details of limp modes and memory retention refer to the Diagnostic Trouble Code Diagnosis Section.

The TCM is designed to operate at ambient temperatures between - 40 and 85 °C (- 40 and 185 °F). It is also protected against electrical noise and voltage spikes, however all the usual precautions should be observed, for example when arc welding or jump starting.



TCM Inputs

To function correctly, the TCM requires engine speed, vehicle speed, transmission fluid temperature, throttle position, gear position and Kickdown Switch inputs to determine the variable pressure solenoid current ramp and on/off solenoid states.

This ensures the correct gear selection and shift feel for all driving conditions.

The inputs required by the TCM are as follows;

- Engine Speed

  The engine speed signal is derived from the Controller Area Network (CAN) via Engine Control Module (ECM).

- Vehicle Speed

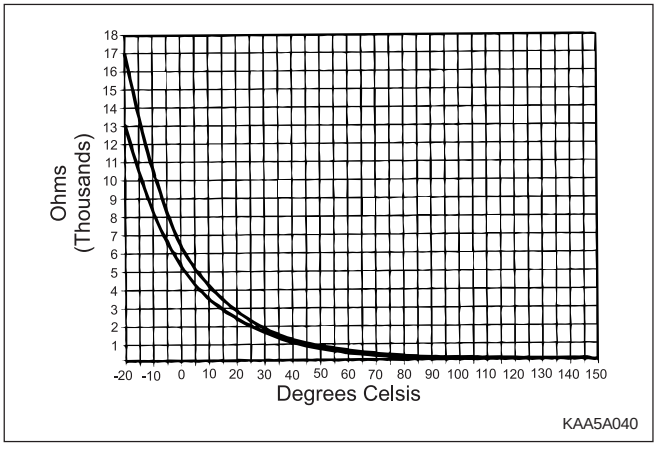
  The vehicle speed sensor, which is located in the transfer case, sends the output shaft speed signal to the Engine Control Module (ECM). The information is then transferred to the TCM via the CAN.

- Transmission Fluid Temperature

  The transmission fluid temperature sensor is a thermistor located in the solenoid wiring loom within the valve body of the transmission. This sensor is a typical Negative Temperature Coefficient (NTC) resistor with low temperatures producing a high resistance and high temperatures producing a low resistance.

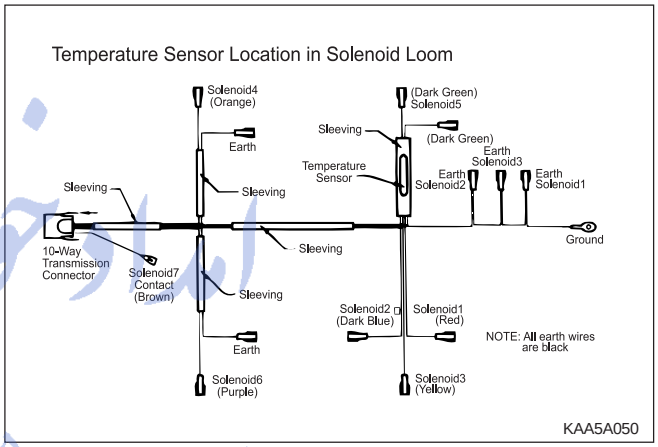
  If the transmission fluid temperature exceeds 135 °C (275 °F), the TCM will impose converter lock-up at lower vehicle speeds and in some vehicles flashes the mode indicator light. This results in maximum oil flow through the external oil cooler and eliminates slippage in the torque converter. Both these actions combine to reduce the oil temperature in the transmission.

Temperature (°C)	Resistance (Ohms)	
	Minimum	Maximum
-20	13,638	17,287
0	5,177	6,616
20	2,278	2, 723
100	117	196
135 (Overheat Mode Threshold)	75	85



Pin No. Codes and colors in Solenoid Loom

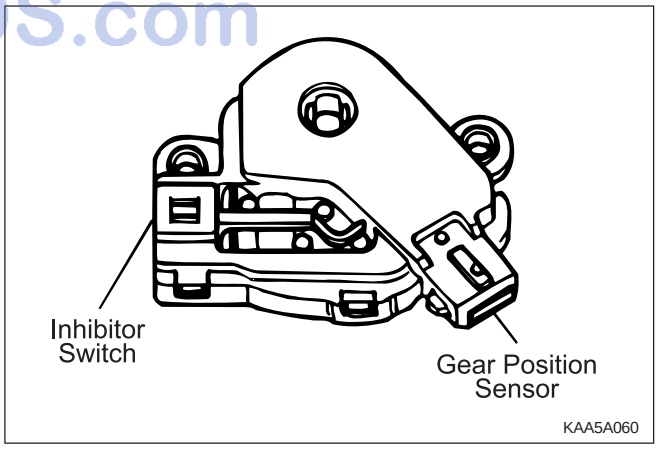
Pin No.	Wire Color	Connects to
1	Red	Solenoid 1
2	Blue	Solenoid 2
3	Yellow	Solenoid 3
4	Orange	Solenoid 4
5	Green	Solenoid 5
6	Violet	Solenoid 6
7	Brown	Solenoid 7
8	Green	Solenoid 5
9	White	Temperature Sensor
10	Red	Temperature Sensor



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Gear Position Sensor

The gear position sensor is incorporated in the inhibitor switch mounted on the side of the transmission case.



The gear position sensor is a multi-function switch providing three functions;

- Inhibit starting of the vehicle when the shift lever is in a position other than Park or Neutral
- Illuminate the reverse lamps when Reverse is selected
- Indicate to the TCM which lever position has been selected by way of a varying resistance.

Readings for Resistance / Shift Lever Positions

Shift Lever Position	Resistance (kΩ)
Manual 1	1 ~ 1.4
Manual 2	21.8 ~ 2.2
Manual 3	3 3 ~ 3.4
Drive	4.5 ~ 4.9
Neutral	6.8 ~ 7.2
Reverse	10.8 ~ 11.2
Park	18.6 ~ 19

Kickdown Switch

The Kickdown Switch is used to signal the TCM that the driver has pressed the acclerator to the floor and requires a kickdown shift. When this switch is used, the POWER light comes ON and the POWER shift pattern is used.

Diagnostic Inputs

The diagnostic control input or K-line is used to initiate the outputting of diagnostic data from the TCM to a diagnostic test instrument. This input may also be used to clear the stored fault history data from the TCM's retentive memory. Connection to the diagnostic input of the TCM is via a connector included in the vehicle's wiring harness or computer interface.

Battery Voltage Monitoring Input

The battery voltage monitoring input is connected to the positive side of the battery. This signal is taken from the main supply to the TCM.

If the battery voltage at the TCM falls below 11.3 V, the transmission will adopt a low voltage mode of operating in which shifts into first gear are inhibited. All other shifts are allowed but may not occur because of the reduced voltage. This condition normally occurs only when the battery is in poor condition.

If the battery voltage is greater than 16.5 V, the transmission will adopt limp home mode and all solenoids are turned OFF.

When system voltage recovers, the TCM will resume normal operation after a 30 seconds delay period.

TCM Outputs

The outputs from the TCM are supplied to the components described below;

- Solenoids
- Mode Indicator Light

Solenoids

The TCM controls seven solenoids. Solenoids 1 to 6 (S1 to S6) are mounted in the valve body, while Solenoid 7 (S7) is mounted in the pump cover.

- Solenoid 1 and 2: S1 and S2 are normally open ON/OFF solenoids that set the selected gear. These solenoids determine static gear position by operating the shift valves. Note that S1 and S2 solenoids also send signal pressure to allow or prohibit rear band engagement.
- Solenoid 3 and 4: S3 and S4 are normally open ON/OFF solenoids that combine to control shift quality and sequencing. S3 switches the clutch regulator valve OFF or ON. S4 switches the front band regulator valve OFF or ON. S5 also provides the signal pressure for the converter clutch regulator valve.
- Solenoid 5: S5 is a variable pressure solenoid that ramps the pressure during gear changes. This solenoid provides the signal pressure to the clutch and band regulator, thereby controlling the shift pressures. S5 also provides the signal pressure for the converter clutch regulator valve.
- Solenoid 6: S6 is a normally open ON/OFF solenoid that sets the high/low level of line pressure. Solenoid OFF gives high pressure.
- Solenoid 7: S7 is a normally open ON/OFF solenoid that controls the application of the converter clutch. Solenoid ON activates the clutch.

Solenoid Logic for Static Gear States

Gear	S1	S2
1st	ON	ON
2nd	OFF	ON
3rd	OFF	OFF
4th	ON	OFF
Reverse	OFF	OFF
Neutral	OFF	OFF
Park	OFF	OFF

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Solenoid Operation during Gearshifts

Shift	To Initiate Shift	Typical S5 Current Ramp	To Complete Shift
1-2	S1 OFF S4 ON	750mA to 600mA	S4 OFF
1-3	S1 OFF S2 OFF S3 ON S4 ON	850mA to 750mA	S3 OFF S4 OFF
1-4	S2 OFF S3 ON S4 ON	850mA to 750mA	S3 OFF S4 OFF
2-3	S2 OFF S3 ON S4 ON	700mA to 500mA	S3 OFF S4 OFF
3-4	S1 ON S4 ON	750mA to 600mA	S4 OFF
4-3	S4 ON	750mA to 900mA	S1 OFF S4 OFF
4-2	S3 ON	750mA to 950mA	S1 OFF S2 ON S3 OFF
4-1	S3 ON S4 ON	600mA to 1000mA	S2 ON S3 OFF S4 OFF
3-2	S2 ON S4 ON	600mA to 450mA @ 20 kph. 550mA to 400mA @ 60 kph. 800mA to 650mA @ 100 kph.	S4 OFF
3-1	S3 ON S4 ON	700mA to 950mA	S1 ON S2 ON S3 OFF S4 OFF
2-1	S4 ON	800mA to 950mA	S1 ON S4 OFF
Conv. Clutch ON OFF	S7 ON	700mA to 400mA 600mA to 100mA	S7 OFF

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Solenoid Valve Symbols

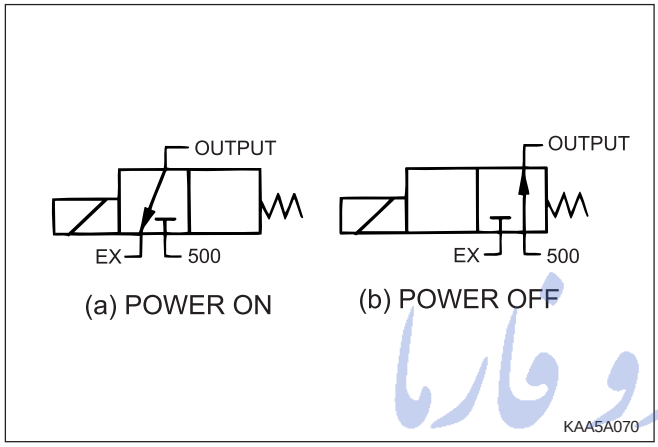
(ON/OFF Solenoids)

The solenoid symbol shown adjacent to each solenoid on the hydraulic system schematics indicates the state of the oil flow through the solenoid valve with the power ON or OFF.

Normally Open (NO) Solenoid

POWER ON: Line 500 port is closed. The output port is open to exhaust at the solenoid valve.

POWER OFF: The exhaust port is closed. The output port is open to line 500.



Variable Pressure Solenoid Multiplexing System

Friction element shifting pressures are controlled by the Variable Pressure Solenoid (VPS).

Line pressure is completely independent of shift pressure and is a function of throttle position, gear state and engine speed.

S5 is a proportional or variable pressure solenoid that provides the signal pressure to the clutch and band regulator valves thereby controlling shift pressures.

VPS pressure is multiplexed to the clutch regulator valve, the band regulator valve and the converter clutch regulator valve during automatic gearshifts.

A variable pressure solenoid produces a hydraulic pressure inversely proportional to the current applied. During a gearshift the TCM applies a progressively increasing or decreasing (ramped) current to the solenoid. Current applied will vary between a minimum oaf 200 mA and a maximum of 1000 mA. Increasing current decreases output (S5) pressure. Decreasing current increases output (S5) pressure.

Line 500 pressure, (approximately 440 to 560 kPa), is the reference pressure for the VPS, and the VPS output pressure is always below line 500 pressure.

When the VPS is at standby, that is no gearshift is taking place, the VPS current is set to 200 mA giving maximum output pressure.

Under steady state conditions the band and clutch regulator valve solenoids are switched OFF.

This applies full Line 500 pressure to the plunger and because Line 500 pressure is always greater than S5 pressure it squeezes the S5 oil out between the regulator valve and the plunger. The friction elements are then fed oil pressure equal to Line 500 multiplied by the amplification ratio.

When a shift is initiated the required ON/OFF solenoid is switched ON cutting the supply of Line 500 to the plunger.

At the same time the VPS pressure is reduced to the ramp start value and assumes control of the regulator valve by pushing the plunger away from the valve. The VPS then carries out the required pressure ramp and the timed shift is completed by switching OFF the ON/ OFF solenoid and returning the VPS to the standby pressure.

This system enables either the band or clutch or both to be electrically controlled for each gearshift.

Mode Indicator Light

Depending on the application, the mode indicator light may be used to indicate the mode that has been selected or if an overheat condition exists. The mode indicator light is usually located on the instrument cluster.

Communication Systems

CAN

The Controller Area Network (CAN) connects various control modules by using a twisted pair of wires, to share common information. This results in a reduction of sensors and wiring. TCM obtains the actual engine speed and throttle position, vehicle speed and accelerator position etc. from ECM via CAN without any additional sensors.

K-Line

The K-line is typically used for obtaining diagnostic information from the TCM. A scan tool with a special interface is connected to the TCM via Data Link Connector (DLC) and all current faults, stored faults, runtime parameters are then available. The stored trouble codes can also be cleared by scan tool.

The K-line can be used for vehicle coding at the manufacturer's plant or in the workshop. This allows for one TCM design to be used over different vehicle mod-els.

The particular code is sent to the microprocessor via the K-line and this results in the software selecting the correct shift and VPS ramp parameters.

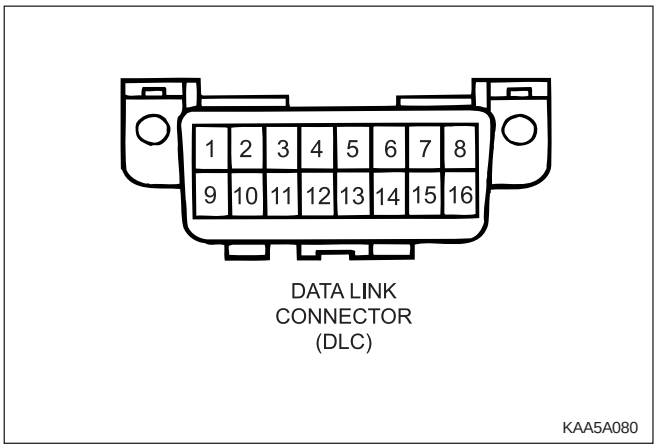
Data Link Connector (DLC)

The Data Link Connector (DLC) is a multiple cavity connector. The DLC provides the means to access the serial data from the TCM.

The DLC allows the technician to use a scan tool to monitor the various systems and display the Diagnostic Trouble Codes (DTCs).

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The DLC connector is located within the driver's compartment, directly below the instrument panel on the driver's side.



HYDRAULIC CONTROL SYSTEM

The hydraulic controls are located in the valve body, pump body and main case.

The valve body contains the following;

- Manual valve
- Three shift valves
- Sequence valve
- Solenoid supply pressure regulator valve
- Line pressure control valve
- Clutch apply feed regulator valve
- Band apply feed regulator valve
- Solenoid S1 to S6
- Reverse lockout valve

The pump cover contains the following;

- Primary regulator valve for line pressure
- Converter clutch regulator valve
- Converter clutch control valve
- Solenoid S7

The main case contains the following;

- B1R exhaust valve

All upshifts are accomplished by simultaneously switching on a shift valve(s), switching VPS pressure to the band and/or clutch regulator valve, and then sending the VPS a ramped current. The shift is completed by switching the regulators OFF and at the same time causing the VPS to reach maximum pressure.

All downshifts are accomplished by switching VPS pressure to the band and/or clutch regulator valve and sending a ramped current to the VPS. The shift is completed by simultaneously switching the regulators OFF, switching the shift valves and at the same time causing the VPS to return to stand-by pressure.

The primary regulator valve is located in the pump cover and supplies four line pressures; high and low for forward gears, and high and low for reverse. This pressure has no effect on shift quality and merely provides static clutch capacity during steady state operation. Low pressure can be obtained by activating an ON/OFF solenoid with high line pressure being the default mode.

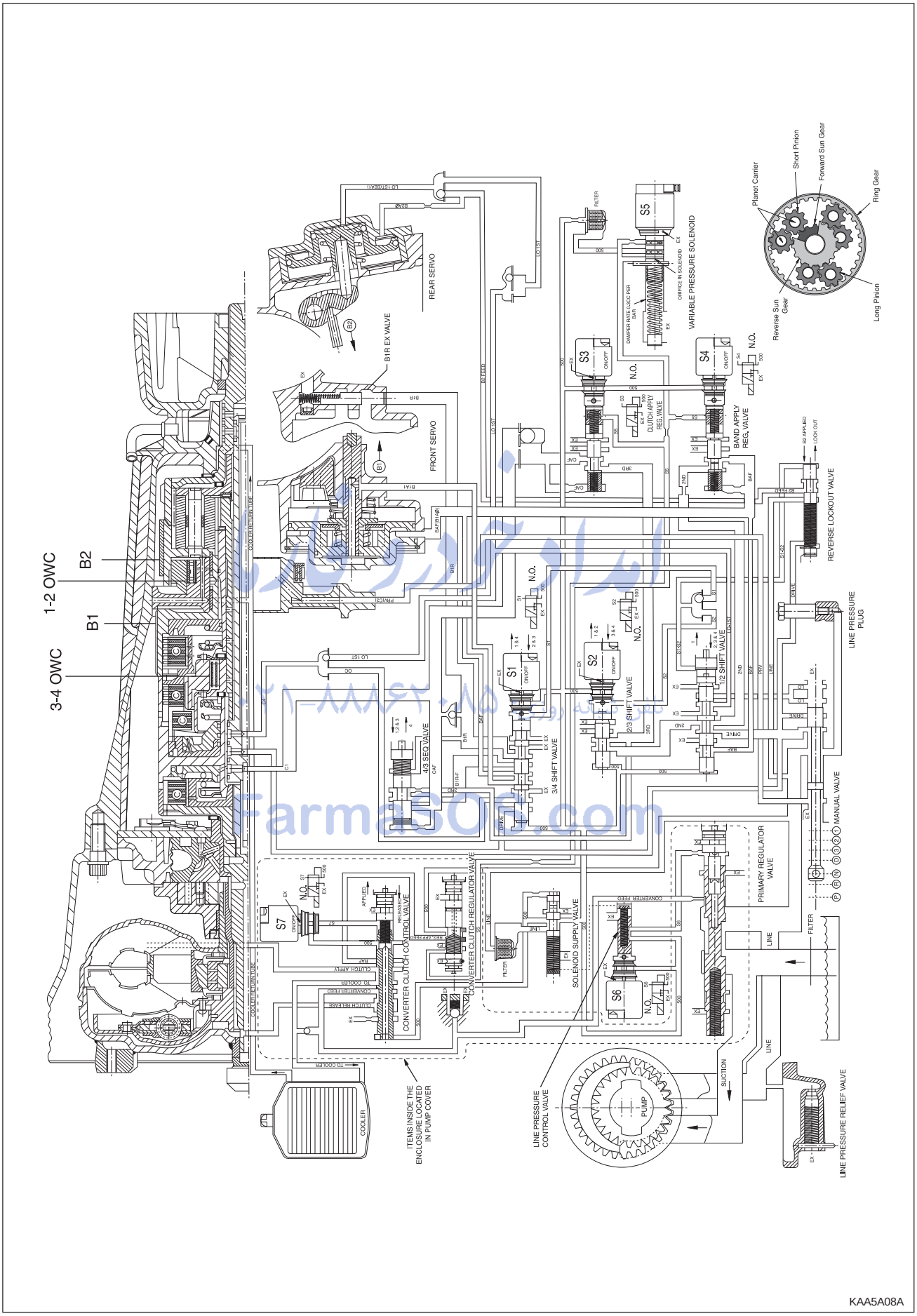
Torque converter lock-up is initiated by toggling the converter clutch control valve with an ON/OFF solenoid.

The actual apply and release of the clutch is regulated by the VPS via the converter clutch regulator valve.

The solenoid supply pressure regulator valve provides reference pressure for all the solenoids.

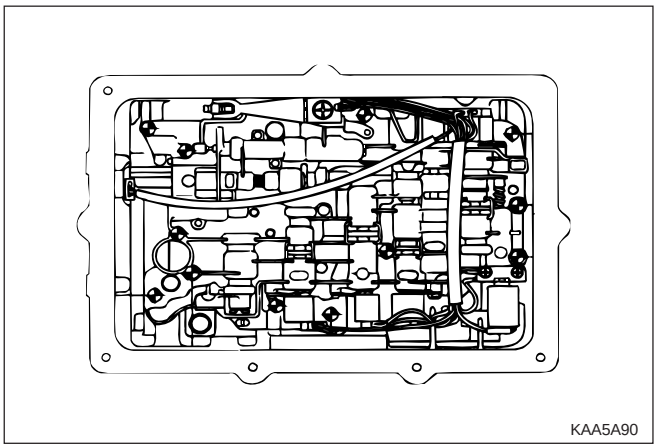
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HYDRAULIC CONTROL CIRCUIT



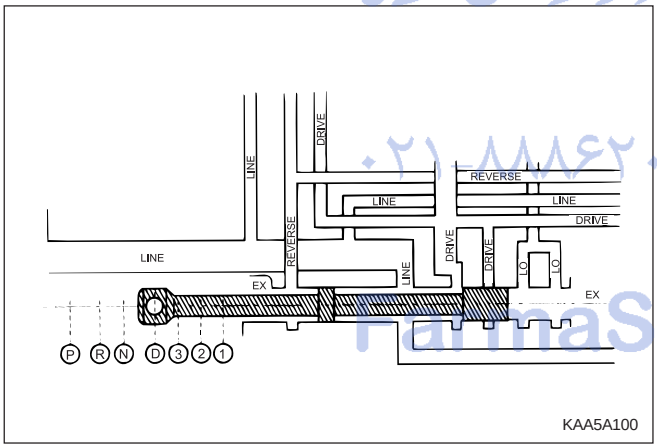
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Valve Body



Manual Valve

The manual valve is connected to the vehicle selector mechanism and controls the flow of oil to the forward and reverse circuits. The manual valve function is identical in all forward gear positions except that in the Manual 1 position an additional supply of oil is directed to the 1-2 shift valve for application of the rear band and the C4 overrun clutch. The manual valve directs the line pressure into the PRND fluid circuits.



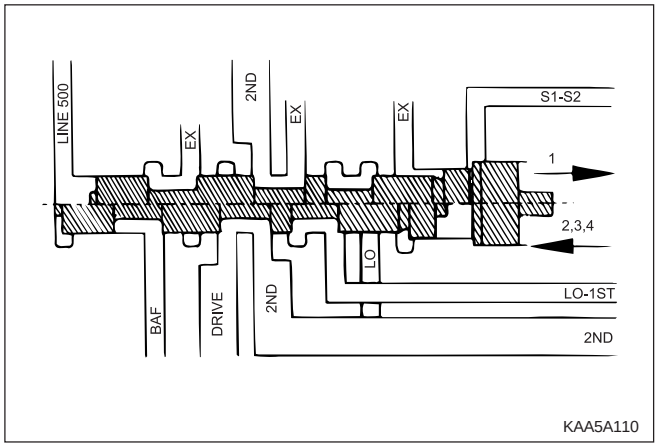
1-2 Shift Valve

The 1-2 shift valve is a two position valve that must be switched to the 2, 3 and 4 position in order to get any forward gear other than first gear. It is used for all 1-2 and 2-1 gearshifts.

The switching of this valve is achieved by using S1 and/ or S2.

During a 1-2 gearshift drive oil from the manual valve passes through to the second gear circuit. During a 2-1 gearshift the band apply feed oil is allowed to exhaust via the 1-2 shift valve.

The 1-2 shift valve works in conjunction with the 3-4 shift valve to disengage the C4 clutch in first gear, and engage C4 in second gear. When Manual 1 is selected the C4 clutch and rear band (B2) are engaged.



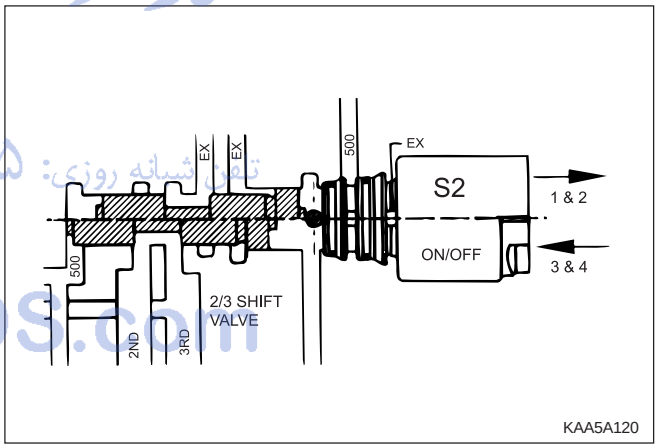
2-3 Shift Valve

The 2-3 shift valve is a two position valve. It is used on all 2-3 and 3-2 gearshifts.

The switching of this valve is achieved by S2 which is located at the end of the valve spool.

In the 1, 2 position, second gear oil from the 1-2 shift valve is prevented from entering the third gear circuit.

When the valve is moved to the 3, 4 position, oil from the second gear circuit is routed to the third gear circuit and the transmission is changed to third gear.



3-4 Shift Valve

The 3-4 shift valve is a two position valve. It is used for all 3-4 and 4-3 gearshifts.

The switching of this valve is achieved by S1 which is located at the end of the valve spool.

During a 3-4 gearshift the 3-4 shift valve:

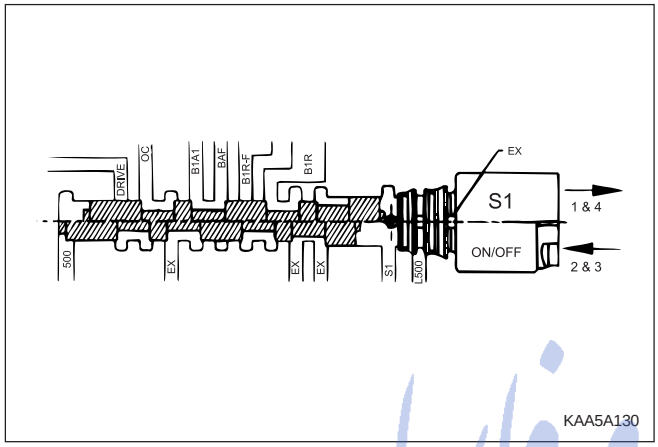
- Exhausts the front band release (B1R) circuit thereby allowing the application of the front band (B1).
- Connects the inner apply area of the front servo (B1AI) to the Band Apply Feed (BAF) circuit thus allowing greater apply forces to the front band.
- Exhausts the Overrun Clutch (OC) circuit which allows the C4 clutch to disengage.

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During a 4-3 gearshift, the C4 clutch is engaged and the front band (B1) is released. These actions are sequenced by the 4-3 sequence valve.

The 3-4 shift valve also switches during 1-2 and 2-1 gearshifts where its function is to apply the overrun clutch (C4) in second gear but to release it in first gear.

Note that the C4 clutch is applied in Manual 1 by virtue of the manual valve and the 1-2 shift valve. Refer to “1-2 Shift Valve” in this section.

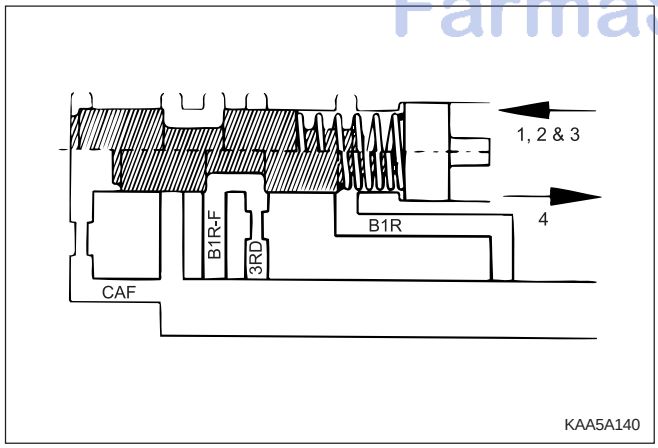


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4-3 Sequence Valve

The 4-3 sequence valve is a two position spring loaded valve. It switches during 3-4 and 4-3 gearshifts although it performs no function during the 3-4 shift.

During the 4-3 shift the 4-3 sequence valve delays the connection of the Clutch Apply Feed (CAF) circuit to the B1R circuit until the B1R circuit has been fully pressurized by using the third gear circuit. This prevents objectionable engine flare on completion of the 4-3 gearshift.



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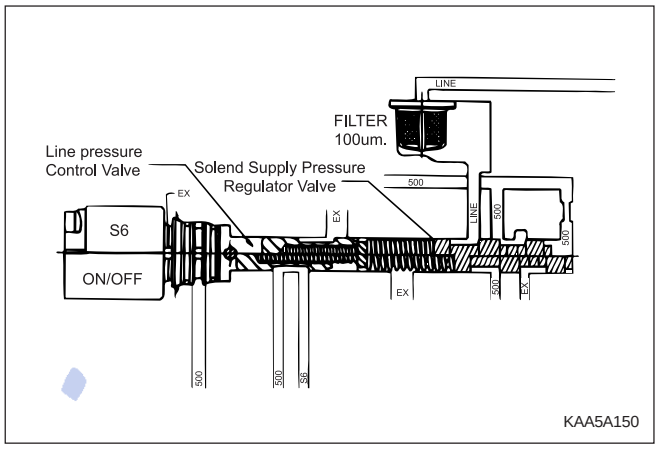
Solenoid Supply Pressure Regulator Valve

The solenoid supply pressure regulator valve supplies a constant pressure to all solenoids (S1 to S7). Line pres-sure is used as the feeding oil to this regulator and the output is termed line 500.

Line Pressure Control Valve

Line pressure is controlled by S6, which acts as the line pressure control valve. When S6 pressure is applied to the end of the Primary Regulator Valve (PRV), it is opposed by spring force and causes LOW line pressure for light throttle application and cruising.

Heavy throttle application causes the normally open S6 to open (switch Off) thus closing line 500 and opening S6 to exhaust. Removal of S6 pressure from the PRV results in HIGH line pressure.

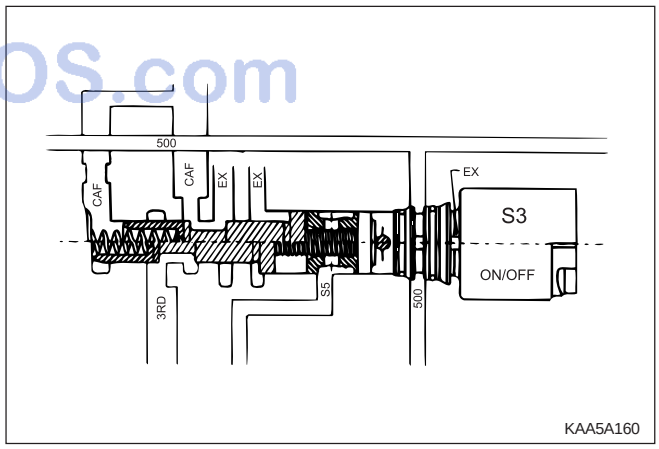


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Clutch Apply Feed Regulator Valve

The clutch apply feed regulator valve is a fixed ratio (2.25:1) valve. This valve provides a regulated pressure to the C1 clutch and controls the change rate of the clutch state to give the desired shift quality.

Third gear oil supplied to the valve is regulated to provide an output pressure, Clutch Apply Feed (CAF) pressure, of 2.25 times the S5 signal pressure when S3 is ON. When S3 is OFF, the output pressure is 2.25 times the line 500 pressure.



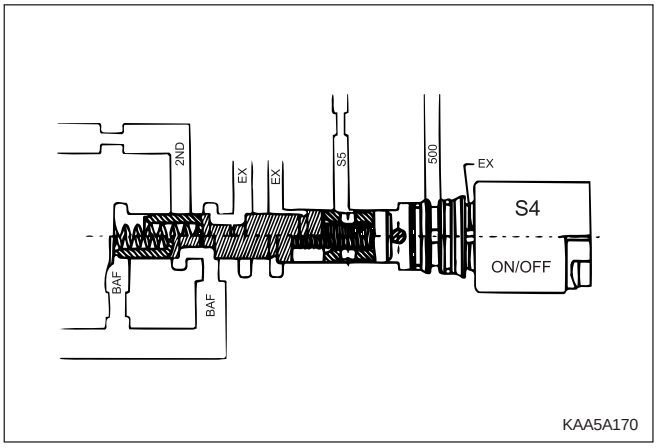
KAA5A160

Band Apply Feed Regulator Valve

The band apply feed regulator valve is a fixed ratio (1.4:1) valve. It provides a regulated pressure to the front servo, and controls the change rate of the front band (B1) state to give the desired shift quality.

Second gear oil supplied to the valve is regulated to provide an output pressure, Band Apply Feed (BAF) pressure, of 1.4 times the S5 signal pressure when S4 is ON. When S4 is OFF the output pressure is 1.4 times the line 500 pressure.

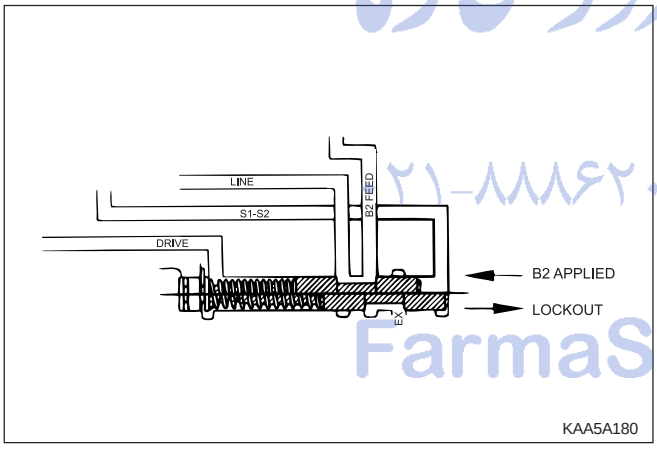
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Reverse Lockout Valve

The reverse lockout valve is a two position valve contained in the upper valve body. This valve uses S1-S2 pressure as a signal pressure and controls the application of the rear band (B2).

While the manual valve is in D, 3, 2 or 1 positions, drive oil is applied to the spring end of the valve, overriding any signal pressures and holding the valve in the lockout position. This prevents the application of B2 in any of the forward driving gears except M1.



When the manual valve is in P, R or N positions, drive oil is exhausted and the reverse lockout valve may be toggled by S1-S2 pressure.

B2 is applied in P, R, and N if the following conditions are satisfied;

- In P or N, vehicle speed = 3 km/h.
- In R, vehicle speed = 10 km/h.
- Engine speed = 1600 rpm.
- Throttle position = 12 %.

Under these conditions, the TCM switches solenoids S1 and S2 to OFF. The reverse lockout valve toggles under the influence of the S1-S2 pressure, to connect the line pressure to the B2 feed. Oil is fed to both the inner and outer apply areas of the rear servo piston, applying B2.

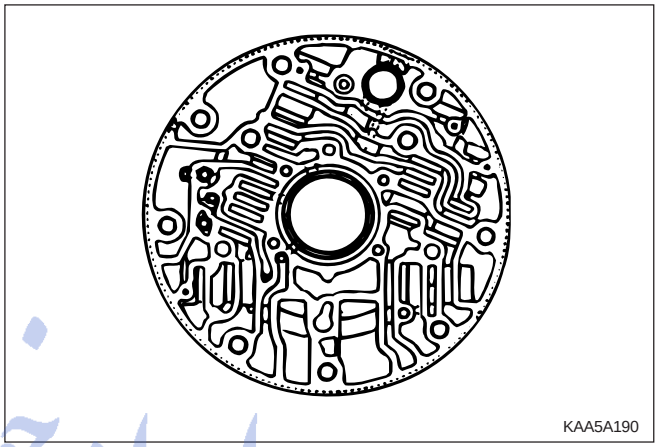
If any of the above conditions are not satisfied, the TCM switches solenoids S1 and S2 to ON.

S1- S2 pressure is exhausted and the valve is held in the lockout position by the spring. In this position, engagement of B2 is prohibited.

This feature protects the transmission from abuse by preventing the undesirable application of B2 at high speed, and by providing a reverse lockout function.

Note that if the transmission is in failure mode, the rear band will be applied at all times in P, R and N.

Pump Cover



Primary Regulator Valve

The Primary Regulator Valve (PRV) regulates the transmission line pressure (or pump output pressure). This valve gives either high or low line pressure depending on whether S6 is switched OFF or ON. When S6 is switched ON, S6 pressure is applied to the PRV moving it against spring pressure and opening the line pressure circuit to the pump suction port resulting in reduced line pressure.

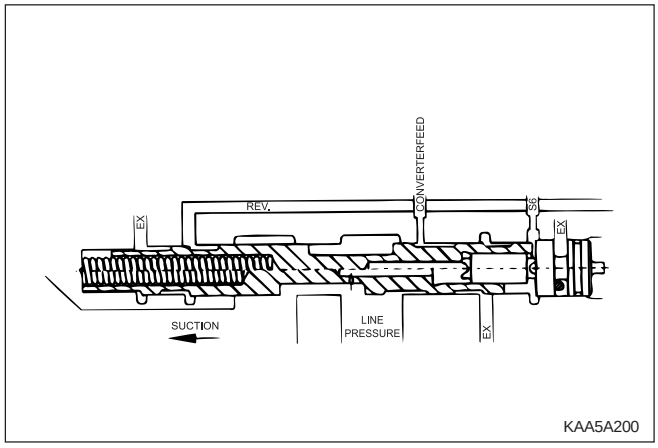
Low line pressure is used during light throttle applications and cruising. Heavy throttle will cause S6 to switch OFF and thereby cause high line pressure.

This stepped line pressure control has no detrimental effect on shift feel because all shifting pressures are controlled by separate band and clutch regulator valves, and the output of S5.

When reverse gear is selected, both the low and high line pressure values are boosted to guard against slippage. This is achieved by applying reverse oil line pressure to the PRV to assist the spring load. The other end of the valve contains ports for line pressure feedback and S6 pressure.

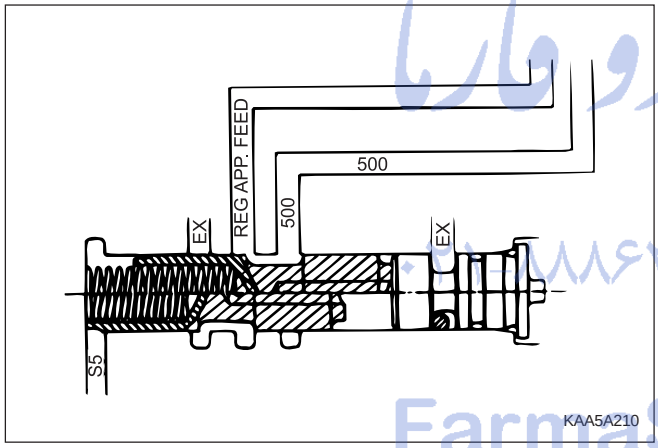
The PRV also regulates the supply of oil to the converter via the converter feed port. The cascade effect of the PRV ensures the first priority of the valve is to maintain line pressure at very low engine speeds. When the engine speed increases and the pump supplies an excess of oil the PRV moves to uncover the converter feed port thereby pressurizing the converter. If there is an excess of oil for the transmission's needs then the PRV moves further to allow oil to return to the suction port.

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Converter Clutch Regulator Valve

The converter clutch regulator valve regulates the pressure of the oil which applies the converter clutch. Input oil from the line 500 circuit is regulated within the valve, with the output pressure being variable according to the signal pressure from the S5 circuit. Converter clutch apply and release application is smoothed by electronically varying the S5 circuit pressure.



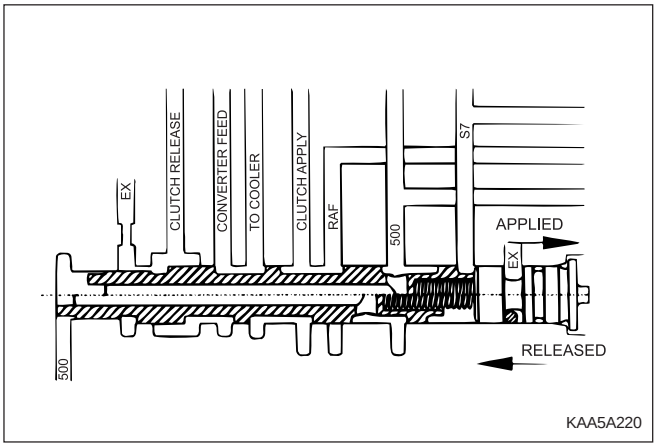
Converter Clutch Control Valve

The converter clutch control valve is a two position valve which applies or releases the converter clutch.

The switching of this valve is governed by the signal pressure from S7.

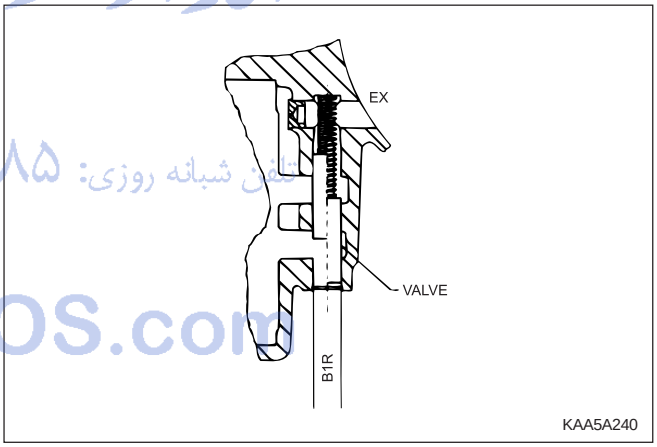
When the valve is in the OFF or released position, converter feed oil from the PRV is directed to the release side of the converter clutch. After flowing through the converter, oil returns to the converter clutch control valve and is then directed to the oil cooler.

When the valve is in the ON or applied position, regulated oil from the converter clutch regulator valve is directed to the apply side of the converter clutch. This oil remains within the converter because the converter clutch piston is sealed against the flat friction surface of the converter cover. To provide oil flow to the cooler the converter clutch control valve directs converter feed oil from the PRV directly to the cooler circuit.



B1R Exhaust Valve

The B1R exhaust valve is a two position spring loaded valve located in the transmission case directly adjacent to the front servo. It permits the servo release oil to be rapidly exhausted into the transmission case during application of the front band (B1). This prevents the need to force the oil back from the front servo through the valve body and through the 3-4 shift valve. The spring positions the valve to prevent oil entering the release area of the servo until the B1R circuit oil pressure reaches approximately 100 kPa.



POWER TRAIN SYSTEM

The Power Train System consists of;

- A torque converter with single face lock-up clutch
- Four multi-plate clutch assemblies
- Two brake bands
- Two one-way clutches
- Planetary gear set
- Parking mechanism

A conventional six pinion Ravigneaux compound planetary gear set is used with overdrive (fourth gear) being obtained by driving the carrier.

The cross-sectional arrangement is very modular in nature.

Four main sub-assemblies are installed within the case to complete the build. These subassemblies are;

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- Gear set-sprag-centre support
- C1 -C2 -C3 -C4 clutch sub-assembly
- Pump assembly
- Valve body assembly

One, or a combination of selective washers are used between the input shaft flange and the number 4 bearing to control the transmission end float. This arrangement allows for extensive subassembly testing and simplistic final assembly during production.

A general description of the operation of the Power Train System is detailed below.

First gear is engaged by applying the C2 clutch and locking the 1-2 One Way Clutch (1-2 OWC). The 1-2 shift is accomplished by applying the B1 band and overrunning the 1-2 OWC. The 2-3 shift is accomplished by applying the C1 clutch and releasing the B1 band. The 3-4 shift is accomplished by re-applying the B1 band and overrunning the 3-4 OWC. Reverse gear is engaged by applying the C3 clutch and the B2 band.

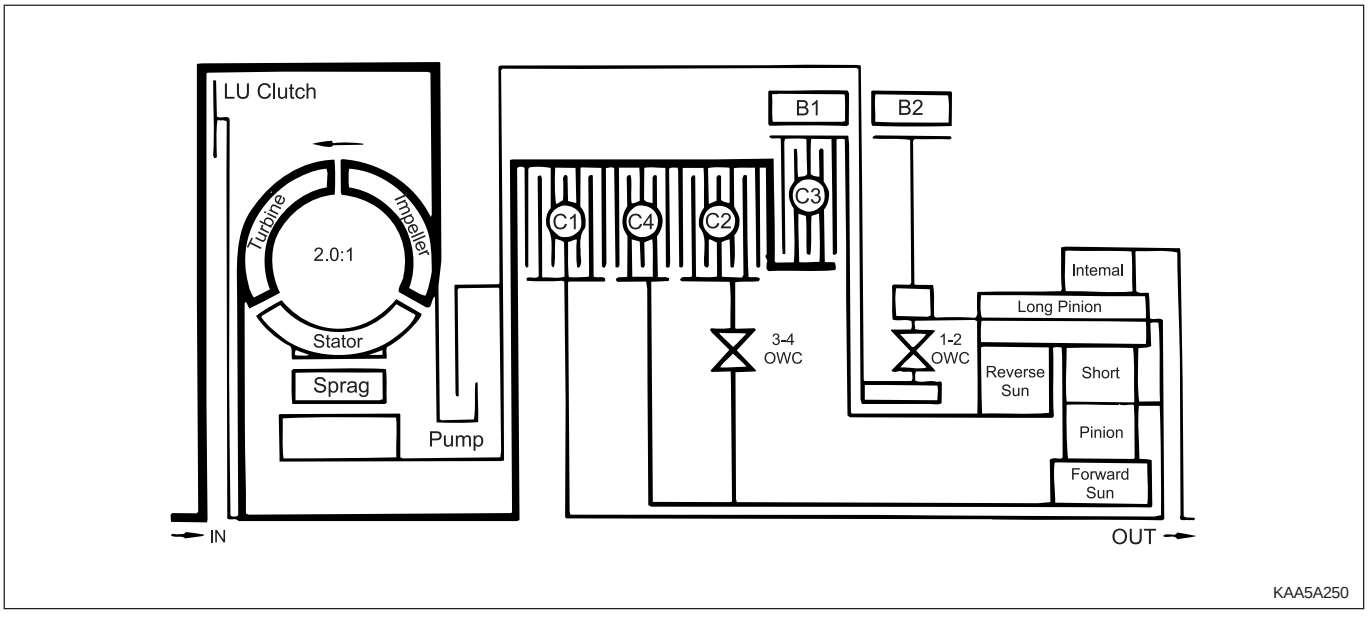
The C4 clutch is applied in the Manual 1, 2 and 3 ranges to provide engine braking. In addition, the C4 clutch is also applied in the Drive range for second and third gears to eliminate objectionable freewheel coasting.

The B2 band is also applied in the Manual 1 range to accomplish the low-overrun shift.

Both the front and rear servos are dual area designs to allow accurate friction element matching without the need for secondary regulator valves. All the friction elements have been designed to provide low shift energies and high static capacities when used with the new low static co-efficient transmission fluids. Non-asbestos friction materials are used throughout.

		ELEMENTS ENGAGED								
Gear	**Gear Ratio**	**C1**	**C2**	**C3**	**C4**	**B1**	**B2**	**1-2 OWC**	**3-4 OWC**	**LU CLUTCH**
First	2.741		X					X	X	
Second	1.508		X			X			X	
Third	1.000	X	X		X	X			X	X*
Fourth	0.708	X	X		X				X	X
Reverse	2.428			X			X			
Manual 1	2.741		X		X		X		X	
* For Certain Vehicle Applications, Refer to the Owner's Manual.										

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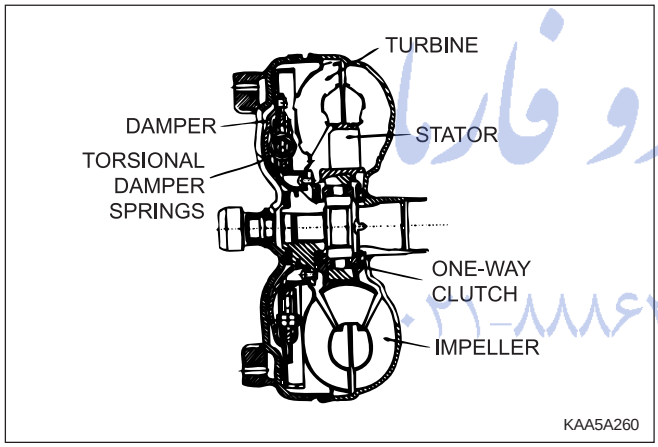


Torque Converter

The torque converter consists of a turbine, stator pump, impeller and a lock-up damper and piston assembly. As in conventional torque converters, the impeller is attached to the converter cover, the turbine is splined to the input shaft and the stator is mounted on the pump housing via a one way clutch (sprag).

The addition of the damper and piston assembly enables the torque converter to lock-up under favorable conditions. Lock-up is only permitted to occur in third and fourth gears under specified throttle and vehicle speed conditions.

Lock-up is achieved by applying hydraulic pressure to the damper and piston assembly which couples the turbine to the converter cover, locking-up the converter and eliminating unwanted slippage. Whenever lock-up occurs, improved fuel consumption is achieved. Torsional damper springs are provided in the damper and piston assembly to absorb any engine torque fluctuations during lock-up.



Clutch Packs

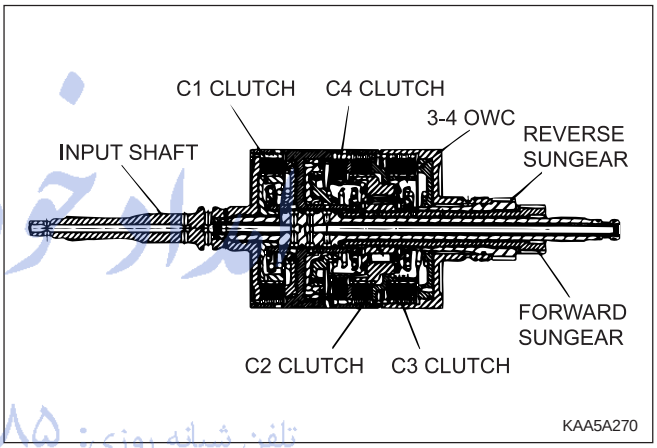
There are four clutch packs. All clutch packs are composed of multiple steel and friction plates.

C1 CLUTCH: When applied, this clutch pack allows the input shaft to drive the planet carrier. This occurs in third and fourth gears.

C2 CLUTCH: When applied this clutch pack allows the input shaft to drive the forward sun gear via the 3-4 OWC. This occurs in all forward gears.

C3 CLUTCH: When applied this clutch pack allows the input shaft to drive the reverse sun gear. This only occurs in reverse gear.

C4 CLUTCH: When applied this clutch provides engine braking on overrun. This occurs in Manual 1, 2 and 3 and also Drive 2 and Drive 3 to prevent objectionable free wheel coasting.

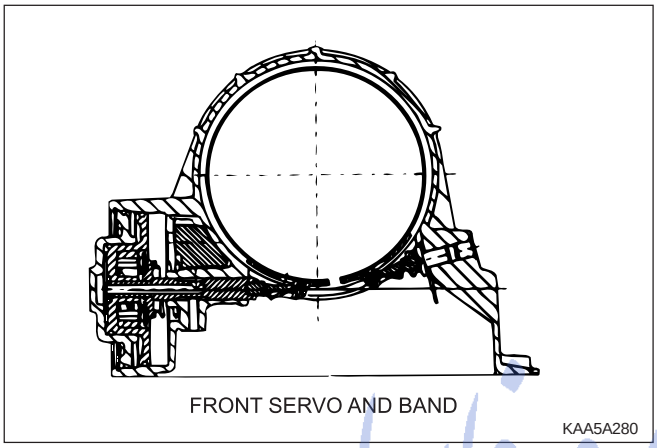


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Bands

The transmission utilizes two bands, the B1 band (sometimes known as the 2-4 band), and the B2 band (sometimes known as the low-reverse band).

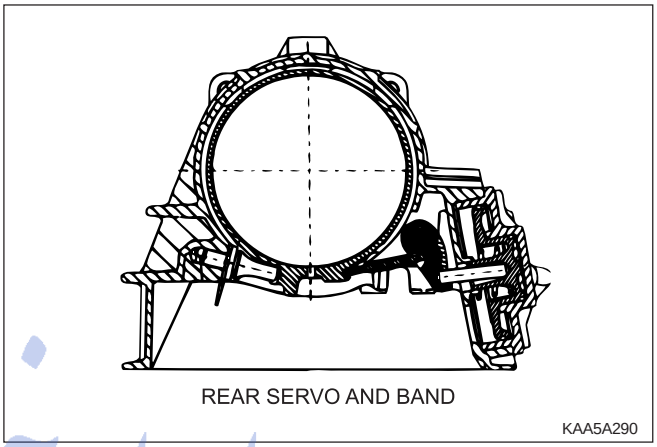
The B1 band is a flexible band which is engaged by the front servo piston. B1 is activated in second and fourth gear. When activated B1 prevents the reverse sun gear from rotating by holding the C3 clutch assembly stationary. In second gear only the outer area of the apply piston is utilized. In fourth gear both areas are utilized for greater clamping force.



FRONT SERVO AND BAND

KAA5A280

The B2 band is a solid band which is engaged by the rear servo piston. B2 is activated in Park, Reverse, Neutral and Manual 1. When activated B2 prevents the planet carrier assembly from rotating. In Manual 1 only the inner area of the apply piston is utilized. In Park, Reverse and Neutral, both areas are utilized for greater clamping force.



REAR SERVO AND BAND

KAA5A290

One Way Clutches

The transmission uses two OWCs, the 1-2 OWC and the 3-4 OWC. (Note that a third OWC is located in the torque converter, also known as a sprag.)

The 1-2 OWC is located between the planetary carrier assembly and the center support. This allows the carrier to rotate around the center support in one direction only. The one way clutch is engaged only in Drive 1.

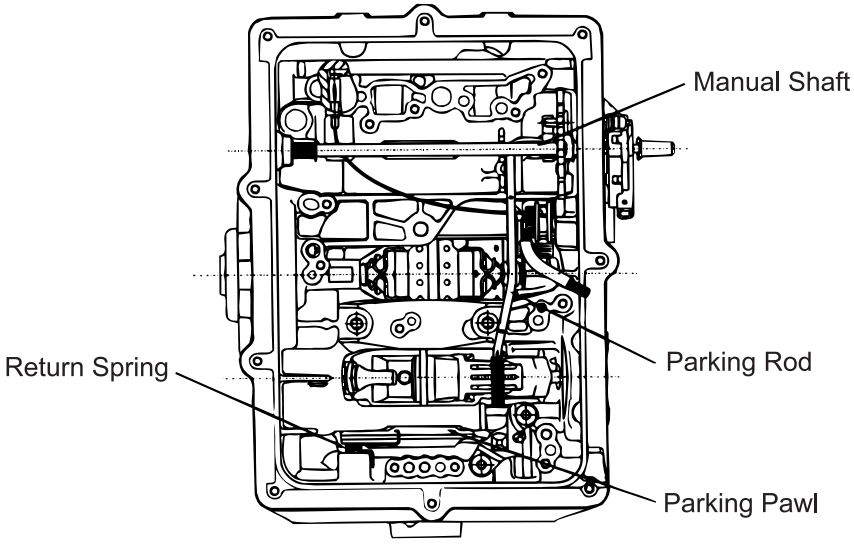
This 3-4 OWC is located between the C4 and the C2 clutch assemblies. This allows the C2 clutch to drive the forward sun gear in first, second and third gears but unlocks in fourth gear and during overrun.

Planetary Gear Set

The planetary gear set used in the transmission is a conventional six pinion Ravigneaux compound gear set.

Parking Mechanism

When Park is selected the manual lever extends the park rod rearwards to engage the parking pawl. The pawl will engage the external teeth on the ring gear thus locking the output shaft to the transmission case. When Park is not selected a return spring holds the parking pawl clear of the output shaft, preventing accidental engagement of Park.



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POWER FLOWS

The power flows for the various transmission selections are listed below;

- Power Flow - Neutral and Park
- Power Flow - Reverse
- Power Flow - Manual 1
- Power Flow - Drive 1
- Power Flow - Drive 2
- Power Flow - Drive 3
- Power Flow - Drive 3 Lock Up
- Power Flow - Drive 4 (Overdrive)
- Power Flow - Drive 4 Lock Up

The following table details the engaged elements versus the gear selected for all transmission selections.

	ELEMENTS ENGAGED								
Gear State	**C1**	**C2**	**C3**	**C4**	**B1**	**B2**	**1-2 OWC**	**3-4 OWC**	**LU CLUTCH**
Park and Neutral	-	-	-	-	-	X	-	-	-
Reverse	-	-	X	-	-	X	-	-	-
Manual 1	-	X	-	X	-	X	-	X	-
Drive 1	-	X	-	-	-	-	X	X	-
Drive 2 and Manual 2	-	X	-	X	X	-	-	X	-
Drive 3 and Manual 3	X	X	-	X	-	-	-	X	-
Drive 3 Lock Up and Manual 3 Lock Up	X	X	-	X	-	-	-	X	X
Drive 4 Overdrive	X	X	-	-	X	-	-	X	-
Drive 4 Lock Up	X	X	-	-	X	-	-	X	X

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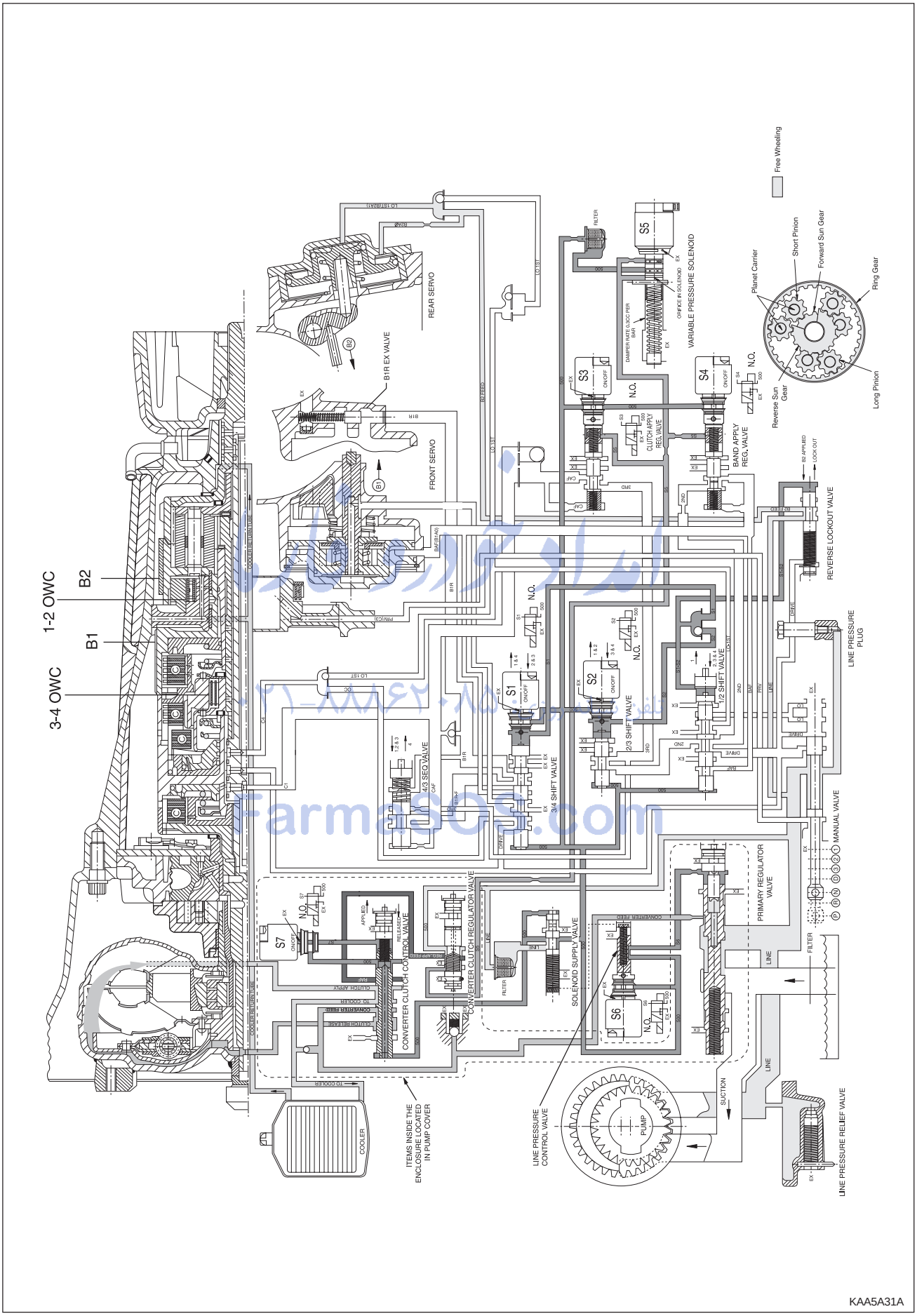
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PARK AND NEUTRAL



Power Flow - Park and Neutral

In Park and Neutral, there is no drive to the planetary gear set. The rear band is applied to eliminate 'clunk' on engagement of the reverse gear, and to improve the low range engagement for 4WD applications. No other clutches or bands are applied.

In Park the transmission is mechanically locked by engaging a case mounted pawl with teeth on the output shaft ring gear.

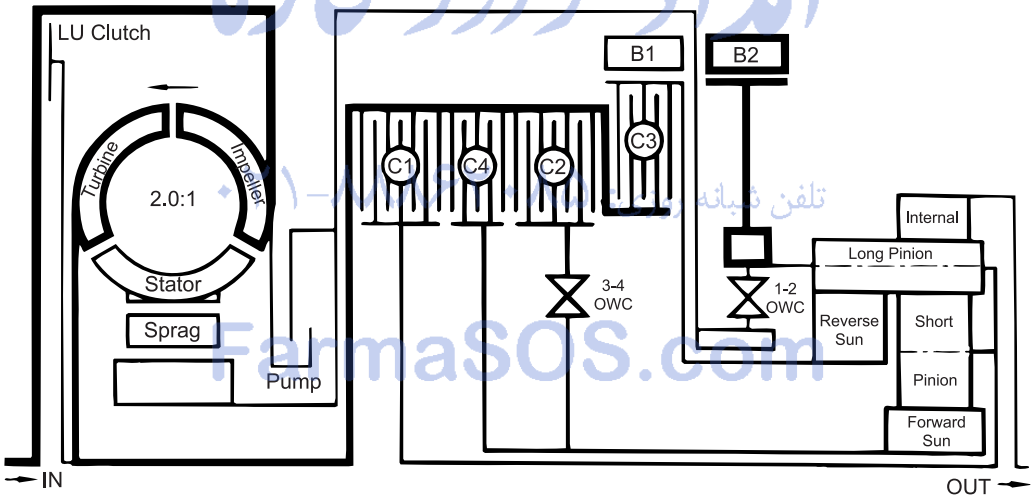
Control

To maintain this arrangement in the steady state solenoids and valves are activated as follows:

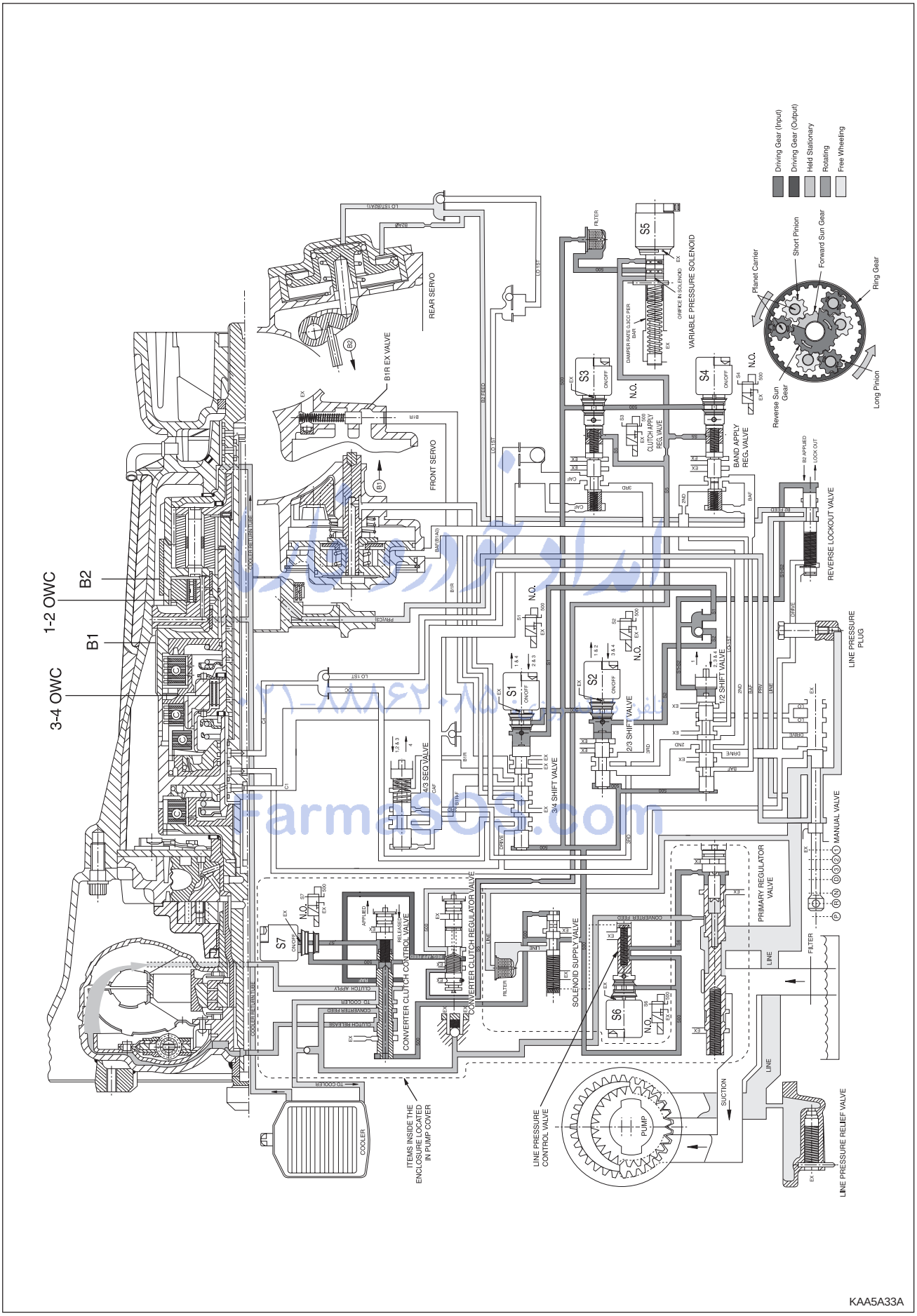
- Solenoids S1 and S2 are switched OFF.
- Line (pump) pressure is applied to the Primary Regulator Valve (PRV) and to the solenoid supply pressure regulator valve.
- The converter, oil cooler, and lubrication circuits are charged from the primary regulator valve.
- The line 500 circuit is charged by the solenoid supply pressure regulator valve.
- The S5 circuit is charged by the variable pressure solenoid (S5).
- Line pressure is prevented from entering the drive circuit by the manual valve.
- The B1 circuit and all clutch circuits are open to exhaust.

	ELEMENTS ENGAGED								
Gear State	**C1**	**C2**	**C3**	**C4**	**B1**	**B2**	**1-2 OWC**	**3-4 OWC**	**LU CLUTCH**
Park and Neutral	-	-	-	-	-	X	-	-	-

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REVERSE


1-2 OWC
B2
B1
3-4 OWC
Driving Gear (Input)
Driving Gear (Output)
Held Stationary
Rotating
Free Wheeling
Planet Carrier
Short Pinion
Forward Sun Gear
Ring Gear
Reverse Sun Gear
Long Pinion
REAR SERVO
B1R EX VALVE
FRONT SERVO
VARIABLE PRESSURE SOLENOID
CLUTCH APPLY REG. VALVE
BAND APPLY REG. VALVE
REVERSE LOCKOUT VALVE
LINE PRESSURE PLUG
1/2 SHIFT VALVE
2/3 SHIFT VALVE
3/4 SHIFT VALVE
4/3 SEQ VALVE
MANUAL VALVE
PRIMARY REGULATOR VALVE
FILTER
SOLENOID SUPPLY VALVE
CONVERTER CLUTCH REGULATOR VALVE
CONVERTER CLUTCH CONTROL VALVE
LINE PRESSURE RELIEF VALVE
LINE PRESSURE CONTROL VALVE
SUCTION
PUMP
COOLER
ITEMS INSIDE THE ENCLOSURE LOCATED IN PUMP COVER
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Power Flow - Reverse

In Reverse, transmission drive is via the input shaft and the forward clutch cylinder to the hub of the C3 clutch. The elements of the transmission function as follows;

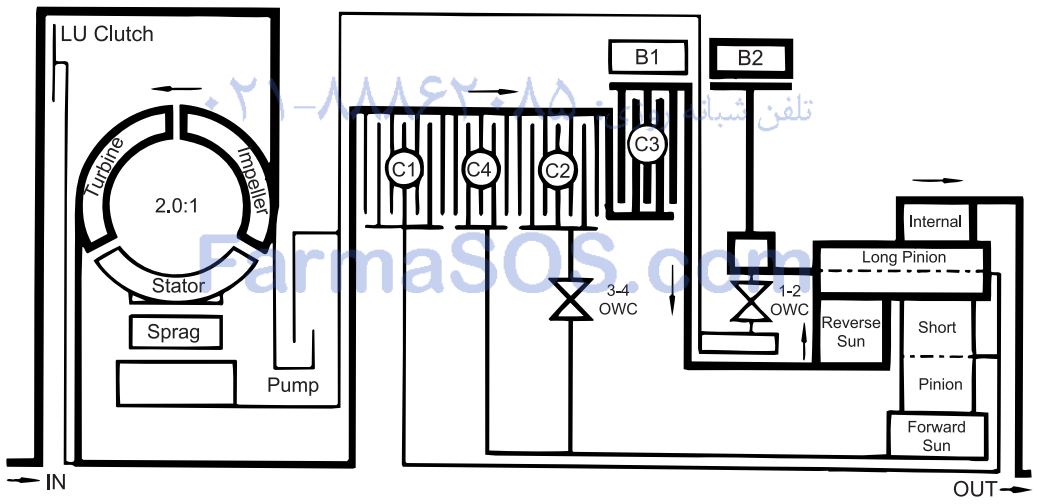
- The C3 clutch is engaged and drives the reverse sun gear in a clock-wise direction.
- The B2 band is engaged and holds the planetary gear carrier stationary causing the long pinion to rotate anti-clockwise about its axis on the pinion shaft.
- The long pinion drives the internal ring gear in the same direction.
- The internal ring being splined to the output shaft drives it in an anti-clockwise or reverse direction.

Control

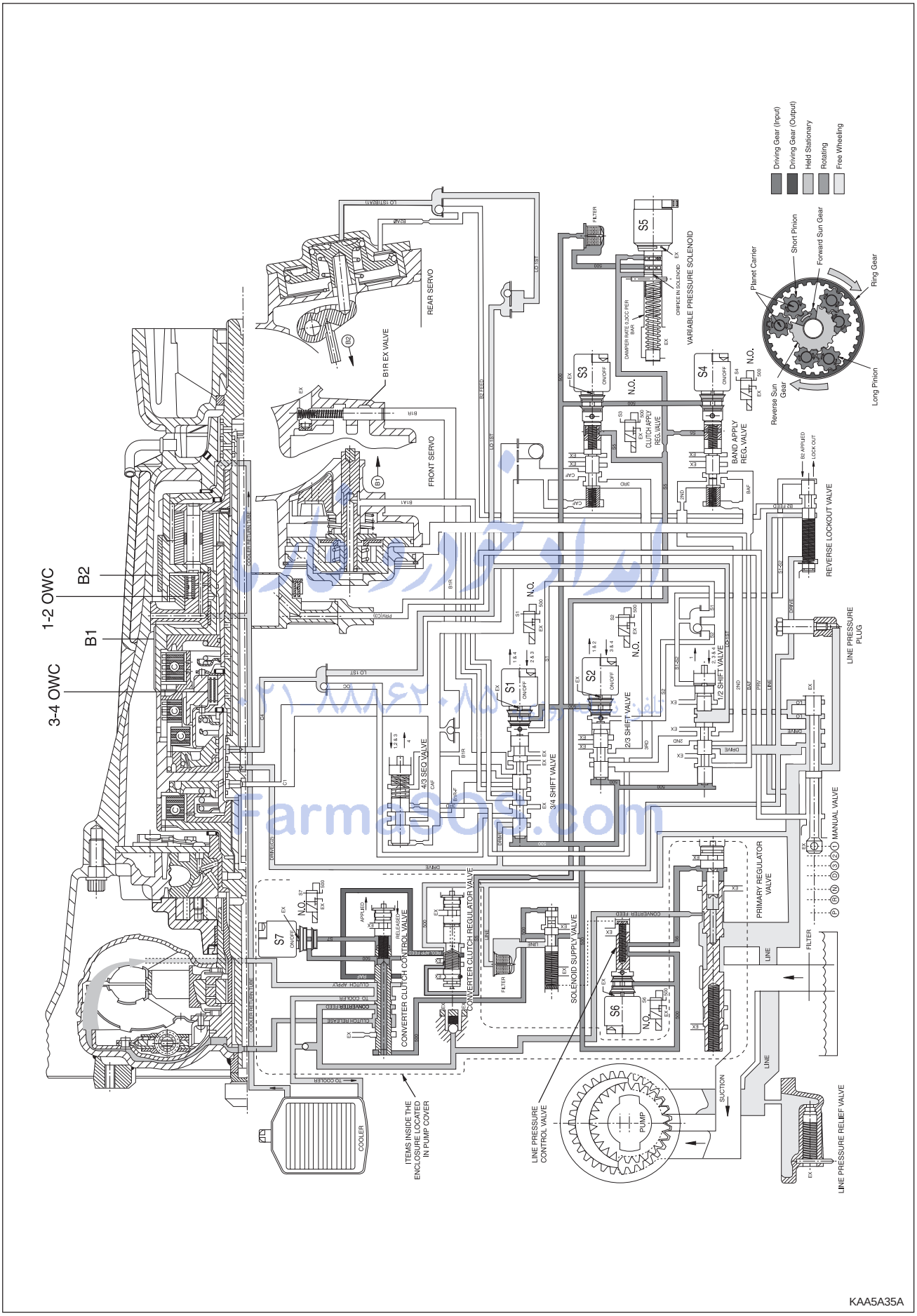
To maintain this arrangement in the steady state solenoids and valves are activated as follows;

- Solenoids S1 and S2 are switched OFF.
- Line pressure is directed through the reverse lockout valve to both the inner and outer apply areas of the rear servo piston for B2 band application.
- Line pressure feeds the reverse oil circuit via the manual valve.
- Reverse oil is routed from the manual valve to the C3 clutch.
- Reverse oil is also applied to the spring end of the primary regulator valve to assist the spring and to boost the line pressure value.
- All other clutch and band apply circuits are open to exhaust.

	ELEMENTS ENGAGED								
Gear State	**C1**	**C2**	**C3**	**C4**	**B1**	**B2**	**1-2 OWC**	**3-4 OWC**	**LU CLUTCH**
Reverse	-	-	X	-	-	X	-	-	-



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Power Flow - Manual 1

In Manual 1, transmission drive is via the input shaft to the forward clutch cylinder. The elements of the trans-mission function as follows;

- The C2 clutch is engaged to drive the forward sun gear, via the 3-4 OWC.
- The B2 band is engaged to hold the planetary gear carrier stationary.
- The forward sun gear drives the short pinion anti-clockwise.
- The short pinion drives the long pinion clockwise.
- The long pinion rotating about its axis drives the inter-nal ring gear and the output shaft in a clockwise or forward direction.
- The C4 clutch provides engine braking through the 3-4 OWC on overrun.

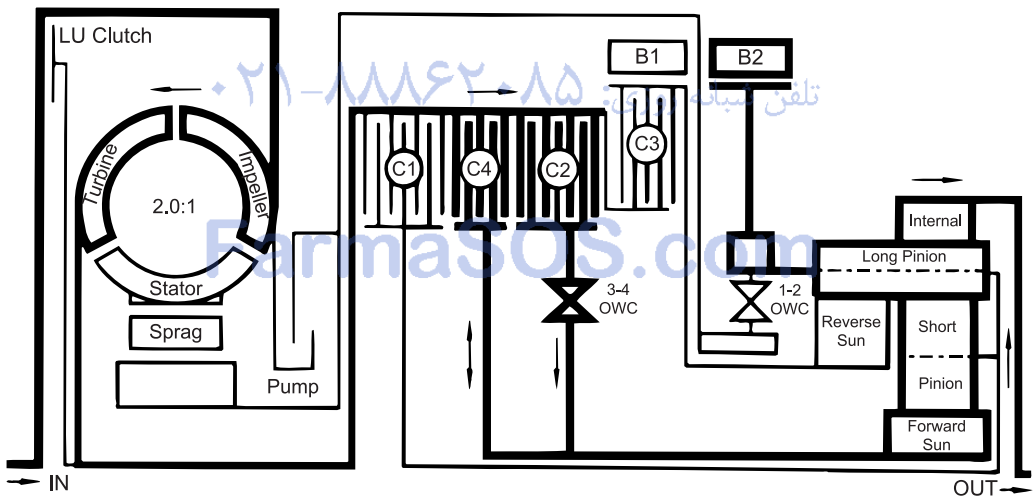
Control

To maintain this arrangement in the steady state solenoids and valves are activated as follows;

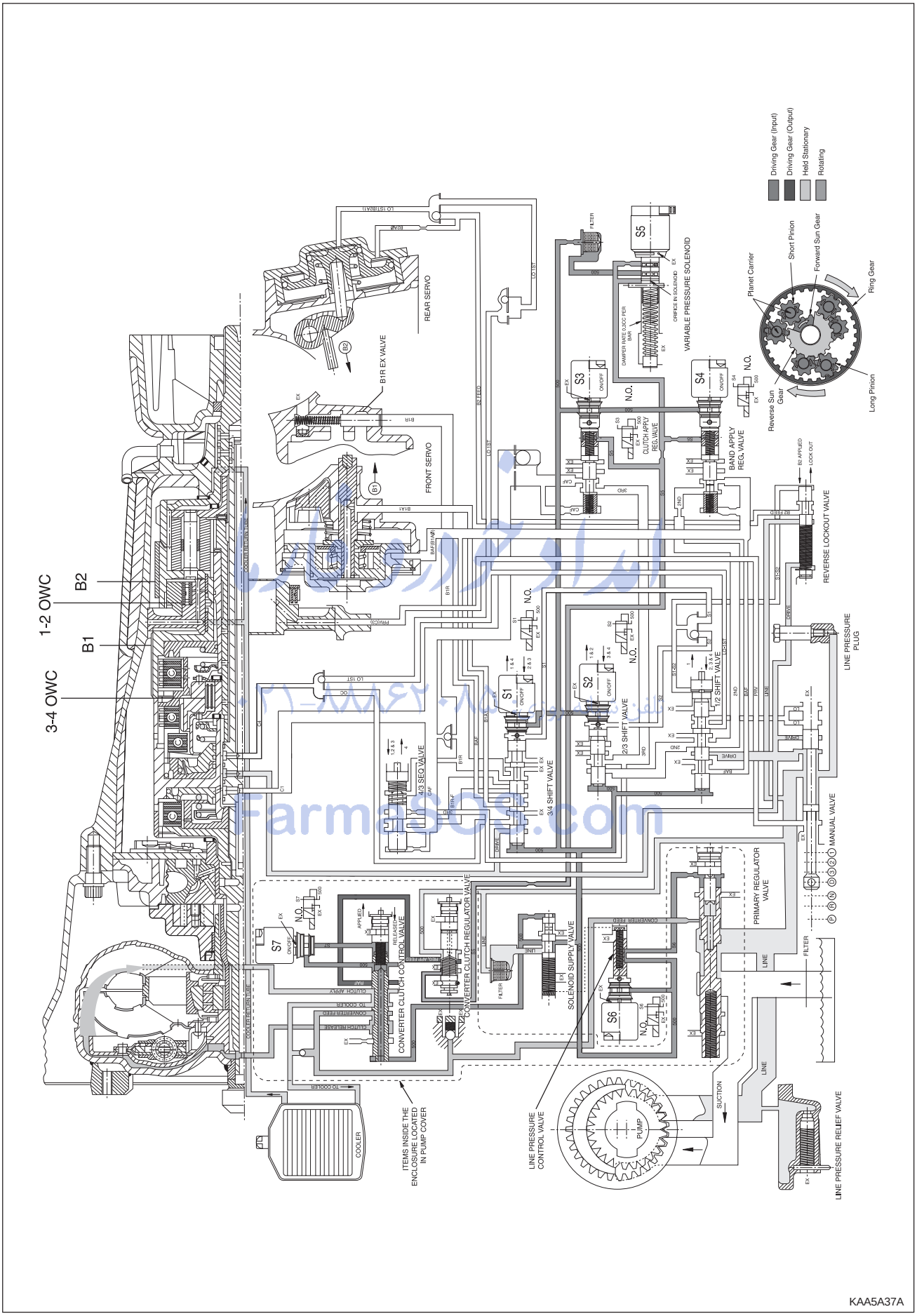
- Solenoids S1 and S2 are switched ON.
- The 1-2, 2-3, and 3-4 shift valves are held in their first gear positions by line 500 pressure.
- Drive (line pressure) oil from the manual valve engages the C2 clutch.
- Lo-1st (line pressure) oil is routed through the 1-2 shift valve to the C4 clutch, and to the inner apply area of the rear servo piston for B2 band application.

Gear State	ELEMENTS ENGAGED								
	C1	C2	C3	C4	B1	B2	1-2 OWC	3-4 OWC	LU CLUTCH
Manual 1	-	X	-	X	-	X	-	X	-

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DRIVE 1



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Power Flow - Drive 1

In Drive 1, transmission drive is via the input shaft to the forward clutch cylinder. The elements of the transmission function as follows :

- The C2 clutch is engaged to drive the forward sun gear via the 3-4 OWC.
- The forward sun gear drives the short pinion anti-clockwise.
- The short pinion drives the long pinion clockwise.
- The 1-2 OWC prevents the planetary gear carrier from rotating under reaction force and the long pinion rotates on its axis driving the internal ring gear and output shaft in a clockwise or forward direction.
- There is no engine braking on overrun.

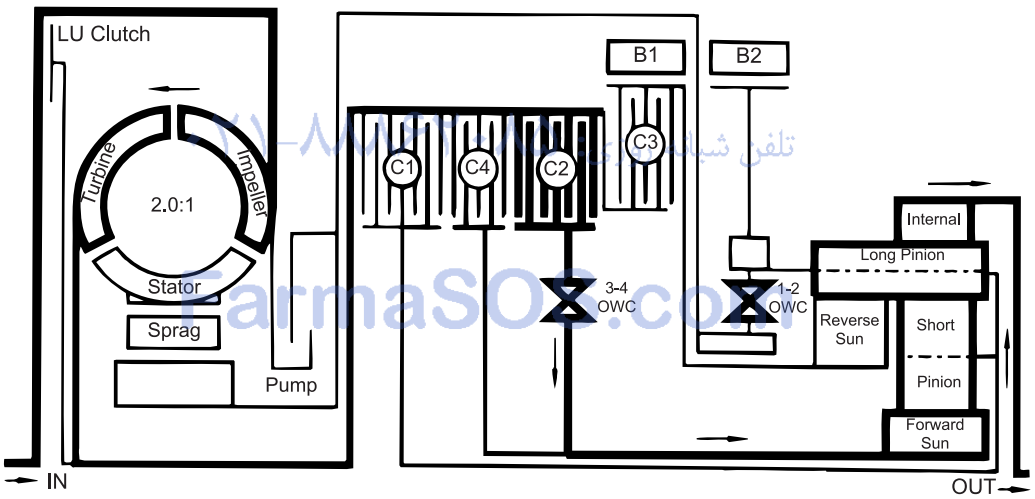
Control

To maintain this arrangement in the steady state solenoids and valves are activated as follows:

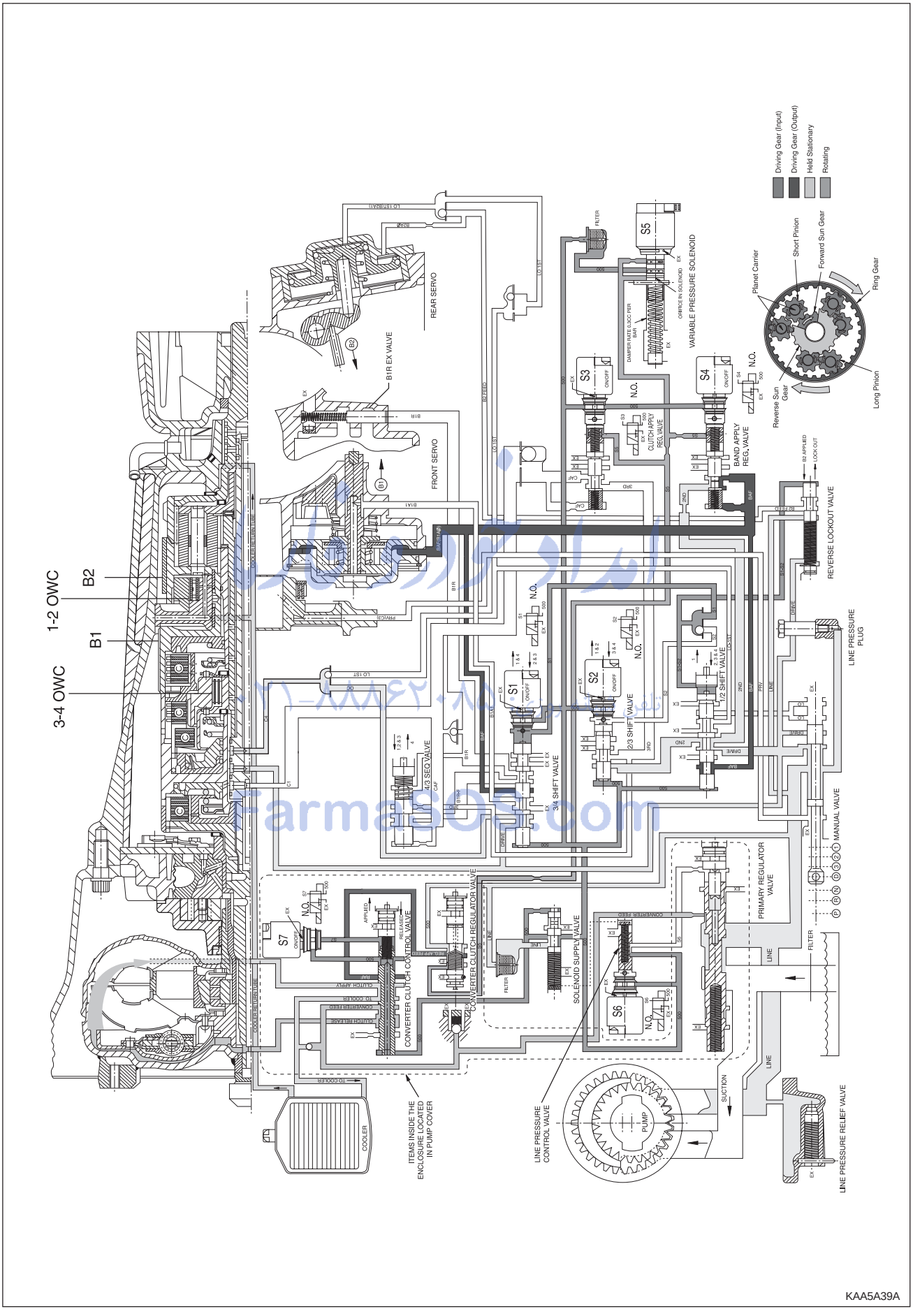
- Solenoids S1 and S2 are switched ON.
- The 1-2, 2-3, and 3-4 shift valves are held in their first gear positions by line 500 pressure.
- Drive (line pressure) oil from the manual valve engages the C2 clutch.

	ELEMENTS ENGAGED								
Gear State	**C1**	**C2**	**C3**	**C4**	**B1**	**B2**	**1-2 OWC**	**3-4 OWC**	**LU CLUTCH**
Drive 1	-	X	-	-	-	-	X	X	-

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DRIVE 2 AND MANUAL 2



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Power Flow - Drive 2 and Manual 2

In Drive 2 and Manual 2, transmission drive is via the input shaft and forward clutch cylinder. The elements of the transmission function as follows;

- The C2 clutch is applied to drive the forward sun gear.
- The forward sun gear drives the short pinion anti-clockwise.
- The short pinion drives the long pinion clockwise.
- The B1 band is applied holding the reverse sun gear stationary therefore the long pinion walks around the reverse sun gear taking the internal ring gear and output shaft with it in a clockwise or forward direction.
- The C4 clutch is applied to bypass the 3-4 OWC and provide engine braking on overrun.

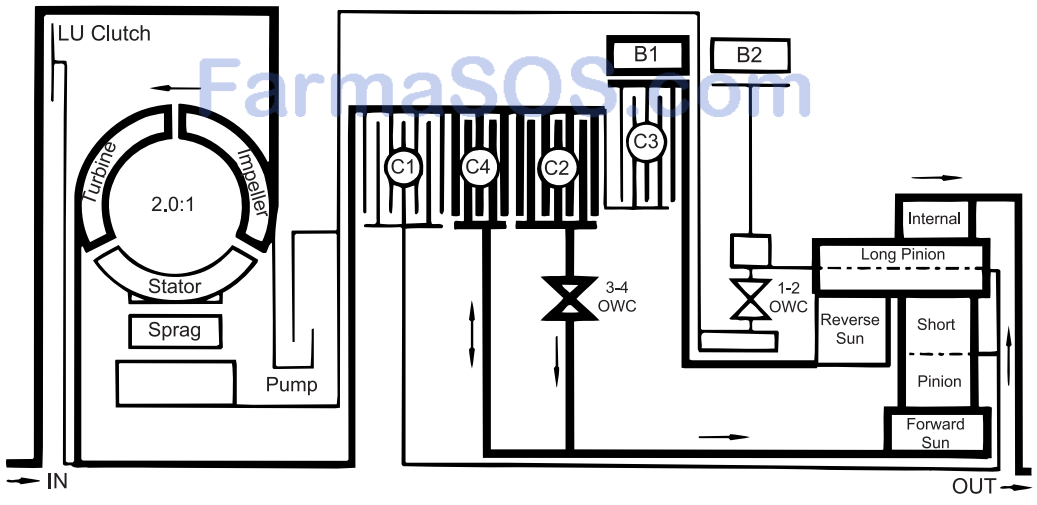
Control

To maintain this arrangement in the steady state solenoids and valves are activated as follows;

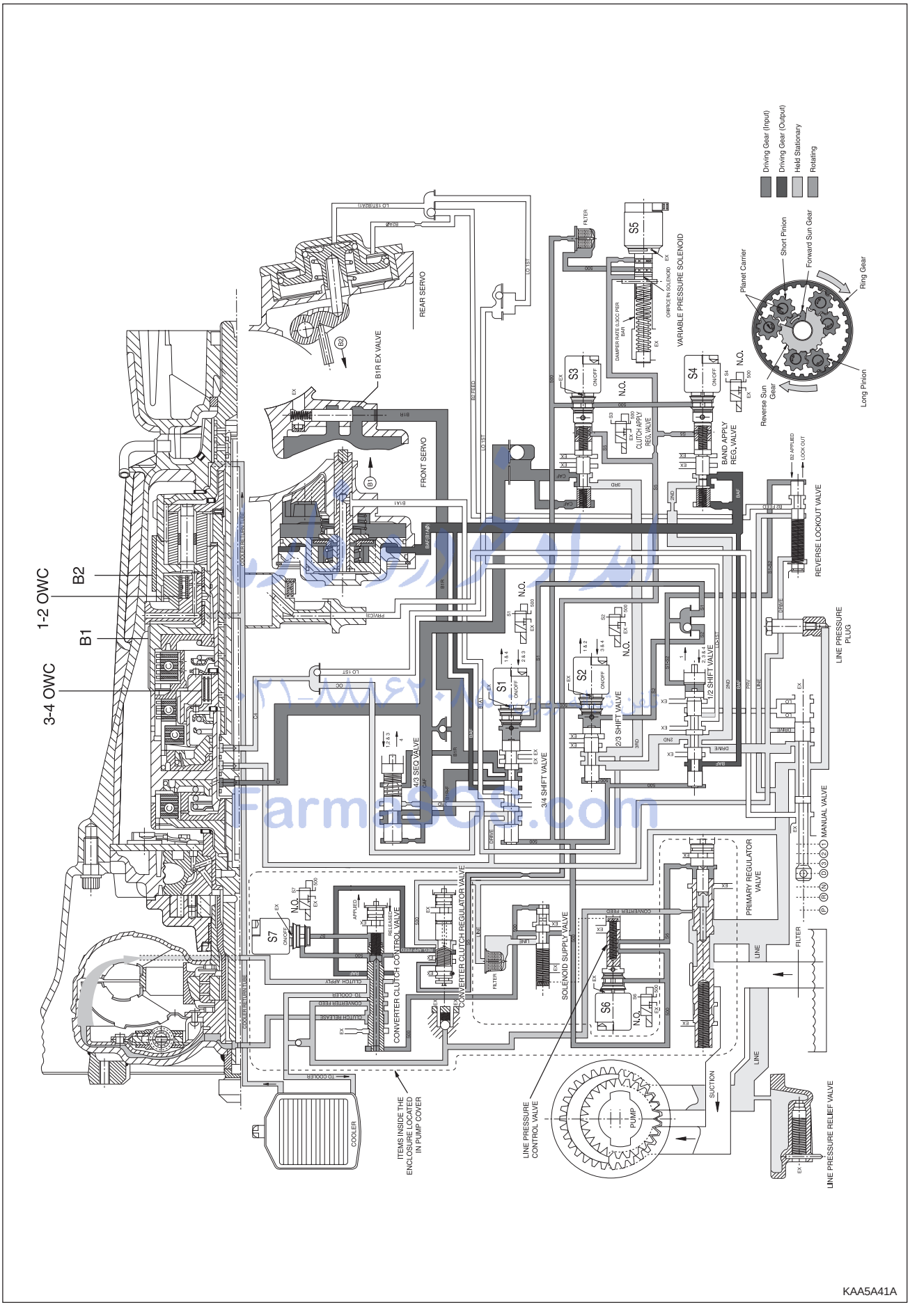
- Solenoid S1 is switched OFF. S2 is switched ON.
- Drive (line pressure) oil from the manual valve engages the C2 clutch.
- When S1 switches OFF, S1 oil pressure, which is derived from line 500 pressure, moves the 3-4 shift valve to the left. At the same time S1 oil is directed to the 1-2 shift valve which moves the valve to the second gear position.
- 2nd oil (line pressure) from the 1-2 shift valve is directed to the band apply regulator valve, and to the 2-3 shift valve.
- The band apply feed regulator valve supplies 2nd oil (regulated to line pressure multiplied by the valve ratio) to the Band Apply Feed (BAF) circuit.
- Band apply feed oil is directed to;
  - The outer apply area of the front servo
  - The 1-2 shift valve to provide an exhaust port when the transmission is shifted to first gear
  - The 3-4 shift valve for use when the transmission is shifted into fourth gear
- Drive (line pressure) is routed through the 3-4 shift valve to apply the C4 clutch.

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Gear State	ELEMENTS ENGAGED								
	C1	C2	C3	C4	B1	B2	1-2 OWC	3-4 OWC	LU CLUTCH
Drive 2 and Manual 2	-	X	-	X	X	-	-	X	-



DRIVE 3 AND MANUAL 3



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Power Flow - Drive 3 and Manual 3

In Drive 2 and Manual 2, transmission drive is via the input shaft and forward clutch cylinder. The elements of the transmission function as follows;

- The C2 clutch is engaged to drive the forward sun gear.
- The C1 clutch is engaged to drive the planet carrier.
- The short pinion drives the long pinion clockwise.
- The forward sun gear and the planet carrier are driven clockwise at the same speed therefore there is no relative motion between the sun gear and the pinions.
- The ring gear and output shaft are driven in a clockwise or forward direction at input shaft speed.
- The C4 clutch is applied to bypass the 3-4 OWC and provide engine braking on overrun.

Control

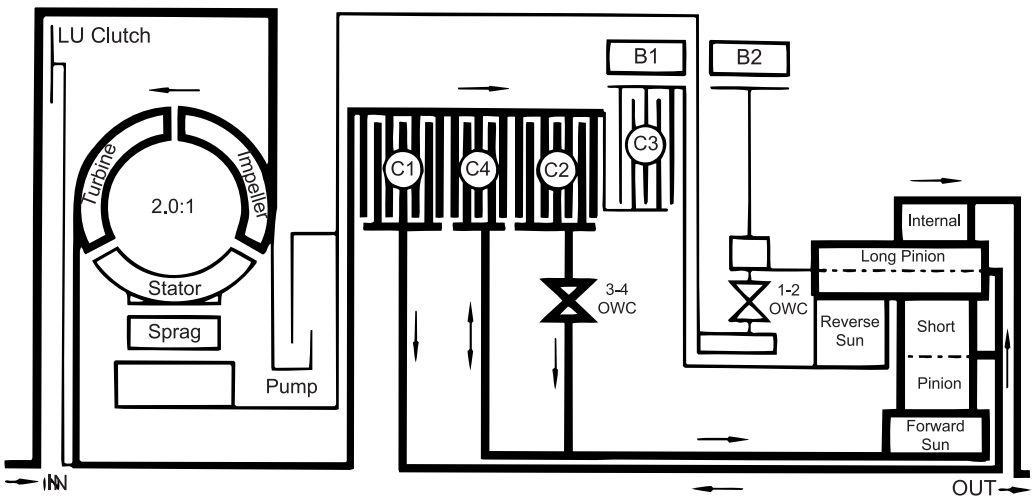
To maintain this arrangement in the steady state solenoids and valves are activated as follows:

- Solenoid S1 is switched OFF. S2 is switched OFF.
- With S1 and S2 switched OFF, the 2-3 and 3-4 shift valves are held in the third gear position by line 500 pressure.
- The 1-2 shift valve is held in the third gear position by S1-S2 oil pressure.
- 2nd oil (line pressure) from the 1-2 shift valve is directed to the band apply feed regulator valve and to the 2-3 shift valve.
- The band apply feed regulator valve supplies 2nd oil (regulated to line pressure multiplied by the valve ra-tio) to the Band Apply Feed (BAF) circuit.
- Band apply feed oil is directed to;
  - The outer apply area of the front servo
  - The 1-2 shift valve to provide an exhaust port when the transmission is shifted to first gear
  - The 3-4 shift valve for use when the transmission is shifted into fourth gear
- 2nd oil at the 2-3 shift valve is directed to the 3rd oil circuit.
- 3rd oil from the 2-3 shift valve is directed to the clutch apply regulator valve, and to the 4-3 sequence valve.
- The clutch apply regulator valve supplies oil (regulated to line 500 pressure multiplied by the valve ratio) to the Clutch Apply Feed (CAF) circuit.

  The CAF oil is directed to;
  - The C1clutch
  - The 4-3 sequence valve
- At the 4-3 sequence valve the CAF oil becomes Band 1 Release Feed (B1R-F) oil, and is directed through the 3-4 shift valve to the spring end of the 4-3 sequence valve, and to the release side of the front servo piston to hold band 1 OFF.
- Drive (line pressure) is routed through the 3-4 shift valve to apply the C4 clutch.

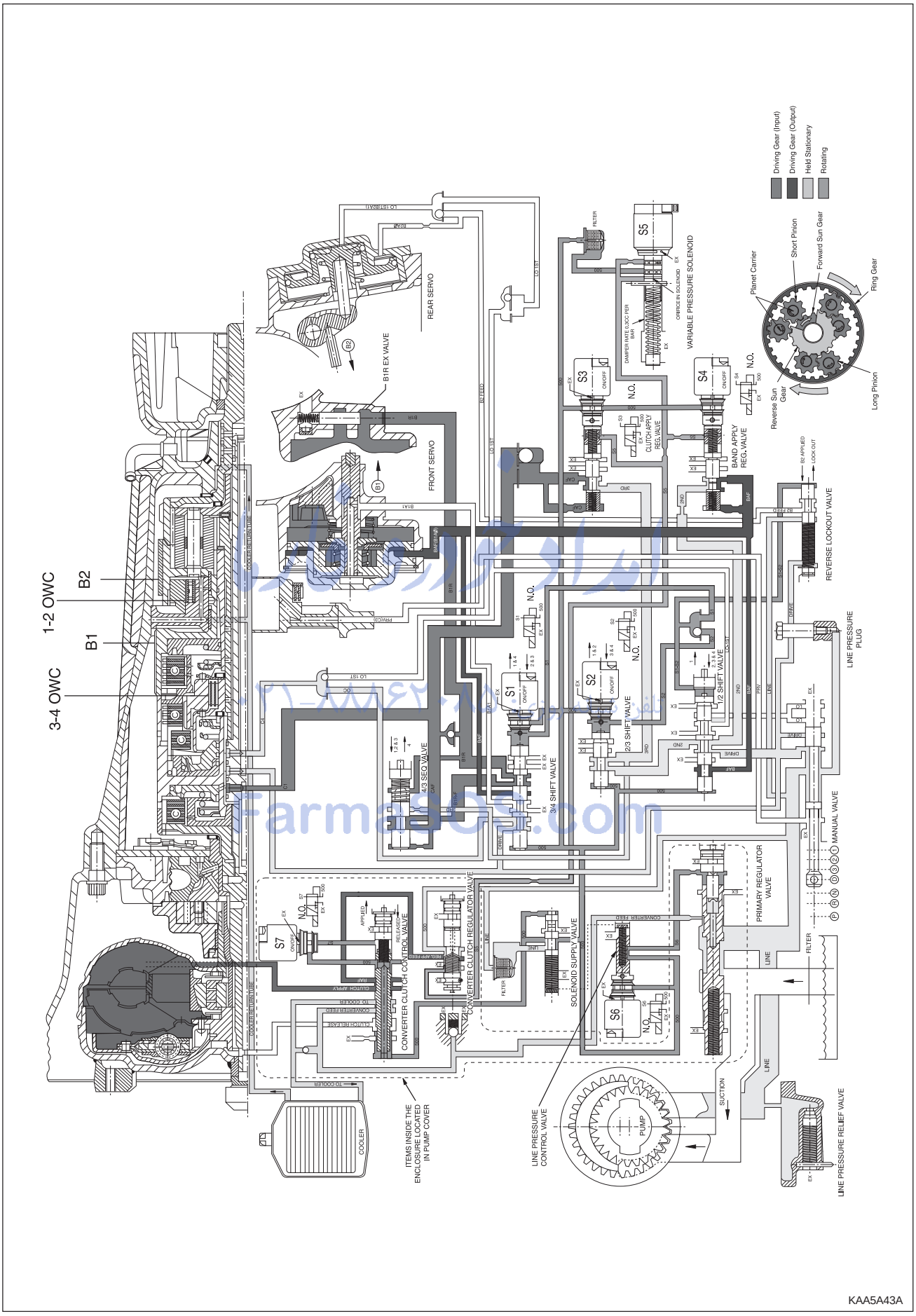
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Gear State	ELEMENTS ENGAGED								
	C1	C2	C3	C4	B1	B2	1-2 OWC	3-4 OWC	LU CLUTCH
Drive 3 and Manual 3	X	X	-	X	-	-	-	X	-



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DRIVE 3 LOCK UP AND MANUAL 3 LOCK UP



Power Flow - Drive 3 Lock Up and Manual 3 Lock Up

In Drive 3 Lock Up and Manual 3 Lock Up, transmission drive is the same as for Drive 3 but with the application of the converter lock up clutch to provide positive no-slip converter drive.

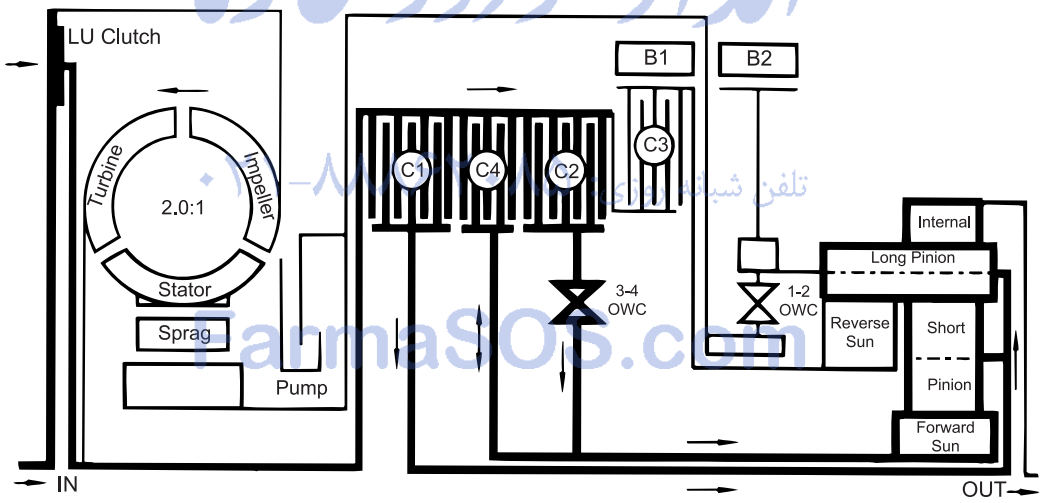
Control

Control for Drive 3 Lock Up and Manual 3 Lock Up is the same as for Drive 3 with the addition of the converter clutch circuit activated by solenoid S7.

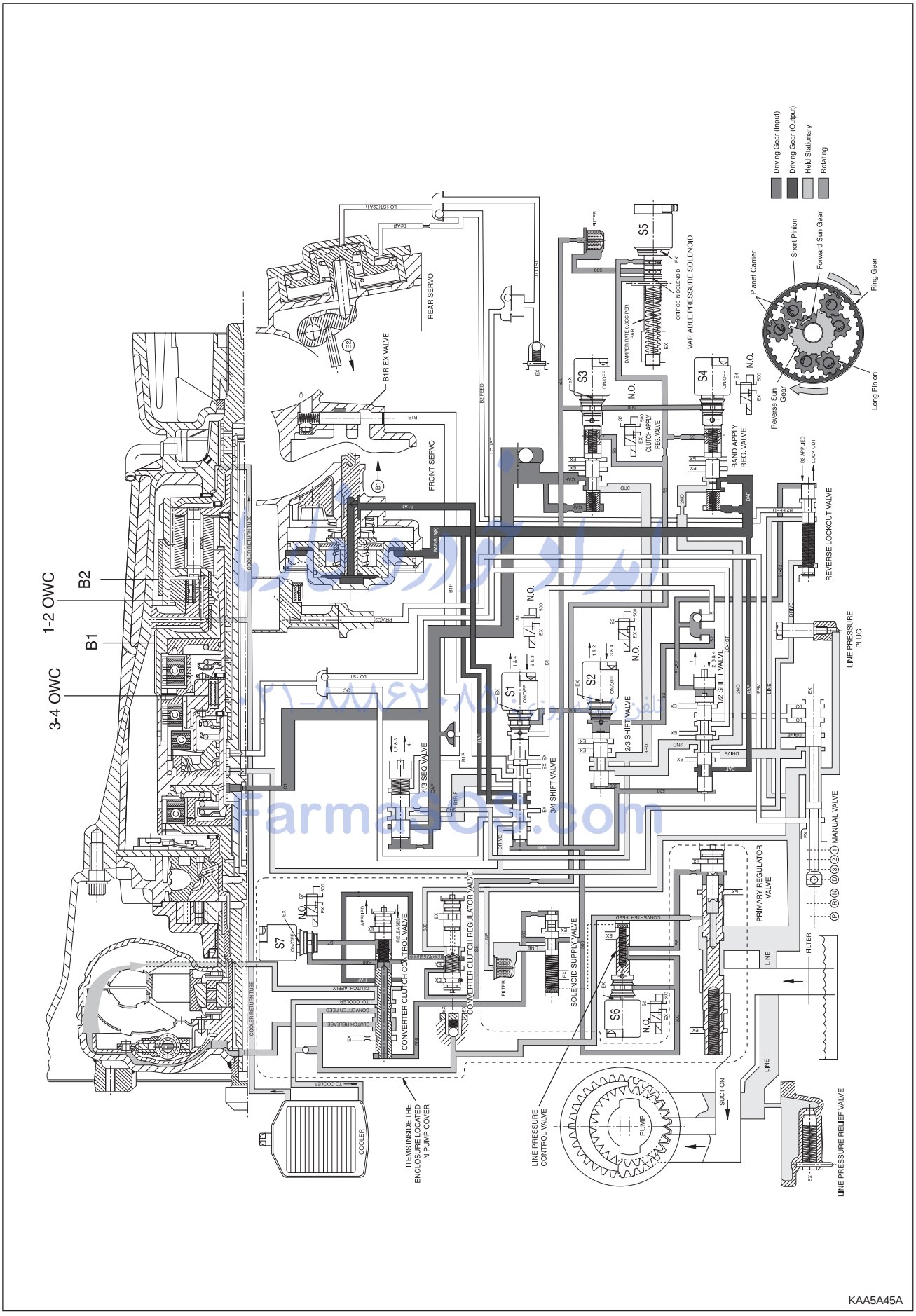
- When S7 is switched ON, S7 feed oil to the converter clutch control valve is switched OFF and allowed to exhaust through the S7 solenoid. This allows the valve to move to the clutch engage position.
- Regulated apply feed oil, drive oil at the converter clutch regulator valve, is directed by the converter clutch control valve to the engage side of the converter clutch.
- Converter clutch release oil is exhausted at the converter clutch control valve.
- Converter feed oil is re-routed by the converter clutch control valve directly to the oil cooler and lubrication circuit.

	ELEMENTS ENGAGED								
Gear State	**C1**	**C2**	**C3**	**C4**	**B1**	**B2**	**1-2 OWC**	**3-4 OWC**	**LU CLUTCH**
Drive 3 Lock Up and Manual 3 Lock Up	X	X	-	X	-	-	-	X	X

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DRIVE 4 (OVERDRIVE)



Power Flow - Drive 4 (Overdrive)

In Drive 4 (Overdrive), transmission drive is via the input shaft to the forward clutch cylinder.

The elements of the transmission function as follows;

- The C1 clutch is applied to drive the planet carrier clockwise.
- The B1 band is applied to hold the reverse sun gear stationary.
- As the planet carrier tuns, the long pinion walks around the stationary reverse sun gear and rotates around its axis driving the internal ring gear and output shaft in a clockwise or forward direction at a speed faster than the input shaft i.e. in overdrive ratio.
- The forward sun gear is also driven faster than the input shaft and overruns the 3-4 OWC.
- The C2 clutch is engaged to reduce the speed differential across the 3-4 OWC.

Control

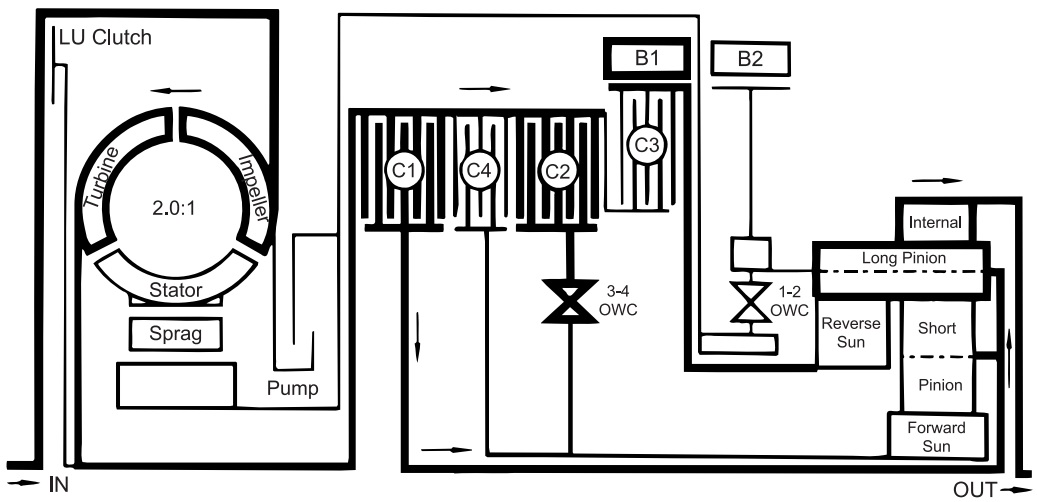
To maintain this arrangement in the steady state solenoids and valves are activated as follows;

- Solenoid S1 is switched ON. S2 is switched OFF.
- With S1 switched ON, the 3-4 shift valve is held in the fourth gear position by line 500 pressure on the small end of the valve.
- With S2 switched OFF, the 2-3 shift valve is held in the fourth gear position by line 500 pressure on the large end of the valve.
- The 1-2 shift valve is held in the fourth gear position by S2 oil pressure.
- 2nd oil (line pressure) from the 1-2 shift valve is directed to the band apply feed regulator valve, and to the 2-3 shift valve.
- The band apply feed regulator valve supplies 2nd oil (regulated to line pressure multiplied by the valve ra-tio) to the Band Apply Feed (BAF) circuit.
- Band apply feed oil is directed to;
  - the outer apply area of the front servo
  - the inner apply area of the front servo piston via the 3-4 shift valve
  - the 1-2 shift valve to provide an exhaust port when the transmission is shifted to first gear
- 2nd oil at the 2-3 shift valve is directed to the 3rd oil circuit.
- 3rd oil from the 2-3 shift valve is directed to the clutch apply regulator valve, and to the 4-3 sequence valve.
- The clutch apply regulator valve supplies oil (regulated to line 500 pressure multiplied by the valve ratio) to the Clutch Apply Feed (CAF) circuit.
- The CAF oil is directed to;
  - the C1 clutch
  - the 4-3 sequence valve
- Drive oil (line pressure) from the manual valve engages the C2 clutch.

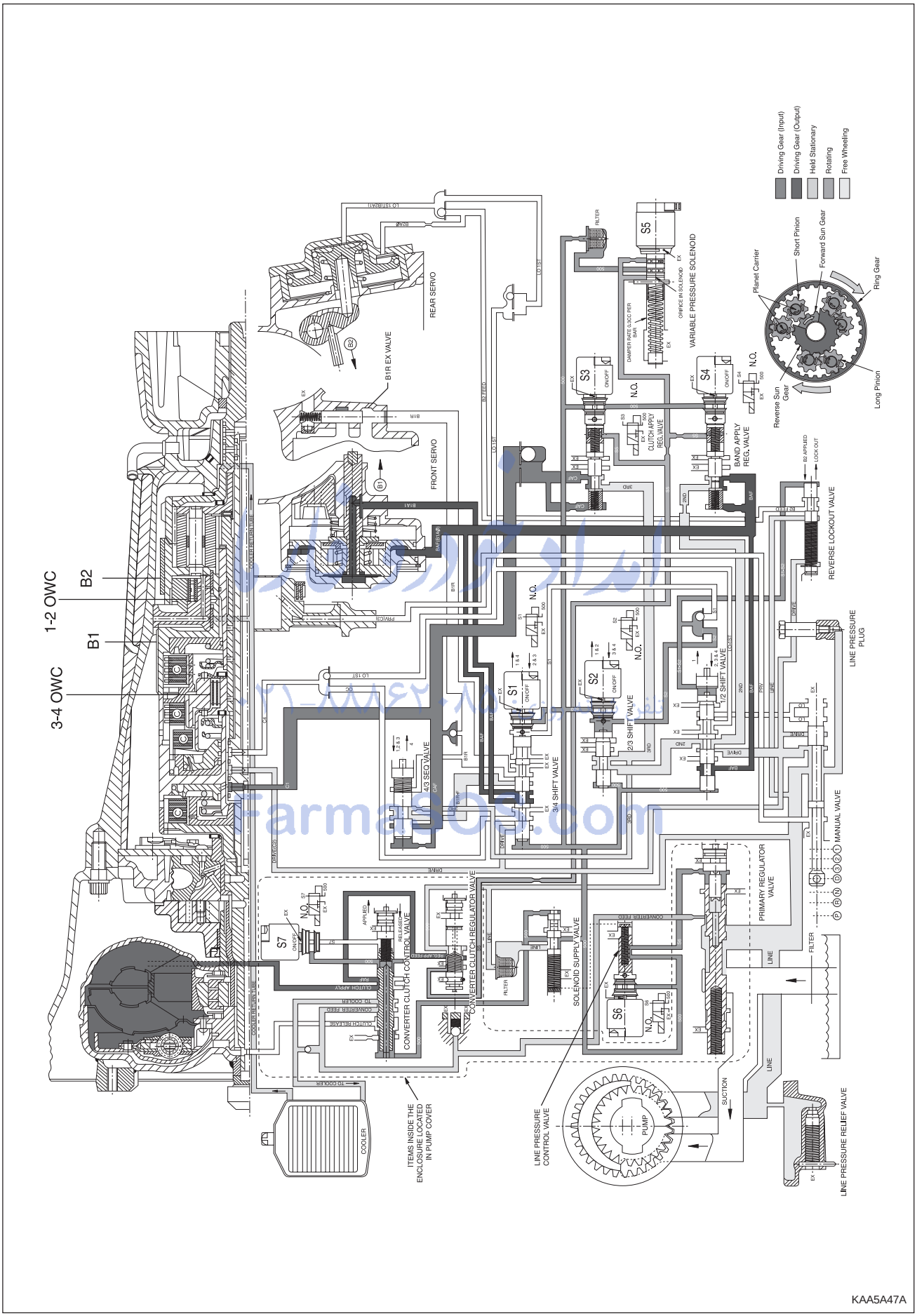
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Gear State	ELEMENTS ENGAGED								
	C1	C2	C3	C4	B1	B2	1-2 OWC	3-4 OWC	LU CLUTCH
Drive 4 Overdrive	X	X	-	-	X	-	-	-	-

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DRIVE 4 LOCK UP



Power Flow - Drive 4 Lock Up

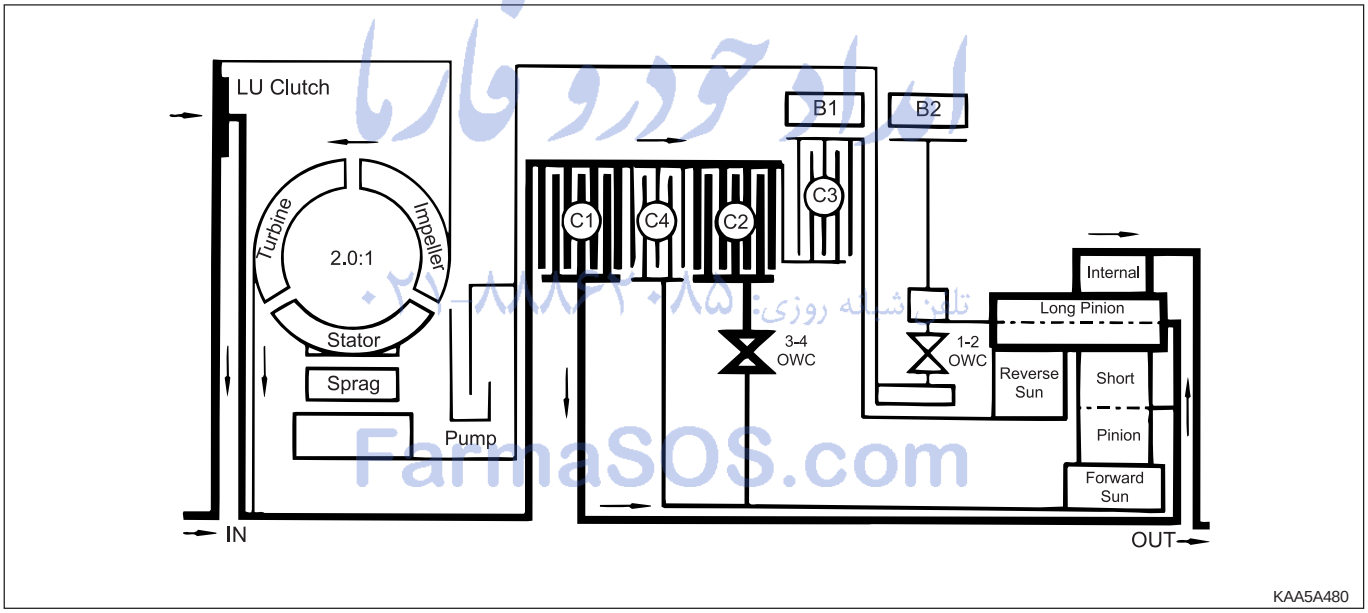
In Drive 4 Lock Up, transmission drive is the same as for Drive 4 but with the application of the converter lock up clutch to provide positive no-slip converter drive.

Control

To maintain this arrangement in the steady state solenoids and valves are activated as follows;

- When S7 is switched ON, S7 feed oil to the converter clutch control valve is switched OFF and allowed to exhaust through the S7 solenoid. This allows the valve to move to the clutch engage position.
- Regulated apply feed oil, drived from drive oil at the converter clutch regulator valve, is directed by the converter clutch control valve to the engage side of the converter clutch.
- Converter clutch release oil is exhausted at the converter clutch control valve.
- Converter feed oil is re-routed by the converter clutch control valve directly to the oil cooler and lubrication circuit.

	ELEMENTS ENGAGED								
Gear State	**C1**	**C2**	**C3**	**C4**	**B1**	**B2**	**1-2 OWC**	**3-4 OWC**	**LU CLUTCH**
Drive 4 Lock Up	X	X	-	-	X	-	-	-	-



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DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSIS

BASIC KNOWLEDGE REQUIRED

You must be familliar with some basic electronics to use this section of the Service Manual. They will help you to follow diagnostic procedures.

Notice: Lack of the basic knowledge of this transmission when performing diagnostic procedures could result in incorrect diagnostic performance or damage to transmission components. Do not, under any circumstances, attempt to diagnose a transmission problem without this basic knowledge.

Notice: If a wire is probed with a sharp instrument and not properly sealed afterward, the wire will corrode and an open circuit will result.

Diagnostic test probes are now available that allow you to probe individual wires without leaving the wire open to the environment. These probe devices are inexpensive and easy to install, and they permanently seal the wire from corrosion.

Special Tools

You should be able to use a Digital Volt Meter (DVM), a circuit tester, jumper wires or leads and a line pressure gauge set. The functional check procedure is designed to verify the correct operation of electronic components in the transmission. This will eliminate the unnecessary removal of transmission components.

FUNCTIONAL CHECK PROCEDURE

Begin with the Functional Check Procedure which provides a general outline of how to diagnose automatic transmission. The following functional check procedure will indicate the proper path of diagnosing the transmission by describing the basic checks and then referencing the locations of the specific checks.

- Check the fluid level according to the Fluid Level Service Procedure.
- Check the transmission fluid leak.
- Check if the transmission fluid is not burnt by smell. **Notice:** The specific fluid used in this transmission turns brown during normal operation. Brown fluid does not indicate a transmission fault.
- Ensure that the transmission is not in Limp Home Mode (LHM).
- Check the battery terminals and the earth connections for corrosion or looseness.
- Check that the cooler flow is not restricted.
- Check all electrical plug connections for tightness.
- Use on-board diagnostic tool or a scan tool to see if any transmission trouble codes have been set. Refer to the appropriate “Diagnostic Trouble Code (DTC)” information and repair the vehicle as directed. After repairing the vehicle, perform the road test and verify that the code has not set again.
- Perform the Electrical/Garage Shift Tests.
- Perform the Road Test Procedure in this section.
- Inspect the oil and check for metal or other contaminants in the oil pan.

TRANSMISSION FLUID LEVEL SERVICE PROCEDURE

This procedure is to be used when checking a concern with the fluid level in a vehicle. A low fluid level will result in slipping and loss of drive/ reverse or delay on engagement of drive/ reverse when the vehicle is cold.

The vehicle is first checked for transmission diagnostic messages on the scan tool. If the oil level is low, it is possible to register a vehicle speed signal fault.

The vehicle is to be test driven to determine if there is an abnormal delay when selecting drive or reverse, or loss of drive. One symptom of low fluid level is a momentary loss of drive when driving the vehicle around a corner. Also when the transmission fluid level is low, a loss of drive may occur when the transmission fluid temperature is low.

If there is no loss of drive when the vehicle is driven warm and a vehicle speed signal fault is registered, then fluid should be added to the transmission.

When adding or changing transmission fluid use only Castrol TQ 95 automatic transmission fluid. The use of incorrect fluid will cause the performance and durability of the transmission to be severely degraded.

Fluid Level Diagnosis procedure

1. If the vehicle is at operating temperature allow the vehicle to cool down for two hours, but no greater than four hours. Or if the vehicle is at cool status, start the engine and allow the engine to idle for approximately 5 minutes or, if possible, drive the vehicle for a few kilometers. This will allow the transmission to be within the correct temperature range. Transmission fluid level should be checked at temperature 50 - 60 °C (82 - 140 °F).

   Caution: Removal of the fluid filler plug when the transmission fluid is hot may cause injury if fluid drains from the filler hole.

2. With the brake pedal pressed, move the gear shift control lever through the gear ranges, pausing a few seconds in each range. Return the gear shift control lever to P (Park). Turn the engine OFF.
3. Park the vehicle on a hoist, inspection pit or similar raised level surface. The vehicle must be control level to obtain a correct fluid level measurement.

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4. Place a fluid container below the fluid filler plug.
5. Clean all dirt from around the fluid filler plug. Remove the fluid filler plug. Clean the filler plug and check that there is no damage to the 'O' ring.
   - If fluid drains through the filler hole the transmission may have been overfilled. When the fluid stops draining the fluid level is correct. Install the fluid filler plug and tighten it to 33 N•m (24 lb-ft).
   - If fluid does not drain through the filler hole, the transmission fluid level may be low. Install the filler pump into the filler hole. Lower the vehicle with the filler pump still connected and partially fill the fluid through the filler hole.

     Start the vehicle in P (Park) with the parking brake and the brake applied. With the engine idling, move the gear shift. control lever through the gear ranges, pausing a few seconds in each range and adding the fluid until gear application is felt.

     Return the gear shift lever to P (Park).

     Turn the engine OFF and raise the vehicle. When the three minutes passed after the engine stopped, remove the filler pump.

     Check if the fluid level is aligned with the bottom of the filler hole. If not, add a small quantity of fluid to the correct level. Install the fluid filler plug and tighten it to 33 N•m (24 lb-ft).
   - If fluid does not drain through the filler hole although adding a total of 1.5 liters, the transmission should be inspected for fluid leaks and any leaks should be fixed before setting the transmission fluid level.
6. When the fluid level checking procedure is completed, wipe any fluid around the filler plug with a rag or shop towel.

Fluid Level Set After Service

1. Depending on the service procedure performed, add the following amounts of fluid through the filler plug hole prior to adjusting the fluid level:

   Converter empty 8.0 liters (8.5 quarts)

   Converter full 3.8 liters (4.0 quarts)
2. Follow steps 1 through 4 of the Fluid Level Diagnosis Procedure.
3. Clean all dirt from around the fluid filler plug. Remove the fluid filler plug. Clean the filler plug and check that there is no damage to the 'O' ring.
4. Lower the vehicle with the filler pump still connected and start the vehicle in P (Park) with the parking brake and the brake applied. With the engine idling, move the gear shift control lever through the gear ranges, pausing a few seconds in each range and adding the fluid until gear application is felt.

   Then add an additional 0.5 litres of fluid. Return the gear shift lever to P (Park). Turn the engine OFF and raise the vehicle. Install the fluid filler plug and tighten it to 33 N•m (24 lb-ft).
5. Drive the vehicle at 3.5 to 4.5 kilometers with light throttle so that the engine does not exceed 2500 rpm.

   This should result in the transmission temperature being in the range 50 - 60 °C (82 - 140 °F). With the brake applied, move the shift lever through the gear ranges, pausing a few seconds in each range at the engine idling.
6. Return the gear shift lever to P (Park).

   Turn the en-gine OFF and raise the vehicle on the hoist, if applicable, ensuring the vehicle is level. When the three minutes passed after the engine stopped, remove the filler plug.

   Check if the fluid level is aligned with the bottom of the filler hole. If not, add a small quantity of fluid to the correct level. Install the fluid filler plug and tighten it to 33 N•m (24 lb-ft).
7. Wipe any fluid around the filler plug with a rag or shop towel.

FLUID LEAK DIAGNOSIS AND REPAIR

The cause of most external leaks can generally be located and repaired with the transmission in the vehicle.

Methods for Locating Leaks

General Method

1. Verify that the leak is transmission fluid.
2. Thoroughly clean the suspected leak area.
3. Drive the vehicle for approximately 25 km (15 miles) or until the transmission reaches normal operating temperature (88 °C, 190 °F).
4. Park the vehicle over clean paper or cardboard.
5. Turn the engine OFF and look for fluid spots on the paper.
6. Make the necessary repairs to correct the leak.

Powder Method

1. Thoroughly clean the suspected leak area.
2. Apply an aerosol type powder (foot powder) to the suspected leak area.
3. Drive the vehicle for approximately 25 km (15 miles) or until the transmission reaches normal operating temperature (88 °C, 190 °F).
4. Turn the engine OFF.
5. Inspect the suspected leak area and trace the leak path through the powder to find the source of the leak.
6. Make the necessary repairs.

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Dye and Black Light Method

1. Add dye to the transmission through the transmission fluid filler plug. Follow the manufacturer's recommendation for the amount of dye to be used.
2. Use the black light to find the fluid leak.
3. Make the necessary repairs.

Repairing the Fluid Leak

Once the leak point is found the source of the leak must be determined. The following list describes the potential causes for the leak:

- Fasteners are not torqued to specification.
- Fastener threads and fastener holes are dirty or corroded.
- Gaskets, seals or sleeves are misaligned, damaged or worn.
- Damaged, warped or scratched seal bore or gasket surface.
- Loose or worn bearing causing excess seal or sleeve wear.
- Case or component porosity.
- Fluid level is too high.
- Plugged vent or damaged vent tube.
- Water or coolant in fluid.
- Fluid drain back holes plugged.

ELECTRICAL / GARAGE SHIFT TEST

This preliminary test should be performed before a hoist or road test to make sure electronic control inputs are connected and operating. If the inputs are not checked before operating the transmission, a simple electrical condition could be misdiagnosed as a major transmission condition.

A scan tool provides valuable information and must be used on the automatic transmission for accurate diagnosis.

1. Move gear shift control lever to P (Park) and set the parking brake.
2. Connect scan tool to Data Link Connector (DLC) terminal.
3. Start engine.
4. Turn the scan tool ON.
5. Verify that the appropriate signals are present. These signals may include:
   - ENGINE SPEED
   - VEHICLE SPEED
   - THROTTLE POSITION
   - ACCEL. PEDAL POSITION
   - TRANSMISSION GEAR STATE
   - GEAR SHIFT LEVER POSITION
   - TRANSMISSION FLUID TEMPERATURE
   - CLOSED THROTTLE POSITION LEARN
   - OPEN THROTTLE POSITION LEARNT
   - CLOSED ACCEL. PEDAL POSITION LEARNT
   - OPEN ACCEL. PEDAL POSITION LEARNT
   - A/C COMPRESSOR STATUS
   - KICKDOWN SWITCH STATUS
   - 4WD STATUS
   - MODE SWITCH
   - THROTTLE POSITION VOLTAGE
   - GEAR SHIFT LEVER POSITION VOLTAGE
   - TRANS. FLUID TEMPERATURE VOLTAGE
   - A/C SWITCH
   - KICKDOWN SWITCH VOLTAGE
   - 4WD LAMP LOW VOLTAGE
   - 4WD LAMP HIGH VOLTAGE
   - MODE SWITCH VOLTAGE
   - BATTERY VOLTAGE
6. Monitor the A/C COMPRESSOR STATUS signal while pushing the A/C switch.
   - The A/C COMPRESSOR STATUS should come ON when the A/C switch is pressed, and turn OFF when the A/C switch is repushed.
7. Monitor the GEAR SHIFT LEVER POSITION signal and move the gear shift control lever through all the ranges.
   - Verify that the GEAR SHIFT LEVER POSITION value matches the gear range indicated on the instrument panel or console.
   - Gear selections should be immediate and not harsh.
8. Move gear shift control lever to neutral and monitor the THROTTLE POSITION signal while increasing and decreasing engine speed with the accelerator pedal.
   - THROTTLE POSITION should increase with engine speed.

ROAD TEST PROCEDURE

- Perform the road test using a scan tool.
- This test should be performed when traffic and road conditions permit.
- Observe all traffic regulations.

ELECTRONIC ADJUSTMENTS

Idle Speed Adjustments

Carry out the adjustments to the idle speed as detailed in the workshop manual.

Vehicle Coding

The vehicle coding is integrated as part of the diagnostic software. A scan tool has the function to code the ve-hicle through the K-line.

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Dye and Black Light Method

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- Case or component porosity.
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- Fluid drain back holes plugged.

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   - VEHICLE SPEED
   - THROTTLE POSITION
   - ACCEL. PEDAL POSITION
   - TRANSMISSION GEAR STATE
   - GEAR SHIFT LEVER POSITION
   - TRANSMISSION FLUID TEMPERATURE
   - CLOSED THROTTLE POSITION LEARN
   - OPEN THROTTLE POSITION LEARNT
   - CLOSED ACCEL. PEDAL POSITION LEARNT
   - OPEN ACCEL. PEDAL POSITION LEARNT
   - A/C COMPRESSOR STATUS
   - KICKDOWN SWITCH STATUS
   - 4WD STATUS
   - MODE SWITCH
   - THROTTLE POSITION VOLTAGE
   - GEAR SHIFT LEVER POSITION VOLTAGE
   - TRANS. FLUID TEMPERATURE VOLTAGE
   - A/C SWITCH
   - KICKDOWN SWITCH VOLTAGE
   - 4WD LAMP LOW VOLTAGE
   - 4WD LAMP HIGH VOLTAGE
   - MODE SWITCH VOLTAGE
   - BATTERY VOLTAGE
6. Monitor the A/C COMPRESSOR STATUS signal while pushing the A/C switch.
   - The A/C COMPRESSOR STATUS should come ON when the A/C switch is pressed, and turn OFF when the A/C switch is repushed.
7. Monitor the GEAR SHIFT LEVER POSITION signal and move the gear shift control lever through all the ranges.
   - Verify that the GEAR SHIFT LEVER POSITION value matches the gear range indicated on the instrument panel or console.
   - Gear selections should be immediate and not harsh.
8. Move gear shift control lever to neutral and monitor the THROTTLE POSITION signal while increasing and decreasing engine speed with the accelerator pedal.
   - THROTTLE POSITION should increase with engine speed.

ROAD TEST PROCEDURE

- Perform the road test using a scan tool.
- This test should be performed when traffic and road conditions permit.
- Observe all traffic regulations.

ELECTRONIC ADJUSTMENTS

Idle Speed Adjustments

Carry out the adjustments to the idle speed as detailed in the workshop manual.

Vehicle Coding

The vehicle coding is integrated as part of the diagnostic software. A scan tool has the function to code the ve-hicle through the K-line.

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SYMPTOM DIAGNOSIS

DRIVE FAULTS

Condition	Possible Causes	Action
No Drive in D	• Insufficient auto transmission fluid.	• Check the fluid level. Top up as necessary.
	• Blocked feed in C1/C2 cylinder.	• Inspect and clean C1/C2 feed.
	• 'Z' link displaced.	• Reinstall/renew the 'z' link.
	• Primary Regulator Valve (PRV) jammed open.	• Remove, clean and re-install the PRV.
	• Overdrive shaft or input shaft seal rings failed.	• Inspect and replace as necessary.
	• 3-4 or 1-2 One Way Clutch (OWC) installed backwards or failed.	• Inspect and replace as necessary.
	• C2 piston broken or cracked.	• Inspect and replace as necessary.
No Drive in Reverse No engine braking in Manual 1 Engine braking in Manual 1 is OK	• Rear band or servo faulty.	• Check servo adjustment or replace rear band as necessary.
	• Failure in C3, C3 hub or C1/C2 cylinder.	• Check for failure in C3, C3 hub or C1/C2 cylinder. Repair as necessary.
	• Damaged input shaft sealing rings.	• Inspect and replace as necessary.
No drive in Drive and Reverse	• Jammed Primary Regulator Valve (PRV).	• Inspect and clean PRV.
	• Damaged/broken pump gears.	• Inspect and replace pump gears as necessary.
	• Dislodged output shaft snap ring.	• Inspect and repair as necessary.

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FAULTY SHIFT PATTERN

Condition	Possible Causes	Action
2-3 shift only (no 4th or 1st)	• S1 always OFF.	• Inspect S1. Repair or replace as necessary. • Check for 12 Volts applied to S1 at all times or for wiring fault.
1-4 shift only1-3-4 (Delayed 1-2 shift)	• S1 always ON.	• Inspect S1. Repair or replace as necessary. • Check for 12 Volts applied to S1 at all times or for wiring fault.
4-3 shift only	• S2 always OFF.	• Inspect S2. Repair or replace as necessary. • Check for open circuit or wiring fault.
1-2-Neutral (1st over run)	• S2 always ON.	• Inspect S2. Repair or replace as necessary. • Check for open circuit or wiring fault.
1-3 shift only	• B1 failed. • Loose band adjustment. • Front servo piston or seal failed. • S1/S2 ball misplaced,	• Inspect and repair as necessary. • Inspect and adjust as necessary. • Inspect and repair as necessary. • Inspect and replace or refit as necessary
1-3-4 only	• Smaller 'O' ring on front servo piston failed or missing. • 2-3 shift valve jammed.	• Inspect 'O' ring. Refit or replace as necessary. • Inspect the 2-3 shift valve. Repair or replace as necessary.
1-2-1 only	• C1 clutch failed or slipping in 3rd and 4th. (Gives 1st in 3rd and 2nd in 4th.)	• Inspect C1 clutch. Repair or replace as necessary.
No manual 4-3, 3-2 or 2-1	• Over-run Clutch (OC) /low ball misplaced.	• Inspect ball. Refit or replace as necessary.
No manual 1st	• Rear band slipping when hot. • Reverse/Low-1st ball misplaced. • Rear servo inner 'O' ring missing.	• Inspect rear band adjustment. Adjust as necessary. • Inspect ball. Refit or replace as necessary. • Inspect 'O' ring. Refit or replace as necessary.
1st gear only or 2nd,3rd, and 4th only	• 1-2 shift valve jammed.	• Inspect the 1-2 shift valve. Repair or replace as necessary.
1st and 2nd only or 1st, 3rd and 4th only	• 2-3 shift valve jammed.	• Inspect the 2-3 shift valve. Repair or replace as necessary.
1st, 2nd and 4th only or 1st, 2nd, and 3rd (tied up in 3rd)	• Inhibitor switch fault, 1-2-3 only. • 3-4 shift valve jammed.	• Inspect inhibitor switch. Repair or replace as necessary. • Inspect the 3-4 shift valve. Repair or replace as necessary.

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Condition	Possible Causes	Action
Harsh 2-3 shift	• Jammed band 1 release valve.	• Inspect the release valve. Repair or replace as necessary.
	• Faulty S3 or S2 solenoid.	• Inspect S3 or S2. Repair or replace as necessary.
	• Faulty clutch apply regulator valve.	• Inspect the regulator valve. Repair or replace as necessary.
	• Missing or damaged clutch apply feed ball.	• Inspect the ball. Refit or replace as necessary.
	• Damaged input shaft sealing rings.	• Inspect the sealing rings. Refit or replace as necessary.
	• Damaged C1 piston 'O' rings.	• Inspect the 'O' rings. Refit or replace as necessary.
	• Damaged or dislodged C1 piston bleedball.	• Inspect the bleed ball. Refit or replace as necessary.
Harsh 3-4 shift	• Faulty S1 or S4 solenoid.	• Inspect S1 or S4. Repair or replace as necessary.
	• Jammed band 1 release valve.	• Inspect the release valve. Repair or replace as necessary.
	• Incorrect front band adjustment.	• Inspect the band. Adjust as necessary.
	• Damaged front servo piston 'O' rings.	• Inspect the 'O' rings. Refit or replace as necessary.
	• Faulty or damaged variable pressure solenoid (S5).	• Inspect S5. Repair or replace as necessary.
	• Faulty band apply regulator valve.	• Inspect the regulator valve. Repair or replace as necessary.

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SHIFT QUALITY FAULTS

Condition	Possible Causes	Action
All Shifts Firm	• Incorrect auto transmission fluid (ATF). • S5 faulty won, or incorrectly fitted. • Band apply and clutch apply regulator springs misplaced.	• Drain and fill with specified ATF. • Check that S5 is fitted correctly, or replace S5. • Inspect band apply and clutch apply regulator springs. Refit or replace as necessary
Manual 4-3-2-1 is soft delayed or missing	• Over-run Clutch (OC) /Low-1st ball misplaced. • C4 clutch worn or burnt. • C4 wave plate not lined up with the holes in the piston.	• Inspect the ball. Refit or replace as necessary. • Inspect C4 clutch. Replace or repair as necessary. • Check the alignment. Realign as necessary.
Firm 1-2 Hot	• S5 worn.	• Inspect S5 and replace as necessary.
4th Tied up	• Incorrect C4 pack clearance. • Damaged C4 clutch. • Cracked C2 piston (leaking into C4).	• Check the clearance and adjust as necessary. • Inspect C4. Repair or replace as necessary. • Inspect piston. Repair or replace as necessary.
Tied up on 2-3	• Incorrect band adjustment • Front servo plastic plug missing • B1R spring broken.	• Inspect and adjust band as necessary. • Replace the plug. • Replace the spring.
Flare on 2-3	• B1R spring/plug left out. • C1/B1R ball misplaced. • C1 clutch damaged. • Restriction in C1 feed. • C1 piston check ball jammed. • Overdrive or input shaft sealing rings damaged.	• Replace the spring/plug. • Refit the ball. • Inspect the clutch. Repair the clutch as necessary. • Inspect and clean C1 feed. • Replace the piston. • Inspect and replace the sealing rings and/or shaft as necessary.
Slips in 4th	• C1/B1R ball misplaced. • Overdrive or input shaft sealing rings damaged. • C1 clutch damaged.	• Inspect and replace the ball. • Inspect and replace the sealing rings and/or shaft as necessary. • Inspect and repair the C1 clutch as necessary.
Slips in reverse, no manual 1st	• Rear band incorrectly adjusted or damage • Low-1st check ball misplaced.	• Inspect and adjust or replace rear band. • Inspect and re-fit the ball.
Flare on 4-3, Flare on 3-2	• 4-3 sequence valve in backwards.	• Refit the valve.
Firm Manual low shift-high line press.	• Low-1st check ball misplaced.	• Replace the ball.

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Condition	Possible Causes	Action
Harsh 1-2 shift	• Faulty inhibitor switch. • Faulty throttle position sensor. • Incorrect front band adjustment. • Damaged front servo piston 'O' rings. • Faulty or damaged variable pressure solenoid (S5). • Faulty S1 or S4 solenoid. • Faulty Band Apply Regulator (BAR) valve. • Misassembled front servo return spring.	• Check the resistance. Replace the inhibitor switch as necessary. • Inspect and replace the sensor as necessary. • Inspect and adjust the band as necessary. • Inspect and replace the 'O' rings as necessary. • Inspect, repair or replace S5 as necessary. • Inspect, repair or replace S1 or S4 as necessary. • Inspect, repair or replace the BAR as necessary. • Inspect and repair as necessary.
Stalls when Drive Or Reverse	• Jammed Converter Clutch Control Valve (CCCV).	• Inspect and clean CCCV.
Selected Shudder on Rolldown	• Faulty solenoid 7.	• Inspect, repair or replace as necessary.

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AFTER TEARDOWN FAULTS

Condition	Possible Causes	Action
C2 burnt	• Gear shift lever linkage out of adjustment. • S6 foiled - stuck low. • Overdrive/output shaft sealing rings damaged. • C2 piston cracked.	• Inspect, repair C2 and adjust the linkage as necessary. • Repair C2. Inspect, repair or replace S6 as necessary. • Repair C2. Inspect, replace the sealing rings and/or shaft as necessary. • Repair C2. Inspect, repair or replace the C2 piston as necessary.
C4 burnt	• Incorrect C4 pack clearance. • C4 wave plate not lined up properly. • Overdrive or output shaft sealing rings damaged. • C2 piston cracked. • Over-run Clutch (OC) /low-1st ball misplaced.	• Inspect C4 and repair as necessary. • Inspect and adjust the C4 pack clearance as necessary. • Repair C4. Inspect and realign the wave plate as necessary. • Repair C4. Inspect and realign the sealing rings and/or shaft as necessary. • Repair C4. Inspect and replace the C2 piston as necessary. • Repair C4. Inspect and refit the ball as necessary.
B1 burnt	• B1R spring broken. • Input shaft sealing ring cut. • C1/B1R ball misplaced.	• Inspect and repair B1 and replace the spring as necessary. • Replace sealing ring. • Repair B1. Refit the ball as necessary.
C1 burnt	• B1R spring left out. • Overdrive or input shaft sealing rings damaged. • C1 piston cracked. • Ball capsule jammed. • 4-3 sequence valve in backwards. • Clutch Apply Feed (CAF) /B1R ball left out.	• Inspect and repair C1 and replace the spring. • Repair C1. Inspect and replace the sealing tongs and/or shaft as necessary. • Repair C1. Inspect and replace the C1 piston as necessary. • Repair C1. Inspect and refit the capsule as necessary. • Repair C1. Inspect and refit the valve as necessary. • Repair C1. Inspect and replace the ball as necessary.
B2 burnt (Slips in reverse - no manual 1st)	• Rear band incorrectly adjusted or damaged. • Reverse-low/first ball misplaced.	• Inspect and adjust the band as necessary. • Inspect and refit the ball as necessary.

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Condition	Possible Causes	Action
Firm converter lock or unlock	• Input shaft 'O' ring missing or damaged. • Converter clutch regulator valve in backwards.	• Inspect and replace the 'O' ring as necessary. • Inspect and refit the valve as necessary.
No lock up at light throttle	• Input shaft 'O' ring missing or damaged. • C1 bias valve in backwards.	• Inspect and replace the 'O' ring as necessary. • Inspect and refit the valve as necessary.

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TROUBLE CODE DIAGNOSIS - GASOLINE VEHICLE

TCM DIAGNOSTIC SYSTEM OVERVIEW

Notice: To prevent Transmission Control Module (TCM) damage. The ignition key must be OFF when disconnection or reconnection the power to the TCM (for example bttery cable, TCM pigtail connector, TCM fuse, jumper cables, etc.).

When the TCM detects a system fault, a Diagnostic Trouble Code (DTC) is set in the TCM. This code is present while the fault conditions are met and is stored as a 'History DTC' until cleared. Condition for setting and clearing each TCM DTC are provided in the relevant sections.

In the case where the vehicle type is certified for Eure On-Board Diagnostic (EOBD) compliance, the Engine Control Module (ECM) provides the communication link to the EOBD scan tool to pass on any EOBD relevant codes from the TCM. The table below contains a list of all supported DTCs and the classification of each for EOBD purposes. Where a type B DTC has been set in an EOBD vehicle, the response to the fault may include action by the ECM, including the illumination of the Malfunction Indicator Lamp (MIL). Refer to *Section 1F, Engine Control,* for details on EOBD system function, checks and fault clearing.

CLEARING TROUBLE CODES

TCM DTCs should be cleared after repairs have been completed. Some diagnostic tables will tell you to clear the codes before using the chart, which will help to find the cause of the problem more quickly. Always note the DTCs present before clearing - this information may be helpful in the diagnostic process."

DIAGNOSTIC TROUBLE CODES

DTC	Description	Type
P0706	Transmission Range Sensor Circuit Range/Performance	B
P0707	Transmission Range Sensor Circuit Low input	B
P0708	Transmission Range Sensor Circuit High input	B
P0710	Transmission Fluid Temperature Sensor Circuit Malfunction	D
P0790	Normal/Performance Switch Circuit Malfunction	D
P1703	Engine Speed Signal Error	D
P1704	Shaft Speed Signal Error	D
P1708	TCM Supply Voltage Low	D
P1709	TCM Supply Voltage High	D
P1712	Kickdown Switch Circuit Malfunction	D
P1713	Pedal Signal Error	D
P1714	EEPROM Vehicle Code Error	D
P1715	VPS Offset Error	D
P1717	RAM Error	D
P1718	ROM Error	D
P1719	CAN Bus Error	D
P1720	EEPROM Error	D
P1721	Throttle Signal Error	D
P1722	Vehicle Type Determination Error	D
P1733	Solenoid 1 Circuit Open	D
P1734	Solenoid 2 Circuit Open	D
P1735	Solenoid 3 Circuit Open	D
P1736	Solenoid 4 Circuit Open	D
P1737	Solenoid 5 Circuit Open	D

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DIAGNOSTIC TROUBLE CODES (Cont'd)

DTC	Description	Type
P1738	Solenoid 6 Circuit Open	D
P1739	Solenoid 7 Circuit Open	D
P1741	Solenoid 1 Circuit Short	D
P1742	Solenoid 2 Circuit Short	D
P1743	Solenoid 3 Circuit Short	D
P1744	Solenoid 4 Circuit Short	D
P1745	Solenoid 5 Circuit Short	D
P1746	Solenoid 6 Circuit Short	D
P1747	Solenoid 7 Circuit Short	D

DTC Types

Each DTC is directly related to a diagnostic test. The Diagnostic management system sets DTCs based on the failure of the tests during a driving cycle or cycles. The following are the two types of DTCs and the characteristics of those codes;

Type B

- Emissions related.
- EOBD system “Armed” after one driving cycle with a fail.
- EOBD system “Disarmed” after one driving cycle with a pass.
- Illuminates the MIL on the second con-secutive driving cycle with a fail.
- TCM stores a history DTC on the first driving cycle with a fail.
- EOBD system stores a history DTC on the second consecutive driving cycle with a fail, (the DTC will be armed after the first fail).
- EOBD system stores a freeze frame on the second consecutive driving cycle with a fail, (if empty).

Type D

- Non-Emissions related.
- Does not request illumination of any lamp.
- Stores a history DTC on the first driving cycle with a fail.
- EOBD system does not store a freeze frame.

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TROUBLE CODE DIAGNOSIS - DIESEL VEHICLE

TCM DIAGNOSTIC SYSTEM OVERVIEW

Notice: To prevent Transmission Control Module (TCM) damage. The ignition key must be OFF when disconnection or reconnection the power to the TCM (for example bttery cable, TCM pigtail connector, TCM fuse, jumper cables, etc.).

When the TCM detects a system fault, a Diagnostic Trouble Code (DTC) is set in the TCM. This code is present while the fault conditions are met and is stored as a 'History DTC' until cleared. Condition for setting and clearing each TCM DTC are provided in the relevant sections.

CLEARING TROUBLE CODES

TCM DTCs should be cleared after repairs have been completed. Some diagnostic tables will tell you to clear the codes before using the chart, which will help to find the cause of the problem more quickly. Always note the DTCs present before clearing - this information may be helpful in the diagnostic process.

DIAGNOSTIC TROUBLE CODES

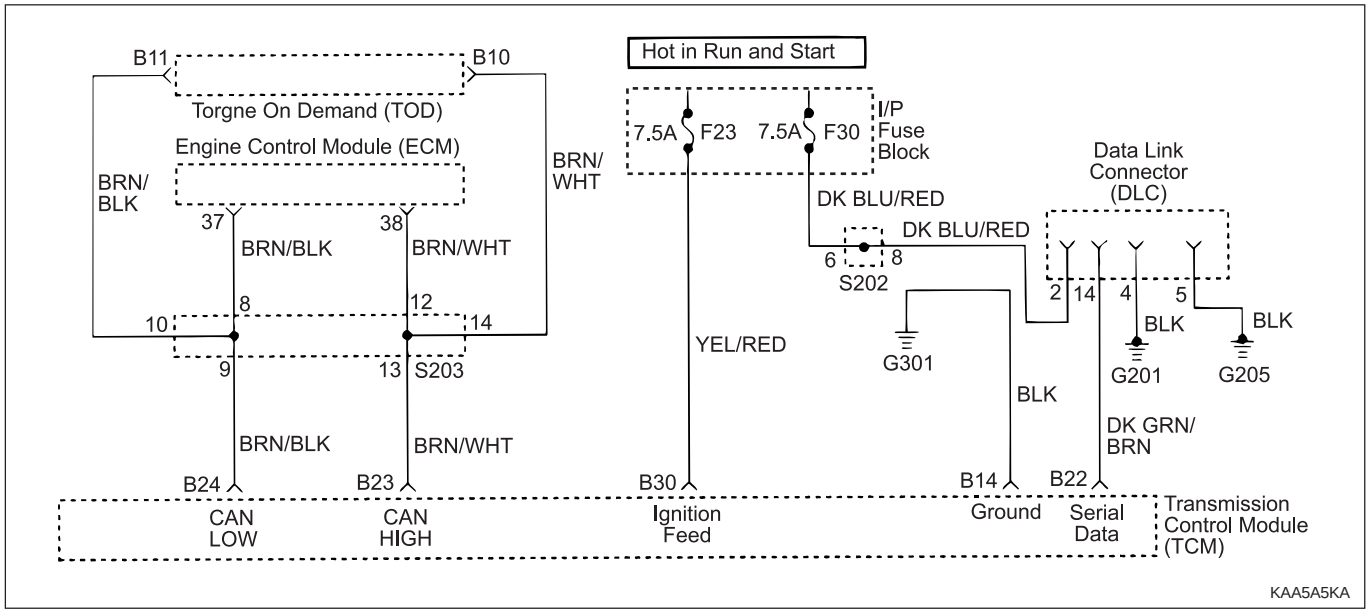
DTC	Description
P0707	Transmission Range Sensor Circuit Low Input
P0708	Transmission Range Sensor Circuit High Input
P0710	Transmission Fluid Temperature Sensor Circuit Malfunction
P0790	Normal/Performance Switch Circuit Malfunction
P1703	Engine Speed Signal Error
P1704	Shaft Speed Signal Error
P1708	TCM Supply Voltage Low
P1709	TCM Supply Voltage High
P1710	Air Conditioning Switch Circuit Malfunction
P1712	Kickdown Switch Circuit Malfunction
P1714	EEPROM Vehicle Code Error
P1715	VPS Offset Error
P1716	Throttle Not Learnt Error
P1717	RAM Error
P1718	ROM Error
P1720	EEPROM Error
P1721	Throttle Signal Error
P1722	Vehicle Type Determination Error
P1733	Solenoid 1 Circuit Open
P1734	Solenoid 2 Circuit Open
P1735	Solenoid 3 Circuit Open
P1736	Solenoid 4 Circuit Open
P1737	Solenoid 5 Circuit Open
P1738	Solenoid 6 Circuit Open
P1739	Solenoid 7 Circuit Open
P1741	Solenoid 1 Circuit Short
P1742	Solenoid 2 Circuit Short
P1743	Solenoid 3 Circuit Short
P1744	Solenoid 4 Circuit Short

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DIAGNOSTIC TROUBLE CODES (Cont'd)

DTC	Description
P1745	Solenoid 5 Circuit Short
P1746	Solenoid 6 Circuit Short
P1747	Solenoid 7 Circuit Short

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TCM DIAGNOSTIC SYSTEM CHECK

Circuit Description

The Transmission Control Module (TCM) Diagnistic System Check is the starting point for any driveability complaint diagnosis. Before using this procedure, perform a careful visual/physical check of the Transmission Control Module (TCM) and the transmission grounds for cleanliness and tightness.

The TCM Diagnostic System Check is an organized approach to identifying a problem created by an electronic transmission control system malfunction.

Diagnostic Aids

An intermittent fault may be caused by a poor connection, rubbed-through wire insulation or a wire broken inside the insulation. Check for poor connections or a damaged harness. Inspect the TCM harness and connections for improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection, and damaged harness.

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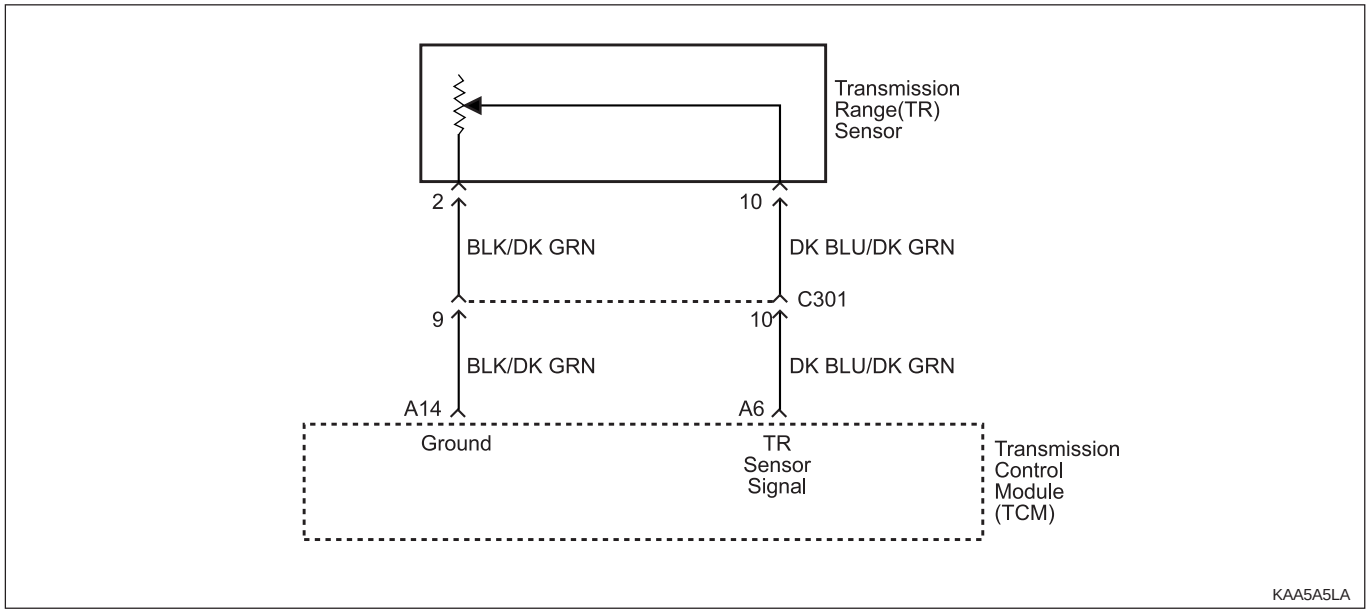
TCM Diagnostic System Check

Step	Action	Value(s)	Yes	No
1	1 Turn the ignition OFF. 2. Install the scan tool. 3. Turn the ignition ON, with the engine OFF. 4. Attempt to display the Transmission Control Module (TCM) Data List with the scan tool. Does the scan tool display the TCM data?	-	Go to Step 2	Go to Step 3
2	Select the Trouble Code with the scan tool. Are any Diagnostic Trouble Codes (DTCs) stored?	-	Go to applicable DTC table	System OK, Check Complete

TCM Diagnostic System Check (Cont'd)

Step	Action	Value(s)	Yes	No
3	1. Turn the ignition OFF. 2. Disconnect the TCM connector B. 3. Turn the ignition ON. 4. Check the serial data line from TCM connector terminal B22 to Data Link Connector (DLC) connector terminal 14 for an open, short to ground, or short to voltage. Also, check the DLC ignition feed circuit for an open or short to ground and the DLC ground circuit for an open. Is a problem found?	-	Go to Step 4	Go to Step 5
4	Repair the open, short to ground or short to voltage in the serial data circuit or the DLC ignition feed circuit or the DLC ground circuit. Is a repair complete?	-	Go to Step 1	-
5	Check the TCM ignition feed circuit for an open or short to ground and the TCM ground circuit for an open.	-	Go to Step 6	Go to Step 7
6	Is a problem found? Repair the open or short to ground in the TCM ignition feed circuit or the TCM ground circuit.	-	Go to Step 1	-
7	Is a repair complete? 1. Turn the ignition OFF. 2. Disconnect the TCM connector.	-	Go to Step 1	-

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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DIAGNOSTIC TROUBLE CODE (DTC) P0706
TRANSMISSION RANGE SENSOR CIRCUIT RANGE/PERFORMANCE

Circuit Description

The Transmission Range (TR) sensor is incorporated in the inhibitor switch mounted on the side of the transmission case. The TR sensor Indicates to the TCM which gear position has been selected by way of a varying resistance.

The TR sensor signal has discrete values indicating the positions selected by the gear shift control lever (PRND321). The Transmission Control Module (TCM) receives that signal with a voltage varying from 0 V to 5 V. DTC P0706 sets when the TR sensor signal is not feasi ble.

Conditions for Setting the DTC

- The engine temperature is greater than 60 °C (140 °F).
- The engine speed is greater than 2000 RPM and less than 4000 RPM.
- Engine load is greater than 60 %.
- DTCs P0707, P0708, P1703 and P1719 are not set.
- Transmission temperature is greater than 0 °C (32 °F) or if P0710 is present the engine coolant temperature is greater than 60 °C (140 °F).
- The TR sensor indicates that the transmission is in a neutral state, however the engine output torque indicates that a drive gear load is present. This condition must be continuously present for 5 seconds.

Action Taken When the DTC Sets

- The Malfunction Indicator Lamp (MIL) will illuminate on the second consecutive driving cycle with the DTC present.
- The EOBD system will record operating conditions at the time the diagnostic fails. This information will be stored in the Failure Records buffer.
- TR signal is assumed to be in the Drive position.
- The transmission is limited to 2nd and R gears only. Namely 1st, 3rd and 4th gears are inhibited.
- Torque Converter Clutch (TCC) is disabled.

Conditions for Clearing the DTC

- The DTC will clear when the malfunction has not occurred for 30 seconds and TR is in P, R, N or D.
- A history DTC will clear after 40 TCM power-up cycles with a warm transmission (>50 °C) and without a fault.
- History DTCs can be cleared by using a scan tool.

Diagnostic Aids

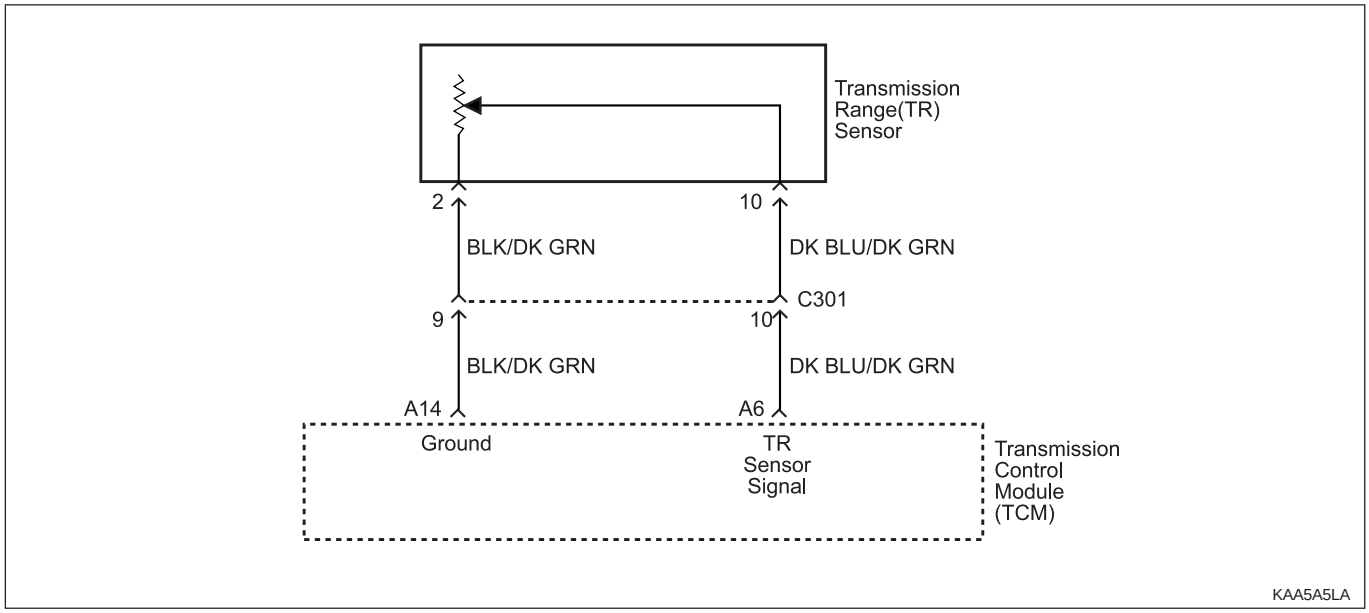
- Inspect the wiring for poor electrical connections at the TCM and at the TR sensor connector. Look for possible bent, backed out, deformed or damaged ter-minals. Check for weak terminal tension as well. Also, check for chafed wires that could short to bare metal or other wiring. Inspect for broken wires inside the in-sulation.

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DTC P0706 Transmission Range Sensor Circuit Range/Performance

Step	Action	Value(s)	Yes	No
1	Perform a Transmission Control Module (TCM) Diagnostic System Check. Is the check performed?	-	Go to Step 2	Go to "TCM Diagnostic System Check"
2	1. Install the scan tool. 2. Turn the ignition ON, with the engine OFF. 3. Record and then clear DTCs. 4. Operate the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool display P0706?	-	Go to Step 3	Go to "Diagnostic Aids"
3	1. Select Gear Lever Position on scan tool Data List. 2. Move the gear shift control lever through all of the gear ranges (P, R, N, D, 3, 2, 1). Does the scan tool display the correct gear lever positions?	-	Go to Step 6	Go to Step 4
4	1. Inspect the TR sensor for damage to its rotating part or its mountings. 2. Inspect the shaft driving the TR sensor for damage. Is a repair necessary?	-	Go to Step 5	Go to Step 6
5	Replace the TR sensor or driving shaft as appropriate. Is the acting complete?	-	Go to Step 7	-
6	Check for damage to the z-link within the transmission and repair as necessary. Is a repair necessary?	-	Go to Step 7	-
7	1. Using the scan tool, clear the DTCs. 2. Road test the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool indicate that this diagnostic has run and passed?	-	Go to Step 8	Go to Step 2
8	Check if any DTCs are set. Are there any DTCs displayed or previously recorded at Step 2 that have not been diagnosed?	-	Go to applicable DTC table	System OK, Check Complete

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DIAGNOSTIC TROUBLE CODE (DTC) P0707 TRANSMISSION RANGE SENSOR CIRCUIT LOW INPUT

Circuit Description

The Transmission Range (TR) sensor is incorporated in the inhibitor switch mounted on the side of the transmis sion case. The TR sensor Indicates to the TCM which gear position has been selected by way of a varying resistance.

The TR sensor signal has discrete values indicating the positions selected by the gear shift control lever (PRND321). The Transmission Control Module (TCM) receives that signal with a voltage varying from 0 V to 5 V. DTC P0707 sets when the TR sensor signal is faulty, causing the gear lever position signal to be less than 0.87 V.

Conditions for Setting the DTC

- TR sensor signal is less than 0.87 V.
- The above condition must be continuously present for 100 milliseconds.

Action Taken When the DTC Sets

- The Malfunction Indicator Lamp (MIL) will illuminate on the second consecutive driving cycle with the DTC present.
- The EOBD system will record operating conditions at the time the diagnostic fails. This information will be stored in the Failure Records buffer.
- Transmission range is assumed to be in the Drive position.
- The transmission is limited to 2nd and R gears only. Namely 1st, 3rd and 4th gears are inhibited.
- Torque Converter Clutch (TCC) is disabled.

Conditions for Clearing the DTC

- The DTC will clear when the malfunction has not occurred for 3 seconds.
- A history DTC will clear after 40 TCM power-up cycles with a warm transmission (>50 °C) and without a fault.
- History DTCs can be cleared by using a scan tool.

Diagnostic Aids

- The voltage measured by the TCM across the TR sensor input terminals has been below on acceptable level for a significant length of time.
- This would typically be caused by a short to ground in the wiring to, or within, the inhibitor switch which has caused the signal at the TCM to read about 0 V.
- Inspect the wiring for poor electrical connections at the TCM and at the TR sensor connector. Look for possible bent, deformed or damaged terminals. Also, check for chafed wires that could short to bare metal or other wiring.
- In searching for a possible intermittent short or open condition, move or massage the wiring harness while observing the test equipment for a change.

Test Description

The number(s) below refer to the step number(s) on the Diagnostic Table.

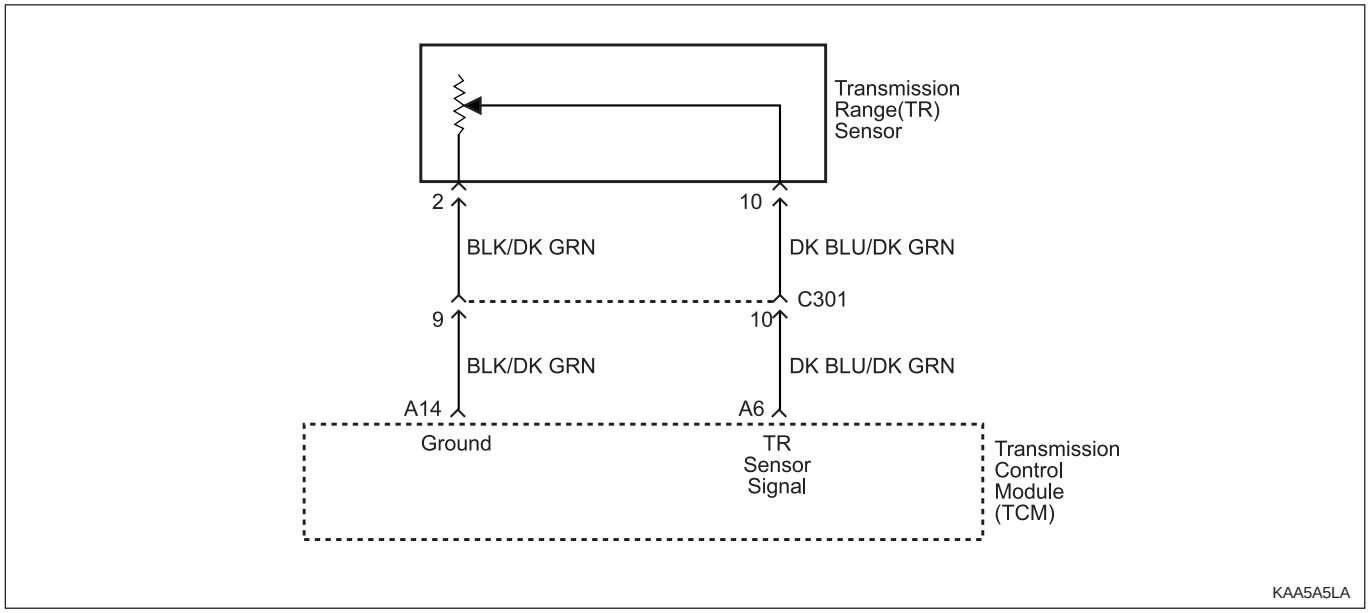
3. This step simulates a DTC P0708 condition. If the scan tool displays the specified value, the TR sensor signal circuit and the TCM are OK.

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DTC P0707 Transmission Range Sensor Circuit Low Input

Step	Action	Value(s)	Yes	No
1	Perform a Transmission Control Module (TCM) Diagnostic System Check. Is the check performed?	-	Go to Step 2	Go to "TCM Diagnostic System Check"
2	1. Turn the ignition ON, with the engine OFF. 2. Install a scan tool. 3. Record and then clear DTCs. 4. Operate the vehicle within the conditions for setting this DTC as specified in the text. 5. Review the TR Sensor value on the scan tool. Is the TR Sensor value less than the specified value?	0.87 V	Go to Step 3	Go to "Diagnostic Aids"
3	1. Turn the ignition OFF. 2. Disconnect the Transmission Range (TR) sensor connector. 3. Turn the ignition ON. Is the TR Sensor value greater than specified value?	4.12 V	Go to Step 4	Go to Step 5
4	Replace the TR sensor. Is the action complete?	-	Go to Step 10	-
5	With a test light connected to B+, probe the TR sensor signal circuit at terminal 1. Does the test light illuminate?	-	Go to Step 6	Go to Step 8
6	1. Turn the ignition OFF. 2. Disconnect the Transmission Control Module (TCM) connector A. 3. Turn the ignition ON. 4. With a test light connected to B+, probe the TR sensor signal circuit at terminal 1. Does the test light illuminate?	-	Go to Step 7	Go to Step 9
7	Repair the short to ground in the TR sensor signal circuit. Is a repair complete?	-	Go to Step 10	-
8	Check for a poor connection at the TR sensor connector and TCM connector and repair the malfunctioning terminals as necessary. Is a repair necessary?	-	Go to Step 10	-
9	1. Turn the ignition OFF. 2. Replace the TCM. Is the action complete?	-	Go to Step 10	-
10	1. Using the scan tool, clear the DTCs. 2. Road test the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool indicate that this diagnostic has run and passed?	-	Go to Step 11	
11	Check if any DTCs are set. Are there any DTCs displayed or DTC previously recorded at Step 2 that have not been diagnosed?	-	Go to applicable DTC table	System OK, Check Complete

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DIAGNOSTIC TROUBLE CODE (DTC) P0708
TRANSMISSION RANGE SENSOR CIRCUIT HIGH INPUT

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Circuit Description

The Transmission Range (TR) sensor is incorporated in the inhibitor switch mounted on the side of the transmission case. The TR sensor Indicates to the TCM which gear position has been selected by way of a varying resistance.

The TR sensor signal has discrete values indicating the positions selected by the gear shift control lever (PRND321). The Transmission Control Module (TCM) receives that signal with a voltage varying from 0 V to 5 V.

The transmission range sensor is faulty, causing the gear lever position signal to be greater than 4.12 V.

Conditions for Setting the DTC

- TR sensor signal is greater than 4.12 V.
- The above condition must be continuously present for 100 milliseconds.

Action Taken When the DTC Sets

- The Malfunction Indicator Lamp (MIL) will illuminate on the second consecutive driving cycle with the DTC present.
- The EOBD system will record operating conditions at the time the diagnostic fails. This information will be stored in the Failure Records buffer.
- Transmission range (gear lever) is assumed to be in the Drive position.
- The transmission is limited to 2nd and R gears only. Namely 1st, 3rd and 4th gears are inhibited.
- Torque Converter Clutch (TCC) is disabled.
- Manually initiated downshifts will not be available.

Conditions for Clearing the DTC

- The DTC will clear when the malfunction has not occurred for 3 seconds.
- A history DTC will clear after 40 TCM power-up cycles with a warm transmission (>50°C) and without a fault.
- History DTCs can be cleared by using a scan tool.

Diagnostic Aids

- The voltage measured by the TCM across the shift lever input terminals has been above an acceptable level for a significant length of time.
- This would typically be caused by a loose connection or an open or short to B+ in the wiring to, or within, the inhibitor switch which has caused the signal at the TCM to read 5 V.
- If the DTC sets when an accessory is operated, check for a poor connection or excessive current draw.
- Inspect the wiring for poor electrical connections at the TCM and at the TR sensor connector. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also, check for chafed wires that could short to other wiring. Inspect for broken wires inside the insulation.
- In searching for a possible intermittent short or open condition, move or massage the wiring harness while observing test equipment for a change.

Test Description

The number(s) below refer to the step number(s) on the Diagnostic Table.

4. This step simulates a DTC P0707 condition. If the scan tool displays the specified value, the TR sensor signal circuit and the TCM are OK.

DTC P0707 Transmission Range Sensor Circuit High Input

Step	Action	Value(s)	Yes	No
1	Perform a Transmission Control Module (TCM) Diagnostic System Check. Is the check performed?	-	Go to Step 2	Go to "TCM Diagnostic System Check"
2	1. Turn the ignition ON, with the engine OFF. 2. Install a scan tool. 3. Record and then clear DTCs. 4. Operate the vehicle within the conditions for setting this DTC as specified in the text. 5. Review the TR Sensor value on the scan tool. Is the TR Sensor value greater than the specified value?	4.12 V	Go to Step 3	Go to "Diagnostic Aids"
3	1. Turn the ignition OFF. 2. Disconnect the Transmission Range (TR) sensor connector. 3. Turn the ignition ON. 4. With a test light connected to ground, probe the TR sensor signal circuit at terminal 1. Is the TR sensor value less than specified value?	0.87 V	Go to Step 4	Go to Step 7
4	With a test light connected to B+, probe the TR sensor ground circuit at terminal 2. Does the test light illuminate?	-	Go to Step 5	Go to Step 8
5	Check for a poor connection at the TR sensor connector and repair the malfunctioning terminals as necessary. Is a repair necessary?	-	Go to Step 11	Go to Step 6
6	Replace the TR sensor. Is the action complete?	-	Go to Step 11	-
7	1. Turn the ignition OFF. 2. Disconnect the Transmission Control Module (TCM) connector A. 3. Check the TR sensor signal circuit at terminal 1 for an open or short to voltage and repair as necessary. Is a repair necessary?	-	Go to Step 11	Go to Step 9
8	Check the TR sensor ground circuit at terminal 2 for an open and repair as necessary. Is a repair necessary?	-	Go to Step 11	Go to Step 9
9	Check for a poor connection at the TCM connector and repair the malfunctioning terminals as necessary. Is a repair necessary?	-	Go to Step 11	Go to Step 10
10	1. Turn the ignition OFF. 2. Replace the TCM. Is the action complete?	-	Go to Step 11	-

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DTC P0707 Transmission Range Sensor Circuit High Input (Cont'd)

Step	Action	Value(s)	Yes	No
11	1. Using the scan tool, clear the DTCs. 2. Road test the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool indicate that this diagnostic has run and passed?	-	Go to Step 12	Go to Step 2
12	Check if any DTCs are set. Are there any DTCs displayed or DTCs previously recorded at Step 2 that have not been diagnosed?	-	Go to applicable DTC table	System OK, Check Complete

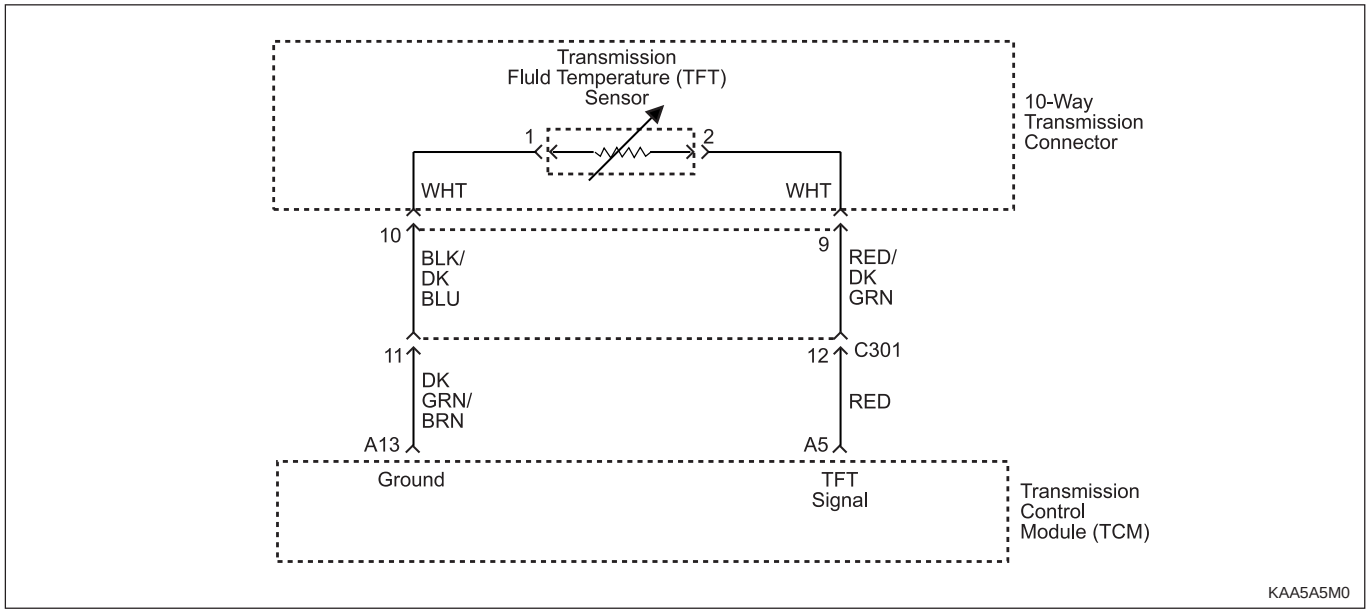
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DIAGNOSTIC TROUBLE CODE (DTC) P0710 TRANSMISSION FLUID TEMPERATURE SENSOR CIRCUIT MALFUNCTION

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Circuit Description

The Transmission Fluid Temperature (TFT) sensor is a thermistor located in the solenoid wiring loom within the valve body of the transmission. This sensor is a typical Negative Temperature Coefficient (NTC) resistor with low temperatures producing a high resistance and high temperatures producing a low resistance.

If the transmission fluid temperature exceeds 135 °C (275 °F), the TCM will impose converter lock-up at lower vehicle speeds. Favour a lower gear to increase engine speed, and in some vehicles flashes the mode indicator lamp. This results in maximum oil flow through the external oil cooler and eliminates slippage in the torque converter. Both these actions combine to reduce the oil temperature in the transmission.

The DTC P0710 sets when the TFT sensor signal is not feasible.

Conditions for Setting the DTC

- Transmission fluid temperature sensor signal is greater than 4.88 volts (immediate detection).
- Transmission fluid temperature sensor signal is less than 0.21 volts (immediate detection).
- Transmission temperature has not changed by 2 °C in 15 minutes since ignition on and temperature is less than 20 °C or greater than 125 °C.

Action Taken When the DTC Sets

- Transmission fluid temperature is assumed to be 120 °C (248 °F).
- All shifts will be firm until the transmission has warmed up because a high transmission fluid temperature is assumed.

Conditions for Clearing the DTC

- The DTC will clear when the malfunction has not occurred for 3 seconds.
- A history DTC will clear after 40 TCM power-up cycles with a warm transmission (>50 °C) and without a fault.
- History DTCs can be cleared by using a scan tool.

Diagnostic Aids

- The voltage measured by the TCM across the transmission fluid temperature input terminals has been outside acceptable levels.
- If the DTC sets when an accessory is operated, check for a poor connection or excessive current draw.
- Inspect the wiring for poor electrical connections at the TCM and at the 10-way transmission connector. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also, check for chafed wires that could short to bare metal or other wiring. Inspect for broken wires inside the insulation.
- In searching for a possible intermittent short or open condition, move or massage the wiring harness while observing test equipment for a change.

Test Description

The number(s) below refer to the step number(s) on the Diagnostic Table.

5. This step simulates a DTC P0710 condition. If the scan tool displays the specified value, the TFT sensor signal circuit and the TCM are OK.

DTC P0710 Transmission Fluid Temperature Sensor Circuit Malfunction

Step	Action	Value(s)	Yes	No
1	Perform a Transmission Control Module (TCM) Diagnostic System Check. Is the check performed?	-	Go to Step 2	Go to "TCM Diagnostic System Check"
2	1. Install the scan tool. 2. Turn the ignition ON, with the engine OFF. 3. Record and then clear DTCs. 4. Select T/M Fluid Temperature on scan tool Data List. Is the TFT sensor value less than specified value?	0.21 V	Go to Step 4	Go to Step 3
3	Is the TFT sensor value greater than specified value?	4.88 V	Go to Step 7	Go to "Diagnostic Aids"
4	1. Turn the ignition OFF. 2. Disconnect the 10-way transmission connector (additional DTCs will set). 3. Turn the ignition ON. Is the TFT sensor value greater than the specified value?	4.88 V	Go to Step 6	Go to Step 5
5	1. Turn the ignition OFF. 2. Disconnect the TCM connector A. 3. Turn the ignition ON. 4. With a test light connected to B+, probe the TFT sensor signal circuit, terminal 9 at the 10-way transmission connector. Does the test light illuminate?	-	Go to Step 8	Go to Step 14
6	Replace the TFT sensor. Is the action complete?	-	Go to Step 16	-
7	1. Turn the ignition OFF. 2. Disconnect the 10-way transmission connector (additional DTCs will set). 3. Turn the ignition ON. 4. Jumper the TFT ground circuit terminal 10 to the TFT sensor signal circuit terminal 9 at the 10-way transmission connector. Is the TFT sensor value less than specified value?	0.21 V	Go to Step 6	Go to Step 9
8	Repair the short to ground in the TFT sensor signal circuit as necessary. Is the repair complete?	-	Go to Step 16	-
9	With a test light connected to B+, probe the TFT sensor ground circuit at terminal 10 at the 10-way transmission connector. Does the test light illuminate?	-	Go to Step 10	Go to Step 11
10	1. Turn the ignition OFF. 2. Disconnect the TCM connector A. 3. Turn the ignition ON. 4. Check the TFT sensor signal circuit, terminal 9 at the 10-way transmission connector for an open or short to voltage. Is a problem found?	-	Go to Step 13	Go to Step 14

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DTC P0710 Transmission Fluid Temperature Sensor Circuit Malfunction (Cont'd)

Step	Action	Value(s)	Yes	No
11	1. Turn the ignition OFF. 2. Disconnect the TCM connector A. 3. Turn the ignition ON. 4. Check the TFT sensor ground circuit for an open. Is a problem found?	-	Go to Step 12	Go to Step 14
12	Repair the TFT ground circuit for an open. Is a repair complete?	-	Go to Step 16	-
13	Repair an open or short to voltage in the TFT sensor signal circuit as necessary. Is the repair complete?	-	Go to Step 16	-
14	Check for a poor connection at the 10-way transmission connector and TCM connector and repair the malfunctioning terminals as necessary. Is a repair necessary?	-	Go to Step 16	Go to Step 15
15	1. Turn the ignition OFF. 2. Replace the TCM. Is the action complete?	-	Go to Step 16	-
16	1. Using the scan tool, clear the DTCs. 2. Road test the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool indicate that this diagnostic has run and passed?	-	Go to Step 17	Go to Step 2
17	Check if any DTCs are set. Are there any DTCs displayed or previously recorded at Step 3 that have not been diagnosed?	-	Go to applicable DTC table	System OK, Check Complete

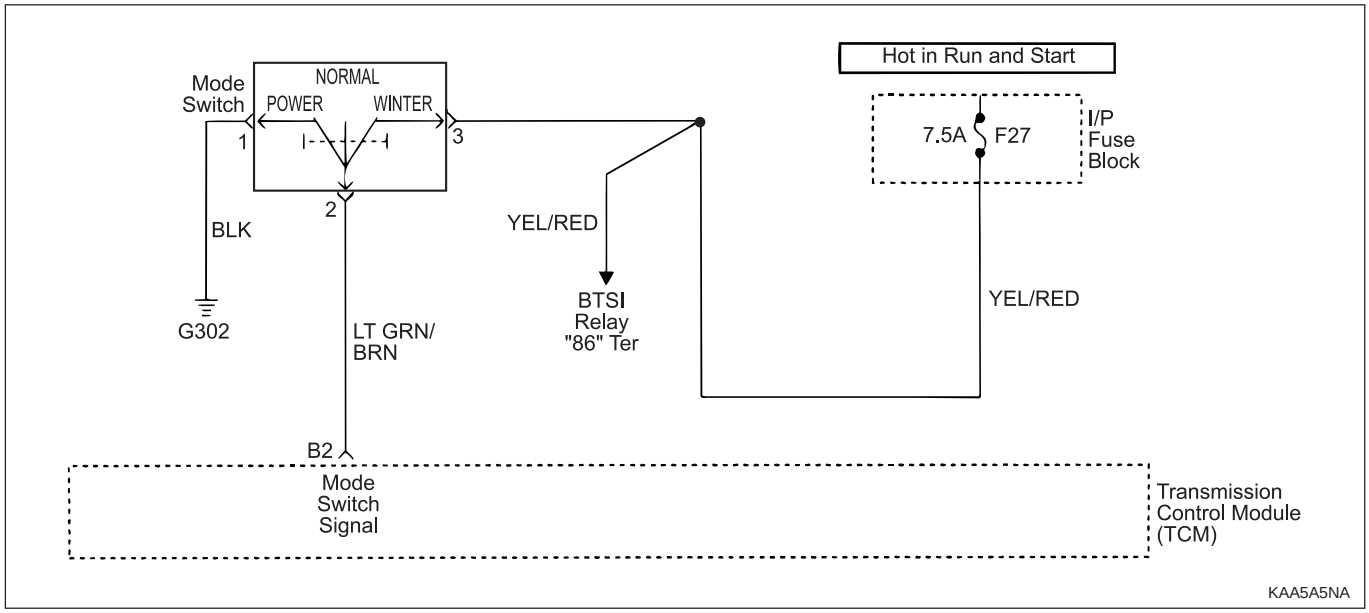
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DIAGNOSTIC TROUBLE CODE (DTC) P0790 NORMAL/PERFORMANCE SWITCH CIRCUIT MALFUNCTION

Circuit Description

The driving mode selector switch is located on the center console and allows the driver to select the driving mode.

When NORMAL mode is selected upshifts will occur to maximize fuel economy. When POWER mode is selected, upshifts will occur to give maximum performance and the POWER mode indicator light is switched ON.

When WINTER mode is selected, starting in second gear is facilitated, the WINTER mode indicator light is switched ON and the POWER mode indicator light is switched OFF.

The DTC P0790 sets when an intermittent connection in the mode selector switch (mode switch) circuit has been detected. The mode switch input is rapidly changing states. The switching frequency is greater than 8.3 Hz.

Conditions for Setting the DTC

- The mode switching frequency is greater than 8.3 Hz.
- The above condition must be continuously present for 4 state changes.

Action Taken When the DTC Sets

- All shifts will occur as if the mode is set to NORMAL.
- The mode indicator will always be OFF indicating that NORMAL mode is selected.
- The mode indicator will not respond to the changes in switch setting.

Conditions for Clearing the DTC

- The DTC will clear after 3 seconds without the fault.
- A history DTC will clear after 40 TCM power-up cycles with a warm transmission (>50 °C) and without a fault.
- History DTCs can be cleared by using a scan tool.

Diagnostic Aids

- This fault is caused by too many changes in the mode input signal over a period of time.
- Typical causes would be an intermittent connection in the switch or wiring or an intermittent short to ground in the wiring.

Test Description

The number(s) below refer to the step number(s) on the Diagnostic Table.

3. Check mode switch signal circuit for an intermittent open / short
5. Check mode switch ground circuit for an intermittent open / short
8. Check mode switch feed circuit for an intermittent open / short

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DTC P0790 Normal/Performance Switch Circuit Malfunction

Step	Action	Value(s)	Yes	No
1	Perform a Transmission Control Module (TCM) Diagnostic System Check. Is the check performed?	-	Go to Step 2	Go to "TCM Diagnostic System Check"
2	1. Install the scan tool. 2. Turn the ignition ON, with the engine OFF. 3. Record and then clear DTCs. 4. Operate the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool display P0790?	-	Go to Step 3	Go to "Diagnostic Aids"
3	1. Turn the ignition OFF. 2. Disconnect the mode switch connector. Refer to Shift Control Lever in this section. 3. Turn the ignition ON. 4. Select Mode Switch on scan tool Data List. Is the Mode Switch value frequently changing?	-	Go to Step 4	Go to Step 5
4	1. Turn the ignition OFF. 2. Disconnect the TCM connector B. 3. Check the mode switch signal circuit for an intermittent open or short and repair as necessary. Is a repair necessary?	-	Go to Step 13	Go to Step 10
5	Jumper the mode switch ground terminal 1 to the signal terminal 2. Is the Mode Switch value frequently changing?	-	Go to Step 6	Go to Step 7
6	1. Turn the ignition OFF. 2. Disconnect the TCM connector B. 3. Check the mode switch ground circuit for an intermittent open and repair as necessary. Is a repair complete?	-	Go to Step 13	-
7	Check the fuse F27 for a malfunctioning and replace as necessary? Is a repair necessary?	-	Go to Step 13	Go to Step 8
8	Jumper the mode switch feed terminal 3 to the signal terminal 2. Is the Mode Switch value frequently changed?	-	Go to Step 9	Go to Step 11
9	1. Turn the ignition OFF. 2. Disconnect the TCM connector B. 3. Check the mode switch feed circuit for an intermittent open and repair as necessary. Is a repair complete?	-	Go to Step 13	-
10	Check for a poor connection at the mode switch and TCM connector and repair the malfunctioning terminals as necessary. Is a repair necessary?	-	Go to Step 13	Go to Step 12

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DTC P0790 Normal/Performance Switch Circuit Malfunction (Cont'd)

Step	Action	Value(s)	Yes	No
11	Replace the mode switch. Refer to Shift Control Lever in this section. Is the action complete?	-	Go to Step 13	-
12	1. Turn the ignition OFF. 2. Replace the TCM. Is the action complete?	-	Go to Step 13	-
13	1. Using the scan tool, clear the DTCs. 2. Road test the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool indicate that this diagnostic has run and passed?	-	Go to Step 14	Go to Step 2
14	Check if any DTCs are set. Are there any DTCs displayed or previously recorded at Step 2 that have not been diagnosed?	-	Go to applicable DTC table	System OK, Check Complete

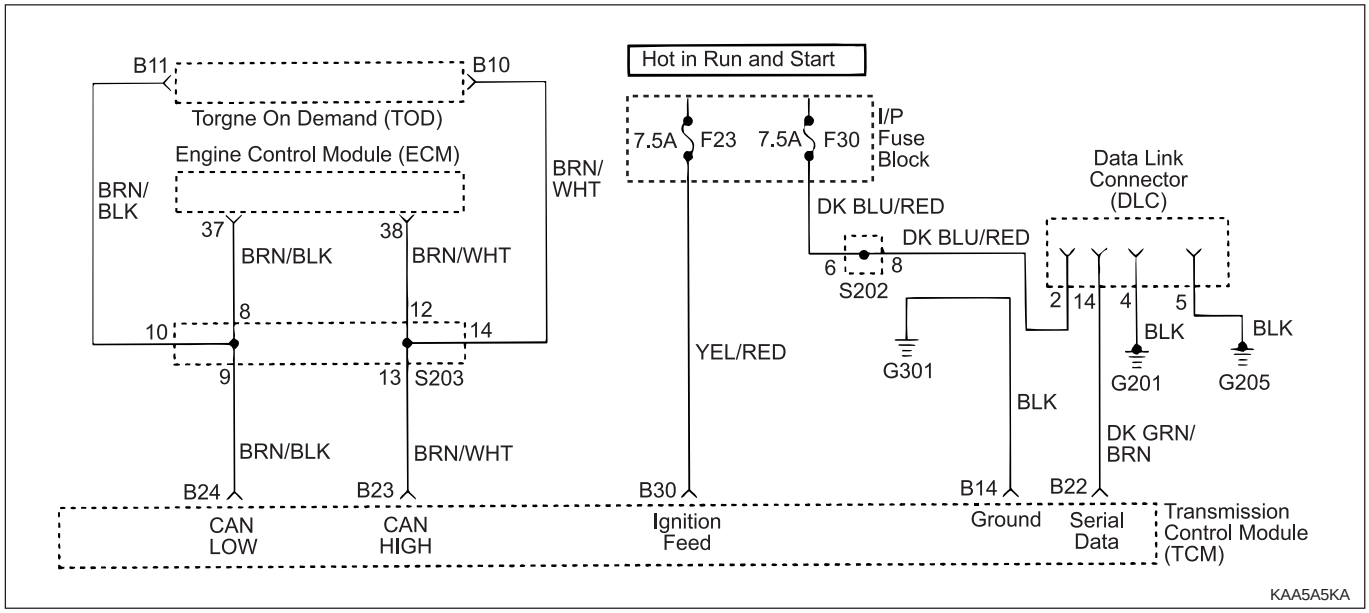
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DIAGNOSTIC TROUBLE CODE (DTC) P1703
ENGINE SPEED SIGNAL ERROR

Circuit Description

The Controller Area Network (CAN) connects various control modules by using a twisted pair of wires, to share common information. This results in a reduction of sensors and wiring. TCM obtains the actual engine speed and throttle position, vehicle speed and accelerator position etc. from ECM via CAN without any additional sensors.

The DTC P1703 sets when the engine speed signal via CAN is out of range or not feasible: The engine speed signal is greater than 7000 rpm or less than 0 rpm, or the indicated engine speed is low while other signals indicate the car is moving (i.e. the vehicle speed has increased more than 125 rpm).

Conditions for Setting the DTC

- Immediately upon the test indicating malfunction as follows.
- The engine speed signal is greater than 7000 rpm or less than 0 rpm under the precondition that DTC P1719 is not set.
- The indicated engine speed is low while other signals indicate the car is moving, i.e. the vehicle speed has increased more than 125 rpm under the following precondition;
  - Driving gear is selected.
  - The applied throttle is greater than 5 %.
  - The engine speed is less than 550 rpm.
  - DTCs P0706, P0707, P0708, P1704, P1719 and 1721 are not set.

Action Taken When the DTC Sets

- Fault detection of some other signals will not possible.

Conditions for Clearing the DTC

- The DTC will clear after 30 seconds without the fault.
- A history DTC will clear after 40 TCM power-up cycles with a warm transmission (>50 °C) and without a fault.
- History DTCs can be cleared by using a scan tool

Diagnostic Aids

- Inspect the wiring for poor electrical connections at the TCM and ECM connectors. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for chafed wires that could short to bare metal or other wiring. Inspect for broken wire inside the insulation.
- If diagnosing for a possible intermittent short or open condition, move or massage the wiring harness while observing test equipment for a change.
- When ECM finds a fault on the engine speed signals, ECM will adopt a default mode and send the default value and trouble message to TCM via CAN.

Test Description

The number(s) below refer to the step number(s) on the Diagnostic Table.

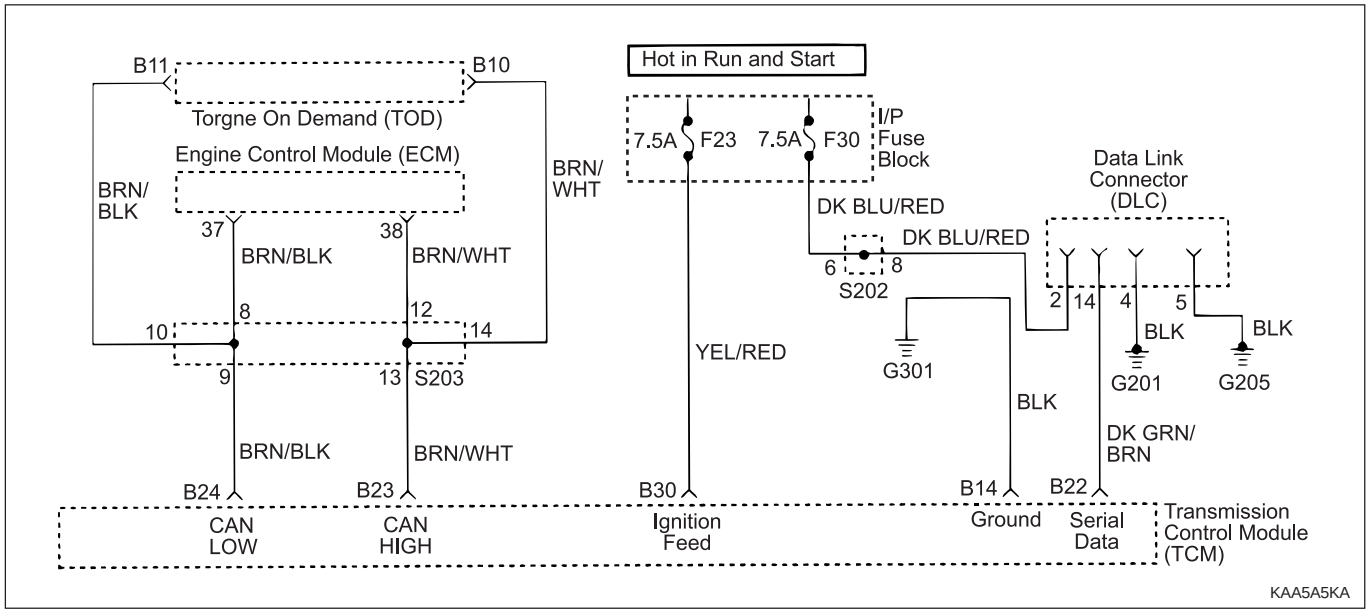
3. Check if there are any DTCs related to the engine speed sensor on the ECM side.
4. Check for a poor connection at the ECM and TCM connectors.

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DTC P1703 Engine Speed Signal Error

Step	Action	Value(s)	Yes	No
1	Perform a Transmission Control Module (TCM) Diagnostic System Check. Is the check performed?	-	Go to Step 2	Go to "TCM Diagnostic System Check"
2	1. Install the scan tool. 2. Turn the ignition ON, with the engine OFF. 3. Record and then clear DTCs. 4. Operate the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool display P1703?	-	Go to Step 3	Go to "Diagnostic Aids"
3	Check if there are any DTCs related to the engine speed sensor on the ECM side. Are any DTCs related to engine speed sensor found?	-	Go to *Section 1F, Engine Controls*	Go to Step 4
4	Check for a poor connection at the ECM connector or TCM connector and repair the malfunctioning terminals as necessary. Is a repair necessary?	-	Go to Step 6	Go to Step 5
5	1. Turn the ignition OFF. 2. Replace the TCM. Is the action complete?	-	Go to Step 6	-
6	1. Using the scan tool, clear the DTCs. 2. Road test the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool indicate that this diagnostic has run and passed?	-	Go to Step 7	Go to Step 2
7	Check if any DTCs are set. Are there any DTCs displayed or previously recorded at Step 2 that have not been diagnosed?	-	Go to applicable DTC table	System OK, Check Complete

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DIAGNOSTIC TROUBLE CODE (DTC) P1704 SHAFT SPEED SIGNAL ERROR

Circuit Description

The Controller Area Network (CAN) connects various control modules by using a twisted pair of wires, to share common information. This results in a reduction of sensors and wiring. TCM obtains the actual engine speed and throttle position, vehicle speed and accelerator position etc. from ECM via CAN without any additional sensors.

The DTC P1704 sets when the indicated drive shaft speed signal via CAN is out of range or not feasible or a shaft speed of 0 is present while other signals indicate the vehicle is being driven.

Conditions for Setting the DTC

- Immediately upon the test indicating malfunction as follows.
- The shaft speed signal is greater than 9000 rpm or less than 0 rpm under the precondition that DTC P1719 is not set.
- The shaft speed indicates 0 rpm while all other signals indicate the car is moving under the following precondition;
  - Driving gear is selected.
  - The transmission range sensor has not recently changed state.
  - The engine speed is greater than 2800 rpm.
  - DTCs P0706, P0707, P0708, P1703 and P1719 are not set.
- The shaft speed has dropped from above 2100 rpm to 0 rpm within 20 ms.

Action Taken When the DTC Sets

- All skip downshifts disabled and fourth gear will be in-hibited.
- The torque converter will be unlocked at all times.
- Gears are selected by the shift control lever but all downshifts are inhibited by engine speed limits to prevent over-revving.
- D position selects 3rd gear.
- 1st and 2nd gears can be manually selected.

Conditions for Clearing the DTC

- The DTC will clear when the malfunction has not occurred for 30 seconds and a non-zero speed is detected.
- A history DTC will clear after 40 TCM power-up cycles with a warm transmission (>50 °C) and without a fault.
- History DTCs can be cleared by using a scan tool.

Diagnostic Aids

- Inspect the wiring for poor electrical connections at the TCM and ECM connectors. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for chafed wires that could short to bare metal or other wiring. Inspect for broken wire inside the insulation.

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- If diagnosing for a possible intermittent short or open condition, move or massage the wiring harness while observing test equipment for a change.
- When ECM finds a fault on the vehicle speed signals, ECM will adopt a default mode and send the default value and trouble message to TCM via CAN.

Test Description

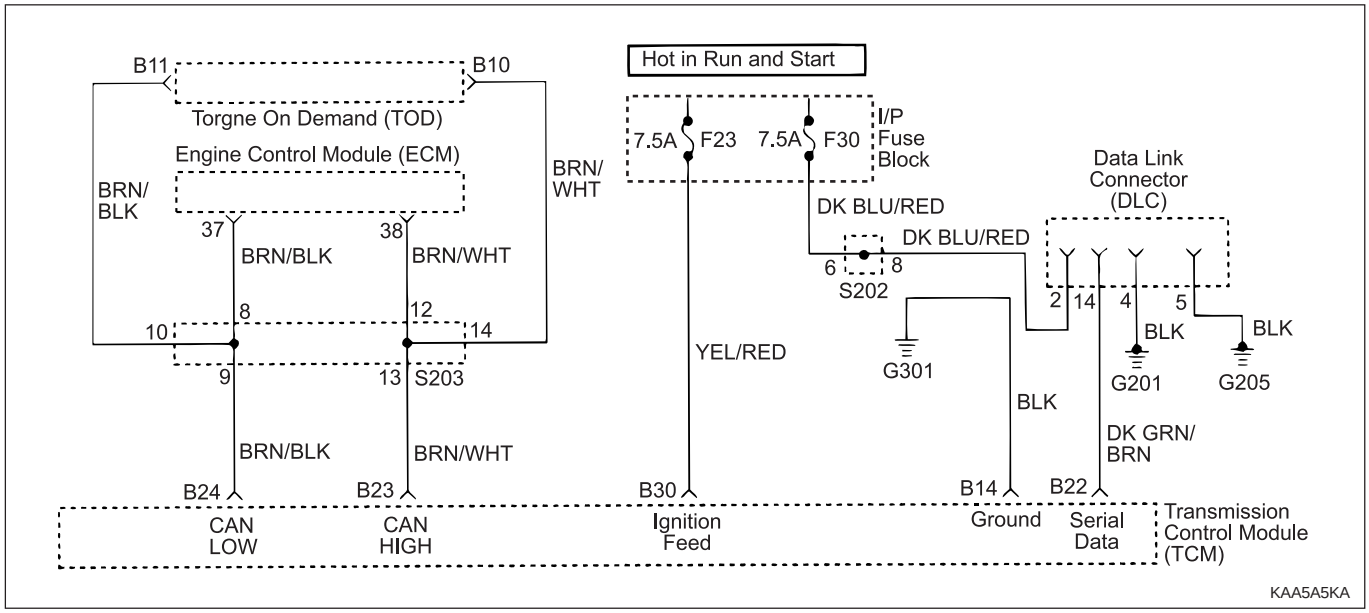
The number(s) below refer to the step number(s) on the Diagnostic Table.

3. Check if there are any DTCs related to the vehicle speed sensor on the ECM side.
4. Check a poor connection at the ECM and TCM connectors.

DTC P1704 Shaft Speed Signal Error

Step	Action	Value(s)	Yes	No
1	Perform a Transmission Control Module (TCM) Diagnostic System Check. Is the check performed?	-	Go to Step 2	Go to "TCM Diagnostic System Check"
2	1. Install the scan tool. 2. Turn the ignition ON, with the engine OFF. 3. Record and then clear DTCs. 4. Operate the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool display P1704?	-	Go to Step 3	Go to "Diagnostic Aids"
3	Check if there are any DTCs related to the vehicle speed sensor on the ECM side. Are any DTCs related to vehicle speed sensor found?	-	Go to *Section 1F, Engine Controls*	Go to Step 4
4	1. Turn the ignition OFF. 2. Replace the TCM. Is the action complete?	-	Go to Step 5	-
5	1. Using the scan tool, clear the DTCs. 2. Road test the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool indicate that this diagnostic has run and passed?	-	Go to Step 6	Go to Step 2
6	Check if any DTCs are set. Are there any DTCs displayed or previously recorded at Step 2 that have not been diagnosed?	-	Go to applicable DTC table	System OK, Check Complete

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DIAGNOSTIC TROUBLE CODE (DTC) P1708
TCM SUPPLY VOLTAGE LOW

Circuit Description

The battery voltage monitoring input is connected to the positive side of the battery. This signal is taken from the main supply to the TCM.

If the battery voltage at the TCM falls below the threshold value, DTC P1708 will be set and the transmission will adopt a low voltage mode of operating in which shifts into first gear are inhibited. All other shifts are attempted but may not occur because of the reduced voltage. This condition normally occurs only when the battery is in poor condition.

When system voltage recovers, the TCM will resume normal operation after a 30 seconds delay period.

Conditions for Setting the DTC

- The engine speed is greater than 550 RPM.
- A driving gear is selected or one of DTCs P0706, P0707 and P0708 is set.
- The indicated supply voltage falls below a linear temperature characteristic threshold or below that required to operate the CPU. If the TCM measures the supply voltage at less than that required for it to be operating, the DTC sets immediately.

Action Taken When the DTC Sets

- 1st gear is inhibited.
- S6 is inhibited.
- S5 standby current is zero.

Conditions for Clearing the DTC

- The DTC will clear when the malfunction has not occurred for 30 seconds.
- A history DTC will clear after 40 TCM power-up cycles with a warm transmission (>50 °C) and without a fault.
- History DTCs can be cleared by using a scan tool.

Diagnostic Aids

- The minimum operating voltage depends on the transmission temperature but is typically between 8 - 9 V for a warm transmission.
- If the DTC sets when an accessory is operated, check for a poor connection.
- Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also, check for chafed wires that could short to bare metal or other wiring. Inspect for broken wires inside the insulation.
- If diagnosing for a possible intermittent short or open condition, move or massage the wiring harness while observing test equipment for a change.

Test Description

The number(s) below refer to the step number(s) on the Diagnostic Table.

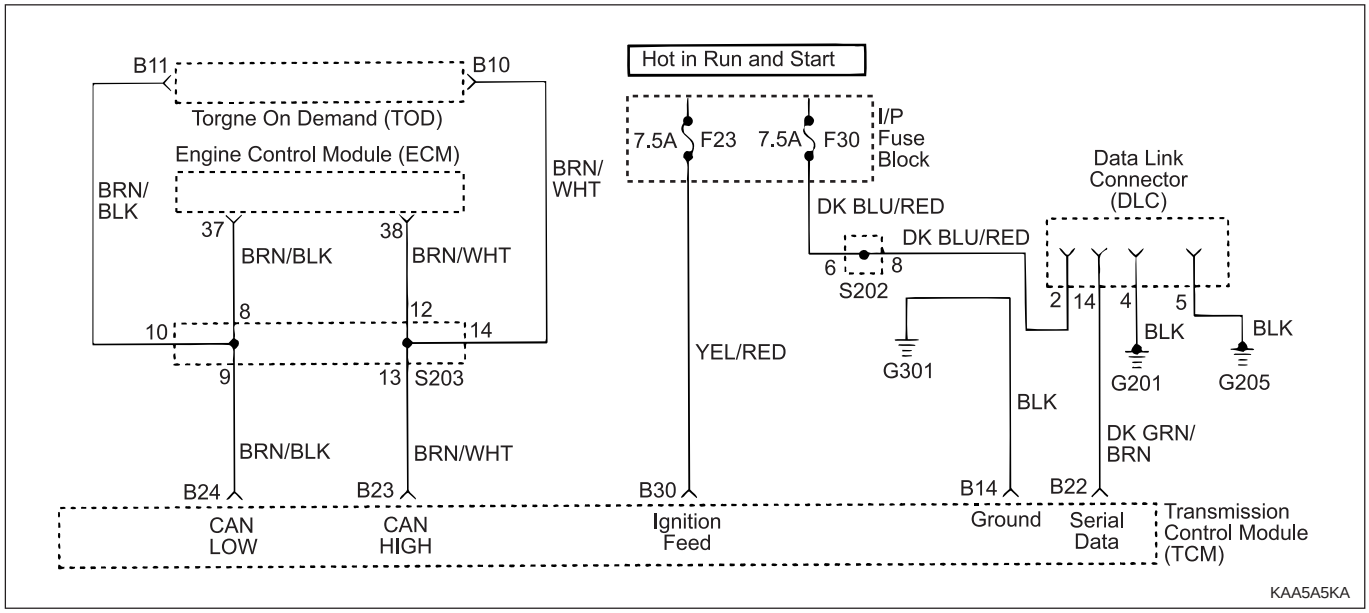
4. Check if the generator is malfunctioning under load condition.
8. Check the ignition feed circuit for excessive resistance.

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DTC P1708 TCM Supply Voltage Low

Step	Action	Value(s)	Yes	No
1	Perform a Transmission Control Module (TCM) Diagnostic System Check. Is the check performed?	-	Go to Step 2	Go to "TCM Diagnostic System Check"
2	1. Install the scan tool. 2. Turn the ignition ON, with the engine OFF. 3. Record and then clear DTCs. 4. Operate the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool display P1708?	-	Go to Step 3	Go to "Diagnostic Aids"
3	1. Isolate the driven wheels from the ground and apply the hand brake. 2. Start the engine and allow it to idle. 3. Move the gear lever to Drive. 4. Select the Ignition Voltage on the scan tool Data List. Is the Ignition Voltage less than the specified value?	10 V	Go to Step 4	Go to Step 10
4	While running the engine at the specified value, measure the battery voltage at the battery using a DVM. Is the battery voltage greater than the specified value?	Idle in Drive 12 V	Go to Step 5	Go to *Section 1E, Engine Electrical*
5	Check the fuse F23 for a malfunction and replace as necessary? Is a repair necessary?	-	Go to Step 10	Go to Step 6
6	1. Turn the ignition OFF. 2. Disconnect the TCM connector B. 3. Start the engine and raise the engine speed to specified value. 4. While running the engine at the specified value, measure the ignition voltage at the ignition feed circuit terminal B30 using a DVM. Is the ignition voltage greater than the specified value?	Idle in Drive 10 V	Go to Step 7	Go to Step 8
7	Check for a malfunctioning connection at the TCM harness terminals and repair as necessary. Is a repair necessary?	-	Go to Step 10	Go to Step 9
8	Repair the poor connection (high resistance) at the ignition feed circuit. Is the action complete?	-	Go to Step 10	-
9	1. Turn the ignition OFF. 2. Replace the TCM. Is the action complete?	-	Go to Step 10	-
10	1. Using the scan tool, clear the DTCs. 2. Road test the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool indicate that this diagnostic has run and passed?	-	Go to Step 11	Go to Step 2
11	Check if any DTCs are set. Are there any DTCs displayed or previously recorded at Step 2 that have not been diagnosed?	-	Go to applicable DTC table	System OK, Check Complete

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DIAGNOSTIC TROUBLE CODE (DTC) P1709 TCM SUPPLY VOLTAGE HIGH

Circuit Description

The battery voltage monitoring input is connected to the positive side of the battery. This signal is taken from the main supply to the TCM.

If the battery voltage is greater than 16.5 V, DTC P1709 will be set and the transmission will adopt limp home mode and all solenoids are turned OFF.

Conditions for Setting the DTC

- The indicated supply voltage is greater than 16.5 V.
- The malfunction triggers immediately after this condition exists.

Action Taken When the DTC Sets

- All solenoids are turned OFF while the high battery voltage condition is detected.
- The transmission goes into Limp Home Mode (LHM).

Conditions for Clearing the DTC

- The DTC will clear when the malfunction has not occurred for 30 seconds.
- A history DTC will clear after 40 TCM power-up cycles with a warm transmission (>50 °C) and without a fault.
- History DTCs can be cleared by using a scan tool.

Diagnostic Aids

- The voltage measured by the TCM corresponding to the battery supply voltage has been outside the range of the maximum operating voltage of 16.5 V.
- Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also, check for chafed wires that could short to bare metal or other wiring. Inspect for broken wires inside the insulation.
- If diagnosing for a possible intermittent short or open condition, move or massage the wiring harness while observing test equipment for a change.

Test Description

The number(s) below refer to the step number(s) on the Diagnostic Table.

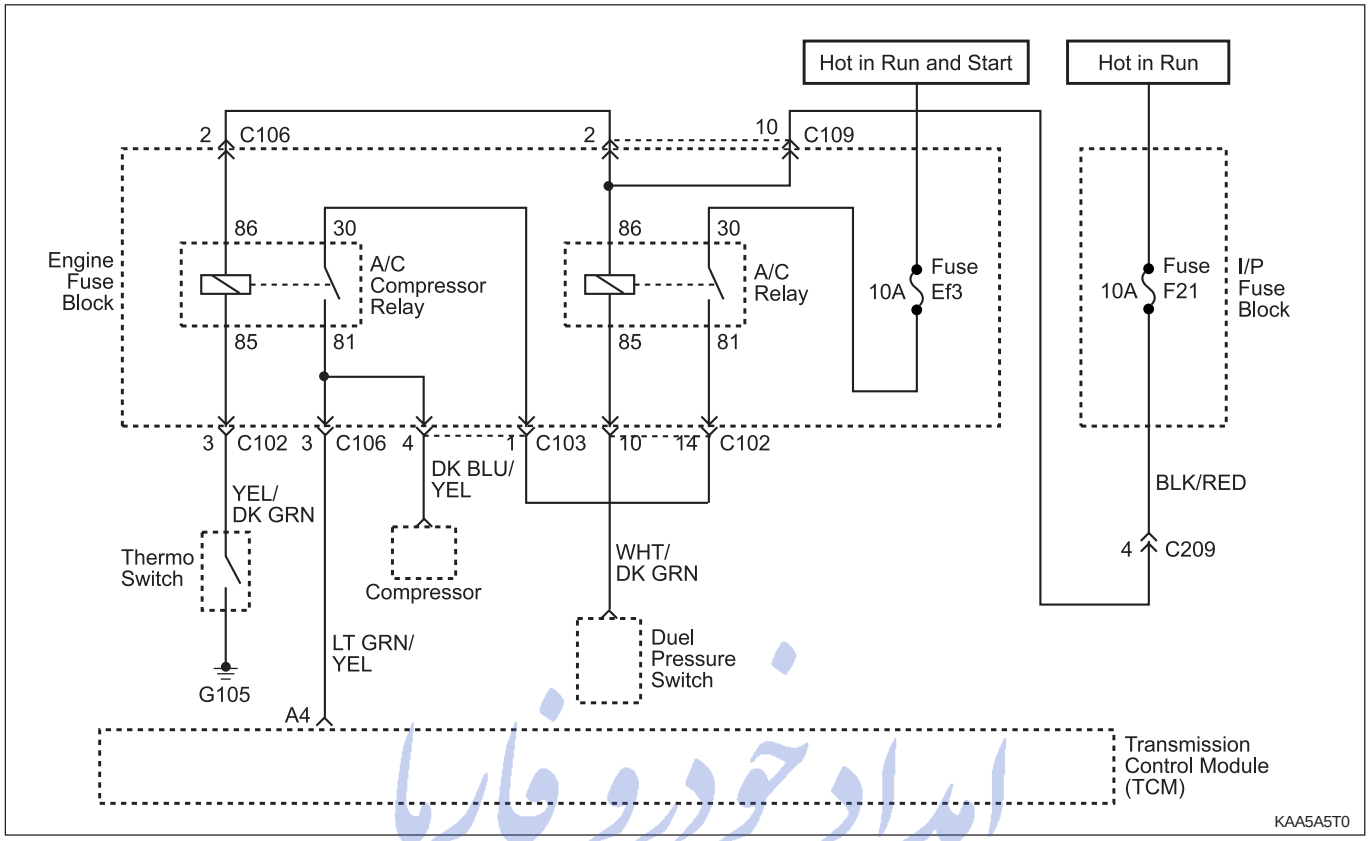
4. Checks if the generator is malfunctioning under load conditions.
5. Check connection of other connectors.

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DTC P1709 TCM Supply Voltage High

Step	Action	Value(s)	Yes	No
1	Perform a Transmission Control Module (TCM) Diagnostic System Check. Is the check performed?	-	Go to Step 2	Go to "TCM Diagnostic System Check"
2	1. Install the scan tool. 2. Turn the ignition ON, with the engine OFF. 3. Record and then clear DTCs. 4. Operate the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool display P1709?	-	Go to Step 3	Go to "Diagnostic Aids"
3	1. Start the engine and raise the engine speed to the specified value. 2. Select the Ignition Voltage on the scan tool Data List. Is the Ignition Voltage greater than the specified value?	1500 rpm 16.5 V	Go to Step 4	Go to Step 8
4	While running the engine at the specified value, measure the battery voltage at the battery using a DVM. Is the battery voltage less than the specified value?	2000 rpm 16.5 V	Go to Step 5	Go to *Section 1E, Engine Electrical*
5	1. Turn the ignition OFF. 2. Disconnect the TCM connector B. 3. Start the engine and raise the engine speed to the specified vale. 4. While running the engine at the specified value, measure the ignition voltage at the ignition feed circuit terminal B30 with respect to the ground terminal B14. Is the ignition voltage greater than the specified value?	1500 rpm 16.5 V	Go to Step 6	Go to Step 7
6	Check the wiring harness from the fuse F23 to TCM terminal B30 and from the ground G301 to TCM terminal B14 for damage.	-	Go to Step 8	-
7	1. Turn the ignition OFF. 2. Replace the TCM. Is the action complete?	-	Go to Step 8	-
8	1. Using the scan tool, clear the DTCs. 2. Road test the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool indicate that this diagnostic has run and passed?	-	Go to Step 9	Go to Step 2
9	Check if any DTCs are set. Are there any DTCs displayed or previously recorded at Step 2 that have not been diagnosed?	-	Go to applicable DTC table	System OK, Check Complete

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DIAGNOSTIC TROUBLE CODE (DTC) P1710
AIR CONDITIONING SWITCH CIRCUIT MALFUNCTION

۰۲۱-۸۸۸۶۲۰۸۸

Circuit Description

The Air Conditioning Switch circuit indicates the state of the air conditioning compressor clutch (on or off). This signal is available to the TCM only on vehicles fitted with air conditioning.

The DTC 1710 sets when an intermittent connection in the air conditioning switch circuit has been detected. The switch input is rapidly changing states and the switching frequency is greater than 8.3 Hz.

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Conditions for Setting the DTC

- The mode switching frequency is greater than 8.3 Hz.
- The above condition must be continuously present for 4 state changes.

Action Taken When the DTC Sets

- The TCM does not compensate for torque variation due to air conditioning compressor clutch activation.

Conditions for Clearing the DTC

- The DTC will clear after 3 seconds without the fault.
- A history DTC will clear after 40 TCM power-up cycles with a warm transmission (>50 °C) and without a fault.
- History DTCs can be cleared by using a scan tool.

Diagnostic Aids

- This fault is caused by too many changes in the mode input signal over a period of time.
- Typical causes would be an intermittent connection in the switch or wiring or an intermittent short to ground in the wiring.

DTC P1710 Air Conditioning Switch Circuit Malfunction

Step	Action	Value(s)	Yes	No
1	Perform a TCM Diagnostic System Check. Is the check performed?	-	Go to Step 2	Go to "TCM Diagnostic System Check"
2	1. Install the scan tool. 2. Turn the ignition ON, with the engine OFF. 3. Record and then clear DTCs. 4. Operate the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool display P1710.	-	Go to Step 3	Go to "Diagnostic Aids"
3	1. Turn the ignition OFF. 2. Disconnect the air conditioning compressor relay connector. 3. Turn the ignition ON. 4. Select Air Conditioning Compressor Switch on scan tool Data List. Is the value frequently changing?	-	Go to Step 4	Go to Step 5
4	1. Turn the ignition OFF. 2. Disconnect the TCM connector A. 3. Check the air conditioning compressor signal circuit for an intermittent open or short and repair as necessary. Is a repair necessary?	-	Go to Step 11	Go to Step 8
5	1. Jumper the air conditioning compressor relay connector terminal 30 and 87. 2. Turn the air conditioning switch ON. Is the air conditioning compressor switch value frequently changing?	-	Go to Step 6	Go to Step 7
6	1. Turn the ignition OFF. 2. Disconnect the TCM connector B. 3. Check the air conditioning compressor signal circuit for an intermittent open and repair as necessary. Is a repair complete?	-	Go to Step 11	-
7	Check the fuse Ef3 for a malfunctioning and replace as necessary? Is a repair necessary	-	Go to Step 11	Go to Step 9
8	Check for a poor connection at the air conditioning compressor relay and TCM connector and repair the malfunctioning terminals as necessary. Is a repair necessary?	-	Go to Step 11	Go to Step 10
9	Replace the air conditioning compressor relay. Is the action complete?	-	Go to Step 11	-
10	1. Turn the ignition OFF. 2. Replace the TCM. Is the action complete?	-	Go to Step 11	-

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DTC P1710 Air Conditioning Switch Circuit Malfunction (Cont'd)

Step	Action	Value(s)	Yes	No
11	1. Using the scan tool, clear the DTCs. 2. Road test the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool indicate that this diagnostic has run and passed?	-	Go to Step 12	Go to Step 2
12	Check if any DTCs are set. Are there any DTCs displayed or previously recorded at Step 2 that have not been diagnosed?	-	Go to applicable DTC table	System OK, Check Complete

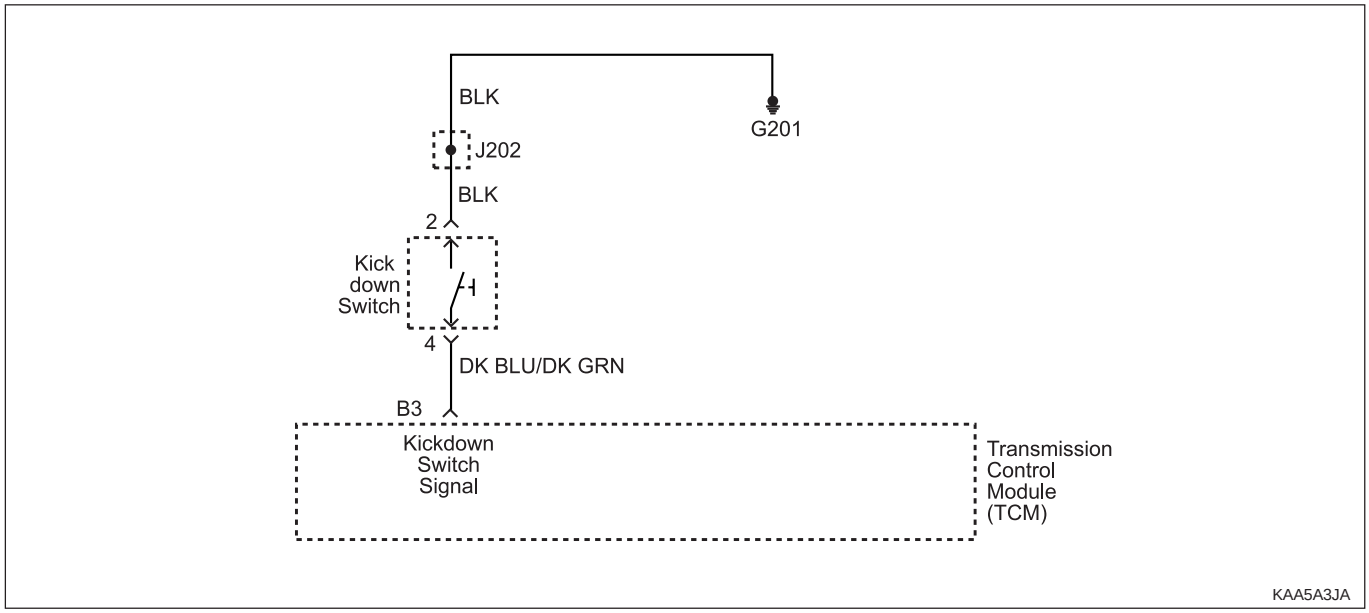
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DIAGNOSTIC TROUBLE CODE (DTC) P1712 KICKDOWN SWITCH CIRCUIT MALFUNCTION

Circuit Description

The Kickdown Switch is used to signal the TCM that the driver requires kickdown indicating the driver pressed the accelerator to the floor. When this switch is used in high range non-winter mode driving, the POWER light comes ON.

The DTC sets when the kickdown switch has an intermittent connection or is stuck ON. Kickdown Switch is closed when other signals indicate otherwise, i.e. the accelerator pedal is released and the engine is running. Or the switch is cycling open/closed more rapidly than the normal operation allows.

Conditions for Setting the DTC

- DTCs P1703, P1713 and P1719 are not set.
- Kickdown Switch is closed when other signals indicate otherwise, i.e. the accelerator pedal is released and the engine is running.
- The switch is cycling open/closed more rapidly than normal operation allows : 10 state changes in less than 30 milliseconds.

Action Taken When the DTC Sets

- Kickdown Switch feature is disabled while the fault exists.

Conditions for Clearing the DTC

- The DTC will clear when the malfunction has not occurred for 30 seconds.
- A history DTC will clear after 40 TCM power-up cycles with a warm transmission (>50 °C) and without a fault.
- History DTCs can be cleared by using a scan tool.

Diagnostic Aids

- Typical causes would be an short circuit within the switch, or a short circuit to ground in the wiring to the switch.
- Inspect the wiring for poor electrical connections at the TCM and at the Kickdown Switch connector. Look for possible bent, backed out, deformed or damagednterminals. Check for weak terminal tension as well. Also check for chafed wires that could short to bare metal or other wiring. Inspect for broken wire inside the insulation.
- If diagnosing for a possible intermittent short or open condition, move or massage the wiring harness while observing test equipment for a change.

Test Description

The number(s) below refer to the step number(s) on the Diagnostic Table.

4. Checks if the kickdown signal circuit is malfunctioning.
7. Checks if the kickdown ground circuit is malfunctioning.
8. Check resistance between Kickdown Switch terminal 4 and 2.
12. Check connections of other connectors.

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DTC P1712 Kickdown Switch Circult Malfunction

Step	Action	Value(s)	Yes	No
1	Perform a Transmission Control Module (TCM) Diagnostic System Check. Is the check performed?	-	Go to Step 2	Go to “TCM Diagnostic System Check”
2	1. Install the scan tool. 2. Turn the ignition ON, with the engine OFF. 3. Select the Kickdown Switch on the scan tool. Is the Kickdown Switch value frequently changed ON/OFF or continuously ON?	-	Go to Step 4	Go to Step 3
3	Push the accelerator pedal fully to the Kickdown Switch. Is the Kickdown Switch value frequently changed OFF/ON?	-	Go to Step 7	Go to “Diagnostic Aids”
4	1. Turn the ignition OFF. 2. Disconnect the Kickdown Switch connector. Refer to the Kickdown Switch in this section. 3. Turn the ignition ON, with the engine OFF. Is the Kickdown Switch value frequently changed ON/OFF or continuously ON?	-	Go to Step 5	Go to Step 8
5	1. Turn the ignition OFF. 2. Disconnect the TCM connector B. 3. Check the Kickdown Switch signal circuit from Kickdown Switch connector terminal 4 to TCM terminal B3 for a short to ground. Is a short to ground found?	-	Go to Step 6	Go to Step 14
6	Repair the short to ground or an open in the Kickdown Switch signal circuit. Is the action complete?	-	Go to Step 15	-
7	1. Turn the ignition OFF. 2. Disconnect the Kickdown Switch connector. Refer to the Kickdown Switch in this section. 3. With a test light connected to B+, probe the Kickdown Switch ground circuit, terminal 2. Does the test light illuminate?	-	Go to Step 10	Go to Step 11
8	Check the resistance between Kickdown Switch terminal 2 and 4 when pushing the switch and not pushing. Is the resistance within the specified value?	Push: less than 5 Ω No push: Open Loop	Go to “Diagnostic Aids”	Go to Step 9
9	Replace the Kickdown Switch. Is the action complete?	-	Go to Step 15	-
10	1. Turn the ignition OFF. 2. Disconnect the TCM connector B. 3. Check the Kickdown Switch signal circuit from Kickdown Switch connector terminal 4 to TCM terminal B3 for an open. Is an open founded?	-	Go to Step 6	Go to Step 12
11	Repair the open in the Kickdown Switch ground circuit. Is the action complete?	-	Go to Step 15	-

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DTC P1712 Kickdown Switch Circuit Malfunction (Cont'd)

Step	Action	Value(s)	Yes	No
12	Check for a poor connection at the Kickdown Switch connector and TCM connector and repair the malfunctioning terminals as necessary. Is a repair necessary?	-	Go to Step 15	Go to Step 13
13	Check the resistance between kickdown switch terminal 2 and 4 when pushing the switch. Is the resistance within the specified value and steady?	less than 5 Ω	Go to Step 14	Go to Step 9
14	1. Turn the ignition OFF. 2. Replace the TCM. Is the action complete?	-	Go to Step 15	-
15	1. Using the scan tool, clear the DTCs. 2. Road test the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool indicate that this diagnostic has run and passed?	-	Go to Step 16	Go to Step 2
16	Check if any DTCs are set. Are there any DTCs displayed or previously recorded at Step 2 that have not been diagnosed?	-	Go to applicable DTC table	System OK, Check Complete

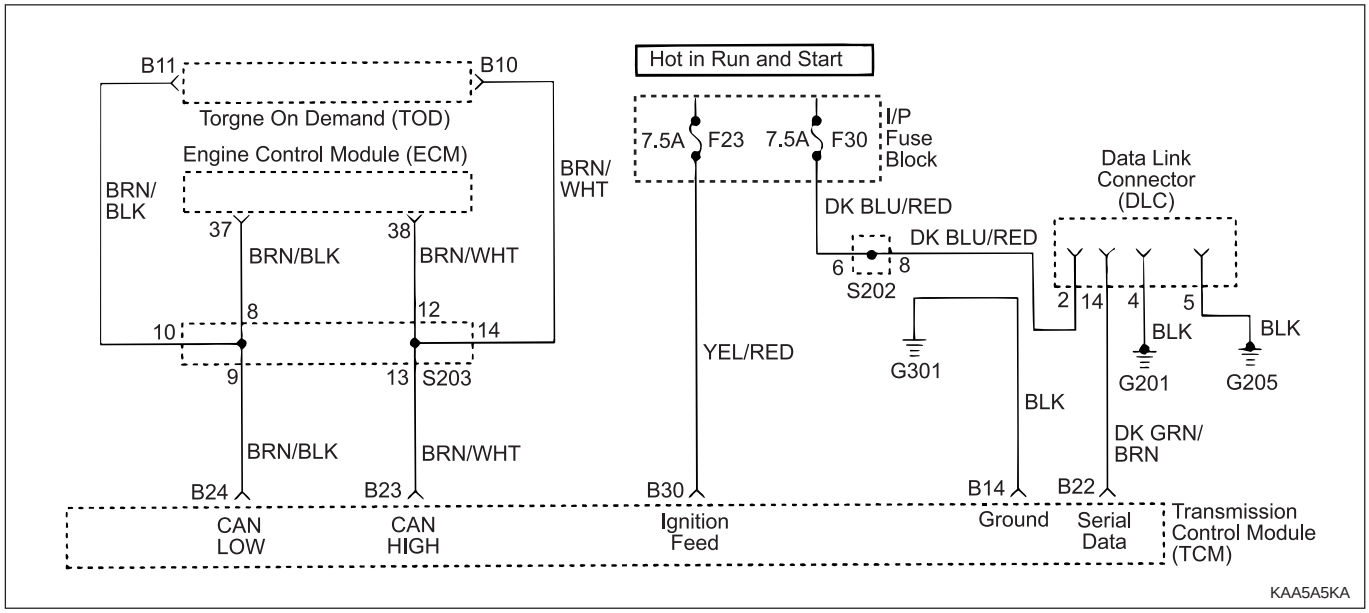
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DIAGNOSTIC TROUBLE CODE (DTC) P1713
PEDAL SIGNAL ERROR

Circuit Description

The Controller Area Network (CAN) connects various control modules by using a twisted pair of wires, to share common information. This results in a reduction of sensors and wiring. TCM obtains the actual engine speed and throttle position, vehicle speed and accelerator pedal position etc. from ECM via CAN without any additional sensors.

The DTC P1713 sets when the accelerator pedal signal via CAN is out of range. The accelerator pedal signal is greater than 254 steps.

Conditions for Setting the DTC

- DTCs P1719 is not set.
- The accelerator pedal signal is greater than 254 steps. The malfunction is triggered immediately after this condition exists.

Action Taken When the DTC Sets

- 4th gear is inhibited.
- Torque Converter Clutch (TCC) is inhibited.
- Default value is adopted for shift point decisions.
- Accelerator pedal is not used for P, R, or N B2 activation decisions.

Conditions for Clearing the DTC

- The DTC will clear when the malfunction has not occurred for 30 seconds.
- A history DTC will clear after 40 TCM power-up cycles with a warm transmission (>50 °C) and without a fault.
- History DTCs can be cleared by using a scan tool.

Diagnostic Aids

- Inspect the wiring for poor electrical connections at the TCM and ECM connectors. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for chafed wires that could short to bare metal or other wiring. Inspect for broken wire inside the insulation.
- If diagnosing for a possible intermittent short or open condition, move or massage the wiring harness while observing test equipment for a change.
- When ECM finds a fault on the accelerator pedal signals, ECM will adopt a default mode and send the default value and trouble message to TCM via CAN.

Test Description

The number(s) below refer to the step number(s) on the Diagnostic Table.

3. Check if there are any DTCs related to the accelerator pedal sensor on the ECM side.
4. Check for a poor connection at the ECM and TCM connectors.

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DTC P1713 Pedal Signal Error

Step	Action	Value(s)	Yes	No
1	Perform a Transmission Control Module (TCM) Diagnostic System Check. Is the check performed?	-	Go to Step 2	Go to "TCM Diagnostic System Check"
2	1. Install the scan tool. 2. Turn the ignition ON, with the engine OFF. 3. Record and then clear DTCs. 4. Operate the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool display P1713?	-	Go to Step 3	Go to "Diagnostic Aids"
3	Check if there are any DTCs related to the accelerator pedal sensor on the ECM side. Are any DTCs related to accelerator pedal sensor found?	-	Go to *Section 1F, Engine Controls*	Go to Step 4
4	1. Turn the ignition OFF. 2. Replace the TCM. Is the action complete?	-	Go to Step 5	-
5	1. Using the scan tool, clear the DTCs. 2. Road test the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool indicate that this diagnostic has run and passed?	-	Go to Step 6	Go to Step 2
6	Check if any DTCs are set. Are there any DTCs displayed or previously recorded at Step 2 that have not been diagnosed?	-	Go to applicable DTC table	System OK, Check Complete

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DIAGNOSTIC TROUBLE CODE (DTC) P1714 EEPROM VEHICLE CODE ERROR

System Description

The Electrically Erasable Programmable Read-Only Memory (EEPROM) is a permanent memory chip that is physically soldered within the Transmission Control Module (TCM). The EEPROM contains the program and the calibration information required for transmission and transmission diagnostics operation.

The DTC P1714 sets when the vehicle ID stored in EEPROM is out of range when checked on initialization. The EEPROM Vehicle identification Number (VIN) value does not lie within the range 0 - 13.

Conditions for Setting the DTC

- DTC P1720 is not set.
- The vehicle type is not recognized. The EEPROM Vehicle Identification Number (VIN) value does not lie within the range 0 - 13. The malfunction is triggered immediately after this condition exists.

Action Taken When the DTC Sets

- If CAN is detected, OBD N32D VIN is selected. Or If CAN is not detected, P29 STi VIN is selected.
- Shift quality may by degraded.

Conditions for Clearing the DTC

- This DTC can only be cleared by reprogramming the EEPROM with the correct vehicle code and than cycling power to the TCM. This is a factor procedure.
- A history DTC will clear after 40 TCM power-up cycles with a warm transmission (>50 °C) and without a fault.
- History DTCs can be cleared by using a scan tool.

Test Description

The number(s) below refer to the step number(s) on the Diagnostic Table.

3. Perform the vehicle coding.

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DTC P1714 EEPROM Vehicle Code Error

Step	Action	Value(s)		No
1	Perform a Transmission Control Module (TCM) Diagnostic System Check. Is the check performed?	-	Go to Step 2	Go to “TCM Diagnostic System Check”
2	1. Install the scan tool. 2. Turn the ignition ON, with the engine OFF. 3. Record and then clear DTCs. 4. Operate the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool display P1714?	-	Go to Step 3	Go to Step 6
3	1. Select the required VIN on TCM Coding of scan tool. 2. Perform the vehicle coding. 3. Turn the ignition OFF. 4. Turn the ignition ON, with the engine OFF. Does the scan tool display P1714?	-	Go to Step 4	Go to Step 5
4	1. Turn the ignition OFF. 2. Replace the TCM. Is the action complete?	-	Go to Step 5	-
5	1. Using the scan tool, clear the DTCs. 2. Road test the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool indicate that this diagnostic has run and passed?	-	Go to Step 6	Go to Step 2
6	Check if any DTCs are set. Are there any DTCs displayed or previously recorded at Step 2 that have not been diagnosed?	-	Go to applicable DTC table	System OK, Check Complete

DIAGNOSTIC TROUBLE CODE (DTC) P1715
VPS OFFSET ERROR

Circuit Description

The VPS is used to regulate the clutch and band pressures during a shift. The TCM compares TP voltage, engine rpm and other inputs to determine the pressure appropriate for a given shift. The TCM will regulate pressure by applying a varying amperage to the Variable Pressure Solenoid (VPS) valve. The applied amperage can vary from 0 to 1.275 amps. The TCM then monitors the amperage at the return line.

This VPS offsets calibrate the accuracy between actual and expected VPS current.

The DTC P1715 sets when the VPS offset value stored in EEPROM is out of range when checked on initialization. The VPS offset is greater than 120 mA from nominal.

Conditions for Setting the DTC

- DTC P1720 is not set.
- The VPS offset is greater than 120 mA from nominal. The malfunction is triggered immediately after this condition exists.

Action Taken When the DTC Sets

- Default values are used which are typical of the calibrated values.
- Shift quality may be degraded.

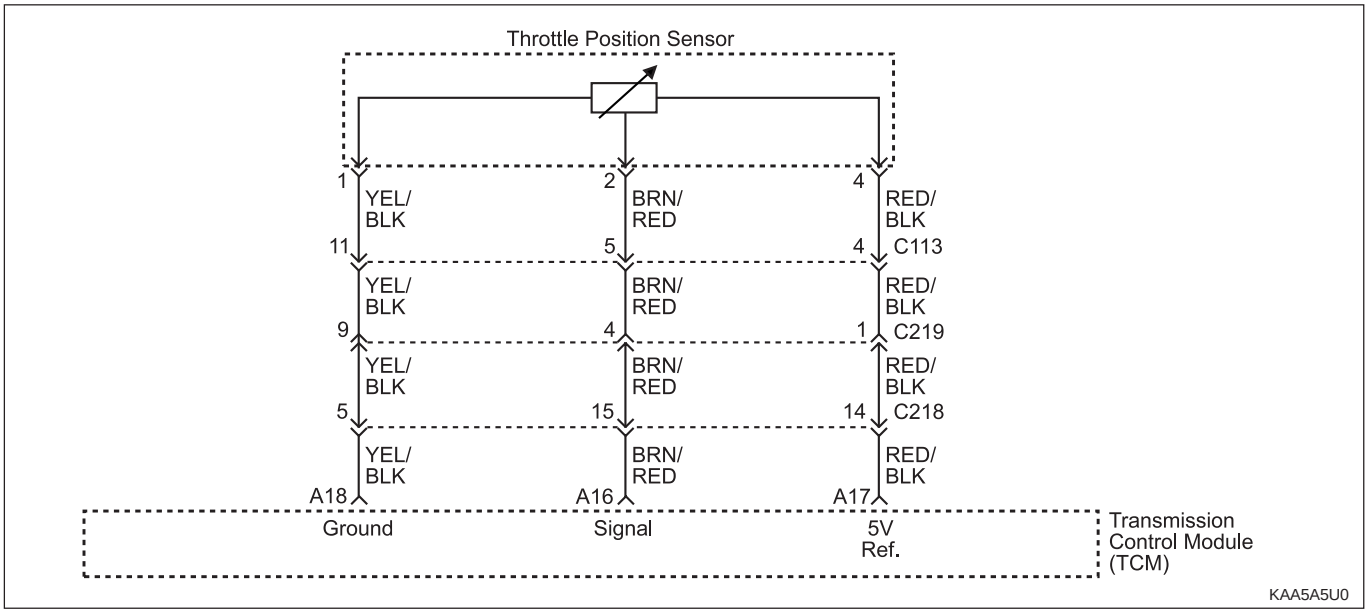
Conditions for Clearing the DTC

- This DTC can only be cleared by recalibrating the VPS and then cycling power to the TCM. This is a factory procedure.
- A history DTC will clear after 40 TCM power-up cycles with a warm transmission (>50 °C) and without a fault.
- History DTCs can be cleared by using a scan tool.

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DTC P1715 VPS Offset Error

Step	Action	Value(s)	Yes	No
1	Perform a Transmission Control Module (TCM) Diagnostic System Check. Is the check performed?	-	Go to Step 2	Go to "TCM Diagnostic System Check"
2	1. Install the scan tool. 2. Turn the ignition ON, with the engine OFF. 3. Record and then clear DTCs. 4. Operate the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool display P1715?	-	Go to Step 3	Go to Step 5
3	1. Turn the ignition OFF. 2. Replace the TCM. Is the action complete?	-	Go to Step 4	-
4	1. Using the scan tool, clear the DTCs. 2. Road test the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool indicate that this diagnostic has run and passed?	-	Go to Step 5	Go to Step 2
5	Check if any DTCs are set. Are there any DTCs displayed or previously recorded at Step 2 that have not been diagnosed?	-	Go to applicable DTC table	System OK, Check Complete



DIAGNOSTIC TABLE CODE (DTC) 1716 THROTTLE NOT LEARNT ERROR

Circuit Description

The Controller Area Network (CAN) connects various control modules by using a twisted pair of wires, to share common information. This results in a reduction of sensors and wiring. TCM obtains the actual engine speed and throttle position, vehicle speed and accelerator etc. from ECM via CAN without any additional sensors.

The DTC P1716 sets when the throttle signal via CAN is out of range. The throttle is greater than 254 steps.

Conditions for Setting the DTC

- The minimum & maximum throttle positions have not been learnt by the TCU.

Action Taken When the DTC Sets

- The minimum & maximum throttle positions are set to their factory default values.
- Incorrect sensitivity to driver demand.
- Incorrect gear shift points.

Conditions for Clearing the DTC

- Throttle learns 0 % position. This value must be greater than 0.2 V.

Diagnostic Aids

- This fault indicates that the TCU has not learnt the throttle position correctly since installation in the vehicle or that the throttle setting have been cleared by a diagnostic tool.

Test Description

The number(s) below refer to the step number(s) on the Diagnostic Table.

4. The “Throttle Position Calibration Procedure” needs to be carried out. This is given in this section.

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DTC P1716 Throttle Not Learnt Error

Step	Action	Value(s)	Yes	No
1	Perform a Transmission Control Module (TCM) Diagnostic System Check. Is the check performed?	-	Go to Step 2	Go to "TCM Diagnostic System Check"
2	1. Install the scan tool. 2. Turn the ignition ON, with the engine OFF. 3. Record and then clear DTCs. 4. Operate the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool display P1716?	-	Go to Step 3	Go to "Diagnostic Aids"
3	Check if there are any DTCs related to the throttle position sensor. Are any DTCs related to throttle position sensor found?	-	Go to applicable DTC table	Go to Step 4
4	Fulfill the Throttle Clearing and Throttle Position Calibration. Is the repair complete?	-	Go to Step 6	Go to Step 5
5	1. Turn the ignition OFF. 2. Replace the TCM. Is the action complete?	-	Go to Step 6	-
6	1. Using the scan tool, clear the DTCs. 2. Road test the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool indicate that this diagnostic has run and passed?	-	Go to Step 7	Go to Step 2
7	Check if any DTCs are set. Are there any DTCs displayed or previously recorded at Step 2 that have not been diagnosed?	-	Go to applicable DTC table	System OK, Check Complete

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DIAGNOSTIC TROUBLE CODE (DTC) P1717 RAM ERROR

Circuit Description

A normal function of the Transmission Control Module (TCM) programming is to perform an internal check that verifies the integrity of the RAM memory allocations.

The DTC P1717 sets when the Random Access Memory (RAM) is not operating correctly when checked on initialization. An area of RAM has failed a read/ write test.

Conditions for Setting the DTC

- An area of RAM has failed a read/ write test.
- Immediately after the above condition occurs.

Action Taken When the DTC Sets

- Adopt Limp Home Mode (LHM)
- Outputs are disabled.
- The transmission adopts the third gear LHM strategy of operation, independent of the vehicle speed. The operation of TCM under this condition is difficult to predict. Its operation may be erratic.

Conditions for Clearing the DTC

- The DTC will clear if the malfunction is not present after cycling the ignition.
- A history DTC will clear after 40 TCM power-up cycles with a warm transmission (>50 °C) and without a fault.
- History DTCs can be cleared by using a scan tool.

Diagnostic Aids

- When DTC P1717 sets, the replacement of TCM is recommended.

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DTC P1717 RAM Error

Step	Action	Value(s)	Yes	No
1	Perform a Transmission Control Module (TCM) Diagnostic System Check. Is the check performed?	-	Go to Step 2	Go to "TCM Diagnostic System Check"
2	1. Install the scan tool. 2. Turn the ignition ON, with the engine OFF. Does the scan tool display P1717?	-	Go to Step 3	Go to "Diagnostic Aids"
3	1. Turn the ignition OFF. 2. Replace the TCM. Is the action complete?	-	Go to Step 4	-
4	1. Using the scan tool, clear the DTCs. 2. Road test the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool indicate that this diagnostic has run and passed?	-	Go to Step 5	Go to Step 2
5	Check if any DTCs are set. Are there any DTCs displayed or previously recorded at Step 2 that have not been diagnosed?	-	Go to applicable DTC table	System OK, Check Complete

DIAGNOSTIC TROUBLE CODE (DTC) P1718 ROM ERROR

Circuit Description

A normal function of the Transmission Control Module (TCM) programming is to perform an internal check that verifies the integrity of the ROM memory allocations. This function is called a checksum.

The DTC P1718 sets when the Read Only Memory (ROM), program memory, is corrupted when checked on initialization. The calculated checksum disagrees with the stored checksum.

Conditions for Setting the DTC

- TCM has been powered ON for greater than 7 seconds.
- The calculated checksum disagrees with the stored checksum. The malfunction is triggered immediately after this condition exists.

Action Taken When the DTC Sets

- Adopt Limp Home Mode (LHM)
- The transmission adopts the third gear LHM strategy of operation, independent of the vehicle speed. The operation of TCM under this condition cannot be predicted. Its operation may be erratic.

Conditions for Clearing the DTC

- The DTC will clear if the malfunction is not present after cycling the ignition.
- A history DTC will clear after 40 TCM power-up cycles with a warm transmission (>50 °C) and without a fault.
- History DTCs can be cleared by using a scan tool.

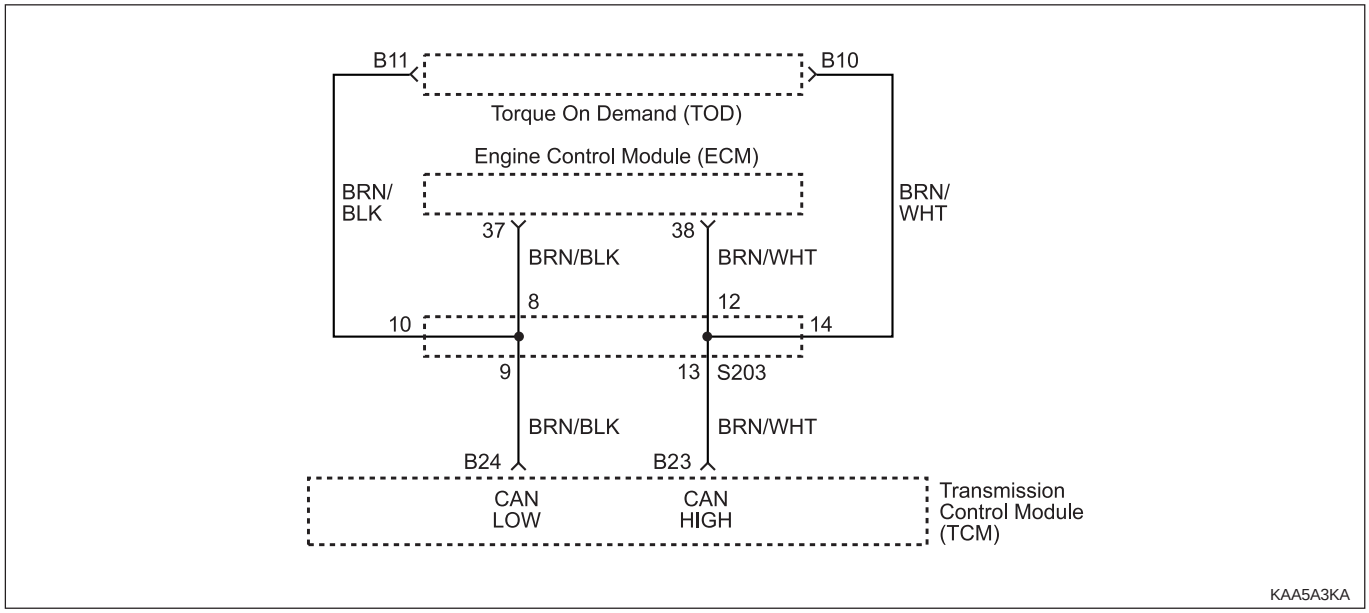
Diagnostic Aids

- When DTC P1718 sets, the replacement of TCM is recommended.

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DTC P1718 ROM Error

Step	Action	Value(s)	Yes	No
1	Perform a Transmission Control Module (TCM) Diagnostic System Check. Is the check performed?	-	Go to Step 2	Go to “TCM Diagnostic System Check”
2	1. Install the scan tool. 2. Turn the ignition ON, with the engine OFF. Does the scan tool display P1718?	-	Go to Step 3	Go to “Diagnostic Aids”
3	1. Turn the ignition OFF. 2. Replace the TCM. Is the action complete?	-	Go to Step 4	-
4	1. Using the scan tool, clear the DTCs. 2. Road test the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool indicate that this diagnostic has run and passed?	-	Go to Step 5	Go to Step 2
5	Check if any DTCs are set. Are there any DTCs displayed or previously recorded at Step 2 that have not been diagnosed?	-	Go to applicable DTC table	System OK, Check Complete



DIAGNOSTIC TROUBLE CODE (DTC) P1719 CAN BUS ERROR

Circuit Description

The Controller Area Network (CAN) connects various control modules by using a twisted pair of wires, to share common information. This results in a reduction of sensors and wiring. TCM obtains the actual engine speed and throttle position, vehicle speed and accelerator position etc. from ECM via CAN without any additional sensors.

The DTC P1719 sets when the information required by TCM is not available on the CAN. One or more CAN messages used by the TCM is timed out, i.e. not refreshed for 1 second.

Conditions for Setting the DTC

- One or more CAN messages used by the TCM are timed out, i.e. not refreshed for 1 second.

Action Taken When the DTC Sets

- TCM uses default values for all CAN dependent signals.

Conditions for Clearing the DTC

- The DTC will clear when the malfunction has not occurred for 30 seconds.
- A history DTC will clear after 40 TCM power-up cycles with a warm transmission (>50 °C) and without a fault.
- History DTCs can be cleared by using a scan tool.

Diagnostic Aids

- Inspect the wiring for poor electrical connections at the TCM and ECM connectors. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for chafed wires that could short to bare metal or other wiring. Inspect for broken wire inside the insulation.
- If diagnosing for a possible intermittent short or open condition, move or massage the wiring harness while observing test equipment for a change.

Test Description

The number(s) below refer to the step number(s) on the Diagnostic Table.

6. Check for a poor connection at the ECM and TCM connectors.

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DTC P1719 CAN Bus Error

Step	Action	Value(s)	Yes	No
1	Perform a Transmission Control Module (TCM) Diagnostic System Check. Is the check performed?	-	Go to Step 2	Go to "TCM Diagnostic System Check"
2	1. Install the scan tool. 2. Turn the ignition ON, with the engine OFF. 3. Record and then clear DTCs. 4. Operate the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool display P1719?	-	Go to Step 3	Go to "Diagnostic Aids"
3	1. Turn the ignition OFF. 2. Disconnect the TCM connector B. 3. Disconnect the Engine Control Module (ECM) connector. 4. Check the wiring harness from ECM connector terminal 38 to TCM connector terminal B23 for an open or a short. Is a problem found?	-	Go to Step 4	Go to Step 5
4	Repair the malfunctioning wiring harness. Is a repair complete?	-	Go to Step 10	-
5	Check the wiring harness from ECM connector terminal 37 to TCM connector terminal B24 for an open or a short. Is a problem found?	-	Go to Step 4	Go to Step 6
6	Check for a poor connection at the ECM connector or TCM connector and repair the malfunctioning terminals as necessary. Is a repair necessary?	-	Go to Step 10	Go to Step 7
7	1. Turn the ignition OFF. 2. Replace the TCM. Is the action complete?	-	Go to Step 8	-
8	1. Using the scan tool, clear the DTCs. 2. Road test the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool indicate that this diagnostic has run and passed?	-	Go to Step 10	Go to Step 9
9	1. Turn the ignition OFF. 2. Replace the TCM with the original.	-	Go to *Section 1F, Engine Control*	-
10	1. Using the scan tool, clear the DTCs. 2. Road test the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool indicate that this diagnostic has run and passed?	-	Go to Step 11	Go to Step 2
11	Check if any DTCs are set. Are there any DTCs displayed or previously recorded at Step 2 that have not been diagnosed?	-	Go to applicable DTC table	System OK, Check Complete

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DIAGNOSTIC TROUBLE CODE (DTC) P1720 EEPROM ERROR

System Description

The Electrically Erasable Programmable Read-Only Memory (EEPROM) is a permanent memory chip that is physically soldered within the Transmission Control Module (TCM). The EEPROM contains the calibration information required for transmission and transmission diagnostics operation. When the EEPROM malfunctions, DTC P1720 will set. The EEPROM memory is corrupted and the calculated checksum disagrees with the stored checksum or an EEPROM communication failure has occurred when checked on initialization.

Conditions for Setting the DTC

- The calculated checksum disagrees with the stored checksum or an EEPROM communication failure has occurred when checked on initialization.
- Immediately after the above condition occurs.

Action Taken When the DTC Sets

- If CAN is detected, OBD N32D VIN is selected. Or If CAN is not detected, P29 STi VIN is selected.
- Default values are used which are typical of calibrated values.
- Shift quality may be degraded.

Conditions for Clearing the DTC

- The DTC will only clear if the malfunction is not present after cycling the ignition.
- A history DTC will clear after 40 TCM power-up cycles with a warm transmission (>50 °C) and without a fault.
- History DTCs can be cleared by using a scan tool.

Diagnostic Aids

- When DTC 1720 is set, it is likely the TCM will need replacing.

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DTC P1720 EEPROM Error

Step	Action	Value(s)	Yes	No
1	Perform a Transmission Control Module (TCM) Diagnostic System Check. Is the check performed?	-	Go to Step 2	Go to “TCM Diagnostic System Check”
2	1. Install the scan tool. 2. Turn the ignition ON, with the engine OFF. 3. Record and then clear DTCs. 4. Operate the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool display P1720?	-	Go to Step 3	Go to “Diagnostic Aids”
3	1. Turn the ignition OFF. 2. Replace the TCM. Is the action complete?	-	Go to Step 4	-
4	1. Using the scan tool, clear the DTCs. 2. Road test the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool indicate that this diagnostic has run and passed?	-	Go to Step 5	Go to Step 2
5	Check if any DTCs are set. Are there any DTCs displayed or previously recorded at Step 2 that have not been diagnosed?	-	Go to applicable DTC table	System OK, Check Complete

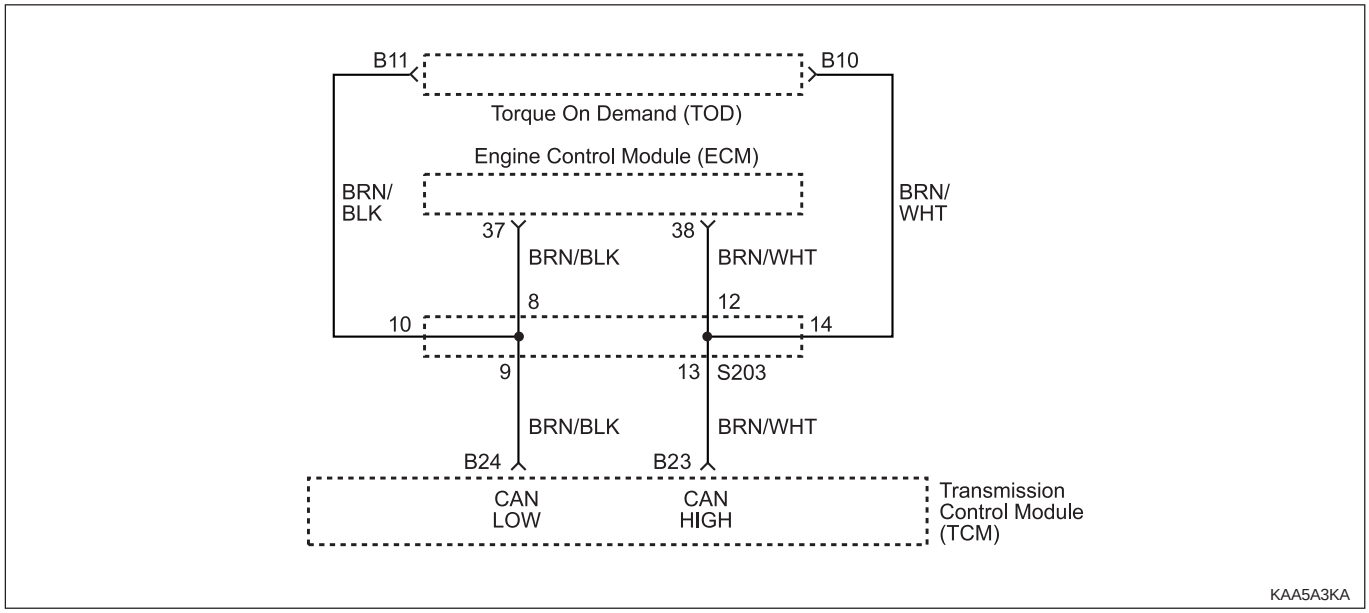
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DIAGNOSTIC TROUBLE CODE (DTC) P1721 THROTTLE SIGNAL ERROR

Circuit Description

The Controller Area Network (CAN) connects various control modules by using a twisted pair of wires, to share common information. This results in a reduction of sensors and wiring. TCM obtains the actual engine speed and throttle position, vehicle speed and accelerator etc. from ECM via CAN without any additional sensors.

The DTC P1721 sets when the throttle signal via CAN is out of range. The throttle is greater than 254 steps.

Conditions for Setting the DTC

- DTC P1719 is not set.
- The throttle is greater than 254 steps. The malfunction triggers immediately after the above condition occurs.

Action Taken When the DTC Sets

- The throttle signal is defaulted to 100 %.
- Shift quality is degraded.
- All shifts will be firm as full throttle and hence high engine torque is assumed.
- Line pressure will always stay high (S6 OFF) to cope with the assumed high throttle/ torque.
- Manual 1 gear selection is inhibited.

Conditions for Clearing the DTC

- The DTC will clear if the malfunction is not present for 30 seconds.
- A history DTC will clear after 40 TCM power-up cycles with a warm transmission (>50 °C) and without a fault.
- History DTCs can be cleared by using a scan tool.

Diagnostic Aids

- Inspect the wiring for poor electrical connections at the TCM and ECM connectors. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for chafed wires that could short to bare metal or other wiring. Inspect for broken wire inside the insulation.
- If diagnosing for a possible intermittent short or open condition, move or massage the wiring harness while observing test equipment for a change.
- When ECM finds a fault on the throttle signals, ECM will adopt a default mode and send the default value and trouble message to TCM via CAN.

Test Description

The number(s) below refer to the step number(s) on the Diagnostic Table.

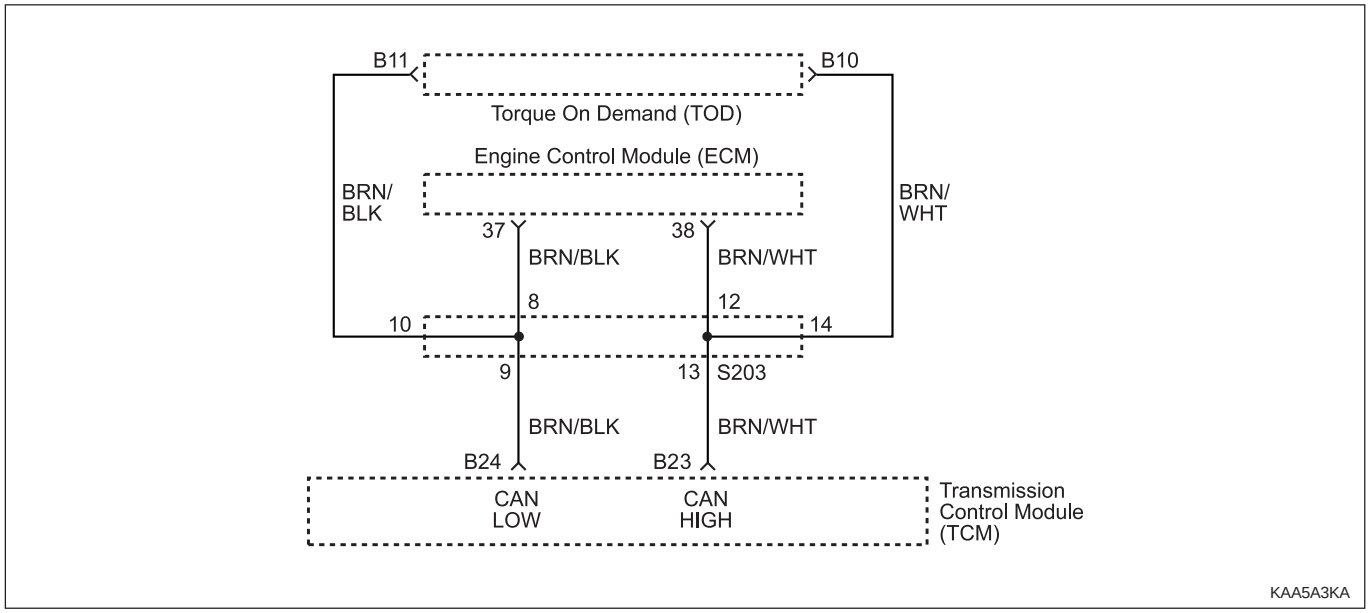
3. Check if there are any DTCs related to the throttle position sensor on the ECM side.
4. Check for a poor connection at the ECM and TCM connectors.

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DTC P1721 Throttle Signal Error

Step	Action	Value(s)	Yes	No
1	Perform a Transmission Control Module (TCM) Diagnostic System Check. Is the check performed?	-	Go to Step 2	Go to "TCM Diagnostic System Check"
2	1. Install the scan tool. 2. Turn the ignition ON, with the engine OFF. 3. Record and then clear DTCs. 4. Operate the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool display P1721?	-	Go to Step 3	Go to "Diagnostic Aids"
3	Check if there are any DTCs related to the throttle position sensor on the ECM side. Are any DTCs related to throttle position sensor found?	-	Go to *Section 1F, Engine Controls*	Go to Step 4
4	1. Turn the ignition OFF. 2. Replace the TCM. Is the action complete?	-	Go to Step 5	-
5	1. Using the scan tool, clear the DTCs. 2. Road test the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool indicate that this diagnostic has run and passed?	-	Go to Step 6	Go to Step 2
6	Check if any DTCs are set. Are there any DTCs displayed or previously recorded at Step 2 that have not been diagnosed?	-	Go to applicable DTC table	System OK, Check Complete

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DIAGNOSTIC TROUBLE CODE (DTC) P1722 VEHICLE TYPE DETERMINATION ERROR

Circuit Description

The Electrically Erasable Programmable Read-Only Memory (EEPROM) is a permanent memory chip that is physically soldered within the Transmission Control Module (TCM) The EEPROM contains the program and the calibration information required for the transmission and transmission diagnostics operation.

The DTC P1722 sets when TCM is unable to determine the vehicle type from EEPROM or CAN. CAN vehicle type information is in error or unavailable in time.

By definition, there must by on EEPROM fault (P1720) or an EEPROM vehicle code error (P1714) to cause the TCM to try and determine the vehicle code by other means.

The DTC P1722 is a reflection of the significance of the problem caused by the other error.

Conditions for Setting the DTC

- EEPROM information is in error or unreliable.
- Vehicle type information on the CAN is not present or in error.
- The above condition exists for 1 second after power up.

Action Taken When the DTC Sets

- If CAN is detected, OBD N32D VIN is selected. Or If CAN is not detected, P29 STi VIN is selected.
- Shift quality may be degraded.

Conditions for Clearing the DTC

- The DTC will clear when the malfunction has not occurred after ignition cycle.
- A history DTC will clear after 40 TCM power-up cycles with a warm transmission (>50 °C) and without a fault.
- History DTCs can be cleared by using a scan tool.

Diagnostic Aids

- Inspect the wiring for poor electrical connections at the TCM connector. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for chafed wires that could short to bare metal or other wiring. Inspect for broken wire inside the insulation.
- If diagnosing for a possible intermittent short or open condition, move or massage the wiring harness while observing test equipment for a change

Test Description

The number(s) below refer to the step number(s) on the Diagnostic Table.

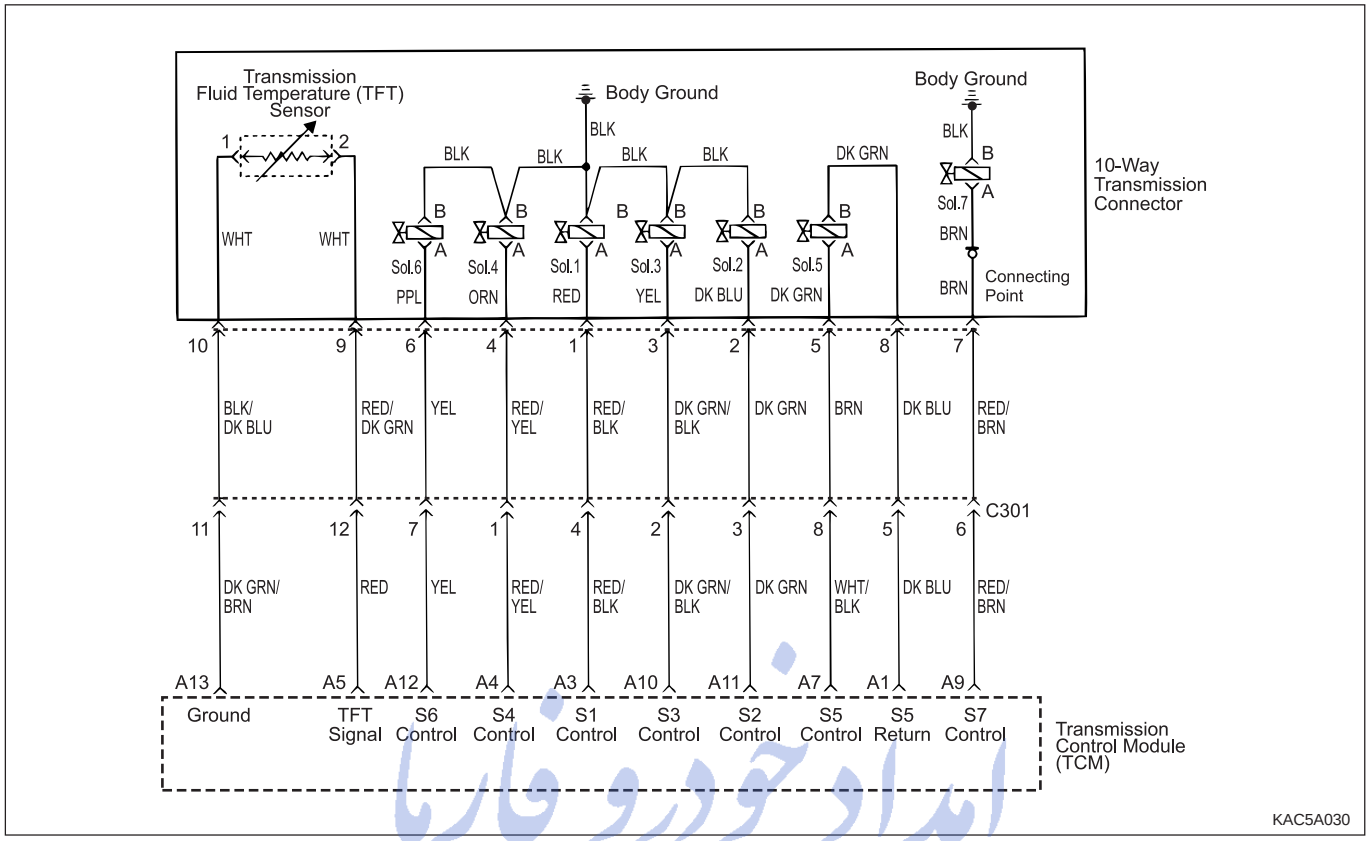
3. If there are any other DTCs like P1714 or P1720, troubleshoot those prior to P1722.

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DTC P1722 Vehicle Type Determination Error

Step	Action	Value(s)	Yes	No
1	Perform a Transmission Control Module (TCM) Diagnostic System Check. Is the check performed?	-	Go to Step 2	Go to “TCM Diagnostic System Check”
2	1. Install the scan tool. 2. Turn the ignition ON, with the engine OFF. Does the scan tool display P1722?	-	Go to Step 3	Go to “Diagnostic Aids”
3	Does the scan tool display DTC P1714.	-	Go to applicable DTC table	Go to DTC P1720 table

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DIAGNOSTIC TROUBLE CODE (DTC) P1733 SOLENOID 1 CIRCUIT OPEN

Circuit Description

The solenoid 1 is used to control fluid flow acting on the 1 - 2 shift valve. The solenoid 1 is a normally open ON/ OFF type solenoid that is used in conjunction with the solenoid 2 to allow four different shifting combinations. Refer to Solenoid Logic for Static Gear States. The solenoid is attached to the valve body within the transmission. Voltage is supplied directly to the solenoid through the Transmission Control Module (TCM).

The DTC P1733 sets when the Solenoid 1 (S1) circuit is open or the switched leg of the solenoid 1 is shorted to battery positive.

Conditions for Setting the DTC

- DTCs P1717 and P1718 are not set.
- S1 is OFF.
- S2 is OFF.
- The solenoid 1's driver Integrated Chip (IC) status indicates a faulty circuit. This condition must be continuously present for 60 milliseconds.

Action Taken When the DTC Sets

- The solenoid 1 is always OFF.
- TCM adopts a Limp Home Mode (LHM) operation.

Conditions for Clearing the DTC

- The DTC will clear when the malfunction has not occurred after ignition cycle.
- A history DTC will clear after 40 TCM power-up cycles with a warm transmission (>50 °C) and without a fault.
- History DTCs can be cleared by using a scan tool.

Diagnostic Aids

- During the TCM's testing, solenoid 1 is turned OFF/ ON by a very small (4 millisecond) pulse. This pulse is too short for the solenoid to react so the transmission operation is not affected.
- The solenoid feedback voltage is measured before the (4 millisecond) pulse and again during the pulse. If the difference is outside the acceptable limits the relevant fault is recorded.
- Typical causes would be an open circuit in the wiring to or within the solenoid, or a short circuit to power in the wiring to or within the solenoid.
- If several faults of solenoids are present, check the wiring or connectors that are common to the selected solenoids, especially the earth connections.

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۰۲۱-۸۸۸۶۲۰۸۸
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- Inspect the wiring for poor electrical connections at the TCM and at the 10-way transmission connector. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for chafed wires that could short to bare metal or other wiring. Inspect for broken wire inside the insulation.
- If diagnosing for a possible intermittent short or open condition, move or massage the wiring harness while observing test equipment for a change.
- Solenoid Logic for Static Gear States

Gear	S1	S2
1st	ON	ON
2nd	OFF	ON
3rd	OFF	OFF
4th	ON	OFF
Reverse	OFF	OFF
Neutral	OFF	OFF
Park	OFF	OFF

Test Description

The number(s) below refer to the step number(s) on the Diagnostic Table.

3. Checks if the S1 circuit in the transmission is malfunctioning.
4. Check cable in the transmission for open / short.
6. Check resistance between S1 terminal A and B. Standard value is 22 - 30 Ω.
9. Check poor connections of other connectors

DTC P1733 Solenoid 1 Circuit Open

Step	Action	Value(s)	Yes	No
1	Perform a Transmission Control Module (TCM) Diagnostic System Check. Is the check performed?	-	Go to Step 2	Go to "TCM Diagnostic System Check"
2	1. Install the scan tool. 2. Turn the ignition ON, with the engine OFF. 3. Record and then clear DTCs. 4. Operate the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool display P1733?	-	Go to Step 3	Go to "Diagnostic Aids"
3	1. Turn the ignition OFF. 2. Disconnect the 10-way transmission connector. (additional DTCs will set) 3. Connect Solenoid/Thermistor Electrical Tester (STET) to the 10-way transmission connector of transmission side and to the good ground. 4. Turn the mode knob of STET to 1 and push the red button. Does the bulb of open circuit on the solenoids side of STET illuminate?	-	Go to Step 4	Go to Step 8
4	1. Remove the valve cover. Refer to the Transmission in this section. 2. Check the wiring harness from 10-way transmission connector to Solenoid 1 (S1) on the valve body for an open or short to positive and repair as necessary. Is a repair necessary?	-	Go to Step 11	Go to Step 5
5	Check the S1 ground circuit for an open and repair as necessary. Is a repair necessary?	-	Go to Step 11	Go to Step 6

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DTC P1733 Solenoid 1 Circuit Open (Cont'd)

Step	Action	Value(s)	Yes	No
6	Using a Digital Volt Meter (DVM), measure the resistance between S1 terminal A and B. Is the resistance within the specified value?	22 - 30 Ω	Go to "Diagnostic Aids"	Go to Step 7
7	Replace the S1. Is the action complete?	-	Go to Step 11	-
8	1. Disconnect the TCM connector A. 2. Check the wiring harness from 10-way transmission connector terminal 1 to TCM terminal A3 for an open or short to positive and repair as necessary. Is a repair necessary?	-	Go to Step 11	Go to Step 9
9	Check for a poor connection at the 10-way transmission connector and TCM connector and repair the malfunctioning terminals as necessary. Is a repair necessary?	-	Go to Step 11	Go to Step 10
10	1. Turn the ignition OFF. 2. Replace the TCM. Is the action complete?	-	Go to Step 11	-
11	1. Using the scan tool, clear the DTCs. 2. Road test the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool indicate that this diagnostic has run and passed?	-	Go to Step 12	Go to Step 2
12	Check if any DTCs are set. Are there any DTCs displayed or previously recorded at Step 2 that have not been diagnosed?	-	Go to applicable DTC table	System OK, Check Complete

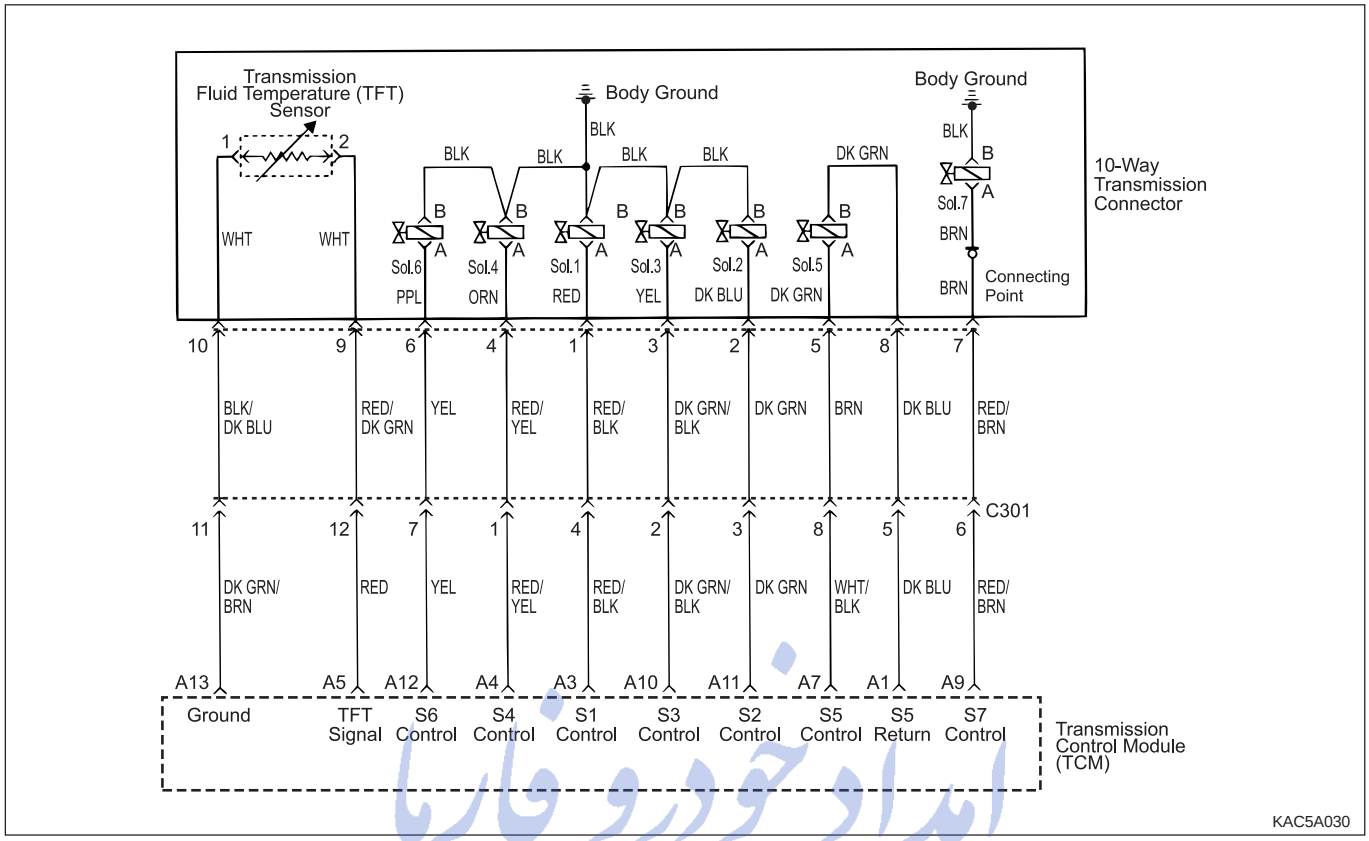
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DIAGNOSTIC TROUBLE CODE (DTC) P1734 SOLENOID 2 CIRCUIT OPEN

Circuit Description

The solenoid 2 is used to control fluid flow acting on the 2 - 3 shift valve. The solenoid 2 is a normally open ON/ OFF type solenoid that is used in conjunction with the solenoid 1 to allow four different shifting combinations. Refer to Solenoid Logic for Static Gear States.

The solenoid is attached to the valve body within the transmission. Voltage is supplied directly to the solenoid through the Transmission Control Module (TCM).

The DTC P1734 sets when the Solenoid 2 (S2) circuit is open or the switched leg of the solenoid 2 is shorted to battery positive.

Conditions for Setting the DTC

- DTCs P1717 and P1718 are not set.
- S2 is OFF.
- S1 is OFF.
- The solenoid 2's driver Integrated Chip (IC) status indicates a faulty circuit. This condition must be continuously present for 60 milliseconds.

Action Taken When the DTC Sets

- The solenoid 2 is always OFF.
- TCM adopts a Limp Home Mode (LHM) operation.

Conditions for Clearing the DTC

- The DTC will clear when the malfunction has not occurred after ignition cycle.
- A history DTC will clear after 40 TCM power-up cycles with a warm transmission (>50 °C) and without a fault.
- History DTCs can be cleared by using a scan tool.

Diagnostic Aids

- During the TCM's testing, solenoid 2 is turned OFF/ ON by a very small (4 millisecond) pulses. This pulse is too short for the solenoid to react so the transmission operation is not affected.
- The solenoid feedback voltage is measured before the (4 millisecond) pulse and again during the pulse. If the difference is outside the acceptable limits the relevant fault is recorded.
- Typical causes would be an open circuit in the wiring to or within the solenoid, or a short circuit to power in the wiring to or within the solenoid.
- If several faults of solenoids are present, check the wiring or connectors that are common to the selected solenoids, especially the earth connections.

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۰۲۱-۸۸۸۶۲۰۸۸
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- Inspect the wiring for poor electrical connections at the TCM and at the 10-way transmission connector. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for chafed wires that could short to bare metal or other wiring. Inspect for broken wire inside the insulation.
- If diagnosing for a possible intermittent short or open condition, move or massage the wiring harness while observing test equipment for a change.
- Solenoid Logic for Static Gear States

Gear	S1	S2
1st	ON	ON
2nd	OFF	ON
3rd	OFF	OFF
4th	ON	OFF
Reverse	OFF	OFF
Neutral	OFF	OFF
Park	OFF	OFF

Test Description

The number(s) below refer to the step number(s) on the Diagnostic Table.

3. Checks if the S2 circuit in the transmission is malfunctioning.
4. Check cable in the transmission for open / short.
6. Check resistance between S2 terminal A and B. Standard value is 22 - 30 Ω.
9. Check connections of other connectors

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DTC P1734 Solenoid 2 Circuit Open

Step	Action	Value(s)	Yes	No
1	Perform a Transmission Control Module (TCM) Diagnostic System Check. Is the check performed?	-	Go to Step 2	Go to "TCM Diagnostic System Check"
2	1. Install the scan tool. 2. Turn the ignition ON, with the engine OFF. 3. Record and then clear DTCs. 4. Operate the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool display P1734?	-	Go to Step 3	Go to "Diagnostic Aids"
3	1. Turn the ignition OFF. 2. Disconnect the 10-way transmission connector. (additional DTCs will set) 3. Connect Solenoid/Thermistor Electrical Tester (STET) to the 10-way transmission connector of transmission side and to the good ground. 4. Turn the mode knob of STET to 2 and push the red button. Does the bulb of open circuit on the solenoids side of STET illuminate?	-	Go to Step 4	Go to Step 8
4	1. Remove the valve cover. Refer to the Transmission in this section. 2. Check the wiring harness from 10-way transmission connector to Solenoid 2 (S2) on the valve body for an open or short to positive and repair as necessary. Is a repair necessary?	-	Go to Step 11	Go to Step 5
5	Check the S2 necessarycircuit for an open and repair as necessary. Is a repair complete?	-	Go to Step 11	Go to Step 6

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DTC P1734 Solenoid 2 Circuit Open (Cont'd)

Step	Action	Value(s)	Yes	No
6	Using a Digital Volt Meter (DVM), measure the resistance between S2 terminal A and B. Is the resistance within the specified value?	22 - 30 Ω	Go to "Diagnostic Aids"	Go to Step 7
7	Replace the S2. Is the action complete?	-	Go to Step 11	-
8	1. Disconnect the TCM connector A. 2. Check the wiring harness from 10-way transmission connector terminal 2 to TCM terminal A11 for an open or short to positive and repair as necessary. Is a repair necessary?	-	Go to Step 11	Go to Step 9
9	Check for a poor connection at the 10-way transmission connector and TCM connector and repair the malfunctioning terminals as necessary. Is a repair necessary?	-	Go to Step 11	Go to Step 10
10	1. Turn the ignition OFF. 2. Replace the TCM. Is the action complete?	-	Go to Step 11	-
11	1. Using the scan tool, clear the DTCs. 2. Road test the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool indicate that this diagnostic has run and passed?	-	Go to Step 12	Go to Step 2
12	Check if any DTCs are set. Are there any DTCs displayed or previously recorded at Step 2 that have not been diagnosed?	-	Go to applicable DTC table	System OK, Check Complete

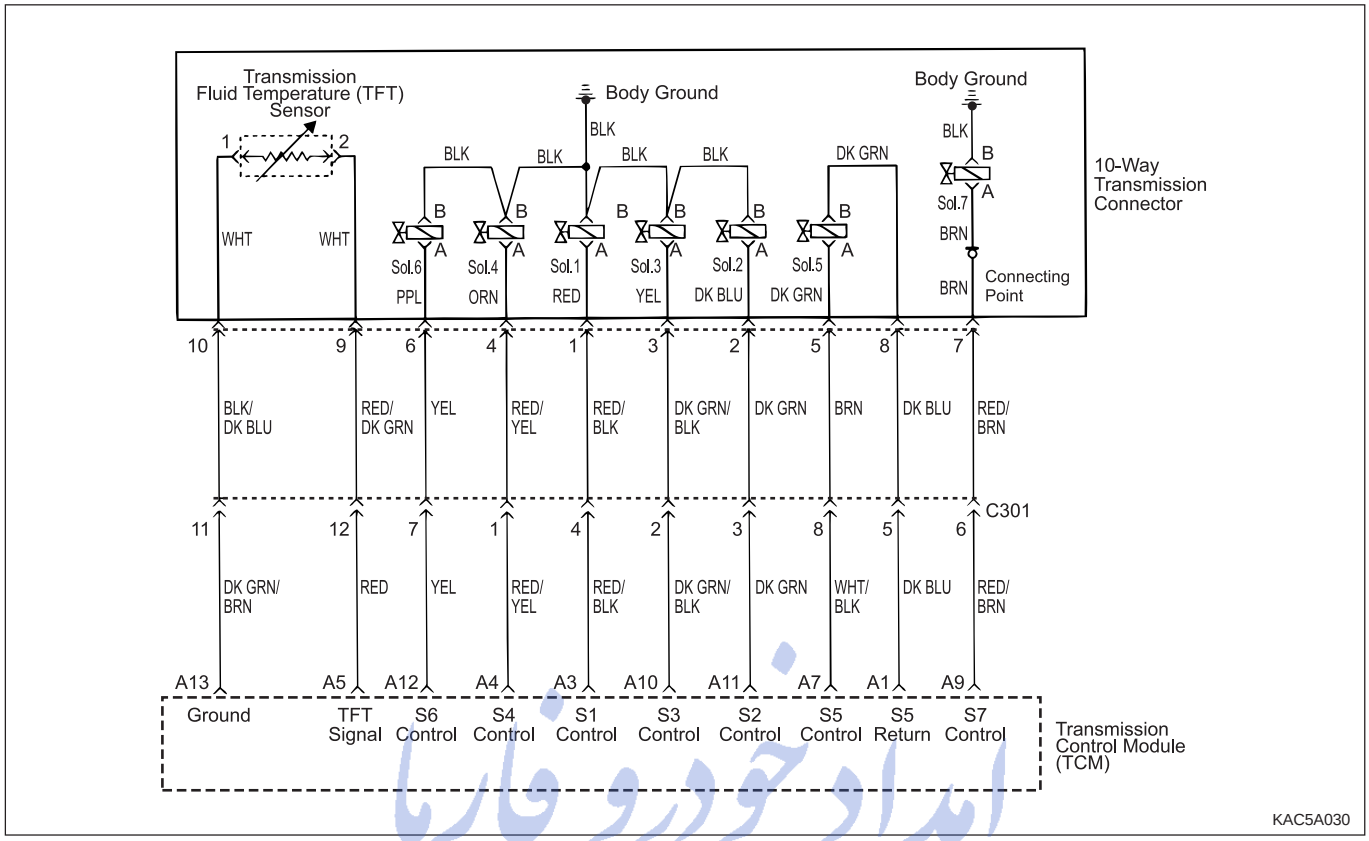
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DIAGNOSTIC TROUBLE CODE (DTC) P1735 SOLENOID 3 CIRCUIT OPEN

Circuit Description

The solenoid 3 is a normally open ON/OFF type solenoid that is used in conjunction with the solenoid 4 to control the shift quality and sequencing.

The solenoid 3 switches the clutch regulator valve OFF or ON and is attached to the valve body within the transmission. Voltage is supplied directly to the solenoid through the Transmission Control Module (TCM).

The DTC P1735 sets when the Solenoid 3 (S3) circuit is open or the switched leg of the solenoid 3 is shorted to battery positive. The solenoid 3's driver Integrated Chip (IC) status indicates a faulty circuit.

Conditions for Setting the DTC

- DTCs P1717 and P1718 are not set.
- S3 is OFF.
- S7 is OFF.
- The solenoid 3's driver Integrated Chip (IC) status indicates a faulty circuit. This condition must be continuously present for 60 milliseconds.

Action Taken When the DTC Sets

- The solenoid 3 is always OFF.
- The 1 → 3, 1 → 4, 2 → 3, 2 → 4, 3 → 1, 3 → 2, 4 → 2 and 4 → 1 shift quality is degraded.

Conditions for Clearing the DTC

- The DTC will clear when the malfunction has not occurred after ignition cycle.
- A history DTC will clear after 40 TCM power-up cycles with a warm transmission (>50 °C) and without a fault.
- History DTCs can be cleared by using a scan tool.

Diagnostic Aids

- During the TCM's testing, solenoid 3 is turned OFF/ON by a very small (4 millisecond) pulses. This pulse is too short for the solenoid to react so the transmission operation is not affected.
- The solenoid feedback voltage is measured before the (4 millisecond) pulse and again during the pulse. If the difference is outside the acceptable limits the relevant fault is recorded.
- Typical causes would be an open circuit in the wiring to or within the solenoid, or a short circuit to power in the wiring to or within the solenoid.
- If several faults of solenoids are present, check the wiring or connectors that are common to the selected solenoids, especially the earth connections.

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- Inspect the wiring for poor electrical connections at the TCM and at the 10-way transmission connector. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for chafed wires that could short to bare metal or other wiring. Inspect for broken wire in-side the insulation.
- If diagnosing for a possible intermittent short or open condition, move or massage the wiring harness while observing test equipment for a change.

Test Description

The number(s) below refer to the step number(s) on the Diagnostic Table.

3. Checks if the S3 circuit in the transmission is malfunctioning.
4. Check cable in the transmission for open / short.
6. Check resistance between S3 terminal A and B. Standard value is 22 - 30 Ω.
9. Check connections of other connectors

DTC P1735 Solenoid 3 Circuit Open

Step	Action	Value(s)	Yes	No
1	Perform a Transmission Control Module (TCM) Diagnostic System Check. Is the check performed?	-	Go to Step 2	Go to "TCM Diagnostic System Check"
2	1. Install the scan tool. 2. Turn the ignition ON, with the engine OFF. 3. Record and then clear DTCs. 4. Operate the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool display P1735?	-	Go to Step 3	Go to "Diagnostic Aids"
3	1. Turn the ignition OFF. 2. Disconnect the 10-way transmission connector. (additional DTCs will set) 3. Connect Solenoid/Thermistor Electrical Tester (STET) to the 10-way transmission connector of transmission side and to the good ground. 4. Turn the mode knob of STET to 3 and push the red button. Does the bulb of open circuit on the solenoids side of STET illuminate?	-	Go to Step 4	Go to Step 8
4	1. Remove the valve cover. Refer to the Transmission in this section. 2. Check the wiring harness from 10-way transmission connector to Solenoid 3 (S3) on the valve body for an open or short to positive and repair as necessary. Is a repair necessary?	-	Go to Step 11	Go to Step 5
5	Check the S3 ground circuit for an open and repair as necessary. Is a repair necessary?	-	Go to Step 11	Go to Step 6
6	Using a Digital Volt Meter (DVM), measure the resistance between S3 terminal A and B. Is the resistance within the specified value?	22 - 30 Ω	Go to "Diagnostic Aids"	Go to Step 7
7	Replace the S3. Is the action necessary?	-	Go to Step 11	-
8	1. Disconnect the TCM connector A. 2. Check the wiring harness from 10-way transmission connector terminal 3 to TCM terminal A10 for an open or short to positive and repair as necessary. Is a repair necessary?	-	Go to Step 11	Go to Step 9

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DTC P1735 Solenoid 3 Circuit Open (Cont'd)

Step	Action	Value(s)	Yes	No
9	Check for a poor connection at the 10-way transmission connector and TCM connector and repair the malfunctioning terminals as necessary. Is a repair necessary?	-	Go to Step 11	Go to Step 10
10	1. Turn the ignition OFF. 2. Replace the TCM. Is the action complete?	-	Go to Step 11	-
11	1. Using the scan tool, clear the DTCs. 2. Road test the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool indicate that this diagnostic has run and passed?	-	Go to Step 12	Go to Step 2
12	Check if any DTCs are set. Are there any DTCs displayed or previously recorded at Step 2 that have not been diagnosed?	-	Go to applicable DTC table	System OK, Check Complete

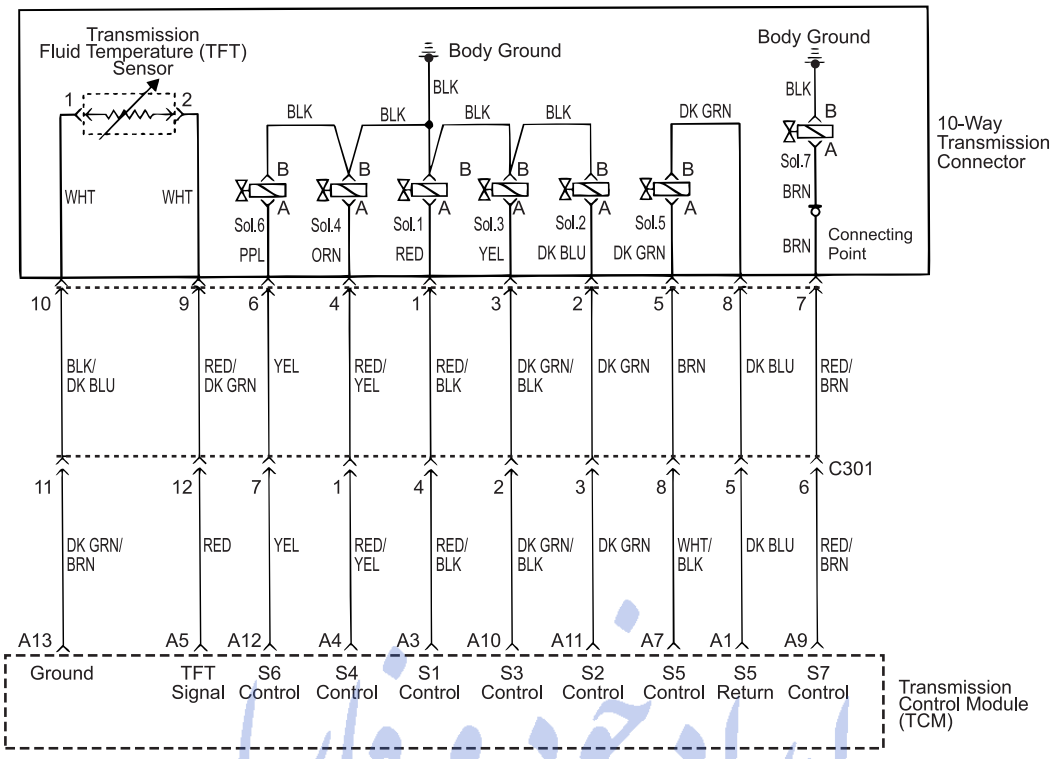
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DIAGNOSTIC TROUBLE CODE (DTC) P1736 SOLENOID 4 CIRCUIT OPEN

Circuit Description

The solenoid 4 is a normally open ON/OFF type solenoid that is used in conjunction with the solenoid 3 to control the shift quality and sequencing.

The solenoid 4 switches the clutch regulator valve OFF or ON and is attached to the valve body within the transmission. Voltage is supplied directly to the solenoid through the Transmission Control Module (TCM).

The DTC P1736 sets when the Solenoid 4 (S4) circuit is open or the switched leg of the solenoid 4 is shorted to battery positive. The solenoid 4's driver Integrated Chip (IC) status indicates a faulty circuit.

Conditions for Setting the DTC

- DTCs P1717 and P1718 are not set.
- S4 is OFF.
- S6 is OFF.
- The solenoid 3's driver Integrated Chip (IC) status indicates a faulty circuit. This condition must be continuously present for 60 milliseconds.

Action Taken When the DTC Sets

- The solenoid 4 is always OFF.
- The 1 → 2, 1 → 4, 2 → 3, 2 → 4, 3 → 2 (all including manual), 3 → 4, 4 → 1 and 4 → 3 shift quality is degraded.

Conditions for Clearing the DTC

- The DTC will clear when the malfunction has not occurred after ignition cycle.
- A history DTC will clear after 40 TCM power-up cycles with a warm transmission (>50 °C) and without a fault.
- History DTCs can be cleared by using a scan tool.

Diagnostic Aids

- During the TCM's testing, solenoid 4 is turned OFF/ON by a very small (4 millisecond) pulses. This pulse is too short for the solenoid to react so the transmission operation is not affected.
- The solenoid feedback voltage is measured before the (4 millisecond) pulse and again during the pulse. If the difference is outside the acceptable limits the relevant fault is recorded.
- Typical causes would be an open circuit in the wiring to or within the solenoid, or a short circuit to power in the wiring to or within the solenoid.
- If several faults of solenoids are present, check the wiring or connectors that are common to the selected solenoids, especially the earth connections.

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- Inspect the wiring for poor electrical connections at the TCM and at the 10-way transmission connector. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for chafed wires that could short to bare metal or other wiring. Inspect for broken wire inside the insulation.
- If diagnosing for a possible intermittent short or open condition, move or massage the wiring harness while observing test equipment for a change.

Test Description

The number(s) below refer to the step number(s) on the Diagnostic Table.

3. Checks if the S4 circuit in the transmission is malfunctioning.
4. Check cable in the transmission for open / short.
6. Check resistance between S4 terminal A and B. Standard value is 22 - 30 Ω.
9. Check connections of other connectors

DTC P1736 Solenoid 4 Circuit Open

Step	Action	Value(s)	Yes	No
1	Perform a Transmission Control Module (TCM) Diagnostic System Check. Is the check performed?	-	Go to Step 2	Go to "TCM Diagnostic System Check"
2	1. Install the scan tool. 2. Turn the ignition ON, with the engine OFF. 3. Record and then clear DTCs. 4. Operate the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool display P1736?	-	Go to Step 3	Go to "Diagnostic Aids"
3	1. Turn the ignition OFF. 2. Disconnect the 10-way transmission connector. (additional DTCs will set) 3. Connect Solenoid/Thermistor Electrical Tester (STET) to the 10-way transmission connector of transmission side and to the good ground. 4. Turn the mode knob of STET to 4 and push the red button. Does the bulb of open circuit on the solenoids side of STET illuminate?	-	Go to Step 4	Go to Step 8
4	1. Remove the valve cover. Refer to the Transmission in this section. 2. Check the wiring harness from 10-way transmission connector to Solenoid 4 (S4) on the valve body for an open or short to positive and repair as necessary. Is a repair necessary?	-	Go to Step 11	Go to Step 5
5	Check the S4 ground circuit for an open and repair as necessary. Is a repair necessary?	-	Go to Step 11	Go to Step 6
6	Using a Digital Volt Meter (DVM), measure the resistance between S4 terminal A and B. Is the resistance within the specified value?	22 - 30 Ω	Go to "Diagnostic Aids"	Go to Step 7
7	Replace the S4. Is the action necessary?	-	Go to Step 11	-
8	1. Disconnect the TCM connector A. 2. Check the wiring harness from 10-way transmission connector terminal 4 to TCM terminal A4 for an open or short to positive and repair as necessary. Is a repair necessary?	-	Go to Step 11	Go to Step 9

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DTC P1736 Solenoid 4 Circuit Open (Cont'd)

Step	Action	Value(s)	Yes	No
9	Check for a poor connection at the 10-way transmission connector and TCM connector and repair the malfunctioning terminals as necessary. Is a repair necessary?	-	Go to Step 11	Go to Step 10
10	1. Turn the ignition OFF. 2. Replace the TCM. Is the action complete?	-	Go to Step 11	-
11	1. Using the scan tool, clear the DTCs. 2. Road test the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool indicate that this diagnostic has run and passed?	-	Go to Step 12	Go to Step 2
12	Check if any DTCs are set. Are there any DTCs displayed or previously recorded at Step 2 that have not been diagnosed?	-	Go to applicable DTC table	System OK, Check Complete

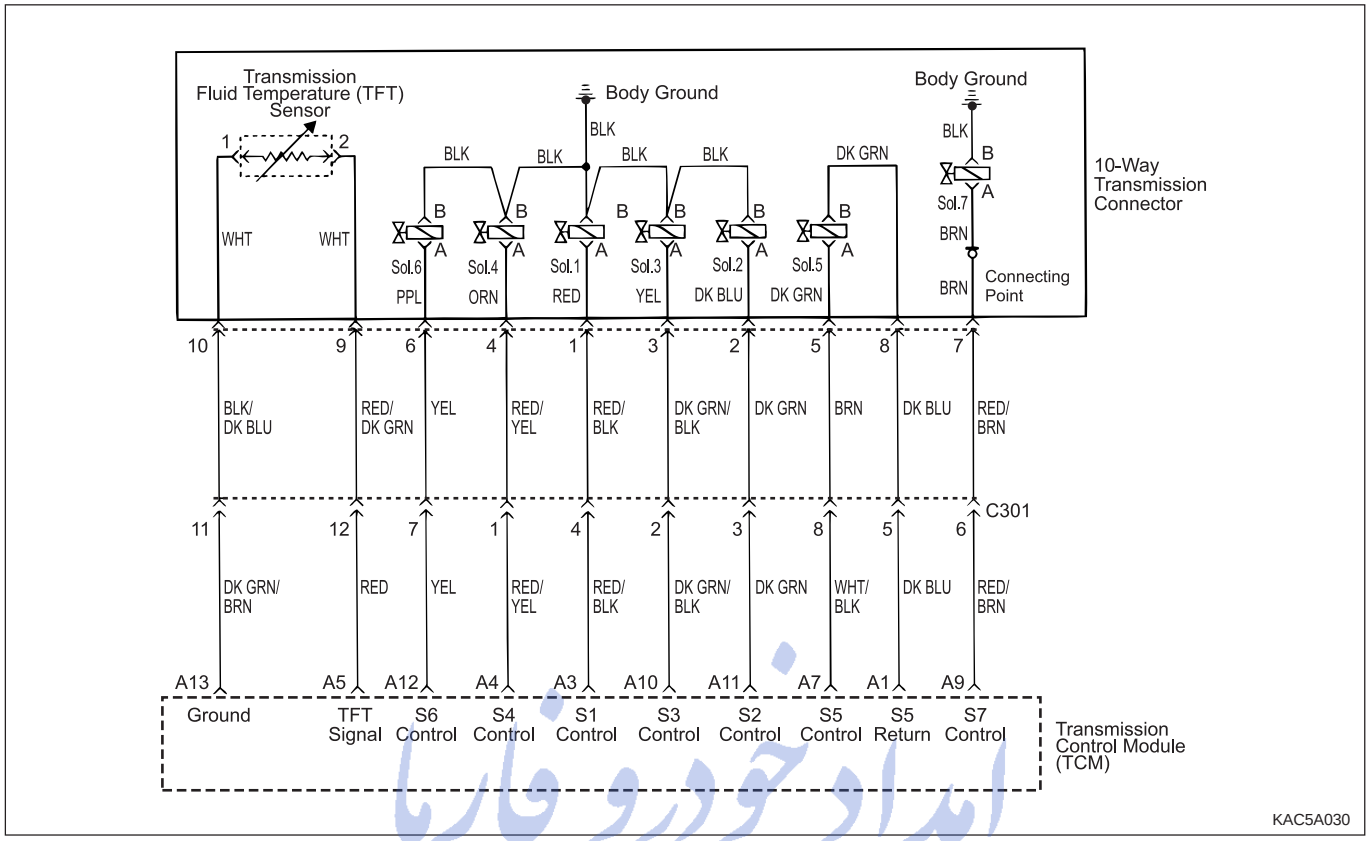
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DIAGNOSTIC TROUBLE CODE (DTC) P1737 SOLENOID 5 CIRCUIT OPEN

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Circuit Description

The solenoid 5 is a variable force solenoid that ramps the pressure during the gear changes and solenoid switching, to enhance the transmission shift quality. This solenoid provides the signal pressure to the clutch and band regulator, thereby controlling the shift pressure.

The solenoid 5 is attached to the valve body within the transmission. Voltage is supplied directly to the solenoid through the Transmission Control Module (TCM).

The DTC P1737 sets when the solenoid 5 (S5) circuit is open or the switched leg of the solenoid 5 is shorted to battery positive. The solenoid 5's driver Integrated Chip (IC) status indicates a fauty circuit.

Conditions for Setting the DTC

- DTCs P1717 and P1718 are not set.
- The solenoid 5's driver Integrated Chip (IC) status indicates a faulty circuit. This condition must be continuously present for 60 milliseconds.
- The measured S5 current is greater than 100 mA below its expected lower limit.

Action Taken When the DTC Sets

- Solenoid 5 is disabled (always OFF).
- The shift quality is degraded.

Conditions for Clearing the DTC

- The DTC will clear when the malfunction has not occurred after ignition cycle.
- A history DTC will clear after 40 TCM power-up cycles with a warm transmission (>50 °C) and without a fault.
- History DTCs can be cleared by using a scan tool.

Diagnostic Aids

- The current to solenoid 5 was outside acceptable limits.
- This fault results from a mismatch between the current set point for solenoid 5 and the current measured by the feedback within the TCM.
- Typical causes would be an open circuit or short circuit to power in the wiring to, from or within the solenoid.
- It is also possible that there has been a fault in the solenoid output circuit. But if this is the cause, the fault should be continually present.
- Inspect the wiring for poor electrical connections at the TCM and at the 10-way transmission connector. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for chafed wires that could short to bare metal or other wiring. Inspect for broken wire in-side the insulation.

- If diagnosing for a possible intermittent short or open condition, move or massage the wiring harness while observing test equipment for a change.

Test Description

The number(s) below refer to the step number(s) on the Diagnostic Table.

3. Checks if the S5 circuit in the transmission is malfunctioning.
4. Check cable in the transmission for open / short.
6. Check resistance between S5 terminal A and B. Standard value is 3.6 - 5.5 Ω.
9. Check connections of other connectors

DTC P1737 Solenoid 5 Circuit Open

Step	Action	Value(s)	Yes	No
1	Perform a Transmission Control Module (TCM) System Check. Is the check performed?	-	Go to Step 2	Go to "TCM Diagnostic System Check"
2	1. Install the scan tool. 2. Turn the ignition ON, with the engine OFF. 3. Record and then clear DTCs. 4. Operate the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool display P1737?	-	Go to Step 3	Go to "Diagnostic Aids"
3	1. Turn the ignition OFF. 2. Disconnect the 10-way transmission connector. (additional DTCs will set) 3. Connect Solenoid/Thermistor Electrical Tester (STET) to the 10-way transmission connector of transmission side. 4. Turn the mode knob of STET to 5 and push the red button. Does the bulb of open circuit on the solenoids side of STET illuminate?	-	Go to Step 4	Go to Step 7
4	1. Remove the valve cover. Refer to the Transmission in this section. 2. Check the wiring harnesses from 10-way trans mission connector to Solenoid 5 (S5) on the valve body for an open or short to positive and repair as necessary. Is a repair complete?	-	Go to Step 11	Go to Step 5
5	Using a Digital Volt Meter (DVM), measure the resistance between S5 terminal A and B. Is the resistance within the specified value?	3.6 - 5.5 Ω	Go to "Diagnostic Aids"	Go to Step 6
6	Replace the S5. Is the action complete?	-	Go to Step 11	-
7	1. Disconnect the TCM connector A. 2. Check the wiring harness from 10-way transmission connector terminal 5 to TCM terminal A1 for an open or short to battery and repair as necessary. Is a repair necessary?	-	Go to Step 11	Go to Step 8
8	Check the wiring harness from 10-way transmission connector terminal 8 to TCM terminal A7 for an open and repair as necessary. Is a repair necessary?	-	Go to Step 11	Go to Step 9

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DTC P1737 Solenoid 5 Circuit Open (Cont'd)

Step	Action	Value(s)	Yes	No
9	Check for a poor connection at the 10-way transmission connector and TCM connector and repair the malfunctioning terminals as necessary. Is a repair necessary?	-	Go to Step 11	Go to Step 10
10	1. Turn the ignition OFF. 2. Replace the TCM. Is the action complete?	-	Go to Step 11	-
11	1. Using the scan tool, clear the DTCs. 2. Road test the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool indicate that this diagnostic has run and passed?	-	Go to Step 12	Go to Step 2
12	Check if any DTCs are set. Are there any DTCs displayed or previously recorded at Step 2 that have not been diagnosed?	-	Go to applicable DTC table	System OK, Check Complete

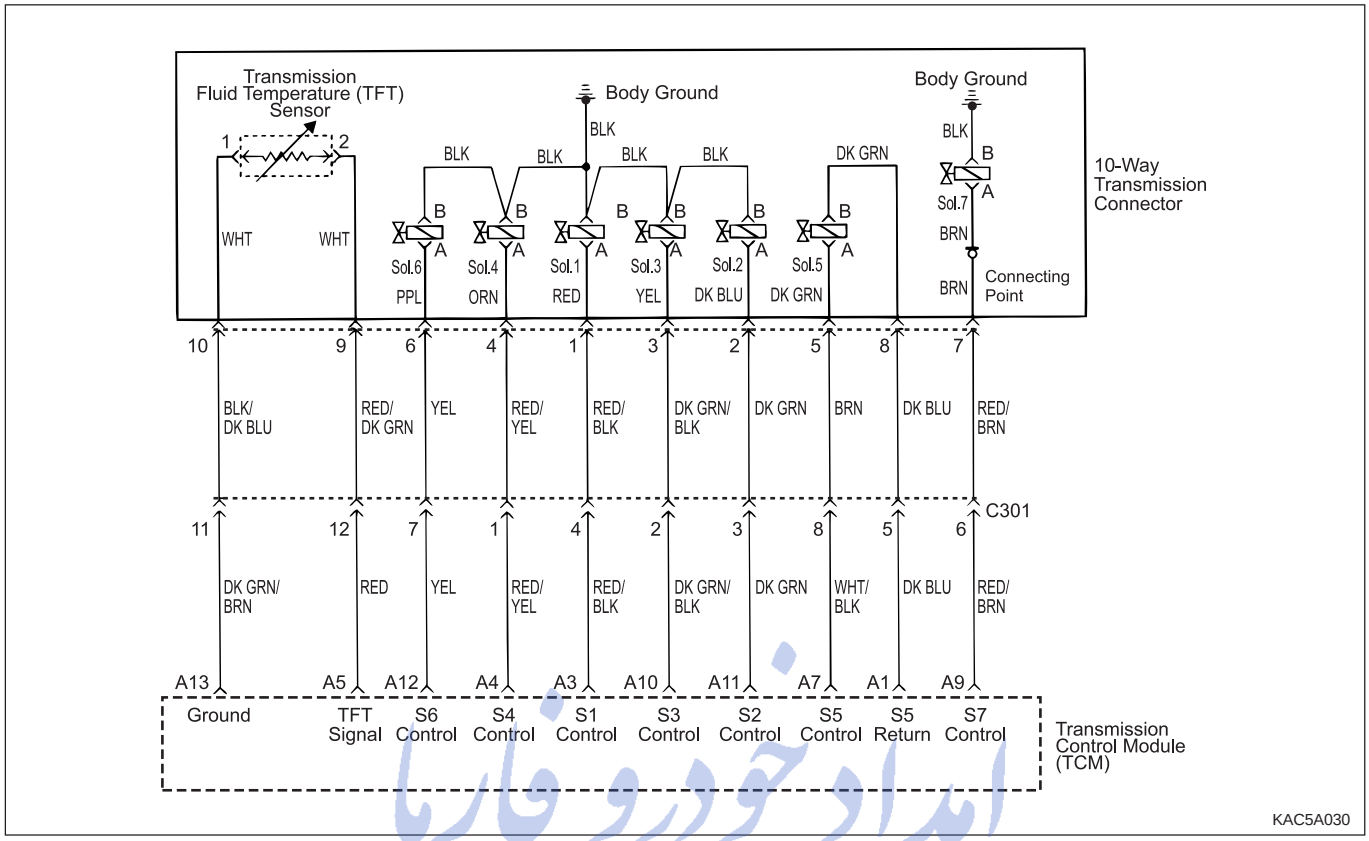
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DIAGNOSTIC TROUBLE CODE (DTC) P1738 SOLENOID 6 CIRCUIT OPEN

Circuit Description

The solenoid 6 is a normally open ON/OFF type solenoid that is used to set the high/ low level of line pressure.

The Solenoid 6 (S6) OFF gives high pressure and the S6 is attached to the valve body within the transmission. Voltage is supplied directly to the solenoid through the Transmission Control Module (TCM).

The DTC P1738 sets when the solenoid 6 circuit is open or the switched leg of the solenoid 6 is shorted to battery positive. The solenoid 6's driver Integrated Chip (IC) status indicates a faulty circuit.

Conditions for Setting the DTC

- DTCs P1717 and P1718 are not set.
- S6 is OFF.
- S4 is OFF.
- The solenoid 6's driver Integrated Chip (IC) status indicates a faulty circuit. This condition must be continuously present for 60 milliseconds.

Action Taken When the DTC Sets

- The solenoid 6 is disabled (OFF) resulting in high line pressure being applied continuously.

Conditions for Clearing the DTC

- The DTC will clear when the malfunction has not occurred after ignition cycle.
- A history DTC will clear after 40 TCM power-up cycles with a warm transmission (>50 °C) and without a fault.
- History DTCs can be cleared by using a scan tool.

Diagnostic Aids

- During the TCM's testing, solenoid 6 is turned OFF/ ON by a very small (4 millisecond) pulses. This pulse is too short for the solenoid to react so the transmission operation is not affected.
- The solenoid feedback voltage is measured before the (4 millisecond) pulse and again during the pulse. If the difference is outside the acceptable limits the relevant fault is recorded.
- Typical causes would be an open circuit in the wiring to or within the solenoid, or a short circuit to power in the wiring to or within the solenoid.
- If several faults of solenoids are present, check the wiring or connectors that are common to the selected solenoids, especially the earth connections.

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۰۲۱-۸۸۴۶۲۰۸۸
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- Inspect the wiring for poor electrical connections at the TCM and at the 10-way transmission connector. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for chafed wires that could short to bare metal or other wiring. Inspect for broken wire inside the insulation.
- If diagnosing for a possible intermittent short or open condition, move or massage the wiring harness while observing test equipment for a change.

Test Description

The number(s) below refer to the step number(s) on the Diagnostic Table.

3. Checks if the S6 circuit in the transmission is malfunctioning.
4. Check cable in the transmission for open / short.
6. Check resistance between S6 terminal A and B. Standard value is 22 - 30 Ω.
9. Check connections of other connectors

DTC P1738 Solenoid 6 Circuit Open

Step	Action	Value(s)	Yes	No
1	Perform a Transmission Control Module (TCM) System Check. Is the check performed?	-	Go to Step 2	Go to "TCM Diagnostic System Check"
2	1. Install the scan tool. 2. Turn the ignition ON, with the engine OFF. 3. Record and then clear DTCs. 4. Operate the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool display P1738?	-	Go to Step 3	Go to "Diagnostic Aids"
3	1. Turn the ignition OFF. 2. Disconnect the 10-way transmission connector. (additional DTCs will set) 3. Connect Solenoid/Thermistor Electrical Tester (STET) to the 10-way transmission connector of transmission side and to the good ground. 4. Turn the mode knob of STET to 6 and push the red button. Does the bulb of open circuit on the solenoids side of STET illuminate?	-	Go to Step 4	Go to Step 8
4	1. Remove the valve cover. Refer to the Transmission in this section. 2. Check the wiring harness from 10-way transmission connector to Solenoid 6 (S6) on the valve body for an open or short to positive and repair as necessary. Is a repair necessary?	-	Go to Step 11	Go to Step 5
5	Check the S6 ground circuit for an open and repair as necessary. Is a repair necessary?	-	Go to Step 11	Go to Step 6
6	Using a Digital Volt Meter (DVM), measure the resistance between S6 terminal A and B. Is the resistance within the specified value?	22 - 30 Ω	Go to "Diagnostic Aids"	Go to Step 7
7	Replace the S6. Is the action complete?	-	Go to Step 11	-
8	1. Disconnect the TCM connector A. 2. Check the wiring harness from 10-way transmission connector terminal 6 to TCM terminal A12 for an open and repair as necessary. Is a repair necessary?	-	Go to Step 11	Go to Step 9

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تلفن شبانه روزی: ۰۸۵-۳۲۲۲۰۸۸۵
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DTC P1738 Solenoid 6 Circuit Open (Cont'd)

Step	Action	Value(s)	Yes	No
9	Check for a poor connection at the 10-way transmission connector and TCM connector and repair the malfunctioning terminals as necessary. Is a repair necessary?	-	Go to Step 11	Go to Step 10
10	1. Turn the ignition OFF. 2. Replace the TCM. Is the action complete?	-	Go to Step 11	-
11	1. Using the scan tool, clear the DTCs. 2. Road test the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool indicate that this diagnostic has run and passed?	-	Go to Step 12	Go to Step 2
12	Check if any DTCs are set. Are there any DTCs displayed or previously recorded at Step 2 that have not been diagnosed?	-	Go to applicable DTC table	System OK, Check Complete

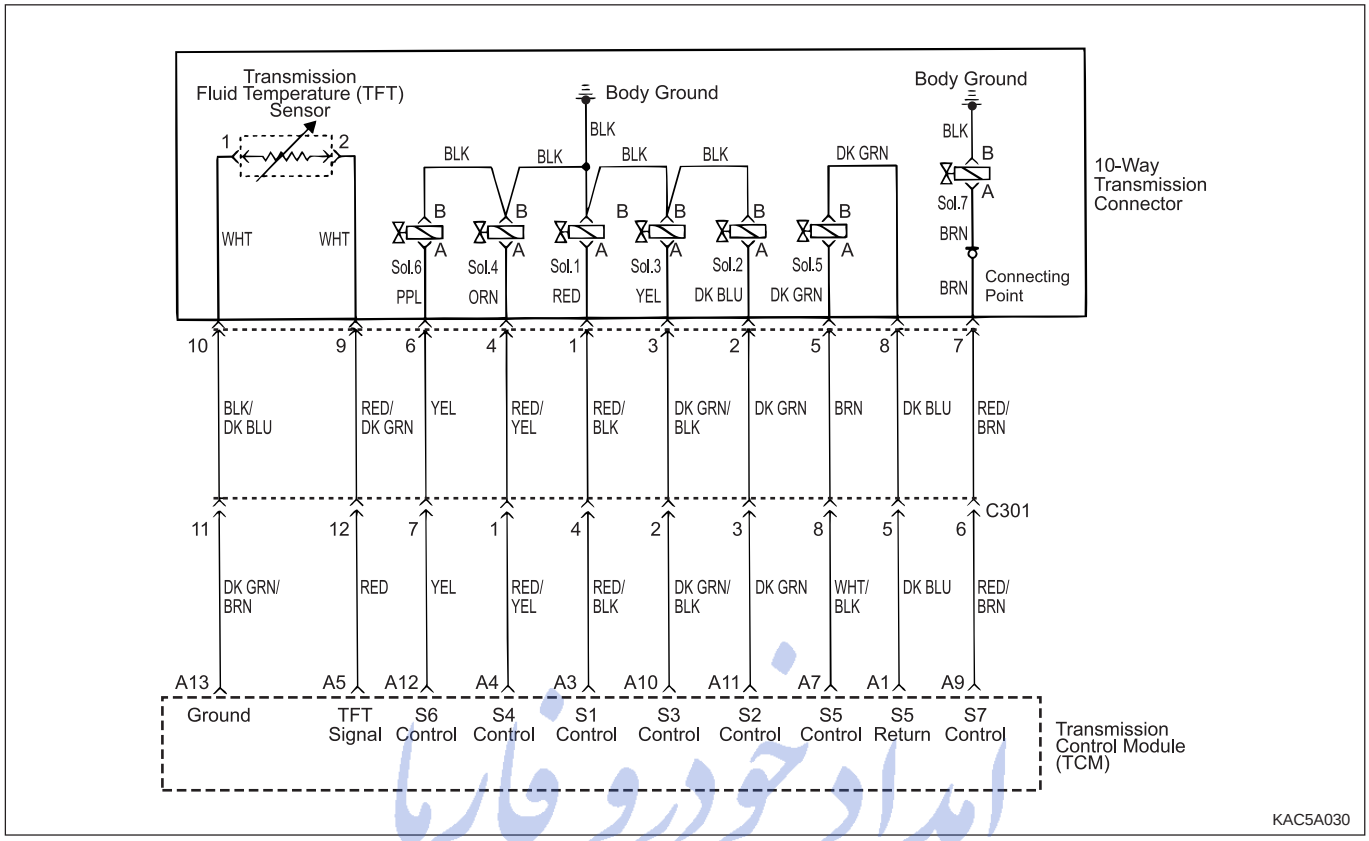
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DIAGNOSTIC TROUBLE CODE (DTC) P1739 SOLENOID 7 CIRCUIT OPEN

Circuit Description

The solenoid 7 is a normally open ON/OFF type solenoid that is used to control the application of the Torque Converter Clutch (TCC).

The Solenoid 7 (S7) ON activates the TCC and the S7 is attached to the pump body within the transmission. Voltage is supplied directly to the solenoid through the Transmission Control Module (TCM).

The DTC P1739 sets when the solenoid 7, Torque Converter Clutch Solenoid, circuit is open or the switched leg of the solenoid 7 is shorted to battery positive. The solenoid 7's driver Integrated Chip (IC) status indicates a faulty circuit.

Conditions for Setting the DTC

- DTCs P1717 and P1718 are not set.
- S7 is OFF.
- S3 is OFF.
- The solenoid 7's driver Integrated Chip (IC) status indicates a faulty circuit. This condition must be continuously present for 60 milliseconds.

Action Taken When the DTC Sets

- The solenoid 7 is always disabled (OFF) resulting in the TCC being unlocked always.

Conditions for Clearing the DTC

- The DTC will clear when the malfunction has not occurred after ignition cycle.
- A history DTC will clear after 40 TCM power-up cycles with a warm transmission (>50 °C) and without a fault.
- History DTCs can be cleared by using a scan tool.

Diagnostic Aids

- During the TCM's testing, solenoid 7 is turned OFF/ON by a very small (4 millisecond) pulses. This pulse is too short for the solenoid to react so the transmission operation is not affected.
- The solenoid feedback voltage is measured before the (4 millisecond) pulse and again during the pulse. If the difference is outside the acceptable limits the relevant fault is recorede.
- Typical causes would be an open circuit in the wiring to or within the solenoid, or a short circuit to power in the wiring to or within the solenoid.
- If several faults of solenoids are present, check the wiring or connectors that are common to the selected solenoids, especially the earth connections.
- Inspect the wiring for poor electrical connections at the TCM and at the 10-way transmission connector.

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۰۲۱-۸۸۸۶۲۰۸۸
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Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for chafed wires that could short to bare metal or other wiring. Inspect for broken wire inside the insulation.

- If diagnosing for a possible intermittent short or open condition, move or massage the wiring harness while observing test equipment for a change.

Test Description

The number(s) below refer to the step number(s) on the Diagnostic Table.

3. Checks if the S7 circuit in the transmission is malfunctioning.
4. Check cable in the transmission for open / short. If the problem is found in the wiring harness from 10-way transmission connector to contact point attached onto the transmission case, repair it with removing the valve cover. Refer to the Transmission in this section.
7. Check resistance between S7 terminal A and B. Standard value is 22 - 30 Ω.
10. Check connections of other connectors.

DTC P1739 Solenoid 7 Circuit Open

Step	Action	Value(s)	Yes	No
1	Perform a Transmission Control Module (TCM) System Check. Is the check performed?	-	Go to Step 2	Go to "TCM Diagnostic System Check"
2	1. Install the scan tool. 2. Turn the ignition ON, with the engine OFF. 3. Record and then clear DTCs. 4. Operate the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool display P1739?	-	Go to Step 3	Go to "Diagnostic Aids"
3	1. Turn the ignition OFF. 2. Disconnect the 10-way transmission connector. (additional DTCs will set) 3. Connect Solenoid/Thermistor Electrical Tester (STET) to the 10-way transmission connector of transmission side and to the good ground. 4. Turn the mode knob of STET to 7 and push the red button. Does the bulb of open circuit on the solenoids side of STET illuminate?	-	Go to Step 4	Go to Step 9
4	1. Remove the pump assembly. Refer to the Pump in this section. 2. Check the wiring harness from 10-way transmission connector to contact point attached onto the transmission case for an open or short to positive and repair as necessary. Is a repair necessary?	-	Go to Step 12	Go to Step 5
5	Check the wiring harness from contact point attached onto the transmission case to S7 for an open or short to positive and repair as necessary. Is a repair necessary?	-	Go to Step 12	Go to Step 6
6	Check the S7 ground circuit for an open and repair as necessary. Is a repair necessary?	-	Go to Step 12	Go to Step 7
7	Using a Digital Volt Meter (DVM), measure the resistance between S7 terminal A and B. Is the resistance within the specified value?	22 - 30 Ω	Go to "Diagnostic Aids"	Go to Step 8
8	Replace the S7. Is the action complete?	-	Go to Step 12	-

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DTC P1739 Solenoid 7 Circuit Open (Cont'd)

Step	Action	Value(s)	Yes	No
9	1. Disconnect the TCM connector A. 2. Check the wiring harness from 10-way transmission connector terminal 7 to TCM terminal A9 for an open or short to positive and repair as necessary. Is a repair necessary?	-	Go to Step 12	Go to Step 10
10	Check for a poor connection at the 10-way transmission connector and TCM connector and repair the malfunctioning terminals as necessary. Is a repair necessary?	-	Go to Step 12	Go to Step 11
11	1. Turn the ignition OFF. 2. Replace the TCM. Is the action complete?	-	Go to Step 12	-
12	1. Using the scan tool, clear the DTCs. 2. Road test the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool indicate that this diagnostic has run and passed?	-	Go to Step 13	Go to Step 2
13	Check if any DTCs are set. Are there any DTCs displayed or previously recorded at Step 2 that have not been diagnosed?	-	Go to applicable DTC table	System OK, Check Complete

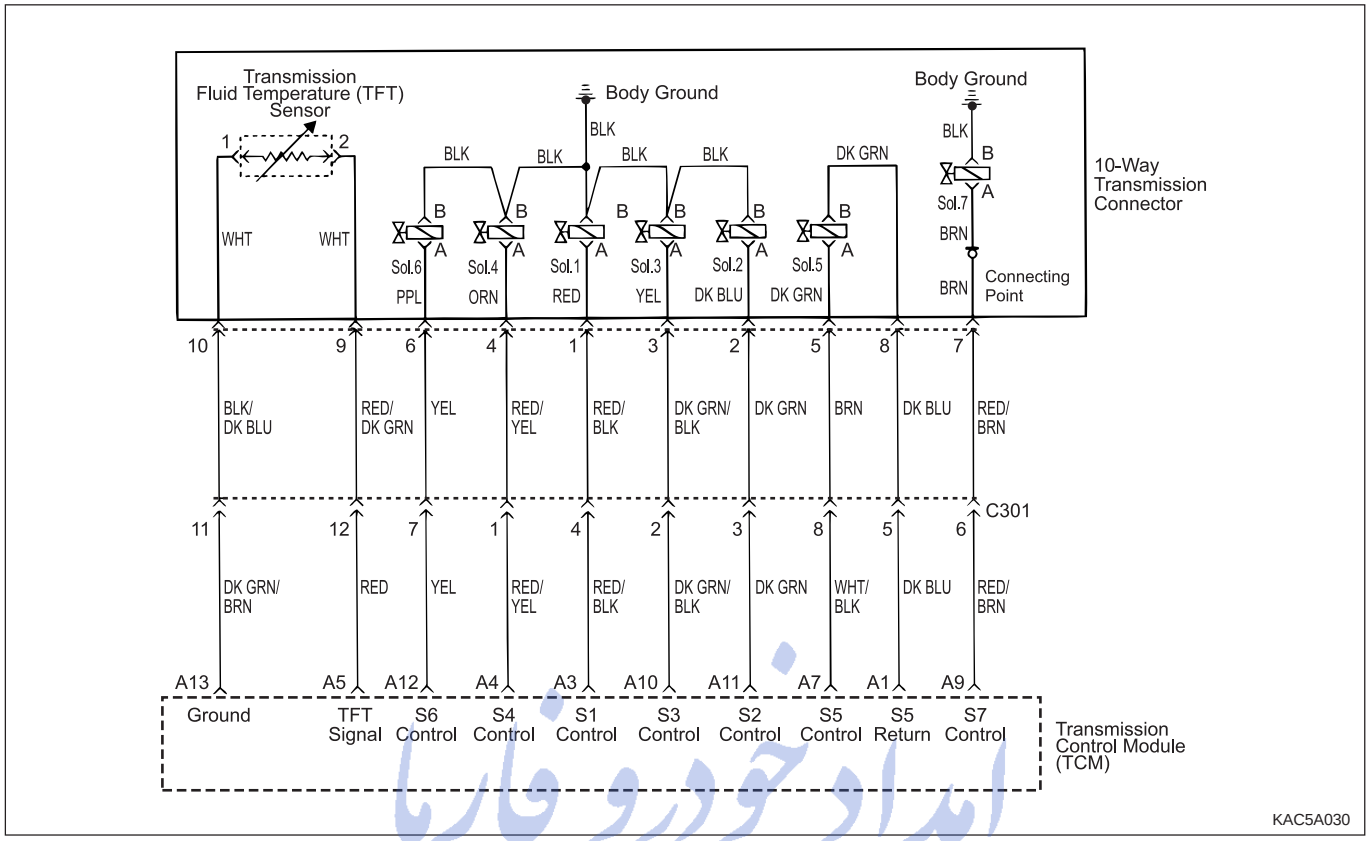
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DIAGNOSTIC TROUBLE CODE (DTC) P1741
SOLENOID 1 CIRCUIT SHORT

Circuit Description

The solenoid 1 is used to control fluid flow acting on the 1 - 2 shift valve. The solenoid 1 is a normally open ON/ OFF type solenoid that is used in conjunction with the solenoid 2 to allow four different shifting combinations. Refer to Static Gear Status.

The solenoid is attached to the valve body within the transmission. Voltage is supplied directly to the solenoid through the Transmission Control Module (TCM).

The DTC P1741 sets when the Solenoid 1 (S1) circuit is shorted to ground. The solenoid 1's driver Integrated Chip (IC) status indicates a faulty circuit.

Conditions for Setting the DTC

- DTCs P1717 and P1718 are not set.
- S1 is ON.
- The solenoid 1's driver Integrated Chip (IC) status indicates a faulty circuit. This condition must be continuously present for 60 milliseconds.

Action Taken When the DTC Sets

- The solenoid 1 is always OFF.
- TCM adopts a Limp Home Mode (LHM) operation.

Conditions for Clearing the DTC

- The DTC will clear when the malfunction has not occurred after ignition cycle.
- A history DTC will clear after 40 TCM power-up cycles with a warm transmission (>50 °C) and without a fault.
- History DTCs can be cleared by using a scan tool.

Diagnostic Aids

- During the TCM's testing, solenoid 1 is turned OFF/ ON by a very small (4 millisecond) pulses. This pulse is too short for the solenoid to react so the transmission operation is not affected.
- The solenoid feedback voltage is measured before the (4 millisecond) pulse and again during the pulse. If the difference is outside the acceptable limits the relevant fault is recorded.
- Typical causes would be a short circuit to ground in the wiring to or within the solenoid.
- If several faults of solenoids are present, check the wiring or connectors that are common to the selected solenoids, especially the earth connections.
- Inspect the wiring for poor electrical connections at the TCM and at the 10-way transmission connector. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for chafed wires that could short to bare metal or other wiring. Inspect for broken wire in-side the insulation.

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- If diagnosing for a possible intermittent short or open condition, move or massage the wiring harness while observing test equipment for a change.
- Solenoid Logic for Static Gear States

Gear	S1	S2
1st	ON	ON
2nd	OFF	ON
3rd	OFF	OFF
4th	ON	OFF
Reverse	OFF	OFF
Neutral	OFF	OFF
Park	OFF	OFF

Test Description

The number(s) below refer to the step number(s) on the Diagnostic Table.

3. Checks if the S1 circuit in the transmission is malfunctioning.
4. Check cable in the transmission for short to ground.
6. Check resistance between S1 terminal A and B. Standard value is 22 - 30 Ω .
9. Check connections of other connectors.

DTC P1741 Solenoid 1 Circuit Short

Step	Action	Value(s)	Yes	No
1	Perform a Transmission Control Module (TCM) System Check. Is the check performed?	-	Go to Step 2	Go to "TCM Diagnostic System Check"
2	1. Install the scan tool. 2. Turn the ignition ON, with the engine OFF. 3. Record and then clear DTCs. 4. Operate the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool display	-	Go to Step 3	Go to "Diagnostic Aids"
3	1. Turn the ignition OFF. 2. Disconnect the 10-way transmission connector. (additional DTCs will set) 3. Connect Solenoid/Thermistor Electrical Tester (STET) to the 10-way transmission connector of transmission side and to the good ground. 4. Turn the mode knob of STET to 1 and push the red button. Does the bulb of close circuit on the solenoids side of STET illuminate?	-	Go to Step 4	Go to Step 8
4	1. Remove the valve cover. Refer to the Transmission in this section. 2. With a test light connected to B+, probe the wiring harness from 10-way transmission connector to Solenoid 1 (S1) on the valve body. Does the test light illuminate?	-	Go to Step 5	Go to Step 6
5	Repair the short to ground in the wiring harness. Is the repair complete?	-	Go to Step 11	-
6	Using a Digital Volt Meter (DVM), measure the resistance between S1 terminal A and B. Is the resistance within the specified value?	20 - 30 Ω	Go to "Diagnostic Aids"	Go to Step 7
7	Replace the S1. Is the action complete?	-	Go to Step 11	-

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DTC P1741 Solenoid 1 Circuit Short (Cont'd)

Step	Action	Value(s)	Yes	No
8	1. Disconnect the TCM connector A. 2. With a test light connected to B+, probe the wiring harness from 10-way transmission connector terminal 1 to TCM terminal A3. Does the test light illuminate?	-	Go to Step 5	Go to Step 9
9	Check for a poor connection at the 10-way transmission connector and TCM connector and repair the malfunctioning terminals as necessary. Is a repair necessary?	-	Go to Step 11	Go to Step 10
10	1. Turn the ignition OFF. 2. Replace the TCM. Is the action complete?	-	Go to Step 11	-
11	1. Using the scan tool, clear the DTCs. 2. Road test the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool indicate that this diagnostic has run and passed?	-	Go to Step 12	Go to Step 2
12	Check if any DTCs are set. Are there any DTCs displayed or previously recorded at Step 2 that have not been diagnosed?	-	Go to applicable DTC table	System OK, Check Complete

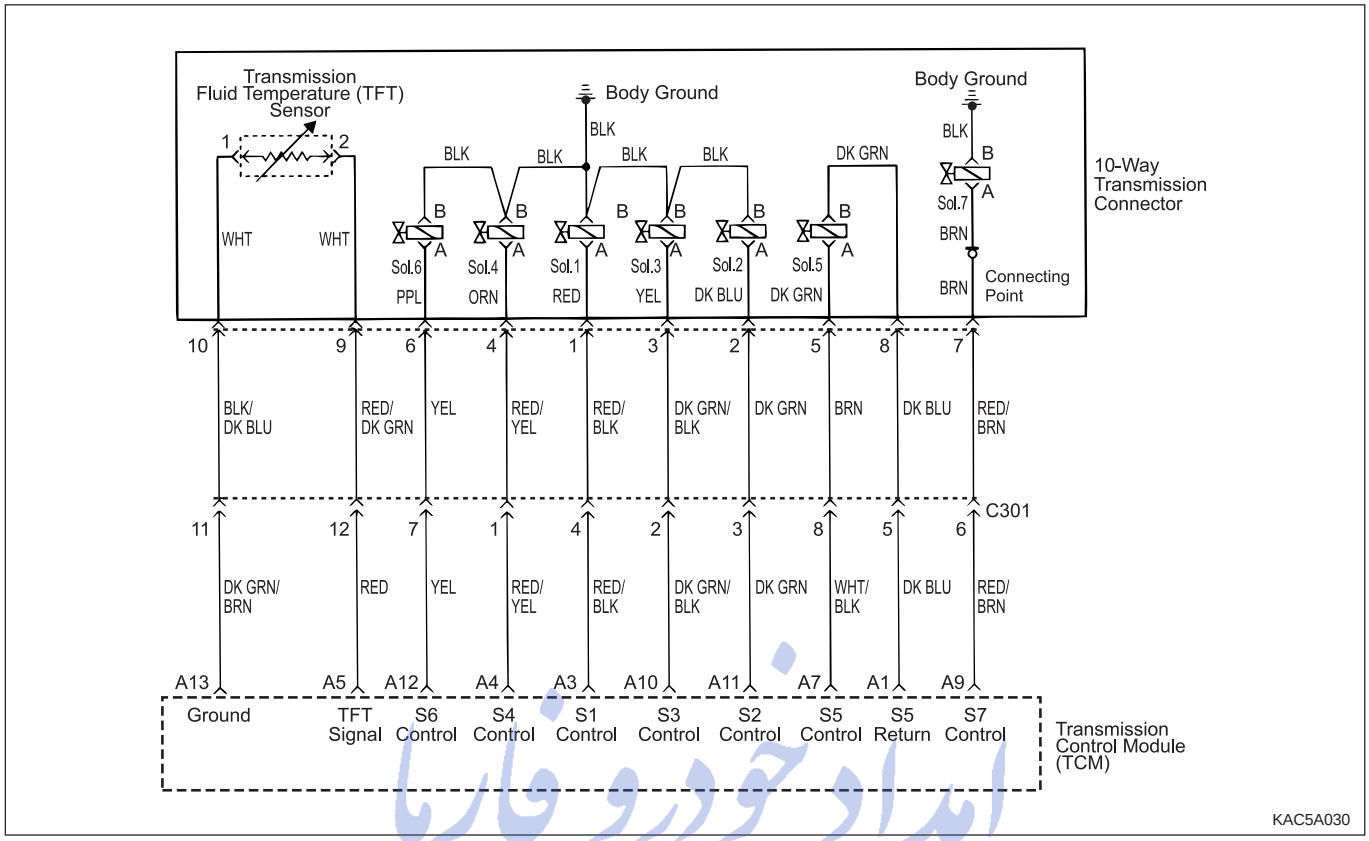
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DIAGNOSTIC TROUBLE CODE (DTC) P1742
SOLENOID 2 CIRCUIT SHORT

Circuit Description

The solenoid 2 is used to control fluid flow acting on the 2 - 3 shift valve. The solenoid 2 is a normally open ON/OFF type solenoid that is used in conjunction with the solenoid 1 to allow four different shifting combinations. Refer to Static Gear Status.

The solenoid is attached to the valve body within the transmission. Voltage is supplied directly to the solenoid through the Transmission Control Module (TCM).

The DTC P1742 sets when the Solenoid 2 (S2) circuit is shorted to ground. The solenoid 2's driver Integrated Chip (IC) status indicates a faulty circuit.

Conditions for Setting the DTC

- DTCs P1717 and P1718 are not set.
- S2 is ON.
- The solenoid 2's driver Integrated Chip (IC) status indicates a faulty circuit. This condition must be continuously present for 60 milliseconds.

Action Taken When the DTC Sets

- The solenoid 2 is always OFF.
- TCM adopts a Limp Home Mode (LHM) operation.

Conditions for Clearing the DTC

- The DTC will clear when the malfunction has not occurred after ignition cycle.
- A history DTC will clear after 40 TCM power-up cycles with a warm transmission (>50 °C) and without a fault.
- History DTCs can be cleared by using a scan tool.

Diagnostic Aids

- During the TCM's testing, solenoid 2 is turned OFF/ ON by a very small (4 millisecond) pulses. This pulse is too short for the solenoid to react so the transmission operation is not affected.
- The solenoid feedback voltage is measured before the (4 millisecond) pulse and again during the pulse. If the difference is outside the acceptable limits the relevant fault is recorded.
- Typical causes would be a short circuit to ground in the wiring to or within the solenoid.
- If several faults of solenoids are present, check the wiring or connectors that are common to the selected solenoids, especially the earth connections.
- Inspect the wiring for poor electrical connections at the TCM and at the transmission 10-way connector. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for chafed wires that could short to bare metal or other wiring. Inspect for broken wire inside the insulation.

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۰۲۱-۸۸۳۴۲۰۸۵
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- If diagnosing for a possible intermittent short or open condition, move or massage the wiring harness while observing test equipment for a change.
- Solenoid Logic for Static Gear States

Gear	S1	S2
1st	ON	ON
2nd	OFF	ON
3rd	OFF	OFF
4th	ON	OFF
Reverse	OFF	OFF
Neutral	OFF	OFF
Park	OFF	OFF

Test Description

The number(s) below refer to the step number(s) on the Diagnostic Table.

3. Checks if the S2 circuit in the transmission is malfunctioning.
4. Check cable in the transmission for short to ground.
6. Check resistance between S2 terminal A and B. Standard value is 22 - 30 Ω.
9. Check connections of other connectors.

DTC P1742 Solenoid 2 Circuit Short

Step	Action	Value(s)	Yes	No
1	Perform a Transmission Control Module (TCM) System Check. Is the check performed?	-	Go to Step 2	Go to "TCM Diagnostic System Check"
2	1. Install the scan tool. 2. Turn the ignition ON, with the engine OFF. 3. Record and then clear DTCs. 4. Operate the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool display P1742?	-	Go to Step 3	Go to "Diagnostic Aids"
3	1. Turn the ignition OFF. 2. Disconnect the 10-way transmission connector. (additional DTCs will set) 3. Connect Solenoid/Thermistor Electrical Tester (STET) to the 10-way transmission connector of transmission side and to the good ground. 4. Turn the mode knob of STET to 2 and push the red button. Does the bulb of close circuit on the solenoids side of STET illuminate?	-	Go to Step 4	Go to Step 8
4	1. Remove the valve cover. Refer to the Transmission in this section. 2. With a test light connected to B+, probe the wiring harness from 10-way transmission connector to Solenoid 2 (S2) on the valve body. Does the test light illuminate?	-	Go to Step 5	Go to Step 6
5	Repair the short to ground in the wiring harness. Is the repair complete?	-	Go to Step 11	-
6	Using a Digital Volt Meter (DVM), measure the resistance between S2 terminal A and B. Is the resistance within the specified value?	20 - 30 Ω	Go to "Diagnostic Aids"	Go to Step 7
7	Replace the S2. Is the action complete?	-	Go to Step 11	-

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DTC P1742 Solenoid 2 Circuit Short (Cont'd)

Step	Action	Value(s)	Yes	No
8	1. Disconnect the TCM connector A. 2. With a test light connected to B+, probe the wiring harness from 10-way transmission connector terminal 2 to TCM terminal A11. Does the test light illuminate?	-	Go to Step 5	Go to Step 9
9	Check for a poor connection at the 10-way transmission connector and TCM connector and repair the malfunctioning terminals as necessary. Is a repair necessary?	-	Go to Step 11	Go to Step 10
10	1. Turn the ignition OFF. 2. Replace the TCM. Is the action complete?	-	Go to Step 11	-
11	1. Using the scan tool, clear the DTCs. 2. Road test the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool indicate that this diagnostic has run and passed?	-	Go to Step 12	Go to Step 2
12	Check if any DTCs are set. Are there any DTCs displayed or previously recorded at Step 2 that have not been diagnosed?	-	Go to applicable DTC table	System OK, Check Complete

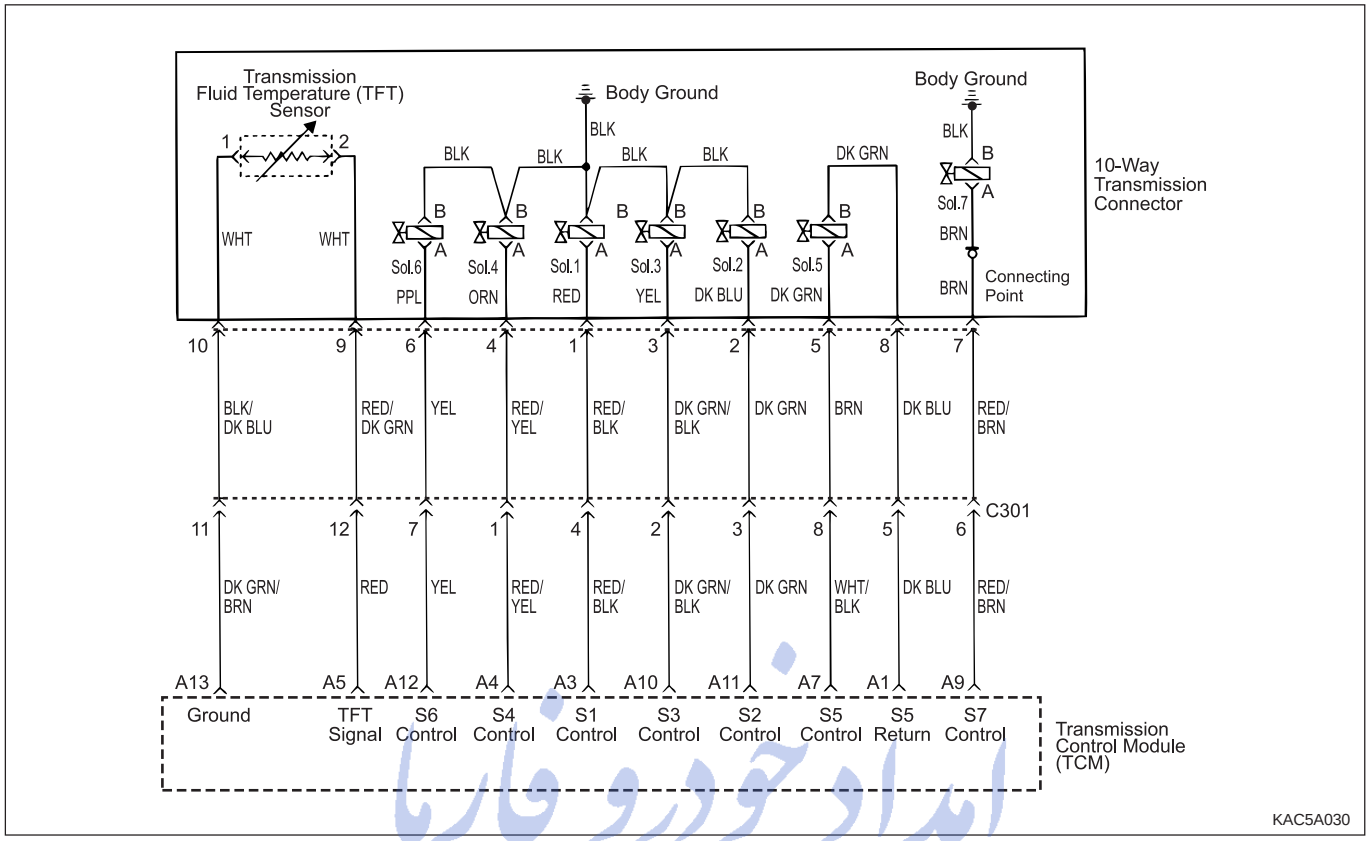
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DIAGNOSTIC TROUBLE CODE (DTC) P1743
SOLENOID 3 CIRCUIT SHORT

Circuit Description

The solenoid 3 is a normally open ON/OFF type solenoid that is used in conjunction with the solenoid 4 to control the shift quality and sequencing.

The solenoid 3 switches the clutch regulator valve OFF or ON and is attached to the valve body within the transmission. Voltage is supplied directly to the solenoid through the Transmission Control Module (TCM).

The DTC P1743 sets when the Solenoid 3 (S3) circuit is shorted to ground. The solenoid 3's driver Integrated Chip (IC) status indicates a faulty circuit.

Conditions for Setting the DTC

- DTCs P1717 and P1718 are not set.
- S3 is ON.
- The solenoid 3's driver Integrated Chip (IC) status indicates a faulty circuit. This condition must be continuously present for 60 milliseconds.

Action Taken When the DTC Sets

- The solenoid 3 is always OFF.
- The 1 → 3, 1 → 4, 2 → 3, 2 → 4, 3 → 1, 3 → 2, 4 → 2 and 4 1 shift quality is degraded.

Conditions for Clearing the DTC

- The DTC will clear when the malfunction has not occurred after ignition cycle.
- A history DTC will clear after 40 TCM power-up cycles with a warm transmission (>50 °C) and without a fault.
- History DTCs can be cleared by using a scan tool.

Diagnostic Aids

- During the TCM's testing, solenoid 3 is turned OFF/ON by a very small (4 millisecond) pulses. This pulse is too short for the solenoid to react so the transmission operation is not affected.
- The solenoid feedback voltage is measured before the (4 millisecond) pulse and again during the pulse. If the difference is outside the acceptable limits the relevant fault is recorded.
- Typical causes would be a short circuit to ground in the wiring to or within the solenoid.
- If several faults of solenoids are present, check the wiring or connectors that are common to the selected solenoids, especially the earth connections.
- Inspect the wiring for poor electrical connections at the TCM and at the 10-way transmission connector. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for chafed wires that could short to bare metal or other wiring. Inspect for broken wire inside the insulation.

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- If diagnosing for a possible intermittent short or open condition, move or massage the wiring harness while observing test equipment for a change.

Test Description

The number(s) below refer to the step number(s) on the Diagnostic Table.

3. Checks if the S3 circuit in the transmission is malfunctioning.
4. Check cable in the transmission for short to ground.
6. Check resistance between S3 terminal A and B. Standard value is 22 - 30 Ω.
9. Check connections of other connectors.

DTC P1743 Solenoid 3 Circuit Short

Step	Action	Value(s)	Yes	No
1	Perform a Transmission Control Module (TCM) System Check. Is the check performed?	-	Go to Step 2	Go to "TCM Diagnostic System Check"
2	1. Install the scan tool. 2. Turn the ignition ON, with the engine OFF. 3. Record and then clear DTCs. 4. Operate the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool display P1743?	-	Go to Step 3	Go to "Diagnostic Aids"
3	1. Turn the ignition OFF. 2. Disconnect the 10-way transmission connector. (additional DTCs will set) 3. Connect Solenoid/Thermistor Electrical Tester (STET) to the 10-way transmission connector of transmission side and to the good ground. 4. Turn the mode knob of STET to 3 and push the red button. Does the bulb of close circuit on the solenoids side of STET illuminate?	-	Go to Step 4	Go to Step 8
4	1. Remove the valve cover. Refer to the Transmission in this section. 2. With a test light connected to B+, probe the wiring harness from 10-way transmission connector to Solenoid 3 (S3) on the valve body. Does the test light illuminate?	-	Go to Step 5	Go to Step 6
5	Repair the short to ground in the wiring harness. Is the repair complete?	-	Go to Step 11	-
6	Using a Digital Volt Meter (DVM), measure the resistance between S3 terminal A and B. Is the resistance within the specified value?	20 - 30 Ω	Go to "Diagnostic Aids"	Go to Step 7
7	Replace the S3. Is the action complete?	-	Go to Step 11	-
8	1. Disconnect the TCM connector A. 2. With a test light connected to B+, probe the wiring harness from 10-way transmission connector terminal 3 to TCM terminal A10. Does the test light illuminate?	-	Go to Step 5	Go to Step 9
9	Check for a poor connection at the 10-way transmission connector and TCM connector and repair the malfunctioning terminals as necessary. Is a repair necessary?	-	Go to Step 11	Go to Step 10

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DTC P1743 Solenoid 3 Circuit Short (Cont'd)

Step	Action	Value(s)	Yes	No
10	1. Turn the ignition OFF. 2. Replace the TCM. Is the action complete?	-	Go to Step 11	-
11	1. Using the scan tool, clear the DTCs. 2. Road test the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool indicate that this diagnostic has run and passed?	-	Go to Step 12	Go to Step 2
12	Check if any DTCs are set. Are there any DTCs displayed or previously recorded at Step 2 that have not been diagnosed?	-	Go to applicable DTC table	System OK, Check Complete

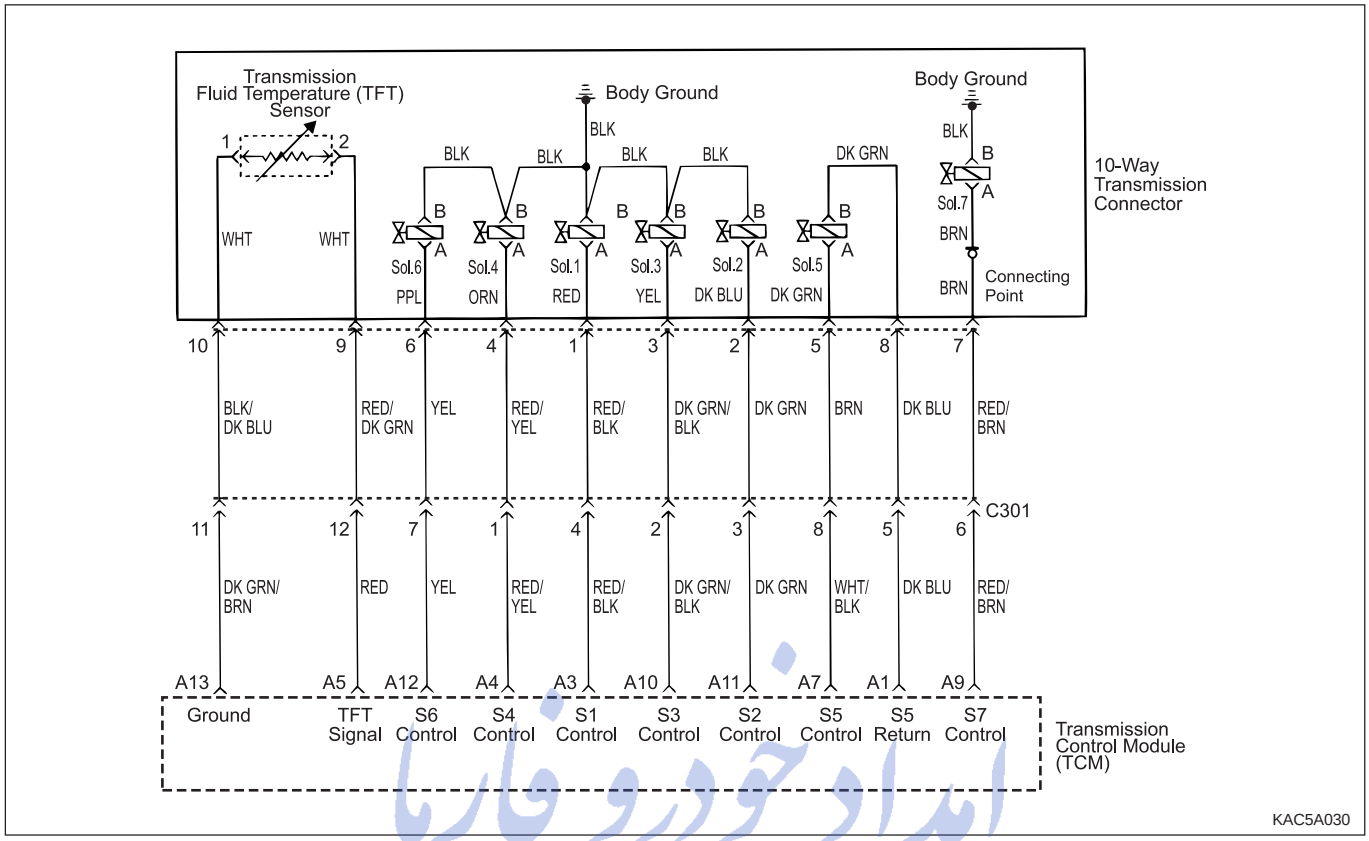
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DIAGNOSTIC TROUBLE CODE (DTC) P1744
SOLENOID 4 CIRCUIT SHORT

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Circuit Description

The solenoid 4 is a normally open ON/OFF type solenoid that is used in conjunction with the solenoid 3 to control the shift quality and sequencing.

The solenoid 4 switches the band regulator valve OFF or ON and is attached to the valve body within the transmission.

Voltage is supplied directly to the solenoid through the Transmission Control Module (TCM).

The DTC P1744 sets when the Solenoid 4 (S4) circuit is shorted to ground. The solenoid 4's driver Integrated Chip (IC) status indicates a faulty circuit.

Conditions for Setting the DTC

- DTCs P1717 and P1718 are not set.
- S4 is ON.
- The solenoid 4's driver Integrated Chip (IC) status indicates a faulty circuit. This condition must be continuously present for 60 milliseconds.

Action Taken When the DTC Sets

- The solenoid 4 is always OFF.
- The 1 → 2, 1 → 4, 2 → 3, 2 → 4, 3 → 1, 3 → 2 (all including manual), 3 → 4, 4 → 1 and 4 → 3 shift quality is degraded.

Conditions for Clearing the DTC

- The DTC will clear when the malfunction has not occurred after ignition cycle.
- A history DTC will clear after 40 TCM power-up cycles with a warm transmission (>50 °C) and without a fault.
- History DTCs can be cleared by using a scan tool.

Diagnostic Aids

- During the TCM's testing, solenoid 4 is turned OFF/ON by a very small (4 millisecond) pulses. This pulse is too short for the solenoid to react so the transmission operation is not affected.
- The solenoid feedback voltage is measured before the (4 millisecond) pulse and again during the pulse. If the difference is outside the acceptable limits the relevant fault is recorded.
- Typical causes would be a short circuit to ground in the wiring to or within the solenoid.
- If several faults of solenoids are present, check the wiring or connectors that are common to the selected solenoids, especially the earth connections.

- Inspect the wiring for poor electrical connections at the TCM and at the 10-way transmission connector. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for chafed wires that could short to bare metal or other wiring. Inspect for broken wire inside the insulation.
- If diagnosing for a possible intermittent short or open condition, move or massage the wiring harness while observing test equipment for a change.

Test Description

The number(s) below refer to the step number(s) on the Diagnostic Table.

3. Checks if the S4 circuit in the transmission is malfunctioning.
4. Check cable in the transmission for short to ground.
6. Check resistance between S4 terminal A and B. Standard value is 22 - 30 Ω.
9. Check connections of other connectors.

DTC P1744 Solenoid 4 Circuit Short

Step	Action	Value(s)	Yes	No
1	Perform Transmission Control Module (TCM) System Check. Is the check performed?	-	Go to Step 2	Go to "TCM Diagnostic System Check"
2	1. Install the scan tool. 2. Turn the ignition ON, with the engine OFF. 3. Record and then clear DTCs. 4. Operate the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool display P1744?	-	Go to Step 3	Go to "Diagnostic Aids"
3	1. Turn the ignition OFF. 2. Disconnect the 10-way transmission connector. (additional DTCs will set) 3. Connect Solenoid/Thermistor Electrical Tester (STET) to the 10-way transmission connector of transmission side and to the good ground. 4. Turn the mode knob of STET to 4 and push the red button. Does the bulb of close circuit on the solenoids side of STET illuminate?	-	Go to Step 4	Go to Step 8
4	1. Remove the valve cover. Refer to the Transmission in this section. 2. With a test light connected to B+, probe the wiring harness from 10-way transmission connector to Solenoid 4 (S4) on the valve body. Does the test light illuminate?	-	Go to Step 5	Go to Step 6
5	Repair the short to ground in the wiring harness. Is the repair complete?	-	Go to Step 11	-
6	Using a Digital Volt Meter (DVM), measure the resistance between S4 terminal A and B. Is the resistance within the specified value?	20 - 30 Ω	Go to "Diagnostic Aids"	Go to Step 7
7	Replace the S4. Is the action complete?	-	Go to Step 11	-
8	1. Disconnect the TCM connector A. 2. With a test light connected to B+, probe the wiring harness from 10-way transmission connector terminal 4 to TCM terminal A4. Does the test light illuminate?	-	Go to Step 5	Go to Step 9

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DTC P1744 Solenoid 4 Circuit Short (Cont'd)

Step	Action	Value(s)	Yes	No
9	Check for a poor connection at the 10-way transmission connector and TCM connector and repair the malfunctioning terminals as necessary. Is a repair necessary?	-	Go to Step 11	Go to Step 10
10	1. Turn the ignition OFF. 2. Replace the TCM. Is the action complete?	-	Go to Step 11	-
11	1. Using the scan tool, clear the DTCs. 2. Road test the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool indicate that this diagnostic has run and passed?	-	Go to Step 12	Go to Step 2
12	Check if any DTCs are set. Are there any DTCs displayed or previously recorded at Step 2 that have not been diagnosed?	-	Go to applicable DTC table	System OK, Check Complete

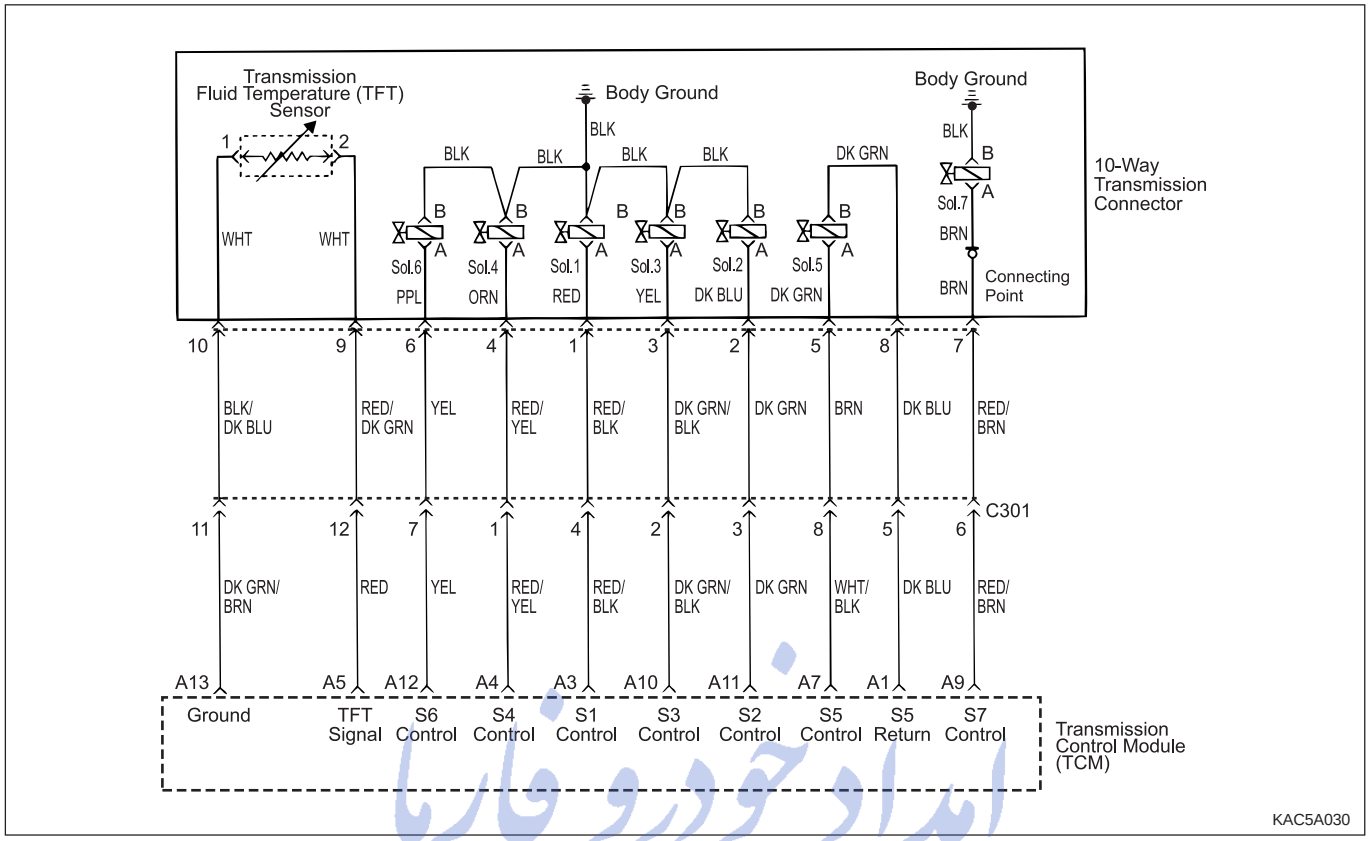
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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵

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DIAGNOSTIC TROUBLE CODE (DTC) P1745
SOLENOID 5 CIRCUIT SHORT

Circuit Description

The solenoid 5 is a variable force solenoid that ramps the pressure during the gear changes and solenoid switching, to enhance the transmission shift quality. This solenoid provides the signal pressure to the clutch and band regulator, there by controlling the shift pressure.

The solenoid 5 is attached to the valve body within the transmission. Voltage is supplied directly to the solenoid through the Transmission Control Module (TCM).

The DTC P1745 sets when the Solenoid 5 (S5) circuit is shorted to ground. The solenoid 5's driver Integrated Chip (IC) status indicates a faulty circuit.

Conditions for Setting the DTC

- DTCs P1717 and P1718 are not set.
- S5 is ON.
- The solenoid 5's driver Integrated Chip (IC) status indicates a faulty circuit. This condition must be continuously present for 60 milliseconds.

Action Taken When the DTC Sets

- Solenoid 5 is disabled (always OFF)
- The shift quality is degraded.

Conditions for Clearing the DTC

- The DTC will clear when the malfunction has not occurred after ignition cycle.
- A history DTC will clear after 40 TCM power-up cycles with a warm transmission (>50 °C) and without a fault.
- History DTCs can be cleared by using a scan tool.

Diagnostic Aids

- The current to solenoid 5 was outside acceptable limits.
- This fault results from a mismatch between the current set point for solenoid 5 and the current measured by the feedback within the TCM.
- Typical causes would be a short circuit to ground in the wiring to, from or within the solenoid.
- It is also possible that there has been a fault in the solenoid output circuit. But if this is the cause, the fault should be continually present.
- Inspect the wiring for poor electrical connections at the TCM and at the 10-way transmission connector. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for chafed wires that could short to bare metal or other wiring. Inspect for broken wire inside the insulation.
- If diagnosing for a possible intermittent short or open condition, move or massage the wiring harness while observing test equipment for a change.

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۰۲۱-۸۸۳۴۲۰۸۵
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Test Description

The number(s) below refer to the step number(s) on the Diagnostic Table.

3. Checks if the S5 circuit in the transmission is malfunctioning.
4. Check cable in the transmission for short to ground.
6. Check resistance between S5 terminal A and B. Standard value is 3.6 - 5.5 Ω.
10. Check connections of other connectors.

DTC P1745 Solenoid 5 Circuit Short

Step	Action	Value(s)	Yes	No
1	Perform Transmission Control Module (TCM) System Check. Is the check performed?	-	Go to Step 2	Go to "TCM Diagnostic System Check"
2	1. Install the scan tool. 2. Turn the ignition ON, with the engine OFF. 3. Record and then clear DTCs. 4. Operate the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool display P1745?	-	Go to Step 3	Go to "Diagnostic Aids"
3	1. Turn the ignition OFF. 2. Disconnect the 10-way transmission connector. (additional DTCs will set) 3. Connect Solenoid/Thermistor Electrical Tester (STET) to the 10-way transmission connector of transmission side. 4. Turn the mode knob of STET to 5 and push the red button. Does the bulb of close circuit on the solenoids side of STET illuminate?	-	Go to Step 4	Go to Step 8
4	1. Remove the valve cover. Refer to the Transmission in this section. 2. With a test light connected to B+ probe the wiring harnesses from 10-way transmission connector to Solenoid 5 (S5) on the valve body. Does the test light illuminate?	-	Go to Step 5	Go to Step 6
5	Repair the short to ground in the wiring harness. Is the repair complete?	-	Go to Step 12	-
6	Using a Digital Volt Meter (DVM), measure the resistance between S5 terminal A and B. Is the resistance within the specified value?	3.6 - 5.5 Ω	Go to "Diagnostic Aids"	Go to Step 7
7	Replace the S5. Is the action complete?	-	Go to Step 12	-
8	1. Disconnect the TCM connector A. 2. With a test light connected to B+, probe the wiring harness from 10-way transmission connector terminal 5 to TCM terminal. Does the test light illuminate?	-	Go to Step 5	Go to Step 9
9	Probe the wiring harness from 10-way transmission connector terminal 8 to TCM terminal A1. Does the test light illuminate?	-	Go to Step 5	Go to Step 10
10	Check for a poor connection at the 10-way transmission connector and TCM connector and repair the malfunctioning terminals as necessary. Is a repair necessary?	-	Go to Step 12	Go to Step 11

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DTC P1745 Solenoid 5 Circuit Short (Cont'd)

Step	Action	Value(s)	Yes	No
11	1. Turn the ignition OFF. 2. Replace the TCM. Is the action complete?	-	Go to Step 12	-
12	1. Using the scan tool, clear the DTCs. 2. Road test the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool indicate that this diagnostic has run and passed?	-	Go to Step 13	Go to Step 2
13	Check if any DTCs are set. Are any there DTCs displayed or previously recorded at Step 2 that have not been diagnosed?	-	Go to applicable DTC table	System OK, Check Complete

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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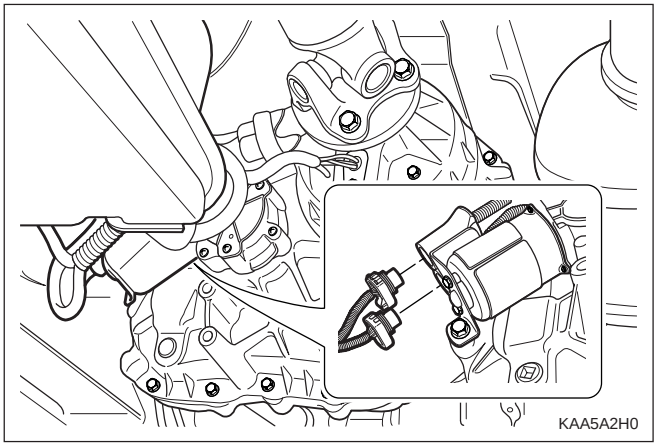
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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵

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REPAIR INSTRUCTIONS

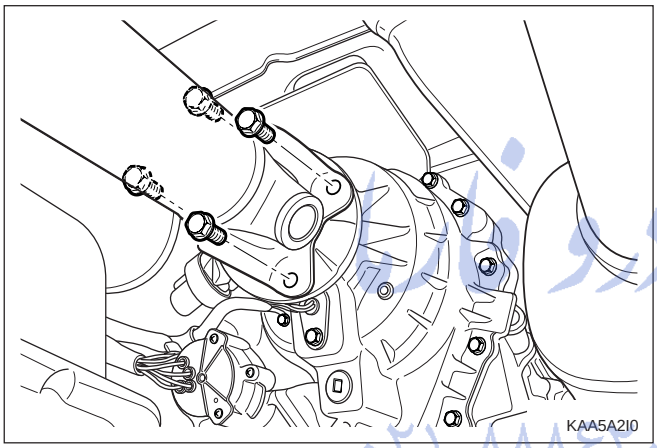


ON-VEHICLE SERVICE

TRANSMISSION

Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Disconnect the connectors from transfer case.
3. Disconnect the speedometer connector from transfer case.
4. Disconnect the inhibitor connector, gear position sensor connector and transmission case connector.

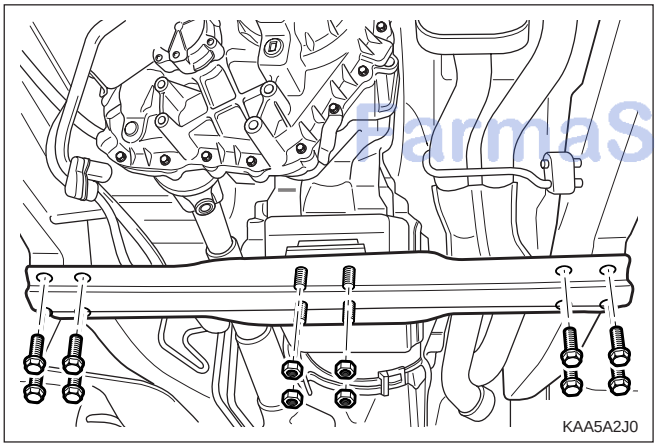


5. Remove the rear propeller shaft bolts.

Installation Notice

Tightening Torque	70 - 80 N•m (52 - 59 lb-ft)

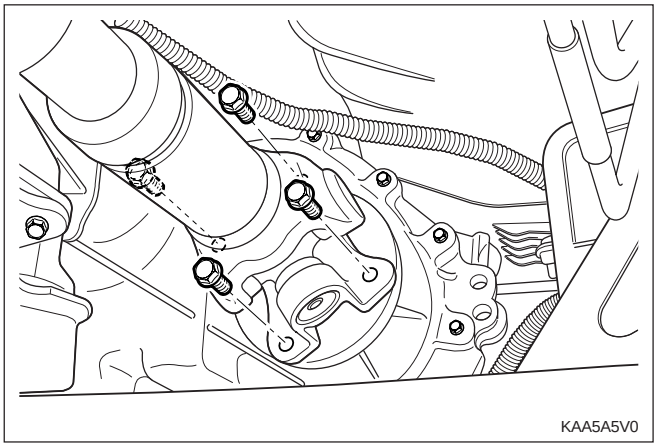
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6. Remove the cross member bolts and nuts.

Installation Notice

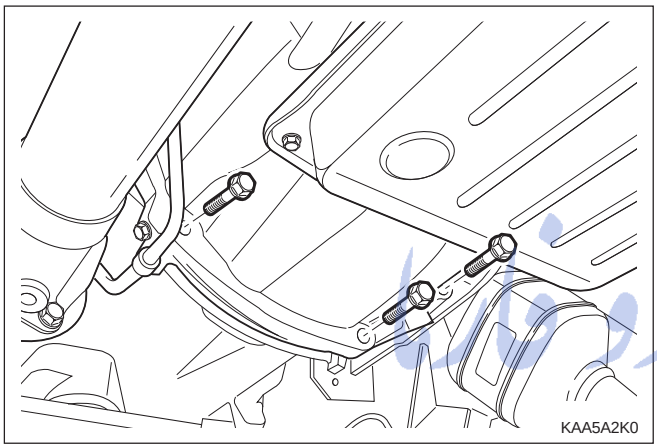
Tightening Torque	70 - 80 N•m (52 - 59 lb-ft)



7. Remove the front propeller shaft bolts from transfer case.

Installation Notice

Tightening Torque	70 - 80 N•m (52 - 59 lb-ft)



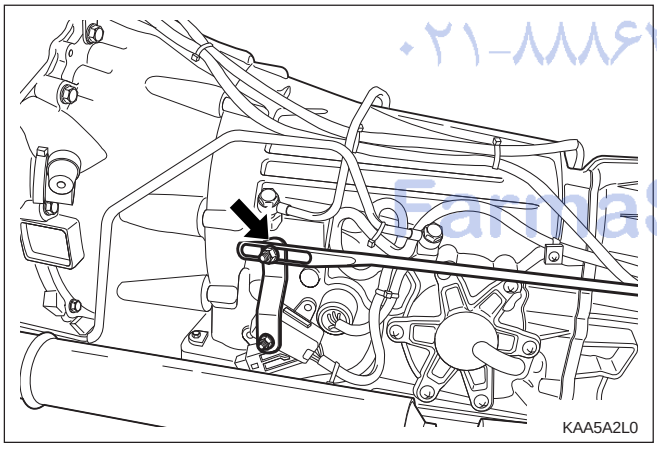
8. Remove the transfer case-to-transmission housing bolts and remove the transfer case.

Installation Notice

Tightening Torque	35 - 60 N•m (28 - 44 lb-ft)

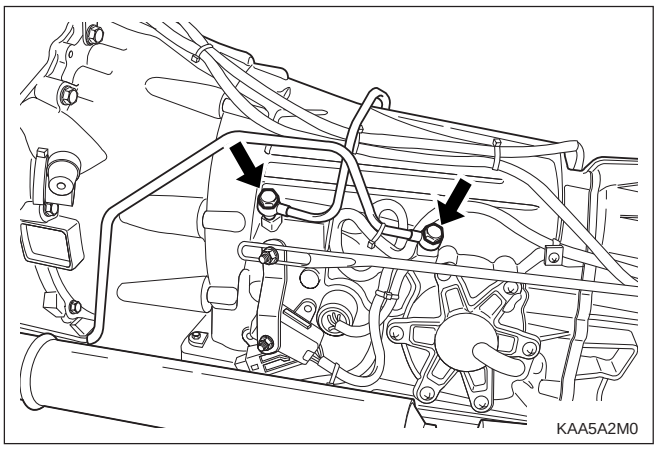
9. Disconnect the 10-Pins Plug connector from transmission.

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10. Separate the locking clip on shift lever and remove the shift rod.

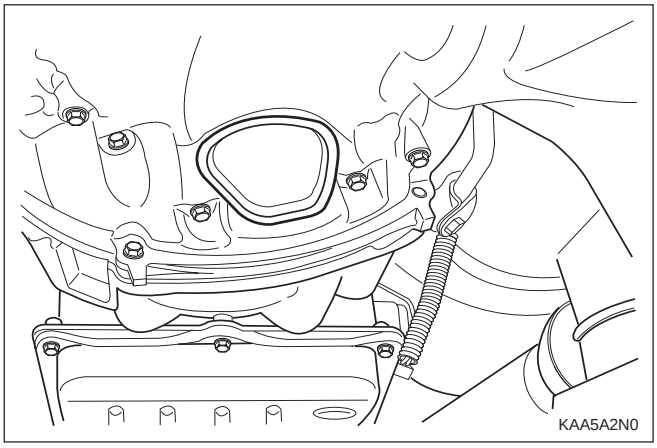
Notice: Removal and installation performed when the shift procedure should be lever is in 'D' range.



11. Remove the oil cooler pipes.

Installation Notice

Tightening Torque	40 - 45 N•m (29 - 33 lb-ft)


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12. Remove the service hole cover in the engine block.
13. Put the alignment mark for installation, and removethe six mounting bolts for torque converter from drive plate through the service hole by rotating the engine and remove the torque converter.

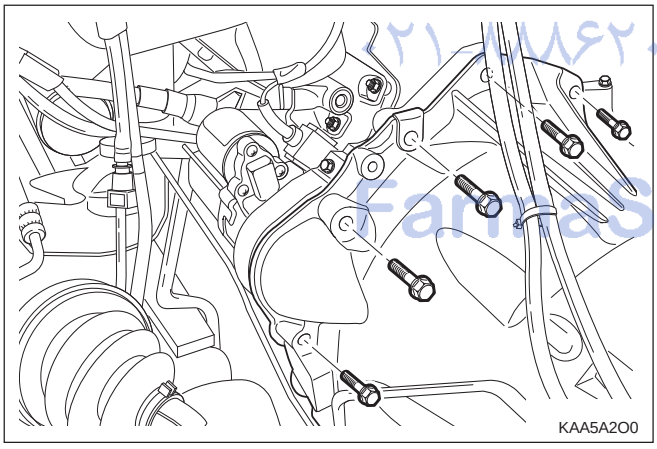
Installation Notice

Tightening Torque	42 N•m (31 lb-ft)

- Screw the six bolts mounting the torque converter through the service hole by using a mirror and rotating the engine.

14. Remover the starter. Refer to Section *1E, Engine Electrical*.

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15. Remove the extension housing to case bolts and remove the transmission assembly.

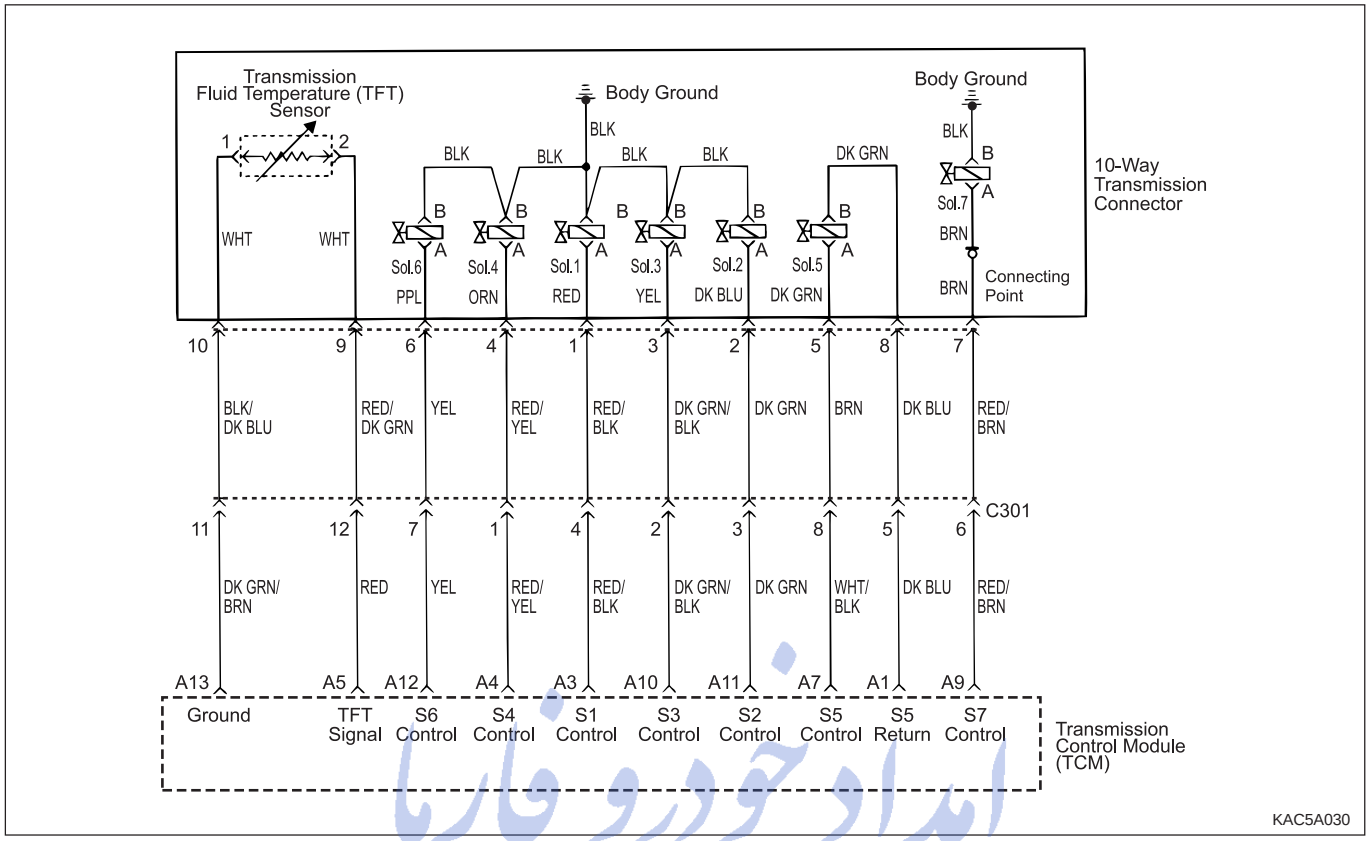
Installation Notice

Tightening Torque	54 - 68 N•m (40 - 50 lb-ft)

- Be careful not to drop the torque converter while removing the transmission.

16. Installation should follow the removal procedure in the reverse order.

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DIAGNOSTIC TROUBLE CODE (DTC) P1746
SOLENOID 6 CIRCUIT SHORT

Circuit Description

The solenoid 6 is a normally open ON/OFF type solenoid that is used to set the high/ low level of line pressure.

The solenoid 6 (S6) OFF gives high pressure and the S6 is attached to the valve body within the transmission. Voltage is supplied directly to the solenoid through the Transmission Control Module (TCM).

The DTC P1746 sets when the Solenoid 6 (S6) circuit is shorted to ground. The solenoid 6's driver Integrated Chip (IC) status indicates a faulty circuit.

Conditions for Setting the DTC

- DTCs P1717 and P1718 are not set.
- S6 is ON.
- The solenoid 6's driver Integrated Chip (IC) status indicates a faulty circuit. This condition must be continuously present for 60 milliseconds.

Action Taken When the DTC Sets

- The solenoid 6 is disabled (OFF) resulting in high line pressure being applied continuously.

Conditions for Clearing the DTC

- The DTC will clear when the malfunction has not occurred after ignition cycle.
- A history DTC will clear after 40 TCM power-up cycles with a warm transmission (>50 °C) and without a fault.
- History DTCs can be cleared by using a scan tool.

Diagnostic Aids

- During the TCM's testing, solenoid 6 is turned OFF/ ON by a very small (4 millisecond) pulses. This pulse is too short for the solenoid to react so the transmission operation is not affected.
- The solenoid feedback voltage is measured before the (4 millisecond) pulse and again during the pulse. If the difference is outside the acceptable limits the relevant fault is recorded.
- Typical causes would be a short circuit to ground in the wiring to or within the solenoid.
- If several faults of solenoids are present, check the wiring or connectors that are common to the selected solenoids, especially the earth connections.
- Inspect the wiring for poor electrical connections at the TCM and at the 10-way transmission connector. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for chafed wires that could short to bare metal or other wiring. Inspect for broken wire inside the insulation.

امداد خودرو فارما
۰۲۱-۸۸۴۶۲۰۸۵ تلفن پشتیبانی نرم افزار
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- If diagnosing for a possible intermittent short or open condition, move or massage the wiring harness while observing test equipment for a change.

Test Description

The number(s) below refer to the step number(s) on the Diagnostic Table.

3. Checks if the S6 circuit in the transmission is malfunctioning.
4. Check cable in the transmission for short to ground.
6. Check resistance between S6 terminal A and B. Standard value is 22 - 30 Ω.
9. Check connections of other connectors.

DTC P1746 Solenoid 6 Circuit Short

Step	Action	Value(s)	Yes	No
1	Perform a Transmission Control Module (TCM) System Check. Is the check performed?	-	Go to Step 2	Go to "TCM Diagnostic System Check"
2	1. Install the scan tool. 2. Turn the ignition ON, with the engine OFF. 3. Record and then clear DTCs. 4. Operate the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool display P1746?	-	Go to Step 3	Go to "Diagnostic Aids"
3	1. Turn the ignition OFF. 2. Disconnect the 10-way transmission connector. (additional DTCs will set) 3. Connect Solenoid/Thermistor Electrical Tester (STET) to the 10-way transmission connector of transmission side and to the good ground. 4. Turn the mode knob of STET to 6 and push the red button. Does the bulb of close circuit on the solenoids side of STET illuminate?	-	Go to Step 4	Go to Step 8
4	1. Remove the valve cover. Refer to the Transmission in this section. 2. With a test light connected to B+, probe the wiring harness from 10-way transmission connector to Solenoid 6 (S6) on the valve body. Does the test light illuminate?	-	Go to Step 5	Go to Step 6
5	Repair the short to ground in the wiring harness. Is the repair complete?	-	Go to Step 11	-
6	Using a Digital Volt Meter (DVM), measure the resistance between S6 terminal A and B. Is the resistance within the specified value?	20 - 30 Ω	Go to "Diagnostic Aids"	Go to Step 7
7	Replace the S6. Is the action complete?	-	Go to Step 11	-
8	1. Disconnect the TCM connector A. 2. With a test light connected to B+, probe the wiring harness from 10-way transmission connector terminal 6 to TCM terminal A12. Does the test light illuminate?	-	Go to Step 5	Go to Step 9
9	Check for a poor connection at the 10-way transmission connector and TCM connector and repair the malfunctioning terminals as necessary. Is a repair necessary?	-	Go to Step 11	Go to Step 10

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تلفن شبانه روزی: ۰۹۱۳۸۸۴۶۰۸۵
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DTC P1746 Solenoid 6 Circuit Short (Cont'd)

Step	Action	Value(s)	Yes	No
10	1. Turn the ignition OFF. 2. Replace the TCM. Is the action complete?	-	Go to Step 11	-
11	1. Using the scan tool, clear the DTCs. 2. Road test the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool indicate that this diagnostic has run and passed?	-	Go to Step 12	Go to Step 2
12	Check if any DTCs are set. Are there any DTCs displayed or previously recorded at Step 2 that have not been diagnosed?	-	Go to applicable DTC table	System OK, Check Complete

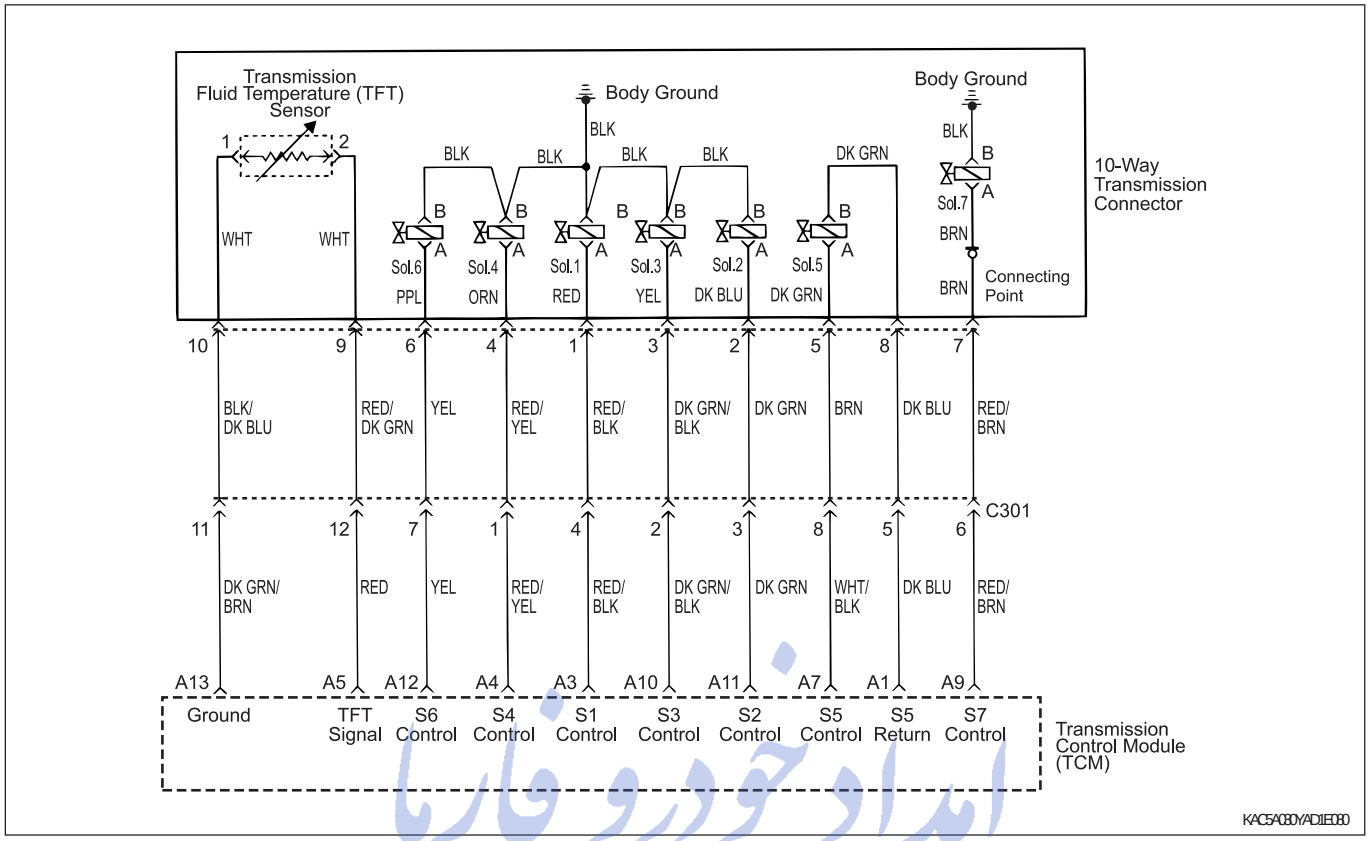
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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵

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DIAGNOSTIC TROUBLE CODE (DTC) P1747 SOLENOID 7 CIRCUIT SHORT

Circuit Description

The solenoid 7 is a normally open ON/OFF type solenoid that is used to control the application of the Torque Converter Clutch (TCC).

The Solenoid 7 (S7) ON activates the TCC and is attached to the pump body within the transmission. Voltage is supplied directly to the solenoid through the Transmission Control Module (TCM).

The DTC P1747 sets when the solenoid 7, Torque Converter Clutch Solenoid, circuit is shorted to ground. The solenoid 7's driver Integrated Chip (IC) status indicates a faulty circuit.

Conditions for Setting the DTC

- DTCs P1717 and P1718 are not set.
- S7 is ON.
- The solenoid 7's driver Integrated Chip (IC) status indicates a faulty circuit. This condition must be continuously present for 60 milliseconds.

Action Taken When the DTC Sets

- The solenoid 7 is always disabled (OFF) resulting in the TCC being unlocked continuously.

Conditions for Clearing the DTC

- The DTC will clear when the malfunction has not occurred after ignition cycle.
- A history DTC will clear after 40 TCM power-up cycles with a warm transmission (>50 °C) and without a fault.
- History DTCs can be cleared by using a scan tool.

Diagnostic Aids

- During the TCM's testing, solenoid 7 is turned OFF/ ON by a very small (4 millisecond) pulses. This pulse is too short for the solenoid to react so the transmission operation is not affected.
- The solenoid feedback voltage is measured before the (4 millisecond) pulse and again during the pulse. If the difference is outside the acceptable limits the relevant fault is recorded.
- Typical causes would be a short circuit to ground in the wiring to or within the solenoid.
- If several faults of solenoids are present, check the wiring or connectors that are common to the selected solenoids, especially the earth connections.
- Inspect the wiring for poor electrical connections at the TCM and at the 10-way transmission connector. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for chafed wires that could short tobare metal or other wiring. Inspect for broken wire inside the insulation.

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۰۲۱-۸۸۴۶۲۰۸۵
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- If diagnosing for a possible intermittent short or open condition, move or massage the wiring harness while observing test equipment for a change.

Test Description

The number(s) below refer to the step number(s) on the Diagnostic Table.

3. Checks if the S7 circuit in the transmission is malfunctioning.
4. Check cable in the transmission for short to ground.
7. Check resistance between S7 terminal A and B. Standard value is 22 - 30 Ω.
10. Check connections of other connectors.

DTC P1747 Solenoid 7 Circuit Short

Step	Action	Value(s)	Yes	No
1	Perform a Transmission Control Module (TCM) System Check. Is the check performed?	-	Go to Step 2	Go to "TCM Diagnostic System Check"
2	1. Install the scan tool. 2. Turn the ignition ON, with the engine OFF. 3. Record and then clear DTCs. 4. Operate the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool display P1747?	-	Go to Step 3	Go to "Diagnostic Aids"
3	1. Turn the ignition OFF. 2. Disconnect the 10-way transmission connector. (additional DTCs will set) 3. Connect Solenoid/Thermistor Electrical Tester (STET) to the 10-way transmission connector of transmission side and to the good ground. 4. Turn the mode knob of STET to 7 and push the red button. Does the bulb of close circuit on the solenoids side of STET illuminate?	-	Go to Step 4	Go to Step 8
4	1. Remove the pump assembly. Refer to the Pump in this section. 2. With a test light connected to B+, probe the wiring harness from 10-way transmission connector to contact point attached onto the transmission case. Does the test light illuminate?	-	Go to Step 5	Go to Step 6
5	Repair the short to ground in the wiring harness. Is the repair complete?	-	Go to Step 12	-
6	With a test light connected to B+, probe the wiring harness from contact point attached onto the transmission case to S7. Does the test light illuminate?	-	Go to Step 15	Go to Step 7
7	Using a Digital Volt Meter (DVM), measure the resistance between S7 terminal A and B. Is the resistance within the specified value?	20 - 30 Ω	Go to "Diagnostic Aids"	Go to Step 8
8	Replace the S7. Is the action complete?	-	Go to Step 12	-
9	1. Disconnect the TCM connector A. 2. With a test light connected to B+, probe the wiring harness from 10-way transmission connector terminal 7 to TCM terminal A9. Does the test light illuminate?	-	Go to Step 5	Go to Step 10

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DTC P1747 Solenoid 7 Circuit Short (Cont'd)

Step	Action	Value(s)	Yes	No
10	Check for a poor connection at the 10-way transmission connector and TCM connector and repair the malfunctioning terminals as necessary. Is a repair necessary?	-	Go to Step 12	Go to Step 11
11	1. Turn the ignition OFF. 2. Replace the TCM. Is the action complete?	-	Go to Step 12	-
12	1. Using the scan tool, clear the DTCs. 2. Road test the vehicle within the conditions for setting this DTC as specified in the text. Does the scan tool indicate that this diagnostic has run and passed?	-	Go to Step 13	Go to Step 2
13	Check if any DTCs are set. Are there any DTCs displayed or previously recorded at Step 2 that have not been diagnosed?	-	Go to applicable DTC table	System OK, Check Complete

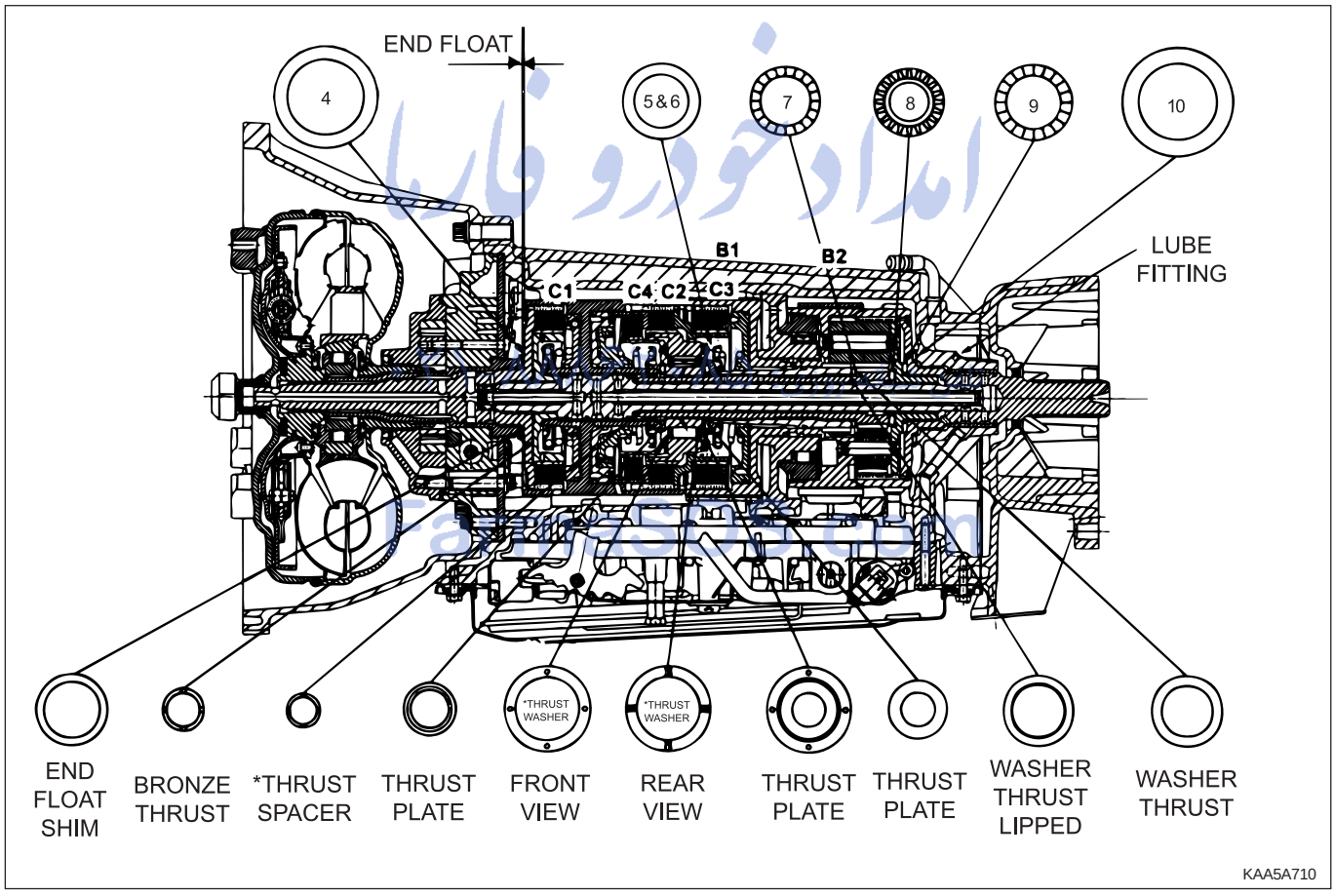
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UNIT REPAIR

REBUILD WARNINGS

Prior to rebuilding a transmission system, the following warnings are to be noted.

- Ensure that, before replacing a transmission the cooler lines are flushed out to remove any debris. This can be done by applying compressed air to the rear cooler line forcing oil and any contaminants out of the front cooler line.
- The cooler flow should be checked after the transmission has been fitted. With the front cooler line connected and the rear line run into a suitable container, measure the flow over 15 seconds with the vehicle idling in park.
- The flow rate should exceed 1 liter in 15 seconds.
- Be wary of any situation where water enters the transmission. This may result in fluid foaming and leaking through the breather.
- Ensure that both earth straps (one at the battery terminal and one on the vehicle body) are connected in the vehicle before connecting the positive side of the battery.
- Follow the throttle position calibration procedure in this manual if the engine control module/ transmission control module (ECM/TCM) is swapped.



DISASSEMBLY PROCEDURE

Transmission

Tools Required

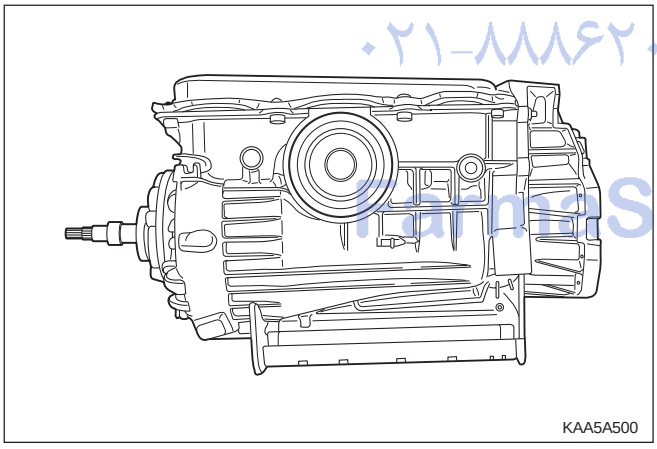
0555-336256 Transmission Bench Cradle

0555-336257 Pump Puller

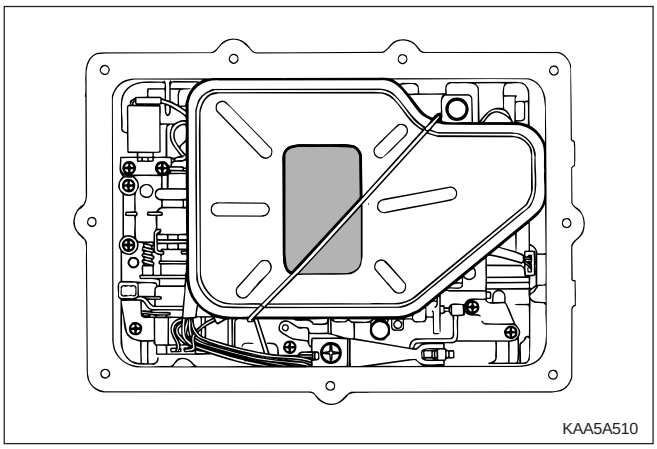
Notice:

- Remove the inhibitor switch before washing the transmission in solvent or hot wash.
- It is assumed that the transmission fluid has been drained when the transmission was removed from the vehicle and that the 'special tools' quoted are available.
- The transmission is dismantled in a modular fashion, and the details of disassembly for each module are given under the appropriate subject. Refer to Special Tools Table in this chapter for details of all special tools required when performing disassembly procedures.
- Technicians overhauling these transmissions will also require a selection of good quality Torx bit sockets, in particular numbers 30, 40 and 50, and an 8 mm, 10 mm and 12 mm double hex socket.

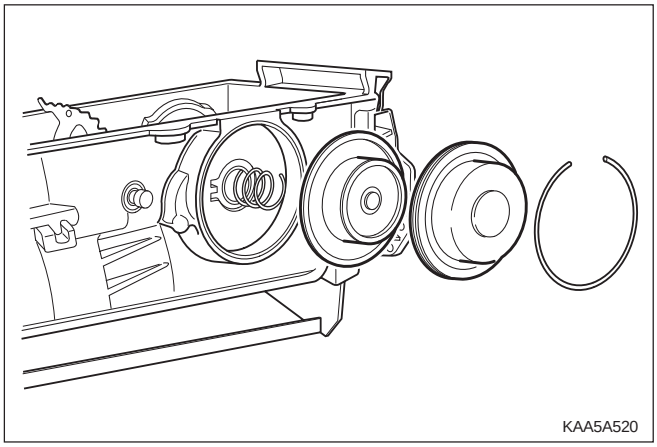
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KAA5A500

1. Remove the converter and the converter housing.
2. Mount the transmission on the transmission bench cradle 0555-336256.
3. Remove the oil pan and the oil pan seal.


KAA5A510

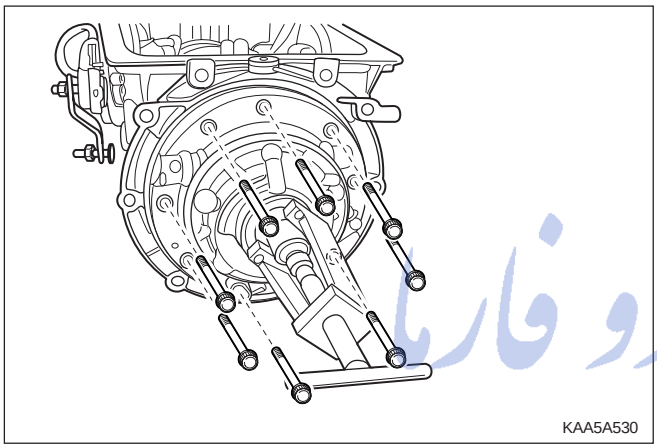
4. Remove each end of the filter retaining clip from the valve body and remove the filter.
5. Disconnect the wires from each solenoid and ground and lay the wiring to one side.
6. Remove the valve body securing screws and remove the valve body from the case.


KAA5A520

7. Remove the front servo cover circlip.
8. Remove the front servo cover, piston and spring.

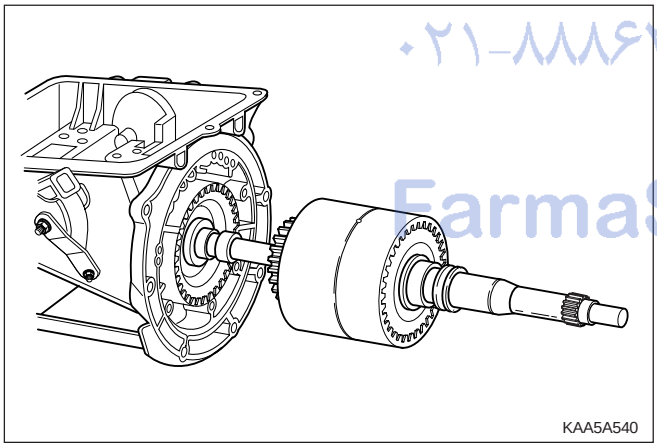
   Notice: The plastic servo block is retained by the piston return spring only.

9. Remove the adaptor housing bolts and adaptor housing.

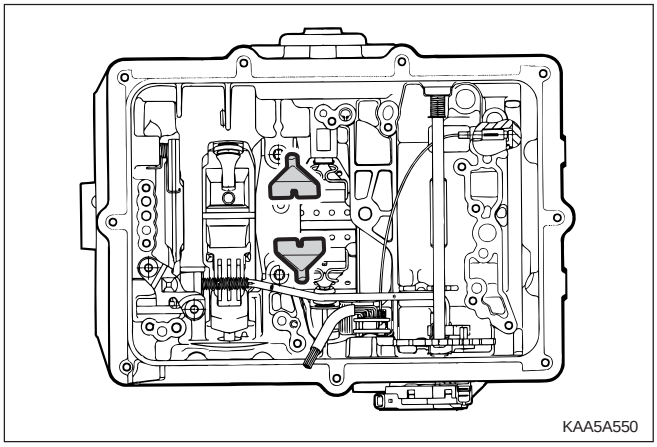

KAA5A530

10. Remove the pump to case bolts using a multi-hex 8 mm spanner.
11. Using the pump puller 0555-336257, remove the pump and pump cover.

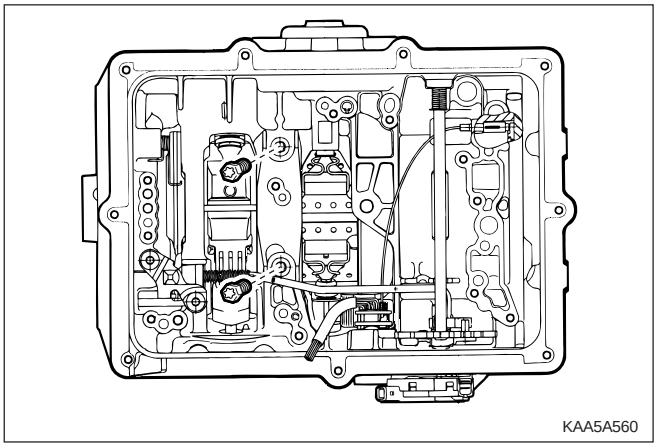
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KAA5A540

12. Remove the input shaft, forward clutch cylinder, and the overdrive shaft as an assembly, withdrawing them through the front of the case.
13. Remove the C3 clutch cylinder and sun gears.


KAA5A550

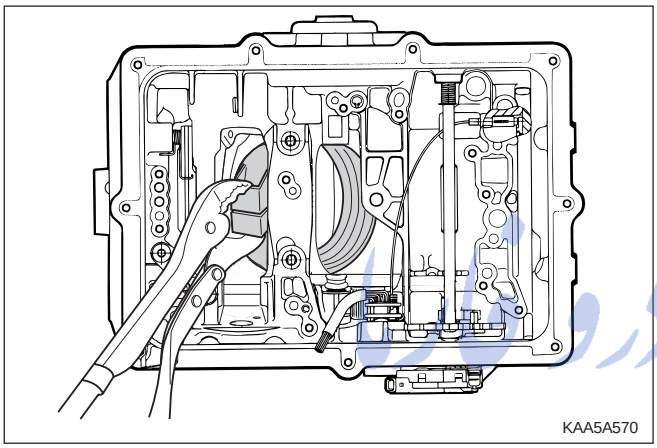
14. Remove the front band struts. Remove the front band.


KAA5A560

15. Remove the two centre support retaining bolts using a T50 Torx bit.
16. Remove the centre support retaining circlip.

    Notice: Do not hammer the output shaft to remove the centre support as this will cause permanent damage to the thrust bearing surfaces.

17. Remove the centre support, 1 - 2 one way clutch, and planetary gear set as an assembly.
18. Remove the parking rod cam plate using a T40 Torx bit.

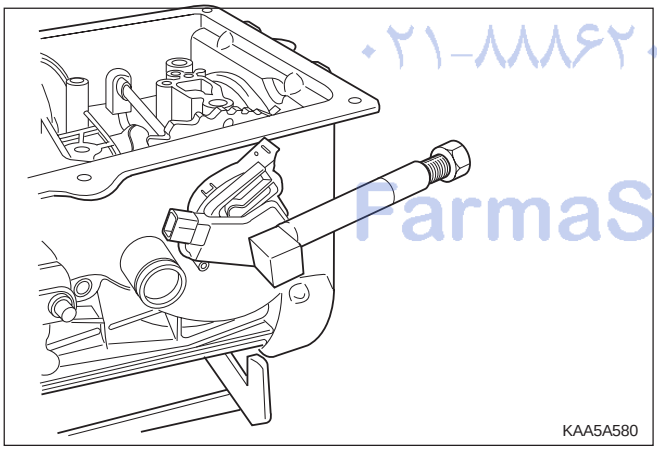

KAA5A570

19. Remove the rear band struts and remove the band.

    Notice: Vise the both end of rear band using the plier and lean forward about 15 degrees

20. Remove the output shaft assembly.

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KAA5A580

Transmission Case

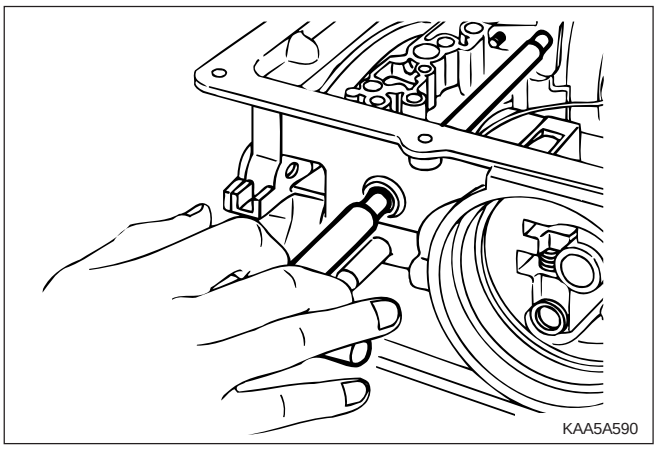
Tools Required

0555-336258 Cross Shaft Pin Remover/Installer (Detent Lever)

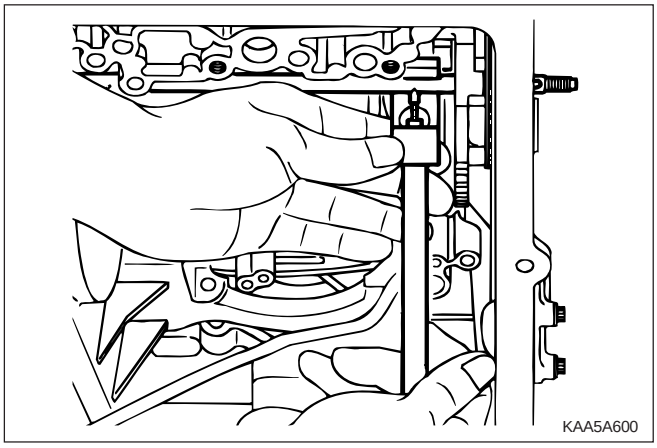
0555-336261 Cross Shaft Seal Remover

0555-336265 Cross Shaft Pin Remover/Installer (Inhibitor Switch)

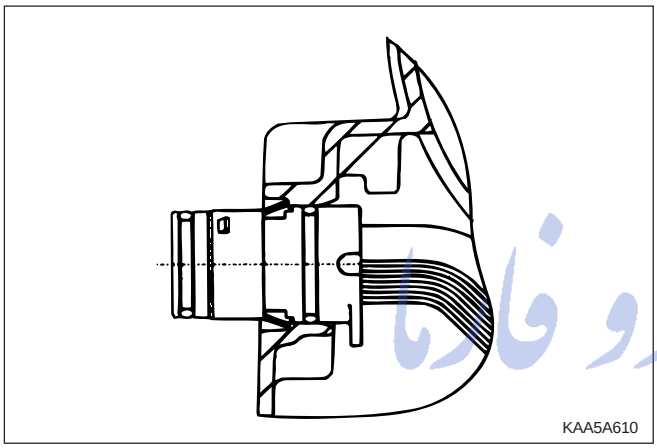
1. Remove the pin from the side of cross shaft inhibitor switch using cross shaft pin remover/ installer (inhibitor switch) 0555-336265.
2. Remove the inhibitor switch bolts and inhibitor switch from the case.


KAA5A590

3. Remove the cross shaft seals with cross shaft seal remover 0555-336261.
4. Remove the circlip from the cross shaft. Pull the shaft to release the drive pin from the selector quadrant.

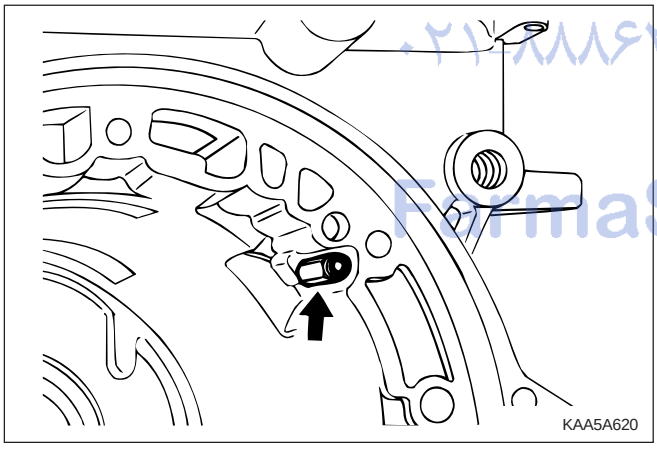

KAA5A600

5. Using cross shaft pin remover/installer (detent lever) 0555-336258, press the pin from the cross shaft and withdraw the shaft from the case.
6. Remove the cross shaft pin and spring.
7. Remove the manual valve lever and the park rod.

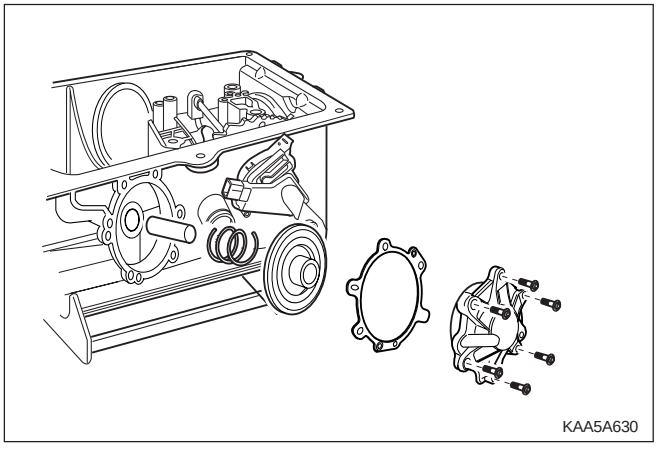

KAA5A610

8. Depress the tangs and withdraw the 10 pin connector into the case. Remove the wiring loom assembly.

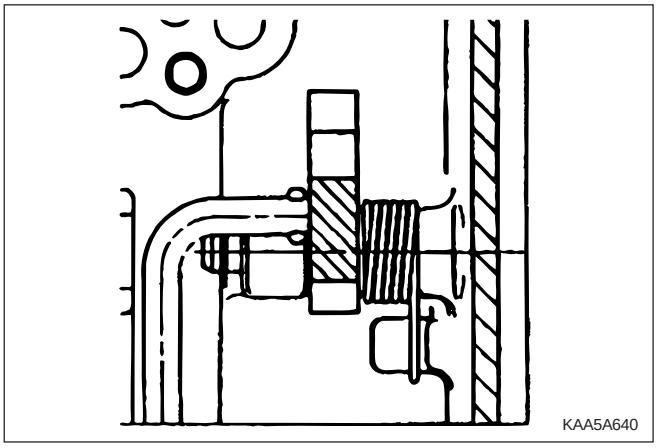
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KAA5A620

9. Detach the No. 7 solenoid wire from the front of the case.
10. Remove the parking pawl pivot pin and the pawl and spring from the case.
11. Remove the shaft and the rear servo lever.

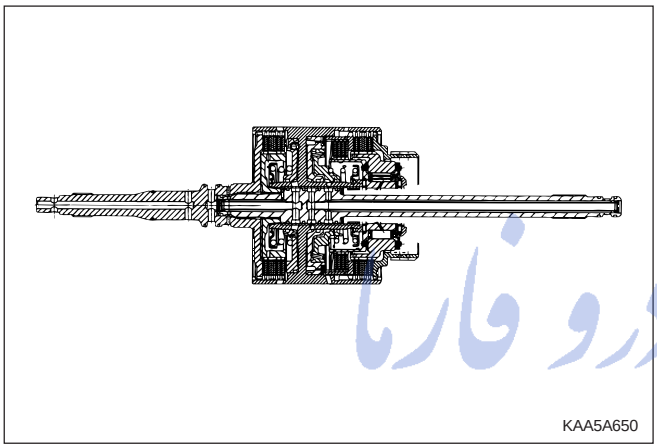

KAA5A630

12. Remove the rear servo cover and piston assembly.
13. Remove the B1R circlip, valve and spring.
14. Remove both band adjustment shims.
15. Inspect the output shaft bushing in the case and replace if necessary.
16. Inspect cooler line fittings and replace as necessary.
17. Inspect the case for damage.


KAA5A640

18. To remove the park rod lever: Remove the circlip from the inner end of the pivot shaft and tap the outer end of the shaft until it moves free from the case, then using a wide shallow tapered drift as a wedge, drive the pin out from the inside of the case and remove the lever and spring.

    Notice: Do not remove the park rod lever unless absolutely necessary.


KAA5A650

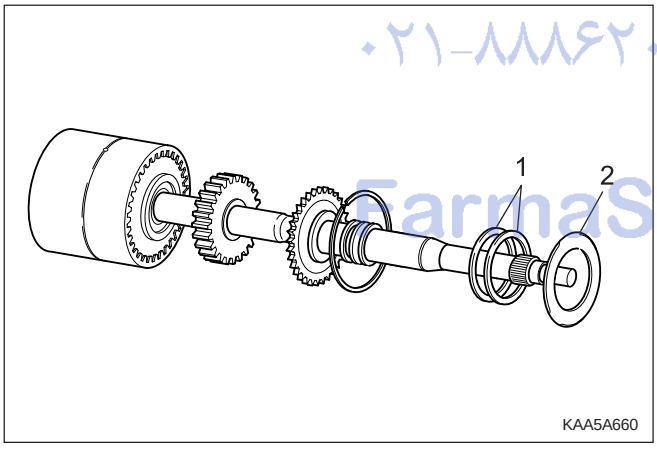
Forward Clutch Cylinder

Tools Required

0555-336259 Clutch Spring Compressor

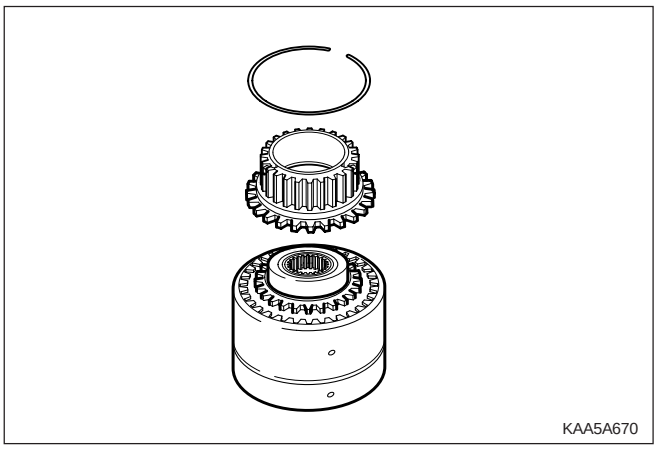
1. Place the assembly in a horizontal position.

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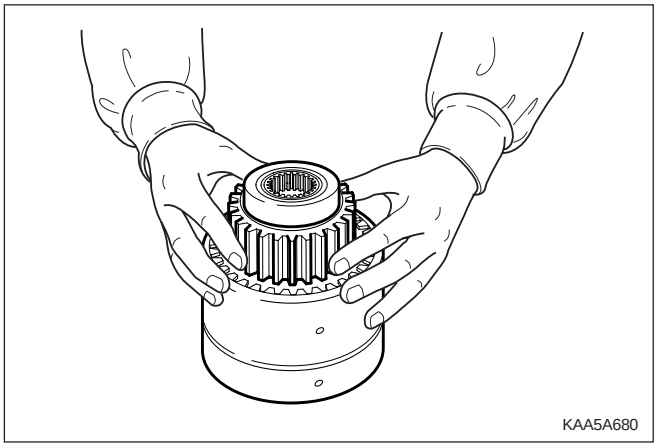


KAA5A660

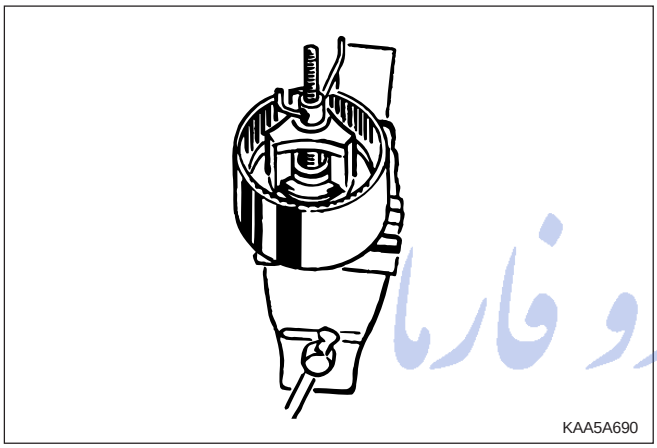
2. Remove the No. 4 needle bearing (2) and adjustment shims (1) from the input shaft.
3. Remove the circlip from the front of the clutch cylinder and remove the input shaft.
4. Remove the overdrive shaft and the C1 clutch hub assembly from the clutch cylinder.
5. Remove the C1 clutch plates from the cylinder.


KAA5A670

6. Remove the circlip retaining the C3 clutch hub in the rear of the clutch cylinder and remove the hub.
7. Remove the C2/C4 clutch hub assembly and remove the No. 5 needle bearing from the C4 hub.
8. Removethe C2 clutch plates.


KAA5A680

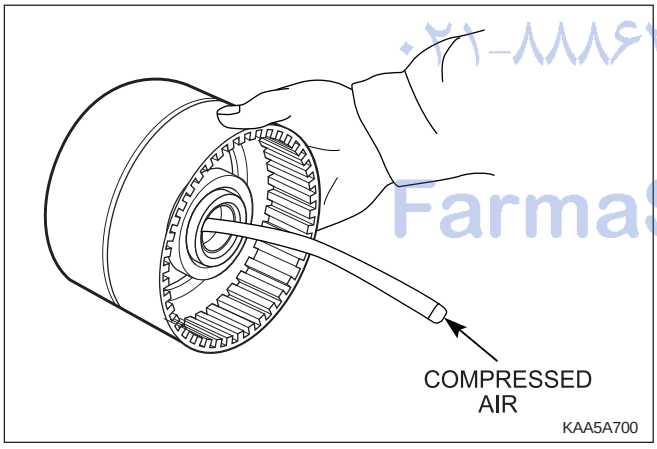
9. Invert the clutch cylinder and remove the C4 clutch sleeve, clutch plates and the two wave washers. The 3 - 4 one way clutch is located between the C2 and C4 clutch hubs, and the hubs may be separated by rotating one hub clockwise and withdrawing it from the other.
10. Remove the thrust block from the C4 clutch cylinder hub.


KAA5A690

11. Mount the clutch cylinder on clutch spring compressor 0555-336259 with the C2/C4 end uppermost and compress the piston return spring. Remove the spring retaining circlip. Release the tool and remove the circlip, keeper and spring.

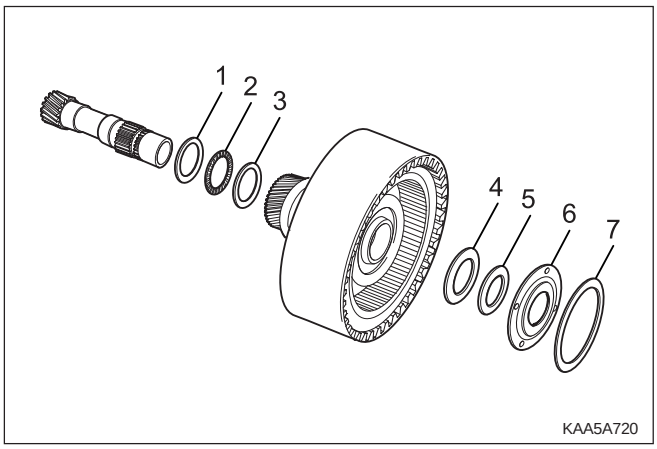
    Notice: Make sure that the spring keeper is not caught in the circlip groove, and that all the spring pressure is released, before removing the tool.

12. Invert the clutch cylinder on the compressor tool and removethe C1 clutch piston return spring in asimilar manner.



KAA5A700

13. To remove the clutch pistons from the clutch cylinder, apply air pressure to the apply ports in the bore of the cylinder.



KAA5A720

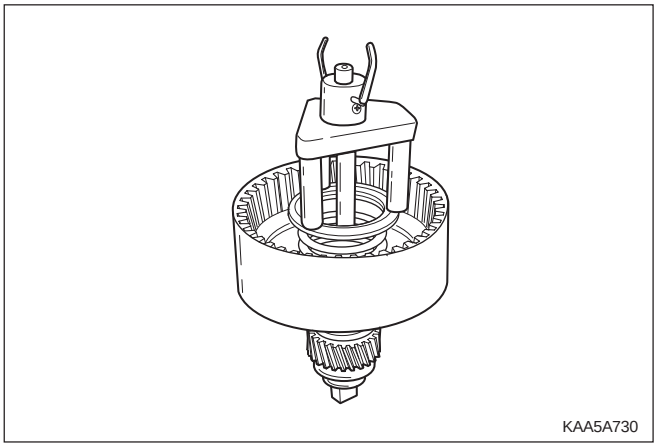
C3 Clutch Cylinder

Tools Required

0555-336259 Clutch Spring Compressor

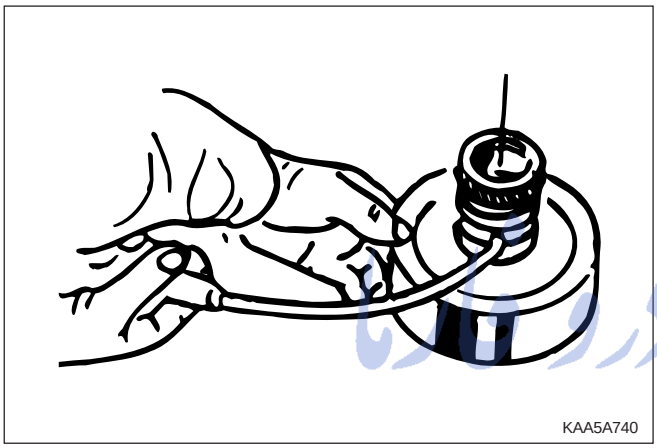
1. Remove the forward sun gear, No. 7 needle bearing (2) thrust washer (1) and lipped thrust washer (3) from the C3 clutch cylinder.
2. Remove the thrust plate (4), No. 6 needle bearing (5), thrust plate (6) and nylon thrust plate (7) from the clutch cylinder hub.
3. Remove the clutch plate retaining circlip and remove the clutch plates.

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KAA5A730

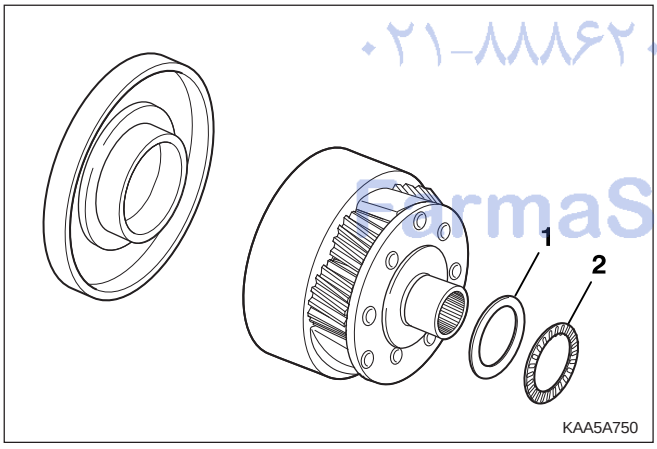
4. Mount the clutch assembly on clutch spring compressor 0555-336259 and compress the piston return spring.
5. Remove the circlip and release the spring.
6. Remove the tool, circlip, keeper and spring.

   Notice: Make sure that the spring keeper has not been caught in the circlip groove, and that all spring pressure has been released, before removing the tool.


KAA5A740

7. Remove the sealing rings from the C3 clutch cylinder.
8. To remove the clutch piston from the clutch cylinder, apply air pressure to the port between the iron sealing rings on the bearing journals of the cylinder.
9. Remove the reverse sun gear and C3 washer from the cylinder.

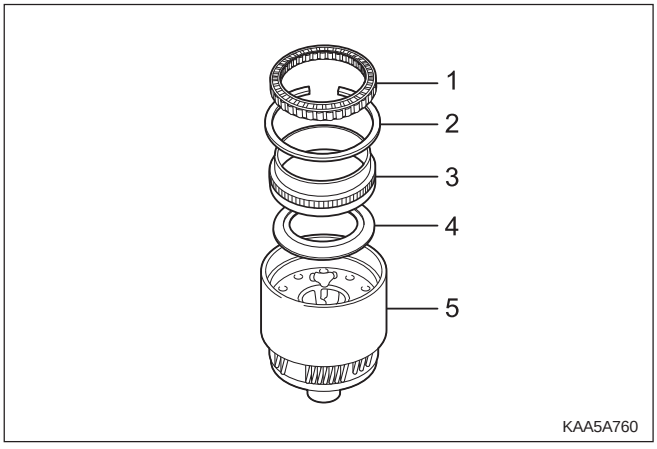
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KAA5A750

Planet Carrier Assembly and Centre Support

1. Remove the No. 9 (2) needle bearing and washer (1) from the output shaft and the planet carrier.
2. Separate the centre support from the planet carrier by rotating it anti-clockwise.



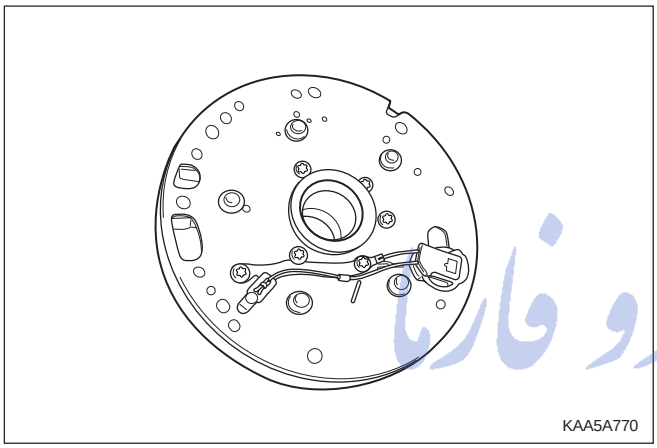
KAA5A760

3. Lift the one way clutch (1) from the planet carrier (5).
4. Remove the circlip (2) retaining the one way clutch outer race (3) in the planet carrier and remove the race.
5. Remove the one way clutch retainer (4) from the planet carrier.

Pump

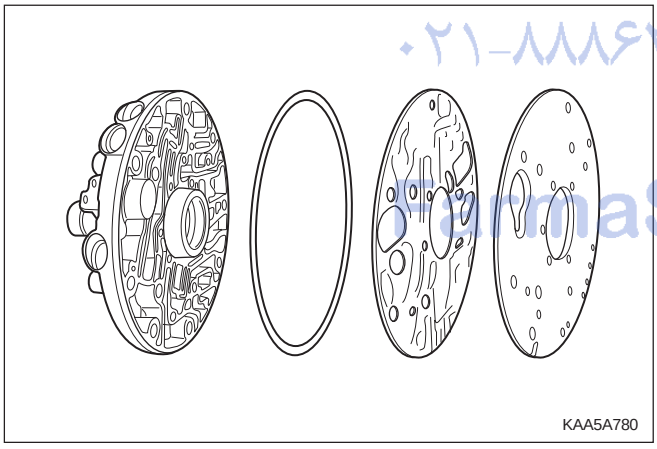
Notice: The following valves are housed in the pump cover:

- Solenoid 7
- Converter clutch control valve
- Converter clutch regulator valve
- Primary regulator valve

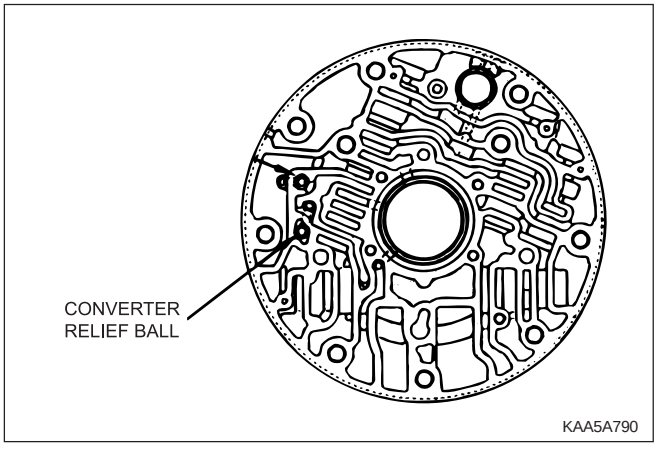


1. Remove the wiring loom retainer plate and remove solenoid 7 with a T30 Torx bit.
2. Remove the five washer head bolts from the cover plate using a multi-point 8 mm socket.
3. Remove the five Torx head screws from the cover plate with T30 Torx bit. Note that the long screw holds the pump body to the pump body cover.

   Notice: Do not strike the converter support tube to loosen the pump body.

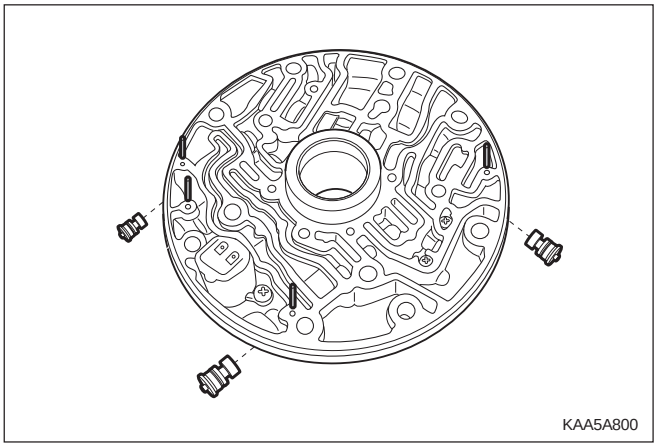


4. Separate the pump body from the pump cover.
5. Remove the cover plate, gasket and seal from the cover.



6. Remove the ball check valve and one spring from the pump cover.

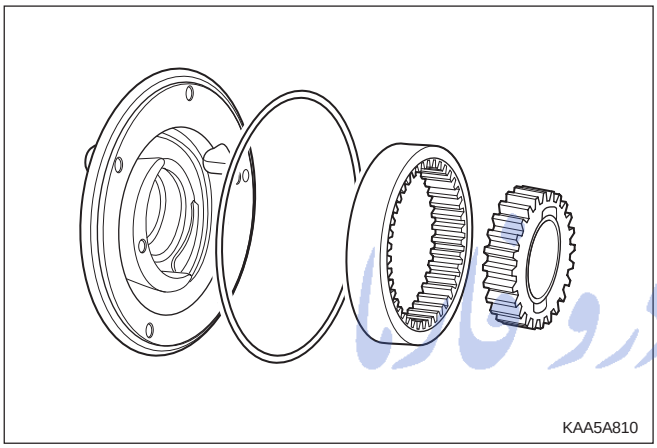
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KAA5A800

7. Depress the plug inward and remove the retaining pin for each of the three valves.

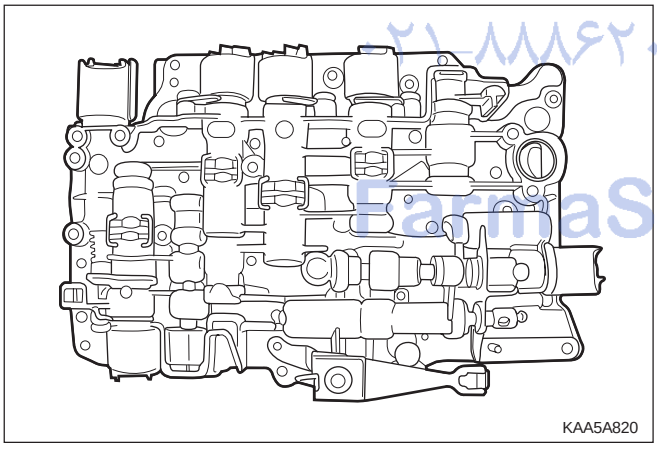
   Notice: Some of the valves and plugs are preloaded by springs and may unexpectedly fall out of the cover when the pins are removed.

8. Remove the four valves, plugs and springs.


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9. Remove the pump gears from the pump body.
10. Remove the lip seal from the front of the pump body.

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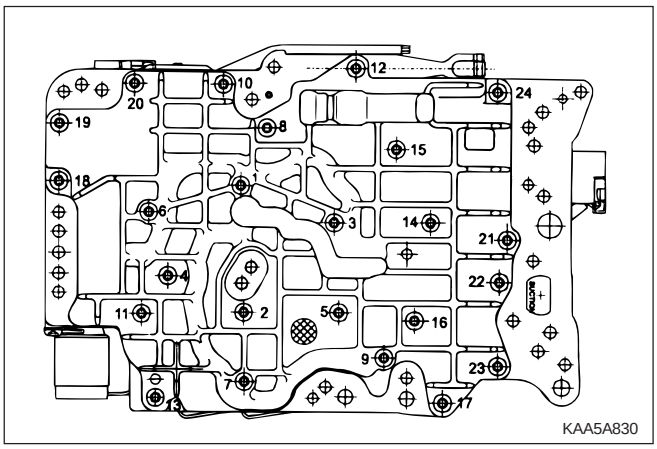
Valve Body

1. Remove the manual valve detent spring and retain-er plate using a T40 Torx bit.
2. Slide the manual valve out of the lower valve body.

   Notice: Be aware that the manual valve will fall out of the valve body.

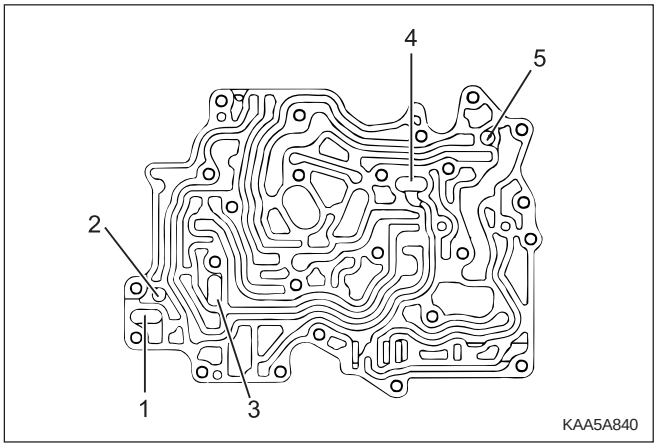
3. Take note of the angular relationship of the solenoid terminals to the valve body and remove the solenoids 1, 2, 3, 4, 5, 6 and valve assemblies.

   Notice: Take care that the bracket is not separated from the solenoid.

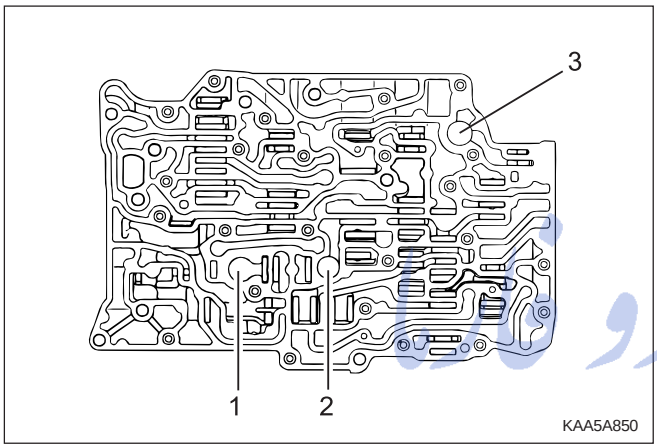


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4. Place the valve body assembly on the bench with the upper body uppermost.
5. Remove the 24 clamping screws with a No. 30 Torx bit. Separate the upper and lower valve bodies by lifting the upper body and the separator plate together.
6. Turn the upper body over and place it on the bench with the separator plate uppermost.



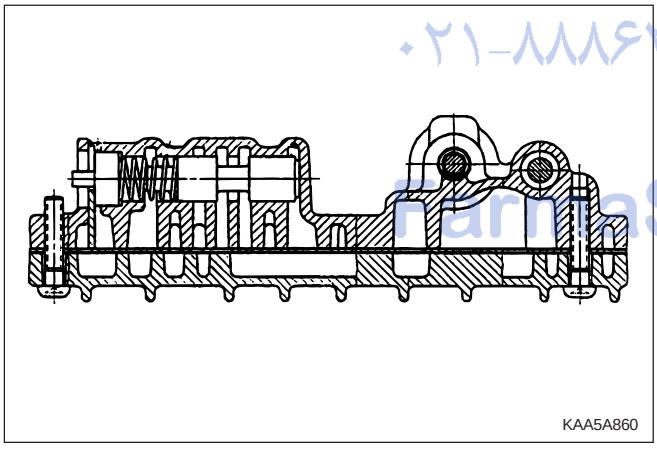
7. Lift the separator plate and gaskets from the upper valve body.
8. Remove the five nylon check balls exposed in the valve body.
9. Remove the retaining plate, plug, spring and reverse lockout valve.



10. Remove the filter (1.3) and the large nylon check ball (2) from the lower valve body.
11. Remove the retaining plates and pins from the 1 - 2, 2 - 3, 3 - 4, BAR and CAR valves. The pins can be removed with a magnet.

    Notice: Once the pins are removed, the plates are loose in the valve body and will drop out when the valve body is turned over.

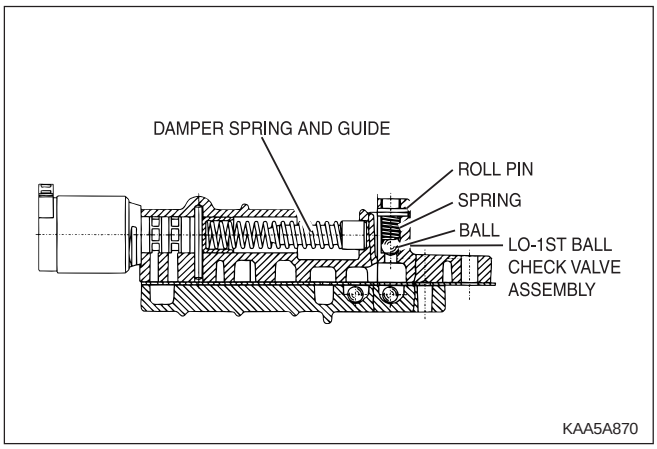
12. Remove the 1 - 2, 2 - 3 and 3 - 4 shift valves.



13. Depress the 4 - 3 sequence valve plug and remove the retaining plate.

    Notice: The plug is preloaded by the spring and may unexpectedly fall out of the valve body.

14. Remove the plug, spring and valve



15. Depress the solenoid 5 valve. Remove the retaining in and remove the valve, damper guide and spring.

    Notice: The valve is preloaded by the spring and may unexpectedly fall out of the valve body.

16. Depress the line pressure release valve, remove the retaining pin, disc (if fitted), spring and valve.
17. Drive out the retaining pin and remove the spring and ball check valve adjacent to the BAR valve.

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ASSEMBLY PROCEDURE

Transmission

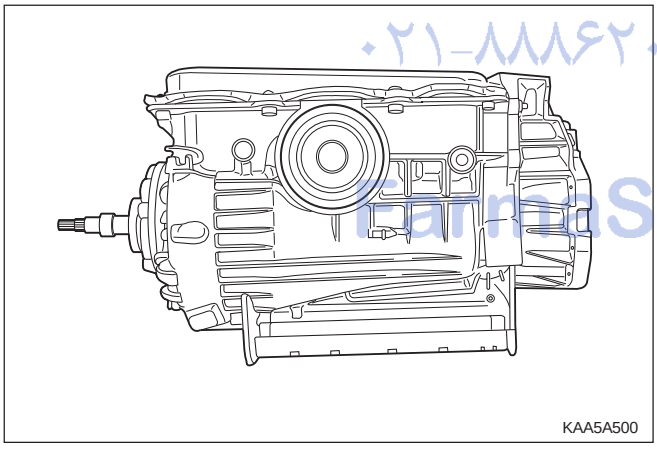
Tools Required

0555-336256 Transmission Bench Cradle
0555-336258 Cross Shaft Pin Remover/Installer (Detent Lever)
0555-336262 Cross Shaft Seal Installer
0555-336263 Cross Shaft bullet
0555-336265 Cross Shaft Pin Remover/Installer (Inhibitor Switch)

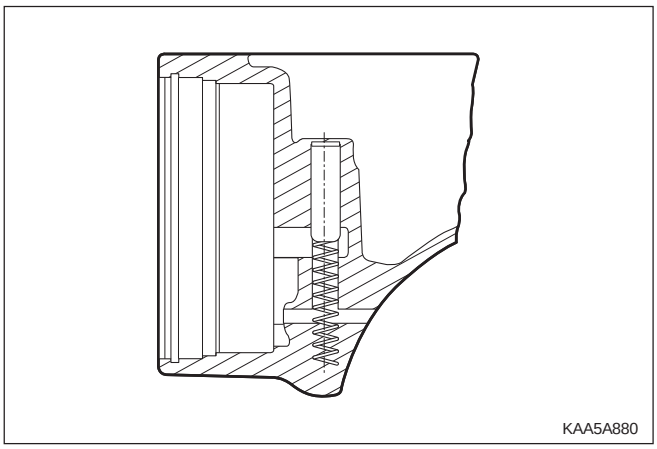
Notice:

- The transmission is assembled in modular fashion and details of assembly for each module are given under the appropriate subject.
- Technicians overhauling these transmissions will also require a selection of good quality Torx bit sockets, in particular numbers 30, 40 and 50, and an 8 mm, 10 mm and 12 mm double hex socket.
- Ensure that the B1R circlip is fitted to the case. (If this is not fitted, the valve will peen its way into and through the separator plate)
- Ensure that the 'E'clip is fitted to the cross shaft.
- Ensure that all aspects of the parking mechanism are working.

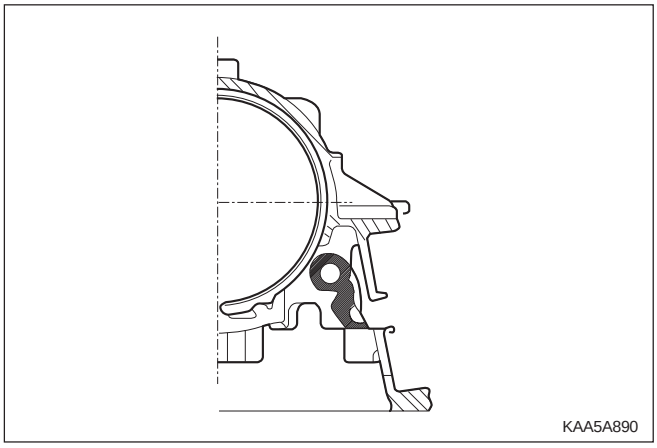
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1. Turn the transmission case upside down on the bench and mount it to the transmission bench cradle 0555-336256.
2. Install all fittings, plugs and the breather, applying a sealant where applicable, Tighten the fittings to specifications. Ensurethatthebreatheris clear, andcheckthat the lube fitting in the rear of the case is fittedand clear of obstruction.

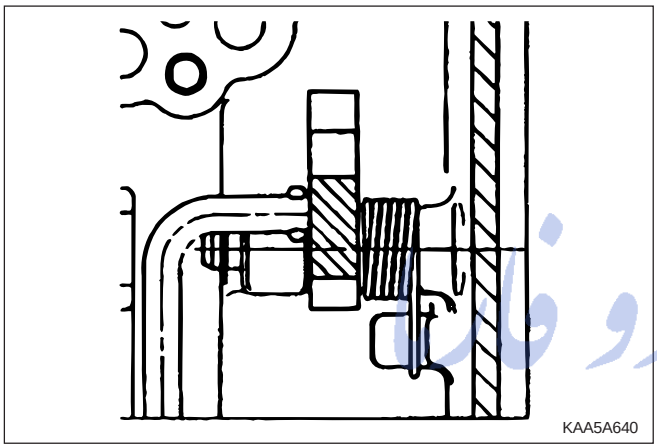

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3. Assemble the B1R valve and spring, and secure with the circlip. Ensure that the circlip is completely seated in its groove.


KAA5A890

4. Install the rear servo lever and pivot pin.

   Notice: The lever must pivot freely on its pin.

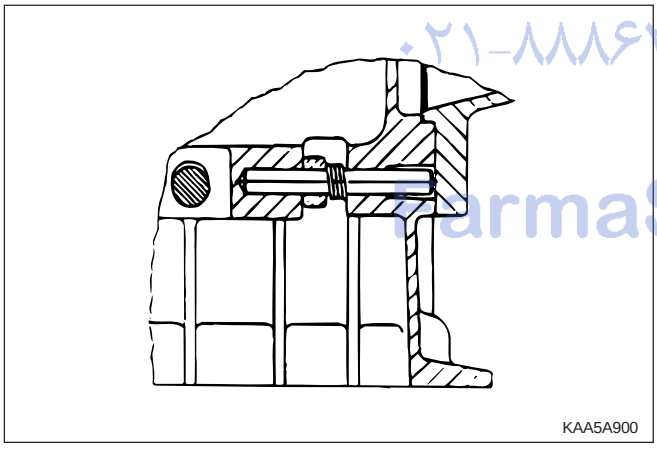

KAA5A640

5. Assemble the park rod lever, complete with the return spring and pivot pin, applying a small amount of sealant to the outer end of the pivot pin.

   Notice: Care must be taken when applying sealant to ensure that it is not applied between the pin and the lever.

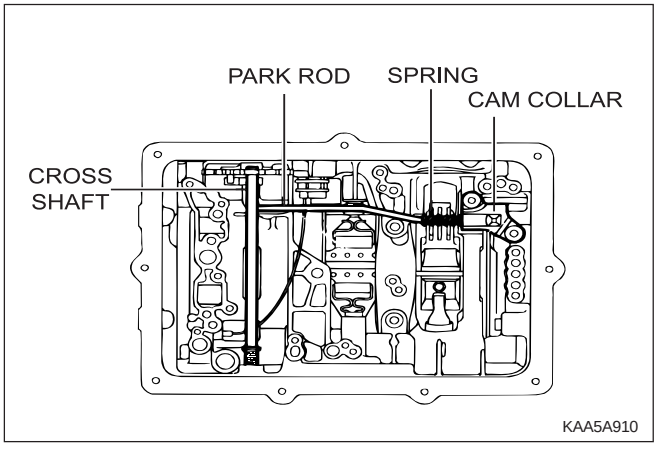
6. Secure the pivot pin with the circlip.

   Notice: The lever must pivot freely on its pin and the spring must return the park rod lever to its correct location.


KAA5A900

7. Install the parking pawl pivot pin and spring.

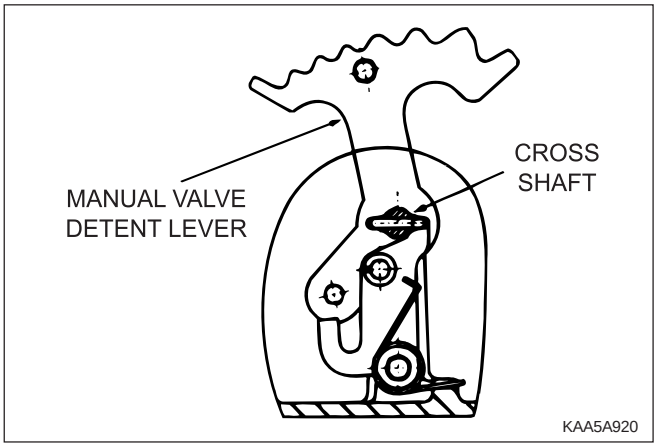
   Notice: The pawl must pivot freely on its pin.



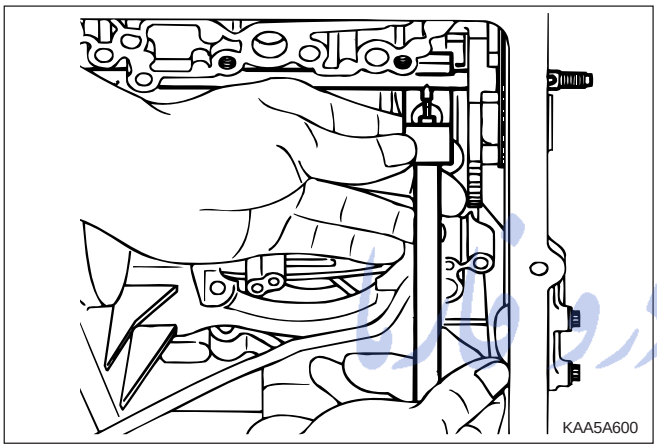
KAA5A910

8. Connect the park rod to the manual valve detent lever. Ensure the spring and cam collar is firmly installed on the rod.
9. Check that the cam collar slides freely on the rod.
10. Insert the cross shaft into the case, from the side opposite to the inhibitor switch, then install the antirattle spring on the shaft.

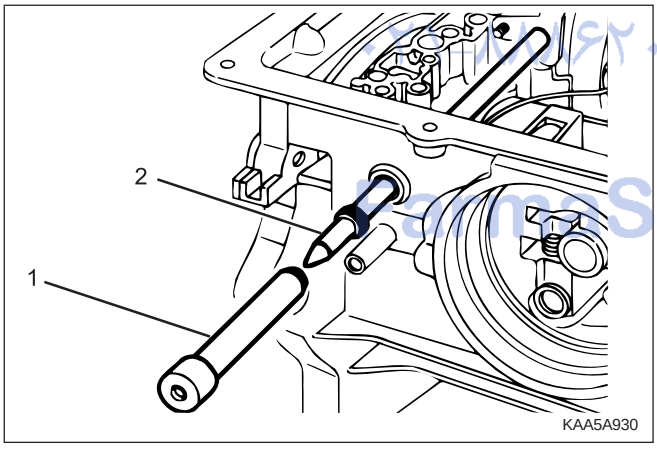
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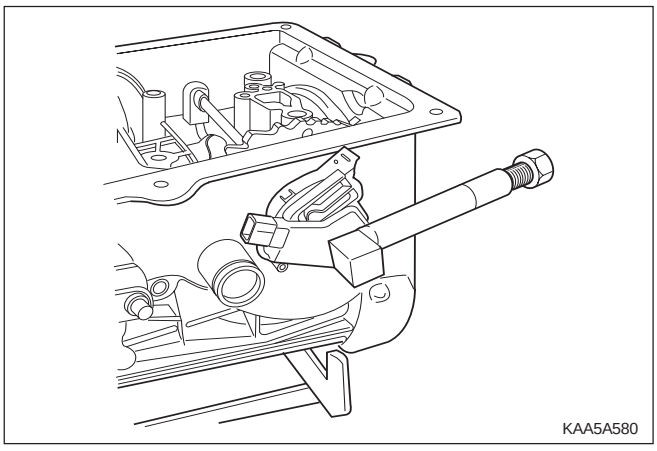
11. Poition the manual valve detent lever, aligning it with the cross-shaft bore in the case.
12. Push the shaft through the detent lever until it starts in the detent lever side of the case.



13. Install the detent lever drive pin in the shaft using cross shaft pin remover/installer (detent lever) 0555-336258 with the adaptor over the pin.
14. Press the pin into the shaft until the tool bottoms.
15. Remove the tool and fit the spring retaining circlip to the shaft.



16. Install the new cross shaft seals using cross shaft seal installer 0555-336262 (1) and cross shaft bullet 0555-336263 (2).



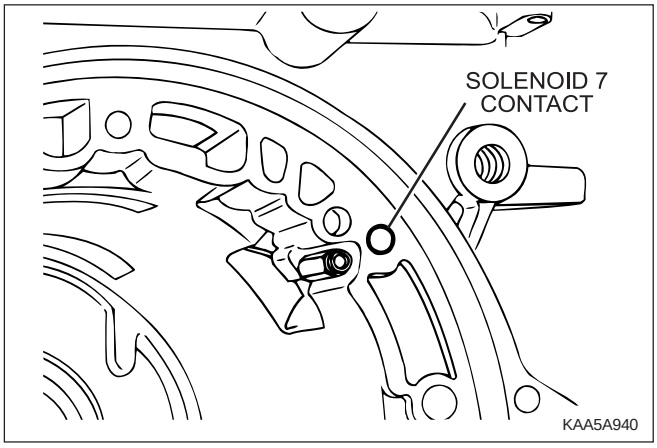
17. Install the inhibitor switch on the case. Torque the bolts as per specifications. Press the pin into the shaft until the tool bottoms using cross shaft pin installer/ remover (inhibitor switch) 0555-336265.

Installation Notice

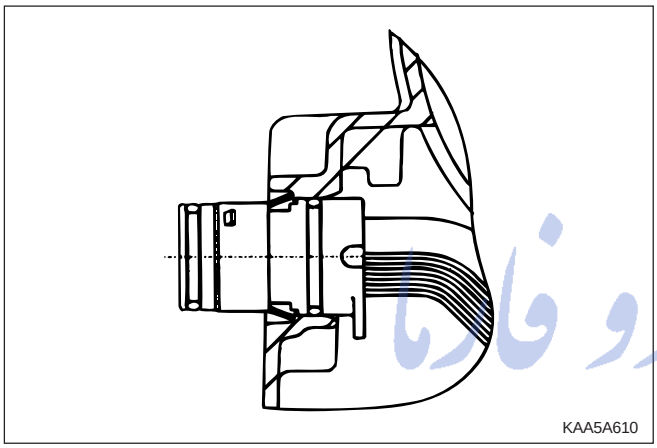
Tightening Torque	4 - 6 N•m (35 - 53 lb-in)

18. Thoroughly check the terminal wiring loom for condition and continuity.

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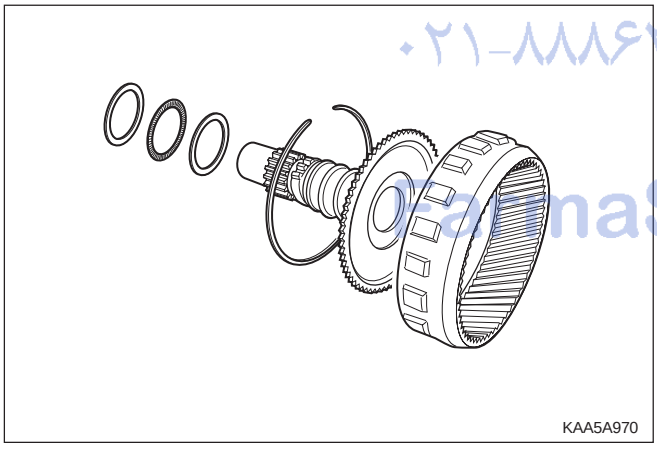


19. Position the wiring loom and locate the solenoid 7 contact and terminal in the pump mounting flange at the front of the case. The solenoid 7 wire is routed under the park rod and cross shaft in the case.



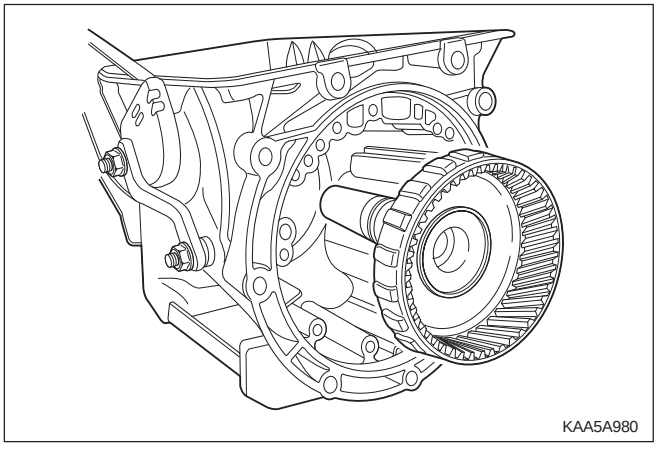
20. Install the 10 pin connector in the case engaging the tangs on the connector in the notches in case.

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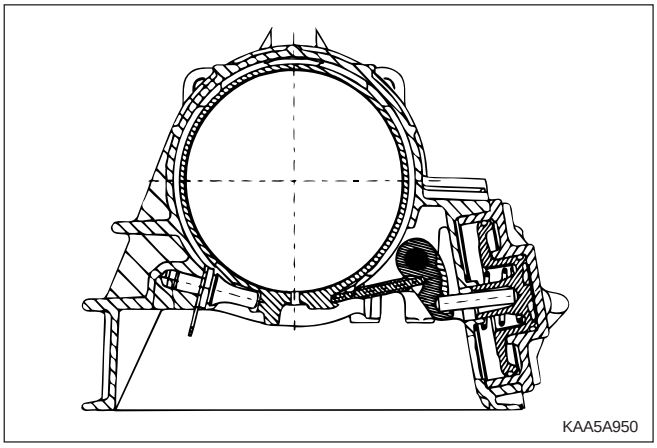


Output Shaft and Gear Assembly

1. Check that the output shaft bush is not worn or damaged. Replace if necessary.
2. Check for damage to parking pawl teeth on the ring gear. Replace if necessary.
3. Check that the sealing ring grooves have not been damaged.
4. Lubricate the sealing rings with automatic transmission fluid.
5. Assemble the sealing rings to the output shaft with the scarf cut uppermost.



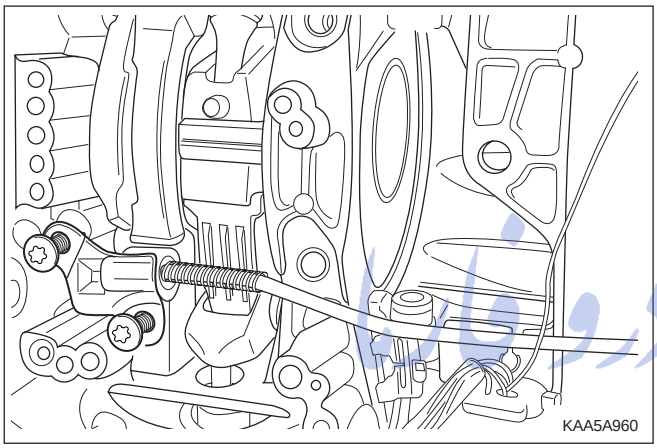
6. If previously dismantled, assemble the ring gear to the output shaft and secure with circlip. Ensure that the circlip is firmly seated in its groove.
7. Install the No. 10 needle bearing assembly onto the output shaft using petroleum jelly.
8. Carefully install the output shaft assembly in the case to prevent damage to the sealing rings.


KAA5A950

Rear Band Assembly

1. Check the rear band for any cracks or damage along the lining and metal backing.
2. Install the reaction anchor strut into the main case, without shims.
3. Carefully install the rear band into the transmission case and ensure that it is properly fitted in the case.

   Notice: If fitting a new band, soak the new band in automatic transmission fluid for a minimum of five minutes prior to assembly.

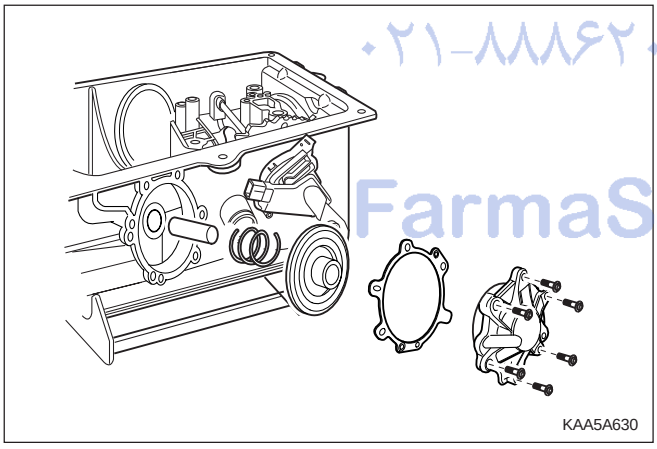

KAA5A960

4. Position the apply strut on the rear band then engage the apply strut in the servo lever.
5. Install the cam plate and tighten the screws to specification.

Installation Notice

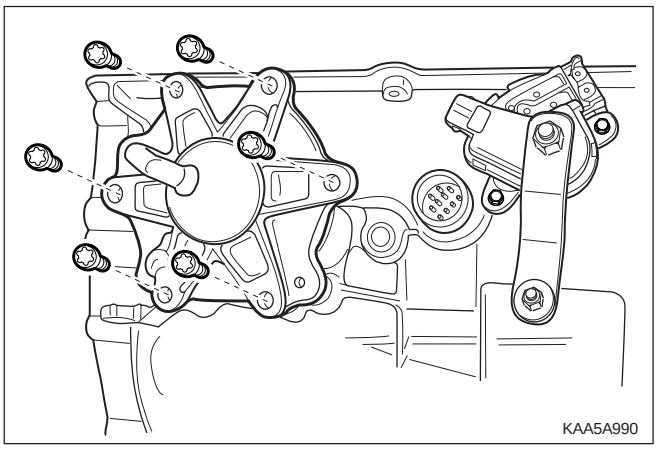
Tightening Torque	16 - 22 N•m (12 - 16 lb-ft)

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Rear Servo Assembly

1. Check the servo piston ‘O’ rings and gasket for any damage.
2. Lubricate the servo piston ‘O’ rings with automatic transmission fluid, and fit the ‘O’ rings to the piston grooves.
3. Assemble the piston to the cover, ensuring that ‘O’ ring compression is adequate but not excessive.
4. Align the spring on the piston spigot, then position the rear servo rod into the spigot.


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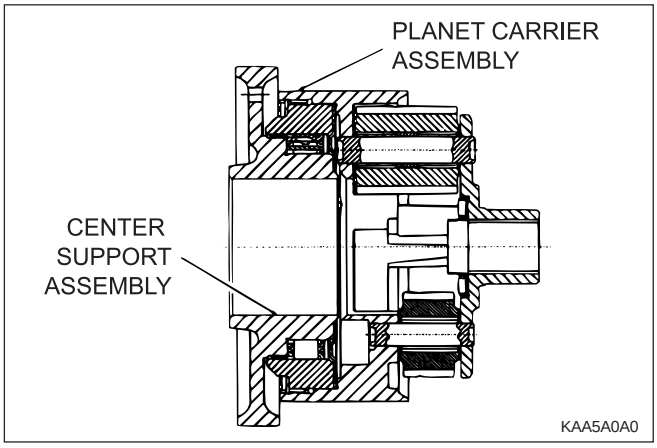
5. Assemble the gasket to the cover and fit the assembly to the case.

   Notice: Do not use petroleum jelly on the gasket.

6. Apply additional Loctite 202 or equivalent as required to the rear servo to case bolts. Install the bolts and tighten to specification.

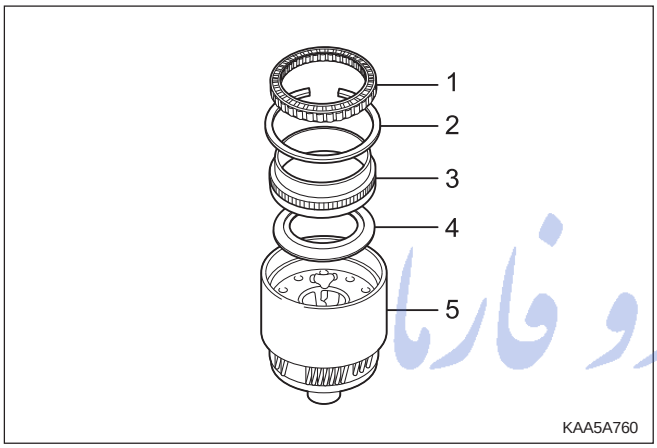
Installation Notice

Tightening Torque	30 - 35 N•m (22 - 26 lb-ft)

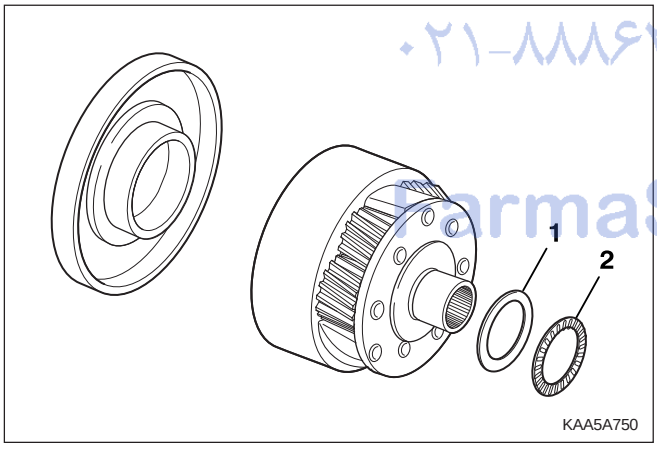


Planet Carrier Assembly and Centre Support

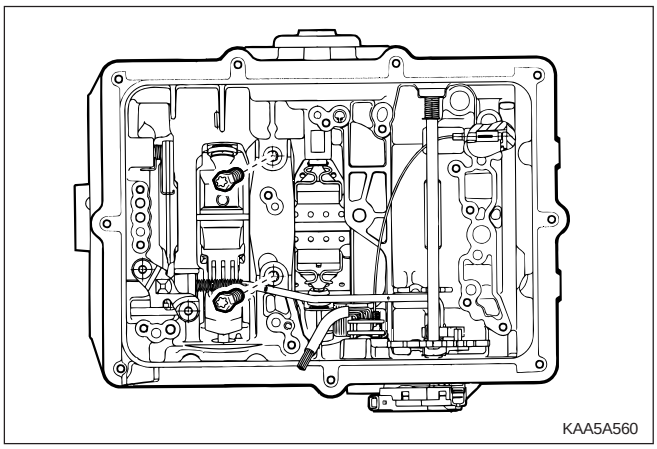
1. Check the carrier and planet assembly for any damage or irregularity and ensure that all pinions rotate freely and that the pinion end float is within 0.10 mm - 0.50 mm.



2. Install the One Way Clutch (OWC) retainer (1) to the planet carrier with the inner edge pointing downwards. Inspect the OWC race and the sprag assemblies for wear or damage. Replace if necessary.
3. Install the outer (3) race in the drum. Press the race to the bottom of the drum and install the retaining circlip (2). Ensure the circlip is firmly seated in its groove.
4. Install the OWC (1) into the outer race with the lip edge uppermost. Lubricate the sprags with automatic transmission fluid.

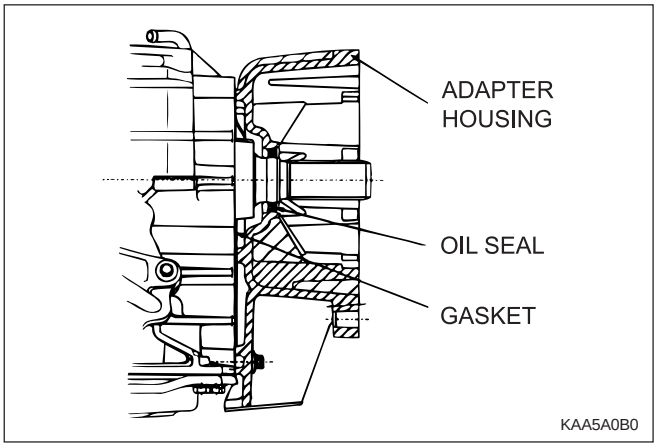


5. Check that the plugs are fitted to the centre support, then assemble the centre support into the OWC, ensuring that the support will rotate in an anti-clock-wise direction only.
6. Lubricate the No. 9 needle bearing and washer with petroleum jelly and fit them to the rear face of the planet carrier.



Tightening Torque	20 - 27 N•m (15 - 20 lb-ft)

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Adaptor Housing Assembly

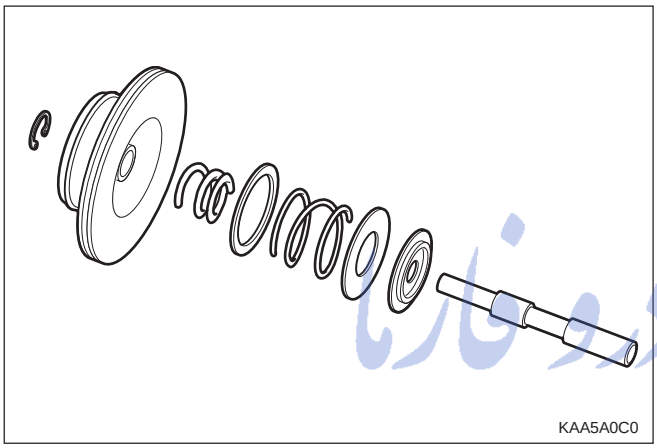
1. Install a new seal to the adaptor housing.
2. Position a new gasket onto the adaptor housing.

   Notice: Do not use petroleum jelly to hold the gasket in position.

3. Apply additional Loctite 202 or equivalent as required to the adapter housing bolts. Install the adaptor housing and torque the bolts to specification.

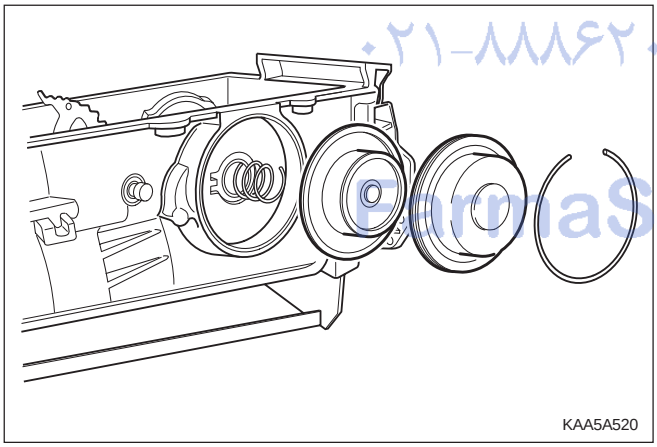
Installation Notice

Tightening Torque	30 - 35 N•m (22 - 26 lb-ft)

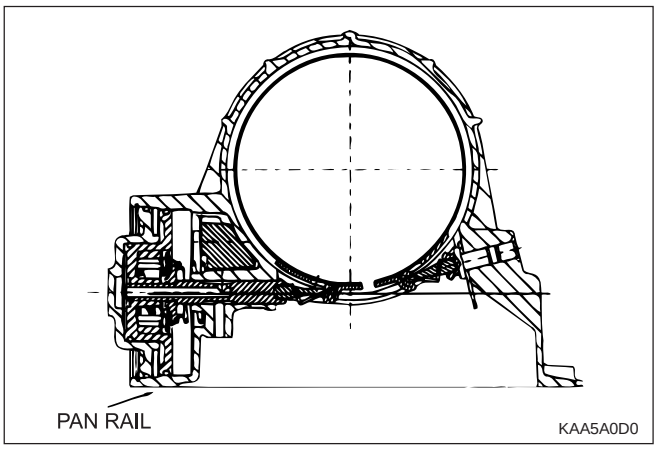


Front Servo Assembly

1. Lubricate the cover 'O' ring with automatic transmission fluid and fit to the cover.
2. Lubricatethepiston'O' rings with automatic transmission fluid and fit to the piston.
3. Assemble the piston, push rod, spring, belleville washer, seat and retaining ring.
4. Fit the piston push rod assembly into the front servo cover.



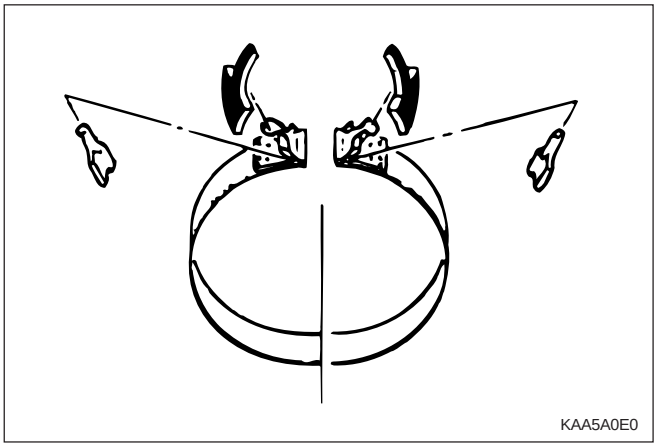
5. Install the front servo block and spring into the case.
6. Install the front servo assembly into the case.



7. Compress the servo cover and fit the servo cover retaining circlip, aligning the gap with the pan rail, and ensuring that it is completely seated in its groove.

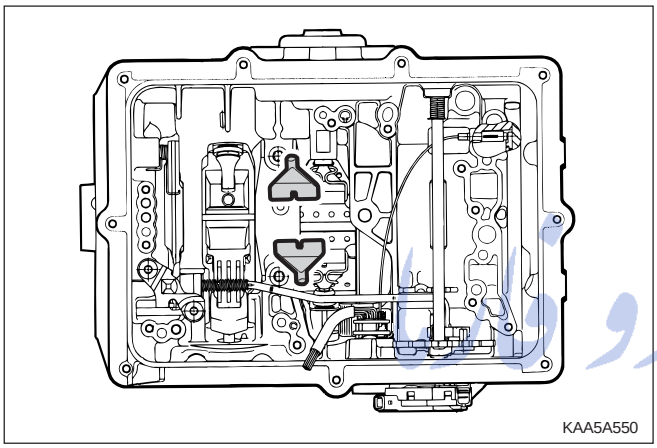
   Notice: Ensure that the front servo snap ring is installed correctly. Orient the circlip with the gap at the bottom, near the pan rail.

امداد خودرو فارنا
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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Front Band Assembly

1. Install the reaction anchor strut to the case.
2. Check the band for all cracks or damage along its lining and metal backing.
3. Position the strut retainers on the band.


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4. Install the front band into the transmission case, ensuring that it is properly seated in place.

   Notice: If fitting a new band, soak the band in automatic transmission fluid for a minimum of 5 minutes prior to assembly.
5. Position the reaction strut in its retaining clip and engage it with the band and anchor strut.
6. Position the apply strut in its retaining clip and engage it with the band and the servo piston rod.

امداد خودرو
۰۲۱-۸۸۸۶۲۰۸۵ تلفن شبانه روز
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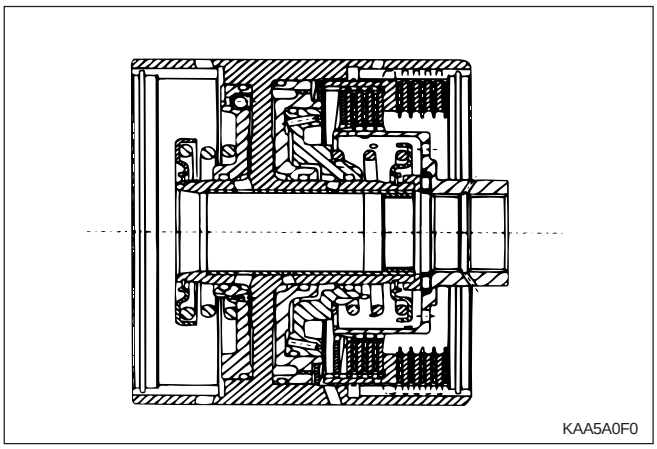
C2/C4 Clutch Assembly

Tools Required

0555-336259 Clutch Spring Compressor
0555-336260 Clutch Pack Clearance Kit

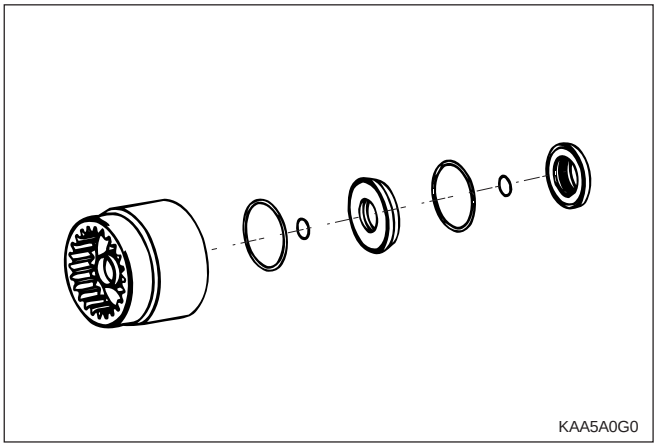
Notice:

- Check pistons for cracks.
- Do not mix the clutch piston return springs.
- Ensure that the snap rings are fitted correctly.


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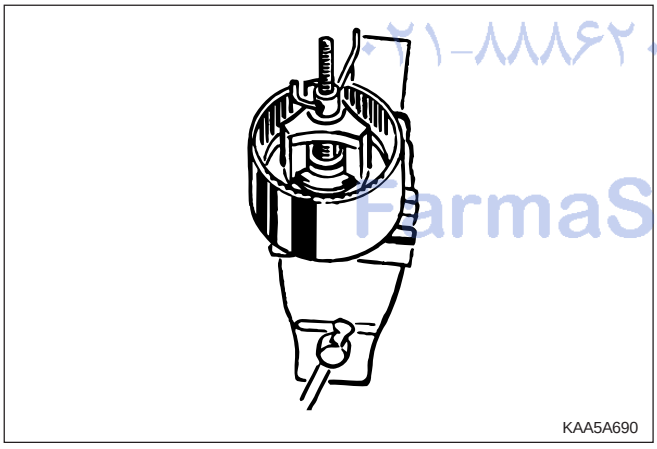
1. Check the feed orifices in the cylinder bore are clear of obstructions.
2. Check the C2 piston bleed orifices are clear of obstructions.
3. Lubricate the ‘O’ rings with Automatic Transmission Fluid (ATF)
4. Fit the small ‘O’ ring onto the inner groove, and the large ‘O’ ring onto the outer groove of the piston.

   Notice: ‘O’ rings must not be twisted in the grooves.


KAA5A0G0

5. Check the C4 piston bleed orifices are clear of obstructions.
6. Lubricate the 'O' rings with ATF.
7. Fit the small 'O' rings onto the inner groove and the large 'O' rings onto the outer groove of the piston.
8. Position the clutch cylinder with the C2/C4 cavity facing upwards.
9. Fit the C4 piston into the C2 piston with the bleed orifices in alignment.
10. Install the C2/C4 piston assembly into the cylinder, with the piston bleed orifices aligned with the holes on the outside of the cylinder, until the outer diameter of the C2 piston enters the inner diameter of the cylinder.

امداد خودرو فارما
۰۲۱-۸۸۸۶۲۰۸۵ تلفن همراه (واتس آپ)
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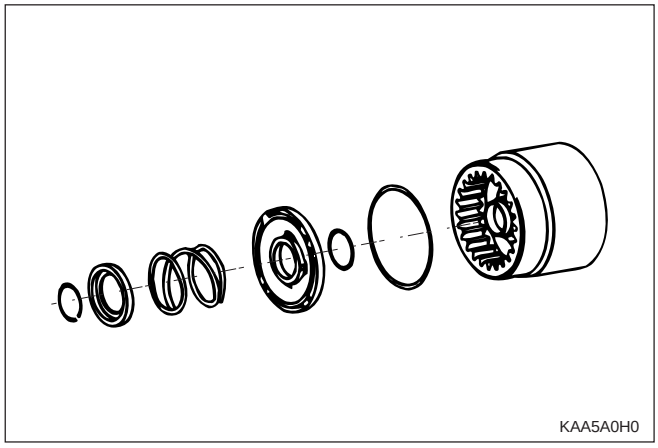

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11. Assemble the piston return spring to the piston, and fit the spring retainer over the spring.
12. Using 0555-336259 clutch spring compressor, compress the spring sufficiently to enable the installation of the retaining circlip ensuring that the circlip is firmly seated in its groove, then remove the tool.

    Notice: The wire diameter of this spring is 4.3 mm.

13. Check the C1 piston check valves are not damaged and are free to move, and that the cylinder feed orifices are clear of obstructions.
14. Lubricate the 'O' rings with ATF and fit them to their respective grooves.

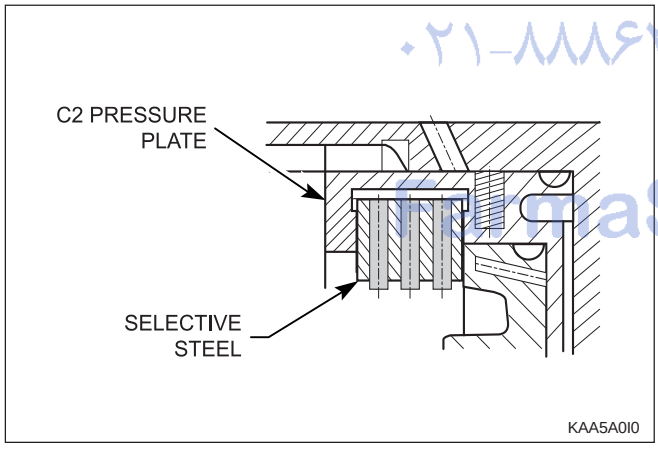
    Notice: 'O' rings must not be twisted in the grooves.



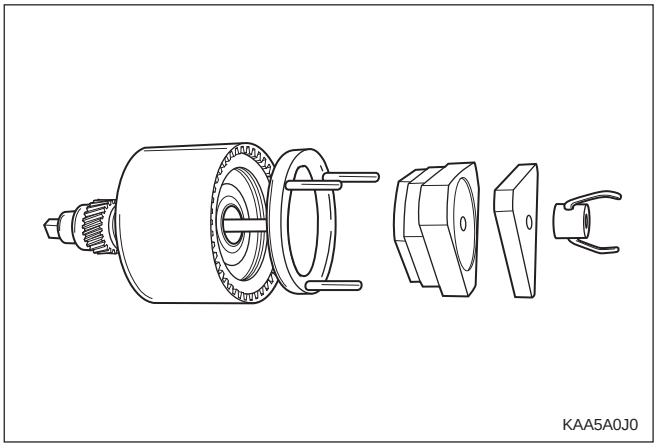
15. Position the cylinder with the C1 cavity upwards. Install the piston into the cylinder until the outer diameter of the piston enters the inner diameter of the cylinder.
16. Install the spring and spring retainer onto the piston.
17. Using 0555-336259 clutch spring compressor, compress the spring sufficiently to enable the installation of the retaining circlip ensuring that the circlip is firmly seated in its groove, then remove the tool.

    Notice: The wire diameter of this spring is 5.26 mm.
18. Install the C2 wave washer into the cylinder with the crest of one wave covering one of the bleed orifices inthe C2 piston.

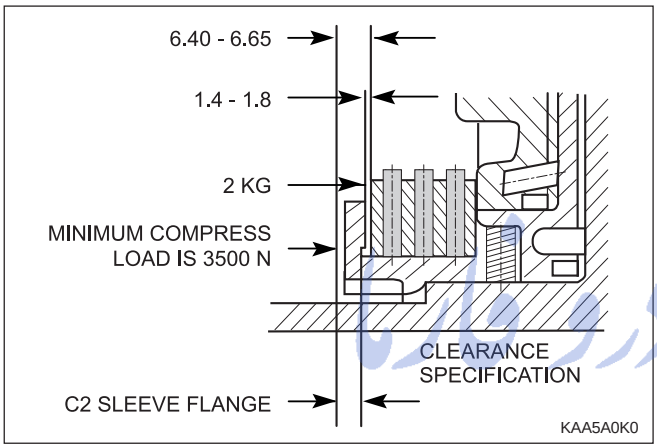
امداد خودرو فارما
۰۲۱-۸۸۸۶۲۰۸۵ تلفن شبانه روزی
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19. Measure and record the thickness of the flange of the C2 sleeve.
20. Install the C4 clutch plates and wave washer into the C2 actuating sleeve, with the rounded edge of the steel plates down, in the following sequence:
    - Steel plate (selective)
    - Friction disc
    - Steel plate
    - Friction disc
    - Steel plate
    - Friction disc
    - Steel plate
    - Wave washer



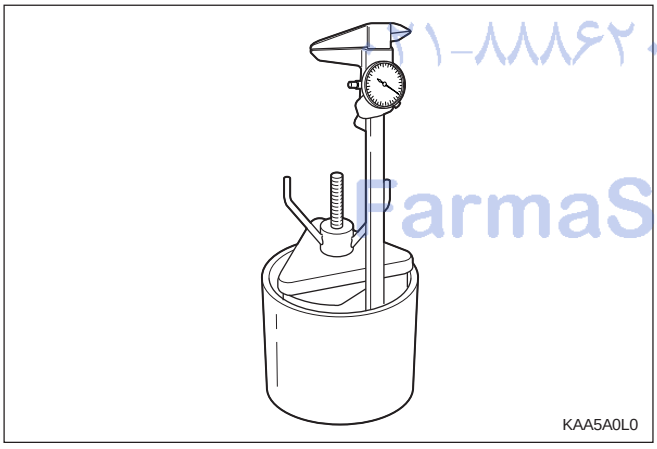
21. Holding the cylinder horizontal, install the sleeve and clutch plate assembly into the cylinder, with the crest of one wave of the washer in line with one of the holes in the outside of the cylinder, until the sleeve contacts the C2 wave washer.
22. Check the C4 clutch pack clearance using 0555-336260 clutch pack clearance kit.



Notice: With the C2 wave spring compressed, and the clutch Pack supporting a 2 kg weight, the dimension from the underside of the C2 pressure plate to the selective steel is to be between 1.4 - 1.8 mm. If the clutch is to be gauged from the top of the pressure plate, then the dimension is to be the actual thickness of the pressure plate plus 1.4 - 1.8 mm.

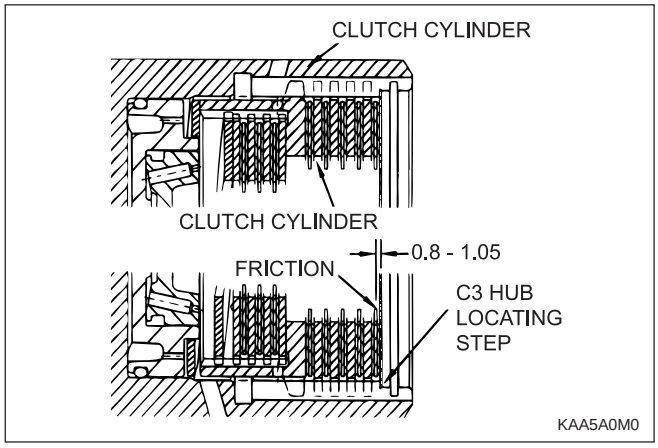
23. Use selective plates to achieve the correct specification. If new friction plates are being fitted, remove the clutch pack and soak the friction plates in ATF for a minimum of 5 minutes prior to reassembly.

Notice: The clutch pack clearance must be taken before the elements are soaked in ATF.



24. Reassemble the sleeve and clutch pack into the cylinder. Observe the alignment of the wave washer to the hole in the cylinder.
25. Install the C2 clutch plates in the cylinder in the following sequence:
    - Friction disc
    - Steel plate
    - Friction disc
    - Steel plate
    - Steel plate (0574-000013, `014, `015, `016, `019, `022), or Friction disc (0574-000012 & `017)
    - Steel plate (selective)
    - Friction disc
    - Steel plate (selective)
    - Friction disc

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26. Check the clutch pack clearance using only the weight from 0555-336260 clutch pack clearance kit.

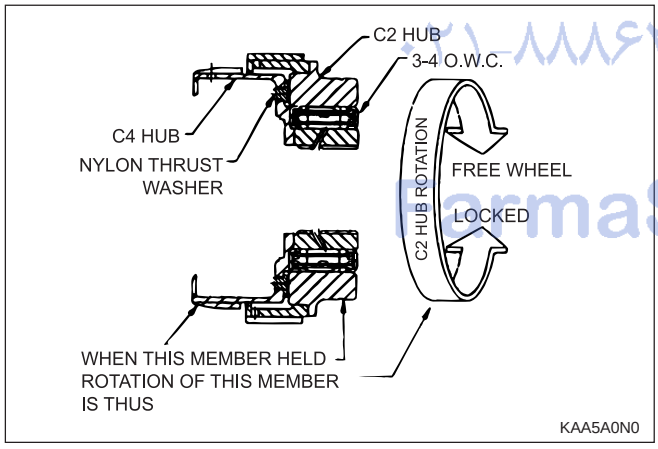
    Notice: With the clutch pack supporting a 2 kgweight, the dimension from the C3 clutch hub locating step to the friction plate is to be between 0.80 - 1.05 mm.

27. Use selective plates to achieve the correct specifica-tion. If new friction plates are being fitted, remove the clutch pack and soak the friction plates in ATF for a minimum of 5 minutes prior to reassembly.

    Notice: The clutch pack clearance must be taken before the elements are soaked in ATF.

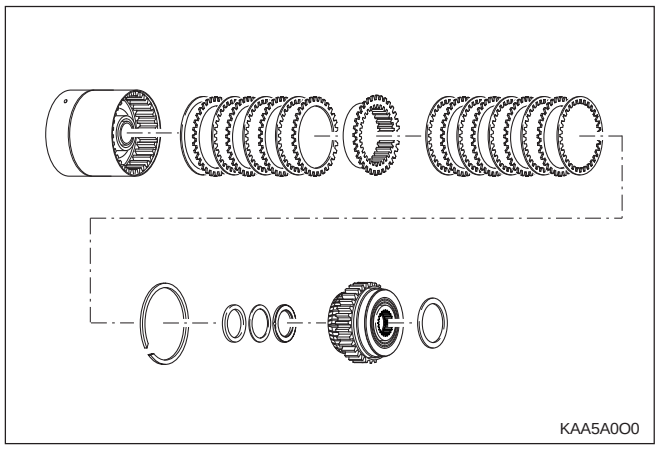
28. Lubricate and fit the 3-4 OWC and end caps to the C2 hub.

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تلفن سفارش روزی ۲۴ ۸۸۸۶۲۰۸۵
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29. Align the tangs and fit the nylon thrust washer onto the C4 hub.
30. Align and fit the C4 hub to the C2 clutch and the OWC assembly.
31. Check the rotation of the C2 hub. While holding the C4 hub, the C2 hub should rotate in the clockwise direction and lockup in the anti-clockwise direction when viewed from the C2 hub.



32. Apply petroleum jelly to the No. 5 needle bearing and fit it to the C4 hub.
33. Remove the C2 clutch plates from the clutch cylin-der.
34. Fit the thrust plate over the cylinder inner hub.
35. Engage the C2/C4 clutch hub assembly in the C4 clutch plates.
36. Install the C2 clutch plates.
37. Install the C3 hub and secure it with the circlip, ensuring that the circlip is firmly seated in its groove.

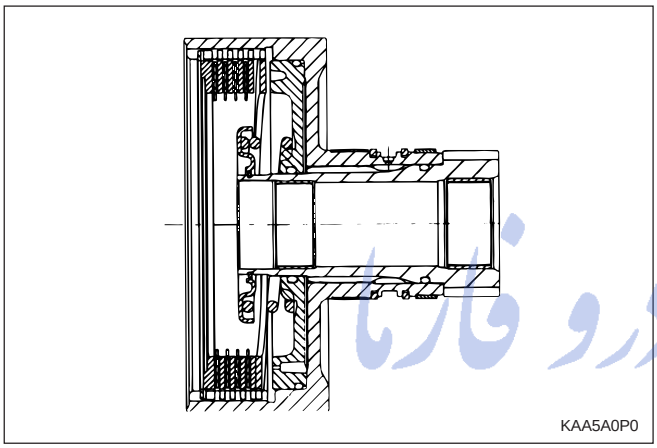
C3 Clutch and Reverse Sun Gear Assembly

Tools Required

0555-336259 Clutch Spring Compressor

0555-336260 Clutch Pack Clearance Kit

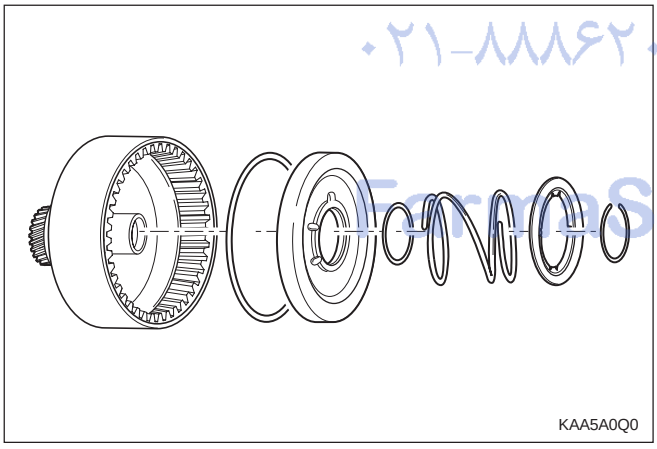
1. Check the orifices in the cylinder are clear of obstructions.
2. Check the C3 cylinder bush outside diameter and the centre support inside diameter are in good condition and not damaged. Coat the sealing rings with automatic transmission fluid and fit into the C3 cylinder grooves.



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3. Check the reverse sun gear splines, grooves and thrust face for condition. Coat the 'O' ring with automatic transmission fluid and fit it to the groove of the reverse sun gear.
4. Lubricate the C3 washer with petroleum jelly and fit to the inner face of the reverse sun gear.
5. Install the reverse sun gear in the C3 cylinder, ensuring that the 'O' ring compression is adequate but not excessive.

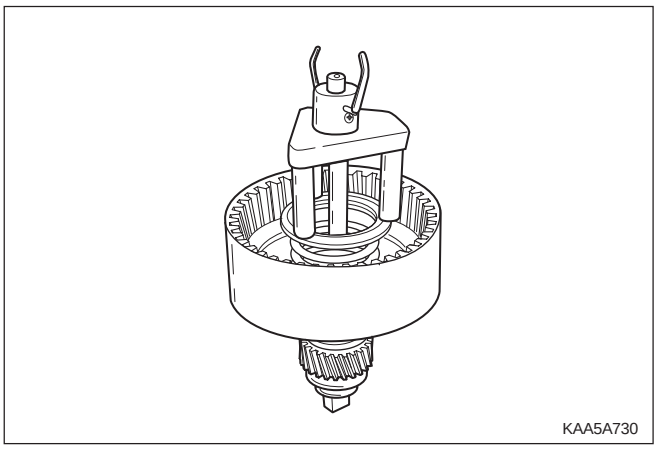
   Notice: 'O' rings must not be twisted in the grooves.



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6. Coat the C3 piston 'O' rings with automatic transmission fluid and fit the small 'O' ring onto the inner ring and the large 'O' ring onto the outer ring of the C3 piston.
7. Check that the bleed orifices of the piston are clean and clear of obstructions.
8. Install the C3 piston in the cylinder until the outside diameter of the piston enters the inside diameter of the cylinder.

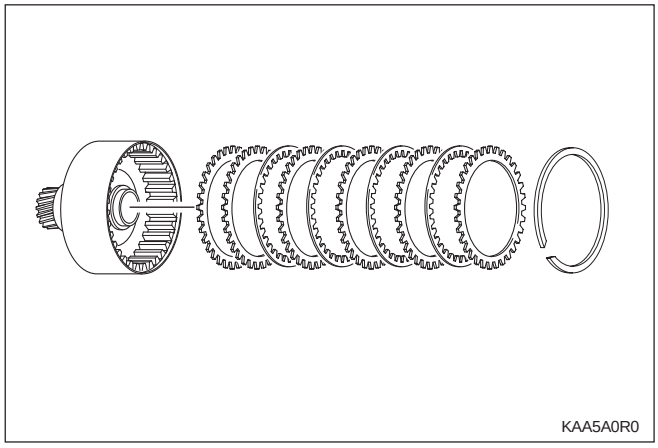
   Notice: Take care not to cut the 'O' ring.



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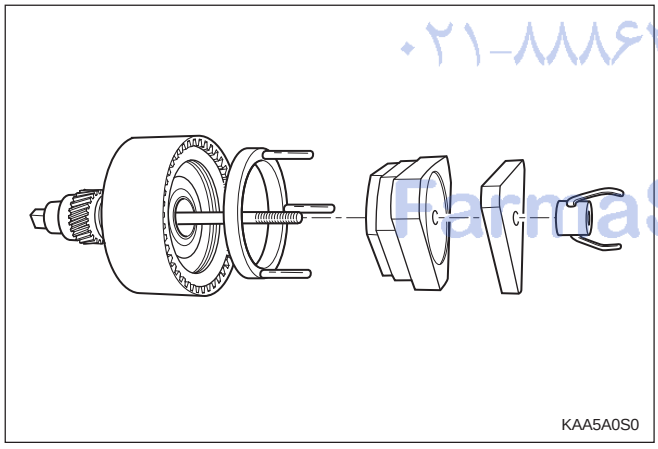
9. Assemble the spring and spring retainer on the piston. Using 0555-336259 clutch spring compressor compress the spring sufficiently to enable the installation of the retaining circlip, ensuring that the circlip is firmly seated in the groove, and remove the tool.
10. Fit the C3 wave plate to the C3 piston face, ensuring that one crest of the wave plate of the C3 piston face is aligned over one of the piston orifices.

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۰۲۱-۸۸۸۶۲۰۸۵
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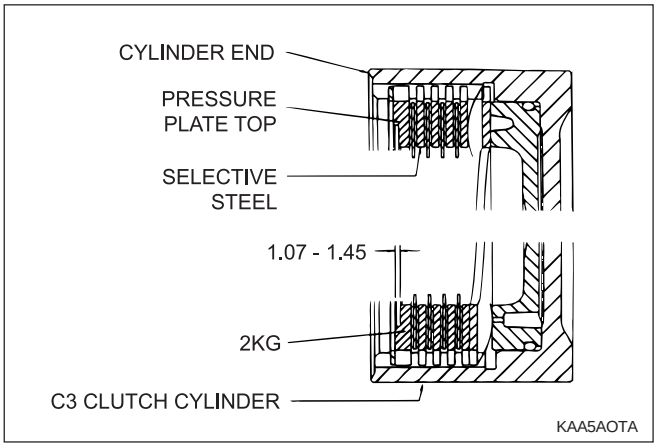

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11. Assemble the clutch plates and discs into the cylinder in the following sequence :
    - Steel plate
    - Friction disc
    - Steel plate
    - Steel plate (0574-000013, `014, `015, `016, `019, `022), or Friction disc (0574-000012, `017)
    - Steel plate (selective)
    - Friction disc
    - Steel plate (selective)
    - Friction disc
12. Align and fit the pressure plate with the counterbore facing away from the clutch plates.

امداد خودرو فارما
۰۲۱-۸۸۸۶۲۰۸۵
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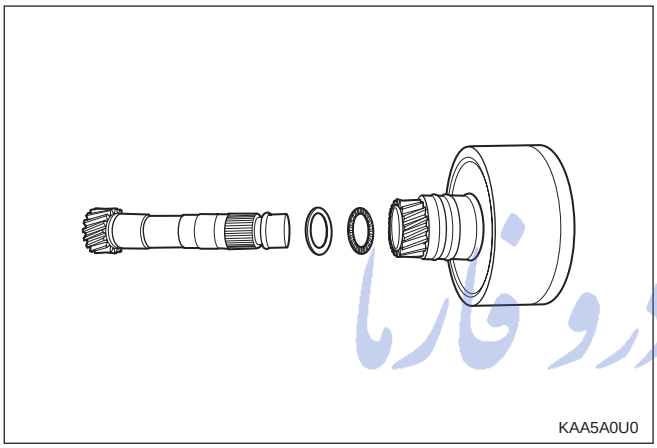
13. Install the circlip.
14. Check the C3 clutch clearance using 0555-336260 clutch pack clearance kit in the following manner (weight only).
    a. Place the weight on the pressure plate and measure the distance from the end of the cylinder to the top of the pressure plate.
    b. Record this figure.
    c. Remove the weight.
    d. Lift the pressure plate up against the circlip and measure the distance from the end of the cylinder to the top of the pressure plate.
    e. Record this figure.
    f. Subtract the second reading from the first reading to obtain the clutch pack clearance.



Notice: With the clutch pack supporting a weight of 2kg, the clearance between the snap ring and the top of the pressure plate is to be between 1.07 - 1.45 mm.

15. If new friction plates are being fitted, remove the clutch pack and soak the friction elements in automatic transmission fluid for a minimum of five minutes prior to reassembly.

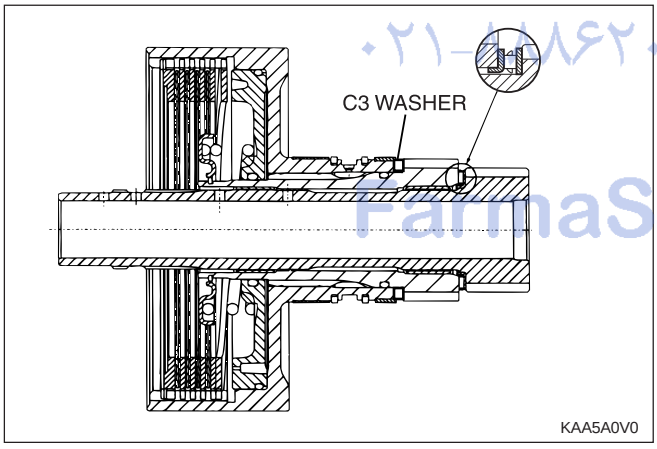
    Notice: The clutch pack clearance must be taken before the elements are soaked in automatic transmission fluid.



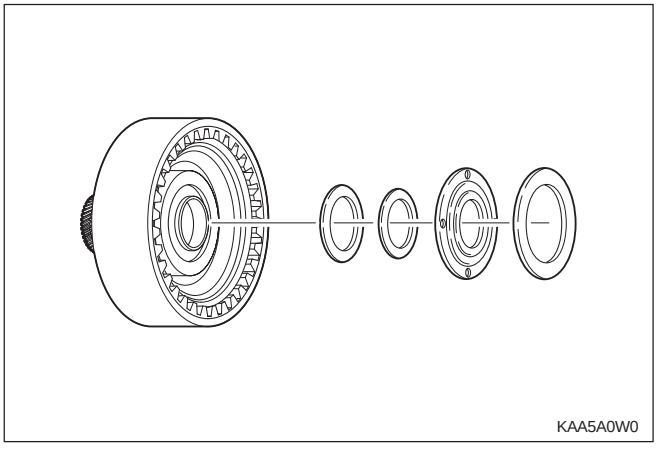
Forward Sun Gear and C3 Clutch Pack Assembly

1. Fit the No. 7 needle bearing assembly over the for-ward sun gear, ensuring that the thrust washer is between the bearing and the sun gear.
2. Lubricate the lipped thrust plate with petroleum jelly and fit the thrust plate onto the reverse sun gear.

امداد خودرو فارما
۰۲۱-۷۷۸۶۲۰۸۵ تلفن همراه فروش
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3. Align and fit the C3 clutch assembly over the for-ward sun gear.



4. Lubricate the No. 6 needle bearing with petroleum jelly and fit it to the thrust plate. Ensure the lugs on the outside diameter of the bearing fit in the thrust plate counterbore.
5. Align and fit the plastic thrust washer to the thrust plate with petroleum jelly.
6. Install the assembly over the forward sun gear shaft against the No. 6 needle bearing.
7. Place the assembly to one side.

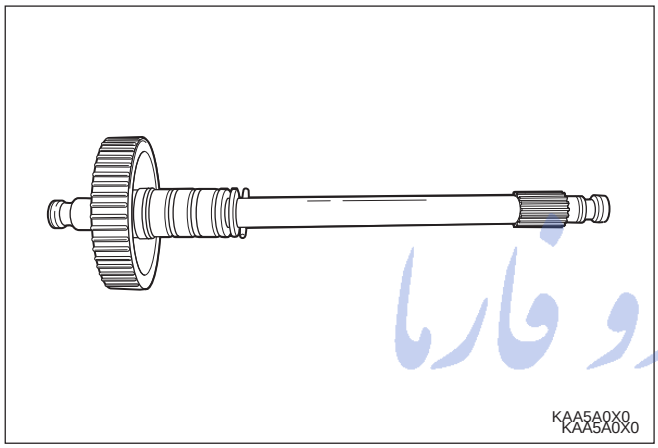
C1 Clutch Overdrive Shaft and Input Shaft Assembly

Tools Required

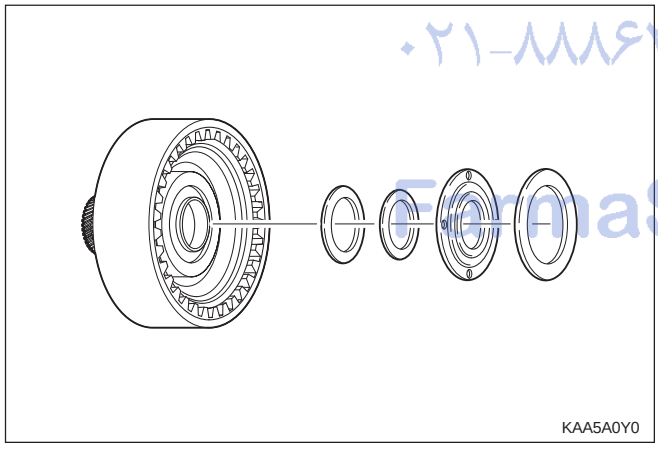
0555-336260 Clutch Pack Clearance Kit

Notice:

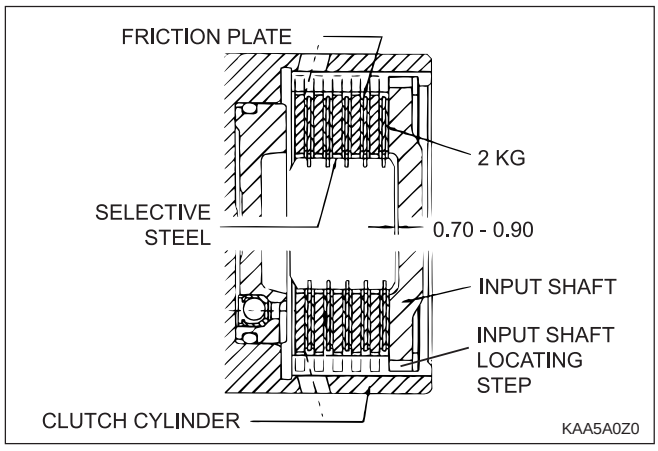
- Ensure that the snap rings are fitted correctly.
- Check pistons for cracks, especially the C1 piston.
- Do not mix clutch piston return springs.
- If the C1/C2 clutch packs separate from the C3 clutch pack, make sure the No. 6 bearing doesn't drop out of the bearing retainer.



1. Check the overdrive shaft grooves for any defect.
2. Coat the sealing rings, large and small, with petroleum jelly and fit them to the overdrive shaft. The sealing rings may be held in place with a small amount of petroleum jelly.



3. Assemble the clutch plate and disc into the cylinder in the following sequence:
   - Steel plate
   - Friction disc
   - Steel plate
   - Friction disc
   - Steel plate
   - Steel plate (0574-000013, `014, `015, `016, `019, `022), or friction disc (0574-000012 & `017)
   - Steel plate (selective)
   - Friction disc
   - Steel plate (selective)
   - Friction disc



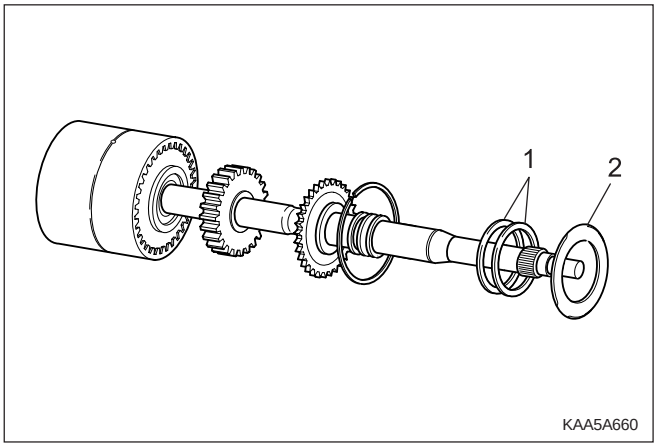
4. Check the clutch pack clearance using 0555-336260 clutch pack clearance kit.
5. Use selective plates to achieve the correct specification.

   Notice: With the clutch pack supporting a 2 kg weight, the dimension from the input shaft locating stop to the friction disc must be 0.70 - 0.90 mm.

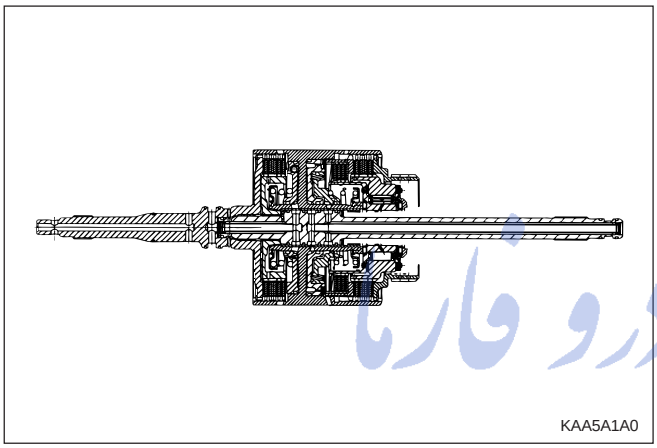
6. If new friction plates are being fitted, remove the clutch pack and soak the friction elements in automatic transmission fluid for a minimum of five minutes prior to assembly.

   Notice: The clutch pack clearance must be taken before elements are soaked in automatic transmission fluid.

امداد خودرو فارما
۰۲۱-۸۸۸۶۲۰۸۵
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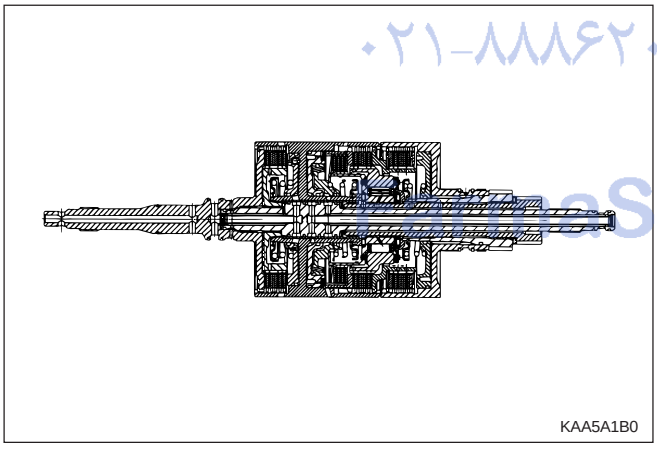


7. Check the fit of the C1 clutch hub on the overdrive shaft. If it is loose, the hub and shaft assembly must be replaced.
8. Coat the small nylon thrust spacer with petroleum jelly and install it over the overdrive shaft.
9. Carefully fit the overdrive shaft into the C1 cylinder so as not to damage the sealing ring.
10. Fit the small bronze C1 hub thrust washer in place with petroleum jelly.
11. Check the input shaft for any defect. Fit the input shaft into the cylinder and secure it with the circlip, ensuring that the circlip is completely seated in the groove.



12. Coat the sealing rings with petroleum jelly and fit onto the input shaft.

امداد خودرو فارنا
۰۲۱-۸۸۸۶۲۰۸۵



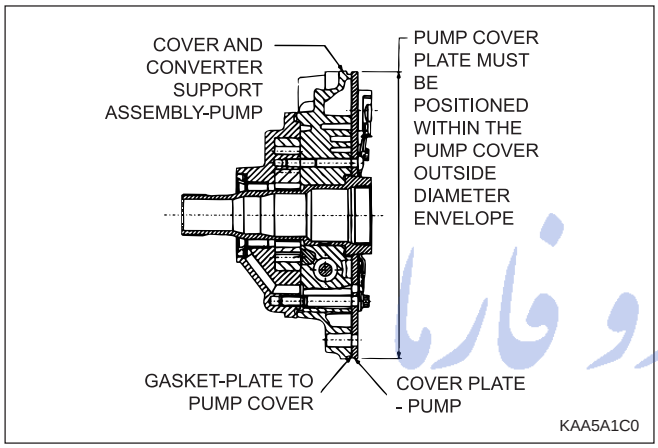
13. Assemble the C1/C2/C4 clutch assembly to the C3 clutch and sun gear assembly.
14. Install this assembly in the transmission case.

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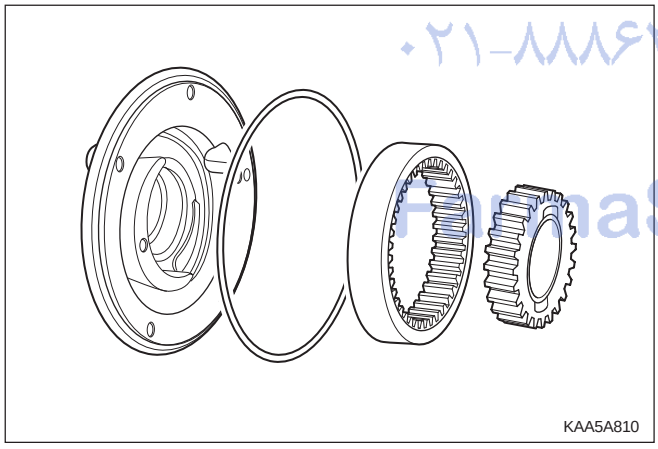
Pump Cover and Converter Support

Notice:

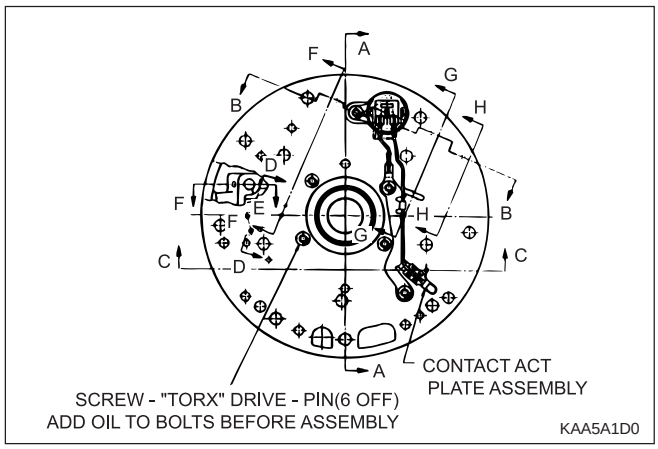
- Do not wash the nose of solenoids in solvent.
- Ensure that the correct 'O' ring is fitted for the application.
- Be careful not to damage the needle bearings on the assembly. Avoid any axial impact loads during assembly.
- Check the transmission end float. This will help to detect any missing parts or incorrect assembly.



1. Check the pump body for any damage, chips or irregularity. Check that the bush is firmly staked in the drive gear.
2. Install the seal flush with the front face of the pump body.
3. Lubricate the pump bush, and the drive and driven gears, with automatic transmission fluid.

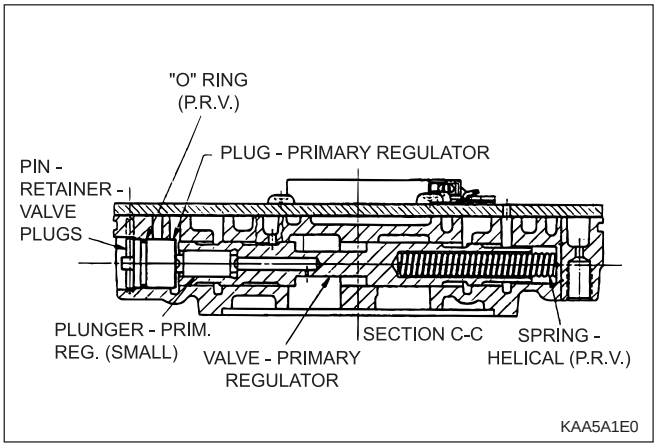


4. Install the pump driven gear and the pump drive gear into the pump body.
5. Using a straight edge and thickness gauge, check that the clearance between pump face and gears is 0.04 - 0.018 mm.
6. Lubricate the pump body 'O' ring with automatic transmission fluid and fit it to the pump body. Put the pump body to one side.

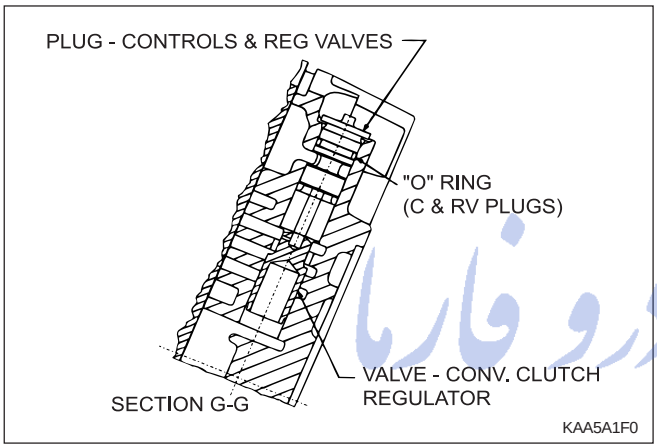


7. Ensure that the pump cover cavities, ports and holes are clean and free of any obstruction.
8. Lubricate all loose parts with automatic transmission fluid prior to assembly.

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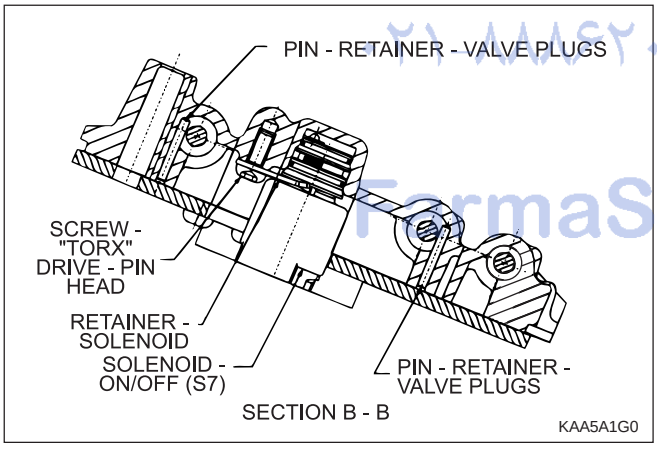


9. Assemble the primary regulator valve, spring and plunger to the pump cover, ensuring that the regulator valve slides freely, then fit the regulator valve plug and 'O' ring.
10. Install the retaining pin.

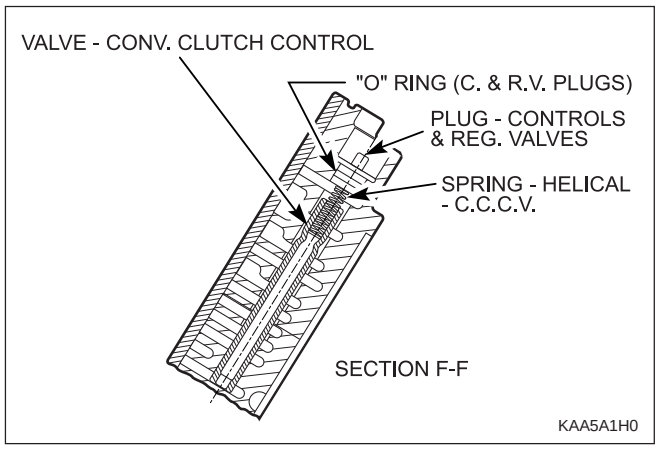


11. Install the converter clutch regulator valve, plug, spring and 'O' ring.

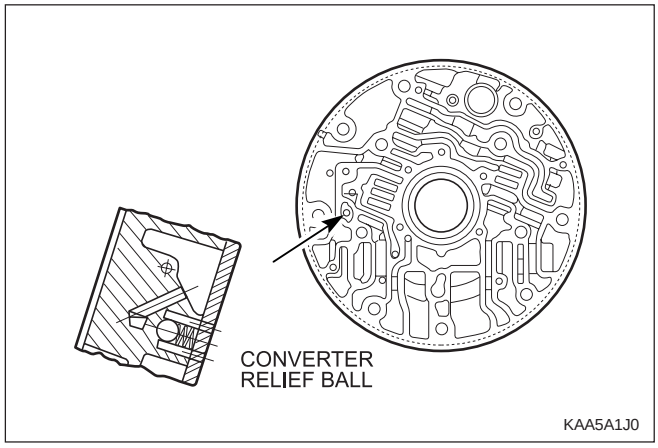
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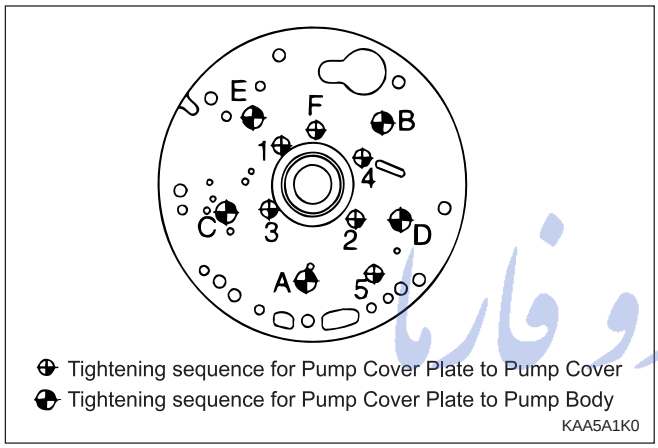
12. Install the retaining pin.



13. Install the converter clutch control valve, spring, plug, and 'O' ring.
14. Install the retaining pin.



15. Install the converter release check ball and spring.
16. Install the gasket on the pump cover.



17. Install the cover plate, solenoid 7 with the retainer and the solenoid wiring retainer to the pump cover, ensuring that the periphery of the cover plate is flush with the periphery of the pump cover.
18. Tighten the screws to specification in the order. (1-5)

Installation Notice

Tightening Torque	13 - 16 N•m (10 - 12 lb-ft)

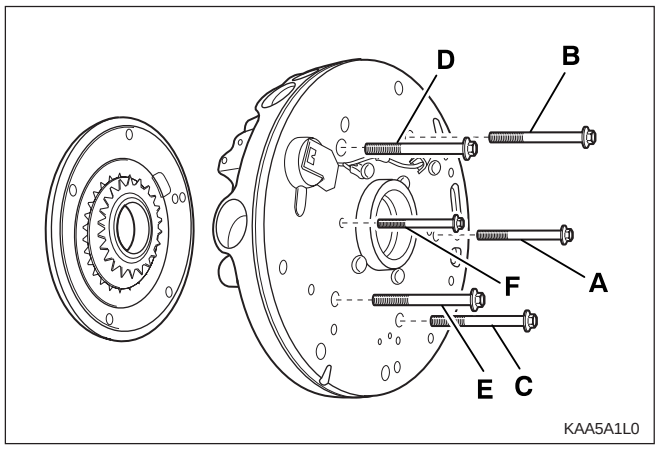
19. Tighten the solenoid 7 screw.

Installation Notice

Tightening Torque	13 - 16 N•m (10 - 12 lb-ft)

- Check that neither the wiring nor the connector protrudes excessively, in order that at assembly neither the wiring and the connector contacts or rubs on the input shaft or the C1/C2 clutch cylinder.

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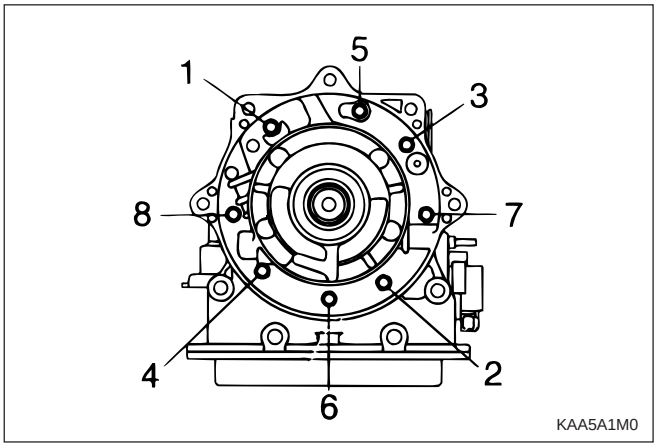


20. Assemble the pump to the pump cover.
21. Tighten all bolts and the crescent screw finger tight, ensuring that the pump is flush against the pump cover. Tighten the bolts and the screw to specification in the order. (A-F)

Installation Notice

Tightening Torque	Bolt (A-E) : 24 - 27 N•m (18 - 20 lb-ft)
	Screw (F) : 13 - 16 N•m (10 - 12 lb-ft)

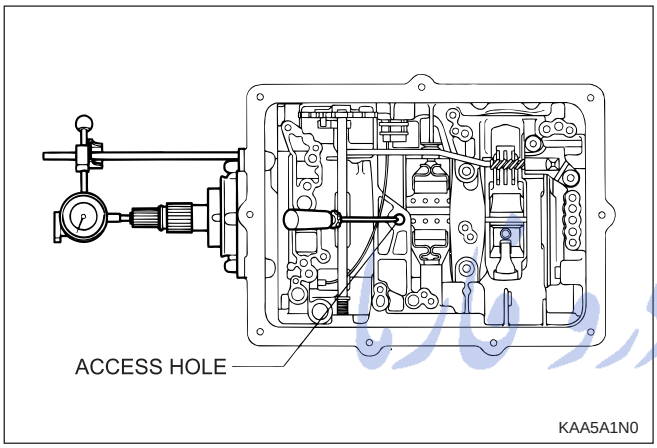
22. Install the pump to transmission case gasket onto the case.
23. Fit the 'O' ring to the pump cover outer diameter.



24. Install the pump and cover assembly over the input shaft being careful not to damage the sealing rings. Apply additional Loctite 202 or equivalent as required to the pump cover to case bolts. Install and tighten bolts to specification.

Installation Notice

Tightening Torque	24 - 34 N•m (18 - 25 lb-ft)



25. Check that the transmission end float is 0.50 - 0.65 mm. If the unshimmed end float clearance is greater than specification, shims are to be placed between the No. 4 bearing and the input shaft bearing surface. If the end float clearance is less than 0.5 mm then the transmission has been assembled incorrectly or the parts are out of specification.
26. Perform the following steps to check the end float :
    a. Attach a dial indicator to the front of the transmission case with the stylus resting on the end of the input shaft.
    b. Apply a force of approximately 250 N or 25 kg to the input shaft.
    c. Zero the dial indicator.
    d. Place a small lever behind the forward clutch cylinder and lever the cylinder forward.
    e. The measurement recorded on the dial indicator is the transmission end float or clearance between the No. 4 bearing and the converter support tube.
27. On completion of this procedure, adjust the front and rear bands to specifications. Refer to “Front and Rear Band Adjustment” in this section.

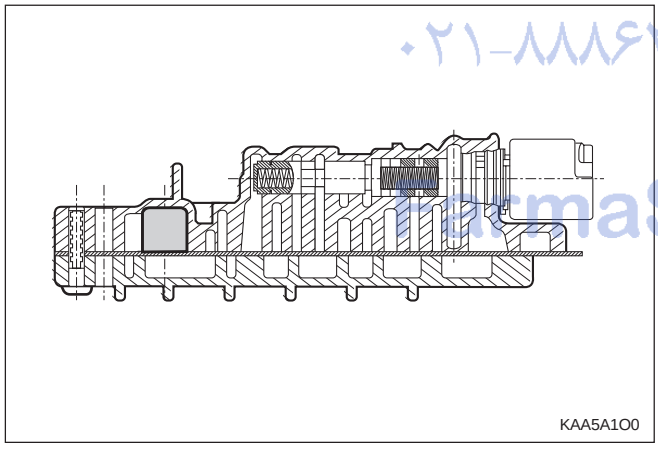
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Valve Body

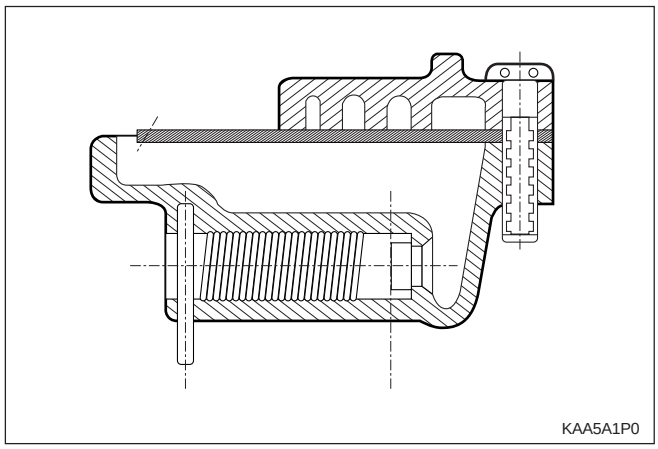
Notice:

- Do not wash the nose of solenoids in solvent.
- Be aware of ball positions in the upper valve body.
- Be aware of 1 - 2 and 3 - 4 shift valve positions, they can be swapped.
- Check the 4 - 3 sequence valve and spring orientation.
- Check that the 12 mm ball is in the lower body.
- Check the line pressure relief valve for swarf, and be aware of replacing the shims.
- When servicing the transmission, ensure that the solenoid 5 damper spring is not broken.
- Locate the detent spring central to the detent lever.
- Wash the upper and lower valve bodies thoroughly with cleansing solvent and blow dry.
- Check the valve body cavities, ports and holes for damage or obstructions.
- The orifices in the valve body are for stability and safeguard. Do not drill them larger.
- Thoroughly wash all loose components.
- Check that all valves slide freely in their location.

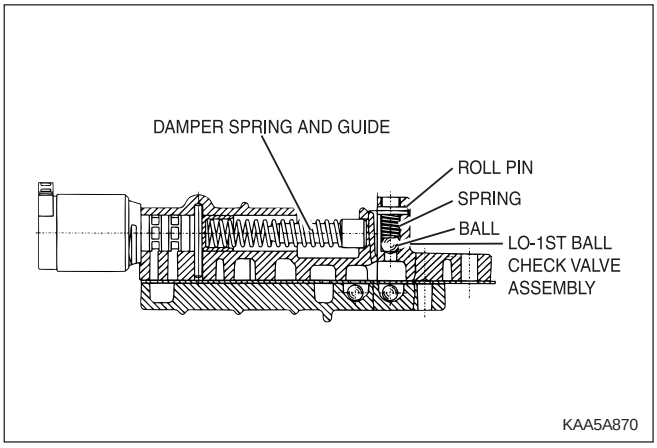
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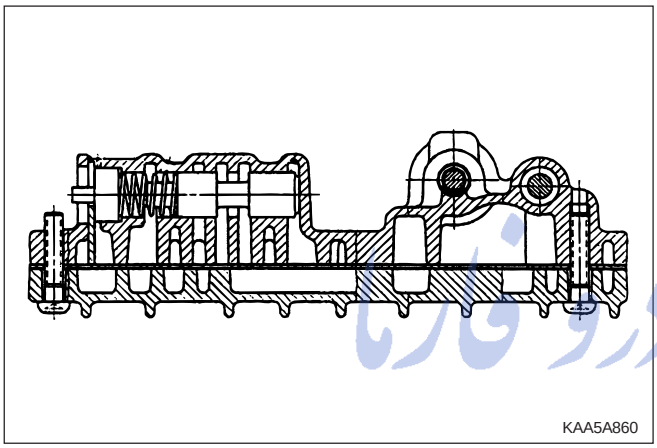
1. Install the detent lever locating pin
2. Install the Band Apply Regulator (BAR) valve, springs, plunger and retaining pin.


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3. Install the line pressure relief valve, tapered end first, spring and disc. Secure with the retaining pin.

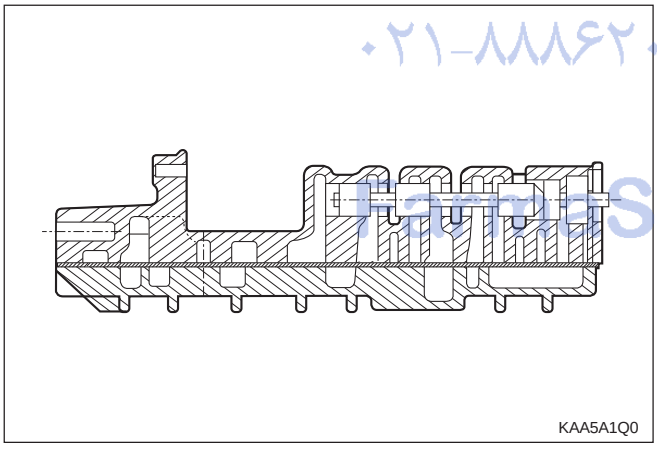


4. Install the solenoid 5 damper guide and spring, piston and retaining pin.

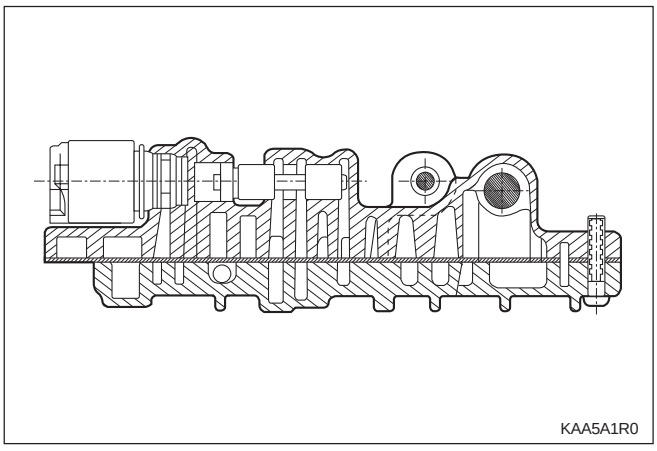


5. Install the 4 - 3 sequence valve, spring, plug and retaining plate.

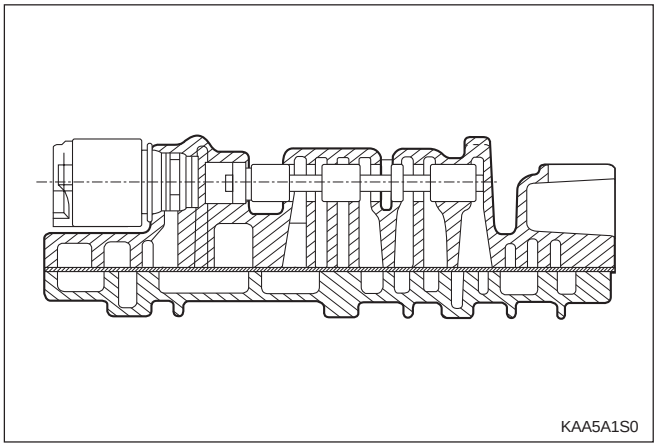
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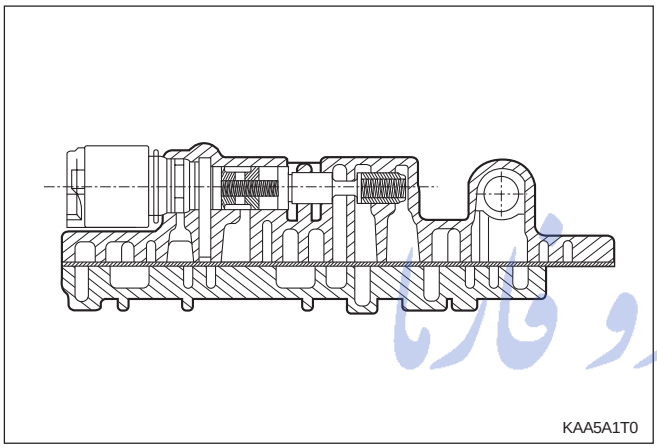
6. Install the 1 - 2 shift valve, plug and retaining pin.



7. Install the 2 - 3 shift valve and retaining pin.

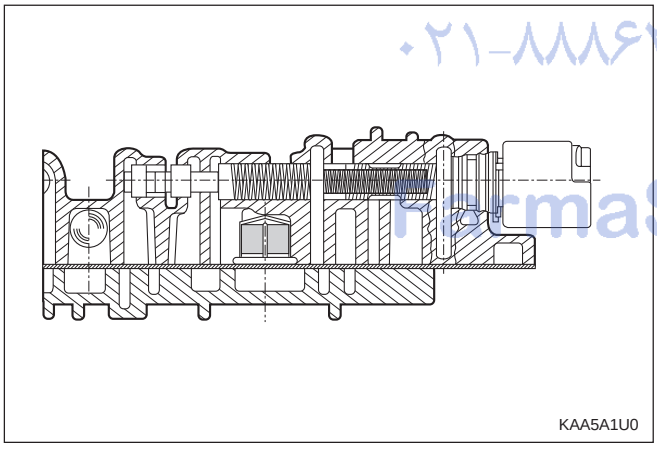

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8. Install the 3 - 4 shift valve and retaining pin.


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9. Install the Clutch Apply Regulator (CAR) valve, springs, plunger and retaining pin.

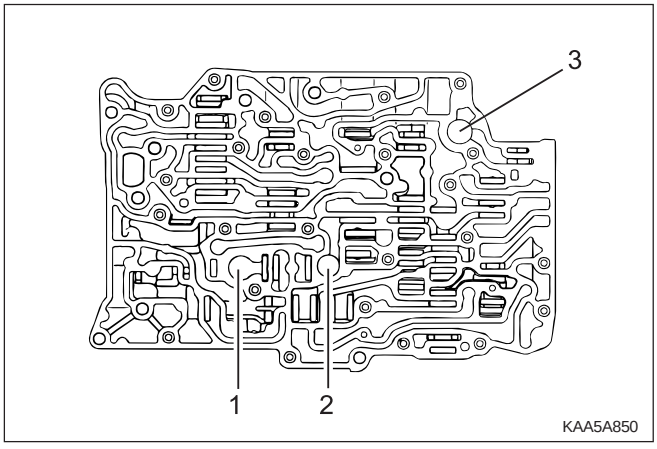
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10. Install the solenoid supply valve, spring and retaining plate.

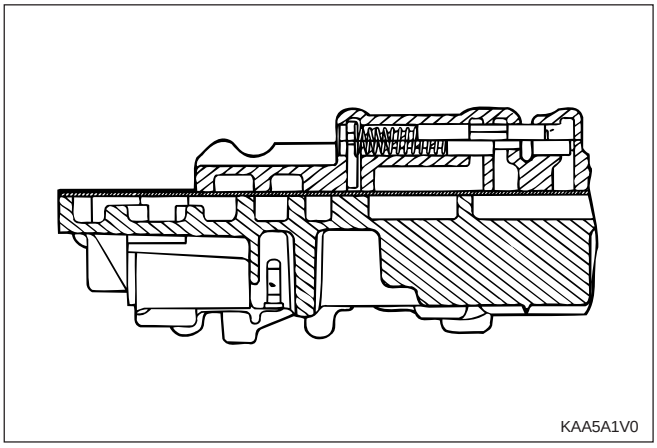
    Notice: This aluminum valve is easily damaged.

11. Install solenoid 6 plunger, spring and retaining pin.

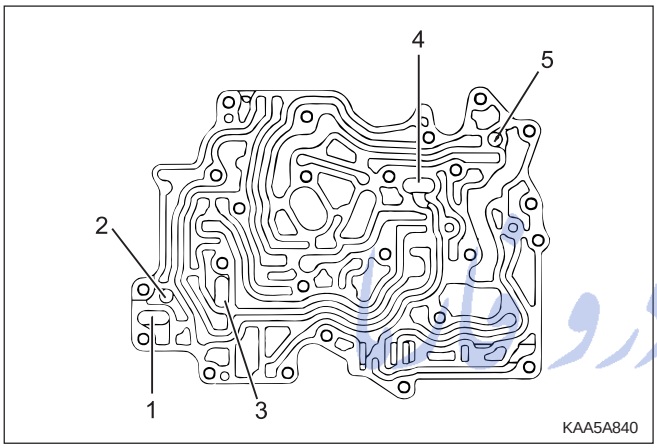


KAA5A850

12. Position the third feed ball (large nylon) in the valve body and install the solenoid 6 filter.
13. Check the separator plate for burrs and damage. Repair or replace the separator plate as necessary.
14. Check the upper and lower valve body gaskets for damage. Replace the gaskets as necessary.
15. Install the lower valve body gasket on the lower valve body.

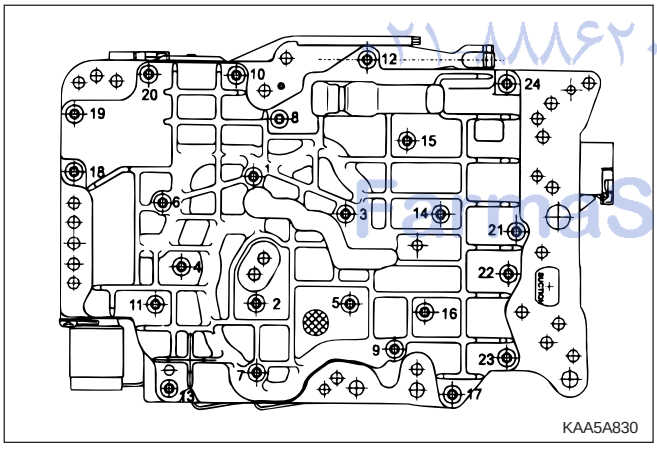

KAA5A1V0

16. Install the reverse lockout valve, spring, plug and retaining plate. Ensure that the valve is correctly oriented.



KAA5A840

17. Position the five nylon ball checks in the upper valve body.
18. Fit the upper valve body gasket. Install the separator plate over the upper valve body.



KAA5A830

19. Holding the separator plate to the upper valve body to prevent the check balls from falling out, install the upper valve body on the lower valve body. Install all screws finger tight then tighten the screws to specification in the prescribed sequence.

Installation Notice

Tightening Torque	11 - 16 N•m (8 - 12 lb-ft)

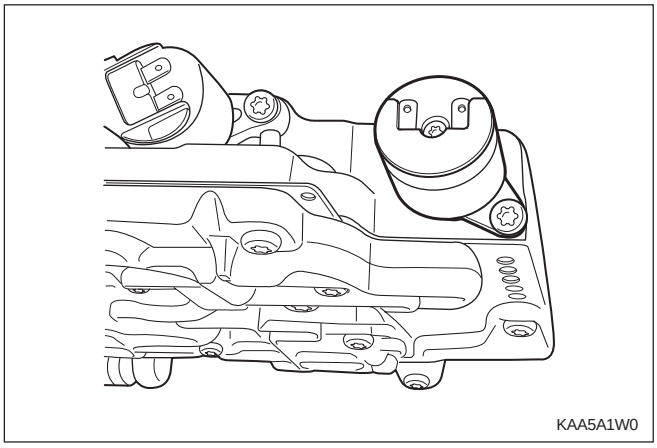
20. Install solenoids 1, 2, 3, 4 and 6. Ensure the solenoid is firmly secured by the retainer and that the screw is tightened to specification.

Installation Notice

	8 - 12 N•m (71 - 106 lb-in)

- The wiring loom ground wire eyelet terminal is secured beneath the solenoid 1 retainer.

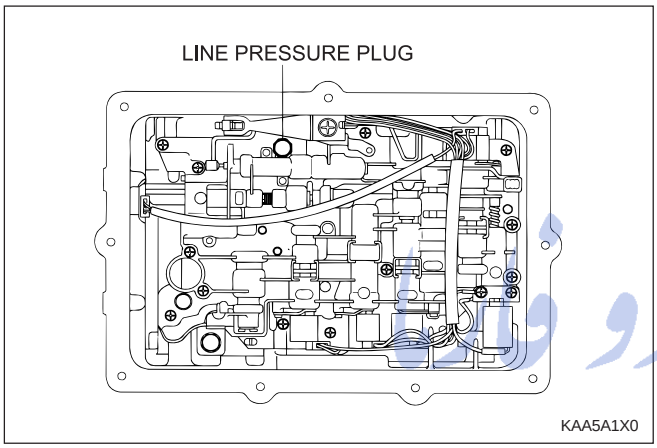
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21. Install solenoid 5. Ensure that the solenoid is pushed firmly into the valve body by the retainer and that the screw is tightened to specification.

Installation Notice

Tightening Torque	8 - 12 N•m (71 - 106 lb-in)



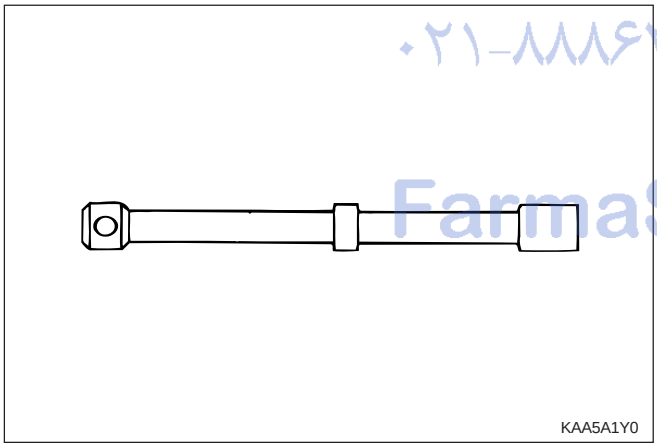
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22. Install the detent spring assembly (spring, support plate and screw), ensuring that the screw is tightened to specification. Check the spring for wear or damage.

Installation Notice

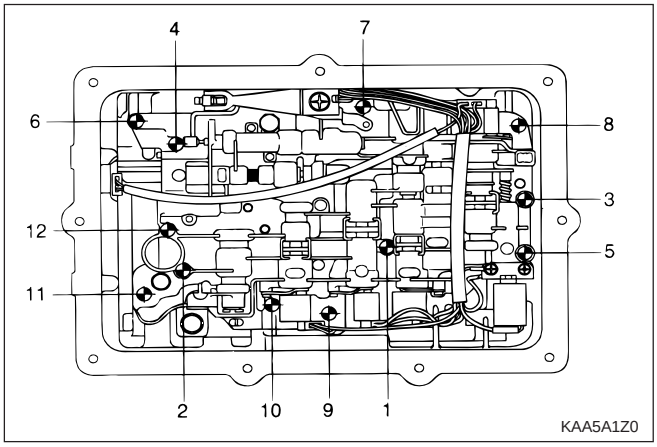
Tightening Torque	20 - 22 N•m (15 - 16 lb-ft)

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23. Install the manual shift valve.

Notice: Be aware that the manual valve will fall out of the valve body.

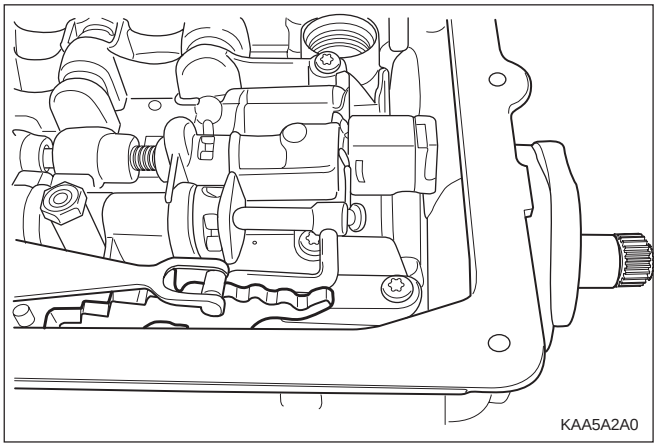


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24. Align the valve body assembly on the transmission case and install the manual valve lever to manual valve link. Fit the long end of the link to the manual valve first. Install the securing bolts and tighten to specification in the specified sequence.

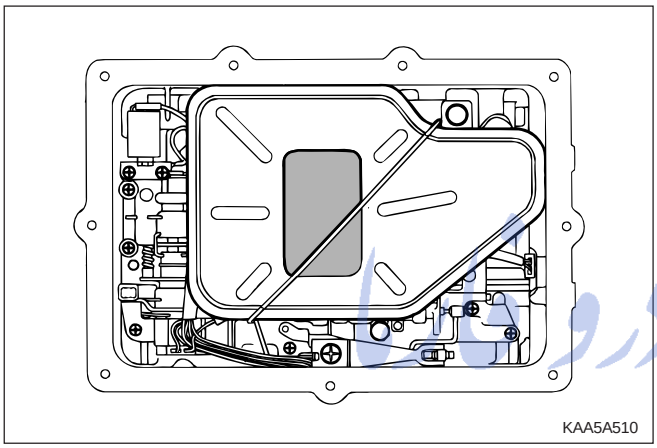
Installation Notice

Tightening Torque	8 - 13 N•m (71 - 115 lb-in)


KAA5A2A0

25. Check the alignment of the detent roller and the manual lever quadrant.
26. Connect the solenoid wiring as detailed below:
    Solenoid 1 - red
    Solenoid 2 - blue
    Solenoid 3 - yellow
    Solenoid 4 - orange
    Solenoid 5 - green
    Solenoid 6 - violet

    Notice: All hardware must be correctly installed and torqued to specification.


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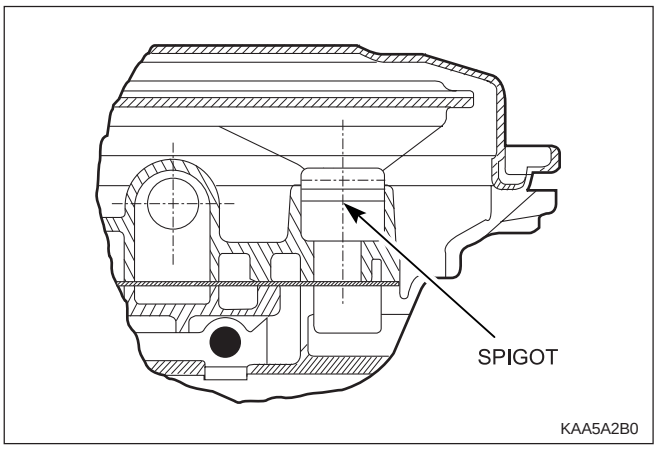
Oil Filter and Pan Assembly

Notice:

- Replace the filter whenever rebuilding a transmission where a significant amount of mechanical damage has occurred.
- To aid the assembly of the pan gasket, use a small amount of Vaseline at the pan/gasket interface. This ensures that the gasket remains on the pan ridge. Do not over torque pan bolts as this may distort the pan and cause leaks.
- Ensure that the internal line pressure plus in the valve body is fitted.

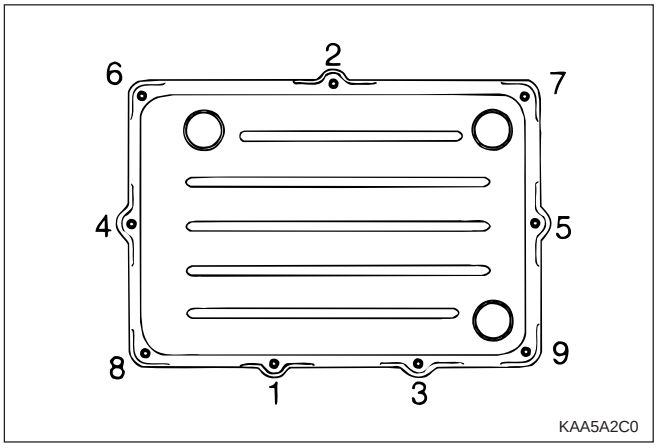
1. Lubricate the oil filter sealing ring with automatic transmission fluid.

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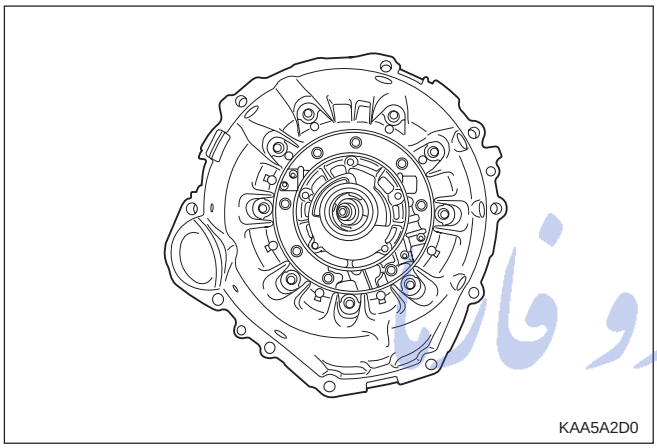
2. Carefully assemble the oil filter to the valve body. The spigot must not lean on one side while being fitted.
3. Secure the oil filter assembly with the retainer.
4. Check that the magnet is located in the dimple in the corner of the oil pan.
5. Assemble the gasket on the pan lip. The gasket must be free of any distortion when installed.



6. Fit the oil pan assembly to the transmission case and tighten the securing bolts to specification and sequence. Do not over torque.

Installation Notice

Tightening Torque	4 - 6 N•m (35 - 53 lb-in)



Torque Converter and Housing Assembly

1. Locate the torque converter housing on the transmission main case.
2. Apply additional Loctite 202 or equivalent as required to the converter housing to case bolts. Install and tighten bolts to specification.

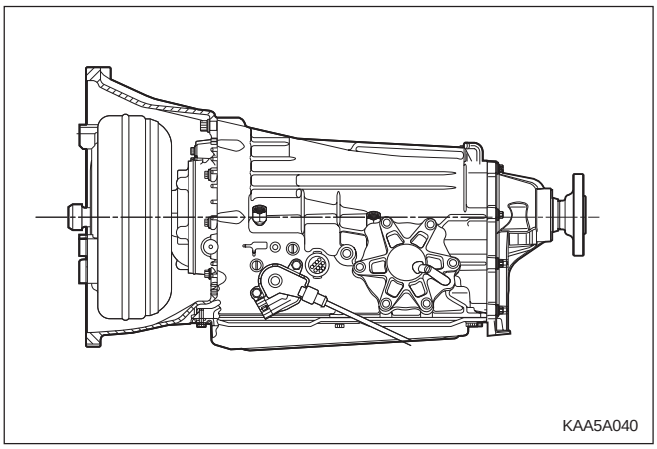
Installation Notice

Tightening Torque	54 - 68 N•m (40 - 50 lb-ft)

- All the hardware must be correctly installed and torqued to specification.

3. Fit the converter ensuring that the tangs are engaged in the pump gear. Ensure that the tangs do not contact the pump seal.

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Output Flange Assembly (2WD Mode)

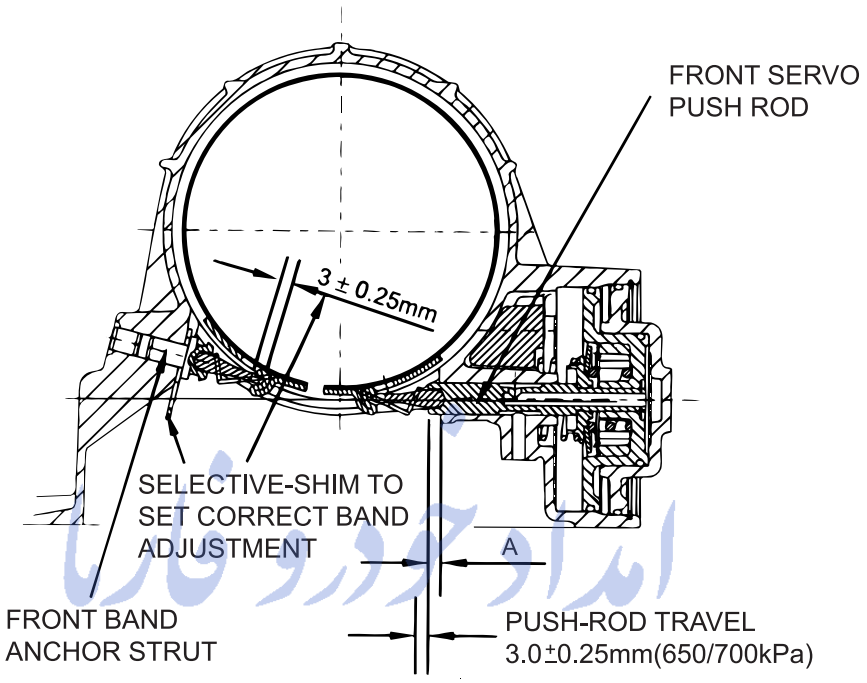
1. Position the transmission detent lever into the park position and lock the output shaft.
2. Clear the threads on the output shaft and apply Loctite 243 or equivalent as required to threads.
3. Install the flange, ‘O’ ring and torque the nut to specification.

Installation Notice

Tightening Torque	35 N•m (26 lb-ft)

FRONT AND REAR BAND ADJUSTMENT

Front Band Setting Procedure



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1. Measure the projection of the front servo push rod from the transmission case dimension 'A'.
   a. Apply air at 650/700 kPa to the front servo apply area (B1 outer)
   b. Measure the travel of the push rod and subtract 3 mm to find the shim size required.
   c. Release the air.

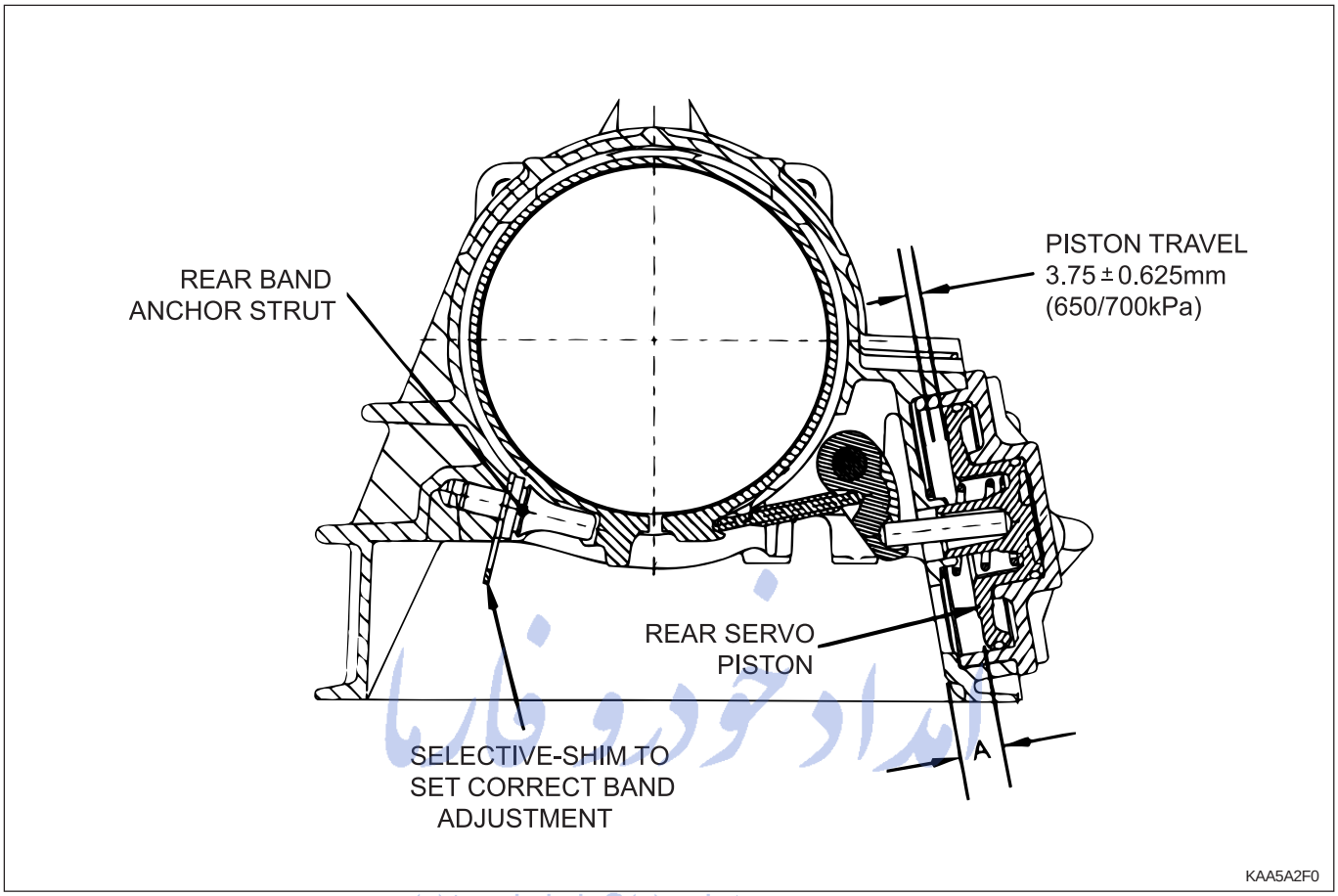
   Notice: A minimum of one shim is required at all times - minimum shim size is 1 mm. The thickness of available shims are listed in the table below.

Thickness (mm)	Part Number
0.95/1.05	0574-037017
1.15/1.25	0574-037018
1.44/1.56	0574-037019
1.73/1.87	0574-037020
1.93/2.07	0574-037021
2.12/2.28	0574-037022
2.42/2.58	0574-037023
2.61/2.79	0574-037024

2. Fit the selected shim(s) to the shank of the anchor strut as follows:
   a. Inspect the shim(s) for damage, wear or corrosion. Replace as necessary.
   b. The shim(s) are to be installed between the case abutment face and the anchor strut flange.
   c. The shim(s) are to be fitted by hand and under no circumstances to be hammered or forced.
   d. Shim(s) are to be pressed on by hand until an audible click is heard. The click indicates that the shim is clipped home correctly.
3. Re-check that the push rod travel. (3 mm ± 0.25 mm)

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Rear Band Setting Procedure



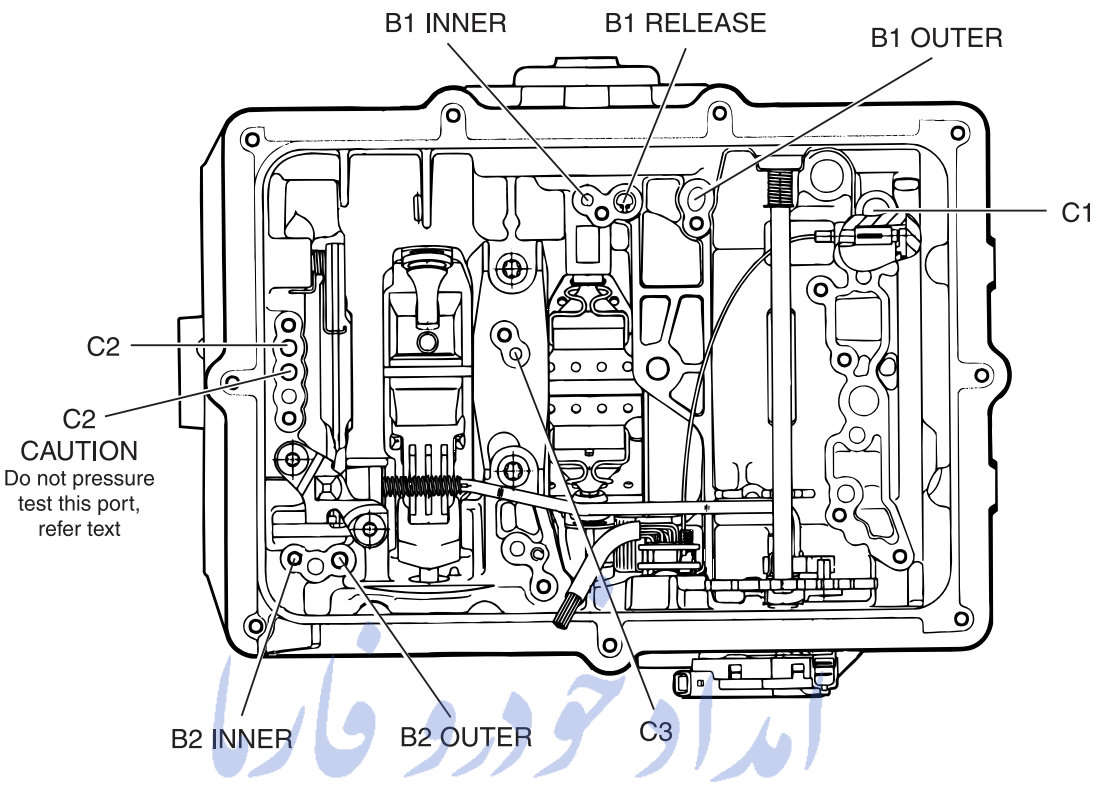
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1. Measure distance'A' from the rear servo piston to the inner face of the transmission case using vernier calipers.
   a. Apply air at 650/700 kPa to the rear servo apply area (B2 outer)
   b. Measure the travel of the piston, subtract 3.75 mm and divide the remainder by 2.5 to find shim size.
   c. Release the air.

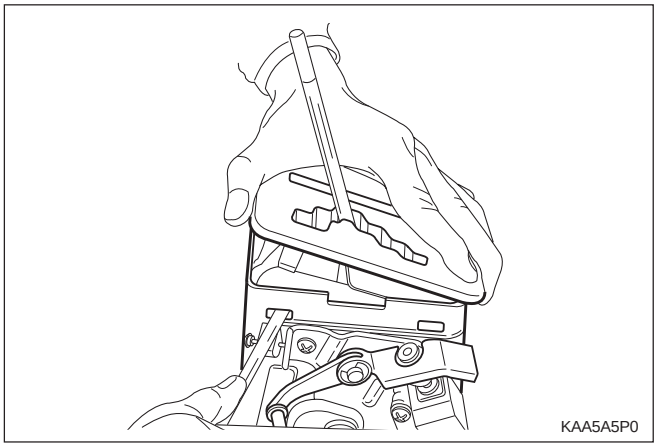
   Notice: A minimum of one shim is required at all times - minimum shim size is 1 mm. The thickness of available shims are listed in the table below.

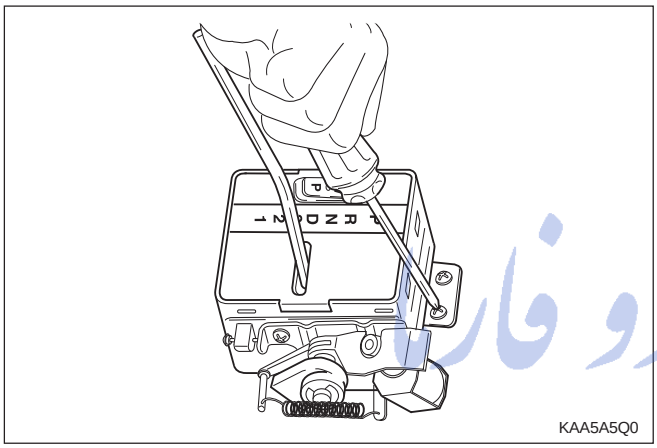
Thickness (mm)	Part Number
0.0.95/1.05	0574-037017
1.15/1.25	0574-037018
1.44/1.56	0574-037019
1.73/1.87	0574-037020
1.93/2.07	0574-037021
2.12/2.28	0574-037022
2.42/2.58	0574-037023
2.61/2.79	0574-037024

2. Fit the selected shim(s) to the shank of the anchor strut as follows.
   a. Inspect the shim(s) for damage, wear or corrosion and replace as necessary. The shim(s) are to be installed between the case abutment face and the anchor strut flange.
   b. The shim(s) are to be fitted by hand and under no circumstances to be hammered or forced
   c. The shim(s) are to be pressed on by hand until an audible click is heard. The click indicates that the shim is clipped home correctly.
3. Re-check that the piston travel.
   (3.75 mm ± 0.625 mm)

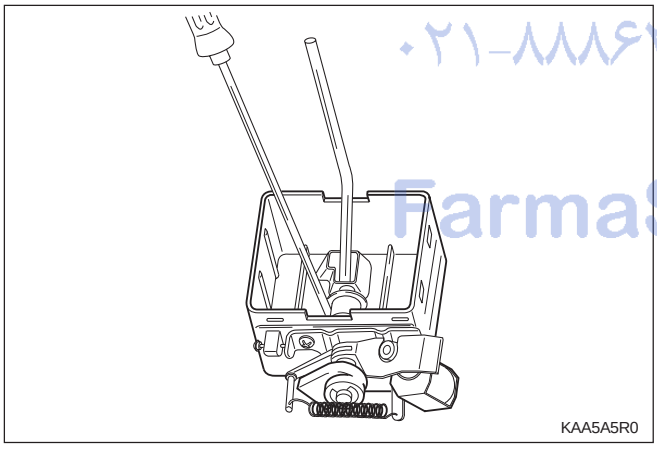


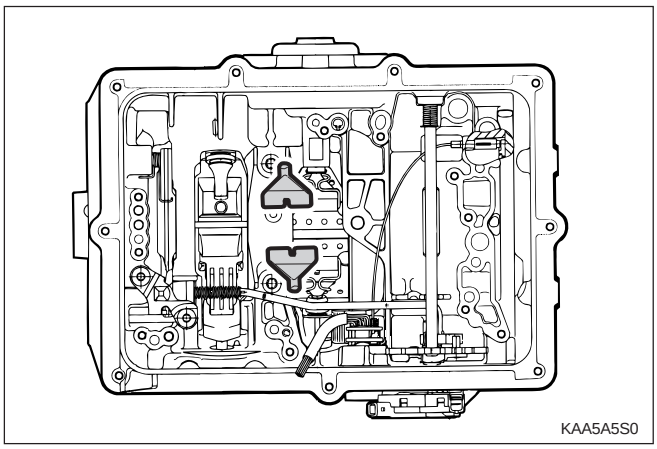
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KAA5A5P0



KAA5A5Q0


KAA5A5R0


KAA5A5S0

GEAR SHIFT CONTROL LEVER

Disassembly and Assembly Procedure

1. Disconnect the negative battery cable.
2. Remove the gear shift control lever assembly. Refer to *Section 9G, interior Trim.*
3. Remove the gear shift control lever knob.
4. Separate the upper and middle housing from the gear shift control lever assembly by unlocking the lock.
5. Remove the upper housing.
6. Disconnect the P position lamp by turning it from the middle housing.
7. Remove the P position switches assembly bolts.
8. Remove the middle housing with the mode selector switch wiring harness from the gear shift control lever assembly.
9. Separate the P position switches assembly with the P position lamp wiring harness from the gear shift control lever assembly.

   Notice: Adjust the brake transmission shift interlock ease the operation well.

10. Remove the clips supporting the springs and bushes from the pin of the pin of the gear shift control lever.
11. Remover the spring and bushes from the pin of the gear shift control lever.
12. Remove the gear shift control lever by pushing the pin.
13. Installation should follow the removal procedure in the reverse order.

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KICKDOWN SWITCH

1. Separate the Kickdown Switch from the Kickdown Switch bracket by pushing the lock.
2. Disconnect the Kickdown Switch connector.
3. Installation should follow the removal procedure in the reverse order.

SPECIFICATIONS

GENERAL SPECIFICATION

Model Part Numbers And Applications

SYMC P/NO	Transmission	Engine Version	Torque Converter
36100-05442	0574-000013	E23	179K
36100-05432	0574-000012	E32	150K

Model Specifications

Application	Descriprtion
Torque Converter	
Mean Diameter of Fluid Circuit Description	260 mm (10.2 in.)
Maximum Torque Multiplication	2.0 : 1
Gear Ratios	
First	2.741 : 1
Second	1.508 : 1
Third	1.000 : 1
Fourth	0.708 : 1
Reverse	2.429 : 1
Lubricant	
Type	Castrol TQ95
Capacity	
Dry System	9.0 Liters (approx.)
Service Refill	4.5 Liters (approx.)
Gear Train End Float	0.50 - 0.65 mm (0.020 - 0.026 in.)
Gear Set Pinion End Float	0.10 - 0.50 mm (0.004 - 0.020 in.)

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Clutch Pack Details

	0574-000012 (13)
C1	
Composition	5 (4)
Steel	5 (6)
C2	
Composition	5 (4)
Steel	4 (5)
C3	
Composition	4 (3)
Steel	4 (5)
C4	
Composition	3 (3)
Steel	4 (4)

E32 Typical Shift Patterns

NORMA MODE						POWER MODE					
THROTTLE OPENING	SHIFT (km/h)					THROTTLE OPENING	SHIFT (km/h)				
	1/2	2/3	3L	3/4	4L		1/2	2/3	3L	3/4	4L
0 %	12	20	-	39	82	0 %	12	24	-	41	82
45 %	24	50	70	93	93	45 %	32	66	-	105	117
100 % (WOT)	57	110	114	170	170	100 % (WOT)	57	110	-	170	170
Kickdown	57	110	119	175	175	Kickdown	57	110	119	175	175

Typical Manual Downshift Maximum Speed

Downshift Type Max.	Speed limitations inhibiting Downshift
Manual 2-1	61 kph (37.9 mph)
Manual 3-2	117 kph (72.7 mph)
Manual 4-3	149 kph (92.5 mph)
Manual 4-2 (4-2 direct)	64 kph (39.8 mph)
Manual 4-2 (4-3-2 sequence)	117 kph (72.7 mph)

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E23 Typical Shift Patterns

NORMA MODE						POWER MODE					
THROTTLE OPENING	SHIFT (km/h)					THROTTLE OPENING	SHIFT (km/h)				
	1/2	2/3	3L	3/4	4L		1/2	2/3	3L	3/4	4L
0 %	10	19	-	36	79	0 %	12	23	-	42	75
50 %	23	46	75	72	92	50 %	31	64	-	97	94
100 % (WOT)	47	92	95	147	147	100 % (WOT)	47	92	-	147	147
Kickdown	48	94	96	150	150	Kickdown	48	94	96	150	150

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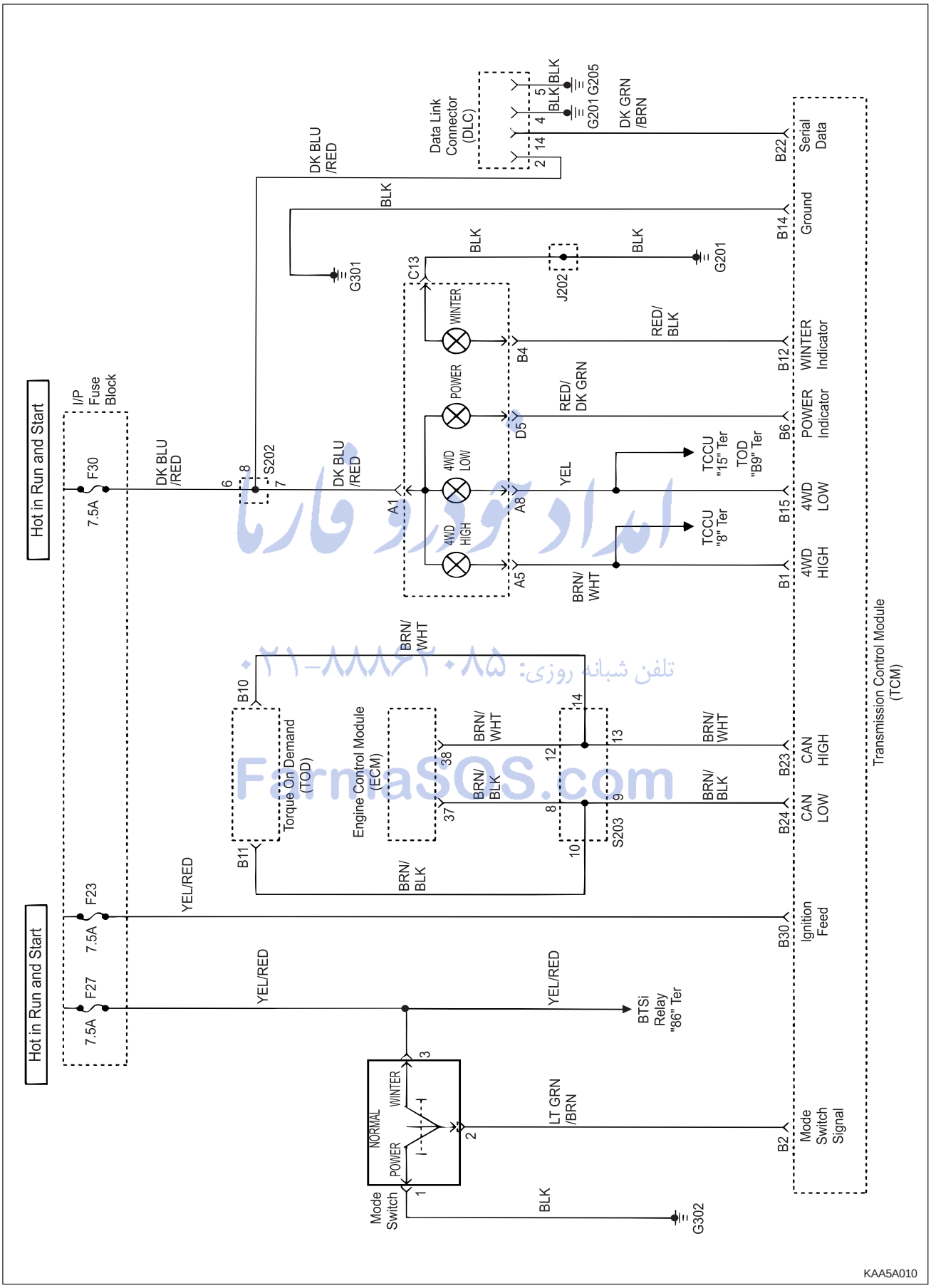
FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-Ft
Adaptor Housing to Case Bolts	35 - 40	26 - 30	-
Cam Plate to Case (Parking Pawl) Screws	16 - 22	12 - 16	-
Centre Support to Case Bolts	20 - 27	15 - 20	-
Detent Spring Screw	20 - 22	15 - 16	-
Extension Housing to Case Bolts	54 - 68	40 - 50	-
Front Propeller Shaft Bolts	70 - 80	52 - 59	-
Inhibitor Switch to Case Bolts	4 - 6	-	35 - 53
Oil Cooler Pipes	40 - 45	29 - 33	-
Oil Pan to Case Bolts	4 - 6	-	35 - 53
On/Off Solenoid Retainer Screws	8 - 12	-	71 - 106
Output Flange Nuts	35	26	-
Pump Cover Plate to Crescent Screw	13 - 16	10 - 12	-
Pump Cover Plate to Pump Cover Screws	13 - 16	10 - 12	-
Pump Cover to Case Bolts	24 - 34	18 - 25	-
Pump to Pump Cover Bolts	24 - 27	18 - 20	-
Rear Propeller Shaft Bolts	70 - 80	52 - 59	-
Rear Servo Cover to Case Bolts	30 - 35	22 - 26	-
Torque Converter Housing to Case Bolts	54 - 68	40 - 50	-
Torque Converter Mounting Bolts	42	31	-
Transfer Case to Transmission Housing Bolts	35 - 60	26 - 44	-
Transmission Filler Plug	30 - 35	22 - 26	-
Upper Valve Body to Lower Valve Body Screws	11 - 16	8 - 12	-
Valve Body To Case Bolts	8 - 13	-	71 - 115
Variable Pressure Solenoid (S5) Retainer Screw	8 - 12	-	71 - 106

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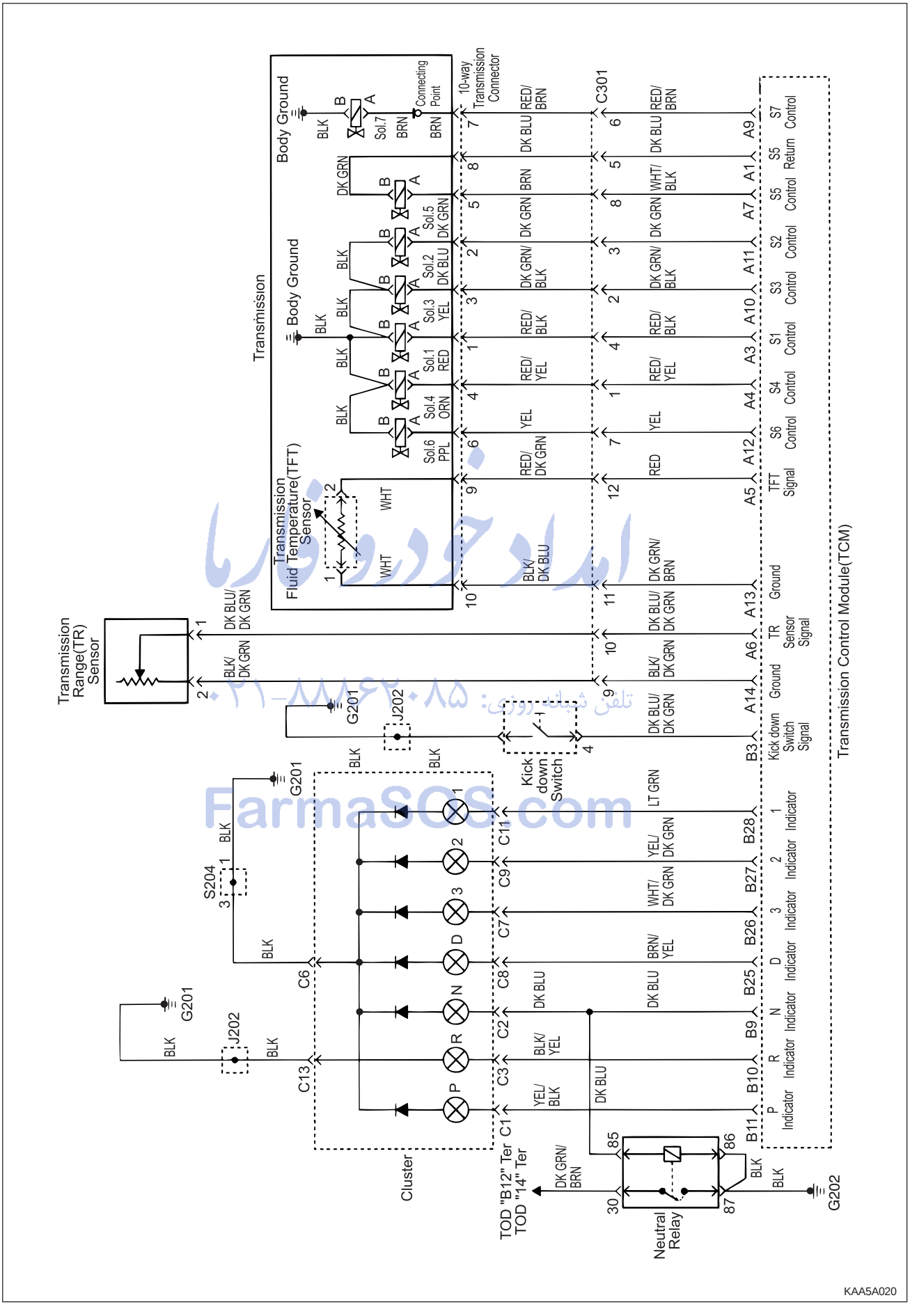
SCHEMATIC AND ROUTING DIAGRAMS

TCM WIRING DIAGRAM (GASOLINE ENGINE - 1



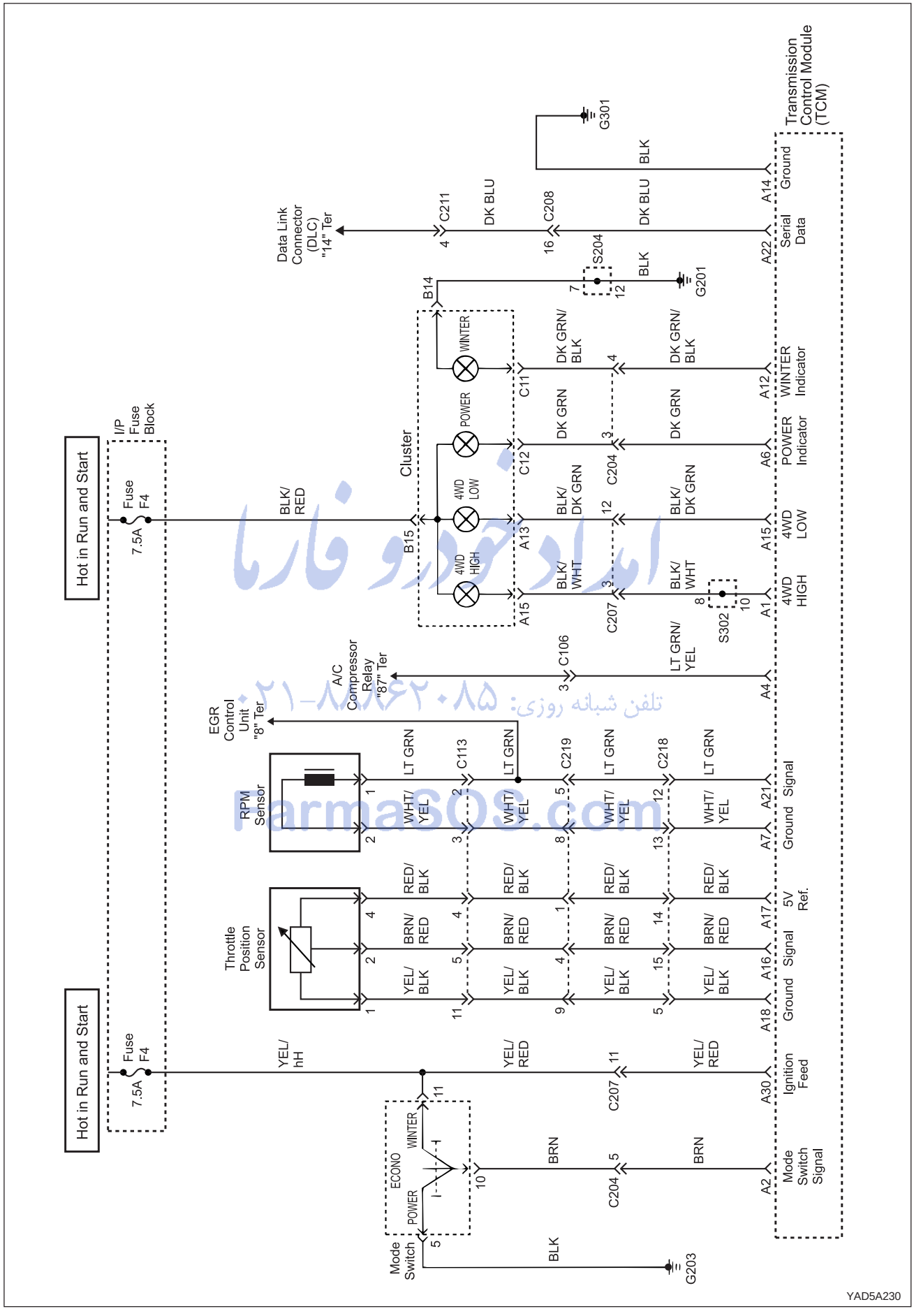
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FarnaSOS.com

TCM WIRING DIAGRAM (GASOLINE ENGINE - 2 OF 2)



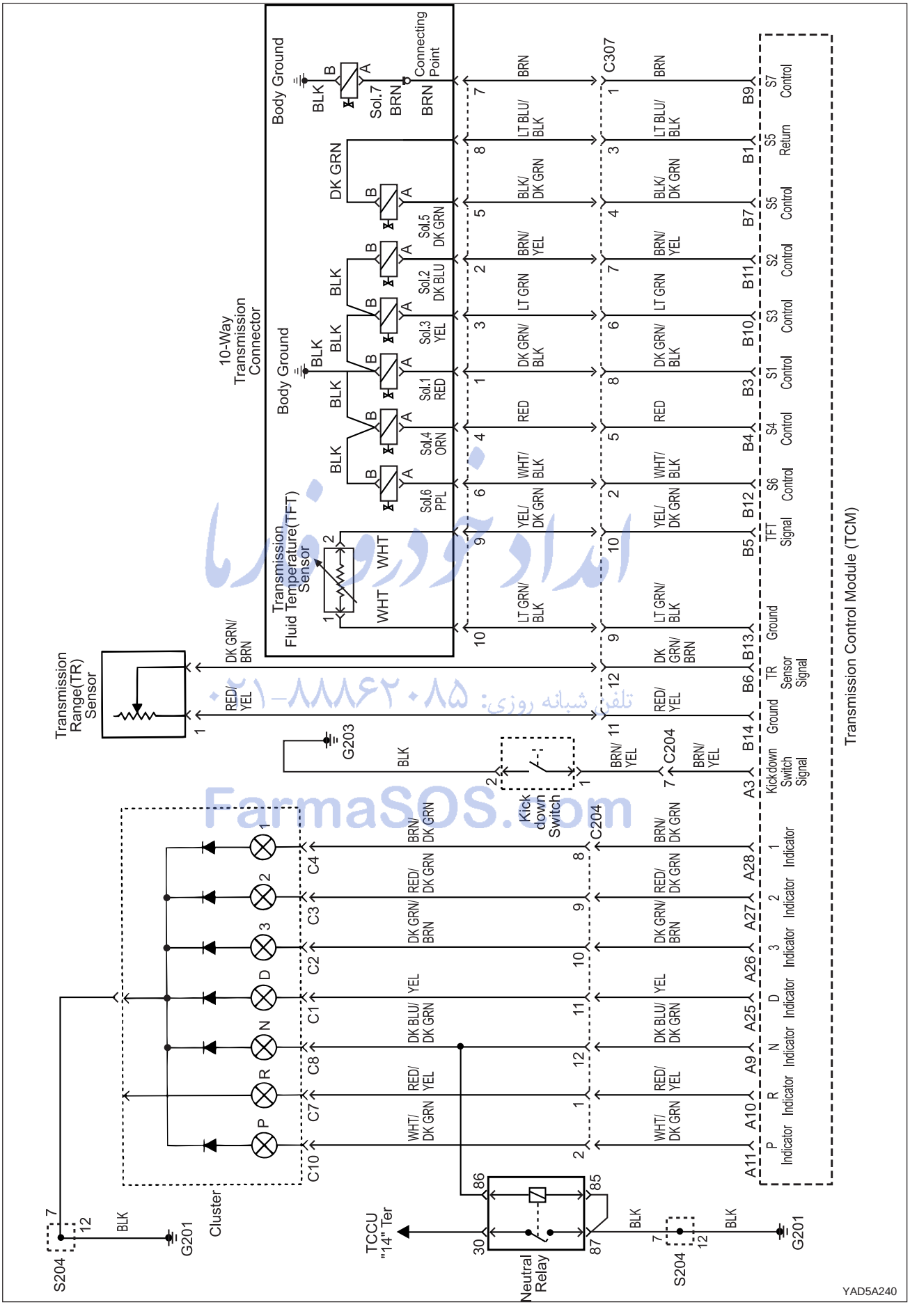
FarmaSCS.com
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TCM WIRING DIAGRAM (DIESEL ENGINE - 1 OF 2)



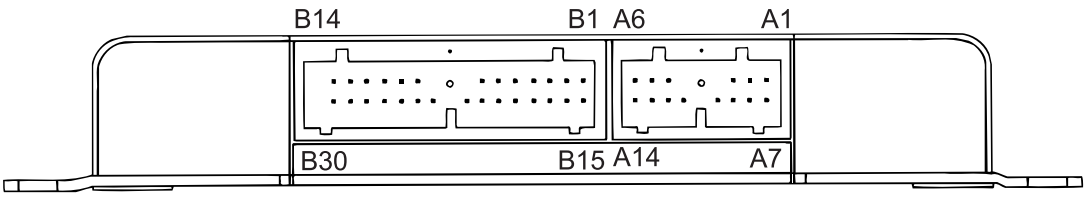
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farmaSOS.com

TCM WIRING DIAGRAM (DIESEL ENGINE - 2 OF 2)

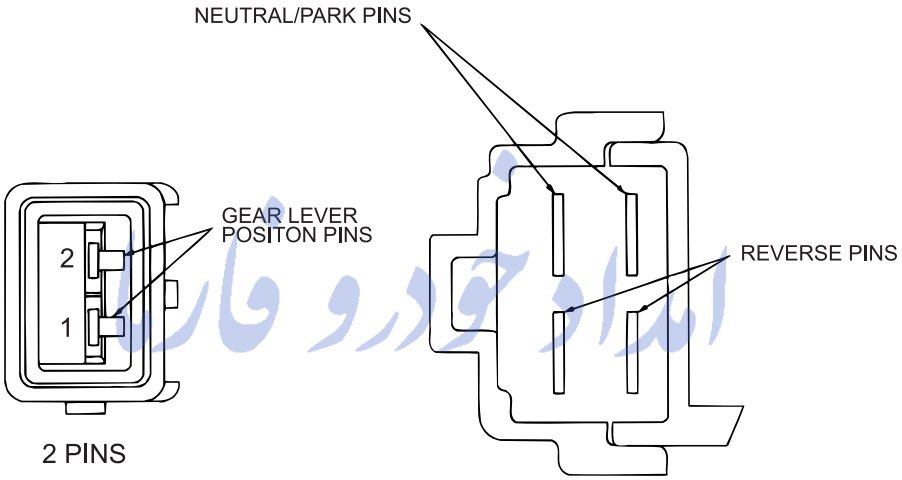


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CONNECTOR END VIEW



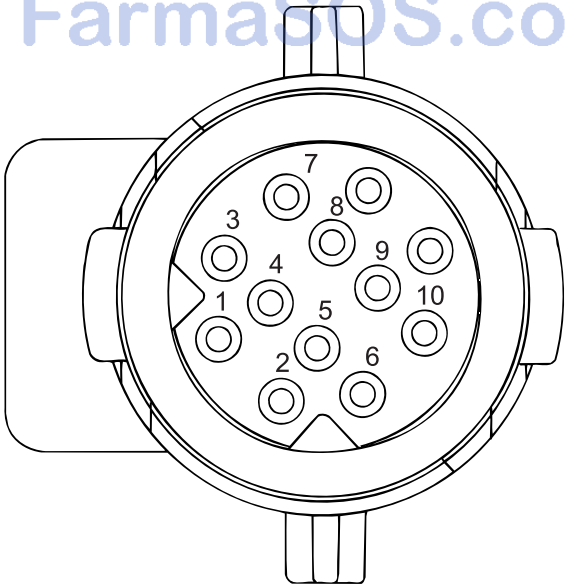
Transmission Control Module (TCM) Pin Numbers



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Inhibitor Switch Pins

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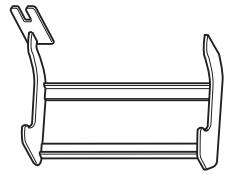
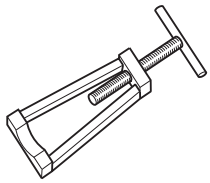
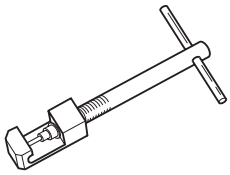
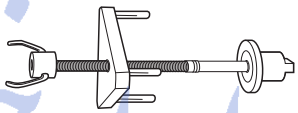
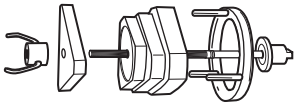
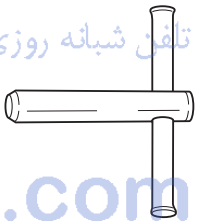
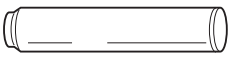
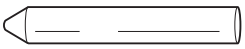


10-Way Transmission Connector

KAA5A5O0

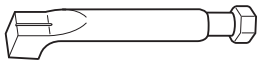
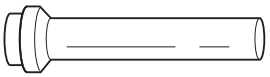
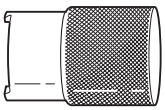
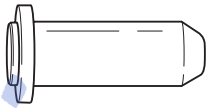
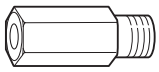
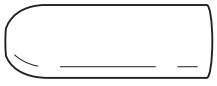
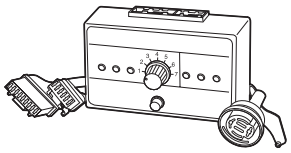
SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS TABLE

 KAA5A2P0	**0555 - 336256 Transmission Bench Cradle**	 KAA5A2Q0	**0555 - 336257 Pump Puller**
 KAA5A2R0	**ss Shaft Pin emover / Instal er (Dentent Lever)**	 KAA5A2S0	**0555 - 336259 Clutch Spring Compressor**
 KAA5A2T0	**0555 - 336260 Clutch Pack Clearance Kit**	 KAA5A2U0	**0555 - 336261 Cross Shaft Seal Remover**
 KAA5A2V0	**0555 - 336262 Cross Shaft Seal Installer**	 KAA5A2W0	**0555 - 336263 Cross Shaft Bullet**

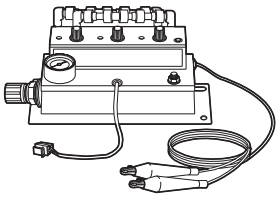
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SPECIAL TOOLS TABLE (Cont'd)

 KAA5AWX0	**0555 - 336265 Cross Shaft Pin Remover / Installer (Inhibitor Switch)**
 KAA5A2Y0	**0555 - 336266 Adaptor Housing Seal Installer**
 KAA5A2Z0	**0555 - 336267 Pump Alignment Tool**
 KAA5A3A0	**0555 - 336268 Pump Seal Installer**
 KAA5A3B0	**0555 - 336269 End Float Measuring Adaptor**
 KAA5A3C0	**0555 - 336270 End Float Measuring Shaft**
 KAA5A3D0	**0555 - 336302 Output Shaft Bullet**
 KAC5A050	**0555 - 336046 Solenoid Bench Tester**

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SPECIAL TOOLS TABLE (Cont'd)

 KAC5A060	**0555 - 332083** **Solenoid /Thermistor** **Electronic Tester**

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SECTION 5B

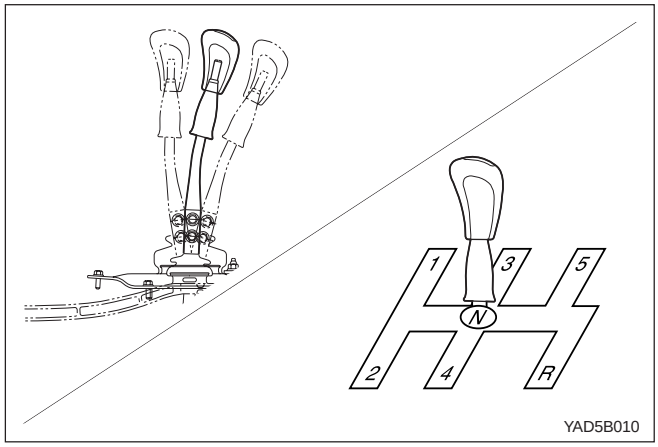
MANUAL TRANSMISSION

TABLE OF CONTENTS

General Description and Operation 5B-2
Shift Lever 5B-2
Transmission Assembly 5B-2
Specifications 5B-3
Diagnostic Information and Procedures 5B-4
Diagnosis Table 5B-6
Component Locator 5B-7
Cross-Sectional View 5B-7
Power Flow 5B-8
Seni-Remote Kit Disassembly and Assembly 5B-9
Transmission Assembly 5B-10
Transmission Assembly Disassembled View 5B-11
Maintenance and Repair 5B-14
On-Vehicle Service 5B-14
Semi-Remote Kit 5B-14
Transmission 5B-19
Unit Repair 5B-24
Major Unit 5B-24
Main Shaft 5B-34
Input Shaft 5B-38
Counter Shaft 5B-40
Extension Housing 5B-40
Shift Cover 5B-41
Inspection of Components 5B-45

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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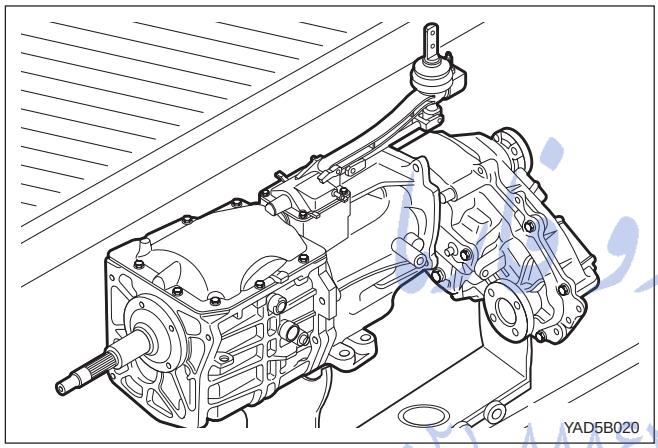
GENERAL DESCRIPTION AND OPERATION



YAD5B010

SHIFT LEVER

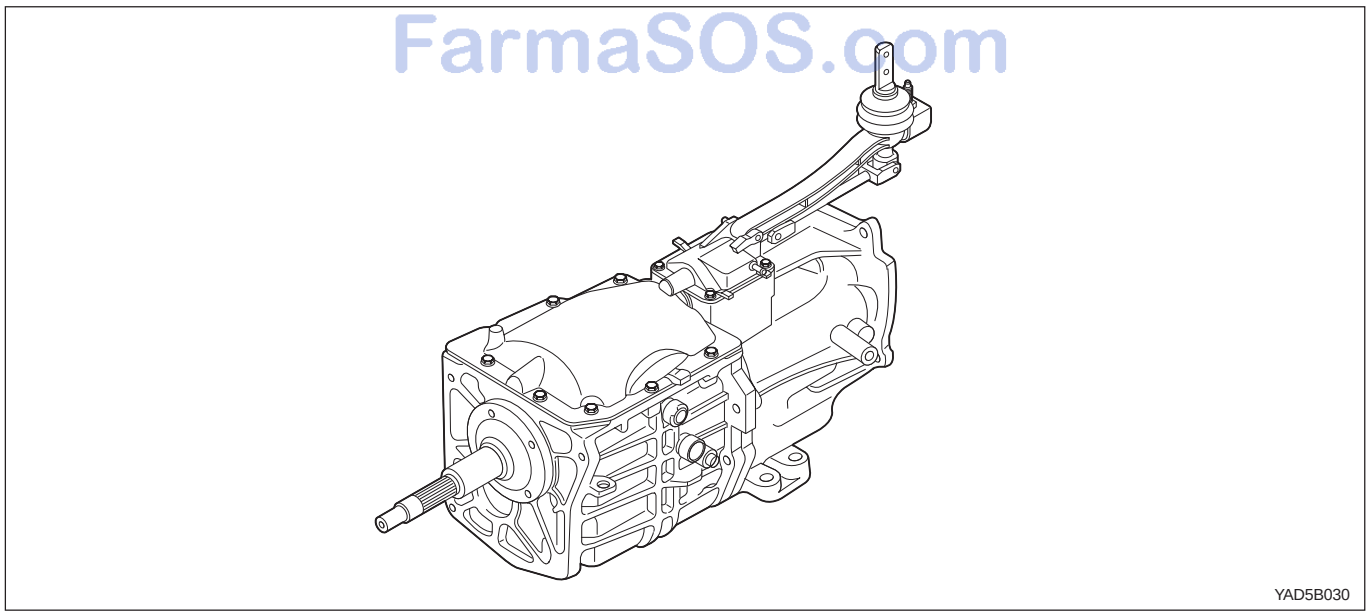
The shift lever is a type of linkage connected directly and lock shifting from 5th to reverse. This unit decreases the possibility of any blown, wear etc.


YAD5B020

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TRANSMISSION ASSEMBLY

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SPECIFICATIONS

Application		Description
Model		T5WC
Type		Floor Change
Gear Ratio	1st	3.969 : 1
	2nd	2.341 : 1
	3rd	1.457 : 1
	4th	1.000 : 1
	5th	0.851 :1
	Reverse	3.710 : 1
Oil	Specification	ATF DEXRON II / III
	Capacity(litre)	3.4 L
	Change Interval	Check : Every 15,000 km, Replace : Every 50,000 km
Weight (Dry)		33kg

Notice: Add LUBRIZOL (280cc) in oil after overhauling.

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DIAGNOSTIC INFORMATION AND PROCEDURES

Applicatio	Check	Action
Will not shift (control lever moves)	Control lever assembly broken or damaged.	Replace control lever and housing assembly.
	Damaged offset lever, shift fork, selector place or selector arm.	Remove extension, adapter or case cover. Check or replace damaged parts.
Hard shift or control lever will not move into gear	Clutch not releasing.	Adjust or replace clutch.
	Improper or low transmission oil.	Add or replace with specified oil.
	Shift or shift rail binding.	Remove extension, adapter or case cover. Check or replace damaged parts.
	Binding of sliding synchronizers or gears.	Remove extension, adapter or case cover. Check synchronizers and gears and replace damaged parts.
	If reverse only, faulty backup switch.	Check or replace backup switch.
	Worn or damaged flywheel pilot bushing.	Replace pilot bushing.
Gears crash when shifting	Engine idle speed too high.	Adjust idle speed to specified speed.
	Damaged or faulty clutch.	Adjust or replace clutch.
	Pilot bearing between input shaft and output shaft binding.	Replace or check roller bearings.
	Damaged synchronizer.	Check or replace synchronizer parts.
	Bell housing misaligned.	Align bell housing and bore.
	Damaged gear(s).	Check or replace gear(s).
	Worn or damaged flywheel pilot bushing.	Replace pilot bushing.
Transmission jumps out	Loosened transmission or flywheel housing bolts, improper alignment.	Tighten bolts to specified value. Realign if necessary.
	Synchronizer damaged or excessively worn.	Check or replace synchronizer parts.
	Blocking ring damaged, worn index slots or friction surfaces worn or damaged.	Check or replace blocking ring.
	Excessive countershaft end play.	Check worn or damaged parts. Adjust shim thickness using roller bearings if necessary.
	Worn or damaged fork due to loosened shaft, rail or shifting fork.	Check for wear or damaged. Replace worn or damaged parts.
Transmission locked in one gear	Fork or offset lever loose on shaft or rail.	Replace extension, adapter or case cover. Check or replace loose parts on shaft or rail. Replace roll pin(s).
	Worn or damaged forks, offset lever, shaft or rail.	Remove extension, adapter or case cover. Check for wear or damaged. Replace damaged parts.

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Applicatio	Check	Action
Transmission locked in one gear	Worn or damaged synchronizer.	Check worn or damaged synchronizer parts and replace if necessary.
	Worn or damaged gears.	Check worn or damaged gears and replace if necessary.
Transmission noise	Improper or low transmission oil.	Add or drain and replace with proper oil.
	Loose bolts or other attaching parts.	Tighten as specified.
	Improper flywheel housing to engine crankshaft alignment.	Realign correctly.
	Noisy transmission bearing.	Check bearings, bearing rollers and parts for wear or damage. Replace if neces-sary.
	Noisy gears.	Check for worn or damaged gears(including speedometer gear). Replace if necessary.
Transmission leakage	Leakage from transmission.	Clean all exposed surfaces, then check for leaks.
	Vent or breather clogged.	Clean or replace vent or breather.
	Too much oil.	Check oil level.
	Loose bolts at sealing faces.	Tighten as specified.
	Improperly applied sealant.	Clean leaking surfaces. Reapply sealant.
	Worn or damaged oil seal.	Replace oil seal.

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DIAGNOSIS TABLE

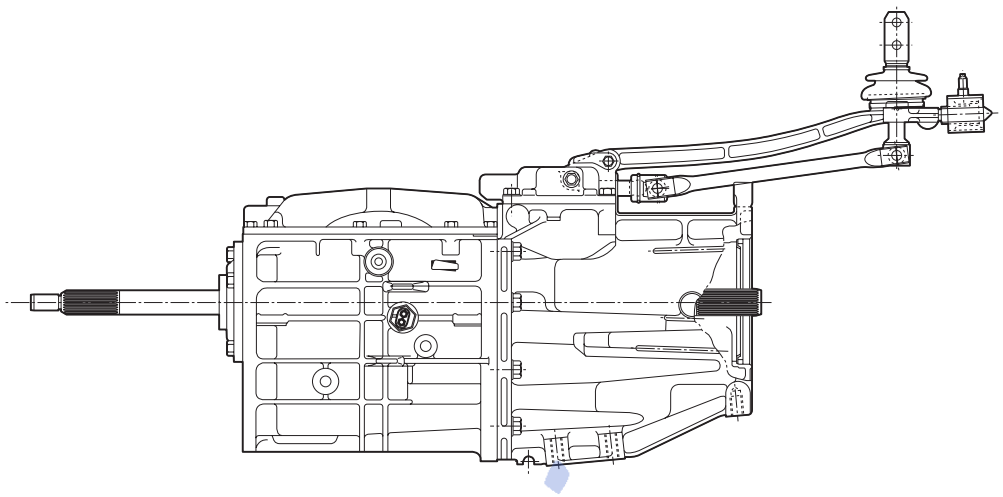
Applicatio	Possible Faulty Part
1 Shift Hop-out	
2 Shift Gear Crash	
3 Shift Block-out	
4 Hard Shift	
5 Noise in Reverse Gear	
6 Noise in 5th Gear	
7 Noise in 4th Gear	
8 Noise in 3rd Gear	
9 Noise in 2nd Gear	
10 Noise in 1st Gear	
11 Noise in All Speeds	
12 Leak at Transmission Rear Part	
13 Leak at Transmission Center Part	
14 Leak at Transmission Front	
● ●	Transmission Case
● ●	Extension Housing
● ● ●	Shift Cover / Shift Shaft
● ● ●	Shift Control Lever
● ●	Input Bearing Retainer
●	Input Gear Set
● ● ●	3rd Speed Gear Set
● ● ●	2nd Speed Gear Set
●	Reverse Speed Gear Set
● ● ●	1st Speed Gear Set
● ●	5th Speed Gear Set
● ●	Clutch Housing and Release Derive
● ●	Crankshaft Pilot Bushing and Release Bearing
●	Input Bearing
●	Main Shaft Input Bearing
● ●	Main Shaft Thrust Bearing
● ●	3rd Speed Gear Bearing
● ●	2nd Speed Gear Bearing
● ● ●	1st Speed Gear Bearing
●	Reverse Idler Gear Bushing
●	Counter Shaft Front Bearing
●	Counter Shaft Rear Bearing
● ● ●	Counter Shaft Thrust Bearing
● ●	5th Speed Drive Gear Bearing
●	Slip Yoke Bushing
●	Slip Yoke Seal
●	Speedometer Drive / Driven Gears
●	Speedometer Driven Gear Housing
●	Input Shaft Seal
● ● ● ● ● ●	1 - 2 Synchronizer Assembly
● ● ● ● ● ●	3 - 4 Synchronizer Assembly
● ● ● ● ●	5th Synchronizer Assembly

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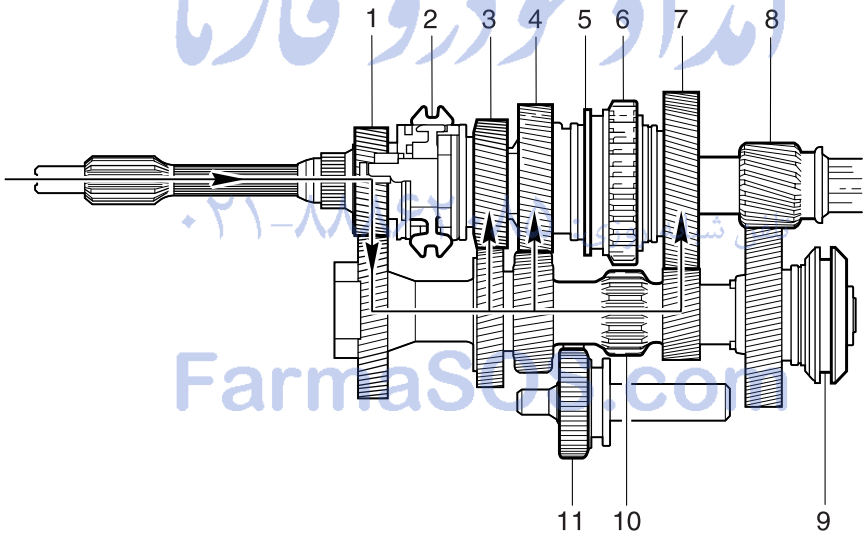
COMPONENT LOCATOR

CROSS-SECTIONAL VIEW

External View



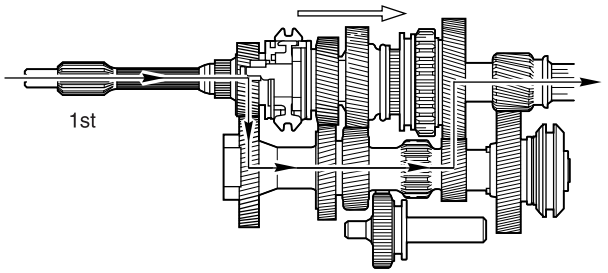
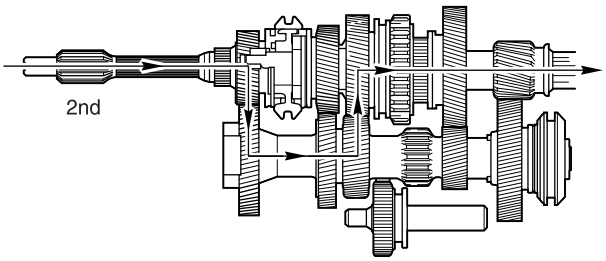
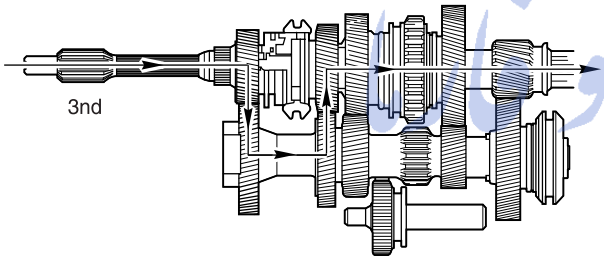
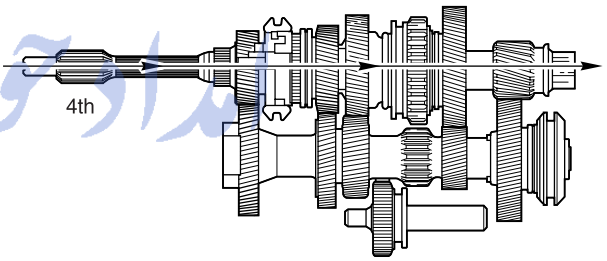
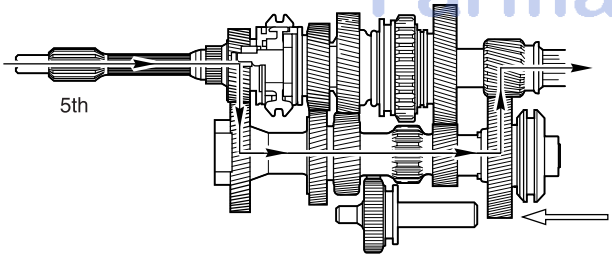
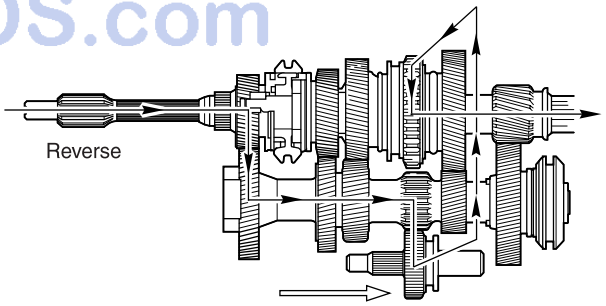
Internal View



YAD5B040

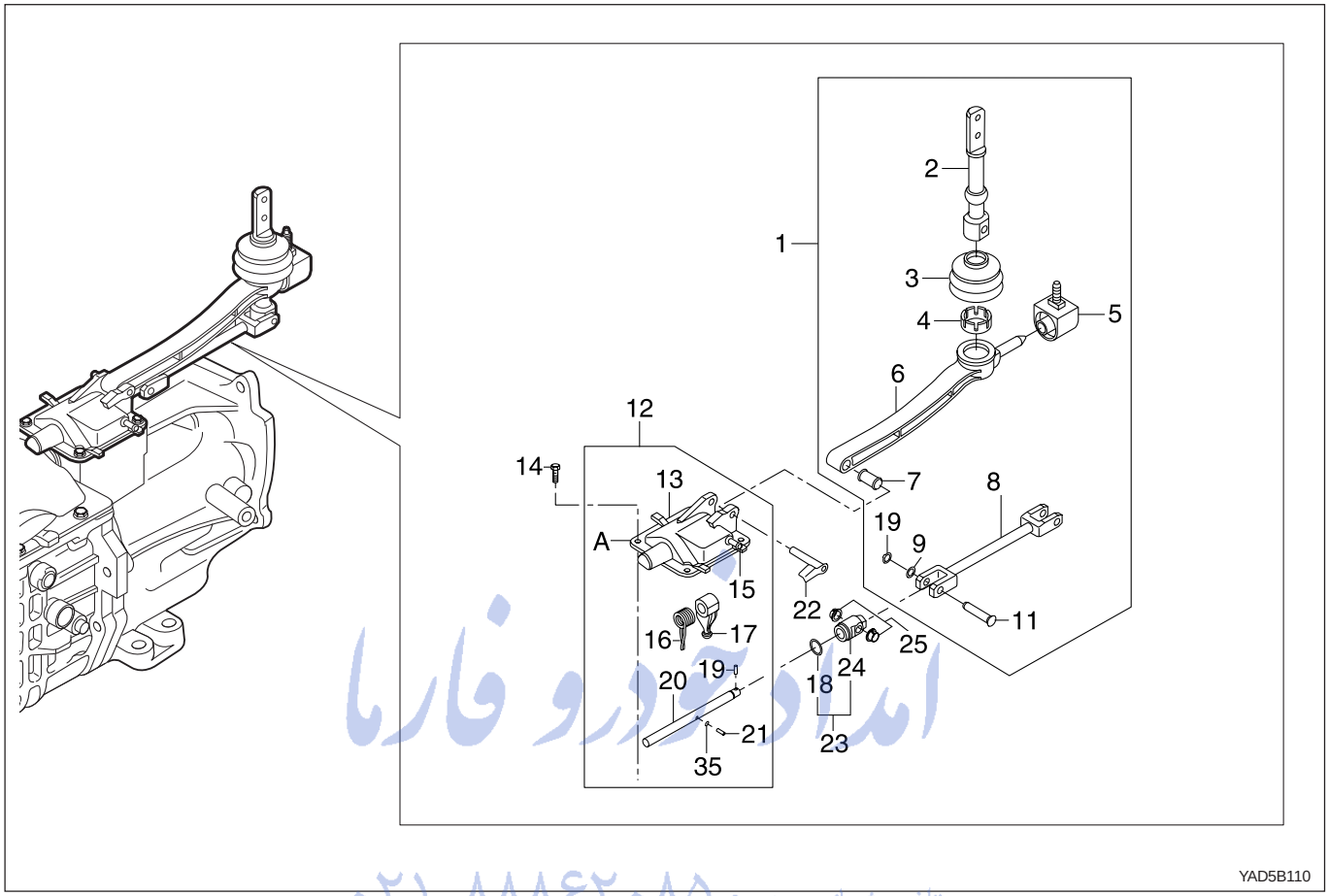
1 4th Gear
2 3rd-4th Synchronizer
3 3rd Gear
4 2nd Gear
5 1st-2nd Synchronizer
6 Reverse Gear
7 1st Gear
8 5th Gear
9 5th Synchronizer
10 Counter Shaft
11 Reverse Idler

POWER FLOW

1st	2nd
 YAD5B050	 YAD5B060
3rd	**4th**
 YAD5B070	 YAD5B080
5th	**Reverse**
 YAD5B090	 YAD5B100

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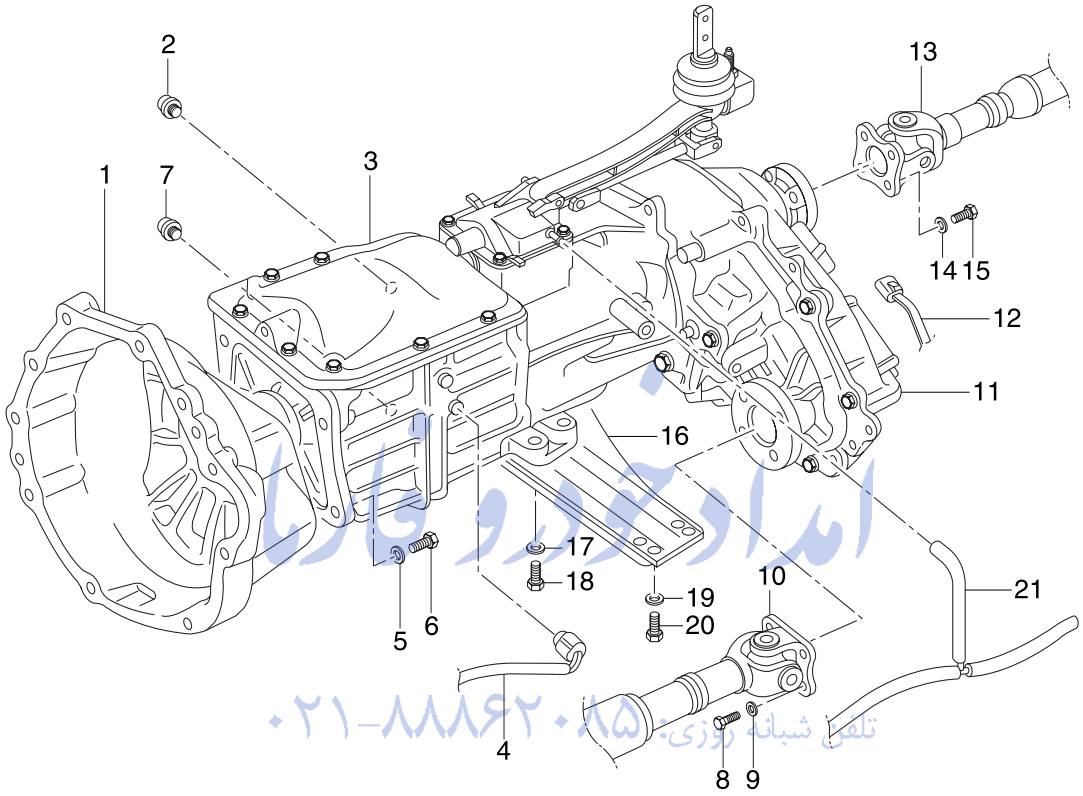
SEMI-REMOTE KIT DISASSEMBLY AND ASSEMBLY



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1 Remote Shift
2 Shift Lever
3 Shift Inner Boot
4 Lining Shift Socket
5 Control Housing Arm Insulator
6 Control Housing Arm
7 Bushing
8 Shift Rod Link
9 Washer
10 Clip
11 Shift Rod Pin
12 Cover Assembly
13 Shift Tower Cover
14 Bolt
15 Breather Hose Bar
16 Control Shift Spring
17 Offset Control Lever
18 Retainer Ring
19 Pin
20 Shift Rail
21 Grove Pin
22 Pin & Clip
23 Joint Assembly
24 Joint Housing
25 Bushing

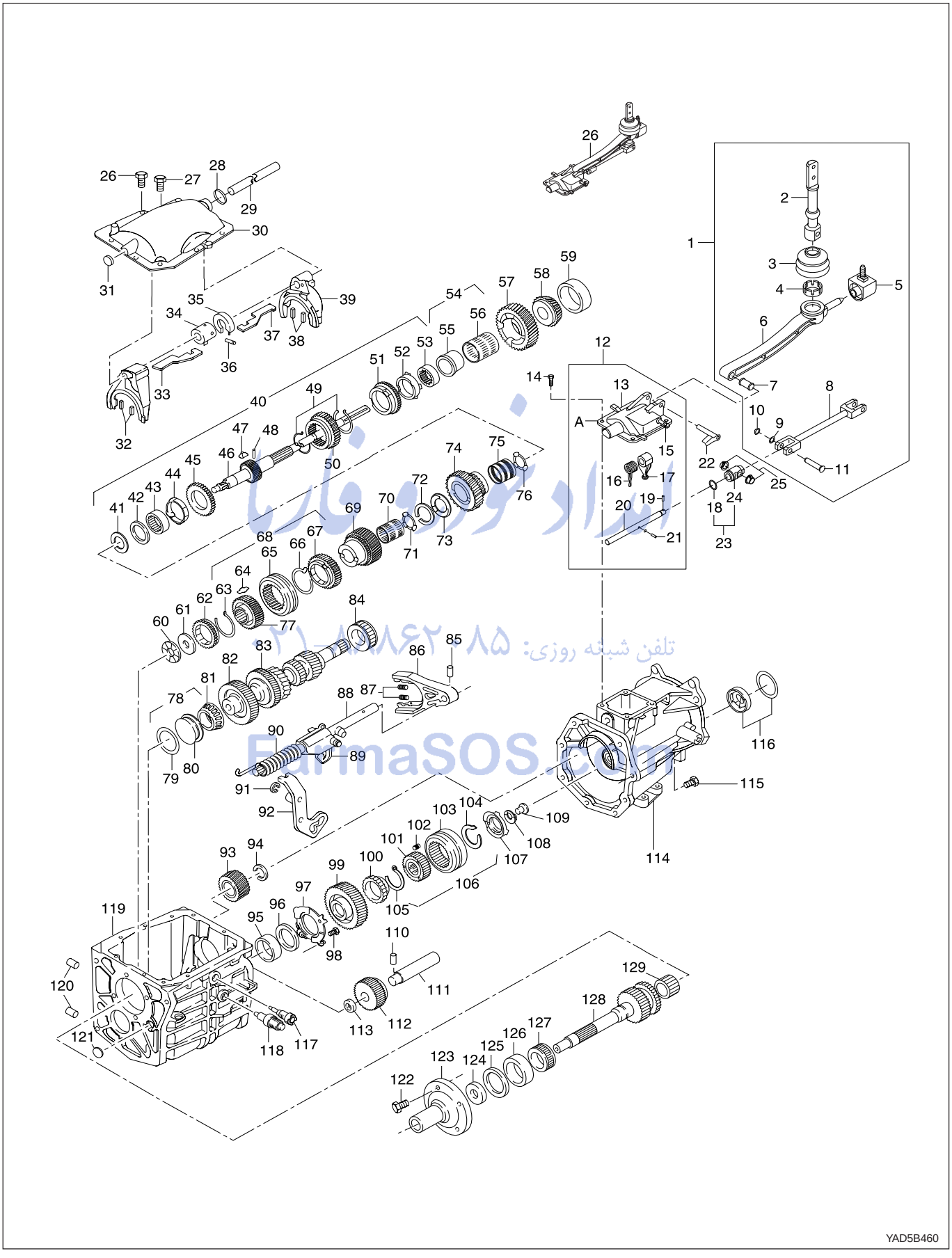
TRANSMISSION ASSEMBLY



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1 Clutch Housing
2 Oil Filler Plug ..... 25 N•m
3 Transmission Assembly
4 Back-up Switch
5 Washer
6 Bolt ..... 77-87 N•m
7 Oil Drain Plug ..... 25 N•m
8 Bolt ..... 81-89 N•m
9 Washer
10 Front Propeller Shaft
11 Transfer Case Assembly
12 Speedometer Cable
13 Rear Propeller Shaft
14 Washer
15 Bolt ..... 70-80 N•m
16 Cross Member
17 Washer
18 Bolt ..... 21-35 N•m
19 Washer
20 Bolt ..... 62-93 N•m
21 Breather Hose

TRANSMISSION ASSEMBLY DISASSEMBLED VIEW



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1 Remote Shift
2 Shift Lever
3 Shift Inner Boot
4 Lining Shift Socket
5 Control Housing Arm Insulator
6 Control Housing Arm
7 Bushing
8 Shift Rod Link
9 Washer
10 Clip
11 Shift Rod Pin
12 Cover Assembly
13 Shift Tower Cover
14 Bolt
15 Bleeder Hose Barb
16 Control Shift Spring
17 Offset Control Lever
18 Retainer Ring
19 Pin
20 Shift Rail
21 Groove Pin
22 Pin and Clip
23 Joint Assembly
24 Joint Housing
25 Bushing
26 Bolt
27 Bolt
28 O-ring
29 Shaft Rail
30 Case Cover
31 Cap Plug
32 Insert
33 Selecter Plate
34 Selecter Arm
35 Inlockter Plate
36 Selecter Arm Pin
37 Selecter Plate
38 Insert
39 Shift Fork
40 Output Shaft
41 Retainer Ring
42 Washer
43 Inner Corn
44 Outer-Race
45 1-2nd Blocking-Ring
46 Output Shaft Assembly
47 Insert
48 Ball
49 Spring
50 Reverse Sliding Gear
51 1-2nd Blocking-Ring
52 Outer Corn Race
53 Inner Corn
54 Sleeve Bearing
55 Sleeve
56 Needle Bearing
57 1st Speed Driven Gear
58 Bearing Corn
59 Bearing Cup
60 Thrust Bearing
61 Thrust Race
62 Blocking-Ring
63 Spring
64 Insert
65 Synchronizer Sleeve
66 Spring
67 Blocking-Ring
68 Synchronizer
69 3rd Speed Gear
70 Needle Bearing
71 Spacer
72 Snap Ring
73 Washer
74 2nd Speed Gear
75 Needle Bearing
76 Spacer
77 Synchronizer Sleeve
78 Bearing
79 O-Ring
80 Bearing
81 Corn Bearing
82 Shaft Gear
83 Counter Shaft Gear
84 Corn Bearing
85 Roll Pin
86 Shift 5th Fork
87 Insert
88 Shift Rail
89 Reverse Fork
90 Spring
91 Retainer Ring
92 Shift Lever
93 5th Speed Driven Gear
94 Snap Ring
95 Bearing Cap
96 Shim
97 Rear Retainer
98 Bolt
99 5th Speed Driven Gear
100 Blocking 5th-Ring
101 Hub Bearing
102 Insert
103 Sleeve
104 Spring
105 Spring
106 Synchronizer
107 5th Synchronizer Retainer
108 Snap Ring
109 Oil Ring Funnel
110 Roll Pin
111 Reverse Idler Shaft
112 Reverse Idler Gear
113 O-Ring
114 Cross member Mounting Hole

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115 Bolt
116 Spacer Seal and O-ring
117 Pivot Pin
118 Back-up Switch
119 Transmission Case
120 Filler/Drain Plug
121 Plug
122 Bolt
123 Input Bearing Retainer
124 Oil Seal
125 Shim
126 Bearing Cap
127 Bearing Corn
128 Input Drive Shaft
129 Roller Bearing

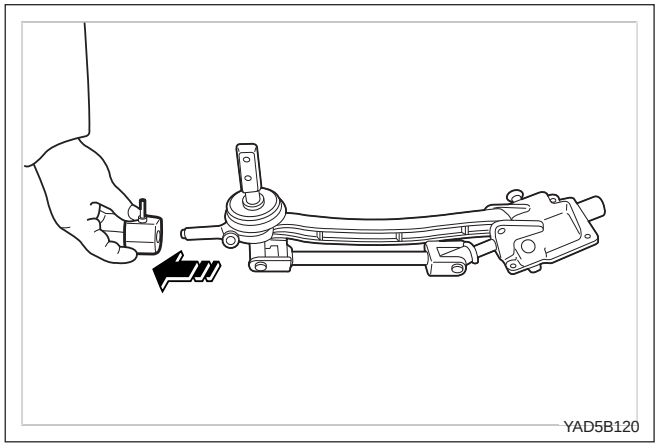
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MAINTENANCE AND REPAIR

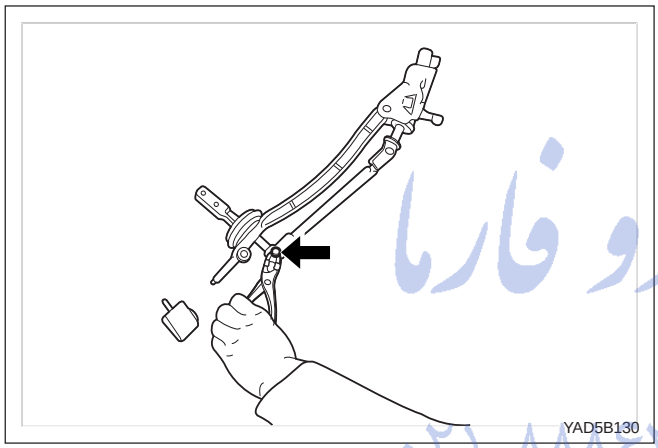
ON-VEHICLE SERVICE

SEMI-REMOTE KIT

Removal Procedure


YAD5B120

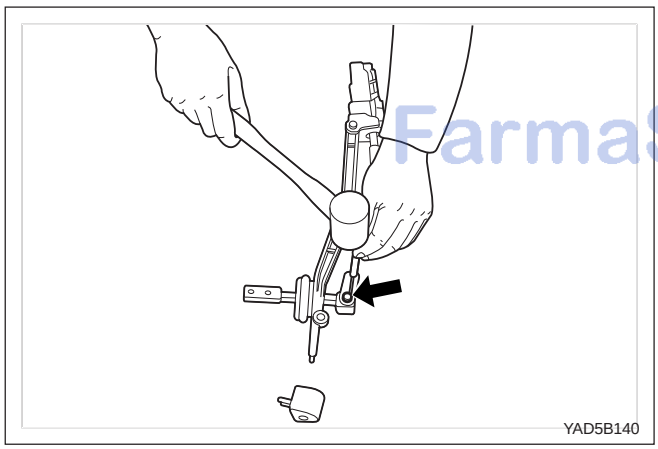
1. Remove the control housing arm insulator from the semi-remote kit.


YAD5B130

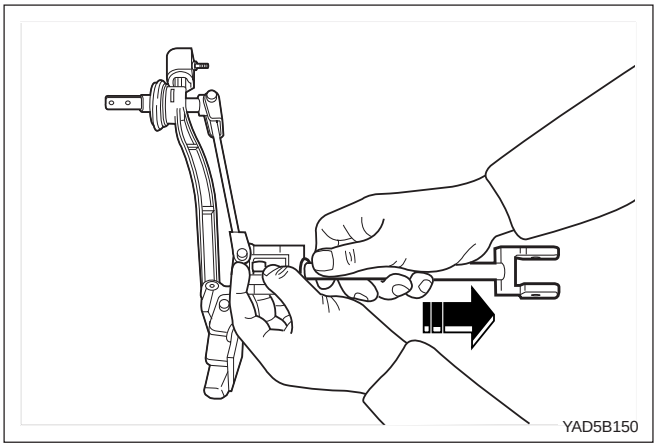
2. Remove two snap rings and two screws using the snap ring plier.

   Notice: Do not reuse the damaged snap ring.

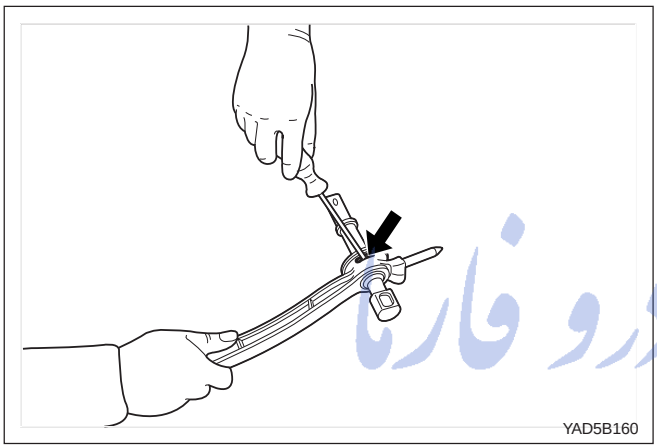
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YAD5B140

3. Disconnect the shift rod pin using the punch.

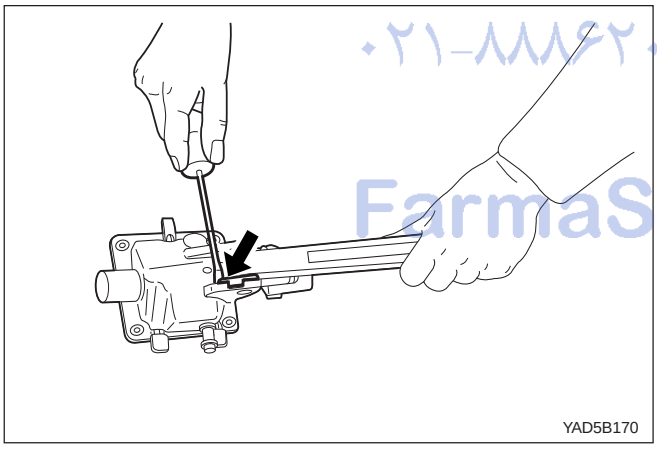

YAD5B150

4. Remove the shift rod link from the semi-remote kit.
5. Remove four metal bushing from the shift rod.

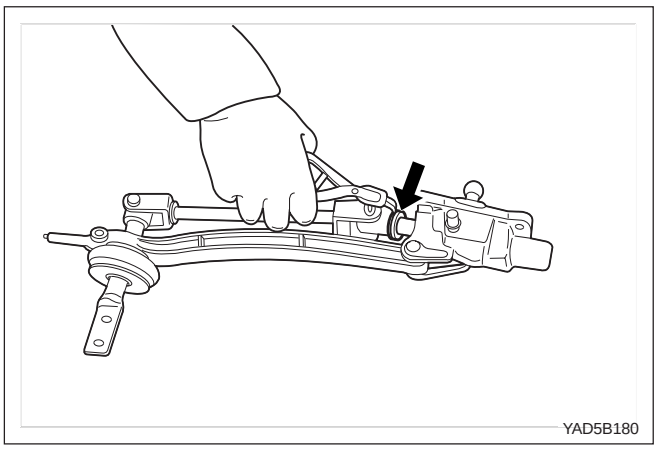

YAD5B160

6. Push down the socket lining's wing from the control housing arm and disconnect the socket lining and shift lever from the semi-remote kit.

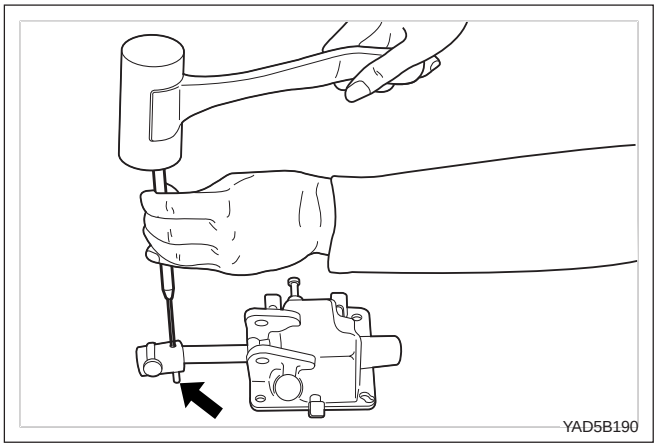
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YAD5B170

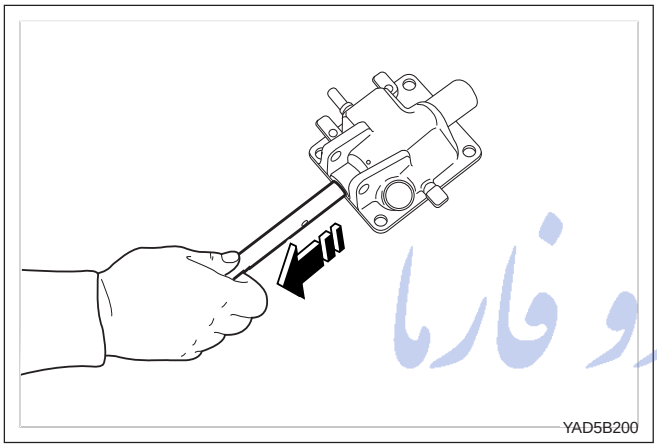
7. Remove the control housing arm by rotating the clip pin.


YAD5B180

8. Remove the retainer-ring from the U-joint assembly using the snap ring plier.

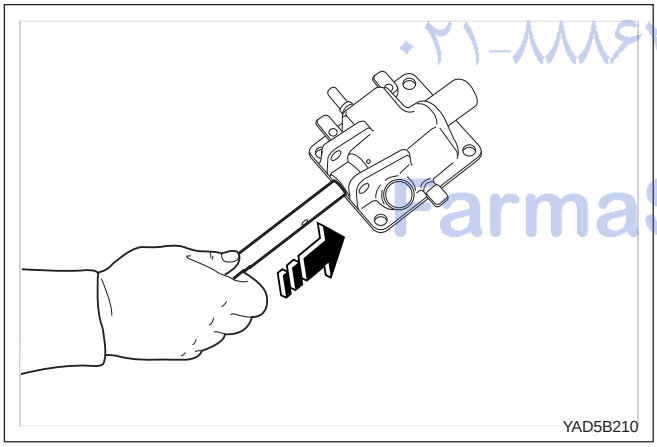


9. Remove the pin from the U-joint assembly using the punch.
10. Remove the U-joint assembly from the cover assembly.



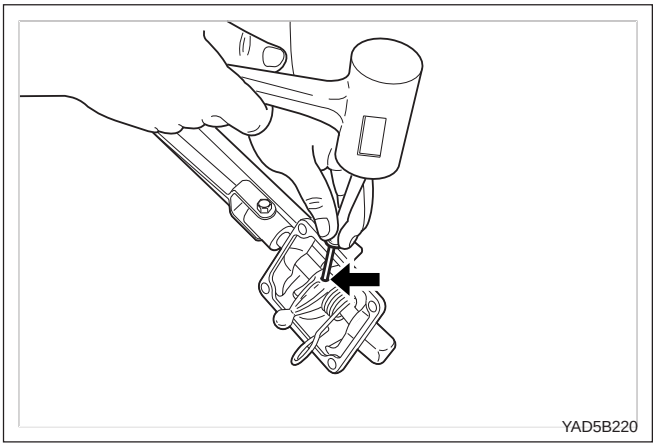
11. Remove the shift rail from the cover assembly using the punch.
12. Pull out the shift rail from the cover assembly.
13. Inspect and clean all of the disassembled parts and replace as needed.

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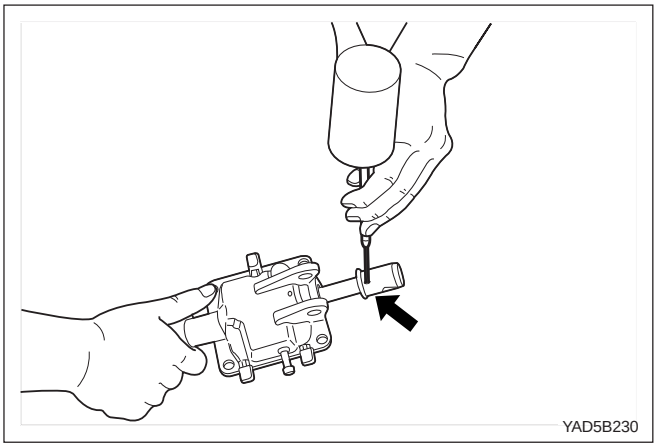


Installation Procedure

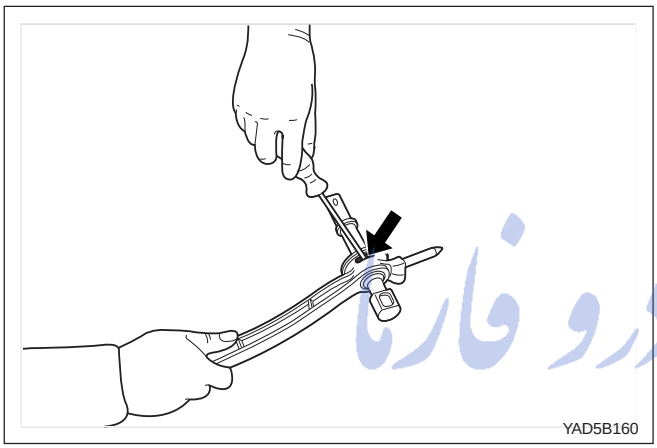
1. Insert the shift rail to the cover.



2. Pull the shift rail to the offset lever using the punch and assemble them.

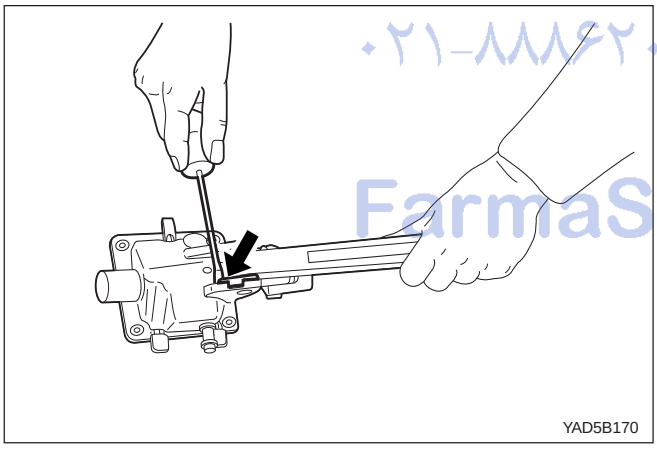


3. Insert the rail to U-joint assembly and assemble the retainer ring using the snap ring plier.

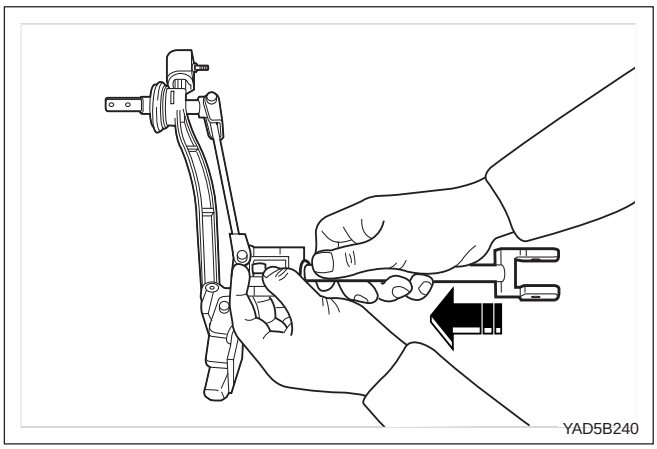


4. Push down the shift lever and the lining shift socket from the control housing arm.

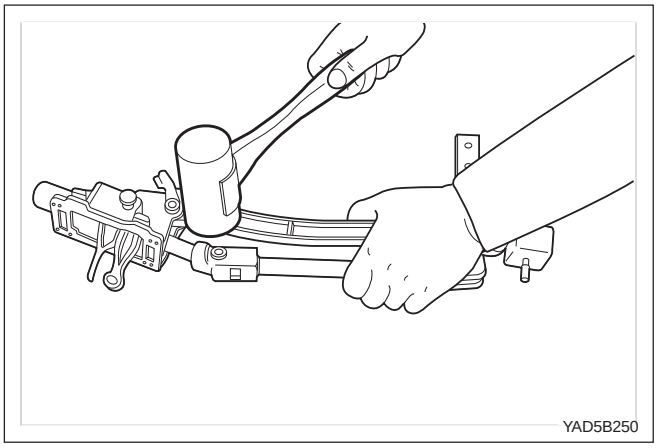
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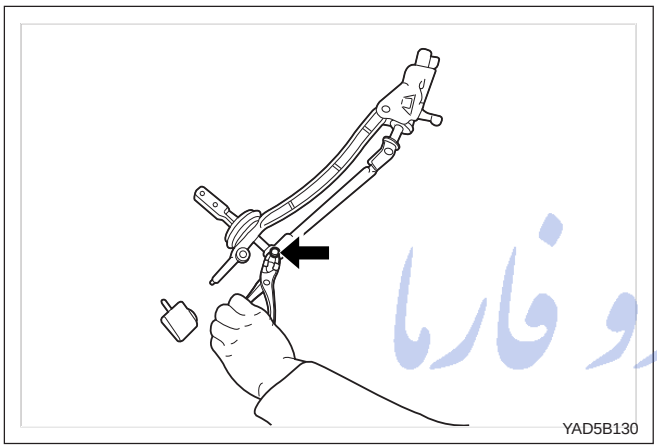
5. Insert the clip pin to fix the cover assembly and the control housing arm.



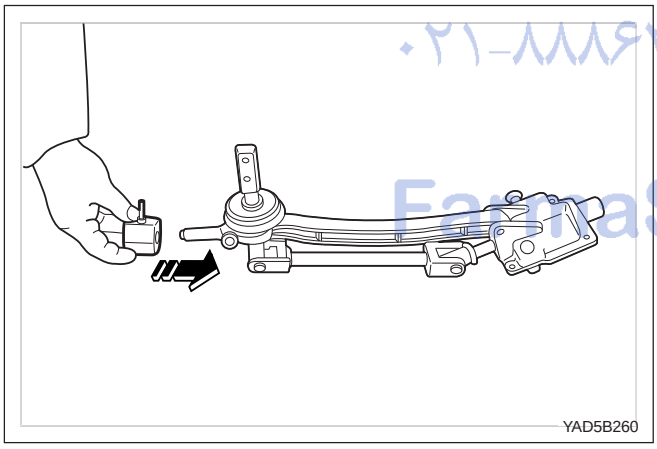
6. Insert the metal bushing to the shift rod.



7. Assemble the shift rod, the shift rail and U-joint using the pin.

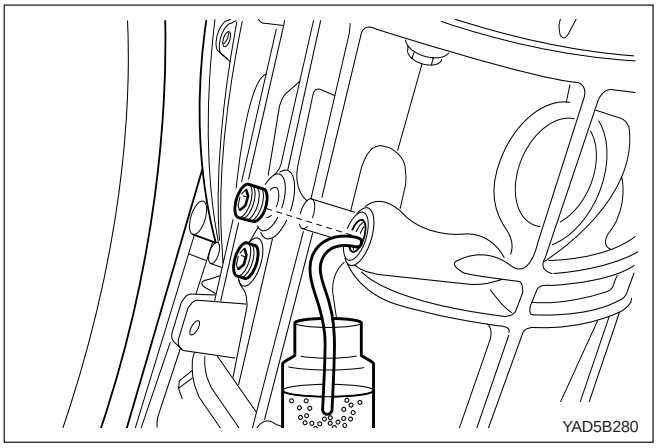


8. Insert the washer and assemble the snap ring.



9. Insert the control housing arm insulator to the semi-remote kit.

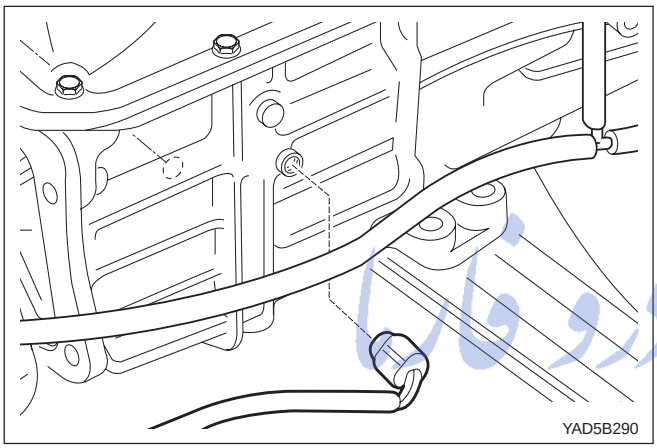
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TRANSMISSION

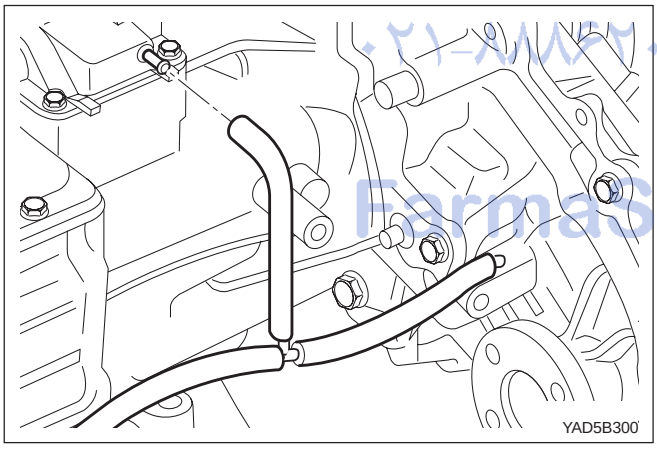
Removal Procedure

1. Disconnect the negative terminal from the battery.
2. Lift up the vehicle and fix it safely.

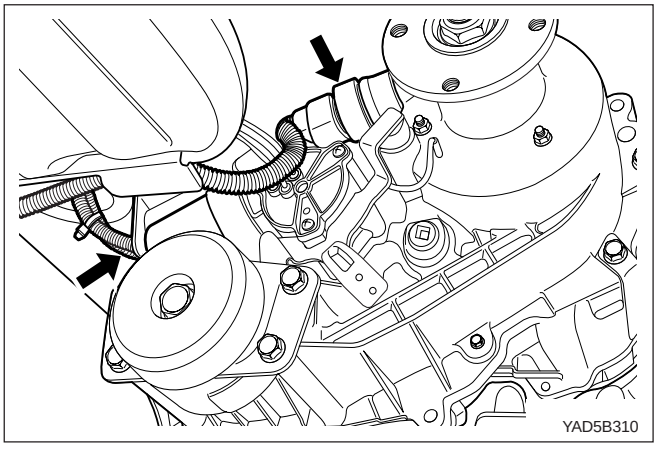


3. Remove the drain plug from the transmission housing and drain the oil. Reinstall the drain plug.
4. Disconnect the back-up switch connector.

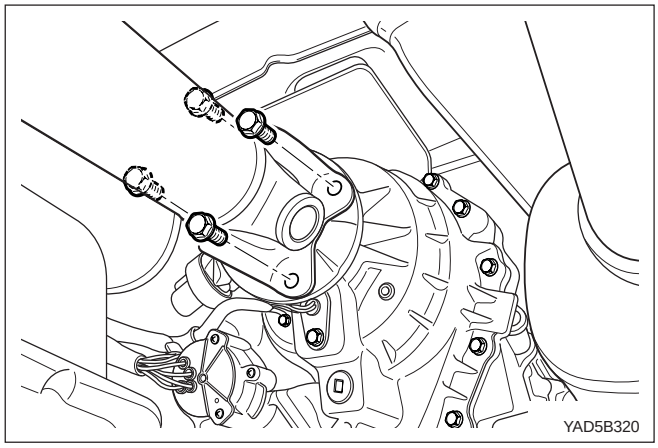
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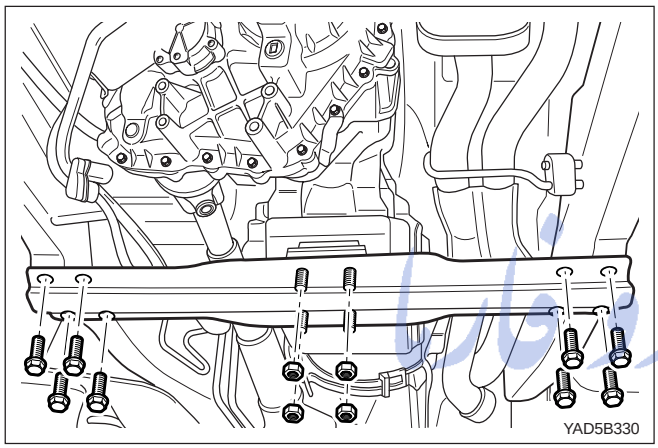
5. Remove the breather hose.



6. Remove the speedometer connector and other wiring harnesses and connectors.

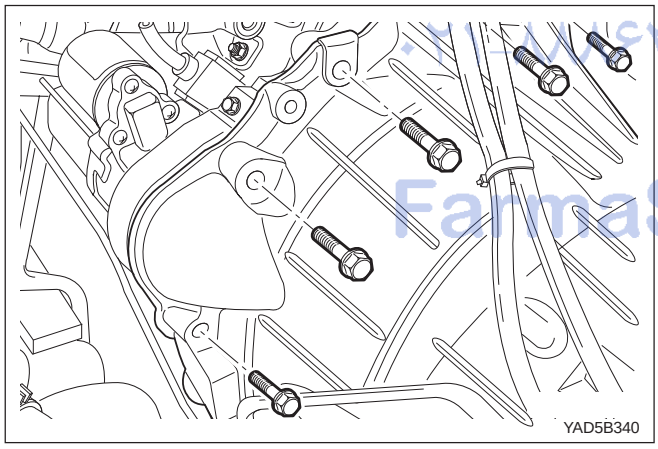


7. Remove the front and rear propeller shafts from the transfercase.



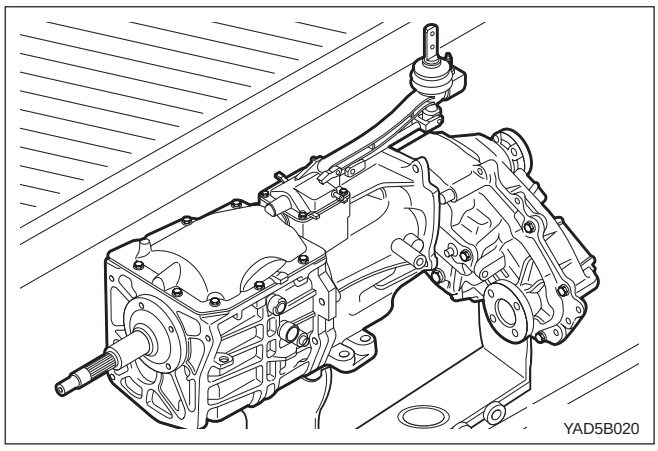
8. Support the transmission on an suitable jack.

   Unscrew the center mounting nuts and each sides mounting bolts and remove the cross member.



9. Remove the transmission mounting bolts.

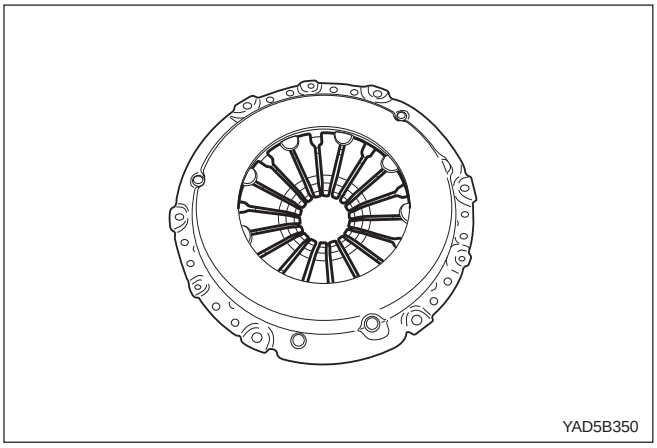
   Notice: For removing the transmission, there may be any damage in the clutch housing inside CSC. Thus remove the transmission with the clutch housing.



10. Move the transmission jack backward careful and disengage the transmission input shaft from the engine.

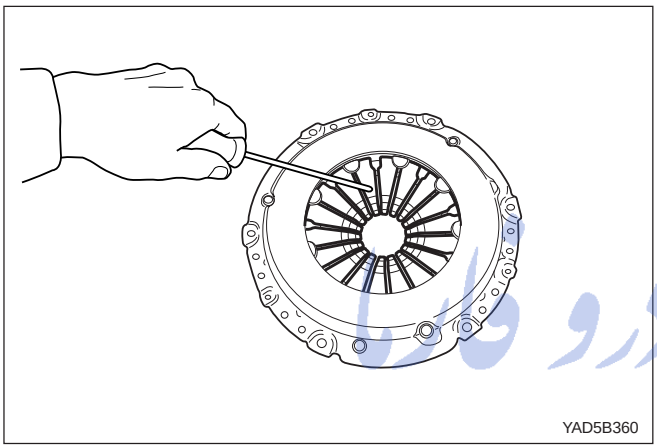
    Remove the transmission.

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Pre-Installation Checks Checking Procedure

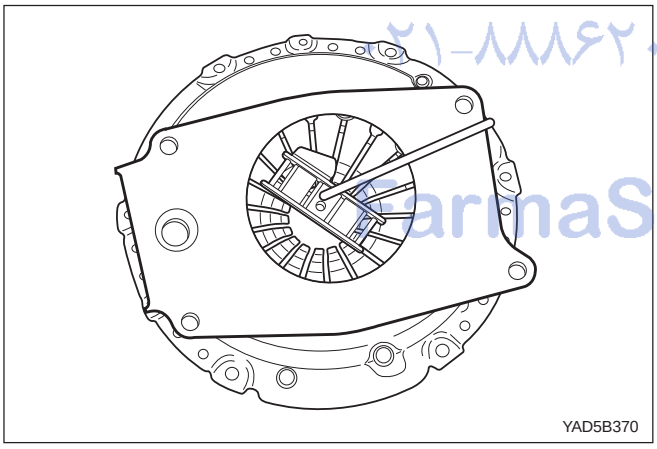
1. Separate the clutch release fork from the pivot and remove the pivot from the clutch housing.
2. Check the pivot. Fork and release bearing.
3. Check the pressure plate spring.


YAD5B360

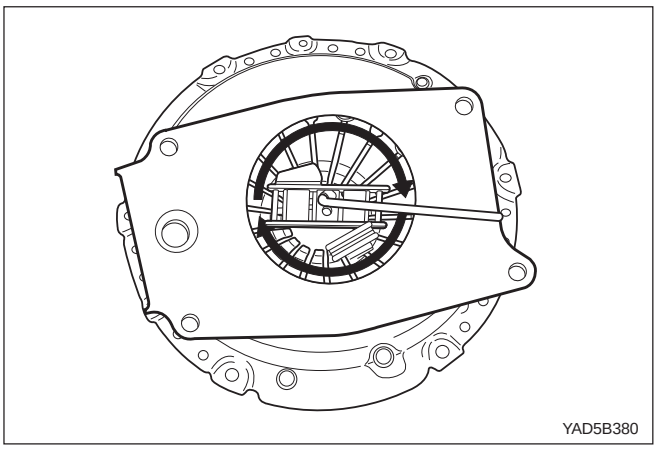
Notice: Inspect each parts and replace the excessively worn parts.

4. Check the clutch housing alignment as follows :

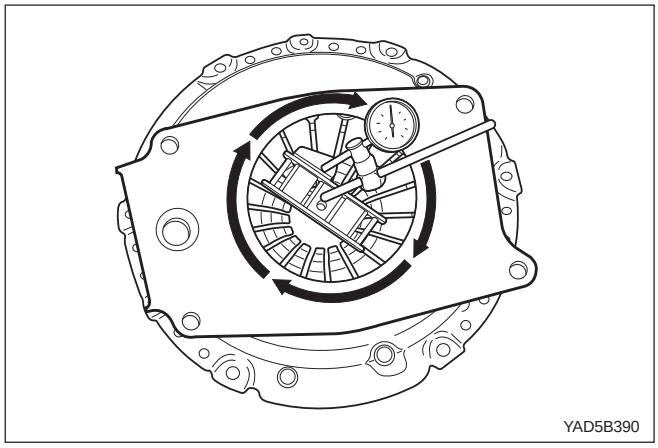
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YAD5B370

- Place the magnetic base on the pressure plate spring.
- Check the housing bore alignment.

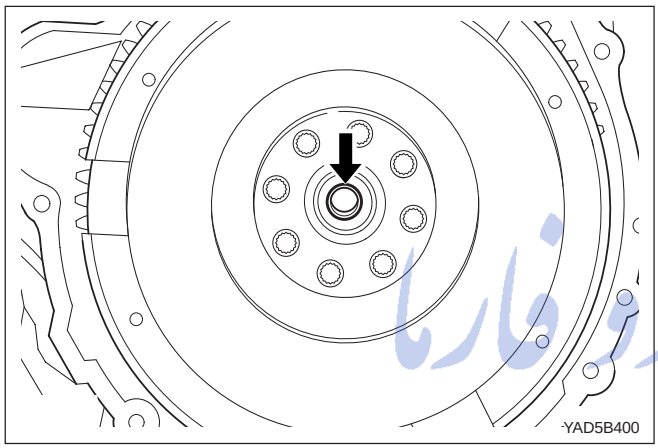

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- Place the dial indicator on the bore.
- By rotating the crankshaft one revolution, record the dial indicator reading.



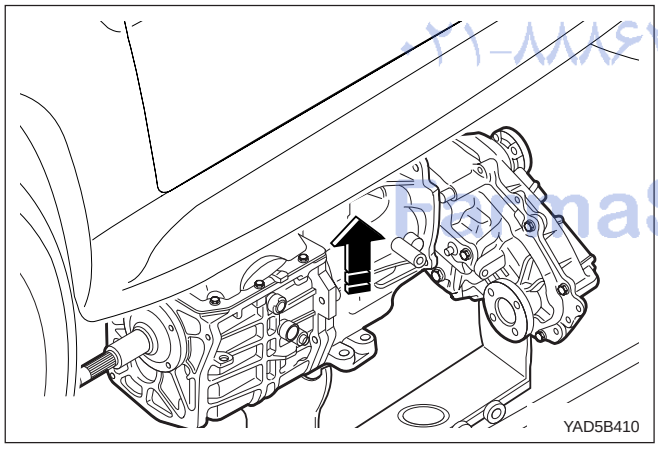
- Check the housing face alignment.
  - Place the dial indicator on the housing face.
  - By rotating the crankshaft one revolution, record the dial indicator reading.

Notice: If the reading is greater than 0.010 inch, insert the shim between the engine and clutch housing and adjust the alignment.



5. Check the following parts :
   - Pressure plate spring assembly
   - Disc
   - Flywheel
   - Input shaft pilot bearing

   Notice: Replace the excessively worn parts.
6. Lubricate the clutch release bearing bore, fork pivot head during assembly.

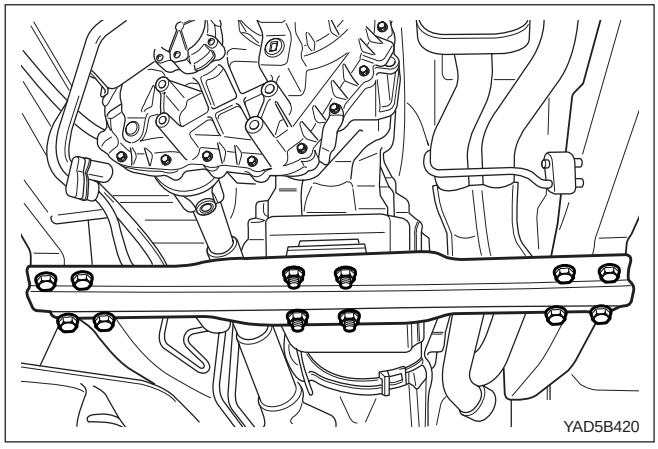


Installation Procedure

1. Install the transmission to the vehicle. At this time, seat correctly the input shaft of the transmission on the pilot bearing of the flywheel.
2. Tighten the transmission mounting bolts as the specified torque on the vehicle.

Installation Notice

Tightening Torque	77 - 87 N•m (57 - 64 lb-ft)

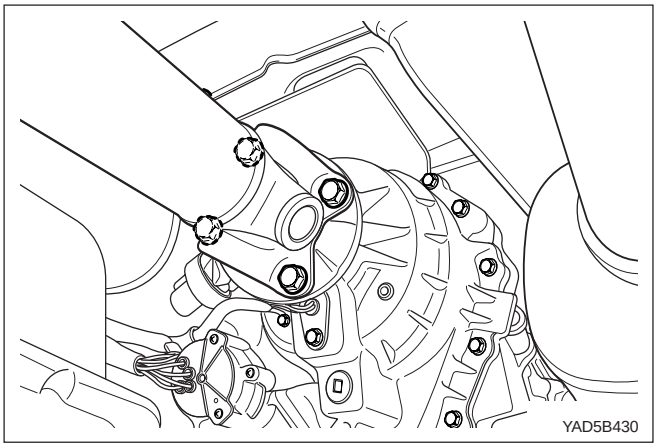


3. Install the cross member and tighten as the specified torque by supporting the suitable jack.

Installation Notice

Tightening Torque	Left/Right	62 - 93 N•m (45 - 69 lb-ft)
	Center	21 - 35 N•m (15 - 26 lb-ft)

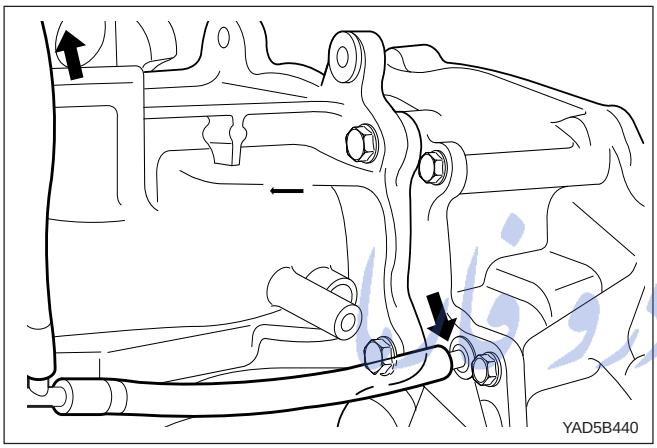
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4. Install the front and rear propeller shafts to the transmission.

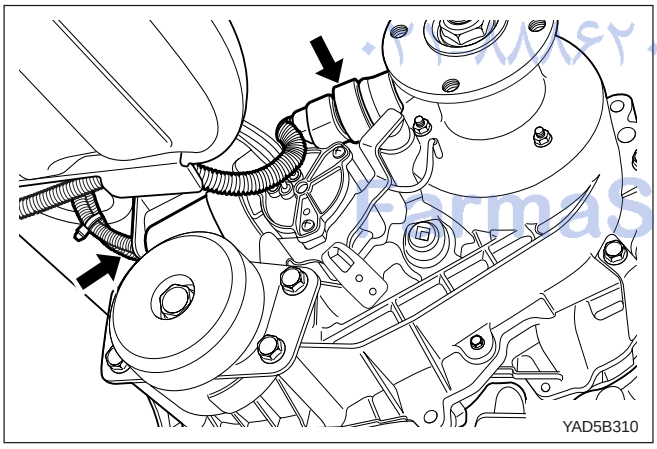
Installation Notice

Tightening Torque	Front	81 - 89 N•m (60 - 66 lb-ft)
	Rear	70 - 90 N•m (52 - 66 lb-ft)

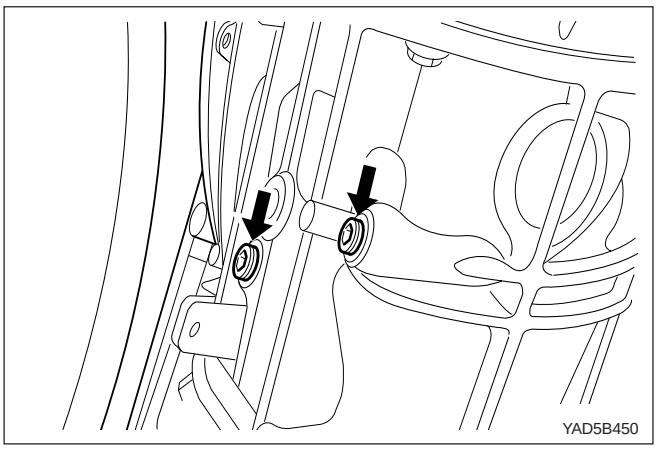


5. Connect the cable, the harness and the bleeder.
6. Install the back lamp switch.

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7. Install the speedometer cable.



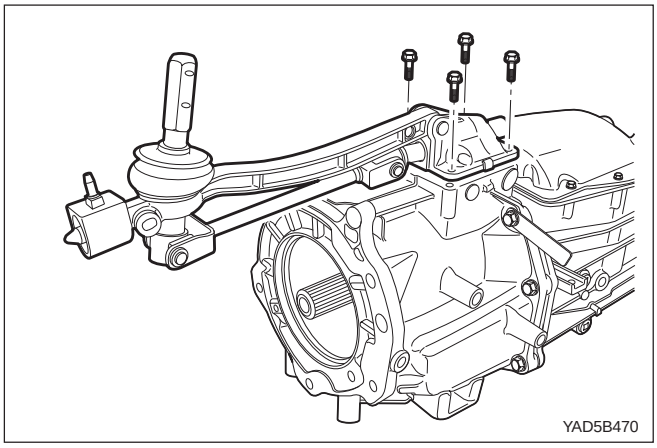
8. Charge the approved oil in the transmission housing and tighten the drain plug and the filler plug.

Installation Notice

Tightening Torque	Filler Plug	25 N•m (18 lb-ft)
	Drain Plug	25 N•m (18 lb-ft)

- Oil

Spec.	ATF Dexron II	
Capacity	4WD	3.4L
	2WD	2.0L

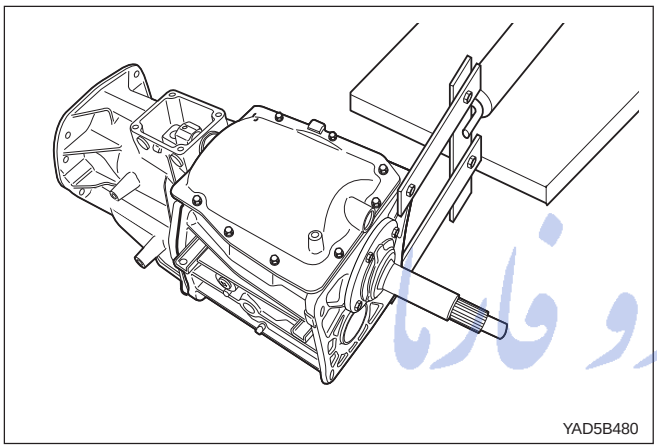

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UNIT REPAIR

MAJOR UNIT

Disassembly Procedure

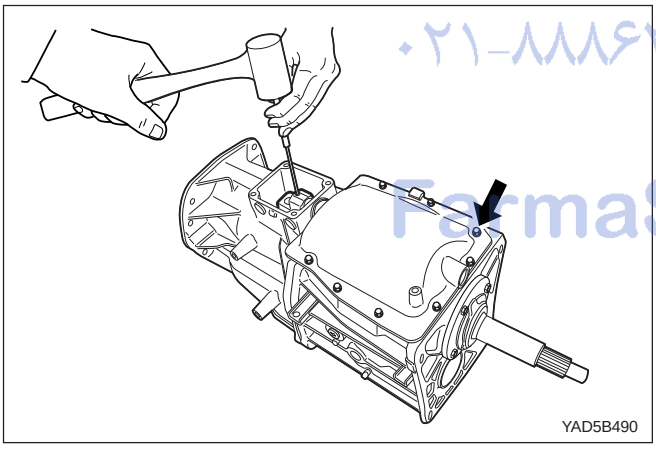
1. Remove the shift lever from the extension housing.


YAD5B480

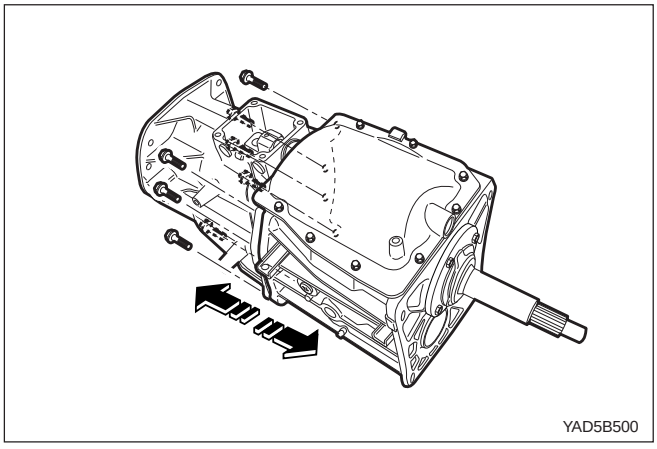
2. Install the removed transmission into a fixture.
3. Remove the drain plug and drain the oil. Using a 10 mm wrench, remove the clamp bolt and position the offset lever in the 3-4 position of neutral.

   Notice: Removal of the offset lever in a position other than 3-4 of neutral will be difficult.

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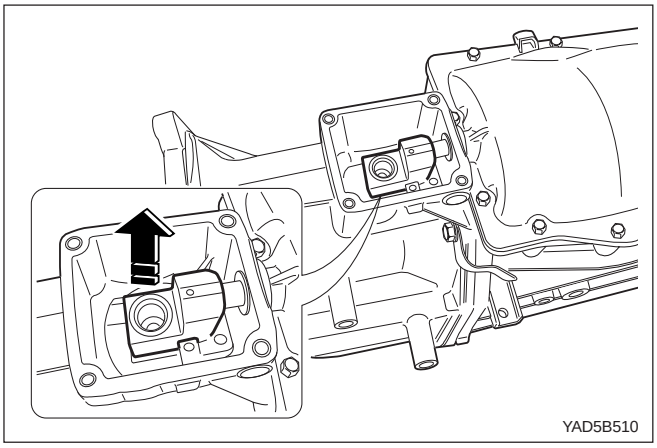
4. Using a pin punch and a hammer, remove the roll pin to remove the shift lever from the offset lever.
5. Using a 15 mm wrench, remove the 8 bolts from the extension housing.


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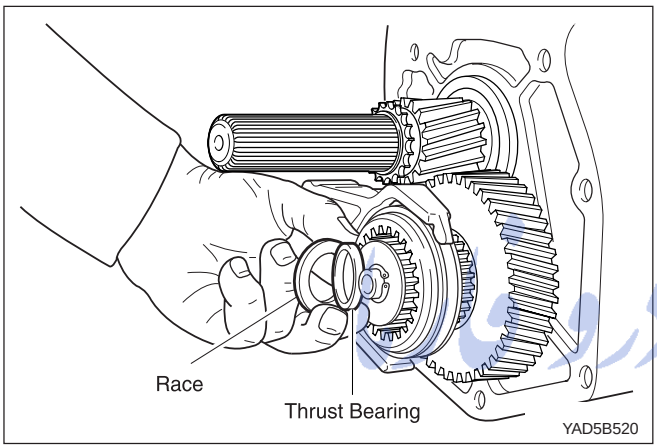
6. Separate the extension housing from the case and shift cover.

   Separate the offset lever from the shift.

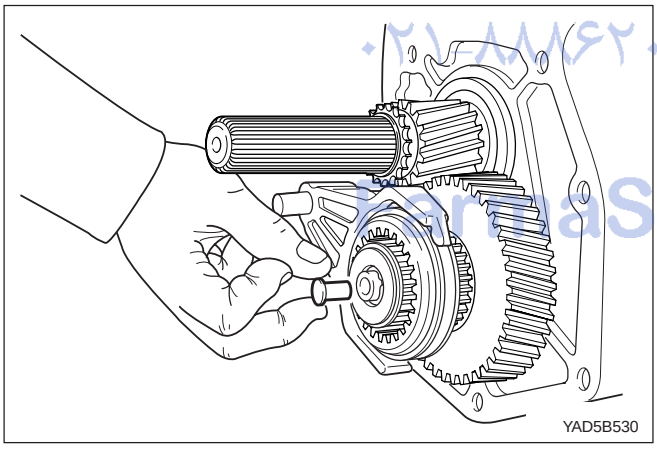
   Notice: Do not remove the offset lever while the extension housing is still assembled to the case.



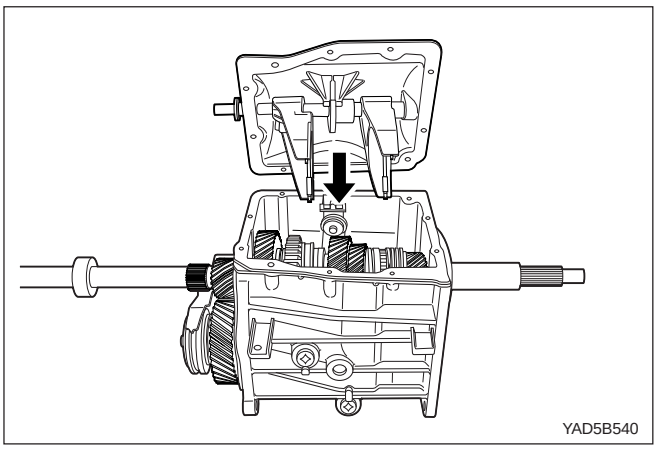
7. Remove the offset lever from the extension housing with the detent ball and spring.
8. Remove the roll pin from either the offset lever or extension housing.



9. Remove the counter shaft thrust race and bearing.



10. Carefully remove the oiling funnel from the end of the counter shaft.

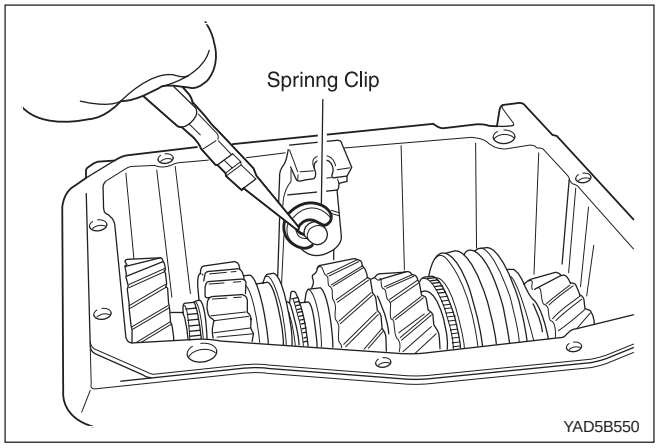


11. Using a 10 mm wrench, remove the 10 bolts from the shift cover.

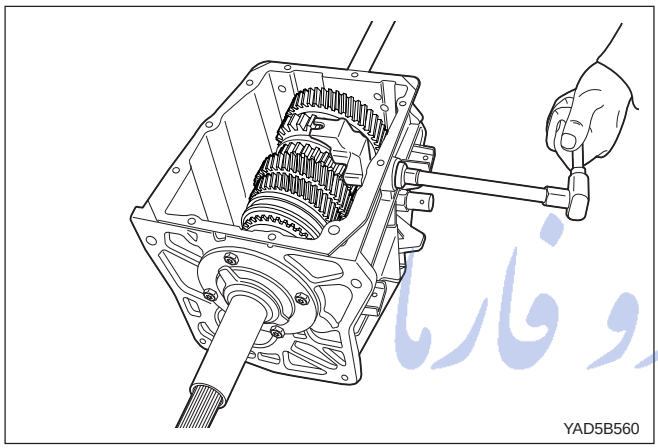
    Notice: For assembly, note the location of the two bolts.

12. Lift up the shift cover after sliding it toward the drain plug about 3 cm. At this time remove sealer bond.

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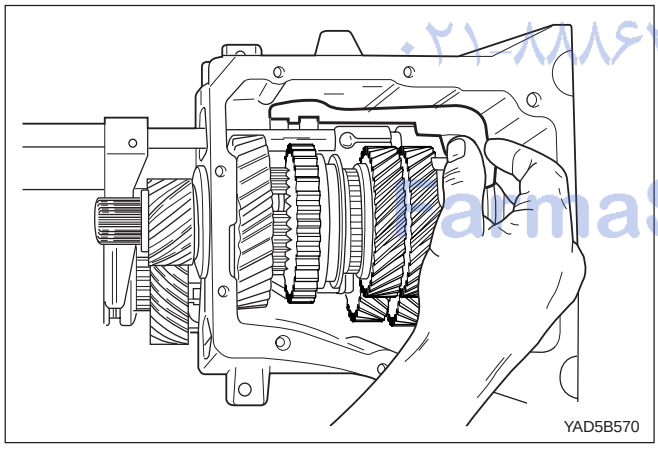
13. Using a needle nose pliers, remove the 5th-R lever clip.



14. Using a 21 mm wrench or a T-50 bit, remove the 5th-R lever pivot bolt.

    Notice: Apply sealer bond to this bolt during assembly.

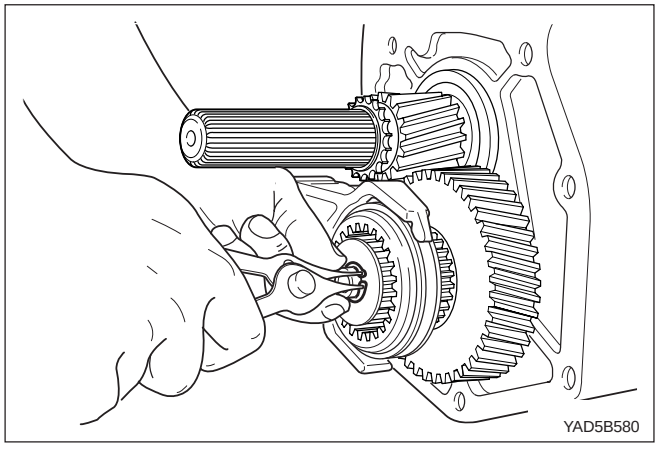
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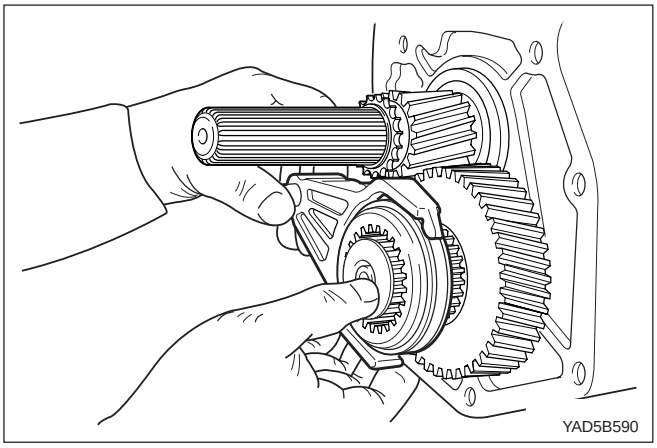
15. Using a 22 mm wrench, remove the back-up lamp switch from the 5-R lever side.

    Notice: Apply sealer to the threads.

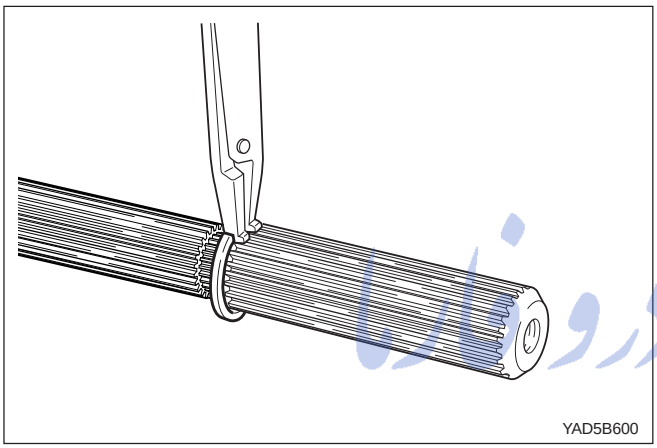
16. Pull out the 5th-R lever out of the transmission.



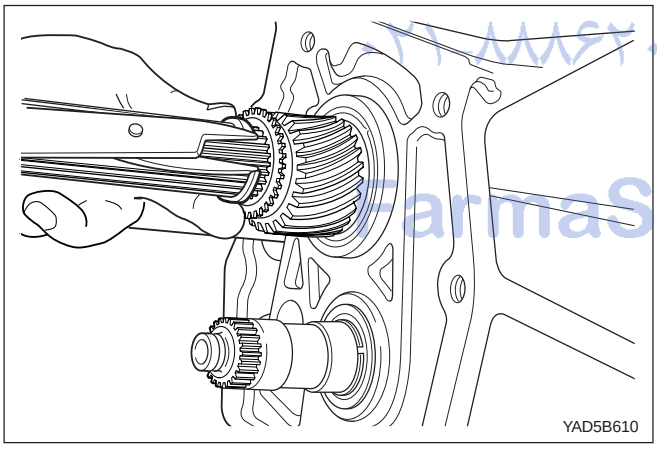
17. Using a snap ring pliers, remove the 5th synchronizer snap ring from the end of the counter shaft.


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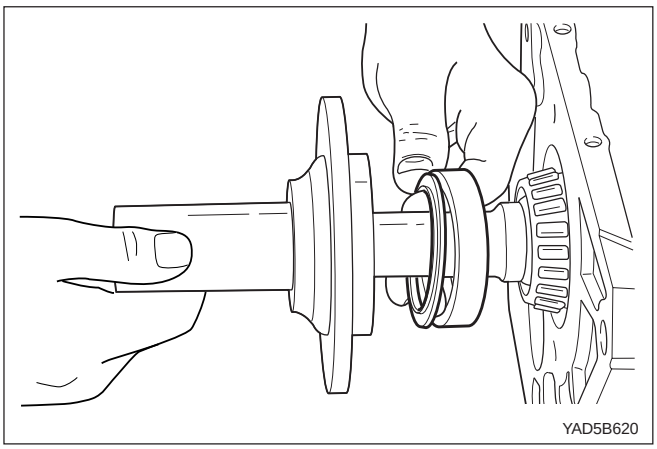
18. Remove the 5th synchronizer assembly with its fork and rail assembly from the counter shaft.


YAD5B600

19. Remove the slip yoke snap ring from the main shaft.


YAD5B610

20. Remove the 5th speed drive gear snap ring from the main shaft.

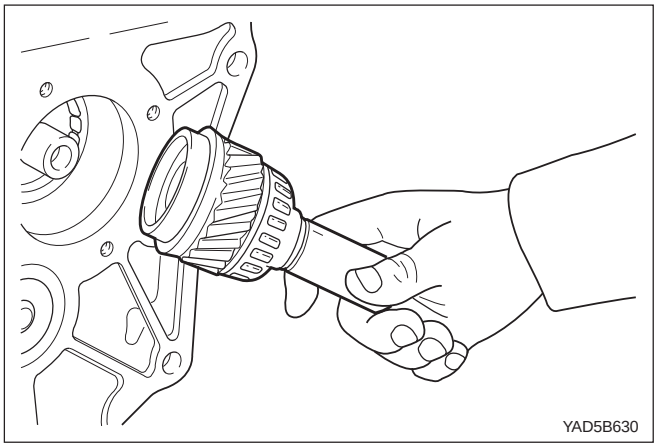

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21. Make alignment marks on the case and input bearing retainer and remove the 4 input shaft bearing retainer bolts, using a 13 mm wrench.

    Remove the input bearing retainer with the bearing outer race and shim.

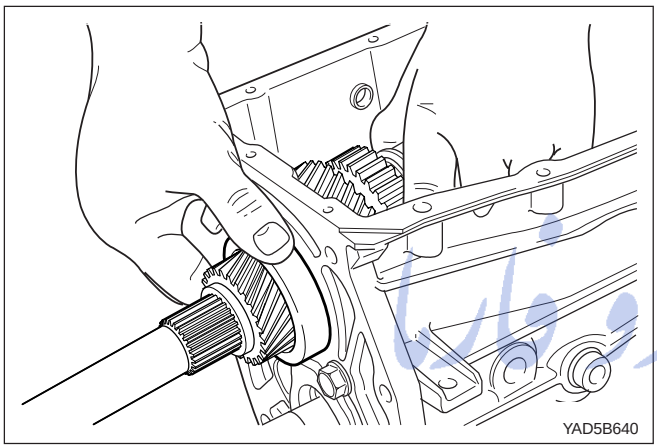
    Notice: Apply sealer on these bolts during assembly.

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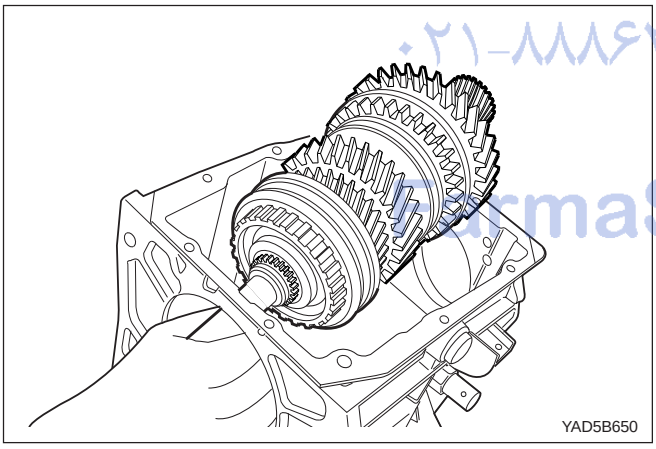
22. Remove the input shaft from the case by rotating it until the flat surface appears.
23. Remove the following parts from the input shaft.
    - 4th speed gear blocking ring.
    - Main shaft thrust race and bearing.
    - Main shaft pilot bearing rollers (15 rollers).

    Notice: Be careful not to dissipate the pilot bearing rollers.

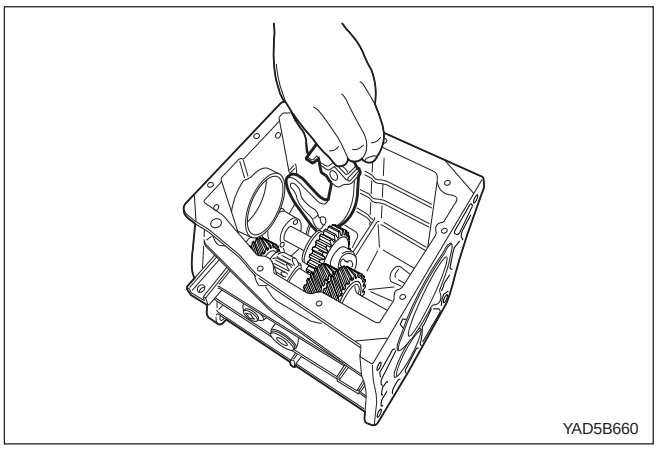

YAD5B640

24. Remove the main shaft in 2 steps.
    - To remove the rear bearing outer race, push the main shaft rearward.

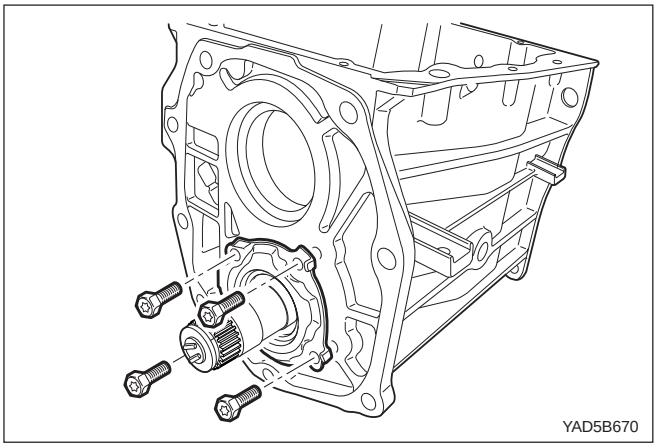
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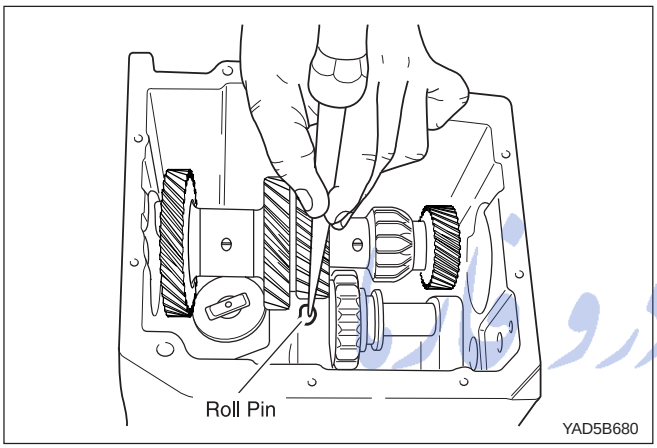
- Tilt and lift the main shaft from the case.


YAD5B660

25. Remove the reverse fork and spring from the case.

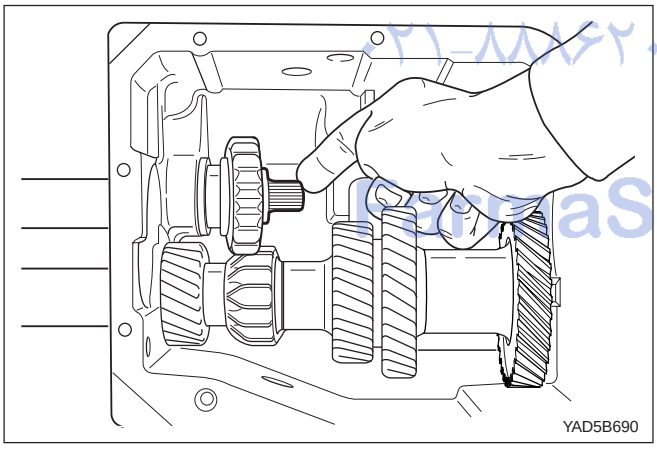

YAD5B670

26. Remove the counter shaft as follows:
    - Using a punch and hammer, pry up the lock tabs.
    - Using a 13 mm wrench or T-40 bit, remove the 4 bolts.
    - Remove the retainer and shim from the case.
    - Push the counter shaft rearward to remove the rear bearing outer race.

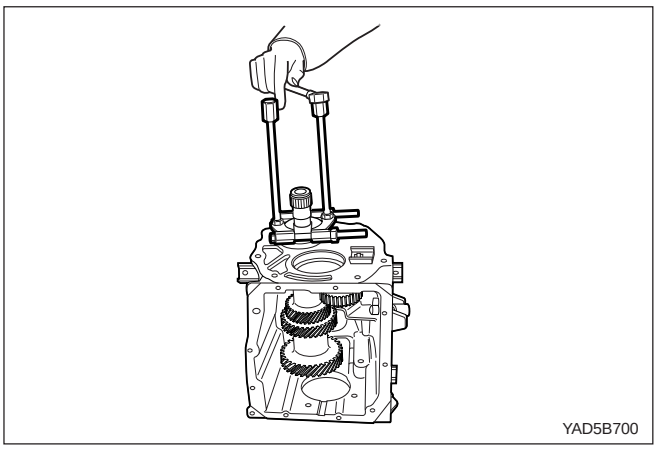


YAD5B680

27. Using a pin punch and a hammer, remove the roll pin fixed on the reverse idler shaft.

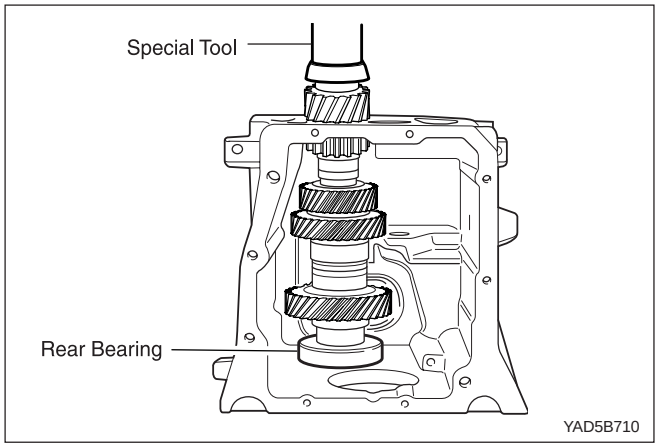

YAD5B690

28. By pushing the reverse idler shaft rearward and out of the case, remove the reverse idler gear and O-ring.


YAD5B700

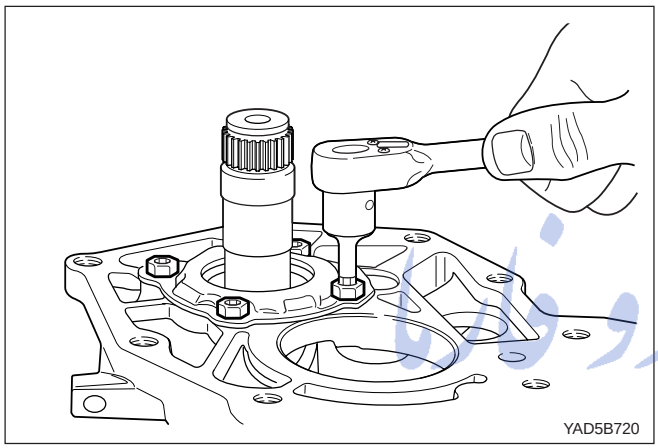
29. Using a puller, remove the rear bearing assembly from the counter shaft.

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Assembly Procedure

1. Using a hydraulic press and a supporting tool, press the counter shaft rear bearing into the case. Be sure that the supporting tool inside of the case should support the counter shaft.

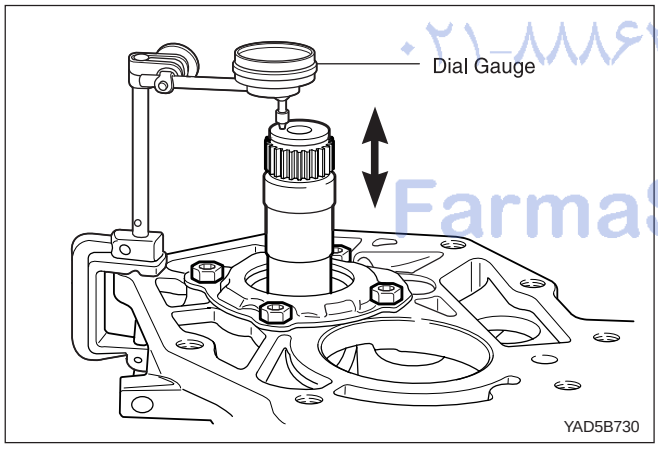


2. Without the shim, install the retainer and counter shaft rear bearing outer race. Tighten the 4 retainer bolts.

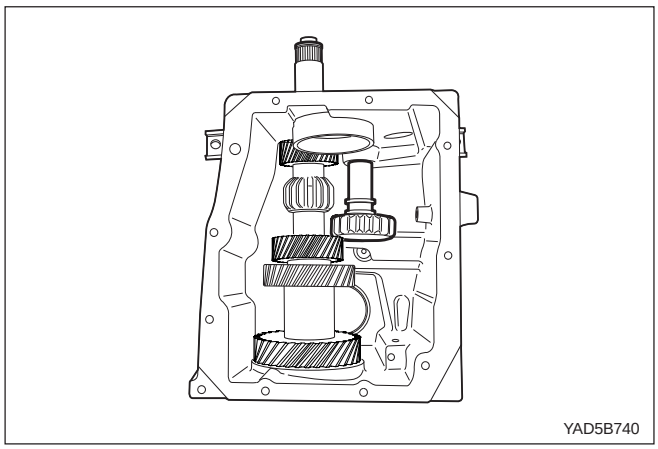
Installation Notice

Tightening Torque	20 N•m (15 lb-ft)

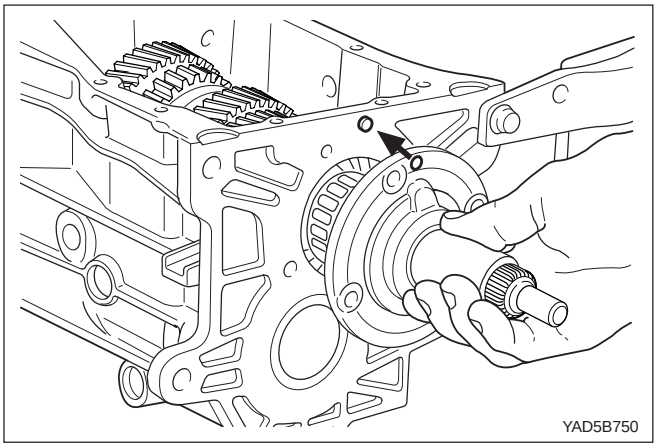
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3. Place a dial indicator on the case and measure counter shaft end play by moving up and down.



4. Select a shim which is the same thickness as the indicator rearing (up to 0.004 inch) and assemble it.
5. When the end play is correctly adjusted, remove the counter shaft rear bearing retainer and outer race.
6. Using a pin punch and rubber hammer, install the reverse idler shaft, gear and O-ring.

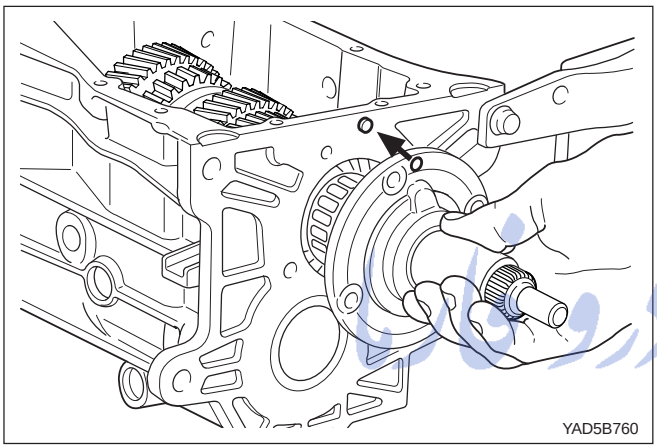

YAD5B750

7. Install the counter shaft rear bearing outer race, shim and retainer.

Installation Notice

Tightening Torque	20 N•m (15 lb-ft)

Notice: Using a punch and hammer, bend the lock tabs on the retainer.

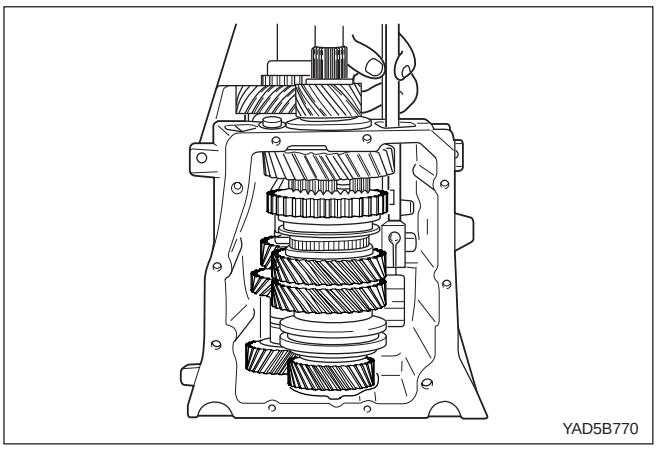

YAD5B760

8. Install the following parts :
   - Install the main shaft into case.
   - Install the main shaft rear bearing outer race into the rear of the case.
   - Install the 4th speed blocking ring onto the front of the main shaft.
   - Install the input shaft onto the front of the main shaft.
   - Install the input bearing retainer without shim onto the front of the case.
   - Using a torque wrench, tighten the 4 bolts.

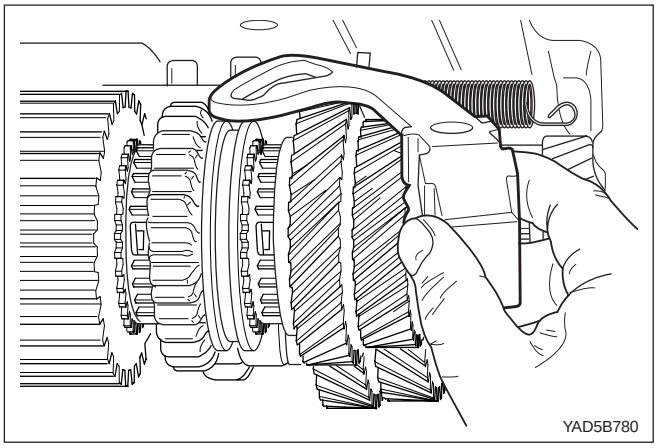
Installation Notice

Tightening Torque	20 N•m (15 lb-ft)

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YAD5B770

9. Install the 5th speed drive gear and blocking ring on the counter shaft.
10. Install the 5th synchronizer and rail/fork.
11. Install the 5th synchronizer snap ring and oiling funnel.

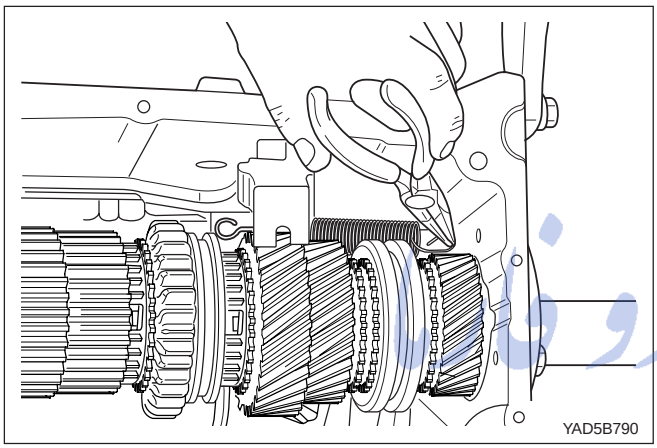


12. Align the slots of the lever with the rollers of the reverse fork and 5th shift rail. Apply sealer on the 5-R lever pivot bolt and install it into the case.

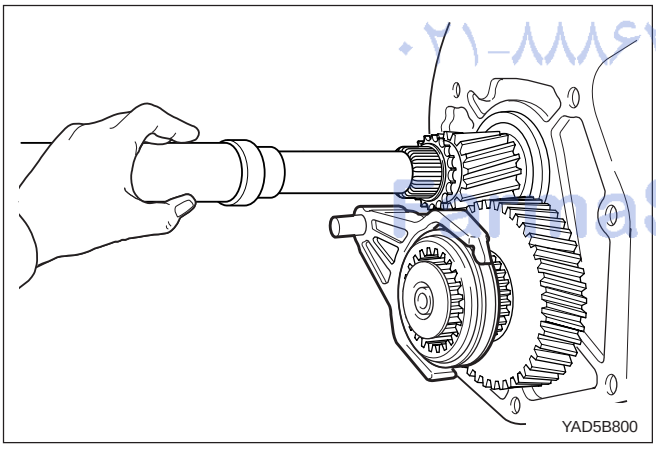
Installation Notice

Tightening Torque	28 N•m (21 lb-ft)

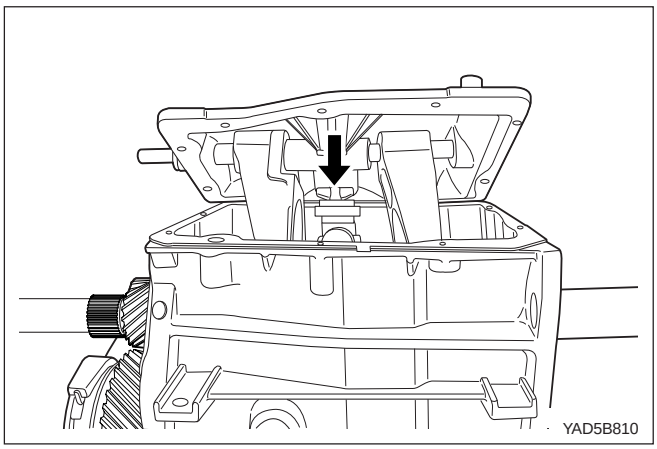
13. Using a needle nose pliers, install the 5-R lever clip.



14. Using a needle nose pliers, install the reverse fork spring to its pin inside the case. Check the operation of the 5-R shift mechanism at this time.



15. Using a snap ring piers, install the slip yoke snap ring onto the end of the main shaft.
16. Make sure that the 1-2 and 3-4 synchronizer sleeves and 5-R shift lever are in neutral position.



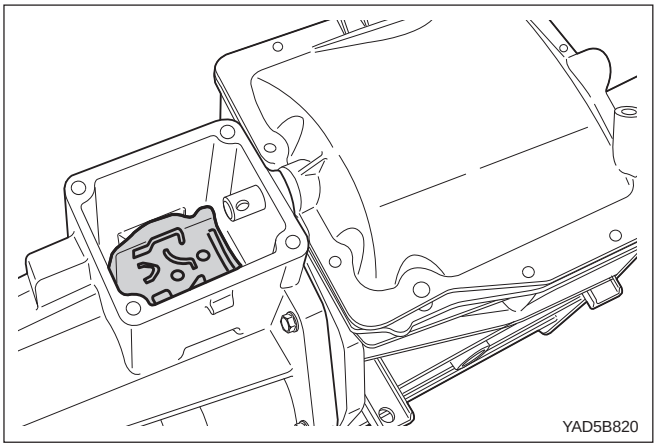
17. Align the holes the case and cover with alignment-type bolts. Tighten the 10 bolts.

Installation Notice

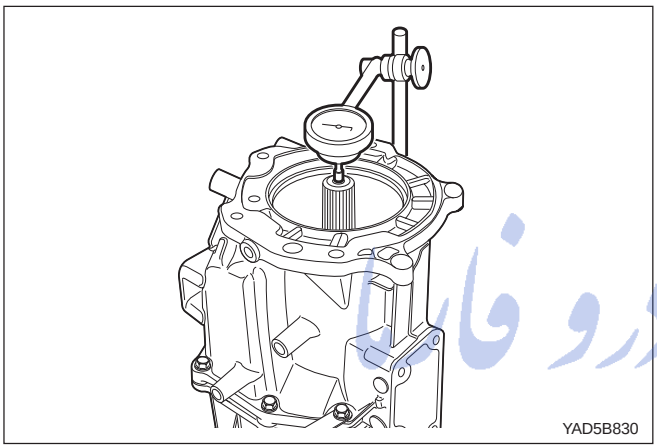
Tightening Torque	15 N•m (11 lb-ft)

18. Apply RTV sealant on the sealing surface of the extension housing.
19. Apply grease on the detent/guide plate in the extension housing. Install the detent ball in the 3-4 position.

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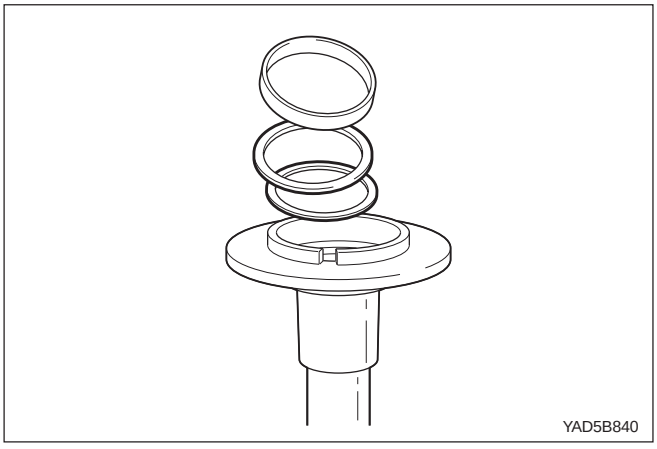

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20. Place the detent spring and offset lever in the extension housing and push the extension against the case and shift cover.


YAD5B830

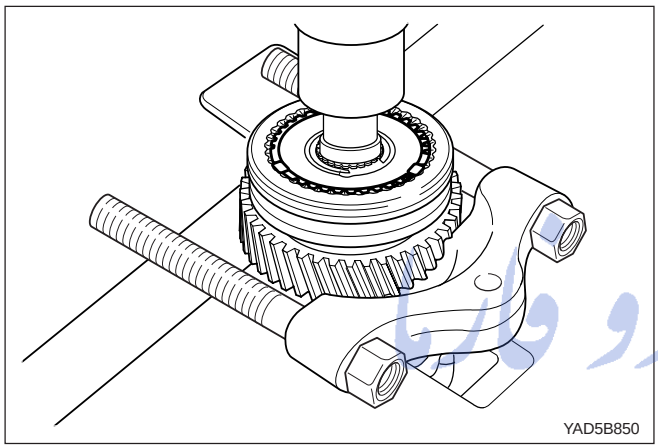
21. Completely compress the detent spring.
22. To install the extension housing to the case, apply sealer to the top two bolts and tighten them and tighten the 6 bolts.
23. Apply sealer to the back-up lamp switch and drain plug and tighten them.
24. Using a hammer, install the offset lever-to-shift roll pin.
25. Turn the transmission case reversely and place a dial indicator on the extension housing. Move the input and main shift up and down and measure end play. Select a shim which is the same thickness as the measurement (0.001 inch). After shim installation, the end play should be “0”.

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26. Remove the input bearing retainer and do the following :
    - Install the adjusting shim behind the input bearing outer race in the retainer and if 2 shims are used, install the thinner one in first.
    - Install the retainer to the case and tighten the bolts.
    - If end play is not 0change the shim again.
    - Apply RTV sealant to the sealing surface of the retainer.
    - Apply sealer to the 4 retainer bolts and tighten them.

27. Remove the fill plug.
28. Remove the transmission from the holding fixture and install it to the vehicle.
29. Clean the sealing surface of the shift control lever.
30. Install the control cables to the shift lever.

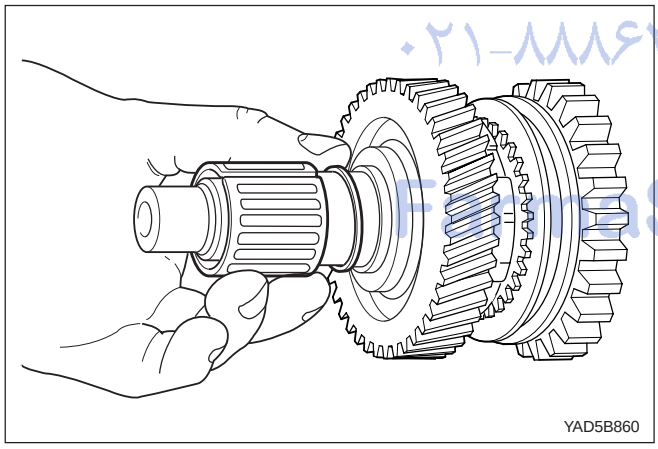

YAD5B850

MAIN SHAFT

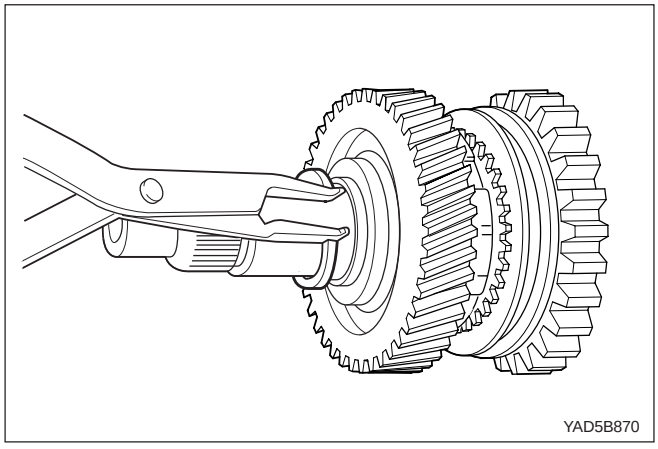
Disassembly Procedure

1. For correct reassemble, place an alignment mark on the 3-4 Synchronizer hub and sleeve.
2. Using a hydraulic press and puller plate, remove the 3-4 Synchronizer assembly and the 3rd speed gear.

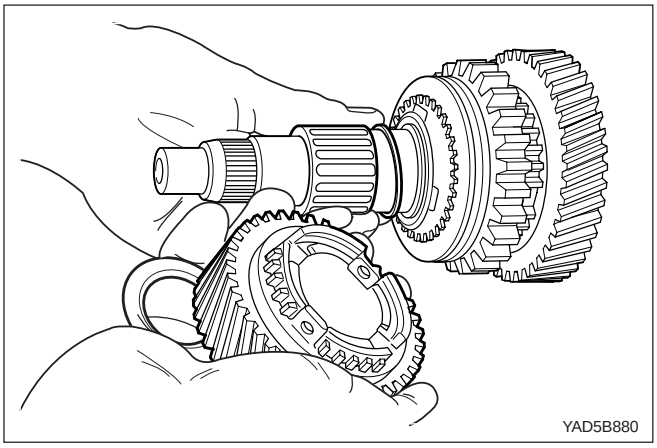
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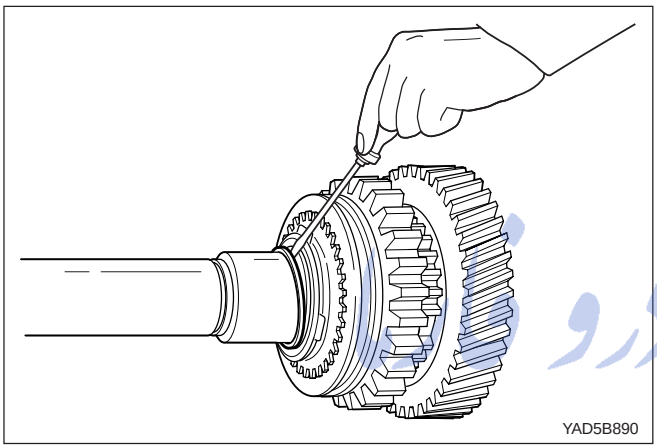
3. Remove the 3rd speed gear bearing and spacer.


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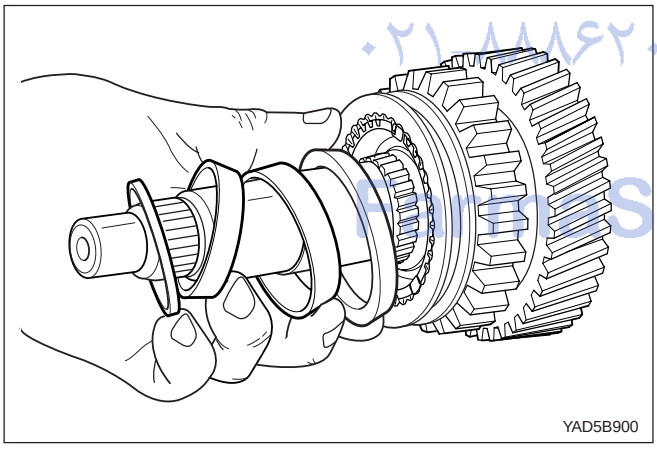
4. Using a snap ring pliers, remove the 2nd speed gear snap ring.
5. Remove the 2nd speed gear thrust washer.



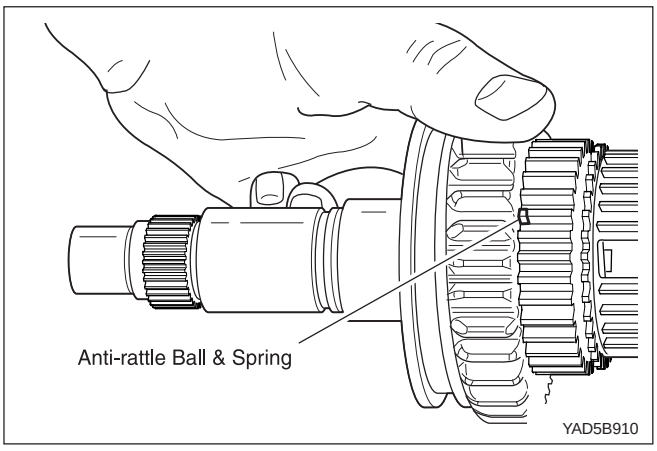
6. Remove the 2nd speed gear, bearing and spacer.



7. Using a screwdriver, remove the spiral retaining ring.

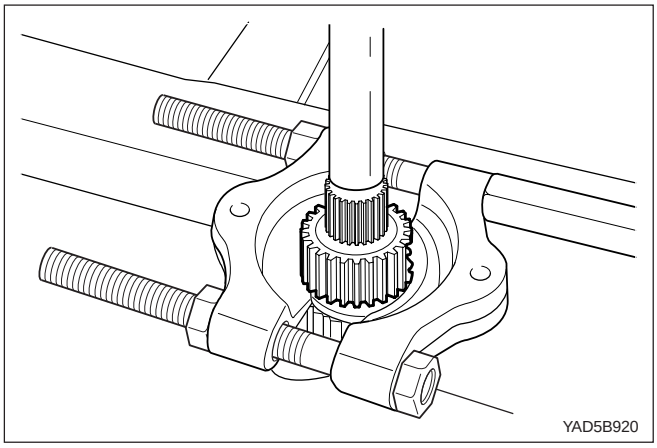


8. Remove the thrust washer and three-piece 2nd speed blocking ring assembly.

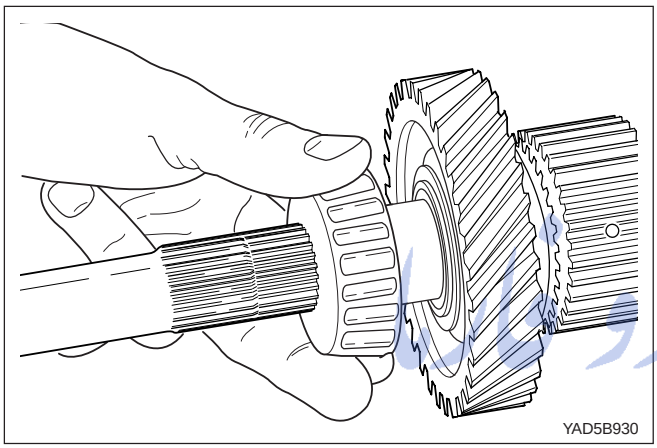


9. For correct reassembly, place an alignment mark on the 1-2 synchronizer hub and sleeve.
10. Remove the 1-2 synchronizer sleeve from the hub with following parts :
    - The anti-rattle ball and spring.
    - The three keys.
    - One of the 3 springs.

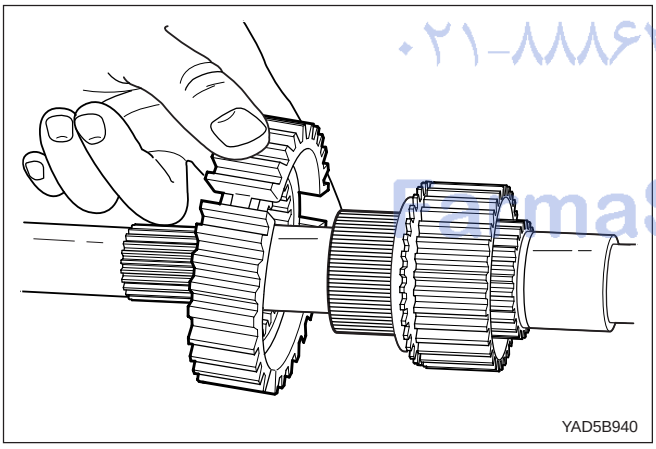
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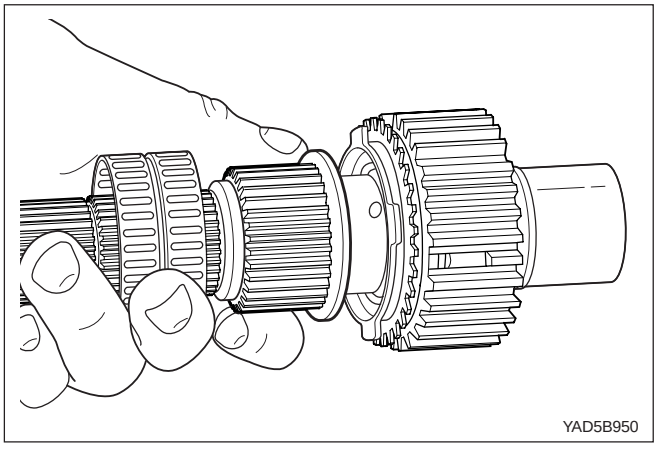
11. Using a hydraulic press and puller plate, remove the 5th speed driven gear from the main shaft.



12. Remove the main shaft rear bearing assembly from the shaft.

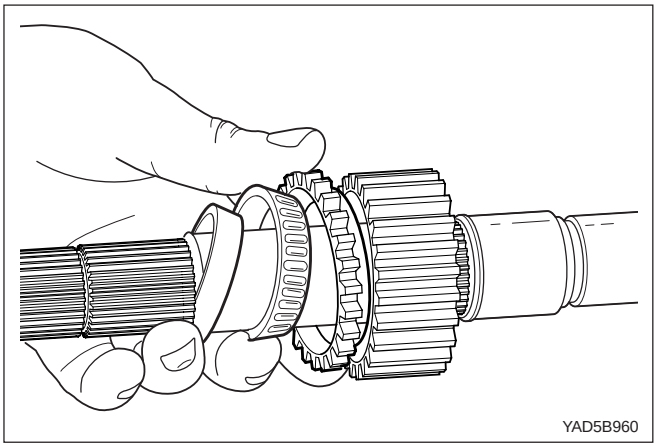


13. Remove the 1st speed gear and bearing.

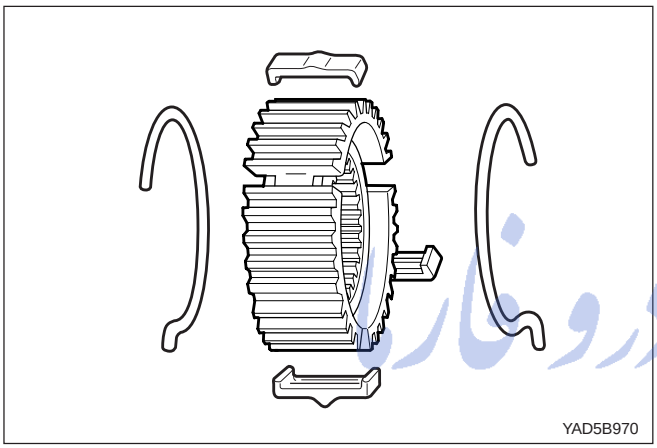


14. Remove the inner race.

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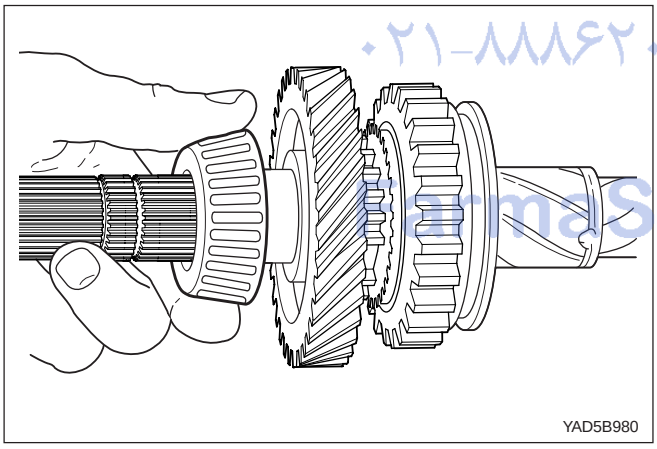
15. Remove the tree-piece 1st speed blocking ring assembly and remaining synchronizer spring.
16. Check and clean all removed parts and replace if necessary.


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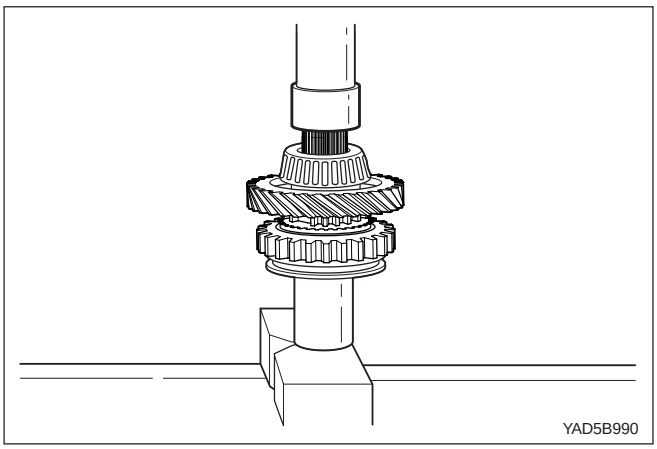
Assembly Procedure

1. When assemble the synchronizer, make sure that the hubs and sleeves are matched and the 3 keys are installed properly. Also align blocking rings with keys during installation.

   Notice: Before assembly, coat all parts with lubricant. In case of the paper-lined blocking rings, soak them in DexronII/III before installation.

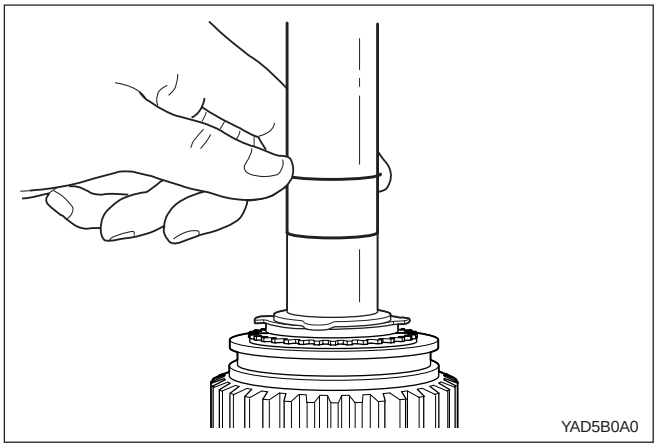

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2. Assemble the following parts :
   - 1st speed blocking ring.
   - Alignment pin and 1st speed gear bearing race.
   - 1st speed gear and its bearing.
3. Install the rear bearing assembly to the main shaft.

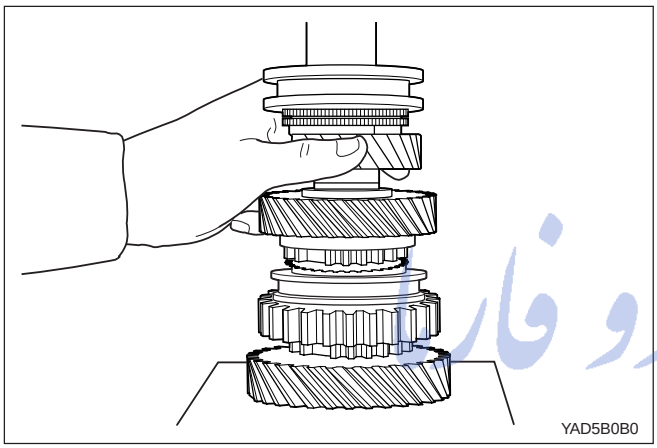

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4. Using a hydraulic press and installer, press the 5th driven gear onto the main shaft. While the main shaft is still on the press bed, install the 5th driven gear snap ring. If the snap ring does not fit completely, continue pressing the 5th driven gear.

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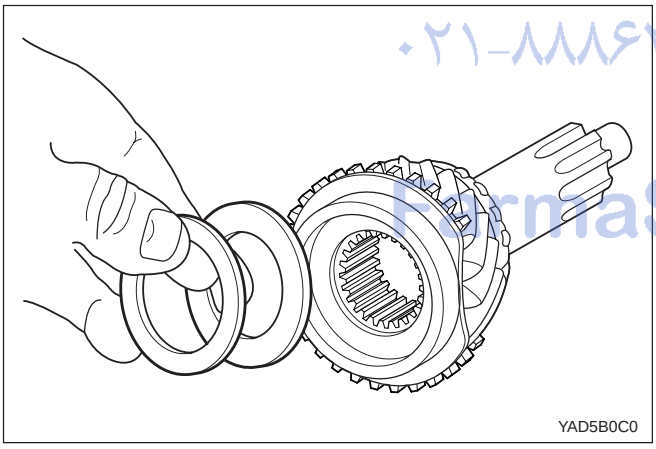
5. Install the following parts :
   - 2nd speed blocking ring assembly.
   - Thrust washer for the blocking ring inner cone.
   - Spiral retaining ring (Use special tools).
   - 2nd speed gear spacer, bearing and gear.
   - 2nd gear thrust washer and snap ring.
   - 3rd speed gear spacer, bearing and gear.
   - 3rd speed blocking ring.


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6. Using a hydraulic press and installer, install the 3-4 synchronizer hub onto the main shaft.

   Notice: Align the blocking ring with the synchronizer keys while installing the hub.

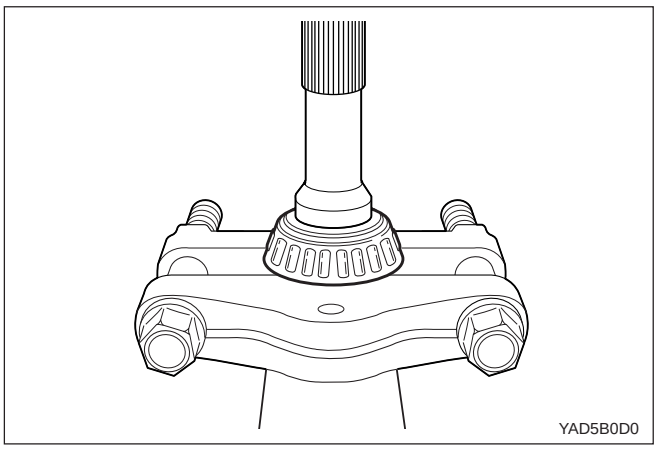
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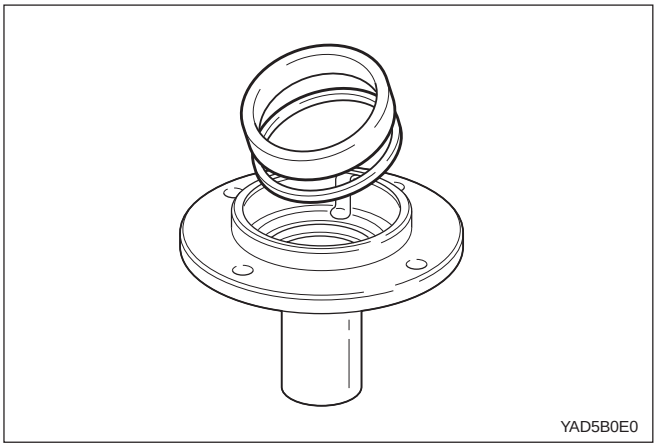
INPUT SHAFT

Disassembly Procedure

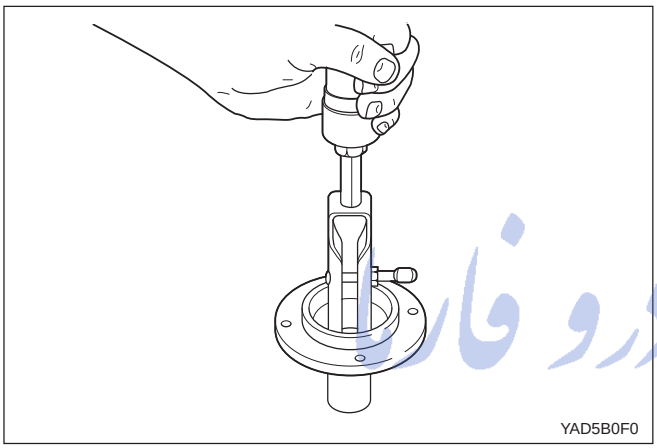
1. Remove the following parts from the input shaft :
   - Main shaft thrust race and bearing.
   - Main shaft pilot bearing rollers (15 rollers).


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2. Using a hydraulic press and puller plate, remove the input shaft bearing assembly from the shaft.

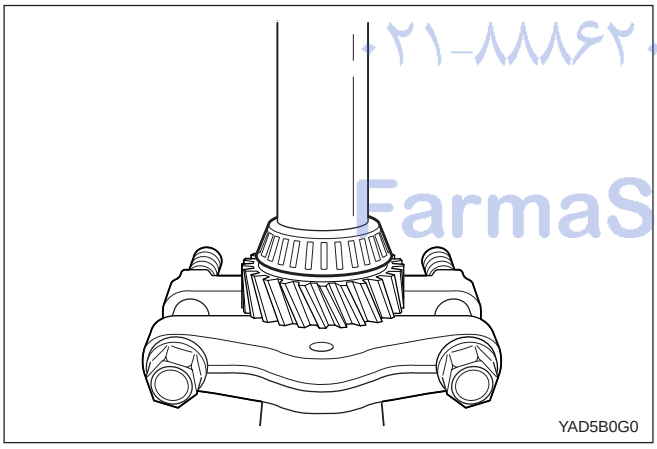

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3. Remove the input bearing.


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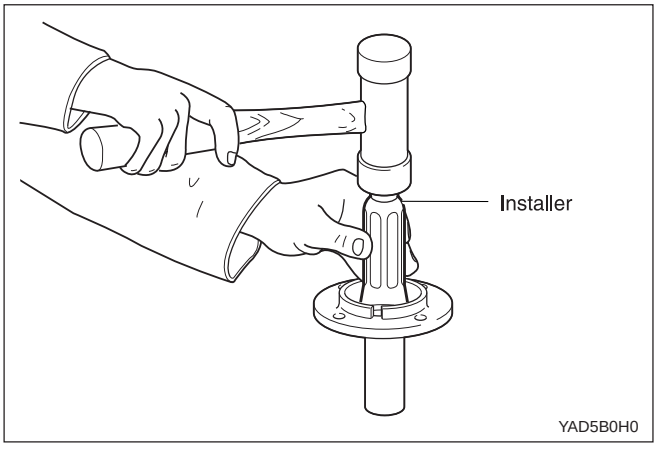
4. Remove the input shaft seal.
5. Check and clean all removed parts and replace if necessary.

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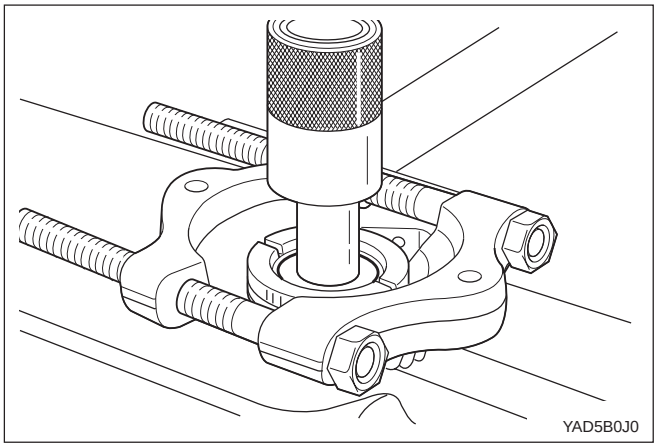
Assembly Procedure

1. Using a hydraulic press and installer, press the input shaft bearing onto the input shaft.
2. Apply grease to the thrust bearing inner roller (15 rollers) and install the main shaft thrust bearing and its race in the rear of the input shaft.



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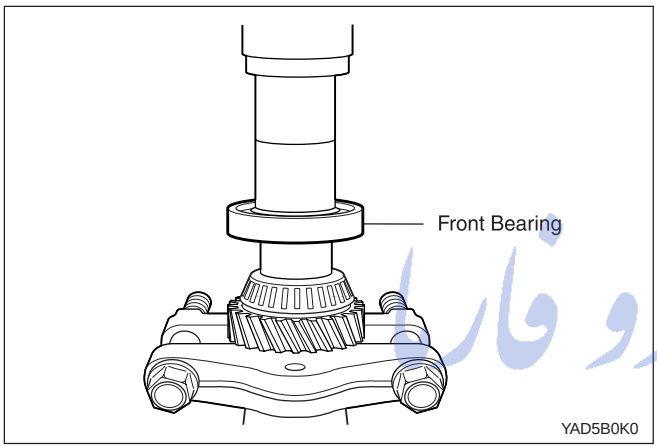
3. Using a rubber hammer and installer, install the input bearing retainer and input shaft seal after applying grease.
4. Install the bearing outer race to the retainer without end play adjusting shim.


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COUNTER SHAFT

Disassembly Procedure

1. Using a hydraulic press and special tool, remove the front bearing assembly from the counter shaft.
2. Check and clean all removed parts and replace if necessary.

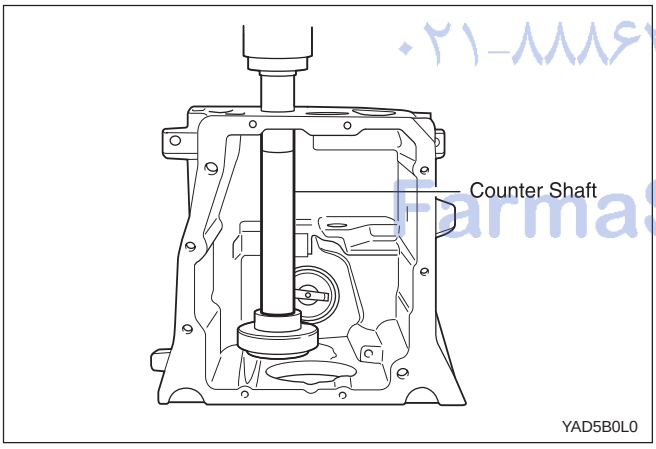


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Assembly Procedure

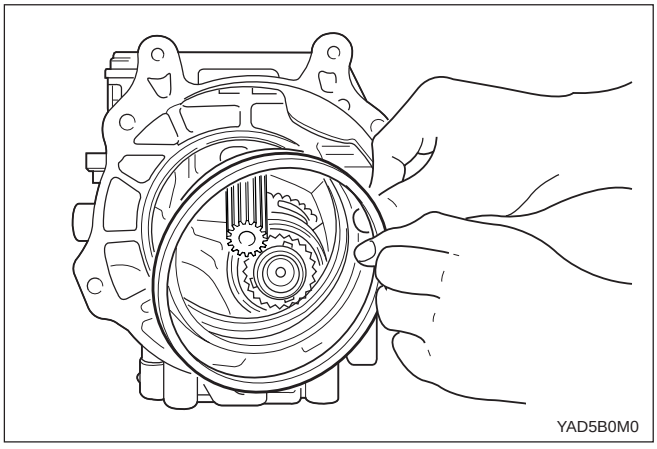
1. Using a hydraulic press and installer, press the front bearing assembly onto the counter shaft.

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2. Install is as follows :
   - Install a new O-ring on the counter shaft outer race and lubricate it.
   - Using a installer, lightly tap the race into its bore until the O-ring is compressed.
   - Install the race to be fully seated on the inside of the case.


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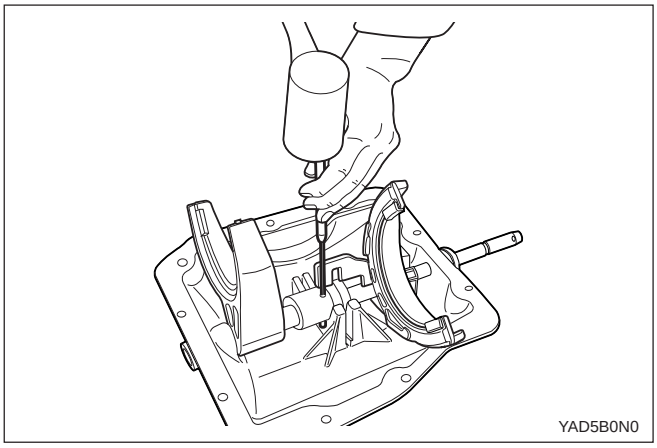
EXTENSION HOUSING

Disassembly Procedure

1. Remove the vent from the extension housing.
2. Remove the O-ring and steel ring from the rear of the extension housing.
3. Check and clean all removed parts and replace if necessary.

Assembly Procedure

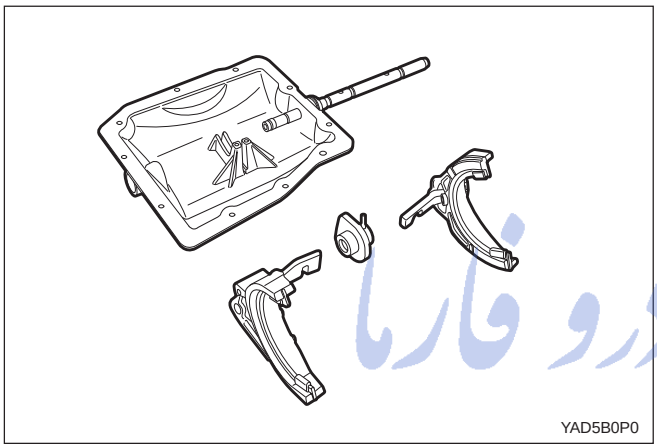
1. Install the O-ring and steel ring to the rear of the extension housing.
2. Install the vent to the extension housing.


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SHIFT COVER

Disassembly Procedure

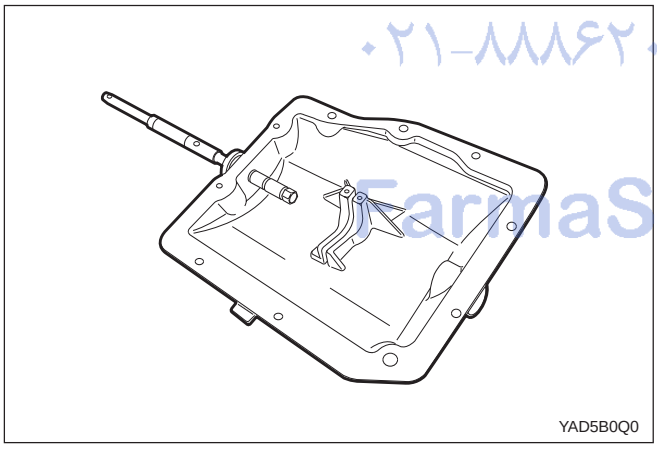
1. Using a hammer and a pin punch (3/16) remove the selector arm roll pin.


YAD5B0P0

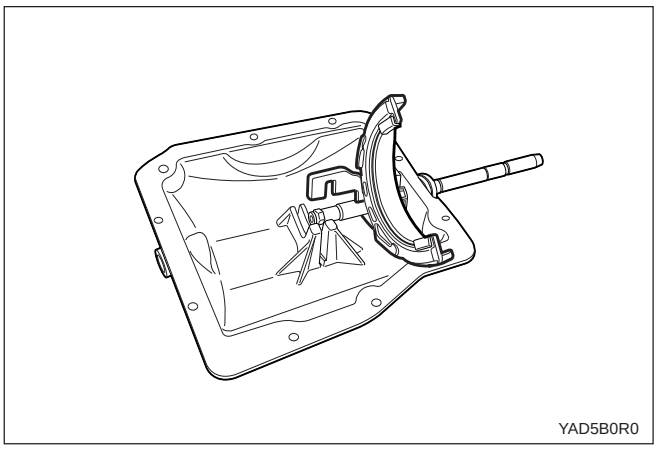
2. Before removal, note the correct position of the interlock plate and selector arm and remove the shift shaft.
3. Check and clean all removed parts and replace if necessary.

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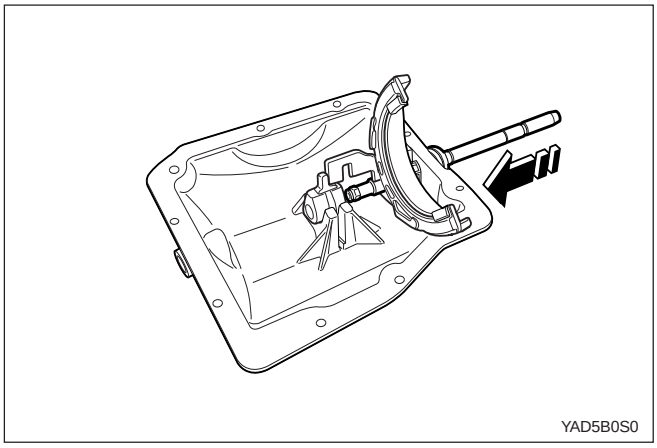
Assembly Procedure


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1. If the shaft cup plug was removed, apply plug outer surface with sealer and install it into the cover.
2. Install the fork pads and selector plates onto the 1-2 and 3-4 shift forks.
3. Assemble the sift cover parts as follows :
   - Push the shift shaft into the cover until the front of the shaft is at the inside of the cover.


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   - Install the 1-2 shift fork and its selector plate.


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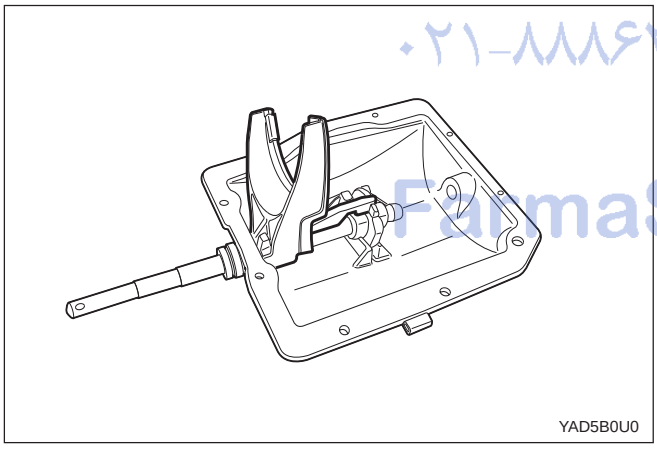
- Push the shift shaft through the 1-2 shift fork.


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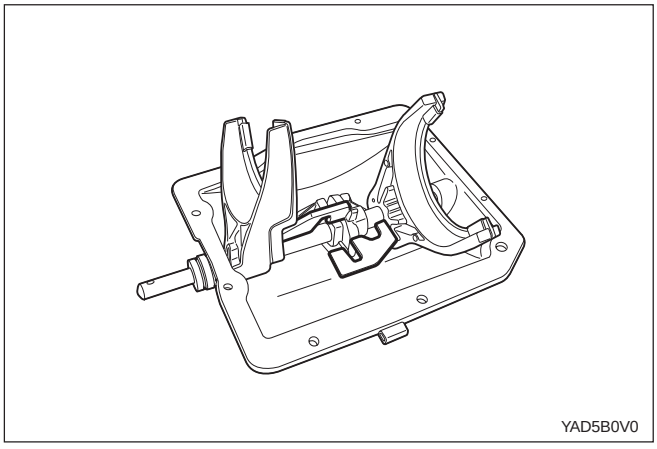
- Place the selector arm and interlock plate in the cover.

  Note the position of the interlock plate and selector arm.

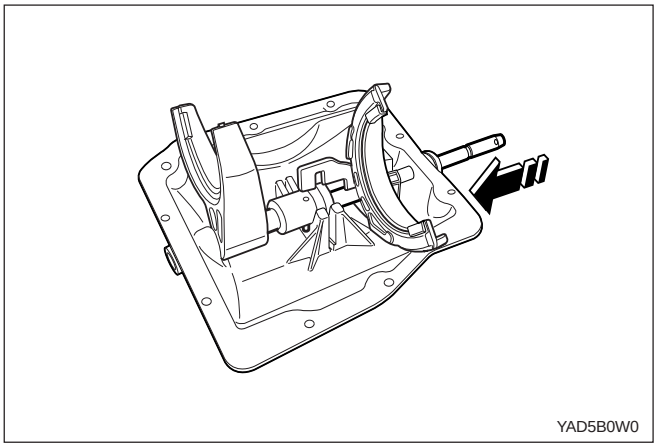
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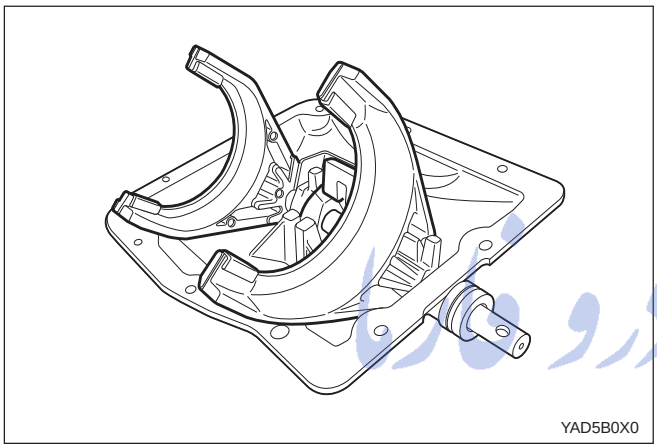
- Push the shift shaft through the 3-4 shift fork.


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- Install the 3-4 shift fork and its selector plate.

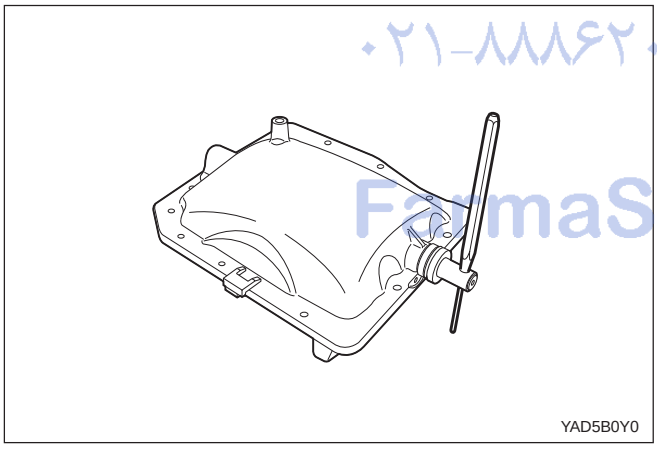

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- Push the shift shaft through the 3-4 shift fork.

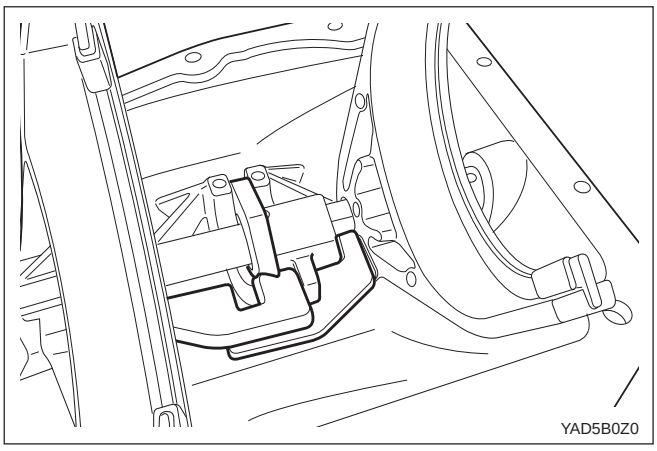

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- Install the roll pin that fixes the selector arm to the shift shaft.

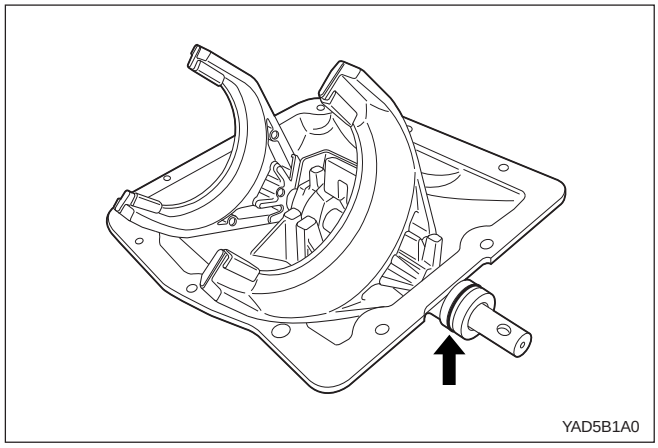
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4. Check the shift cover parts for proper assembly as follows :
   - Insert a pin punch (3/16) into the offset lever hole of the shift shaft.
   - Place the shift cover to the flat ground and rotate the shift shaft so that the punch is vertical.

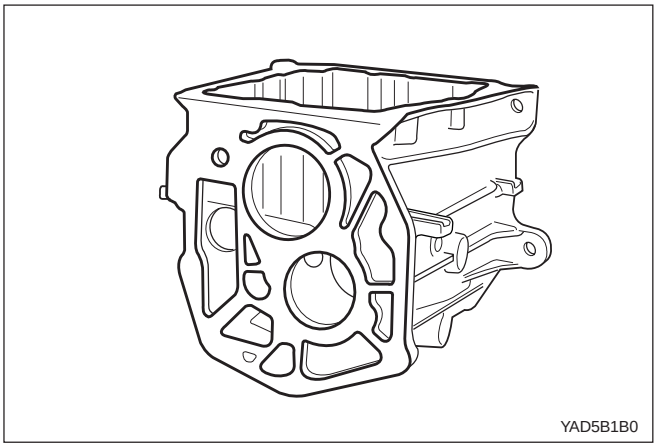

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- Selector arm should be aligned with the 3/4 shift fork selector plate.



5. Lubricate and install the O-ring on the rear of the shift cover.

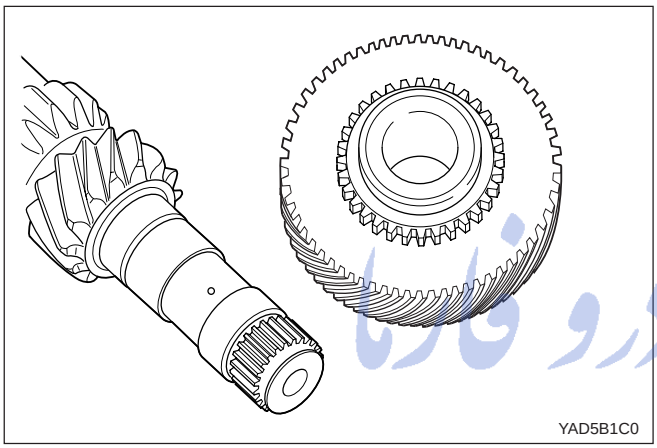
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INSPECTION OF COMPONENTS

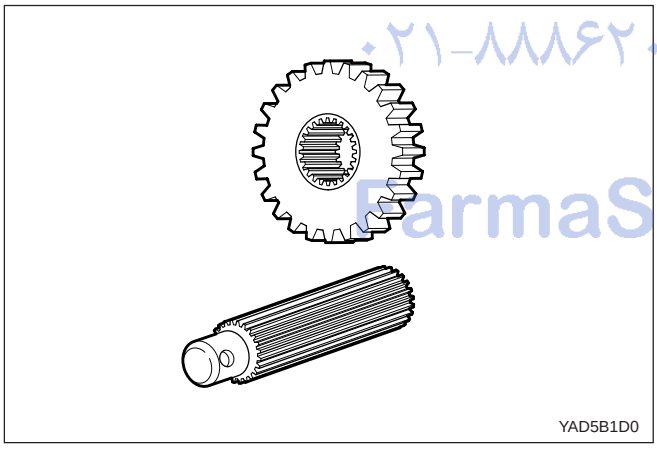
Inspection Procedure

1. Clean all parts with solvent and dry them with compressed air. Check the following parts for cracks and damaged sealing surfaces.
   - Case
   - Extension housing
   - Shift Cover
   - Input bearing retainer
   - Counter shaft rear bearing retainer
2. Check the parts which support bearings and shafts for excessive wear and replace them if necessary.

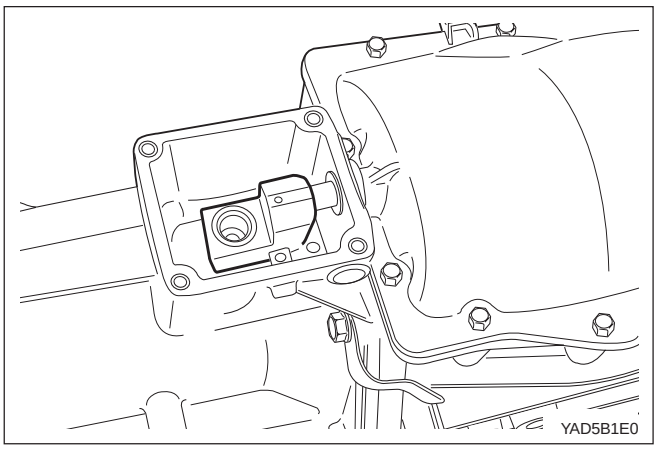

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3. Check the bearing surfaces of the following parts ;
   - Input shaft
   - Main shaft and its gears
   - Counter shaft and 5th drive gear
4. Check the reverse idler shaft and its gears.

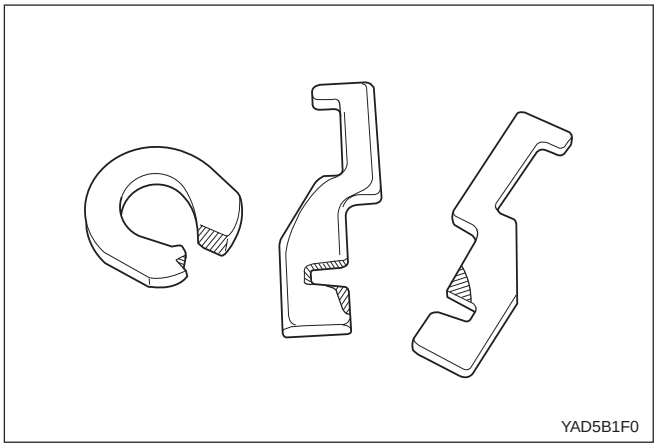
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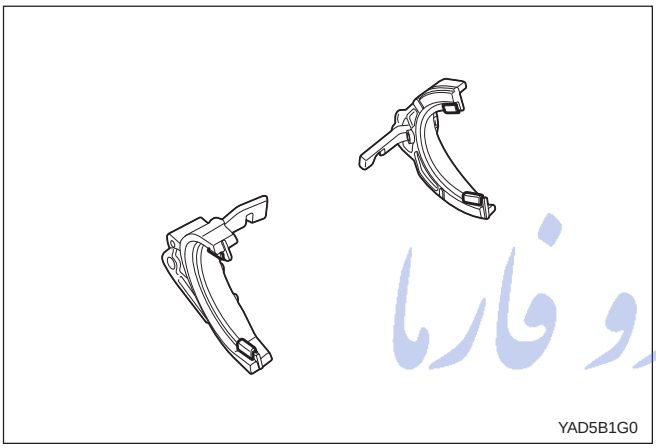
Notice: Replace excessive wear parts and do not file on the hardened surface and precision ground.


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5. Check the shift mechanism parts as follows :
   - Wear of the shift shaft.
   - Wear of the detent/guide plate and offset lever.

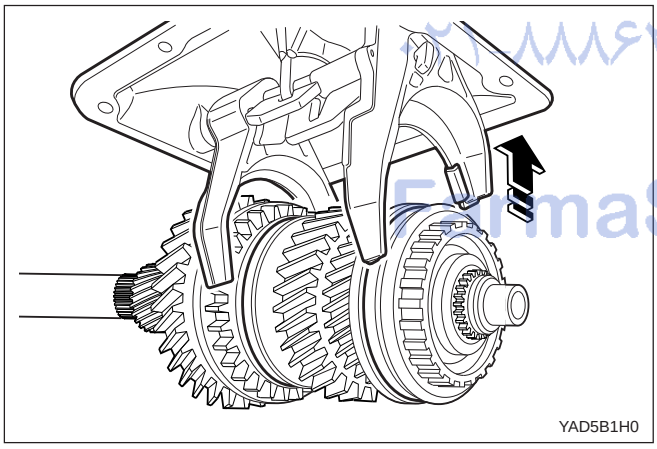

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6. Check worn edges on the following parts :
   - Selector arm.
   - Interlock plate.
   - Selector plates for the 1-2 and 3-4 shift forks.

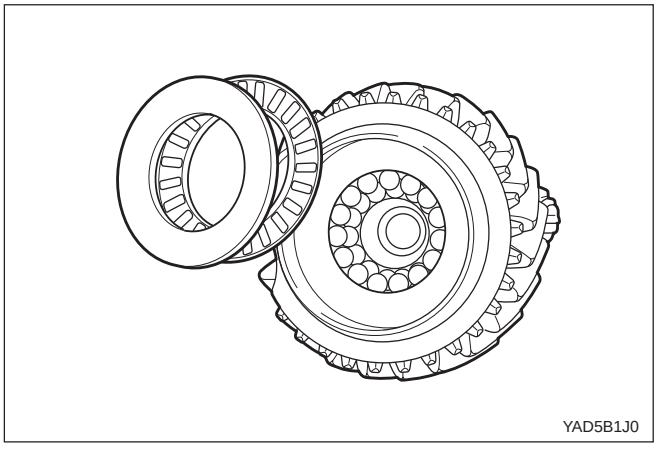

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- 5-R shift lever and the rollers on the reverse fork and the 5th shift rail/fork.

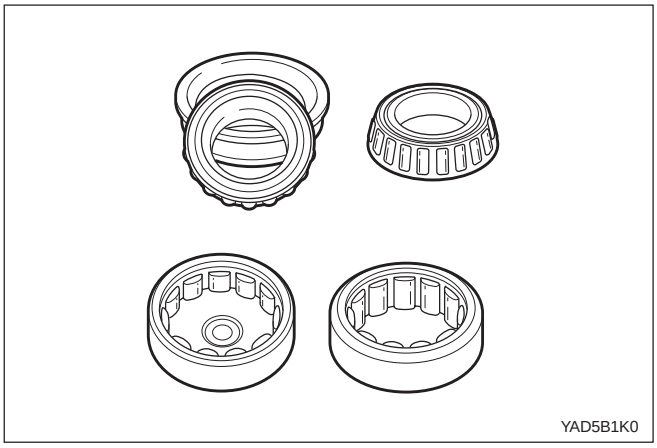
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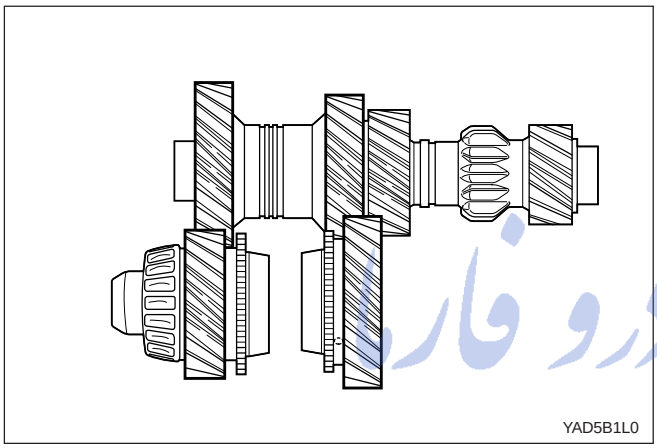
7. Check worn mating surfaces on the following parts :
   - 1-2 shift fork, pads and synchronizer sleeve.
   - 3-4 shift fork, pads and synchronizer sleeve.
   - 5th shift rail/fork pads and synchronizer sleeve.
   - Reverse fork and reverse idler gear sleeve.


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8. Check the following Bearing for excessive war:
   - Crankshaft pilot bushing for the front of the input shaft.
   - Clutch release bearing.
   - Input shaft bearing.
   - Main shaft pilot bearing rollers.
   - Main shaft thrust Bearing and its surfaces.

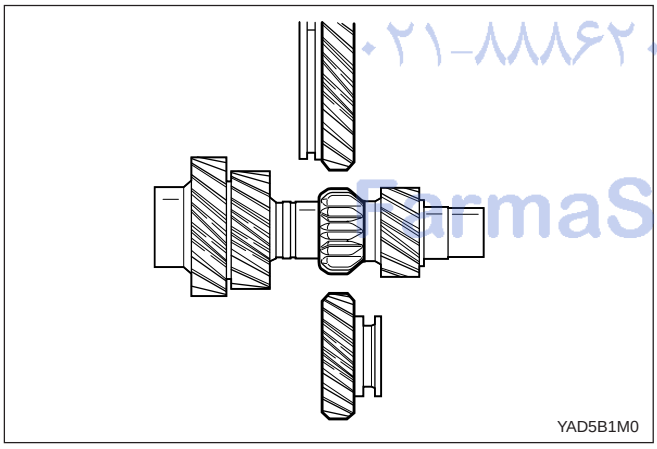

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- Speed gear roller bearing on the main shaft.
- Main shaft rear bearing.
- Counter shaft front and rear bearings.

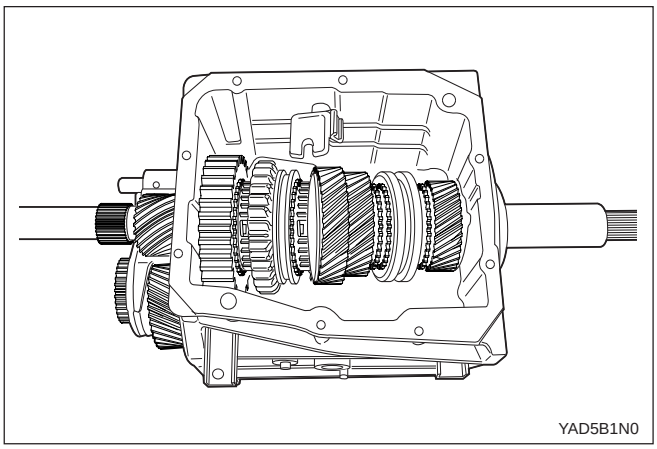

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9. Check the gear tooth surfaces of all gear sets.

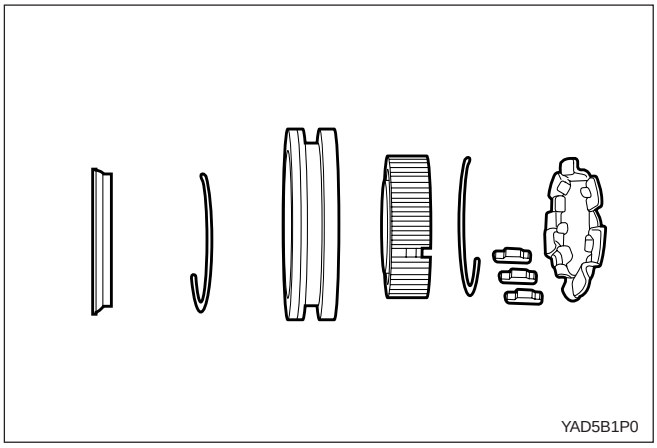
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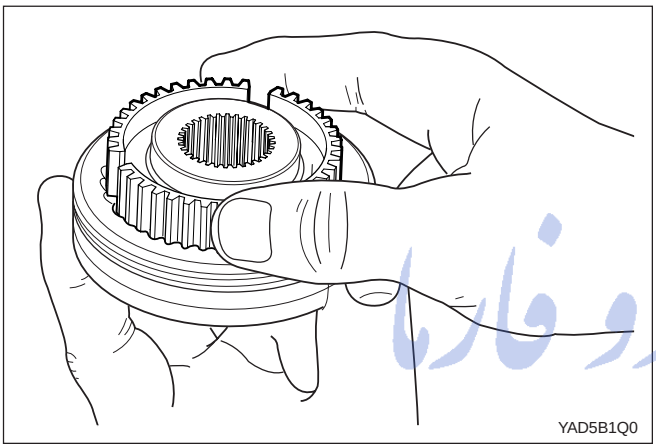
10. Check the reverse gear set surfaces. Check the surfaces of gear teeth for excessive wear, pitting, scoring and spalling and replace if necessary.


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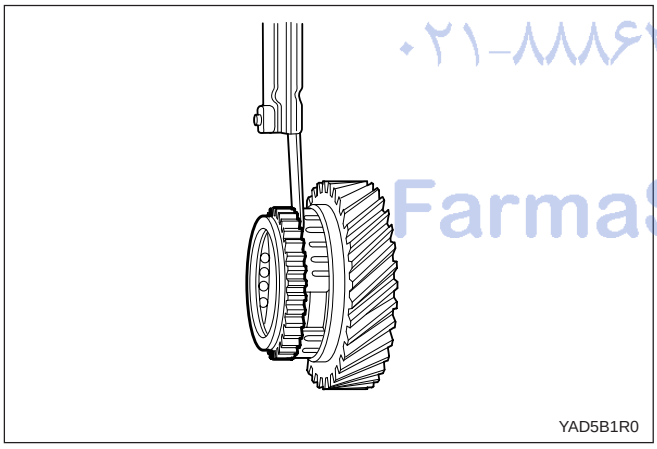
11. Take apart the three synchronizer assemblies and check :
    - The 1-2 synchronizer.


YAD5B1P0

- The 5th blocking ring.

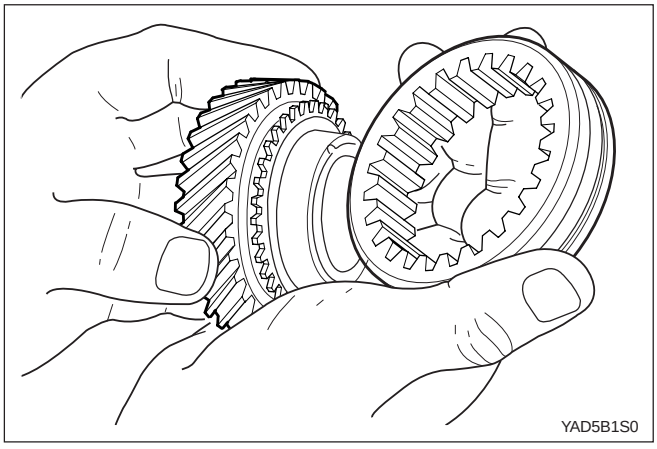

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12. Check the fit between the hub and sleeve of each synchronizer
    - Excessively tight or loose hub-to-sleeve fit.
    - Wear of the cone clutch surfaces of brass blocking rings and gears.


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13. Measure the clearance between the blocking ring and the speed gear
    - New 1-2 blocking ring : 0.87 - 1.4mm
    - New 3-4 blocking ring : 0.88 - 1.5mm

    Notice: Excessive wear of the blocking ring or the speed gear cone surface will cause shift block-out gear clash.


YAD5B1S0

14. Check for gear clash on the synchronizer sleeve teeth or the clutch teeth on the speed gear.
15. Check the synchronizer sleeve and gear clutch tooth for hop-out.

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SECTION 5C

CLUTCH

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

Specifications 5C-2

General Specifications 5C-2

Fastener Tightening Specifications 5C-2

Component Locator 5C-3

Clutch Assembly 5C-3

Pedal and Master Cylinder 5C-4

Maintenance and Repair 5C-5

On-Vehicle Service 5C-5

Bleeding of Clutch System 5C-5

Clutch Disc 5C-6

Master Cylinder 5C-10

Clutch Pedal 5C-12

Clutch Oil Chamber 5C-14

Diagnosis 5C-15

Clutch Slips 5C-15

Poor Disengagement 5C-15

Hard to Shift or Will not Shift 5C-15

Clutch Chatters When Starting 5C-15

Difficult Pedal Operation 5C-16

Clutch Noisy 5C-16

Special Tools and Equipment 5C-17

Special Tools Table 5C-17

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تلفن و فاکس: ۰۲۱-۸۸۸۶۲۰۸۵

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SPECIFICATIONS

GENERAL SPECIFICATIONS

Application			Description
Type			Hydraulic
Clutch Pedal	Type		Suspended
	Max. Pedal Stroke		158 mm
	Pedal Free Play		5 - 10 mm
Clutch Dise	Type		Single Dry Diaphragm
	Thickness of Disc	Free	9.85 - 10.2 mm
		With Load	9.2 mm
Clutch Master Cylinder	Stroke		19.8 mm
	Inner Diameter		ϕ15.87 mm
Clutch Release Cylinder	Stroke		14.0 mm
	Inner Diameter		ϕ17.46 mm
Clutch Fluid			SAE J1703 / DOT3

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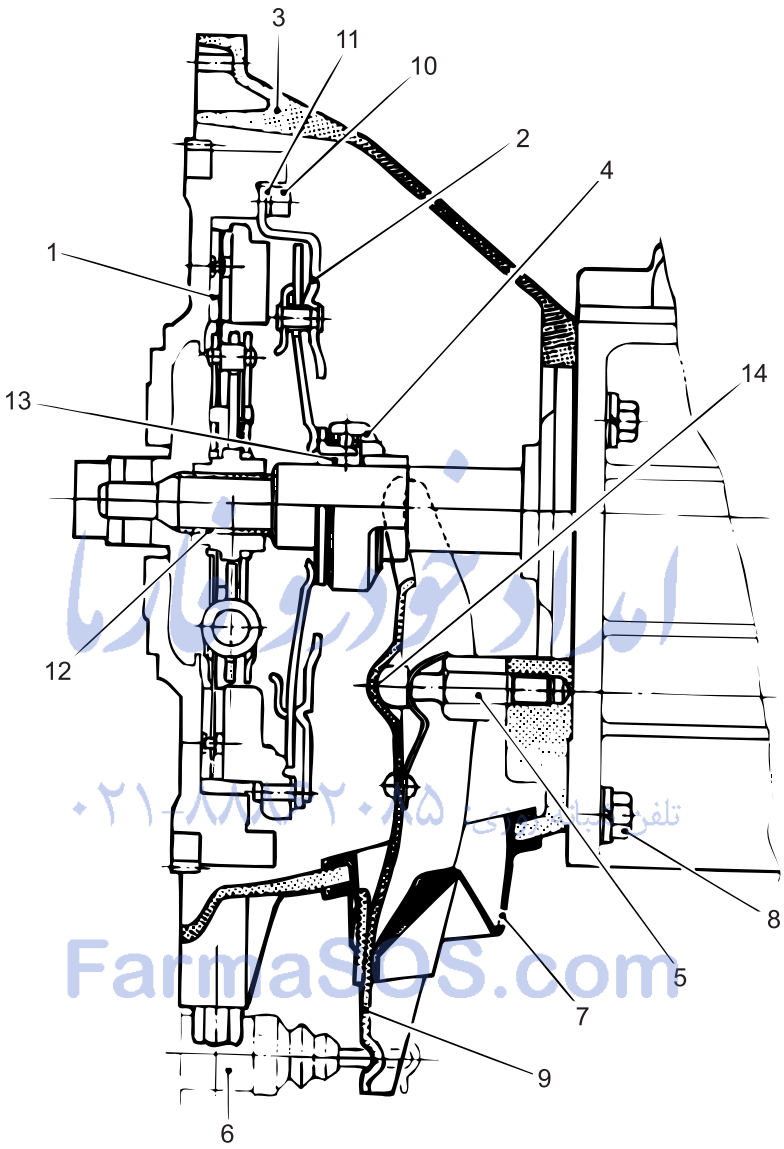
FASTENER TIGHTENING SPECIFICATIONS

Application		N•m	Lb-Ft	Lb-In
Clutch Cover Bolt		24	17.7	212.4
Clutch Housing Bolt		54	39.8	477.9
Clutch Release Cylinder		30 - 40	22.1 - 29.5	265.5 - 354.0
Master Cylinder Nut		8 - 18	8.9 - 13.2	70.8 - 159.3
Clutch Tube Nut		15 - 18	11.0 - 13.2	132.7 - 159.3
Pedal Push Rod Nut		16 - 22	11.8 - 16.2	141.6 - 194.7
Pedal Mounting	Bracket Bolt	8 - 18	8.9 - 13.2	70.8 - 159.3
	Stopper Bolt	21 - 25	15.4 - 18.4	185.8 - 221.2
T/M Case Bolt		74	54.5	654.9

۰۲۱-۸۸۸۶۲۰۸۵ تلفن شبانه روزی
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COMPONENT LOCATOR

CLUTCH ASSEMBLY

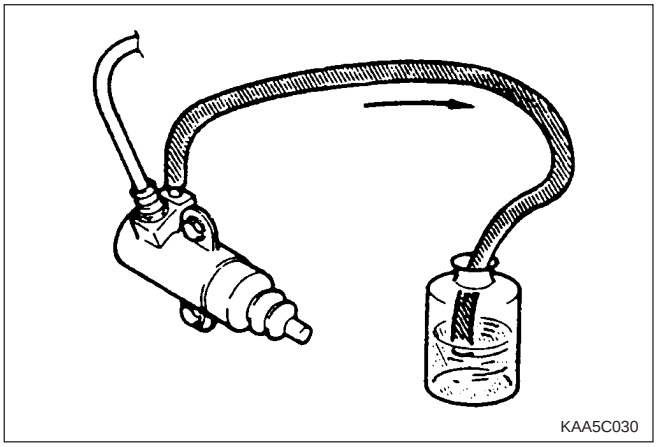


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1 Clutch Disc
2 Clutch Cover
3 Clutch Housing
4 Release Bearing
5 Release Fork Pivot
6 Release Cylinder
7 Release Fork Boot
8 Bolt
9 Release Fork
10 Bolt
11 Spring Lock Washer
12 Transmission Input Spline
13 Release Bearing Contacting Surface
14 Contacting Point of Release Fork and Pivot

Notice: Apply the long-term grease (DBL 6811.00) to No.12,13 and 14.

MAINTENANCE AND REPAIR


KAA5C030

ON-VEHICLE SERVICE

BLEEDING OF CLUTCH SYSTEM

Bleeding procedure

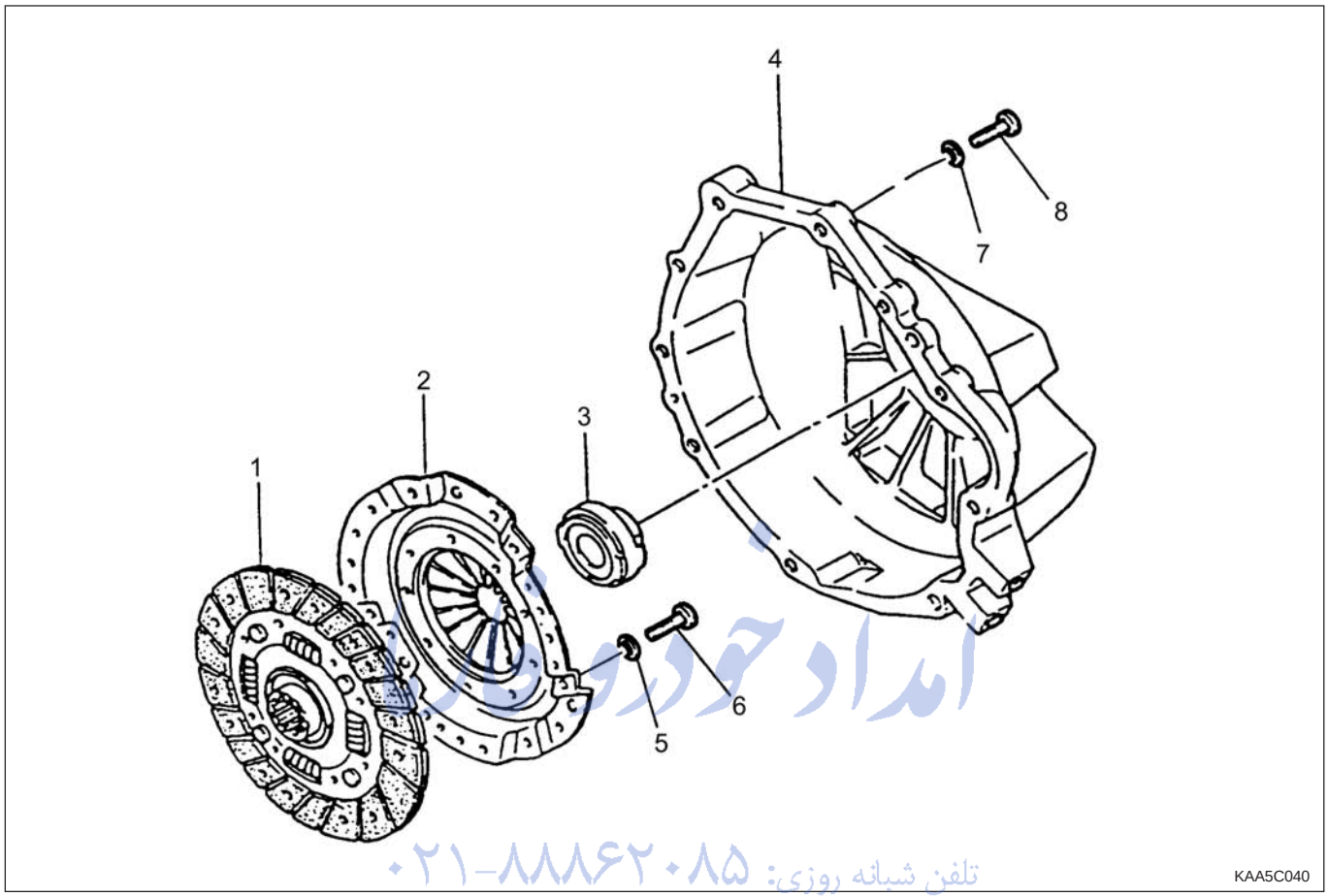
Notice: Keep the fluid level over 'MAX' in reservoir during bleeding operation.
Do not let fluid contact a painted surface.

1. Remove the air bolt cap of the release cylinder.
   Connect a vinyl tube to the bolt.
2. Insert the other end of the tube in a vacant container.
3. Slowly depress the clutch pedal several times.
4. With clutch pedal fully depressed, open the air bolt and release air rind fluid in the fluid line,
5. Repeat this procedure until there are no more air bubbles in the fluid flows.

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CLUTCH DISC

Preceding Work : Removal of the transmission

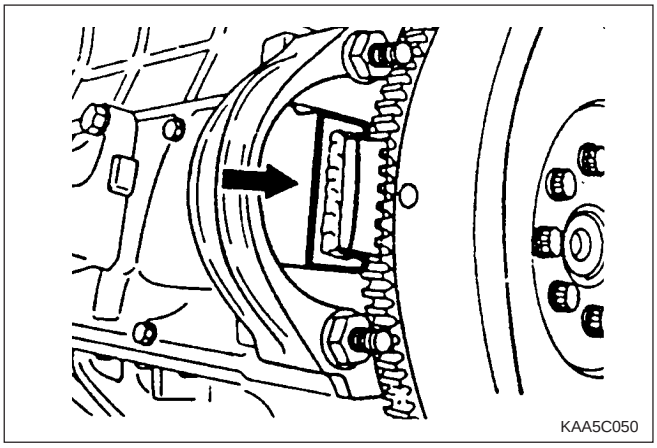


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1 Clutch Disc
2 Clutch Cover Assembly
3 Release Bearing
4 Clutch Housing
5 Washer
6 Bolt ..... 23 N•m (17 lb-ft)
7 Washer
8 Bolt ..... 54 N•m (40 lb-ft)

Tools

602 589 00 40 00 Engine Lock
661 589 00 15 00 Centering Pin

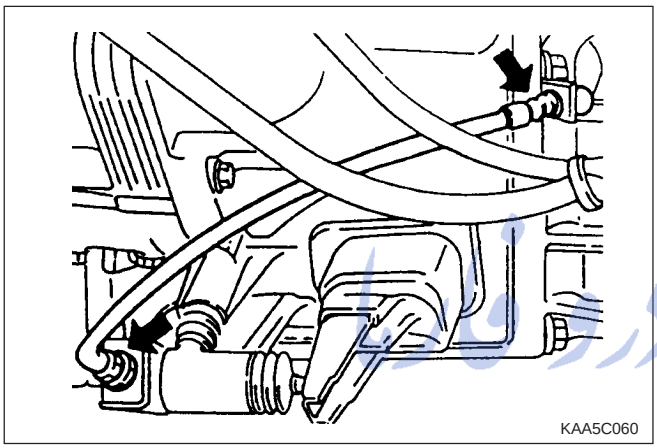

KAA5C050

Removal & Installation Procedure

Tools Required

602589 00 40 00 Engine Lock

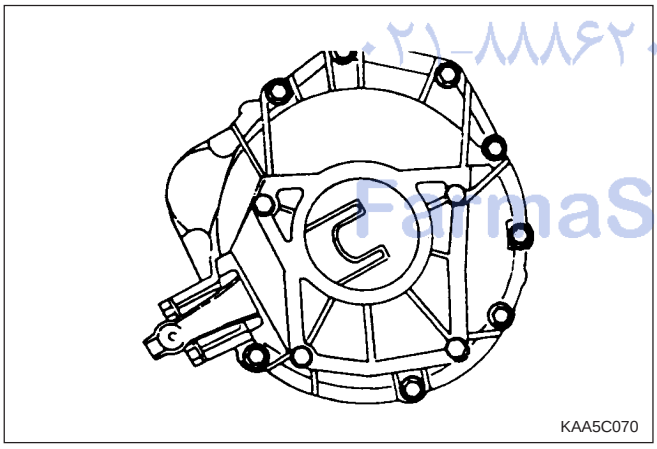
1. Remove the starter motor. Install the special tool to the flywheel through the starter motor mounting holes.


KAA5C060

2. Unscren the release cylinder mounting bolts and remove the release cylinder.

Installation Notice

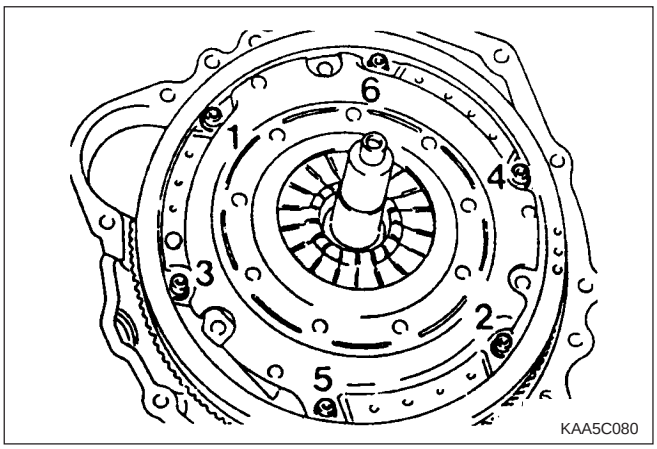
Tightening Torque	15 - 18 N•m (11 - 13 lb-ft)


KAA5C070

3. Unscrew the clutch housing bolts and remove the clutch housing, release fork and release bearing.

Installation Notice

Tightening Torque	54 N•m (40 lb-ft)



KAA5C080

4. Insert the centering pin into the clutch spline.

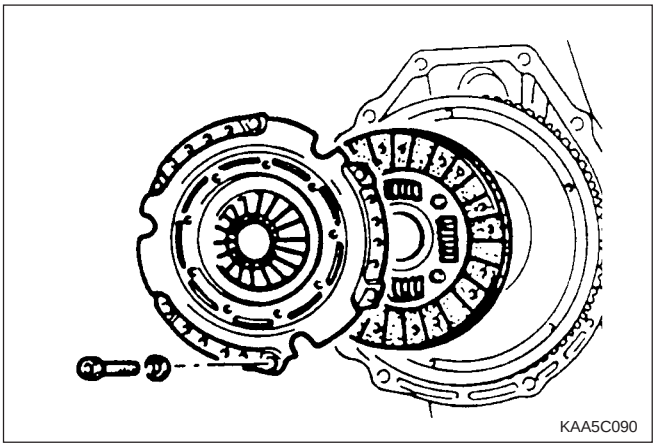
   Loosen the clutch cover bolts 1/2 turn in crisscross sequence until the spring tension is released.

   Notice: Do not remove the bolts at a time, or clutchcover can be damaged or deformed.

Tools Required

Centering Pin 661 589 00 15 00

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KAA5C090

5. Unscrew the bolts and remove the clutch cover, pressure plate and clutch disc.

   Notice: Be careful not to drop the pressure plate and clutch disc.

Installation Notice

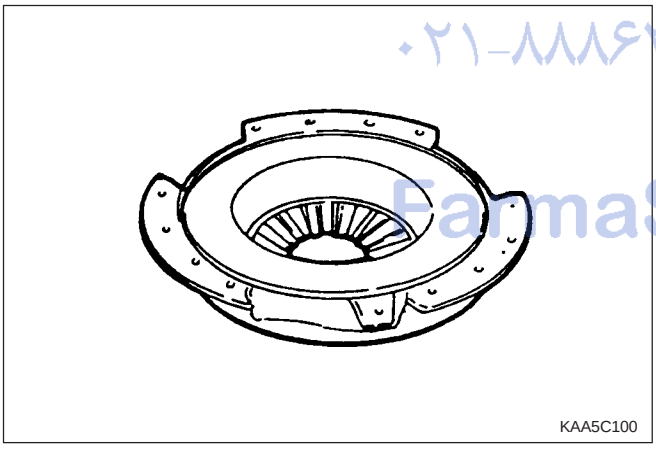
Tightening Torque	21 - 27 N•m (15 - 20 lb-ft)

6. Installation should follow the removal procedure in the reverse order.

   Notice:

   - Before installation, clean oil and grease on the flywheel surface.
   - Do not clean the clutch disc and release bearing in solvent.

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KAA5C100

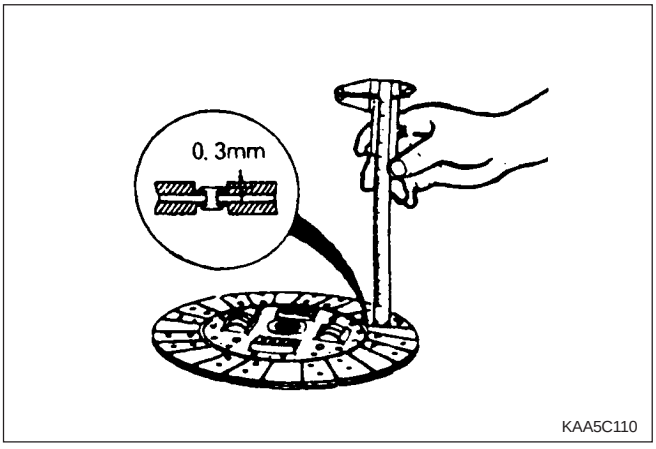
Inspection Procedure

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1. Clutch Cover
   - Check the diaphragm spring tip for wear and height unevenness.

Unevenness Limit	0.8 mm

   - Check the pressure plate surface for wear, crack and discoloration.
   - Check the strap plate rivet for looseness and replace the clutch cover if loosened.

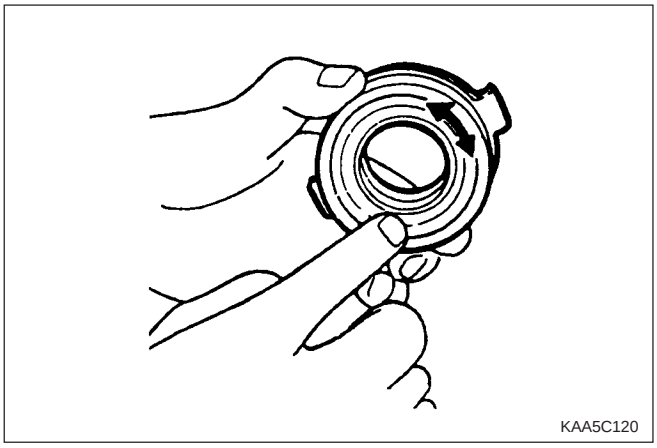


KAA5C110

2. Clutch Disc
   - Check the facing for rivet looseness, excessive runout, sticks, oil and grease.
   - Measure the rivet head depth.

     If out limit, replace the disc.

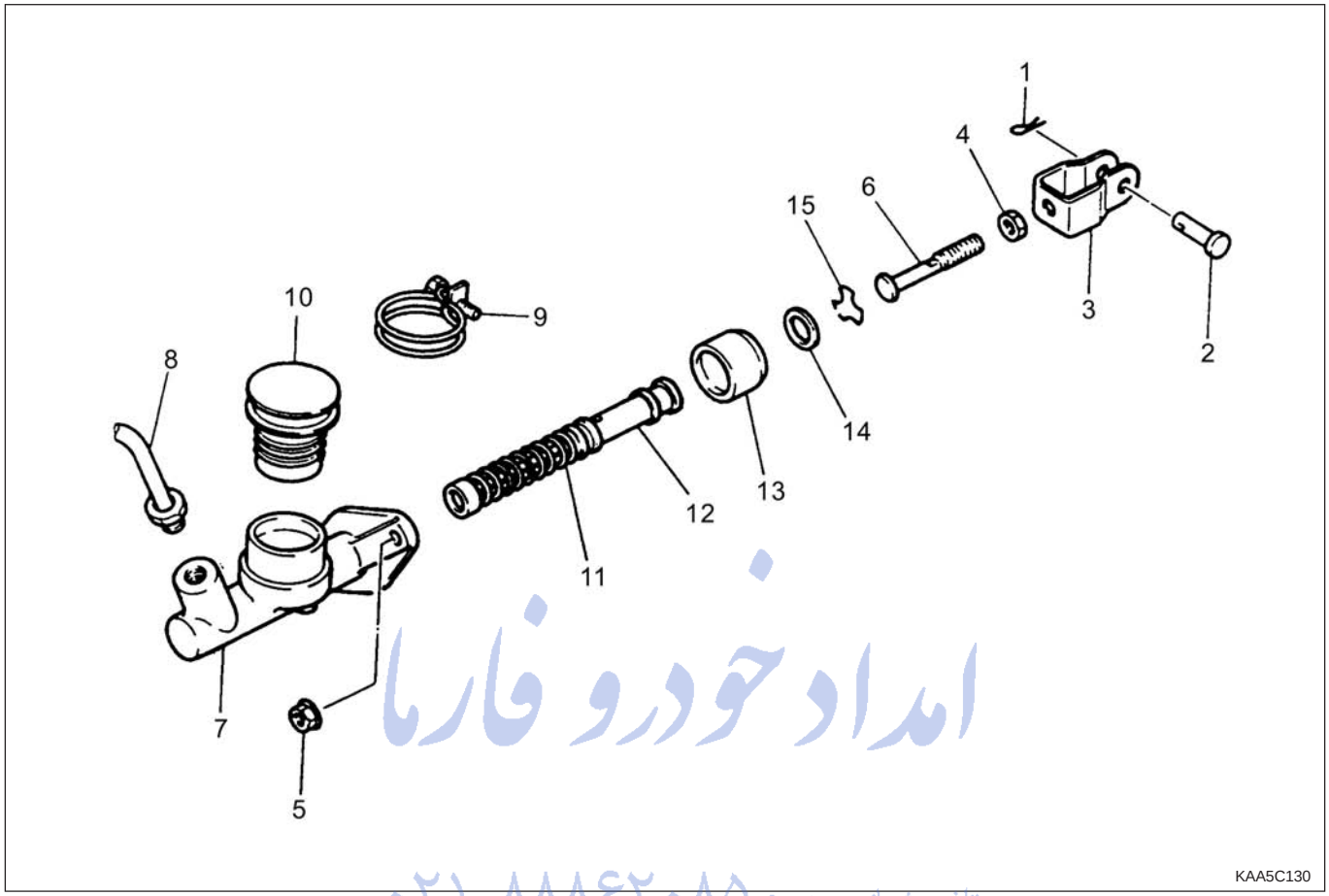
Wear Limit	0.3 mm


KAA5C120

3. Clutch Release Bearing
   - The release bearing is permanently lubricated and requires no cleaning.
   - Check the bearing for sticks, damage, abnormal noise, turning drag and wear.
4. Release Fork
   - If there is abnormal wear in contact point with bearing, replace the release fork.

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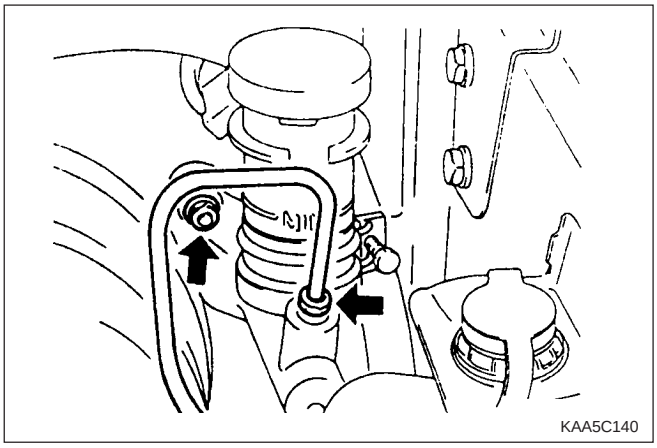
MASTER CYLINDER



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1 Snap Pin
2 Clevis Pin
3 Clevis
4 Lock Nut
5 Flange Nut ..... 8 - 18 N•m (6 - 13 lb-ft)
6 Push Rod
7 Cylinder Body
8 Oil Pipe ..... 15 - 18 N•m (11 - 13 lb-ft)
9 Clamp
10 Reservoir
11 Spring
12 Piston Assembly
13 Boot
14 Plate
15 Snap Ring

Notice: Do not disassemble the No. 12.


KAA5C140

Removal & Installation Procedure

1. Draw out the fluid.
2. Pull out the snap pin and clevis pin from the clutch pedal connection.
3. Remove the clutch tube.

Installation Notice

Tightening Torque	15 - 18 N•m (11 - 13 lb-ft)

Notice: Be careful not the fluid contact a painted surface.

4. Remove the master cylinder mounting nuts and pull off the master cylinder.

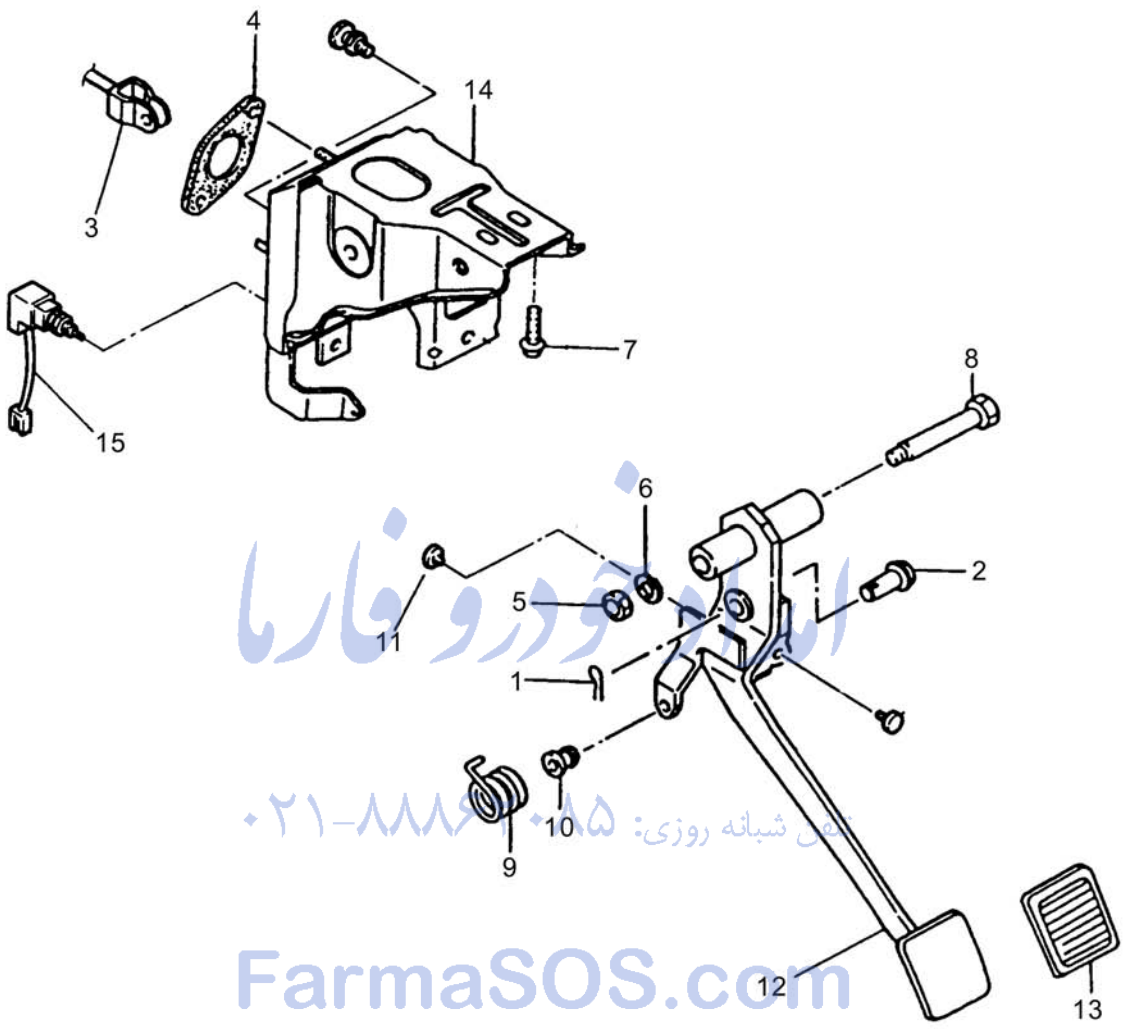
Installation Notice

Tightening Torque	8 - 18 N•m (6 - 13 lb-ft)

5. Check the clutch pedal operation.
6. Bleed the clutch system.

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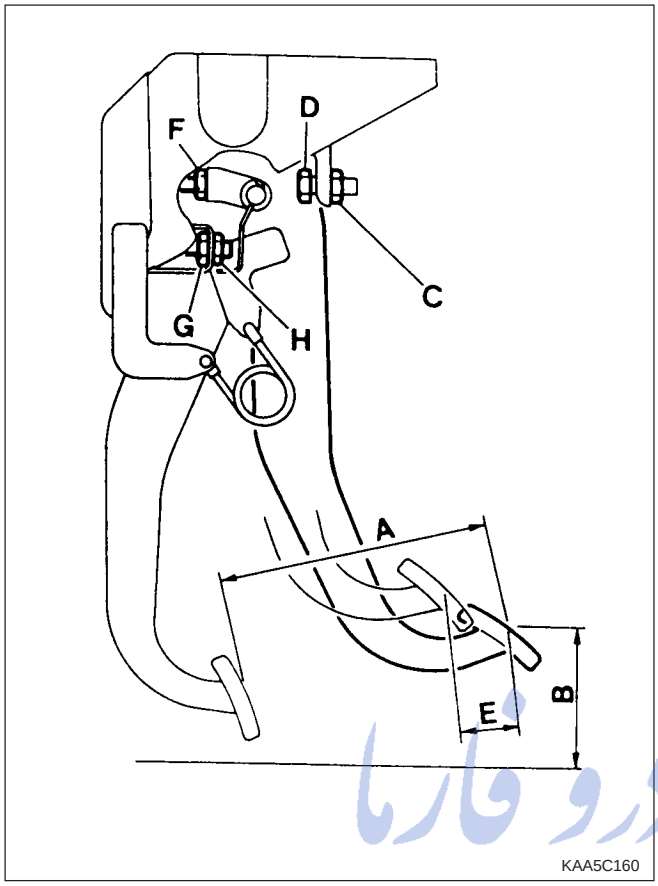
CLUTCH PEDAL



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1 Snap Pin ..... Replace
2 Clevis Pin ..... Apply Grease
3 Master Cylinder Push Rod
4 Gasket
5 Nut ..... 16 - 32 N•m (12 - 24 lb-ft)
6 Spring Washer
7 Bolt ..... 8 - 18 N•m (6 - 13 lb-ft)
8 Fulcrum Pin
9 Turn Over Spring ..... Apply Grease
10 Bushing ..... Replace, Apply Grease
11 Full Stroke Stopper Contact Pad
12 Clutch Pedal
13 Pedal Pad
14 Pedal Mounting Bracket
15 Clutch Interlock Switch

Notice: Assembly should follow the disassembly procedure in the reverse order.
Grease specification: Long - term grease (T/Mn DBL6611.00)



KAA5C160

Inspection Procedure

1. Pedal Stroke (A).

   Installation Notice

Max. Stroke	158 mm

   Notice: To adjust the pedal stroke, loosen the lock nut (H) of the interlock switch (G) and turn the two lock auto until the stroke is correct.

2. Pedal Height (B).

   Installation Notice

Height (From the Floor Carpet)	147 - 187 mm

   Notice: To adjust the pedal height, loosen the lock nut (C) of the stopper bolt (D) and turn the stopper bolt until the height is correct.

3. Pedal Free Play (E).

   Installation Notice

Free Play	5 - 10 mm

   Notice: To adjust the pedal free play, loosen the lock nut (F) of the master cylinder and turn the push rod until the free play is correct.

4. Check the fulcrum pin and the bushing for wear, the pedal for bending and the spring for damage.

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DIAGNOSIS

CLUTCH SLIPS

Checks	Action
Excessive Wear of Facing	Replace
Hard or Oily Facing	Repair or Replace
Damaged Pressure Plate or Flywheel	Replace
Damaged or Burnt Diaphragm Spring	Replace
Clutch Pedal Free play Insufficient	Adjust
Faulty Operation of Clutch Pedal	Repair or Replace
Worn or Damaged Clutch Disc	Replace

POOR DISENGAGEMENT

Checks	Action
Vibration or Excessive Run-out of Disc	Replace
Rust or Wear of Disc Spline	Repair or Replace
Oily Facing	Repair or Replace
Damaged Diaphragm Spring	Replace
Excessive Clutch Pedal Free play	Adjust

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HARD TO SHIFT OR WILL NOT SHIFT

Checks	Action
Excessive Clutch Pedal Free play	Adjust Pedal Freeplay
Faulty Clutch Release Cylinder	Repair Release Cylinder
Worn Disc, Excessive Run-out, Damaged Lining	Repair or Replace
Dirty or Burred Splines on Input Shaft or Clutch Disc	Repair as Necessary
Damaged Clutch Pressure Plate	Replace

CLUTCH CHATTERS WHEN STARTING

Checks	Action
Oily Facing	Repair or Replace
Hard or Faulty Facing	Replace
Burnt Torsion Spring	Replace
Faulty Pressure Plate	Replace
Bent Clutch Diaphragm Spring	Replace
Hard or Bent Flywheel	Repair or Replace
Engine Mounts Loose or Burnt Lever	Tighten or Replace

DIFFICULT PEDAL OPERATION

Checks	Action
Poor Lubrication on Clutch Cable	Lubricate or Replace
Poor Lubrication on Pedal Shaft	Lubricate or Replace
Poor Lubrication on Clutch Pedal	Repair

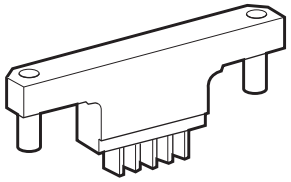
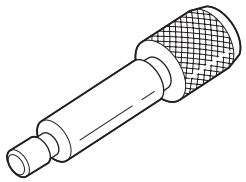
CLUTCH NOISY

Checks		Action
Not Using the Clutch	Insufficient Clutch Pedal Free play	Adjust
	Excessive Wear of Facing	Replace
After Disengagement	Worn or Damaged Release Bearing	Replace
When Disengaging	Poor Lubrication Contact Surface of Bearing	Replace
	Faulty Installation of Clutch Assembly or Bearing	Repair
Clutch Pedal is Partially Depressed and Vehicle Speed is Reduced	Damaged Pilot Bushing	Replace

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SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS TABLE

 KAA5C180	**602 589 00 40 00** **Engine Lock**
 KAA5C190	**661 589 00 15 00** **Centering Pin**

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SECTION 5D1

TRANSFER CASE (TOD)

***CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless other-wise* noted.**

TABLE OF CONTENTS

Description and Operation 5D1-2

Torque on Demand (TOD) System Transfer Case 5D1-2

Transfer Case Control Unit (TCCU) 5D1-2

TCCU Coding 5D1-2

Pin Description 5D1-3

Components of the TOD Transfer Case System .. 5D1-4

Definition of Terminology 5D1-4

Operation of the TOD Transfer Case System 5D1-4

Component Locator 5D1-7

Torque on Demand (TOD) Type Transfer Case 5D1-7

Transfer Case Disassembled View 5D1-8

TOD Control Unit 5D1-10

Diagnosis 5D1-11

Self-Diagnostic Tests 5D1-11

Diagnostic Trouble Codes (DTCs) 5D1-12

Clearing Diagnostic Trouble Codes 5D1-12

4WD Check Indicator Stays on with Ignition Switch ON 5D1-14

4WD Low Indicator Stays on with Ignition Switch ON 5D1-16

No 4WD Check or 4WD Low Indicator with Ignition Switch ON 5D1-18

4WD Low Indicator Blink Steadily 5D1-20

TCCU Diagnostic System Check 5D1-21

DTC 1714 Eeprom Checksum Fault 5D1-22

DTC 1715 Tp Sensor Loss of Signal 5D1-24

DTC 1716 Tp Sensor Out of Range 5D1-26

DTC 1721 Electromagnetic Clutch Open / Short to Battery 5D1-28

DTC 1722 Electromagnetic Clutch Short to Ground 5D1-32

DTC 1731 Front Speed Sensor Voltage Low 5D1-36

DTC 1732 Front Speed Sensor Voltage High 5D1-38

DTC 1733 Rear Speed Sensor Voltage Low 5D1-40

DTC 1734 Rear Speed Sensor Voltage High 5D1-42

DTC 1735 Speed Sensor Reference Voltage Low 5D1-44

DTC 1736 Speed Sensor Reference Voltage High 5D1-46

DTC 1741 Motor Output Open / Shorted to Battery 5D1-48

DTC 1742 Motor Output Shorted to Ground 5D1-52

DTC 1743 Shift System Timeout 5D1-55

DTC 1750 General Position Encoder Fault (Invalid Code) 5D1-56

DTC 1751 Position 1 Shorted to Ground 5D1-58

DTC 1752 Position 2 Shorted to Ground 5D1-60

DTC 1753 Position 3 Shorted to Ground 5D1-62

DTC 1754 Position 4 Shorted to Ground 5D1-64

Repair Instructions 5D1-66

On-Vehicle Service 5D1-66

Oil Replacement 5D1-66

Transfer Case Control Unit (TCCU) 5D1-67

Transfer Case 5D1-67

Shift Motor 5D1-69

Front and Rear Propeller Shaft Speed Sensor ... 5D1-70

Unit Repair 5D1-71

Transfer Case Overhaul 5D1-71

Specifications 5D1-79

General Specification 5D1-79

TCCU Electric Characteristics 5D1-79

Fastener Tightening Specifications 5D1-79

Schematic and Routing Diagram 5D1-80

TOD Transfer Case Control Unit (TCCU) 5D1-80

Special Tools and Equipment 5D1-82

Special Tool Table 5D1-82

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۰۲۱-۸۸۶۲۰۸۵ تلفن شبانه روزی
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PIN DESCRIPTION

Pin No.	Description
A1	Shift motor output (- High to low: Battery voltage/ - Low to high or motor brake : Ground)
A2	Shift motor output (- Low to high: Battery voltage/ - High to Low or motor brake : Ground)
A3	TOD output: Electromagnetic clutch control
A4	B (+) : Fuse F17
A5	Ignition Voltage: Fuse F23
A6	Shift motor output (- High to low: Battery voltage/ - Low to high or motor brake : Ground)
A7	Shift motor output (- Low to high: Battery voltage/ - High to Low or motor brake : Ground)
A8	Reference voltage (5V) supply to Throttle Position (TP) sensor and speed sensor
A9	Ground
A10	Ground
A11	B (+) : Fuse F17
A12	Diagnosis (K-line)
B1	Position encoder ground
B2	Illuminate 4WD CHECK lamp
B3	Not in used
B4	Mode (4H/4L) input
B5	Position encoder 2 input
B6	Front propeller shaft speed sensor input
B7	Not in used
B8	Speed sensor ground. Throttle position (TP) sensor return
B9	Illuminate 4WD LOW indicator
B10	CAN bus high line
B11	CAN bus low line
B12	Neutral position sensor signal input (A/T only)
B13	ABS operation signal (ON/OFF)
B14	Brake switch signal input
B15	Position encoder 1 input
B16	Position encoder 3 input
B17	Rear propeller shaft speed sensor signal input
B18	Position encoder 4 input

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COMPONENTS OF THE TOD TRANSFER CASE SYSTEM

Shift Motor

It locates backside transfer case, which drives rotary helical cam. When mode select switch changes to 4L, shift fork is on position for 2.48 : 1 by rotation of helical cam.

Rear Speed Sensor

A hall effect speed sensor which produces a square wave. 0 to 5 volts direct current signal in response to a rotating 30-tooth wheel coupled to the rear propeller shaft inside the transfer case. Each rotation of the rear propeller shaft will result in 30 speed sensor pulse.

Front Speed Sensor

A hall effect speed sensor which produces a square wave. 0 to 5 volts direct current signal in response to a rotating 30-tooth wheel coupled to the front propeller shaft inside the transfer case. Each rotation of the front propeller shaft will result in 30 speed sensor pulse.

Electro-Magnetic Clutch

An electromagnetic clutch used to control the amount of torque applied to the front propeller shaft.

Position Encoder

A set of 4 gray code switches which provide feedback to the TCCU indicating the position of the shift motor.

Clutch Pedal Position Switch

A switch on vehicles equipped with a manual transmission which indicates that the clutch pedal is depressed

Park/Neutral Position Switch

A switch on vehicles equipped with an automatic transmission which indicates that the transmission is in neutral.

4H/4L Switch

A switch selects the desired gear ratio.

DEFINITION OF TERMINOLOGY

Shift Inhibit Speed

The vehicle speed limit, which transfer case shifts, is disallowed. Vehicle speed is indicated by propeller shaft speed measurement.

Duty Cycle

Duty cycle is the time the electromagnetic clutch is on divided by the period in which it is being modulated.

Touch-off

A minimum amount of duty cycle applied to the electro magnetic clutch.

Front Overrun

A condition where the front propeller shaft is turning at a rate which is faster than the rear propeller shaft.

Rear Overrun

A condition where the rear propeller shaft is turning at a rate which is faster than the front propeller shaft.

High Range

The highest (numerically lowest = 1 : 1) gear ratio between the input and outputs of the transfer case.

Low Range

The lowest (numerically highest = 2.48 : 1) gear ratio between the input and outputs of the transfer case.

OPERATION OF THE TOD TRANSFER CASE SYSTEM

Initial Operation of TOD Control Unit

When ignition switch is turned to ON, 4WD LOW and 4WD CHECK lamp illuminates for 0.6 second to check bulb in instrument panel, then perform diagnosis of system. Refer to “Self-Diagnosis Test” in this section.

Electric Shift System Operation

The electric shift system is responsible for changing the transfer case gear ratio by controlling the electric shift motor. The TCCU monitors the 4H/4L switch, park/neutral position switch, speed sensors, position encoder, and ignition switch.

A range change is initiated when:

- The 4H/4L switch is changed from 4H to 4L or from 4L to 4H.
- The motor position (as indicated by the position encoder) does not match the 4H/4L switch immediately after the ignition is turned on.

Shift Criteria

When a range change is initiated a diagnostic test will be completed on the motor, speed sensors, and position encoder. If the diagnostic test fails, the shift will not be attempted. If all components are operating properly, the TCCU will attempt a range change after the following shift criteria are met:

- The transmission is in neutral for 2 seconds after the shift is requested.
- Both propeller shaft speeds are below 87 rpm (2580 pulses/minute). If the transmission is taken out of neutral before 2 seconds has passed, or either propeller shaft speed increases above the limit, the shift will be suspended and the 4L indicator will continue to blink until the criteria are met again or the 4H/4L switch is returned to the original position.

Range Change

When the shift criteria are met, the motor is rotated in the appropriate direction (as determined by the selector switch) until one of the following occurs:

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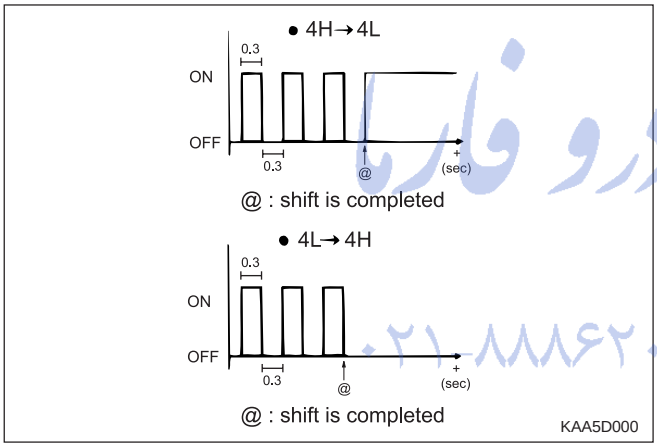
- The motor reaches its destination.
- The motor is on for 5 seconds without reaching its destination. The shift has failed and the TCCU will respond as default mode.
- A fault occurs with either the motor or position encoder. Refer to the diagnosis requirement.

When the motor is energized, the Ignition, 4H/4L switch, propeller shaft speeds, and transmission neutral inputs are ignored.

Indicator Function

Once a range change has been initiated the 4WD LOW indicator will begin to blink at a rate of 0.3 seconds on, 0.3 seconds off until the shift is completed or canceled. If a successful shift has been completed, the 4WD LOW indicator will be illuminated if the motor is in low range and it will be turned off if the motor is in high range.

4WD LOW indicator illuminates as below figure.



TOD™ System Operation

The TOD™ System is responsible for distributing torque between the front and rear axles. The TCCU monitors the propeller shaft speeds, operating range (high/low), and ABS activity and then applies a calculated amount of torque to the front axle by pulse width modulating (PWM) the current applied to the electromagnetic clutch (EMC).

Touch-off Torque

The minimum EMC duty cycle is based on the vehicle speed and throttle position. The TCCU receives the throttle position (TP) sensor signal from the engine con trol module (ECM) through CAN bus line.

Wheel Slip Detection and Control

The TCCU continuously monitors the front and rear propeller shaft speeds to detect wheel slip.

When wheel slip is detected the TCCU controls the EMC duty cycles as necessary until the wheel slip is reduced below the allowable limit. The EMC duty cycle will then be reduced to the touch-off value.

Brake/ABS Strategy

When the ABS System is active, the EMC duty cycle is set to a fixed duty cycle (30%) to aid in braking without counteracting the ABS System.

4L Strategy

When the system is operating in 4WD low range, the TCCU continues TOD™ operation provided that the pro peller shaft speed is below 175 rpm (5220 pulses/minute). When the speed increases above 175 rpm, the EMC duty cycle is set to the maximum value (88 %) which applies the maximum available torque to the front axle.

Position Encoder

The position encoder is used by the TCCU to determine the position of the shift motor. Each motor position is identified by a position code as shown.

Position code 1/2/3/4	Motor Position
1111	Left Stop
1010	Left of High
0010	High
0000	Right of High
1110	Zone 1
1001	Neutral
0001	Zone 2
0101	Low
0100	Right Stop

Notice:

- All other position codes are invalid
- Position input : open circuit (> 4.5V) = 1
- Position input : Shorted to speed/position return (< 0.5V) = 0

Position Sensor Interpretation

1. When the module powers up, it will read the position sensor and the 4H/4L switch input and respond to the possible codes as following tables.
2. A command to shift will only be acted upon if the TCCU is reading a valid code at the time the command to shift is made.
3. After a shift has started, the TCCU will power the shift motor until the code for the requested position is read. If an invalid code is read, the TCCU will go into a default mode.
4. During a shift attempt, the shift motor will be energized for a maximum of 5 second

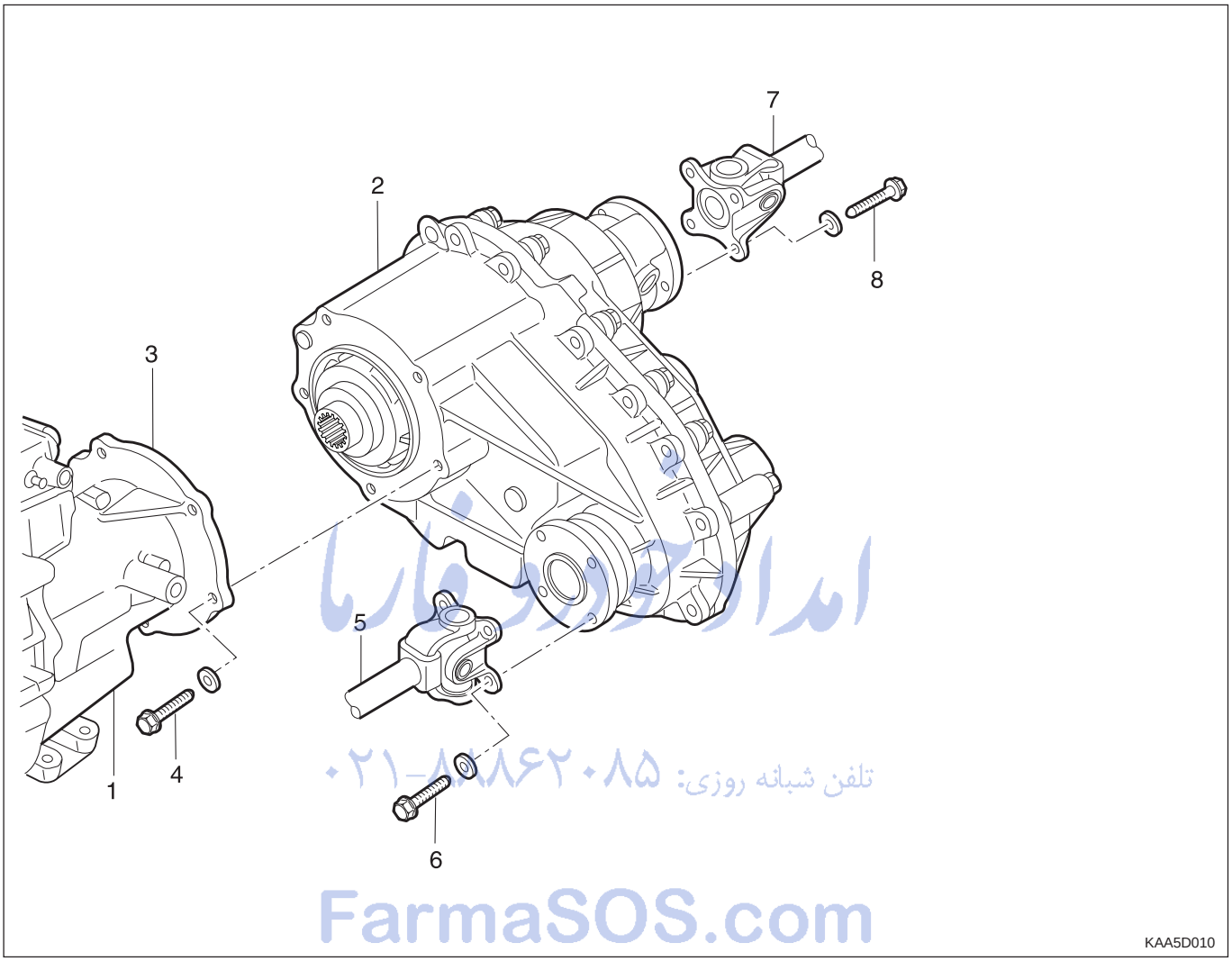
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4H/4L Switch Input	Motor Position	Action
4H	Left Stop	No action required. 4WD LOW indicator off.
4H	Left of High	
4H	High	
4H	Right of High	Blink 4WD LOW indicator. After the shift conditions are input, attempt a shift to 4H mode if following conditions are maintained for 2 seconds conditions are maintained for 2 seconds. • Shift lever position is in neutral. • The speed of front and rear propeller shaft is below 87 rpm. After successfully shifting into 4L mode, stop blinking 4WD LOW indicator.
4H	Zone 1	
4H	Neutral	
4H	Zone 2	
4H	Low	
4H	Right Stop	
4H	Left Stop	Blink 4WD LOW indicator. After the shift conditions are input, attempt a shift to 4L mode if following conditions are maintained for 2 conditions are maintained for 2 seconds. • Shift lever position is in neutral. • The speed of front and rear propeller shaft is below 87 rpm. After successfully shifting into 4L mode, stop blinking 4WD LOW indicator.
4H	Left of High	
4H	High	
4H	Right to High	
4H	Zone 1	
4H	Neutral	
4H	Zone 2	
4H	Low	No action required. 4WD LOW indicator on.
4H	Right stop	

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COMPONENT LOCATOR

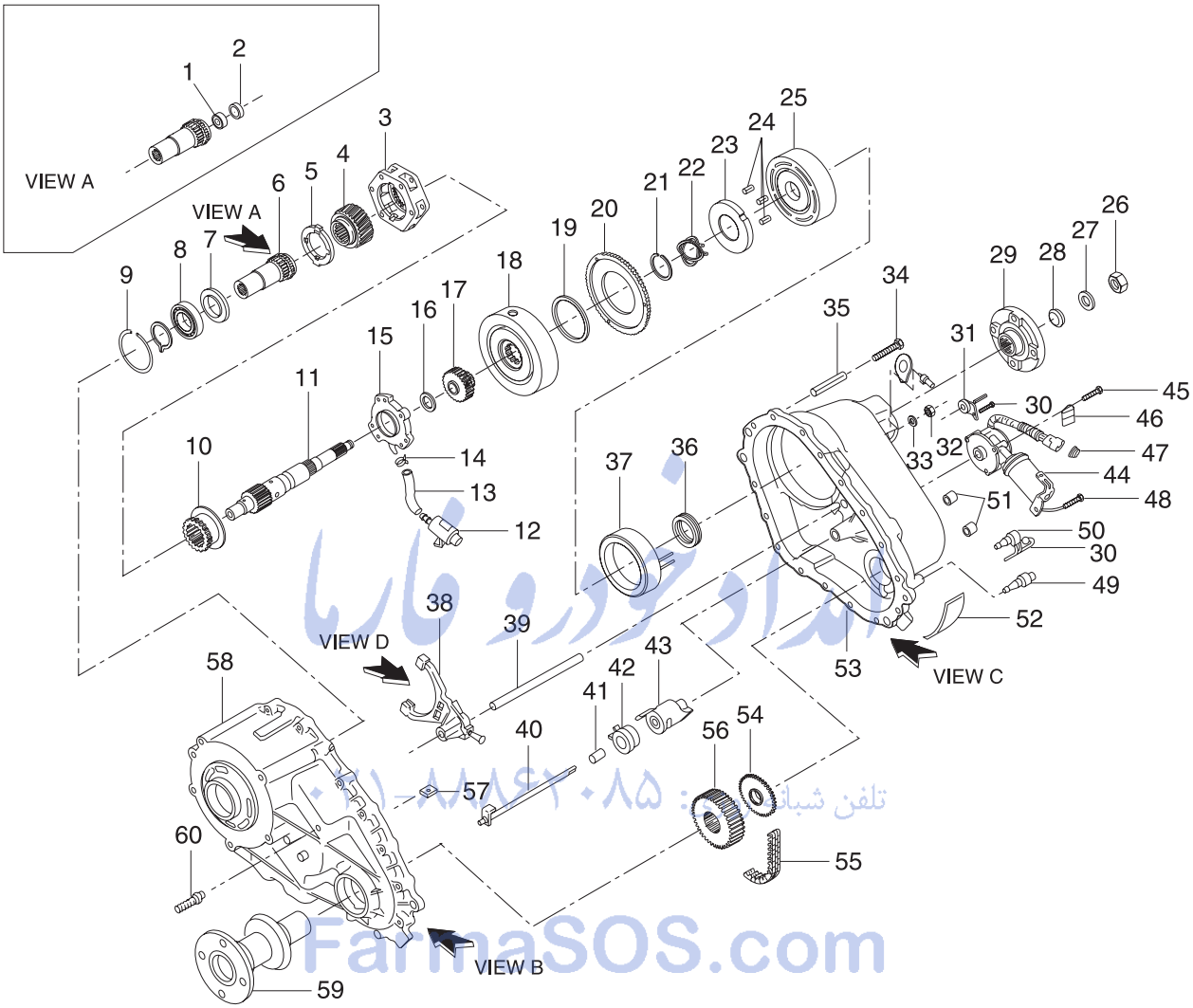
TORQUE ON DEMAND (TOD) TYPE TRANSFER CASE



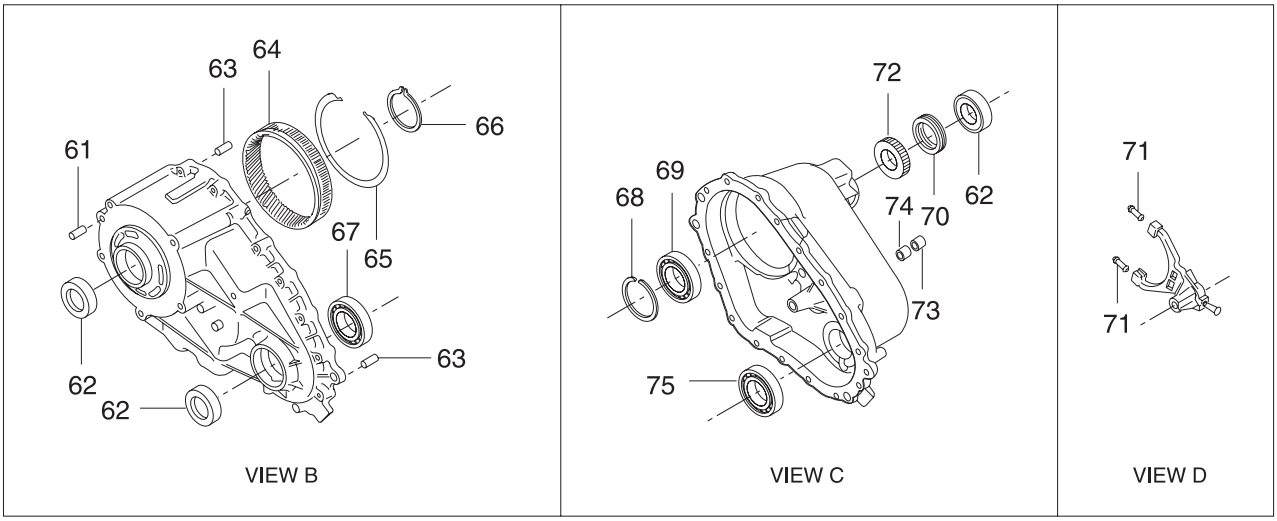
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1 Transmission
2 Transfer Case
3 Rear Propeller Shaft
4 Bolt
5 Bolt
6 Front Propeller Shaft
7 Bolt

TRANSFER CASE DISASSEMBLED VIEW



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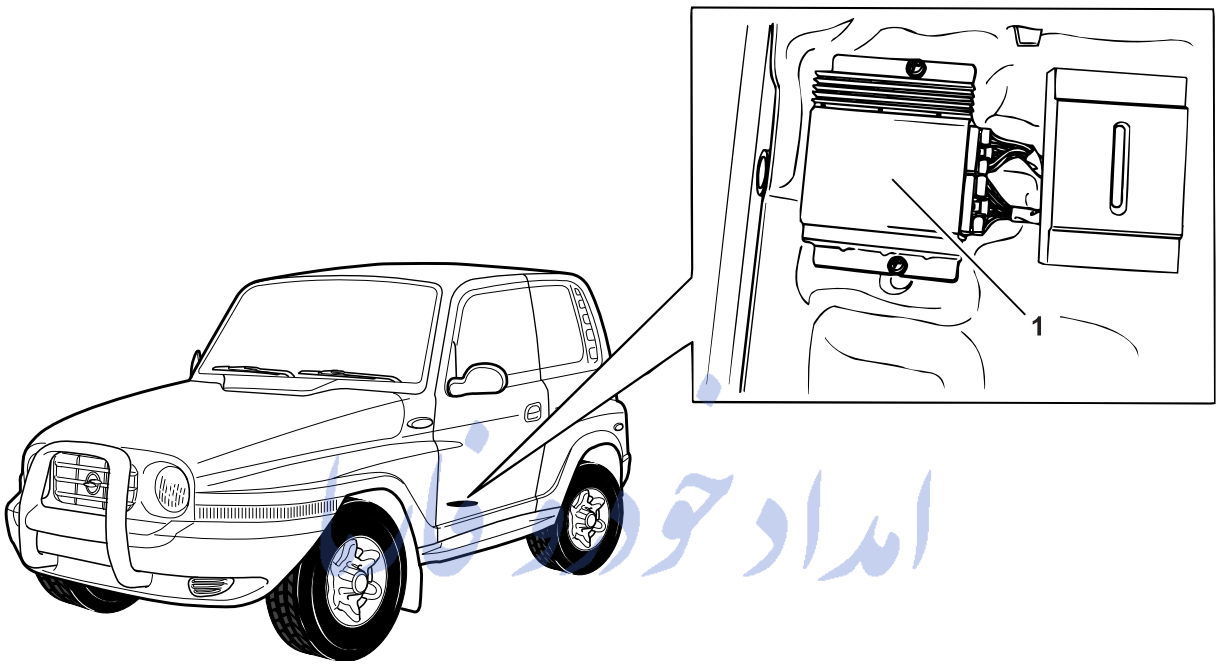


KAA5D020

1 Bearing
2 Bushing
3 Carrier Assembly
4 Sun Gear
5 Thrust Plate
6 Input Shaft
7 Output Shaft Thrust Washer
8 Bearing
9 Snap Ring
10 High-Low Collar
11 Rear Output Shaft
12 Oil Strainer
13 Coupling Hose
14 Hose Clamp
15 Pump Assembly
16 Thrust Washer
17 Sprocket, Drive (214t)
18 lutch Pack Assembly
19 Insulator Washer
20 Armature
21 Snap Ring
22 Wave Washer
23 Apply Cam
24 Ball
25 Cam And Coil Assembly
26 Nut, Metric (2)
27 Output Shaft Yoke Washer
28 Oil Seal
29 Case Flange
30 Bolt
31 Upper Speed Sensor (Rear)
32 Nut
33 Washer
34 Bolt (M10 X 1.5 X 30)
35 Tag, Identification
36 Thrust Bearing
37 Clutch Coil Assembly
38 Fork, Reduction Shift
39 Shift Rail
40 Shaft, Shift
41 Spacer
42 Torsion Spring
43 Spring, Electric Shift
44 Transfer Case Shift Motor
45 Bolt
46 J-Clip
47 Connector Retainer
48 Bolt
49 Support Stud
50 Lower Speed Sensor (Front)
51 Plug
52 Identification Decal
53 Case
54 Tone Wheel, Lower
55 Chain, Drive
56 Sprocket, Driven (24t)
57 Oil Pan Magnet
58 Case Flange And Output Shaft
59 Case Assembly
60 Barb, Breather
61 Spirol Pin
62 Oil Seal
63 Pin, Dowel
64 Ring Gear
65 Retaining Ring
66 Snap Ring
67 Bearing
68 Snap Ring
69 Bearing
70 Speedometer Drive Gear
71 Facing, Shift Fork
72 Upper Tone Wheel
73 Oil Seal
74 Bearing Sleeve
75 Bearing

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TOD CONTROL UNIT



KAA5D030

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1 Transfer Case Control Unit (TCCU)

DIAGNOSIS

While the transfer case control unit (TCCU) is active it periodically monitors its inputs and outputs. If a fault is detected the 4WD CHECK lamp is illuminated and a fault code is stored in the TCCU memory.

When requested, fault codes are downloaded to scan tool through a diagnostic connector (K-line) serial com munication.

SELF-DIAGNOSTIC TESTS

TCCU Internal Function

When the ignition is turned on the TCCU tests its read only memory (ROM) and random access memory (RAM). If there is a fault, the TCCU immediately resets itself and re-tests the ROM and RAM. If the fault persists the TCCU continues to reset and re-test until the fault is corrected or the ignition is turned off. All TCCU functions are inhibited until the fault is corrected. The 4WD CHECK lamp is not illuminated if there is a ROM or RAM fault.

If the ROM/RAM passes the electronically erasable programmable read only memory (EEPROM) is tested. If there is a fault the 4WD CHECK lamp is illuminated and the TCCU continues to operate using the default calibration data stored in ROM. Fault codes are not stored when there is an EEPROM fault.

An EEPROM fault can only be cleared by cycling ignition OFF-ON.

Shift Motor Assembly Test

If the TCCU detects a shift motor or position encoder fault continuously for one second the 4WD CHECK lamp is turned on and the appropriate fault code is stored in memory.

1. A shift motor fault when the motor is off is defined as follows:
   - Motor HI-LO circuits are shorted to ground.
   - Motor LO-HI circuits are shorted to ground.
   - Motor circuits are open.
2. A shift motor fault when the motor is energized is defined as follows:
   - Motor HI-LO circuits are shorted to ground.
   - Motor LO-HI circuits are shorted to ground.
   - Motor HI-LO circuits are shorted to motor LO HI circuits.
   - Motor circuits are open.
3. A position encoder fault is defined as follows:
   - Any position code which does not correspond to the valid 9 codes.
   - A short to ground on any of the encoder lines.
4. If no shifts are in progress when a failure occurs the TCCU will not respond to any shift commands.
5. If a shift command has been received but not acted upon when a failure occurred the TCCU would cancel the command and not respond to any subsequent shift commands.
6. If a shift command is in progress when an invalid position code is confirmed it will be halted and the TCCU will turn the motor toward the high position. Afterwards the TCCU will not respond to any shift commands.
7. If the shift motor or position encoder assembly failures, other than a motor failure which occurs when the motor is energized, recovers continuously for one second the TCCU will function normally. The 4WD CHECK lamp is turned off but the fault code will remain in memory.
8. A motor failure (i.e. open or short circuit) which occurs when the motor is energized can only be cleared by cycling the ignition OFF-ON.

Front Speed Sensor Test

If a front speed sensor fault is detected continuously for 0.5 second the 4WD CHECK lamp is illuminated. The TCCU then responds as follows:

1. If the system is in high range the TCCU uses the rear speed sensor to determine the EMC touch off level and wheel slip control is suspended.
2. If the system is in low range, the EMC duty cycle is set to maximum, independent of vehicle speed, until the system is shifted out of low range.
3. All electric shift activity is halted until the Ignition is cycled. If a shift is in progress it will be completed.

If the front speed sensor recovers continuously for O.5 second the TCCU will function normally. The 4WD CHECK lamp is turned off but the fault code will remain in memory.

Rear Speed Sensor Test

If a rear speed sensor fault is detected continuously for 0.5 second the 4WD CHECK lamp is illuminated. The TCCU then responds as follows:

1. If the system is in high range the TCCU uses the front speed sensor to determine the EMC touch off level and wheel slip control is suspended.
2. If the system is in low range, the EMC duty cycle is set to maximum independent of vehicle speed until the system is shifted out of low range.
3. All electric shift activity is halted until the Ignition is cycled. If a shift is in progress it will be completed.
4. If the rear speed sensor recovers continuously for 0.5 second the TCCU will function normally. The 4WD CHECK lamp is turned off but the fault code will remain in memory.

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Both Speed Sensor Faulty

If both the front and rear speed sensors are faulty con tinuously for 0.5 seconds the 4WD CHECK lamp is illuminated. The TCCU then responds as follows:

1. If the system is in high range the TCCU sets the EMC touch off level based on a vehicle speed of 0 and wheel slip control is suspended.
2. If the system is in low range, the EMC duty cycle is set to maximum until the system is shifted out of low range.
3. All electric shift activity is halted until the Ignition is cycled. If a shift is in progress it will be completed.

If both speed sensors recover continuously for 0.5 second the TCCU will function normally. The 4WD CHECK lamp is turned off but the fault code will remain in memory.

Electro-Magnetic Clutch Test

The electromagnetic clutch (EMC) is tested for open circuit or short circuit to ground. If a fault is detected continuously for 0.8 second the 4WD CHECK lamp is turned on and all TODTM activity is halted. If the EMC recovers continuously for 0.8 second the TCCU will function normally. The 4WD CHECK lamp is turned off but the fault code will remain in memory.

DIAGNOSTIC TROUBLE CODES (DTCS)

When a fault is detected a diagnostic trouble code (DTC) is stored in the TCCU and illuminates the 4WD CHECK indicator. This DTC will remain in memory until the TCCU is instructed to erase DTCs by scan tool.

Notice: DTCs can not be erased by disconnecting of power supply to the TCCU.

Diagnostic Trouble Codes Table

DTC	Description
1714	EEPROM Checksum Fault
1715	TP Sensor Loss of Signal
1716	TP Sensor Out of Range
1721	Electro-Magnetic Clutch Open / Short to Battery
1722	Electro-Magnetic Clutch Short to Ground
1731	Front Speed Sensor Voltage Low
1732	Front Speed Sensor Voltage High
1733	Rear Speed Sensor Voltage Low
1735	Rear Speed Sensor Voltage High
1736	Speed Sensor Reference Voltage Low
1741	Speed Sensor Reference Voltage High
1742	Motor Open / Shorted to Battery
1714	Motor Output Shorted to Ground
1743	Shift System Timeout
1750	General Position Encoder Fault (In-validCode)
1751	Position 1 Shorted to Ground
1752	Position 2 Shorted to Ground
1753	Position 3 Shorted to Ground
1754	Position 4 Shorted to Ground

CLEARING DIAGNOSTIC TROUBLE CODES

When diagnose by scan tool, it is required that you make adequate service on defects against all fault codes. And then you should delete the memorized fault codes in transfer case control unit (TCCU) using scan tool as follows;

1. Connect a scan tool with dada link connector (DLC).
2. Select TROUBLE CODE CLEAR in scan tool.
3. In TROUBLE CODE CLEAR screen, press ENTER key to erase the fault code.

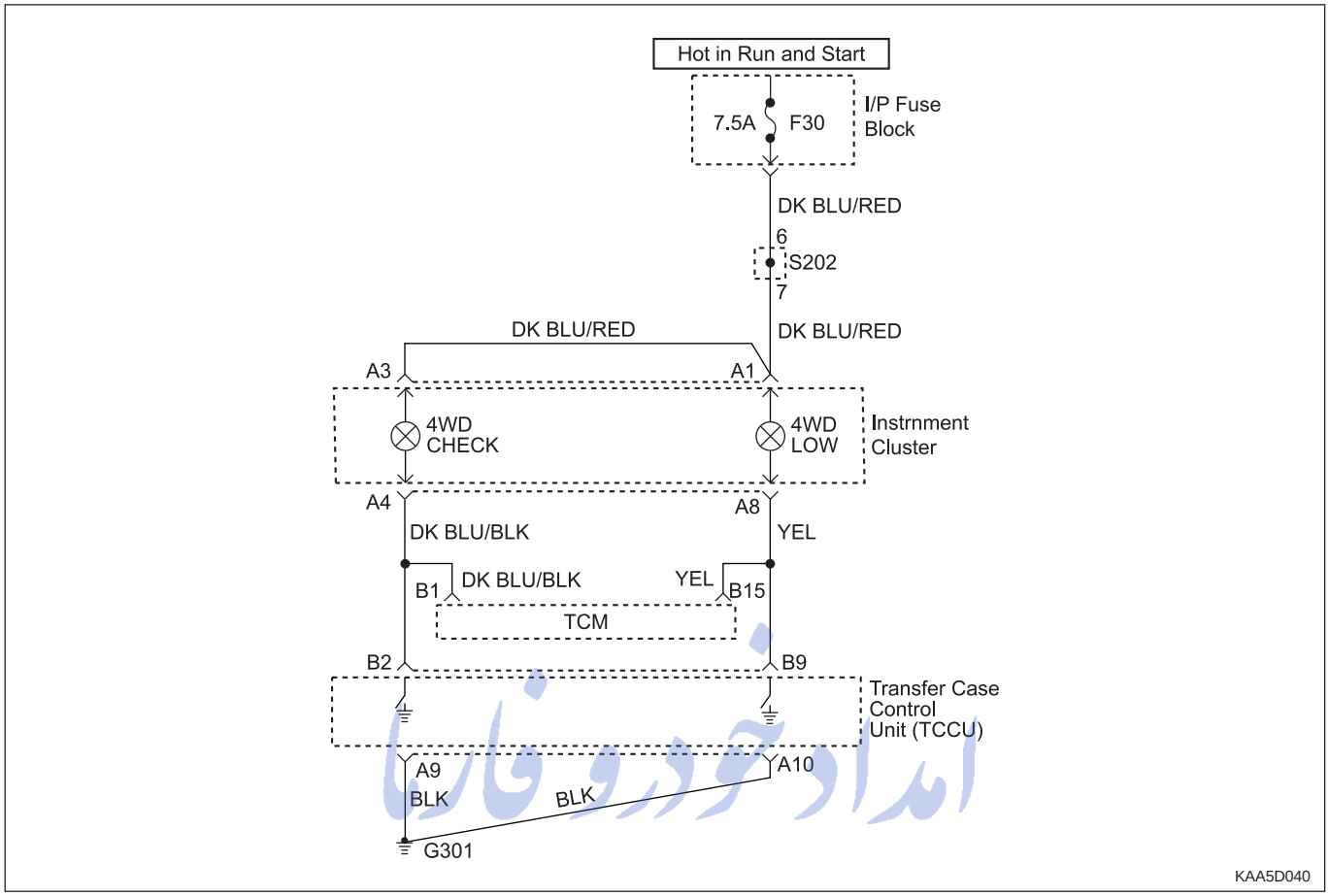
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4WD CHECK INDICATOR STAYS ON WITH IGNITION SWITCH ON

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Circuit Description

When the ignition switch turns to ON the transfer case control unit (TCCU) illuminates 4WD CHECK and 4WD LOWindicator to check bulb operation and turns off after 0.6 seconds. Then TCCU starts self-diagnosis and illuminate 4WD CHECK indicator when TCCU detects any fault.

Diagnostic Aids

- If the 4WD CHECK indicator illuminates steadily the TCCU may detect some fault. TCCU should be checked by scan tool to solve the problem.
- The 4WD CHECK indicator also illuminates steadily if the terminal B2 of TCCU connector is shorted to ground. The shorted wire or terminals should be re-paired.

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Test Description

The number(s) below refer to step(s) on the diagnostic table.

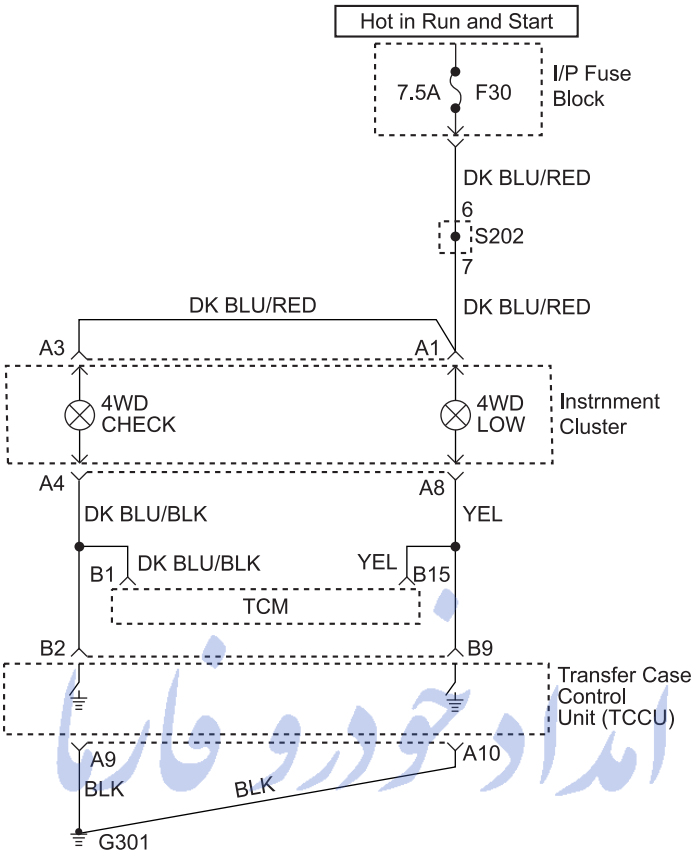
2. This step, along with step 4, checks the short to ground condition of the wire or terminals

ABS INDICATOR LAMP ILLUMINATED CONTINUOUSLY, NO DTCs STORED

Step	Action	Value(s)	Yes	No
1	1. Turn the ignition switch to OFF. 2. Connect the scan tool to the data link connector (DLC). 3. Turn the ignition switch to ON and request the DTC. Does the scan tool display any DTC?		Go to the specific DTC diagnostic table	Go to Step 2

Step	Action	Value(s)	Yes	No
2	1. Turn the ignition switch to OFF. 2. Disconnect the 18-pin connector from transfer case control unit (TCCU). 3. Turn the ignition switch to ON and check the 4WD CHECK bulb operation. Does the 4WD CHECK indicator come on steadily?		Go to Step 3	Go to Step 4
3	Repair any short to ground circuit between terminal B2 of TCCU connector and terminal A4 of cluster. Is the repair complete?		System OK	-
4	1. Turn the ignition OFF. 2. Check the pin or terminals for damage or improper connection. 3. Reconnect all the connectors. 4. Turn the ignition ON. Does the 4WD CHECK indicator come on steadily?		Go to Step 5	System OK
5	Replace the TCCU. Is the repair complete?		System OK	-

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NO 4WD LOW INDICATOR STAYS ON WITH IGNITION SWITCH ON

Circuit Description

When the ignition switch turns to ON the transfer case control unit (TCCU) illuminates 4WD CHECK and 4WD LOWindicator to check bulb operation and turns off after 0.6 seconds. Then TCCU starts self-diagnosis and illuminate 4WD CHECK indicator when TCCU detects any fault.

Diagnostic Aids

- If the 4WD LOW indicator illuminates steadily the transfer case in 4 wheel drive low range and 4H/4L switch set to 4L. It is normal condition.
- The 4WD LOW indicator also illuminates steadily if the terminal B9 of TCCU connector is shorted to ground. The shorted wire or terminals should be repaired.

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Test Description

The number(s) below refer to step(s) on the diagnostic table.

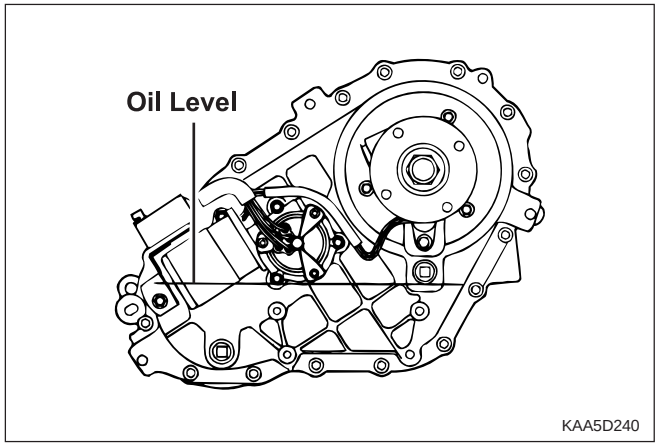
2. This step checks for the normal bulb operation.

Step	Action	Value(s)	Yes	No
1	Check the position of 4H/4L switch. Does the 4H/4L switch set on 4L.		Go to Step 2	Go to Step 3
2	1. Turn the ignition switch to ON. 2. Set the shift lever to N (neutral). 3. Turn the 4H/4L switch to 4H. Does the 4WD LOWindicator go off?		System OK	-

Step	Action	Value(s)	Yes	No
3	1. Turn the ignition switch to ON. 2. Set the shift lever to N (neutral). 3. Turn the 4H/4L switch to 4L. Does the 4WD LOWindicator go off?		Go to Step 4	Go to Step 5
4	The wiring of 4H/4L switch is reversed. Repair the wiring. Is the repair complete?		System OK	-
5	1. Turn the ignition OFF. 2. Check the pin or terminals for damage or improper connection. 3. Reconnect all the connectors. 4. Turn the ignition ON. Does the 4WD LOW indicator come on steadily?		Go to Step 6	System OK
6	Repair any short to ground circuit between terminal B9 of TCCU connector and terminal A8 of cluster. Is the repair complete?		System OK	Go to Step-7
7	Replace the TCCU. Is the repair complete?		System OK	-

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REPAIR INSTRUCTIONS



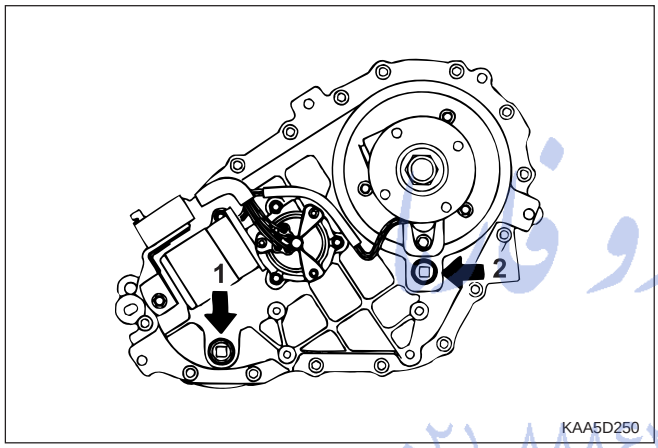
ON-VEHICLE SERVICE

OIL REPLACEMENT

Important: Use only recommended oil or not the transfer case will be severely damaged. Inspect every 10,000 km and replace every 60,000 km.

Specified Oil Level

The oil level should be just under the filler hole.



Oil Replacement

1. Lift the vehicle and make sure safety.
2. Prepare a vessel to drain transfer case oil.
3. Remove the planner damper, if equipped.
4. Remove the drain plug and filler plug, and drain the oil completely.
5. Install and tighten the drain plug.

Installation Notice

Tightening Torque	19 - 30 N•m (14 - 22 lb-ft)

6. Replenish recommended transfer case oil to specified oil level through the filler plughole.
7. Install and tighten the filler plug.

Installation Notice

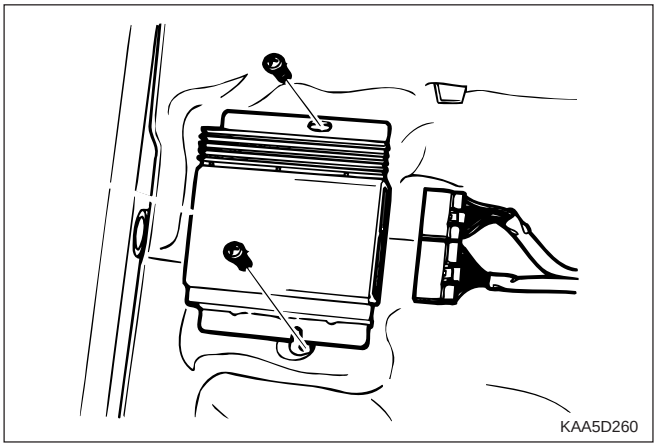
Tightening Torque	4 - 6 N•m (35 - 53 lb-in)

8. Check oil leakage.
9. Install the planner damper.

Installation Notice

Tightening Torque	29 - 41 N•m (21 - 30 lb-ft)

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TRANSFER CASE CONTROL UNIT (TCCU)

Removal and Installation Procedure

1. Turn the ignition switch to OFF.
2. Disconnect two connectors from the TCCU under the driver seat.
3. Remove two bolts and the TCCU.

Installation Notice

Tightening Torque	10 N•m (7 lb-ft)

- When replacing the TCCU, it is required to a cod-ing correspondent with the vehicle specification. Refer to “TCCU Coding” in this section.

4. Installation should follow the removal procedure in the reverse order.

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TRANSFER CASE

Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Lift the vehicle and make sure safety.

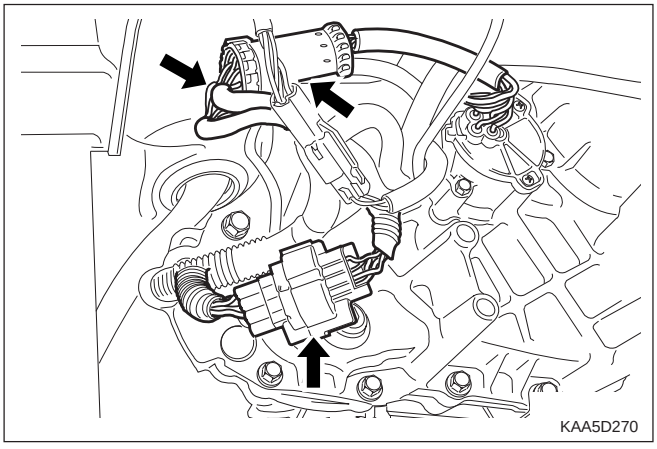
Notice: Be careful not to touch the catalytic converter which is very hot after driving or engine running.

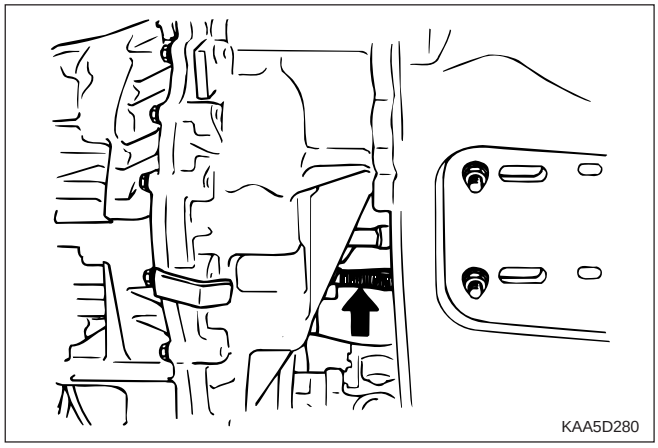
3. Remove the drain plug and drain the transfer case oil. Refer to “Oil Replacement” in this section.

Installation Notice

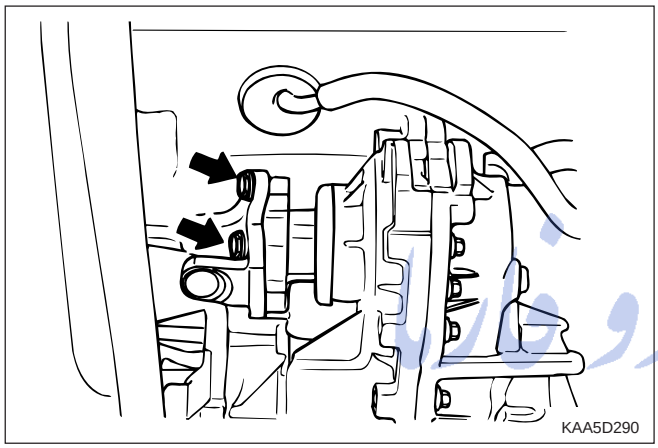
Tightening Torque	19 - 30 N•m (14 - 22 lb-ft)

4. Disconnect the transmission extension wiring con-nector on backside of transfer case.
5. Disconnect shift motor and clutch coil connector (black 7 pin) on upper backside of transfer case.
6. Disconnect front and rear speed sensor connector (white 7 pin).
7. Disconnect speedometer sensor connector.


KAA5D270



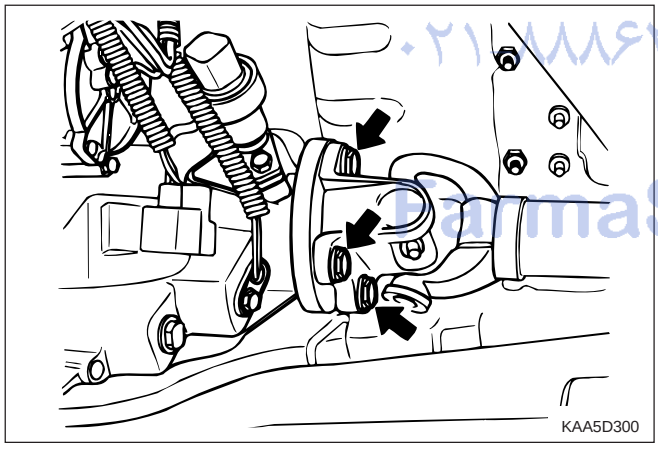
8. Disconnect breather hose on the front upper side of the transfer case near front propeller shaft.



9. Prepare a hydraulic jack and support the transfer case assembly.
10. Remove 4 bolts that connecting the front propeller shaft and front output shaft/flange.

Installation Notice

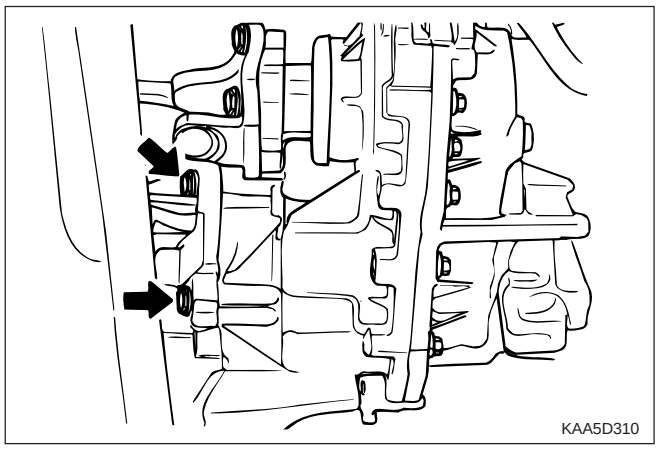
Tightening Torque	81 - 89 N•m (60 - 66 lb-ft)



11. Remove 4 bolts that connecting the rear propeller shaft and rear output shaft flange.

Installation Notice

Tightening Torque	81 - 89 N•m (60 - 66 lb-ft)



12. Remove five bolts that connect transfer case and transmission adapter housing.

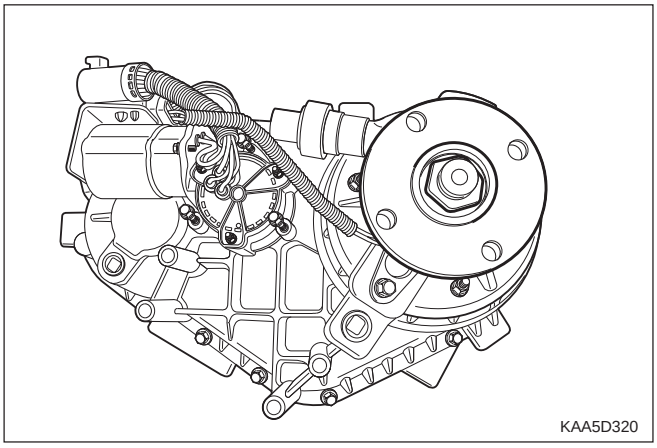
Installation Notice

Tightening Torque	38 - 52 N•m (28 - 38 lb-ft)

- Make sure the connecting surface is clean.
- Apply long life grease inside transfer case input shaft.

13. Installation should follow the removal procedure in the reverse order.

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KAA5D320

SHIFT MOTOR

Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Disconnect shift motor and clutch coil connector (black 7 pin) on upper backside of transfer case.
3. Remove three shift motor mounting bolts.

Installation Notice

Tightening Torque	8 - 11 N•m (70 - 97 lb-in)

4. Remove one shift motor bracket bolt.

Installation Notice

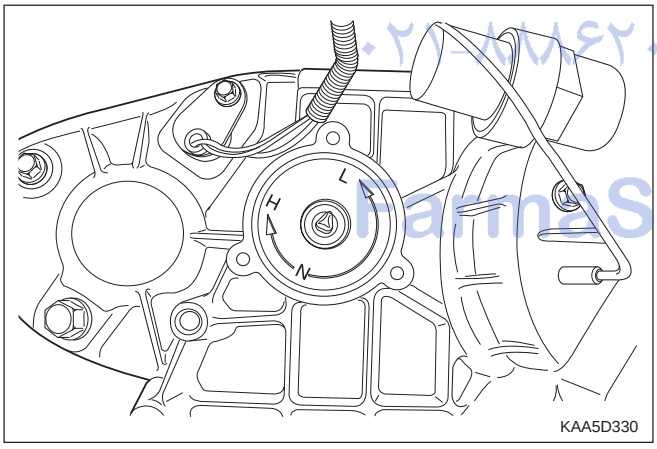
Tightening Torque	8 - 11 N•m (70 - 97 lb-in)

5. Loose two adjusting bolts on the shift motor if neces-sary.

Installation Notice

Tightening Torque	3 - 5 N•m (27 - 44 lb-in)

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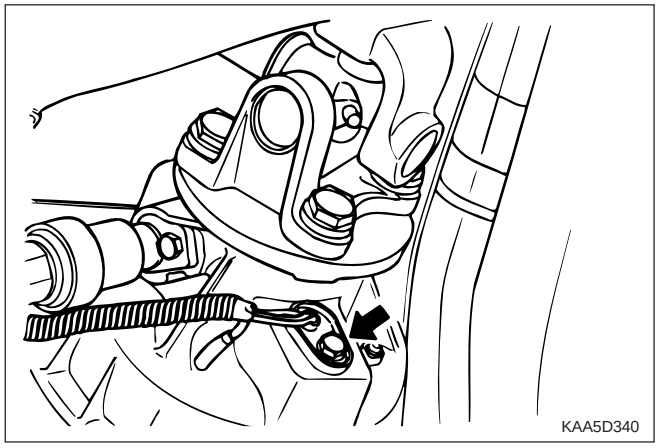
6. Keeps the shift motor even and pull out carefully.

Notice: When removing shift motor, pay attention to the location of triangular slot and shaft in transfer case inside motor and mark the position.

7. Installation should follow the removal procedure in the reverse order.

Installation Notice:

- Clean the connection surface between transfer case and shift motor.
- Apply black non-acid cure silicone rubber or equivalent to the surface.
- Do not disassemble the shift motor and replace with new one, if necessary.
- Make sure the motor position to match with 4H/ 4L switch selection.


KAA5D340

FRONT AND REAR PROPELLER SHAFT SPEED SENSOR

Removal and Installation Procedure

1. Disconnect negative battery cable.
2. Disconnect front and rear speed sensor connector (white 7 pin).
3. Remove shift motor. Refer to “Shift Motor” in this sec-tion.
4. Remove front and rear propeller shaft speed sensor retaining bolts.

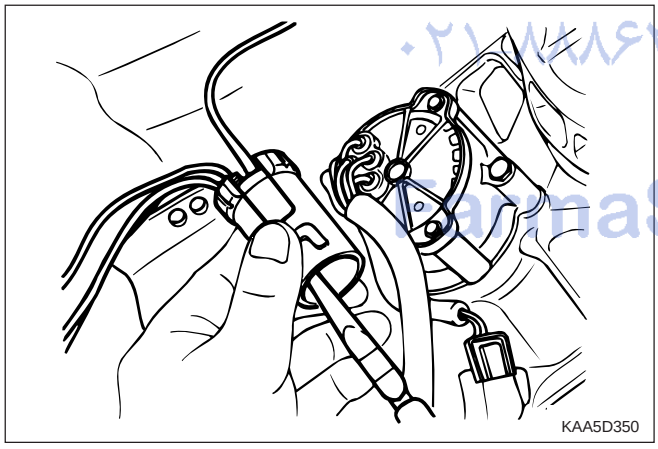
   Installation Notice

Tightening Torque	3 - 6 N•m (27 - 53 lb-in)

5. Remove the speed sensors by lifting up using a tool such as flat screw drive.

   Notice: Do not shock the speed sensor because it is too sensitive at shock.

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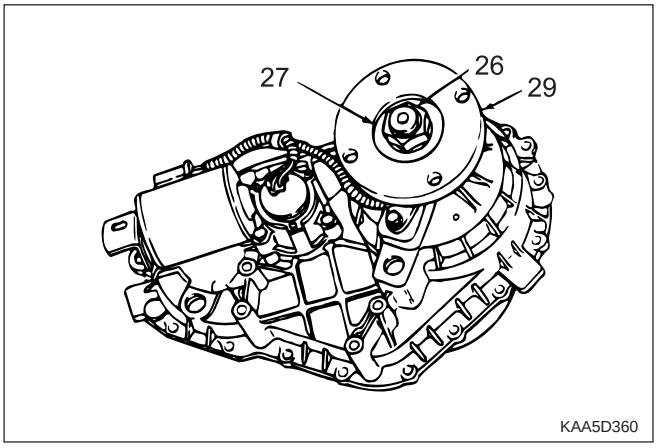

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6. Disassemble the connector of front and rear propeller shaft speed sensor.
7. Replace front or rear propeller shaft speed sensor, as necessary.

   Notice:

   - While replacing the speed sensor, make sure the proper pin position.
   - Do not remove one wire to clutch coil in the transfer case.
   - Make tidy on the wiring harness including conduct tube.
8. Installation should follow the removal procedure in the reverse order.



KAA5D360

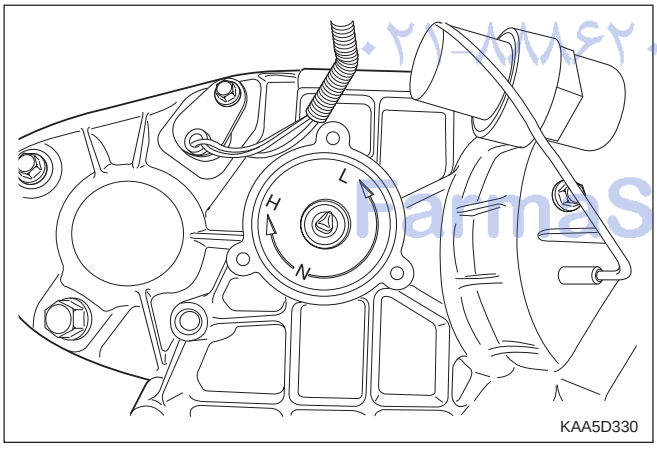
UNIT REPAIR

TRANSFER CASE OVERHAUL

Disassembly Procedure

1. Remove the transfer case assembly. Refer to “Transfer Case” in this section.
2. Disassemble the white 7 pin connector of propeller shaft speed sensor and separate the pin connected to brown wire to clutch coil.
3. Remove the propeller shaft speed sensors with wires. Refer to “Front and Rear Propeller Shaft Speed Sensor” in this section.
4. Remove vehicle speed sensor. Refer to *Section 1F, Engine Control*.

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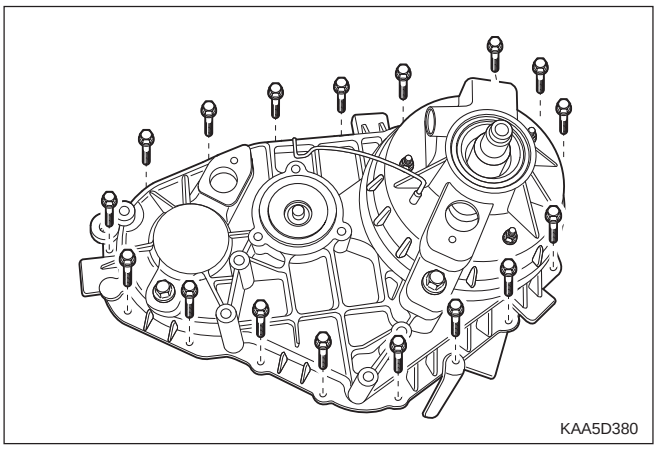
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5. Remove shift motor/clutch coil. Refer to “Shift Motor and Clutch Coil” in this section.

   Notice: When removing shift motor, pay attention to the location of triangular slot and shaft in transfer case inside motor and mark the position.

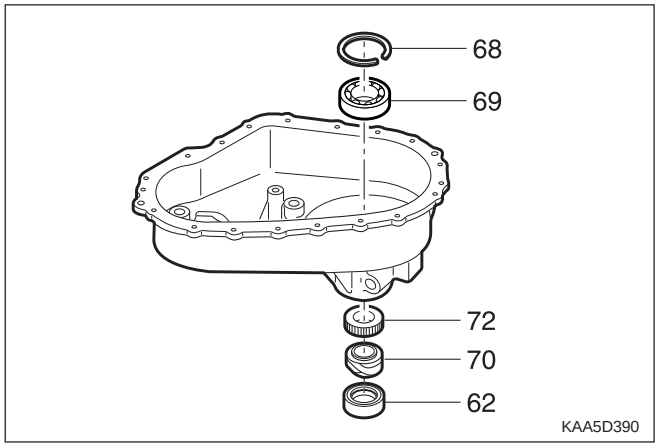
6. Using a 30 mm thin-wall socket, first remove the rear output shaft nut, rear output shaft yoke washer, oil seal then the rear output shaft flange.


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7. Remove the bolts that retain the front case to the rear cover.

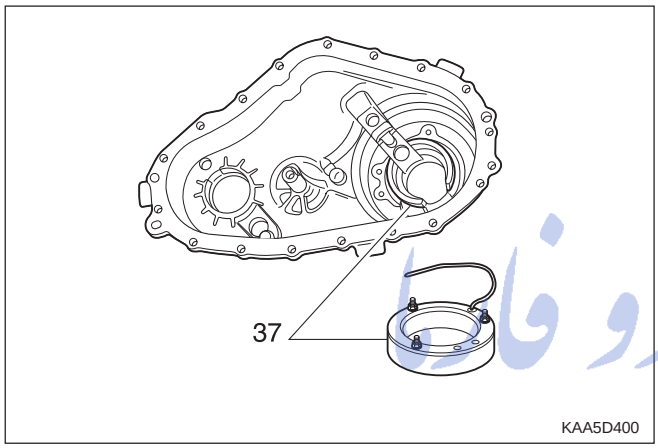
   Notice:

   - Make sure that the front case is facing downward so that the rear cover is facing upwards.
   - Pry on the bosses and separate the front case from the rear cover.
   - Remove all traces of gasket sealant from the mating surfaces of the front case and rear cover.



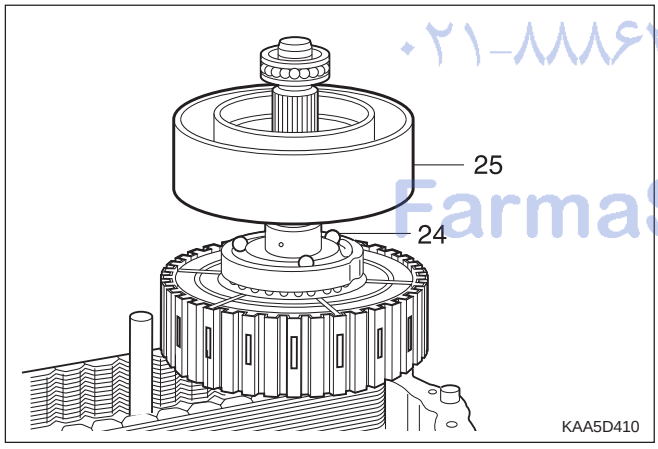
8. Remove the rear output shaft oil seal and discard it, if required.
9. Remove the speedometer drive gear and rear propeller shaft speed sensor tooth wheel.
10. Remove the internal snap ring that retains the rear output shaft bearing in the bore.

    Notice: Push the bearing from the outside of the case.

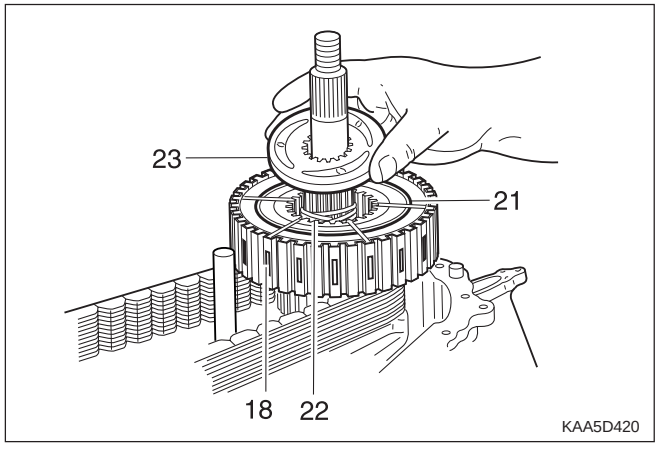


11. Remove three nuts retaining the clutch coil assembly and pull the clutch coil assembly along with the wire from the case.

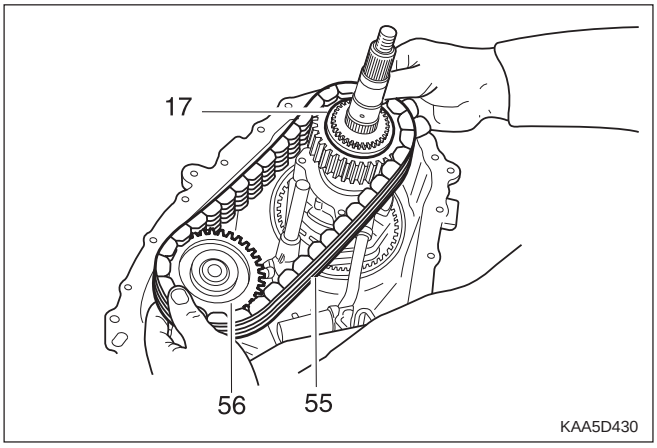
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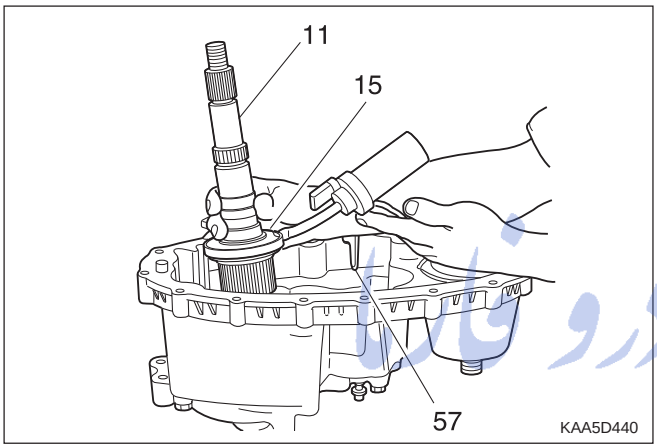
12. Remove thrust bearing from the rear output shaft.
13. Remove the clutch coil housing from the rear output shaft.



14. Remove the balls, apply cam and wave washer from the output shaft.
15. Remove snap ring from output shaft.
16. Remove clutch pack assembly from output shaft.

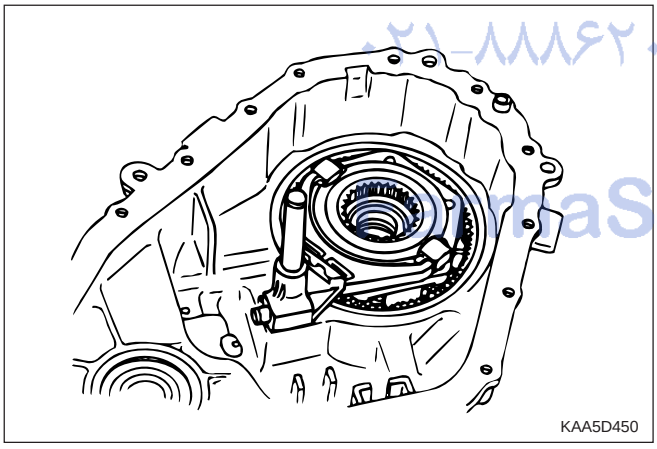


17. Remove the front propeller shaft speed sensor tooth wheel.
18. Remove the chain, driven sprocket and drive sprocket as an assembly.
19. Remove thrust washer from output shaft.

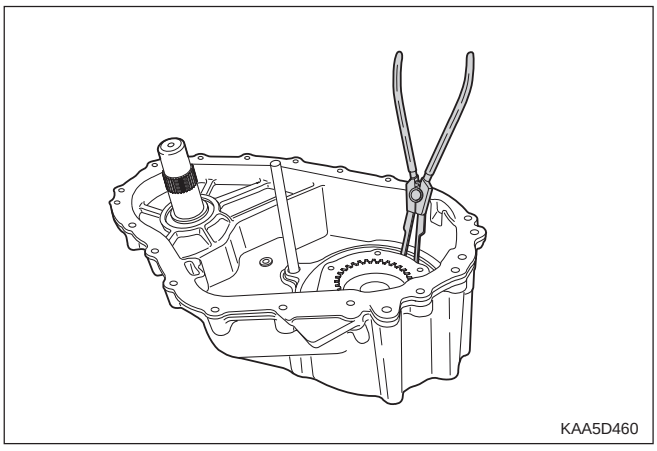


20. Remove the magnet from the slot in the front of the case bottom.
21. Remove the rear output shaft and oil pump as an as-sembly.

Notice: If there is removal resistance, do not pound or use force to disassemble the pump. Do not disassemble oil pump. It is serviced only as an assembly. Check the pump to make sure the pump rotates freely.

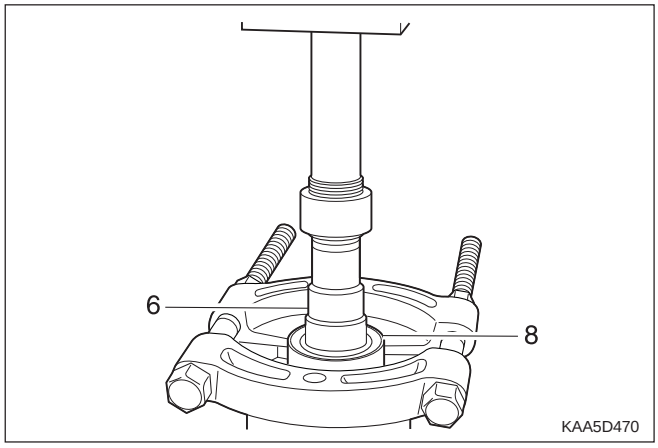


22. Remove the helical cam and shift rail as an assembly by gently pulling out the shift rail. Check the helical cam for damages and replace it if required.
23. Remove the high-low shift fork and high-low collar as an assembly.
24. Remove the shift shaft.

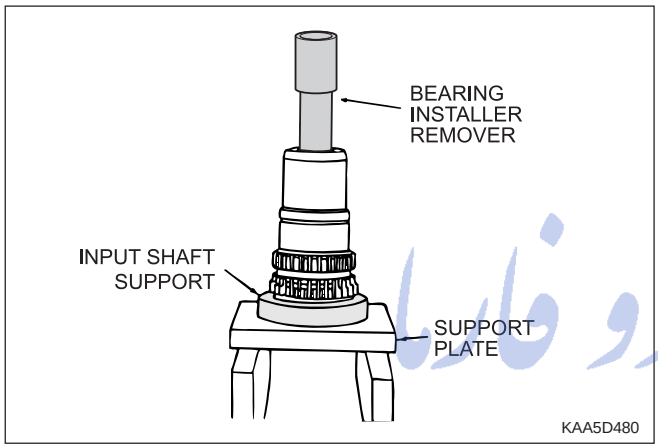


25. With expanding the tangs of the snap ring under the planetary carrier assembly using SST snap ring plier support the input shaft against a bench, push the case down and slide the input shaft bearing. Remove the input shaft and planetary carrier.
26. Remove and discard the input shaft oil seal as re quired.
27. Remove the internal snap ring from the planetary carrier and separate the planetary carrier from the input shaft.

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۰۲۱-۸۸۸۶۲۰۸۵
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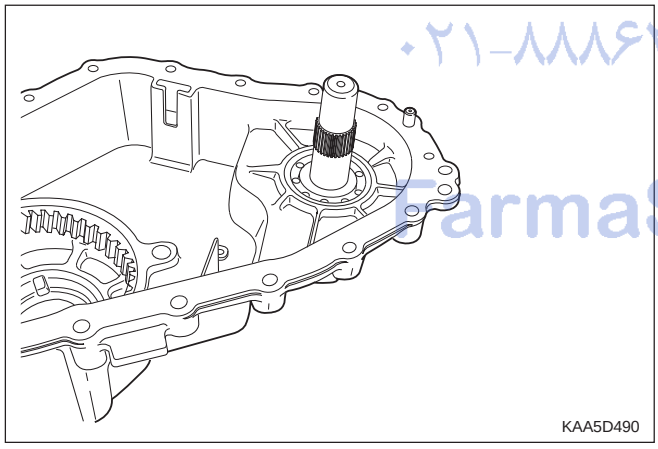
28. Remove the external snap ring from the input shaft.
29. Place the input shaft in a vise and remove the bear ing.
30. Remove the thrust washer, thrust plate and the sun gear off the input shaft.



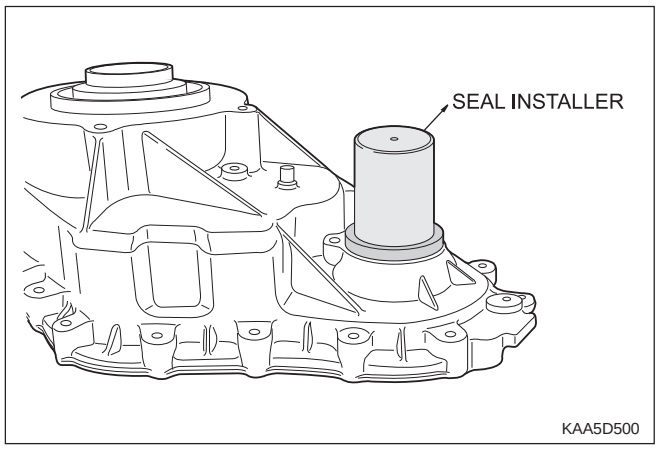
31. Position the input shaft on SST input shaft support.
32. Remove the needle bearing and bushing using SST bearing installer/remover, as required.

    Notice: Under normal use, the needle bearing and bushing may not require replacement. After inspection, If replacement is required, the bushing and needle bearing must be replaced as a set.

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۰۲۱-۸۸۸۶۲۰۸۵ تلفن شبانه روزی
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33. Remove the external snap ring retaining the front output shaft.
34. Remove the front output shaft/flange.
35. Remove and discard front output shaft oil seal, as required.
36. Remove the internal snap ring and remove the front output shaft bearing, as required.



Assembly Procedure

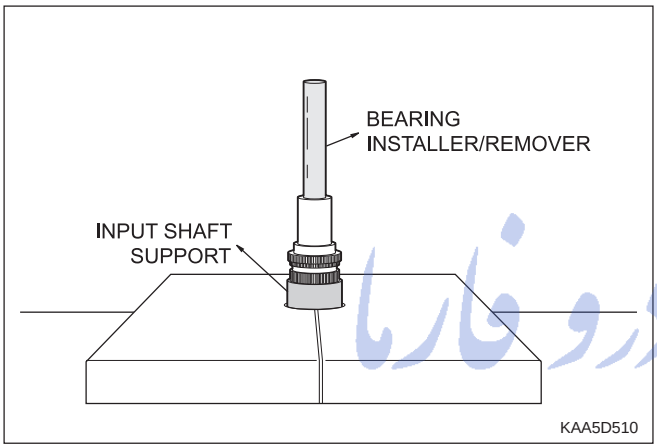
Important: Lubricate all parts with automatic transmission fluid (ATF) or equivalent before assemble. Remove all traces of gasket sealant from the front case and mounting adapter mating surfaces

1. Install the front output shaft bearing, if removed.

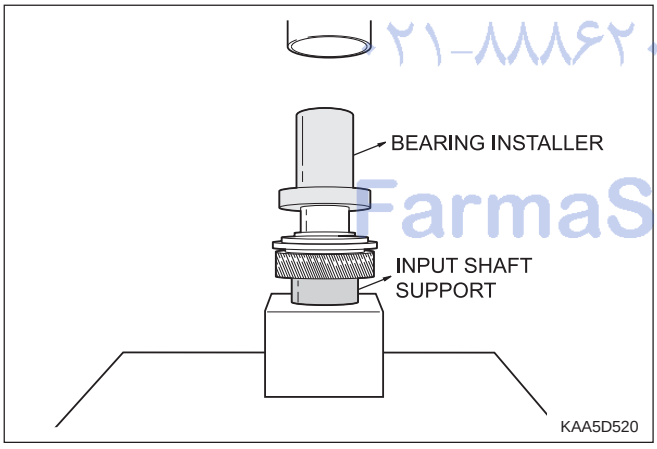
   Notice: Press the bearing in straight, making sure it is not cocked in the bore.

2. Install the internal snap ring that retains the front output shaft bearing.

3. Install the front output shaft oil seal using oil seal installer, if removed.
4. Install the front output shaft/flange and install the snap ring.



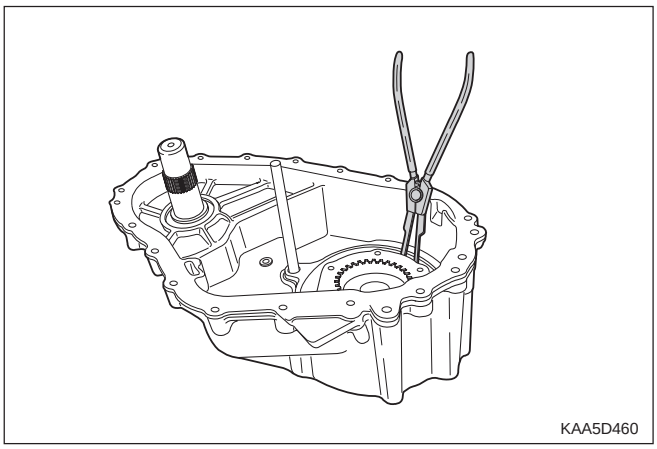
5. Install a new input shaft needle bearing and a new bushing, if removed. Keep the following steps to install the bearing and the bushing:
   - Position the input shaft on input shaft support.
   - Press a new needle bearing into the end of the input shaft until it seats in the input shaft using bearing remover/installer.
   - Press in a new bushing.



6. Slide the sun gear, thrust plate and thrust washer into position on the input shaft.

   Notice: The recessed face of the sun gear and the snap ring groove on the bearing outer race should be toward the rear of the transfer case. The stepped face of the thrust washer should face toward the bearing.

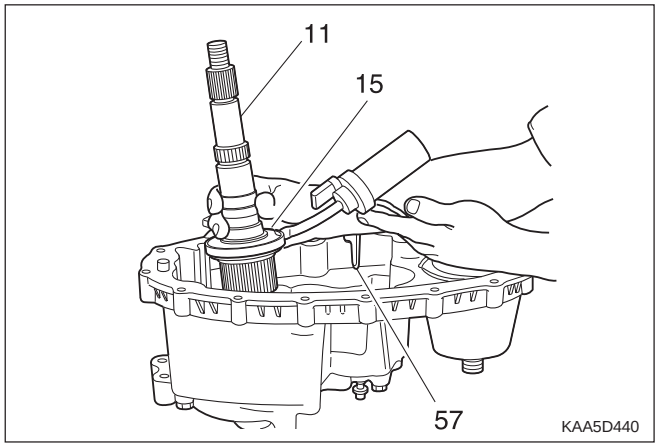
7. Install the bearing over the input shaft using input shaft bearing installer SST. Install the external snap ring.



8. Assemble the planetary carrier to the sun gear and input shaft and install the internal snap ring to the planetary carrier.
9. While expanding the tanged snap ring with SST snap ring pliers install planetary carrier assembly.
10. Install the high-low shift fork and collar as an assembly.

    Notice: Make sure that the nylon wear pads are installed on the shift fork and snapped securely into place.

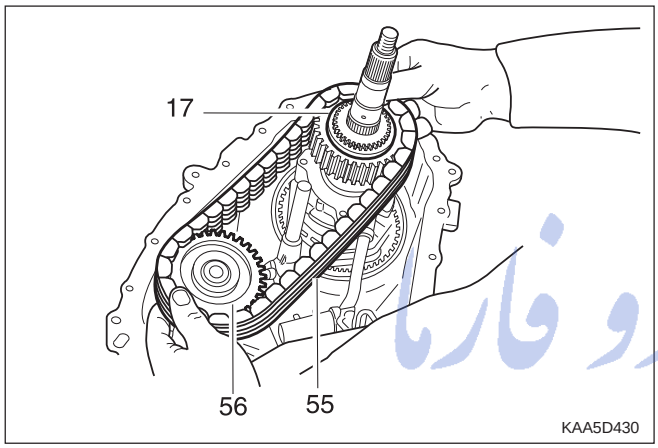
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11. Install the output shaft and oil pump in the input shaft

    Notice:

    - If a new pump is used, align the flat of the output shaft and the flat of the pump. Slide the pump onto the rear output shaft.
    - Do not remove the plastic insert from the bore of the new pump. Discard it after it slides out during pump installation to the rear output shaft.
    - While turning the output shaft, prime the pump through the oil filter pickup tube or housing inlet hole with clean ATF or equivalent.

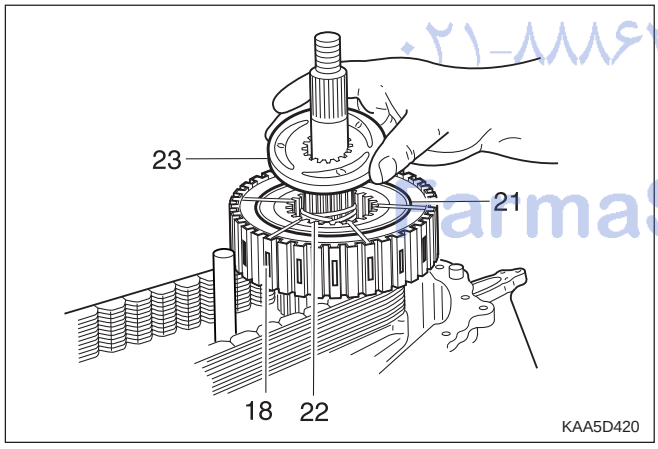


12. Install the magnet in the slot in the front case just above the oil filter leg.
13. Install the thrust washer on the rear output shaft.
14. Install the chain, drive sprocket and driven sprocket as an assembly over the output shafts.

    Notice: The driven sprocket on the front output shaft must be installed with the marking REAR facing toward the rear case, if so marked.

15. Install front propeller shaft speed sensor tooth wheel onto the front output shaft.

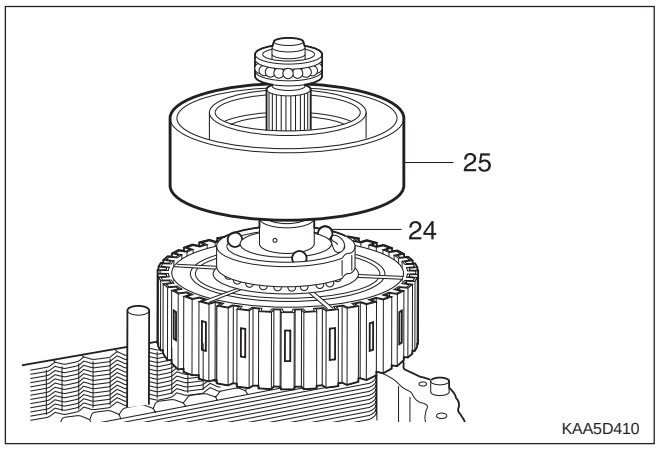
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16. Install clutch pack assembly onto the rear output shaft
17. Install snap ring onto the rear output shaft.

    Notice: If the snap ring will not install, the thrust washer inside the clutch pack may not be seated properly.

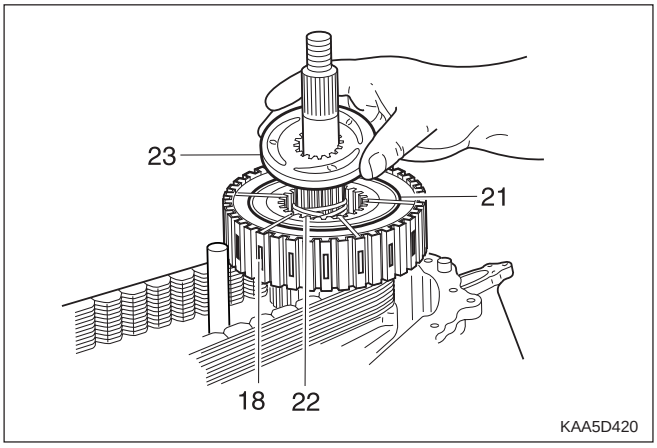
18. Install wave spring, apply cam and balls.



19. Install cam and coil housing assembly onto rear out-put shaft.
20. Install thrust bearing assembly onto output shaft.
21. Install the rear output shaft bearing, if removed.

    Notice: Make sure that the bearing is not cocked in the bore.

22. Install the internal snap ring that retains the bearing to the rear case.

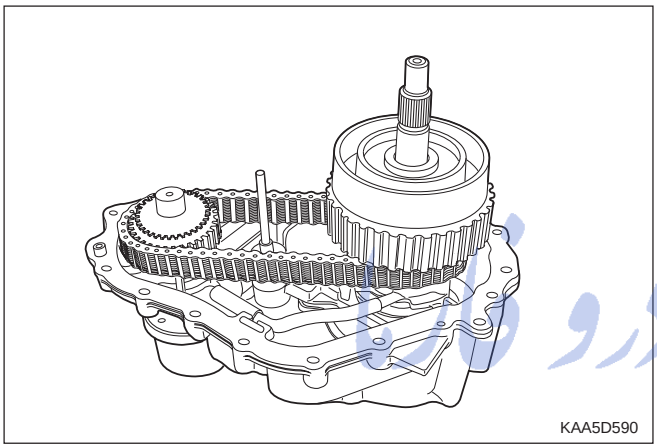


23. Install the clutch coil and tighten three bolts.

Installation Notice

Tightening Torque	8 - 11 N•m (6 - 8 lb-ft)

Caution: Do not kink or trap the wire while seating the clutch coil to the case.

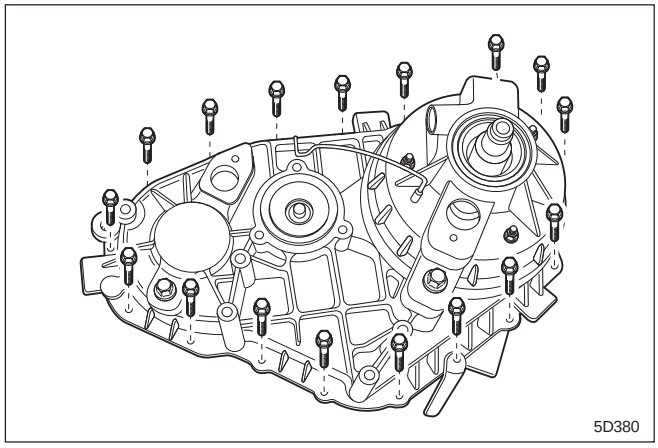


24. Install the pin on the tang end of the helical cam into the hole in the front case.
25. Position the torsion spring tangs so that they are pointing toward the top side of the transfer case and just touching the high-low shift fork.

Caution: Do not bend the helical cam during installation to the front case because of possible damage to the pin at the tang end of the motor shaft.

26. Install the shift rail through the high-low shift fork and make sure that the reverse gear shift rail is seated in the front case bore.
27. Install rear propeller shaft speed sensor toothed wheel, vehicle speedometer gear and rear output shaft seal if removed. Use oil seal installer or equivalent.

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28. Coat the mating surface of the front case with a bead of black non-acid cure silicone rubber or equivalent.
29. Assemble the rear case on to front case.

    Notice: Align the rear output shaft with the rear case output shaft bore. Align the helical cam with the rear case motor bore.

30. Install the bolts retaining the case halves and tighten the bolts.

    Installation Notice

Tightening Torque	27 - 35 N•m (20 - 26 lb-ft)

31. Install the rear output shaft flange on rear output shaft. Install the rubber seal, output shaft yoke washer and nut. Tighten the nut and calk the nut on the flat area.

    Installation Notice

Tightening Torque	140 - 200 N•m (103 - 148 lb-ft)

32. Install the shift motor. Refer to the “Shift Motor” in this section.
33. Insert the brown wire and pin to speed sensor connect and assemble the connector. Refer to “Front and Rear Propeller Shaft Speed Sensors” in this section.
34. Install the drain plug and tighten the drain plug.

    Installation Notice

Tightening Torque	19 - 30 N•m (14 - 22 lb-ft)

35. Fill the transfer case with 1.4 liters of ATF or equivalent.

    Notice: Fluid level should be just below the filler plug-hole.

36. Install the filler plug and tighten.

    Installation Notice

Tightening Torque	4 - 6 N•m (35 - 53 lb-in)

37. Install the transfer case to the vehicle. Refer to “Transfer Case” in the section.

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SECTION 5D2

TRANSFER CASE (PART TIME - 4408)

TABLE OF CONTENTS

General Infromation and Operation 5D2-2
4WD Operation Overview 5D2-2
System Structure 5D2-3
2H Mode (Rear Wheel Drive) 5D2-5
4H Mode (4WD Drive - High Speed) 5D2-6
4H Mode (4WD Drive - Low Speed) 5D2-7
System Description 5D2-8
Specifications 5D2-9
Diagnostic Infromation and Procedures 5D2-10
General Diagnosis 5D2-10
Self-Diagnosis Test 5D2-11
Diagnostic Diagram 5D2-15
Component Locator 5D2-16
Cross Sectional View 5D2-16
Transfer Case Assembly 5D2-17
Disassembly and Assembly 5D2-18
Maintenance and Repair 5D2-20
On-Vehicle Service 5D2-20
Maintenance of Transfer Case Lubricant 5D2-20
4H and 4L Indicator 5D2-21
TCCU Inspection 5D2-21
Transfer Case Assembly 5D2-22
TCCU 5D2-24
Unit Repair 5D2-25
Disassembly Procedure 5D2-25
Assembly Procedure 5D2-35

امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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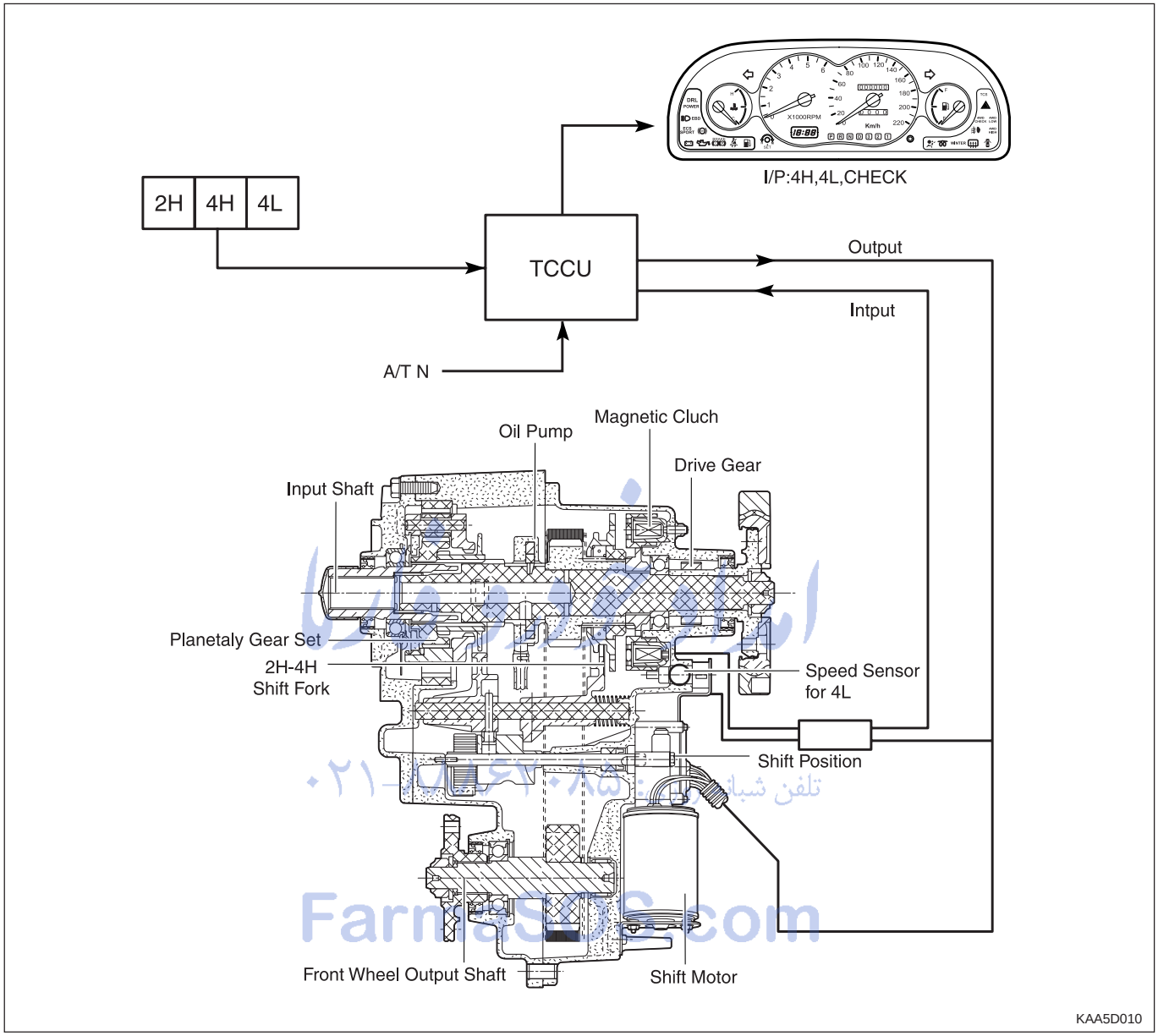
GENERAL INFORMATION AND OPERATION

4WD OPERATION OVERVIEW

Application	Mode Position		Operation Condition
Driving Type	2H	2WD Drive (Rear Wheel Drive)	• Normal Driving on the normal road or highway, or high speed driving
	4H	4WD Drive (High Speed)	• Slipped road such as snow, rainy, sand, mud etc.
	4L	4WD Drive (Low Speed)	• Max driving force requiring condition such as towing, rough road. • When a vehicle is driven in turning at low speed on the paved road, a vibration and a noise may be occurred by tight corner braking.
Transferring	2H ↔ 4H	2WD Drive ↔ 4WD Drive (High Speed)	• 2WD ↔ 4WD transfer is possible below 70 km without operating the clutch.
	2H, 4H ↔ 4L	2WD Drive, 4WD Drive (High Speed) ↔ 4WD Drive (Low Speed)	• Manual Transmission Transfer starts after the vehicle stops and the clutch is applied • Automatic Transmission Transfer starts after the vehicle stops and the shift lever is shifted [N] position. **Notice:** After the vehicle stops and the mode switch is selected with applying the brake pedal, shifting [N-R-N] makes the mode transfer easier.

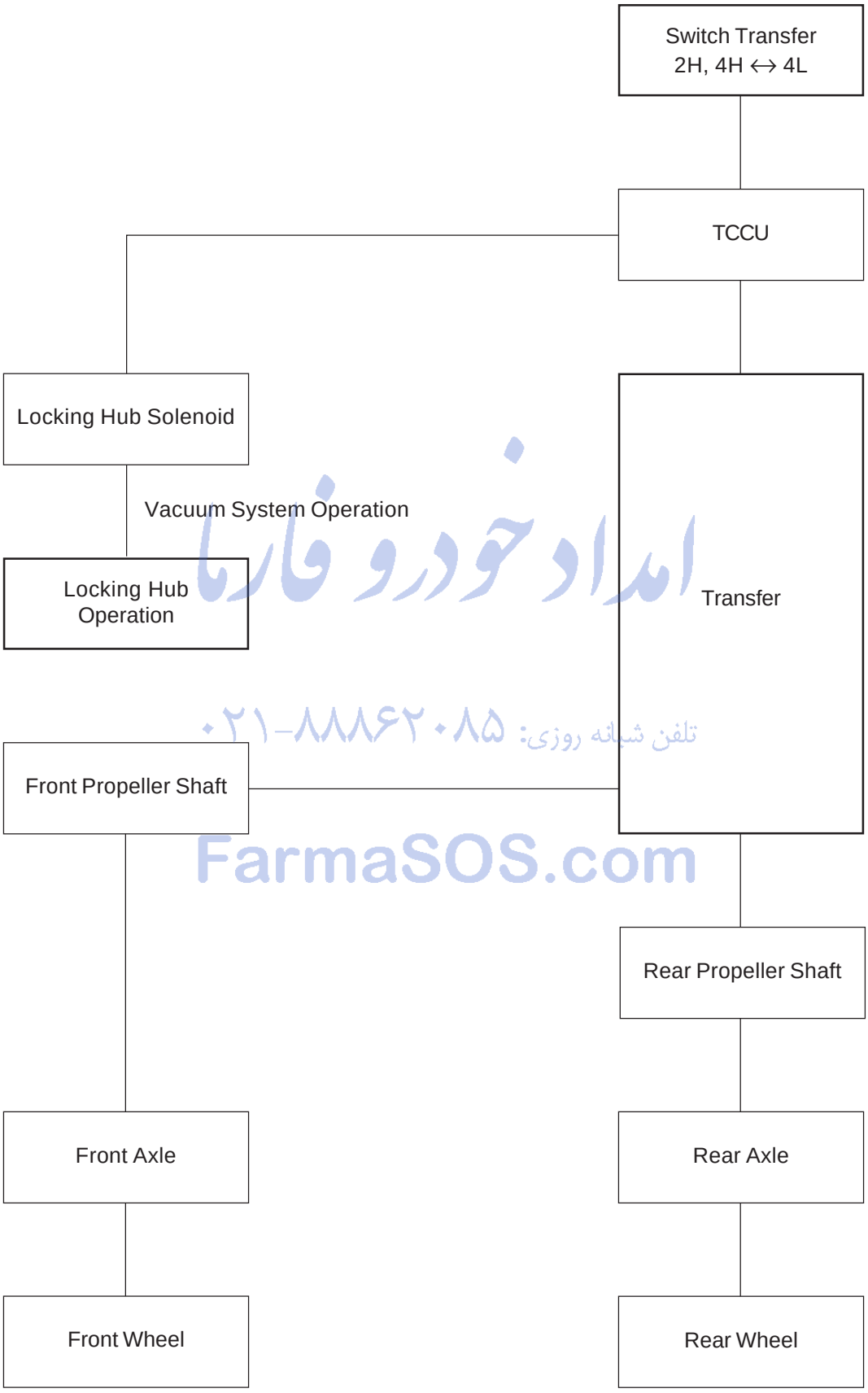
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SYSTEM STRUCTURE



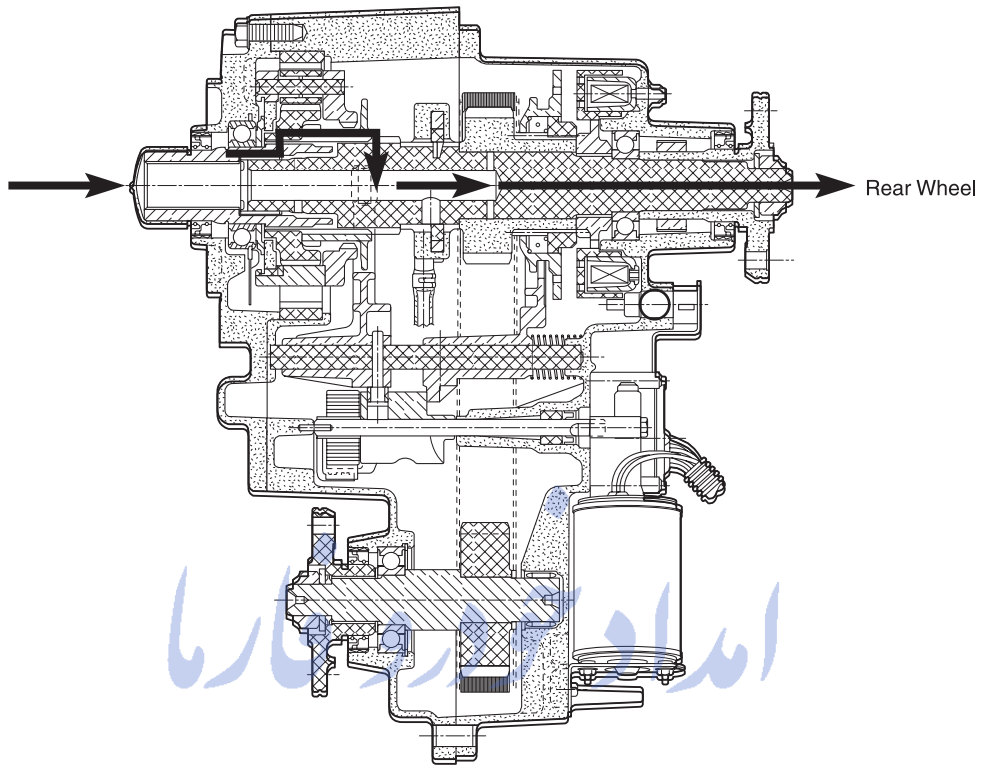
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Power Flow



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2H MODE (REAR WHEEL DRIVE)

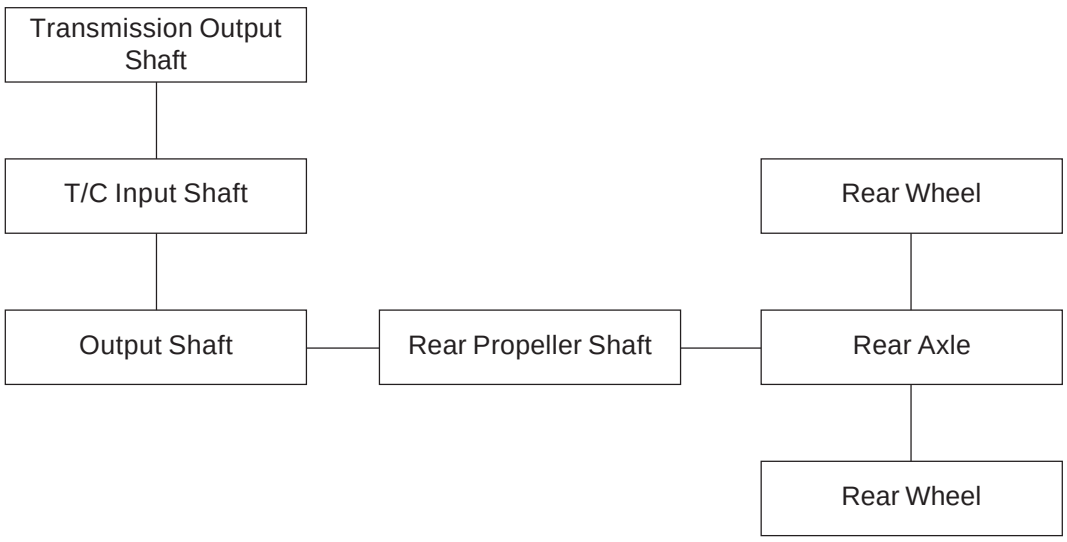


KAA5D020

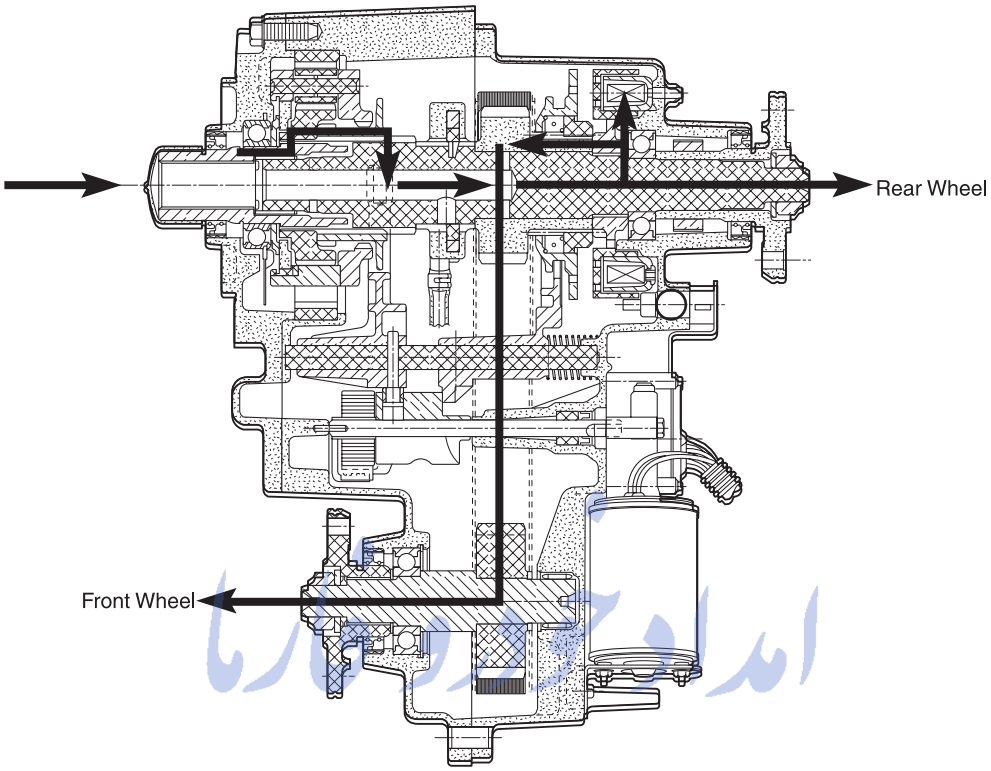
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Power Flow

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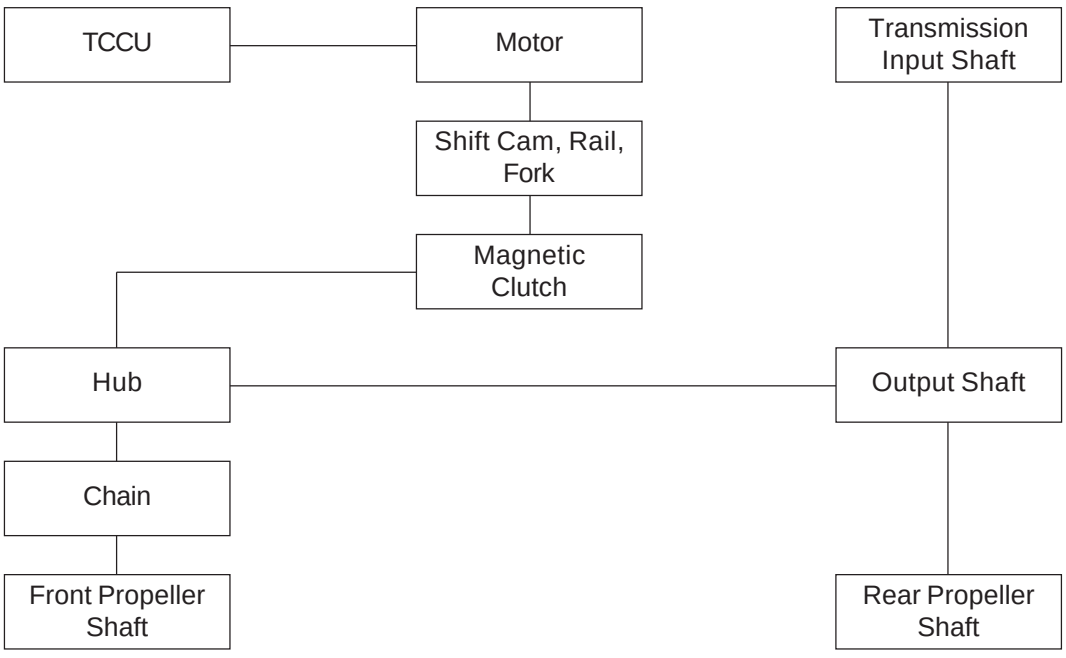
4H MODE (4WD DRIVE - HIGH SPEED)



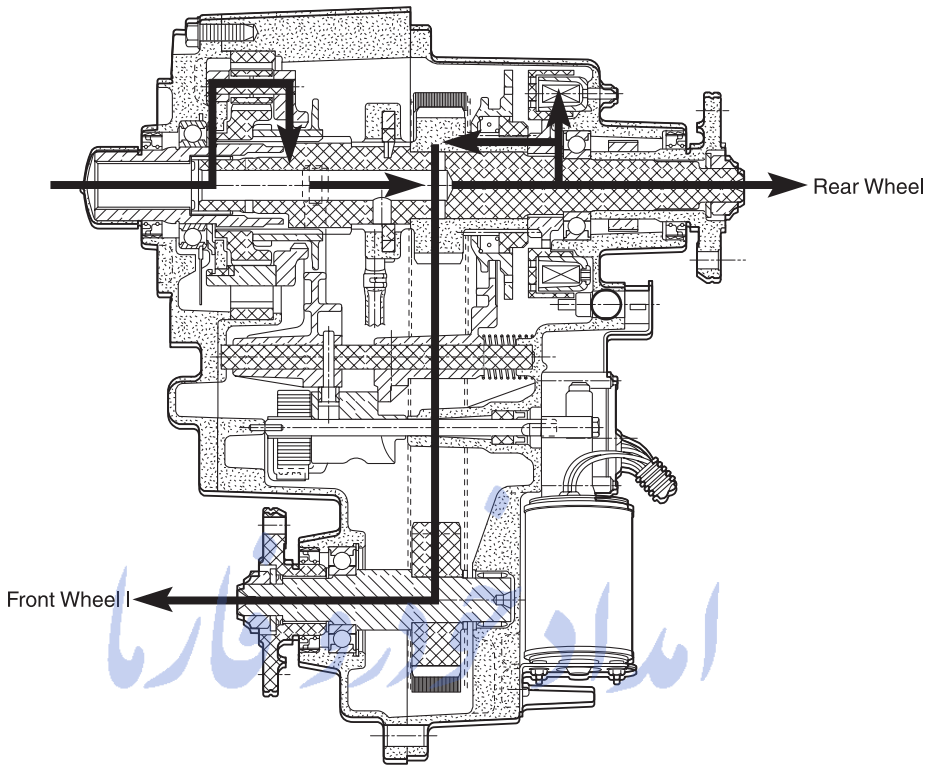
KAA5D030

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Power Flow



4L MODE (4WD DRIVE - LOW SPEED)

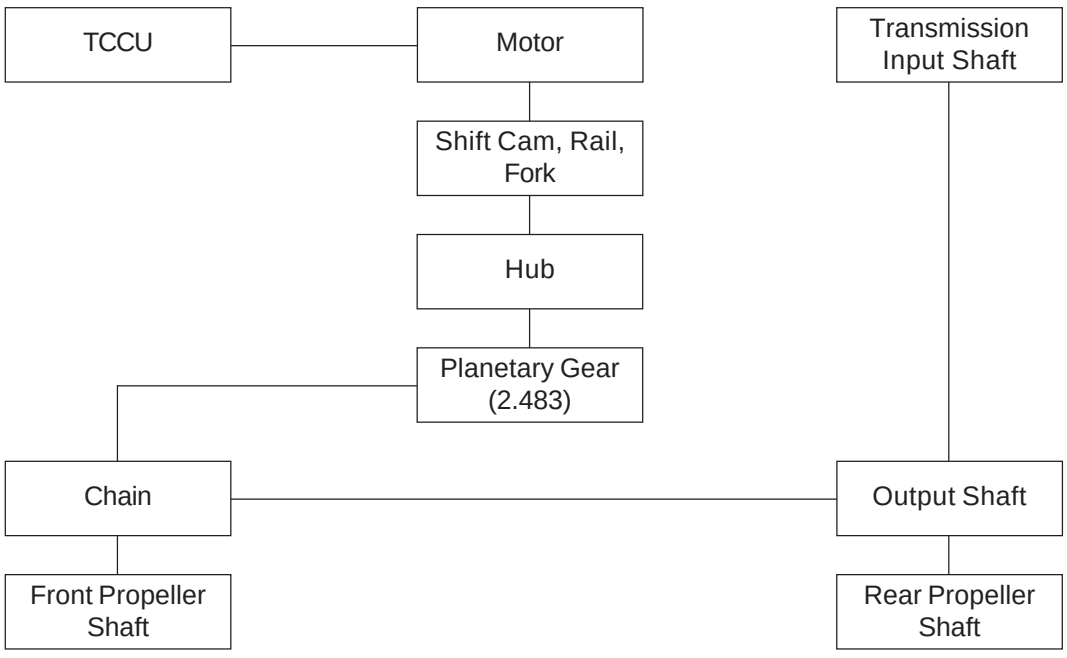


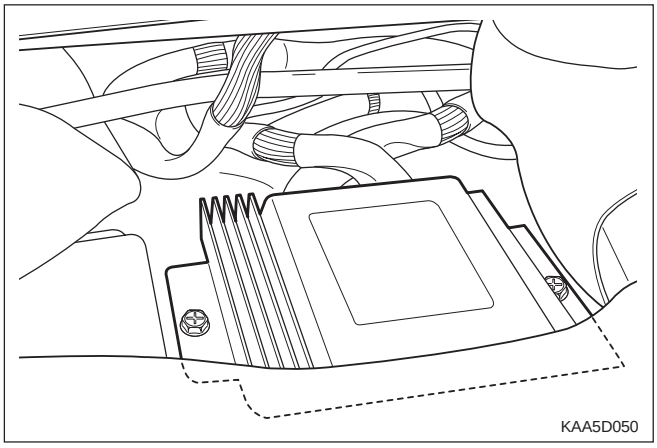
KAA5D040

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Power Flow

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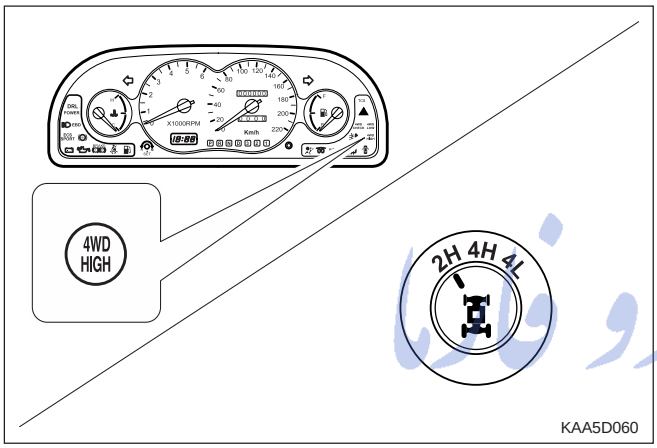



KAA5D050

SYSTEM DESCRIPTION

Transfer Case Control Unit (TCCU)

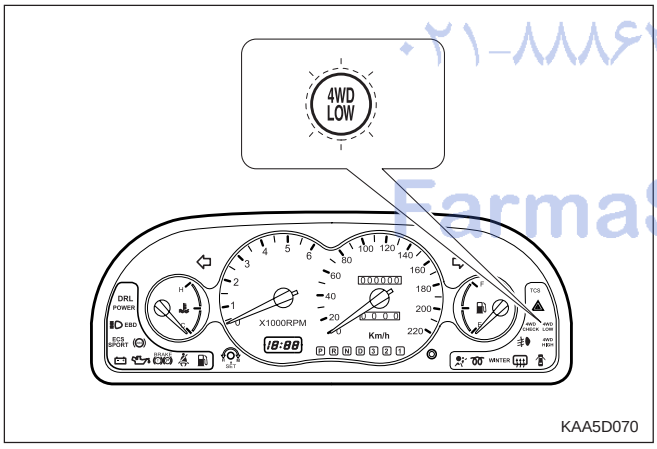
TCCU is located under the front left handed seat and permits the vehicle to shift from two-wheel drive to four-wheel drive (and back shift) according to drivers switch operation during driving (For the shifting between 4WD HIGH and 4WD LOW, stop the vehicle).



KAA5D060

1. Shifting from 2H to 4H
   - Position the transfer case switch from '2H' to '4H'.
   - Shifting is possible during driving.
   - '4WD HI' indicator light will turn on.

2. Shifting from 4H to 2H
   - Position the transfer case switch from '4H' to '2H'.
   - Shifting is possible during driving.
   - 4WD HI' indicator light will turn off.



KAA5D070

3. Shifting between 4H and 4L
   - Shifting is possible when the vehicle is almost stopped (below approx. 2 km/h), so it would be better stop the vehicle.
   - In case of manual transmission equipped vehicle, apply clutch pedal.
   - In case of auto transmission equipped vehicle, put the lever position into 'N'.
   - Position the transfer case switch '4H' to '4L' or '4L' to '4H'.
   - According to the shifted position, indicator light will turn on.

   Notice: If there are malfunctions during shifting, '4H' or '4L' indicator light will blink.

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SPECIFICATIONS

Model		Part-Time 4408 (E)
Type		E.S.O.F. Type
Gear Ratio	High	1 : 1
	Low	2.48 : 1
Oil	Specification	ATF S-3, S-4 or DEXRON II, III
	Capacity	1.2 L
	Lubrication	Check : Every 10,000 km
		Replace : Every 60,000 km
Manufacturer		Borg Warner
Weight		30 kg

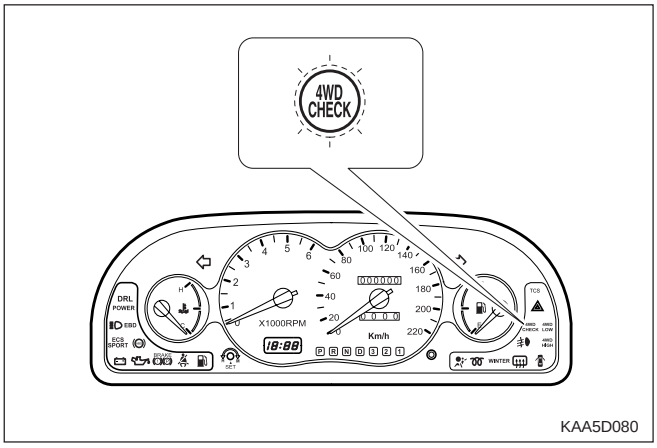
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DIAGNOSTIC INFORMATION AND PROCEDURES

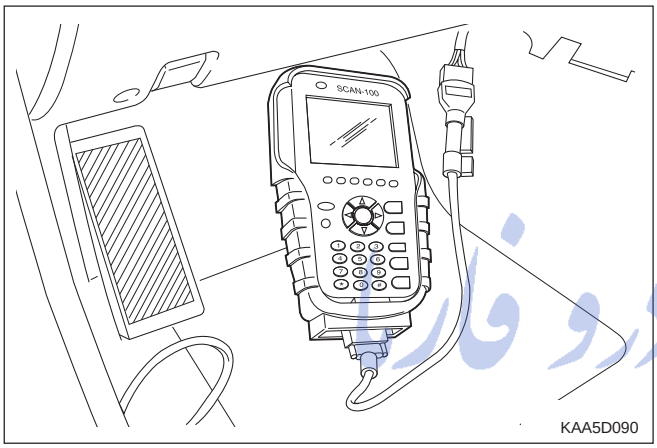
GENERAL DIAGNOSIS

Symptoms	Check	Action
Electric shift problems	• Faulty or damaged TCCU, speed sensor, motor, clutch or internal wirings • Damaged or worn shift cam, hub, fork and rail shift	• Overhaul and check, replace if necessary. • Overhaul and check for wear and damage.
	• Binding shift fork, hub collar or gear	• Replace if necessary.
Cannot front wheel drive when shifted 4H, 4L	• Broken drive chain	• Check sliding parts, replace if necessary.
Noise in 4WD operation	• Improper or low oil • Loosened bolts or mounted parts • Noisy T/C bearing	• Drain and replace with specified oil. • Retighten as specified. • Disassemble bearings and parts and check for wear or damage. Replace if necessary.
	• Gear abnormal noise	• Check for wear and damage including speedometer gear, replace if necessary.
Noise in 4H or 4L	• Worn or damaged sprockets or drive chain • Incorrect tire pressure	• Disassemble and check for wear and damage, replace if necessary. • Adjust tire pressure.
Transfer case oil leakage	• Cracked transfer case	• Replace the case.
	• Leakage from other parts	• Clean case and parts and check for leakage.
	• Breather clogging • Improper or too much oil	• Remove breather hose and clean, replace if necessary. • Use specified oil and adjust oil level.
	• Loosened sealing bolts	• Retighten
	• Improperly applied sealant • Worn or damaged oil seal	• Use specified sealant and retighten. • Replace

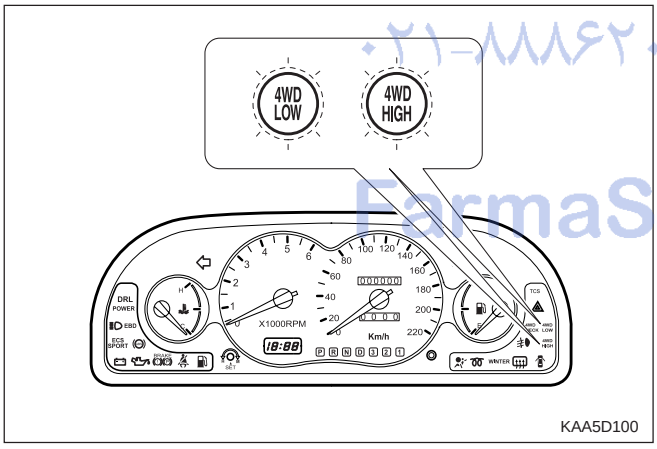
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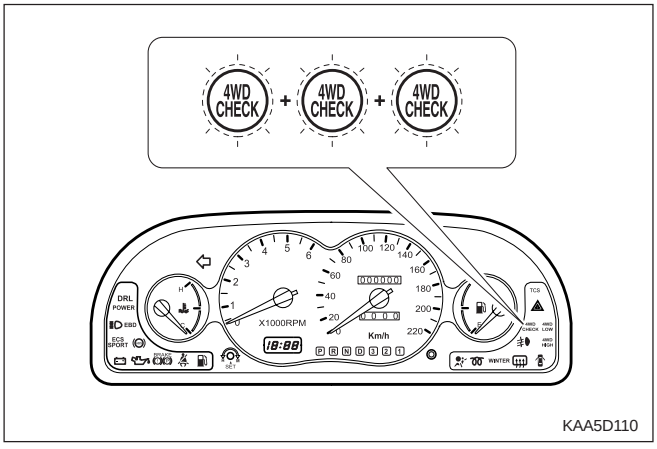
KAA5D080



KAA5D090



KAA5D100



KAA5D110

SELF-DIAGNOSIS TEST

System Description

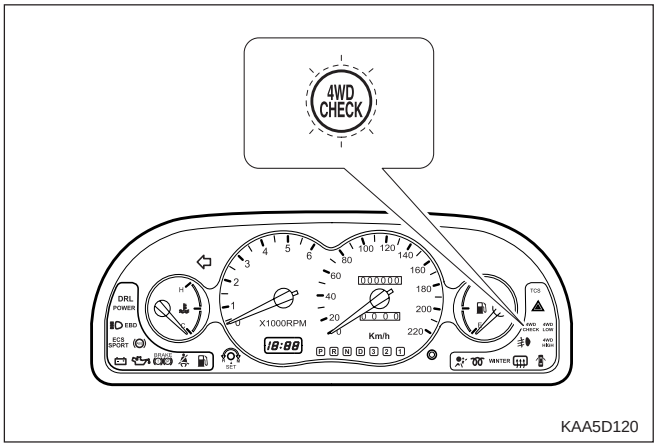
1. TCCU detects transfer case system malfunctions and indicates malfunctioning part(s) through flashing 4H, 4L indicator lights.

   Using a service connector, connect it to the diagnosis box in under instrument pannel and read the flashing of the “4WD CHECK” indicator light.

   The flashing indicator light will show you defective code(s).
2. Identify 7 defective codes after reading the flashing indicator light.
   - TCCU
   - Shift motor
   - Magnetic synchronizer clutch
   - Speed sensor
   - Hub solenoid
   - Selector switch
   - Motor position sensor
3. Transfer case system is malfunctioning when:
   - 4H, 4L indicator lights are remain on after 0.6 second when turning the ignition switch ON.
   - 4H, 4L indicator lights are continuously come on during driving.
4. If only 1 part is malfunctioning, 4WD CHECK indicator light will display defective code 3 times continuously.
5. If more then 2 part is malfunctioning, the first malfunctioning part will be displayed 3 times and following malfunctioning parts will be displayed .
6. To read defective code, connect the service connector and turn the ignition switch ‘ON’.
7. After repairing, eliminate the defective code stored in the TCCU.

   Notice: Before replacing the malfunction parts with defective code, check the wires and connectors for proper condition.

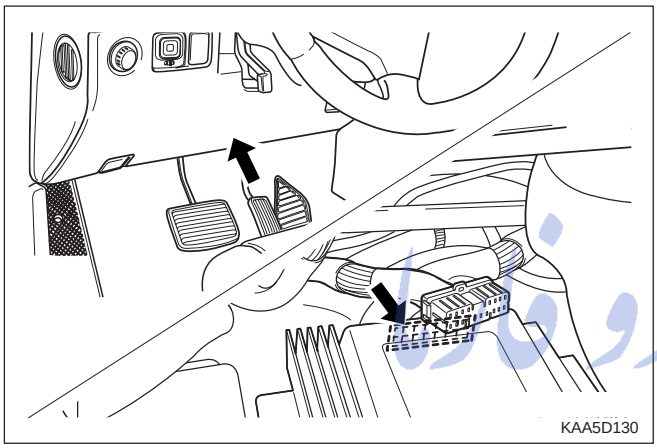
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KAA5D120

Defective Code Reading

1. Position the ignition switch to OFF.
2. Using a service connector, connect the diagnosis socket under instrument pannel.
3. Position the ignition switch to ON.
4. Read the flashing 4WD CHECK indicator light and identify the malfunctioning part (See Diagnosis Table).


KAA5D130

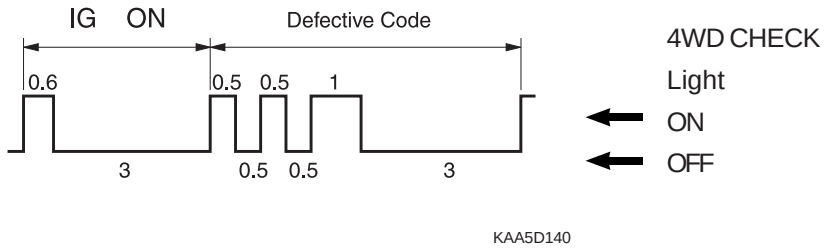
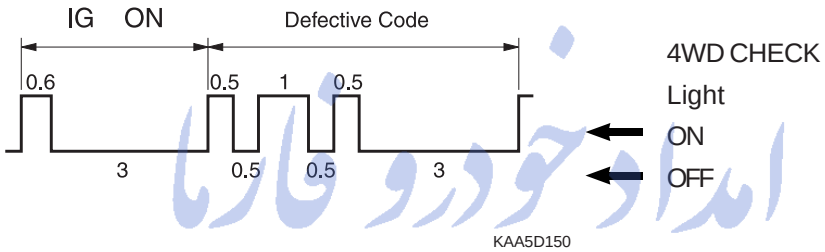
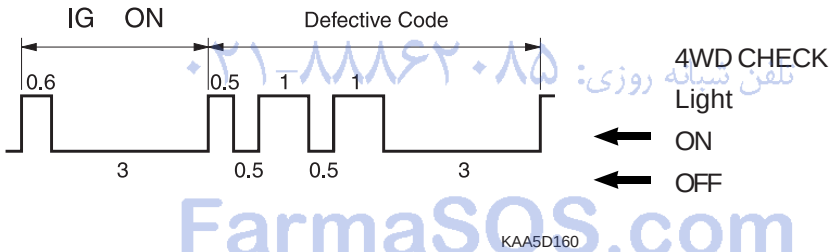
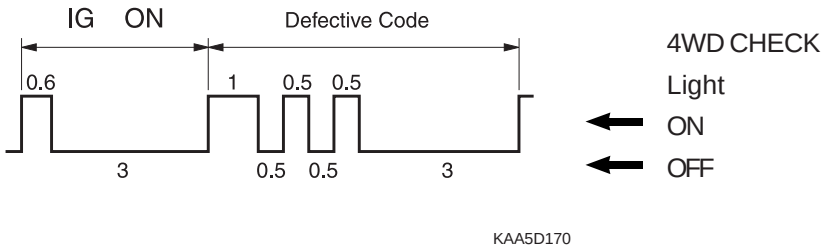
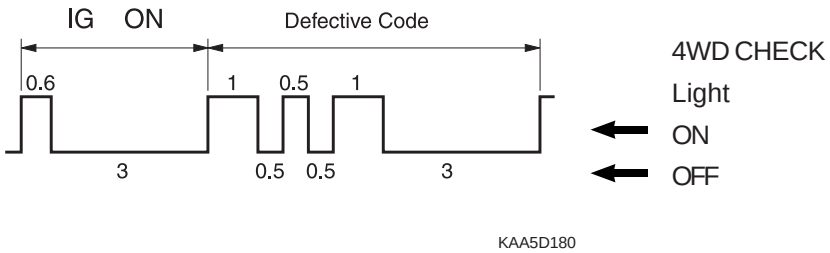
How to Clear the Fault Code

1. Position the ignition switch to OFF.
2. Using a service connector, connect the diagnosis socket in under instrument pannel.
3. Position the ignition switch to ON over 5 seconds.
4. Do defective code reading and make sure that all defective codes are eliminated.

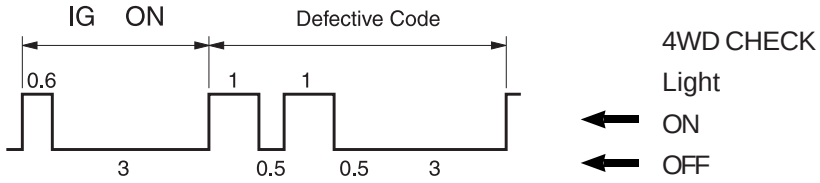
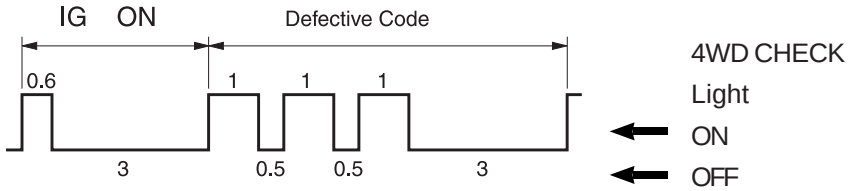
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Diagnostic Table

Connect a service connector. If turn the ignition switch "ON" "4WD CHECK" indicator light will come on for 0.6 second and turn off for 3 seconds and then display a defective code 3 times continuously.

No.	Defective Code	Malfunctioning Part
1	 KAA5D140	TCCU
2	 KAA5D150	Shift Motor
3	 KAA5D160	Synchronizer Clutch
4	 KAA5D170	Speed Sensor
5	 KAA5D180	Locking Hub Solenoid

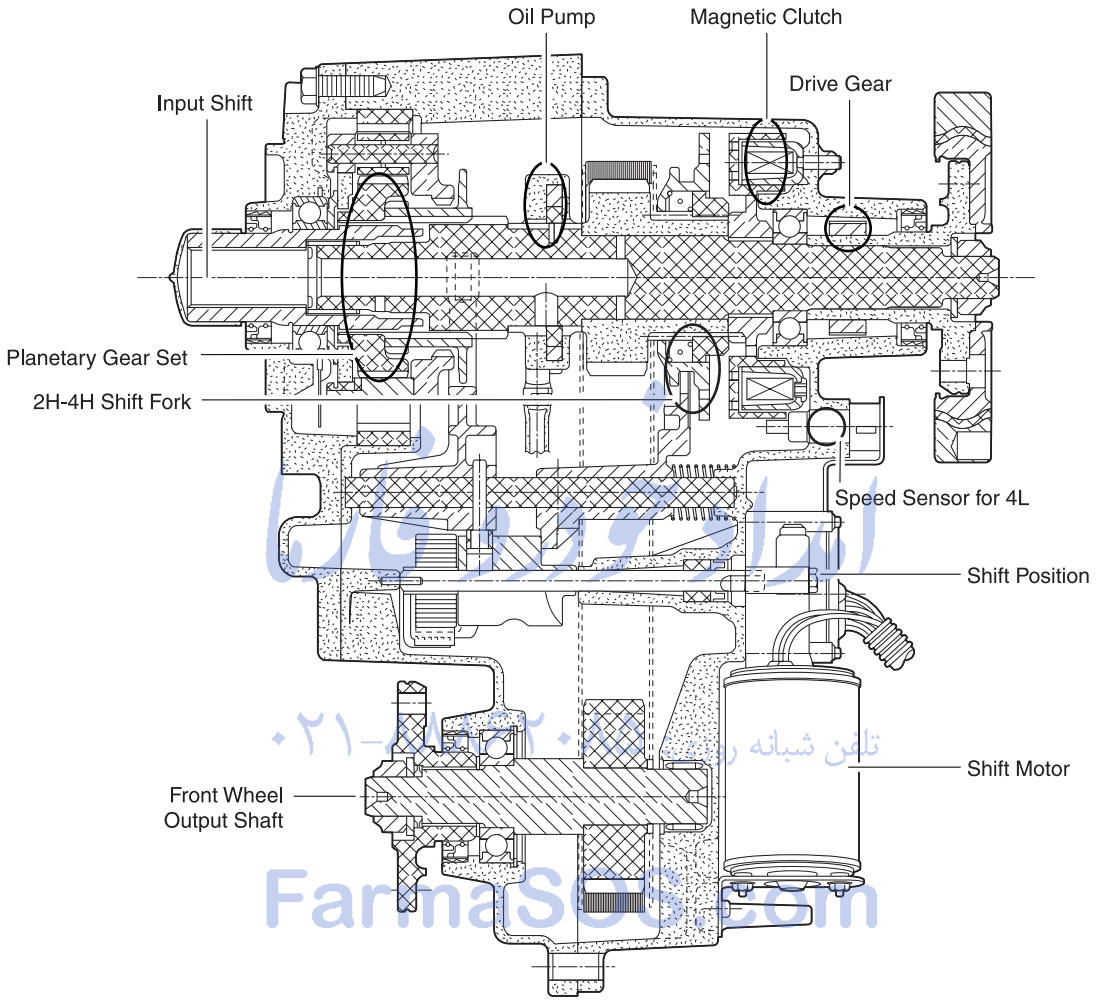
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No.	Defective Code	Malfunctioning Part
6	 KAA5D190	Selector Switch
7	 KAA5D200	Motor Position Sensor

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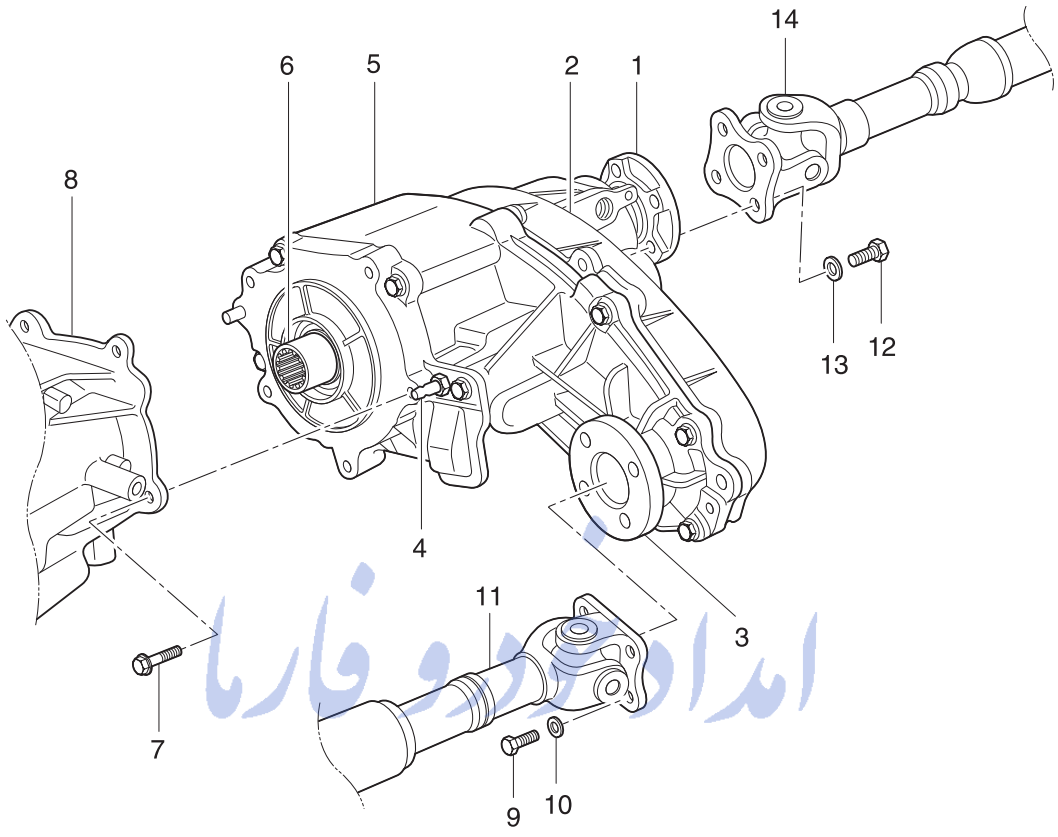
COMTONENT LOCATOR

CROSS SECTIONAL VIEW



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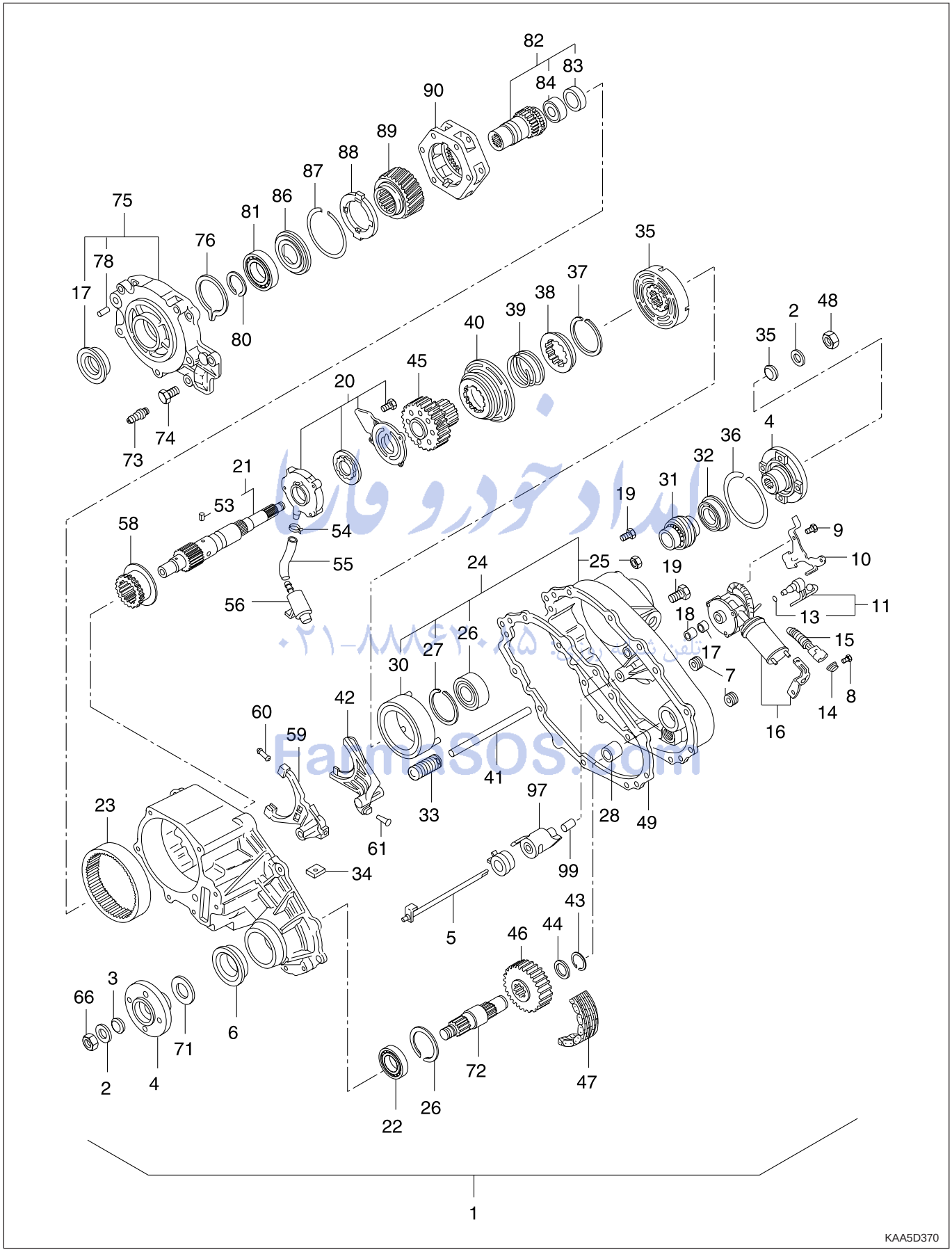
TRANSFER CASE ASSEMBLY



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1 Rear Companion Flange
2 Case Cover
3 Front Companion Flange
4 Breather Plug
5 Transfer Case
6 Input Shaft
7 Mounting Bolt
8 Transmission Extension Housing
9 Bolt
10 Washer
11 Front Propeller Shaft
12 Bolt
13 Washer
14 Rear Propeller Shaft

DISASSEMBLY AND ASSEMBLY

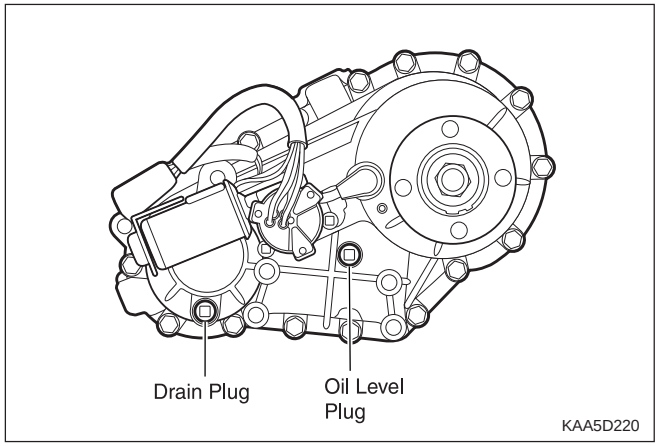


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1 Transfer Case
2 Spring Washer
3 Oil Seal
4 Companion Flange
5 Shift shaft
6 Oil Seal
7 Pipe Plug
8 Screw
9 Bolt
10 Speed Sensor and Harness Bracket
11 Speed Sensor Assembly
12 Speed Sensor
13 O-Ring
14 Locking Clip
15 Connector
16 Motor Assembly
17 Oil Seal
18 Bearing
19 Bolt
20 Pump Assembly
21 Output Shaft Assembly
22 Bearing
23 Ring Gear
24 Cover Assembly
25 Nut
26 Snap Ring
27 Bearing
28 Needle Bearing
30 Clutch Coil Assembly
31 Speed Gear
32 Oil Seal
33 Return Spring
34 Magnet
35 Clutch Housing
36 Snap Ring (option)
37 Snap Ring
38 Lock-up Hub
39 Sleeve Return Spring
40 Lock-up Collar
41 Rail Shaft
42 Lock-up Fork
43 Snap ring
44 Spacer
45 Driven Sprocket
46 Driving Sprocket
47 Drive Chain
48 Nut
49 Gasket
53 Spring Pin
54 Hose Clamp
55 Hose Coupling
56 Oil Strainer
58 Reduction Hub
59 Shift Fork Assembly
60 Shift Fork Facing
61 Roller and Retainer
66 Nut
67 Plane Washer
68 Oil Seal
71 Spacer
72 Front Output Assembly
73 Breather
74 Bolt
75 Front Adapter Assembly
76 Snap Ring
80 Snap Ring
81 Bearing
82 Input Shaft Assembly
83 Sleeve Assembly
84 Needle Bearing
86 Thrust Washer
87 Retaining Ring
88 Thrust Plate
89 Sun Gear
90 Gear Carrier Assembly
97 Electric Shift Cam
99 Spacer

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MAINTENANCE AND REPAIR



ON-VEHICLE SERVICE

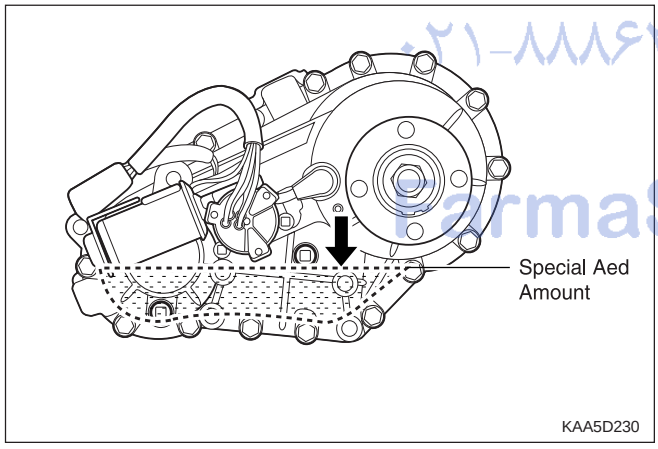
MAINTENANCE OF TRANSFER CASE LUBRICANT

1. Oil Level Check
   - Clean the oil level plug and surrounding area.
   - Remove the oil level plug and check whether oil is drip out or not.
   - Tighten the oil level plug.

Installation Notice

Tightening Torque	4 - 6 N•m (35 - 53 lb-in)

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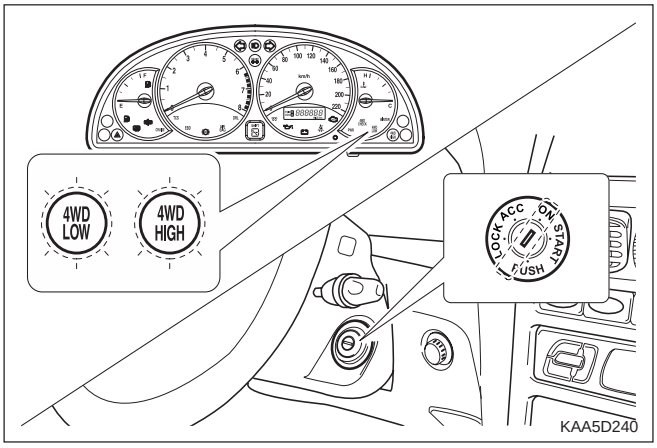
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2. Oil Change
   - Clean the oil level plug and surrounding area
   - Place a suitable container under the transfer case.
   - Remove the oil and tighten the drain plug.

Installation Notice

Tightening Torque	20 - 30 N•m (15 - 22 lb-ft)

   - Fill the oil through the oil level plug until oil begins to drip out.
   - Tighten the oil level plug.
3. Cautions for oil level check and plugs tightening
   - Do not use an impact wrench to remove or tighten the oil level plug or drain plug since this will damage the threads in the transfer case.



4H AND 4L INDICATOR

When the ignition switch turns on, 4H and 4L indicators turn on for 0.6 seconds and turn off.

Notice: If 4H and 4L indicators do not turn on, check the related bulb, the wiring harness and TCCU.

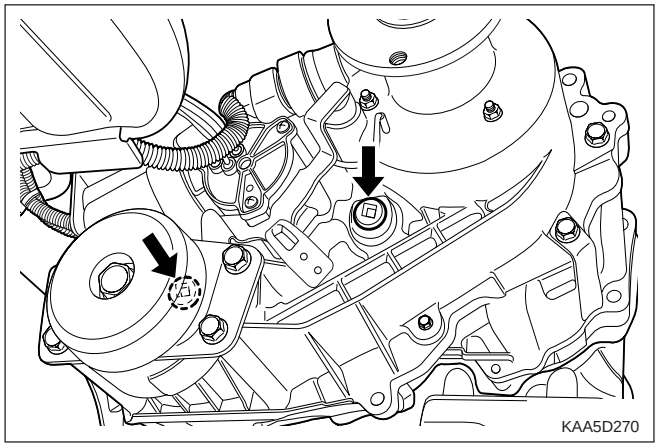
TCCU INSPECTION

Pin No.	Operation Condition	Voltage(V)
J1 - 7	4H or 4L	4.75 - 5.35
	2H	0 - 0.50
J1 - 8	4H indicator light ON	< 1.00
	4H indicator light OFF	> 11.00
J1 - 13	2H or 4H	4.75 - 5.35
	4L	0 - 0.50
J1 - 14	Clutch pedal applied	< 0.50
	Clutch pedal released	> 11.00
J1 - 15	4L indicator light ON	< 1.00
	4L indicator light OFF	> 11.00
J1 - 16	Motor OFF	< 1.00
	Motor ON	> 11.00
J1 - 17	Motor OFF	< 1.00
	Motor ON	> 11.00
J1 - 23	Auto locking hub ON	> 11.00
	Auto locking hub OFF	< 1.00

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تلفن شبانه روزی: ۰۹۱۲-۸۸۸۶۲۰۸۵
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Notice:

- DC 12V for the TCCU operation should be maintained.
- In case of J1-8 and J1-15, indicator light will turn on for 0.6 second when turn the ignition switch ON.
- If 4H and 4L indicator lights remain turned on when turn the ignition switch on or during driving, perform the TCCU diagnosis.



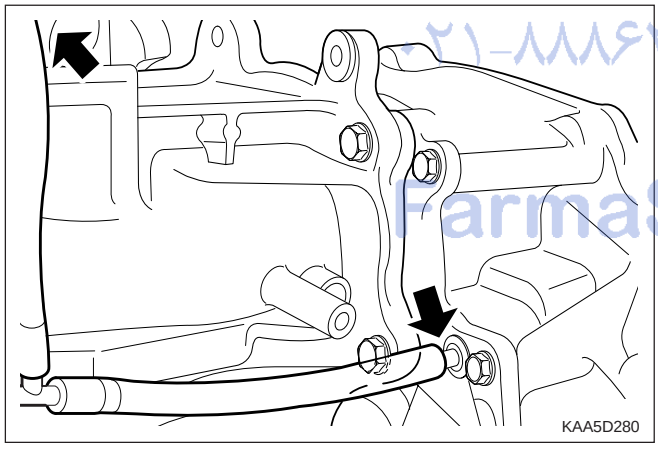
TRANSFER CASE ASSEMBLY

1. Disconnect the negative terminal from the battery.
2. Lift up the vehicle and fix it safely.
3. Remove the damper mounting bolt.
4. Remove the drain plug and drain the oil.
   Reinstall the drain plug.

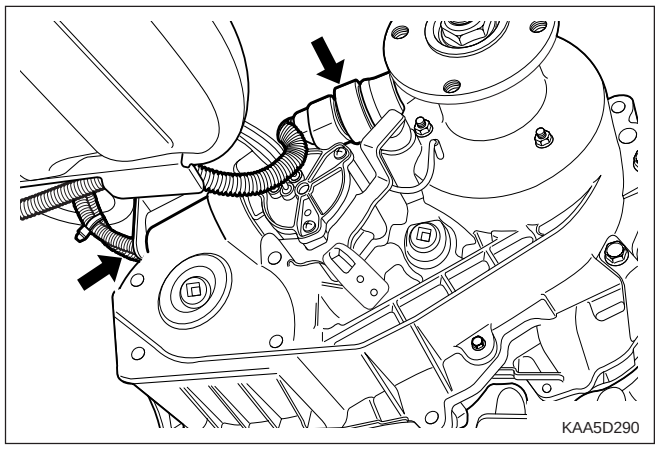
Installation Notice

Drain Plug Tightening Torque	20 - 30 N•m (15 - 22 lb-ft)
Damper Tightening Torque	30 - 40 N•m (22 - 30 lb-ft)
Fill plug Tightening Torque	4 - 6 N•m (35 - 53 lb-in)

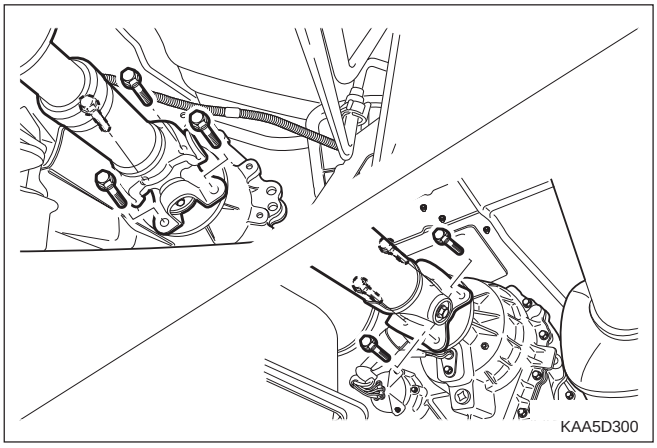
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5. Remove the breather hose.



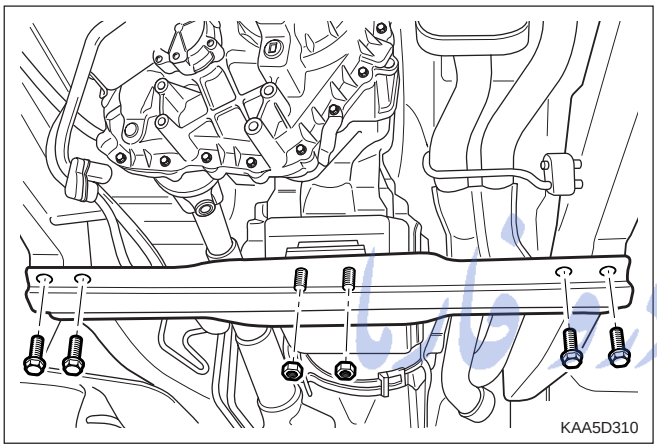
6. Disconnect the speedometer cable connector and other cable connectors and wiring harnesses.



7. Support the transfer case with jack and remove the front and rear propeller shafts from the transfer case.

Installation Notice

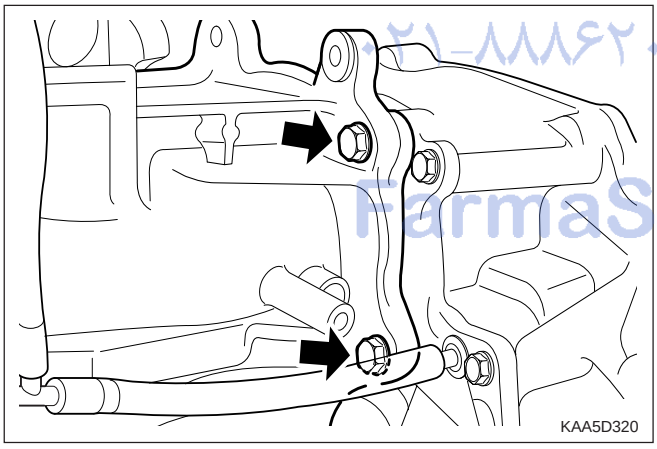
Tightening Torque	Front	81 - 89 N•m (60 - 66 lb-ft)
	Rear	70 - 90 N•m (52 - 66 lb-ft)



8. Remove the center mounting nuts and end sides mounting bolts of the cross member and then remove the cross member.

Installation Notice

Tightening Torque(1)	12 - 23 N•m (9 - 17 lb-ft)
Tightening Torque(2)	6 - 8 N•m (53 - 71 lb-in)



9. Remove the transfer case by removing the bolts attaching the transfer case to the transmission.

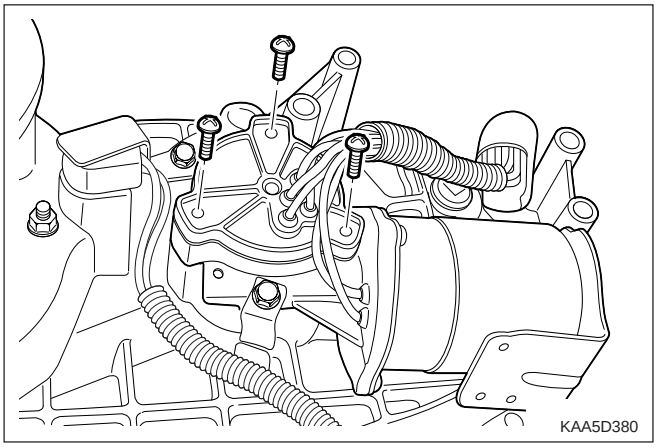
Installation Notice

Tightening Torque	35 - 60 N•m (26 - 44 lb-ft)

Notice: Apply long-term grease to the inner spline of the transfer case input shaft.

10. Installation should follow the removal procedure in the reverse order.

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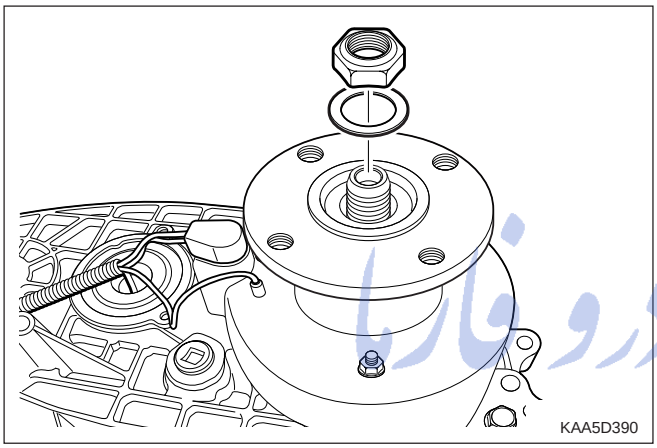

KAA5D380

UNIT REPAIR

DISASSEMBLY PROCEDURE

Shift Motor Assembly

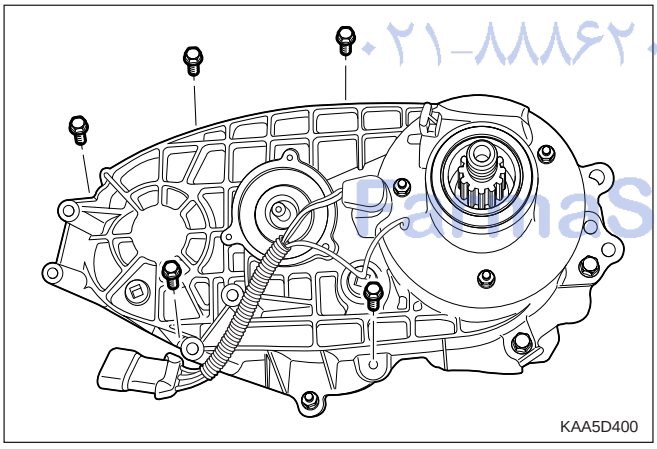
1. Separate the harness bracket.
2. Remove the shift motor mounting bolt and remove the shift motor assembly.


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Companion Flange

1. Holding the companion flange, remove the nut and washer and then remove the companion flange.
2. Remove the oil seal.
3. Remove the companion flange from the case cover.

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۰۲۱-۸۸۸۶۲۰۸۵
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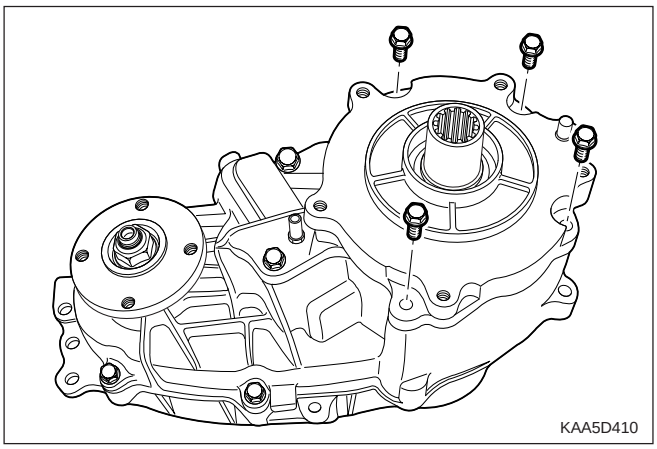

KAA5D400

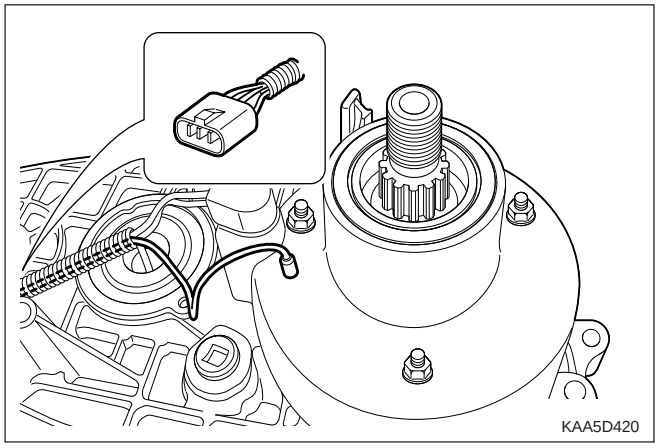
Case Cover Assembly

1. Remove the cover mounting bolts(9), and the case mounting bolts(5).

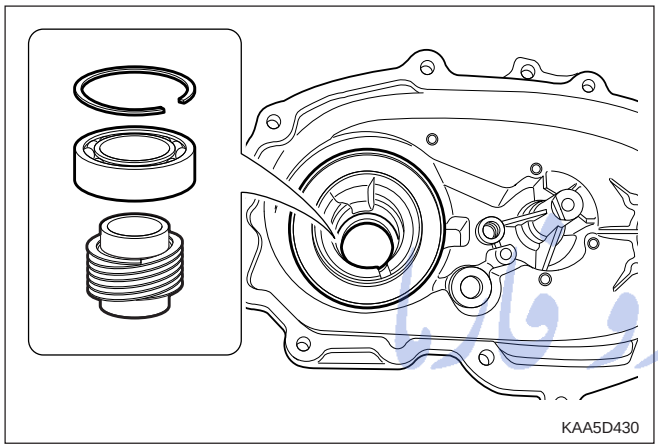
   Notice: Identification tag has information required for ordering replacement parts, so be careful not to lose it.

2. Using a driver, pry and disconnect the sealant bond of the cover and required case.

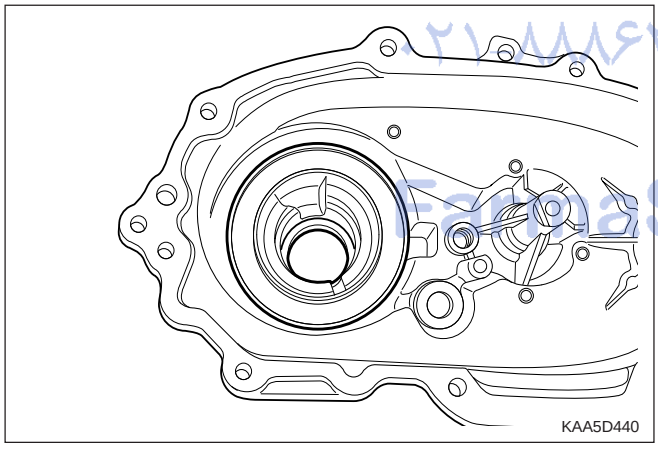

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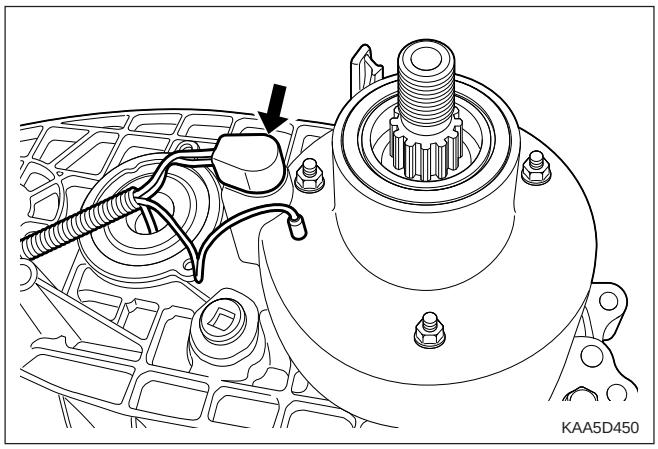
3. Remove the clutch coil wiring from the connector.
4. Remove the clutch coil assembly mounting nut.



5. Remove the snap ring and pull out the ball bearing from the cover to remove the speed gear.

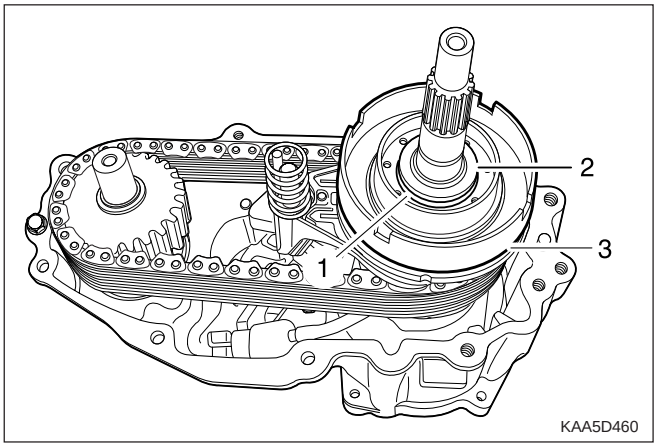


6. Remove the clutch coil assembly and the oil seal from the cover.



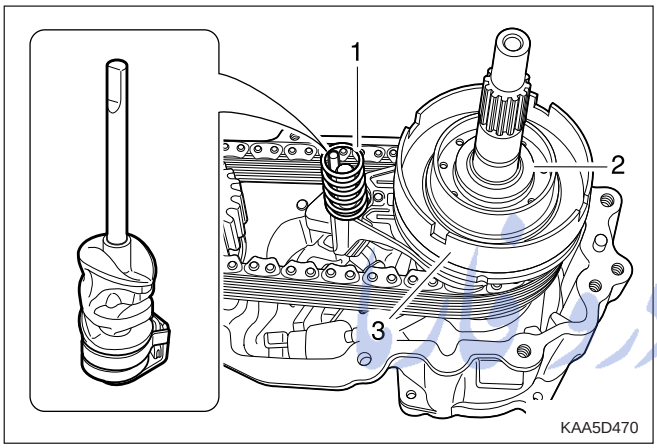
7. Remove the speed sensor and the O-ring from the case cover.

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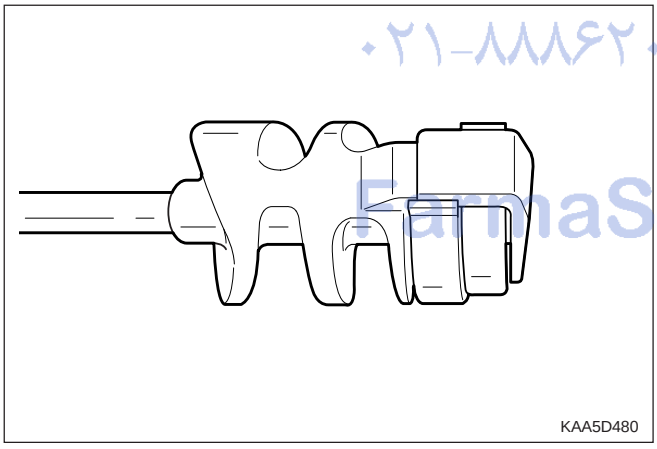
Transfer Case Assembly

1. Separate the shift motor shaft cam assembly and the spring (1).

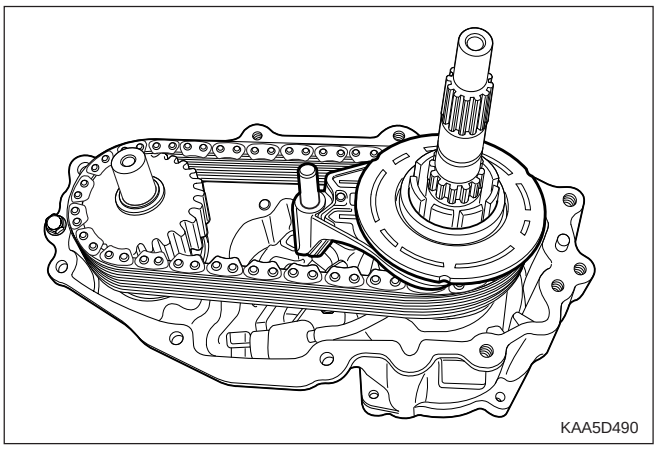


2. Remove the clutch housing assembly from the output shaft.
   - Clutch Housing Component
     (1) Retaining Ring
     (2) Shift collar Hub
     (3) Clutch Housing

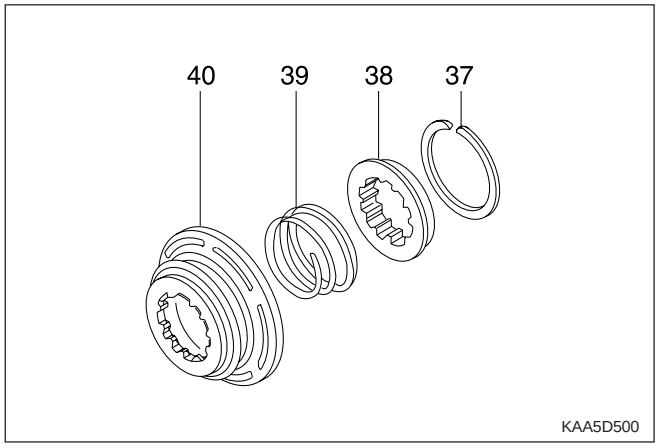
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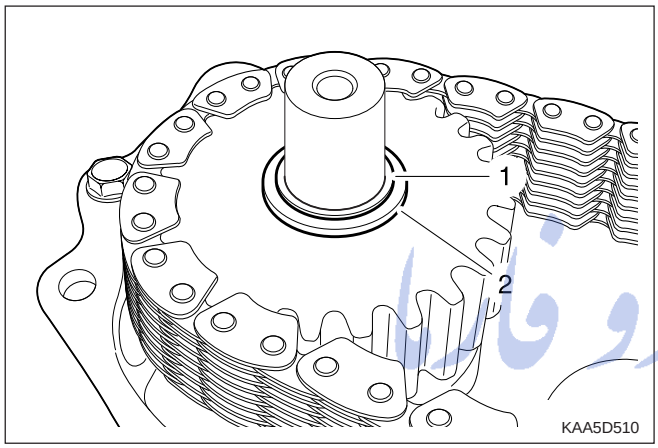
- Remove the shift cam from the shaft.
- Fix the shaft at the vise with the cam removed and remove the torsion bar using a driver.



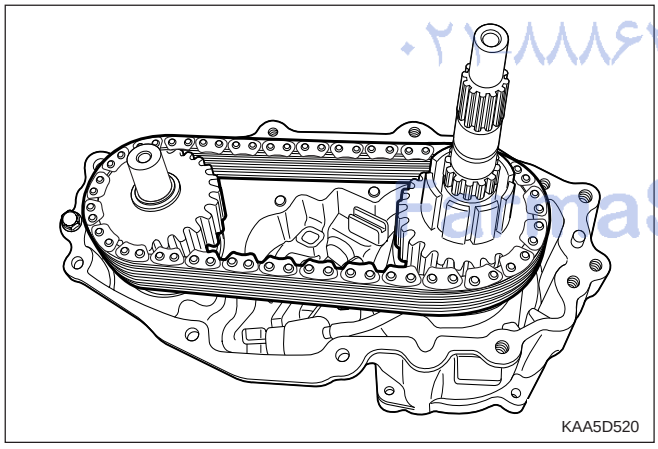
3. Remove the 2WD/4WD lock up assembly, the lock up fork and rail shaft from the output shaft.



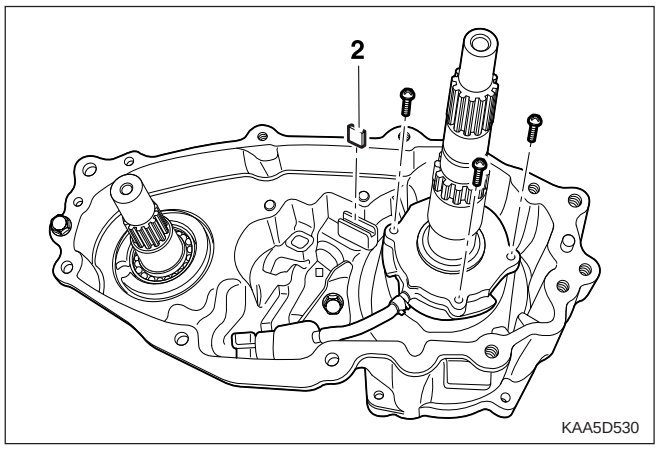
- 2WD/4WD Lock Up Assembly Component.
  (37) Snap Ring
  (38) Lock up Hub
  (39) Return Spring
  (40) Lock up Collar



4. Remove the snap ring from the front output driven sprocket and separate the snap ring and the spacer.

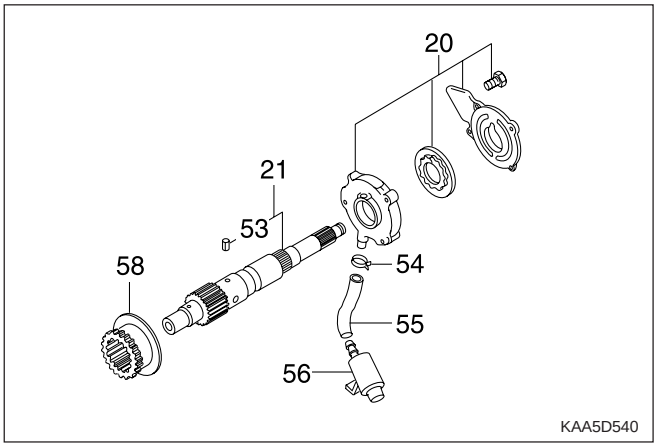


5. Remove the driving sprocket, the driven sprocket and the driving chain from the front/rear output shaft.

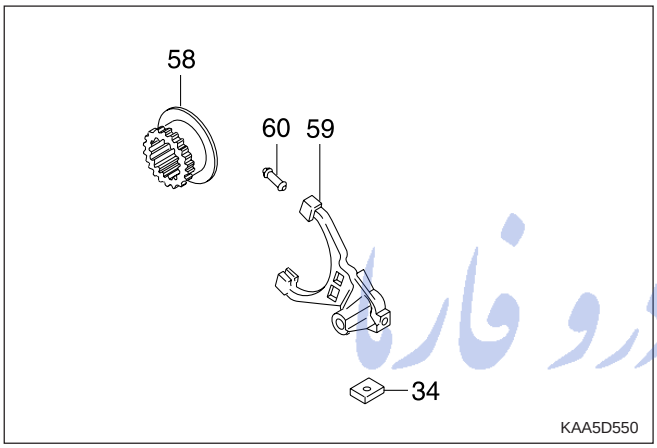


6. Remove the oil pump assembly and the magnetic from the output shaft.

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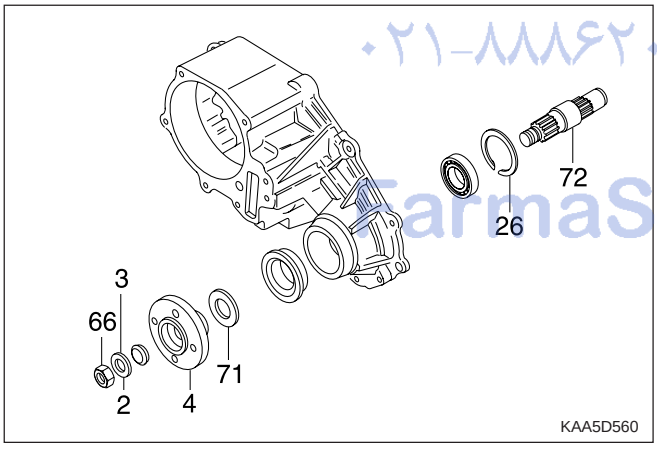


- Remove the bolt and the retainer. Separate the output shaft and rear pump cover.
- Remove the hose clamp and remove the hose coupling cover from the pump housing.
- Remove the hose clamp, the hose coupling and the strainer.
- Remove two pump pins and the spring from the output shaft.
- Separate the front pump and remove the output shaft.



Reduction Shift Parts

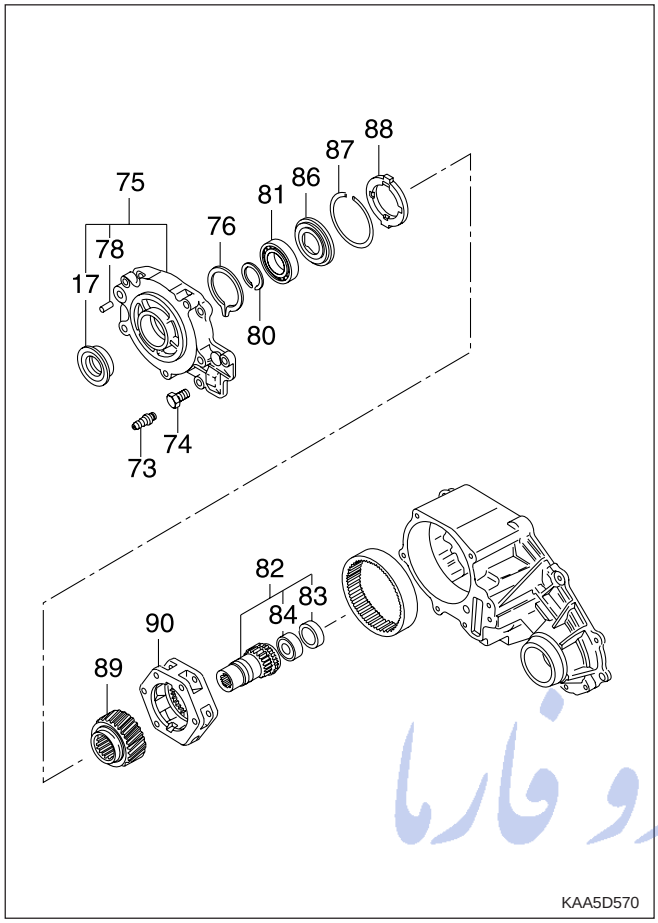
1. Remove the reduction hub and reduction shift fork assembly from the case.
2. Remove the 2 shill fork facings from the shift fork assembly.
3. To remove the roller cam and pin, cut elf the plastic retainer when disassembling the fork assembly.



Front Output Assembly

1. Holding the companion flange, remove the nut and washer and then remove the companion flange and oil seal.
2. Remove the output shaft.

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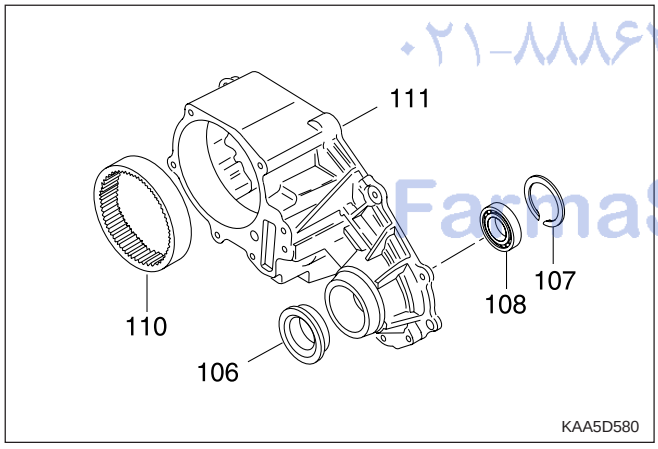
Adapter, Input Shaft and Carrier Gear

1. Remove the breather.
2. After removing 6 bolts, remove the front adopter by separating the adapter sealer bond from the case using a screw driver.

   Notice: Be careful not to damage the contacting surface of the case and adapter.

3. Remove the adapter assembly, input shaft assembly and carrier gear assembly.
4. Remove the snap ring and oil seal from the front adapter.
5. After removing snap ring, pull out the bearing and thrust washer from the input shaft assembly and separate the input shaft assembly from the carrier gear assembly.
6. Remove the needle bearing and sleeve bearing from the input shaft assembly.
7. Remove the retaining ring, thrust plate rind sun gear from the planet carrier assembly.

   Notice: Do not disassemble the planet carrier assembly.



Transfer Case Assembly (Front)

1. Remove the oil seal.
2. Remove the retaining ring and the ball bearing.
3. Remove the pin from the transfer case.

   Notice: Be careful not to give any damage to the case for removing the pin.

4. Remove the ring gear from the case using the press.

   Notice: Replace new part for installation.

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Cleaning Procedure

Notice: Before cleaning, check the magnet for the presence of metal particles which indicate internal chipping of the transfer case.

1. Using cleaning solvent, clean the residual oil and dirt deposits.

   Notice: During cleaning, be careful not to damage the metal surfaces.

2. After cleaning, dry the parts with low pressure(Max. 20 psi) compressed air.
3. Lubricate the ball bearings and needle bearings with transfer case oil after cleaning.

   Notice: Protect the lubricated bearings from dust.

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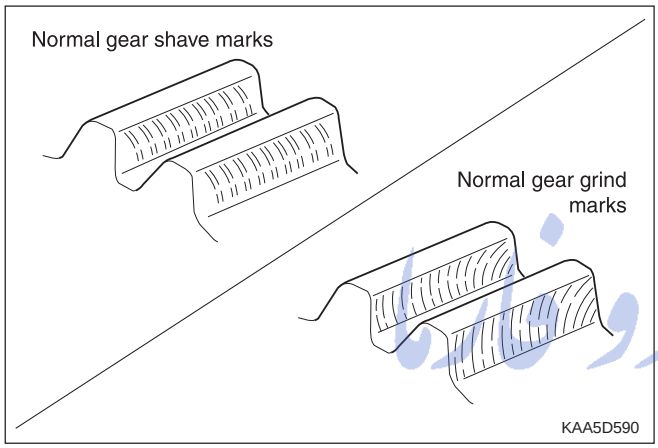
Inspection Procedure

1. Visually check the all removed parts.

   Notice: Always replace the hose coupling, O-ring and oil seal with new parts.

2. Inspection Terms
   - Burr : Local rise of material forming protruding sharp edge
   - Chip : An area from which a small fragment has been broken off or cut
   - Crack : Surface break of line nature indicating partial or complete separation of material.
   - Excessive wear : Heavy or obvious wear beyond expectations considering conditions of operation.
   - Indentation : Displacement of material caused by localized heavy contact.
   - Galling : Breakdown of metal surface due to excessive friction between parts. Particles of the softer material are torn loose and welded to the harder material.
   - Nick : Local break or notch, usually displacement of material rather than loss.
   - Scoring : Tear or break in metal surface from contact under abnormal pressure.

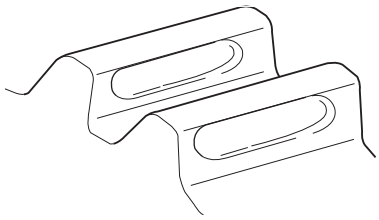
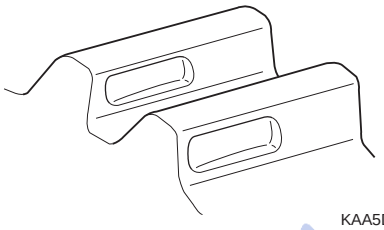
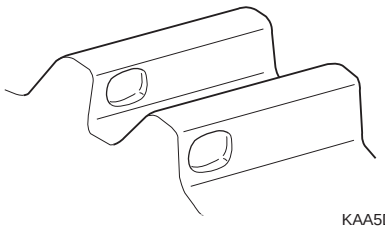
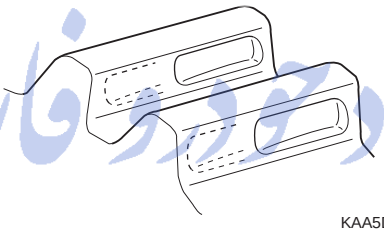
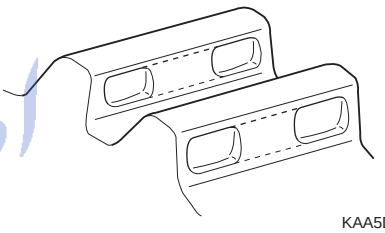
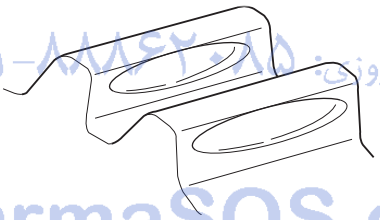
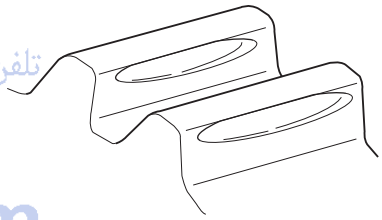
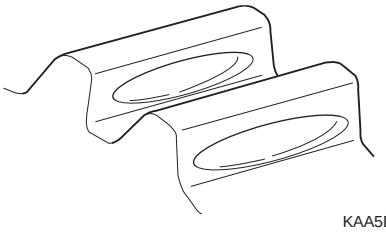
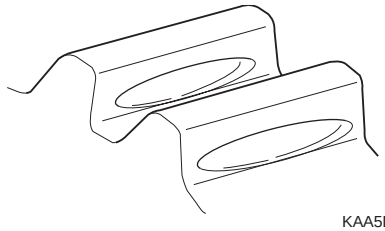
- Step wear : Heavy wear that produces a step that can be seen or felt between adjacent contact and non-contact surfaces.
- Uneven wear : Condition of localized, unevenly distributed wear Includes hollows, shiny spots, uneven polish and other visual indications.



3. Specific Inspection
   - Referring to normal gear tooth face, specifically inspect the uneven wear and chips of gear tooth. Replace or repair if necessary.

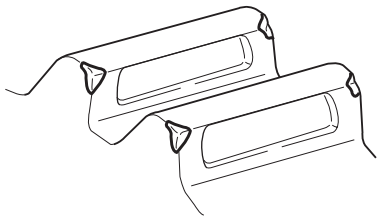
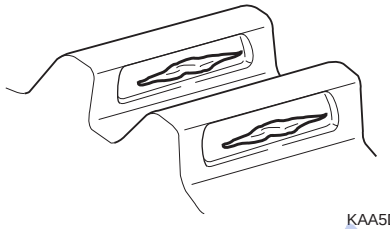
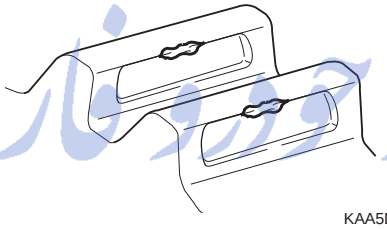
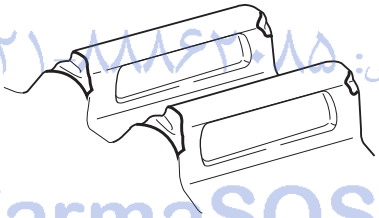
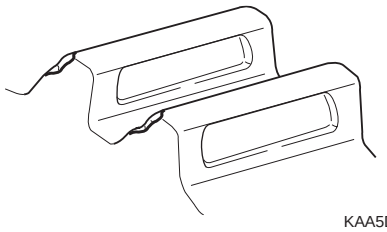
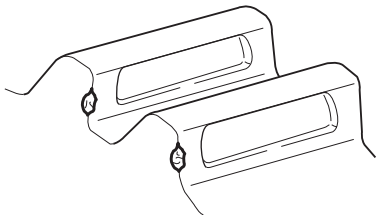
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4. Inspection of contact patterns

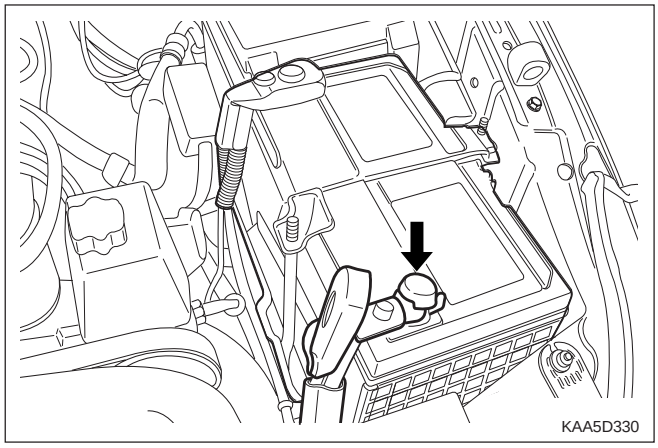
Description	Normal	Abnormal
Normal Wear	 KAA5D600	
End Face Wear	 KAA5D610	 KAA5D620
Traveling Face Wear	 KAA5D630	 KAA5D640
Upper Face Wear	 KAA5D650	 KAA5D660
Lower Face Wear	 KAA5D670	 KAA5D680

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5. Chip pattern of the gear face

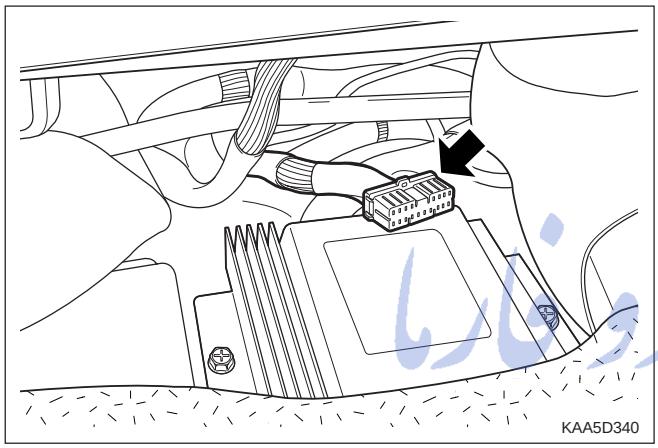
Description	Patterns	Action
Corner chip at drive face	 KAA5D690	Repair
Edge chip at drive face	 KAA5D700	Repair
Corner chip at coast face	 KAA5D710	Repair
Chip within contact pattern	 KAA5D720	Replace
Chip completely through tooth	 KAA5D730	Replace
Side edge chip at drive face	 KAA5D740	Replace

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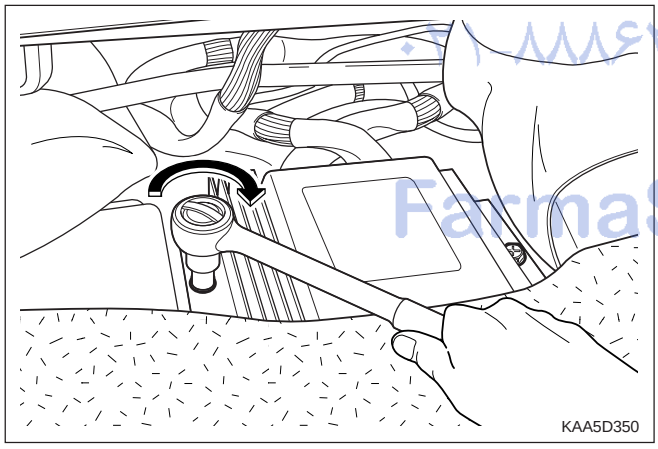


TCCU

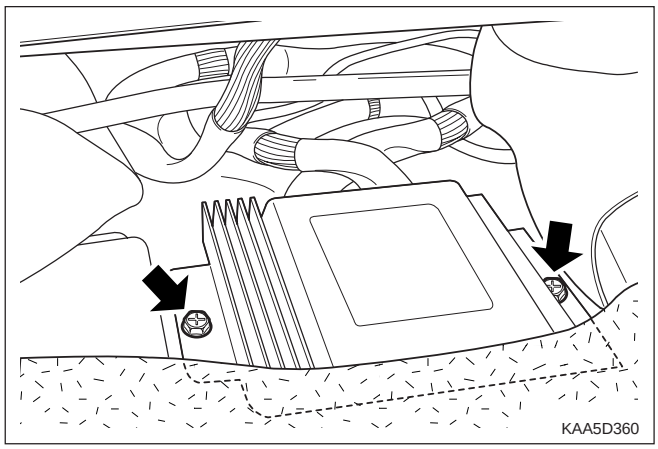
1. Disconnect the negative terminal from the battery.



2. Remove the TCCU connector.



3. Remove the TCCU mounting bolt and remove the TCCU.
   - TCCU installation position : Under the driver's seat



4. Installation should follow the removal procedure in the reverse order.

   Notice: Be careful not to give any impact to the TCCU body.

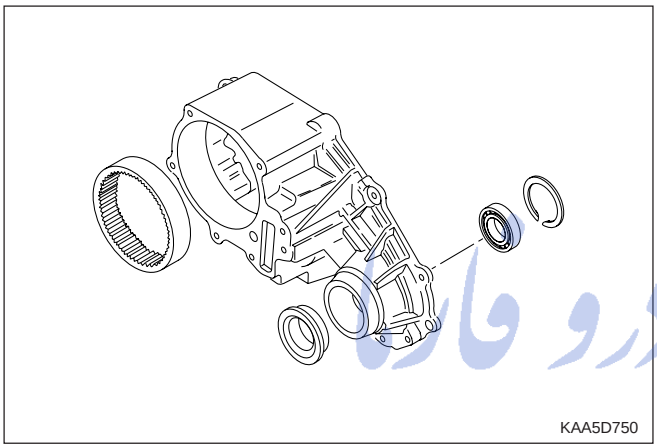
Installation Notice

Tightening Torque	10 N•m (89 lb-ft)

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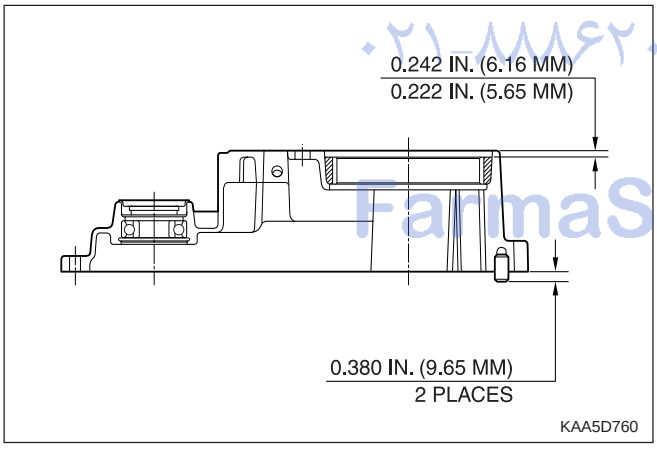
ASSEMBLY PROCEDURE

- Use special tools during assembly of oil seals and bearings.
- Lubricate bearings, oil seals and bushings before assembly.


KAA5D750

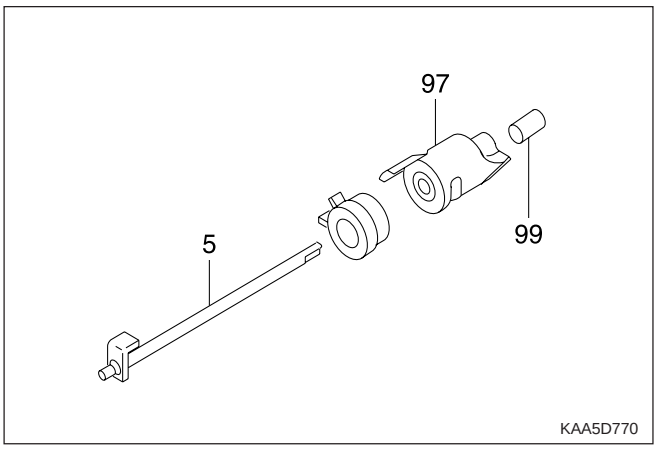
Transfer Case Assembly

1. If the ring gear was removed, align the outer diameter of the new replaced ring gear with transfer case and assemble it.
2. Insert the pin.
3. Insert the ball bearing to the case and install the retaining ring.
4. Install the new oil seal by pressing into the case.



KAA5D760

5. Make sure that all parts are correctly and firmly installed into the case.

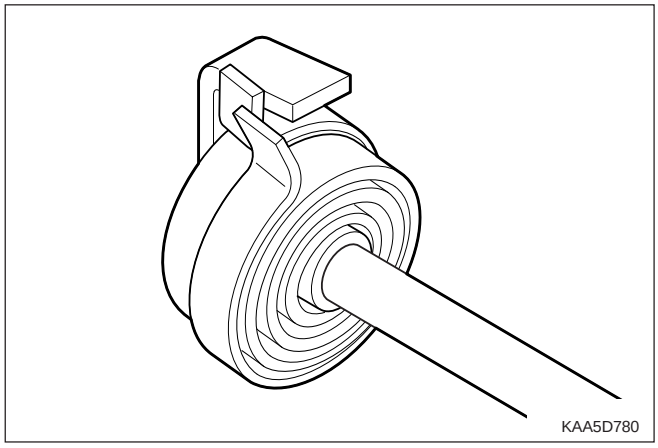


KAA5D770

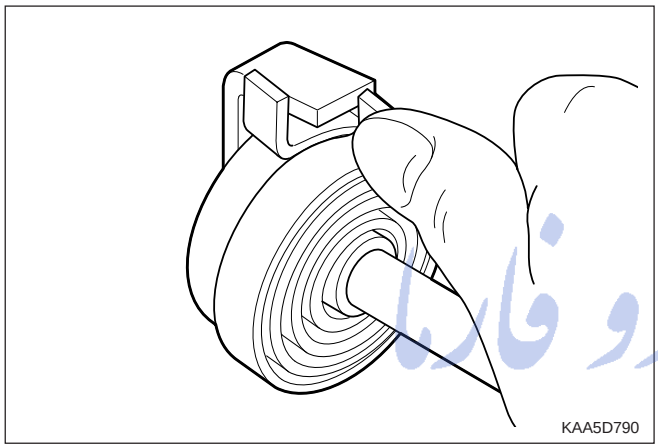
Electric Shift Cam Parts

1. Insert the spacer into torsion spring.
2. Insert the end of the shift shaft into the spacer smoothly.

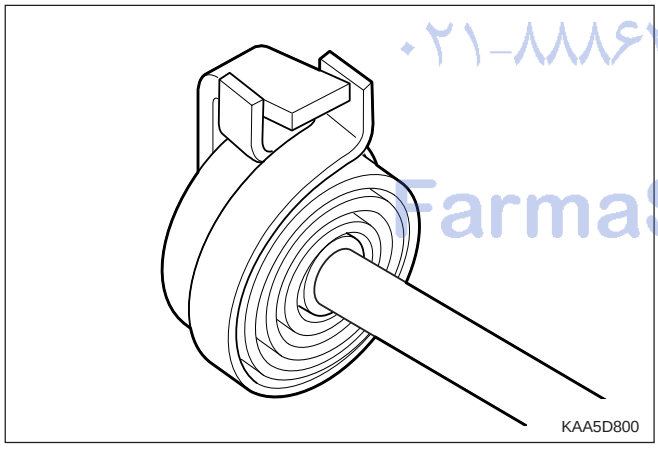
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3. Slide the torsion spring and spacer to the left of the shift shaft and position the end of the first spring to fix on the drive tang.

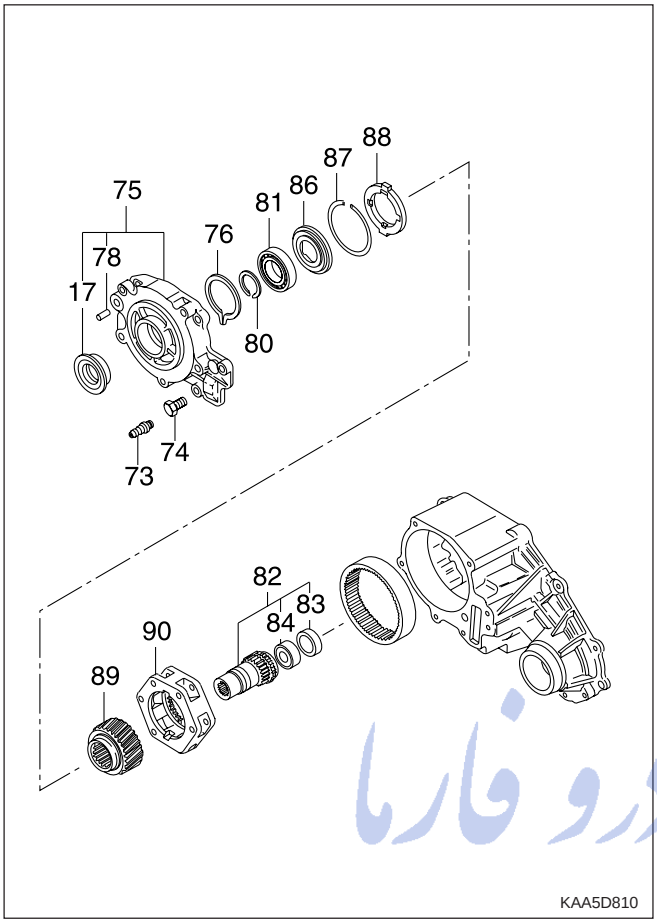


4. Push the end of the second spring to right and fix it on the drive tang.



5. Push the torsion spring and spacer together back them completely.
6. Slide the electric shift cam onto the shift shaft.
7. Install the electric shift cam assembly into the transfer case after installation of the shift fork.

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Adapter, Input Shaft and Carrier

1. Place the planet carrier assembly on work bench to be the retaining ring mounting groove upward.
2. Install the sun gear with the hub end up into the planet carrier assembly and rotate the sun gear to make sure that gears are fully engaged.
3. Align the tabs and install the thrust plate into the planet carrier assembly.
4. Install the retaining ring to the planet carrier assembly.
5. Press the needle bearing into the input shaft and press the new sleeve bearing into the input shaft assembly.
6. Install the planet carrier assembly onto the input shaft and install the thrust washer. Press the bearing over input shaft.
7. After pressing the bearing, install the retaining ring.
8. Press the pin into the front adapter.
9. Slowly press the oil seal into the front adapter.
10. Install the front adapter assembly.

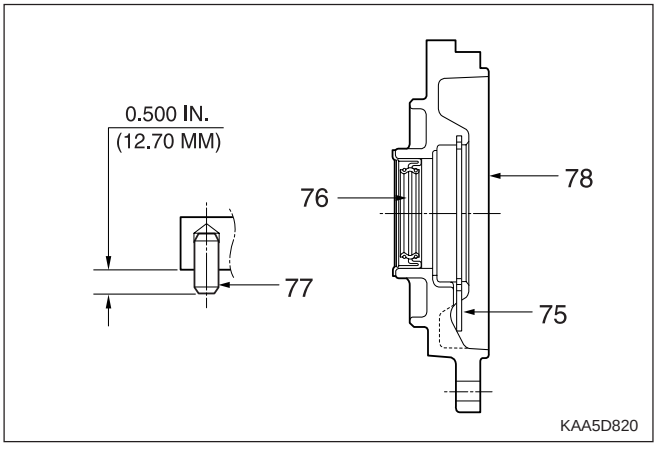
    Notice: After installation, make sure that snap ring is correctly installed into the groove.

11. Position the input shaft assembly over front cover and engage into the bearing groove by expanding the ends of snap ring.
12. Apply 1.6mm bead of sealant on the mounting face for the transfer case and tighten the 6 bolts.
13. Install the breather.

Installation Notice

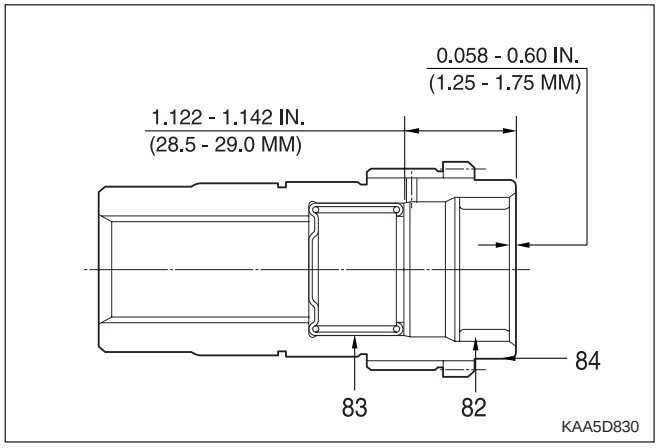
Item	Tightening Torque
6 Bolts	28 - 40 N•m (21 - 30 lb-ft)
Breather	4 - 7 N•m (35 - 62 lb-in)

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۰۲۱-۸۸۸۶۲۰۸۵
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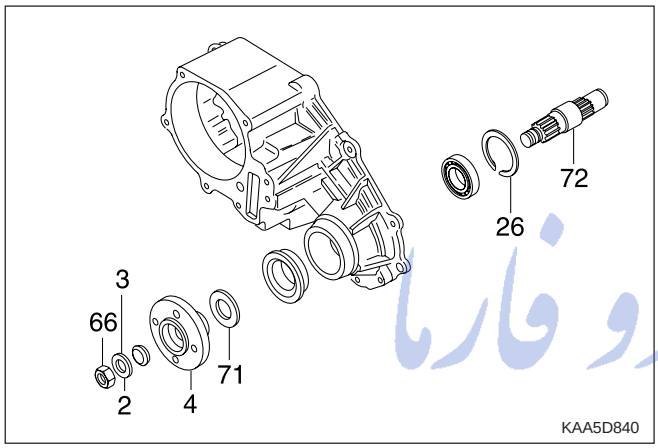
Front Output Shaft

Cross Sectional View



Input Shaft

Cross Sectional View

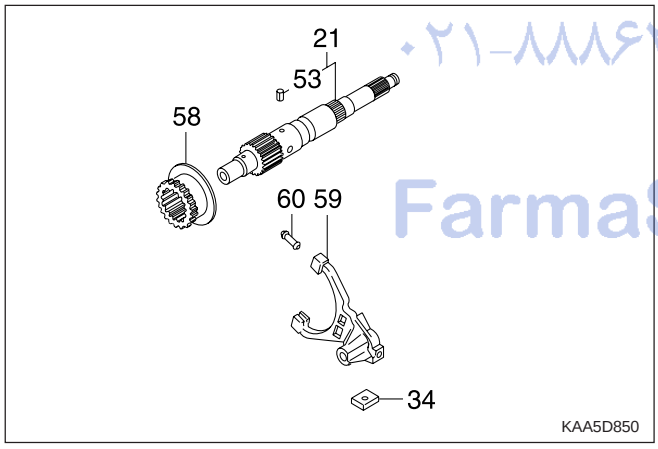


Front Output Shaft

1. Install the deflector on the yoke.
2. Position the output shaft in transfer case and install the companion flange assembly, oil seal, washer and nut.
3. Holding the companion flange, tighten the nut.

Installation Notice

Tightening Torque	346 - 380 N•m



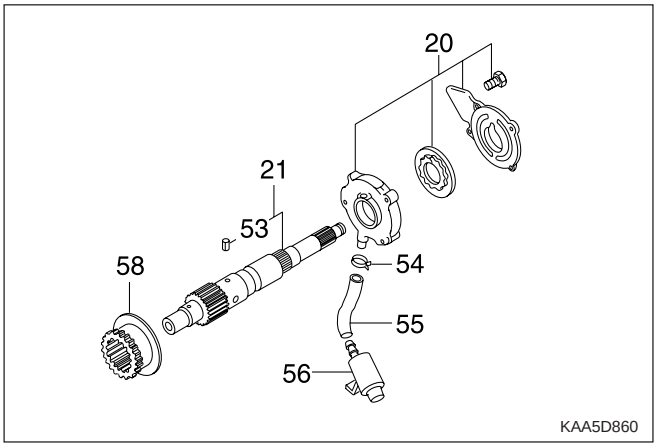
Reduction Shift Parts

1. Install the new pin, roller and retainer into the reduction shift fork.
2. Press the pin, roller and retainer into the reduction spilt fork bore completely.

   Notice: Make sure that the cam roller turns freely.
3. Install the 2 fork facing on the reduction shift fork assembly.
4. Install the reduction shift fork onto the previously installed reduction hub in the transfer case.
5. Install the output shaft spline into the reduction hub and engage the output shaft end with input shaft bearing.

   Notice: For installation of the output shaft, assemble the oil pump temporarily.

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Oil Pump

1. Install the pump front cover to be the “TOP” mark down and turn the cover to be the “TOP” mark up when installed in vehicle.
2. Install the 2 pump pins and spring to the output shaft.

   Notice: Flat surface of the pins must point out and align the center line of pins and spring.

3. Connect the hose coupling to the strainer coupling and install the strainer foot into the transfer case slot.

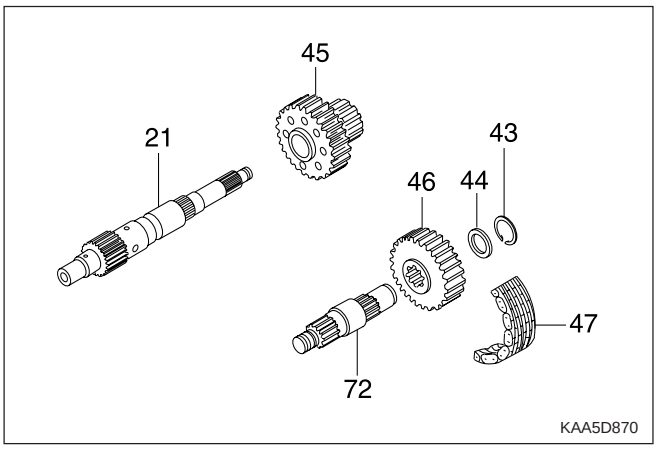
   Notice: The hose coupling must face the pump assembly.

4. Install the pump housing to be the ‘REAR’ mark up and seat the 2 pump pins inside of the pump housing by moving pump pins inward and compressing the spring.
5. Tighten the hose to pump housing by hose clamp.
6. Position the pump rear cover to be the TOP REAR mark up and located at the top of transfer case when installed in vehicle. Position the pump retainer on the cover so that tab on the retainer is in notch in the transfer case. Apply Loctite to the bolts and tighten the bolts with turning the output shaft by hand to make the pump pins move freely.

Installation Notice

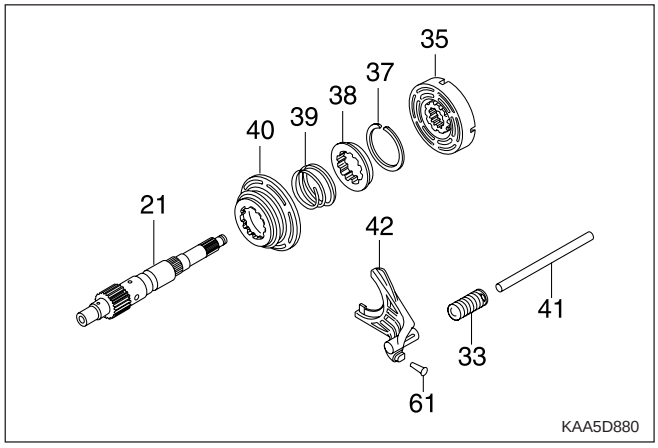
Tightening Torque	4 - 8.5 N•m (35 - 75.5 lb-in)

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۰۲۱-۸۸۸۶۲۰۸۵ تلفن شبانه روزی
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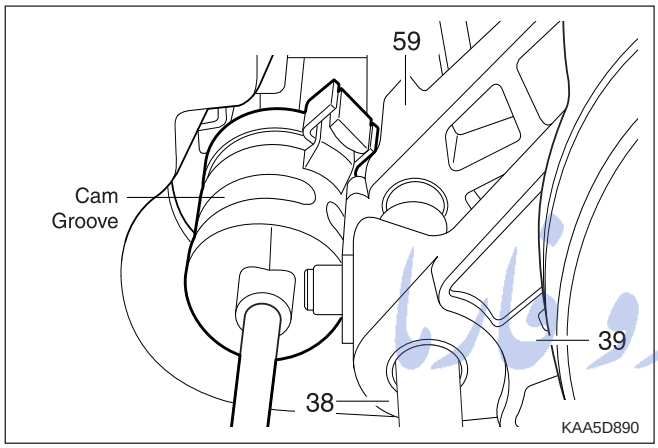
Drive Chain

1. Position the drive sprocket to the rear output shaft end and driven sprocket to the front output shaft end.
2. Install the drive chain onto the sprocket.
3. Holding each sprocket to be the drive chain tight and parallel with transfer case, install the drive chain assembly to the output shafts.
4. Rotate the driven sprocket slightly to engage splines on the front output shaft.
5. Install the spacer to the front output shaft and insert the snap ring into the shaft groove over spacer.



Lockup Shift

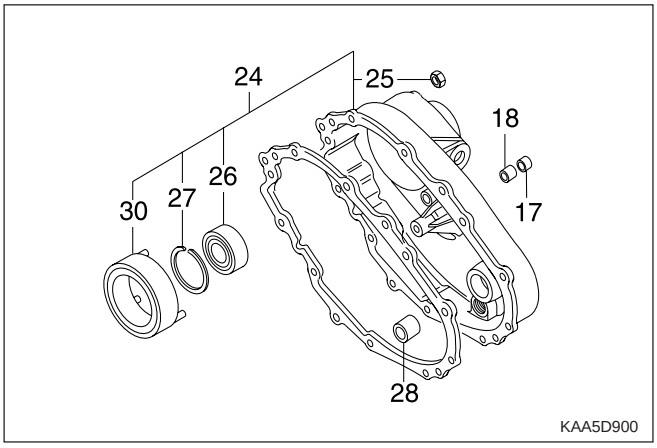
1. Install the lockup hub and return spring to the lockup collar and insert the snap ring.
2. Install the rail shaft through reduction shift fork assembly previously installed and into the blind hole in case.
3. Engage the lockup fork into the 2WD/4WD groove and check operation.
4. Install the shift collar hub to the output shaft spline.



5. Install the previously assembled electric shift cam and assemble the clutch housing as follows.
   - Rotate the shift cam assembly to right so that the end of the torsion spring contacts with reduction shift fork side.
   - Holding the rail shaft, lift up the fork assembly slightly.

     Adjust electric shift cam assembly so that the roller on reduction shift fork assembly is in groove in shift cam and button on lockup fork is on cam end.
   - Install the clutch housing over shift collar hub and insert the retaining ring into the clutch collar hub groove.

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Cover

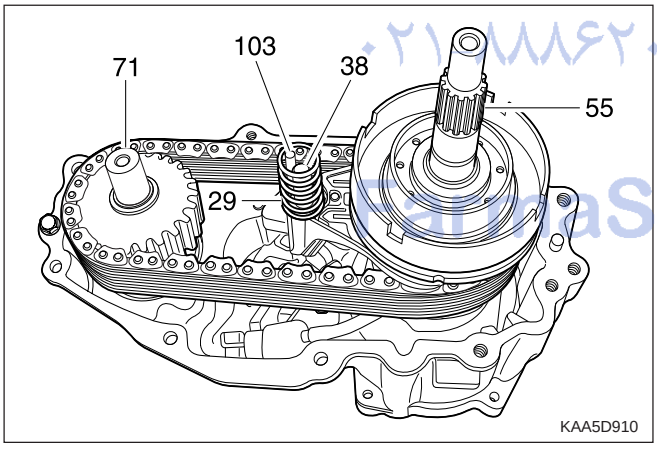
1. Position the cover to be the open end up on the work table.
2. Position the end of needle bearing to be identification mark up and press into the cover until upper end of bearing is 40.47 - 40.97 mm below cover face that contacts with transfer case.
3. Press the ball bearing into the cover and install the snap ring .
4. Install remaining parts as follows.
   - Install the 4 O-rings on the stud bolts of the clutch coil assembly.
   - Install the clutch coil assembly inside the cover and tighten 3 nuts.

   Installation Notice

Tightening Torque	8 - 11 N•m (71 - 97 lb-in)

   - Install the bearing and motor bearing into the cover.

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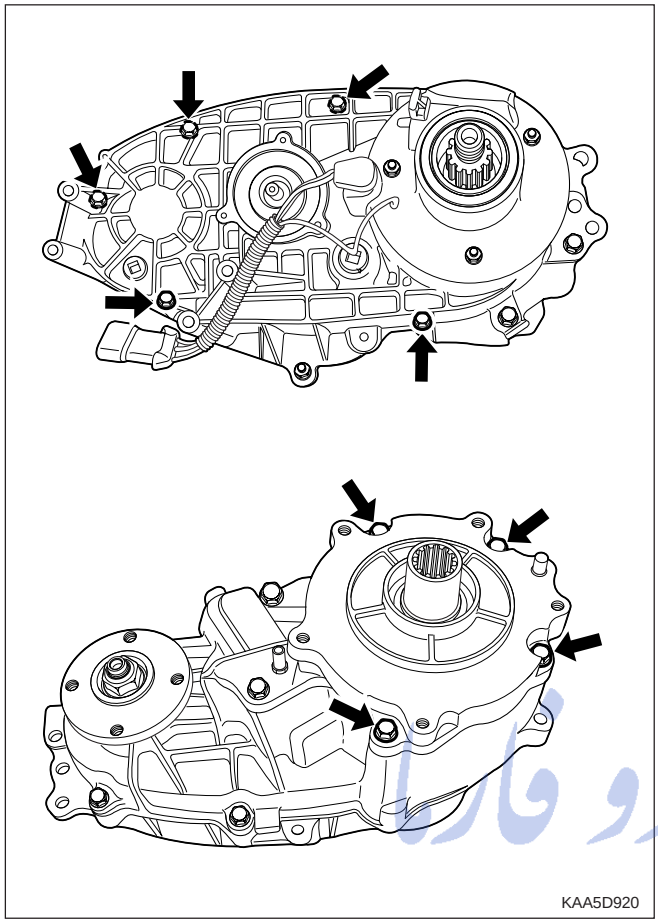
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Cover Assembly

1. Install the return spring over rail shaft in the transfer case.
2. Insert the magnet into the transfer case slot.
3. Apply 1.6 mm bead of Loctite RTV 598 to the transfer case mounting surface.

   Notice: For installation of cover, align the transfer case with cover not to use excessive force.

4. Install the cover onto the transfer case as follows:
   - Align the cover bores with transfer case pins.
   - Align the cover bearings with output shafts.
   - Align the cover blind hole with rail shaft and make sure that return spring is not cocked.



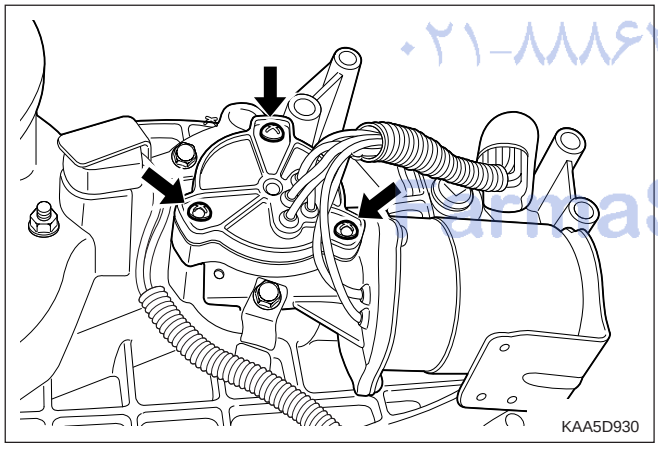
5. Tighten 9 bolts positioning identification tag and wiring clip.

Installation Notice

Tightening Torque	28 - 40 N•m (21 - 30 lb-ft)

6. Install the speed gear over output shaft spline in the cover assembly.
7. Press the new oil seal into the cover assembly.

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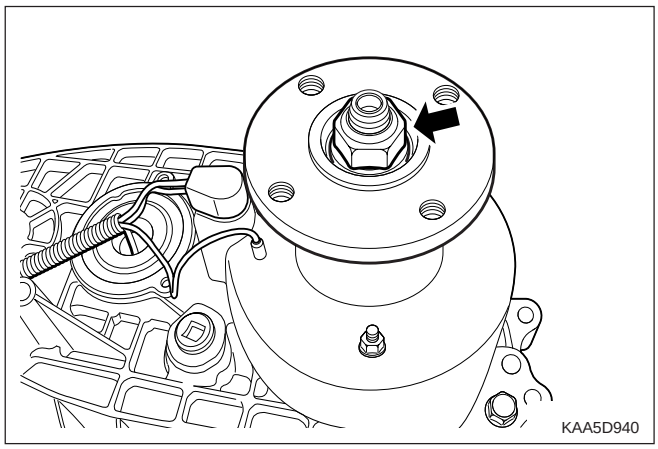


External Electric Shift

۰۲۱-۸۸۸۶۲۰۸۵

1. Align the motor with shift shaft and position the motor assembly onto the cover.
2. Install the motor to the shift shaft and contact cover and rotate the motor clockwise direction to check correct engagement.

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3. Insert the O-ring on the speed sensor assembly to the cover.
4. Install the bracket to the motor assembly and tighten 3 bolts.

Installation Notice

Tightening Torque	8 - 11 N•m (71 - 97 lb-in)

Companion Flange

1. Install the 2 plugs to the cover.
2. Install the companion flange, oil seal and washer.
3. Holding the companion flange, tighten the nut.

Installation Notice

Front Flage Nut Tighteng Torque	210 - 240 N•m (155 - 177 lb-ft)
Rear Flage Nut Tighteng Torque	310 - 340 N•m (229 - 251 lb-ft)

Notice: Apply Loctite #262 to nut before installation.

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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SECTION 6A

POWER STEERING SYSTEM

TABLE OF CONTENTS

Description and Operation 6A-2
General Description 6A-2
Component Locator 6A-3
Diagnostic Information and Procedures 6A-4
Power Steering System Pressure Test 6A-4
Power Steering System Leak Test 6A-4
Maintenance 6A-5
Bleeding the Power Steering System 6A-5
Checking and Adding Fluid 6A-5
Repair Instructions 6A-6
On-Vehicle Service 6A-6
Power Steering Fluid Reservoir 6A-6
Power Steering Pump Hoses and Pipes 6A-7
Specifications 6A-9
General Specification 6A-9
Fastener Tightening Specifications 6A-9
Special Tools and Equipment 6A-10
Special Tools Table 6A-10

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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DESCRIPTION AND OPERATION

GENERAL DESCRIPTION

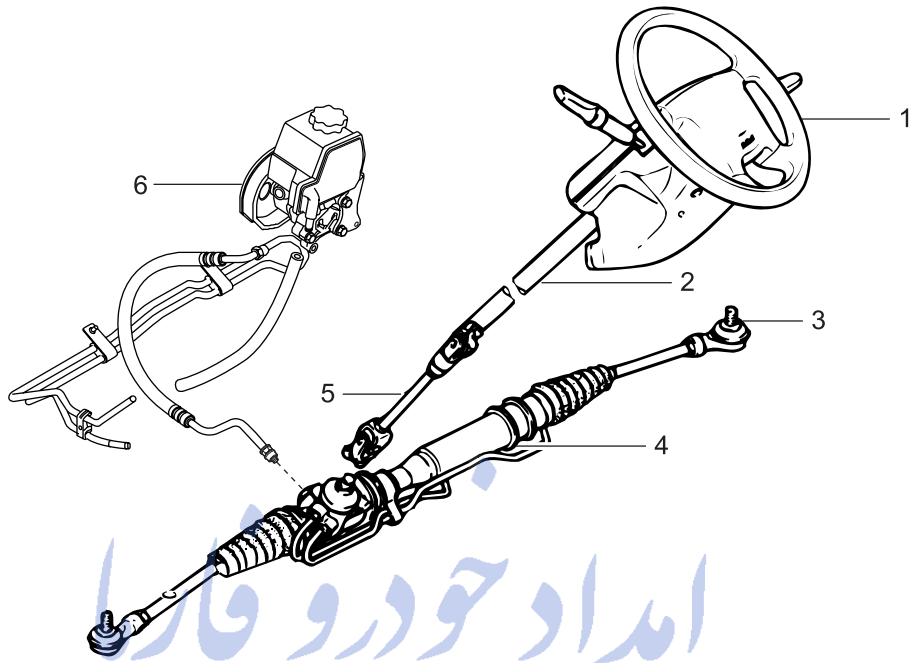
The power steering system consists of three compo nents: the power steering pump, the power steering fluid reservoir and the power steering rack and pinion gear.

The power steering pump is a vane-type pump providing hydraulic pressure for the system and is powered by the engine. It draws on the power steering fluid reservoir, which in turn is connected to the power steering gear.

A pressure-relief valve inside the flow control valve limits the pump pressure. The power steering rack and pinion gear has a rotary control valve, which directs hydraulic fluid coming from the power steering pump to one side or the other side of the rack piston. The integral rack piston is attached to the rack. The rack piston converts hydraulic pressure to a linear force, which moves the rack to the left or the right. The force is then transmitted through the inner and the outer tie rods to the steering knuckles, which turn the wheels.

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COMPONENT LOCATOR



KAA6A010

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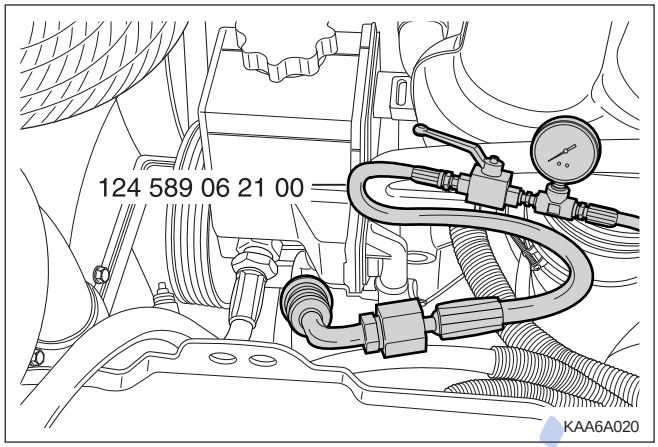
1 Steering Wheel
2 Steering Column Shaft
3 Tie Rod End
4 Power Steering Gear Rack
5 Intermediate Shaft
6 Power Steering Pump

DIAGNOSTIC INFORMATION AND PROCEDURES

POWER STEERING SYSTEM PRESSURE TEST

Tools Required

124 589 06 21 00 Power Steering Pump Testing Unit



Check the fluid pressure as follow to trouble is in the pump or gear unit.

Test Procedure

1. Disconnect the pressure hose from the oil pump and connect a pressure gauge between the oil pump and pressure hose.
2. Bleed the system. Start the engine and turn the steering wheel form lock several times until oil temperature is up to 50 °C.
3. Run the engine at 1,000 rpm.
4. Close the gauge valve fully, and read pressure. The pump pressure with the valve closed should be between 7,355 kPa to 8,041 kPa (1,067 psi to 1,166 psi).

   Notice: Do not keep the valve closed for more than 10 seconds.

5. Remove the pressure gauge and connect the pressure hose.
6. Do bleeding procedure.

POWER STEERING SYSTEM LEAK TEST

General Procedure

Inspect the following :

- The power steering fluid reservoir for overfill.
- Fluid for aeration and overflow.
- The hoses for loose connections.
- The torsion bar, stub shaft and adjuster seals for leaks.
- The component sealing surfaces for damage.

Important: Verify the exact point of the leak. The point from which the fluid is dripping is not necessarily the point at which the system is leaking. When service is required, clean the leak area upon disassembly, replace the leaking seal, check the component sealing surfaces for damage and reset the torque bolt to specifications required.

External Leak Check

The purpose of this procedure is to pinpoint the location of the leak. In some cases, the leak can be easily located, but seepage-type leaks may be harder to find. To locate seepage leaks, use the following method:

1. With the engine off, wipe dry the complete power steering system.
2. Check the power steering fluid level in the pump's reservoir. Adjust the fluid level as necessary. Refer to "Checking and Adding Fluid" in this section.

   Notice: Do not hold the steering wheel at a stop for any length of time as this can damage the power steering pump.

3. Start the engine. Turn the steering wheel counterclockwise and clockwise from stop to stop several times.
4. Find the exact area of the leak and repair it.

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MAINTENANCE

BLEEDING THE POWER STEERING SYSTEM

1. Disconnect the fuel line. Using a starter motor, crank the engine and turn the steering wheel from lock to start 5 or 6 times.

   Notice: Do bleeding with engine cranking. If bleed with idling, there can be a air contact with oil.

2. Connect the fuel feed line and start the engine at idle speed.
3. Turn the steering wheel from lock to lock until there is no more air in oil reservoir.
4. Connect the oil level is within specification.
5. By turning the steering wheel left to right, check the oil level change.

   Notice: If oil is not changes more than 5 mm, do bleeding again. If oil level rises suddenly when stopped engine, again.

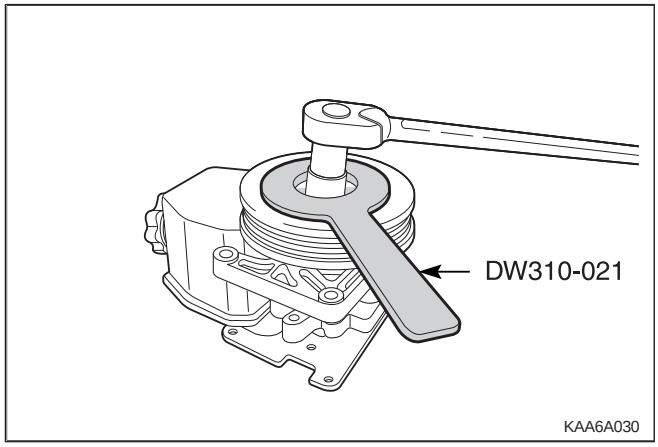
CHECKING AND ADDING FLUID

Notice: When adding fluid or making a complete fluid change, always use DEXRON. - II power steering fluid. Failure to use the proper fluid will cause hose and seal damage and fluid leaks.

1. The power steering fluid level is indicated by marks on a fluid level indicator on the fluid reservoir cap.
2. If the fluid is warmed up to 66 °C (150 °F), the fluid level should be between the MAX and MIN marks. Add fluid as needed.
3. If the fluid is cool, 21 °C (70 °F), the fluid level should be at the MIN mark. Add fluid as needed.

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REPAIR INSTRUCTIONS



ON-VEHICLE SERVICE

POWER STEERING FLUID RESERVOIR

Tools Required

DW310-021 Power Steering Pump Pulley Remover/ Installer

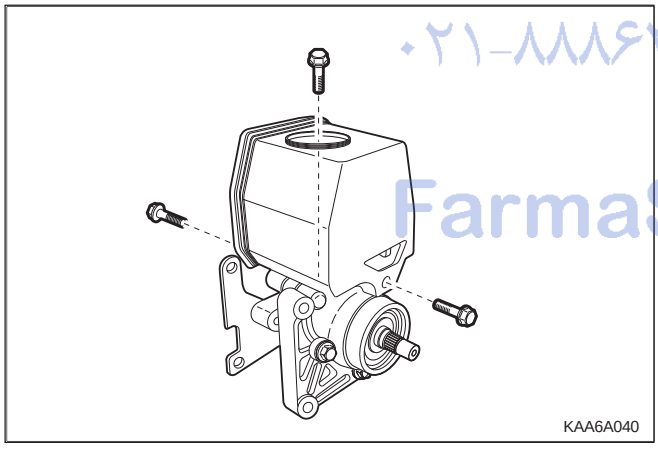
Removal and Installation Procedure

1. Remove the power steering pump. Refer to *Section 6B, Power Steering Pump.*
2. Remove the power steering pump pulley nut, using the power steering pump pulley remover/installer DW310-021.

Installation Notice

Tightening Torque	61 N•m (44 lb-ft)

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۰۲۱-۸۸۸۶۲۰۸۵
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3. Remove the power steering fluid reservoir mounting bolts (1).

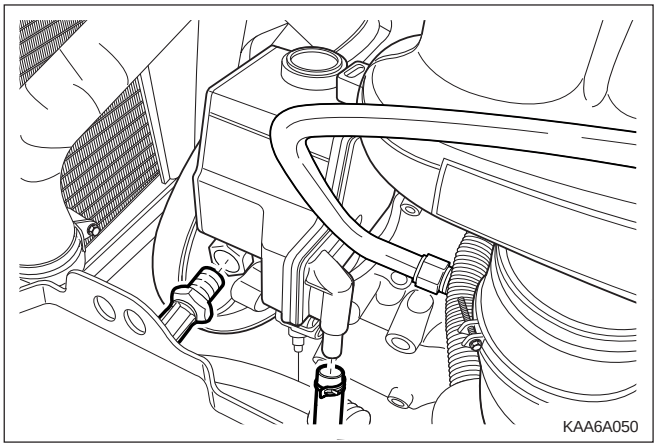
Removal Notice:

- One power steering fluid reservoir mounting bolt (2) is located in the fluid reservoir.

Installation Notice

Tightening Torque	Bolts (1)	15 N•m (11 lb-ft)
	Bolt (2)	18 N•m (13 lb-ft)

4. Remove the power steering fluid reservoir upward.
   - After installing the power steering fluid reservoir, bleed the power steering system. Refer to “Bleeding the Power Steering System” in this section.
5. Installation should follow the removal procedure in the reverse order.



POWER STEERING PUMP HOSES AND PIPES

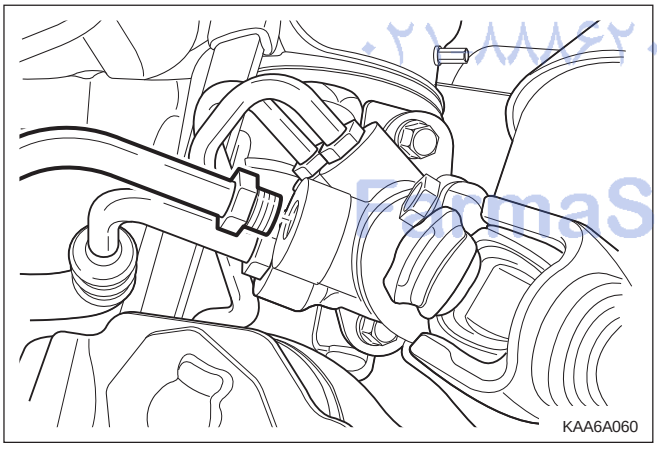
Removal and Installation Procedure

1. Remove the battery. Refer to *Section 1E, Engine Electrical.*
2. Siphon the power steering fluid from the fluid reservoir.
3. Disconnect the pressure line pipe from the outlet connection on the power steering pump and return hose from the inlet connection on the power steering fluid reservoir.

Installation Notice

Tightening Torque	44 N•m (33 lb-ft)

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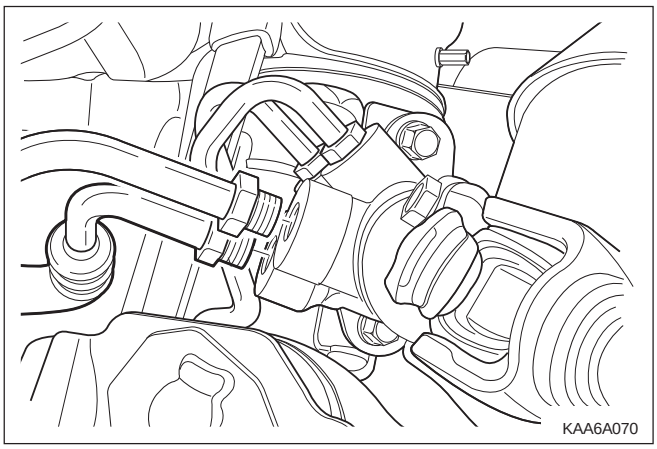


4. Disconnect the return line pipe from the power steering gear outlet.

Installation Notice

Tightening Torque	17 N•m (13 lb-ft)

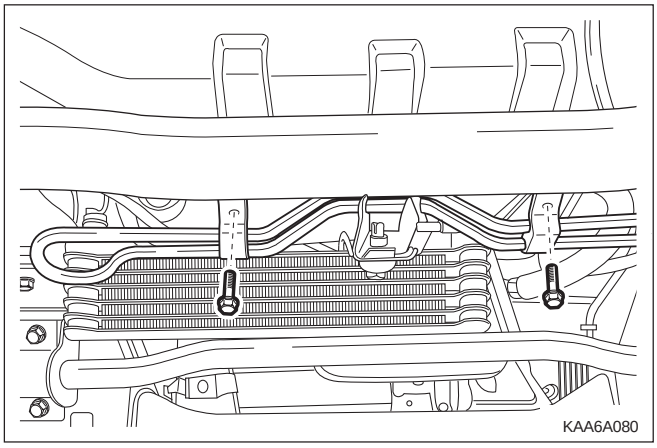
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5. Disconnect the pressure line pipe from the power steering gear inlet.

Installation Notice

Tightening Torque	17 N•m (13 lb-ft)



6. Remove the return line support clip from the front frame.

Installation Notice

Tightening Torque	9 N•m (80 lb-in)

- After installing the power steering fluid reservoir, bleed the power steering system. Refer to “Bleeding the Power Steering System” in this section.

7. Installation should follow the removal procedure in the reverse order.

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SPECIFICATIONS

GENERAL SPECIFICATION

Application	Description
Capacity	1.0 Liter (1.06 qt)
Lubricant	Power Steering Fluid DEXRON .- I I

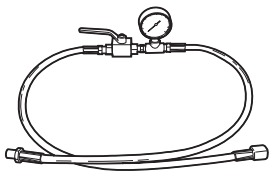
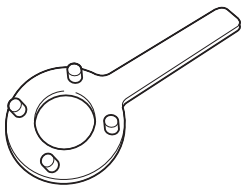
FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Power Steering Gear Inlet And Outlet Pipe Fitting	17	13	-
Power Steering Fluid Reservoir Mounting Bolts (1)	15	11	-
Power Steering Fluid Reservoir Mounting Bolt (2)	18	13	-
Power Steering Pump Pressure Line Fittings	44	33	-
Power Steering Pump Pulley Nut	61	44	-
Return Line Support Clip Bolt	9	-	80

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SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS TABLE

 KAA6A090	**124 589 06 21 00** **Power Steering Pump Testing Unit**
 KAA6A100	**DW310-021** **Power Steering Pump Pulley Remover/Installer**

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DESCRIPTION AND OPERATION

GENERAL DESCRIPTION

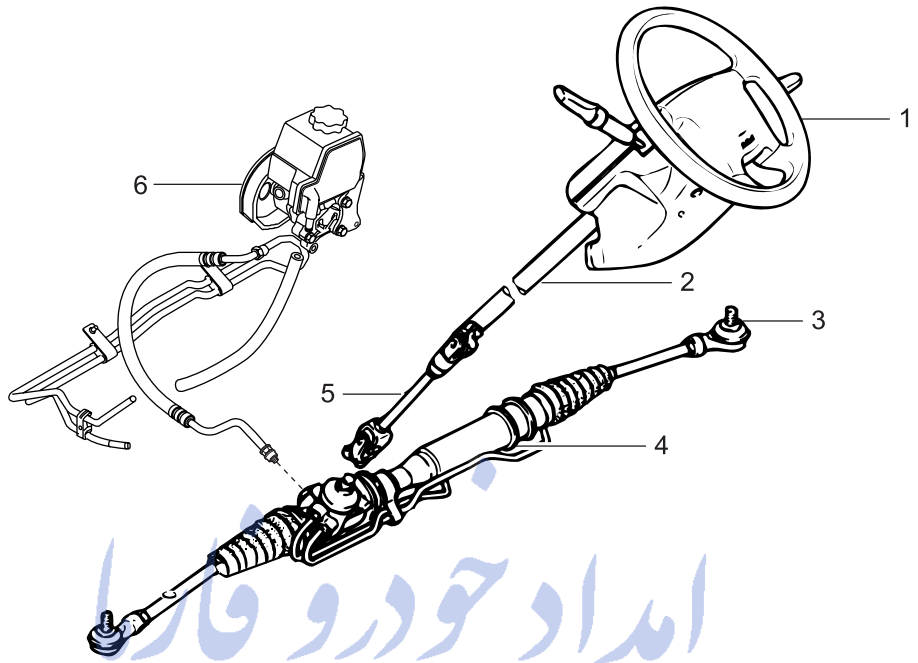
The power steering system consists of three compo nents: the power steering pump, the power steering fluid reservoir and the power steering rack and pinion gear.

The power steering pump is a vane-type pump providing hydraulic pressure for the system and is powered by the engine. It draws on the power steering fluid reservoir, which in turn is connected to the power steering gear.

A pressure-relief valve inside the flow control valve limits the pump pressure. The power steering rack and pinion gear has a rotary control valve, which directs hydraulic fluid coming from the power steering pump to one side or the other side of the rack piston. The integral rack piston is attached to the rack. The rack piston converts hydraulic pressure to a linear force, which moves the rack to the left or the right. The force is then transmitted through the inner and the outer tie rods to the steering knuckles, which turn the wheels.

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COMPONENT LOCATOR



KAA6A010

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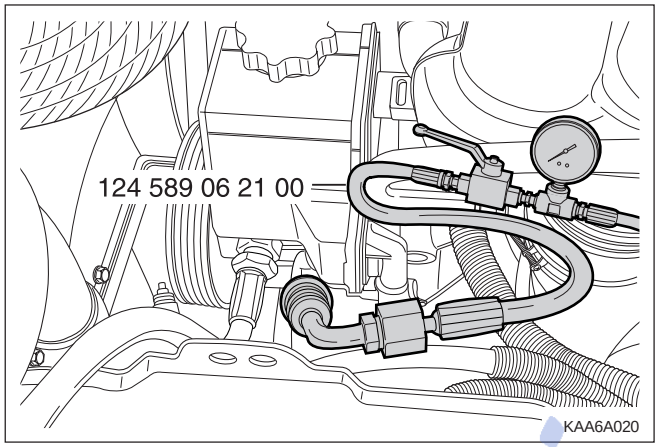
1 Steering Wheel
2 Steering Column Shaft
3 Tie Rod End
4 Power Steering Gear Rack
5 Intermediate Shaft
6 Power Steering Pump

DIAGNOSTIC INFORMATION AND PROCEDURES

POWER STEERING SYSTEM PRESSURE TEST

Tools Required

124 589 06 21 00 Power Steering Pump Testing Unit



Check the fluid pressure as follow to trouble is in the pump or gear unit.

Test Procedure

1. Disconnect the pressure hose from the oil pump and connect a pressure gauge between the oil pump and pressure hose.
2. Bleed the system. Start the engine and turn the steering wheel form lock several times until oil temperature is up to 50 °C.
3. Run the engine at 1,000 rpm.
4. Close the gauge valve fully, and read pressure. The pump pressure with the valve closed should be between 7,355 kPa to 8,041 kPa (1,067 psi to 1,166 psi).

   Notice: Do not keep the valve closed for more than 10 seconds.

5. Remove the pressure gauge and connect the pressure hose.
6. Do bleeding procedure.

POWER STEERING SYSTEM LEAK TEST

General Procedure

Inspect the following :

- The power steering fluid reservoir for overfill.
- Fluid for aeration and overflow.
- The hoses for loose connections.
- The torsion bar, stub shaft and adjuster seals for leaks.
- The component sealing surfaces for damage.

Important: Verify the exact point of the leak. The point from which the fluid is dripping is not necessarily the point at which the system is leaking. When service is required, clean the leak area upon disassembly, replace the leaking seal, check the component sealing surfaces for damage and reset the torque bolt to specifications required.

External Leak Check

The purpose of this procedure is to pinpoint the location of the leak. In some cases, the leak can be easily located, but seepage-type leaks may be harder to find. To locate seepage leaks, use the following method:

1. With the engine off, wipe dry the complete power steering system.
2. Check the power steering fluid level in the pump's reservoir. Adjust the fluid level as necessary. Refer to "Checking and Adding Fluid" in this section.

   Notice: Do not hold the steering wheel at a stop for any length of time as this can damage the power steering pump.

3. Start the engine. Turn the steering wheel counterclockwise and clockwise from stop to stop several times.
4. Find the exact area of the leak and repair it.

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MAINTENANCE

BLEEDING THE POWER STEERING SYSTEM

1. Disconnect the fuel line. Using a starter motor, crank the engine and turn the steering wheel from lock to start 5 or 6 times.

   Notice: Do bleeding with engine cranking. If bleed with idling, there can be a air contact with oil.

2. Connect the fuel feed line and start the engine at idle speed.
3. Turn the steering wheel from lock to lock until there is no more air in oil reservoir.
4. Connect the oil level is within specification.
5. By turning the steering wheel left to right, check the oil level change.

   Notice: If oil is not changes more than 5 mm, do bleeding again. If oil level rises suddenly when stopped engine, again.

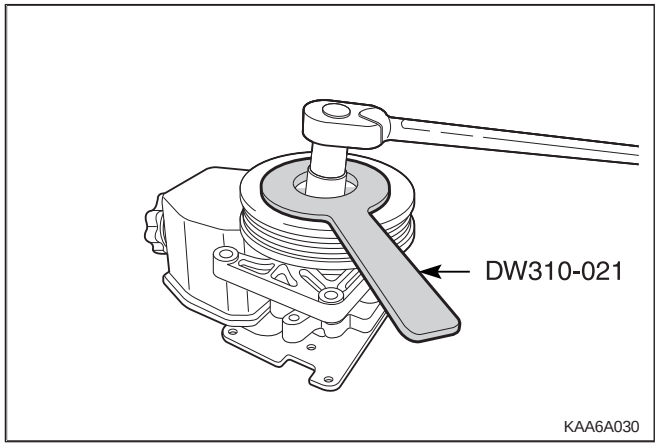
CHECKING AND ADDING FLUID

Notice: When adding fluid or making a complete fluid change, always use DEXRON. - II power steering fluid. Failure to use the proper fluid will cause hose and seal damage and fluid leaks.

1. The power steering fluid level is indicated by marks on a fluid level indicator on the fluid reservoir cap.
2. If the fluid is warmed up to 66 °C (150 °F), the fluid level should be between the MAX and MIN marks. Add fluid as needed.
3. If the fluid is cool, 21 °C (70 °F), the fluid level should be at the MIN mark. Add fluid as needed.

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REPAIR INSTRUCTIONS



ON-VEHICLE SERVICE

POWER STEERING FLUID RESERVOIR

Tools Required

DW310-021 Power Steering Pump Pulley Remover/ Installer

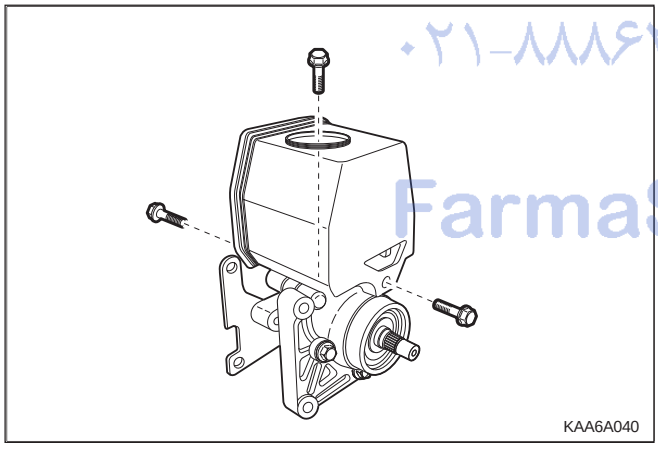
Removal and Installation Procedure

1. Remove the power steering pump. Refer to *Section 6B, Power Steering Pump.*
2. Remove the power steering pump pulley nut, using the power steering pump pulley remover/installer DW310-021.

Installation Notice

Tightening Torque	61 N•m (44 lb-ft)

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۰۲۱-۸۸۸۶۲۰۸۵
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3. Remove the power steering fluid reservoir mounting bolts (1).

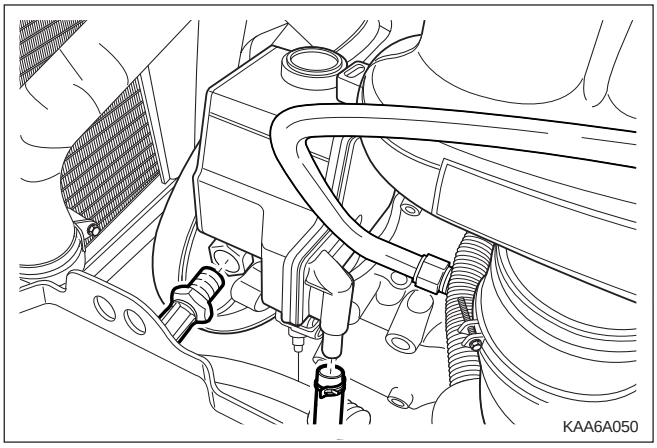
Removal Notice:

- One power steering fluid reservoir mounting bolt (2) is located in the fluid reservoir.

Installation Notice

Tightening Torque	Bolts (1)	15 N•m (11 lb-ft)
	Bolt (2)	18 N•m (13 lb-ft)

4. Remove the power steering fluid reservoir upward.
   - After installing the power steering fluid reservoir, bleed the power steering system. Refer to “Bleeding the Power Steering System” in this section.
5. Installation should follow the removal procedure in the reverse order.



POWER STEERING PUMP HOSES AND PIPES

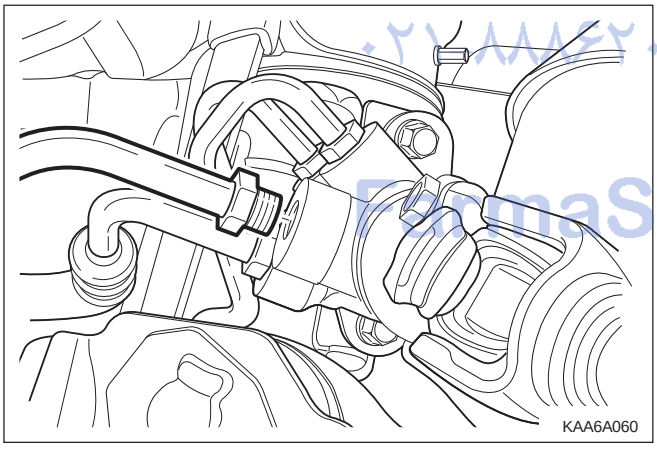
Removal and Installation Procedure

1. Remove the battery. Refer to *Section 1E, Engine Electrical.*
2. Siphon the power steering fluid from the fluid reservoir.
3. Disconnect the pressure line pipe from the outlet connection on the power steering pump and return hose from the inlet connection on the power steering fluid reservoir.

Installation Notice

Tightening Torque	44 N•m (33 lb-ft)

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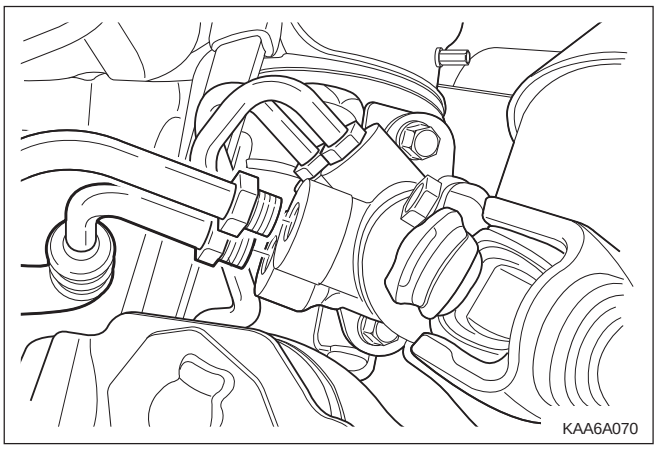


4. Disconnect the return line pipe from the power steering gear outlet.

Installation Notice

Tightening Torque	17 N•m (13 lb-ft)

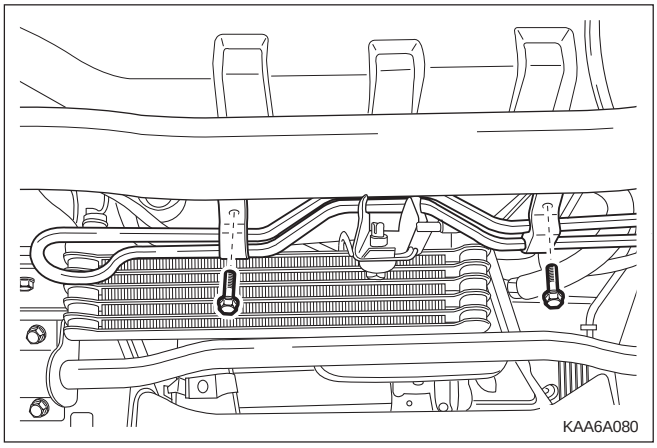
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5. Disconnect the pressure line pipe from the power steering gear inlet.

Installation Notice

Tightening Torque	17 N•m (13 lb-ft)



6. Remove the return line support clip from the front frame.

Installation Notice

Tightening Torque	9 N•m (80 lb-in)

- After installing the power steering fluid reservoir, bleed the power steering system. Refer to “Bleeding the Power Steering System” in this section.

7. Installation should follow the removal procedure in the reverse order.

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SPECIFICATIONS

GENERAL SPECIFICATION

Application	Description
Capacity	1.0 Liter (1.06 qt)
Lubricant	Power Steering Fluid DEXRON .- I I

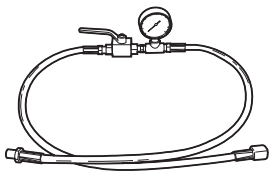
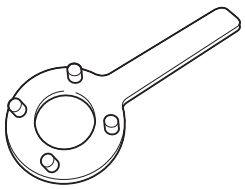
FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Power Steering Gear Inlet And Outlet Pipe Fitting	17	13	-
Power Steering Fluid Reservoir Mounting Bolts (1)	15	11	-
Power Steering Fluid Reservoir Mounting Bolt (2)	18	13	-
Power Steering Pump Pressure Line Fittings	44	33	-
Power Steering Pump Pulley Nut	61	44	-
Return Line Support Clip Bolt	9	-	80

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SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS TABLE

 KAA6A090	**124 589 06 21 00** **Power Steering Pump Testing Unit**
 KAA6A100	**DW310-021** **Power Steering Pump Pulley Remover/Installer**

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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SECTION 6B

POWER STEERING PUMP

TABLE OF CONTENTS

Description and Operation 6B-2

General Description 6B-2

Diagnostic Information and Procedures 6B-3

Power Steering Pump Diagnosis 6B-3

Repair Instructions 6B-4

On-Vehicle Service 6B-4

Serpentine Accessory Drive Belt 6B-4

Power Steering Pump Assembly 6B-4

Unit Repair 6B-6

Pump 6B-6

Specifications 6B-7

Fastener Tightening Specifications 6B-7

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵

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DESCRIPTION AND OPERATION

GENERAL DESCRIPTION

The power steering pump is a multivaned hydraulic pump. The serpentine accessory drive belt on the engine drives the power steering pump. The power steering pump provides the hydraulic pressure to the power steering gear.

The power steering gear uses the hydraulic pressure to assist in steering the vehicle.

When steering conditions exceed maximum pressure requirements, such as when the wheels are turned against the stops, the pressure built up in the steering gear exerts pressure on the spring end of the flow control valve. The high pressure lifts the relief valve ball from its seat and allows oil to flow through a trigger orifice located in the outlet fitting. This reduce pressure on the spring end of the flow control valve which then opens and allows the oil to return to the intake side of the pump. This action limits maximum pressure output of the pump to a safe level.

No repair procedures are to be done on the internal components of the power steering pump. The only serviceable components of the power steering pump are the power steering pump pulley and the pump itself.

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DIAGNOSTIC INFORMATION AND PROCEDURES

POWER STEERING PUMP DIAGNOSIS

Foaming or Milky Power Steering Fluid (Air in Fluid)

Checks	Action
Check for internal leakage in the power steering pump, causing an overflow.	Repair the internal pump leakage. Bleed the system.
Clean for a low fluid level.	Repair the internal pump leakage. Bleed the system. Cold temperatures will cause the air bubbles in the system if the fluid level is low.

Low Pressure Due to Power Steering Pump

Checks	Action
Check for an external leakage of the power steering pump at the seals.	Replace the seals. Repair the leak. Bleed the system.
Check for a worn serpentine accessory drive belt.	Replace the serpentine accessory drive belt.

Low Pressure Due to Power Steering Gear

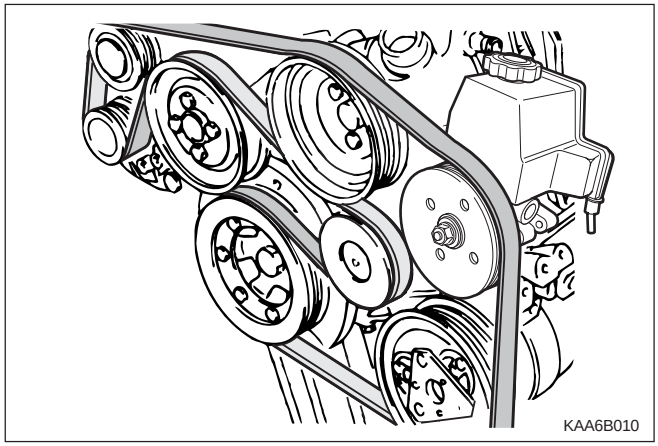
Checks	Action
Check for a scored housing bore.	Replace the housing bore.
Check for leakage at the valve rings or the seals.	Repair the leak. Bleed the system.

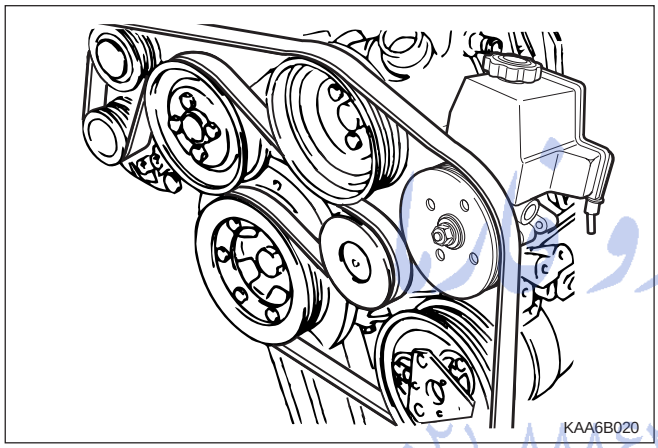
Groaning Noise in the Power Steering Pump

Checks	Action
Check for air in the power steering fluid.	Perform the checks listed in “Foaming or Milky Power Steering Fluid (Air in Fluid)” above.
Check for a low level of power steering fluid.	Repair any internal or external leaks. Bleed the system.
Check for a loose mounting of the power steering pump.	Tighten the pump mounting to specifications.

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REPAIR INSTRUCTIONS





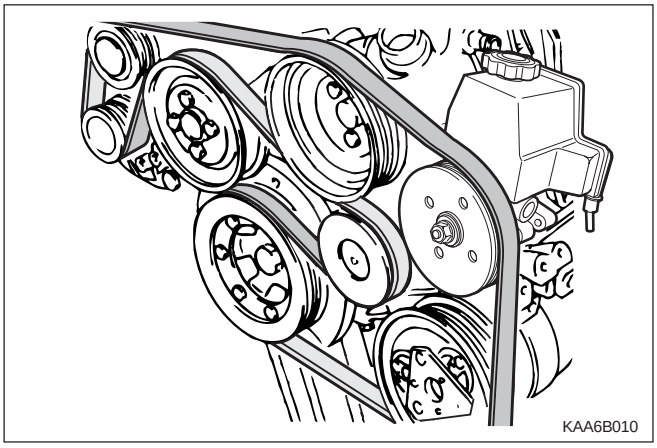
ON-VEHICLE SERVICE

SERPENTINE ACCESSORY DRIVE BELT

Removal and Installation Procedure

1. Remove the electric cooling fan. Refer to *Section 1D, Engine Cooling.*
2. Use a wrench to turn the tensioner bolt clockwise, compressing the tensioner, and releasing the tension on the serpentine accessory drive bolt.
3. Remove the serpentine accessory drive belt.

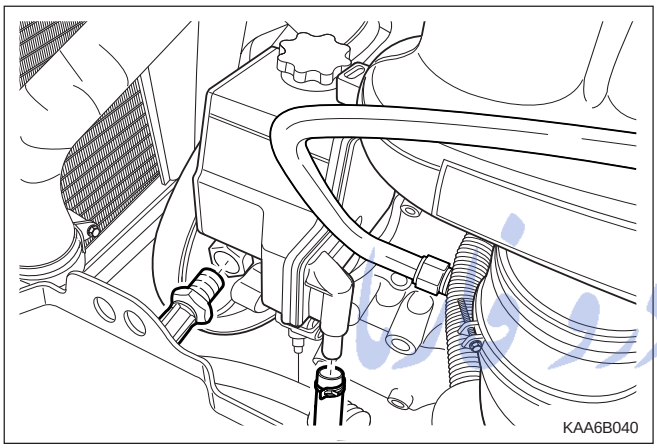
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POWER STEERING PUMP ASSEMBLY

Removal and Installation Procedure

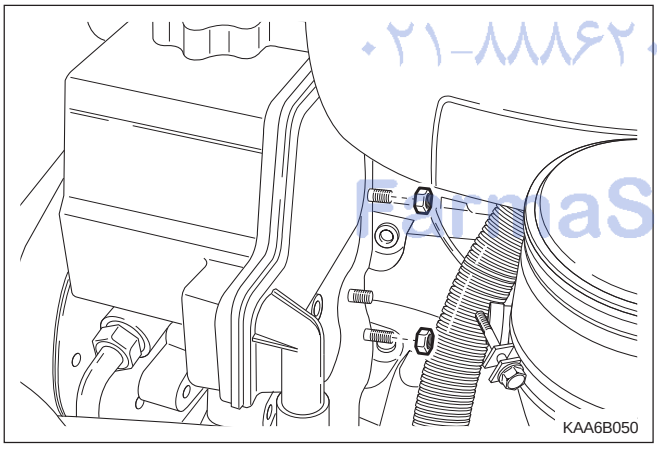
1. Remove the battery. Refer to *Section 1E, Engine Electrical.*
2. Use a wrench to turn the tensioner bolt clockwise, compressing the tensioner, and releasing the tension on the serpentine accessory drive belt. Loosen the serpentine accessory drive belt.



3. Siphon the power steering fluid from the fluid reservoir.
4. Disconnect the pressure line pipe from the outlet connectionon the power steering pump and return hose from the inlet connection on the power steering fluid reservoir.

Installation Notice

Tightening Torque	44 N•m (33 lb-ft)



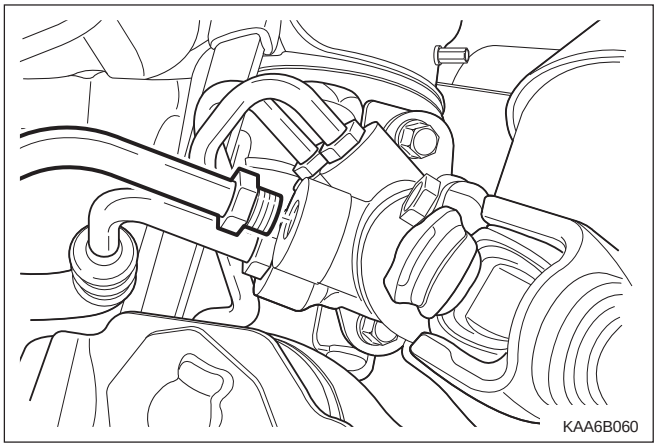
5. Remove the power steering pump assembly mounting bolts.

Installation Notice

Tightening Torque	25 N•m (17 lb-ft)

6. Remove the power steering pump assembly.

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UNIT REPAIR

PUMP

Tools Required

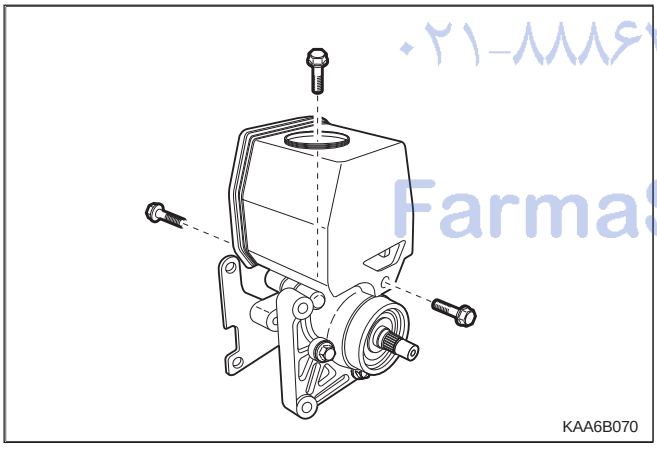
DW310-021 Power Steering Pump Pulley Remover/ Installer

Disassembly and Assembly Procedure

Important: The power steering pump in this vehicle is not serviceable. Replace, do not repair, a faulty power steering pump. Refer to “Power Steering Pump Diagnosis” in this section.

1. Remove the power steering pump assembly. Refer to “Power Steering Pump Assembly” in this section.
2. Remove the power steering pump pulley nut, using the power steering pump pulley remover/installer DW 310-021.

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۰۲۱-۸۸۸۶۲۰۸۵
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3. Remove the power steering fluid reservoir mounting bolts (1).

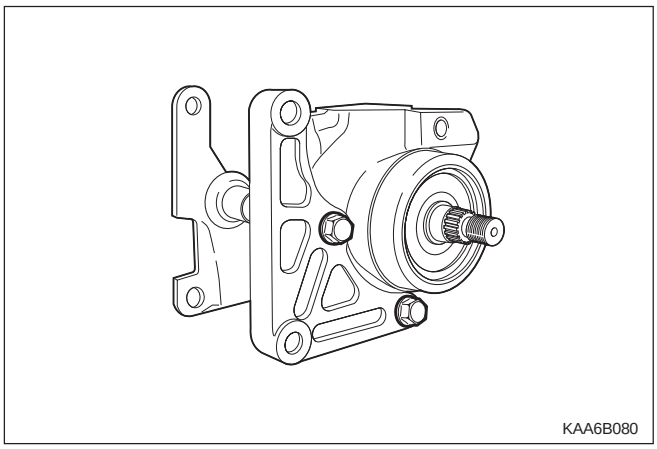
Remove Notice:

- One power steering fluid reservoir mounting bolt (2) is located in the fluid reservoir.

Installation Notice

Tightening Torque	Bolts (1)	15 N•m (11 lb-ft)
	Bolt (2)	18 N•m (13 lb-ft)

4. Remover the power steering fluid reservoir upward.


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5. Remove the power steering pump mounting bracket bolts.

Installation Notice

Tightening Torque	16 N•m (12 lb-ft)

6. Installation should follow the removal procedure in the reverse order.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Power Steering Fluid Reservoir Mounting Bolts (1)	15	11	-
Power Steering Fluid Reservoir Mounting Bolt (2)	18	13	-
Power Steering Pump Assembly Mounting Bolts	23	17	-
Power Steering Pump Assembly Mounting Bracket Bolts	16	12	-
Power Steering Pump Pressure Line Fittings	44	33	-

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SECTION 6C

POWER STEERING GEAR

TABLE OF CONTENTS

Description and Operation 6C-2

Power Rack and Pinion 6C-2

Component Locator 6C-3

Diagnostic Information and Procedures 6C-4

Power Steering Rack and Pinion Gear 6C-4

Power Steering Rack and Pinion Gear Bench Testing 6C-6

Straight-Ahead Check 6C-6

Repair Instructions 6C-8

On-Vehicle Service 6C-8

Rack and Pinion Assembly 6C-8

Outer Tie Rod 6C-9

Dust Boot 6C-10

Intermediate Shaft 6C-10

Hydraulic Cylinder Lines 6C-11

Unit Repair 6C-13

Rack and Pinion 6C-13

Valve and Pinion Assembly 6C-14

Rack Bearing 6C-15

Rack Bearing Preload Adjustment 6C-16

Specifications 6C-17

Fastener Tightening Specifications 6C-17

Special Tools and Equipment 6C-18

Special Tools Table 6C-18

امداد خودرو فارما

تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵

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DESCRIPTION AND OPERATION

POWER RACK AND PINION

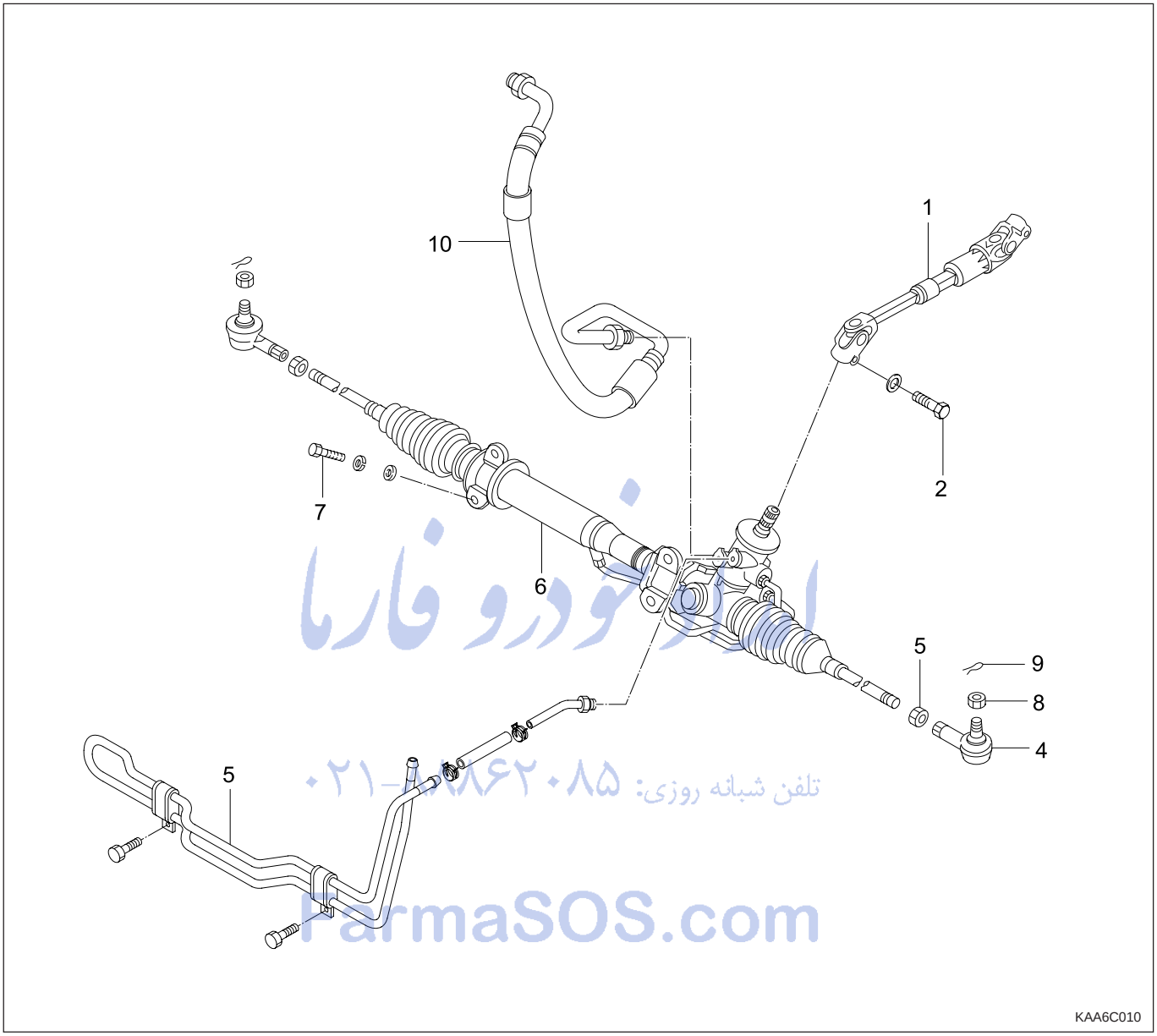
The power steering rack and pinion system has a rotary control valve that directs hydraulic fluid coming from the hydraulic pump to one side or the other side of the rack piston. The integral rack piston is attached to the rack. The rack piston converts hydraulic pressure to a linear force that moves the rack left or right. That force is then transmitted through the tie rods to the steering knuckles, which turn the wheels.

If power rack and pinion steering is not available, manual rack and pinion control is used; however, with this system, more steering effort is required. The movement of the steering wheel is transferred to the pinion. The rotary movement of the pinion is then transferred through the pinion threads, which mesh with teeth on the rack, thereby causing the rack to move in a linear direction.

A vane-type of hydraulic pump provides hydraulic pressure for both steering systems.

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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COMPONENT LOCATOR



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1 Intermediate Shaft
2 Lower Pinch Bolt
3 Boot
4 Outer Tie Rod
5 Return Line Pipe
6 Rack and Pinion Assembly
7 Rack and Pinion Assembly Mounting Bolt
8 Castle Nut
9 Cotter Pin
10 Pressure Line Pipe

DIAGNOSTIC INFORMATION AND PROCEDURES

POWER STEERING RACK AND PINION GEAR

Hissing Noise

Checks	Action
Check the intermediate shaft joints for looseness.	Tighten the intermediate shaft joints.
Check the power steering hose for contact with other components.	Be sure the power steering hose is correctly fitted into the hose clips.

Loss of Coolant

Checks	Action
Check the power steering hose for contact with the body.	Be sure the power steering hose is correctly fitted into the hose clips.
Check the steering gear for insufficient lubrication.	Lubricate the steering gear.
Check the steering gear mounting for improper installation.	Tighten the steering gear mounting bracket nuts and bolts.
Check the outer tie rods for improper installation.	Tighten the outer tie rod joints. Replace the outer tie rods.

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Loss of Coolant

Checks	Action
Check the steering wheel for contact with the turn signal housing.	Adjust the turn signal housing.
Check the intermediate shaft joints for binding or looseness.	Replace the intermediate shaft.
Check the power steering pump flow control valve for sticking and improper alignment.	Replace the power steering pump.
Check the wheel alignment.	Align the wheels.
Check the wheel bearings for wear or damage.	Replace the wheel bearings.
Check the intermediate shaft joints for improper installation.	Adjust the intermediate shaft between the steering gear and the steering column. Replace the intermediate shaft.
Check the outer tie rods and the ball joints for binding or looseness.	Tighten the tie rods and the ball joints. Replace the tie rods and the ball joints.
Check the steering gear adjustments.	Perform a straight-ahead check.
Check the steering column shaft seal for rubbing on the shaft.	Replace the dash seal.
Check the steering shaft bearings for binding.	Replace the stub shaft bearings.

۰۲۱۱-۸۸۸۶۲۰۸۵ تلفن شبانه روزی:
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Momentary Increase in Effort When Turning the Wheel Quickly

Checks	Action
Check the power steering pump for internal leaks.	Replace the power steering pump.
Check the hoses for damage or restricted flow.	Replace the power steering hoses and/or pipes.
Check the power steering fluid level.	Fill the power steering fluid reservoir.
Check the power steering pump flow control valve for sticking and improper operation.	Replace the power steering pump.

Steering Surges or Jerks When Turning with Engine Running

Checks	Action
Check the power steering pump for insufficient pressure.	Replace the power steering pump.
Check the power steering pump flow control valve for sticking and improper operation.	Replace the power steering pump.
Check the power steering pump serpentine belt for slippage.	Tighten the power steering serpentine belt.
Check for air contamination in the power steering system.	Bleed the power steering system

Steering Vibrates During Low Speed or Static Steering

Checks	Action
Check for air contamination in the power steering system.	Bleed the power steering system.
Check the power steering pump serpentine belt for looseness.	Tighten the power steering serpentine belt.

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Excessive Wheel Kickback or Loose Steering

Checks	Action
Check for air contamination in the power steering system.	Bleed the power steering system.
Check the wheel bearings for wear or damage.	Replace the wheel bearings.
Check the steering gear mounting for improper installation.	Tighten the steering gear mounting bracket nuts and bolts.
Check the intermediate shaft joints for improper Installation.	Adjust the intermediate shaft between the steering gear and the steering column. Replace the intermediate shaft.
Check the outer tie rods and the ball joints for looseness.	Tighten the tie rods and the ball joints. Replace the tie rods and the ball joints.

۰۲۱-۸۸۸۴۶۲۰۸ FarmaSOS.com

Hard Steering or Lack of Assist (Especially During Parking)

Checks	Action
Check the intermediate shaft joints for improper installation.	Adjust the intermediate shaft between the steering gear and the steering column. Replace the coupling flange.
Check the power steering pump flow control valve for sticking and improper installation.	Replace the power steering pump.
Check the power steering pump for insufficient pressure.	Replace the power steering pump.
Check the power steering pump for internal leaks.	Replace the power steering pump.
Check for a loose or a worn intermediate shaft.	Tighten the intermediate shaft. Replace the intermediate shaft, as needed.
Check the power steering pump serpentine belt tension.	Tighten the power steering serpentine belt.

POWER STEERING RACK AND PINION GEAR BENCH TESTING

Removal and Installation Procedure

Notice: Pressure checks or pressure and flow checks may also be conducted using this setup.

1. Disconnect and remove the power steering gear. Refer to “Rack and Pinion Assembly” in this section.
2. Place the power steering gear on a bench next to the vehicle.
3. Disconnect the pressure line at the point where the hose connects to the pipe. Extend this line to reach the power steering gear on the bench.
4. Disconnect the return line from the power steering fluid reservoir. Extend this line to reach the power steering gear on the bench.
5. Connect the power steering pipes to the power steering gear.
6. Start the engine and allow it to idle for 10 seconds.
7. Check the power steering fluid level. Refer to *Section 6A, Power Steering System.*
8. Start the engine and turn the rack and pinion stub shaft a full turn in each direction. Hold the shaft against each stop for 5 seconds.
9. Inspect for possible leak points. Refer to *Section 6A, Power Steering System.*

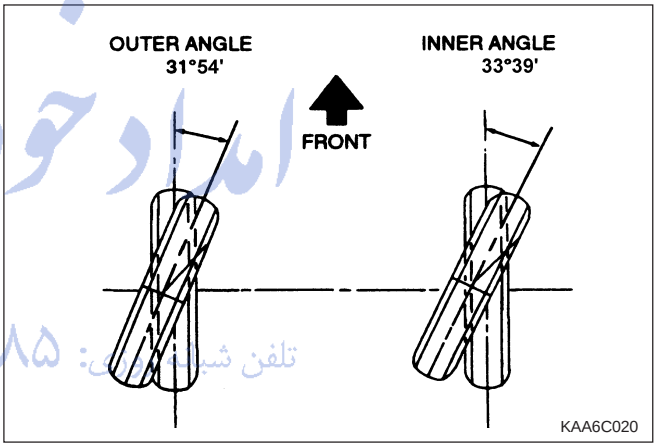
Installation Procedure

1. Stop the engine.
2. Disconnect the power steering pipes from the power steering gear.
3. Remove the extensions and reconnect the pressure and return lines.
4. Install and connect the power steering gear. Refer to “Rack and Pinion Assembly” in this section.
5. Start the engine and allow it to idle for 10 seconds.
6. Check the power steering fluid level. Refer to *Section 6A, Power Steering System.*

STRAIGHT-AHEAD CHECK

After all the necessary operations on the steering gear are completed (removing and installing, disassembling and assembling), check the exact straight-ahead position of the steering in each case.

With the vehicle on the floor, place the steering wheel in the straight-ahead position. Mark the centerline of both tires on the floor. Turn the steering wheel all the way to the right and mark the new centerline of both tires on the floor.



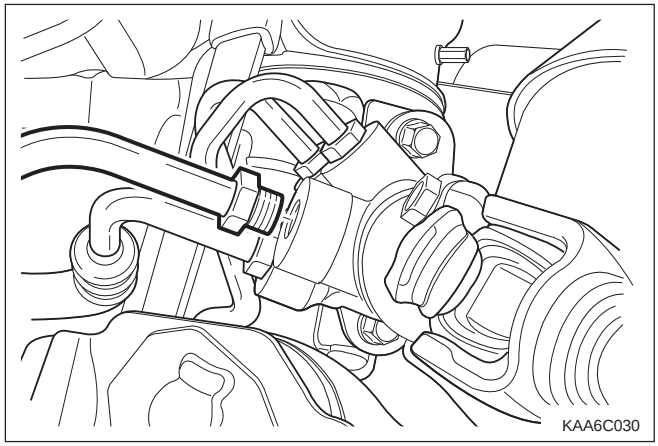
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Straight-Ahead Check Table

Step	Action	Value	Yes	No
1	Place the steering wheel in the straight-ahead position. Is the wheel in the correct position?	-	Go to Step 2	-
2	Is the lower intermediate shaft pinch bolt lying parallel to the steering gear?	-	Go to Step 3	Go to Step 4
3	Is the steering wheel off center by more than 5 degrees?	-	Go to Step 5	Go to Step 6
4	The pinion is displaced on the rack. The steering pinion position must be corrected. Is the repair complete?	-	Go to Step 2	-
5	Remove steering wheel and center on the spindle splines. Is the repair complete?	-	Go to Step 3	-
6	Turn the steering wheel all the way to the right. Measure the inner and the outer angles of the tire centerline compared to the straight-ahead centerline. Are the angle within specifications?	Inner angle : 33°39′ Outer angle : 31°54′	System OK	Go to Step 7
7	The rack assembly was not assembled correctly. Repair as needed. Is the repair complete?	-	Go to Step 6	-

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REPAIR INSTRUCTIONS


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ON-VEHICLE SERVICE

RACK AND PINION ASSEMBLY

Tools Required

661 589 13 33 00 Ball Joint Remover

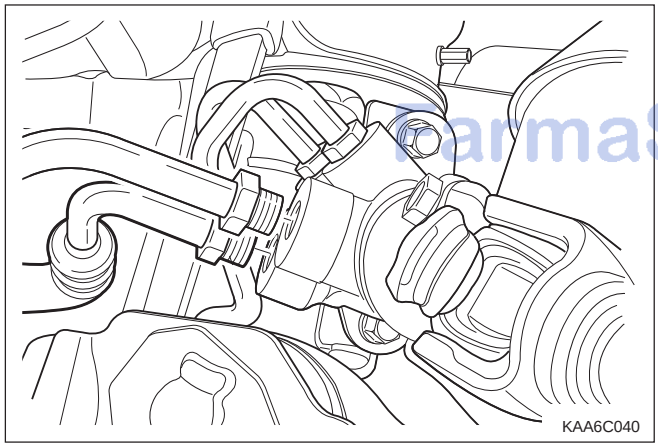
Removal and Installation Procedure

1. Raise and suitably support the vehicle.
2. Remove the wheels. Refer to *Section 2E, Tires and Wheels.*
3. Remove the intermediate shaft. Refer to “Intermediate shaft” in this section.
4. Disconnect the return line pipe from the power steering gear outlet. Place a drain pan under the steering gear to catch the power steering fluid.

Installation Notice

Tightening Torque	17 N•m (13 lb-ft)

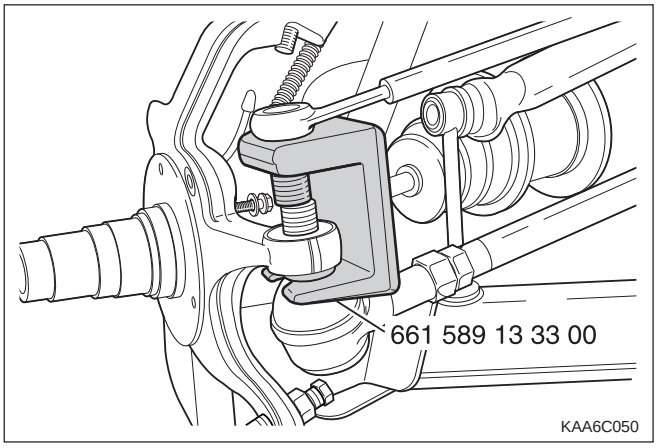
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5. Disconnect the pressure line pipe from the power steering gear inlet.

Installation Notice

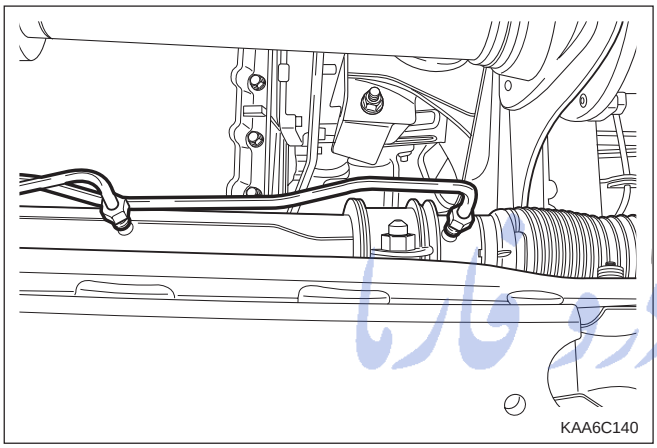
Tightening Torque	17 N•m (13 lb-ft)



6. Remove the outer tie rod nuts and disconnect the tie rod ends from the knuckle using the ball joint remover 661 589 13 33 00.

Installation Notice

Tightening Torque	40 N•m (30 lb-ft)



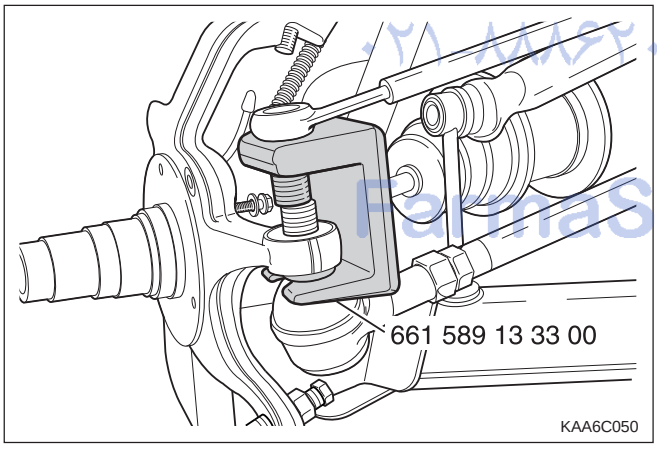
7. Remove the rack and pinion assembly mounting bolts and remove therackand pinion assembly.

Installation Notice

Tightening Torque	78 N•m (58 lb-ft)

- After installing the rack and pinion assembly, bleed the power steering system. Refer to *Section 6A, Power Steering System.*

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۰۲۱-۸۸۸۶۲۰۸۵ تلفن شبانه روزی
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OUTER TIE ROD

Tools Required

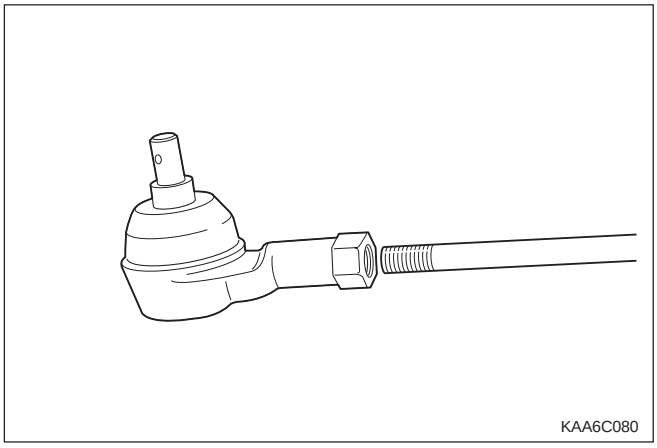
661589 13 33 00 BallJointRemover

Removal and Installation Procedure

1. Remove the wheel. Refer to *Section 2E, Tires and wheels*.
2. Mark the threads on the inner tie rod to aid in repositioning the adjusting nut.
3. Remove the outer tie rod nut and disconnect the outer tie rod from the knuckle using the ball joint remover 661 589 13 33 00.

Installation Notice

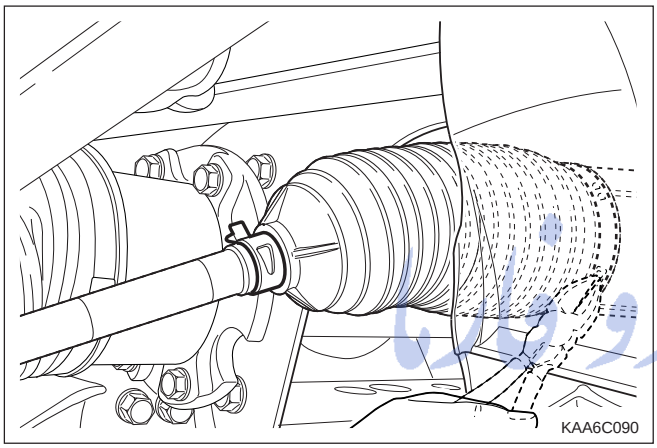
Tightening Torque	40 N•m (30 lb-ft)


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4. Loosen the outer tie rod adjusting nut and remove the outer tie rod by twisting it off the inner tie rod.

Installation Notice:

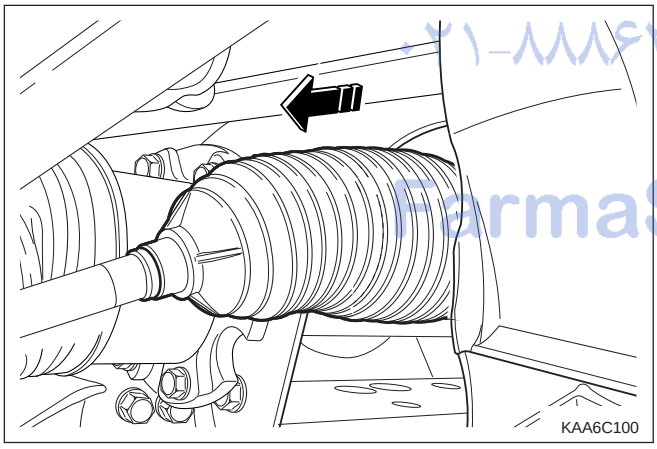
- After Installation, perform a front toe adjustment. Refer to *Section 2B, Wheel Alignment.*


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DUST BOOT

Removal and Installation Procedure

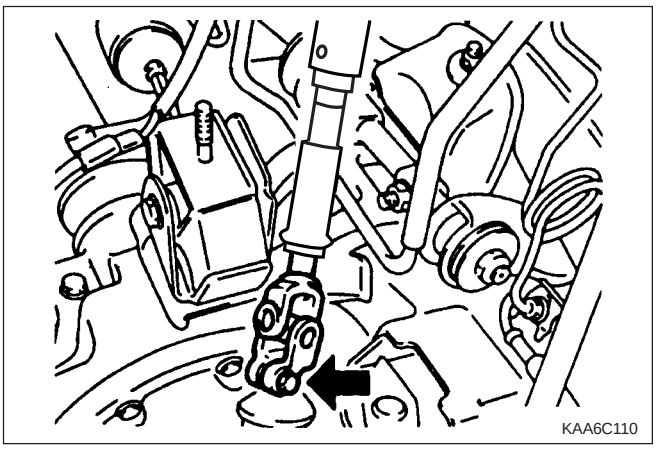
1. Raise and suitably support the vehicle.
2. Remove the wheel. Refer to *Section 2E, Tires and wheels.*
3. Remove the outer tie rod. Refer to “Outer Tie Rod” in this section.
4. Remove the dust boot retaining clamps.


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5. Remove the dust boot.

Installation Notice:

- After Installation, perform a front toe adjustment. Refer to *Section 2B, Wheel Alignment.*


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INTERMEDIATE SHAFT

Removal and Installation Procedure

1. Turn the steering wheel until it is horizontal. This is the straight-ahead position. Make a mark on the stub shaft housing that lines up with a mark on the intermediate shaft lower universal joint.

Installation Notice:

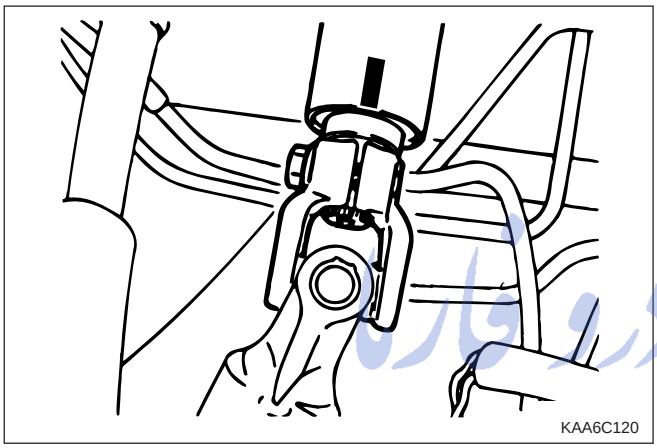
- When attaching the lower universal joint, the marks on the intermediate shaft and on the stub shaft should line up

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2. Remove the lower pinch bolt from the universal joint on the intermediate shaft.

Installation Notice

Tightening Torque	27 N•m (20 lb-ft)


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3. Make a mark on the steering column shaft that lines up with a mark on the intermediate shaft upper universal joint.

Installation Notice:

- When attaching the upper universal joint, the marks on the intermediate shaft and steering column shaft should line up

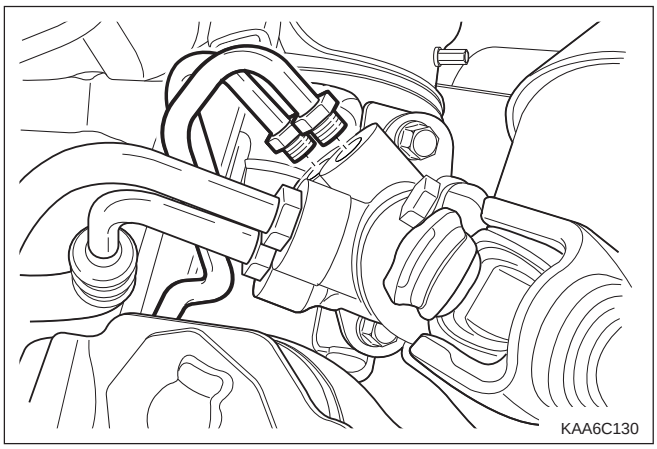
4. Remove the upper pinch bolt from the universal joint on the intermediate shaft.

Installation Notice

Tightening Torque	27 N•m (20 lb-ft)

5. Remove the intermediate shaft.

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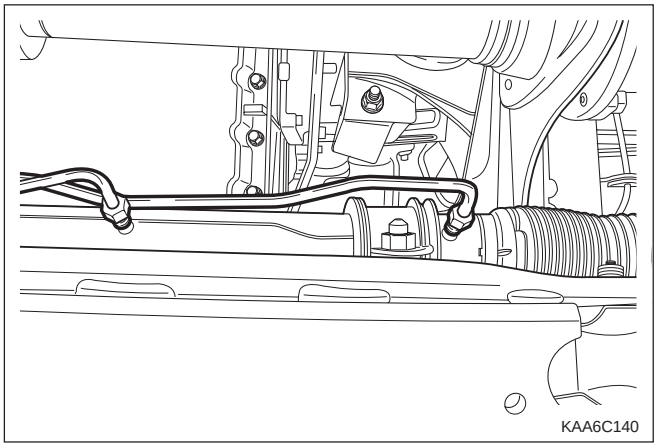
HYDRAULIC CYLINDER LINES

Removal and Installation Procedure

1. Siphon the power steering fluid from the power steering fluid reservoir.
2. Disconnect the power steering gear hydraulic cylinder pipes from the power steering gear at the valve end. Replace the O-ring seals as needed.

Installation Notice

Tightening Torque	14 N•m (10 lb-ft)



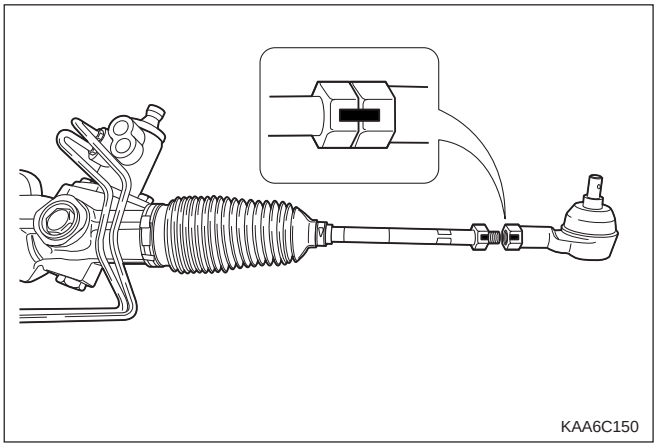
3. Raise and suitably support the vehicle.
4. Disconnect the power steering gear hydraulic cylinder pipes from the power steering gear at the cylinder end.
5. Remove the steering gear hydraulic cylinder pipes from the vehicle.

Installation Notice

Tightening Torque	61 N•m (44 lb-ft)

- When adding power steering fluid or making a complete change, always use DEXRON. - II power steering fluid. Failure to use the proper fluid will cause hose and seal damage and fluid leaks.
- Fill the reservoir with power steering fluid.
- Inspect for leaks. If there are leaks, correct the cause of the leaks and bleed the system. Refer to “Bleeding the Power Steering System” in this section.

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UNIT REPAIR

RACK AND PINION

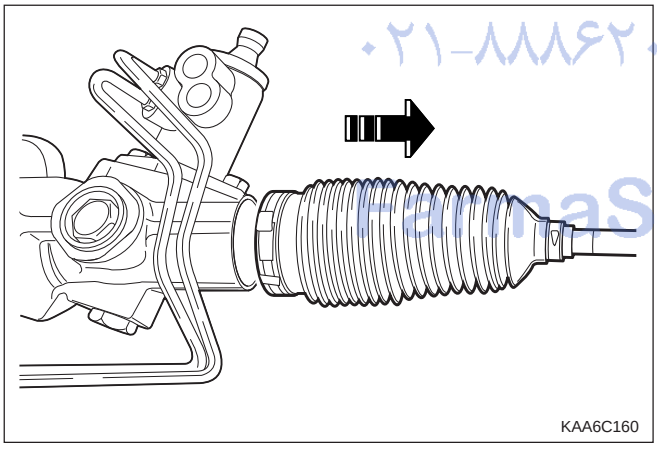
Disassembly and Assembly Procedure

1. Remove the rack and pinion assembly from the vehicle. Refer to “Rack and Pinion Assembly” in this section.
2. Remove the valve and pinion assembly from the rack and pinion steering assembly. Refer to “Valve and Pinion” in this section.
3. Remove the rack bearing assembly from the rack and pinion steering assembly. Refer to “Rack Bearing” in this section.
4. Mark the threads on the inner tie rod to aid in repositioning the adjusting nut.
5. Loosen the adjusting nut and remove the outer tie rod nut and the adjusting nut.

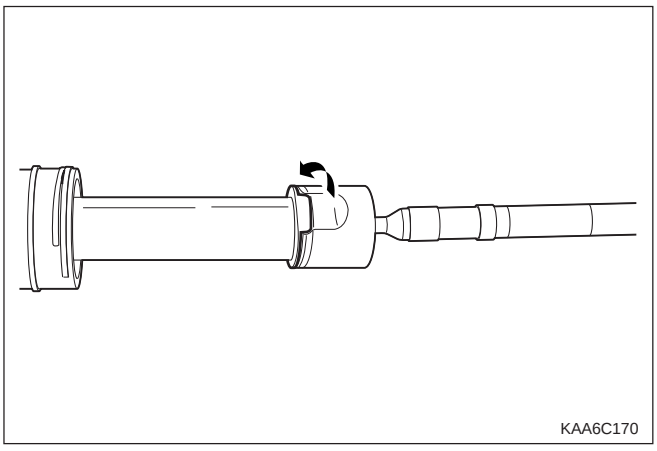
Installation Notice:

- When installing the outer tie rod nut, the mark on the inner tie rod and adjusting nut should line up.
- After installation, perform a front toe adjustment. Refer to *Section 2B, Wheel Alignment.*

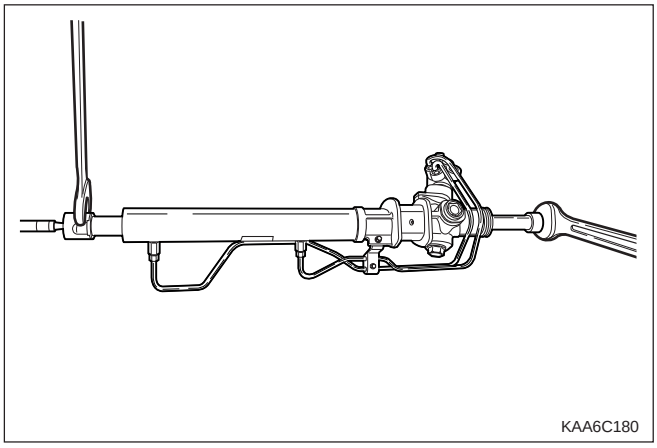
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KAA6C160

6. Remove the dust boot retaining clamps and remove the dust boot.


KAA6C170

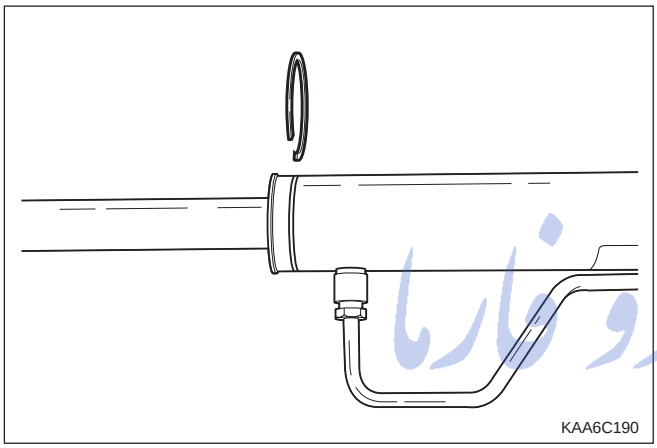
7. Push back the retainer holding the connection between the inner tie rod and the power steering gear rack.


KAA6C180

8. Counterhold the pinion-side inner tie rod and remove the cylinder-side inner tie rod.

   Installation Notice:

   - To prevent the inner tie rods from loosening, use Loctite® 242 (or equivalent) on both inner tie rod connections to secure them to the rack shaft.


KAA6C190

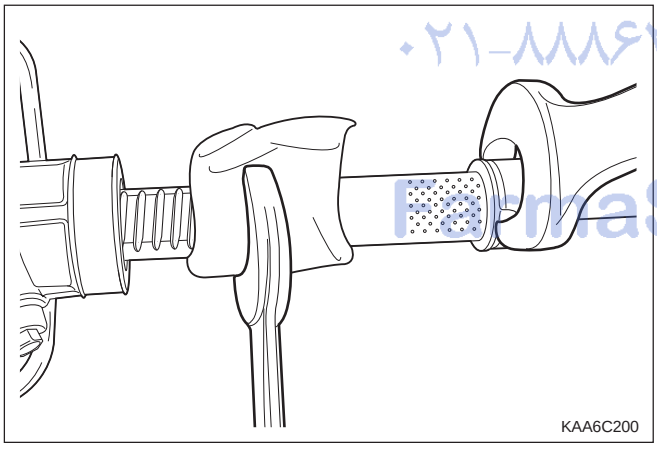
Important: The retaining ring can be released by inserting a small screwdriver through the hole in the side of the housing.

9. Remove the bulkhead inner cylinder retaining ring.

   Installation Notice:

   - Coat all the seals with power steering fluid to ensure proper sealing.

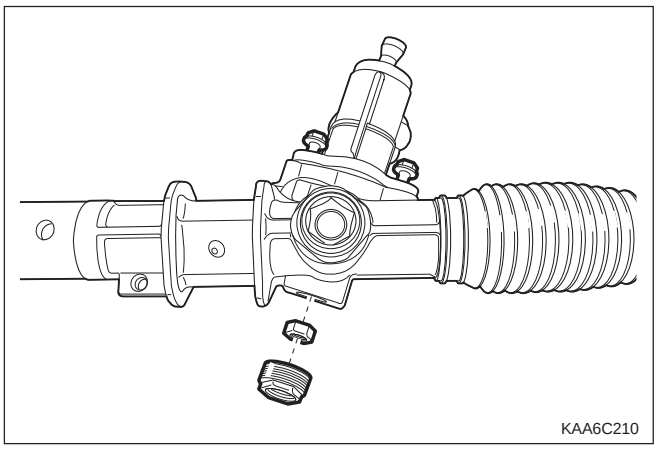
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KAA6C200

10. Place a rag over the rack, counterhold the rack assembly on the teeth with a wrench, and remove the pinion-side inner tie rod.

    Installation Notice:

    - The right and left inner tie rods are unequal in length. Be sure to install the correct inner tie rod on the proper side of the power steering gear.


KAA6C210

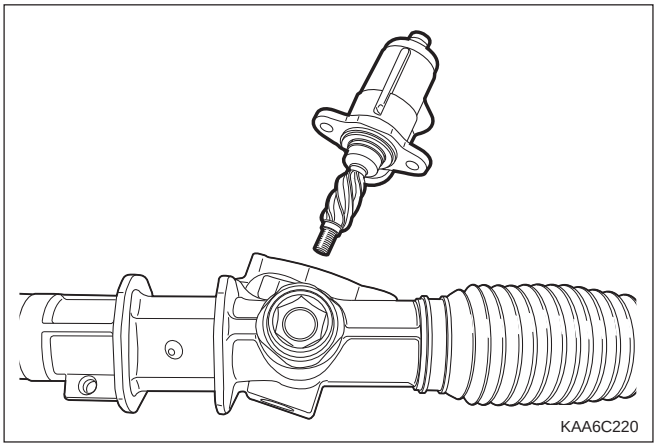
VALVE AND PINION ASSEMBLY

Disassembly and Assembly Procedure

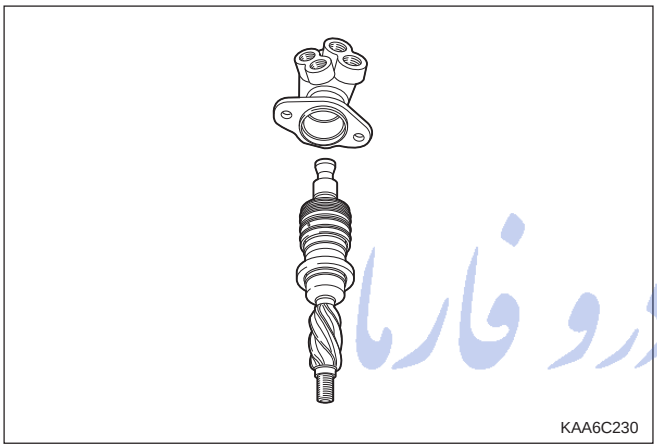
1. Remove the rack and pinion steering assembly from the vehicle. Refer to “Rack and Pinion Assembly” in this section.
2. Remove the dust cover from the lower end of the housing.

   Notice: If the stub shaft is not held, damage to the pinion teeth will occur.

3. While holding the stub shaft with a wrench, remove the locknut from the pinion.


KAA6C220

4. Remove the stub shaft and stub shaft housing.

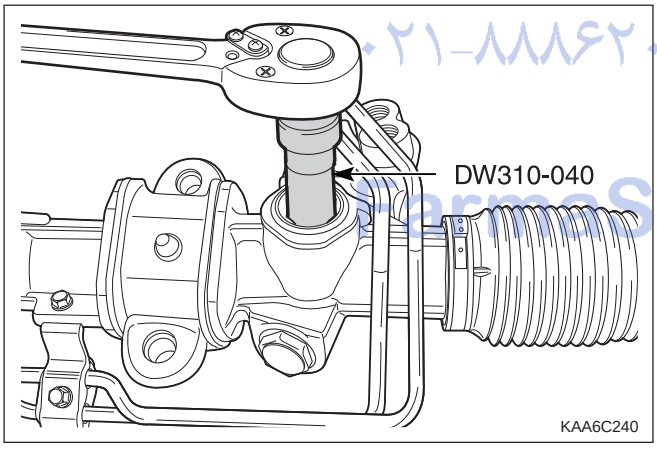

KAA6C230

5. Remove the stub shaft from the stub shaft housing
6. Remove the stub shaft seal in the stub shaft.

Installation Notice:

- Coat all the seals with power steering fluid to ensure proper sealing.

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KAA6C240

RACK BEARING

Disassembly and Assembly Procedure

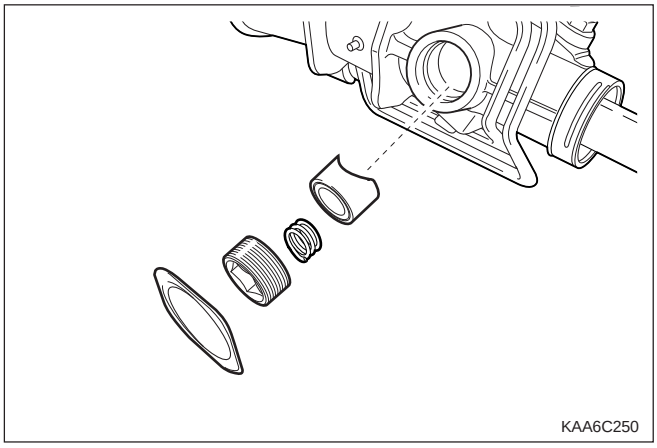
Tools Required

DW310-040 Power Steering Rack Guide Spring Cap Wrench

1. Remove the rack and pinion steering assembly from the vehicle. Refer to “Rack and Pinion Assembly” in this section.
2. Remove the adjuster plug locknut from the adjuster plug, and remove the adjuster plug from the housing with the power steering rack guide spring cap wrench DW310-040.

Installation Notice

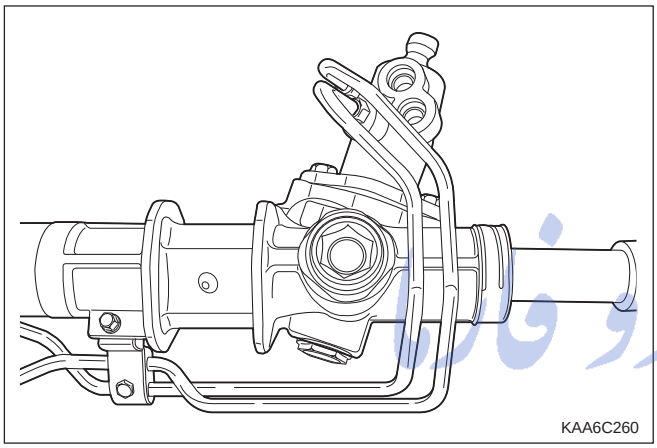
Tightening Torque	59 N•m (43 lb-ft)


KAA6C250

3. Remove the adjuster spring and the rack bearing.

Installation Notice:

- Coat the rack bearing, the adjuster spring and the adjuster plug with lithium-based grease
- With the rack centered, turn the adjuster plug clockwise untila torque of4 N•m (35 lb-in) is obtained, then back it off by 15 degrees. Check the pinion torque. Maximum pinion preloaded torque is 25 N•m (18 lb-ft).


KAA6C260

RACK BEARING PRELOAD ADJUSTMENT

Adjustment Procedure

1. Raise and suitably support the vehicle.
2. Center the steering wheel.
3. Remove the power steering gear. Refer to “Rack and Pinion Assembly” in this section.
4. Loosen the locknut and turn the adjuster plug clock-wise until a torque of 4 N•m (35 lb-in) is obtained, then loosen it by 15 degrees. Check the pinion orque. Maximum pinion preloaded torque is 25 N•m (18 lb-ft).
5. Tighten the locknut on the adjuster plug while holding the adjuster plug stationary.

Installation Notice

Tightening Torque	59 N•m (43 lb-ft)

6. Install the power steering gear. Refer to “Rack and Pinion Assembly” in this section.
7. Be sure to check the returnability of the steering wheel to center position after adjustment.

۰۲۱-۸۸۸۶۲۰۸۵ تلفن شبانه روزی
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SPECIFICATIONS

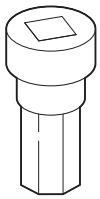
FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Adjust Plug Locknut	59	43	-
Hydraulic Cylinder Line Fitting At The Valve End	14	10	-
Hydraulic Cylinder Line Fitting At The Cylinder End	14	10	-
Intermediate Shaft Lower Pinch Bolt	27	20	-
Intermediate Shaft Upper Pinch Bolt	27	20	-
Outlet Tie Rod Nut	39	29	-
Power Steering Gear Inlet Pipe Fitting	17	13	-
Power Steering Gear Outlet Pipe Fitting	17	13	-
Rack And Pinion Assembly Mounting Bolts	78	58	-

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SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS TABLE

 KAA6C270	**DW 310 - 040** **Power Steering Rack Guide Spring Cap Wrench**

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SECTION 6E

POWER STEERING AND COLUMN

TABLE OF CONTENTS

Description and Operation 6E-2
General Description 6E-2
Ignition Switch Keyhole Lamp 6E-2
Ignition Key Reminder 6E-2
Component Locator 6E-3
Diagnostic Information and Procedures 6E-4
Steering Wheel Freeplay Inspection 6E-4
Steering Effort Inspection 6E-4
Steering Column Diagnosis 6E-5
Repair Instructions 6E-9
On-Vehicle Service 6E-9
Headlamp/Turn Signal Switch and Lever 6E-9
Wiper Switch and Lever 6E-10
Steering Wheel With Sir 6E-10
Ignition Lock Cylinder and Switch 6E-11
Steering Column 6E-12
Specifications 6E-14
Fastener Tightening Specifications 6E-14
Special Tools and Equipment 6E-15
Special Tools Table 6E-15

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DESCRIPTION AND OPERATION

GENERAL DESCRIPTION

Caution: To ensure the energy-absorbing action of the steering column, it is important to use only the specified screws, bolts, and nuts, tightened to the specified torque.

In addition to the steering function, the steering column provides safety and security.

The energy-absorbing column is designed to compress in a front-end collision to lessen the chance of driver injury.

The ignition switch and the lock are mounted on the column, allowing the ignition and steering operations to be locked to inhibit theft of the car.

The column levers trigger the turn signals, the headlight beams, and the windshield washer and wipers.

A tilt steering column uses a spherical joint to allow the steering wheel to tilt up and down. This enables the driver to adjust the steering wheel to a comfortable position.

Notice: Apply a thin coat of lithium grease to all friction points when reassembling.

The column may be disassembled and reassembled easily.

IGNITION SWITCH KEYHOLE LAMP

For description and lamp replacement information, Refer to *Section 9B, Lighting Systems.*

IGNITION KEY REMINDER

The ignition key reminder alerts the driver that the key is still in the ignition when the driver attempts to exit the vehicle.

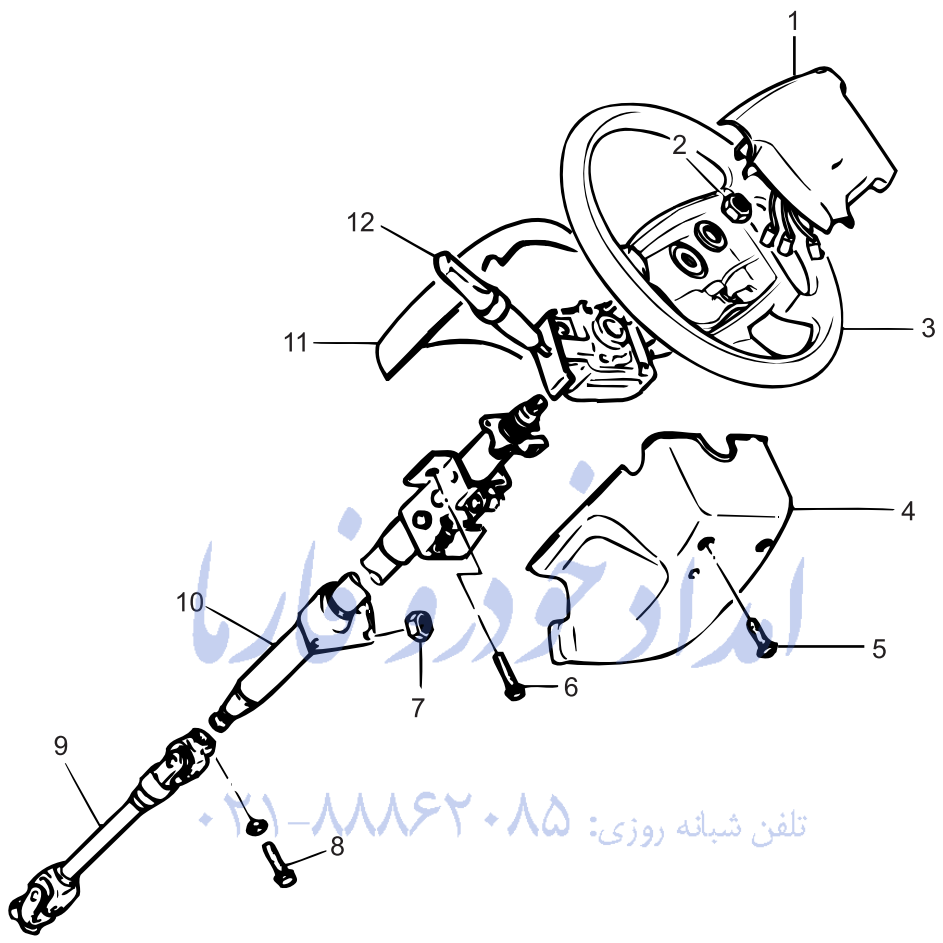
An internal switch in the ignition lock cylinder supplies battery voltage to the reminder chime module when all of the following conditions are true:

- The key is in the ignition switch.
- The ignition is OFF.
- The driver's door is open.

For information on removal and installation of the reminder chime module, Refer to *Section 9E, Instrumentation/Driver Information.*

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COMPONENT LOCATOR

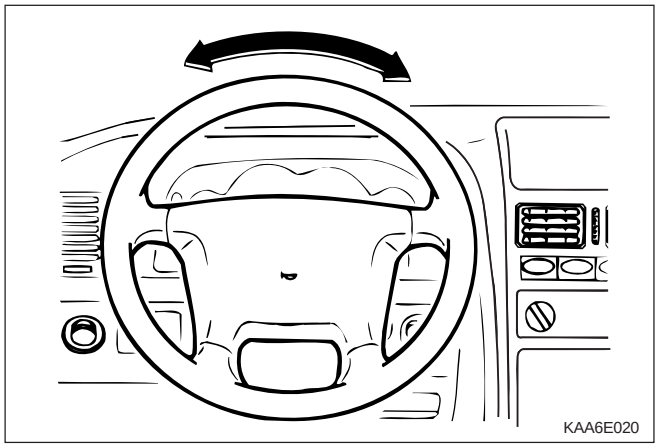


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1 Driver Airbag Module
2 Steering Wheel Nut
3 Steering Wheel
4 Lower Steering Column Cover
5 Lower Steering Column Cover Screw
6 Steering Column Upper Mounting Bolt
7 Steering Column Lower Mounting Nut
8 Intermediate Shaft Upper Pinch Bolt
9 Intermediate Shaft
10 Steering Column
11 Upper Steering Column Cover
12 Headlamp/Turn Signal Switch and Lever

DIAGNOSTIC INFORMATION AND PROCEDURES

STEERING WHEEL FREEPLAY INSPECTION



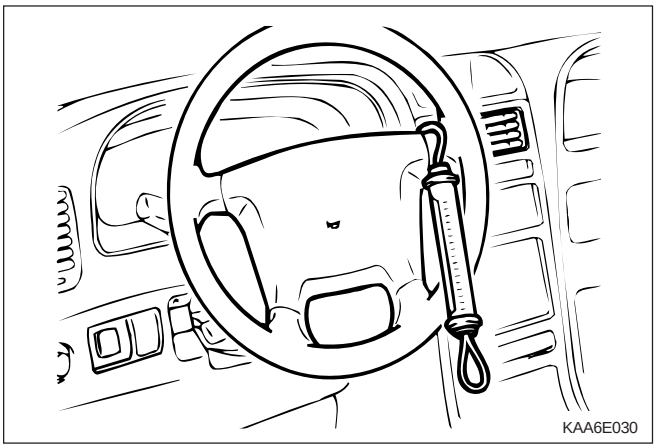
Inspection Procedure

1. Start the engine and set the wheels in straight ahead position.
2. Slightly move the steering wheel to the left and right and measure steering wheel free play when the front wheel is start to move.

Standard	Max. 30 mm

Notice: If exceeds specification, the steering column shaft connections and steering linkage clearance. Replace or repair if necessary.

STEERING EFFORT INSPECTION



Inspection Procedure

1. Place a vehicle on the paved flat ground with front wheels in a straight ahead position.
2. Start the engine and run it at 1,000 rpm.
3. Using a scale, measure the steering effort in both directions.

Standard	Max. 3.0 kg

Notice : The difference in steering effort of left and right should be within 0.6 kg.

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STEERING COLUMN DIAGNOSIS

Lock System

Lock System Will Not Unlock

Checks	Action
Check the lock cylinder for damage.	Replace the lock cylinder.
Check the ignition switch for lack of free movement.	Lubricate the ignition switch.
Check the steering column housing for binding or damage.	Remove the steering shaft and clear the steering column housing. Replace the steering column housing as needed.

Lock System Will Not Lock

Checks	Action
Check the lock cylinder for damage.	Replace the lock cylinder.
Check the ignition switch for lack of free movement.	Lubricate the ignition switch.
Check the steering column housing for binding or damage.	Remove the steering shaft and clear the steering column housing. Replace the steering column housing as needed.

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High Lock Effort

Checks	Action
Check the lock cylinder for damage.	Replace the lock cylinder.
Check the ignition switch for lack of free movement.	Lubricate the ignition switch.
Check for extreme misalignment of the housing to the cover.	Realign the cover on the housing. Replace the cover as needed.
Check for a bent ignition switch mounting bracket.	Replace the ignition switch mounting bracket.

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High Lock Effort

Checks	Action
Check to see that the ignition switch is set correctly.	Reset the ignition switch.
Check the lock cylinder for damage.	Replace the lock cylinder. Reset the ignition switch.

Column

Noise in the Column

Checks	Action
Check the steering gear-to-column joints for improper installation.	Tighten the steering shaft universal joint pinch bolts. Replace the steering shaft joints as needed.
Check the steering shaft bearing for wear or damage.	Replace the steering shaft bearing.
Check the spherical joint for lack of lubrication.	Lubricate the spherical joint.
Check the steering shaft for lack of lubrication.	Lubricate the steering shaft bearing.
Check the shaft lock snap ring for improper seating.	Adjust the shaft lock snap ring. Replace the shaft lock snap ring as needed.

High Steering Shaft Effort

Checks	Action
Check the steering shaft bearing for wear or damage.	Replace the steering shaft bearing.
Check for an improperly installed or deformed dust seal.	Replace the dust seal.
Check for a damaged upper or lower bearing.	Replace the upper or the lower bearing.
Check the steering shaft universal joints for a lack of free movement.	Lubricate the steering shaft universal joints. Replace the steering shaft universal joints as needed.

Lash in the Steering Column

Checks	Action
Check the steering column bracket mounting bolts for improper Installation Note.	Tighten the steering column bracket mounting bolts.
Check for broken weld nuts on the steering column jacket.	Replace the steering column jacket.

Loose Steering Wheel

Checks	Action
Check for excessive clearance between the holes in the steering wheel support or the housing and the pivot-pin diameters.	Replace the pivot pins with pivot pins of the correct size.
Check to see if the upper bearing is seated correctly in the housing.	Correctly seat the upper bearing. Replace the upper bearing as needed.

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Noise When Tilting the Column

Checks	Action
Check for worn upper tilt bumpers.	Replace the upper tilt bumpers.
Check for tilt spring binding.	Adjust the tilt spring. Replace the tilt spring as needed.

Turn Signal/Dimmer Switch

Turn Signal Will Not Stay in the Turn Position

Checks	Action
Check the turn signal switch for an improper installation.	Remove and inspect the turn signal switch. Reinstall the switch.
Check the canceling mechanism for broken or missing components.	Replace the canceling mechanism.
Check the turn signal switch housing for foreign material.	Remove any foreign material.

Turn Signal Will Not Cancel

Checks	Action
Check the canceling mechanism for broken or missing components.	Replace the canceling mechanism.

Turn Signal/Dimmer Switch Difficult to Operate

Checks	Action
Check the turn signal/dimmer switch and turn signal/ dimmer switch lever for improper installation.	Remove and inspect the turn signal/dimmer switch and signal/dimmer switch lever. Reinstall the signal/ dimmer switch and signal/dimmer switch lever.
Check the signal/dimmer switch housing for foreign material.	Remove any foreign material.

Turn Signal Will Not Indicate Lane Change

Checks	Action
Check for a broken lane change pressure pad or a broken spring hanger.	Replace the lane change pressure pad or the spring hanger.
Check for improper functioning of the lane change spring.	Replace the lane change spring.
Check the turn signal switch for improper installation.	Replace the turn signal switch.

No Turn Signal Lights

Checks	Action
Check for an inoperative turn signal flasher.	Replace the turn signal flasher.
Check for a faulty turn signal switch.	Replace the turn signal switch.
Check the chassis-to-column connector for an improper connection.	Reconnect the chassis-to-column connector.

Turn Indicator Lights On, but Not Flashing

Checks	Action
Check for an inoperative turn signal flasher.	Replace the turn signal flasher.
Check for a faulty turn signal switch.	Replace the turn signal switch.
Check the chassis-to-column connector for an improper connection.	Reconnect the chassis-to-column connector.

Front or Rear Turn Signal Lights Not Flashing

Checks	Action
Check for a faulty turn signal switch.	Replace the turn signal switch.
Check the chassis-to-column connector for an improper connection.	Reconnect the chassis-to-column connector.

Turn Signal Lights Flash Very Slowly

Checks	Action
Check the chassis-to-column connector for an improper connection.	Reconnect the chassis-to-column connector.

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Ignition Switch

Electrical System Will Not Function

Checks	Action
Check the ignition switch for damage.	Replace the ignition switch.
Check the ignition switch for improper installation.	Remove and inspect the ignition switch. Reinstall the ignition switch.
Check the ignition switch electrical connector for improper installation.	Reconnect the ignition switch electrical connector. Replace the ignition switch electrical connector.

Ignition Switch Will Not Turn

Checks	Action
Check the ignition switch for damage.	Replace the ignition switch.
Check the ignition switch for improper installation.	Remove and inspect the ignition switch. Reinstall the ignition switch.

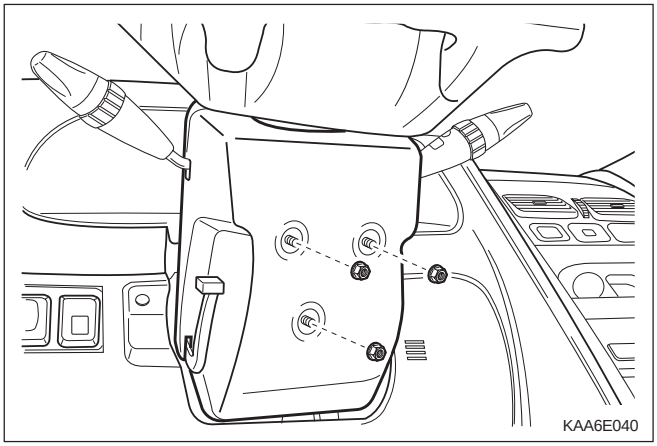
Wiper/Cruise Control Switch Lever

Switch Inoperative: No LOW, HIGH, INTERMITTENT or WASH

Checks	Action
Check the wiper switch for damage.	Replace the wiper/cruise control switch.
Check the wiper switch for improper installation.	Remove and inspect the wiper/cruise control switch. Reinstall the wiper/cruise control switch.
Check the cruise control switch for damage.	Replace the wiper/cruise control switch.

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REPAIR INSTRUCTIONS

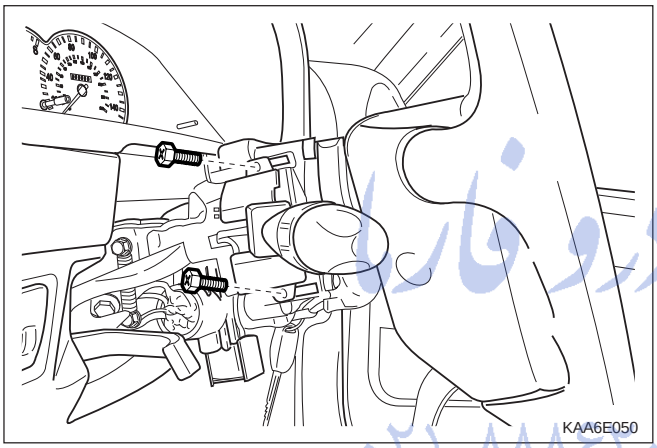


ON-VEHICLE SERVICE

HEADLAMP/TURN SIGNAL SWITCH AND LEVER

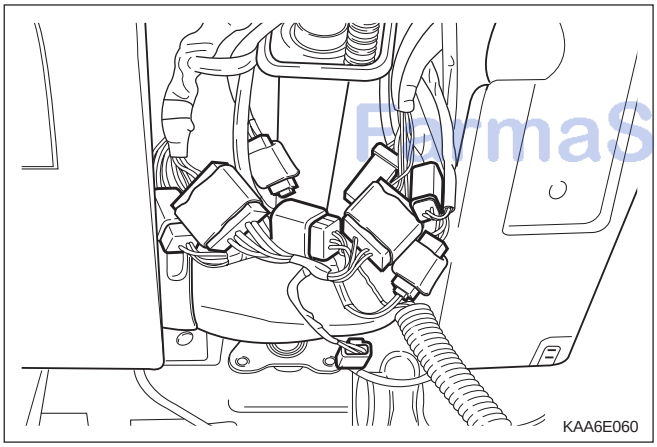
Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Remove the upper and the lower steering column cover screws.
3. Remove the upper and the lower steering column cover.

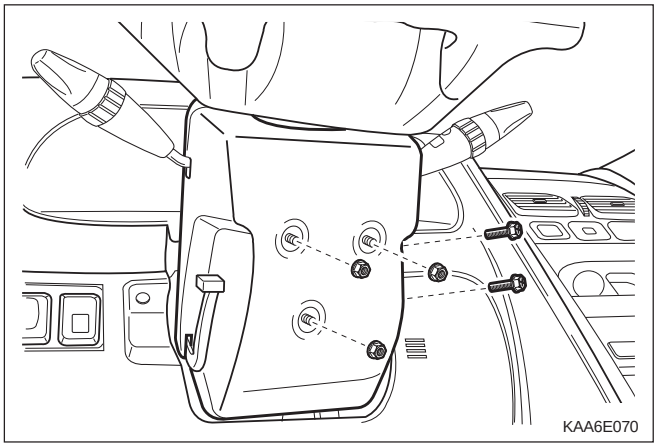


4. Remove the turn signal switch mounting screws.

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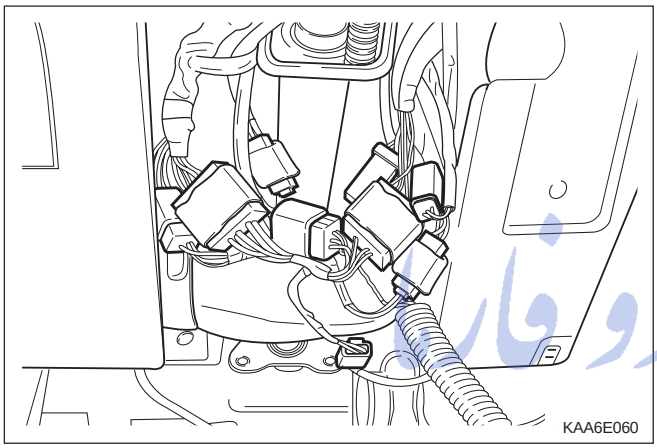
5. Disconnect the turn signal switch connector.
6. Remove the turn signal switch.



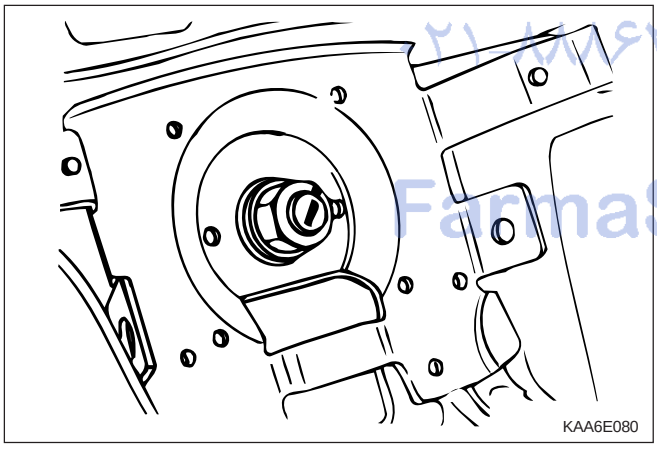
WIPER SWITCH AND LEVER

Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Remove the upper and the lower steering column cover screws.
3. Remove the upper and the lower steering column cover.
4. Remove the wiper switch and lever mounting mounting screws.



5. Disconnect the wiper switch and lever connector.
6. Remove the wiper switch and lever.



STEERING WHEEL WITH SIR

Tools Required

661 589 00 33 00 Steering Wheel Puller

Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Remove the SIR module. Refer to *Section 8B, Supplemental Inflatable Restraints.*
3. Remove the steering wheel nut.

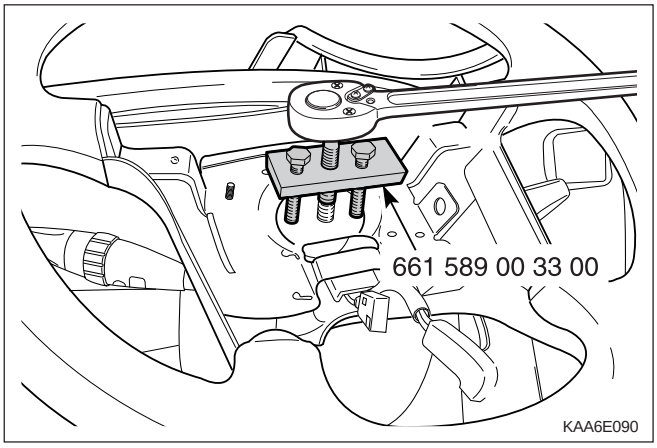
Removal Notice:

- In order to install the steering wheel correctly, match mark the steering column shaft to the steering wheel.

Installation Notice

Tightening Torque	65 N•m (48 lb-ft)

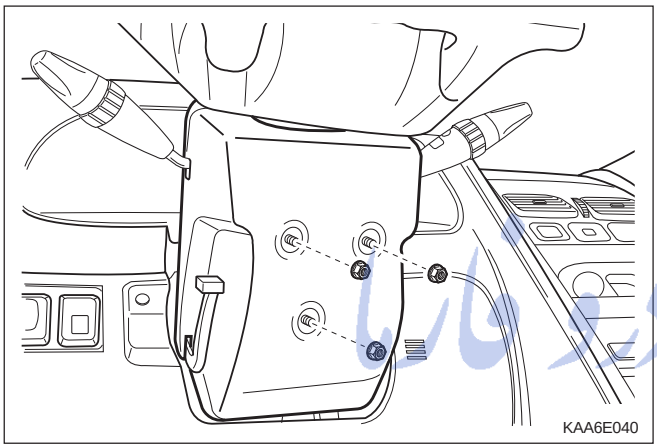
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4. Remove the steering wheel using the steering wheel puller 661 589 00 33 00.

Installation Notice:

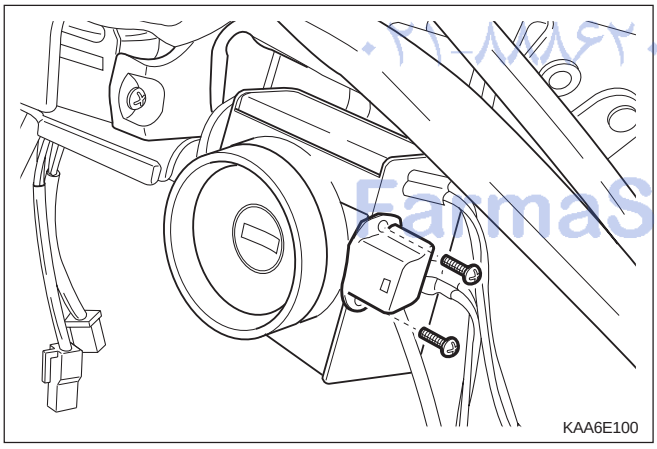
- Align the match marks on the steering wheel and the steering column shaft.



IGNITION LOCK CYLINDER AND SWITCH

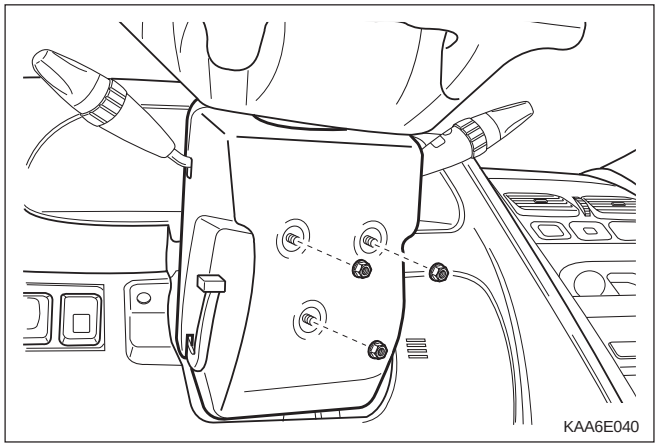
Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Remove the upper and the lower steering column cover screws.
3. Remove the upper and the lower steering column cover.



4. Remove the screws for illumination keyhole connection.
5. With the key in the ignition turned to the position designated ACC, remove the lock cylinder by pressing down the detent spring with a 2.5 mm allen wrench or other suitable tool, and pulling the lock cylinder out of the cylinder housing.

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STEERING COLUMN

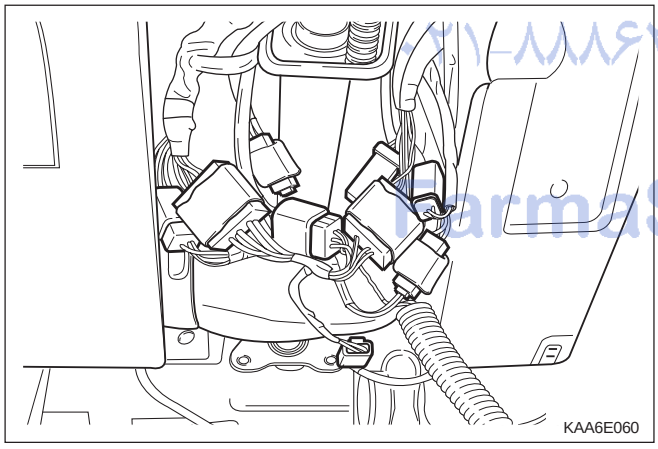
Important: Remove the steering column only if the following conditions exist:

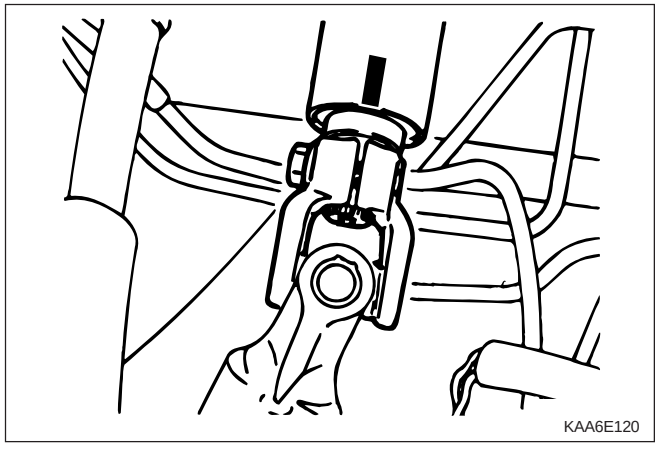
- The steering column requires replacement.
- The steering and the ignition lock housing require replacement.
- Another operation requires the removal of the steering column

Notice: The steering column is extremely susceptible to damage after it has been removed from the vehicle. Dropping the column assembly on its end or hammering the end of the steering shaft can collapse the steering shaft or loosen the plastic injections which maintain column rigidity. Leaning on the column can cause it to bend or deform. Any of the above damage can impair the column's collapsible design. If it is necessary to remove the steering wheel, use only the specified steering wheel puller.

Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Remove the upper and the lower steering column cover screws.
3. Remove the upper and the lower steering column cover.
4. Remove the lower instrument trim panel. Refer to *Section 9E, Instrumentation/Driver Information.*
5. Remove the immoblilzer module. Refer to *Section 9T, Immobilizer Anti-Theft system.*
6. Disconnect the airbag electrical connections.
7. Disconnect electrical switch connections.


KAA6E060

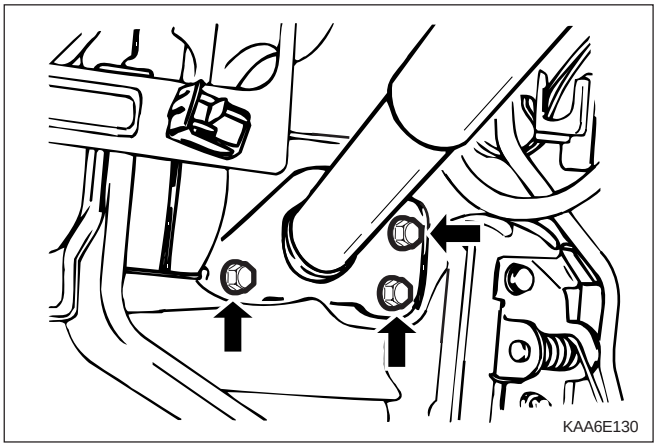

KAA6E120

8. Adjust the steering to the straight-ahead position.
9. Make a mark on the steering column shaft that lines up with a mark on the intermediate shaft upper universal joint.
10. Remove the intermediate shaft upper pinch bolt.

Installation Notice

Tightening Torque	27 N•m (20 lb-ft)

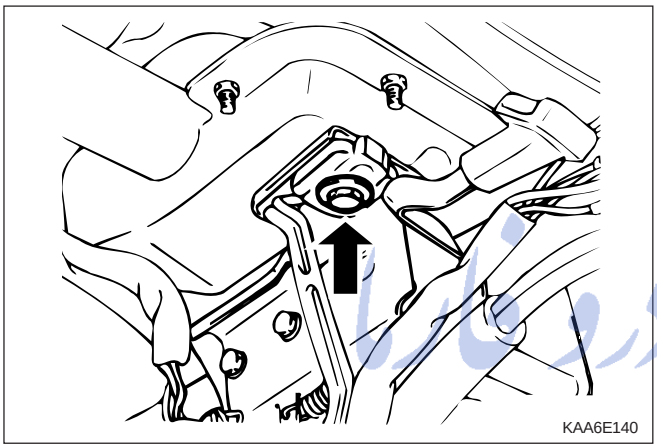
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11. Remove the steering column lower mounting nuts.

Installation Notice

Tightening Torque	22 N•m (16 lb-ft)



12. Remove the steering column upper mounting bolts that hold the rear bracket of the steering column jacket assembly.
13. Guide the steering column assembly out of the steering shaft flange and carefully lay down the assembly.

Installation Notice

Tightening Torque	22 N•m (16 lb-ft)

- Provide support for the steering column assembly until the mounting bolts are fastened. Do not let the steering column assembly hang unsupported.

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SPECIFICATIONS

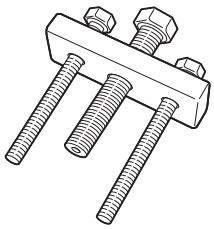
FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Intermediate Shaft Upper Pinch Bolt	27	20	-
Steering Wheel Nut	65	48	-
Steering Column Lower Mounting Nuts	22	16	-
Steering Column Lower Mounting Bolts	22	16	-

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SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS TABLE

 KAA6E150	**661 589 00 33 00** **Steering Wheel Puller**

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SECTION 7A

HEATING AND VENTILATION SYSTEM

CAUTION: The cooling system is pressurized when hot. Injury can result from removing the coolant reservoir cap before the engine is sufficiently cool.

TABLE OF CONTENTS

Description and Operation 7A-2

Heating and Ventilation System 7A-2

Components Locator 7A-3

Heater System 7A-3

Diagnostic Information and Procedures 7A-4

Heater System 7A-4

Blower Electrical 7A-8

Mode Controls Do Not Work 7A-10

Air Source Selection Not Controlled 7A-12

Temperature Controls Do Not Work 7A-13

Too Much Heat 7A-14

Blower Noise 7A-16

Repair Instructions 7A-18

On-Vehicle Service 7A-18

Temperature Control Cable Adjustment 7A-18

Controller Assembly and Temperature Control Cable 7A-18

Control Assembly Knob Lighting 7A-19

Air Intake Door Actuator 7A-19

Mode Control Door Actuator 7A-20

Heater/Air Distributor Case Assembly 7A-20

Blower Motor 7A-21

Blower Resistor 7A-22

Blower Unit 7A-22

Heater Inlet Hose 7A-23

Heater Outlet Hose 7A-23

Heater Core 7A-24

Rear Heater Duct 7A-24

Air Filter 7A-24

Specifications 7A-25

Heater Temperature Specification 7A-25

Heater Unit 7A-25

Fastener Tightening Specification 7A-25

Schematic and Routing Diagrams 7A-26

Non - A/C Wiring Diagram 7A-26

Airflow Through Vents 7A-28

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DESCRIPTION AND OPERATION

HEATING AND VENTILATION SYSTEM

The base heater system is designed to provide heating, ventilation, windshield defrosting, side wind defogging and rear seat area.

The heater and fan assembly blower regulates the airflow from the air inlet for further processing and distribution.

The heater core transfers the heater from the engine coolant to the inlet air.

The temperature door regulates the amount of the air that passes through the heater core. The temperature door also controls the temperature of the air by controlling mix of heated air with the ambient air.

The mode door regulates the flow and distribution of the processed air to the heater ducts and to the defroster ducts.

The console mounted heating and ventilation control panel contains one rotary control knob, one sliding control lever and six push control knobs, which operate as follows:

Sliding Temperature Control Lever

- Actuates by cable.
- Raise the temperature of the air entering the vehicle by sliding to the right, or the red portion of the knob.

Five Mode Control Knob

- Actuates by electricity.
- Regulates the air distribution between the windshield, the instrument panel, and the floor vents.

Rotary Blower Control Knob

- Turns on to operate the blower motor at four speeds.
- Turns OFF to stop the blower.
- Operates completely independently from both the mode control knob and temperature control knob.
- Changes the fan speed in any mode and at any speed.

Intake Air Control Knob

- Operates by electricity.
- Switches between recirculating the passenger compartment air and bringing outside air into the passenger compartment.
- Is normally in fresh air mode.
- Illuminates the indicator lamp when in the recalculat ing mode.

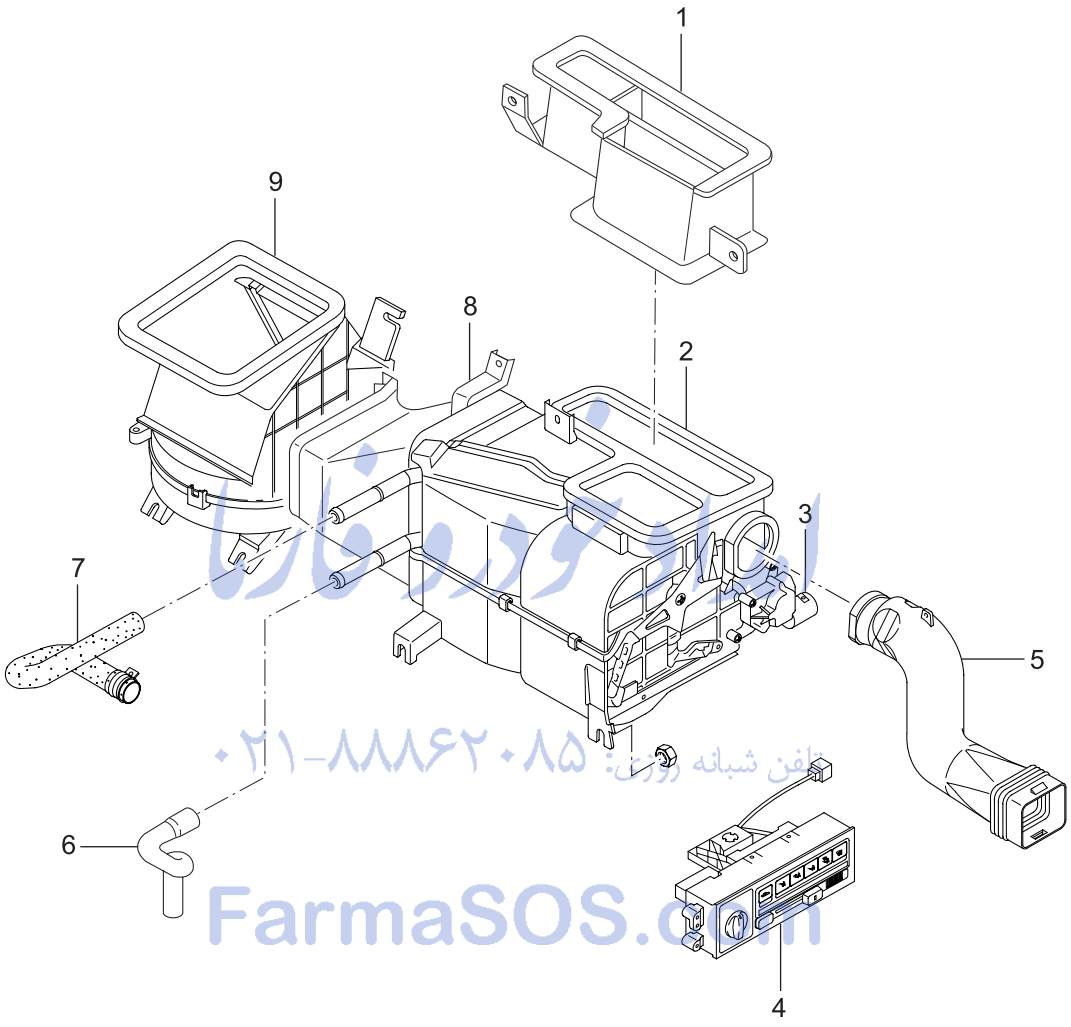
Heater Core

The heater core heats the air before enters the vehicle. Engine coolant is circulated through the core to heat the outside air passing over the fins of the core. The core is functional at all times and may be used to temper conditioned air in the A/C mode as well as in the heat or the vent mode.

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COMPONENTS LOCATOR

HEATER SYSTEM



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1 Heater-to-Defrost Duct
2 Heater Unit
3 Mode Actuator Assembly
4 Heater Controller
5 Side Air Vent
6 Coolant Outlet Hose
7 Coolant Inlet Hose
8 Heater-to-Blower Duct
9 Blower Unit

DIAGNOSTIC INFORMATION AND PROCEDURES

HEATER SYSTEM

Insufficient Heating or Defrosting

CAUTION: The cooling system is pressurized when hot. Injury can result from removing the coolant reservoir cap before the engine is sufficiently cool.

Step	Action	Value(s)	Yes	No
1	Verify the customer's complaint. Are the customer's concerns verified?	-	Go to Step 2	System OK
2	Check the coolant level. Is the coolant level correct?		Go to Step 4	Go to Step 3
3	Add coolant as needed Is the repair complete?		System OK	Go to Step 4
4	Check the serpentine accessory drive belt for tension or damage. Is the 'serpentine accessory drive belt OK?		Go to Step 5	Go to Step 6
5	Correct any problem with serpentine accessory drive belt. Is the repair complete?		System OK	Go to Step 6
6	Check the coolant hoses for leaks or kinks. Are the coolant hoses OK?		Go to Step 8	Go to Step 7
7	Repair any problem with the coolant hoses. Is the repair complete?		System OK	Go to Step 8
8	Check the coolant reservoir cap. Refer to *Section 1D,* Engine Cooling. Is the coolant reservoir cap OK?		Go to Step 10	Go to Step 9
9	Repair or replace the coolant reservoir cap as needed. Is the repair complete?		System OK	Go to Step 10
10	1. Set the A/C switch OFF on the vehicles equipped with air conditioning. 2. Set the temperature control lever to full hot. 3. Set the blower motor switch on 4. 4. Turn the ignition ON. 5. Check for the airflow from the vent outlet. Is there a heavy airflow from the vent outlet?		Go to Step 11	Go to Step 25
11	Check for change in the airflow at various blower speeds. Does the blower speed increase as the switch is turned from 1 to 4?		Go to Step 12	Go to "Blower Electrical"
12	1. With the engine sufficiently cool, remove the coolant reservoir cap. 2. Set the blower motor switch on 4. 3. Set the temperature control lever to full hot. 4. Start the engine and idle the engine. 5. Watch for the flow of the coolant. Is the coolant flow visible?		Go to Step 16	Go to Step 13

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Insufficient Heating or Defrosting (Cont'd)

Step	Action	Value(s)	Yes	No
13	Check the thermostat. Refer to *Section 1D, Engine Cooling*. Is the thermostat installed and seated properly?		Go to Step 14	Go to Step 15
14	Replace the thermostat. Refer to *Section 1D, Engine* Cooling. Is the repair complete?		System OK	-
15	Reinstall the thermostat. Is the repair complete?		System OK	-
16	1. Install the coolant reservoir cap. 2. With the ignition ON, allow the engine to warm up for about 20 minutes. Drive the vehicle at 48 km/h (30 mph). 3. Use a thermometer to measure the ambient air temperature and the discharge air temperature at the heater outlet. Does the heater output meet the minimum value given?		Go to Step 17	Go to Step 18
17	1. Check the vehicle for cold air leaks at the following locations: • Dash. • Heater case. • Vents. 2. Check under the seat for obstructions. 3. Repair any leaks or obstructions. Are the repairs complete?		System OK	-
18	1. Turn the ignition OFF. 2. Turn the temperature control lever to full cold, then rapidly to full hot. 3. Listen for a second of the end of travel range of the control lever Does the door slam?		Go to Step 20	Go to Step 19
19	1. Check the following aspects of the temperature door: • Travel • Heater case • Vents 2. Verify the accuracy of the temperature controls at full hot. 3. Verify the accuracy of the temperature controls at full cold. Is the repair complete?		System OK	-
20	1. Set the temperature door to full hot. 2. Start the vehicle 3. Check the temperature of the heater inlet hose and the heater outlet hose by feel. The air temperature around the hoses should be at least 29 °C (84 °F) Is the heater inlet hose hot and heater outlet hose warm?		Go to Step 26	Go to Step 21

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Insufficient Heating or Defrosting (Cont'd)

Step	Action	Value(s)	Yes	No
21	Inspect heater hoses for proper installation. Are heater hoses reversed?		Go to Step 22	Go to Step 23
22	Reinstall the heater hoses properly. Is the repair complete?		System OK	-
23	1. Back flushes the heater core. 2. Drain the cooling system. 3. Replace the coolant. 4. Warm the engine to an average operating temperature. 5. Feel the heater inlet hose and outlet hose. Are the heater inlet hose hot and the heater outlet hose warm?		System OK	Go to Step 24
24	Replace heater core. Is the repair complete?		System OK	-
25	Recheck the system using the "Control setting/ Correct Results" tests. Refer to "Improper Air Delivery or No Mode Shift" in this section. Is the repair complete?		System OK	Go to Step 26
26	Check for airflow from the defroster or the vent outlets. Is there high airflow form the defroster or vent outlets?		Go to Step 27	Go to Step 28
27	Check the heater door at the floor and the vent door to get proper airflow, verify proper operation, and repair as required. Is the repair complete?		System OK	-
28	Push the defroster knob Is the defroster airflow OK?		Go to Step 29	Go to Step 30
29	1. Remove the heater outlet and check for obstructions. 2. Remove any obstructions in the heater outlet. Is the repair complete?		System OK	-
30	Check for obstructions in the system at blower inlet and the air filter, if the vehicle equipped with one. Are there any obstructions?		Go to Step 31	Go to Step 32
31	Remove the obstructions in the system at the blower inlet or replace a clogged filter. Are the repairs complete?		System OK	-
32	1. Set the blower on 4. 2. Slide the temperature control lever from full hot to full cold. 3. Listen for an airflow change. Does the airflow change?		Go to Step 33	Go to Step 34

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Insufficient Heating or Defrosting (Cont'd)

Step	Action	Value(s)	Yes	No
33	1. Check the following aspects of the temperature door: • Travel. • Cable. • Linkage. 2. Verify the accuracy of the temperature controls at full hot. 3. Verify the accuracy of the temperature controls at full cold. Is the repair complete?		Go to Step 1	-
34	1. Check the system for any obstruction between the blower and the system outlets. 2. Remove any obstructions. Is the repair complete?		Go to Step 1	-

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BLOWER ELECTRICAL

Refer to “Non A/C Diagrams” for electrical schematic diagram of the circuits described in this procedure.

Step	Action	Value(s)	Yes	No
1	Verify the customer’s complaint. Are the customer’s concerns verified?	-	Go to Step 2	System OK
2	Does the blower run at any speed?		Go to Step 16	Go to Step 3
3	1. Disconnect the power connector from the blower motor under the dashboard on the passenger side of the vehicle. 2. Turn the ignition ON. 3. Turn the blower ON. 4. Test the voltage on the connector. The terminal connected to the BLK/WHT wire is positive and the terminal connected to the BLU/YEL wire is negative. Is the voltage within the specified range?	11 - 14 v	Go to Step 4	Go to Step 5
4	Replace the blower motor. Is the repair complete?		System OK	-
5	Check fuse EF2 in the engine fuse block and F19 in the I/P fuse block. Is the fuse blown?		Go to Step 6	Go to Step 7
6	1. Turn the ignition ON. 2. Use a short detector to locate the following possible short: • From the fuse EF2 to terminal 30 of blower motor relay. • From the fuse F19 to terminal 86 of blower motor relay. • From the terminal 87 of blower motor relay to blower motor. 3. Repair any short. 4. Replace any blown fuse. Is the repair complete?		System OK	-
7	1. Turn the ignition ON. 2. Remove the blower motor relay. 3. Using test light check the continuity between following terminals and ground: • Terminal 30 of blower motor relay. • Terminal 86 of blower motor relay. Does the test light come on?		Go to Step 9	Go to Step 8
8	Repair the open circuit. Is the repair complete?		System OK	-
9	1. Turn the ignition OFF. 2. Set the blower motor switch at 4. 3. Using ohmmeter, measure the resistance between terminal 85 of blower motor relay and ground. Is the resistance within specified value?	≈ 0 Ω	Go to Step 11	Go to Step 10
10	Repair open circuit. Is the repair complete?		System OK	-

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Blower Electrical (Cont'd)

Step	Action	Value(s)	Yes	No
11	Using ohmmeter, measure the resistance between terminal 87 of blower motor relay. Is the resistance within specified value?	≈ 0 Ω	Go to Step 12	Go to Step 13
12	Replace the blower motor relay. Is the repair complete?		System OK	-
13	1. Disconnect blower motor switch connector. 2. Turn the ignition switch ON. 3. Jump terminal 5 and terminal 1 of the blower motor switch connector with jump wire. Does the blower motor run?		Go to Step 15	Go to Step 7
14	Repair open circuit between terminal 87 of blower motor relay to ground G203. Is the repair complete?		System OK	-
15	Replace the blower motor switch. Is the repair complete?		System OK	-
16	1. Disconnect the blower motor switch connector. 2. Turn the ignition switch ON. 3. Using test light, check the power feed between terminal 2, 3, 4, and 5 of the blower motor switch connector and ground. Does the light come on?		Go to Step 15	Go to Step 17
17	Repair open circuit or replace the blower resister. Is the repair complete?		System OK	-

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MODE CONTROLS DO NOT WORK

Refer to “Non A/C Diagrams” for electrical schematic diagram of the circuits described in this procedure.

Mode Controls Do Not Work

Step	Action	Value(s)	Yes	No
1	Verify the customer’s complaint. Are the customer’s concerns verified?	-	Go to Step 2	System OK
2	Measure the voltage between terminal 8 of heating and ventilation control (HVC) controller and ground. Is the voltage within the specified value?	11 - 14 v	Go to Step 6	Go to Step 3
3	Check fuse F19 in the I/P fuse block. Is the fuse blown?		Go to Step 4	Go to Step 5
4	1. Turn the ignition ON. 2. Use a short detector to locate the following possible short: • From the fuse F24 to terminal 8 of C204. • From the terminal 8 of the C212 to terminal 8 of HVC controller. 3. Repair any short. 4. Replace any blown fuse. Is the repair complete?		System OK	-
5	Repair open circuits from fuse F19 to terminal 8 of the HVC controller. Is the repair complete?		System OK	-
6	1. Turn the ignition switch to OFF. 2. Disconnect the mode actuator connector. 3. Using Motor Control Table, measure the resistance between the specified terminals of the specified motor connector. 4. Change the mode settings and observe the resistance change. Are the resistance equal to specified value?	See the “Motor Control Table”	Go to Step 10	Go to Step 7
7	1. Disconnect the HVC controller. 2. Using Motor Control Table, measure the resistance between the specified terminals of the specified HVC controller. 3. Change the mode settings and observe the resistance change. Are the resistance equal to specified value?	See the “Motor Control Table”	Go to Step 9	Go to Step 8
8	Replace the HVC controller. Is the repair complete?		System OK	-
9	Repair open or short circuits between HVC controller and mode moor actuator. Is the repair complete?		System OK	-
10	Replace mode control motor. Is the repair complete?		System OK	Go to Step 11
11	1. Examine the affected door in the unit for proper attachment to the actuator. 2. Check the actuator connection to the door. 3. Check that the connector is properly connected. Is everything connected properly?		Go to Step 13	Go to Step 12

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Mode Controls Do Not Work (Cont'd)

Step	Action	Value(s)	Yes	No
12	Repair as necessary. Is the repair complete?		System OK	-
13	1. Disconnect the actuator at the door. 2. Check the range of the door travel and the effort required moving it. Does the door move freely through its entire range of travel so that it can close at both ends of the range?		Go to Step 5	Go to Step 12
14	Adjust the door travel and repair as necessary. Is the repair complete?		System OK	-

Motor Control Table

Mode Setting	Connector Terminal (Controller / Motor)				
	14/8	6/7	15/6	7/5	16/4
Defrost (Terminal 5/9)	3.9 - 4.1 Ω	3.9 - 4.1 Ω	3.9 - 4.1 Ω	3.9 - 4.1 Ω	3.9 - 4.1 Ω
Defrost/Foot (Terminal 5/9)	≈ 0 Ω	3.9 - 4.1 Ω	3.9 - 4.1 Ω	3.9 - 4.1 Ω	3.9 - 4.1 Ω
Foot (Terminal 5/9)	≈ 0 Ω	≈ 0 Ω	3.9 - 4.1 Ω	3.9 - 4.1 Ω	3.9 - 4.1 Ω
Bi-Level (Terminal 5/9)	≈ 0 Ω	≈ 0 Ω	≈ 0 Ω	3.9 - 4.1 Ω	3.9 - 4.1 Ω
Vent (Terminal 5/9)	≈ 0 Ω	≈ 0 Ω	≈ 0 Ω	≈ 0 Ω	3.9 - 4.1 Ω

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AIR SOURCE SELECTION NOT CONTROLLED

Refer to “Non A/C Diagrams” for electrical schematic diagram of the circuits described in this procedure.

Air Source Selection Not Controlled

Step	Action	Value(s)	Yes	No
1	Verify the customer’s complaint. Are the customer’s concerns verified?	-	Go to Step 2	System OK
2	Measure the voltage between terminal 8 of heating and ventilation control (HVC) controller and ground. Is the voltage within the specified value?	11 - 14 v	Go to Step 6	Go to Step 3
3	Check fuse F19 in the I/P fuse block. Is the fuse blown?		Go to Step 4	Go to Step 5
4	1. Turn the ignition ON. 2. Use a short detector to locate the following possible short: • From the fuse F19 to terminal 8 of C212. • From the terminal 8 of the C212 to terminal 8 of HVC controller. 3. Repair any short. 4. Replace any blown fuse. Is the repair complete?		System OK	-
5	Repair open circuits from fuse F19 to terminal 8 of the HVC controller. Is the repair complete?		System OK	-
6	1. Turn the ignition switch to OFF. 2. Disconnect the intake air control actuator connector. 3. Measure the voltage at terminal 3 of the connector. Is the voltage within the specified value?	11 - 14 v	Go to Step 8	Go to Step 7
7	Repair open circuit from terminal 8 of C212 to terminal 3 of the intake air actuator. Is the repair complete?		System OK	-
8	Measure the resistance between terminal 2 and 3 of the actuator. Is the resistance within the specified value?	≈ 2 k Ω	Go to Step 10	Go to Step 9
9	Replace the intake air door actuator. Is the repair complete?		System OK	-
10	1. Disconnect the HVC controller. 2. Measure the resistance between following point: • Terminal 9 of HVC controller and terminal 1 of actuator. • Terminal 10 of HVC controller and terminal 2 of actuator. Is the resistance within the specified value?	≈ 0 Ω	Go to Step 12	Go to Step 11
11	Repair open or short circuit. Is the repair complete?		System OK	-
12	Replace the HVC controller. Is the repair complete?		System OK	-

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TEMPERATURE CONTROLS DO NOT WORK

Step	Action	Value(s)	Yes	No
1	Verify the customer's complaint. Are the customer's concerns verified?	-	Go to Step 2	System OK
2	Move the temperature control lever. Is an excessive effort required to move the control lever?		Go to Step 5	Go to Step 3
3	Move the blower control switch on 4. Does the temperature door move too easily?		Go to Step 4	System OK
4	Remove the temperature control cable from the controller. Does the control knob slide freely, without the click stops?		Go to Step 14	System OK
5	Check the cable for improper routing, kinks, wiring interference, or other instrument panel interference. Is there a problem.		Go to Step 6	Go to Step 7
6	Repair as needed. Is the repair complete?		System OK	-
7	1. Remove the cable from temperature door. 2. Circle the door manually. 3. Check for door binding. Is there any door binding?		Go to Step 8	Go to Step 11
8	Check the door seal for proper installation. Is the door seal OK?		Go to Step 9	Go to Step 10
9	1. Check a binding door for shaft alignment, a bent shaft, a bent door, or a warped case. 2. Repair as need. Is the repair complete?		System OK	-
10	Repair the door seal, as needed. Is the repair complete?		System OK	-
11	Check the control binding. Does the control bind?		Go to Step 13	Go to Step 12
12	1. Reinstall the cable to the door. 2. Check the clearance for the cable to dash compartments. 3. Repair any interface. Is the repair complete?		System OK	-
13	1. Remove the cable from the control. 2. Check the control for binding. Does the control bind?		Go to Step 14	Go to Step 15
14	Replace the control. Is the repair complete?		System OK	-
15	Replace the cable. Is the repair complete?		System OK	-

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TOO MUCH HEAT

Step	Action	Value(s)	Yes	No
1	Verify the customer's complaint. Are the customer's concerns verified?	-	Go to Step 2	System OK
2	Is there too much heat when the mode switch is in the floor position?		Go to Step 3	Go to Step 9
3	Is there objectionable defroster bleed?		Go to Step 4	Go to Step 5
4	1. Check the door travel, the cable, the actuator, and the linkage for the heater and the defroster. 2. Adjuster or repair, as required. Is the repair complete?		System OK	-
5	1. In vehicles equipped with A/C, set the A/C switch OFF. 2. Set the blower speed to 4. 3. Set the temperature control lever to full hot. 4. Turn the ignition switch to ON. 5. Start the engine. 6. Check for airflow from the floor outlets. 7. Check the floor outlet attachment. Is the airflow high?		Go to Step 6	Go to Step 8
6	Check for a change in airflow at different blower speeds. Does the airflow change as the setting for the blower speed switch is changed?		Go to Step 7	Go to "Blower Electrical"
7	1. Check the temperature door travel, the cable, and the linkage. 2. Adjust to full hot. 3. Check for full hot. Is the repair complete?		System OK	-
8	Adjust or repair the floor/defroster and/or the vent/floor mode. Is the repair complete?		System OK	-
9	In the vent position. Is the problem objectionable bleed?		Go to Step 10	Go to Step 15
10	1. Check the system case for leaks. 2. Check the floor outlet attachment. Are there problems?		Go to Step 11	Go to Step 12
11	Repair the system case or the floor outlet attachment as required. Is the repair complete?		System OK	Go to Step 12
12	1. Turn the ignition switch OFF. 2. Turn the temperature control lever to full hot, then rapidly to full cold. Did you hear the door slam just before you reached the end of the control travel?		Go to Step 13	Go to Step 14
13	Adjust the vent door to vent mode. Is the repair complete?		System OK	-

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Too Much Heat (Cont'd)

Step	Action	Value(s)	Yes	No
14	1. Check the temperature door travel, the cable, and the linkage. 2. Verify the temperature door goes to full cold. 3. Check the temperature door for full hot. Is the temperature door travel correct?		System OK	-
15	Set the intake air control to fresh air (indicator lamp OFF). 2. Set the temperature control to full cold. 3. Start the vehicle and allow the engine to warm up. 4. Measure the air temperature at the blower inlet, or cowl, and at the vent air outlet inside the vehicle. Is the outlet air more than 1 °C (41 °F) warmer than the inlet air?		Go to Step 16	System OK
16	1. Check for hot air leaks from the engine compartment to the blower inlet. 2. Repair as needed. Is the repair complete?		System OK	-

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BLOWER NOISE

Step	Action	Value(s)	Yes	No
1	Verify the customer's complaint. Are the customer's concerns verified?	-	Go to Step 2	System OK
2	1. Sit inside the vehicle. 2. Close the doors and windows. 3. Turn the ignition ON. 4. Start the engine. 5. Set the temperature to full cold. 6. Cycle through the blower speeds, the modes, and the temperature settings in order to find the noise. Is the blower noise constant at high blower speeds or in other modes?		Go to Step 11	Go to Step 3
3	Check for vibrations from the blower motor and fan assembly at each blower speed by feeling the blower motor housing. Did you find excessive vibration?		Go to Step 6	Go to Step 4
4	1. Remove the blower motor and fan assembly. Refer to "Blower Motor" in this section. 2. Check for foreign materials at the opening of the blower inlet. Did you find any foreign materials at the blower inlet?		Go to Step 5	Go to Step 6
5	Remove all foreign materials. Is the repair complete?		System OK	Go to Step 6
6	1. Examine the blower fan for wear spots, cracked blades, a cracked hub, a loose fan retaining nuts, or bad alignment. 2. Examine the blower case for sports. Did you find any problem?		Go to Step 7	Go to Step 9
7	Repair as required. Is the repair complete?		System OK	Go to Step 8
8	Replace the motor and fan assembly. Is the repair complete?		System OK	Go to Step 9
9	If the noise is a click/tick or whine, replace the motor. Is the repair complete?		System OK	Go to Step 10
10	Reinstall the original motor. Is the problem still present?		Go to Step 11	System OK
11	1. Set the blower speed on 4. 2. Check full hot to full cold temperature positions in the defroster, floor, and vent modes. Is the noise present in the defrost mode only?		Go to Step 12	Go to Step 14
12	1. Check the ducts for obstructions for foreign materials. 2. Remove any obstructions or foreign materials. 3. Check floor /defroster door seals. 4. Repair or replace as needed. Is the repair complete?		System OK	-
13	Is the noise present in the floor mode only?		Go to Step 12	Go to Step 14
14	Is the noise present in the vent mode only?		Go to Step 15	Go to Step 16

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Blower Noise (Cont'd)

Step	Action	Value(s)	Yes	No
15	1. Check the ducts for obstruction or foreign materials. 2. Remove any obstructions or foreign materials. 3. Check the vent door seals. 4. Repair or replace as needed. Is the repair complete?		System OK	-
16	Is the noise present in all modes, but not all temperature positions?		Go to Step 16	Go to Step 18
17	1. Check the temperature door seals. 2. Repair or replace as needed. Is the repair complete?		System OK	-
18	1. Check the system for obstructions for foreign materials between the fan and the temperature door. 2. Repair or replace as needed. Is the repair complete?		System OK	Go to Step 2

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MAINTENANCE AND REPAIR

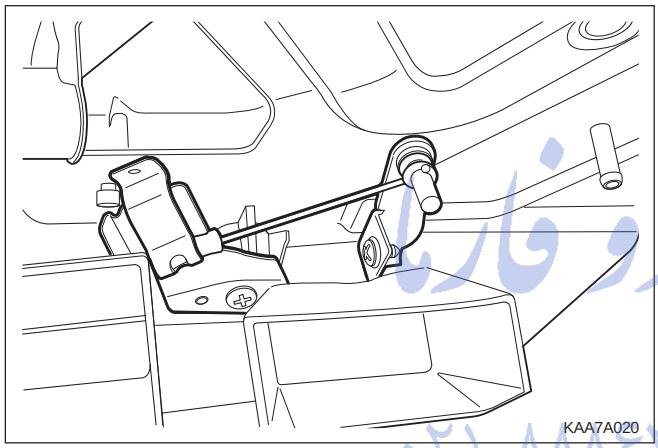
ON-VEHICLE SERVICE

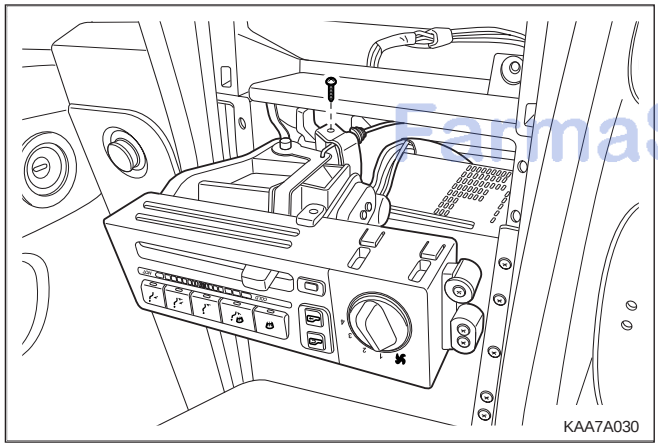
TEMPREATURE CONTROL CABLE ADJUSTMENT

Because the cable and the cable housing have fixed lengths, it is impossible to make a temperature cable adjustment.

The heater/air distributor case linkage also cannot be adjusted.

If a malfunction is suspected, verify the proper operation of the controller and the mechanical doors for heater/air distributor case assembly.


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CONTROLLER ASSEMBLY AND TEMPERATURE CONTROL CABLE

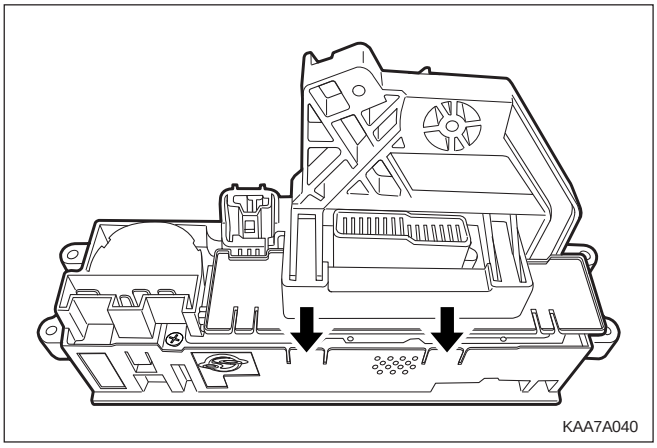
Removal and installation Procedure

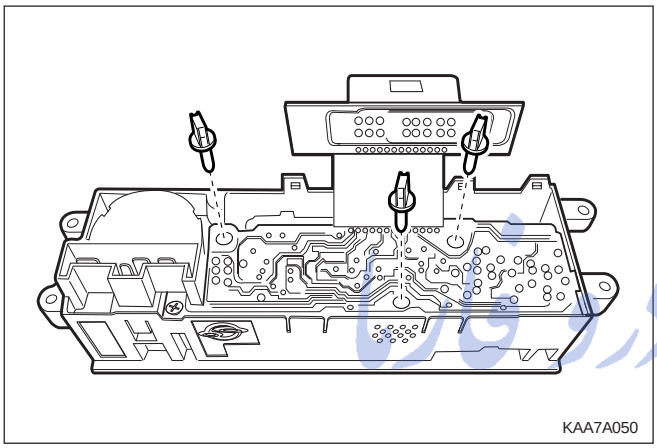
1. Disconnect the negative battery cable.
2. Slide the cable eyelet off the post on the temperature door lever (under the I/P center).
3. Unsnap the clip that securing temperature control cable.

   Notice: Do not remove the bracket.

4. Remove the I/P center trim plate.
5. Remove four controller retaining screws.
6. Disconnect the electrical connectors.
7. Remove one screw that securing the temperature control cable.
8. Disconnect the temperature control cable by gently unsnapping the temperature control cable.
9. Remove and replace temperature control cable as required.
10. Remove the controller assembly.
11. Installation should follow the removal procedure in the reverse order.

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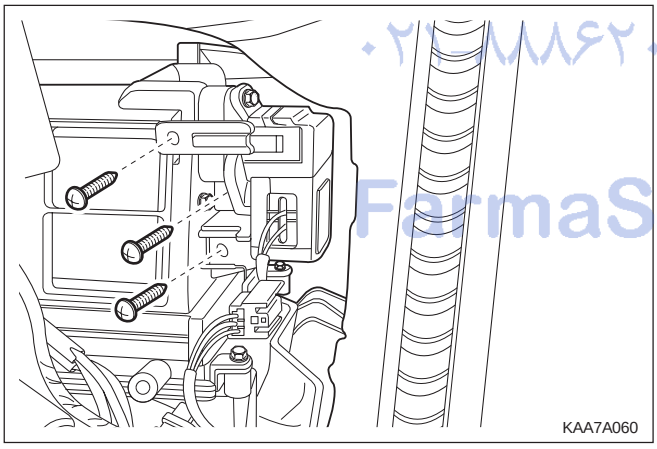

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KAA7A050

CONTROL ASSEMBLY KNOB LIGHTING

Removal and installation Procedure

1. Disconnect the negative battery cable.
2. Remove the heating and ventilation control (HVC) controller assembly. Refer to “Controller Assembly and Temperature Control Cable” in this section.
3. Remove the connector cover by sliding away.
4. Remove the connector from the temperature control cable control mechanism.
5. Separate the temperature control cable control mechanism.
6. Turn the bulb holder to the left and pull out the bulb.
7. Installation should follow the removal procedure in the reverse order.

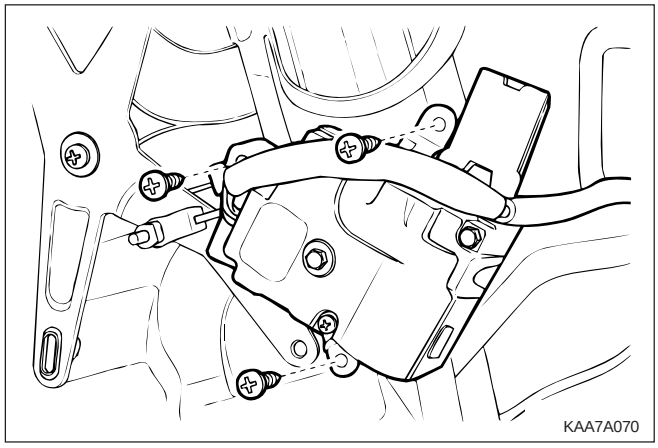

KAA7A060

AIR INTAKE DOOR ACTUATOR

Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Remove the glove box. Refer to *Section 9E, Instrumentation/Driver Information.*
3. Disconnect the connector to intake air control door actuator.
4. Remove three screws that securing mode control door actuator to heater/air distributor case.
5. Remove the mode control door actuator by gently snapping the actuator.
6. Installation should follow the removal procedure in the reverse order.

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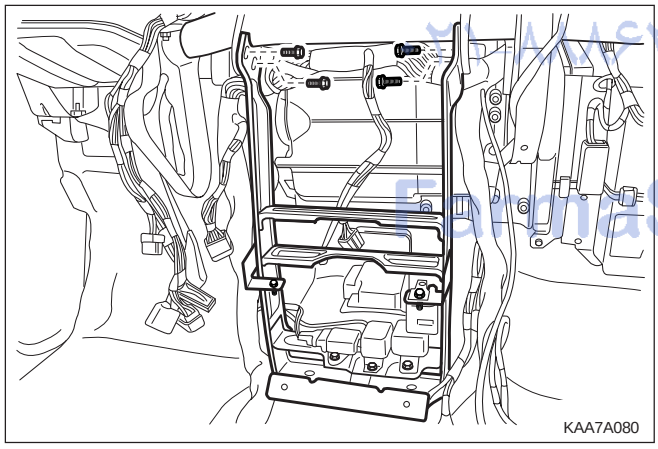


MODE CONTROL DOOR ACTUATOR

Removal and installation Procedure

1. Disconnect the negative battery cable.
2. Remove the driver knee bolster. Refer to *Section 9E, Instrumentation/Driver Information.*
3. Disconnect the connector to mode control door actuator.
4. Remove three sxrews that securing mode control door actuator to heater/air distributor case.
5. Remove the mode control door actuator by gently snapping the actuator.
6. Installation should follow the removal procedure in the reverse order.

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HEATER/AIR DISTRIBUTOR CASE ASSEMBLY

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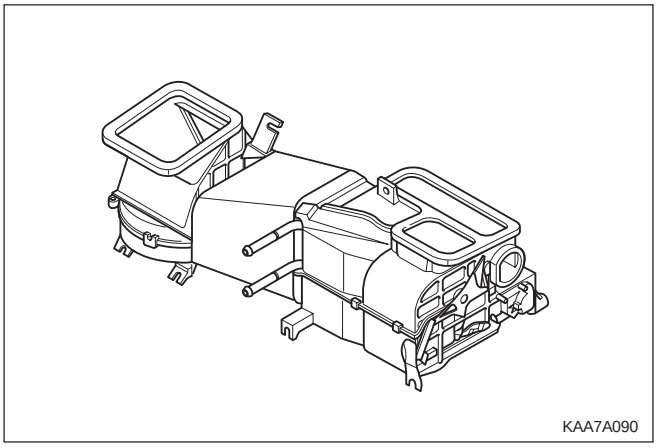
Removal and installation Procedure

1 .Disconnect the negative battery cable.
2. Drain the cooling system. Refer to *Section 1D, Engine Cooling*.
3. Remove the inlet and outlet heater hoses from the firewall.
4. Remove the instrument panel carrier assembly. Refer to *Section 9E, Instrumentation/Driver Information.*
5. Remove upper four bolts and lower two bolts on I/P centers bracket.

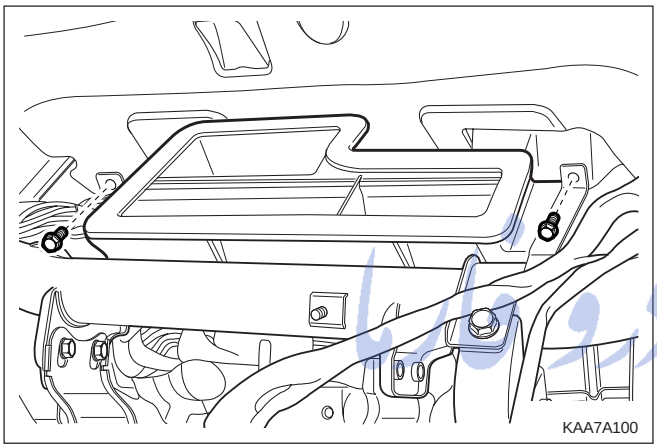
Installation Notice

Tightening Torque	5 N•m (44 lb-in)

6. Remove the I/P center bracket.
7. Remove one screw and the joint duct for heater/air distributor-to-rear heater duct.


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8. Remove one bolt, one nut and two screws that securing the heater/air distributor case-to-blower unit duct.
9. Remove the heater/air distributor case-to-blower unit duct.

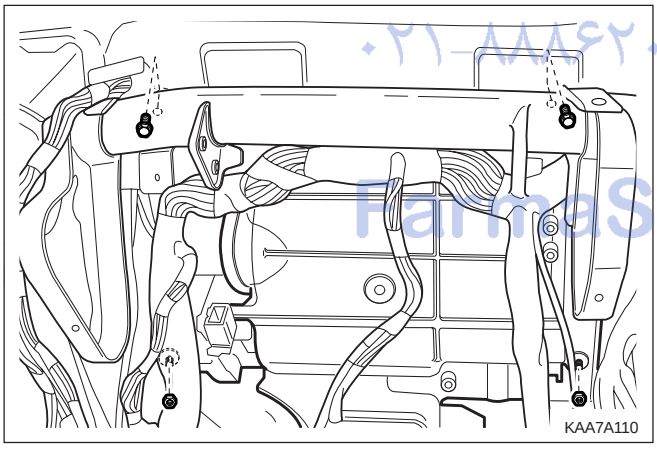

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10. Remove two bolts and the heater/air distributor case-to-defroster duct.

Installation Notice

Tightening Torque	5 N•m (44 lb-in)

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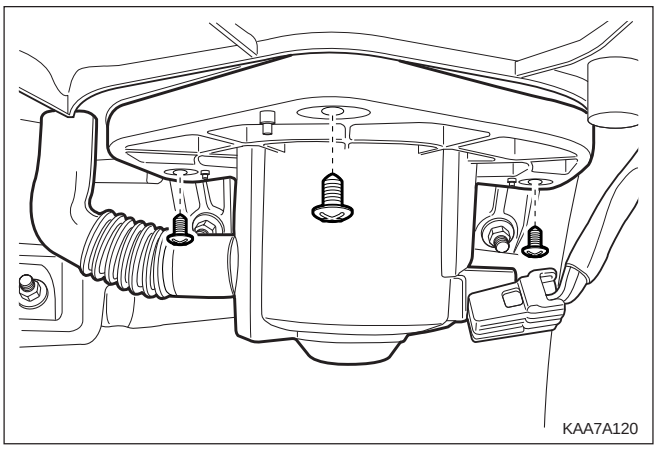

KAA7A110

11. Remove electrical connector to the mode control actuator.
12. Remove one bolt and two nuts that securing heater/air distributor case.

Installation Notice

Tightening Torque	Bolt 5 N•m (44 lb-it)
	Nut 5 N•m (44 lb-it)

13. Remove the heater/air distributor case.
14. Installation should follow the removal procedure in the reverse order.


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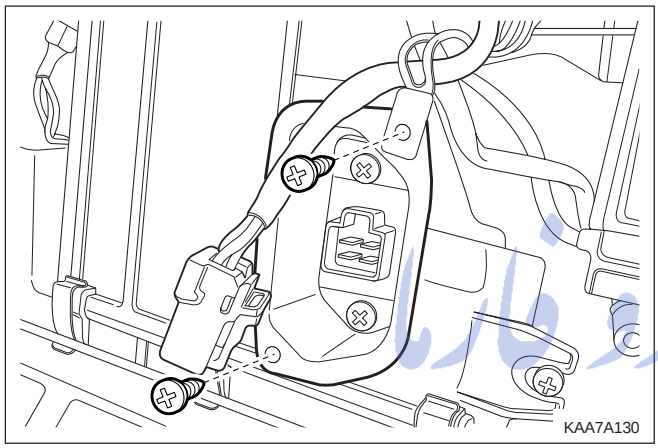
BLOWER MOTOR

Removal and Installation Procedures

1. Disconnect the negative battery cable.
2. Remove the glove box. Refer to *Section 9E, Instrumentation/Driver Information*.
3. Disconnect the blower motor electrical connector.
4. Remove the blower motor cooling hose.
5. Remove the screws that secure the motor to the heater/air distributor case.
6. Remove the blower motor from the blower unit by gently pulling the motor straight down and out.

7. Installation should follow the removal procedure in the reverse order.

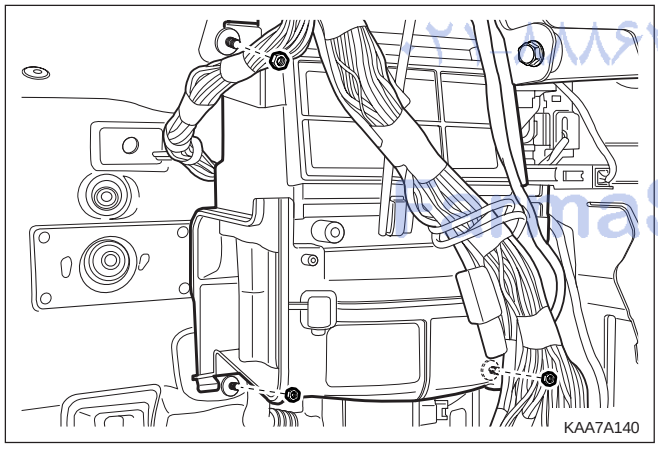
   Installation Notice: After install the blower motor confirm that the blower motor operates properly.



BLOWER RESISTOR

Removal and Installation Procedures

1. Disconnect the negative battery cable.
2. Remove the glove box. Refer to *Section 9E, Instrumentation/Driver Information*.
3. Disconnect the electrical connector at the resistor.
4. Remove two screws from the resistor.
5. Remove the resistor from the heater/air distributor case by gently pulling the resistor.
6. Installation should follow the removal procedure in the reverse order.



BLOWER UNIT

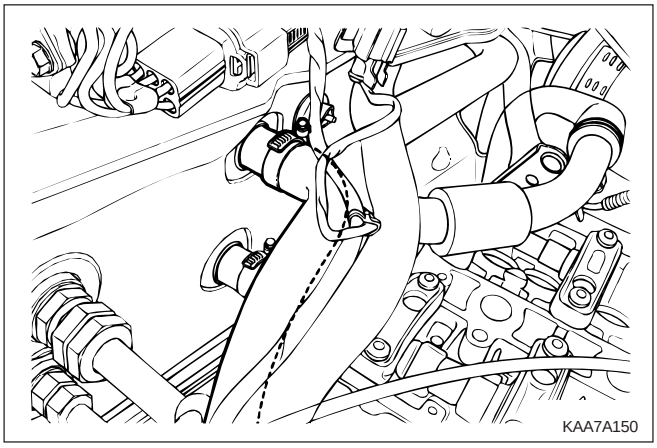
Removal and Installation Procedures

1. Disconnect the negative battery cable.
2. Remove the instrument panel carrier assembly. Refer to *Section 9E, Instrumentation/Driver Information.*
3. Remove one nut, one bolt and two screws that securing the heater/air distributor case-to-blower unit duct.
4. Remove the heater/air distributor case-to-blower unit duct.
5. Disconnect the connector for air intake door actuator and the connector for blower motor.
6. Remove three nuts that securing the blower unit.

   Installation Notice

Tightening Torque	5 N•m (44 lb-it)

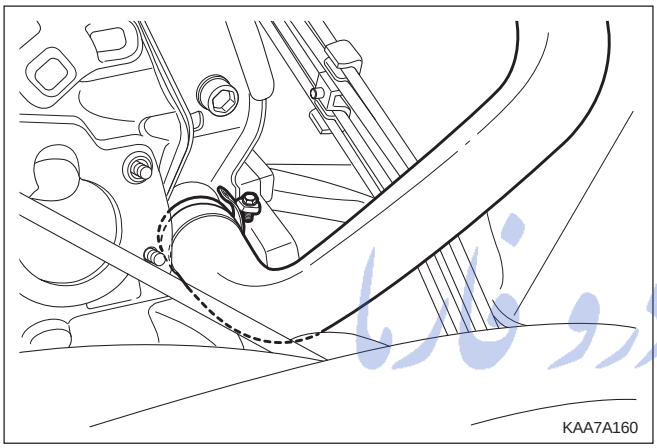
7. Remove the blower unit.
8. Installation should follow the removal procedure in the reverse order.



HEATER INLET HOSE

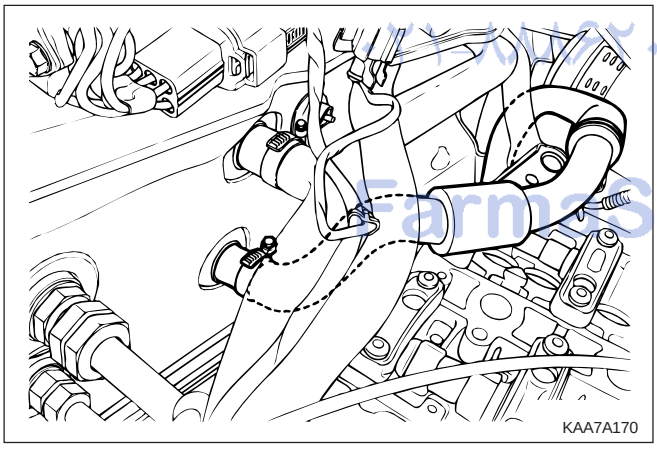
Removal and Installation Procedures

1. Partially drain the cooling system. Refer to *Section 1D, Engine Cooling*.
2. Remove the clip and slide rearward the inlet heater hose clamp at the firewall.
3. Gently twist the hose from the left to right and back again to loosen the bond between the hose and the tube.
4. Remove the end of the hose from the tube.



5. Remove the clip and slide rearward the inlet heater hose at the engine block.
6. Remove the inlet heater hose from the vehicle.
7. Installation should follow the removal procedure in the reverse order.

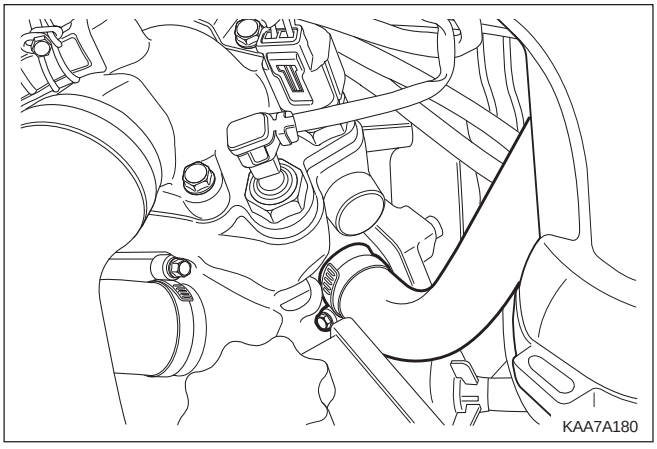
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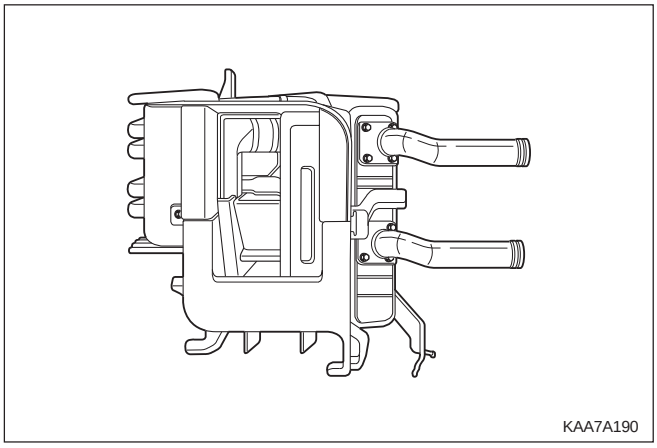
HEATER OUTLET HOSE

Removal and Installation Procedures

1. Partially drain the cooling system. Refer to *Section 1D, Engine Cooling*.
2. Remove the clip and slide rearward the outlet heater hose clamp at the firewall.
3. Gently twist the hose from the left to right and back again to loosen the bond between the hose and the tube.
4. Remove the end of the hose from the tube.



5. Remove the intake manifolds. Refer to *Section 1C, DOHC Engine Mechanical*.
6. Remove the clip and slide rearward the outlet heater hose at the thermostat housing.
7. Remove the outlet heater hose from the vehicle.
8. Installation should follow the removal procedure in the reverse order.


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HEATER CORE

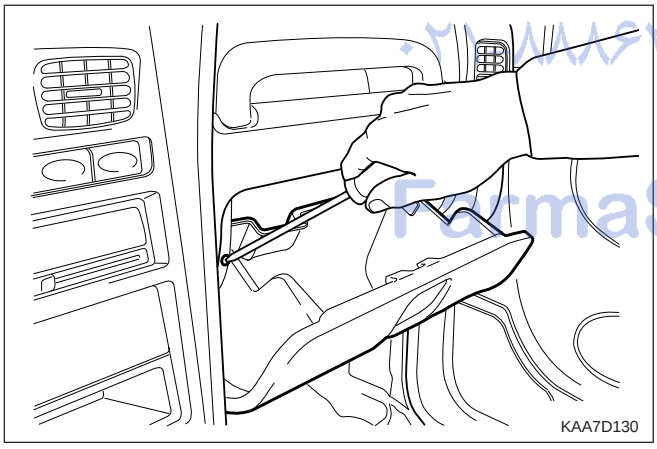
Removal and Installation Procedures

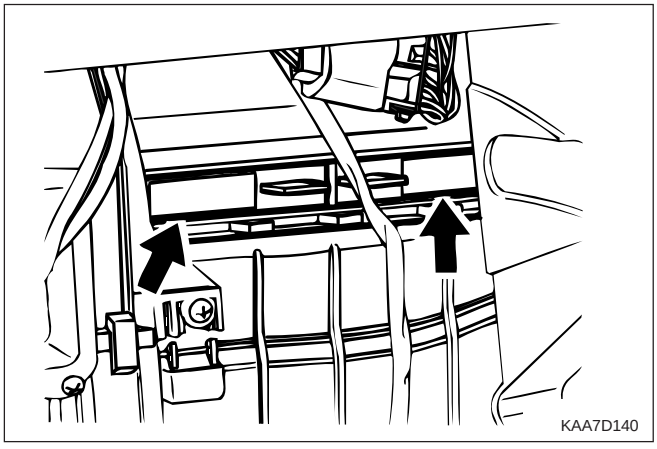
1. Disconnect the negative battery cable.
2. Remove the heater/air distribution case from the vehicle. Refer to “Heater/Air Distribution Case Assembly” in this section.
3. Remove the plastic holder and two screws that secure the heater core to heater/air distributor case assembly.
4. Slowly separate the heater/air distributor case assembly and remove the heater core.
5. Installation should follow the removal procedure in the reverse order.

REAR HEATER DUCT

This vehicle is equipped with rear seat heater ducts. Should there be no airflow to the rear, look for any obstructions, such as items on the floor under the front seats. Also check for air leaks between the heater/air distributor assembly and the rear ducts.

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AIR FILTER

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Removal and Installation Procedures

Replacement Interval	Every 10,000 km

Notice: Replace earlier if air pollution is heavy.

1. Open the glove box and pull it inward to release the upper left and right locking portion.

   Notice: Remove the glove box by unscrewing lower 2 screws, if necessary.

2. Press the 2 filter cover holds and remove the air filter cover.
3. Remove the 2 air filters.

   Notice: For installation, remember the installed direction of the air filter before removal.

SPECIFICATIONS

HEATER TERMERATURE SPECIFICATION

Ambient Air Temperature	Heater Outlet Air Temperature
-18 °C (0 °F)	54 °C (129 °F)
-4 °C (25°F)	59 °C (138 °F)
10 °C (50 °F)	64 °C (147 °F)
24 °C (75 °F)	68 °C (154 °F)

HEATER UNIT

Application	Description
-18 °C (0 °F)	54 °C (129 °F)
-4 °C (25°F)	59 °C (138 °F)
10 °C (50 °F)	64 °C (147 °F)
24 °C (75 °F)	68 °C (154 °F)

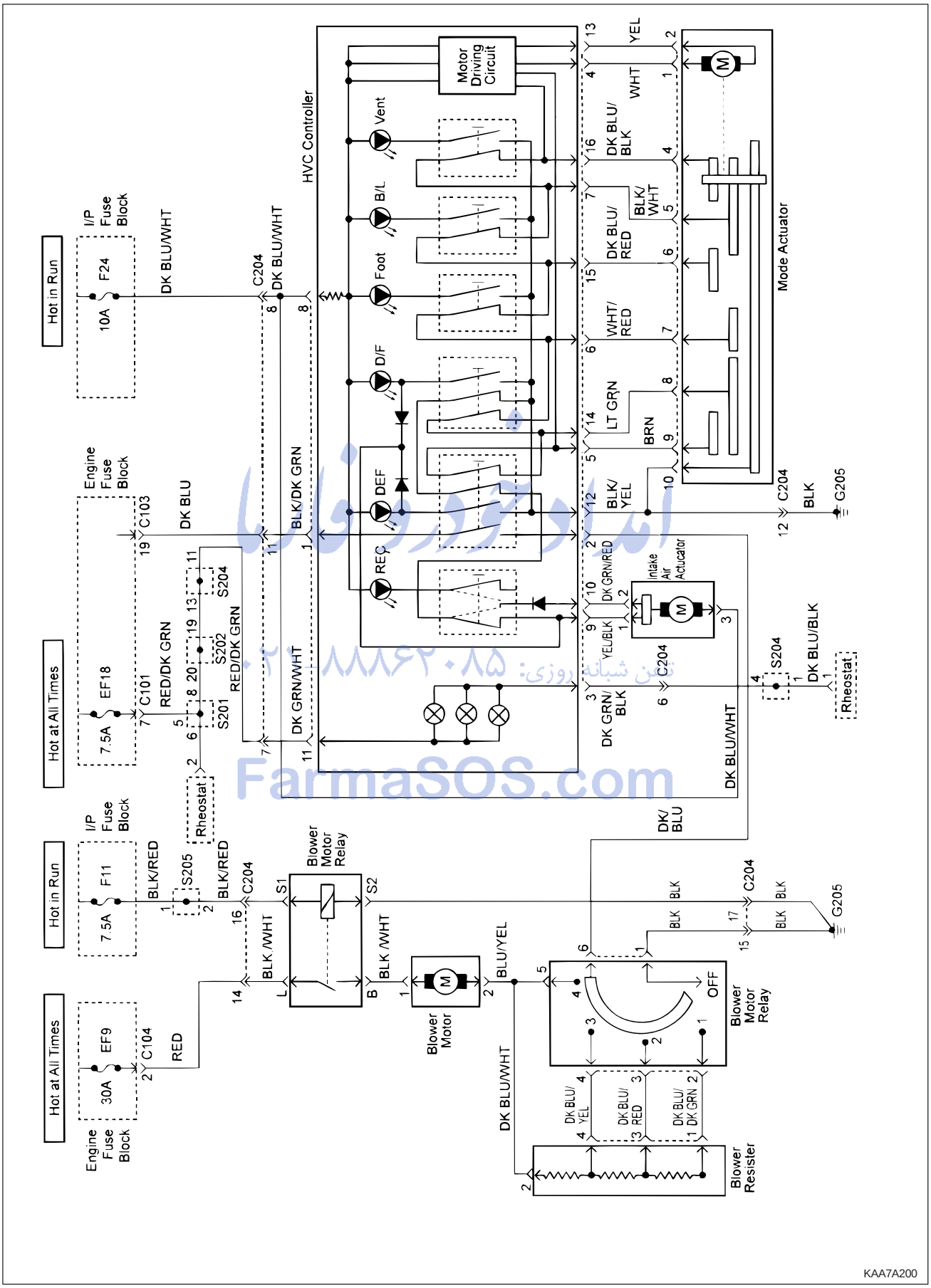
FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Heater/Air Distributor Case Retaining Bolt	5	-	44
Heater/Air Distributor Case-to-Blower Unit Connecting Duct Nut	5	-	44
Heater/Air Distributor Case-to-Defroster Connecting Duct Retaining Bolts	5	-	44
I/P Center Bracket Bolts	5	-	44

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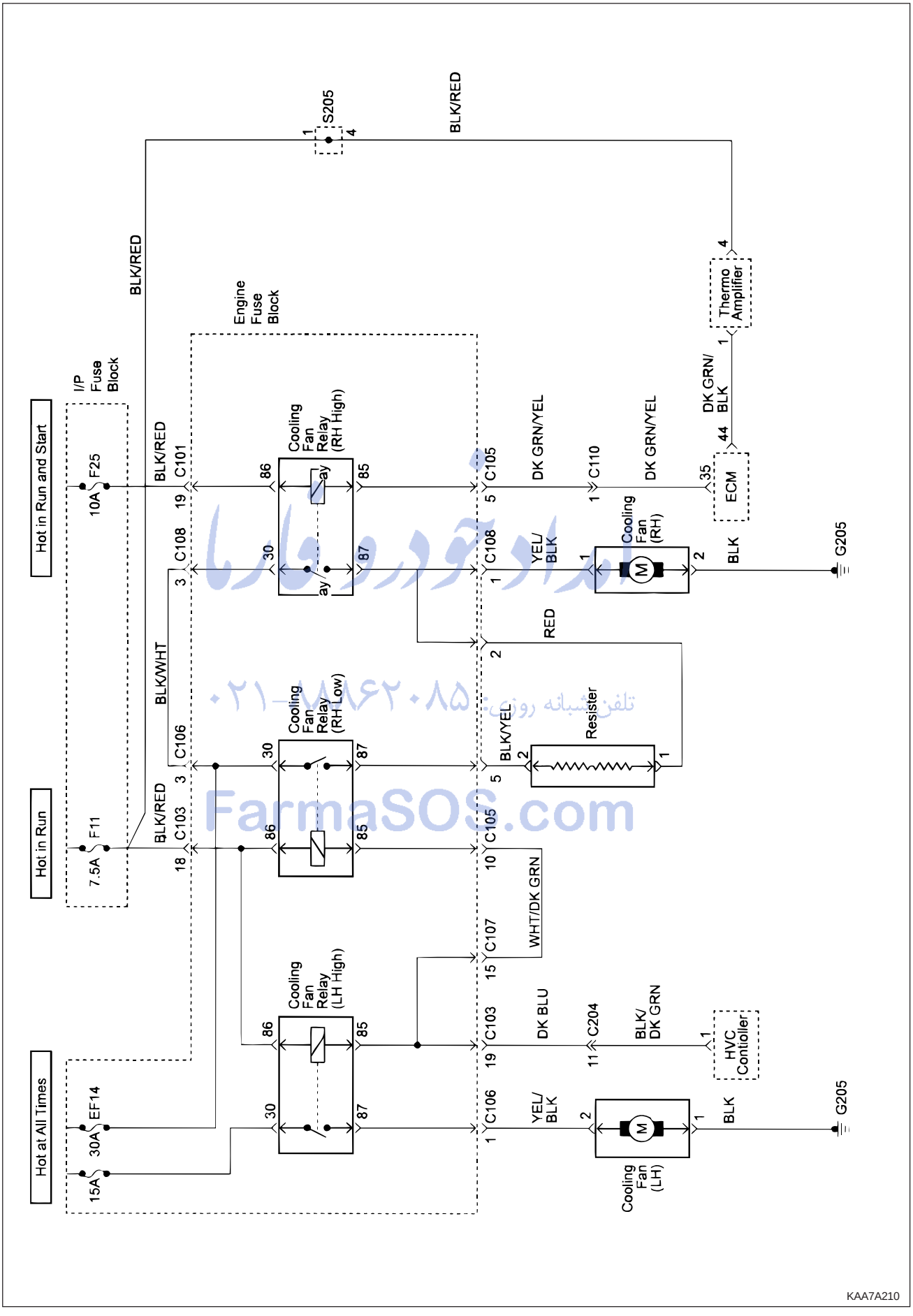
SCHEMATIC AND ROUTING DIAGRAMS

NON-A/C WIRING DIAGRAMS (1 OF 2)



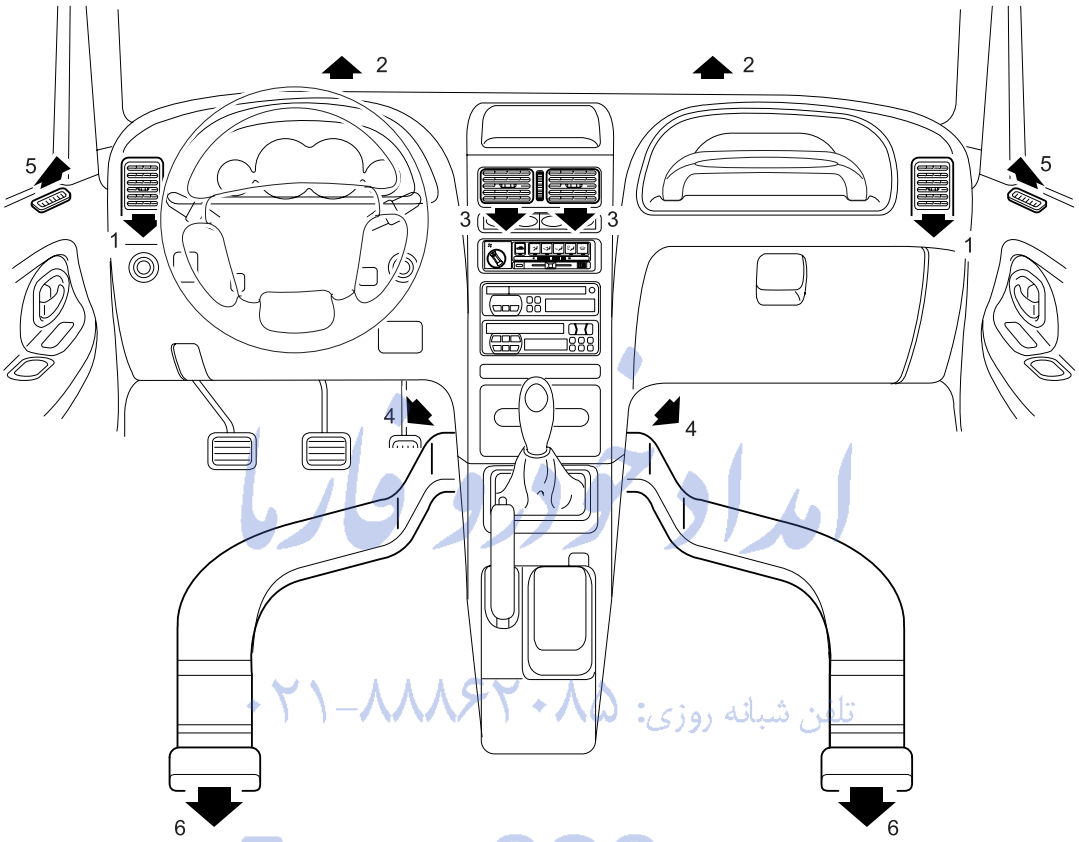
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NON-A/C WIRING DIAGRAMS (2 OF 2)



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AIRFLOW THROUGH VENTS



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KAA7A220

1 Side Ventilation Vents (Face Position)
2 Front windshiel Defroster Vents
3 Conter Ventilation Vents (Face Position)
4 Ventilation Vents (Face Position)
5 Side Door Window Defroster Vents
6 Rear Ventilation Vents

SECTION 7C

MANUAL CONTROL / SEMIAUTO TEMPERATURE CONTROL HEATING, VENTILATION AND AIR CONDITIONING SYSTEM

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless other-wise noted.

TABLE OF CONTENTS

Specifications 7C-2
- Refrigerant 7C-2
- Evaporator Unit 7C-2
- Blower Unit 7C-2
- Compressor 7C-2
- Condenser 7C-2
- Receiver Drier 7C-2
- Pressure Switch 7C-3
- Air Filter 7C-3
- Heater Unit 7C-3
- Fastener Tightening Specifications 7C-3

Diagnosis 7C-4
- Defectives in Fan Motor Circuit 7C-5
- Defectives in Compressor Circuit 7C-6
- Diagnosis Using the Manifold Gauge 7C-7

Component Locator 7C-9
- Ventilation 7C-9
- Heater System 7C-11

Air Conditioner System 7C-12
- Diesel Engine 7C-12
- Gasoline Engine 7C-13

Maintenance and Repair 7C-14
- Refrigerant Charging 7C-14
- Compressor Oil Replacement 7C-18

Repair Instructions 7C-19

On-Vehicle Service 7C-19
- Condener 7C-19
- Receiver Drier 7C-21
- Air - Conditioner Compressor 7C-23
- Heater and Air Conditioner Control Box 7C-24
- Air Filter 7C-25

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SPECIFICATIONS

REFRIGERANT

Application	Description
Capacity	650 - 750 g
Type	R134a

EVAPORATOR UNIT

Application	Description
Core Size (LxWxT)	237.0 x 232.0 x 92.0
Core Type	Aluminum plate
Expansion Valve Type	Angle
Thermostat	ON:4.5 ± 0.6°C, OFF:1.5 ± 0.6°C
Resister Type	Aluminum plate
Cooling Capacity	4,300 Kcal/h (AT 420 CMH)

BLOWER UNIT

Application	Description
Motor Type	Magnetic
Motor Size	ϕ 70 x 145

COMPRESSOR

Application	Description
Model	FK-II (DKV 14C)
Type	Vane rotary type
Displacement (cc/rev.)	140.5 (cc/rev)
PCD (Pulley Center Diameter)	ϕ 143
Oil	ZXL 200 PG (PAG Oil)
Magnetic clutch output	45 W

CONDENSER

Application	Description
Size (WxHxT)	650 x 339.2 x 22.0
Capacity	11,000 Kcal/h
Type	Parallel Flow

RECEIVER DRIER

Application	Description
Material	Aluminum
Capacity	250 cc
Desiccant	XH-9 (35 g)

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PRESSURE SWITCH

Application	Description
Type	Direct
High (OFF)	OFF : 32 ± 2 Kgf/cm^2, DIFF : 6 ± 2 Kgf/cm^2
Low (ON)	OFF : 2.0 ± 0.2 Kgf/cm^2, ON : 2.1 ± 0.2 Kgf/cm^2

AIR FILTER

Application	Description
Replacement	Every 12,000 km (replace earlier if air pollution is heavy)

HEATER UNIT

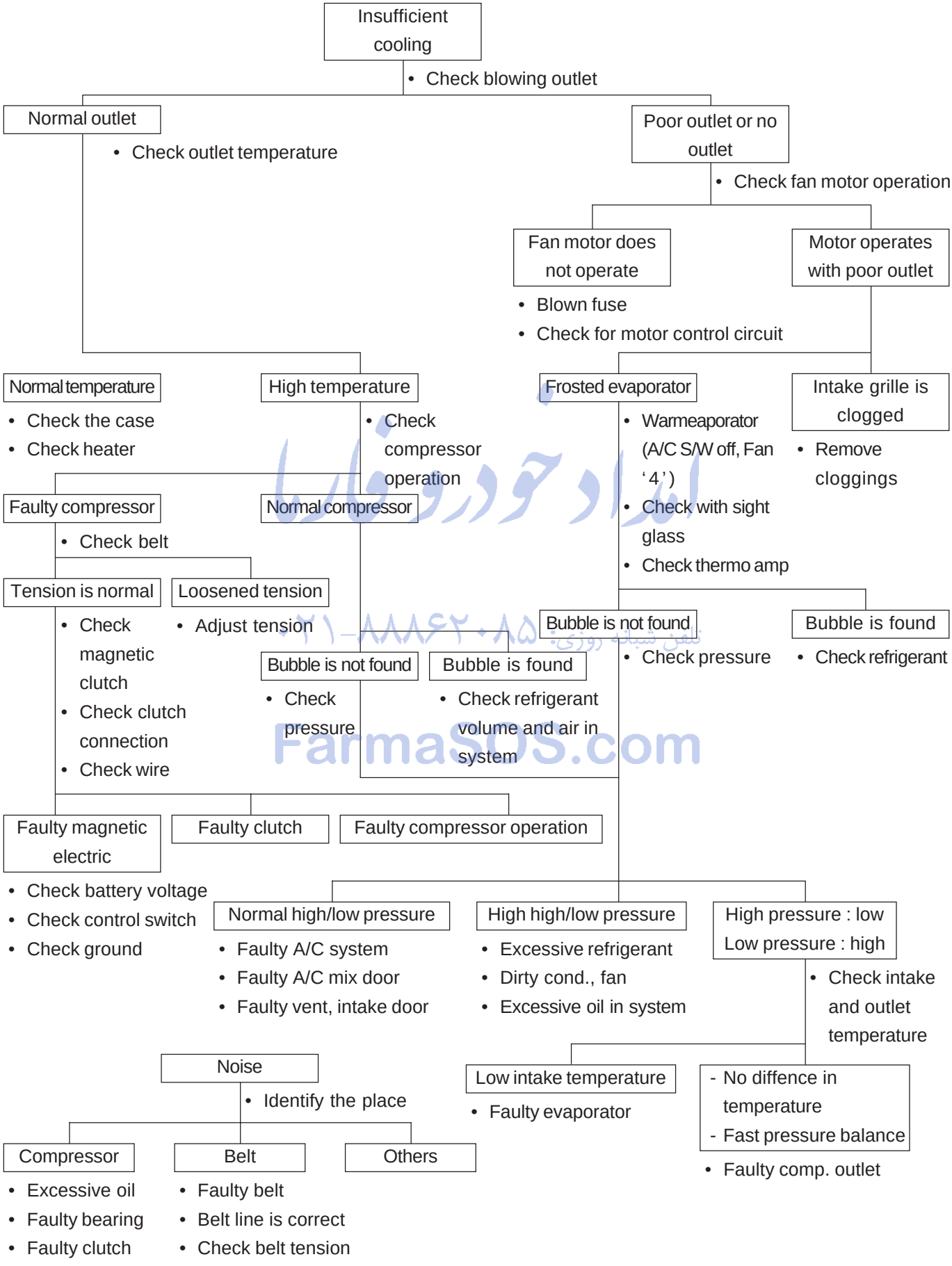
Application	Description
Heater Core Type	2-ROW
Heating Capacity	4,600 Kcal/h (AT 300 CMH)
Heater Core Size (L x W x T)	219.5 x 151.8 x 52

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Condenser Bolt	4 - 6	2.9 - 4.4	35.4 - 53.1
Condenser Fan Nut	4 - 6	2.9 - 4.4	35.4 - 53.1
Condenser Bolt	4 - 6	2.9 - 4.4	35.4 - 53.1
Receiver Drier Pipe Bolt	5 - 8	3.7 - 5.9	44.2 - 70.8
Receiver Drier Pipe Bolt (Condenser)	4 - 6	2.9 - 4.4	35.4 - 53.1
Pressure Pipe Bolt	20 - 30	14.7 - 22.1	177.0 - 265.5
Pressure Mounting Bolt	20 - 26	14.7 - 19.1	177.0 - 230.1

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DIAGNOSIS



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DEFECTIVES IN FAN MOTOR CIRCUIT

Fan Motor Does Not Run

Checks	Action
Blown fuse	Check for short and replace fuse.
Battery voltage is low	Check battery voltage.
Faulty wiring	Check connectors' connection. Do not apply grease. This can cause voltage down.
Faulty ground	Remove body painting and completely ground, Tighten ground bolts and make sure body ground connection.

Fan Motor Runs in '4'position Only ('3', '2', '1' : Does Not Run)

Checks	Action
Blown resister temperature fuse	Replace resistor.
Air leakage in parts connection	Check heater, cooling unit and blower for proper connection.

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Motor Runs With Poor Blowing

Checks	Action
Clogged or blocked intake grille	Clogged or blocked intake grille reduces blowing capacity.

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Frosted Evaporator

Checks	Action
Faulty thermo amp	Frosted evaporator reduces cooling capacity.
	Off compressor and maximize blowing capacity

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DEFECTIVES IN COMPRESSOR CIRCUIT

Compressor Does Not Run

Checks	Action
Faulty high/low pressure	Check compressor magnet voltage supply.
Faulty A/C relay	A/C relay.

Magnetic Clutch Slips / Idles

Checks	Action
Oily clutch plate	Clean oily plate using cleaning agent.
Low voltage	Charge battery or check for cause.
Faulty electric connection or operation	Check wire continuity Check A/C switch and fan switch for continuity and ground.

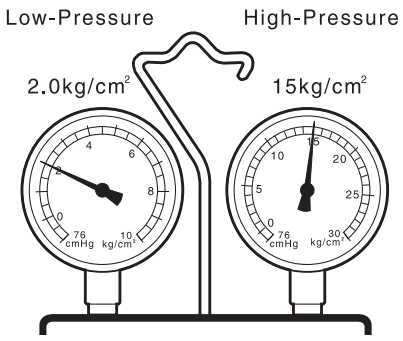
Magnetic Clutch Plays By Hand Only

Checks	Action
Excessive clearance between	Adjust clutch clearance (0.2-0.6mm).
Clutch plate and clutch coil	

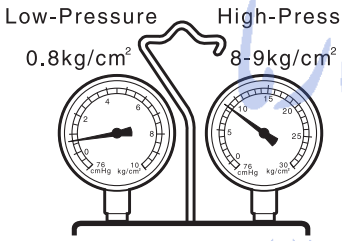
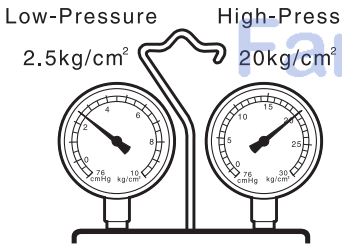
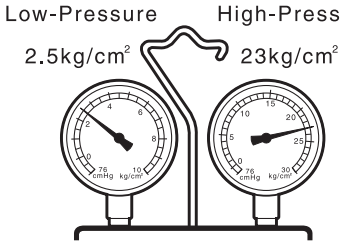
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DIAGNOSIS USING THE MANIFOLD GAUGE

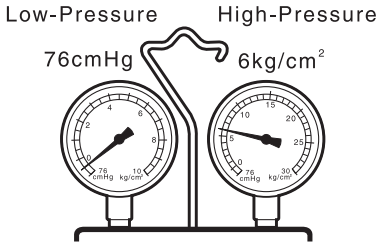
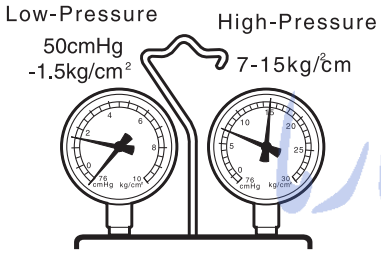
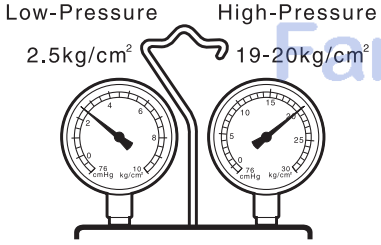
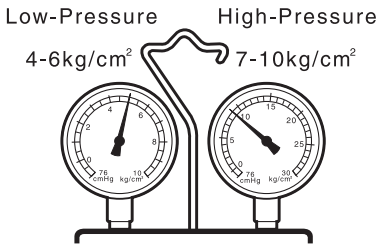
On normal operation during the cooling cycle, the manifold gauge must indicate approximately 1.5 - 2.0 kg/cm^2 at low pressure side and 14.5 - 15 kg/cm^2 at high pressure side, on condition that the temperature at the cooler inlet, 30 °C - 35 °C, 2,000 rpm of the engine rpm , full cold and maximum blower speed.



YAD7B070

Symptom	Cause	Action
1. High and low pressure are abnormally low. 2. Air at cooler outlet is not cold.  YAD7B080	• There is a gas leak in the cooling system.	• Check the oil leak, repair • Add the refrigerant
1. High and low pressure are abnormally high.  YAD7B090	• Insufficient cooling and faulty condenser cooling by excessive refrigerant.	• Keep the specified amount of the refrigerant, Clean the condenser • Repair the belt
1. High and low pressure are abnormally high. 2. Connection at the low pressure is not cold.  YAD7B100	• Belt is slipped • There is an air in the cooling system	• Clean and repair the receiver-drier • Check the oil contamination etc.

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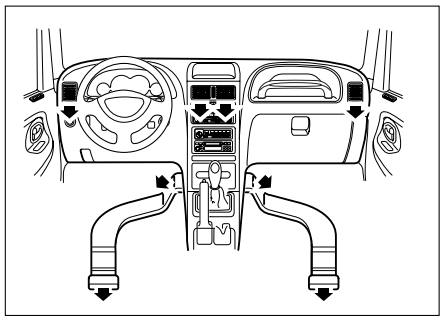
Symptom	Cause	Action
1. The low-pressure side indicates excessive high and high-pressure indicates excessive low. 2. There is a moisture in the connection of the receiver-drier and the front/back of the expansion valve.  YAD7B110	• The dust and moisture etc. are frozen at the expansion valve • A gas leak in the heat reducer	• Repair the receiver-drier • Replace the expansion valve for the faulty heat reducer
1. The low-side pressure is high or normal intermittently.  YAD7B120	• The mixed moisture is frozen at the expansion valve	• Repair the receiver-drier and perform the bleeding
1. The low-pressure and high-pressure are excessive high. 2. There are a lot of moistures in the connection of the low-side pressure  YAD7B130	• The faulty expansion valve, the improper installation of the heat reducer • Fail to control the flow rate	• Repair the receiver-drier • Check the oil contamination etc.
1. The low-pressure is excessive high and high-pressure is excessive low.  YAD7B140	• There is an oil leak in the compressor	• Replace the compressor

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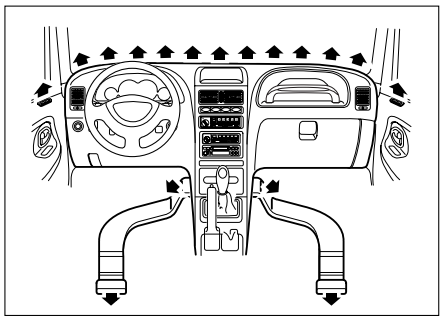
COMPONENT LOCATOR

VENTILATION

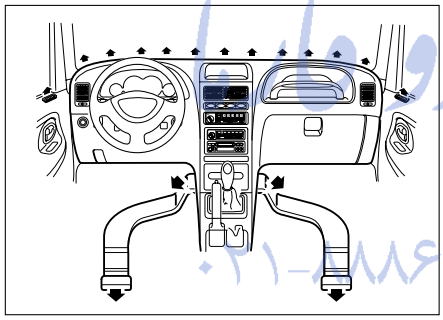
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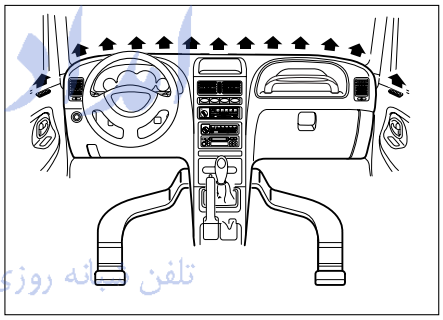
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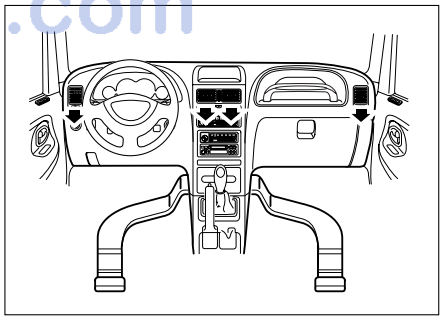
3.



4.



5.



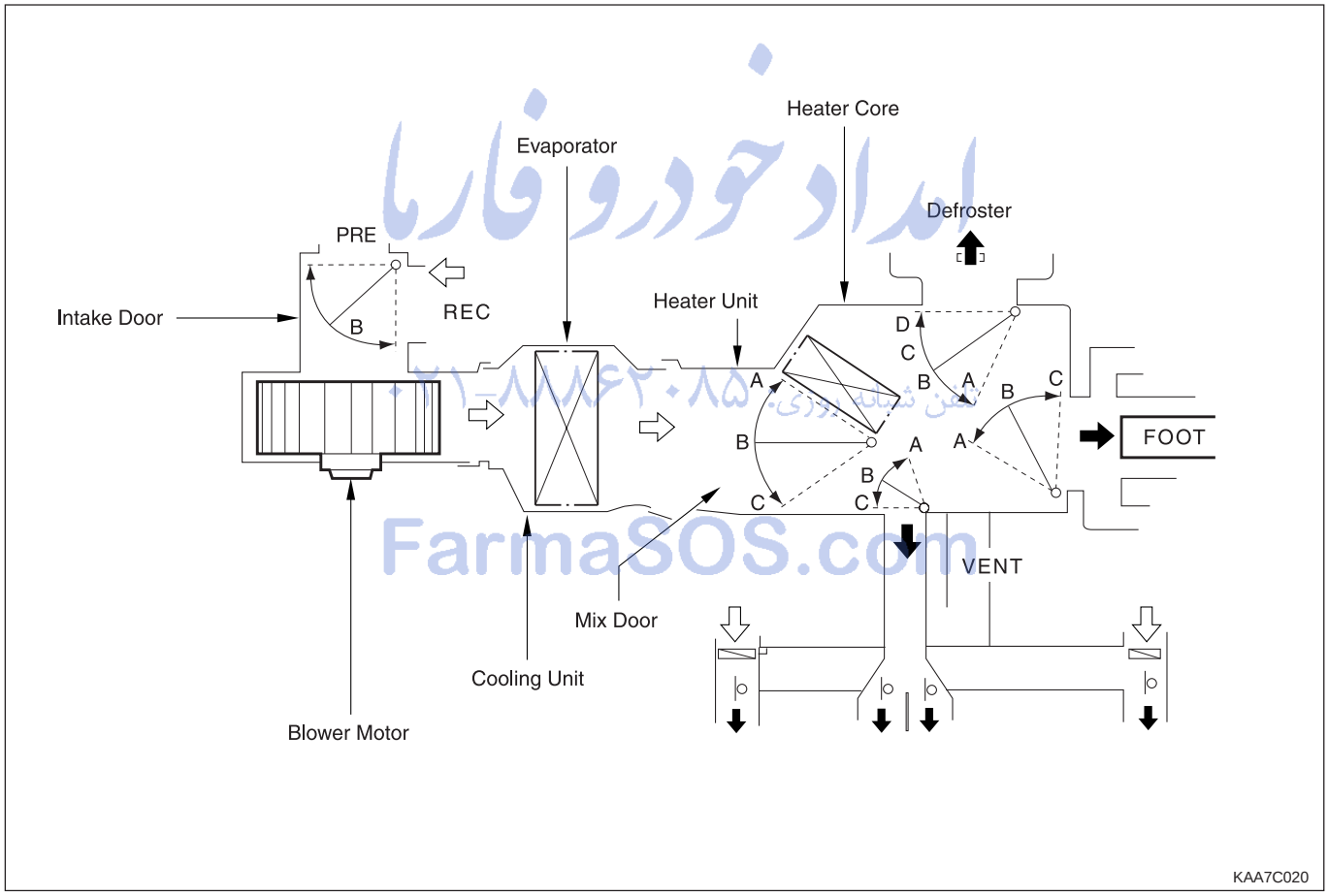
KAA7C010

1 Foot / Face
2 Foot / Defroster
3 Foot
4 Defroster
5 Face

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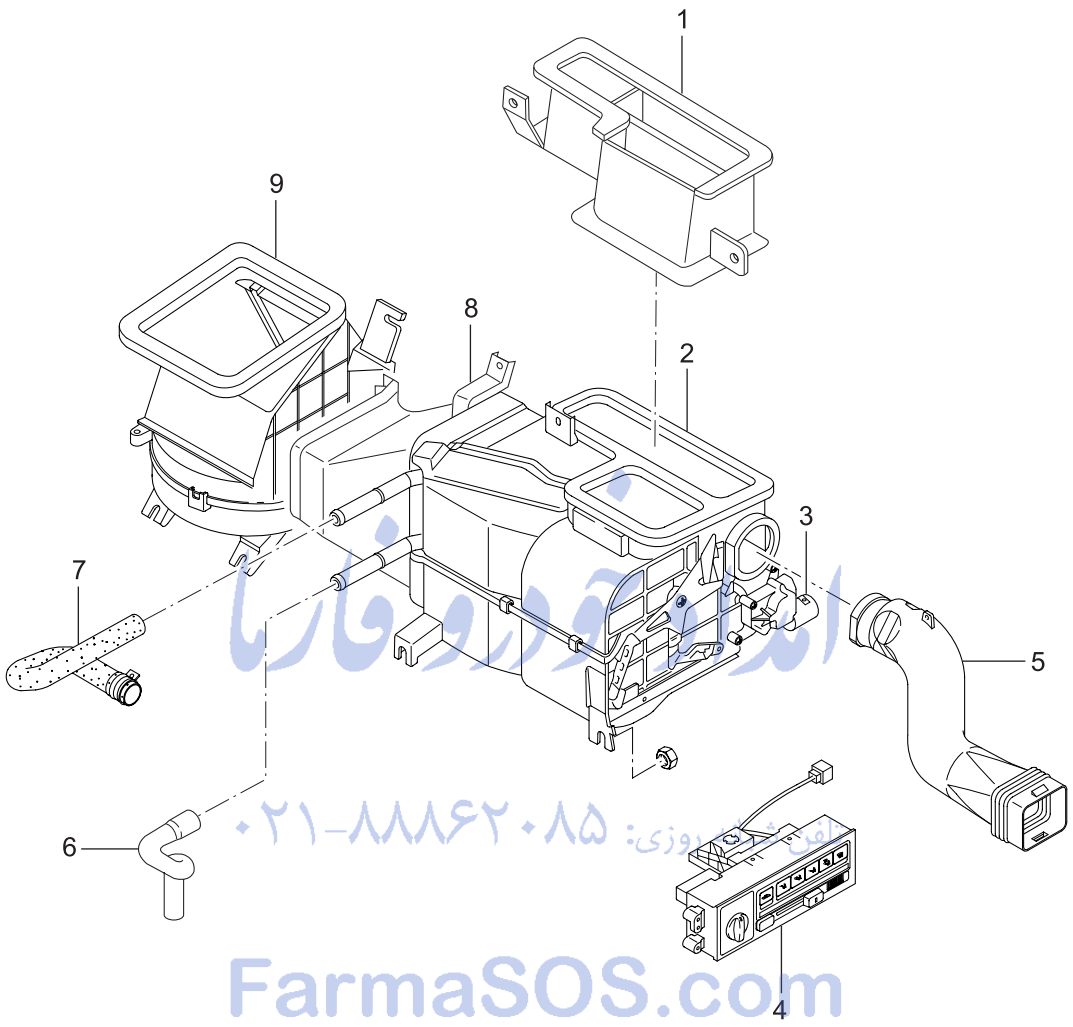
Air Flow

Switch / Door	Mode Switch					Recirculation Switch		Temperature Control Lever		
	VENT	B/L	FOOT	D/F	DEF	REC	FRE			
							INDI. On	INDI. Off	[MANUAL]  [SEMI AUTO]		
VENT Door	A	B	C	C	C	-	-	-		
FOOT Door	C	B	A	B	C	-	-	-		
DEF Door	D	D	D	B	A	-	-	-		
INTAKE Door	-					A	B	-		
AIR MIX Door	-							A	B	C



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HEATER SYSTEM

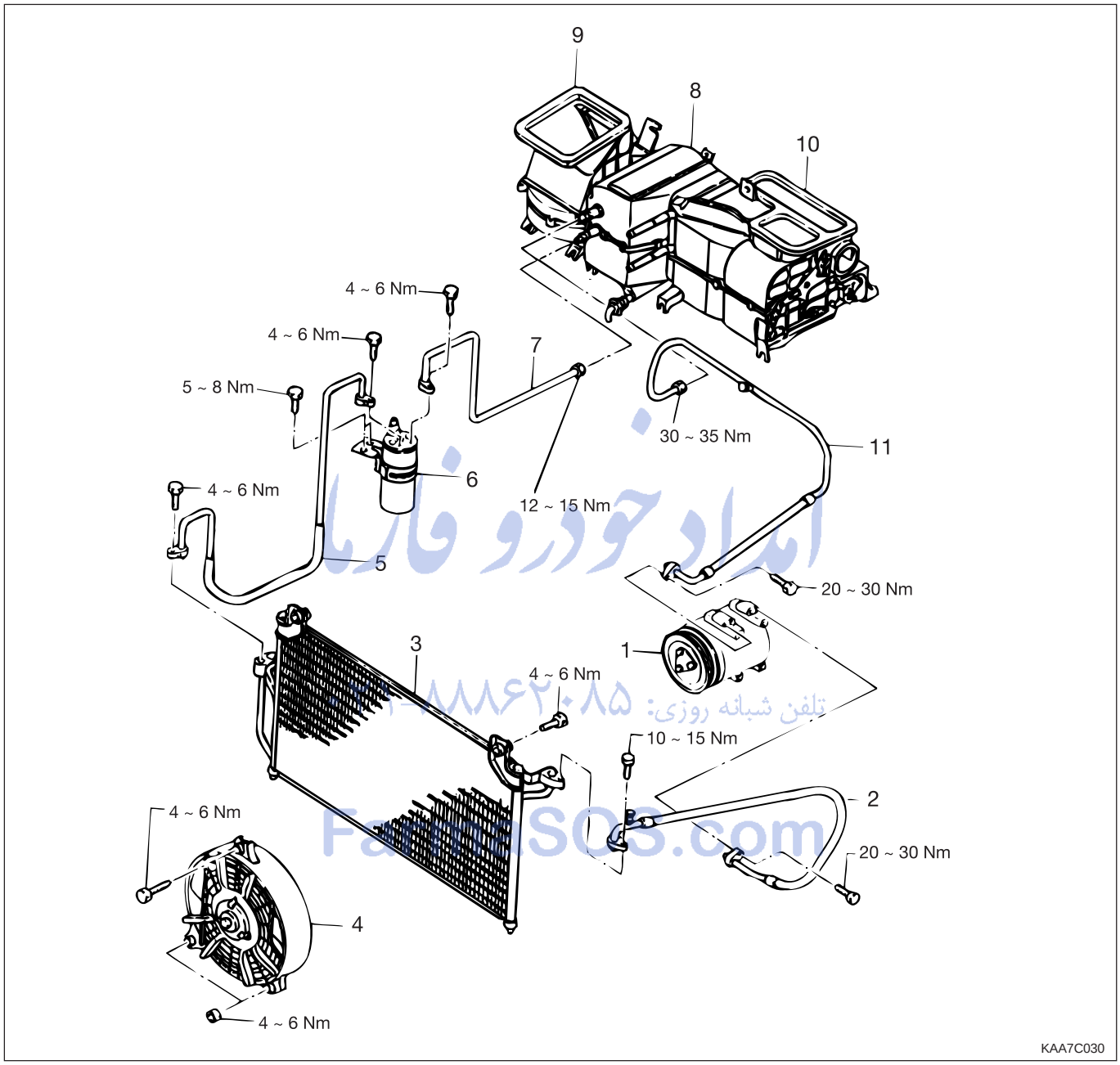


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1 Heater-to Defrost Duct
2 Heater Unit
3 Mode Actuator Assembly
4 Heater Controller
5 Side Air Vent
6 Coolant Outlet Hose
7 Coolant Inlet Hose
8 Heater-to-Blower Duct
9 Blower Unit

AIR CONDITIONER SYSTEM

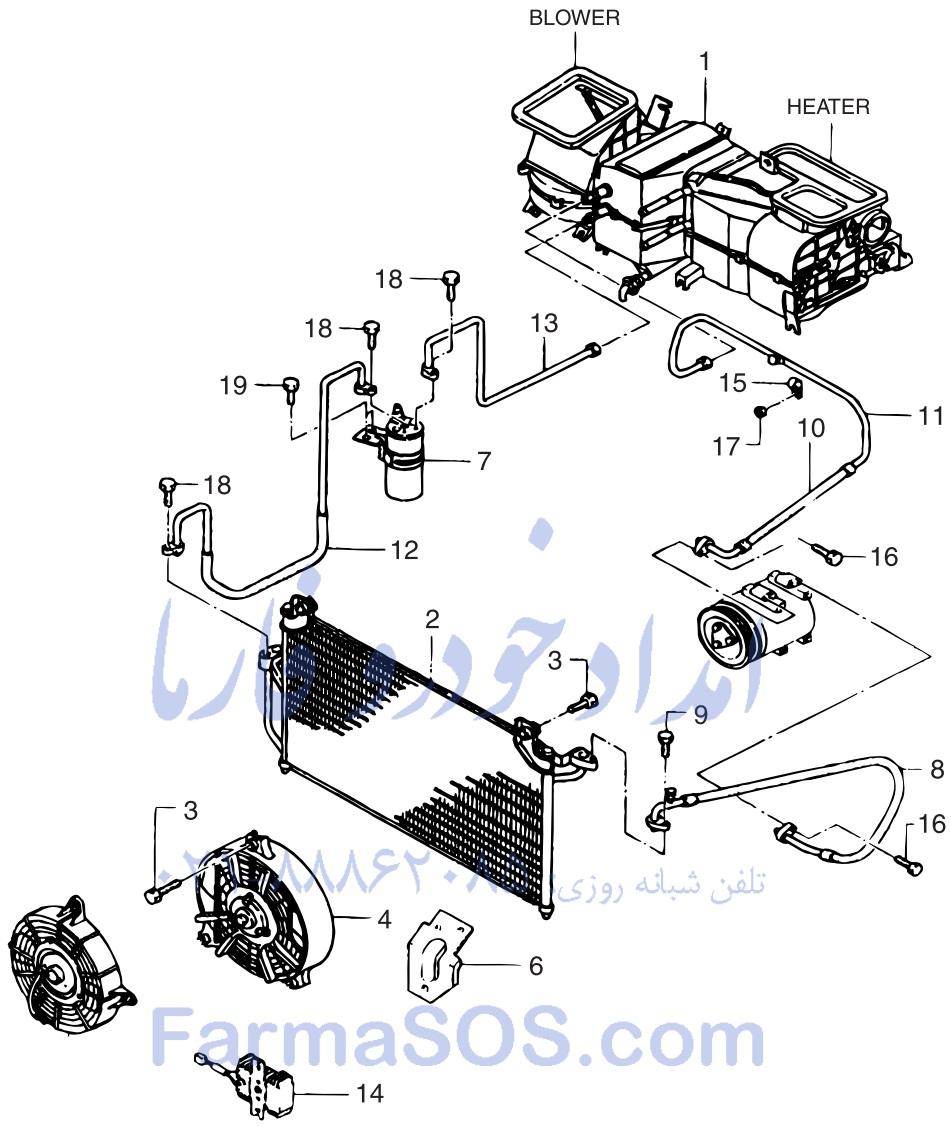
DIESEL ENGINE



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1 Compressor
2 High Pressure Hose
3 Condenser
4 Condenser Fan
5 Liquid Pipe (A)
6 Reveiver Drier
7 Liquid (B)
8 Evaporator Assembly
9 Blower Unit
10 Heater Unit
11 Low Pressure Hose

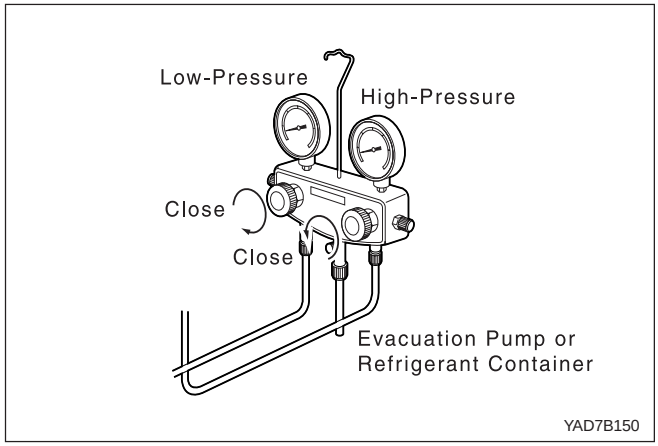
GASOLINE ENGINE



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1 Evaporator Assembly
2 Condenser Asembly
3 Screw-Hex SEMS (M8 x 1.5 x 35)
4 Fan & Shroud Assembly-Main
5 Fan & Shroud Assembly-Add
6 Supplement Assembly- c/ fan Mounting
7 Receiver & Bracket Assembly
8 Hose-Discharge
9 Bolt-Hex Sems (M8 x 1.25 x 30)
10 Hose Assembly-Suction
11 Pipe Assembly-Suction
12 Pipe-Liquid-A
13 Pipe-Liquid-B
14 Resister-Condenser Fan
15 Clip-Closed-CT (M8)
16 Bolt-Hex FLG (M8 x 1.25 x 25)
17 Nut-Hex (M6 x 1.0)
18 Screw-Hex SEMS (M6 x 1.0 x 25)
19 Screw-Hex SEMS (M6 x 1.0 x 16)

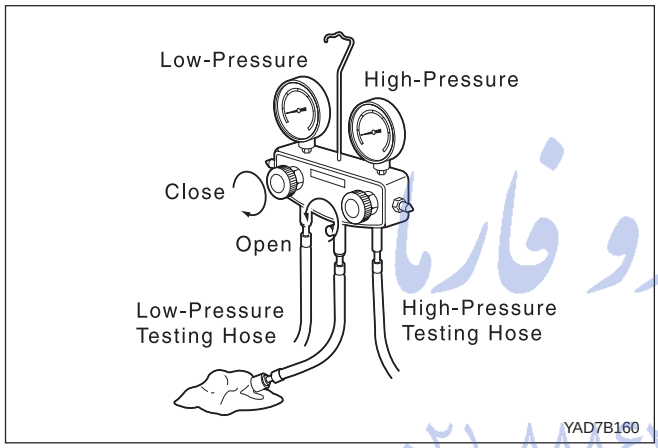
MAINTENANCE AND REPAIR



REFRIGERANT CHARGING

Installation of Manifold Gauge

1. Close both high/low pressure hand valves of manifold gauge before installation of gauge to the charging valve.
2. Both high/low pressure hand valves of manifold gauge connect the appropriate charging valve. Tighten the hose nuts by hand.
   - high pressure hand valve → high pressure charging valve
   - low pressure hand valve → low pressure charging valve

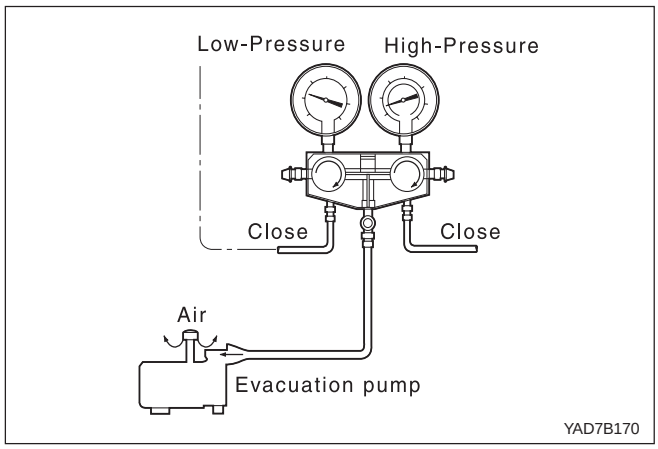


Discharging Refrigerant

1. Connect the manifold gauge to the charging valve.
2. Place the free end of the center hose in a shop towel.
3. Slowly open the high pressure hand valve and discharge refrigerant.

   Notice: If refrigerant is allowed to escape too fast, compressor oil will be drawn out of the system.
4. Check whether the shop towel gets wet in oil and if wet, close the hand valve.
5. After the high pressure gauge reading drops below 3.5 kg/cm^2, slowly open the low pressure valve.
6. When both high and low pressure gauges reading drops to 0 kg/cm^2, discharging is completed.

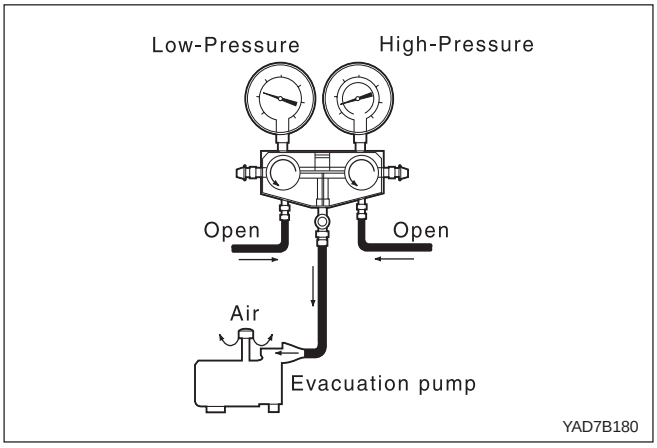
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Evacuating Refrigeration System

Notice: The unit tank must contain a sufficient amount of R-134a refrigerant for charging. Check the amount of refrigerant in the tank. If there is less than 3.6 kg (8 pounds) of refrigerant, add new refrigerant to the tank.

1. Verify that the high-side and the low-side hoses are connected to the A/C system. Open both the high-side and the low-side valves on the unit's control panel.
2. Open both the gas and the liquid valves on the tank.

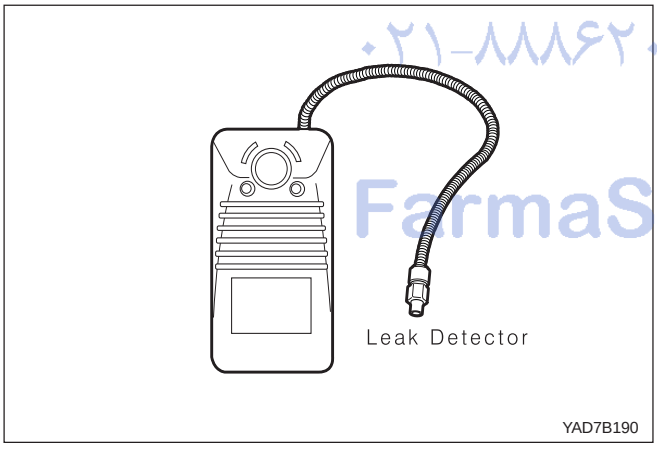


Important: Refer to the manufacturer's instructions for the charging station in use. It is necessary to evacuate the system before recharging it with new or recycled refrigerant.

3. Start the vacuum pump and begin the evacuation process. Non-condensable gases (mostly air) are vented from the tank automatically during the recycling process. The pressure being released may be heard.
4. Check for leaks in the system. Refer to the manufacturer's instructions for the charging station in use.

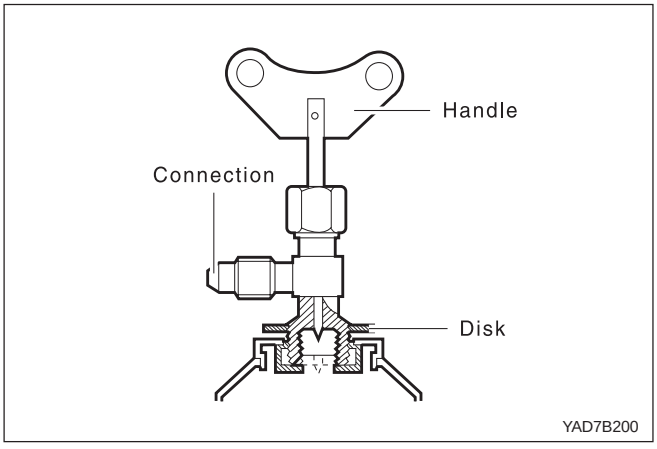
Important: Change the vacuum pump oil frequently. Refer to the manufacturer's instructions for the charging station in use.

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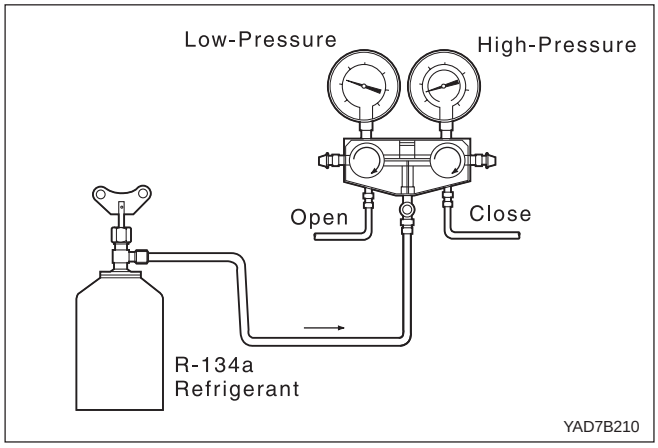
Check for Refrigerant Leaks

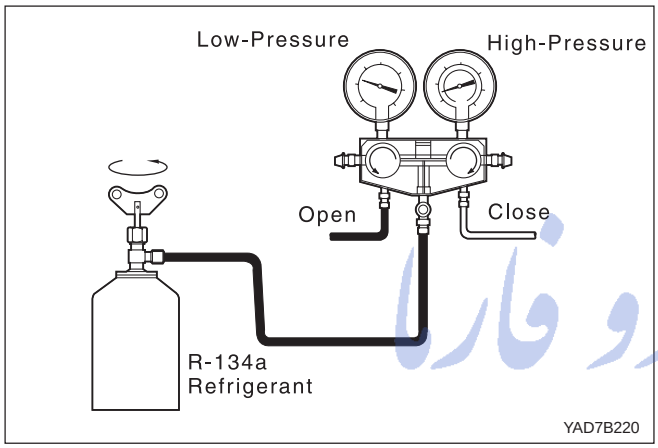
1. Connect the center hose of the gauge to the refrigerant tank.
2. Open the high pressure valve of the gauge to charge with refrigerant gas.
3. Charge until the low pressure gauge reads 1.0 kg/cm^2 and close the valve.
4. Using a gas leak detector, check the system for leaks.
5. If any leak is found, replace O-ring or repair the faulty connection.



How to Use the Tap Valve

1. Rotate the handle counterclockwise fully before connecting the valve to the refrigerant tank.
2. Rotate the disk counterclockwise fully.
3. Connect the center hose to the valve fitting and then rotate the disk clockwise fully by hand.
4. Rotate the handle clockwise to drill the sealed hole.
5. Remove the hose nut securing the center fitting of the manifold gauge and then tighten the nut again in a few seconds.





Charging Refrigerant

Charging for Gas

1. Connect the tap valve to the refrigerant tank.
2. Open the low pressure and adjust the low-side reading below 4.2 kg/cm^2.
3. Place the refrigerant tank in the warm water (40 °C) and keep the gas pressure in the refrigerant tank higher than the gas pressure in the charging valve.
4. Run the engine at high speed and operate A/C system.

   Notice: Place the refrigerant tank on the flat floor to protect the liquid refrigerant from coming through the suction inlet resulting in the compressor's damage.

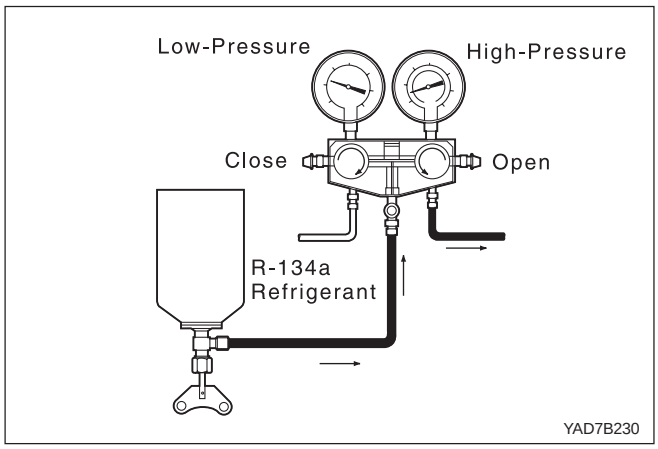
5. Charge the specified amount to the charging valve and close the low pressure valve.

Specified amount	Single: 850 ± 50 g
	Dual: 1200 ± 50 g

Notice:

- If the charging speed is low, it's more efficient to place the refrigerant tank in the warm water (40 °C). But the temperature should keep below (52 °C) at any situation.
- Be careful not to contact the heating device or material.

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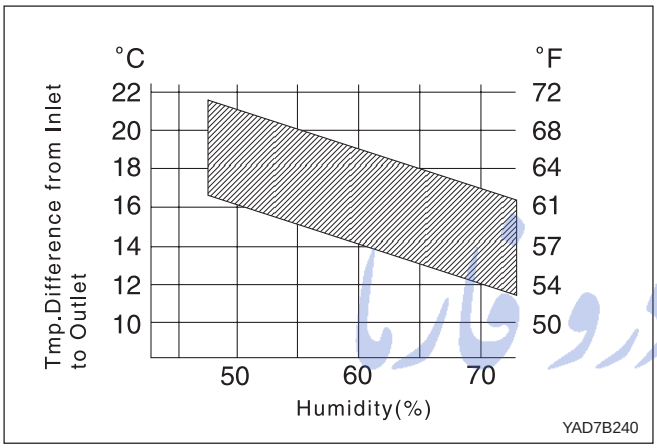
Charging for Liquid

Notice:

- Do not operate when charging the system through the high-side rpessure.
- Do not open the low pressure valve when charging the system by the liquid refrigerant.

1. Tighten both high pressure and low pressure completely before evacuating the charging valve.
2. Connect the tap valve of the refrigerant tank.
3. Open the high pressure valve and turn the refrigerant tank upside down.

4. The discharging pressure increases when the charging valve charges excessively, so charge the charging valve to the specified amount with measuring the weight of the refrigerant before closing the high pressure valve.
5. Charge the specified amount of the refrigerant and then close the valve of the manifold gauge. Check the system for any leak.



Operation Check

Notice: Operation Check is recommended before removing the manifold gauge.

1. Install the manifold gauge set.
2. Run the engine at 2,000 rpm and set the blower switch at 'HI' and A/C switch 'ON'. Set the temperature control lever at 'COOL'.
3. Keep opening all of the window and door.
4. Place a dry bulb thermometer to the front duct.
5. Place a psychrometer close to the inlet of the cooling unit.
6. Check the high pressure gauge reading within 14 - 16 kg/cm^2

   If the reading indicates high excessively, spray the water to the condenser.

   If the reading indicates low excessively, cover the condenser with the towel.
7. Check the temperature of air inlet within 25 - 35 °C.
8. Calculate the relative humidity from the psychrometic graph comparing the wet/dry temperature at the air inlet.
9. Measure the wet/dry temperature at the cold air outlet and calculate the temperature difference of the dry bulb between the inlet and the outlet.
10. Check the cross point of the relative humidity and check the temperature difference between the black line. If the cross point is located between the black line, the cooling performance is normal.

۰۲۱-۸۸۸۶۲۰۸۵
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COMPRESSOR OIL REPLACEMENT

Before Oil Replacement

When any part is replaced or there are a lot of gas leaks in the A/C system, you should add the specified amount of the oil to keep the approval oil capacity because the oil for lubricating the compressor circulates through the A/C system during operating the compressor.

Total Oil Capacity	265 cc

Handling Oil

- Be careful that moistures, dusts etc. must not flow into the oil.
- Do not mix with any other material.
- If the oil leaves outside for long time, it's possible to mix it with the moistures and so keep the oil sealed with a container.

Circulating Oil

For checking or adjusting the oil level, set the control unit to full cold and max blower speed with keeping the engine run at idle for 20 - 30 minutes in order to circulate the oil through the compressor.

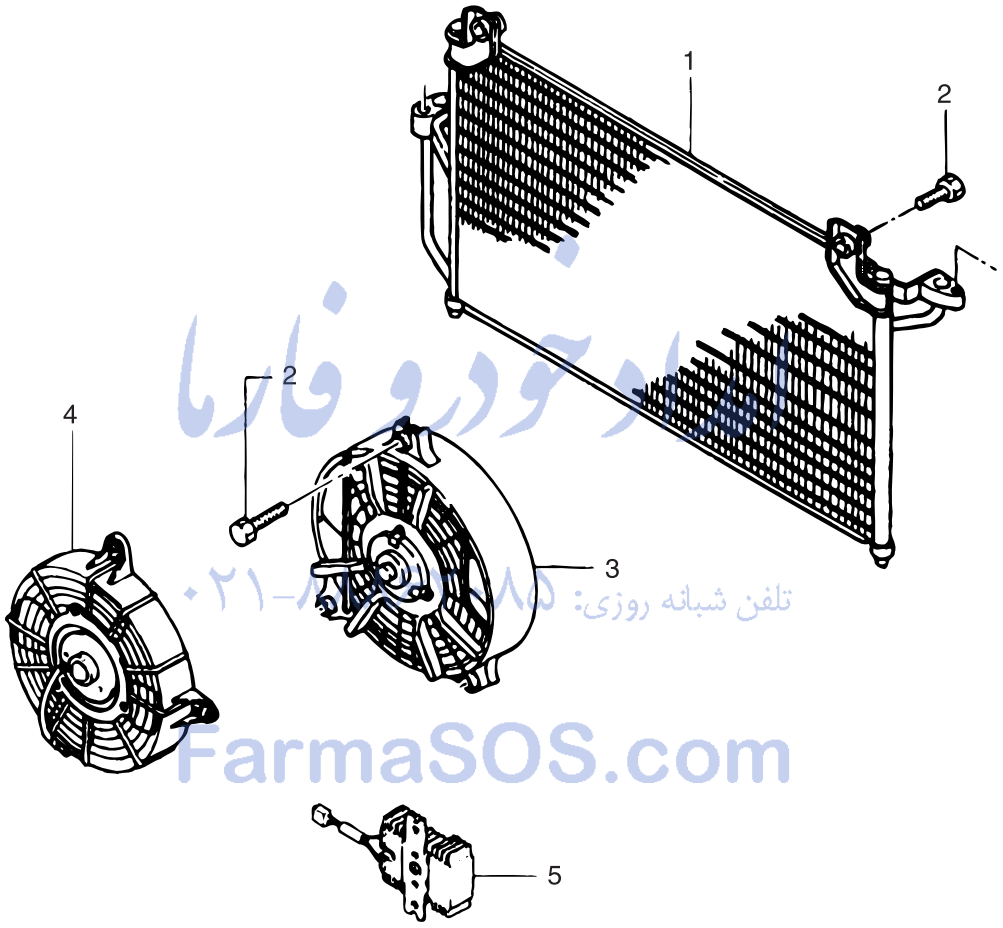
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REPAIR INSTRUCTIONS

ON-VEHICLE SERVICE

CONDENSER

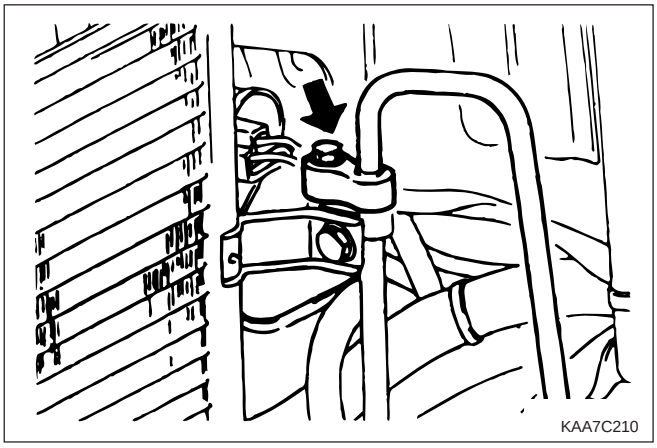
Preceding Work : Removal of the radiator

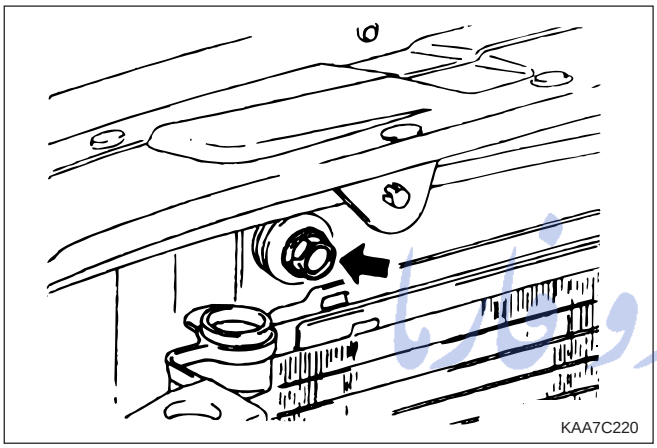


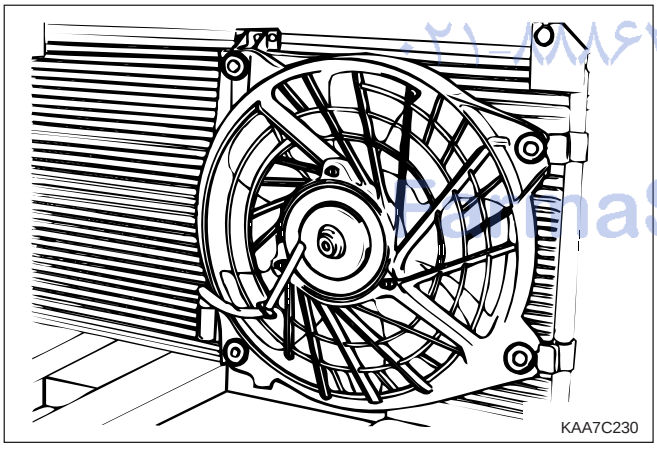
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KAA7C200

1 Condenser
2 Bolt ..... 4 - 6 N•m (35 - 53 lb-in)
3 Condenser Fan
4 Sub Fan (Gasoline Engine)
5 Resister (Gasoline Engine)


KAA7C210


KAA7C220


KAA7C230

Removal & Installation Procedure

1. Disconnect the inlet and outlet pipes of condenser.

   Notice: Before disconnection, evacuate the refrigerant from the system.

Tightening Torque	Inlet Side to 10 - 15N•m (7 - 11 lb-ft)
	Outlet Side to 4 - 6 N•m (35 - 53 lb-in)

   Notice: When installing, check the O-ring and apply compressor oil.

2. Remove the mounting bolts (2EA) and condenser assembly.

   Installation Notice

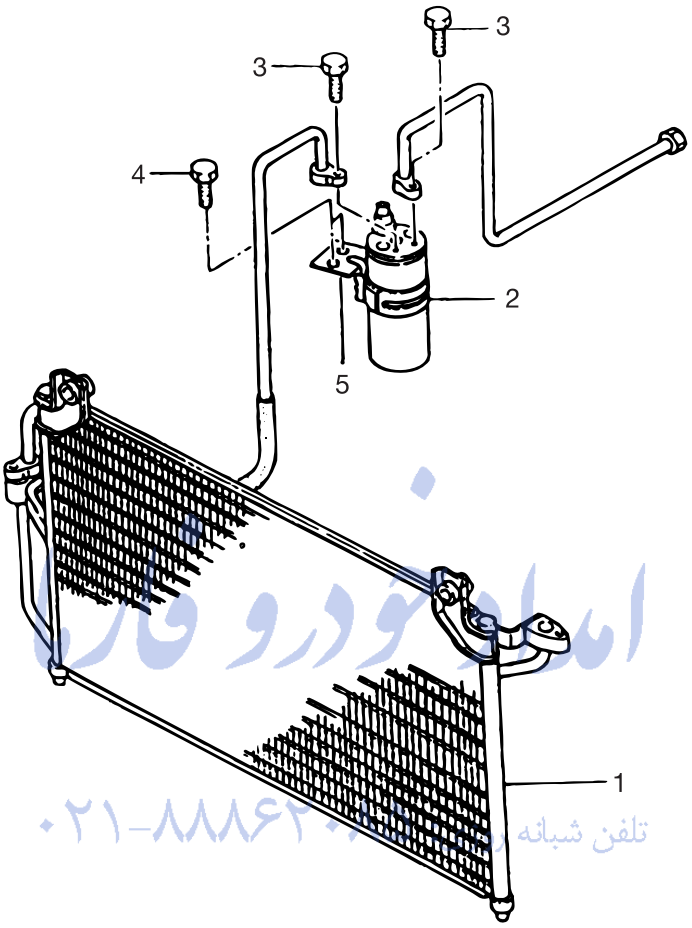
Tightening Torque	4 - 6 N•m (35 - 53 lb-in)

3. Remove the main condenser fan from condenser.

4. Installation should follow the removal procedure in the reverse order.

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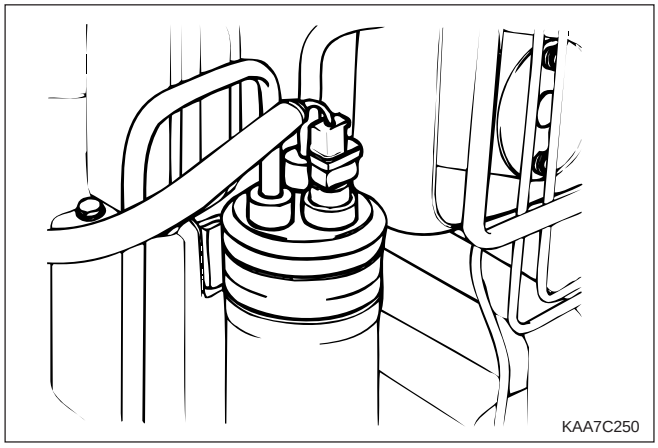
RECEIVER DRIER



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KAA7C240

1 Condenser
2 Receiver Drier
3 Bolt ..... 4 - 6 N•m (35 - 53 lb-in)
4 Bolt ..... 5 - 8 N•m (44 - 71 lb-in)
5 Bracket


KAA7C250

Removal & Installation Procedure

1. Disconnect the negative(-) terminal from the battery.
2. Discharge refrigerant from the system.

   Notice: By connecting a manifold gauge connection hose to High/Low pressure line, discharge the refrigerant.

3. Disconnect the inlet and outlet pipes of receiver drier.

   Notice: When installing, check the O-ring and apply the compressor oil.

   Installation Notice

Tightening Torque	4 - 6 N•m (35 - 53 lb-in)

4. Remove the bracket bolt and then remove the receiver drier.

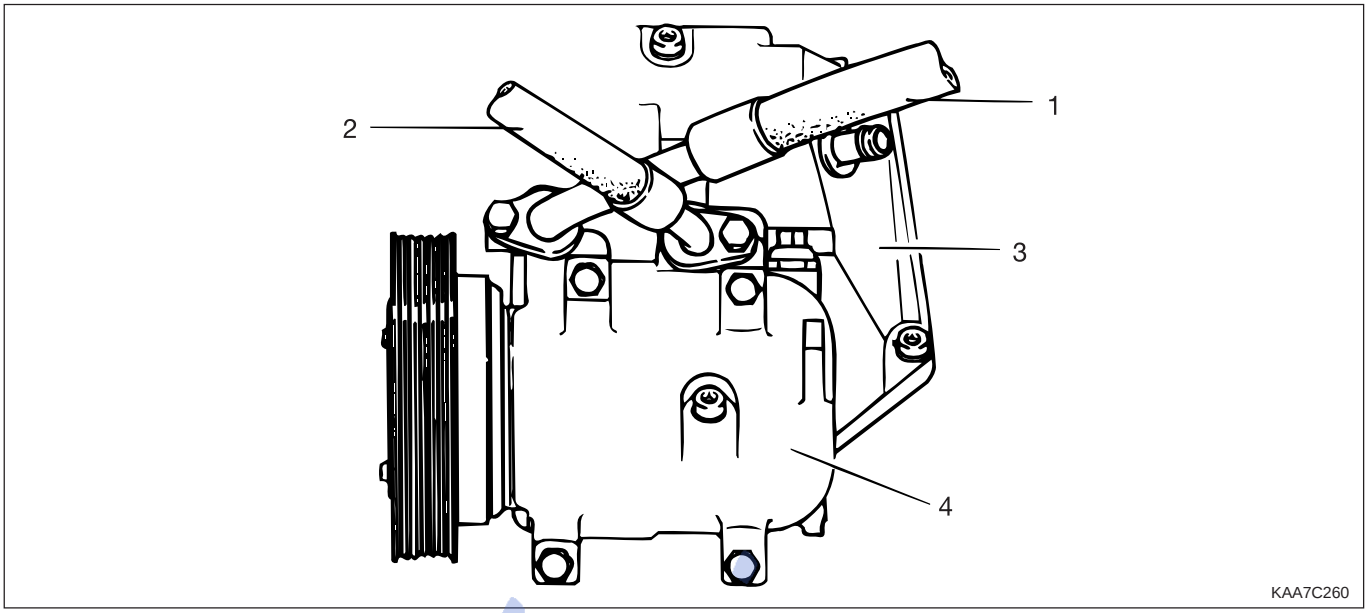
   Installation Notice

Tightening Torque	5 - 8 N•m (44 - 71 lb-in)

5. Installation should follow the removal procedure in the reverse order.

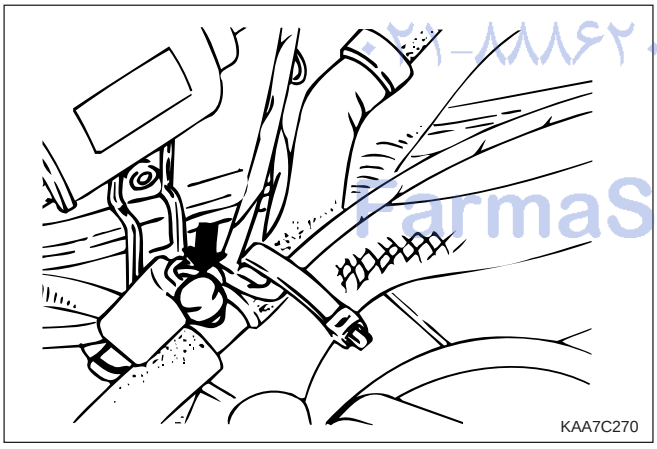
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AIR-CONDITIONER COMPRESSOR



1 Compressor Bracket
2 High Pressure Hose
3 Low Pressure Hose
4 Compressor

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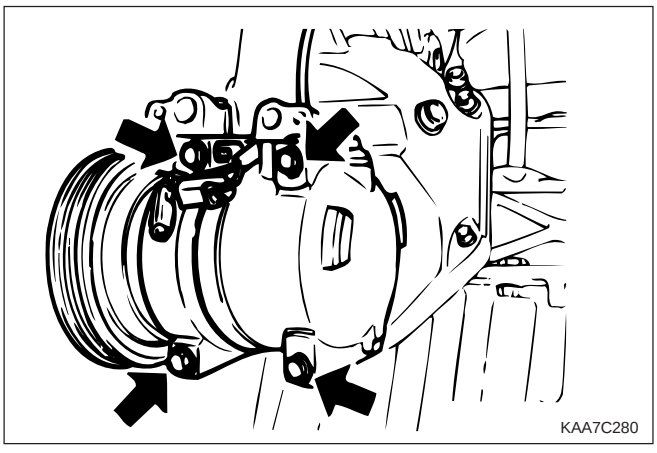


Removal & Installation Procedure

1. Disconnect the negative (-) terminal from the battery.
2. Discharge refrigerant from the system.

   Notice: By connecting a manifold gauge connection hose to High/Low pressure line, discharge the refrigerant.

3. Disconnect the high/low pressure pipe and wire connectors.



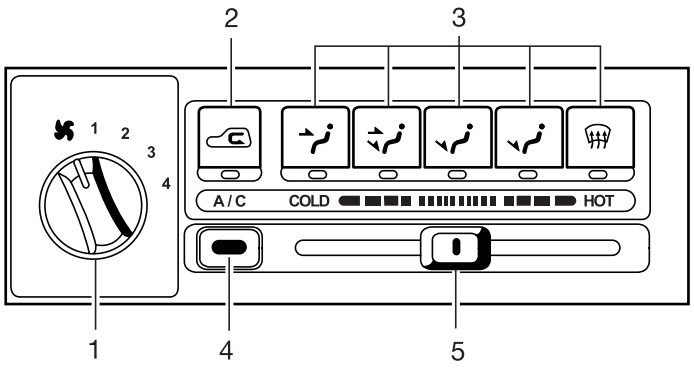
4. Remove the mounting bolt from the compressor bracket and remove compressor assembly.

   Notice: Place the removed compressor in vertical position.

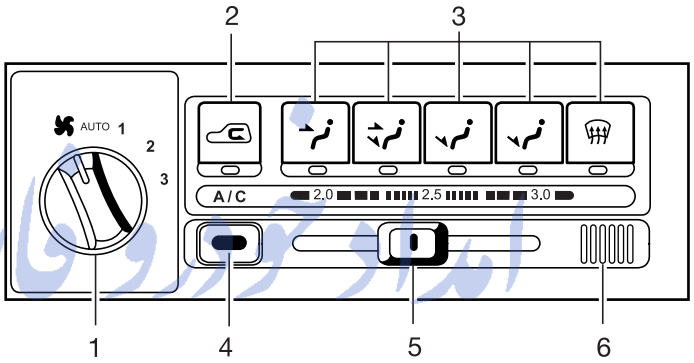
5. Installation should follow the removal procedure in the reverse order.

HEATER AND AIR CONDITIONER CONTROL BOX

MANUAL



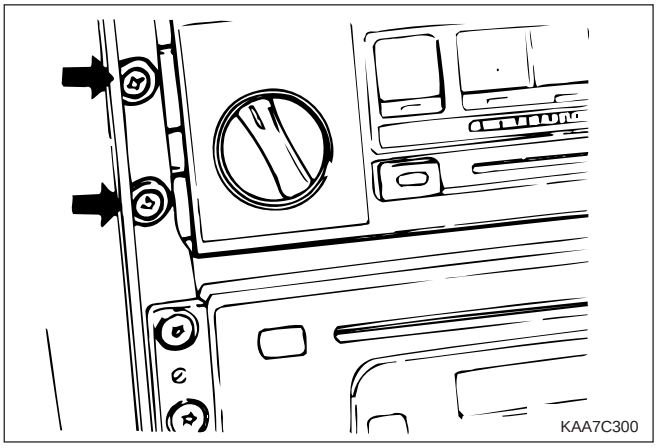
SATC



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1 Blower Switch
2 Recirculation Switch
3 Mode Switch
4 A/C Switch
5 Temperature Control Lever
6 In-vehicle Sensor

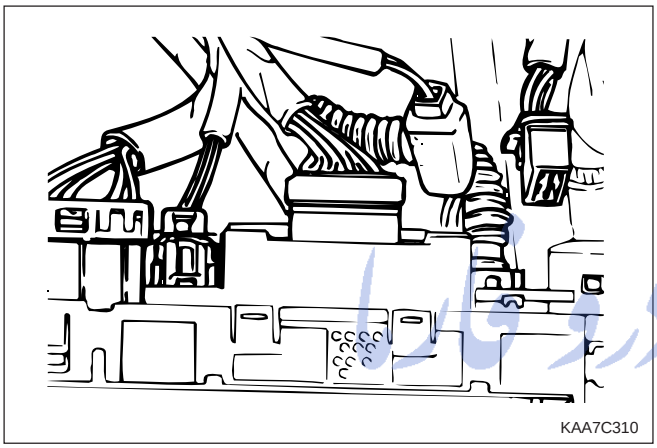


Removel & Installation Procedure

1. Remove the switch panel.

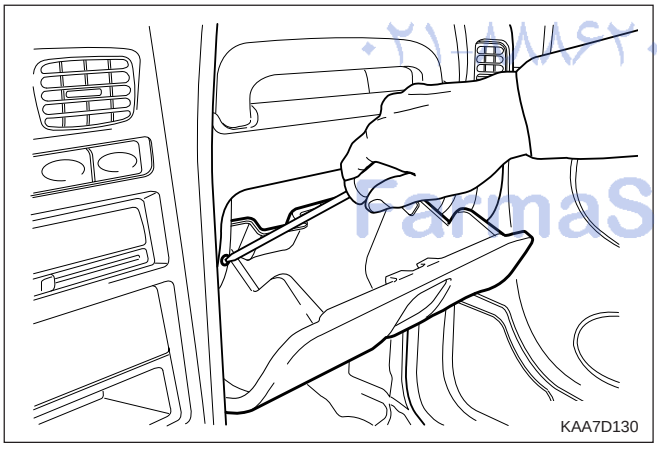
   Notice: Be careful not to damage the switch panel.

2. Remove the fixing screws (4 screws) of the control box.



3. Disconnect the wire connectors and remove the control box.
4. Installation is reverse order of the removal.

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AIR FILTER

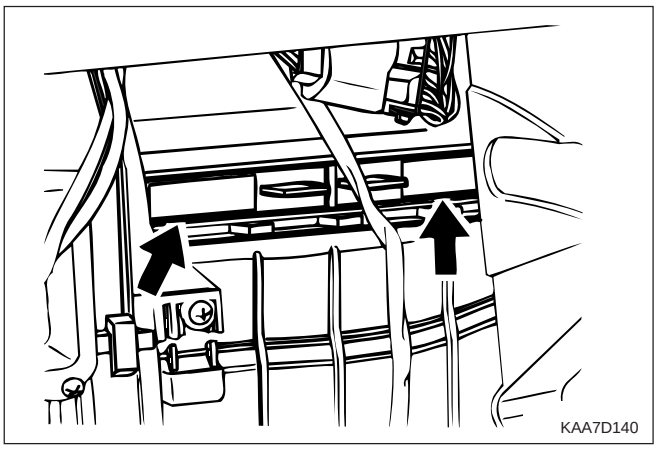
Removal and Installation Procedures

Replacement Interval	Every 10,000 km

Notice: Replace earlier if air pollution is heavy.

1. Open the glove box and pull it inward to release the upper left and right locking portion.

   Notice: Remove the glove box by unscrewing lower 2 screws, if necessary.



2. Press the 2 filter cover holds and remove the air filter cover.
3. Remove the 2 air filters.

   Notice: For installation, remember the installed direction of the air filter before removal.

SECTION 7D

FULL AUTOMATIC TEMPERATURE CONTROL HEATING, VENTILATION AND AIR CONDITIONING SYSTEM

FATC (Full Automatic Temperature Control) is full automatic heater and airconditioning system that detects incar temperature, ambient temperature, sun load and coolant temperature and controls airconditioner system blowing capacity, outlet temperature and intaking/outlet mode to maintain interior comfort.

TABLE OF CONTENTS

Specifications 7D-2
- Refrigerant 7D-2
- Evaporator Unit 7D-2
- Blower Unit 7D-2
- Compressor 7D-2
- Condenser 7D-2
- Receiver Drier 7D-2
- Pressure Switch 7D-3
- Air Filter 7D-3
- Heater Unit 7D-3
- Service Specifications 7D-4
- Fastener Tightening Specifications 7D-4

Schematic and Routing Diagrams 7D-5
- Circuit Diagram 7D-5
- FATC Block Diagram 7D-6

Component Locator 7D-7
- Ventilation System 7D-7
- Function Description 7D-8

Diagnosis 7D-9
- Diagnosis Test 7D-9

Maintenance and Repair 7D-13
- FATC Control Panel 7D-13
- Air Filter 7D-16
- Troubleshooting 7D-17

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SPECIFICATIONS

REFRIGERANT

Application	Description
Capacity	650 - 750 g
Type	R134a

EVAPORATOR UNIT

Application	Description
Core Size (LxWxT)	237.0 x 232.0 x 92.0
Core Type	Aluminum plate
Expansion Valve Type	Angle
Thermostat	ON:4.5 ± 0.6°C, OFF:1.5 ± 0.6°C
Resister Type	Aluminum plate
Cooling Capacity	4,300 Kcal/h (AT 420 CMH)

BLOWER UNIT

Application	Description
Motor Type	Magnetic
Motor Size	ϕ 70 x 145

COMPRESSOR

Application	Description
Model	FK-II (DKV 14C)
Type	Vane rotary type
Displacement (cc/rev.)	140.5 (cc/rev)
PCD (Pulley Center Diameter)	ϕ 143
Oil	ZXL 200 PG (PAG Oil)
Magnetic clutch output	45 W

CONDENSER

Application	Description
Size (WxHxT)	650 x 339.2 x 22.0
Capacity	11,000 Kcal/h
Type	Parallel Flow

RECEIVER DRIER

Application	Description
Material	Aluminum
Capacity	250 cc
Desiccant	XH-9 (35 g)

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PRESSURE SWITCH

Application	Description
Type	Direct
High (OFF)	OFF : 32 ± 2 Kgf/cm^2, DIFF : 6 ± 2 Kgf/cm^2
Low (ON)	OFF : 2.0 ± 0.2 Kgf/cm^2, ON : 2.1 ± 0.2 Kgf/cm^2

AIR FILTER

Application	Description
Replacement	Every 12,000 km (replace earlier if air pollution is heavy)

HEATER UNIT

Application	Description
Heater Core Type	2-ROW
Heating Capacity	4,600 Kcal/h (AT 300 CMH)
Heater Core Size (L x W x T)	219.5 x 151.8 x 52

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SERVICE SPECIFICATIONS

Input Section

Application	Description	
Incar Sensor	Resistance (25°C)	2.186 kΩ ± 0.07 kΩ
	Voltage Rating	5 V
	Current Rating	3 mA
Ambient Sensor	Resistance (25°C)	1.0 kΩ ± 0.03 kΩ
	Voltage Rating	5 V
	Current Rating	3 mA
Coolant Temperature Sensor	Resistance (25°C)	0.55 kΩ ± 0.02 kΩ
	Voltage Rating	5 V
	Current Rating	3 mA

Evaporator Unit

Application	Description	
Intake Actuator	Current Rating (at 12 V)	70 ± 30 mA
	LOCK Current	Less than 500 mA
Mode Actuator	Current Rating (at 12 V)	100 ± 40 mA
	LOCK Current	Less than 500 mA
Mix Actuator	Current Rating (at 12 V)	100 ± 40 mA
	LOCK Current	Less than 500 mA
Power TR	Ic	30 A
	Pc	200 W
Blower Motor Power Consumption		220 W

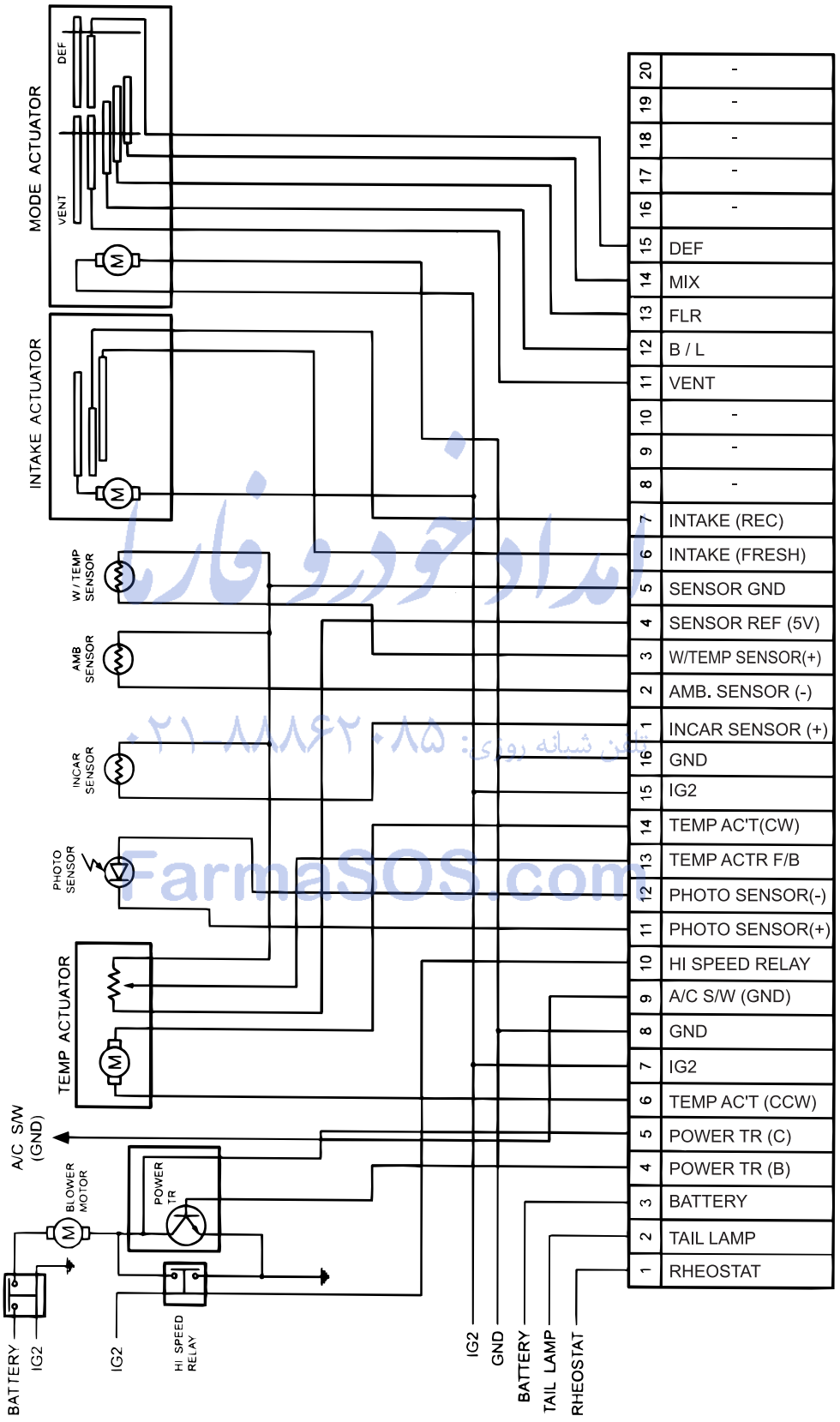
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FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Condenser Bolt	4 - 6	2.9 - 4.4	35.4 - 53.1
Condenser Fan Nut	4 - 6	2.9 - 4.4	35.4 - 53.1
Condenser Bolt	4 - 6	2.9 - 4.4	35.4 - 53.1
Receiver Drier Pipe Bolt	5 - 8	3.7 - 5.9	44.2 - 70.8
Receiver Drier Pipe Bolt (Condenser)	4 - 6	2.9 - 4.4	35.4 - 53.1
Pressure Pipe Bolt	20 - 30	14.7 - 22.1	177.0 - 265.5
Pressure Mounting Bolt	20 - 26	14.7 - 19.1	177.0 - 230.1

SCHEMATIC AND ROUTING DIAGRAMS

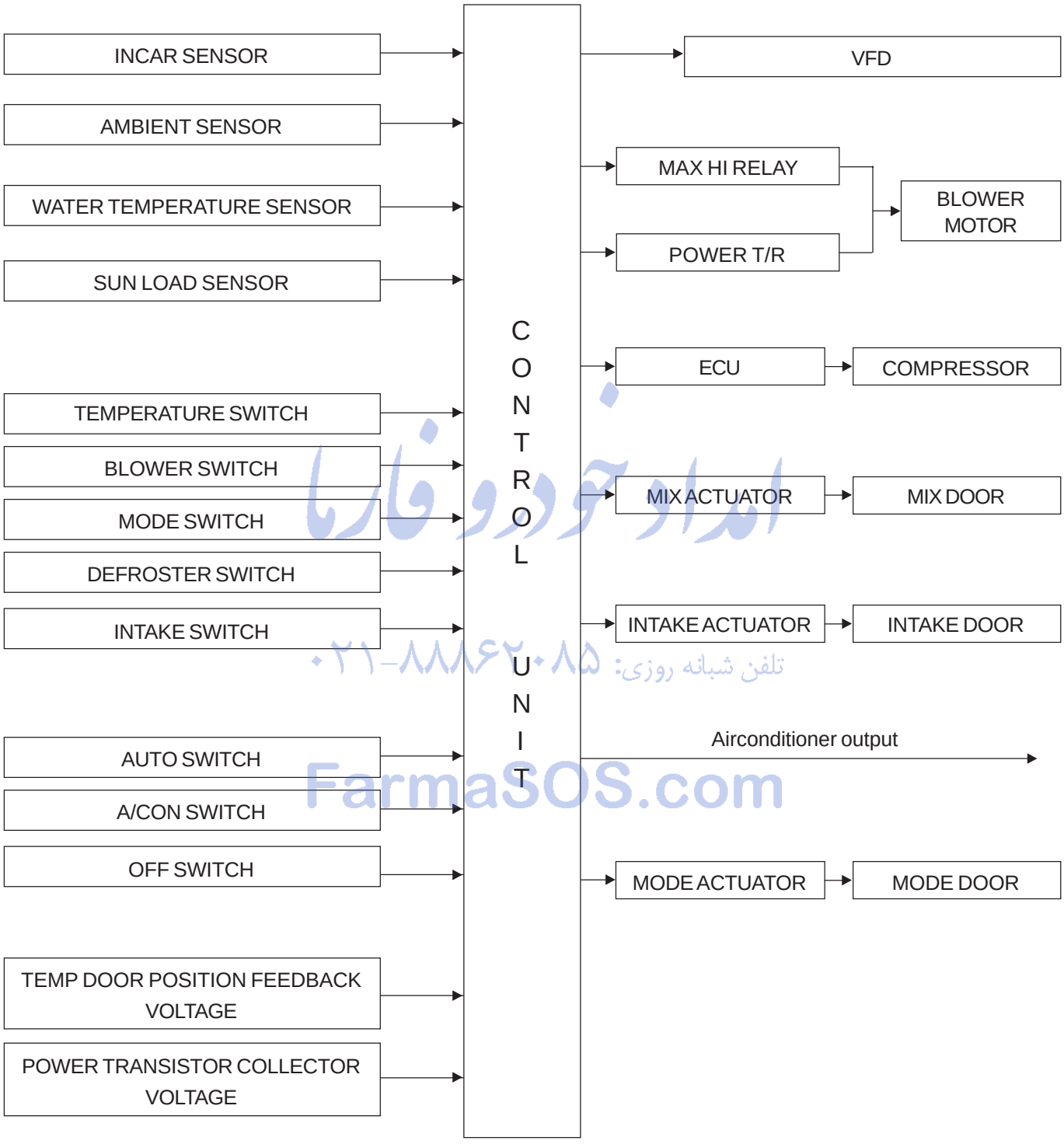
CIRCUIT DIAGRAM



KAA7D010

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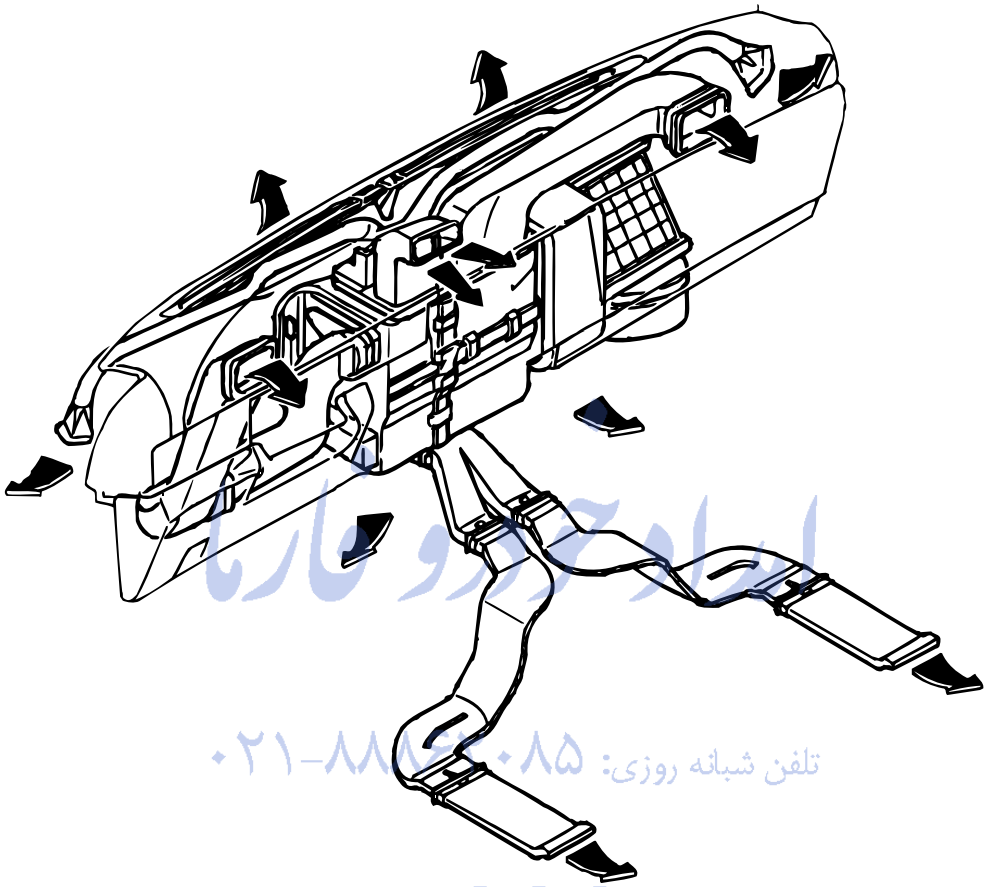
FATC BLOCK DIAGRAM



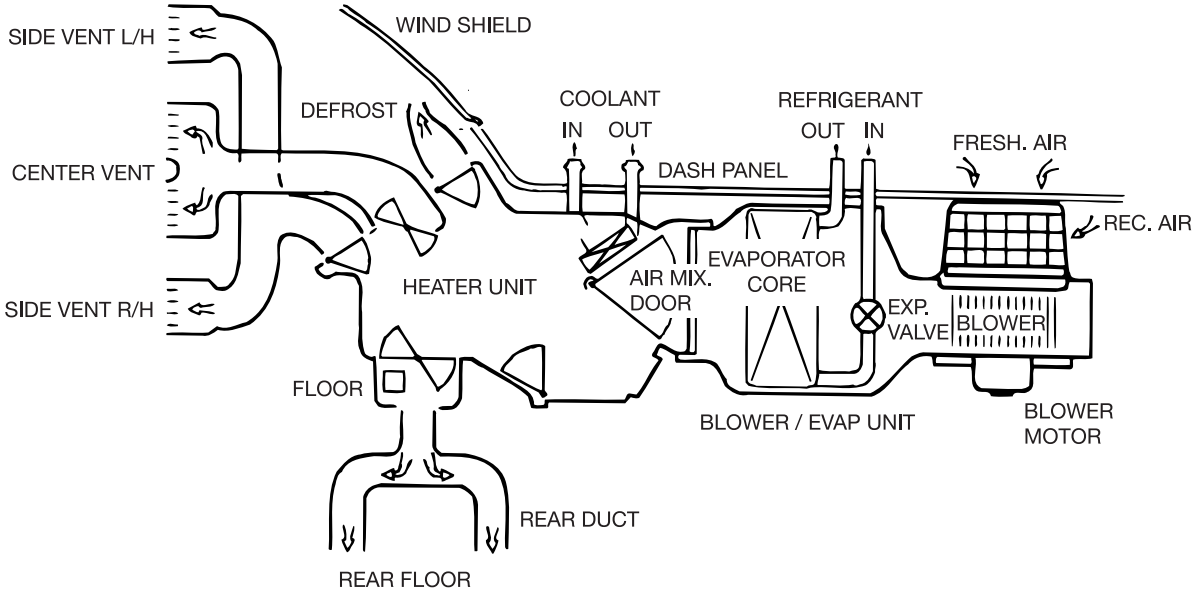
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COMPONENT LOCATOR

VENTILATION SYSTEM



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KAA7D020

FUNCTION DESCRIPTION

1. AUTO switch

- By pressing the AUTO switch, set temperature, AUTO, fan speed, air source, air flow mode will be appeared on the VFD display.
- Following items will be controlled automatically according to set temperature.
  - Mode and intake door
  - Temperature door
  - Blower fan speed
  - Compressor ON/OFF control
- When AUTO switch is released, other functions will be controlled automatically except for manually selected switches.

2. MODE switch

- By pressing the MODE switch while the AUTO switch is turned ON, AUTO indicator light will go off and air flow mode will be controlled manually in the order of VENT → B/L → FLR → MIX → VENT.

3. OFF switch

- Press this switch and the airconditioner system will be turned OFF.

4. Temperature UP/DOWN switch

- This switch is a switch increasing or decreasing set temperature and position of the temperature door will be automatically controlled according to set temperature and outlet temperature will be controlled by adjusting blending ratio of cold and hot air.
- By operating the switch, set temperature will be increased/decreased by 0.5°C.
- Set temperature range is 17 - 32°C.
- Max. cold function will be performed at set temperature of 17°C and max. hot function will be performed at set temperature of 32°C.
- When pressed more than 1 second, it will be automatically UP/DOWN by interval of 0.28 sec. after 1 second.
- When it changed 17.5°C → 17°C, 31.5°C → 32°C and DOWN switch is pressed after 17°C or UP switch is pressed after 32°C, there will be operating sounds 3 times during 0.1 sec.

5. DEFROST switch

- By pressing this switch, DEF will turn on and mode door will be fixed at DEF.
- Recirculation/fresh air switch will be fixed as FRESH.
- When airconditioner is turned ON and ambient temperature is less than 1.5°C, the airconditioner will be turned off.
- Selection of airconditioner OFF is possible by manual.

6. A/C switch

- The airconditioner system will be turned ON or OFF by pressing this switch.

7. Recirculation•fresh air switch

- Air intake will be automatically switched to recirculation or fresh air (REC → FRE) by pressing this switch.

8. Blower switch (UP/DOWN)

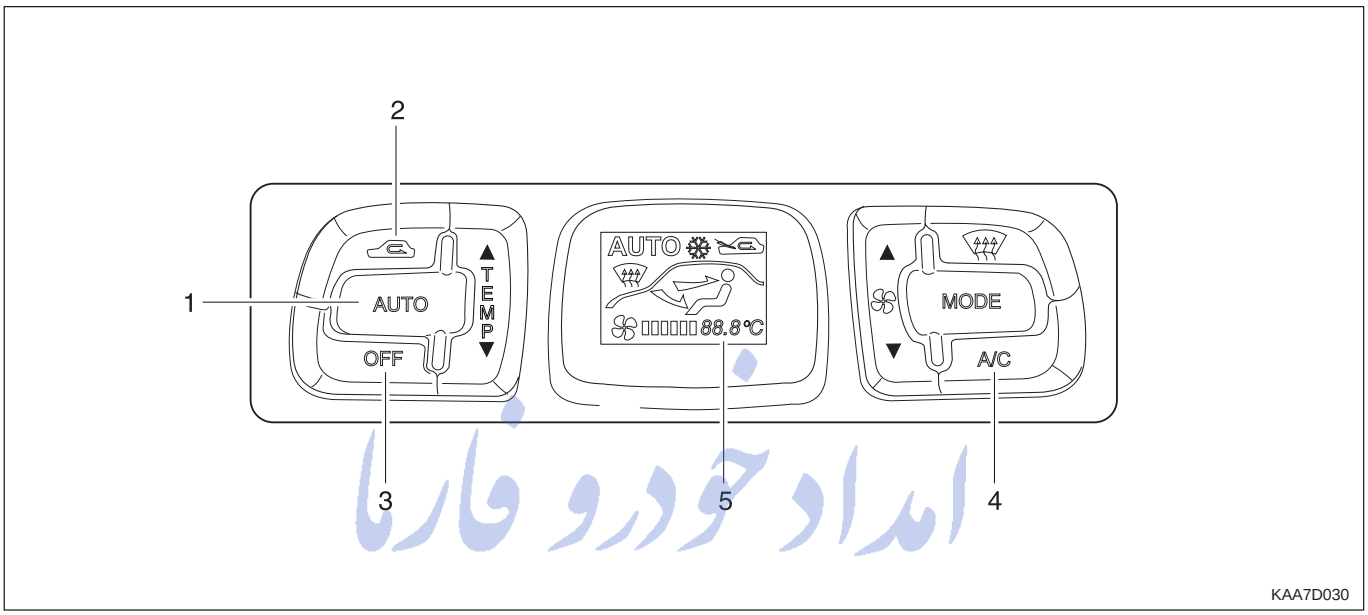
- Blower speed can be controlled by manual and if fan UP/DOWN switch is pressed when AUTO mode is selected, fan speed will UP/DOWN based on current fan level.
- When 6 segments are turned on, it is max. HI operation.
- When pressed more than 1 second, it will be automatically UP/DOWN by interval of 0.28 sec. after 1 second.
- When segment is changed stage 2 → stage 1 (LO), stage 5 → stage 6 (HI) and HI switch is pressed in HI status or DOWN switch is pressed in LO status, there will be operating sounds 3 times during 0.1 sec.
- When switch is operated in OFF status, it will be operated as stage 1 (1 segment display).

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DIAGNOSIS

DIAGNOSIS TEST

FATC airconditioner system has self-diagnosis function. Turn the ignition switch ON and press intake switch more than 4 times within 2 seconds while the AUTO switch is pressed, then it will diagnose incar sensor, ambient sensor, water temperature sensor and temperature actuator for open/short and will display numerical fault code on the set temperature display of VFD.

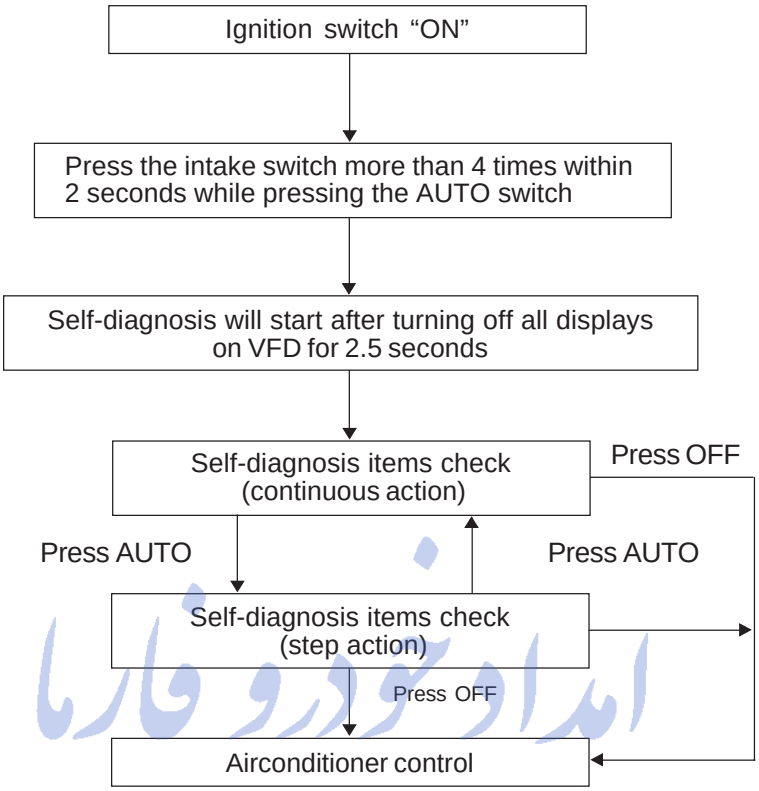


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1 AUTO Switch
2 Fresh/Recirculation Switch
3 OFF Switch
4 Airconditioner Switch
5 VFD (Vaccum Fluorescent Display)

۰۲۱-۸۸۸۶۲۰۸۵ تلفن شبانه روزی
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Self-diagnosis Method



Diagnosis Item and Fault Code

00 : normal
11 : incar Sensor Open
12 : incar Sensor Short
13 : ambient Sensor Open
14 : ambient Sensor Short
15 : coolant Sensor Open
16 : coolant Sensor Short
17 : temperature Actuator Open/Short
18 : temperature Actuator Drive Fault

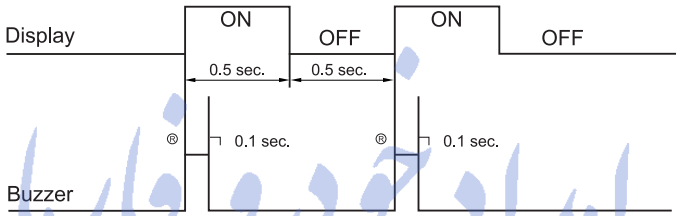
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Self-diagnosis Display

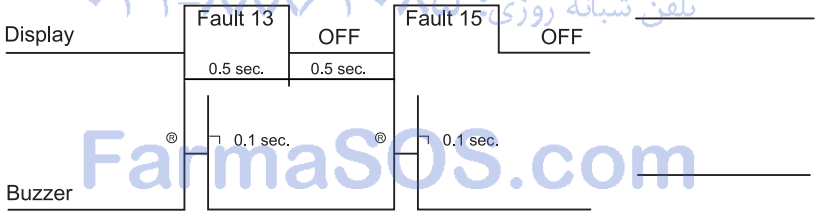
1. Data will be displayed at the set temperature display as 2-digit number during self-diagnosis function and other set temperature displays will be OFF.
2. Display of self-diagnosis fault code will be blinking fault code number in the intervals of 0.5 sec.
3. Following fault code number will be displayed at the set temperature display during self-diagnosis function.
4. If no defective, normal display number (00) will blink.

Display during continuous action

A. Normal or 1 fault (00 or 11)



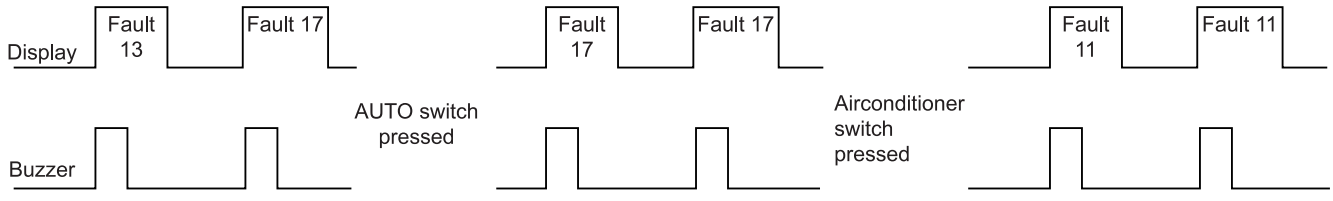
B. Multiple faults (11, 13, 15.....)



Display during step action

A. Normal or 1 fault : the same as continuous action

B. Multiple faults



Fault Safety Function

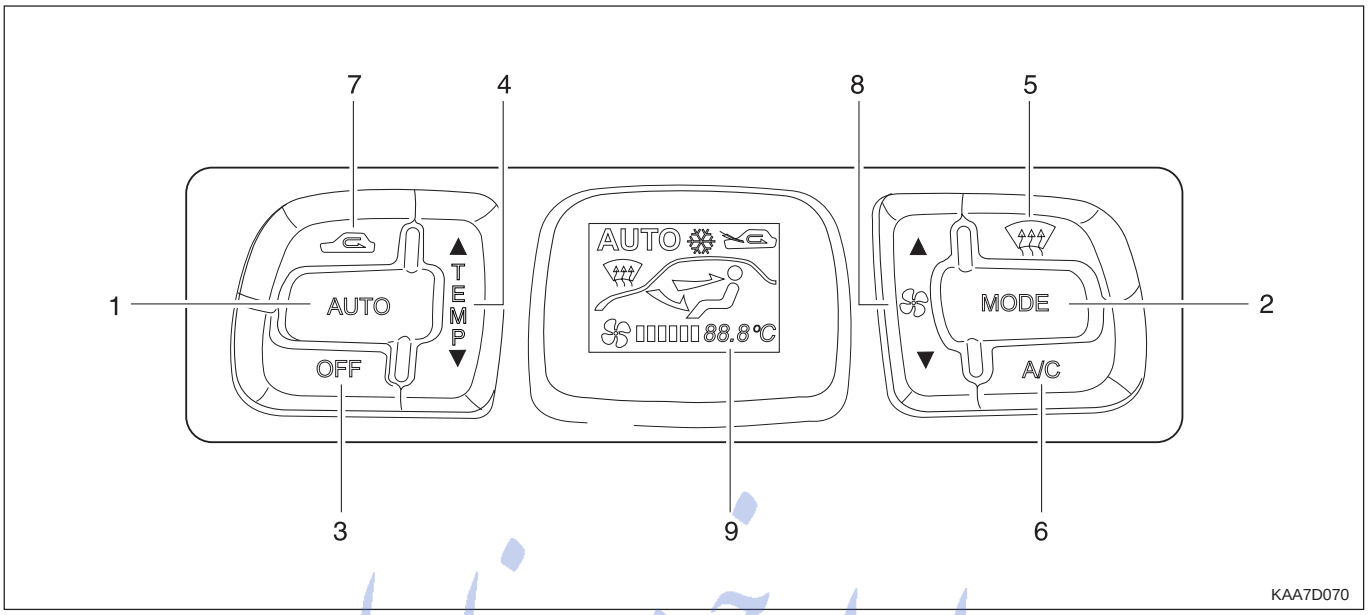
FATC airconditioner system not only performs self-diagnosis but also has safety function against faults if there is open or short in the incar sensor, ambient sensor, water temperature sensor and temperature door potentiometer.

NO.	Item	Defects	Fault safety function
1	Incar sensor	Open or short	Control When substituted 25°C
2	Ambient sensor	Open or short	Control When substituted 20°C
3	Water temperature sensor	Open or short	Perform heating maneuver control function under refrigeration maneuver control entering conditions and release after 10 minutes.
4	Temperature door potentiometer	Open or short	Set temperature 17 - 24.5°C : max. COLD position Set temperature 25 - 32°C : max. HOT position

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MAINTENANCE AND REPAIR

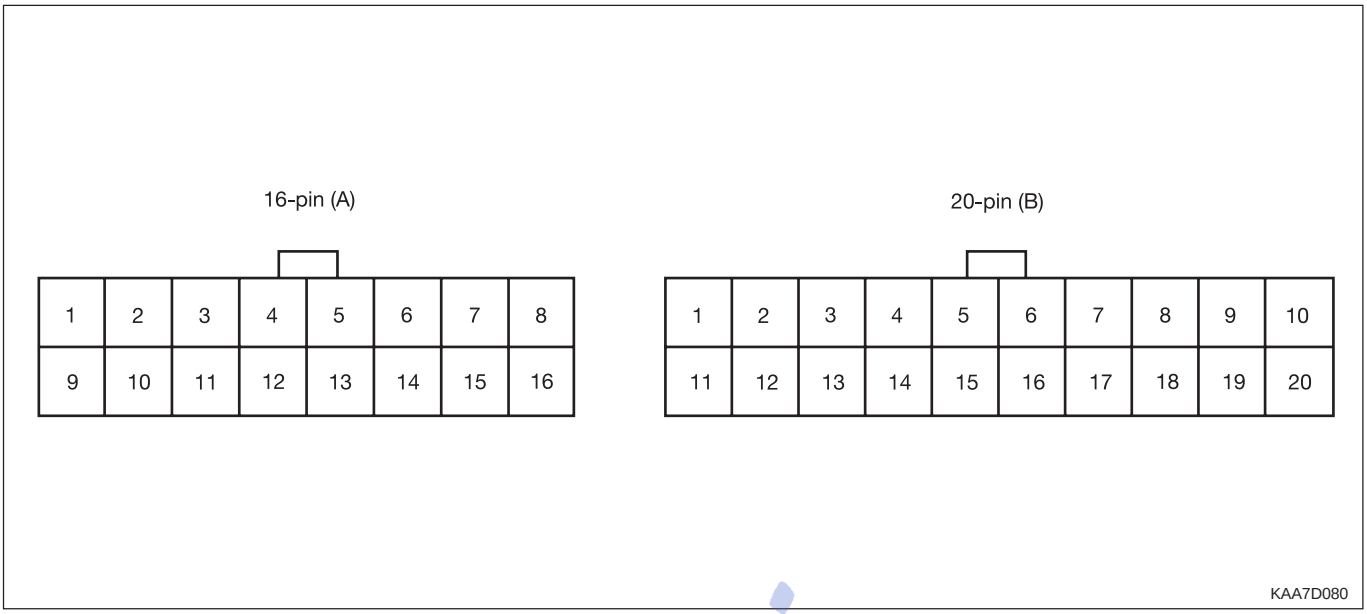
FATC CONTROL PANEL



1 AUTO Switch
2 MODE Switch
3 OFF Switch
4 Temperature UP/DOWN Switch
5 Defrost Switch
6 Airconditioner Switch
7 Fresh/Recirculation Switch
8 Blower Switch (UP/DOWN)
9 VFD (Vacuum Fluorescent Display)

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Pin Number and Connection Circuit



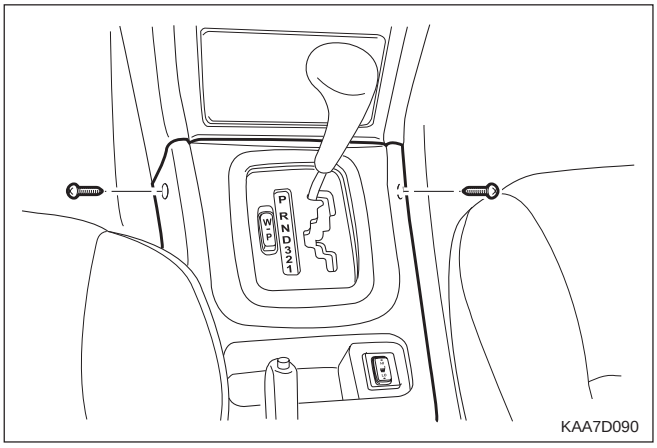
Connector A

Pin No.	Connection circuit
1	Rheostat
2	Tail lamp
3	Battery (+)
4	Power TR (B)
5	Power TR (C)
6	Temperature actuator (CCW)
7	IG2
8	Ground
9	Airconditioner switch ground
10	HI speed relay
11	Photo sensor (+)
12	Photo sensor (-)
13	Temperature actuator F/B
14	Temperature actuator (CW)
15	IG2
16	Ground

Connector B

Pin No.	Connection circuit
1	Incar sensor (+)
2	Ambient sensor (+)
3	Coolant sensor (+)
4	Sensor voltage 5V
5	Sensor ground
6	Intake (ambient)
7	Intake (incar)
8	-
9	-
10	-
11	VENT
12	B/L
13	FLR
14	MIX
15	DEF
16	-
17	-
18	-
19	-
20	-

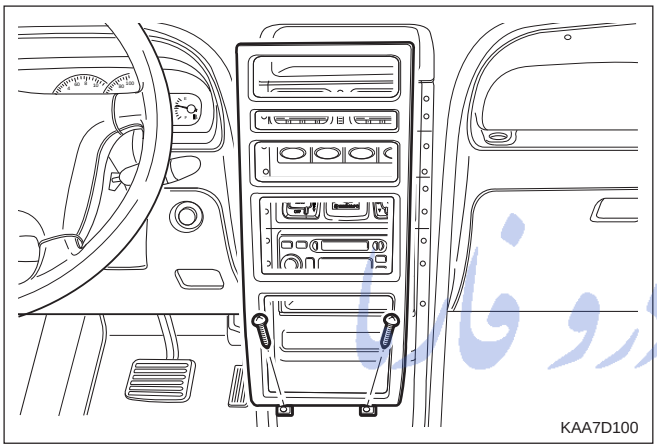
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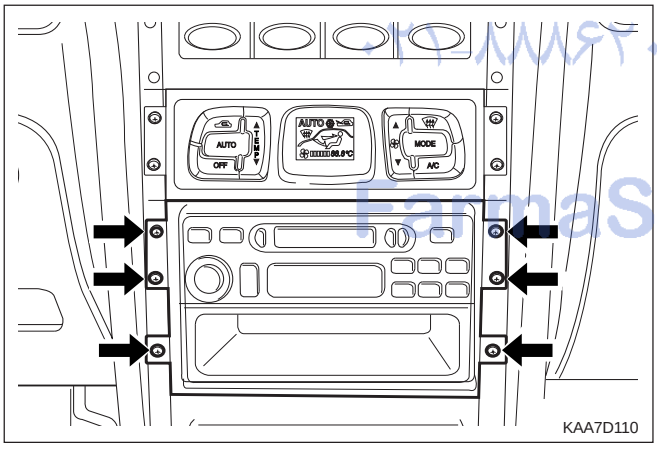
KAA7D090

Removal & Installation Procedure

1. Turn the ignition switch to OFF position.
2. Remove two screws on the cover of shift lever box.

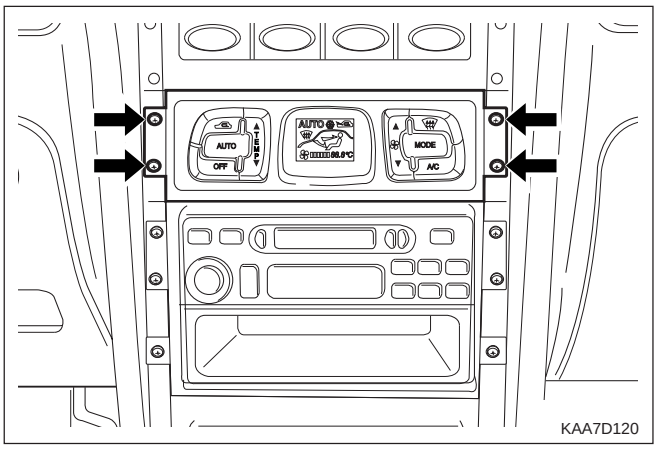

KAA7D100

3. Unscrew the screw from the center panel, pull out each switches and remove the center panel.



KAA7D110

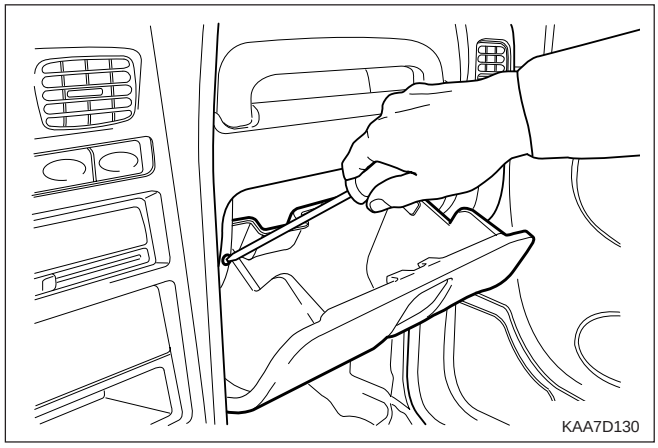
4. Unscrew the 6 screws and remove the audio control panel assembly.

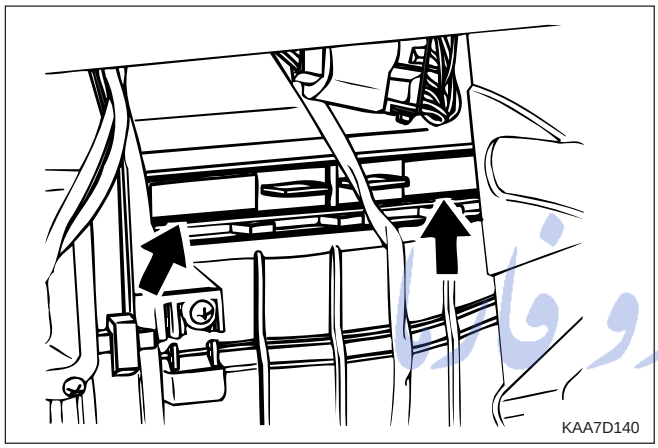


KAA7D120

5. Unscrew the 4 screws and remove the airconditioner control panel assembly.
6. Installation should follow the removal procedure in the reverse order.

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AIR FILTER

Removal and Installation Procedures

Replacement Interval	Every 10,000 km

Notice: Replace earlier if air pollution is heavy.

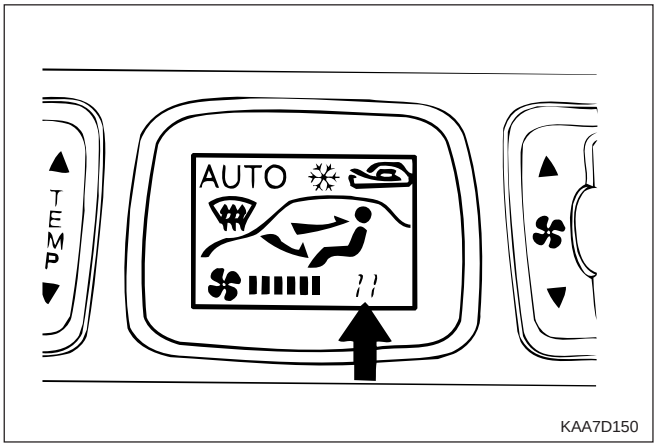
1. Open the glove box and pull it inward to release the upper left and right locking portion.

   Notice: Remove the glove box by unscrewing lower 2 screws, if necessary.

2. Press the 2 filter cover holds and remove the air filter cover.
3. Remove the 2 air filters.

   Notice: For installation, remember the installed direction of the air filter before removal.

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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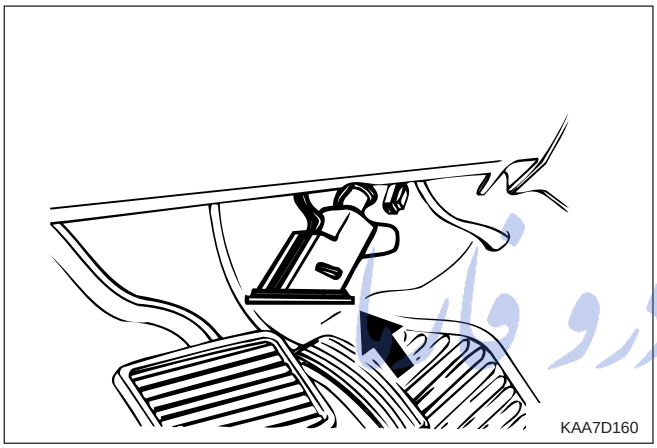
KAA7D150

TROUBLESHOOTING

Check and Service

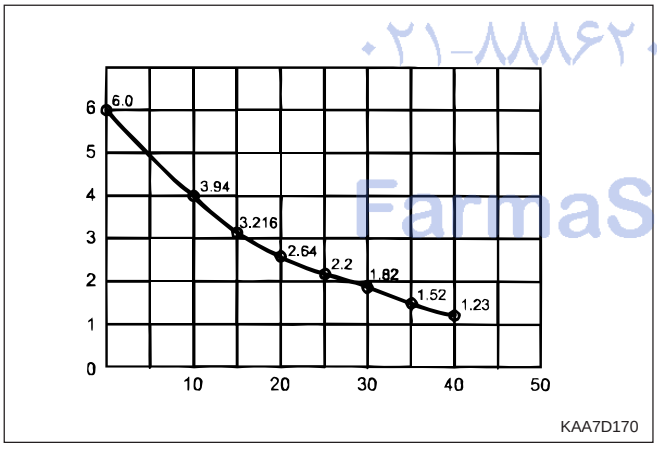
Incar sensor is a sensor that detects interior air temperature and a thermistor that decreases its resistance when temperature up and increases when temperature down.

1. Check that there are incar sensor fault code (11,12) by using self-diagnosis function.


KAA7D160

2. Disconnect incar sensor 2-pin connector that installed on inner lower instrument panel cover of driver's side and remove the sensor.

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۰۲۱-۸۸۸۶۲۰۸۵ شبانه روزی
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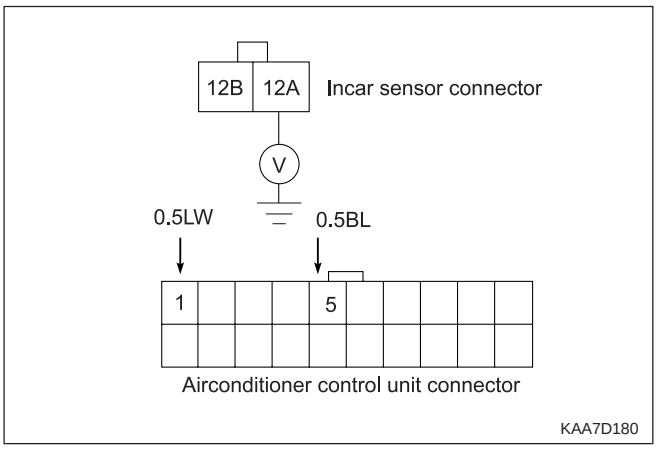


KAA7D170

3. Check that measured resistance value among incar sensor terminals is as shown in the right side graph.

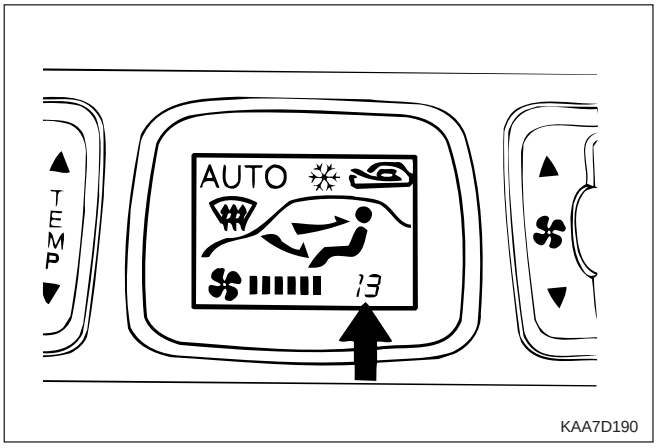
   Notice: Measure resistance value by soaking the sensor in the ice water and check changes in resistance values after soaking it in the very hot water.

4. If resistance value is out of specification, replace the incar sensor.



KAA7D180

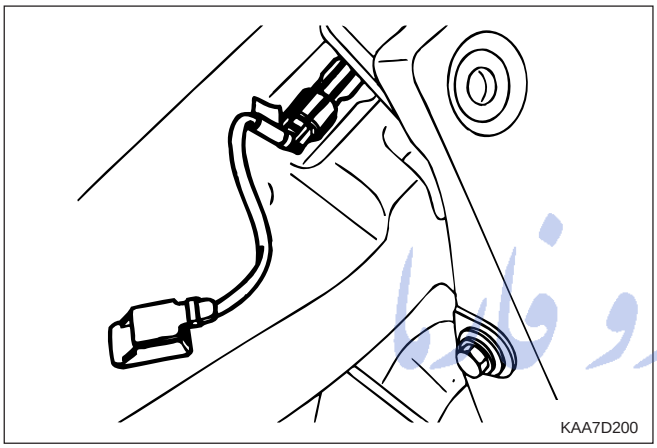
5. Install the sensor and turn the ignition switch to ON position and check that voltage between No. 12A terminal of incar sensor and body (-) is 5V.
6. Check current between the No. 12B and 12A connector terminals of the incar sensor and the No. 1 and 5 connector terminals of the airconditioner control unit and repair the wire if defective.



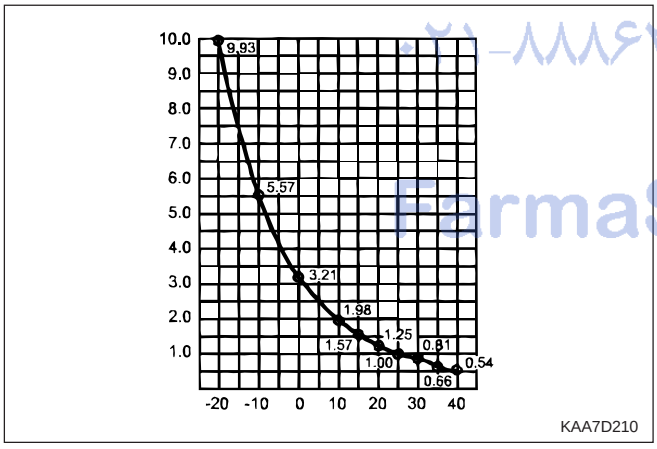
Ambient Sensor

Ambient sensor is a sensor that detects ambient temperature and a thermistor that decreases its resistance when temperature up and increases when temperature down.

1. Check that there are ambient sensor fault code (13,14) by using self-diagnosis function.



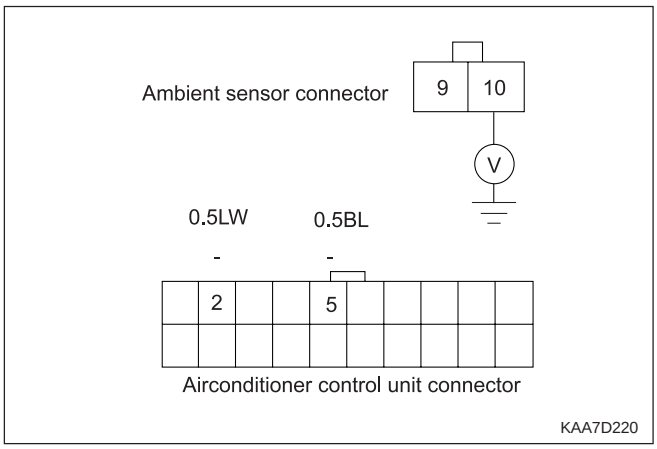
2. Disconnect ambient sensor 2-pin connector that installed on front right side of the frame and remove the sensor.



3. Check that measured resistance value among ambient sensor terminals is as shown in the right side graph.

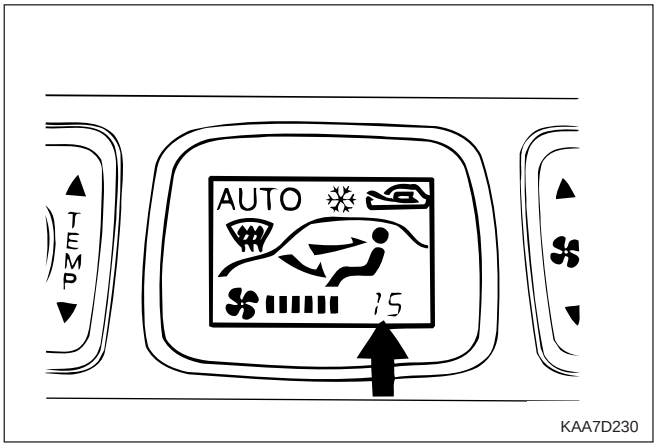
   Notice: Measure resistance value by soaking the sensor in the ice water and check changes in resistance values after soaking it in the very hot water.

4. If resistance value is out of specification, replace the ambient sensor.



5. Install the sensor and turn the ignition switch to ON position and check that voltage between No. 10 terminal of the ambient sensor and body (-) is 5V.
6. Check current between the No. 10 and 9 connector terminals of the ambient sensor and the No. 2 and 5 connector terminals of the airconditioner control unit and repair the wire if defective.

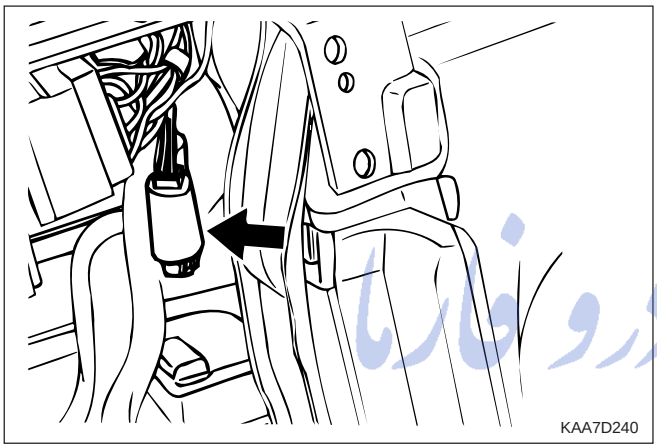
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Water Sensor

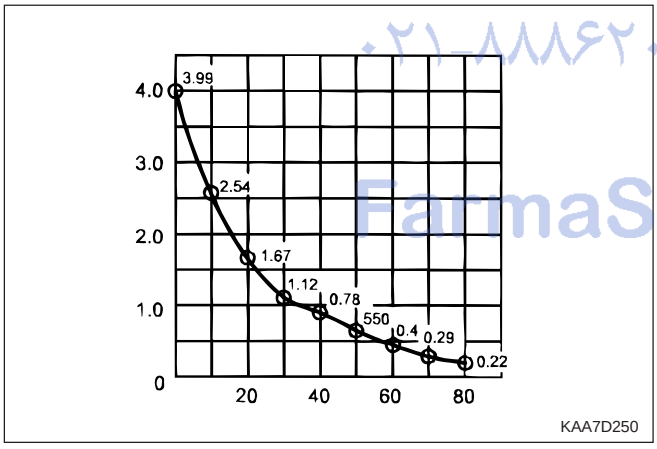
Water sensor is a thermistor that detects engine coolant temperature to operate the blower speed to LO when water temperature is less than 50.

1. Check that there are water sensor fault code (15,16) by using self-diagnosis function.



2. Disconnect water sensor 2-pin connector that installed on the heater unit of inner instrument panel and remove the water sensor.

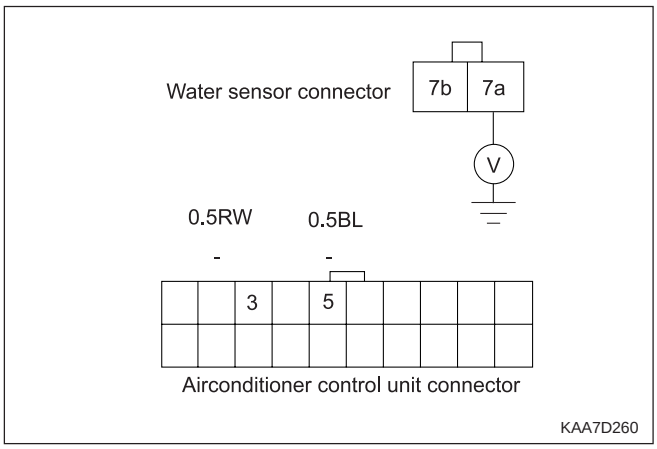
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۰۲۱-۸۸۸۶۲۰۸۵
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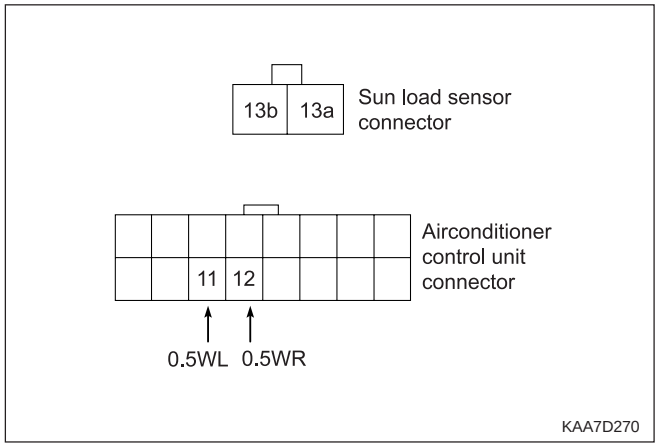
3. Check that measured resistance value among water sensor terminals is as shown in the right side graph.

   Notice: Measure resistance value by soaking the sensor in the ice water and check changes in resistance values after soaking it in the very hot water.

4. If resistance value is out of specification, replace the water sensor.



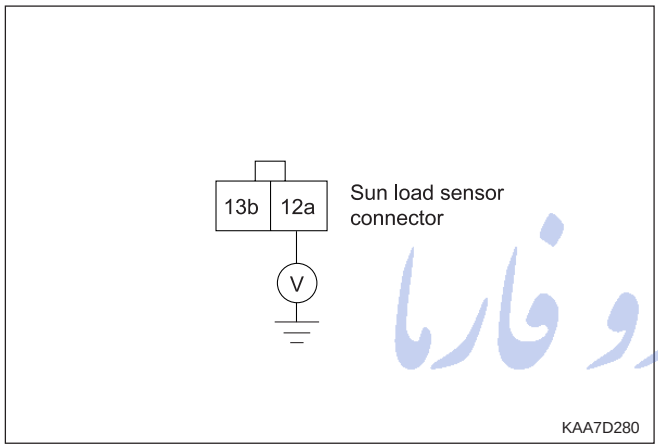
5. Install the sensor and turn the ignition switch to ON position and check that voltage between No. 7a terminal of the water sensor and body (-) is 5V.
6. Check current between the No. 7a and 7b connector terminals of the water sensor and the No. 3 and 5 connector terminals of the airconditioner control unit and repair the wire if defective.



Sun load Sensor

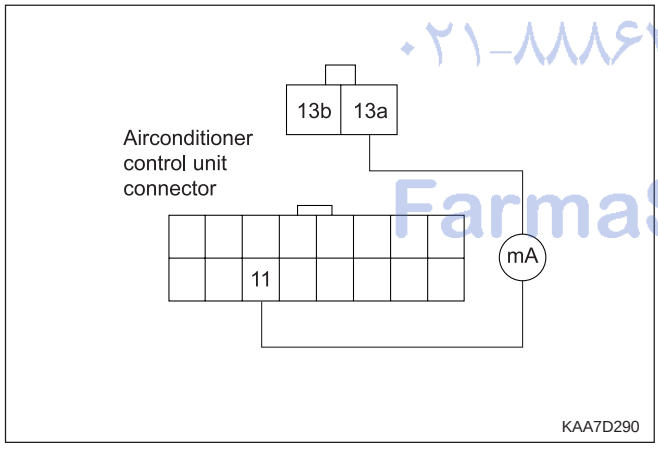
Sun load sensor is a photo diode that detects lights. Resistance of diode can be measured as current by using multimeter according to increasing sun loads.

1. Check current on the circuits between the sun load sensor and the airconditioner control unit.

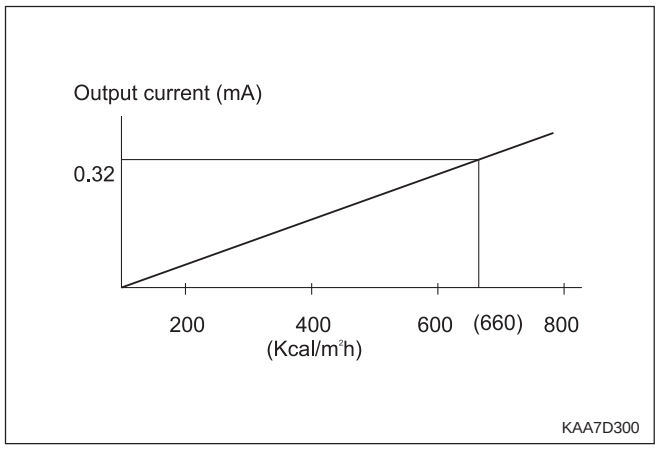


2. Turn the ignition switch to ON position and check that voltage between No. 13a terminal of the sun load sensor and vehicle ground is 5V.

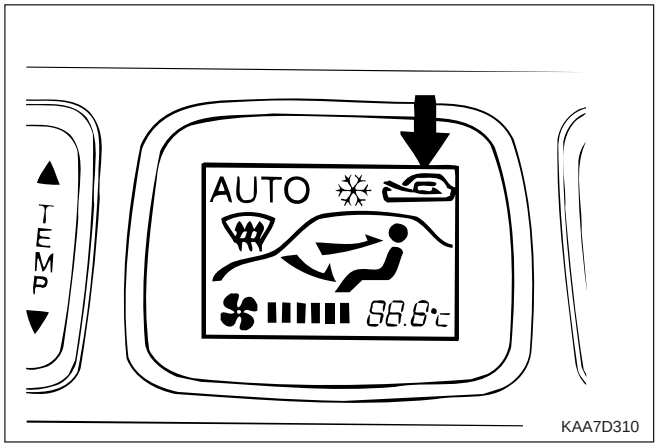
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۰۲۱-۸۸۸۶۲۰۸۵ FarmaSOS.com



3. Measure current between No. 13a terminal of the sun load sensor and No. 11 terminal of the control unit and check it is as shown in the below graph.
4. If current value is out of specification, replace the sun load sensor.



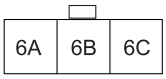
Fault : intake (recirculation/fresh air) door inoperative



Remove the glove box.

Disconnect 3-pin connector of the intake mode actuator and turn the ignition switch to ON position.

Measure voltage between 6c terminal positive pole (+) and body (-).



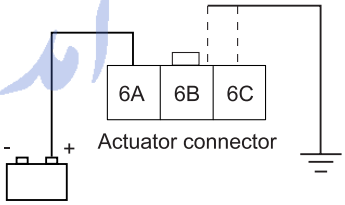
Wiring side connector

Measured voltage is 12V.

No → Check No. 24 fuse (15A) in the box.

Yes

Turn the ignitin switch OFF and disconnect harness of the intake actuator.



Check that it operates toward each direction after connecting the battery to the 6C terminal of intake actuator and ground 6A & 6B to the body.

Intake actuator is normal.

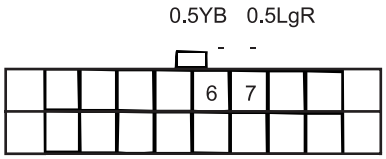
No → Repair and replace the intake actuator.

Yes

Disconnect 20-pin connector from the airconditioner control unit.

Check intake actuator linkage and door for proper operation and repair if necessary.

Check current between the intake actuator (6A, 6B) and the airconditioner control unit (6,7).



Is there current?

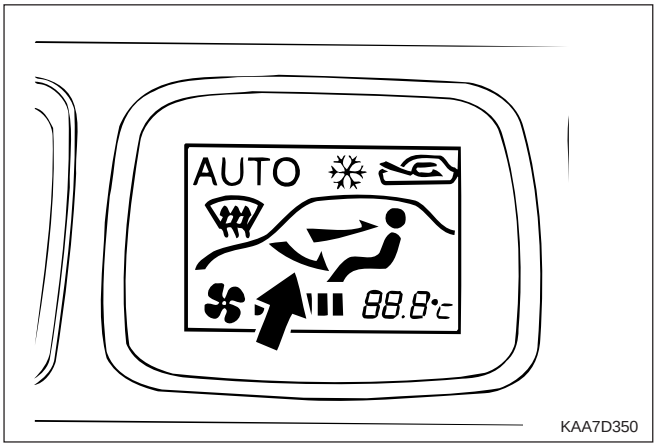
No → Repair open wire between the intake actuator and the control unit.

Yes

Replace the good control unit and re-check. If no fault, replace the control panel.

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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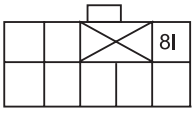
Fault : air flow does not change toward panel side.



Remove the center panel of the instrument panel.

Disconnect 8-pin connector of the mode actuator and turn the ignition switch to ON position.

Measure voltage between 8I terminal positive pole (+) and body (-).

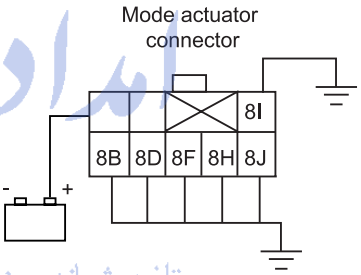


Wiring side connector

Measured voltage is 12V. — No → Check No. 24 fuse (15A) in the fuse box.

Yes

Turn the ignition switch OFF and disconnect harness of the mode actuator.



Check that it operates toward each directions when ground is connected to terminal (8J, 8H, 8F, 8D, 8B) of the mode actuator alternatively.

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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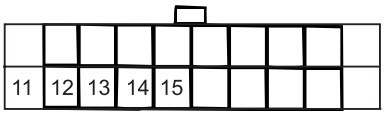
Mode actuator is normal. — No → Repair and replace the mode actuator.

Yes

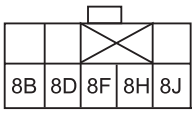
Check the intake actuator linkage and door for proper operation and repair if necessary.

Disconnect 20-pin connector from the airconditioner control unit.

Check current between the mode actuator (8J, 8H, 8F, 8D, 8B) and the airconditioner control unit (11, 12, 13, 14, 15).



Control unit connector



Mode actuator connector

Is there current? — No → Repair open wire between the mode actuator and the control unit.

Yes

Replace the good control unit and re-check. If no fault, replace the control panel.

SECTION 8A

SEAT BELTS

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must be in B unless otherwise noted.

TABLE OF CONTENTS

Description and Operation 8A-2

Driver Seat Belt Warning 8A-2

Three-Point Front Seat Belt With Pretensioner 8A-2

Three-Point Rear Outboard Seat Belt 8A-2

Two-Point Lap Rear Center Seat Belt 8A-2

Operational and Functional Checks 8A-2

Child Seat Tether Anchor 8A-2

Component Locator 8A-3

Front Seat Belt 8A-3

Rear Seat Belt 8A-4

Repair Procedures 8A-5

On-Vehicle Service 8A-5

Three-Point Front Seat Belt With Pretensioner 8A-5

Front Seat Belt Height Adjuster 8A-6

Three-Point Rear Outboard Seat Belt 8A-6

Two-Point Lap Rear Center Seat Belt 8A-7

Child Seat Tether Anchor 8A-7

Specifications 8A-8

Fastener Tightening Specifications 8A-8

Schematic and Routing Diagrams 8A-9

Seat Belt & Tension Reducer 8A-9

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DESCRIPTION AND OPERATION

DRIVER SEAT BELT WARNING

The driver's seat belt incorporates a seat belt warning lamp in the instrument cluster to remind the driver if the seat belt is not fastened when the ignition is turned ON. The warning lamp blinks for eight seconds with chime and goes out.

THREE-POINT FRONT SEAT BELT WITH PRETENSIONER

The front seat belt contains an electronically controlled pyrotechnic retractor, pretensioner, which reduces seat belt slack when it activated in a head-on or angled front collision. The front seat belt must be replaced after an accident that causes its activation. At normal condition the driver's seat belt operates as emergency locking retractor (ELR).

Emergency Locking Retractor (ELR)

The ELR seat belt is always unlocked, allowing the passenger freedom of movement, except in emergencies such as rapid deceleration, rapid acceleration, or hard cornering maneuvers.

THREE-POINT REAR OUTBOARD SEAT BELT

The rear outboard seating position uses the emergency locking retractor (ELR). Refer to Three-point front seat belt with pretensioner in this section for details.

TWO-POINT LAP REAR CENTER SEAT BELT

The two-point lap rear center seat belt is a single continuous length of webbing. The webbing is routed from the anchor through plate and into a single retractor.

OPERATIONAL AND FUNCTIONAL CHECKS

Caution:

- ***Keep sharp objects and potentially damaged ob jects away from seat belts.***
- ***Avoid bending or damaging any portion of buckle or the latch plate***
- ***Do not breach or dye the belt webbing. Use only mild soap and water in order to clean the belts.***
- ***When installing the seat belt anchor bolts and screws, start the bolts and screws by hand in order to prevent cross-threading.***
- ***Do not attempt any repairs on the retractor mechanisms or covers. Replace any defective assemblies with new assemblies.***
- ***Replace any belts that are cut or damaged in any way.***

1. Inspect all seat anchor bolts and screws in order to verify that they are secure.
2. Inspect the seat belt buckle. The buckle must lock and unlock easily.
3. After inserting the latch into the buckle, tug sharply on the belt. The buckle must remain locked.
4. Fully extend the shoulder belt portion to make sure that there is no twisting or tears in the belt.
5. Let the shoulder belt retract fully. The belt should retract easily.

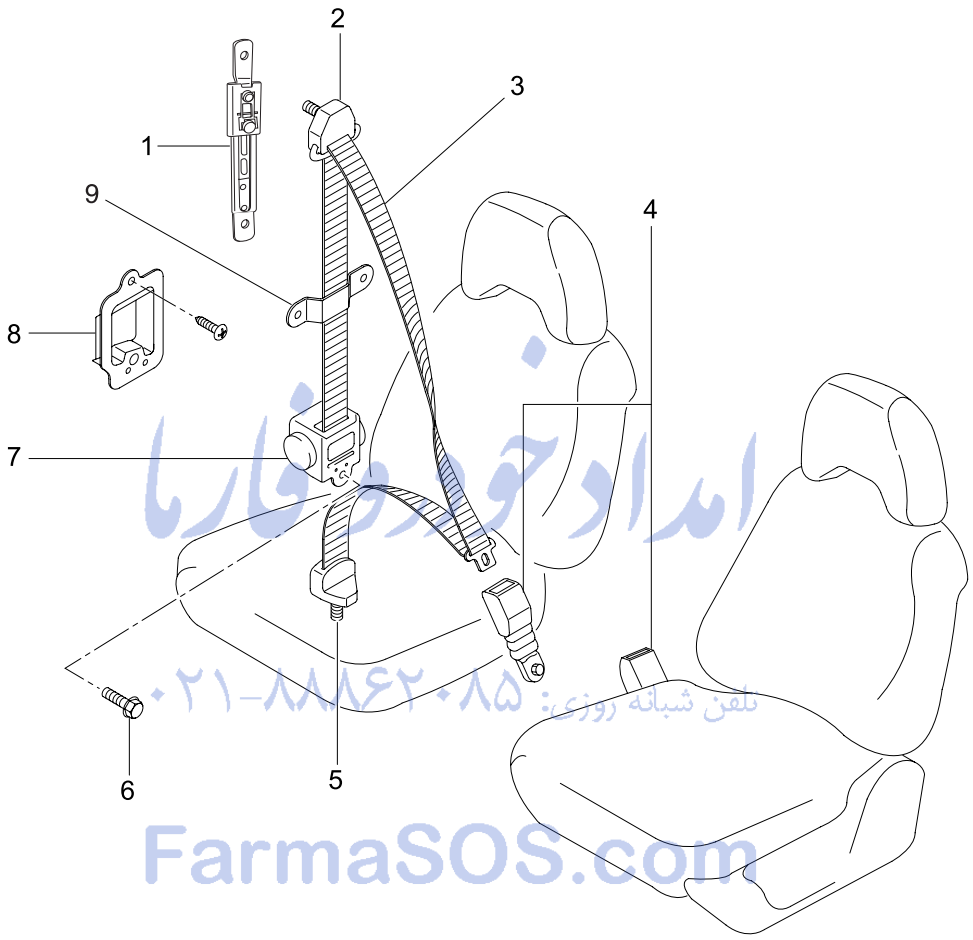
CHILD SEAT TETHER ANCHOR

There are three child seat tether anchors to hold the child seat firmly. One is located rear center of ceiling and two are located on the rear corner of floor.

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COMPONENTS LOCATOR

FRONT SEAT BELT

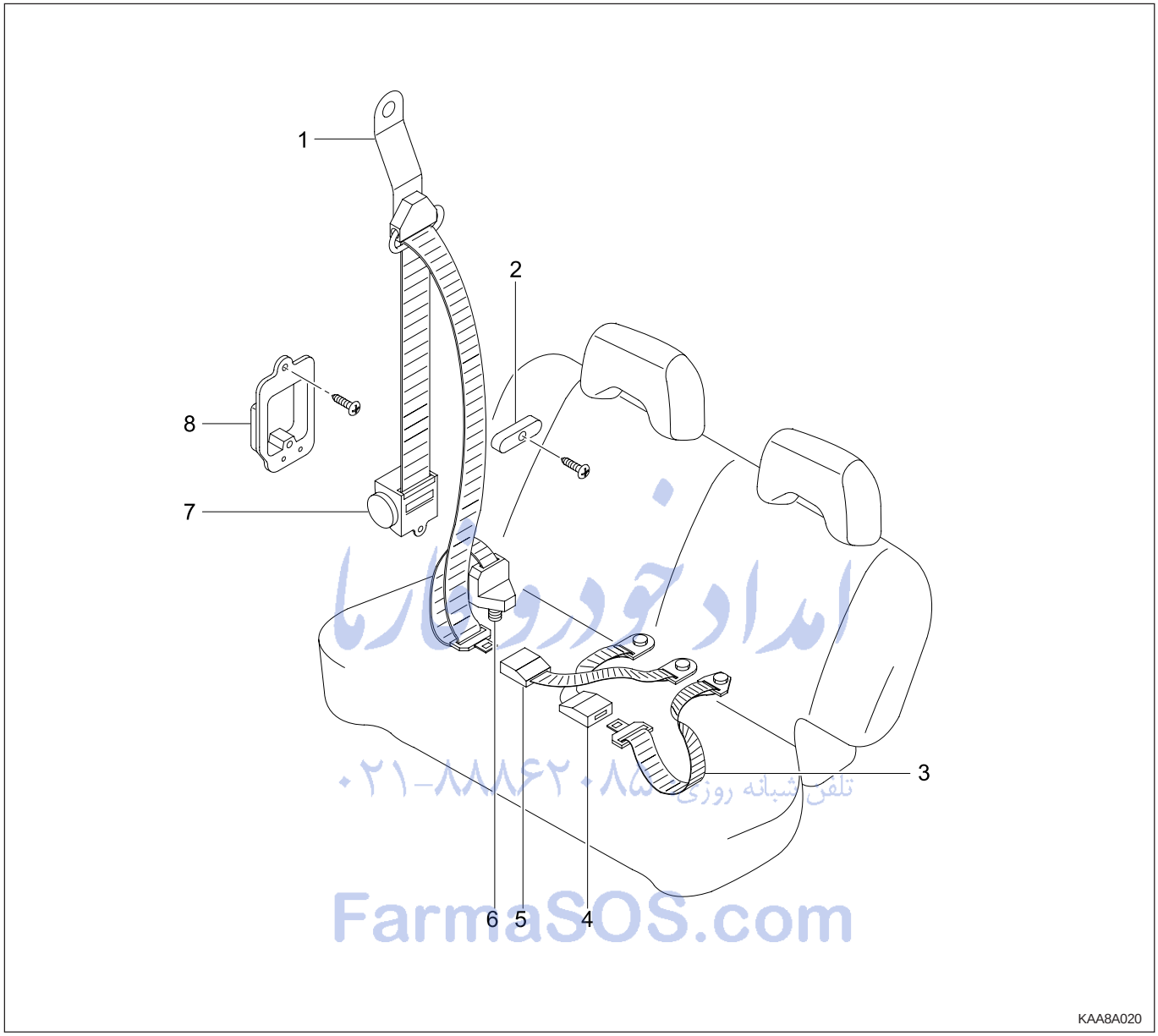


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1 Front Seat Belt Height Adjuster
2 Front Seat Belt Upper Anchor
3 Front Seat Belt With Pretensioner
4 Buckle Assembly
5 Front Seat Belt Lower Anchor
6 Seat Belt Retractor Bolt
7 Seat Belt Retractor With Pretensioner
8 Seat Belt Dust Cover and Screw
9 Seat Belt Webbing Guide

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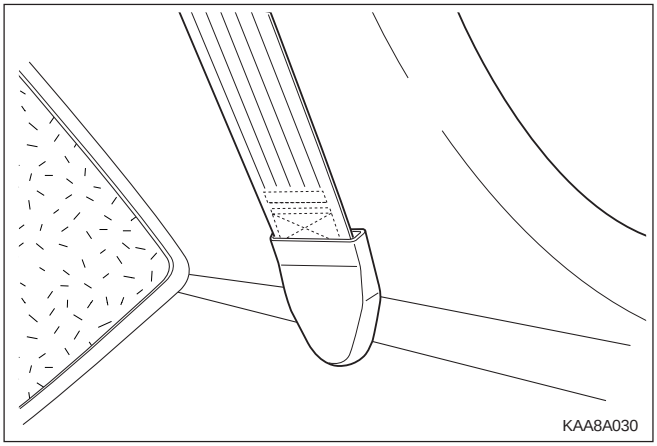
REAR SEAT BELT



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1 Rear Seat Belt Upper Anchor
2 Rear Seat Belt Webbing Hanger
3 Rear Center Seat Belt
4 Rear Center Seat Belt Buckle
5 Rear Seat Belt Buckle
6 Rear Seat Belt Lower Anchor
7 Rear Seat Belt Retractor
8 Rear Seat Belt Dust Cover

REPAIR PROCEDURES



ON-VEHICLE SERVICE

THREE-POINT FRONT SEAT BELT WITH PRETENSIONER

Caution: the sensing and diagnosis module (SDM) can maintain sufficient voltage to deploy the air-bags and pretensioner for 0.15 minutes after the ignition is OFF and the fuse has been removed. If the airbags or pretensioners are not disconnected, do not begin service until one minute has passed after disconnecting power to the SDM. Otherwise, injury could result.

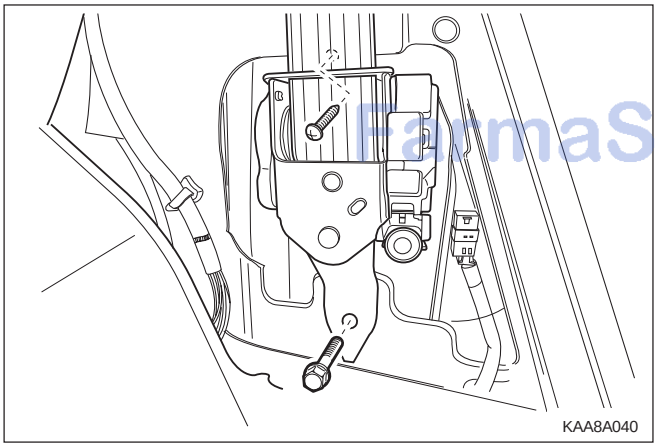
Removal and installation Procedure

1. Turn the ignition switch to LOCK and remove the key.
2. Remove the plastic cap to reveal the lower B-pillar seat belt anchor.
3. Remove the bolt and the lower B-pillar seat belt anchor.

Installation Notice

Tightening Torque	45 N•m (33 lb-ft)

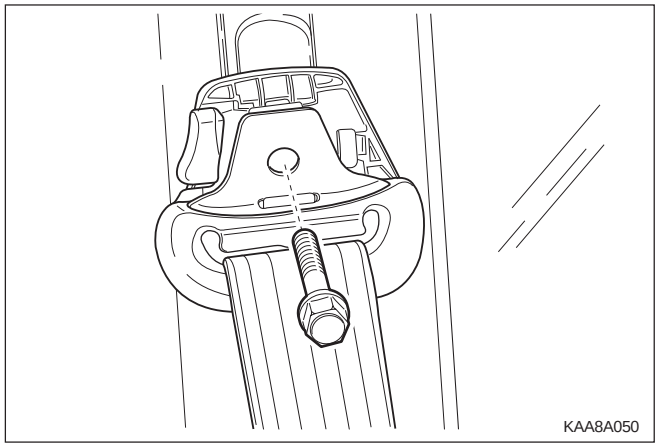
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4. Remove the lower quarter trim panel. Refer to *Section 9G, Interior Trim.*
5. Disconnect the pretensioner connector.
6. Remove the bolt, screw and the seat belt retractor (pretensioner).

Installation Notice

Tightening Torque	Bolt 45 N•m (33 lb-ft)

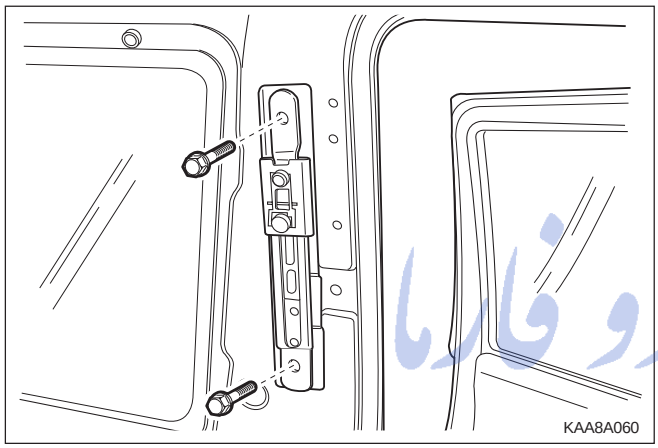

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7. Remove the plastic cap to reveal the upper B-pillar seat belt anchor.
8. Remove the bolt and B-pillar seat belt anchor.

Installation Notice

Tightening Torque	45 N•m (33 lb-ft)

9. Installation should follow the removal procedure in the reverse order.


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FRONT SEAT BELT HEIGHT ADJUSTER

Removal and installation Procedure

1. Remove the front seat belt upper B-pillar anchor bolt.

Installation Notice

Tightening Torque	45 N•m (33 lb-ft)

2. Remove the rear seat belt upper anchor bolt.

Installation Notice

Tightening Torque	45 N•m (33 lb-ft)

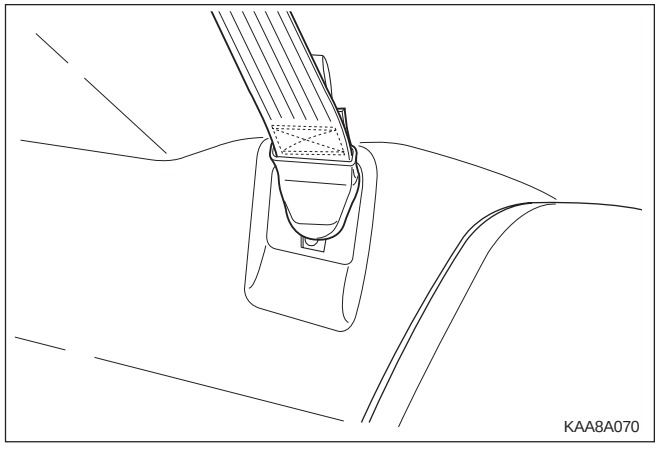
3. Remove the rear upper quarter trim panel. Refer to *Section 9G, Interior Trim.*
4. Remove the bolts and seat belt height adjuster.

Installation Notice

Tightening Torque	45 N•m (33 lb-ft)

5. Installation should follow the removal procedure in the reverse order.

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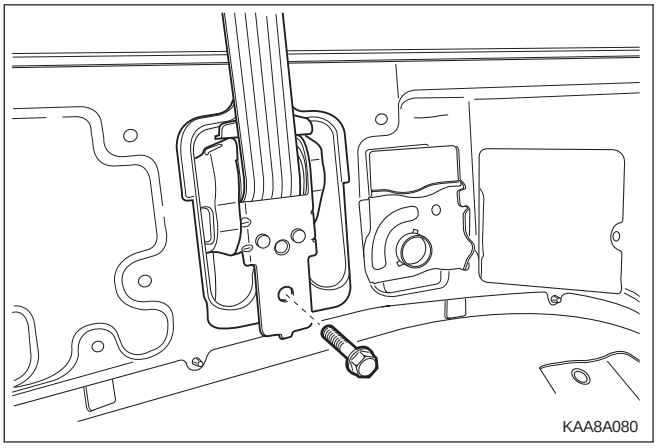
THREE-POINT REAR OUTBOARD SEAT BELT

Removal and installation Procedure

1. Remove the plastic cap to reveal the seat belt lower anchor bolt.
2. Remove the lower anchor bolt.

Installation Notice

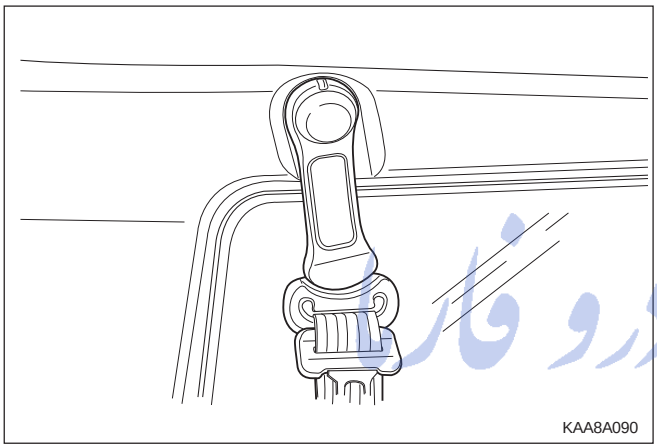
Tightening Torque	45 N•m (33 lb-ft)



3. Remove the lower quarter trim panel. Refer to *Section 9G Interior Trim*.
4. Remove the bolt, screw and seat belt retractor.

Installation Notice

Tightening Torque	Bolt 45 N•m (33 lb-ft)

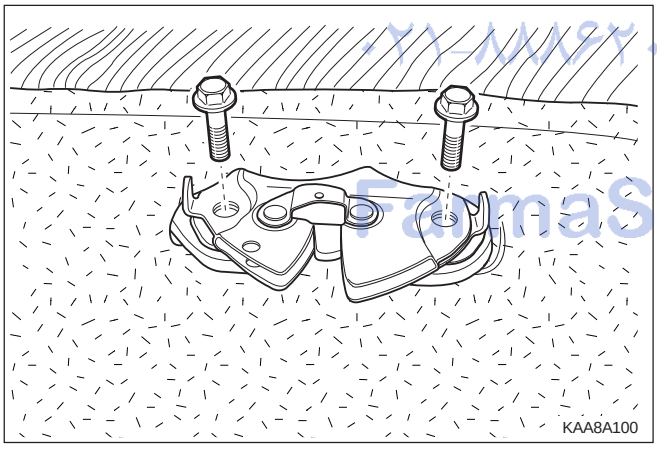


5. Remove the plastic cap to reveal the bolt.
6. Remove the upper anchor bolt.

Installation Notice

Tightening Torque	Bolt 45 N•m (33 lb-ft)

7. Installation should follow the removal procedure in the reverse order.



TWO-POINT LAP REAR CENTER SEAT BELT

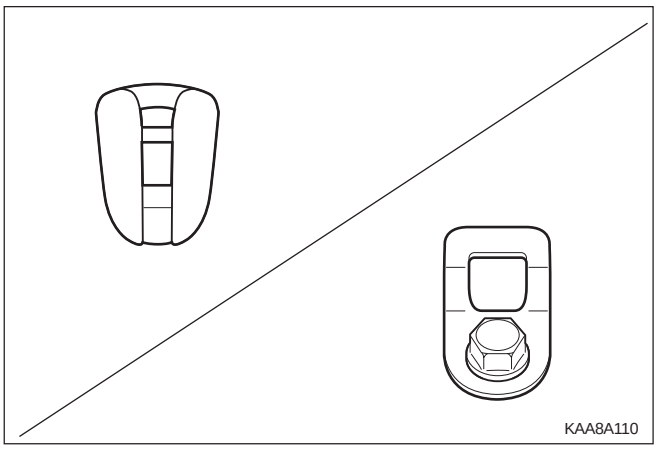
Removal and installation Procedure

1. Fold the rear seat cushion.
2. Remove the bolts and the seat belt anchors.

Installation Notice

Tightening Torque	Bolt 45 N•m (33 lb-ft)

3. Installation should follow the removal procedure in the reverse order.



CHILD SEAT TETHER ANCHOR

Removal and installation Procedure

1. Open the tether anchor access cap if equipped.
2. Remove the bolt and the tether anchor.

Installation Notice

Tightening Torque	Bolt 19 N•m (14 lb-ft)

3. Installation should follow the removal procedure in the reverse order.

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SPECIFICATIONS

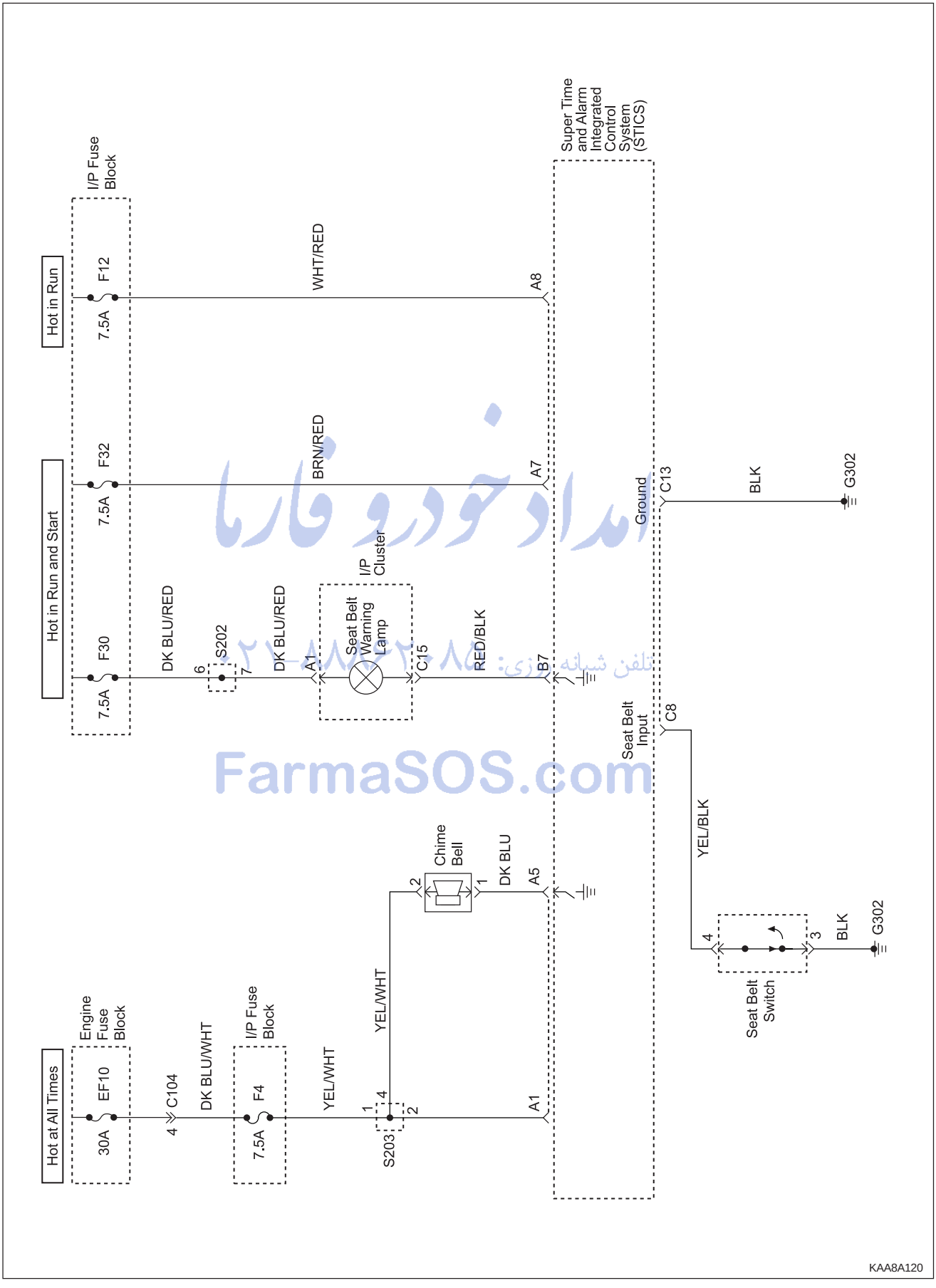
FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Child Seat Tether Anchor Bolt	19	14	-
Seat Belt Anchor Bolt	45	33	-
Seat Belt Height Adjuster Bolt	45	33	-
Seat Belt Retractor Bolt	45	33	-

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SCHEMATIC AND ROUTING DIAGRAM

SEAT BELT & TENSION REDUCER



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SECTION 8B

SUPPLEMENTAL RESTRAINTS SYSTEM

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless other-wise noted.

TABLE OF CONTENTS

Description and Operation 8B-3
- Supplemental Restraint System (SRS) 8B-3
- Airbag Modules 8B-3
- Front Seat Belt Pretensioners 8B-4
- Sensing and Diagnostic Module (SDM) 8B-4
- Airbag Warning Lamp 8B-5
- Clock Spring 8B-5
- Wiring Harness Connectors 8B-5

Components Locator 8B-6
- SRS Component and Wiring Location View 8B-6

Diagnostic Information and Procedures 8B-7
- Diagnostic Trouble Codes (DTC) 8B-7
- Scan Tool Diagnostics 8B-7
- Use of Special Tools 8B-7
- Diagnostic Trouble Code Table 8B-7
- SRS Diagnostic System Check 8B-10
- Sensing and Diagnostic Module (SDM) Integrity Check 8B-12
- Airbag Warning Lamp Stays on with Ignition Switch ON 8B-14
- DTCs - Internal Fault 8B-16
- DTCs 01 Driver Deployment Loop Shorted to Voltage 8B-18
- DTC 02 Passenger Deployment Loop Shorted to Voltage 8B-20
- DTC 03 Driver Seat Belt Pretensioner Shorted to Voltage 8B-22
- DTC 04 Passenger Seat Belt Pretensioner Shorted to Voltage 8B-24
- DTC 05 Driver Deployment Loop Shorted to Ground 8B-26
- DTC 06 Passenger Deployment Loop Shorted to Ground 8B-28
- DTC 07 Driver Seat Belt Pretensioner Shorted to Ground 8B-30
- DTC 08 Passenger Seat Belt Pretensioner Shorted to Ground 8B-32
- DTC 17 Driver Deployment Loop Resistance High 8B-34
- DTC 18 Passenger Deployment Loop Resistance High 8B-38
- DTC 19 Driver Seat Belt Pretensioner Deployment Loop resistance High 8B-40
- DTC 20 Passenger Seat Belt Pretensioner Deployment Loop Resistance High 8B-42
- DTC 21 Driver Airbag Deployment Loop Resistance Low 8B-44
- DTC 22 Passenger Airbag Deployment Loop Resistance Low 8B-48
- DTC 23 Driver Seat Belt Pretensioner Deployment Loop resistance Low 8B-50
- DTC 24 Passenger Seat Belt Pretensioner Deployment Loop Resistance Low 8B-52
- DTC 46 Airbag Warning Lamp Circuit Open or Short to Ground/Battery 8B-54
- DTC 47 Battery Voltage is Out of Specification 8B-56

Repair Instruction 8B-58

On-Vehicle Service 8B-58
- Service Precaution 8B-58
- Disabling the Supplemental Restraint System (SRS) 8B-58
- Enabling the Supplemental Restraint System (SRS) 8B-58
- Handling, Installation and Diagnosis 8B-58
- Repairs and Inspections Required After an Accident 8B-58
- Accident with Deployment - Components Replacement 8B-58
- Accident without Deployment - Component Inspection 8B-59

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تلفن تماس: ۸۸۸۶۲۰۸۵-۰۲۱
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Sensing and Diagnostic Module (SDM) 8B-59
Driver Airbag Module 8B-60
Clock Spring 8B-61
Passenger Airbag Module 8B-62
Front Seat Belt Pretensioner 8B-62
Airbag Module Deployment (In Vehicle) 8B-63
Airbag Module Deployment (Outside of Vehicle) 8B-65
Deployed Airbag Module Disposal Procedure 8B-66
SRS Wiring Repair 8B-66
Specifications 8B-67
General Specification 8B-67
Fastener Tightening Specifications 8B-67
Schematic and Wiring Diagrams 8B-68
Supplemental Restraint System 8B-68
Supplemental Restraint System Schematic Diagram 8B-69

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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DESCRIPTION AND OPERATION

SUPPLEMENTAL RESTRAINT SYSTEM (SRS)

The supplemental restraint system (SRS) is safety device used in conjunction with the seat belts.

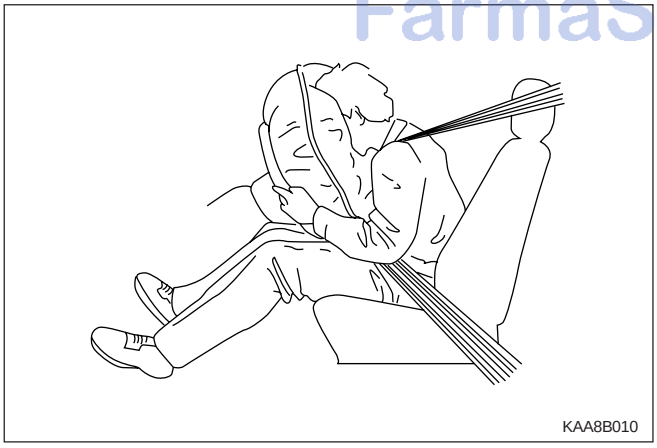
The air bag does not replace the function of the seatbelt. The driver and the passengers must always fasten their seat belts adjust them for a proper fit.

The SRS is designed to protect the driver and the front seat passenger in the event of a significant frontal impact to the vehicle. The airbags deploy if the force is applied from a direction within about 30 degrees of the vehicle's centerline.

The SRS system consists of the following components:

- Driver side airbag module.
- Passenger airbag module.
- Driver's and passengers front seat belt pretensioners.
- Sensing and diagnostic module (SDM).
- Clock spring.
- Wire harness and connectors.
- Airbag warning lamp on the instrument cluster.

There are there are for separate four separate deployment loops in the SRS system. The term "loop" is used because current leaves the SDM and returns to the SDM during deployment or testing. First loop is the circuit from SDM to the driver airbag and back to the SDM. Second loop is the circuit from the SDM to the passenger airbag and back to the SDM. The third and forth loops are for right and left pretensioners.



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System Control

The sensing and diagnostic module (SDM) continuously monitors and controls the supplemental restraint system (SRS) function during ignition ON or driving. When SDM detects any problem it turns on or blink the airbag warning lamp and keeps the diagnostic trouble codes (DTCs). If there is a danger of improper deployment, the system will enter overall or partial shutdown status and the airbag will not inflate. The Diagnostic System Check reveals diagnostic trouble codes (DTCs) through the use of scan tool. It also checks for proper airbag warning lamp operation.

Battery Voltage Check

The SDM checks the battery voltage continuously and if the voltage is out of normal operating range (9-16 volts), all system diagnosis stops and turns on the warning warning lamp.

Deployment Line Check

The SDM checks not only low or high resistance in the deployment loop but also short to battery or ground condition to indicates defects in deployment loop. It indicates the defects by blinking the airbag warning warning lamp.

Safety Function Check

The SDM checks the operation of arming sensor. If the arming sensor is shorted more than 2 seconds, the SDM will enter overall shutdown mode.

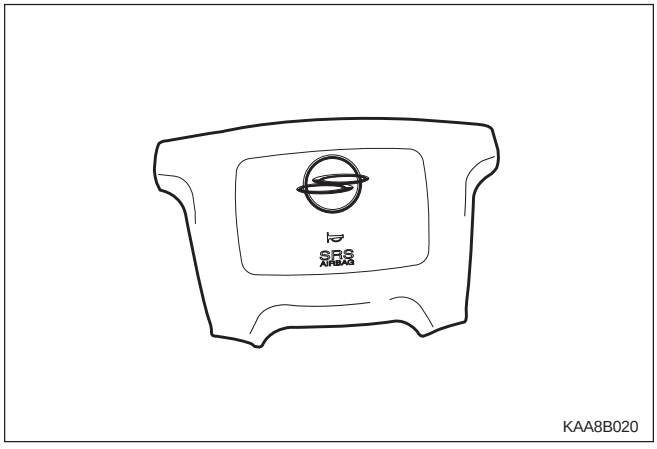
AIRBAG MODULES

Driver Airbag Module

Caution: Tampering with driver side airbag module creates the risk of an injury from unexpected deployment. Therefore, the passenger airbag module should never be disassembled.

The passenger airbag module is under the center pad of the steering wheel. The driver airbag module contains an igniter charge and a gas generator to inflate the folded airbag.

The airbag contains a shorting bar, which short-circuit the driver high circuit to driver low circuit when the connector is disconnected. The shorting bar prevents current from traveling through the driver airbag module during servicing. The shorting bar is disengaged when the connector is connected.



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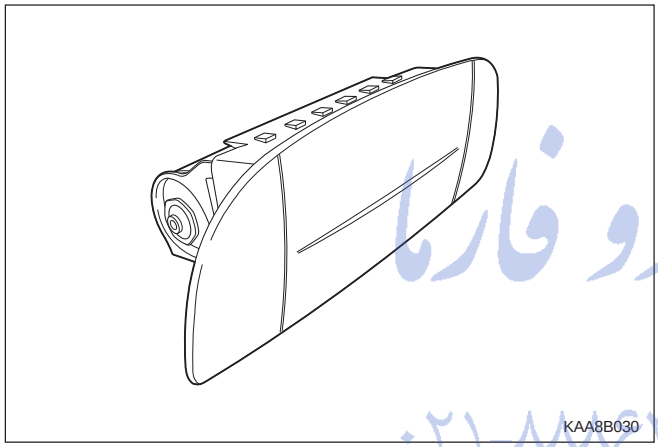
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Passenger Airbag Module

Caution: Tampering with passenger airbag module creates the risk of an injury from unexpected deployment. Therefore, the passenger airbag module should never be disassembled.

The passenger airbag module is on the passenger of the instrument panel. The passenger airbag module contains an igniter charge and a gas generator to inflate the folded airbag.

The airbag contains a shorting bar, which short-circuit the passenger high circuit to passenger low circuit when the connector is disconnected. The shorting bar prevents current from traveling through the passenger airbag module during servicing. The shorting bar is disengaged when the connector is connected.


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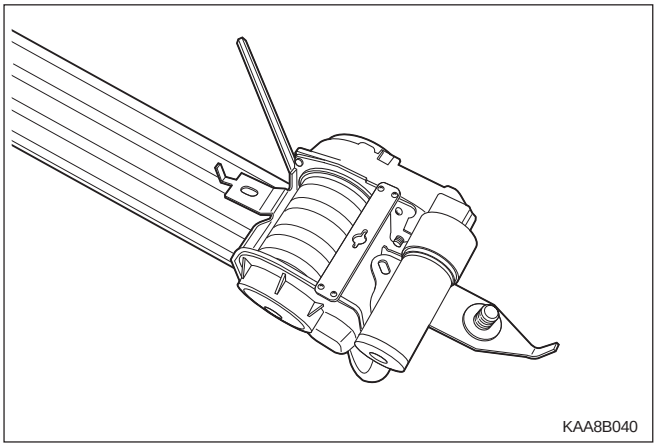
FRONT SEAT BELT PRETENSIONERS

Caution: Tampering with seat belt pretensioner creates the risk of an injury from unexpected deployment. Therefore, the seat belt pretensioner should never be disassembled.

The seat belt pretensioners are assembled with each front seat belt retractor to retract the seat belt webbing when accounted a frontal collision. The seat belt pretentioners are controlled by sensing and diagnostic Module (SDM).

The seat belt pretensioner contains an igniter charge and a gas generator to pull the seat belt webbing. The seat belt pretensioner must be replaced after an accident that causes its activation.

The seat belt pretensioner also contains a shorting bar to prevent current from traveling through the seat belt pretensioner during servicing. The shorting bar is disengaged when the connector is connected.


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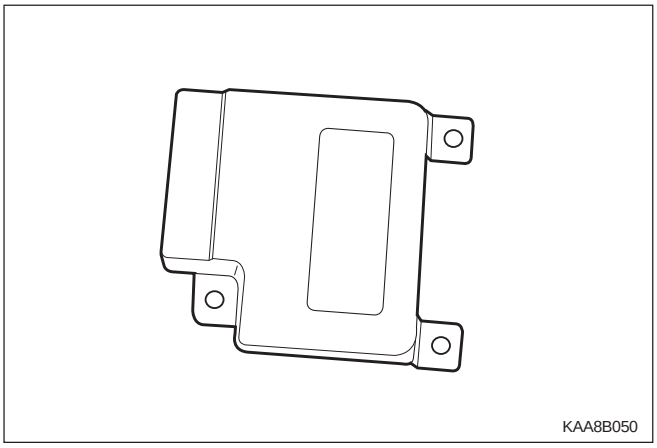
SENSING AND DIAGNOSTIC MODULE (SDM)

Caution: During the service procedures, be careful when handling the SDM. Never shake or jar the SDM. Never apply power to SRS when the SDM is not rigidly attached to the vehicle. All SDM mounting nuts and grounding nut must be fully tightened. Failures to follow these precautions could cause deployment and results in personal injury.

The SDM located on floor beneath the instrument panel. The SDM performs the following functions:

- Monitors the supplemental restraint system (SRS) electrical components and sets a diagnostic trouble code (DTC) when malfunction is detected.
- Displays SRS diagnostic trouble codes and system status information when connected to a scan tool.
- Illuminates the airbag indicator to alert the driver to any fault.
- Provides a reserve power source to deploy the airbags and pretensioners if an accident has disabled the normal power source.
- Monitors vehicle velocity changes to detect frontal impacts, which are severe enough to warrant deployment.
- Causes current to flow through the airbag modules and pretensioner to cause deployment if a frontal impact of sufficient force is detected.

The SDM contains no user-serviceable parts.

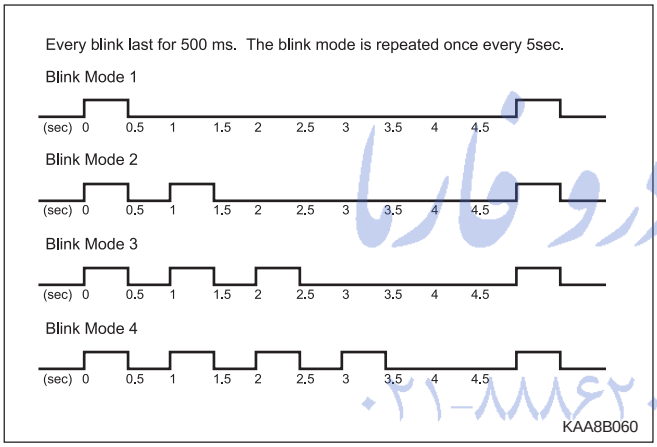

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AIRBAG WARNING LAMP

The instrument cluster contains an airbag warning indicator bulb to verify the operation of the airbag indicator and sensing and diagnostic module (SDM). The SDM performs a start-up test when the ignition is turned ON and turns the airbag indicator on for 4.5 seconds by supplying an internal ground to the indicator lamp circuit. After 4.5 seconds, the airbag indicator will turn off if no more malfunctions have been detected.

If the SDM has detected malfunctions, which could potentially affect the operation of the supplemental restraint system (SRS) it turns on or blinks the airbag warning indicator. The airbag indicator stays on for the malfunction of internal system and blinks for external circuit problem such as short to battery or ground. The airbag indicator blinks four different modes according to the fault.



Some malfunctions could result in non-deployment when necessary or deployment under conditions which would no normally result in deployment.

When the SDM is not properly attached to its connector the airbag circuit is shorted to ground because there is a shorting bar within the SDM electronic connector. The shorting bar is disengaged when proper connection is made, but if a poor connection exists the SDM connector supplies a ground to the airbag indicator in dependently of the SDM, and the airbag indicator turns on.

CLOCK SPRING

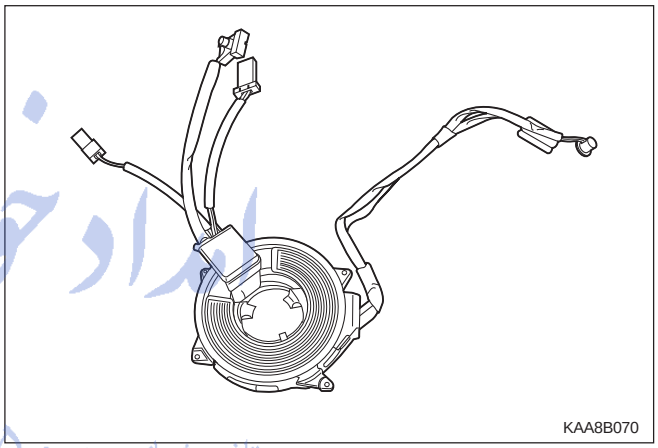
Caution: Disassembling the clock spring can cause injury or cause the clock spring to malfunction.

Caution: Over-rotating the clock spring without the steering wheel in position could damage the clock spring and result in an inoperative driver airbag.

There is a coil assembly in the steering which is referred to as a clock spring because of its internal resemblance to the type of spring used in a mechanical clock. The clock spring should never be disassembled, and there is no timekeeping function. The clock spring contains current- carrying coils. One of the current-carrying coils maintains continuous contact within the driver deployment loop while the steering wheel is rotated. The clock spring also contains coils that maintain continuous contact for horn and remote audio control switch.

Turning the steering wheel in one direction tightens the coil, and turning the steering wheel in the opposite direction loosens the coil. Do not turn the clock spring when the steering wheel is not attached.

A yellow two-way connector on the lower steering column is attached to the clock spring wiring.



WIRING HARNESS CONNECTORS

If the sensing and diagnostic module (SDM) electrical connector is not attached properly, a built in shorting bar will connect the wire from airbag warning lamp with the SDM ground wire. This turns on the airbag indicator.

To prevent deployment during servicing, additional shorting bars are located in following locations:

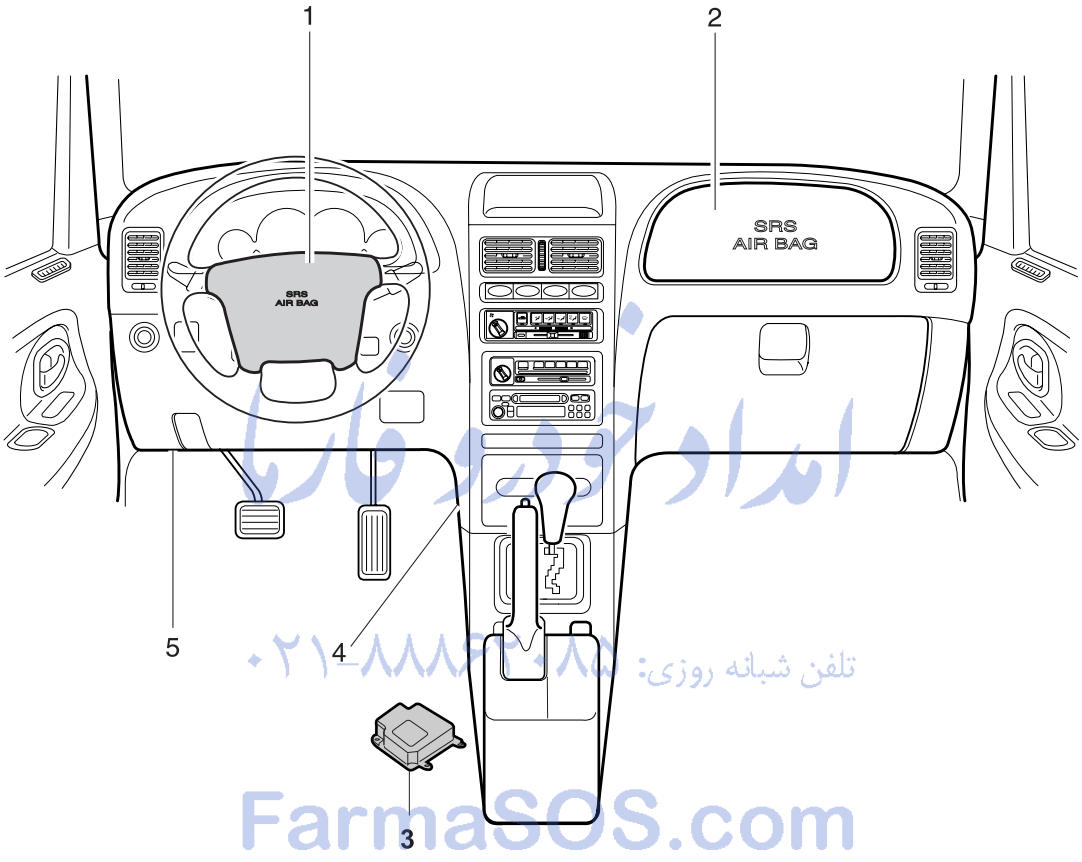
- The clock spring electrical connector at the lower steering column.
- The passenger airbag module.
- The driver airbag module.
- The seat belt pretensioners.
- The SDM connector.

The shorting bar is only a backup safety device. Always disable the supplemental restraints system (SRS) before beginning any service procedure.

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COMPONENTS LOCATOR

SRS COMPONENT AND WIRING LOCATION VIEW



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1 Driver Airbag Module & Clock Spring
2 Passenger Airbag Module
3 Sensing And Diagnostic Module (SDM)
4 Data Link Connector (DLC)
5 Pretensioner (at A Pillar)

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC TROUBLE CODES (DTC)

When the sensing and diagnosticmodule (SDM) detects any problem it illuminates or blinks the airbag warning indicator and keeps the diagnostic trouble codes (DTCs). The supplemental restraint system (SRS) Diagnostic System Check must always be the starting point for any SRS diagnosis. The SRS Diagnostic System Check reveals DTCs through the use of scan tool. It also checks for proper airbag warning lamp operation.

The two types of DTCs that may be recorded are as follows:

1. Current DTCs represent malfunction currently being detected. Current DTCs are stored in random access memory (RAM).
2. Historic DTCs represent malfunctions detected since the last time the historic memory was cleared. Historic DTCs are stored in the electrically erasable programmable read-only memory (EEPROM).

The DTC is differentiates internal and external faults upon the cause of the defects. Internal faults can not be cured, replace the SDM. Refer to “Diagnostic Trouble Code Table” in this section.

SCAN TOOL DIAGNOSTICS

A scan tool can read serial data from terminal 9 of the data link connector (DLC). The scan tool is used to read diagnostic trouble codes (DTCs), and to clear some DTCs after a repair is completed. By design, certain codes cannot be cleared.

To use the scan tool, turn the ignition OFF, connect the scan tool to the DLC, and turn the ignition switch to ON. Follow the instructions in the scan tool manual. The SDM sends serial data from terminal 20 of the SDM to terminal 9 of the DLC.

USE OF SPECIAL TOOLS

Use a scan tool to read and clear diagnostic trouble codes (DTCs). A connector adapter kit provides jumper wires and terminal adapters to make it easier to test small terminals. In diagnostic testing, use load tool or dummy resistance to substitute for airbag modules.

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DIAGNOSTIC TROUBLE CODE TABLE

DTC	Description	Type of the Faults	Error Handing	Airbag Warning Indicator Blink Mode
01	Driver Deployment Loop Shorted to Voltage		Partial Shutdown	3
02	Passenger Deployment Loop Shorted to Voltage			3
03	Driver Seat Belt Pretensioner Shorted to Voltage			4
04	Passenger Seat Belt Pretensioner Shorted to Voltage			4
05	Driver Deployment Loop Shorted to Ground			3
06	Passenger Deployment Loop Shorted to Ground			3
07	Driver Seat Belt Pretensioner Shorted to Ground			4
08	Passenger Seat Belt Pretensioner Shorted to Ground			4
09	Driver Energy Shutdown Switch Error	Internal		
10	Passenger Energy Shutdown Switch Error	Internal		
11	Driver Seat Belt Pretensioner Energy Shutdown Switch Error	Internal		
12	Passenger Seat Belt Pretensioner Energy Shutdown Switch Error	Internal		
13	Driver Ignition Switch Fault Internal	Internal		
14	Passenger Ignition Switch Fault Internal	Internal		
15	Driver Seat Belt Pretensioner Ignition Switch Fault	Internal		
16	Passenger Seat Belt Pretensioner Ignition Switch Fault	Internal		

Diagnostic Trouble Code Table (Cont'd)

DTC	Description	Type of the Faults	Error Handing	Airbag Warning Indicator Blink Mode
17	Driver Deployment Loop Resistance High		Partial Shutdown	1
18	Passenger Deployment Loop Resistance High			2
19	Driver Seat Belt Pretensioner Deployment Loop Resistance High			4
20	Passenger Seat Belt Pretensioner Deployment Loop Resistance High			4
21	Driver Deployment Loop Resistance Low			1
22	Passenger Deployment Loop Resistance Low			2
23	Driver Seat Belt Pretensioner Deployment Loop Resistance Low			4
24	Passenger Seat Belt Pretensioner Deployment Loop Resistance Low			4
25	Driver Deployment Loop Energy Reserve Voltage	Internal		
26	Passenger Deployment Loop Energy Reserve Voltage	Internal		
27	Driver Seat Belt Pretensioner Deployment Loop Energy Reserve Voltage	Internal		
28	Passenger Seat Belt Pretensioner Deployment Loop Energy Reserve Voltage	Internal		
29	System Energy Reserve Voltage	Internal		
30	Safety Energy Reserve Capacitor Voltage	Internal		
31	Driver Deployment Loop Energy Reserve Current off Capacity	Internal		
32	Passenger Deployment Loop Energy Reserve Current off Capacity	Internal		
33	Driver Seat Belt Pretensioner Deployment Loop Energy Reserve Current off Capacity	Internal		
34	Passenger Seat Belt Pretensioner Deployment Loop Energy Reserve Current off Capacity	Internal		
35	5th Energy Reserve Current off Capacity	Internal		
36	Condenser Voltage	Internal	Total Shutdown	
37	Collision Times Checksum	Internal		
38	Accelerometer Error	Internal		
39	Accelerometer Off-Set Error	Internal		
40	Arming Sensor Shorted	Internal		
41	Major Upper Side Application Specific Integrated Circuit	Internal		
42	Application Specific Integrated Circuit Over Heat	Internal		
43	Micro Control Unit Error	Internal		
44	Standard Band Gap	Internal		
45	Temperature Sensor	Internal		
46	Warning Lamp circuit open or short to ground/battery			

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Diagnostic Trouble Code Table (Cont'd)

DTC	Description	Type of the Faults	Error Handing	Airbag Warning Indicator Blink Mode
47	Battery Voltage is out of specification		Total Shutdown	
49	Fault Code List	Internal		
50	Upper Side Application Specific Integrated Circuit Communication	Internal	Additional Error Code	
51	Lower Side Application Specific Integrated Circuit Communication	Internal		
52	No Electronically Erasable Programmable Read Only Memory (EEPROM) Program Error	Internal		
53	Electronically Erasable Programmable Read Only Memory (EEPROM) Checksum Error	Internal		
54	Electronically Erasable Programmable Read Only Memory (EEPROM) Map Error	Internal		
55	External Watchdog 1 Internal	Internal		
56	Arming Sensor No Close Internal	Internal		
57	Random Access Memory (RAM) Check Internal	Internal		
58	System Internal	Internal		
59	External Watchdog 2 Internal	Internal		
60	Pulse Internal	Internal		
127	Collision Signal Internal	Internal		
128	Collision Number Internal	Internal		

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SRS DIAGNOSTIC SYSTEM CHECK

Notice: If the vehicle interior has been exposed to extensive water intrusion such as water leaks, driving through high water, flooding, or other caucuses, the sensing and diagnostic module (SDM) and SDM connector may be need to be replaced. With ignition OFF, inspect the area around the SDM, including the carpet. If any significant soaking or evidence of previous soaking is detected, the water must be removed, water damage repaired, and the SDM and SDM connector must be replaced. Before attempting any of these repairs, the supplemental restraint system (SRS) must be disabled. Refer to “Disabling the SRS” and “Sensing and Diagnostic Module (SDM)” in this section.

The SRS Diagnostic System Check must always be the starting point for any SRS system diagnosis. The SRS Diagnostic System Check reveals diagnostic trouble codes (DTCs) through the use of scan tool.

The diagnostic procedures used in this section are designed to find and repair SRS conditions. To get the best results, it is important to use the diagnostic charts and follow the sequence listed below.

1. Perform the SRS Diagnostic System Check, which reveals diagnostic trouble codes (DTCs) through the use of scan tool. It also checks for proper airbag indicator operation.
2. Refer to the proper diagnostic chart as directed by SRS Diagnostic System Check. Bypassing these procedures may result in extended diagnostic time, incorrect diagnosis, and incorrect parts replacement.
3. Repeat the SRS Diagnostic System Check after any repair or diagnostic procedures have been performed to ensure that the repair has beenmade correctly and that no other malfunction exists.

Circuit Description

When the ignitions witch is first turned to ON, ignition voltage is supplied from airbag fuse to the SDM at input terminal 5. The SDM responds by turning on the airbag indicator for 4.5 seconds and then turning it off while the SDM performs tests on the SRS system.

Diagnostic Aids

The order in which DTCs are diagnosed is very important. Failure to diagnose the DTCs in the order specified may result in extended diagnostic time, incorrect diagnosis, and incorrect parts replacement.

Test Description

The numbers below refer to steps on the diagnostic table.

2. This test differentiates between an indicator that will not come on and an indicator that stays on when it should be off.
3. Refer to the first caution below
5. This test, along with step 6, differentiates internal or external faults of SDM.
9. Refer to the cautions below.

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SRS Diagnostic System Check

Caution: the sensing and diagnosis module (SDM) can maintain sufficient voltage to deploy the airbags and pretensioners for 0.15 seconds after the ignition is OFF and the fuse has been removed. If the airbags or pretensioners are not disconnected, do not begin service until one minute has passed after disconnecting power to the SDM. Otherwise, injury could result.

Caution: During service procedure, be very careful when handling the SDM. Never strike or jar the SDM. Never power the supplemental restraints system (SRS) when the SDM is not rigidly attached to the vehicle. Also SDM mounting nuts must be carefully tightened to ensure proper operation of the SRS. The SDM could be activated if it is powered when it is not rigidly attached to the vehicle, resulting in unexpected deployment and possible injury.

Step	Action	Value	Yes	No
1	1. Turn the ignition switch to ON. 2. Observe the airbag indicator as the ignition is being turned ON. Does the indicator turn on for 4.5 seconds and go out?	-	Go to Step 5	Go to Step 2
2	Observe the airbag indicator after the ignition has been turned ON. Does the airbag indicator stay on?	-	Go to "Airbag Warning Lamp Stays on with Ignition Switch ON"	Go to Step 3
3	1. Turn the ignition to LOCK and remove the key. 2. Disconnect the sensing and diagnostic module (SDM) connector. 3. Check the airbag indicator bulb and circuit. Are the bulb and bulb circuit in good condition?	-	Go to Step 9	Go to Step 4
4	1. Replace the bulb or repair the bulb circuit. 2. Connect SDM connector and ensure that all components are properly mounted. Is the repair complete?	-	Go to Step 1	-
5	Observe the airbag indicator after 4.5 seconds. Does the indicator turn on again and stay?	-	Go to Step 8	Go to Step 6
6	Observe the airbag indicator after 4.5 seconds. Does the indicator blink?	-	Go to Step 7	System OK
7	1. Turn the ignition to LOCK and remove the key. 2. Connect the scan tool to the data link connector (DLC). Follow the directions given in the scan tool manual. 3. Turn the ignition to ON. 4. Request SRS DTC display with the scan tool. Are any SRS DTCs displayed? Check the bulb circuit for improper connections.	-	Refer to the DTC chart for any DTC that was set or internal fault.	-
8	Is the repair complete? 1. Turn the ignition to LOCK and remove the key.	-	System OK	Go to Step 9
9	2. Disconnect the SDM connector. 3. Replace the SDM. 4. Reconnect SDM connector and ensure that all components are properly mounted. Is the repair complete?	-	Go to Step 1	-

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SENSING AND DIAGNOSTIC MODULE (SDM) INTEGRITY CHECK

The following diagnostic chart must be used when all circuitry outside the sensing and diagnostic module (SDM) has been found to operate properly, as indicated by following the appropriate diagnostic trouble code (DTC) chart. The chart verifies the need for SDM replacement.

Circuit Description

When the SDM recognizes ignition voltage greater then 9 volts at terminal 5 of the SDM, the airbag indicator is turns on for 4.5 seconds to verify operation. At this time the SDM performs start-up tests followed by resistance measurement tests and continues monitoring tests. When malfunction is detected, the SDM sets a current DTC and illuminates or blinks the airbag indicator. When the malfunction is no longer detected and/or the ignition switch is cycled, the SDM will clear current DTCs and move them to a history file, except for the DTCs 18, 24, 51, 53 and sometimes 71. DTCs 18, 24, 51 and 53 will not clear using a scan tool because these codes require replacement of SDM. The SDM must be replaced only after the malfunction that set the DTC has been repaired.

Diagnostic Aids

The order in which DTCs are diagnosed is very important. Failure to diagnose the DTCs in the order specified may result in extended diagnostic time, incorrect diagnosis, and incorrect parts replacement.

Test Description

The numbers below refer to steps on the diagnostic table.

1. This test confirms a current malfunction. If no current malefaction is occurring, refer to “Diagnostic Aids” for the appropriate DTC. The SDM should not be replaced for a historic DTC except when directed.
2. This test checks for a malfunction introduced into the supplemental restraints system (SRS) during the diagnostic procedure. It is extremely unlikely that a malfunctioning SDM would cause a new malfunction to occur during the diagnostic process.
4. See the caution below.

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Sensing and Diagnostic Module (SDM) Integrity Check

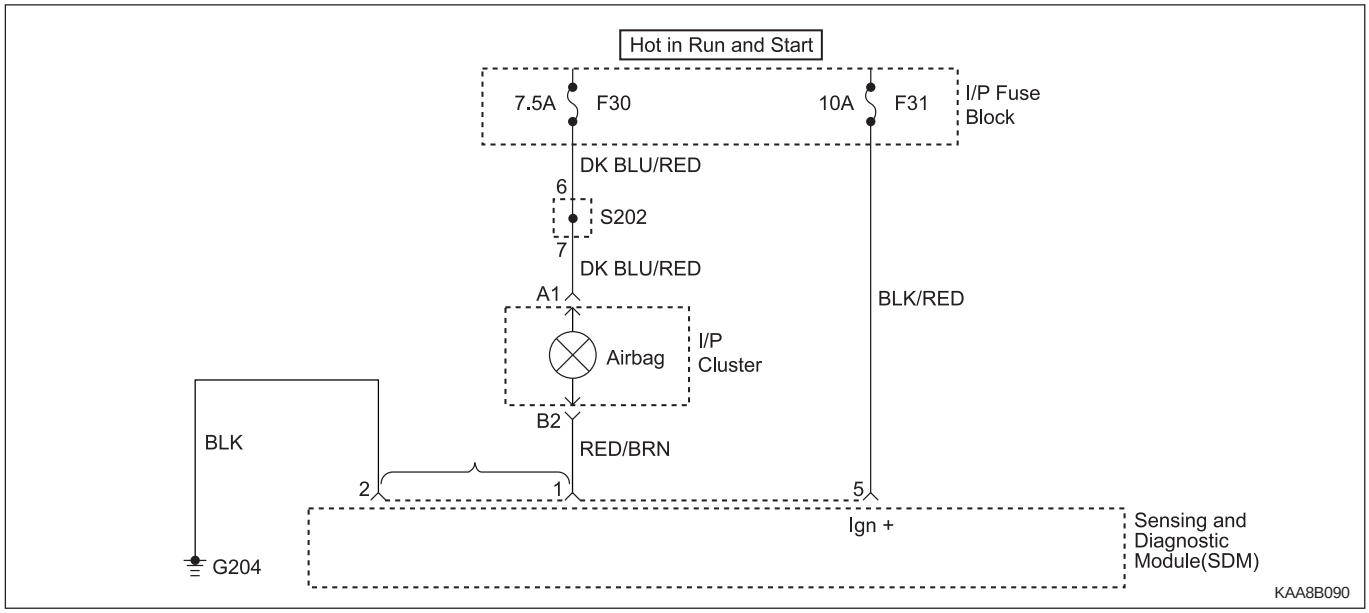
Caution: The sensing and diagnosis module (SDM) can maintain sufficient voltage to deploy the airbags and pretensioners for 0.15 seconds after the ignition is OFF and the fuse has been removed. If the airbags or pretensioners are not disconnected, do not begin service until one minute has passed after disconnecting power to the SDM. Otherwise, injury could result.

Caution: During service procedure, be very careful when handling the SDM. Never strike or jar the SDM. Never power the supplemental restraints system (SRS) when the SDM is not rigidly attached to the vehicle. Also SDM mounting nuts must be carefully tightened to ensure proper operation of the SRS operation. The SDM could be activated if it is powered when it is not rigidly attached to the vehicle, resulting in unexpected deployment and possible injury.

Step	Action	Value	Yes	No
1	1. Turn the ignition to LOCK and remove the key. 2. Connect all SRS components, and ensure that all components are properly mounted. 3. Ensure that the ignition switch has been off for at least 30 seconds. 4. Observe the airbag indicator as the ignition is turned ON. Does the indicator lamp turn on for 4.5 seconds and then turn off?	-	Chear the SRS DTCs and go to “Diagnostic system Check”	Go to Step 2
2	1. Turn the ignition to LOCK and remove the key. 2. Connect the scan tool to DLC. Follow the directions given in the scan tool manual. 3. Turn the ignition to ON. 4. Request SRS DTC display with the scan tool. Is the same DTC displayed that was previously occurring when the SRS Diagnostic System Check was previously performed?	-	Go to Step 3	Go to table for the DTC indicated

Step	Action	Value	Yes	No
3	1. Clear SRS DTCs. 2. Turn the ignition OFF for at least 30 seconds. 3. Observe the airbag indicator as the ignition is turned ON. Does the airbag indicator turn on for 4.5 seconds and turn off?	-	System OK	Go to Step 4
4	1. Turn the ignition to LOCK and remove the key. 2. Disconnect the SDM connector. 3. Replace the SDM. 4. Connect SDM connector and ensure that all components are properly mounted. Is the repair complete?	-	Go to “Diagnostic System Check”	-

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AIRBAG WARNING LAMP STAYS ON WITH IGNITION SWITCH ON

Circuit Description

The airbag indicator will stay on if the sensing and diagnostic module (SDM) connector is not securely attached to the SDM. There is a shorting bar in SDM connector which completes the circuit between the indicator lamp circuit and ground. The shorting bar is disengaged when the connector is properly attached. When the ignition switch is first turned to ON, ignition voltage applied to the instrument use for the indicator lamp and also to the airbag fuse for input terminal 5. If ignition voltage is outside the range of 9 to 16 volts, the airbag indicator will come on and stay on and DTC47 will set.

Test Description

The numbers below refer to steps on the diagnostic table.

8. See the caution below.

Airbag Warning Lamp Stays on with Ignition Switch ON

Caution: The sensing and diagnosis module (SDM) can maintain sufficient voltage to deploy the airbags and pretensioners for 0.15 seconds after the ignition is OFF and the fuse has been removed. If the airbags or pretensioners are not disconnected, do not begin service until one minute has passed after disconnecting power to the SDM. Otherwise, injury could result.

Step	Action	Value	Yes	No
1	Check the SDM connector to verify that it is properly connected to the SDM. Is the SDM connector properly connected?	-	Go to Step 3	Go to Step 2
2	Connect the SDM connector. Is the repair complete?	-	System OK	-
3	1. Turn the ignition OFF. 2. Disconnect the SDM connector. 3. Turn the ignition ON. 4. Check the voltage at SDM connector terminal 5. Is the ignition voltage greater than the specified value?	9 v	Go to “SDM Integrity Check”	Go to Step 4
4	1. Turn the ignition ON. 2. Check the voltage supply to the airbag fuse F31. Is the voltage within the specified value?	9 - 16 v	Go to Step 6	Go to Step 4

Step	Action	Value	Yes	No
5	Repair the power supply to the airbag fuse. Is the repair complete?	-	System OK	-
6	Check the airbag fuse. Is the fuse in good condition?	-	Go to Step 8	Go to Step 7
7	Replace the airbag fuse F31. Is the repair complete?	-	System OK	-
8	1. Turn the ignition to LOCK and remove the key. 2. Disconnect the SDM connector. 3. Check for open circuit between terminal 5 of the SDM and the airbag fuse F31. Is there an open circuit?	-	Go to Step 9	Go to Step 10
9	Repair the open circuit between the SDM and airbag fuse F31. Is the repair complete?	-	System OK	-
10	Repair the short to ground circuit between the airbag indicator lamp and terminal 1 of the SDM. Is the repair complete?	-	System OK	-

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DIAGNOSTIC TROUBLE CODES (DTCS) - INTERNAL FAULT

Circuit Description

When the ignition switch is turned to ON, the sensing and diagnostic module (SDM) will perform tests to diagnose critical malfunctions within SDM itself. Internal fault DTC will set when any of the malfunctions detected by SDM itself. Refer to “Diagnostic Trouble Code Table” in this section.

Action Taken

The SDM will turn on the airbag indicator and set diagnostic trouble code.

The SDM will shutdown its function partially or totally.

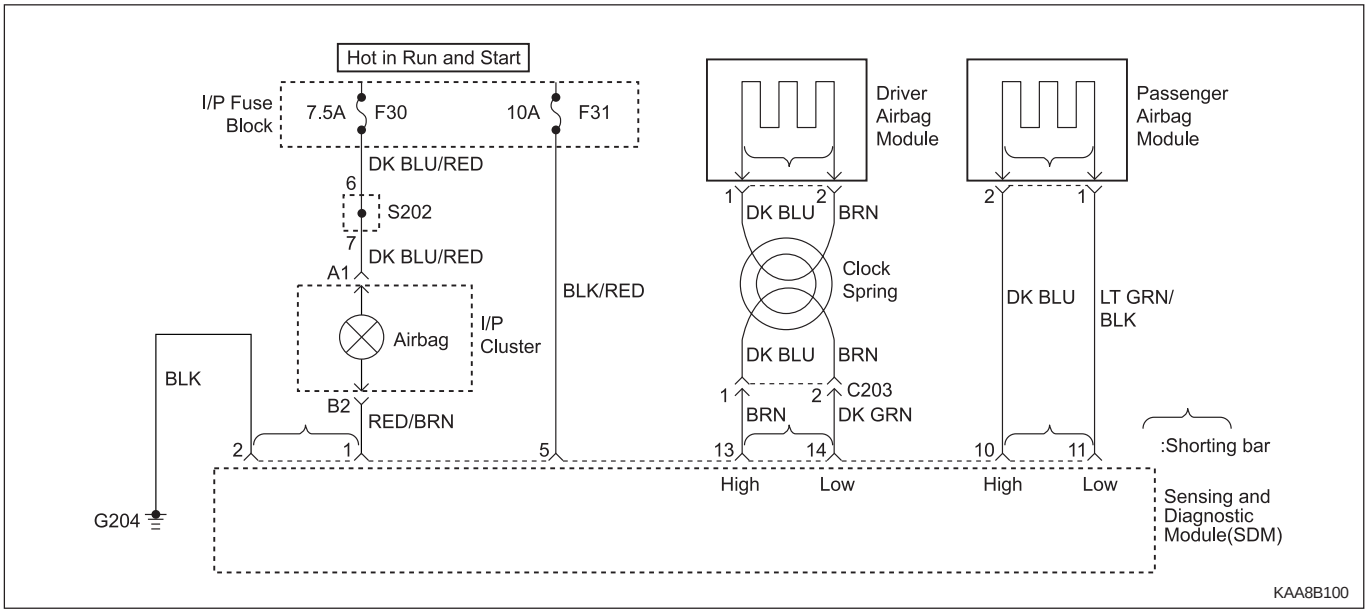
Diagnostic Trouble Code (DTC) - Internal Fault

Caution: The sensing and diagnosis module (SDM) can maintain sufficient voltage to deploy the airbags and pretensioners for 0.15 seconds after the ignition is OFF and the fuse has been removed. If the airbags or pretensioners are not disconnected, do not begin service until one minute has passed after disconnecting power to the SDM. Otherwise, injury could result.

Caution: During service procedure, be very careful when handling the SDM. Never strike or jar the SDM. Never power the supplemental restraints system (SRS) when the SDM is not rigidly attached to the vehicle. Also SDM mounting nuts must be carefully tightened to ensure proper operation of the SRS. The SDM could be activated if it is powered when it is not rigidly attached to the vehicle, resulting in unexpected deployment and possible injury.

Step	Action	Value	Yes	No
1	Perform the SRS Diagnostic System Check. Is the SRS Diagnostic System Check complete?	-	Go to Step 2	-
2	Check for any DTCs that is not internal fault. Is there any DTCs that set except internal DTC?		Go to specific DTC chart.	Go to Step 2
3	1. Disable the supplemental restraint system (SRS) in this section. 2. Replace SDM. 3. Enable the SRS. 4. Make sure all the components are properly mounted. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-

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DIAGNOSTIC TROUBLE CODE (DTC) 01 DRIVER DEPLOYMENT LOOP SHORTED TO VOLTAGE

Circuit Description

When the ignition switch is turned to ON, the sensing and diagnostic module (SDM) will perform tests to diagnose critical malfunctions within SDM itself. Upon passing these tests ignition and deployment loop voltages are measured to ensure that they are within their respective normal voltage ranges. The SDM monitors the voltages at the driver low (terminal 14), passenger low (terminal 11), driver seat belt pretensioner low (terminal 7) and passenger seat belt pretensioner low (terminal 4) to detect short to voltage in the deployment loops.

DTC 01 Will Set When

DTC 01 will set when the driver low is above 5 volts for 250 milliseconds while the other deployment loop low is below 5 volts and ignition voltage is within the normal operating voltage range.

This test is run during start-up test and every 250 milliseconds during continuous monitoring.

Action Taken

The SDM will turn on the airbag indicator (blink mode 3) and set DTC 01. The SDM will shutdown deployment loop of driver airbag module.

DTC 01 Will Clear When

The scan tool CLEAR CODES command is received.

Diagnostic Aids

Carefully inspect the wires in driver airbag deployment loop for cutting or chafing.

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DTC 01 - Driver Deployment Loop Shorted to Voltage

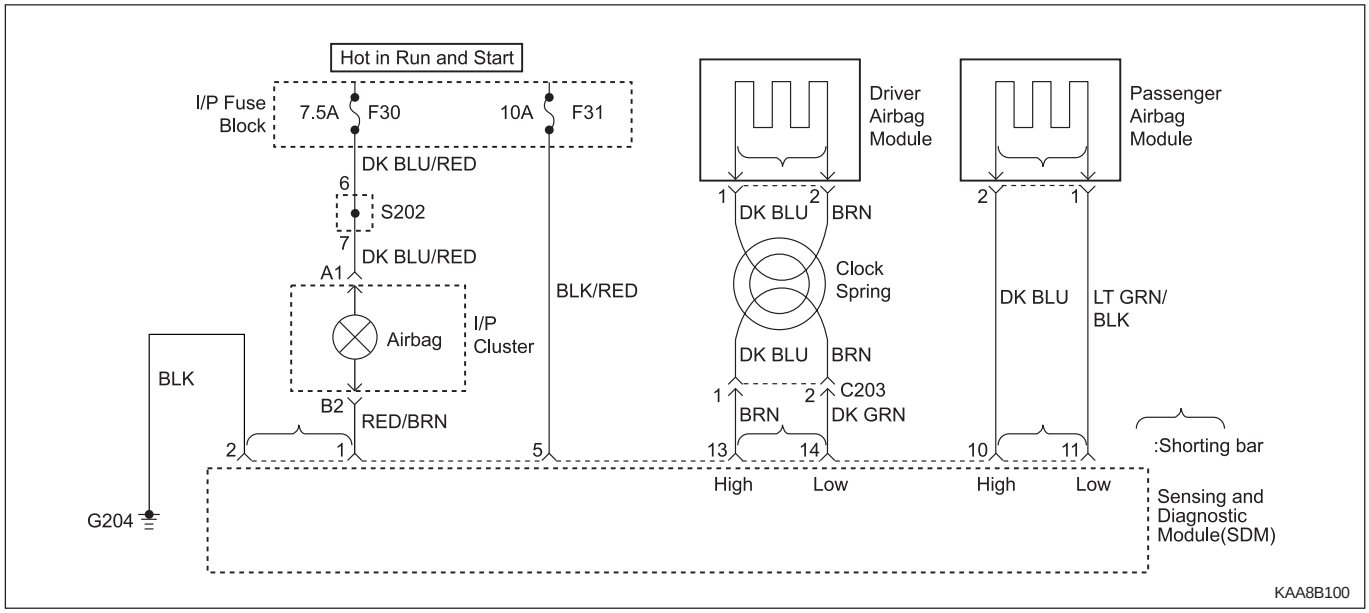
Caution: The sensing and diagnosis module (SDM) can maintain sufficient voltage to deploy the airbags and pretensioners for 0.15 seconds after the ignition is OFF and the fuse has been removed. If the airbags or pretensioners are not disconnected, do not begin service until one minute has passed after disconnecting power to the SDM. Otherwise, injury could result.

Caution: During service procedure, be very careful when handling the SDM. Never strike or jar the SDM. Never power the supplemental restraints system (SRS) when the SDM is not rigidly attached to the vehicle. Also SDM mounting nuts must be carefully tightened to ensure proper operation of the SRS. The SDM could be activated if it is powered when it is not rigidly attached to the vehicle, resulting in unexpected deployment and possible injury.

Step	Action	Value(s)	Yes	No
1	Perform the SRS Diagnostic System Check. Is the SRS Diagnostic System Check complete?	-	Go to Step 2	-

Step	Action	Value(s)	Yes	No
2	1. Disable the Supplemental Restraint System (SRS). Refer to “Disabling the Supplemental Restraint System (SRS)” in this section. 2. Virtually inspect the driver airbag circuit and connectors, especially at the SDM. Is there any evidence of rubbing, damage or chafing?	-	Go to Step 3	Go to Step 4
3	1. Repair the damaged wires or connectors. 2. Connect all the SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
4	1. Disconnect the SDM connector. 2. Disconnect driver airbag. 3. Turn the ignition ON. 4. Measure the voltage between terminal 1 (or 2) of the driver airbag connector and ground. Is the voltage within the specified value?	≈ 0 v	Go to Step 8	Go to Step 5
5	1. Disconnect C203. 2. Measure the voltage between terminal 1 (or 2) of the driver airbag connector and ground. Is the voltage within the specified value?	≈ 0 v	Go to Step 7	Go to Step 6
6	1. Repair short to voltage in clock spring or replace the clock spring as needed. 2. Connect all SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
7	1. Repair short to voltage between SDM and C203. 2. Connect all SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
8	1. Connect dummy resistance (2.15 ± 0.35 Ω) to driver airbag connector instead of driver airbag. 2. Enable the SRS. 3. Connect the scan tool to the data link connector (DLC). 4. Clear DTC and request DTC. Is the DTC 01 still present?	-	Go to Step 10	Go to Step 9
9	Replace driver airbag. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
10	1. Replace SDM. 2. Connect all SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-

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DIAGNOSTIC TROUBLE CODE (DTC) 02 PASSENGER DEPLOYMENT LOOP SHORTED TO VOLTAGE

Circuit Description

When the ignition switch is turned to ON, the sensing and diagnostic module (SDM) will perform tests to diagnose critical malfunctions within SDM itself. Upon passing these tests ignition and deployment loop voltages are measured to ensure that they are within their respective normal voltage ranges. The SDM monitors the voltages at the driver low (terminal 14), passenger low (terminal 11), driver seat belt pretensioner low (terminal 7) and passenger seat belt pretensioner low (terminal 4) to detect short to voltage in the deployment loops.

DTC 02 Will Set When

DTC 02 will set when the driver low is above 5 volts for 250 milliseconds while the other deployment loop low is below 5 volts and ignition voltage is within the normal operating voltage range. This test is run during start-up test and every 250 milliseconds during continuous monitoring.

Action Taken

The SDM will turn on the airbag indicator (blink mode 3) and set DTC 02. The SDM will shutdown the passenger airbag deployment loop.

DTC 02 Will Clear When

The scan tool CLEAR CODES command is received.

Diagnostic Aids

Carefully inspect the wires in passenger airbag deployment loop for cutting or chafing.

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DTC 02 - Passenger Deployment Loop Shorted to Voltage

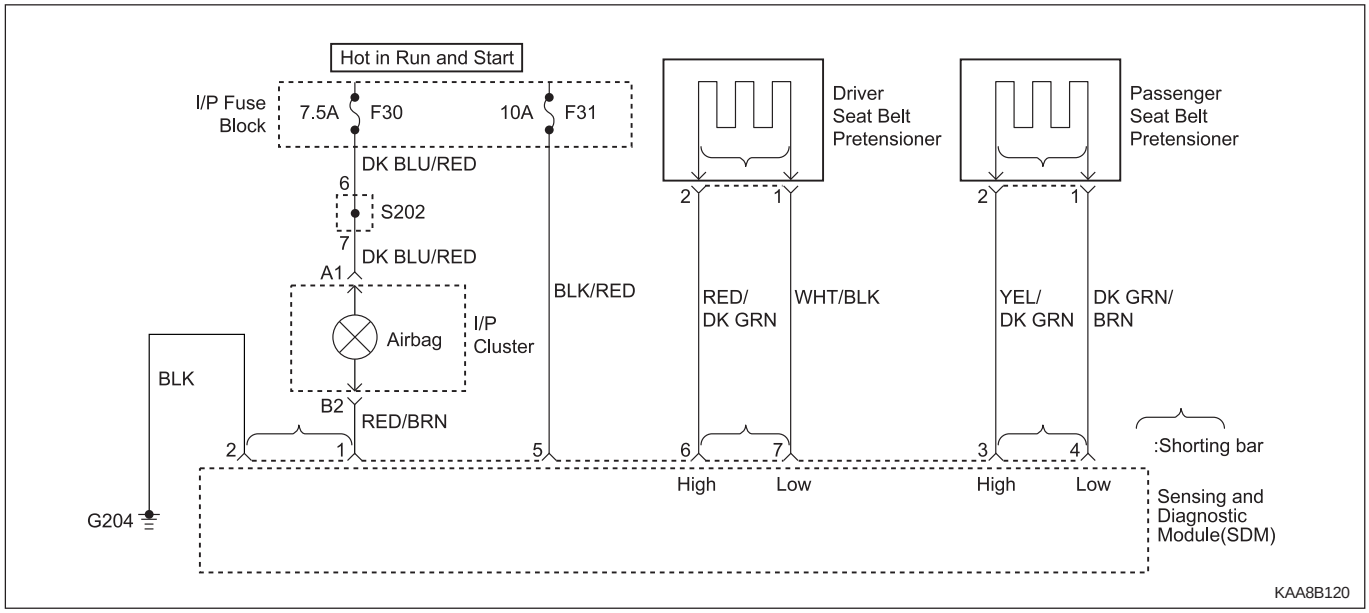
Caution: The sensing and diagnosis module (SDM) can maintain sufficient voltage to deploy the airbags and pretensioners for 0.15 seconds after the ignition is OFF and the fuse has been removed. If the airbags or pretensioners are not disconnected, do not begin service until one minute has passed after disconnecting power to the SDM. Otherwise, injury could result.

Caution: During service procedure, be very careful when handling the SDM. Never strike or jar the SDM. Never power the supplemental restraints system (SRS) when the SDM is not rigidly attached to the vehicle. Also SDM mounting nuts must be carefully tightened to ensure proper operation of the SRS. The SDM could be activated if it is powered when it is not rigidly attached to the vehicle, resulting in unexpected deployment and possible injury.

Step	Action	Value(s)	Yes	No
1	Perform the SRS Diagnostic System Check. Is the SRS Diagnostic System Check complete?	-	Go to Step 2	-

Step	Action	Value(s)	Yes	No
2	1. Disable the Supplemental Restraint System (SRS). Refer to “Disabling the Supplemental Restraint System (SRS)” in this section. 2. Virtually inspect the passenger airbag circuit and connectors, especially at the SDM. Is there any evidence of rubbing, damage or chafing?	-	Go to Step 3	Go to Step 4
3	1. Repair the damaged wires or connectors. 2. Connect all the SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
4	1. Disconnect the SDM connector. 2. Disconnect passenger airbag. 3. Turn the ignition ON. 4. Measure the voltage between terminal 1 (or 2) of the passenger airbag connector and ground. Is the voltage within the specified value?	≈ 0 v	Go to Step 6	Go to Step 5
5	1. Repair short to voltage in passenger airbag deployment loop. 2. Connect all SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
6	1. Connect dummy resistance (2.15 ± 0.35 Ω) to passenger airbag connector instead of driver airbag. 2. Enable the SRS. 3. Connect the scan tool to the data link connector (DLC). 4. Clear DTC and request DTC. Is the DTC 02 still present?	-	Go to Step 8	Go to Step 7
7	Replace passenger airbag. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
8	1. Replace SDM. 2. Connect all SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-

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DIAGNOSTIC TROUBLE CODE (DTC) 03
DRIVER SEAT BELT PRETENSIONER SHORTED TO VOLTAGE

Circuit Description

When the ignition switch is turned to ON, the sensing and diagnostic module (SDM) will perform tests to diagnose critical malfunctions within SDM itself. Upon passing these tests ignition and deployment loop voltages are measured to ensure that they are within their respective normal voltage ranges. The SDM monitors the voltages at the driver low (terminal 14), passenger low (terminal 11), driver seat belt pretensioner low (terminal 7) and passenger seat belt pretensioner low (terminal 4) to detect short to voltage in the deployment loops.

DTC 03 Will Set When

DTC 03 will set when the driver seat belt pretensioner low is above 5 volts for 250 milliseconds while the other deployment loop low is below 5 volts and ignition voltage is within the normal operating voltage range. This test is run during start-up test and every 250 milliseconds during continuous monitoring.

Action Taken

The SDM will turn on the airbag indicator (blink mode 4) and set DTC 03. The SDM will shutdown the driver seat belt pretensioner deployment loop.

DTC 03 Will Clear When

The scan tool CLEAR CODES command is received.

Diagnostic Aids

Carefully inspect the wires in passenger airbag deployment loop for cutting or chafing.

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DTC 03 - Driver Seat Belt Pretensioner Shorted to Voltage

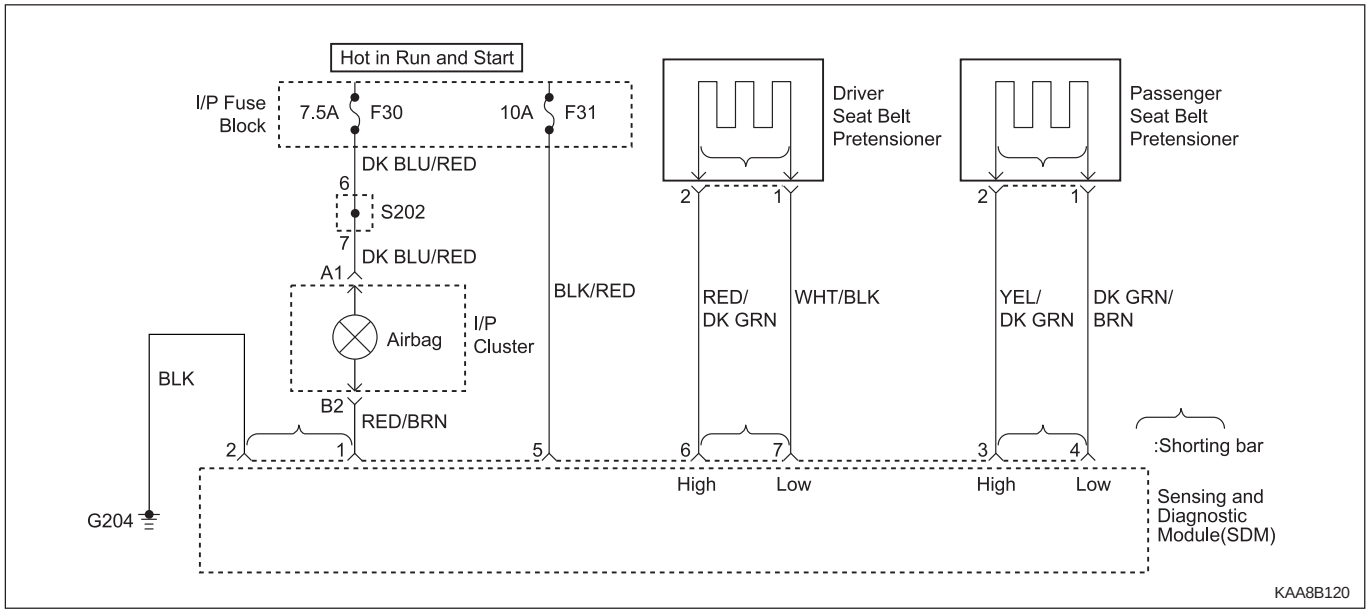
Caution: The sensing and diagnosis module (SDM) can maintain sufficient voltage to deploy the airbags and pretensioners for 0.15 seconds after the ignition is OFF and the fuse has been removed. If the airbags or pretensioners are not disconnected, do not begin service until one minute has passed after disconnecting power to the SDM. Otherwise, injury could result.

Caution: During service procedure, be very careful when handling the SDM. Never strike or jar the SDM. Never power the supplemental restraints system (SRS) when the SDM is not rigidly attached to the vehicle. Also SDM mounting nuts must be carefully tightened to ensure proper operation of the SRS. The SDM could be activated if it is powered when it is not rigidly attached to the vehicle, resulting in unexpected deployment and possible injury.

Step	Action	Value(s)	Yes	No
1	Perform the SRS Diagnostic System Check. Is the SRS Diagnostic System Check complete?	-	Go to Step 2	-

Step	Action	Value(s)	Yes	No
2	1. Disable the Supplemental Restraint System (SRS). Refer to “Disabling the Supplemental Restraint System (SRS)” in this section. 2. Virtually inspect the driver seat belt pretensioner circuit and connectors, especially at the SDM. Is there any evidence of rubbing, damage or chafing?	-	Go to Step 3	Go to Step 4
3	1. Repair the damaged wires or connectors. 2. Connect all the SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
4	1. Disconnect the SDM connector. 2. Disconnect driver airbag. 3. Turn the ignition ON. 4. Measure the voltage between terminal 1 (or 2) of the driver seat belt pretensioner connector and ground.	≈ 0 v	Go to Step 6	Go to Step 5
5	Is the voltage within the specified value? 1. Repair short to voltage in driver seat belt pretensioner deployment loop. 2. Connect all SRS components.	-	Go to “SRS Diagnostic System Check”	-
6	Is the repair complete? 1. Connect dummy resistance (2.15 ± 0.35 Ω) to driver seat belt pretensioner connector instead of driver seat belt pretensioner. 2. Enable the SRS. 3. Connect the scan tool to the data link connector (DLC). 4. Clear DTC and request DTC. Is the DTC 03 still present?	-	Go to Step 8	Go to Step 7
7	Replace driver seat belt pretensioner. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
8	1. Replace SDM. 2. Connect all SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-

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DIAGNOSTIC TROUBLE CODE (DTC) 04 PASSENGER SEAT BELT PRETENSIONER SHORTED TO VOLTAGE

Circuit Description

When the ignition switch is turned to ON, the sensing and diagnostic module (SDM) will perform tests to diagnose critical malfunctions within SDM itself. Upon passing these tests ignition and deployment loop voltages are measured to ensure that they are within their respective normal voltage ranges. The SDM monitors the voltages at the driver low (terminal 14), passenger low (terminal 11), driver seat belt pretensioner low (terminal 7) and passenger seat belt pretensioner low (terminal 4) to detect short to voltage in the deployment loops.

DTC 04 Will Set When

DTC 04 will set when the passenger seat belt pretensioner low is above 5 volts for 250 milliseconds while the other deployment loop low is below 5 volts and ignition voltage is within the normal operating voltage range. This test is run during start-up test and every 250 milliseconds during continuous monitoring.

Action Taken

The SDM will turn on the airbag indicator (blink mode 4) and set DTC 04. The SDM will shutdown the passenger seat belt pretensioner deployment loop.

DTC 04 Will Clear When

The scan tool CLEAR CODES command is received.

Diagnostic Aids

Carefully inspect the wires in passenger airbag deployment loop for cutting or chafing.

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DTC 04 - Passenger Seat Belt Pretensioner Shorted to Voltage

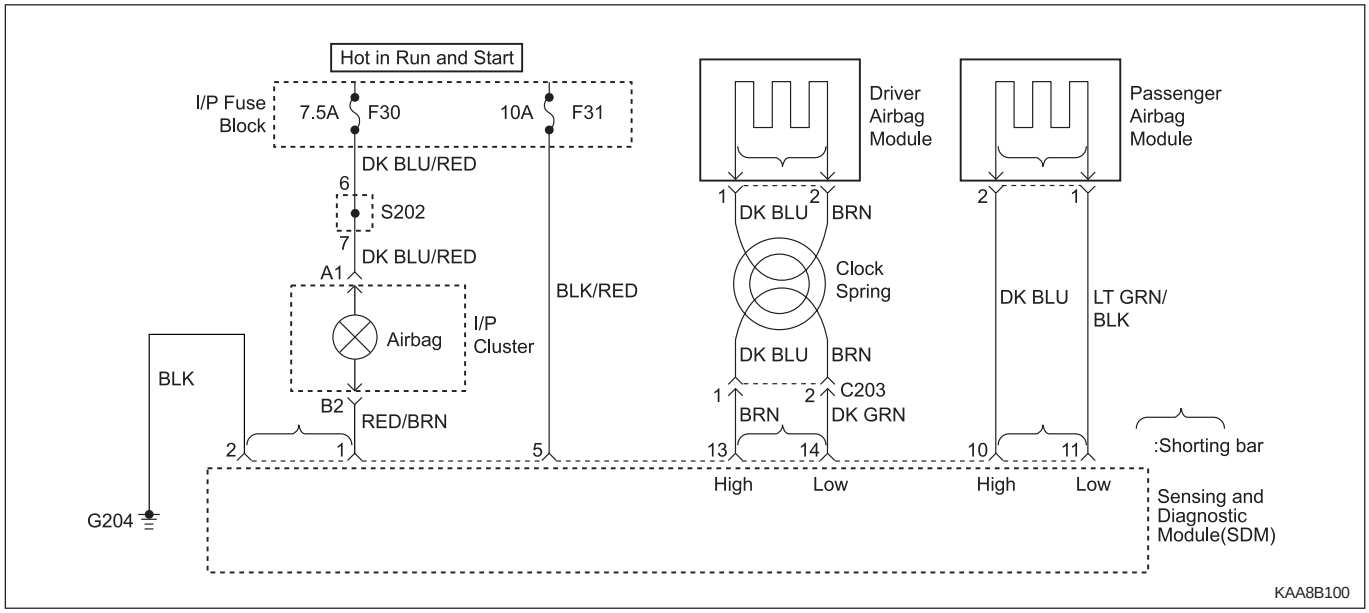
Caution: The sensing and diagnosis module (SDM) can maintain sufficient voltage to deploy the airbags and pretensioners for 0.15 seconds after the ignition is OFF and the fuse has been removed. If the airbags or pretensioners are not disconnected, do not begin service until one minute has passed after disconnecting power to the SDM. Otherwise, injury could result.

Caution: During service procedure, be very careful when handling the SDM. Never strike or jar the SDM. Never power the supplemental restraints system (SRS) when the SDM is not rigidly attached to the vehicle. Also SDM mounting nuts must be carefully tightened to ensure proper operation of the SRS. The SDM could be activated if it is powered when it is not rigidly attached to the vehicle, resulting in unexpected deployment and possible injury.

Step	Action	Value(s)	Yes	No
1	Perform the SRS Diagnostic System Check. Is the SRS Diagnostic System Check complete?	-	Go to Step 2	-

Step	Action	Value(s)	Yes	No
2	1. Disable the Supplemental Restraint System (SRS). Refer to “Disabling the Supplemental Restraint System (SRS)” in this section. 2. Virtually inspect the passenger seat belt pretensioner circuit and connectors, especially at the SDM. Is there any evidence of rubbing, damage or chafing?	-	Go to Step 3	Go to Step 4
3	1. Repair the damaged wires or connectors. 2. Connect all the SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
4	1. Disconnect the SDM connector. 2. Disconnect passenger seat belt pretensioner. 3. Turn the ignition ON. 4. Measure the voltage between terminal 1 (or 2) of the passenger seat belt pretensioner connector and ground. Is the voltage within the specified value?	≈ 0 v	Go to Step 6	Go to Step 5
5	1. Repair short to voltage in passenger seat belt pretensioner deployment loop. 2. Connect all SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
6	1. Connect dummy resistance (2.15 ± 0.35 Ω) to passenger seat belt pretensioner connector instead of passenger seat belt pretensioner. 2. Enable the SRS. 3. Connect the scan tool to the data link connector (DLC). 4. Clear DTC and request DTC. Is the DTC 04 still present?	-	Go to Step 8	Go to Step 7
7	Replace passenger seat belt pretensioner. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
8	1. Replace SDM. 2. Connect all SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-

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DIAGNOSTIC TROUBLE CODE (DTC) 05 DRIVER DEPLOYMENT LOOP SHORTED TO GROUND

Circuit Description

When the ignition switch is turned to ON, the sensing and diagnostic module (SDM) will perform tests to diagnose critical malfunctions within SDM itself. Upon passing these tests ignition and deployment loop voltages are measured to ensure that they are within their respective normal voltage ranges. The SDM monitors the voltages at the driver low (terminal 14), passenger low (terminal 11), driver seat belt pretensioner low (terminal 7) and passenger seat belt pretensioner low (terminal 4) to detect short to ground in the deployment loops.

DTC 05 Will Set When

DTC 05 will set when the voltage at driver airbag low falls below a specified value, and ignition voltage is within the normal operating voltage range.

This test is run during start-up test and every 250 milliseconds during continuous monitoring.

Action Taken

The SDM will turn on the airbag indicator (blink mode 3) and set DTC 05. The SDM will shutdown the driver airbag module deployment loop.

DTC 05 Will Clear When

The scan tool CLEAR CODES command is received.

Diagnostic Aids

Carefully inspect the wires in driver airbag deployment loop for cutting or chafing.

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DTC 05 - Driver Deployment Loop Shorted to Ground

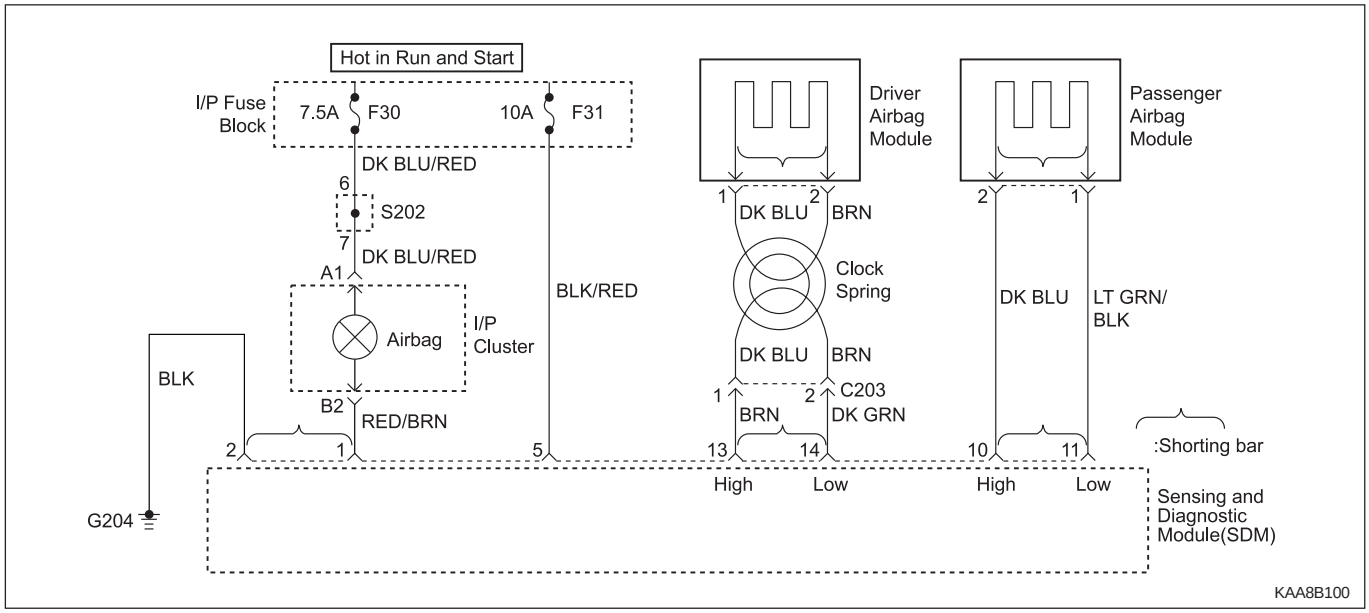
Caution: The sensing and diagnosis module (SDM) can maintain sufficient voltage to deploy the airbags and pretensioners for 0.15 seconds after the ignition is OFF and the fuse has been removed. If the airbags or pretensioners are not disconnected, do not begin service until one minute has passed after disconnecting power to the SDM. Otherwise, injury could result.

Caution: During service procedure, be very careful when handling the SDM. Never strike or jar the SDM. Never power the supplemental restraints system (SRS) when the SDM is not rigidly attached to the vehicle. Also SDM mounting nuts must be carefully tightened to ensure proper operation of the SRS. The SDM could be activated if it is powered when it is not rigidly attached to the vehicle, resulting in unexpected deployment and possible injury.

Step	Action	Value(s)	Yes	No
1	Perform the SRS Diagnostic System Check. Is the SRS Diagnostic System Check complete?	-	Go to Step 2	-

Step	Action	Value(s)	Yes	No
2	1. Disable the Supplemental Restraint System (SRS). Refer to “Disabling the Supplemental Restraint System (SRS)” in this section. 2. Virtually inspect the driver airbag circuit and connectors, especially at the SDM. Is there any evidence of rubbing, damage or chafing?	-	Go to Step 3	Go to Step 4
3	1. Repair the damaged wires or connectors. 2. Connect all the SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
4	1. Disconnect the SDM connector. 2. Disconnect driver airbag. 3. Turn the ignition ON. 4. Measure the resistance between terminal 1 (or 2) of the driver airbag connector and ground. Is the resistance within the specified value?	∞	Go to Step 8	Go to Step 5
5	1. Disconnect C203. 2. Measure the resistance between terminal 1 (or 2) of the driver airbag connector and ground. Is the resistance within the specified value?	∞	Go to Step 7	Go to Step 6
6	1. Repair short to ground in clock spring or replace the clock spring as needed. 2. Connect all SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
7	1. Repair short to ground between SDM and C203. 2. Connect all SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
8	1. Connect dummy resistance (2.15 ± 0.35 Ω) to driver airbag connector instead of driver airbag. 2. Enable the SRS. 3. Connect the scan tool to the data link connector (DLC). 4. Clear DTC and request DTC. Is the DTC 05 still present?	-	Go to Step 10	Go to Step 9
9	Replace driver airbag. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
10	1. Replace SDM. 2. Connect all SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-

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DIAGNOSTIC TROUBLE CODE (DTC) 06 PASSENGER DEPLOYMENT LOOP SHORTED TO GROUND

Circuit Description

When the ignition switch is turned to ON, the sensing and diagnostic module (SDM) will perform tests to diagnose critical malfunctions within SDM itself. Upon passing these tests ignition and deployment loop voltages are measured to ensure that they are within their respective normal voltage ranges. The SDM monitors the voltages at the driver low (terminal 14), passenger low (terminal 11), driver seat belt pretensioner low (terminal 7) and passenger seat belt pretensioner low (terminal 4) to detect short to ground in the deployment loops.

DTC 06 Will Set When

DTC 06 will set when the voltage at passenger airbag low falls below a specified value, and ignition voltage is within the normal operating voltage range.

This test is run during start-up test and every 250 milliseconds during continuous monitoring.

Action Taken

The SDM will turn on the airbag indicator (blink mode 3) and set DTC 06. The SDM will shutdown the passenger airbag deployment loop.

DTC 06 Will Clear When

The scan tool CLEAR CODES command is received.

Diagnostic Aids

Carefully inspect the wires in passenger airbag deployment loop for cutting or chafing.

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DTC 06 - Passenger Deployment Loop Shorted to Ground

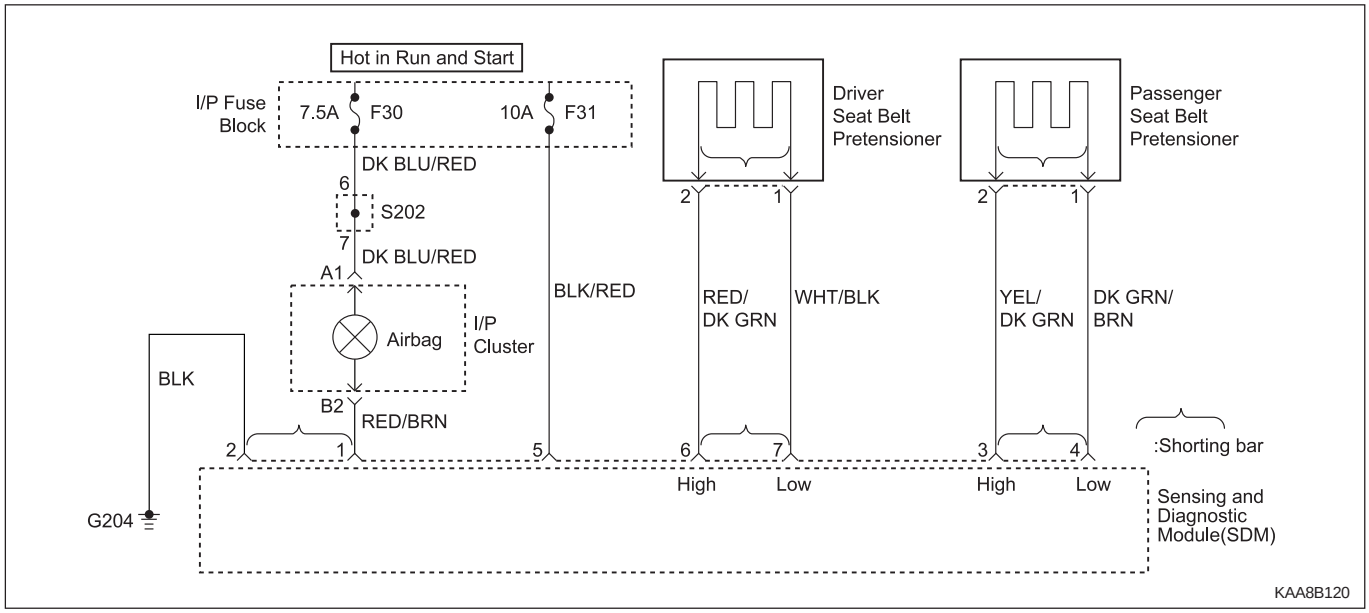
Caution: The sensing and diagnosis module (SDM) can maintain sufficient voltage to deploy the airbags and pretensioners for 0.15 seconds after the ignition is OFF and the fuse has been removed. If the airbags or pretensioners are not disconnected, do not begin service until one minute has passed after disconnecting power to the SDM. Otherwise, injury could result.

Caution: During service procedure, be very careful when handling the SDM. Never strike or jar the SDM. Never power the supplemental restraints system (SRS) when the SDM is not rigidly attached to the vehicle. Also SDM mounting nuts must be carefully tightened to ensure proper operation of the SRS. The SDM could be activated if it is powered when it is not rigidly attached to the vehicle, resulting in unexpected deployment and possible injury.

Step	Action	Value(s)	Yes	No
1	Perform the SRS Diagnostic System Check. Is the SRS Diagnostic System Check complete?	-	Go to Step 2	-

Step	Action	Value(s)	Yes	No
2	1. Disable the Supplemental Restraint System (SRS). Refer to “Disabling the Supplemental Restraint System (SRS)” in this section. 2. Virtually inspect the passenger airbag circuit and connectors, especially at the SDM. Is there any evidence of rubbing, damage or chafing?	-	Go to Step 3	Go to Step 4
3	1. Repair the damaged wires or connectors. 2. Connect all the SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
4	1. Disconnect the SDM connector. 2. Disconnect passenger airbag. 3. Turn the ignition ON. 4. Measure the resistance between terminal 1 (or 2) of the passenger airbag connector and ground. Is the resistance within the specified value?	∞	Go to Step 6	Go to Step 5
5	1. Repair short to ground in passenger airbag deployment loop. 2. Connect all SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
6	1. Connect dummy resistance (2.15 ± 0.35 Ω) to passenger airbag connector instead of passenger airbag. 2. Enable the SRS. 3. Connect the scan tool to the data link connector (DLC). 4. Clear DTC and request DTC. Is the DTC 06 still present?	-	Go to Step 8	Go to Step 7
7	Replace passenger airbag. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
8	1. Replace SDM. 2. Connect all SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-

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DIAGNOSTIC TROUBLE CODE (DTC) 07
DRIVER SEAT BELT PRETENSIONER SHORTED TO GROUND

Circuit Description

When the ignition switch is turned to ON, the sensing and diagnostic module (SDM) will perform tests to diagnose critical malfunctions within SDM itself. Upon passing these tests ignition and deployment loop voltages are measured to ensure that they are within their respective normal voltage ranges. The SDM monitors the voltages at the driver low (terminal 14), passenger low (terminal 11), driver seat belt pretensioner low (terminal 7) and passenger seat belt pretensioner low (terminal 4) to detect short to ground in the deployment loops.

DTC 07 Will Set When

DTC 07 will set when the voltage at driver seat belt pretensioner low falls below a specified value, and ignition voltage is within the normal operating voltage range.

This test is run during start-up test and every 250 milliseconds during continuous monitoring.

Action Taken

The SDM will turn on the airbag indicator (blink mode 4) and set DTC 07. The SDM will shutdown the driver seat belt pretensioner deployment loop.

DTC 07 Will Clear When

The scan tool CLEAR CODES command is received.

Diagnostic Aids

Carefully inspect the wires in passenger airbag deployment loop for cutting or chafing.

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DTC 07 - Driver Seat Belt Pretensioner Shorted to Ground

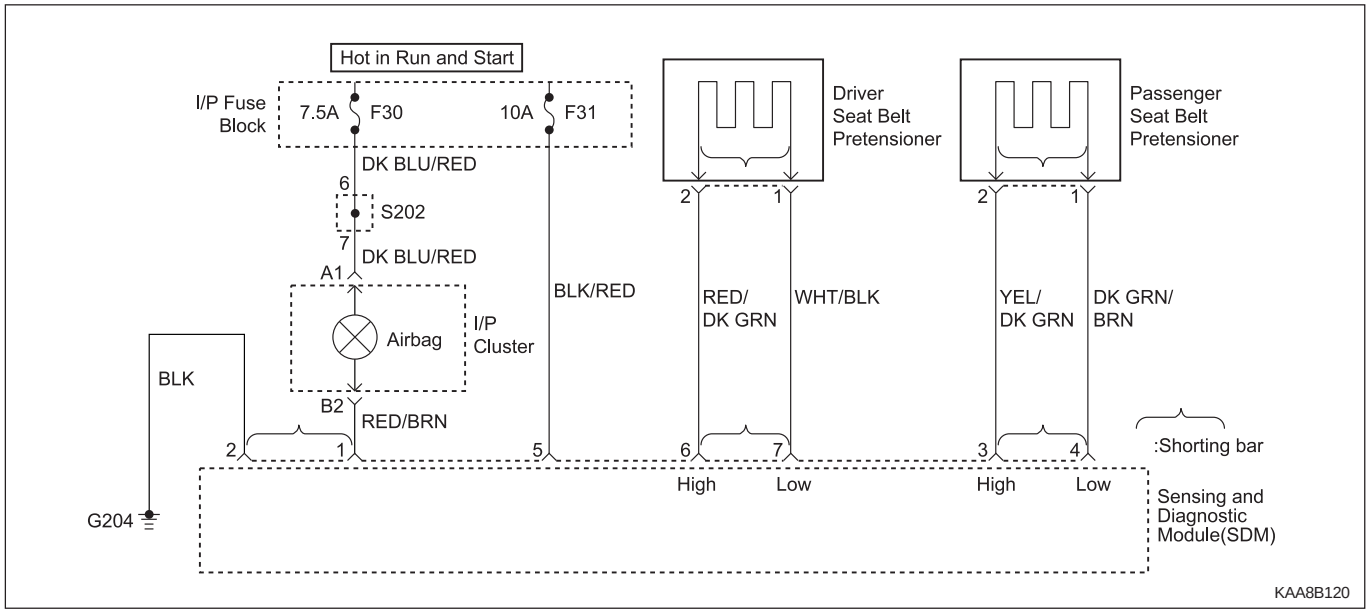
Caution: The sensing and diagnosis module (SDM) can maintain sufficient voltage to deploy the airbags and pretensioners for 0.15 seconds after the ignition is OFF and the fuse has been removed. If the airbags or pretensioners are not disconnected, do not begin service until one minute has passed after disconnecting power to the SDM. Otherwise, injury could result.

Caution: During service procedure, be very careful when handling the SDM. Never strike or jar the SDM. Never power the supplemental restraints system (SRS) when the SDM is not rigidly attached to the vehicle. Also SDM mounting nuts must be carefully tightened to ensure proper operation of the SRS. The SDM could be activated if it is powered when it is not rigidly attached to the vehicle, resulting in unexpected deployment and possible injury.

Step	Action	Value(s)	Yes	No
1	Perform the SRS Diagnostic System Check. Is the SRS Diagnostic System Check complete?	-	Go to Step 2	-

Step	Action	Value(s)	Yes	No
2	1. Disable the Supplemental Restraint System (SRS). Refer to “Disabling the Supplemental Restraint System (SRS)” in this section. 2. Virtually inspect the driver seat belt pretensioner circuit and connectors, especially at the SDM. Is there any evidence of rubbing, damage or chafing?	-	Go to Step 3	Go to Step 4
3	1. Repair the damaged wires or connectors. 2. Connect all the SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
4	1. Disconnect the SDM connector. 2. Disconnect driver airbag. 3. Turn the ignition ON. 4. Measure the resistance between terminal 1 (or 2) of the driver seat belt pretensioner connector and ground. Is the voltage within the specified value?	∞	Go to Step 6	Go to Step 5
5	1. Repair short to ground in driver seat belt pretensioner deployment loop. 2.Connect all SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
6	1. Connect dummy resistance (2.15 ± 0.35 Ω) to driver seat belt pretensioner connector instead of driver seat belt pretensioner. 2. Enable the SRS. 3. Connect the scan tool to the data link connector (DLC). 4. Clear DTC and request DTC. Is the DTC 07 still present?	-	Go to Step 8	Go to Step 7
7	Replace driver seat belt pretensioner. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
8	1. Replace SDM. 2. Connect all SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-

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DIAGNOSTIC TROUBLE CODE (DTC) 08 PASSENGER SEAT BELT PRETENSIONER SHORTED TO GROUND

Circuit Description

When the ignition switch is turned to ON, the sensing and diagnostic module (SDM) will perform tests to diagnose critical malfunctions within SDM itself. Upon passing these tests ignition and deployment loop voltages are measured to ensure that they are within their respective normal voltage ranges. The SDM monitors the voltages at the driver low (terminal 14), passenger low (terminal 11), driver seat belt pretensioner low (terminal 7) and passenger seat belt pretensioner low (terminal 4) to detect short to ground in the deployment loops.

DTC 08 Will Set When

DTC 08 will set when the voltage at passenger seat belt pretensioner low falls below a specified value, and ignition voltage is within the normal operating voltage range.

This test is run during start-up test and every 250 milliseconds during continuous monitoring.

Action Taken

The SDM will turn on the airbag indicator (blink mode 4) and set DTC 08. The SDM will shutdown the passenger seat belt pretensioner deployment loop.

DTC 08 Will Clear When The scan tool CLEAR CODES command is received.

Diagnostic Aids

Carefully inspect the wires in passenger airbag deployment

loop for cutting or chafing.

DTC 08 - Passenger Seat Belt Pretensioner Shorted to Ground

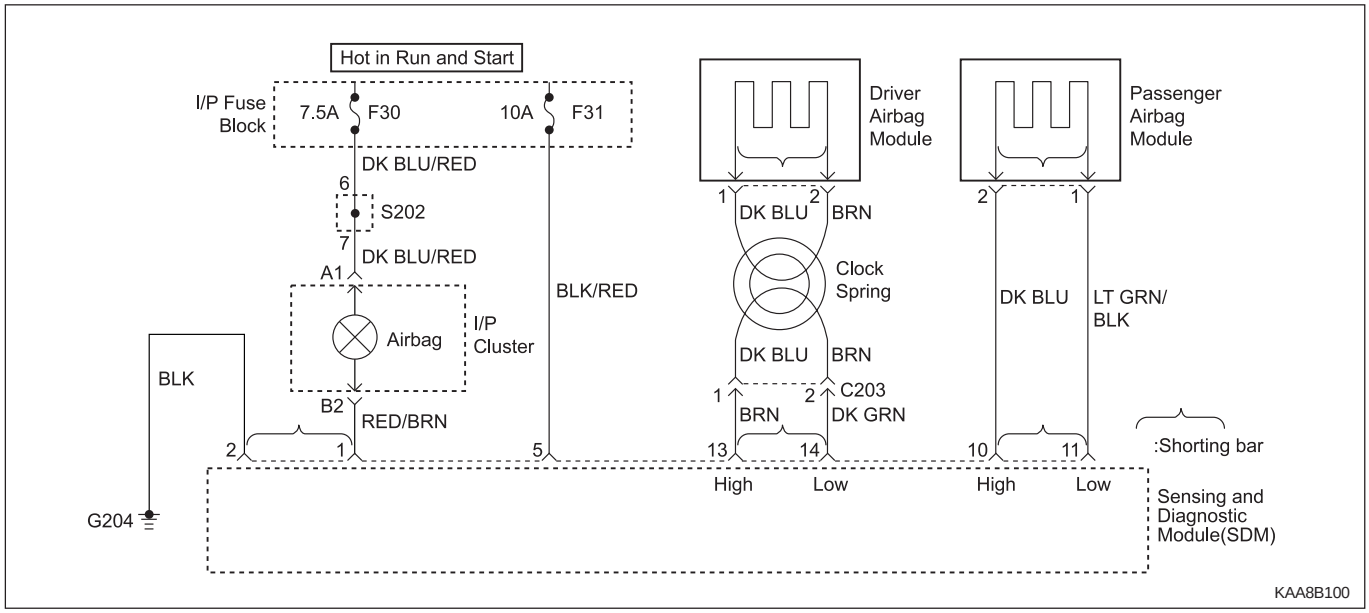
Caution: The sensing and diagnosis module (SDM) can maintain sufficient voltage to deploy the airbags and pretensioners for 0.15 seconds after the ignition is OFF and the fuse has been removed. If the airbags or pretensioners are not disconnected, do not begin service until one minute has passed after disconnecting power to the SDM. Otherwise, injury could result.

Caution: During service procedure, be very careful when handling the SDM. Never strike or jar the SDM. Never power the supplemental restraints system (SRS) when the SDM is not rigidly attached to the vehicle. Also SDM mounting nuts must be carefully tightened to ensure proper operation of the SRS. The SDM could be activated if it is powered when it is not rigidly attached to the vehicle, resulting in unexpected deployment and possible injury.

Step	Action	Value(s)	Yes	No
1	Perform the SRS Diagnostic System Check. Is the SRS Diagnostic System Check complete?	-	Go to Step 2	-

Step	Action	Value(s)	Yes	No
2	1. Disable the Supplemental Restraint System (SRS). Refer to “Disabling the Supplemental Restraint System (SRS)” in this section. 2. Virtually inspect the passenger seat belt pretensioner circuit and connectors, especially at the SDM. Is there any evidence of rubbing, damage or chafing?	-	Go to Step 3	Go to Step 4
3	1. Repair the damaged wires or connectors. 2. Connect all the SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
4	1. Disconnect the SDM connector. 2. Disconnect passenger seat belt pretensioner. 3. Turn the ignition ON. 4. Measure the resistance between terminal 1 (or 2) of the passenger seat belt pretensioner connector and ground. Is the resistance within the specified value?	∞	Go to Step 6	Go to Step 5
5	1. Repair short to ground in passenger seat belt pretensioner deployment loop. 2. Connect all SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
6	1. Connect dummy resistance (2.15 ± 0.35 Ω) to passenger seat belt pretensioner connector instead of passenger seat belt pretensioner. 2. Enable the SRS. 3. Connect the scan tool to the data link connector (DLC). 4. Clear DTC and request DTC. Is the DTC 08 still present?	-	Go to Step 8	Go to Step 7
7	Replace passenger seat belt pretensioner. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
8	1. Replace SDM. 2. Connect all SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-

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DIAGNOSTIC TROUBLE CODE (DTC) 17
DRIVER DEPLOYMENT LOOP RESISTANCE HIGH

Circuit Description

When the ignition switch is turned to ON, the sensing and diagnostic module (SDM) will perform tests to diagnose critical malfunctions within SDM itself. Upon passing these tests ignition and deployment loop voltages are measured to ensure that they are within their respective normal voltage ranges. The SDM then proceeds with resistance measurement test. Driver low terminal 14 is grounded through a current sink. The current source is connected to driver high terminal 13 to allow a known amount of the current flow. By monitoring the voltage difference between drive high and driver low, the SDM calculates the combined resistance of the driver inflator module, the clock spring, the harness wiring, and connector terminal contacts.

DTC 17 Will Set When

DTC 17 will set when the resistance of the driver airbag deployment loop is above specified value (4.5 ± 0.5 Ω).

The test is run once each ignition cycle during the resistance measurement test when the ignition voltage is above a specified value.

Action Taken

The SDM will turn on the airbag indicator (blink mode 1) and set DTC 17. And driver airbag deployment loop shutdown.

DTC 17 Will Clear When

The ignition switch is turned OFF or the scan tool CLEAR CODES command is received.

Diagnostic Aids

All intermittent condition is likely to be the caused by a poor connection from the driver airbag to the clock spring or SDM terminal 13 or 14. The test for this DTCis run only while the airbag indicator is performing the start-up test. When a scan tool CLEAR CODES command is issued and the malfunction is still present, the DTC will not reappear until next ignition cycle.

DTC 17 - Driver Deployment Loop Resistance High

Caution: The sensing and diagnosis module (SDM) can maintain sufficient voltage to deploy the airbags and pretensioners for 0.15 seconds after the ignition is OFF and the fuse has been removed. If the airbags or pretensioners are not disconnected, do not begin service until one minute has passed after disconnecting power to the SDM. Otherwise, injury could result.

Caution: During service procedure, be very careful when handling the SDM. Never strike or jar the SDM. Never power the supplemental restraints system (SRS) when the SDM is not rigidly attached to the vehicle. Also SDM mounting nuts must be carefully tightened to ensure proper operation of the SRS. The SDM could be activated if it is powered when it is not rigidly attached to the vehicle, resulting in unexpected deployment and possible injury.

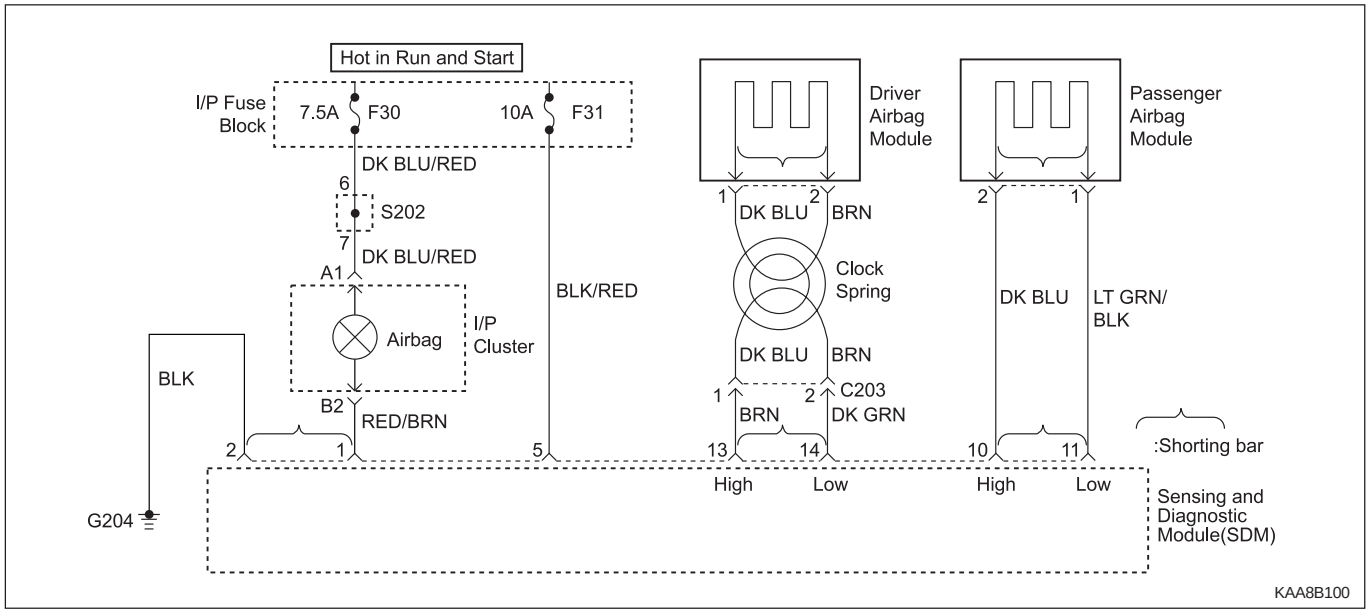
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Step	Action	Value(s)	Yes	No
1	Perform the SRS Diagnostic System Check. Is the SRS Diagnostic System Check complete?	-	Go to Step 2	-
2	1. Disable the Supplemental Restraint System (SRS). Refer to “Disabling the Supplemental Restraint System (SRS)” in this section. 2. Inspect the yellow clock spring connector at the lower steering column. Is a faulty connector or terminal or loose wire detected?	-	Go to Step 3	Go to Step 4
3	1. Repair or Replace the faulty connector, terminal, or wire. 2. Connect all the SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
4	1. Disconnect the SDM connector. 2. Check terminals 13 and 14 for loose terminals or wire. Is a problem found?	-	Go to Step 5	Go to Step 6
5	Replace the loose terminals or wires at SDM connector. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
6	1. Reconnect the SDM. 2. Connect dummy resistance (2.15 ± 0.35 Ω) to driver airbag connector instead of driver airbag. 3. Connect other SRS components. 4. Enable the SRS. 5. Turn the ignition switch to ON and check for DTCs with scan tool. Is DTC 17 still current?	-	Go to Step 8	Go to Step 7
7	Replace driver airbag. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
8	1. Disable the SRS. 2. Disconnect C203. 3. Connect dummy resistance (2.15 ± 0.35 Ω) to SDM side terminal of C203. 4. Enable the SRS. 5. Turn the ignition switch to ON and check for DTCs with scan tool. Is DTC 17 still current?	-	Go to Step 9	Go to Step 12
9	1. Disconnect the SDM. 2. Measure resistance between terminal 1 or 2 of C203 and ground. Is the resistance equal to specified value? 3. Measure the voltage between terminal 1 or 2 of C203 and ground. Is the voltage within the specified value?	∞ ≈ 0 v	Go to Step 11	Go to Step 10
10	1. Repair short to ground or short to voltage circuit between SDM and C203. 2. Connect all SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-

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Step	Action	Value(s)	Yes	No
11	1. Replace SDM. 2. Connect all SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
12	1. Repair short to ground or short to voltage circuit in clock spring and replace the clock spring as needed. 2. Connect all SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-

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DIAGNOSTIC TROUBLE CODE (DTC) 18
PASSENGER DEPLOYMENT LOOP RESISTANCE HIGH

Circuit Description

When the ignition switch is turned to ON, the sensing and diagnostic module (SDM) will perform tests to diagnose critical malfunctions within SDM itself. Upon passing these tests ignition and deployment loop voltages are measured to ensure that they are within their respective normal voltage ranges. The SDM then proceeds with resistance measurement test. Passenger low terminal 11 is grounded through a current sink. The current source is connected to driver high terminal 10 to allow a known amount of the current flow. By monitoring the voltage difference between passenger high and passenger low, the SDM calculates the combined resistance of the passenger inflator module, the harness wiring, and connector terminal contacts.

DTC 18 Will Set When

DTC 18 will set when the resistance of the passenger airbag deployment loop is above specified value (4.5 ± 0.5 Ω).

The test is run once each ignition cycle during the resistance measurement test when the ignition voltage is above a specified value.

Action Taken

The SDM will turn on the airbag indicator (blink mode 2) and set DTC 18. And passenger airbag deployment loop shutdown.

DTC 18 Will Clear When

The ignition switch is turned OFF or the scan tool CLEAR CODES command is received.

Diagnostic Aids

All intermittent condition is likely to be the caused by a poor connection from the passenger airbag to the SDM terminal 11 or 12. The test for this DTC is run only while the airbag indicator is performing the start-up test.When a scan tool CLEAR CODES command is issued and the malfunction is still present, the DTC will not reappear until next ignition cycle.

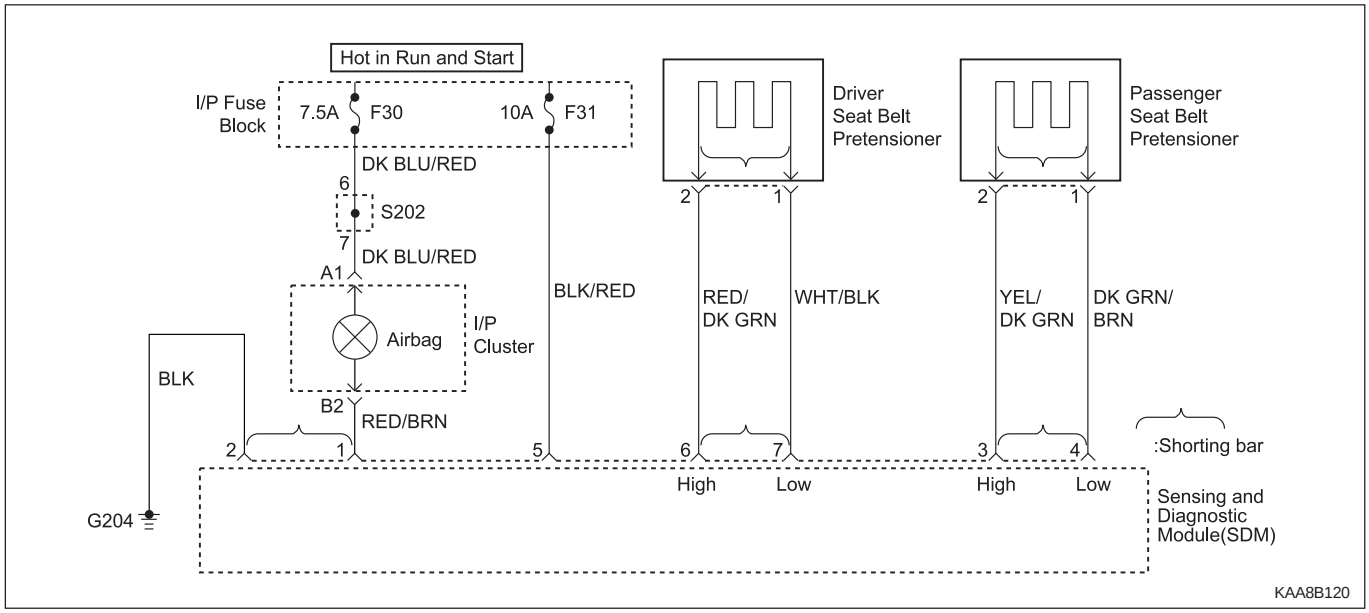
DTC 18 - Passenger Deployment Loop Resistance High

Caution: The sensing and diagnosis module (SDM) can maintain sufficient voltage to deploy the airbags and pretensioners for 0.15 seconds after the ignition is OFF and the fuse has been removed. If the airbags or pretensioners are not disconnected, do not begin service until one minute has passed after disconnecting power to the SDM. Otherwise, injury could result.

Caution: During service procedure, be very careful when handling the SDM. Never strike or jar the SDM. Never power the supplemental restraints system (SRS) when the SDM is not rigidly attached to the vehicle. Also SDM mounting nuts must be carefully tightened to ensure proper operation of the SRS. The SDM could be activated if it is powered when it is not rigidly attached to the vehicle, resulting in unexpected deployment and possible injury.

Step	Action	Value(s)	Yes	No
1	Perform the SRS Diagnostic System Check. Is the SRS Diagnostic System Check complete?	-	Go to Step 2	-
2	1. Disable the Supplemental Restraint System (SRS). Refer to “Disabling the Supplemental Restraint System (SRS)” in this section. 2. Disconnect the passenger airbag module yellow connector located at the rear of glove box. 3. Inspect the passenger airbag module connector for damage or loose terminals or wires. Is a faulty connector, terminal, or wire detected?	-	Go to Step 3	Go to Step 4
3	1. Repair or replace the faulty wires, terminals or connectors. 2. Connect all the SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
4	1. Disconnect the SDM connector. 2. Check the SDM connector terminal 11 and 12 for loose terminals. Is a problem found?	-	Go to Step 5	Go to Step 6
5	1. Repair the loose terminals or wires. 2. Connect all SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
6	1. Connect dummy resistance (2.15 ± 0.35 Ω) to passenger airbag connector instead of passenger airbag. 2. Enable the SRS. Is the repair complete?	-	Go to Step 7	Go to Step 8
7	Replace passenger airbag. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
8	1. Disable the SRS. 2. Disconnect the SDM. 3. Measure resistance between terminal 1 or 2 of passenger airbag module connector and ground. Is the resistance equal to specified value? 4. Measure the voltage between terminal 1 or 2 of passenger airbag module connector and ground. Is the voltage within the specified value?	∞ ≈ 0 v	Go to Step 10	Go to Step 9
9	Repair short to ground or short to voltage circuit between SDM to passenger airbag module. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
10	1. Replace SDM. 2. Connect all SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-

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DIAGNOSTIC TROUBLE CODE (DTC) 19 DRIVER SEAT BELT PRETENSIONER DEPLOYMENT LOOP RESISTANCE HIGH

Circuit Description

When the ignition switch is turned to ON, the sensing and diagnostic module (SDM) will perform tests to diagnose critical malfunctions within SDM itself. Upon passing these tests ignition and deployment loop voltages are measured to ensure that they are within their respective normal voltage ranges. The SDM then proceeds with resistance measurement test. Driver seat belt pretensioner low terminal 7 is grounded through a current sink. The current source is connected to driver seat belt pretensioner high terminal 6 to allow a known amount of the current flow. By monitoring the voltage difference between driver seat belt pretensioner high and driver seat belt pretensioner low, the SDM calculates the combined resistance of the driver seat belt pretensioner inflator module, the harness wiring, and connector terminal contacts.

DTC 19 Will Set When

DTC 19 will set when the resistance of driver seat belt pretensioner deployment loop is above specified value (4.5 ± 0.5 Ω). The test is run once each ignition cycle during the resistance measurement test when the ignition voltage is above a specified value.

Action Taken

The SDM will turn on the airbag indicator (blink mode 4) and set DTC 19. And driver seat belt pretensioner deployment loop shutdown.

DTC19 Will Clear When

The ignition switch is turned OFF or the scan tool CLEAR CODES command is received.

Diagnostic Aids

All intermittent condition is likely to be the caused by a poor connection from the driver seat belt pretensioner to the SDM terminal 6 or 7. The test for this DTCis run only while the airbag indicator is performing the start-up test. When a scan tool CLEAR CODES command is issued and the malfunction is still present, the DTC will not reappear until next ignition cycle.

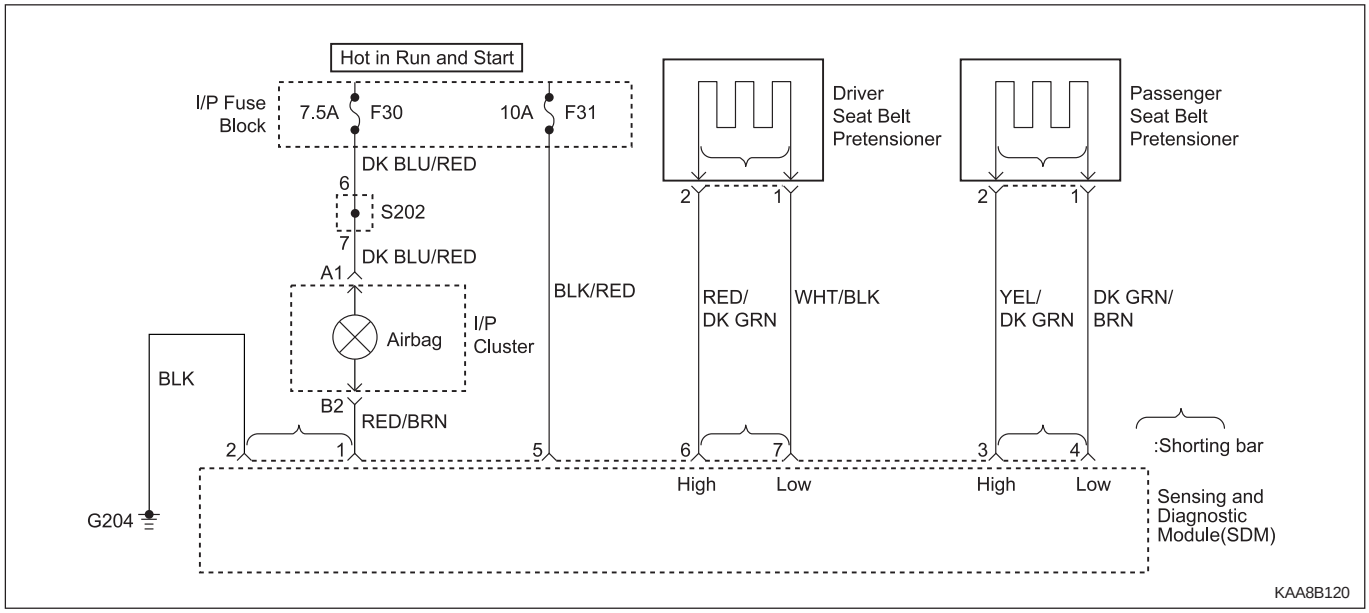
DTC 19 - Driver Seat Belt Pretensioner Deployment Loop Resistance High

Caution: The sensing and diagnosis module (SDM) can maintain sufficient voltage to deploy the airbags and pretensioners for 0.15 seconds after the ignition is OFF and the fuse has been removed. If the airbags or pretensioners are not disconnected, do not begin service until one minute has passed after disconnecting power to the SDM. Otherwise, injury could result.

Caution: During service procedure, be very careful when handling the SDM. Never strike or jar the SDM. Never power the supplemental restraints system (SRS) when the SDM is not rigidly attached to the vehicle. Also SDM mounting nuts must be carefully tightened to ensure proper operation of the SRS. The SDM could be activated if it is powered when it is not rigidly attached to the vehicle, resulting in unexpected deployment and possible injury.

Step	Action	Value(s)	Yes	No
1	Perform the SRS Diagnostic System Check. Is the SRS Diagnostic System Check complete?	-	Go to Step 2	-
2	1. Disable the Supplemental Restraint System (SRS). Refer to “Disabling the Supplemental Restraint System (SRS)” in this section. 2. Disconnect the driver seat belt pretensioner yellow connector located inside of rear lower quarter panel. 3. Inspect the driver seat belt pretensioner connector for damage or loose terminals or wires. Is a faulty connector, terminal, or wire detected?	-	Go to Step 3	Go to Step 4
3	1. Repair or replace the faulty wires, terminals or connectors. 2. Connect all the SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
4	1. Disconnect the SDM connector. 2. Check the SDM connector terminal 6 and 7 for loose terminals. Is a problem found?	-	Go to Step 5	Go to Step 6
5	1. Repair the loose terminals or wires. 2. Connect all SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
6	1. Connect dummy resistance (2.15 ± 0.35 Ω) to driver seat belt pretensioner connector instead of driver seat belt pretensioner. 2. Enable the SRS. Is the repair complete?	-	Go to Step 7	Go to Step 8
7	Replace the driver seat belt pretensioner. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
8	1. Disable the SRS. 2. Disconnect the SDM. 3. Measure resistance between terminal 1 or 2 of driver seat belt pretensioner connector and ground. Is the resistance equal to specified value? 4. Measure the voltage between terminal 1 or 2 of driver seat belt pretensioner connector and ground. Is the voltage within the specified value?	∞ ≈ 0 v	Go to Step 10	Go to Step 9
9	Repair short to ground or short to voltage circuit between SDM to driver seat belt pretensioner. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
10	1. Replace SDM. 2. Connect all SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-

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DIAGNOSTIC TROUBLE CODE (DTC) 20 PASSENGER SEAT BELT PRETENSIONER DEPLOYMENT LOOP RESISTANCE HIGH

Circuit Description

When the ignition switch is turned to ON, the sensing and diagnostic module (SDM) will perform tests to diagnose critical malfunctions within SDM itself. Upon passing these tests ignition and deployment loop voltages are measured to ensure that they are within their respective normal voltage ranges. The SDM then proceeds with resistance measurement test. Passenger seat belt pretensioner low terminal 4 is grounded through a current sink. The current source is connected to passenger seat belt pretensioner high terminal 3 to allow a known amount of the current flow. By monitoring the voltage difference between passenger seat belt pretensioner high and passenger seat belt pretensioner low, the SDM calculates the combined resistance of the passenger seat belt pretensioner inflator module, the harness wiring, and connector terminal contacts.

DTC 20 Will Set When

DTC 20 will set when the resistance of passenger seat belt pretensioner deployment loop is above specified value (4.5 ± 0.5 Ω). The test is run once each ignition cycle during the resistance measurement test when the ignition voltage is above a specified value.

Action Taken

The SDM will turn on the airbag indicator (blink mode 4) and set DTC 20. And passenger seat belt pretensioner deployment loop shutdown.

DTC 20 Will Clear When

The ignition switch is turned OFF or the scan tool CLEAR CODES command is received.

Diagnostic Aids

All intermittent condition is likely to be the caused by a poor connection from the passenger seat belt pretensioner to the SDM terminal 3 or 4. The test for this DTC is run only while the airbag indicator is performing the start-up test. When a scan tool CLEAR CODES command is issued and the malfunction is still present, the DTC will not reappear until next ignition cycle.

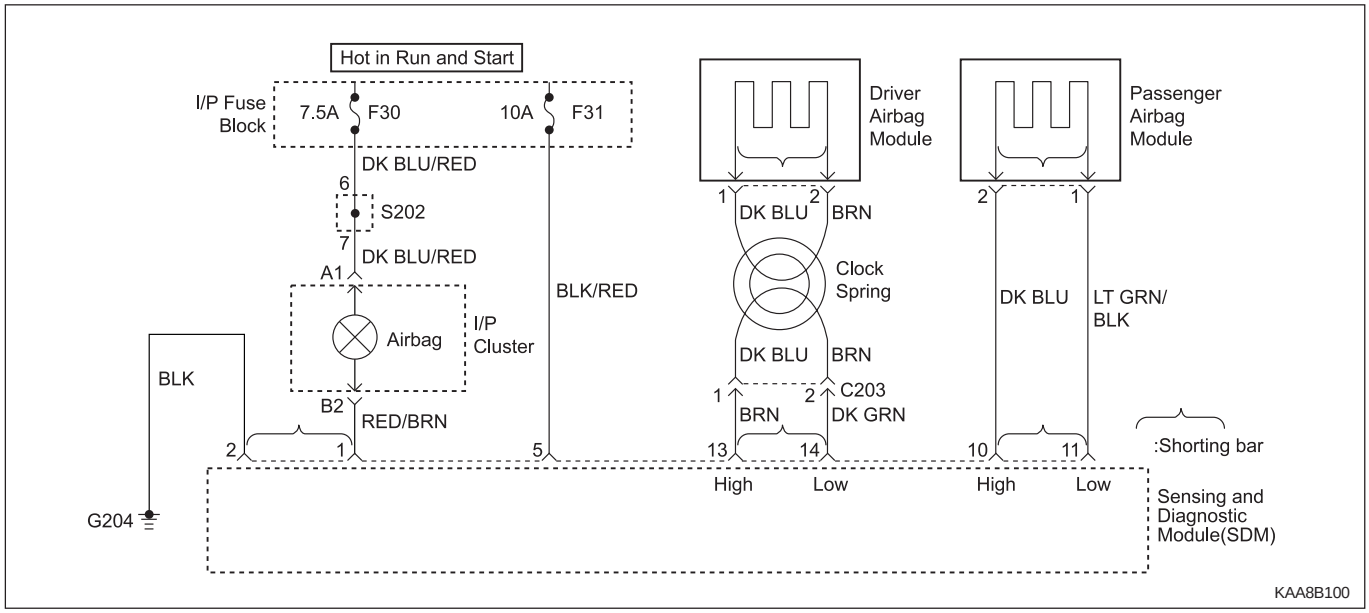
DTC 20 - Passenger Seat Belt Pretensioner Deployment Loop Resistance High

Caution: The sensing and diagnosis module (SDM) can maintain sufficient voltage to deploy the airbags and pretensioners for 0.15 seconds after the ignition is OFF and the fuse has been removed. If the airbags or pretensioners are not disconnected, do not begin service until one minute has passed after disconnecting power to the SDM. Otherwise, injury could result.

Caution: During service procedure, be very careful when handling the SDM. Never strike or jar the SDM. Never power the supplemental restraints system (SRS) when the SDM is not rigidly attached to the vehicle. Also SDM mounting nuts must be carefully tightened to ensure proper operation of the SRS. The SDM could be activated if it is powered when it is not rigidly attached to the vehicle, resulting in unexpected deployment and possible injury.

Step	Action	Value(s)	Yes	No
1	Perform the SRS Diagnostic System Check. Is the SRS Diagnostic System Check complete?	-	Go to Step 2	-
2	1. Disable the Supplemental Restraint System (SRS). Refer to “Disabling the Supplemental Restraint System (SRS)” in this section. 2. Disconnect the passenger seat belt pretensioner yellow connector located inside of rear lower quarter panel. 3. Inspect the passenger seat belt pretensioner connector for damage or loose terminals or wires. Is a faulty connector, terminal, or wire detected?	-	Go to Step 3	Go to Step 4
3	1. Repair or replace the faulty wires, terminals or connectors. 2. Connect all the SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
4	1. Disconnect the SDM connector. 2. Check the SDM connector terminal 3 and 4 for loose terminals. Is a problem found?	-	Go to Step 5	Go to Step 6
5	1. Repair the loose terminals or wires. 2. Connect all SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
6	1. Connect dummy resistance (2.15 ± 0.35 Ω) to passenger seat belt pretensioner connector instead of passenger seat belt pretensioner. 2. Enable the SRS. Is the repair complete?	-	Go to Step 7	Go to Step 8
7	Replace the passenger seat belt pretensioner. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
8	1. Disable the SRS. 2. Disconnect the SDM. 3. Measure resistance between terminal 1 or 2 of passenger seat belt pretensioner connector and ground. Is the resistance equal to specified value? 4. Measure the voltage between terminal 1 or 2 of passenger seat belt pretensioner connector and ground. Is the voltage within the specified value?	∞ ≈ 0 v	Go to Step 10	Go to Step 9
9	Repair short to ground or short to voltage circuit between SDM to passenger seat belt pretensioner. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
10	1. Replace SDM. 2. Connect all SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-

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DIAGNOSTIC TROUBLE CODE (DTC) 21
DRIVER AIRBAG DEPLOYMENT LOOP RESISTANCE LOW

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Circuit Description

When the ignition switch is turned to ON, the sensing and diagnostic module (SDM) will perform tests to diagnose critical malfunctions within SDM itself. Upon passing these tests ignition and deployment loop voltages are measured to ensure that they are within their respective normal voltage ranges. The SDM then proceeds with resistance measurement test. Driver low terminal 14 is grounded through a current sink. The current source is connected to driver high terminal 13 to allow a known amount of the current flow. By monitoring the voltage difference between drive high and driver low, the SDM calculates the combined resistance of the driver inflator module, the clock spring, the harness wiring, and connector terminal contacts.

DTC 21 Will Set When

DTC 21 will set when the resistance of the driver airbag deployment loop is below a specified value (1.4 ± 0.5 Ω). The test is run once each ignition cycle during the resistance measurement test when the ignition voltage is above a specified value.

Action Taken

The SDM will turn on the airbag indicator (blink mode 1) and set DTC 21. And driver airbag deployment loop shutdown.

DTC 21 Will Clear When

The ignition switch is turned OFF or the scan tool CLEAR CODES command is received.

Diagnostic Aids

All intermittent condition is likely to be the caused by a poor connection from the driver airbag to the clock spring or SDM terminal 13 or 14. The test for this DTC is run only while the airbag indicator is performing the start-up test. When a scan tool CLEAR CODES command is issued and the malfunction is still present, the DTC will not reappear until next ignition cycle.

DTC 21 - Driver Airbag Deployment Loop Resistance Low

Caution: The sensing and diagnosis module (SDM) can maintain sufficient voltage to deploy the airbags and pretensioners for 0.15 seconds after the ignition is OFF and the fuse has been removed. If the airbags or pretensioners are not disconnected, do not begin service until one minute has passed after disconnecting power to the SDM. Otherwise, injury could result.

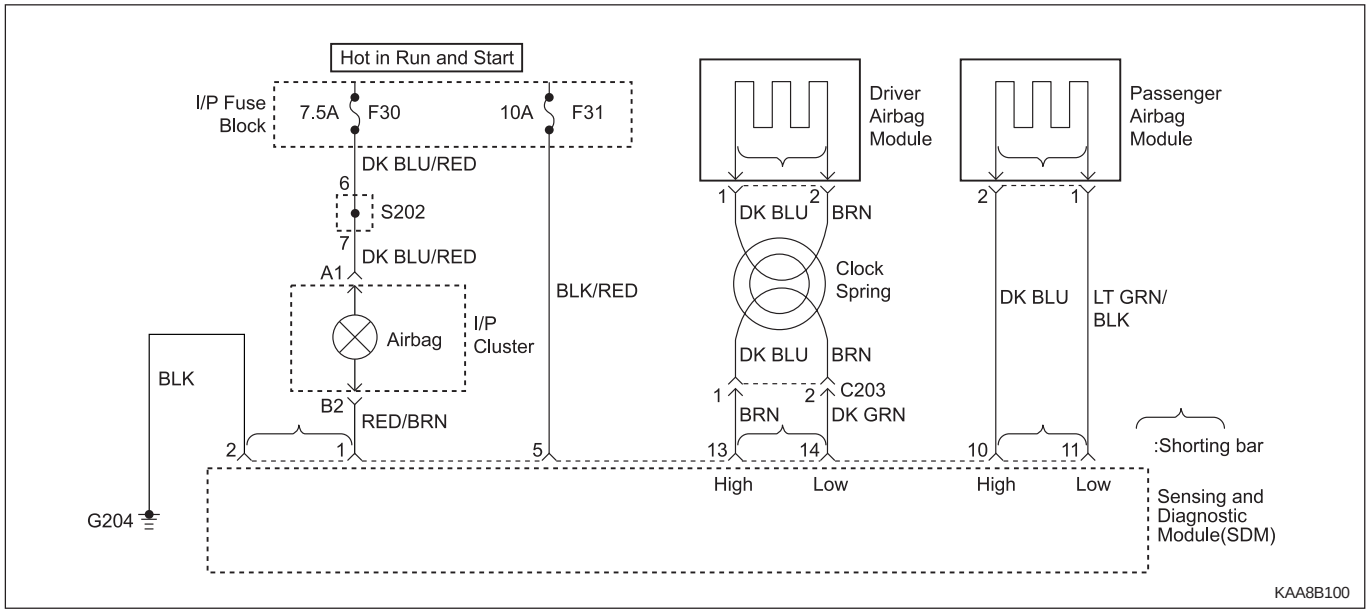
Caution: During service procedure, be very careful when handling the SDM. Never strike or jar the SDM. Never power the supplemental restraints system (SRS) when the SDM is not rigidly attached to the vehicle. Also SDM mounting nuts must be carefully tightened to ensure proper operation of the SRS. The SDM could be activated if it is powered when it is not rigidly attached to the vehicle, resulting in unexpected deployment and possible injury.

Step	Action	Value(s)	Yes	No
1	Perform the SRS Diagnostic System Check. Is the SRS Diagnostic System Check complete?	-	Go to Step 2	-
2	1. Disable the Supplemental Restraint System (SRS). Refer to “Disabling the Supplemental Restraint System (SRS)” in this section. 2. Inspect the yellow clock spring connector at the lower steering column. Is a faulty connector or terminal or loose wire detected?	-	Go to Step 3	Go to Step 4
3	1. Repair or Replace the faulty connector, terminal, or wire. 2. Connect all the SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
4	1. Disconnect the SDM connector. 2. Check terminals 13 and 14 for loose terminals or wire. Is a problem found?	-	Go to Step 5	Go to Step 6
5	Replace the loose terminals or wires at SDM connector. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
6	1. Reconnect the SDM. 2. Connect dummy resistance (2.15 ± 0.35 Ω) to driver airbag connector instead of driver airbag. 3. Connect other SRS components. 4. Enable the SRS. 5. Turn the ignition switch to ON and check for DTCs with scan tool. Is DTC 21 still current?	-	Go to Step 8	Go to Step 7
7	Replace driver airbag. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
8	1. Disable the SRS. 2. Disconnect C203. 3. Connect dummy resistance (2.15 ± 0.35 Ω) to SDM side terminal of C203. 4. Enable the SRS. 5. Turn the ignition switch to ON and check for DTCs with scan tool. Is DTC 21 still current?	-	Go to Step 9	Go to Step 14
9	Measure resistance between terminal 1 and 2 of connector C203. Is the resistance within the specified value?	≈ 0 v	Go to Step 11	Go to Step 10
10	Repair open circuit between C203 and SDM. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
11	1. Disconnect the SDM. 2. Measure resistance between terminal 1 or 2 of C203 and ground. Is the resistance equal to specified value? 3. Measure the voltage between terminal 1 or 2 of the driver airbag module and ground. Is the voltage within the specified value?	∞ ≈ 0 v	Go to Step 10	Go to Step 9

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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Step	Action	Value(s)	Yes	No
12	1. Repair short to ground or short to voltage circuit between SDM and C203. 2. Connect all SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
13	1. Replace SDM. 2. Connect all SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
14	1. Repair short to ground or short to voltage circuit in clock spring and replace the clock spring as needed. 2. Connect all SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-

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DIAGNOSTIC TROUBLE CODE (DTC) 22
PASSENGER AIRBAG DEPLOYMENT LOOP RESISTANCE LOW

Circuit Description

When the ignition switch is turned to ON, the sensing and diagnostic module (SDM) will perform tests to diagnose critical malfunctions within SDM itself. Upon passing these tests ignition and deployment loop voltages are measured to ensure that they are within their respective normal voltage ranges. The SDM then proceeds with resistance measurement test. Passenger low terminal 11 is grounded through a current sink. The current source is connected to driver high terminal 10 to allow a known amount of the current flow. By monitoring the voltage difference between passenger high and passenger low, the SDM calculates the combined resistance of the passenger inflator module, the harness wiring, and connector terminal contacts.

DTC 22 Will Set When

DTC 22 will set when the resistance of the passenger airbag deployment loop is below a specified value ($1.4 \pm 0.5\,\Omega$).

The test is run once each ignition cycle during the resistance measurement test when the ignition voltage is above a specified value.

Action Taken

The SDM will turn on the airbag indicator (blink mode 2) and set DTC 22. And passenger airbag deployment loop shutdown.

DTC 22 Will Clear When

The ignition switch is turned OFF or the scan tool CLEAR CODES command is received.

Diagnostic Aids

All intermittent condition is likely to be the caused by a poor connection from the passenger airbag to the SDM terminal 11 or 12. The test for this DTC is run only while the airbag indicator is performing the start-up test. When a scan tool CLEAR CODES command is issued and the malfunction is still present, the DTC will not reappear until next ignition cycle.

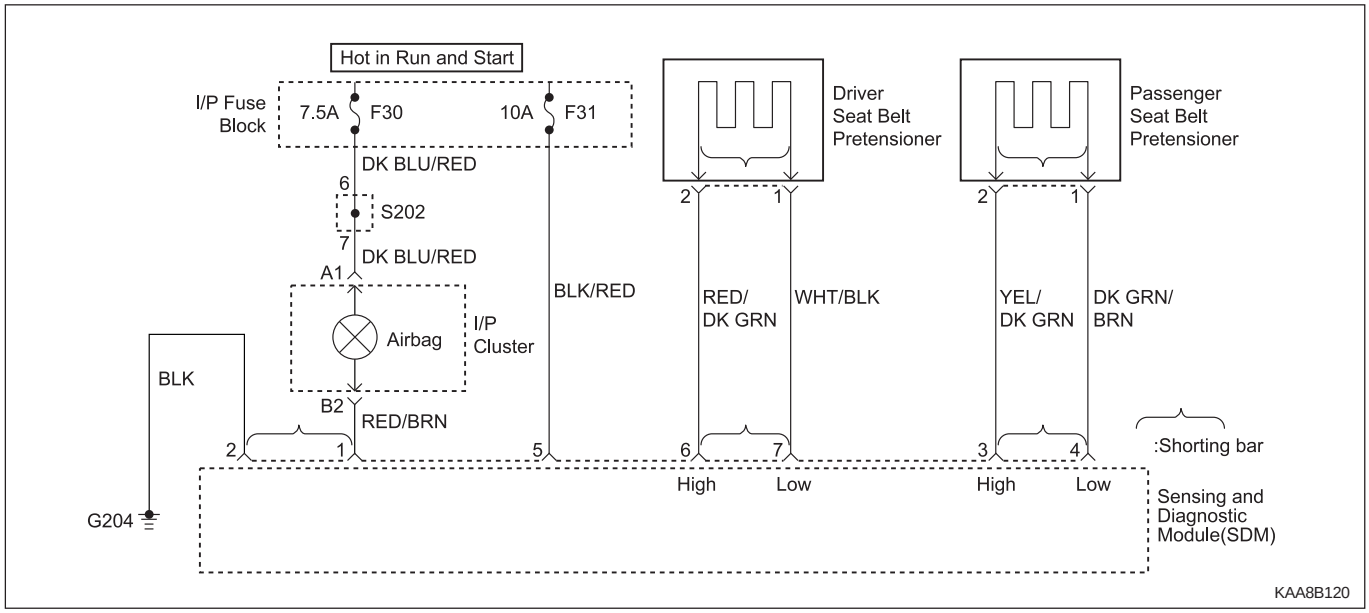
DTC 22 - Passenger Airbag Deployment Loop Resistance Low

Caution: The sensing and diagnosis module (SDM) can maintain sufficient voltage to deploy the airbags and pretensioners for 0.15 seconds after the ignition is OFF and the fuse has been removed. If the airbags or pretensioners are not disconnected, do not begin service until one minute has passed after disconnecting power to the SDM. Otherwise, injury could result.

Caution: During service procedure, be very careful when handling the SDM. Never strike or jar the SDM. Never power the supplemental restraints system (SRS) when the SDM is not rigidly attached to the vehicle. Also SDM mounting nuts must be carefully tightened to ensure proper operation of the SRS. The SDM could be activated if it is powered when it is not rigidly attached to the vehicle, resulting in unexpected deployment and possible injury.

Step	Action	Value(s)	Yes	No
1	Perform the SRS Diagnostic System Check. Is the SRS Diagnostic System Check complete?	-	Go to Step 2	-
2	1. Disable the Supplemental Restraint System (SRS). Refer to “Disabling the Supplemental Restraint System (SRS)” in this section. 2. Disconnect the passenger airbag module yellow connector located at the rear of glove box. 3. Inspect the passenger airbag module connector for damage or loose terminals or wires. Is a faulty connector, terminal, or wire detected?	-	Go to Step 3	Go to Step 4
3	1. Repair or replace the faulty wires, terminals or connectors. 2. Connect all the SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
4	1. Disconnect the SDM connector. 2. Check the SDM connector terminal 11 and 12 for loose terminals. Is a problem found?	-	Go to Step 5	Go to Step 6
5	1. Repair the loose terminals or wires. 2. Connect all SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
6	1. Connect dummy resistance (2.15 ± 0.35 Ω) to passenger airbag connector instead of passenger airbag. 2. Enable the SRS. Is the repair complete?	-	Go to Step 7	Go to Step 8
7	Replace passenger airbag. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
8	Measure resistance between terminal 1 and 2 of the passenger airbag module connector. Is the resistance within the specified value?	≈ 0 v	Go to Step 10	Go to Step 9
9	Repair open circuit between passenger airbag module connector and SDM. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
10	1. Disconnect the SDM. 2. Measure resistance between terminal 1 or 2 of the passenger airbag module connector and ground. Is the resistance equal to specified value? 3. Measure the voltage between terminal 1 or 2 of the passenger airbag module connector and ground. Is the voltage within the specified value?	∞ ≈ 0 v	Go to Step 12	Go to Step 11
11	Repair short to ground or short to voltage circuit between SDM to passenger airbag module. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
12	1. Replace SDM. 2. Connect all SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-

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DIAGNOSTIC TROUBLE CODE (DTC) 23 DRIVER SEAT BELT PRETENSIONER DEPLOYMENT LOOP RESISTANCE LOW

Circuit Description

When the ignition switch is turned to ON, the sensing and diagnostic module (SDM) will perform tests to diagnose critical malfunctions within SDM itself. Upon passing these tests ignition and deployment loop voltages are measured to ensure that they are within their respective normal voltage ranges. The SDM then proceeds with resistance measurement test. Driver seat belt pretensioner low terminal 7 is grounded through a current sink. The current source is connected to driver seat belt pretensioner high terminal 6 to allow a known amount of the current flow. By monitoring the voltage difference between driver seat belt pretensioner high and driver seat belt pretensioner low, the SDM calculates the combined resistance of the driver seat belt pretensioner inflator module, the harness wiring, and connector terminal contacts.

DTC 23 Will Set When

DTC 23 will set when the resistance of driver seat belt pretensioner deployment loop is below a specified value (1.4 ± 0.5 Ω). The test is run once each ignition cycle during the resistance measurement test when the ignition voltage is above a specified value.

Action Taken

The SDM will turn on the airbag indicator (blink mode 4) and set DTC 23. And driver seat belt pretensioner deployment loop shutdown.

DTC23 Will Clear When

The ignition switch is turned OFF or the scan tool CLEAR CODES command is received.

Diagnostic Aids

All intermittent condition is likely to be the caused by a poor connection from the driver seat belt pretensioner to the SDM terminal 6 or 7. The test for this DTCis run only while the airbag indicator is performing the start-up test. When a scan tool CLEAR CODES command is issued and the malfunction is still present, the DTC will not reappear until next ignition cycle.

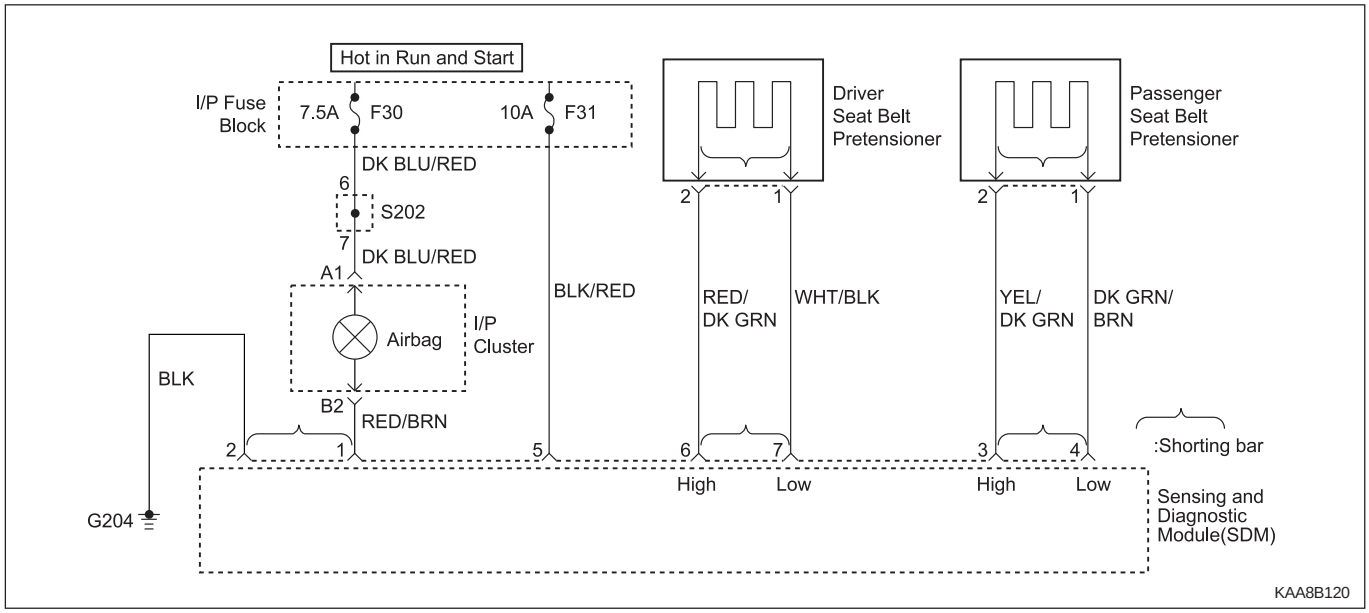
DTC 23 - Driver Seat Belt Pretensioner Deployment Loop Resistance Low

Caution: The sensing and diagnosis module (SDM) can maintain sufficient voltage to deploy the airbags and pretensioners for 0.15 seconds after the ignition is OFF and the fuse has been removed. If the airbags or pretensioners are not disconnected, do not begin service until one minute has passed after disconnecting power to the SDM. Otherwise, injury could result.

Caution: During service procedure, be very careful when handling the SDM. Never strike or jar the SDM. Never power the supplemental restraints system (SRS) when the SDM is not rigidly attached to the vehicle. Also SDM mounting nuts must be carefully tightened to ensure proper operation of the SRS. The SDM could be activated if it is powered when it is not rigidly attached to the vehicle, resulting in unexpected deployment and possible injury.

Step	Action	Value(s)	Yes	No
1	Perform the SRS Diagnostic System Check. Is the SRS Diagnostic System Check complete?	-	Go to Step 2	-
2	1. Disable the Supplemental Restraint System (SRS). Refer to “Disabling the Supplemental Restraint System (SRS)” in this section. 2. Disconnect the driver seat belt pretensioner yellow connector located inside of rear lower quarter panel. 3. Inspect the driver seat belt pretensioner connector for damage or loose terminals or wires. Is a faulty connector, terminal, or wire detected?	-	Go to Step 3	Go to Step 4
3	1. Repair or replace the faulty wires, terminals or connectors. 2. Connect all the SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
4	1. Disconnect the SDM connector. 2. Check the SDM connector terminal 6 and 7 for loose terminals. Is a problem found?	-	Go to Step 5	Go to Step 6
5	1. Repair the loose terminals or wires. 2. Connect all SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
6	1. Connect dummy resistance (2.15 ± 0.35 Ω) to driver seat belt pretensioner connector instead of driver seat belt pretensioner. 2. Enable the SRS. Is the repair complete?	-	Go to Step 7	Go to Step 8
7	Replace the driver seat belt pretensioner. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
8	Measure resistance between terminal 1 and 2 of the driver seat belt pretensioner connector. Is the resistance within the specified value?	≈ 0 v	Go to Step 10	Go to Step 9
9	Repair open circuit between the driver seat belt pretensioner connector and the SDM. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
10	1. Disconnect the SDM. 2. Measure resistance between terminal 1 or 2 of the driver seat belt pretensioner connector and ground. Is the resistance equal to specified value? 3. Measure the voltage between terminal 1 or 2 of the driver seat belt pretensioner connector and ground. Is the voltage within the specified value?	∞ ≈ 0 v	Go to Step 12	Go to Step 1
11	Repair short to ground or short to voltage circuit between SDM to driver seat belt pretensioner. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
12	1. Replace SDM. 2. Connect all SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-

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DIAGNOSTIC TROUBLE CODE (DTC) 24 PASSENGER SEAT BELT PRETENSIONER DEPLOYMENT LOOP RESISTANCE LOW

Circuit Description

When the ignition switch is turned to ON, the sensing and diagnostic module (SDM) will perform tests to diagnose critical malfunctions within SDM itself. Upon passing these tests ignition and deployment loop voltages are measured to ensure that they are within their respective normal voltage ranges. The SDM then proceeds with resistance measurement test. Passenger seat belt pretensioner low terminal 4 is grounded through a current sink. The current source is connected to passenger seat belt pretensioner high terminal 3 to allow a known amount of the current flow. By monitoring the voltage difference between passenger seat belt pretensioner high and passenger seat belt pretensioner low, the SDM calculates the combined resistance of the passenger seat belt pretensioner inflator module, the harness wiring, and connector terminal contacts.

DTC 24 Will Set When

DTC 24 will set when the resistance of passenger seat belt pretensioner deployment loop is below a specified value (1.4 ± 0.5 Ω). The test is run once each ignition cycle during the resistance measurement test when the ignition voltage is above a specified value.

Action Taken

The SDM will turn on the airbag indicator (blink mode 4) and set DTC 24. And passenger seat belt pretensioner deployment loop shutdown.

DTC24 Will Clear When

The ignition switch is turned OFF or the scan tool CLEAR CODES command is received.

Diagnostic Aids

All intermittent condition is likely to be the caused by a poor connection from the passenger seat belt pretensioner to the SDM terminal 3 or 4. The test for this DTC is run only while the airbag indicator is performing the start-up test. When a scan tool CLEAR CODES command is issued and the malfunction is still present, the DTC will not reappear until next ignition cycle.

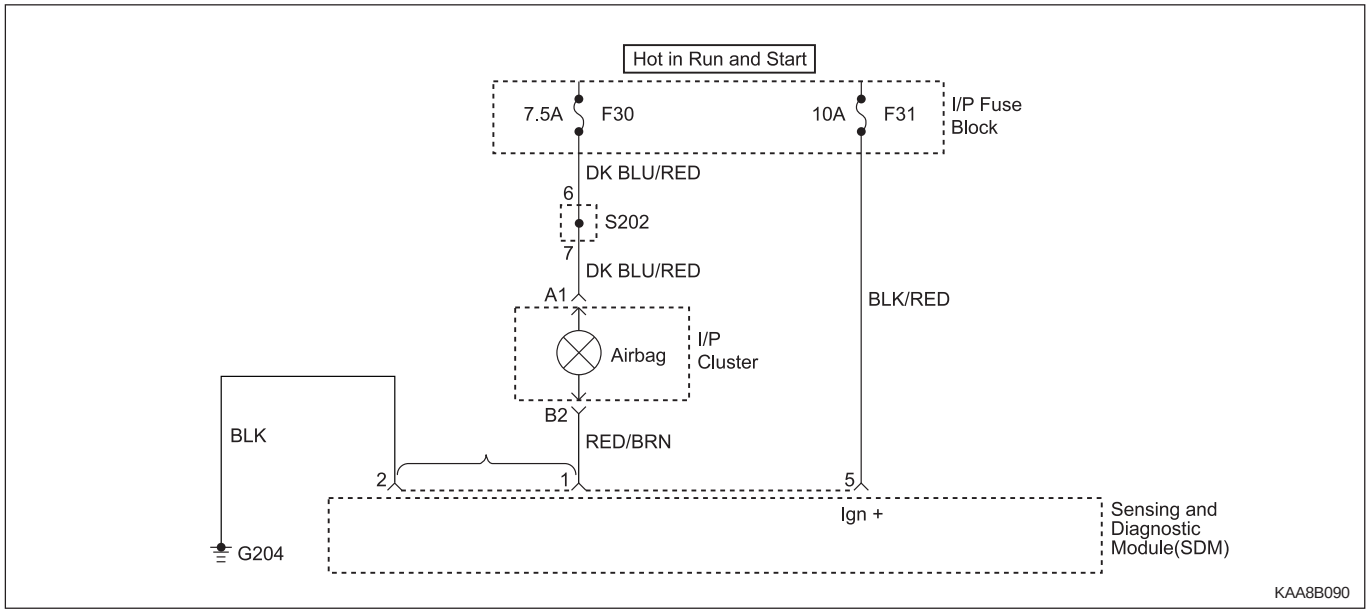
DTC 24 - Passenger Seat Belt Pretensioner Deployment Loop Resistance Low

Caution: The sensing and diagnosis module (SDM) can maintain sufficient voltage to deploy the airbags and pretensioners for 0.15 seconds after the ignition is OFF and the fuse has been removed. If the airbags or pretensioners are not disconnected, do not begin service until one minute has passed after disconnecting power to the SDM. Otherwise, injury could result.

Caution: During service procedure, be very careful when handling the SDM. Never strike or jar the SDM. Never power the supplemental restraints system (SRS) when the SDM is not rigidly attached to the vehicle. Also SDM mounting nuts must be carefully tightened to ensure proper operation of the SRS. The SDM could be activated if it is powered when it is not rigidly attached to the vehicle, resulting in unexpected deployment and possible injury.

Step	Action	Value(s)	Yes	No
1	Perform the SRS Diagnostic System Check. Is the SRS Diagnostic System Check complete?	-	Go to Step 2	-
2	1. Disable the Supplemental Restraint System (SRS). Refer to “Disabling the Supplemental Restraint System (SRS)” in this section. 2. Disconnect the passenger seat belt pretensioner yellow connector located inside of rear lower quarter panel. 3. Inspect the passenger seat belt pretensioner connector for damage or loose terminals or wires. Is a faulty connector, terminal, or wire detected?	-	Go to Step 3	Go to Step 4
3	1. Repair or replace the faulty wires, terminals or connectors. 2. Connect all the SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
4	1. Disconnect the SDM connector. 2. Check the SDM connector terminal 3 and 4 for loose terminals. Is a problem found?	-	Go to Step 5	Go to Step 6
5	1. Repair the loose terminals or wires. 2. Connect all SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
6	1. Connect dummy resistance (2.15 ± 0.35 Ω) to passenger seat belt pretensioner connector instead of passenger seat belt pretensioner. 2. Enable the SRS. Is the repair complete?	-	Go to Step 7	Go to Step 8
7	Replace the passenger seat belt pretensioner. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
8	Measure resistance between terminal 1 and 2 of the passenger seat belt pretensioner connector. Is the resistance within the specified value?	≈ 0 v	Go to Step 10	Go to Step 9
9	Repair open circuit between the passenger seat belt pretensioner connector and the SDM. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
10	1. Disconnect the SDM. 2. Measure resistance between terminal 1 or 2 of passenger seat belt pretensioner connector and ground. Is the resistance equal to specified value? 3. Measure the voltage between terminal 1 or 2 of passenger seat belt pretensioner connector and ground. Is the voltage within the specified value?	∞ ≈ 0 v	Go to Step 12	Go to Step 11
11	Repair short to ground or short to voltage circuit between SDM to passenger seat belt pretensioner. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
12	1. Replace SDM. 2. Connect all SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-

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DIAGNOSTIC TROUBLE CODE (DTC) 46 AIRBAG WARNING LAMP CIRCUIT OPEN OR SHORT TO GROUND/ BATTERY

Circuit Description

When the ignition switch is first turned ON, ignition voltage applied to the indicator lamp and also to the sensing and diagnostic module (SDM) input terminal 5. The SDM respond by illuminating the airbag indicator in instrument cluster for 4.5 seconds. If the SDM cannot detect ignition voltage at terminal 1, a DTC 46 will be set. The SDM also attempts to turn on the airbag indicator, but the indicator will not turn on if the inputs have not been correctly processed.

DTC 46 Will Set When

DTC 46 will set when during the continuos monitoring, the SDM fails to detect voltage terminal 1, the input terminal for airbag indicator.

Action Taken

The SDM also attempts to turn on the airbag indicator, but the indicator will not turn on if the inputs have not been correctly processed.

DTC 46 Will Clear When

The ignition switch is turned OFF or the problem is repaired.

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DTC 46 - Airbag Warning Lamp Circuit Open or Short to Ground/Battery

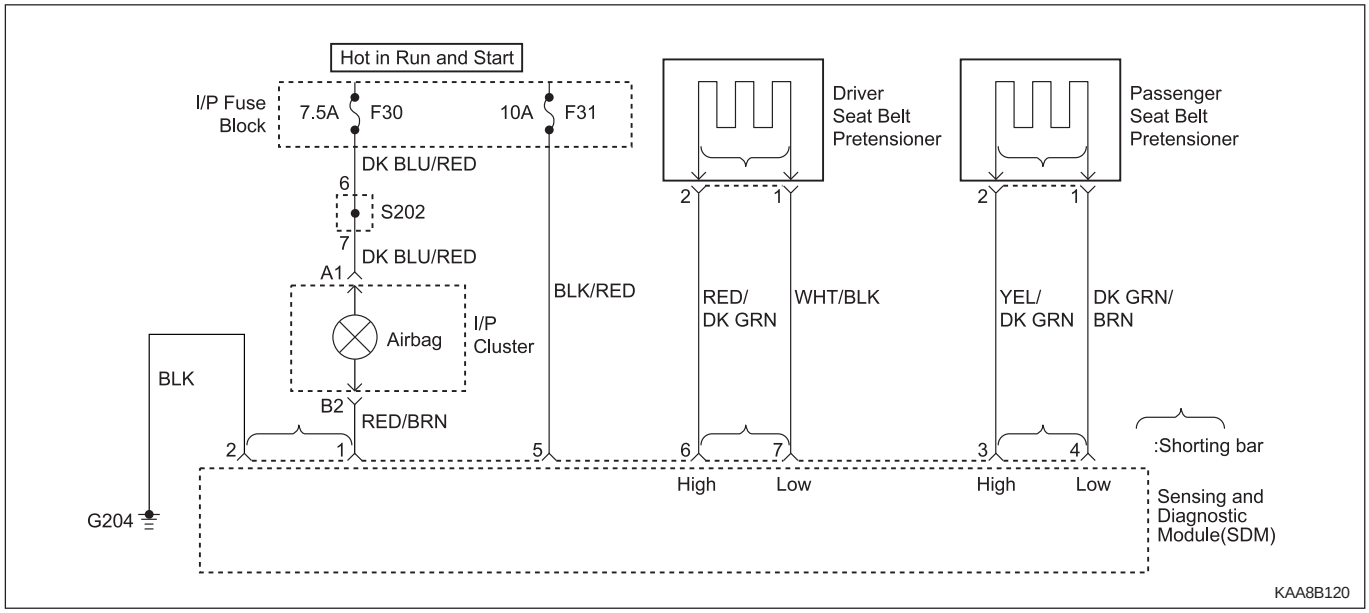
Caution: The sensing and diagnosis module (SDM) can maintain sufficient voltage to deploy the airbags and pretensioners for 0.15 seconds after the ignition is OFF and the fuse has been removed. If the airbags or pretensioners are not disconnected, do not begin service until one minute has passed after disconnecting power to the SDM. Otherwise, injury could result.

Caution: During service procedure, be very careful when handling the SDM. Never strike or jar the SDM. Never power the supplemental restraints system (SRS) when the SDM is not rigidly attached to the vehicle. Also SDM mounting nuts must be carefully tightened to ensure proper operation of the SRS. The SDM could be activated if it is powered when it is not rigidly attached to the vehicle, resulting in unexpected deployment and possible injury.

Step	Action	Value(s)	Yes	No
1	Perform the SRS Diagnostic System Check. Is the SRS Diagnostic System Check complete?	-	Go to Step 2	-
2	Check the fuse F30 in instrument panel fuse block. Is the fuse F30 blown?	-	Go to Step 3	Go to Step 4

Step	Action	Value(s)	Yes	No
3	1. Check for a short circuit and repair it. 2. Replace the fuse. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
4	1. Turn the ignition switch to ON. 2. Check power supply to fuse F30. Is the voltage equal to specified value?	11 - 14 v	Go to Step 6	Go to Step 5
5	Repair the power supply to fuse F30. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
6	1. Remove instrument cluster. 2. Check the airbag indicator bulb. Is the bulb in good condition?	-	Go to Step 8	Go to Step 7
7	Replace the airbag indicator bulb. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
8	1. Turn the ignition switch to ON. 2. Measure voltage at terminal A1 of instrument cluster connector. Is the voltage within the specified value?	11 - 14 v	Go to Step 10	Go to Step 9
9	Repair open circuit between the fuse F30 and terminal A1 of instrument connector. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
10	Test the instrument cluster printed circuit for continuity between terminal A1 and terminal B2 of the instrument cluster connector. Is there continuity between terminal A1 and terminal B2 on the printed circuit?	-	Go to Step 12	Go to Step 11
11	Replace the instrument cluster printed circuit or instrument cluster. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
12	1. Disable the SRS. Refer to “Disabling the supplemental restraint system (SRS)” in this section. 2. Disconnect the SDM electric connector. 3. Turn the ignition switch to ON. 4. Measure the voltage at terminal 1 of the SDM connector Is the voltage within the specified value?	-	Go to Step 14	Go to Step 13
13	Repair open circuit between terminal B2 of instrument cluster and terminal 1 of the SDM connector. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
14	1. Replace the SDM. 2. Connect all the SRS components and make sure properly mounted. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-

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DIAGNOSTIC TROUBLE CODE (DTC) 47 BATTERY VOLTAGE IS OUT OF SPECIFICATION

Circuit Description

When the ignition switch is first turned ON, ignition voltage applied to the indicator lamp and also to the sensing and diagnostic module (SDM) input terminal 5. The SDM respond by illuminating the airbag indicator in instrument cluster for 4.5 seconds. If the SDM cannot detect ignition voltage at terminal 5, a DTC 47 will be set.

DTC 47 Will Set When

DTC 47 will set when during the continuos monitoring, the SDM fails to detect normal operating voltage at terminal 5, the input terminal for ignition voltage supply.

Action Taken

The SDM will illuminates the airbag indicator, but the indicator will not turn on if the inputs have not been correctly processed.

DTC 47 Will Clear When

The ignition switch is turned OFF or the problem is repaired.

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DTC 47 - Battery Voltage is Out of Specification

Caution: The sensing and diagnosis module (SDM) can maintain sufficient voltage to deploy the airbags and pretensioners for 0.15 seconds after the ignition is OFF and the fuse has been removed. If the airbags or pretensioners are not disconnected, do not begin service until one minute has passed after disconnecting power to the SDM. Otherwise, injury could result.

Caution: During service procedure, be very careful when handling the SDM. Never strike or jar the SDM. Never power the supplemental restraints system (SRS) when the SDM is not rigidly attached to the vehicle. Also SDM mounting nuts must be carefully tightened to ensure proper operation of the SRS. The SDM could be activated if it is powered when it is not rigidly attached to the vehicle, resulting in unexpected deployment and possible injury.

Step	Action	Value(s)	Yes	No
1	Perform the SRS Diagnostic System Check. Is the SRS Diagnostic System Check complete?	-	Go to Step 2	-
3	1. Repair or replace the faulty wires, terminals or connectors. 2. Connect all the SRS components. Is the repair complete?	-	Go to Step 3	Go to Step 4

Step	Action	Value(s)	Yes	No
4	Measure the voltage at terminal 5 of SDM connector. Is the voltage within the specified value?	11 - 14 v	Go to Step 12	Go to Step 5
5	Check fuse F31 in I/P fuse block. Is the fuse F31 blown?	-	Go to Step 6	Go to Step 7
6	1. Check for a short circuit and repair it. 2. Replace the fuse. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
7	Measure the voltage at fuse F31. Is the voltage within the specified value?	11 - 14 v	Go to Step 9	Go to Step 8
8	Repair power supply to fuse F31. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
9	Repair open circuit between the terminal 5 of SDM connector and fuse F31. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-
12	1. Replace SDM. 2. Connect all SRS components. Is the repair complete?	-	Go to “SRS Diagnostic System Check”	-

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REPAIR INSTRUCTION

ON-VEHICLE SERVICE

SERVICE PRECAUTION

Caution: The sensing and diagnosis module (SDM) can maintain sufficient voltage to deploy the airbags and pretensioner for 0.15 seconds after the ignition is OFF and the airbag fuse has been removed. If the airbags or pretensioners are not disconnected, do not begin service until one minute has passed after disconnecting power to the SDM. If the airbag are disconnected, service can begin immediately without waiting for one-minute time period to expire. Failure to temporarily disable the SRS during service can result in unexpected deployment, personal injury, and otherwise unneeded SRS repairs.

DISABLING THE SUPPLEMENTAL RESTRAINT SYSTEM (SRS)

1. Turn the steering wheel to the straight-ahead position.
2. Turn the ignition switch to LOCK and remove the key.
3. Remove the airbag fuse F31 in the I/P fuse block and wait more than one minute for SRS capacitor to discharge.

ENABLING THE SUPPLEMENTAL RESTRAINT SYSTEM (SRS)

Enabling the supplemental restraint system (SRS) is reverse order of “Disabling the Supplemental Restraint System (SRS)”.

Caution: Staying well away from the inflator modules, turn the ignition key switch to ON, and verify that the airbag indicator illuminates for 4.5 seconds and turns OFF. If it does not operate as described, perform the “SRS Diagnostic System Check” referring in this section.

HANDLING, INSTALLATION AND DIAGNOSIS

- Airbag modules should not be subjected to temperature above 65°C (149°F)
- An airbag module or sensing and diagnostic module (SDM) should not be used if it has been dropped from height of 0.9 meters (3 feet) or greater.
- It is very important for the SDM to be installed flat on the mounting surface, parallel to the vehicle’s longitudinal axis.
- To avoid setting diagnostic trouble codes (DTCs), do not apply power to the SRS unless all components are connected or a diagnostic chart request it.
- The SRS Diagnostic System Check must be the starting point of any SRS diagnostics. The SRS Diagnostic System Check will verify proper airbag indicator operation and will lead you to correct chart to diagnose any SRS malfunctions. Bypassing these procedures may result in extended diagnostic time and incorrect parts replacements.

REPAIRS AND INSPECTIONS REQUIRED AFTER AN ACCIDENT

Caution: any repairs to the vehicle’s structure must return it to the original production configuration. Deployment requires replacement of SDM, the inflator modules, and a dimensional inspection of the steering column.

- If any SRS components are damaged, they must be replaced. If SRS components mounting points are damaged, they must be repaired or replaced.
- Never use SRS parts from another vehicle. This does not include remanufactured parts purchased from an authorized source.
- Do not attempt to service the SDM, the clock spring, or other airbag modules, these items must be replaced if they are defective.
- Verify the part number of replacement airbag modules. Some inflator modules look identical but contain different internal components.

ACCIDENT WITH DEPLOYMENT - COMPONENTS REPLACEMENT

All SRS components must be replaced after frontal crash involving airbag deployment. After deployment, a powdery residue may be on the surface of the airbag. The powder consists primarily of cornstarch (used to lubricate the bag as it inflates) and by-products of the chemical reaction. Sodium hydroxide dust (similar to lye soap) is produced as a by-product of the deployment reaction. The sodium hydroxide then quickly reacts with atmospheric moisture and is converted to sodium carbonate and sodium bicarbonate (also known as baking soda). Therefore, it is unlikely that sodium hydroxide will be present after deployment. Replace the following SRS components.

Caution: Wear gloves and safety glasses during the disposal procedure. Refer to “Deployed Airbag Module Disposal Procedure” in this section.

- The SDM.
- Airbag modules and pretensioners
- SRS wiring
- Clock spring

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ACCIDENT WITHOUT DEPLOYMENT - COMPONENT INSPECTION

Certain inspection must be performed after any crash, whether the airbag has deployed or not:

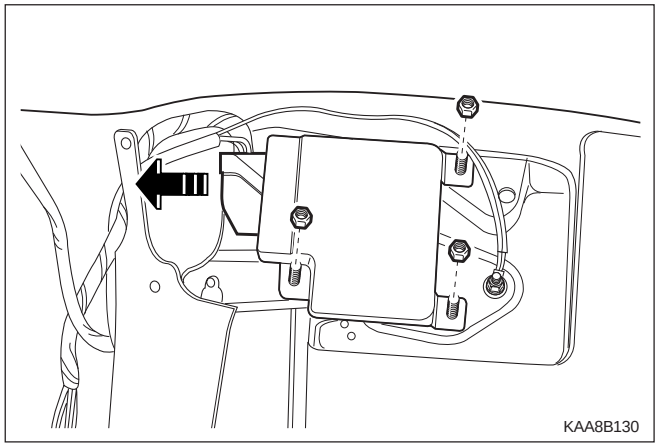
- The steering column must be dimensionally inspected.
- Inspect the knee bolsters and mounting points for distortion, bending, cracking, or other damage.
- Inspect the instrument panel (I/P) and steering column reinforcement plate for distortion, bending, cracking, or other damage.
- Inspect the I/P braces for distortion, bending, cracking, or other damage.
- Inspect seat belt and mounting points. Refer to *Section 8A, Seat Belts*.

SENSING AND DIAGNOSTIC MODULE (SDM)

Caution: during service procedures, be very careful when handling the SDM. Never strike or jar the SDM. Never power up the SRS when the SDM is not rigidly attached to the vehicle. All SDM mounting nuts must carefully tightened, to ensure proper operation of the SRS. The SDM could be activated if it is powered while not rigidly attached to the vehicle, resulting in unexpected deployment and possible injury.

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Important: If the vehicle interior has been exposed to extensive water intrusion such as water leaks, driving through high water, flooding, or other causes, the sensing and diagnostic module (SDM) and SDM connector may need to be replaced. With the ignition OFF, inspect the area around the SDM, including the carpet. If any significant soaking or evidence of previous soaking is detected, the water must be removed, the water damage repaired, and the SDM and SDM connector must be replaced. Before attempting any of these repairs, the supplemental restraint system (SRS) must be disabled. Refer to"Disabling the Supplemental Restraint System (SRS)" in this section.



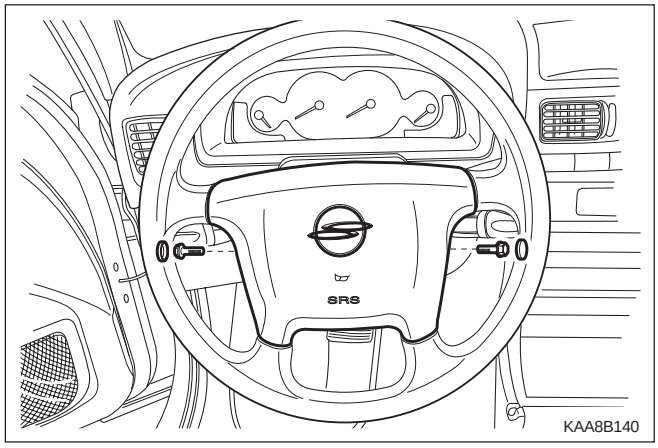
Removal and installation Procedure

1. Disable the supplemental restraint system (SRS). Refer to “Disabling the SRS” in this section.
2. Remove the connector position assurance lock, which is tethered to the SDM connector.
3. Disconnect the SDM electrical connector.
4. Remove the SDM mounting nuts and grounding nut.

   Installation Notice

Tightening Torque	12 N•m (106 lb-in)

5. Remove the SDM.
6. Installation should follow the removal procedure in the reverse order.
   Notice: Enable the SRS. Refer to “Enabling the SRS” in this section.



DRIVER AIRBAG MODULE

Removal and installation Procedure

1. Disconnect the negative battery cable.

   Caution: The SDM can maintain sufficient voltage to deploy the airbags for 0.15 seconds after the Ignition is OFF and the airbag fuse has been removed. If the airbags are not disconnected, service cannot begin until one minute has passed after disconnecting power to the SDM. If the airbags are disconnected, service can begin immediately without waiting for one-minute time period to expire. Failure to temporarily disable the SRS during service result in unexpected deployment, personal injury, and otherwise unneeded SRS repair.

2. Disable the supplemental restraint system (SRS). Refer to “Disabling the SRS” in this section.
3. Position the steering wheel straight ahead.
4. Remove the driver airbag module mounting bolts.

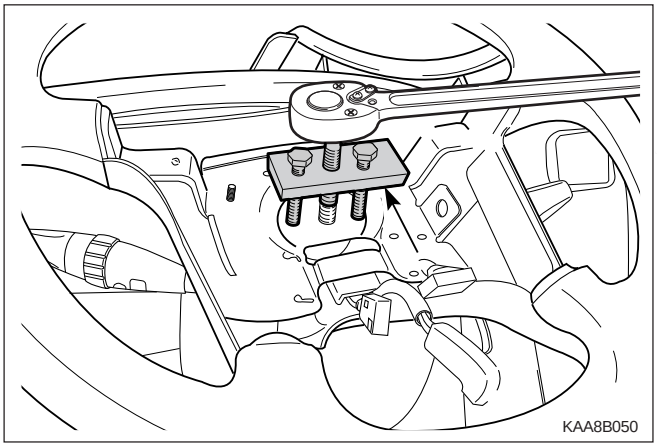
   Installation Notice

Tightening Torque	8 N•m (71 lb-in)

   Caution: When handling an airbag module, always keeps the top of the unit facing upward. This leaves room for the airbag to expand if the module unexpectedly deploys. Without room for expansion, a module suddenly propelled toward a person or object can cause injury or vehicle damage.

5. Remove the connector from the horn terminal and the driver airbag module.
6. Remove the driver airbag module.
7. Installation should follow the removal procedure in the reverse order.

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CLOCK SPRING

Removal and installation Procedure

Caution: The SDM can maintain sufficient voltage to deploy the airbags for 0.15 seconds after the Ignition is OFF and the airbag fuse has been removed. If the airbags are not disconnected, service cannot begin until one minute has passed after disconnecting power to the SDM. If the airbags are disconnected, service can begin immediately without waiting for one-minute time period to expire. Failure to temporarily disable the SRS during service result in unexpected deployment, personal injury, and otherwise unneeded SRS repair.

1. Disconnect the negative battery cable.
2. Remove the driver airbag module. Refer to “Driver Airbag Module” in this section.
3. Remove the steering wheel. Refer to *Section 6E, Steering Wheel and Column*.
4. Remove the steering column cover. Refer to *Section 6E, Steering Wheel and Column*.
5. Carefully full the instrument panel lower cover.
6. Remove driver side knee bolster.
7. Disconnect the clock spring, horn and remote audio control connectors at the lower steering column.
8. Remove the screws and the clock spring from the steering shaft.

Installation Notice

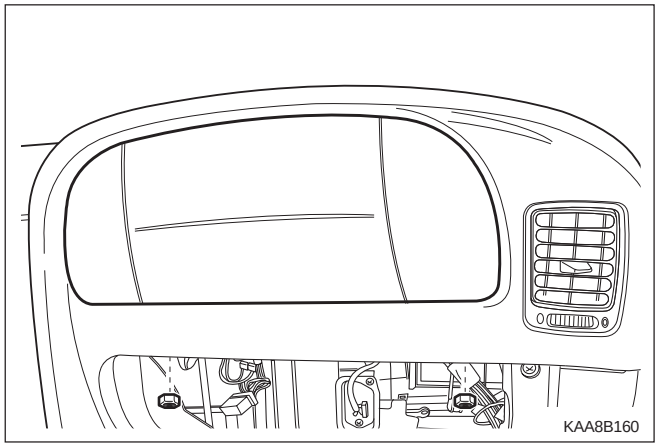
Tightening Torque	4 N•m (35 lb-in)

- Turning the clock spring more than three turns clockwise or counterclockwise can damage the spring.
- Align the clock spring before installation. Turn the lobe of the clock spring clockwise to lock but do not force. Then turn the lobe of clock spring count clockwise approximately three turns to the neutral position, with the front of the wheels straight ahead. Properly align the pointed marks on the components of the clock spring.

9. Installation should follow the removal procedure in the reverse order.

Caution: If the clock spring is not properly aligned, the steering wheel may not be able to rotate completely during a turn. Restricted turning ability can cause the vehicle to crash. Improper alignment of the clock spring also may make the supplemental restraint system (SRS) inoperative, preventing the airbag from deploying during crash. Both of the out comes can result in injury.

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PASSENGER AIRBAG MODULE

Removal and installation Procedure

Caution: The SDM can maintain sufficient voltage to deploy the airbags for 0.15 seconds after the Ignition is OFF and the airbag fuse has been removed. If the airbags are not disconnected, service cannot begin until one minute has passed after disconnecting power to the SDM. If the airbags are disconnected, service can begin immediately without waiting for one-minute time period to expire. Failure to temporarily disable the SRS during service result in unexpected deployment, personal injury, and otherwise unneeded SRS repair.

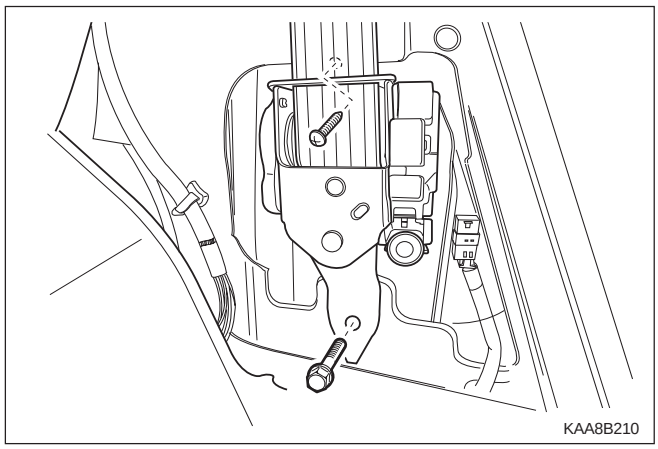
1. Disconnect the negative battery cable.
2. Remove the glove box. Refer to *Section 9E, Instrumentation/Driver Information*.
3. Disconnect the passenger airbag yellow electrical connector.
4. Remove two nuts form the airbag bracket.

Installation Notice

Tightening Torque	16 N•m (12 lb-ft)

5. Remove the passenger airbag module from the instrument panel by pushing back side of passenger airbag.
6. Installation should follow the removal procedure in the reverse order.

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FRONT SEAT BELT PRETENSIONER

For removal and installation refer to *Section 8A, Seat Belts.*

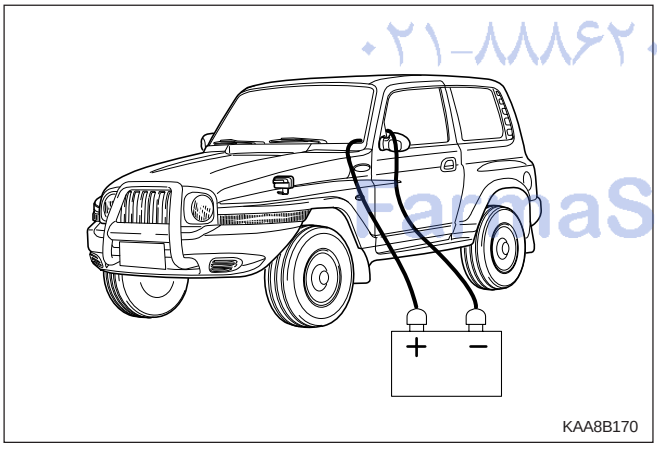
AIRBAG MODULE DEPLOYMENT (IN VEHICLE)

Deploy airbags before disposing of them. If a vehicle to be scraped, the airbag may be deployed inside the vehicle.

Caution: To avoid injury while deploying an airbag or a pretensioner in the vehicle, observe the following precaution:

- ***Before deploying the airbags, remove all loose objects from the airbag's expansion area.***
- ***Deploy the airbags with the vehicle doors closed and the side windows open.***
- ***Deploy the airbags only in an evacuated area. Service personnel who must be present during the deployment should be at least 10 meters (33 feet) in front of the vehicle.***
- ***Do not connect the voltage source until after having completed all other preparations for the deployment of the airbags.***
- ***Allow a deployed airbag module or pretensioner to cool for at least 30 minutes before handling.***
- ***Wear gloves and eye protection during the disposal procedure.***
- ***If the deployment fails, disconnect the voltage source and wait 5 minutes before approaching the vehicle.***

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Deployment Procedure

Caution: The SDM can maintain sufficient voltage to deploy the airbags for 0.15 seconds after the Ignition is OFF and the airbag fuse has been removed. If the airbags are not disconnected, service cannot begin until one minute has passed after disconnecting power to the SDM. If the airbags are disconnected, service can begin immediately without waiting for one-minute time period to expire. Failure to temporarily disable the SRS during service result in unexpected deployment, personal injury, and otherwise unneeded SRS repair.

1. Disconnect both battery cables and place the battery at least 10 meters (33 feet) from the vehicle.
2. Remove the knee bolster from the steering column. Refer to *Section 9G, Interior Trim.*
3. At the lower steering column, cut the two wires leading from the supplemental restraint system (SRS) harness to the clock spring.
4. Strip 13 mm (0.5 inch) of the insulation from the end of the wires leading to the clock spring.
5. Use two additional wires, each at least 10 meters (33 feet) long, to reach from the deployment battery to the inflator module.
6. Strip 13 mm (0.5 inch) of the insulation from the ends of these two additional wires.

7. Twist the two wires together at one end.
8. Place the twisted ends of the two wires near the deployment battery. Do not connect the wires to the battery at this time.
9. Using the free ends of the 10 meters (33 feet) wires leading to the clock spring, make two splices, one at each wires from the airbag modules.
10. Wrap the wires with insulation tape.
11. Now that the free ends of the 10 meters (33 feet) wires are spliced to the airbag module wires, and the ends that are twisted together are near the deployment battery, clear the area.
12. Untwist the wires that near the deployment battery.
13. Touch one wire to the positive battery terminal and touch the other wire to the negative battery terminal. The airbag will deploy.
14. Repeat the procedure for the passenger airbag and pretensioners.
15. Using proper precautions, dispose of the deployed airbag/pretensioner. Refer to “Deployed Airbag Module Disposal Procedure” in this section.

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AIRBAG MODULE DEPLOYMENT (OUTSIDE OF VEHICLE)

If the vehicle is within the warranty period, contact the Daewoo regional service manager for approval or special instructions before deploying the airbag modules.

Deploy airbag modules in following situations:

- If the vehicle is to be scrapped. Refer to “Airbag Module Deployment (Inside of Vehicle)” in this section.
- If an airbag module is damaged during transit, storage, or service.

Caution: to avoid injury while deploying an airbag module or pretensioner outside the vehicle, observe following precaution:

- ***Deploy the airbags only in an evacuated area. Service personnel who must be present during the deployment should be at least 10 meters (33 feet) in front of the airbag module.***
- ***Do not connect the voltage source until after having completed all other preparations for the deployment of the airbags.***
- ***Allow a deployed airbag module or pretensioner to cool for at least 30 minutes before handling.***
- ***Wear gloves and eye protection during the disposal procedure.***
- ***If the deployment fails, disconnect the voltage source and wait 5 minutes before approaching the vehicle.***

1. Position the airbag module face up, on flat ground outdoors, at least 10 meters (33 feet) from the any obstacles or people.
2. Place a vehicle battery at least 10 meters (33 feet) away from the airbag module.
3. Deploy the airbag module using the deployment tool.
4. If you do not have deployment tool follow below procedure.
5. Cut the yellow wires to the airbag module/ pretensioner.
6. Strip 13 mm (0.5 inch) of the insulation from the end of the wires leading to the airbag module/ pretensioner.
7. Use two additional wires, each at least 10 meters (33 feet) long, to reach from the deployment battery to the airbag module/pretensioner.
8. Strip 13 mm (0.5 inch) of the insulation from the ends of these two additional wires.
9. Twist the two wires together at one end.
10. Place the twisted ends of the two wires near the deployment battery. Do not connect the wires to the battery at this time.
11. Using the free ends of the 10 meters (33 feet) wires leading to the airbag module/pretensioner, make two splices, one at each wires from the airbag module/pretensioner.
12. Wrap the splices with insulating tape.
13. Now that the free ends of the 10 meters (33 feet) wires are spliced to the airbag module/ pretensioner wires, and the ends that are twisted together are near the deployment battery, clear the area.
14. Untwist the wires that near the deployment battery.
15. Touch one wire to the positive battery terminal and touch the other wire to the negative battery terminal. The airbag module/pretensioner will deploy.
16. Using proper precautions, dispose of the deployed airbag module/pretensioner. Refer to “Deployed Airbag Module Disposal Procedure” in this section.

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DEPLOYED AIRBAG MODULE DISPOSAL PROCEDURE

Caution: After deployment, a powdery residue may be on the surface of the airbag. The powder consists primarily of cornstarch (used to lubricate the bag as it inflates) and by-products of the chemical reaction. Sodium hydroxide dust (similar to lye soap) is produced as a by-product of the deployment reaction. The sodium hydroxide then quickly reacts with atmospheric moisture and is converted to sodium carbonate and sodium bicarbonate (also known as baking soda). Therefore, it is unlikely that sodium hydroxide will be present after deployment.

Caution: Wear gloves and eye protection during the disposal procedure.

Caution: After deployment, the metal surfaces of the airbag module will be hot. In order to avoid the risk of an injury or a fire, do not place the deployed airbag module near any flammable objects, and allow the airbag module to cool for 30 minutes before handling.

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Deploy an airbag or pretensioner before disposing of it. This includes those in a whole vehicle being scrapped. If the vehicle is still within the warranty period contact the Daewoo regional service manager for approval or special instructions before deploying an airbag module or a pretensioner. Deployed airbag module or pretensioner should be disposed of in the same manner as other scrap parts, with the addition of the following steps:

1. Place the deployed airbag or pretensioner in a sturdy plastic bag.
2. Seal the plastic bag securely.
3. Wash your hands and rinse them with water after handling a deployed airbag.

SRS WIRING REPAIR

Connector Repair

Caution: Before attempting any repairs, the SRS must be disabled. Refer to "Disabling the SRS" in this section for instructions on how to disable the SRS.

The terminals in the SRS are made of special metal to provide necessary contact integrity for the sensitive, low-energy circuits. These terminals are available only in connector repair assembly packs. Do not substitute any other terminals for those in the assembly packs.

Wire Repair

Caution: Before attempting any repairs, the SRS must be disabled. Refer to "Disabling the SRS" in this section for instructions on how to disable the SRS.

Do not repair any wires of supplemental restraint system (SRS). Replace any damaged wires with new one.

SPECIFICATIONS

GENERAL SPECIFICATION

Application	Description
Airbag System Deployment Time	< 20ms
Detection Time	< 5ms
Operating Temperature	- 40°C ~ + 85°C
Storage Temperature	- 40°C ~ + 90°C
Airbag Replacement interval	Every 10-year after installation
Voltage Range	9 - 16 V
Current Consumption	5 ms after ignition switch ON < 1A 5 ms ~ 5 sec < 300 mA, after 5sec. < 100 mA
Acceleration Range	± 50 g
Maximum Acceleration	± 600 g pulse
Voltage Ramp	0.2 ~ 2.0 V/s
Energy Reservation	150 ms after battery disconnection
Inflator Ignition Energy	4.3 mJ
Squib Resistance	2.15 ± 0.35 Ω
Airbag Warning Lamp ON Time (When Ignition ON)	6 sec ± 4.5 sec

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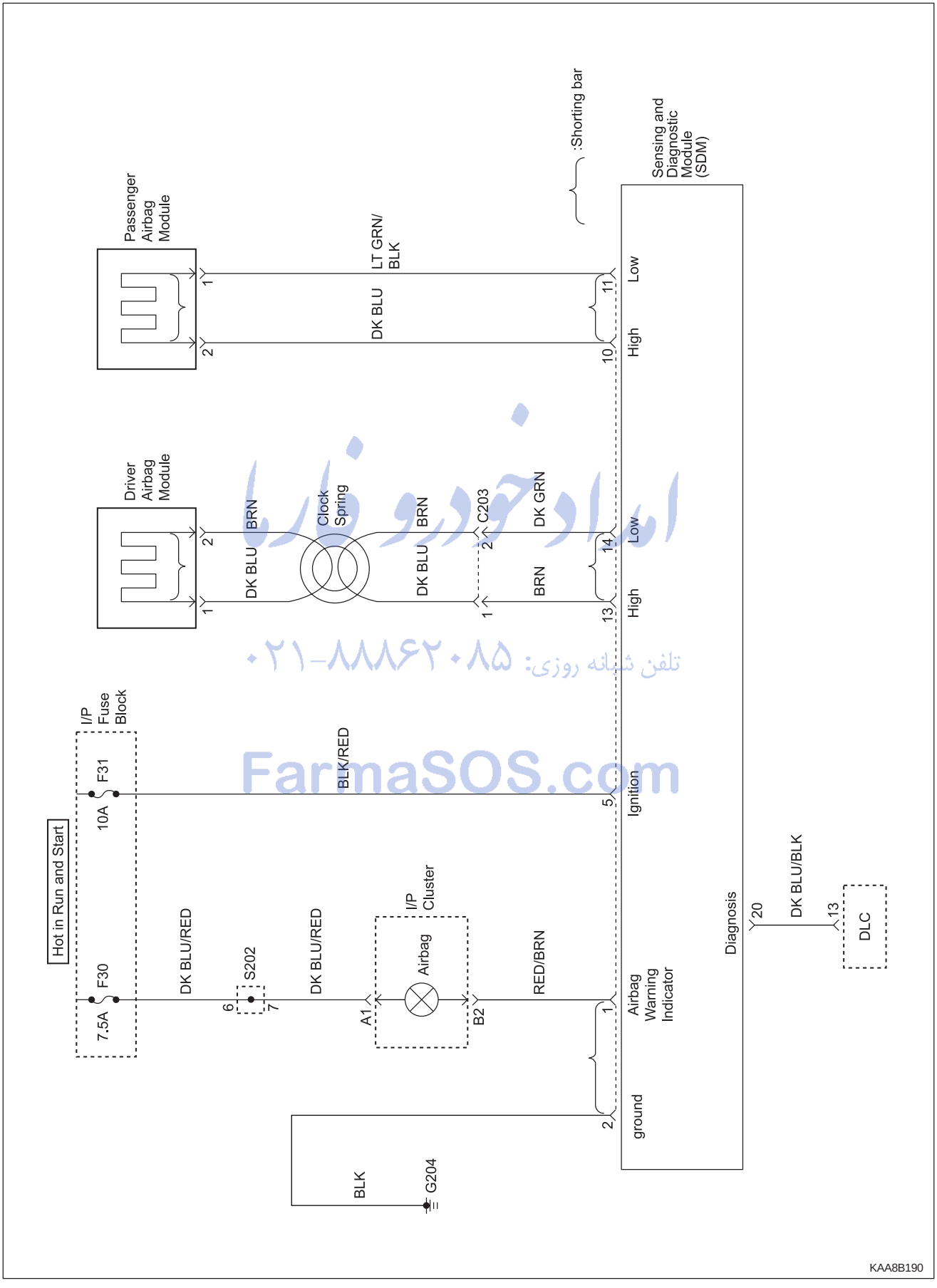
FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Clock Spring Mounting Bolt	4	-	35
Driver Airbag Module Mounting Nuts	8	-	71
Passenger Airbag Module Mounting Bolts	16	12	-
Sensing and Diagnostic Module (SDM) Mounting Bolts	12	-	106

۰۲۱-۸۸۸۶۲۰۸۵ تلفن شبانه روزی
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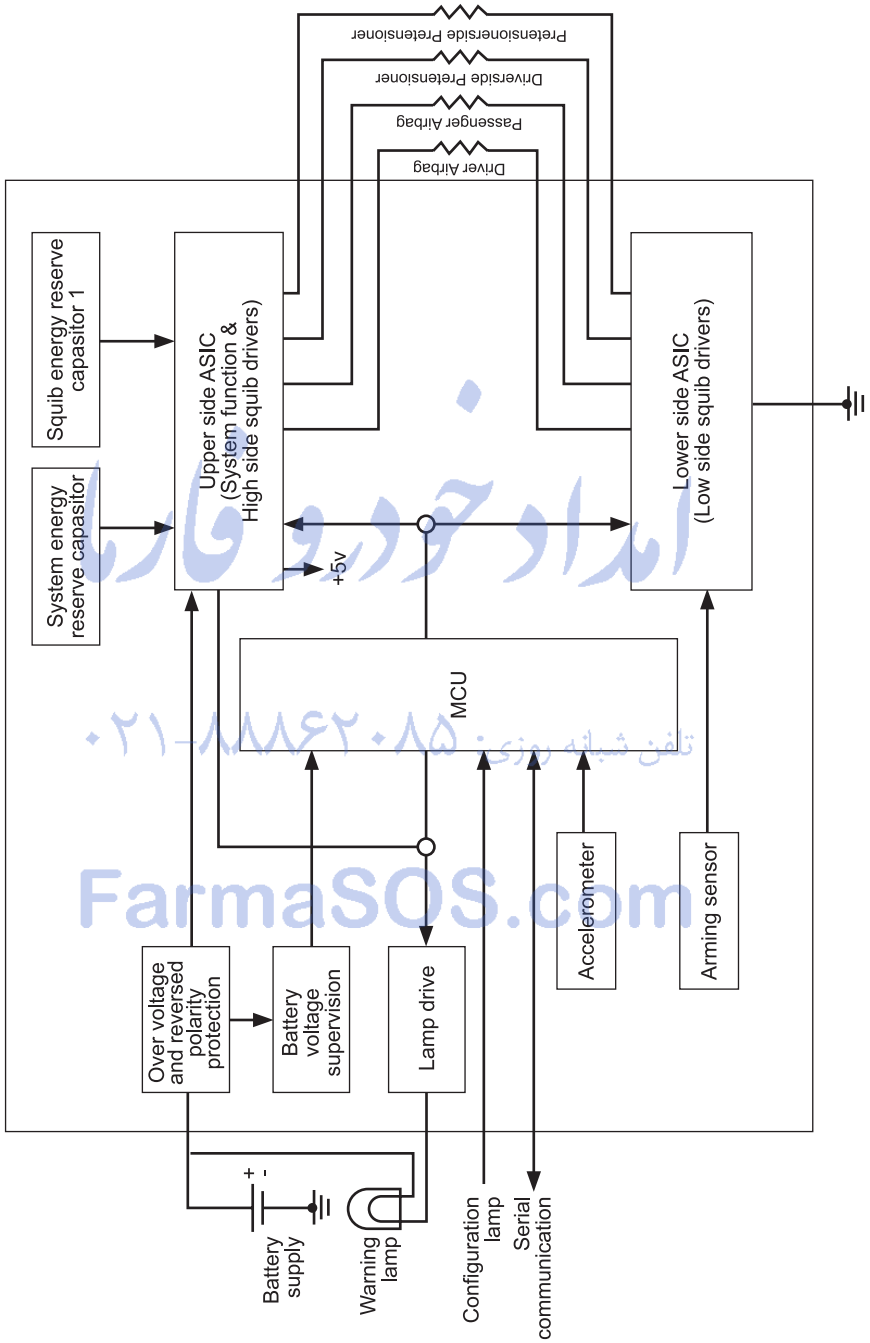
SCHEMATIC AND WIRING DIAGRAMS

SUPPLEMENTAL RESTRAINT SYSTEM



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SUPPLEMENTAL RESTRAINT SYSTEM SCHEMATIC DIAGRAM



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SECTION 9A

BODY WIRING SYSTEM

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

General Description 9A-2

Wire Color Chart 9A-2

Engine Room Fuse & Relay Box 9A-3

Usage of Fuse in Engine Room Fuse Box 9A-5

Passenger Room Fuse Box 9A-6

Usage of Fuse in Engine Room Fuse Box 9A-7

Schematic and Routing Diagrams 9A-8

Engine Room Fuse & Relay Circuit 9A-8

Wiring Harness & Connector & Ground Location 9A-11

W/H Engine Room 9A-11

W/H Main 9A-12

W/H Main (Floor) 9A-14

W/H Roof 9A-15

W/H Seat Heater 9A-16

W/H Door 9A-17

W/H Tail Gate 9A-18

W/H Air-Conditioner 9A-19

W/H Engine Control (Gasoline) 9A-20

W/H Pre-Heating (Diesel) 9A-21

W/H Transmission 9A-22

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GENERAL DESCRIPTION

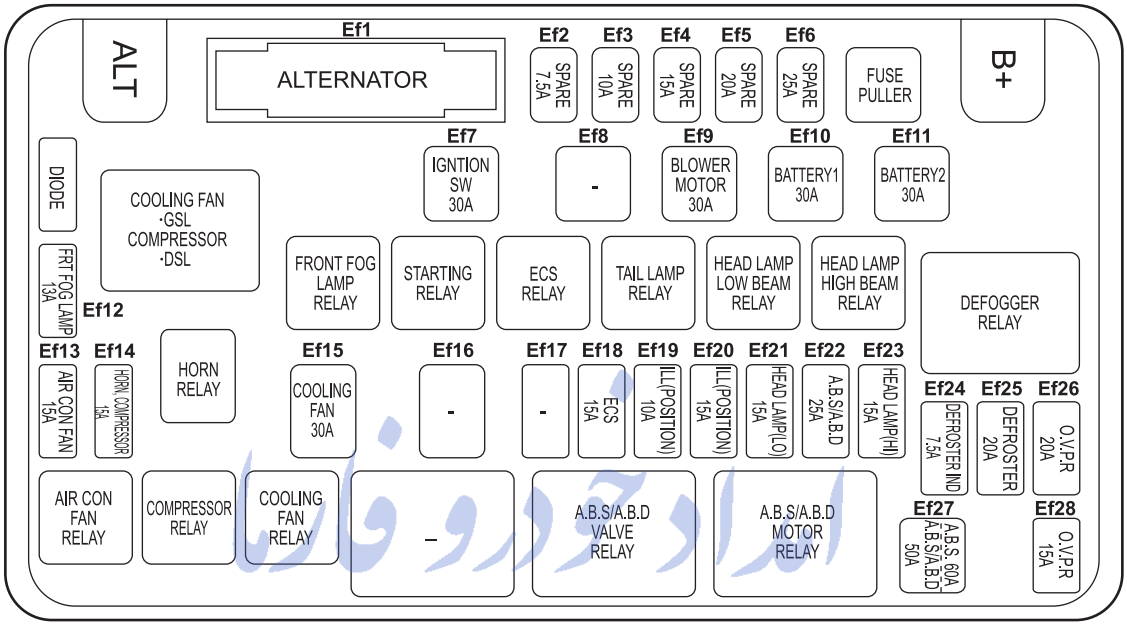
WIRE COLOR CHART

Wire Color	Abbreviation On Schematic
Green	DK GRN
Light Green	LT GRN
Blue	DK BLU
Brown	BRN
Orange	ORN
Yellow	YEL
Grey	GRY
Sky Blue	LT BLU
Red	RED
Black	BLK
Pink	PNK
White	WHT
Purple	PPL

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ENGINE ROOM FUSE & RELAY BOX

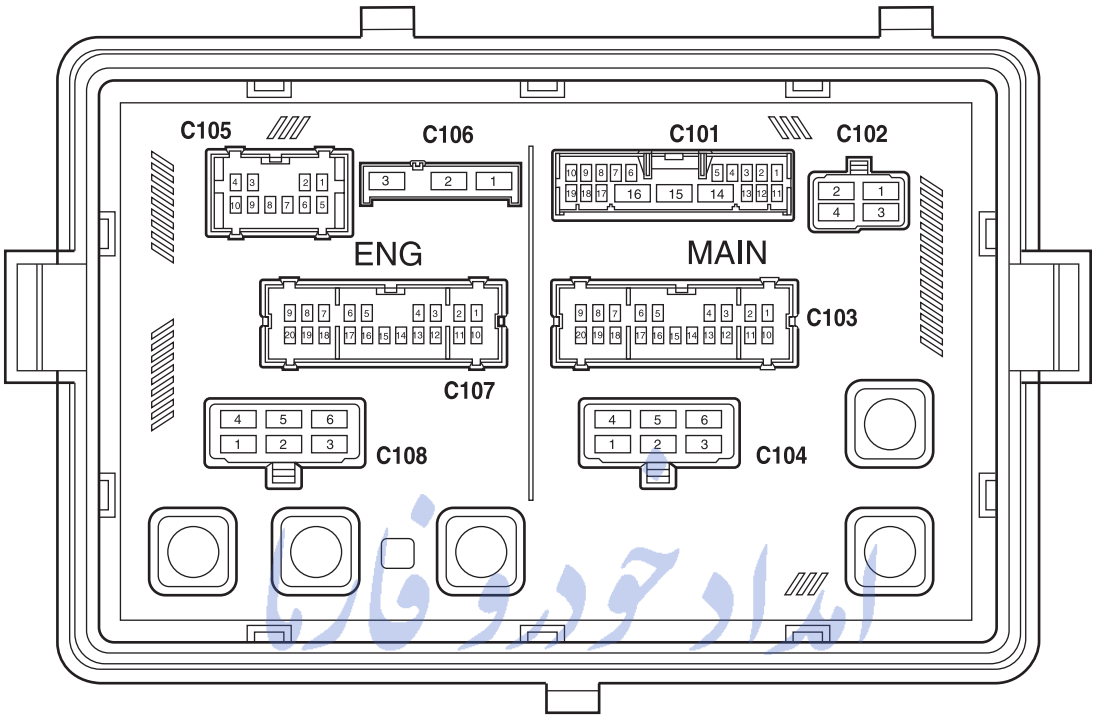
Position Of Relay And Fuse (Front View)



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Position Of Relay And Fuse (Rear View)



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USAGE OF FUSE IN ENGINE ROOM FUSE BOX

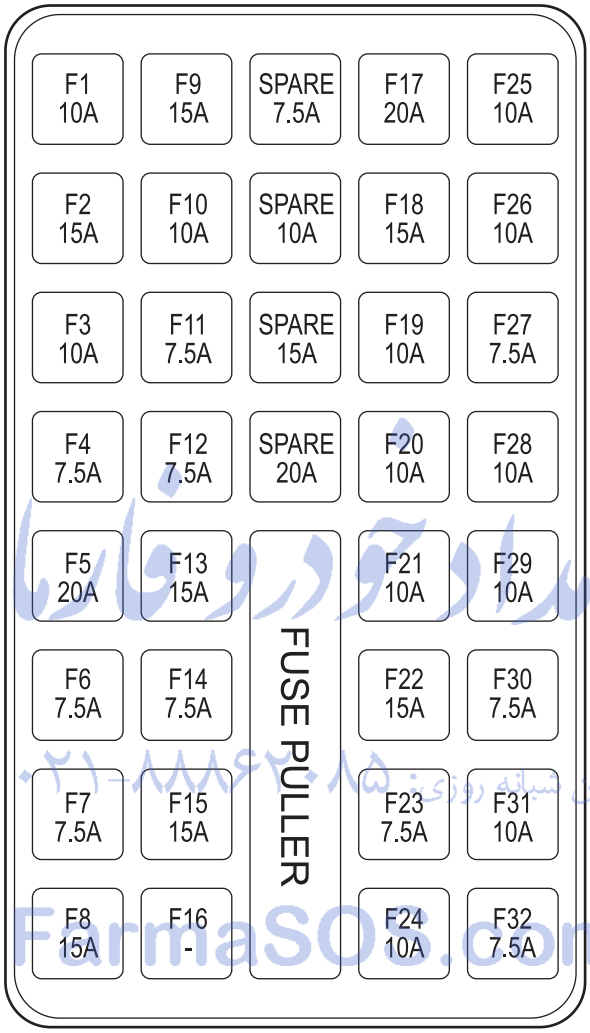
Power Supply	Classification	Fuse No	Capacity	Usage
30 BAT (+)	SB (Slow-Blow) Fuse	Ef1	120A	Alternator Main - Gasoline
			80A	Alternator Main - Diesel
Spare	Blade Type Fuse	Ef2	7.5A	Not Used
		Ef3	10A	Not Used
		Ef4	15A	Not Used
		Ef5	20A	Not Used
		Ef6	25A	Not Used
30 BAT (+) 30	SB (Slow-Blow) Fuse	Ef7	30A	Ignition SW
	Blade Type Fuse	Ef8	-	Not Used
		Ef9	30A	Blower Motor
		Ef10	30A	Battery 1 (F1 ~ F7)
		Ef11	30A	Battery 2 (F17 ~ F22)
		Ef12	15A	Front Fog Lamp
		Ef13	15A	A/C Condenser Fan
		Ef14	15A	Horn, A/C Compressor
	SB (Slow-Blow) Fuse	Ef15	30A	Cooling Fan
		Ef16	-	Not Used
IGN 2 (15A)	Blade Type Fuse	Ef17	-	Not Used
		Ef18	15A	ECS
Illumination (58)		Ef19	10A	Illumination (Position)
		Ef20	7.5A	Illumination (Switch)
30 BAT (+)		Ef21	15A	HeadLamp (LO)
		Ef22	25A	ABS/ABD
IGN 2 (15A)		Ef23	15A	Head Lamp (HI)
		Ef24	7.5A	Defroster Indicator
		Ef25	20A	Dsfroster
		Ef26	20A	O.V.P.R
30 BAT (+)	SB (Slow-Blow) Fuse	Ef27	60A	ABS
			50A	ABS/ABD
	Blade Type Fuse	Ef28	15A	O.V.P.R

*30 : Battery (+) Power Supply

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PASSENGER ROOM FUSE BOX

Position of Fuse



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USAGE OF FUSE IN ENGINE ROOM FUSE BOX

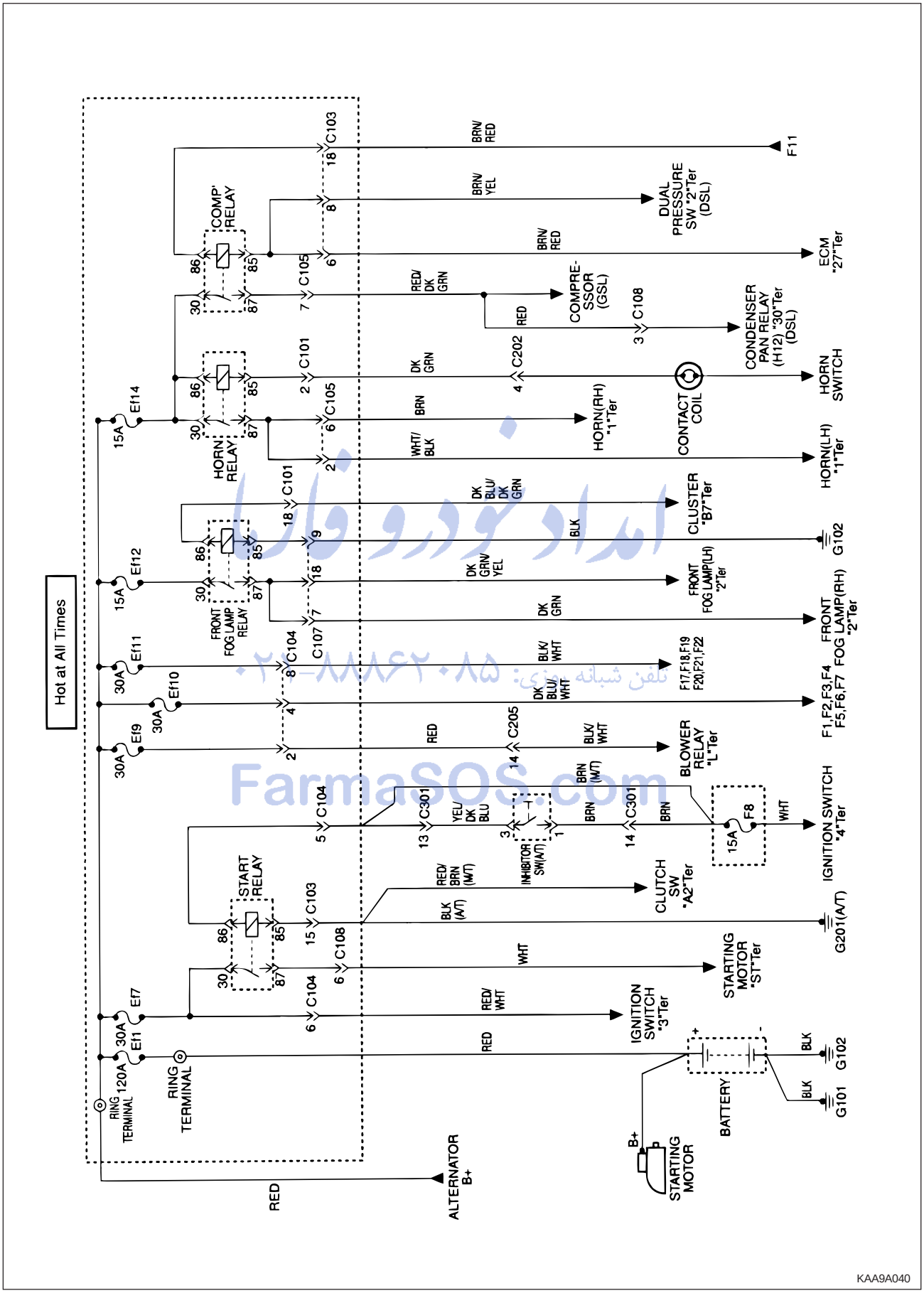
Power Supply	Classification	Fuse No	Capacity	Usage
30 BAT(+)	Blade Type	F1	10A	Interior Lamp
		F2	15A	Hazard Lamp
		F3	10A	Audio
		F4	7.5A	STICS, REKES, Clock
		F5	20A	Power Window
		F6	7.5A	Seat Belt
		F7	7.5A	DRL
ST		F8	15A	Starting
15A IGN2		F9	15A	Front Wiper & Washer
		F10	10A	Rear Wiper
		F11	7.5A	A/C System, Defroster
		F12	7.5A	Head Lamp, STICS
15A IGN1		F13	15A	DRL
15C ACC		F14	7.5A	Audio, OSRV Mirror
		F15	15A	Cigar Lighter
		F16		
30 BAT(+)		F17	20A	TOD, TCCU
		F18	15A	Stop Lamp
		F19	10A	ABD
		F20	10A	Seat Heater, Auto Antenna
		F21	10A	Door Lock System
		F22	15A	Fuel Pump
15 IGN1		F23	7.5A	TOD, TCCU, TCM
		F24	10A	OVPR, Pre-heating
		F25	10A	HLLD
		F26	10A	Turn Signal Lamp
		F27	7.5A	BTSI
		F28	10A	Speedometer
		F29	10A	ABS, ABD
		F30	7.5A	Inside Rear View Mirror, Cruise Control
		F31	10A	Air Bag
		F32	7.5A	DRL, Seat Heater

*30 : Battery (+) Power Supply

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SCHEMATIC AND ROUTING DIAGRAMS

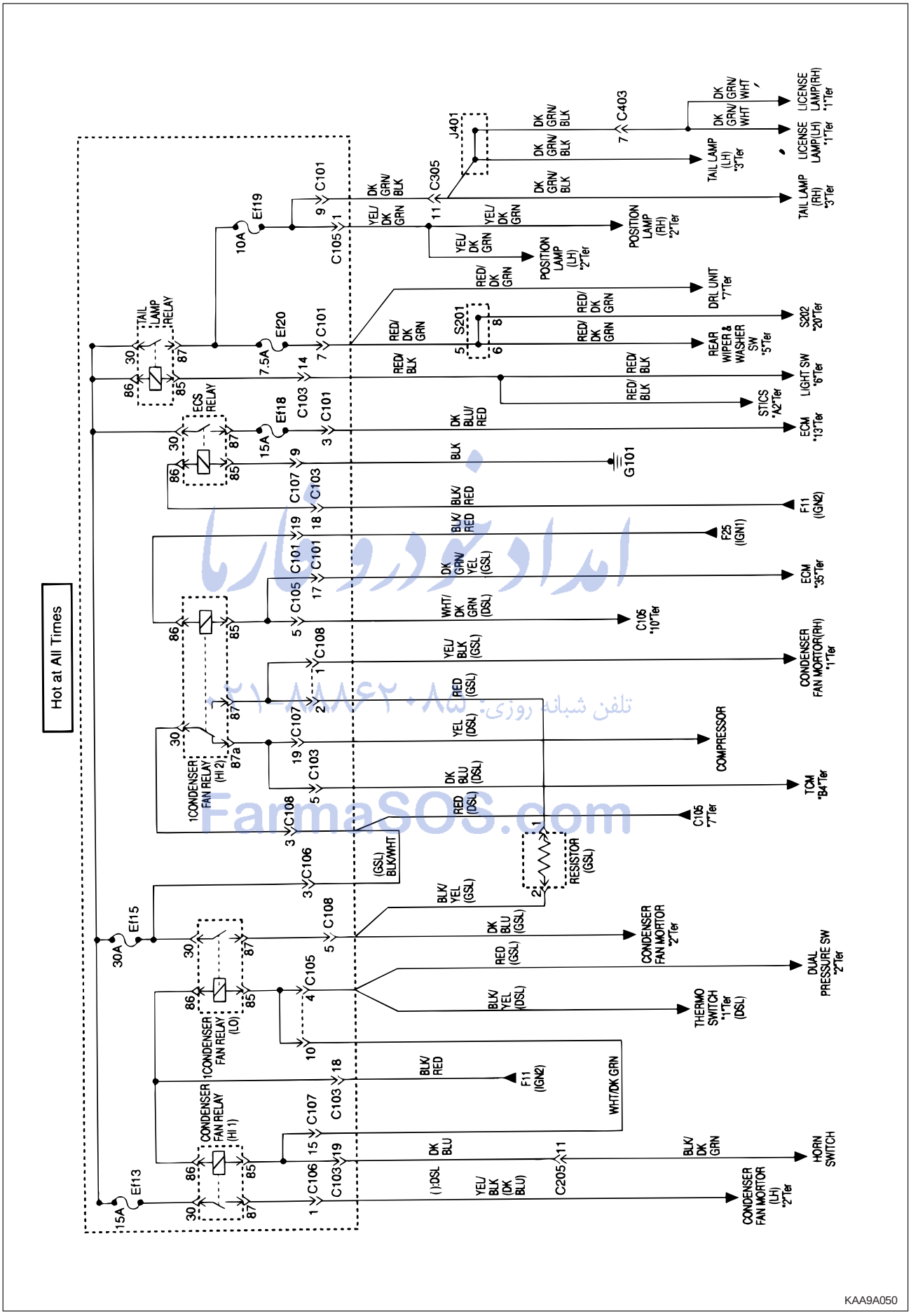
ENGINE ROOM FUSE & RELAY CIRCUIT (1 OF 3)



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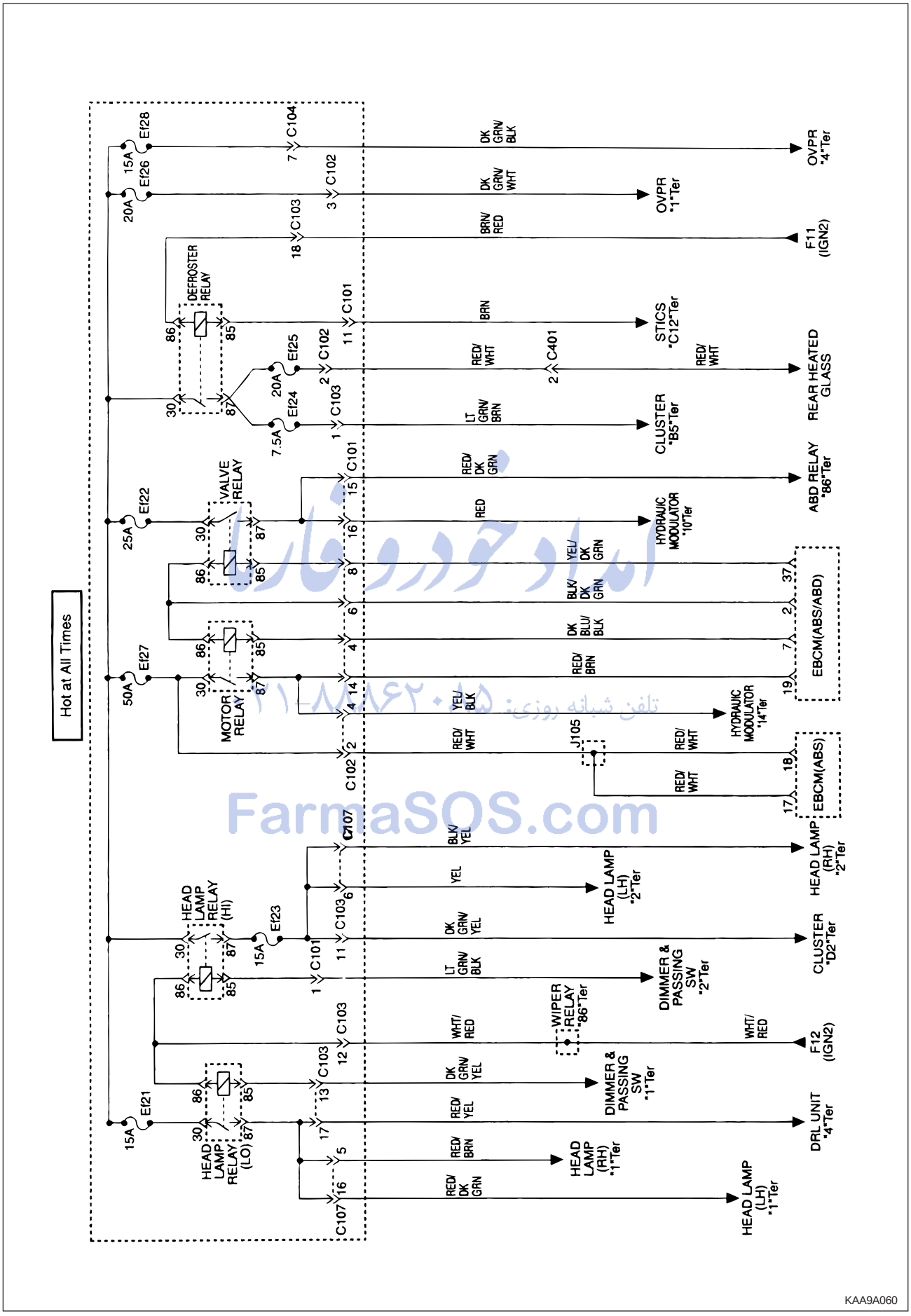
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ENGINE ROOM FUSE & RELAY CIRCUIT (2 OF 3)



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ENGINE ROOM FUSE & RELAY CIRCUIT (3 OF 3)

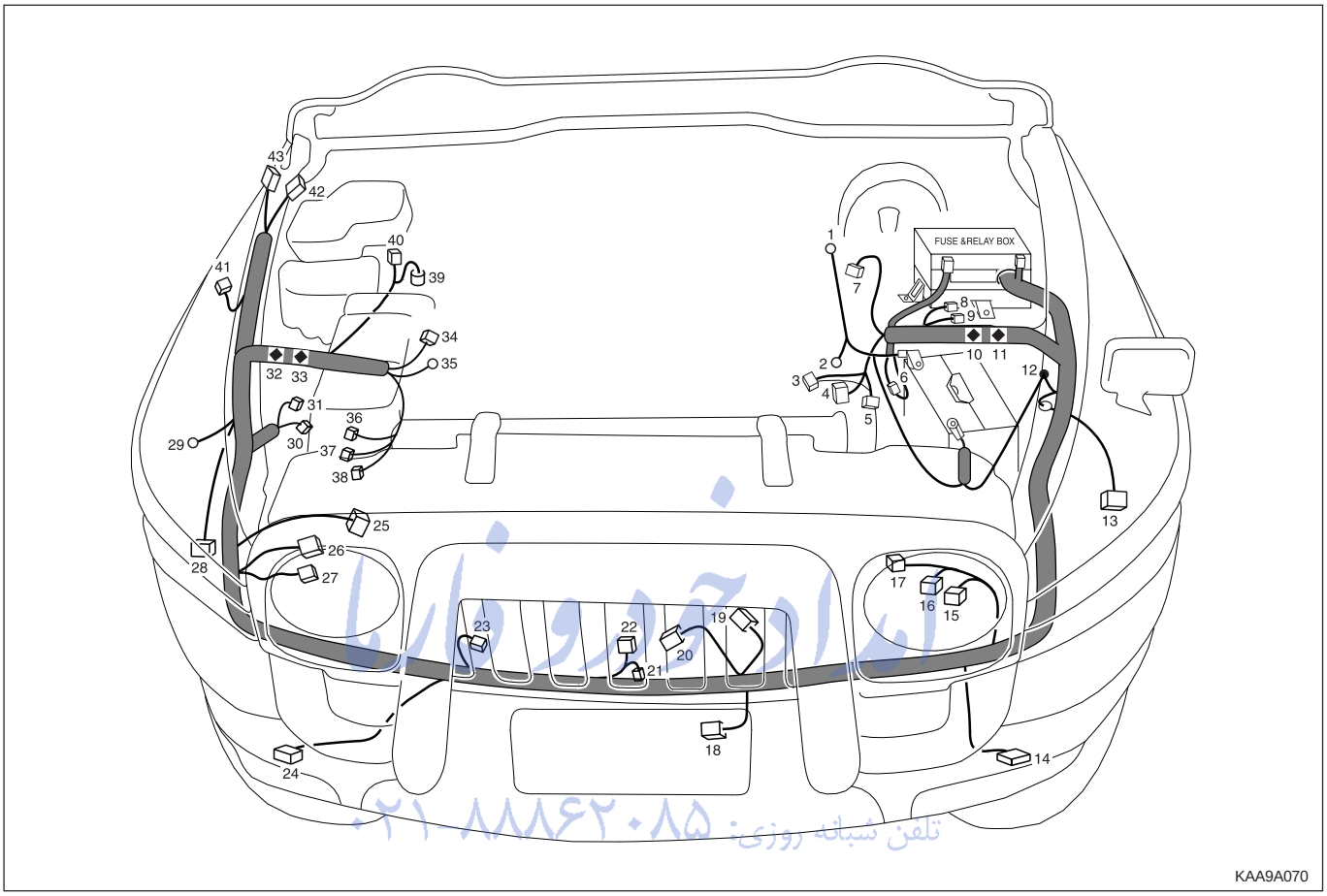


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WIRING HARNESS & CONNECTOR & GROUND LOCATION

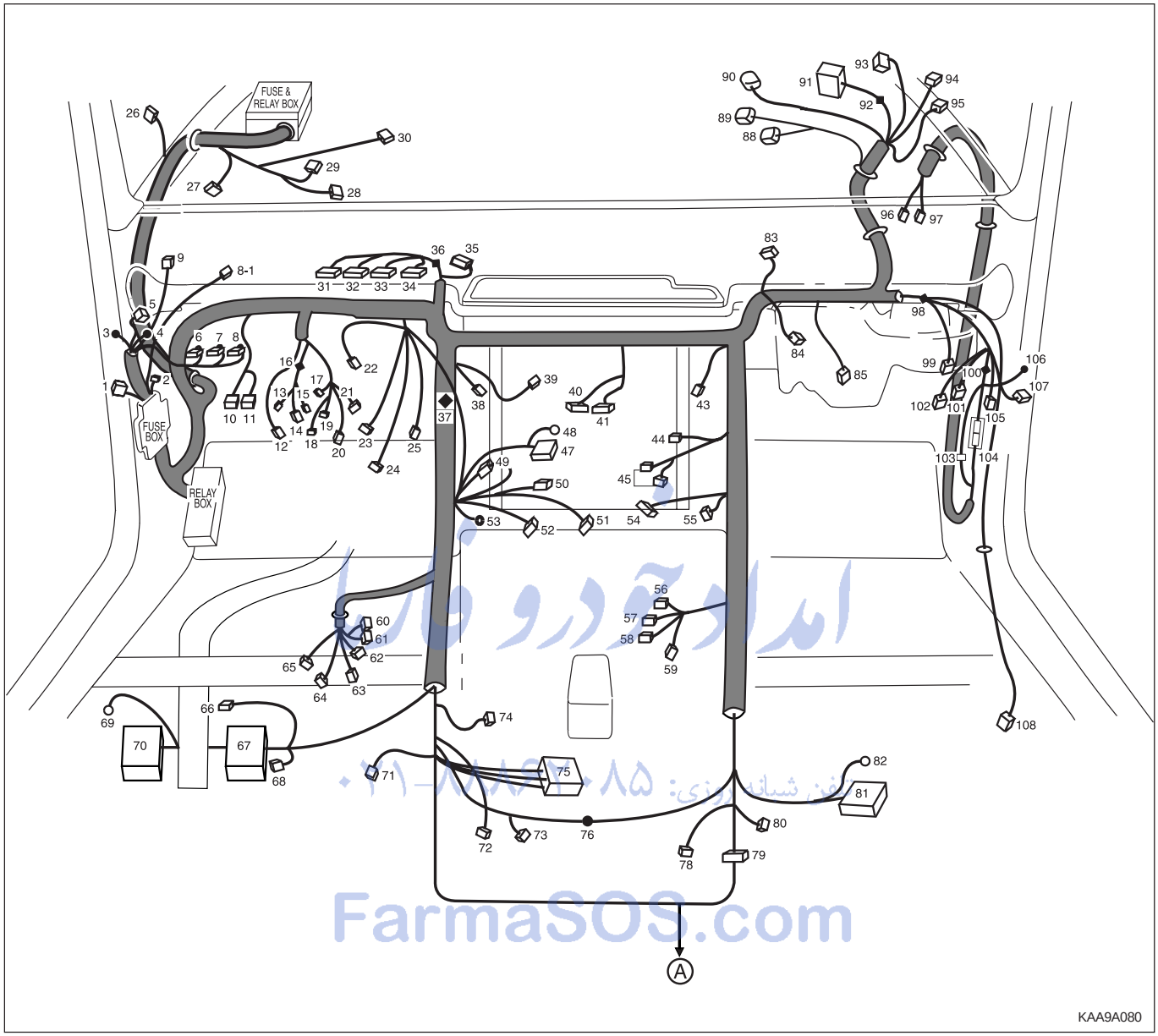
W/H ENGINE ROOM



1 Starting motor
2 G102
3 Damper solenoid (FRT LH)
4 Compressor
5 Wheel speed sensor (FRT LH)
6 Starting motor “ST” terminal connector
7 Canister purge valve (Gasoline E/G)
8 Pre-heating time control unit (Diesel E/G)
9 C109 (Diesel E/G)
10 J102
11 J101
12 G101
13 Turn signal & position lamp (FRT LH)
14 Fog lamp (FRT LH)
15 Head lamp (FRT LH)
16 HLLD (FRT LH)
17 Hood switch
18 Thermo switch (Diesel E/G)
19 LH horn
20 Condenser fan motor-Non A/conditioner
21 Condenser fan motor (LH)
22 Resistor
23 RH horn
24 Fog lamp (FRT RH)
25 Condenser fan motor (RH)
26 Head lamp (FRT RH)
27 HLLD (FRT RH)
28 Turn signal & position lamp (FRT RH)
29 G103
30 C110 (Diesel E/G)
31 Alternator B+ (Diesel E/G)
32 J104
33 J103
34 C110 (Gasoline E/G)
35 Alternator B+ (Gasoline E/G)
36 Damper Solenoid (FRT RH)
37 C111
38 Wheel speed sensor (FRT RH)
39 Dual pressure switch
40 Washer motor
41 ADD (FRT RH)
42 C112
43 C113

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W/H MAIN

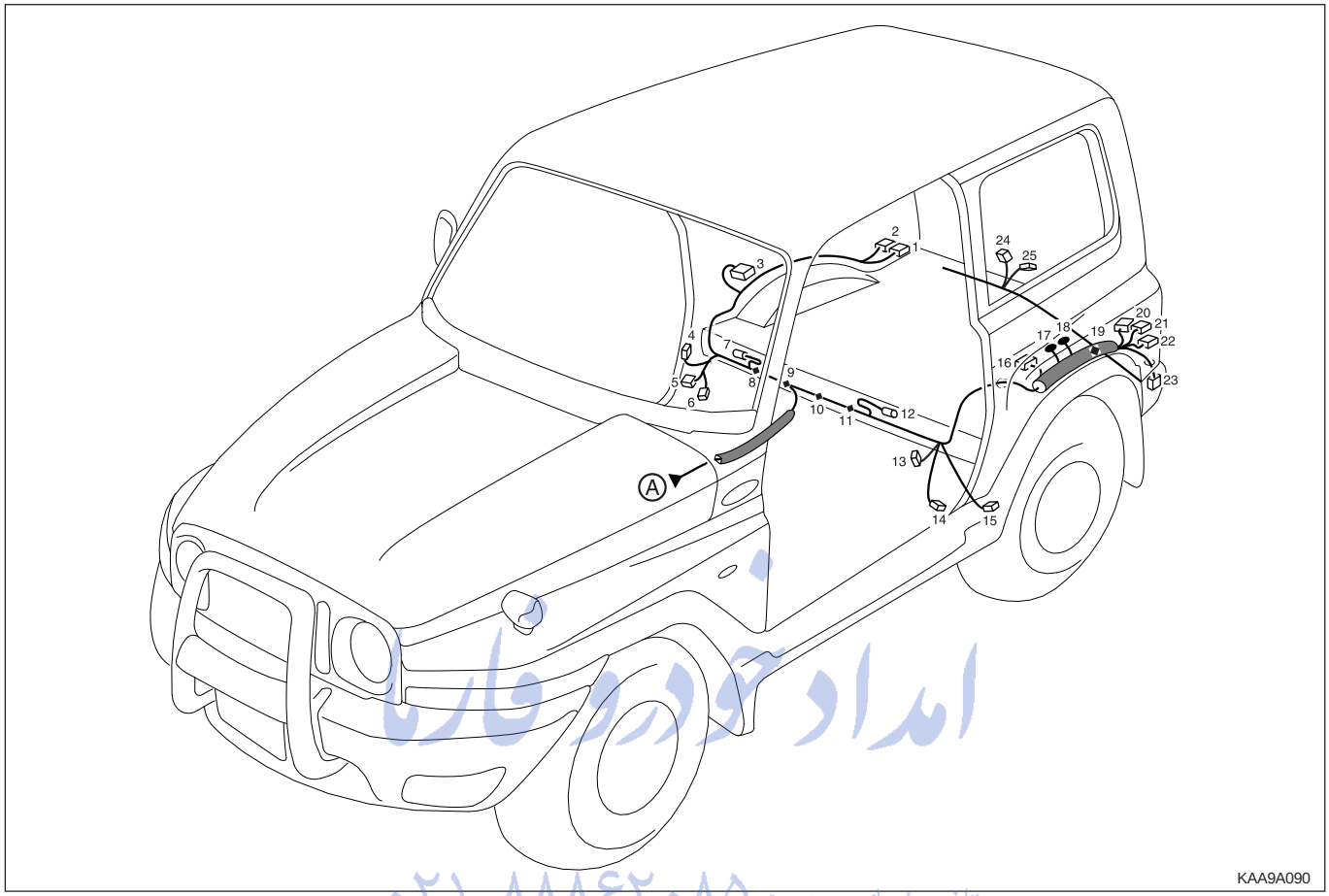


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1 C351
2 S201
3 G201
4 G202
5 Auto down unit
6 HLLD switch
7 OSRV switch
8 Rear wiper & washer switch
9 C201
10 Clutch switch “A”
11 Clutch switch “B” (Gasoline E/G)
12 Stop lamp switch
13 Dimmer & passing switch
14 Turn signal,FRT fog lamp & Light switch
15 Wiper switch
16 J201
17 C202
18 Immobilizer antenna
19 Ignition switch
20 Cruise control switch
21 Key reminder switch
22 C203
23 Acceleration pedal sensor
24 Kick down switch
25 REKES
26 ADD’ (LH)
27 Diagnosis connector
28 Brake fluid switch
29 Locking hud solenoid (TCCU)
30 C116
31 Cluster “D”
32 Cluster “C”
33 Cluster “B”
34 Cluster “A”
35 J202
36 J202
37 J203
38 S203
39 4WD switch
40 Hazard switch
41 Defroster switch
42 ECS switch
43 Antenna feeder cable
44 S204
45 Audio
46 DRL unit
47 SDM
48 G204
49 C204
50 Chime Bell
51 Buzzer
52 Acceleration sensor
53 G203
54 Cigar lighter
55 Central door lock relay
56 BTSI solenoid
57 A/Tsocket
58 BTSI “P” position sw
59 Mode switch
60 Shift motor
61 Speed sensor & clutch coil
62 VSS
63 C301
64 C302
65 C303
66 C304
67 TCM
68 TOD Resistor (Gasoline E/G)
69 G301
70 TOD or TCCU
71 FRT LH seat belt sw
72 Parking brake sw
73 W/D Burglar connector
74 Seat heater switch
75 STICS
76 G303
77 ECS
78 OVPR (Gasoline E/G)
79 C305
80 Seat belt sw (FRT RH)
81 EBCM (ADD)
82 G303
83 C205
84 Thermo amp
85 Passenger inflator
86 Vertical sensor
87 Lateral sensor
88 Front wiper motor
89 Siren
90 O2 sensor 1 / (Gasoline E/G)
91 EBCM (ABS) & Modulator (ABD)
92 J105
93 C113
94 C112
95 EGR solenoid (Diesel E/G)
96 C114 (Gasoline E/G)
97 C115 (Gasoline E/G)
98 J204 (Gasoline E/G)
99 S205
100 J205 (Gasoline E/G)
101 Antenna feeder cable
102 Auto antenna
103 C206
104 ECM (GSL) or Immobilizer unit (DSL)
105 EGR control unit (Diesel E/G)
106 G205
107 C361
108 O2 sensor 2 (Gasoline E/G)

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۰۲۱-۸۸۸۶۲۰۸۵
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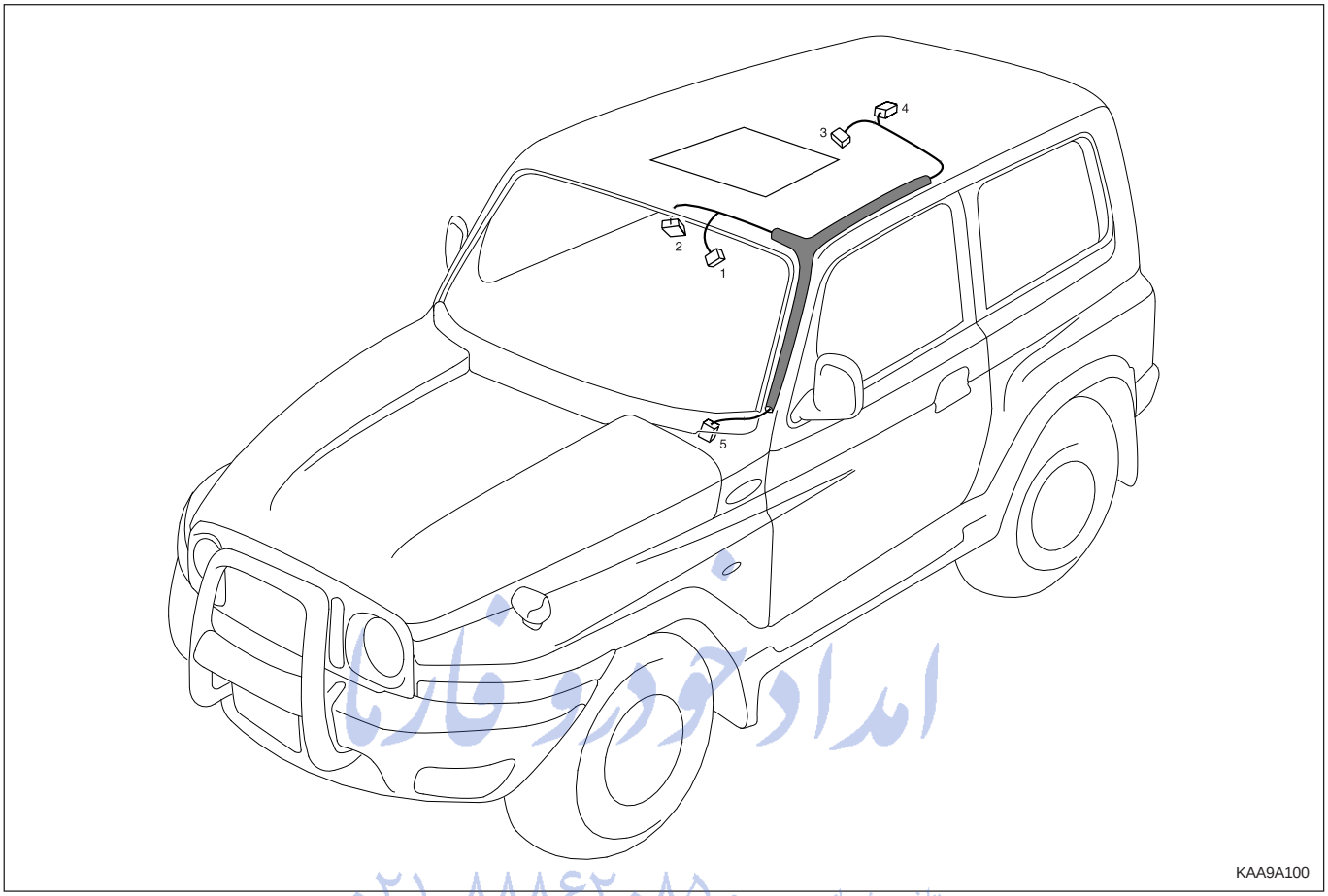
W/H MAIN (FLOOR)



امداد خودرو ۲۴
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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1 Rear combination lamp (RH)
2 Tail gate contact sw
3 Rear speaker (RH)
4 Door contact sw (FRT RH)
5 Damper solenoid (RR RH)
6 Passenger pretensioner
7 Wheel speed sensor (RR RH)
8 J304
9 J303
10 J302
11 J301
12 Wheel speed sensor (RR RH)
13 Damper solenoid (RR LH)
14 Driver tension reducer
15 Door contact sw (FRT LH)
16 Rear speaker (LH)
17 G401
18 Luggage lamp
19 J401
20 C401
21 C402
22 Rear combination lamp (LH)
23 C403
24 License lamp (RH)
25 License lamp (LH)

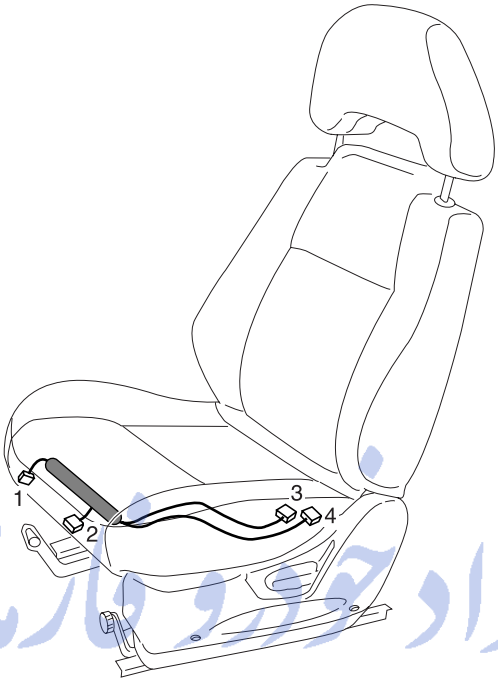
W/H ROOF



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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1 Inside rear view mirror
2 Room lamp
3 Not used
4 Map lamp
5 C201

W/H SEAT HEATER

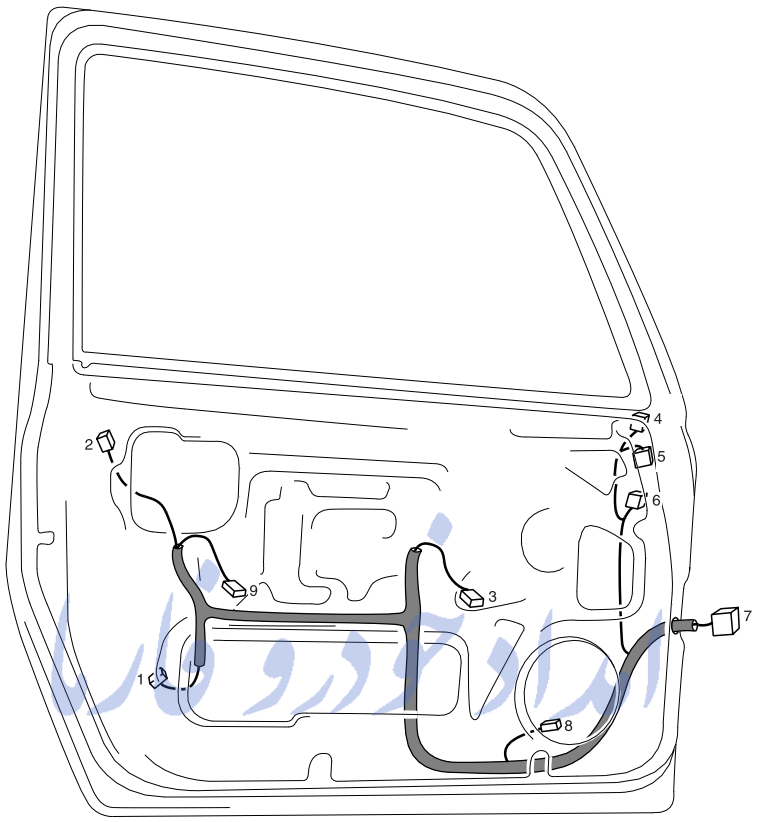


KAA9A110

امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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1 C304
2 Seat heater control unit
3 Seat heater
4 Back seat heater

W/H DOOR

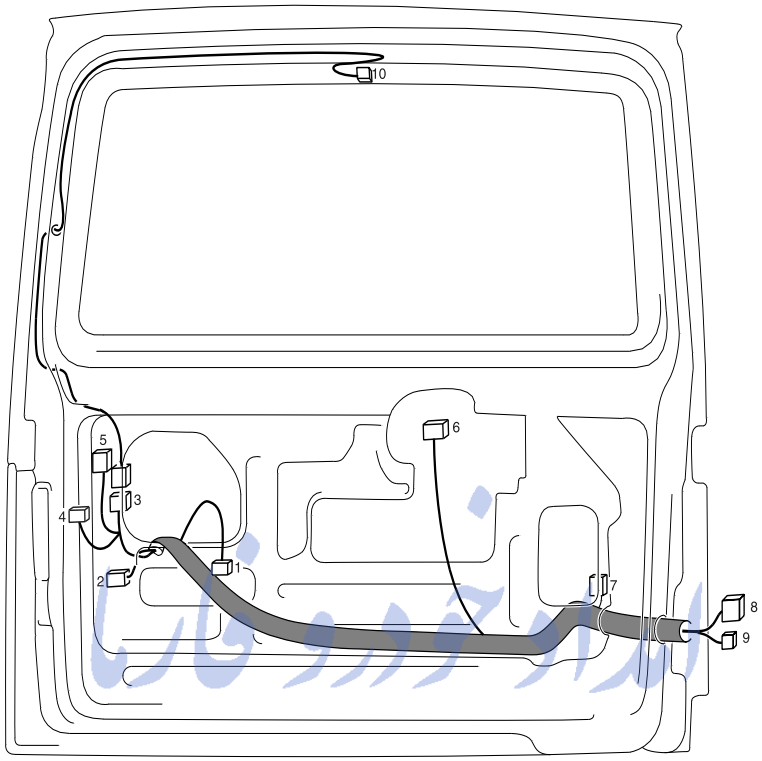


KAA9A120

تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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1 Door actuator
2 Door key cylinder switch
3 Power window switch
4 OSRV mirror motor
5 Power window motor
8 Speaker
9 Courtesy lamp

W/H TAIL GATE

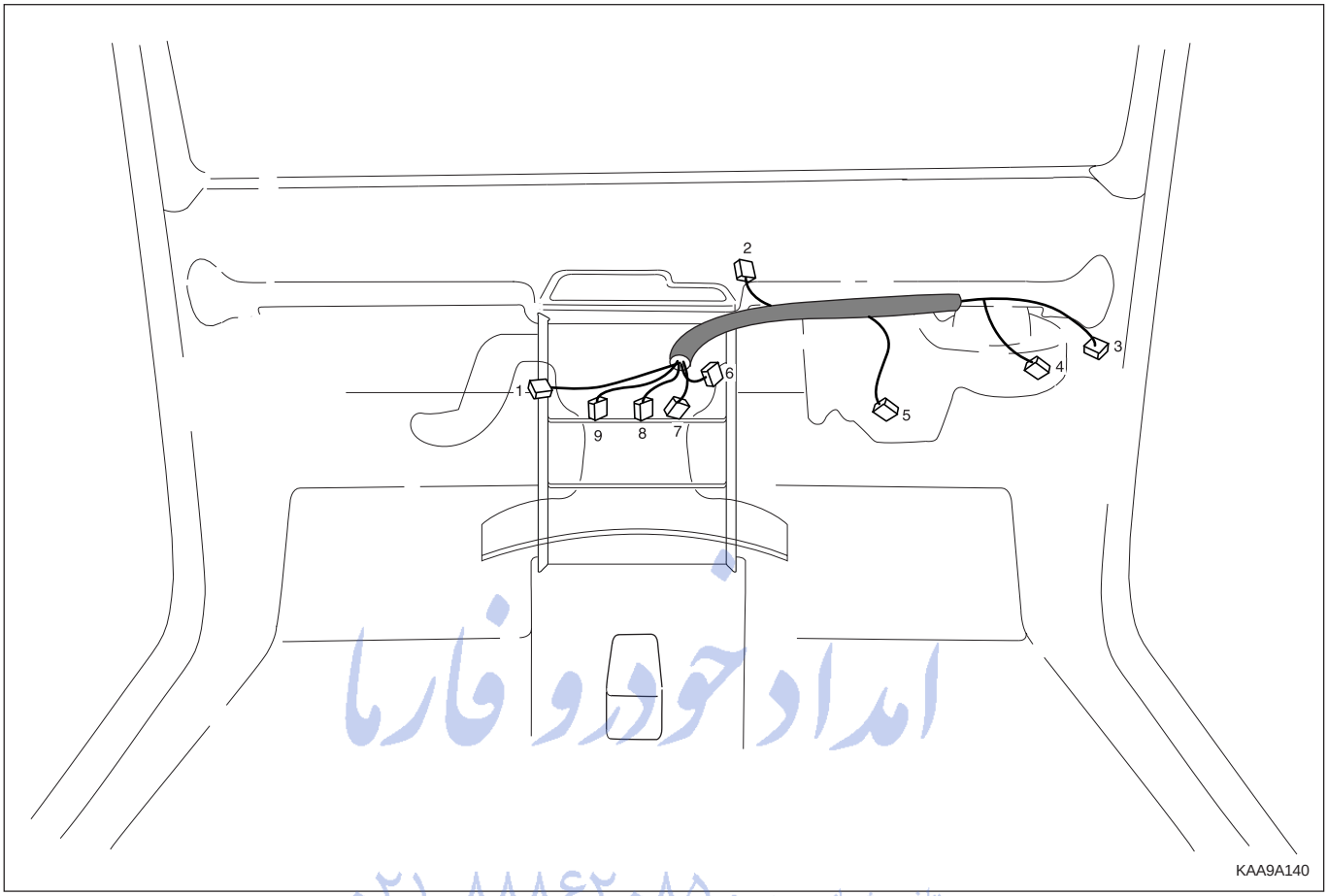


KAA9A130

تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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1 Rear washer motor
2 Tail gate door lock actuator
3 C403 (soft top)
4 Tail gate key cylinder sw
5 Rear heated glass
6 Rear wiper motor
7 Rear heated glass

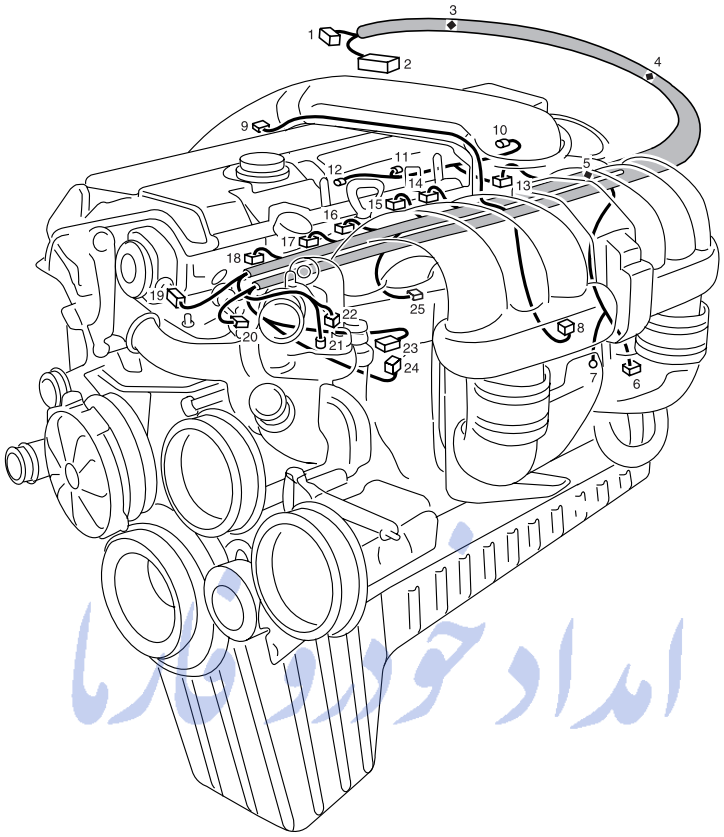
W/H AIR - CONDITIONER



امداد خودو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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1 Mode actuator
3 Intake actuator
4 Blower motor
5 Resistor
6 Blower relay
7 A/CON switch
8 Control pannel
9 Blower switch

W/H ENGINE CONTROL (GASOLINE)

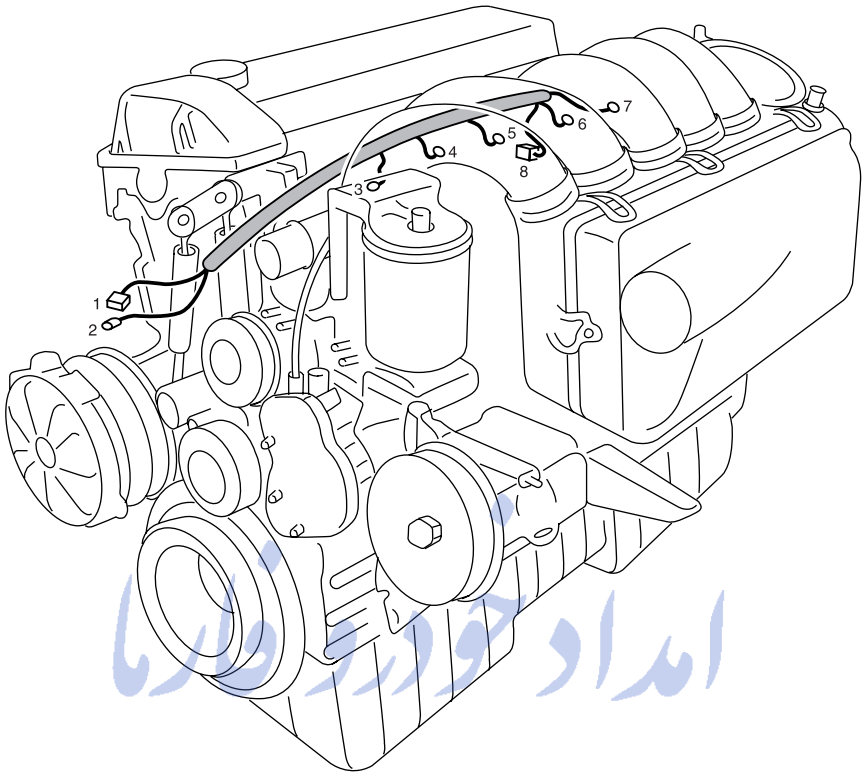


KAA9A150

امداد خودرو ایرانیان
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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6 Crankshaft position sensor
7 Oil pressure switch
8 Knock sensor 2
9 Air flow sensor
10 Ignition coil 3
11 Ignition coil 2
12 Ignition coil 1
13 Injector 6
14 Injector 5
15 Injector 4
16 Injector 3
17 Injector 2
18 Injector 1
19 Camshaft actuator
20 Camshaft position sensor
21 Engine coolant temperature sensor (Gauge)
22 Engine temperature sensor
23 Throttle motor & sensor
24 Knock sensor 1
25 Intake manifold resonance flap

W/H PRE - HEATING (DIESEL)



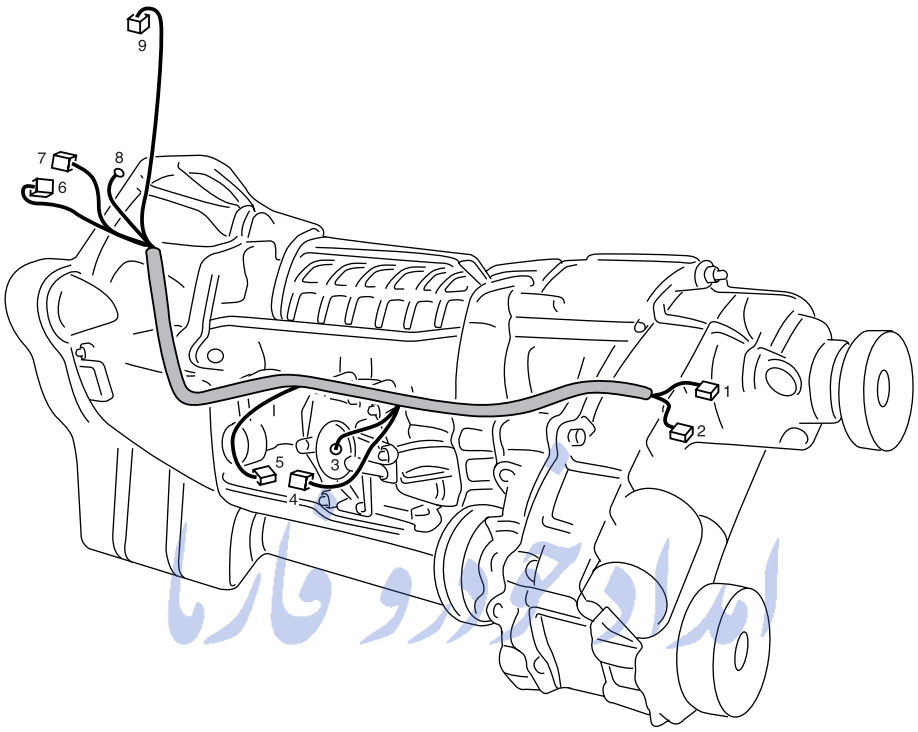
KAA9A160

امداد خودرو دارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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1 Preheating time control relay
3 Glow plug 1
4 Glow plug 2
5 Glow plug 3
6 Glow plug 4
7 Glow plug 5 (662 LA only)
8 Engine coolant temperature sensor (Gauge)

W/H TRANSMISSION

Automatic Transmission



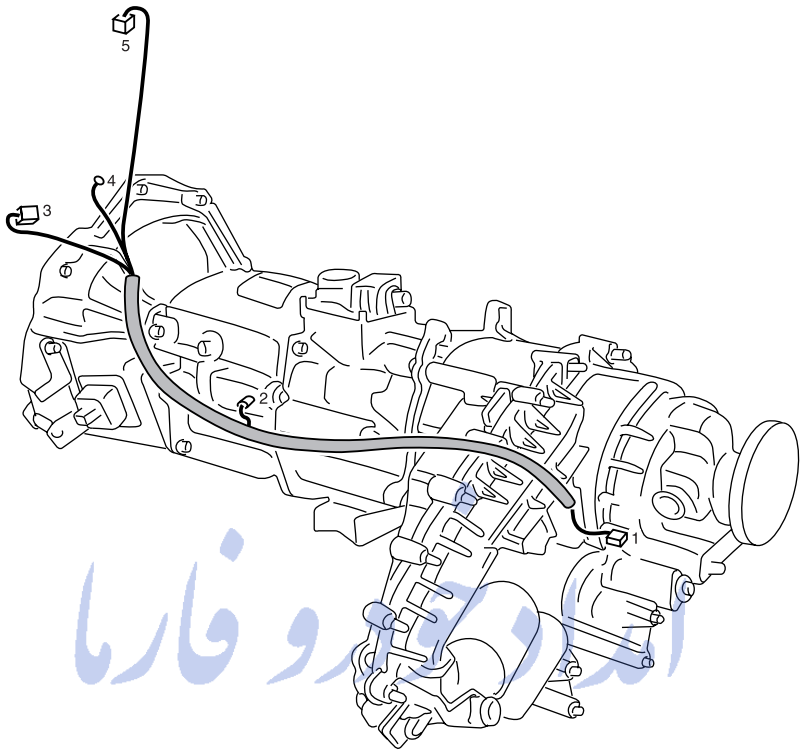
امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵

YAD9B350

3 Transmission
4 T/M Lever
5 Inhibitor switch
6 Micro switch (Diesel E/G)
7 Throttle position sensor (Diesel E/G)
8 Engine oil pressure switch
9 Engine speed sensor (Diesel E/G)

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Manual Transmission



YAD9B350

تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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1 C302
2 Back up switch
3 Micro switch
4 Engine oil pressure switch
5 Engine speed sensor

SECTION 9B

LIGHTING SYSTEM

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

Description and Operation 9B-2
- Head Lamps - ON Reminder 9B-2
- Head Lamps 9B-2
- Daytime Running Lamps 9B-2
- Parking and Turn Signal Lamps 9B-2
- Fog Lamps 9B-2
- Rear Combination Lamps 9B-2
- Center High-Mounted Stop Lamp 9B-2
- Backup Lamps 9B-3
- License Plate Lamps 9B-3
- Interior Room Lamps 9B-3
- Luggage Lamps 9B-3

Components Locator 9B-4

Diagnostic Information and Procedure 9B-5
- Head Lamps 9B-5
- Fog Lamps 9B-7
- Tail Lamps 9B-8
- Interior Room and Luggage Lamps 9B-11
- Door Courtesy Lamps 9B-13
- Cigar Lighter 9B-14

Repair Instructions 9B-15

On-Vehicle Service Unit Repair 9B-15
- Head Lamps 9B-15
- Front Combination Lamp 9B-16
- Center High-Mounted Stop Lamp 9B-16
- Rear Combination Lamps 9B-17
- Fog Lamps 9B-17
- Interior Courtesy Lamp 9B-18
- Door Courtesy Lamp 9B-18
- Luggage Lamp 9B-19
- License Plate Lamps 9B-19

Specifications 9B-20
- Bulb Usage Chart 9B-20
- Fastener Tightening Specifications 9B-20

Schematic and Routing Diagrams 9B-21
- Head Lamp Leveling Device (HLLD) : Gasoline 9B-21
- Head Lamp Leveling Device (HLLD) : Diesel 9B-22
- Tail Lamp Relay Circuit Position Lamp, Tail Lamp, License Lamp 9B-23
- Illumination Switch 9B-24
- Turn Signal Lamp 9B-25
- Front Fog Lamp 9B-26
- Rear Fog Lamp 9B-27
- Stop Lamp, BTSI (Brake Transmission Shift Interlock) - Metal Top 9B-28
- Stop Lamp, BTSI (Brake Transmission Shift Interlock) - Soft Top 9B-29

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۰۲۱-۸۸۸۶۲۰۸۵
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DESCRIPTION AND OPERATION

HEAD LAMPS - ON REMINDER

When the headlamp switch is in the headlamps-on or parkinglamps-on positions, voltage is applied to the chime module. With the headlamp switch on and the driver's side door open, the module loses voltage. The module senses this change. If voltage is still available, it is applied to sound the chime. The chime can be turned off by turning the headlamp switch off or closing the driver's side door. To replace the chime module, refer to Section 9E, Instrumentation / Driver Information.

HEAD LAMPS

The headlamps are controlled by the multifunction lever on the left side of the steering column. They will come on with the ignition switch in on position. Turning the headlamp switch to the first position turns on the parking lamps, the license plate lamps, and the instrument panel illumination. Turning the switch to the second position turns on all of the previous lamps and the headlamps. Turning the switch off turns off all the lamps.

The headlamps high beam and low beams are also controlled by this lever. When the headlamps are on, pushing the lever away from the driver until the switch clicks changes the lamp from low beam to high beam. An indicator lamp on the instrument cluster assembly will come on when the high beam headlamps are on. To return the headlamps to low beams, pull the lever toward the driver.

The headlamps must be aimed for proper illumination of the road. Headlamp aim should be checked whenever a new headlamp assembly is installed or when service or repairs to the front end may have disturbed the headlamp assembly or its mountings.

DAYTIME RUNNING LAMPS

The daytime running lamps (DRL) will illuminate under the following conditions:

- The ignition is ON.
- The light switch is OFF.
- The parking brake is released.

When the head lamps are on, the DRL will turn off.

To turn the DRL off when idling, apply the parking brake.

PARKING AND TURN SIGNAL LAMPS

The parking lamps can be turned on by turning the headlamp switch to the first position. The parking lamps can be turned off by turning the switch off.

When the turn signals are activated, the appropriate turn signal lamps flash to signal a turn. The front, the rear, work only when the ignition is on.

The front and rear turn signals are controlled by the multifunction lever on the left side of the steering column. Moving the lever all the way up or down past the detent will turn on the turn signals. When the turn is complete, the lever will automatically be release, and the front and the rear turn signals will stop flashing.

For changing lanes or shallow turns in which the steering wheel does not turn far enough to cancel the signal, move the signal to the first detent and hold it there. The turn signal will cancel when the lever is released.

FOG LAMPS

The fog lamp switch is located in multifunction lever on the right side of steering column. To use the fog lamps, first turn on the parking lamps. Then, turning the fog lamps switch on position. The indicator light in the instrument cluster will illuminate to indicate that the fog lamps are on. Turning the switch again to turn off the fog lamps. The indicator light will then go off.

The fog lamps must be aimed for proper illumination of the road. Fog lamp aim should be checked when a new bulb is installed or if service or repairs to the front end may have disturbed the fog lamp assembly or its mountings.

REAR COMBINATION LAMPS

The taillamps, stoplamps, backup lamps and turn signals are one assembly.

Turning on either the headlamps or the parking lamps will also turn on the taillamps. When the brake pedal is pushed, the taillamps will glow more brightly to serve as stop lamps.

CENTER HIGH-MOUNTED STOP LAMP

The center high-mounted stoplamp is on the tail gate and will come on when the brake pedal is pressed.

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BACKUP LAMPS

The backup lamps will come on when the transaxle is shifted into reverse. On a vehicle with an automatic transaxle, the backup lamps are activated by inhibitor switch. On a vehicle with a manual transaxle, they are activated by a reverse switch with is part of the transaxle.

LICENSE PLATE LAMPS

The license plate lamps will come on when the head lamps or the parking lamps are on. The license plate lamps are mounted on the rear door handle cover, above the license plate.

INTERIOR ROOM LAMPS

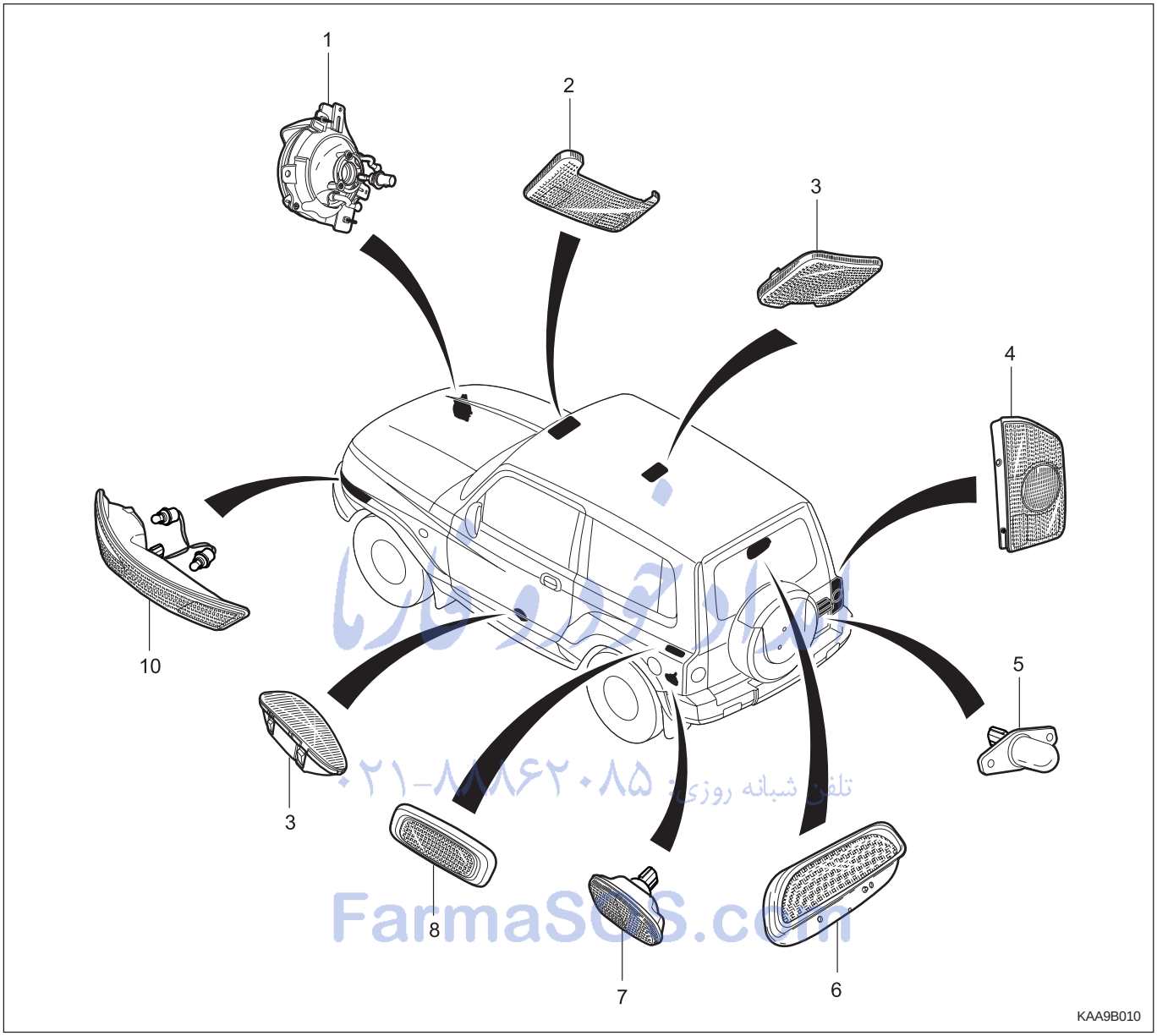
The room lamp is located on the front position of head liner and has three the center switch pushed, both of two bulbs of the lamp are on at the same tine. When any door is open. The switchs on the left and right side turn on the bulbs of each side. They are off, if the switch is pushed again the second room lamp is located on the middle position it the switch push off again, the lamp will turn off.

LUGGAGE LAMPS

The luggage lamp is under the trin plate on the left side of quarter.

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COMPONENTS LOCATOR



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1 Head Lamp
2 Front Room Lamp
3 Center Room Lamp
4 Rear Combination Lamp
5 License Plate Lamp
6 Center High Mounted Stop Lamp
7 Rear Side Marker Lamp
8 Luggage Lamp
9 Door Courtesy Lamp
10 Front Combination Lamp

DIAGNOSTIC INFORMATION AND PROCEDURE

HEAD LAMPS

Low-Beam Headlamps are Inoperative, High-Beam Headlamps Are OK

Step	Action	Value(s)	Yes	No
1	Check fuses EF21 and F12. Are fuses EF21 or F12 blown?	-	Go to Step 2	Go to Step 3
2	1. Check for a short circuit and repair if necessary. 2. Replace the fuse. Is the repair complete?	-	System OK	-
3	Check the voltage at fuses EF21 and F12. Dose the voltage available at fuses EF21 and F12 equal the value specified?	11 - 14 v	Go to Step 4	Go to Step 9
4	Remove the headlamp relay (Low) and temporarily substitute a known good relay such as the fog lamp relay or the illumination lamp relay.	-	Go to Step 5	Go to Step 6
5	1. Return the substituted relay to its original position. 2. Replace the inoperative headlamp relay (Low). Is the repair complete?	-	System OK	-
6	1. Return the substituted relay to its original position, but do not reinstall the handlamp relay (Low) 2. Using a voltmeter or test lamp, check for the headlamp relay socket terminal 30. Does the battery voltage available at the headlamp relay (Low) socket equal the specified value?	0 Ω	Go to Step 8	Go to Step 7
7	Repair the open circuit between fuse EF20 and the headlamp relay (Low). Is the repair complete?	-	System OK	-
8	Replace the faulty headlamps. Is the repair complete?	-	System OK	-
9	Check the voltage between fuses EF21 or F12 and the headlamp relay. Does the voltage available at fuses EF21 and F12 equal the specified value?	11 - 14	System OK	Go to Step 10
10	Repair the open circuit between fuses EF21 and F12 and the headlamp relay. Is the repair complete?	-	System OK	-

High-Beam Headlamps Are Inoperative, Low-Beam Headlamps Are OK

Step	Action	Value(s)	Yes	No
1	Check fuse F12, and EF23. Is fuse F12 blown, or EF23?	-	Go to Step 2	Go to Step 3
2	1. Check for a short ciruit and repair if necessary. 2. Replace the fuse.	-	System OK	-
3	Use an ohmmeter to sheck continuity between the fuse F12. Does the ohmmeter indicate the specified value?	0 Ω	Go to Step 4	Go to Step 5

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High-Beam Headlamps Are Inoperative, Low-Beam Headlamps Are OK (Cont'd)

Step	Action	Value(s)	Yes	No
4	1. Check for a short circuit. Repair it if necessary. 2. Replace the fuse. Is the repair complete?	0 Ω	System OK	-
5	1. Disconnect the headlamp switch. 2. Put the switch in the high-beam position. 3. Use an ohmmeter to check the continuity of the headlamp dimmer switch between terminals 3 and 2. Does the ohmmeter indicate the specified value?	0 Ω	Go to Step 7	Go to Step 6
6	Replace the headlamp switch. Is the repair complete?	-	System OK	-
7	1. Disconnect the high-beam headlamp connectors. 2. Turn the high-beam headlamps on. 3. Use a voltmeter to check the voltage at terminal 2 of the headlamp connectors. Does the voltmeter indicate the specified value?	11 - 14 v	Go to Step 9	Go to Step 8
8	Repair the open circuit between the fuse block and the high-beam headlamps. Is the repair complete?	-	System OK	-
9	Use an ohmmeter to check continuity between terminal 2 of the headlamp connectors and ground G104. Does the ohmmeter indicate the specified value?	0 Ω	Go to Step 11	Go to Step 10
10	Repair the open ground circuit. Is the repair complete?	-	System OK	-
11	Replace the faulty high-beam headlamps. Is the repair complete?	-	System OK	-

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FOG LAMPS

Fog Lamps Inoperative

Step	Action	Value(s)	Yes	No
1	Check fuse EF12. Is EF12 blown.	-	Go to Step 2	Go to Step 3
2	1. Check for a short circuit and repair it, if necessary. 2. Replace the fuse. Is the repair complete?	-	System OK	-
3	Use a voltmeter or test lamp to check fuse EF12. Does the battery voltage available at fuse EF12 equal the specified value?	11 - 14 v	Go to Step 5	Go to Step 4
4	Repair the open circuit from the battery to fuse EF12. Is the repair complete?	-	System OK	-
5	Remove the fog lamp relay and temporarily substitute a known good relay such as the headlamp relay or the illumination lamp relay.	-	Go to Step 6	Go to Step 7
6	1. Return the substituted relay to its original position. 2. Replace the inoperative fog lamp relay. Is the repair complete?	-	System OK	-
7	1. Return the substituted relay to its original position, but do not reinstall the fog lamp relay. 2. Using a voltmeter or test lamp, check the fog lamp relay socket terminal 30. Does the battery voltage available at the fog lamp relay socket equal the specified value?	11 - 14 v	Go to Step 9	Go to Step 8
8	Repair the open circuit between fuse EF12 and the fog lamp relay. Is the repair complete?	-	System OK	-
9	At the fog lamp relay socket, use an ohmmeter or test lamp to verify that the connector for relay terminal 85 is connected to ground. Does the resistance equal the specified value?	0 Ω	Go to Step 11	Go to Step 10
10	Repair the ground circuit for the fog lamp relay. Is the repair complete?	-	System OK	-
11	With the fog lamp relay reinstalled and the switch on, test for voltage at the fog lamp connector. Does the battery voltage available at the fog lamp connector equal the specified value?	11 - 14 v	Go to Step 13	Go to Step 12
12	Repair the open circuit between the fog lamp relay terminal 87 and the fog lamps. Is the repair complete?	-	System OK	-
13	Use an ohmmeter or test lamp to check the ground at the ground side of the fog lamp connector. Does the resistance equal the specified value?	0 Ω	Go to Step 15	Go to Step 14
14	Repair the fog lamp ground circuit. Is the repair complete?	-	System OK	-
15	Replace the faulty fog lamp bulbs.Is the repair complete?	-	System OK	-

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TAIL LAMPS

Taillamps Do Not Work

Step	Action	Value(s)	Yes	No
1	Check fuse EF12. Is EF12 blown.	-	Go to Step 2	Go to Step 3
2	1. Check for a short circuit and repair it, if necessary. 2. Replace the fuse. Is the repair complete?	-	System OK	-
3	1. Press the brake pedal down. 2. Check the positive terminals of the bulb sockets with a test lamp. Does the test lamp illuminate?	-	Go to Step 2	Go to Step 6
4	Connect an ohmmeter between ground and the stoplamp ground terminal. Is the resistance equal to specified value?	0 Ω	-	Go to Step 4
5	Repair the ground circuit. Is the repair complete?	-	System OK	-

Turn Signal Lamps and Hazard Lamps Do Not Work

Step	Action	Value(s)	Yes	No
1	Check fuses F26, F2 and EF10, EF20. Is either fuse blown?	-	Go to Step 2	Go to Step 3
2	Check for a short circuit and repair if necessary Replace the fuse. Is the repair complete?	-	System OK	-
3	1. Turn the ignition on. 2. Check the voltage at fuse F26, F2 and EF10, EF20. Does the battery voltage available at both fuses F26, F2 and EF10, EF20 equal the specified value?	11 - 14 v	Go to Step 4	Go to Step 7
4	1. Turn the hazard lamp switch on. 2. Remove each or the inoperative lamps from socket. 3. Test each lamp socket positive terminal with a voltmeter. Does the battery voltage pulsing at the turn-signal, hazard-lamp socket positive terminal equal the specified value?	11 - 14 v	Go to Step 5	Go to Step 9
5	At each bulb socket, use an ohmmeter to check the ground circuit. Is the resistance equal to the specified value?	0 Ω	Go to Step 6	Go to Step 8
6	Replace any faulty turn signal/hazard bulbs. Is the repair complete?	-	System OK	-
7	Repair the power supply circuit to fuses. Is the repair complete?	-	System OK	-
8	Repair the open ground circuit. Is the repair complete?	-	System OK	-

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Trun Signal Lamps and Hazard Lamps Do Not Work (Cont'd)

Step	Action	Value(s)	Yes	No
9	1. Turn on the hazard switch. 2. Test the blinker unit connector terminal 49 with a voltmeter. Does the battery voltage pulsing at the blinker unit terminal 113 equal the specified value?	11 - 14 v	Go to Step 15	Go to Step 10
10	1. Turn on the hazard switch. 2. Test the blinker unit connector terminal 31 with a voltmeter. Does the battery voltage pulsing at the blinker unit terminal 31 equal the specified value?	11 - 14 v	Go to Step 11	Go to Step 14
11	1. Disconnect the blinker unit from the connector. 2. Use an ohmmeter to check between ground and the connector for terminal 31, 49 of the blinker unit. Is the resistance equal to the specified value?	0 - 0.5 Ω	Go to Step 13	Go to Step 12
12	Repair the blinker unit ground connection. Is the repair complete?	-	System OK	-
13	Replace faulty blinker unit. Is the repair complete?	-	System OK	-
14	1. Disconnect the hazard switch connector. 2. Check for voltage at terminal 49. 3. Turn the ignition on. 4. Check for voltage at terminal 111.	11 - 14 v	Go to Step 15	Go to Step 19
15	Does the battery voltage available at both terminals equal the specified value? 1. Remove the hazard switch. 2. Turn the hazard switch OFF. 3. Check for continuity between terminals 66 and 111. 4. Turn the hazard switch on. 5. Check for continuity between terminals 66 and 64. Do both tests show the specified value?	0 Ω	Go to Step 18	Go to Step 16
16	1. Remove the hazard switch. 2. Turn the hazard switch to the on position. 3. Use an ohmmeter to check for continuity between terminals 112, 62, and 63. Does the continuity between terminals 112, 62, and 63 equal the specified value?	0 Ω	System OK	System OK
17	Replace the faulty hazard switch. Is the repair complete?	-	System OK	-
18	Repair the open circuit between hazard switch terminal 113 and blinker unit terminal 42. Is the repair complete?	-	System OK	-
19	Repair the open circuit between the hazard switch and the fuses EF12 or F11. Is the repair complete?	-	System OK	-

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Hazard Lamps Do Not Operate, Turn Signals Are OK (Cont'd)

Step	Action	Value (s)	Yes	No
1	Check fuses F26 and F2. Is fuse EF12 blown?	-	Go to Step 2	Go to Step 3
2	1. Check for a short circuit and repair if necessary. 2. Replace the fuse. Is the repair complete?	-	System OK	-
3	Use a voltmeter to check for power to fuse F26. Does the battery voltage available at fuse F26 equal the value specified?	11 - 14 v	Go to Step 5	Go to Step 4
4	Repair the power supply circuit to fuse F2. Is the repair complete?	-	System OK	-
5	1. Disconnect the hazard switch connector. 2. Use a voltmeter to check power to the hazard switch terminal 112. Does the battery voltage available at connector terminal 112 equal the value specified?	11 - 14v	Go to Step 6	Go to Step 9
6	1. Remove the hazard switch and disconnect it for testing. 2. Turn the hazard switch to the on position. 3. Test with an ohmmeter between terminals 112 and 113. Is the resistance equal to the specified value?	0 Ω	Go to Step 7	Go to Step 10
7	1. With the hazard switch still removed and disconnected for testing, turn the hazard switch to the on position. 2. Use an ohmmeter to check between terminals 11, 62, and 63. Is the resistance equal to the specified value?	0 Ω	Go to Step 8	Go to Step 10
8	Repair the open circuit between the hazard switch connector and splice connector. Is the repair complete?	-	System Ok	-
9	Repair the open circuit between the hazard switch connector terminal 111 and fuse F26. Is the repair complete?	-	System OK	-
10	Replace the faulty hazard switch. Is the repair complete?	-	System OK	-

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INTERIOR ROOM AND LUGGAGE LAMPS

Interior Room Lamp Inoperative

Step	Action	Value (s)	Yes	No
1	1. Remove the interior room lamp bulb and inspect the filament. 2. If the filament is not broken, test the bulb using the vehicle's battery and a jumper wire. Does the bulb pass the visual and physical checks?	-	Go to Step 3	Go to Step 2
2	1. Check for a short circuit and repair if necessary. 2. Replace the fuse. Is the repair complete?	-	System OK	-
3	Use a voltmeter to check for power to fuse F1. Does the battery voltage available at fuse F1 equal the value specified?	11 - 14 v	Go to Step 5	Go to Step 4
4	Repair the power supply circuit to fuse F1. Is the repair complete?	-	System OK	-
5	1. Disconnect the hazard switch connector. 2. Use a volmeter to check power to the hazard switch terminal 3. Does the battery voltage available at connector terminal 3 equal the value specified?	0 Ω	Go to Step 6	Go to Step 9
6	1. Remove the hazard switch and disconnect it for testing. 2. Turn the hazard switch to the on position. 3. Test with an ohmmeter between terminals 8 and 7. Is the resistance equal to the specified value?	0 Ω	Go to Step 7	Go to Step 10
7	1. With the hazard switch still removed and disconnected for testing, turn the hazard switch to the on position. 2. Use an ohmmeter to check between terminals 111 and 63. Is the resistance equal to the specified value?	-	Go to Step 8	Go to Step 10
8	Repair the open circuit between the hazard switch connector and splice connector. Is the repair complete?	-	System OK	-
9	Repair the open circuit between the hazard switch connector terminal 3 and fuse F1. Is the repair complete?	-	System OK	-
10	Replace the faulty hazard switch. Is the repair complete?	-	System OK	-

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Luggage Lamp Inoperative (Cont'd)

Step	Action	Value (s)	Yes	No
1	1. Remove the luggage lamp bulb and inspect the filament. 2. If the filament is not broken, test the bulb using the vehicle's battery and a jumper wire. Does the bulb pass the visual and physical check?	-	Go to Step 3	Go to Step 2
2	Replace the bulb. Is the repair complete?	-	System OK	-
3	1. Reinstall the luggage lamp bulb. 2. Check fuse F1. Is fuse F1 blown?	-	Go to Step 4	Go to Step 5
4	1. Check for a short circuit and repair if necessary. 2. Replace the fuse. Is the repair complete?	-	System OK	-
5	Check the voltage at fuse F1. Does the voltage at fuse F1 equal the specified value?	11 - 14 v	Go to Step 7	Go to Step 6
6	Repair the open circuit between the battery and fuse F1. Is the repair complete?	-	System OK	-
7	1. Disconnect the luggage lamp electrical connector. 2. Check the voltage at the ORN wire. Does the voltage at the ORN wire equal the specified value?	11 - 14 v	Go to Step 8	Go to Step 9
8	Repair the open circuit between fuse F1 and the luggage lamp. Is the repair complete?	-	System OK	-
9	1. Reconnect the luggage lamp. 2. Remove the luggage lamp switch. 3. With a voltmeter or test lamp, test the 204, 114 wire at the luggage lamp switch. Does the voltage at the luggage lamp switch equal the specified value.	11 - 14 v	Go to Step 11	Go to Step 10
10	Repair the open circuit between the luggage lamp and the luggage lamp switch. Is the repair complete?	-	System OK	-
11	Use an ohmmeter to check the resistance between ground and the luggage lamp switch.Is the resistance equal to the specified value?	0 Ω	Go to Step 12	Go to Step 13
12	Replace the luggage lamp switch.Is the repair complete?	-	System OK	-
13	Repair the ground circuit for the luggage lamp switch. Is the repair complete?	-	System OK	-

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DOOR COURTESY LAMPS

Door Courtesy Lamps Inoperative

Step	Action	Value(s)	Yes	No
1	1. Remove the door courtesy lamp bulb and inspect the filament. 2. If the filament is not broken, test the bulb using the vehicle's battery and a jumper wire. Does the bulb pass the visual and physical check?	-	Go to Step 3	Go to Step 2
2	Replace the bulb. Is the repair complete?	-	System OK	-
3	1. Reinstall the door courtesy lamp bulb. 2. Check fuse F1. Is fuse F1 blown?	-	Go to Step 4	Go to Step 5
4	1. Check for a short circuit and repair if necessary. 2. Replace the fuse.Is the repair complete?	-	System OK	-
5	Check the voltage at fuse F1. Does the voltage at fuse F1 equal the specified value?	11 - 14 v	Go to Step 7	Go to Step 6
6	Repair the open circuit between the battery and fuse F1. Is the repair complete?	-	System OK	-
7	1. Disconnect the door courtesy lamp electrical connector. 2. Check the voltage at terminal 129, 130 of connectors main DR and C361. Does the voltage at terminal 20 of connectors C351 and C361 equal the specified value?	11 - 14 v	Go to Step 8	Go to Step 9
8	Repair the open circuit between the door courtesy lamp and the front door switch. Is the repair complete?	-	System OK	-
9	1. Reconnect the door courtesy lamp. 2. Remove the front door switch. 3. With a voltmeter or test lamp, test the WHT wire at the front door switch. Does the voltage at the front door switch equal the specified value?	11 - 14 v	Go to Step 11	Go to Step 10
10	Repair the open circuit between the door courtesy lamp and the front door switch. Is the repair complete?	-	System OK	-
11	Use an ohmmeter to check the resistance between ground and the BLK wire at the front door switch connector on the harness side. Is the resistance equal to the specified value?	0 Ω	Go to Step 12	Go to Step 13
12	Replace the front door switch. Is the repair complete?	-	System OK	-
13	Repair the ground circuit for the front door switch. Is the repair complete?	-	System OK	-

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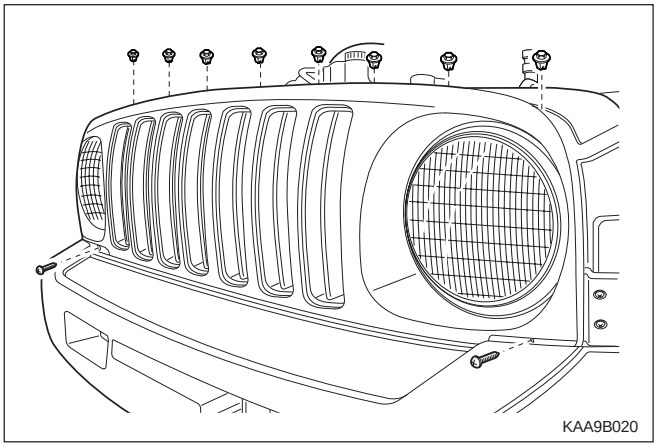
CIGAR LIGHTER

Cigar Lighter Inoperative

Step	Action	Value(s)	Yes	No
1	Check fuse F15. Is the fuse blown?	-	Go to Step 2	Go to Step 3
2	1. Check for a short circuit and repair if necessary. 2. Replace the fuse. Is the repair complete?	-	System OK	-
3	1. Turn the ignition key to the ACC position. 2. Use a voltmeter to check for voltage at fuse F15. Does the battery voltage available at the fuse F15 match the value specified?	11 - 14 v	Go to Step 5	Go to Step 4
4	Repair the open power-supply circuit for fuse F15. Is the repair complete?	-	System OK	-
5	1. Remove the electrical connector from the back of the cigar lighter. 2. Turn the ignition key to the ACC position. 3. Use a voltmeter to check the voltage at terminal 1 of the cigar lighter. Does the battery voltage available at terminal 1 of the cigar light match the value specified?	11 - 14 v	Go to Step 7	Go to Step 6
6	Repair the open circuit between the fuse F15 and the cigar lighter. Is the repair complete?	-	System OK	-
7	With the ignition key still in the ACC position, use an ohmmeter to check continuity between terminal 2 of the cigar lighter connector and ground. Does the battery voltage match the value specified?	11 - 14 v	Go to Step 9	Go to Step 8
8	Repair the open ground circuit. Is the repair complete?	-	System OK	-
9	Replace the cigar lignter. Is the repair complete?	-	System OK	-

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REPAIR INSTRUCTIONS


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ON-VEHICLE SERVICE UNIT REPAIR

HEAD LAMPS

Removal and Installation Procedure

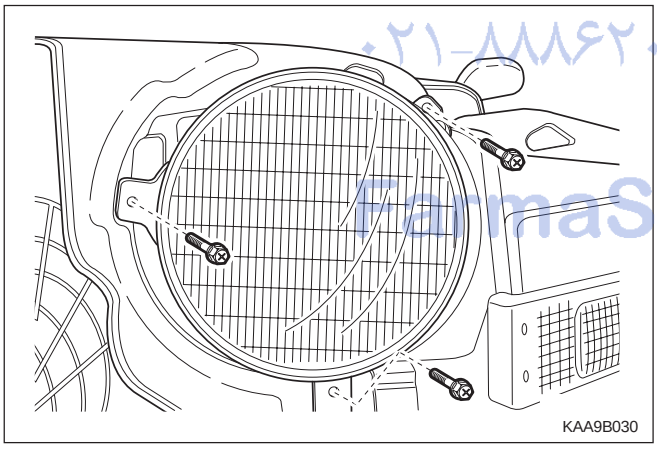
1. Open the hood.
2. Disconnect the negative battery cable.
3. Remove screws and row the radiator grille.

Installation Notice

Tightening Torque	5 - 9 N•m (44 - 80 lb-in)

- Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

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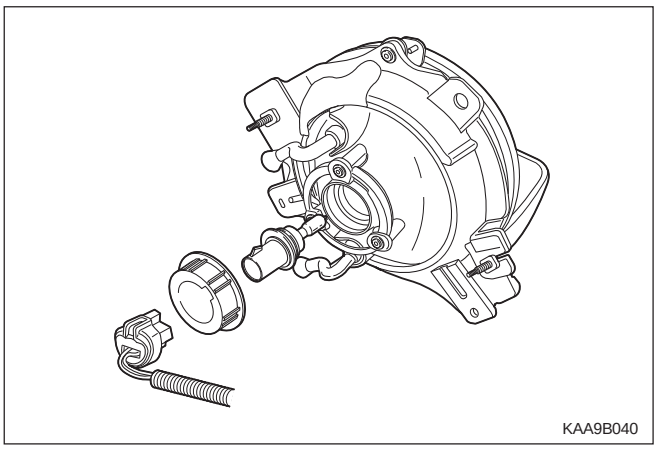
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4. Disconnect the headlamp assembly electrical connector.
5. Remove the headlamp.

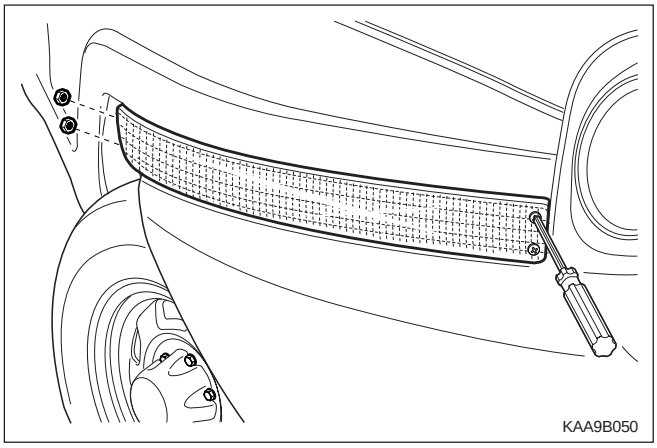
Installation Notice

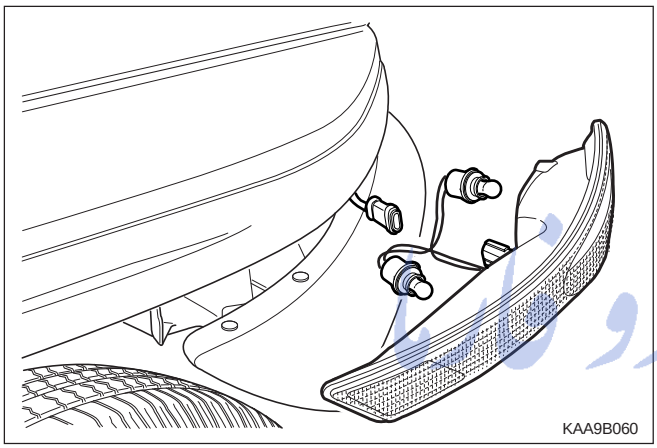
Tightening Torque	5 - 9 N•m (44 - 80 lb-in)

- Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.


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6. Turn the headlamp bulb locker and remove the headlamp bulb.
7. Installation should follow the removal procedure in the reverse order.


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FRONT COMBINATION LAMP

Removal and Installation Procedure

1. Disconnect negative battery cable.
2. Remove the screws and nuts.

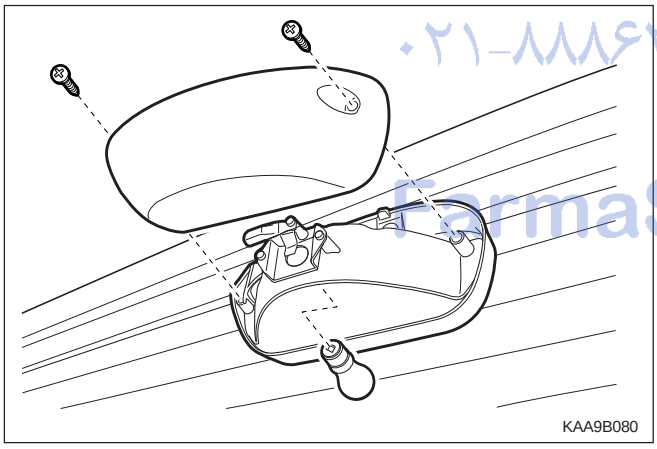
Installation Notice

Tightening Torque	5 - 9 N•m (44 - 80 lb-in)

- Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

3. Disconnect and remover the front combination lamp.
4. Remove the inoperative bulb.
5. Installation should follow the removal procedure in the reverse order.

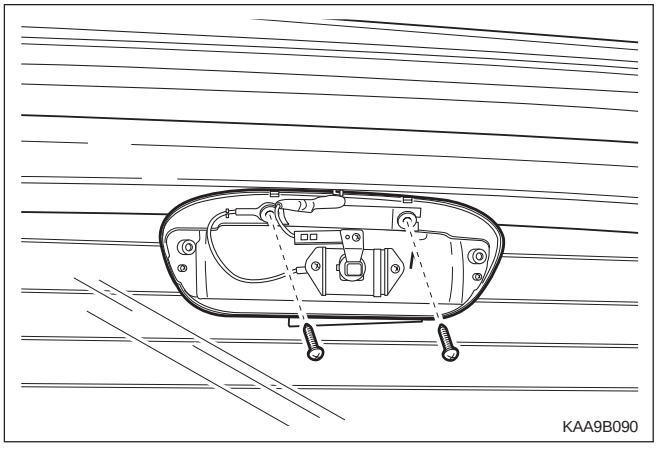
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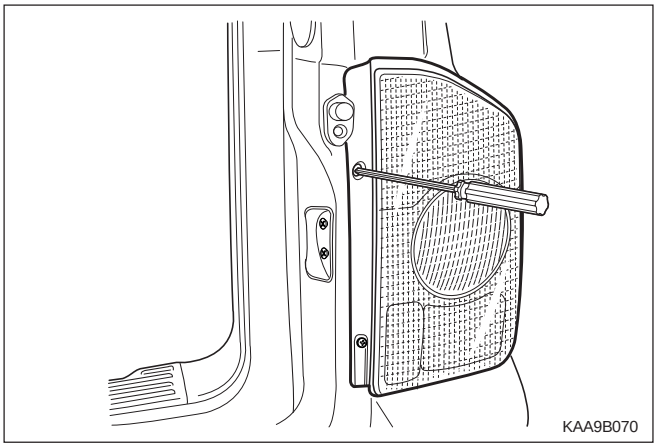
CENTER HIGH-MOUNTED STOP LAMP

Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Remove the center high-mounted stop lamp cover


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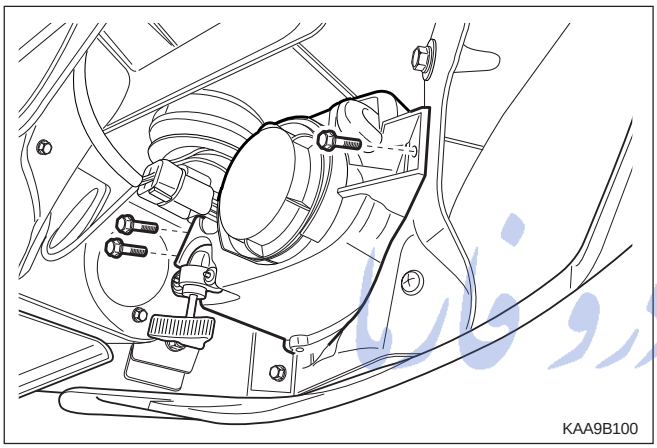
3. Disconnect the CHMSL electrical connector.
4. Remove the screws with the CHMSL
5. Installation should follow the removal procedure in the reverse order.



REAR COMBINATION LAMPS

Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Remove the screws and the lamp assembly
3. Remove any inoperative bulb.
4. Installation should follow the removal procedure in the reverse order.



FOG LAMPS

Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Remove the bolts that secure the fog lamp assembly

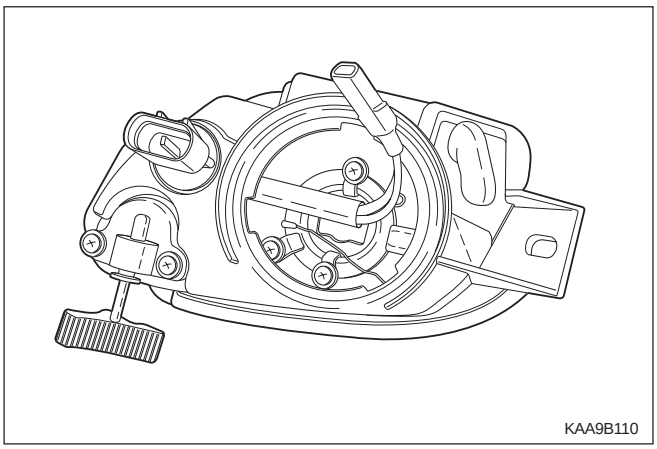
Installation Notice

Tightening Torque	5 - 9 N•m (44 - 80 lb-in)

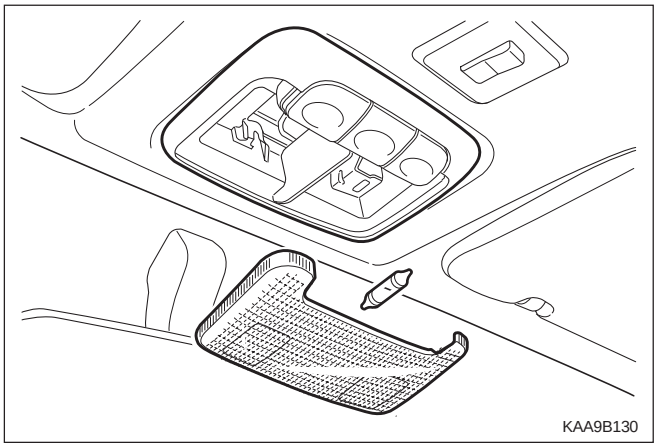
- Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

3. Remove the fog assembly.
4. Disconnect the fog lamp assembly electrical connector.

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5. Remove the fog lamp dust cover.
6. Remove the locking clip.
7. Remove the bulb fromthefog lamp assembly.
8. Disconnect the bulb electrical connector.
9. Installation should follow the removal procedure in the reverse order.

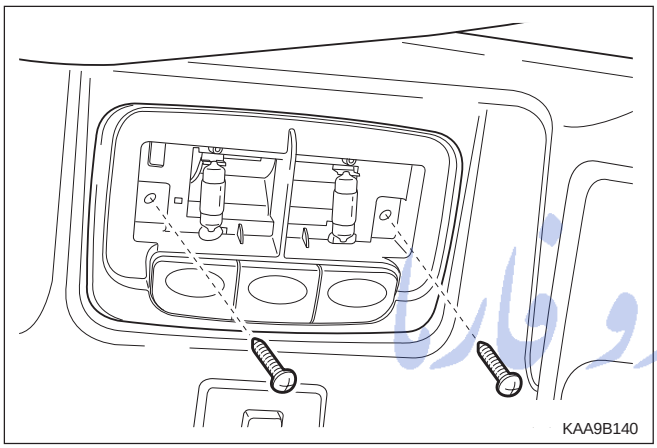

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INTERIOR COURTESY LAMP

(Front Room Lamp Shown, Center Room Lamp Similar)

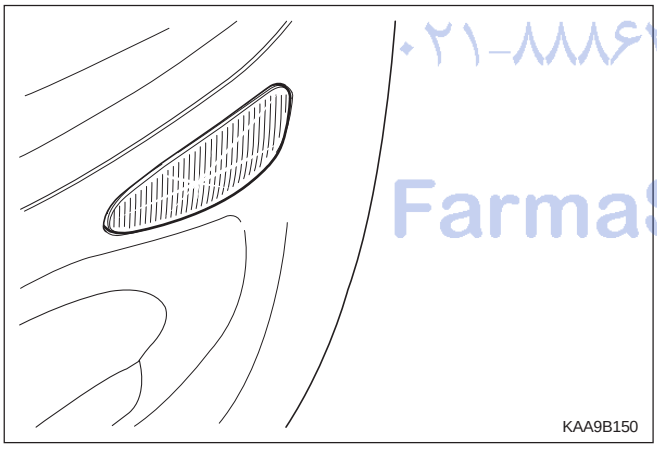
Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Pry off the room lamp lens by inserting a screw driver into the recess along the edge of the lens.
3. Remove the screws and the room lamp housing from the headliner.


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4. Disconnect the electrical connector.
5. Remove the bulb.
6. Installation should follow the removal procedure in the reverse order.

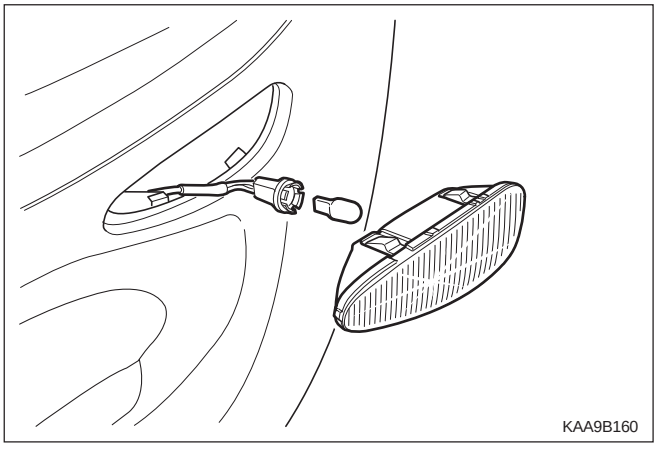
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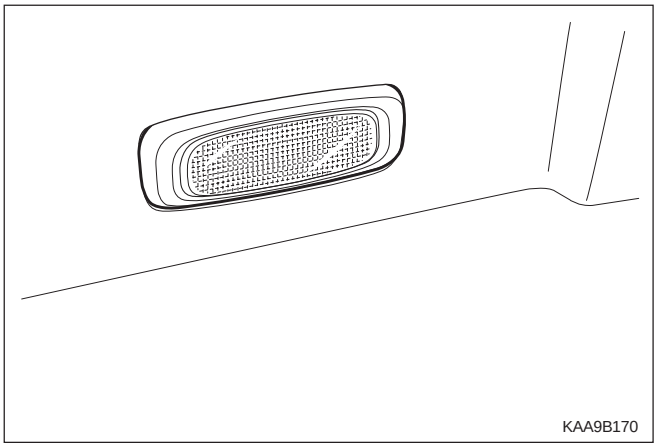
DOOR COURTESY LAMP

Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Pry off the door courtesy lamp assembly by inserting a flat driver.


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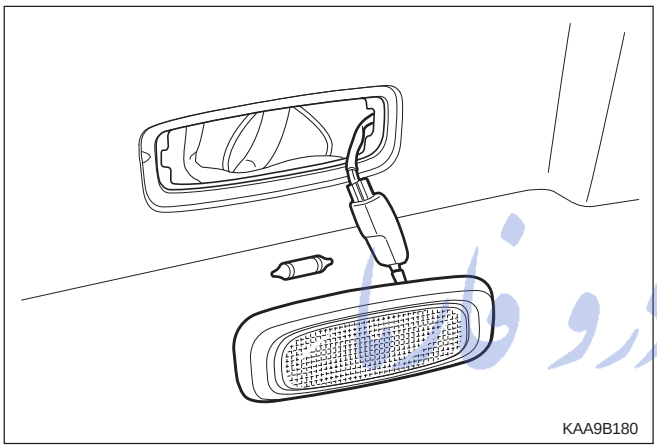
3. Disconnect the electrical connector.
4. Remove the bulb.
5. Installation should follow the removal procedure in the reverse order.


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LUGGAGE LAMP

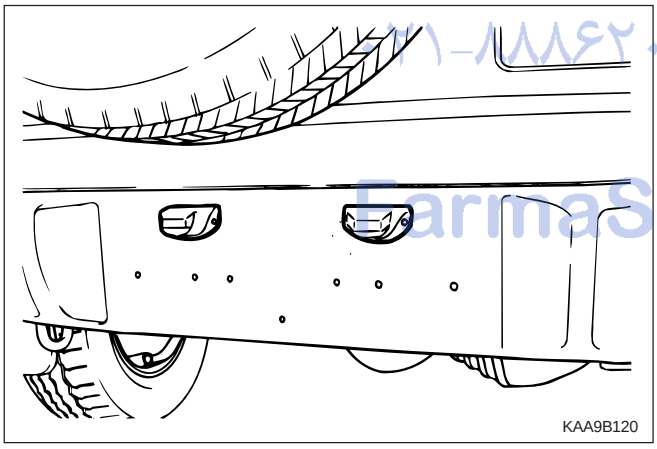
Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Open the tail gate.
3. Pry off the luggage lamp assembly by inserting a flat driver.


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4. Disconnect the electrical connector.
5. Remove the bulb.
6. Installation should follow the removal procedure in the reverse order.

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LICENSE PLATE LAMPS

Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Remove the screws and the license plate lamp assembly.
3. Remove the license plate lamps
4. Installation should follow the removal procedure in the reverse order.

SPECIFICATIONS

BULB USAGE CHART

Bulb	Replacement Bulb Number
Headlamp High/Low	65 w / 45 w
Turn Signal Lamp	28 w
Position Lamp	8 w
Front Side Maker Lamp	8 w
Tail Lamp	8 w
Stop Lamp	27 w
Rear Trun Signal Lamp	27 w
Back Up Lamp	27 w
Front Fog Lamp	55 w
Rear Side Maker Lamp	5 w
License Plate Lamp	5 w
Center High-Mounted Stop Lamp	27 w
Front Interior Room Lamp	8 w
Second Interior Room Lamp	10 w
Luggage Lamp	5 w

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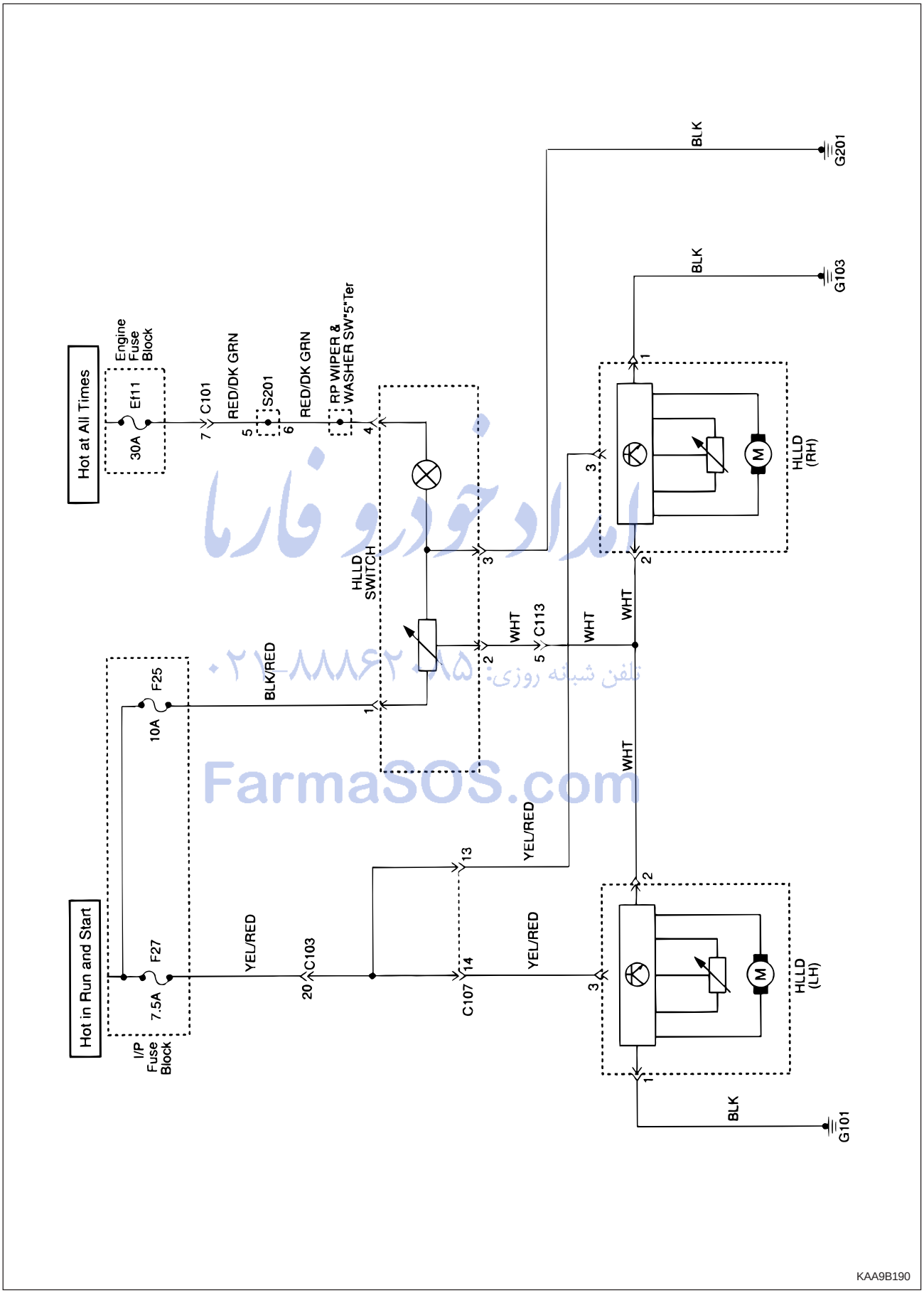
FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Front Combination Lamp Mounting Nuts	5 - 9	-	44 - 80
Fog Lamp Mounting Bolts	5 - ۹	-	44 - 80
Headlamp Mounting Bolts	5 - 9	-	44 - 80
Radiator Mounting Rivet	2 - 5	-	18 - 44

۲۱-۸۸۸۶۲۰۸۵ تلفن شبانه روزی
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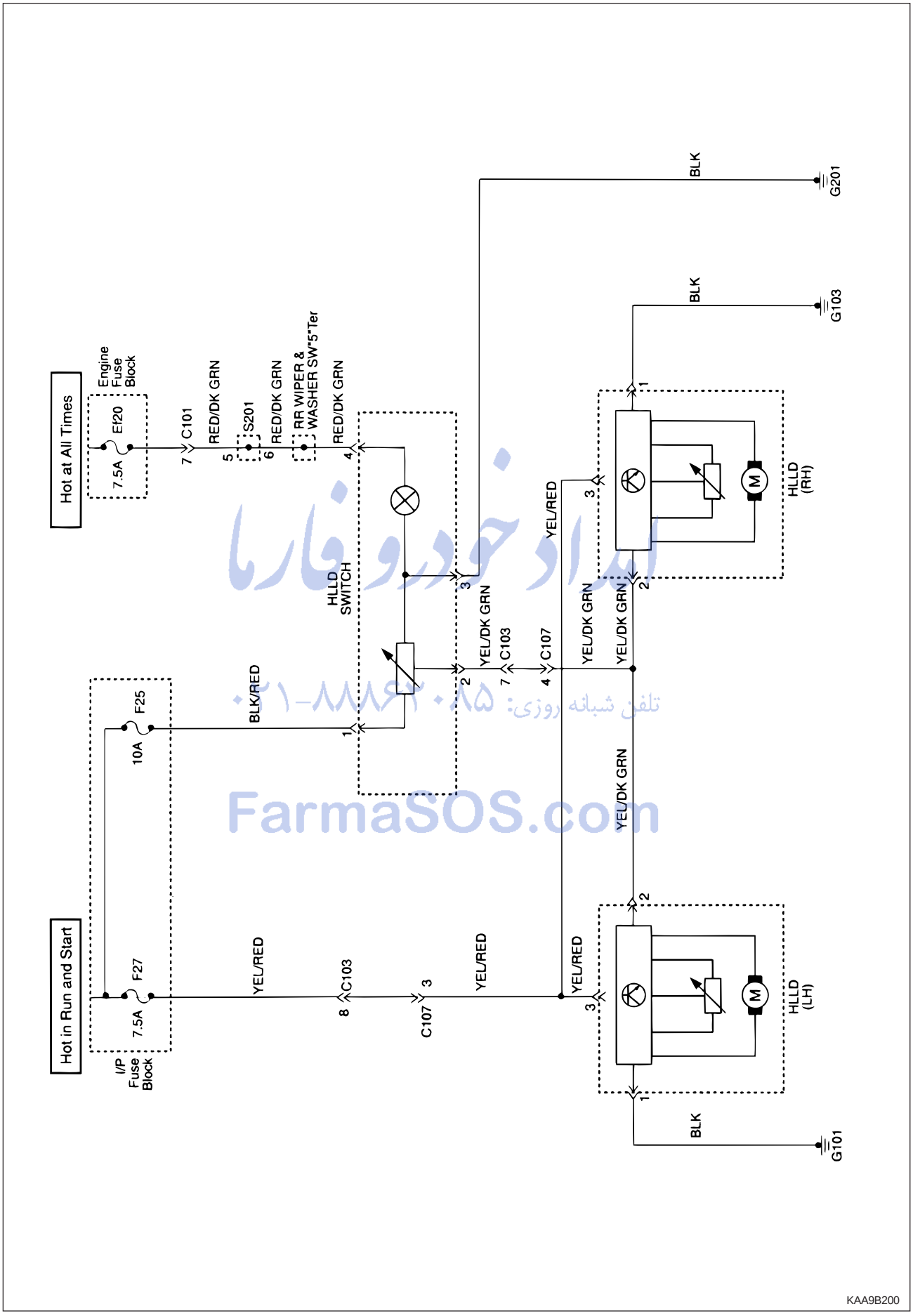
SCHEMATIC AND ROUTING DIAGRAMS

HEAD LAMP LEVELING DEVICE (HLLD) : GASOLINE



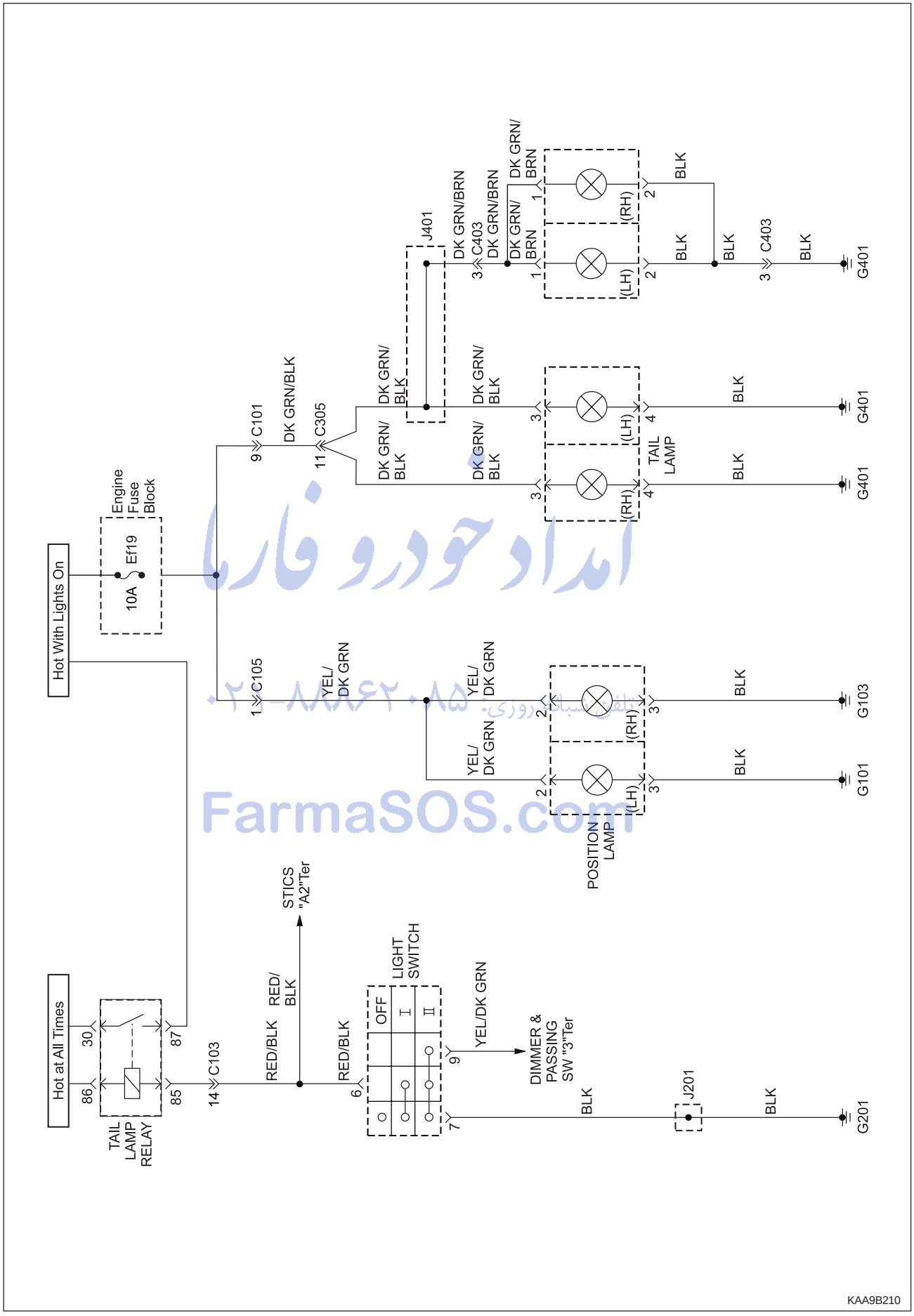
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HEAD LAMP LEVELING DEVICE (HLLD) : DIESEL



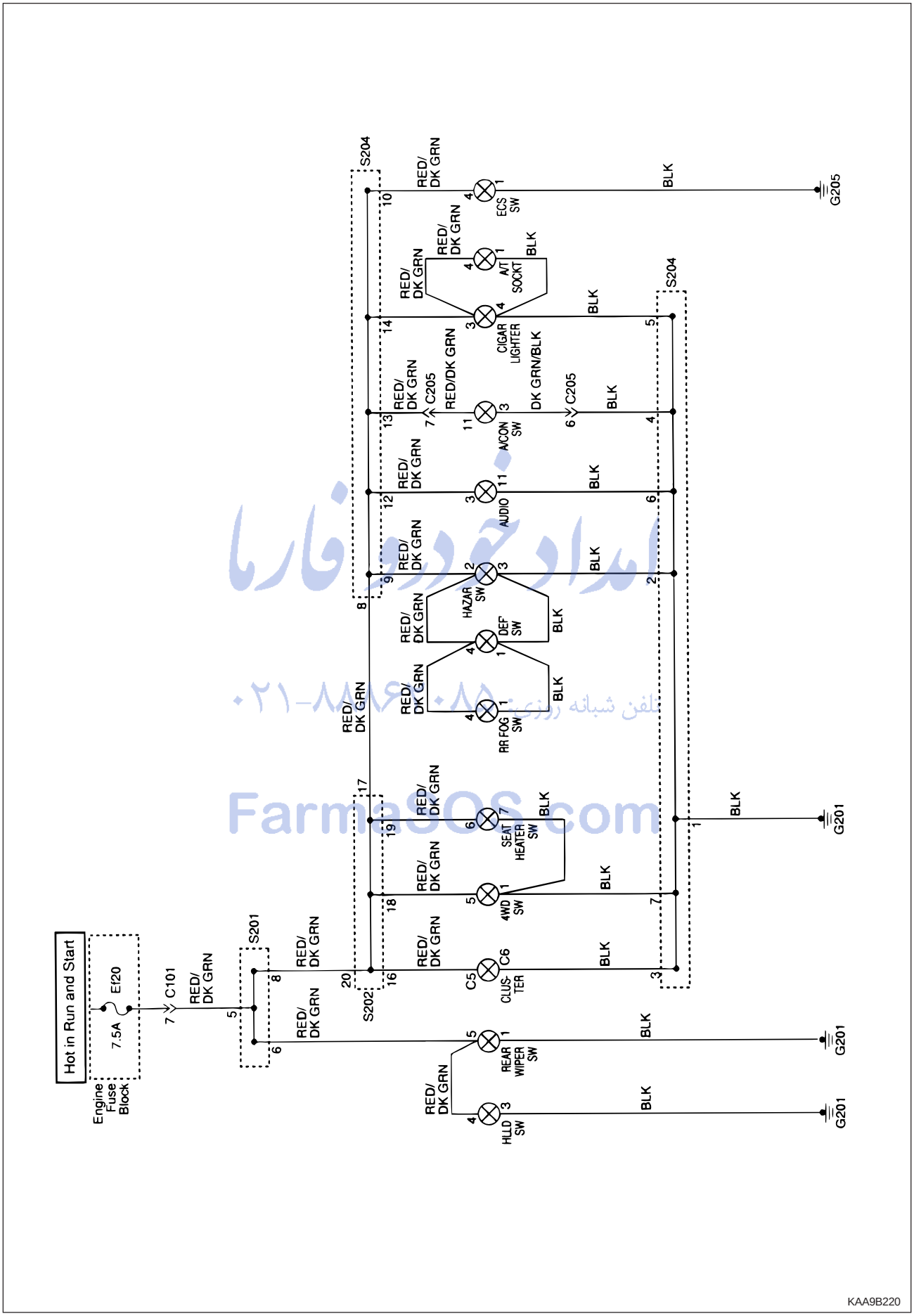
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TAIL LAMP RELAY CIRCUIT POSITION LAMP, TAIL LAMP, LICENSE LAMP



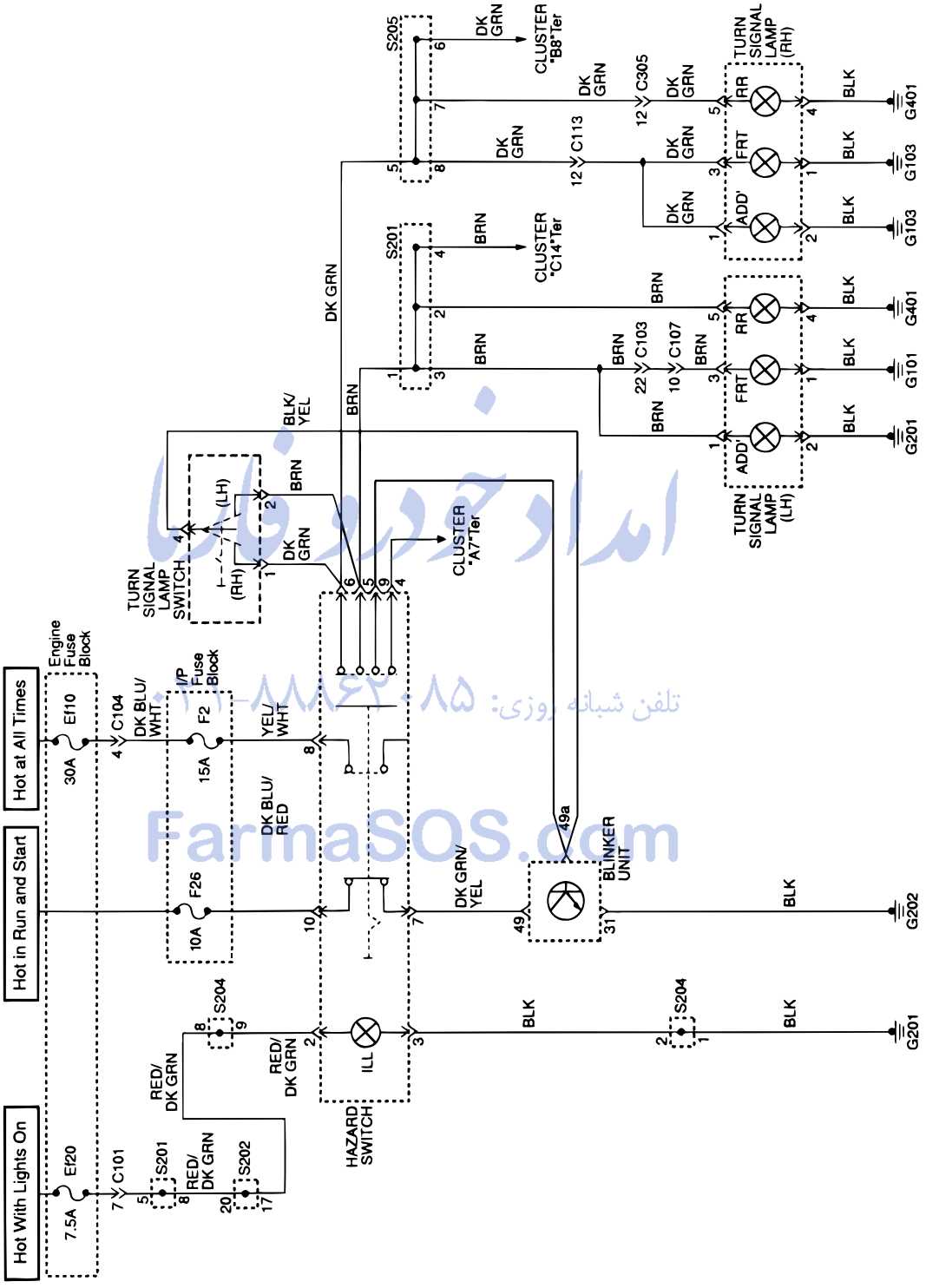
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ILLUMINATION SWITCH



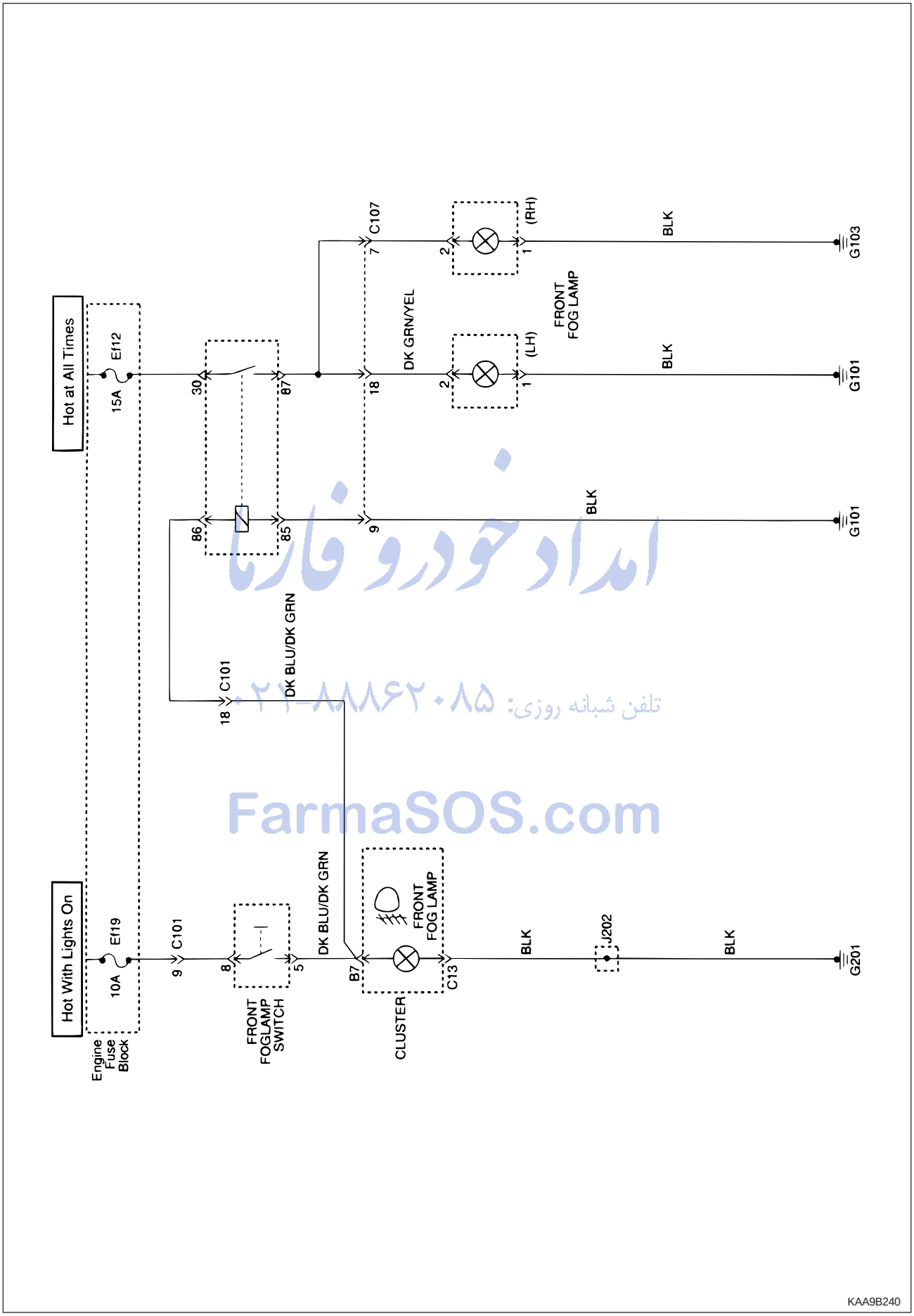
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TURN SIGNAL LAMP



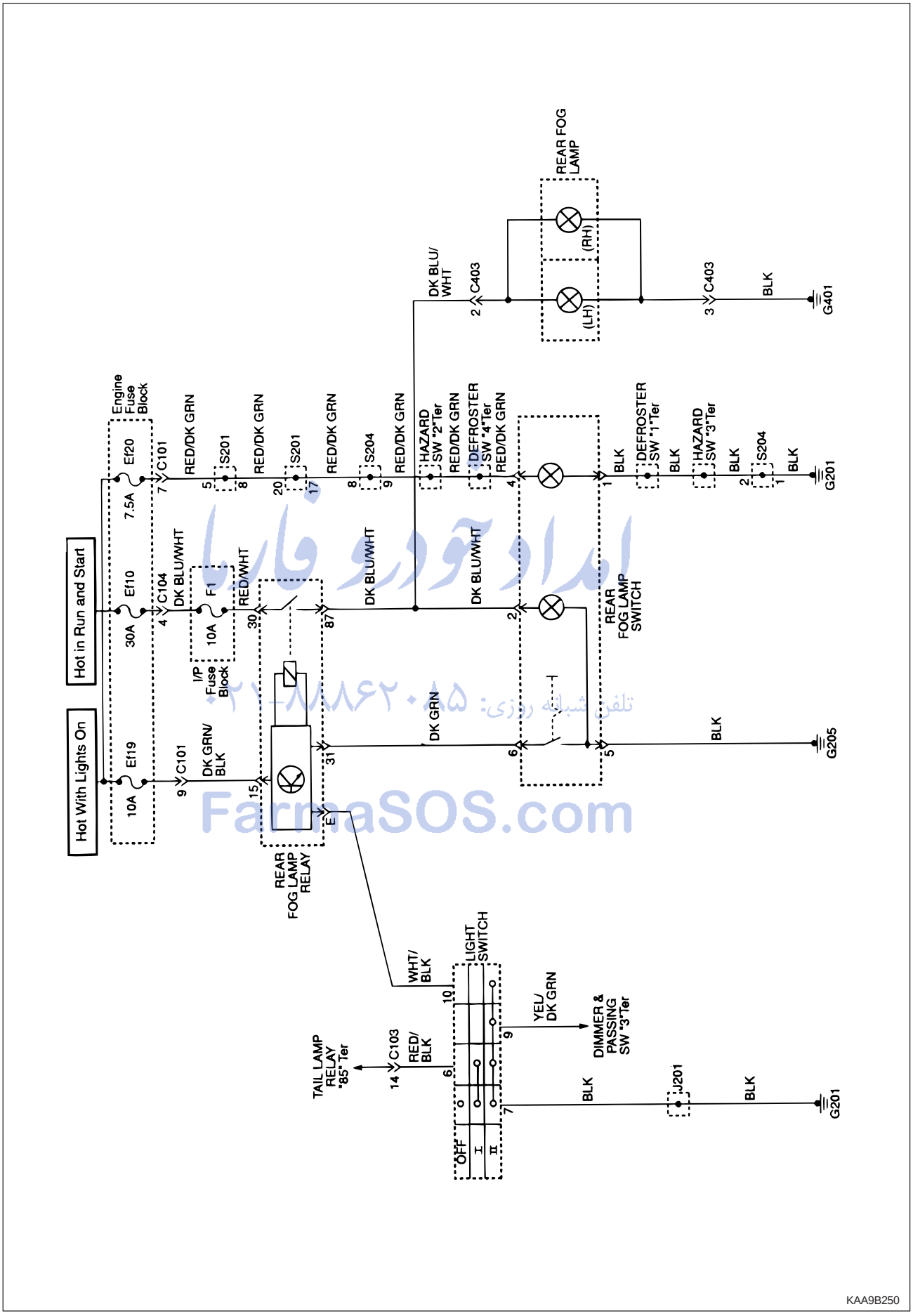
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FRONT FOG LAMP



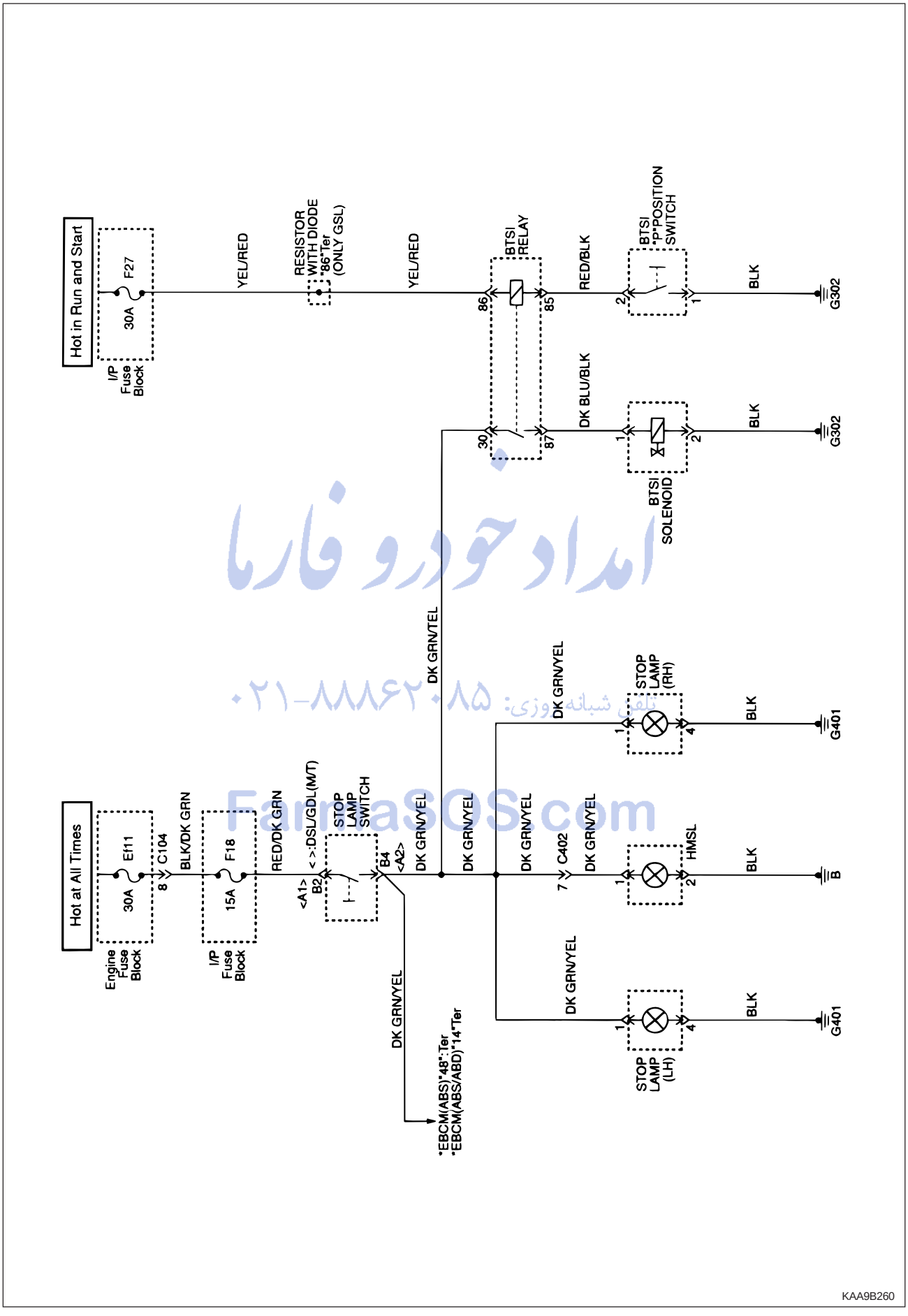
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REAR FOG LAMP



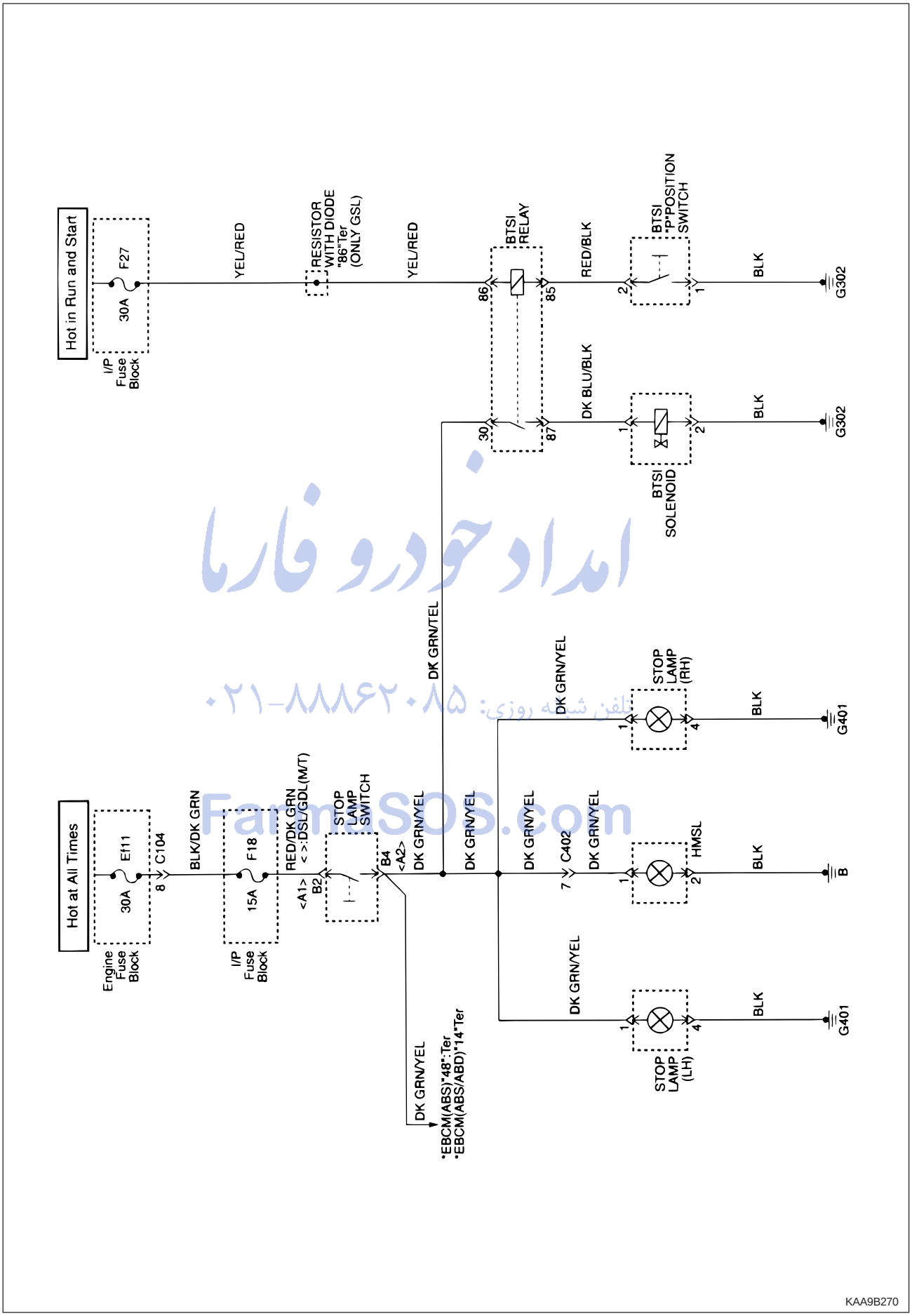
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STOP LAMP, BTSI (BRAKE TRANSMISSION SHIFT INTERLOCK) - METAL TOP



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STOP LAMP, BTSI (BRAKE TRANSMISSION SHIFT INTERLOCK) - SOFT TOP



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SECTION 9C

HORNS

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

Description and Operation 9C-2

Horns 9C-2

Components Locator 9C-3

Lighting System 9C-3

Repair Instructions 9C-4

On-Vehice Service Unit Repair 9C-4

Dual Horns 9C-4

Schematic and Routing Diagram 9C-5

Horn Wiring System 9C-5

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DESCRIPTION AND OPERATION

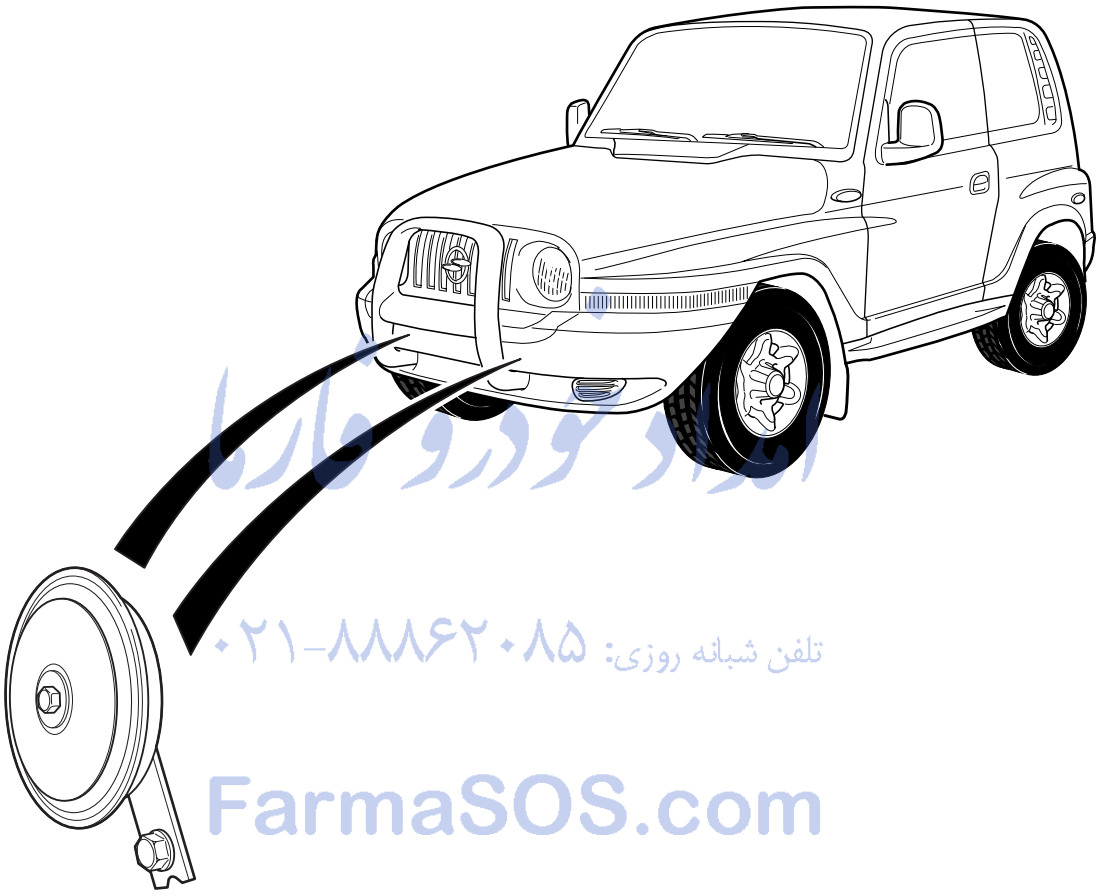
HORNS

The horns are located in the front bumper. They are at tached near the radiator at the front of the vehicle. The horns are actuated by pressing the steering wheel pad, which grounds the horns' electrical circuit.

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COMPONENTS LOCATOR

LIGHTING SYSTEM

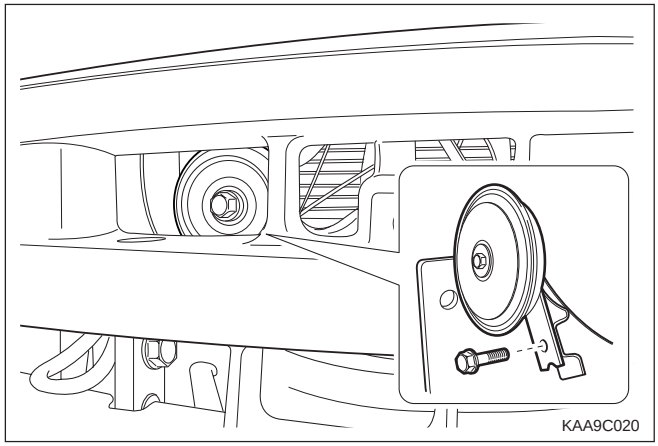


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1 HORN

REPAIR INSTRUCTIONS



ON-VEHICLE SERVICE UNIT REPAIR

DUAL HORNS (LEFT HORN SHOWN, RIGHT HORN SIMILAR)

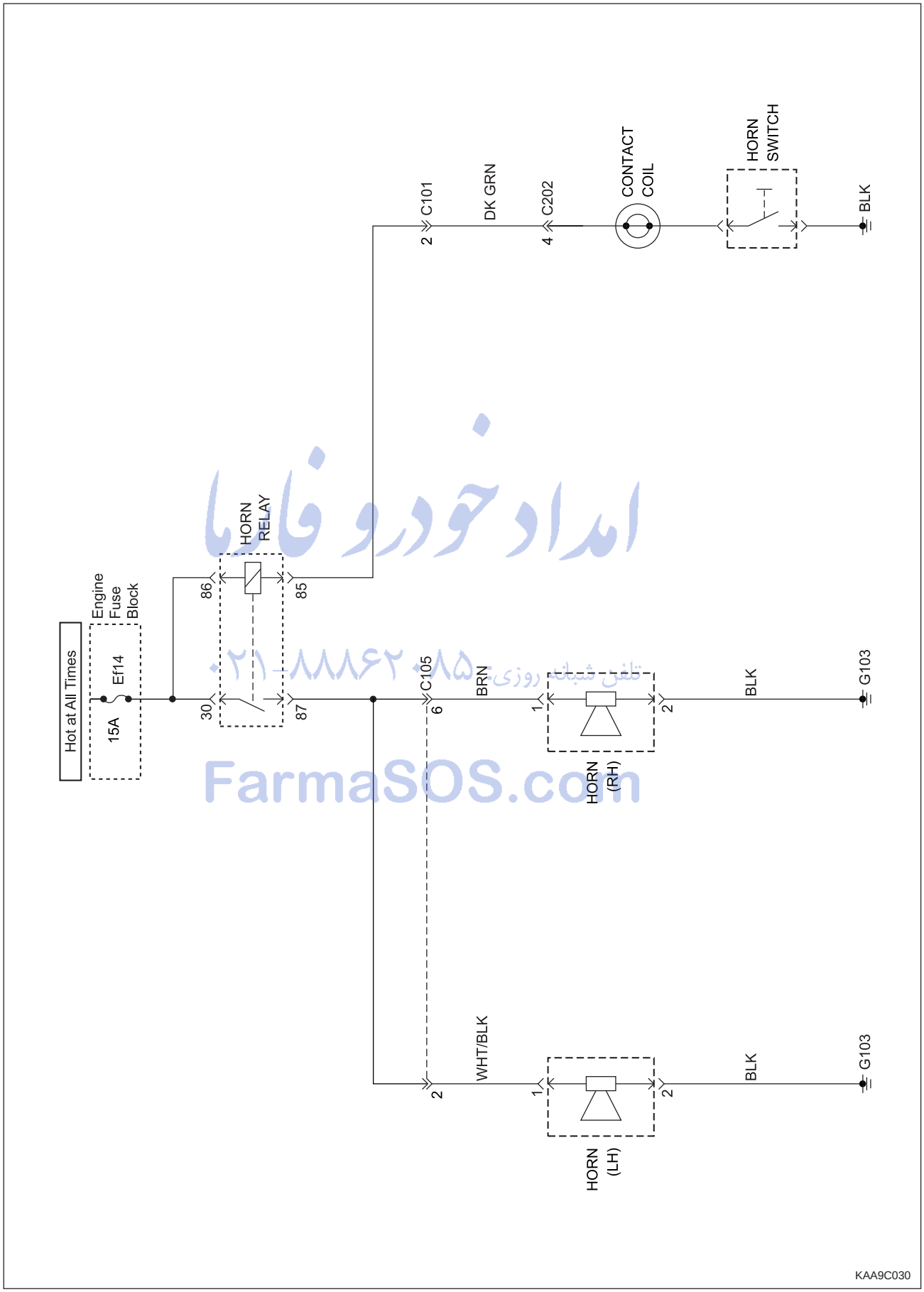
Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Disconnect the electrical connector.
3. Remove the bolt and the horn.
   - Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.
4. Installation should follow the removal procedure in the reverse order.

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SCHEMATIC AND ROUTING DIAGRAMS

HORN WIRING SYSTEM



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SECTION 9D

WIPER, WASHER SYSTEMS

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

Description and Operation 9D-2

Windshield Wiper System 9D-2

Windshield Washer System 9D-2

Components Locator 9D-3

Lighting System 9D-3

Repair Instructions 9D-4

On-Vehice Service Unit Repair 9D-4

Windshield Wiper Arm 9D-4

Windshield Wiper Motor 9D-4

Windshield Wiper Blade 9D-5

Windshield Washer Reservoir 9D-5

Windshield Washer Pump 9D-6

Windshield Washer Nozzles 9D-6

Windshield Washer Hoses 9D-6

Rear Wiper Arm 9D-6

Rear Wiper Motor 9D-7

Rear Washer Reservoir 9D-7

Specifications 9D-8

Fastener Tightening Specifications 9D-8

Schematic and Routing Diagrams 9D-9

Windshield Wipers System 9D-9

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DESCRIPTION AND OPERATION

WINDSHIELD WIPER SYSTEM

The windshield wiper system consists of a wiper motor, a linkage, wiper arms and blade, and a wiper/washer switch. The windshield wiper circuit incorporates a self parking device which consists of a worm gear and a camplate in order to keep the circuit engaged temporarily when the switch is turned off. The wiper system is driven by a permanent magnet-type motor. The windshield wiper motor is mounted on the dash panel and is directly con-nected to the windshield wiper linkage.

The windshield wiper motor has two speeds, LO and HI, and also has intermittent wiper. The wiper switch is an integral part of the wiper/washer switch. Windshield wiper operation is actuated through the lever on the right side of the steering column.

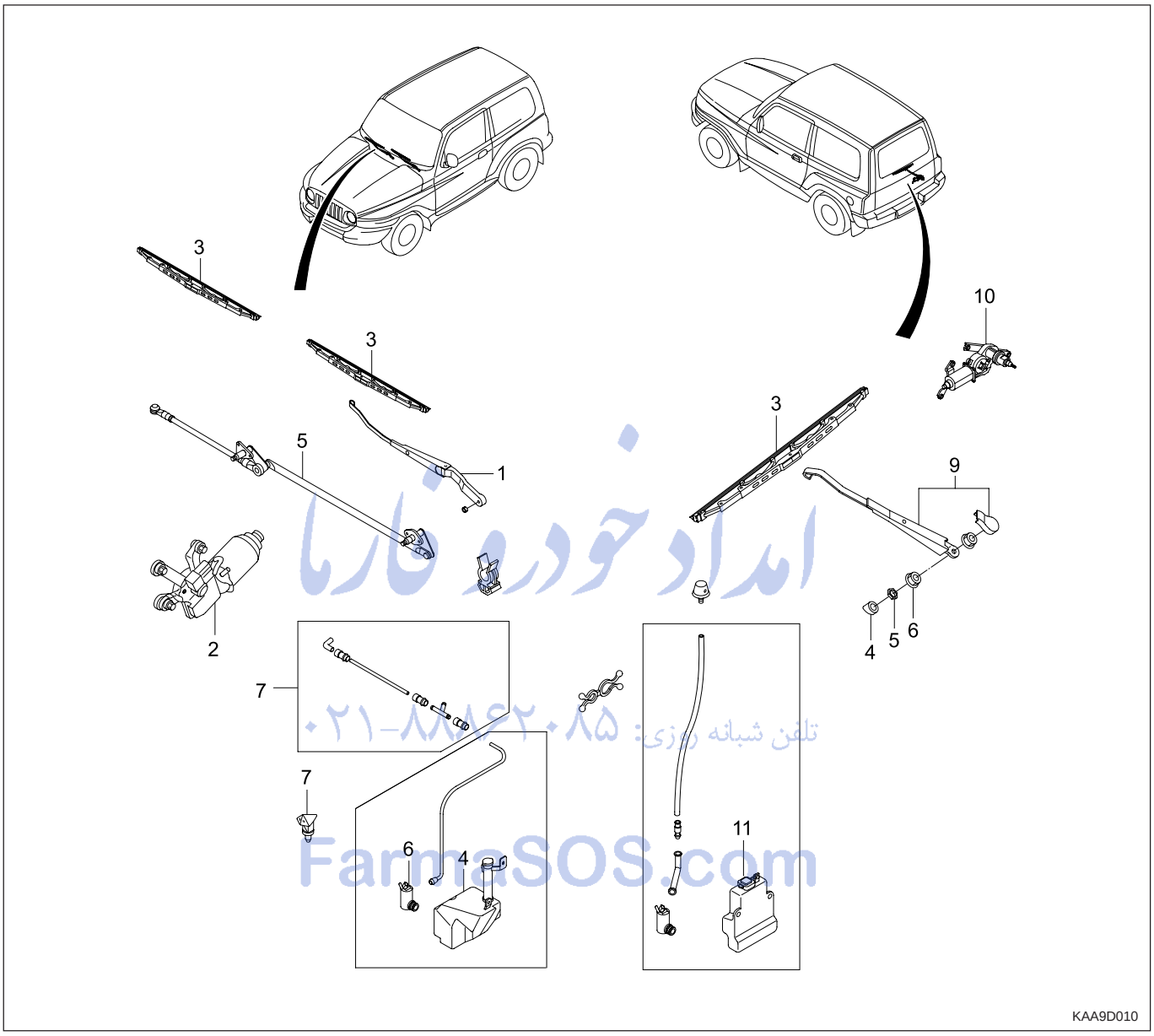
WINDSHIELD WASHER SYSTEM

The windshield washer system is equipped with a washer fluid reservoir, a washer fluid pump, hoses, nozzles, and a wiper/washer switch. The windshield washer reservoir is mounted above the front right apron panel. Attached to the reservoir is a washer pump, which pumps fluid through the hoses to the two nozzles mounted on the hood. The washer switch is an integral part of the wiper/washer switch. Windshield washer operation is actuated through the lever on the right side of the steering column.

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COMPONENTS LOCATOR

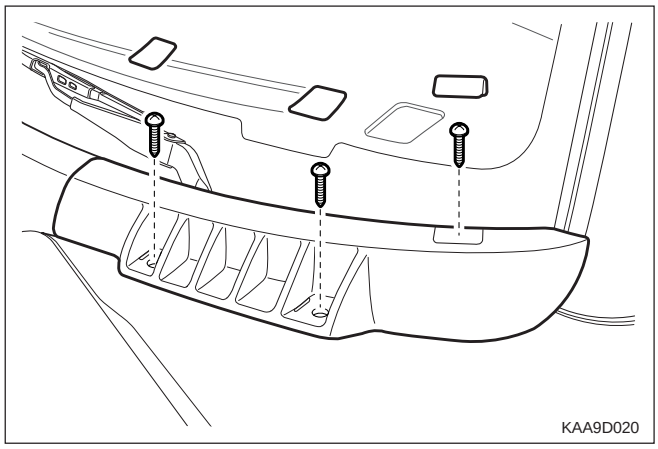
LIGHTING SYSTEM



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1 Windshield Wiper Arm
2 Windshield Wiper Motor
3 Windshield Wiper Blade
4 Windshield Washer Reservoir
5 Windshield Wiper Linkage
6 Windshield Washer Pump
7 Windshield Washer Nozzles
8 Windshield Washer Hoses
9 Rear Wiper Arm
10 Rear Wiper Motor
11 Rear Washer Reservoir

REPAIR INSTRUCTIONS

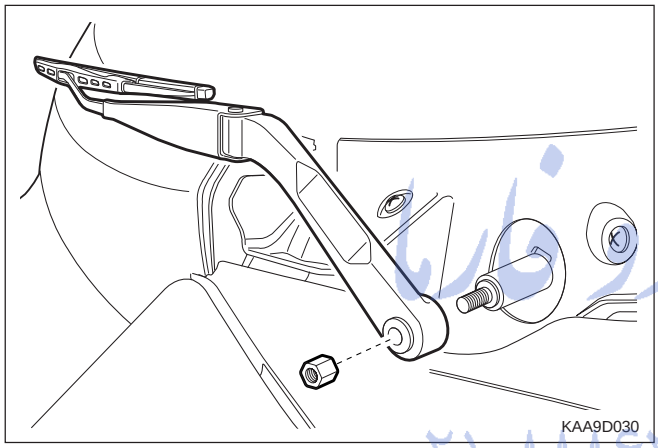


ON-VEHICLE SERVICE UNIT REPAIR

WINDSHIELD WIPER ARM

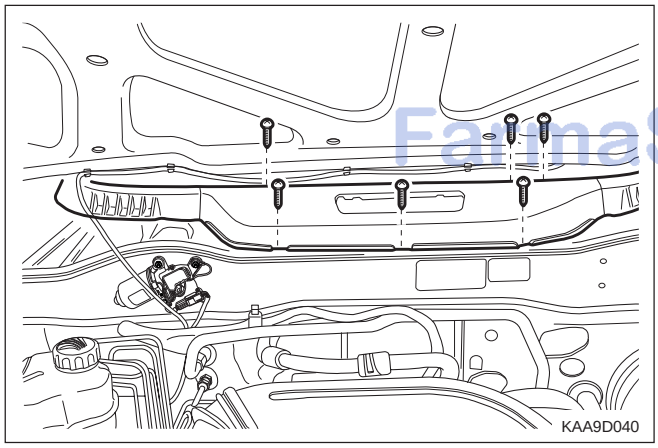
Removal and Installation Procedure

1. Remove the left cowl top cover cap.
2. Remove the screws with the left cowl top cover.



3. Remove the nut and the wiper arm.
   - Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.
4. Installation should follow the removal procedure in the reverse order.

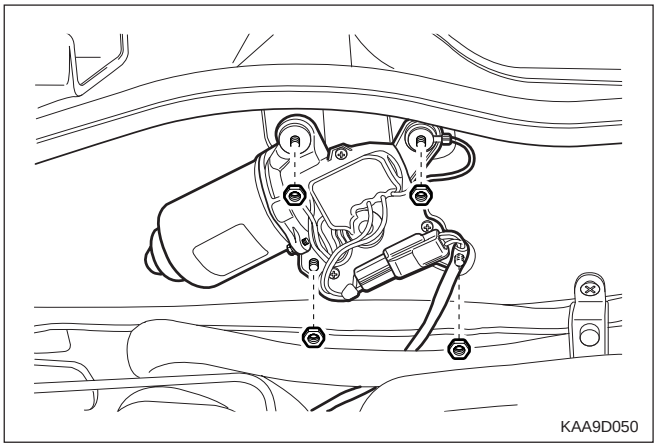
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WINDSHIELD WIPER MOTOR

Removal and Installation Procedure

1. Remove the left cowl top cover. Refer to “WINDSHIELD WIPER ARM” in this section.
2. Remove the center cowl top cover with the screws.
3. Remove the nut and the washer that secure the wiper arm linkage to the motor driveshaft.
4. Pry the wiper arm linkage off the motor driveshaft.



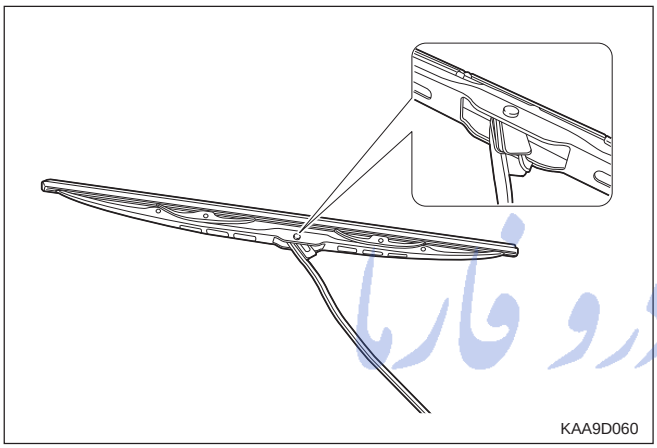
5. Remove nuts and the wiper motor.

Installation Notice

Tightening Torque	8 - 12 N•m (71 - 106 lb-ft)

- Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

6. Installation should follow the removal procedure in the reverse order.



WINDSHIELD WIPER BLADE

Removal and Installation Procedure

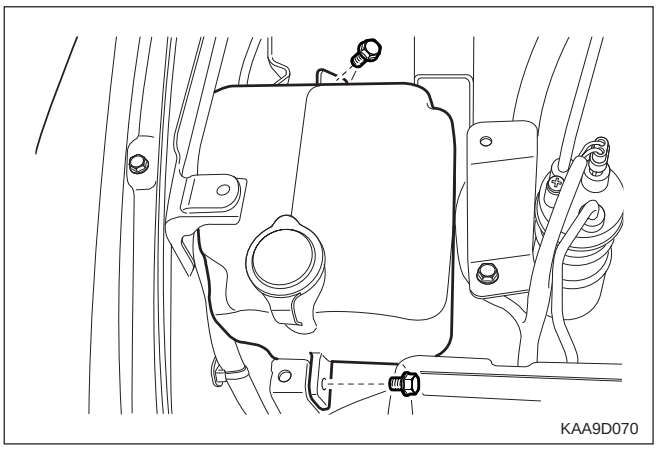
1. Rotate the wiper blade on the arm.
2. While pressing the retainer clip, slide the wiper blade down the wiper arm and remove the blade.
3. Installation should follow the removal procedure in the reverse order.

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WINDSHIELD WASHER RESERVOIR

Removal and Installation Procedure

1. Open the hood.
2. Disconnect the negative battery cable.
3. Remove the coolant reservoir. Refer to Section 1D, ENGING COOLING.
4. Disconnect the washer hose from the washer pump.



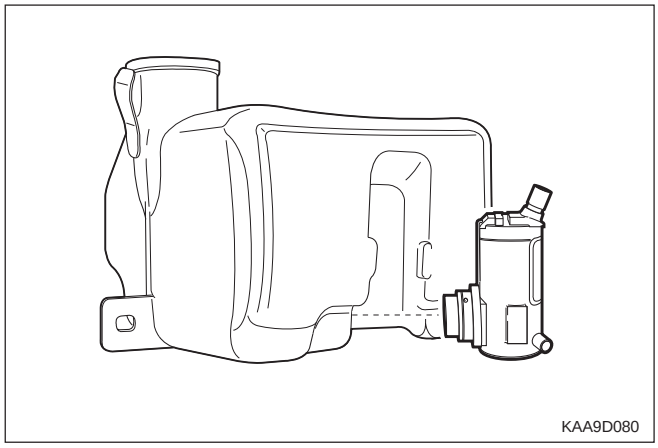
5. Disconnect the reservoir pump electrical connector.
6. Remove the bolt and the reservoir

Installation Notice

Tightening Torque	5 - 9 N•m (44 - 80 lb-in)

- Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

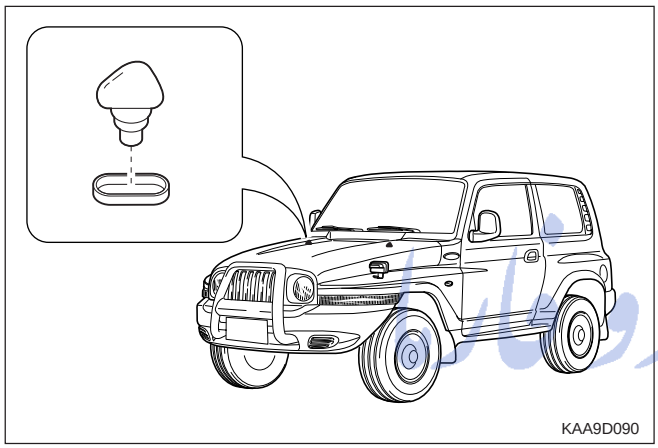
7. Installation should follow the removal procedure in the reverse order.


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WINDSHIELD WASHER PUMP

Removal and Installation Procedure

1. Remove the windshield washer reservoir. Refer to in this section “windshield washer reservoir”.
2. Remove the windshield washer pump.
3. Installation should follow the removal procedure in the reverse order.

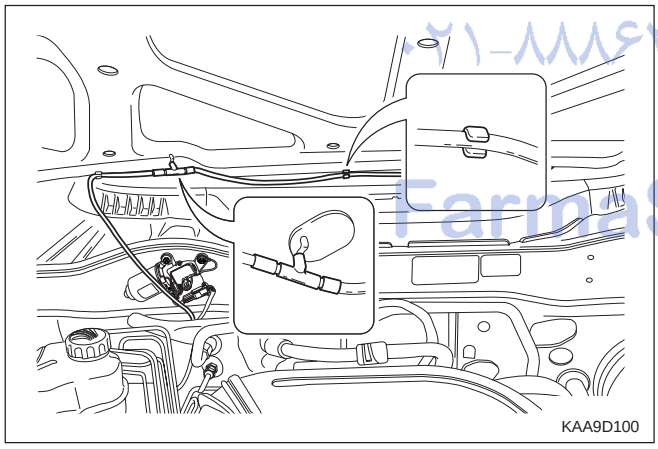

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WINDSHIELD WASHER NOZZLES

Removal and Installation Procedure

1. Open the hood.
2. Disconnect the washer hose from the nozzle.
3. Remove the nozzle from the hood.
4. Installation should follow the removal procedure in the reverse order.

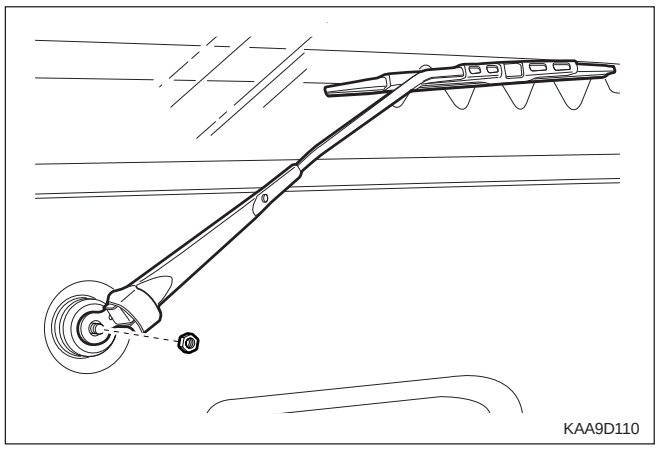
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WINDSHIELD WASHER HOSES

Removal and Installation Procedure

1. Open the hood.
2. Disconnect the windshield washer hose from the washer nozzles on the hood.
3. Disconnect the washer hose from the washer reservoir.
4. Remove the washer hose.
5. Installation should follow the removal procedure in the reverse order.


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REAR WIPER ARM

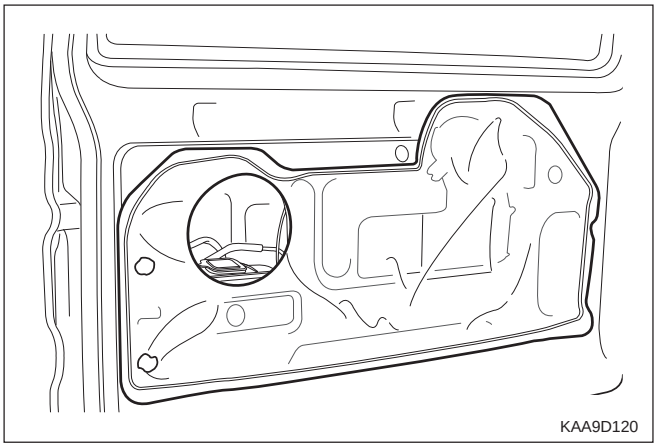
Removal and Installation Procedure

1. Remove the spare tire with wheel nuts.
2. Pry off the rear wiper arm cap.
3. Remove the rear wiper arm with the nut.

   Installation Notice

Tightening Torque	8 - 12 N•m (71 - 106 lb-in)

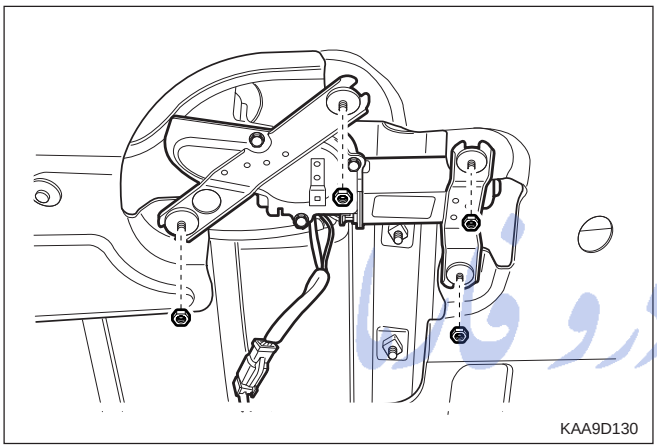
   - Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.
4. Installation should follow the removal procedure in the reverse order.


KAA9D120

REAR WIPER MOTOR

Removal and Installation Procedure

1. Remove the tailgate trim panel. Refer to *Section 9G "INTERIOR TRIM"*.
2. Remove the tailgate seal trim.


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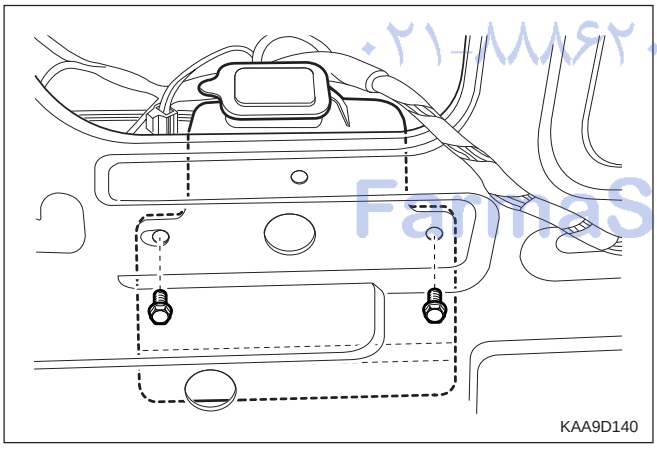
3. Remove the wiper motor.

Installation Notice

Tightening Torque	8 - 12 N•m (71 - 106 lb-in)

- Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

4. Installation should follow the removal procedure in the reverse order.


KAA9D140

REAR WASHER RESERVOIR

Removal and Installation Procedure

1. Remove the tailgate trim panel. Refer to Section 9G *"INTERIOR TRIM"*.
2. Remove the tailgate seal trim.
3. Disconnect the washer hose and electrical connector.
4. Remove the rear washer reservoir.

Installation Notice

Tightening Torque	8 - 12 N•m (71 - 106 lb-in)

- Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

5. Installation should follow the removal procedure in the reverse order.

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SPECIFICATIONS

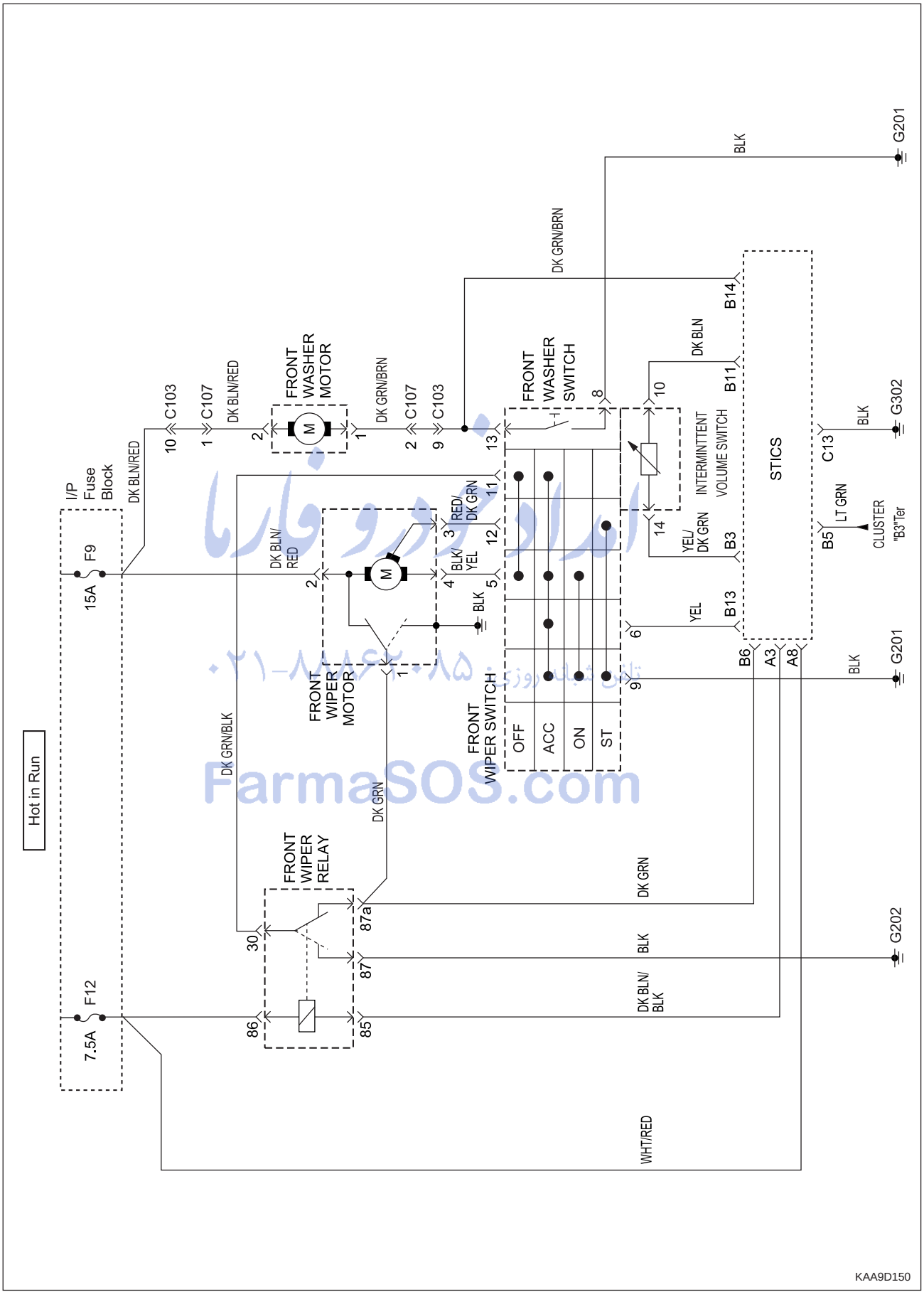
FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Rear Wiper Arm Nut	14 - 18	10 - 13	-
Windshield Washer Reservoir Mounting Bolts	8 -12	10.5 - 15.8	126 - 190
Windshield Washer Reservoir Mounting Bolts (Front)	8 -12	10.5 - 15.8	126 - 190
Wiper Motor Mounting Nuts (Front)	8 -12	10.5 - 15.8	126 - 190
Wiper Motor Mounting Nut (Rear)	8 -12	10.5 - 15.8	126 - 190

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SCHEMATIC AND ROUTING DIAGRAMS

WINDSHIELD WIRING SYSTEM



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SECTION 9E

INSTRUMENTATION, DRIVER INFORMATION

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

Description and Operation 9E-2
- Cigar Lighter 9E-2
- Ashtray 9E-2
- Instrument Panel Vents 9E-2
- Glove Box 9E-2
- Digital Clock 9E-2
- Instrument Cluster 9E-2
- Speedometer and Tachometer 9E-2
- Trip Odometer 9E-2
- Fuel Gauge 9E-2
- Temperature Gauge 9E-2
- Instrument Cluster Indicator Lamps 9E-2
- Chime Module 9E-2

Components Locator 9E-3
- Instrumentation/Driver Information 9E-3

Diagnostic Information and Procedure 9E-5
- Cigar Lighter 9E-5
- Disital Clock 9E-5
- Speedo Meter 9E-6
- Fuel Gauge 9E-7
- Temperature Gauge 9E-8
- Instrument Cluster Indicator Lamps 9E-9

Repair Instructions 9E-10
- On-Vehice Service Unit Repair 9E-10
- Center Tray 9E-10
- Center Facia 9E-10
- Ashtray 9E-10
- Cigar Lighter 9E-11
- Cup Holder 9E-11
- Instrument Panel Vent 9E-11
- Glove Box 9E-12
- Chime Module 9E-12
- Hood Latch Release Handle 9E-12
- Instrument Lower Cover 9E-13
- Instrument Cluster Trim Panel 9E-13
- Instrument Cluster 9E-13
- Speedometer/Odometer/Trip Odometer/ Tachometer 9E-14
- Fuel Gauge 9E-14
- Temperature Gauge 9E-15
- Digital Clock 9E-15
- Instrument Cluster Indicator Lamps 9E-15
- Instrument Panel 9E-16

Specifications 9E-18
- Bulb Usage Chart 9E-18

Schematic and Routing Diagram 9E-19
- Instrument Panel Illumination 9E-19
- Cluster (VSS, Meter & Gauge): Diesel 9E-20
- Cluster (VSS, Meter & Gauge): Gasoline 9E-21
- Warning Lamp, TCS Indicator 9E-22
- Indicator 9E-23
- Warning Lamp 9E-24
- Digital Clock, Warning Cluster Illumination 9E-25
- Selector Lever Position Lamp 9E-26

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DESCRIPTION AND OPERATION

CIGAR LIGHTER

The cigar lighter is located in the front portion of the floor console. To use the lighter, push it in completely. When the lighter is hot, it will release itsef from contact with the heating element. The lighter and the heating element can be damaged if the lighter does not fully release itsef from the heating element.

ASHTRAY

The ashtray is located in the console. To access the ashtray, pullit out of the ashtray housing. The ashtray lamp will go on when the parking lamps or headlamps are turned on.

INSTRUMENT PANEL VENTS

The center and the side vents in the instrument panel can be adjusted up and down and from side to side. The side vents can also be aimed toward the side windows to defog them.

GLOVE BOX

The glove box can be opened by pulling upon the latch handle.

DIGITAL CLOCK

The digital clock is located in the instrument cluster.

INSTRUMENT CLUSTER

The instrument cluster is located above the steering column and in the instrument cluster trim panel. The instrument cluster contains the instruments that provide the driver with vehicle performance information. The instrument cluster contains a speedometer, a tachometer, an odometer, a trip odometer, a temperature gauge, a fuel gauge, and several indicator lamps. For replacement of the indicator lamp bulbs contained in the instrument cluster, refer to “Instrument Cluster Indicator Lamps Specifications” in the section.

SPEEDOMETER AND TACHOMETER

The speedometer measures the speed of the vehicle in km/h (with mph) or mph (with km/h). It consists of an instrument cluster gauge connected to the vehicle speed sensor on the transaxle output shaft. The tachometer measures the engine’s speed in terms of thousands of revolutions per minute. It consists of an instrument cluster gauge connected to a sending unit in the engine con-trol module. Do not operate the engine in the red zone. Engine damage may occur.

TRIP ODOMETER

The trip odometer measures the distance the vehicle has traveled since it was last reset. It consists of an instrument cluster gauge connected to the sending unit on the tasnsaxle output shaft. The trip oddometer can be record the distance traveled from any starting point.

FUEL GAUGE

The fuel gauge consists of an instrument cluster gauge connected to a sending unit in the fuel tank. The fuel gauge indicates the quantity of fuel in the tank only when the ignition is turned to ON or ACC. When the ignition is turned to LOCK or START, the pointer may come to rest at any position.

TEMPERATURE GAUGE

The temperature gauge consists of an instrument cluster gauge connected to a temperature sensor that is in con-tact with the circulating engine coolant. The temperature gauge indicates the temperature of the coolant. Prolonged driving or idling in very hot weather may cause the pointer to move beyond the center of the gauge. The engine is overheating if the pointer moves into the red zone at the upper limit of the gauge.

INSTRUMENT CLUSTER INDICATOR LAMPS

The instrument cluster contains indicator lamps that indicatethe functioning of certain systems or the existenceof potential problems with the operation of the vehicle. The indicator lamps are replaceable. For replacement of the indicator lamps contained in the instrument cluster, refer to “instrument cluster indicator lamps specifications” in this section.

CHIME MODULE

The chime module will sound to bring attention to one or more of the following conditions:

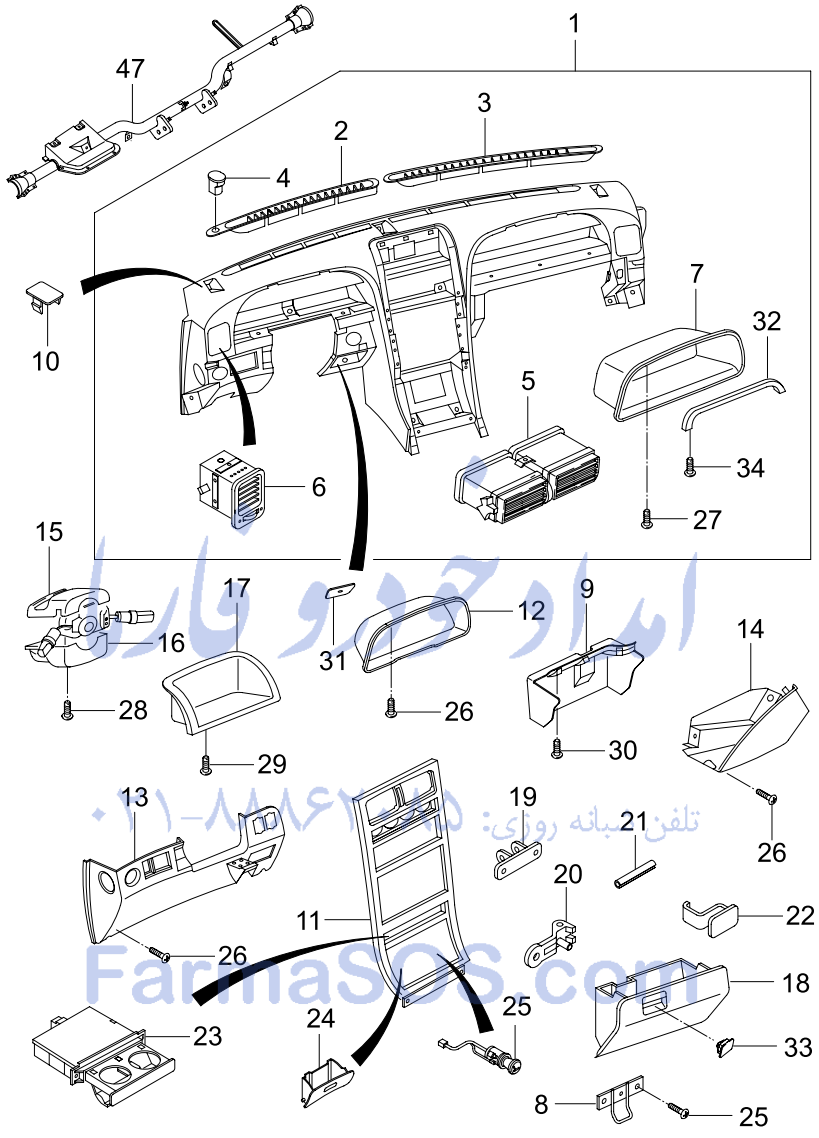
- The lights are on and the ignition not in ACC, ON, or START.
- The ignition key is in the ignition switch when the driver’s side door is open.
- The seat belt is unbuckled when the ignition is in ACC, ON, or START.

Voltage is supplied at all times through the fuse block to power the chime module.

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COMPONENTS LOCATOR

INSTRUMENTATION/DRIVER INFORMATION



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1 Crash Pad Complete
2 Cover A-Def Nozzle
3 Cover A-Def Nozzle
4 Blacking Cover-Sun Sensor
5 Louver A-CTR A/Vent
6 Louver A-Side A/Vent
7 PNL A-Side Facia
8 Striker A-Glove Box
9 Shroud-Gloved Box Behind
10 Cover-C/Pad Main MTG
11 PNL A-CTR Facia
12 PNL A-Cluster Facia
13 PNL A-C/Pad LWR Main
14 PNL A-C/Pad LWR Main
15 PNL A-Shroud UPR
16 PNL A-Shroud LWR
17 Tray A-C/Pad CTR
18 Glove Box A
19 BRKT-Glove Box Hinge #1
20 BRKT-Glove Box Hinge #2
21 PNL-Glove Box Hinge
22 Stopper-G/Box Housing
23 Holder-Cup
24 Ash Tray-FRT
25 Cigar Lighter A
26 Screw-Truss
27 T/Screw-Oval
28 T/Screw-Oval
29 T/Screw
30 T/Screw-Truss SEMS
31 Cover-Black Out SW
32 Handel A-C/Pad
33 Lock A-Glove Box
34 Grommet-Shroud
35 Member A-Cowl Cross

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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DIAGNOSTIC INFORMATION AND PROCEDURE

CIGAR LIGHTER

Cigar lighter inoperative

Step	Action	Value(s)	Yes	No
1	Check fuse F15. Is the fuse blown?	-	Go to Step 2	Go to Step 3
2	1. Check for a short circuit and repair if necessary. 2. Replace the fuse. Is the repair complete?	-	System OK	-
3	1. Turn the ignition key to the ACC position. 2. Use a voltmeter to check for voltage at fuse Ef20. Does the battery voltage available at the fuse Ef20 match the value specified?	11 - 14 v	Go to Step 5	Go to Step 4
4	Repair the open power supply circuit for fuse Ef20. Is the repair complete?	-	System OK	-
5	1. Remove the electrical connector from the back of the cigar lighter. 2. Turn the ignition key to the ACC position. 3. Use a voltmeter to check the voltage at the WHT/DK BLU wire. Does the battery voltage available at the WHT/DK BLU wire match the value specified?	11 - 14 v	Go to Step 7	Go to Step 6
6	Repair the open circuit between the fuse Ef20 and the cigar lighter. Is the repair complete?	-	System OK	-
7	With the ignition key still in the ACC position, Connect the voltmeter between the WHT/DK BLU and the BLK wires at the cigar lighter conector. Does the battery voltage match the value specified?	11 - 14 v	Go to Step 9	Go to Step 8
8	Repair the open ground circuit. Is the repair complete?	-	System OK	-
9	Replace the cigar lighter. Is the repair complete?	-	System OK	-

DISITAL CLOCK

Digital Clock Inoperative

Step	Action	Value(s)	Yes	No
1	Is either of the fuses Ef10 and F4 blown?	-	Go to Step 2	Go to Step 3
2	1. Check for a short circuit and repair if necessary. 2. Replace the blown fuses. Is the repair complete?	-	System OK	-
3	1. Turn the ignition ON. 2. Use a voltmeter to check battery voltage available at fuses F4. Does the voltmeter indicate the value specified?	11 - 14 v	Go to Step 5	Go to Step 4

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Digital Clock Inoperative (Cont'd)

Step	Action	Value(s)	Yes	No
1	Repair the open power supply circuit for the fuse. Is the repair complete?	–	System OK	–
2	1. Turn the ignition ON. 2. Use a voltmeter to check the battery voltage available at the clock connector terminal D1. Does the voltmeter indicate the value specified?	11 - 14 v	Go to Step 7	Go to Step 6
3	Repair the open circuit between the clock connector terminal D1 and the fuse F4. Is the repair complete?	-	System Ok	-
4	Turn the ignition ON. Is battery voltage available at the clock connector terminal C13?	-	Go to Step 9	Go to Step 8
5	Repair the open circuit between the clock connector terminal C13 and the fuse F4. Is the repair complete?	-	System OK	-
6	Check continuity between the clock connector terminal C13 and ground. Does the multimeter indicate the value specified?	0 Ω	Go to Step 10	Go to Step 11
7	Replace the clock. Is the repair complete?	-	System OK	-
8	Repair the open ground circuit between the clock connector terminal C13 and the ground G201. Is the repair complete?	-	System OK	-

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تلفن شبانه روزی ۰۲۱-۸۸۴۶۲۰۸۵

SPEEDO METER

Speedometer Is Inoperative

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Step	Action	Value(s)	Yes	No
1	Check fuse F28, and F30. Is fuse F28 and F30 blown?	-	Go to Step 7	Go to Step 3
2	1. Check for a short circuit and repair if necessary. 2. Replace the fuse F28, and F30. Is the repair complete?	-	System OK	-
5	1. Turn the ignition ON. 2. Check the voltage at fuse F28 and F30. Is the voltage equal to the specified value?	11 - 14 v	Go to Step 5	Go to Step 4
6	1. connect a scan tool. 2. Check for engine control diagnostic trouble codes (DTCs). Is a vehicle speed sensor DTC set?	-	Go to *Section 2F, Engine Controls*	Go to Step 6
7	1. Remove the instrument cluster. 2. Turn the ignition ON. 3. Check the voltage at instrument cluster connector terminal A1. Is the voltage equal to the specified value?	11 - 14 v	Go to Step 8	Go to Step 7
8	Repair the open circuit between fuse F30 and the instrument cluster. Is the repair complete?	-	System OK	-

Speedometer Is Inoperative (Cont'd)

Step	Action	Value(s)	Yes	No
8	Use an ohmmeter to check the resistance between ground and instrument cluster connector terminal B3. Does the ohmmeter indicate the specified value?	0 Ω	Go to Step 10	Go to Step 9
9	Repair the open circuit between ground and instrument cluster connector terminal B3. Is the repair complete?	-	System OK	-
10	Use an ohmmeter to check continuity of the DK GRN/WHT wire between the vehicle speed sensor terminal 1 and instrument cluster connector terminal C10. Does the ohmmeter indicate the specified value?	0 Ω	Go to Step 12	Go to Step 11
11	Repair the open circuit between the vehicle speed sensor and the instrument cluster. Is the repair complete?	-	System OK	-
12	Replace the speedometer. Is the repair complete?	-	System OK	-

FUEL GAUGE

Fuel Gauge Inoperative

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تلفن شبانه روزی: ۰۲۱ ۸۸۸۶۲۰۸۵
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Step	Action	Value(s)	Yes	No
1	Turn the ignition ON. Does the fuel gauge always indicate a full fuel tank with the ignition ON?	-	Go to Step 2	Go to Step 7
2	Disconnect the fuel tank sending unit. Does the fuel gauge change to empty?	-	Go to Step 3	Go to Step 4
3	Replace the fuel tank sending unit. Is the repair complete?	-	System OK	-
4	Check the wiring harness for a short to ground between the fuel tank sending unit and the fuel gauge. Is there a short to ground?	-	Go to Step 5	Go to Step 6
5	Repair the short to ground. Is the repair complete?	-	System OK	-
6	Replace the fuel gauge. Is the repair complete?	-	System OK	-
7	1. Disconnect the fuel tank sending unit electrical connector. 2. Turn the Ignition ON. 3. Check the voltage at the fuel tank sending unit connector C303 terminal 1. Does the boltmeter indicate the specified value?	11 - 14 v	Go to Step 9	-
8	Repair the open circuit between the fuel gauge and the fuel tank sending unit. Is the repair complete?	-	System OK	-

Fuel Gauge Inoperative (Cont'd)

Step	Action	Value(s)	Yes	No
1	Check continuity between the fuel tank sending unit connector C303 terminal 3, and groun. Does the multimeter indicate the specified value?	0 Ω	Go to Step 11	Go to Step 10
2	Repair the open circuit or poor ground connection. Is the repair complete?	-	System OK	-
3	1. With the fuel tank sending unit electrical connector C303 disconnected, attach a jumper between ground and C303 terminal 1. 2. Turn the ignition ON. Does the fuel gauge move to full?	-	Go to Step 3	Go to Step 6

TEMPERATURE GAUGE

Temperature Gauge Inoperative, Other Gauges OK

Step	Action	Value(s)	Yes	No
1	Allow the engine to cool to room temperature. With the ignition ON, does the temperature gauge always read at the high end of the scale?	-	Go to Step 7	Go to Step 2
2	Disconnect the coolant temperature sensor electrical connector. Does the termperature gauge indicator drop to the low end of the scale?	-	Go to Step 3	Go to Step 4
3	Replace the coolant temperature sensor. Is the repair complete?	-	System OK	-
4	Check for a short to ground between the coolant temperature sensor and the temperature gauge. Is there a short to ground?	-	Go to Step 5	Go to Step 6
5	Repair the short to ground. Is the repair complete?	-	System OK	-
6	Replace the temperature gauge. Is the repair complete?	-	System OK	-
7	1. Disconnect the coolant temperature sensor. 2. Turn the ignition ON. 3. Check the voltage at the coolant temperature sensor connector. Does the the voltage equal the value specified?	11 - 14 v	Go to Step 10	Go to Step 8
8	Check for an open circuit between the coolant temperature sensor and the temperature gauge. Is the repair complete?	-	Go to Step 8	Go to Step 6
9	Repair the open circuit between the coolant temperature sensor and the temperature gauge. Is the repair complete?	-	System OK	-

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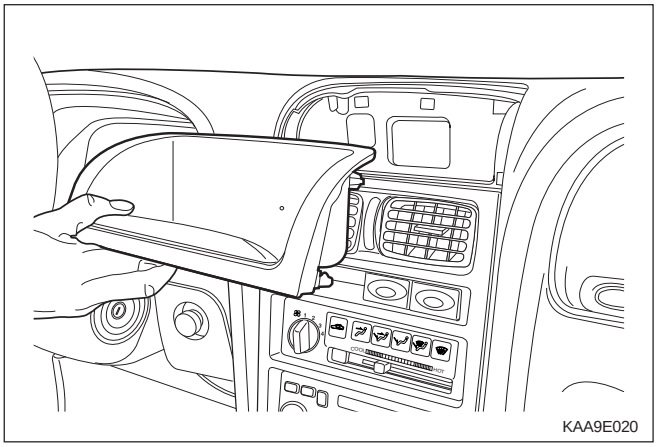
INSTRUMENT CLUSTER INDICATOR LAMPS

Instrument Cluster Indicator Lamps Do Not Operate

Step	Action	Value(s)	Yes	No
1	Is fuse F30 blown?	-	Go to Step 2	Go to Step 3
2	1. Check for a short circuit and repair if necessary. 2. Replace the blown fuse. Is the relpair complete?	-	System OK	-
3	1. Turn the ignition ON. 2. Check the votage at fuse F30. Does the battery voltage match the value specified?	11 - 14 v	Go to Step 5	Go to Step 4
4	Repair the open power supply circuit to fuse F30. Is the repair complete?	-	System OK	-
5	1. Remove the instrument cluster. 2. Disconnect the instrument cluster connectors A1. 3. Turn the ignition ON. Does the battery voltage match the value specified?	11 - 14 v	Go to Step 7	Go to Step 6
6	Repair the open circuit between fuese F30 and the instrument cluster connectors A1. Is the repair complete?	-	System OK	-
7	Check the instrument cluster warning lamp bulbs. Are the bulbs OK?	-	Go to Step 9	Go to Step 8
8	1. Replace any warning lamp bulbs that were defective. 2. Check the charging system to make sure the alternator is not overcharging. 3. Repair the charging system if necessary. Is the repair complete?	-	System OK	-
9	Replace the instrument cluster. Is the repair complete?	-	System OK	-

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REPAIR INSTRUCTIONS

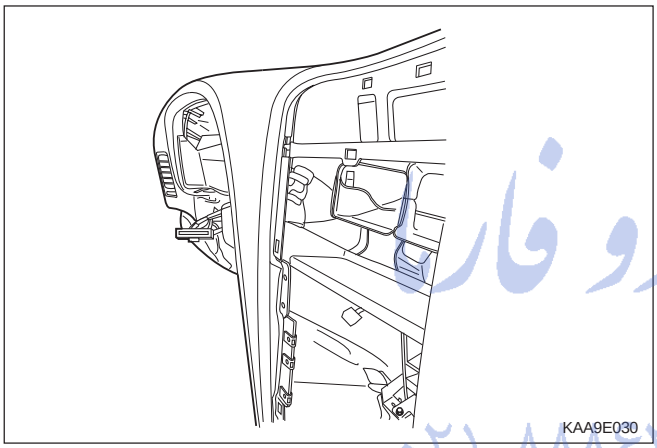

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ON-VEHICLE SERVICE UNIT REPAIR

CENTER TRAY

Removal and Installation Procedure

1. Pull the center tray.
2. Installation should follow the removal procedure in the reverse order.

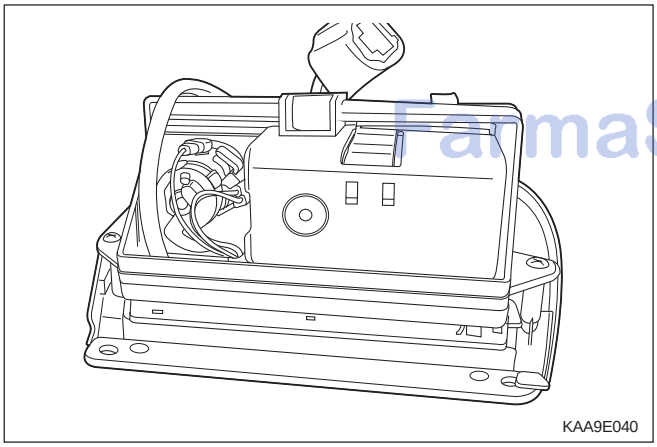

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CENTER FACIA

Removal and Installation Procedure

1. Remove the floor console. Refer to Section 9G, Floor Console
2. Remove the center tray. Refer to “Center Tray” in this section.
3. Remove the center facia with the screws.
4. Installation should follow the removal procedure in the reverse order.

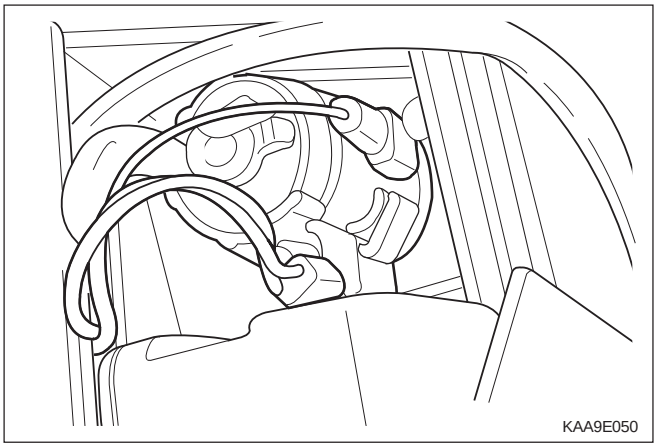
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ASHTRAY

Removal and Installation Procedure

1. Remove the center facia. Refer to “Center Facia” in this section.
2. Remove the ashtray assembly from the center facia.
3. Installation should follow the removal procedure in the reverse order.

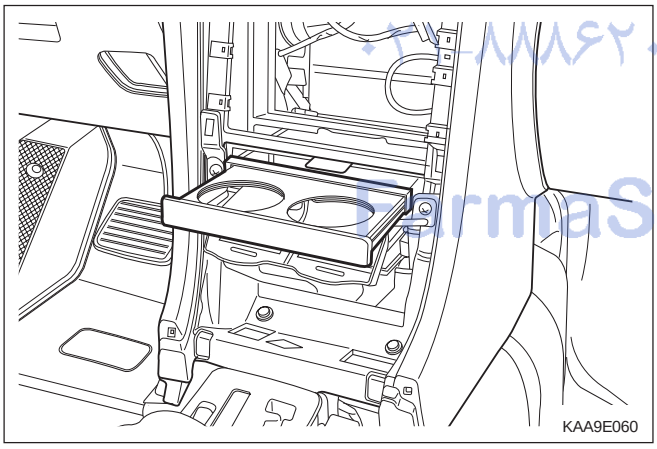

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CIGAR LIGHTER

Removal and Installation Procedure

1. Removed the floor console. Refer to “floor console” in this section.
2. Remove the center tray. Refer to “Center tray” in this section.
3. Remove the center facia with the screws. Refer to “Center Facia” in this section.
4. Remove the ashtray assembly with the screws. Refer to “Ashtray” in this section.
5. Disconnect the cigar lighter connector.
6. Turn the cigar lighter locker and remove.
7. Installation should follow the removal procedure in the reverse order.

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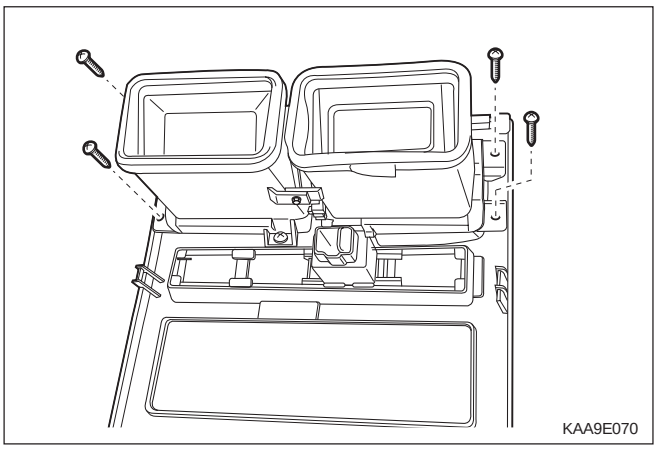

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CUP HOLDER

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Removal and Installation Procedure

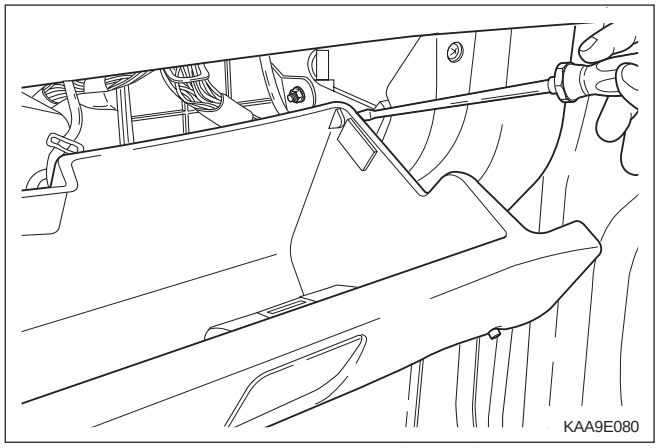
1. Remove the center facia. Refer to “Center Facia” in this section.
2. Remove the cup holder with the screws.
3. Installation should follow the removal procedure in the reverse order.


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INSTRUMENT PANEL VENT

Removal and Installation Procedure

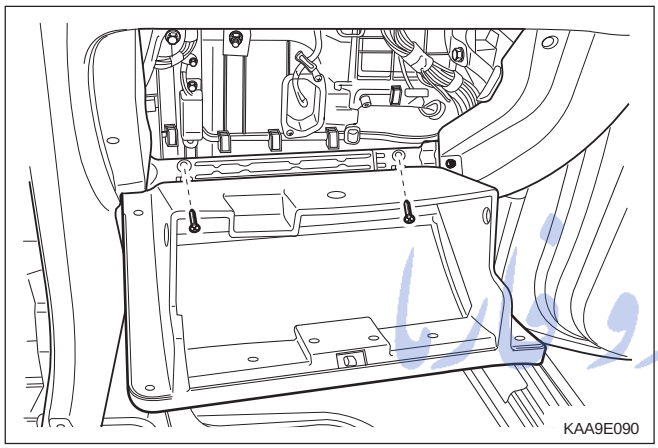
1. Remove the center facia. Refer to “Center Facia” in this section.
2. Remove the instrument panel vents from the center facia.
3. Installation should follow the removal procedure in the reverse order.



GLOVE BOX

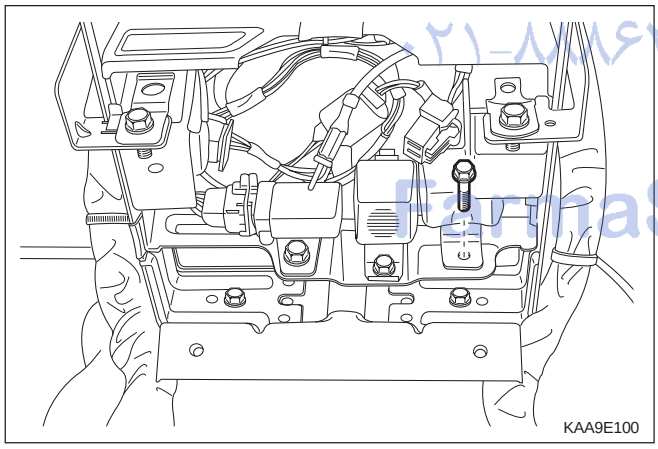
Removal and Installation Procedure

1. Remove the side facia panel. Refer to “Side Facia Panel” in this section.
2. Pull and remove the glove box stopper of both.



3. Remove the glove box with the screws
4. Installation should follow the removal procedure in the reverse order.

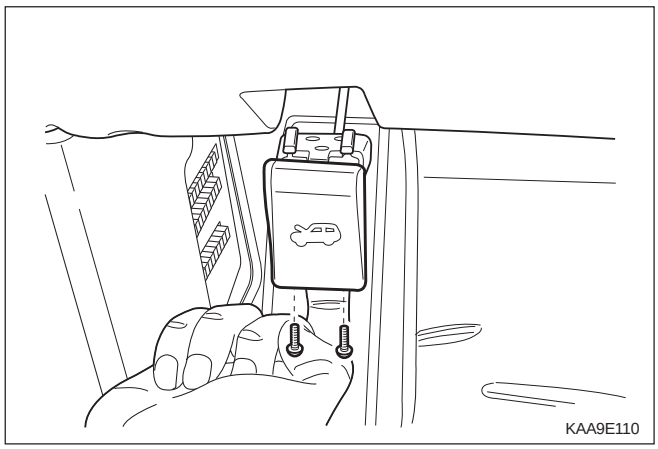
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CHIME MODULE

Removal and Installation Procedure

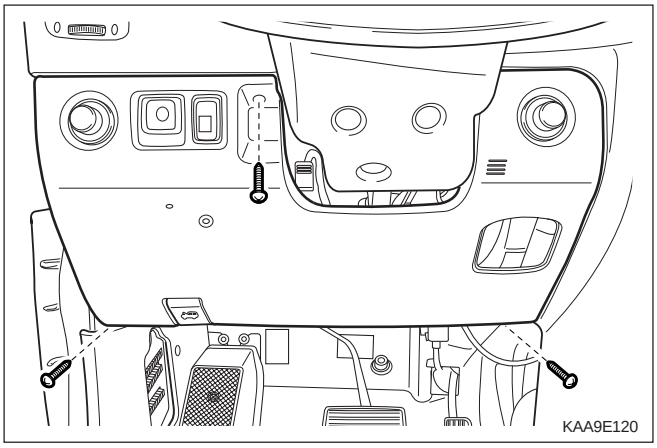
1. Disconnect the negative battery cable.
2. Remove the center tray. Refer to “Center tray” in this section.
3. Remove the center facia. Refer to “Center Facia” in this section.
4. Remove the cup holder. Refer to “Cup Holder” in this section.
5. Remove the chime module with the screws
6. Installation should follow the removal procedure in the reverse order.



HOOD LATCH RELEASE HANDLE

Removal and Installation Procedure

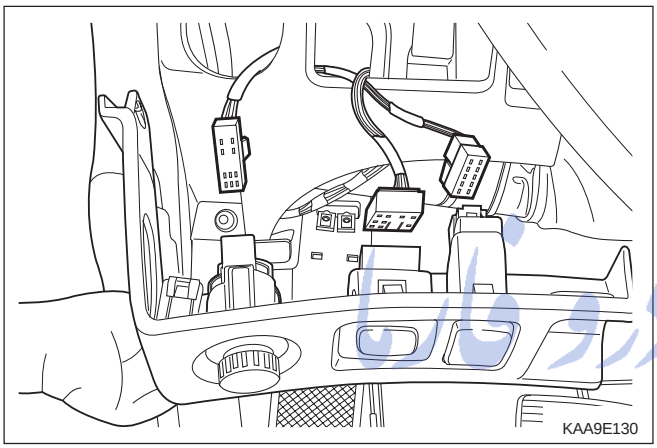
1. Remove the hood latch release handle with the screws.
2. Installation should follow the removal procedure in the reverse order.



INSTRUMENT LOWER COVER

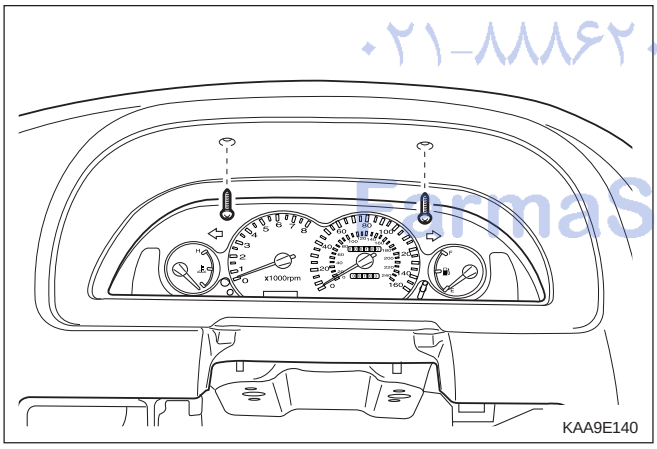
Removal and Installation Procedure

1. Remove the hood latch release handle. Refer to “Hood Latch Release Handle” in this section.
2. Remove the screws from the instrument lower cover.



3. Disconnect the electrical connector.
4. Remove the instrument lower cover.
5. Installation should follow the removal procedure in the reverse order.

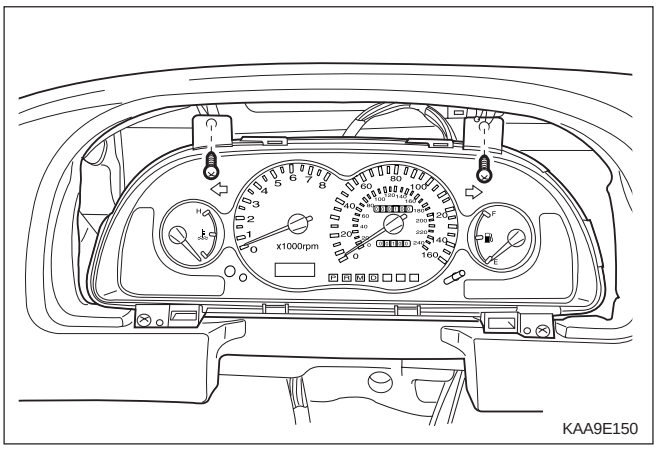
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INSTRUMENT CLUSTER TRIM PANEL

Removal and Installation Procedure

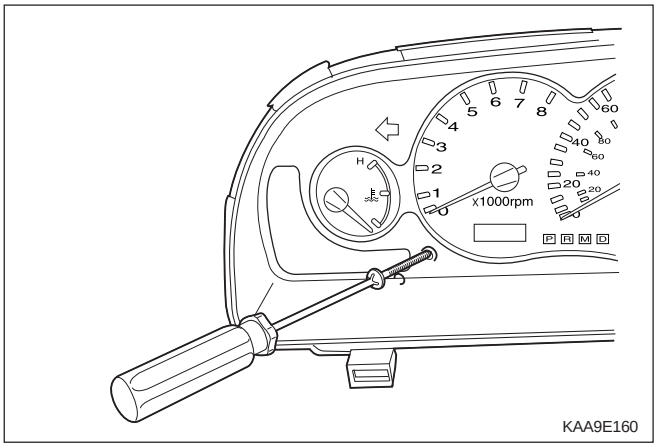
1. Remove the instrument cluster trim panel with the screws.
2. Installation should follow the removal procedure in the reverse order.



INSTRUMENT CLUSTER

Removal and Installation Procedure

1. Remove the instrument cluster trim panel. Refer to “instrument cluster trim panel” in this section.
2. Remove the instrument cluster mounting screws
3. Disconnect the instrument cluster electrical connector.
4. Installation should follow the removal procedure in the reverse order.

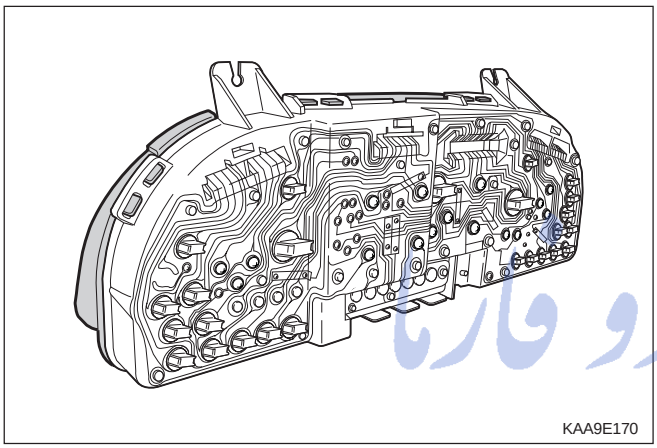


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SPEEDOMETER/ODOMETER/TRIP ODOMETER/TACHOMETER

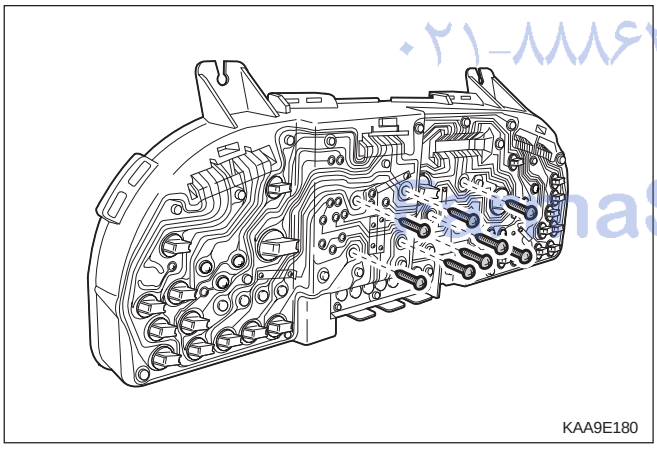
Removal and Installation Procedure

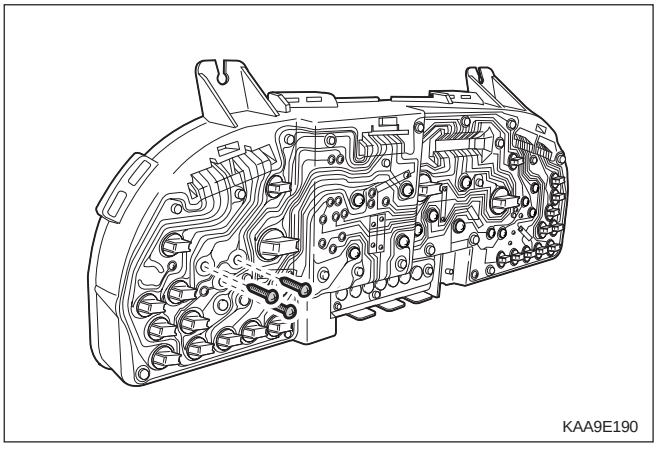
1. Disconnect the negative battery cable.
2. Remove the instrument cluster. Refer to “Instrument Cluster” in this section.
3. Remove the screw of digital clock adjusting knob.
4. Press the clips down and remove the instrument cluster lens.


KAA9E170

5. Remove the screws and the speedometer/ odometer/trip odometer/tachometer.
6. Installation should follow the removal procedure in the reverse order.

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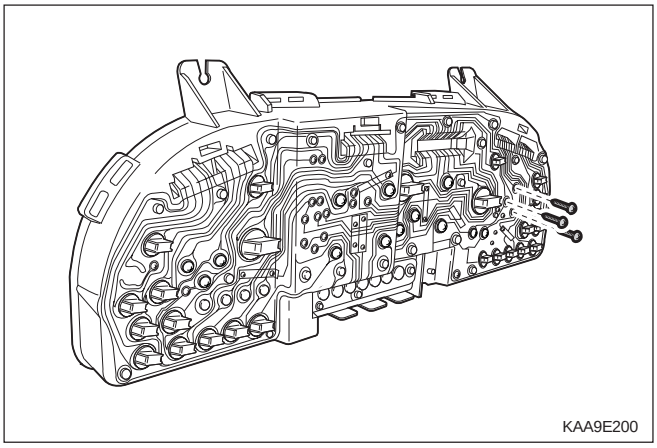

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KAA9E190

FUEL GAUGE

Removal and Installation Procedure

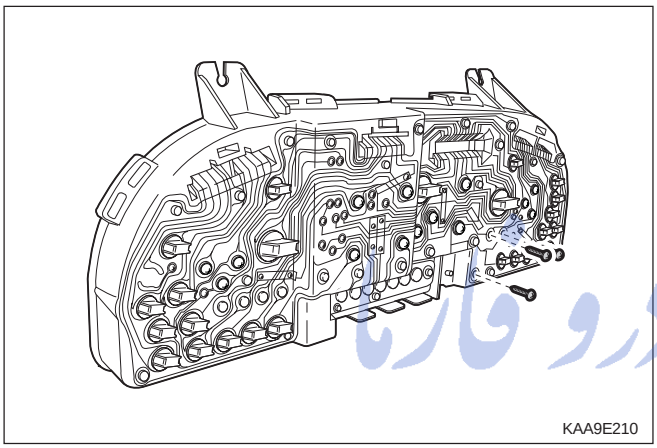
1. Disconnect the negative battery cable.
2. Remove the instrument cluster. Refer to “Instrument Cluster” in this section.
3. Remove the screw of digital clock adjusting knob.
4. Remove the clips down and remove the instrument cluster lens.
5. Remove the fuel gauge screws and the fuel gauge from the cluster assembly
6. Installation should follow the removal procedure in the reverse order.


KAA9E200

TEMPERATURE GAUGE

Removal and Installation Procedure

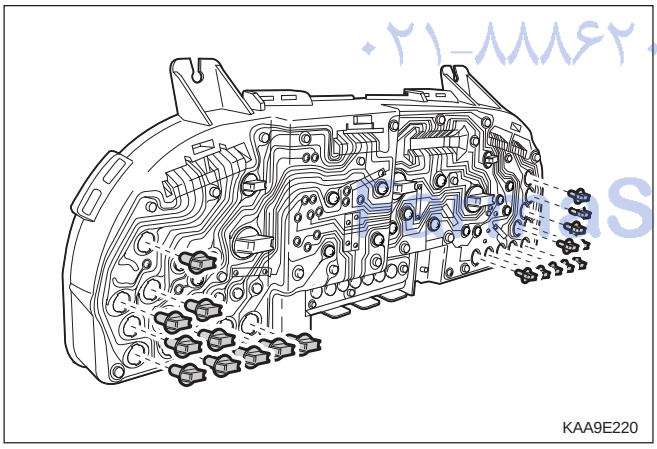
1. Disconnect the negative battery cable.
2. Remove the instrument cluster. Refer to “Instrument Cluster” in this section.
3. Remove the screw of digital clock adjusting knob.
4. Press the clips down and remove the instrument cluster lens.
5. Remove the screws and the temperature gauge from the cluster assembly.
6. Installation should follow the removal procedure in the reverse order.


KAA9E210

DIGITAL CLOCK

Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Remove the instrument cluster. Refer to “Instrument Cluster” in this section.
3. Remove the screw of digital clock adjusting knob.
4. Press the clips down and remove the instrument cluster lens.
5. Remove the digital clock from the cluster assembly.
6. Installation should follow the removal procedure in the reverse order.

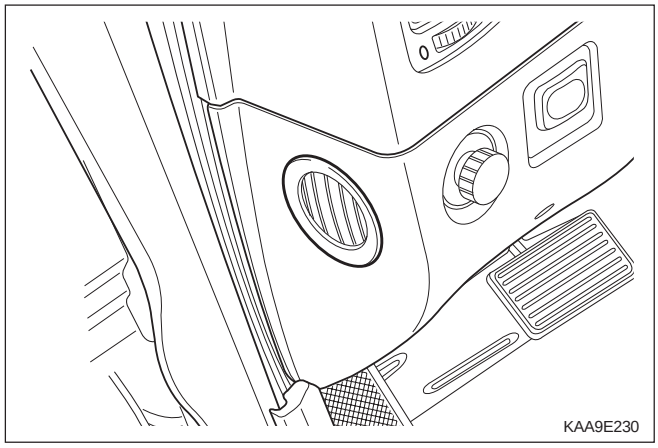

KAA9E220

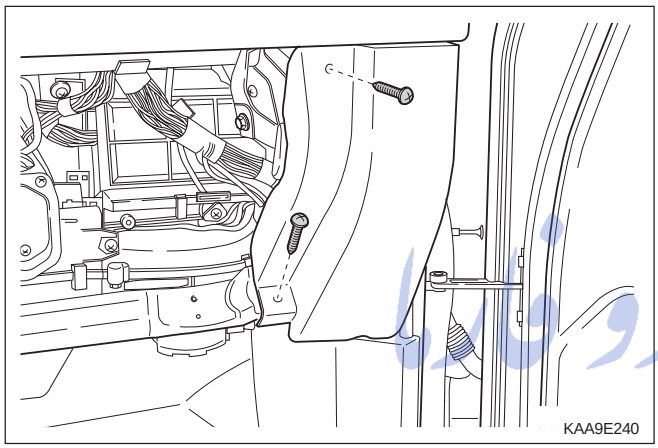
INSTRUMENT CLUSTER INDICATOR LAMPS

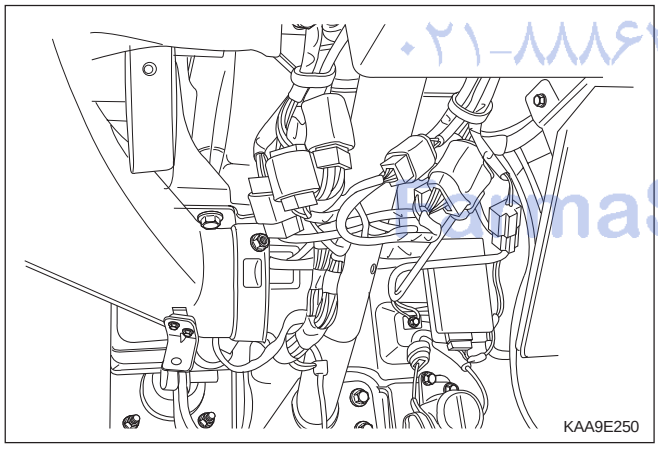
Removal and Installation Procedure

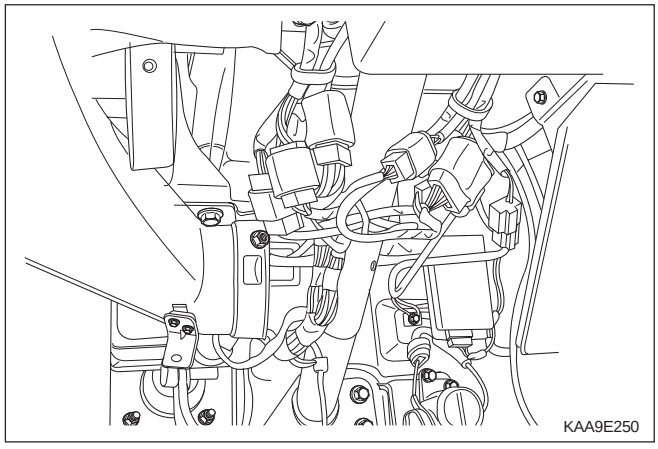
1. Disconnect the negative battery cable.
2. Remove the instrument cluster. Refer to “Instrument Cluster” in this section.
3. Remove the defective bulb from the rear of the cluster.
4. Installation should follow the removal procedure in the reverse order.

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KAA9E230


KAA9E240


KAA9E250

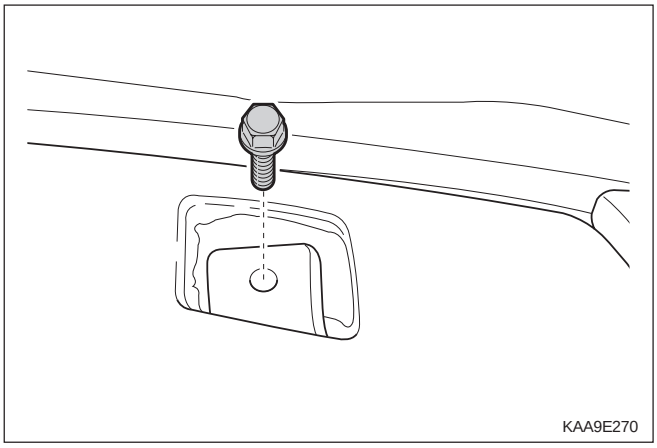

KAA9E250

INSTRUMENT PANEL

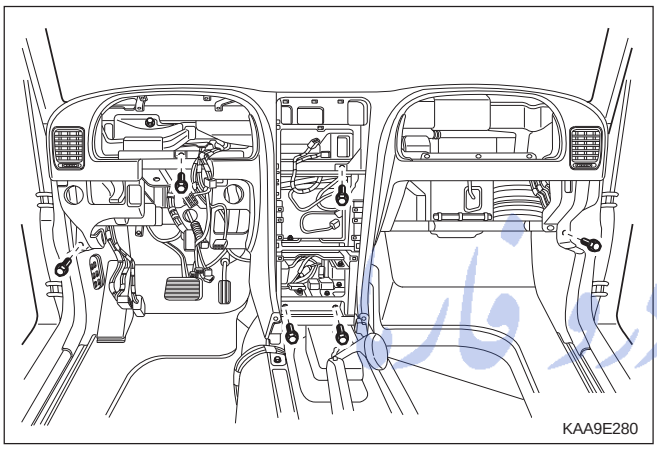
Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Remove the instrument panel defroster duct.
3. Remove the floor console. Refer to Section 9G, Floor Console.
4. Remove the center tray. Refer to “Center tray” in this section.
5. Remove the center facia. Refer to “Center Facia” in this section.
6. Remove the automatic temperature control assembly. Refer to *Section 7D, Automatic Temperature Control Assembly.*
7. Remove the stereo cassette. Refer to Section 9F, Audio system.
8. Remove the cup holder. Refer to “Cup Holder” in this section.
9. Remove the side facia panel. Refer to “Side Facia Panel” in this section.
10. Remove the glove box. Refer to “Glove Box” in this section.
11. Remove the instrument cluster trim panel. Refer to “Instrument cluster trim panel” in this section.
12. Remove the instrument cluster. Refer to “Instrument Cluster” in this section.
13. Remove the screws and the instrument panel side trim cover.
14. Remove the instrument lower cover with screws. Refer to “Instrument Lower Cover” in this section.
15. Disconnect the steering column electrical connector.

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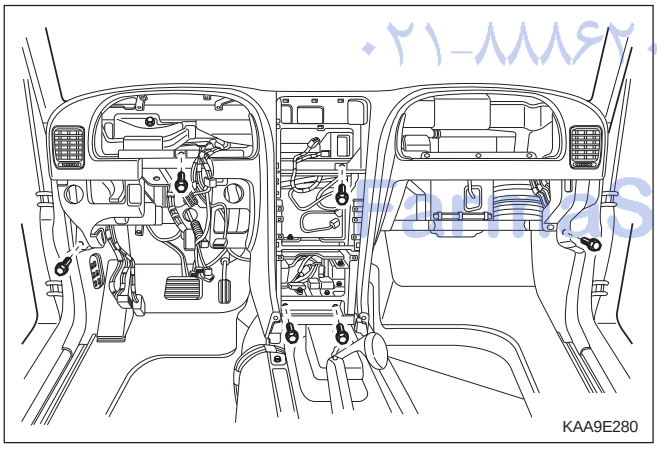

KAA9E270

16. Remove the left heat distributor duct with bolt.
    - Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.
17. Remove the nuts and the bolts securing the steering column.
    - Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

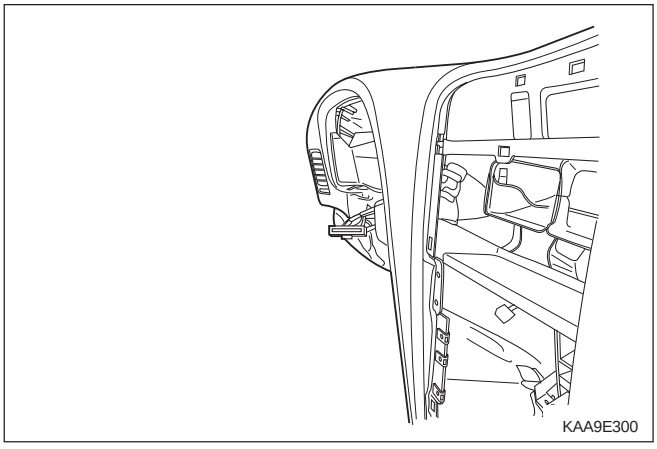

KAA9E280

18. Remove the instrument panel nuts below the windshield of both.
    - Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

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۰۲۱-۸۸۸۶۲۰۸۵ تلفن شبانه روزی
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KAA9E280

19. Remove the instrument mounting bolts.
    - Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.


KAA9E300

20. Remove the remote keyless entry system antenna from the instrument panel.
21. Remove the instrument panel.
22. Installation should follow the removal procedure in the reverse order.

SPECIFICATIONS

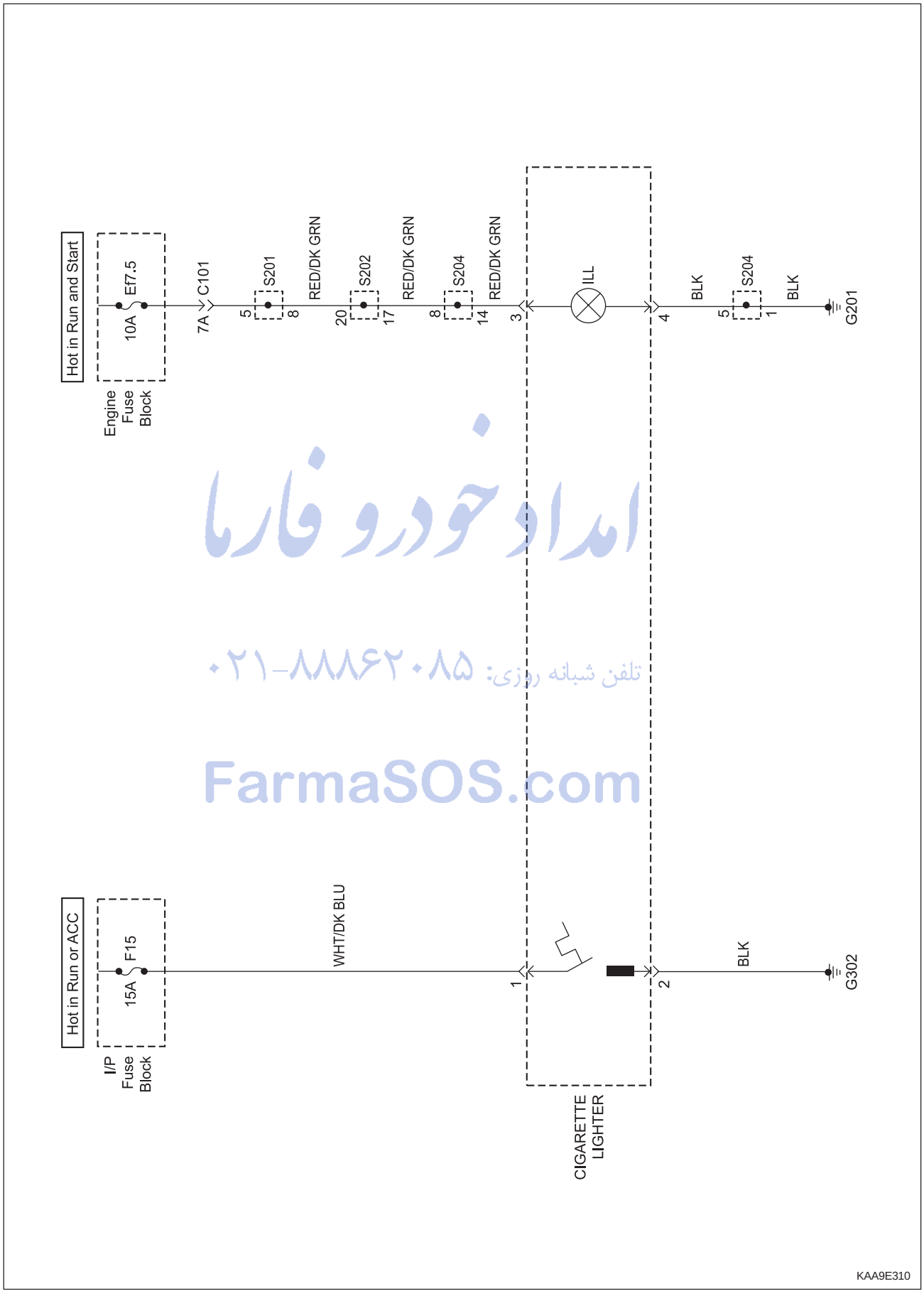
BULB USAGE CHART

Bulb	Replacement Bulb Number
Headlamp High/Low	65 W / 45 W
Turn Signal Lamp	28 W
Position Lamp	8 W
Front Side Maker Lamp	8 W
Tail Lamp	8 W
Stop Lamp	27 W
Rear Trun Signal Lamp	27 W
Back Up Lamp	27 W
Front Fog Lamp	55 W
Rear Side Maker Lamp	5 W
License Plate Lamp	5 W
Center High-Mounted Stop Lamp	27 W
Front Interior Courtesy Lamp	8 W
Second Interior Courtesy Lamp	10 W
Luggage Compartment Lamp	5 W

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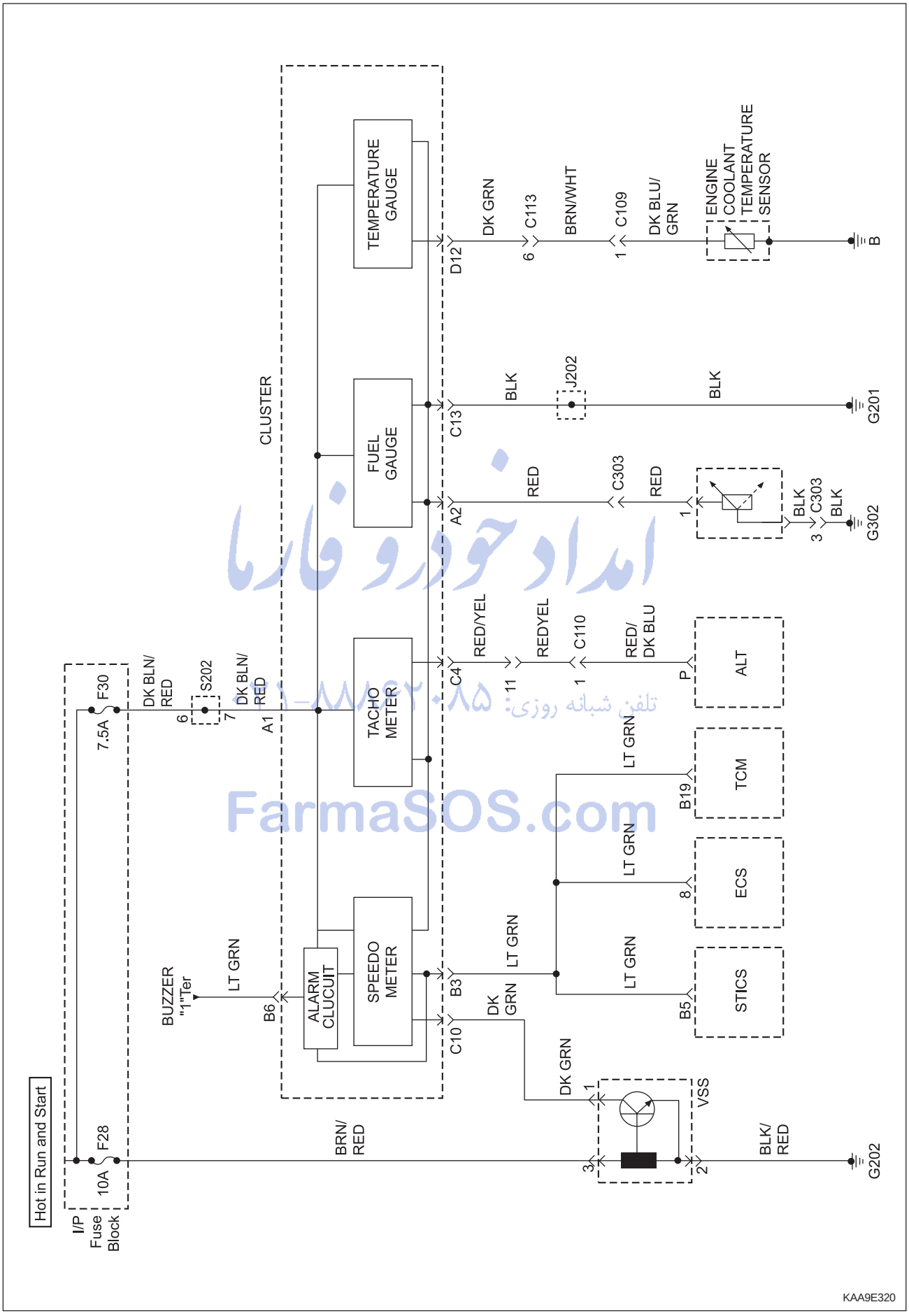
SCHEMATIC AND ROUTING DIAGRAMS

CIGAR LIGHTER



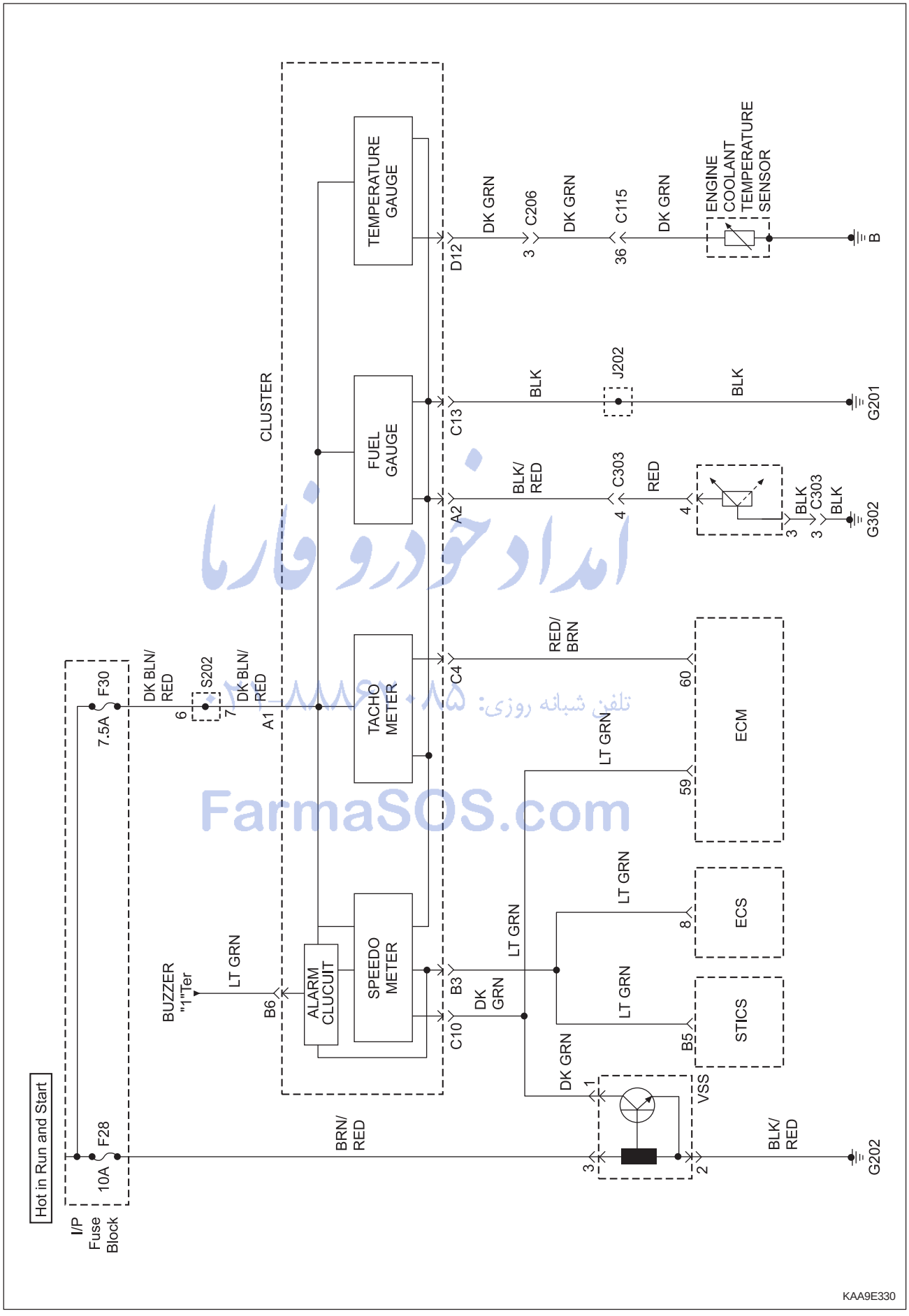
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CLUSTER (VSS, METER & GAUGE) : DIESEL



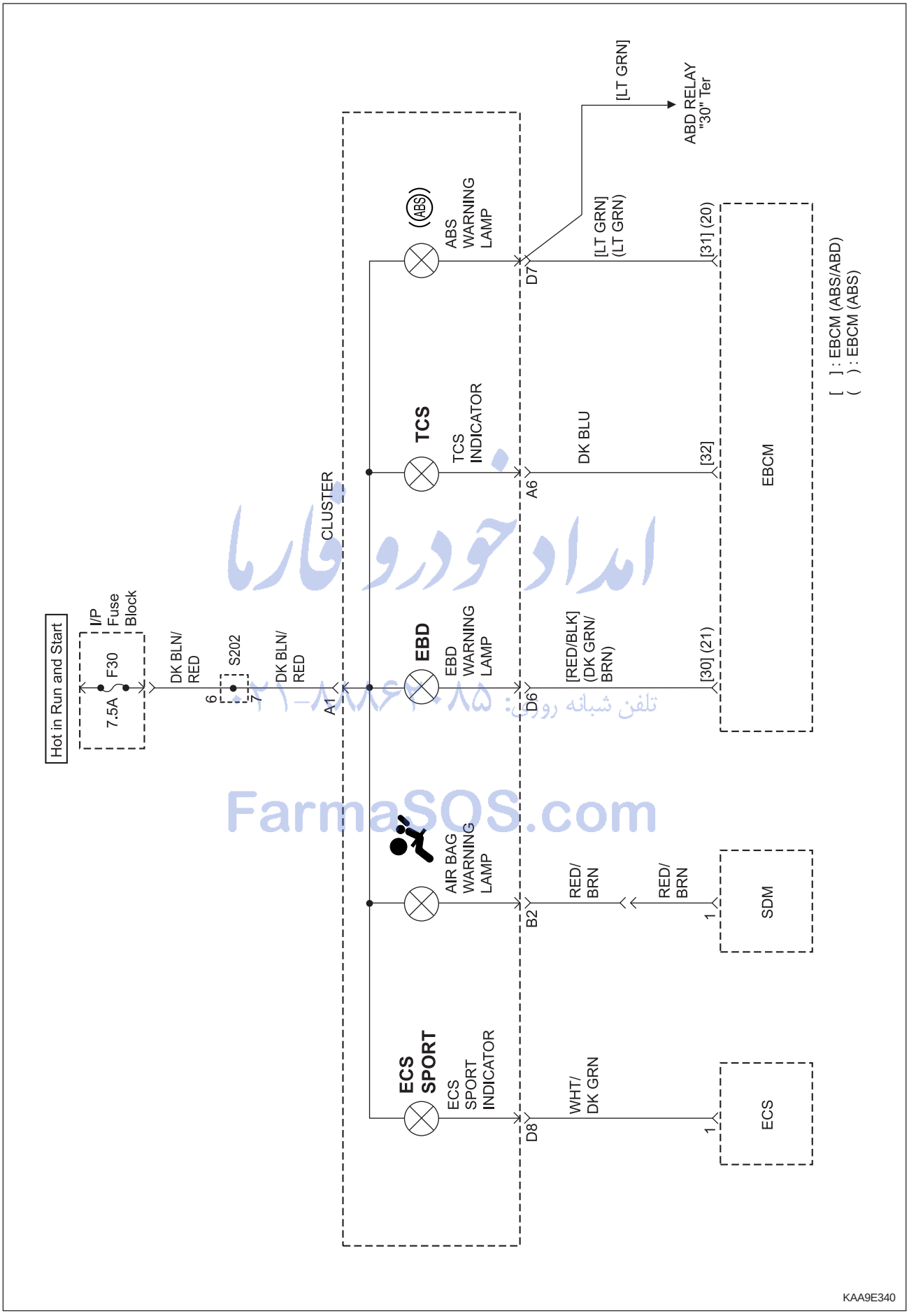
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CLUSTER (VSS, METER & GAUGE) : GASOLINE



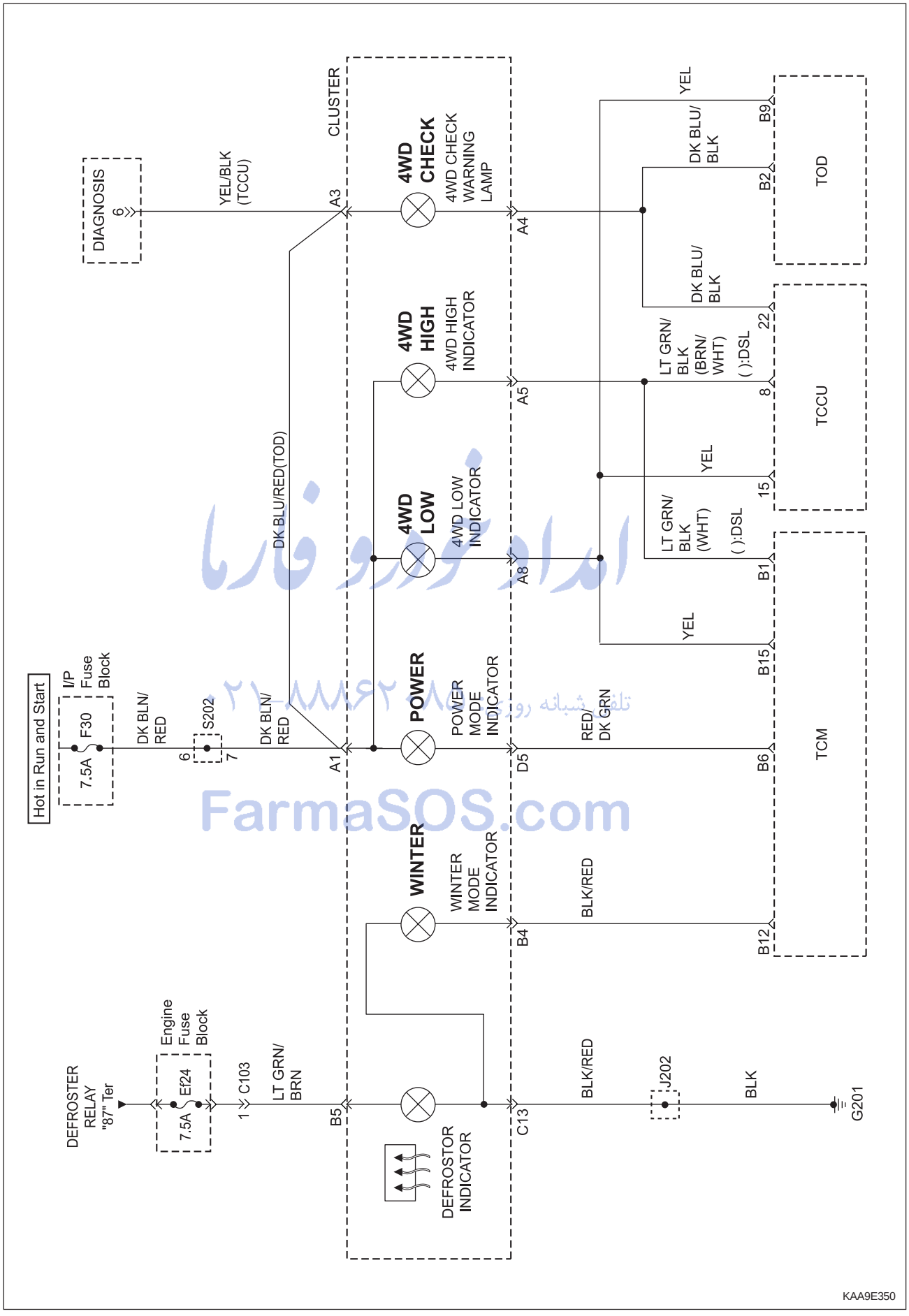
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WARNING LAMP, TCS INDICATOR



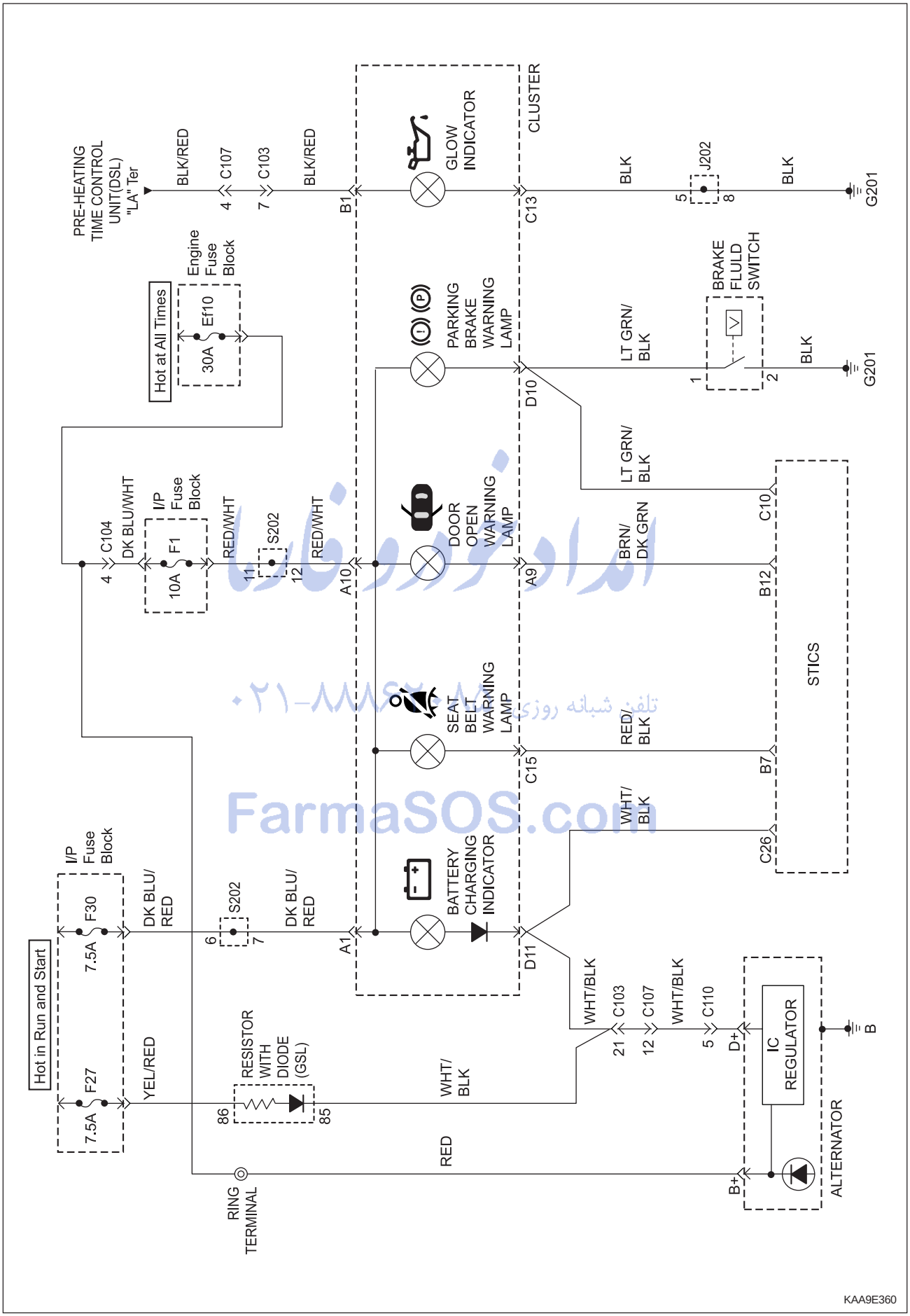
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INDICATOR



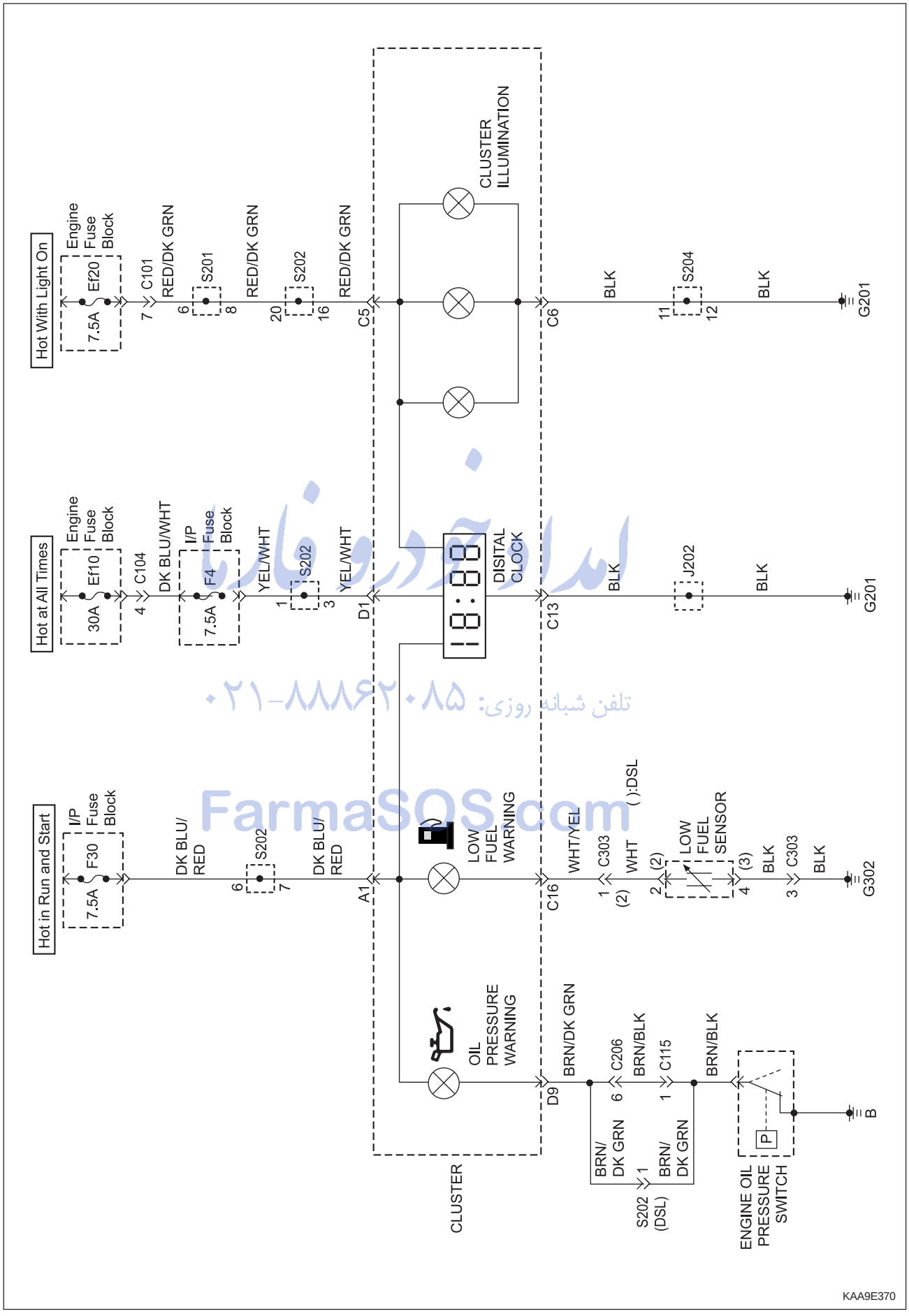
FarmaSOS.com

WARNING LAMP



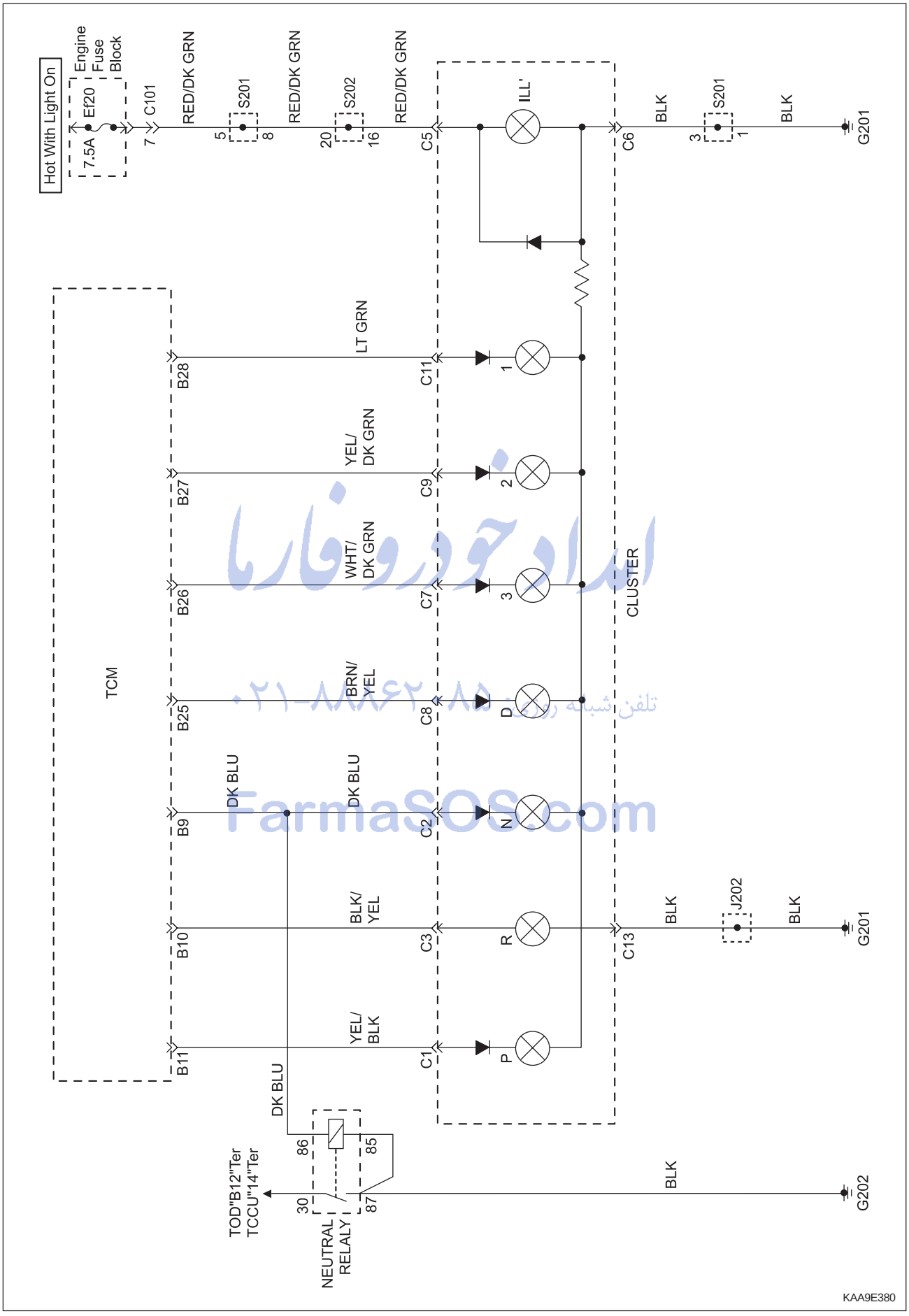
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DIGITAL CLOCK, WARNING CLUSTER ILLUMINATION



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SELECTOR LEVER POSITION LAMP



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SECTION 9F

AUDIO SYSTEM

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

Description and Operation 9F-2

Speakers 9F-2

Mast Antenna 9F-2

Tape Player and Cassette Care 9F-2

Components Locator 9F-3

Audio System 9F-3

Repair Instructions 9F-4

On-Vehicle Service Unit Repair 9F-4

Stereo Cassette AM/FM Radio 9F-4

Front Door Speakers 9F-4

Rear Speakers 9F-5

Mast Antenna 9F-5

Schematic and Routing Diagram 9F-7

Audio System Circuit 9F-7

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵

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DESCRIPTION AND OPERATION

SPEAKERS

All audio systems use four speakers : two speakers mounted in the front doors and two speakers mounted in the quarter trim panel.

MAST ANTENNA

The center and the side vents in the instrument panel can be adjusted up and down and from side to side. The side vents can also be aimed toward the side windows to defog them.

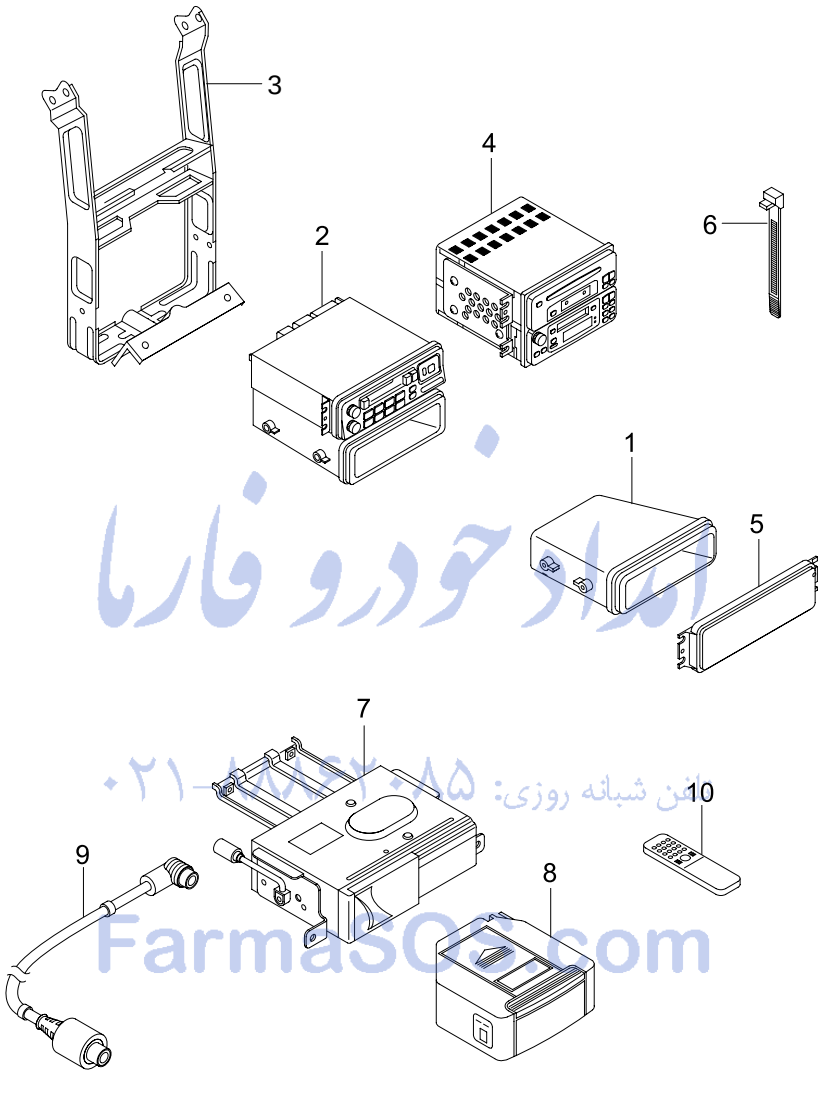
TAPE PLAYER AND CASSETTE CARE

The glove box can be opened by pulling upon the latch handle. The glove box must be removed to gain access to the passenger side airbag module, (if equipped).

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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COMPONENTS LOCATOR

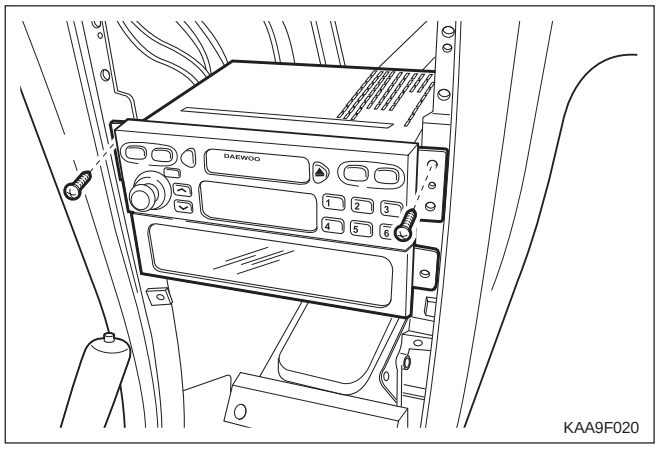
AUDIO SYSTEM



KAA9F010

1 Tray A-Audio
2 Tuner & Cassette & Tray A
3 BRKT-Audio MTG
4 Tuner & Cassette & W/COP
5 Blacking Cover-Audio
6 Band
7 CD Changer A
8 Magazine-CD Changer
9 Cable-CD Changer
10 Wireless Remocon-Audio-RR

REPAIR INSTRUCTIONS

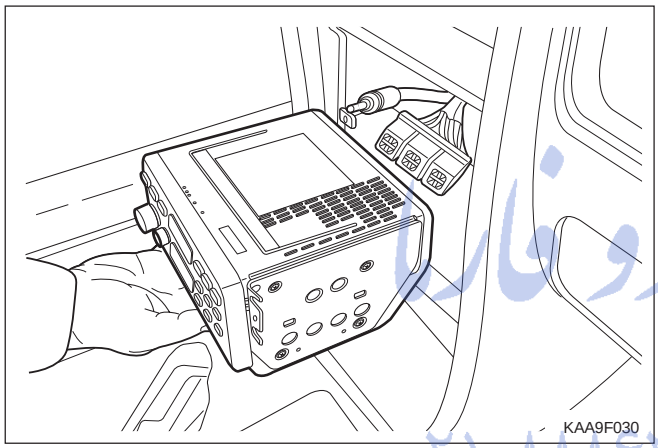


ON-VEHICLE SERVICE UNIT REPAIR

STEREO CASSETTE AM/FM RADIO

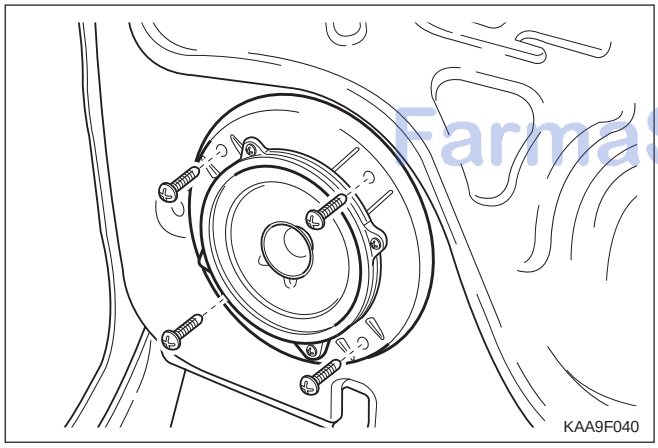
Removal and Installation Procedure

1. Disconnect negative battery cable.
2. Remove the audio system trim plate.
3. Remove the screws and the audio system.



4. Disconnect the audio system electrical connectors.
5. Installation should follow the removal procedure in the reverse order.

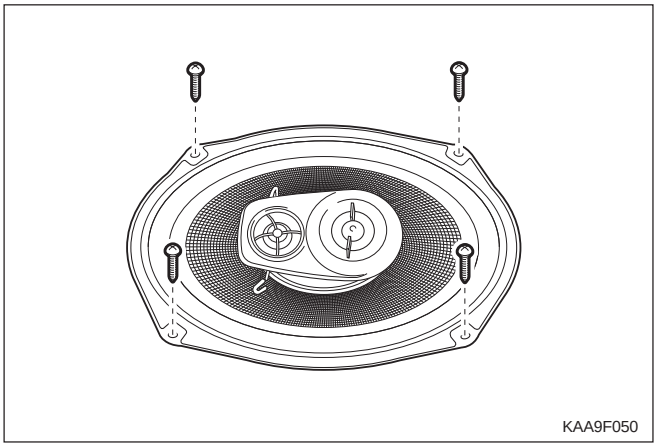
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FRONT DOOR SPEAKERS

Removal and Installation Procedure

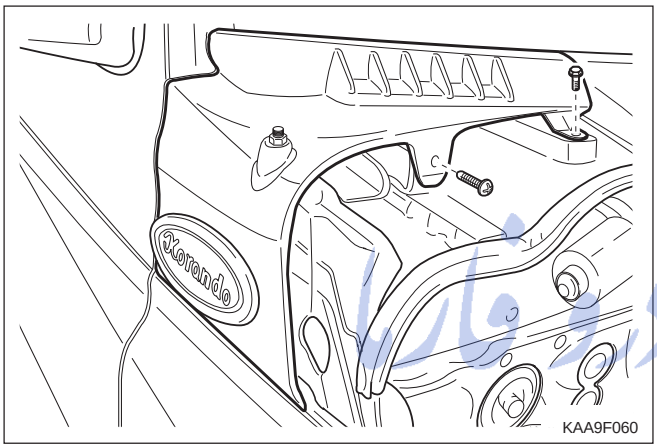
1. Disconnect negative battery cable.
2. Remove the front door trim panel. Refer to *Section 9G, Interior Trim*.
3. Disconnect the electrical connector.
4. Remove the screws and the front door speaker.
5. Installation should follow the removal procedure in the reverse order.


KAA9F050

REAR SPEAKERS

Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Remove the quarter trim panel. Refer to *Section 9G, Interior Trim*.
3. Installation should follow the removal procedure in the reverse order.



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MAST ANTENNA

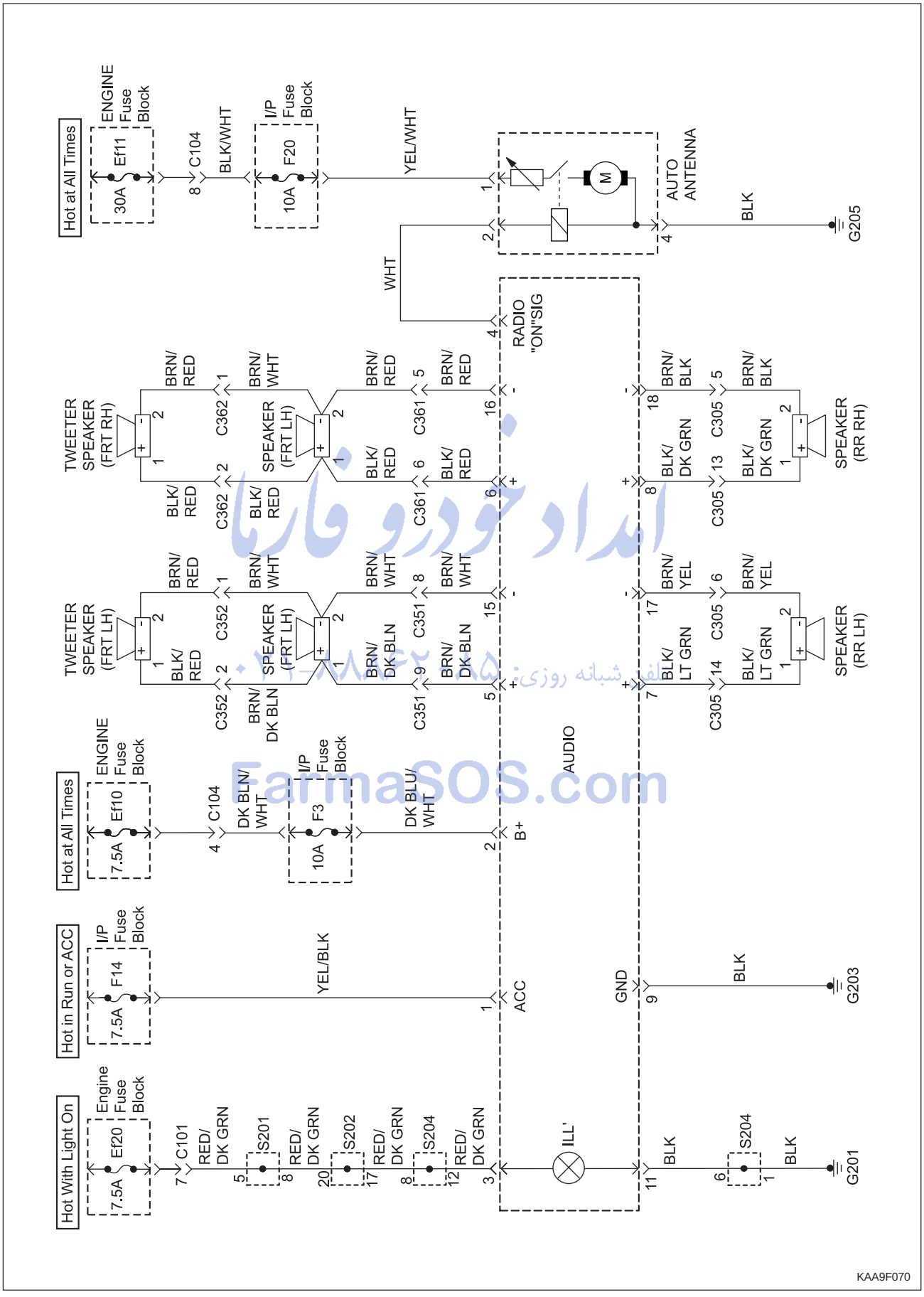
Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Remove the center high-mounted stop lamp cover
3. Disconnect the CHMSL electrical connector.
4. Remove the screws with the CHMSL.
5. Installation should follow the removal procedure in the reverse order.

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SCHEMATIC AND ROUTING DIAGRAM

AUDIO SYSTEM CIRCUIT



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SECTION 9G

INTERIOR TRIM

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

Description and Operation 9G-2

Interior Trim Panels 9G-2

Floor Console 9G-2

Floor Carpet 9G-2

Components Locator 9G-3

Interior Trim 9G-3

Repair Instructions 9G-4

On-Vehicle Service Unit Repair 9G-4

Door Trim Panel 9G-4

A-Pillar Trim Panel 9G-5

Upper Quarter Trim Panel 9G-5

Lower Quarter Trim Panel 9G-6

Cowl Side Trim Panel 9G-6

Front Rocker Trim Panel 9G-7

Floor Console 9G-7

Floor Carpet 9G-7

Specifications 9G-9

Fastener Tightening Specifications 9G-9

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵

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DESCRIPTION AND OPERATION

INTERIOR TRIM PANELS

The interior trim panels are molded plastic and fasten with screws or plastic clips.

FLOOR CARPET

The floor carpets are divided front and rear floor carpet.

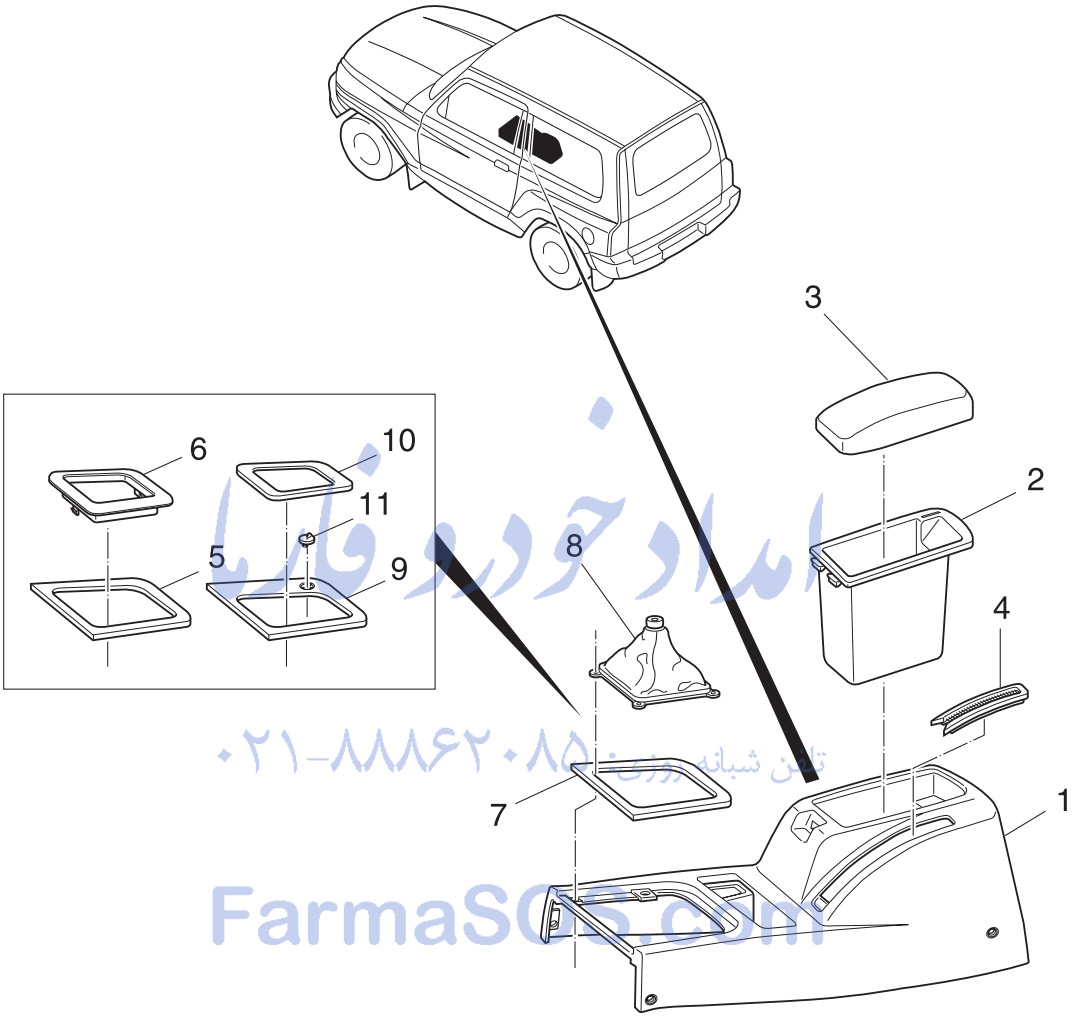
FLOOR CONSOLE

The floor console fits over the tunnel in the floor of the vehicle and extends from under the center of the instrument panel to the rear seat area. The floor console contains the transaxle shift lever, parking brake lever, a storage compartment and coin storage

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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COMPONENTS LOCATOR

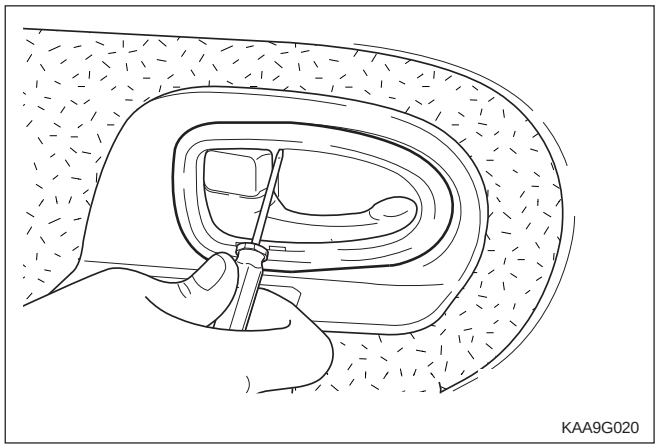
INTERIOR TRIM



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۰۲۱-۸۸۸۶۲۰۸۵ تلفن شبانه روزی
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1 Console Box
2 Tray
3 Arm Rest
4 Parking Lever Strip
5 Facia (BTRA A/T)
6 Indicator Cover
7 Facia (M/T)
8 Boot Assembly (M/T)
9 Facia (MB A/T)
10 Rear Facia Strip
11 Rear Facia Cap

REPAIR INSTRUCTIONS

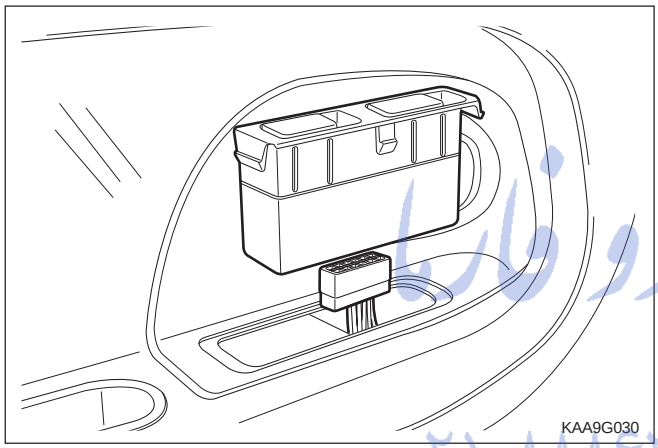

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ON-VEHICLE SERVICE UNIT REPAIR

DOOR TRIM PANEL

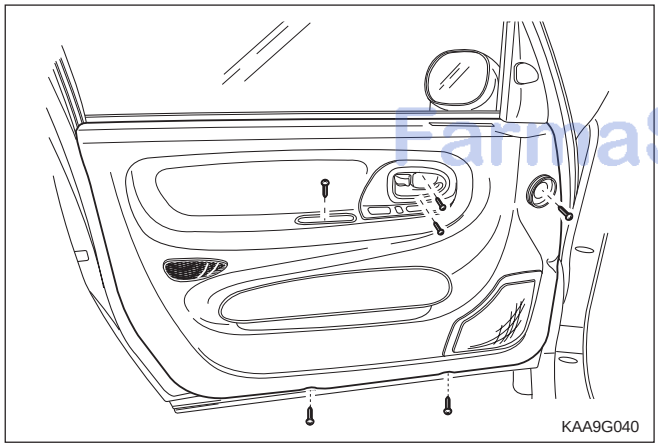
Removal and Installation Procedure

1. Lower the window.
2. Pry off the inside door handle trim bezel.

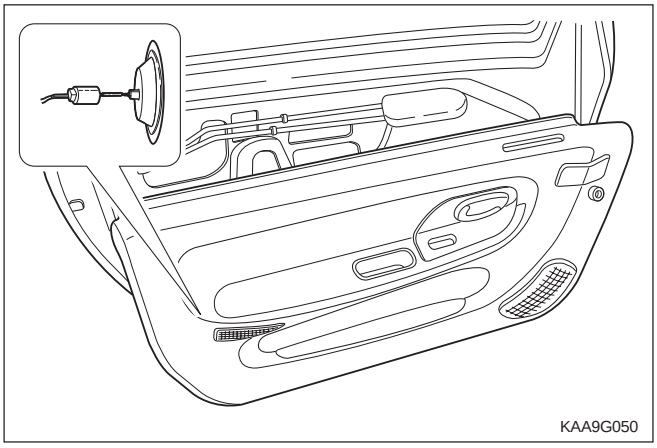

KAA9G030

3. Remove the power window control switch.
4. Disconnect the power window control switch electrical connector.

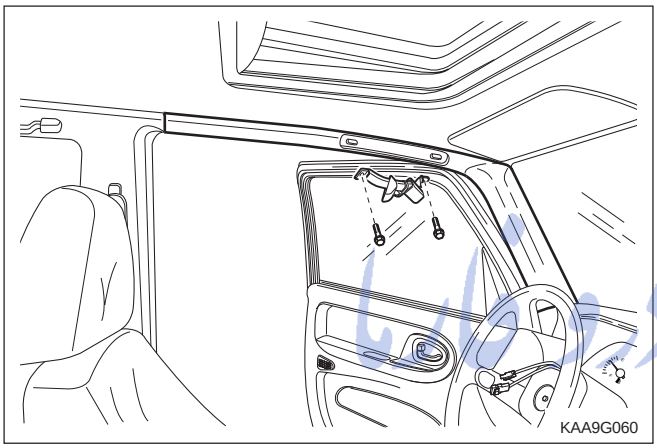
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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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KAA9G040

5. Remove the door trim panel screws.


KAA9G050

6. Disconnect the electrical connector.
7. Remove the door trim panel.
8. Installation should follow the removal procedure in the reverse order.

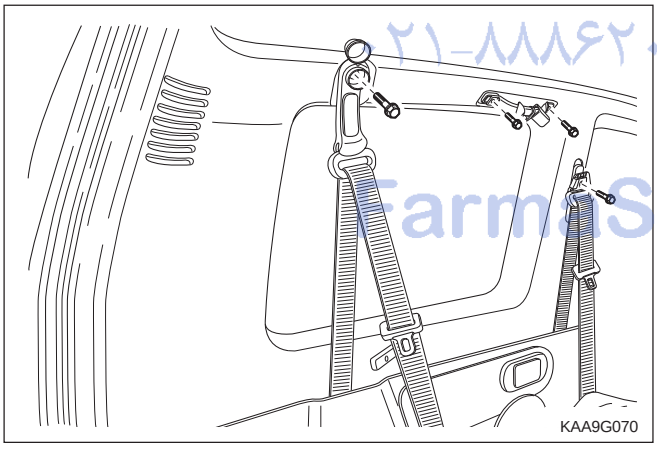

KAA9G060

A-PILLAR TRIM PANEL

Removal and Installation Procedure

1. Remove the roof assist handle with the screws.
2. Remove the A-pillar trim panel.
3. Installation should follow the removal procedure in the reverse order.

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UPPER QUARTER TRIM PANEL

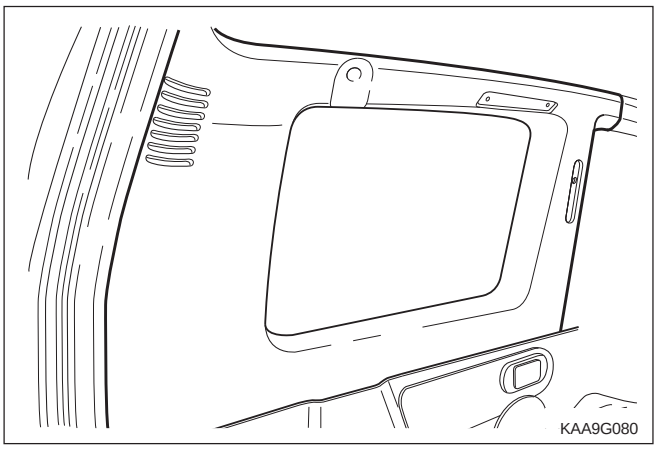
Removal and Installation Procedure

1. Remove the roof assist handle with the screws.
2. Remove the seat belt anchor with the bolt.

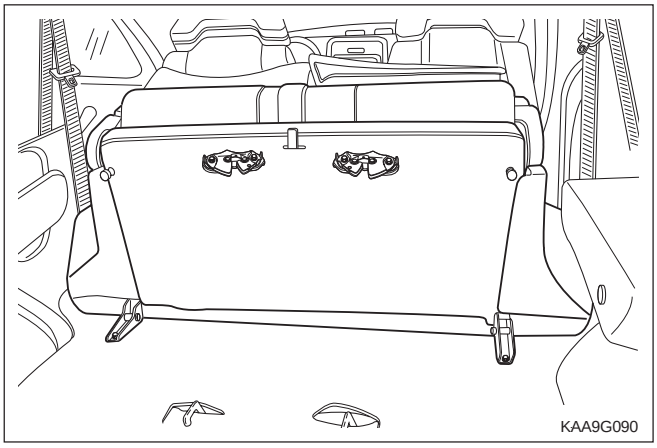
Installation Notice

Tightening Torque	45 N•m (33 lb-ft)

- Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.


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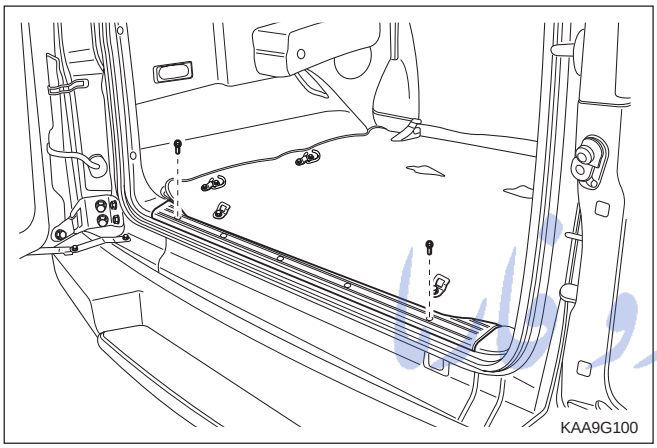
3. Remove the upper quarter trim panel.
4. Installation should follow the removal procedure in the reverse order.



LOWER QUARTER TRIM PANEL

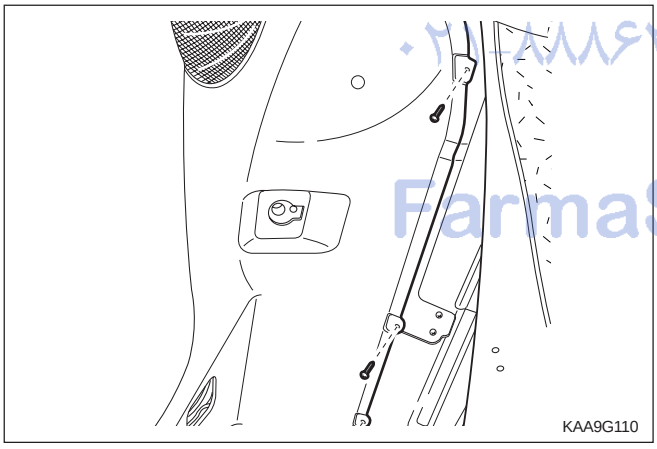
Removal and Installation Procedure

1. Lift up the rear seat from the floor.

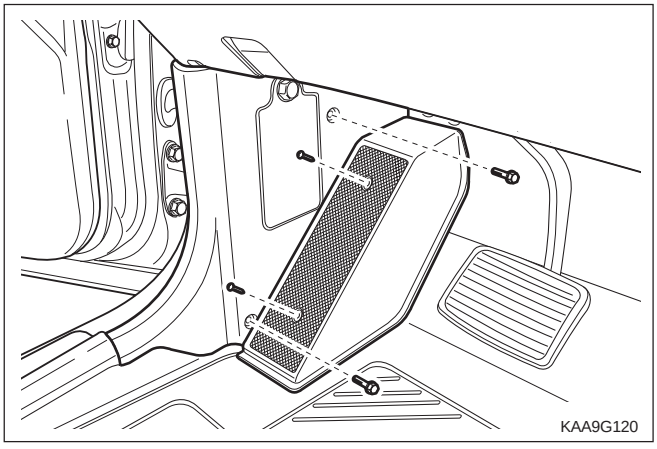


2. Remove the armrest. Refer to *Section 9H "SEATS".*
3. Remove the ashtray and compartment lamp from lower quarter trim panel.
4. Remove the roof rear trim and back panel cover.

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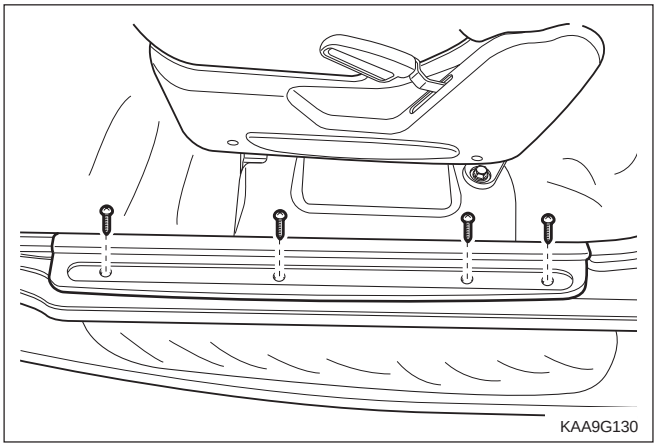
5. Remove the lower quarter trim panel with the screws.
6. Installation should follow the removal procedure in the reverse order.



COWL SIDE TRIM PANEL

Removal and Installation Procedure

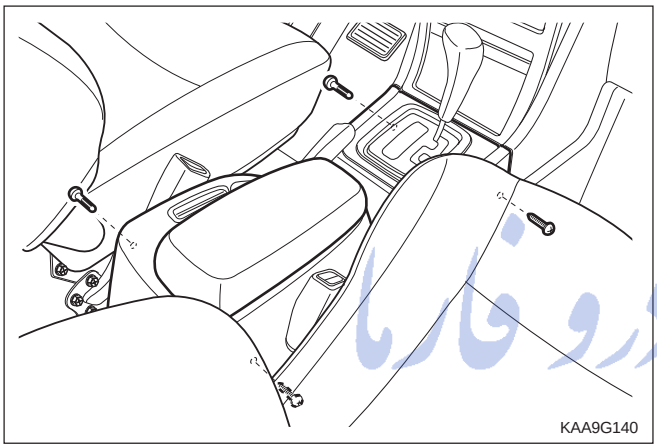
1. Remove the cowl side trim panel. Refer to front rocker trim panel in this section.
2. Remove the cowl side trim panel with the screws.
3. Installation should follow the removal procedure in the reverse order.



FRONT ROCKER TRIM PANEL

Removal and Installation Procedure

1. Remove the screws.
2. Remove the rocker trim panel.
3. Installation should follow the removal procedure in the reverse order.

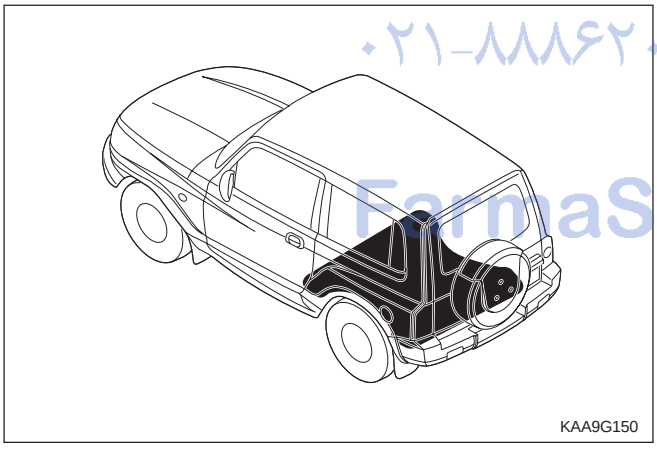


FLOOR CONSOLE

Removal and Installation Procedure

1. Remove the screws.
2. Remove the floor console.
3. Disconnect the electrical connector.
4. Installation should follow the removal procedure in the reverse order.

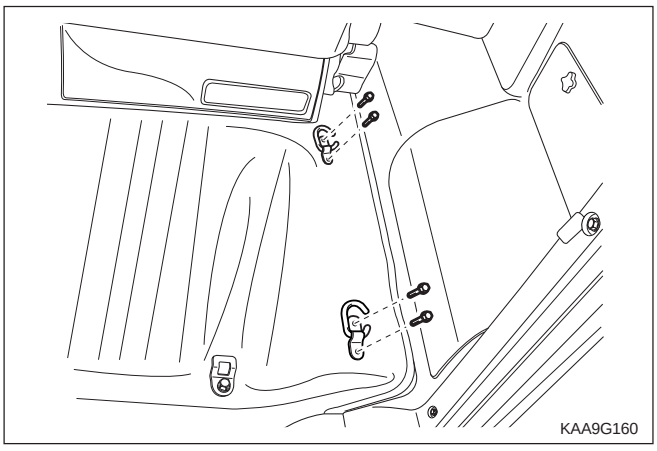
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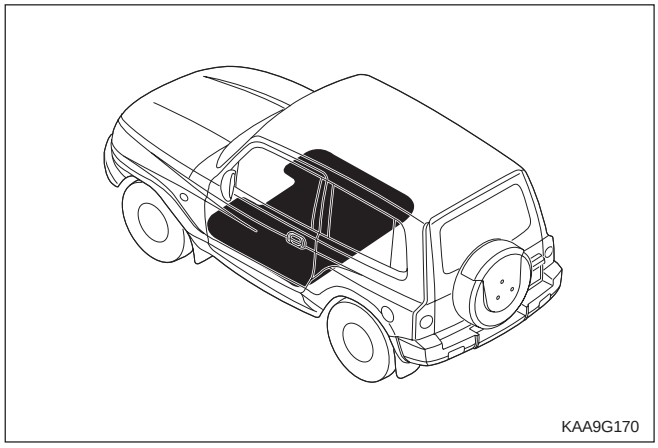
FLOOR CARPET

Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Remove the rear seat. Refer to *Section 9H, Seats.*
3. Remove the bolts and the left and the right lower seat belt anchors.
4. Remove the child seat anchor. Refer to *Section 9H, Seats.*
5. Remove the floor carpet screws.



6. Remove the luggage hook with the mounting screws.
7. Remove the front seat. Refer to *Section 9H, Seats.*


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8. Remove the kick panel. Refer to “Kick Panel” in this section.
9. Remove the lower quarter trim panel. Refer to “Lower Quarter Trim Panel” in this section.
10. Remove the front floor carpet.
11. Installation should follow the removal procedure in the reverse order.

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SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Seat Belt Anchor Bolt	45	33	-

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SECTION 9H

SEATS

TABLE OF CONTENTS

Components Locator 9H-2

Seats 9H-2

Repair Instructions 9H-3

On-Vehicle Service Unit Repair 9H-3

Front Seat 9H-3

Front Seat Cushion 9H-3

Front Seatback 9H-4

Front Seat Guide Rail 9H-4

Front Seat Recliner Lever 9H-5

Front Seat Trim 9H-5

Head Restraint 9H-5

Walk In Device 9H-6

Front Seat Armrest 9H-6

Rear Seat Armrest 9H-6

Rear Seat 9H-7

50/50 Split Rear Seat Cushion Hinge 9H-7

50/50 Split Rear Seat Cushion Lock Striker 9H-8

Child Seat Anchorage 9H-8

Specifications 9H-9

Fastener Tightening Specifications 9H-9

Schematic and Routing Diagram 9H-10

Seat Heater 9H-10

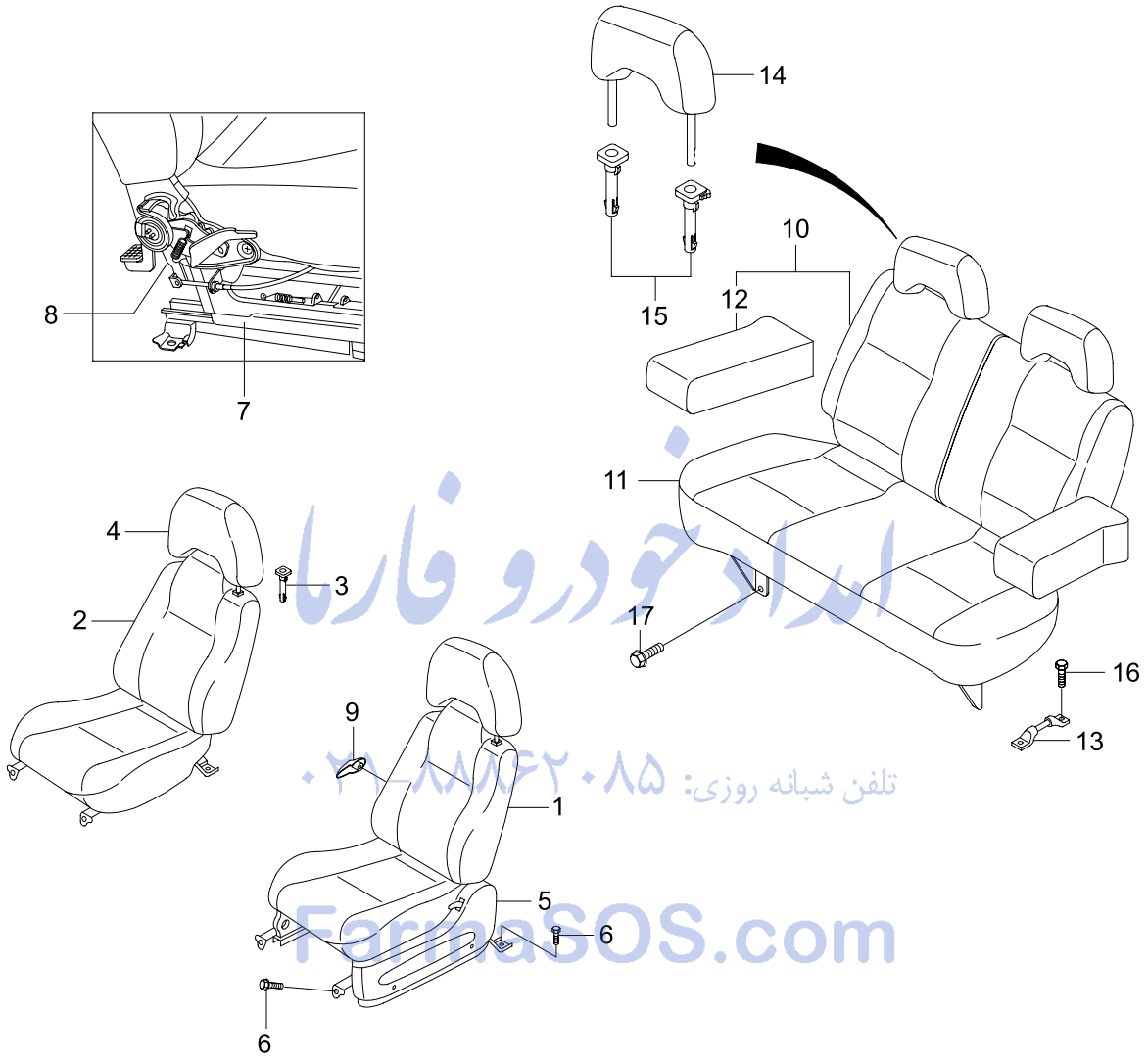
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COMPONENTS LOCATOR

SEATS

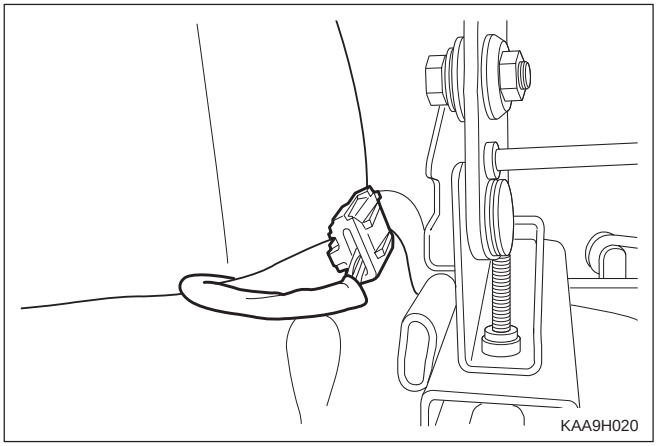


KAA9H010

1 Seat A-FRT
2 Seat A-FRT
3 Head Rest Sleeve A
4 Head Rest A-FRT
5 Shield Cover
6 Bolt-Hex SEMS
7 G/Rail A-FRT
8 Recliner A-FRT
9 Lumber Support-Knob
10 Seat-RR
11 Seat-RR
12 Arm Rest A-RR
13 Striker-RR Seat
14 Head Rest A-RR
15 Head Rest Sleeve A
16 Bolt-Hex SEMS
17 Bolt-Hex SEMS

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REPAIR INSTRUCTIONS

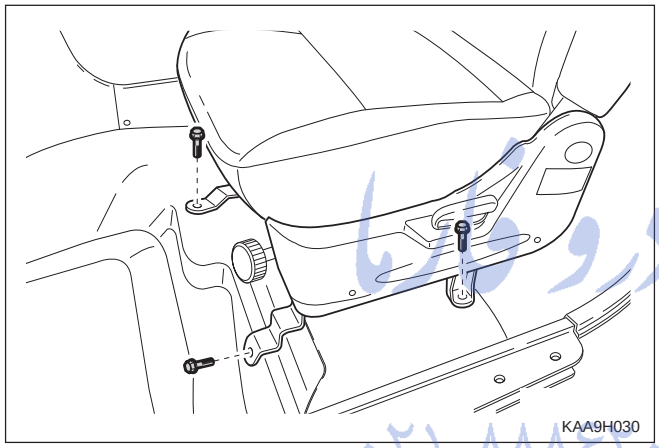


ON-VEHICLE SERVICE UNIT REPAIR

FRONT SEAT

Removal and Installation Procedure

1. Remove the electrical connector from front seat.



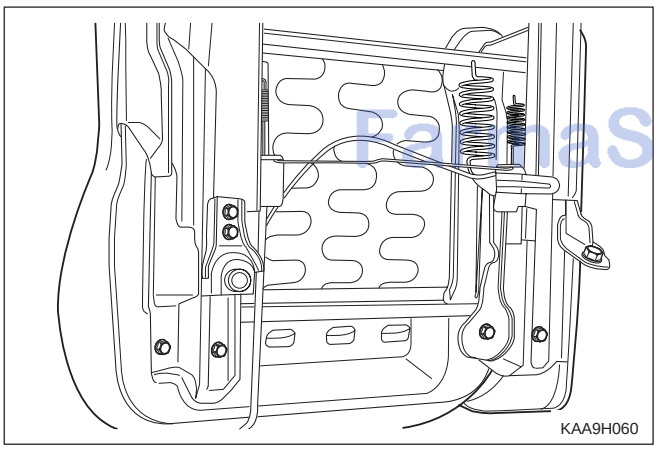
2. Remove the bolts with the front seat.

   Installation Notice

Tightening Torque	19.6 - 31.4 N•m (14.5 - 23.2 lb-ft)

   - Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.
3. Installation should follow the removal procedure in the reverse order.

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FRONT SEAT CUSHION

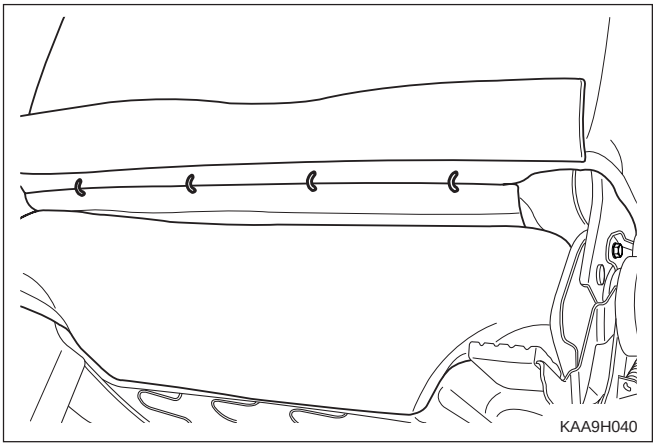
Removal and Installation Procedure

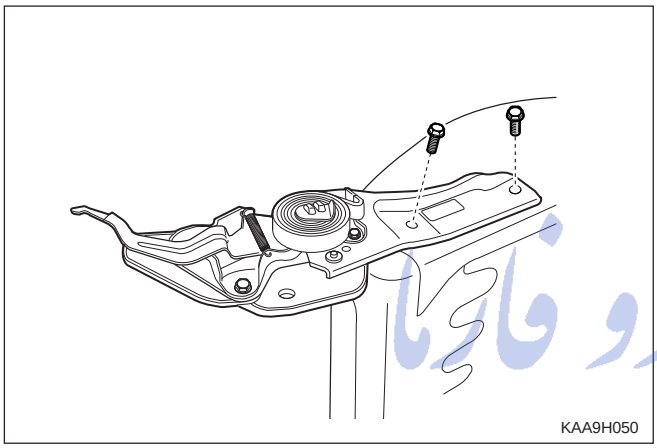
1. Remove the front seat from the vehicle. Refer to “front seat” in this section.
2. Remove the front seatback. Refer to “Front Seat back” in this section.
3. Remove the seat cushion bolts.

   Installation Notice

Tightening Torque	16.7 - 25.5 N•m (12 - 18 lb-ft)

   - Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.
4. Installation should follow the removal procedure in the reverse order.


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FRONT SEATBACK

Removal and Installation Procedure

1. Remove the front seat from the vehicle. Refer to “front seat” in this section.
2. Remove the head restraint. Refer to “head restraint” in this section.
3. Remove the seat recliner lever. Refer to “seat recliner lever” in this section.
4. Remove the seat trim. Refer to “seat trim” in this section.
5. Remove the seatback cover.
6. Remove the bolts and the seatback.

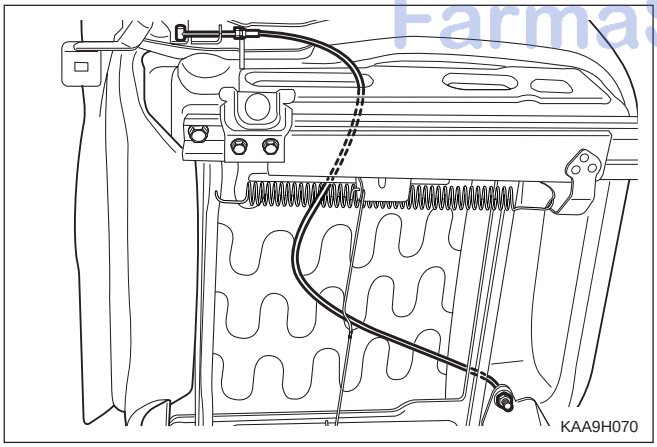
Installation Notice

Tightening Torque	34.3 - 55.9 N•m (25 - 41 lb-ft)

- Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

7. Installation should follow the removal procedure in the reverse order.

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FRONT SEAT GUIDE RAIL

Removal and Installation Procedure

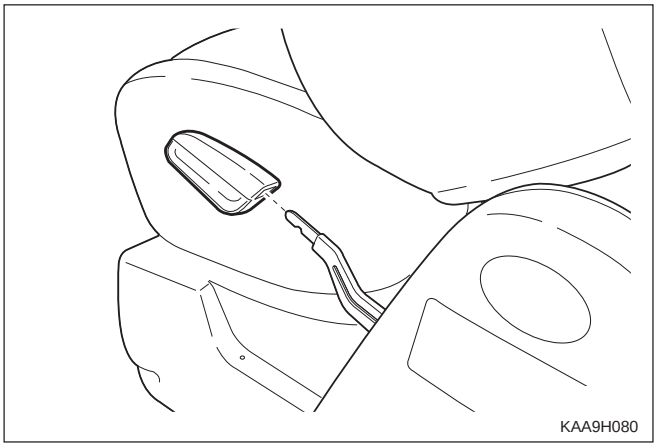
1. Remove the front seat from the vehicle. Refer to in this section.
2. Remove the front seat trim. Refer to “front seat trim” in this section.
3. Remove the bolts and the guide rail.

Installation Notice

Tightening Torque	17.6 - 25.5 N•m (12 - 18 lb-ft)

- Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

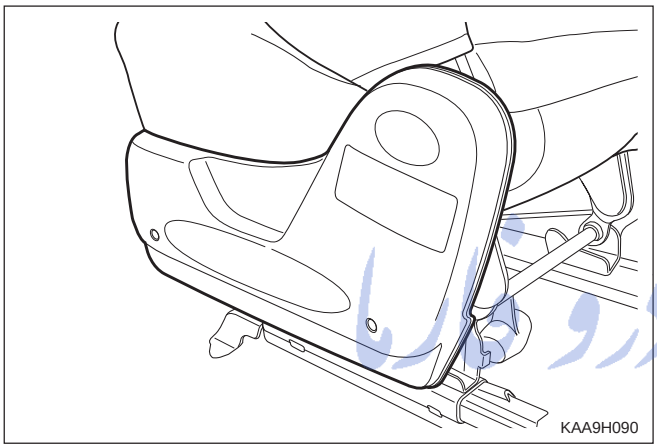
4. Installation should follow the removal procedure in the reverse order.



FRONT SEAT RECLINER LEVER

Removal and Installation Procedure

1. Remove the seat recliner lever by rubber hammer.
2. Installation should follow the removal procedure in the reverse order.

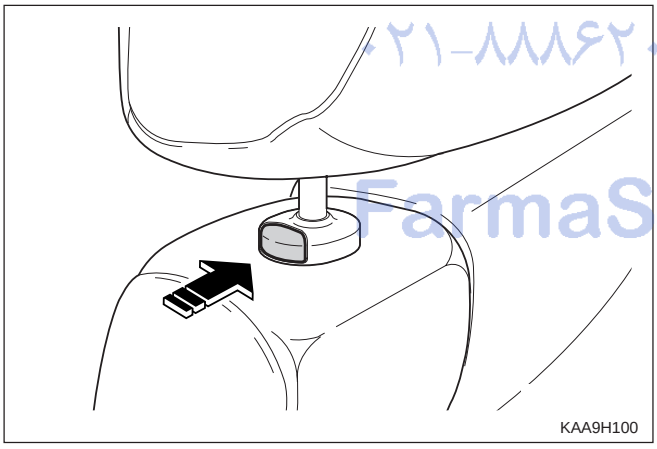


FRONT SEAT TRIM

Removal and Installation Procedure

1. Remove the recliner lever by rubber hammer. Refer to “seat recliner lever” in this section.
2. Remove the screws and the seat trim.
3. Installation should follow the removal procedure in the reverse order.

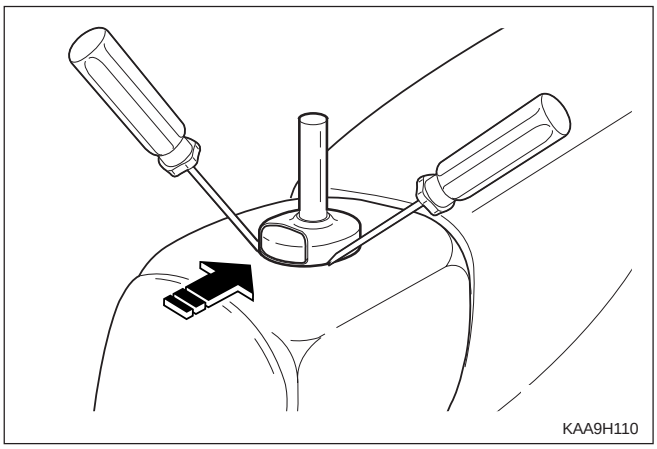
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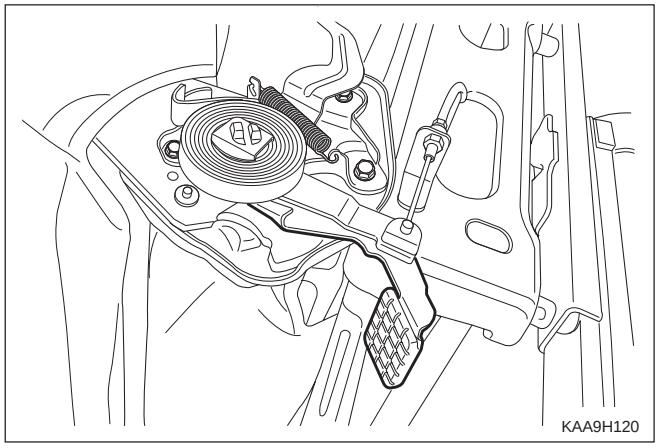
HEAD RESTRAINT

Removal and Installation Procedure

1. Press in the head restraint adjust button and remove the head restraint from the seatback.



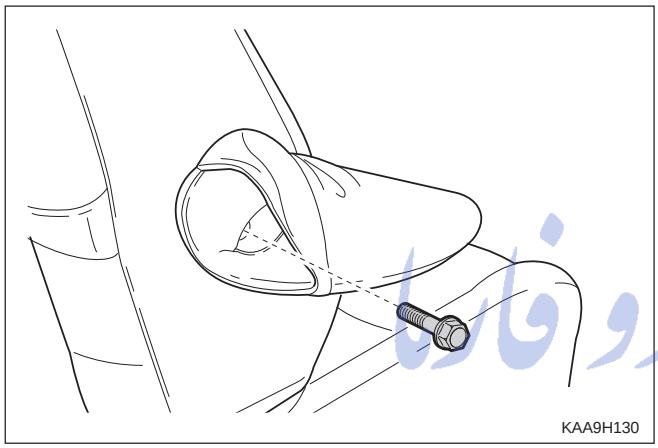
2. Insert two flat head screwdrivers down the front and back side of the guide sleeves.
3. With the screwdrivers, press in the retaining latches and remove the guide sleeves.
4. Installation should follow the removal procedure in the reverse order.



WALK IN DEVICE

Removal and Installation Procedure

1. Remove the front seat. Refer to “front seat” in this section.
2. Remove the seat recliner. Refer to “seat recliner” in this section.
3. Remove the seat trim. Refer to “seat trim” in this section.
4. Remove the walk in device assembly.
5. Installation should follow the removal procedure in the reverse order.



FRONT SEAT ARMREST

Removal and Installation Procedure

1. Remove the arm rest cover.
2. Remove the arm rest mounting bolt.

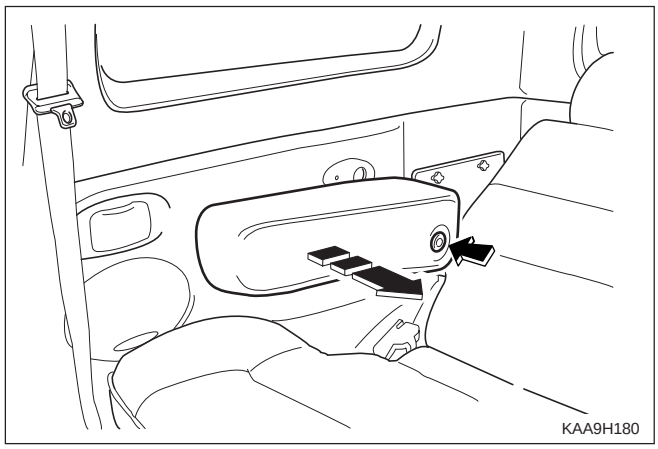
Installation Notice

Tightening Torque	17.6 - 25.5 N•m (12 - 18 lb-ft)

- Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

3. Remove the arm rest.
4. Installation should follow the removal procedure in the reverse order.

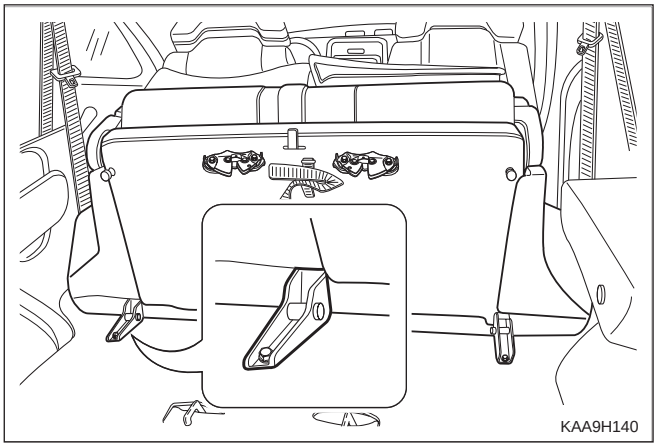
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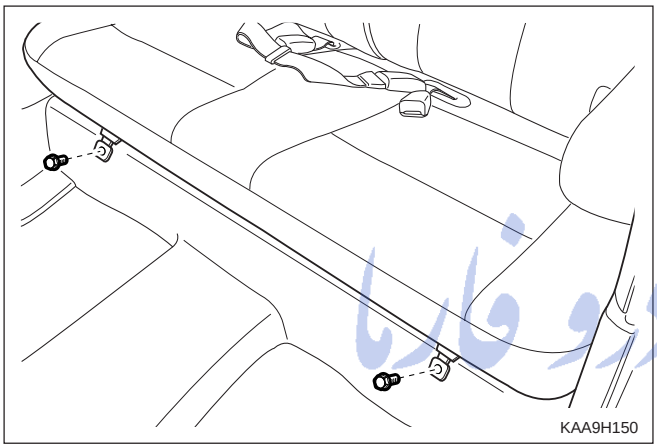


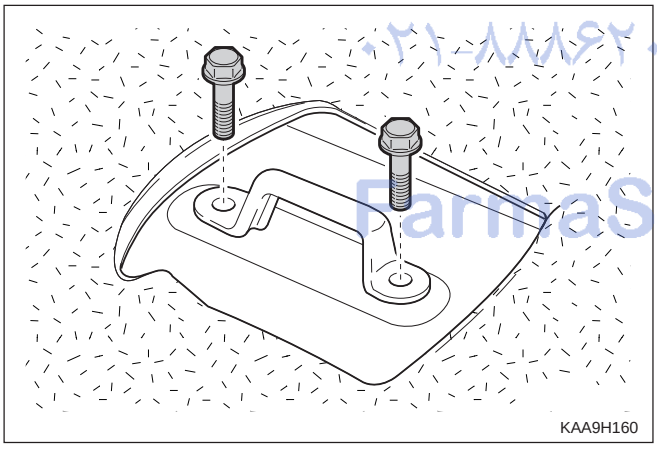
REAR SEAT ARMREST

Removal and Installation Procedure

1. Push the button in the arm rest.
2. Turn and remove from the side quarter trim panel.
3. Installation should follow the removal procedure in the reverse order.


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KAA9H160

REAR SEAT

Removal and Installation Procedure

1. Lift up the rear seat from the floor.
2. Remove the bolts.

Installation Notice

Tightening Torque	19.6 - 31.4 N•m (14.5 - 23.2 lb-ft)

- Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

3. Remove the bolts and the rear seat.

Installation Notice

Tightening Torque	19.6 - 31.4 N•m (14.5 - 23.2 lb-ft)

- Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

4. Installation should follow the removal procedure in the reverse order.

50/50 SPLIT REAR SEAT CUSHION HINGE

Removal and Installation Procedure

1. Remove the bolts and the rear seat cushion hinge.

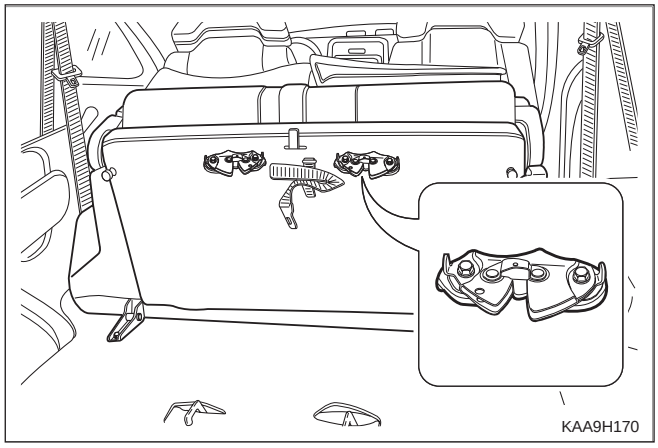
Installation Notice

Tightening Torque	34.3 - 53.9 N•m (25 - 39 lb-ft)

- Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correctfasteners to prevent premature corrosion.

2. Installation should follow the removal procedure in the reverse order.

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50/50 SPLIT REAR SEAT CUSHION LOCK STRIKER

Removal and Installation Procedure

1. Remove the bolts and rear seat cushion lock striker.

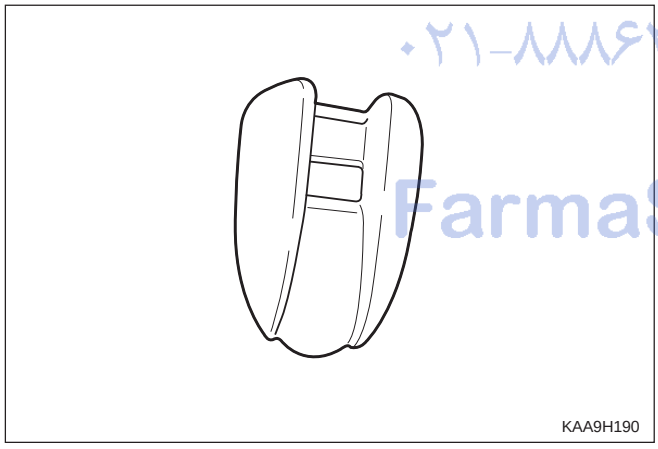
Installation Notice

Tightening Torque	34.3 - 53.9 N•m (25 - 39 lb-ft)

- Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

2. Installation should follow the removal procedure in the reverse order.

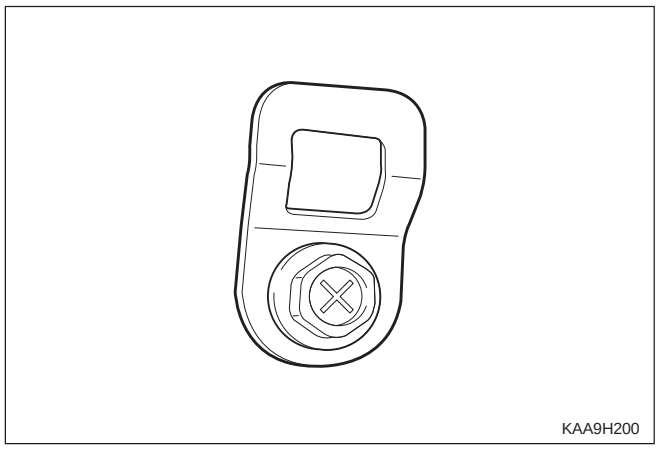
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CHILD SEAT ANCHORAGE

Removal and Installation Procedure

1. Remove the child seat anchorage cover.


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2. Remove the child seat anchorage bolt.

Installation Notice

Tightening Torque	19 N•m (14 lb-ft)

- Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

3. Installation should follow the removal procedure in the reverse order.

SPECIFICATIONS

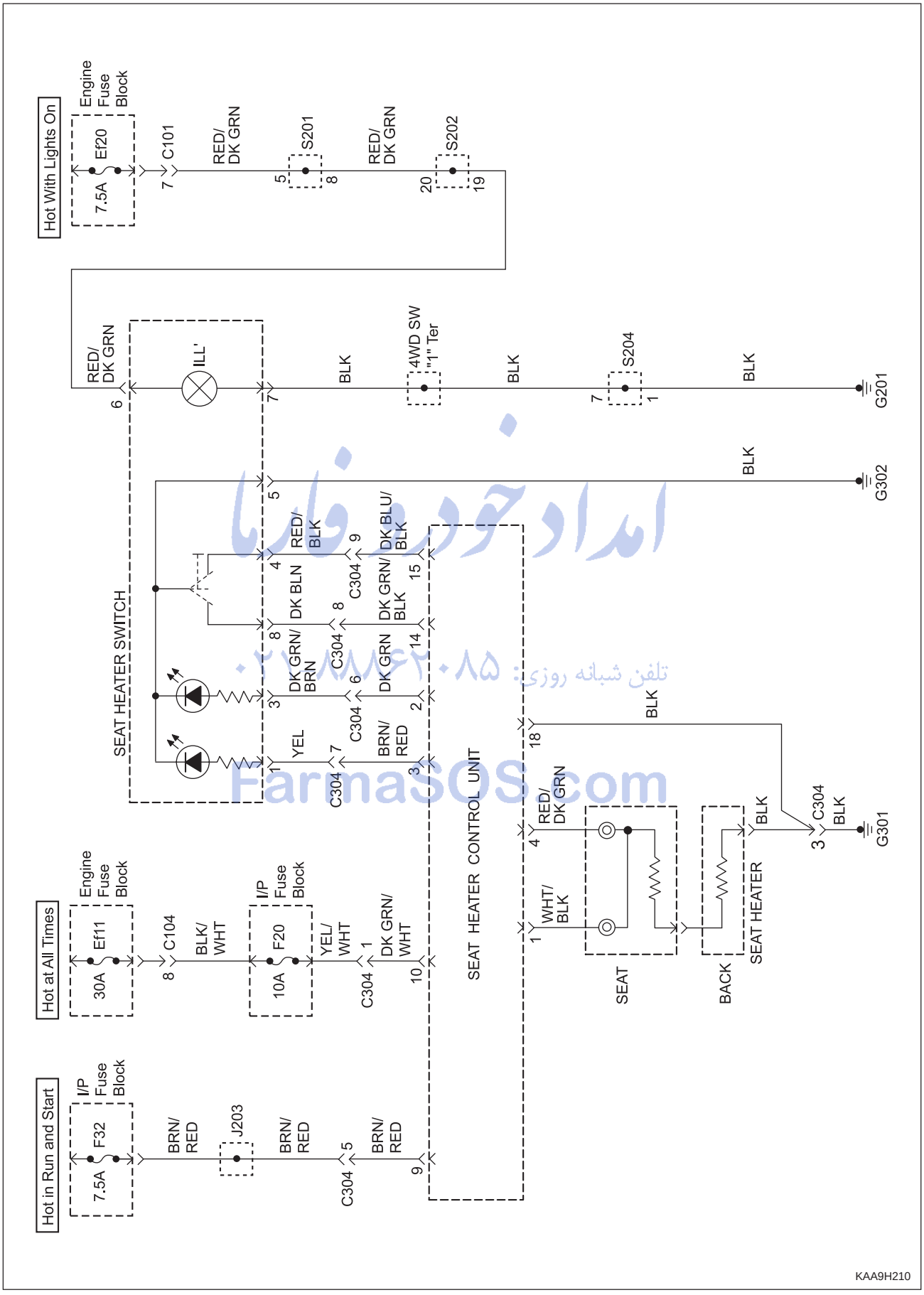
FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Child Seat Anchorage Bolt	19	14	-
Front Armrest Mounting Bolt	16.7 - 25.5	12 - 18	-
Front Seat Bolts	19.6 - 31.4	14.5 - 23.2	-
Guide Rail Bolts	17.6 - 25.5	13 - 18	-
Rear Seat Bolts (Lift Up)	19.6 - 31.4	14.5 - 23.2	-
Rear Seat Bolts (Front)	19.6 - 31.4	14.5 - 23.2	-
Rear Seat Cushion Hinge Bolts	34.3 - 53.9	25 - 39	-
Rear Seat Cushion Lock Striker Bolts	34.3 - 53.9	25 - 39	-
Seat Back Bolts	34.3 - 55.9	25 - 41	-
Seat Cushion Bolts	16.7 - 25.5	12 - 18	-

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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SCHEMATIC AND ROUTING DIAGRAM

SEAT HEATER



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SECTION 9I

WATERLEAKS

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

Specifications 9I-2

Recommended Materials for Waterleak Repairs 9I-2

Watertest Stand Specifications 9I-2

Diagnosis 9I-3

Waterleak Diagnosis 9I-3

Maintenance and Repair 9I-6

On-Vehicle Service 9I-6

Waterleak Repair 9I-6

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵

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SPECIFICATIONS

RECOMMENDED MATERIALS FOR WATERLEAK REPAIRS

Leak Areas	Repair Materials
Windshield, back window	Urethane adhesive, caulking kit, or the equivalent
Metal joints	Brushable seam sealer which can be painted
Ventilation ducts	3M™ Auto Bedding and Glazing Compound or the equivalent
Small cracks and pin holes	3M™ Drip-Check Sealer or the equivalent
Large holes	3M™ Automotive Joint and Seam Sealer
Weatherstrips	3M™ 08011 Weatherstrip Adhesive or the equivalent
Bolts, studs, and screws	Strip caulk

WATERTEST STAND SPECIFICATIONS

Application	Description
Nozzle Type	Full jet spray nozzle #1/2 GG-25 or equivalent with a 60 ° included angle
Nozzle Height	Approximately 1,600 mm (63.0 in.) from the floor
Volume of Flow	14 L (3.7 gal) per minute
Pressure	155 kPa (22.5 psi) measured at the nozzle
Windshield and A-Pillar Test Stand Position	Approximately 30° down, 45° toward the rear, and aimed at the corner of the windshield
B-Pillar Test Stand Position	Approximately 30° down, 45° toward the rear, and aimed at the center of the rear door
Back Window and Rear Deck Lid Test Stand Position	Approximately 30° down, 30° toward the front and aimed approximately 610 mm (24.0 in.) from the corner of the back window

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DIAGNOSIS

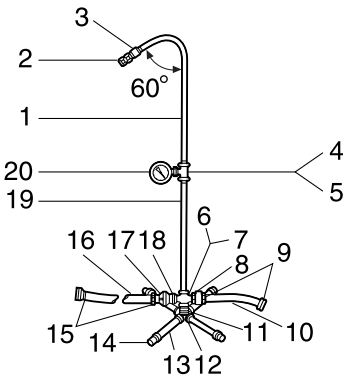
WATERLEAK DIAGNOSIS

The repair of waterleaks in the body requires proper testing and diagnosis. Repair waterleaks by adjusting the misaligned parts and using the proper repair materials. First, determine what conditions cause the leak. For example, the leak may occur only when the vehicle is parked on an incline, or water may appear only in the spare tire compartment. Second, test the area for the source of the leak using the following testing methods. If the general leak area is found, determine the exact entry point of the leak by using a water hose or an air hose. If the general leak area is not obvious, use the watertest stands to determine the area of the leak. It may be necessary to remove some interior trim panels or some parts in order to locate the leaks.

Important: It is necessary to find the origin of all the leaks before making any repairs. Random repairs may stop the leak only temporarily and may make future repairs more difficult. Continue localized testing in the general area in order to ensure that all leaks are found.

Generalized Testing

1. Set up the watertest stands.

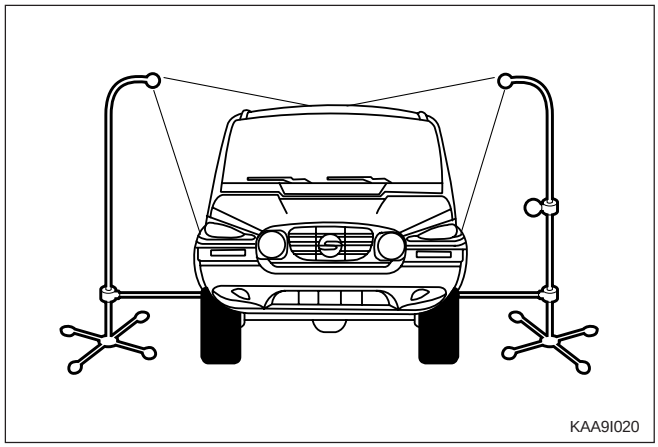


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1 1/2-inch by 36-inch Pipe
2 Full-jet Spray Nozzle #1/2 GG-25 or Equivalent . Nozzle Height at 1,600 mm to the Floor
3 1/2-inch Coupling
4 1/2-inch by 1/2-inch by 1/4-inch Reducing T (Right Only)
5 1/2-inch Coupling (Left Only)
6 1/2-inch Cross (Right Only)
7 1/2-inch Tee (Left Only)
8 1/2-inch Pipe-to-Hose Nipple (Right Only)
9 5/8-inch Female Hose Coupling
10 5/8-inch Input Hose (2 Feet Long, Right Only)
11 1/2-inch Close Nipple
12 1/2-inch Cross with Weld-on 1/2-inch Cap
13 1/2-inch by 12-inch Nipple
14 1/2-inch Cap
15 5/8-inch Female Hose Coupling
16 5/8-inch Cross Hose (12 Feet Long)
17 5/8-inch Hose Quick Connect
18 1/2-inch Pipe-to-Hose Nipple
19 1/2-inch by 30-inch Pipe (Straight)
20 1/4-inch Water Pressure Gauge (Right Only)

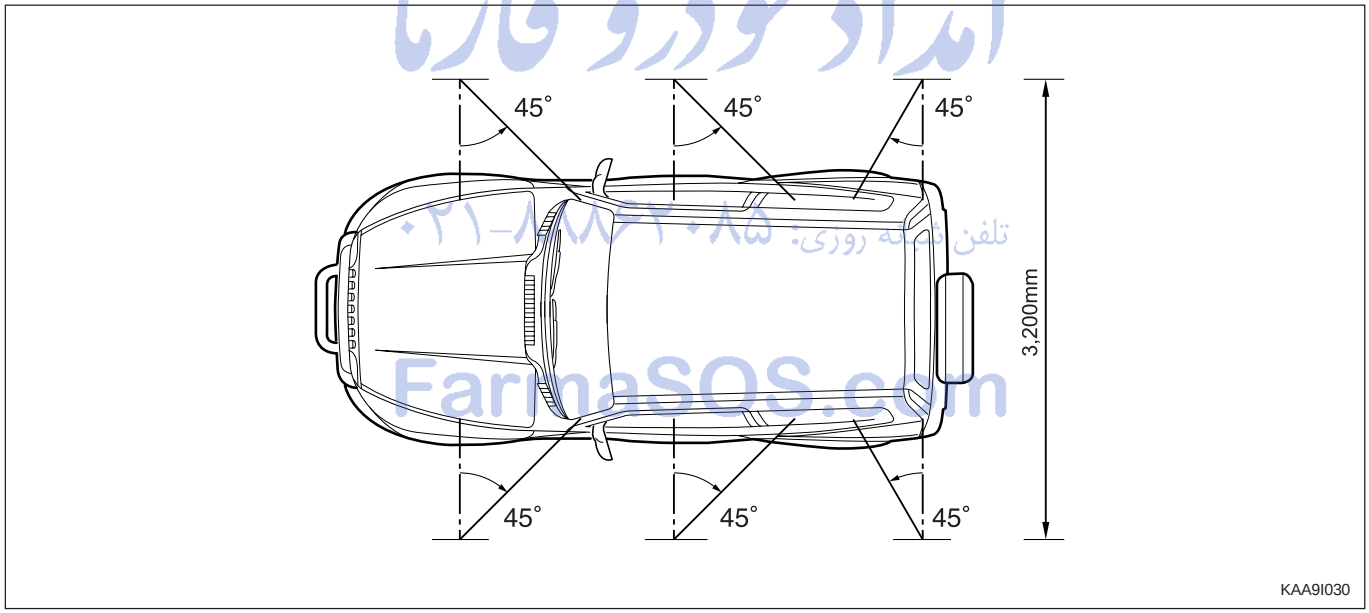
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2. Set up the watertest stand leak test.



3. Perform the watertest stand leak test. Refer to “Watertest Stand Specifications” in this section.
4. If the local water pressure does not allow the required water pressure of 155 kPa (22.5 psi), move both stands closer to the vehicle so that the water sprayoverlaps.

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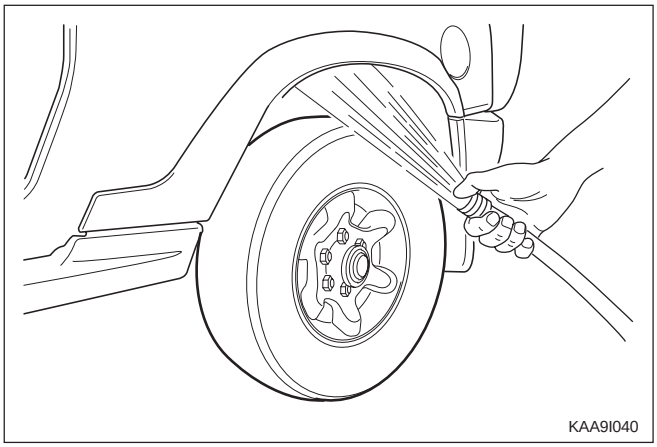


Localized Testing (Spot Test)

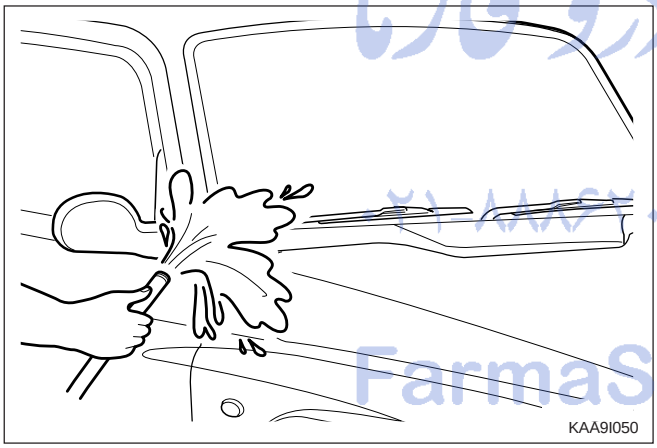
1. Do localized testing with a water hose or an air hose.
2. Begin testing by spraying the air or the water at the base of the suspected leak area. Continue spraying the air or the water upward until the leak is found.

Water Hose Test

1. Place another person inside the vehicle in order to detect the location of the leak.
2. Use a water hose without a nozzle.

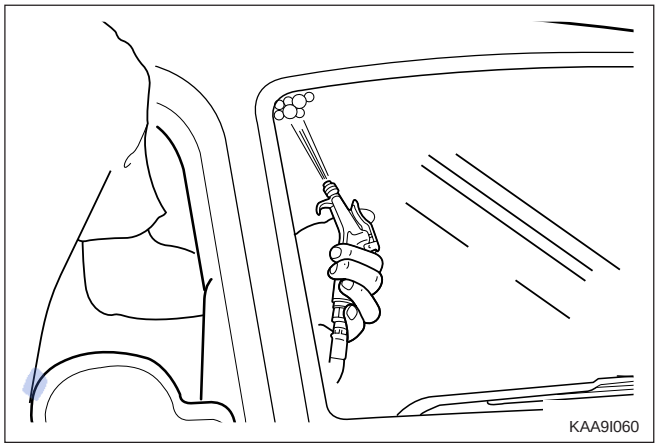


3. Begin spraying the water at the base of the suspected leak area. Continue spraying the water upward until the leak is found.



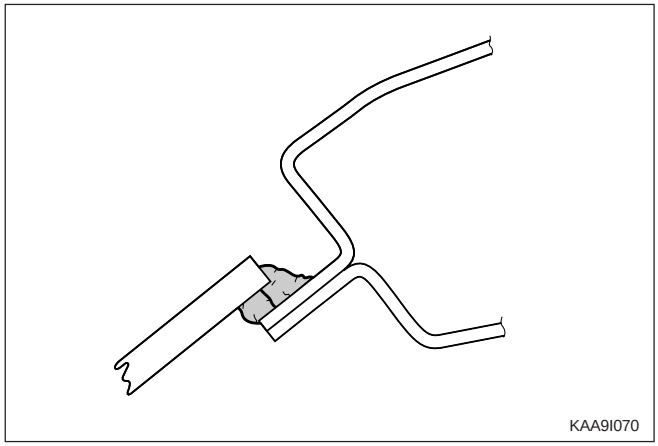
Air Hose Test

1. Apply soapy water to the outside of the vehicle in the suspected leak area.
2. Blow air from inside the vehicle. The air pressure should not exceed 205 kPa (29.7 psi).
3. Determine the location of the leaks from the bubbles formed in the soapy water.



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MAINTENANCE AND REPAIR


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ON-VEHICLE SERVICE

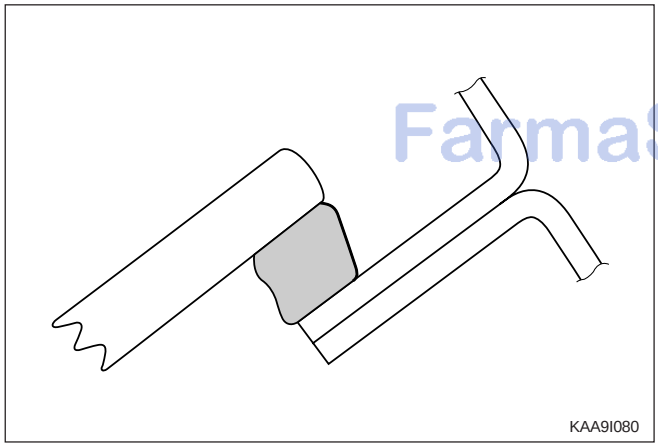
WATERLEAK REPAIR

Some waterleaks around the glass can be repaired without removing the glass.

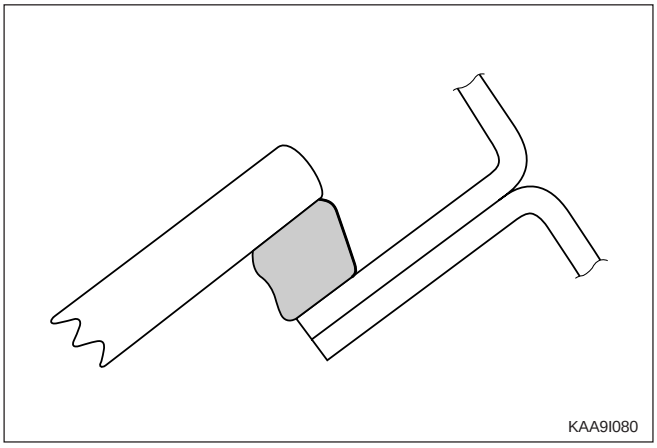
Important: This type of repair may be used only for urethane-installed glass.

1. Remove the reveal molding in the area of the leak. It may be necessary to remove the garnish molding or the trim strip lace in order to locate the leak.
2. While spraying water over the leak area, carefully push the glass outward in order to determine the size of the leak.
3. Mark the location of the leak.
4. Use water to clean any dirt from the area. Dry the area with an air hose.
5. Using a sharp knife, trim off the uneven edges of the adhesive caulking material around the leak for a distance of 75 to 100 mm (3 to 4 inches) on both sides of the leak.

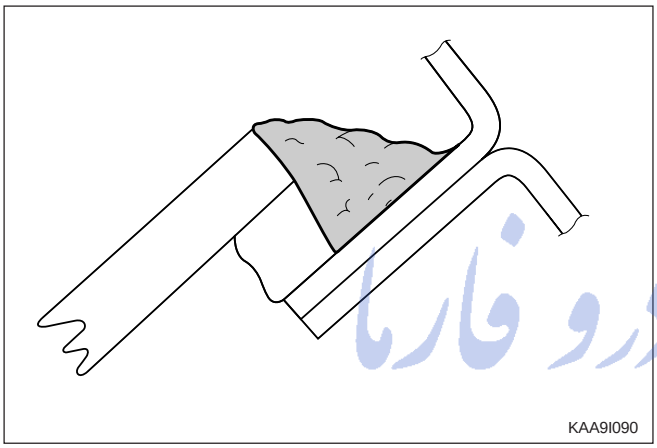
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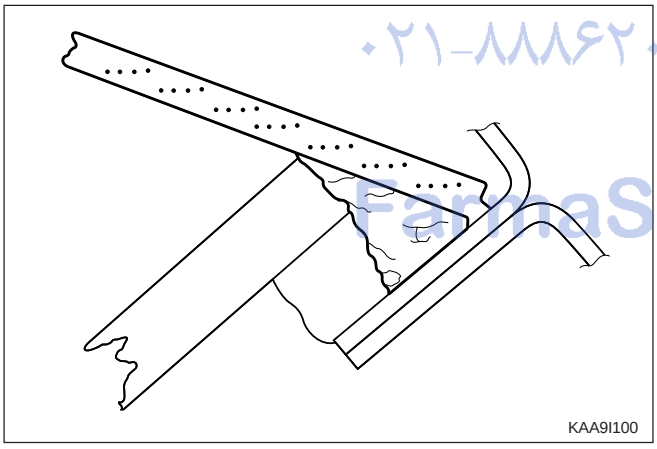
6. Using a sharp knife, trim off the uneven edges of the adhesive material around the leak 75 to 100 mm (3 to 4 inches) on both sides of the leak.


KAA9I080

7. Prime the trimmed area with the primer.


KAA9I090

8. Allow the primer to dry for 5 minutes.
9. Apply the adhesive over the leak and for a distance of 75 to 100 mm (3 to 4 inches) on both sides of the leak.


KAA9I100

10. Immediately after applying the adhesive, use a flat stick or a similar tool to work the adhesive into the leak area and into the joint between the original material and the vehicle body in order to ensure a watertight seal.
11. Spray warm or hot water over the repaired area in order to determine if the leak was repaired. Do not run a heavy stream of water directly on the freshly-applied adhesive.
12. Install the trim strip lace if it was removed.
13. Install the garnish molding if it was removed.
14. Install the reveal molding.

    Important: After the completion of any waterleak repair, re-test the area using the watertest stands. Do not use localized testing procedures on the newly-repaired areas, as the repair material may dislodge under abnormal pressure.

15. Installation should follow the removal procedure in the reverse order.

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۰۲۱-۸۸۸۶۲۰۸۵
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SECTION 9J

WINDNOISE

TABLE OF CONTENTS

Diagnosis 9J-2

Windnoise Diagnosis 9J-2

Maintenance and Repair 9J-3

On-Vehicle Service 9J-3

Windnoise Repair 9J-3

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵

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DIAGNOSIS

WINDNOISE DIAGNOSIS

Caution: An assistant should drive the vehicle while the technician checks for the location of the windnoise, in order to prevent personal injury or vehicle damage.

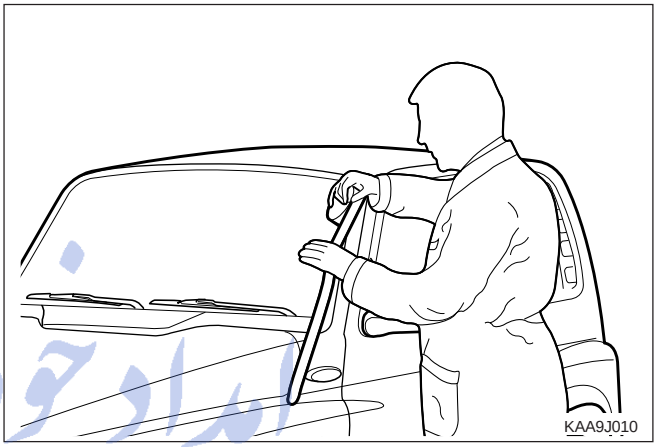
A test drive in the vehicle is necessary to accurately determine the location of the windnoise. Often there is a primary leak and secondary leaks. Failure to repair all leaks will only reduce the windnoise, not eliminate it.

During the test drive the technician should bring the following items to aid in determining the location of the windnoise.

- A mechanics stethoscope or vacuum hose
- Masking tape
- Strip caulk
- A china marking pencil
- A screwdriver

Perform the following steps in order to conduct the road test:

1. Choose a route that includes smooth straight streets that run in all four directions (north, south, east, and west).
2. Choose streets with little traffic or noise that would interfere with the test.
3. Drive the vehicle at the speeds at which the noise was noticed by the customer or until the noise is produced. Do not exceed legal speed limits.
4. The windnoise is external if any of the following conditions occur:
   - The windnoise is caused by the wind.
   - The windnoise can be heard with the door glass lowered and while the vehicle is being driven.
   - The windnoise is eliminated when tape is placed over various moldings and gaps.
5. Internal windnoise is air leaving the vehicle and should be repaired in the following manner.
   - In order to locate the leak, tape off the body lock pillar pressure relief valves. This will cause air pressure to build up inside the vehicle and enhance the windnoise.
   - Use a stethoscope or a vacuum hose to locate the leak.
   - Temporarily repair the leak with masking tape.



   - Continue testing in order to determine if the noise has been eliminated or if other leaks exist.
   - When all leaks have been found, return to the shop and make permanent repairs with the proper alignment techniques and sealing materials.

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۰۲۱-۸۸۸۶۲۰۸۵
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MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

WINDNOISE REPAIR

Windnoise leak repairs are very similar to waterleak repairs. Refer to *Section 9I, Waterleaks*. The actual procedure depends on the type of seal being repaired.

Leaks around the door opening weatherstrips do not al-ways indicate a faulty weatherstrip. A door or window adjustment may resolve the condition. Refer to *Section 9P, Doors or Section 9L, Glass and Mirrors*.

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SECTION 9K

SQUEAKS AND RATTLES

TABLE OF CONTENTS

Diagnosis 9K-2

Squeak and Rattle Diagnosis 9K-2

Maintenance and Repair 9K-4

On-Vehicle Service 9K-4

Squeak and Rattle Repair 9K-4

امداد خودرو فارما

تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵

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DIAGNOSIS

SQUEAK AND RATTLE DIAGNOSIS

Rattle Coming From the Side Rail

Checks	Action
Check the brake lines.	• Tap lightly on the brake lines and listen for a rattle. • Install plastic tie straps to secure the brake lines tightly together.

Rattle Under Vehicle at Higher RPM

Checks	Action
Check for heat shield contact with the underbody.	• Raise the vehicle and perform a visual inspection. • Bend the heat shield slightly to gain clearance from the underbody.

Squeak From the Front of the Vehicle in Cold Weather

Checks	Action
Check the front stabilizer shaft insulators.	• While the vehicle is cold, perform a test drive and achieve full front suspension travel by driving through a dip in the road. • Remove the insulators and wrap teflon tape around the stabilizer shaft. Reinstall the insulators over the tape.

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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Thump From Rear of Vehicle on Bumps

Checks	Action
Check for a properly secured spare tire in the rear compartment.	• Open the rear compartment and perform a visual inspection of the spare tire and the tools. • Tightly secure the spare tire and all tools. • Perform a road test to verify that the noise is elimi nated.

Glass Knock Coming From the Rear of the Vehicle When Driving Over Bumps

Checks	Action
Check for an out-of-adjustment hatchback latch.	• Test drive the vehicle in order to verify this condi-tion. • Loosen the latch nuts and adjust the latch down-ward.

Rattle Coming From Door

Checks	Action
Check the door lock solenoid.	• Remove the door trim panel and check if the solenoid is loose. • Tighten the solenoid bolts.
Check for rattling electrical connectors inside the door trim panel.	• Tap on the trim panel and listen for a rattle. • Remove the trim panel and wrap foam padding around the connectors as required.

Squeak When Operating Doors

Checks	Action
Check for a lack of lubrication of the door hinge pins.	• Operate the doors and listen for squeaks. • Lubricate the door hinge pins with light oil and coat with lithium grease.

Squeak Coming From Console When Shifting Manual Transaxle (Condition Occurs In Cold Weather with a Cold Engine)

Checks	Action
Check the manual transaxle control lever lower boot.	• Move the control lever between gears and listen for squeaks. • Remove the floor console and replace the lower shift boot or apply talcum powder to the lower shift boot.

Buzz From the Left Side of Instrument Panel

Checks	Action
Check for vibration of the fuse box cover against the instrument panel side trim.	• Tap on thecoverwith a fingerandlisten fora buzz. • Apply 6.35 mm (0.250 inch) by 25.4 mm (1.00 inch) felt pads to the side trim where the cover makes contact.

Squeak Coming From Instrument Cluster Trim Plate

Checks	Action
Check for rubbing of the cluster trim plate on the instrument panel.	• Test drive the vehicle in order to verify this condition. • Remove the instrument cluster trim plate and install felt tape to the edges.

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MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

SQUEAK AND RATTLE REPAIR

Squeaks and rattles are caused by the unwanted movement between parts of a vehicle. There are three means to prevent squeaks or rattles.

- Attach the parts securely so that there is no relative motion during the operation of the vehicle.
- Separate the parts so that there is no contact during operation.
- Insulate the parts so that no squeaks or rattles occur with the movement of the parts. Low uniform friction surfaces can be used to eliminate “stick-slip” motion.

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SECTION 9L

GLASS AND MIRRORS ON

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

Description and Operation 9L-2

Stationary Glass 9L-2

Inside Rearview Mirror 9L-2

Outside Rearview Mirrors 9L-2

Components Locator 9L-3

Glass and Mirror 9L-3

Repair Instructions 9L-4

On-Vehicle Service Unit Repair 9L-4

Windshield 9L-4

Rear Window Glass 9L-6

Rear Window Defogger Braided Lead Wire Repair 9L-7

Rear Window Defogger Grid Line Repair 9L-8

Front Door Glass 9L-9

Fixed Glass 9L-9

Inside Rearview Mirror 9L-10

Outside Rearview Mirror 9L-10

Specifications 9L-11

Fastener Tightening Specifications 9L-11

Schematic and Routing Diagram 9L-12

Defroster 9L-12

Inside Rear View Mirror (Dimming) & Backup Lamp 9L-13

امداد خودرو فارما

تلفن: ۰۲۱-۸۸۶۲۰۸۵

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DESCRIPTION AND OPERATION

STATIONARY GLASS

Stationary glass consists of all the glass on the vehicle which is immovable within its frame, such as the wind shield glass, the back glass, the quarter window, and the inside rearview mirror.

INSIDE REARVIEW MIRROR

The inside rearview mirror can be manually adjusted up/down, and left/right.

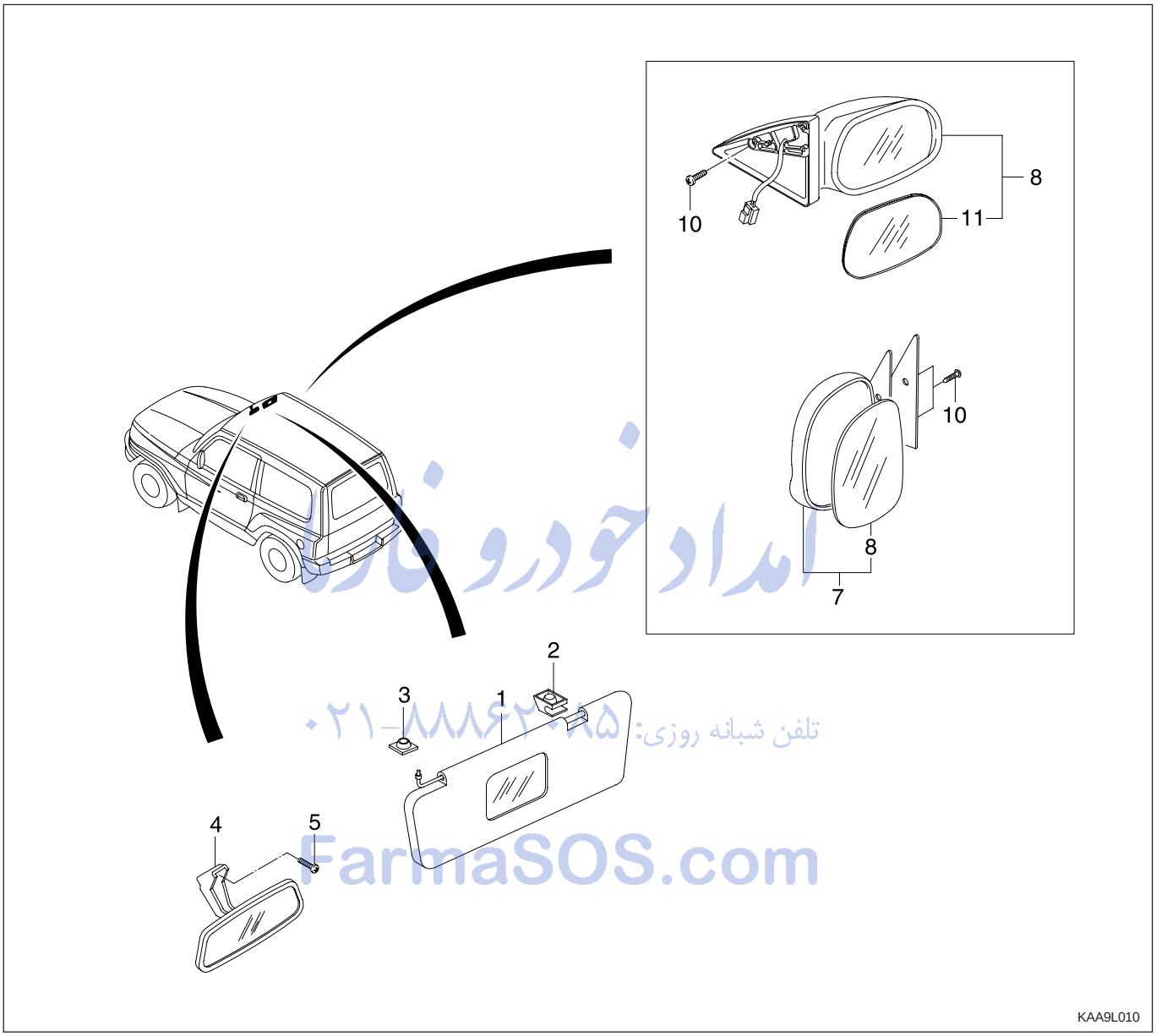
OUTSIDE REARVIEW MIRRORS

The outside rearview mirrors are equipped with a remote control mirror. The electric control outside rearviewmirror can be adjusted by an electric control switch on the instrument panel

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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COMPONENTS LOCATOR

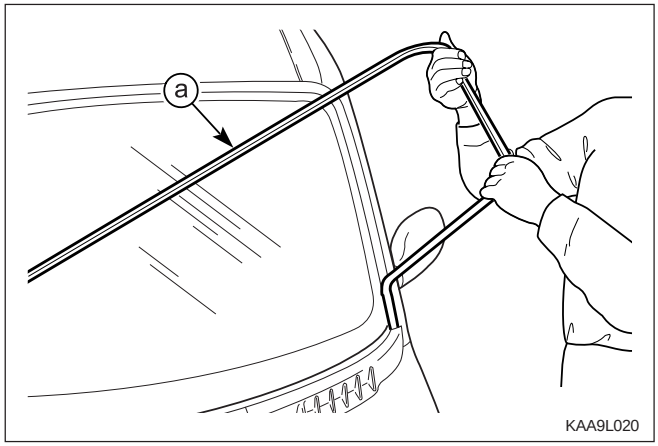
GLASS AND MIRROR



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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۳۰۸۵
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1 SunVisorA
2 Adapter-S/Visor CTR
3 Grommet-Screw
4 Mirror A-I/S RR View
5 Screw-Oval
6 Cover-I/Side Mirror
7 Mirror A-O/Side
8 Mirror A-O/Side
9 Glass Holder A-O/S
10 Screw-Hex SEMS
11 Glass Holder A-O/S

REPAIR INSTRUCTIONS



ON-VEHICLE SERVICE UNIT REPAIR

WINDSHIELD

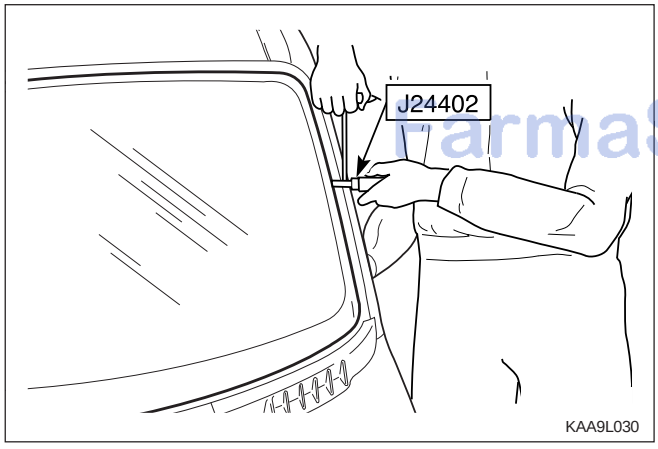
Tools Required

J-24402 Glass Sealant Remover

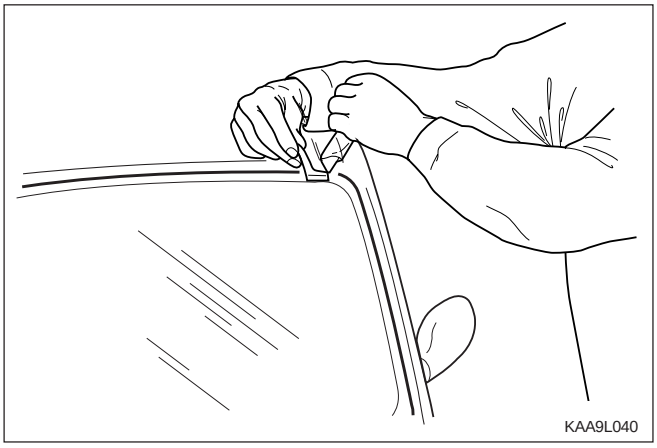
Removal Procedure

1. Remove the cowl vent grille. Refer to *Section 9R, Body Front End*.
2. Remove the inside rearview mirror. Refer to “Rear view Mirror” in this section.
3. Remove the weatherstrip around the windshield.

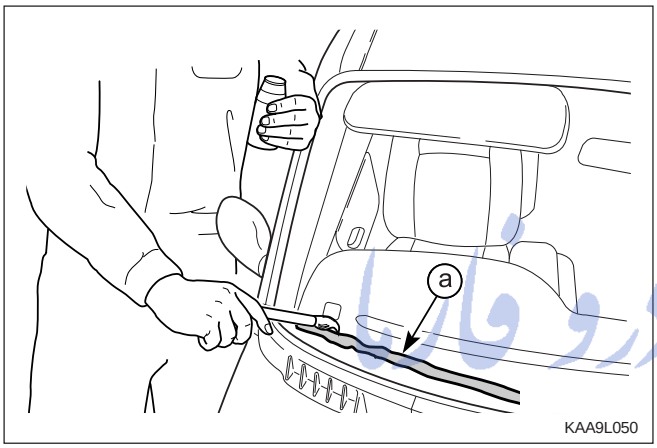
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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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4. Using the glass sealant remover J-24402, cut the adhesive around the windshield.



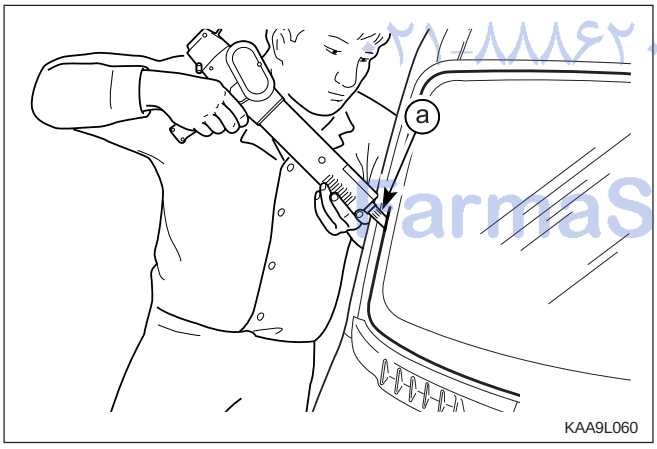
5. Remove the windshield from the vehicle.
6. Using a knife, remove the adhesive from the wind shield.
7. Using a knife, remove the adhesive from the wind shield frame.



Installation Procedure

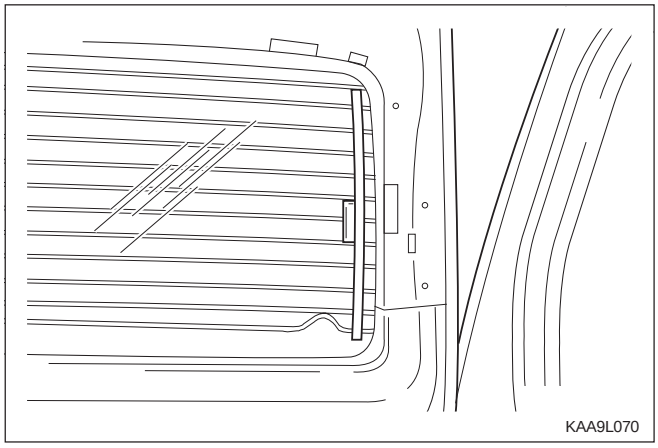
1. Install the new weatherstrip to the windshield.
2. Apply tape to the new weatherstrip and the wind shield to hold the weatherstrip in place.
3. Apply adhesive primer to the windshield frame and the perimeter of the windshield.

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4. Apply glass adhesive to the windshield frame.
5. Install the windshield into the windshield frame.
6. Reposition the tape over the weatherstrip, the wind-shield, and the windshield frame to hold the wind-shield in place.
7. Let the adhesive dry for 24 hours.
8. Remove the tape.
9. Check for waterleaks by pouring water on the wind shield. If a leak is found, dry the windshield and fill the area that leaks with adhesive. If the leak persists, remove the windshield and repeat the entire procedure.
10. Install the inside rearview mirror. Refer to “Rearview Mirror” in this section.
11. Install the cowl vent grille. Refer to Section 9R, Body Front End.


KAA9L070

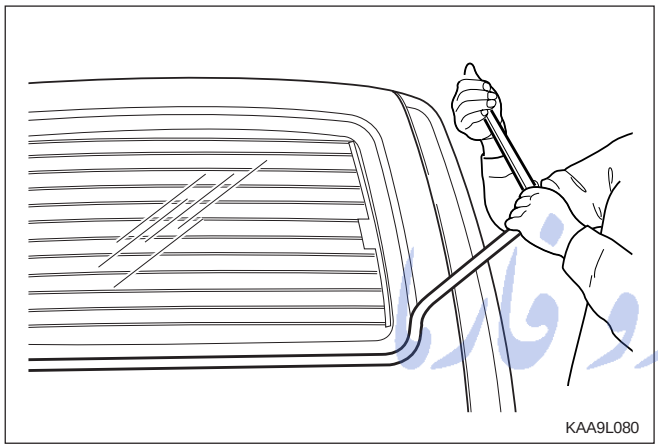
REAR WINDOW GLASS

Tools Required

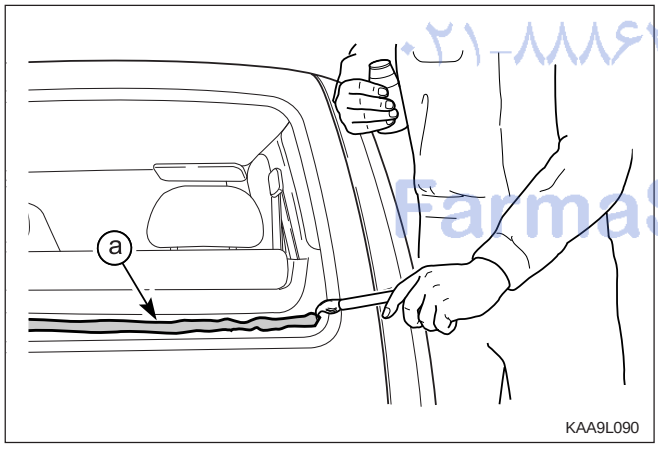
J-24402 Glass Sealant Remover

Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Disconnect the rear window defogger electrical connector.

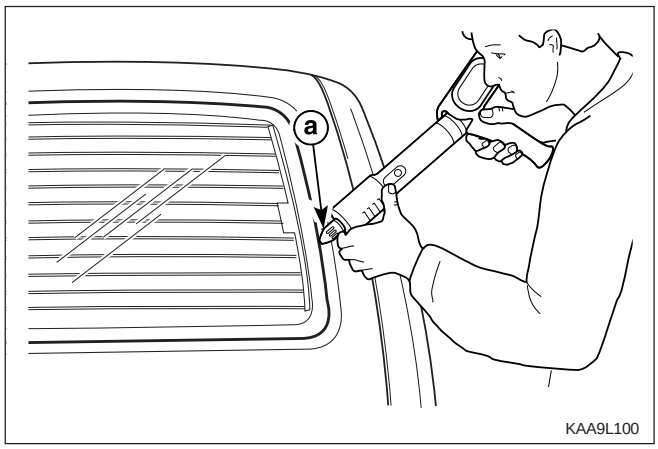

KAA9L080

3. Remove the weatherstrip around the rear window.



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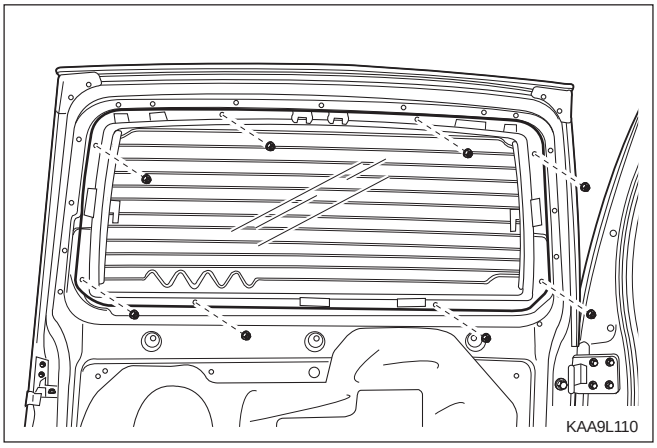
4. Remove the tailgate trim panel.
5. Remove the screws that secure the glass to the tailgate panel.
6. Remove the glass from the tailgate panel.



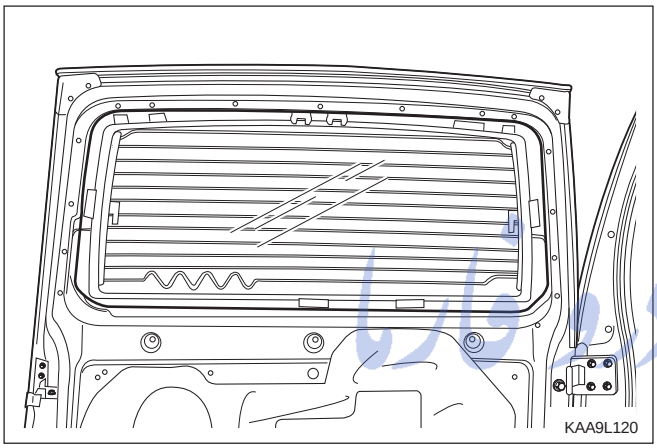
KAA9L100

7. Apply adhesive primer to the rear window frame and the perimeter of the rear window.

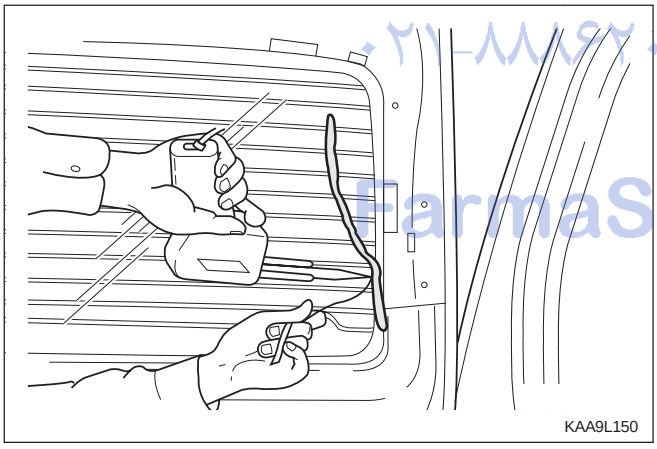
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8. Apply glass adhesive to the rear window frame.
9. Install the rear window into the rear window frame using the glass plastic nut.
10. Reposition the tape over the weatherstrip, the rear window, and the rear window frame to hold the rear window in place.


KAA9L120

11. Let the adhesive dry for 24 hours.
12. Remove the tape.
13. Check for waterleaks by pouring water on the rear window. If a leak is found, dry the window and fill the area that leaks with adhesive. If the leak persists, remove the rear window and repeat the entire procedure.
14. Connect the rear window defogger electrical connector.
15. Connect the negative battery cable.
16. Installation should follow the removal procedure in the reverse order.

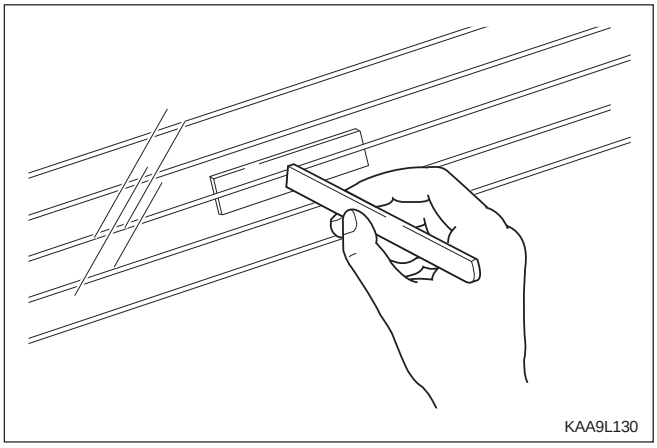

KAA9L150

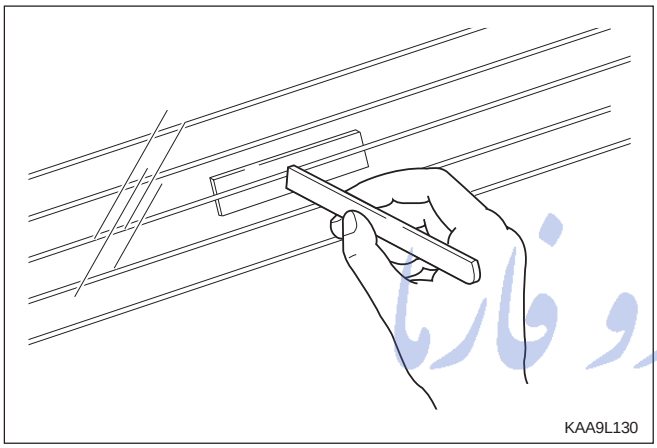
REAR WINDOW DEFOGGER BRAIDED LEAD WIRE REPAIR

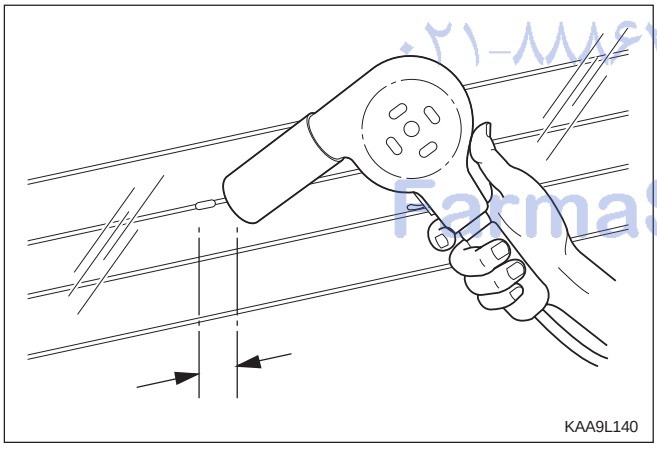
The rear window defogger bus lead wire or the terminal can be reattached by resoldering. Use a solder containing 3 percent silver and a rosin flux paste.

1. The repair area should be buffed with fine steel wool before soldering the bus lead wire.
2. Apply the paste-type rosin flux in small quantities to the wire lead and the bus lead wire repair area using a brush.
3. Coat the soldering iron tip with solder. Use only enough solder to ensure a complete repair.
4. Use only enough heat to melt the solder. Do not overheat the wire when resoldering to the bus lead wire.
5. Installation should follow the removal procedure in the reverse order.

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REAR WINDOW DEFOGGER GRID LINE REPAIR

1. Disconnect the negative battery cable.
2. Disconnect the rear window defogger electrical connector.
3. Inspect the rear window defogger grid lines.
4. Mark the grid line break on the outside of the glass with a wax pencil or a crayon.
5. Buff the grid lines that are to be repaired with steel wool. Wipe the lines clean using a cloth dampened with alcohol. Buff and clean about 6 mm (0.25 inch) beyond each side of the break in the grid line.
6. Attach a grid line repair decal or two strips of tape above and below the repair areas.
   - A repair decal or tape must be used in order to control the width of the repair areas.
   - If a decal is used, the die-cut metered slot must be the same width as the grid line.
7. Apply the grid repair material to the repair area using a small wooden stick or a spatula. The grid repair material should be at room temperature.
8. Carefully remove the decal or the tape.

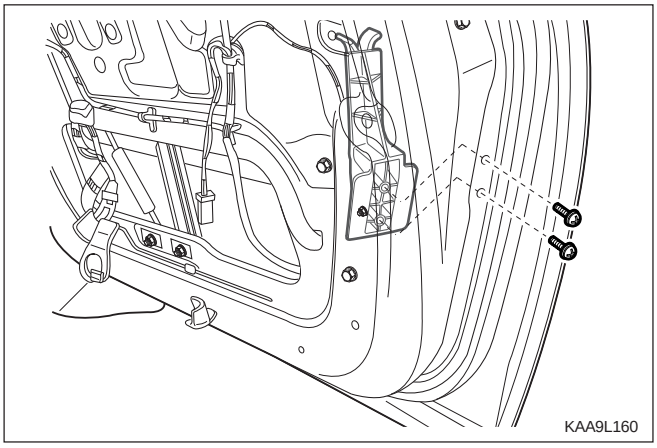
Notice: The grid line repair material must be cured with heat. In order to avoid heat damage to the interior trim, protect the trim near the repair area where heat will be applied.

9. Heat the repair area for 1 to 2 minutes.
10. Hold the heat gun nozzle 25 mm (1 inch) from the surface. A minimum temperature of 149°C (300°F) is required.
11. Inspect the grid line repair area. If the repair appears discolored, apply a coating of tincture of iodine to the area using a pipe cleaner or a line brush. Allow the iodine to dry for about 30 seconds. Carefully wipe off the excess iodine with a lint-free cloth.
12. Test the operation of the rear window defogger in order to verify that the repair was successful.

    Important: At least 24 hours is required for complete curing of the repair materials. The repair area should not be physically disturbed until after that time.

13. Installation should follow the removal procedure in the reverse order.

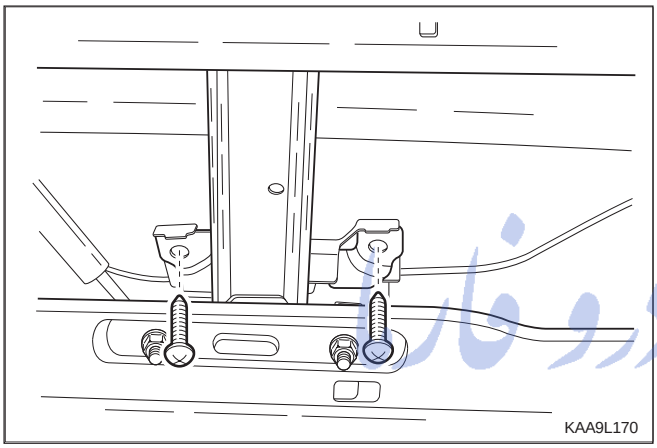
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KAA9L160

FRONT DOOR GLASS

Removal Procedure

1. Remove the door seal trim. Refer to Section 9P, Doors.
2. Remove the screws that secure the glass to the window regulator.
3. Remove the glass from the door.
4. Removal procedure should follow the installation procedure in the reverse order.


KAA9L170

Installation Procedure

1. Install the glass in the door and position the glass within the window regulator.

   Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

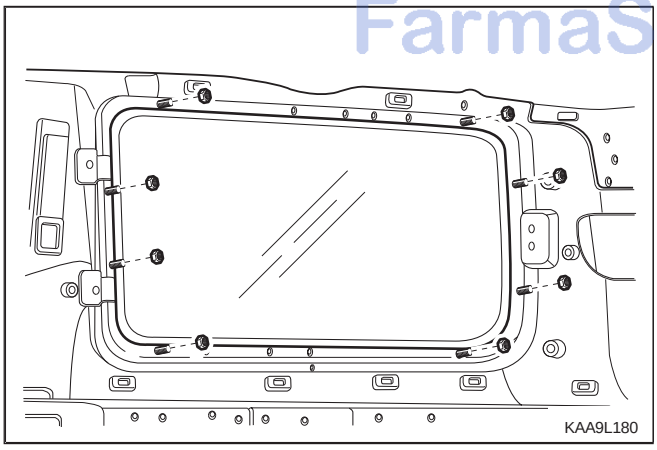
2. Install the glass to the window regulator with the screws.

   Installation Notice

Tightening Torque	1.96 - 2.94 N•m (17.50 - 26.25 lb-in)

3. Install the door seal trim. Refer to Section 9P, Doors.
4. Removal procedure should follow the installation procedure in the reverse order.

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FIXED GLASS

Removal and Installation Procedure

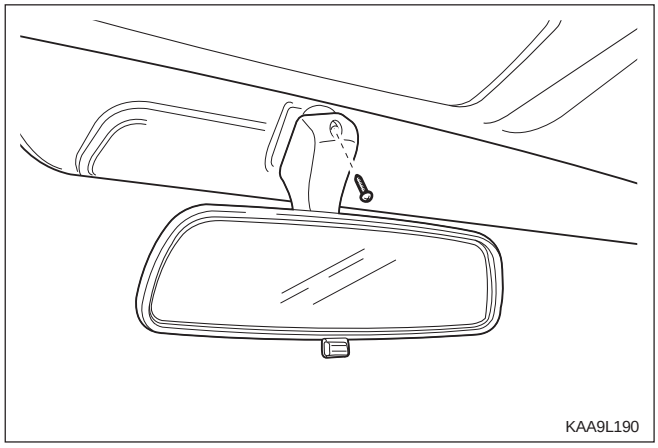
1. Remove the exterior B-pillar molding. Refer to *Section 9M, Exterior Trim*.
2. Remove the screws that secure the glass to the window regulator.
3. Remove the glass from the door.

   Installation Notice

Tightening Torque	7 N•m (62 lb-in)

   - Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

4. Installation should follow the removal procedure in the reverse order.


KAA9L190

INSIDE REARVIEW MIRROR

Removal and Installation Procedure

1. Remove the screw with the inside rearview mirror.

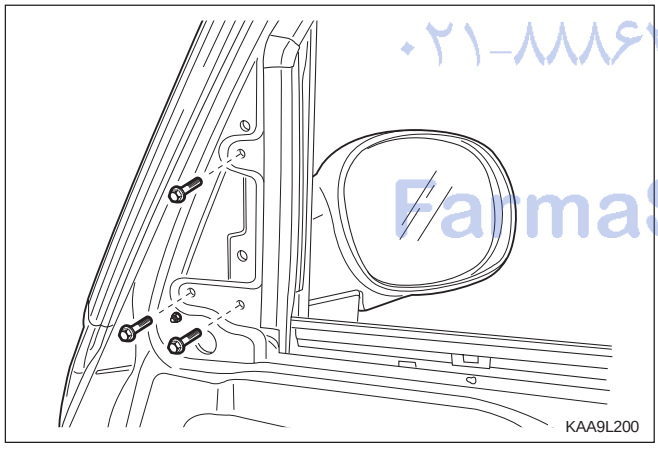
Installation Notice

Tightening Torque	1.4 - 1.7 N•m (9 lb-in)

- Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

2. Installation should follow the removal procedure in the reverse order.

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OUTSIDE REARVIEW MIRROR

Removal and Installation Procedure

1. Remove the tweeter inner cover.
2. Remove the screws with the outside rearview mirror.

Installation Notice

Tightening Torque	3 - 5 N•m (27 - 44 lb-in)

- Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

3. Installation should follow the removal procedure in the reverse order.

SPECIFICATIONS

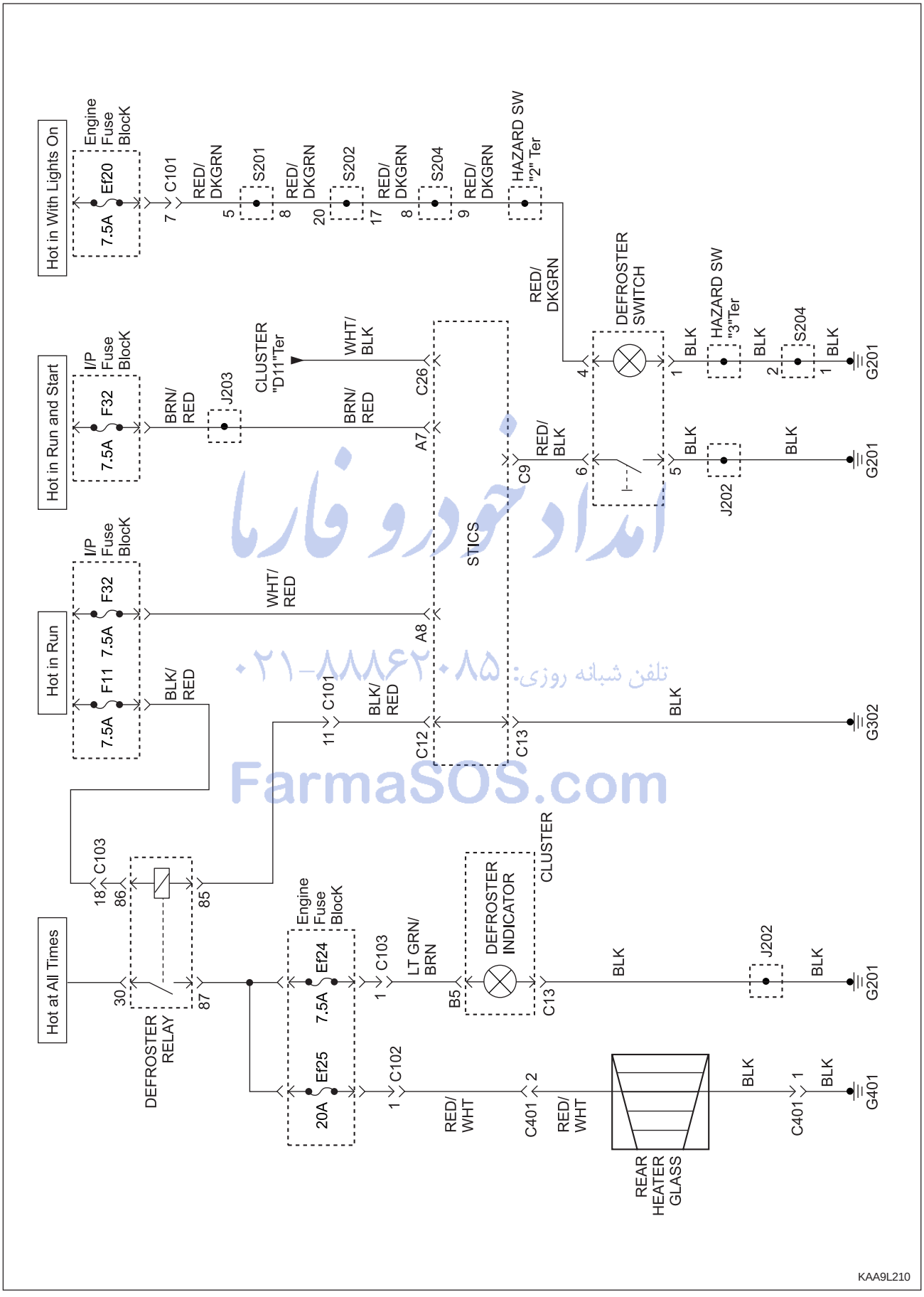
FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Fixed Glass Door Glass	7	-	62
Front Door	1.96 - 2.94	1.46 - 2.19	17.50 - 26.25
Outside Mirror	3 - 5	-	27 - 44
Room Mirror	1.4 - 1.7	-	9

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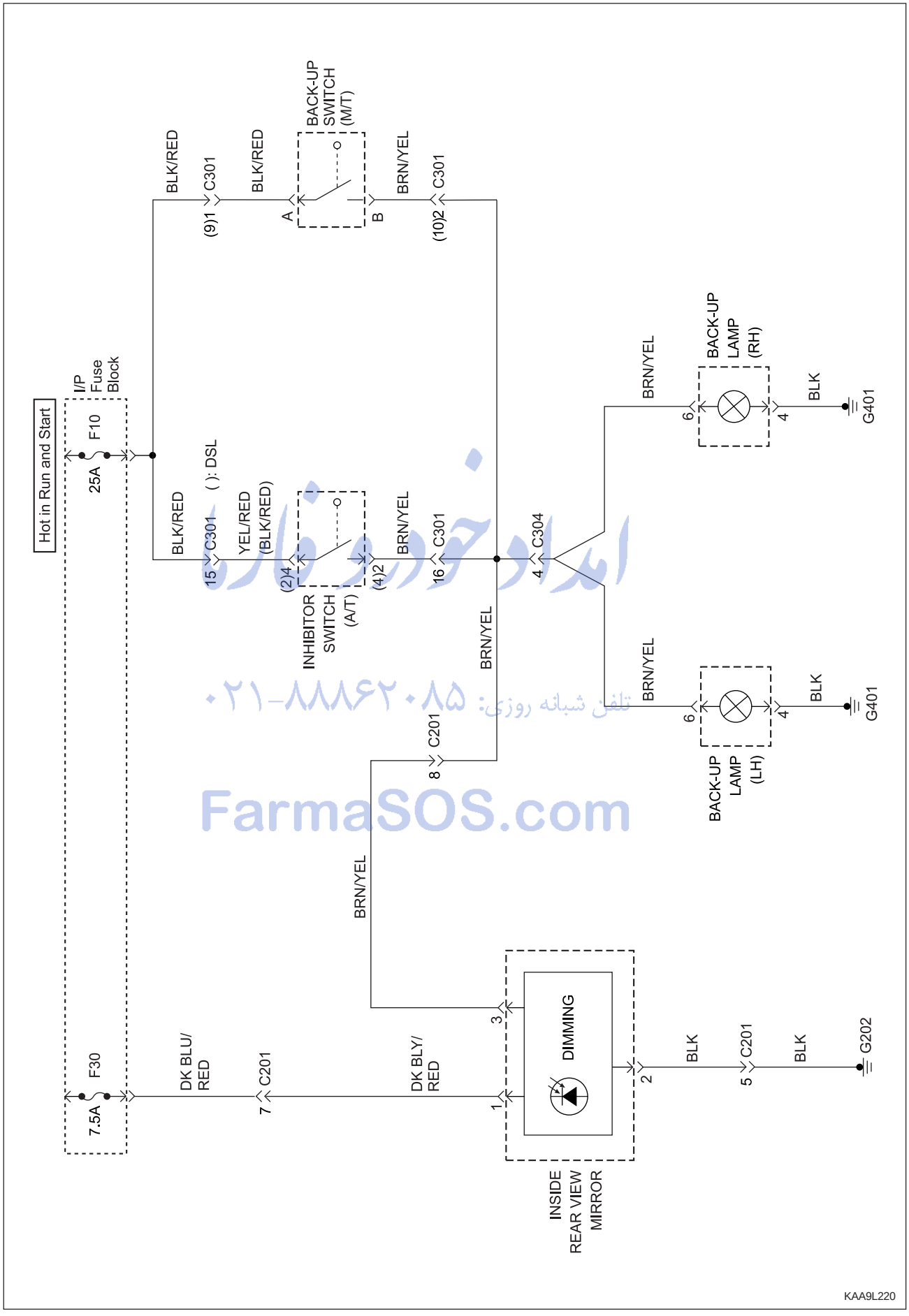
SCHEMATIC AND ROUTING DIAGRAMS

DEFROSTER



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INSIDE REAR VIEW MIRROR (DIMMING) & BACKUP LAMP



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SECTION 9M

EXTERIOR TRIM

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

Description and Operation 9M-2

Emblems and Lettering 9M-2

Mud Guards 9M-2

Components Locator 9M-3

Exterior Trim 9M-3

Repair Instructions 9M-4

On-Vehicle Service Unit Repair 9M-4

B-Pillar Molding 9M-4

B-Pillar Cover 9M-4

Air Extractor Grille 9M-4

Door Molding 9M-5

Front Wheel Molding 9M-5

Rear Wheel Molding 9M-5

Side Step 9M-6

C-Pillar Cover 9M-6

Roof Molding 9M-6

Specifications 9M-7

Fastener Tightening Specifications 9M-7

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵

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DESCRIPTION AND OPERATION

EMBLEMS AND LETTERING

The emblems and lettering on the vehicle are attached by adhesive. The company emblem appears on the hood. The lettering, which appears in several places on the body of the vehicle, Features the model, the grade, and the company name.

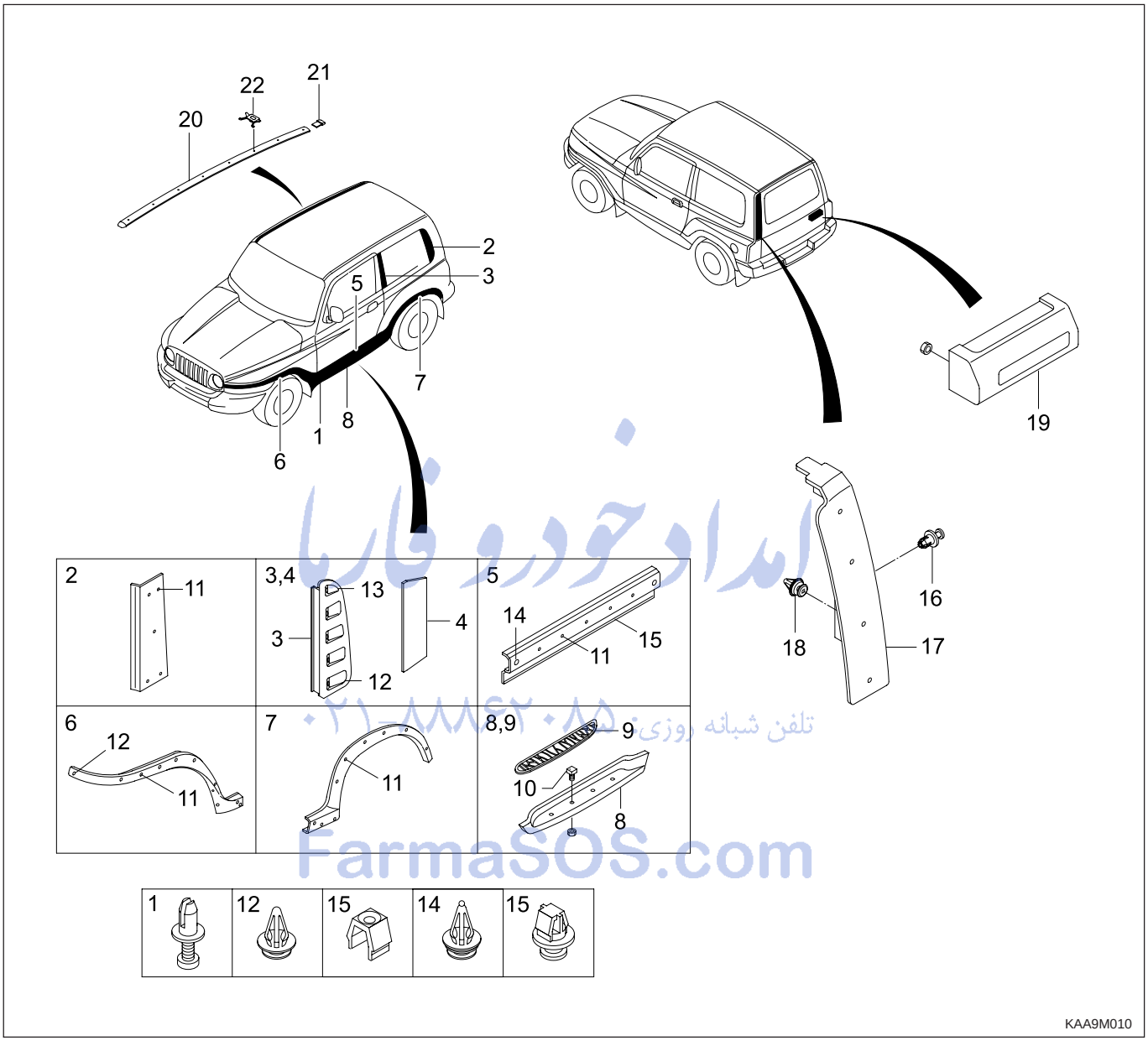
MUD GUARDS

Front and rear mud guards are optional equipment on all models. Mud guards will help prevent an excessive build up of mud on the body.

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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COMPONENTS LOCATOR

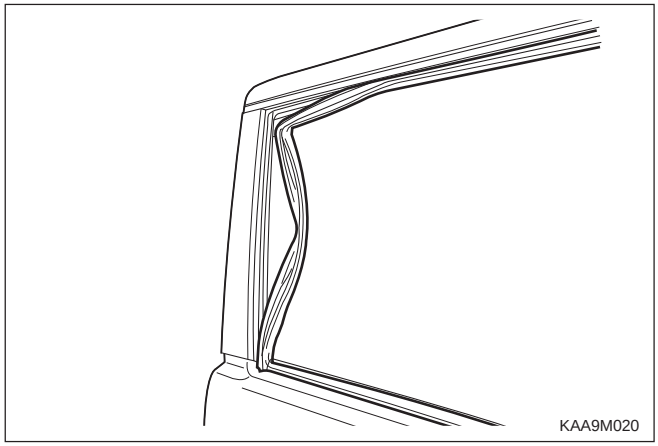
EXTERIOR TRIM



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1 Rivet
2 B Pillar Cover
3 Air Extractor Grill
4 Air Extractor Grill Tape
5 Door Molding
6 Front Wheel Arch Molding
7 Rear Wheel Arch Molding
8 Side Step
9 Side Step Upper Cover
10 Bolt
11 Wheel Arch Clip
12 Garnish Clip
13 Garnish Clip
14 Door Molding Clip
15 Door Molding Clip
16 Clip
17 “C” Pillar Cover
18 Clip
19 Tailgate Garnish
20 Roof Molding
21 Roof Molding Endcap
22 Clip

REPAIR INSTRUCTIONS

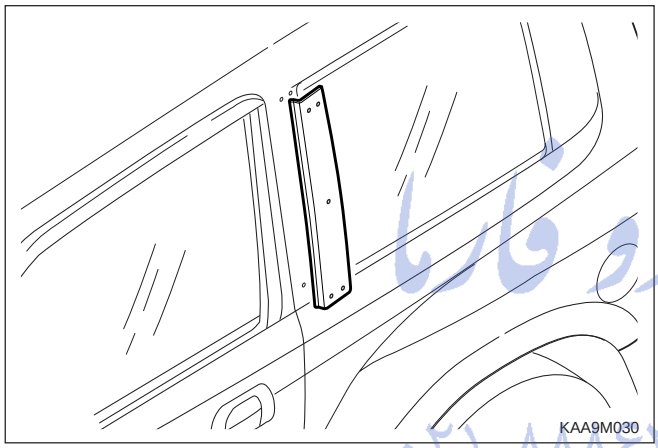


ON-VEHICLE SERVICE UNIT REPAIR

B-PILLAR MOLDING

Removal and Installation Procedure

1. Remove the door guide rail from the door. Refer to *Section 9P, Doors*.
2. Remove the screws from the door.
3. Remove the B-pillar molding.
4. Installation should follow the removal procedure in the reverse order.

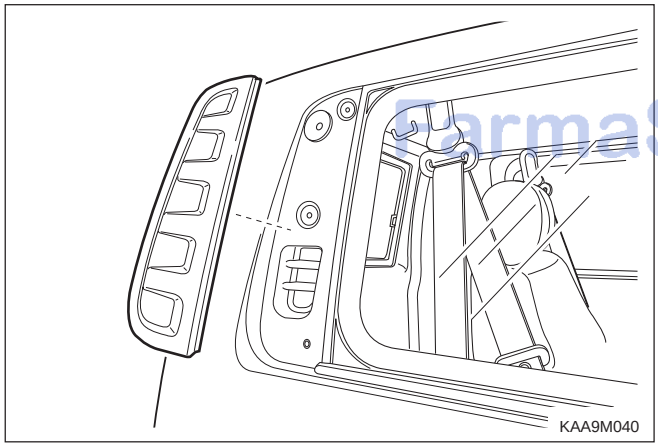


B-PILLAR COVER

Removal and Installation Procedure

1. Remove the B-pillar cover.
2. Installation should follow the removal procedure in the reverse order.

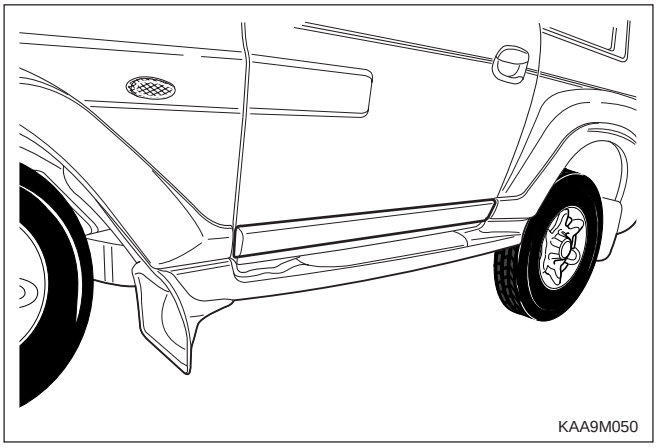
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AIR EXTRACTOR GRILLE

Removal and Installation Procedure

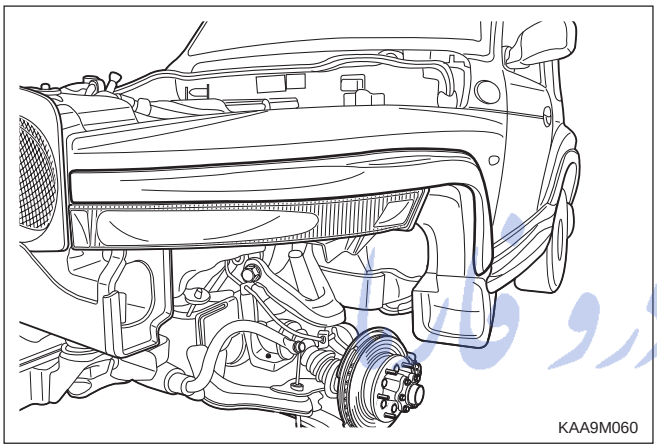
1. Remove the air extractor grille.
2. Installation should follow the removal procedure in the reverse order.



DOOR MOLDING

Removal and Installation Procedure

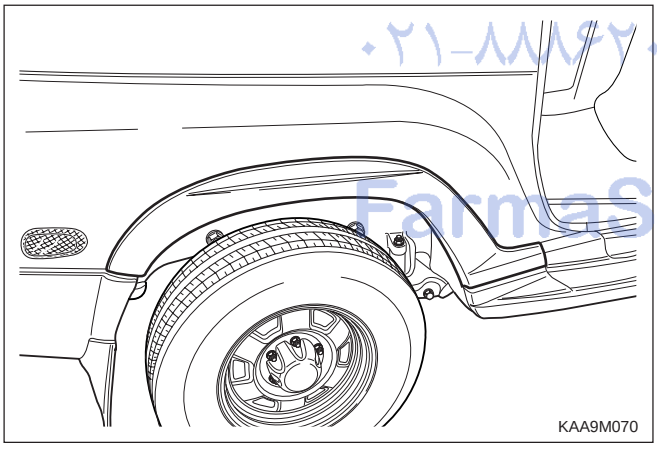
1. Remove the door protective molding.
2. Installation should follow the removal procedure in the reverse order.



FRONT WHEEL MOLDING

Removal and Installation Procedure

1. Remove the front combination lamp. Refer to *Section 9B, Lighting System*.
2. Remove the front wheel molding screws.
3. Remove the front wheel molding from the body.
4. Installation should follow the removal procedure in the reverse order.

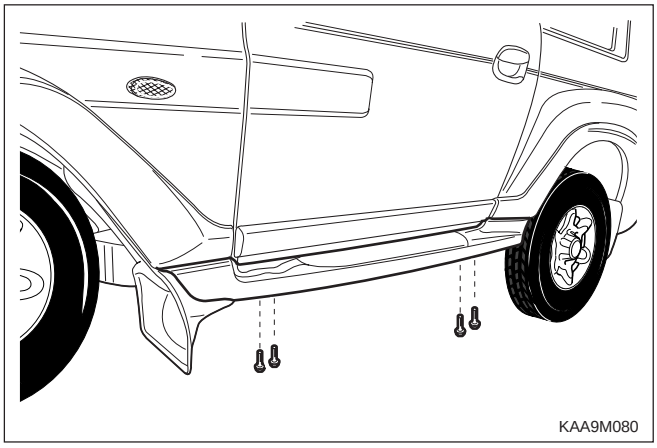


REAR WHEEL MOLDING

Removal and Installation Procedure

1. Remove the rear wheel molding screws.
2. Remove the rear wheel molding from the body.
3. Installation should follow the removal procedure in the reverse order.

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SIDE STEP

Removal and Installation Procedure

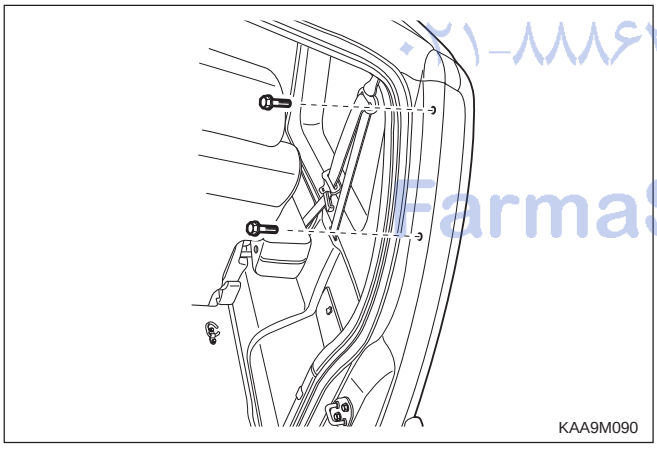
1. Remove the Mud guard. Refer to “Mud Guard” in this section.
2. Remove the side step mounting bolts.

   Installation Notice

Tightening Torque	15 N•m(11 lb-ft)

   - Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.
3. Remove the side step from the body.
4. Installation should follow the removal procedure in the reverse order.

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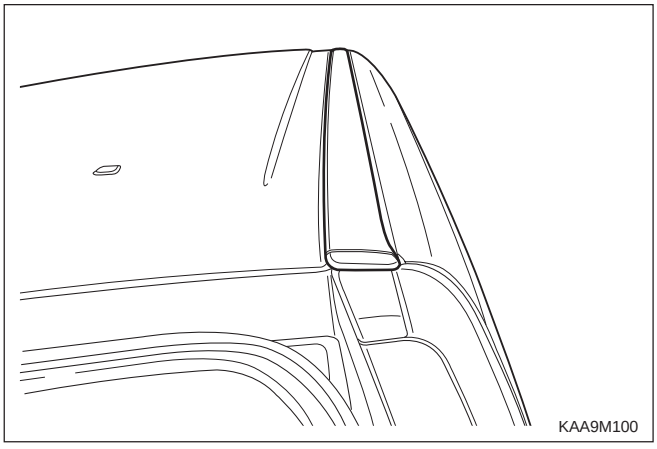

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۰۲۱-۸۸۸۶۲۰۸۵ تلفن شبانه روزی
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C-PILLAR COVER

Removal and Installation Procedure

1. Open the tailgate.
2. Remove the C- pillar cover with the screws.
3. Installation should follow the removal procedure in the reverse order.


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ROOF MOLDING

Removal and Installation Procedure

1. Remove the C-pillar cover. Refer to “C-pillar Cover” in this section.
2. Remove the roof molding.
3. Installation should follow the removal procedure in the reverse order.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Side Step Mounting Bolts	15	11	-

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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SECTION 9N

FRAME AND UNDERBODY

TABLE OF CONTENTS

Specifications 9N-2

Fastener Tightening Specifications 9N-2

Underbody Dimensions 9N-3

Maintenance and Repair 9N-7

On-Vehicle Service 9N-7

Alignment Checking 9N-7

Floor Pan Insulators 9N-7

Engine Under Covers 9N-8

General Description and System Operation 9N-9

General Body Construction 9N-9

Engine Under Covers 9N-9

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵

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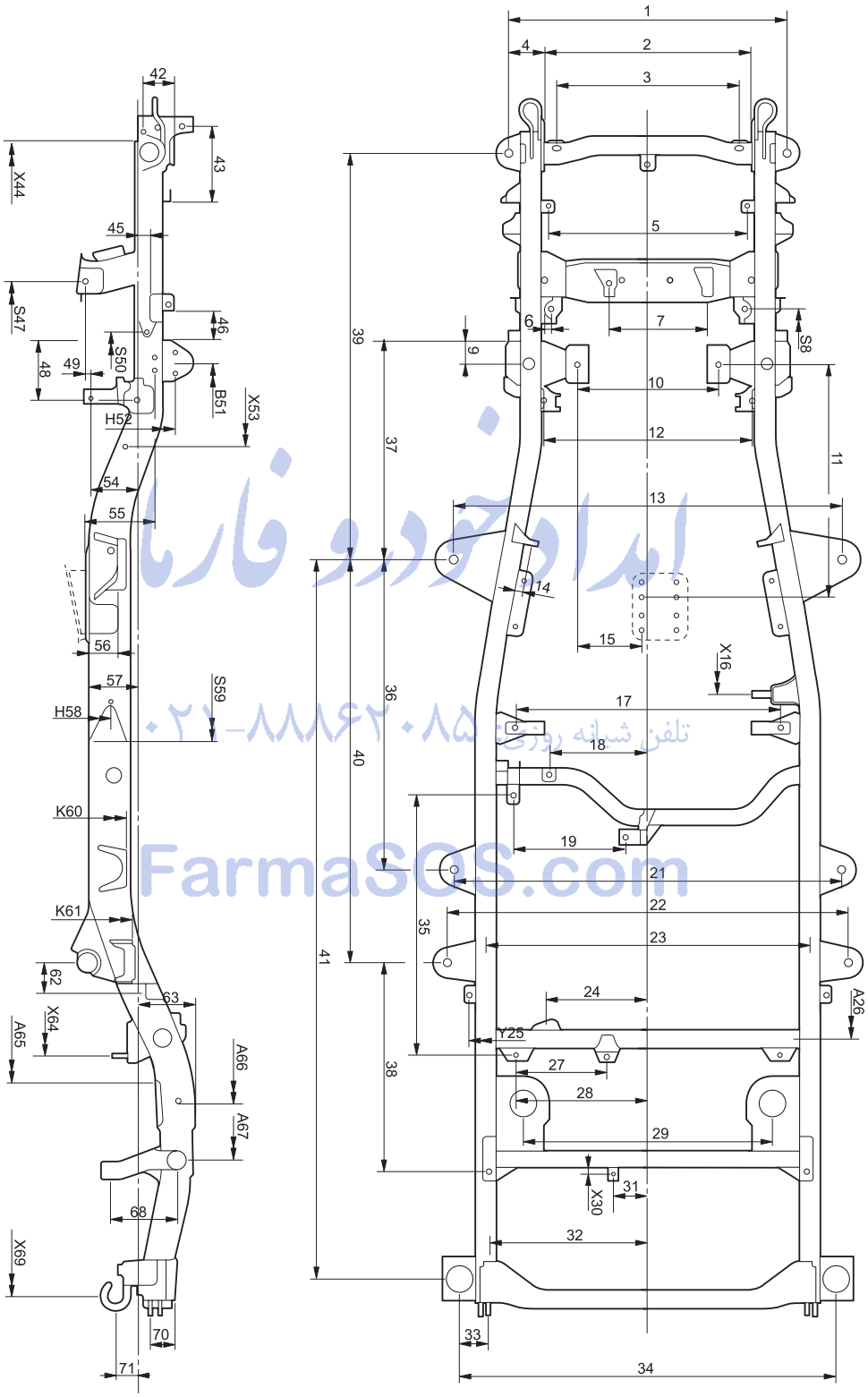
SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Center Member-to-Crossmember Bolt	90	66	-
Center Member-to-Radiator Bolt	90	66	-
Engine Under Cover Bolts	10	-	89
Forward Engine Mount Through-Bolt	80	59	-
Rear Engine Mount Through-Bolt	80	59	-

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UNDERBODY DIMENSIONS



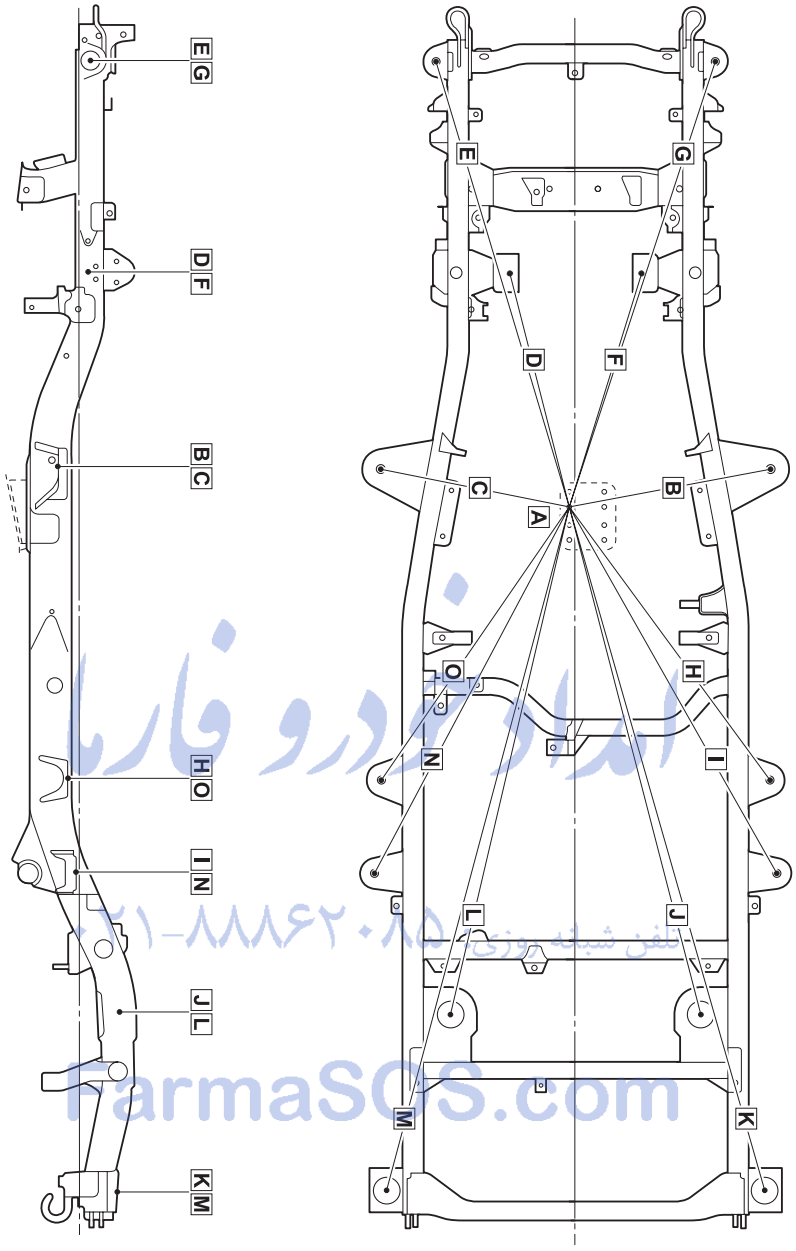
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KAA9N010

(mm)

	Size	No	Size	No	Size	No	Size
1	910	19	355	38	710	56	232
2	674	21	1250	39	1305	57	166
3	570	22	1300	40	1314	H58	65.8
4	113	23	1040	41	2367	S59	1085
5	644	24	320	42	102	K60	7.5
6	7.5	Y25	575	43	204	K61	18.2
7	350.5	A26	265	X44	625	62	13
S8	315	27	291.5	45	50	63	163
9	71.2	28	420.5	46	99	X64	2335
10	460	29	800	S47	396	A65	425
11	722.8	X30	2725	48	200	A66	485
12	681	31	170	49	24	A67	675
13	1250	32	510	S50	231	68	215
14	47	33	90	S51	178.5	X69	3110
15	218	34	1200	H52	251	70	79.8
X16	1035	35	875	X53	290	71	85
17	722	36	1010	54	137		
18	290	37	700	55	47		

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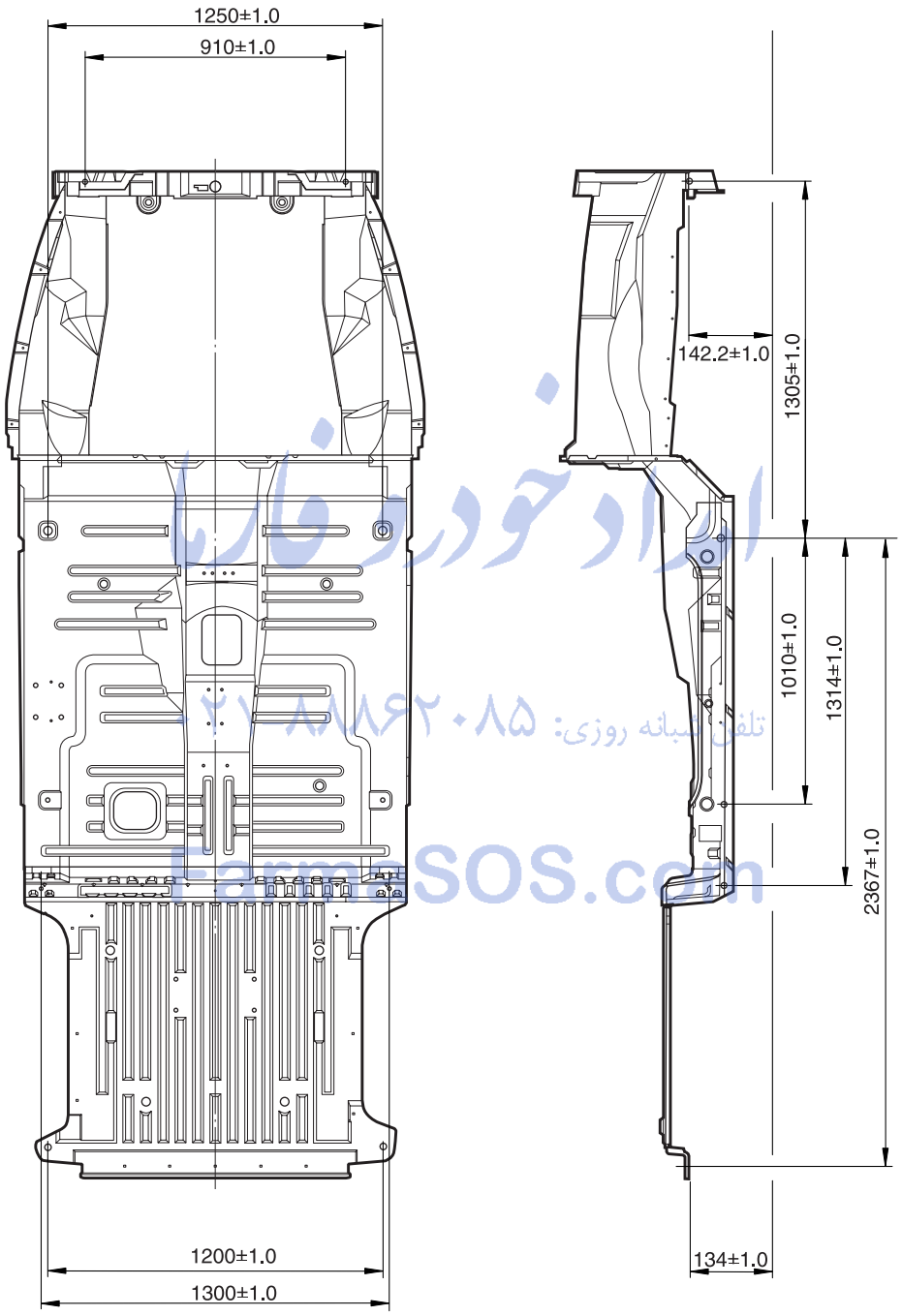
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(mm)

Point	AE	AG	AD	AF	AB	AC	AH	AO	AI	AN	AJ	AL	AK	AM
Length	1495.3	1502.5	796.1	803.6	672.6	648.8	1124.8	1111.4	1393.6	1382.4	1785.9	1780.6	2372.8	2366.7

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Unit: mm



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MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

ALIGNMENT CHECKING

An accurate method of determining the alignment of the underbody uses a measuring tram gauge. The tram gauge set used to perform the recommended measuring checks must include a vertical pointer able to reach 457 mm (18 inches).

Two types of measurements can be made with a tram gauge: direct point-to-point measurements and measurements calculated on a horizontal plane (datum line) parallel to the underbody. Point-to-point measurements are generally taken on steering and suspension engine compartment parts and simply require the vertical pointers to be set equally.

For horizontal plane measurements, the vertical pointers must be set as specified for each point to be measured. Dimensions-to-gauge holes are measured to the center of the holes and flush to the adjacent surface metal unless otherwise specified. It is recommended that the diagonal dimensions to the cross-body be checked on both sides in order to verify the dimensional accuracy of the vehicle underbody.

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FLOOR PAN INSULATORS

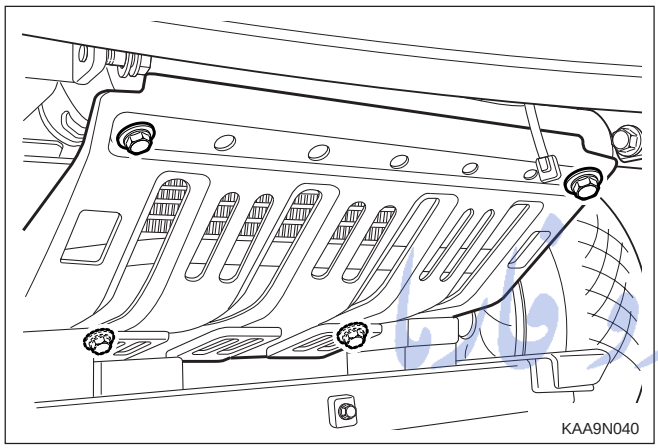
The floor pan insulators have been designed for the higher floor pan temperatures that result from the use of the catalytic converter in the exhaust system. Therefore, when servicing a vehicle, it is essential that any insulators that may have been disturbed or removed be reinstalled in the original sequence and location. Also, if an insulator needs to be replaced, use only the insula-tion specified for that location on the floor pan.

When servicing or replacing interior insulators, observe the following instructions.

- Install the insulators in the original position and sequence. Butt the pieces together in order to avoid gapping or overlapping.
- If it is necessary to replace an insulator, use only the specified insulation.
- Use the original part to determine the amount of re-placement material required and as a template for cutting and fitting the new piece to the floor pan.
- When installing the insulator, do not enlarge any cut-outs or holes that are used for the attachment of interior parts such as the instrument panel or the floor console.

- Route the cross-body harness for interior parts over the floor pan insulators. Clip it in the original location.
- Do not apply spray-on deadeners or trim adhesives to the top of the floor pan at the area directly over the catalytic converter or the muffler.

Any insulator service repair or replacement should be the same thickness, size, and location as the original installation in the vehicle.



ENGINE UNDER COVERS

Removal and Installation Procedure

1. Raise and suitably support the vehicle.
2. Remove the bolts and the engine under cover.
3. Install the engine under cover with the bolts.

Installation Notice

Tightening Torque	10 N•m (89 lb-in)

- Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

4. Lower the vehicle.
5. Installation should follow the removal procedure in the reverse order.

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GENERAL DESCRIPTION AND SYSTEM OPERATION

GENERAL BODY CONSTRUCTION

This vehicle is constructed with a unitized body which in-corporates integral front and rear frame side rails.

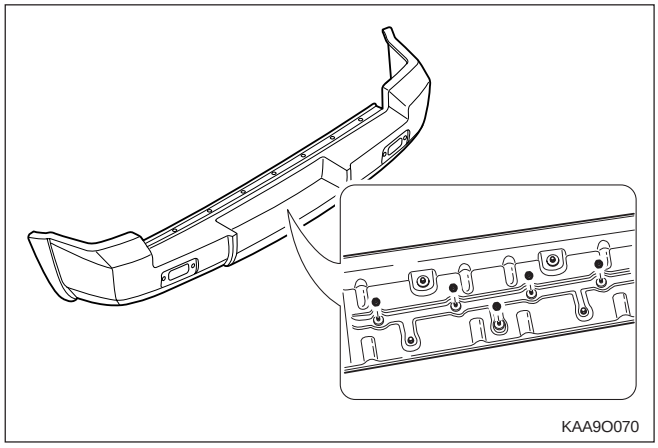
The front suspension lower control arms are bolted to and retained by supports, one each on the right and left sides. The front suspension lower control arm supports are attached to the underbody with three bolts at two locations. The engine is bolted to the integral front side rails. The suspension strut towers must be dimensionally correct in relation to the remainder of the underbody in order to maintain specified suspension strut and caster/camber angles.

Since the individual underbody parts contribute directly to the overall strength of the body, it is essential to observe proper welding techniques during service repair operations. The underbody parts should be properly sealed and rustproofed whenever body repair operations destroy or damage the original sealing and rustproofing. When rustproofing critical underbody parts, use a good-quality type of air-dry primer, such as a corrosion-resistant chromate or an equivalent material. Combination-type primer/surfacers are not recommended.

ENGINE UNDER COVERS

The engine under covers are molded pieces of plastic that serve as shields for the underside of the engine. The covers help protect the engine from small rocks, gravel and other objects that would otherwise come into contact with the engine during normal driving conditions.

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REAR BUMPER IMPACT BAR

Removal and Installation Procedure

1. Remove the rear bumper fascia. Refer to Rear Bumper Fascia in this section.
2. Remove the rear bumper impact bar.
3. Installation should follow the removal procedure in the reverse order.

ROOF MOLDING

Removal and Installation Procedure

1. Remove the C-pillar cover. Refer to “C-pillar Cover” in this section.
2. Remove the roof molding
3. Installation should follow the removal procedure in the reverse order.

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SECTION 9O

BUMPERS AND FASCIAS

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

Description and Operation 9O-2

Bumpers 9O-2

Components Locator 9O-3

Bumpers and Fascias 9O-3

Repair Instructions 9O-4

On-Vehicle Service Unit Repair 9O-4

Front Bumper Fascia 9O-4

Rear Bumper Fascia 9O-5

Front Bumper Impact Bar 9O-5

Rear Bumper Impact Bar 9O-6

Roof Molding 9O-6

Specifications 9O-7

Fastener Tightening Specifications 9O-7

امداد خودرو فارما

تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵

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DESCRIPTION AND OPERATION

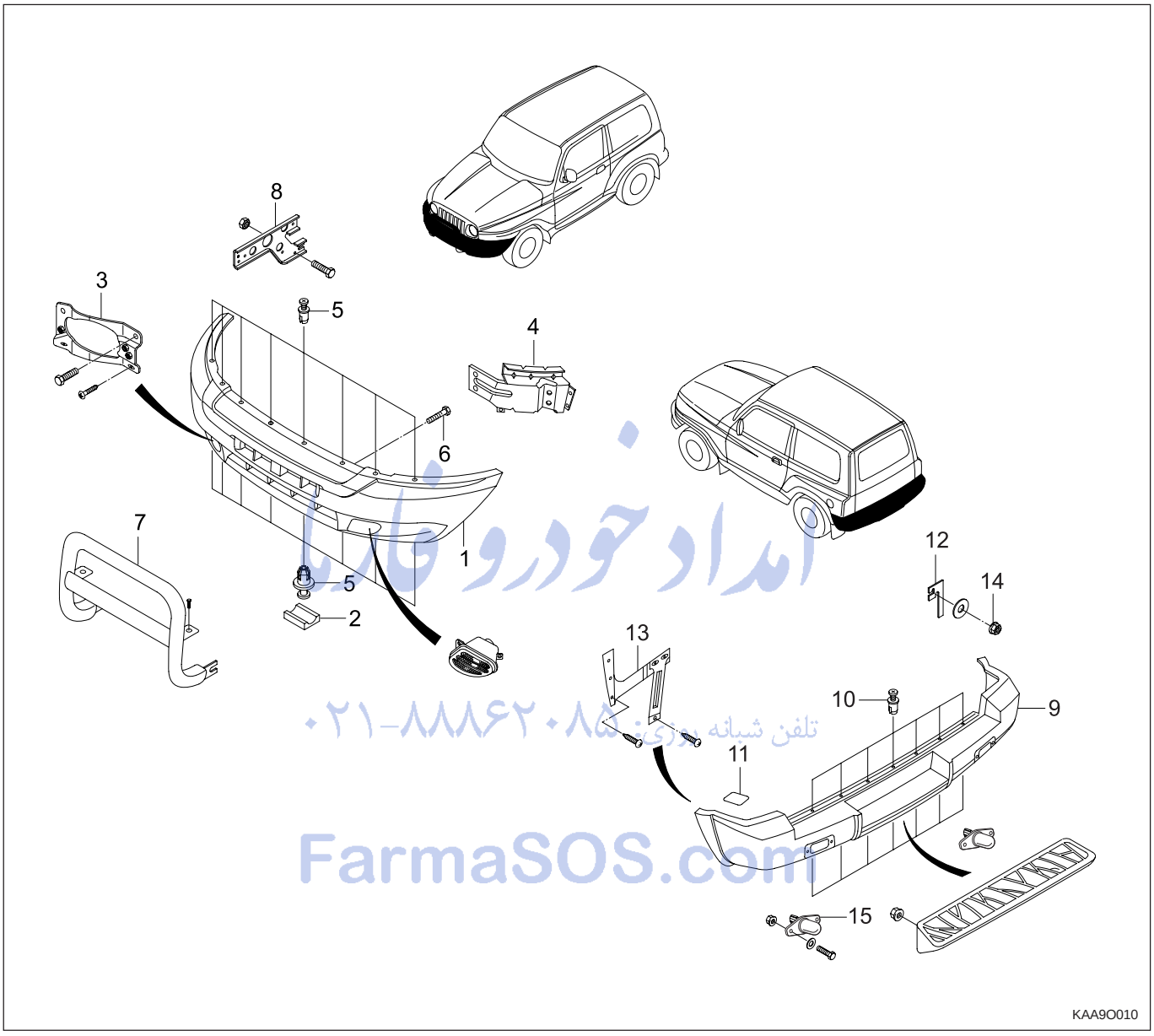
BUMPERS

The bumper systems are designed to sustain a collision into a fixed barrier at 8 km/h (5 mph) without damage.

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COMPONENTS LOCATOR

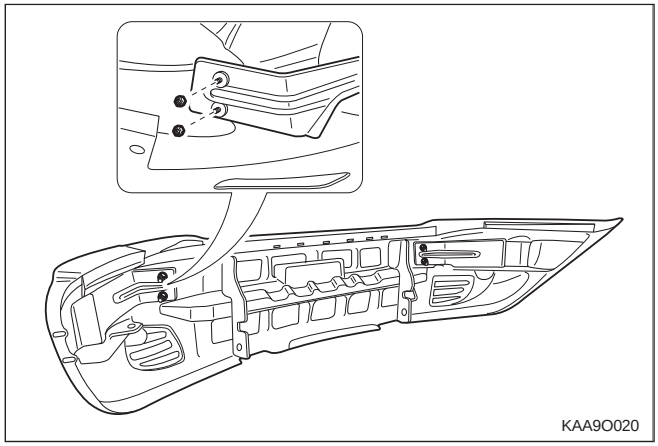
BUMPERS AND FASCIAS



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1 Front Bumper Assembly
2 Pad
3 Fog Lamp Mounting Bracket
4 Side Mounting Bracket
5 Rivet
6 Bolt
7 Front Nudge Bar Assembly
8 Side Support Bracket
9 Front Bumper Assembly
10 Rivet
11 Protection Tape
12 Rear Bumper Spacer
13 Side Bracket
14 Nut
15 License Lamp Assembly

REPAIR INSTRUCTIONS


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ON-VEHICLE SERVICE UNIT REPAIR

FRONT BUMPER FASCIA

Removal and Installation Procedure

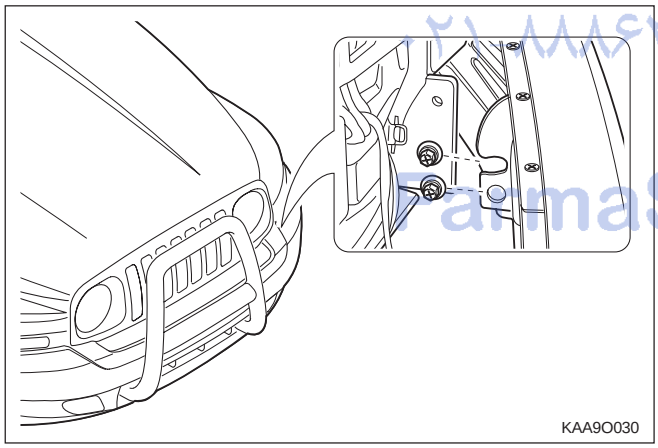
1. Remove the side support bracket nuts.

Installation Notice

Tightening Torque	11 N•m (97 lb-in)

- Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

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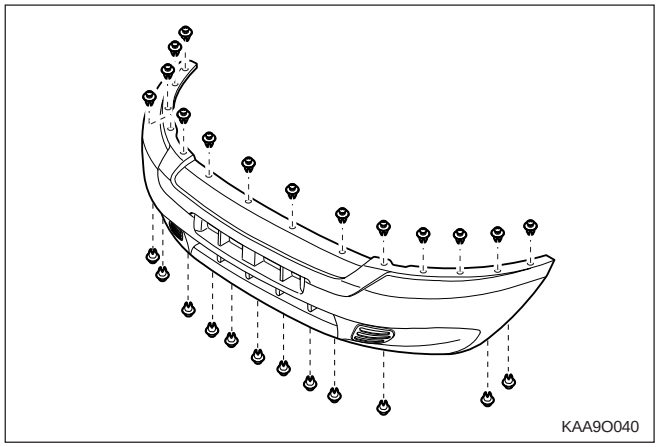
2. Remove the front bumper with the bolts.

Installation Notice

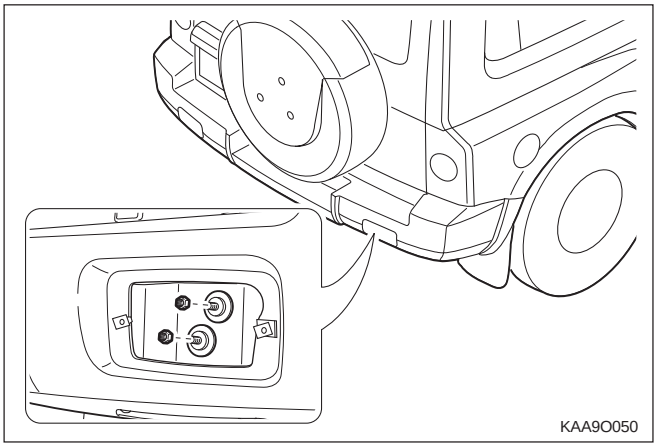
Tightening Torque	117 N•m (154 lb-ft)

- Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

تلفن شبانه روزی: ۰۸۵-۳۲۱۸۸۴۶۲
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3. Remove the front bumper fascia.
4. Installation should follow the removal procedure in the reverse order.



REAR BUMPER FASCIA

Removal and Installation Procedure

1. Remove the mud guard. Refer to Section 9M, Exterior Trim.
2. Remove the rear bumper with the bolts.
3. Remove the rear bumper fascia from the rear bumper.

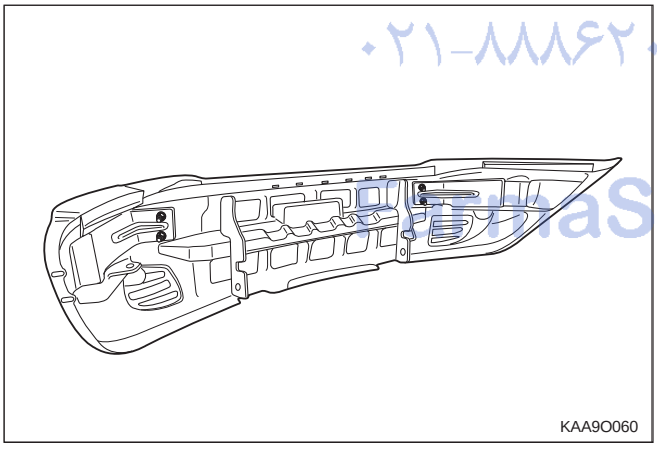
Installation Notice

Tightening Torque	29 N•m (21 lb-ft)

- Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

4. Installation should follow the removal procedure in the reverse order.

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۰۲۱-۸۸۸۶۲۰۸۵ تلفن شبانه روزی
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FRONT BUMPER IMPACT BAR

Removal and Installation Procedure

1. Remove the front bumper fascia. Refer to Front Bumper Fascia in this section.
2. Remove the nuts with the front bumper impact bar.

Installation Notice

Tightening Torque	117 N•m (154 lb-ft)

- Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

3. Installation should follow the removal procedure in the reverse order.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Front Bumper Fascia Scrivet	11	-	97
Front Bumper Mounting Bolts	117	154	-
Front Bumper Im Pact Bar Nuts	117	154	-
Rear Bumper Fascia Nuts	29	21	-
Side Support Bracket Nuts	11	-	97

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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SECTION 9P

DOORS

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

Description and Operation 9P-2

Power Door Locks 9P-2

Power Windows 9P-2

Door Lock Striker 9P-2

Components Locator 9P-3

Doors 9P-3

Repair Instructions 9P-4

On-Vehicle Service Unit Repair 9P-4

Door Glass Run 9P-4

Door Side Opening Weatherstrip 9P-4

Door Lock Striker 9P-4

Door Lock Striker Adjustment 9P-5

Front Door Lock 9P-6

Inside Door Handle 9P-7

Outside Door Handle 9P-7

Door Lock Cylinder 9P-7

Power Window Regulator 9P-8

Front Door Assembly 9P-8

Tail Gate Assembly 9P-8

Door Hinge 9P-9

Door Hold Open Link 9P-9

Outside Channel Molding 9P-9

Door Weatherstrip 9P-9

Door Seal Trim 9P-10

Specifications 9P-11

Fastener Tightening Specifications 9P-11

Schematic and Routing Diagrams 9P-12

Central Door Locks System 9P-12

Power Windows 9P-13

امداد خودرو فارما

۰۲۱-۸۸۸۶۳۰۸۵ تلفن شبانه روزی

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DESCRIPTION AND OPERATION

POWER DOOR LOCKS

The power door locks use a solenoid that is contained in each door lock assembly. The door locks are activated by the actuator on the inside door handle or by the lock cylinder on the driver's side door only. When the driver's side door is locked or unlocked by the actuator or lock cylinder, all doors are locked or unlocked accordingly.

POWER WINDOWS

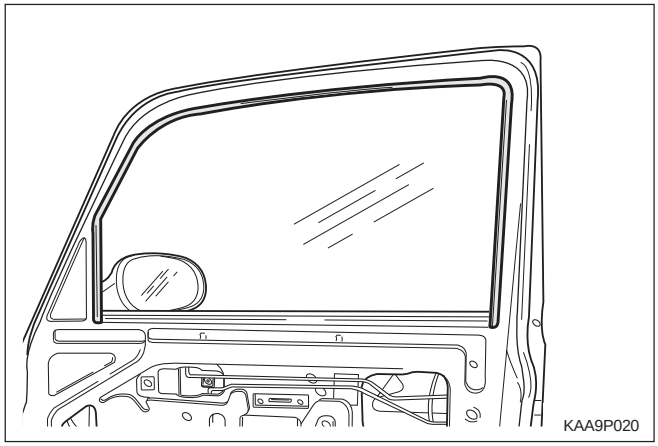
The power windows are controlled by electrical switches on the door trim center upper panel and are operated by a motor at each window regulator. The windows are lowered by pressing the switch and are raised by pulling up on the switch. The window will stop movement when the switch is released or when the windowis completely open or closed.

DOOR LOCK STRIKER

The front door lock strikers each consist of a striker with two screws threaded into a floating cage plate in the B-pillars. The door lock fork snaps over and engages the striker.

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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REPAIR INSTRUCTIONS

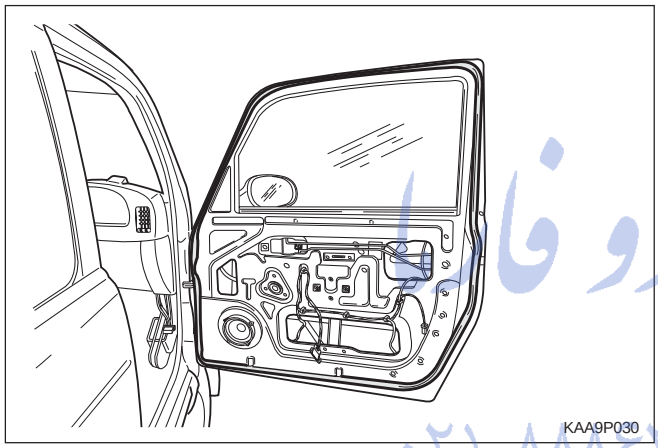


ON-VEHICLE SERVICE UNIT REPAIR

DOOR GLASS RUN

Removal and Installation Procedure

1. Lower the window.
2. Remove the glass from the door.
3. Remove the front door glass run.
4. Installation should follow the removal procedure in the reverse order.

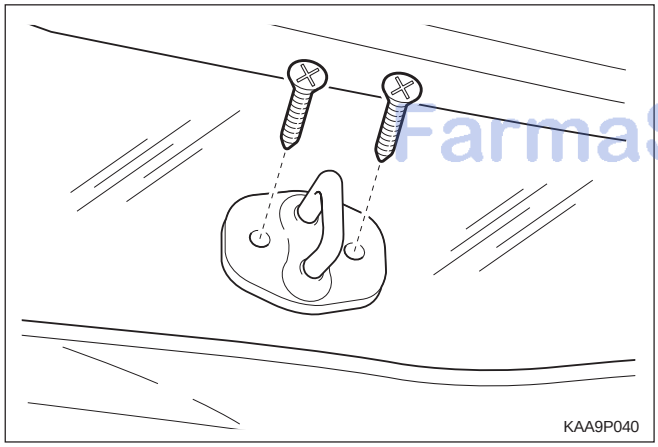


DOOR SIDE OPENING WEATHERSTRIP

Removal and Installation Procedure

1. Remove the side opening weatherstrip.
2. Installation should follow the removal procedure in the reverse order.

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DOOR LOCK STRIKER

Removal and Installation Procedure

1. Remove the screws and the door lock striker.

Installation Notice

Tightening Torque	9.8 - 18.62 N•m (7.23 - 13.74 lb-ft)

- Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

2. Installation should follow the removal procedure in the reverse order.

DOOR LOCK STRIKER ADJUSTMENT

Installation Notice:

The door lock striker is an important attaching part that can affect the performance of vital components and systems and can cause major repair expenses. If replacement becomes necessary, the door lock striker must be replaced by one with the same part number or with an equivalent part. Do not use a replacement part of lesser quality or of a substitute design. The specified torque values must be used during reassembly in order to ensure the proper retention of the part.

The door lock striker consists of a striker with two screws that are threaded into a tapped, floating cage plate located in the appropriate body pillar. This floating cage plate allows the striker to be easily adjusted in or out and up or down. The door is secured in the closed position when the door lock fork snaps over and engages the striker.

Fore/Aft Adjustment

1. The door must be properly aligned.
2. Close the door until the lock fork contacts the striker.
3. Stand next to the door opening and move the door slowly in and out, just touching the striker each time.
4. The alignment of the lock fork and the striker can be easily seen. The lock fork should be perpendicular to and fall near the middle of the striker between the B-pillar and the end of the striker.
5. If a fore or aft adjustment is required, use the following steps:
   - 5.1 Remove the striker screws.
   - 5.2 Remove the spacer in order to move the striker toward the front of the vehicle.
   - 5.3 Add a 2 mm (0.8 inch) spacer in order to move the striker toward the front of the vehicle.
   - 5.4 Install the striker screws.
6. Perform the up/down or the in/out adjustment. Refer to “up/down or in/out Adjustment” in this section.

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Up/Down or In/Out Adjustment

An adjustment of the striker in the up/down or in/out directions may be necessary for a number of reasons:

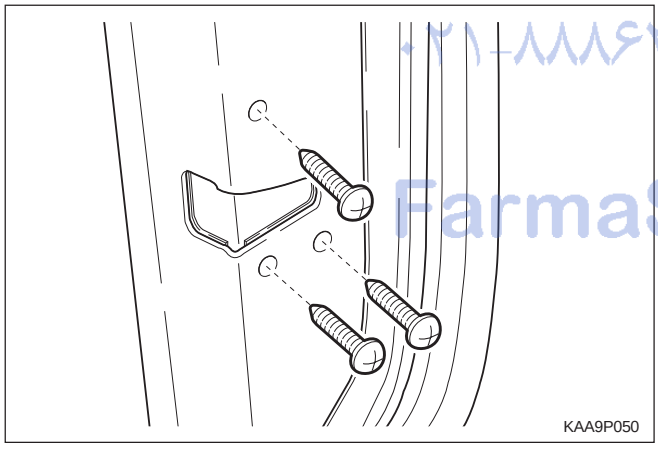
- Vehicle frame damage as the result of a collision.
- Installation of new door weather stripping.
- Customer complaints of excessive wind noise.
- Difficulty in opening or closing the door.

In order to adjust the door striker in an up/down or in/out direction, perform the following procedure:

1. The door must be properly aligned.
2. Loosen the striker screws.
3. The floating cage plate can be moved slightly using the ends of the striker screws. Move the floating cage plate to the desired position.

   Notice: It is important to use a flat-end rotary file in order not to damage the tapped floating cage plate. The striker screws and the tapped floating cage plate are important attaching parts that could affect the performance of vital components and systems.

4. If proper adjustment requires that the floating cage plate be moved more than is possible, use an electric hand drill and a 3/8-inch rotary file with a flat head in order to enlarge the body opening in the direction required.
5. Tighten the striker screws to the correct position.



FRONT DOOR LOCK

Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Remove the inside door handle. Refer to “Inside door Handle” in this section.
3. Disconnect the inside door handle and the lock rods.
4. Remove the screws and the guide rail.
5. Remove the screws and the front door lock.

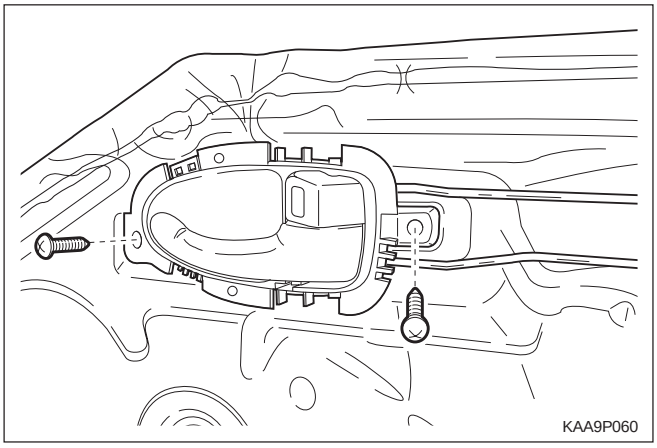
   Installation Notice

Tightening Torque	6.86 - 9.8 N•m (5.06 - 7.23 lb-ft)

   - Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

6. Installation should follow the removal procedure in the reverse order.

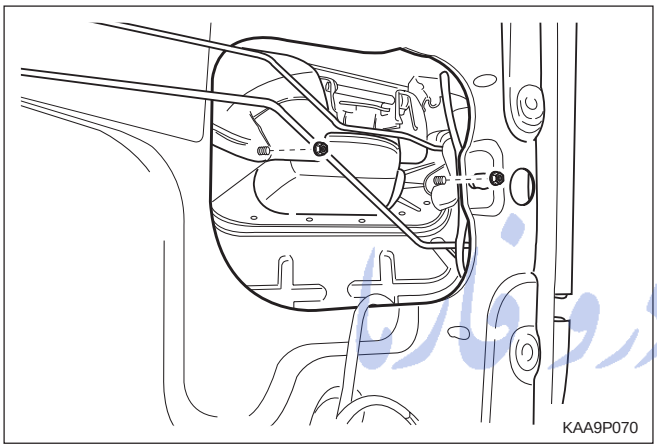
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INSIDE DOOR HANDLE

Removal and Installation Procedure

1. Remove the door trim panel. Refer to *Section 9G, Door Trim Panel*.
2. Remove the inside door handle with the screws.
3. Disconnect the inside door handle and the lock rods.
4. Installation should follow the removal procedure in the reverse order.



OUTSIDE DOOR HANDLE

Removal and Installation Procedure

1. Remove the door seal trim. Refer to “Door Seal Trim” in this section.
2. Remove the nuts of outside door handle.

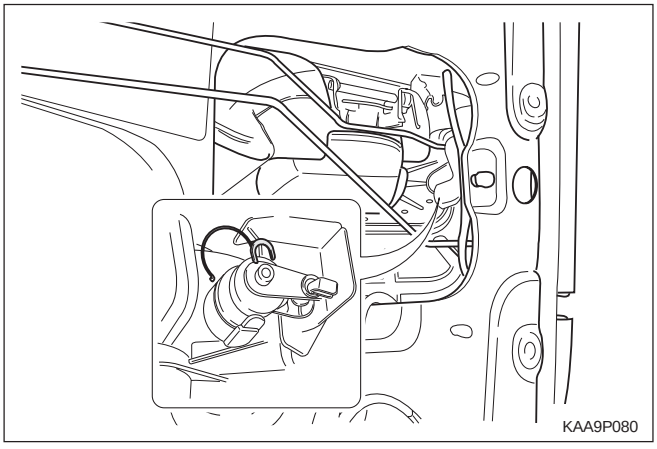
Installation Notice

Tightening Torque	3.92 - 5.49 N•m (2.92 - 4.08 lb-ft)

- Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

3. Disconnect the outside door handle and the lock rods.
4. Disconnect the electrical connector.
5. Installation should follow the removal procedure in the reverse order.

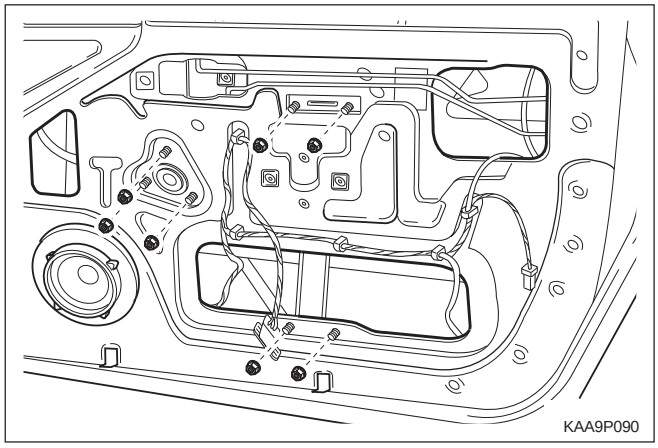
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۰۲۱-۸۸۸۶۲۰۸۵ تلفن شبانه روز
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DOOR LOCK CYLINDER

Removal and Installation Procedure

1. Remove the door seal trim. Refer to “Door Seal Trim” in this section.
2. Remove the outside door handle. Refer to “Outside Door Handle” in this section.
3. Remove the retaining clip.
4. Remove the door lock cylinder.
5. Installation should follow the removal procedure in the reverse order.


KAA9P090

POWER WINDOW REGULATOR

Removal and Installation Procedure

1. Disconnect the battery cable.
2. Remove the door glass. Refer to *Section 9L, Glass and Mirrors*.
3. Remove the nuts and the regulator.

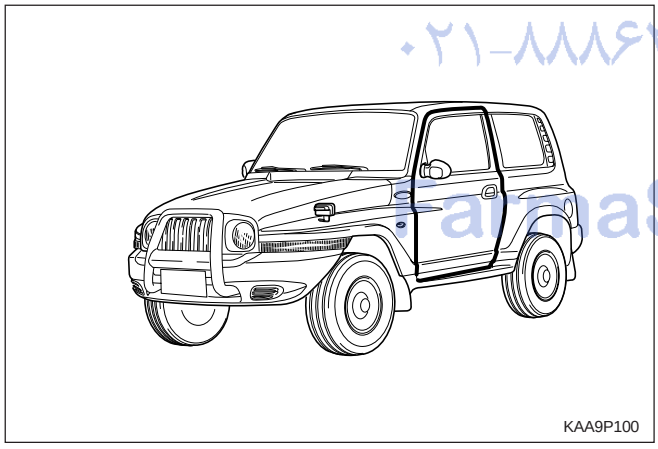
Installation Notice

Tightening Torque	3.92 - 5.49 N•m (2.92 - 4.08 lb-in)

- Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

4. Disconnect the electrical connector.
5. Installation should follow the removal procedure in the reverse order.

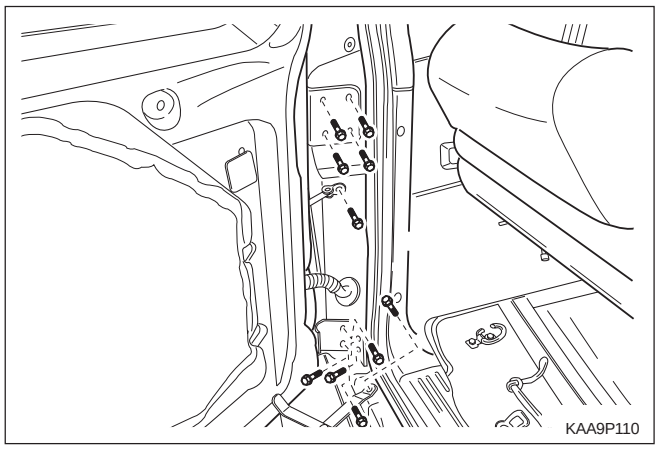
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۰۲۱-۸۸۸۶۲۰۸۵ تلفن شبانه روزی
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KAA9P100

FRONT DOOR ASSEMBLY

Removal and Installation Procedure

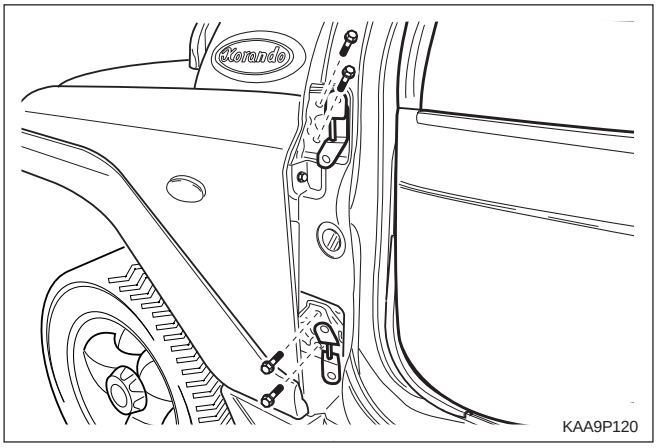
1. Disconnect the negative battery cable.
2. Remove the door hold open link. Refer to “Door Hold Open Link” in this section.
3. Disconnect the body to door rubber grommet and the electrical connector.
4. With the aid of another technician, remove the bolts and the door.
5. Installation should follow the removal procedure in the reverse order.


KAA9P110

TAIL GATE ASSEMBLY

Removal and Installation Procedure

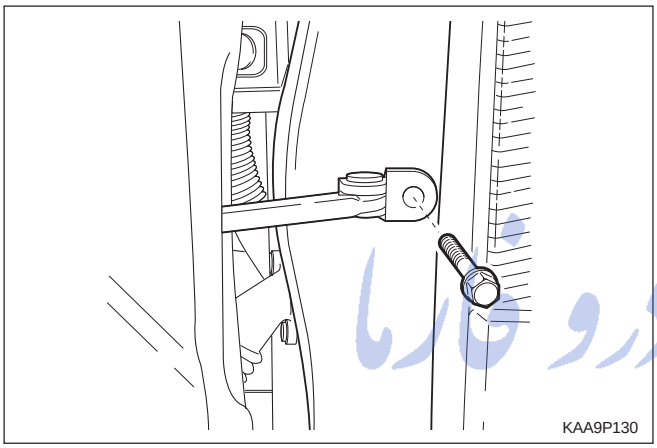
1. Disconnect the negative battery cable.
2. Remove the door hold open link with the bolt.
3. Disconnect the body to tailgate rubber grommet and the electrical connector.
4. With the aid of another technician, remove the bolts and the door.
5. Installation should follow the removal procedure in the reverse order.



DOOR HINGE

Removal and Installation Procedure

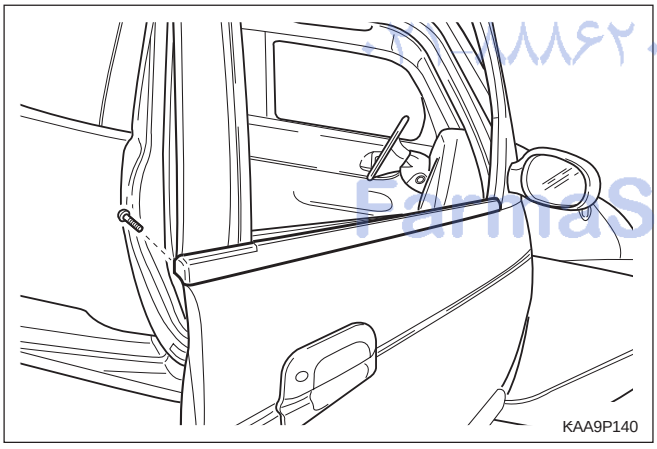
1. With the aid of another technician, remove the bolts and the hinge from the door and the body.
2. Installation should follow the removal procedure in the reverse order.



DOOR HOLD OPEN LINK

Removal and Installation Procedure

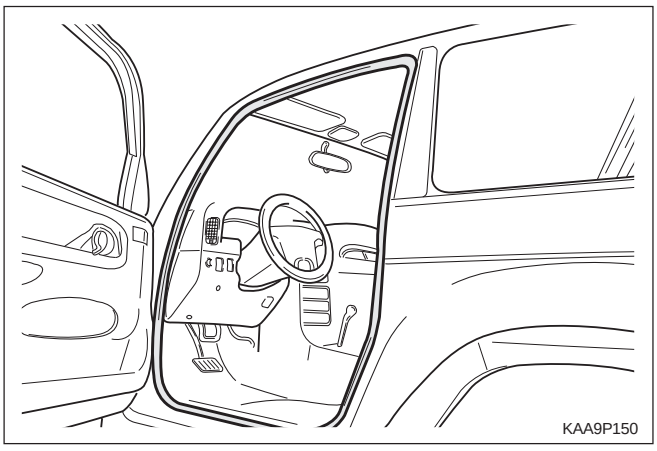
1. Remove the door trim panel. Refer to *Section 9G. Interior Trim*.
2. Remove the bolts on the door and on the body.
3. Remove the door hold open link.
4. Installation should follow the removal procedure in the reverse order.



OUTSIDE CHANNEL MOLDING

Removal and Installation Procedure

1. Lower the window completely.
2. Remove the outside rearview mirror. Refer to *Section 9L, Glass and Mirror*.
3. Remove the screws and the outside channel molding.
4. Installation should follow the removal procedure in the reverse order.

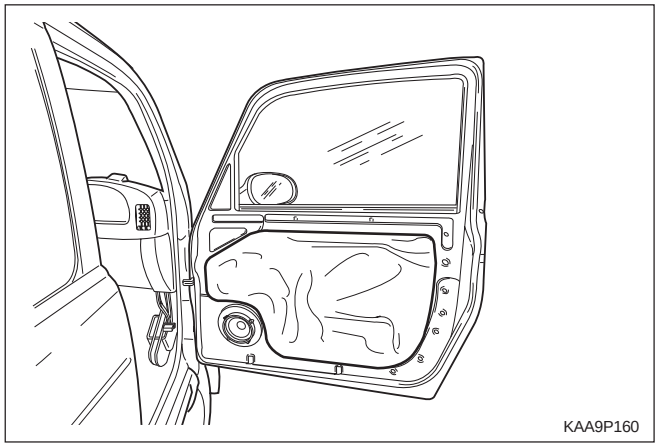


DOOR WEATHERSTRIP

Removal and Installation Procedure

1. Remove the door weatherstrip.
2. Installation should follow the removal procedure in the reverse order.

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KAA9P160

DOOR SEAL TRIM

Removal and Installation Procedure

1. Remove the door trim panel. Refer to *Section 9G, Interior Trim*.
2. Remove the screws and the door pull bracket.
3. Remove the inside door handle. Refer to “inside door handle” in this section.
4. Remove the door seal trim.
5. Installation should follow the removal procedure in the reverse order.

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SPECIFICATIONS

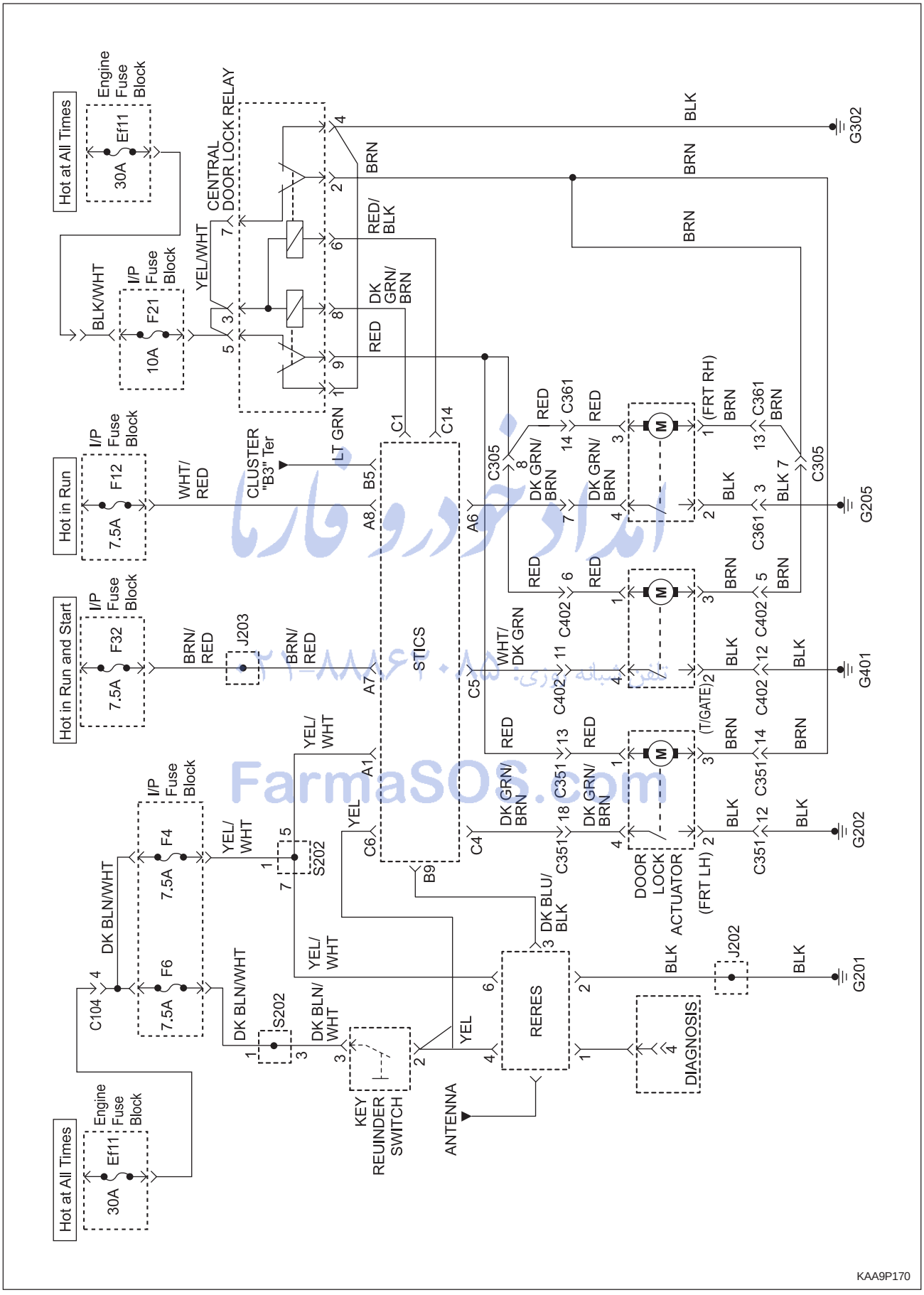
FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Power Window Regulator Nuts	3.92 - 5.49	2.92 - 4.08	34.71 - 48.60
Door Lock Striker Bolts	9.8 - 18.62	7.23 - 13.74	86.79 - 164.09
Front Door Lock Screw	6.89 - 9.8	5.06 - 7.23	60.75 - 86.79
Outside Door Handle Nuts	3.92 - 5.49	2.92 - 4.08	34.71 - 48.60
Door Hinge Bolts	35.28 - 47.04	26.03 - 34.71	312.46 - 416.61
Door Hold Open Link	13.72 - 25.48	10.12 - 18.08	121.51 - 225.66

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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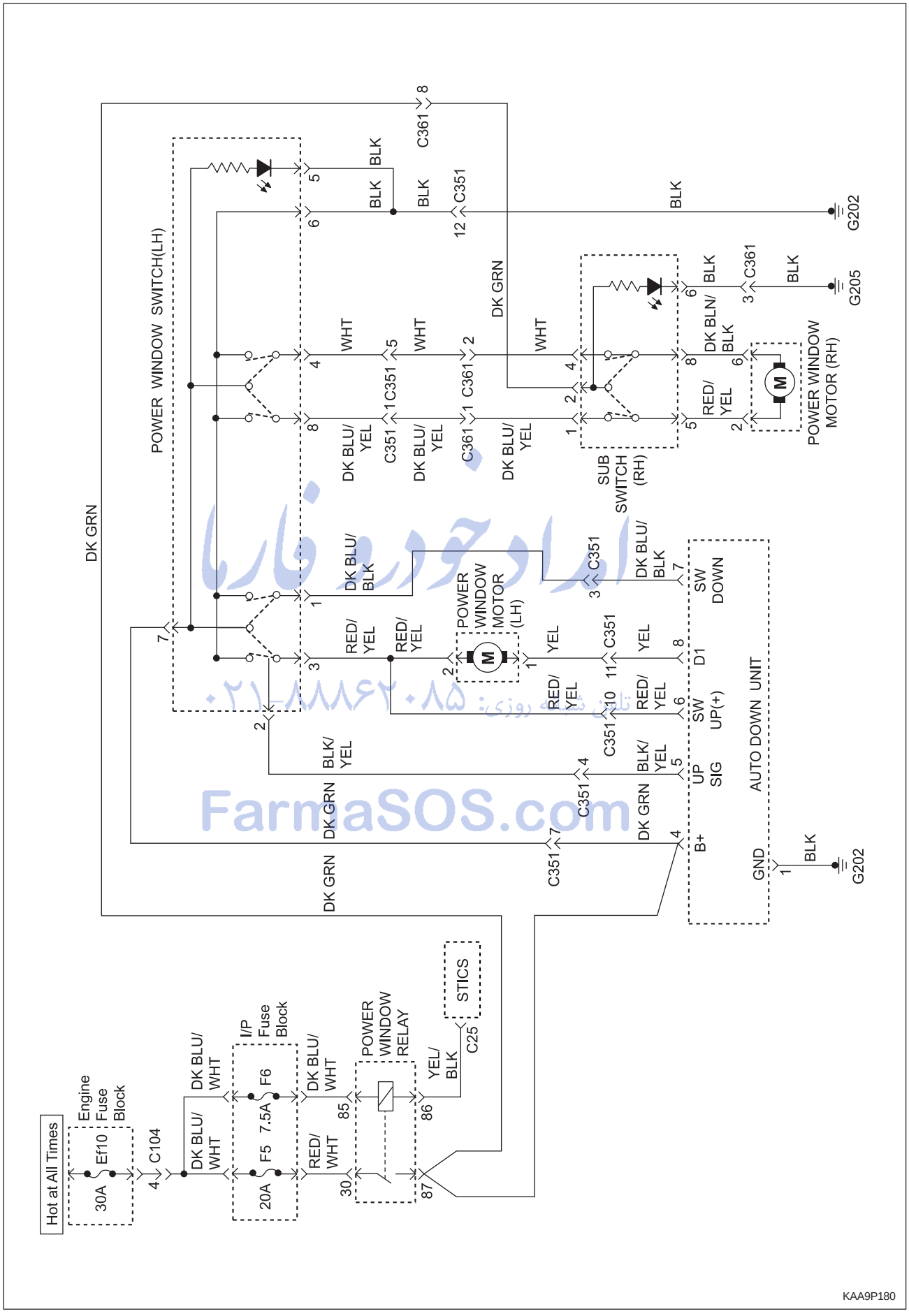
SCHEMATIC AND ROUTING DIAGRAMS

CENTER DOOR LOCK SYSTEM



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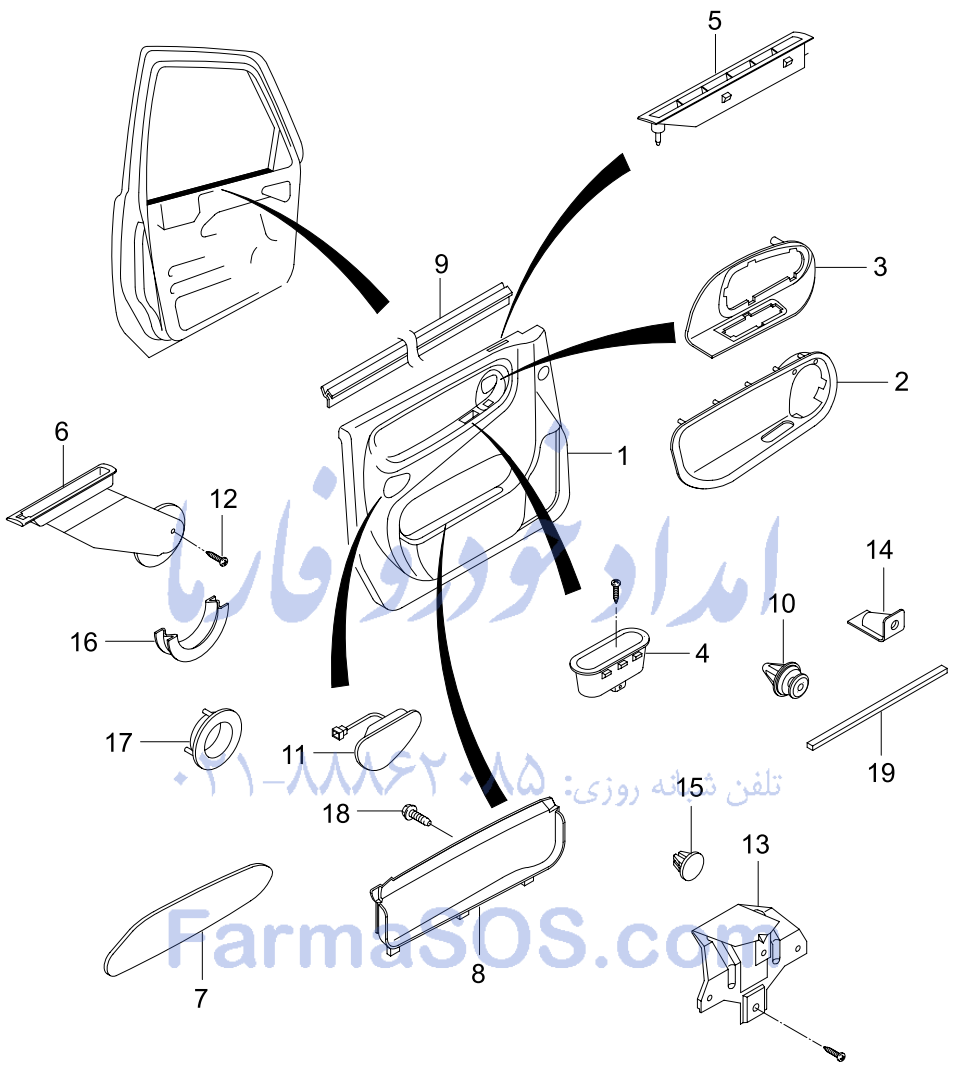
POWER WINDOW



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COMPONENTS LOCATOR

DOORS



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1 Door Trim Panel Assembly
2 Center Upper Panel
3 Inside Handle Mounting Plate
4 Door Pull Handle
5 Door Defroster Nozzle
6 Door Defroster Duct
7 Door Trim Panel
8 Door Pocket
9 Belt Inside Strap
10 Door Trim Mounting Fastener
11 Door Courtesy Lamp
12 Screw
13 Door Pull Handle Mounting Support Bracket
14 Door Trim Complete Mounting Clip
15 Door Inside Handle Mounting Grommet
16 Door Defroster Grommet
17 Door Defroster Grommet Vessel
18 Door Pocket Mounting Screw
19 Door Trim Pad

SECTION 9Q

ROOF

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

Description and Operation 9Q-2

Sunvisors 9Q-2

Cat Hook 9Q-2

Components Locator 9Q-3

Roof 9Q-3

Unit Repair 9Q-4

Formed Headliner 9Q-4

Sun Visors 9Q-4

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵

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DESCRIPTION AND OPERATION

SUNVISORS

The sun visors swing down in order to block out glare. They also swing to the side when they are released from the support. Each sun visor has a vanity mirror.

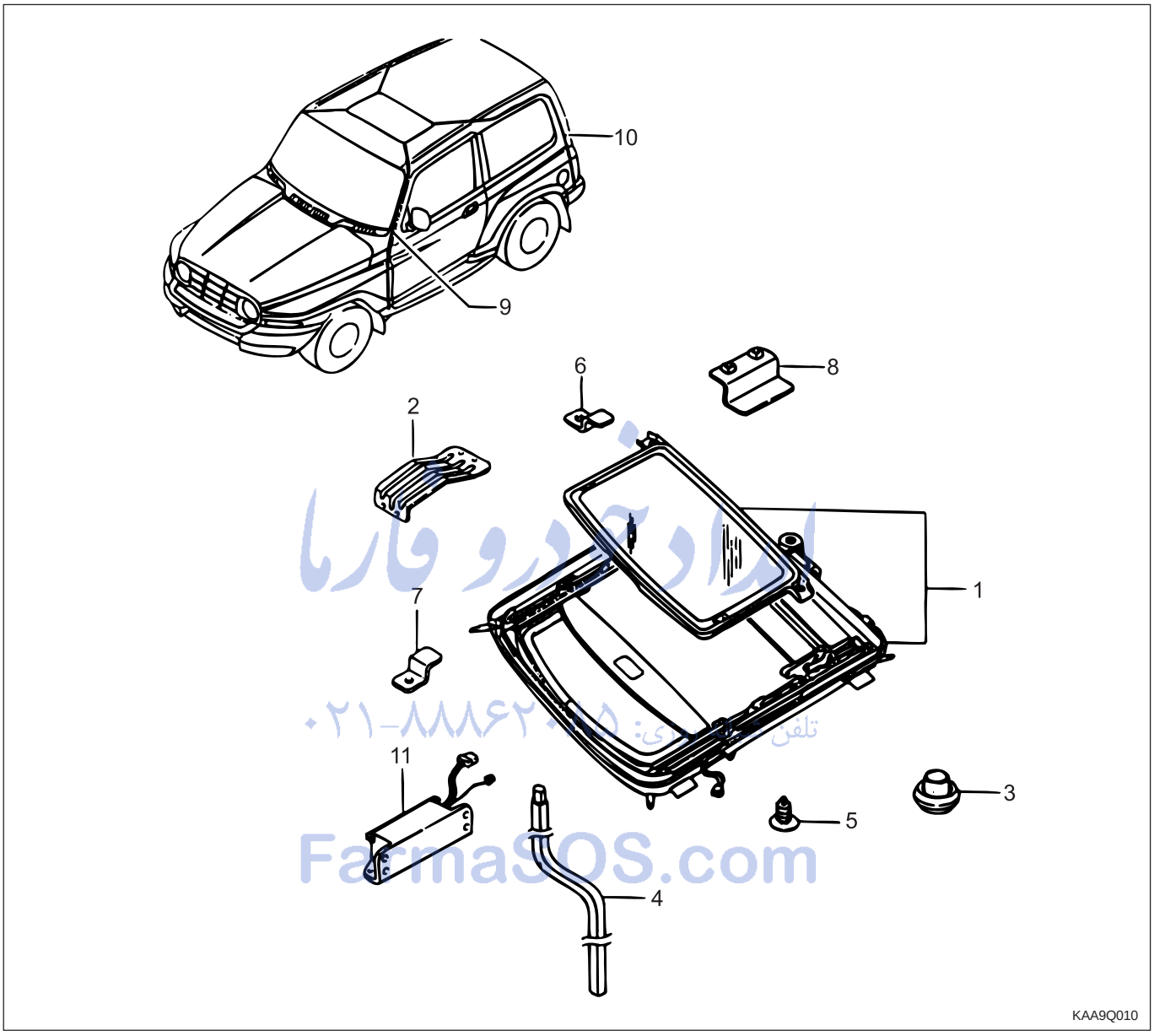
CAT HOOK

The coat hook is fastened to the headliner above the left hand rear passenger's seat.

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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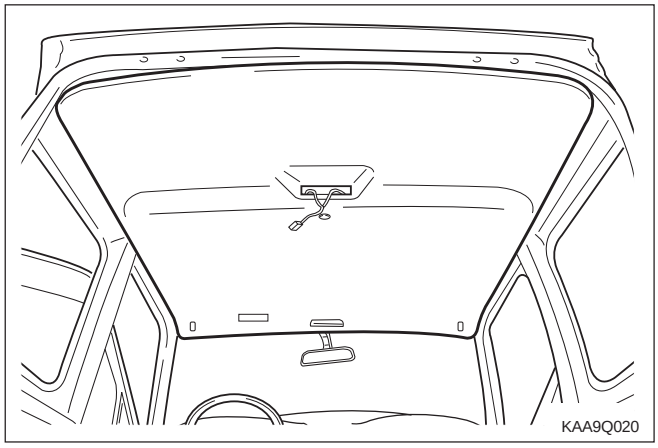
COMPONENTS LOCATOR

ROOF



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1 Inner Sliding Sun Roof Assembly
2 Sun Roof Body Mounting Bracket
3 Drain Hose Rear Grommet
4 Sun Roof Motor Spanner
5 Mounting Clip
6 Mounting Bracket
7 Mounting Bracket assembly
8 Sun Roof Mounting Bracket
9 Drain Front Hose
10 Drain Rear Hose
11 Sun Roof Module Assembly


KAA9Q020

UNIT REPAIR

FORMED HEADLINER

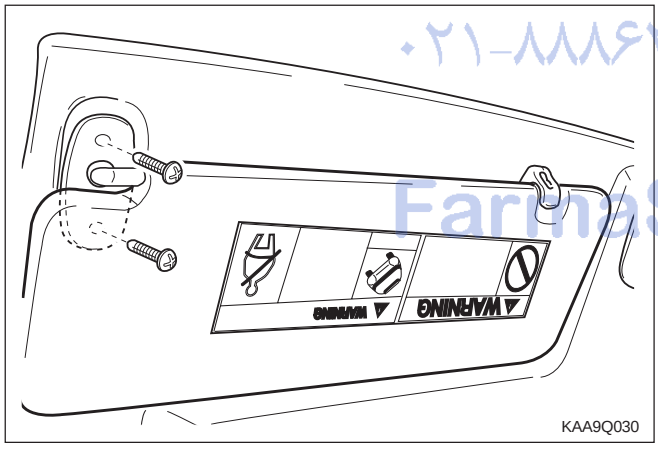
Removal and Installation Procedure

1. Remove the front and rear upper seat belt anchor. Refer to *Section 8A, Seat Belts*.
2. Remove the assist handles. Refer to *Section 9G, Interior trim*.
3. Remove the sun visors. Refer to “Sun visors” in this section.
4. Remove the power sunroof control switch. Refer to “Power Sunroof Control Switch” in this section.
5. Remove the interior courtesy lamp. Refer to *Section 9B, Lighting system*.
6. Remove the left and the right A-pillar trim panel.
7. Remove the upper quarter trim panel. Refer to *Section 9G, Interior Trim*.
8. Remove the child seat anchor. Refer to *Section 9H, Seats*.
9. Remove the headliner.
10. Installation should follow the removal procedure in the reverse order.

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۰۲۱-۸۸۸۶۲۰۸۵ تلفن شبانه روزی
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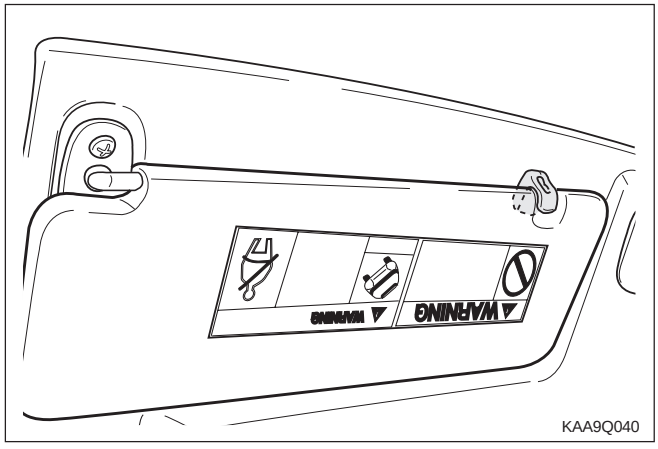
SUN VISORS

Removal and Installation Procedure



KAA9Q030

1. Remove the screws and the sun visor from the headliner.



KAA9Q040

2. Remove the screw and the sun visor support from the headliner.
3. Installation should follow the removal procedure in the reverse order.

SECTION 9R

BODY FRONT END

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

Description and Operation 9R-2

Body Front End 9R-2

Components Locator 9R-3

Body Front End 9R-3

Repair Instructions 9R-4

On-Vehicle Service Unit Repair 9R-4

Lubrication 9R-4

Fasteners 9R-4

Anticorrosion Materials 9R-4

Cowl Vent Grille 9R-5

Hood 9R-5

Hood Hinges 9R-6

Hood Gas Spring 9R-6

Specifications 9R-7

Fastener Tightening Specifications 9R-7

امداد خودرو فارما

تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵

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DESCRIPTION AND OPERATION

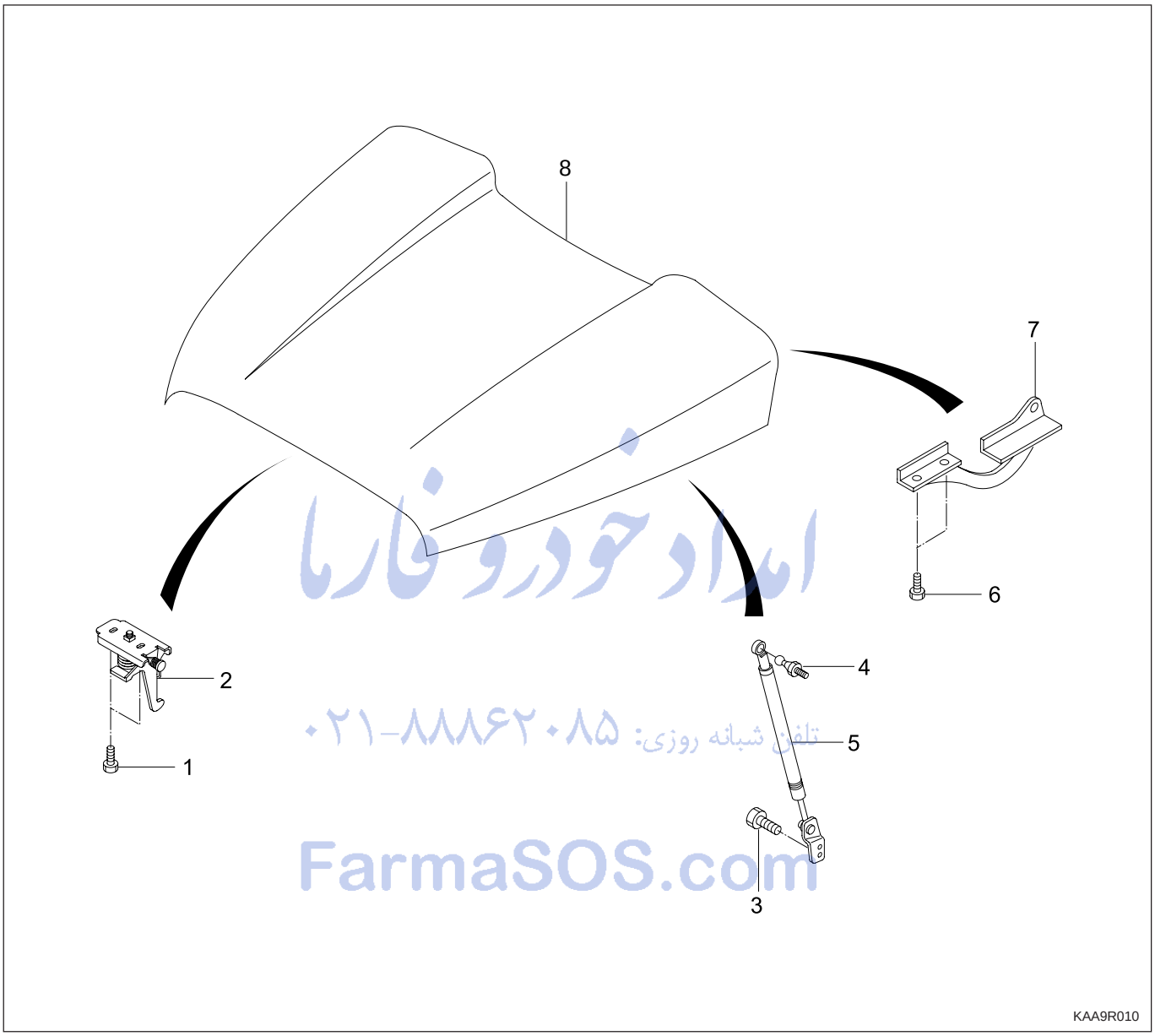
BODY FRONT END

This vehicle has a unitized body with a frame assembly supporting the engine and the transaxle. The fender panels and the radiator support are also integral parts of the body.

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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COMPONENTS LOCATOR

BODY FRONT END



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1 Bolt
2 Hood Striker Safety Assembly
3 Bolt
4 Mounting Ball Stud
5 Hood Lifter Assembly
6 Bolt
7 Hood Hinge Assembly
8 Hood

REPAIR INSTRUCTIONS

ON-VEHICLE SERVICE UNIT REPAIR

LUBRICATION

The hood hinges and the locking mechanisms require periodic lubrication for proper operation. Refer to *Section 0B, General Information* for the specific types and intervals of lubrication.

FASTENERS

Notice: Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

Many aluminum components are used on current models. Aluminum in contact with steel may corrode rapidly if it is not protected by special finishes or isolators.

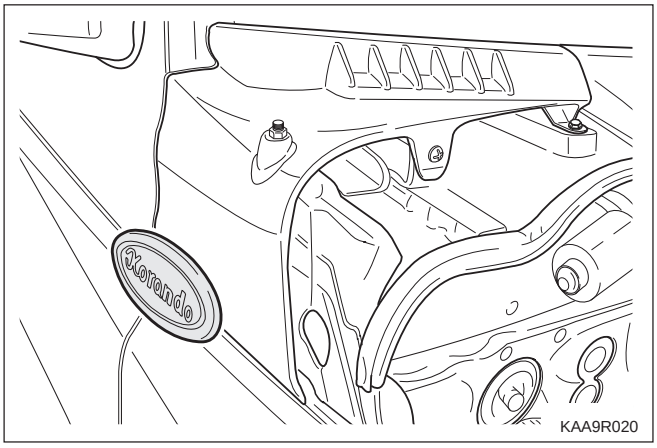
The fasteners used have a special finish which provides adequate protection from corrosion. These special fasteners differ in color to easily identify them from the standard metric fasteners, which are medium blue in color.

When replacing fasteners, avoid substituting otherwise similar fasteners in the same location.

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ANTICORROSION MATERIALS

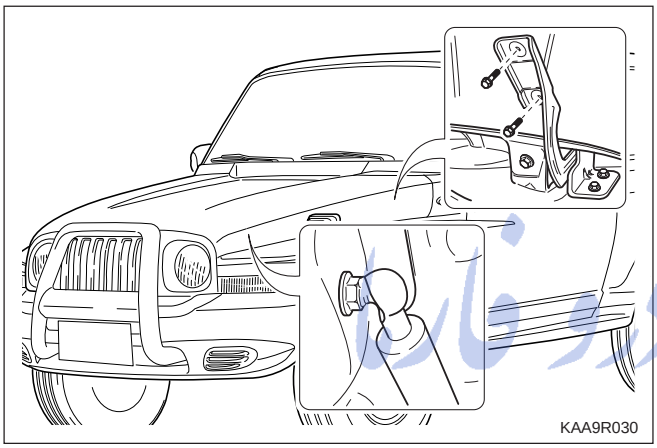
To provide rust resistance, anticorrosion materials have been applied to the interior surfaces of most of most of the metal panels. When servicing these panels, properly recoat them with a service-type anticorrosion material if any of the original material has been disturbed.



COWL VENT GRILLE

Removal and Installation Procedure

1. Open the hood.
2. Remove the wiper arms. Refer to *Section 9D, Wipers/Washer System*.
3. Remove the cowl vent grille with the screws.
4. Installation should follow the removal procedure in the reverse order.



HOOD

Removal and Installation Procedure

Important: Install protective coverings over the fenders and the windshield to prevent damage to the paint, the glass, and the moldings when removing and installing the hood.

1. Open the hood.
2. Mark the position of the hinge to the hood to aid in alignment during installation.
3. Remove the washer hoses from the hood.
4. Remove the hood gas spring. Refer to “Hood Gas Spring” in this section.
5. Remove the bolts retaining the hood to both of the hinges.

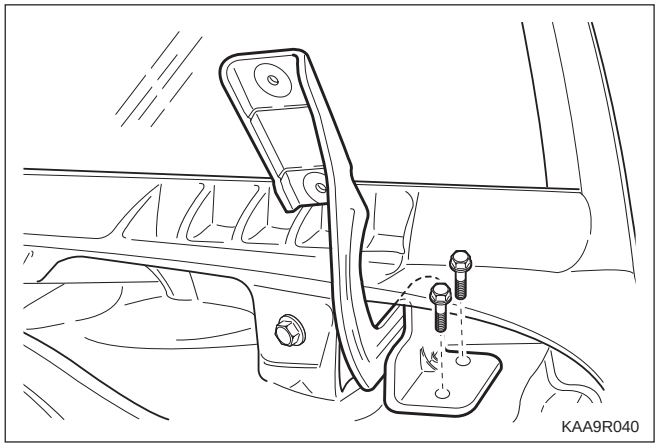
Installation Notice

Tightening Torque	7.84 - 11.76 N•m (5.78 - 8.68 lb-ft)

- Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

6. With the aid of another technician, remove the hood from the hinges.
7. Installation should follow the removal procedure in the reverse order.

۰۲۱-۸۸۸۶۲۰۸۵ تلفن شبانه روزی
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HOOD HINGES

Removal and Installation Procedure

1. Remove the hood. Refer to “Hood” in this section.
2. Remove the cowl vent grille. Refer to “Cowl Vent Grille” in this section.
3. Remove the side cowl vent panel Refer to “Side Cowl Vent Panel” in this section.
4. Remove the bolts and the hood hinges

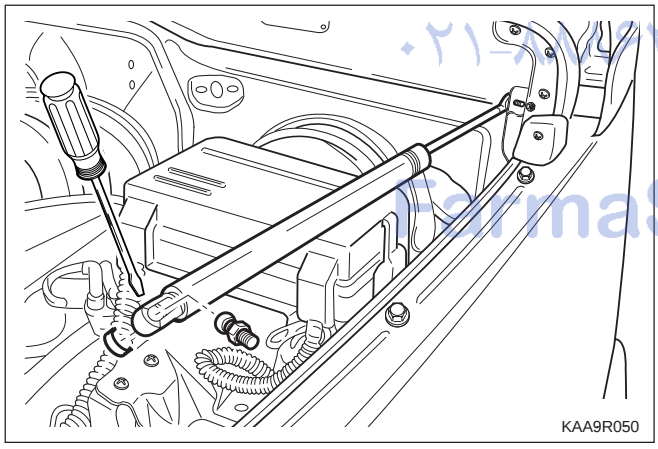
Installation Notice

Tightening Torque	12.74 - 25.48 N•m (9.4 - 18.8 lb-ft)

- Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

5. Installation should follow the removal procedure in the reverse order.

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۰۲۱-۸۸۷۲۲۰۸۵ تلفن شبانه روزی
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HOOD GAS SPRING

Removal and Installation Procedure

1. Open the hood.
2. Remove the wiper arms. Refer to *Section 9D, Wipers/Washer System*.
3. Remove the cowl vent grille with the screws.
4. Remove gas spring fix bolt and pull up the gas spring from the ball stud by spreding the retainer with screw driver.
5. Remove ball stud from hood. (or not)

Installation Notice

Tightening Torque	Spring fix bolt	9 - 11 N•m (6.63 - 8.11 lb-ft)
	Ball stud bolt	16 - 23 N•m (11.8 - 16.96 lb-ft)

6. Installation should follow the removal procedure in the reverse order.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Ball Stud Bolt	16 - 23	11.8 - 16.96	-
Hood Hinges Bolts	7.84 - 11.76	5.78 - 8.68	-
Hood to Bolts of the Hinges Bolts	12.74 - 25.48	9.40 - 18.8	-
Spring Fix Bolt	9 - 11	6.63 - 8.11	-

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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SECTION 9S

BODY REAR END

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

Description and Operation 9S-2

Fuel Filler Door 9S-2

Components Locator 9S-3

Lighting System 9S-3

Repair Instructions 9S-4

On-Vehicle Service Unit Repair 9S-4

Fuel Filler Door 9S-4

Fuel Filler Door Remote Handle and Cable 9S-4

Specifications 9S-5

Fastener Tightening Specifications 9S-5

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵

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DESCRIPTION AND OPERATION

FUEL FILLER DOOR

The fuel filler door attaches to the fuel tank pocket of the left side of the vehicle. The door is opened by pulling on the fuel filler door remote handle located on the floor in front of the driver's seat.

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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COMPONENTS LOCATOR

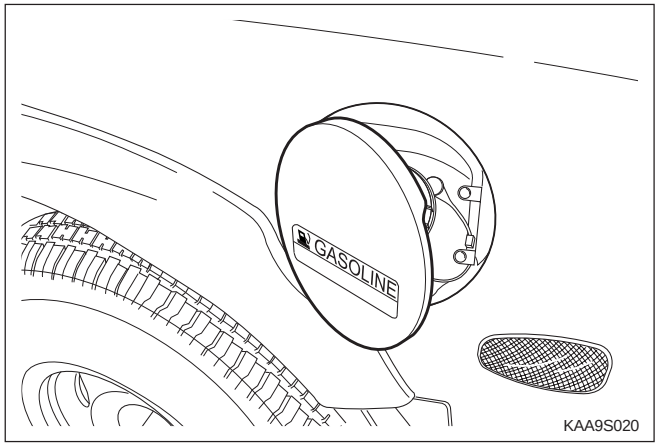
LIGHTING SYSTEM



امداد خودرو فارما
۰۲۱-۸۸۸۶۲۰۸۵ پاسخگوی شبانه روزی
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1 PNL & HE A-F/Filler DR
2 Catch & Cable-F/Filler DR
3 BRKT-F/Filler DR O/Slam
4 HDL A-F/Filler DR Release
5 Band
6 Screw-Hex SEMS

REPAIR INSTRUCTIONS



ON-VEHICLE SERVICE UNIT REPAIR

FUEL FILLER DOOR

Removal and Installation Procedure

1. Remove the bolts and the fuel filler door.

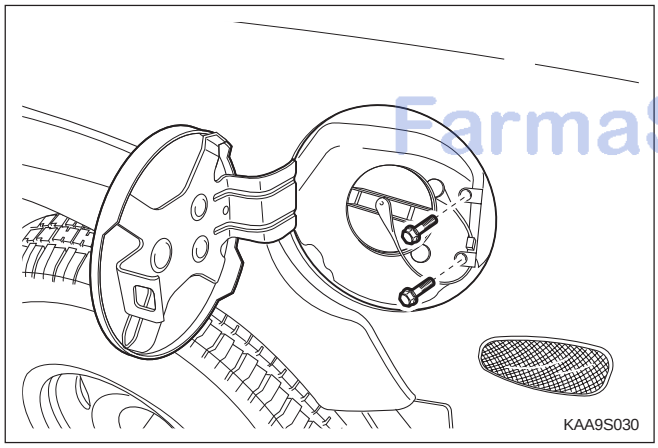
Installation Notice

Tightening Torque	3.92 - 5.49 N•m (2.92 - 4.08 lb-ft)

- Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.

2. Installation should follow the removal procedure in the reverse order.

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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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FUEL FILLER DOOR REMOTE HANDLE AND CABLE

Removal and Installation Procedure

1. Remove the front seat. Refer to *Section 9H, Seats*.
2. Remove the front floor insulator.
3. Remove the screw with the fuel filler door remote handle.
4. Remove the quarter trim panel. Refer to *Section 9G, Interior Trim*.
5. Disconnect the fuel filler door cable.
6. Installation should follow the removal procedure in the reverse order.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
Fuel Filler Door Bolts	3.92 - 5.49	2.92 - 4.08	34.71 - 48.60

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SECTION 9T1

REMOTE KEYLESS ENTRY AND ANTI-THEFT SYSTEM

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

Description and Operation 9T1-2

Remote Keyless Entry and Anti-Theft System 9T1-2

Components Locator 9T1-3

REKES & STICS 9T1-3

Diagnostic Information and Procedure 9T1-4

Input Memory 9T1-5

Repair Instructions 9T1-6

On-Vehicle Service Unit Repair 9T1-6

Receiver 9T1-6

Antenna 9T1-6

Stics 9T1-6

Schematic and Routing Diagrams 9T1-7

STICS - Stics Unit 9T1-7

STICS - Door Contact Switch 9T1-8

STICS - Keyless, Key Reminder Switch, Siren, Chime Bell Buzzer 9T1-9

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تلفن شبانه روزی: ۰۳۱-۸۸۸۶۲۰۸۵

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DESCRIPTION AND OPERATION

REMOTE KEYLESS ENTRY AND ANTI-THEFT SYSTEM

The remote keyless entry and anti-theft system can perform the following functions:

- Remotely lock and unlock the vehicle doors by means of a hand-held, high-frequency transmitter.
- Sense intrusion into the vehicle through the doors or the hood.
- Activate a warning if an intrusion is detected.
- Automatically relock the doors if thedoor or the tail gate is not opened within 30 seconds after the vehicle has been unlocked by remote keyless entry.
- Help the driver find the vehicle in a parking area.

The remote keyless entry system consist of the following components:

- STICS.
- Remote keyless entry system receiver.
- Hand-held transmitter.
- Tailgate open switch.
- Door contact switch.
- Siren.
- Hood open switch
- Key reminder switch.
- Antenna.

STICS can perform the following functions:

1. Wiper INT sening vehicle speed.
- By operating INT tiem control volume, variable time will be changed within 1.5-20 seconds
2. Washer relating wiper.
-
3. Dimming room lamp.
- When room lamp is coupled with door, it truns on if door is opened. After closing the door it maintains 2 seconds of lighting and dims off whithin 3 seconds.
4. Time delayed power window control.
- Power window can be operated within 30 seconds after truning the IGN 1 switch from ON to OFF. If driver/passenger's door is opened within the 30 seconds from that moment.
5. Rear defogger timer.
- The rear defogger will be operated for 12 min. by turning ON the defogger switch while engine is running.
- Defogger will be stopped by pushing the switch again.
- The defogger will be operated 6 mim, if push ON the switch within 10 min. after 12 min. of operation.
6. Seat belt waring.
- The warning lamp will be turned on for about 6 sec. With an intermittent chime bell when the IGN. Switch is ON unless fastening the seat belt.
7. parking brake warning.
- The indicator lamp will flash if drive while the parking brake is applied.
8. Tail lamp lighting warning.
- When the driver's door is opened while the tail lamp is still ON, the buzzer operates intermittently. In this condition, the door will be automatically unlock when it locked.
9. Door ajar warning.
- The indicator lamp will be blinking when the door is not closed completely and driving.
10. IGN key reminder.
- The chime will be operated intermittently if the driver's door is opened while the IGN key is still remain-ing in the ignition switch. In this condition, the door will be automatically unlocked when it locked.
11. Central door lock.
- All doors will be locked/unlocked by locking/ unlocking the driver's or passenger's door.
12. coupled with REKES.
- Being coupled with REKES (remote keyless entry system), all doors will be locked/unlocked according to signals of transmitter when the ignition key is not inserted.
13. iginition key hole illumination.
- coupled with door switch, ignition key hole illumination lamp will trun on when the driver 's door is opened and will dim off after 10 sec. After closing the door.
14. Auto door lock.
- All doors will be locked automatically if the vehicle speed reaches 50 km/h though the doors are in unlock.
15. Auto door unlock.
- All doors will be automatically unlock if the vehicle crashes while driving (over 15km/h).

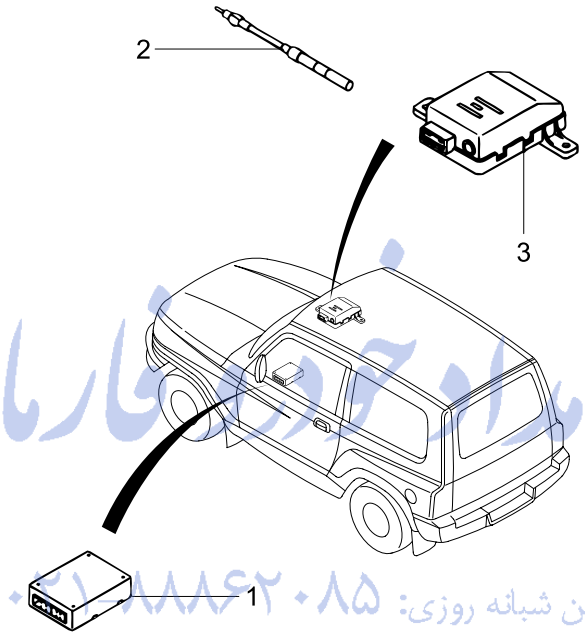
Operate the burglar alarm.

1. Burglar alarm must operate immediately when the door, tailgate or hood is opened with improper ways after all doors and hood were closed and continued this status for 1 seconds.
2. If the tailgate is opened by key when the system is on the burglar alarm cindition, the sysem must be changed to the second burglar alarm condition frim normal condition.

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COMPONENTS LOCATOR

REKES & STICS



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KAA9T010

1. Remote Keyless Entry System Receiver
2. Antenna
3. STICS

DIAGNOSTIC INFORMATION AND PROCEDURE

DIAGNOSIS TEST

Introduction

Using the service connector, possible defects in power section, input output section of internal STICS unit can be detected and each normal status and defect mode can be checked.

Diagnosis method

1. Use buzzer for diagnosis check status output.
2. Following function outputs should not act when diagnosis switch is ON (STICS in the diagnosis socket box : connection of No. 7 and ground No. 1)

- Tail lamp ON warning (buzzer output stop, door lock/unlock output stop)
- Seat belt warning (chime bell output stop)
- Central door lock (door lock/unlock output stop)

3. Functions in No. 2 should be restored when diagnosis switch is OFF.
4. Check output should be made once while the diagnosis switch is ON.
5. When inputs are made by operating each different switches more than 2 continuously, make output according to input order (buzzer ON) and trun off the buzzer for 1 second and than make other remaining outputs for input switch.
6. Buzzer output is as follows.

T1 : 0.3 ± 0.1 sec.

T2 : 0.3 ± 0.1 sec.

T : 0.6 ± 0.2 sec.

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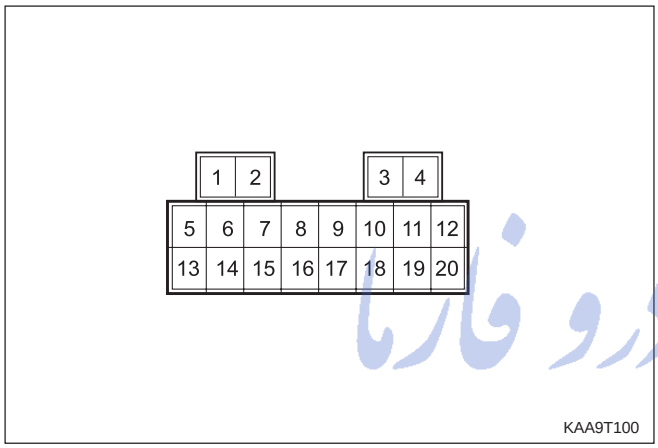
Note:

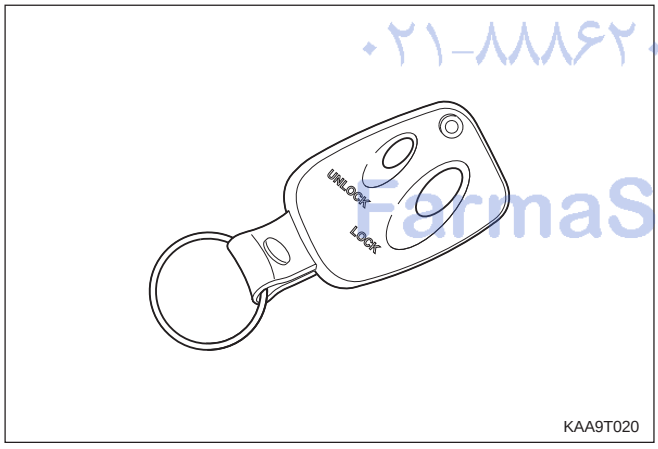
- In case of checking related devices, there will be buzzer sound if it is normal and no buzzer sound if it is defective.

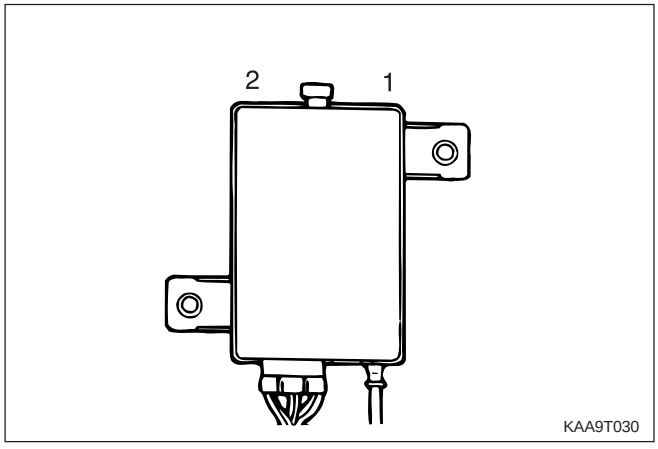
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Step	Required Condition	Action	Valve (s)	Remark
1	Diagnosis switch ON	Confirm thediagnosis function start	Buzzer once	Diagnosis switch ON
2	Battery voltage supply	Check the battery	Buzzer twice	
3	Operation of battery and related devices	Tailgate, rear door lock switch	Buzzer once	
4		Driver's door lock switch	Buzzer once	
5		Passenger's door lock switch	Buzzer once	
6		Driver's door switch	Buzzer once	
7		Passenger and rear door switch	Buzzer once	
8		REKES input	Buzzer once	
9	IGN key insertion	Key reminder switch	Buzzer once	
10	Operation of IGN and related devices	IGN and power window relay	IGN 1 buzzer twice, IGN 2 buzzer once, Power window buzzer 3 times	
11		Parking brake switch	Buzzer once	
12		Seat belt switch	Buzzer once	
13		Washer switch	Wiper motor parking 3 times, washer switch once, wiper relay twice	

Step	Required Condition	Action	Valve (s)	Remark
14	Operation of IGN and related devices	Wiper auto switch	Wiper motor parking 3 times, washer switch once, wiper relay twice	
15		ALT 'L'	Buzzer once	
16	Operation of IGN and starting and related devices	Volume variable switch	Buzzer once	
17		Defogger switch	Buzzer once	
18		Speed sensor signal	Buzzer once	







INPUT MEMORY

- When the REKES transmitter is lost

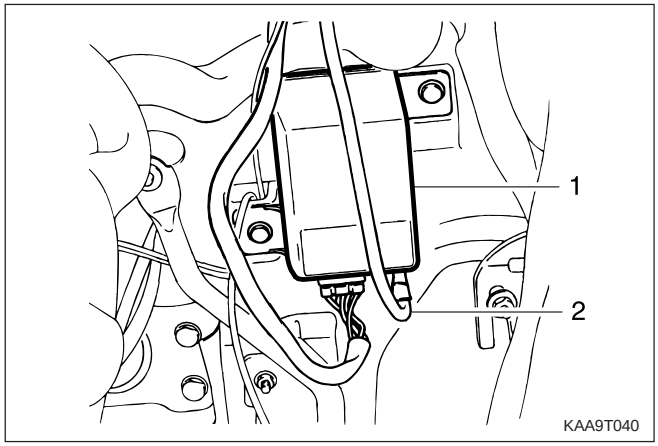
1. Connect the battery terminal No. 3 and REKES terminal No. 4 which are on the diagnosis socket under the dash board with service lead wire.
2. push the lock or unlock button on the REKES transmitter.
3. Input memory and close all doors.
4. Check the operation of door locking system by pushing the lock or unlock button on the REKES transmitter.

- When the transmitter is faulty

1. Connect the battery terminal No. 3 and REKES terminal No. 4 which are on the diagnosis socket under the dash board with service lead wire.
2. Set the input switch of the REKES receiver onto the No. 1 or No. 2 position and push the lock or unlock button on the REKES transmitter.
3. Set the input switch of the REKES receiver onto the central position and close all doors.
4. Check the operation of door locking system by pushing the lock or unlock button on the REKES transmitter.

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REPAIR INSTRUCTIONS



1 Receiver
2 Antenna

ON-VEHICLE SERVICE UNIT REPAIR

RECEIVER

Removal and Installation Procedure

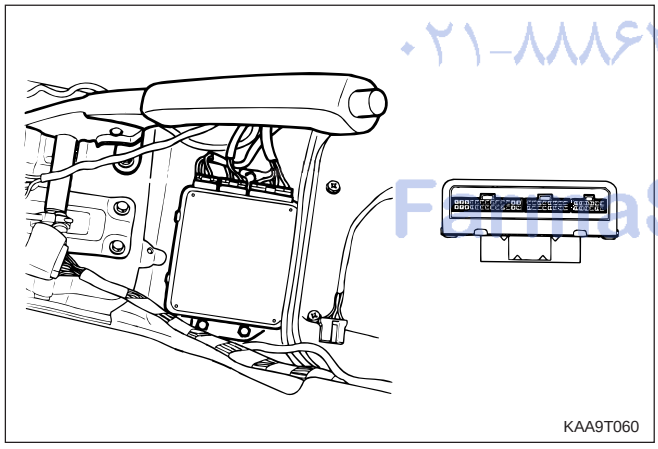
1. Remove the bolts with the receiver.
   - Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.
2. Installation should follow the removal procedure in the reverse order.

ANTENNA

Removal and Installation Procedure

1. Disconnect the antenna cable from the receiver.
2. Remove the REKES antenna.
3. Installation should follow the removal procedure in the reverse order.

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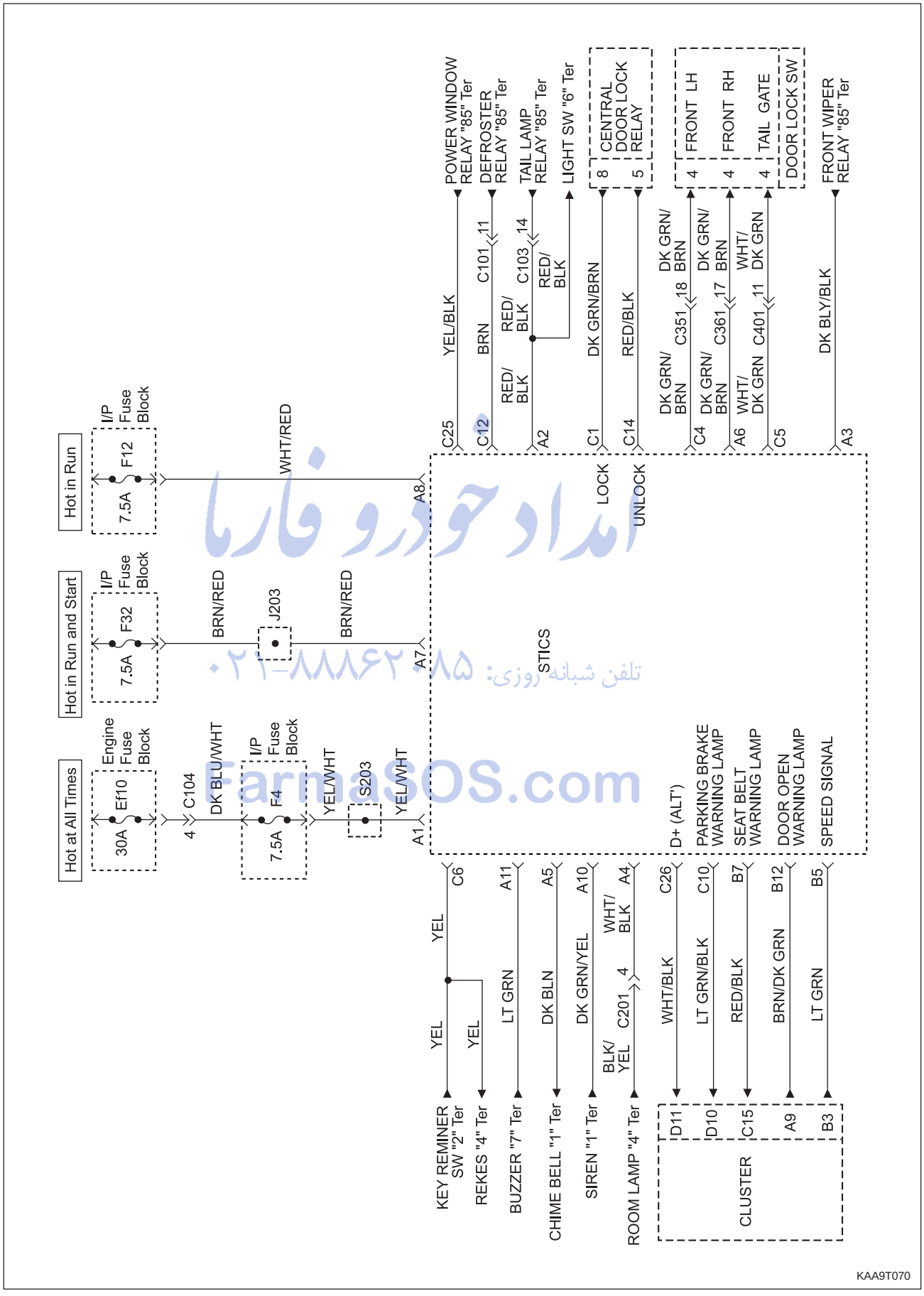
STICS

Removal and Installation Procedure

1. Disconnect the negative battery cable.
2. Remove the floor console. Refer to *Section 9G, Interior Trim*.
3. Disconnect the electrical connector.
4. Remove the bolts with the STICS.
   - Dissimilar metals in direct contact with each other may corrode rapidly. Make sure to use the correct fasteners to prevent premature corrosion.
5. Installation should follow the removal procedure in the reverse order.

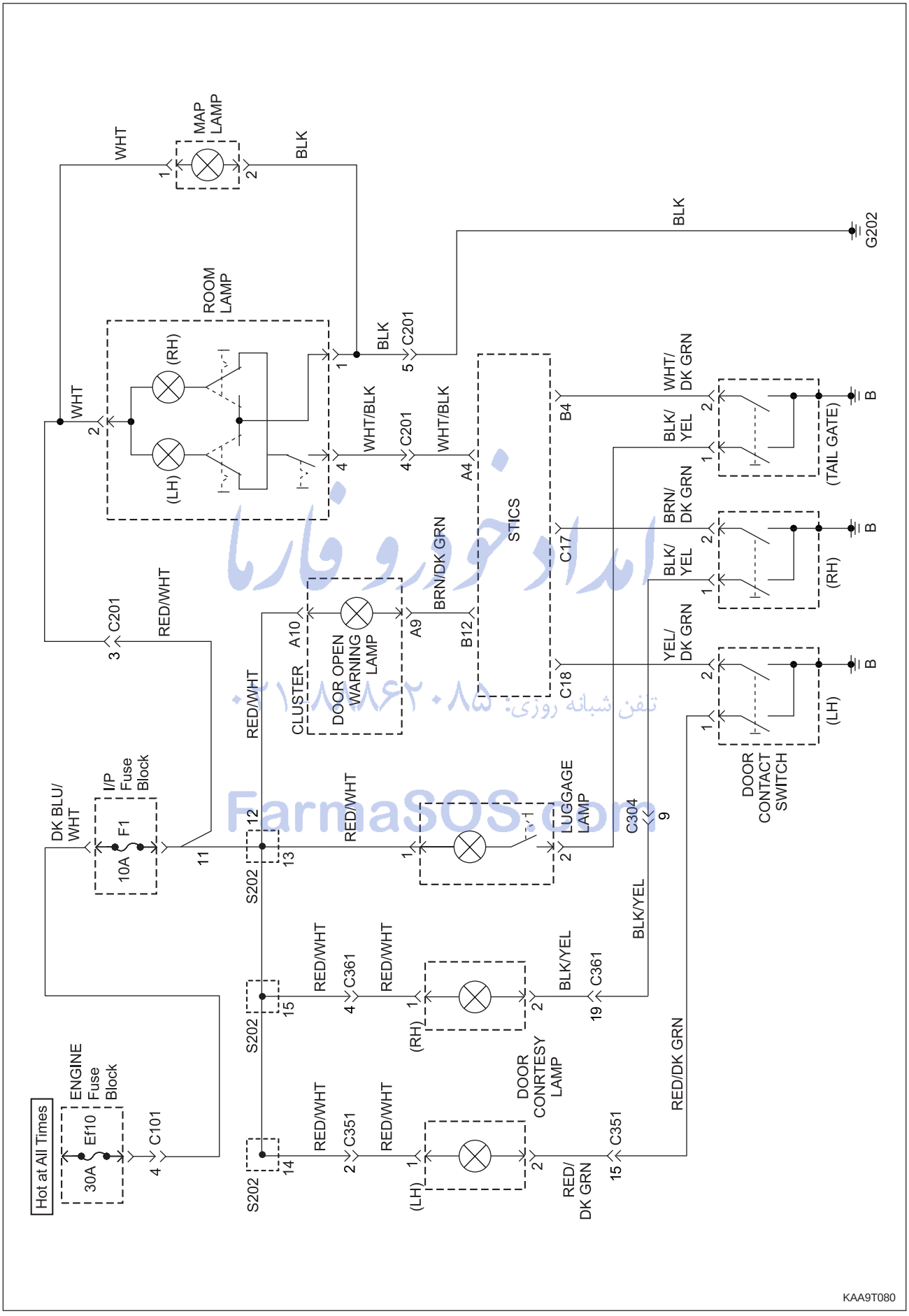
SCHEMATIC AND ROUTING DIAGRAMS

STICS - STICS UNIT



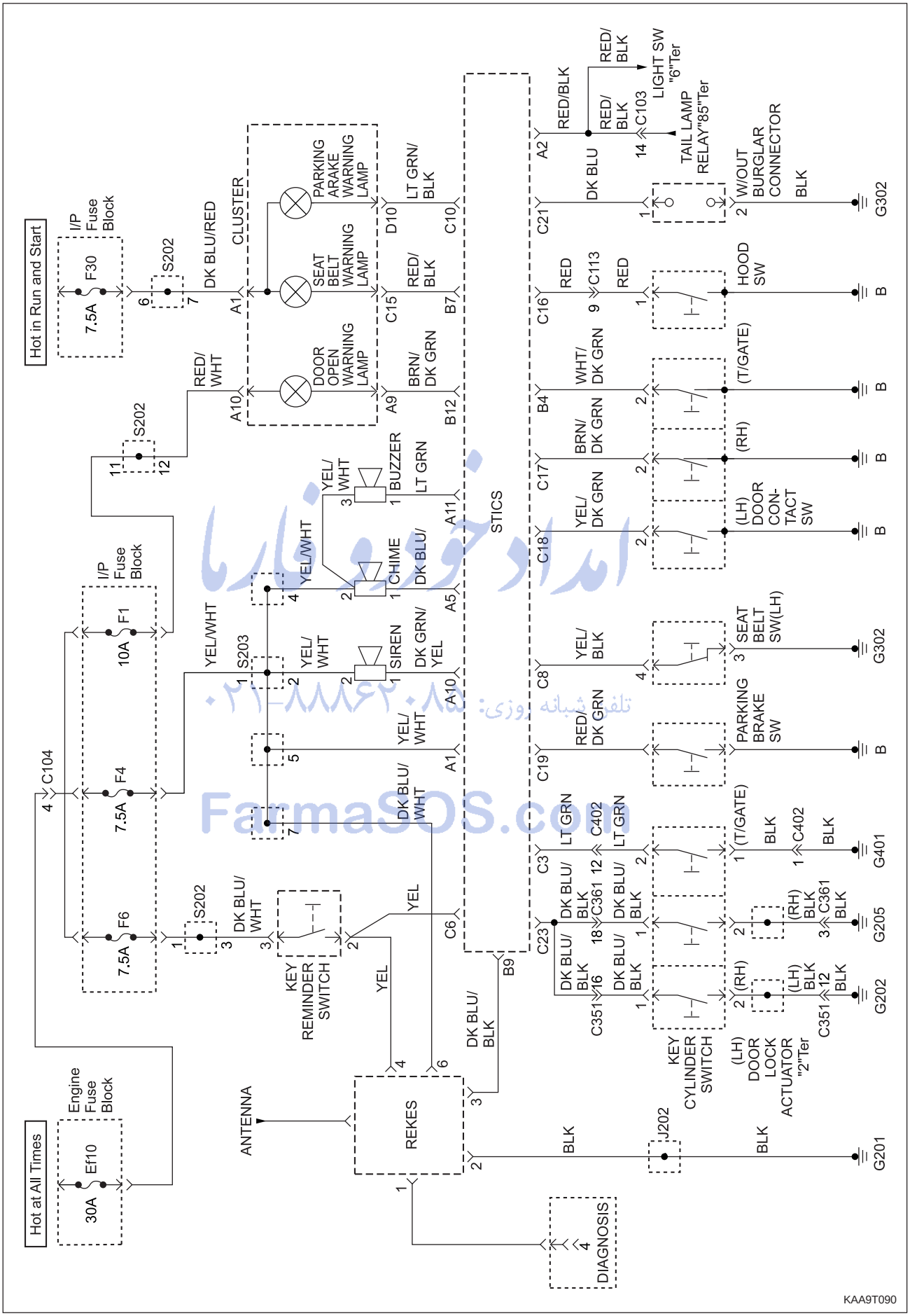
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STICS - DOOR CONTACT SWITCH



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STICS - KEYLESS, KEY REMINDER SWITCH, SIREN, CHIME BELL BUZZER



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SECTION 9T2

IMMOBILIZER SYSTEM

CAUTION: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

Description and Operation 9T2-2

Components Locator 9T2-3

Immobilizer System 9T2-3

Repair Instructions 9T2-4

On-Vehicle Service Unit Repair 9T2-4

Immobilizer Antenna 9T2-4

Transponder Replacement 9T2-4

Schematic and Routing Diagrams 9T2-5

Immobilizer System (Diesel : Vod) 9T2-5

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DESCRIPTION AND OPERATION

Immobilizer is a device disabling vehicle ignition unless a speific key is used and designed to help prevent vehicle theft.

Immobilizer is comprised of two devices, a key with encoded transponder and engine control unit (ECU) with the same encoding of the transponder. When a key is inserted into the key hole to start vehicle and turned to 'ON', the ECU reads and decodes the transponder code and, if the same, starts the engine, it is called immobilizer. It means immobilizer system disables starting by stopping fuel supply if the code in the transponder does not match the code stored in ECU each other.

Notice:

- If vehicle is equipped with immobilizer system and the engine cranks normally but not start, check immobilizer system first rather than ignition and other electrical systems because it can be disabled fuel supply of injectors by ECU due to defective immobilizer system.
- Programming of the immobilizer system will be performed by authorized personnel only. If following defective codes for immobilizer system appear during diagnosis of vehicle with SCANNER, ask immobilizer programming to authorized personnel and actual programming should be performed by authorized per-sonnel only.
  - Display of defectives relevant to immobilizer system : SCANNER
    1. No communication with transponder
    2. No immobilizer programming
- The transponder in the key can be damaged by shocks of dropping or hitting other objectives, so handle it with care.
- Each supplied key has programming of code on its own. Accordingly if ECU needs to be replaced, replace the transponder in the key.
- The vehicle equipped with immobilizer system will never be started with remote ignition device, so do not attempt to install it.
- The immobilizer system will never be removed from the vehicle. So never attempt to remove it to install a remote ignition device or others.
- If engine does not start during service, use every key to start the engine and then check immobilizer sys-tem finally.

Cases that requires immobilizer programming

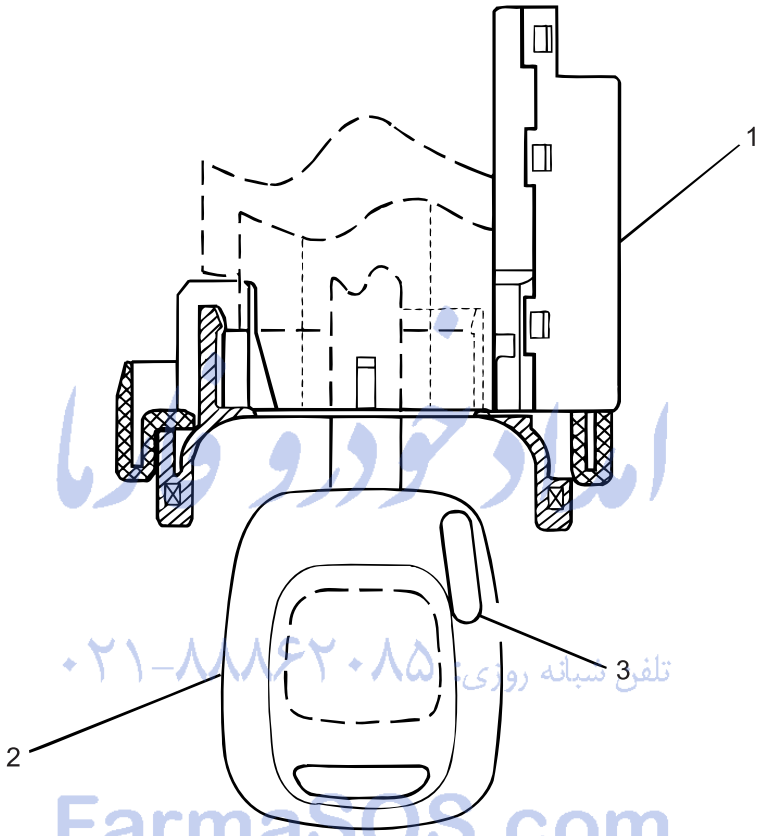
1. Replacement ECU

   In this case, replace the every transponder of the key at once.
2. Replacement of the transponder
3. Additional key for lost 1 or 2 keys
   1) Clear all codes for current keys from the ECU
   2) When using current key : clear code of the transponder and re-program it
   3) Additional (purchased) key : perform programming
4. When lost all keys
   1) Clear all memorized key codes from the ECU
   2) Replace the key and key set
   3) Immobilizer programming

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COMPONENTS LOCATOR

IMMOBILIZER SYSTEM

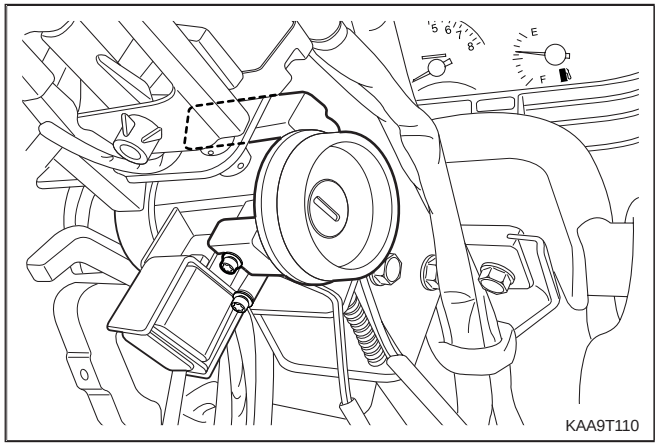


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1. Immobilizer Antenna
2. Key
3. Transponder

REPAIR INSTRUCTIONS

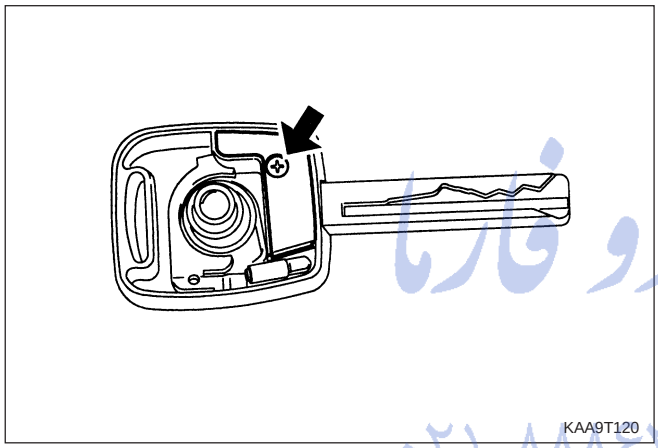


ON-VEHICLE SERVICE UNIT REPAIR

IMMOBILIZER ANTENNA

Removal and Installation Procedure

1. Remove the combination switch upper and lower cover. Refer to S*ection 6E, Steering Wheel and colmun*.
2. Remove the immobilizer antenna.
3. Installation should follow the removal procedure in the reverse order.

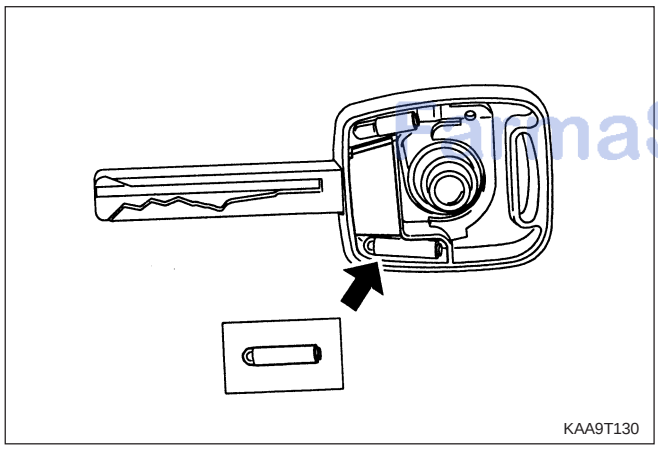


TRANSPONDER REPLACEMENT

Removal Procedure

1. Open the cover on key handle.
2. Remove the small screw in symmetrical position of key illumination.
3. Remove the cover.

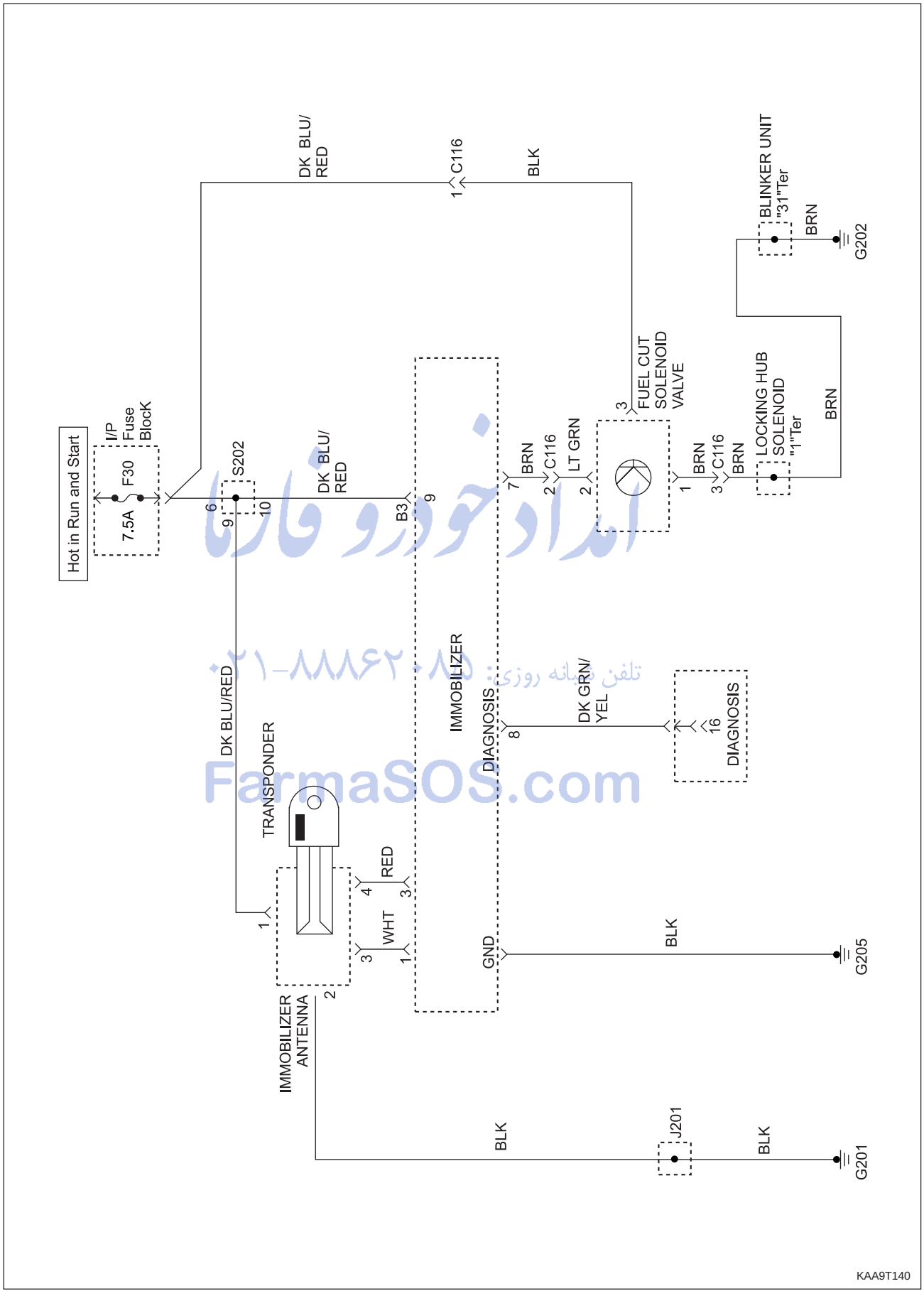
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4. Remove the transponder. Carefully remove the old shock absorbing sealant with a razor blade if applied.
5. Replace the transponder with new one, and apply the small amount of shock absorbing sealant.
6. Installation should follow the removal procedure in the reverse order.
7. Installation should follow the removal procedure in the reverse order.

SCHEMATIC AND ROUTING DIAGRAMS

IMMOBILIZER SYSTEM (DIESEL : VOD)



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SECTION 1

HOW TO USE ELECTRICAL WIRING DIAGRAM

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CONTENTS

1. HOW TO READ ELECTRICAL WIRING DIAGRAM 1-2

2. CIRCUIT IDENTIFICATION SYMBOL 1-3

3. FUNCTION OF POWER SUPPLY LINE 1-3

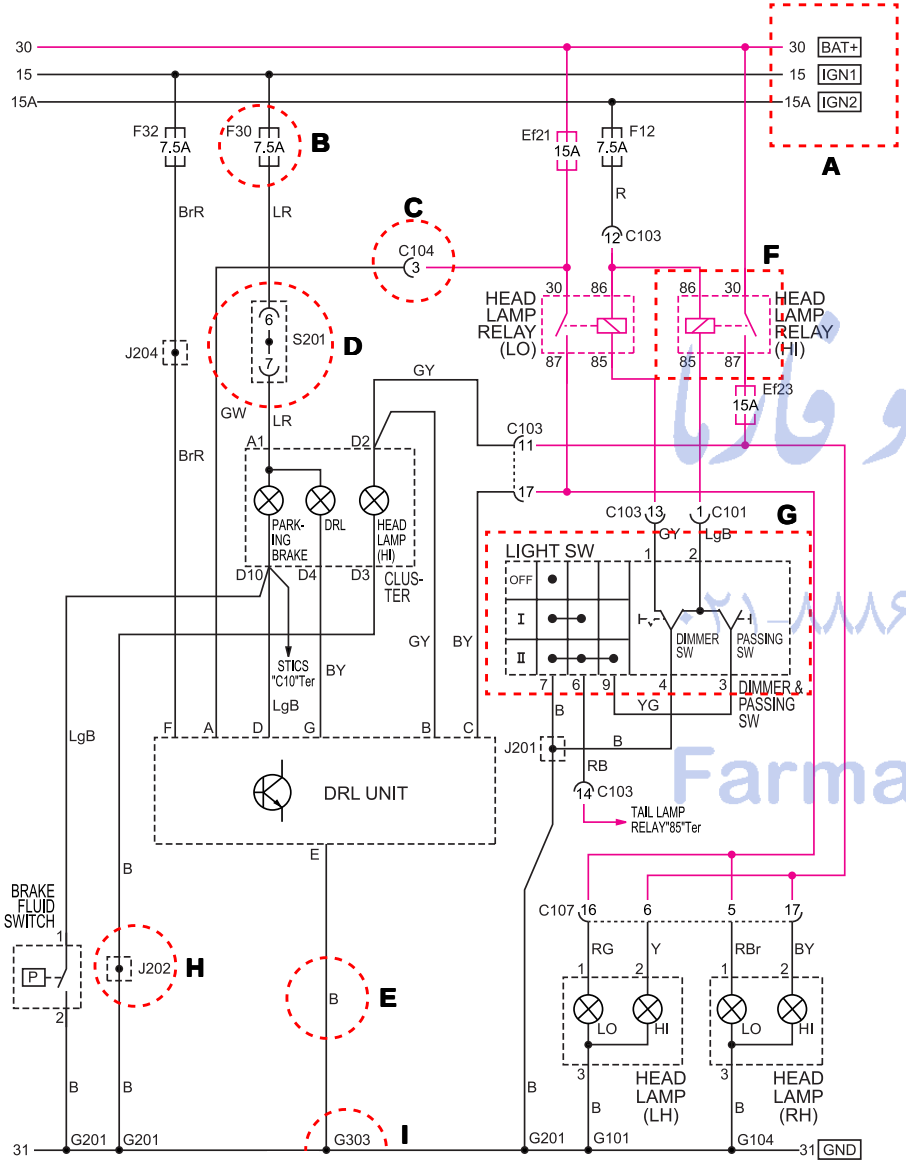
4. WIRING HARNESS COLOR IDENTIFICATION 1-3

5. HOW TO CHECK TERMINAL NUMBER OF CONNECTOR 1-3

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1. HOW TO READ ELECTRICAL WIRING DIAGRAM



1) CONTENTS OF ELECTRICAL WIRING DIAGRAM (CIRCUIT)

POSITION	EXPLANATION
A	- Upper horizontal lines : Power supply lines - Power supply lines : 30, 15, 15A, 15C, 58
B	- Ef20 or F2 : Fuse Number • Ef20 : Fuse No #20 in engine room compartment • F2 : Fuse No #2 in passenger room compartment
C	- Connector (C101~C901) • Connector No C203 terminal No1 * Refer to Major Connector Position (Section 2)
D	- S201 : Splice pack (S101~S306) * Refer to Major Splice Pack Position (Section2)
E	- Wiring Harness Color * Refer to Wiring Harness Color Abbreviation
F	- Internal circuit of component (Relay) (Component Name and Terminal Number)
G	- Internal circuit of component (Switch) (Component Name, Terminal Number and Connecting Wiring Circuit)
H	- J201 : Joint(J101~J401) * Refer to Major Joint Position(Section2)
I	- Lower horizontal line : Ground line • Ground position(G101~G402) • B : Body Ground * Refer to Major Ground Position (Section2)

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2. CIRCUIT IDENTIFICATION SYMBOL

IDENTIFICATION SYMBOL	MEANING
C	Connector
D	Diode
Ef	Fuse in engine room fuse & relay box
F	Fuse in passenger room fuse box
G	Ground
J	Joint - Inline wire connected point
S	Splice pack(Junction connector)

3. FUNCTION OF POWER SUPPLY LINE (NUMBER)

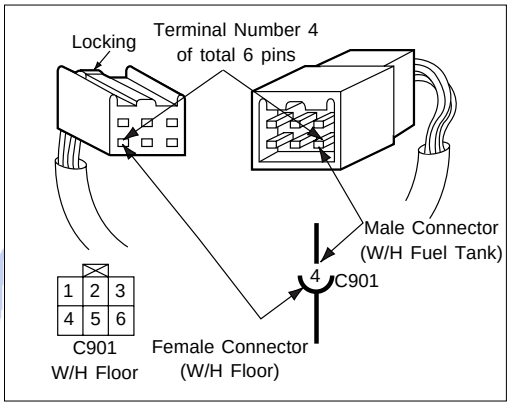
Power supply No	Power supply condition
15	Battery Voltage(B+) supply in Ignition Switch "ON" and "ST" (IGN 1)
15A	Battery Voltage(B+) supply in Ignition Switch "ON" (IGN 2)
15C	Battery Voltage(B+) supply in Ignition Switch "ON" and "ACC"
30	Battery Voltage(B+) supply directly regardless of Ignition Switch
31	Ground connected to battery(–)
58	Battery Voltage(B+) supply in Head Lamp Switch 1st and 2nd step (Illumination circuit)

4. WIRING HARNESS COLOR IDENTIFICATION

Abbreviation	Color	Abbreviation	Color
Br	Brown	Sb	Sky Blue
G	Green	R	Red
V	Violet	L	Blue
P	Pink	Y	Yellow
W	White	Gr	Gray
Or	Orange	B	Black
Lg	Light Green		

5. HOW TO CHECK TERMINAL NUMBER OF CONNECTOR

- Terminal number is given based on Female Terminal Connector
  ex) Terminal Number 4 of C901 connection



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2. CIRCUIT IDENTIFICATION SYMBOL

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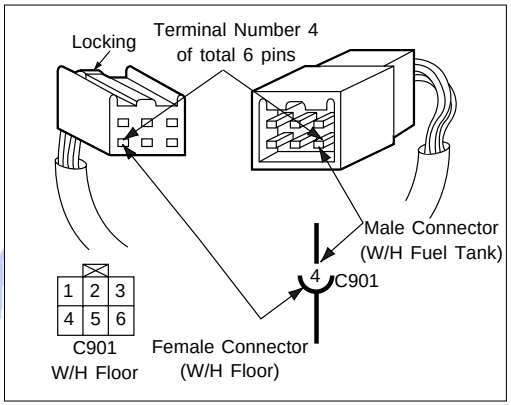
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Lg	Light Green		

5. HOW TO CHECK TERMINAL NUMBER OF CONNECTOR

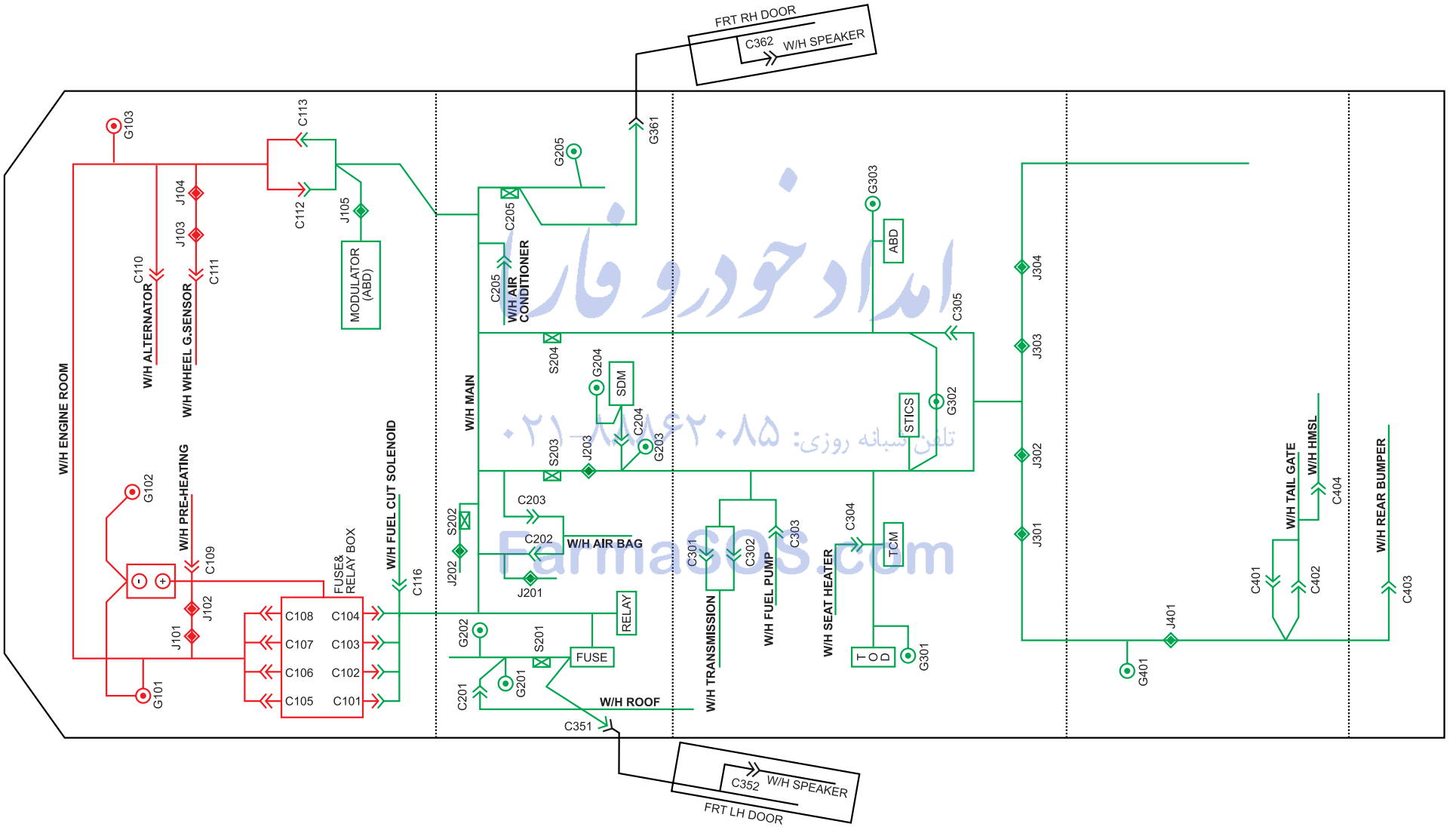
- Terminal number is given based on Female Terminal Connector
  ex) Terminal Number 4 of C901 connection



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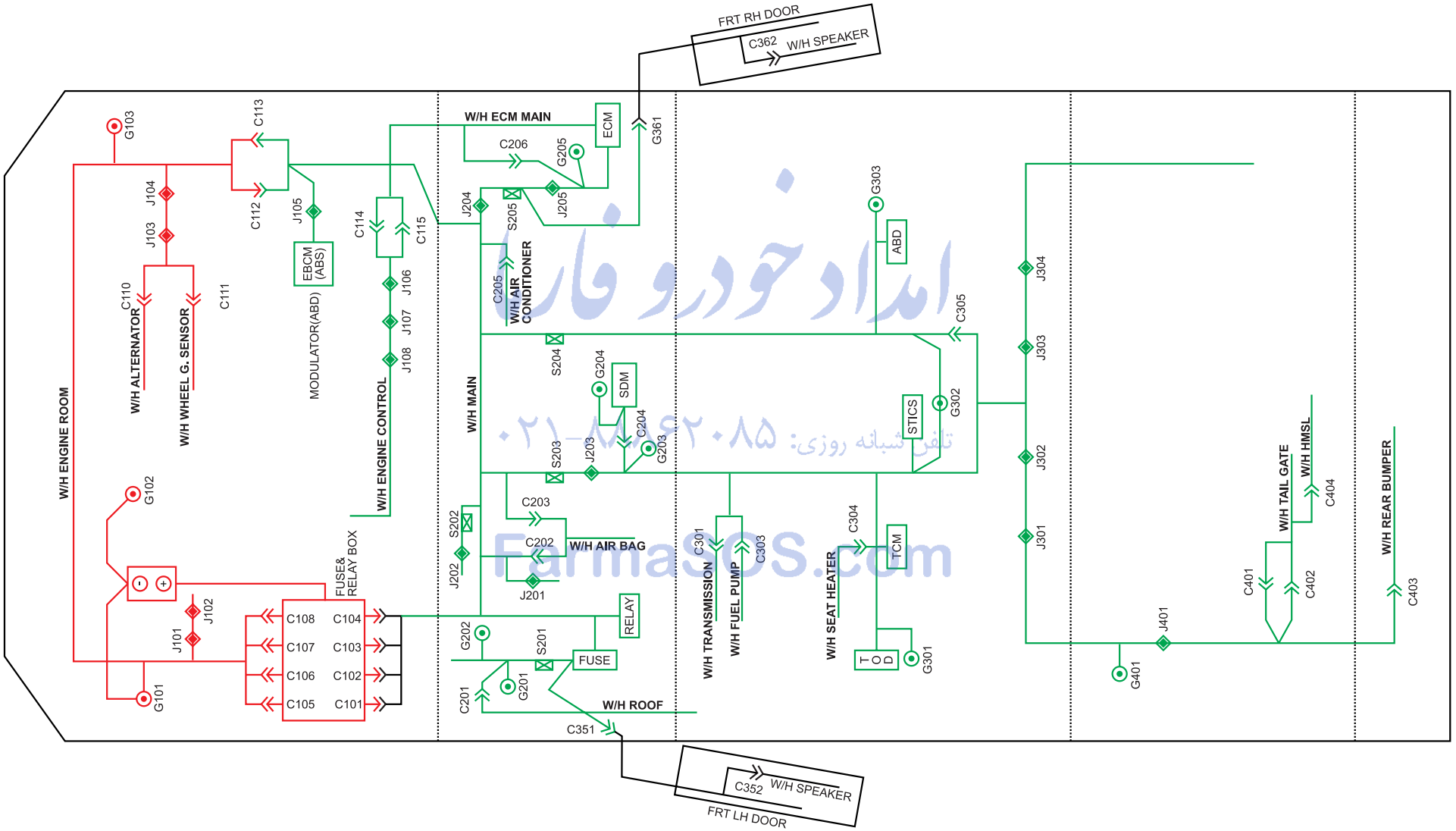
1. POSITION OF CONNECTOR, GROUND, SPLICE PACK & JOINT

DIESEL VEHICLE



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GASOLINE VEHICLE



2. CONNECTOR, GROUND AND SPLICE PACK INFORMATION

1) CONNECTOR

Connector Number (Pin Number, Color)	Connecting Wiring Harness	Connector Position	Remark
C101 (19Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box	
C102 (4Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box	
C103 (22Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box	
C104 (8Pin, Colorless)	Engine Room FuseBox - W/H Main	Engine Room Fuse Box	
C105 (10Pin, White)	Engine Room Fuse Box - W/H Engine Room	Engine Room Fuse Box	
C106 (3Pin, Black)	Engine Room Fuse Box - W/H Engine Room	Engine Room Fuse Box	
C107 (20Pin, White)	Engine Room Fuse Box - W/H Engine Room	Engine Room Fuse Box	
C108 (6Pin, Colorless)	Engine Room Fuse Box - W/H Engine Room	Engine Room Fuse Box	
C109 (1Pin, Black)	W/H Engine Room - W/H Pre - Heating	Bhind Battery	Diesel only
C110 (2Pin, Black)	W/H Engine Room - W/H Alternator	Below Air Cleaner	Gasoline
C110 (4Pin, Black)	W/H Engine Room - W/H Alternator	Below Air Cleaner	Diesel
C111 (3Pin, Black)	W/H Engine Room - W/H Wheel G. sensor	Upper Front Right Control Arm	
C112 (6Pin, Black)	W/H Engine Room - W/H Main	Next to Hydraulic Unit	
C113 (12Pin, Black)	W/H Engine Room - W/H Main	Next to Hydraulic Unit	
C114 (6Pin, Gray)	W/H Engine Control - W/H ECM Main	Behind Hydraulic Unit	Gasoline
C115 (40Pin, Black)	W/H Engine Control - W/H ECM Main	Behind Hydraulic Unit	Gasoline
C116 (3Pin, Black)	W/H Main - W/H Fuel Cut Solenoid	Next to Engine Room Fuse Box	Diesel
C201 (8Pin, White)	W/H Main - W/H Roof	Inside Left Cluster	
C202 (4Pin, White)	W/H Main - W/H Air Bag	Above FRT LH Seat Under Cover	
C203 (2Pin, Black)	W/H Main - W/H Air Bag	Above FRT LH Seat Under Cover	
C204 (4Pin, Colorless)	W/H Main - W/H SDM	Lower Rear Center Facia	
C205 (17Pin, White)	W/H Main - W/H Air Conditioner	Upper Evaporator	
C206 (6Pin, Black)	W/H Main - W/H ECM Main	Lower "A" Piller(Upper ECM)	Gasoline
C301 (2Pin, Black)	W/H Main - W/H Transmission	Upper Transfer Case	Manual T/M
C301 (16Pin, Black)	W/H Main - W/H Transmission	Upper Transfer Case	Automatic T/M
C302 (10Pin, Black)	W/H Main - W/H Transmission	Upper Transfer Case	Diesel
C303 (3Pin, Black)	W/H Main - W/H Fuel Pump	Upper Transfer Case	Diesel
C303 (4Pin, Black)	W/H Main - W/H Fuel Pump	Upper Transfer Case	Gasoline
C303 (6Pin, Black)	W/H Main - W/H Fuel Pump	Upper Transfer Case	GSL : EURO III
C304 (10Pin, White)	W/H Main - W/H Seat Heater	Below FRT LH Seat	
C305 (14Pin, White)	W/H Main - W/H Main	Below Center Console	
C351 (22Pin, White)	W/H Main - W/H FRT LH Door	Upper Fuse Box (Passenger Room)	
C352 (2Pin, Black)	W/H FRT LH Door - W/H Speaker	Inside FRT LH Door Trim	
C361 (22Pin, Blue)	W/H Main - W/H FRT RH Door	Behind Front Right Panel	
C362 (2Pin, Black)	W/H FRT RH Door - W/H Speaker	Inside FRT RH Door Trim	
C401 (2Pin, Black)	W/H Tail Gate - W/H Main	Behind Left Tail Lamp	
C402 (12Pin, Black)	W/H Tail Gate - W/H Main	Behind Left Tail Lamp	
C403 (3Pin, Black)	W/H Rear Bumper - W/H Main	Inside Rear Bumper	
C404 (2Pin, Black)	W/H Tail Gate - W/H HMSL	Inside Tail Gate	

2) SPLICE PACK

Splice Pack Number	Pin Number	Color	Wiring Harness	Splice Pack Position
S201	8	Colorless	W/H Main	Upper Fuse Box(Passenger Room)
S202	20	Black	W/H Main	Behind Cluster
S203	14	Colorless	W/H Main	Behind 4WD Switch
S204	14	Colorless	W/H Main	Behind Audio
S205	8	Colorless	W/H Main	Behind Front Right Kick Panel

3) GROUND

Number Ground	Wiring Harness	Ground Position
G101	W/H Engine Room	Left Fender Next to Battery
G102	Battery	Center Engine Block
G103	W/H Engine Room	Right Fender Engine Room
G201	W/H Main	Upper Front Left Leg Room
G202	W/H Main	Upper Front Left Leg Room
G203	W/H Main	Left Upper Center Facia
G204	W/H Main	Left Lower Center Facia
G205	W/H Main	Center "A" Pillar Front Right
G301	W/H Main	Below Front Left seat
G302	W/H Main	Below Center Console
G303	W/H Main	Below Front Right seat
G401	W/H Main	Inside Lower Trim Rear Left Quater

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4) JOINT

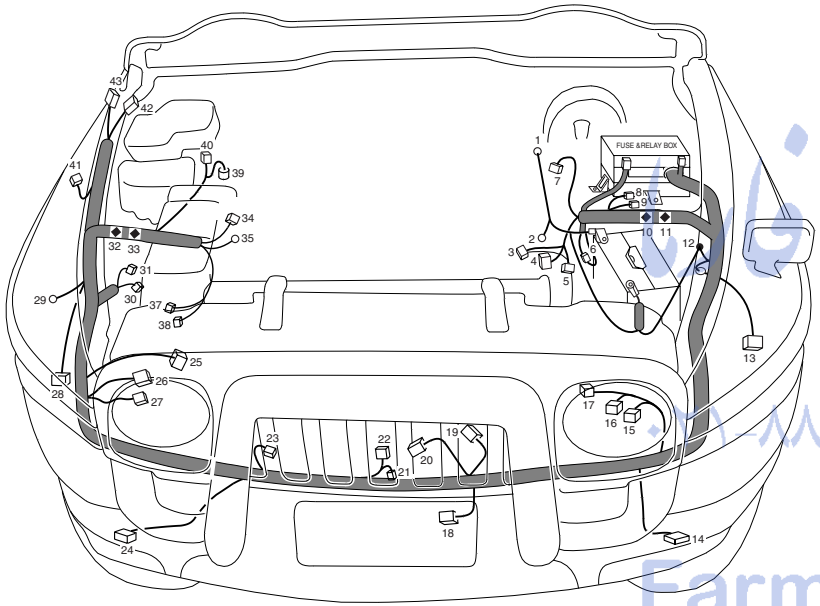
Joint Number	Wiring Harness	Joint Position	Remark
J101	W/H Engine Room	Behind Battery	
J102	W/H Engine Room	Behind Battery	
J103	W/H Engine Room	Below Air Cleaner	
J104	W/H Engine Room	Below Air Cleaner	
J105	W/H Main	Next to Hydraulic Unit	Gasoline
J106	W/H Engine Control	Behind Hydraulic Unit	Gasoline
J107	W/H Engine Control	Next to Yellow Label	Gasoline
J108	W/H Engine Control	Upper Injector #4 (4CYL) or #6 (6CYL)	Gasoline
J201	W/H Main	Above FRT LH Seat Under Cover	
J202	W/H Main	Behind Cluster	
J203	W/H Main	Next to BTSI Unit	
J204	W/H Main	Upper Blower Unit	Gasoline
J205	W/H Main	Behind Front Right Kick Panel	Gasoline
J301	W/H Main	Below Rear Left Seat	
J302	W/H Main	Below Rear Left Seat	
J303	W/H Main	Below Rear Right Seat	
J304	W/H Main	Below Rear Right Seat	
J401	W/H Main	Below Luggage Lamp	

*CYL : Cylinder

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3. WIRING HARNESS & CONNECTOR & GROUND LOCATION

1) W/H ENGINE ROOM

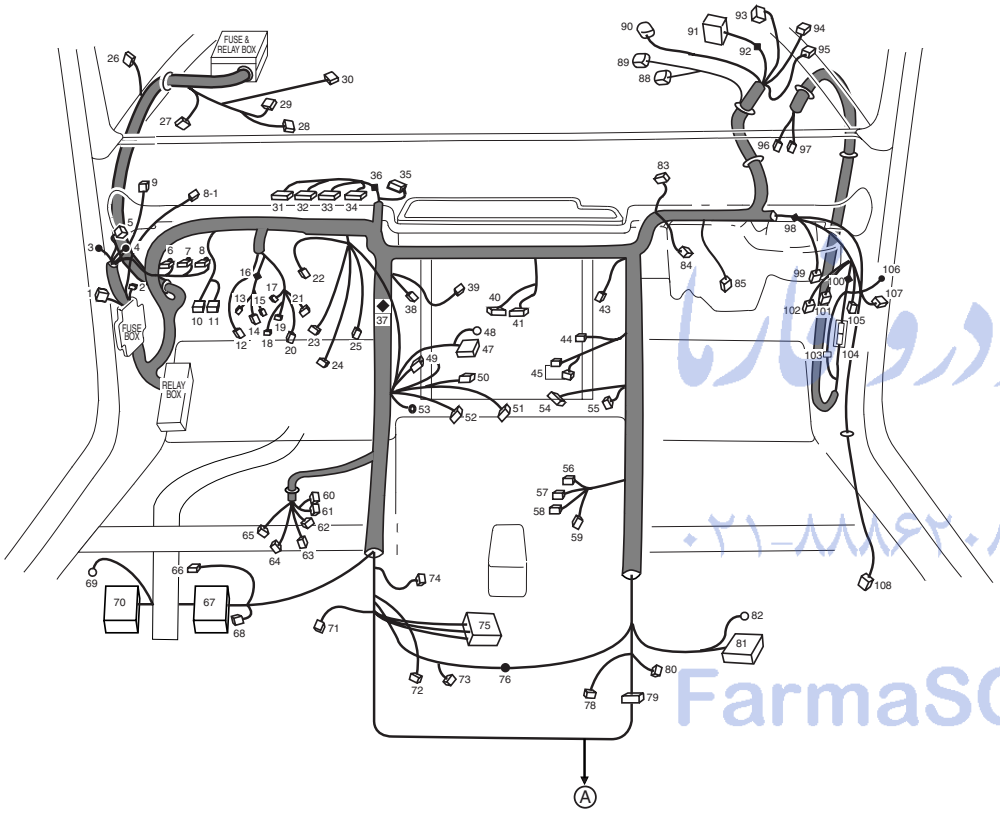


1. Starting motor
2. G102
3. -
4. Compressor
5. Wheel speed sensor(FRT LH)
6. Starting motor "ST" terminal connector
7. Canister purge valve (Gasoline E/G)
8. Pre-heating time control unit (Diesel E/G)
9. C109 (Diesel E/G)
10. J102
11. J101
12. G101
13. Turn signal & position lamp(FRT LH)
14. Fog lamp(FRT LH)
15. Head lamp(FRT LH)
16. HLLD (FRT LH)
17. Hood switch
18. Thermo switch (Diesel E/G)
19. LH horn
20. Condenser fan motor-Non A/conditioner
21. Condenser fan motor(LH)
22. Resistor
23. RH horn
24. Fog lamp(FRT RH)
25. Condenser fan motor(RH)
26. Head lamp(FRT RH)
27. HLLD (FRT RH)
28. Turn signal & position lamp(FRT RH)
29. G103
30. C110 (Diesel E/G)
31. Alternator B+ (Diesel E/G)
32. J104
33. J103
34. C110 (Gasoline E/G)
35. Alternator B+ (Gasoline E/G)
36. -
37. C111
38. Wheel speed sensor(FRT RH)
39. Dual pressure switch
40. Washer motor
41. ADD (FRT RH)
42. C112
43. C113

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2) W/H MAIN

- **W/H MAIN**



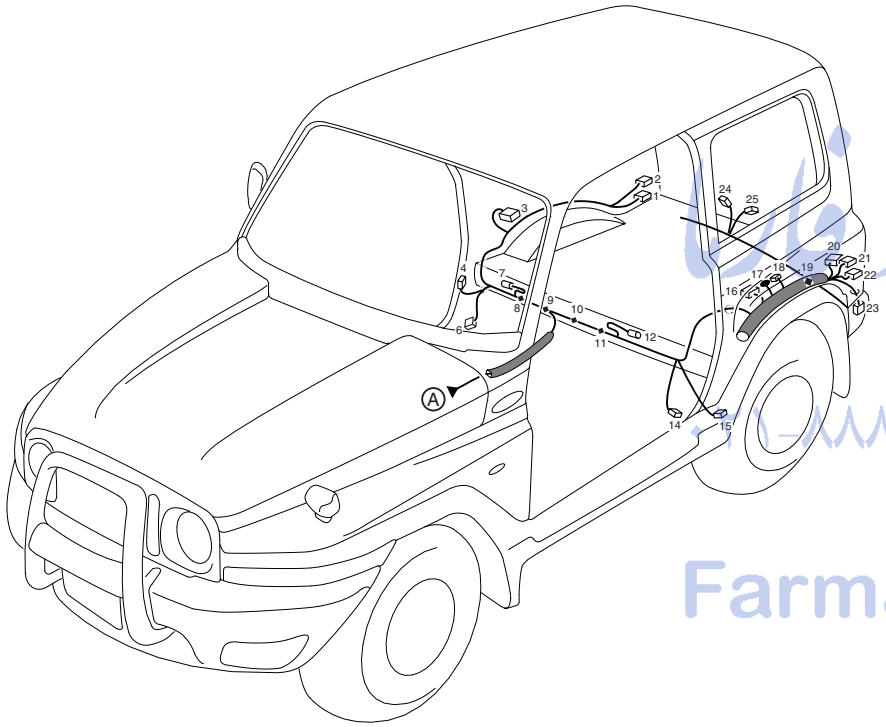
1. C351
2. S201
3. G201
4. G202
5. Auto down unit
6. HLLD switch
7. OSRV switch
8. Rear wiper & washer switch

8-1. DLC

9. C201
10. Clutch switch "A"
11. Clutch switch "B" (Gasoline E/G)
12. Stop lamp switch
13. Dimmer & passing switch
14. Turn signal,FRT fog lamp & Light switch
15. Wiper switch
16. J201
17. C202
18. Immobilizer antenna
19. Ignition switch
20. Cruise control switch
21. Key reminder switch
22. C203
23. Acceleration pedal sensor
24. Kick down switch
25. REKES
26. ADD' (LH)
27. Diagnosis connector
28. Brake fluid switch
29. Locking hud solenoid (TCCU)
30. C116
31. Cluster "D"
32. Cluster "C"
33. Cluster "B"
34. Cluster "A"
35. J202
36. J202
37. J203
38. S203
39. 4WD switch
40. Hazard switch
41. Defroster switch
42. -
43. Antenna feeder cable
44. S204
45. Audio
46. -
47. SDM
48. G204
49. C204
50. Chime Bell
51. Buzzer
52. Acceleration sensor
53. G203
54. Cigar lighter
55. Central door lock relay
56. BTSI solenoid
57. A/Tsocket
58. BTSI "P" position sw
59. Mode switch
60. Shift motor
61. Speed sensor & clutch coil
62. VSS
63. C301
64. C302
65. C303
66. C304
67. TCM
68. TOD Resistor (Gasoline E/G)
69. G301
70. TOD or TCCU
71. FRT LH seat belt sw
72. Parking brake sw
73. W/D Burglar connector
74. Seat heater switch
75. STICS
76. G303
77. -
78. OVPR (Gasoline E/G)
79. C305
80. Seat belt sw (FRT RH)
81. EBCM (ADD)
82. G303
83. C205
84. Thermo amp
85. Passenger inflator
86. -
87. -
88. Front wiper motor
89. Siren
90. O2 sensor 1 / (Gasoline E/G)
91. EBCM (ABS) & Modulator (ABD)
92. J105
93. C113
94. C112
95. EGR solenoid (Diesel E/G)
96. C114 (Gasoline E/G)
97. C115 (Gasoline E/G)
98. J204 (Gasoline E/G)
99. S205
100. J205 (Gasoline E/G)
101. Antenna feeder cable
102. Auto antenna
103. C206
104. ECM (GSL) or Immobilizer unit (DSL)
105. EGR control unit (Diesel E/G)
106. G205
107. C361
108. O2 sensor 2 (Gasoline E/G)

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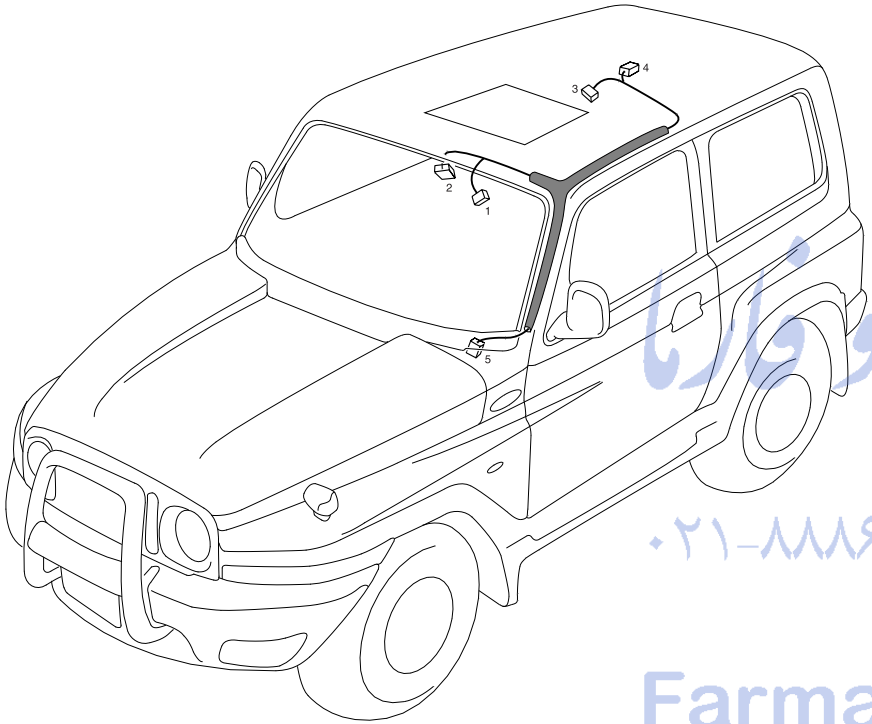
- **W/H MAIN (FLOOR)**



1. Rear combination lamp (RH)
2. Tail gate contact sw
3. Rear speaker (RH)
4. Door contact sw (FRT RH)
5. -
6. Passenger pretensioner
7. Wheel speed sensor (RR RH)
8. J304
9. J303
10. J302
11. J301
12. Wheel speed sensor (RR RH)
13. -
14. Driver tension reducer
15. Door contact sw (FRT LH)
16. Rear speaker (LH)
17. G401
18. Luggage lamp
19. J401
20. C401
21. C402
22. Rear combination lamp (LH)
23. C403
24. License lamp (RH)
25. License lamp (LH)

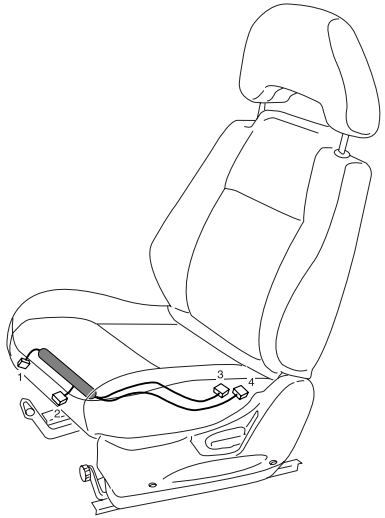
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3) W/H ROOF



1. Inside rear view mirror
2. Room lamp
3. Not used
4. Map lamp
5. C201

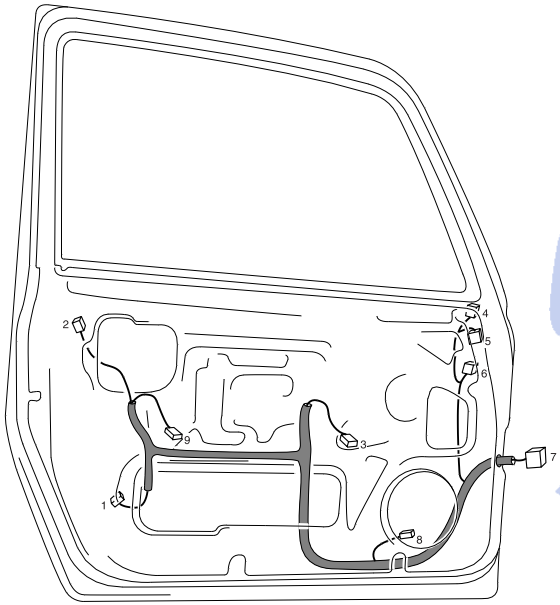
4) W/H SEAT HEATER



1. C304
2. Seat heater control unit
3. Seat heater
4. Back seat heater

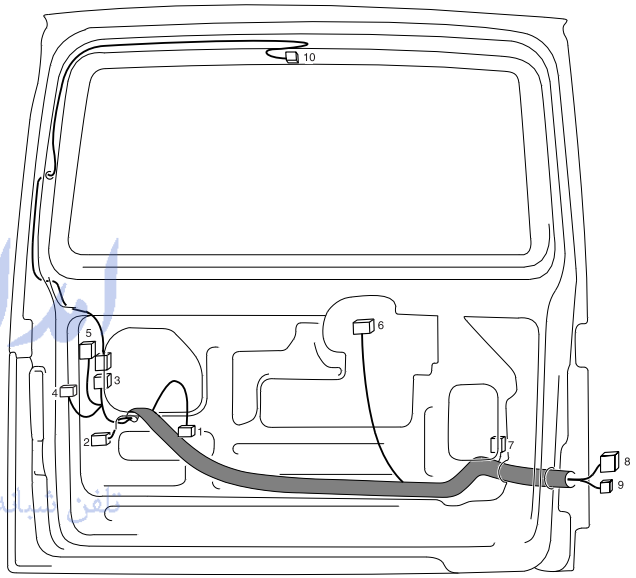
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5) W/H DOOR



1. Door actuator
2. Door key cylinder switch
3. Power window switch
4. OSRV mirror motor
5. Power window motor
6. C352 (FRONT LH),C362(FRONT RH)
7. C351 (FRONT LH),C361(FRONT RH)
8. Speaker
9. Courtesy lamp

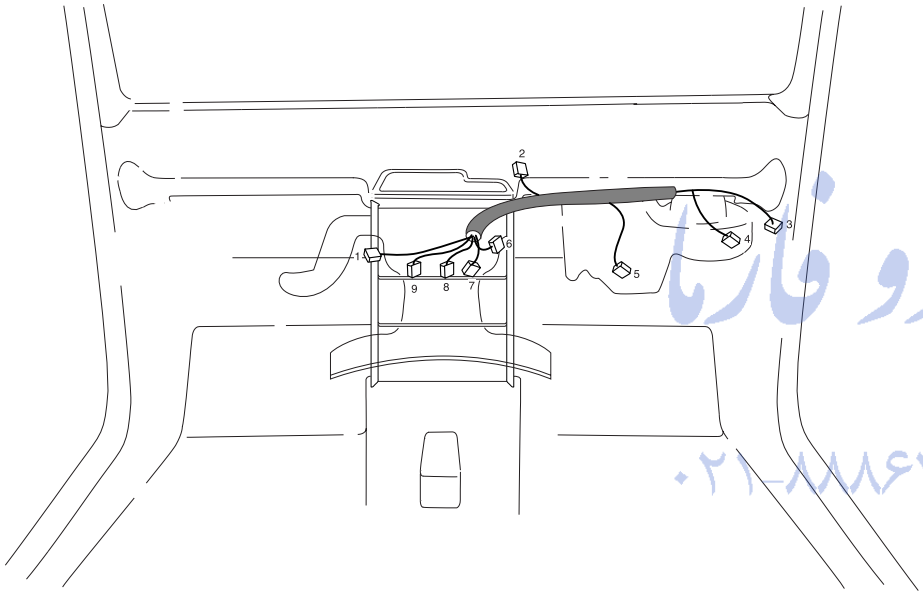
6) W/H TAIL GATE



1. Rear washer motor
2. Tail gate door lock actuator
3. C403 (soft top)
4. Tail gate key cylinder sw
5. Rear heated glass
6. Rear wiper motor
7. Rear heated glass
8. C402
9. C401

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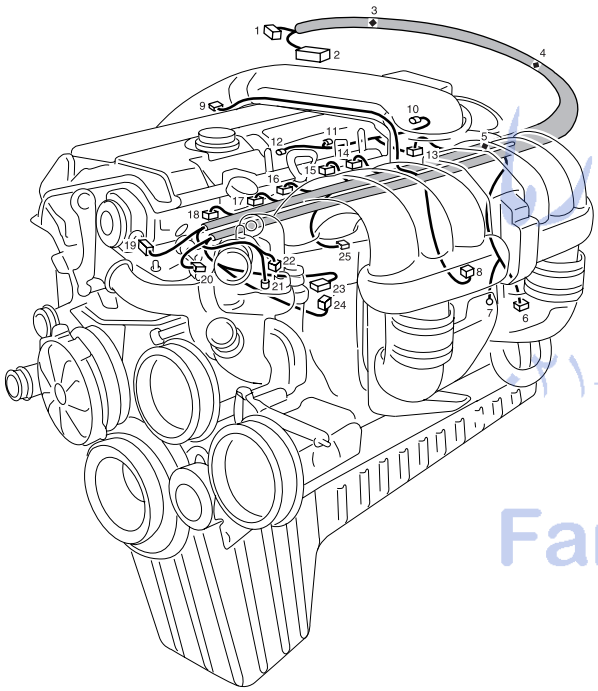
7) W/H AIR-CONDITIONER



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1. Mode actuator
2. C204
3. Intake actuator
4. Blower motor
5. Resistor
6. Blower relay
7. A/CON switch
8. Control pannel
9. Blower switch

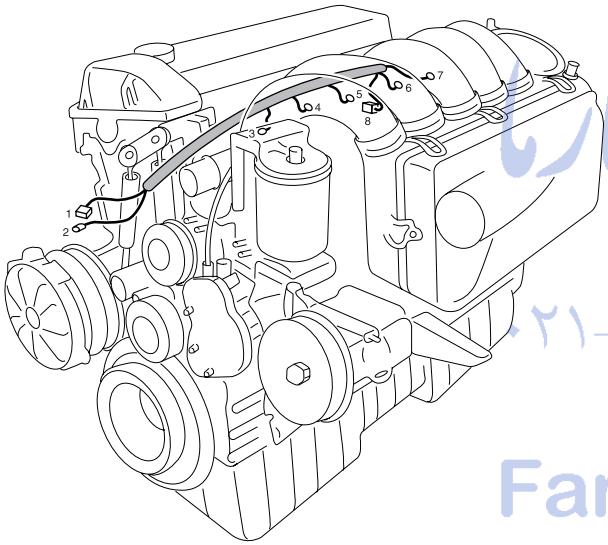
8) W/H ENGINE CONTROL (GASOLINE)



1. C114
2. C115
3. J106
4. J107
5. J108
6. Crankshaft position sensor
7. Oil pressure switch
8. Knock sensor 2
9. Air flow sensor
10. Ignition coil 3
11. Ignition coil 2
12. Ignition coil 1
13. Injector 6
14. Injector 5
15. Injector 4
16. Injector 3
17. Injector 2
18. Injector 1
19. Camshaft actuator
20. Camshaft position sensor
21. Engine coolant temperature sensor (Gauge)
22. Engine temperature sensor
23. Throttle motor & sensor
24. Knock sensor 1
25. Intake manifold resonance flap

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9) W/H PRE-HEATING (DIESEL)

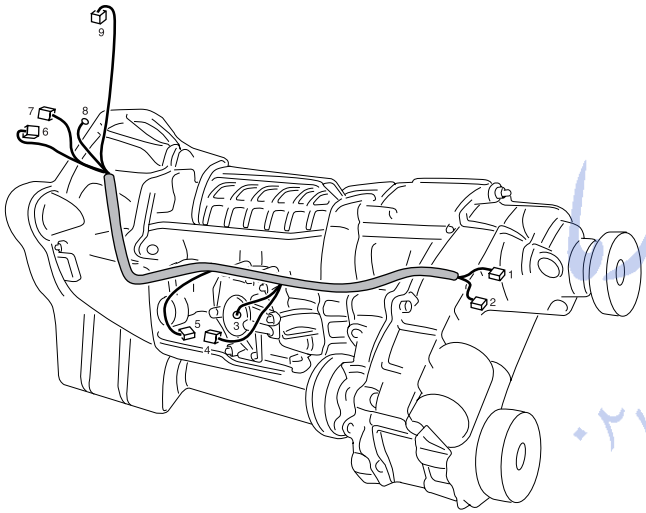


1. Preheating time control relay
2. C109
3. Glow plug 1
4. Glow plug 2
5. Glow plug 3
6. Glow plug 4
7. Glow plug 5 (662 LA only)
8. Engine coolant temperature sensor (Gauge)

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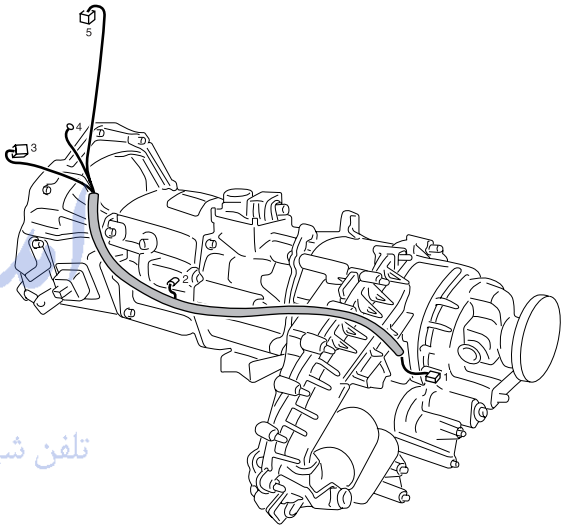
10) W/H TRANSMISSION

- **AUTOMATIC TRANSMISSION**



1. C301
2. C302 (Diesel E/G)
3. Transmission
4. T/M Lever
5. Inhibitor switch
6. Micro switch (Diesel E/G)
7. Throttle position sersor (Diesel E/G)
8. Engine oil pressure switch
9. Engine speed sensor (Diesel E/G)

- **MANUAL TRANSMISSION**

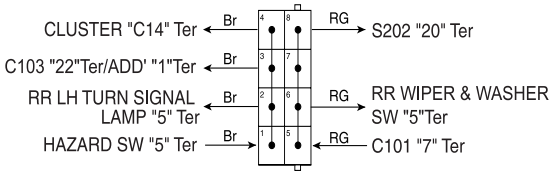


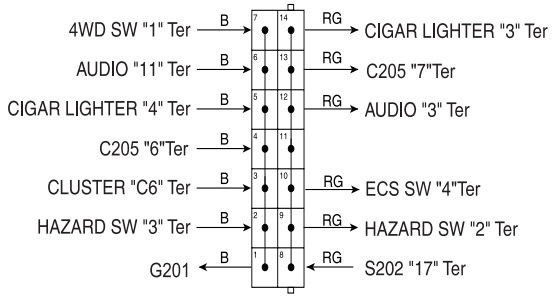
1. C302
2. Back up switch
3. Micro switch
4. Engine oil pressure switch
5. Engine speed sensor

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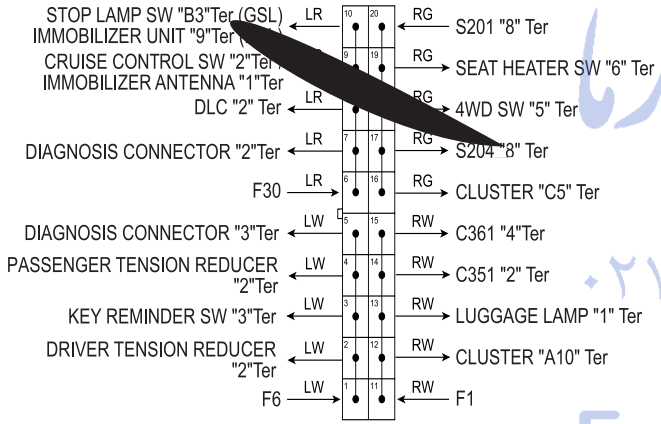
11) SPLICE PACK

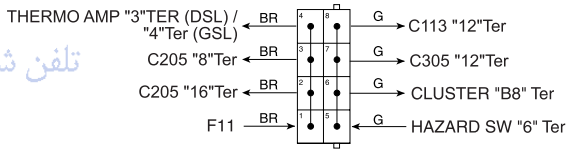
S201 (COLORLESS)





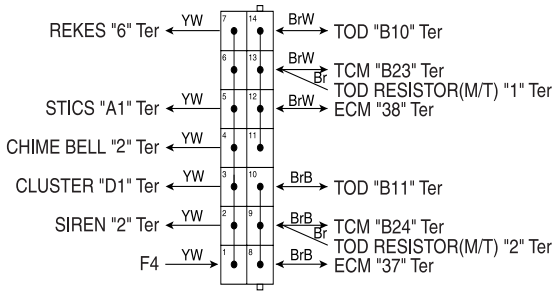
S202 (BLACK)





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S203 (COLORLESS)

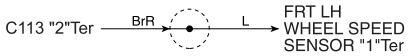


12) JOINT

J101



J102



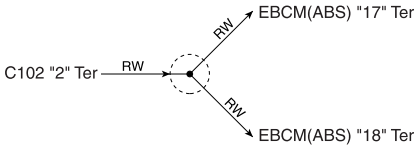
J103



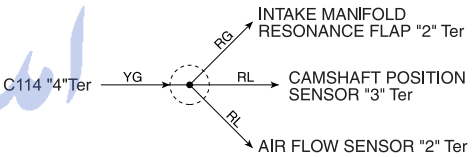
J104



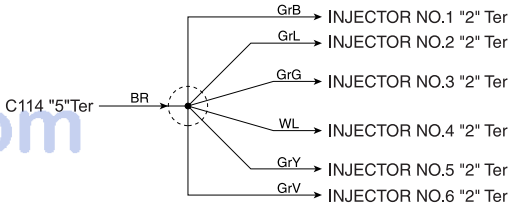
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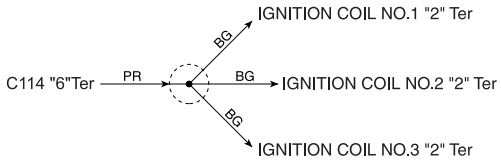
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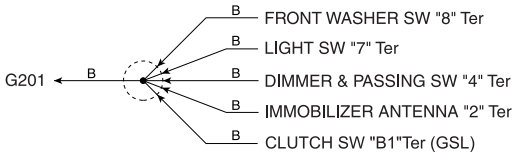


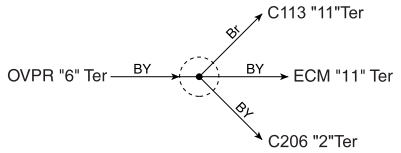
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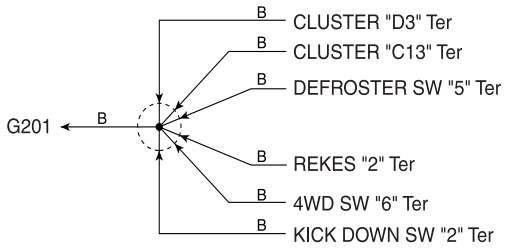
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J201



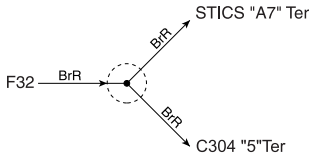


J202

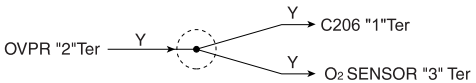


امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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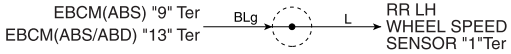
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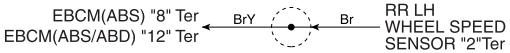
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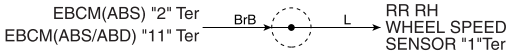
J301



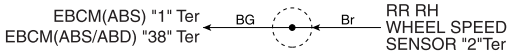
J302



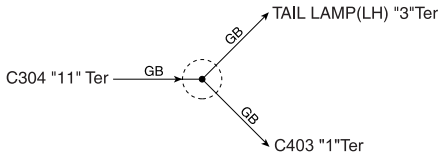
J303



J304



J401



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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SECTION 3

WIRING DIAGRAM FOR POWER SUPPLIES

امداد خودرو فارما

CONTENTS

1. IGNITION SWITCH CIRCUIT 3-2

2. 30 TER BAT+ POWER SUPPLY CIRCUIT
(PASSENGER ROOM FUSE BOX) 3-2

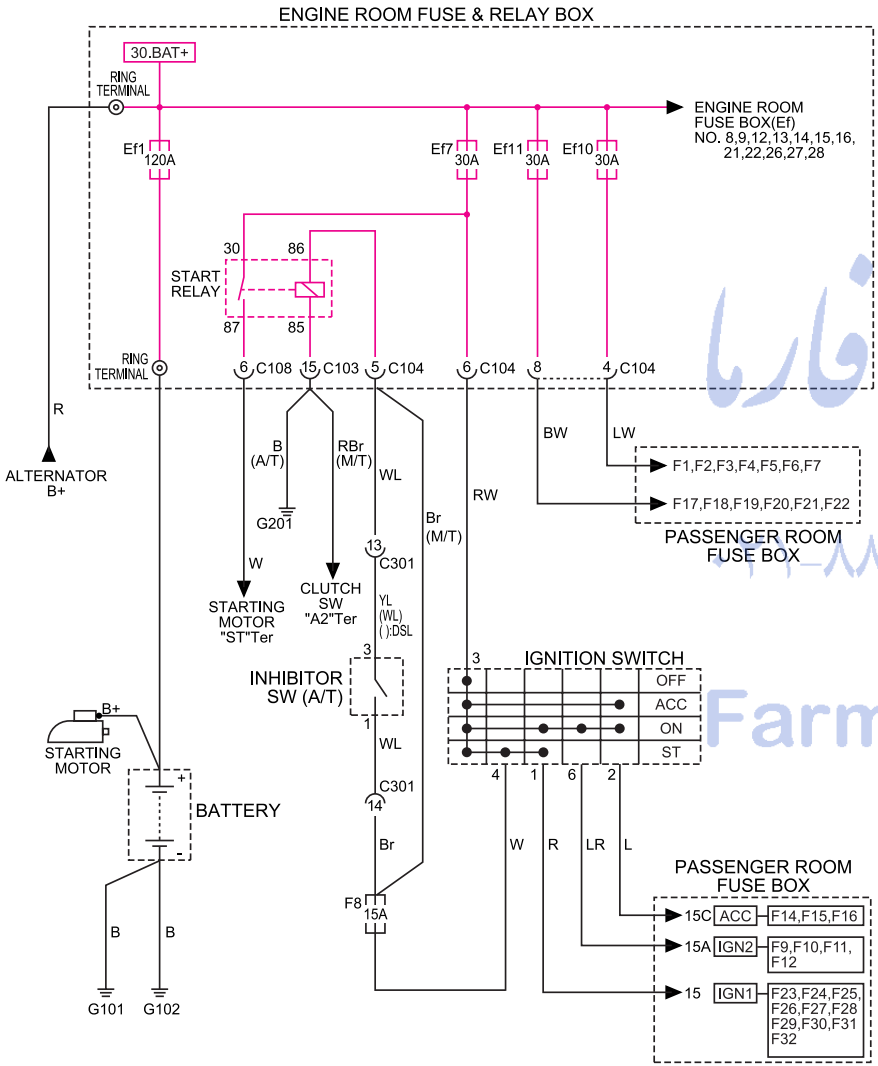
3. 15A IGN 2 , 15C ACC POWER SUPPLY CIRCUIT
(PASSENGER ROOM FUSE BOX) 3-4

4. 15 TER IGN 1 POWER SUPPLY CIRCUIT
(PASSENGER ROOM FUSE BOX) 3-4

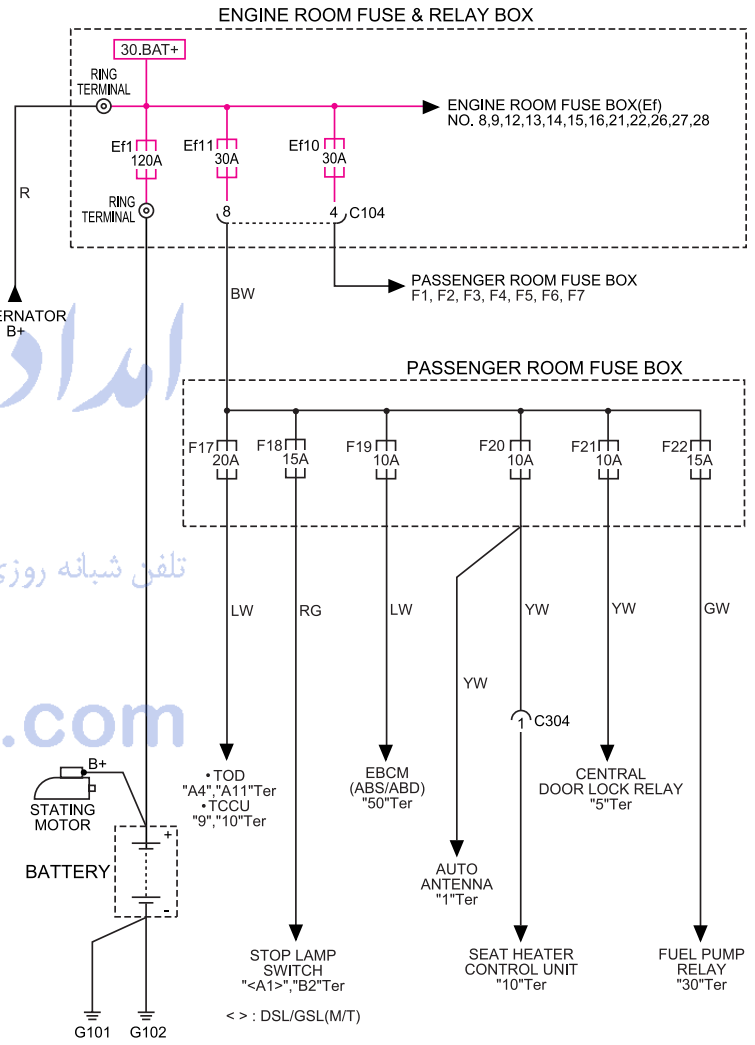
5. ENGINE ROOM FUSE & RELAY CIRCUIT 3-5

تلفن شبانه روزی ۰۲۱-۸۸۴۶۲۰۰۱
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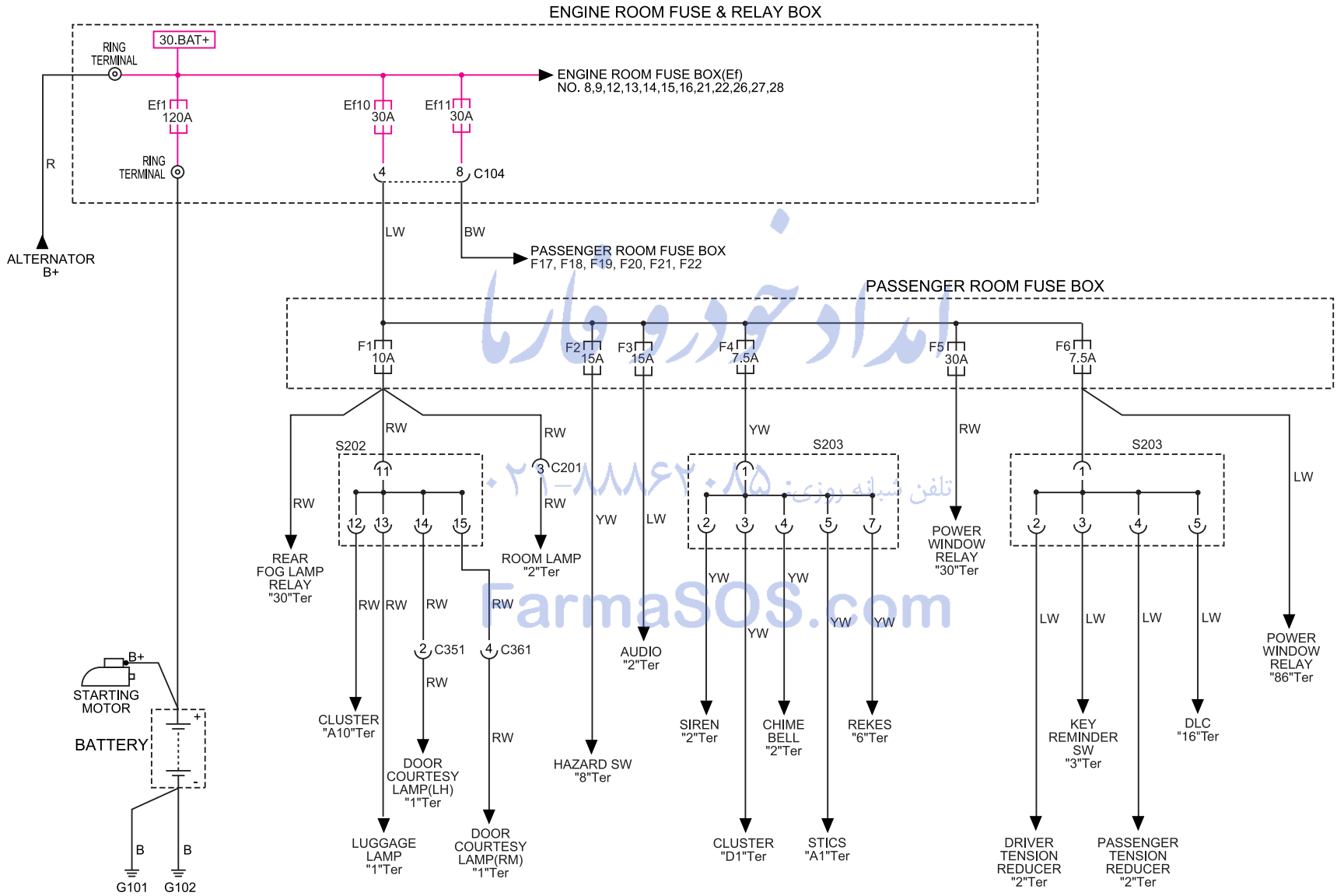
1. IGNITION SWITCH CIRCUIT



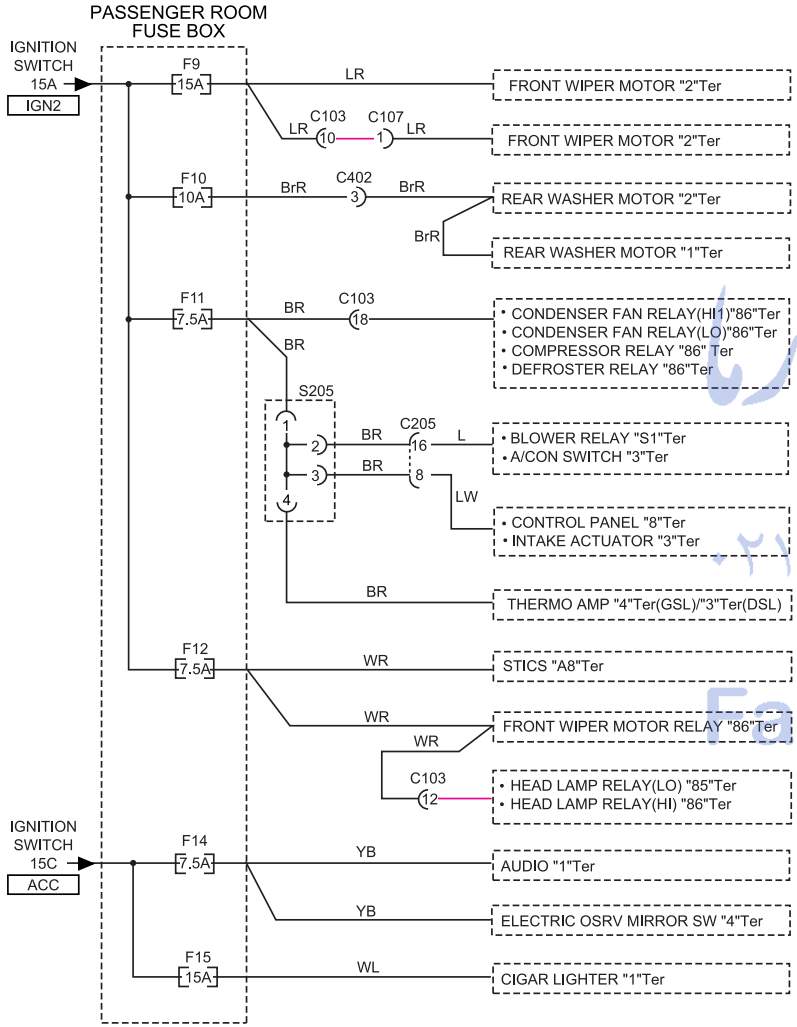
2. 30 Ter BAT+ POWER SUPPLY CIRCUIT (PASSENGER ROOM FUSE BOX)



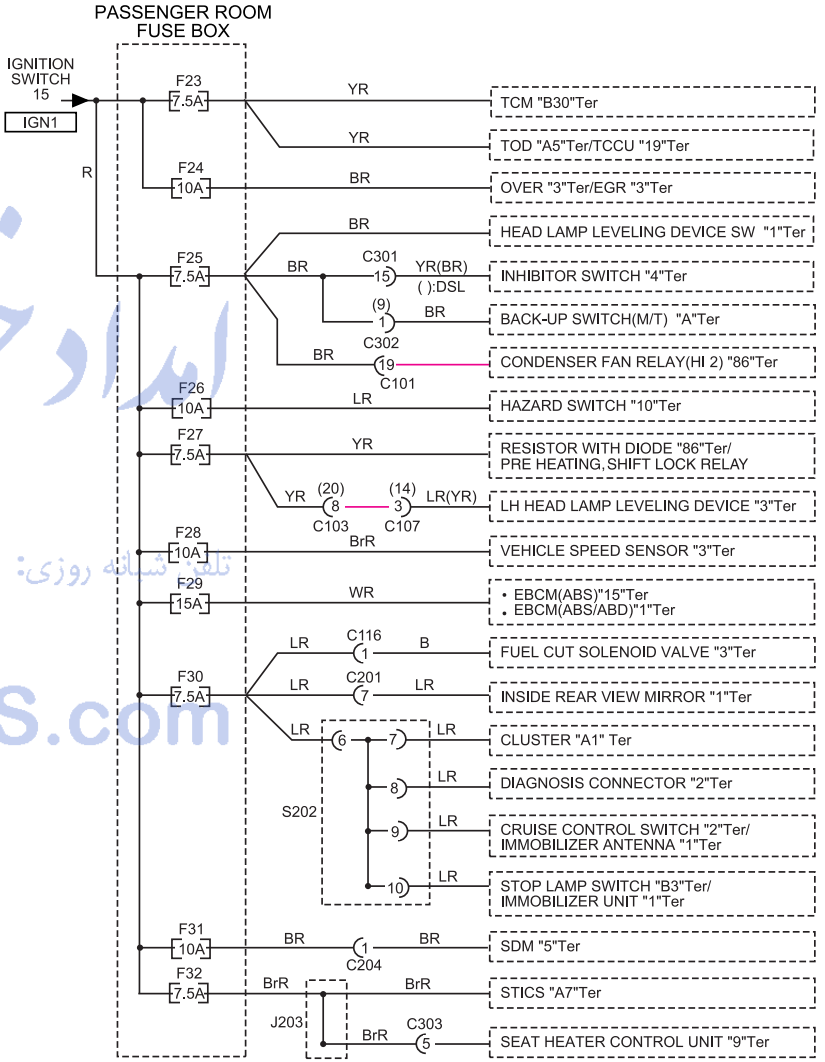
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ENGINE ROOM FUSE & RELAY BOX
RING TERMINAL
30.BAT+
ENGINE ROOM FUSE BOX(Ef)
NO. 8,9,12,13,14,15,16,21,22,26,27,28
Ef1 120A
Ef10 30A
Ef11 30A
RING TERMINAL
R
4
8
C104
ALTERNATOR B+
LW
BW
PASSENGER ROOM FUSE BOX
F17, F18, F19, F20, F21, F22
PASSENGER ROOM FUSE BOX
F1 10A
F2 15A
F3 15A
F4 7.5A
F5 30A
F6 7.5A
RW
RW
YW
RW
LW
S202
S203
S203
11
3
C201
1
1
12
13
14
15
2
3
4
5
7
2
3
4
5
REAR FOG LAMP RELAY "30"Ter
ROOM LAMP "2"Ter
HAZARD SW "8"Ter
AUDIO "2"Ter
POWER WINDOW RELAY "30"Ter
POWER WINDOW RELAY "86"Ter
RW
RW
RW
RW
2
C351
4
C361
RW
RW
YW
YW
YW
YW
LW
LW
LW
LW
CLUSTER "A10"Ter
DOOR COURTESY LAMP(LH) "1"Ter
LUGGAGE LAMP "1"Ter
DOOR COURTESY LAMP(RM) "1"Ter
SIREN "2"Ter
CHIME BELL "2"Ter
REKES "6"Ter
CLUSTER "D1"Ter
STICS "A1"Ter
KEY REMINDER SW "3"Ter
DLC "16"Ter
DRIVER TENSION REDUCER "2"Ter
PASSENGER TENSION REDUCER "2"Ter
B+
STARTING MOTOR
BATTERY
+
-
B
B
G101
G102

3. 15A IGN 2 , 15C ACC POWER SUPPLY CIRCUIT (PASSENGER ROOM FUSE BOX)

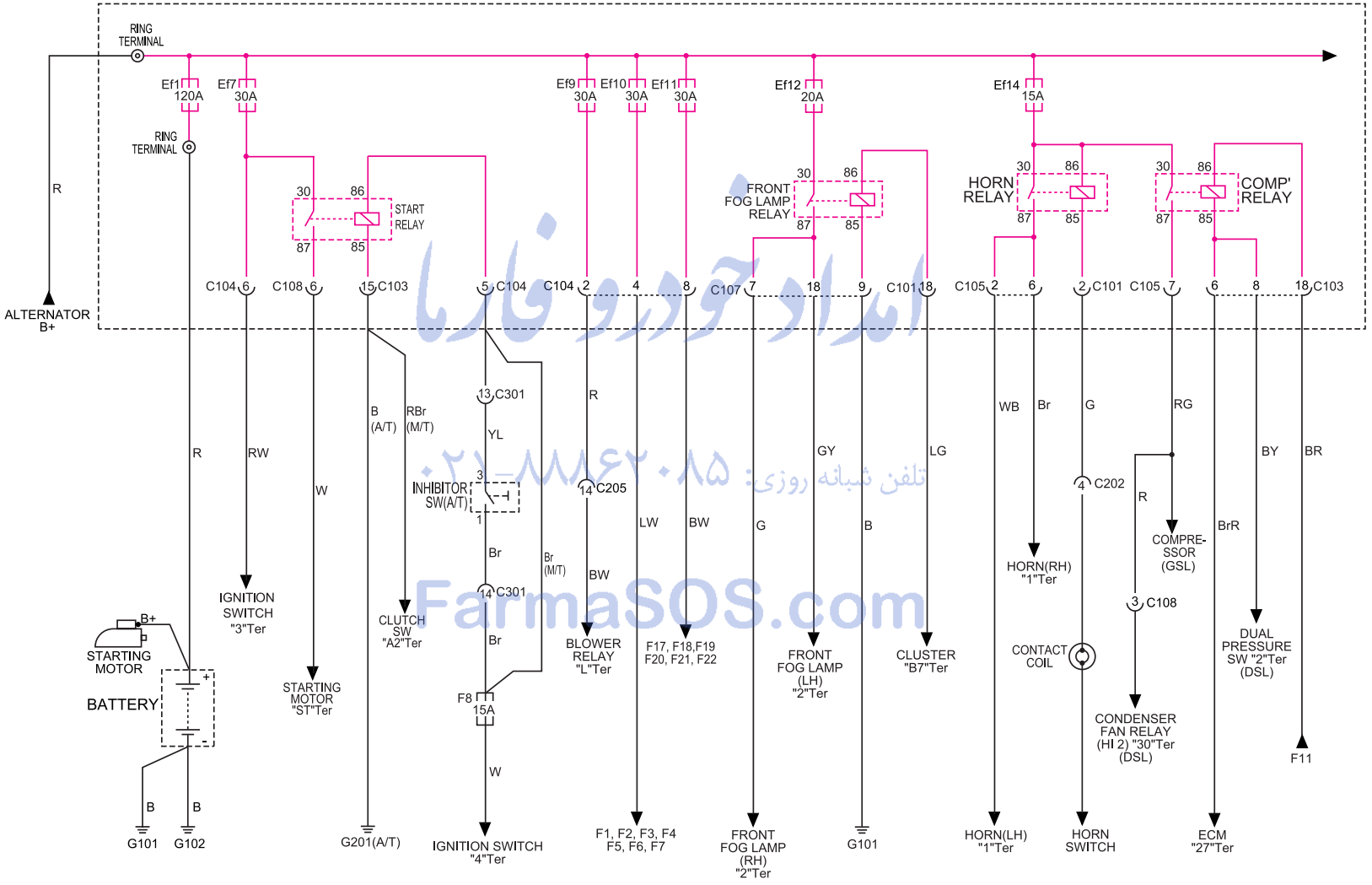


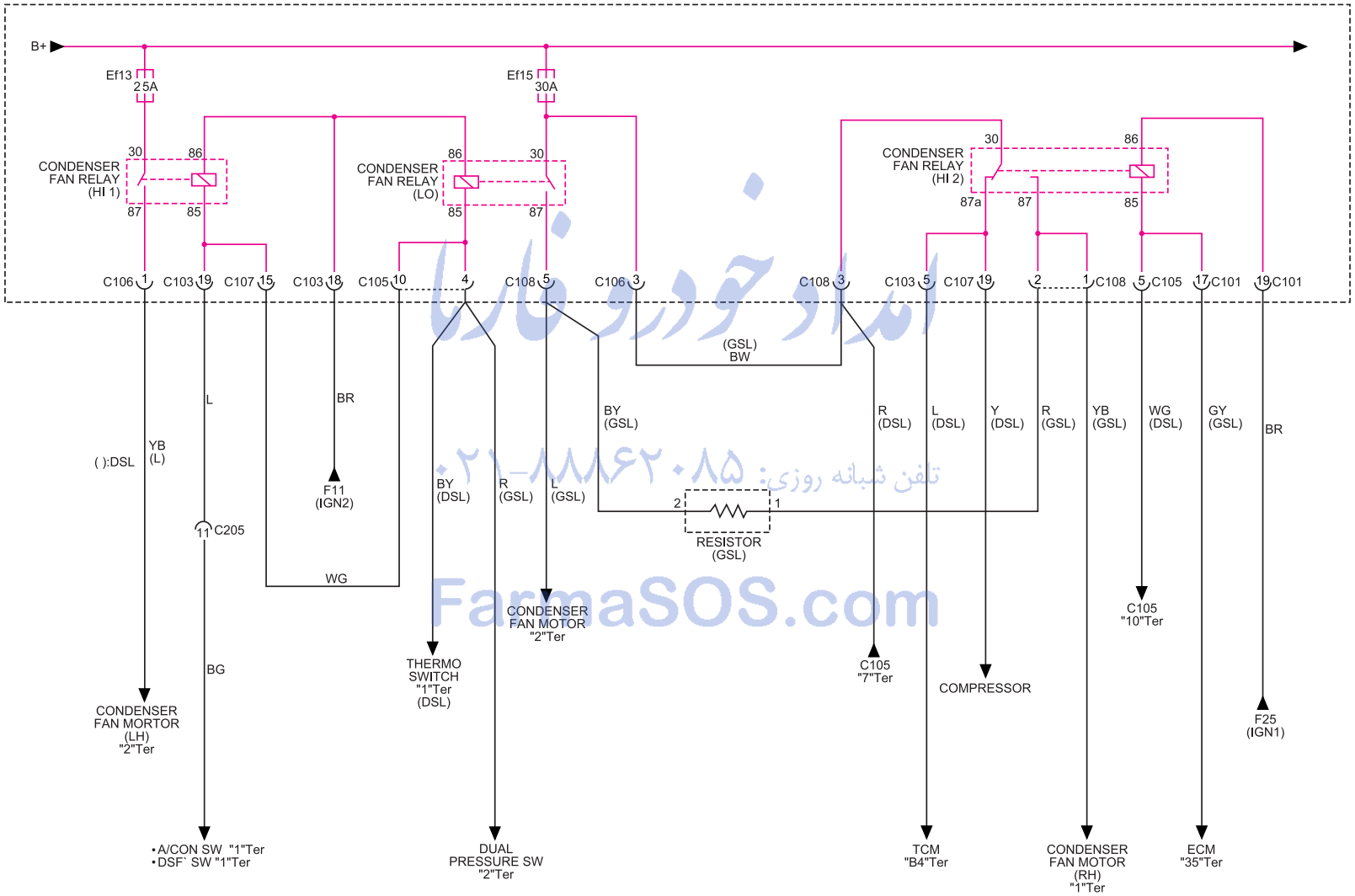
4. 15Ter IGN 1 POWER SUPPLY CIRCUIT (PASSENGER ROOM FUSE BOX)



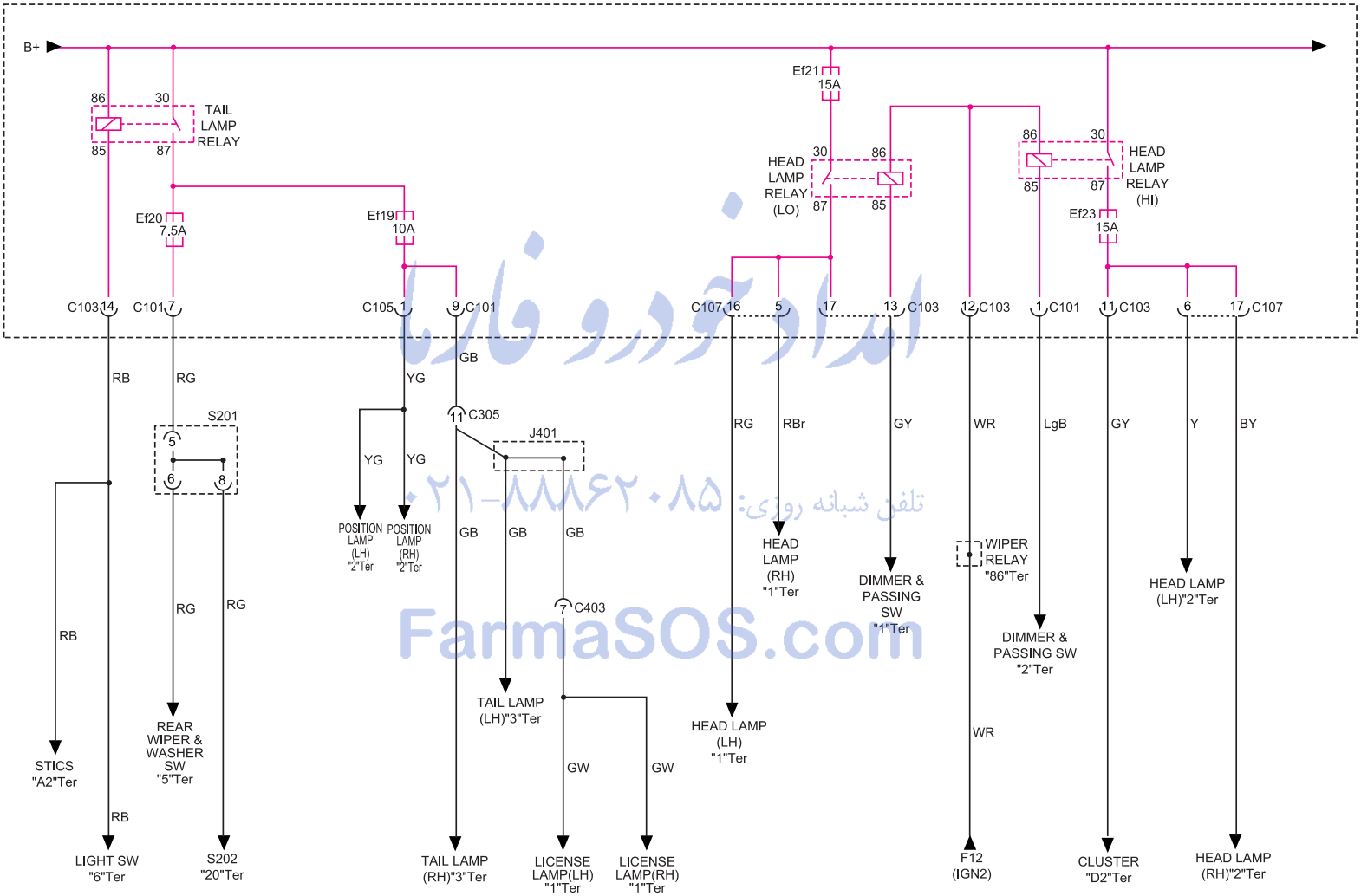
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تلفن شبانه روزی: ۰۲۱-۸۸۴۶۲۰۸۵
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5. ENGINE ROOM FUSE & RELAY CIRCUIT

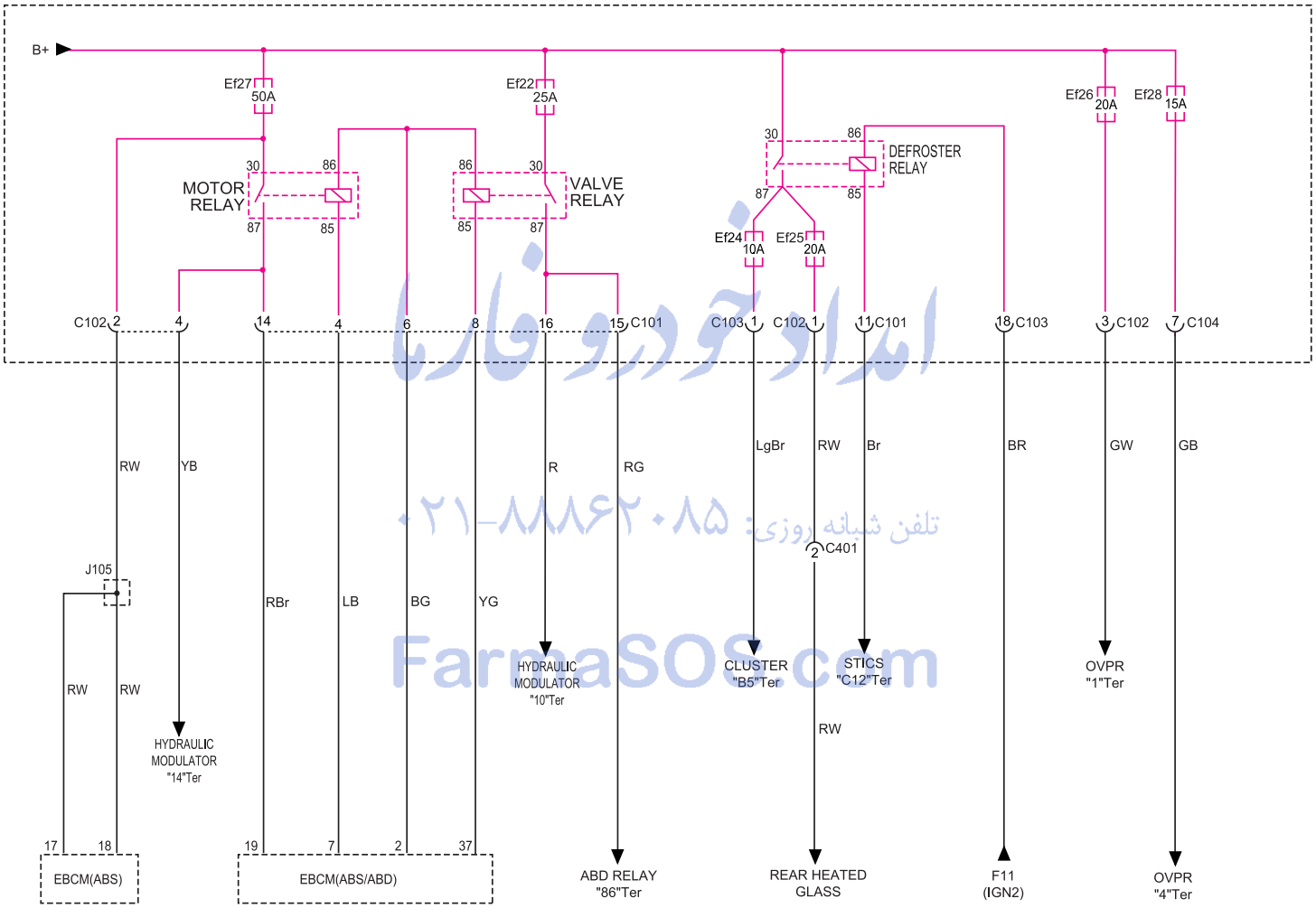




امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۶۲۰۸۵
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SECTION 4

USAGE AND CAPACITY OF FUSES IN FUSE BOX

امداد خودرو فارما

CONTENTS

1. ENGINE ROOM FUSE & RELAY BOX 4-2

2. PASSENGER ROOM FUSE BOX 4-3

3. PASSENGER ROOM RELAY BOX 4-4

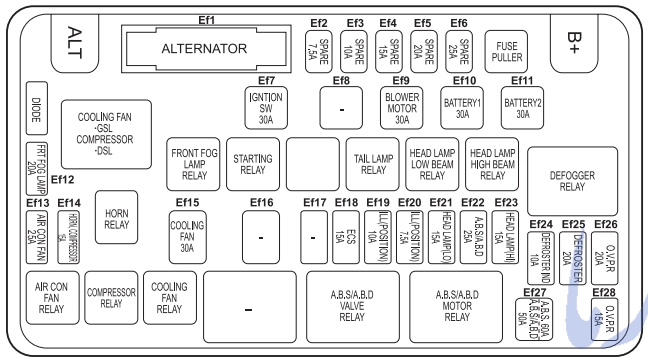
تلفن شبانه روزی: ۰۲۱-۸۸۴۶۲۰۸۵

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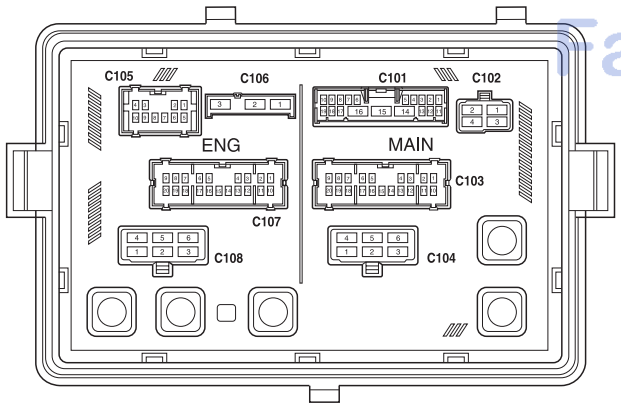
1. ENGINE ROOM FUSE & RELAY BOX

1) POSITION OF RELAY AND FUSE

- Front View



- Rear View



2) USAGE OF FUSE IN ENGINE ROOM FUSE BOX

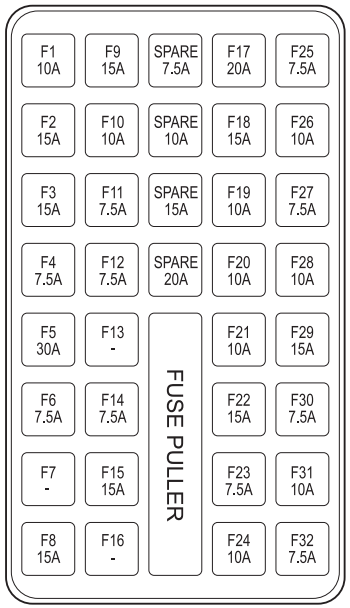
Power Supply	Classification	Fuse No	Capacity	Usage
30 BAT(+)	SB(Slow-Blow)Fuse	Ef 1	120A	Alternator Main - Gasoline
			80A	Alternator Main - Diesel
Spare	Blade Type Fuse	Ef2	7.5A	Not Used
		Ef3	10A	Not Used
		Ef4	15A	Not Used
		Ef5	20A	Not Used
		Ef6	25A	Not Used
30 BAT(+)	SB(Slow-Blow)Fuse	Ef7	30A	Ignition SW
	Blade Type Fuse	Ef8	-	Not Used
		Ef9	30A	Blower Motor
		Ef10	30A	Battery 1 (F1~F7)
		Ef11	30A	Battery 2 (F17~F22)
		Ef12	20A	Front Fog Lamp
		Ef13	25A	A/C Condenser Fan
		Ef14	15A	Horn,A/C Compressor
	SB(Slow-Blow)Fuse	Ef15	30A	Cooling Fan
		Ef16	-	Not Used
IGN 2(15A)	Blade Type Fuse	Ef17	-	Not Used
		Ef18	-	-
Illumination(58)		Ef19	10A	Illumination (Position)
		Ef20	7.5A	Illumination (Switch)
30 BAT(+)		Ef21	15A	Head Lamp (LO)
		Ef22	25A	ABS/ABD
IGN 2(15A)		Ef23	15A	Head Lamp (HI)
		Ef24	10A	Defroster Indicator
		Ef25	20A	Dsfroster
		Ef26	20A	O.V.P.R
30 BAT(+)	SB(Slow-Blow)Fuse	Ef27	60A	ABS
			50A	ABS/ABD
	Blade Type Fuse	Ef28	15A	O.V.P.R

* 30 : Battery(+) Power Supply

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۰۲۱-۸۸۸۶۲۰۸۵ تلفن شبانه روزی
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2. PASSENGER ROOM FUSE BOX

1) POSITION OF FUSE



2) USAGE OF FUSE IN PASSENGER ROOM FUSE BOX

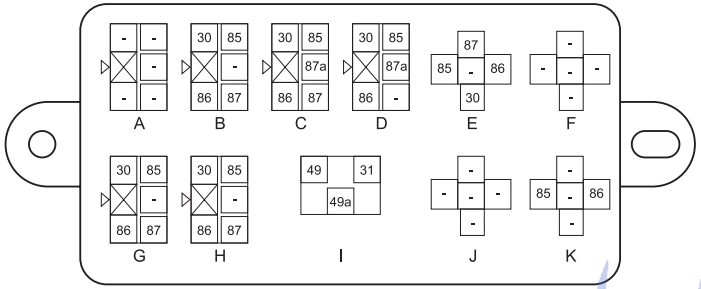
Power Supply	Classification	Fuse No	Capacity	Usage
30 BAT(+)	Blade Type	F1	10A	Interior Lamp, Rr Fog Lp, Cluster
		F2	15A	Hazard Lamp
		F3	15A	Audio
		F4	7.5A	STICS,REKES,Clock
		F5	30A	Power Window
		F6	7.5A	Seat Belt, Diagnosis(DLC)
		F7	-	-
ST		F8	15A	Starting
15A IGN2		F9	15A	Front Wiper & Washer
		F10	10A	Rear Wiper
		F11	7.5A	A/C System,Defroster
		F12	7.5A	Head Lamp,STICS
15A IGN1		F13	-	-
15C ACC		F14	7.5A	Audio,OSRV Mirror
		F15	15A	Cigar Lighter
		F16		
30 BAT(+)		F17	20A	TOD,TCCU
		F18	15A	Stop Lamp
		F19	10A	ABD
		F20	10A	Seat Heater,Auto Antenna
		F21	10A	Door Lock System
		F22	15A	Fuel Pump
15 IGN1		F23	7.5A	TOD,TCCU,TCM
		F24	10A	OVPR,EGR
		F25	7.5A	HLLD, B/UP Lamp
		F26	10A	Turn Signal Lamp
		F27	7.5A	BTSI, Pre-heating, Shift Lock
		F28	10A	Speedometer
		F29	15A	ABS,ABD
		F30	7.5A	Inside Rear View Mirror, Cruise Control, Immobilizer, Cluster
		F31	10A	Air Bag
		F32	7.5A	Seat Heater

* 30 : BAT(+) Power Supply Through Ef1.

ایراد خودرو فارما
۰۲۱-۸۸۸۶۲۰۸۵ تلفن شاه
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3. PASSENGR ROOM RELAY BOX

1) POSITION OF RELAY



A :	NOT USED	G :	POWER WINDOW RELAY
B :	NETURAL RELAY	H :	SHIFT LOCK RELAY
C :	FRONT WIPER RELAY	I :	FLASHER UNIT
D :	ABD RELAY	J :	REAR FOG LAMP RELAY
E :	FUEL PUMP RELAY	K :	RESISTOR WITH DIODE
F :	NOT USED		

امداد خودرو فارما
تلفن شبانه روزی: ۲۱-۸۸۸۶۲۰۸۵
FarmaSOS.com

SECTION 5

ELECTRICAL WIRING DIAGRAMS

امداد خودرو فارما

CONTENTS

1. STARTING & CHARGING SYSTEM 5-6
1) DIESEL 5-6
2) GASOLINE 5-8

2. DIAGNOSIS CONNECTOR 5-10
1) DIESEL 5-10
2) GASOLINE 5-12
(1) W/O EURO III 5-12
(2) W/ EURO III 5-14

3. PRE-HEATING SYSTEM 5-16

4. EGR (EXHAUST GAS RECIRCULATION) SYSTEM 5-18
1) MANUAL TRANSMISSION 5-18
2) AUTOMATIC TRANSMISSION 5-20

5. ECM (ELECTRONIC CONTROL MODULE) : E23 MSE 5-22
1) SENSOR (CRANK SHAFT POSITION, ACCELERATION PEDAL), THROTTLE MOTOR & SENSOR, IGNTION COIL & SPARK PLUG 5-22

تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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2) INJECTOR, FUEL PUMP RELAY, FUEL PUMP, IMMOBILIZER 5-24
(1) W/O EURO III 5-24
(2) W/ EURO III 5-26
3) SENSOR (CAM SHAFT POSITION, MAP, O_2), CAM SHAFT ACTUATOR 5-28
(1) W/O EURO III 5-28
(2) W/ EURO III 5-30
4) SENSOR (ENGINE TEMPERATURE, INTAKE AIR TEMP', KNOCK),
CANISTER PURGE VALVE, DIAGNOSIS 5-32
(1) W/O EURO III 5-32
(2) W/ EURO III 5-34
5) VEHICLE SPEED SENSOR, SWITCH (CRUISE CONTROL, STOP LAMP, INHIBITOR, CLUTCH) 5-36

6. ECM (ELECTRONIC CONTROL MODULE) : E32 MSE 5-38

1) SENSOR (CRANK SHAFT POSITION, ACCELERATION PEDAL), THROTTLE MOTOR .....
& SENSOR, IGNTION COIL & SPARK PLUG 5-38
2) INJECTOR, FUEL PUMP RELAY, FUEL PUMP, IMMOBILIZER 5-40
(1) W/O EURO III 5-40
(2) W/ EURO III 5-42
3) SENSOR (CAM SHAFT POSITION, AIR FLOW), INTAKE MANIFOLD RESONANCE .....
FLAP, CAM SHAFT ACTUATOR, FUEL GAUGE 5-44
(1) W/O EURO III 5-44
(2) W/ EURO III 5-46
4) SENSOR (ENGINE TEMPERATURE, KNOCK1, KNOCK2), CANISTER PURGE VALVE, DIAGNOSIS 5-48
5) VEHICLE SPEED SENSOR, SWITCH (CRUISE CONTROL, STOP LAMP, INHIBITOR, CLUTCH) 5-50
6) O_2 SENSOR (1,2,3,4) 5-52

7. TCM (TRASMISSION CONTROL MODULE) - DIESEL 5-54

1) MODE SWITCH, INDICATOR, DIAGNOSIS 5-54
2) TRANSMISSION, INDICATOR, T/M LEVER, KICK DOWN SWITCH 5-56

8. TCM (TRASMISSION CONTROL MODULE) - GASOLINE 5-58

1) MODE SWITCH, INDICATOR, DIAGNOSIS 5-58
2) TRANSMISSION, INDICATOR, T/M LEVER, KICK DOWN SWITCH 5-60

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9. ABS (ANTI-LOCK BRAKE SYSTEM) 5-62

10. ABS/ABD (AUTOMATIC BRAKE DIFFERENTIAL LOCK): DIESEL 5-64

1) INDICATOR, RELAY (ABD, MOTOR, VALVE), HYDRAULIC MODULATOR 5-64

2) STOP LAMP SWITCH, ACCELERATION SENSOR, WHEEL SPEED SENSOR, DIAGNOSIS 5-66

11. ABS/ABD (AUTOMATIC BRAKE DIFFERENTIAL LOCK): GASOLINE 5-68

1) INDICATOR, RELAY (ABD, MOTOR, VALVE), HYDRAULIC MODULATOR 5-68

2) STOP LAMP SWITCH, ACCELERATION SENSOR, WHEEL SPEED SENSOR, DIAGNOSIS 5-70

12. ABS/ABD (AUTOMATIC BRAKE DIFFERENTIAL LOCK): EURO III 5-72

-ATTACHED EBCM- 5-72

13. TCCU 5-74

1) INDICATOR, DIAGNOSIS 5-74

2) 4WD SWITCH, SPEED SENSOR & CLUTCH COIL, SHIFT MOTOR, LOCKING HUB SOLENOID 5-76

14. TOD (TORQUE ON DEMAND) 5-78

1) 4WD SWITCH, INDICATOR, DIAGNOSIS, SHIFT MOTOR 5-78

2) SPEED SENSOR & CLUTCH (COIL, CLUTCH SW(M/T) & NEUTRAL RELAY (A/T)) 5-80

15. MANUAL AIR CONDITIONING SYSTEM : DIESEL 5-82

1) CONDNSER FAN MOTOR, THERMO SWITCH, COMPRESOR, THERMO AMP 5-82

MANUAL AIR CONDITIONING SYSTEM : GASOLINE 5-84

1) CONDNSER FAN MOTOR(LH/RH), COMPRESOR, THERMO AMP 5-84

2) BLOWER MOTOR CIRCUIT 5-86

3) CONTROL PANEL, INTAKE ACTUATOR, MODE ACTUATOR 5-88

16. AIR BAG (SDM : SENSING & DIAGNOSIS MODULE) 5-90

17. SEAT BELT & TENSION REDUCER 5-92

18. CLUSTER 5-94

1) VSS(VEHICLE SPEED SENSOR), METER(SPEEDO, TACHO) & GAUGE(FUEL, TEMPERATURE)

- DIESEL 5-94

ایران خودرو فانیا
تلفن شبانه روزی: ۰۲۱-۷۷۷۶۲۷۷۵
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1) VSS(VEHICLE SPEED SENSOR), METER(SPEEDO, TACHO) & GAUGE(FUEL, TEMPERATURE)
- GASOLINE 5-96
(1) W/O EURO III 5-96
(2) W/ EURO III 5-98
2) WARNING LAMP(ENGINE CHECK, AIR BAG, EBD, ABS), TCS INDICATOR 5-100
3) INDICATOR(DEFROSTER, WINTER MODE, POWR MODE, 4WD LOW, 4WD HIGH, 4WD CHECK) 5-102
4) WARNING LAMP (SEAT BELT, DOOR OPEN, PARKING BRAKE), INDICATOR (BATTERY CHARGING, GLOW) 5-104
5) FRONT FOG LAMP, TURN SIGNAL, HAZARD, HIGH BEAM 5-106
6) DIGITAL CLOCK,WARNING (OIL PRESSURE, LOW FUEL LEVEL) CLUSTER ILLUMINATION 5-108
7) SELECTOR LEVER POSITION LAMP (P,R,N,D,3,2,1) 5-110

19. STICS(SUPER TIME & ALARM INTEGRATED CONTROL SYSTEM) 5-112
1) STICS UNIT 5-112
2) FRONT WIPER CIRCUIT 5-114
3) CENTRAL DOOR LOCK SYSTEM 5-116
4) KEYLESS, KEY REMINDER SWITCH, SIREN, CHIME BELL BUZZER 5-118
5) DEFROSTER 5-120
6) LAMP(ROOM, DOOR COURTESY LH/RH, LUGGAGE), DOOR CONTACT SWITCH 5-122

20. SEAT HEATER 5-124

21. STOP LAMP, BTSI (BRAKE TRANSMISSION SHIFT INTERLOCK) 5-126
1) METAL TOP 5-126
2) SOFT TOP 5-128

22. POWER WINDOW 5-130

23. ELECTRIC OSRV (OUTSIDE REAR VIEW) MIRROR 5-132

24. REAR WIPER & WASHER 5-134

25. CIGARETTE LIGHTER, HORN 5-136

26.HEAD LAMP 5-138

27. HEAD LAMP LEVELING DEVICE (HLLD) 5-140

امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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1) GASOLINE 5-140
2) DIESEL 5-142

28. TURN SIGNAL LAMP 5-144

29. TAIL LAMP RELAY CIRCUIT 5-146

1) POSITION LAMP, TAIL LAMP, LICENSE LAMP 5-146
2) ILLUMINATION SWITCH 5-148

30. FRONT FOG LAMP 5-150

31. REAR FOG LAMP 5-152

32. INSIDE REAR VIEW MIRROR(DIMMING) & BACK-UP LAMP 5-154

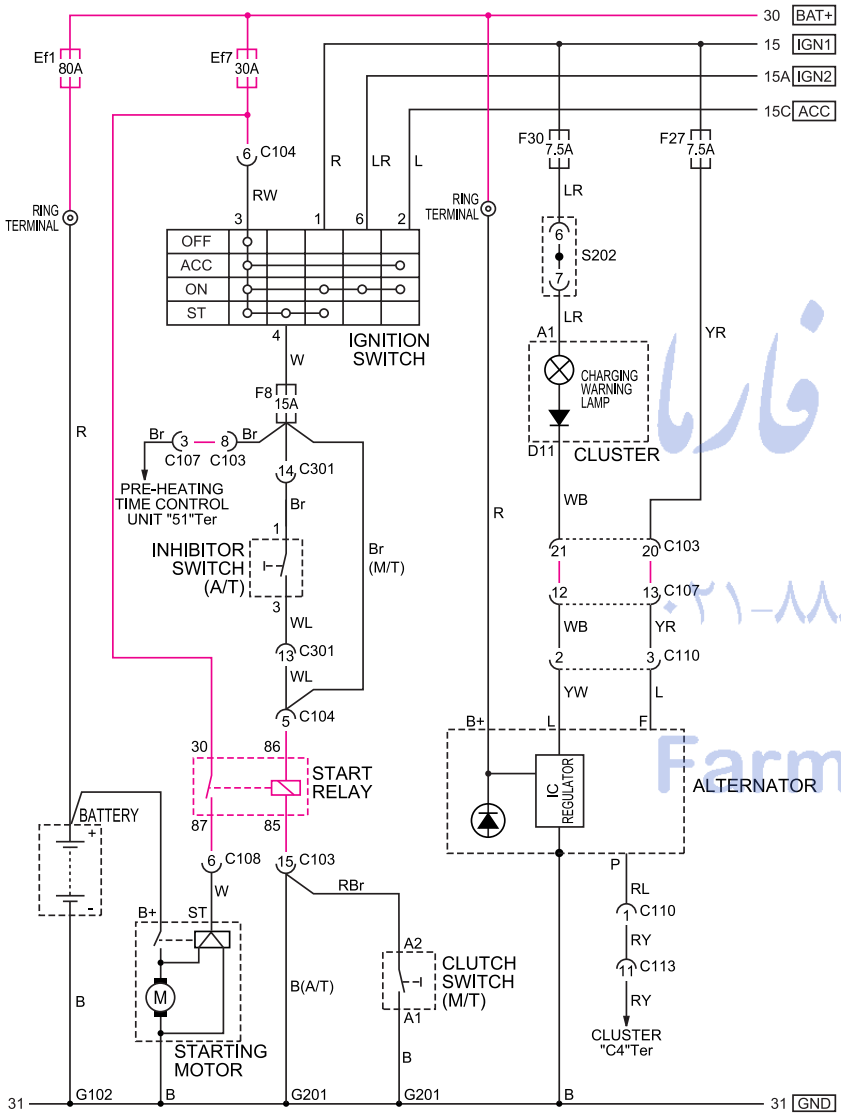
33. AUDIO 5-156

34. IMMOBILIZER SYSTEM (DIESEL : VDO) 5-158

امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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1. STARTING & CHARGING SYSTEM

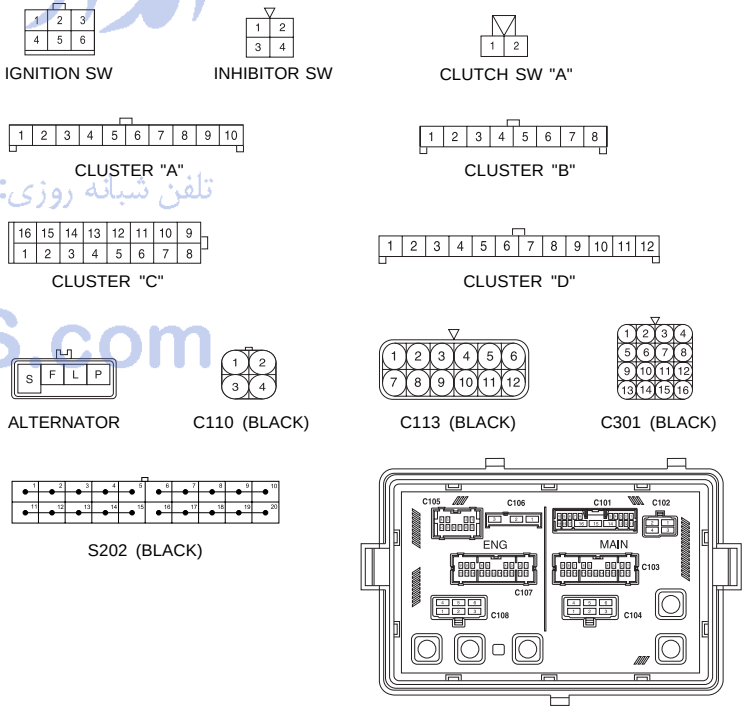
1) DIESEL



a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING WIRING HARNESS	CONNECTOR POSITION
C103 (22Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C104 (8Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C107 (20Pin, White)	Engine Room Fuse Box - W/H Engine Room	Engine Room Fuse Box
C108 (6Pin, Colorless)	Engine Room Fuse Box - W/H Engine Room	Engine Room Fuse Box
C110 (4Pin, Black)	W/H Engine Room - W/H Alternator	Below Air Cleaner
C113 (12Pin,Black)	W/H Engine Room - W/H Main	Next to Hydraulic Unit
C301 (16Pin, Black)	W/H Main - W/H Transmission	Upper Transfer Case
S202 (20Pin,Black)	W/H Main	Behind Cluster
G102	Battery	Center Engine Block
G201	W/H Main	Upper Front Left Leg Room

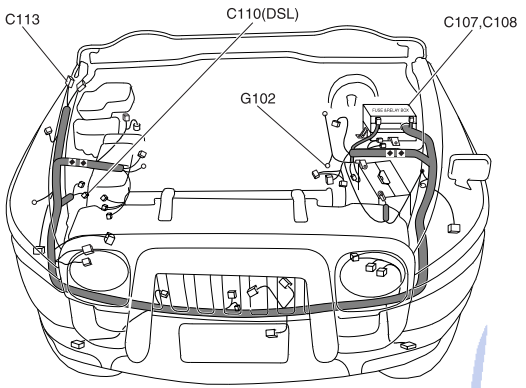
b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



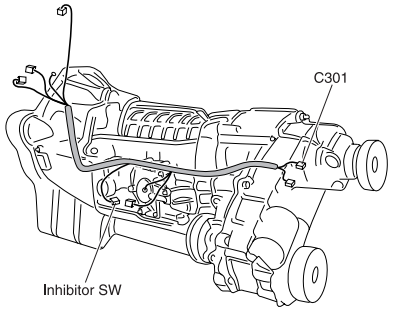
امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۶۲۰۸۵
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c. POSITION OF CONNECTORS AND GROUNDS

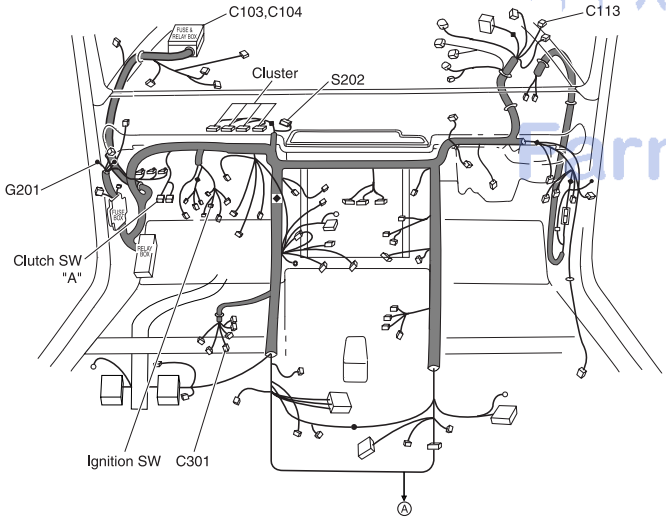
- W/H ENGINE ROOM



- W/H TRANSMISSION (AUTOMATIC TRANSMISSION)

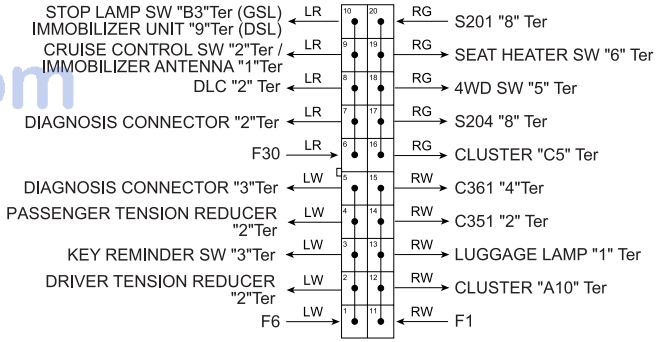


- W/H MAIN



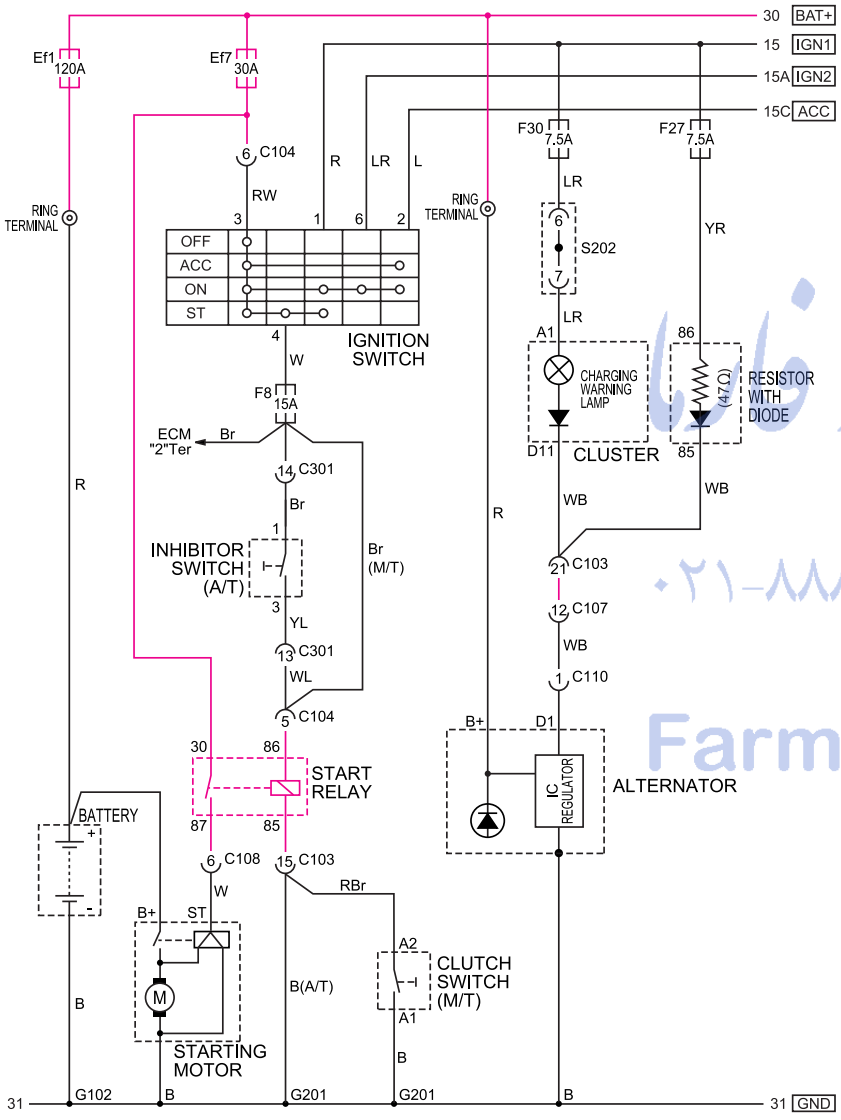
d. SPLICE PACK

S202 (BLACK)



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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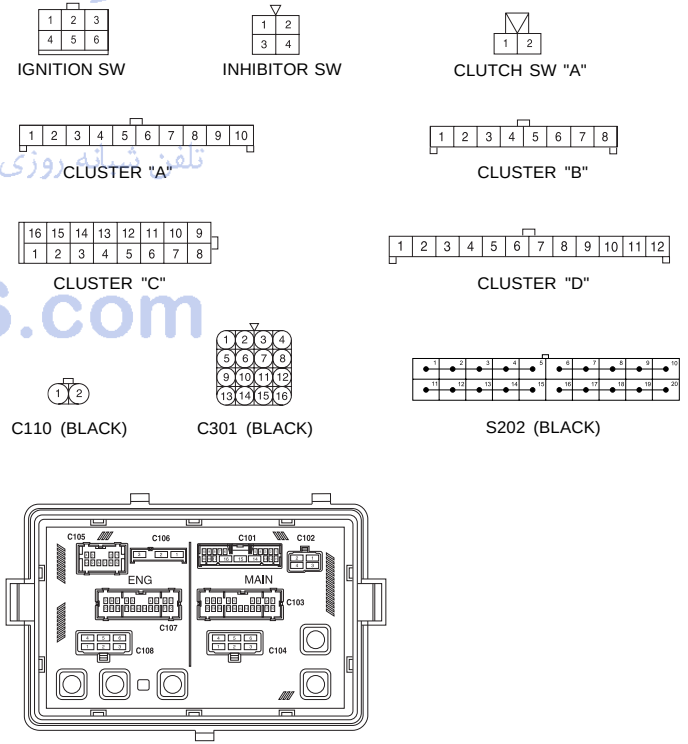
2) GASOLINE



a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C103 (22Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C104 (8Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C107 (20Pin, White)	Engine Room Fuse Box - W/H Engine Room	Engine Room Fuse Box
C108 (6Pin, Colorless)	Engine Room Fuse Box - W/H Engine Room	Engine Room Fuse Box
C110 (2Pin, Black)	W/H Engine Room - W/H Alternator	Below Air Cleaner
C301 (16Pin, Black)	W/H Main - W/H Transmission	Upper Transfer Case
S202 (20Pin,Black)	W/H Main	Behind Cluster
G102	Battery	Center Engine Block
G201	W/H Main	Upper Front Left Leg Room

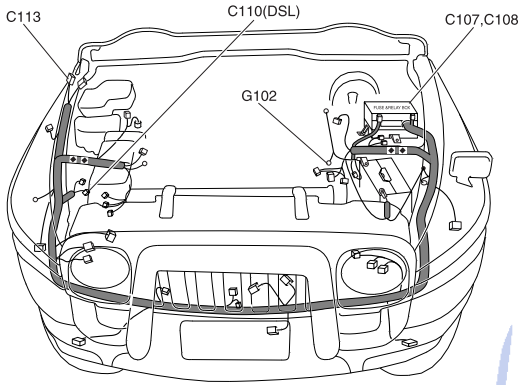
b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



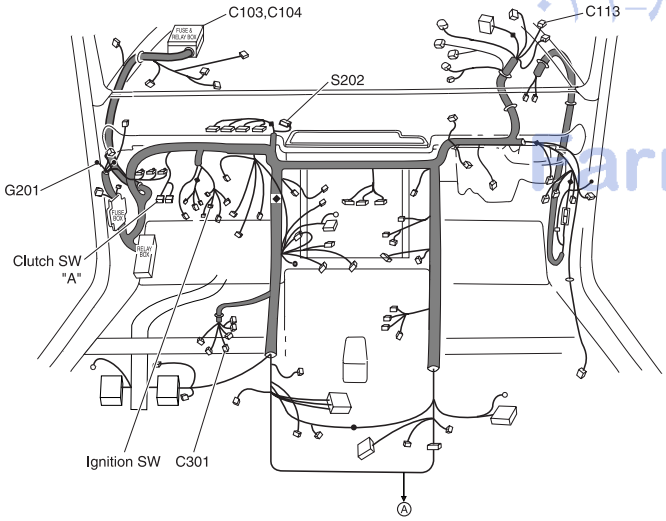
امداد خودرو فارما
۰۲۱-۸۸۴۶۲۰۸۵ تلفن شبانه روزی
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c. POSITION OF CONNECTORS AND GROUNDS

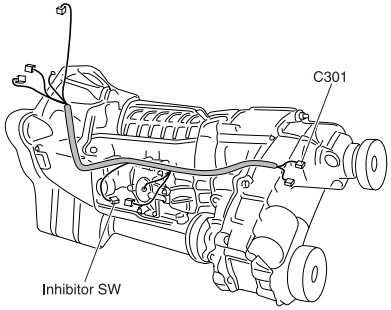
- W/H ENGINE ROOM



- W/H MAIN

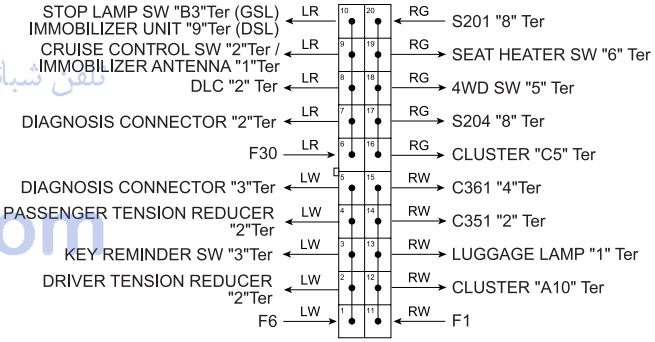


- W/H TRANSMISSION (AUTOMATIC TRANSMISSION)



d. SPLICE PACK

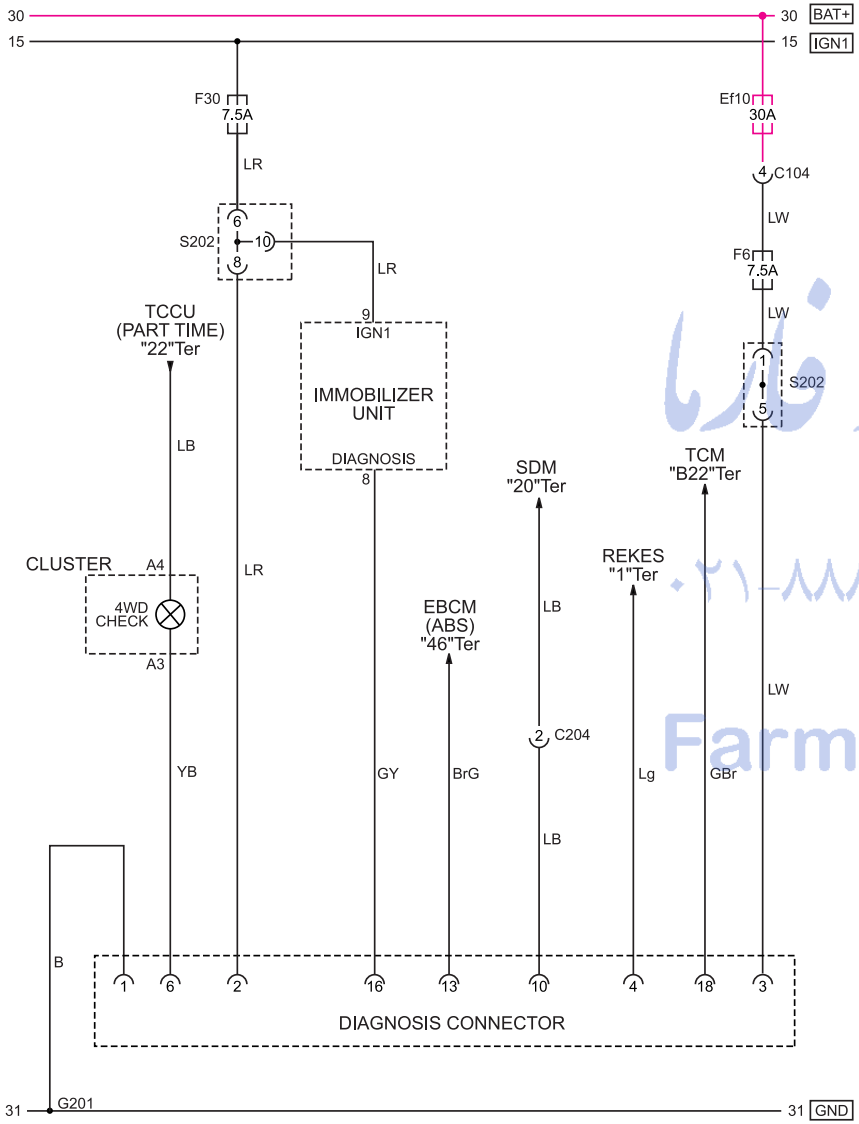
S202 (BLACK)



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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2. DIAGNOSIS CONNECTOR

1) DIESEL



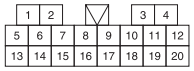
a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C104 (8Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C204 (4Pin, Colorless)	W/H Main - W/H SDM	Lower Rear Center Facia
S202 (20Pin, Black)	W/H Main	Behind Cluster
G201	W/H Main	Upper Front Lefft Leg Room

b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



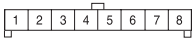
IMMOBILIZER UNIT



DIAGNOSIS CONNECTOR



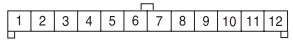
CLUSTER "A"



CLUSTER "B"



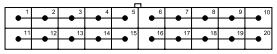
CLUSTER "C"

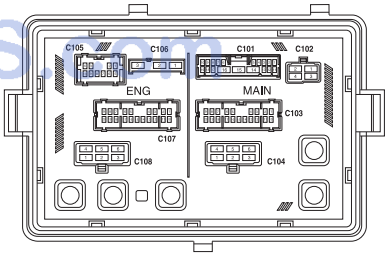


CLUSTER "D"



C204 (COLORLESS)

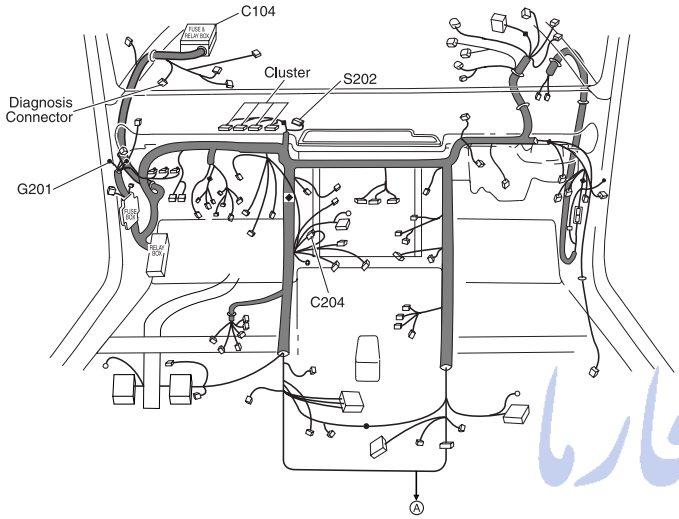

S202 (BLACK)



امداد خودرو فارما
تلفن تماس روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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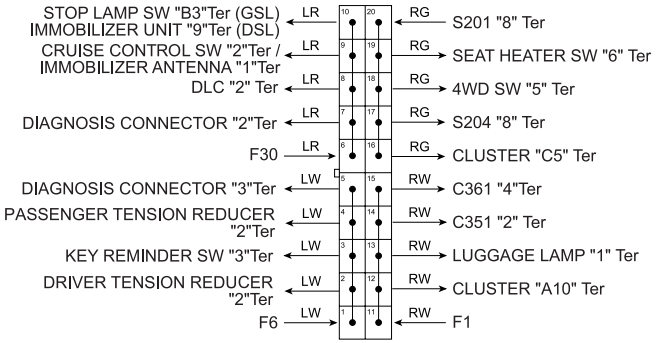
c. POSITION OF CONNECTORS AND GROUNDS

- W/H MAIN



d. SPLICE PACK

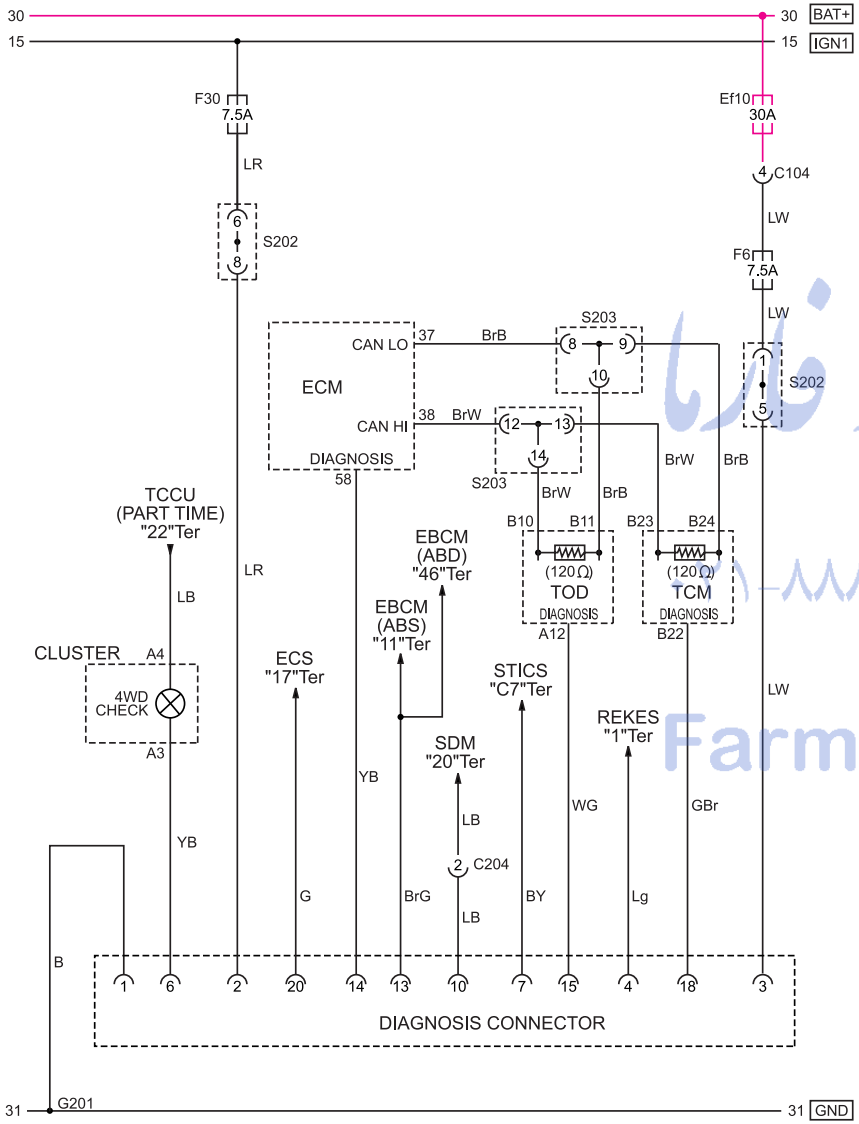
S202 (BLACK)



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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2) GASOLINE

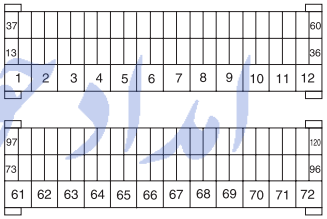
(1) W/O EURO III



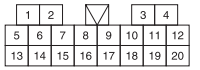
a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C104 (8Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C204 (4Pin, Colorless)	W/H Main - W/H SDM	Lower Rear Center Facia
S202 (20Pin, Black)	W/H Main	Behind Cluster
S203 (14Pin, Colorless)	W/H Main	Behind 4WD Switch
G201	W/H Main	Upper Front Leftt Leg Room

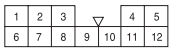
b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



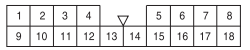
ECM



DIAGNOSIS CONNECTOR



TOD "A"



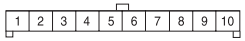
TOD "B"



TCM "A"



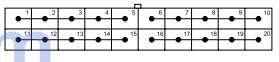
TCM "B"



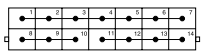
CLUSTER "A"



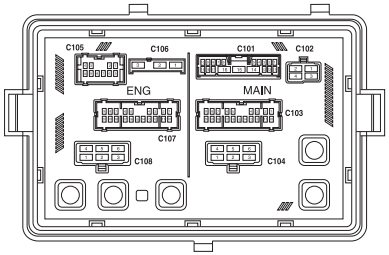
C204 (COLORLESS)



S202 (BLACK)



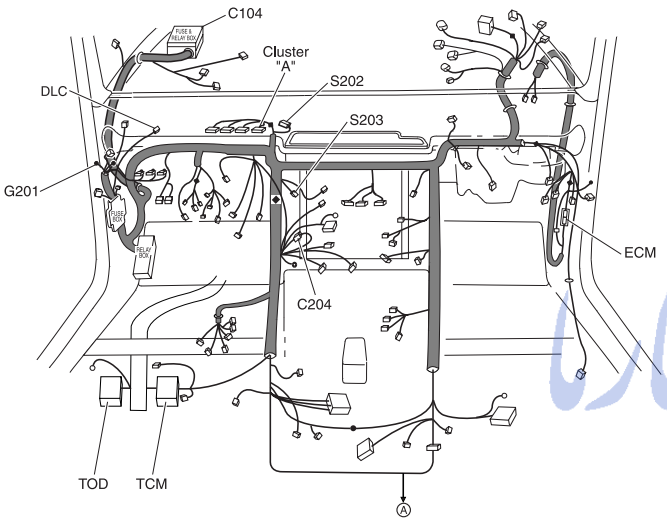
S203 (COLORLESS)



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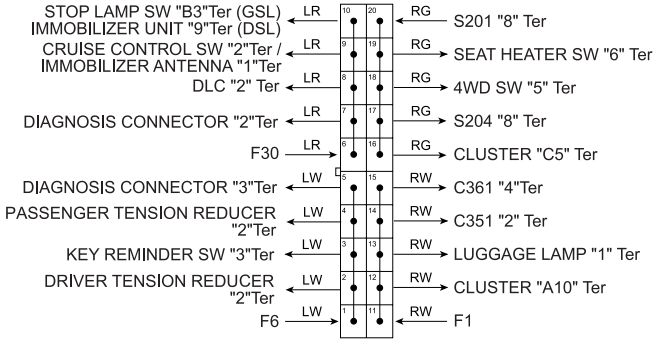
c. POSITION OF CONNECTORS AND GROUNDS

- W/H MAIN

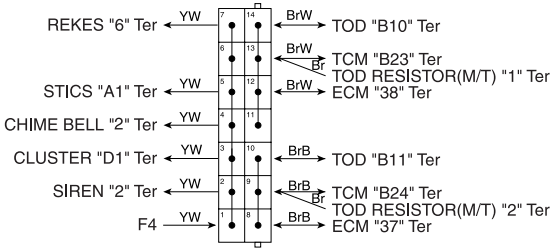


d. SPLICE PACK

S202 (BLACK)

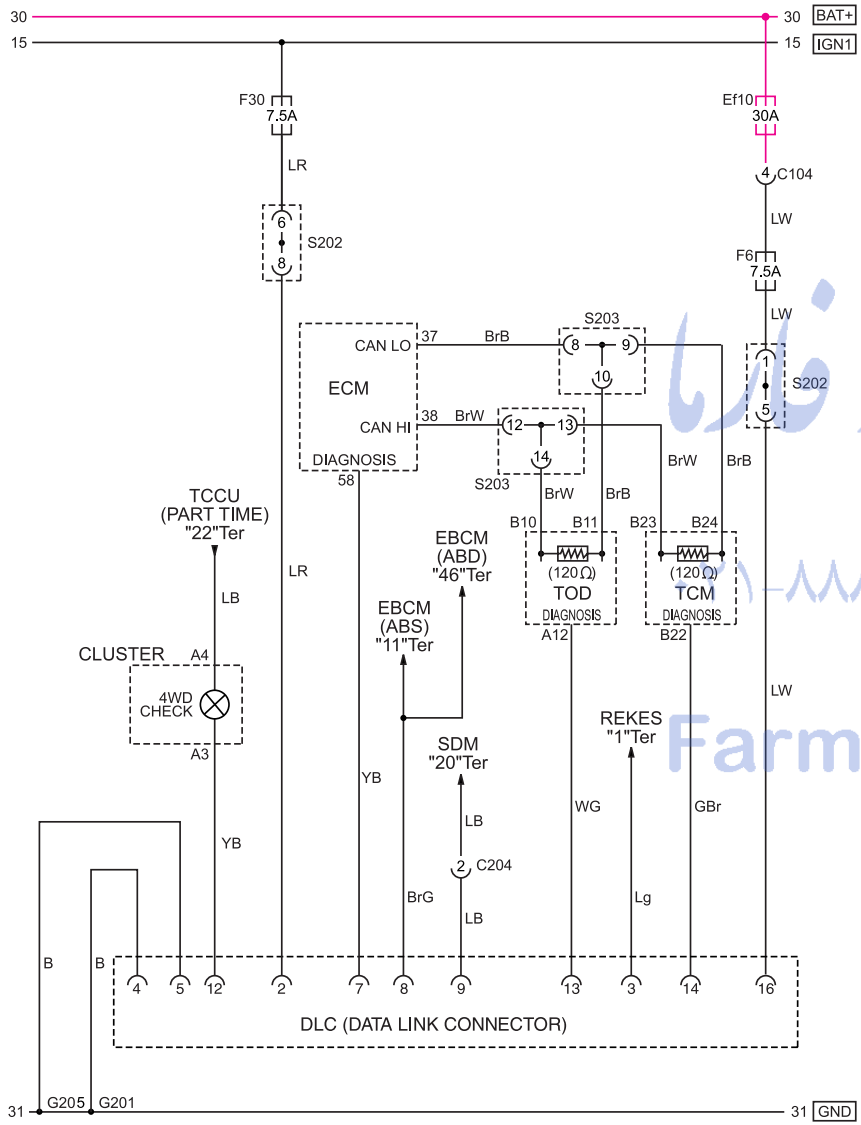


S203



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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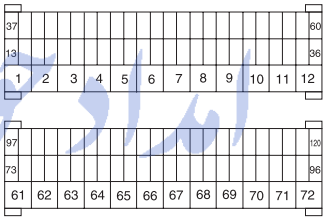
(2) W/ EURO III

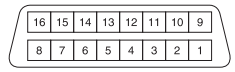


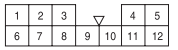
a. CONNECTOR INFORMATION

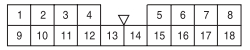
CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C104 (8Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C204 (4Pin, Colorless)	W/H Main - W/H SDM	Lower Rear Center Facia
S202 (20Pin, Black)	W/H Main	Behind Cluster
S203 (14Pin, Colorless)	W/H Main	Behind 4WD Switch
G201	W/H Main	Upper Front Leftt Leg Room

b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



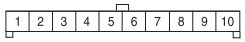




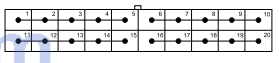


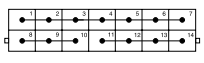


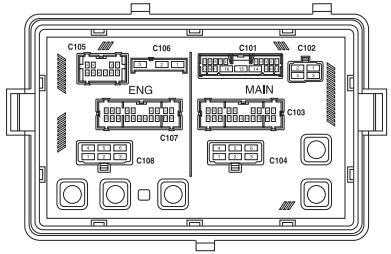








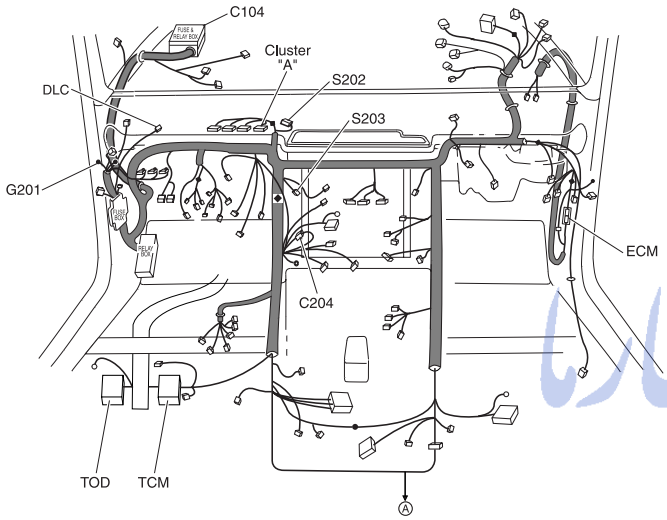




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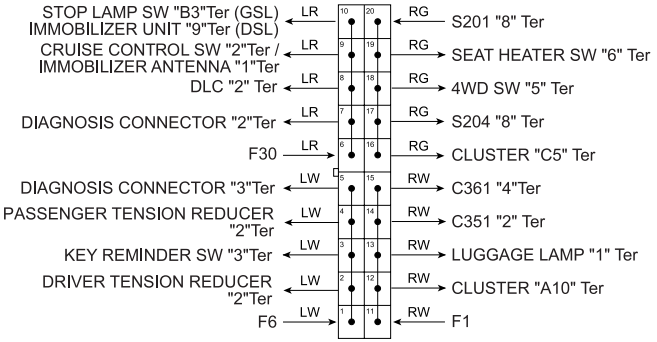
c. POSITION OF CONNECTORS AND GROUNDS

- W/H MAIN

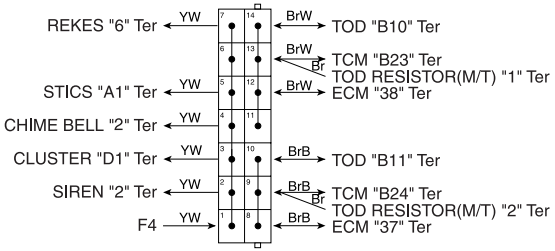


d. SPLICE PACK

S202 (BLACK)

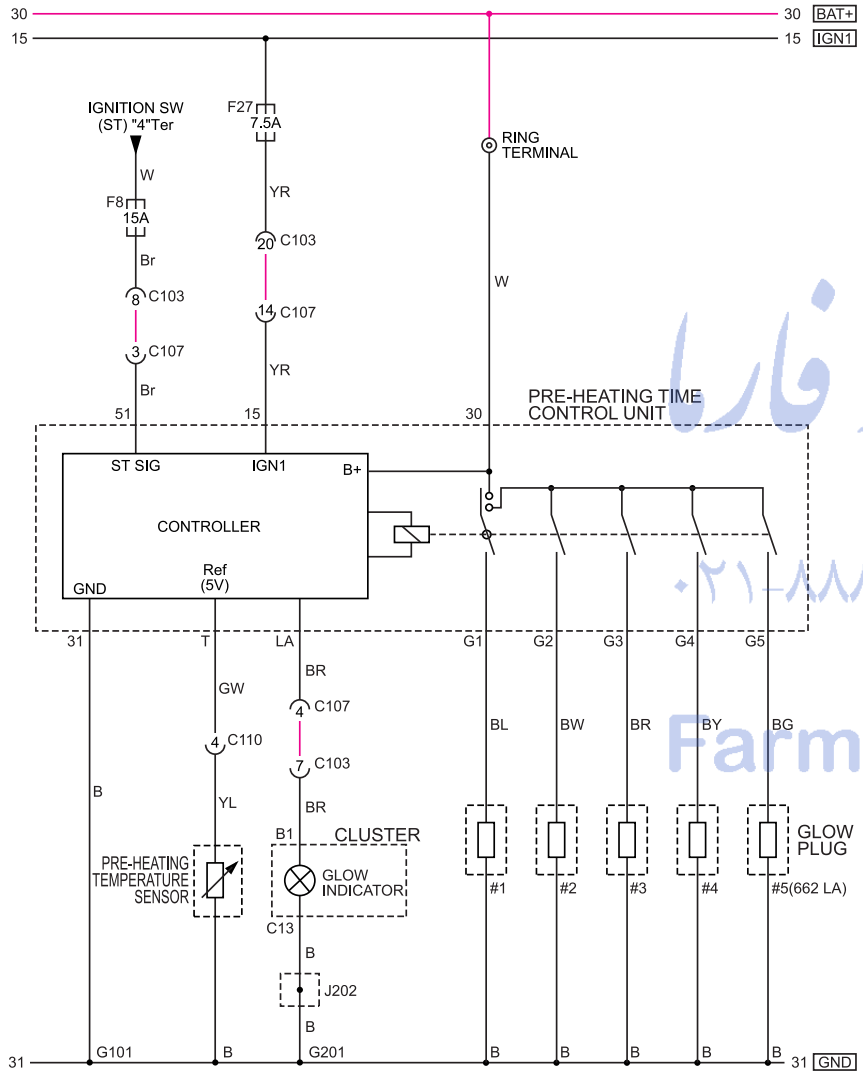


S203



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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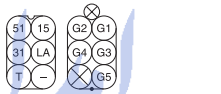
3. PRE-HEATING SYSTEM



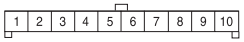
a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C103 (22Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C107 (20Pin, White)	Engine Room Fuse Box - W/H Engine Room	Engine Room Fuse Box
C110 (4Pin, Black)	W/H Engine Room - W/H Alternator	Below Air Cleaner
J202	W/H Main	Behind Cluster
G102	Battery	Center Engine Block
G201	W/H Main	Upper Front Left Leg Room

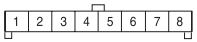
b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



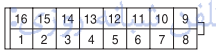
PRE-HEATING TIME CONTROL UNIT



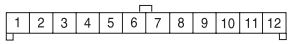
CLUSTER "A"



CLUSTER "B"



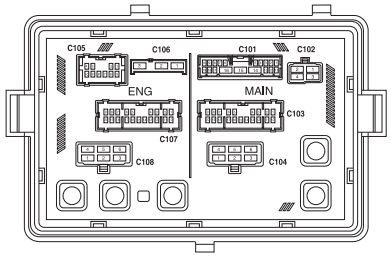
CLUSTER "C"



CLUSTER "D"



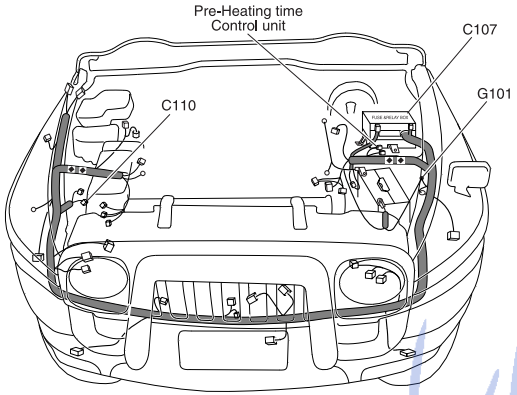
C110 (BLACK)



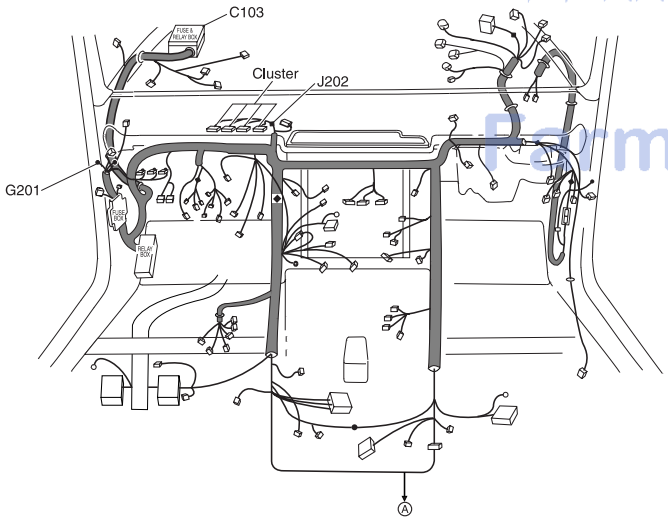
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c. POSITION OF CONNECTORS AND GROUNDS

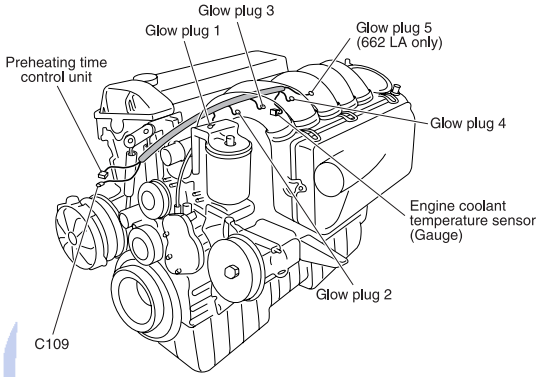
- W/H ENGINE ROOM



- W/H MAIN

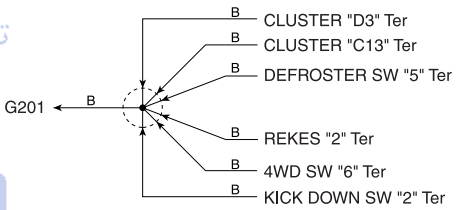


- W/H PRE-HEATING (DIESEL)



d. JOINT

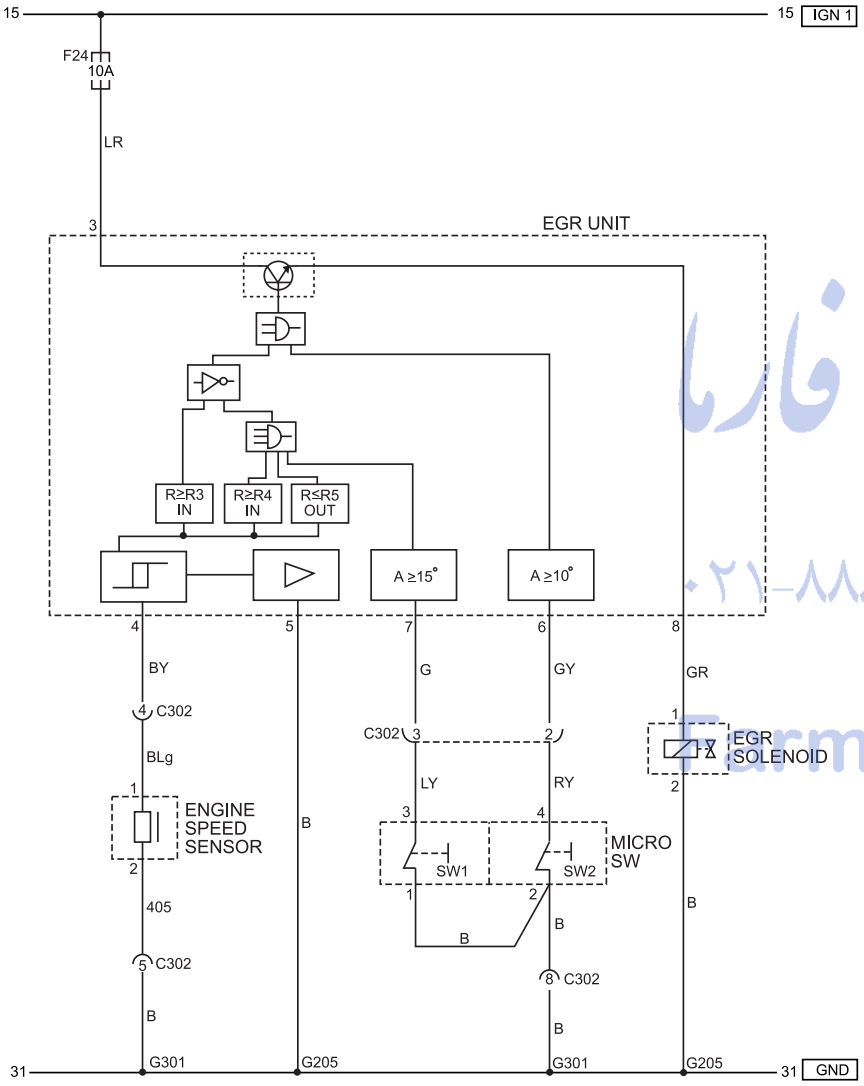
J202



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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4. EGR (EXHAUST GAS RECIRCULATION) SYSTEM

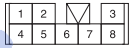
1) MANUAL TRANSMISSION



a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C302 (10Pin, Black)	W/H Main - W/H Transmission	Upper Transfer Case
G205	W/H Main	Center "A" Pillar Front Right
G301	W/H Main	Below Front Left Seat

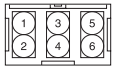
b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



EGR UNIT



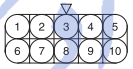
ENGINE SPEED SENSOR



MICRO SW



EGR SOLENOID

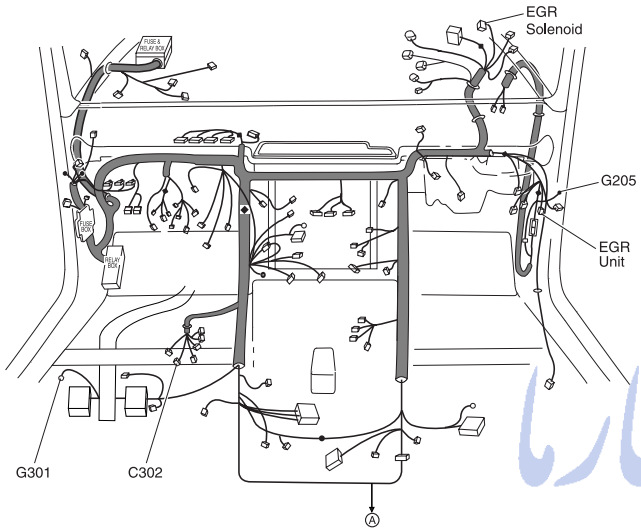


C302 (BLACK)

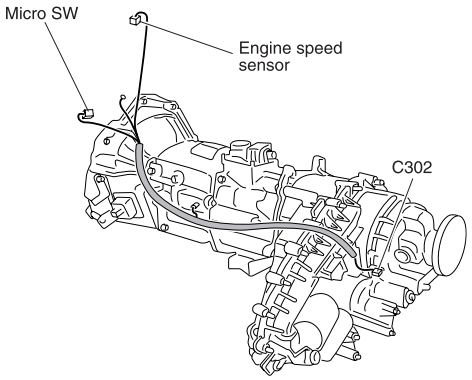
امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۶۲۰۸۵
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c. POSITION OF CONNECTORS AND GROUNDS

- W/H MAIN

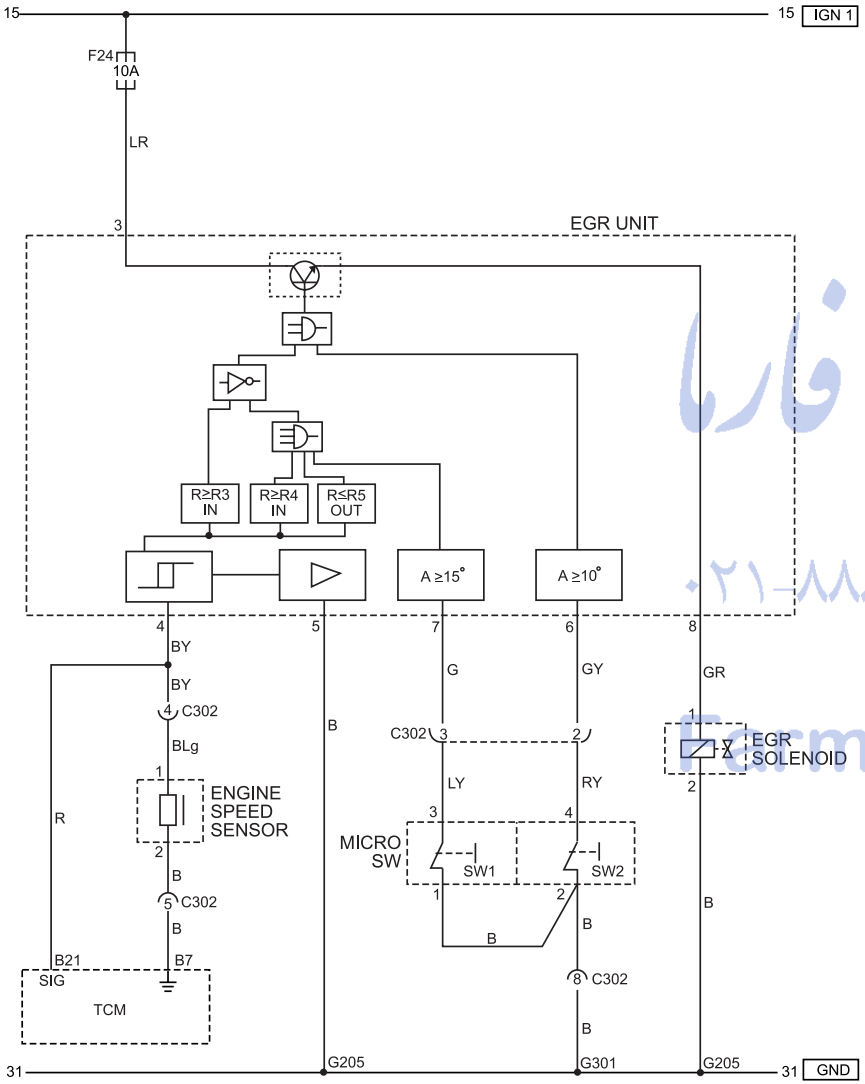


- W/H TRANSMISSION (MANUAL TRANSMISSION)



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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2) AUTOMATIC TRANSMISSION



a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C302 (10Pin, Black)	W/H Main - W/H Transmission	Upper Transfer Case
G205	W/H Main	Center "A" Pillar Front Right
G301	W/H Main	Below Front Left Seat

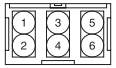
b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



EGR UNIT



ENGINE SPEED SENSOR



MICRO SW



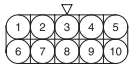
EGR SOLENOID



TCM "A"



TCM "B"

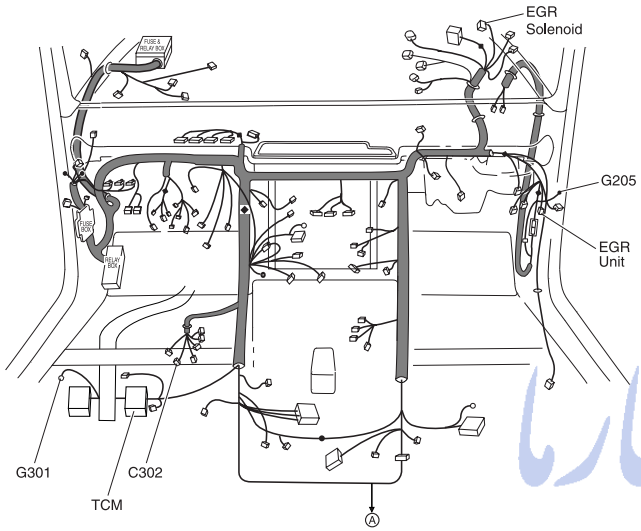


C302 (BLACK)

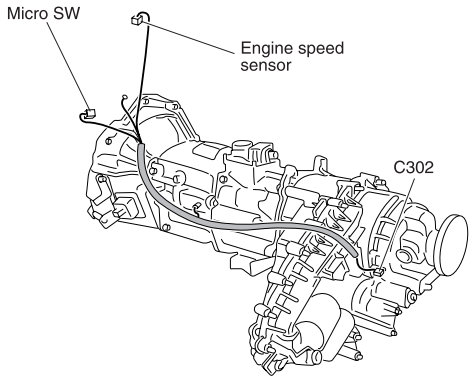
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۰۲۱-۸۸۴۶۲۰۸۵ تلفن شبانه روزی
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c. POSITION OF CONNECTORS AND GROUNDS

- W/H MAIN



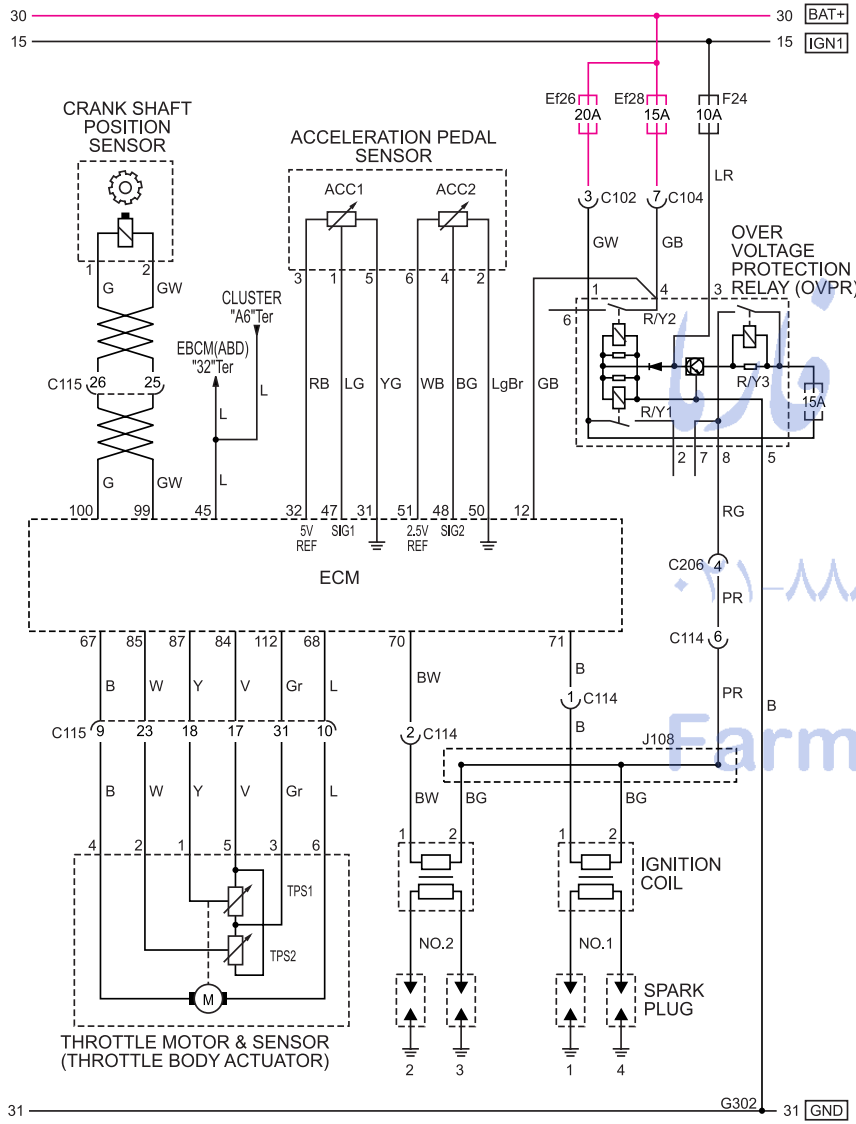
- W/H TRANSMISSION (MANUAL TRANSMISSION)



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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5. ECM (ELECTRONIC CONTROL MODULE) : E23 MSE

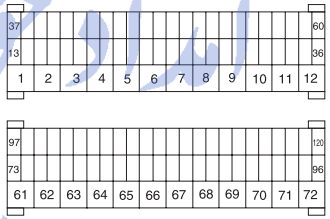
1) SENSOR (CRANK SHAFT POSITION, ACCELERATION PEDAL), THROTTLE MOTOR & SENSOR, IGNITION COIL & SPARK PLUG



a. CONNECTOR INFORMATION

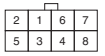
CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C102 (4Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C104 (8Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C114 (6Pin, Gray)	W/H Engine Control - W/H ECM Main	Behind Hydraulic Unit
C115 (2Pin, Black)	W/H Engine Control - W/H ECM Main	Behind Hydraulic Unit
C206 (6Pin, Black)	W/H Main - W/H ECM Main	Lower "A" Piller (Upper ECM)
J108	W/H Engine Control	Upper Injecter #4 (4CYL) or #6 (6CYL)
G302	W/H Main	Below Center Console

b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

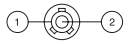


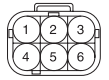
CRANK SHAFT POSITION SENSOR

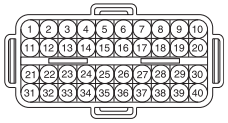

ACCELERATION PEDAL SENSOR


OVPR

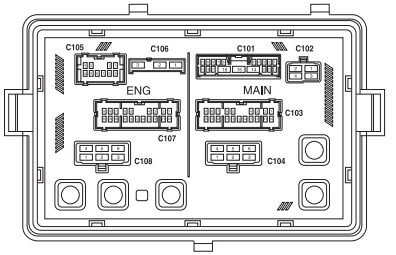

THROTTLE MOTOR & SENSOR


IGNITION COIL


C114 (GRAY)


C115 (BLACK)

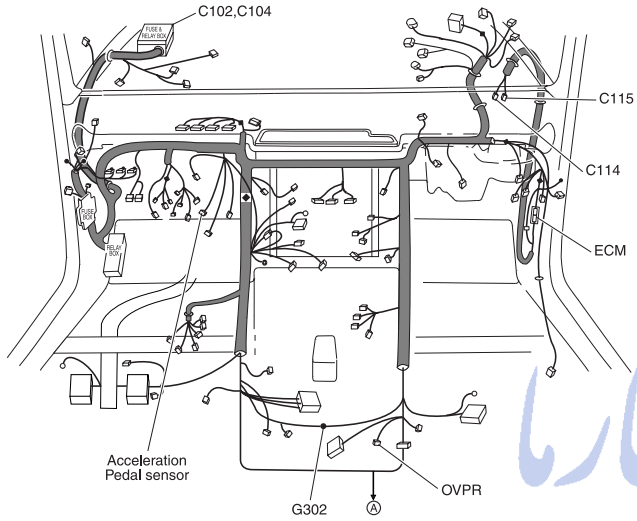

C206 (BLACK)



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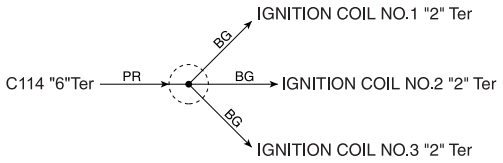
c. POSITION OF CONNECTORS AND GROUNDS

- W/H MAIN



d. JOINT

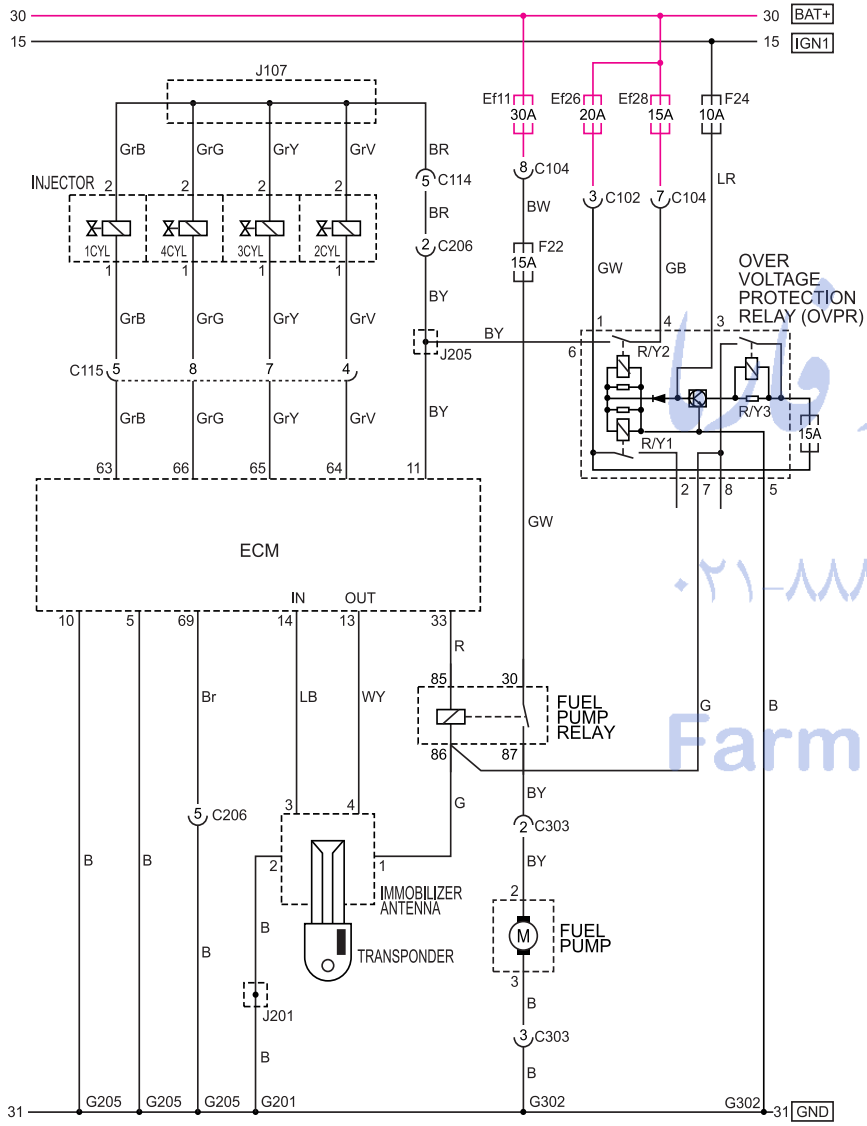
J108



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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2) INJECTOR, FUEL PUMP RELAY, FUEL PUMP, IMMOBILIZER

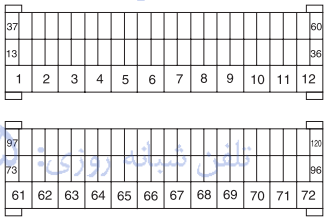
(1) W/O EURO III

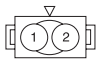


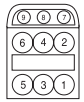
a. CONNECTOR INFORMATION

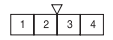
CONNECTOR(NUMBER)	CONNECTING WIRING HARNESS	CONNECTOR POSITION
C102 (4Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C104 (8Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C114 (6Pin, Gray)	W/H Engine Control - W/H ECM Main	Behind Hydraulic Unit
C115 (40Pin, Black)	W/H Engine Control - W/H ECM Main	Behind Hydraulic Unit
C206 (6Pin, Black)	W/H Main - W/H ECM Main	Lower "A" Piller (Upper ECM)
C303 (4Pin, Black)	W/H Main - W/H Fuel Pump	Upper Transfer Case
J107	W/H Engine Control	Next to Yellow Label
J205	W/H Main	Behind Front Right Kick Panel
G201	W/H Main	Upper Front Left Leg Room
G205	W/H Main	Center "A" Piller Front Right
G302	W/H Main	Below Center Console

b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

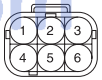


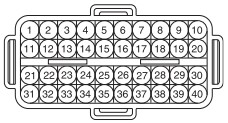






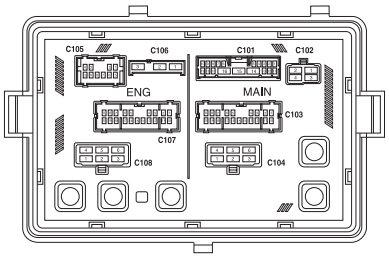








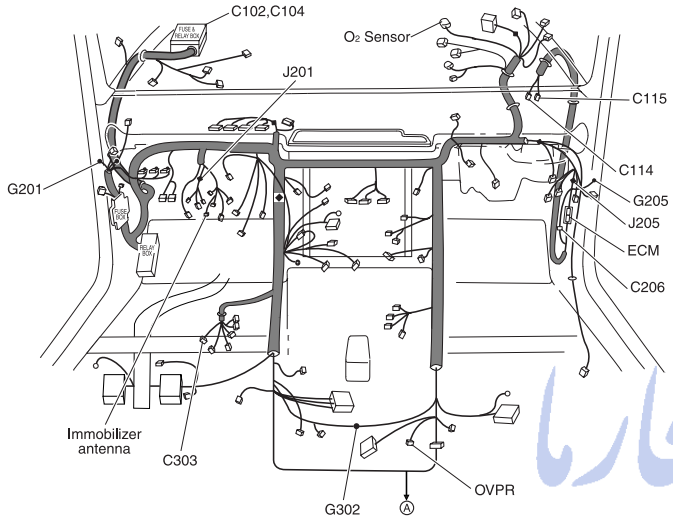




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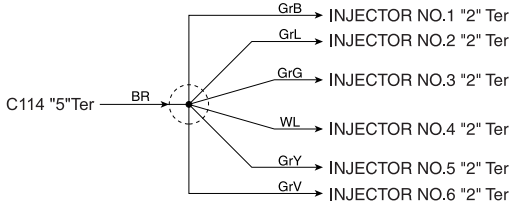
c. POSITION OF CONNECTORS AND GROUNDS

- W/H MAIN

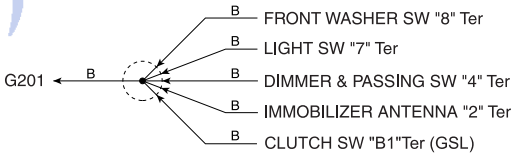


d. JOINT

J107

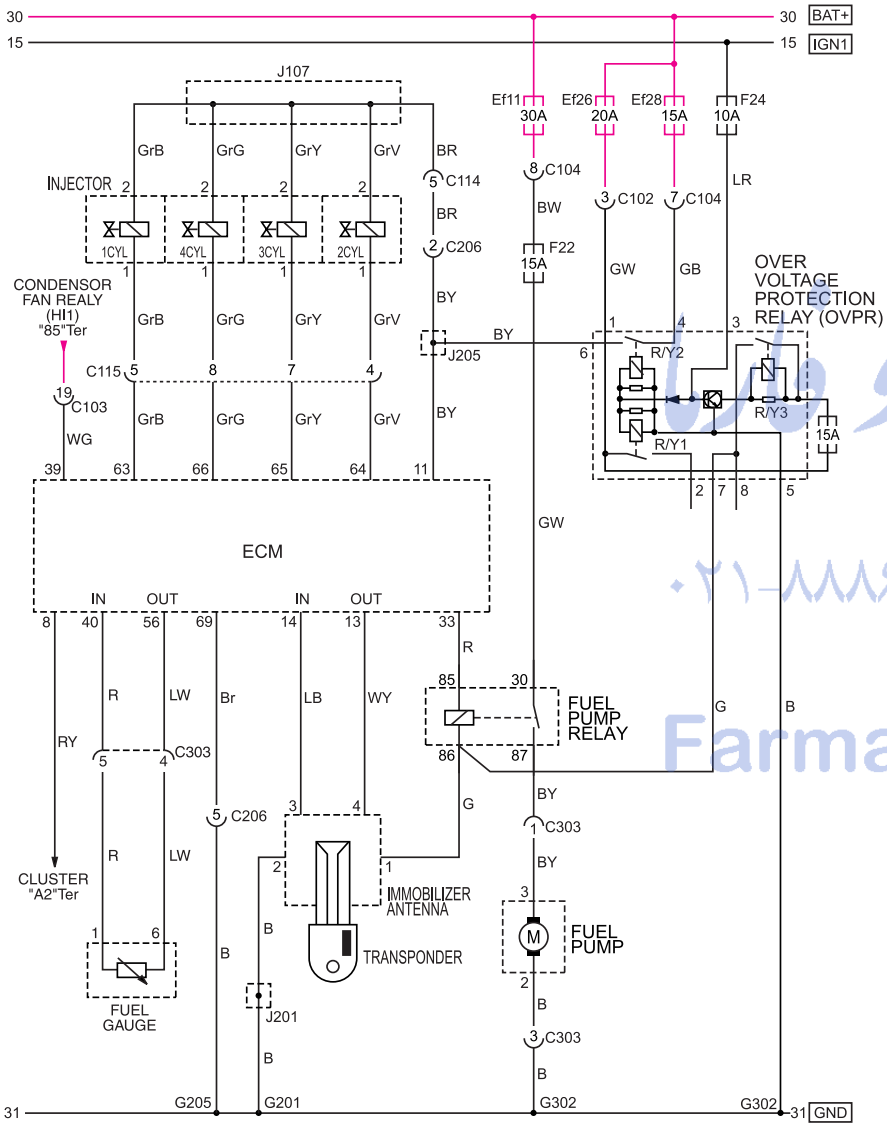


J201



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
FarmaSOS.com

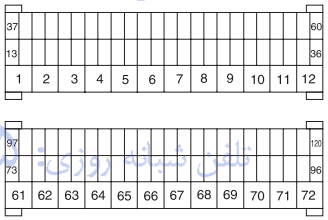
(2) W/ EURO III

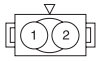


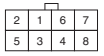
a. CONNECTOR INFORMATION

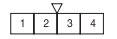
CONNECTOR(NUMBER)	CONNECTING WIRING HARNESS	CONNECTOR POSITION
C102 (4Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C104 (8Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C114 (6Pin, Gray)	W/H Engine Control - W/H ECM Main	Behind Hydraulic Unit
C115 (40Pin, Black)	W/H Engine Control - W/H ECM Main	Behind Hydraulic Unit
C206 (6Pin, Black)	W/H Main - W/H ECM Main	Lower "A" Piller (Upper ECM)
C303 (6Pin, Black)	W/H Main - W/H Fuel Pump	Upper Transfer Case
J107	W/H Engine Control	Next to Yellow Label
J205	W/H Main	Behind Front Right Kick Panel
G201	W/H Main	Upper Front Left Leg Room
G205	W/H Main	Center "A" Piller Front Right
G302	W/H Main	Below Center Console

b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

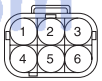


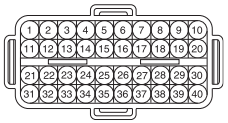






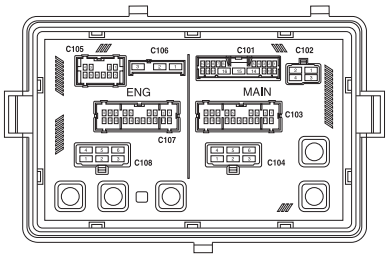








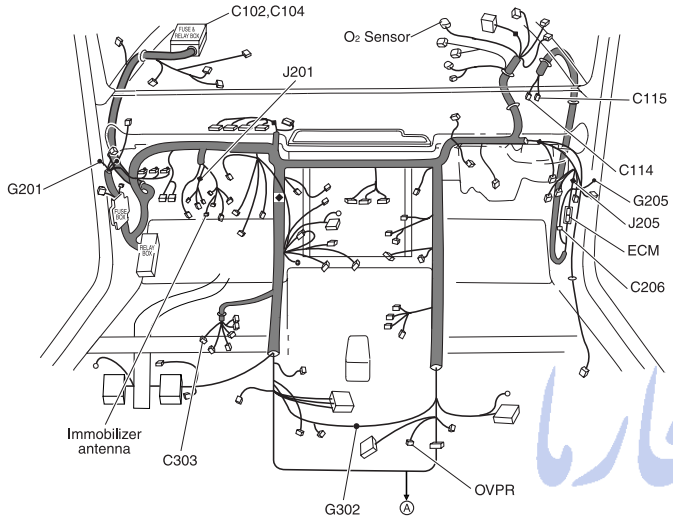




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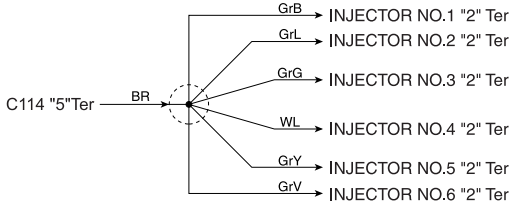
c. POSITION OF CONNECTORS AND GROUNDS

- W/H MAIN

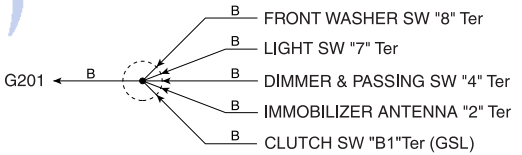


d. JOINT

J107



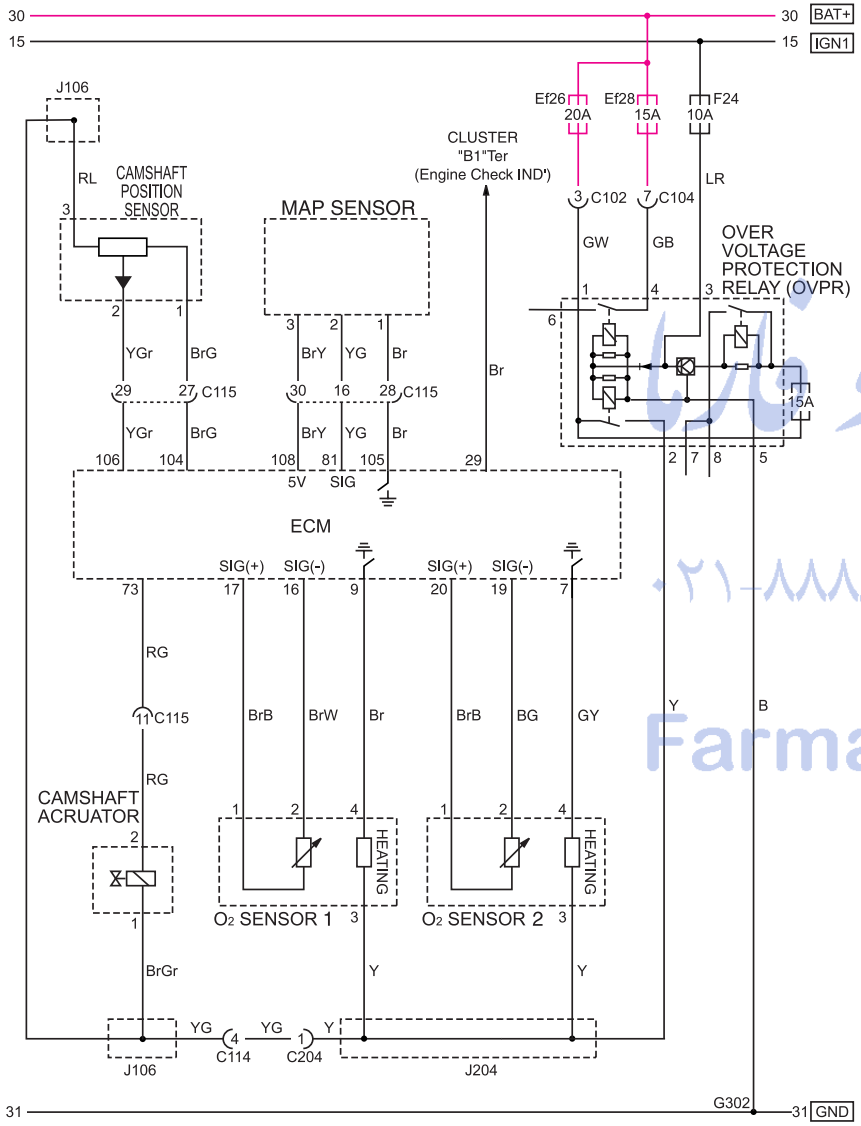
J201



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
FarmaSOS.com

3) SENSOR (CAM SHAFT POSITION, AIR FLOW, O_2), CAM SHAFT ACTUATOR

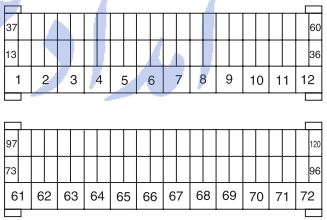
(1) W/O EURO III



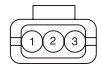
a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C102 (4Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C104 (8Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C114 (6Pin, Gray)	W/H Engine Control - W/H ECM Main	Behind Hydraulic Unit
C115 (40Pin, Black)	W/H Engine Control - W/H ECM Main	Behind Hydraulic Unit
C206 (6Pin, Black)	W/H Main - W/H ECM Main	Lower "A" Piller (Upper ECM)
J106	W/H Engine Control	Behind Hydrauilc Unit
J204	W/H Main	Upper Blower Unit
G302	W/H Main	Below Center Console

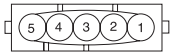
b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



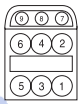
ECM



CAM SHAFT POSITION



AIR FLOW SENSOR

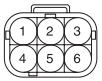


OVPR

CAM SHAFT ACTUATOR



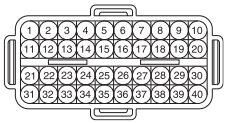
O_2 SENSOR



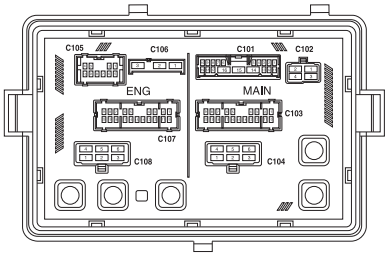
C114 (GRAY)



C206 (BLACK)



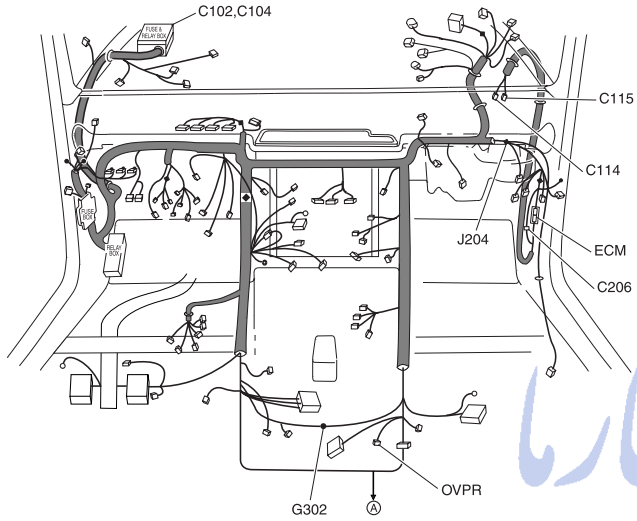
C115 (BLACK)



FarmaSOS.com
تلفن شبانه روزی: ۰۲۱-۸۸۶۲۰۸۵

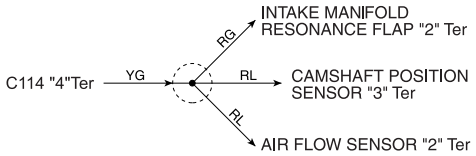
c. POSITION OF CONNECTORS AND GROUNDS

- W/H MAIN

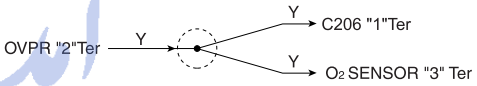


d. JOINT

J106

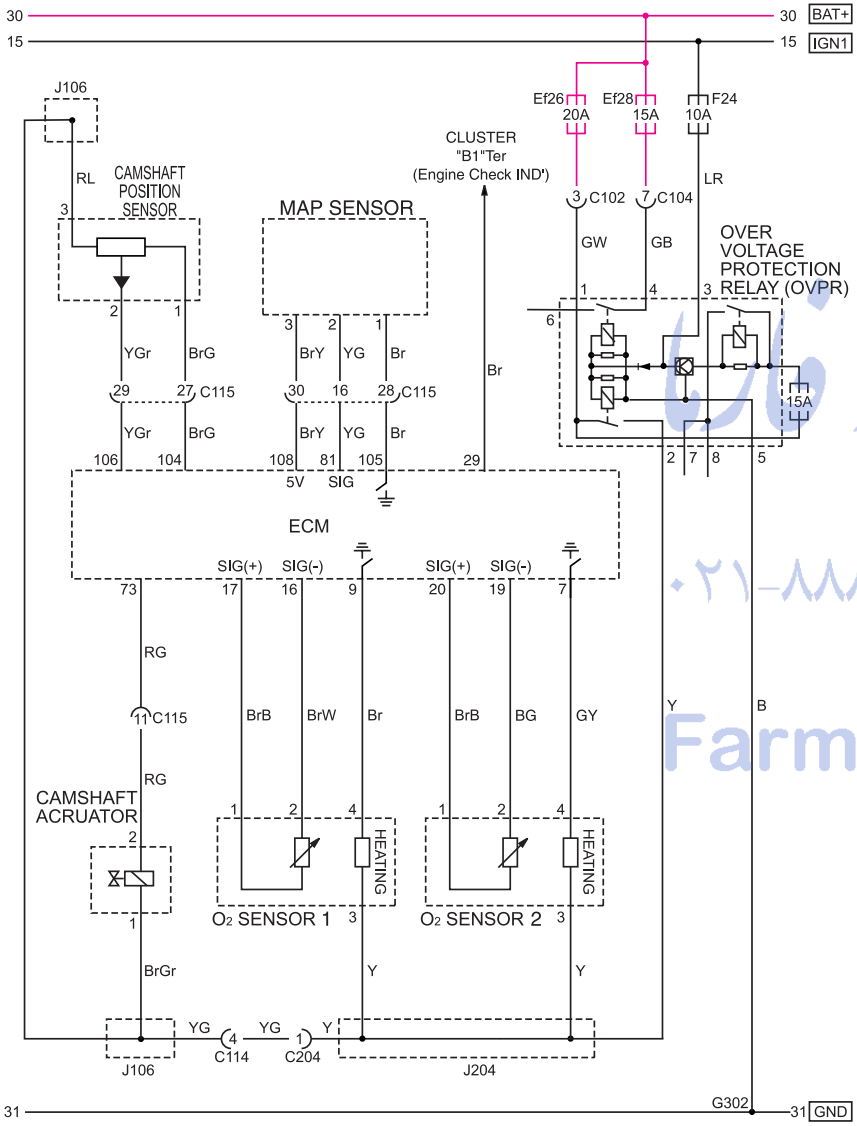


J204



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
FarmaSOS.com

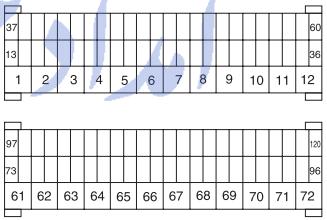
(2) W/ EURO III



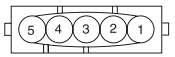
a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C102 (4Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C104 (8Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C114 (6Pin, Gray)	W/H Engine Control - W/H ECM Main	Behind Hydraulic Unit
C115 (40Pin, Black)	W/H Engine Control - W/H ECM Main	Behind Hydraulic Unit
C206 (6Pin, Black)	W/H Main - W/H ECM Main	Lower "A" Piller (Upper ECM)
J106	W/H Engine Control	Behind Hydrauilc Unit
J204	W/H Main	Upper Blower Unit
G302	W/H Main	Below Center Console

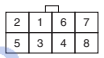
b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION




CAM SHAFT POSITION

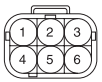

AIR FLOW SENSOR


MAP SENSOR

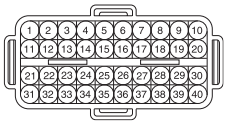

OVPR

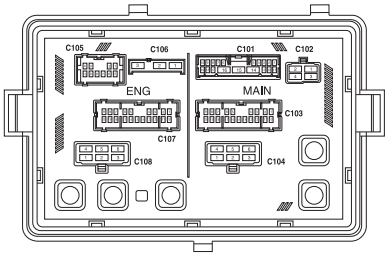

CAM SHAFT ACTUATOR


O2 SENSOR


C114 (GRAY)


C206 (BLACK)

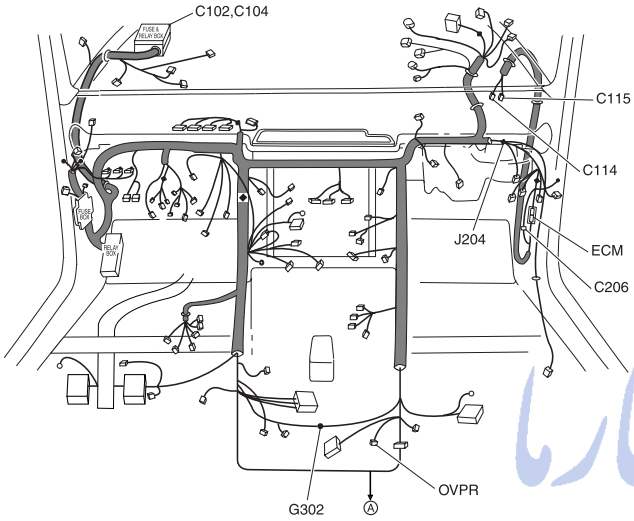

C115 (BLACK)



FarmaSOS.com
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵

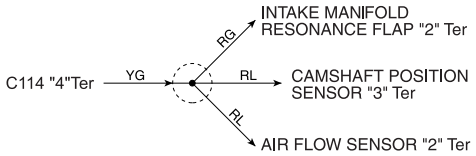
c. POSITION OF CONNECTORS AND GROUNDS

- W/H MAIN

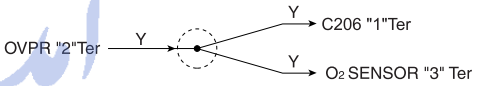


d. JOINT

J106



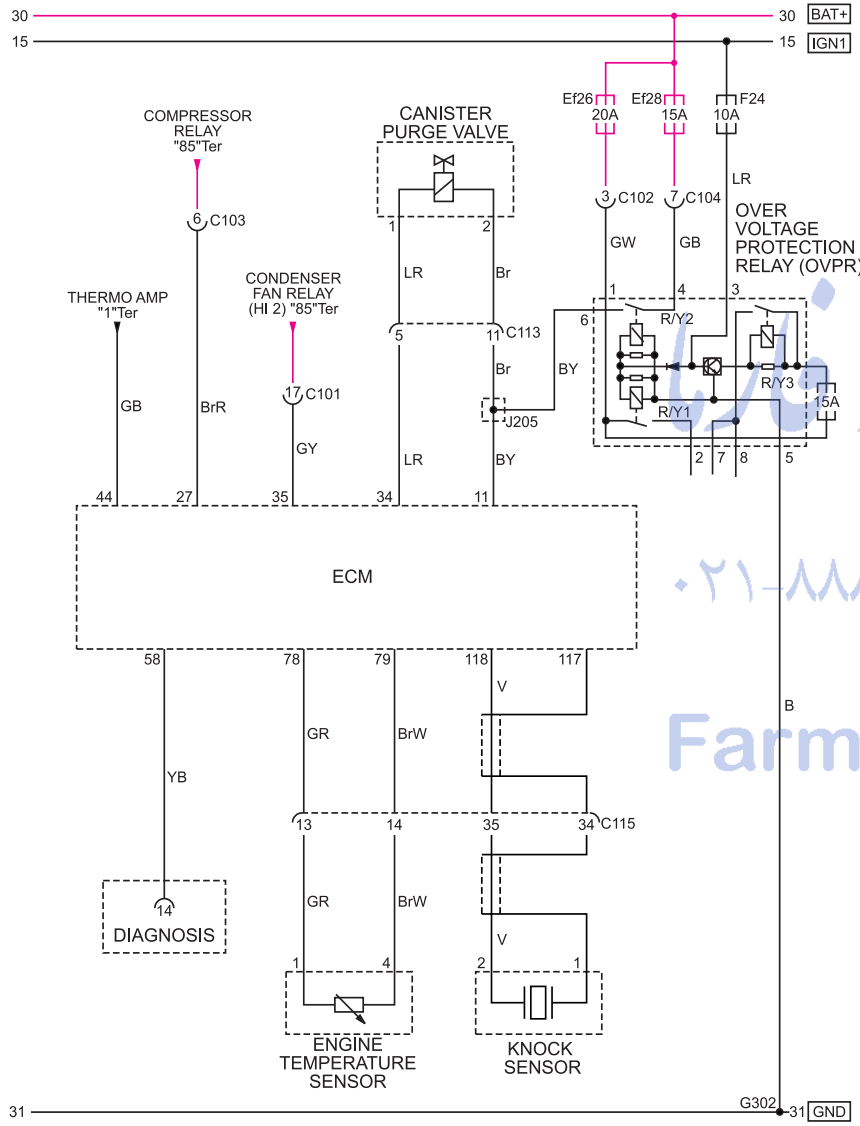
J204



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
FarmaSOS.com

4) SENSOR (ENGINE TEMPERATURE, KNOCK), CANISTER PURGE VALVE, DIAGNOSIS

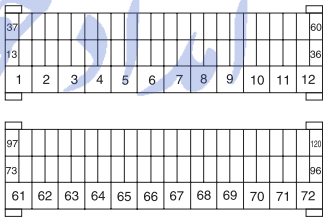
(1) W/O EURO III



a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C101 (19Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C102 (4Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C103 (22Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C104 (8Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C113 (12Pin, Black)	W/H Engine Room - W/H Main	Next to Hydraulic Unit
C115 (40Pin, Black)	W/H Engine Control - W/H ECM Main	Behind Hydraulic Unit
J205	W/H Main	Below Center Console
G302	W/H Main	

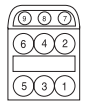
b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



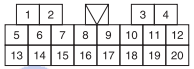
ECM



CANISTOR PURGE VALVE



OVPR



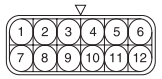
DIAGNOSIS CONNECTOR



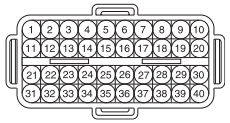
ENGINE TEMP' SENSOR



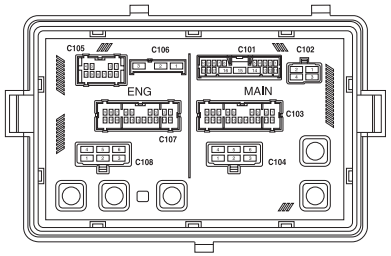
KNOCK SENSOR



C113 (BLACK)



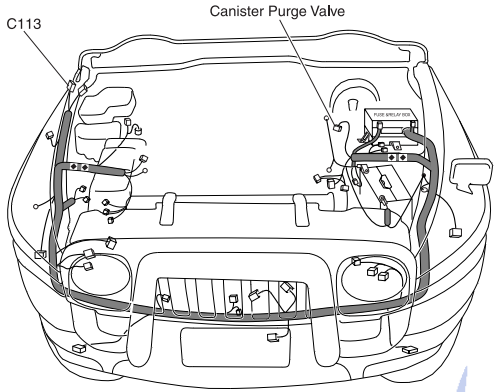
C115 (BLACK)



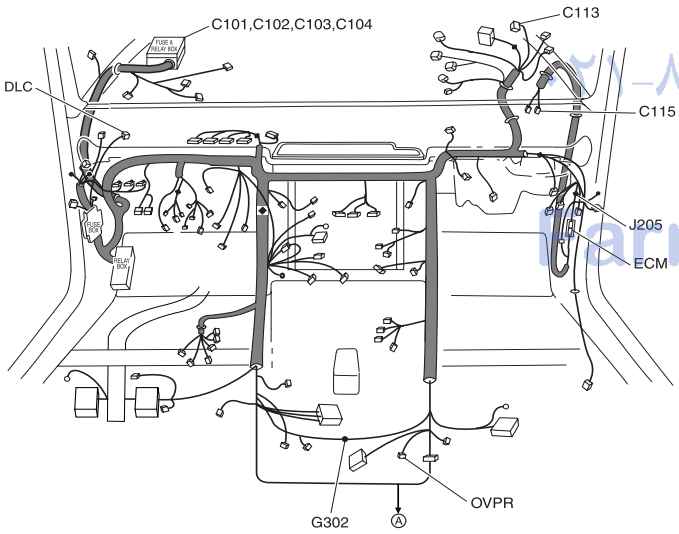
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۰۲۱-۸۸۴۶۲۰۸۵ تلفن شبانه روزی:

c. POSITION OF CONNECTORS AND GROUNDS

- W/H ENGINE ROOM

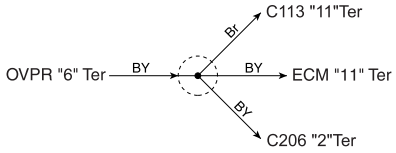


- W/H MAIN



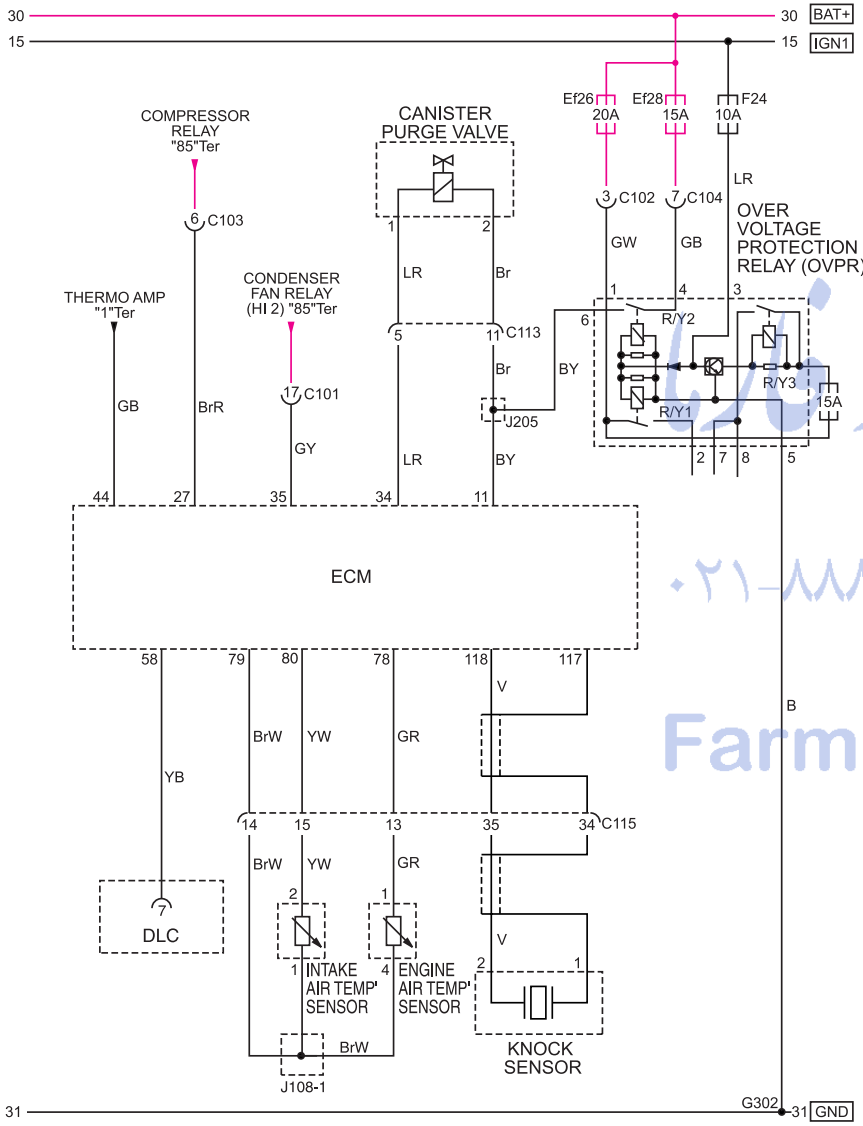
d. JOINT

J205



امداد خودرو فارما
تلفن شبانه روزی: ۸۸۸۶۲۰۸۵-۰۲۱
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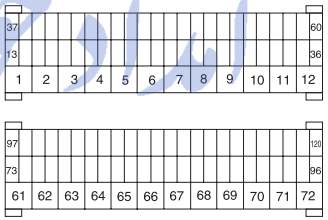
(2) W/ EURO III



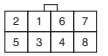
a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C101 (19Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C102 (4Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C103 (22Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C104 (8Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C113 (12Pin, Black)	W/H Engine Room - W/H Main	Next to Hydraulic Unit
C115 (40Pin, Black)	W/H Engine Control - W/H ECM Main	Behind Hydraulic Unit
J205	W/H Main	Below Center Console
G302	W/H Main	

b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



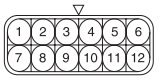

CANISTOR PURGE VALVE

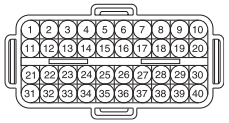

OVPR

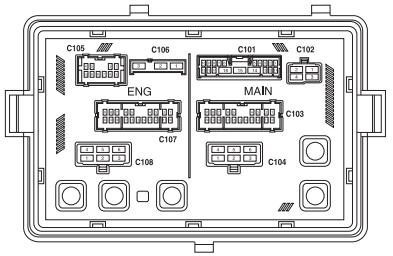

INTAKE AIR TEMP' SENSOR


ENGINE TEMP' SENSOR


KNOCK SENSOR


C113 (BLACK)

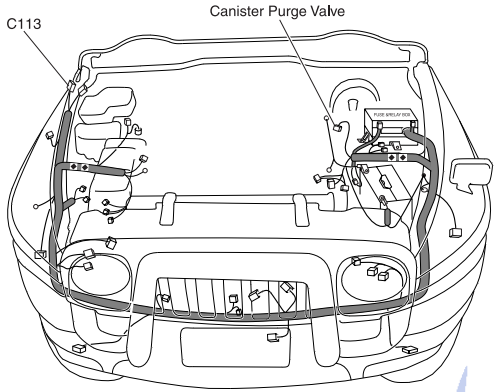

C115 (BLACK)



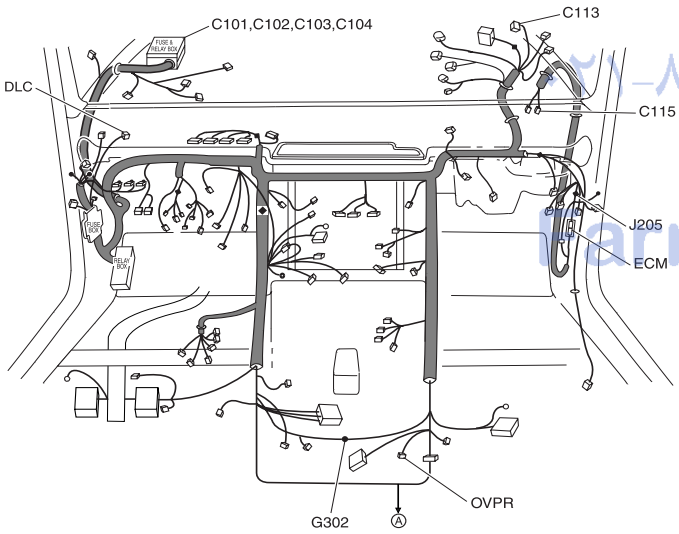
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c. POSITION OF CONNECTORS AND GROUNDS

- W/H ENGINE ROOM

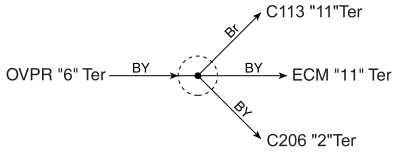


- W/H MAIN



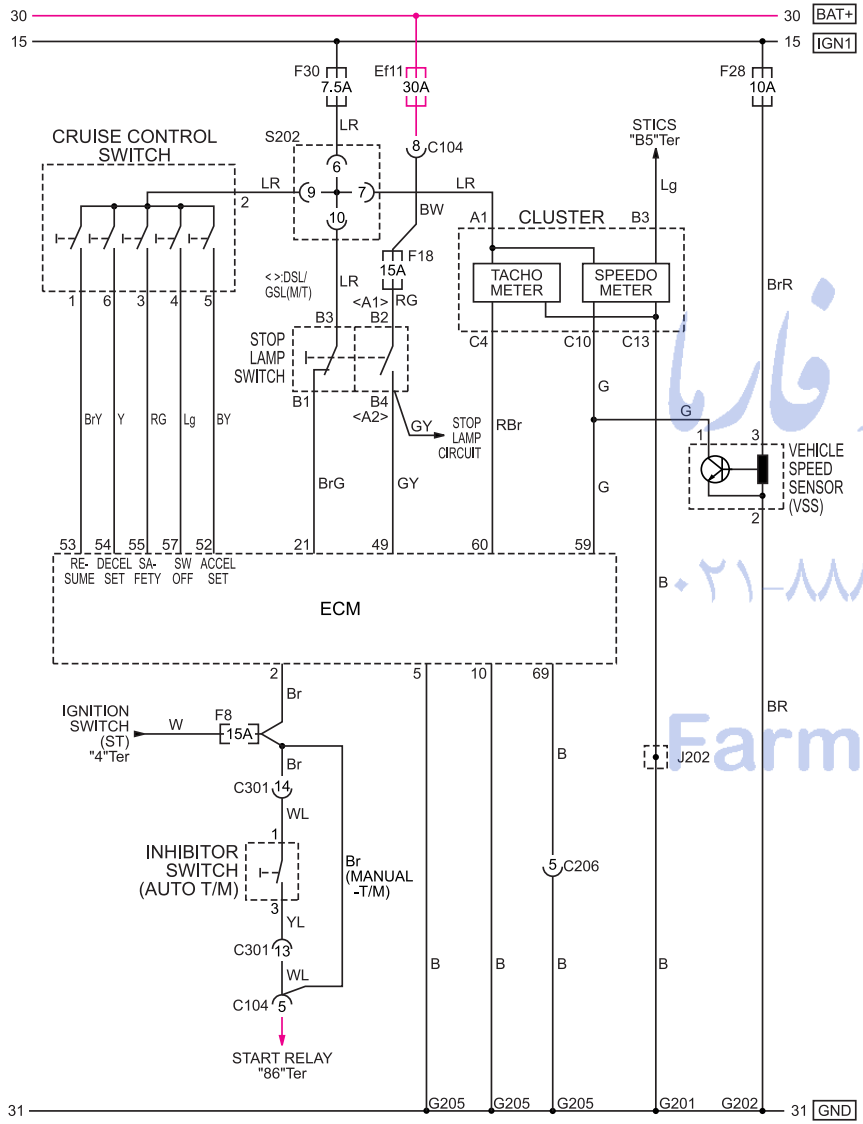
d. JOINT

J205



امداد خودرو فارما
تلفن شبانه روزی: ۸۸۸۶۲۰۸۵-۰۲۱
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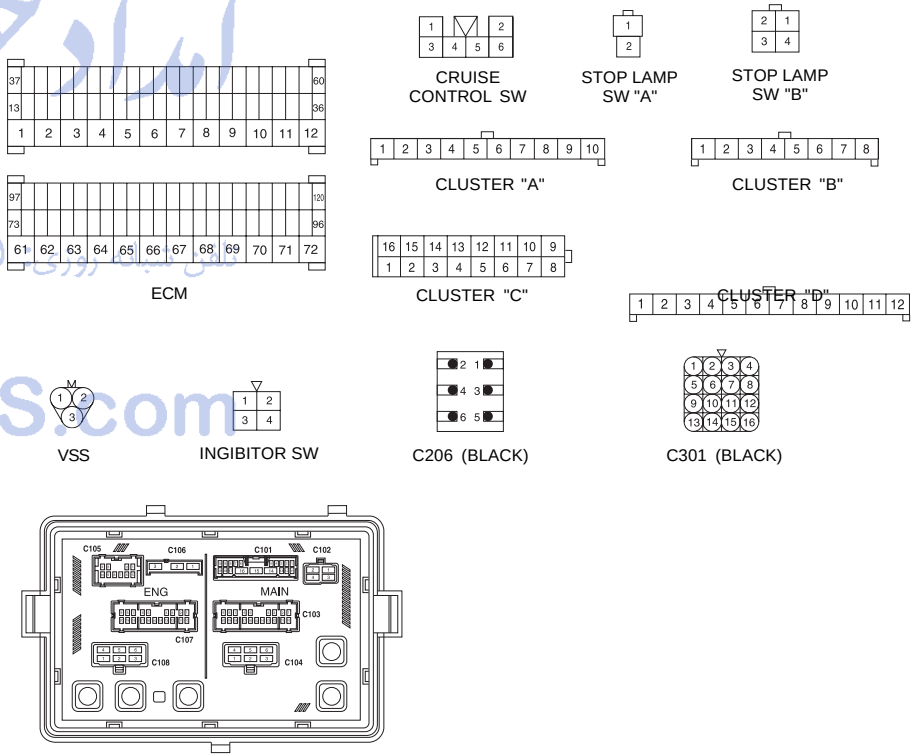
5) VEHICLE SPEED SENSOR, SWITCH (CRUISE CONTROL, STOP LAMP, INHIBITOR, CLUTCH)



a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C104 (8Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C206 (6Pin, Black)	W/H Main - W/H ECM Main	Lower "A" Piller (Upper ECM)
C301 (16Pin, Black)	W/H Main - W/H Transmission	Upper Transfer Case
S202 (20Pin,Black)	W/H Main	Behind Cluster
J202	W/H Main	Behind Cluster
G201	W/H Main	Upper Front Left Leg Room
G202	W/H Main	Upper Front Left Leg Room
G205	W/H Main	Center "A" Piller Front Right

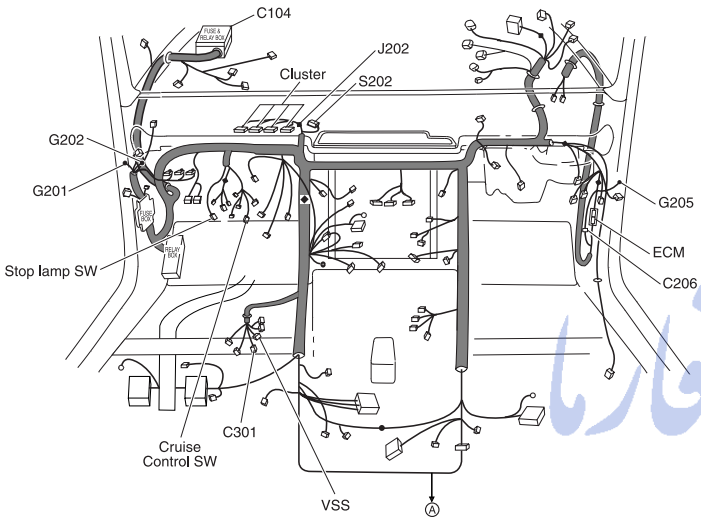
b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



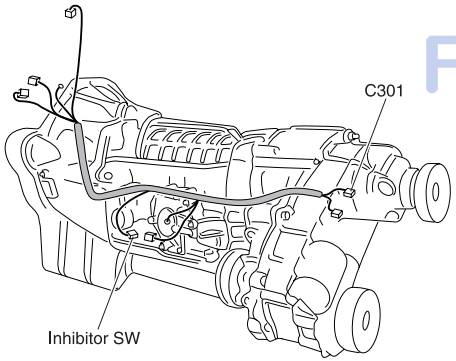
ایران خودرو فارما
۰۲۱-۸۸۴۶۲۰۸۵
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c. POSITION OF CONNECTORS AND GROUNDS

- W/H MAIN

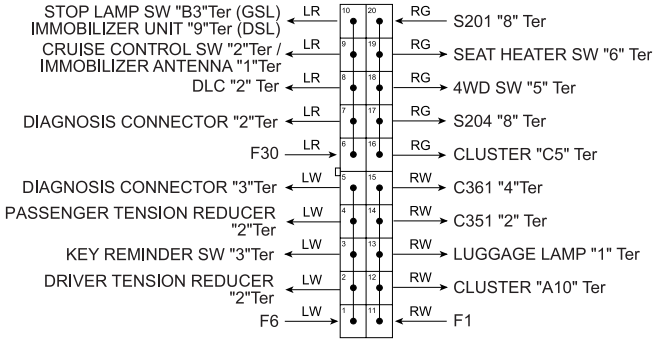


- W/H TRANSMISSION (AUTOMATIC TRANSMISSION)



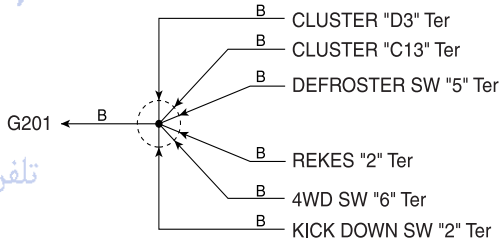
d. SPLICE PACK

S202 (BLACK)



e. JOINT

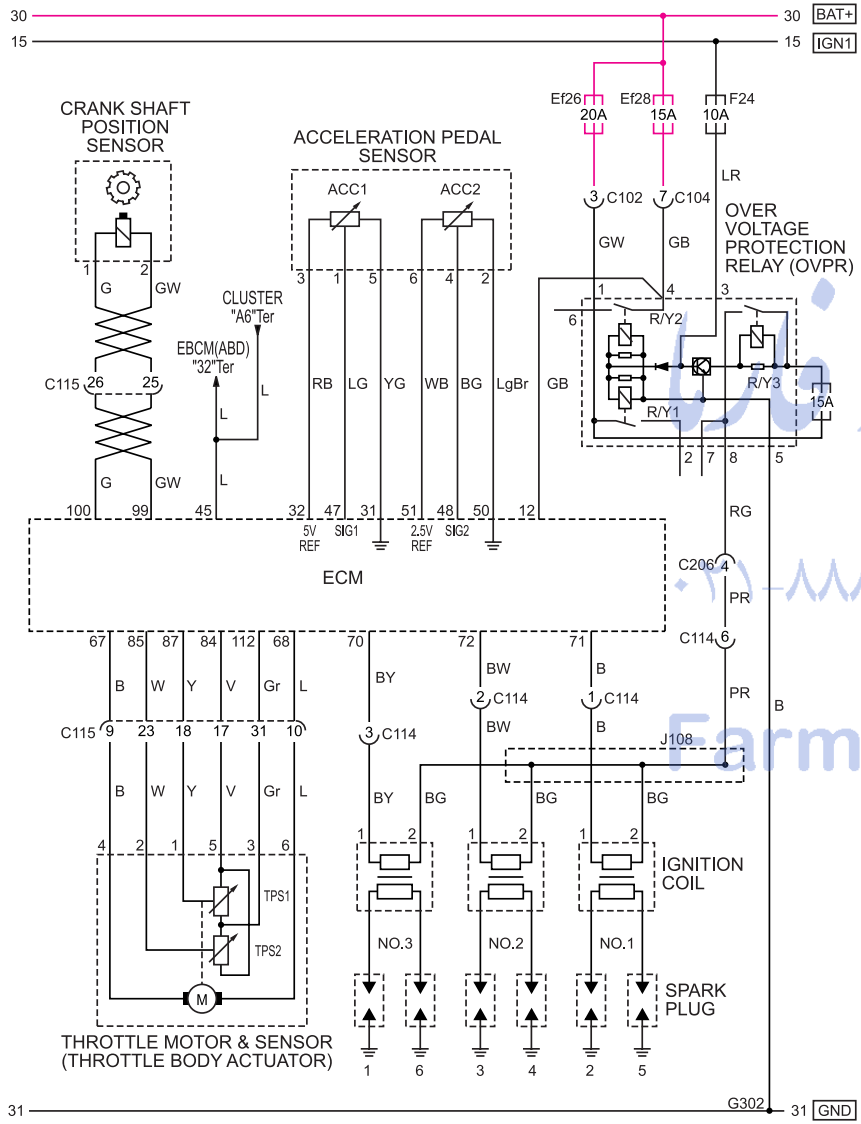
J202



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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6. ECM (ELECTRONIC CONTROL MODULE) : E32 MSE

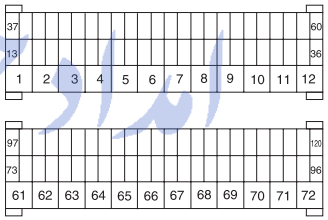
1) SENSOR (CRANK SHAFT POSITION, ACCELERATION PEDAL), THROTTLE MOTOR & SENSOR IGNITION COIL & SPARK PLUG



a. CONNECTOR INFORMATION

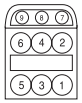
CONNECTOR(NUMBER)	CONNECTING WIRING HARNESS	CONNECTOR POSITION
C102 (4Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C104 (8Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C114 (6Pin, Gray)	W/H Engine Control - W/H ECM Main	Behind Hydraulic Unit
C115 (4Pin, Black)	W/H Engine Control - W/H ECM Main	Behind Hydraulic Unit
C206 (6Pin, Black)	W/H Main - W/H ECM Main	Lower "A" Piller (Upper ECM)
J108	W/H Engine Control	Upper Injector #4 (4CYL) or #6 (6CYL)
G302	W/H Main	Below Center Console

b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



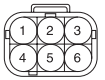

CRANK SHAFT POSITION SENSOR

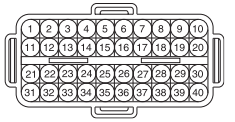

ACCELERATION PEDAL SENSOR


OVPR

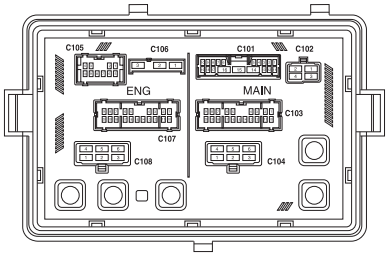

THROTTLE MOTOR & SENSOR


IGNITION COIL


C114 (GRAY)


C115 (BLACK)

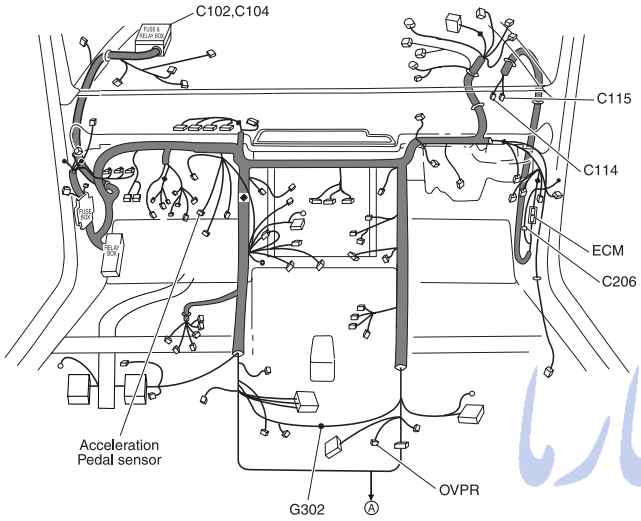

C206 (BLACK)



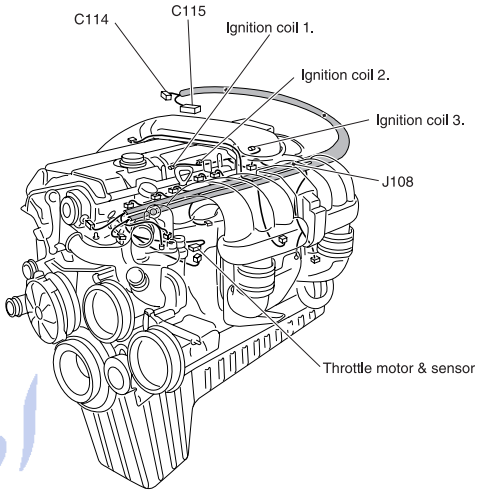
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c. POSITION OF CONNECTORS AND GROUNDS

- W/H MAIN



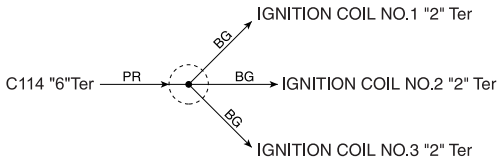
- W/H ENGINE CONTROL (GASOLINE)



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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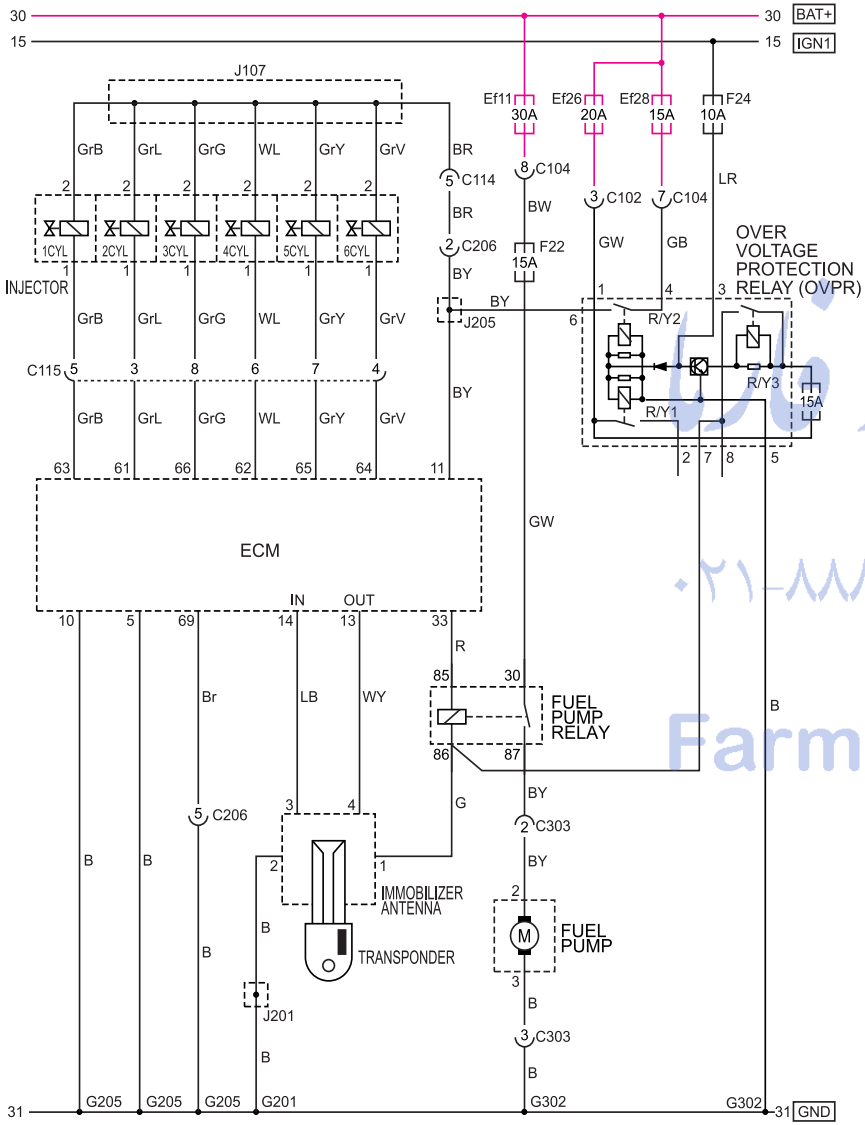
d. JOINT

J108



2) INJECTOR, FUEL PUMP RELAY, FUEL PUMP, IMMOBILIZER

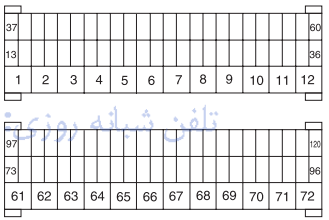
(1) W/O EURO III



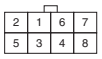
a. CONNECTOR INFORMATION

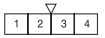
CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C102 (4Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C104 (8Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C114 (6Pin, Gray)	W/H Engine Control - W/H ECM Main	Behind Hydraulic Unit
C115 (40Pin, Black)	W/H Engine Control - W/H ECM Main	Behind Hydraulic Unit
C206 (6Pin, Black)	W/H Main - W/H ECM Main	Lower "A" Piller (Upper ECM)
C303 (3Pin, Black)	W/H Main - W/H Fuel Pump	Upper Transfer Case
J107	W/H Engine Control	Next to Yellow Label
J201	W/H Main	Above FRT LH Seat Unit Cover
J205	W/H Main	Behind Front Right Kick Panel
G201	W/H Main	Upper Front Left Leg Room
G205	W/H Main	Center "A" Piller Front Right
G302	W/H Main	Below Center Console

b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

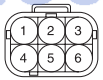


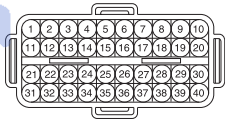

INJECTOR


OVPR


IMMOBILIZER ANTENNA

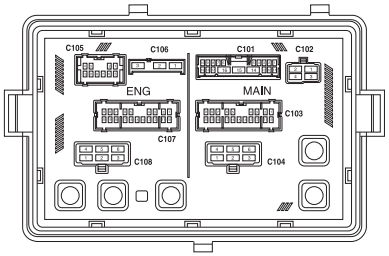

FUEL PUMP


C114 (GRAY)


C115 (BLACK)


C206 (BLACK)

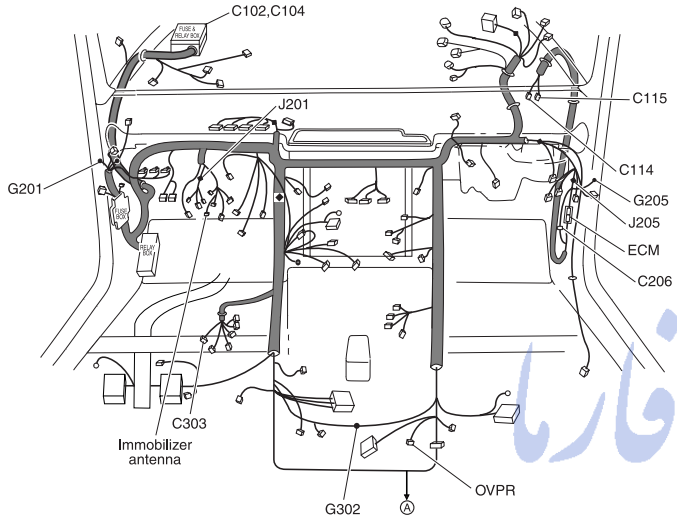

C303 (BLACK)



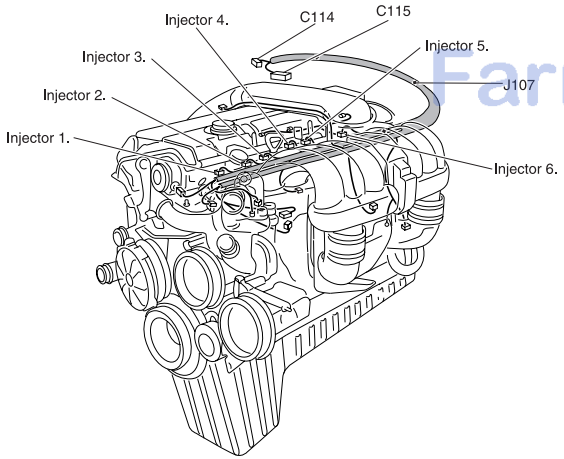
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۰۲۱-۸۸۸۶۲۰۸۵

c. POSITION OF CONNECTORS AND GROUNDS

- **W/H MAIN**

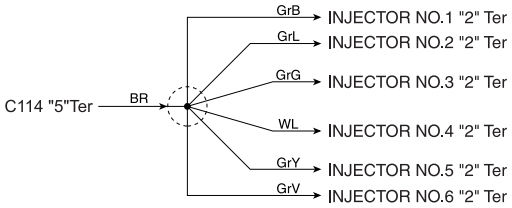


- **W/H ENGINE CONTROL (GASOLINE)**

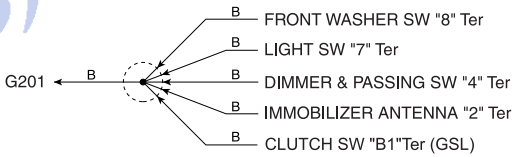


d. JOINT

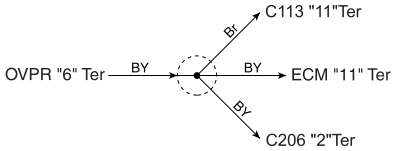
J107



J201

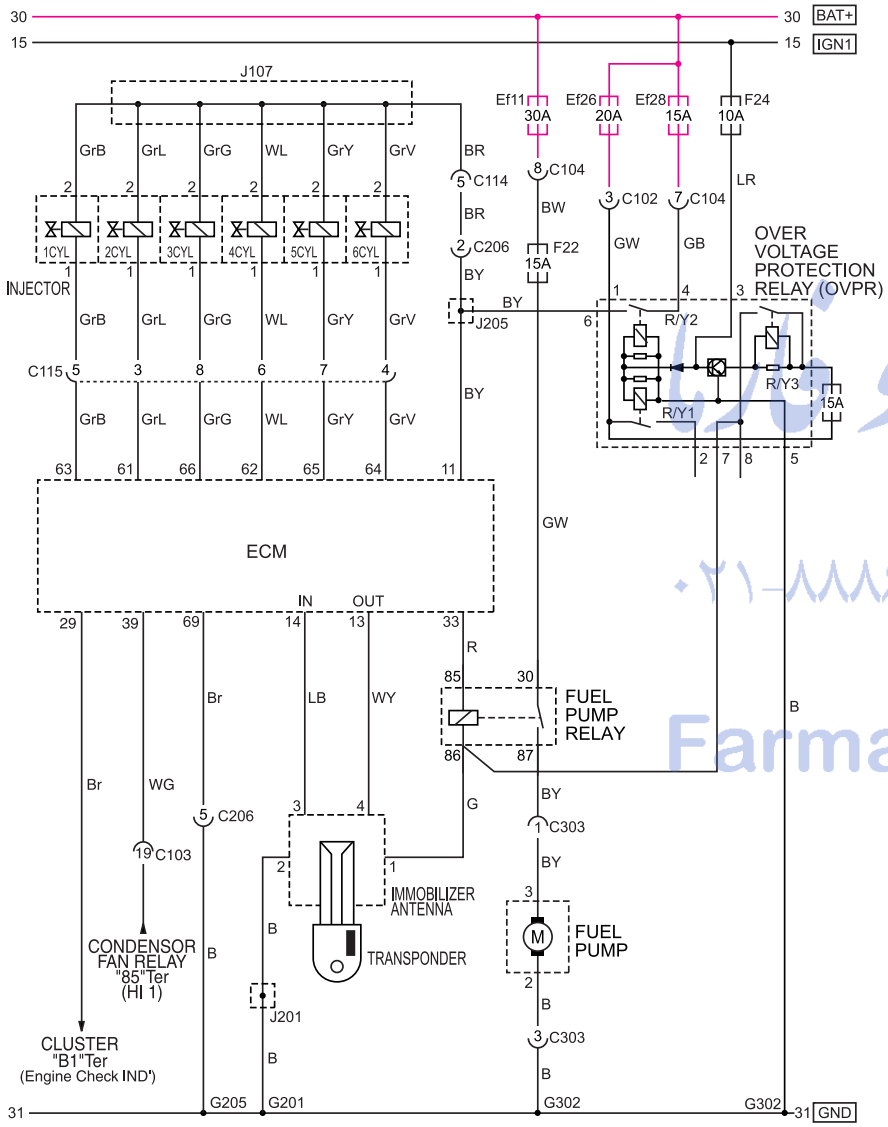


J205



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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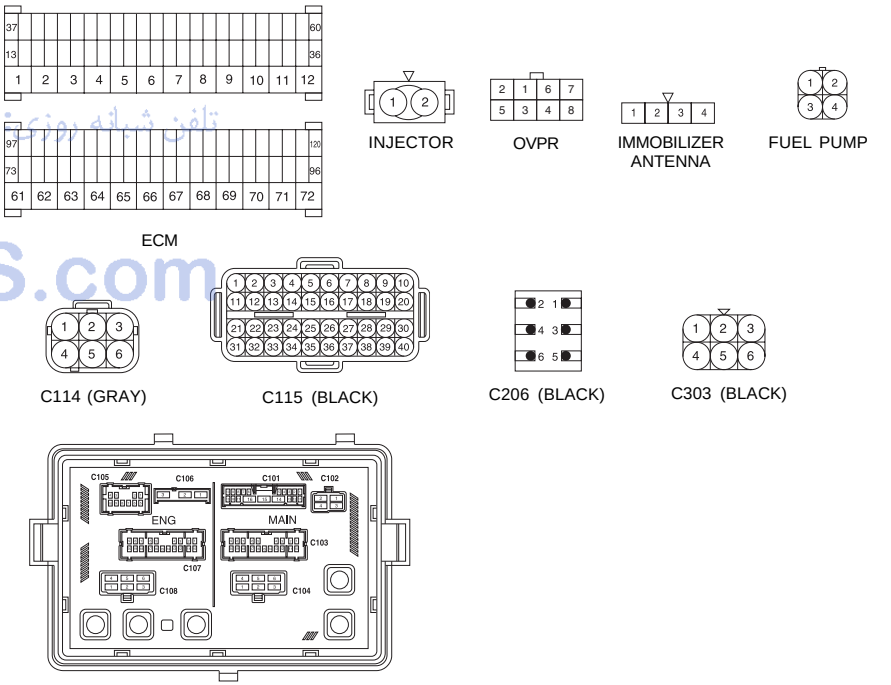
(2) W/ EURO III



a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C102 (4Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C104 (8Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C114 (6Pin, Gray)	W/H Engine Control - W/H ECM Main	Behind Hydraulic Unit
C115 (40Pin, Black)	W/H Engine Control - W/H ECM Main	Behind Hydraulic Unit
C206 (6Pin, Black)	W/H Main - W/H ECM Main	Lower "A" Piller (Upper ECM)
C303 (6Pin, Black)	W/H Main - W/H Fuel Pump	Upper Transfer Case
J107	W/H Engine Control	Next to Yellow Label
J201	W/H Main	Above FRT LH Seat Unit Cover
J205	W/H Main	Behind Front Right Kick Panel
G201	W/H Main	Upper Front Left Leg Room
G205	W/H Main	Center "A" Piller Front Right
G302	W/H Main	Below Center Console

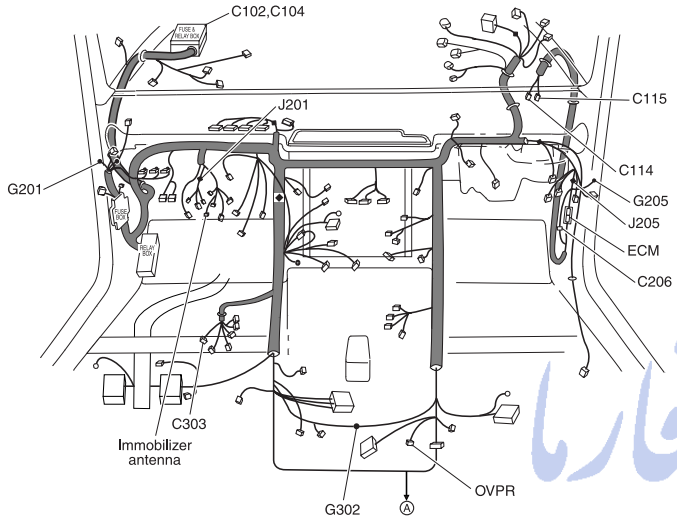
b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



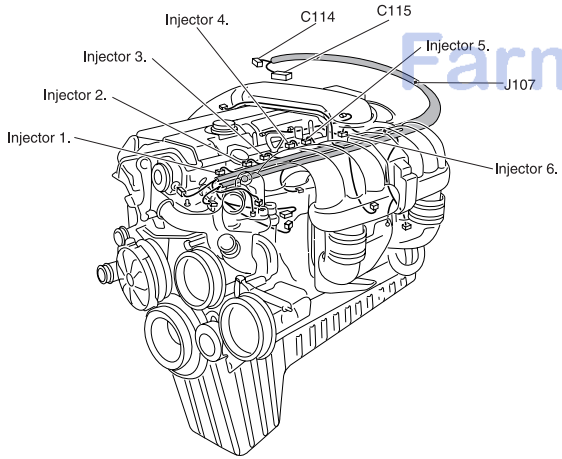
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۰۲۱-۸۸۸۶۲۰۸۵

c. POSITION OF CONNECTORS AND GROUNDS

- **W/H MAIN**

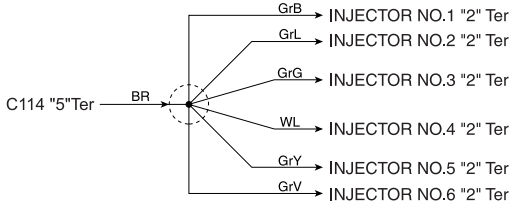


- **W/H ENGINE CONTROL (GASOLINE)**

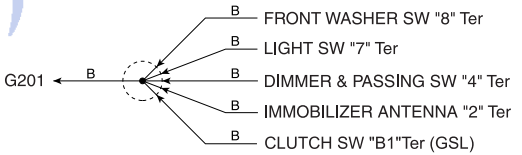


d. JOINT

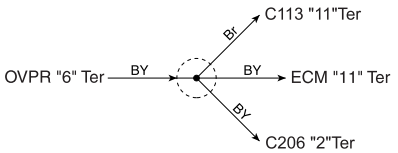
J107



J201



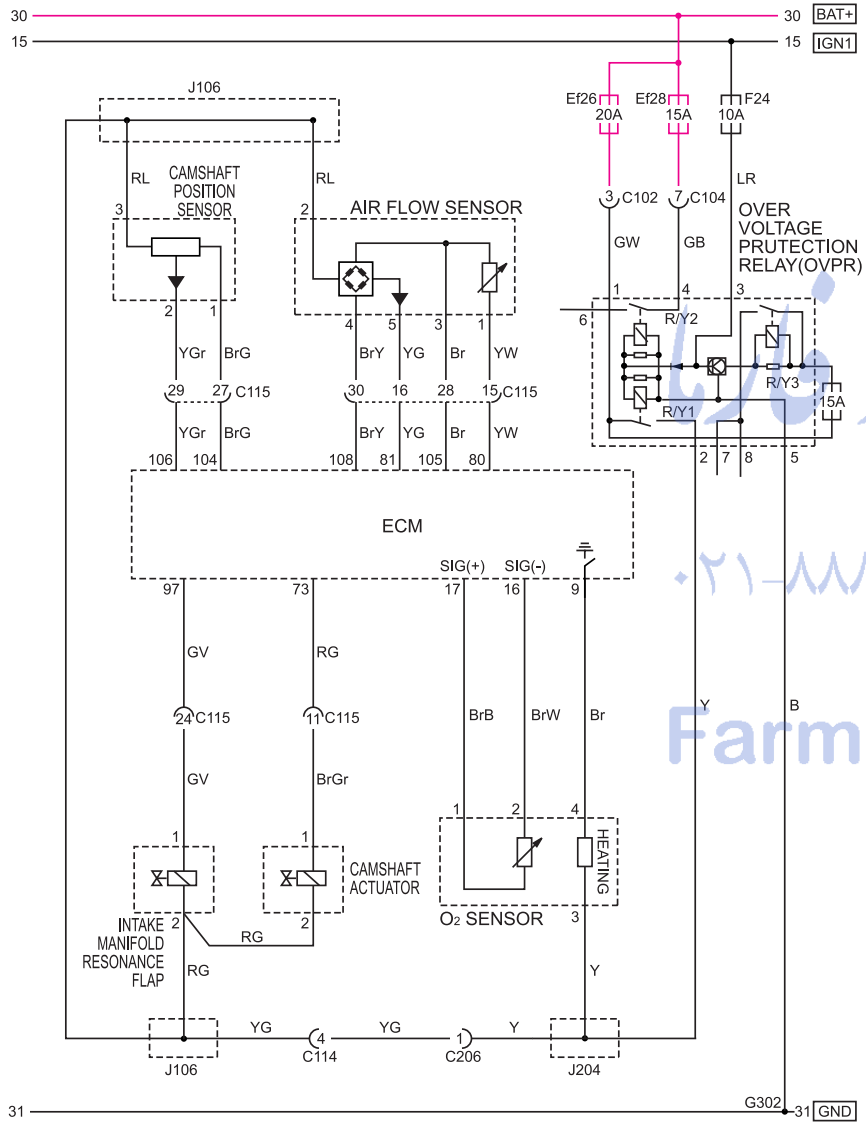
J205



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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3) SENSOR (CAMSHAFT POSITION, AIR FLOW, O_2), INTAKE MANIFOLD RESONANCE FLAP, CAMSHAFT ACTUATOR, FUEL GAUGE

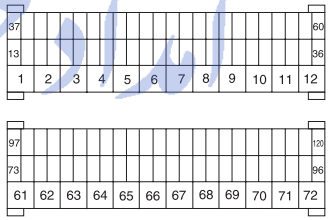
(1) W/O EURO III



a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING WIRING HARNESS	CONNECTOR POSITION
C102 (4Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C104 (8Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C114 (6Pin, Gray)	W/H Engine Control - W/H ECM Main	Behind Hydraulic Unit
C115 (40Pin, Black)	W/H Engine Control - W/H ECM Main	Behind Hydraulic Unit
C206 (6Pin, Black)	W/H Main - W/H ECM Main	Lower "A" Piller (Upper ECM)
J106	W/H Engine Control	Behind Hydraulic Unit
J204	W/H Main	Upper Blower Unit
G302	W/H Main	Below Center Console

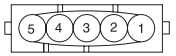
b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



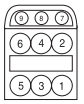
ECM



CAMSHAFT POSITION SENSOR



AIR FLOW SENSOR



OVPR



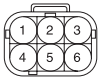
INTAKE MANIFOLD RESONACE FLAP



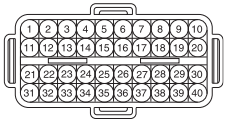
CAMSHAFT ACTUATOR



O_2 SENSOR



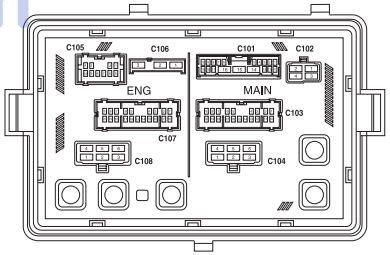
C114 (GRAY)



C115 (BLACK)



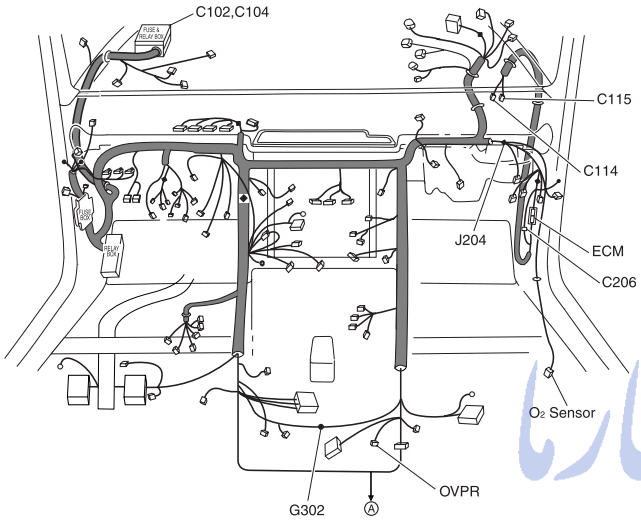
C206 (BLACK)



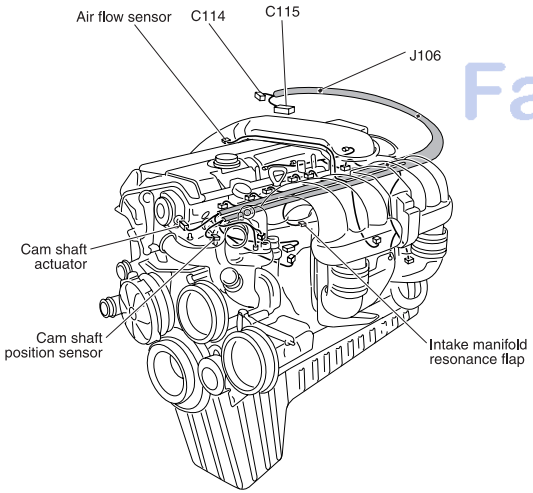
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تلفن شبانه روزی: ۰۲۱-۸۸۶۲۰۸۵

c. POSITION OF CONNECTORS AND GROUNDS

- **W/H MAIN**

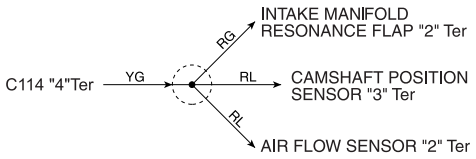


- **W/H ENGINE CONTROL (GASOLINE)**

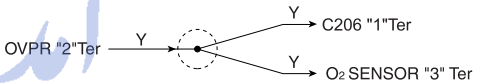


d. JOINT

J106

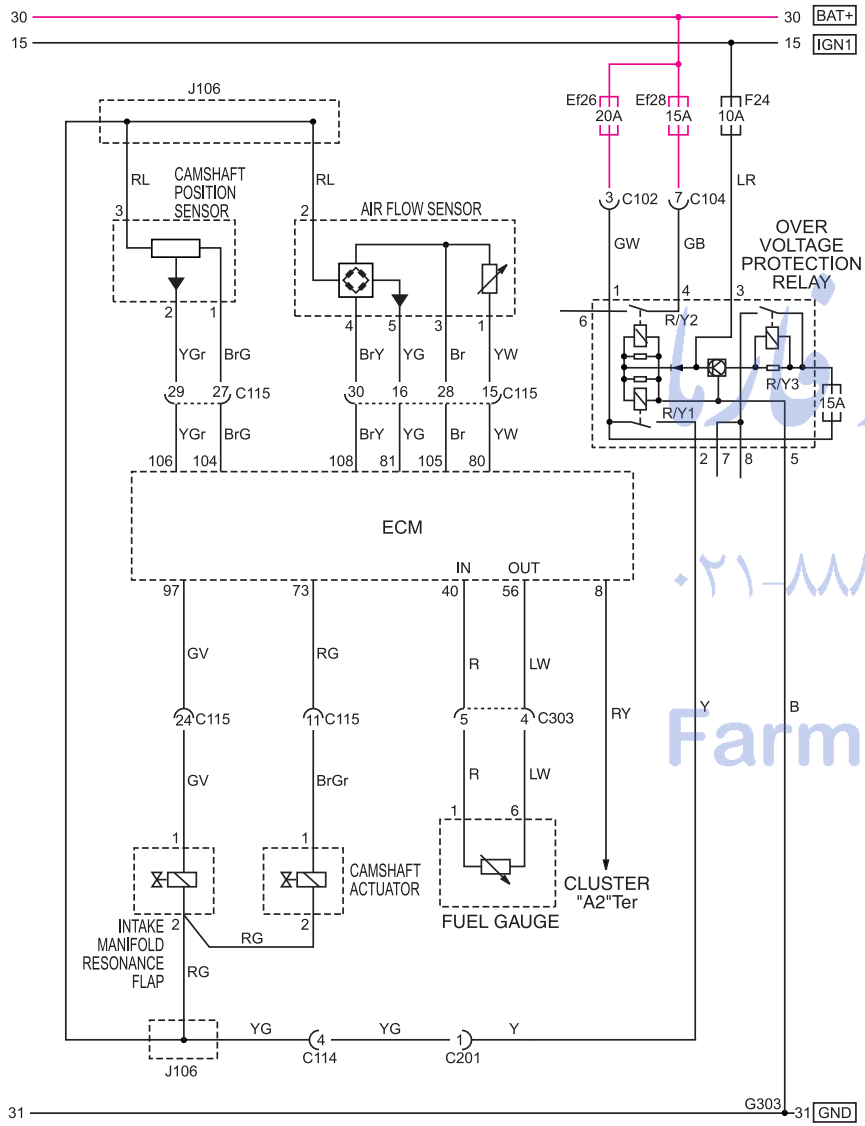


J204



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
FarmaSOS.com

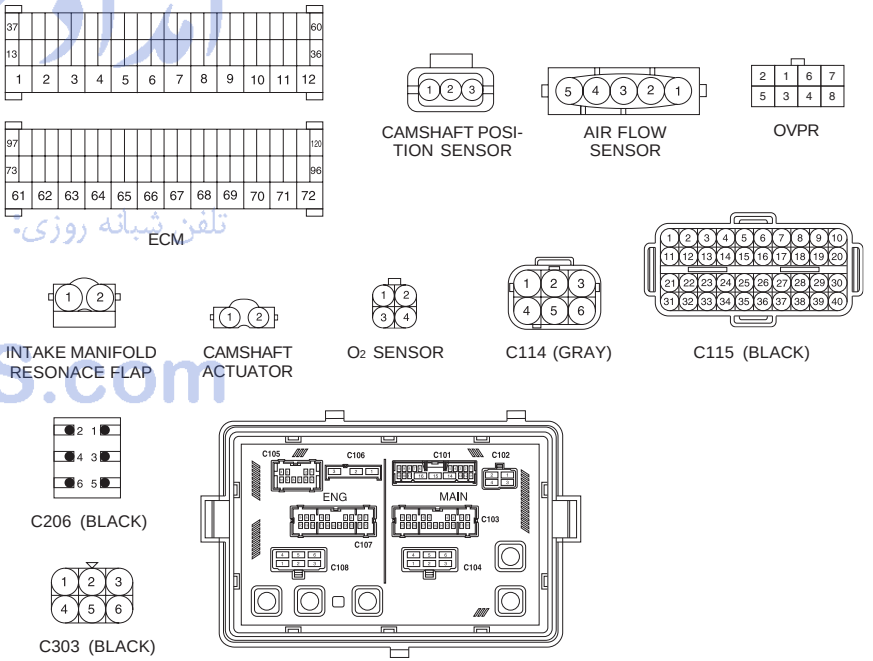
(2) W/ EURO III



a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING WIRING HARNESS	CONNECTOR POSITION
C102 (4Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C104 (8Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C114 (6Pin, Gray)	W/H Engine Control - W/H ECM Main	Behind Hydraulic Unit
C115 (40Pin, Black)	W/H Engine Control - W/H ECM Main	Behind Hydraulic Unit
C206 (6Pin, Black)	W/H Main - W/H ECM Main	Lower "A" Piller (Upper ECM)
C303 (6Pin, Black)	W/H Main - W/H Fuel Pump	Upper Transfer Case
J106	W/H Engine Control	Behind Hydraulic Unit
J204	W/H Main	Upper Blower Unit
G302	W/H Main	Below Center Console

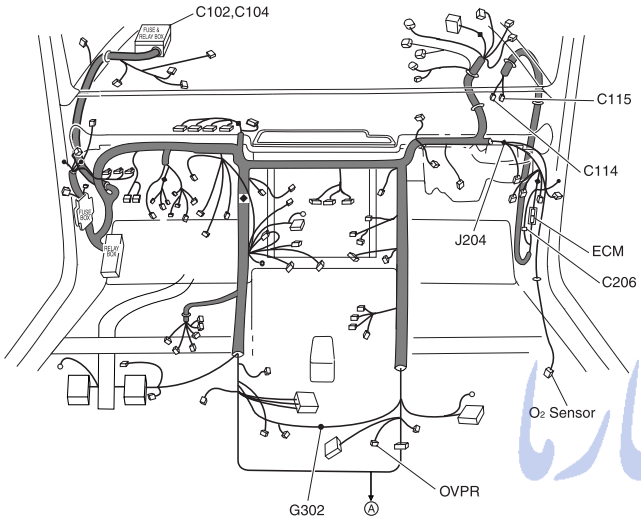
b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



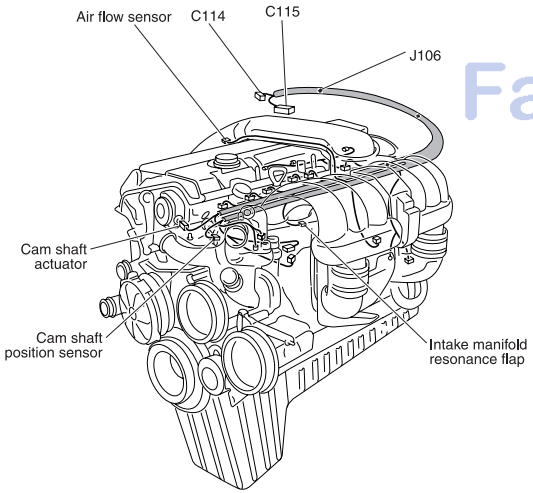
FarmaSOS.com
۰۲۱-۸۸۴۶۲۰۸۵ تلفن شبانه روزی

c. POSITION OF CONNECTORS AND GROUNDS

- **W/H MAIN**

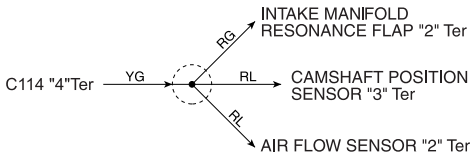


- **W/H ENGINE CONTROL (GASOLINE)**

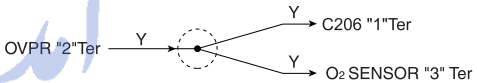


d. JOINT

J106

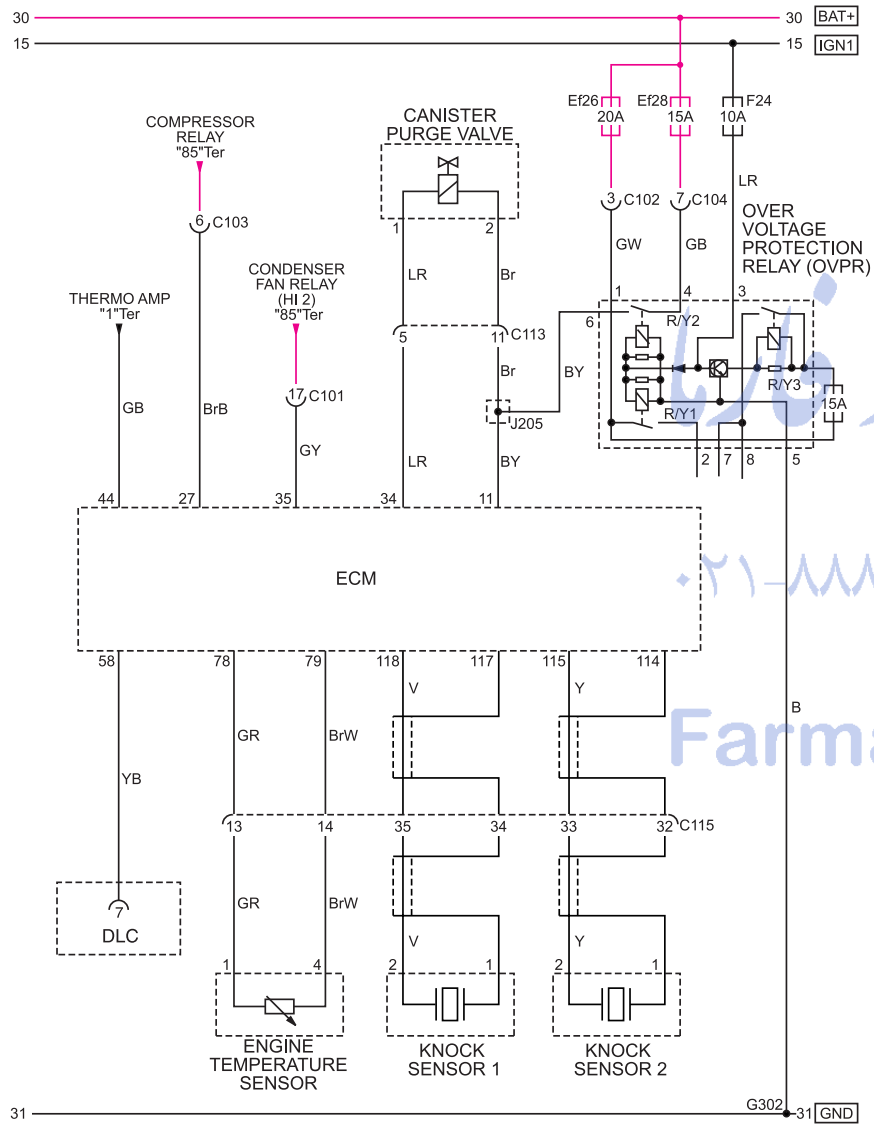


J204



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
FarmaSOS.com

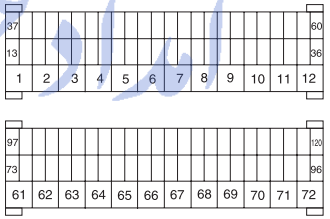
4) SENSOR (ENGINE TEMPERATURE, KNOCK1, KNOCK2), CANISTER PURGE VALVE, DIAGNOSIS



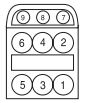
a. CONNECTOR INFORMATION

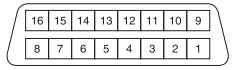
CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C101 (19Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C102 (4Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C103 (22Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C104 (8Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C113 (12Pin, Black)	W/H Engine Room - W/H Main	Next to Hydraulic Unit
C115 (40Pin, Black)	W/H Engine Control - W/H ECM Main	Behind Hydraulic Unit
J205	W/H Main	Below Center Console
G302	W/H Main	Below Center Console

b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION


ECM

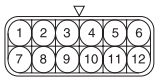

CANISTOR PURGE VALVE

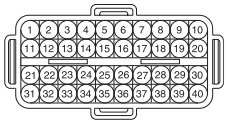

OVPR

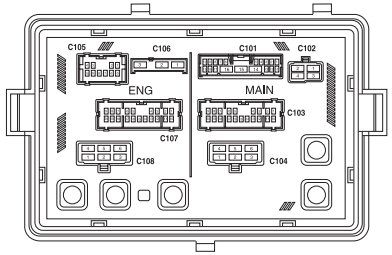

DLC


ENGINE TEMP' SENSOR


KNOCK SENSOR


C113 (BLACK)

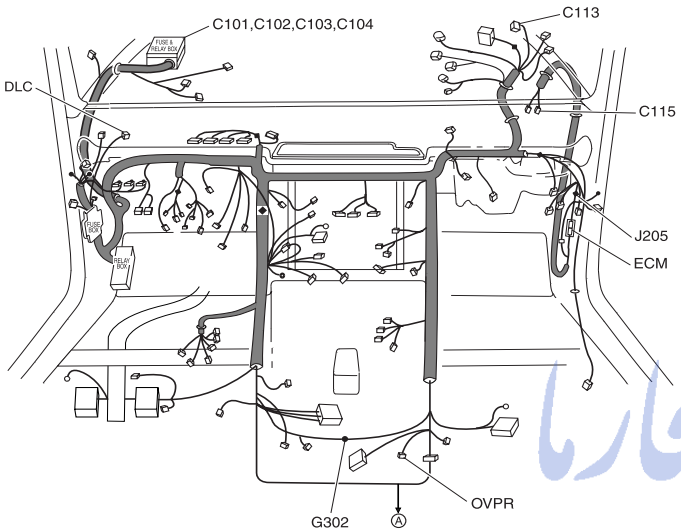

C115 (BLACK)



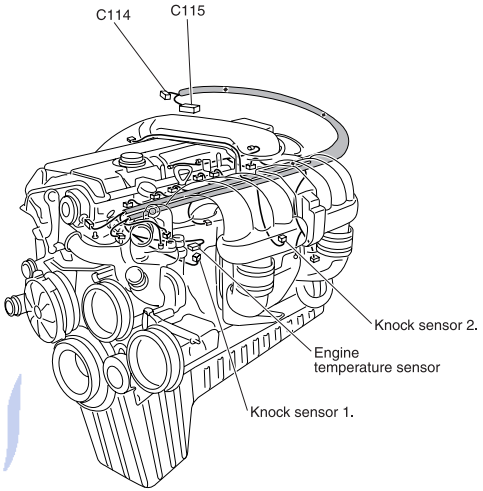
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تلفن شبانه روزی: ۰۲۱-۸۸۶۲۰۸۵

c. POSITION OF CONNECTORS AND GROUNDS

- W/H MAIN



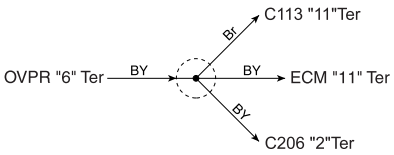
- W/H ENGINE CONTROL (GASOLINE)



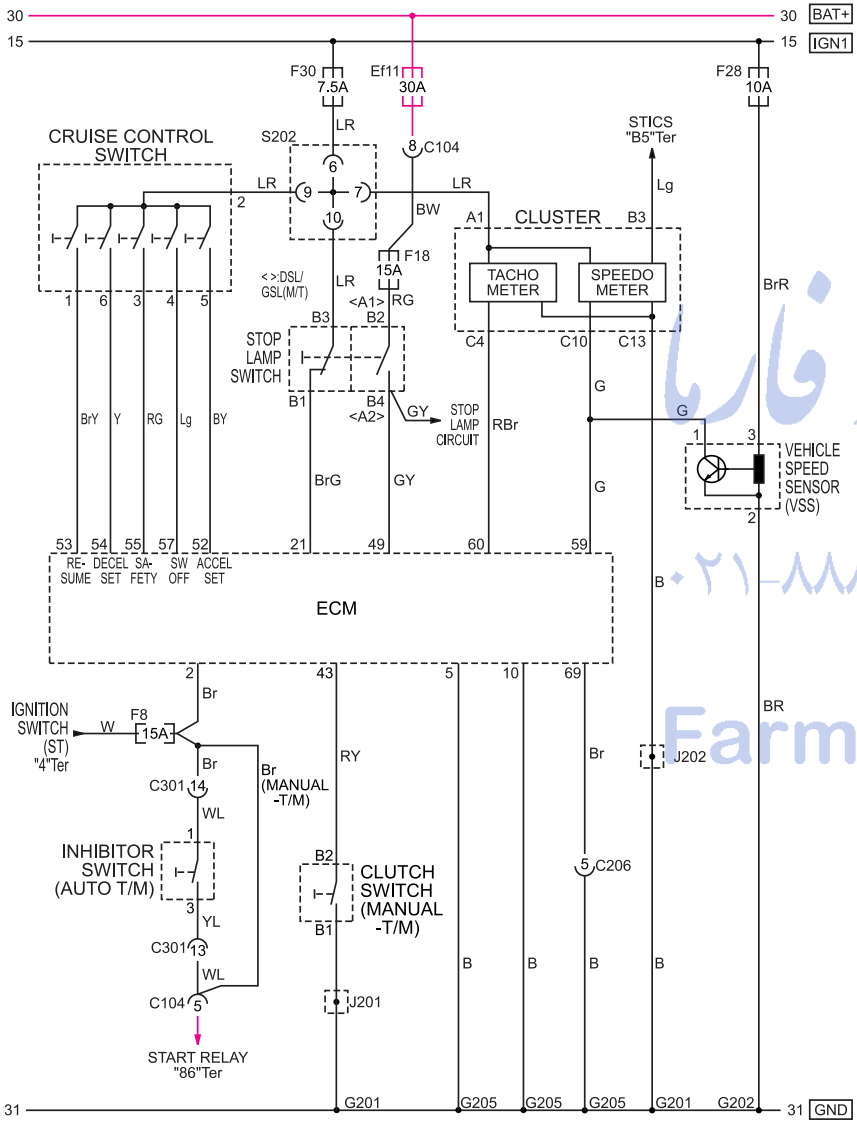
امداد خودرو فارما
۰۲۱-۸۸۸۶۲۰۸۵ تلفن شبانه روزی
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d. JOINT

J205



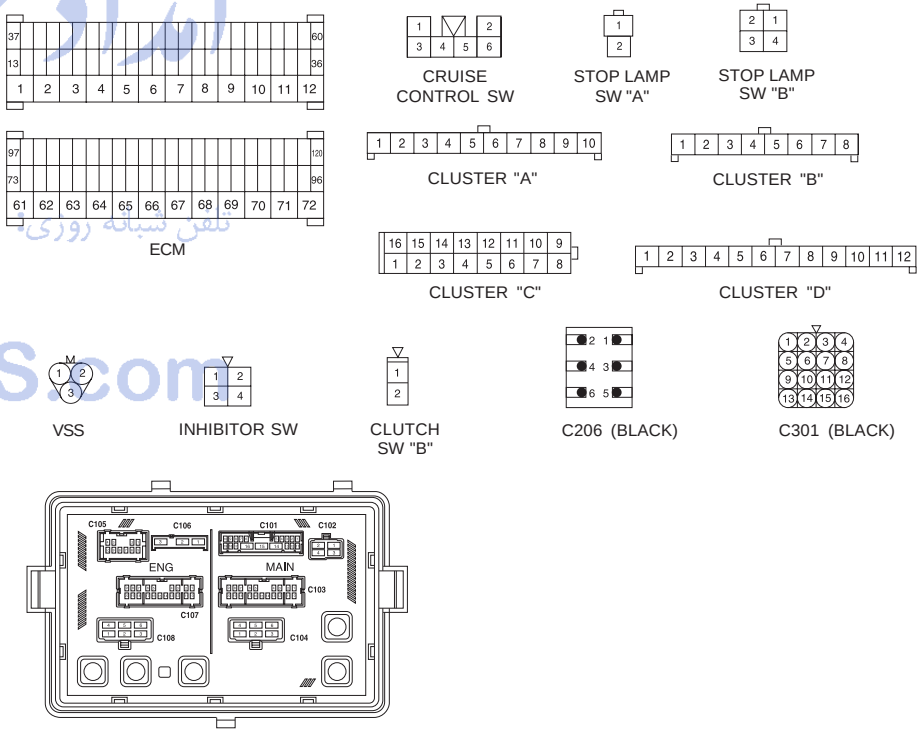
5) VEHICLE SPEED SENSOR, SWITCH (CRUISE CONTROL, STOP LAMP, INHIBITOR, CLUTCH)



a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C104 (8Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C206 (6Pin, Black)	W/H Main - W/H ECM Main	Lower "A" Piller (Upper ECM)
C301 (16Pin, Black)	W/H Main - W/H Transmission	Upper Transfer Case
S202 (20Pin,Black)	W/H Main	Behind Cluster
J201	W/H Main	Above FRT LH Seat Under Cover
J202	W/H Main	Behind Cluster
G201	W/H Main	Upper Front Left Leg Room
G202	W/H Main	Upper Front Left Leg Room
G205	W/H Main	Center "A" Piller Front Right

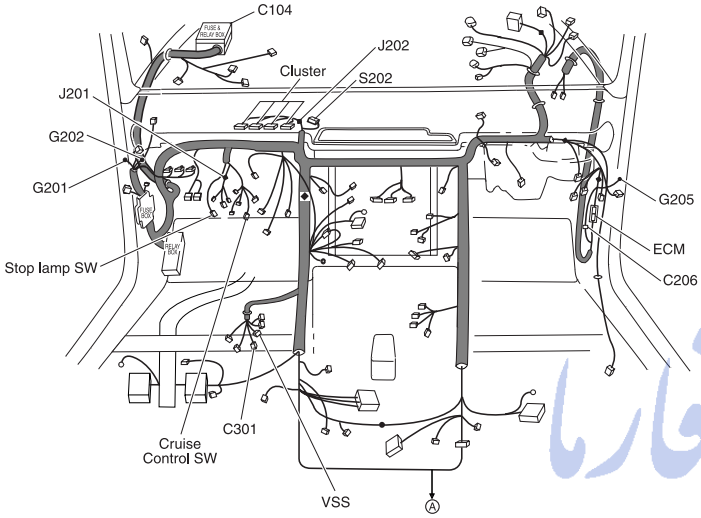
b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



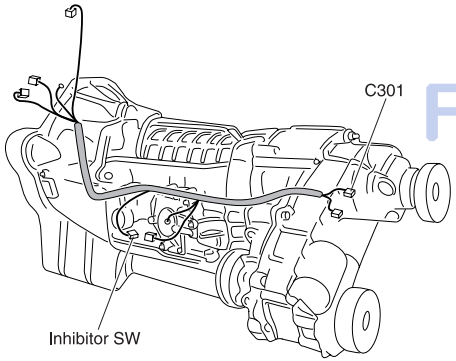
ایران خودرو فارما
۰۲۱-۸۸۴۶۲۰۸۵
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c. POSITION OF CONNECTORS AND GROUNDS

- **W/H MAIN**

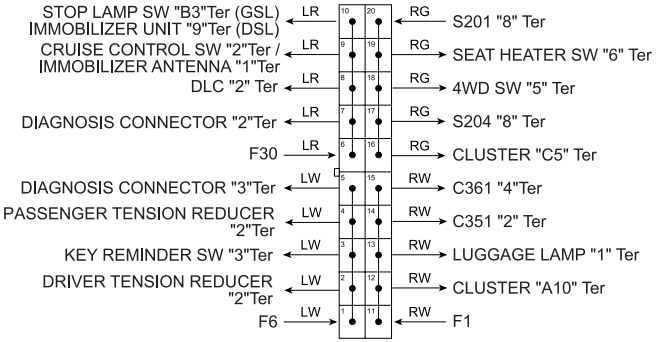


- **W/H TRANSMISSION (AUTOMATIC TRANSMISSION)**



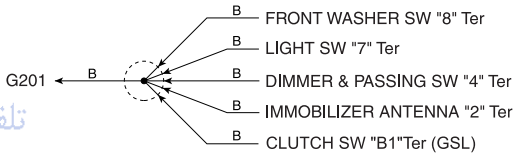
d. SPLICE PACK

S202 (BLACK)

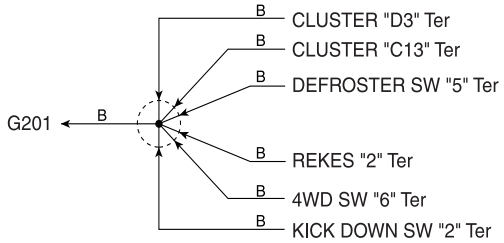


e. JOINT

J201



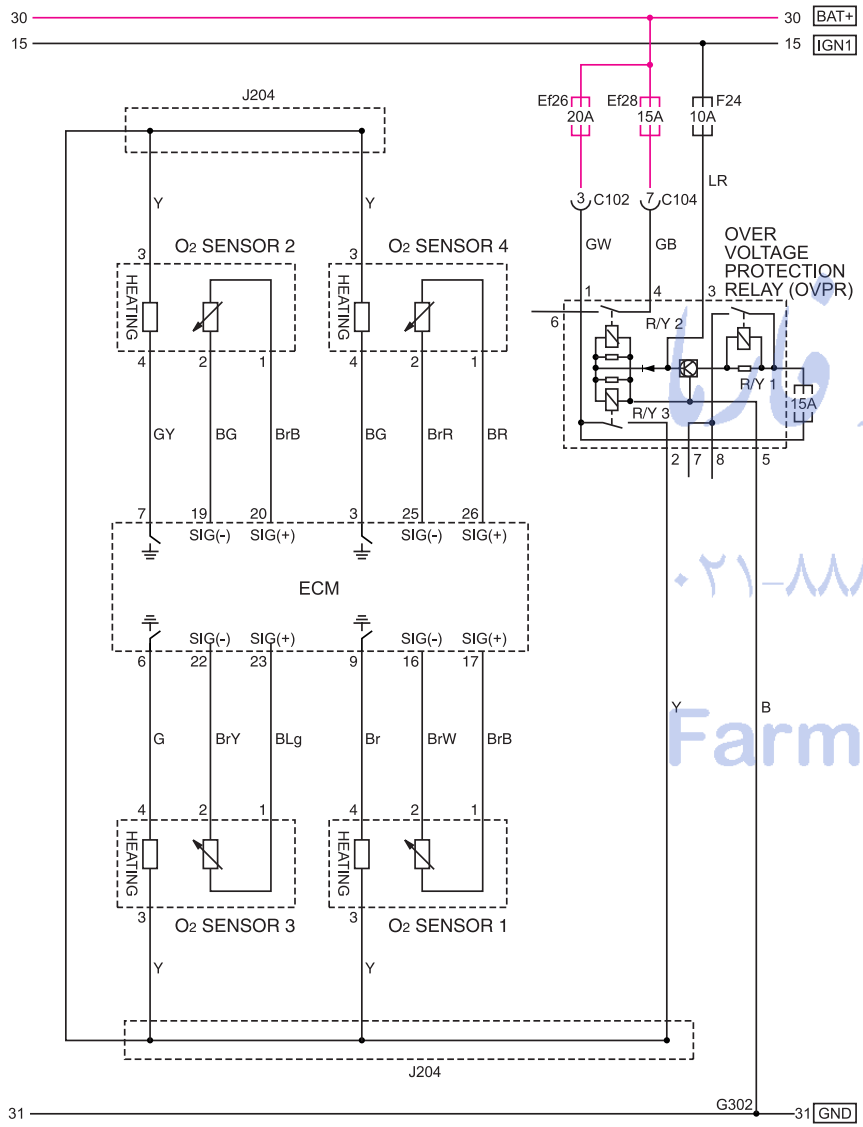
J202



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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6) O2 SENSOR (1,2,3,4)

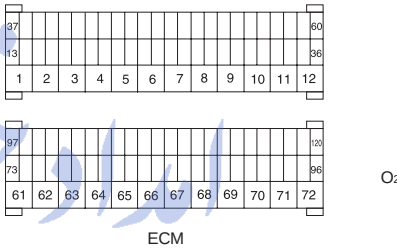
- **W/ EURO III**



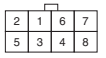
a. CONNECTOR INFORMATION

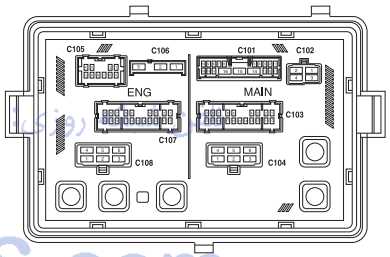
CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C102 (4Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C104 (8Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
J204	W/H Main	Upper Blower Unit
G302	W/H Main	Below Center Console

b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION





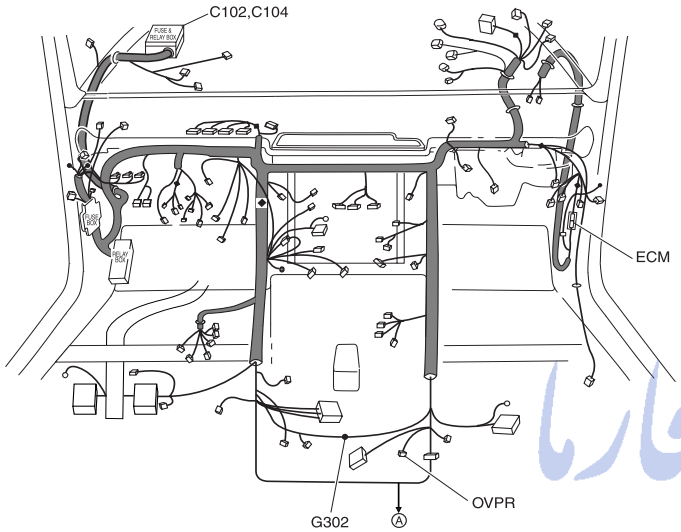




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c. POSITION OF CONNECTORS AND GROUNDS

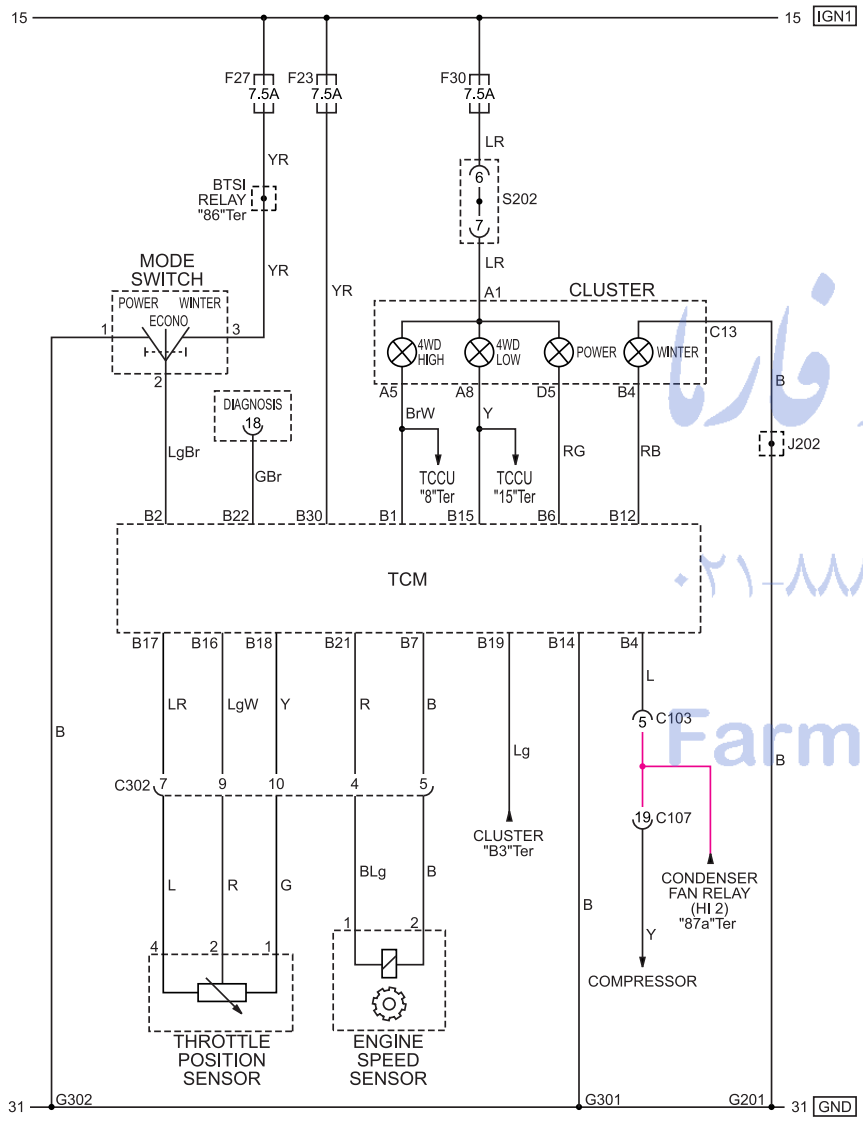
- **W/H MAIN**



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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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7. TCM (TRANSMISSION CONTROL MODULE) - DIESEL

1) MODE SWITCH, INDICATOR, DIAGNOSIS



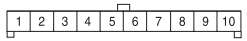
a. CONNECTOR INFORMATION

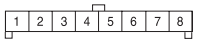
CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C103 (22Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C107 (8Pin, Colorless)	Engine Room Fuse Box - W/H Engine Room	Engine Room Fuse Box
C302 (10Pin, Black)	W/H Main - W/H Transmission	Upper Transfer Case
S202 (20Pin, Black)	W/H Main	Behind Cluster
J202	W/H Main	Behind Cluster
G201	W/H Main	Upper Front Left Leg Room
G301	W/H Main	Below Front Left Seat
G302	W/H Main	Below Center Console

b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

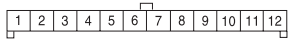

TCM "A"


TCM "B"

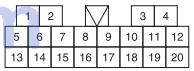

CLUSTER "A"

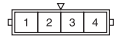

CLUSTER "B"


CLUSTER "C"

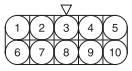

CLUSTER "D"

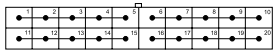

MODE SW

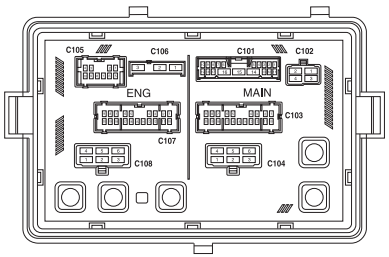

DIAGNOSIS CONNECTOR


THROTTLE POSITION SENSOR


ENGINE SPEED SENSOR


C302 (BLACK)

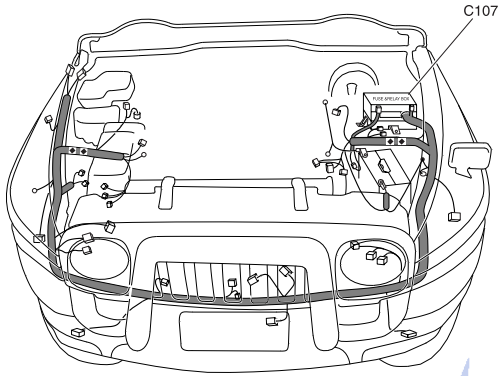

S202 (BLACK)



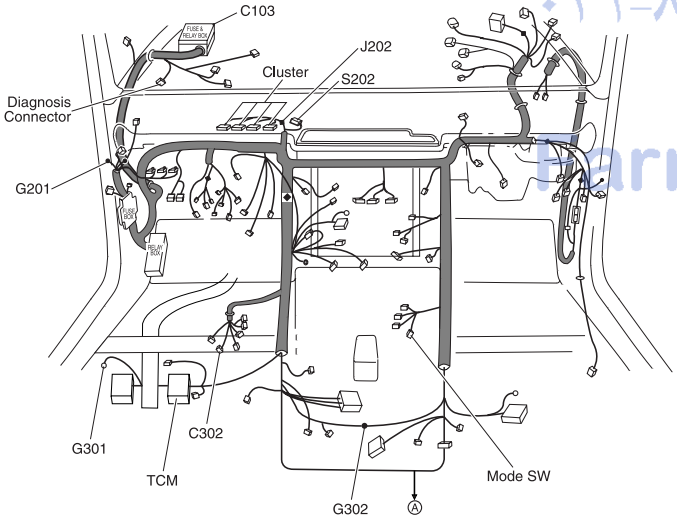
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c. POSITION OF CONNECTORS AND GROUNDS

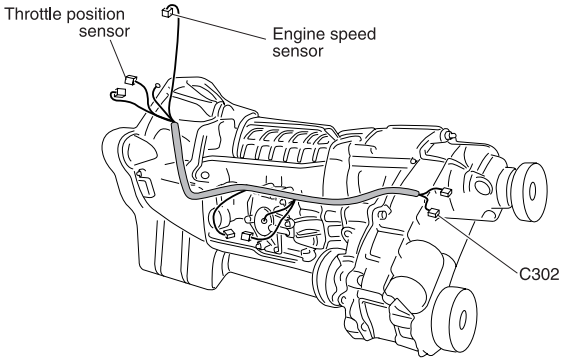
- W/H ENGINE ROOM



- W/H MAIN

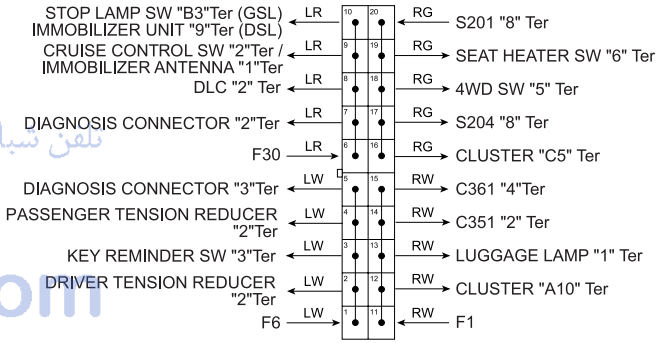


- W/H TRANSMISSION (AUTOMATIC TRANSMISSION)



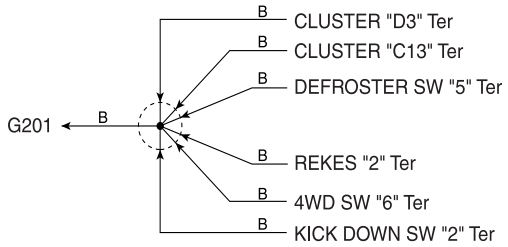
d. SPLICE PACK

S202 (BLACK)



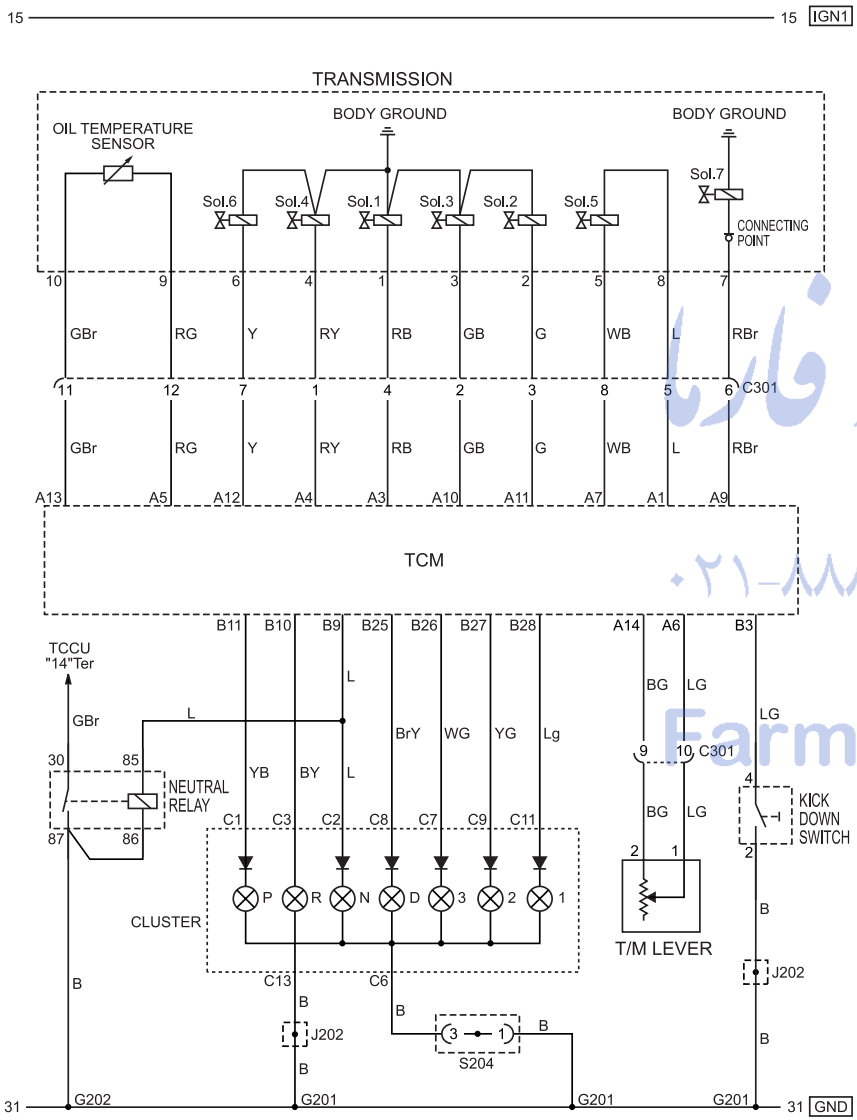
e. JOINT

J202



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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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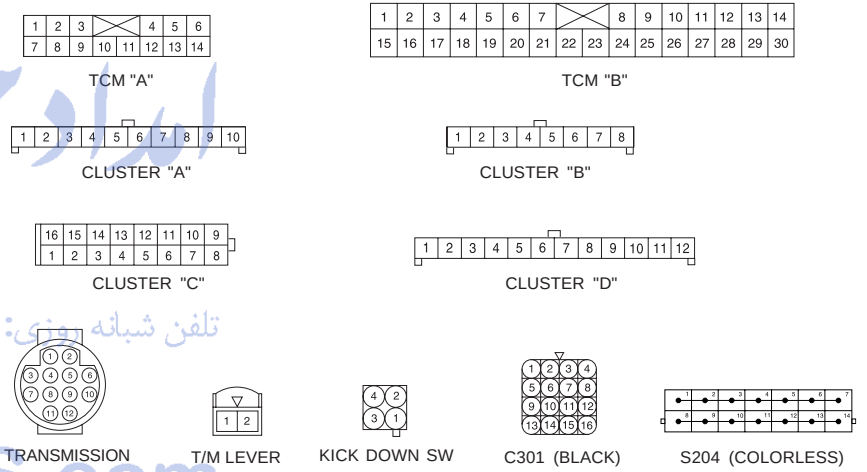
2) TRANSMISSION, INDICATOR, T/M LEVER, KICK DOWN SWITCH



a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C301 (16Pin, Black)	W/H Main - W/H Transmission	Upper Transfer Case
S204 (14Pin,Colorless)	W/H Main	Behind Audio
J202	W/H Main	Behind Cluster
G201	W/H Main	Upper Front Left Leg Room
G202	W/H Main	Upper Front Left Leg Room

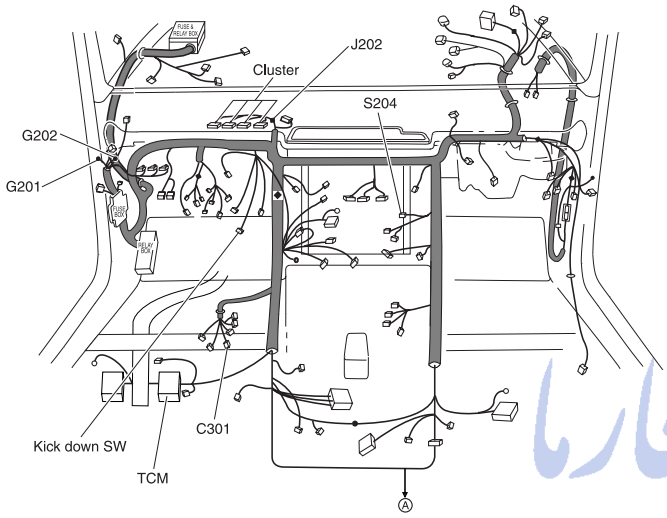
b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



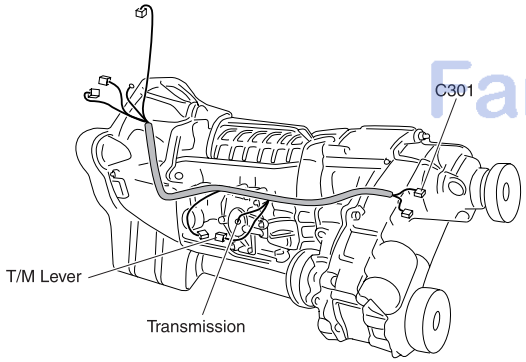
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c. POSITION OF CONNECTORS AND GROUNDS

- **W/H MAIN**

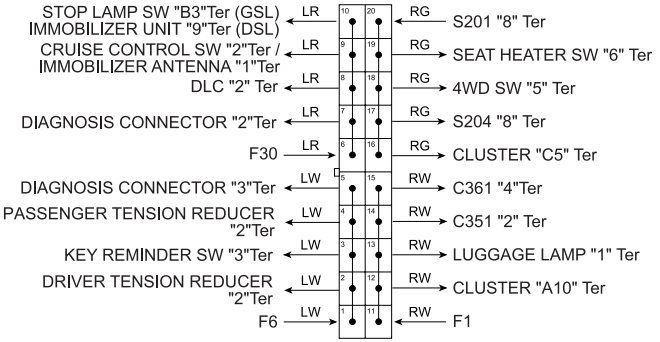


- **W/H TRANSMISSION (AUTOMATIC TRANSMISSION)**



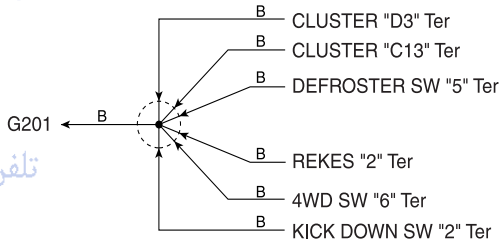
d. SPLICE PACK

S202 (BLACK)



e. JOINT

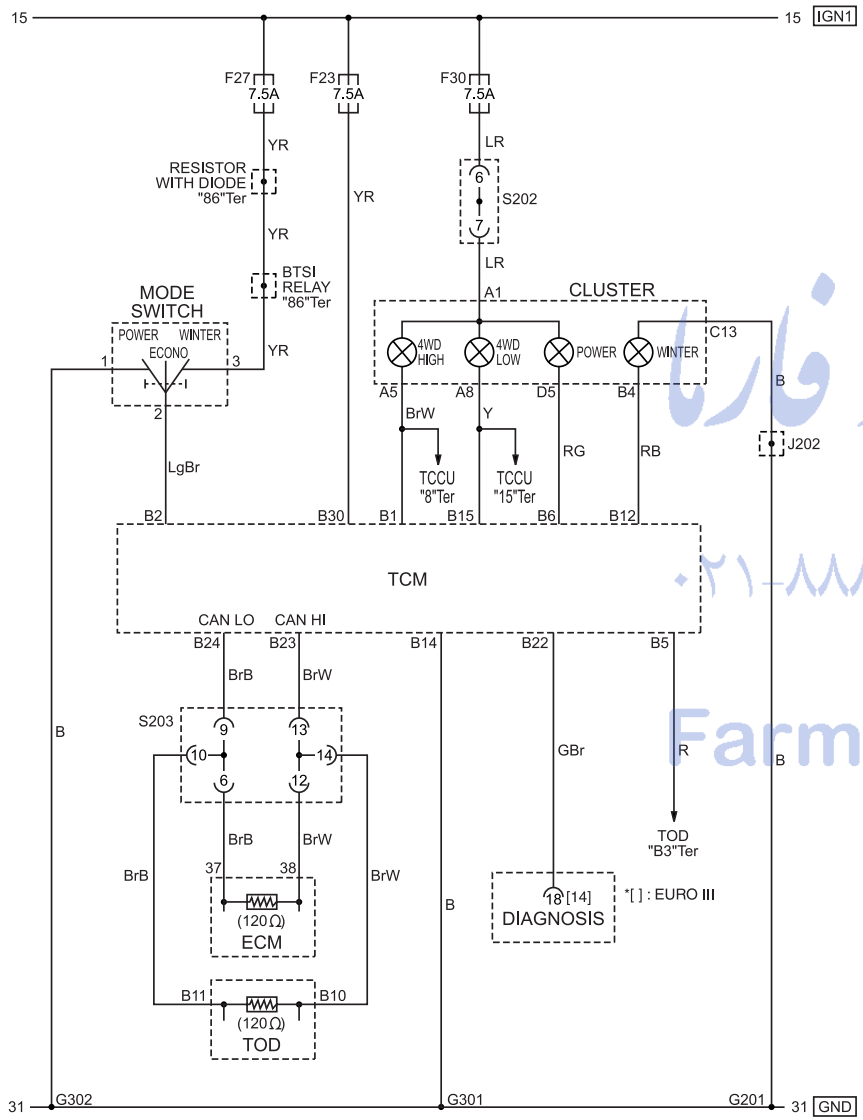
J202



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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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8. TCM (TRANSMISSION CONTROL MODULE) - GASOLINE

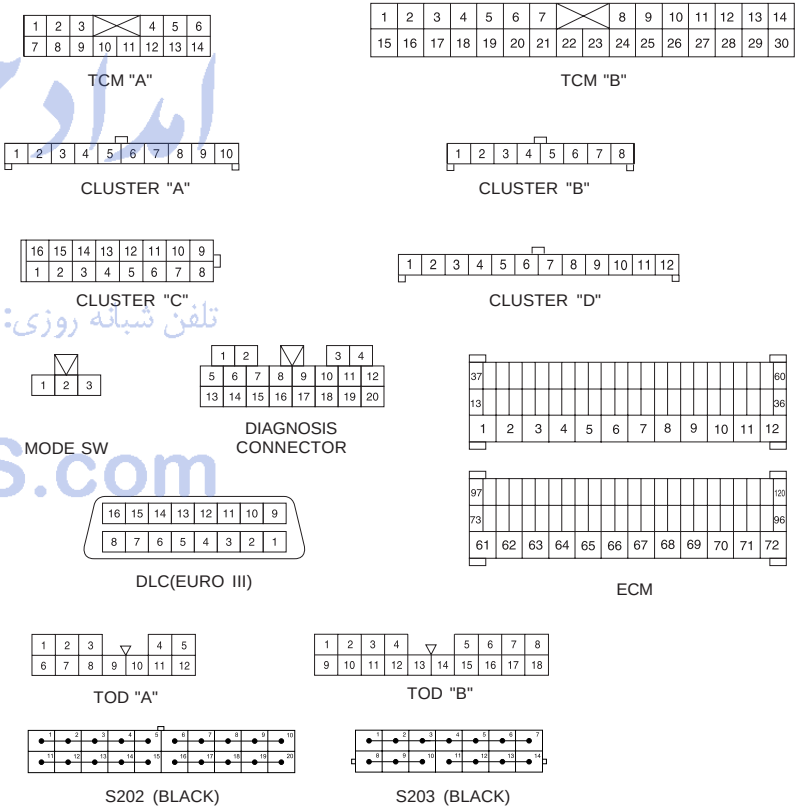
1) MODE SWITCH, INDICATOR, DIAGNOSIS



a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING WIRING HARNESS	CONNECTOR POSITION
S202 (20Pin, Black)	W/H Main	Behind Cluster
S203 (14Pin, Colorless)	W/H Main	Behind 4WD Switch
J202	W/H Main	
G201	W/H Main	Upper Front Left Leg Room
G301	W/H Main	Below Front Left Seat
G302	W/H Main	Below Center Console

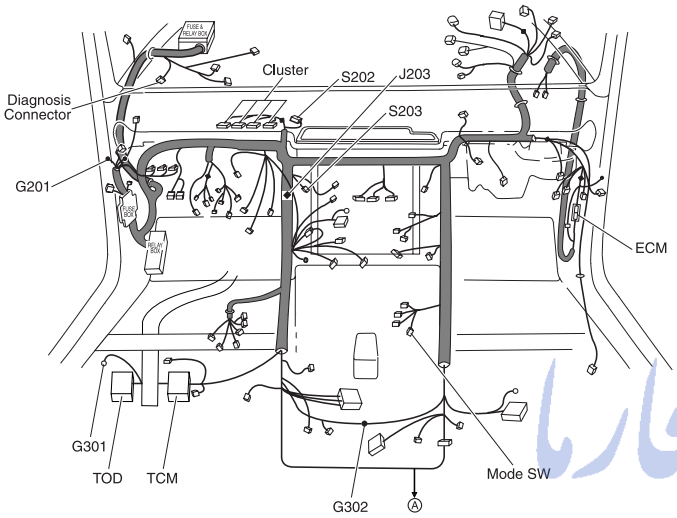
b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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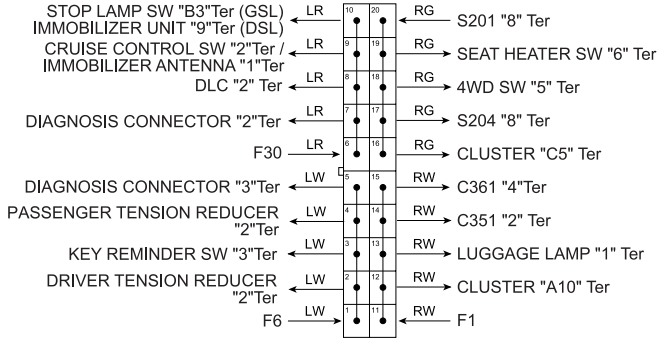
c. POSITION OF CONNECTORS AND GROUNDS

- W/H MAIN

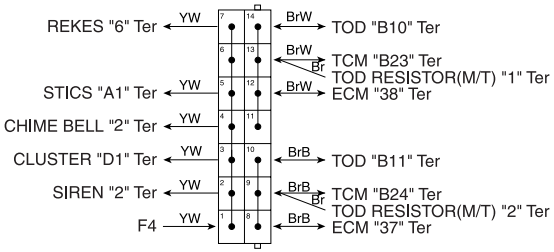


d. SPLICE PACK

S202 (BLACK)

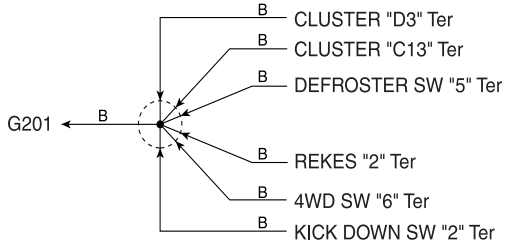


S203 (COLORLESS)



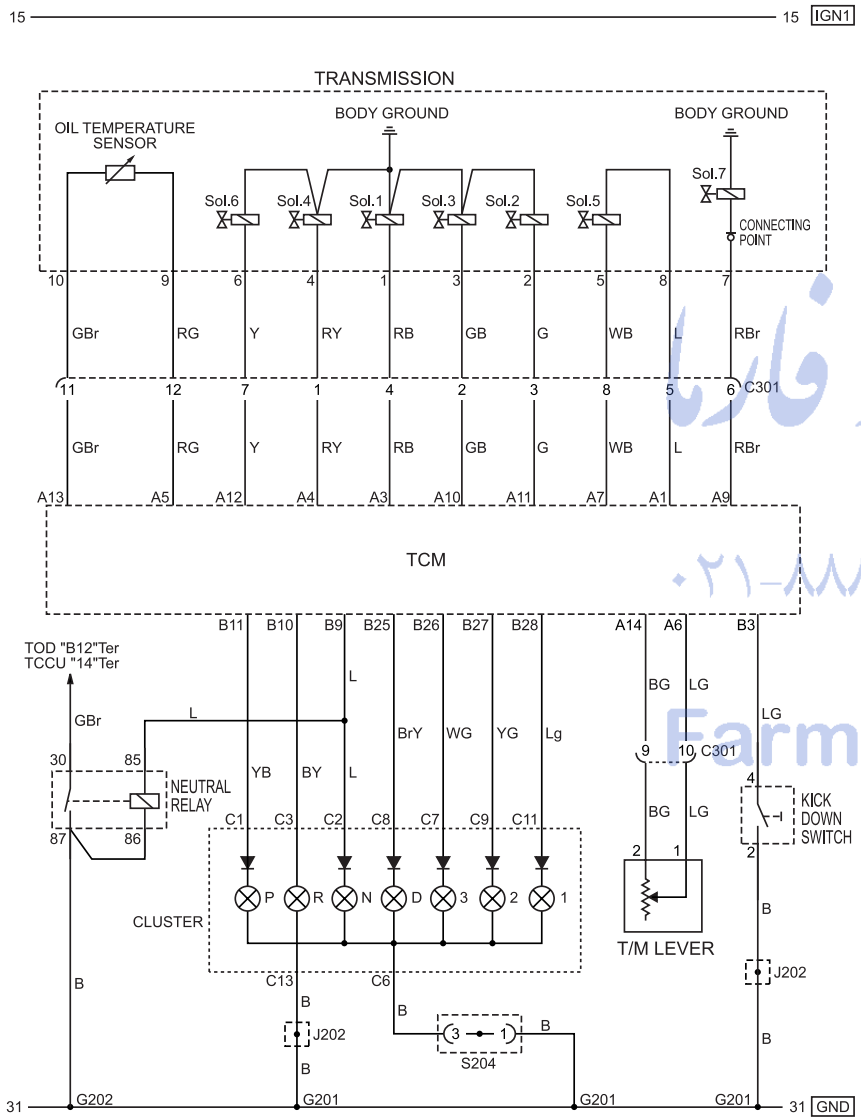
e. JOINT

J202



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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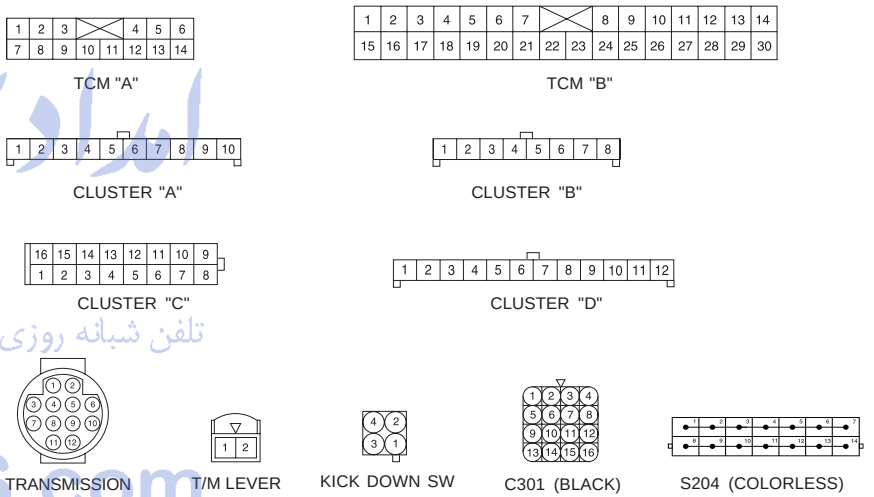
2) TRANSMISSION, INDICATOR, T/M LEVER, KICK DOWN SWITCH



a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C301 (16Pin, Black)	W/H Main - W/H Transmission	Upper Transfer Case
S204 (14Pin,Colorless)	W/H Main	Behind Audio
J202	W/H Main	Behind Cluster
G201	W/H Main	Upper Front Left Leg Room
G202	W/H Main	Upper Front Left Leg Room

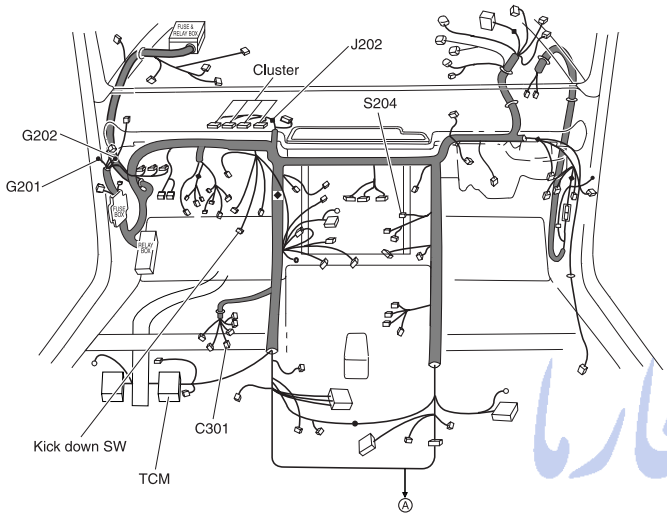
b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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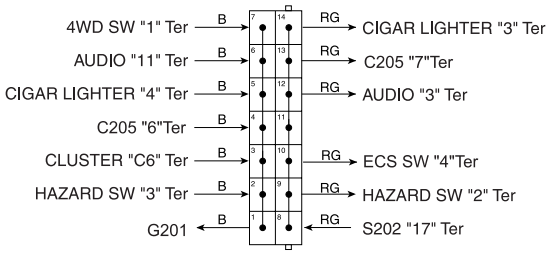
c. POSITION OF CONNECTORS AND GROUNDS

- W/H MAIN



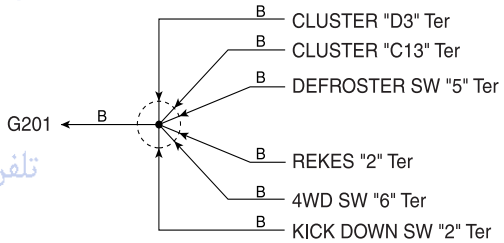
d. SPLICE PACK

S204 (COLORLESS)



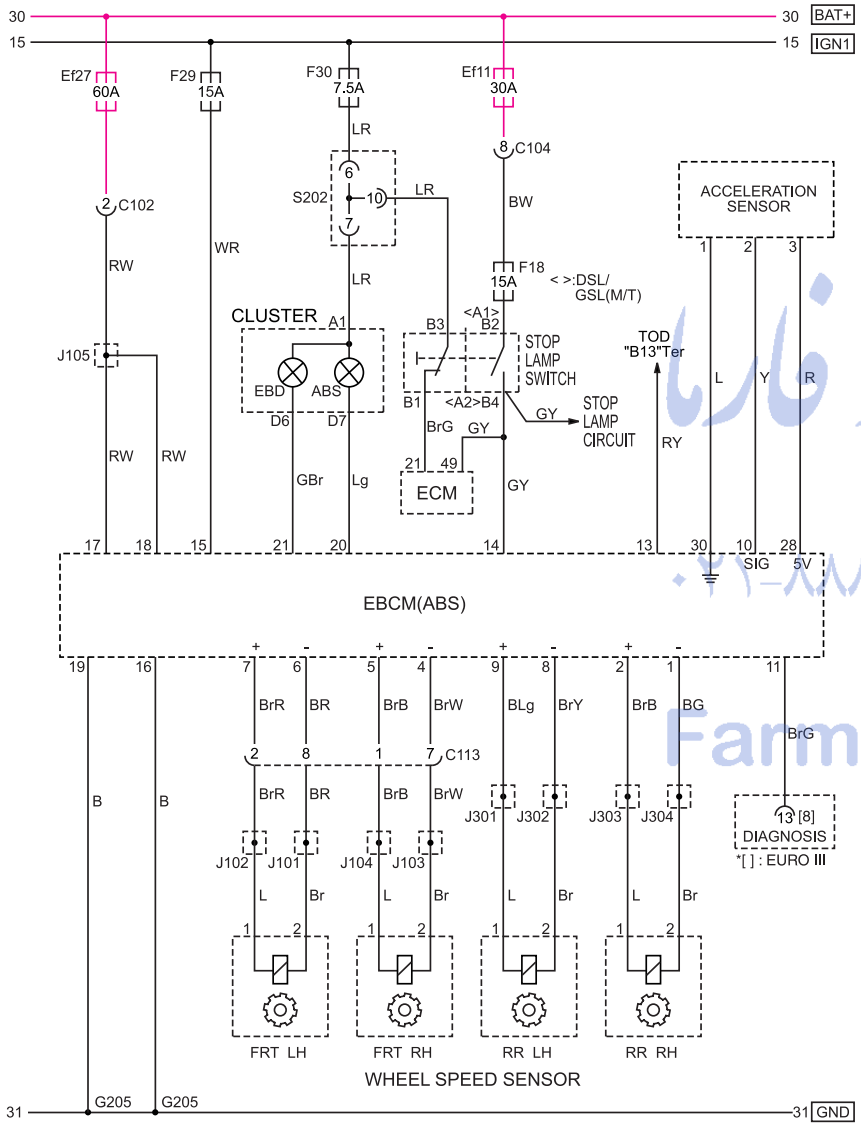
e. JOINT

J202



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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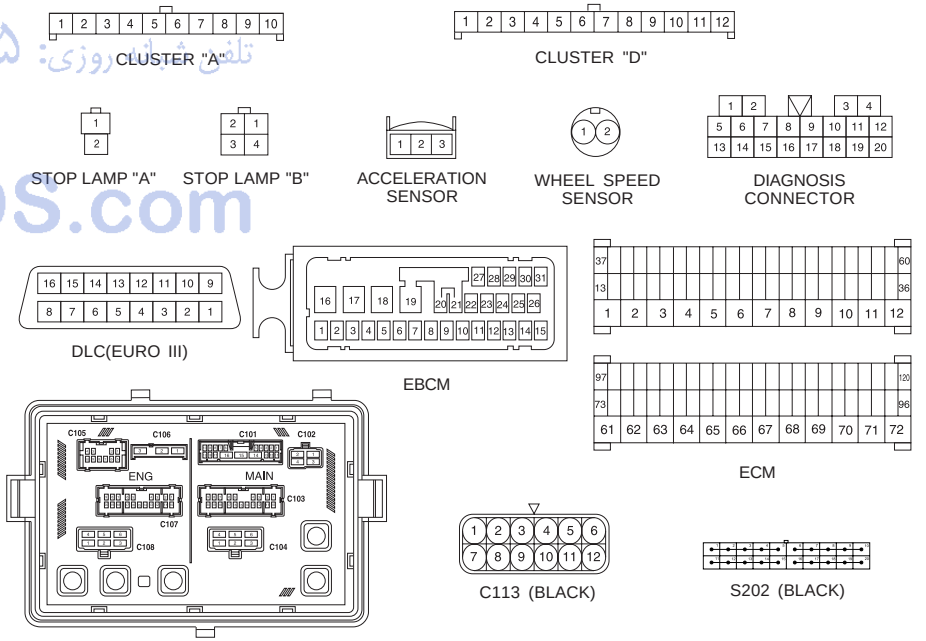
9. ABS (ANTI-LOCK BRAKE SYSTEM)



a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C102 (4Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C104 (8Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C113 (12Pin, Black)	W/H Engine Room - W/H Main	Next to Hydraulic Unit
S202 (20Pin, Black)	W/H Main	Behind Cluster
J101	W/H Engine Room	Behind Battery
J102	W/H Engine Room	Behind Battery
J103	W/H Engine Room	Below Air Cleaner
J104	W/H Engine Room	Below Air Cleaner
J105	W/H Main	Next to Yellow Label
J301	W/H Main	Below Rear Left Seat
J302	W/H Main	Below Rear Left Seat
J303	W/H Main	Below Rear Right Seat
J304	W/H Main	Below Rear Right Seat
G205	W/H Main	Center "A" Pillar Front Right

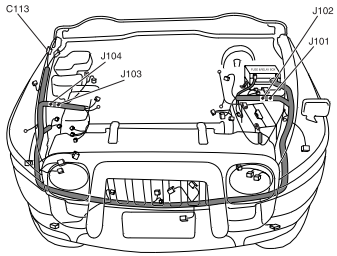
b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



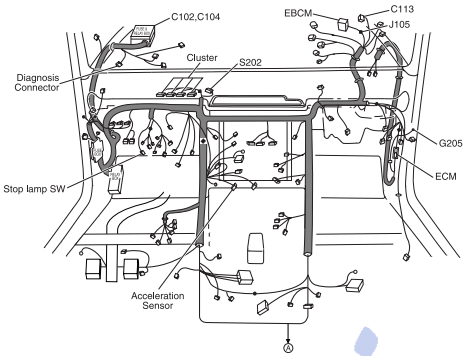
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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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c. POSITION OF CONNECTORS AND GROUNDS

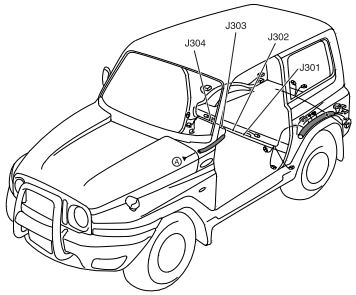
- W/H ENGINE ROOM



- W/H MAIN

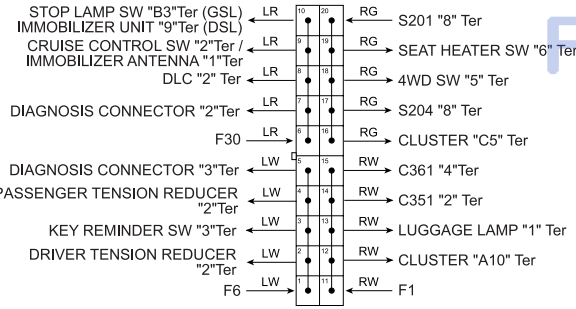


- W/H MAIN (FLOOR)



d. SPLICE PACK

S202 (BLACK)



e. JOINT

J101



J102



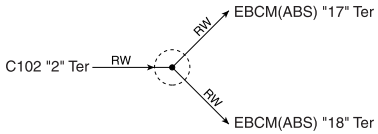
J103



J104



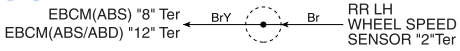
J105



J301



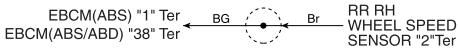
J302



J303



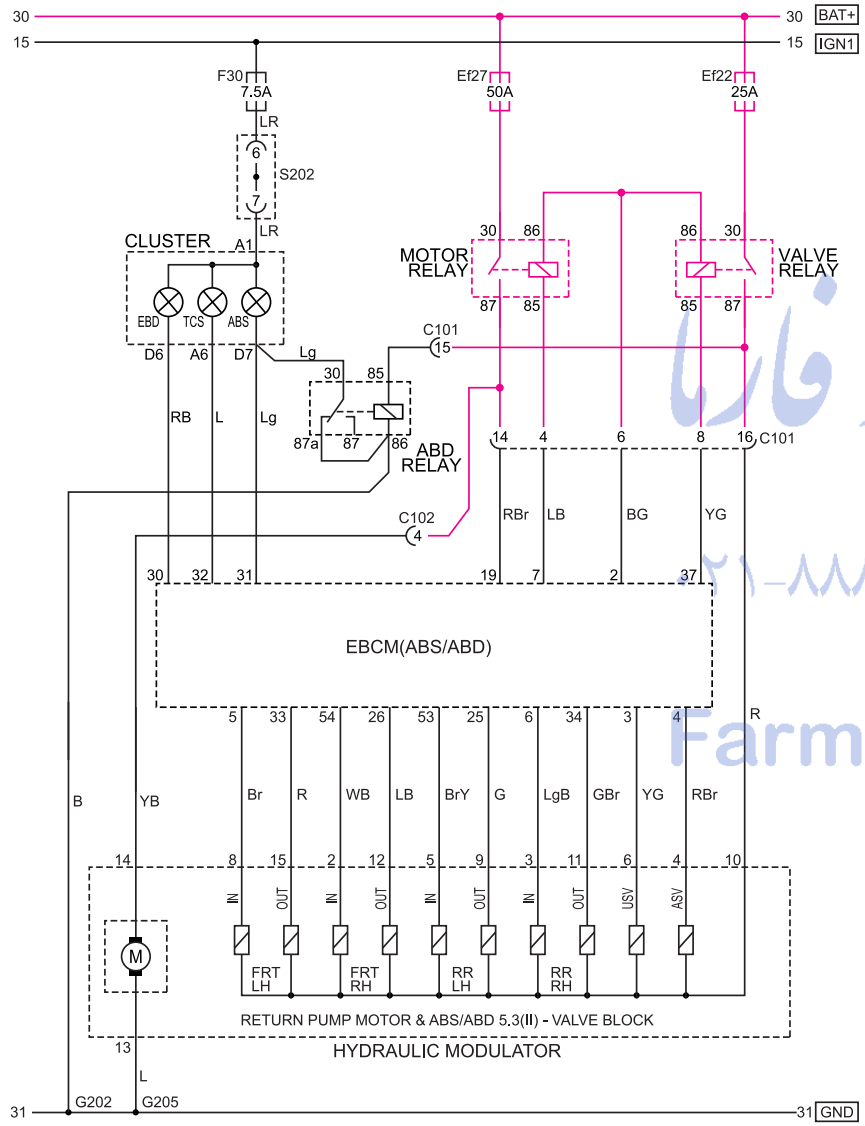
J304



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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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10. ABS/ABD (AUTOMATIC BRAKE DIFFERENTIAL LOCK) : DIESEL

1) INDICATOR, RELAY (ABD, MOTOR, VALVE) HYDRAULIC MODULATOR



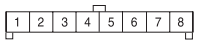
a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C101 (19Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C102 (4Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
S202 (20Pin,Black)	W/H Main	Behind Cluster
G202	W/H Main	Upper Front Left Leg Room
G205	W/H Main	Center "A" Piller Front Right

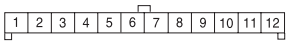
b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

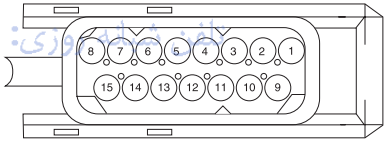

EBCM

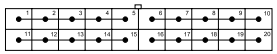

CLUSTER "A"

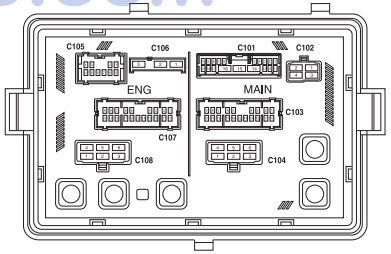

CLUSTER "B"


CLUSTER "C"


CLUSTER "D"


HYDRAULIC MODULATOR

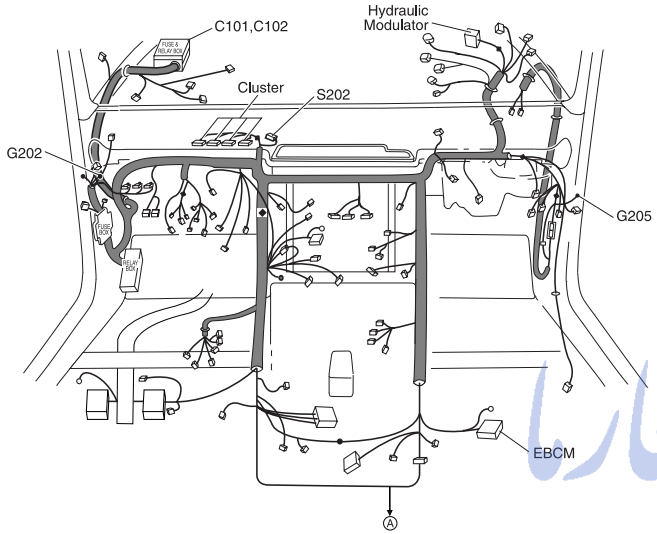

S202 (BLACK)



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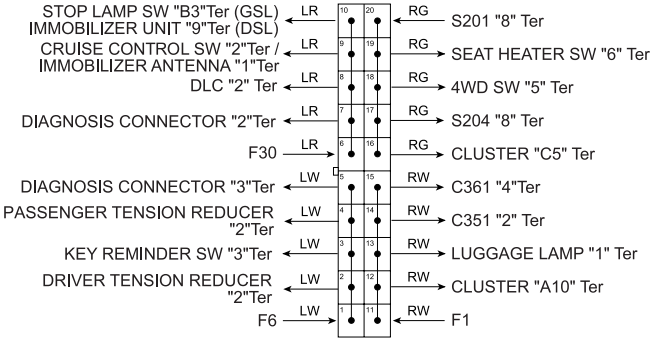
c. POSITION OF CONNECTORS AND GROUNDS

- W/H MAIN



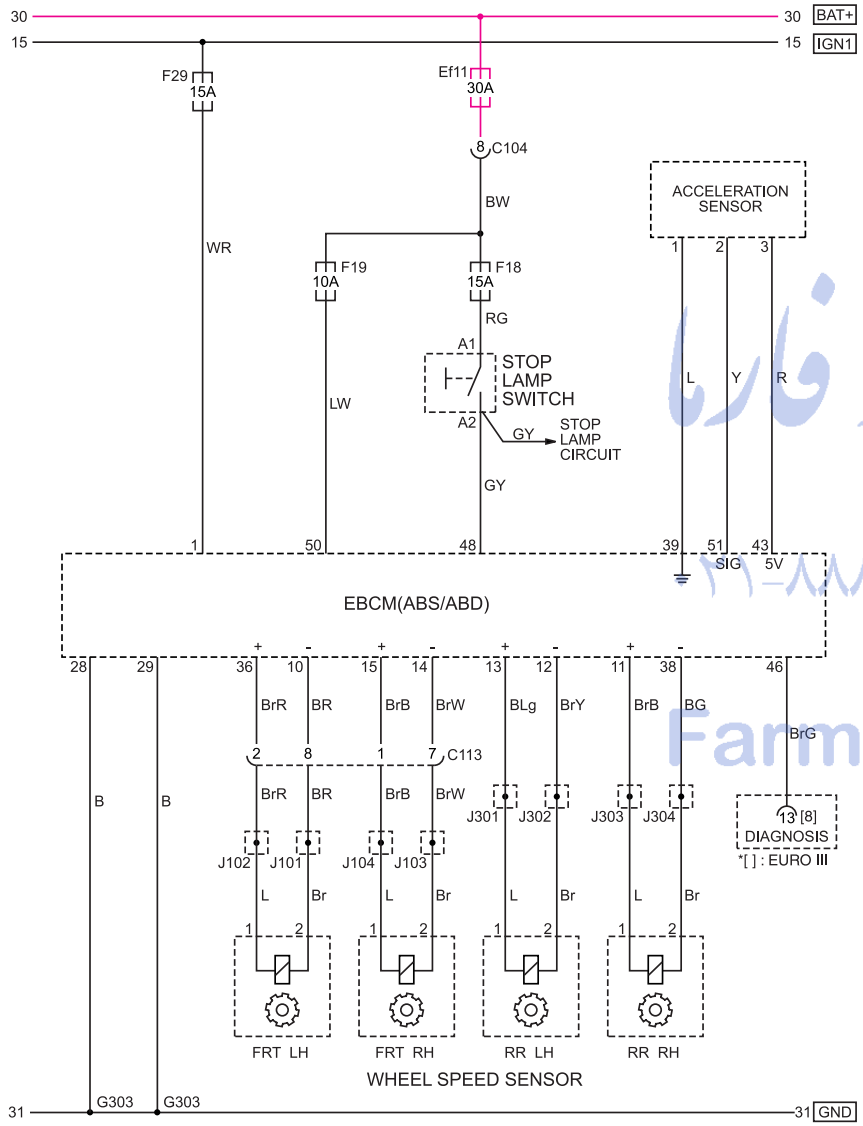
d. SPLICE PACK

S202 (BLACK)



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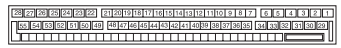
2) STOP LAMP SWITCH, ACCELERATION SENSOR, WHEEL SPEED SENSOR, DIAGNOSIS



a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C104 (8Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C113 (12Pin, Black)	W/H Engine Room - W/H Main	Next to Hydraulic Unit
J101	W/H Engine Room	Behind Battery
J102	W/H Engine Room	Behind Battery
J103	W/H Engine Room	Below Air Cleaner
J104	W/H Engine Room	Below Air Cleaner
J301	W/H Main	Below Rear Left Seat
J302	W/H Main	Below Rear Left Seat
J303	W/H Main	Below Rear Right Seat
J304	W/H Main	Below Rear Right Seat
G303	W/H Main	Below Front Right Seat

b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



EBCM

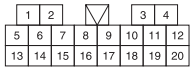


STOP LAMP "A"

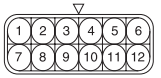
ACCELERATION SENSOR



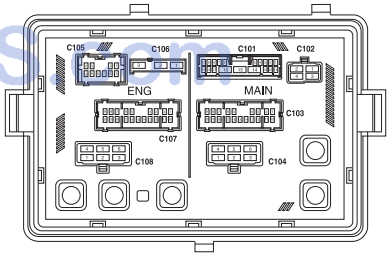
WHEEL SPEED SENSOR

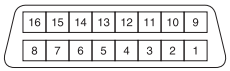


DIAGNOSIS CONNECTOR



C113 (BLACK)



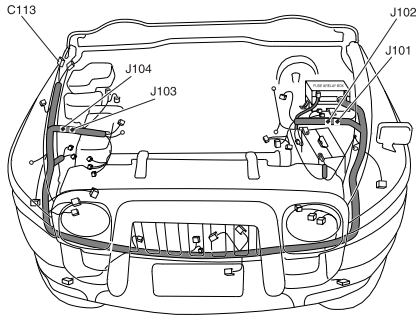


DLC(EURO III)

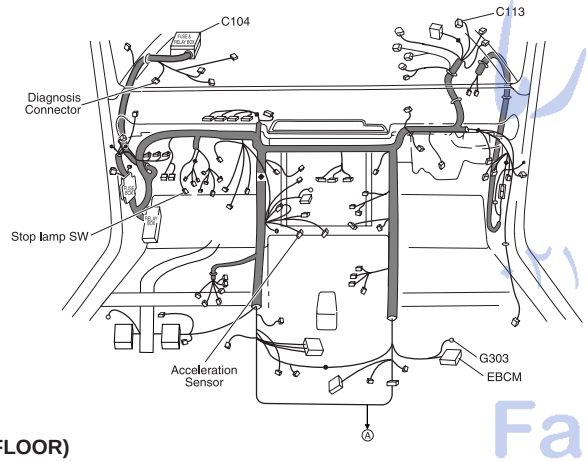
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c. POSITION OF CONNECTORS AND GROUNDS

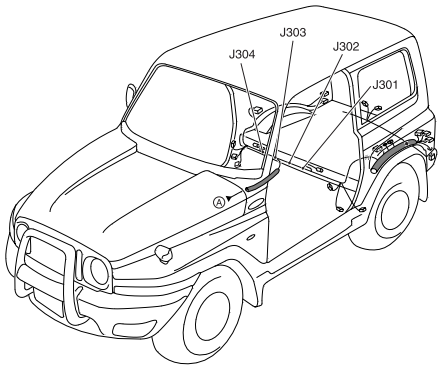
- W/H ENGINE ROOM



- W/H MAIN



- W/H MAIN (FLOOR)



d. JOINT

J101

C113 "8"Ter — BR — Br — FRT LH WHEEL SPEED SENSOR "2"Ter

J102

C113 "2"Ter — BrR — L — FRT LH WHEEL SPEED SENSOR "1"Ter

J103

C113 "7"Ter — BrW — Br — FRT RH WHEEL SPEED SENSOR "2"Ter

J104

C113 "1"Ter — BrB — L — FRT RH WHEEL SPEED SENSOR "1"Ter

J301

EBCM(ABS) "9" Ter
EBCM(ABS/ABD) "13" Ter — BLg — L — RR LH WHEEL SPEED SENSOR "1"Ter

J302

EBCM(ABS) "8" Ter
EBCM(ABS/ABD) "12" Ter — BrY — Br — RR LH WHEEL SPEED SENSOR "2"Ter

J303

EBCM(ABS) "2" Ter
EBCM(ABS/ABD) "11" Ter — BrB — L — RR RH WHEEL SPEED SENSOR "1"Ter

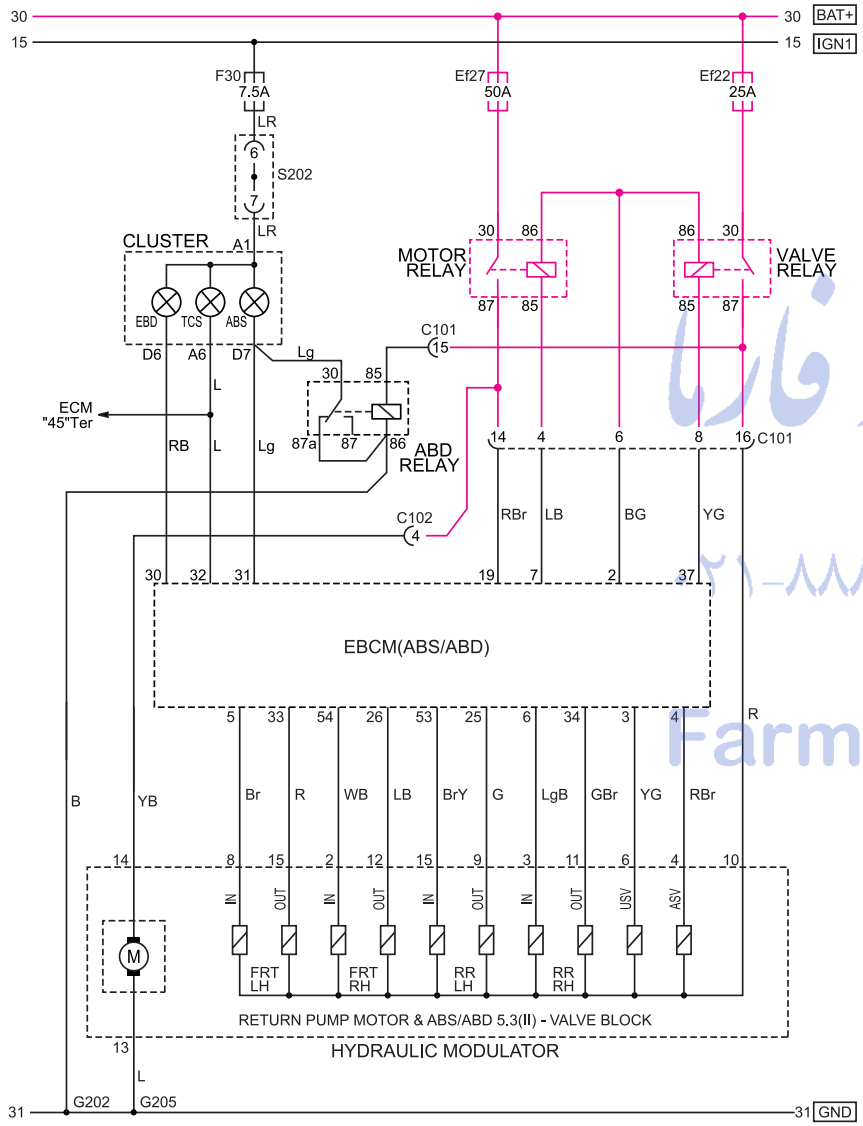
J304

EBCM(ABS) "1" Ter
EBCM(ABS/ABD) "38" Ter — BG — Br — RR RH WHEEL SPEED SENSOR "2"Ter

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11. ABS/ABD (AUTOMATIC BRAKE DIFFERENTIAL LOCK) : GASOLINE

1) INDICATOR, RELAY (ABD, MOTOR, VALVE), HYDRAULIC MODULATOR



a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C101 (19Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C102 (4Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
S202 (20Pin,Black)	W/H Main	Behind Cluster
G202	W/H Main	Upper Front Left Leg Room
G205	W/H Main	Center "A" Piller Front Right

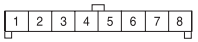
b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



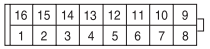
EBCM



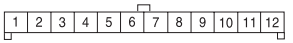
CLUSTER "A"



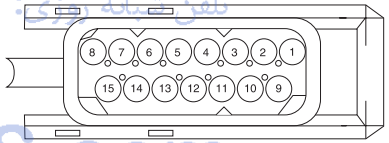
CLUSTER "B"



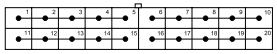
CLUSTER "C"



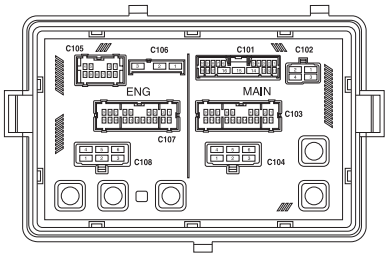
CLUSTER "D"



HYDRAULIC MODULATOR



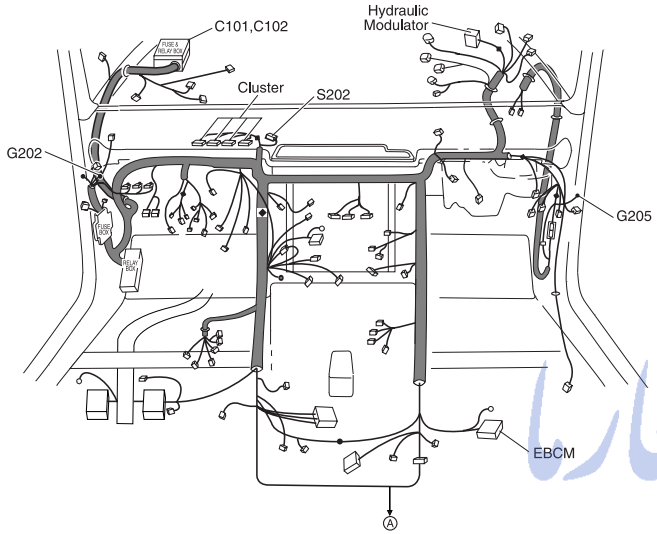
S202 (BLACK)



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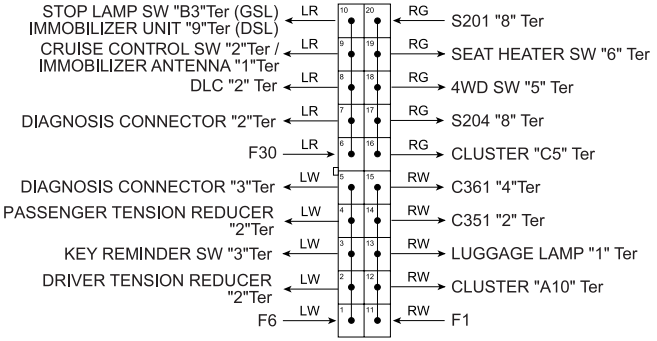
c. POSITION OF CONNECTORS AND GROUNDS

- W/H MAIN



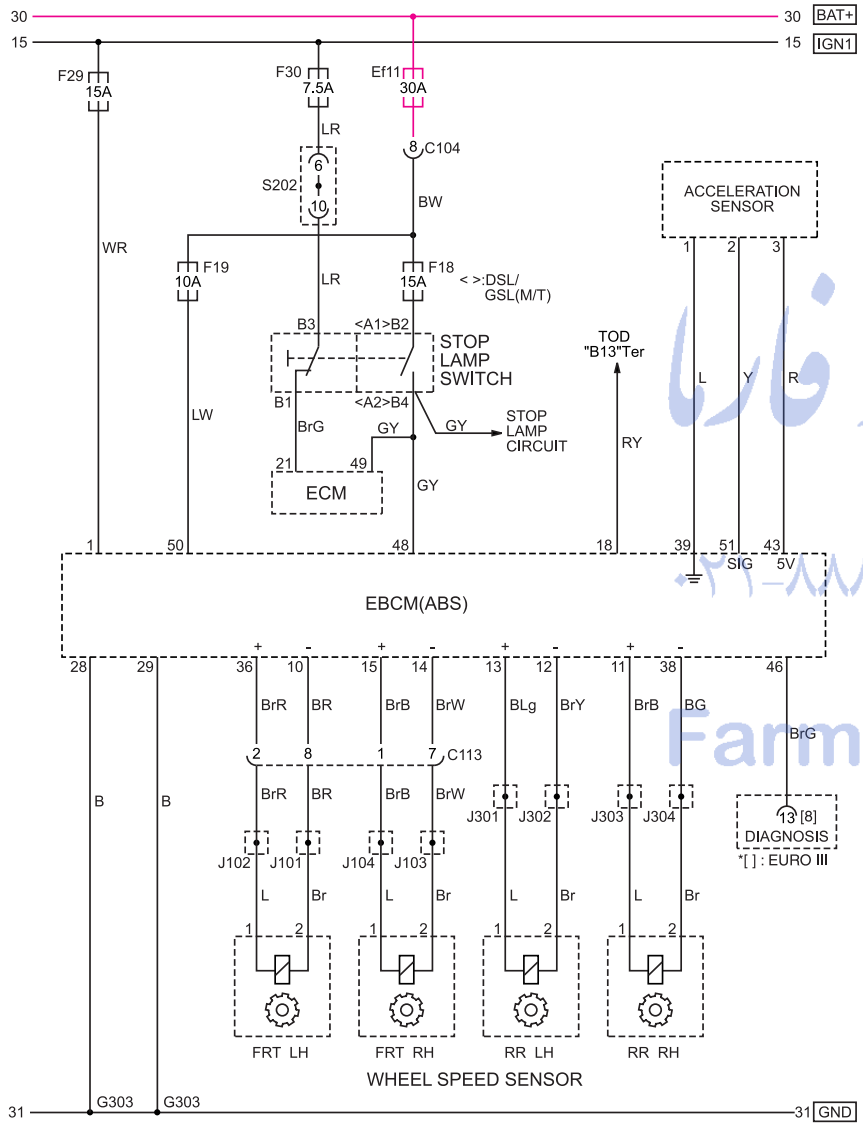
d. SPLICE PACK

S202 (BLACK)



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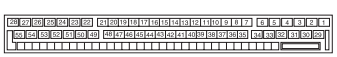
2) STOP LAMP SWITCH, ACCELERATION SENSOR, WHEEL SPEED SENSOR, DIAGNOSIS



a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C104 (8Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C113 (12Pin, Black)	W/H Engine Room - W/H Main	Next to Hydraulic Unit
S202 (20Pin, Black)	W/H Main	Behind Cluster
J101	W/H Engine Room	Behind Battery
J102	W/H Engine Room	Behind Battery
J103	W/H Engine Room	Below Air Cleaner
J104	W/H Engine Room	Below Air Cleaner
J301	W/H Main	Below Rear Left Seat
J302	W/H Main	Below Rear Left Seat
J303	W/H Main	Below Rear Right Seat
J304	W/H Main	Below Rear Right Seat
G303	W/H Main	Below Front Right Seat

b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

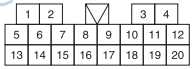

EBCM

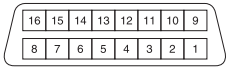
STOP LAMP "A"

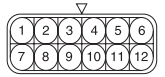

STOP LAMP "B"

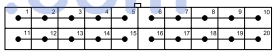

ACCELERATION SENSOR

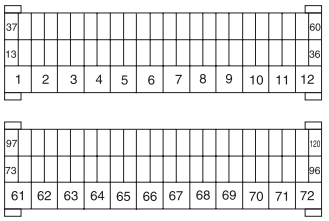

WHEEL SPEED SENSOR

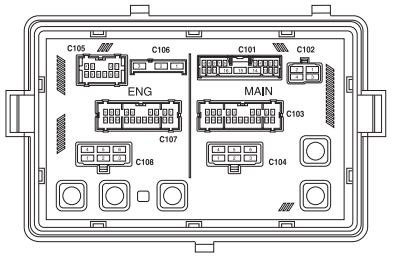

DIAGNOSIS CONNECTOR


DLC(EURO III)


C113 (BLACK)


S202 (BLACK)

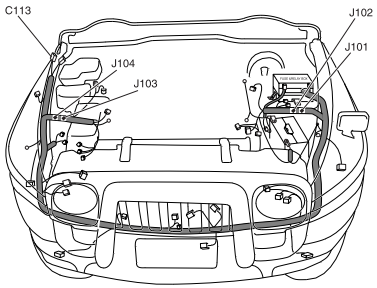

ECM



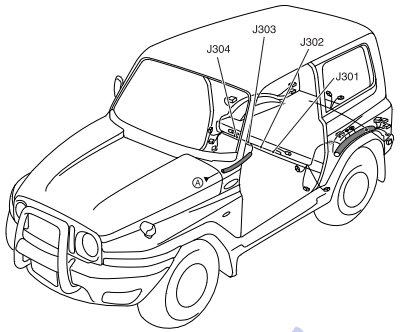
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c. POSITION OF CONNECTORS AND GROUNDS

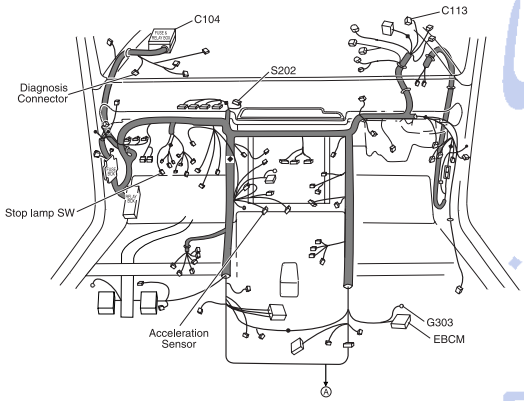
- W/H ENGINE ROOM



- W/H MAIN (FLOOR)

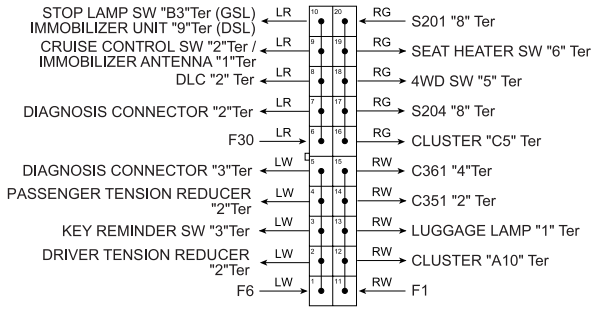


- W/H MAIN



d. SPLICE PACK

S202 (BLACK)



e. JOINT

J101

C113 "8"Ter — BR — Br — FRT LH WHEEL SPEED SENSOR "2"Ter

J102

C113 "2"Ter — BrR — L — FRT LH WHEEL SPEED SENSOR "1"Ter

J103

C113 "7"Ter — BrW — Br — FRT RH WHEEL SPEED SENSOR "2"Ter

J104

C113 "1"Ter — BrB — L — FRT RH WHEEL SPEED SENSOR "1"Ter

J301

EBCM(ABS) "9" Ter
EBCM(ABS/ABD) "13" Ter — BLg — L — RR LH WHEEL SPEED SENSOR "1"Ter

J302

EBCM(ABS) "8" Ter
EBCM(ABS/ABD) "12" Ter — BrY — Br — RR LH WHEEL SPEED SENSOR "2"Ter

J303

EBCM(ABS) "2" Ter
EBCM(ABS/ABD) "11" Ter — BrB — L — RR RH WHEEL SPEED SENSOR "1"Ter

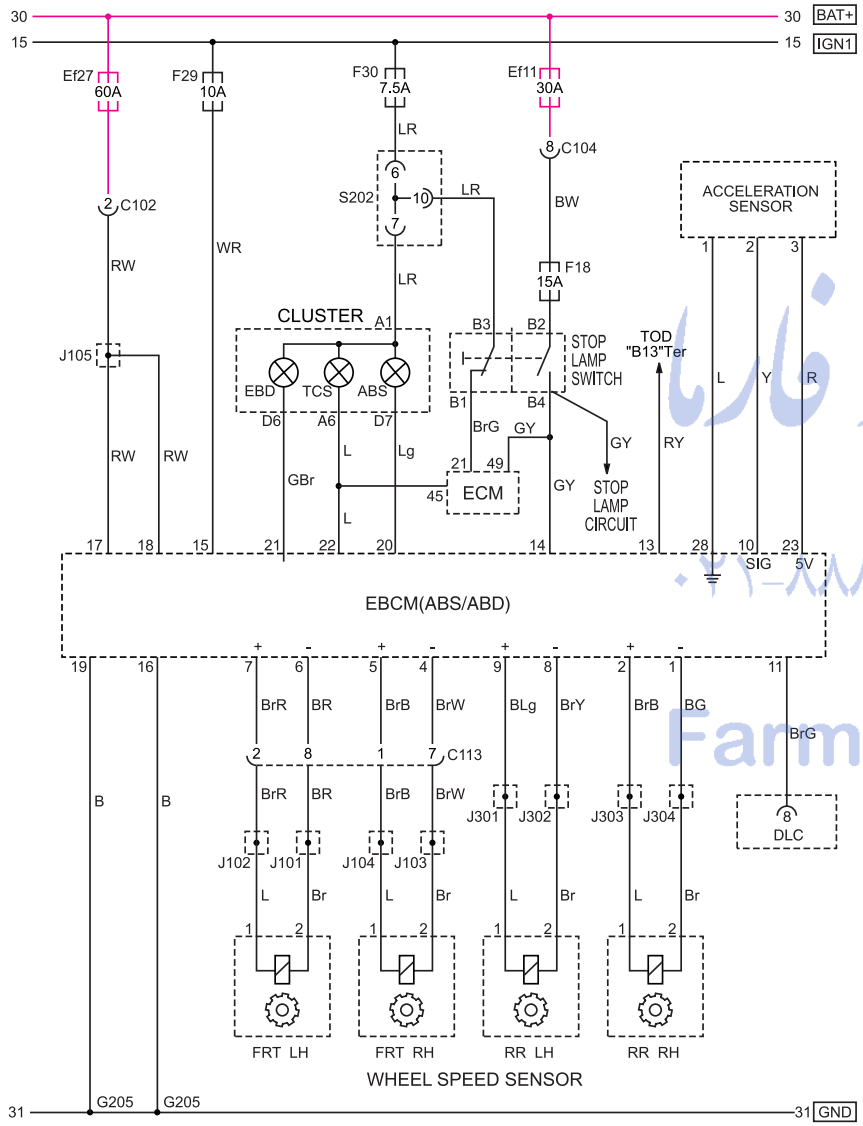
J304

EBCM(ABS) "1" Ter
EBCM(ABS/ABD) "38" Ter — BG — Br — RR RH WHEEL SPEED SENSOR "2"Ter

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12. ABS/ABD (AUTOMATIC BRAKE DIFFERETIAL LOCK) : EURO III

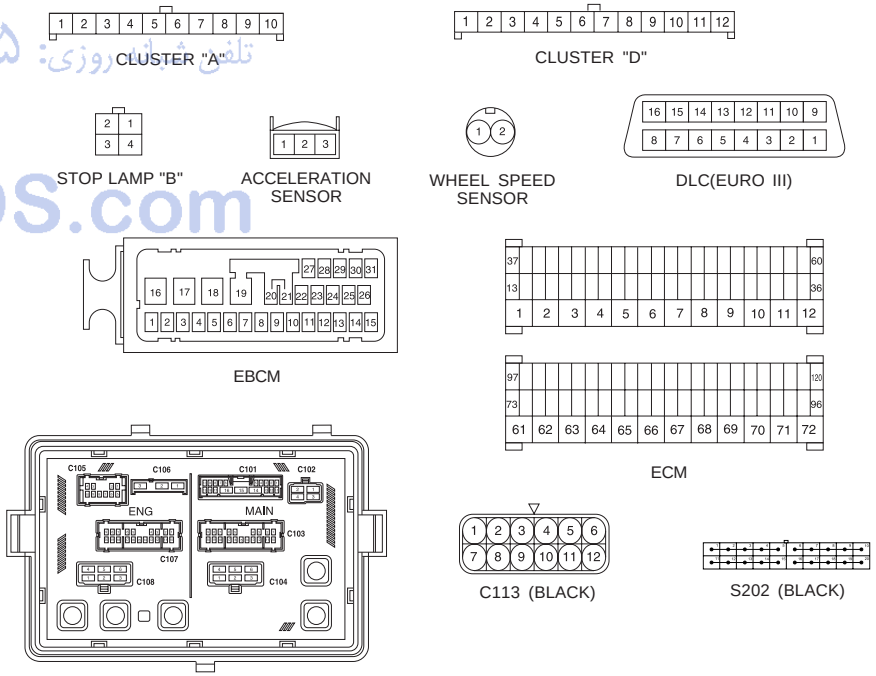
-ATTACHED EBCM-



a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING WIRING HARNESS	CONNECTOR POSITION
C102 (4Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C104 (8Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C113 (12Pin, Black)	W/H Engine Room - W/H Main	Next to Hydraulic Unit
S202 (20Pin, Black)	W/H Main	Behind Cluster
J101	W/H Engine Room	Behind Battery
J102	W/H Engine Room	Behind Battery
J103	W/H Engine Room	Below Air Cleaner
J104	W/H Engine Room	Below Air Cleaner
J105	W/H Main	Next to Yellow Label
J301	W/H Main	Below Rear Left Seat
J302	W/H Main	Below Rear Left Seat
J303	W/H Main	Below Rear Right Seat
J304	W/H Main	Below Rear Right Seat
G205	W/H Main	Center "A" Pillar Front Right

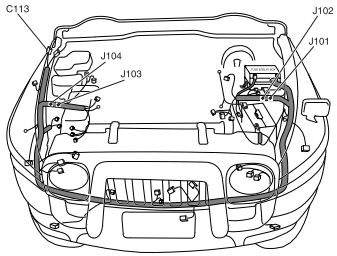
b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



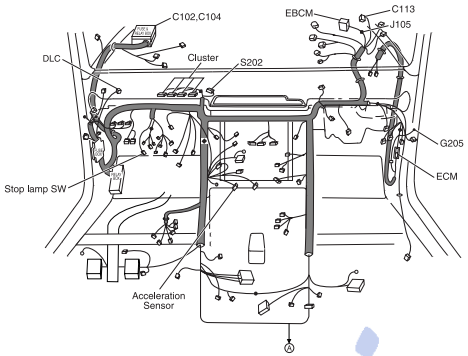
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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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c. POSITION OF CONNECTORS AND GROUNDS

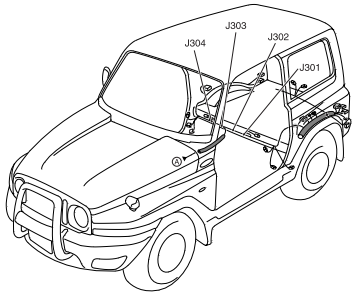
- W/H ENGINE ROOM



- W/H MAIN

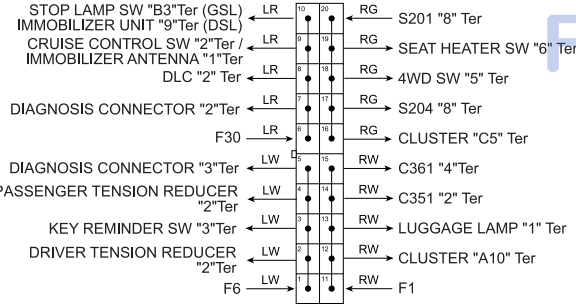


- W/H MAIN (FLOOR)



d. SPLICE PACK

S202 (BLACK)



e. JOINT

J101



J102



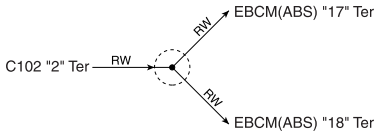
J103



J104



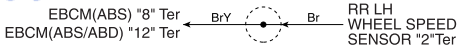
J105



J301



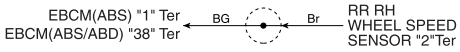
J302



J303



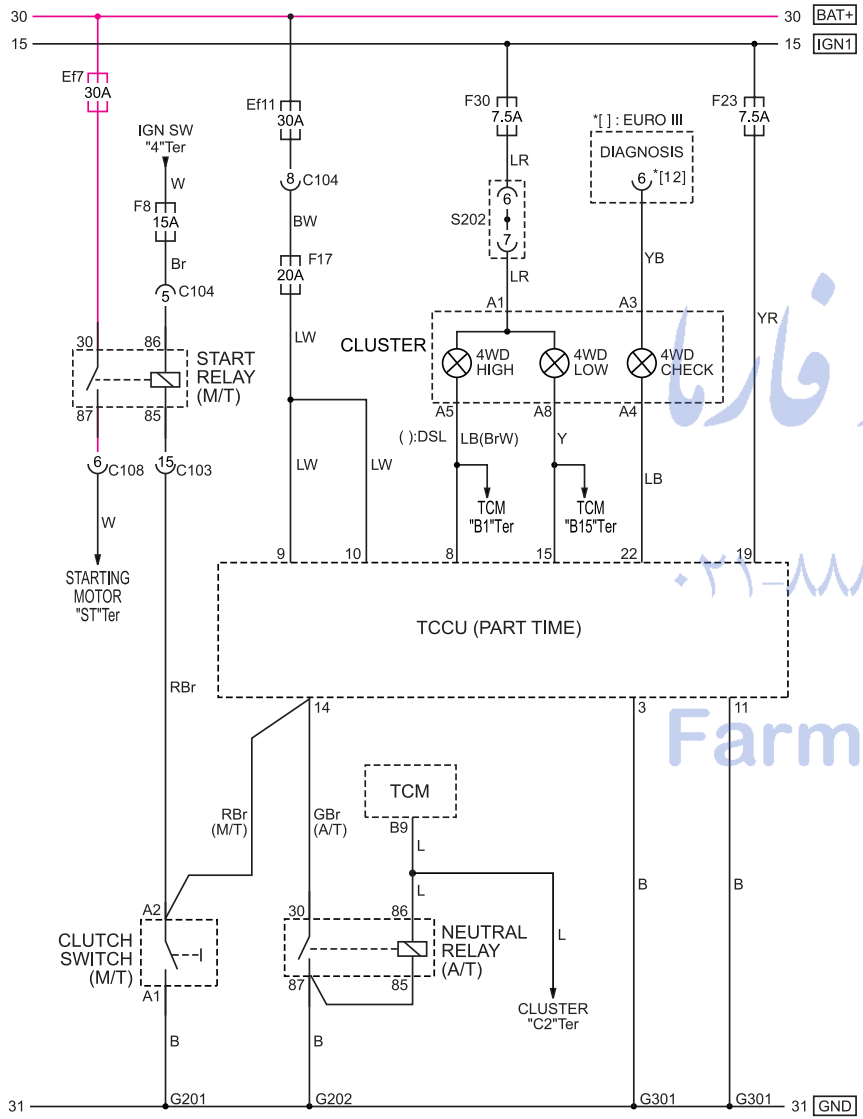
J304



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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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13. TCCU

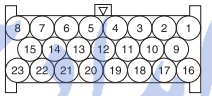
1) INDICATOR, DIAGNOSIS

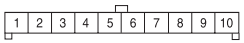


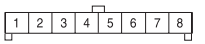
a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C103 (22Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C104 (8Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C108 (6Pin, Colorless)	Engine Room Fuse Box - W/H Engine Room	Engine Room Fuse Box
S202 (20Pin,Black)	W/H Main	Behind Cluster
G201	W/H Main	Upper Front Left Leg Room
G202	W/H Main	Upper Front Left Leg Room
G301	W/H Main	Below Front Left Seat

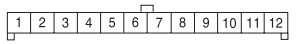
b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

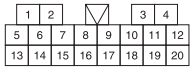

TCCU

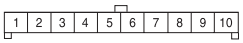

CLUSTER "A"

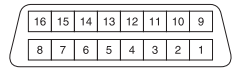

CLUSTER "B"


CLUSTER "C"


CLUSTER "D"

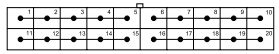

DIAGNOSIS CONNECTOR

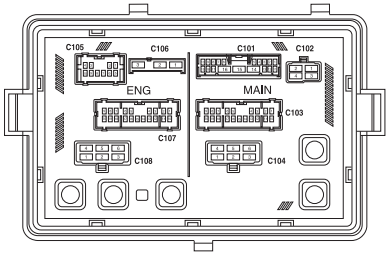

CLUSTER "A"


DLC(EURO III)


TCM "A"


TCM "B"

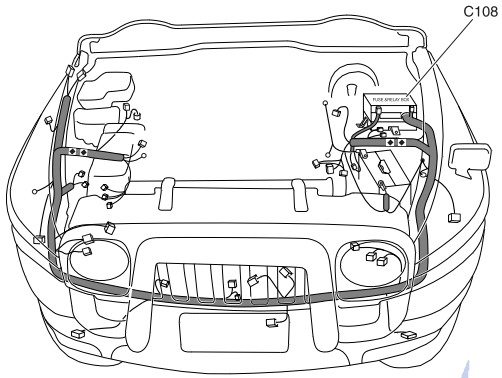

S202 (BLACK)



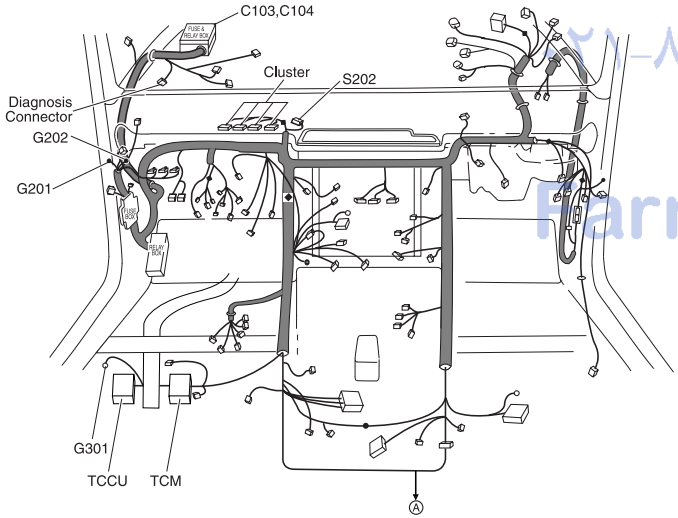
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c. POSITION OF CONNECTORS AND GROUNDS

- W/H ENGINE ROOM

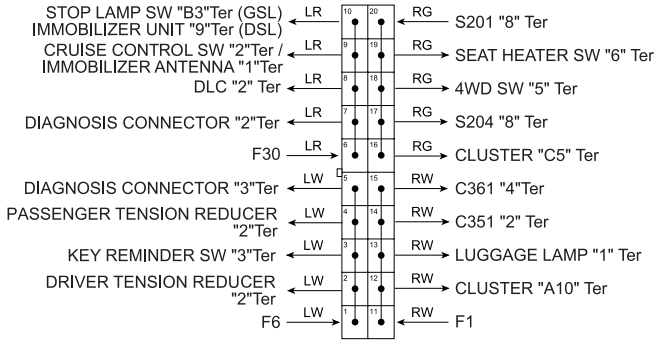


- W/H MAIN



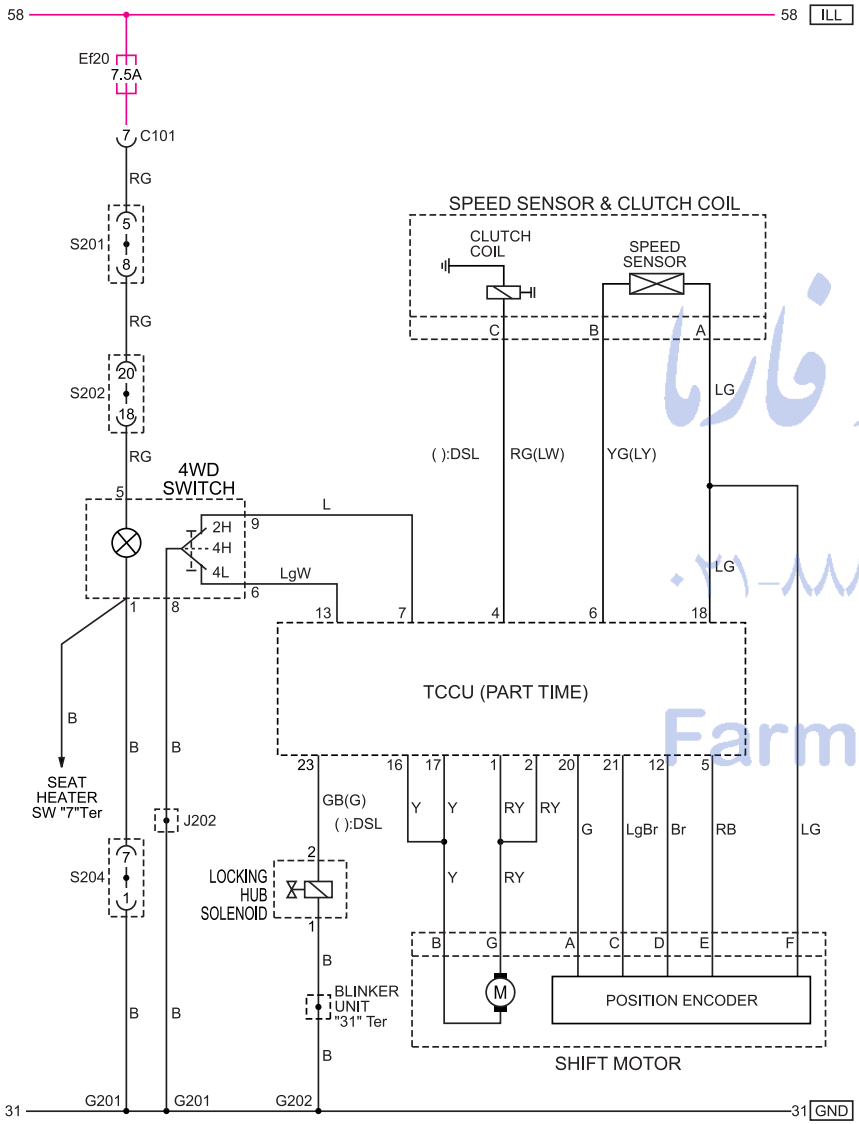
d. SPLICE PACK

S202 (BLACK)



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تلفن شبانه روزی: ۰۲۱-۸۸۶۲۰۸۵
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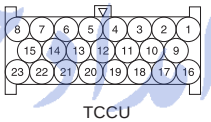
2) 4WD SWITCH, SPEED SENSOR & CLUTCH COIL, SHIFT MOTOR, LOCKING HUB SOLENOID

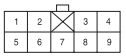


a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C101 (19Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
S201 (8Pin,Colorless)	W/H Main	Upper Fuse Box (Passenger Room)
S202 (20Pin,Black)	W/H Main	Behind Cluster
S204 (14Pin,Colorless)	W/H Main	Behind Audio
J202	W/H Main	Behind Cluster
G201	W/H Main	Upper Front Left Leg Room
G202	W/H Main	Upper Front Left Leg Room

b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION
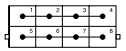


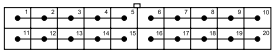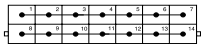




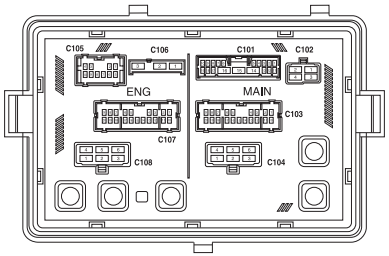








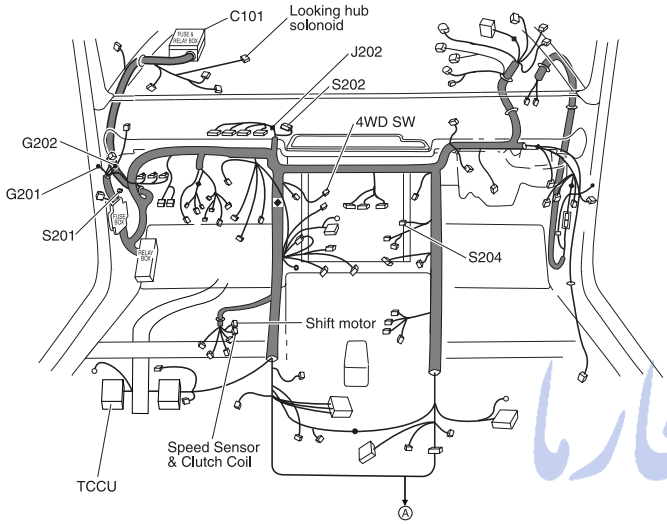




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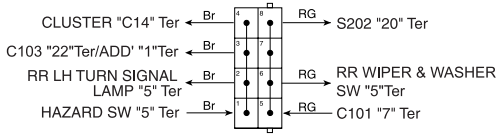
c. POSITION OF CONNECTORS AND GROUNDS

- W/H MAIN

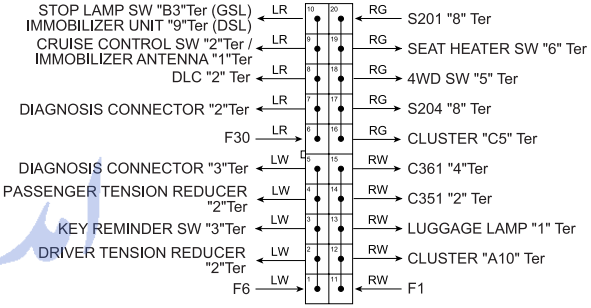


d. SPLICE PACK

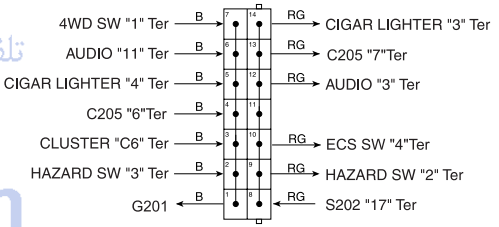
S201 (COLORLESS)



S202 (BLACK)

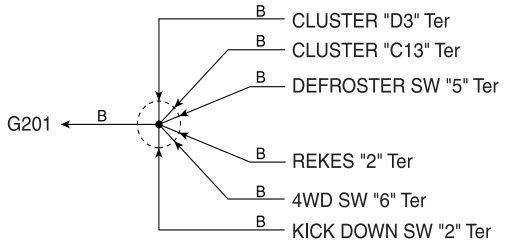


S204 (COLORLESS)



e. JOINT

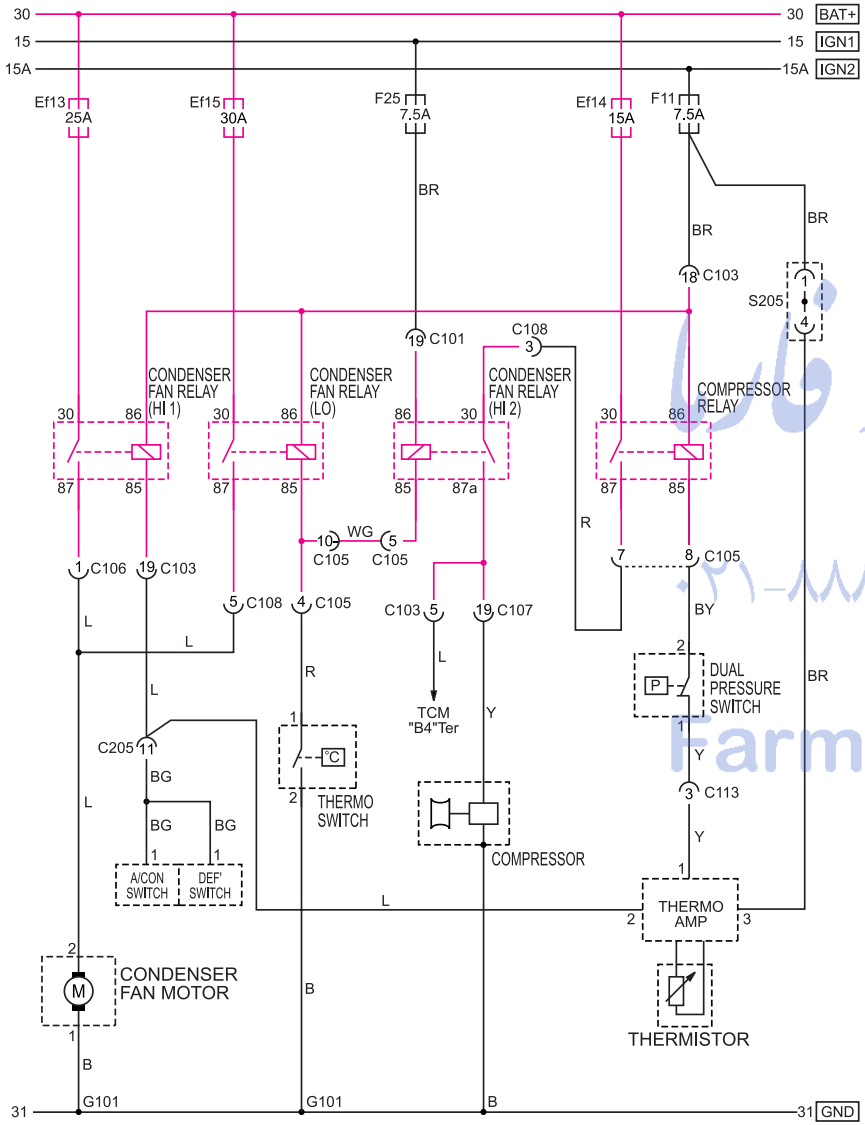
J202



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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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15. MANUAL AIR CONDITIONING SYSTEM : DIESEL

1) CONDENSER FAN MOTOR, THERMO SWITCH, COMPRESSOR, THERMO AMP



a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING WIRING HARNESS	CONNECTOR POSITION
C101 (19Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C103 (22Pin,White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C105 (10Pin,White)	Engine Room Fuse Box - W/H Engine Room	Engine Room Fuse Box
C106 (3Pin,Black)	Engine Room Fuse Box - W/H Engine Room	Engine Room Fuse Box
C107 (20Pin,White)	Engine Room Fuse Box - W/H Engine Room	Engine Room Fuse Box
C108 (6Pin,Colorless)	Engine Room Fuse Box - W/H Engine Room	Engine Room Fuse Box
C113 (12Pin,Black)	W/H Engine Room - W/H Main	Next to Hydraulic Unit
C205 (17Pin,White)	W/H Main - W/H Air Conditioner	Upper Evaporator
S205 (8Pin,Colorless)	W/H Main	Behind Front Right Kick Panel
G101	W/H Engine Main	Left Fender Next to Battery

b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

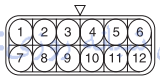

CONTROL PANNEL

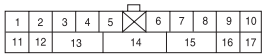

CONDENSOR FAN MOTOR
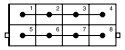

THERMO SW

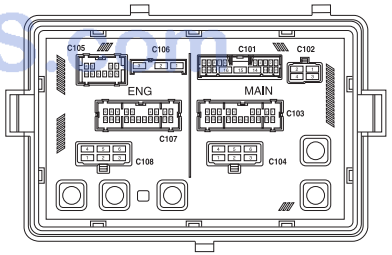

DUAL PRESSURE SW


THERMO AMP


C113 (BLACK)


C205 (WHITE)

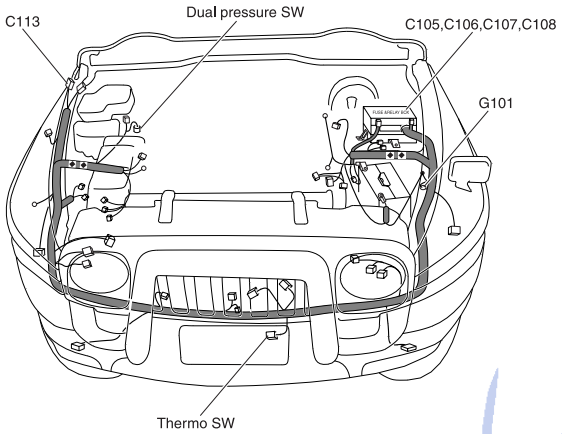

S205 (COLORLESS)



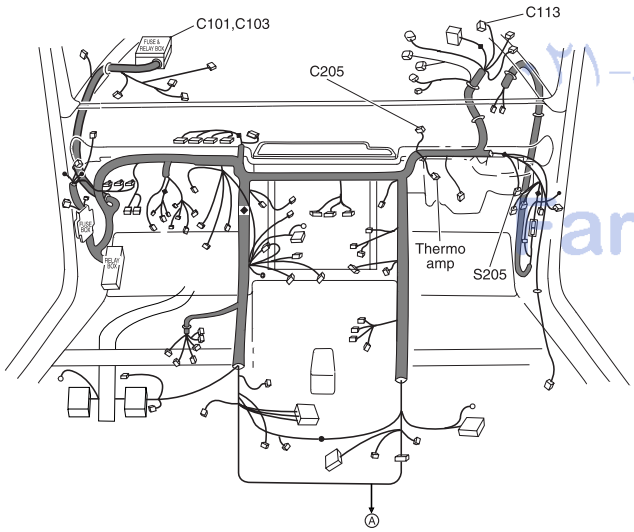
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c. POSITION OF CONNECTORS AND GROUNDS

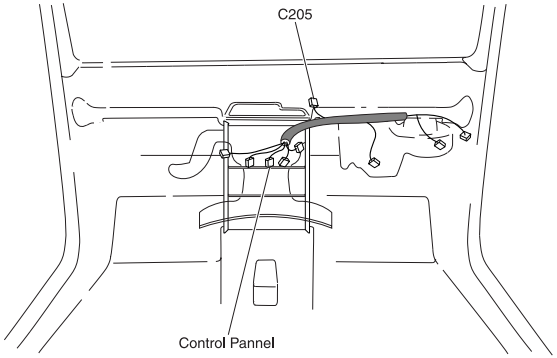
- W/H ENGINE ROOM



- W/H MAIN

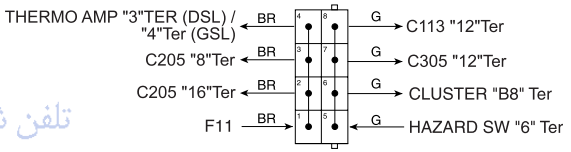


- W/H AIR-CONDITIONER



d. SPLICE PACK

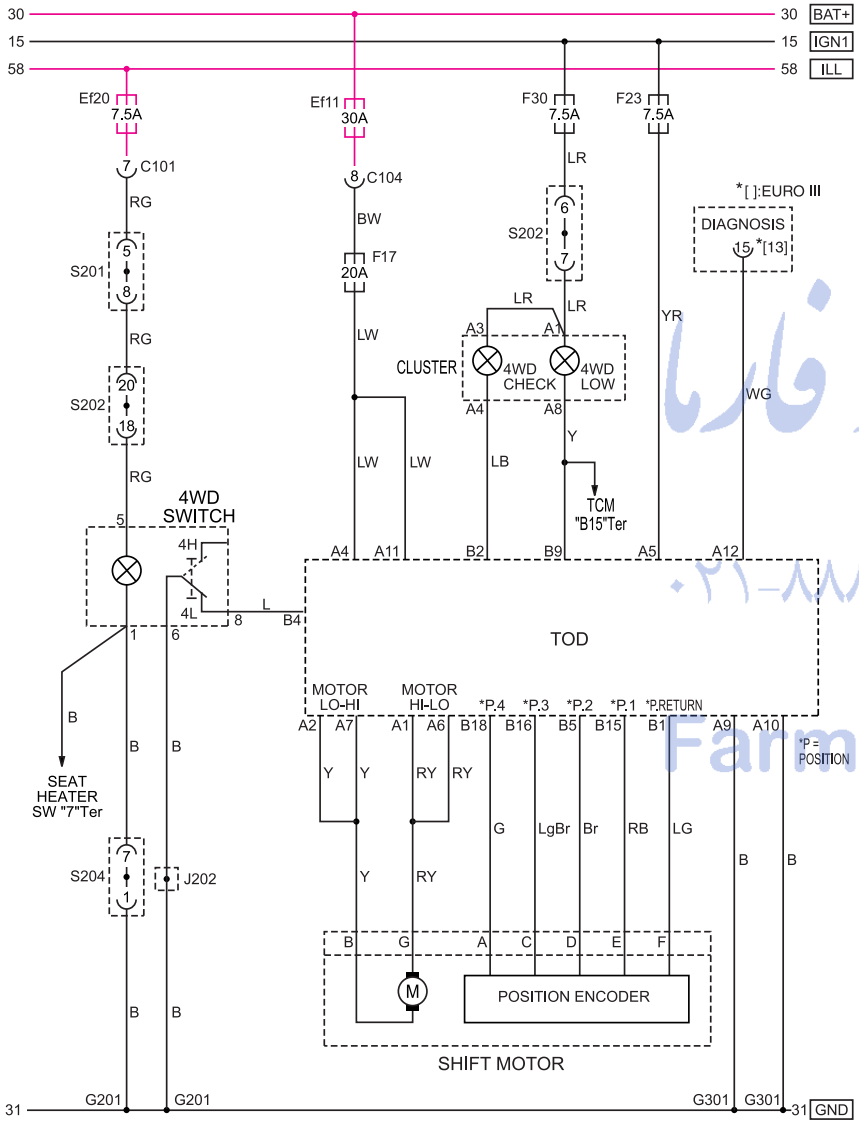
S205 (COLORLESS)



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۶۲۰۸۵
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14. TOD (TORQUE ON DEMAND)

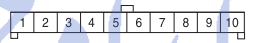
1) 4WD SWITCH, INDICATOR, DIAGNOSIS, SHIFT MOTOR

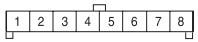


a. CONNECTOR INFORMATION

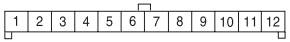
CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C101 (19Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C104 (8Pin,Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
S201 (8Pin,Colorless)	W/H Main	Upper Fuse Box (Passenger Room)
S202 (20Pin,Black)	W/H Main	Behind Cluster
S204 (14Pin,Colorless)	W/H Main	Behind Audio
J202	W/H Main	Behind Cluster
G201	W/H Main	Upper Front Left Leg Room
G301	W/H Main	Below Front Left Seat

b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

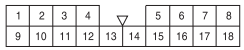

CLUSTER "A"

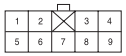

CLUSTER "B"

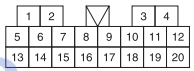

CLUSTER "C"


CLUSTER "D"

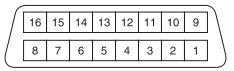

TOD "A"

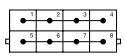

TOD "B"

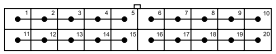

4WD SWITCH

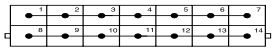

DIAGNOSIS CONNECTOR

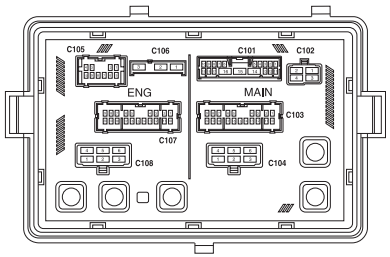

SHIFT MOTOR


DLC(EURO III)


S201 (COLORLESS)


S202 (BLACK)

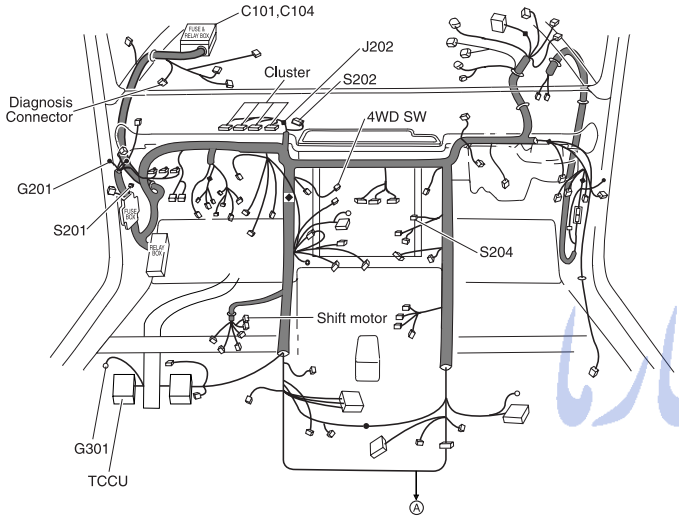

S204 (COLORLESS)



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۴۶۲۰۸۵
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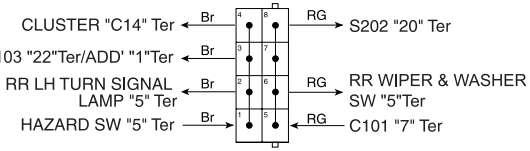
c. POSITION OF CONNECTORS AND GROUNDS

- W/H MAIN

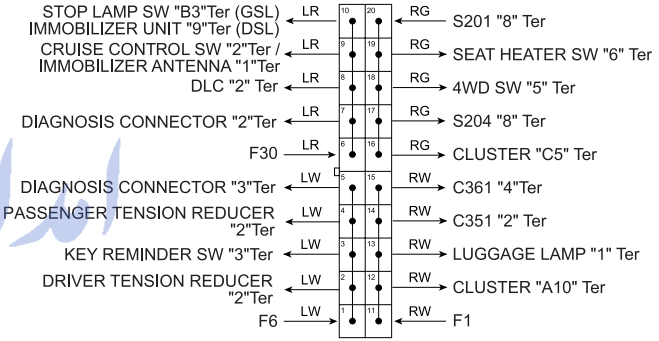


d. SPLICE PACK

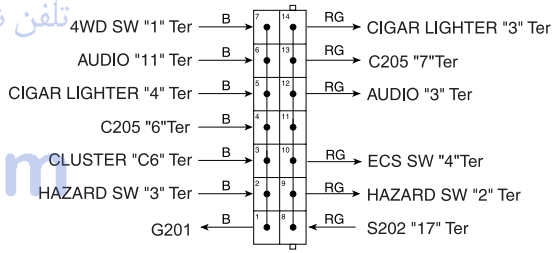
S201 (COLORLESS)



S202 (BLACK)

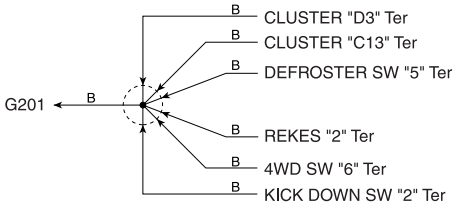


S204 (COLORLESS)



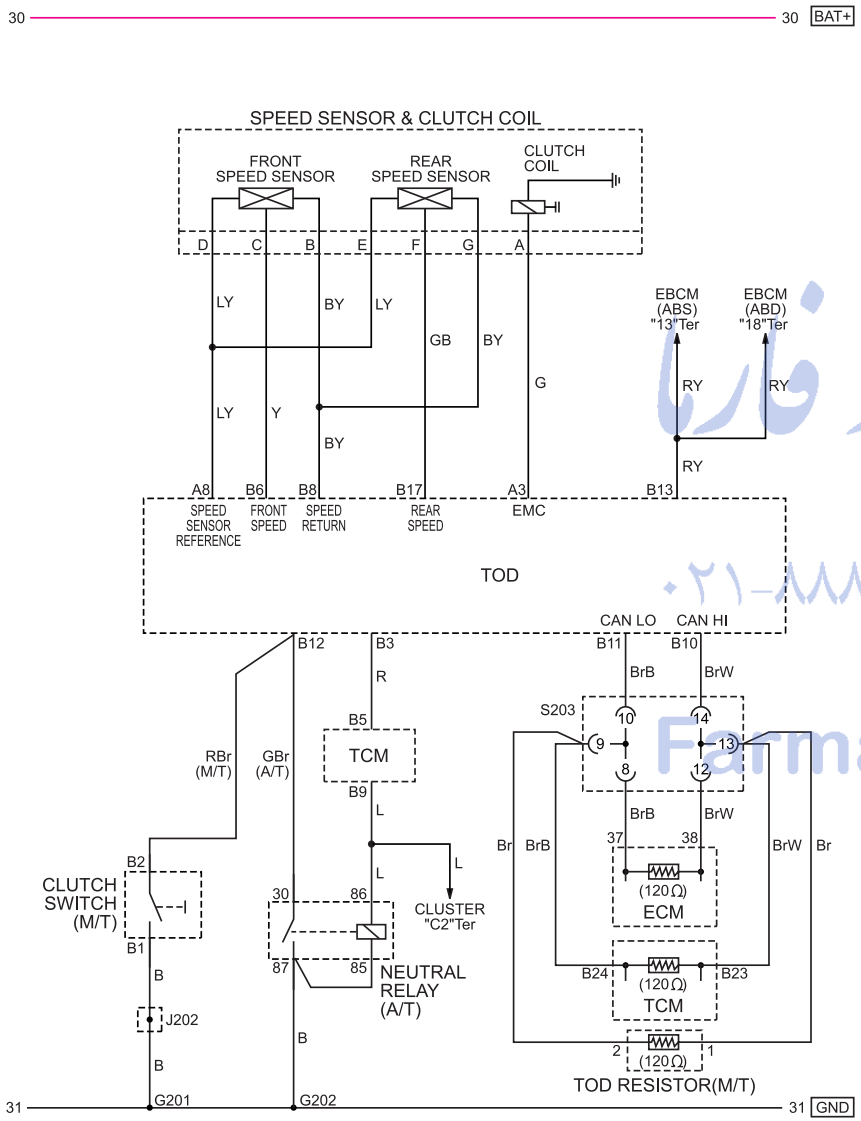
e. JOINT

J202



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
FarmaSOS.com

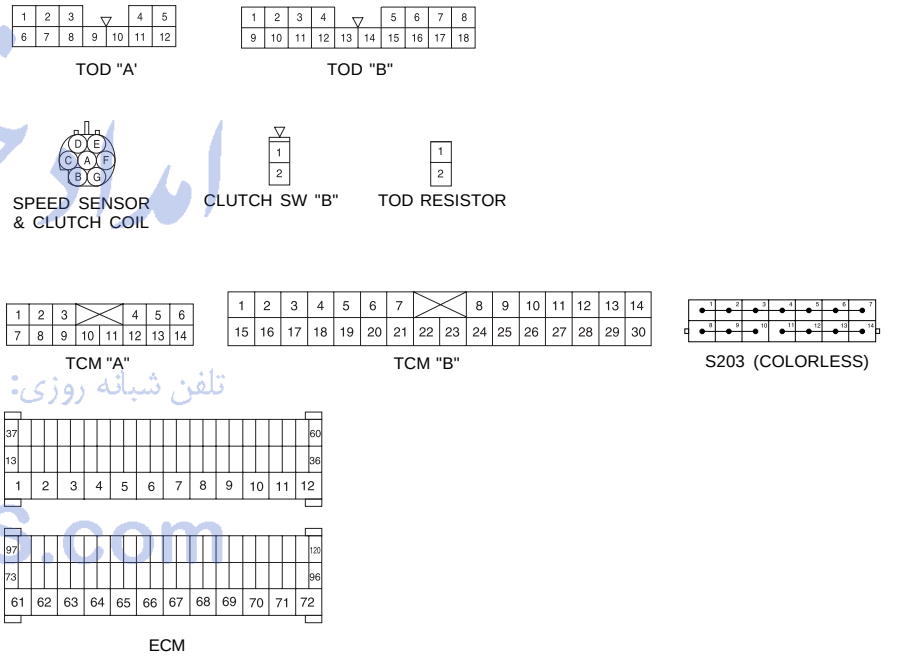
2) SPEED SENSOR & CLUTCH (COIL, CLUTCH SW(M/T) & NEUTRAL RELAY(A/T))



a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
S203 (20Pin,Black)	W/H Main	Behind Cluster
J201	W/H Main	Above FRT LH Seat Under Cover
G201	W/H Main	Upper Front Left Leg Room
G202	W/H Main	Upper Front Left Leg Room

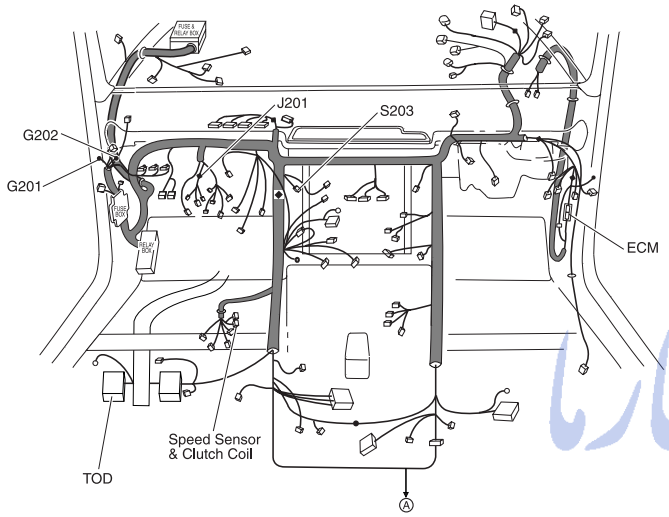
b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



امداد خودرو فارما
۰۲۱-۸۸۶۲۰۸۵ تلفن شبانه روزی:
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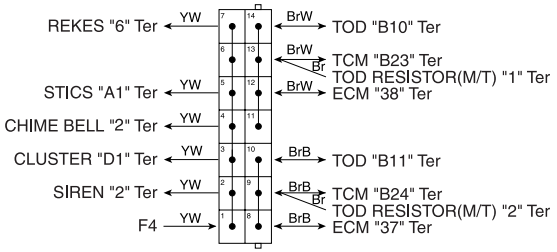
c. POSITION OF CONNECTORS AND GROUNDS

- W/H MAIN



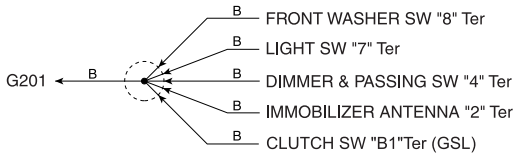
d. SPLICE PACK

S203 (COLORLESS)



e. JOINT

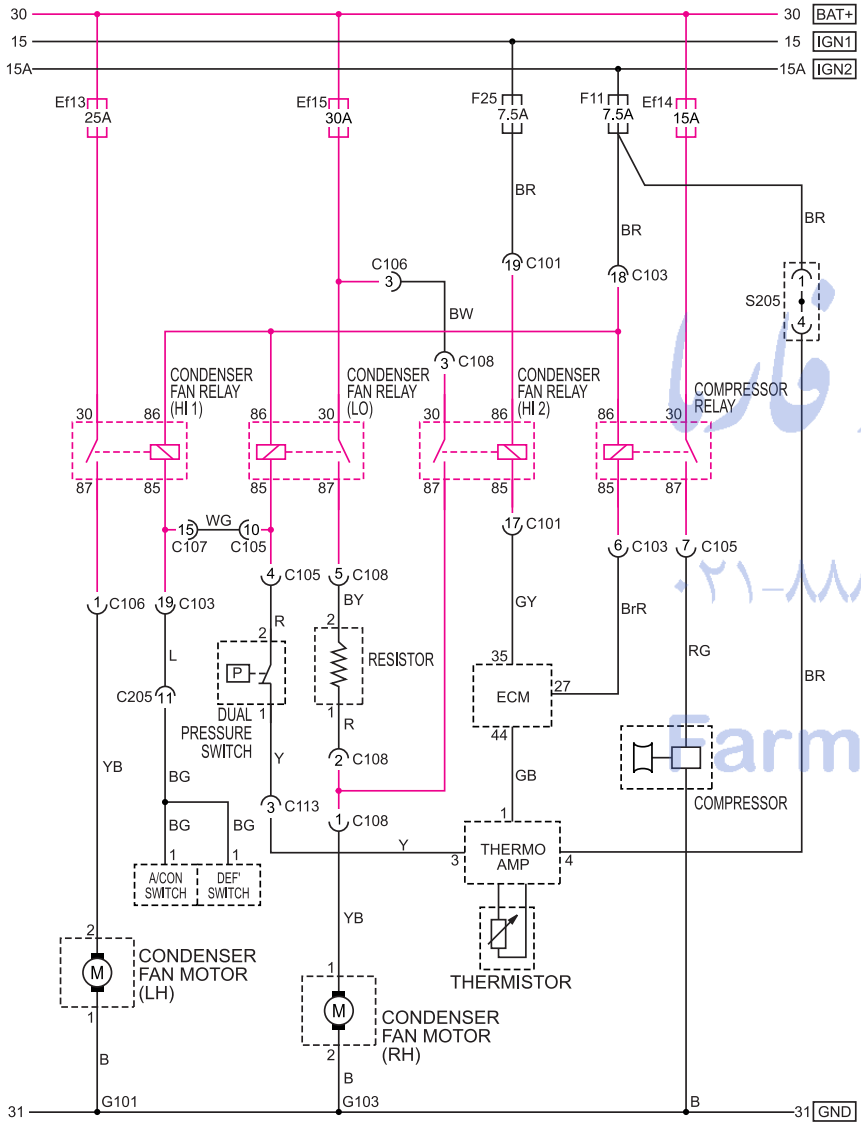
J202



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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MANUAL AIR CONDITIONING SYSTEM : GASOLINE

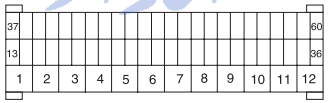
1) CONDENSER FAN MOTOR(LH/RH), COMPRESSOR, THERMO AMP



a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING WIRING HARNESS	CONNECTOR POSITION
C101 (19Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C103 (22Pin,White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C105 (10Pin,White)	Engine Room Fuse Box - W/H Engine Room	Engine Room Fuse Box
C106 (3Pin,Black)	Engine Room Fuse Box - W/H Engine Room	Engine Room Fuse Box
C107 (20Pin,White)	Engine Room Fuse Box - W/H Engine Room	Engine Room Fuse Box
C108 (6Pin,Colorless)	Engine Room Fuse Box - W/H Engine Room	Engine Room Fuse Box
C113 (12Pin,Black)	W/H Engine Room - W/H Main	Next to Hydraulic Unit
C205 (17Pin,White)	W/H Main - W/H Air Conditioner	Upper Evaporator
S205 (8Pin,Colorless)	W/H Main	Behind Front Right Kick Panel
G101	W/H Engine Room	Left Fender Next to Battery
G103	W/H Engine Room	Right Fender Engine Room

b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



ECM



CONTROL PANNEL



CONDENSOR FAN MOTOR (LH)



CONDENSOR FAN MOTOR (RH)



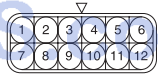
THERMO AMP



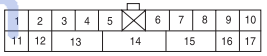
DUAL PRESSURE SW
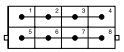


RESISTOR



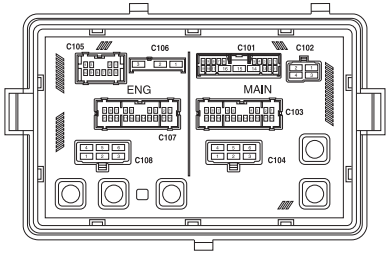
C113 (BLACK)



C205 (WHITE)



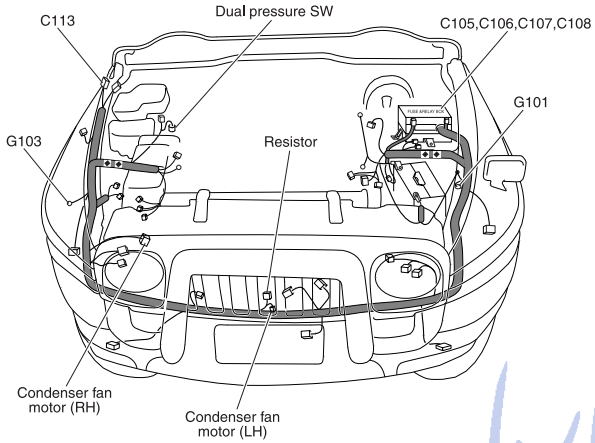
S205 (COLORLESS)



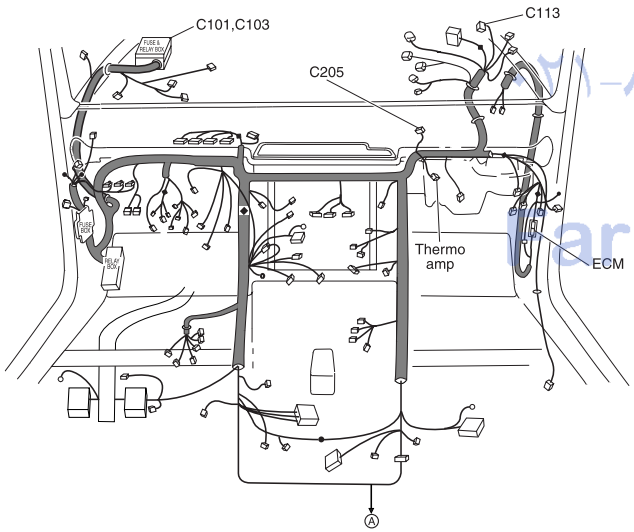
ایران خودرو فارما
۰۲۱-۸۸۴۶۲۰۸۵
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c. POSITION OF CONNECTORS AND GROUNDS

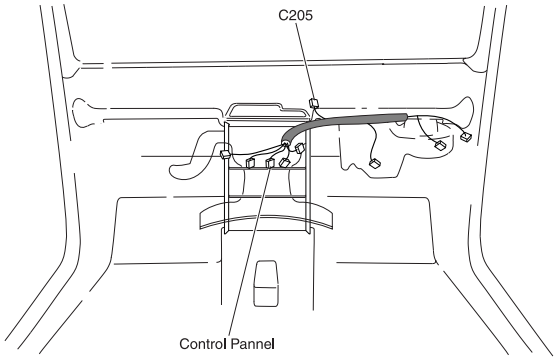
- W/H ENGINE ROOM



- W/H MAIN

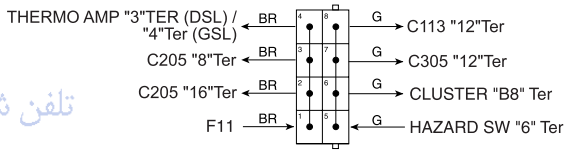


- W/H AIR-CONDITIONER



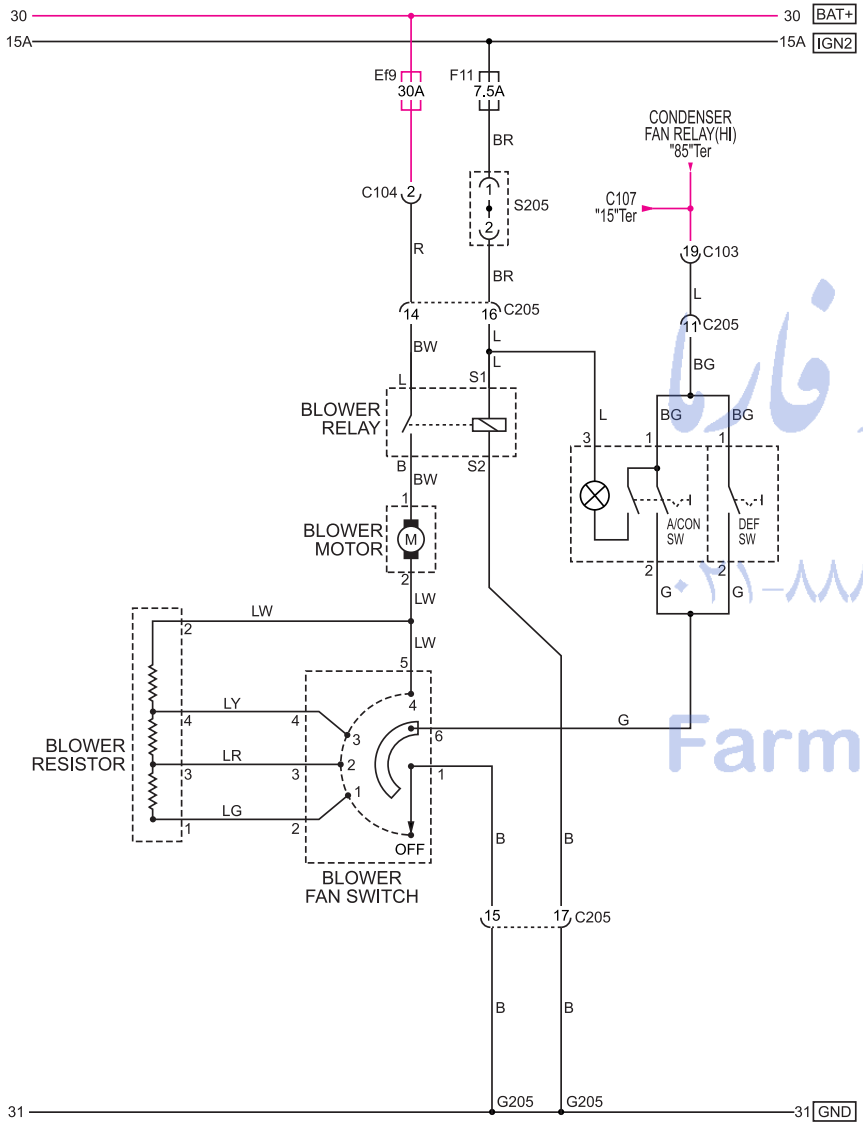
d. SPLICE PACK

S205 (COLORLESS)



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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2) BLOWER MOTOR CIRCUIT



a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C103 (22Pin,White)	Engine Room Fuse Box – W/H Main	Engine Room Fuse Box
C104 (8Pin,Colorless)	Engine Room Fuse Box – W/H Main	Engine Room Fuse Box
C205 (17Pin,White)	W/H Main – W/H Air Conditioner	Upper Evaporator
S205 (8Pin,Colorless)	W/H Main	Behind Front Right Kick Panel
G205	W/H Main	Center "A" Pillar Front Right

b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

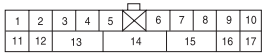

CONTROL PANNEL

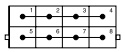

A/CON SW

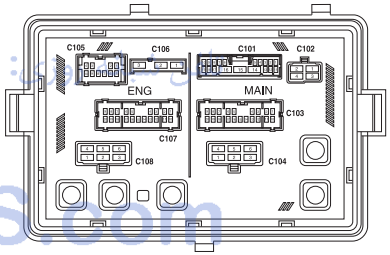

BLOWER MOTOR


BLOWER FAN SW


BLOWER RESISTOR


C205 (WHITE)

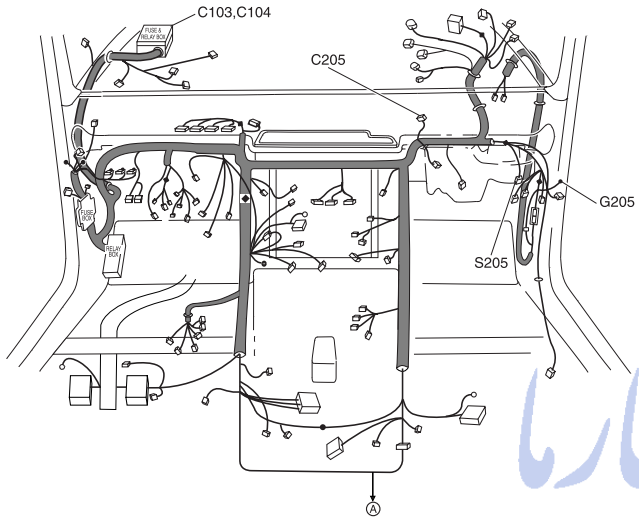

S205 (COLORLESS)



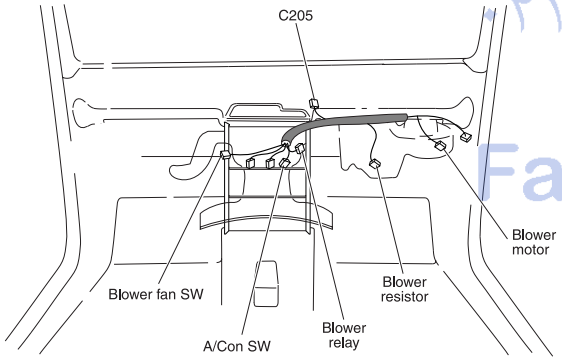
امداد خودرو فارما
۰۲۱-۸۸۴۶۲۰۸۵
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c. POSITION OF CONNECTORS AND GROUNDS

- W/H MAIN

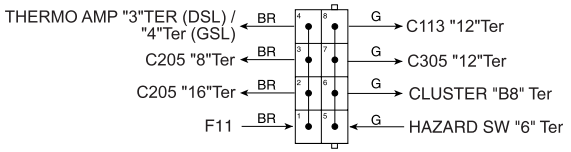


- W/H AIR-CONDITIONER



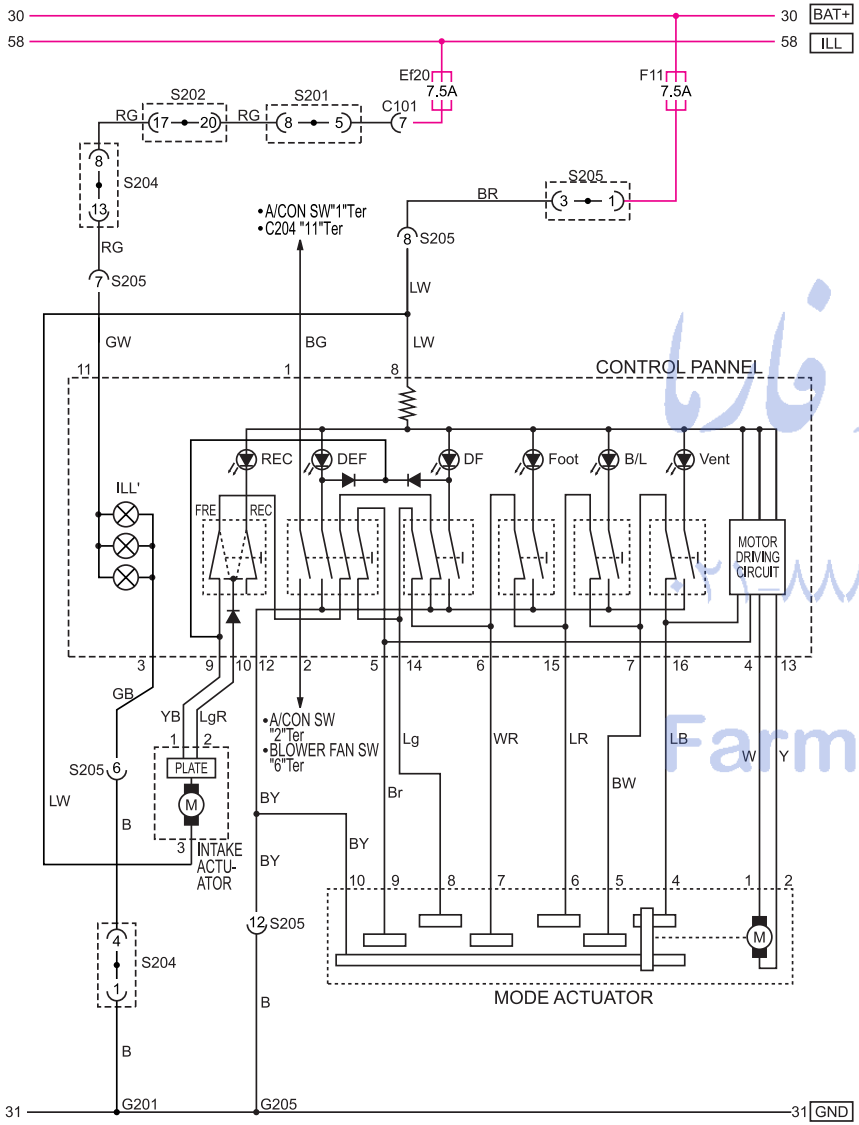
d. SPLICE PACK

S205 (COLORLESS)



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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3) CONTROL PANNEL, INTAKE ACTUATOR, MODE ACTUATOR



a. CONNECTOR INFORMATION

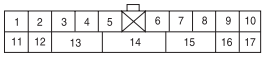
CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C101 (19Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C205 (17Pin,White)	W/H Main - W/H Air Conditioner	Upper Evaporator
S201 (8Pin,Colorless)	W/H Main	Upper Fuse Bos(Interior)
S202 (20Pin,Black)	W/H Main	Behind Cluster
S204 (14Pin,Colorless)	W/H Main	Behind Audio
S205 (8Pin,Colorless)	W/H Main	Behind Front Right Kick Panel
G201	W/H Main	Upper Front Left Leg Room
G205	W/H Main	Center "A" Pillar Front Right

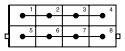
b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

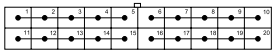

CONTROL PANNEL

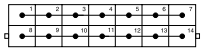

INTAKE ACTUATOR
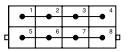

MODE ACTUATOR

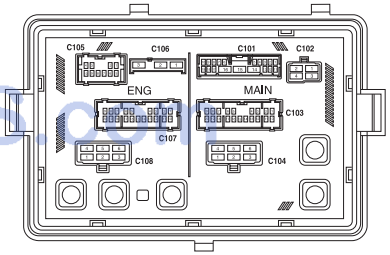

C205 (WHITE)


S201 (COLORLESS)


S202 (BLACK)


S204 (COLORLESS)

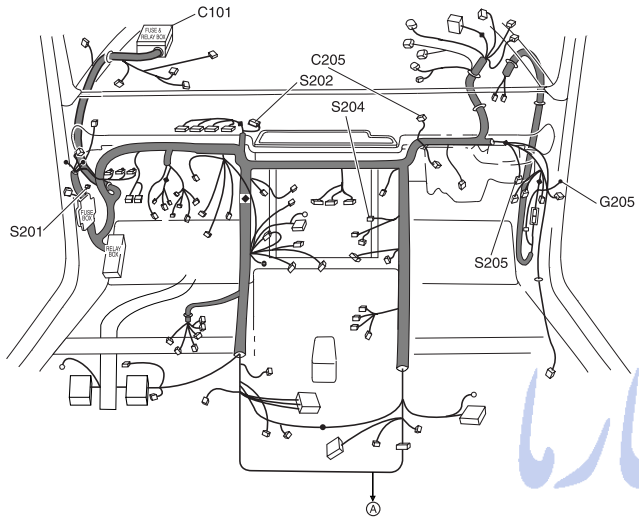

S205 (COLORLESS)



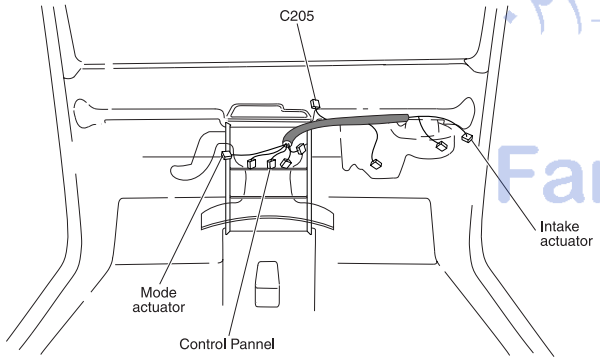
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c. POSITION OF CONNECTORS AND GROUNDS

- W/H MAIN

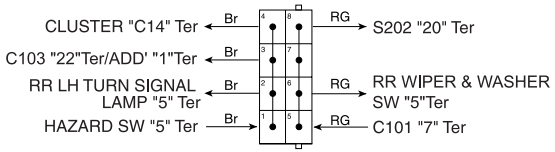


- W/H AIR-CONDITIONER

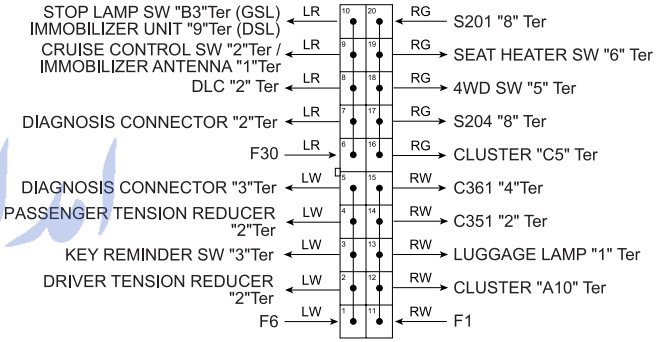


d. SPLICE PACK

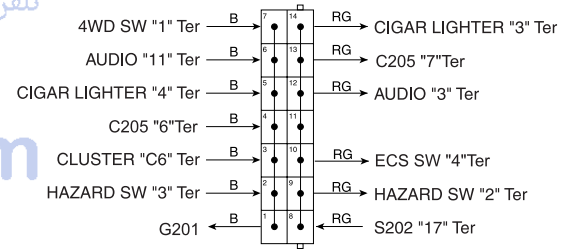
S201 (COLORLESS)



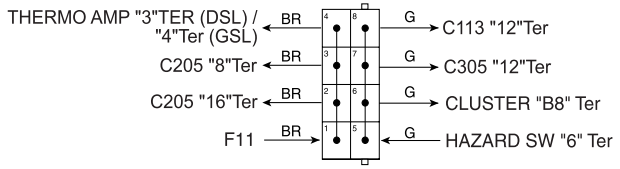
S202 (BLACK)



S204 (COLORLESS)

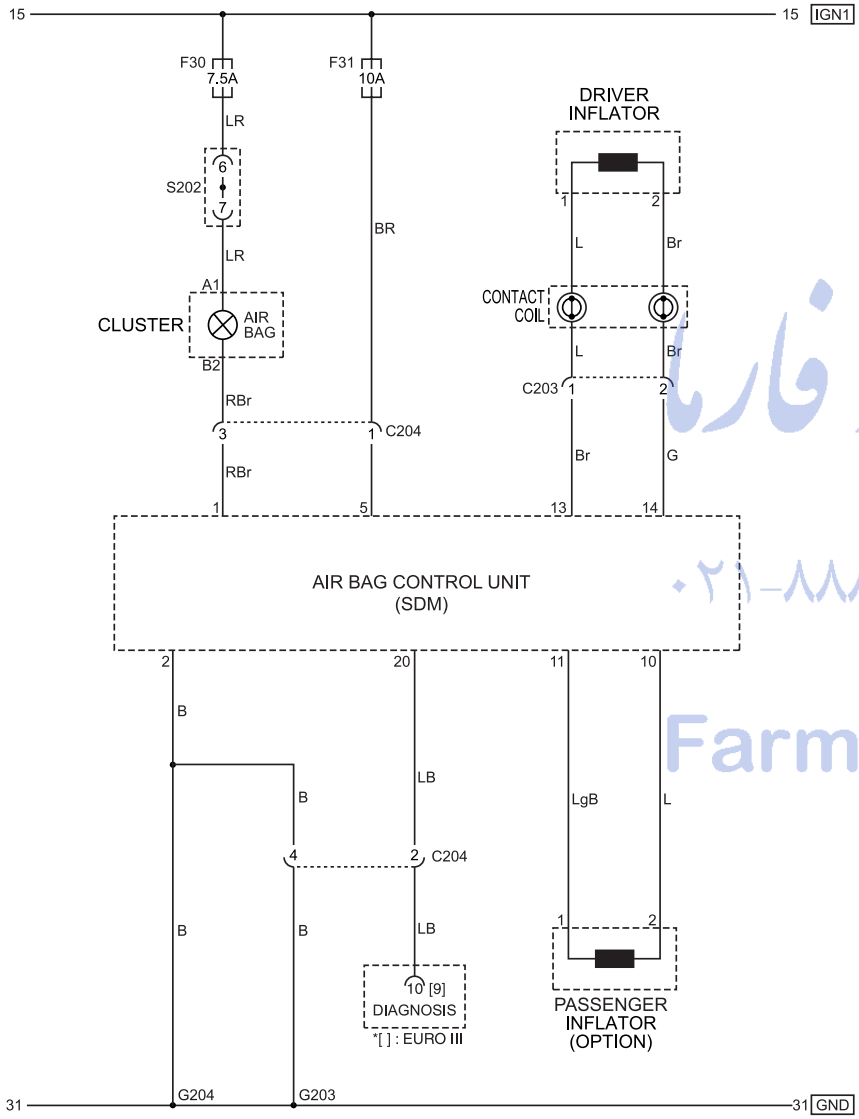


S205 (COLORLESS)



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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵

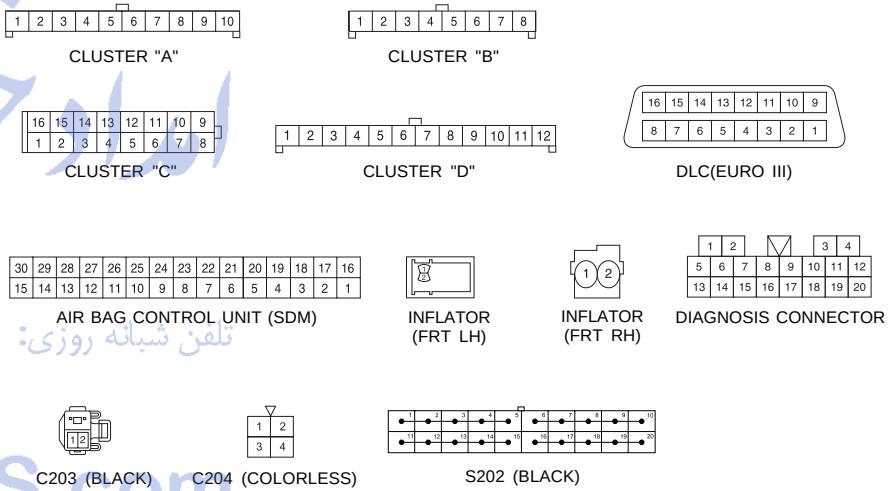
16. AIR BAG (SDM : SENSING & DIAGNOSIS MODULE)



a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C203 (2Pin, Black)	W/H Main - W/H Air Bag	Above Driver Seat Under Cover
C204 (4Pin, Colorless)	W/H Main - W/H SDM	Lower Rear Center Facia
S202 (20Pin,Black)	W/H Main	Behind Cluster
G203	W/H Main	Left Upper Center Facia
G204	W/H Main	Left Lower Center Facia

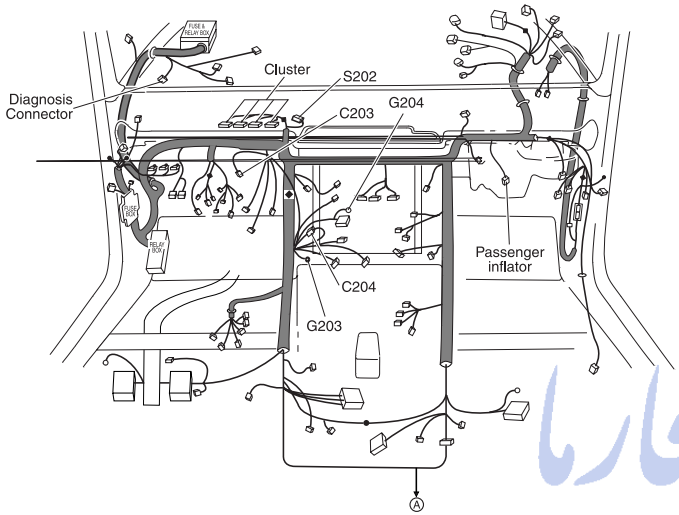
b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



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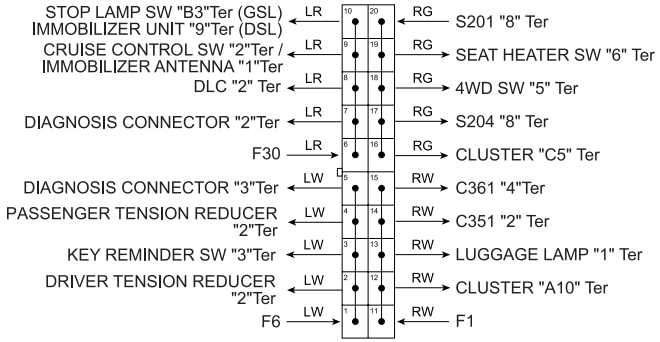
c. POSITION OF CONNECTORS AND GROUNDS

- W/H MAIN



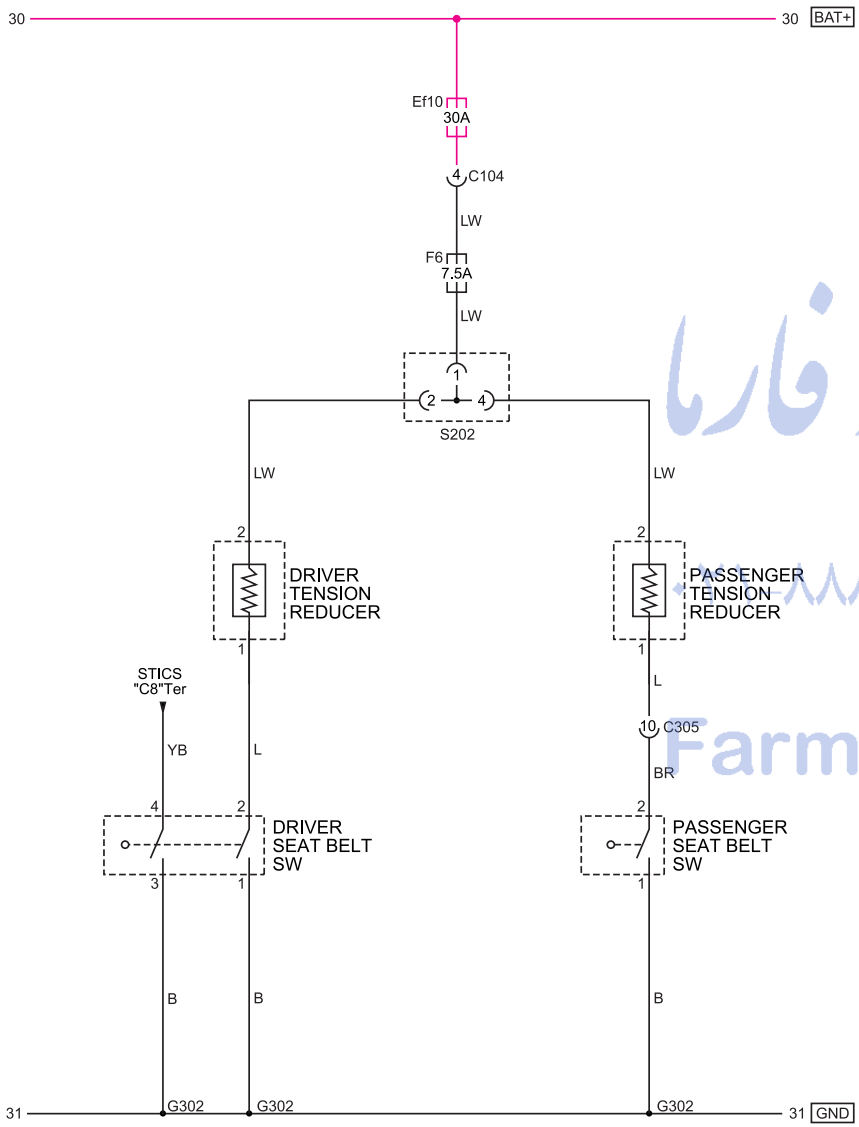
d. SPLICE PACK

S202 (BLACK)



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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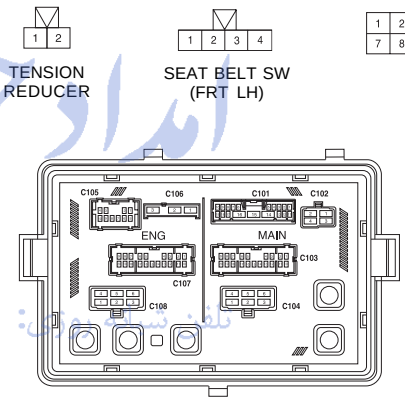
17. SEAT BELT & TENSION REDUCER



a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C104 (8Pin,Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C305 (14Pin,White)	W/H Main- W/H Main	Below Center Console
S202 (20Pin,Black)	W/H Main	Behind Cluster
G302	W/H Main	Below Center Console

b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



TENSION REDUCER

SEAT BELT SW (FRT LH)

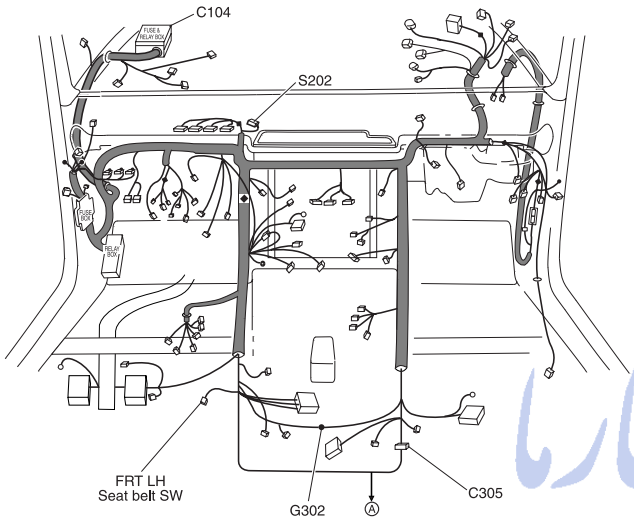
C305 (WHITE)

S202 (BLACK)

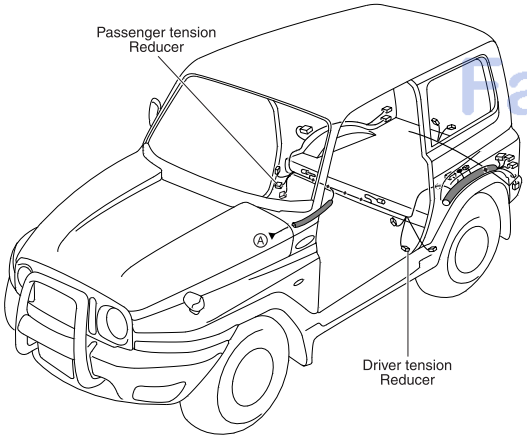
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تلفن: ۸۸۴۶۲۰۸۵
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c. POSITION OF CONNECTORS AND GROUNDS

- W/H MAIN

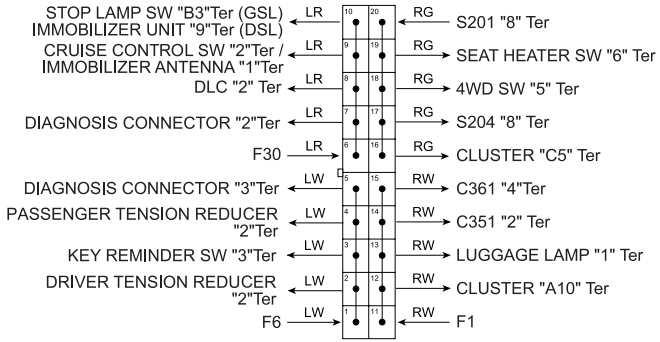


- W/H MAIN (FLOOR)



d. SPLICE PACK

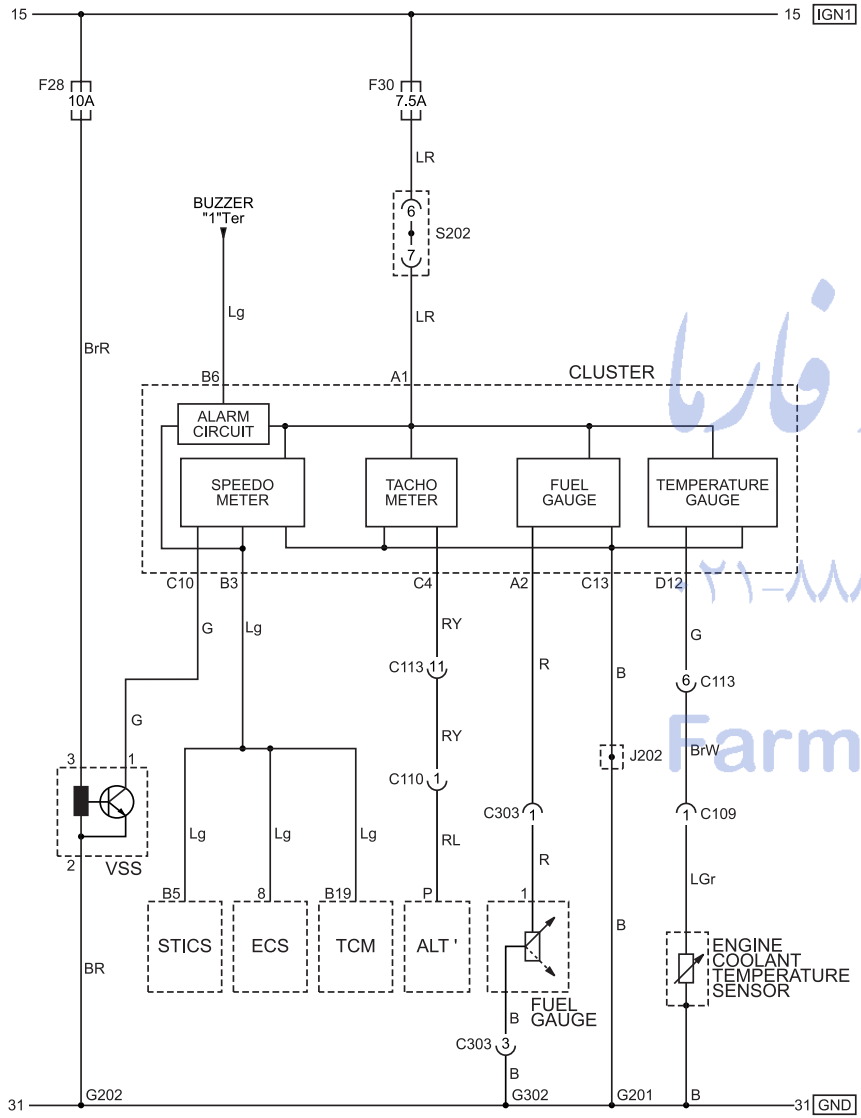
S202 (BLACK)



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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18. CLUSTER

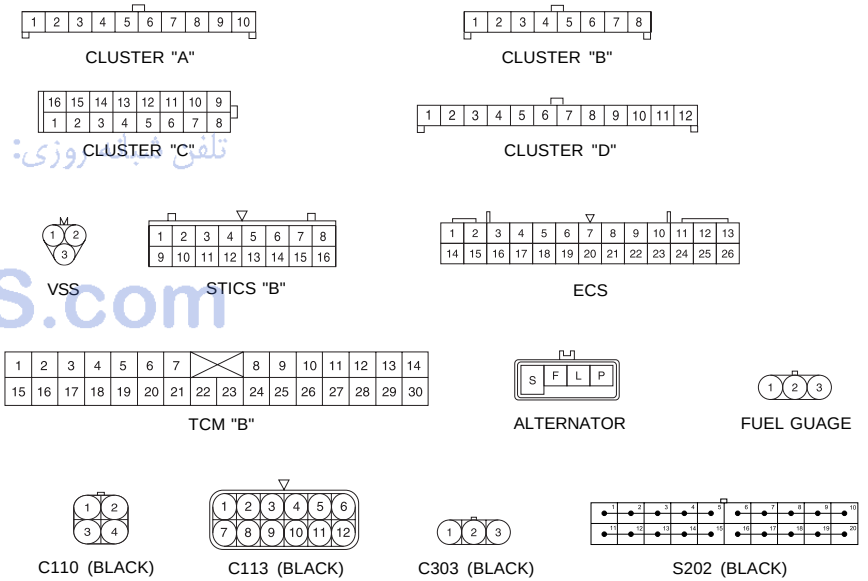
1) VSS(VEHICLE SPEED SENSOR), METER(SPEEDO, TACHO) & GAUGE(FUEL, TEMPERATURE) - DIESEL



a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING WIRING HARNESS	CONNECTOR POSITION
C109 (1Pin,Black)	Engine Room Fuse Box - W/H Pre Heating	Behind Battery
C110 (2Pin, Black)	W/H Engine Room - W/H Alternator	Below Air Cleaner
C110 (4Pin, Black)	W/H Engine Room - W/H Alternator	Below Air Cleaner
C113 (12Pin,Black)	W/H Engine Room - W/H Main	Next to Hydaulic Unit
C303 (3Pin, Black)	W/H Main - W/H Fuel Pump	Upper Transfer Case
S202 (20Pin,Black)	W/H Main	Behind Cluster
J202	W/H Main	Behind Cluster
G201	W/H Main	Upper Front Left Leg Room
G202	W/H Main	Upper Front Left Leg Room
G302	W/H Main	Below Center Console

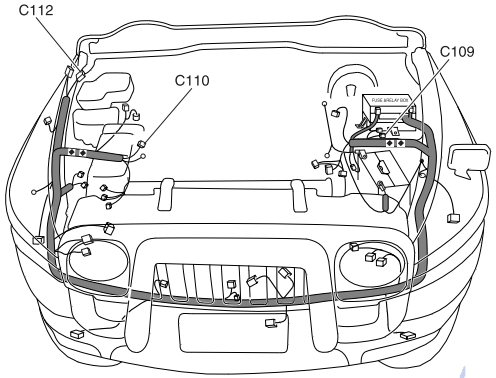
b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



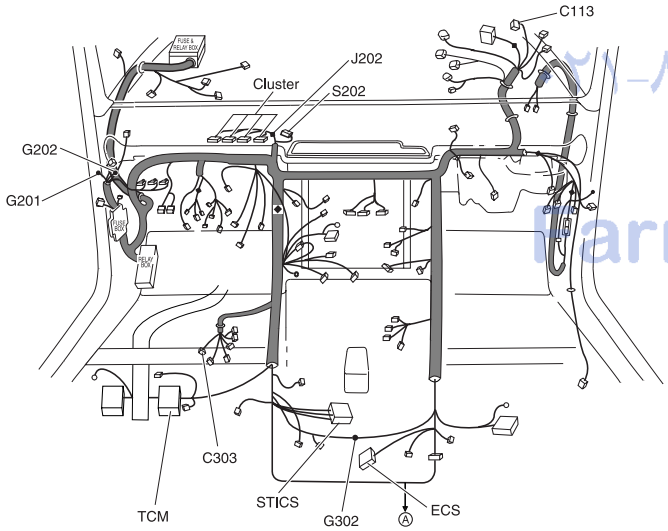
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c. POSITION OF CONNECTORS AND GROUNDS

- W/H ENGINE ROOM

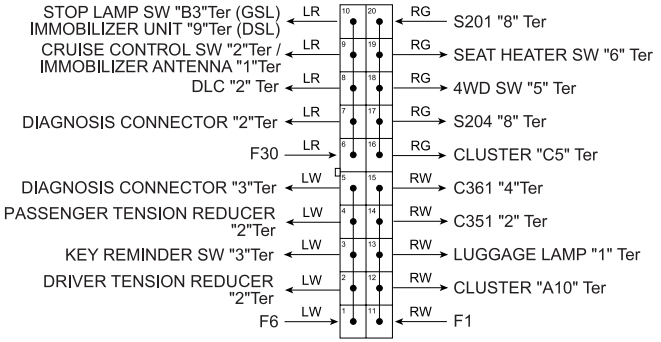


- W/H MAIN



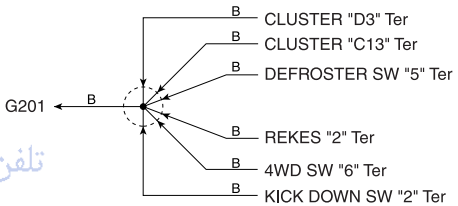
d. SPLICE PACK

S202 (BLACK)



e. JOINT

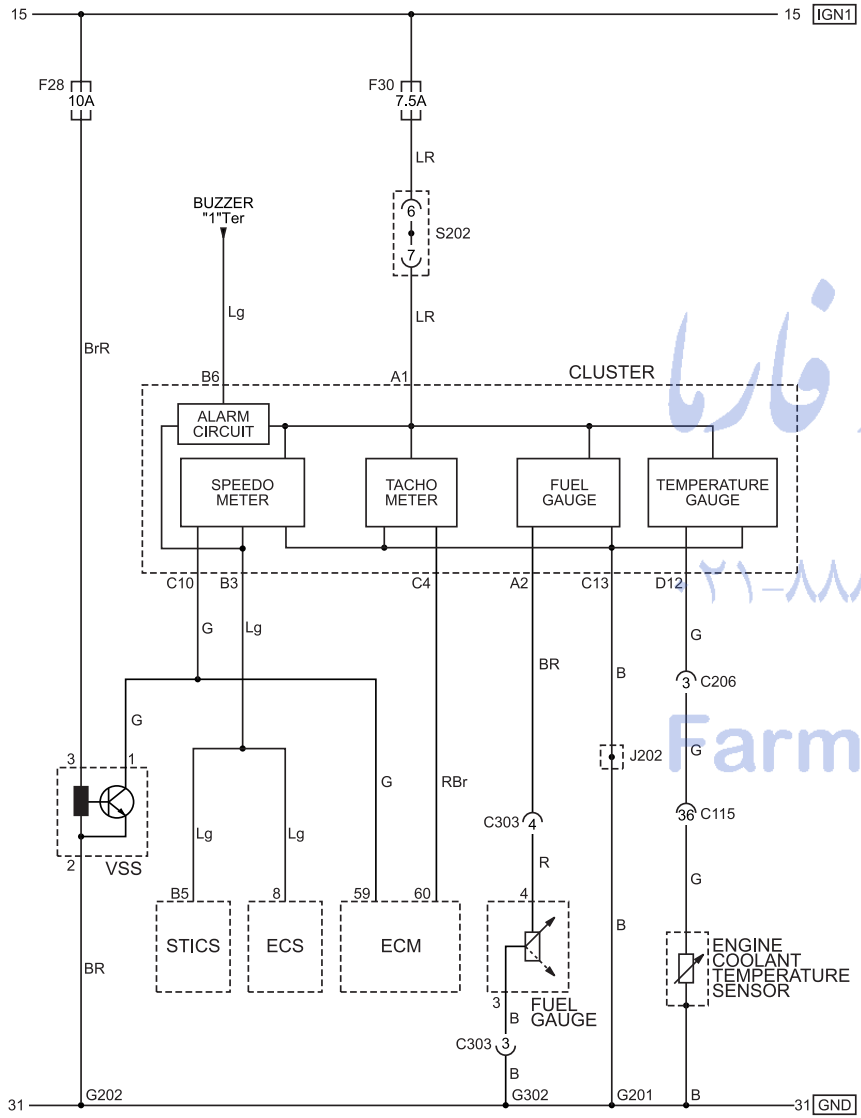
J202



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۶۲۰۸۵
FarmaSOS.com

1) VSS(VEHICLE SPEED SENSOR), METER(SPEEDO, TACHO) & GAUGE(FUEL, TEMPERATURE) - GASOLINE

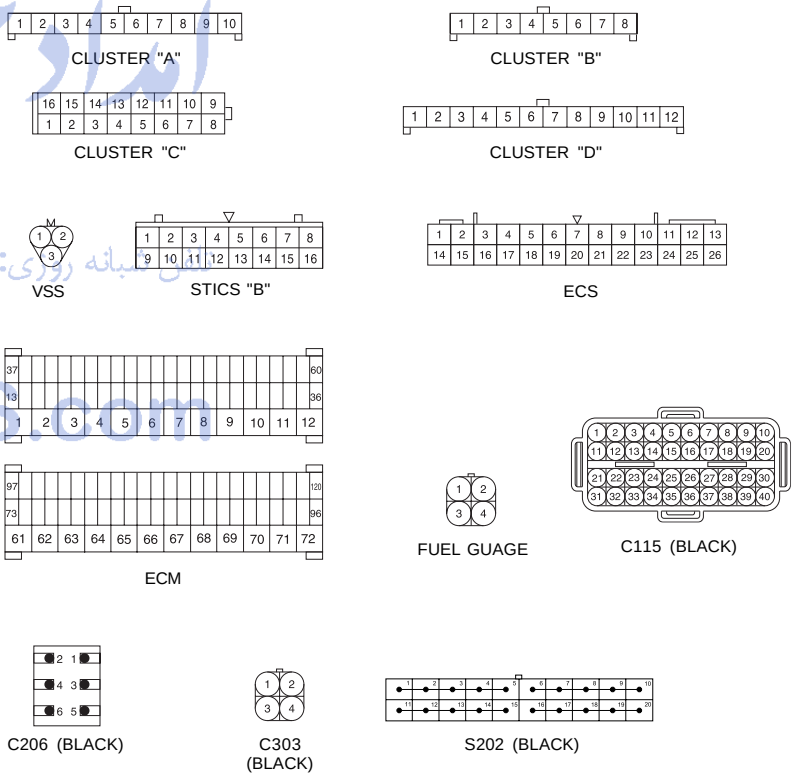
(1) W/O EURO III



a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION&MARK
C115 (2Pin, Black)	W/H Engine Control - W/H ECM Main	Behind Hydraulic Unit
C206 (4Pin, Black)	W/H Main - W/H ECM Main	Lower "A" Piller (Upper ECM)
C303 (4Pin, Black)	W/H Main - W/H Fuel Pump	Upper Transfer Case
S202 (20Pin,Black)	W/H Main	Behind Cluster
J202	W/H Main	Behind Cluster
G201	W/H Main	Upper Front Left Leg Room
G202	W/H Main	Upper Front Left Leg Room
G302	W/H Main	Below Center Console

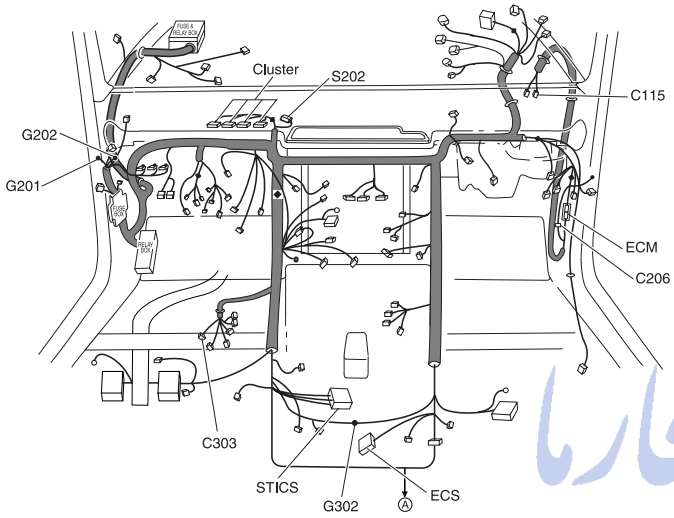
b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



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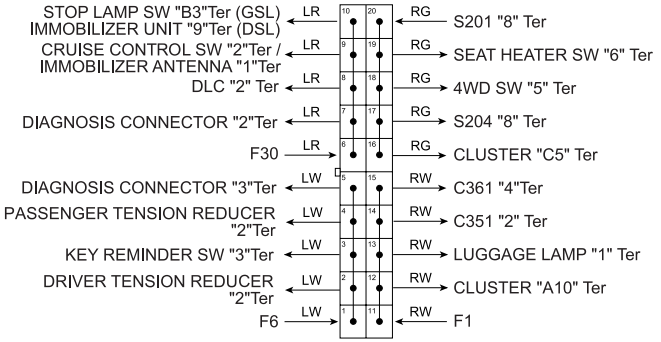
c. POSITION OF CONNECTORS AND GROUNDS

- W/H MAIN



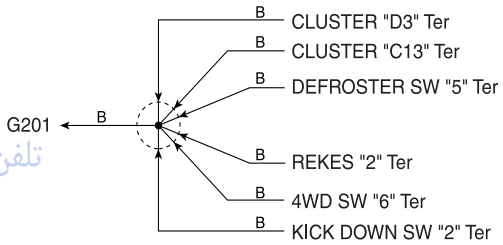
d. SPLICE PACK

S202 (BLACK)



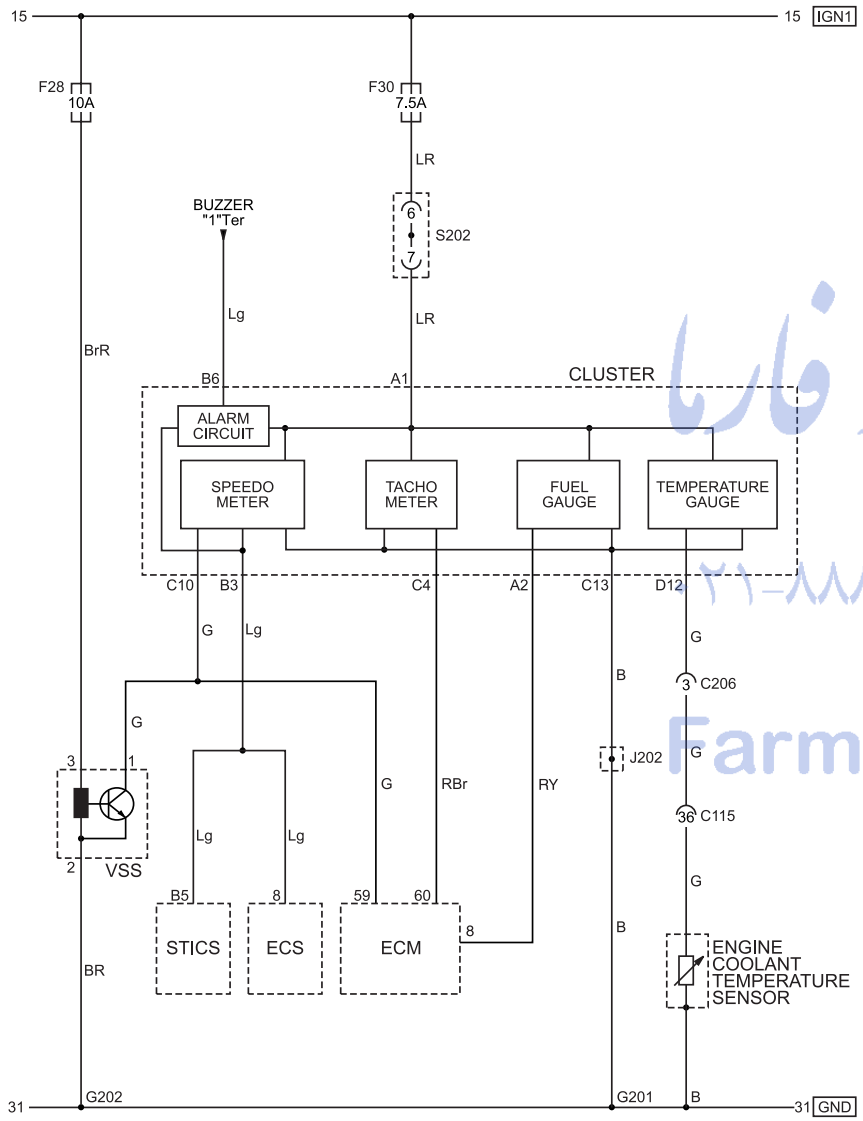
e. JOINT

J202



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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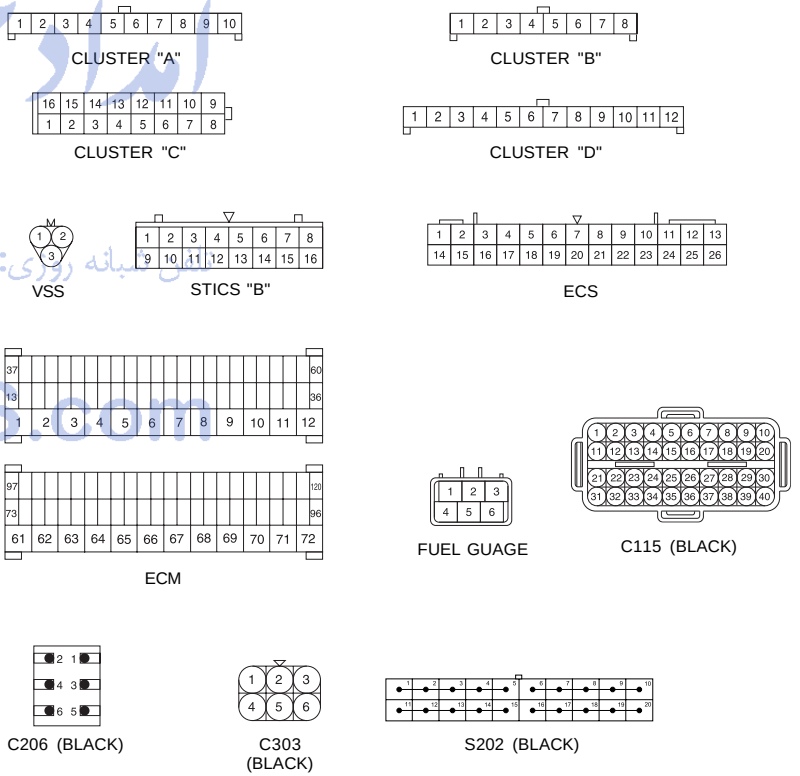
(2) W/ EURO III



a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION&MARK
C115 (2Pin, Black)	W/H Engine Control - W/H ECM Main	Behind Hydraulic Unit
C206 (4Pin, Black)	W/H Main - W/H ECM Main	Lower "A" Piller (Upper ECM)
C303 (6Pin, Black)	W/H Main - W/H Fuel Pump	Upper Transfer Case
S202 (20Pin,Black)	W/H Main	Behind Cluster
J202	W/H Main	Behind Cluster
G201	W/H Main	Upper Front Left Leg Room
G202	W/H Main	Upper Front Left Leg Room
G302	W/H Main	Below Center Console

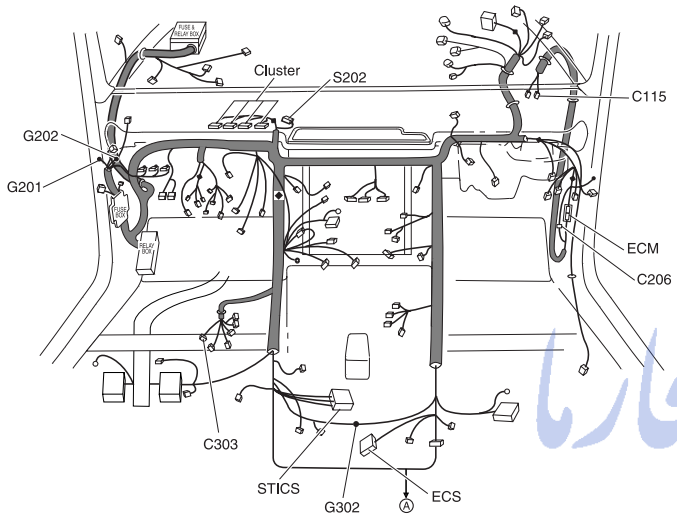
b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



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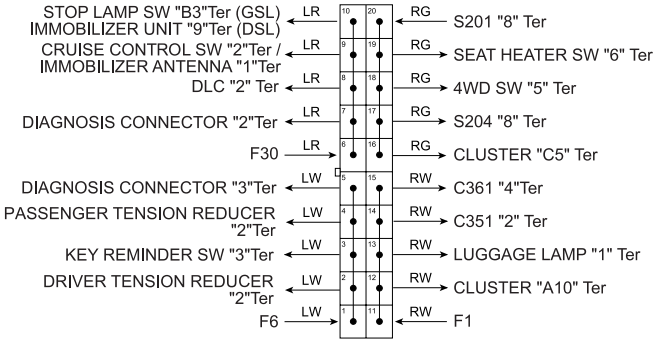
c. POSITION OF CONNECTORS AND GROUNDS

- W/H MAIN



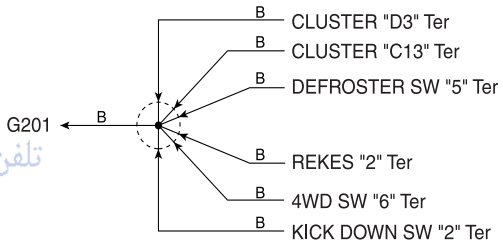
d. SPLICE PACK

S202 (BLACK)



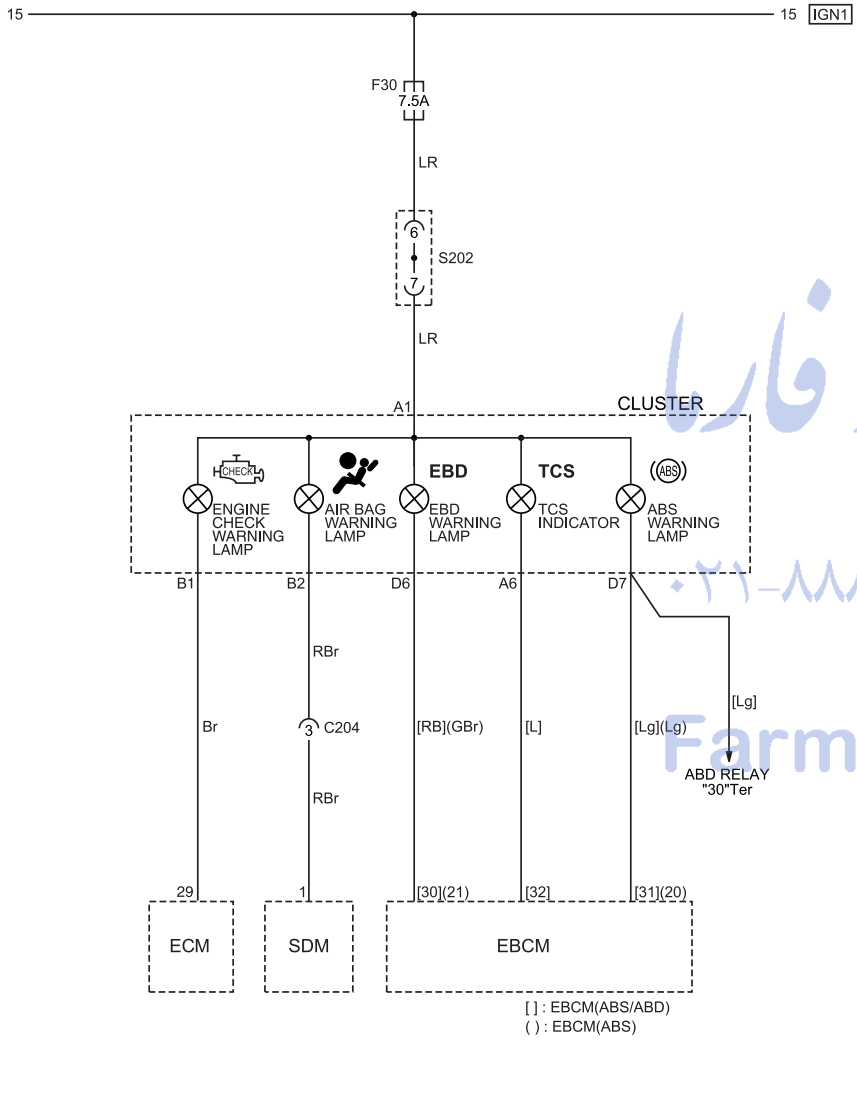
e. JOINT

J202



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
FarmaSOS.com

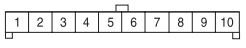
2) WARNING LAMP(ENGINE CHECK, AIR BAG, EBD, ABS), TCS INDICATOR



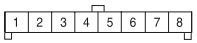
a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C204 (4Pin, Colorless)	W/H Main - W/H SDM	Lower Rear Center Facia
S202 (20Pin,Black)	W/H Main	Behind Cluster

b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



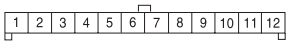
CLUSTER "A"



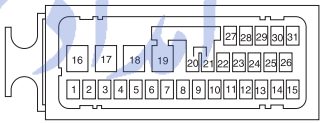
CLUSTER "B"

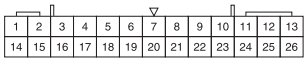


CLUSTER "C"



CLUSTER "D"


EBCM (ABS)

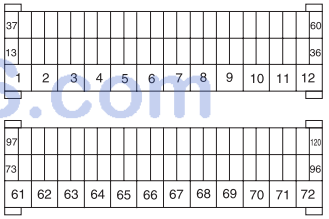


ECS



AIR BAG CONTROL UNIT (SDM)

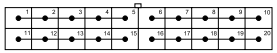

EBCM (ABS/ABD)



ECM



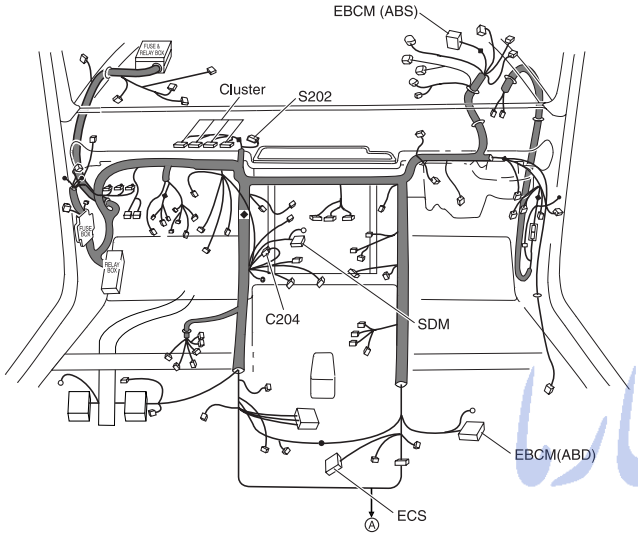
C204 (COLORLESS)


S202 (BLACK)

FarmaSOS.com
۰۲۱-۸۸۴۶۲۰۸۵

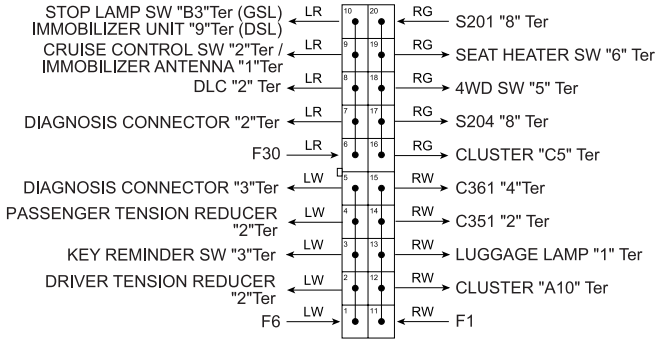
c. POSITION OF CONNECTORS AND GROUNDS

- W/H MAIN



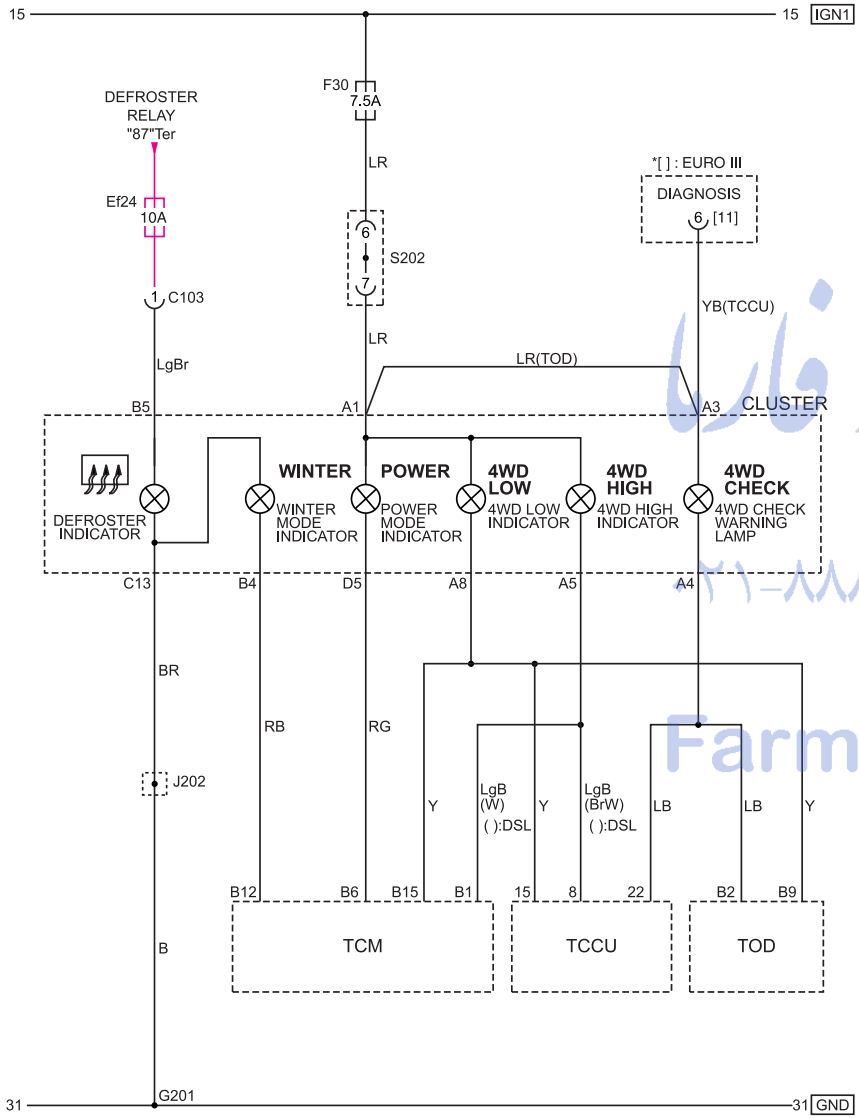
d. SPLICE PACK

S202 (BLACK)



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
FarmaSOS.com

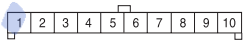
3) INDICATOR (DEFROSTER, WINTER MODE, POWER MODE, 4WD LOW, 4WD HIGH, 4WD CHECK)



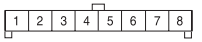
a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C103 (4Pin, Black)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
S202 (20Pin,Black)	W/H Main	Behind Cluster
J202	W/H Main	
G201	W/H Main	Upper Front Left Leg Room

b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



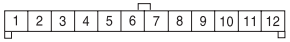
CLUSTER "A"



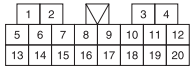
CLUSTER "B"



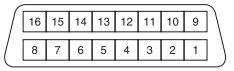
CLUSTER "C"



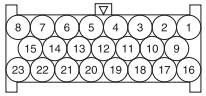
CLUSTER "D"



DIAGNOSIS CONNECTOR



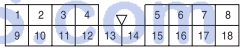
DLC(EURO III)



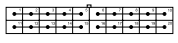
TCCU

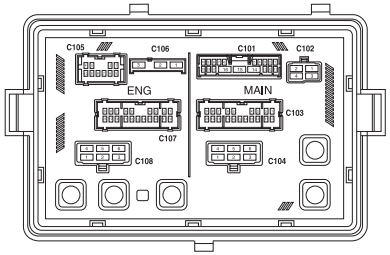


TCM "B"



TOD "B"

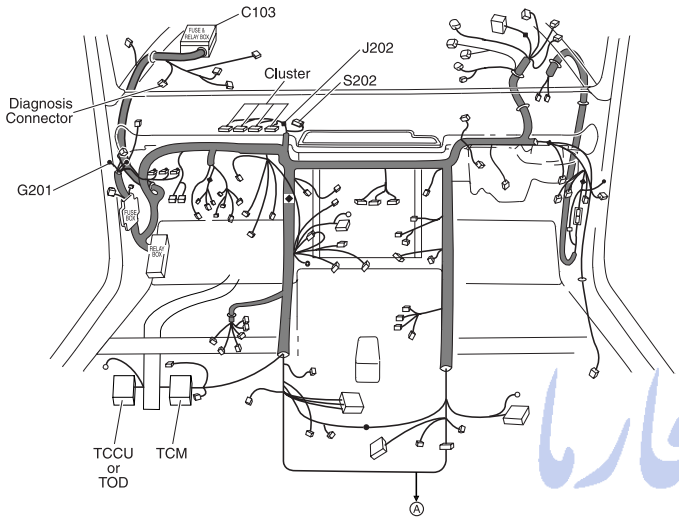

S202 (BLACK)



امداد خودرو فارس
۰۷۱-۸۸۴۶۲۰۸۵
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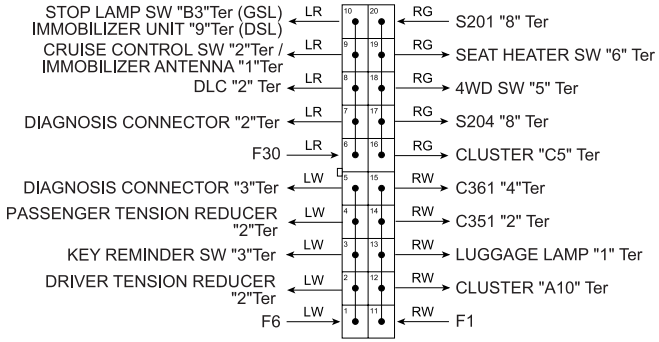
c. POSITION OF CONNECTORS AND GROUNDS

- W/H MAIN



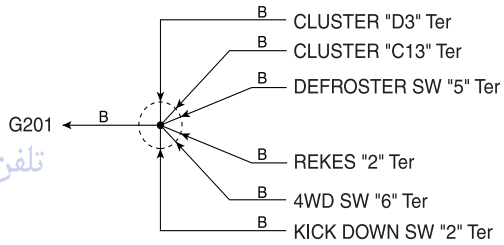
d. SPLICE PACK

S202 (BLACK)



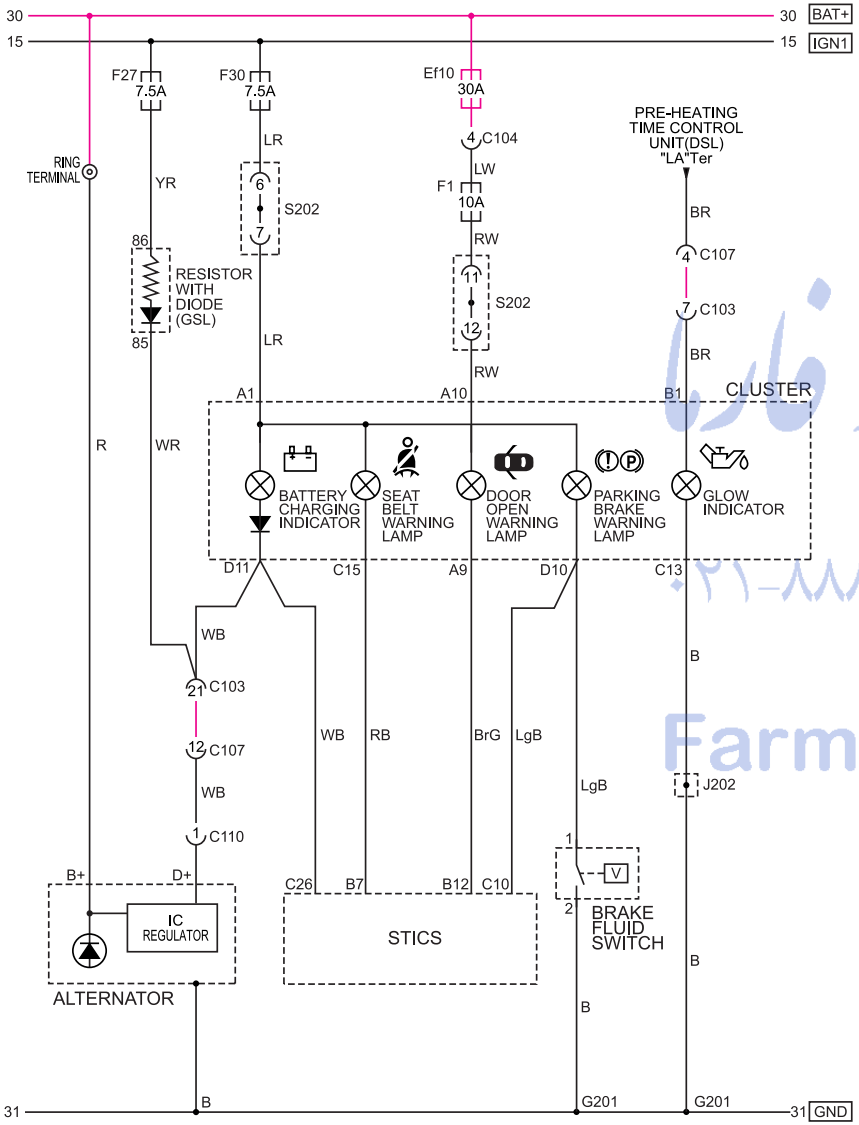
e. JOINT

J202



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
FarmaSOS.com

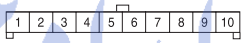
4) WARNING LAMP (SEAT BELT, DOOR OPEN, PARKING BRAKE), INDICATOR (BATTERY CHARGING, GLOW)



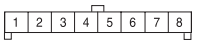
a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING WIRING HARNESS	CONNECTOR POSITION
C103 (22Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C104 (8Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C107 (20Pin, White)	Engine Room Fuse Box - W/H Engine Room	Engine Room Fuse Box
C110 (2Pin, Black)	W/H Engine Room - W/H Alternator	Below Air Cleaner
C110 (4Pin, Black)	W/H Engine Room - W/H Alternator	Below Air Cleaner
S202 (20Pin,Black)	W/H Main	Behind Cluster
J202	W/H Main	Upper Front Left Leg Room
G201	W/H Main	Upper Front Left Leg Room

B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



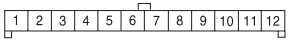
CLUSTER "A"



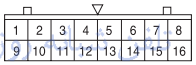
CLUSTER "B"



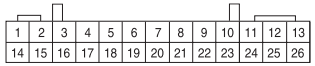
CLUSTER "C"



CLUSTER "D"



STICS "B"



STICS "C"



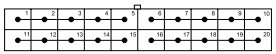
BRAKE FLUID SW

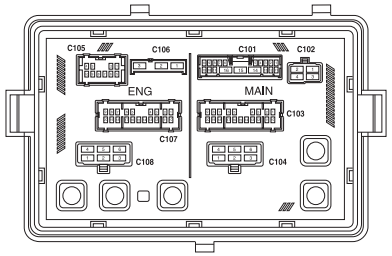


C110 (BLACK)



C110 (BLACK)

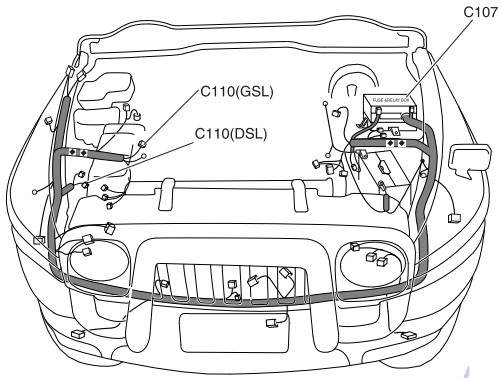

S202 (BLACK)



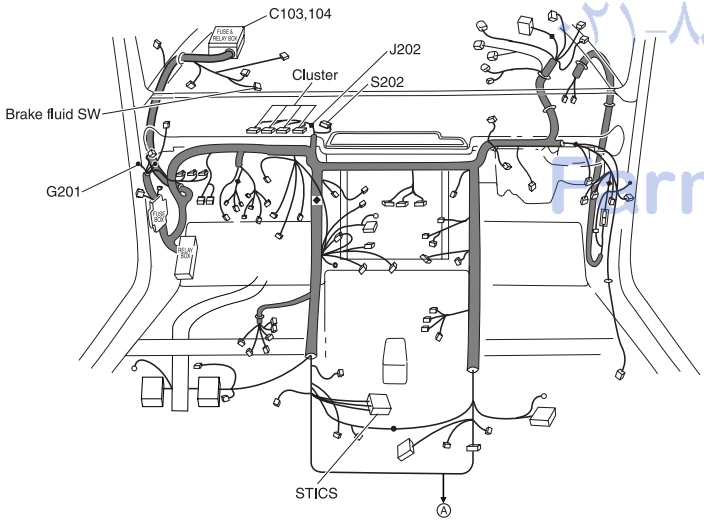
امداد خودرو فارما
تلفن: ۰۲۱-۸۸۴۶۲۰۸۵
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c. POSITION OF CONNECTORS AND GROUNDS

- W/H ENGINE ROOM

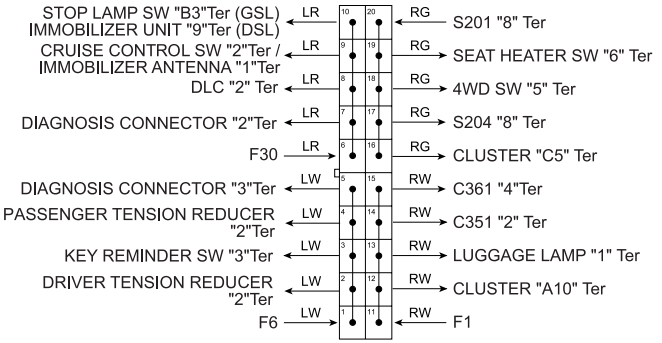


- W/H MAIN



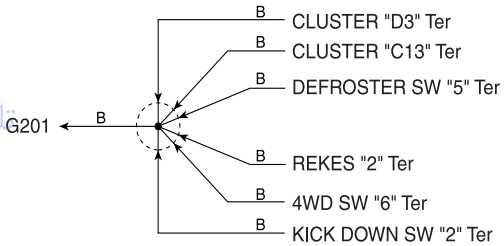
d. SPLICE PACK

S202 (BLACK)



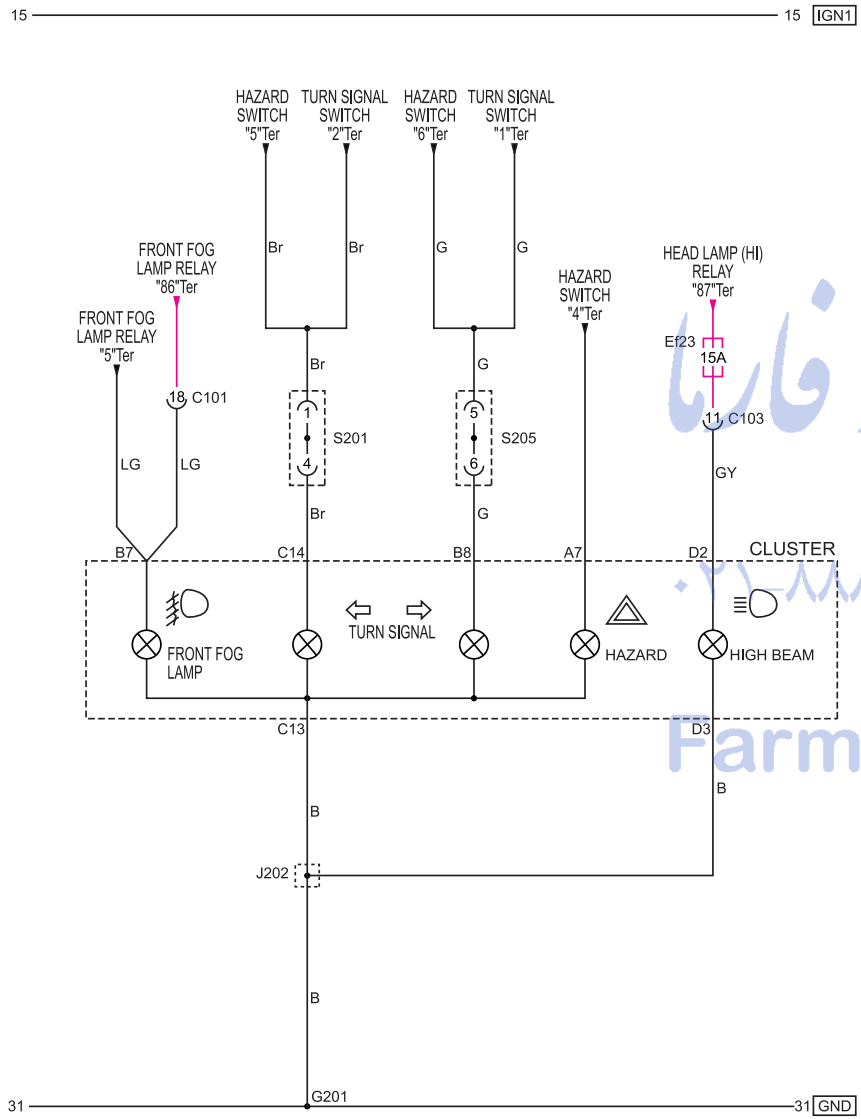
e. JOINT

J202



امداد خودرو فارما
تلفن شبانه روزی: ۸۸۸۶۲۰۸۵-۰۲۱
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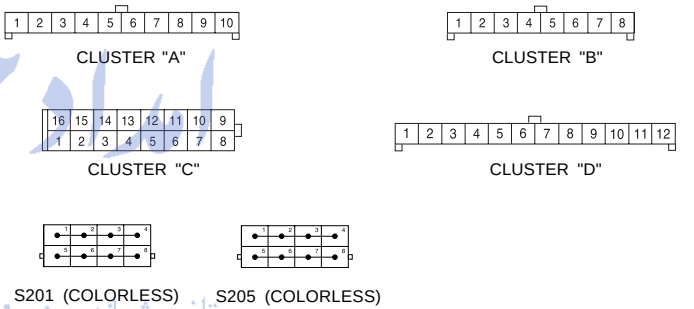
5) FRONT FOG LAMP, TURN SIGNAL, HAZARD, HIGH BEAM



a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING WIRING HARNESS	CONNECTOR POSITION
C101 (19Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C103 (22Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
S201 (8Pin,Colorless)	W/H Main	Upper Fuse Box (Passenger Room)
S205 (8Pin,Colorless)	W/H Main	Behind Front Right Kick Panel
J202	W/H Main	Upper Front Left Leg Room
G201	W/H Main	Upper Front Left Leg Room

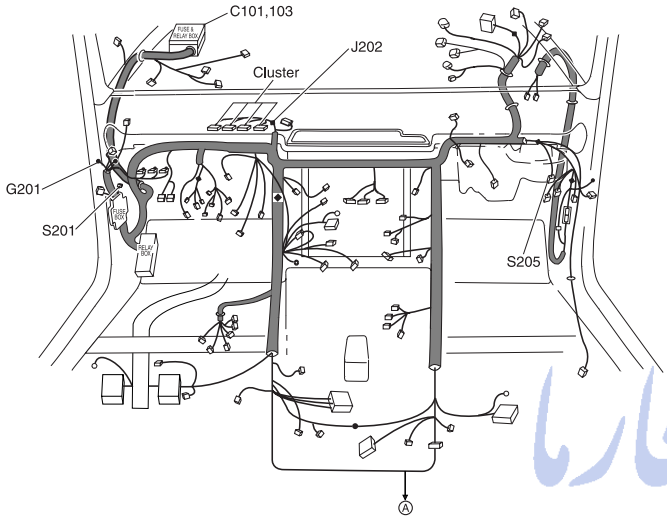
b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



ایران خودرو فارما
۰۲۱-۸۸۸۶۲۰۸۵ تلفن شبانه روزی
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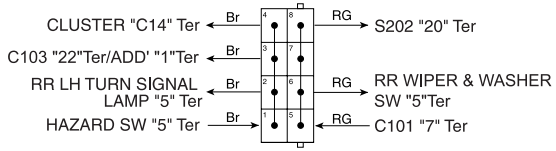
c. POSITION OF CONNECTORS AND GROUNDS

- W/H MAIN

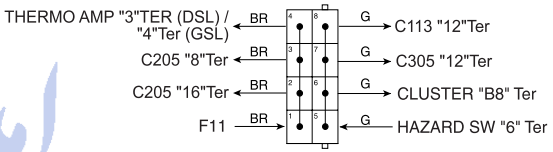


d. SPLICE PACK

S201 (COLORLESS)

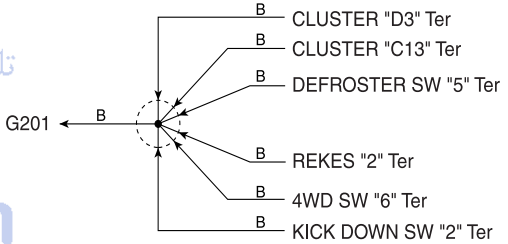


S205 (COLORLESS)



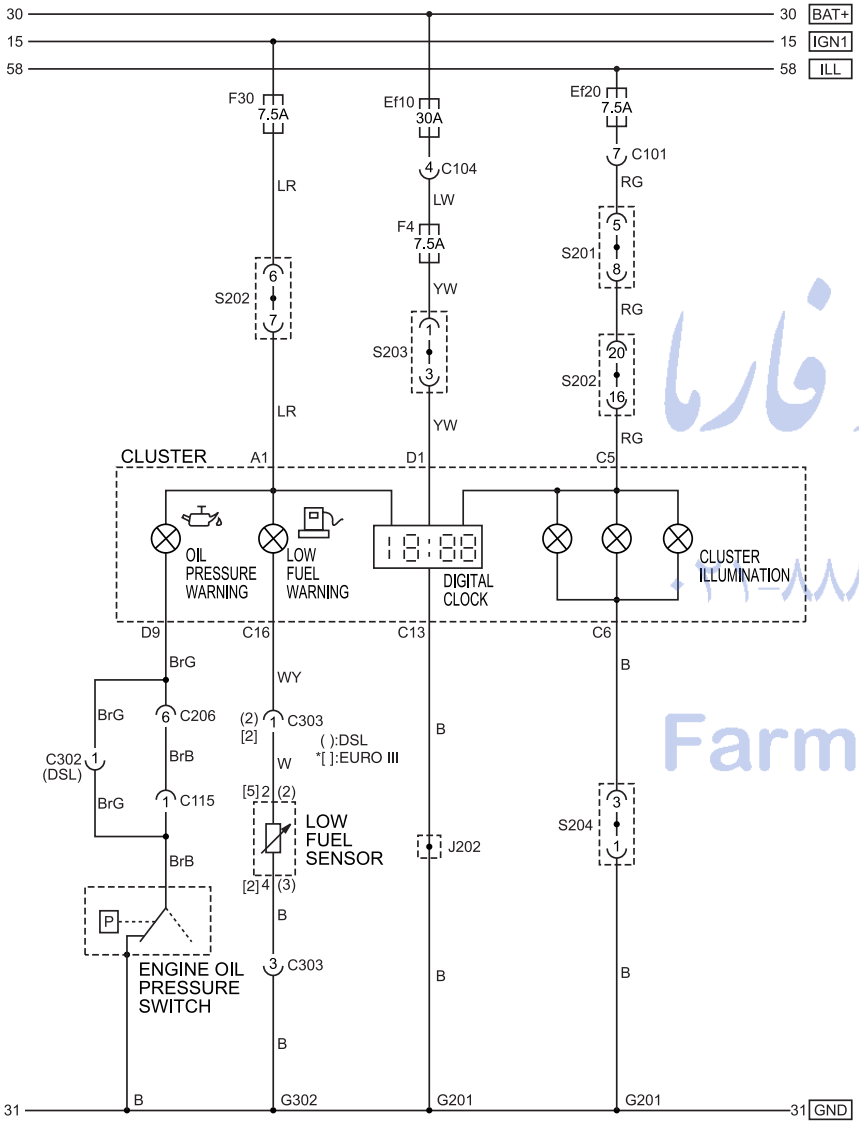
e. JOINT

J202



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
FarmaSOS.com

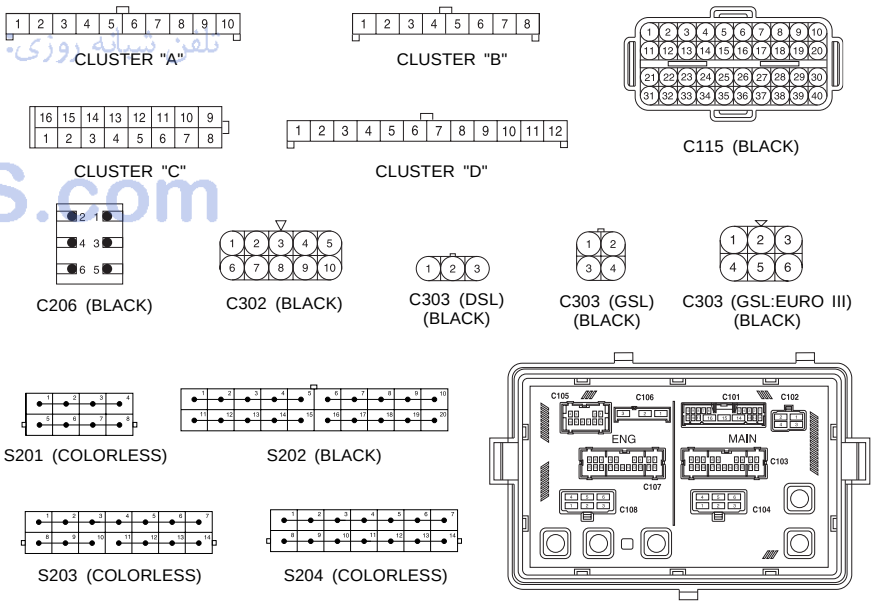
6) DIGITAL CLOCK, WARNING (OIL PRESSURE, LOW FUEL LEVEL) CLUSTER ILLUMINATION



a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C101 (19Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C104 (8Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C115 (40Pin, Black)	W/H Engine Control - W/H ECM Main	Behind Hydraulic Unit
C206 (6Pin, Black)	W/H Engine Control - W/H ECM Main	Lower "A" Piller (Upper ECM)
C302 (10Pin, Black)	W/H Main - W/H Transmission	Below Center Console
C303 (3Pin, Black)	W/H Main - W/H Fuel Pump	Below Center Console
C303 (4Pin, Black)	W/H Main - W/H Fuel Pump	Below Center Console
C303 (6Pin, Black)	W/H Main - W/H Fuel Pump	Below Center Console
S201 (8Pin, Colorless)	W/H Main	Upper Fuse Box (Passenger Room)
S202 (20Pin, Black)	W/H Main	Behind Cluster
S203 (14Pin, Colorless)	W/H Main	Behind 4WD Switch
S204 (14Pin, Colorless)	W/H Main	Behind Audio
J202	W/H Main	Behind Cluster
G201	W/H Main	Upper Front Left Leg Room
G302	W/H Main	Below Center Console

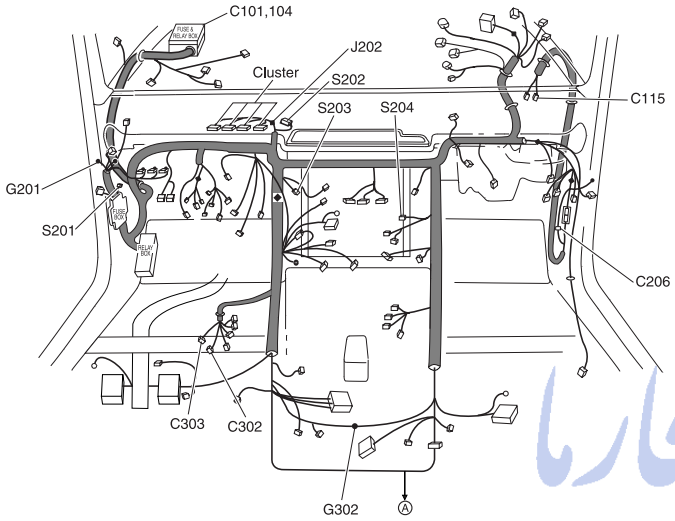
b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



امداد خودرو فارما
تلفن شبانه روزی ۰۲۱-۸۸۸۶۲۰۸۵
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c. POSITION OF CONNECTORS AND GROUNDS

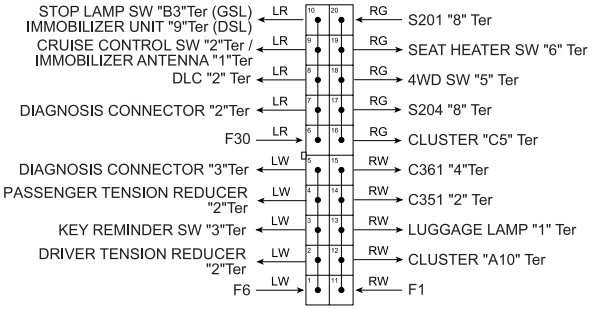
- W/H MAIN



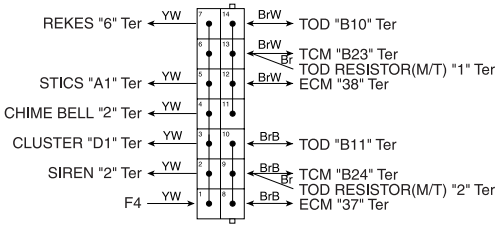
d. SPLICE PACK

S201 (CORORLESS)

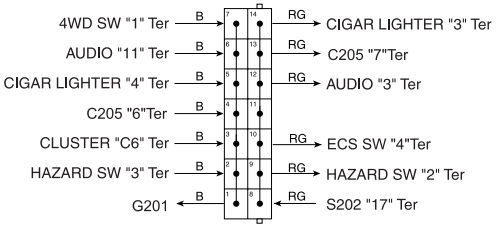
S202 (BLACK)



S203 (CORORLESS)

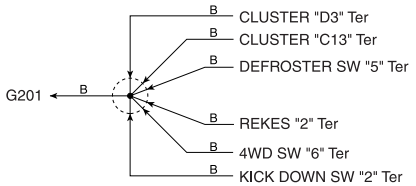


S204 (CORORLESS)



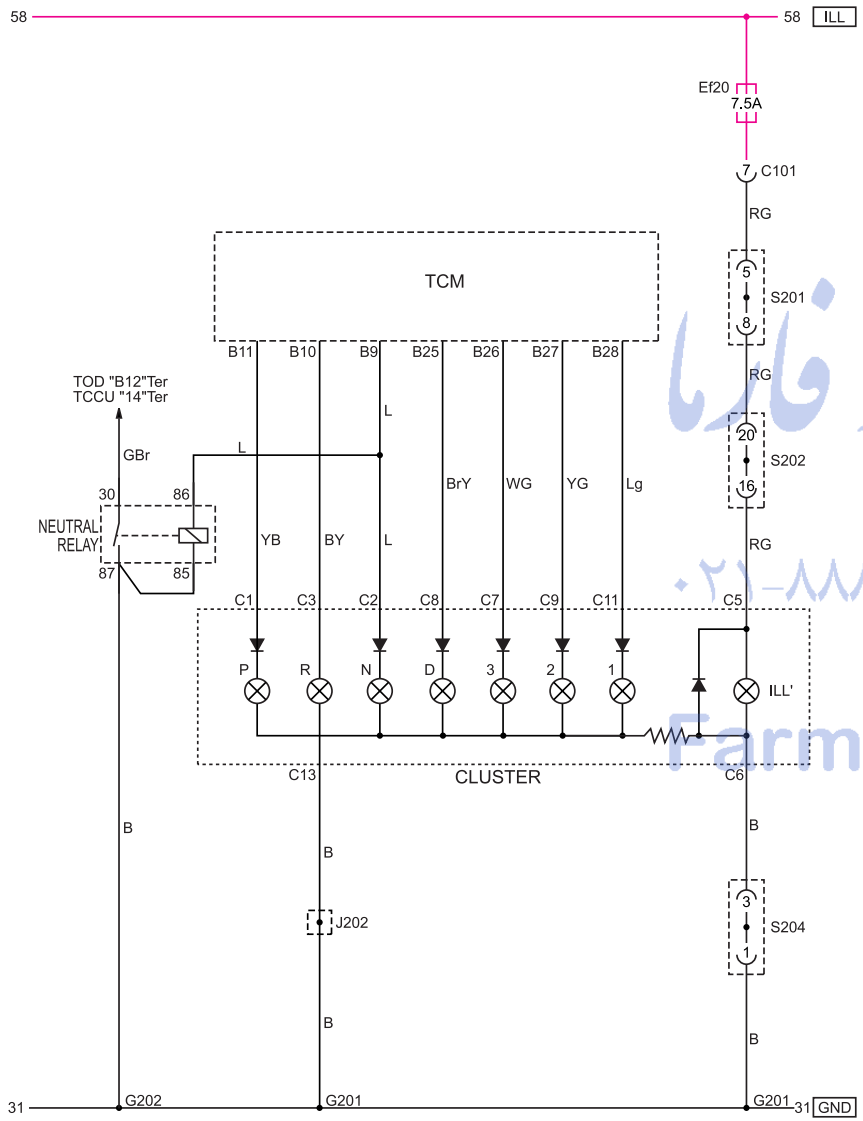
e. JOINT

J202



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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7) SELECTOR LEVER POSITION LAMP (P, R, N, D, 3, 2, 1)



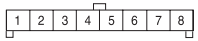
a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C101 (19Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
S201 (8Pin, Colorless)	W/H Main	Upper Fuse Box(Passenger Room)
S202 (20Pin, Black)	W/H Main	Behind Cluster
S204 (14Pin, Colorless)	W/H Main	Behind Audio
J202	W/H Main	Behind Cluster
G201	W/H Main	Upper Front Left Leg Room
G302	W/H Main	Below Center Console

b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



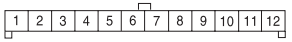
CLUSTER "A"



CLUSTER "B"



CLUSTER "C"



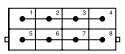
CLUSTER "D"

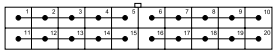


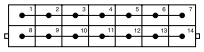
TCM "A"

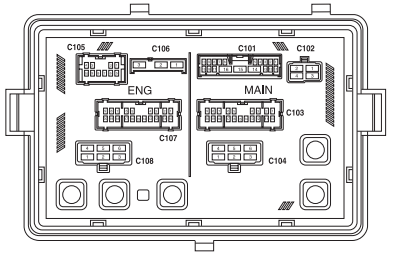


TCM "B"


S201 (COLORLESS)


S202 (BLACK)

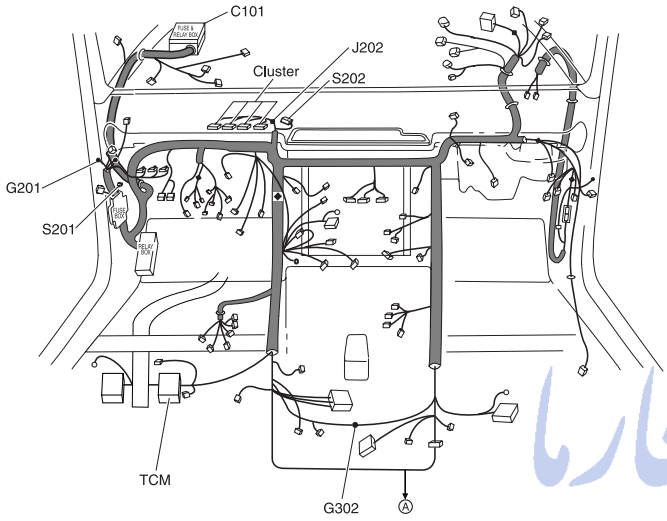

S204 (COLORLESS)



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۰۲۱-۸۸۴۶۲۰۸۵ تلفن شبانه روزی
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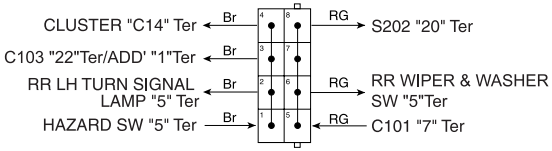
c. POSITION OF CONNECTORS AND GROUNDS

- W/H MAIN

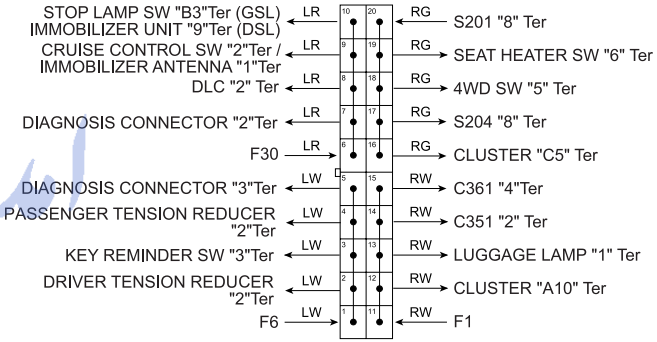


d. SPLICE PACK

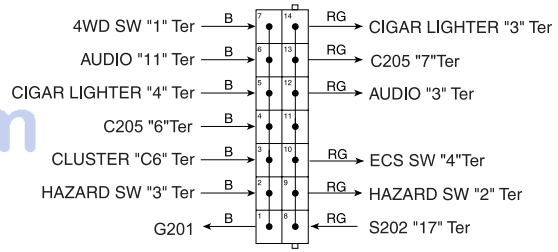
S201 (COLORLESS)



S202 (BLACK)

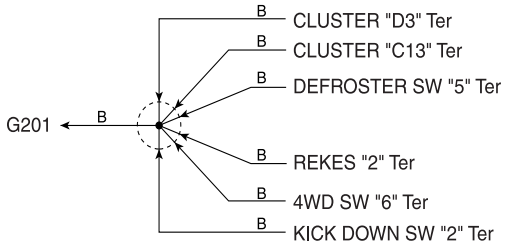


S204 (COLORLESS)



e. JOINT

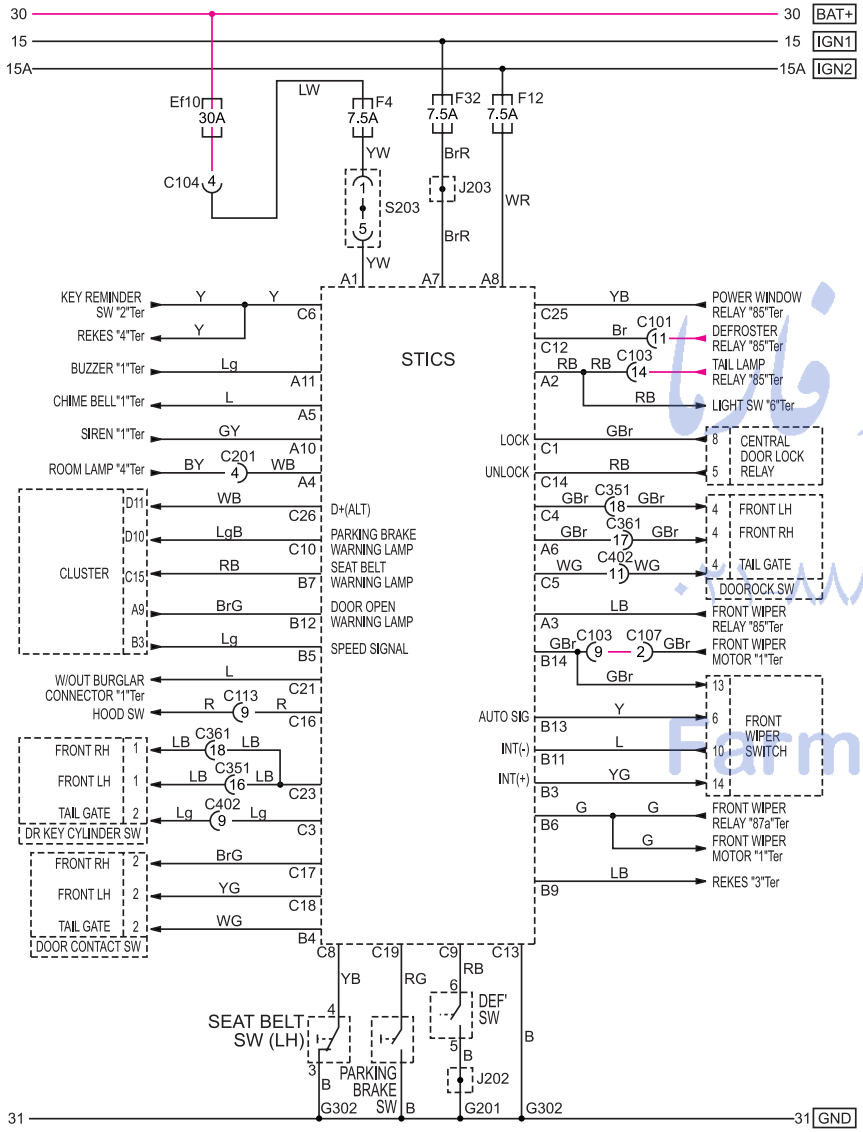
J202



ایراد خودرو فارما
۰۲۱-۸۸۸۶۲۰۸۵
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19. STICS (SUPER TIME & ALARM INTEGRATED CONTROL SYSTEM)

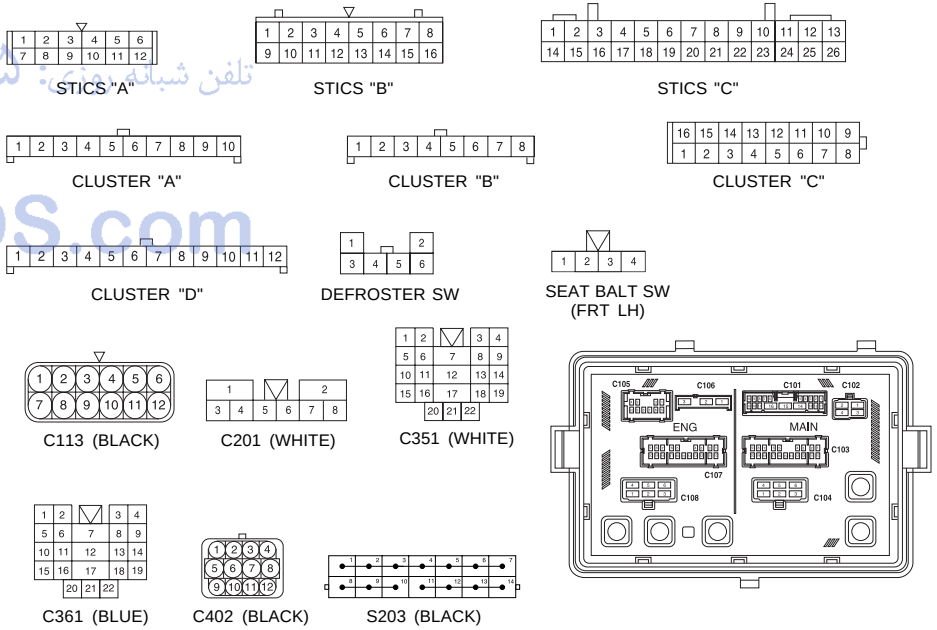
1) STICS UNIT



a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING WIRING HARNESS	CONNECTOR POSITION
C101 (19Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C103 (22Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C104 (8Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C107 (20Pin, White)	Engine Room Fuse Box - W/H Engine Room	Engine Room Fuse Box
C113 (12Pin, Black)	W/H Engine Room - W/H Main	Next to Hydraulic Unit
C201 (8Pin, White)	W/H Main - W/H Roof	Inside Left Cluster
C351 (22Pin, White)	W/H Main - W/H FRT LH Door	Upper Fuse Box (Passerger Room)
C361 (22Pin, Blue)	W/H Main - W/H FRT RH Door	Behind Front Right Panel
C402 (12Pin, Black)	W/H Tail Gate - W/H Main	Behind Left Tail Lamp
S203 (14Pin, Colorless)	W/H Main	Behind 4WD Switch
J202	W/H Main	Behind Cluster
J203	W/H Main	Next to BTSI Unit
G201	W/H Main	Upper Front Left Leg Room
G302	W/H Main	Below Center Console

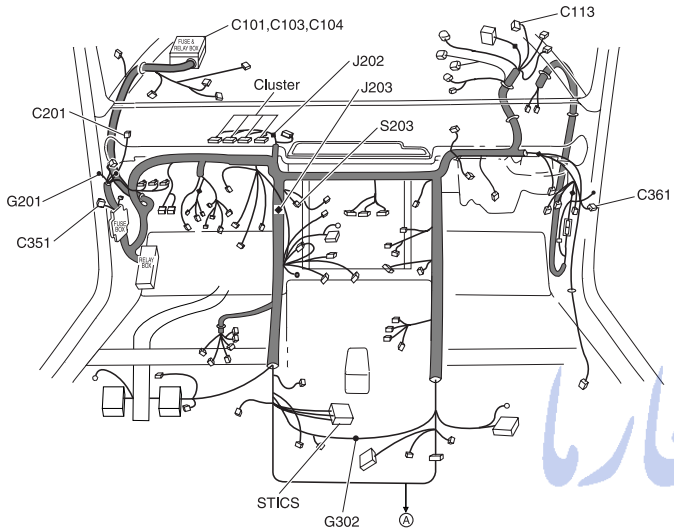
b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



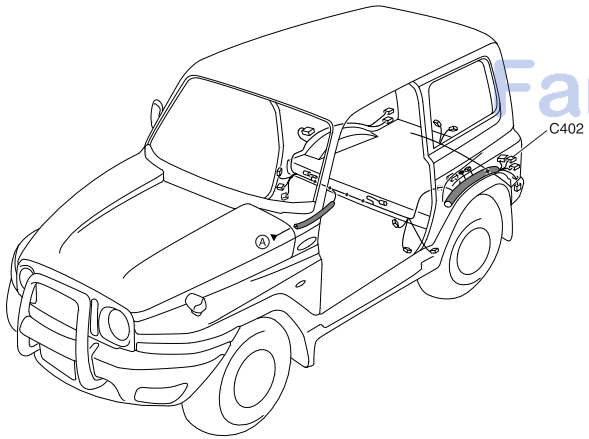
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c. POSITION OF CONNECTORS AND GROUNDS

- W/H MAIN

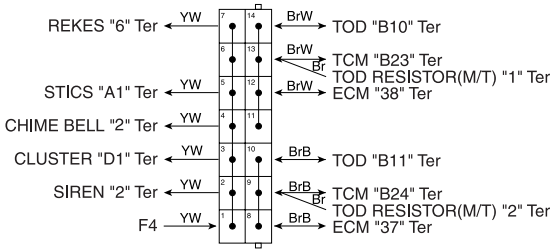


- W/H MAIN (FLOOR)



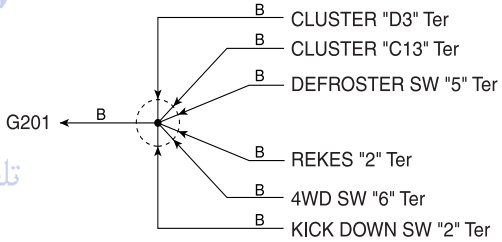
d. SPLICE PACK

S203 (COLORLESS)

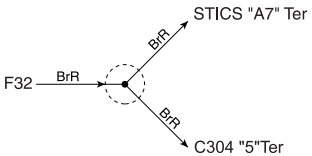


e. JOINT

J202

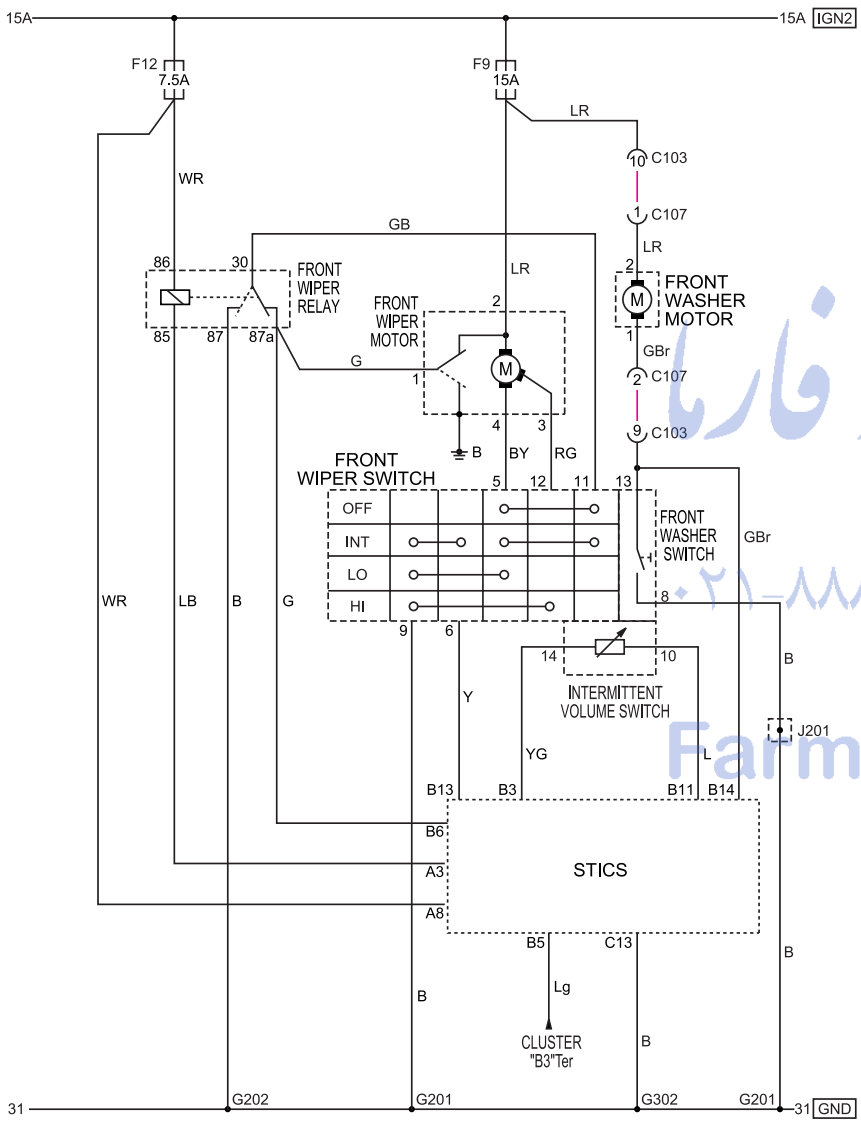


J203



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2) FRONT WIPER CIRCUIT



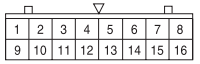
a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C103 (22Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C107 (20Pin, White)	Engine Room Fuse Box - W/H Engine Room	Engine Room Fuse Box
J201	W/H Main	Above FRT LH Seat Under Cover
G201	W/H Main	Upper Front Left Leg Room
G202	W/H Main	Upper Front Left Leg Room
G302	W/H Main	Below Center Console

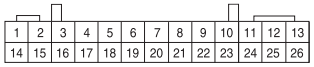
b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



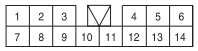
STICS "A"



STICS "B"



STICS "C"



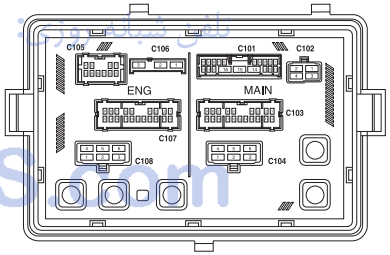
FRONT WIPER SW



FRONT WIPER MOTOR



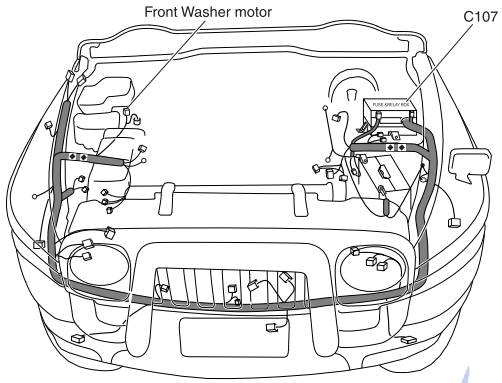
FRONT WASHER MOTOR



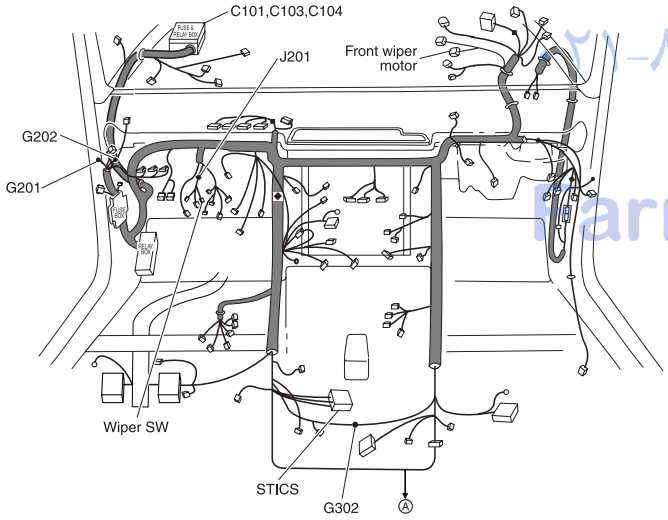
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c. POSITION OF CONNECTORS AND GROUNDS

- W/H ENGINE ROOM

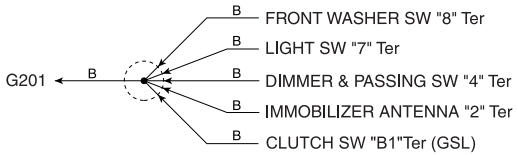


- W/H MAIN



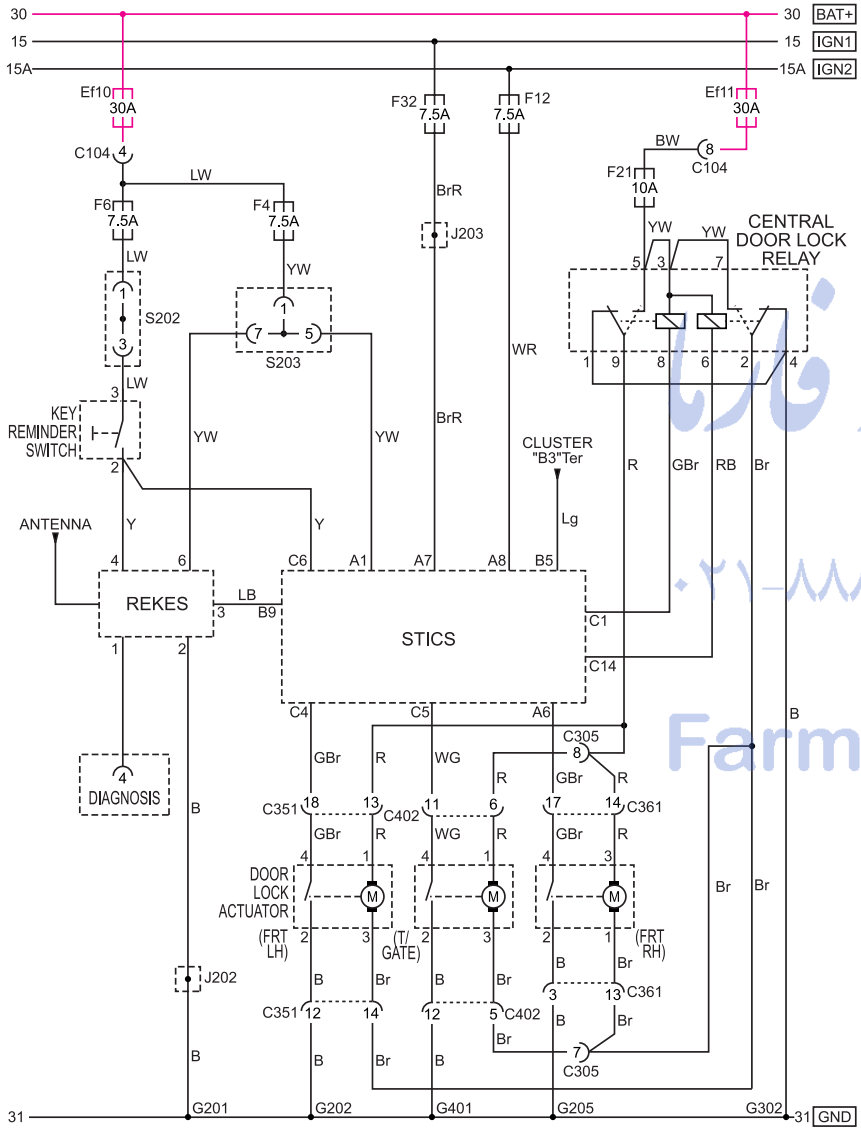
e. JOINT

J201



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3) CENTRAL DOOR LOCK SYSTEM

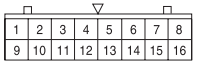


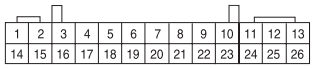
a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C104 (8Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C305 (14Pin, White)	W/H Main - W/H Main	Below Center Console
C351 (22Pin, White)	W/H Main - W/H FRT LH Door	Upper Fuse Box (Passenger Room)
C361 (22Pin, Blue)	W/H Main - W/H FRT RH Door	Behind Front Right Panel
C402 (12Pin, Black)	W/H Tail Gate - W/H Main	Behind Left Tail Lamp
S202 (20Pin, Black)	W/H Main	Behind Cluster
S203 (14Pin, Colorless)	W/H Main	Behind 4WD Switch
J202	W/H Main	Behind Cluster
J203	W/H Main	Next to BTIS Unit
G201	W/H Main	Upper Front Left Leg Room
G202	W/H Main	Upper Front Left Leg Room
G205	W/H Main	Center "A" Pillar Front Right
G401	W/H Main	Inside Lower Trim Rear Left Quater

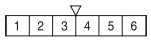
b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

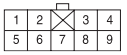

STICS "A"


STICS "B"

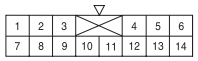

STICS "C"


KEY REMINDER SW

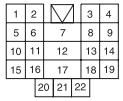

REKES

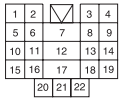

CENTRAL DOOR LOCK RELAY

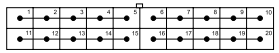

DOOR LOCK ACTUATOR

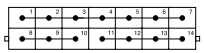

C305 (WHITE)

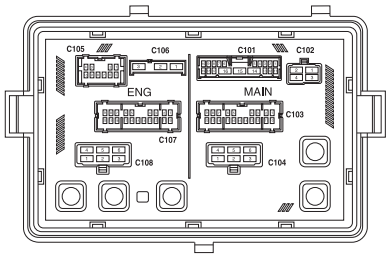

C402 (BLACK)


C351 (WHITE)


C361 (BLUE)


S202 (BLACK)

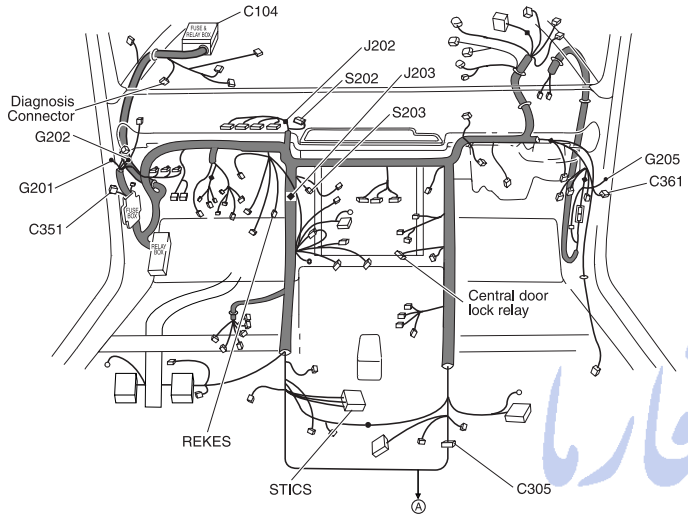

S203 (COLORLESS)



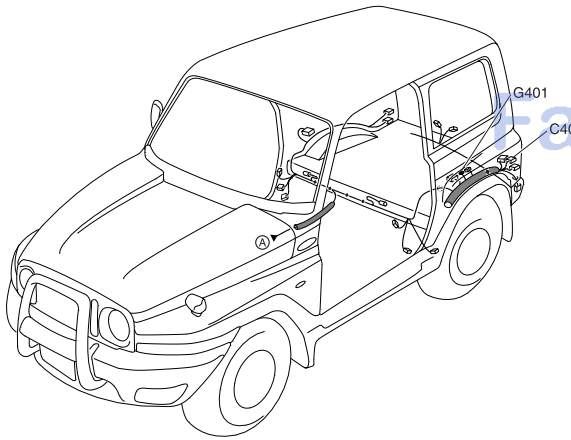
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c. POSITION OF CONNECTORS AND GROUNDS

- W/H MAIN

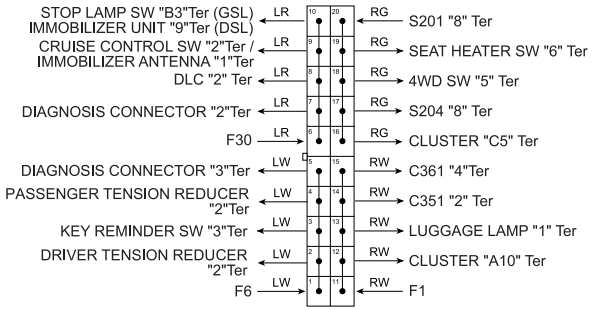


- W/H MAIN (FLOOR)

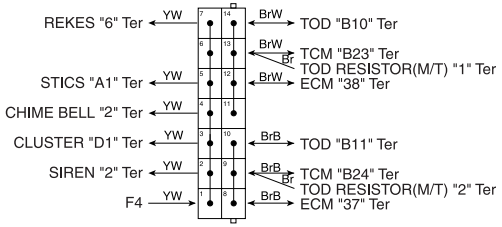


d. SPLICE PACK

S202 (BLACK)

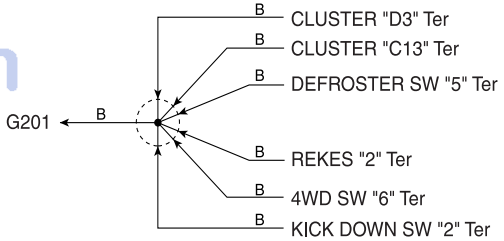


S203 (COLORLESS)



e. JOINT

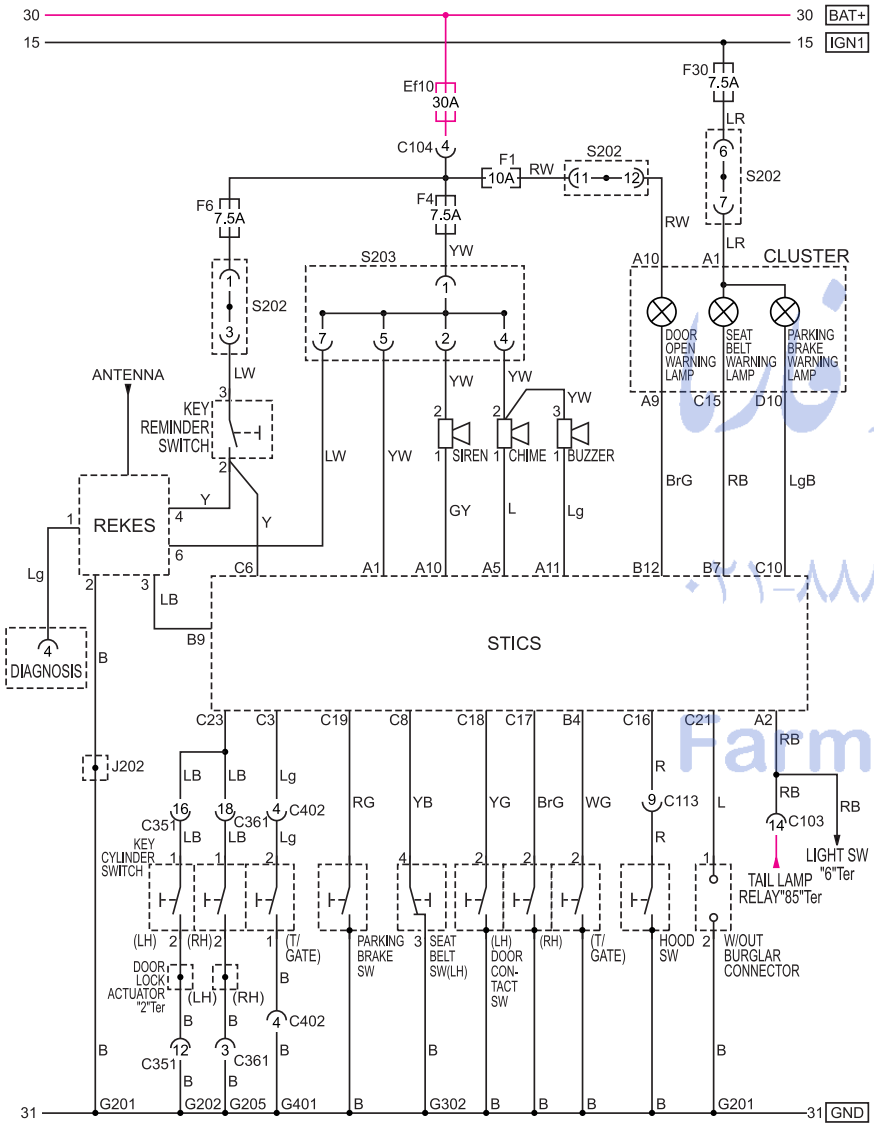
J202



J203

امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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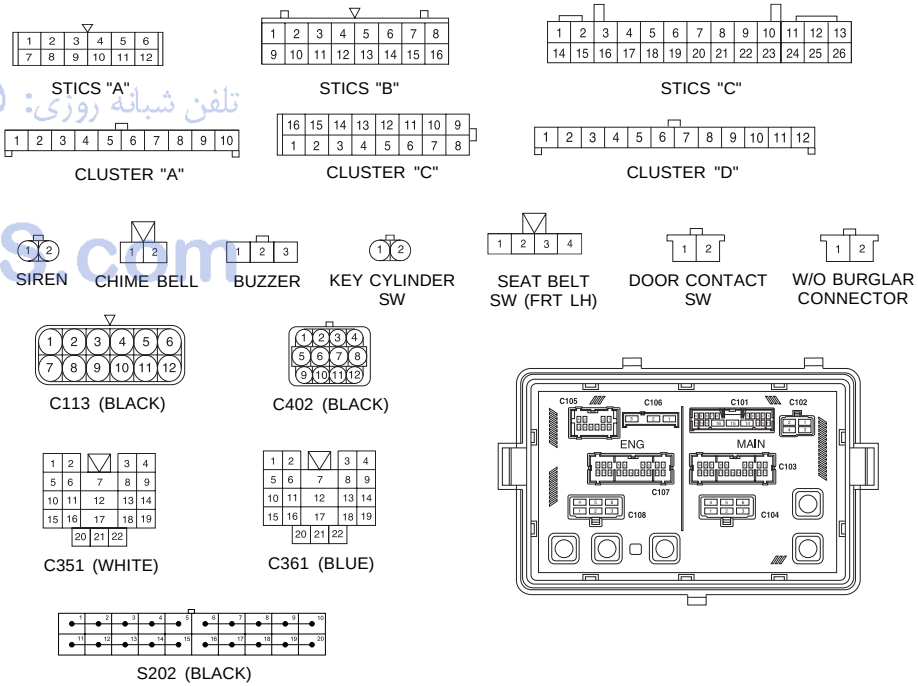
4) KEYLESS, KEY REMINDER SWITCH, SIREN, CHIME BELL, BUZZER



a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C103 (22Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C104 (8Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C113 (12Pin,Black)	W/H Engine Room - W/H Main	Next to Hydraulic Unit
C351 (22Pin, White)	W/H Main - W/H FRT LH Door	Upper Fuse Box (Passenger Room)
C361 (22Pin, Blue)	W/H Main - W/H FRT RH Door	Behind Front Right Panel
C402 (12Pin, Black)	W/H Tail Gate - W/H Main	Behind Left Tail Lamp
S202 (20Pin, Black)	W/H Main	Behind Cluster
J202	W/H Main	Behind Cluster
G201	W/H Main	Upper Front Left Leg Room
G202	W/H Main	Upper Front Left Leg Room
G205	W/H Main	Center "A" Pillar Front Right
G302	W/H Main	Below Center Console
G401	W/H Main	Inside Lower Trim Rear Left Quater

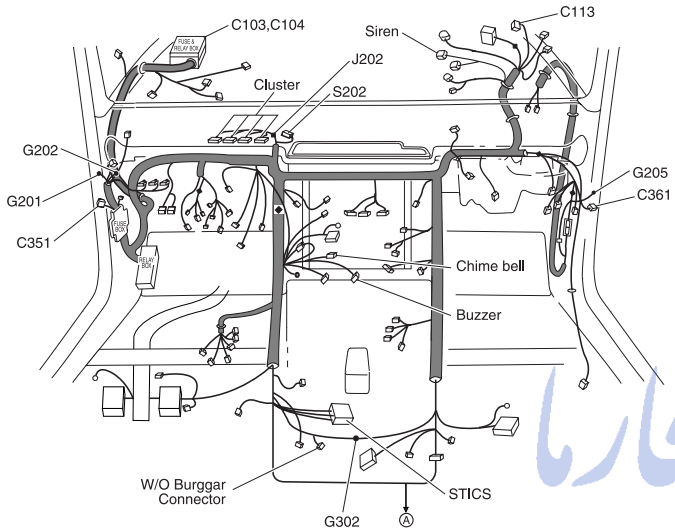
B. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



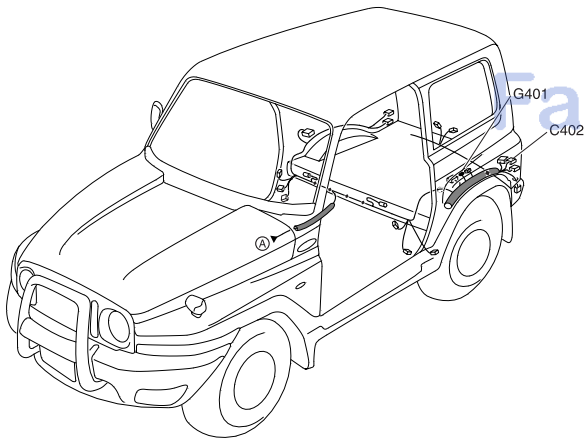
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c. POSITION OF CONNECTORS AND GROUNDS

- W/H MAIN

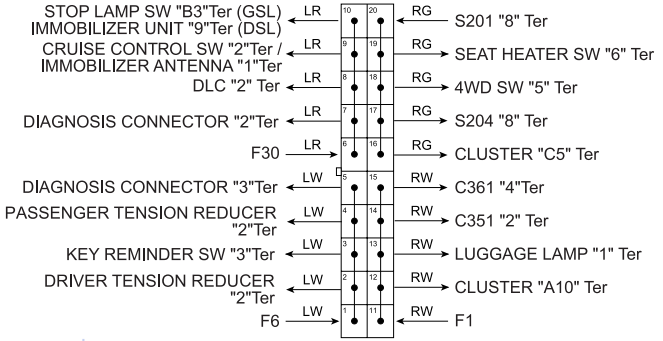


- W/H MAIN (FLOOR)



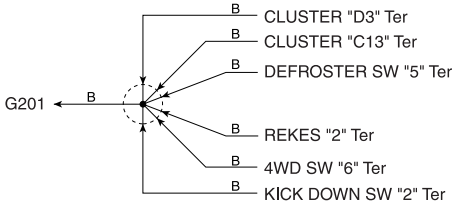
d. SPLICE PACK

S202 (BLACK)



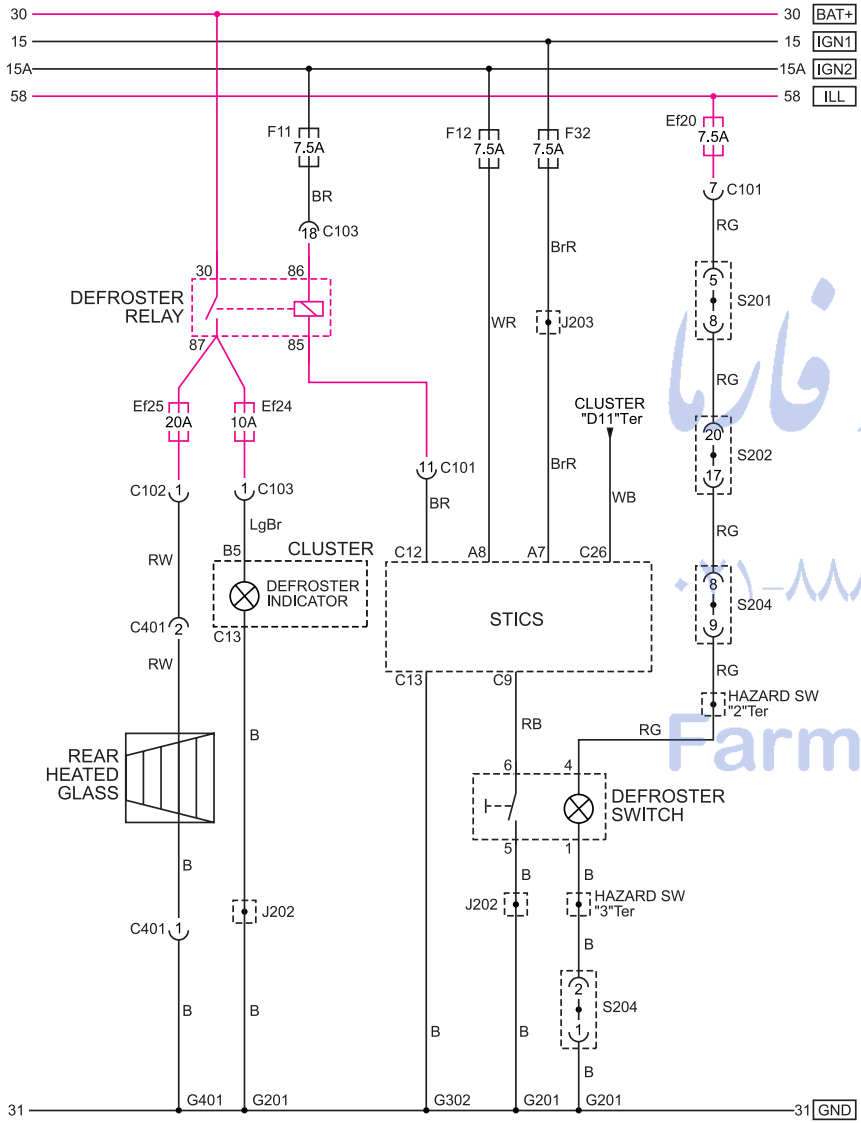
e. JOINT

J202



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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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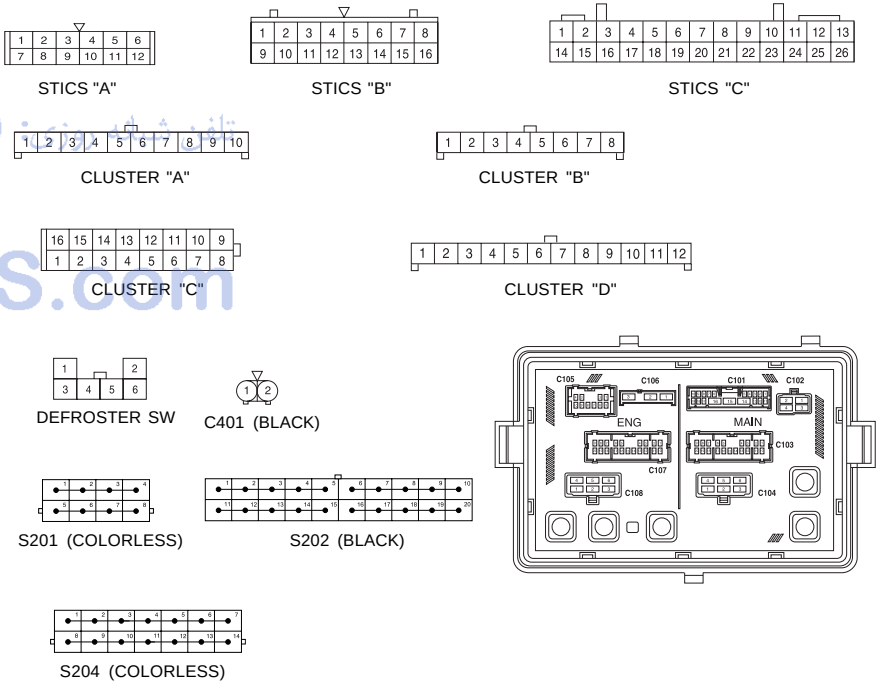
5) DEFROSTER



a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C101 (19Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C102 (4Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C103 (22Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C401 (2Pin, Black)	W/H Tail Gate - W/H Main	Behind Left Tail Lamp
S201 (8Pin, Colorless)	W/H Main	Upper Fuse Box(Passengr Room)
S202 (20Pin, Black)	W/H Main	Behind Cluster
S204 (14Pin, Colorless)	W/H Main	Behind Audio
J202	W/H Main	Behind Cluster
J203	W/H Main	Next to BTSI Unit
G201	W/H Main	Upper Front Left Leg Room
G302	W/H Main	Below Center Console
G401	W/H Main	Inside Lower Trim Rear Left Quater

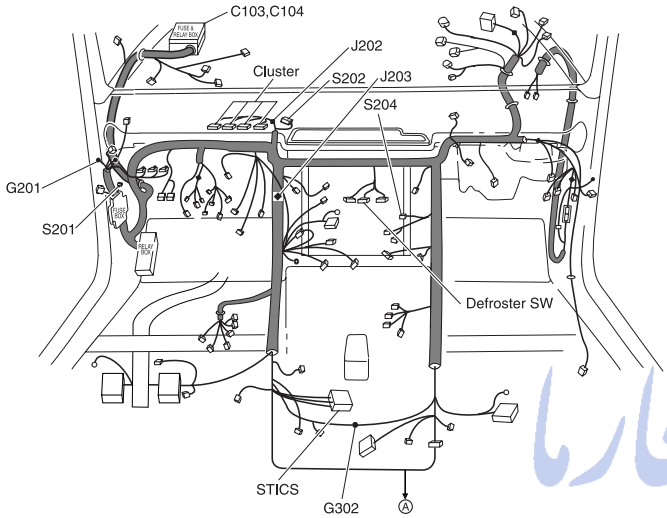
b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



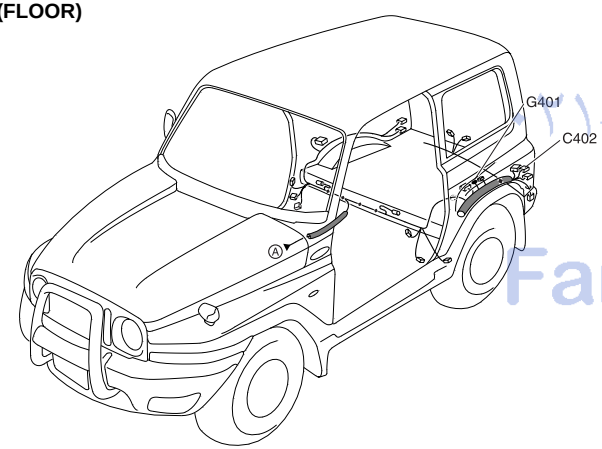
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۰۲۱-۸۸۴۶۲۰۸۵
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c. POSITION OF CONNECTORS AND GROUNDS

- W/H MAIN

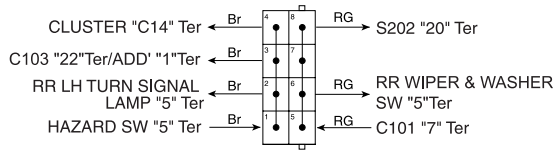


- W/H MAIN (FLOOR)

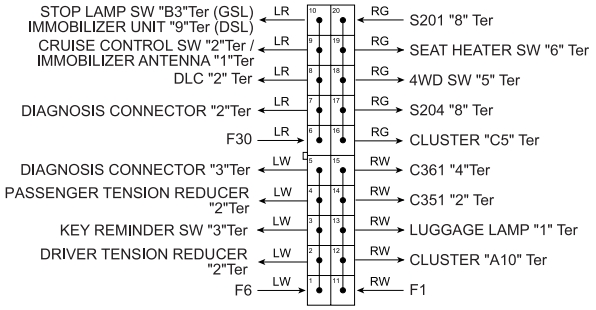


d. SPLICE PACK

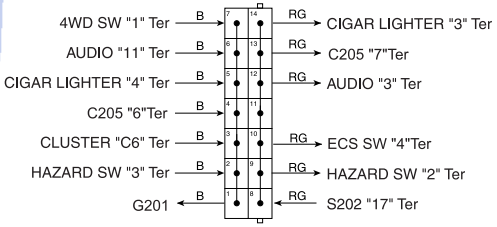
S201 (COLORLESS)



S202 (BLACK)

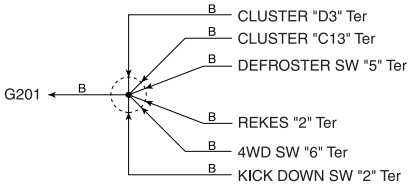


S204 (COLORLESS)

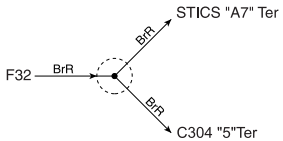


e. JOINT

J202

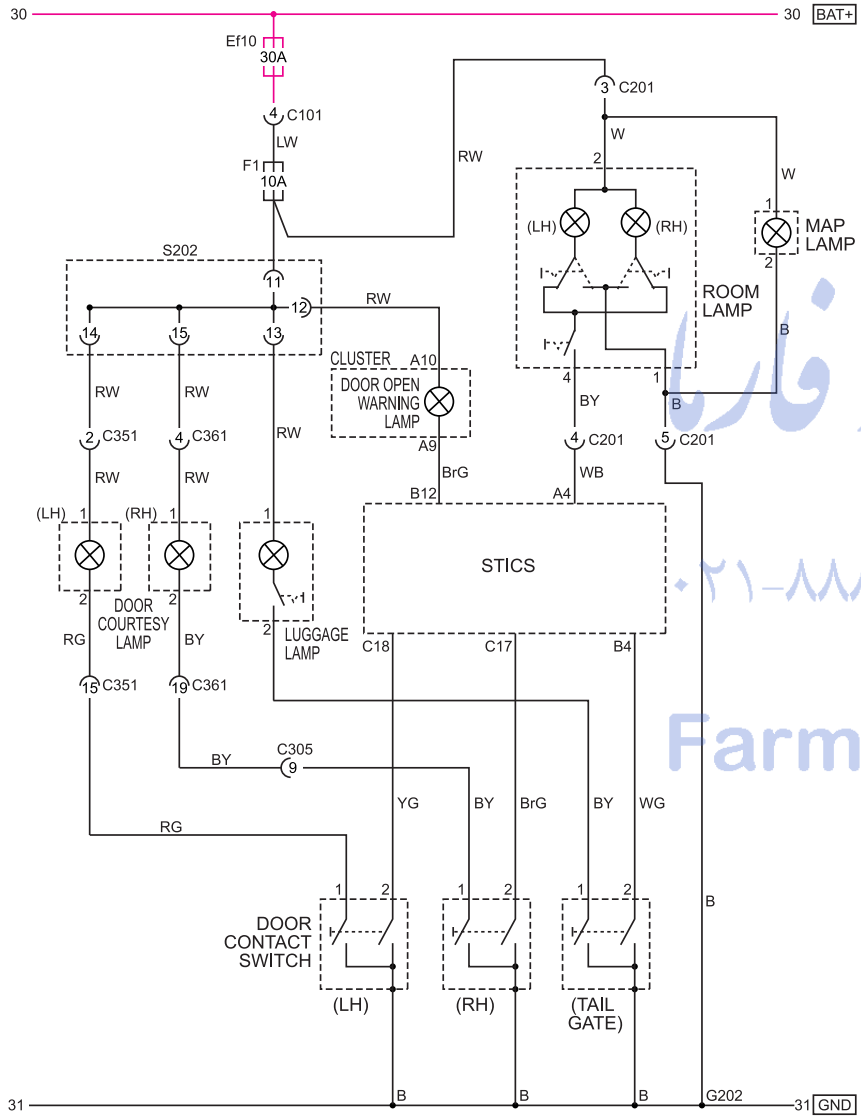


J203



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۶۲۰۸۵
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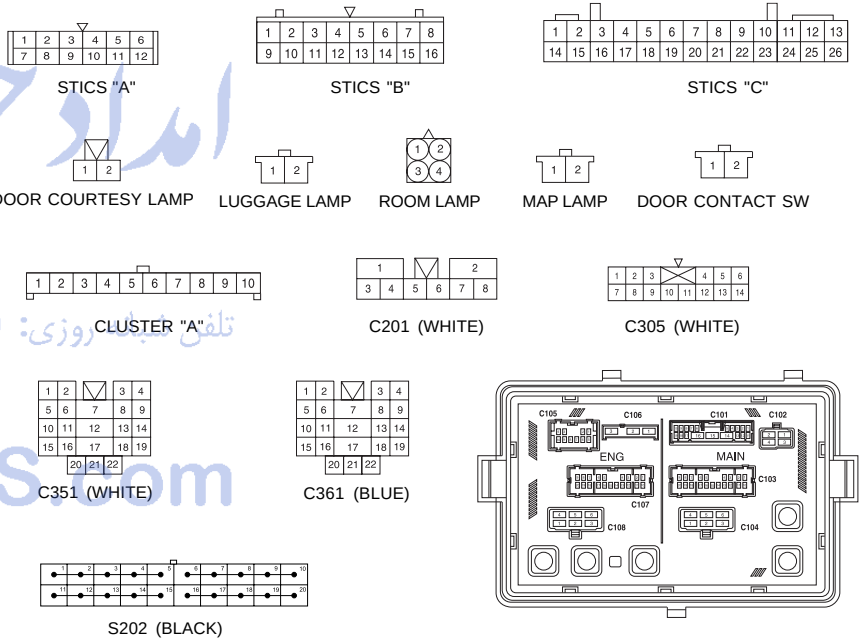
6) LAMP (ROOM, DOOR COURTESY LH/RH, LUGGAGE), DOOR CONTACT SWITCH



a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C101 (19Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C201 (8Pin, White)	W/H Main - W/H Roof	Inside Left Cluster
C305 (14Pin, White)	W/H Main - W/H Main	Below Center Console
C351 (22Pin, White)	W/H Main - W/H FRT LH Door	Upper Fuse Box (Passenger Room)
C361 (22Pin, Blue)	W/H Main - W/H FRT RH Door	Behind Front Right Panel
S202 (20Pin, Black)	W/H Main	Behind Cluster
G202	W/H Main	Upper Front Left Leg Room

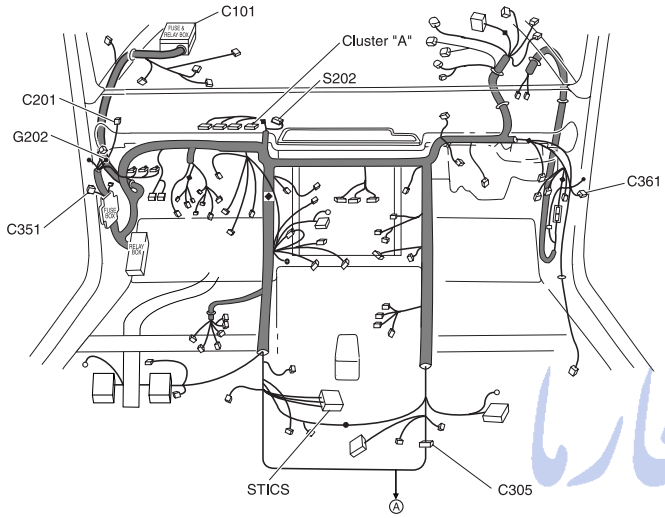
b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



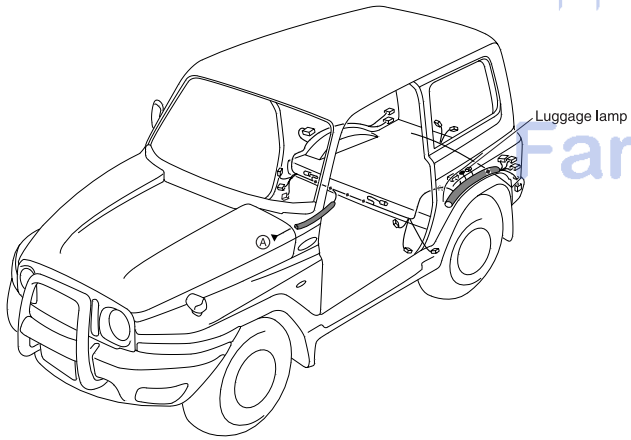
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۰۲۱-۸۸۴۶۲۰۸۵ تلفن پاسخگویی روزی
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c. POSITION OF CONNECTORS AND GROUNDS

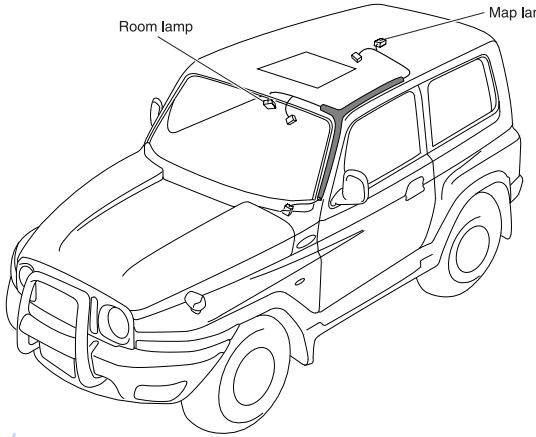
- **W/H MAIN**



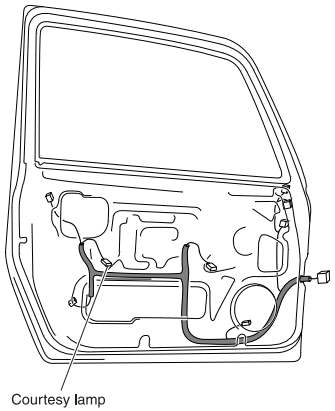
- **W/H MAIN (FLOOR)**



- **W/H ROOF**



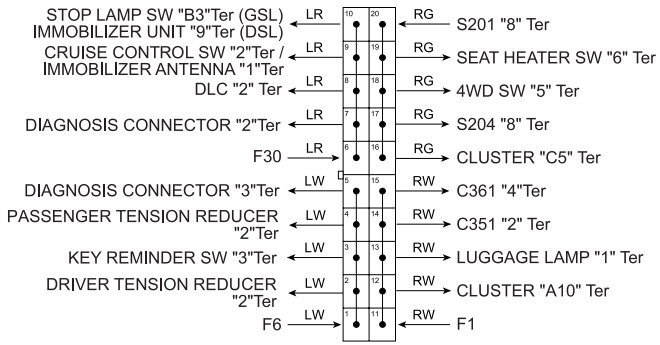
- **W/H DOOR**



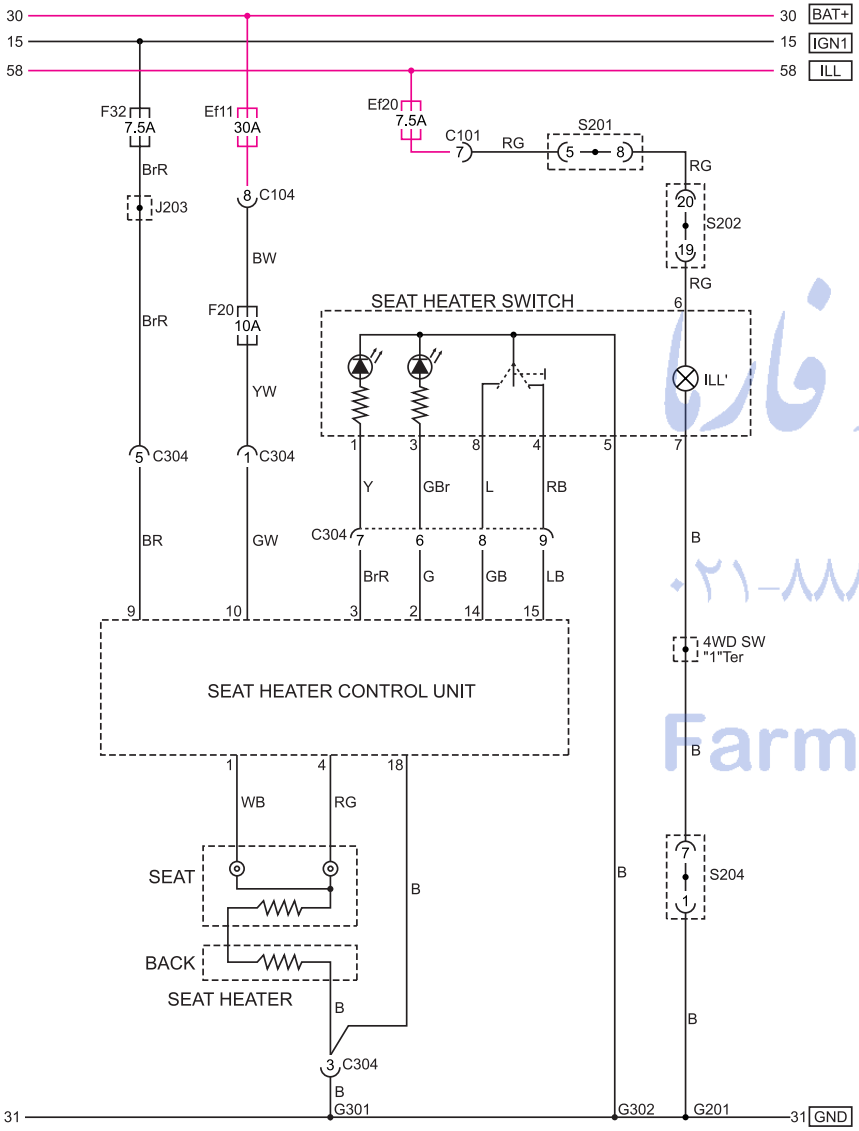
امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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d. SPLICE PACK

S202 (BLACK)



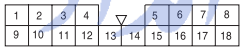
20. SEAT HEATER



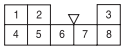
a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C101 (19Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C104 (8Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C304 (10Pin, White)	W/H Main - W/H Seat Heater	Below Driver Seat
S201 (8Pin, Colorless)	W/H Main	Upper Fuse Box(Passenger Room)
S202 (20Pin, Black)	W/H Main	Behind Cluster
S204 (14Pin, Colorless)	W/H Main	Behind Audio
J203	W/H Main	Next to BTSI Unit
G201	W/H Main	Upper Front Left Leg Room
G301	W/H Main	Below Front Laft Seat
G302	W/H Main	Below Center Console

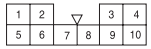
b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION
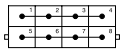


SEAT HEATER UNIT



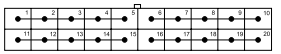
SEAT HEATER SW
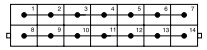


C304 (WHITE)



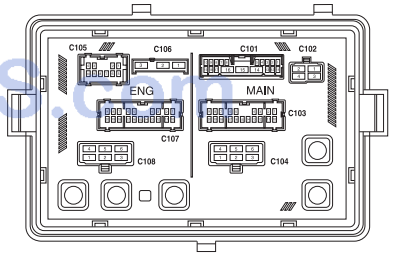
S201 (COLORLESS)



S202 (BLACK)



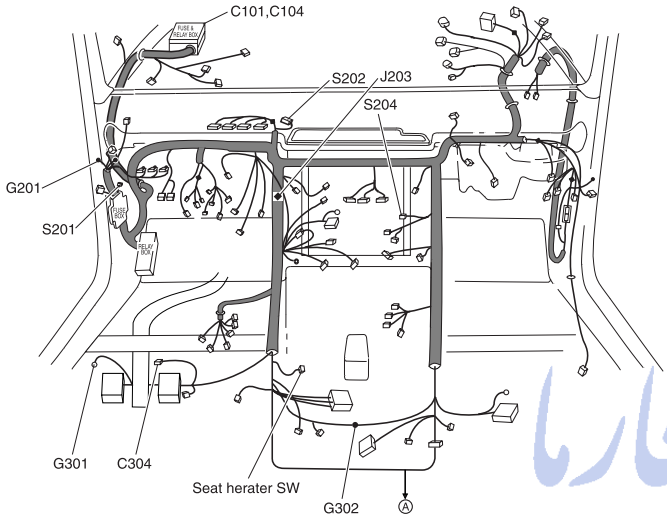
S204 (COLORLESS)



امداد خودرو فارما
۰۲۱-۸۸۴۶۲۰۸۵ تلفن شبانه روزی
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c. POSITION OF CONNECTORS AND GROUNDS

- W/H MAIN

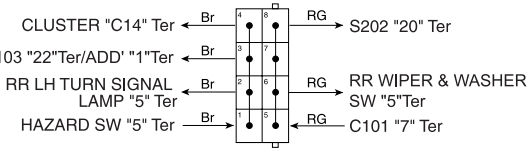


- W/H SEAT HEATER

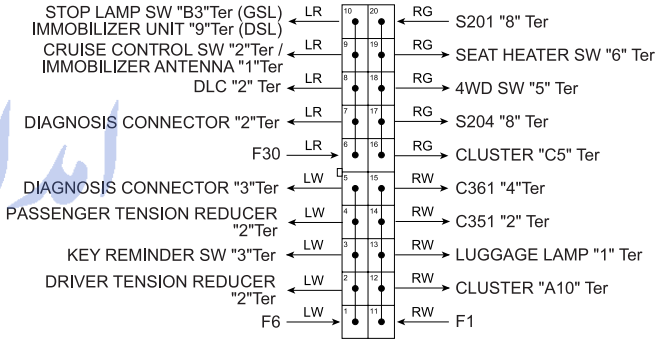


d. SPLICE PACK

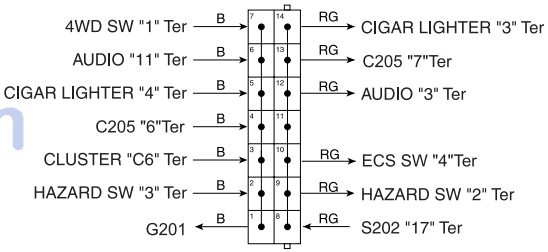
S201 (COLORLESS)



S202 (BLACK)

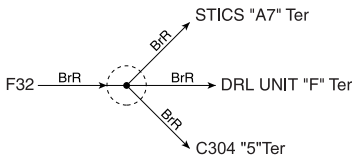


S204 (COLORLESS)



e. JOINT

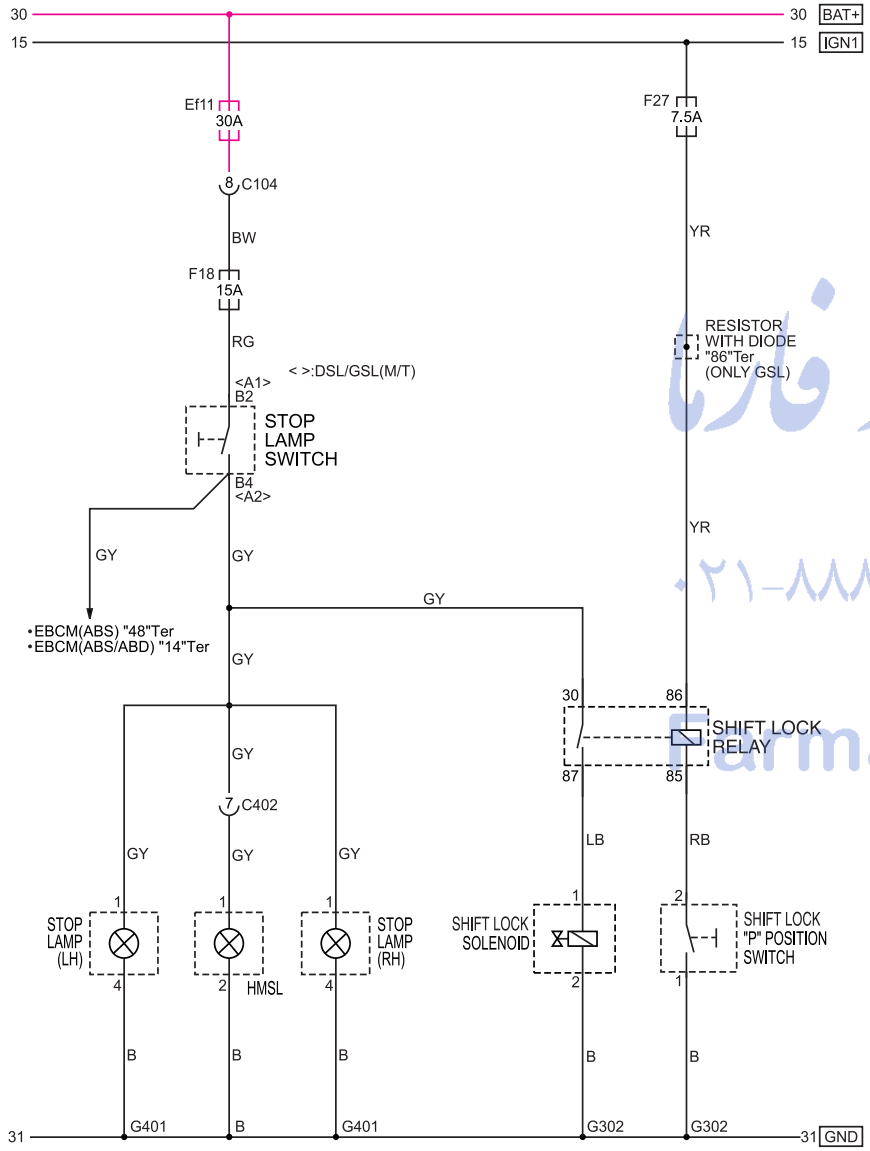
J203



ایراد خودرو فارما
۰۲۱-۸۸۸۶۲۰۸۵
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21. STOP LAMP, BTSI (BRAKE TRANSMISSION SHIFT INTERLOCK)

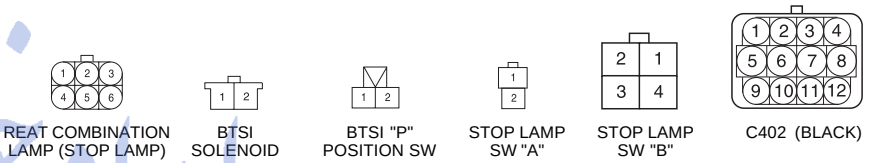
1) METAL TOP

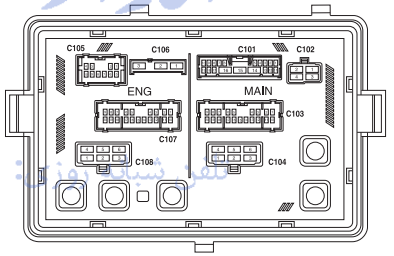


a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C104 (8Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C402 (12Pin, Black)	W/H Tail Gate - W/H Main	Behind Left Tail Lamp
G302	W/H Main	Below Center Console
G401	W/H Main	Inside Lower Trim Rear Left Quater

b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

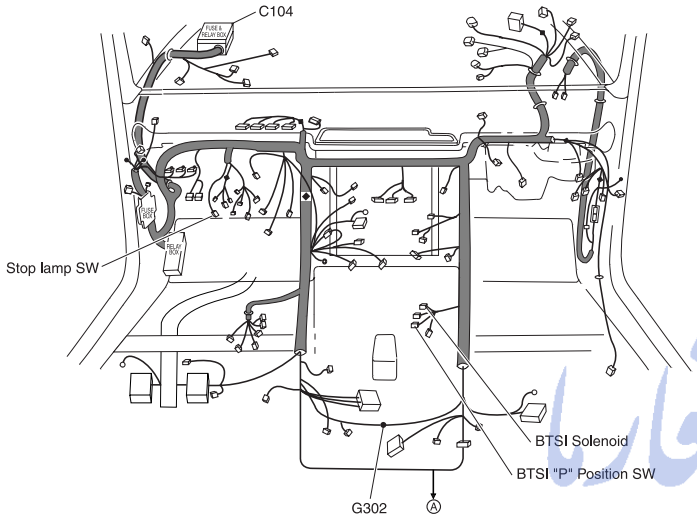




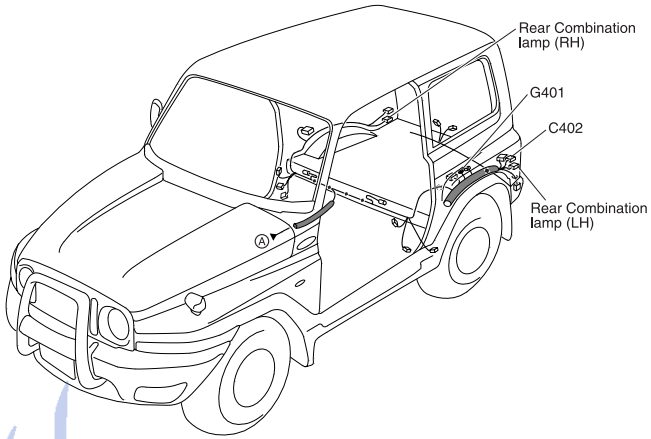
امداد خودرو فارما
۰۲۱-۸۸۴۶۲۰۸۵
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c. POSITION OF CONNECTORS AND GROUNDS

- W/H MAIN

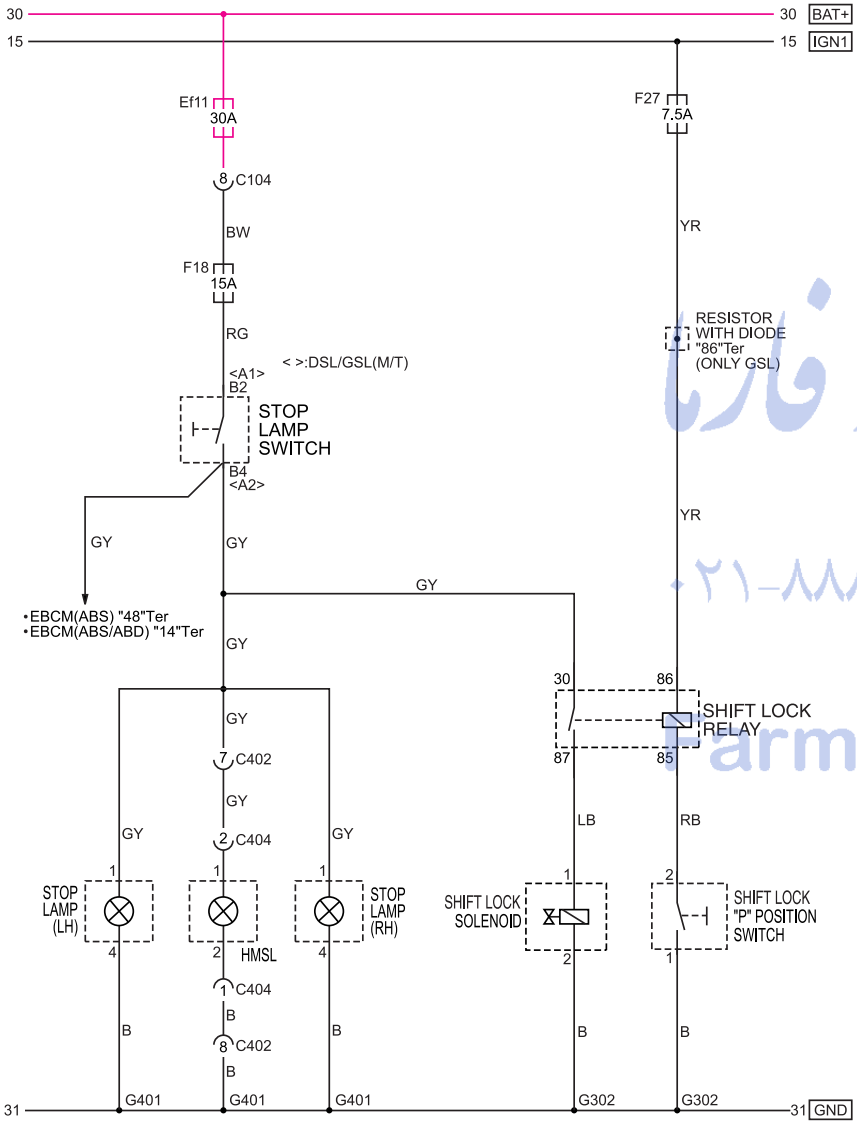


- W/H MAIN (FLOOR)



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
FarmaSOS.com

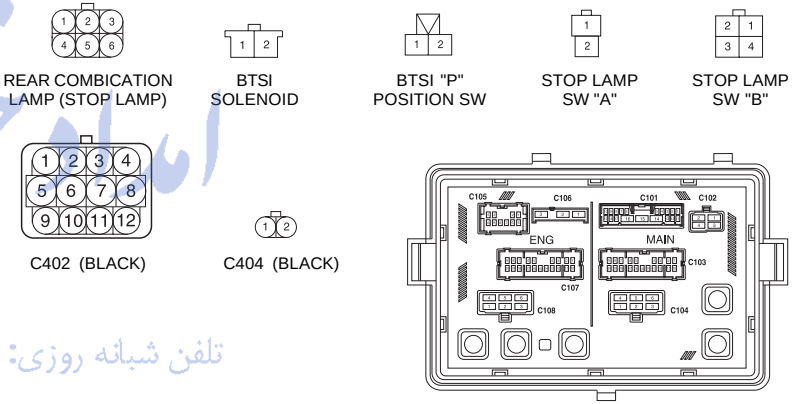
2) SOFT TOP



a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C104 (8Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C402 (12Pin, Black)	W/H Tail Gate - W/H Main	Behind Left Tail Lamp
C404 (2Pin, Black)	W/H Tail Gate - W/H HMSL	Inside Tail Gate
G302	W/H Main	Below Center Console
G401	W/H Main	Inside Lower Trim Rear Left Quater

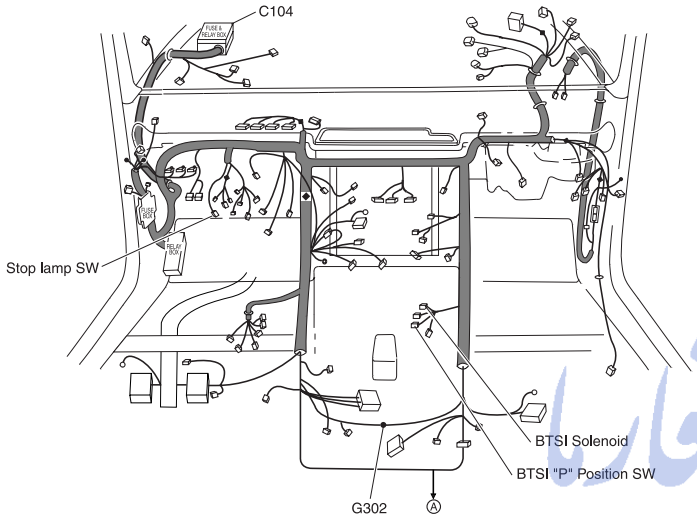
b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



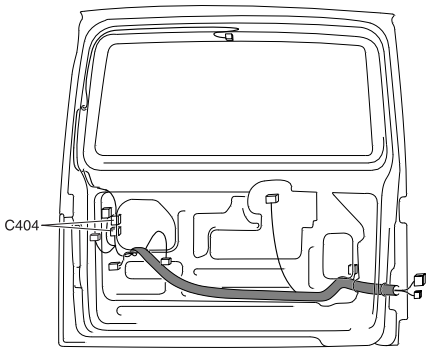
ایران خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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c. POSITION OF CONNECTORS AND GROUNDS

- W/H MAIN

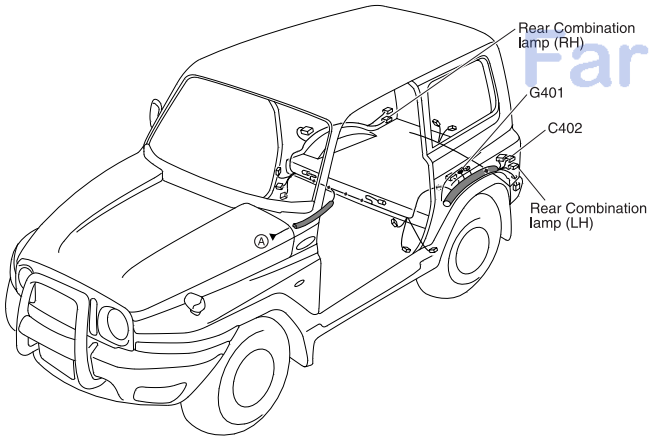


- W/H TAIL GATE

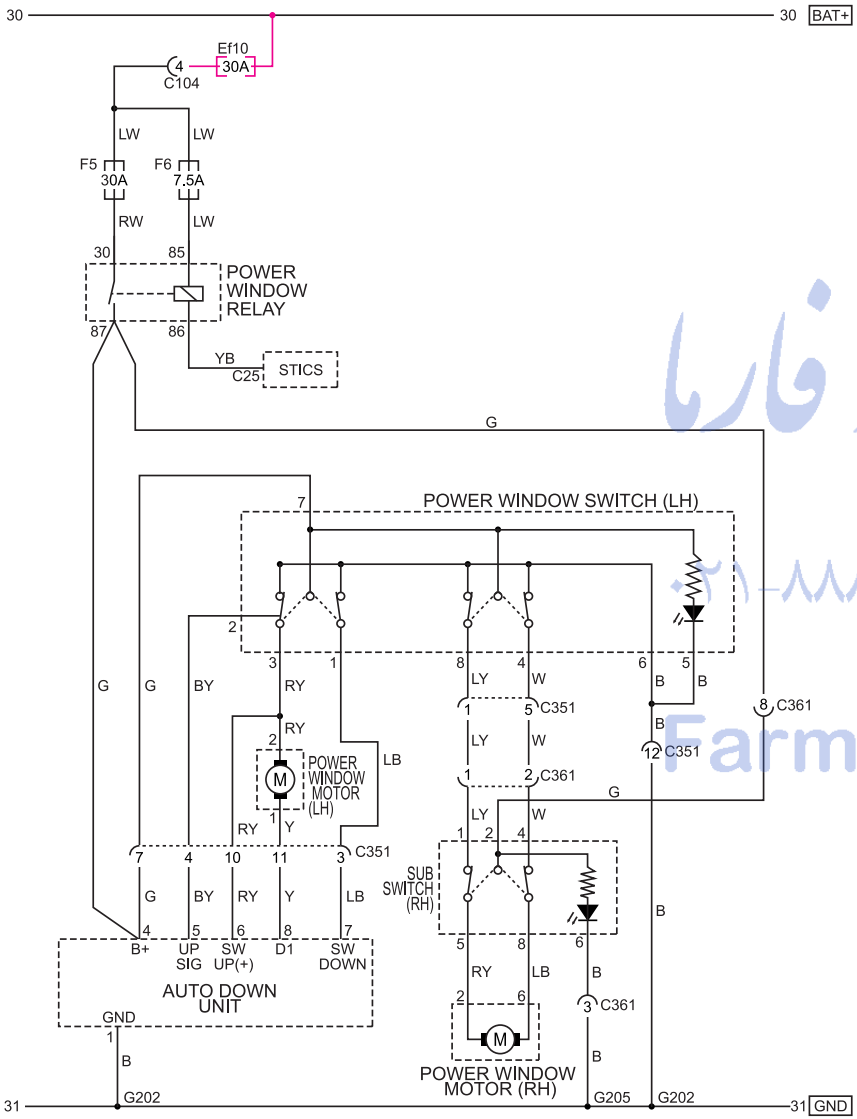


امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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- W/H MAIN (FLOOR)



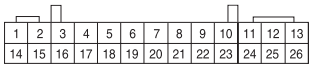
22. POWER WINDOW



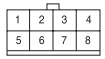
a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C104 (8Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse & Relay Box
C351 (22Pin, White)	W/H Main - W/H FRT LH Door	Upper Fuse Box (Passenger Room)
C361 (22Pin, Blue)	W/H Main - W/H FRT RH Door	Behind Front Right Panel
G202	W/H Main	Upper Front Left Leg Room
G205	W/H Main	Center "A" Pillar Front Right

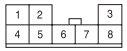
b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



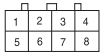
STICS "C"



AUTO DOWN UNIT



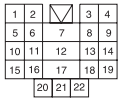
POWER WINDOW SW (LH)



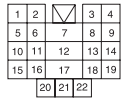
SUB SW (RH)



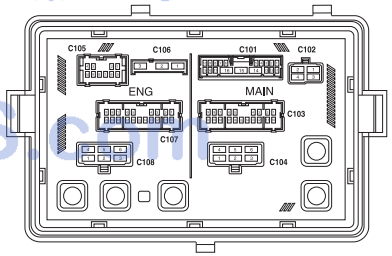
POWER WINDOW MOTOR



C351 (WHITE)



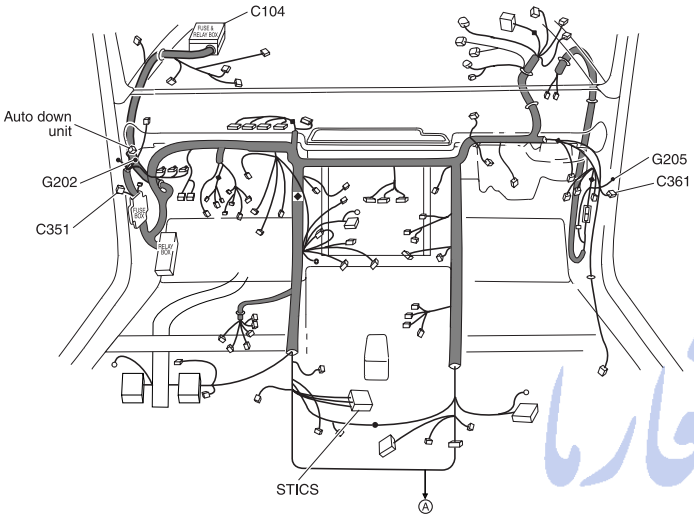
C361 (BLUE)



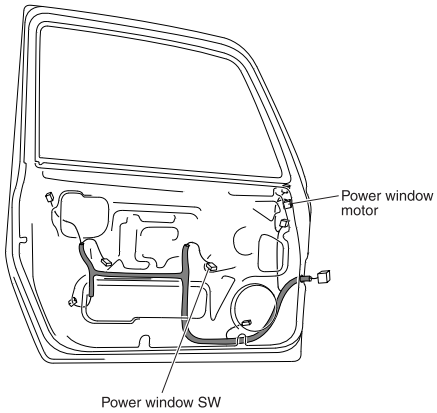
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c. POSITION OF CONNECTORS AND GROUNDS

- W/H MAIN

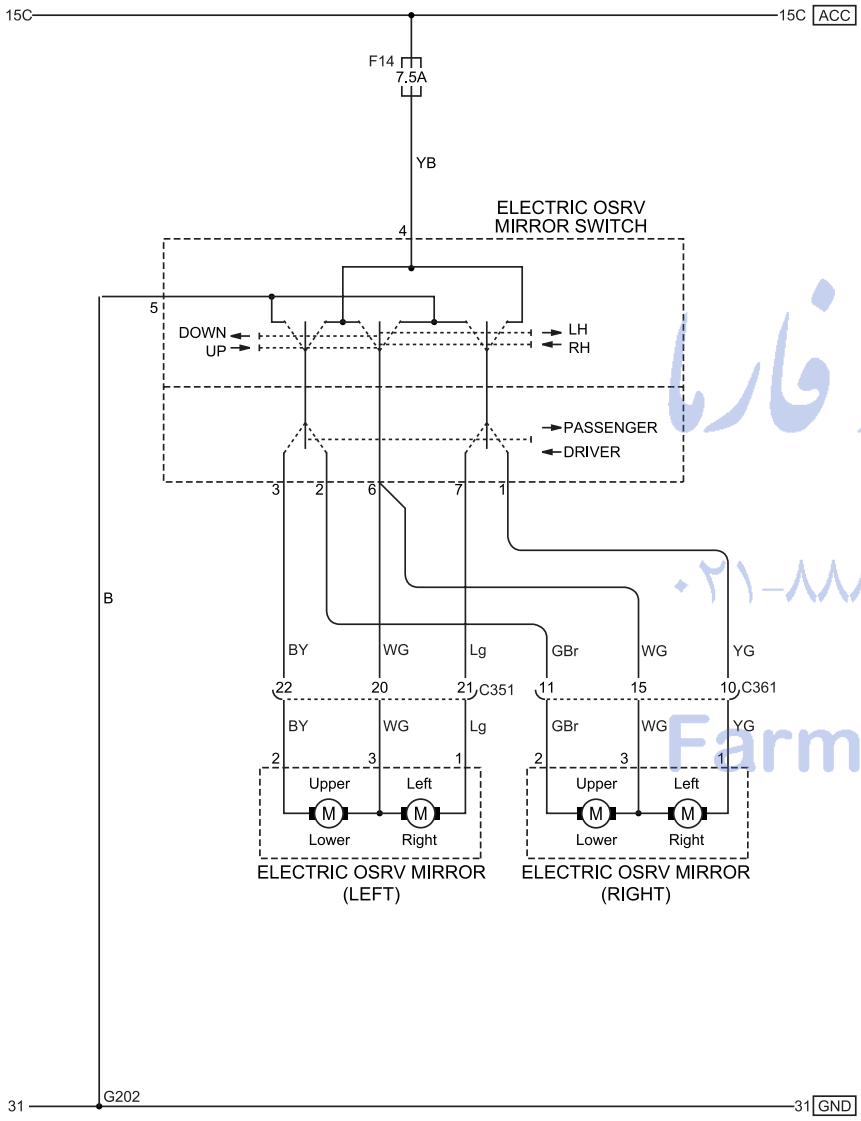


- W/H DOOR



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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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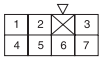
23. ELECTRIC OSRV (OUTSIDE REAR VIEW) MIRROR



a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C351 (22Pin, White)	W/H Main - W/H FRT LH Door	Upper Fuse Box (Passenger Room)
C361 (22Pin, Blue)	W/H Main - W/H FRT RH Door	Behind Front Right Panel
G202	W/H Main	Upper Front Left Leg Room

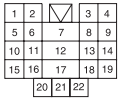
b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



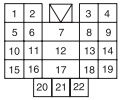
ELECTRIC OSRV MIRROR SW



ELECTRIC OSRV MIRROR MOTOR



C351 (WHITE)

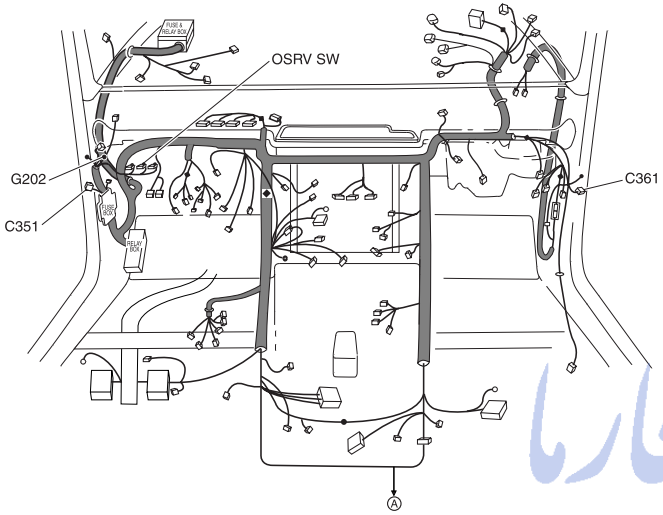


C361 (BLUE)

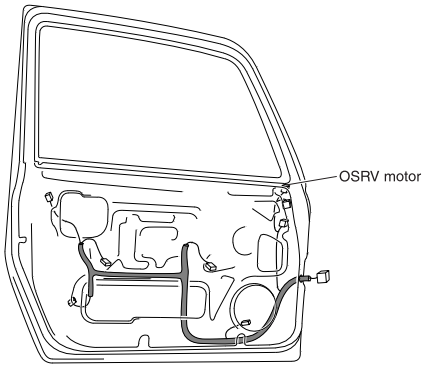
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FarmaSOS.com

c. POSITION OF CONNECTORS AND GROUNDS

- W/H MAIN

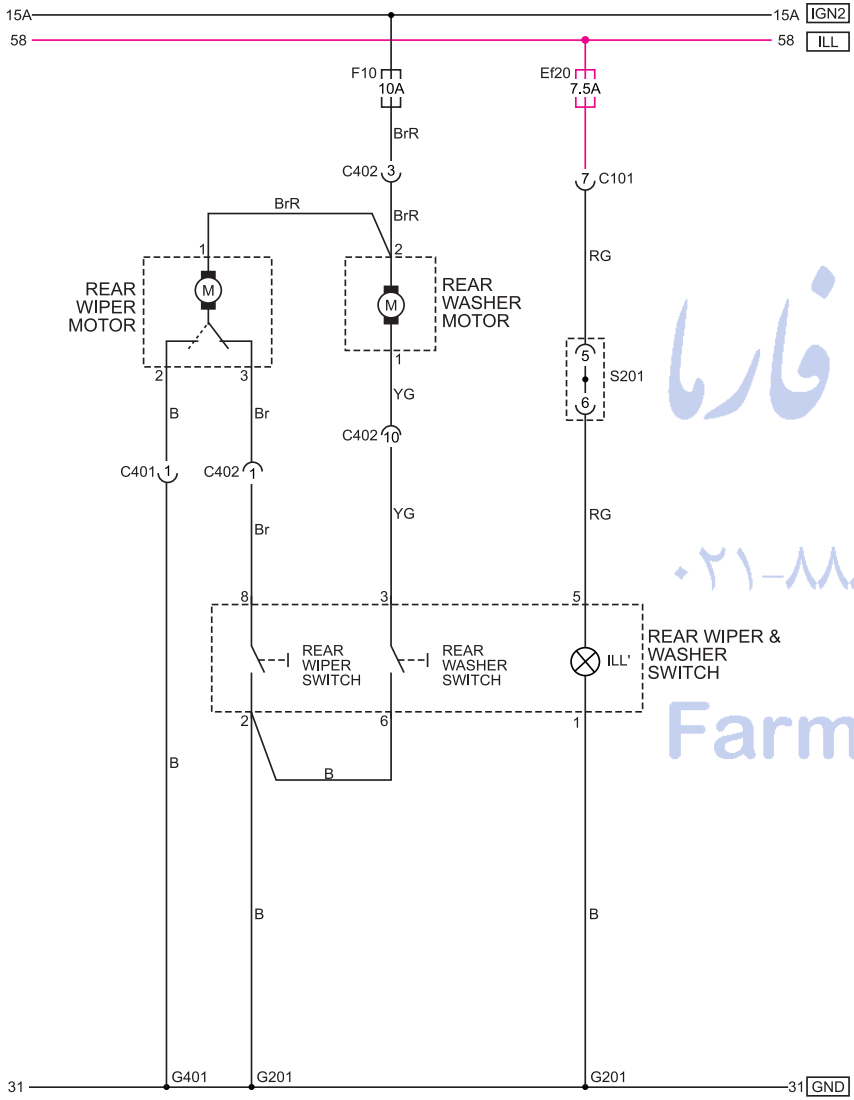


- W/H DOOR



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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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24. REAR WIPER & WASHER



a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C101 (19Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C401 (2Pin, Black)	W/H Tail Gate - W/H Main	Behind Left Tail Lamp
C402 (12Pin, Black)	W/H Tail Gate - W/H Main	Behind Left Tail Lamp
S201 (8Pin, Colorless)	W/H Main	Upper Fuse Box(Passenger Room)
G201	W/H Main	Upper Front Left Leg Room
G401	W/H Main	Inside Lower Trim Rear Left Quater

b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

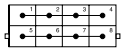

RR WIPER & WASHER SW

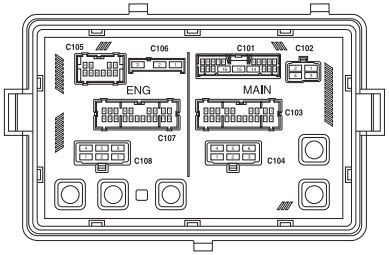

REAR WASHER MOTOR


REAR WIPER MOTOR


C401 (BLACK)


C402 (BLACK)

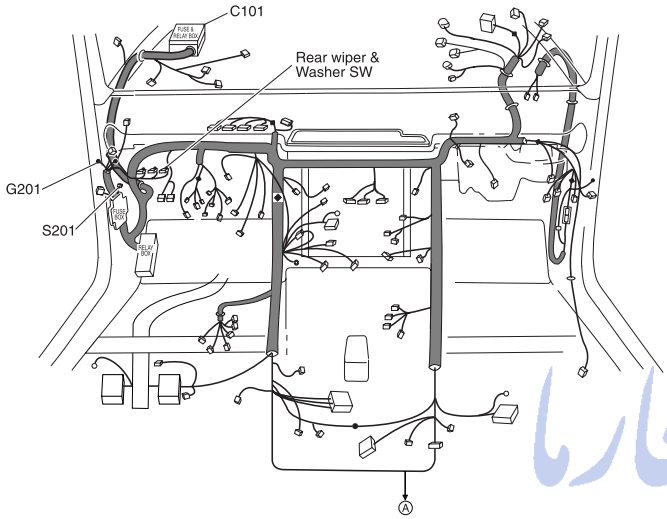

S201 (COLORLESS)



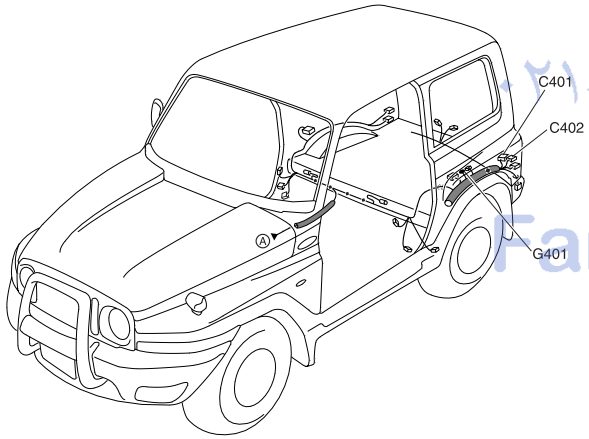
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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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c. POSITION OF CONNECTORS AND GROUNDS

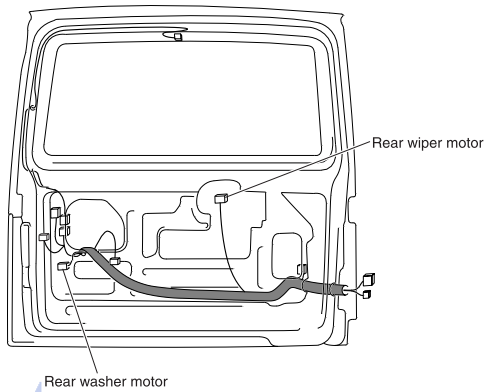
- W/H MAIN



- W/H MAIN (FLOOR)

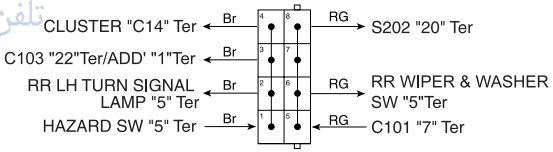


- W/H TAIL GATE



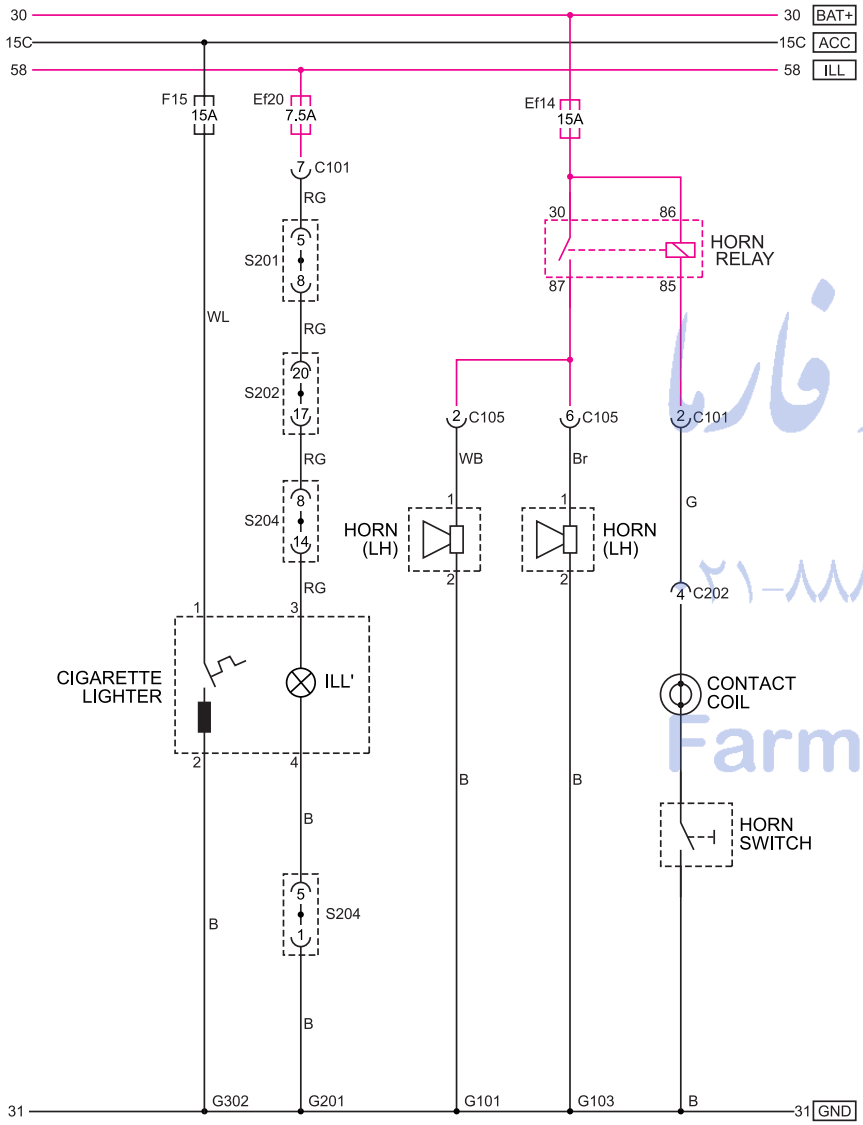
d. SPLICE PACK

S201 (COLORLESS)



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تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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25. CIGARETTE LIGHTER, HORN

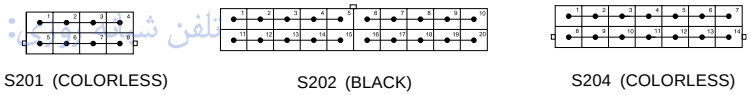


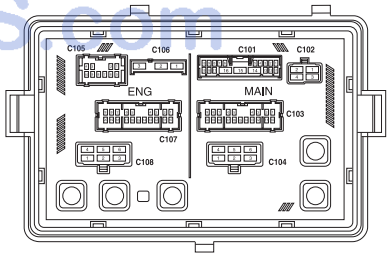
a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C101 (19Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C105 (10Pin, White)	Engine Room Fuse Box - W/H Engine Room	Engine Room Fuse Box
C202 (4Pin, White)	W/H Main - W/H Air Bag	Above Driver Seat Under Cover
S201 (8Pin, Colorless)	W/H Main	Upper Fuse Box(Passenger Room)
S202 (20Pin, Black)	W/H Main	Behind Cluster
S204 (14Pin, Colorless)	W/H Main	Behind Audio
G101	W/H Engine Room	Left Fender Next to Battery
G103	W/H Engine Room	Right Fender Engine Room
G201	W/H Main	Upper Front Left Leg Room
G302	W/H Main	Below Center Console

b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



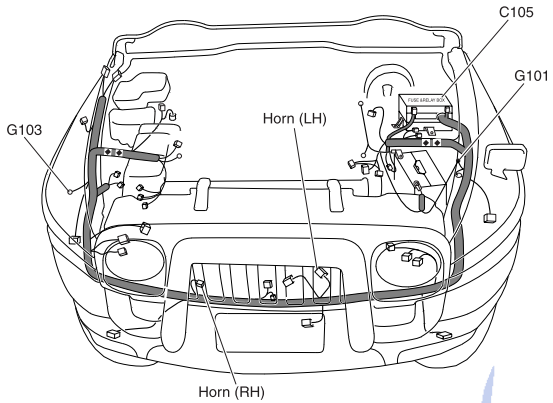




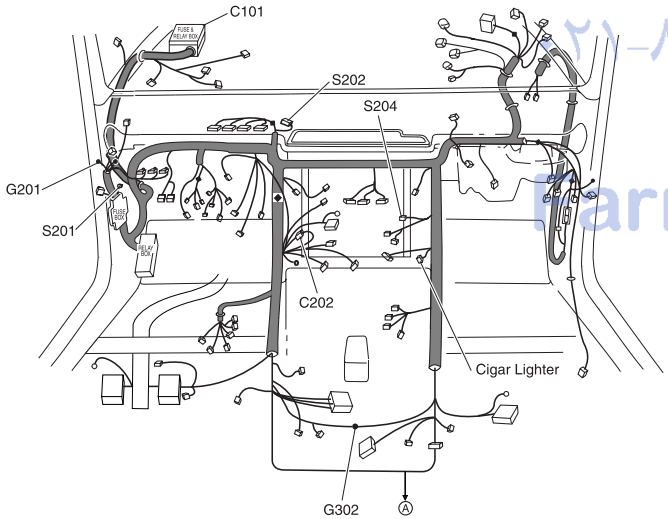
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c. POSITION OF CONNECTORS AND GROUNDS

- W/H ENGINE ROOM

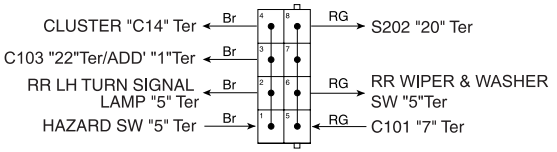


- W/H MAIN

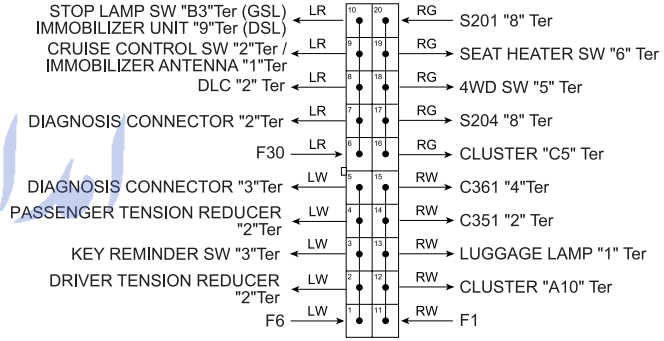


d. SPLICE PACK

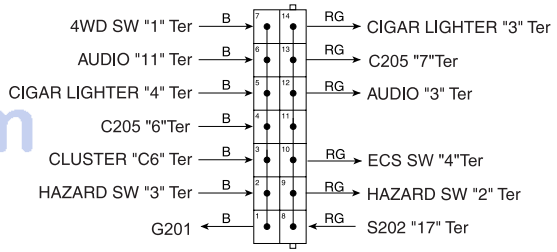
S201 (COLORLESS)



S202 (BLACK)

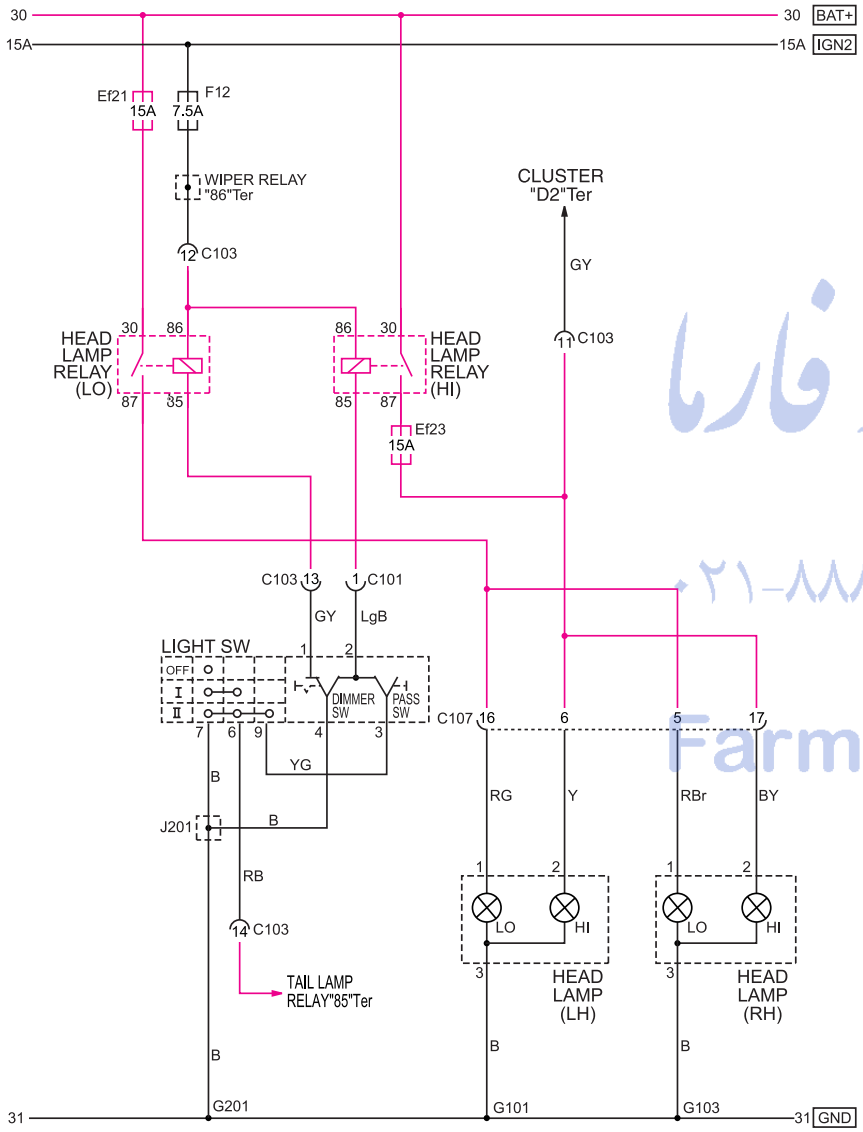


S204 (COLORLESS)



ایران خودرو فارما
تلفن فارما سوس ۰۲۱-۸۸۴۶۲۰۸۵
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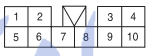
26. HEAD LAMP



a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C101 (19Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C103 (22Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C107 (20Pin, White)	Engine Room Fuse Box - W/H Engine Room	Engine Room Fuse Box
J201	W/H Main	Above FRT LH Seat Under Cover
G101	W/H Engine Room	Left Fender Next to Battery
G103	W/H Engine Room	Right Fender Engine Room
G201	W/H Main	Upper Front Left Leg Room

b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



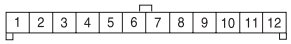
LIGHT SW



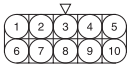
DIMMER & PASSING SW



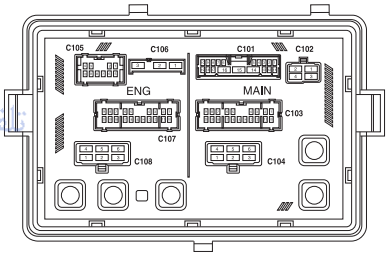
HEAD LAMP



CLUSTER "D"



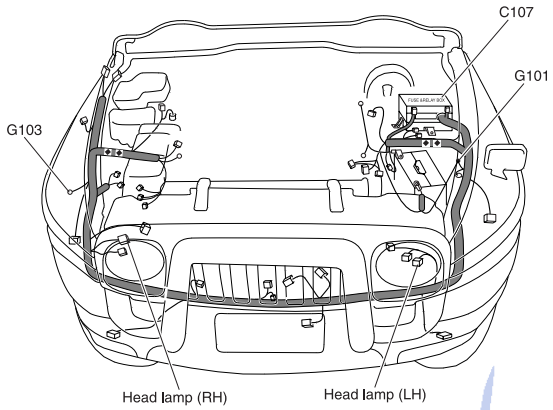
C302 (BLACK)



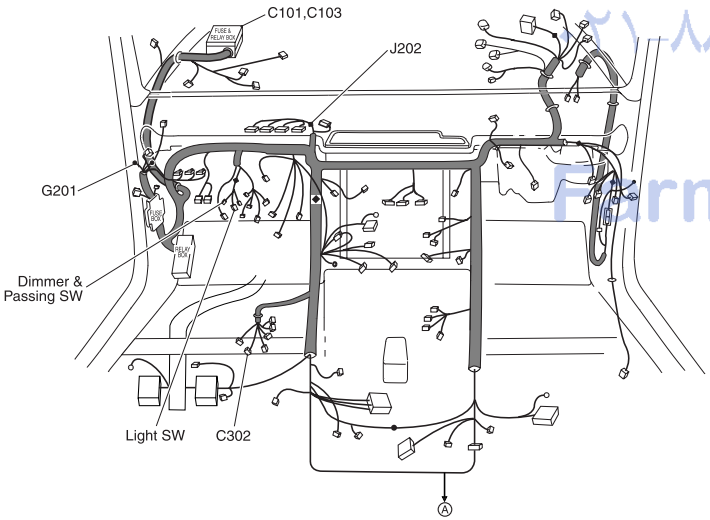
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c. POSITION OF CONNECTORS AND GROUNDS

- W/H ENGINE ROOM

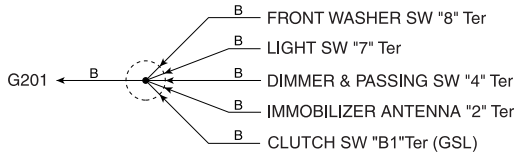


- W/H MAIN



d. JOINT

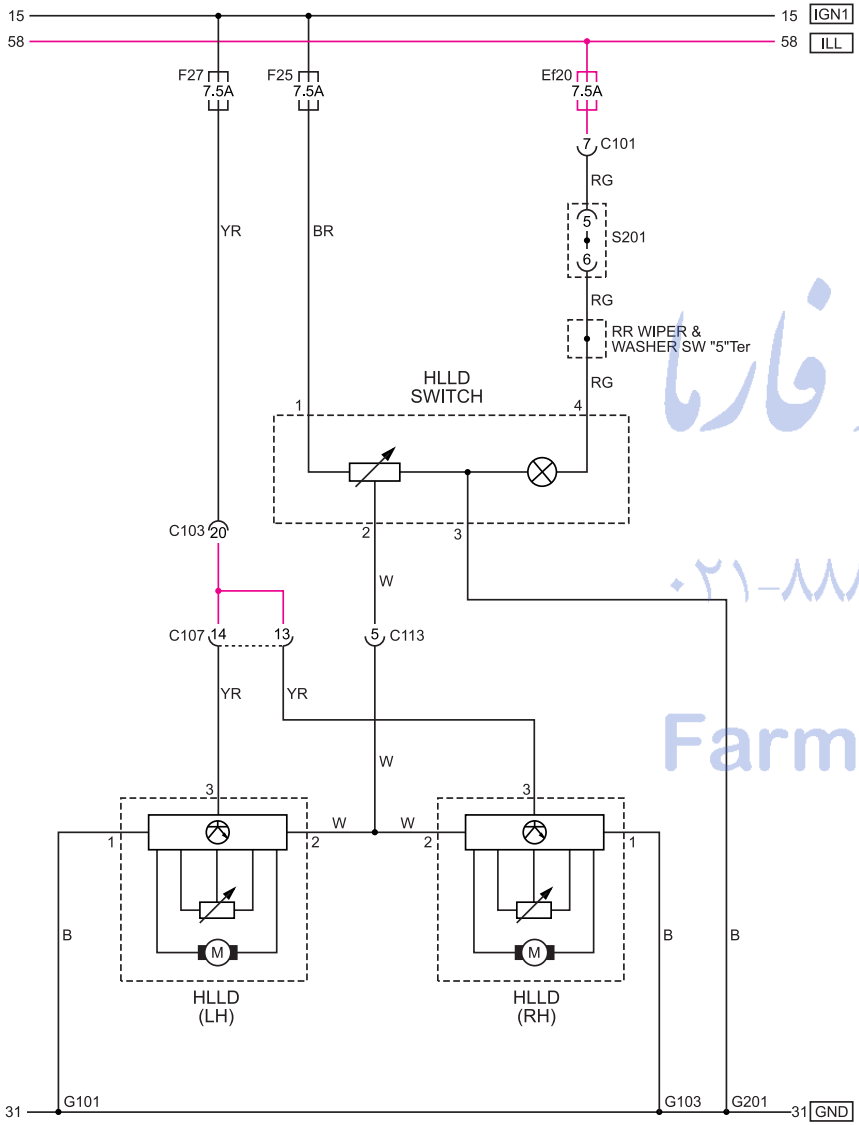
J201



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۶۲۰۸۵
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27. HEAD LAMP LEVELING DEVICE (HLLD)

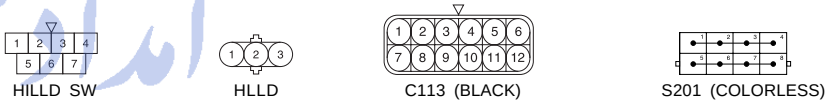
1) GASOLINE

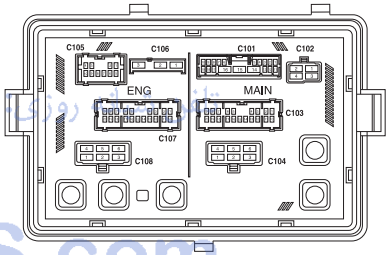


a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C101 (19Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C103 (22Pin, White)	Engine Room Fuse Box -W/H Main	Engine Room Fuse Box
C107 (20Pin, White)	Engine Room Fuse Box -W/H Engine Room	Engine Room Fuse Box
C113 (12Pin, Black)	W/H Engine Room - W/H Main	Next to Hydraulic Unit
S201 (8Pin, Colorless)	W/H Main	Upper Fuse box(Passenger Room)
G101	W/H Engine Room	Left Fender Next to Battery
G103	W/H Engine Room	Right Fender Engine Room
G201	W/H Main	Upper Front Left Leg Room

b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

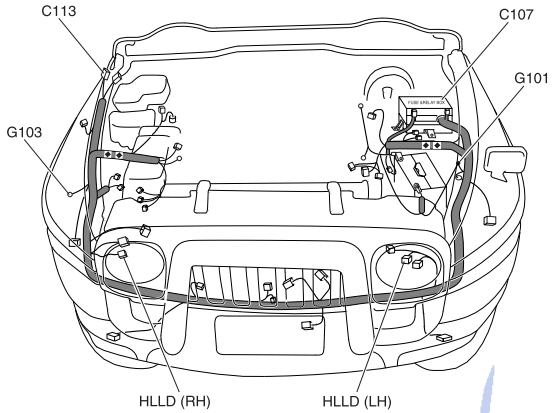




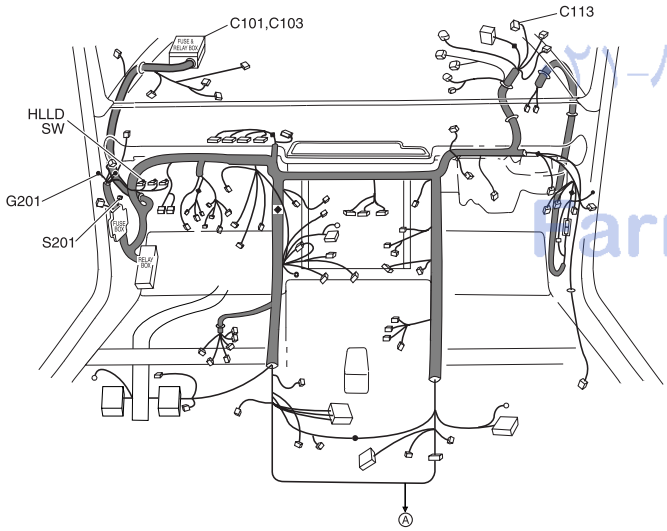
امداد خودرو فارما
۰۲۱-۸۸۴۶۲۰۸۵
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c. POSITION OF CONNECTORS AND GROUNDS

- W/H ENGINE ROOM

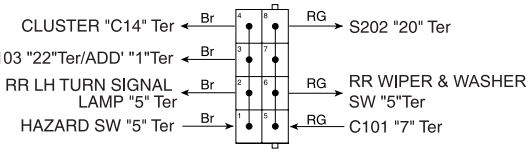


- W/H MAIN



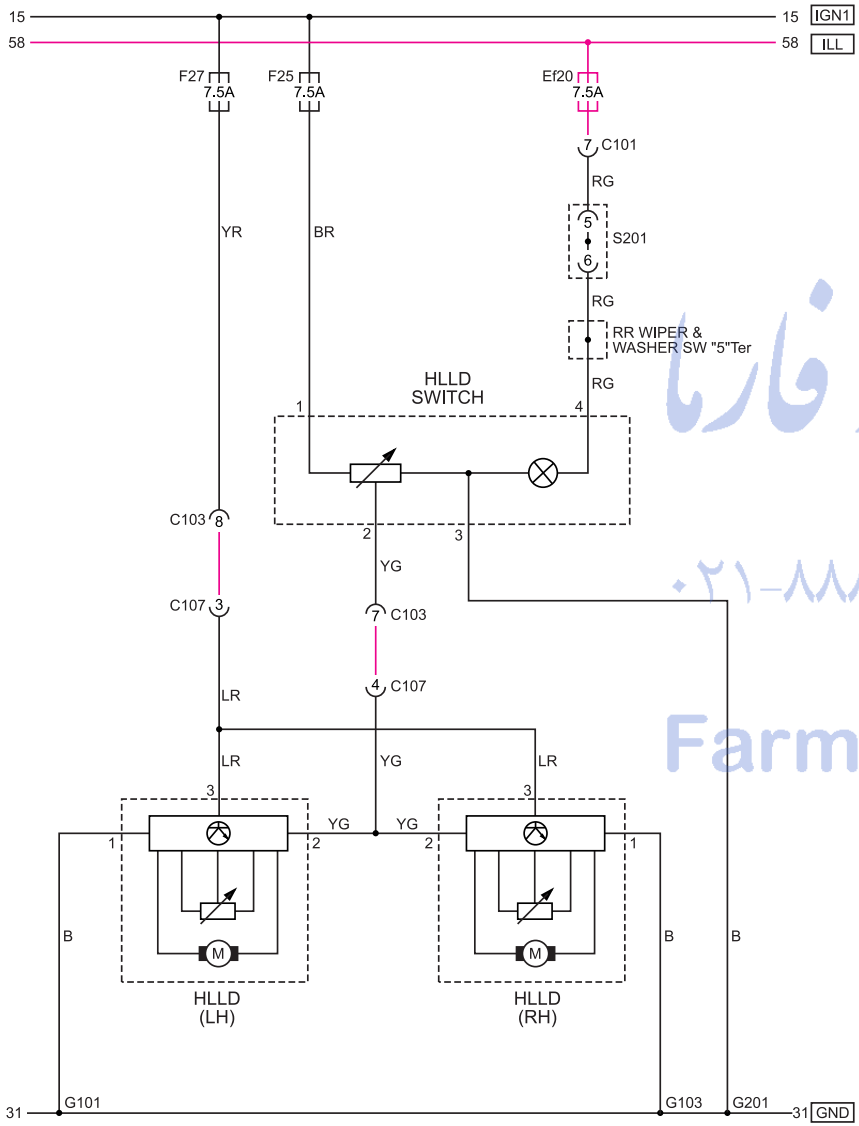
d. SPLICE PACK

S201 (COLORLESS)



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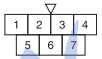
2) DIESEL



a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C101 (19Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C103 (22Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C107 (20Pin, White)	Engine Room Fuse Box - W/H Engine Room	Engine Room Fuse Box
S201 (8Pin, Colorless)	W/H Main	Upper Fuse box(Passenger Room)
G101	W/H Engine Room	Left Fender Next to Battery
G103	W/H Engine Room	Right Fender Engine Room
G201	W/H Main	Upper Front Left Leg Room
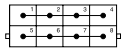
b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION

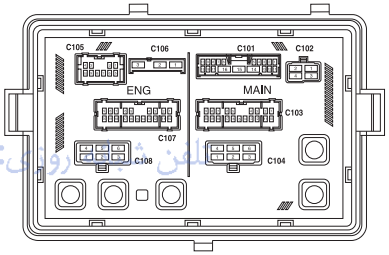


HILLD SW



HLLD

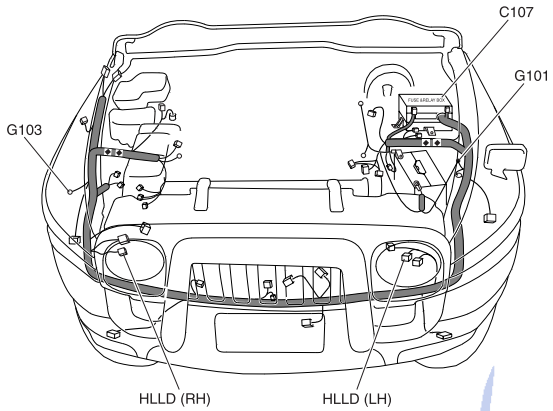

S201 (COLORLESS)



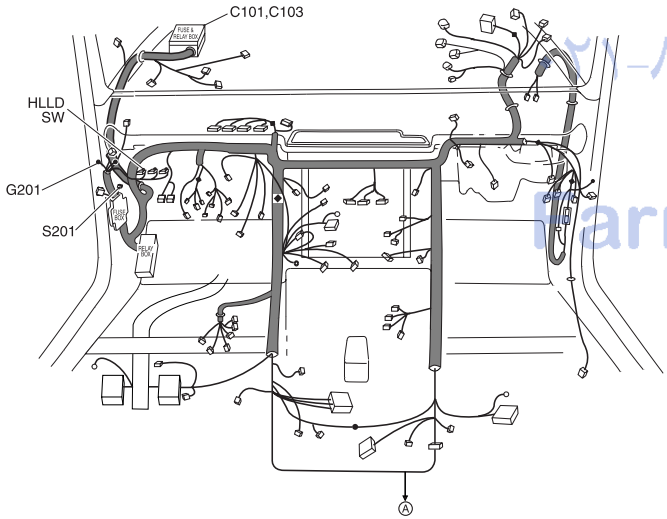
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c. POSITION OF CONNECTORS AND GROUNDS

- W/H ENGINE ROOM

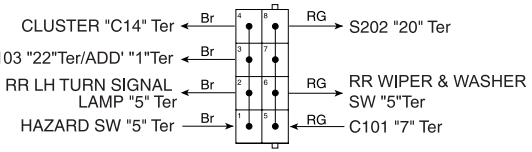


- W/H MAIN



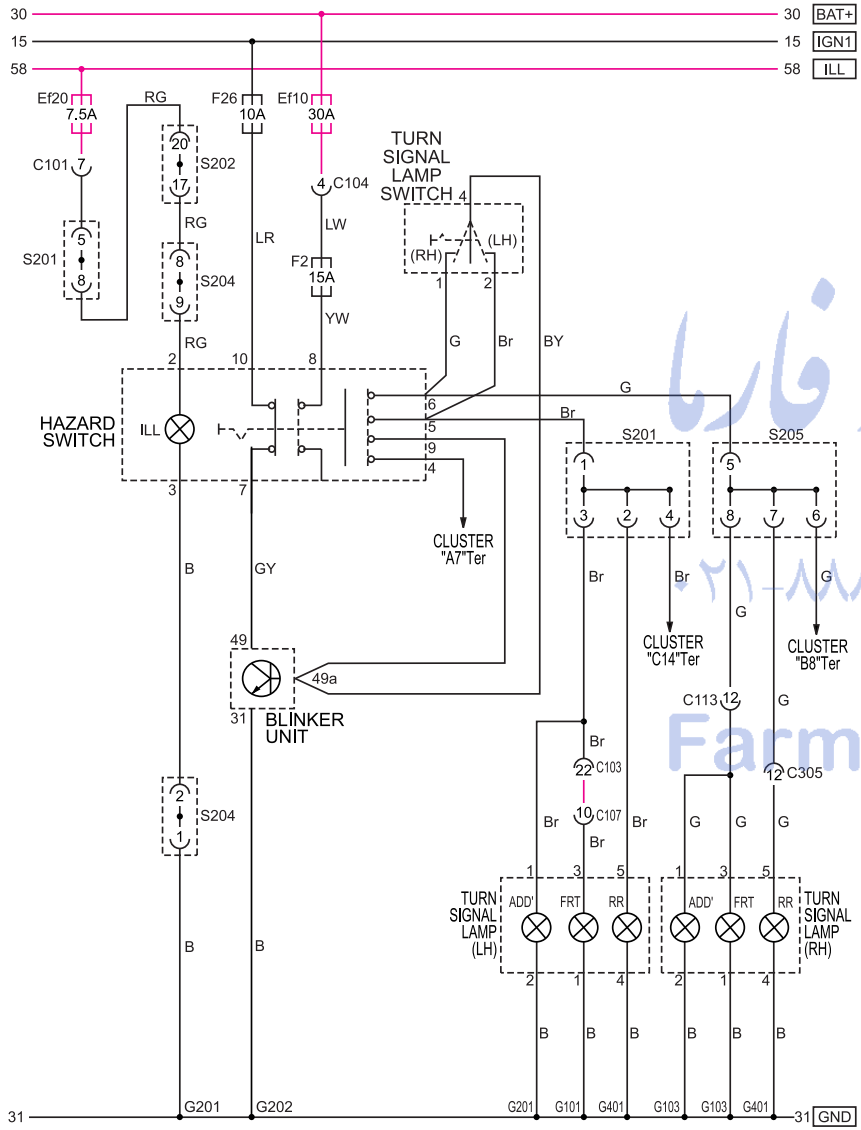
d. SPLICE PACK

S201 (COLORLESS)



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تلفن شبانه روزی: ۰۲۱-۸۸۶۲۰۸۵
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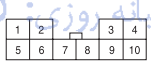
28. TURN SIGNAL LAMP

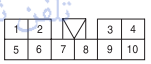


a. CONNECTOR INFORMATION

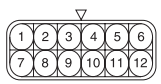
CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C101 (19Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C103 (22Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C104 (8Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C107 (20Pin, White)	Engine Room Fuse Box - W/H Engine Room	Engine Room Fuse Box
C113 (12Pin, Black)	W/H Engine Room - W/H Main	Next to Hydraulic Unit
C305 (14Pin, White)	W/H Main - W/H Main	Below Center Console
S201 (8Pin, Colorless)	W/H Main	Upper Fuse box (Passenger Room)
S202 (20Pin, Black)	W/H Main	Behind Cluster
S204 (14Pin, Colorless)	W/H Main	Behind Audio
S205 (8Pin, Colorless)	W/H Main	Behind Front Right Kick Panel
G101	W/H Engine Room	Left Fender Next to Battery
G103	W/H Engine Room	Right Fender Engine Room
G201	W/H Main	Upper Front Left Leg Room
G202	W/H Main	Upper Front Left Leg Room
G401	W/H Main	Inside Lower Trim Rear Left Quater

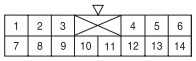
b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION


HAZARD SW

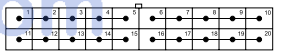

TURN SIGNAL LAMP SW

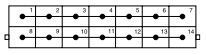

REAR COMBINATION LAMP (TURN SIGNAL LAMP)
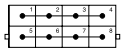

C113 (BLACK)

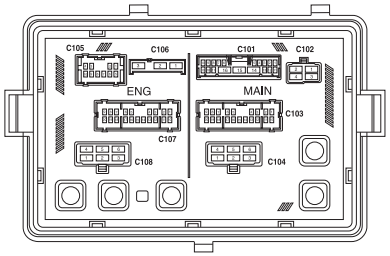

C305 (WHITE)


S201 (COLORLESS)


S202 (BLACK)


S204 (COLORLESS)

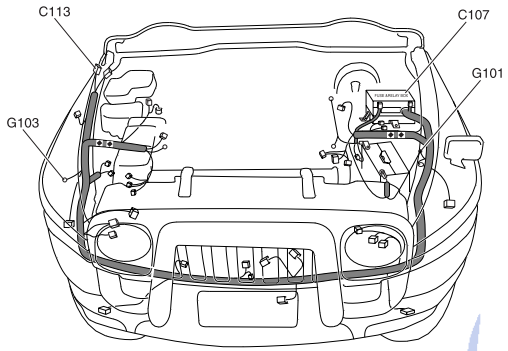

S205 (COLORLESS)



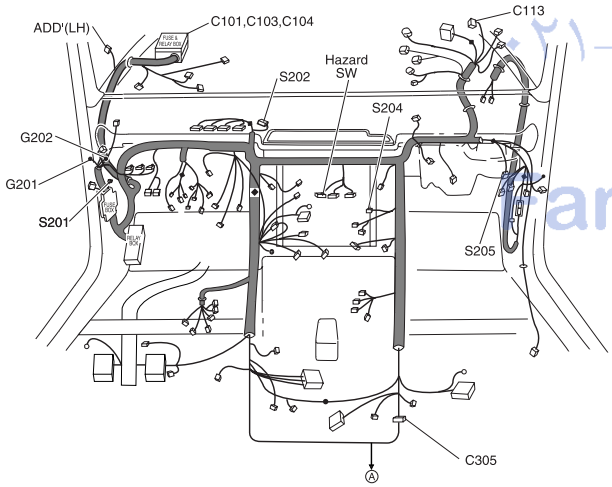
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۰۲۱-۸۸۸۶۲۰۸۵
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c. POSITION OF CONNECTORS AND GROUNDS

- W/H ENGINE ROOM

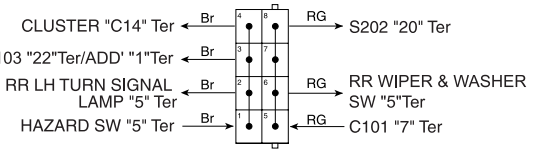


- W/H MAIN

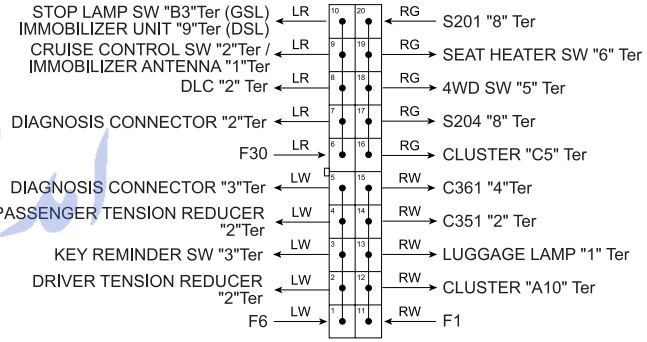


d. SPLICE PACK

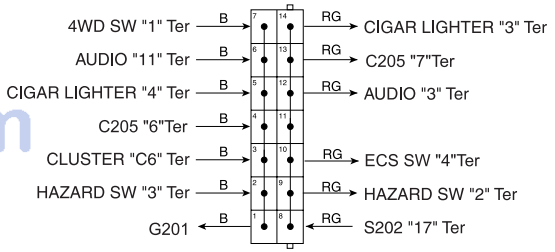
S201 (COLORLESS)



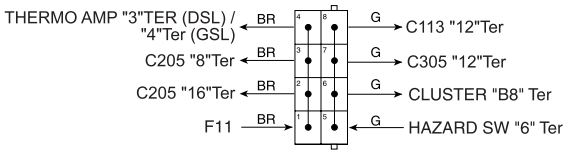
S202 (BLACK)



S204 (COLORLESS)



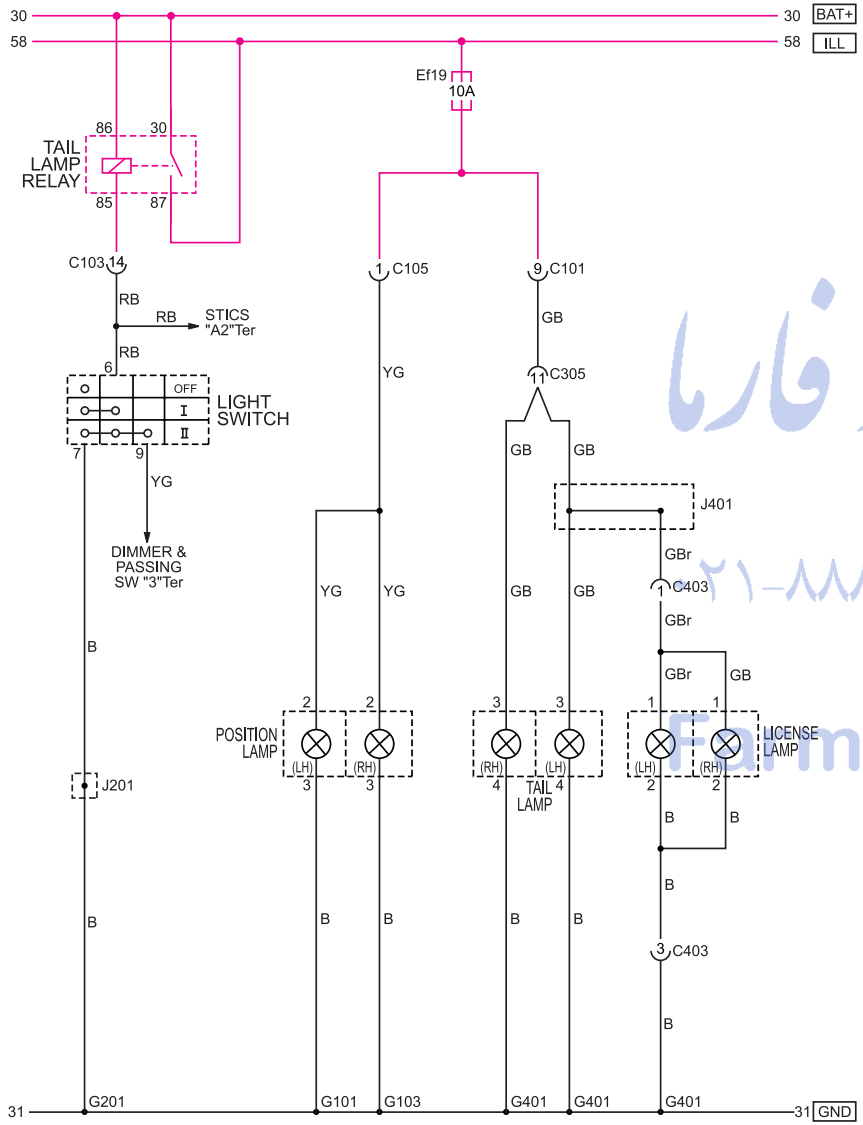
S205 (COLORLESS)



امداد خودرو فارما
تلفن همراه: ۰۹۱۲۱-۸۸۴۶۲۰۸۵
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29. TAIL LAMP RELAY CIRCUIT

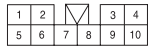
1) POSITION LAMP, TAIL LAMP, LICENSE LAMP



a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C101 (19Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C103 (22Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C105 (10Pin, White)	Engine Room Fuse Box -W/H Engine Room	Engine Room Fuse Box
C305 (14Pin, White)	W/H Main - W/H Main	Below Center Console
C403(3Pin, Black)	W/H Rear Bumper - W/H Main	Inside Rear Bumper
J201	W/H Main	Above FRT LH Seat Under Cover
J401	W/H Main	Below Luggage Lamp
G101	W/H Engine Room	Left Fender Next to Battery
G103	W/H Engine Room	Right Fender Engine Room
G201	W/H Main	Upper Front Left Leg Room
G401	W/H Main	Inside Lower Trim Rear Left Quater

b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



LIGHT SW



POSITION LAMP



REAR COMBINATION LAMP (TURN SIGNAL LAMP)



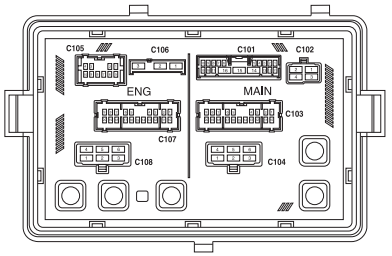
LICENSE LAMP



C305 (WHITE)



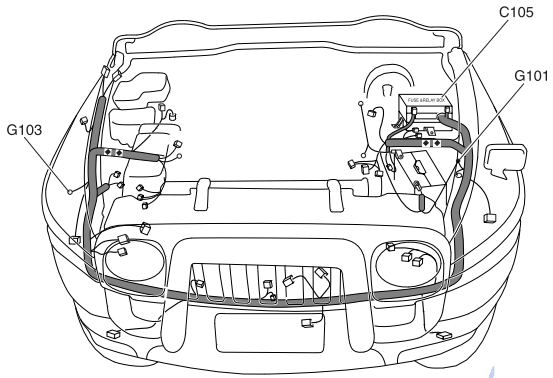
C403 (BLACK)



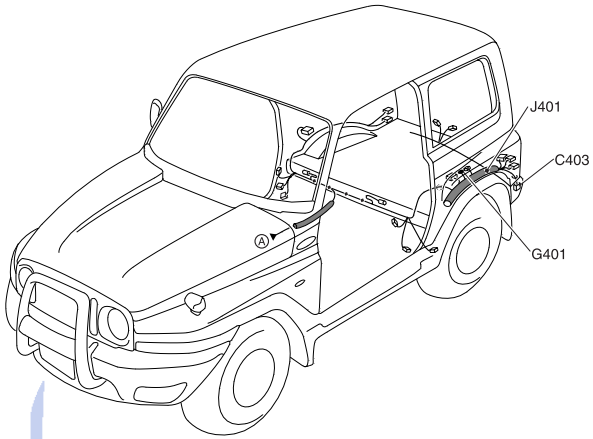
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c. POSITION OF CONNECTORS AND GROUNDS

- W/H ENGINE ROOM

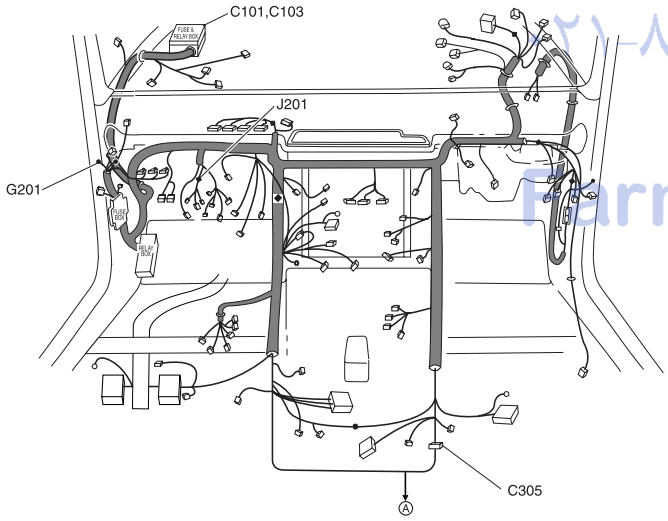


- W/H MAIN (FLOOR)



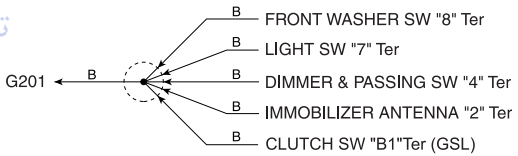
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- W/H MAIN

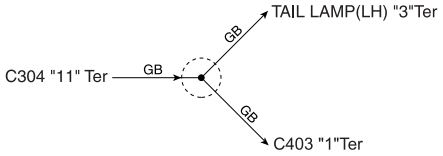


d. JOINT

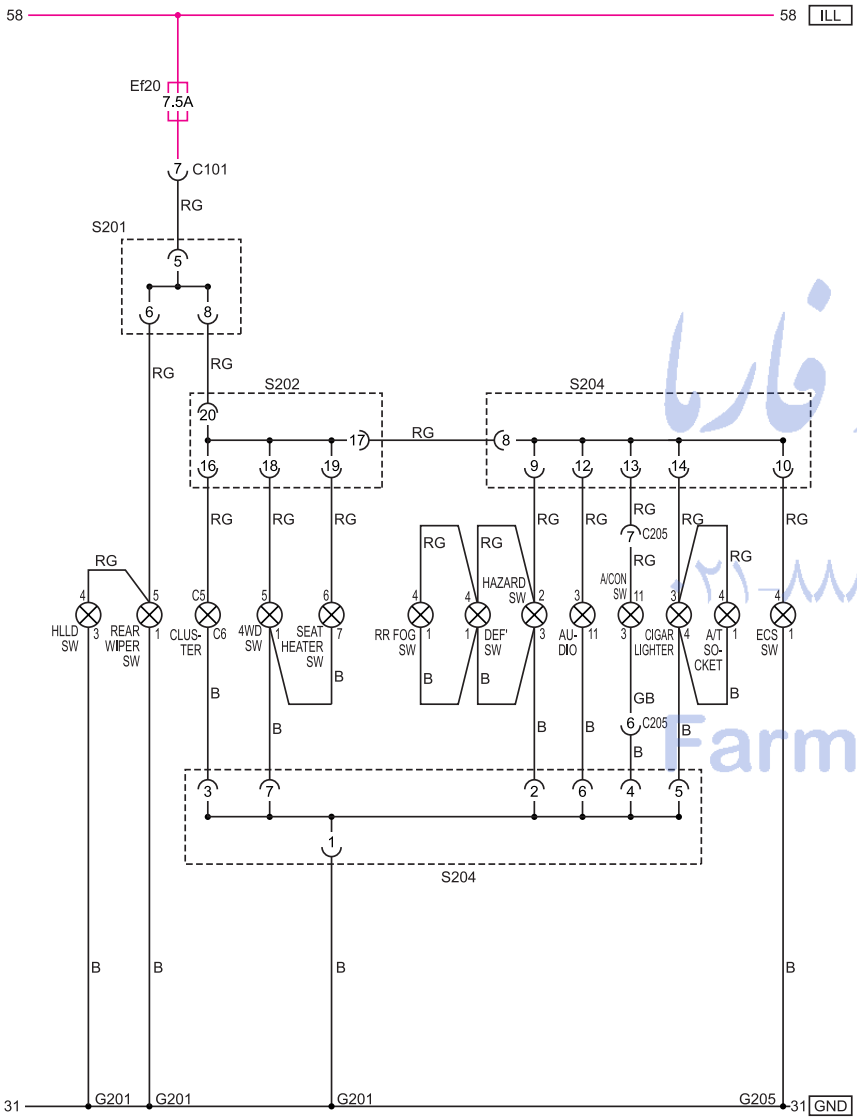
J201



J401



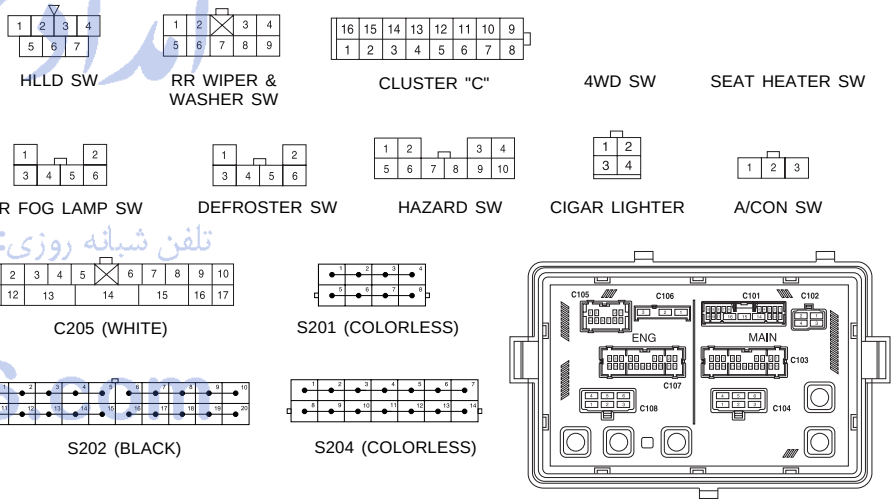
2) ILLUMINATION SWITCH



a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C101 (19Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C205 (17Pin, White)	W/H Main -- W/H Air Conditioner	Upper Evaporator
S201 (8Pin, Colorless)	W/H Main	Upper Fuse Box(Passenger Room)
S202 (20Pin, Black)	W/H Main	Behind Cluster
S204 (14Pin, Colorless)	W/H Main	Behind Audio
G201	W/H Main	Upper Front Left Leg Room
G205	W/H Main	Center "A" Pillar Front Right

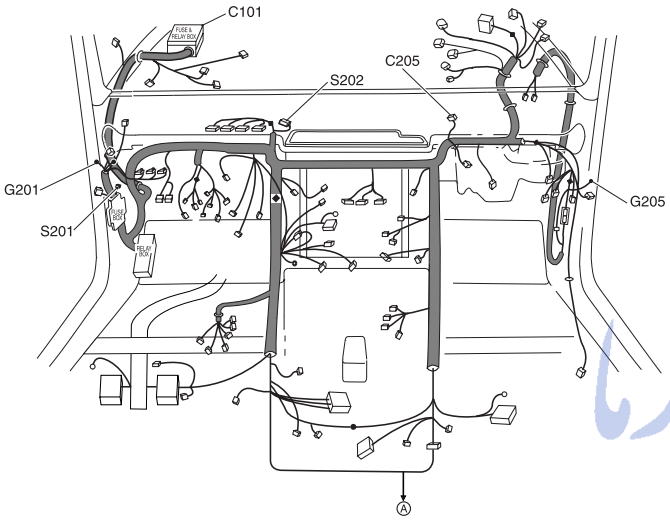
b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



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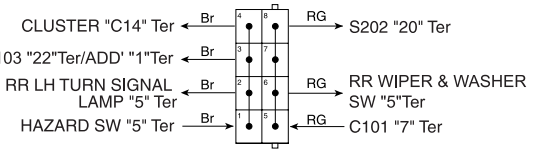
c. POSITION OF CONNECTORS AND GROUNDS

- W/H MAIN

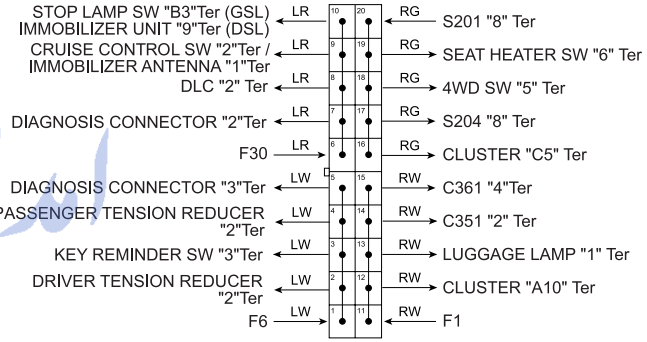


d. SPLICE PACK

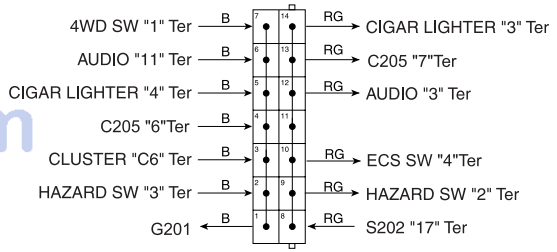
S201 (COLORLESS)



S202 (BLACK)

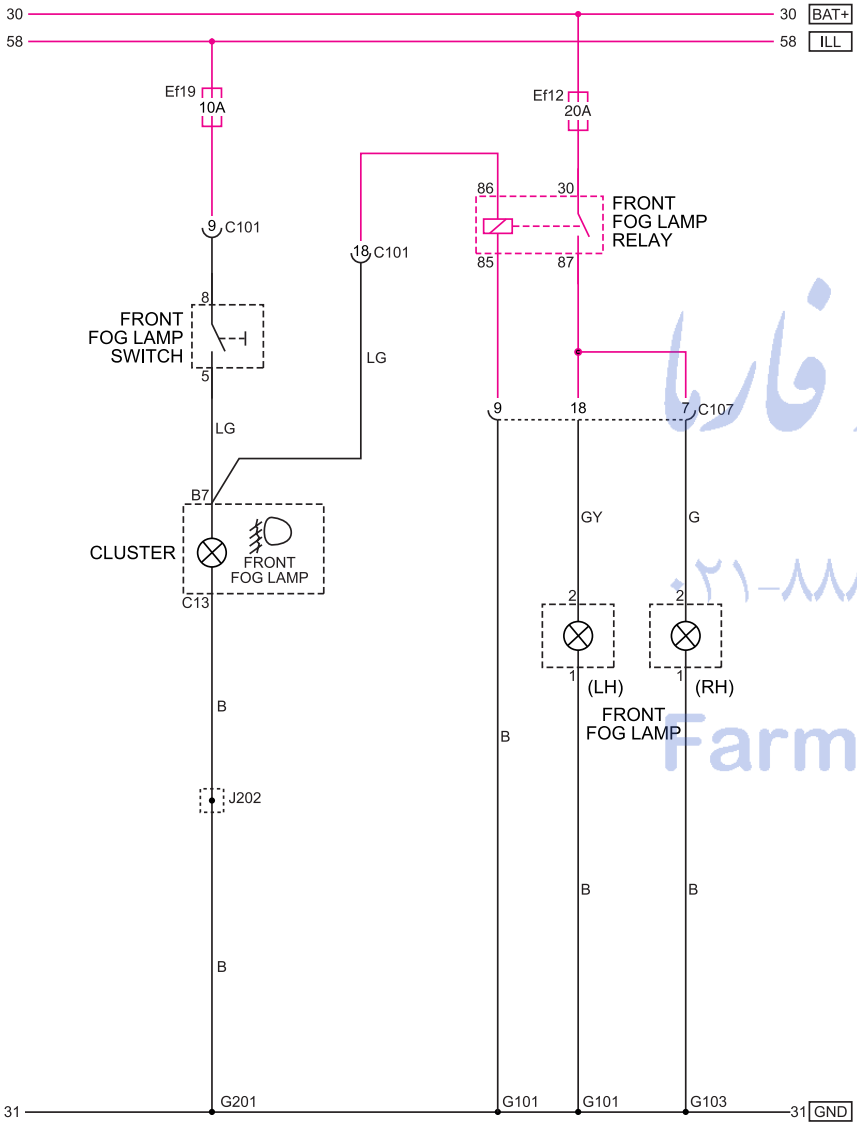


S204 (COLORLESS)



امداد خودرو فارما
۰۲۱-۸۸۸۶۲۰۸۵
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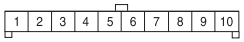
30. FRONT FOG LAMP



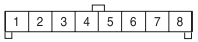
a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C101 (19Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C107 (20Pin, White)	Engine Room Fuse Box - W/H Engine Room	Engine Room Fuse Box
J202	W/H Main	Behind Cluster
G101	W/H Engine Room	Left Fender Next to Battery
G103	W/H Engine Room	Right Fender Engine Room
G201	W/H Main	Upper Front Left Leg Room

b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



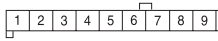
CLUSTER "A"



CLUSTER "B"



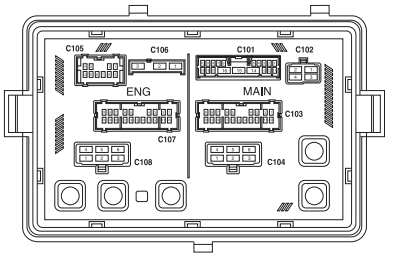
CLUSTER "C"



CLUSTER "D"



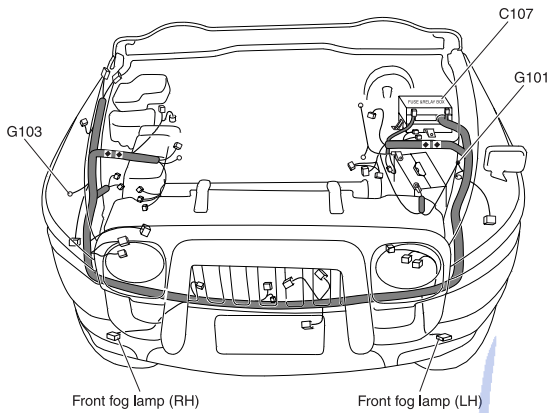
FRONT FOG LAMP



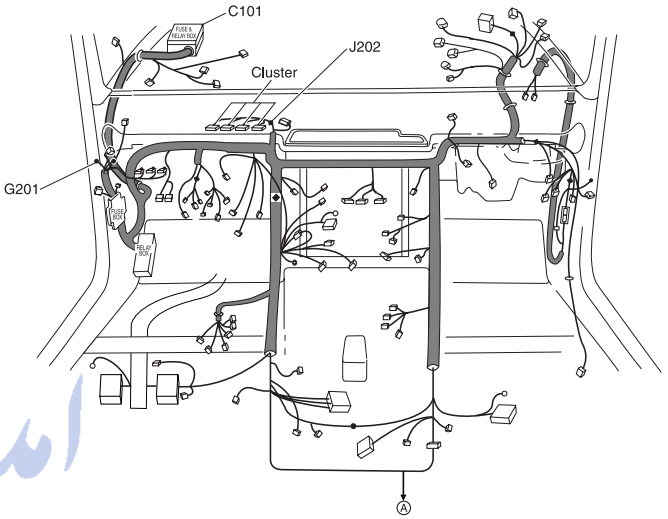
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c. POSITION OF CONNECTORS AND GROUNDS

- W/H ENGINE ROOM

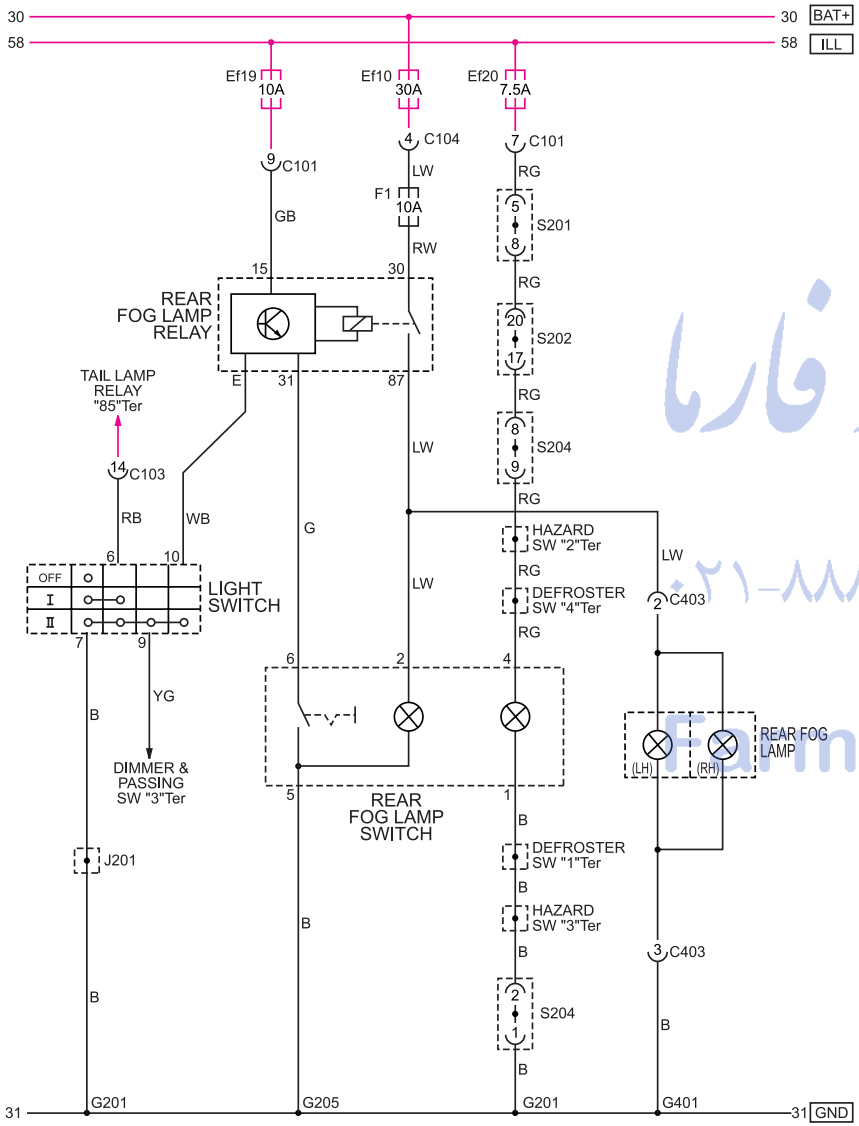


- W/H MAIN



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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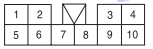
31. REAR FOG LAMP



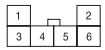
a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C101 (19Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C103 (22Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C104 (8Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C403(3Pin, Black)	W/H Rear Bumper - W/H Main	Inside Rear Bumper
S201 (8Pin, Colorless)	W/H Main	Upper Fuse Box(Passenger Room)
S202 (20Pin, Black)	W/H Main	Behind Cluster
S204 (14Pin, Colorless)	W/H Main	Behind Audio
J201	W/H Main	Above FRT LH Seat Under Cover
G201	W/H Main	Upper Front Left Leg Room
G205	W/H Main	Center "A" Pillar Front Right
G401	W/H Main	Inside Lower Trim Rear Left Quater

b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



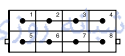
LIGHT SW



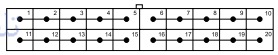
RR FOG LAMP SW
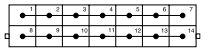


C403 (BLACK)



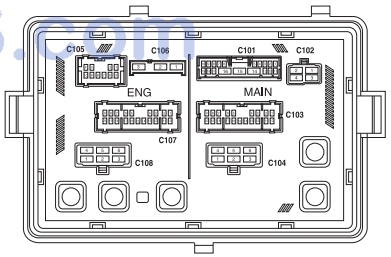
S201 (COLORLESS)



S202 (BLACK)



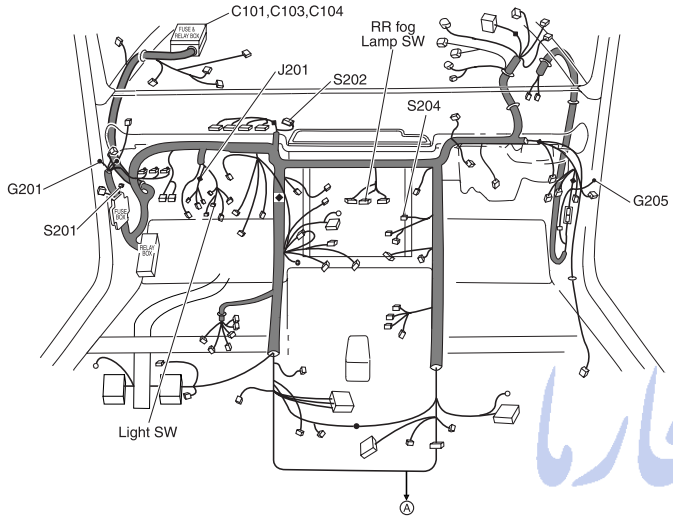
S204 (COLORLESS)



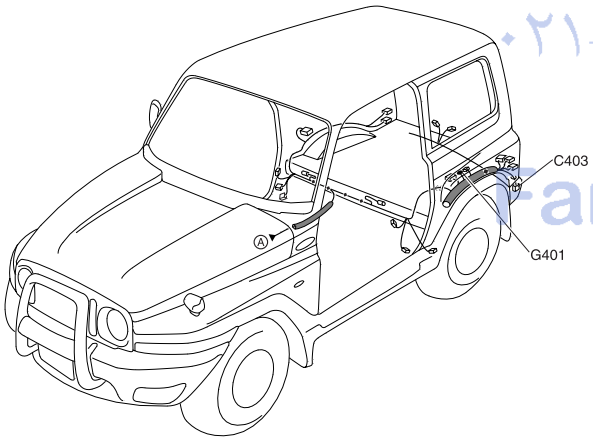
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۰۲۱-۸۸۴۶۲۰۸۵
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c. POSITION OF CONNECTORS AND GROUNDS

- W/H MAIN

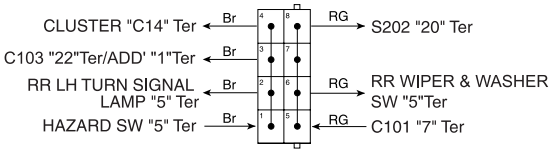


- W/H MAIN (FLOOR)

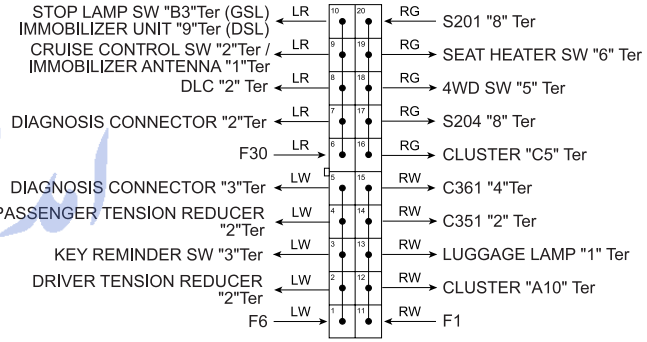


d. SPLICE PACK

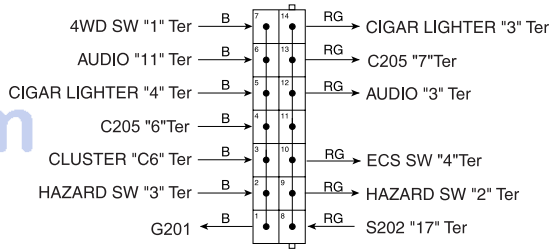
S201 (COLORLESS)



S202 (BLACK)

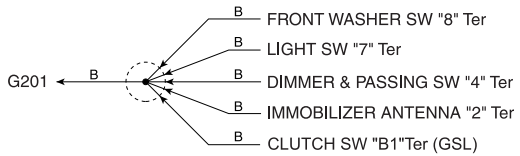


S204 (COLORLESS)



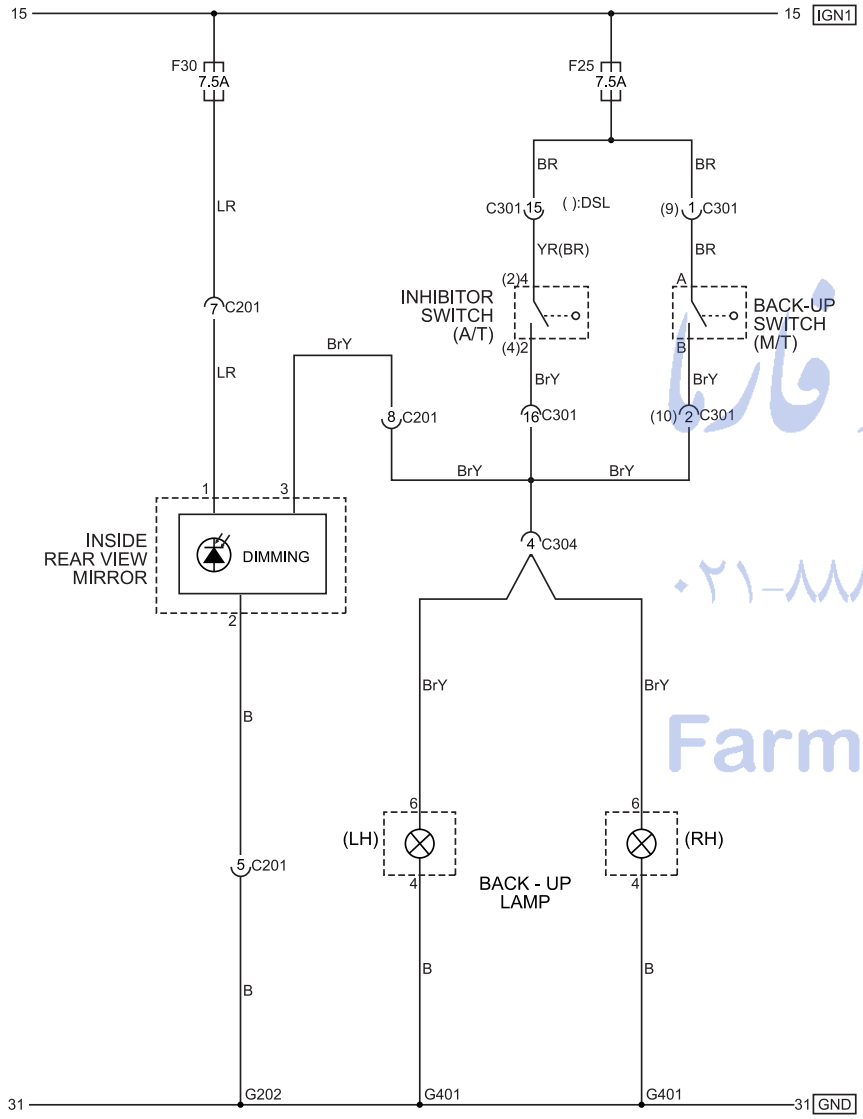
e. JOINT

J201



امداد خودرو فارما
۰۲۱-۸۸۸۶۲۰۸۵
FarmaSOS.com

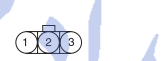
32. INSIDE REAR VIEW MIRROR (DIMMING) & BACK-UP LAMP



a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
	W/H Main - W/H Transmission	Lower "A" Piller (Upper ECM)
	W/H Main - W/H Transmission	Upper Transfer Case
	W/H Main - W/H Seat Heater	Below Driver Seat
	W/H Main	Upper Front Left Leg Room
	W/H Main	Inside Lower Trim Rear Left Quater

b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION


INSIDE REAR VIEW MIRROR


INHIBITOR SW

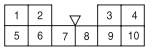

BACK UP LAMP SW


REAR COMBINATION LAMP (BACK UP LAMP)


C201 (WHITE)


C301 A/T (BLACK)

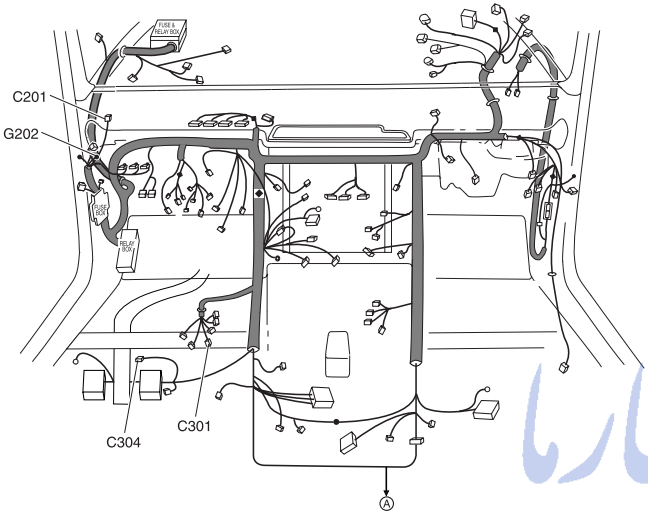

C301 M/T(BLACK)


C304 (WHITE)

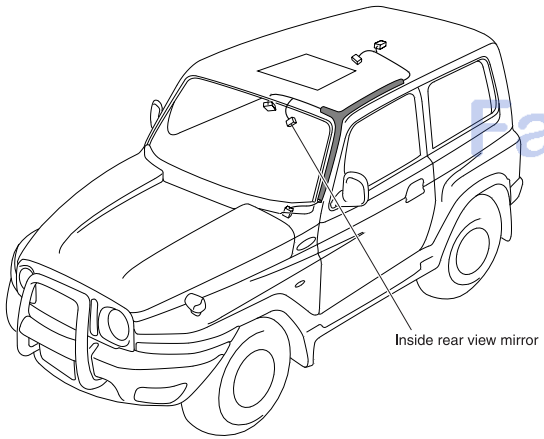
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۰۲۱-۸۸۴۶۲۰۸۵ تلفن نسخه رونوی
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c. POSITION OF CONNECTORS AND GROUNDS

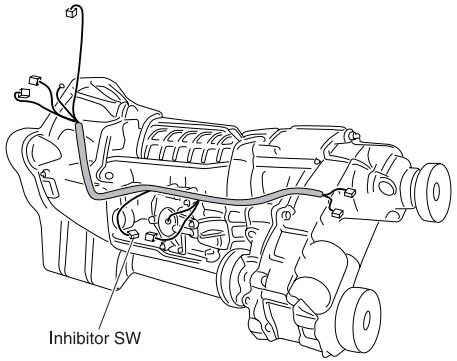
- W/H MAIN



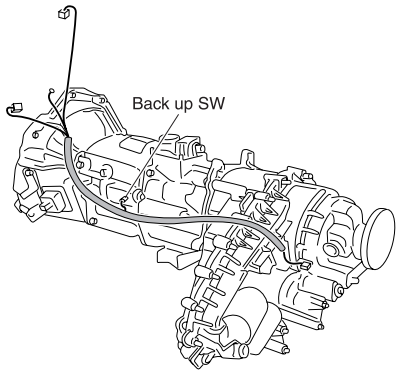
- W/H ROOF



- W/H TRANSMISSION (AUTOMATIC TRANSMISSION)

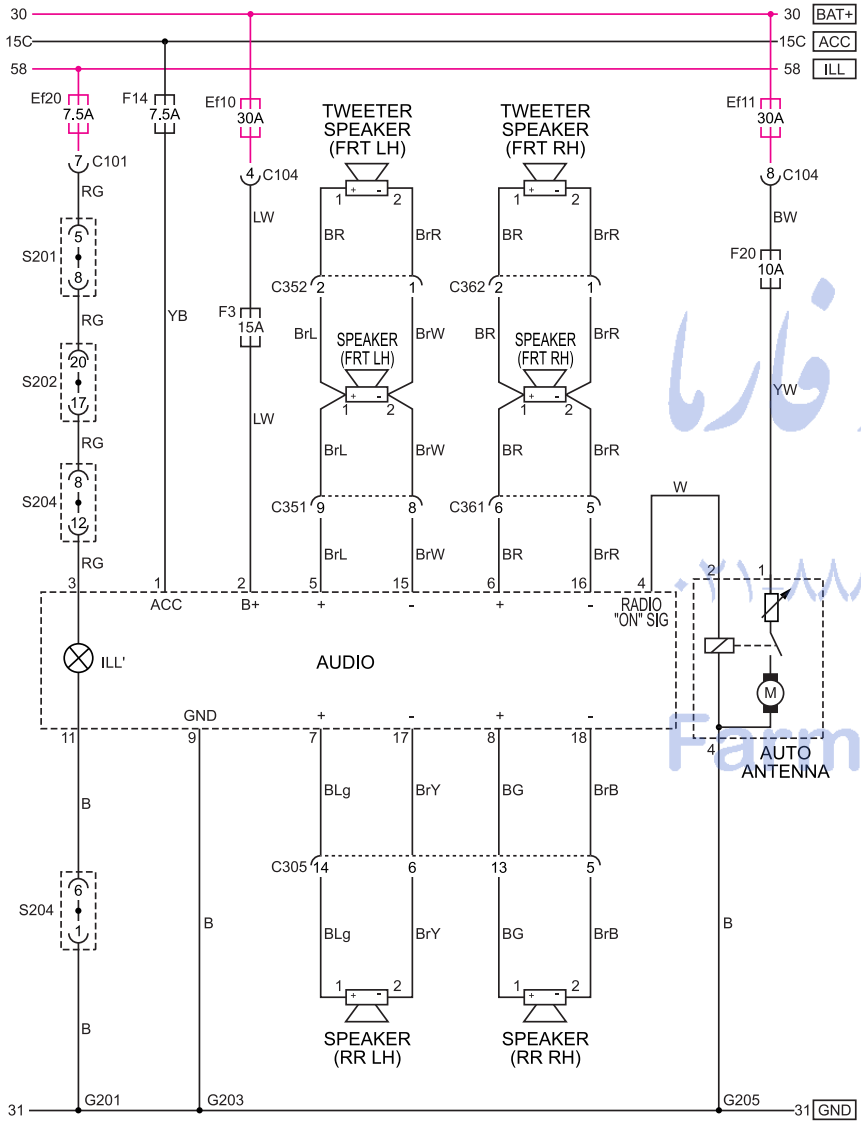


- W/H TRANSMISSION (MANUAL TRANSMISSION)



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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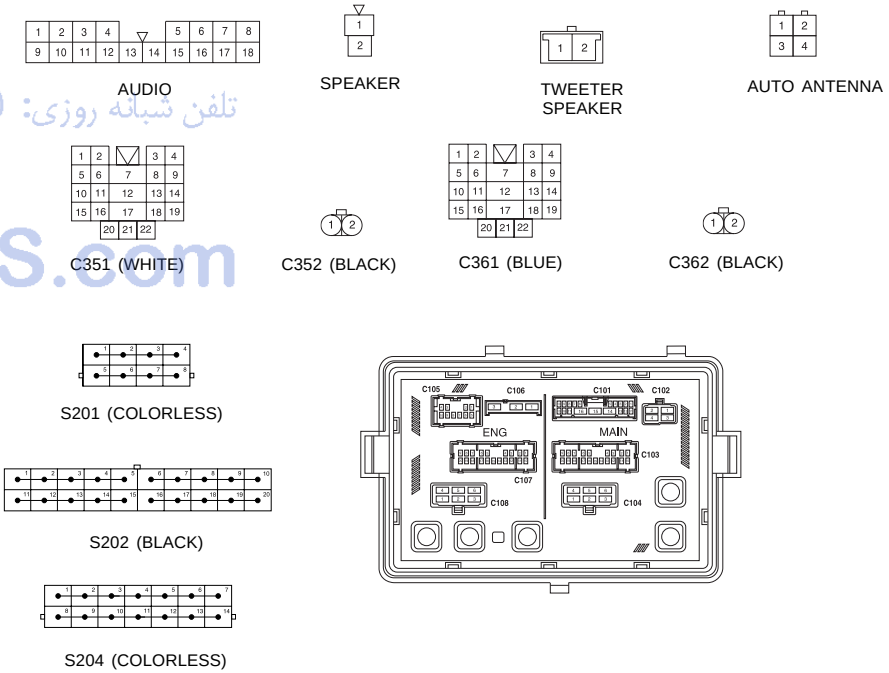
33. AUDIO



a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C101 (19Pin, White)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C104 (8Pin, Colorless)	Engine Room Fuse Box - W/H Main	Engine Room Fuse Box
C351 (22Pin, White)	W/H Main - W/H FRT LH Door	Upper Fuse Box(Passenger Room)
C352 (2Pin, Black)	W/H FRT LH Door - W/H Speaker	Inside FRT LH Door Trim
C361 (22Pin, Blue)	W/H Main - W/H FRT RH Door	Behind Front Right Panel
C362 (2Pin, Black)	W/H FRT RH Door - W/H Speaker	Inside FRT RH Door Trim
S201 (8Pin, Colorless)	W/H Main	Upper Fuse Box(Passenger Room)
S202 (20Pin, Black)	W/H Main	Behind Cluster
S204 (14Pin, Colorless)	W/H Main	Behind Audio
G201	W/H Main	Upper Front Left Leg Room
G203	W/H Main	Left Upper Center Facia
G205	W/H Main	Center "A" Pillar Front Right

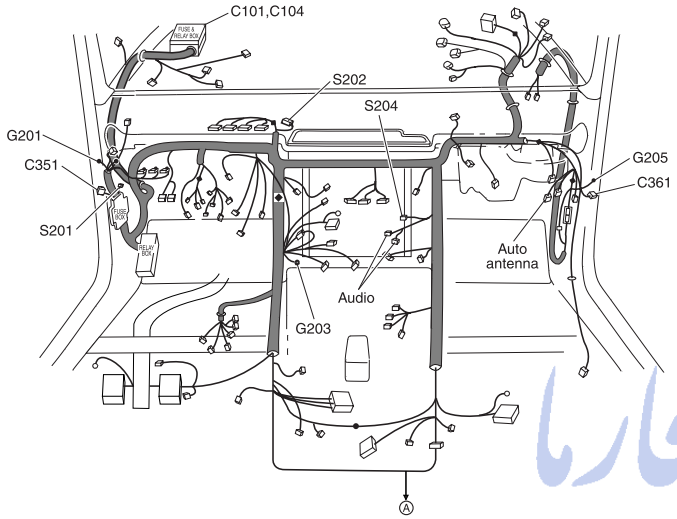
b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



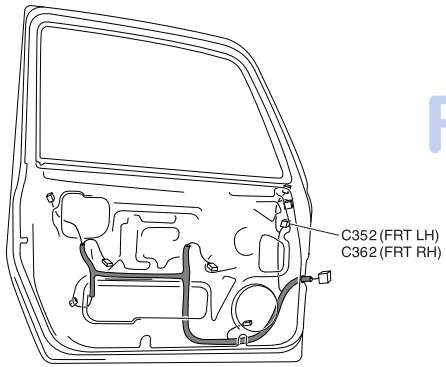
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c. POSITION OF CONNECTORS AND GROUNDS

- W/H MAIN

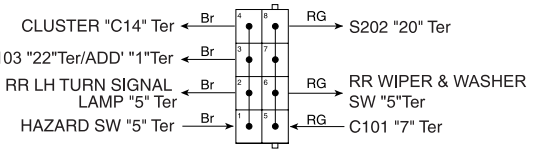


- W/H DOOR

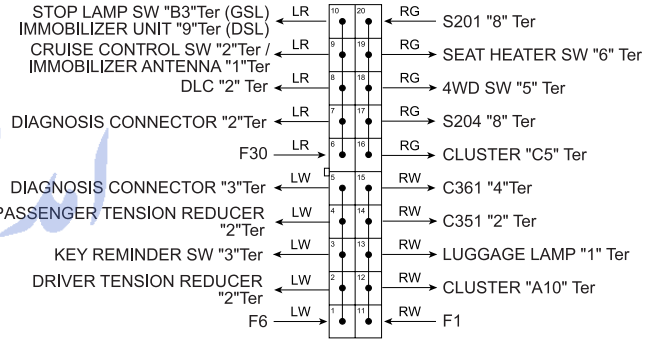


d. SPLICE PACK

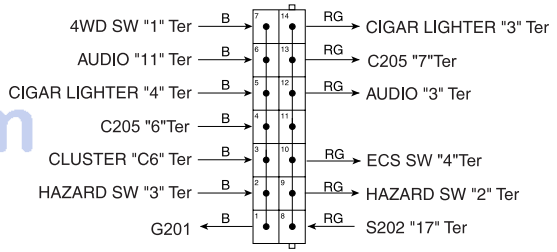
S201 (COLORLESS)



S202 (BLACK)

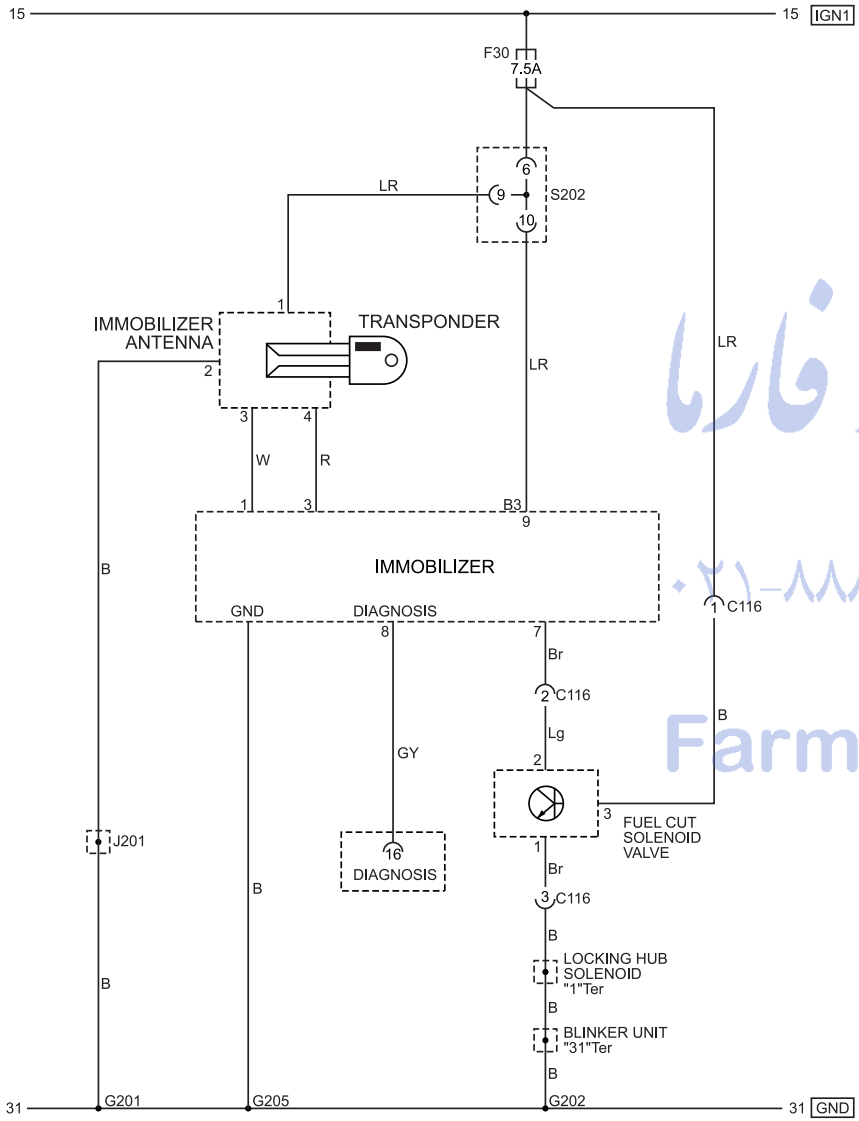


S204 (COLORLESS)



امداد خودرو فارما
۰۲۱-۸۸۸۶۲۰۸۵
FarmaSOS.com

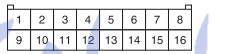
34. IMMOBILIZER SYSTEM (DIESEL : VDO)



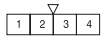
a. CONNECTOR INFORMATION

CONNECTOR(NUMBER)	CONNECTING. WIRING HARNESS	CONNECTOR POSITION
C116 (3Pin, Black)	W/H Main - W/H Fuel Cut Solenoid	Next to Engine Room Fuse Box
S202 (20Pin, Black)	W/H Main	Behind Cluster
J201	W/H Main	Behind Cluster
G201	W/H Main	Upper Front Left Leg Room
G202	W/H Main	Upper Front Left Leg Room
G205	W/H Main	Center "A" Pillar Front Right

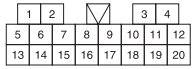
b. CONNECTOR IDENTIFICATION SYMBOL & PIN NUMBER POSITION



IMMOBILIZER UNIT



IMMOBILIZER ANTENNA



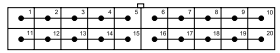
DIAGNOSIS CONNECTOR



FUEL CUT SOLENOID VALVE



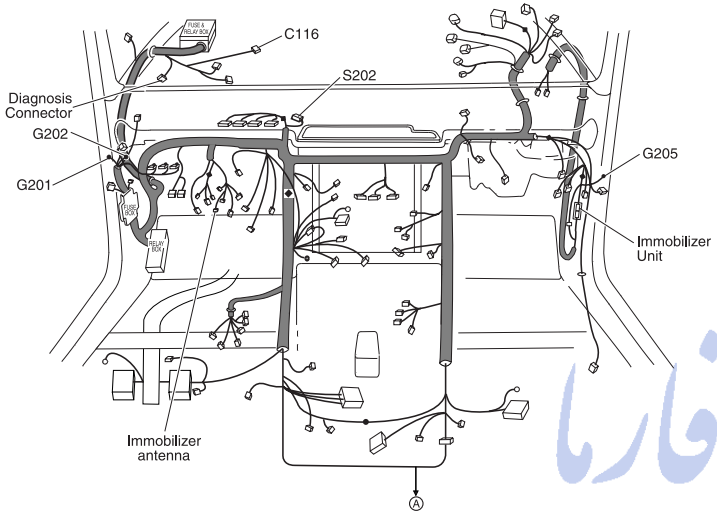
C116 (BLACK)


S202 (BLACK)

امداد خودرو فارما
۰۲۱-۸۸۶۲۰۸۵ تلفن شبانه روزی:
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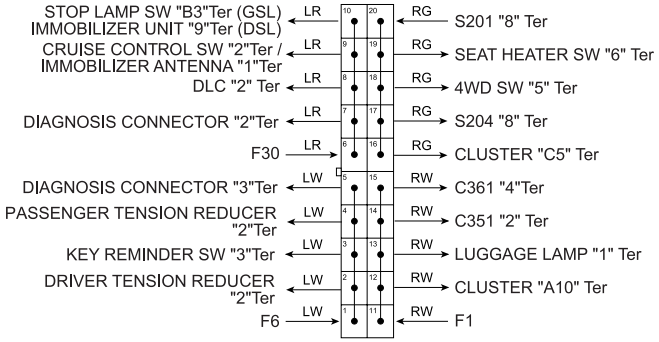
c. POSITION OF CONNECTORS AND GROUNDS

- W/H MAIN



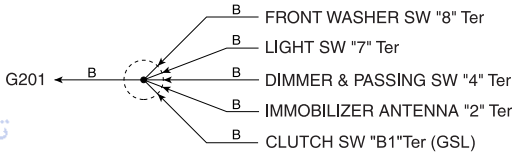
d. SPLICE PACK

S202 (BLACK)



e. JOINT

J201



امداد خودرو فارما
تلفن شبانه روزی: ۰۲۱-۸۸۸۶۲۰۸۵
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