7 Steering System

7.1 Warnings and Notices

7.1.1 Warnings and Notices

Anti-Corrosion Materials

Warning!

Notice: If the power steering system has been serviced, an accurate fluid level reading cannot be obtained unless air is bled from the steering system. The air in the fluid may cause pump cavitation noise and may cause pump damage over a period of time.

Power Steering Hose Disconnected

Warning!

Notice: Do not start the vehicle with any power steering gear inlet or outlet hoses disconnected. When disconnected, plug or cap all openings of components. Failure to do so could result in contamination or loss of power steering fluid and damage to the system.

Steering Wheel in the Full Turn Position

Warning!

Notice: Do not hold the steering wheel in the full turn position longer than 5 s, as damage to the steering pump may result.

Using Proper Power Steering Fluid

Warning!

Notice: When adding fluid or making a complete fluid change, always use DEXRON¢. Failure to use the proper fluid will cause hose and seal damage and fluid leaks.

7.2 Hydraulic Power Steering System

7.2.1 Specifications

7.2.1.1 Fastener Tightening Specifications

Applications	Model	Specifications	
		Metric (Nm)	US English (lb-ft)
Intermediate Shaft Assembly Bolt	M8 × 30	25-28	18.5-20.7
Power Steering Assembly Tie Rod Right Assembly Bolt	M12 × 58	53-63	39.2-46.6
Power Steering Assembly Tie Rod Left Assembly Bolt	M12 × 33	53-58	39.2-43.0
Steering Tie Rod End Lock Nut	M12	69-79	50.9-58.3
Steering Tie Rod Ball Joint Locking Nut	M12	33-43	24.4-31.9
Power Steering Outlet Pipe to Subframe and Crossmember Retaining Bolts	M6 × 14	10-12	7.4-8.9
Power Steering Pipe to Crossmember Retaining Bolts	M6 × 30	10-12	7.4-8.9
Power Steering High Pressure Pipe to Power Steering Pump Retaining Bolts	M6 × 20	10-12	7.4-8.9
Power Steering Assembly Bolts	M10 × 122	50-55	37.0-40.7
Power Steering Pump Assembly Nuts	M10	50-55	37.0-40.7
Inlet Pipe Connecting Nut (to Power Steering Pump Assembly)	M16	38-44	28.1-32.6
Inlet Pipe Connecting Nut (to Steering)	M16	41-49	30.2-36.1
Outlet Pipe Connecting Nut (to Steering)	M17	41-49	30.2-36.1
Power Steering Pump Assembly Pulley Assembly Retaining Nut	M12	72-92	53.1-67.7

7.2.1.2 General Specifications

Applications	Specifications	
	Metric	US English
System Pressure Difference (Straight Direction)	490 kPa or less	71 psi or less
Idle System Pressure (Full Turn Position)	Greater Than or Equal To 8,000 kPa	Greater Than or Equal To 928 psi
Approximate Fluid Capacity (Entire Power Steering System)	0.9 L	4.58 pt

Applications	Type	Specifications
Fluid	Power Steering Fluid	DEXRON III

7.2.2 Description and Operation

7.2.2.1 Description and Operation

Warning!

Refer to "Steering Wheel in the Full Turn Position Notice" in "Warnings and Notices".

Warning!

Before disconnecting the mechanical steering column assembly with the power steering gear, the wheels should be kept in the straight front positions and the mechanical steering column assembly must be in the LOCK (lock) position.

After disconnecting the above components, do not move front tires and wheels, otherwise it will cause some parts are not positioned correctly during the installation process and lead to mechanical steering column airbag assembly spiral off center position, and damage the airbag spiral coil.

Power Steering Pump Assembly Instructions

Power steering pump assembly provides hydraulic pressure for the whole steering system, and it is a vane-type pump.

Power steering pump assembly consists the following components:

- Pump Housing
- Impeller Pump Rotor
- Pump Impeller Blades
- Impeller Pump Front Side Panel
- Impeller Shaft
- Impeller Shaft Bearings
- Fluid Pressure Switch Assembly
- Flow Control Valve Assembly
- Fluid Pipe
- Fluid Seals and O-ring

Following components are installed in the pump housing side hole :

- Fluid Pipe
- Fluid Pressure Switch Assembly
- Flow Control Valve Assembly

Flow control valve assembly consists of the following components:

- Filling Joints
- Flow Control Valve
- Flow Control Valve Compression Spring

Flow control valve hole and the outlet connector is an integrated part. Flow control valve's primary role is to prevent high steering pump pressure.

Power Steering Gear Assembly Instructions

Power steering gear assembly uses the rack and pinion hydraulic power steering.

When turning the steering wheel, steering wheel movement is passed to the steering control valve shaft, steering control valve axle pinion and rack mesh, so the rack moves left and right.

Power steering gear assembly has a steering control valve. Steering control valve assembly introduces high pressure fluid from the power steering pump to both sides of the rack piston to move the rack piston. Integral power cylinder piston and rack connection can convert rack piston hydraulic pressure to linear force and move the rack. linear force is transmitted to the inner and outer steering tie rod, and then passed to the steering knuckle, which turns the wheel.

If the auxiliary hydraulic fails, manually control steering will require much greater effort.

Power Steering Fluid Description

Warning!

After adding or completely replace the power steering fluid, make sure use the correct power steering fluid. using the incorrect power steering fluid will cause damage to hoses and seals, and oil leaks. Refer to this chapter for recommended power steering fluid.

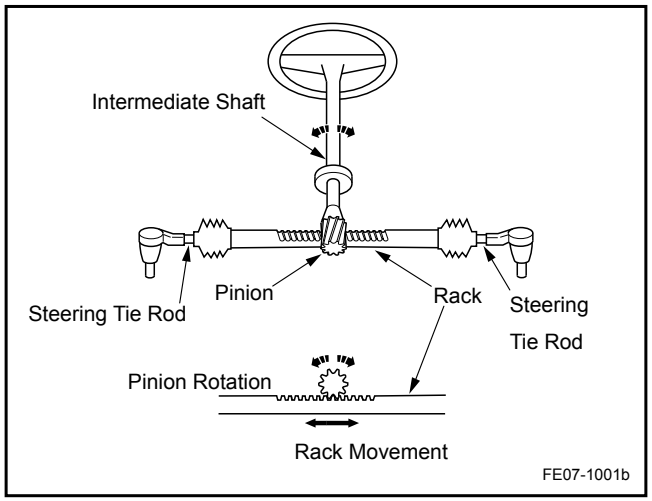
Power steering fluid reservoir and pipe assembly is made from plastic, and the fluid level within the reservoir can be seen from outside. There are fluid level mark on the fluid reservoir side. The marks are used to indicate the power steering fluid level.

Make sure use proper power steering fluid. Refer to .

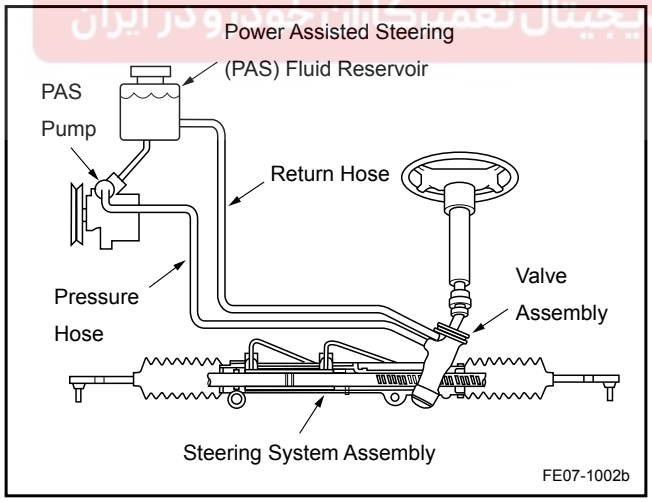
- After preheating the power steering fluid, its temperature is about 75 °C -80 °C (167-176 ºF). Power steering fluid level should be between "HOT-MAX" and "HOT-MIN".
- After cooling the power steering fluid, its temperature is about 20 °C -25 °C (68-77 ºF). Power steering fluid level should be between "COLD-MAX" and "COLD-MIN".

7.2.3 System Working Principle

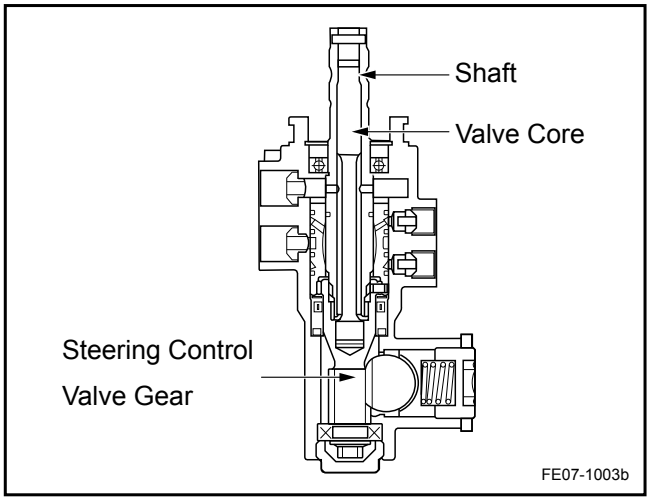
7.2.3.1 Hydraulic Power Rack and Pinion Steering Working Principle



When there is no hydraulic pressure assistance, the steering working principle is as shown in the graphic. The torque applied on the steering wheel, passes through the intermediate shaft to the steering drive gear (steering control valve gear), because the drive gear tooth (steering control valve gear tooth) and the rack teeth are in meshing state, it will convert the torque to rack linear force, move the rack. Linear force passes through the inner and outer steering tie rod, to the steering knuckle, which steers the wheel.



Rack and pinion with hydraulic pressure assistance steering system is as shown in the graphic. The mechanical rack and pinion steering, steering cylinder and steering control valve are designed to be integrated to form the integral power steering system. Power cylinder piston and the rack is made as a whole, the power cylinder is divided into about two chambers.

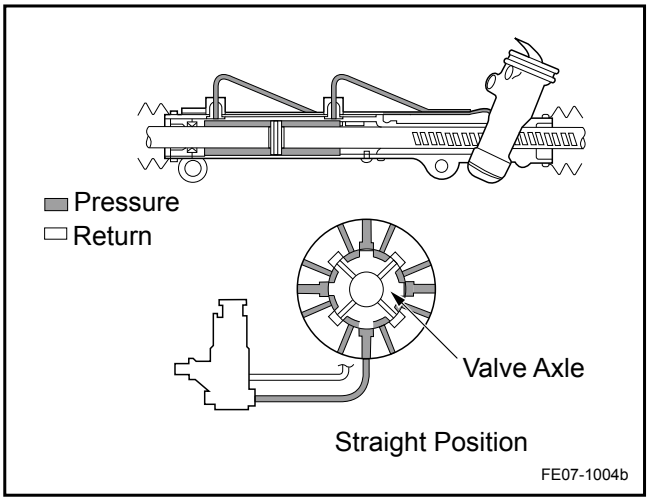


When the steering wheel is not turned, the steering control valve is in the middle position, fluid the master cylinder flows through the steering control valve inlet into the valve cavity. As the steering control valve is in the middle position, so that power cylinder two chamber are connected. The fluid flows from the steering control valve outlet to to the fluid reservoir, so the hydraulic power does not work.

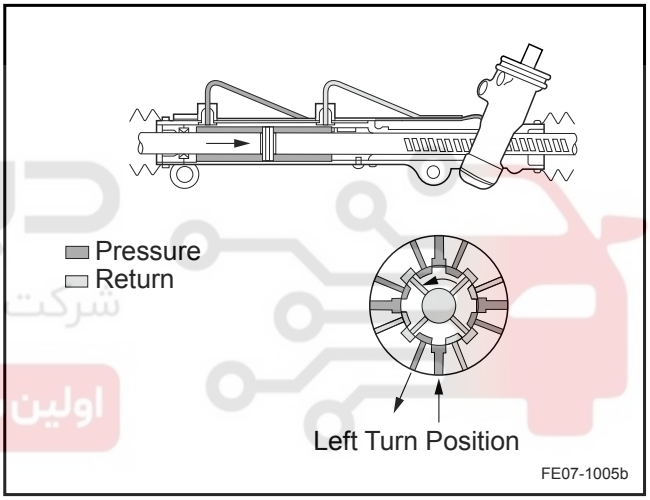
When turning the steering wheel, the steering shaft, together with the steering control valve spool rotation, as transmitted by the steering knuckle arm of the road turning resistance, power cylinder piston and the rack can not be a temporary movement, it turned to control valve and steering gear before they can rotate with the shaft. In this way, transmitted by the steering shaft torque steering control valve gear steering control valve can only produce a little to reverse the deformation of the torsion bar, so that, together with the steering shaft steering control valve control valve spool to shift gears produce a relatively small rotation, thereby steering control valve to the side of power cylinder high-pressure chamber into the oil chamber into the other side of the back cavity has become the low-pressure oil chamber. The role of the high-powered hydraulic cylinder piston force to help force the steering gear steering control valve to the side of the mobile rack, and steering control valve and steering gear shaft itself began to rotate in the same direction. Continue as long as the steering wheel rotation, the torsional deformation of torsion bar has been unchanged, the role of steering control valve is also the same help. Once the steering wheel to stop turning, power cylinder side of the cavity of the high hydraulic forces temporarily continue to exist, led to a shift control valve gear continues to rotate, so that reduces the deformation of torsion bars, until the torsion bar to return to its natural state. Steering control valve back to the middle position, left and right power cylinder interlinked, so that hydraulic power does not work. At this point, steering wheel that is docked in a position without moving, then the wheels to maintain a certain corner. If rotating steering wheel, hydraulic power also play a role.

Power cylinder piston suffered a hydraulic pressure into linear force to help the rack and move around, through the steering horizontal rod to promote the steering knuckle and the wheels turning.

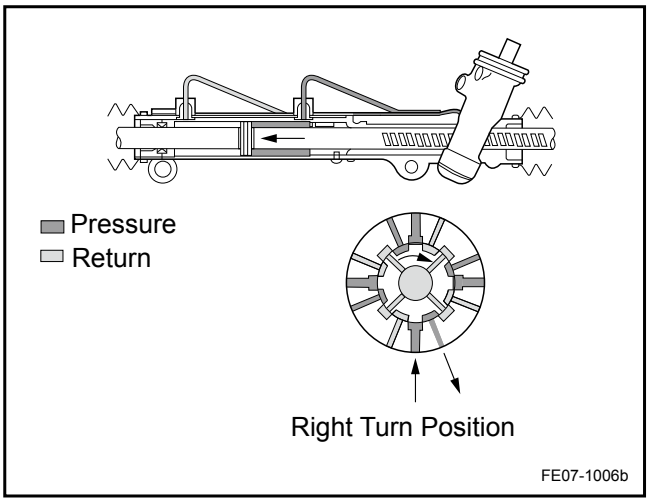
Control Valve In the Middle



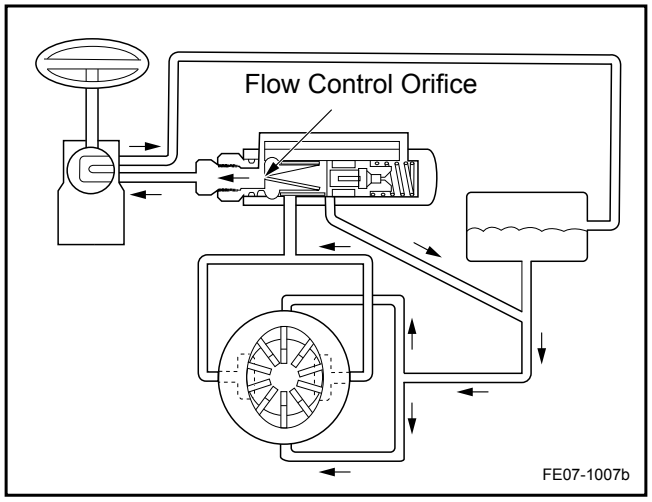
Control Valve Turning Left



Control Valve Turning Right



7.2.3.2 Power Steering Pump Assembly Working Principle

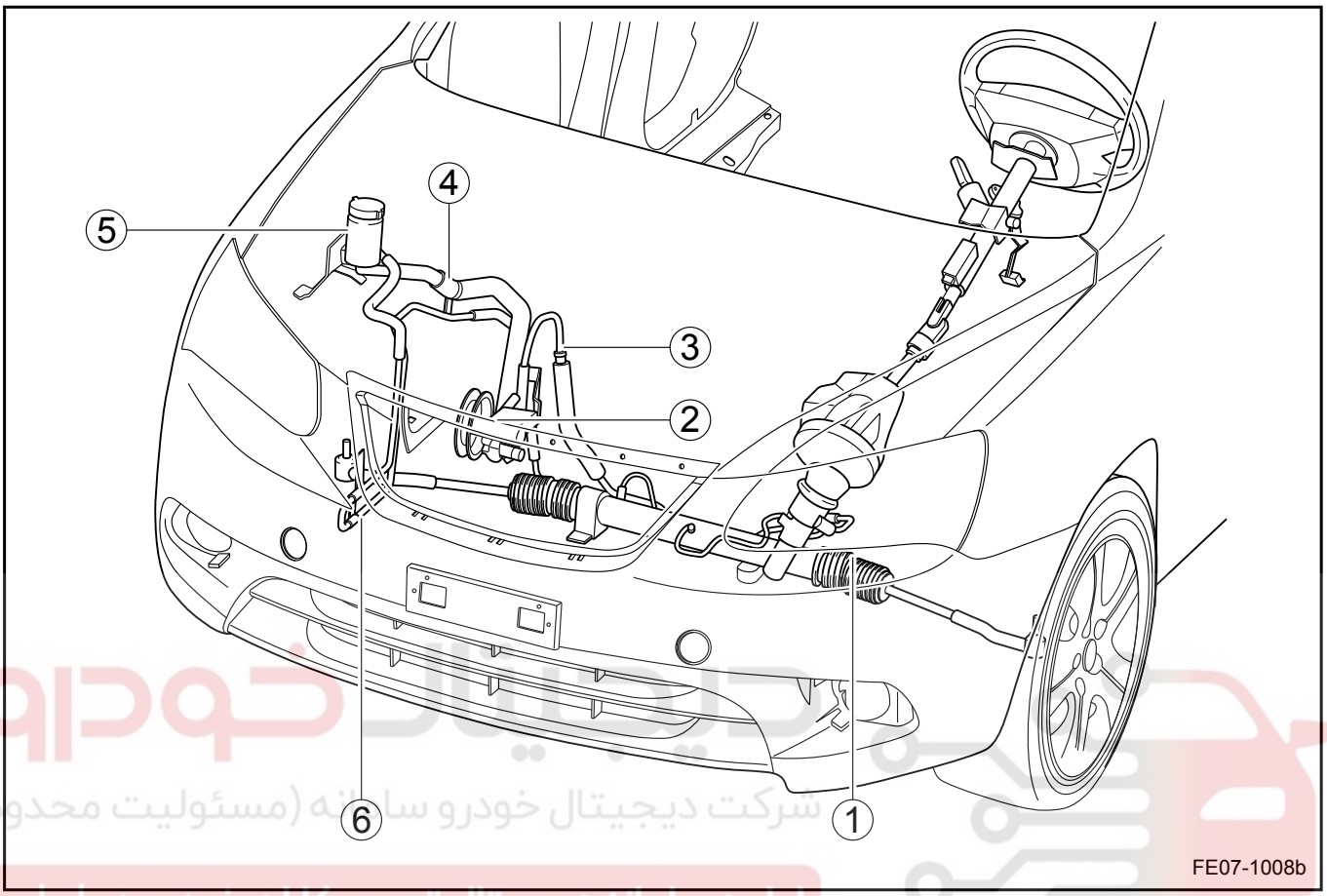


Power steering pump is a blade power steering pump and its working principle is as shown in the graphic. The engine rotating torque is delivered through the drive belt to the power steering pump belt drive assembly and rotates the power steering pump assembly drive shaft and the rotor. Blades installed on the rotor are thrown out due to the centrifugal force, rotate close to the pump ring (rear pump housing) wall, draw the steering fluid from the fluid reservoir to the pump chamber, and press the fluid through the flow control valve to the steering gear, provide power steering hydraulic assistance.

Flow control valve regulates the steering gear fluid flow based on the system fluid pressure. adjust the system fluid pressure. Prevent the system hydraulic pressure being too high.

7.2.4 Component Locator

7.2.4.1 Component Locator

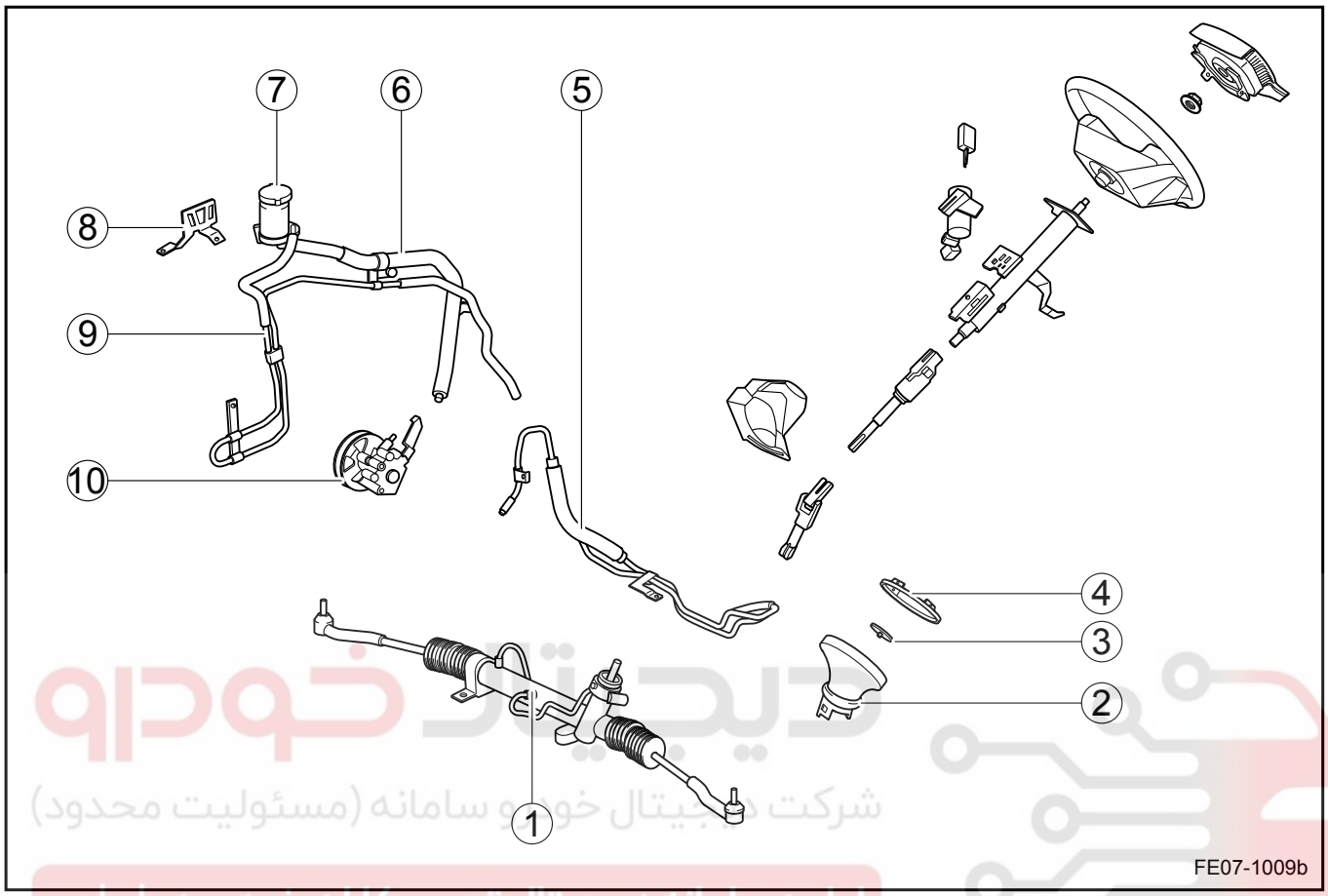


Legend

1. Power Steering Gear and Rack Assembly
2. Power Steering Pump Assembly
3. Power Steering Inlet/Outlet Pipe/Hose Assembly (to Steering Gear, Power Steering Pump)
4. Power Steering Inlet/Outlet Pipe/Hose Assembly (to Power Steering Pump, Reservoir)
5. Power Steering Pipe with Fluid Reservoir Assembly
6. Power Steering Inlet/Outlet Pipe/Hose Assembly (to Steering Gear, Reservoir)

7.2.5 Disassemble View

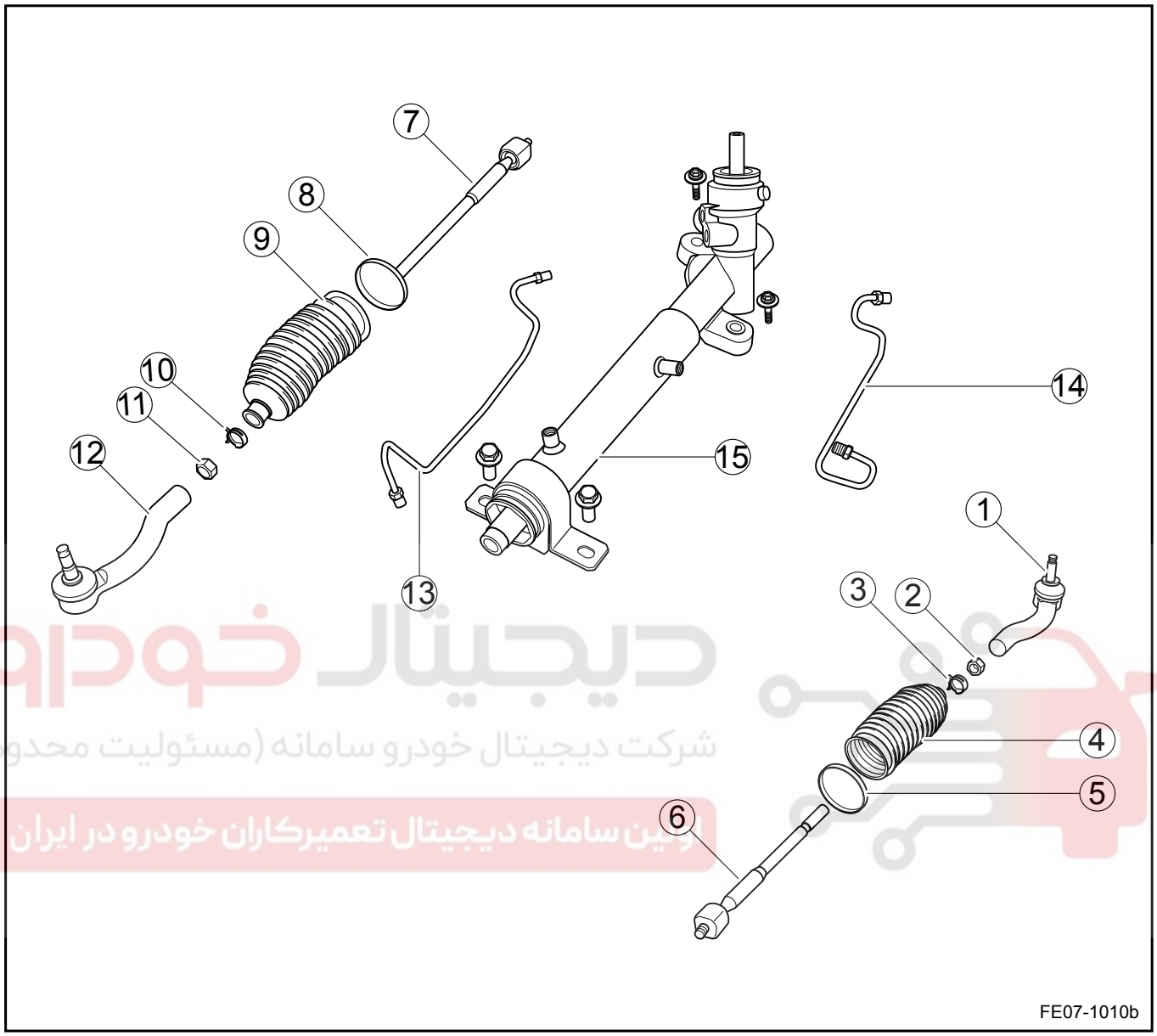
7.2.5.1 Disassemble View



Legend

1. Power Steering Gear and Rack Assembly
2. Steering Dust Cover
3. Washer
4. Steering Dust Cover Liner
5. Power Steering Inlet/Outlet Pipe Assembly
6. Power Steering Inlet/Outlet Pipe Assembly (Fluid Inlet)
7. Power Steering Pipe with Fluid Reservoir Assembly
8. Fluid Reservoir Bracket
9. Power Steering Inlet/Outlet Pipe Assembly (Fluid Outlet)
10. Power Steering Pump Assembly

7.2.5.2 Steering Disassemble View

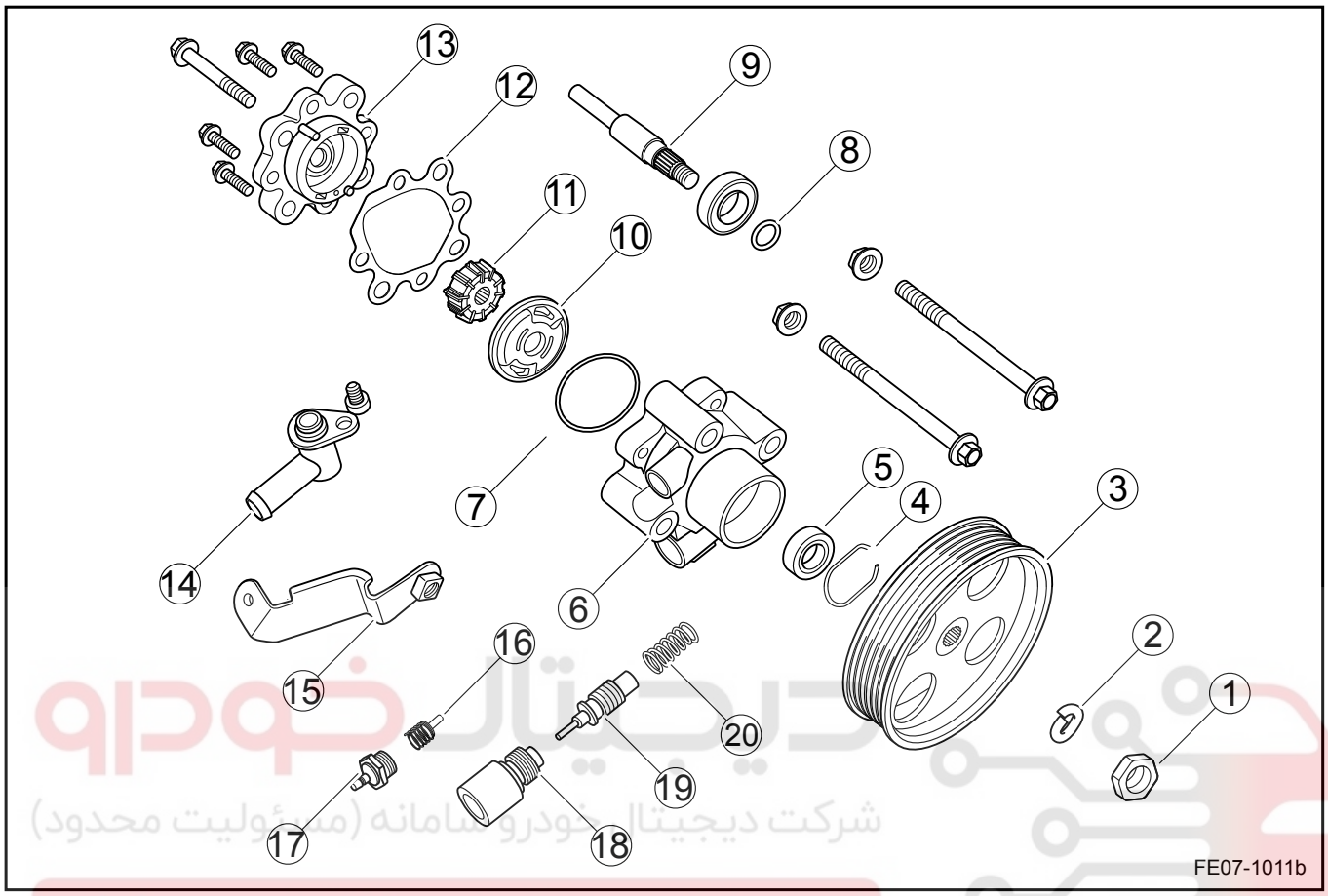


Legend

1. Left Tie Rod Assembly
2. Locking Nut
3. Lateral Hoop
4. Left Protective Cover
5. Inside Hoop
6. Left Intermediate Bar
7. Right Intermediate Bar
8. Inside Hoop
9. Right Protective Cover
10. Lateral Hoop
11. Locking Nut
12. Right Tie Rod Assembly
13. Right Turn Pipe
14. Left Turn Pipe
15. Steering Case

7.2.5.3 Power Steering Pump Assembly

Disassemble View

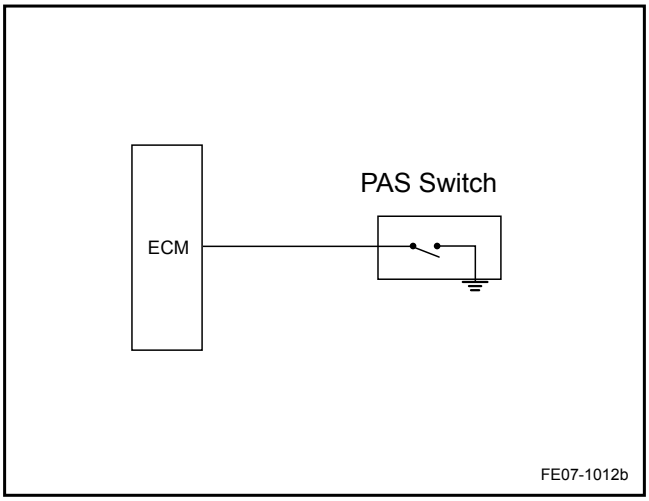


Legend

1. Pulley Locking Nut
2. Washer
3. Pulley
4. Bearing Clamp
5. Oil Seal
6. Pump Front Shell
7. Large O-ring
8. Small O-ring
9. Impeller Shaft with Bearings
10. Impeller Pump Front Side Panel
11. Impeller Pump Rotor and Vane
12. Gasket
13. Impeller Pump Rear Shell
14. Fluid Pipe
15. Bracket
16. Hydraulic Switch Valve and Compression Spring
17. Fluid Pressure Switch Connector
18. Fluid Outlet Joint
19. Flow Control Valve
20. Flow Control Valve Compression Spring

7.2.6 Schematic

7.2.6.1 Schematic



7.2.7 Diagnostic Information and Procedures

7.2.7.1 Diagnosis Description

Refer to 7.2.2.1 Description and Operationget familiar with the system functions and operation before start system diagnostics, so that it will help to determine the the correct diagnostic steps, more importantly, it will also help to determine whether the customer described situation is normal.

7.2.7.2 Visual Inspection

Prior to maintenance, confirm the fault, carry out road test. Consider and visual inspect the following systems:

- Tire and Wheel
  a. Check whether the tire pressure is appropriate, whether the wear is even.
  b. Whether the tires lose roundness.
  c. Whether the tires are unbalanced.
  d. Whether the wheel bearings loose or noisy.
- Suspension System
  a. Front suspension, rear suspension, whether the connecting rod is loose or damaged.
- Steering System
  a. Whether the mechanical steering column and steering gear assembly connection is loose or worn.
  b. Whether the power steering pump assembly, steering gear and the pipe are leaking.
  c. Whether the power steering fluid surface is correct. Refer to 7.2.8.2 Power Steering Fluid Level Inspection.

7.2.7.3 Fault Symptom Table

During diagnostic process. Refer to the following table. It can help to determine the cause and location of faults. Numbers are in descending order to indicate the possible causes of faults, check each component. If necessary, repair or Replace these components.

Symptoms	Suspected Parts	Measures / Refer to
Steering Effort Hard	1. Tires (Tire pressure inadequate or tread damage)	Add air or replace the tires. Refer to4.4 Wheels and Tires.
	2. Power Steering Fluid Level (Low)	Add steering fluid. Refer to 7.2.8.2 Power Steering Fluid Level Inspection.
	3. Drive Belt (Loose)	Adjust or Replace the drive belt. Refer to 7.2.8.1 Drive Belt Inspection.
	4. Front Wheel Positioning (Incorrect)	Adjust the front wheel positioning. Refer to 4.4.3.1 Wheel Alignment.
	5. Power Steering Tie Rod Ball Joint (wear)	Replace the Power Steering Tie Rod Ball Joint. Refer to 7.2.8.11 Steering Bar and Ball Joint Replacement.
	6. Lower Control Arm Ball Joint (Wear)	Replace the lower control arm Ball joint. Refer to 4.2.7.7 Lower Control Arm Ball Joint Replacement.
	7. Front Shock Absorber Upper Bearing Assembly (Wear)	Replace the Front shock absorber Upper bearing assembly. Refer to 4.2.7.4 Front Shock Absorber Components and Spring Replacement.

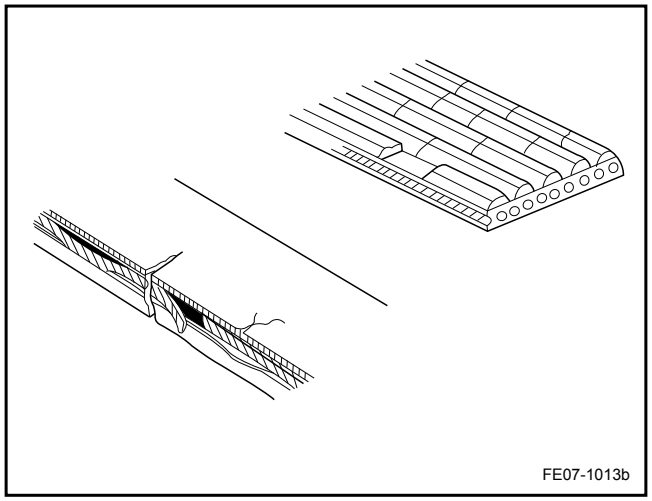
Symptoms	Suspected Parts	Measures / Refer to
	8. Steering Column Intermediate Shaft (Catching)	Repair or Replace the steering column. Refer to 7.3.6.4 Mechanical Steering Column Assembly Replacement.
	9. Upper and Lower Intermediate Shaft Assembly Joints (Wear, Rusty)	Lubricate or replace the mechanical steering column intermediate shaft assembly. Refer to 7.3.6.4 Mechanical Steering Column Assembly Replacement.
	10. Power Steering Pump Assembly (Internal Pressure Relief or Blockage, Pump Blade Damage)	Replace the power steering pump assembly. Refer to 7.2.8.10 Power Steering Pump Assembly Replacement.
	11. Power Steering Gear (Internal pressure relief, control valves or rack catching or damaged)	Replace the power steering gear. Refer to 7.2.8.13 Power Steering Gear Assembly Replacement.
Poor Steering Wheel Return	1. Tires (Insufficient Pressure)	Add air or Replace the tires. Refer to4.4 Wheels and Tires.
	2. Front Wheel Positioning (Incorrect)	Adjust the front wheel positioning. Refer to 4.4.3.1 Wheel Alignment.
	3. Lower Control Arm Ball Joint (Catching)	Repair or replace the lower control arm ball joint. Refer to 4.2.7.7 Lower Control Arm Ball Joint Replacement.
	4. Upper and Lower Intermediate Shaft Assembly Joints (Rusty, Catching)	Lubricate or replace the upper and lower intermediate shaft assembly. Refer to 7.3.6.4 Mechanical Steering Column Assembly Replacement.
	5. Steering Column Axle (Catching)	Lubricate or replace the steering column. Refer to 7.3.6.4 Mechanical Steering Column Assembly Replacement.
	6. Power Steering (Control valves viscous or a rack bearing pre-load is too high, catching)	Clean or repair the steering hydraulic system. Replace the power steering gear. Refer to 7.2.8.13 Power Steering Gear Assembly Replacement.
	7. Front Shock Absorber Upper Bearing Assembly (Wear)	Replace the front shock absorber upper bearing assembly. Refer to 4.2.7.4 Front Shock Absorber Components and Spring Replacement.
Steering system travel is too great.	1. Steering Rack (Loose)	Tighten or replace the steering rack. Refer to 7.2.8.11 Steering Bar and Ball Joint Replacement.
	2. Lower control arm ball joint (Wear or Loose)	Replace the lower control arm ball joint. Refer to 4.2.7.7 Lower Control Arm Ball Joint Replacement.
	3. Front wheel bearing (Wear and Tear, or Loose)	Replace the front wheel bearings. Refer to 4.2.7.9 Front Wheel Hub Replacement.
	4. Power Steering Steering Tie Rod Assembly (Retaining Bolts Loose)	Tighten bolts. Refer to 7.2.8.13 Power Steering Gear Assembly Replacement.

Symptoms	Suspected Parts	Measures / Refer to
Noise	1. Power Steering Fluid Level (Low)	Add steering fluid. Refer to 7.2.8.2 Power Steering Fluid Level Inspection.
	2. Steering Column (Axle, Bearings Loose)	Repair or replace the steering column. Refer to 7.3.6.4 Mechanical Steering Column Assembly Replacement.
	3. Intermediate Shaft Upper and Lower Universal Joints (Loose)	Tighten or replace the upper and lower intermediate shaft assembly. Refer to 7.3.6.4 Mechanical Steering Column Assembly Replacement.
	4. Power Steering Steering Tie Rod Assembly (Retaining Bolts Loose)	Tighten nuts. Refer to 7.2.8.13 Power Steering Gear Assembly Replacement.
	5. Steering Rack (Loose)	Tighten nuts or replace the tie rod. Refer to 7.2.8.11 Steering Bar and Ball Joint Replacement.
	6. Power Steering Gear (Rack Bearing Pre-load Too Loose)	Repair or replace the power steering gear. Refer to 7.2.8.13 Power Steering Gear Assembly Replacement.
	7. Power Steering Pump Assembly (Flow Control Valve or Pump Blade Damage)	Replace the power steering pump assembly. Refer to 7.2.8.10 Power Steering Pump Assembly Replacement.
Steering wheel retuning force is too great or steering wheel too loose	1. Power Steering System (Loose)	Bleed air in the steering system. Refer to 7.2.8.7 Power Steering System Bleeding.
	2. Upper and lower intermediate steering shaft assembly and power steering gear assembly connection (loose)	Tighten nuts. Refer to 7.3.6.4 Mechanical Steering Column Assembly Replacement.
	3. Tie Rod (Loose)	Tighten or replace the steering tie rod ball joint. Refer to 7.2.8.11 Steering Bar and Ball Joint Replacement.
	4. Front Wheel Bearing (Worn)	Replace the front wheel bearing. Refer to 4.2.7.9 Front Wheel Hub Replacement.
	5. Power Steering Gear (Internal Loose)	Repair or Replace the power steering gear assembly. Refer to 7.2.8.13 Power Steering Gear Assembly Replacement.
Steering Instability	1. Front Wheel Alignment (Incorrect)	Adjust the front wheel alignment. Refer to 4.4.5.2 Front Toe Adjustment.
	2. Front Suspension (Location Inaccurate)	Adjust the front suspension components fasteners. Refer to4.2 Front Suspension.
	3. Tires and Wheels (Imbalance)	Tire balancing or Replace the tires, wheel rim. Refer to4.4 Wheels and Tires.
	4. Front wheel bearing (Worn, Loose)	Replace the front wheel bearing. Refer to 4.2.7.9 Front Wheel Hub Replacement.

Symptoms	Suspected Parts	Measures / Refer to
	5. Coil spring (Broken / or Weak)	Replace the coil spring. Refer to 4.2.7.4 Front Shock Absorber Components and Spring Replacement.
	6. Front Strut (Loose or Damaged)	Tighten or replace the front strut. Refer to 4.2.7.3 Front Strut Assembly Replacement.
	7. Brake System (Loose or Not Working Properly)	Check the brake system. Refer to6 Brake System.
	8. Rear Suspension (Positioning Inaccurate or Loose)	Adjust rear suspension components fasteners. Refer to4.3 Rear Suspension.
Steering Unstable When Braking	1. Front Suspension (Strut Inclination Incorrect)	Check and adjust the front suspension position. Refer to4.2 Front Suspension.
	2. Lower Control Arm (Loose)	Tighten or replace the lower control arm bushing. Refer to 4.2.7.2 Lower Control Arm Bushing Replacement.
	3. Brake Disc (Deformation)	Replace the brake disc's. Refer to 6.2.5.3 Brake Disc Replacement.
	4. Coil Spring (Broken / or Weak)	Replace the coil spring. Refer to 4.2.7.4 Front Shock Absorber Components and Spring Replacement.
	5. Front or Rear Wheel Bearings (Worn, Loose)	Replace the front or rear wheel bearing. Refer to 4.2.7.9 Front Wheel Hub Replacement,4.3.7.5 Rear Wheel Hub Replacement.
	6. Brake System (Braking force is uneven or incorrect.)	Check the brake system. Refer to6 Brake System.

7.2.8 Removal and Installation

7.2.8.1 Drive Belt Inspection

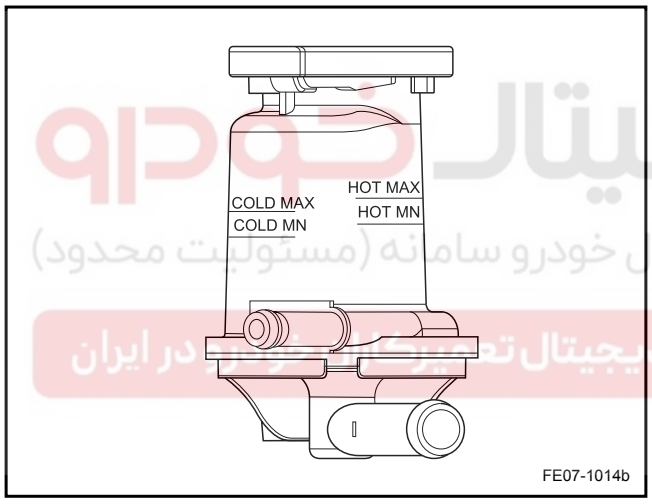


1. Check whether the drive belt pre-load is normal. Refer to 2.6.7.9 Drive Belt Inspection.
2. Check whether there is excessive drive belt wear, cord broken and so on.
3. If the drive belt is found faulty, replace the drive belt.

Note

Slight crack on the drive belt rib side is acceptable. If the drive belt cracks from the rib or convex shoulder missing, it should be replaced.

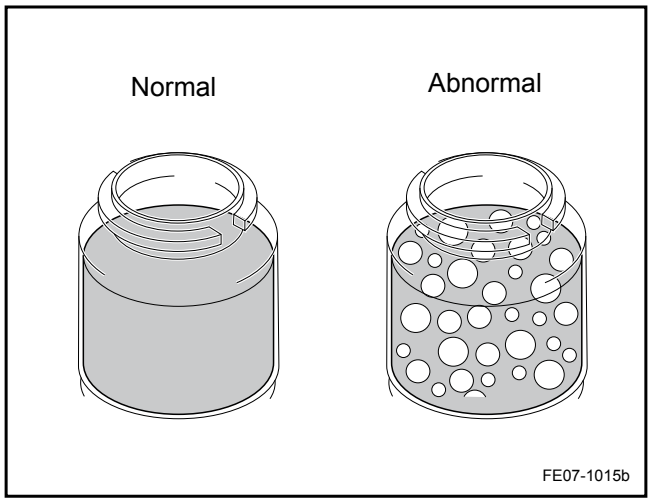
7.2.8.2 Power Steering Fluid Level Inspection



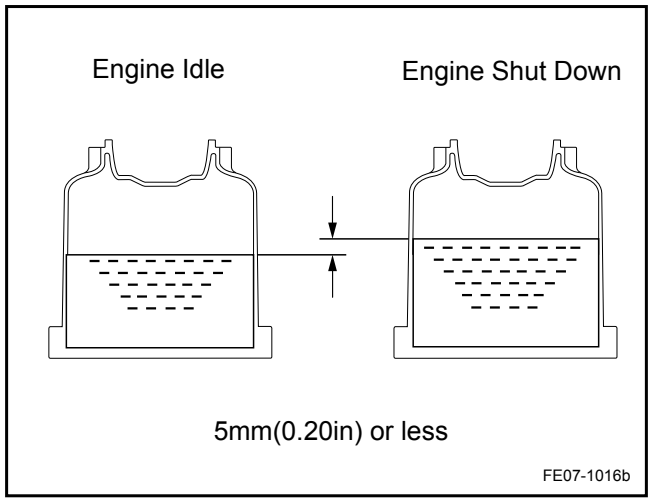
1. Park the vehicle on a level position.
2. Shut down the engine. check the fluid level. If necessary, add fluid to the reservoir. After preheating the fluid, its temperature is about 75-80°C (167-176 ºF). Fluid level should be between "HOT MAX "and" HOT MIN ". After cooling the fluid, its temperature is about 20 °C -25 °C (68-77 ºF). Fluid level should be between "COLD MAX " and "COLD MIN ".

Note

Note: Please use correct fluid.

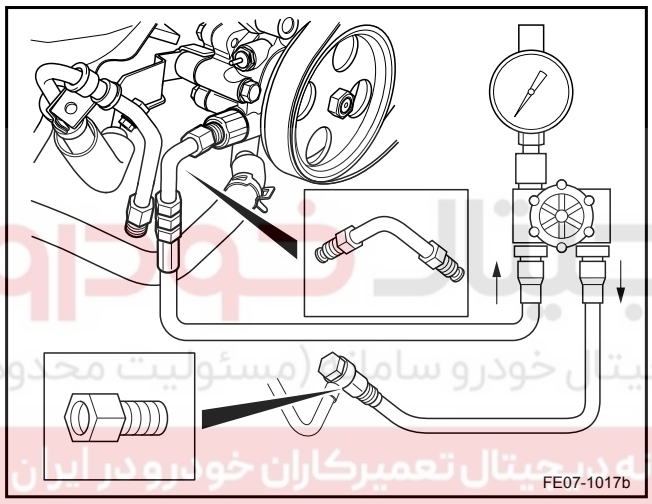


3. Preheat the power steering fluid, start the engine and let the engine run at idle.
4. Rotate the steering wheel from right to left and then rotate back and forth several times, so that the fluid temperature rise. Preheat fluid temperature to: 75-80 °C (167-176 ºF).
5. Check whether there is foam or emulsion, if so, it is necessary to bleed the power steering system. Refer to 7.2.8.7 Power Steering System Bleeding.



6. With the engine idling, check the fluid level.
7. Stop the engine.
8. Wait for a few minutes, re-check the fluid level.

   maximum fluid level rising height: 5 mm (0.20 in)
9. If problems are detected, bleed the power steering system. Refer to 7.2.8.7 Power Steering System Bleeding.
10. Re-check the fluid level height.



7.2.8.3 Steering Fluid Pressure Inspection

1. Disconnect the power steering pump assembly outlet pipe. Refer to 7.2.8.6 Power Steering Outlet Pipe Replacement.
2. Install the hydraulic pressure detection tool as shown in the graphic.

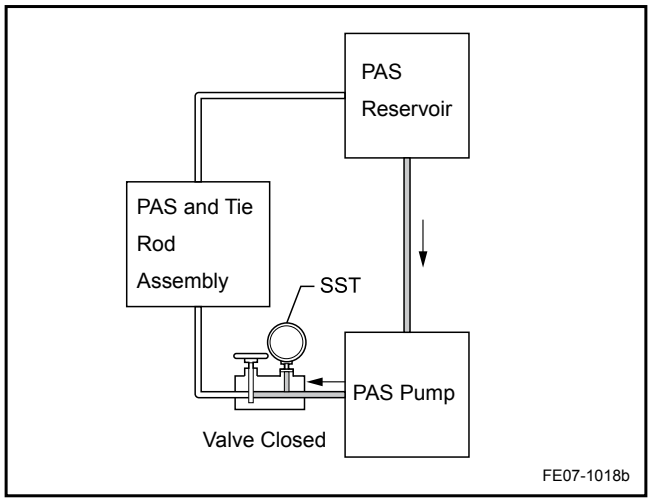
   Note

   At the beginning of the inspection, the tool valve should be at open position.
3. Bleed the power steering system. Refer to 7.2.8.7 Power Steering System Bleeding.
4. Preheat the power steering fluid, start the engine and let the engine run at idle.
5. Rotate the steering wheel from right to left and then rotate back and forth several times, so that the fluid temperature rise.

   Preheat the fluid temperature to: 75-80 °C (167-176 ºF)

   Note

   Refer to "Steering Wheel in the Full Turn Position Notice" in "Warnings and Notices".

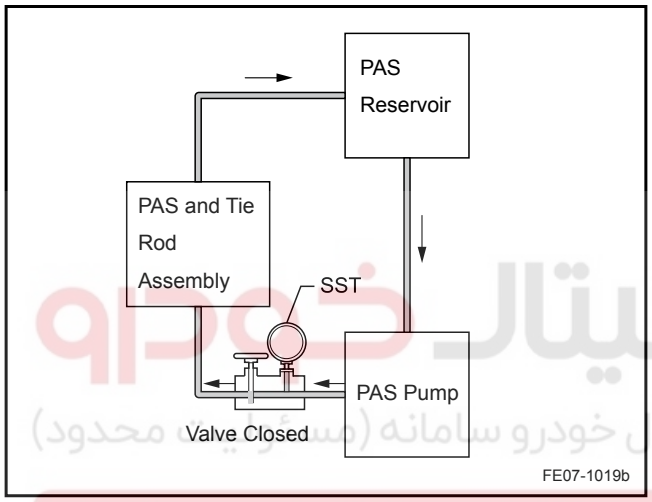


6. Keep the engine at idle, close the tool valves, observe the pressure gage readings and take notes.

   Minimum hydraulic: 6,400 kPa (928 psi)
   If the fluid pressure is too low, then the power steering pump assembly is damaged, it needs to be Replaced. Refer to 7.2.8.10 Power Steering Pump Assembly Replacement.

   Warning!

   Special tool valves closing time can not exceed 5s, otherwise the fluid temperature becomes too high causing damage to the power steering pump assembly.



7. Keep the engine at idle, open the valve.

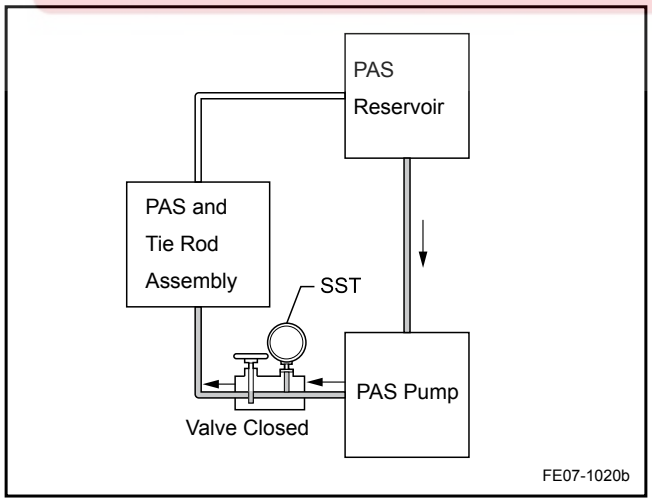
8. Maintain the engine speed between 1,000 rpm and 3,000 rpm, measure the fluid pressure.

   Hydraulic pressure difference: 490 kPa (71 psi) or less

   Note

   Do not turn the steering wheel.

   If the fluid pressure difference is too great, the power steering pump flow control valve assembly is damaged and it needs repair or to be replaced. Refer to 7.2.8.10 Power Steering Pump Assembly Replacement.
   If there is blockage or leakage in the power steering system, clean the fluid pipes and the relevant parts.



9. Keep the engine at idle, fully open the valve, turn the steering wheel to the left or right to the end, measure fluid pressure.

   Minimum hydraulic: 6,400 kPa (928 psi)
   If the oil pressure is too low, then the power steering leaks or is damaged, replace the damaged power steering pump assembly. Refer to 7.2.8.10 Power Steering Pump Assembly Replacement.
   If the power steering system hydraulic pipes leak, repair or replace the relevant hydraulic piping components. Refer to 7.2.8.6 Power Steering Outlet Pipe Replacement.

   Note

   Keep the steering wheel at fully turned position no more than 5s, otherwise it may damage the steering pump.

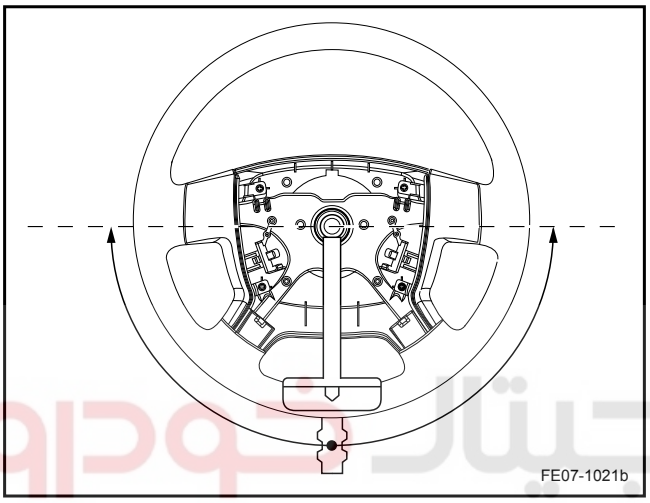
10. Remove the test tool.

11. Connect the power steering pump outlet pipe. Refer to 7.2.8.6 Power Steering Outlet Pipe Replacement.
12. Bleed the power steering system air. Refer to 7.2.8.7 Power Steering System Bleeding.

7.2.8.4 rower Steering Effort Check

Warning!

Refer to "Battery Disconnect Warning" in "Warnings and Notices" .



1. Park the vehicle on a even surface and straighten the front wheels.
2. Disconnect the battery negative cable. Refer to 2.11.8.1 Battery Disconnection.

   Note

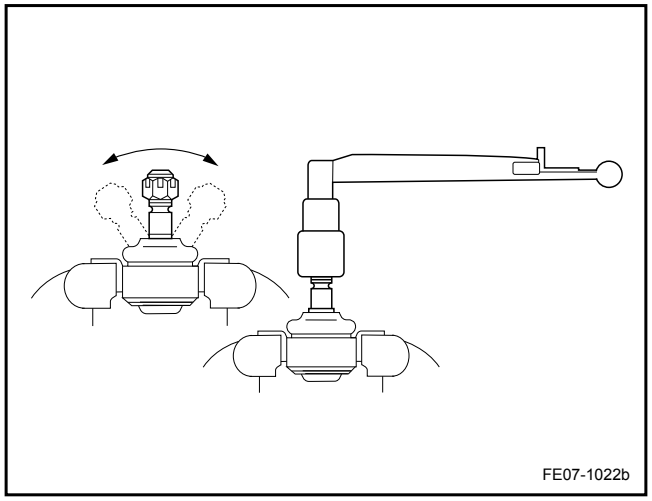
   Disconnect the battery cable and wait for at least 60s, prevent airbag and seat belt pre-tensioner being activated.
3. Remove the driver front airbag. Refer to 9.2.7.2 Driver Front Airbag Replacement.
4. Connect the battery negative cable.
5. Use a torque wrench to check whether the steering wheel nut fastening torque is correct.
6. Start the engine and let the engine run at idle.
7. Use a torque wrench to turn the steering wheel left and right 90 degrees, check the left and right rotation torque.

   Steering torque (reference): 5.5 Nm (Metric) 4.1 lb-ft (US English)

   Note

   Before the test, consider the tire type, tire pressure and the contacting surface.
8. Disconnect the battery negative cable.
9. Re-examine the steering wheel nut torque.

   Torque: 45 Nm (Metric) 33.3 lb-ft (US English)
10. Install the driver front airbag.
11. Connect the battery negative cable.



7.2.8.5 Steering Tie Rod Ball Joint Inspection

1. Remove the horizontal steering bar. Refer to 7.2.8.11 Steering Bar and Ball Joint Replacement.
2. Firmly clamp the tie rod ball joint between the calipers.
3. Install the bolt on the ball joint nut.
4. Shake the ball joint bolt back and forth more than five times.
5. Using a torque wrench, continuously rotate the nut at 2-4 rpm / s speed, and then read the fifth lap torque.

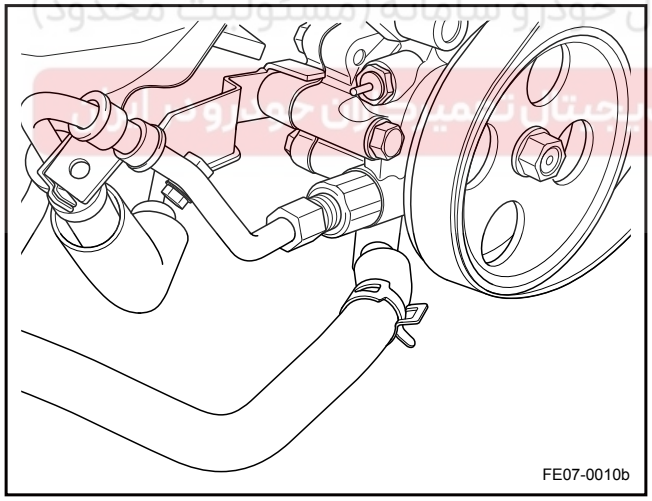
   Rotation torque: 1.5-3.0 Nm (Metric) 1.1-2.2 lb-ft (US English)
   If the rotation torque is not in the specified range, replace the steering horizontal bar assembly.

   Note

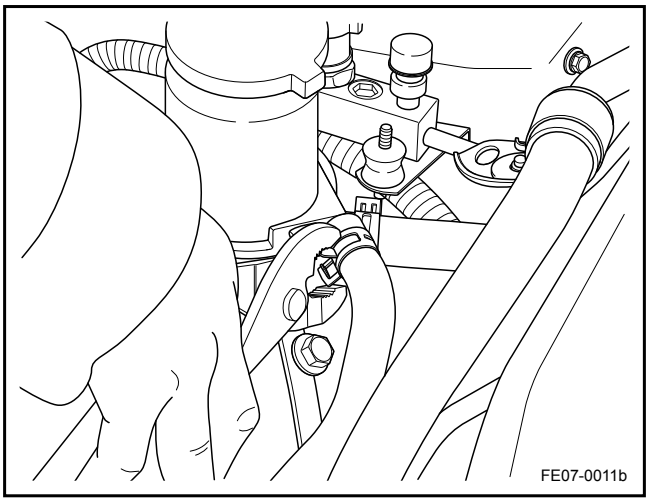
   The left and right steering tie rod ball check is the same.

7.2.8.6 Power Steering Outlet Pipe Replacement

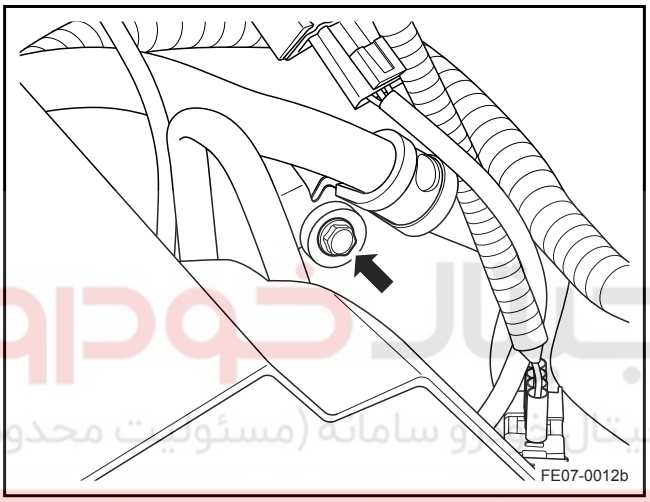
Removal Procedure:



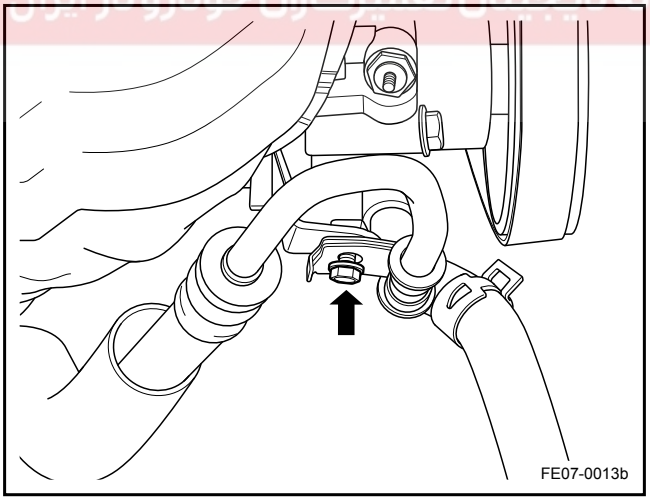
1. Drain the power steering fluid from the power steering assembly.
2. Disconnect the power steering pump hose and high pressure fluid pipe connection.



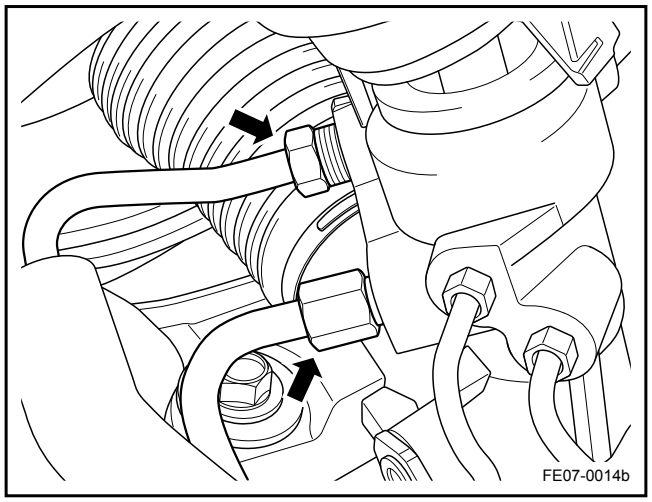
3. Disconnect the power steering outlet pipe from the fluid reservoir.



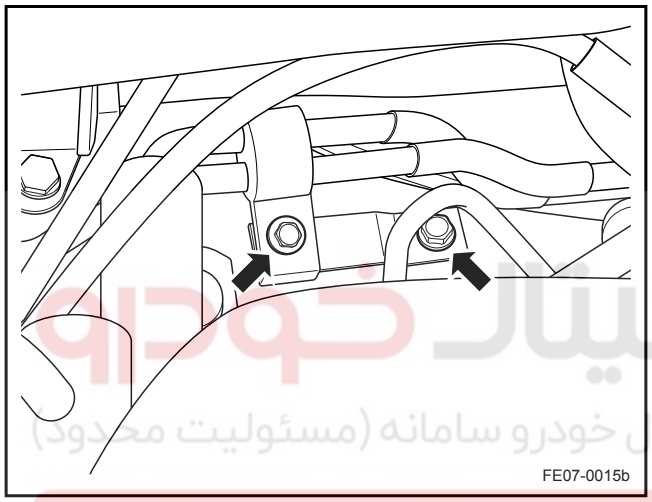
4. Remove the steering system pipe bracket bolt from the subframe.



5. Remove the power steering inlet/outlet pipe bracket bolts from the power steering pump assembly.

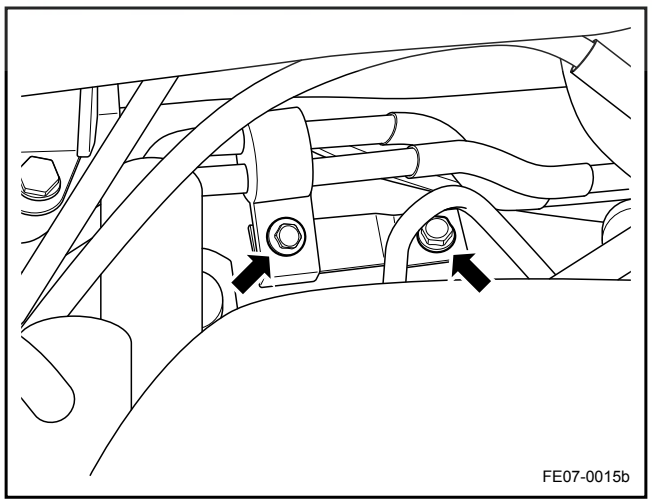


6. Lift and support the vehicle. Refer to 1.3.1.1 Lifting and Jacking the Vehicle.
7. Disconnect the high pressure fluid pipe and the return pipe from the power steering gear assembly horizontal bar.



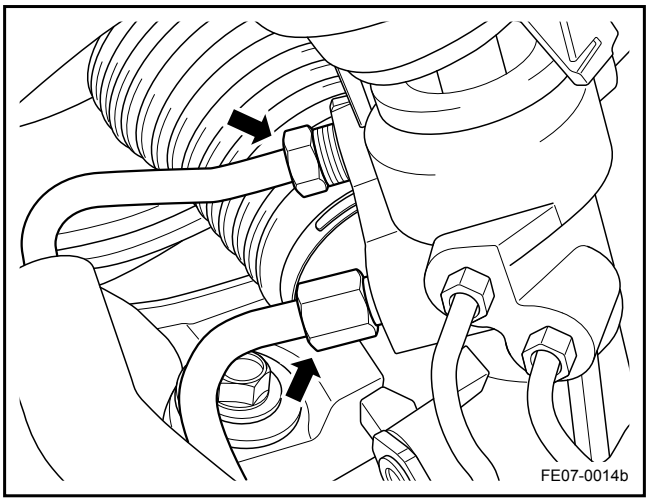
8. Remove the pipe bracket bolt from the subframe.
9. Remove the return pipe and the high pressure pipe from the vehicle.

Installation Procedure:



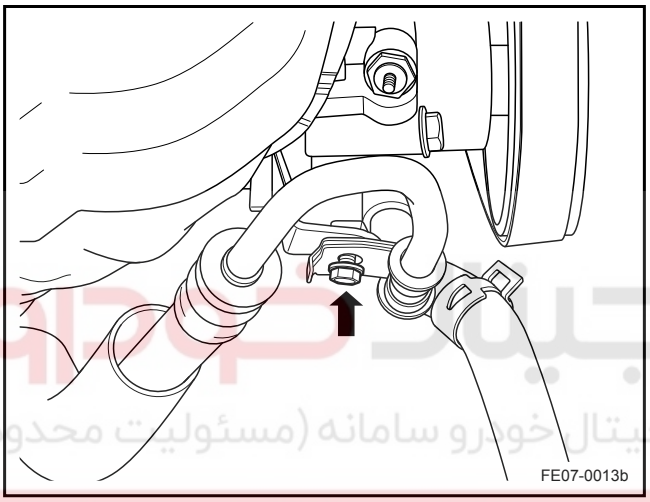
1. Connect the high pressure pipe from the power steering pump assembly to the power steering gear.
2. Connect the return pipe from the fluid reservoir to the power steering gear.
3. Lift and support the vehicle.
4. Install the fluid pipe to the subframe and tighten the bolts.

   Torque: 10 Nm (Metric) 7.4 lb-ft (US English)



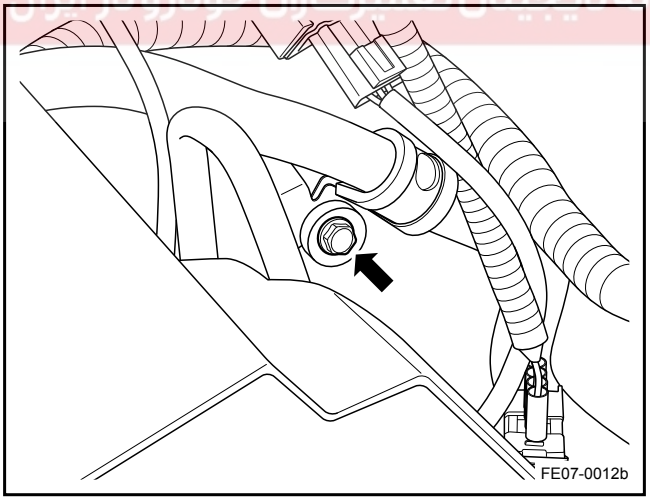
5. Connect the high pressure pipe and the return pipe to the power steering gear and tighten.

   Torque: 28 Nm (Metric) 20.7 lb-ft (US English)



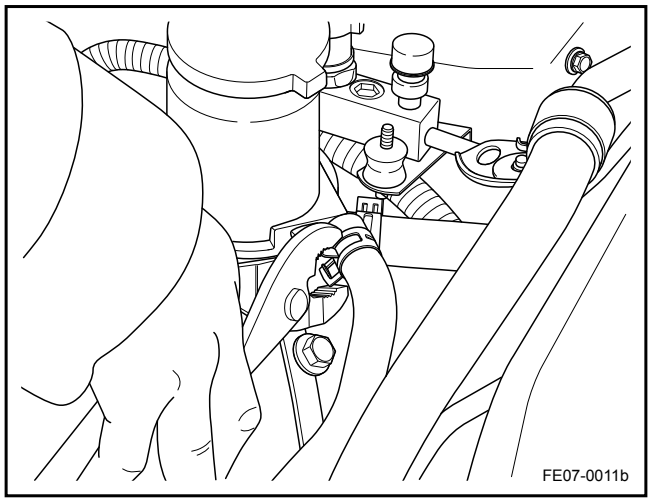
6. Install the high pressure pipe bracket bolts to the power steering pump assembly.

   Torque: 10 Nm (Metric) 7.4 lb-ft (US English)

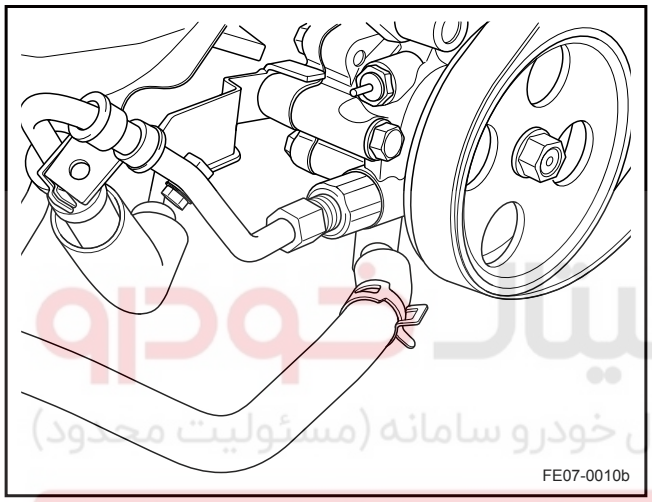


7. Install the steering system pipe bracket to the right side crossmember and tighten.

   Torque: 10 Nm (Metric) 7.4 lb-ft (US English)



8. Connect the steering system pipe to the fluid reservoir.



9. Connect the fluid supply hose and high pressure pipe to the power steering pump assembly.

   Torque: 30 Nm (Metric) 22.2 lb-ft (US English)

10. Fill the power steering fluid to the power steering fluid reservoir.

11. Check the existence for pipe leakage. if there is leakage, repeat the above steps to re-install the pipe, and bleed air in the pipes.

7.2.8.7 Power Steering System Bleeding

1. Shut down the engine. Turn the steering wheel from one locking position to the other, repeat several times.

2. Start the engine, let the engine run at idle, check the power steering fluid level. If necessary, add fluid, so that the fluid level is remained above "MIN".

3. Turn the steering wheel back and forth, but do not fully turn the steering wheel, bleed the system. To maintain the fluid level above "MIN", bleed the system to obtain the proper power steering performance.

4. Return the steering wheel to the straight position, let the engine continue to run at idle for 2-3 min.

5. Road test the vehicle, confirm whether the power steering is functioning correctly and whether there is abnormal sound.

6. According to steps 1 and 2, re-check the power steering fluid level to ensure that when the system reaches the normal operating temperature and stabilize, the fluid level reaches "MAX". if necessary, add proper amount of fluid.

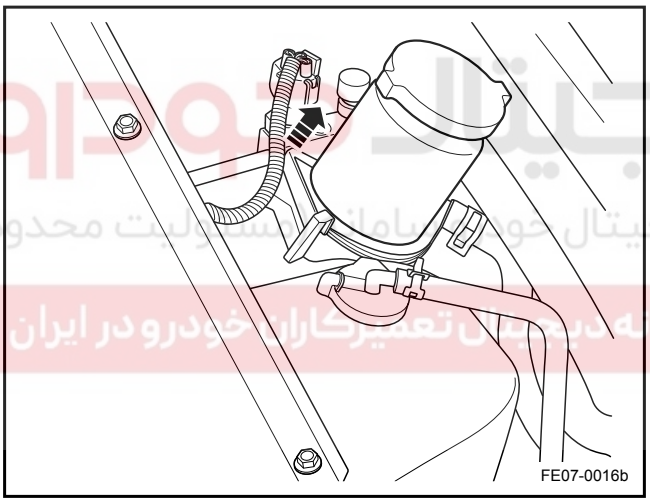
7.2.8.8 Check Power Steering Fluid

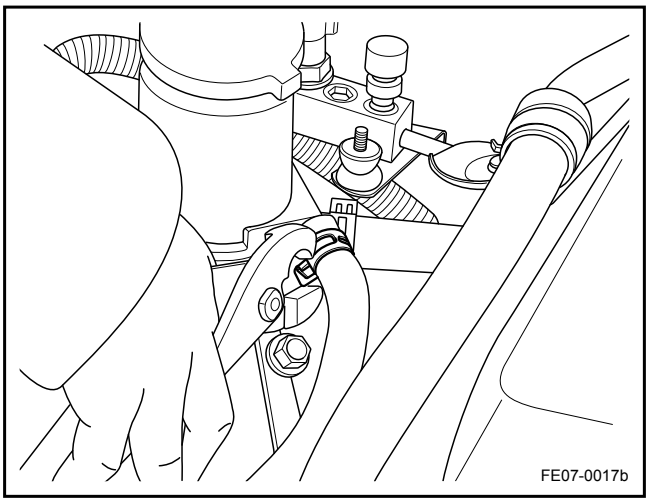
- Power steering fluid level is indicated through the scale on the transparent power steering reservoir.
- If the steering fluid reaches normal working temperature, the fluid level should be between the MAX (maximum) and MIN (minimum). if necessary, add steering fluid.
- If the steering fluid temperature is low, the fluid level should be at the MIN (minimum) mark. If necessary, add steering fluid.

7.2.8.9 Power Steering Pipe Assembly with Fluid Reservoir Replacement

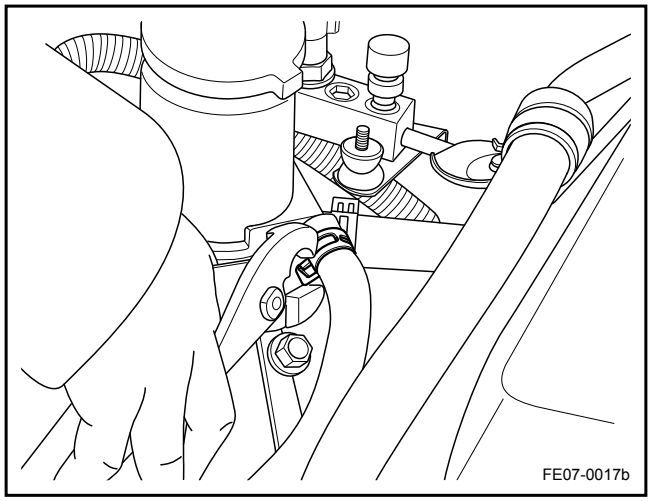
Removal Procedure:

1. Drain the power steering fluid from the power steering fluid reservoir.
2. Remove the fluid reservoir from the power steering fluid reservoir bracket, remove the power steering pipe assembly.



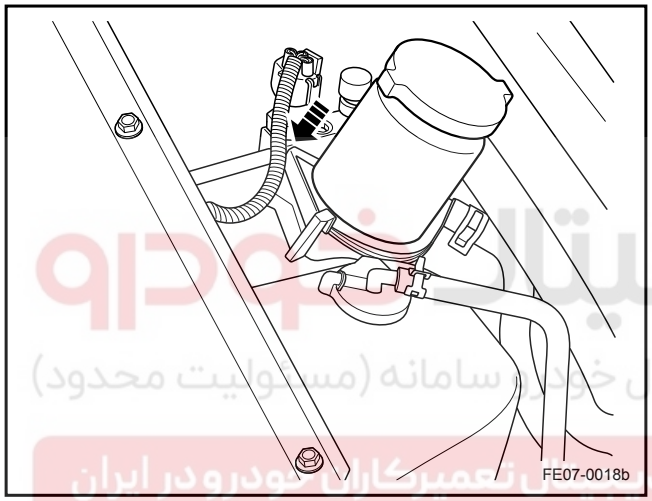


3. Release the power steering hose clamp and remove the hoses.



Installation Procedure:

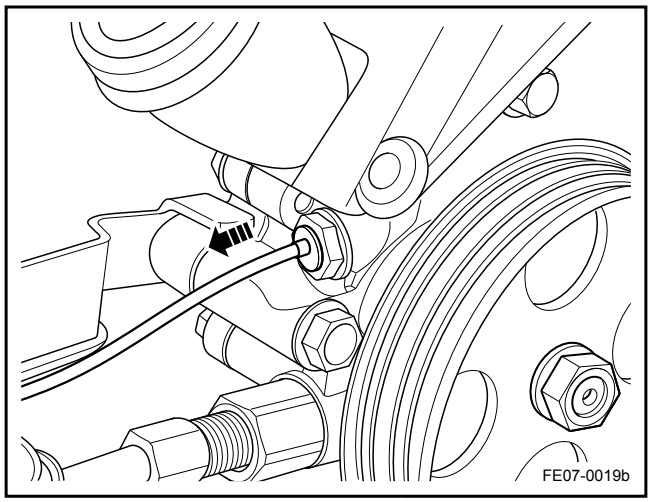
1. Install the power steering hose to the fluid reservoir and tighten the clamps.



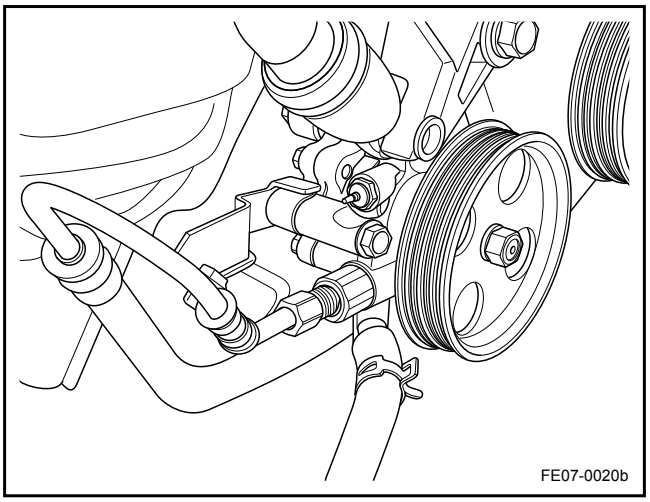
2. Install the fluid reservoir to the fluid reservoir bracket.
3. Add power steering fluid to the fluid reservoir.
4. Check the power steering system pipes for leakage. If there is leakage, repeat the above steps until there is no leakage.
5. Bleed the power steering system.

7.2.8.10 Power Steering Pump Assembly Replacement

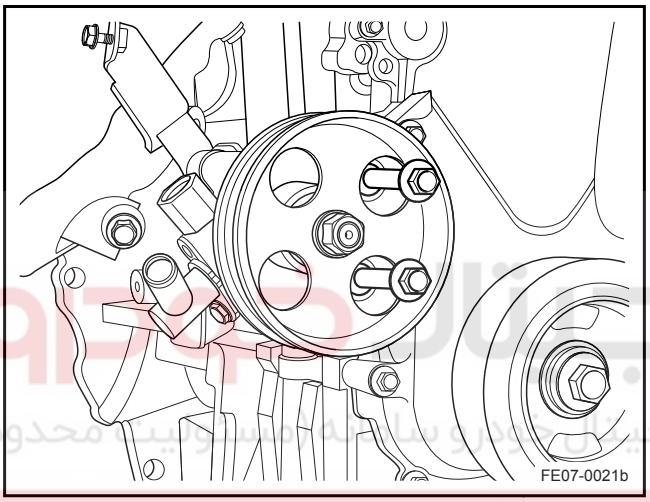
Removal Procedure:



1. Remove the engine drive belt. Refer to 2.6.8.3 Drive Belt Replacement.
2. Recycle the power steering fluid with a suitable recycling container.
3. Disconnect the power steering pump pressure switch wiring harness connector.

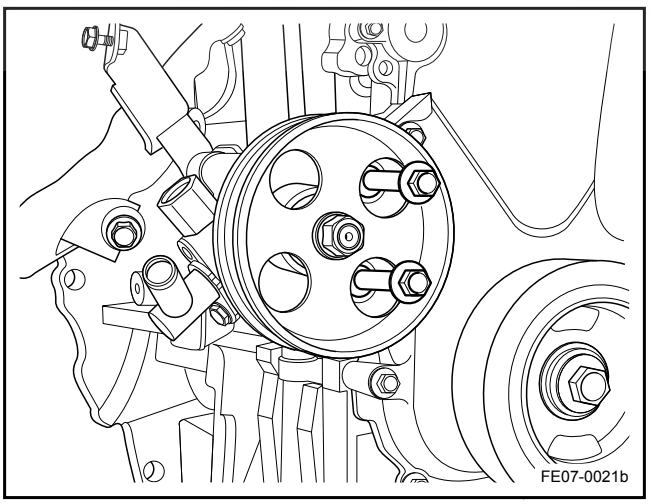


4. Disconnect the high pressure pipe and fluid supply hose from the power steering pump assembly.



5. Remove the power steering pipe retaining bolts.
6. Remove the power steering pump assembly retaining bolts, and remove the power steering pump assembly.

Installation Procedure:

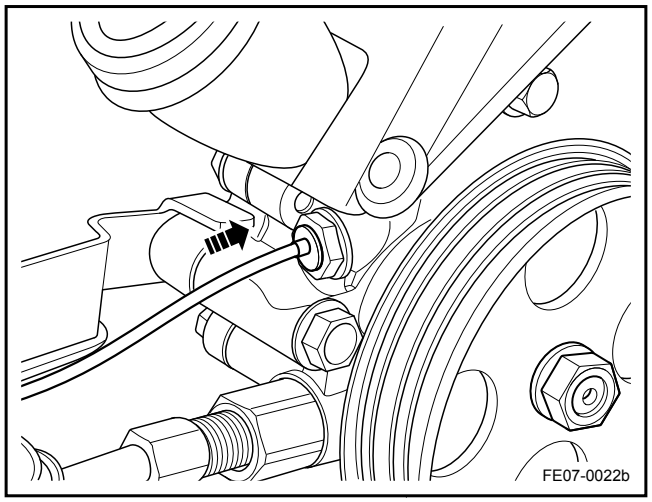


1. Install the power steering pump assembly to the vehicle and tighten the retaining bolts.

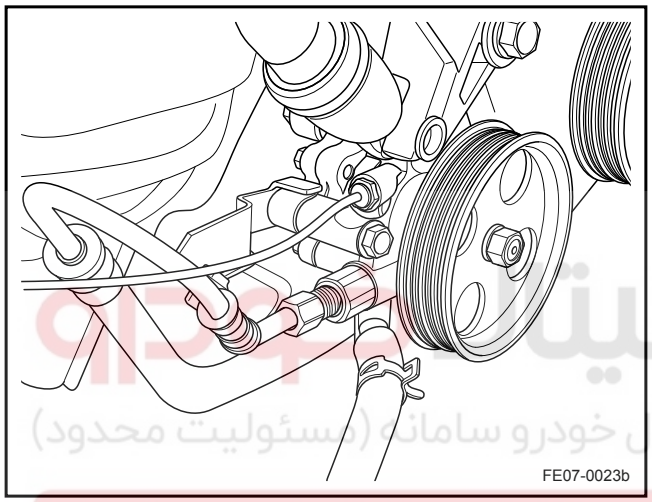
   Torque: 50 Nm (Metric) 37 lb-ft (US English)

2. Install the power steering pipe retaining bolts.

   Torque: 10 Nm (Metric) 7.4 lb-ft (US English)



3. Connect the power steering pump pressure switch wiring harness connector.

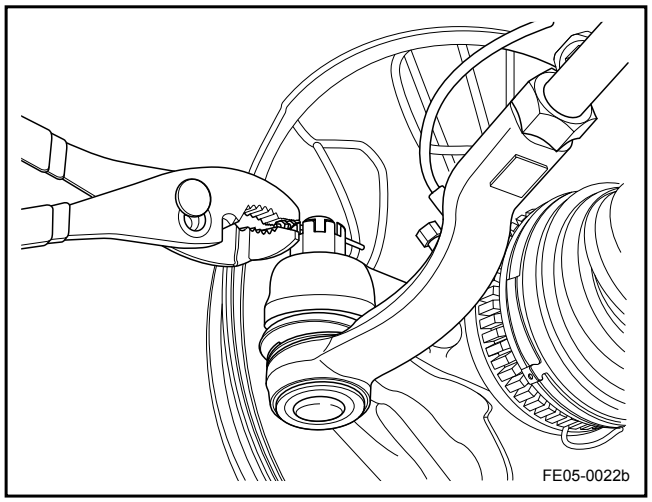


4. Connect power steering oil pump hose assembly.
5. Connect the power steering pump assembly high pressure pipe and tighten.

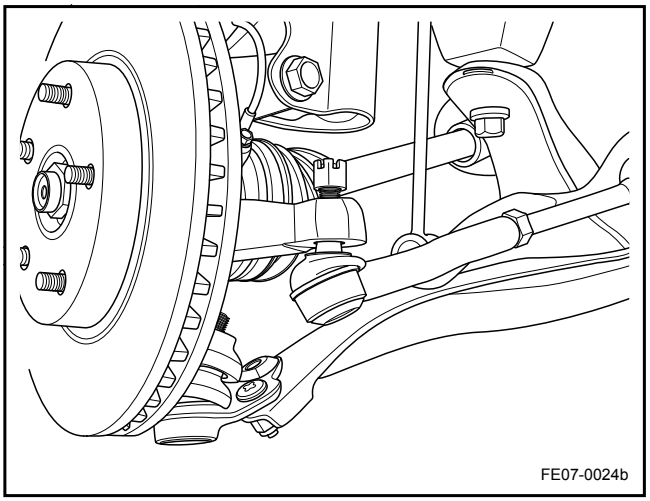
   Torque: 30 Nm (Metric) 22.2 lb-ft (US English)
6. Install the engine drive belt.
7. Fill the power steering fluid.
8. Bleed the power steering system. Refer to 7.2.8.7 Power Steering System Bleeding.

7.2.8.11 Steering Bar and Ball Joint Replacement

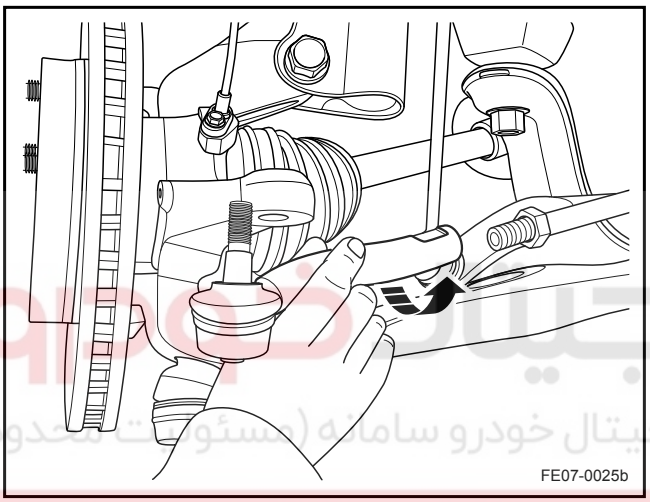
Removal Procedure:



1. Remove the tires. Refer to 4.4.5.1 Wheel Replacement.
2. Remove the steering tie rod ball nut locking pin.

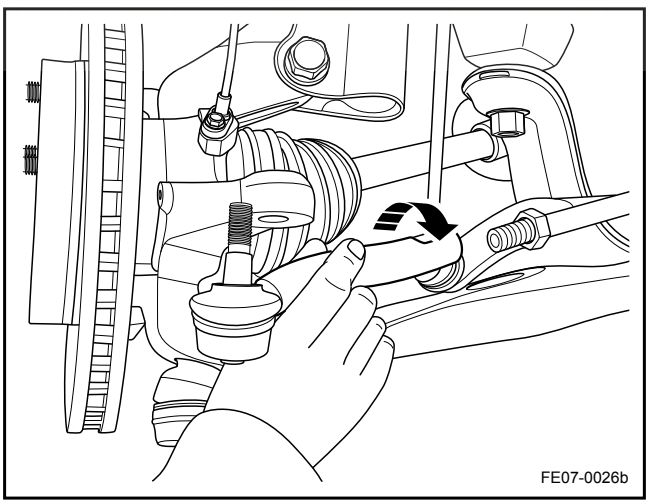


3. Mark the thead location on the inner steering horizontal rod to facilitate the nut installation and adjustment.
4. Remove the tie rod and the ball joint retaining nut and separate the tie rod and the ball joint from the steering knuckle.

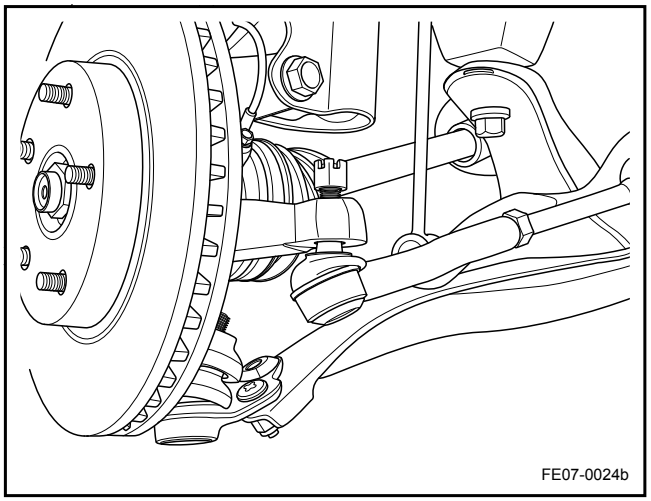


5. Loosen the steering tie rod adjustment nut and unscrew the steering tie rod and ball joint.

Installation Procedure:



1. Align the adjustment nut with the mark on the steering tie rod.
2. Install the tie rod and the ball joint to the inner steering horizontal bar.



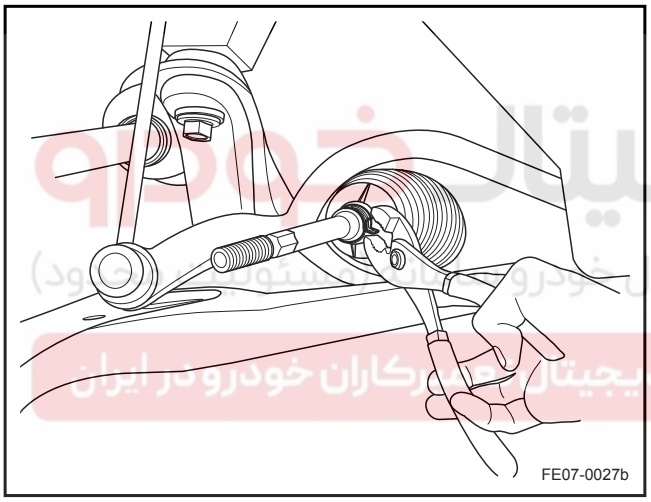
3. Install the tie rod and the ball joint to the steering knuckle.
4. Install the tie rod and the slotted hex nut and tighten.

   Torque: 33 Nm (Metric) 24.3 lb-ft (US English)
5. Install the tie rod ball nut locking pin.
6. Install the tires.
7. Carry out the front toe adjustment. Refer to 4.4.5.2 Front Toe Adjustment.
8. Tighten the steering bar and the ball joint adjust nut.

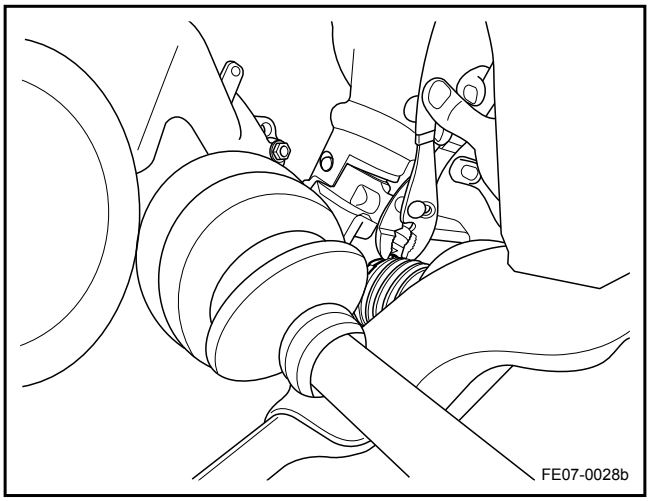
   Torque: 78 Nm (Metric) 57.5 lb-ft (US English)

7.2.8.12 Power Steering Dust Cover Replacement

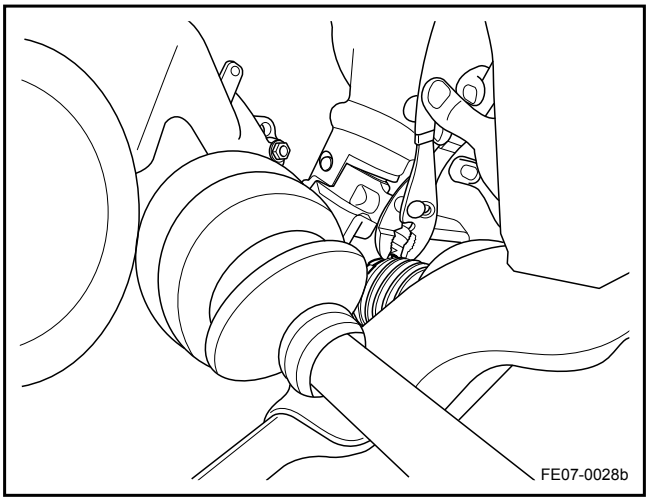
Removal Procedure:

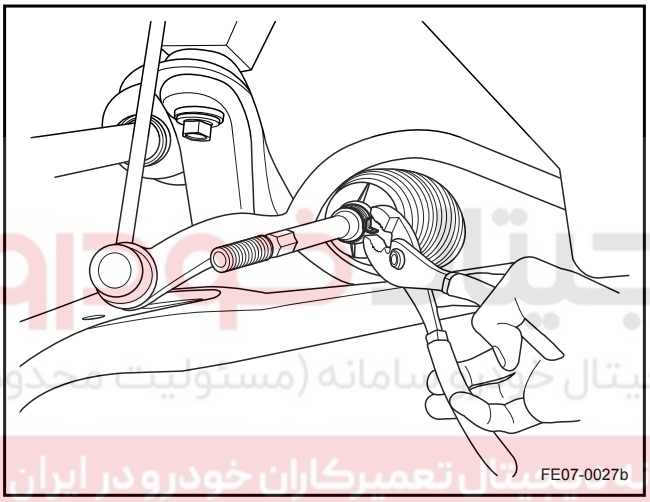


1. Remove the wheels. Refer to 4.4.5.1 Wheel Replacement.
2. Remove the power steering steering tie rod and the ball joint. Refer to 7.2.8.11 Steering Bar and Ball Joint Replacement.
3. Remove the tie rod adjustment nut.
4. Remove the Power Steering dust cover external retaining clamp.



5. Remove the power steering dust cover internal retaining clamp.
6. Remove the power steering dust cover.





Installation Procedure:

1. Install the power steering dust cover.
2. Install the power steering dust cover internal retaining clamp.
3. Install the power steering dust cover external retaining clamp.
4. Install the tie rod adjustment nut.
5. Install the the power steering steering tie rod and the ball joint.
6. Install the wheels.
7. Carry out the front toe adjustment. Refer to 4.4.5.2 Front Toe Adjustment.

7.2.8.13 Power Steering Gear Assembly Replacement

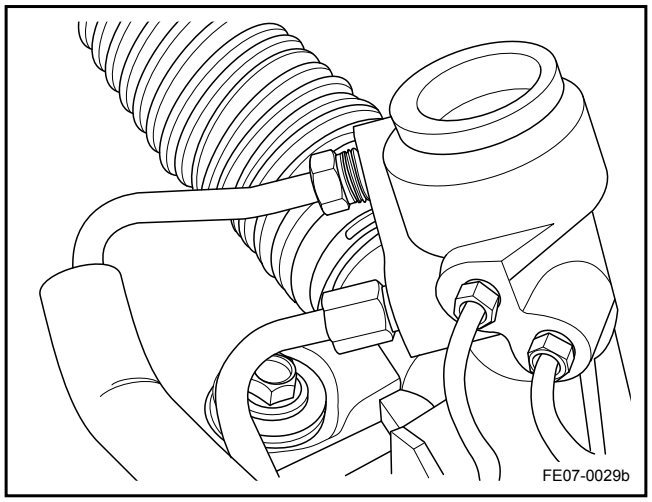
Removal Procedure:

Note

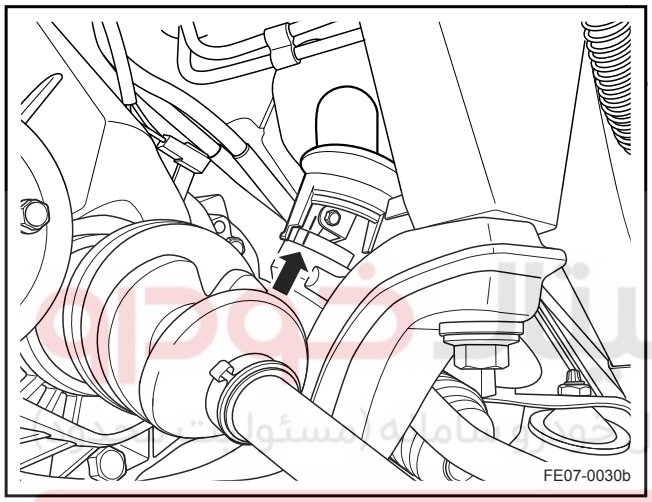
Before the removal, turn off the ignition switch.

Warning!

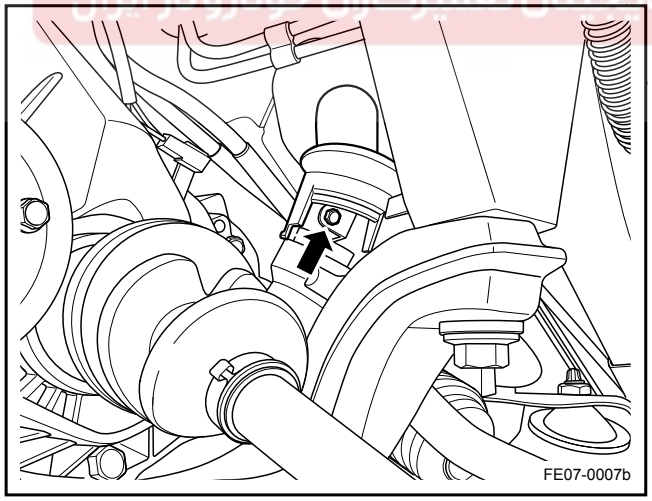
Refer to "Battery Disconnect Warning" in "Warnings and Notices".



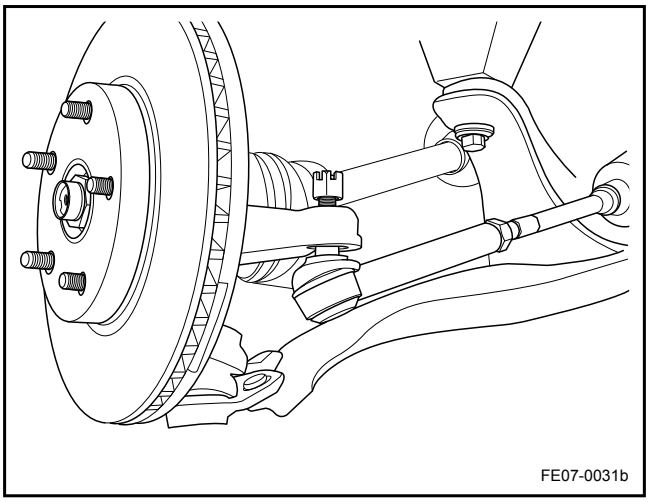
1. Disconnect the battery negative cable. Refer to 2.11.8.1 Battery Disconnection.
2. Lift and support the vehicle. Refer to 1.3.1.1 Lifting and Jacking the Vehicle.
3. Remove the wheels. Refer to 4.4.5.1 Wheel Replacement.
4. Place a recycling container under the steering system to recycle the power steering fluid.
5. Disconnect the power steering fluid inlet and outlet pipes and return pipe from the power steering gear assembly.



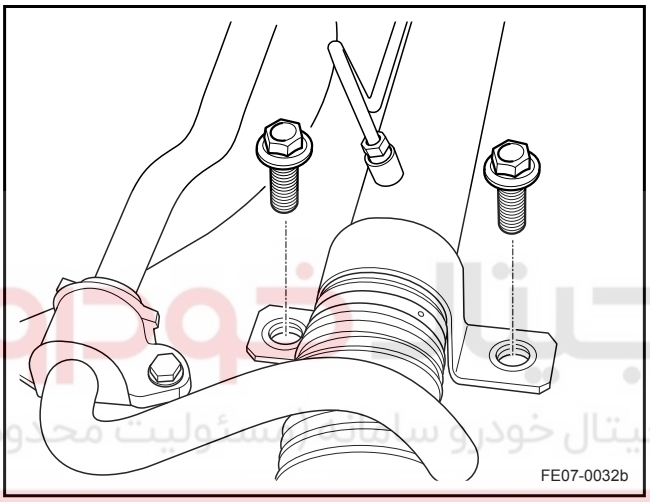
6. Turn the steering wheel to align the steering column with the short axle shell mark.



7. Remove the steering column assembly universal joint bolt.

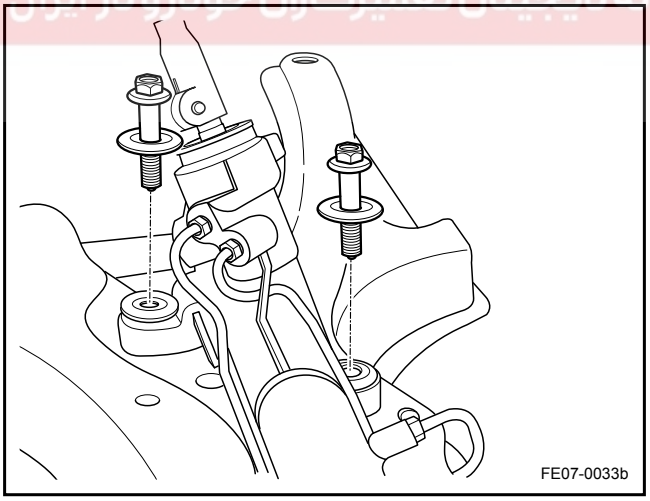


8. Remove the tie rod and the ball joint retaining nut.



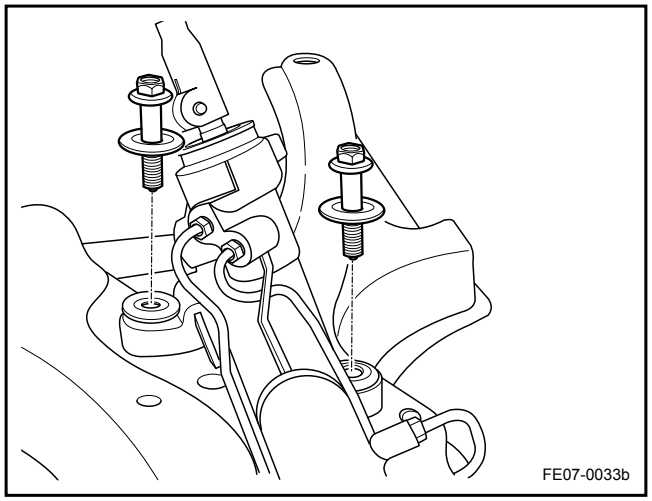
9. Remove the subframe assembly. Refer to 12.6.4.2 Subframe Replacement.

10. Remove the power steering gear retaining bolts.



11. Remove the power steering gear to the subframe retaining bolts.

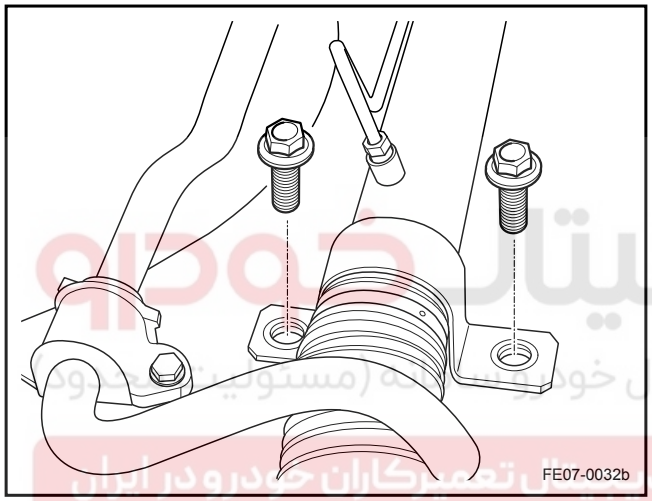
12. Remove the power steering gear assembly from the subframe.



Installation Procedure:

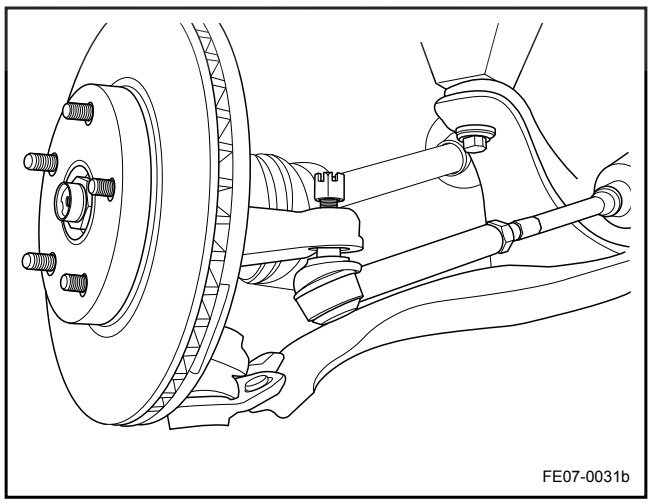
1. Install the power steering gear assembly to the subframe.
2. Install the power steering gear to the subframe retaining bolts and tighten.

   Torque: 58 Nm (Metric) 42.8 lb-ft (US English)



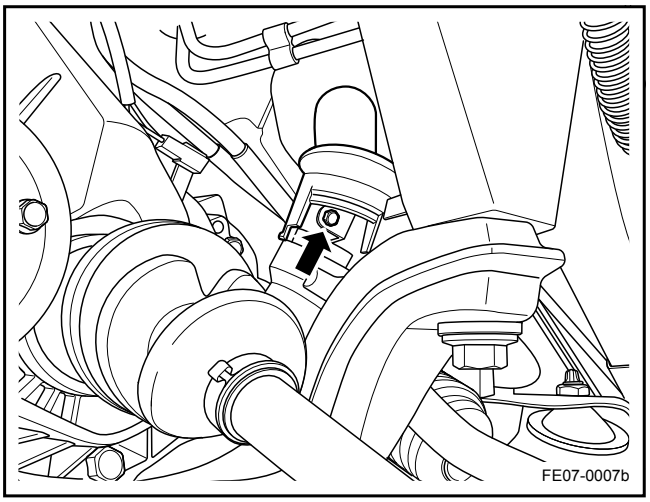
3. Tighten the power steering gear bracket and subframe retaining bolts.

   Torque: 58 Nm (Metric) 42.8 lb-ft (US English)
4. Install the subframe.



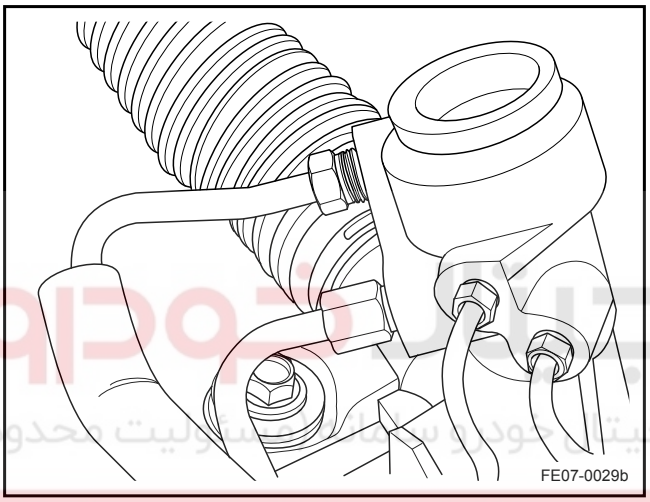
5. Install the power steering tie rod and the ball joint to the steering knuckle and tighten the retaining nuts.

   Torque: 33 Nm (Metric) 24.3 lb-ft (US English)



6. Install the steering column universal joints, and tighten the bolts.

   Torque: 25 Nm (Metric) 18.4 lb-ft (US English)



7. Connect the power steering gear inlet/outlet pipes and the return pipe.

   Torque: 28 Nm (Metric) 20.7 lb-ft (US English)

8. Install the wheels.

9. Lower the vehicle.

10. Re-fill the power steering fluid and check whether the system leaks. if there is leakage, repeat the above steps until the pipes are normal.

11. Carry out the power steering system bleeding procedure. Refer to 7.2.8.7 Power Steering System Bleeding.

12. Connect the battery negative cable.

7.3 Steering Wheel and Steering Column

7.3.1 Specifications

7.3.1.1 Fastener Tightening Specifications

Applications	Model	Specifications	
		Metric (Nm)	US English (lb-ft)
Steering Wheel Retaining Nut	M12	41-49	30.3-36.3
Steering Wheel Retaining Nut	ST4.8 × 13	2-4	1.5-3.0
Steering Column Universal Joint Bolts	M8	22-25	16.3-18.5
Steering Column Upper Retaining Bolt	M8 × 30	22-25	16.3-18.5
Steering Column Lower Retaining Bolt	M8 × 55	25-28	18.5-20.7

7.3.2 Description and Operation

7.3.2.1 Description and Operation

Warning!

Refer to "SIR Warning" in "Warnings and Notices".

Note

Refer to "Steering Wheel in the Full Turn Position Notice" in "Warnings and Notices".

Note

Disconnect the mechanical steering column assembly, the upper intermediate shaft assembly, the lower intermediate shaft assembly. The wheels should be kept in the straight front direction, the mechanical steering column assembly must be in the LOCK (locked) position. After disconnecting the above components, do not move the front tires and wheels, otherwise it will cause some parts incorrect installation location, and lead to mechanical steering column assembly airbag spiral off the center, resulting in airbag spiral coil damage.

Note

Steering column can not only change the vehicle direction, but also provide protection. To ensure the steering column energy absorption, make sure use the provided screws, bolts and nuts and tighten to the required torque.
In the event of front end collision energy absorbing column will crumple, reducing the chance of injury to the driver.

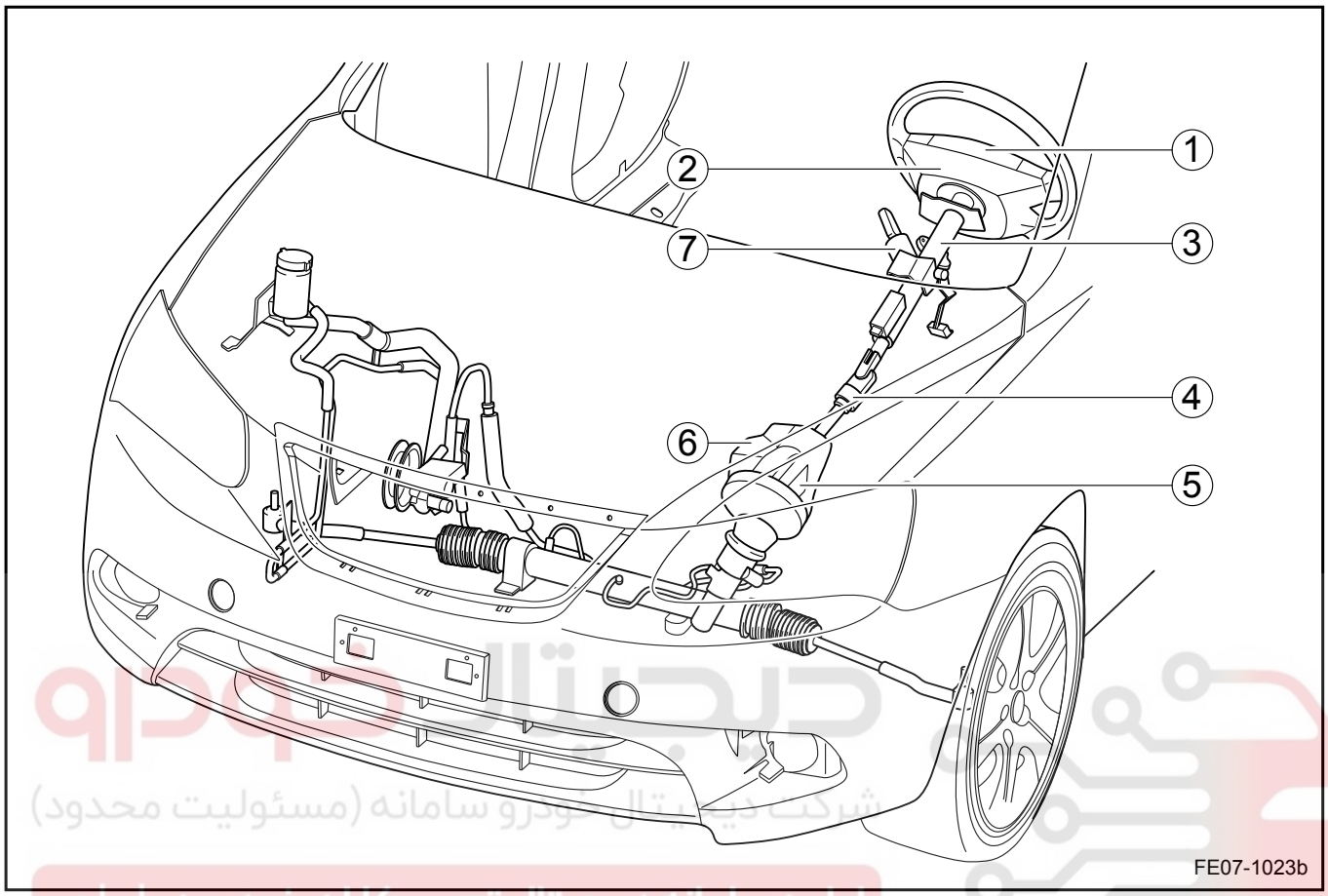
Ignition switch includes a steering wheel lock, installed in the mechanical steering column assembly. It is able to lock the steering wheel to prevent theft. When the ignition key is removed from the ignition switch, turn the steering wheel left and right, the pin inside the ignition switch pops up to lock the steering wheel. Release the locking handle, the steering wheel can tilt up and down. Therefore, the driver can adjust the steering wheel to a comfortable position. When driver leaves the vehicle, if the key is still inside the ignition switch, the reminder device inside the ignition key will beep to remind the driver. Refer to the11.10 Remote Anti-theft System.

Note

When reassemble, apply a thin layer of lithium-based grease at all friction points. In this way, mechanical steering column assembly can removed and assembled easily.

7.3.3 Component Locator

7.3.3.1 Component Locator

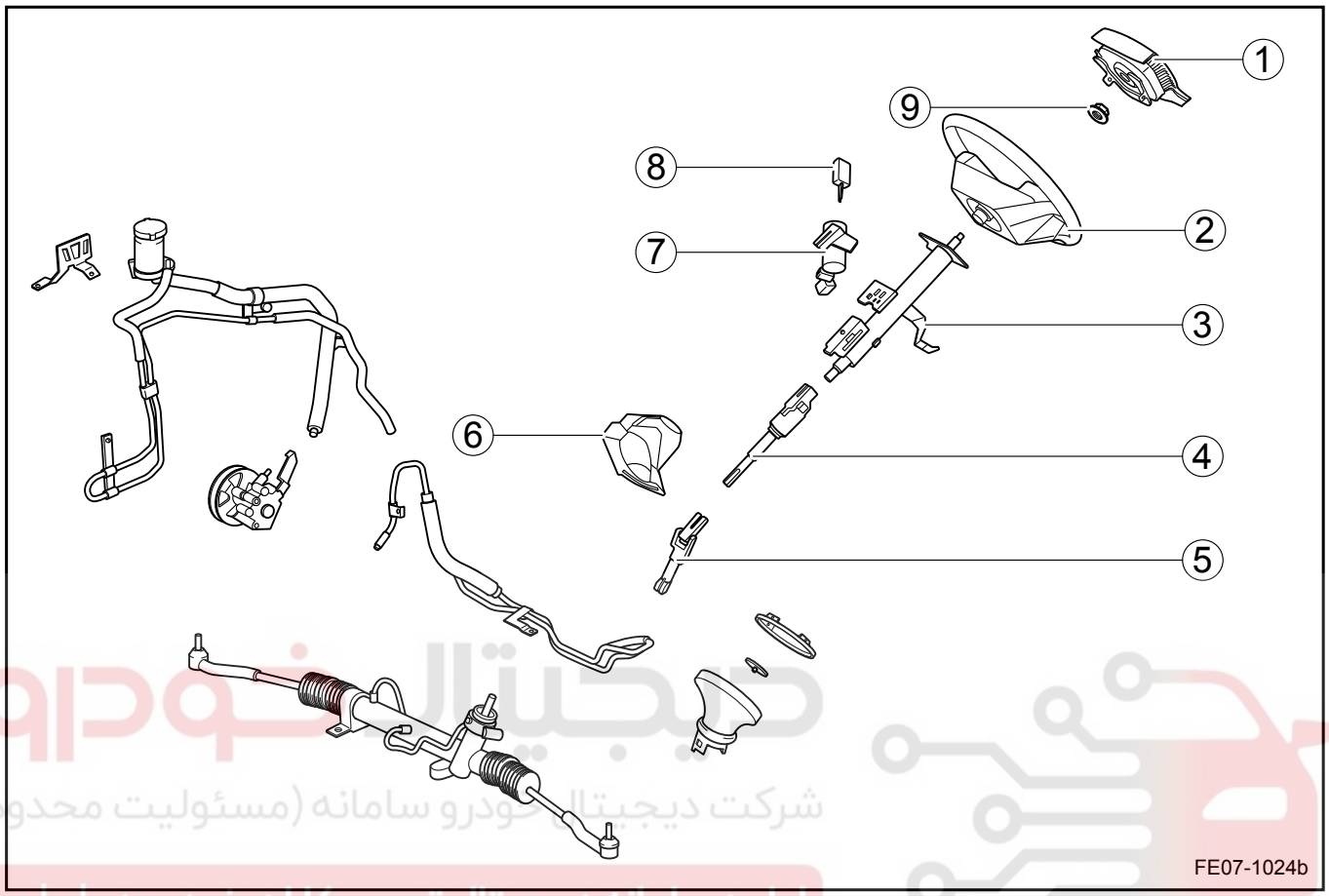


Legend

1. Driver Front Airbag
2. Steering Wheel
3. Mechanical Steering Column Assembly
4. Upper Intermediate Shaft Assembly
5. Lower Intermediate Shaft Assembly
6. Steering Column Silencer Cover
7. Ignition Switch

7.3.4 Disassemble View

7.3.4.1 Disassemble View



Legend

1. Driver Front Airbag
2. Steering Wheel
3. Mechanical Steering Column Assembly
4. Upper Intermediate Shaft Assembly
5. Lower Intermediate Shaft Assembly
6. Steering Column Silencer Cover
7. Ignition Switch
8. Ignition Switch Key
9. Steering Wheel Retaining Nut

7.3.5 Diagnostic Information and Procedures

7.3.5.1 Diagnosis Description

Refer to7.3.2 Description and Operationget familiar with the system functions and operation before start system diagnostics, so that it will help to determine the correct diagnostic steps, more importantly, it will also help to determine whether the customer described situation is normal.

7.3.5.2 Visual Inspection

Before diagnostic, verify the fault. Check whether tire pressure is normal, whether there are obvious signs of mechanical or electrical damage, whether the mechanical steering column shaft assembly connecting bolt is loose, whether the mechanical steering column assembly mounting bracket retaining bolt is loose.

7.3.5.3 Fault Symptom Table

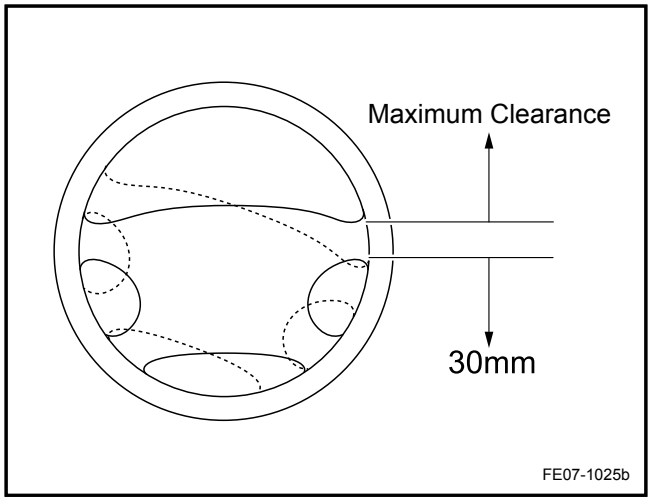
During the diagnostic. Refer to the following table. It can help to determine the cause and location of faults. Ascending order indicates the possible causes of failure. Check each component. If necessary, repair or replace these components.

Symptoms	Suspected Parts	Measures / Refer to
Steering Wheel Loose	1. Steering wheel retaining nut (Loose / Damaged)	Tighten or replace the nut. Refer to 7.3.6.3 Steering Wheel Replacement.
	2. Mechanical steering column assembly connecting bolt (Loose / Damaged)	Tighten or replace bolt. Refer to 7.3.6.4 Mechanical Steering Column Assembly Replacement.
	3. Upper and lower intermediate shaft universal joints (Worn)	Replace the upper and lower intermediate shaft assembly. Refer to 7.3.6.4 Mechanical Steering Column Assembly Replacement.
	4. Steering wheel spline sleeve (Worn)	Replace the steering wheel. Refer to 7.3.6.3 Steering Wheel Replacement.
	5. Steering column spline shaft (Worn)	Replace the steering column. Refer to 7.3.6.4 Mechanical Steering Column Assembly Replacement.
	6. Upper and lower intermediate shaft spline sleeve / shaft (wear)	Replace the upper and lower intermediate shaft. Refer to 7.3.6.4 Mechanical Steering Column Assembly Replacement.
	7. Power steering gear assembly	Repair or replace the power steering gear assembly. Refer to 7.2.8.13 Power Steering Gear Assembly Replacement.
Mechanical Steering Column Assembly Loose	1. Mechanical steering column mounting bolt (Loose / Damaged)	Tighten or replace the blot. Refer to 7.3.6.4 Mechanical Steering Column Assembly Replacement.
	2. Mechanical steering column assembly installation bearings (Damaged)	Replace the Instrument panel carrier. Refer to 12.8.3.3 Instrument Panel Carrier Replacement.
	3. Mechanical steering column assembly (Damaged)	Replace the mechanical steering column assembly. Refer to 7.3.6.4 Mechanical Steering Column Assembly Replacement.

Symptoms	Suspected Parts	Measures / Refer to
Steering Column Assembly Noise	1. Mechanical steering column assembly mounting bolt (Loose / Damaged)	Tighten or replace the bolt. Refer to 7.3.6.4 Mechanical Steering Column Assembly Replacement.
	2. Airbag clock spring (Loose / Damaged)	Install or replace the clock spring. Refer to 9.2.7.3 Clock Spring Replacement.
	3. Mechanical steering column assembly system connecting bolt (Loose / Damaged)	Tighten or replace the bolts. Refer to "7.3.6.4 Mechanical Steering Column Assembly Replacement.
	4. Mechanical steering column assembly shaft / bearing (Worn)	Replace the mechanical steering column assembly. Refer to 7.3.6.4 Mechanical Steering Column Assembly Replacement.
Steering Column Assembly Noise	5. Upper and lower intermediate shaft universal joints (Lack of lubrication / Worn)	Apply grease or replace the upper and lower intermediate shaft. Refer to 7.3.6.4 Mechanical Steering Column Assembly Replacement.
Adjustable Steering Column Tilt Function Abnormal	1. Steering column tilt locking block (Jam)	Clean impurities and rust, lubricate or replace the steering column locking block. Refer to 7.3.6.4 Mechanical Steering Column Assembly Replacement.
	2. Adjustable steering column tilt handle (Loose / Damaged)	Tighten the nuts or replace the handle. Refer to 7.3.6.4 Mechanical Steering Column Assembly Replacement.
	3. Steering column tilt spring (Weak / Damaged)	Install or replace the spring. Refer to 7.3.6.4 Mechanical Steering Column Assembly Replacement.
	4. Mechanical steering column assembly tilt pivot (Rusty / Damaged)	Remove rust, lubricate or replace the mechanical steering column assembly. Refer to 7.3.6.4 Mechanical Steering Column Assembly Replacement.
Mechanical Steering Column Assembly Hard to Lock / Unable to Lock	1. Ignition switch mounting bolt (Loose / Damaged)	Tighten or replace the installed bolt.
	2. Ignition switch lock (Stagnating / Damaged)	Remove rust, lubricate or replace the ignition switch.
	3. Ignition switch lock pin (Broken / Damaged)	Replace the ignition switch.
	4. Mechanical steering column assembly internal axle (Damaged)	Replace the mechanical steering column assembly. Refer to 7.3.6.4 Mechanical Steering Column Assembly Replacement.
Mechanical Steering Column Assembly Hard to Unlock / Unable to Unlock	1. Ignition switch lock (Stagnating / Damaged)	Remove rust, lubricate or replace the ignition switch.
	2. Ignition key (Worn / Damaged)	Replace the ignition switch.

7.3.6 Removal and Installation

7.3.6.1 Steering Wheel Free Space Check



1. Park the vehicle, straighten the front wheels.

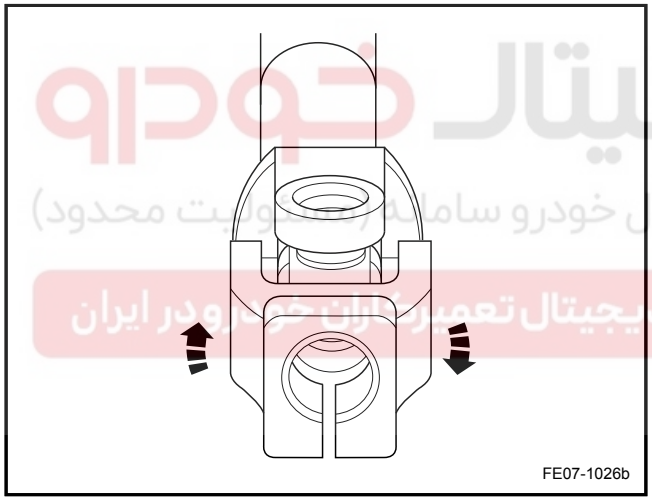
   Note

   This vehicle steering wheel free space can not be adjusted. When the upper and lower intermediate shaft universal joints are normal, replace the power steering gear assembly.

2. Turn the steering wheel while feel whether there is free space. If there is free space, replace the upper and lower intermediate shafts.

   Maximum free-space:30 mm (1.18 in)

7.3.6.2 Upper and Lower Intermediate Shaft Universal Joints Inspection



1. Fix one end of the upper and lower intermediate shaft universal joints, rotate the other end clockwise and counterclockwise.
2. Check whether it feels any movement. If there is any movement, replace the upper and lower intermediate shafts.

7.3.6.3 Steering Wheel Replacement

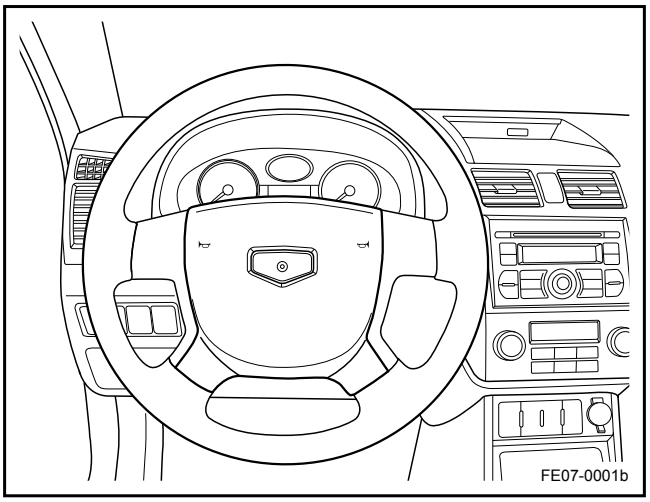
Removal Procedure:

Warning!

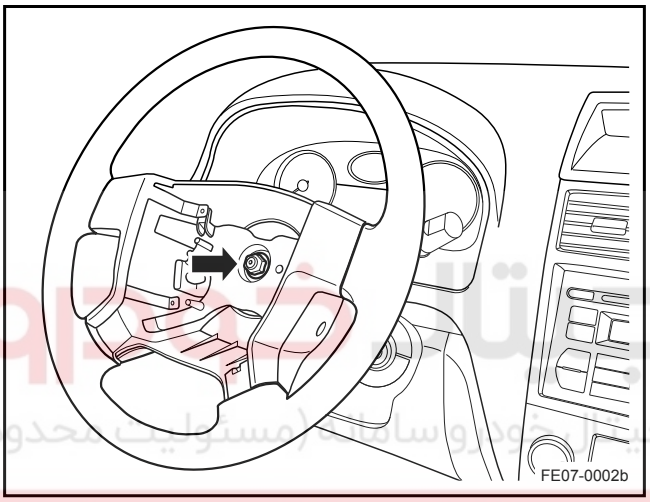
Refer to "Battery Disconnect Warning" in "Warnings and Notices" .

Note

Before operation, straighten the front wheels and lock the steering wheel.

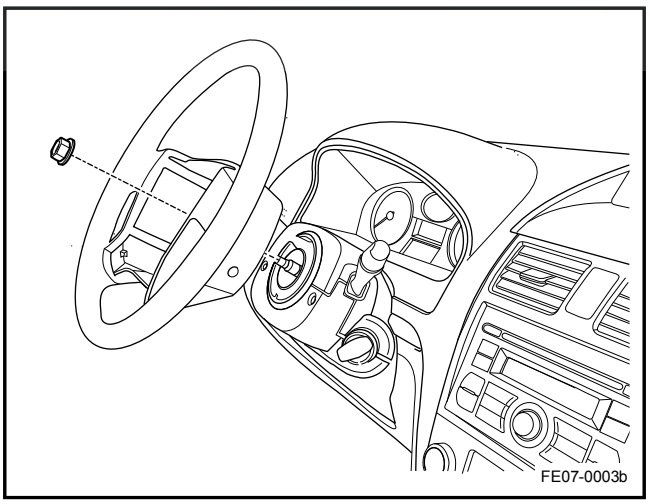


1. Remove the battery negative cable. Refer to 2.11.8.1 Battery Disconnection.
2. Remove the driver front airbag. Refer to 9.2.7.2 Driver Front Airbag Replacement.



3. Remove the steering wheel retaining nut.
4. Remove the steering wheel.

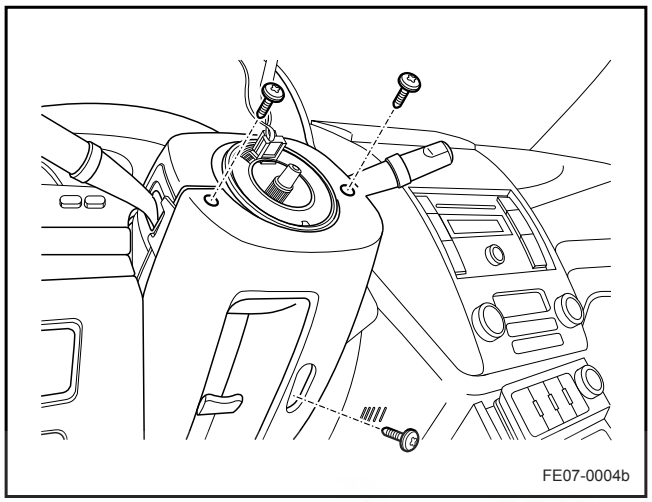
Installation Procedure:

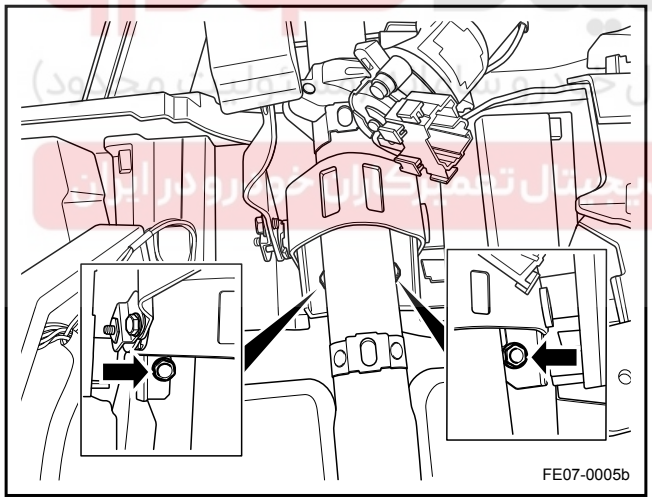


1. Straighten the front wheels, install the steering wheel.
2. Install the steering wheel retaining nut.

   Torque: 45 Nm (Metric) 33.3 lb-ft (US English)
3. Install the driver front airbag.

7.3.6.4 Mechanical Steering Column Assembly Replacement





Removal Procedure:

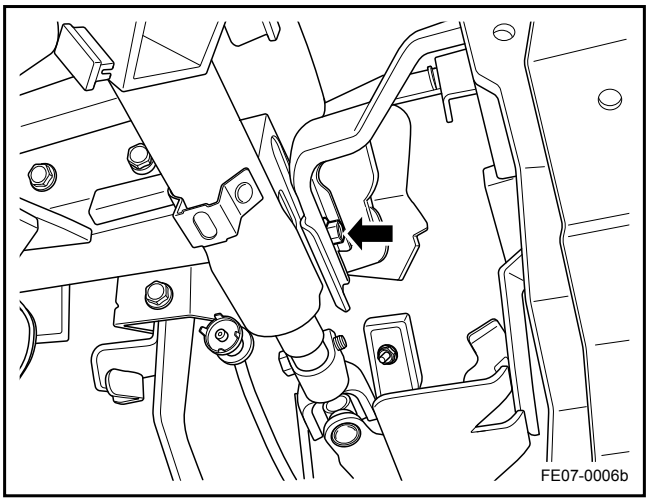
Warning!

Refer to "Battery Disconnect Warning" in "Warnings and Notices" .

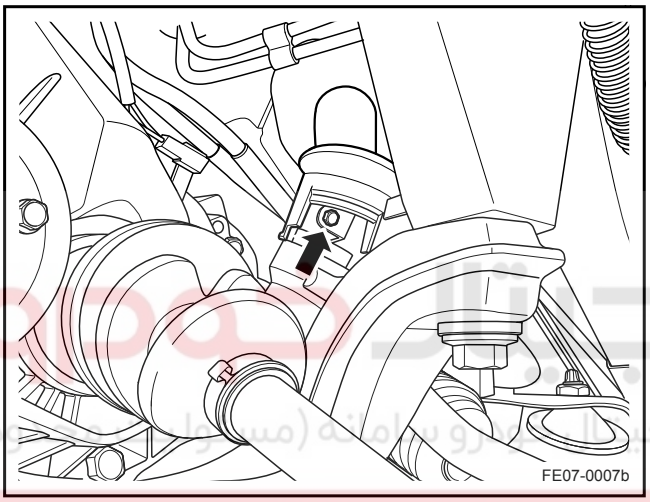
1. Turn the steering wheel, so that the front wheels are straight ahead.
2. Disconnect the battery negative cable. Refer to 2.11.8.1 Battery Disconnection.

   Note

   Disconnect the battery negative cable and wait at least 90s, prevent the airbag and seat belt pre-tensioner being activated.
3. Remove the steering wheel. Refer to 7.3.6.3 Steering Wheel Replacement.
4. Remove the mechanical steering column assembly upper and lower shield screws.
5. Remove the mechanical steering column assembly upper and lower shield panels.
6. Remove the clock spring.
7. Remove the headlamp switch. Refer to 11.4.8.1 Headlamp Switch Replacement.
8. Remove the wiper and washer switch. Refer to 11.6.8.8 Wiper and Washer Switch Replacement.
9. Remove the instrument panel side panel and lower panel. Refer to 12.8.3.1 Instrument Panel Replacement.
10. Remove the mechanical steering column assembly bracket retaining blots.

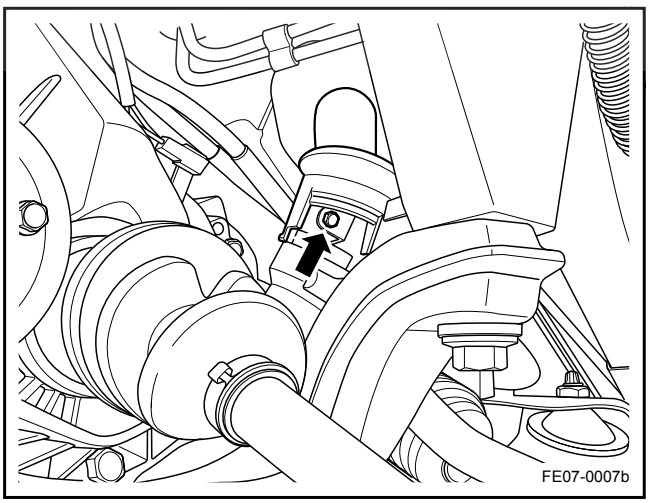


11. Remove the mechanical steering column assembly bracket to carrier connecting bolt.
12. Remove the ignition switch cylinder.



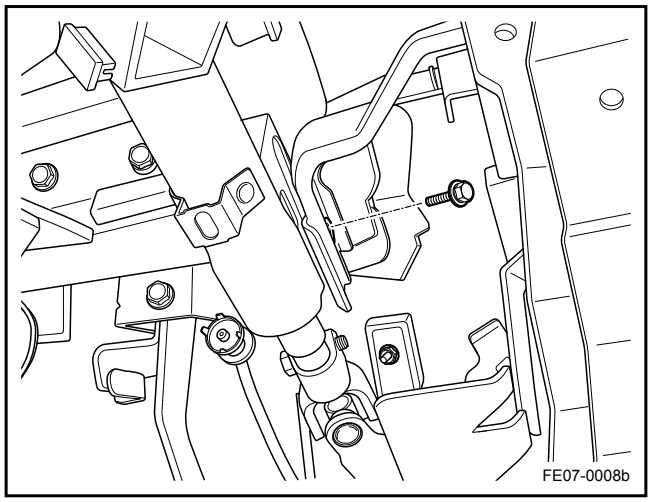
13. Remove the mechanical steering column assembly universal joint bolt, disconnect the upper and lower intermediate shafts from the power steering gear assembly input shaft.
14. Remove the mechanical steering column assembly with universal joint .

Installation Procedure:



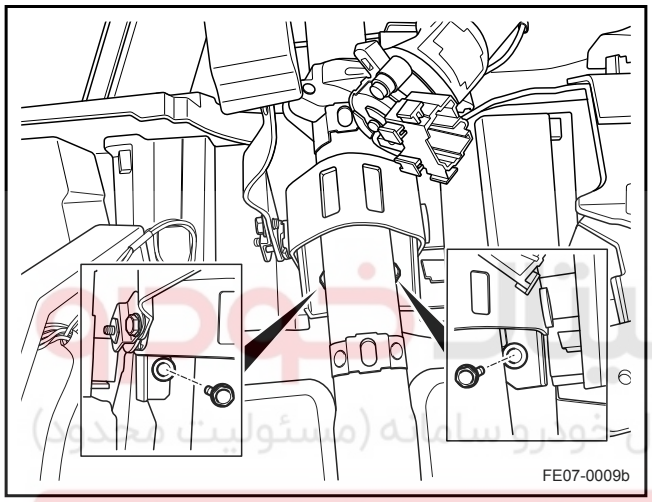
1. Install the mechanical power steering column with the upper and lower steering intermediate shaft assembly to the power steering gear assembly input shaft and tighten the bolts.

   Torque: 28 Nm (Metric) 20.7 lb-ft (US English)



2. Install the mechanical steering column assembly bracket and carrier connecting bolts and tighten.

   Torque: 25 Nm (Metric) 18.5 lb-ft (US English)



3. Install the mechanical steering column assembly bracket retaining bolts.

   Torque: 25 Nm (Metric) 26 lb-ft (US English)

4. Install the ignition switch cylinder.
5. Install the side and the lower instrument panel shield panels.
6. Install the wiper and washer switch.
7. Install the headlamp switch.
8. Install the clock spring.
9. Install the mechanical steering column assembly upper and lower shield panels.
10. Install the steering wheel.
11. Connect the battery negative cable.
12. Check the airbag warning lamp.