FUEL DELIVERY
04

CONTENTS

FUEL DELIVERY SYSTEM

GENERAL INFORMATION

Description

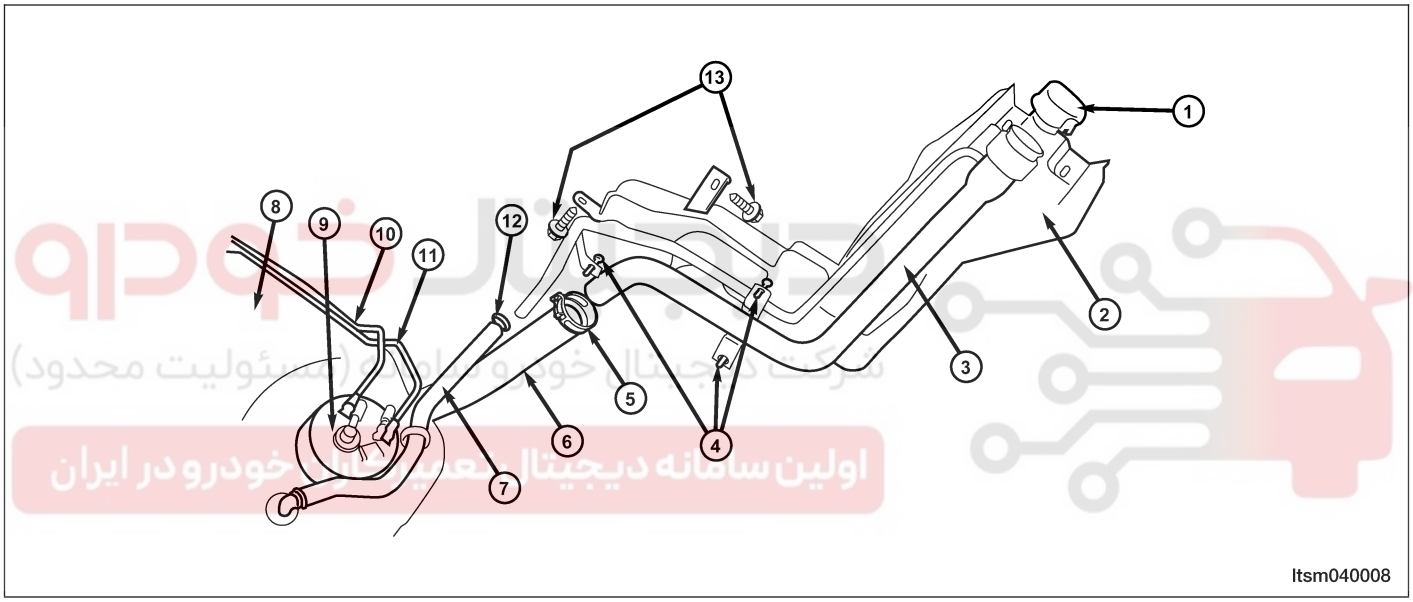
The fuel system consists of a fuel tank with a reservoir, fuel pump, fuel filter, fuel delivery line, fuel rail, fuel rail pulse damper and fuel injectors. The Engine Control Module (ECM) controls the fuel system based on signal inputs. The immobilizer module signals the ECM to activate the fuel system. If the ECM does not receive the proper signal from the immobilizer module, the ECM will not allow the fuel system to operate.

- The ACTECO engine utilizes a returnless fuel delivery system.
- The MITSUBISHI engine utilizes a fuel return fuel delivery system.

WARNING!

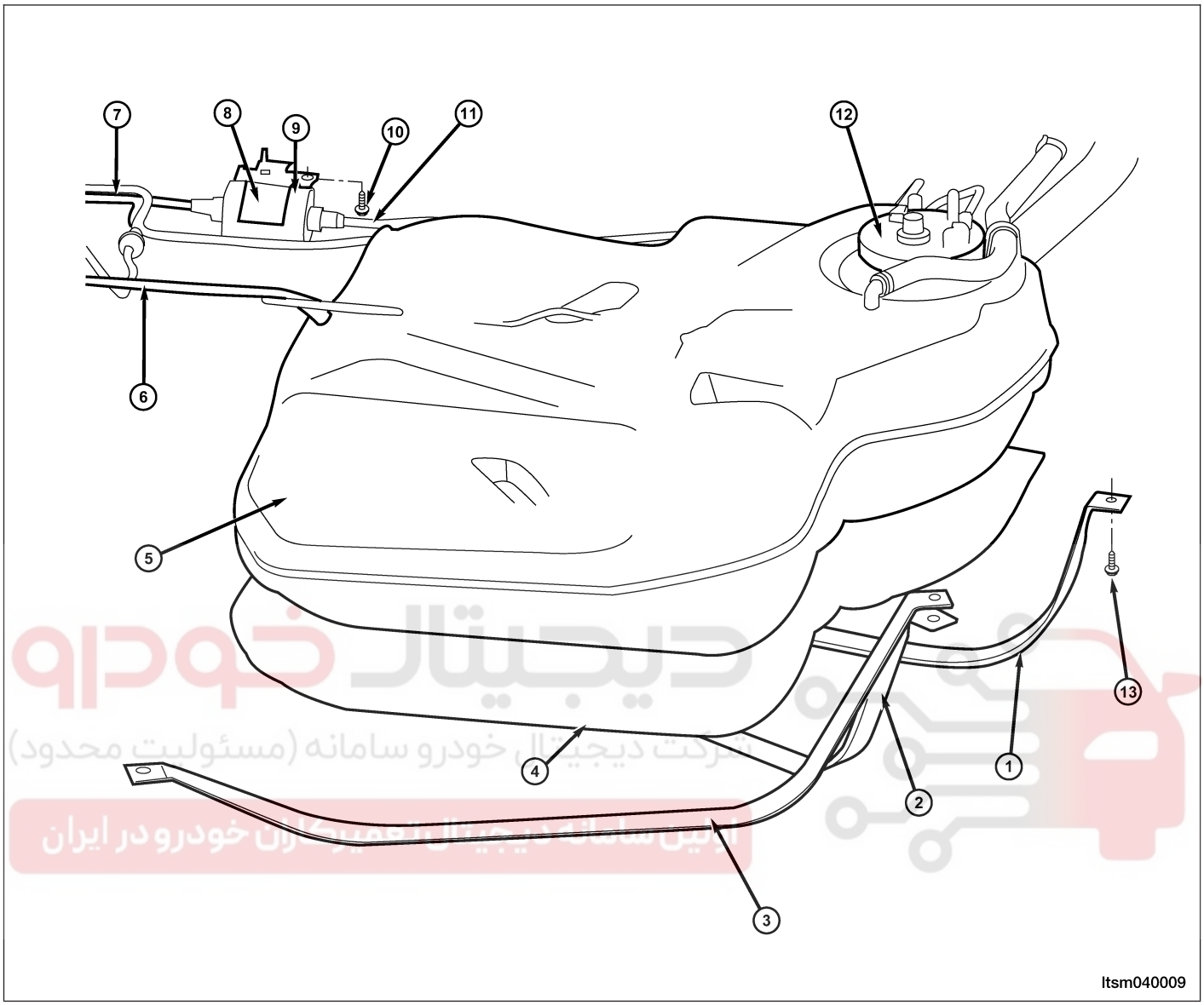
Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

Fuel Filler Assembly



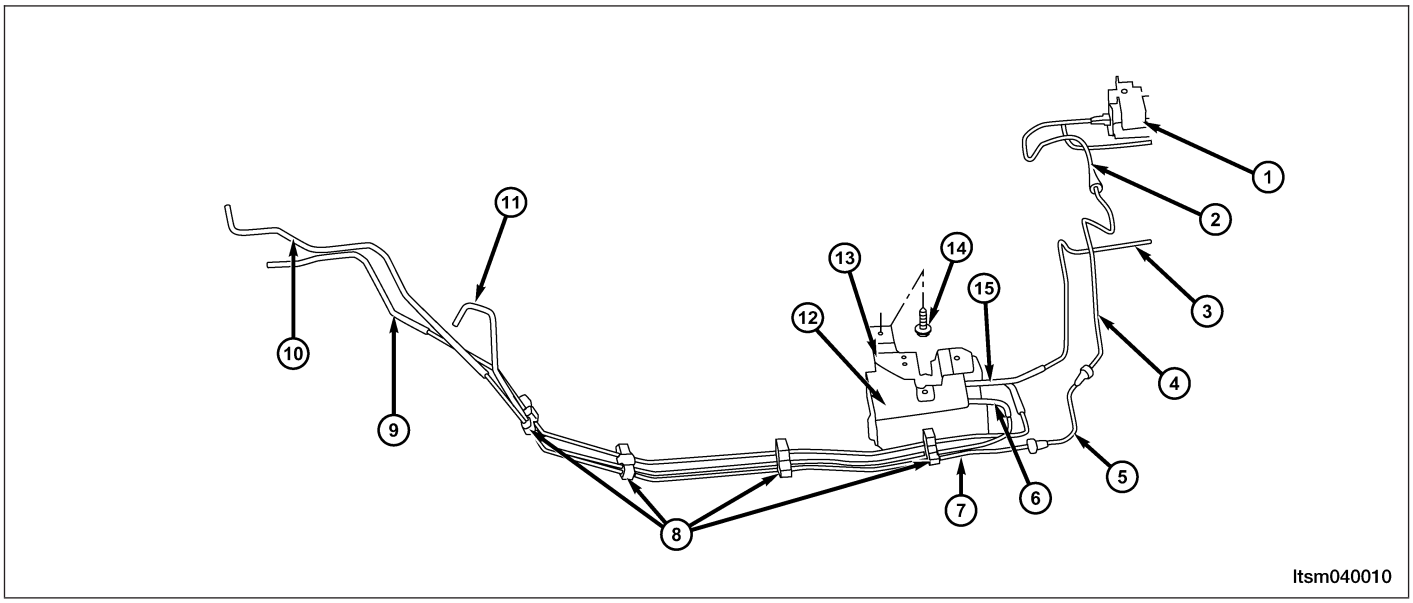
1 - Fuel Filler Cap Assembly	8 - Fuel Tank Assembly
2 - Fuel Filler Shield	9 - Electric Fuel Pump Assembly
3 - Fuel Filler Tube Assembly	10 - Fuel Delivery Pipe Assembly
4 - Bolt	11 - Fuel Return Pipe Assembly
5 - Hose Clamp	12 - Hose Clamp
6 - Fuel Filler Hose	13 - Bolt
7 - Fuel Filler Air Hose	

Fuel Tank Assembly



1 - Fuel Tank Band I	8 - Fuel Filter Bracket
2 - Fuel Tank Band II	9 - Fuel Filter Assembly
3 - Fuel Tank Band III	10 - Bolt
4 - Fuel Tank Protector	11 - Fuel Delivery Pipe
5 - Fuel Tank Assembly	12 - Electric Fuel Pump Assembly
6 - EVAP Hose	13 - Bolt
7 - Fuel Delivery And Return Pipes Assembly	

EVAP Emissions Assembly



1 - Fuel Filter Assembly	9 - EVAP Hose V
2 - Fuel Delivery and Return Pipes	10 - Fuel Delivery Hose
3 - EVAP Pipe I	11 - Air Duct
4 - Fuel Delivery Pipe III	12 - Canister Assembly
5 - Fuel Delivery Pipe IV	13 - Canister Bracket Assembly
6 - Air Duct	14 - Bolt
7 - Fuel Delivery Pipe V	15 - EVAP Hose I
8 - Pipe Clamps	

Operation

The fuel delivery system is enabled when it reaches the following conditions:

- Turn the ignition switch ON (engine off), the fuel delivery system is enabled for 3-6 seconds.
- The Engine Control Module (ECM) receives a Crankshaft Position (CKP) sensor signal.

The fuel injectors are a solenoid-operated valve that meter fuel flow to each cylinder. The fuel injectors are opened and closed constantly during engine operation. The amount of fuel is controlled by the length of time the fuel injector is held open. The fuel injectors are powered by a 12 V source and are controlled through the ground side of the circuit by the ECM.

The fuel pump operation is defined in the fuel system control strategy and is controlled by the ECM.

Specifications

Torque Specifications

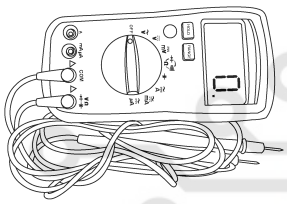
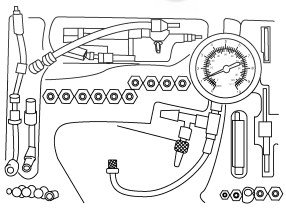
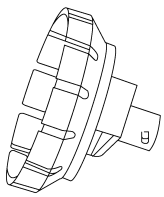
DESCRIPTION	TORQUE (N·m)
Fuel Rail Bracket Bolts	11
Fuel Filter Mounting Bolts	10

Fuel Pressure Specifications

1.6L & 1.8L & 2.0L	PRESSURE
Fuel Pressure at Fuel Rail - Key On	400 kPa (4.0 bar)
Fuel Pressure at Fuel Rail - Engine Idle	400 kPa (4.0 bar) - 420 kPa (4.2 bar)
Fuel Pressure at Fuel Rail - Key Off	380 kPa (3.8 bar) in 10 minutes

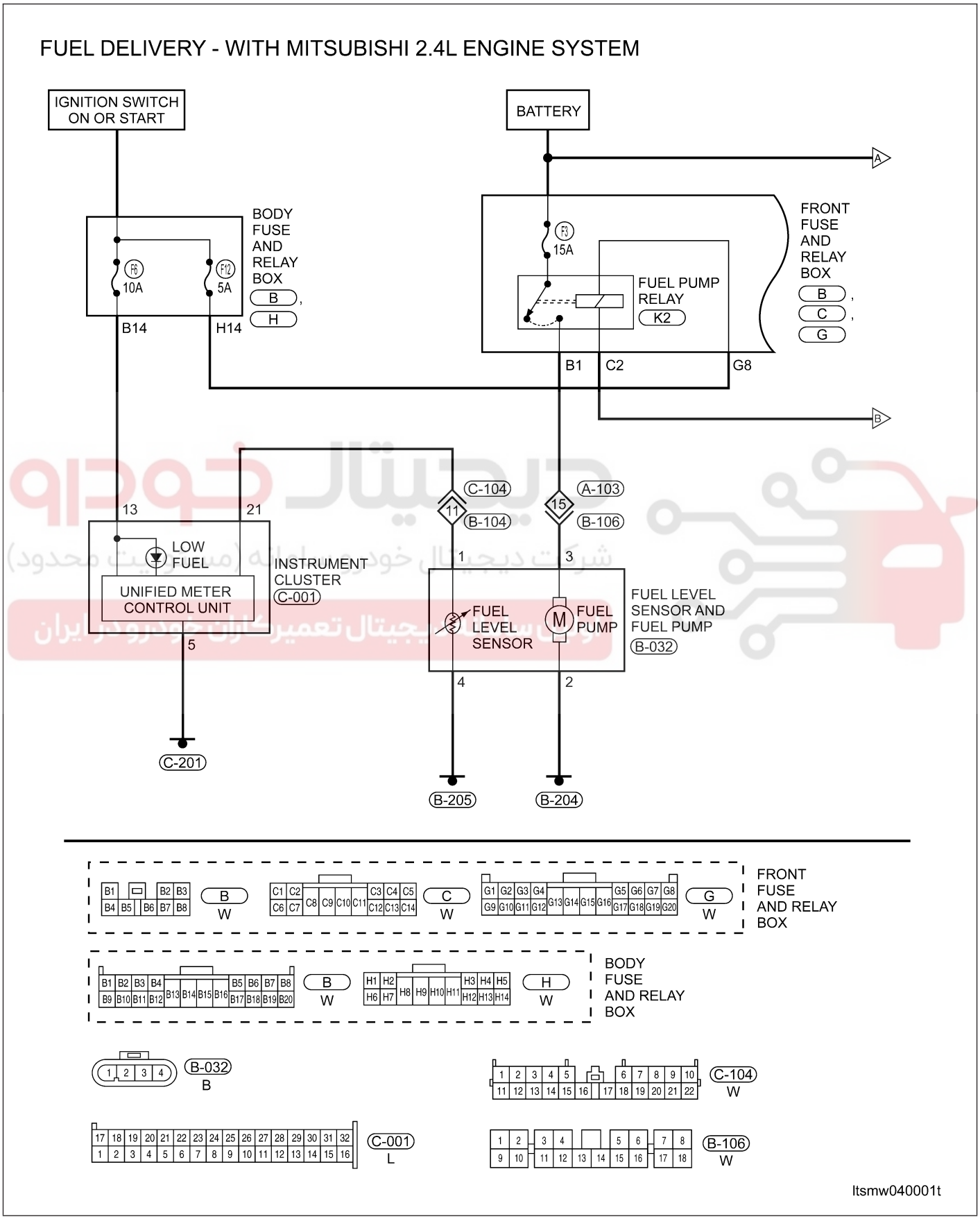
2.4L	PRESSURE
Fuel Pressure at Fuel Rail - Key On	329 kPa (3.29 bar)
Fuel Pressure at Fuel Rail - Engine Idle	320 kPa (3.2 bar) - 350 kPa (3.5 bar)
Fuel Pressure at Fuel Rail - Key Off	350 kPa (3.5 bar) in 10 minutes

Special Tools

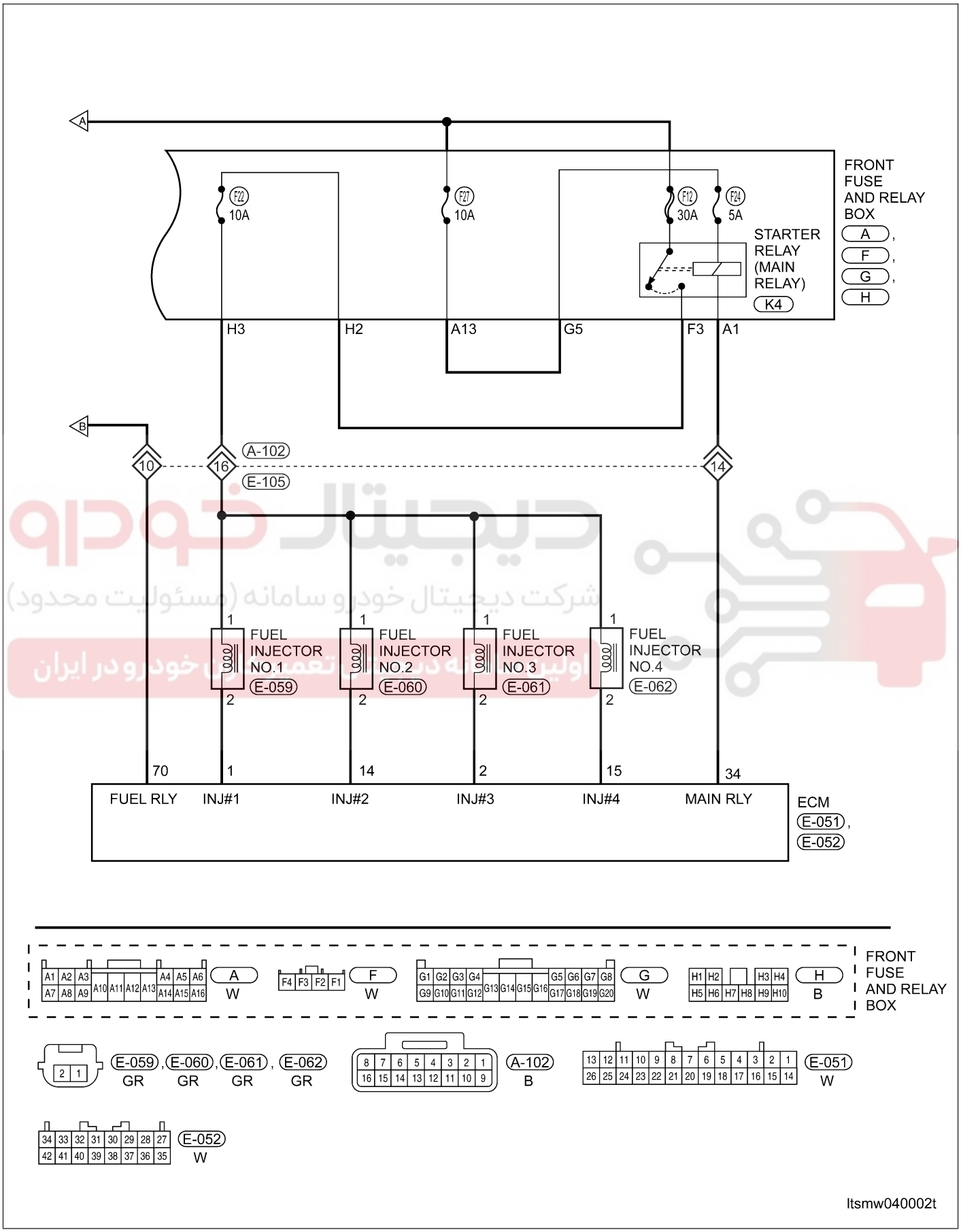
Digital Multimeter Fluke 15B & 17B	 besm030002
Fuel Pressure Gauge	 besm030008
Fuel Pump Remover CH-20032	 ltsm040011

Electrical Schematics

Fuel Delivery System (Page 1 of 6)



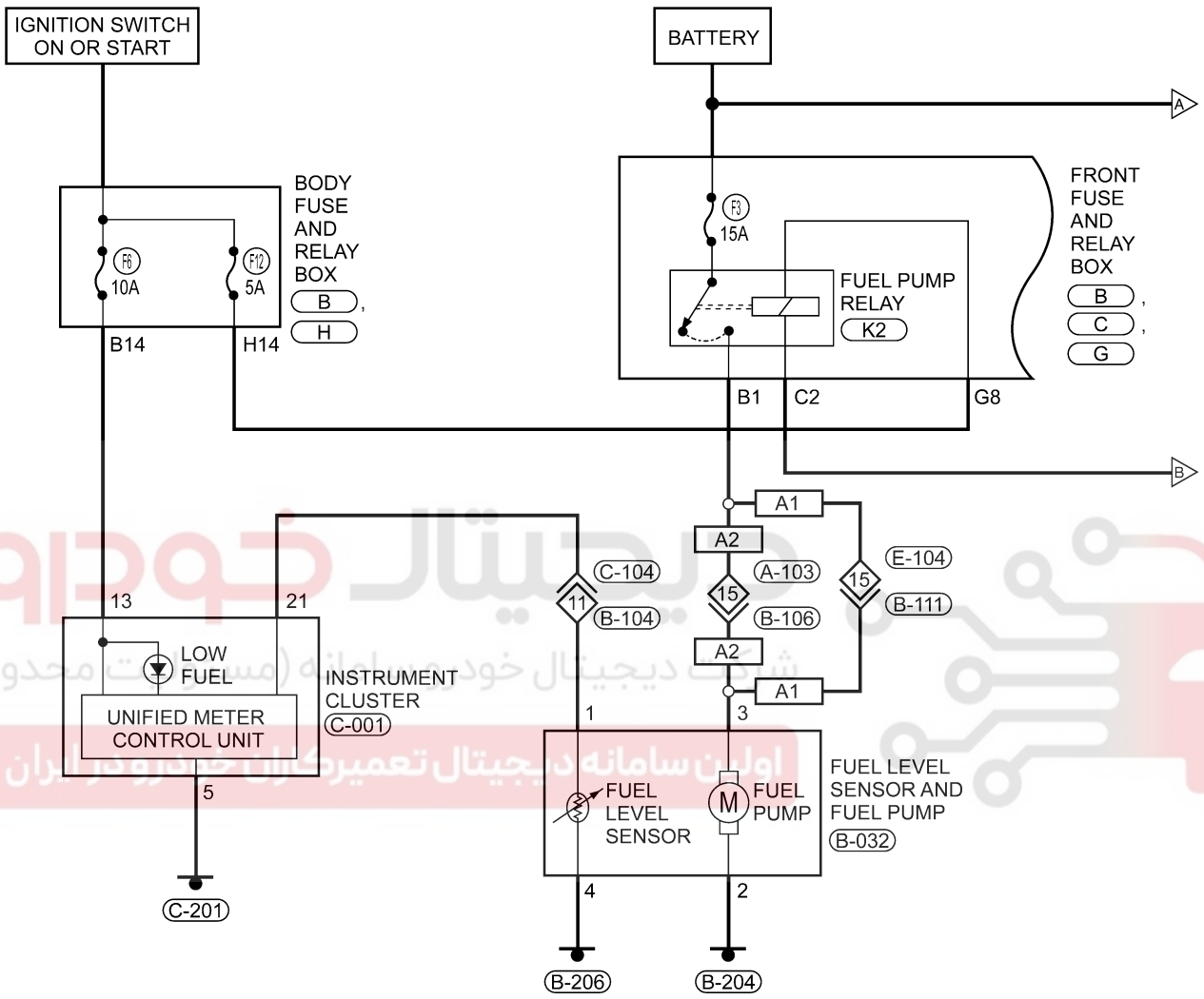
Fuel Delivery System (Page 2 of 6)

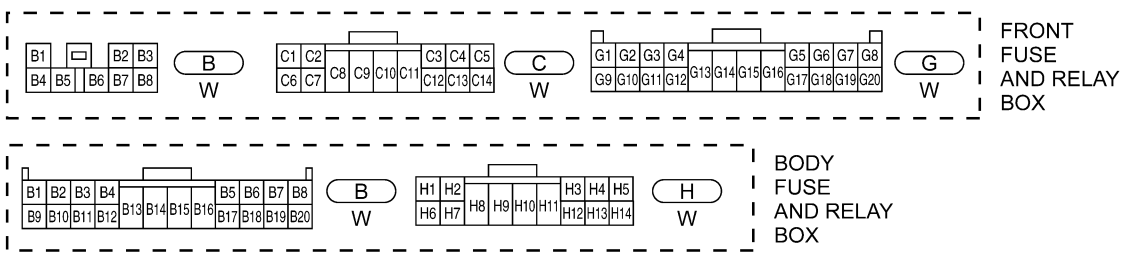


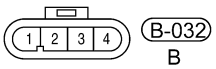
Fuel Delivery System (Page 3 of 6)

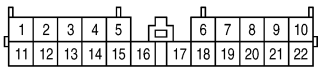
FUEL DELIVERY - WITH ACTECO ENGINE SYSTEM

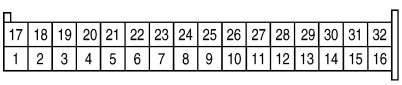
A1 : WITH ACTECO 1.6L - 1.8L ENGINE SYSTEM
A2 : WITH ACTECO 2.0L ENGINE SYSTEM

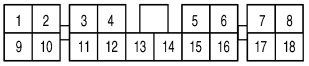












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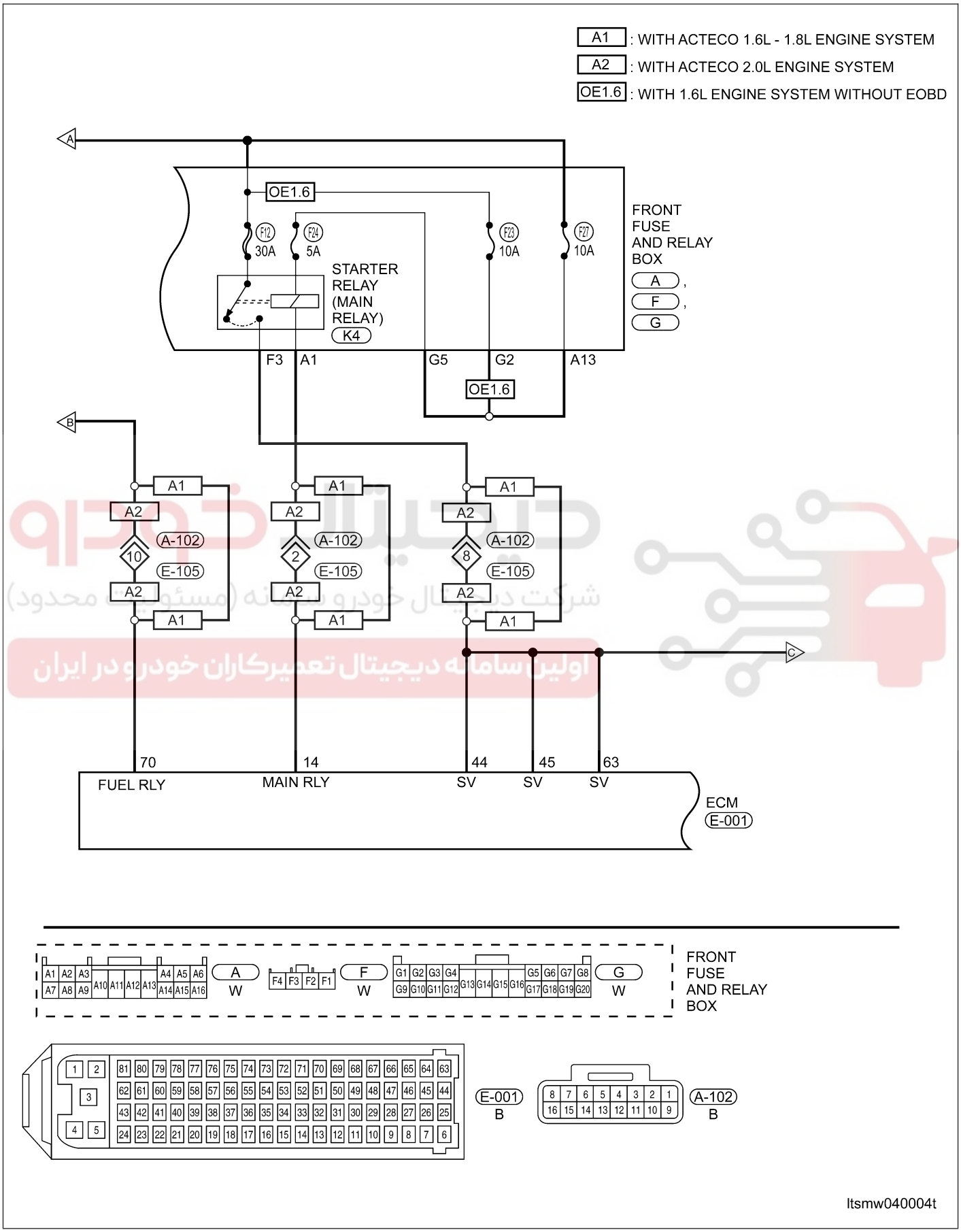
Fuel Delivery System (Page 4 of 6)



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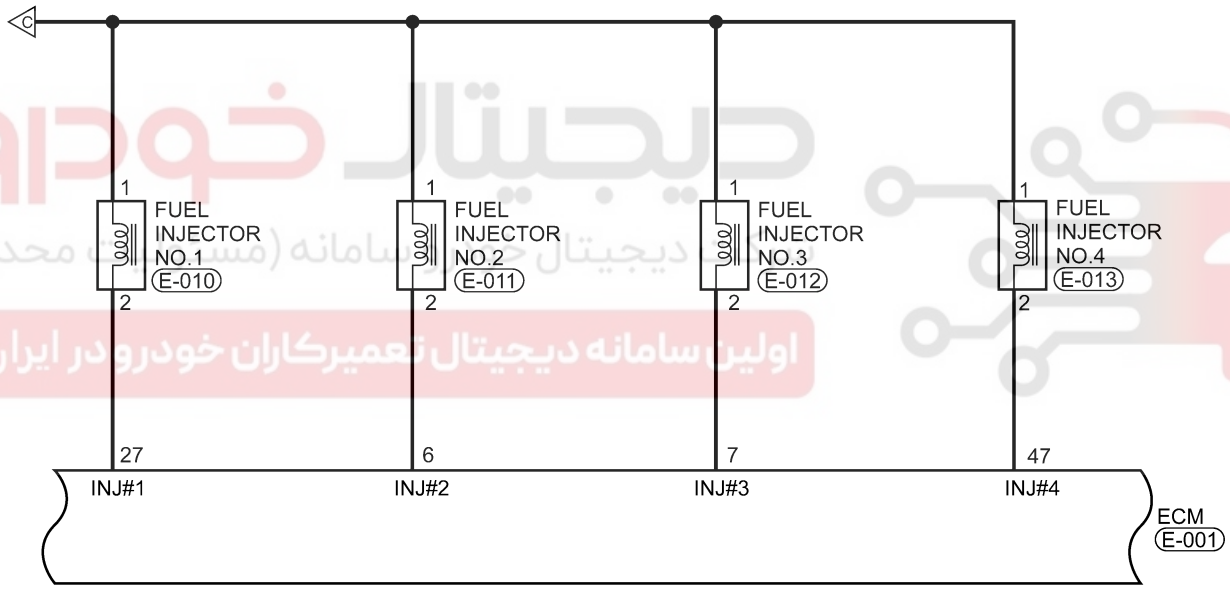
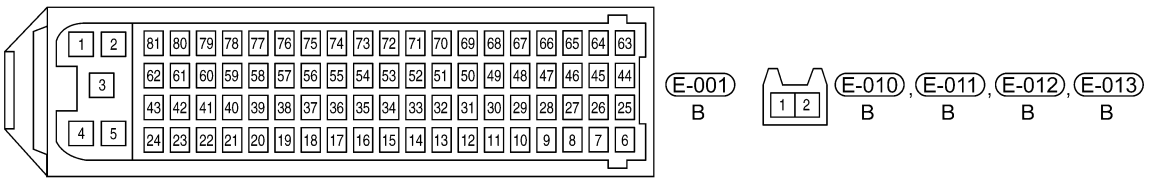
Fuel Delivery System (Page 5 of 6)





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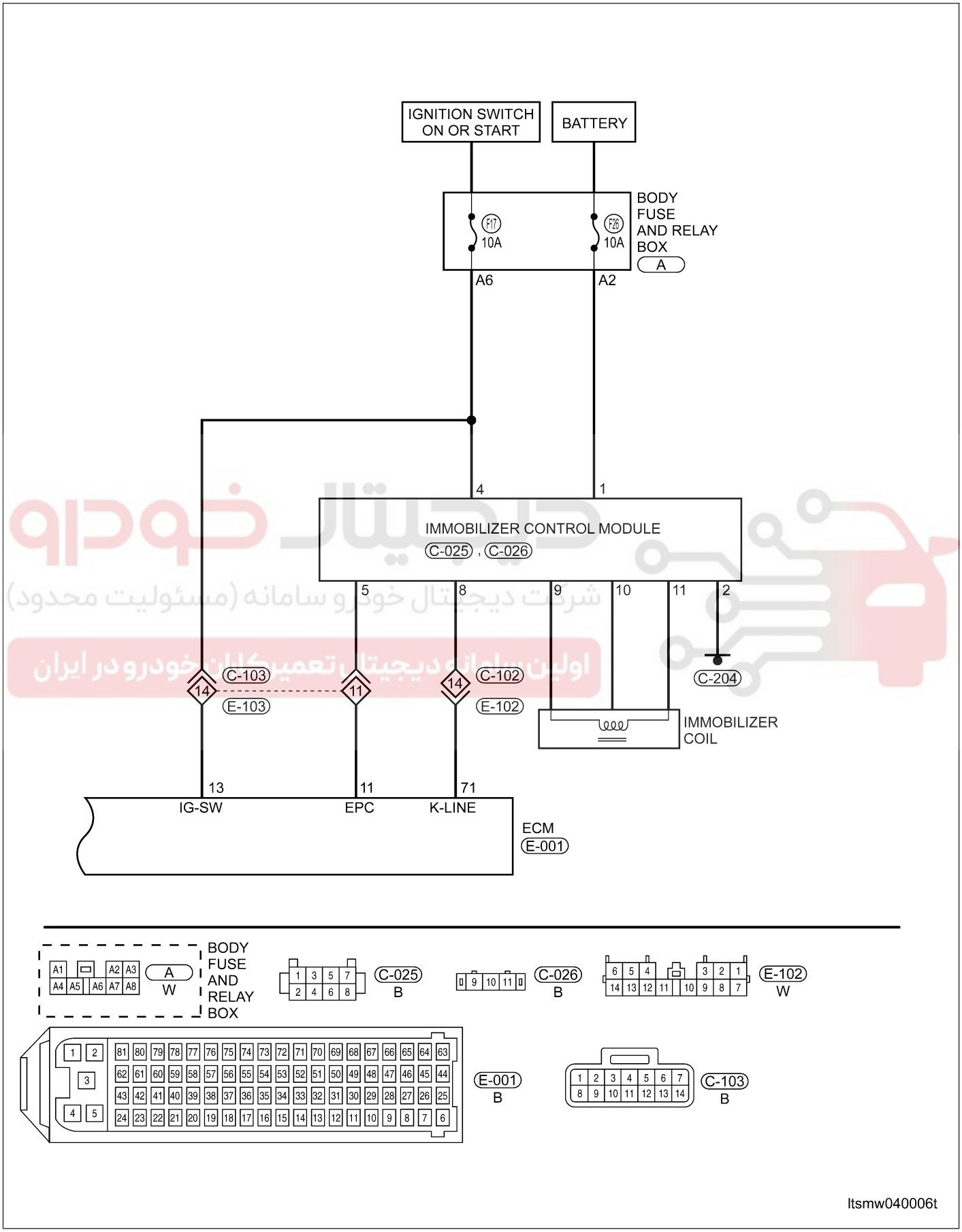
Fuel Delivery System (Page 6 of 6)



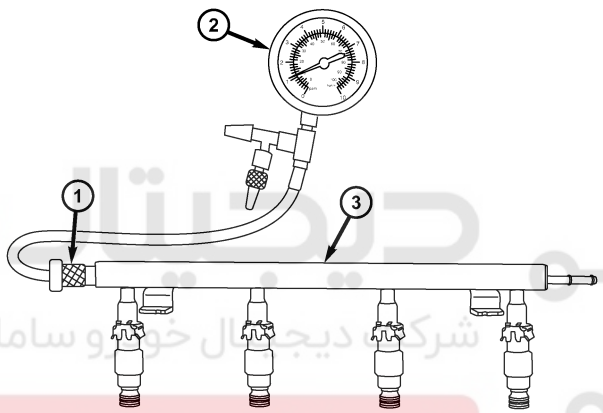
DIAGNOSIS & TESTING

Fuel Pressure Test

WARNING!

Fuel in the fuel system remains under high pressure, even when the engine is not running. Before servicing or disconnecting any of the fuel lines or fuel system components, the fuel system pressure must be relieved to prevent accidental spraying of fuel (See Fuel Pressure Relief Procedure in Section 04 Fuel Delivery). Failure to follow these instructions may result in serious personal injury or death.

Perform the following procedure to test for proper fuel pressure.



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WARNING!

Wrap towels around hoses to catch any gasoline spillage.

1. Remove the protective cap and connect the fuel pressure gauge (2) to the fuel rail service test port pressure fitting (1) on the fuel rail (3).
2. Start and warm the engine and note the pressure gauge reading:

1.6L & 1.8L & 2.0L

- Fuel pressure at idle: 400-420 kPa (4.0 - 4.2 bar)

2.4L

- Fuel pressure at idle: 320-350 kPa (3.2 - 3.5 bar)

3. If engine runs, but pressure is below minimum pressure, check the following:
   a. Check for a kinked fuel supply line between the fuel rail and the fuel pump, repair if necessary.
   b. Check the fuel filter for blockage, and replace the fuel filter if necessary (See Fuel Filter Removal & Installation in Section 04 Fuel Delivery).
   c. Check the fuel pump, and replace if necessary (See Fuel Pump Removal & Installation in Section 04 Fuel Delivery).
4. If operating pressure is above the maximum pressure, the electric fuel pump is OK, but fuel pressure regulator is defective. Replace the fuel pressure regulator (See Fuel Pump Removal & Installation in Section 04 Fuel Delivery).

NOTE:

- The 1.6L & 1.8L & 2.0L fuel pressure regulator is integrated into the fuel pump assembly and is not serviced separately.
- The 2.4L fuel pressure regulator is connected to the fuel rail, and is serviced separately.

5. Install the protective cap to the service test port pressure fitting (1) on the fuel rail.

Observe the following fuel pressures when testing:

FUEL PRESSURE - 1.6L & 1.8L & 2.0L	
Key On	400 kPa (4.0 bar)
Engine Idle	400-420 kPa (4.0 - 4.2 bar)
Key Off	380 kPa (3.8 bar) in 10 minutes

FUEL PRESSURE - 2.4L	
Key On	329 kPa (3.29 bar)
Engine Idle	320-350 kPa (3.2 - 3.5 bar)
Key Off	350 kPa (3.5 bar) in 10 minutes

Fuel System Troubleshooting Chart

CONDITION	POSSIBLE CAUSES	CORRECTION
No Start/Hard Start/Start and then Stall	· Contaminated fuel · Low fuel pressure · Restricted fuel filter · Fuel pump relay inoperative · Restricted or leaking fuel lines · Fuel pressure regulator	· Drain, flush and refill fuel system. · Check fuel pump pressure. · Replace fuel filter. · Test fuel pump relay. · Inspect/replace necessary fuel line(s), perform fuel system air purge. · Inspect/replace the fuel pump if necessary.
Stalls Under Aggressive Maneuvers/ Loss Of Fuel Pressure	· Restricted or damaged fuel filter · Contaminated fuel · Damaged fuel tank	· Replace fuel filter. · Drain, flush and refill fuel system. · Replace fuel tank.
Cannot Refill Fuel Tank/Excessive Pressure in Fuel Tank When Cap is Removed	· Sticking or damaged fuel tank fill/vent valve, hose or lines.	· Inspect, repair vent hose and lines, replace fuel tank.

Fuel Pump Troubleshooting Chart

CONDITION	POSSIBLE CAUSES	CORRECTION
Symptoms of a Defective Fuel Pump	· Noisy operation · Poor acceleration · Failure to start (starting difficulties)	· Replace the fuel pump
Reasons For Fuel Pump Failure	· Accumulated contaminants causing an insulation layer · Fuel pump bushing and armature blocked · Eroded fuel level sensor components	· Replace the fuel pump

Fuel Injector Troubleshooting Chart

CONDITION	POSSIBLE CAUSES	CORRECTION
Symptoms of a Defective Fuel Injector(s)	· Poor idling · Poor acceleration · Failure to start (starting difficulties)	· Replace the fuel injector(s)
Reasons For Fuel Injector Failure	· An accumulation of contaminants inside the injector due to lack of maintenance	· Clean injectors regularly with an approved method

ON-VEHICLE SERVICE

Fuel Pressure Relief Procedure

Description

WARNING!

Fuel in the fuel system remains under high pressure, even when the engine is not running. Before servicing or disconnecting any of the fuel lines or fuel system components, the fuel system pressure must be relieved to prevent accidental spraying of fuel. Failure to follow these instructions may result in serious personal injury or death.

Perform the following procedure to relieve fuel pressure from the fuel system:

1. Remove the cover of the front fuse and relay box.
2. Identify and remove the fuel pump relay from the front fuse and relay box.
3. Start and run engine until it stalls.
4. Attempt to restart engine until it will no longer run.
5. Turn the ignition key to the OFF position.

Fuel Pump

Description

The fuel pump assembly contains the fuel pump motor and fuel level sensor.

Operation

The Engine Control Module (ECM) activates the fuel pump relay for several seconds after the ignition switch is turned ON. When the relay is activated, it provides voltage to the fuel pump. When the ECM receives an engine speed signal from the Crankshaft Position (CKP) sensor and a signal from the Immobilizer control module, the ECM will energize the fuel pump relay.

NOTE :

- The electric fuel pump has different flow ratings based on engine requirements
- For service, the part number of the replacement fuel pump must be the equivalent of the original fuel pump
- Do not operate the fuel pump dry, this will damage the fuel pump
- Keep the fuel tank and pipeline clean, and replace the fuel filter if the fuel pump is replaced

Removal & Installation

WARNING!

Release fuel system pressure before servicing fuel system components. Service vehicles in well-ventilated areas and avoid ignition sources. Never smoke while servicing the vehicle. This may result in personal injury or death.

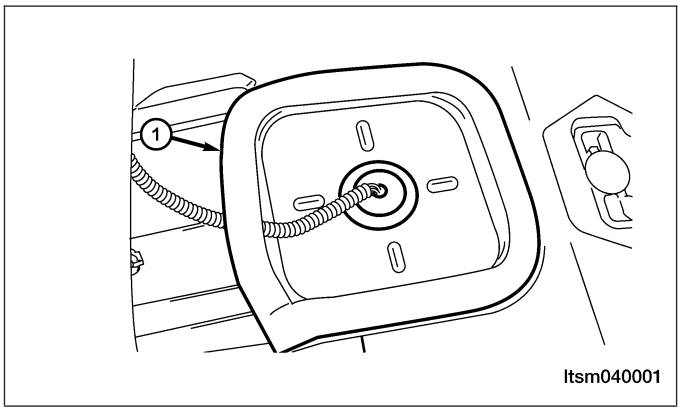
NOTE :

The following special tool is required to perform the repair procedure:

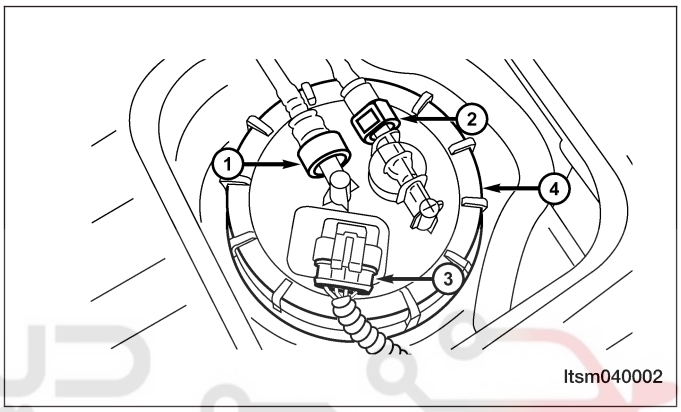
- CH-20032 - Fuel Pump Remover

1. Release the fuel system pressure (See Fuel Pressure Relief Procedure in Section 04 Fuel Delivery).
2. Disconnect the negative battery cable.
3. Remove the rear seat cushion.

4. Remove the fuel pump cover (1).



5. Disconnect the fuel pump connector (3) and the fuel delivery hose (2) and fuel return hose (1).
6. Using special tool CH-20032, remove the fuel pump mounting cover (4).



7. Pull the fuel pump up and out of the fuel tank.

WARNING!

Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury or death.

Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury or death.

When handling fuel, always observe fuel handling precautions and be prepared in the event of fuel spillage. Spilled fuel may be ignited by hot vehicle components or other ignition sources. Failure to follow these instructions may result in serious personal injury or death.

NOTE :
Make sure not to spill fuel inside of the vehicle.

8. Tip the fuel pump on its side and drain the fuel from the fuel pump and remove the fuel pump from the vehicle.
   NOTE: To keep the fuel tank portion clean and to avoid damage and foreign materials, cover them completely with plastic bags or something similar.
9. Remove and discard the seal from the fuel tank.
10. Installation is in the reverse order of removal.

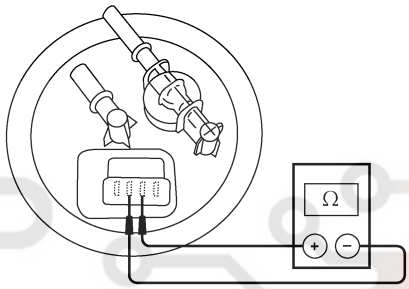
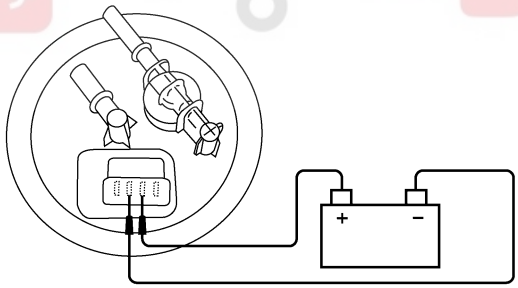
Installation Notes:

- Install a new seal to the fuel pump sealing surface.
- Turn the ignition switch to ON (without starting the engine) to apply fuel pressure to the fuel system, then check the connections for fuel leaks.
- Start the engine and let it idle and check for fuel leaks at the fuel system connections.

Fuel Pump Inspection

1. Using the following table, apply battery voltage to the specified connector terminals.
2. Check the fuel pump resistance.
   - Take out the fuel pump.
   - Connect the digital multimeter to terminals 2 and 3. Check the fuel pump resistance.
   - If the result is not as specified, replace the fuel pump.
3. Check fuel pump operation.
   - Remove the fuel pump.
   - Apply battery voltage to terminals 2 and 3. Check that the pump operates within 10 seconds.
   - If the pump does not operate, replace the fuel pump.

   NOTE:
   - These tests must be completed within 10 seconds to prevent the coil from burning out.
   - Keep the fuel pump as far away from the battery as possible.
   - Always switch the voltage on and off on the battery side, not on the fuel pump side.

MEASURING CONDITION	SPECIFICATION	INSPECTION DIAGRAM
Digital Multimeter Positive (+) to terminal – 2 Digital Multimeter Negative (-) to terminal – 3	< 130 Ω	 Itsm040012
Battery positive (+) to terminal – 2 Battery negative (-) to terminal – 3	8 - 16 V	 Itsm040013

Fuel Filter

Description

The fuel filter consists of a housing with an integrated filter element.

Operation

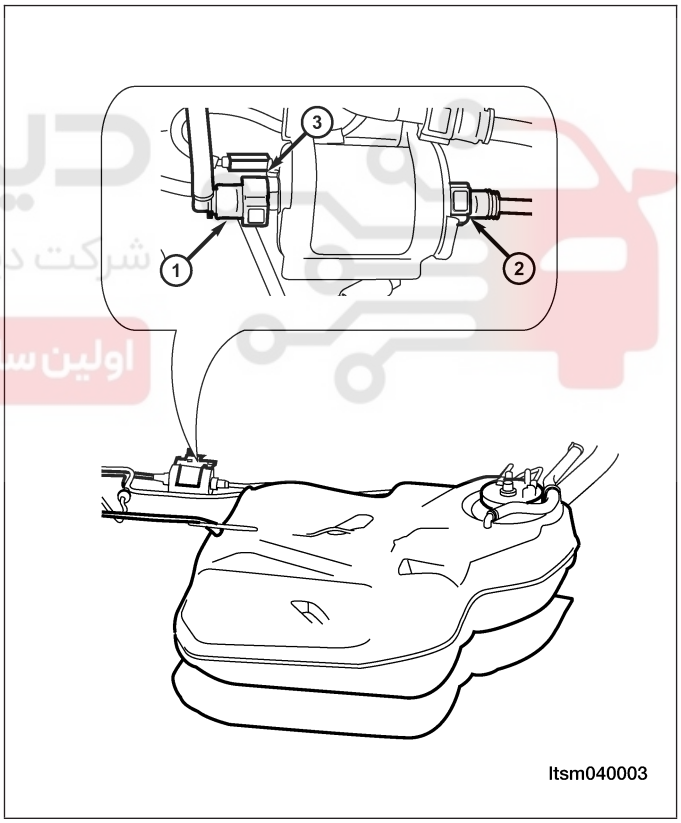
The fuel flows through the filter from the outside to the inside. As a result, any impurities are trapped inside the filter.

Removal & Installation

WARNING!

Release fuel system pressure before servicing fuel system components. Service vehicles in well-ventilated areas and avoid ignition sources. Never smoke while servicing the vehicle. This may result in personal injury or death.

1. Release the fuel system pressure (See Fuel Pressure Relief Procedure in Section 04 Fuel Delivery).
2. Disconnect the negative battery cable.
3. Remove the fuel delivery hose (1), fuel outlet hose (2) and the ground wire (3).
4. Remove the fuel filter.
5. Installation is in the reverse order of removal.



Installation Notes:

- Verify there are no leaks at the fuel line connections of the fuel filter.

Fuel Injector Rail

Description

The fuel rail is used to mount the fuel injectors to the engine and it is mounted to the intake manifold.

Operation

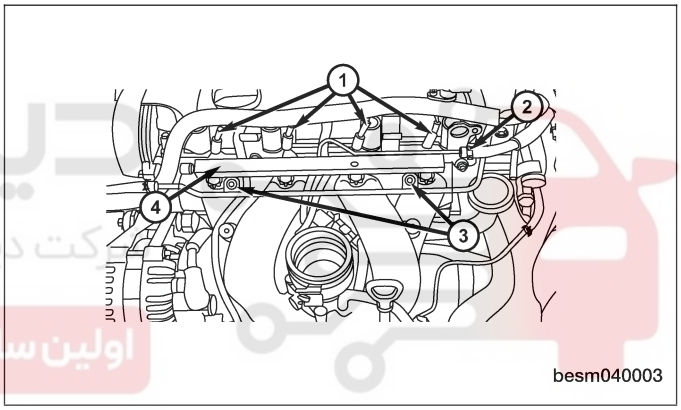
The fuel rail supplies the necessary fuel to each individual fuel injector and is located above the intake manifold and fuel injectors.

Removal & Installation - 1.6L & 1.8L & 2.0L

WARNING!

Release fuel system pressure before servicing fuel system components. Service vehicles in well-ventilated areas and avoid ignition sources. Never smoke while servicing the vehicle. This may result in personal injury or death.

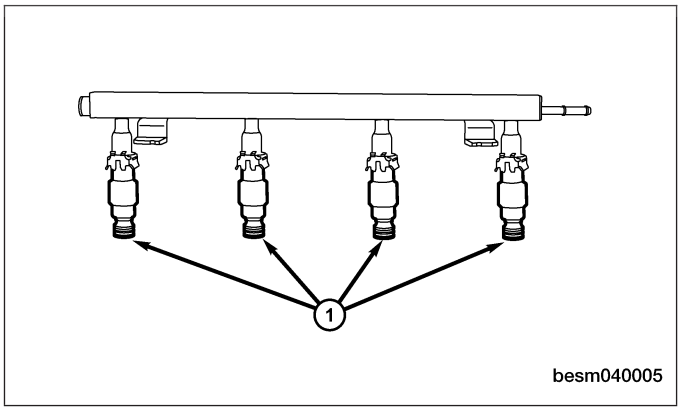
1. Release the fuel system pressure (See Fuel Pressure Relief Procedure in Section 04 Fuel Delivery).
2. Disconnect the negative battery cable.
3. Remove the engine cover.
4. Disconnect the electrical connectors (1) from the fuel injectors.
5. Remove the fuel line (2) from the fuel rail.
6. Remove the two fuel rail (4) bracket bolts (3) that mount the fuel rail to the intake manifold. (Tighten: Fuel rail bracket bolts to 11 N·m)



7. Remove the fuel rail with the four fuel injectors (1).
8. Installation is in the reverse order of removal.

Installation Notes:

- Install new seals on the fuel injector sealing surfaces.

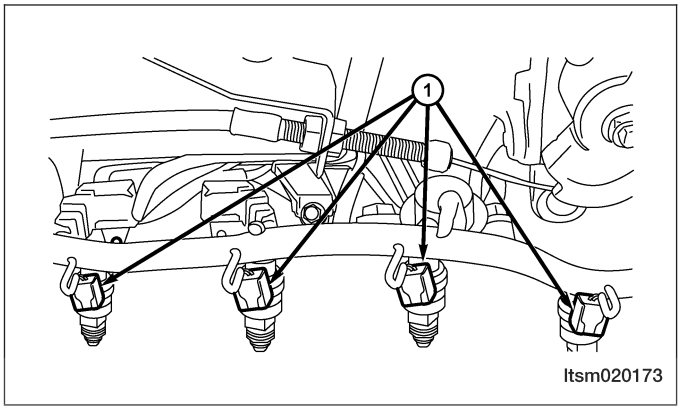


Removal & Installation - 2.4L

WARNING!

Release fuel system pressure before servicing fuel system components. Service vehicles in well-ventilated areas and avoid ignition sources. Never smoke while servicing the vehicle. This may result in personal injury or death.

1. Release the fuel system pressure (See Fuel Pressure Relief Procedure in Section 04 Fuel Delivery).
2. Disconnect the negative battery cable.
3. Disconnect four fuel injector electrical connectors (1).



4. Remove the fuel pressure regulator (See Fuel Pressure Regulator Removal & Installation in Section 04 Fuel Delivery).
5. Remove the two fuel rail mounting bolts.
   (Tighten: Fuel rail mounting bolts to 12 N·m)
6. Remove the fuel rail with the four fuel injectors.
7. Installation is in the reverse order of removal.

Installation Notes:

- Install new seals on the fuel injector sealing surfaces.

Fuel Injector

Description

The fuel injectors are positioned in the intake manifold with the nozzle ends directly above the intake valve port.

Operation

Injector operation is controlled by a ground path provided for each injector by the Engine Control Module (ECM). Injector on-time (pulse-width) is variable, and is determined by the ECM. Based on the engine operating conditions, the ECM will control injector pulse-width operation to obtain optimum performance.

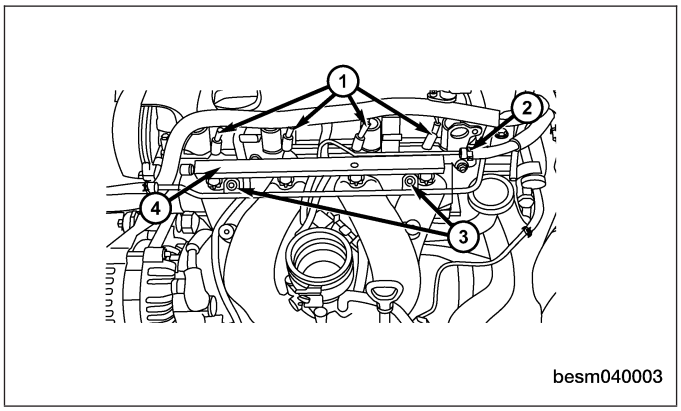
Removal & Installation - 1.6L & 1.8L & 2.0L

WARNING!

Release fuel system pressure before servicing fuel system components. Service vehicles in well ventilated areas and avoid ignition sources. Never smoke while servicing the vehicle. This may result in personal injury or death.

1. Release the fuel system pressure (See Fuel Pressure Relief Procedure in Section 04 Fuel Delivery).
2. Disconnect the negative battery cable.
3. Remove the engine cover.
4. Remove the ground cable on the cylinder head.

5. Disconnect the electrical connectors (1) from the fuel injectors.
6. Remove the fuel line (2) from the fuel rail.
7. Remove the two fuel rail (4) bracket bolts (3) that mount the fuel rail to the intake manifold. (Tighten: Fuel rail bracket bolts to 11 N·m)



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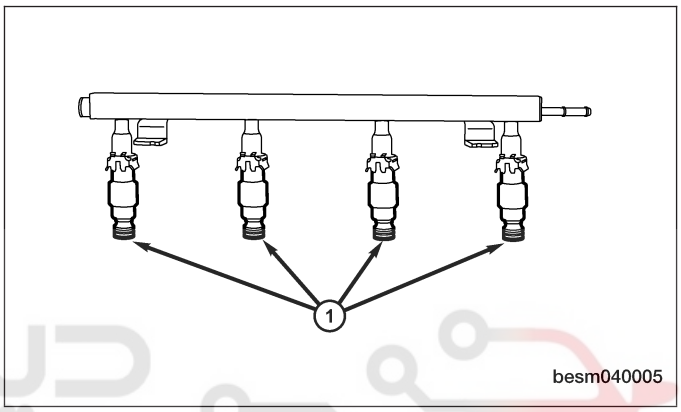
8. Remove the fuel injectors (1) from the fuel rail.



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9. Installation is in the reverse order of removal.

Installation Notes:

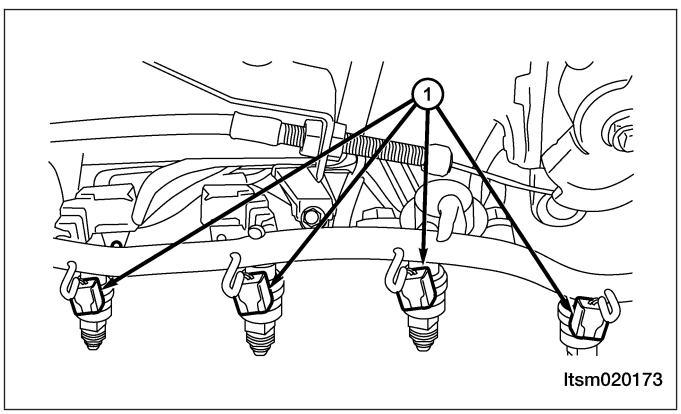
- Coat the surface of the O-ring seals with clean engine oil before installing the fuel injector. Be careful not to damage the O-ring seals when inserting the fuel injector into the fuel distribution tube.

Removal & Installation - 2.4L

WARNING!

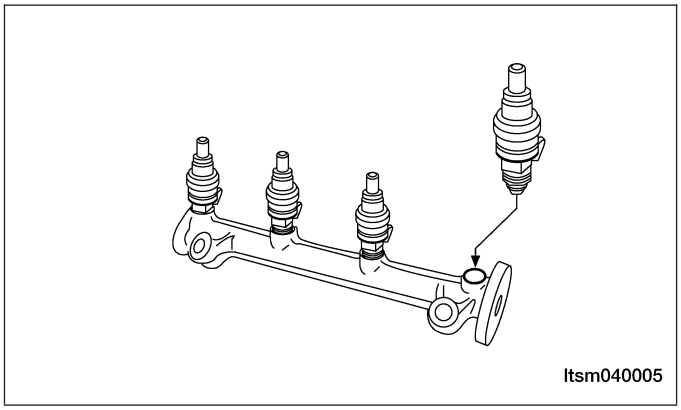
Release fuel system pressure before servicing fuel system components. Service vehicles in well ventilated areas and avoid ignition sources. Never smoke while servicing the vehicle. This may result in personal injury or death.

1. Release the fuel system pressure (See Fuel Pressure Relief Procedure in Section 04 Fuel Delivery).
2. Disconnect the negative battery cable.
3. Disconnect four fuel injector electrical connectors (1).



ltsm020173

4. Remove the fuel pressure regulator (See Fuel Pressure Regulator Removal & Installation in Section 04 Fuel Delivery).
5. Remove the two fuel rail mounting bolts.
   (Tighten: Fuel rail mounting bolts to 12 N·m)
6. Remove the fuel rail with the four fuel injectors.
7. Remove the clamp holding the fuel injector to the fuel rail.
8. Remove the fuel injector from the fuel rail.



9. Installation is in the reverse order of removal.

Installation Notes:

- Install new seals on the fuel injector sealing surfaces.

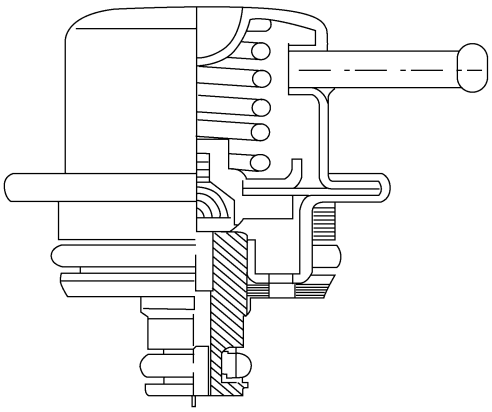
Fuel Injector Inspection

1. Remove the fuel injector electrical connector.
2. Use a digital multimeter to measure the resistance between the two fuel injector pins (fuel injector side).

SPECIFICATION	TEMPERATURE
11 - 13 Ω	20°C

Fuel Pressure Regulator - With Mitsubishi 2.4L Engine

Description



ltsm040007

The fuel pressure regulator is connected to the fuel rail. The fuel pressure regulator has a vacuum connection to it. The fuel pressure regulator is used to regulate the fuel pressure in the fuel system.

NOTE :
The 2.4L is the ONLY engine that uses an external fuel pressure regulator.

Operation

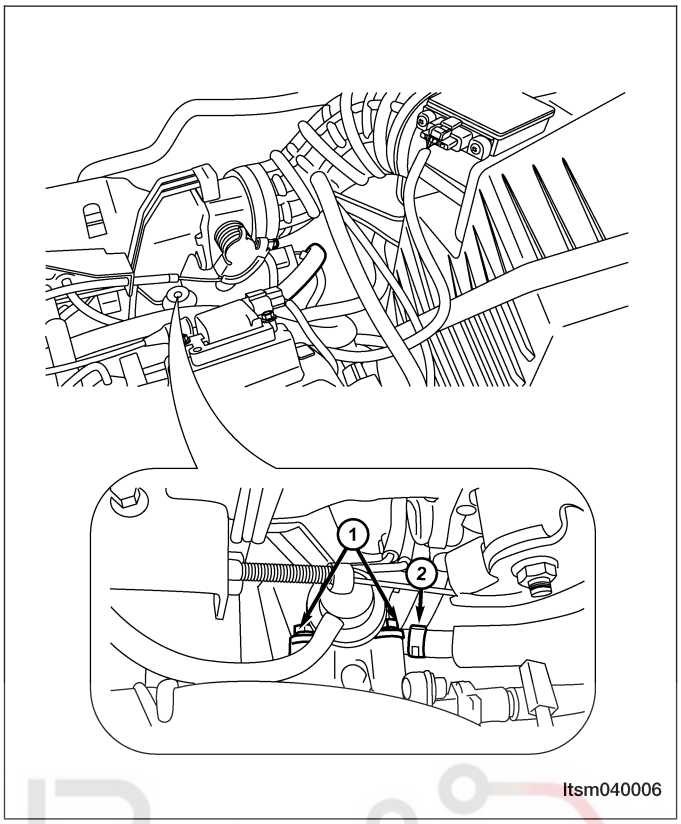
The fuel pressure regulator is designed to keep the fuel pressure in the fuel system at a constant pressure. It does this with a spring-loaded diaphragm that controls a valve. The valve, when opened by excessive pressure in the fuel lines, uncovers a fuel line that returns excess fuel to the fuel tank. The vacuum connection is there to help reduce emissions during deceleration. During deceleration, the vacuum connection serves to open the fuel return valve wider, which reduces pressure in the system and prevents excess hydrocarbon emissions due to less fuel being injected as a result of the lower pressure in the system.

Removal & Installation

WARNING!
Release fuel system pressure before servicing fuel system components. Service vehicles in well ventilated areas and avoid ignition sources. Never smoke while servicing the vehicle. This may result in personal injury or death.

1. Release the fuel system pressure (See Fuel Pressure Relief Procedure in Section 04 Fuel Delivery).
2. Disconnect the negative battery cable.

3. Disconnect the fuel return pipe (2).
4. Remove the fuel pressure regulator mounting bolts (1).
   (Tighten: Fuel pressure regulator mounting bolts to 9 N·m)



ltsm040006

5. Remove the fuel pressure regulator.
6. Installation is in the reverse order of removal.

Installation Notes:

- Install new seals on the fuel pressure regulator sealing surfaces.
- Coat the surface of the fuel pressure regulator O-ring seal with clean engine oil before assembly.
- While installing the fuel pressure regulator, ensure that the fuel pressure regulator rotates smoothly in the fuel distribution tube. If it does not rotate smoothly, the O-ring seal may have been damaged. Remove the fuel pressure regulator and inspect the O-ring seal for damage.

Fuel Pressure Regulator Inspection

1. Connect a fuel pressure gauge to the inlet fuel pipe.
2. Start and idle the engine (note the fuel pressure).
3. Increase the engine speed to 2500 RPM (note the fuel pressure).

SPECIFICATION	PRESSURE
Idle	350 kPa
2500 RPM	350 kPa