1.1.1 Technical Parameters

Technical Parameters of Complete Equipment

Item			Parameter			Remark
Model			GN15-VF	GN16-VF	GN16-VF1	
Cylinder quantity and arrangement			In-line 4-cylinder			
Combustion chamber			Roof shape			
Ignition sequence			1-3-4-2			By cylinder number
Rotation direction			Counterclockwise			From back to front (flywheel side taken as the back end)
Valve timing mechanism			dual overhead camshaft, timing chain drive (silent chain), intake VVT			
Valve quantity			16			
Displacement (cc)			1497	1591		
Bore× stroke (mm)			74.8×85.2	74.8x90.5		
Compression ratio			10	10		
Valve timing (°)	Intake	ON	-14～26(BTDC)			
		OFF	66～26(ABDC)			
	Exhaust	ON	39(BBDC)			
		OFF	5(ATDC)			
Max. power(kW/rpm)			77/6000	81.5/6000	85/6000	Net power
Max. torque(N·m/rpm)			140/4000	149/4000	153/4000	Net torgue
Idle speed (rpm)			Air conditioning idle speed:800±50			
			Target idle speed:750±50			
Ignition advance angle(°)			3～10			Idle state
Starting mode			Electrical starting			
Cooling mode			Water cooling forced circulation			
Lubricating mode			Pressure, Split, Complex			
Overall dimension (mm)			573.2×615.0×606.3	573.32x724.2x6063		
Net weight (kg)			94.8	96.5		

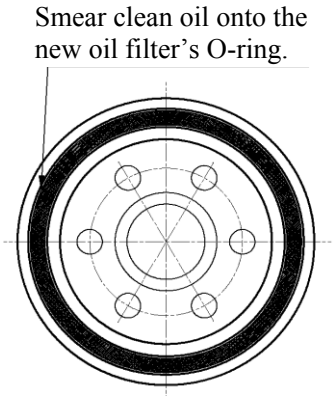
Tightening torque

Mounting place	Torque value		Remark
	N•m	kgf•m	
Power generator			
Bracket	45.1	4.6	
Adjusting arm	45.1	4.6	
Adjusting slider	21.6	2.2	
Power generator pivot's bolt and nut	45.1	4.6	
Ignition, control system			
Ignition coil	8.8	0.9	
Spark plug	25	2.6	
Fuel rail	21.6	2.2	
Camshaft position sensor	8.8	0.9	
Water temperature sensor	15	1.53	
Knock sensor	21.6	2.2	
Knock sensor bracket	16.8	1.7	
Crankshaft position sensor	8.8	0.9	
OCV valve	8.8	0.9	
Intake and exhaust system			
Throttle body	8.8	0.9	
Intake manifold	21.6	2.2	
Intake manifold bracket (manifold side)	21.6	2.2	
Exhaust manifold	21.6	2.2	
Exhaust manifold bracket (cylinder body side)	21.6	2.2	
Exhaust manifold bracket (manifold side)	45.1	4.6	
Exhaust manifold heat shield	8.8	0.9	
Lubricating system			
Oil switch	14.7	1.5	
Oil filter	14.0	1.43	
Oil filter adapter	21.6	2.2	
Oil filter	8.8	0.9	
Oil sump	8.8	0.9	
Cylinder body, crank connecting rod mechanism			
Crankshaft pulley	50±2	16.7	First set the pretension torque and then tighten the angle.
	60±2°		
Flywheel	100	10.3	

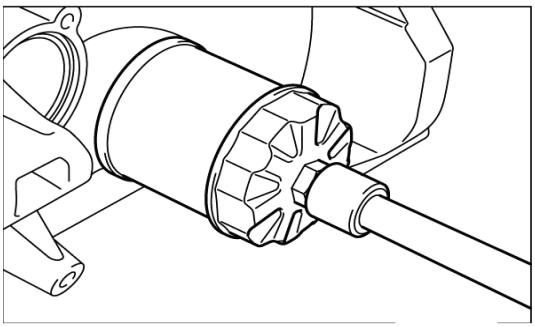
Oil viscosity standard	Oil viscosity level
Higher than–25℃	SAE10W–30
–30℃～37℃	SAE5W–30

1.2.5 Replacement of Oil Filter

1. Dismantle the oil filter with special tools.
2. Rub and clean the new oil filter with a clean cloth.
3. Smear clean oil onto the new oil filter's O-ring.



4. Mount the oil filter with special tools Tightening torque:13.0～15.0N·m{1.32～1.52kgf·m}.



5. Start the engine and inspect if there is leakage. Inspect the oil level and check if oil adding is needed (see Inspection of Engine Oil).

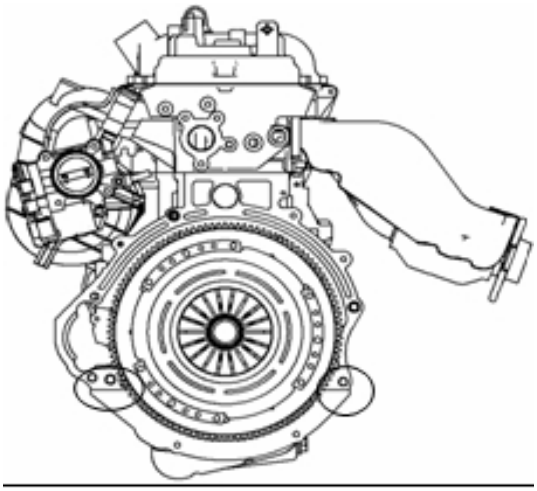
Others

Other inspection and maintenance like power generator inspection and starter inspection etc can be conducted on the complete vehicle. See this manual and corresponding complete vehicle maintenance manual for processing procedures.

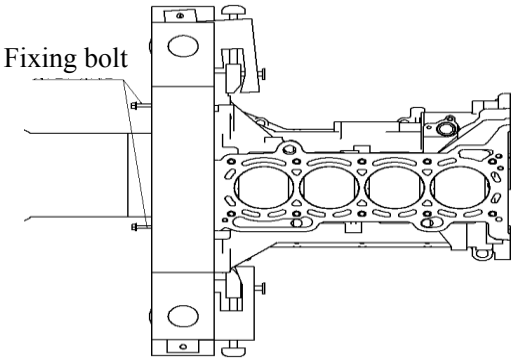
1.3 Application of Engine Maintenance Platform

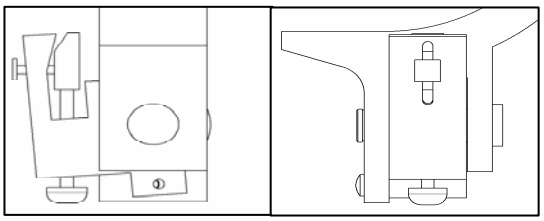
1.3.1 Mount the Engine onto Maintenance Platform

1. Lift the engine, and align the cylinder body's pin hole to the maintenance platform's mounting dowel pin to mount the engine(see the figure).



2. Mount the work fixture according to the figure and lock it.





3. Adjust the fixing bolt to appropriate place and prevent the engine mounting from getting loose.
4. Pour the engine oil into specified vessel.
5. Mount the new oil drain plug, and tighten the oil drain plug. tightening torque: 30～41N·m{3.1～4.2kgf·m}

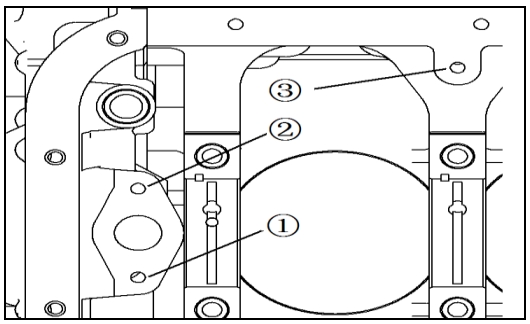
figure..

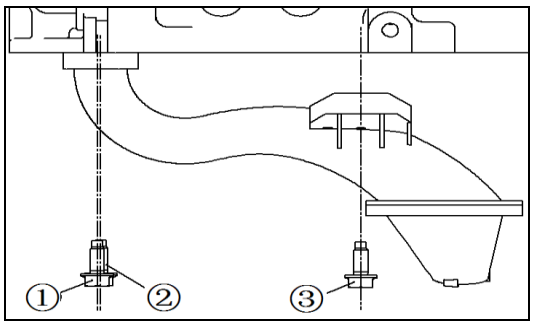
Bolt Specifications and Mounting Torque

No.	Specification	Bolt rod length (mm)	Mounting torque (N·m)
1a, 3a, 4a, 5a 6a, 7a, 8a,	M6	25	8～12
2b, 10b	M6	30	8～12
12c	M6	45	8～12
13d, 14d	M10	90	36.5～42.5

1.8.7 Explanations on the oil filter mounting

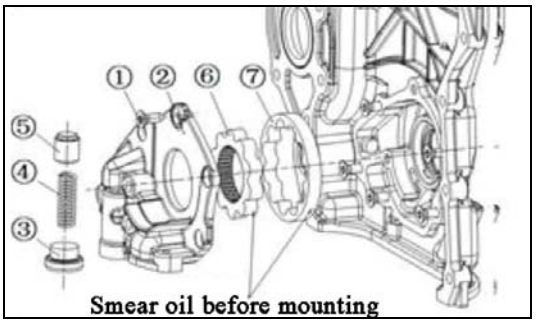
Tighten bolts by steps according to the sequence illustrated in the figure





1.8.8 Explanations on oil pump disassembling/ mounting

1. Dismantle oil pump and timing chain case assembly (see oil pump and timing chain case assembly dismantling/mounting).
2. Disassemble parts according to the sequence illustrated in the figure.
3. Mount parts according to the sequence reverse to the disassembling process.



1 Bolt
2 Oil pump cover
3 Screw plug
4 Pressure spring
5 Control piston
6 Inner rotor (Smear oil before mounting)
7 Outer rotor (Smear oil before mounting)

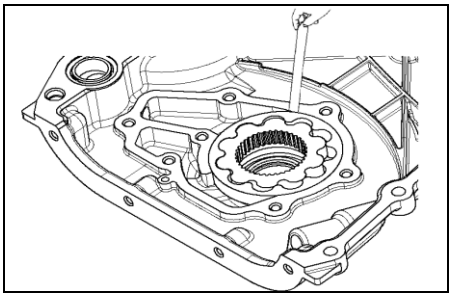
1.8.9 Inspection of Oil Pump

Explanations on inspection of rotor clearance

1. Measure the following clearance, and replace the rotor or pump body if necessary.

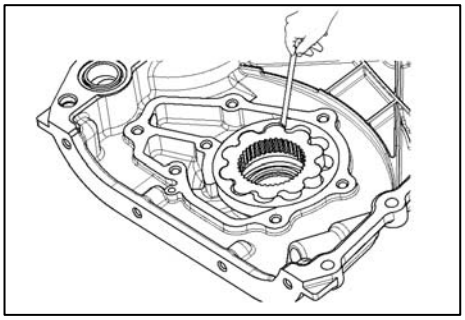
Standard gear tip clearance: 0.06～0.20mm

Maximum gear tip clearance: 0.22mm



Standard pump body clearance: 0.250～0.325

Maximum pump body clearance: 0.35mm



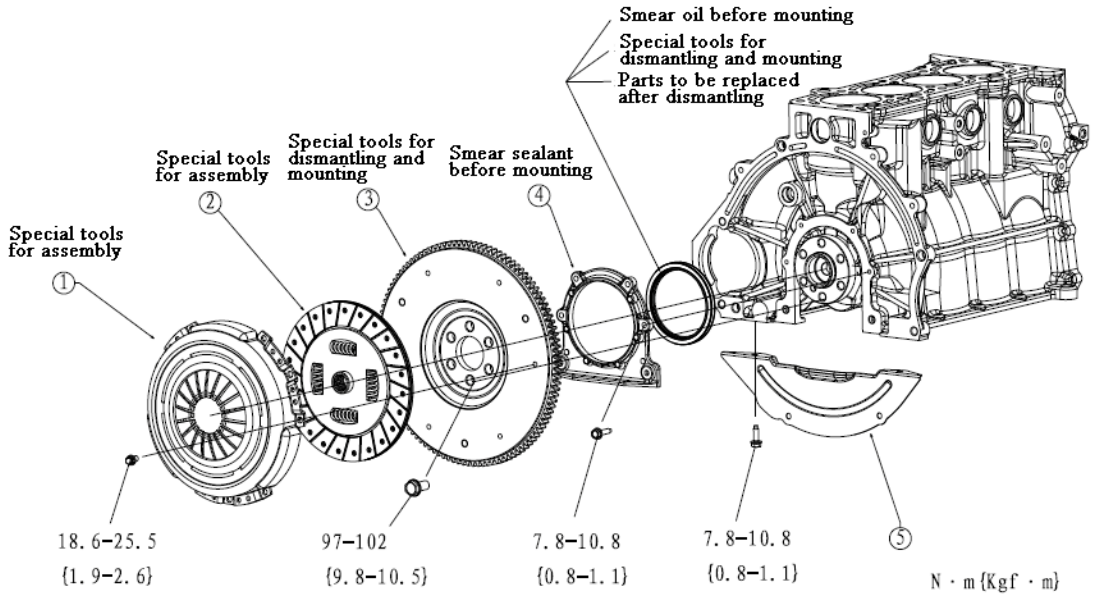
Standard backlash: 0.03～0.09mm

Maximum backlash: 0.14mm

1.11 Flywheel, clutch

1.11.1 Flywheel and Clutch Dismantling/Mounting

1. If the crankshaft's back cover needs to be dismantled, oil sump body shall be dismantled at first (see lubricating system, oil sump body dismantling and mounting).
2. Dismantle parts according to sequence illustrated in the figure. .
3. Mount the parts according to the sequence reverse to the dismantling process.



1	clutch pressure plate (see dismantling explanations/see mounting explanations)
2	Clutch friction disc (see dismantling explanations/see mounting explanations)
3	flywheel (see dismantling explanations/see mounting explanations)
4	Crankshaft's back cover (see the rear oil seal dismantling explanations /see rear oil seal mounting explanations /see mounting explanations)
5	Transmission's baffle plate

Tool name: Vacuum Meter

Function:

Inspect the pressure in the intake manifold.

Tool name: Cylinder Pressure Gauge

Function:

Inspect every cylinder's pressure.

Tool name: Fuel Pressure Gauge

Function:

Inspect the fuel system's pressure, and judge the fuel system's fuel pump extrusion as well as the pressure regulator's working condition.

Tool name: Tail gas analyzer

Function:

Inspect the vehicle's tail gas emission, which helps locate the electronic fuel injection system's faults.

the electronic control unit will immediately set the fault information record in RAM fault memory, and save it in the form of fault code, which will be displayed according to the fault occurrence sequence. According to the fault frequency, faults can be classified into “Steady-state Faults” and “Sporadic Faults” (like the faults resulting from short-lived open circuit or poor contact between connectors)

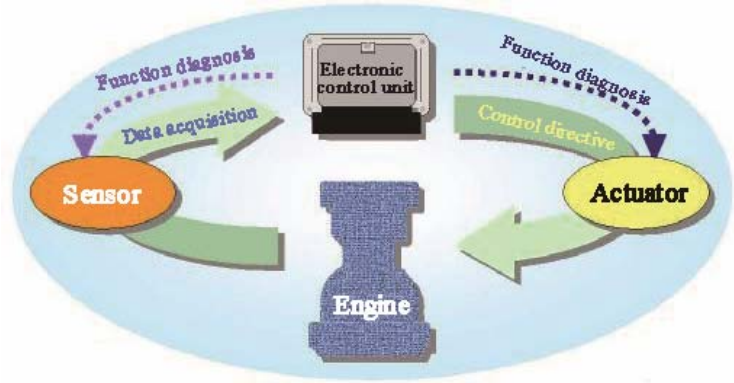


Fig. 2.4 Electronic Fuel Injection System’s Troubleshooting Principle

2.4.2 Classification of Fault Types

Diagnostic Fault Path and Fault Categories

Diagnostic fault path (DFP) is, in fact, a sub-function for fault diagnosis that is used to inspect functions of a given sensor, actuator, or others in the EMS system. By respective diagnostic path, the fault information will be transmitted to the fault diagnosis management module, which will take corresponding actions and determine if the fault lamp should be activated or the fault should be displayed on the diagnostic unit. When a fault is detected at a given DFP, the fault diagnosis management module will make definite the fault type. Usually, the fault types include:

B_mxdfp Maximum fault, signal goes beyond the upper limit of the normal range.

B_mndfp Minimum Fault, the signal goes beyond the lower limit of the normal range.

B_sidfp signal fault, without signal.

B_npdfp unreasonable signal, with signal, but the signal is unreasonable.

Definitions of Fault Types

In this project there are 10 fault types. Closed fault path is defined as “Class0”, namely, the fault information will not enter the fault memory, and also the diagnostic unit will not read the fault. In addition, faults of Class2, Class3, Class4, Class5, Class6, Class7, Class11, Class12, and Class13 belong to those fault types that have been defined by the system in a uniform manner.

Class2: fault is inputted into the fault memory upon taking place; DFP fault types relating to misfire are usually defined as Class 2. As for the misfire fault resulting in damage of catalyst, the MIL lamp will flash in no time to prompt the driver. As for the misfire fault resulting in deterioration of emission, if the misfire fault of corresponding extent has been fully detected in three consecutive driving cycles, the MIL lamp will be activated, and also the fault will be displayed on the diagnostic unit. If the fault fails to be confirmed or eliminated in 40 driving cycles (namely, in a warm-up cycle, E_xxx＝1, but Z_xxx ＝0), the fault information will be deleted from the fault memory. if the fault disappears before the fault confirmation and never occurs within 40 driving cycles, the fault information will be deleted from the fault memory; If the fault disappears after being confirmed, the fault information cannot be deleted from the fault memory until it does not occur within 40 warm-up cycles, and the fault priority is defined as 20. After the fault confirmation, SVS lamp is off. If the fault disappears after the fault confirmation and never occurs within three driving cycles, it means that the fault has been corrected.

Class3: fault is inputted into the fault memory upon taking place. After the fault confirmation, the MIL lamp is activated, and the fault confirmation needs three driving cycles, with fault being displayed on the diagnostic unit. If the fault fails to be confirmed or eliminated within 40 warm-up cycles(namely, in a warm-up cycle, E_xxx＝1, but Z_xxx＝0), the fault information will be deleted from the fault memory; if the fault disappears before the fault confirmation and

5 Functional Requirements on ME7 System's Diagnostic Unit

Functions required:

I. Self-diagnosis

Mostly including: read fault code, and clear fault code;

II. System Parameter Display

Mostly including: including: water temperature, air intake temperature, throttle opening, engine rotating speed, ignition angle, A/F ratio short-term modification, A/F ratio long-term plus and multiplication modification, intake pressure, intake flow, oxygen sensor signal, system voltage, and torque demand value etc;

III. System Modes

Mostly including: display of 10 modes like programming, cooling system, stable working condition, dynamic working condition, emission control, oxygen sensor, idling speed, fault indicator, emergency operation, and air conditioning etc.

IV. Actuator Test

Mostly including: six function tests on fault indicator, fuel pump, air conditioning relay, fan control, ignition test, and single-cylinder oil interruption;

V. System Initialization Resetting (self-adaption stop resetting)

After being stalled, engine will send the initialization directive, and the system will stop resetting previous self-adaption.

VI. Speedometer

Mostly including: display of vehicle driving mileage and driving time;

VII. Version Information

Mainly including: display of car frame number (optional), ECU hardware number, and ECU software number

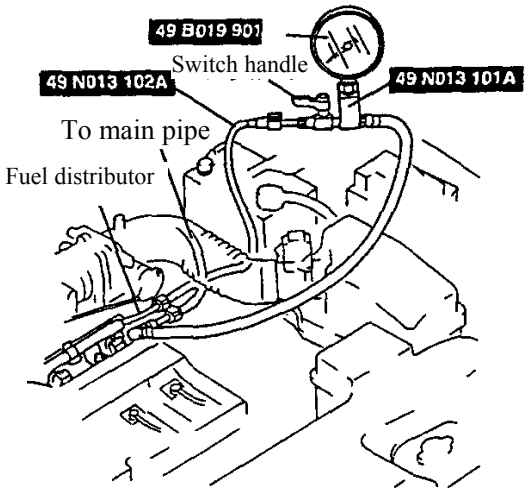
5.1 Parts Mounting Torque Specification Table

No.	Part Name	Mounting Torque (N·m)
1	Coolant temperature sensor	39.2 (Max)
2	Knock sensor	20±5
3	Oxygen sensor	50±10
4	Rotating speed sensor	10±2
5	Phase sensor	10±2
6	Magnetic fuel injector	6
7	Electronic accelerator pedal	6±0.5
8	Electronic throttle	10 (Max)
9	Brake vacuum degree sensor	10±2

fuel pipe dismantling" to complete the under-mentioned work (see the Fuel System, Explanations on Plastic Fuel Pipe Dismantling)

3. Dismantle the main fuel hose (fuel supply pipe assembly) from the main pipe (fuel rigid pipe).

4. Connect the special tool's quick connector with the fuel distributor(fuel rail), and insert the fuel supply pipe assembly onto the special tool's interface.

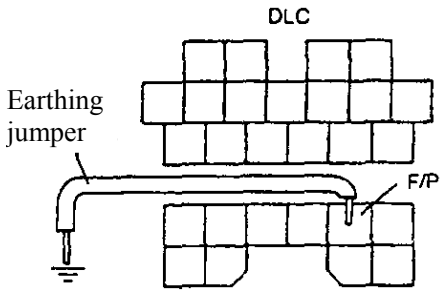


5. Remount the accumulator's negative cable.

Caution

- Wrong connection with other wiring terminals may lead to fault, and so caution is needed during the connection process.

6. Connect the DLC's wiring terminal F/P with the Vehicle body's earthing point GND with a jumper wire.



7. Turn the ignition switch to "ON" position to make fuel pump run, and measure the pipeline's maximum oil pressure.

   Standard value

   390～410kpa

8. Turn the ignition switch to the "OFF" position and loosen the jumper wire.

- If the pressure is higher than the standard value, inspect the fuel pump's maximum pressure

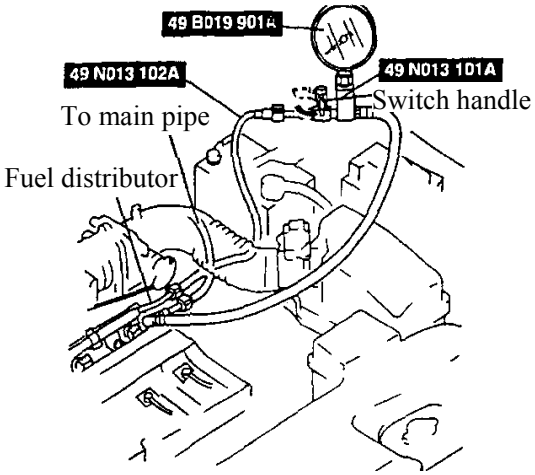
- If the pressure is normal, inspect if the oil return pipe and pressure regulator suffer blockage.

- If the pressure is lower than standard value, turn the switch handle and measure the oil pressure's variation (see the figure).

  —If the oil pressure rises speedily, inspect the pressure regulator.

  —If the oil pressure rises slowly, inspect the oil pressure's maximum value.

- If the oil pump's maximum pressure is normal, inspect if the oil circuit between the oil pump and pressure regulator suffers blockage.



9. Dismantle the special tool unit.

Caution

- To avoid the quick connector's damage or oil leakage, follow the "Explanations on plastic fuel pipe dismantling" to complete the under-mentioned work (see the Cylinder Dismantling/Mounting, Explanations on Plastic Fuel Pipe Dismantling)

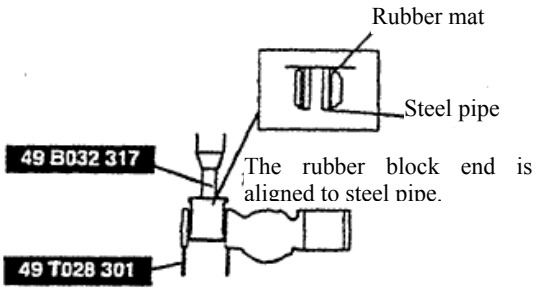
10. Connect the main fuel hose (fuel supply pipe assembly) and the main pipe (fuel rigid pipe)

11. Complete the inspection work after repair (see Inspection Work after Repair).

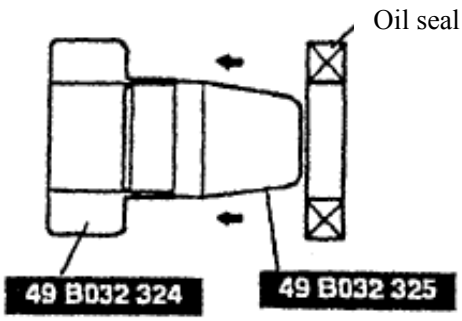
1.3.4 Inspection of Fuel Pressure Maintenance

Warning

- Fuel overflow or leakage is dangerous, and the fuel is combustible, which may lead to personnel injury. In addition, the fuel has side effect on the skin and eye.

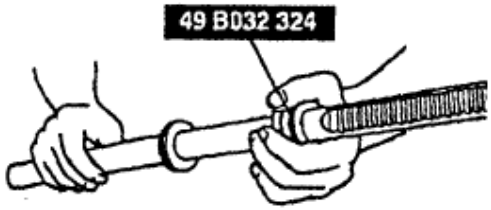


3. Turn back the gear chamber, and press the rubber supporting block, until the rubber block comes out of its other side.
4. Align the rubber supporting block to steel pipe.



Attentions for installing the oil seal and bush

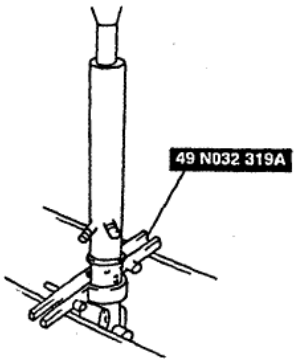
1. Install a new “O” ring and seal ring on the rack lever.
2. After installing the seal ring, make it tightly affix the lever.
3. Attach a new oil seal to (49B032 325) with a special tool (49 B032 324).



4. Remove the special tool (49B032325).
5. Place the oil seal on the edge of rack lever with a special tool, and remove the special tool.
6. Attach a new bush to steering rack.

Note:

- While pressing it in, the applied force shall not exceed 39kpa{400kg}cm2, 5688psi} to avoid the damages of oil seal and bush.
- Apply a little of grease to the seal ring and oil seal bush.



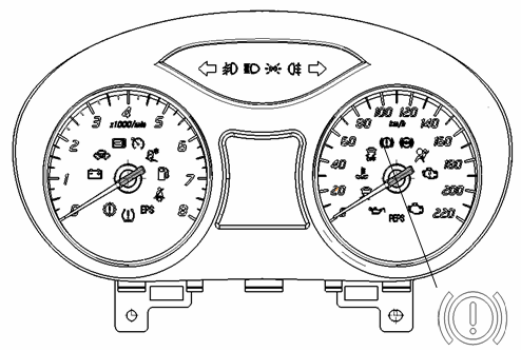
7. Install the steering rack into gearbox, and press in the oil seal and bush with a special tool, until it’s difficult to press.

General and operation

Operation of brake caution light

The brake caution light (BRAKE) applied in this brake system is located inside the instrument panel. When the ignition switch is in ON gear, the brake caution light will go on. When the ignition switch returns to ACC gear, the caution light will go out. The following cases will make the caution light go on.

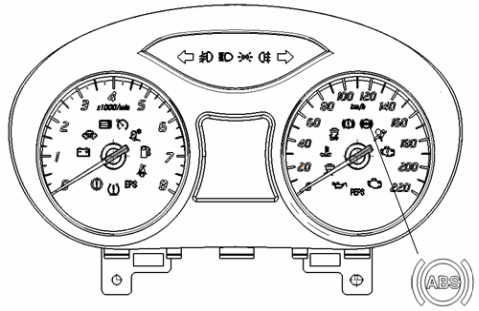
- In case of applying the parking brake when the ignition switch is in ON gear, the caution light will go on.
- When the level of brake fluid is below a certain value, "BRAKE" caution light will go on.



Description of ABS fault light

ABS fault light applied in this brake system is located inside the instrument panel (as shown in the figure).

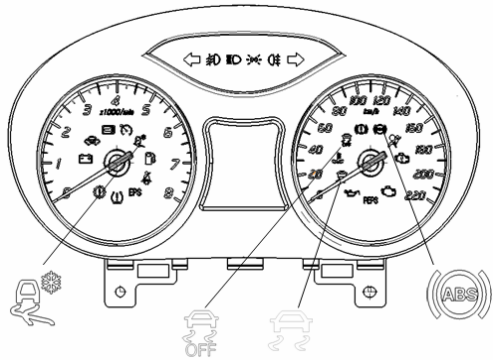
Self-check of ABS: when the ignition switch is turned from ACC to ON, the self-check of ABS is started, and the fault light goes on. After finishing its self-check within 0.7 to 3s, the fault light goes out, it certifies the normality of ABS system; if it's constantly on, ABS system will be faulty, and the professionals are required to check the faults of ABS system (for its details, see the description of ABS anti-lock system repair).



Description of ESC fault light

ESC fault light applied in this brake system is located inside the instrument panel (as shown in the figure).

ESC self-check: when the ignition switch is turned from ACC to ON, the self-check of ESC is started, and the fault light goes on at this time. After finishing its self-check, the fault light goes out, and it certifies the normality of ESC system; if it's constantly on, ESC system will be faulty, and the professionals are required to check the faults of ESC system (for its details, see the description of ESC anti-lock system repair).



Description of ESC-OFF switch indicator lamp

ESC manual switch indicator lamp applied in this brake system is located inside the instrument panel (as shown in the figure).

When ESC-OFF light goes on, it indicates the functions of ESC is manually closed, its functions can be started with ESC switch button, and ESC-OFF light will go out after starting it.

ESC snow mode lamp located in the instrument panel. When snow mode ESC lighting, indicating the snow mode ESC mode is active.

Repair instructions 1

(I) Repair on the vehicle

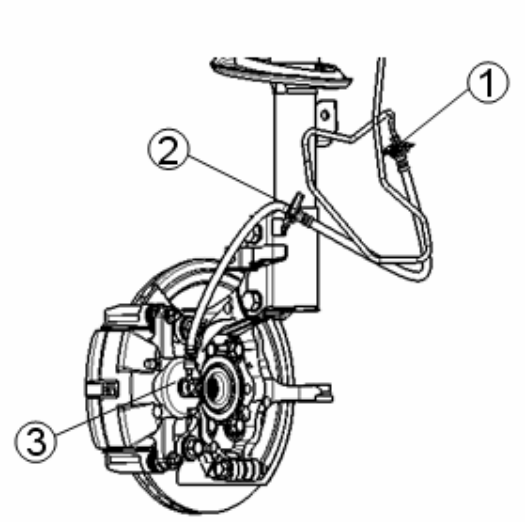
Front brake hose

Procedures for removing:

Note:
Do not spill brake fluid or splashed paint. Brake fluid will damage the paint. If splashed paint on, then immediately wipe clean and washed with water.

1. Remove the wheel.
2. Remove the brake hose.

- Loosen the connector ① connected to brake pipe.
- Block the opening of brake pipe, and avoid the loss and pollution of brake fluid.
- Remove the snap spring ②.
- Loosen the connecting bolt ③.
- Remove the brake hose from the support.



Installation procedures:

1. Connect the brake hose to pipe ①. Tightening torque: 14 to 18N·m.
2. Install the snap spring ②.
3. Install the brake hose connecting bolt ③. Tightening torque: 22-29N·m.

Important: please apply the brake fluid recommended by Sino Maersk Co., Ltd.

4. Exhaust the brake system. Refer to manual exhaustion in this chapter.
5. Confirm whether the brake system is leaked.
6. Install the wheel.

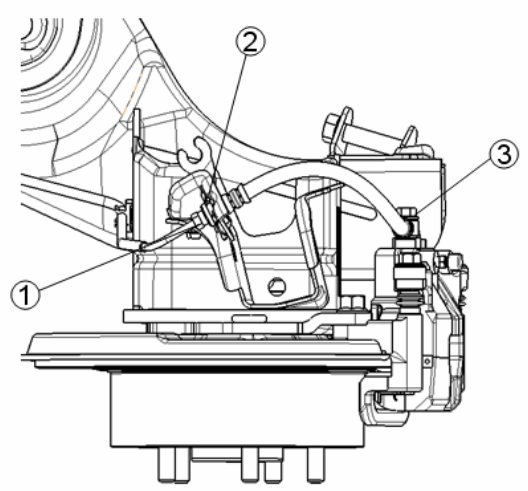
Rear brake hose

Removal procedures:

① Remove the wheel,

② Remove the brake hose.

- Loosen the connector connected to brake pipe ①.
- Remove the snap spring ②.
- loosen bolts ③.
- Block the opening of brake pipe, and avoid the loss and pollution of brake fluid.



Installation procedures:

1. Connect the brake hose to the pipe. Tightening torque: 14 to 18N·m (12 Ib-ft).
2. Install the snap spring.
3. Install the brake hose connecting bolt ③. Tightening torque: 22-29N·m.

Important: please apply only the recommended brake fluid.

4. Exhaust the brake system. Refer to manual exhaustion in this chapter.
5. Confirm whether the brake system is leaked.
6. Install the wheel.

Brake lamp switch

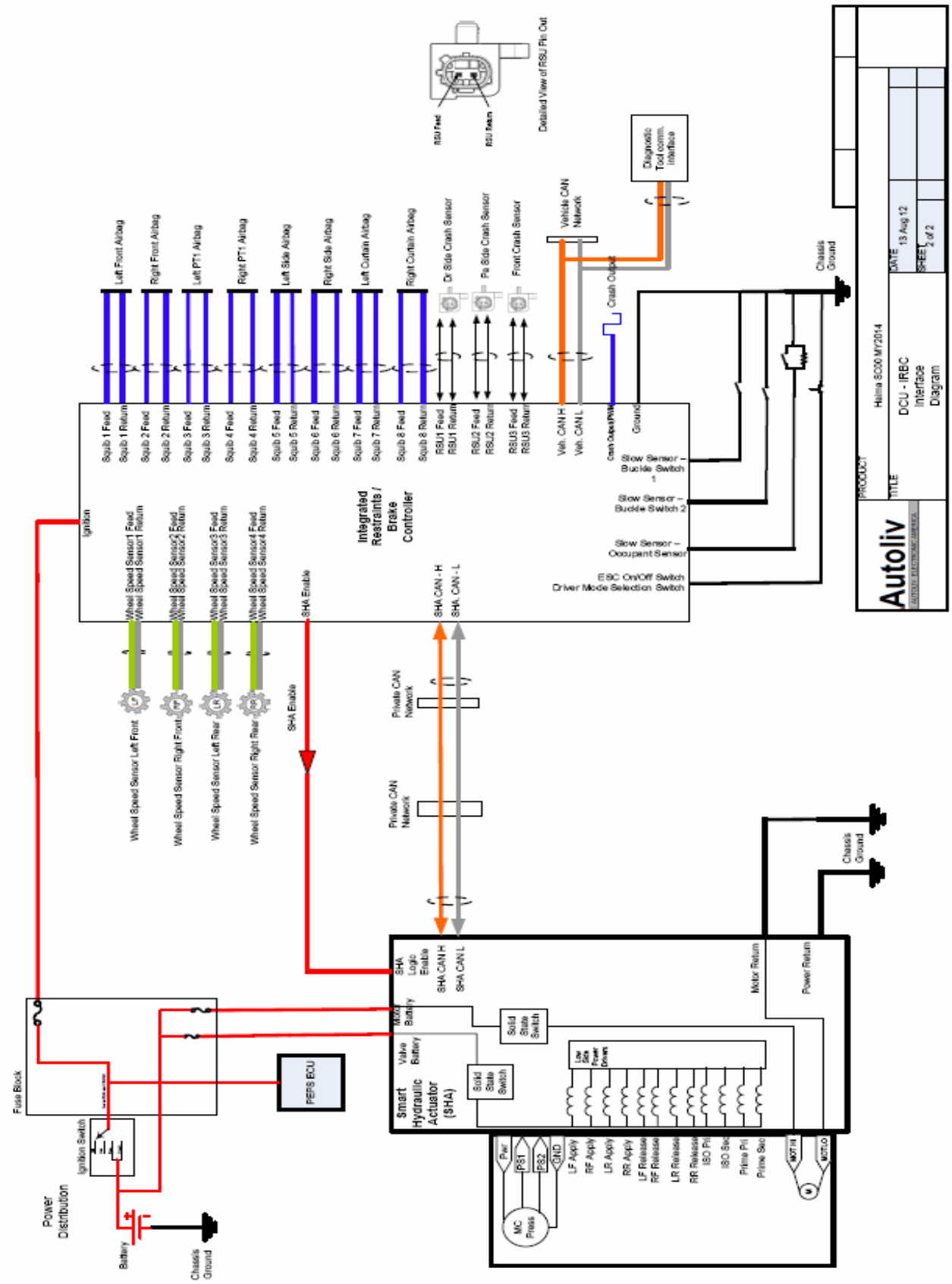
Removal procedures:

1. Disconnect the negative cable of battery.
2. Remove the brake lamp switch.

- Pull down the plug ①.

III. Haima S5 ESC interface circuit

3.1 ECU circuit diagram

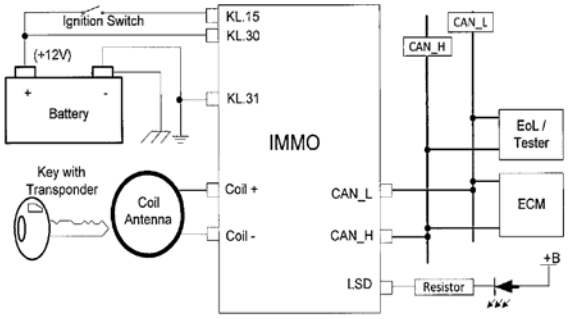


The immobilizer coil, mounted on the ignition lock cylinder, is connected with the immobilizer controller via the harness, which undertaken the transmission of signals and energy between the immobilizer controller and the transponder.

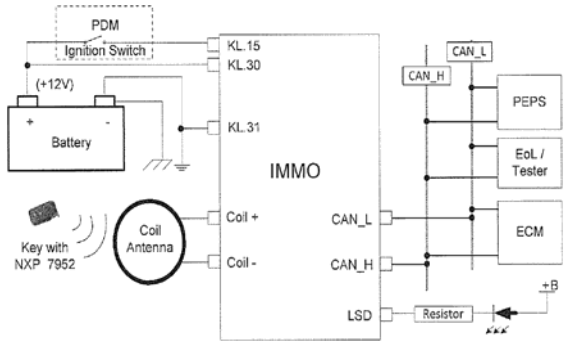
Immobilizer controller (IMMO)

The immobilizer controller is a electronic control module consisting of the microprocessor and various semiconductor components and is the core component of the immobilizer system.

Electrical Schematic Diagram



Anti-theft system electrical schematics (without PEPS)



Anti-theft system electrical schematics (with PEPS)

System Operating Principle

After the key with a transponder is inserted into the ignition lock and it is turned from OFF to ON, the immobilizer controller is awakened entering the wireless authentication status; at this time, the immobilizer controller outputs energy and data to the transponder via the coil. The transponder that installed in the key receives the wireless signal and transmits the encrypted ID signal back to the controller via the coil. The controller decodes the signal and compares the received ID with the internal stored ID. If they are the same, the wireless authentication is passed. If not, the controller ends the identification and enters the sleep mode.

After passing the wireless identification, the immobilizer controller and the engine ECM will conduct the mutual encryption and authentication. They will compare the stored PIN with the key respectively. If they are the same, the ECM can start the engine successfully. If different, the ECM won't start the engine.

Some models, burglar match with PEPS function keys and PEPS mainly through intelligent control module, PEPS control module and anti-theft controller uses an internal algorithm using UMC between HITAG2 encryption and authentication algorithms, security controls and engine ECM is encrypted authentication, only the smart key and anti-theft controller (or PEPS and security controller), two anti-theft security authentication between the controller and the engine ECM through after all, it allows the engine to start the engine ECM normal.

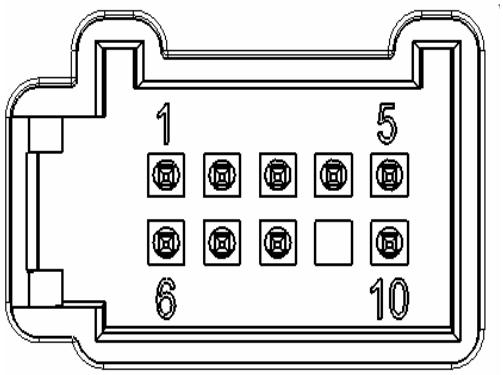
Immobilizer Indicator Lamp

The immobilizer indicator lamp, which is controlled by the immobilizer controller, can display different status of the immobilizer system:

1	After the vehicle is electrified and the key is located at ACC, the immobilizer controller is still under the standby mode; at this time, 5S cycle indicator flashes, each cycle indicator light 250ms;
2	With the key turned to ON, if the authentication between the immobilizer controller and the key fails, 0.5s cycle indicator flashing lights each cycle 250ms;
3	With the key turned to ON, if the authentication succeeds, the indicator lamp goes out.

Harness Connector

The immobilizer controller is equipped with a 10-pin connector, shown as follows:



Schematic Diagram of the 10-Pin Connector of the Immobilizer Controller

The 10-pin connector is connected with the female

Failure analysis of BCM Control Unit

Failure Phenomenon		Possible Reasons	Solution
Lighting system	The hazard warning lamp and turn signal do not operate	● The BCM-2 fuse wire in the fuse box burns out. ● Switch signal is disconnected. ● The turn signal is short-circuited. ● IG signal is disconnected (only the turn signal does not operate).	1. Replace the fuse wire. 2. Inspect the circuit and load.
	The clearance lamp, low beam lamp and high beam lamp do not operate.	● The relay in the fuse box is broken. ● The relay in the fuse box is short-circuited. ● The multi-function switch signal is disconnected.	1. Replace the relay. 2. Inspect the circuit and switch.
	The DOOR gear of the interior lamp does not operate.	● The interior lamp is short-circuited. ● The detection signal of door state is abnormal.	1 Inspect the circuit and switch. 2 Replace the fuse wire.
	The daytime running lamp does not operate.	● The CAN bus breaks down. ● The daytime running lamp is short-circuited. ● The BCM-1 fuse wire in the fuse box burns out.	1. Replace the fuse wire. 2. Inspect the CAN bus signal.
Remote and center control system	The center control does not operate.	● The center control pushbutton and/or switch signal is/are disconnected. ● The center control pushbutton signal does not reach to four door locks.	Inspect the circuit and switch.
	Front and rear frog lamps	● Switch signal is disconnected.	Inspect the circuit and switch.
		● Bulbs are damaged.	Replace the bulbs.
	The controller fails.	● The key insertion detector switch breaks down. ● Signal interference (such as in a military area or signal blackout area etc.) ● The battery of the remote control key is with no electricity. ● The controller key does not work properly.	1. Inspect the switch connector for its state. 2. Inspect whether there is any interference signal. 3. Replace the battery. 4. Replace the controller.
	Back door switch fails.	● The back door state signal is short-circuited to earth. ● The switch and its circuit are disconnected. ● The speed signal is abnormal (>5km/h).	1. Inspect the circuit of the back door state. 2. Inspect the circuit of the back door switch. 3. Inspect the speed signal.
Windshield wiper cleaning system	The front windshield wiper pause does not properly operate.	● The pause gear switch signal fails. ● The pause adjustable signal fails.	Inspect the circuit and switch.
	The front windshield wiper pause does not return to its place.	● The pause restoration signal is disconnected.	Inspect the circuit of the restoration signal.