

SERVICE MANUAL (vol. 1 of 2)

KYRON

FOREWORD

This manual includes procedure for maintenance, adjustment, service operation and removal and installation of components.

All information, illustrations and specifications contained in this manual are based on the latest product information available at the time of manual approval.

The right is reserved to make changes at any time without notice.

 **SsangYong Motor CO., LTD.**
PYUNGTAEK, KOREA

SECTION INDEX

VOLUME 1 OF 2

GENERAL INFORMATION

ENGINE

- 0A. ENGINE GENERAL INFORMATION
- 01. ENGINE ASSEMBLY
- 02. ENGINE HOUSING
- 03. INTAKE SYSTEM
- 04. EXHAUST SYSTEM
- 05. LUBRICATION SYSTEM
- 06. COOLING SYSTEM
- 07. FUEL SYSTEM
- 08. ENGINE CONTROL SYSTEM
- 09. ELECTRIC DEVICES AND SENSORS

DIAGNOSIS

- ▶ SCAN-100
- ▶ ECU
- ▶ TCU
- ▶ MANUAL TRANSMISSION
- ▶ TCCU
- ▶ CLUTCH
- ▶ BRAKE
- ▶ AIR BAG
- ▶ AIR CONDITIONING SYSTEM
- ▶ FFH
- ▶ RK-STICS
- ▶ RAIN SENSOR
- ▶ SUNROOF

GENERAL INFORMATION

GENERAL INFORMATION

GENERAL INFORMATION

00

■ TABLE OF CONTENTS ■

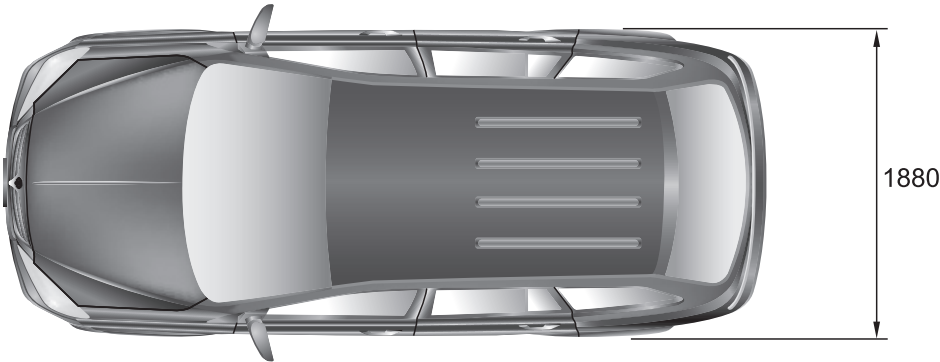
DIMENSIONS	3
SPECIFICATIONS	4
VEHICLE IDENTIFICATION	6
MAINTENANCE SCHEDULE	9
RECOMMENDED FLUIDS AND LUBRICANTS	11

DIMENSIONS

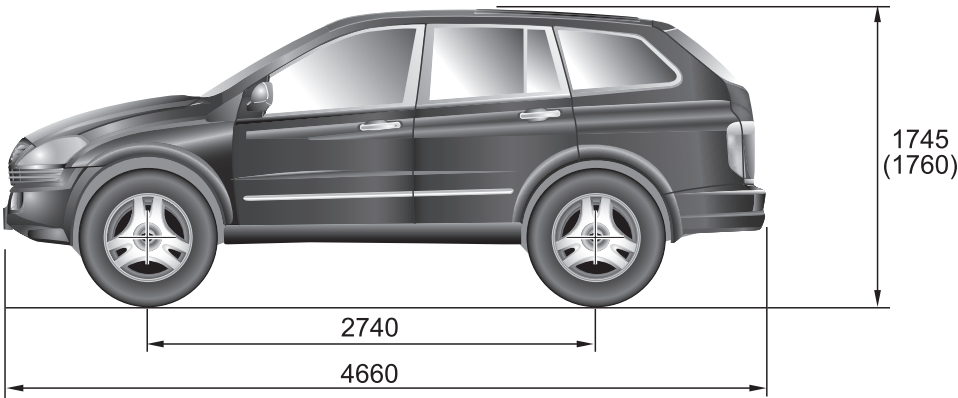
GENERAL

Unit: mm

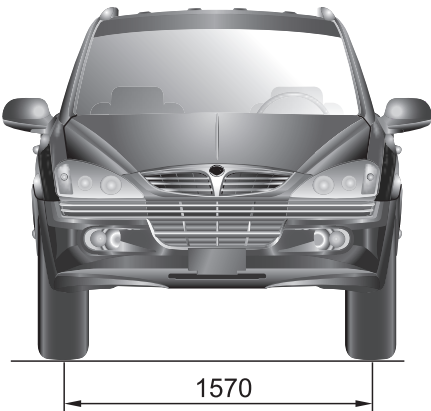
Top View



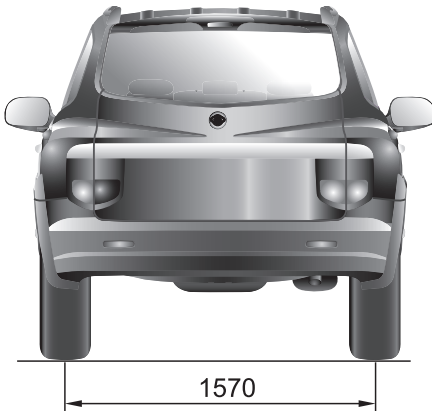
Side View



Front View



Rear View



* () : Optional

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

SPECIFICATIONS

Descriptions			D20DT	D27DT
General	Overall length (mm)		4,660	4,660
	Overall width (mm)		1,880	1,880
	Overall height (mm)		1,740 (1,755: with roof rack)	1,740 (1,755: with roof rack)
	Gross vehicle weight (kg)	A/T	2,530	2,530
		M/T	2,530	2,530
	Curb vehicle weight (kg)	A/T	2WD: 1,920 / 4WD: 2,028	4WD: 2,071
		M/T	2WD: 1,893 / 4WD: 2,001	4WD: 2,030
	Fuel		Diesel	Diesel
	Fuel tank capacity (ℓ)		75	75
Engine	Engine name		D20DT	D27DT
	Numbers of cylinders/Compression ratio		4 / 17.5:1	5 / 18:1
	Total displacement (cc)		1,998	2,696
	Camshaft arrangementMax. power		DOHC	DOHC
	Max. power	A/T	141 ps / 4,000 rpm	165 ps / 4,000 rpm
		M/T	141 ps / 4,000 rpm	165 ps / 4,000 rpm
	Max. torque	A/T	310 Nm / 1,800 ~ 2,750 rpm	340 Nm / 1,800 ~ 3,250 rpm
		M/T	310 Nm / 1,800 ~ 2,750 rpm	340 Nm / 1,800 ~ 3,250 rpm
	Idle speed		750 ± 20 rpm	750 ± 20 rpm
	Cooling system		Water- cooled / forced circulation	Water- cooled / forced circulation
	Coolant capacity (ℓ)		11.5	11.5
	Lubrication type		Gear pump, forced circulation	Gear pump, forced circulation
	Max. oil capacity (ℓ)		8.2	9.2
	Turbocharger and cooling type		Turbocharger, air-cooled	Turbocharger, air-cooled
Manual Transmission	Operating type		Semi- Remote control, floor change type	Semi- Remote control, floor change type
	Gear ratio	1st	4.315	4.315
		2nd	2.475	2.475
		3rd	1.536	1.536
		4th	1.000	1.000
		5th	0.807	0.807
		Reverse	3.919	3.919
Automatic Transmission	Model		Electronic, 5-speed	Electronic, 5-speed
	Operating type		Floor change type	Floor change type

* () Optional

Descriptions			D20DT	D27DT
Automatic Transmission	Gear ratio	1st	3.951	3.595
		2nd	2.423	2.186
		3rd	1.486	1.405
		4th	1.000	1.000
		5th	0.833	0.831
		Reverse 1st	3.147	3.167
		Reverse 2nd	1.930	1.926
Transfer Case	Model		Part-time	Part-time
	Type		Planetary gear type	Planetary gear type
	Gear ratio	High (4H)	1.000 : 1	1.000 : 1
		Low (4L)	2.483 : 1	2.483 : 1
Clutch (M/T)	Operating type		Hydraulic type	Hydraulic type
	Disc type		Dry single diaphragm type	Dry single diaphragm type
Power Steering	Type		Rack and pinion	Rack and pinion
	Steering angle	Inner	36.2°	36.2°
		Outer	32.4°	32.4°
Front Axle	Drive shaft type		Ball joint type	Ball joint type
	Axle housing type		Build-up type	Build-up type
	Gear ratio	M/T	4.27	3.91
		A/T	3.54	3.31
Rear Axle	Drive shaft type	5-Link type	Semi-floating type	Semi-floating type
		Independent type	Independent type	Independent type
	Axle housing type		Build-up type	Build-up type
	Gear ratio	M/T	4.27	3.91
		A/T	3.54	3.31
Brake	Master cylinder type		Tandem type	Tandem type
	Booster type		Vacuum assisted booster type	Vacuum assisted booster type
	Brake type	Front wheels	Disc type	Disc type
		Rear wheels	Drum (disc)	Drum (disc)
	Parking brake		Cable type (internal expansion)	Cable type (internal expansion)
Suspension	Front suspension		Wishbone + coil spring	Wishbone + coil spring
	Rear suspension	Solid axle suspension	5-link + coil spring	5-link + coil spring
Air Conditioner	Refrigerant (capacity)		R-134a (650 ± 30g)	R-134a (650 ± 30g)
Electrical	Battery type / Capacity (V-AH)		MF / 12 - 90	MF / 12 - 90
	Starter capacity (V-kW)		12 - 2.2	12 - 2.2
	Alternator capacity (V-A)		With PTC: 12 - 140 (With FFH: 12 - 115)	With PTC: 12 - 140 (With FFH: 12 - 115)

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

VEHICLE IDENTIFICATION

Chassis Number

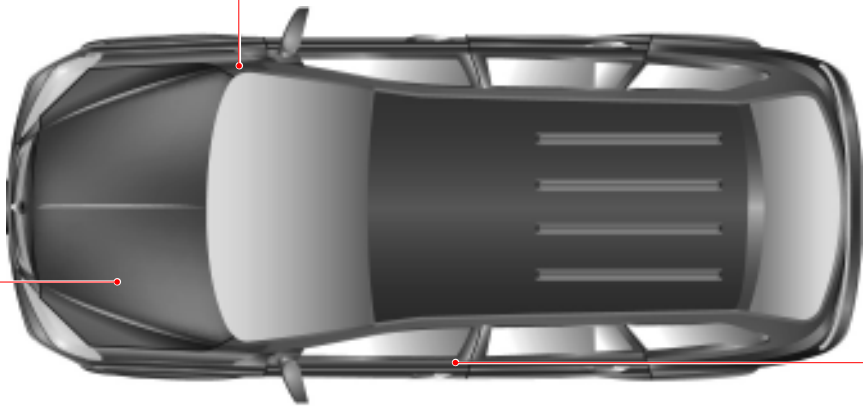


The chassis number is stamped on the frame behind the front right tire.

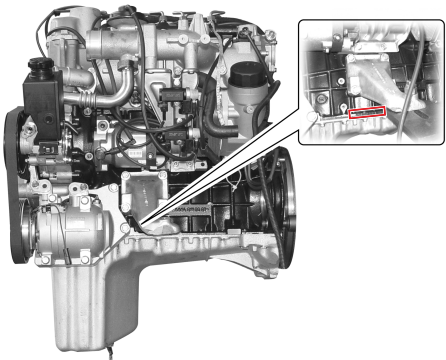
Certification Label



The certification label is located on the driver's door sill.

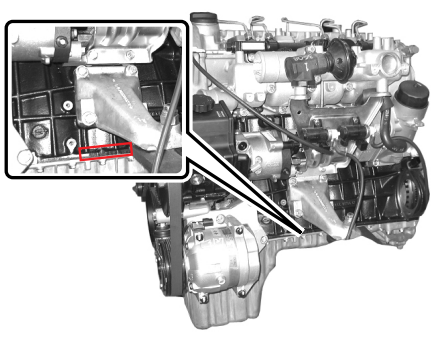


Engine Number (D20DT)



The engine number is stamped on the lower area of cylinder block in the intake manifold side.

Engine Number (D27DT)



1. Vehicle Identification Number

Vehicle identification number (VIN) is on the right front axle upper frame.

[KPTS0A1KS5P 122357]

K .. Nation	(K: Korea)
P .. Maker Identification	(P: Ssangyong Motor Company)
T .. Vehicle Type	(T: Passenger car - 4WD)
S .. Line Models	(S: Kyron)
0 .. Body Type	(0: 5-door)
A .. Trim Level	(A: Standard, B: Deluxe, C: Super deluxe)
1 .. Restraint System	(0: No seatbelts, 1: 3-point seatbelts, 2: 2-point seatbelt)
K .. Engine Type	(9: 3199cc, In-line 6 cylinders, Gasoline E32) (K: 1998cc - common rail direct injection (D20DT), F: 2696cc - common rail direct injection (D27DT))
S .. Check Digit	(S: All area except North America)
5 .. Model Year	(3: 2003, 4: 2004, 5: 2005)
P .. Plant Code	(P: Pyungtaek plant)
122357	(Production serial number)



2. Certification Label

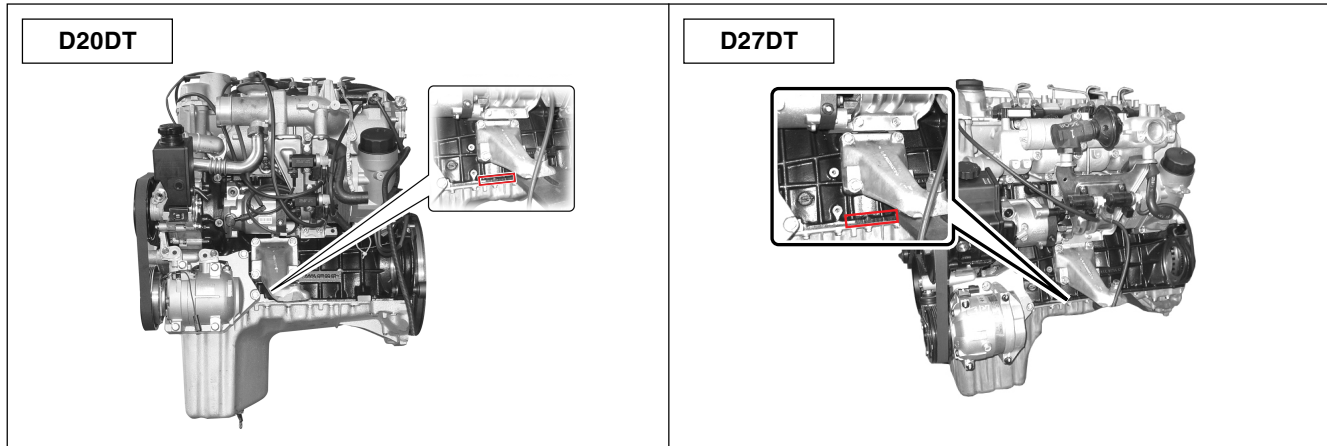
The certification label is affixed on the bottom of driver's side B-pillar.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

3. Engine Serial Number

The engine serial number is stamped on the lower area of cylinder block in intake manifold side.

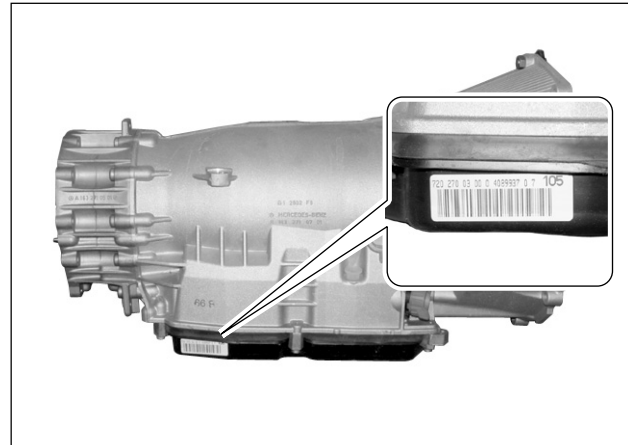


4. Manual Transmission Number

The transmission label is affixed on the upper area of clutch housing.

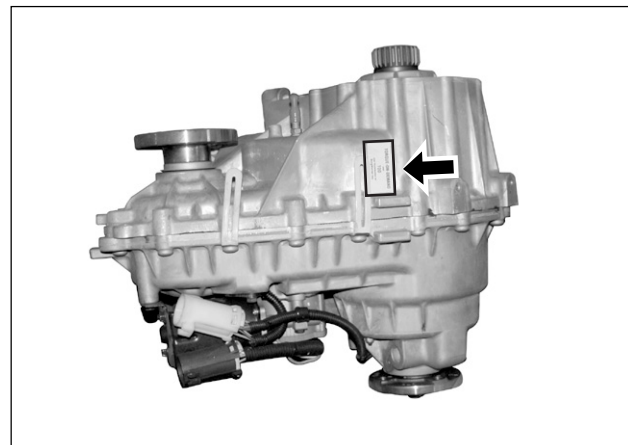
5. Automatic Transmission Number

The transmission label is affixed on the right area of transmission housing.



6. Transfer Case Number

The transfer case label is affixed on the transfer case housing.



MAINTENANCE SCHEDULE

► General

* Use only approved Ssangyong genuine parts.

Descriptions		Daily Check	Weekly Check	Service Interval
Engine Oil and Oil Filter		○	—	Initial change: 5,000 km, change every 10,000 km or 12 months (But, shorten the service interval under severe conditions)
Coolant		○	—	Change every 60,000 km or 3 years. And, inspect and replenish as necessary.
Additional Water Separator: A.W.S.		—	—	Inspect 10,000 km, change every 150,000 km or 5 years
Brake / Clutch Fluid		○	—	Change every 2 years (Inspect frequently)
Brake Pipes and Hoses		—	—	Initial check: 1,000 km, periodic check: every 20,000 km or 1 year, replace as necessary.
Brake Pad, Shoe, and Disc		—	—	Periodic check: every 10,000 km, adjust or replace as necessary.
Air Cleaner Element		—	○	Initial clean: 5,000 km, clean every 10,000 km, replace every 30,000 km (But, shorten the service interval under severe conditions)
Fuel Filter		—	—	Replace every 25,000 km (Draining water from fuel filter: every 10,000 km)
Automatic Transmission Fluid		—	—	Inspect every 10,000 km or 6 months (But change every 60,000 km under severe conditions)
Manual Transmission Fluid		—	—	Inspect 10,000 km, change every 60,000 km (Frequent check of oil leak)
Transfer Case Fluid		—	—	Inspect 10,000 km, change every 60,000 km (Frequent check of oil leak)
Axle Oil	Front	—	—	Inspect frequently, change every 30,000 km
	Rear	—	—	Inspect frequently, change every 30,000 km
Air Conditioner Filter		—	—	Change every 10,000 km (But, shorten the service interval under severe conditions)

Severe Conditions in Engine

1. Frequent stop-and-go traffic, extended idling, short driving distance below 6 km, driving distance below 16 km when the outside temperature remains below freezing
2. Driving in hilly or mountainous terrain, sandy or dusty area
3. High load driving such as trailer towing

Severe Conditions in Automatic Transmission and Axle

1. Towing a trailer or off-road driving
2. Taxi, patrol service or delivery service (extended idling and excessive driving with low speed)

Severe Conditions in Air Conditioner Filter

1. Pollutant area or off-road driving, extended air conditioner or heater operation

Sever Conditions in Air Cleaner Element

1. Pollutant area or off-road driving

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► EU ONLY

* Use only approved Ssangyong genuine parts.

Descriptions		Daily Check	Weekly Check	Service Interval
Engine Oil and Oil Filter		○	—	Change every 15,000 km or 12 months (But, shorten the service interval under severe conditions)
Coolant		○	—	Change every 60,000 km or 3 years. And, inspect and replenish as necessary.
Brake / Clutch Fluid		○	—	Change every 2 years (Inspect frequently)
Brake Pipes and Hoses		—	—	Periodic check: every 15,000 km or 1 year, replace as necessary.
Brake Pad, Shoe, and Disc		—	—	Periodic check: every 15,000 km, adjust or replace as necessary.
Air Cleaner Element		—	○	Clean every 15,000 km, replace every 30,000 km (But, shorten the service interval under severe conditions)
Fuel Filter		—	—	Replace every 30,000 km (Draining water from fuel filter: every 10,000 km)
Automatic Transmission Fluid		—	—	Inspect every 15,000 km or 12 months (But change every 60,000 km under severe conditions)
Manual Transmission Fluid		—	—	Inspect 15,000 km, change every 60,000 km (Frequent check of oil leak)
Transfer Case Fluid		—	—	Inspect 15,000 km, change every 60,000 km (Frequent check of oil leak)
Axle Oil	Front	—	—	Inspect frequently, change every 30,000 km
	Rear	—	—	Inspect frequently, change every 30,000 km
Air Conditioner Filter		—	—	Change every 10,000 km (But, shorten the service interval under severe conditions)

Severe Conditions in Engine

1. Frequent stop-and-go traffic, extended idling, short driving distance below 6 km, driving distance below 16 km when the outside temperature remains below freezing
2. Driving in a hilly or mountainous terrain, sandy, or dusty area
3. High load driving such as trailer towing

Severe Conditions in Automatic Transmission and Axle

1. Towing a trailer or off-road driving
2. Taxi, patrol service or delivery service (extended idling and excessive driving with low speed)

Severe Conditions in Air Conditioner Filter

1. Pollutant area or off-road driving, extended air conditioner or heater operation

Sever Conditions in Air Cleaner Element

1. Pollutant area or off-road driving

*** EU Countries**

1. Only countries that belong to EU. (It does not apply to all countries in EU.)

RECOMMENDED FLUIDS AND LUBRICANTS

Descriptions			Capacity		Specifications
			D20DT	D27DT	
Engine Oil			≡ 7.5 ℓ	≡ 8.5 ℓ	Ssangyong genuine engine oil (Approved by MB Sheet 229.1 or 229.3)
Engine Coolant			≡ 11.5 ℓ	≡ 11.5 ℓ	Ssangyong genuine coolant
Automatic Transmission Fluid			≡ 8.0 ℓ	≡ 8.0 ℓ	Shell AFT 3353 or Fuchs AFT 3353
Manual Transmission Fluid			4WD: ≡ 3.6 ℓ 2WD: ≡ 3.4 ℓ	4WD: ≡ 3.6 ℓ	Ssangyong genuine oil (ATF DEXRON II)
Transfer Case Fluid			≡ 1.3 ℓ	≡ 1.3 ℓ	Ssangyong genuine oil (ATF DEXRON III)
Axle Oil	Front	Automatic Transmission	≡ 1.4 ℓ	≡ 1.4 ~ 1.5 ℓ	Ssangyong genuine oil (API GL-5 or SAE 80W/90)
		Manual Transmission	≡ 1.4 ℓ	≡ 1.4 ℓ	
	Rear	Solid Axle Suspension	≡ 1.9 ℓ	≡ 2.2 ℓ	Ssangyong genuine oil (API GL-5 or SAE 80W/90)
Brake/Clutch Fluid			As required	As required	Ssangyong genuine oil (DOT4)
Power Steering Fluid			≡ 1.0 ℓ	≡ 1.0 ℓ	Ssangyong genuine oil (ATF DEXRON III)



NOTICE

- Use only Ssangyong recommended fluids and lubricants.
- Do not mix any different types or brands of oils or fluids. This may cause damages.
- Keep the specified levels when adding or replacing the fluids.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

MEMO

ENGINE

CONTENTS

ENGINE GENERAL INFORMATION	SECTION 0A
ENGINE ASSEMBLY	SECTION 01
ENGINE HOUSING	SECTION 02
INTAKE SYSTEM	SECTION 03
EXHAUST SYSTEM	SECTION 04
LUBRICATION SYSTEM	SECTION 05
COOLING SYSTEM	SECTION 06
FUEL SYSTEM	SECTION 07
ENGINE CONTROL SYSTEM	SECTION 08
ELECTRIC DEVICES AND SENSORS..	SECTION 09

SECTION 0A

**ENGINE GENERAL
INFORMATION**

ENGINE GENERAL INFORMATION

0A

TABLE OF CONTENTS

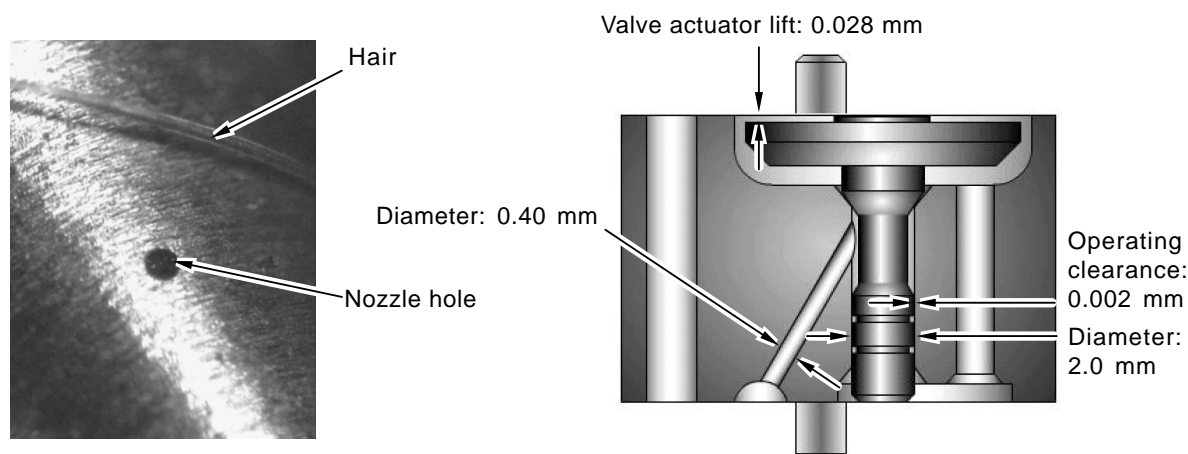
CLEANNESS	2	COOLING SYSTEM	27
ENGINE ASSEMBLY	7	FUEL SYSTEM	29
1. LH side view	7	Fuel supply system	31
2. RH side view	8	MAINTENANCE AND REPAIR	33
3. Front view	9	Maintenance and lubrication	33
COMPONENTS IN D20DT ENGINE AND D27DT ENGINE	11	Guidelines for service work safety	34
ENGINE CONTROLS	15	OWNER INSPECTIONS AND SERVICES ..	39
ECU related components	15	While operating the vehicle	39
Engine and sensors	17	At each fuel fill	39
Electrical components and preheating system	19	At least twice a month	39
INTAKE SYSTEM	21	At least monthly	39
EXHAUST SYSTEM	23	At least twice a year	40
LUBRICATION SYSTEM	25	Each time the oil is changed	40
		At least annually	40
		STANDARD BOLTS SPECIFICATIONS ...	41

CLEANNESS

Cleanness of DI Engine Fuel System and Service Procedures

The fuel system for DI engine consists of transfer (low pressure) line and high pressure line. Its highest pressure reaches over 1600 bar. Some components in injector and HP pump are machined at the micrometer 100 μ m of preciseness. The pressure regulation and injector operation are done by electric source from engine ECU. Accordingly, if the internal valve is stucked due to foreign materials, injector remains open. Even in this case, the HP pump still operates to supply high pressurized fuel. This increases the pressure to combustion chamber (over 250 bar) and may cause fatal damage to engine.

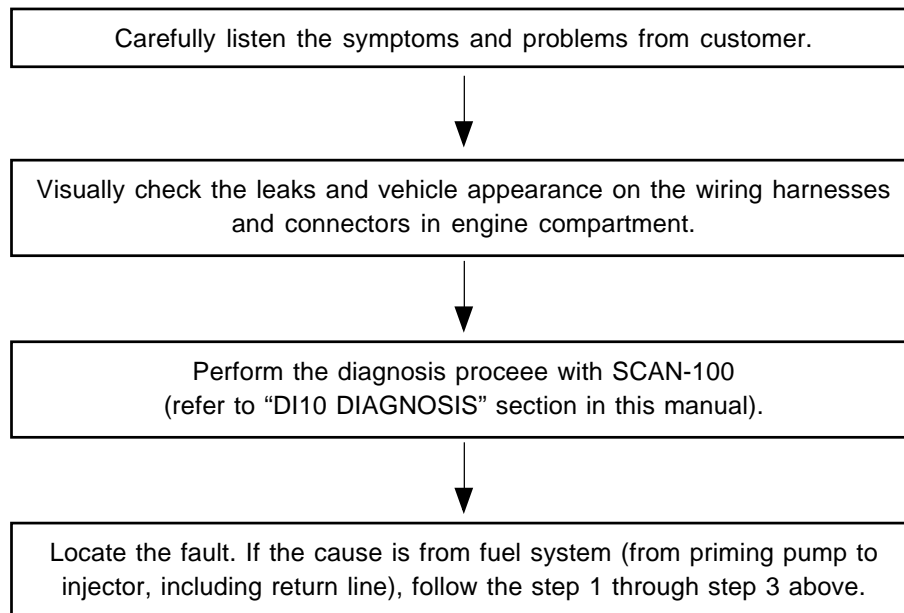
You can compare the thickness of injector nozzle hole and hair as shown in below figure (left side). The right side figure shows the clearance between internal operating elements.



The core elements of fuel system has very high preciseness that is easily affected by dust or very small foreign material. Therefore, make sure to keep the preliminary works and job procedures in next pages. If not, lots of system problems and claims may arise.

Job Procedures

1. Always keep the workshop and lift clean (especially, from dust).
2. Always keep the tools clean (from oil or foreign materials).
3. Wear a clean vinyl apron to prevent the fuzz, dust and foreign materials from getting into fuel system. Wash your hands and do not wear working gloves.
4. Follow the below procedures before starting service works for fuel system.



5. If the problem is from HP pump, fuel supply line or injector, prepare the clean special tools and sealing caps to perform the diagnosis for DI engine fuel system in "DIAGNOSIS" section in this manual. At this point, thoroughly clean the related area in engine compartment.

NOTICE

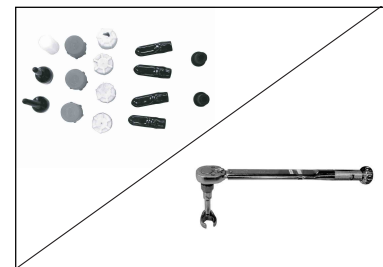
- Clean the engine compartment before starting service works.



Tool kit for high pressure line



Took kit for low pressure line



Removal tool box and cap kits

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

6. Follow the job procedures. If you find a defective component, replace it with new one.

Disconnect the negative battery cable.

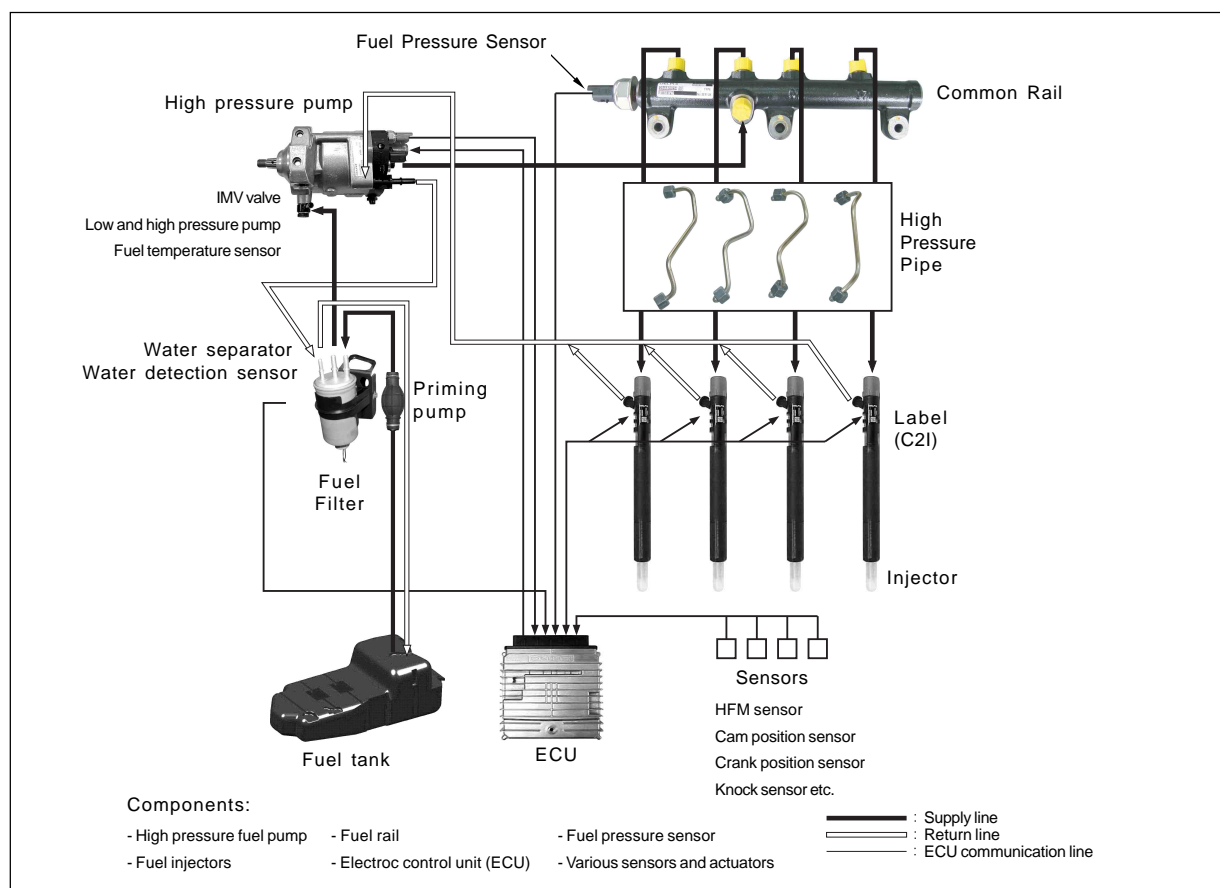
For safety reasons: check pressure is low before opening the HP systems (pipes)

Use special tools and torque wrench to perform the correct works.

Once disconnected, the fuel pipes between HP pump and fuel rail and between fuel rail and each injector should be replaced with new ones. The pipes should be tightened to specified tightening torques during installation. Over or under torques out of specified range may cause damages and leaks at connections. Once installed, the pipes have been deformed according to the force during installtion, therefore they are not reusable.

The copper washer on injector should be replaced with new one. The injector holder bolt should be tightened to specified tightening torque as well. If not, the injection point may be deviated from correct position, and it may cause engine disorder.

Plug the disconnected parts with sealing caps, and remove the caps immediately before replacing the components.



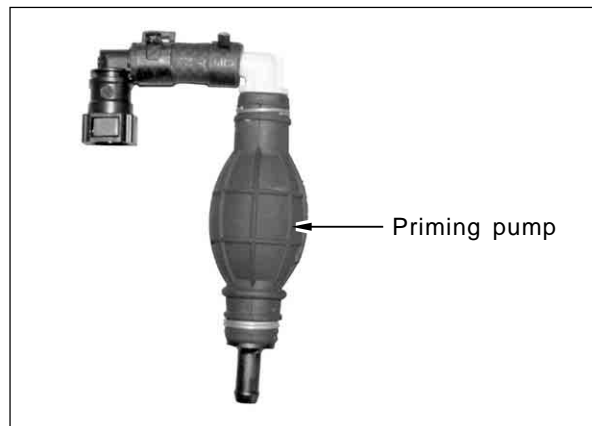
7. Plug the removed components with clean and undamaged sealing caps and store it into the box to keep the conditions when it was installed.
8. Clear the high pressure offset value by SCAN-100 after replacing the high pressure pump.



9. To supply the fuel to transfer line of HP pump press the priming pump until it becomes hard.

**NOTICE**

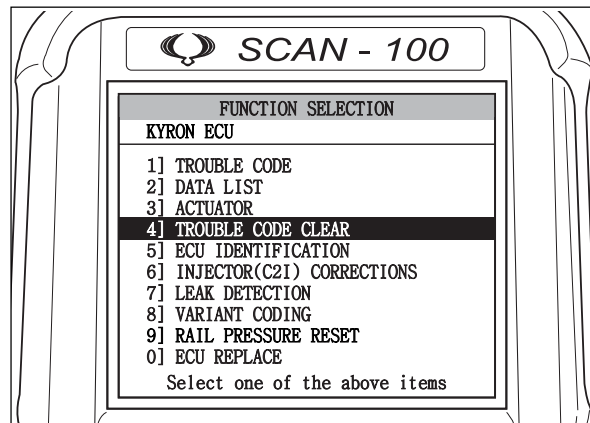
- Do not crank engine before having filled pump.



10. Check the installed components again and connect the negative battery cable. Start the engine and check the operating status.
11. With SCAN-100, check if there are current faults and erase the history faults.

NOTE

- For details, refer to "Diagnosis table".



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DI Engine and Its Expected Problems and Remedies Can be Caused by Water in Fuel

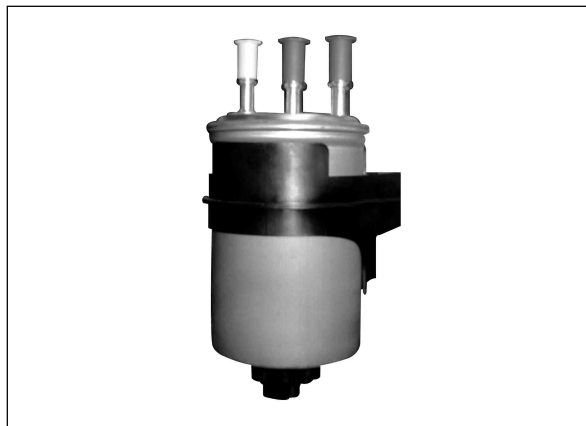
► SYSTEM SUPPLEMENT AGAINST PARAFFIN SEPARATION.


In case of Diesel fuel, paraffin, one of the elements, can be separated from fuel during winter and then can stick on the fuel filter blocking fuel flow and causing difficult starting finally. Oil companies supply summer fuel and winter fuel by differentiating mixing ratio of kerosene and other elements by region and season. However, above phenomenon can be happened if stations have poor facilities or sell improper fuel for the season.

In case of DI engine, purity of fuel is very important factor to keep internal preciseness of HP pump and injector. Accordingly, more dense mesh than conventional fuel filter is used. To prevent fuel filter internal clogging due to paraffin separation, SYMC is using fuel line that high pressure and temperature fuel injected by injector returns through fuel filter to have an effect of built-in heater (see fuel system).

► SYSTEM SUPPLEMENT AND REMEDY AGAINST WATER IN FUEL

As mentioned above, some gas stations supply fuel with excessive than specified water. In the conventional IDI engine, excessive water in the fuel only causes dropping engine power or engine hunting. However, fuel system in the DI engine consists of precise components so water in the fuel can cause malfunctions of HP pump due to poor lubrication of pump caused by poor coating film during high speed pumping and bacterization (under long period parking). To prevent problems can be caused by excessive water in fuel, water separator is installed inside of fuel filter. When fuel is passing filter, water that has relatively bigger specific gravity is accumulated on the bottom of the filter.

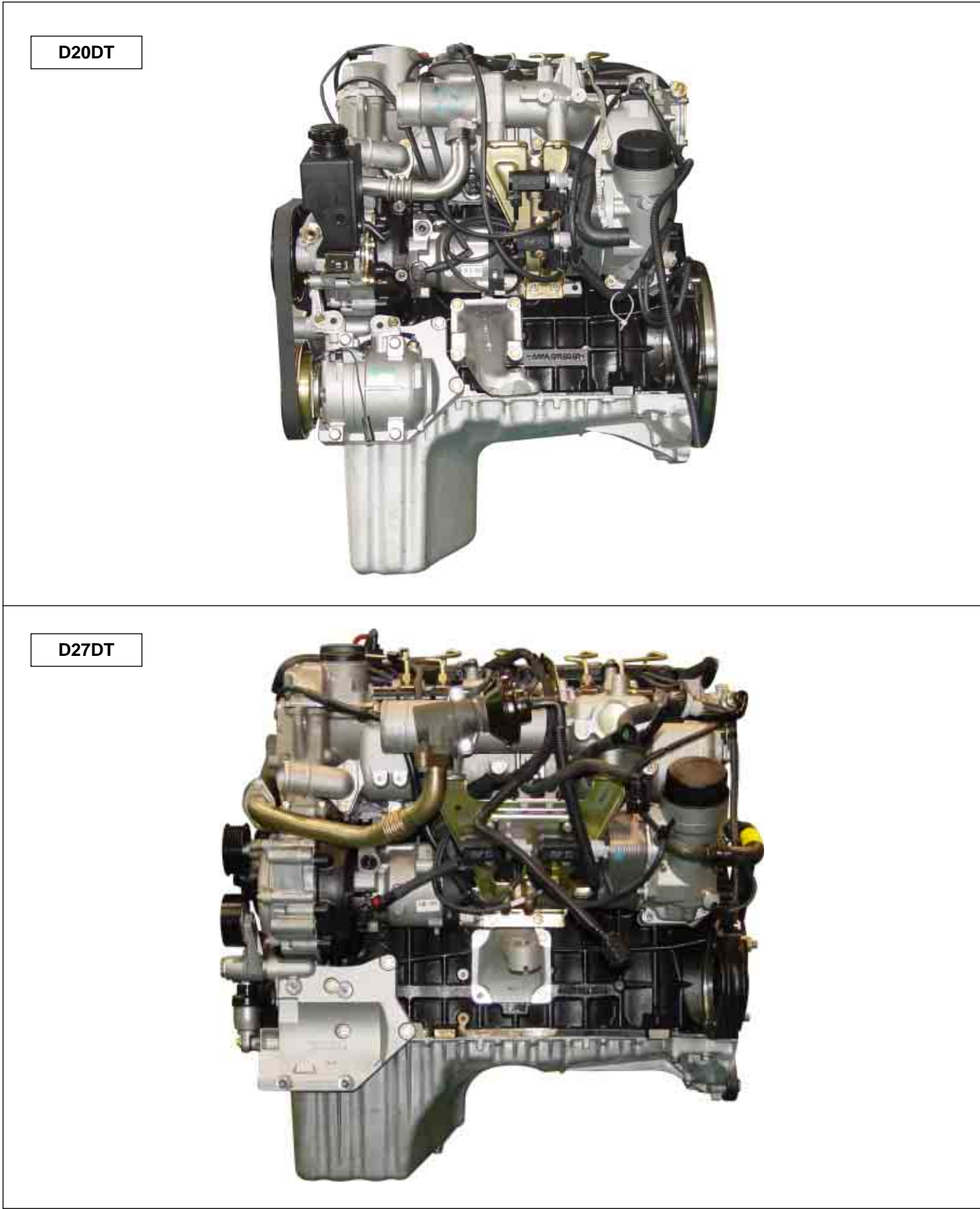


If water in the separator on the fuel filter exceeds a certain level, it will be supplied to HP pump with fuel, so the engine ECU turns on warning light () on the meter cluster and buzzer if water level is higher than a certain level.

Due to engine layout, a customer cannot easily drain water from fuel filter directly, so if a customer checks in to change engine oil, be sure to perform water drain from fuel filter. (See fuel system for details.)

ENGINE ASSEMBLY

1. LH SIDE VIEW



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

2. RH SIDE VIEW

D20DT




D27DT



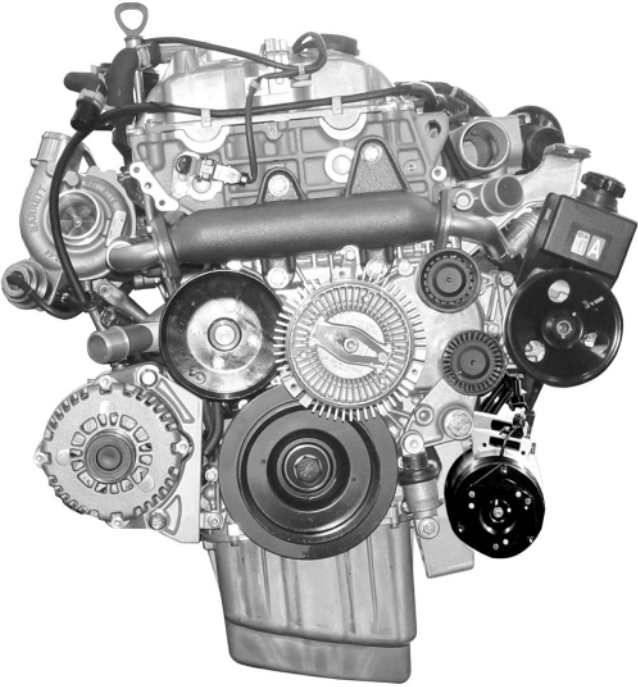
3. FRONT VIEW

D20DT



A detailed front view of a D20DT engine. The engine is a four-cylinder unit with a cast iron block and aluminum head. It features a timing belt drive system with a large crank pulley and a smaller cam pulley. Various accessories are mounted on the front, including a water pump, alternator, and a power steering pump. The engine is shown with its main components and hoses.

D27DT



A detailed front view of a D27DT engine. This is a larger six-cylinder engine with a cast iron block and aluminum head. It features a timing belt drive system with a large crank pulley and a smaller cam pulley. Various accessories are mounted on the front, including a water pump, alternator, and a power steering pump. The engine is shown with its main components and hoses.

GENERAL
ASSY
HOUSING
INTAKE
EXHAUST
LUB
COOLING
FUEL
CONTROL
SENSOR

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► Fan Belt













D20DT




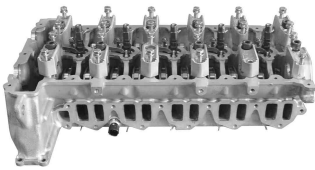

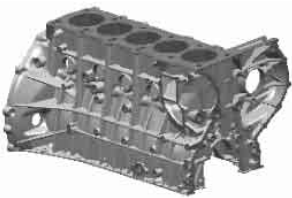







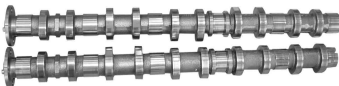

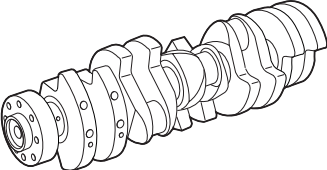
D27DT




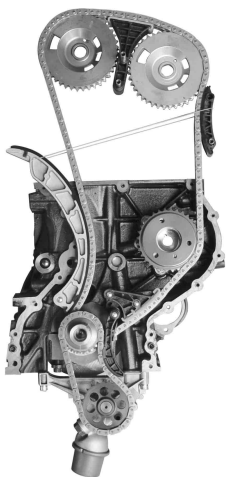








COMPONENTS IN D20DT ENGINE AND D27DT ENGINE

Components	D20DT	D27DT
Turbocharger		
Common rail		
EGR valve		
Exhaust manifold		
Intake manifold		
Cylinder head cover		









CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Components	D20DT	D27DT
Cylinder head		
Cylinder block		
Oil pan		
High pressure pipe	 	 
Intake camshaft and exhaust camshaft		
Crankshaft		

Components	D20DT	D27DT
Sprocket - HP pump		
Timing chain devices		
Chain double bush	<div><div>D20DT</div></div> <div><div>D27DT</div></div>	
Tensioner rail		
Oil pump assy		

GENERAL
ASSY
HOUSING
INTAKE
EXHAUST
LUB
COOLING
FUEL
CONTROL
SENSOR





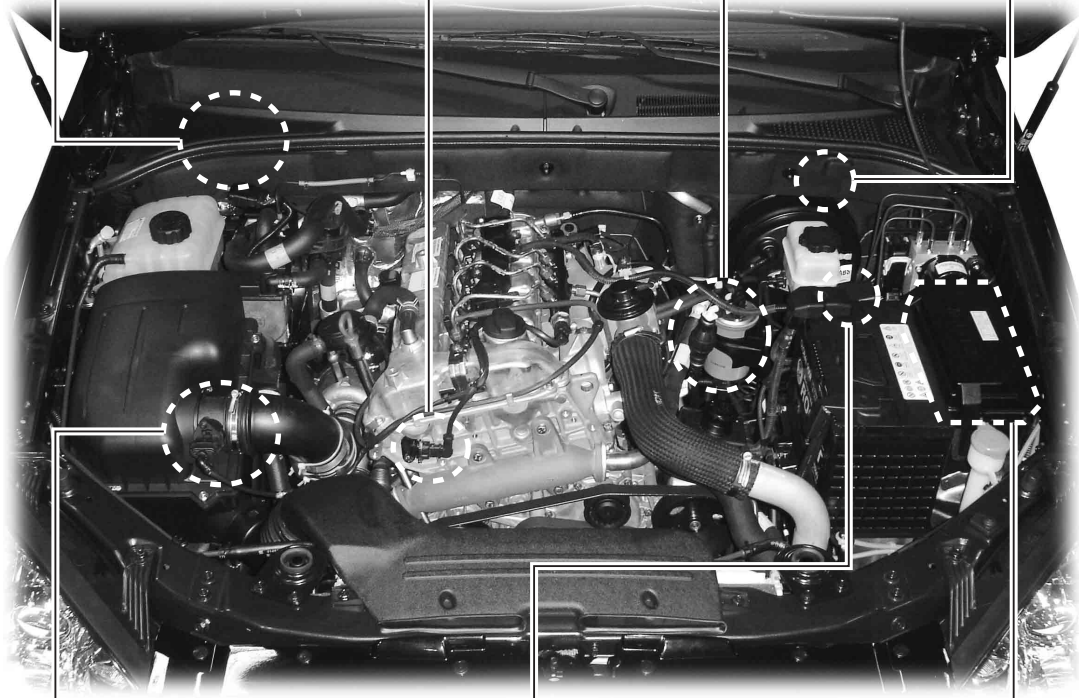


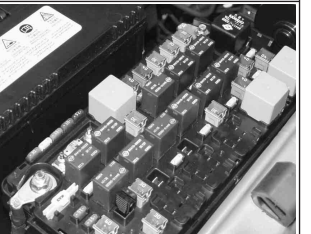
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Components	D20DT	D27DT
Clamping rail comp		
Guid rail LWR		
EGR pipe - LH		
Fuel injector		

ENGINE CONTROLS

ECU RELATED COMPONENTS


► D20DT Engine

ECU/Barometric Sensor	Cam Position Sensor	Fuel Filter (Water Detection Sensor)	Accelerator Pedal Sensor
			
			
			


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► D27DT Engine


ECU/Barometric Sensor




Cam Position Sensor

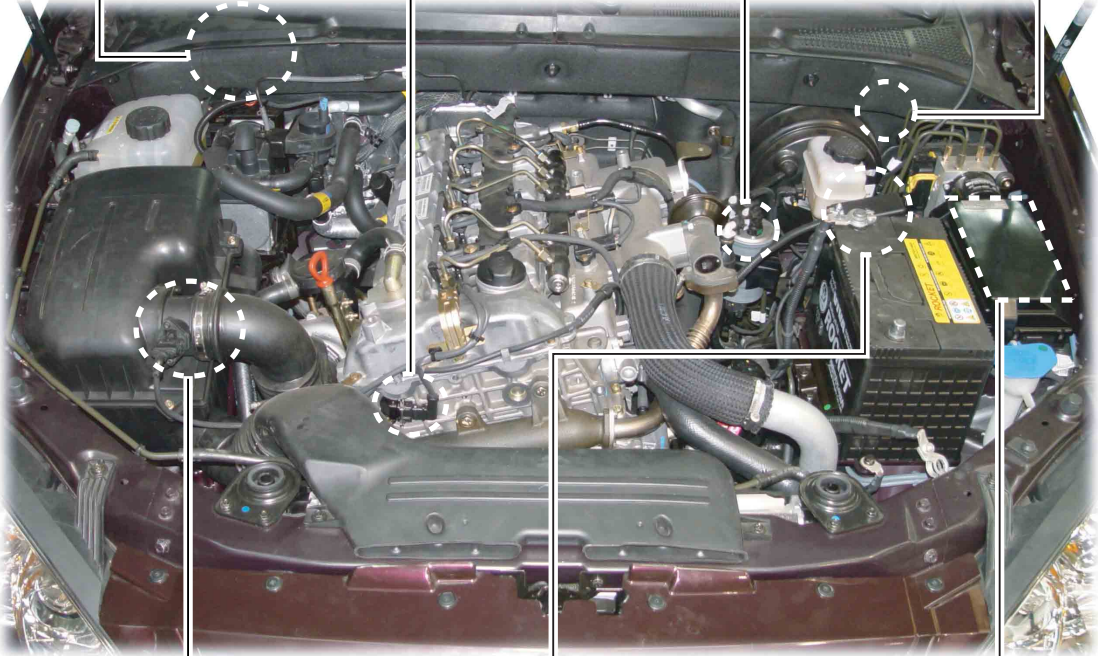


Fuel Filter
(Water Detection Sensor)




Accelerator Pedal Sensor






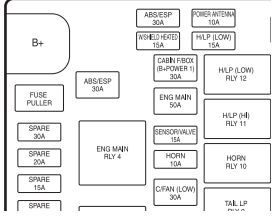
HFM Sensor/Intake Air Temperature Sensor



Pre Heating Time Relay

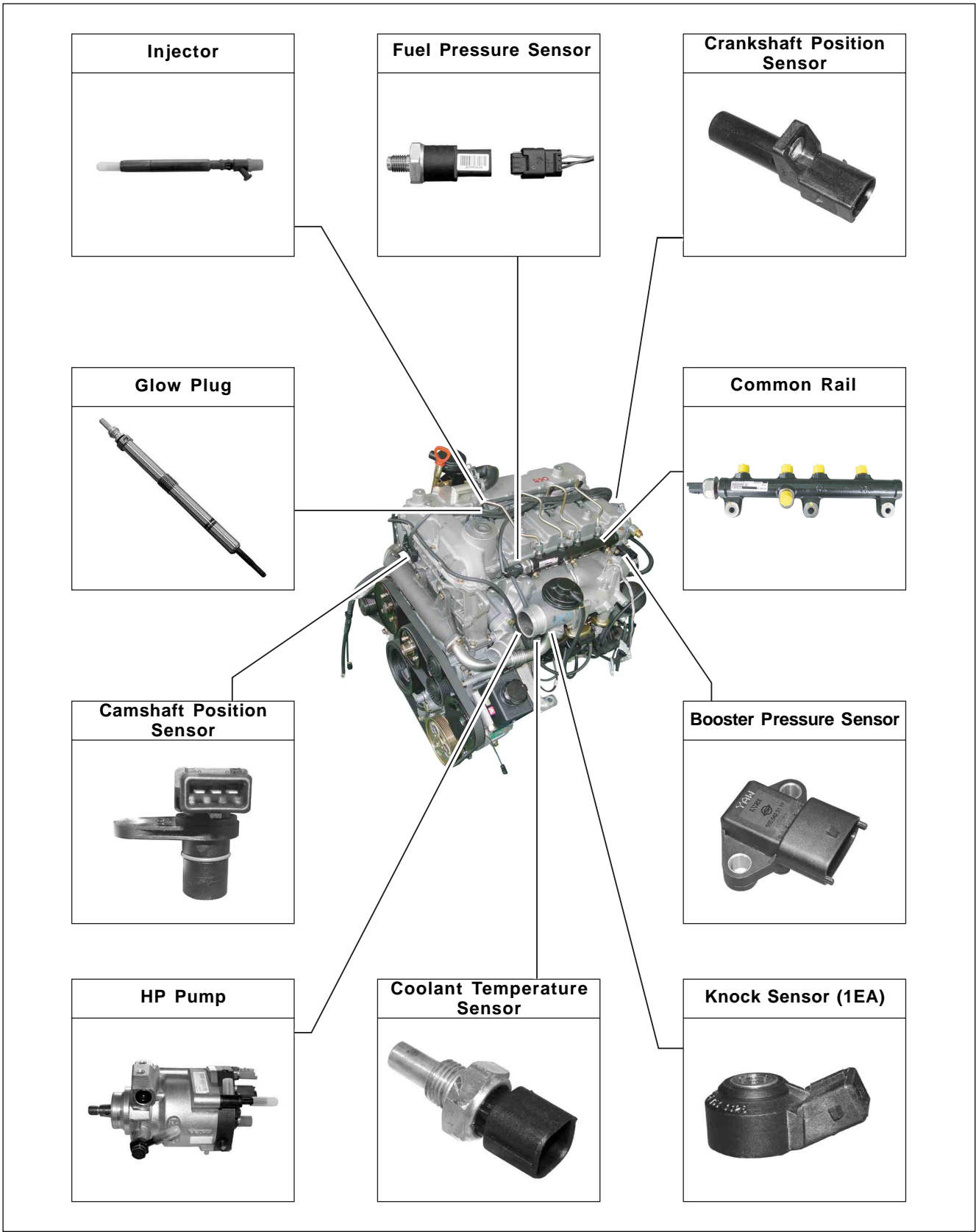


Main Relay



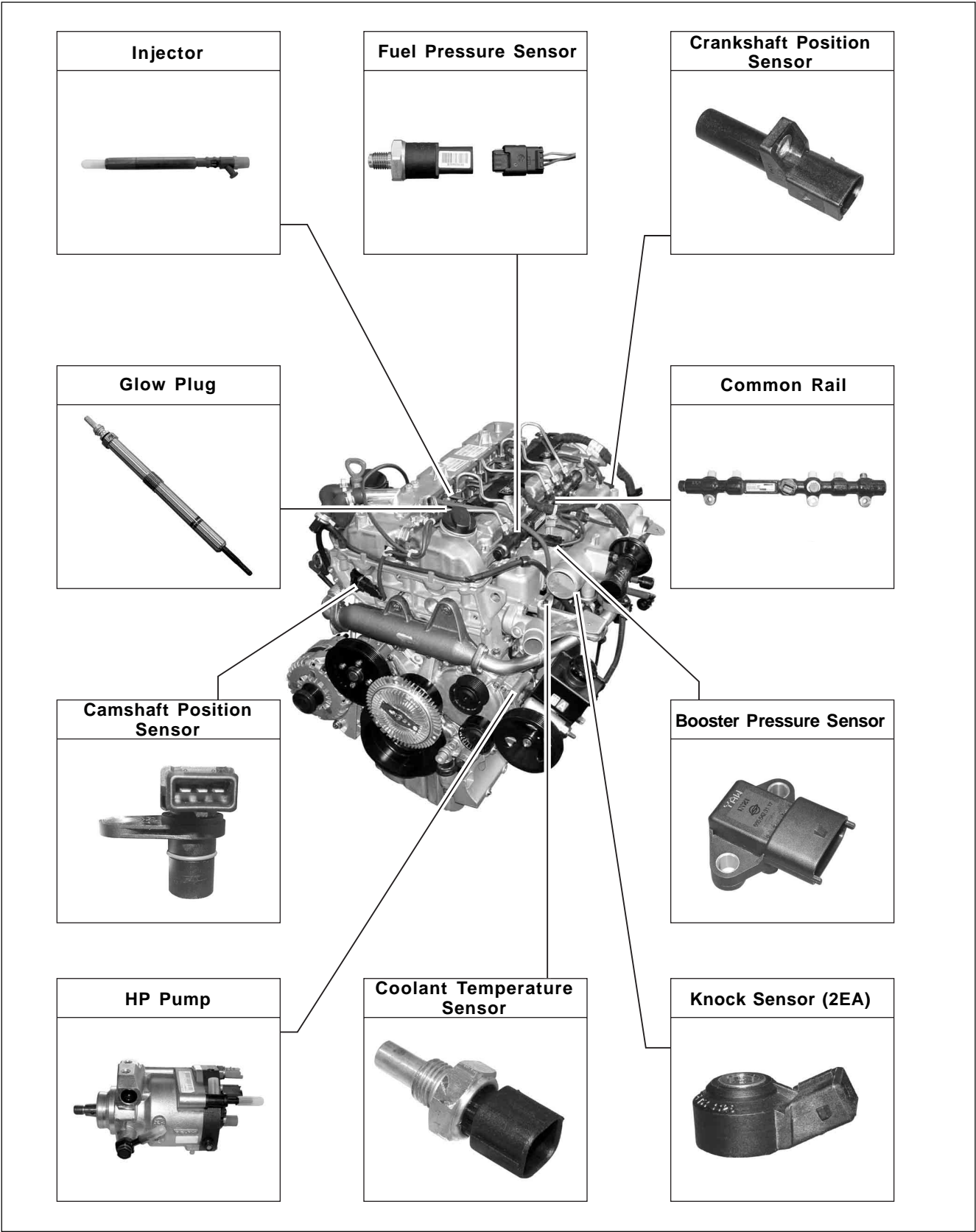
ENGINE AND SENSORS

► D20DT Engine



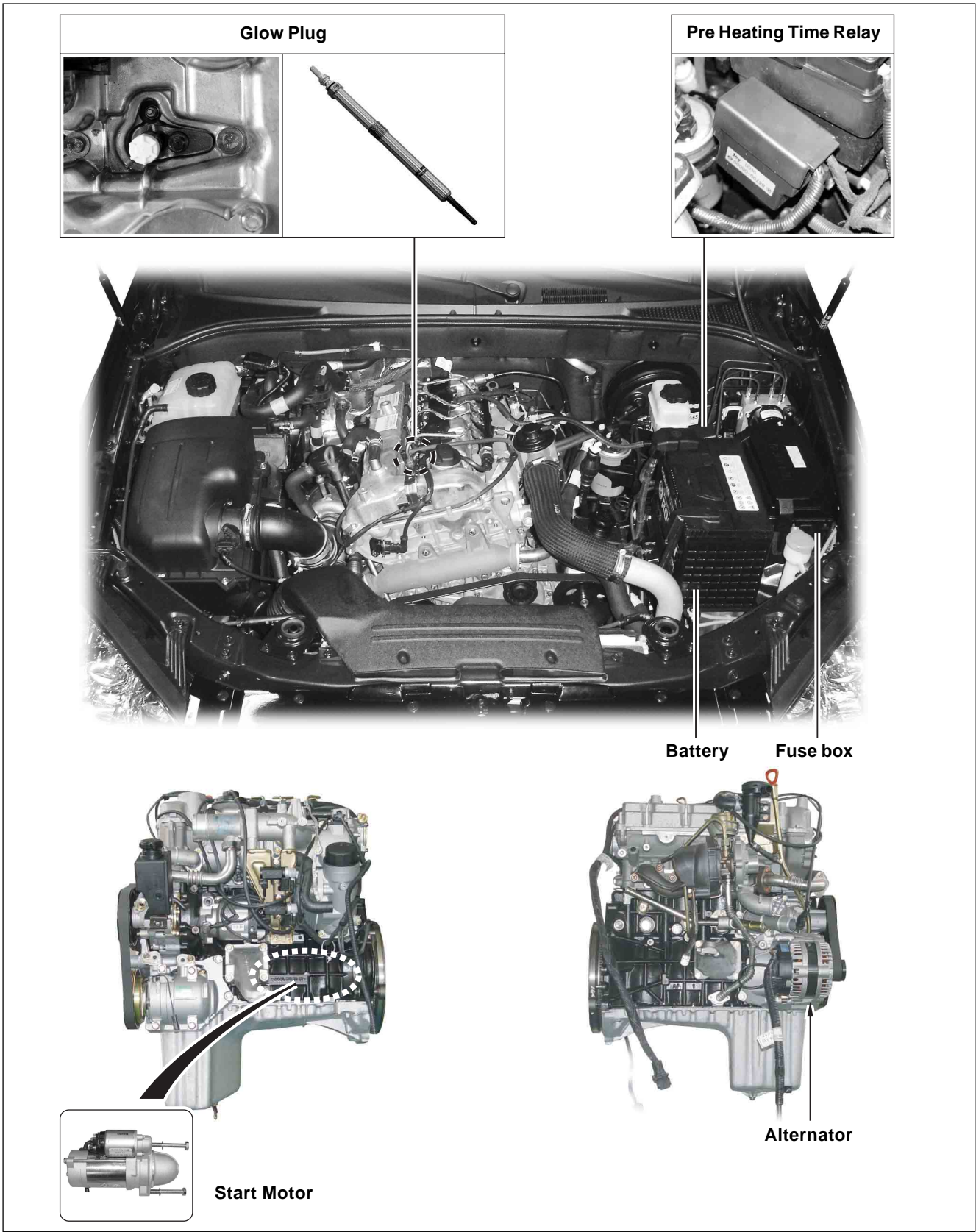
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► D27DT Engine



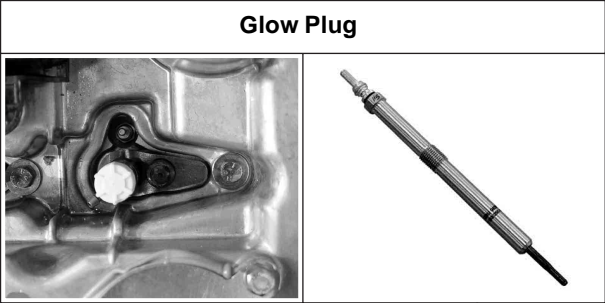
ELECTRICAL COMPONENTS AND PRE HEATING SYSTEM

► D20DT Engine

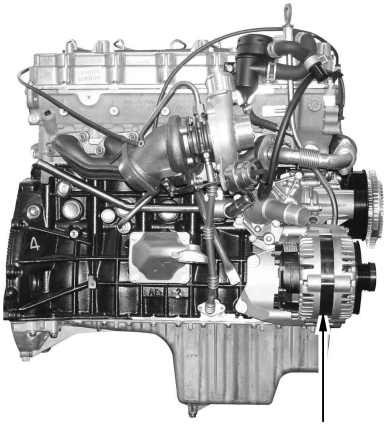
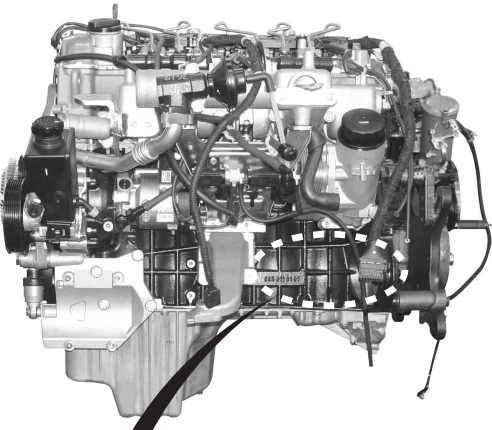


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► D27DT Engine



Battery Fuse Box



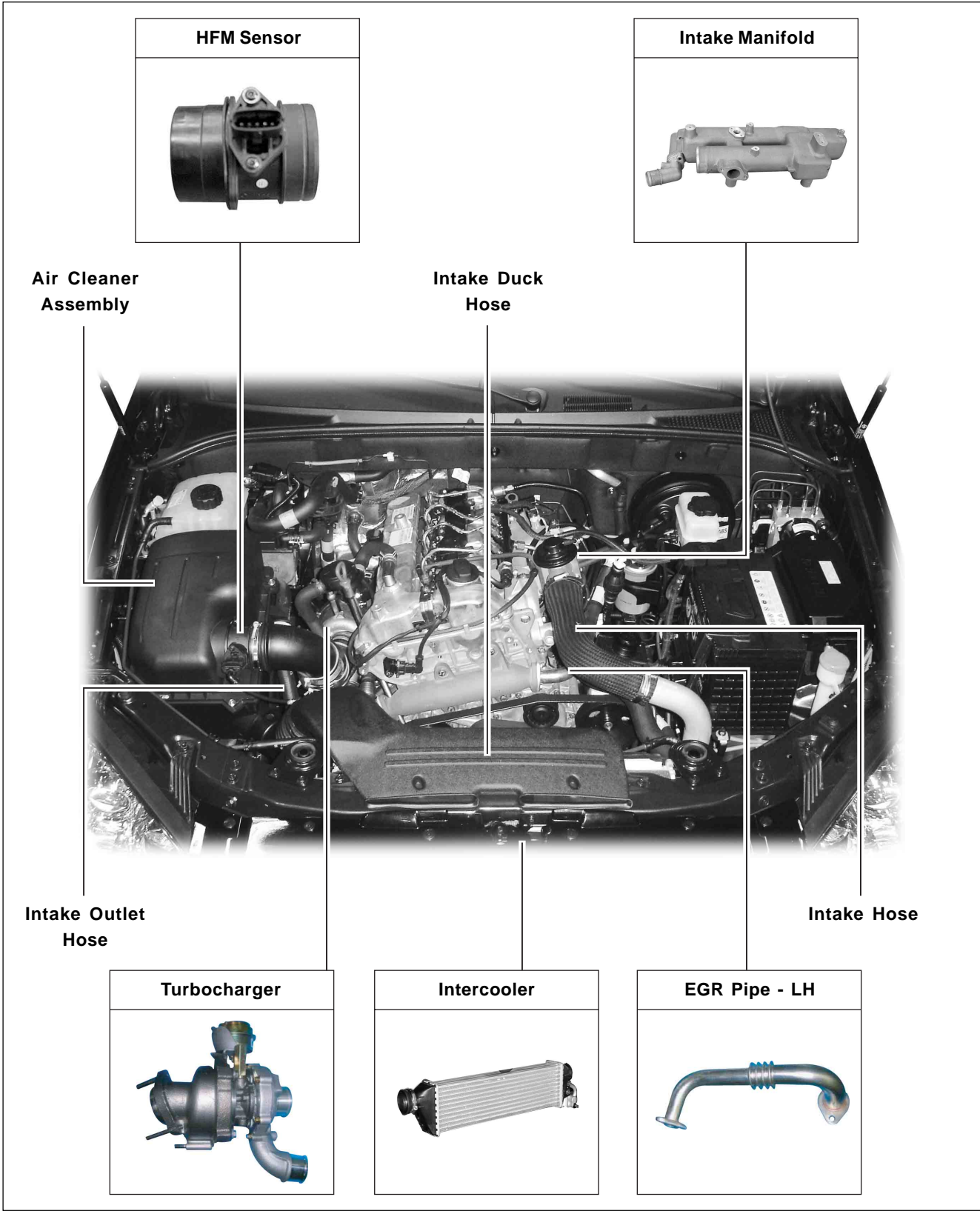
Alternator



Start Motor

INTAKE SYSTEM

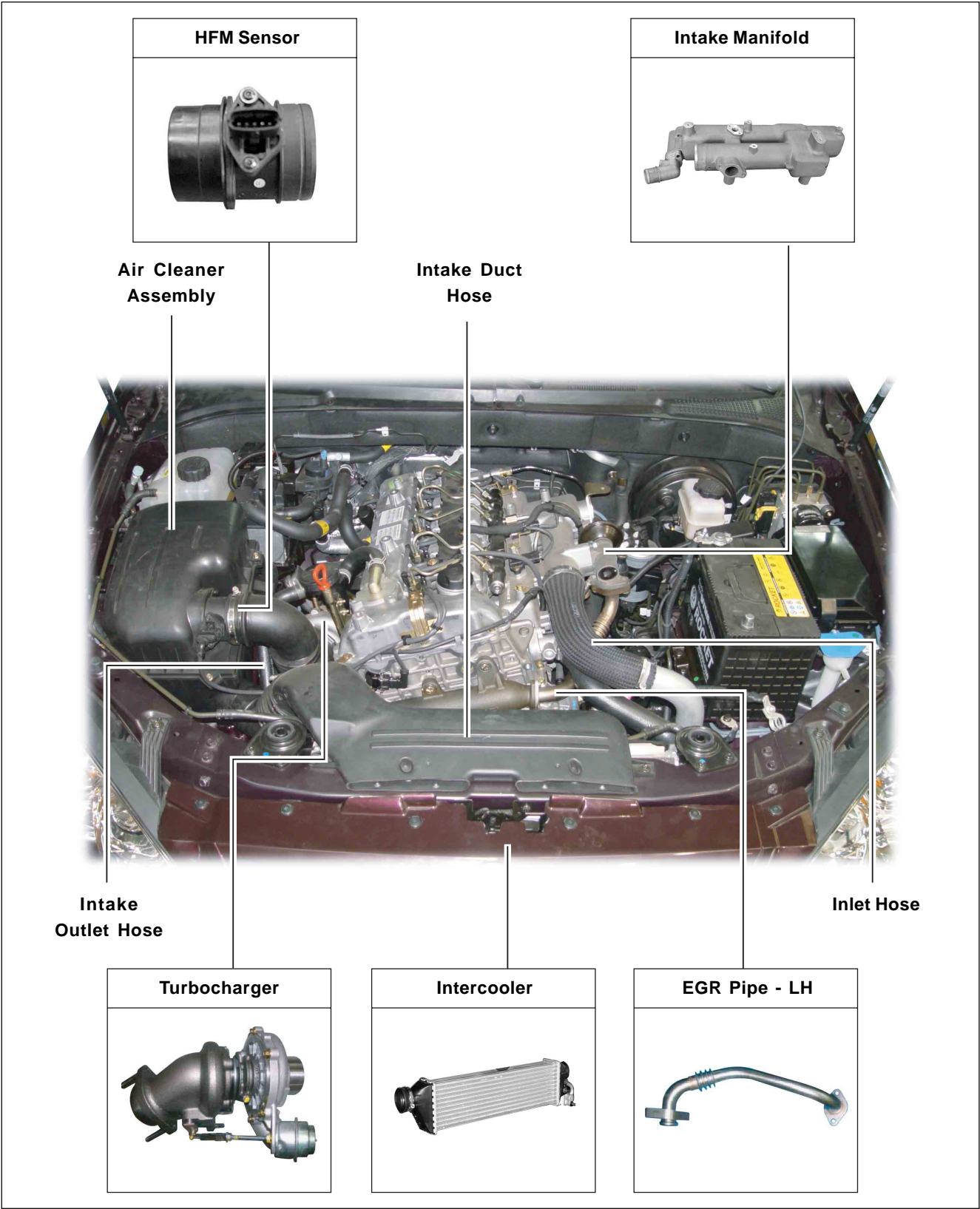
► D20DT Engine



GENERAL
ASSY
HOUSING
INTAKE
EXHAUST
LUB
COOLING
FUEL
CONTROL
SENSOR




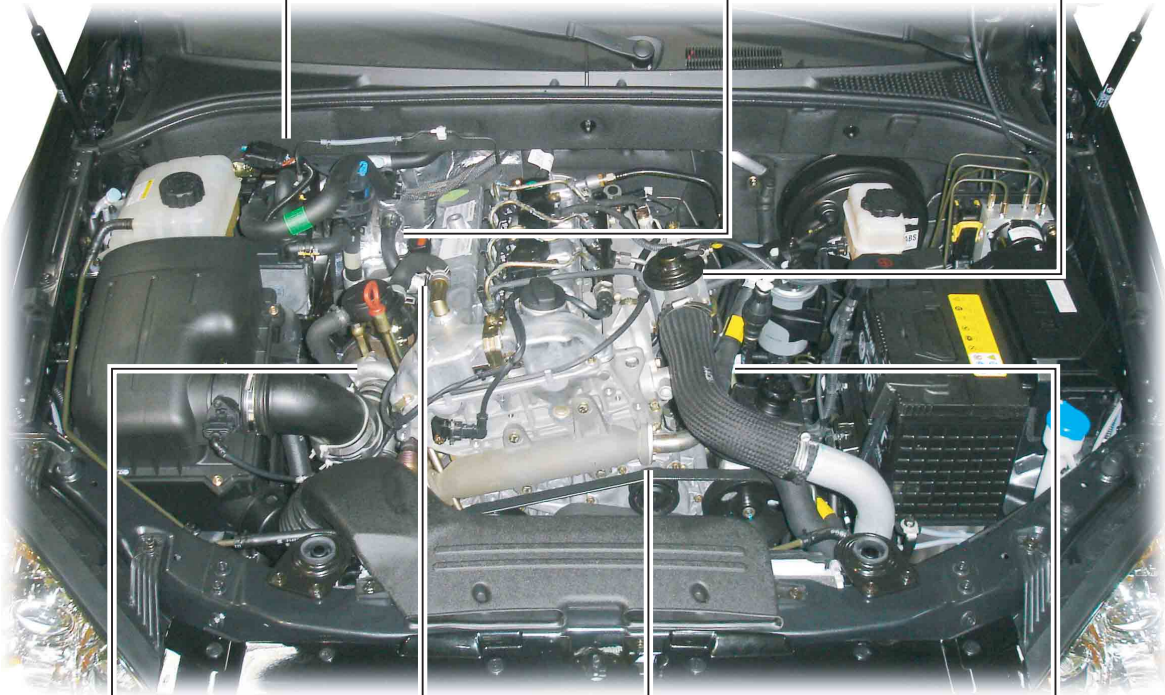

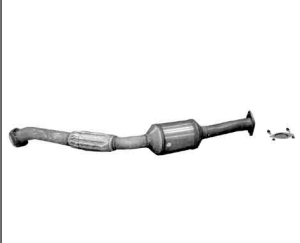
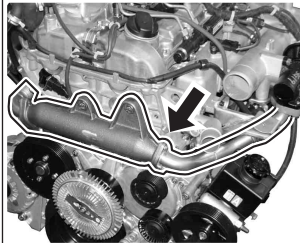
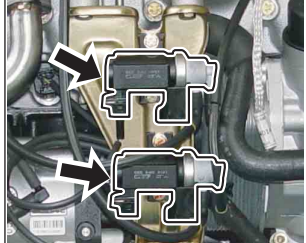
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► D27DT Engine



EXHAUST SYSTEM




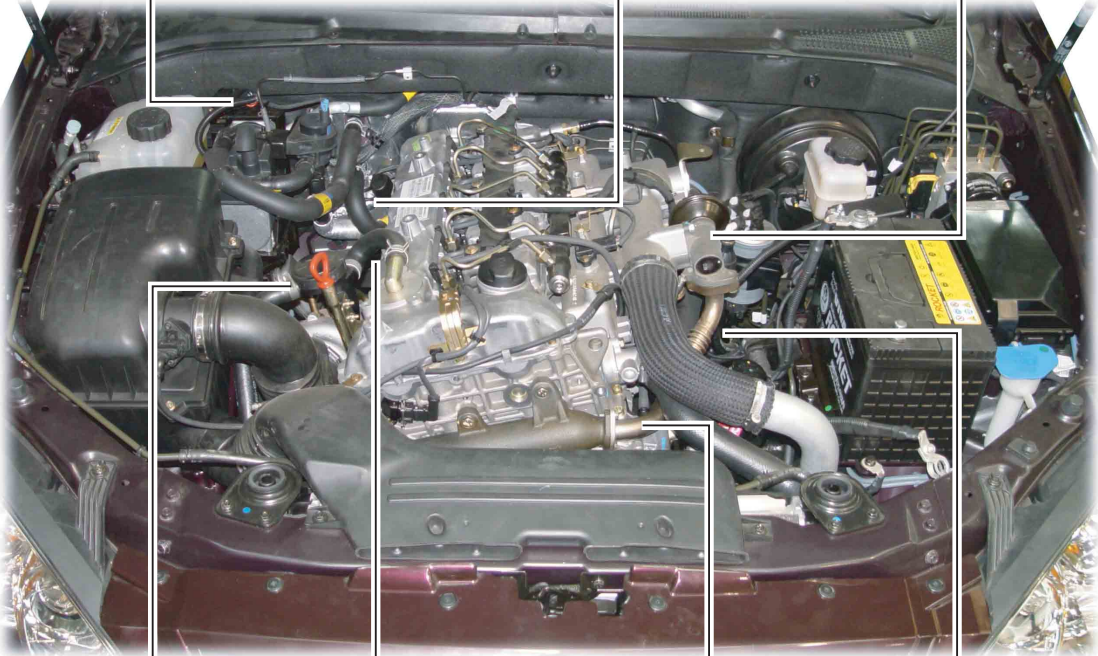

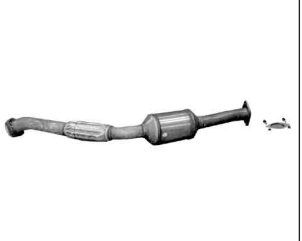
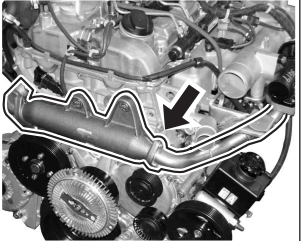
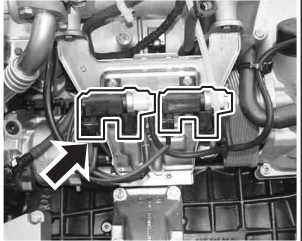
► D20DT Engine

Muffler	Exhaust Manifold	EGR Valve	
			
			
Turbocharger	Catalytic Converter	EGR Pipe	Vacuum Modulator
			

GENERAL
ASSY
HOUSING
INTAKE
EXHAUST
LUB
COOLING
FUEL
CONTROL
SENSOR

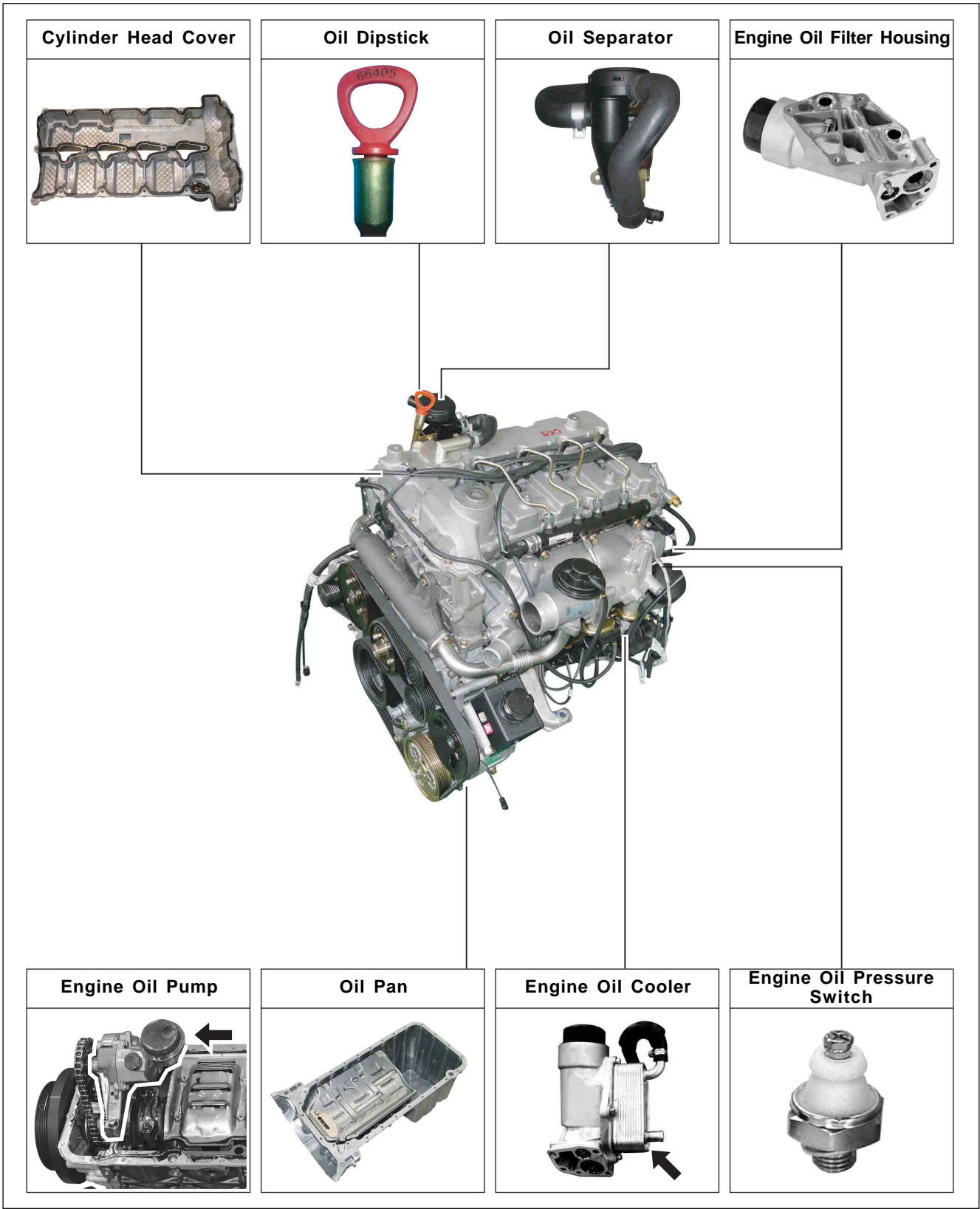
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► D27DT Engine

Muffler	Exhaust Manifold	EGR Valve	
			
			
Turbocharger	Catalytic Converter	EGR Pipe	Vacuum Modulator
			

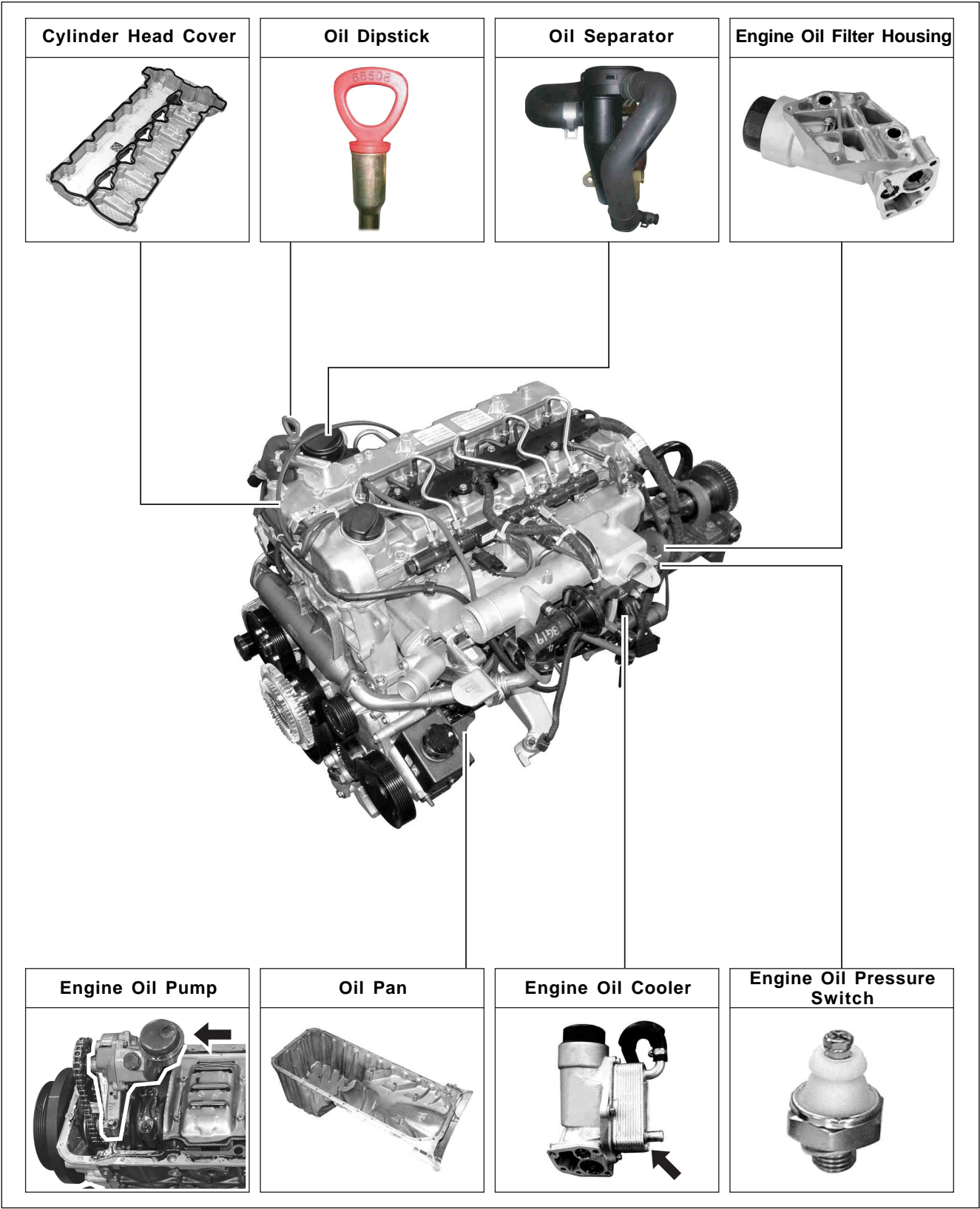
LUBRICATION SYSTEM

► D20DT Engine



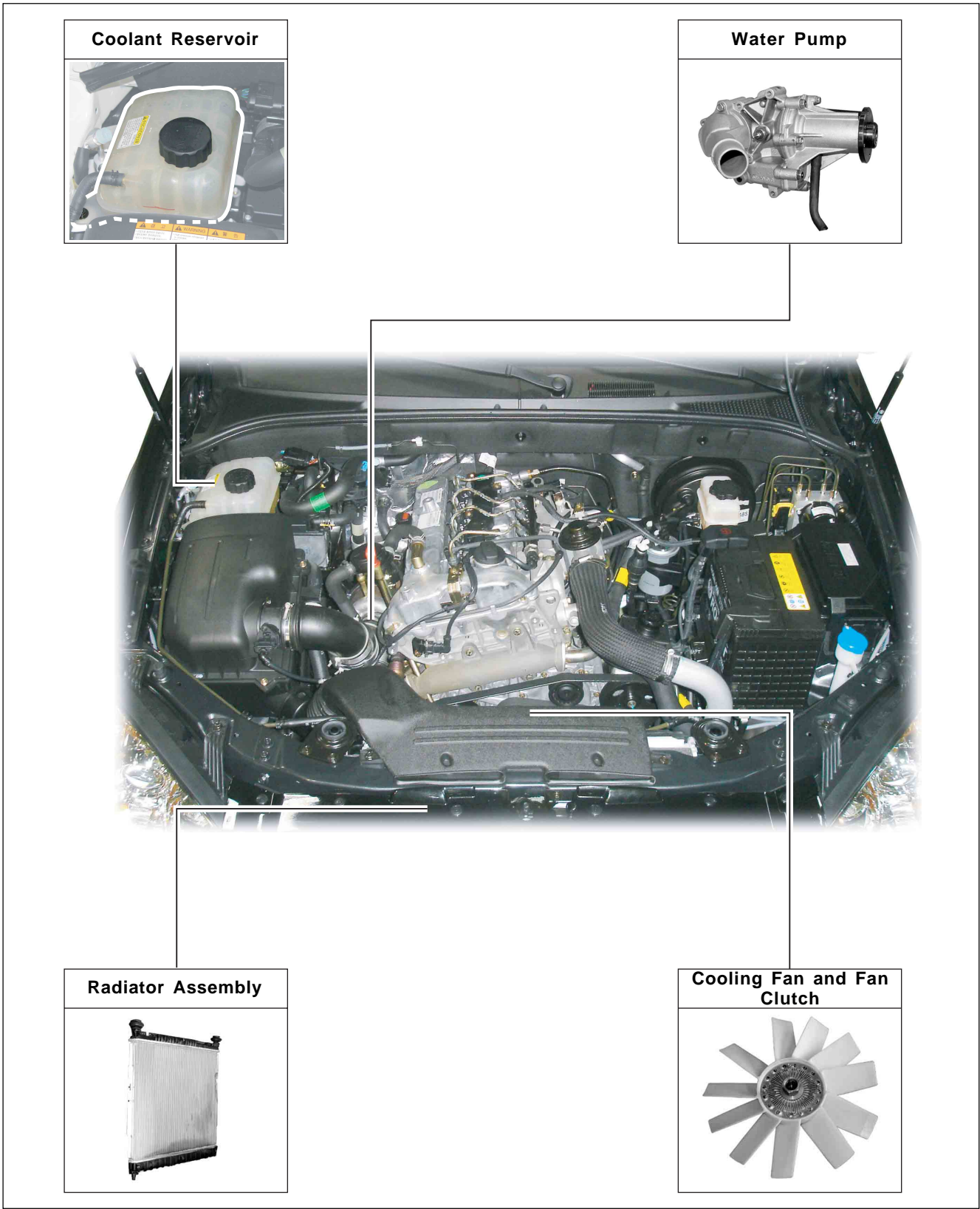
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► D27DT Engine



COOLING SYSTEM

► D20DT Engine



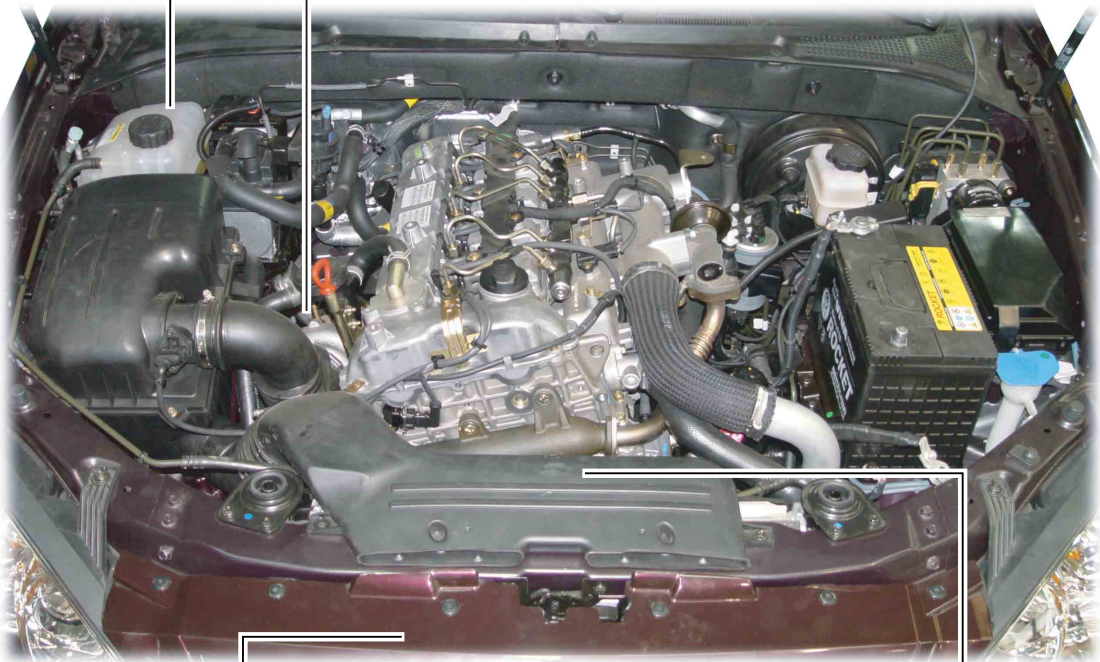
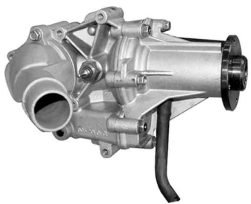
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► D27DT Engine

Coolant Reservoir



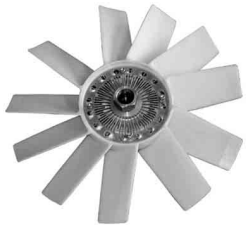
Water Pump



Radiator Assembly



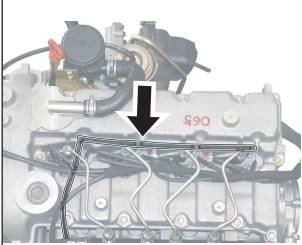
Cooling Fan and Fan Clutch



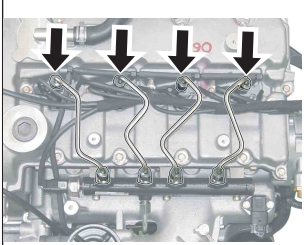
FUEL SYSTEM

► D20DT Engine

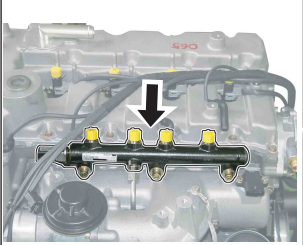
Fuel Return Hose




Fuel Pressure Pipe

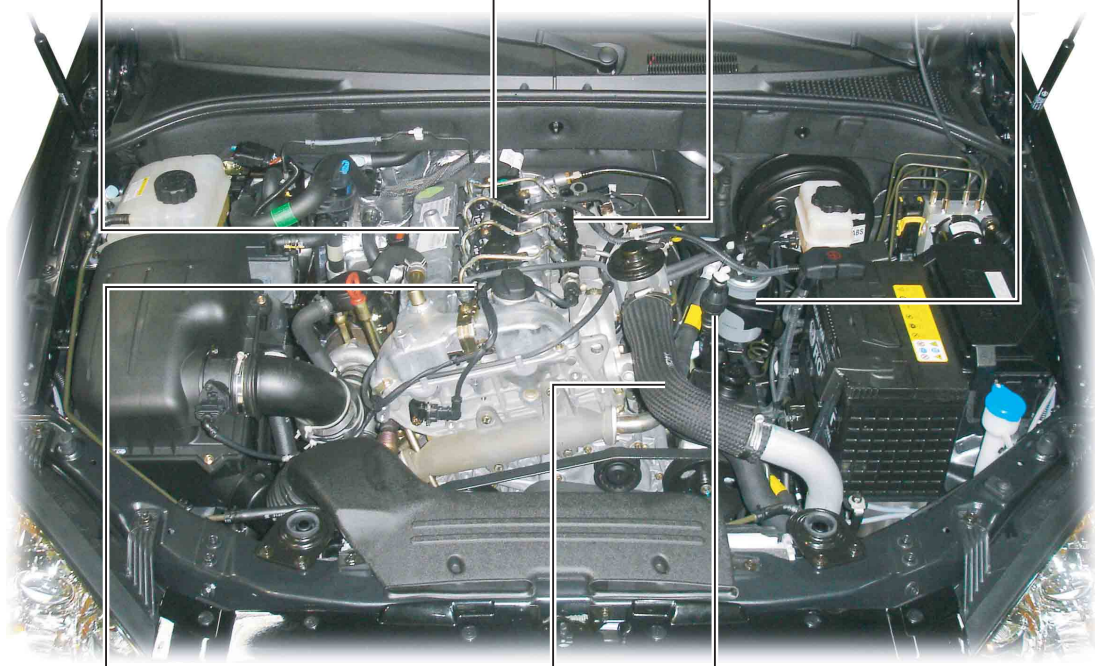


Common Rail




Fuel Filter







Injector



HP Pump

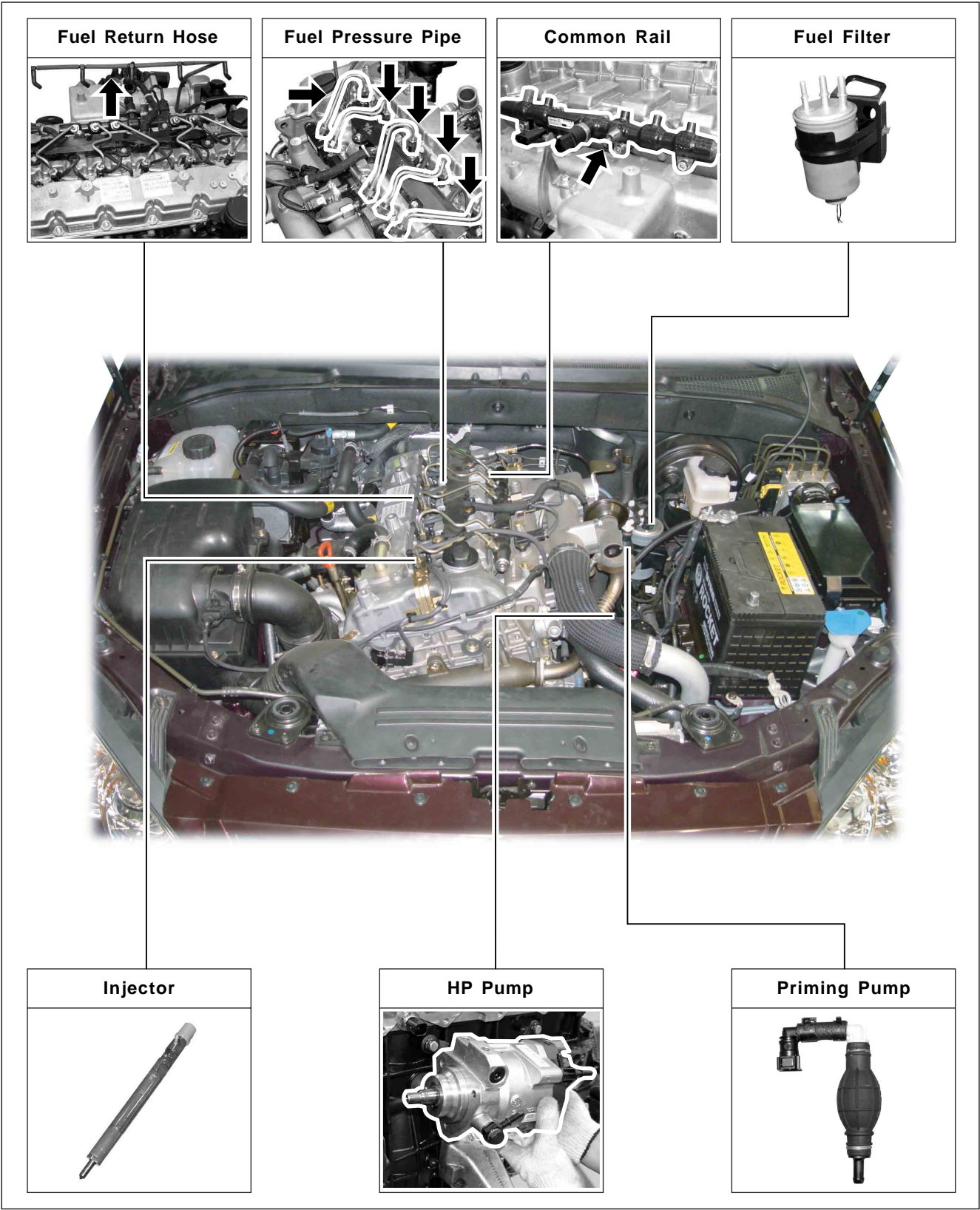


Priming Pump



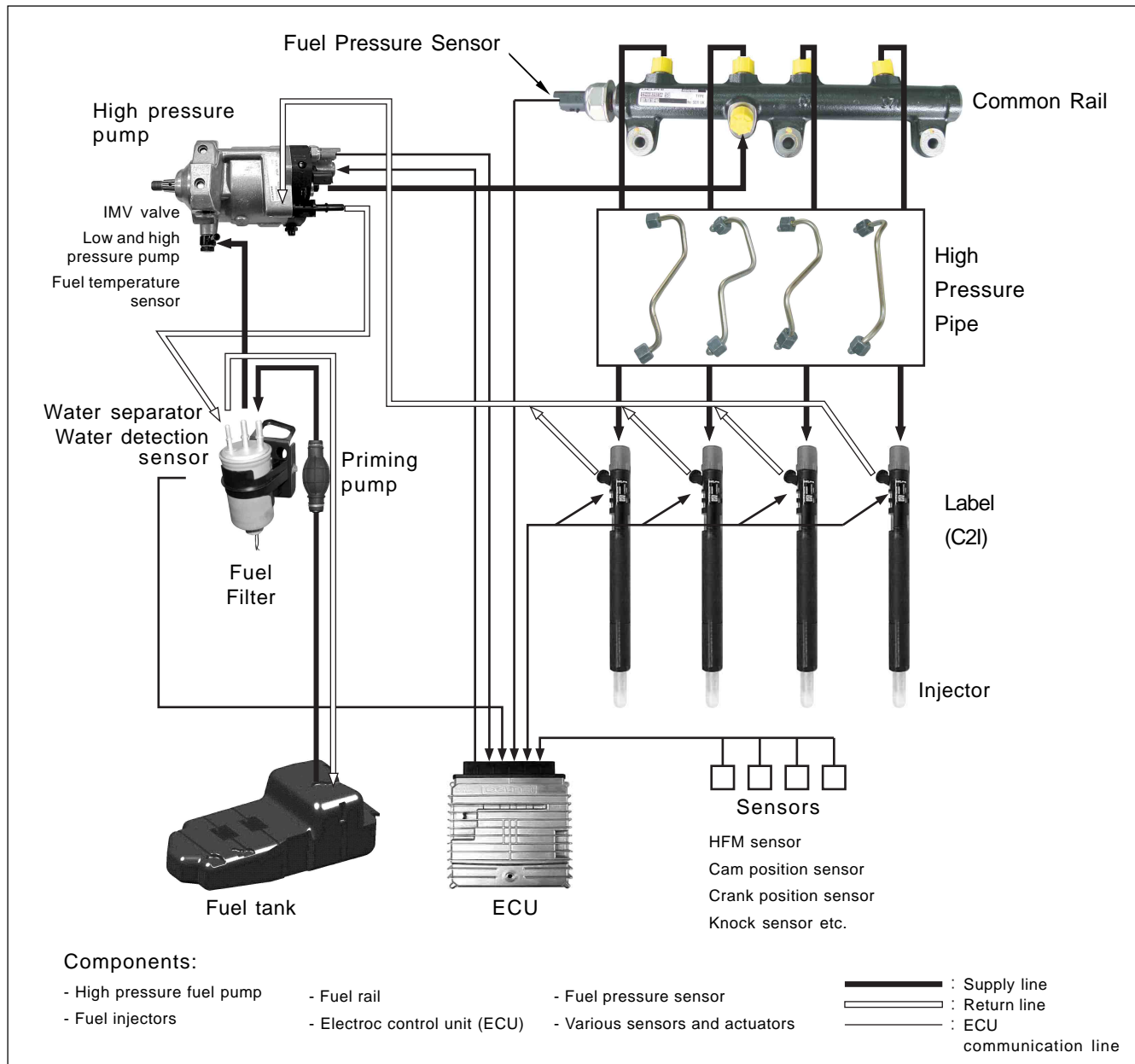
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► D27DT Engine



FUEL SUPPLY SYSTEM

► D20DT Engine

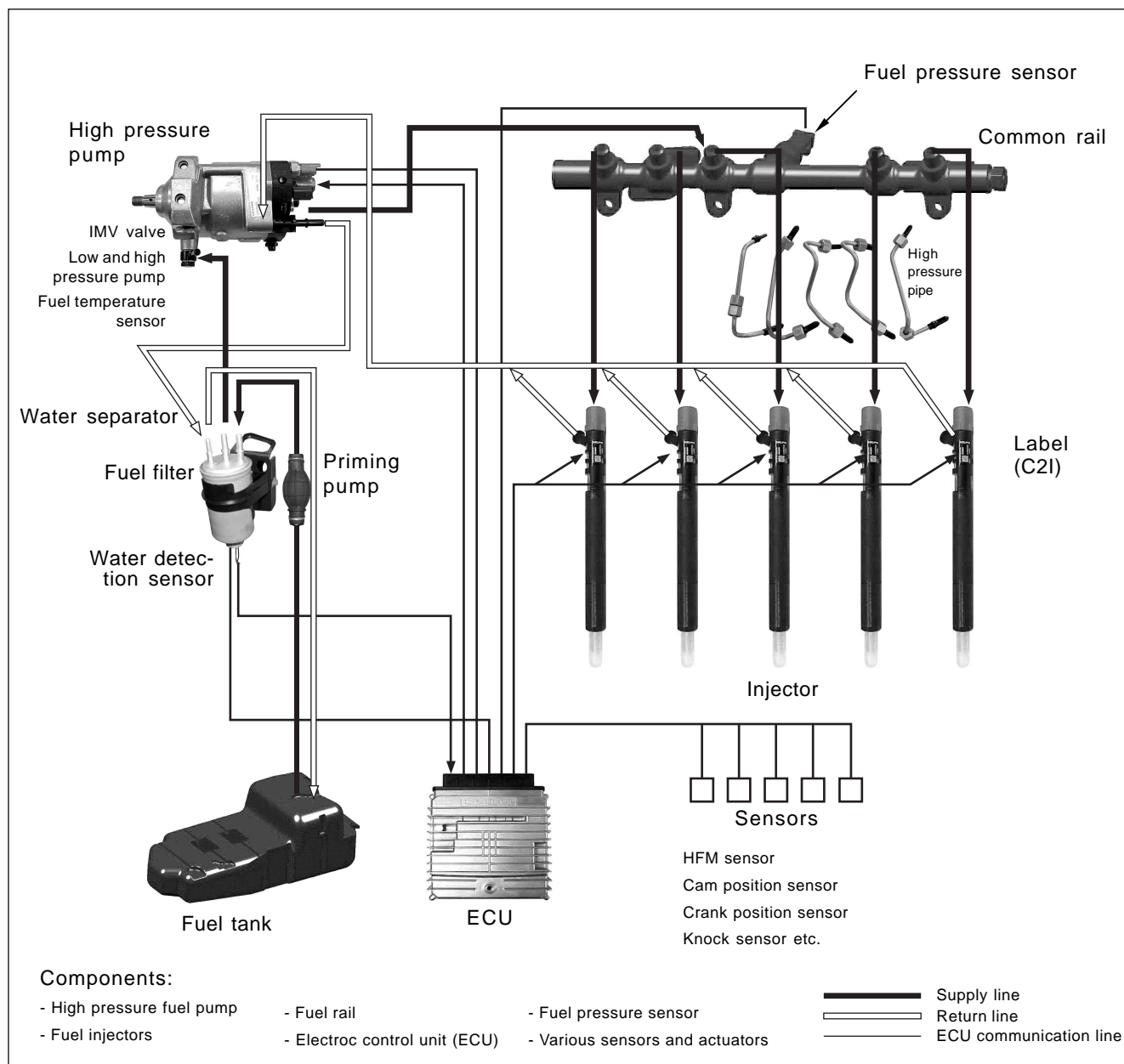


According to input signals from various sensors, engine ECU calculates driver's demand (position of the accelerator pedal) and then controls overall operating performance of engine and vehicle on that time.

ECU receives signals from sensors via data line and then performs effective engine air-fuel ratio controls based on those signals. Engine speed is measured by crankshaft speed (position) sensor and camshaft speed (position) sensor determines injection order and ECU detects driver's pedal position (driver's demand) through electrical signal that is generated by variable resistance changes in accelerator pedal sensor. Air flow (hot film) sensor detects intake air volume and sends the signals to ECU. Especially, the engine ECU controls the air-fuel ratio by recognizing instant air volume changes from air flow sensor to decrease the emissions (EGR valve control). Furthermore, ECU uses signals from coolant temperature sensor and air temperature sensor, booster pressure sensor and barometric sensor as compensation signal to respond to injection starting, pilot injection set values, various operations and variables.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► D27DT Engine



MAINTENANCE AND REPAIR

MAINTENANCE AND LUBRICATION

► Normal Vehicle Use

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

1. To carry passengers and cargo within the limitation of the tire inflation pressure. Refer to "Wheels and Tire" in section 4H.
2. To be driven on reasonable road surfaces and within legal operating limits.

► Explanation of Scheduled Maintenance Services

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

Engine Oil and Oil Filter Change

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

Engine Oil Viscosity

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

Cooling System Service

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

Air Cleaner Element Replacement

Clean the air cleaner element every.

1. Gasoline Engine: 15,000 km (10,000 miles)
2. Diesel Engine: 10,000 km (6,000 miles)

Replace the air cleaner element every.

1. Gasoline Engine: 60,000 km (36,000 miles)
2. Diesel Engine: 30,000 km (18,000 miles)

Replace the air cleaner more often under dusty conditions.

Fuel Filter Replacement

Replace the engine fuel filter every.

1. Gasoline Engine: 60,000 km (36,000 miles)
2. Diesel Engine: 30,000 km (18,000 miles)

Spark Plug Replacement

Replace spark plugs with same type.

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

Spark Plug Wire Replacement

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

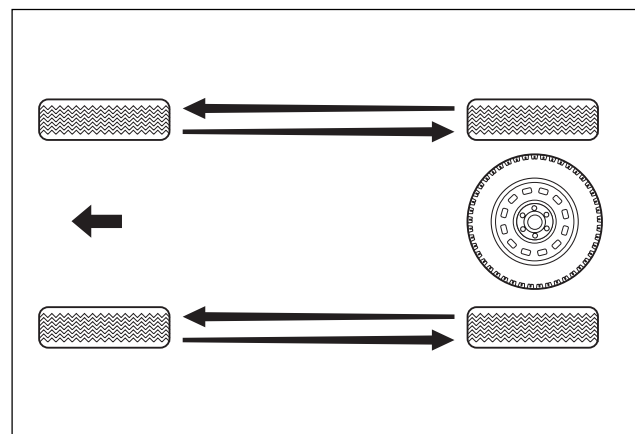
Brake System Service

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

Tire and Wheel Inspection and Rotation

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

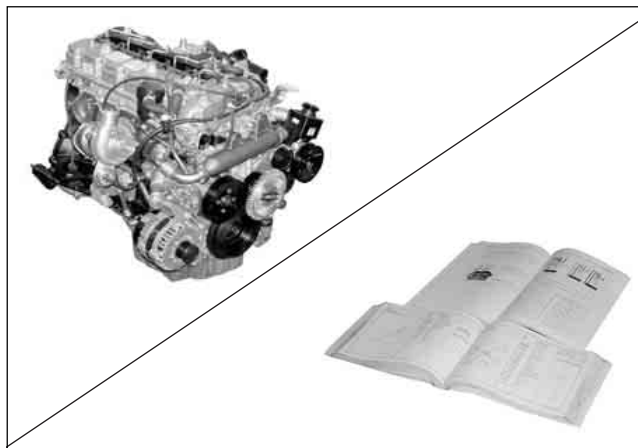
Tire Rotation (Left-hand Drive Type)



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

GUIDELINES FOR SERVICE WORK SAFETY

► General



To maintain and operate the vehicle under optimum state by performing safe service works, the service works should be done by following correct methods and procedures.

Accordingly, the purpose of this manual is to prevent differences that can be caused by personal working method, skill, ways and service procedures and to allow prompt/correct service works.

Note, Notice

While using this manual, there are a lot of Note or Notice having below meaning.

NOTE

- Note means detailed description of supplementary information on work procedure or skill.



NOTICE

- Notice means precautions on tool/device or part damages or personal injuries that can occur during service works.

However, above references and cautions cannot be inclusive measures, so should have habits of taking concerns and cautions based on common senses.

► Cautions on Inspection/Service



NOTICE

During service works, be sure to observe below general items for your safety.

- For service works, be sure to disconnect battery negative (-) terminal if not starting and inspection.
- While inspecting vehicle and replacing various consumable parts, be sure to take caution not to damage vehicle and injure people.
- Engine and transmission may be hot enough to burn you. So inspect related locations when they cooled down enough.
- If engine is running, keep your clothing, tools, hair and hands away from moving parts.
- Even when the ignition key is turned off and positioned to LOCK, electrical fan can be operated while working on near around electrical fan or radiator grille if air conditioner or coolant temperature rises.
- Every oil can cause skin trouble. Immediately wash out with soap if contacted.
- Painted surface of the body can be damaged if spilled over with oil or anti-freeze.
- Never go under vehicle if supported only with jack.
- Never near the battery and fuel related system to flames that can cause fire like cigarette.
- Never disconnect or connect battery terminal or other electrical equipment if ignition key is turned on.
- While connecting the battery terminals, be cautious of polarities (+, -) not to be confused.
- There are high voltage and currency on the battery and vehicle wires. So there can be fire if short-circuited.
- Do not park while running the engine in an enclosed area like garage. There can be toxication with CO, so make sufficient ventilation.
- The electrical fan works electrically. So the fan can be operated unexpectedly during working causing injuries if the ignition key is not in LOCK position. Be sure to check whether ignition key is in LOCK position before work.
- Be careful not to touch hot components like catalytic converter, muffler and exhaust pipe when the engine is running or just stopped. They may burn you badly.

► Guidelines on Engine Service

To prevent personal injuries and vehicle damages that can be caused by mistakes during engine and unit inspection/repair and to secure optimum engine performance and safety after service works, basic cautions and service work guidelines that can be easily forgotten during engine service works are described in.

Cautions before service works

1. Before work on engine and each electrical equipment, be sure to disconnect battery negative (-) terminal.
2. Before service works, be sure to prepare the works by cleaning and aligning work areas.
3. Always position the ignition switch to OFF if not required. If not, there can be electrical equipment damages or personal injuries due to short-circuit or ground by mistake.
4. There should be no leak from fuel injection system (HP pump, fuel hose, high pressure pipe) of the D20DT & D27DT engine. So they should be protected from foreign materials.
5. While removing the engine, do not position the jack and others under the oil pan or engine. To secure the safety, use only safety hook on the engine.

Engine and accessories

Engine has a lot of precise portions so tightening torque should be correct during disassembly/assembly and removal/installation and service work should be done in clean ways during disassembly/assembly.

Maintaining working area clean and cautious service administration is essential element of service works while working on the engine and each section of the vehicle. So the mechanics should well aware of it.

1. While removing the engine, related parts (bolts, gaskets, etc.) should be aligned as a group.
2. While disassembling/assembling internal components of the engine, well aware of disassembly/assembly section in this manual and clean each component with engine oil and then coat with oil before installation.
3. While removing engine, drain engine oil, coolant and fuel in fuel system to prevent leakage.
4. During service work of removal/installation, be sure to check each connected portions to engine not to make interference.

Fuel and lubrication system

Painted surface of the body can be damaged or rubber products (hoses) can be corroded if engine oil and fuel are spilled over. If spilled over engine, foreign materials in air can be accumulated on the engine damaging fuel system.

1. If work on the fluid system such as fuel and oil, working area should be well ventilated and mechanic should not smoke.
2. Gasket or seal on the fuel/lubrication system should be replaced with new and bolts and nuts should be tightened as specified.
3. After removal/installation works, be sure to check whether there is leak on the connecting section.

If fine dust or foreign material enters into DI engine's fuel system, there can be serious damages between HP pump and injectors. So, be sure to cover removed fuel system components with cap and protect removed parts not to be contaminated with dirt. (Refer to cleanliness in this manual while working on DI engine fuel system)

Electrical equipment

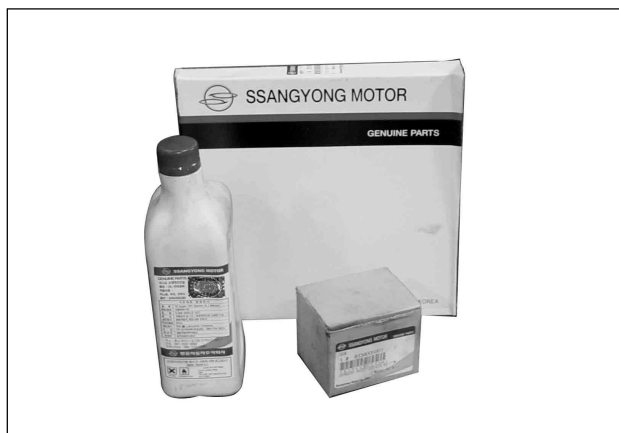
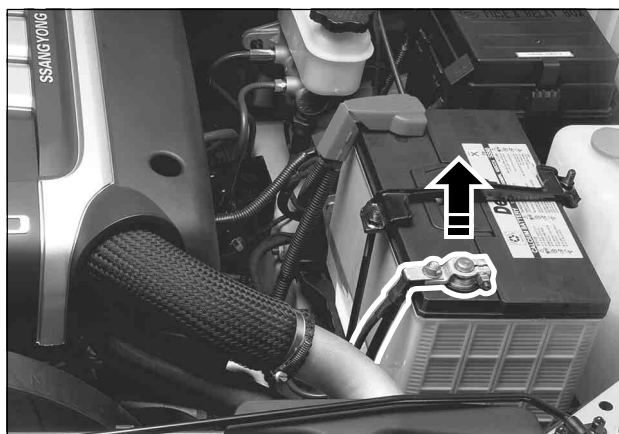
Electrical equipment should be handled more carefully. Currently, the engine is equipped with a lot of electrical equipments so there can be engine performance drops, incomplete combustion and other abnormalities due to short and poor contact. Mechanics should well aware of vehicle's electrical equipment.

1. If have to work on the electrical equipment, be sure to disconnect battery negative (-) terminal and position the ignition switch to off if not required.
2. When replacing electrical equipment, use the same genuine part and be sure to check whether ground or connecting portions are correctly connected during installation. If ground or connecting portion is loosened, there can be vehicle fire or personal injury.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

During Service Work - Inspection

1. Before lifting up the vehicle with lift, correctly support the lifting points and lift up.
2. When using a jack, park the vehicle on the level ground and block front and rear wheels. Position the jack under the frame and lift up the vehicle and then support with chassis stand before service work.
3. Before service work, be sure to disconnect battery negative (-) terminal to prevent damages by bad wire and short.
4. If service from interior of the vehicle, use protection cover to prevent damage and contamination of seat and floor.
5. Brake fluid and anti-freeze can damage painted surface of body. So carefully handle them during service work.
6. Use recommended and specified tools to increase efficiency of service work.
7. Use only genuine spare parts.



8. Never reuse cotter pin, gasket, O-ring, oil seal, lock washer and self-locking nut. Replace them with new. If reused, normal functions cannot be maintained.
9. Align the disassembled parts in clean according to disassembling order and group for easy assembling.
10. According to installing positions, the bolts and nuts have different hardness and design. So be careful not to mix removed bolts and nuts each other and align them according installing positions.
11. To inspect and assemble, clean the parts.
12. Securely clean the parts that related with oil not to be affected by viscosity of oil.
13. Coat oil or grease on the driving and sliding surfaces before installing parts.
14. Use sealer or gasket to prevent leakage if necessary.
15. Damaged or not, never reuse removed gasket. Replace with new and cautious on installing directions.
16. Tighten every bolt and nut with specified torque.
17. When service work is completed, check finally whether the work is performed properly or the problem is solved.
18. If work on the fuel line between priming pump and injector (including return line), be sure to cover the removed parts with cap and be careful not to expose the connecting passage and removed parts to external foreign materials or dust. (Refer to cleanness.)
19. If remove high pressure fuel supply pipe between HP pump and fuel rail and high pressure fuel pipe between fuel rail and each injector, be sure to replace them with new.



GENERAL

A S S Y

H O U S I N G

I N T A K E

E X H A U S T

L U B

C O O L I N G

F U E L

C O N T R O L

S E N S O R

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

During Service Work for Electric Devices



NOTICE

- Be careful not to modify or alter electrical system and electrical device. Or there can be vehicle fire or serious damage.

1. Be sure to disconnect battery negative (-) terminal during every service work. Before disconnecting battery negative (-) terminal, turn off ignition key.
2. Replace with specified capacity of fuse if there is bad, blown or short circuited fuse. If use electrical wire or steel wire other than fuse, there can be damages on the various electrical systems. If replaced with over-capacity fuse, there can be damages on the related electrical device and fire.
3. Every wire on the vehicle should be fastened securely not to be loosened with fixing clip.
4. If wires go through edges, protect them with tape or other materials not to be damaged.
5. Carefully install the wires not to be damaged during installation/removal of parts due to interference.
6. Be careful not to throw or drop each sensor or relay.
7. Securely connect each connector until hear a "click" sound.

► Lifting Positions

1. 4-post lift

As illustrated, position the vehicle on the 4-post lift securely and block the front and rear of each tire not to move during working.



NOTICE

During lifting, be sure to check whether vehicle is empty.

- Board-on lift connection device installed in front of vehicle should be positioned in front of sill locating under the front door.
- Install lift connecting device on the edge of front and rear of board-on lift.



WARNING

- Be sure to use attachment during lifting to prevent the lift from contacting with body floor.
- While lifting the vehicle, widen the lift floor as far as possible to stabilize between vehicle front and rear. When fixing the lift floor, be careful not to contact with brake tube and fuel lines.

2. Safety jack and safety stand

If lift up the vehicle with safety jack and stand, should be more careful during works.



WARNING

- Never be under the vehicle if supported with only jack. If have to be under the vehicle, be sure to use safety block.
- Use wheel block in front and rear of every wheel.

OWNER INSPECTIONS AND SERVICES

WHILE OPERATING THE VEHICLE

Horn Operation

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

Brake System Operation

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

Exhaust System Operation

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

Tires, Wheels and Alignment Operation

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

Steering System Operation

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

Headlamp Aim

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

AT EACH FUEL FILL

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

Engine Oil Level

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

1. After stopping the engine, wait a few minutes for the oil to drain back to the oil pan.
2. Pull out the oil level indicator (dip stick).
3. Wipe it clean, and push the oil level indicator back down all the way.

4. Pull out the oil level indicator and look at the oil level on it.
5. Add oil, if needed, to keep the oil level above the lower mark. Avoid overfilling the engine, since this may cause engine damage.
6. Push the indicator all the way back down into the engine after taking the reading.

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

Engine Coolant Level and Condition

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

Windshield Washer Fluid Level

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

AT LEAST TWICE A MONTH

Tire And Wheel Inspection and Pressure Check

Check the tire for abnormal wear or damage. Also check for damaged wheels. Check the tire pressure when the tires are cold (check the spare also, unless it is a stow-away).

Maintain the recommended pressures. Refer to "Wheels and Tire" is in section 4H.

AT LEAST MONTHLY

Lamp Operation

Check the operation of the license plate lamp, the headlamps (including the high beams), the parking lamps, the fog lamps, the taillamp, the brake lamps, the turn signals, the backup lamps and the hazard warning flasher.

Fluid Leak Check

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

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

AT LEAST TWICE A YEAR

Power Steering System Reservoir Level

Check the power steering fluid level. Keep the power steering fluid at the proper level. Refer to Section 4G, Power Steering System.

Brake Master Cylinder Reservoir Level

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

Weather-Strip Lubrication

Apply a thin film silicone grease using a clean cloth.

EACH TIME THE OIL IS CHANGED

Brake System Inspection

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

Steering, Suspension and Front Drive Axle Boot And Seal Inspection

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

Exhaust System Inspection

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

Drain the Water from Fuel Filter

When the water level inside water separator in fuel filter exceeds a certain level, water separator warning light comes on and buzzer sounds. Also, the driving force of the vehicle decreases.

If these conditions occur, immediately drain the water from fuel filter & water separator.

Hood Latch Operation

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

AT LEAST ANNUALLY

Lap and Shoulder Belts Condition and Operation

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

Movable Head Restraint Operation

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

Spare Tire and Jack Storage

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

Key Lock Service

Lubricate the key lock cylinder.

Body Lubrication Service

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

Underbody Flushing

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

Engine Cooling System

Inspect the coolant and freeze protection fluid. If the fluid is dirty or rusty, drain, flush and refill the engine cooling system with new coolant. Keep the coolant at the proper mixture in order to ensure proper freeze protection, corrosion protection and engine operating temperature. Inspect the hoses. Replace the cracked, swollen, or deteriorated hoses. Tighten the clamps.

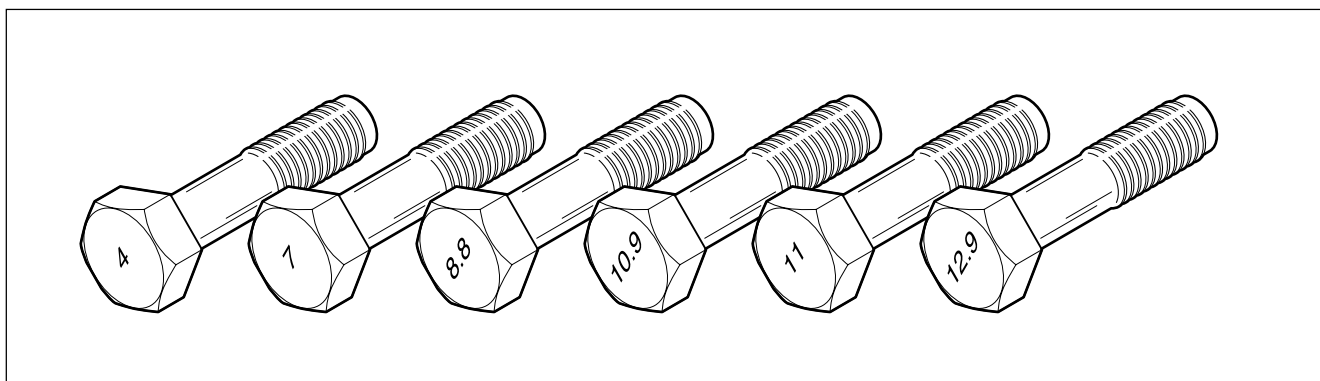
Clean the outside of the radiator and the air conditioning condenser. Wash the filler cap and the neck. Pressure test the cooling system and the cap in order to help ensure proper operation.

STANDARD BOLTS SPECIFICATIONS

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

*Diameter X pitch in millimeters

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	



1. Metric bolt strength is embossed on the head of each bolt. The strength of bolt can be classified as 4T, 7T, 8.8T, 10.9T, 11T and 12.9T in general.
2. Observe standard tightening torque during bolt tightening works and can adjust torque to be proper within 15 % if necessary. Try not to over max. allowable tightening torque if not required to do so.
3. Determine extra proper tightening torque if tightens with washer or packing.
4. If tightens bolts on the below materials, be sure to determine the proper torque.
 - 1) Aluminum alloy: Tighten to 80 % of above torque table.
 - 2) Plastics: Tighten to 20 % of above torque table.

SECTION 01

ENGINE ASSEMBLY

ENGINE ASSEMBLY

01

■ TABLE OF CONTENTS ■

STRUCTURE AND FUNCTION DESCRIPTIONS 3

D20DT engine	3
D27DT engine	4
Specifications and performance curve	9
General diagnosis	14

DIAGNOSTIC INFORMATION AND PROCEDURE 19

Oil leak diagnosis	19
Compression pressure test	20
Cylinder pressure leakage test	22
Tightening torque	23

REMOVAL AND INSTALLATION OF ENGINE 26

Removal and installation of engine assembly	26
Engine accessories	30
Engine mountings and other accessories	32
Removal and installation of engine oil pan	36

DISASSEMBLY AND REASSEMBLY 38

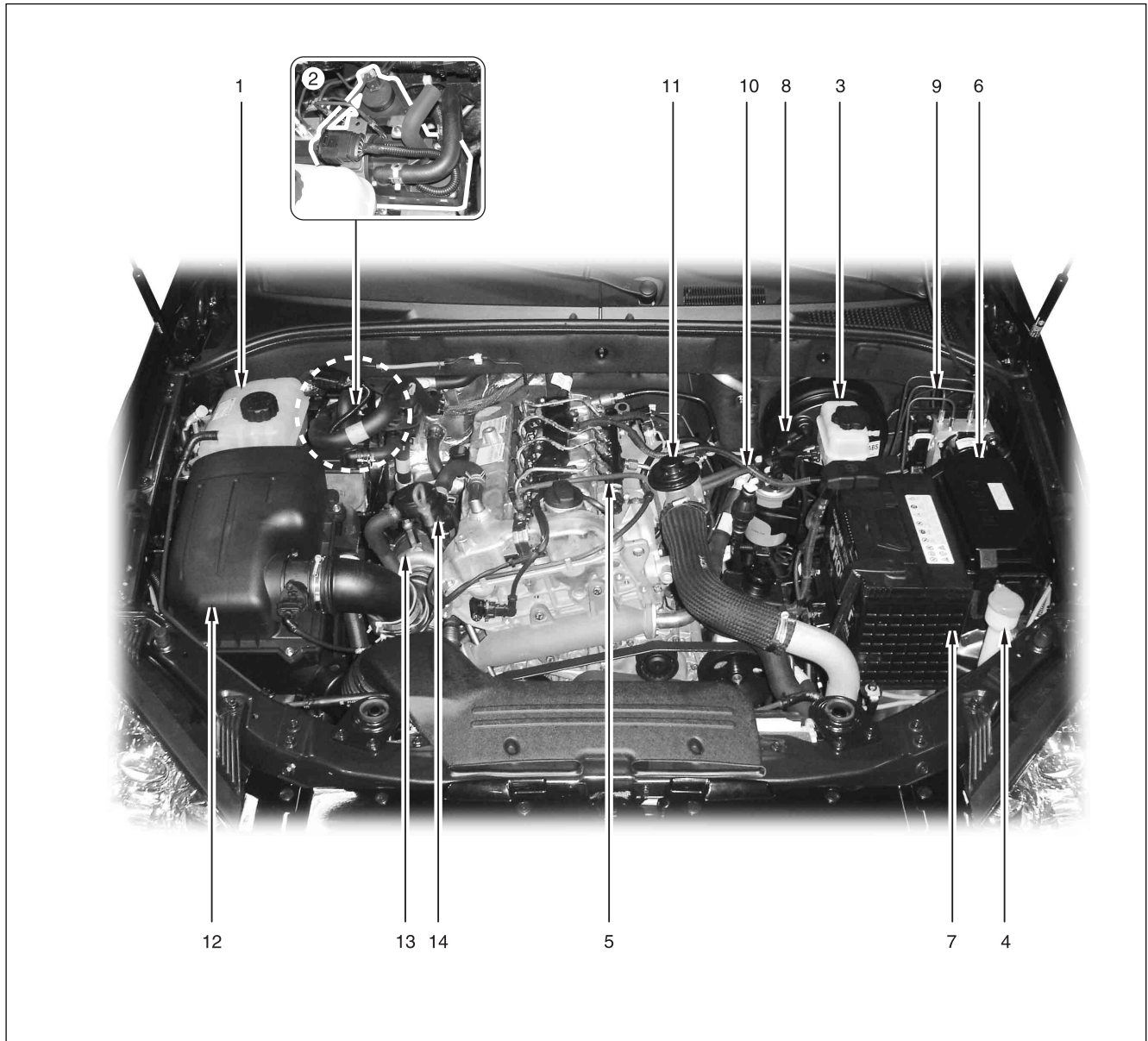
Components and special tools	38
Inspection before disassembly and reassembly	40
Engine accessories	41
Engine overhaul	59

STRUCTURE AND FUNCTION DESCRIPTIONS

D20DT ENGINE

► Major Components in Engine and Engine Compartment

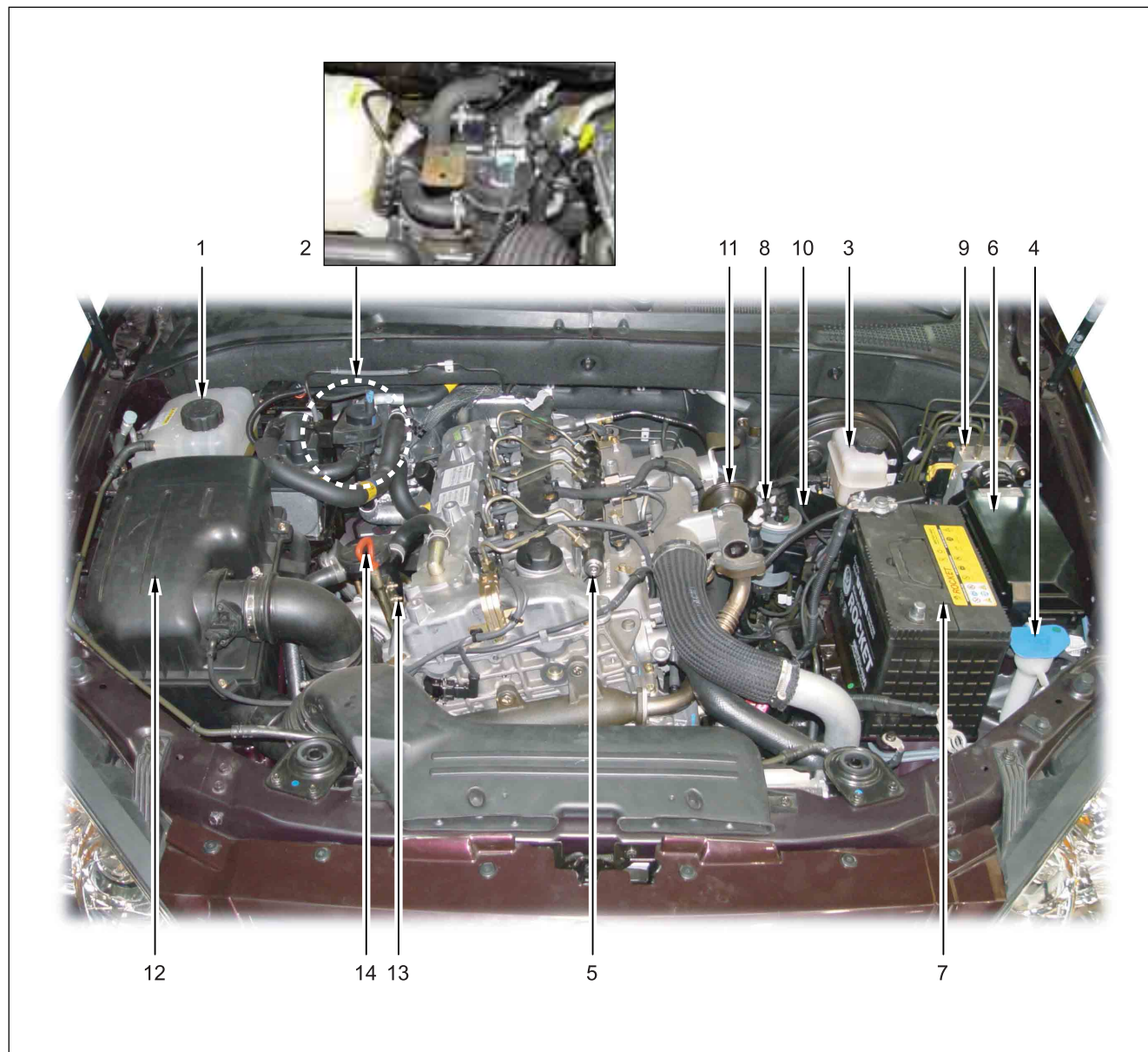
The advanced electronically controlled D20DT engine that has high pressure fuel system has been introduced to this vehicle. It satisfies the strict emission regulation and provides improved output and maximum torque.



- | | | |
|---------------------------|------------------|--------------------------|
| 1. Coolant reservoir | 6. Fuse box | 11. EGR valve |
| 2. FFH device | 7. Battery | 12. Air cleaner assembly |
| 3. Brake fluid reservoir | 8. Fuel filter | 13. Turbo charger |
| 4. Washer fluid reservoir | 9. ABS/ESP unit | 14. Oil dipstick |
| 5. Common rail | 10. Priming pump | |

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

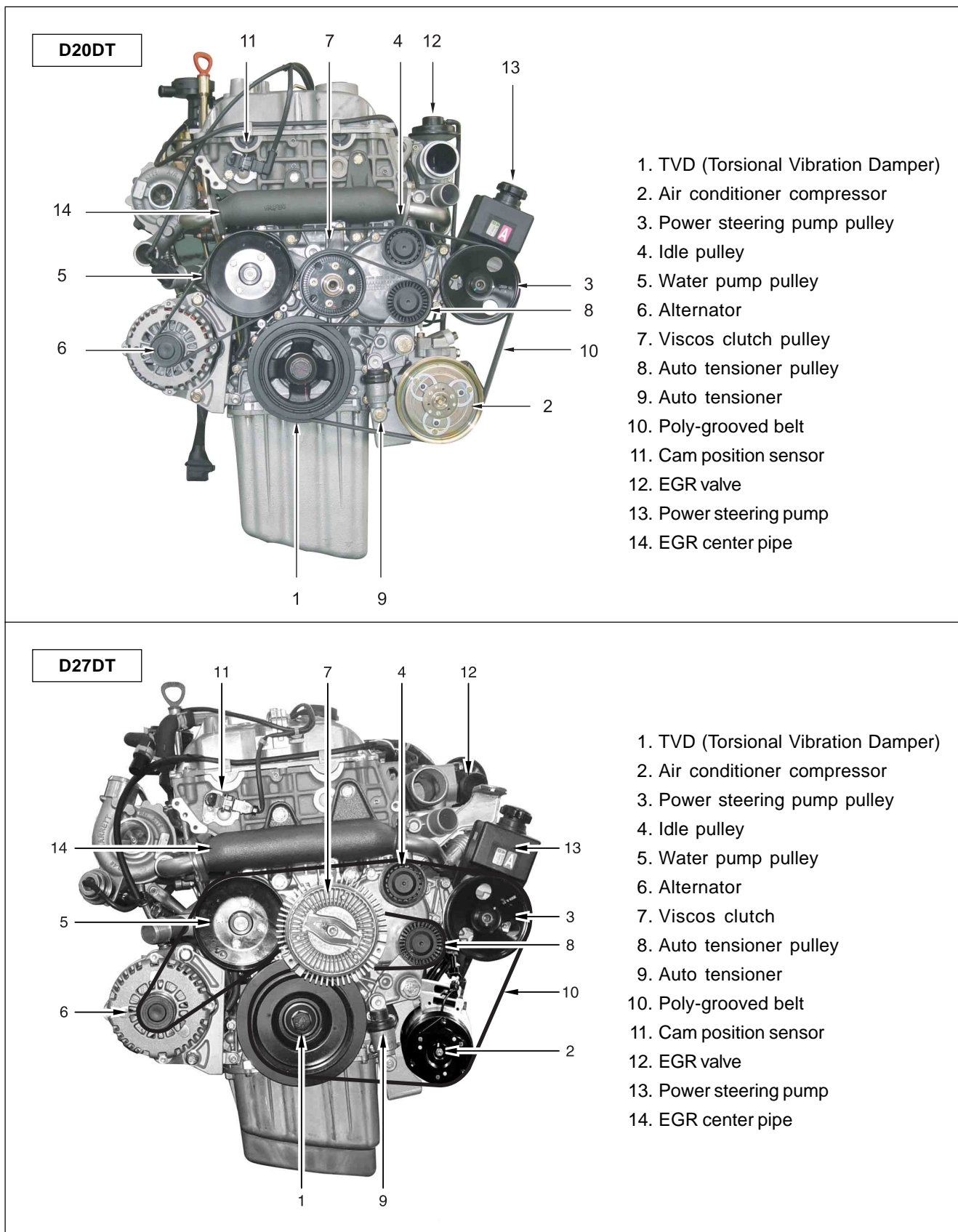
D27DT ENGINE



- | | | |
|---------------------------|------------------|--------------------------|
| 1. Coolant reservoir | 6. Fuse box | 11. EGR valve |
| 2. FFH device | 7. Battery | 12. Air cleaner assembly |
| 3. Brake fluid reservoir | 8. Fuel filter | 13. Turbo charger |
| 4. Washer fluid reservoir | 9. ABS/ESP unit | 14. Oil dipstick |
| 5. Common rail | 10. Priming pump | |

► Engine Structure

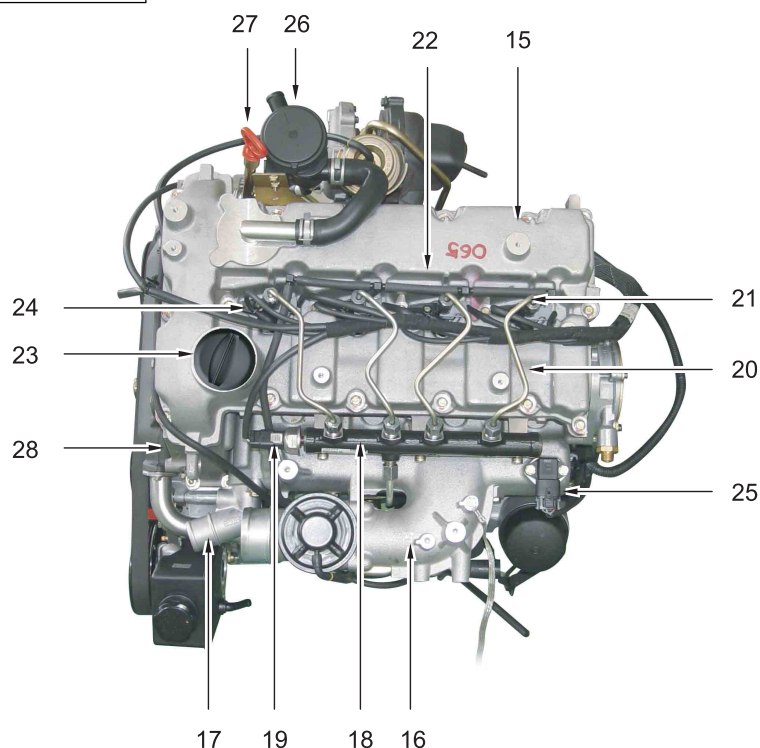
Front View



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

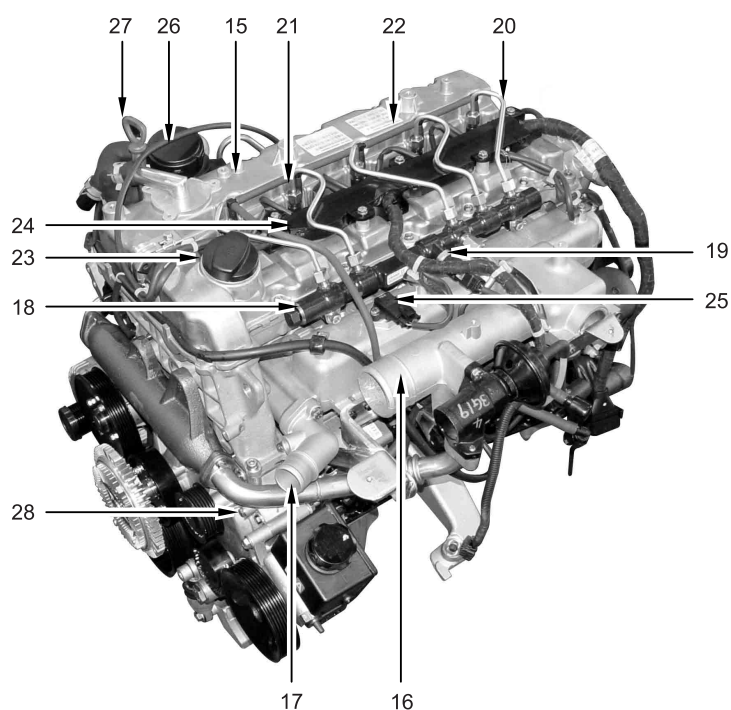
Top View

D20DT



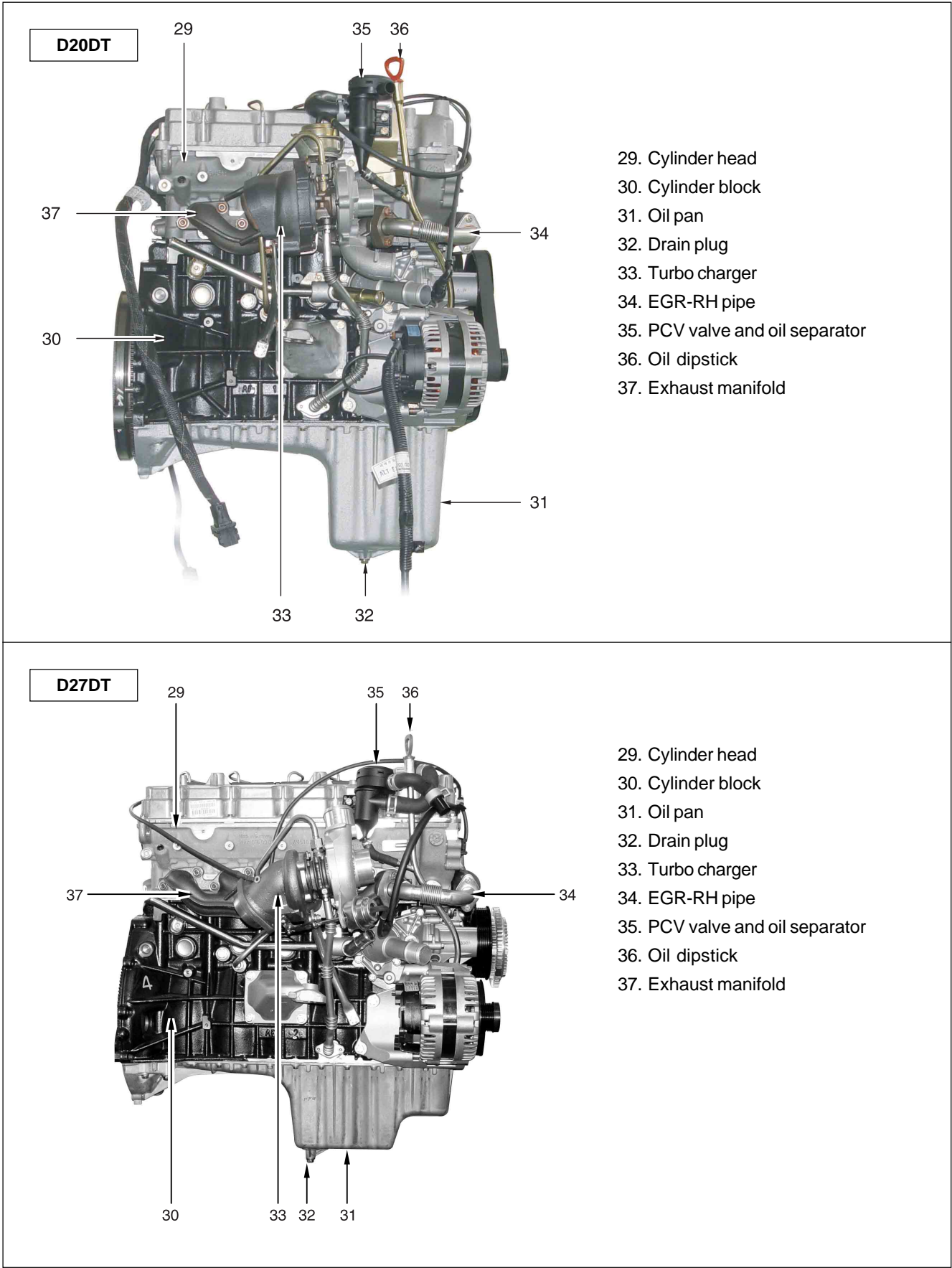
- 15. Cylinder head cover
- 16. Intake manifold
- 17. Water outlet port
- 18. Common rail
- 19. Fuel pressure sensor
- 20. Fuel pipe
- 21. Injector
- 22. Fuel return line
- 23. Oil filler cap
- 24. Glow plug
- 25. Booster pressure sensor
- 26. PCV valve and oil separator
- 27. Oil dipstick
- 28. EGR-LH pipe

D27DT



- 15. Cylinder head cover
- 16. Intake manifold
- 17. Water outlet port
- 18. Common rail
- 19. Fuel pressure sensor
- 20. Fuel pipe
- 21. Injector
- 22. Fuel return line
- 23. Oil filler cap
- 24. Glow plug
- 25. Booster pressure sensor
- 26. PCV valve and oil separator
- 27. Oil dipstick
- 28. EGR-LH pipe

Left Side View

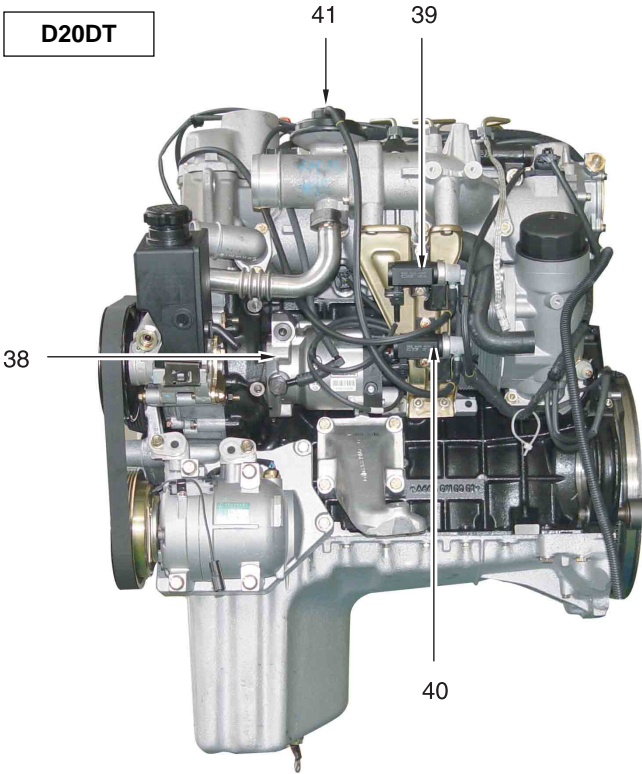


GENERAL
ASSY
HOUSING
INTAKE
EXHAUST
LUB
COOLING
FUEL
CONTROL
SENSOR

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Left Side View

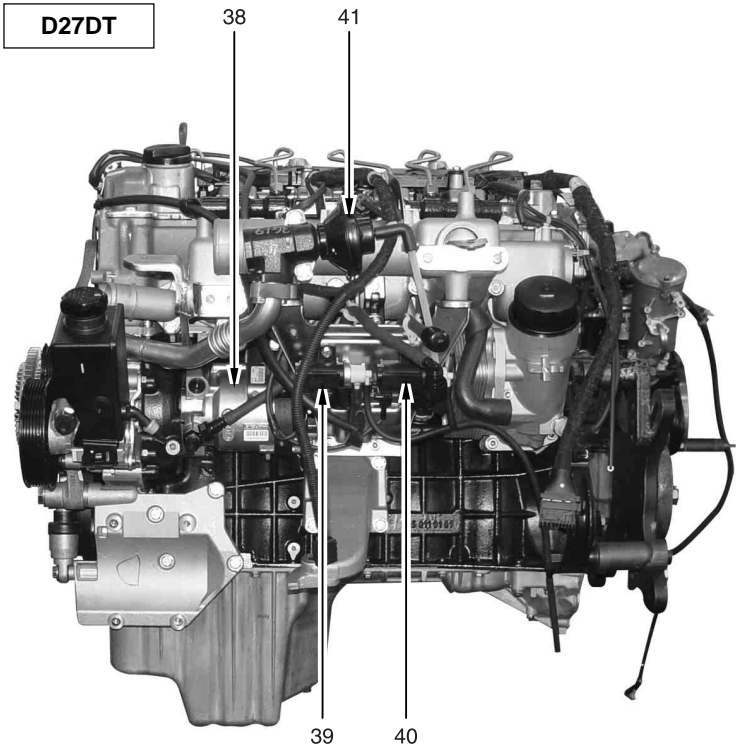
D20DT



- 38. High pressure pump
- 39. Turbo charger booster vacuum modulator (Gray)
- 40. EGR valve vacuum modulator
- 41. EGR valve (Black)



D27DT



- 38. High pressure pump
- 39. Turbo charger booster vacuum modulator
- 40. EGR valve vacuum modulator
- 41. EGR valve



SPECIFICATIONS AND PERFORMANCE CURVE

► Specifications

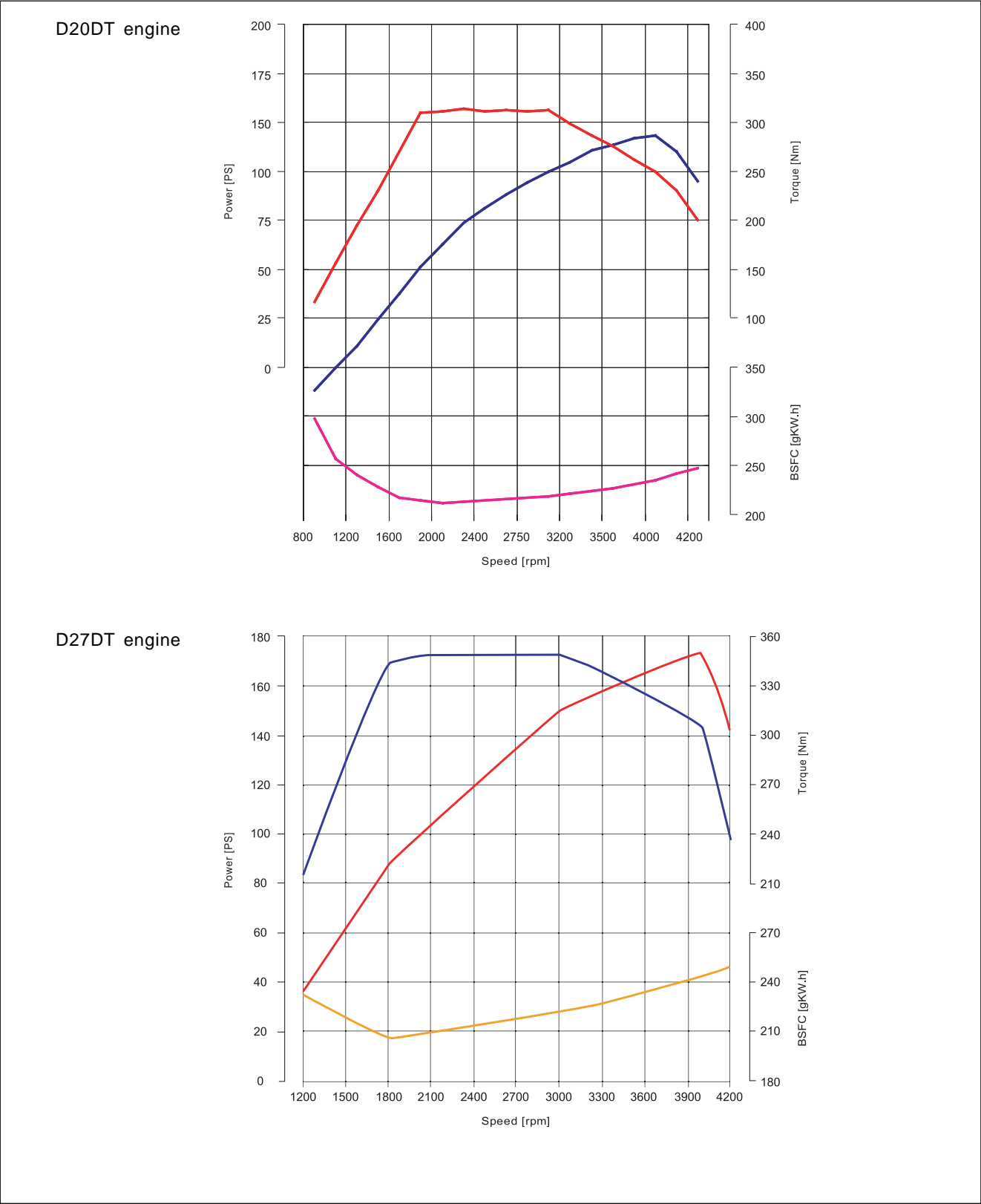
Description			D20DT	D27DT
Engine	Type/Number of cylinders		D20DT/4-cylinder	D27DT/5-cylinder
Cylinder	Inner diameter (mm)		86.2	86.2
	Stroke (mm)		85.6	92.4
Displacement (cc)			1998	2696
Compression ratio			17.5:1	18:1
Maximum output (ps/rpm)			141/4,000	165/4,000
Maximum torque (Nm/rpm)			310/1,800 ~ 2,750	340/1,800 ~ 3,250
Idle speed	For Manual Transmission		750 ± 50 rpm	750 ± 50 rpm
	For Automatic Transmission		750 ± 50 rpm	750 ± 50 rpm
Valve	Intake	Opens (BTDC)	9°	9°
		Closes (ABDC)	26°	26°
	Exhaust	Opens (BBDC)	38°	38°
		Closes (ATDC)	16°	16°
Camshaft	Type		DOHC	DOHC
Fuel system	Fuel type		Low sulfur diesel	Low sulfur diesel
	Fuel pump type		Vane pump in HP pump	Vane pump in HP pump
	Fuel supply pressure		HP pump inlet port: max. 400 mbar HP pump outlet port (with IMV fully open): over 1,050 bar	HP pump inlet port: max. 400 mbar HP pump outlet port (with IMV fully open): over 1,050 bar
	Water separation in fuel filter		at every 10,000 km	at every 10,000 km
	Fuel tank capacity (ℓ)		80	80
Lubrication system	Oil specification		SAE 10W40, 5W40 (MB Sheet 229.1, 229.3 approved oil)	SAE 10W40, 5W40 (MB Sheet 229.1, 229.3 approved oil)
	Lubrication type		Forced delivery	Forced delivery
	Oil filter type		Full flow, filter element type	Full flow, filter element type
	Oil capacity (ℓ)		5.0 ~ 7.5	6.0 ~ 8.5
Cooling system	Cooling type		Water cooling type	Water cooling type
	Cooling fan operation type		Belt operated type	Belt operated type
	Thermostat: Fully Open: 100°C)	Opening temperature (°C)	85	85
		Type	WAX pellet type	WAX pellet type
	Coolant capacity (ℓ)		≒ 11.5	≒ 11.5

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► Engine Performance Curve

Vehicle with A/T

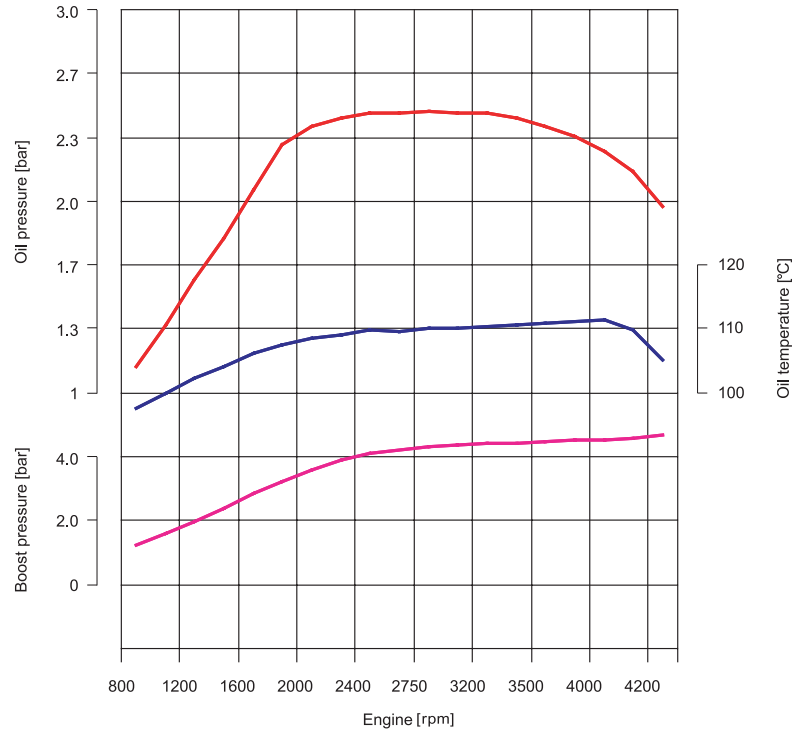
Output and Torque



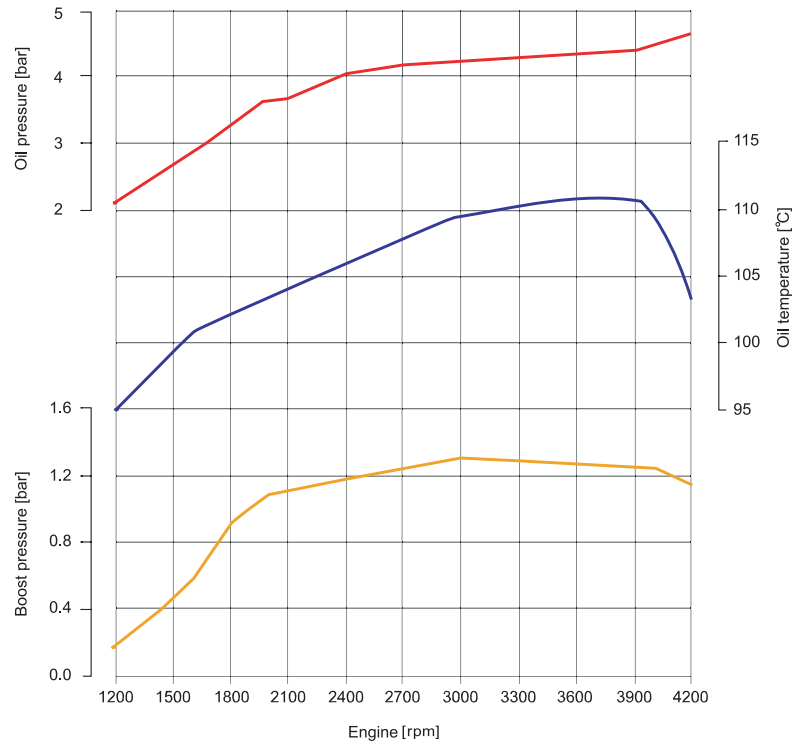
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Oil Temperature/Pressure and Boost Pressure

D20DT engine



D27DT engine

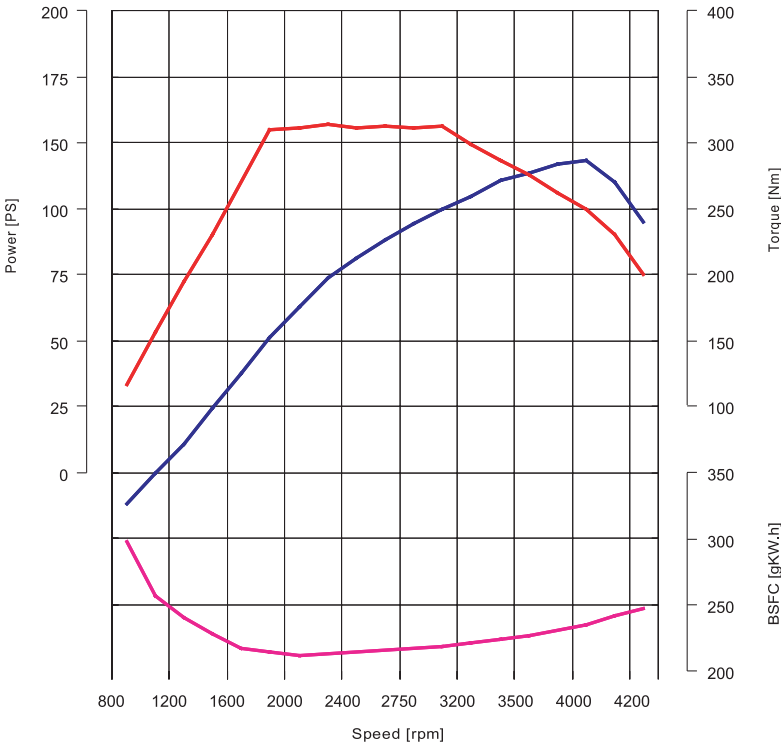


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

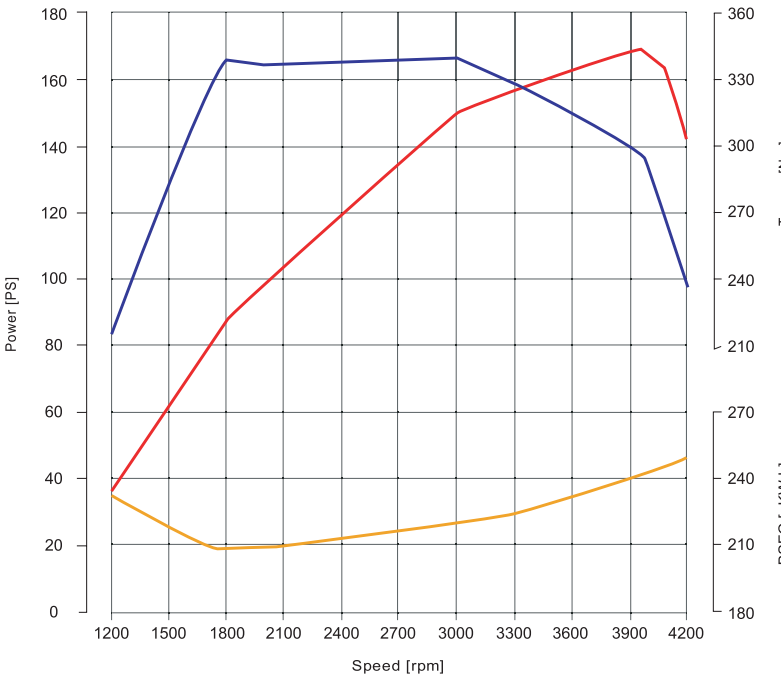
Vehicle with M/T

Output and Torque

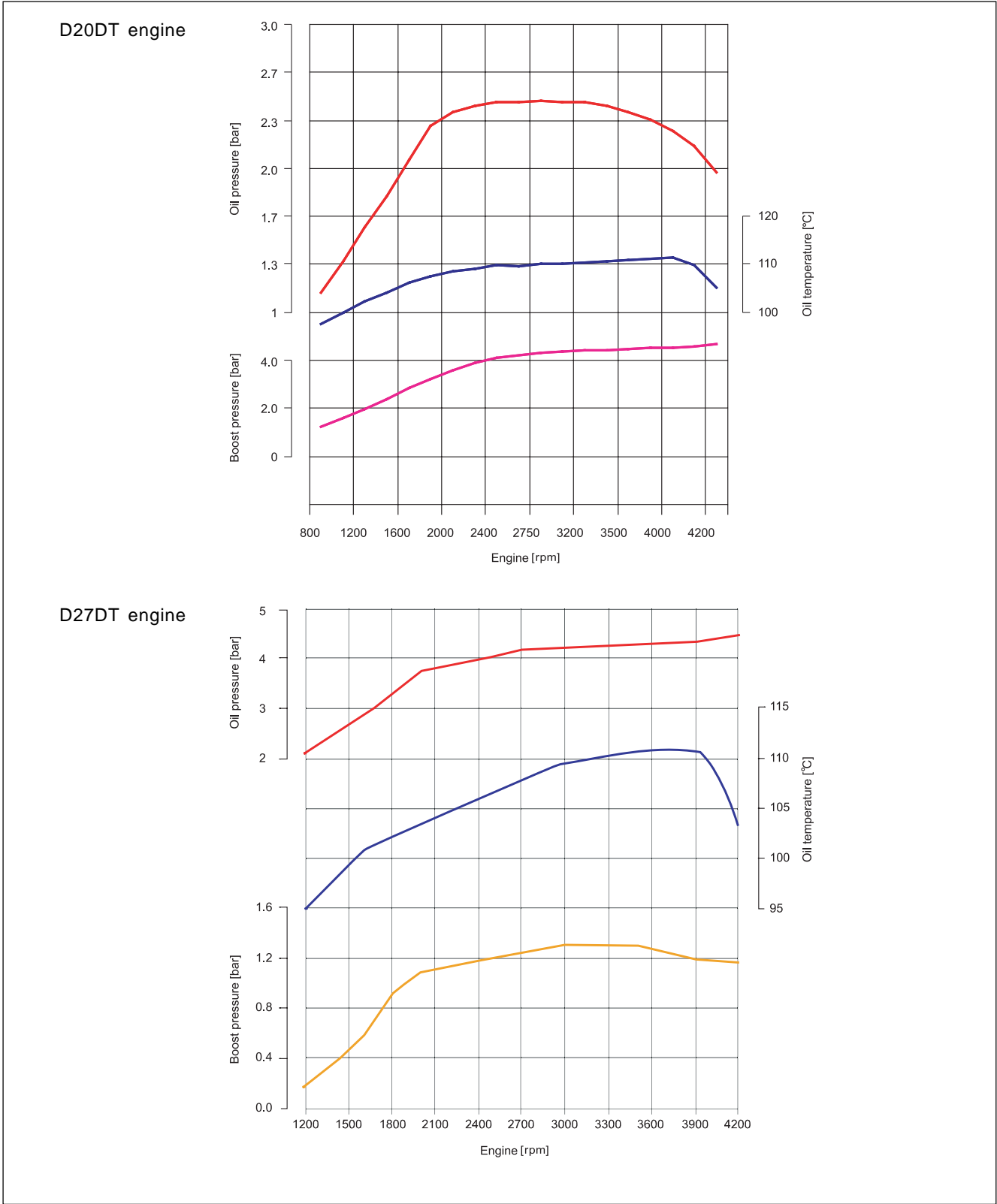
D20DT engine



D27DT engine



Oil Temperature/Pressure and Boost Pressure



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

GENERAL DIAGNOSIS

Condition		Probable Cause	Correction
Hard Starting (With normal cranking)	Malfunction of Ignition System	• Faulty fuse.	• Replace the fuse.
		• Faulty spark plug.	• Clean, adjust the plug gap or replace.
		• Electric leakage at the high tension cable.	• Replace the cable.
		• Poor connection of the high tension cable or lead wires.	• Replace the cable or wires.
		• Improper ignition timing.	• Adjust the ignition timing.
		• Faulty ignition coil.	• Replace the ignition coil.
	Malfunction of Fuel System	• Lack of fuel in the fuel tank.	• Feed the fuel.
		• Dirty or clogged fuel filter.	• Replace the filter.
		• Clogged fuel pipe.	• Clean the fuel pipe.
		• Malfunction of the fuel pump.	• Replace the fuel pump.
		• Malfunction of the fuel injector.	• Replace the injector.
		• The foreign material in the fuel tank.	• Clean the fuel tank.
	Decline of Compression Pressure	• Poor tightening spark plug.	• Tighten to the specified torque. Compression
		• Cracked cylinder head gasket.	• Replace the gasket.
		• Inadequate the valve clearance.	• Adjust the clearance.
		• Leakage of the valve clearance.	• Repair the valve.
		• Interference of the valve stem.	• Replace the valve or the valve guide.
		• Low elasticity or damage of the valve spring.	• Replace the valve spring.
		• Abnormal interference of pistons and cylinders.	• Replace the piston ring.
		• Excessive wear of pistons, rings, or cylinders.	• Replace the ring or the piston and boring or replace the cylinder.
	Others	• Broken timing belt.	• Replace the belt.
		• Loosening, damage or leakage of the vacuum hose.	• Connect the hose correctly or replace it.
		• Leakage of intake system.	• Replace intake system.
Lack of Engine Power	Decline of Compression Pressure	• Refer to above in this page.	• Refer to above in this page.
	Malfunction of Ignition System	• Improper ignition timing.	• Adjust the ignition timing.
		• Faulty spark plug.	• Adjust or replace the spark plug.
		• Electric leakage or poor connection of the high tension cable.	• Connect the cable correctly or replace it.

GENERAL DIAGNOSIS (Cont'd)

Condition		Probable Cause	Correction
Lack of Engine Power	Malfunction of Fuel System	• Clogged fuel pipe.	• Clean the pipe.
		• Clogged or contaminated fuel filter.	• Replace the filter.
	Others	• Clogged exhaust system.	• Check and repair the system.
		• Clogged or contaminated air cleaner element.	• Clean or replace the air cleaner element.
		• Leak of the intake manifold gasket.	• Replace the gasket.
	• Dragging brakes.	• Repair or replace the brakes.	
Rough Engine Idling	Decline of Compression Pressure	• Refer to “Compression Pressure Test”.	• Refer to “Compression Pressure Test”.
	Malfunction of Fuel System	• Clogged fuel pipe.	• Clean the pipe.
		• Clogged or contaminated fuel filter.	• Replace the filter.
		• Malfunction of the fuel pressure regulator.	• Replace the regulator.
	Malfunction of Ignition System	• Malfunction of the spark plug.	• Adjust or replace the spark plug.
		• Electric leakage or poor connection of the high tension cable.	• Connect the cable correctly or replace it.
		• Poor ignition timing.	• Adjust the ignition timing.
		• Malfunction of the ignition coil.	• Replace the ignition coil.
	Others	• Clogged or contaminated air cleaner element.	• Clean or replace the air cleaner element.
		• Leak of the intake manifold gasket.	• Replace the gasket.
• Poor connection or damage or leakage of the vacuum hose.		• Connect the hose correctly or replace it.	
Engine Hesitate (Upon pressing accelerating pedal, the engine makes delayed response This situation is remarkable when cruising or starting.)	Decline of Compression Pressure	• Refer to “Compression Pressure Test”.	• Refer to “Compression Pressure Test”.
	Malfunction of Ignition System	• Poor ignition timing.	• Adjust the ignition timing.
		• Poor spark plug or Poor adjustment of the plug gap.	• Replace the plug or adjust the gap.
		• Electric leakage or poor connection of the high tension cable.	• Connect the cable correctly or replace it.
	Others	• Malfunction of the air cleaner system.	• Clean or replace the air cleaner system.
• Leak of the intake manifold gasket.		• Replace the gasket.	

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

GENERAL DIAGNOSIS (Cont'd)

Condition		Probable Cause	Correction
Engine Surging (Engine power makes fluctuation in a fixed speed and speed changes without operating the accelerating pedal.)	Decline of Compression Pressure	<ul style="list-style-type: none"> Refer to "Compression Pressure Test". 	<ul style="list-style-type: none"> Refer to "Compression Pressure Test".
	Malfunction of Fuel System	<ul style="list-style-type: none"> Clogged fuel pipe. 	<ul style="list-style-type: none"> Clean the pipe.
		<ul style="list-style-type: none"> Clogged or contaminated fuel filter. 	<ul style="list-style-type: none"> Replace the filter.
		<ul style="list-style-type: none"> Malfunction of the fuel pressure regulator. 	<ul style="list-style-type: none"> Replace the fuel pressure regulator.
	Malfunction of Ignition System	<ul style="list-style-type: none"> Malfunction of the spark plug. 	<ul style="list-style-type: none"> Adjust or replace the spark plug.
		<ul style="list-style-type: none"> Electric leakage or poor connection of the high tension cable. 	<ul style="list-style-type: none"> Connect the cable correctly or replace it.
		<ul style="list-style-type: none"> Poor ignition timing. 	<ul style="list-style-type: none"> Adjust the ignition timing.
	Others	<ul style="list-style-type: none"> Leak of the intake manifold gasket. 	<ul style="list-style-type: none"> Clean or replace the gasket.
		<ul style="list-style-type: none"> Leakage of the vacuum hose. 	<ul style="list-style-type: none"> Connect the hose correctly or replace it.
Excessive Detonation (According to the opening range of Malfunction of metallic is made with abnormal explosion)	Overheated Engine	<ul style="list-style-type: none"> Refer to "Overheat" in this page. 	<ul style="list-style-type: none"> Refer to "Overheat" in this page.
	Malfunction of Fuel System	<ul style="list-style-type: none"> Abnormal spark plug. 	<ul style="list-style-type: none"> Replace the spark plug.
		<ul style="list-style-type: none"> Poor ignition timing. 	<ul style="list-style-type: none"> Adjust the ignition timing
		<ul style="list-style-type: none"> Electric leakage or poor connection of the high tension cable. 	<ul style="list-style-type: none"> Connect the cable correctly or replace it.
	Malfunction of Ignition System	<ul style="list-style-type: none"> Clogged or contaminated fuel filter and fuel pipe. 	<ul style="list-style-type: none"> Clean or replace the fuel filter and the fuel pipe.
	Others	<ul style="list-style-type: none"> Leak of the intake manifold gasket. 	<ul style="list-style-type: none"> Replace the gasket.
		<ul style="list-style-type: none"> Excessive carbon deposit due to abnormal combustion. 	<ul style="list-style-type: none"> Remove the carbon.
Overheat	Malfunction of Cooling System	<ul style="list-style-type: none"> Lack of coolant. 	<ul style="list-style-type: none"> Refill coolant.
		<ul style="list-style-type: none"> Malfunction of the thermostat. 	<ul style="list-style-type: none"> Replace the thermostat.
		<ul style="list-style-type: none"> Malfunction of the cooling fan. 	<ul style="list-style-type: none"> Check or replace the cooling fan.
		<ul style="list-style-type: none"> Poor water pump performance. 	<ul style="list-style-type: none"> Replace the pump.
		<ul style="list-style-type: none"> Clogged or leaky radiator. 	<ul style="list-style-type: none"> Clean, repair or replace the radiator.
	Malfunction of Lubrication System	<ul style="list-style-type: none"> Poor engine oil. 	<ul style="list-style-type: none"> Replace engine oil with the specified one.
		<ul style="list-style-type: none"> Blocking oil filter or strainer. 	<ul style="list-style-type: none"> Clean or repair the oil filter or the strainer.
		<ul style="list-style-type: none"> Lack of engine oil. 	<ul style="list-style-type: none"> Refill oil.
		<ul style="list-style-type: none"> Poor oil pump performance. 	<ul style="list-style-type: none"> Replace or repair the pump.
	Other	<ul style="list-style-type: none"> Leakage of oil 	<ul style="list-style-type: none"> Repair.
		<ul style="list-style-type: none"> Damaged cylinder head gasket. 	<ul style="list-style-type: none"> Replace the gasket.

GENERAL DIAGNOSIS (Cont'd)

Condition		Probable Cause	Correction
Poor Fuel Consumption	Decline of Compression Pressure	<ul style="list-style-type: none"> Refer to "Compression Pressure Test". 	<ul style="list-style-type: none"> Refer to "Compression Pressure Test".
	Malfunction of Fuel System	<ul style="list-style-type: none"> Leakage of the fuel tank or the fuel pipe. 	<ul style="list-style-type: none"> Repair or replace the fuel tank or the fuel pipe
	Malfunction of Ignition System	<ul style="list-style-type: none"> Improper ignition timing. 	<ul style="list-style-type: none"> Adjust the ignition timing.
		<ul style="list-style-type: none"> Abnormal spark plug (Excessive carbon deposit, inadequate gap, burnt electrode). 	<ul style="list-style-type: none"> Replace the plug.
		<ul style="list-style-type: none"> Electric leakage or poor connection of the high tension cable. 	<ul style="list-style-type: none"> Connect the cable normally or replace it.
	Malfunction of Cooling System	<ul style="list-style-type: none"> Malfunction of the thermostat. 	<ul style="list-style-type: none"> Repair the thermostat.
Excessive Consumption of Engine Oil	Leakage of Engine Oil	<ul style="list-style-type: none"> Improperly installed valve. 	<ul style="list-style-type: none"> Repair or replace the valve.
		<ul style="list-style-type: none"> Low pressure of tires. 	<ul style="list-style-type: none"> Adjust the pressure of tires.
		<ul style="list-style-type: none"> Loosened oil drain plug. 	<ul style="list-style-type: none"> Tighten the plug.
		<ul style="list-style-type: none"> Loosened oil pan bolt. 	<ul style="list-style-type: none"> Tighten the bolt.
		<ul style="list-style-type: none"> Loosened oil filter. 	<ul style="list-style-type: none"> Tighten the filter.
		<ul style="list-style-type: none"> Loosened oil pressure switch. 	<ul style="list-style-type: none"> Tighten the switch.
		<ul style="list-style-type: none"> Leakage of camshaft front oil seal. 	<ul style="list-style-type: none"> Replace the seal.
		<ul style="list-style-type: none"> Leakage of crankshaft front oil seal. 	<ul style="list-style-type: none"> Replace the seal.
	Oil Mixing in Combustion Chamber	<ul style="list-style-type: none"> Leakage at the cylinder head cover gasket. 	<ul style="list-style-type: none"> Replace the gasket.
		<ul style="list-style-type: none"> Damage of the cylinder head gasket. 	<ul style="list-style-type: none"> Replace the gasket.
		<ul style="list-style-type: none"> Stuck piston ring. 	<ul style="list-style-type: none"> Remove carbon and replace the ring.
		<ul style="list-style-type: none"> Worn piston or cylinder. 	<ul style="list-style-type: none"> Replace the piston or the cylinder.
		<ul style="list-style-type: none"> Worn piston ring or ring groove. 	<ul style="list-style-type: none"> Replace the piston or ring.
		<ul style="list-style-type: none"> Inadequate position of the piston ring cutting part. 	<ul style="list-style-type: none"> Adjust the position.
Low Oil Pressure	Malfunction of Lubrication System	<ul style="list-style-type: none"> Abrasion or damage of the valve system. 	<ul style="list-style-type: none"> Replace the valve system.
		<ul style="list-style-type: none"> Inadequate oil viscosity. 	<ul style="list-style-type: none"> Replace with the specified one.
		<ul style="list-style-type: none"> Loosening of the oil pressure switch. 	<ul style="list-style-type: none"> Tighten the switch.
		<ul style="list-style-type: none"> Lack of engine oil. 	<ul style="list-style-type: none"> Refill oil.
		<ul style="list-style-type: none"> Blocking oil strainer. 	<ul style="list-style-type: none"> Clean the strainer.
		<ul style="list-style-type: none"> Lowered function of the oil pump. 	<ul style="list-style-type: none"> Replace the pump.
Low Oil Pressure	Malfunction of Lubrication System	<ul style="list-style-type: none"> Abrasion or damage of the oil pump relief valve. 	<ul style="list-style-type: none"> Replace the valve.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

GENERAL DIAGNOSIS (Cont'd)

Condition		Probable Cause	Correction
Engine Noise	Valve Noise	• Inadequate valve clearance	• Adjust the valve clearance.
		• Abrasion of valve stem or guide.	• Replace the valve stem or the guide.
		• Weak valve spring.	• Replace the spring.
	Piston, Ring, Cylinder Noise	• Abrasion of the piston, the ring or the cylinder.	• Boring the cylinder or replace the piston, the ring or the cylinder.
	Connecting Rod Noise	• Abrasion of the connecting rod bearing.	• Replace the bearing.
		• Loosened the connecting rod nut.	• Tighten to the specified torque
	Crankshaft Noise	• Abrasion of the crankshaft bearing.	• Replace the bearing.
		• Abrasion of the crankshaft journal.	• Grind or replace the crankshaft journal.
		• Loosened bearing cap bolt.	• Tighten to the specified torque.
		• Excessive clearance of the crankshaft thrust bearing.	• Adjust or replace.
		• Low oil pressure.	• Refer to "Low Oil Pressure" in this section.

DIAGNOSTIC INFORMATION AND PROCEDURE

OIL LEAK DIAGNOSIS

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

► Finding the Leak

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

► Powder Method

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

► Black Light and Dye Method

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

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

► Repairing the Leak

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

► Gaskets

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

Seals

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

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

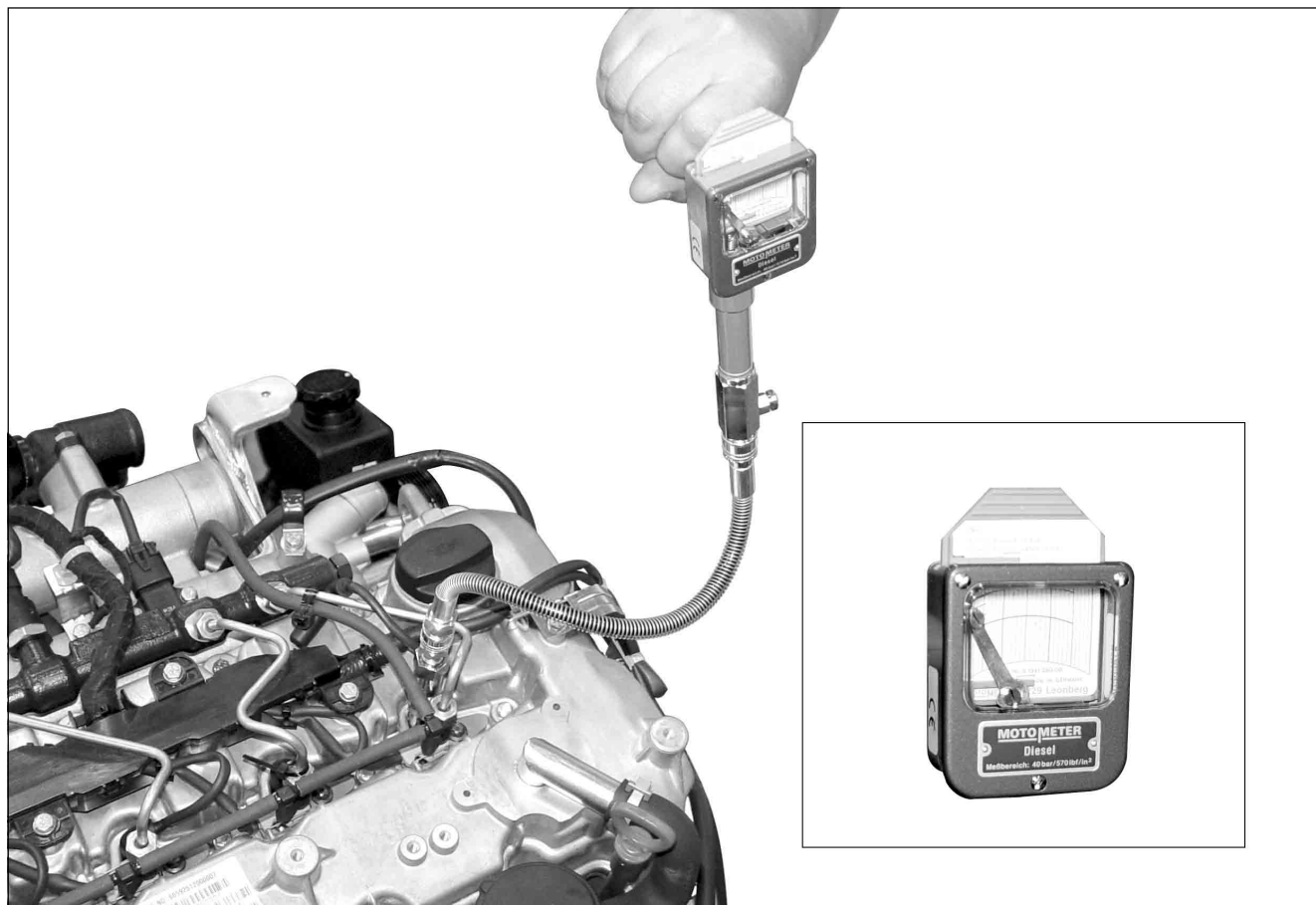
COMPRESSION PRESSURE TEST

The compression pressure test is to check the conditions of internal components (piston, piston ring, intake and exhaust valve, cylinder head gasket). This test provides current engine operating status.



NOTICE

- Before cranking the engine, make sure that the test wiring, tools and persons are keeping away from moving components of engine (e.g., belt and cooling fan).
- Park the vehicle on the level ground and apply the parking brake.
- Do not allow anybody to be in front of the vehicle.



► Specifications

Compression ratio		18 : 1
Test temperature		at normal operating temperature (80°C)
Compression pressure	Normal value	32 bar
	Minimum value	18 bar
Permissible pressure difference between individual cylinders		Max. 3 bar

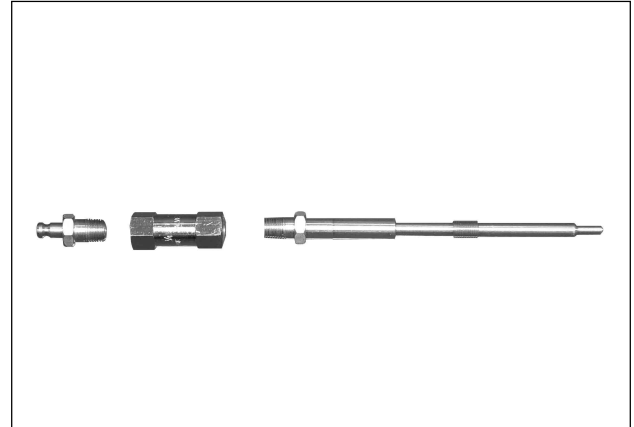
► Measuring Procedure



NOTICE

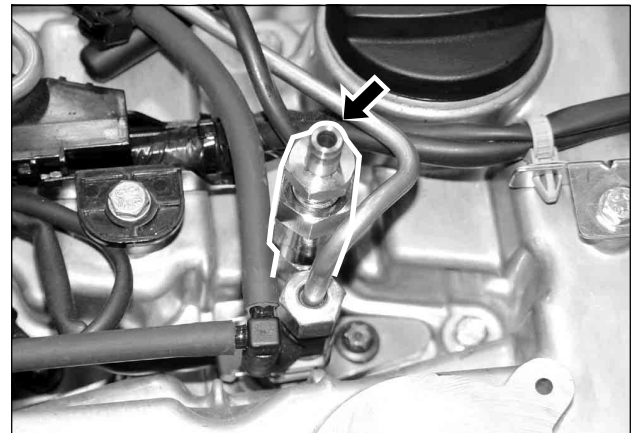
- Disconnect the fuel rail pressure sensor connector to cut off the fuel injection.
- Discharge the combustion residues in the cylinders before testing the compression pressure.
- Apply the parking brake before cranking the engine.

1. Warm the engine up to normal operating temperature (80°C).
2. Disconnect the fuel rail pressure sensor connector to cut off the fuel injection.
3. Place the diagram sheet to compression pressure tester.

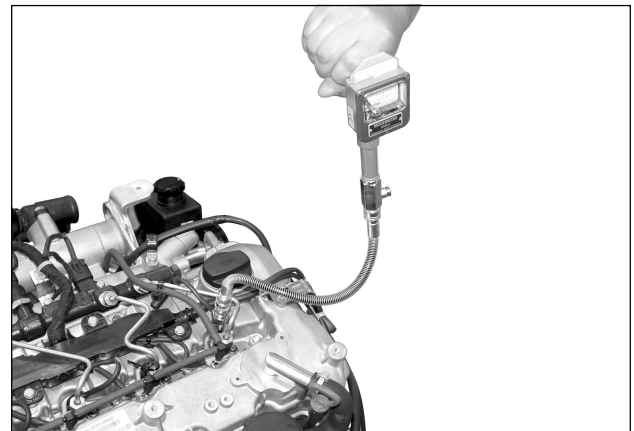


4. Remove the glow plugs and install the compression pressure tester into the plug hole.

Tightening torque (Tester)	15 Nm
----------------------------	-------



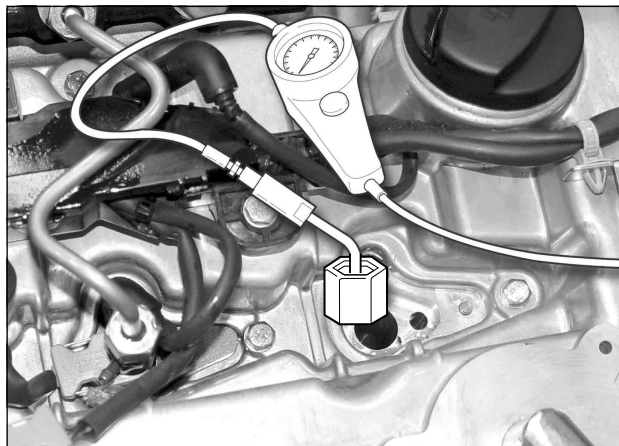
5. Crank the engine for approx. 10 seconds by using the start motor.
6. Record the test result and measure the compression pressure of other cylinders with same manner.
7. If the measured value is not within the specifications, perform the cylinder pressure leakage test.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

CYLINDER PRESSURE LEAKAGE TEST

If the measured value of the compression pressure test is not within the specifications, perform the cylinder pressure leakage test.



► Permissible Pressure Leakage

Test temperature	at normal operating temperature (80°C)
At whole engine	Max. 25 %
At valve and cylinder head gasket	Max. 10 %
At piston ring	Max. 20 %



NOTICE

- Perform the pressure leakage test in order (D20DT: 1 - 2 - 3 - 4
D27DT: 1 - 2 - 3 - 4 - 5)
- Do not test the cylinder pressure leakage with wet type test procedure. (do not inject the engine oil into the combustion chamber)

TIGHTENING TORQUE

NO.	Name	Size	Quantity	Tightening Torque (Nm)
1	Oil nozzle	M6 x 22	5	10 ± 1
2	Main bearing cap	M11 x 62	12	55 ± 5 90° ± 10°
3	Connecting rod cap	M9 x 52	5	40 ± 5 90° ± 10°
4	Rear cover	M6 x 20	6	10 ± 1
5	Oil pump	M8 x 35SOC	3	25 ± 2.5
6	Oil baffle plate assembly	M6 x 20	10	10 ± 1
7	T.G.C.C	M6 x 16	1	10 ± 1
		M6 x 40	6	10 ± 1
		M6 x 60	3	10 ± 1
		M6 x 70	2	10 ± 1
		M8 x 80SOC	1	25 ± 2.5
8	Flywheel	M10 x 28.5	8	45 ± 5 90° ± 10°
9	Crankshaft hub	M20 x 85 Head: M18	1	200 ± 20 180° ± 10°
10	Oil pan	M6 x 20	24	10 ± 1
		M6 x 35	3	10 ± 1
		M6 x 85	3	10 ± 1
		M8 x 40	4	25 ± 2.5
11	High pressure pump assembly	M8 x 40	4	25 ± 2.5
12	High pressure pump sprocket assembly	M14 x 1.5-8-1	1	65 ± 5
13	High pressure pump bracket	M7 x 16	3	20 ± 2 x 90° + 10°
14	Cylinder head assembly	M8 x 25	2	25 ± 2.5
		M8 x 50	2	
		M12 x 177	11	Step1: 20 ± 2 Step2: 85 ± 5
		M12 x 158	1	Step3: 3 x 90° + 10°
15	Camshaft cap	M8 x 60	24	25 ± 2.5
16	Stud bolt	M8	10	15 ± 1.5
17	Camshaft sprocket (Intake)	M11 x 52	1	25 ± 2.5
	Camshaft sprocket (Exhaust)		1	90° ± 10°
18	Chain tensioner	M22	1	65 ± 5
19	Coolant temperature sensor	M14	1	22 ± 2.2

GENERAL

ASSY

HOUSING

INTAKE

EXHAUST

LUB

COOLING

FUEL

CONTROL

SENSOR

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

NO.	Name	Size	Quantity	Tightening Torque (Nm)
20	Auto tensioner	M8 x 45(LOWER)	1	32 ± 3
		M12 x 90	1	82 ± 6
21	Water pump assembly	M6 x 50	7	10 ± 1
22	Water pump pulley	M6 x 12	4	10 ± 1
23	Hot water inlet pipe assembly	M6 x 12	2	10 ± 1
24	Alternator bracket	M8 x 32	4	25 ± 2.5
25	Alternator	M10 x 90	2	46 ± 4.6
26	Air conditioner compressor assembly	M8 x 95	4	46 ± 4.6
27	Air conditioner compressor bracket assembly	M8 x 25	1	25 ± 2.5
		M8 x 60	3	25 ± 2.5
28	Air conditioner compressor sub bracket assembly	M6 x 14	1	10 ± 1.0
		M8 x 16	1	25 ± 2.5
29	Intake manifold	M8 x 45	6	25 ± 2.5
		M8 x 130	6	25 ± 2.5
30	Bracket	M6 x 16	1	10 ± 1.0
31	Knock sensor	M8 x 28	2	20 ± 2.6
32	Camshaft position sensor	M8 x 16	1	12 ± 1.7
33	Booster pressure sensor	M6 x 16	2	10 ± 1.0
34	Exhauster manifold	M8	10	40 ± 4
35	Turbo charger assembly	M8	4	25 ± 2.5
36	Turbo charger adaptor piece		1	32 ± 3.2
37	Nut	M8	1	25 ± 2.5
38	Combination bolt	M8 x 22	1	25 ± 2.5
39	T/C oil supply pipe	M6 x 16 (Cylinder block side)	1	25 ± 2.5
		M16 (T/C side)	1	20 ± 2.0
40	T/C oil return pipe	M6 x 16 (T/C side)	2	10 ± 1.0
		M6 x 16 (Cylinder block side)	2	10 ± 1.0
41	EGR valve assembly	M8 x 22	2	25 ± 2.5
42	EGR-LH pipe bolt	M6 x 16	2	10 ± 1.0
		M8 x 22	2	35 ± 2.0
43	EGR combination bolt	M6 x 16	4	10 ± 1.0
		M8 x 16	4	25 ± 2.5
	EGR-RH pipe nut	M8	2	35 ± 2.0
44	Glow plug cable nut	M5	5	15 ± 3
45	Vacuum pump	M6 x 20	3	10 ± 1.0
46	Cooling fan bracket assembly	M6 x 25	5	10 ± 1.0
		M6 x 65	1	10 ± 1.0
		M6 x 85	3	10 ± 1.0
47	Cylinder head cover	M6 x 35	21	23 ± 2.3

ENGINE ASSEMBLY

KYRON SM - 2005.09

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

NO.	Name	Size	Quantity	Tightening Torque (Nm)
48	Vacuum modulator	M6 x 16SOC	4	10 ± 1.0
49	WDT combination bolt	M6 x 16	3	10 ± 1.0
50	Oil dipstick tube	M6 x 16	1	10 ± 1.0
51	Oil filter assembly	M8 x 35SOC	1	25 ± 2.5
		M8 x 50SOC	2	25 ± 2.5
		M8 x 55SOC	1	25 ± 2.5
52	Fuel rail assembly	M8 x 35SOC	3	25 ± 2.5
53	Injector clamp washer	M6 x 60	5	10 ± 1.0 180 + 20°
54	Fuel pipe clip (H-C)	M6 x 19	1	10 ± 1.0
55	Fuel pipe clip (C-I)	M6 x 16	5	10 ± 1.0
56	Crankshaft position sensor	M5 x 17	1	0.8 ± 0.4
57	Crankshaft position sensor	GAP	-	0.7 ~ 1.5 mm
58	Wiring	M6 x 16	5	10 ± 1.0
59	Intake manifold bracket	M8 x 16	2	25 ± 2.5
		M8 x 40	2	25 ± 2.5
60	Power steering pump	M8 x 100	2	25 ± 2.5
		NUT	2	25 ± 2.5
61	Piston protrusion	-	-	0.765 ~ 1.055 mm
62	Clearance between connecting rod and pin boss	-	-	0.05 ~ 0.31 mm
63	End play of crankshaft	NEW: 0.100 ~ 0.245 mm // USED: 0.300 mm		

GENERAL

ASSY

HOUSING

INTAKE

EXHAUST

LUB

COOLING

FUEL

CONTROL

SENSOR

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

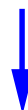
REMOVAL AND INSTALLATION OF ENGINE

REMOVAL AND INSTALLATION OF ENGINE ASSEMBLY

► Removal

Preceding Work

1. Disconnect the negative battery cable.
2. Drain the engine coolant.



Summary of Engine Removal

Remove the engine accessories, front bumper and radiator. Unscrew the engine mounting bolts (17 mm) at both sides and remove the engine assembly.



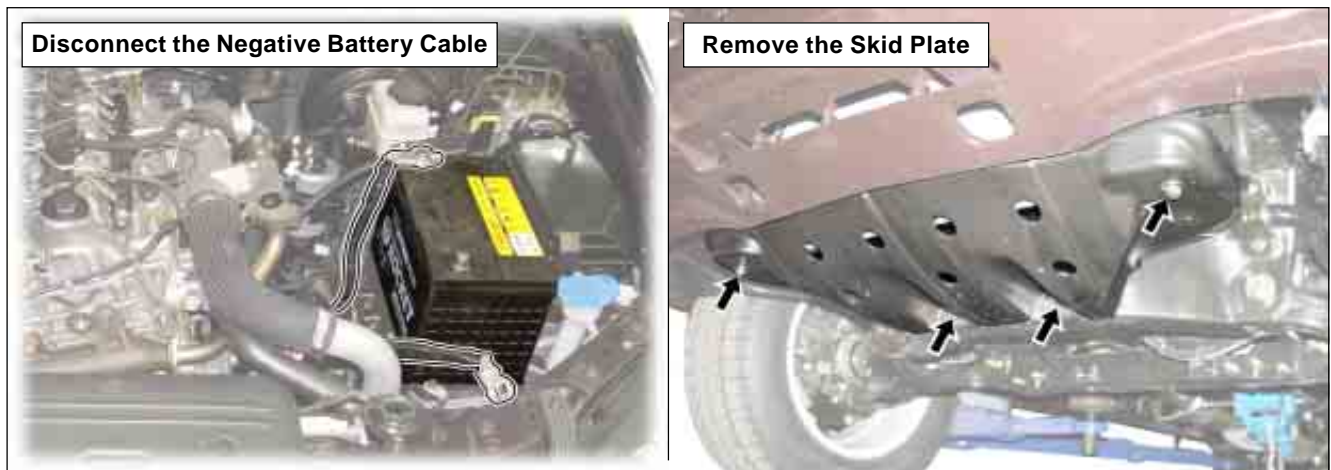
► Removal and Installation

Preceding Work

1. Disconnect the negative battery cable and remove the skid plate under the engine compartment.

Installation Notice

Tightening torque	12 ± 1.2 Nm
-------------------	-----------------



2. Drain the engine coolant.

NOTICE

- Use only the designated container to collect the coolant. Store it in a safe place and observe the regulation when disposing.
- Use only Ssangyong genuine engine coolant when refilling.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

3. Remove the transmission and transfer case assembly.
Be careful not to spill the oil from the oil lines when disconnecting them in the vehicle with automatic transmission.

Vehicle with Automatic Transmission



Vehicle with Manual Transmission




4. Remove the engine hood assembly (refer to “Body” section).



5. Remove the coolant reservoir (A), coolant return hose (B) and air cleaner front air duct (C).


A. Coolant Reservoir

Unscrew the mounting bolts (10 mm), disconnect the return/supply hoses, and remove the coolant reservoir.




B. Return Hose and Pipe


Release the clamps on the reservoir and radiator and remove the return hose and pipe.



C. Air Cleaner Front Duct

Unscrew the mounting bolts (10 mm), release the hose clamps, and remove the air cleaner front duct.





GENERAL
ASSY
HOUSING
INTAKE
EXHAUST
LUB
COOLING
FUEL
CONTROL
SENSOR

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

ENGINE ACCESSORIES

Remove/disconnect the accessories as below (no specific sequence):

Air cleaner, Intake Hose, HFM Sensor



Engine Main Wiring Connector



Intercooler Hose and Coolant Hose



Heater Hose and Pipe



Alternator Ground



Alternator Wiring Harness



Vacuum Hose in Booster and Fuel Filter Hose



Radiator Upper Hose



Preglow Connector in Preglow Relay

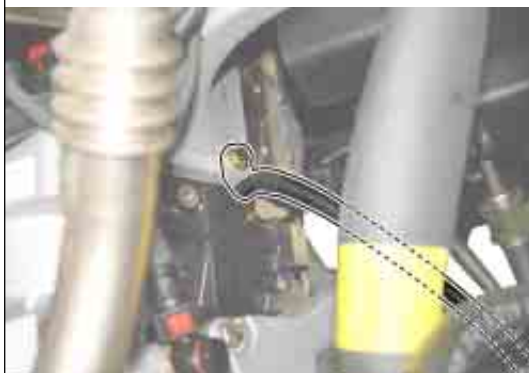


A/C Compressor Connector and Inlet/Outlet Pipes



Tightening torque: 16 ~ 23 Nm

Negative Cable at Engine Side



Power Steering Pump Assembly



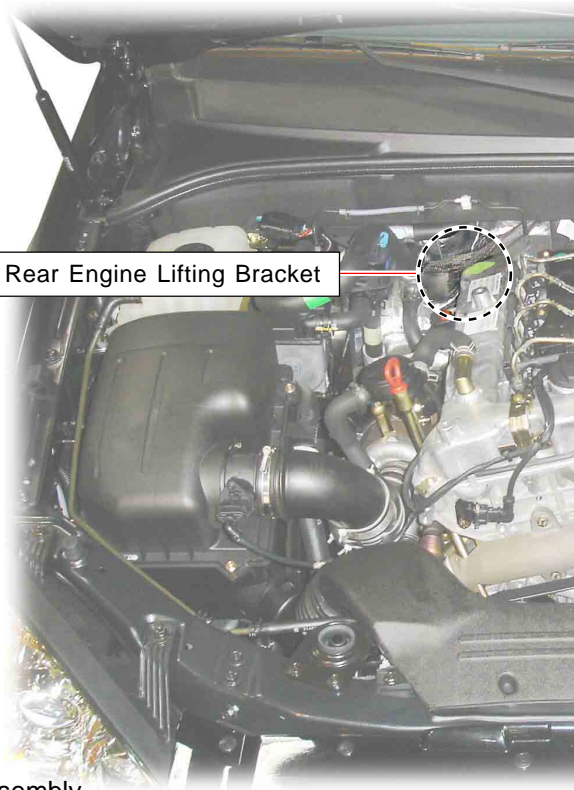
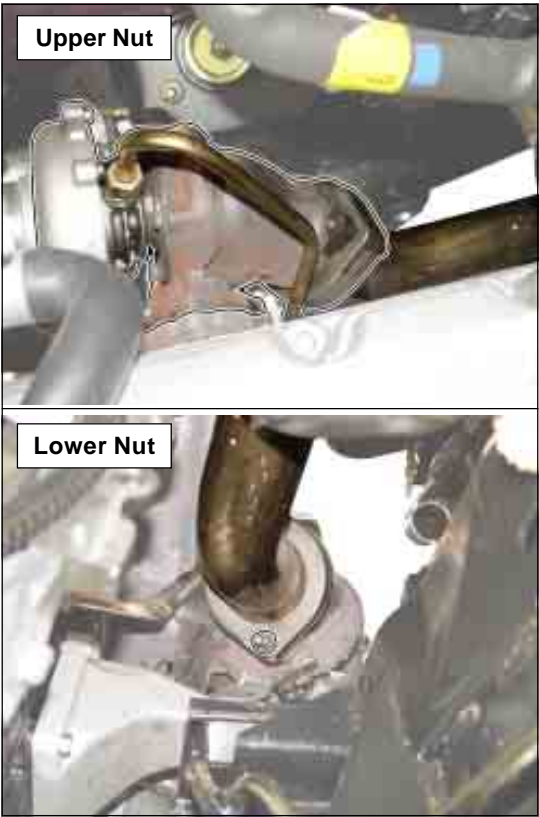
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

ENGINE MOUNTINGS AND OTHER ACCESSORIES

1. Remove all engine accessories and hook the chains on the engine lifting bracket.



2. Unscrew the exhaust manifold mounting nuts (13 mm).



3. Remove the FFH assembly.



4. Remove the right mounting insulator. (However, unscrew the right mounting bolt and raise the engine assembly slightly)



5. Remove the A/C compressor.

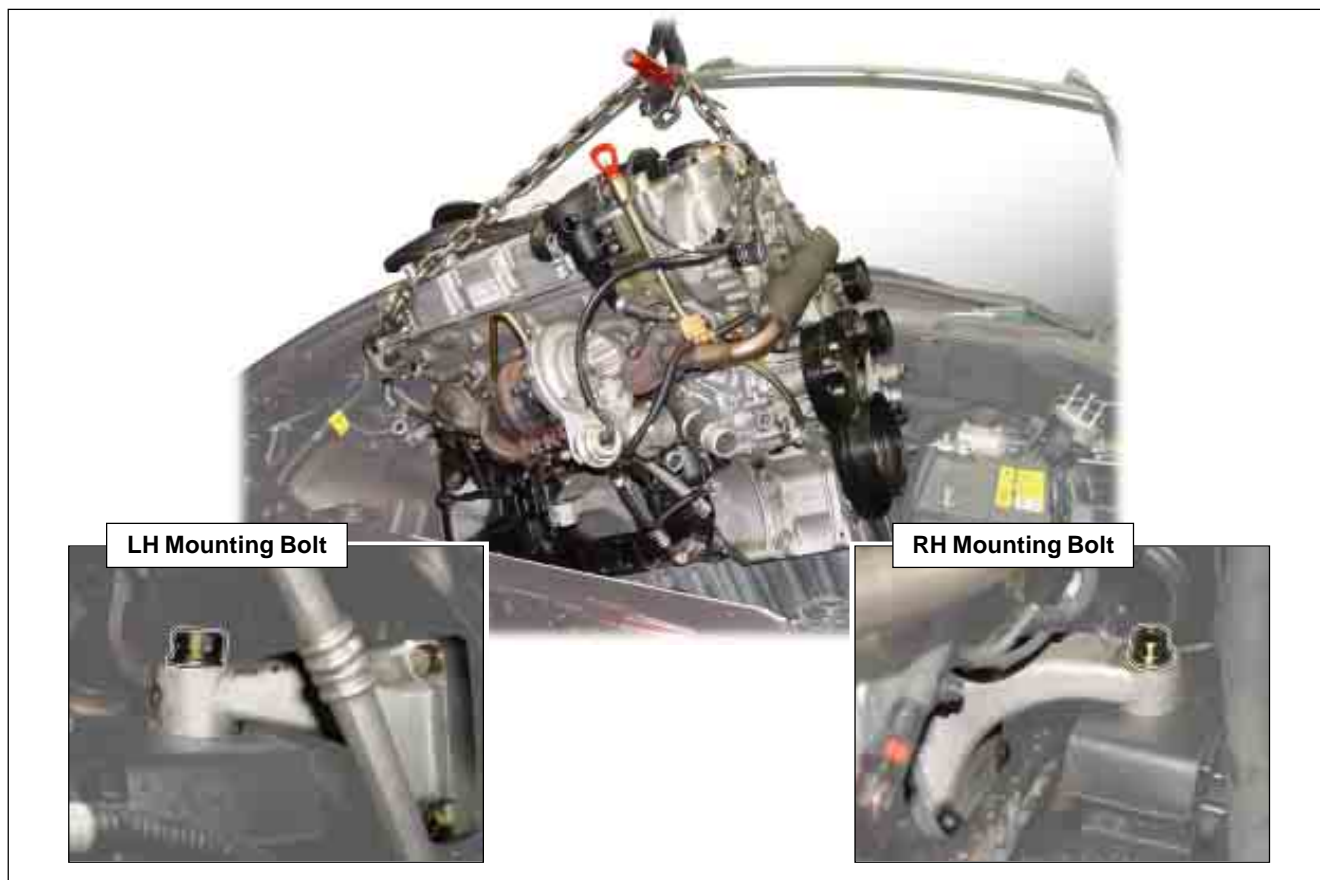


6. Disconnect the transmission oil pipes from the engine.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

7. Unscrew the engine mounting bolts (19 mm) at both sides and remove the engine assembly with a hoist or engine jack.



8. Install in the reverse order of removal.



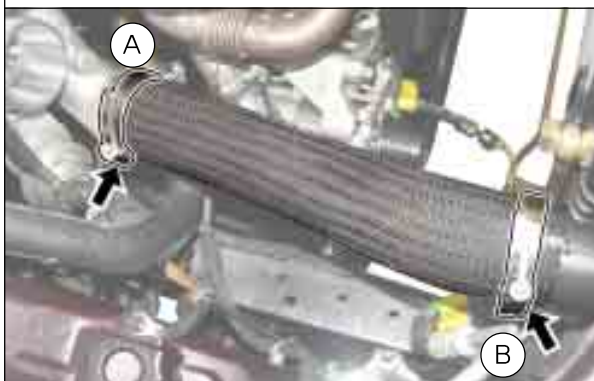
► Cautions When Installing the Engine

Installation of Intercooler Hose

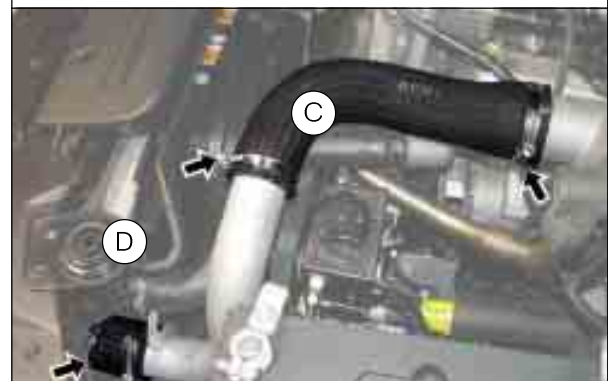
Securely tighten the hose clamps when installing the air cleaner duct, turbo charger and intercooler.



LH InterCooler Hose



RH InterCooler Hose



1. Symptom

Lack of power, smoke, abnormal noise (hissing) when acceleration

2. Cause

Loose clamp due to turbo charger pressure

3. Action

- 1) Check the clamp for looseness and the intercooler for leakage.
- 2) Keep the specified tightening torque with the designated tools.
- 3) Never use a screwdriver to tighten the clamps. It may cause looseness of clamps while driving at high speed.

Tightening torque

6 ~ 7 Nm

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

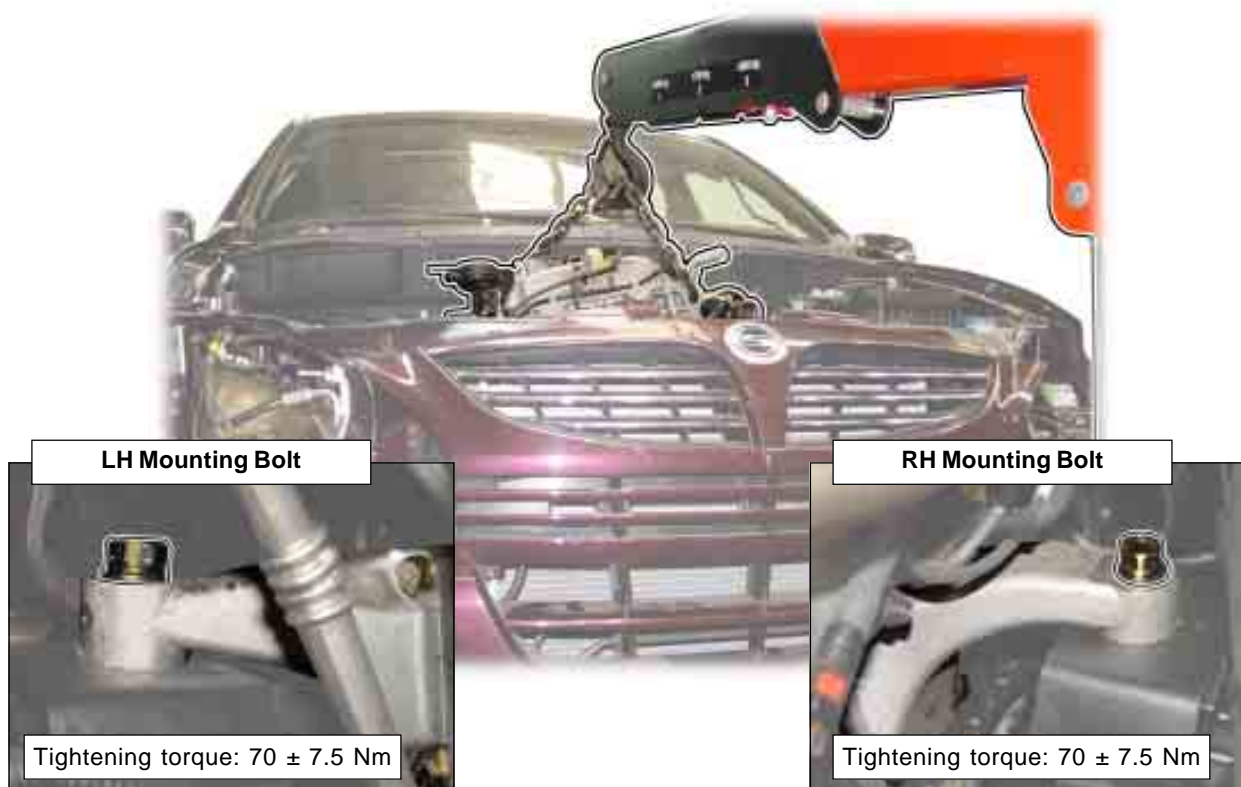
REMOVAL AND INSTALLATION OF ENGINE OIL PAN

※ **Preceding Work:** Remove the front axle assembly and drain the engine coolant.

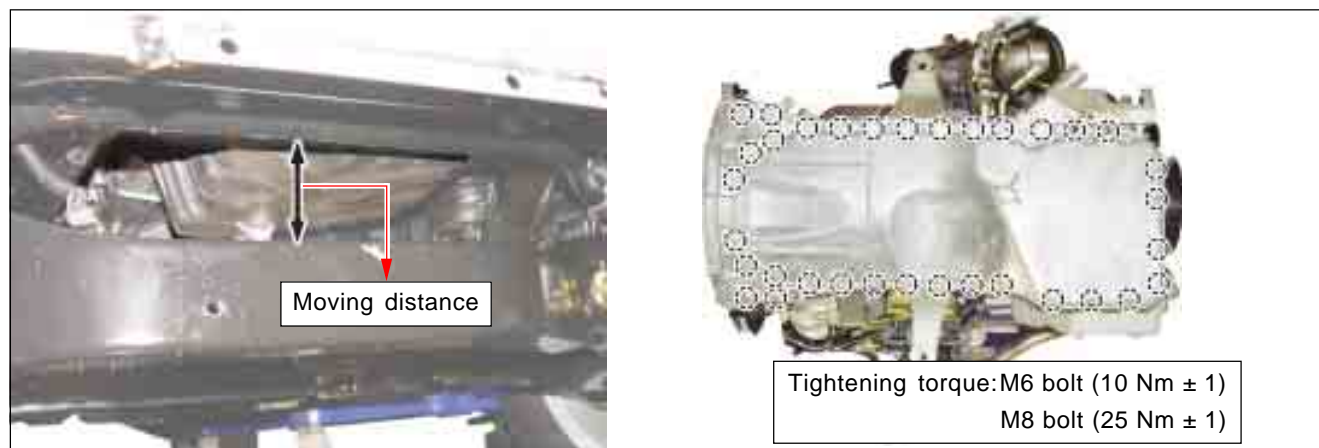
NOTICE

- For removing the oil pan, unscrew the engine mounting bolts and raise the engine assembly slightly. Otherwise, the oil strainer gets interfered with frame.
- Do not excessively raise the engine assembly. It may damage the pipes, hoses and wiring harnesses.

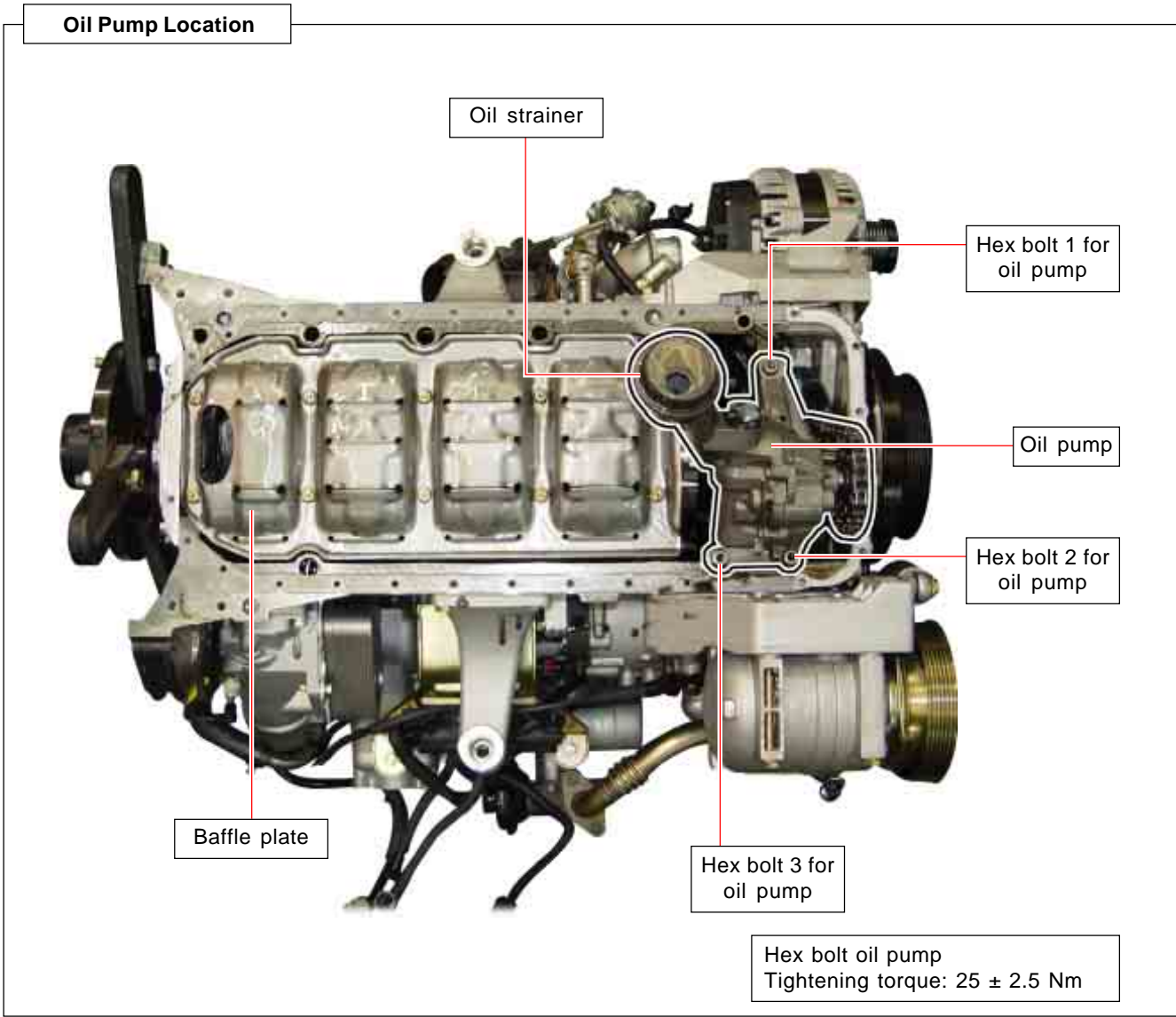
1. Unscrew the engine mounting bolts and raise the engine assembly slightly.



2. Unscrew the oil pan screws when the nearest distance between frame and oil is 13 to 15 cm.



3. Lower the engine oil pan and remove the oil pump assembly with oil pan. At this moment, the oil pan rests on the axle housing and front sub frame.

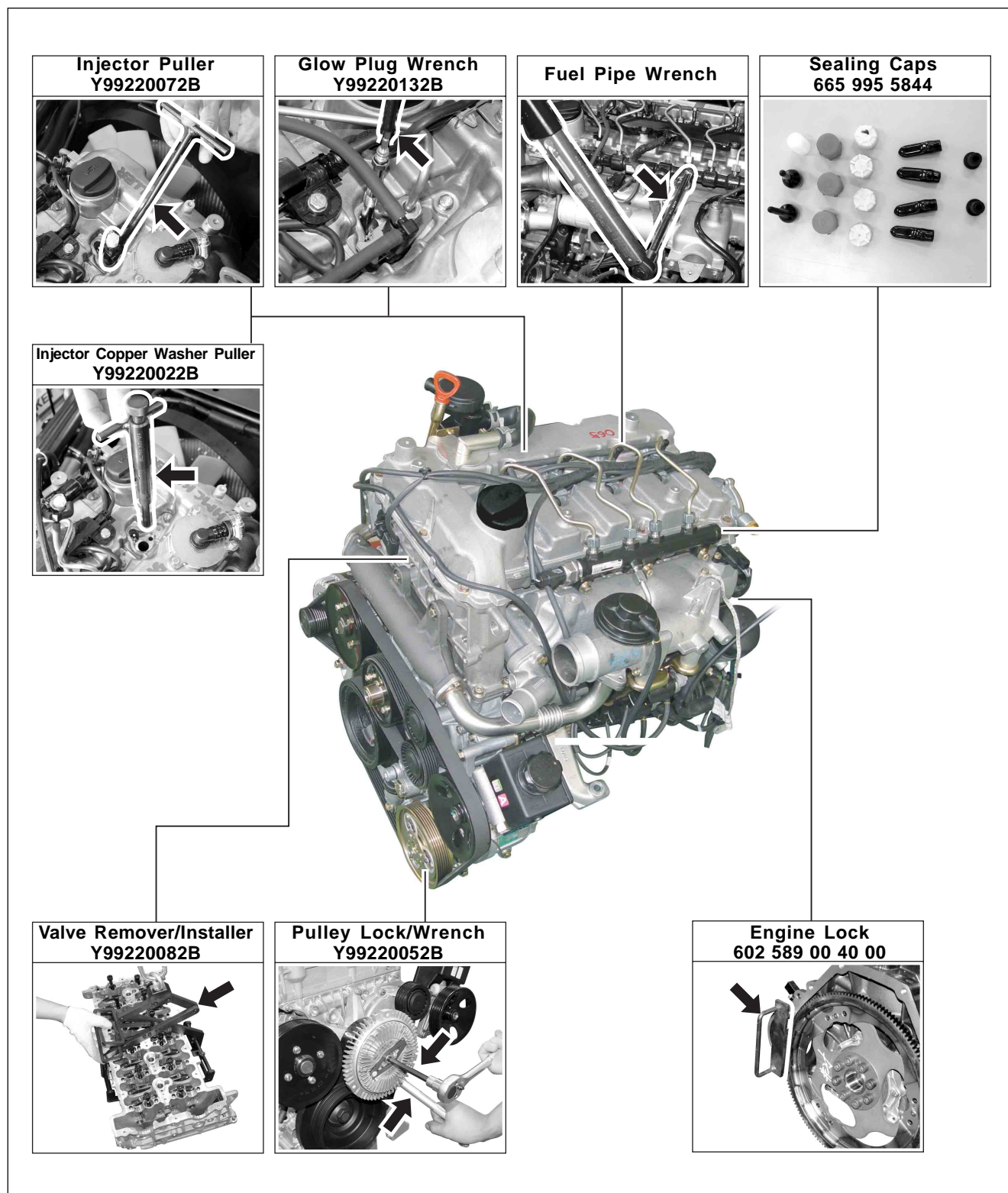


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DISASSEMBLY AND REASSEMBLY

COMPONENTS AND SPECIAL TOOLS

► D20DT Engine

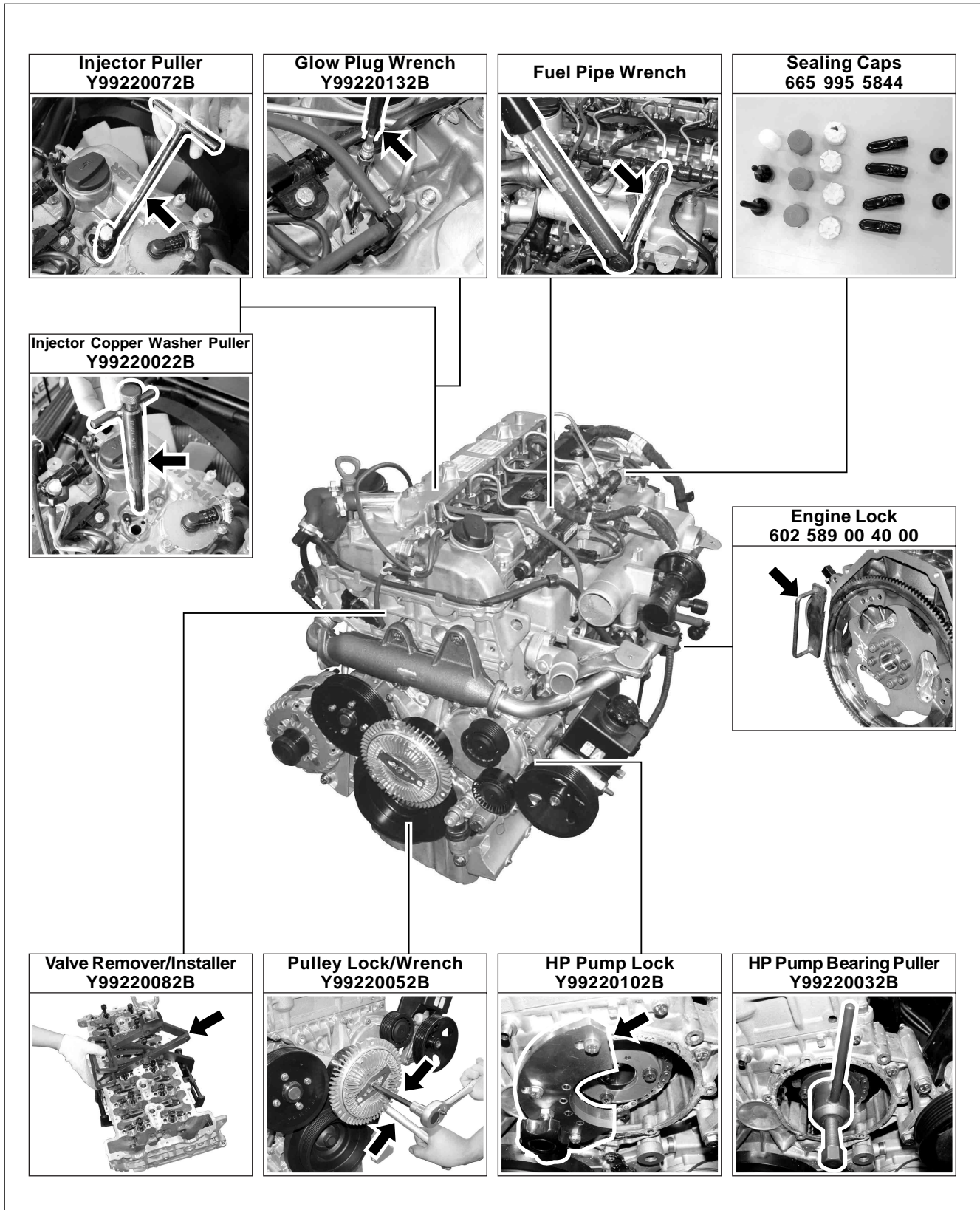


ENGINE ASSEMBLY

KYRON SM - 2005.09

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► D27DT Engine



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

INSPECTION BEFORE DISASSEMBLY AND REASSEMBLY

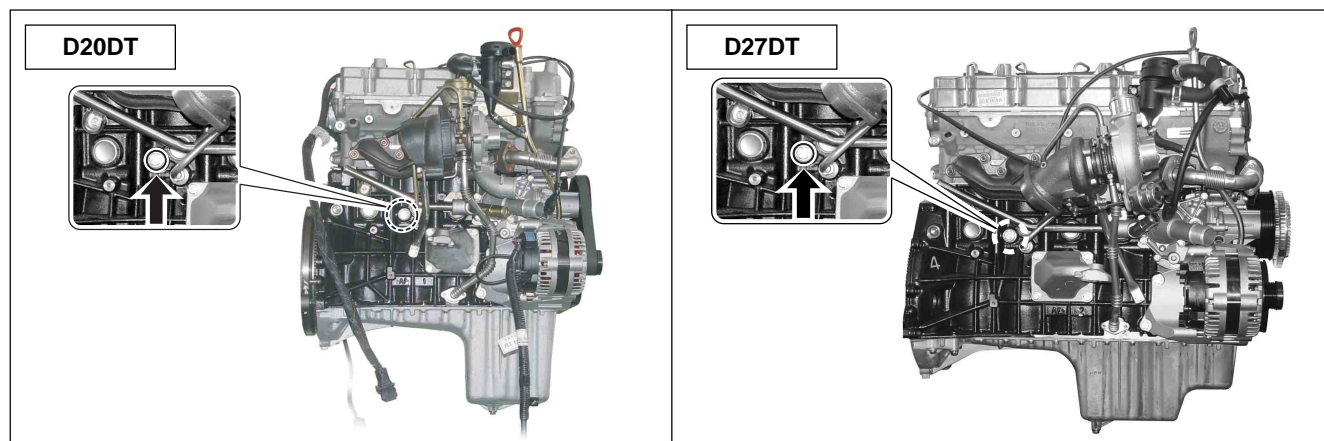
Preparations and Preceding Works

1. Remove the cylinder block drain plug and seal and completely drain the residual coolant from the cylinder block.

Installation Notice

Tightening torque	30 Nm
-------------------	-------

Replace the seal with new one once removed.



2. When the fan belt is installed, gently pump the belt shock absorber mounting bolt (M19) 3 times.
3. Take off the fan belt while pushing the mounting bolt (M19).



4. Loosen the oil drain plug and completely drain the engine oil.

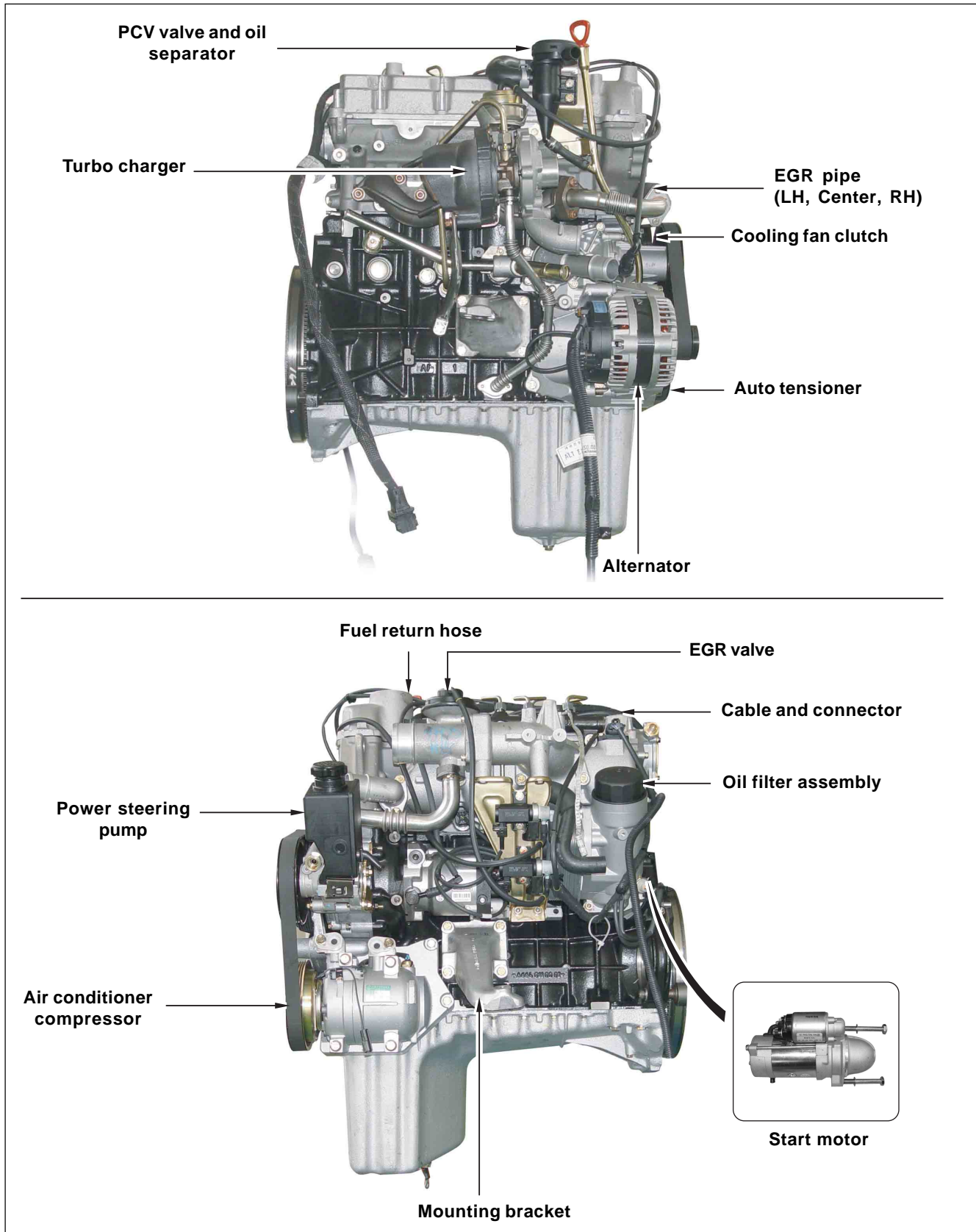
Installation Notice

Tightening torque	25 ± 2.5 Nm
-------------------	-------------



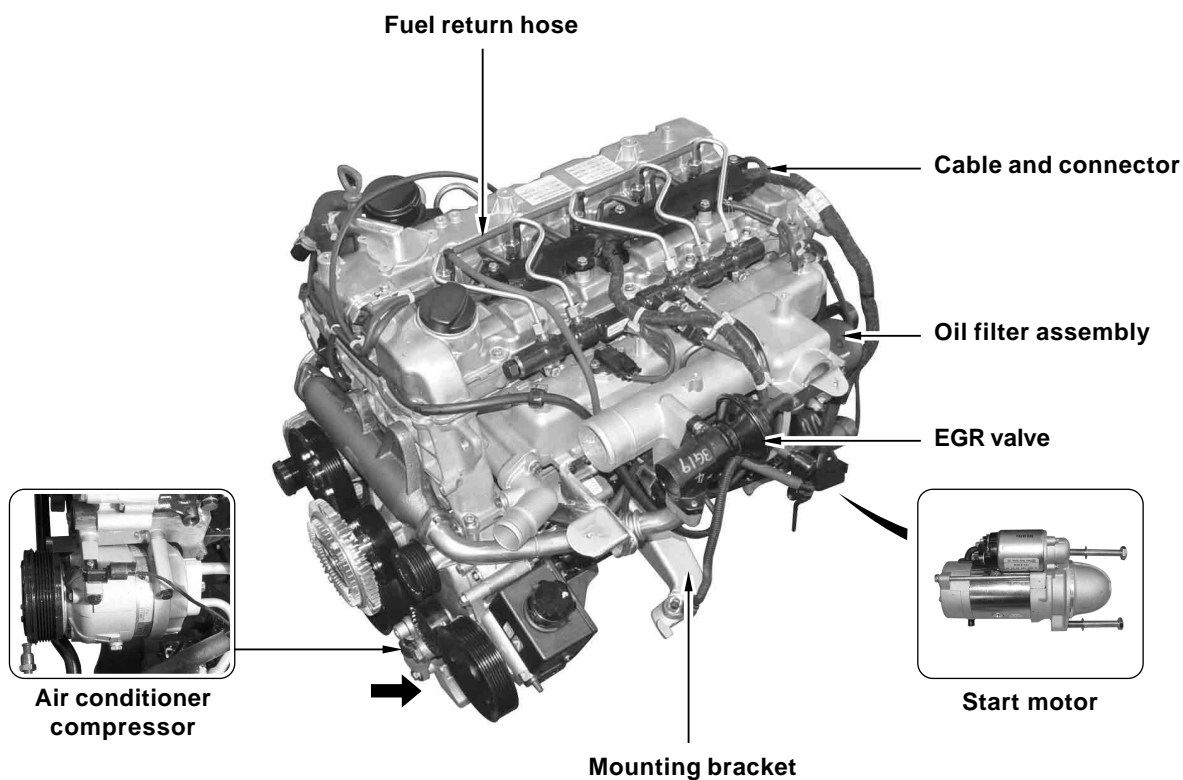
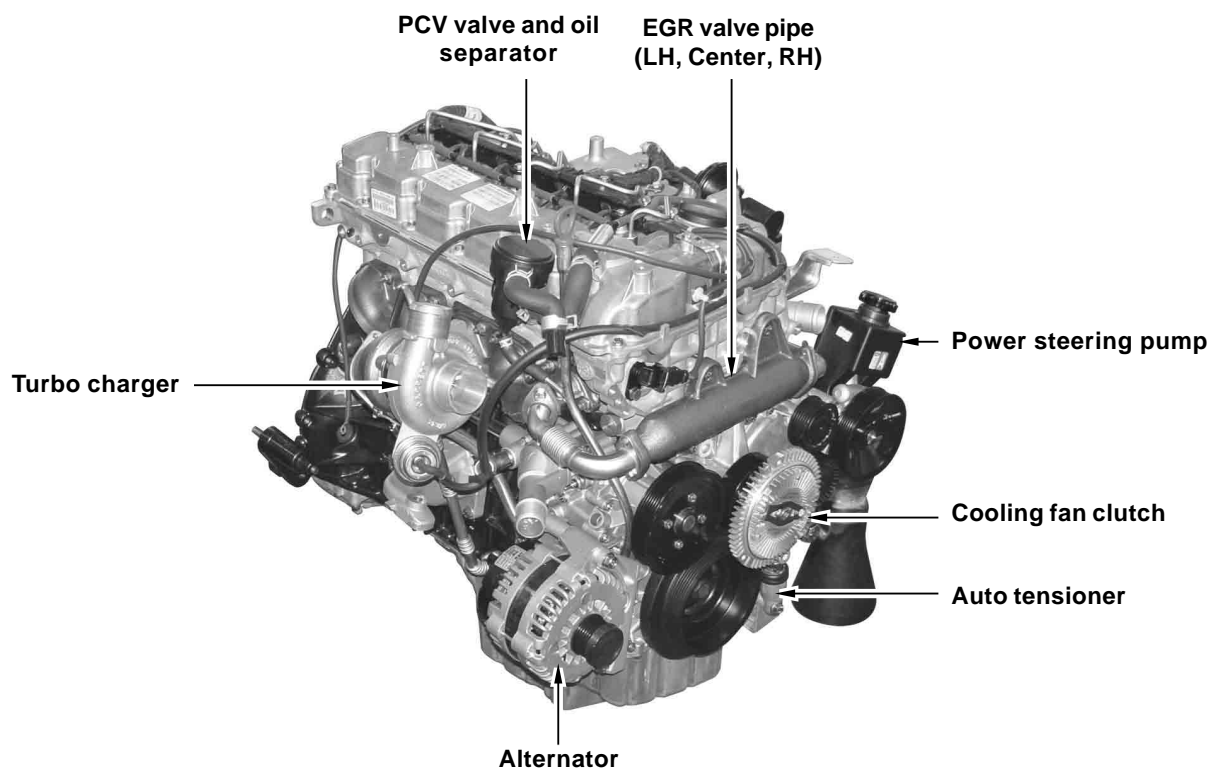
ENGINE ACCESSORIES

► D20DT Engine



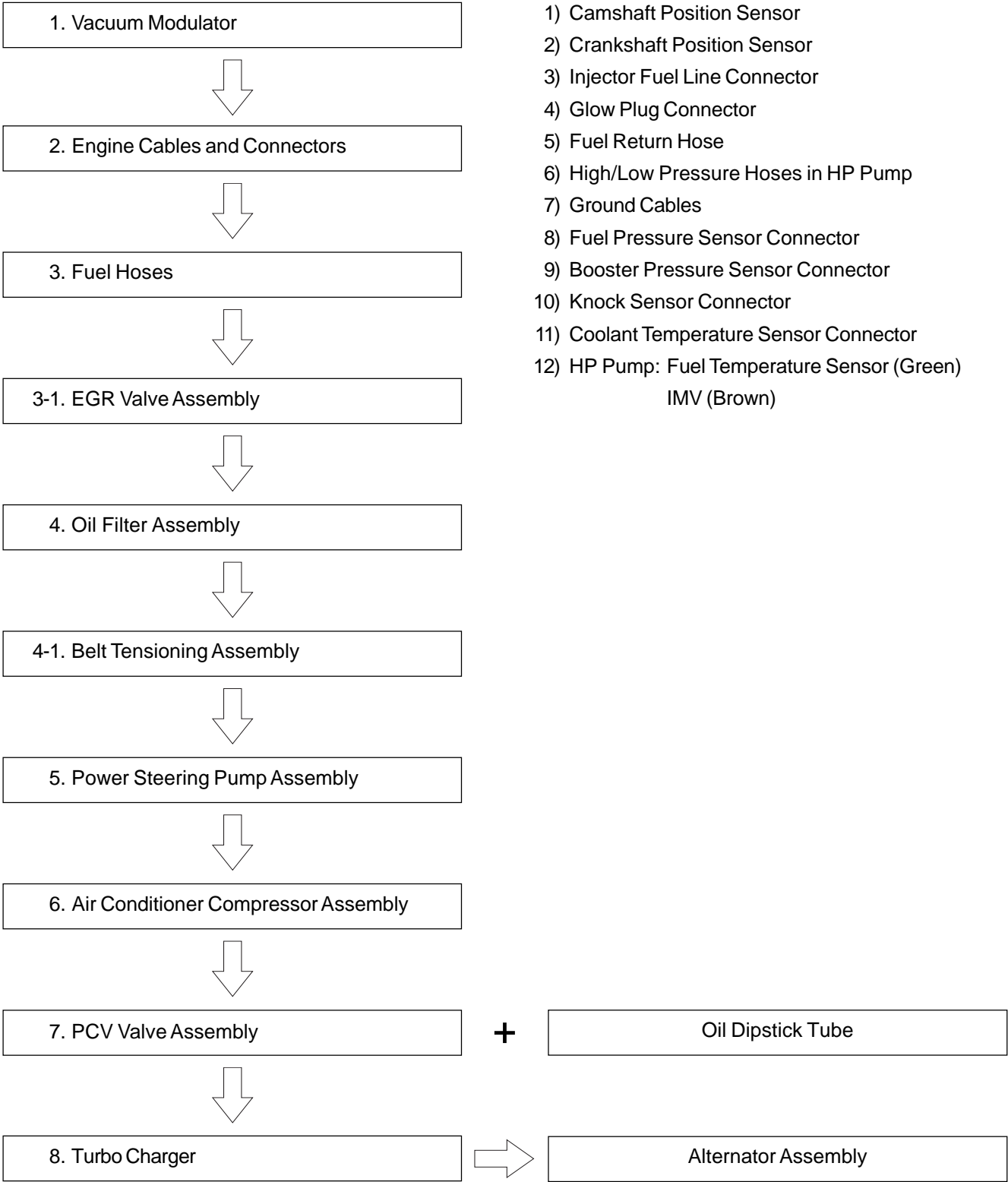
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► D27DT Engine



The engine accessories can be removed without any specific order. In general, remove the components from top to bottom. However, be careful not to splash the lubricants to engine and body when disassembly. Especially, avoid getting into other components.

► Removal and Installation Order of Major Accessories

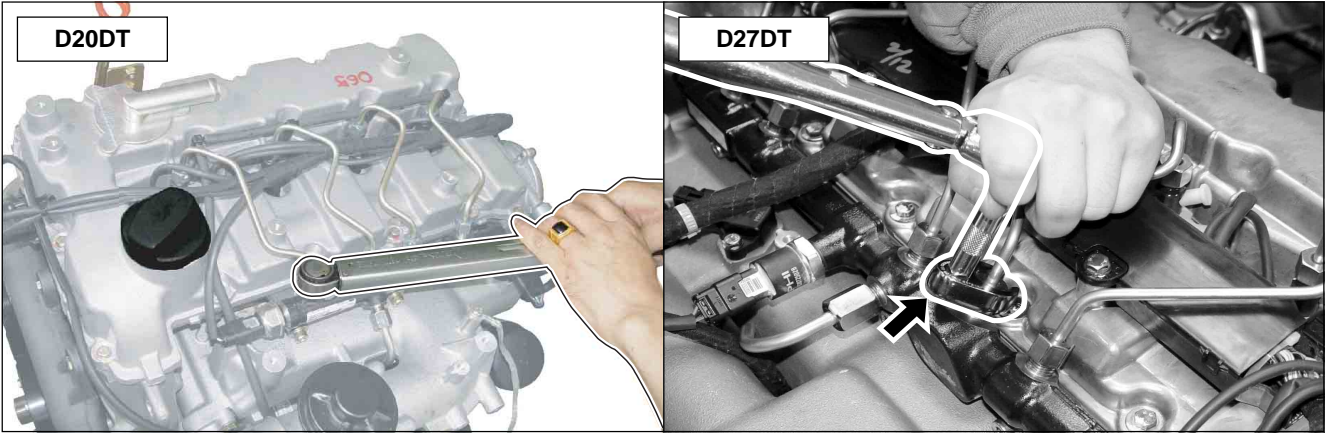


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

1. Remove the fuel pipes.
- 1) Remove the fuel supply pipes between each cylinder and common rail with a special tool.

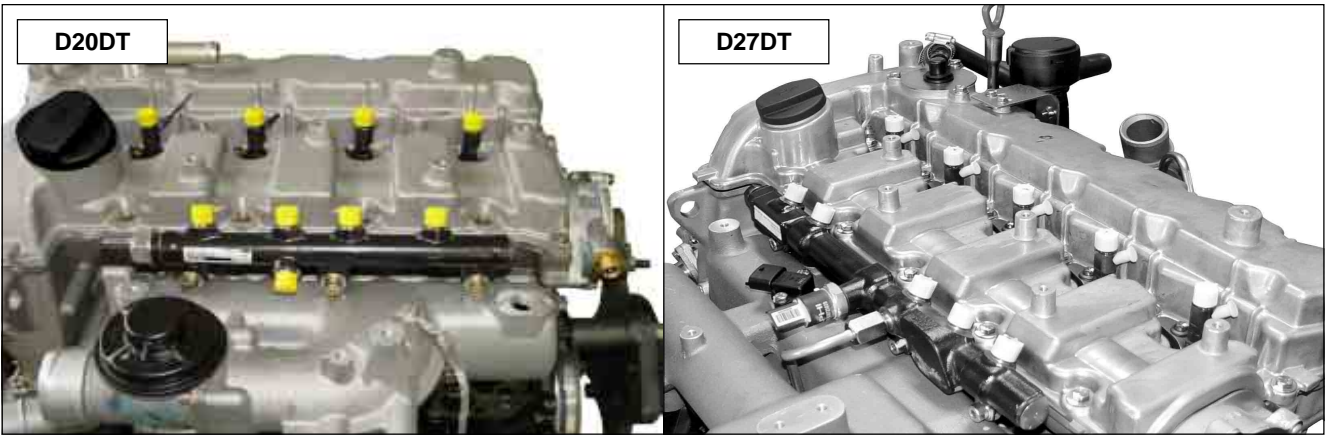
Installation Notice

Tightening torque	40 ± 4.0 Nm
-------------------	-------------



NOTICE

- Plug the openings of injector nozzle and common rail with sealing caps after removed the fuel pipes.





NOTICE

- Replace the pipes with new ones. Be careful not to be mixed the fuel pipes because the pipe appearance of D27DT (#1 and #3 cylinders and #2 and #4) are same each other.



- 2) Remove the high fuel pressure pipe mounting bolts with a special tool.
- High fuel pressure supply pipe at common rail side

Installation Notice

Tightening torque	40 ± 4 Nm
-------------------	-----------

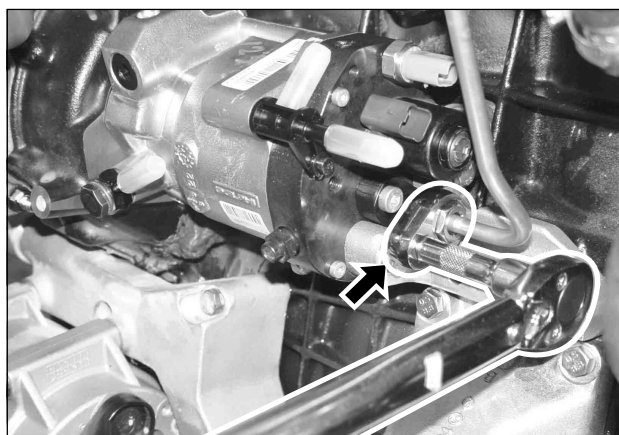


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

3) High fuel pressure supply pipe at HP pump side

Installation Notice

Tightening torque	40 ± 4.0 Nm
-------------------	-------------



4) Unscrew the bracket mounting bolts and remove the high fuel pressure supply pipes.

NOTE

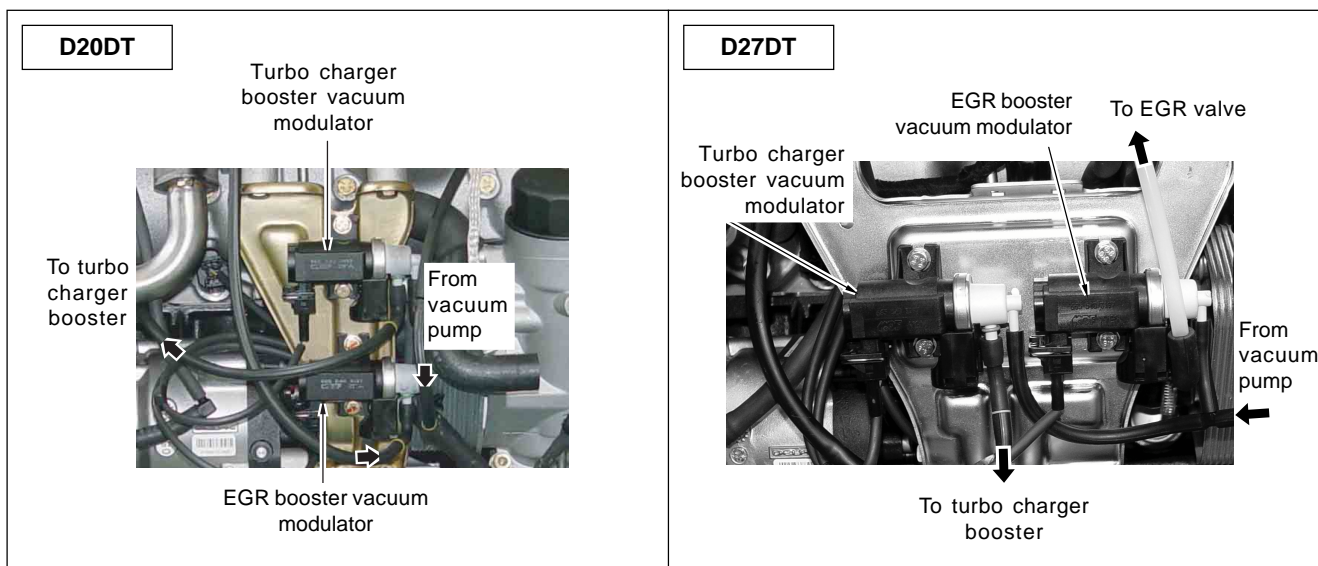
- Special tool: Fuel pipe remover and installer



2. Disconnect the vacuum hoses and module cables from the vacuum modulator.

**NOTICE**

- Put the installation marks on the modulator hoses and connectors.



- 1) Remove the vacuum modulator bracket.
(Upper: 10 M x 2, Lower: 10M x 2)

Installation Notice

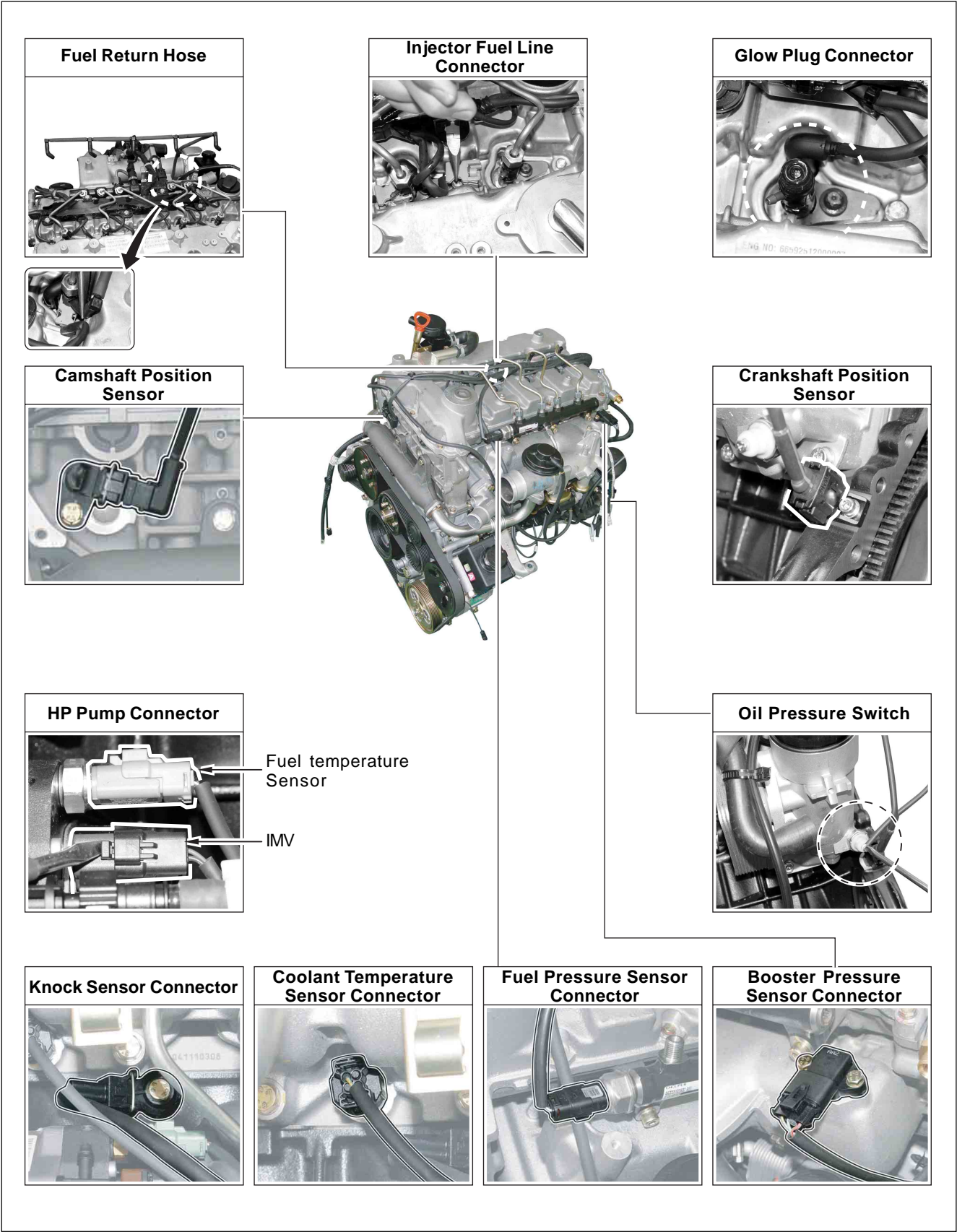
Upper bolt	25 ± 2.5 Nm
Lower bolt	25 ± 2.5 Nm



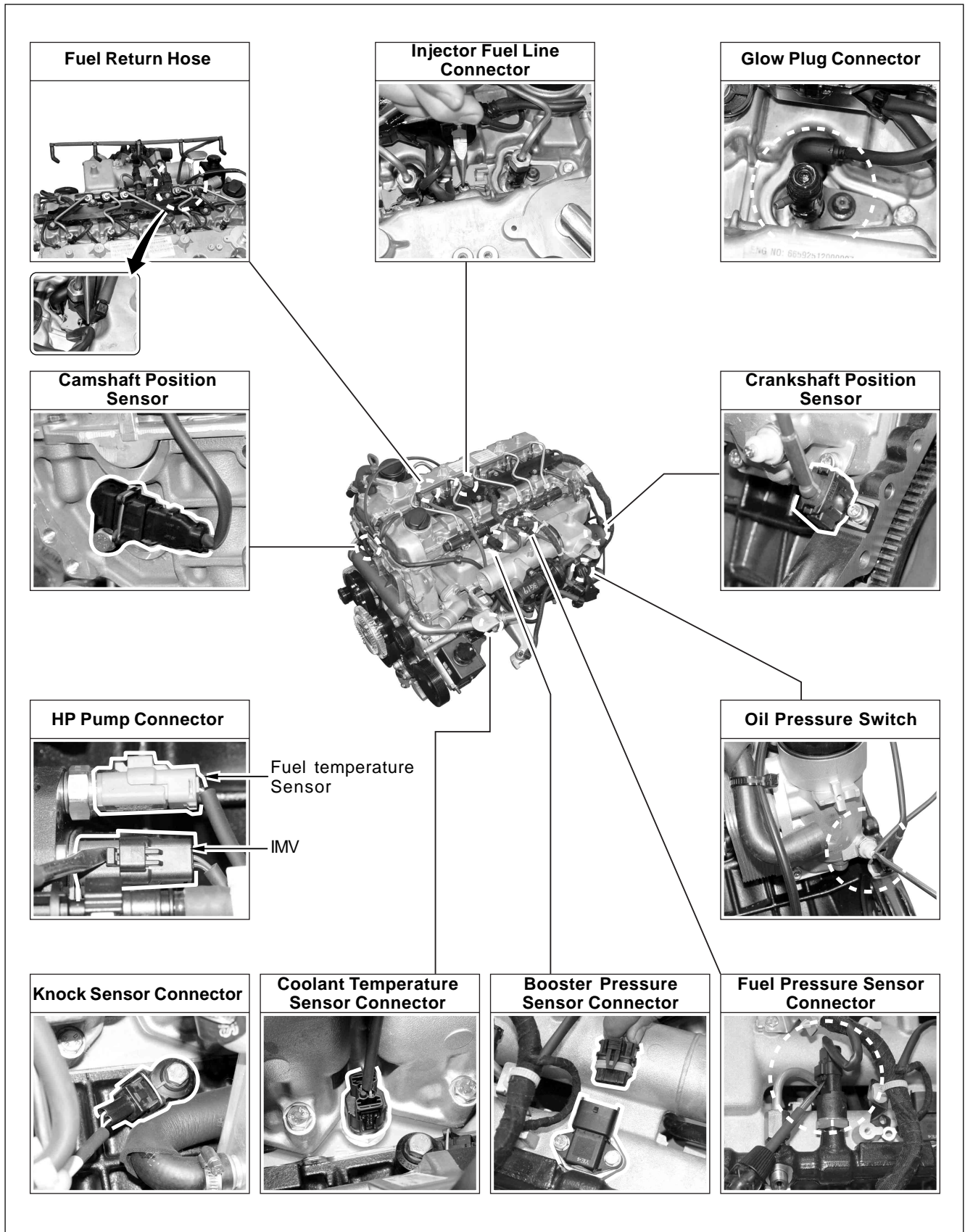
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

3. Disconnect the wiring harnesses and connectors from the engine.

► D20DT Engine



► D27DT Engine



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

- 1) Remove the cable assembly from the engine.

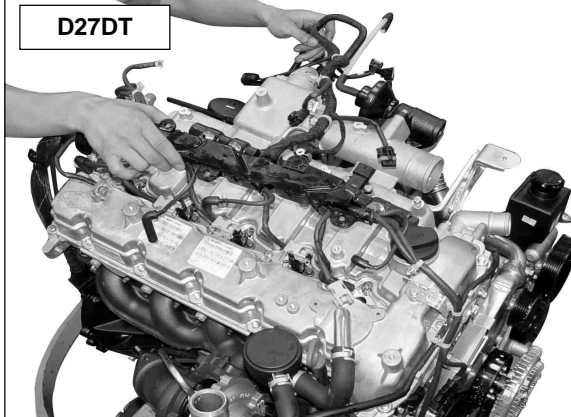
IMPORTANT

- If possible, remove the cables after removing the fuel pipes. It makes the operation easier and protect the cables and connectors.

D20DT



D27DT



IMPORTANT

- Remove the cable screws and ground cable, and then remove the engine cable assembly.

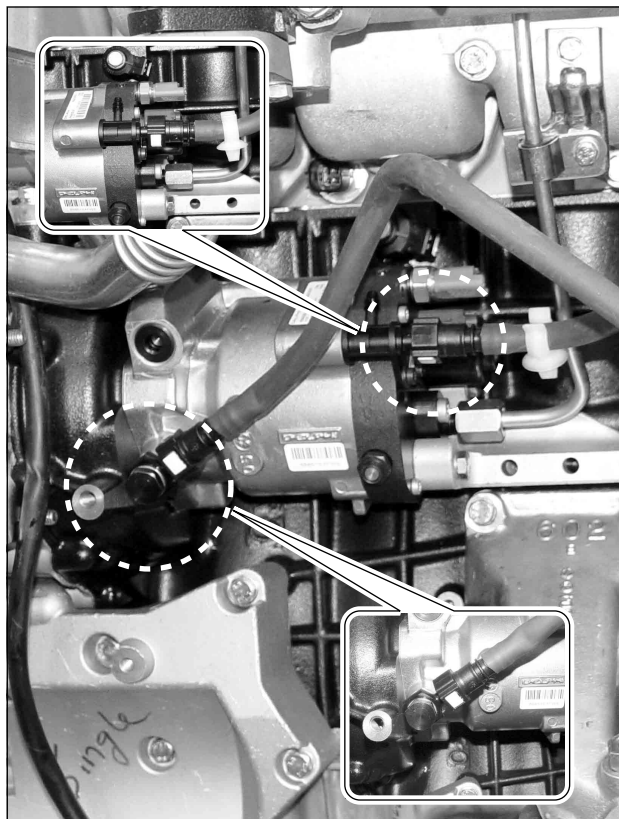
NOTICE

- Be careful not to damage the HP pump connecting pipe (venturi) while removing the fuel hose from the HP pump.

4. Disconnect the high and low fuel pressure hoses from the HP pump.

NOTICE

- Be careful not to damage the hose connections.
- Plug the openings in HP pump immediately after disconnecting the hoses.



5. Remove the EGR valve and EGR valve pipe.

- 1) Disconnect the vacuum hose from the EGR valve.
- 2) Unscrew the EGR valve bolts and EGR #1 pipe connecting bolts and remove the EGR valve and steel gasket.

Installation Notice	D20DT	D27DT
EGR valve bolt	10 ± 1.0 Nm, M6	24 ± 2.4 Nm, M8
EGR valve and center pipe bolt	10 ± 1.0 Nm, M6	24 ± 2.4 Nm, M8



3) Remove the EGR valve #1 pipe.

Installation Notice

Center pipe mounting bolt	25 ± 2.5 Nm
Center pipe and #1 pipe bolt and nut	35 ± 3.5 Nm

- **The EGR #2 pipe should be replaced with new one.**



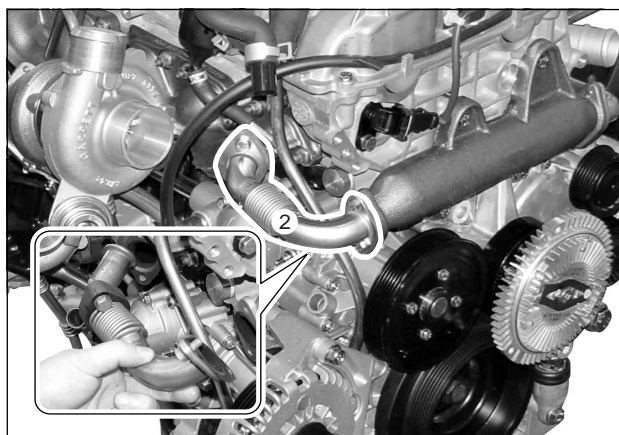
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

- 4) Unscrew the EGR valve #3 pipe (2) mounting bolts and remove the pipe from the exhaust manifold.

Installation Notice

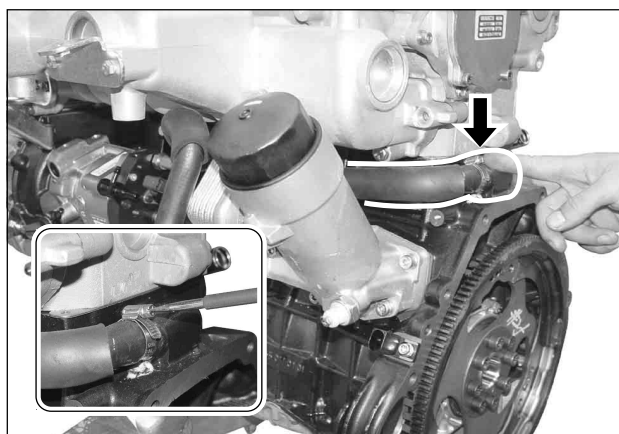
Tightening torque	Nut 35 ± 3.5 Nm Bolt 10 ± 1.0 Nm
-------------------	---

- **The EGR #3 pipe should be replaced with new one.**
- **Make sure that the convex surface of new steel gasket is facing to the bolts.**



6. Remove the oil filter assembly.

- 1) Remove the oil cooler hose.

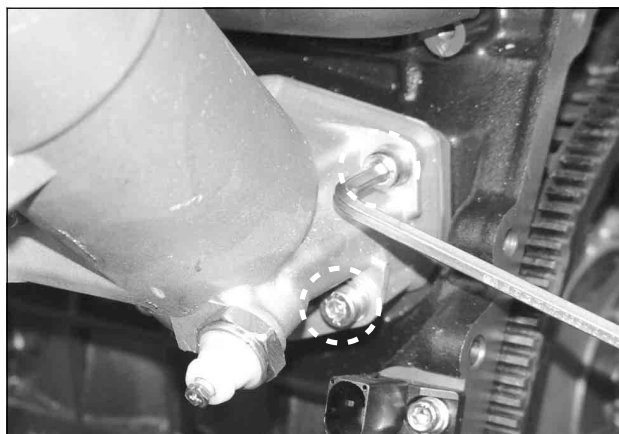


- 2) Remove the oil filter assembly mounting bolts.



NOTICE

- **Be careful not to flow out the residual oil from the engine. If flown out, immediately wipe it out.**

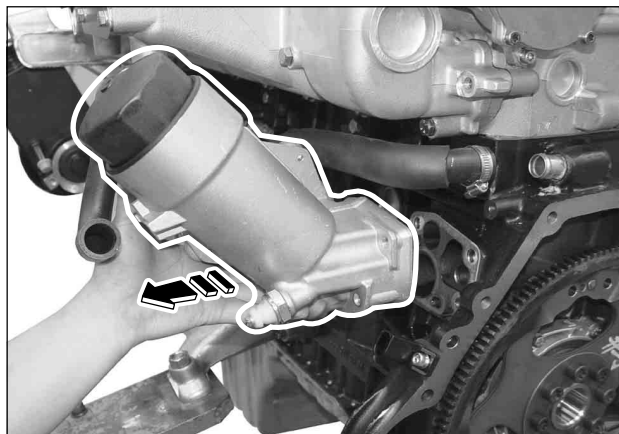


- 3) Remove the oil filter assembly from the cylinder block.

Installation Notice

- **Replace the oil filter gasket with new one.**

Tightening torque	25 ± 2.5 Nm
-------------------	-----------------

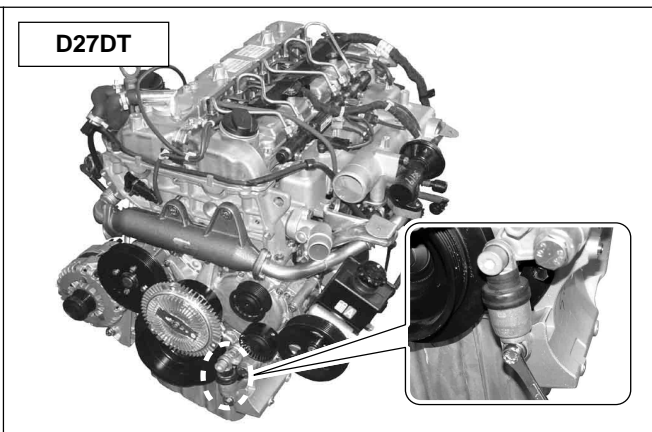
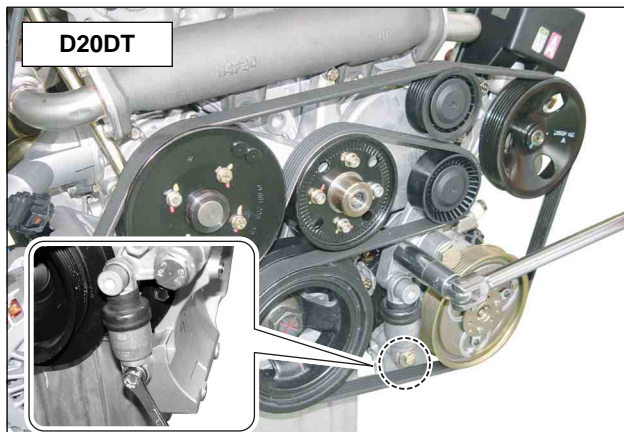


7. Remove the belt tensioning device.

- 1) Remove the shock absorber lower mounting bolt.

Installation Notice

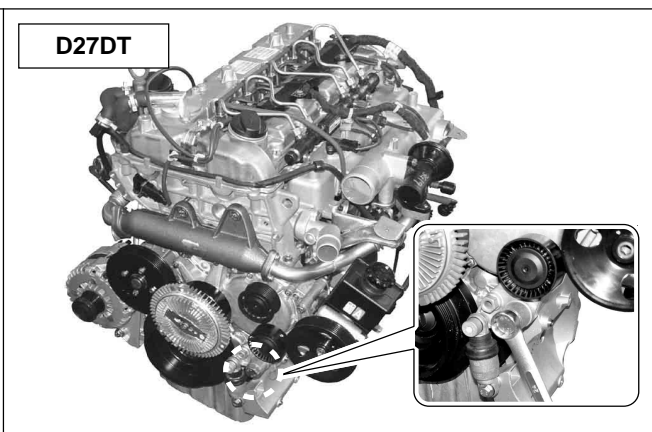
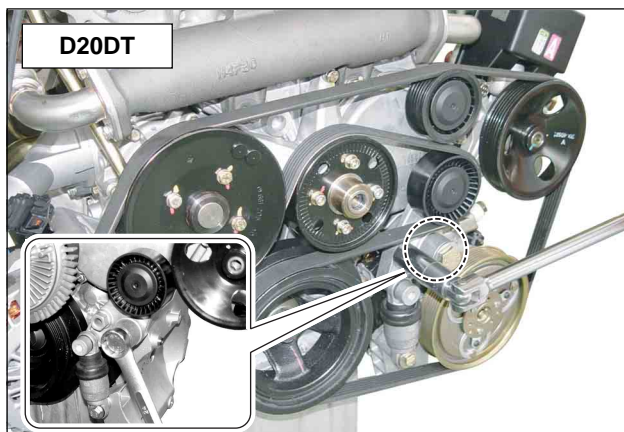
Tightening torque	32 ± 3 Nm
-------------------	---------------



- 2) Remove the shock absorber upper mounting bolt.

Installation Notice

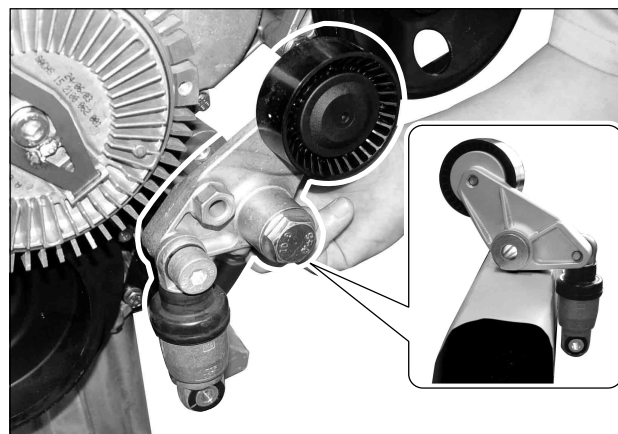
Tightening torque	82 ± 6 Nm
-------------------	---------------



- 3) Remove the belt tensioning device.

NOTICE

- To prevent the oil leaks, store the removed shock absorber assembly with standing up.
- For air bleeding, pump the shock absorber around 3 times after installation.
- Be careful not to damage the rubber parts of the shock absorber when removing.
- To prevent the oil leaks, remove the bolts from bottom to top section. On the contrary, when installing, tighten the bolts from top to bottom section.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

8. Remove the power steering pump assembly.
 - 1) Remove the power steering pump mounting bolts.

Installation Notice

Tightening torque	25 ± 2.5 Nm
-------------------	-----------------

- ***Be careful not to flow out the oil.***

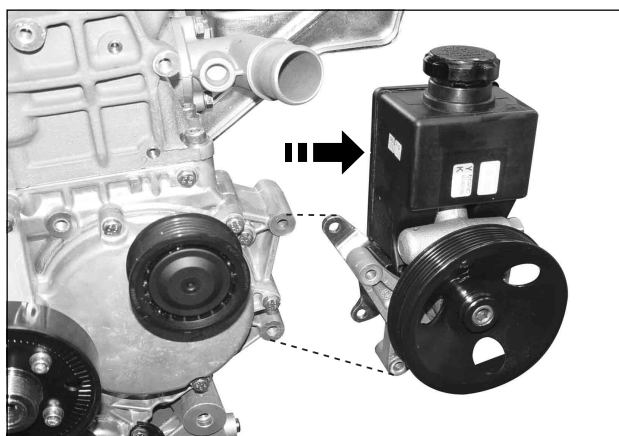


- 2) Remove the power steering pump assembly from the engine.



NOTICE

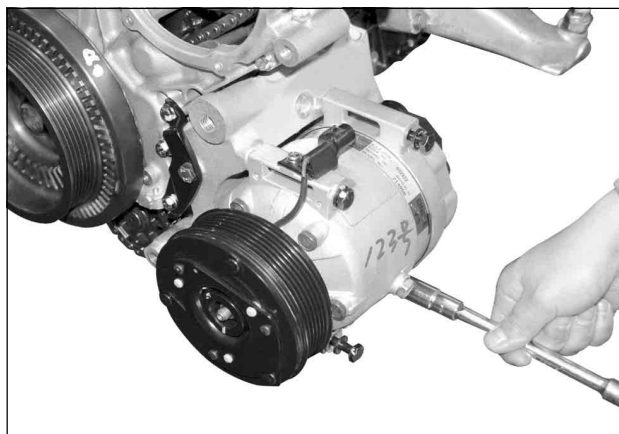
- To prevent the oil leaks, store the removed power steering pump assembly with standing up.



9. Remove the air conditioner compressor assembly.
 - 1) Unscrew the bolts and remove the air conditioner compressor assembly.

Installation Notice

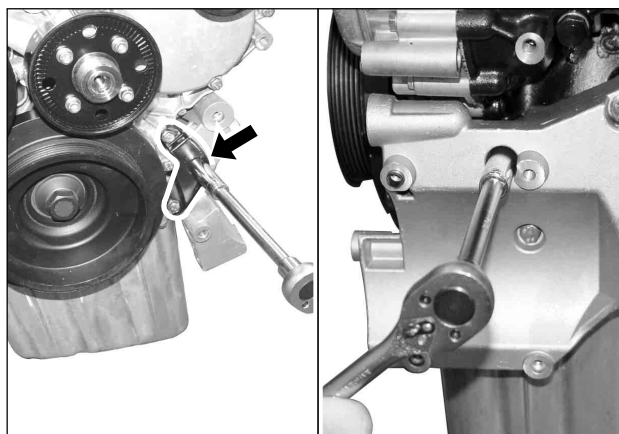
Tightening torque	25 ± 2.5 Nm
-------------------	-----------------



- 2) Unscrew the bolts and remove the air conditioner mounting bracket.

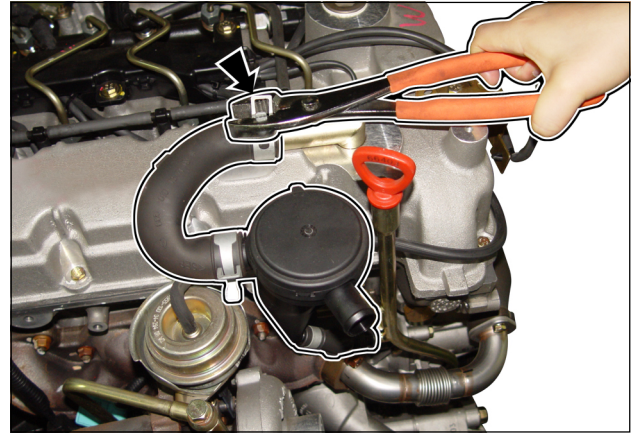
Installation Notice

Front bolt	25 ± 2.5 Nm
Side bolt	25 ± 2.5 Nm

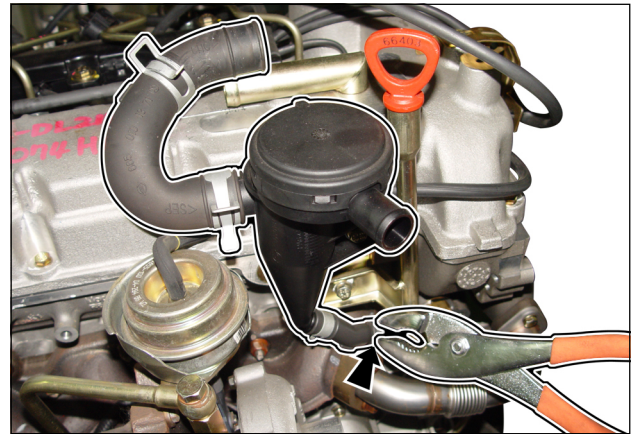


10. Remove the PCV valve assembly.

1) Remove the PCV valve hose.



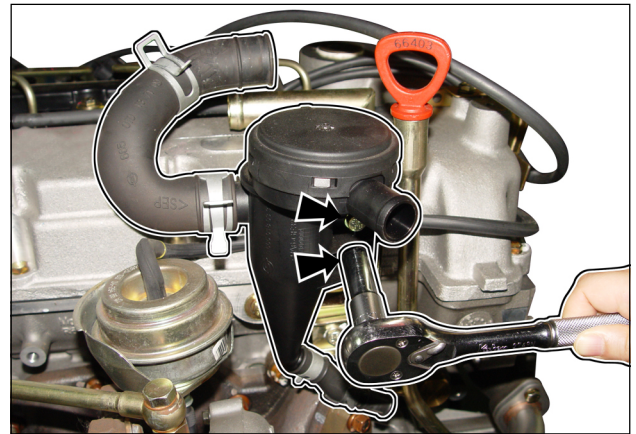
2) Remove the PCV valve hose connected to the engine oil hose.



3) Unscrew the PCV valve mounting bolts and remove the PCV valve assembly.

Installation Notice

Tightening torque	$10 \pm 1.0 \text{ Nm}$
-------------------	-------------------------



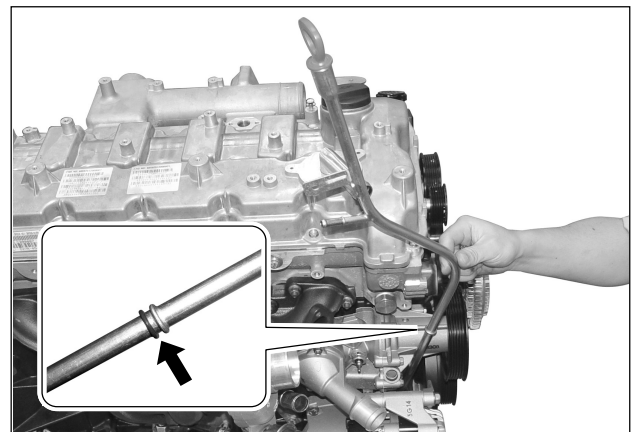
11. Remove the oil dipstick tube assembly.

Unscrew the bracket bolts and remove the dipstick tube with O-ring.



NOTICE

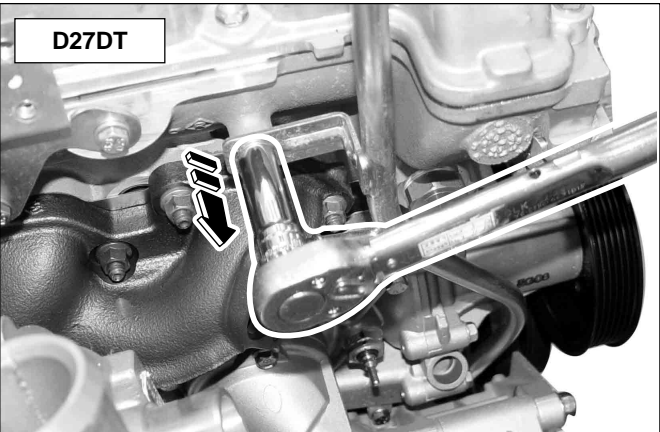
- Insert new O-ring into the oil dipstick tube before installation.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Installation Notice

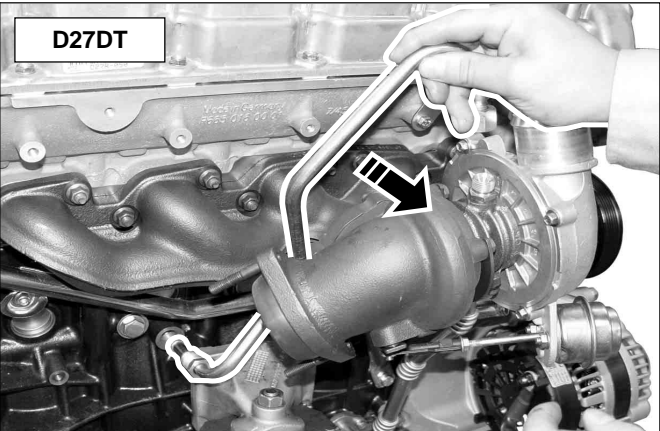
Tightening torque	10 ± 1.0 Nm
-------------------	-------------



12. Remove the turbo charger assembly.
- 1) Unscrew the bolts and remove the oil supply pipe.

Installation Notice

Upper bolt (M19)	25 ± 2.5 Nm
Lower bolt (M17)	20 ± 2.0 Nm

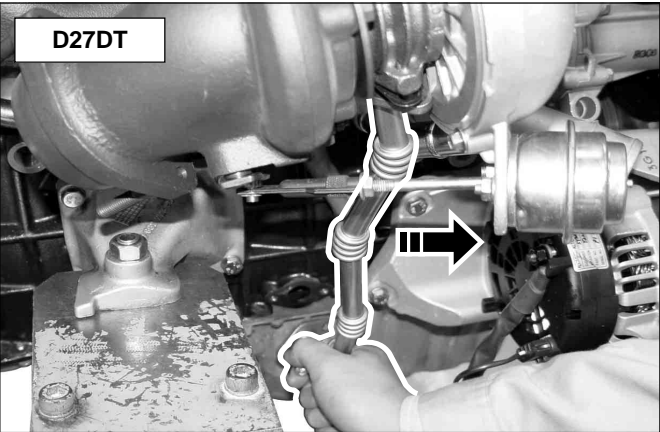


- 2) Unscrew the bolts and remove the oil return pipe.

Installation Notice

- Make sure to install the gasket with correct direction.

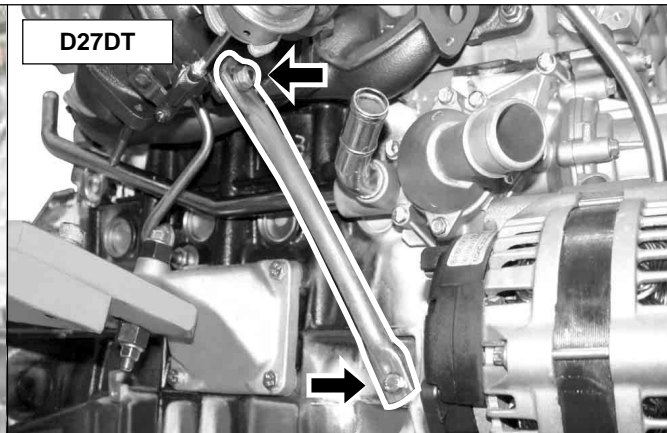
Tightening torque	10 ± 1.0 Nm
-------------------	-------------



3) Unscrew the turbo charger mounting bracket bolts.

Installation Notice

Tightening torque	25 ± 2.5 Nm
-------------------	-------------



4) Unscrew the turbo charger mounting bolts to exhaust manifold.

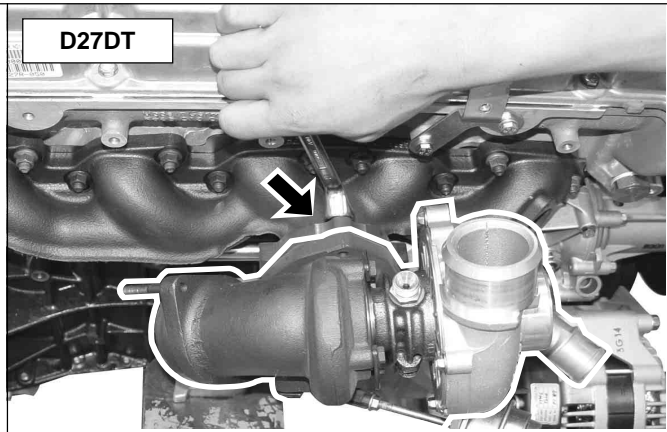
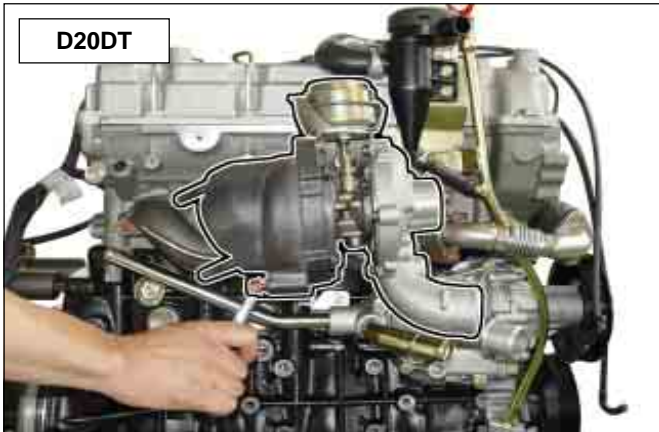


NOTICE

- Use only 12 1/2 wrench.

Installation Notice

Tightening torque	25 ± 2.5 Nm
-------------------	-------------



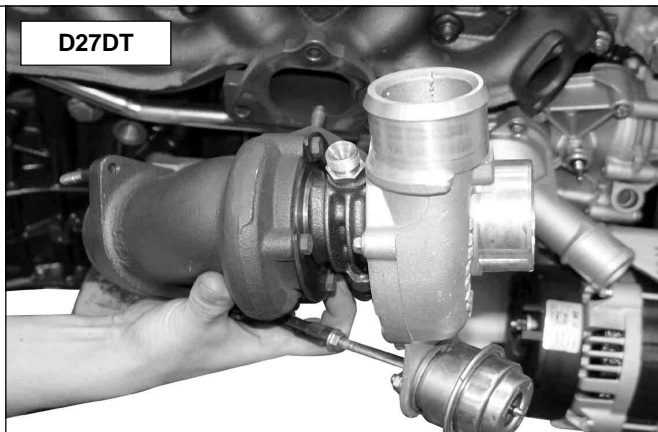
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

5) Remove the turbo charger assembly.

D20DT



D27DT



13. Remove the alternator assembly.

1) Unscrew the bolts and remove the alternator.

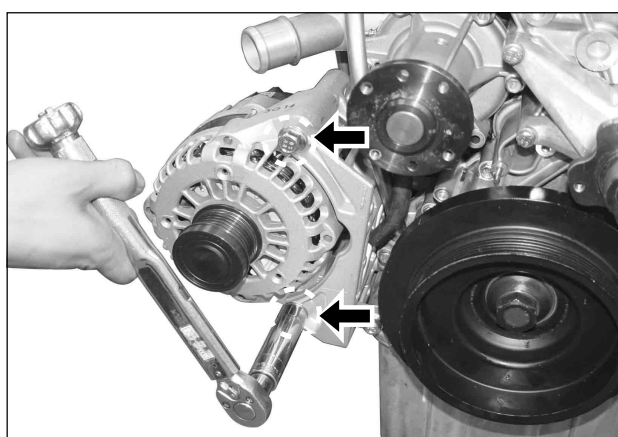


NOTICE

- Alternator Capacity: 140 A

Installation Notice

Tightening torque	$46 \pm 4.6 \text{ Nm}$
-------------------	-------------------------



2) Remove the alternator mounting bracket.

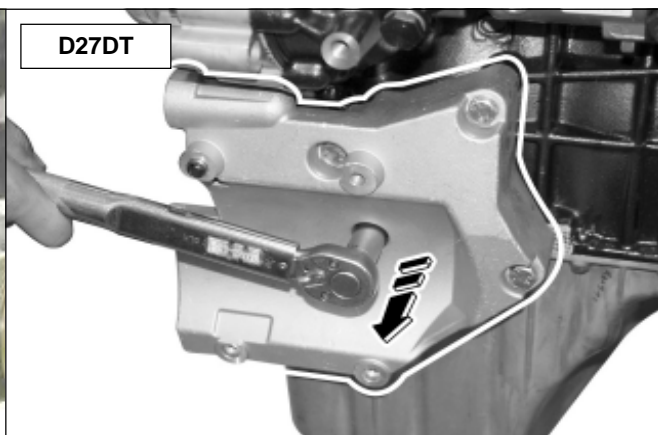
Installation Notice

M13 bolt	$25 \pm 2.5 \text{ Nm}$
Torx 6 bolt	$25 \pm 2.5 \text{ Nm}$

D20DT



D27DT



ENGINE OVERHAUL

1. Unscrew the injector nozzle holder bolts (12-sided) and remove the injector bracket.

Installation Notice

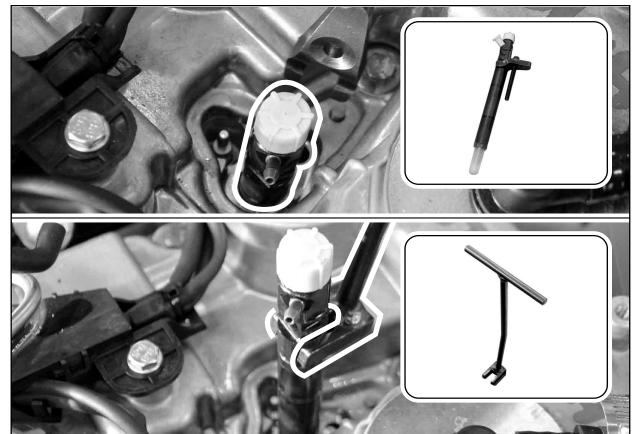
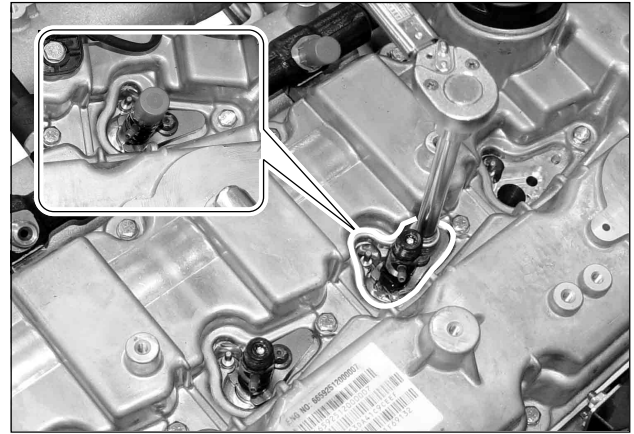
Tightening torque	$9 \pm 1.0 \text{ Nm}$, $190^\circ + 10^\circ$
-------------------	--

2. Remove the injectors with a injector extractor (special tool).



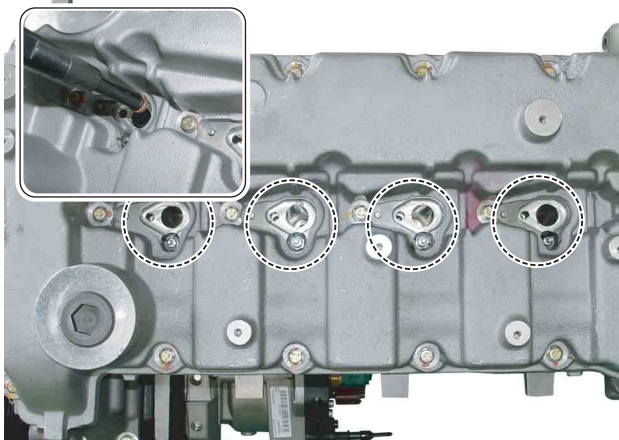
NOTICE

- Be careful not to take off the sealing caps on the injectors and fuel system.
- Replace the copper washers with new ones when installing.

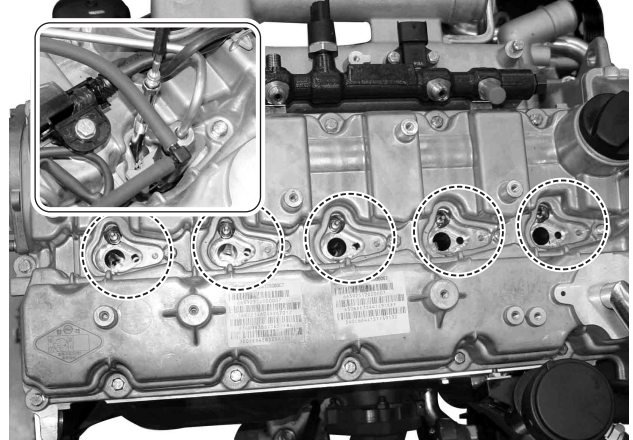


3. If the copper washer is in injector hole, remove it with a special tool as shown in the figure.

D20DT



D27DT

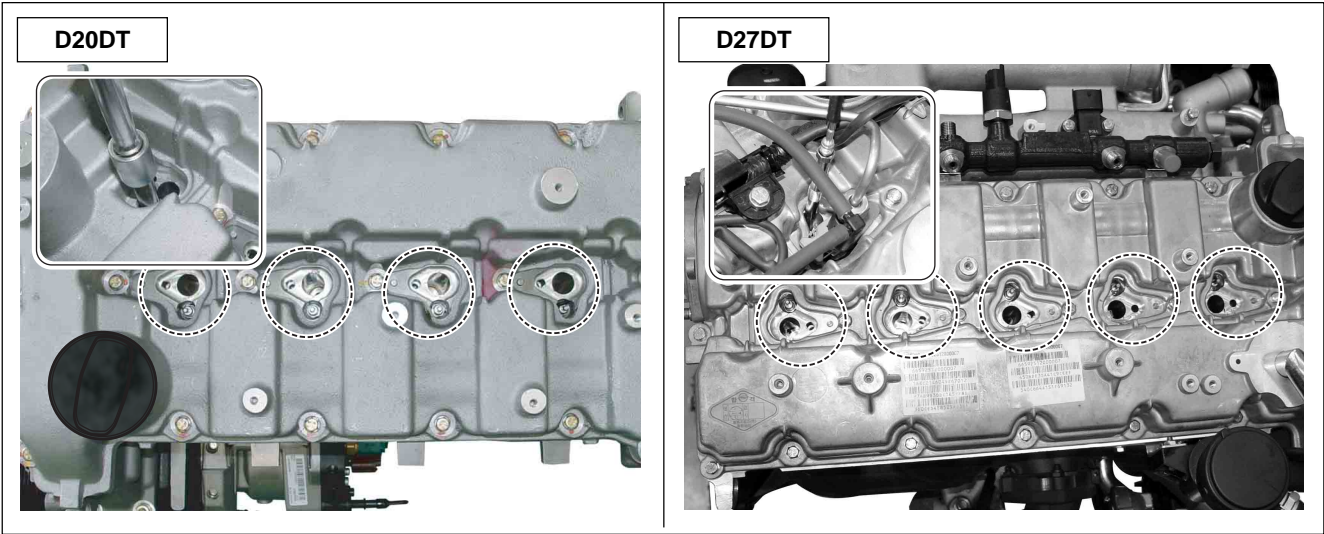


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

4. Remove the glow plugs with a special tool.

Installation Notice


Tightening torque	15 ~ 18 Nm
-------------------	------------



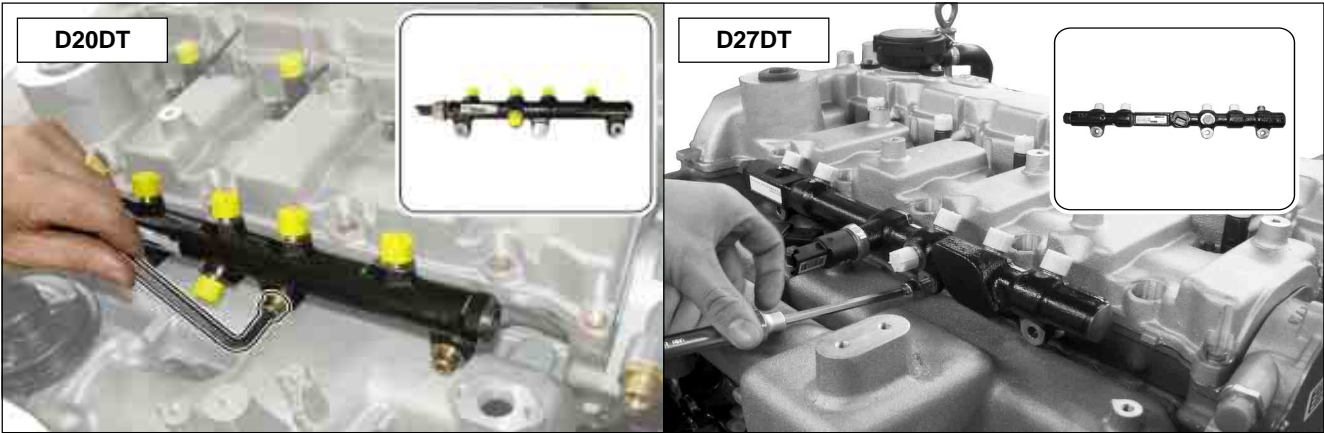
5. Unscrew the Torx bolts and remove the common rail from the engine.

Installation Notice

Tightening torque	25 ± 2.5 Nm
-------------------	-------------

**NOTICE**

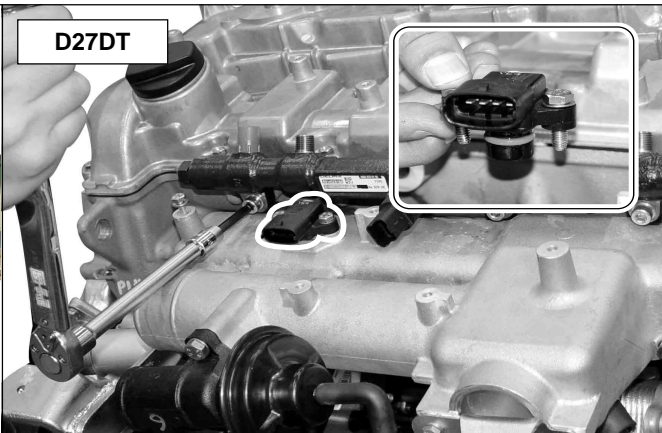
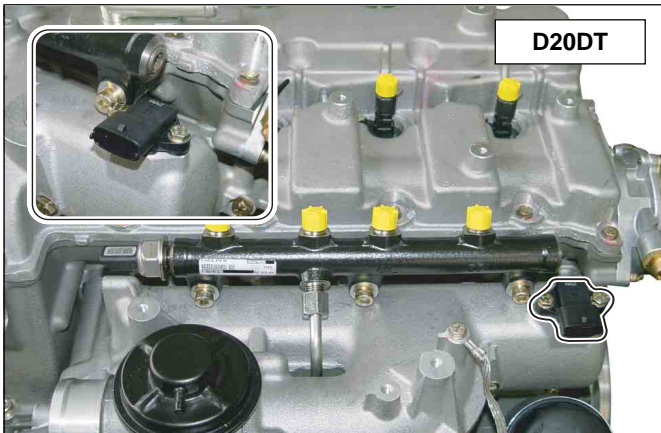
- Plug the openings with sealing cap.



6. Remove the booster sensor from the engine.

Installation Notice

Tightening torque	10 ± 1.0 Nm
-------------------	-------------

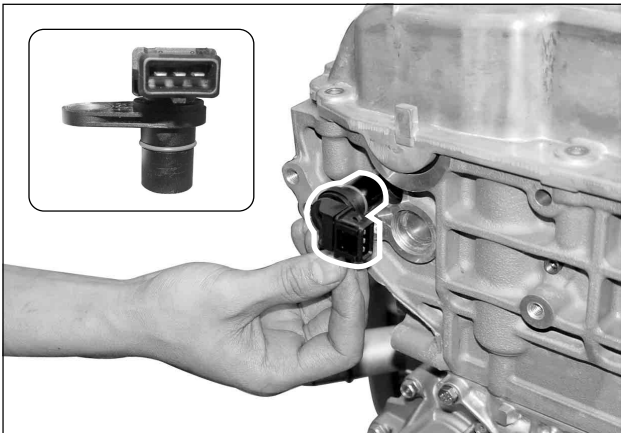


7. Unscrew the bolt and remove the camshaft position sensor.

Installation Notice

Tightening torque	12 ± 2 Nm
-------------------	-----------

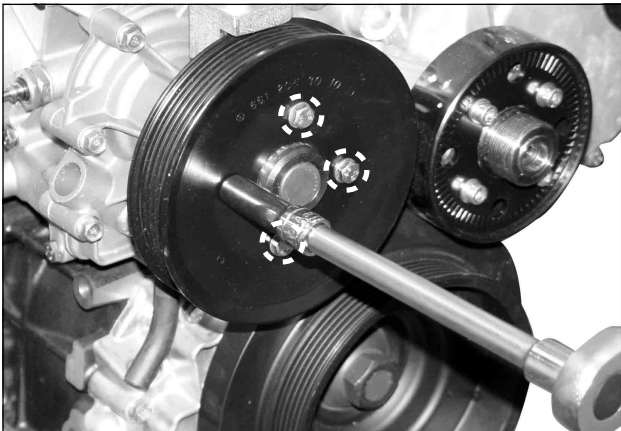
Apply Loctite on the thread before installation.



8. Unscrew the bolts and remove the cooling fan pulley while holding it with a special tool.

Installation Notice

Tightening torque	10 ± 1.0 Nm
-------------------	-------------

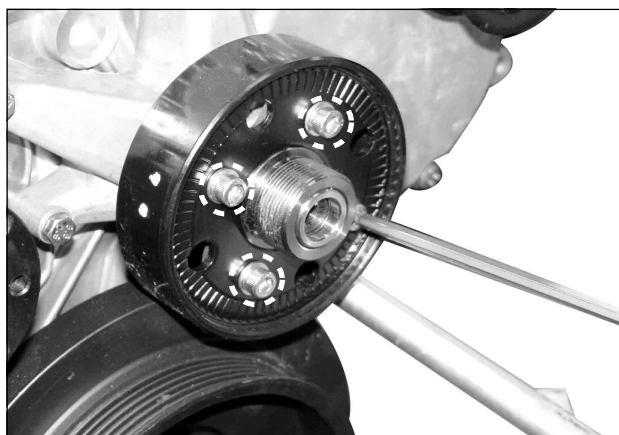


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

9. Remove the cooling fan belt idle pulley while holding it with a special tool.

Installation Notice

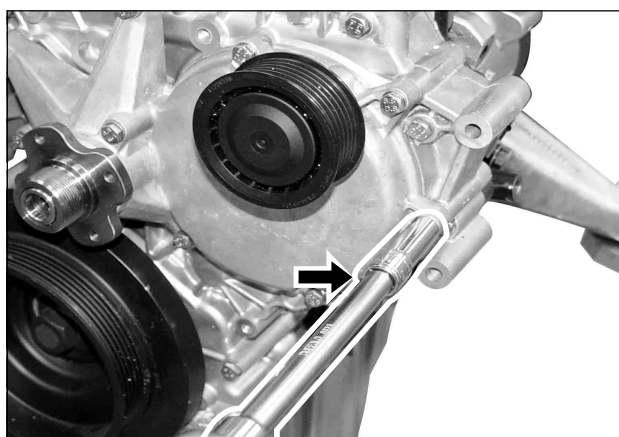
Tightening torque	10 ± 1.0 Nm
-------------------	-----------------



10. Unscrew the bolts and remove the cooling fan bracket assembly (timing chain cover).

Installation Notice

Tightening torque	10 ± 1.0 Nm
-------------------	-----------------



11. Unscrew the bolts and remove the cylinder head cover.

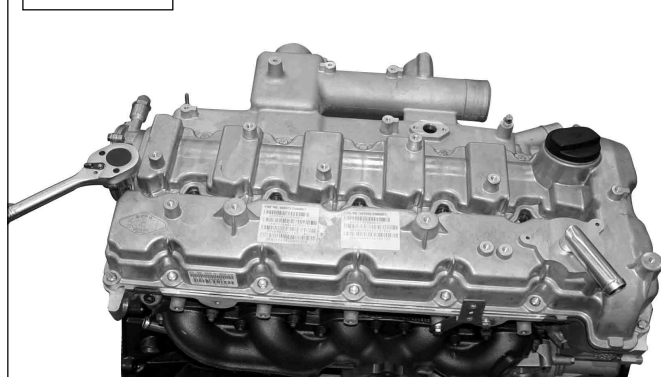
Installation Notice

Tightening torque	10 ± 1.0 Nm
-------------------	-----------------

D20DT



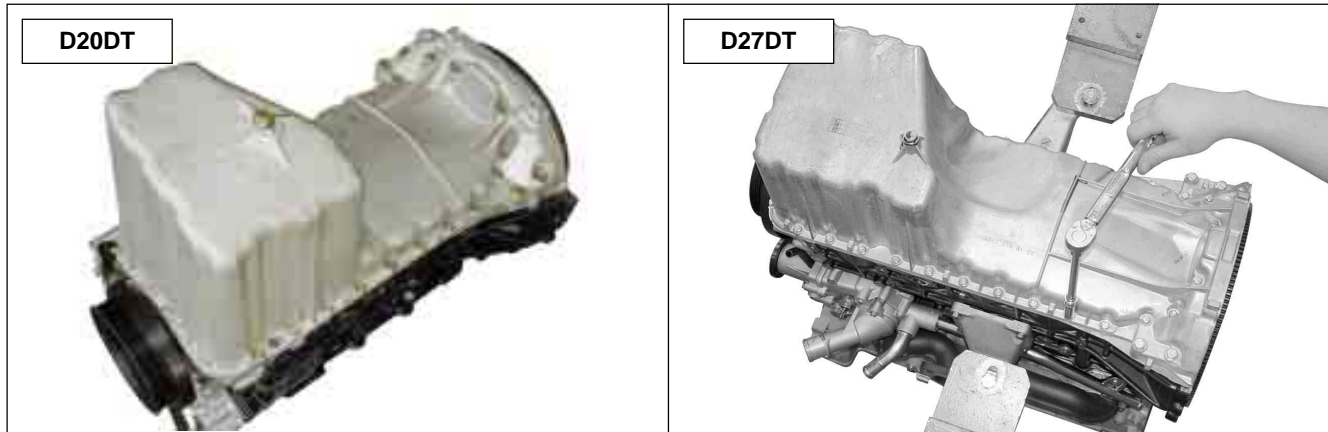
D27DT



12. Turn over the engine and remove the oil pan.

Installation Notice (): D27DT

Tightening torque	Nm
M6 x 20: 24 EA	10 ± 1.0
M6 x 35: 3 (2) EA	10 ± 1.0
M6 x 85: 3 (2) EA	10 ± 1.0
M8 x 40: 4 EA	25 ± 2.5



NOTICE

- Remove the oil seal residues from the oil pan and apply the liquid gasket on the parting surface.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

13. Unscrew the nuts and remove the exhaust manifold.

Installation Notice

Tightening torque	40 ± 4.0 Nm
-------------------	-------------



NOTICE

- The exhaust manifold gasket is removed along with the exhaust manifold. Mark the installation direction to prevent wrong installation. Otherwise, it may cause a sealing trouble.

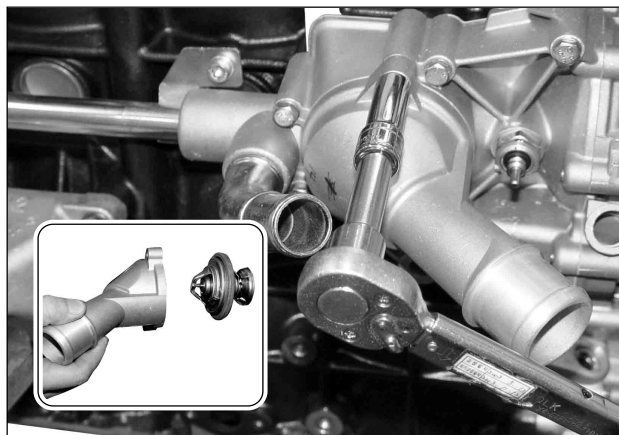


14. Unscrew the bolts and remove the thermostat.

Installation Notice

Tightening torque	10 ± 1.0 Nm
-------------------	-------------

- ***Be careful not to flow out the residual coolant.***



15. Unscrew the bolts and remove the water pump.

Installation Notice

Tightening torque	10 ± 1.0 Nm
-------------------	-------------

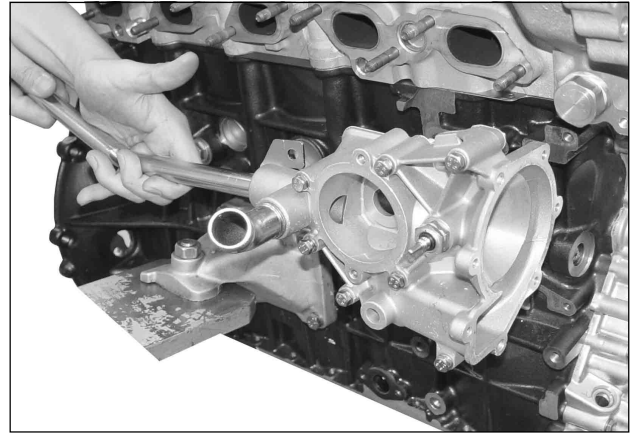


16. Unscrew the bolts and remove the water pump housing.

Installation Notice

Tightening torque	$10 \pm 1.0 \text{ Nm}$
-------------------	-------------------------

- ***Be careful not to flow out the residual coolant.***

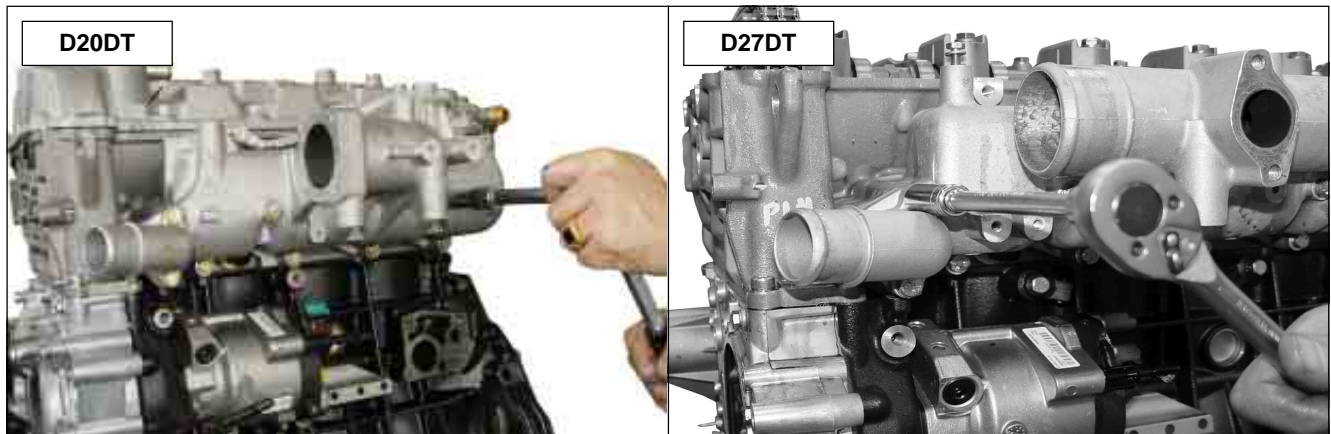


17. Unscrew the bolts and remove the coolant inlet port from the intake manifold.

Installation Notice

Tightening torque	$25 \pm 2.5 \text{ Nm}$
-------------------	-------------------------

- ***Be careful not to get the coolant into the intake manifold and engine.***



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

18. Unscrew the bolts and remove the intake manifold assembly.

Installation Notice

Tightening torque	25 ± 2.5 Nm
-------------------	-------------

**NOTICE**

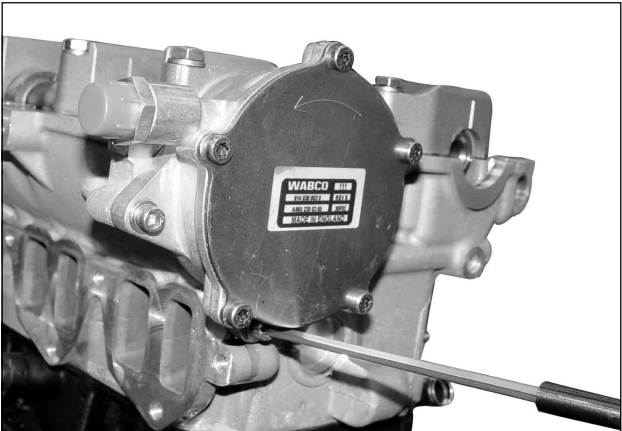
- Replace the gasket with new one once removed.



19. Remove the vacuum pump from the cylinder head.

Installation Notice

Tightening torque	10 ± 1.0 Nm
-------------------	-------------



20. Install the engine lock (special tool) onto the flywheel ring gear so that the engine will not rotate.

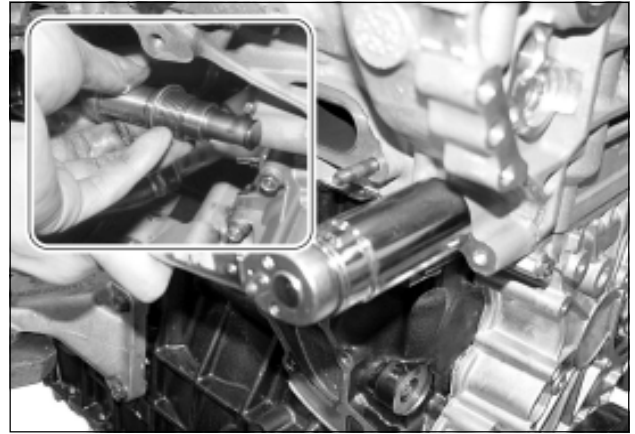


21. Remove the chain tensioner.

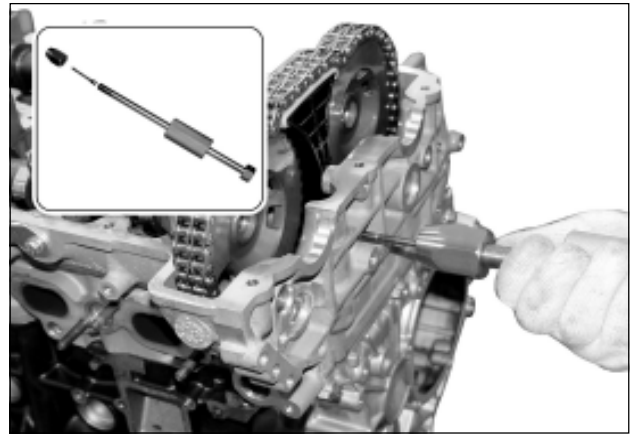
※ **Preceding Works:** removal of EGR pipe and oil dipstick tube

Installation Notice

Tightening torque	65 ± 5.0 Nm
-------------------	-----------------



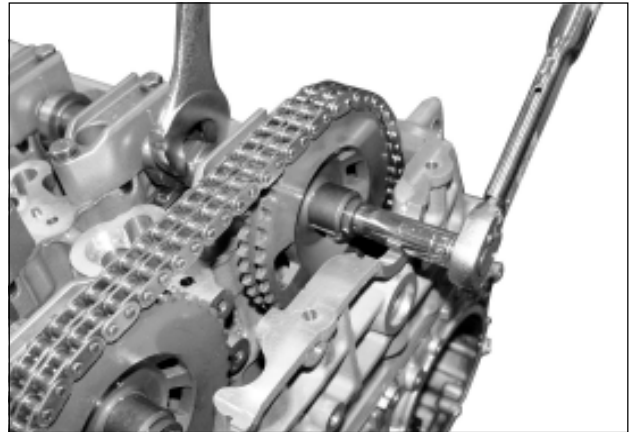
22. Pull out the lock pin and remove the upper chain guide bracket.



23. Unscrew the bolt and remove the intake camshaft sprocket.

Installation Notice

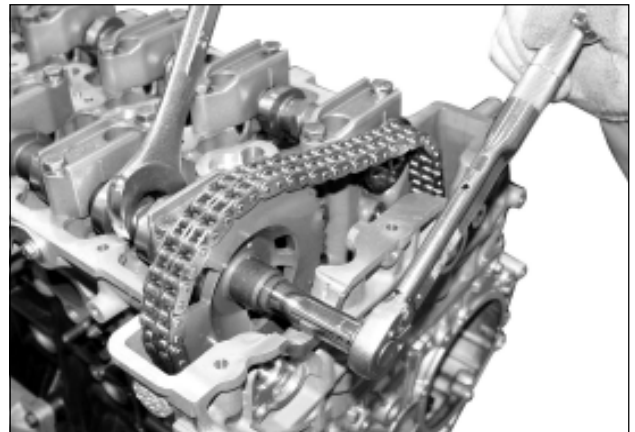
Tightening torque	25 ± 2.5 Nm, $90^\circ \pm 10^\circ$
-------------------	---



24. Unscrew the bolt and remove the exhaust camshaft sprocket.

Installation Notice

Tightening torque	25 ± 2.5 Nm, $90^\circ \pm 10^\circ$
-------------------	---



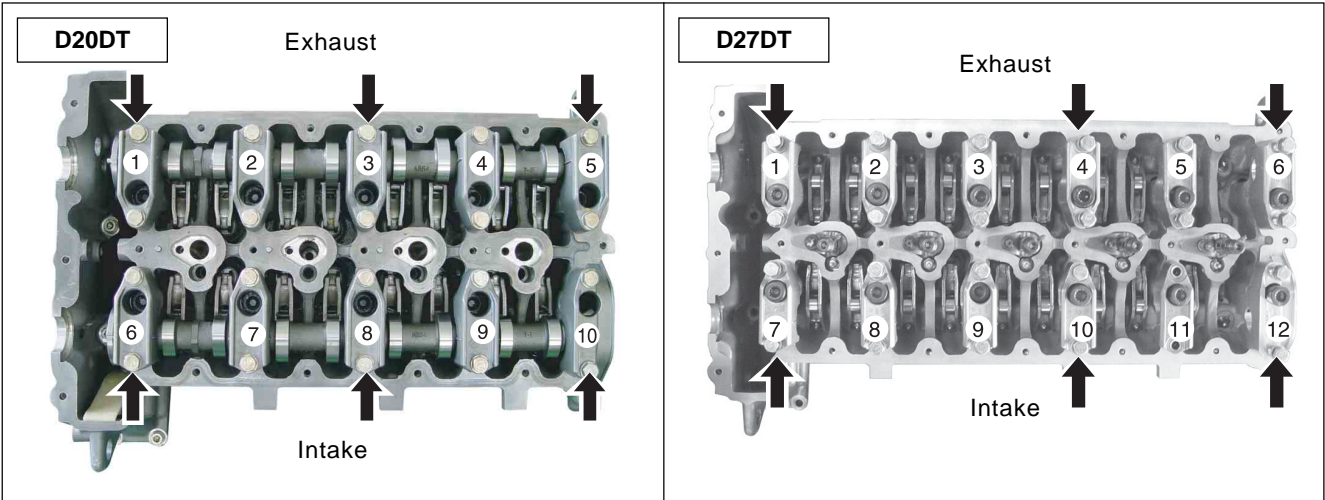
25. Remove the camshaft bearing cap bolts so that the tightening force can be relieved evenly.
- D20DT

• Intake: #6, #8, #10

• Exhaust: #1, #3, #5
- D27DT

• Intake: #7, #10, #12

• Exhaust: #1, #4, #6
- However, there is no specific removal sequence.



- D20DT

• Intake: #7, #9

• Exhaust: #2, #4
- D27DT

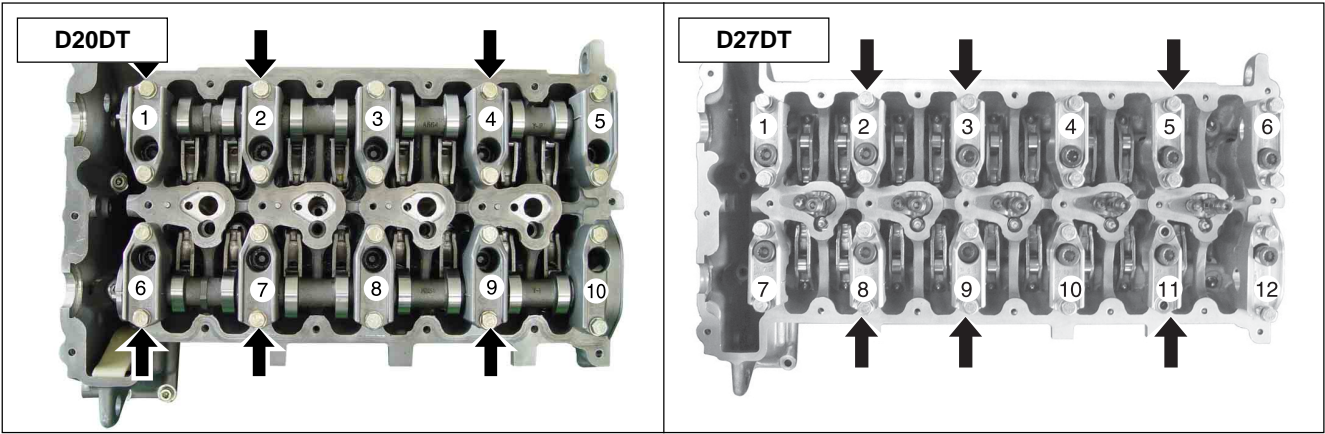
• Intake: #8, #9, #11

• Exhaust: #2, #3, #5

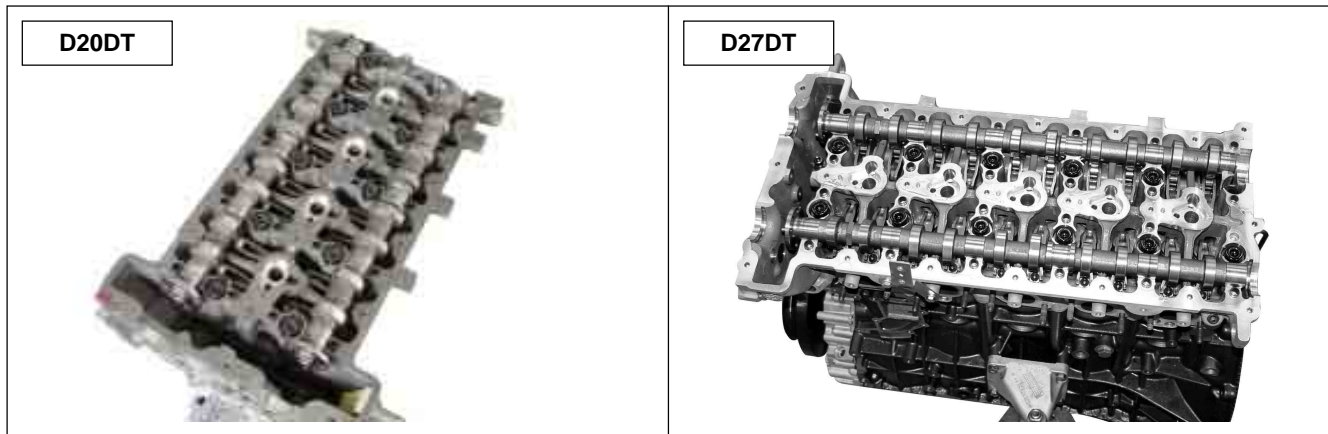
Do not remove the bolts at a time completely. Remove them step by step evenly or camshaft can be seriously damaged.

Installation Notice

Tightening torque	25 ± 2.5 Nm
-------------------	-------------



26. Remove the intake and exhaust camshafts from the cylinder head.

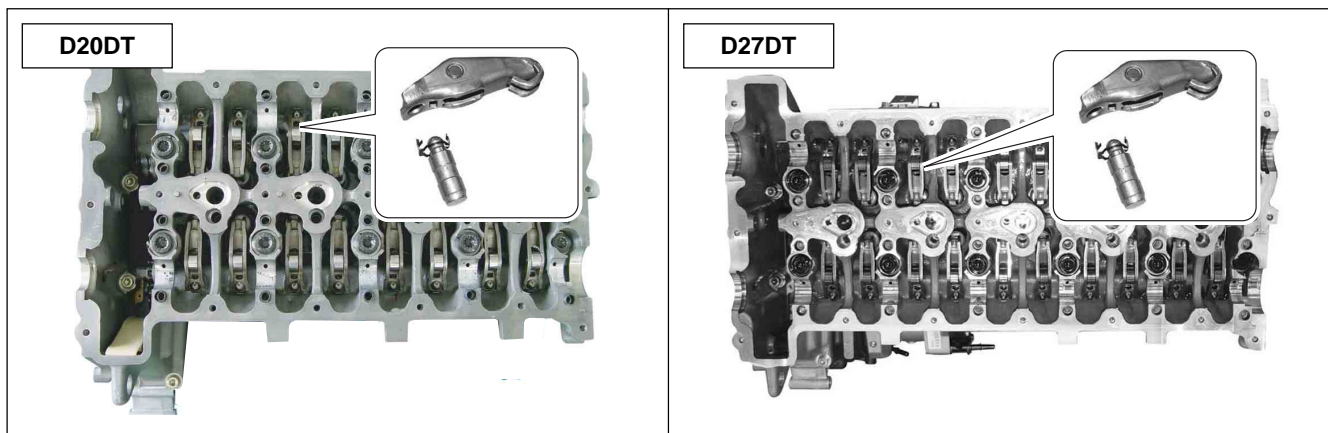


27. Remove the finger follower and the HLA device.

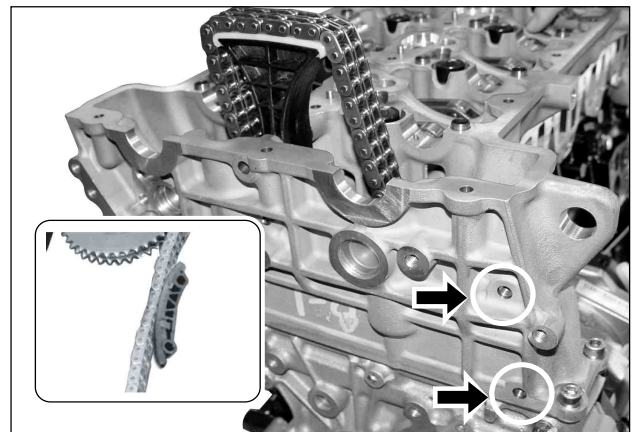


NOTICE

- Avoid contact with hot metal parts when removing the HLA device immediately after stopping the engine.
- Be careful not to be contaminated by foreign materials.
- To prevent the oil leaks, store the removed finger follower and HLA device with standing up.
- If the HLA can be easily pressed in by hand, it indicates the oil inside of HLA has been flown out. In this case, replace it with new one.



28. Pull out the pin and remove the timing chain guide from the engine.

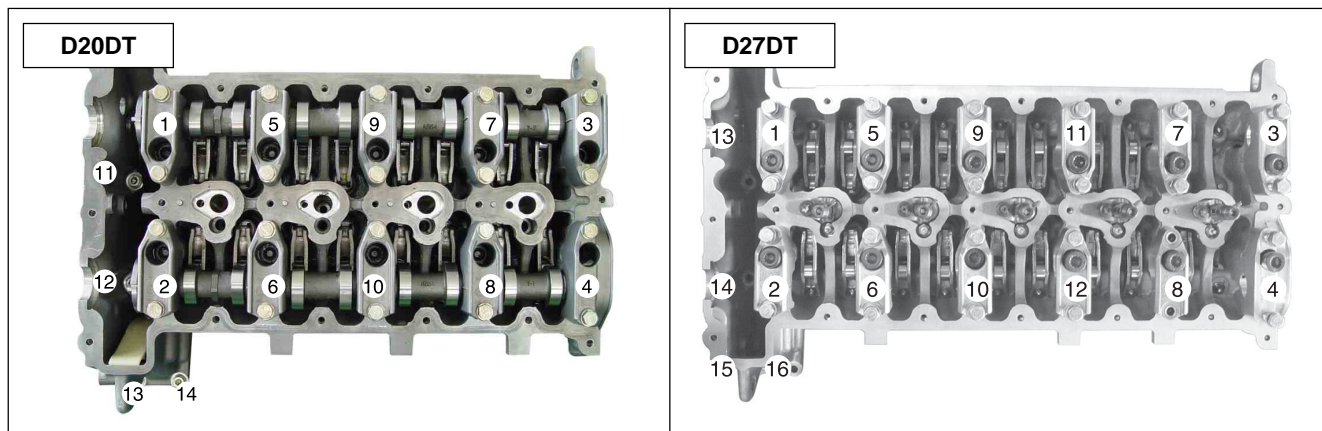


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

29. Remove the cylinder head bolts according to the numerical sequence.

Installation Notice

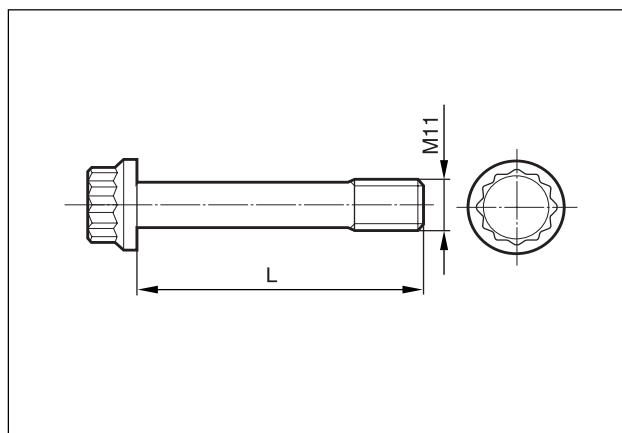
Tightening torque	Nm
M8 x 25: 2 EA	25 ± 2.5
M8 x 50: 2 EA	25 ± 2.5
M12 x 177: 11 EA	85 ± 5 Nm, $3 \times 90^\circ + 10^\circ$
M12 x 158: 1 EA (Vacuum pump side)	



30. Measure the length of cylinder head bolts.

If the maximum length is exceeded by 2 mm, replace the cylinder head bolt.

Length when new	Maximum Limit
177 mm	179 mm
158 mm	160 mm

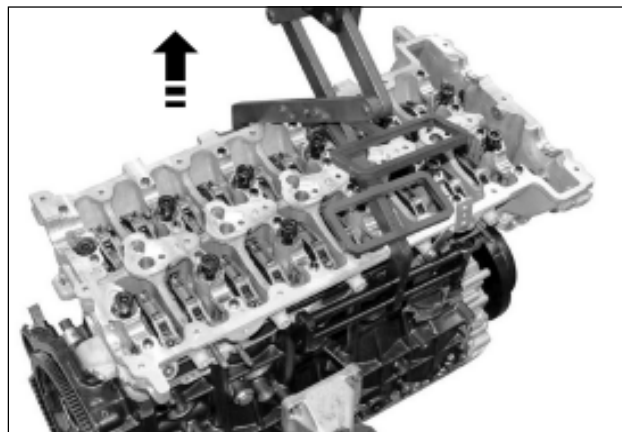


31. Remove the cylinder head.



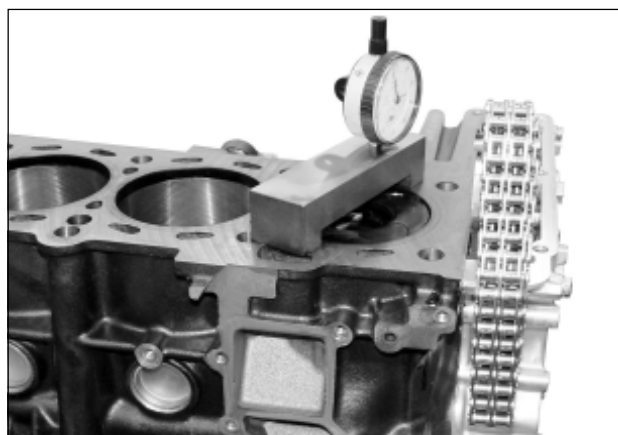
NOTICE

- Inspect the cylinder head surface.
- Store the removed injectors and glow plugs so that they will not be damaged.



32. Measure the piston protrusion from the parting surface.

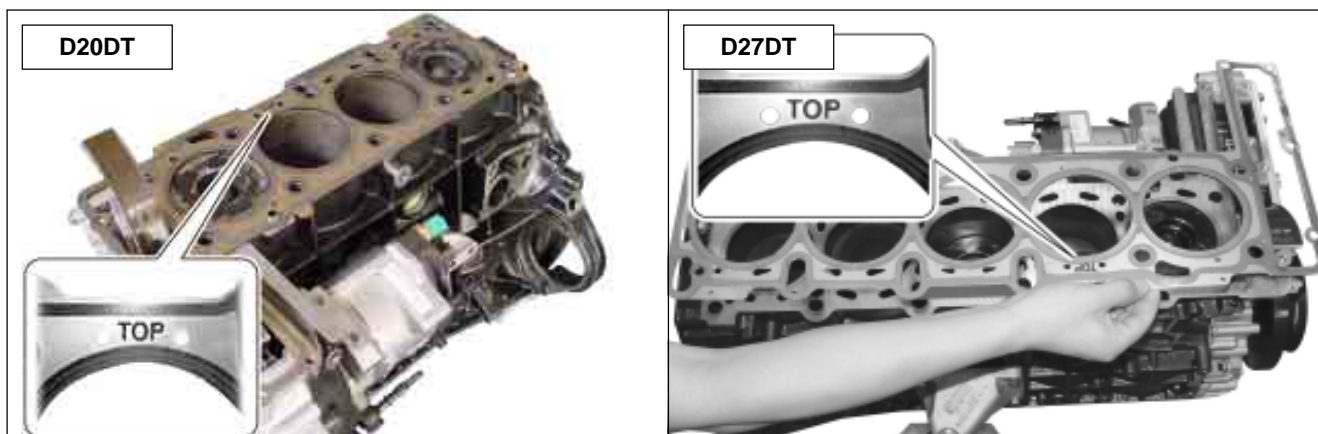
Specified Value: 0.765 ~ 1.055 mm



33. Remove the cylinder head gasket.

Installation Notice

- **Replace the cylinder head gasket with new one. Make sure to place the "TOP" mark upward.**
1. Put the steel gasket on the cylinder block and position the cylinder head.



GENERAL

ASSY

HOUSING

INTAKE

EXHAUST

LUB

COOLING

FUEL

CONTROL

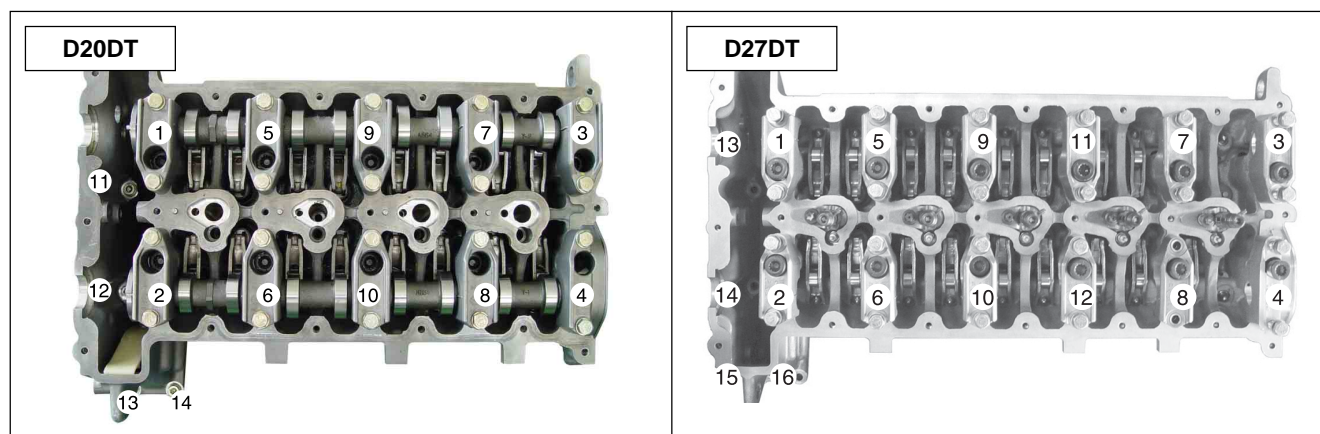
SENSOR

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

2. Tighten the cylinder head bolts to specified torque and torque angle.

Tightening torque	Step 1	$20 \pm 2.0 \text{ Nm}$
	Step 2	$85 \pm 5.0 \text{ Nm}$
	Step 3	$90 \pm (3 \text{ times}) + 10^\circ$

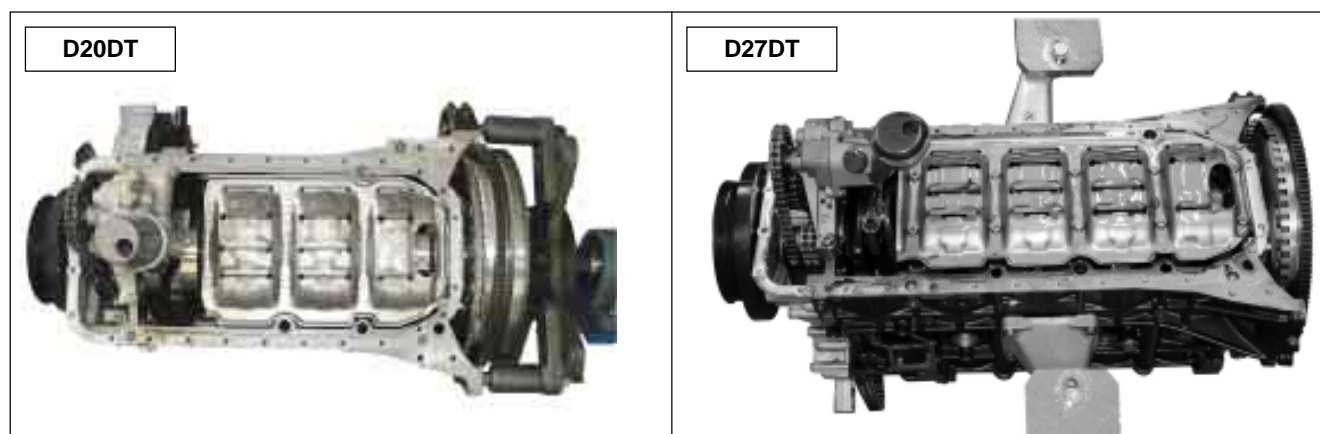
- Apply the oil on the bolt thread when installing.
- Always insert new washer first.
- The bolts (12) at vacuum pump side are shorter than others.



34. Turn over the engine and remove the baffle plate.

Installation Notice

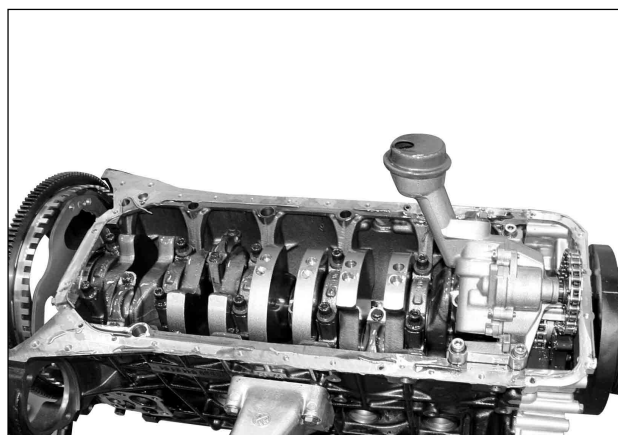
Tightening torque	$10 \pm 1.0 \text{ Nm}$
-------------------	-------------------------



35. Unscrew the bolts and remove the oil strainer assembly.

Installation Notice

Tightening torque	$25 \pm 2.5 \text{ Nm}$
-------------------	-------------------------

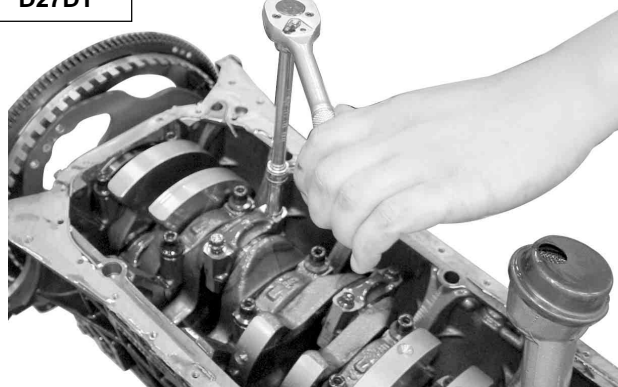


36. Remove the piston assembly from the cylinder block.
1) Unscrew the bearing cap bolts.

Installation Notice

Step 1	$55 \pm 5.0 \text{ Nm}$
Step 2	$90^\circ + 10^\circ$

Tighten the bolts from #1 cap.

D20DT**D27DT**

GENERAL

ASSY

HOUSING

INTAKE

EXHAUST

LUB

COOLING

FUEL

CONTROL

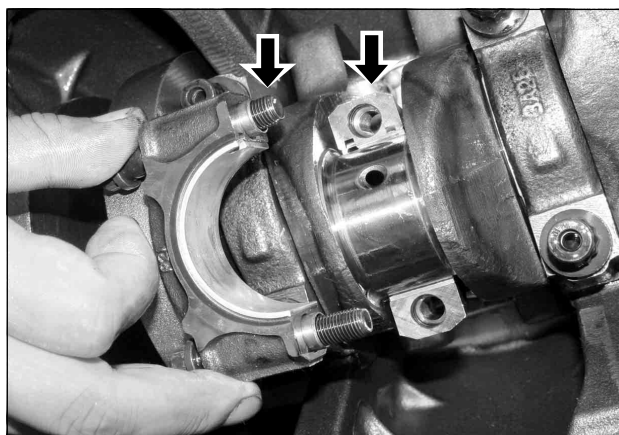
SENSOR

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

**NOTICE**

- Align the oil grooves in bearing cap and connecting rod.

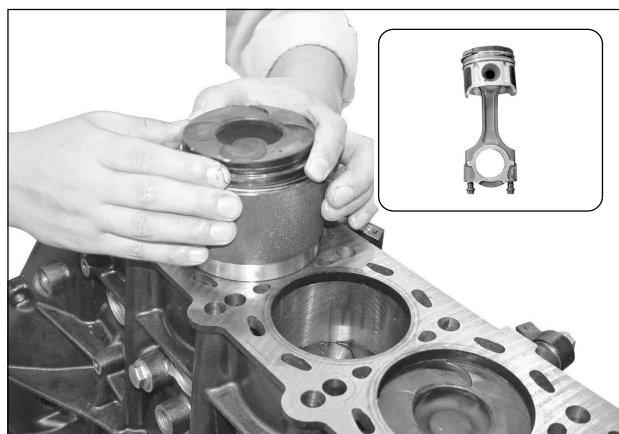
- 2) Remove the bearing caps and lower bearing shells.



- 3) Remove the piston assembly through the cylinder.

**NOTICE**

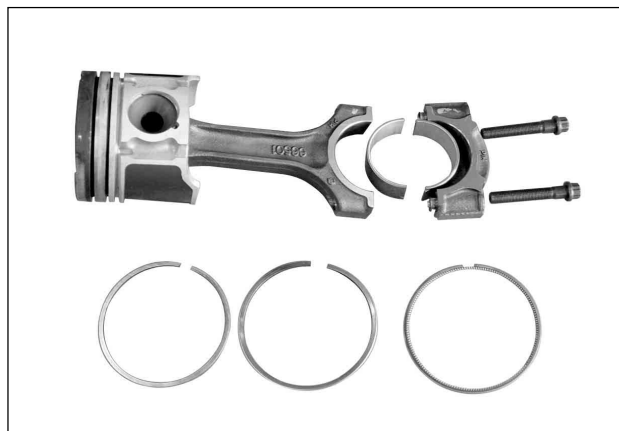
- Do not mix up upper and lower crankshaft bearing shells.



- 4) Remove the snap ring piston pin from the piston.
- 5) Disassemble the piston and connecting rod.
- 6) Remove the piston rings from the piston.

**NOTICE**

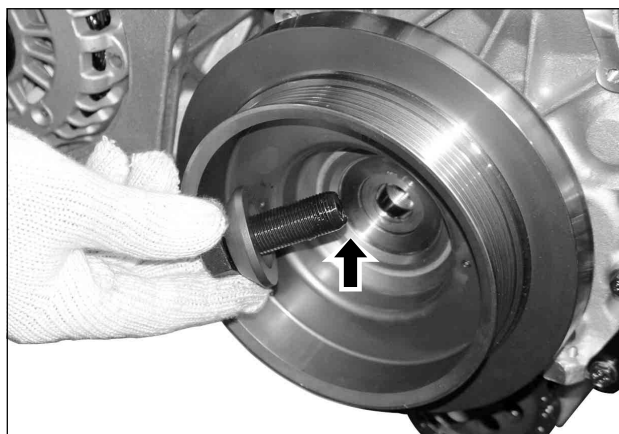
- Replace the piston ring, bearing and snap ring with new ones.



37. Lock the flywheel and remove the center bolt and crankshaft pulley.

Installation Notice

Tightening torque	200 ± 20 Nm, 180° + 10°
-------------------	----------------------------

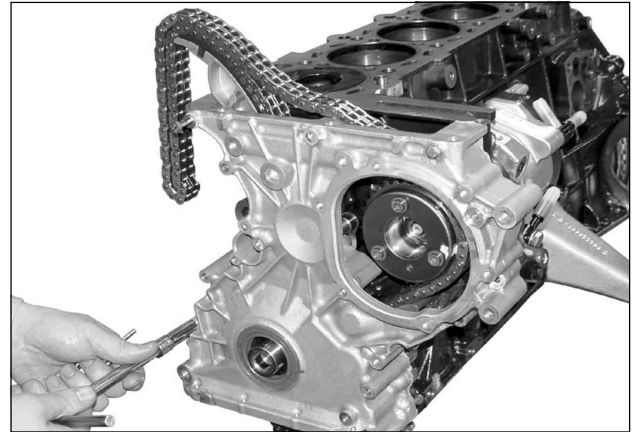


38. Remove the timing chain cover assembly.

1) Remove the cover bolts.

Installation Notice

Tightening torque	$10 \pm 1.0 \text{ Nm}$
-------------------	-------------------------

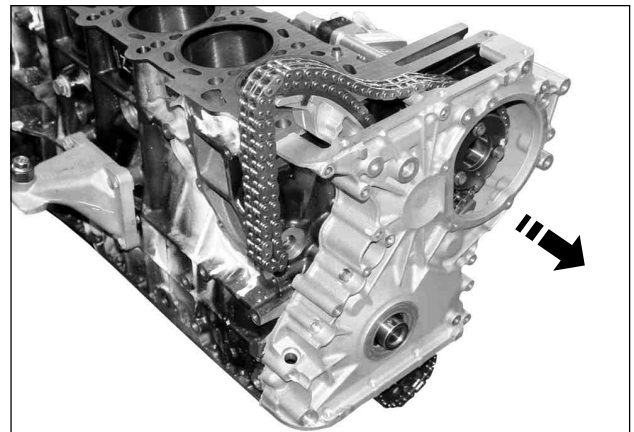


2) Hold the timing chain and remove the timing chain cover by tapping it with a rubber hammer and a screwdriver.

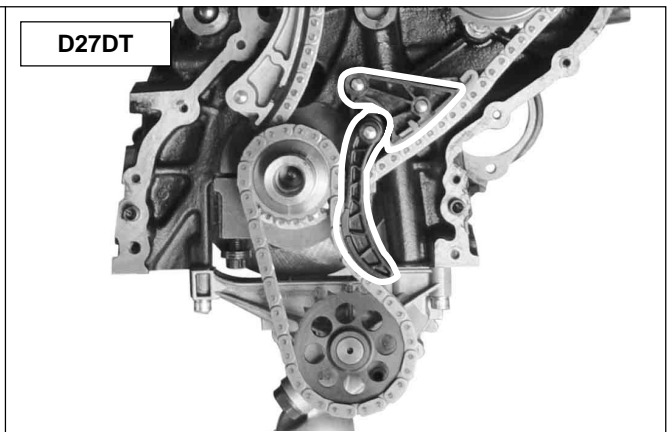
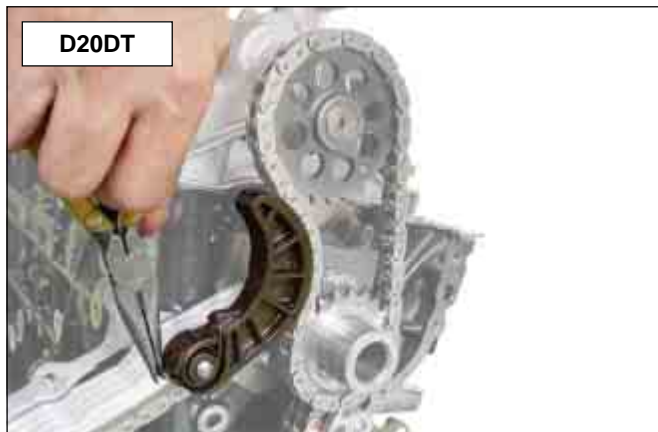


NOTICE

- Apply the sealant on the parting surface.



39. Remove the timing chain guide rail and timing chain.



GENERAL

ASSY

HOUSING

INTAKE

EXHAUST

LUB

COOLING

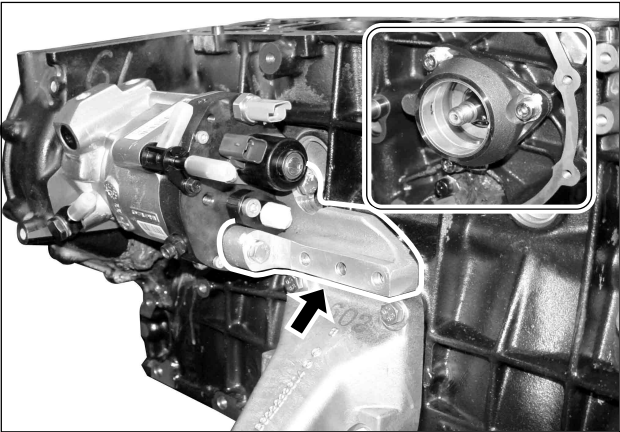
FUEL

CONTROL

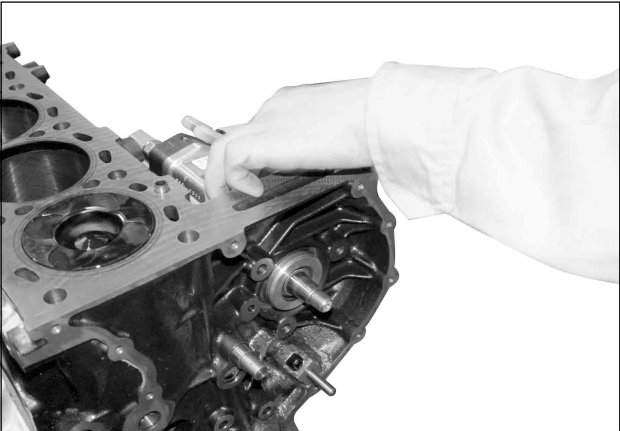
SENSOR

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

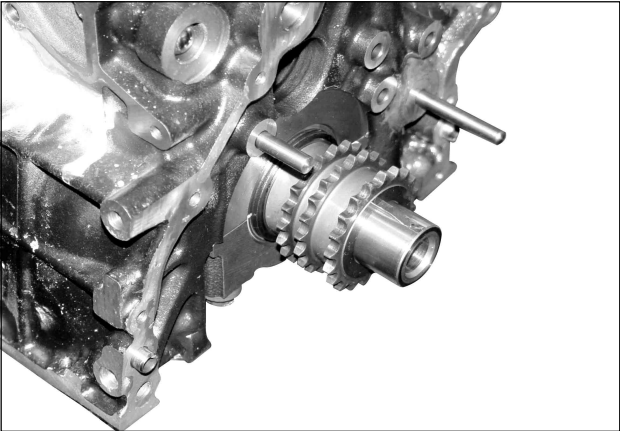
40. Remove the HP pump bolts and the HP pump bracket bolts.



1) Remove the HP pump assembly.



41. Remove the crankshaft sprocket with a special tool.



42. Remove the flywheel and the crankshaft strainer.

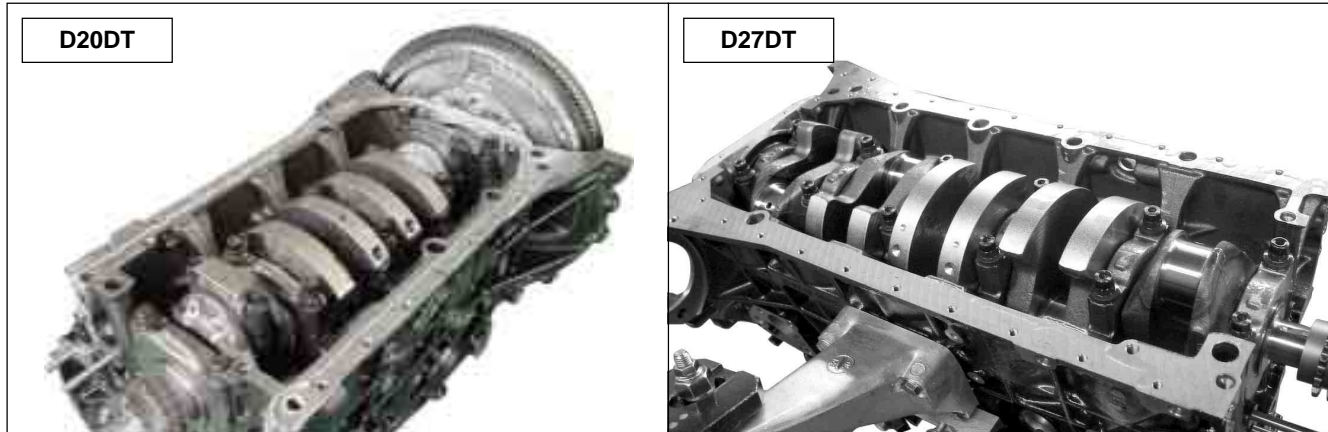
Installation Notice

Tightening torque	45 ± 5.0 Nm, 90° + 10°
-------------------	---------------------------

43. Unscrew the bolts and remove the crankshaft bearing caps.

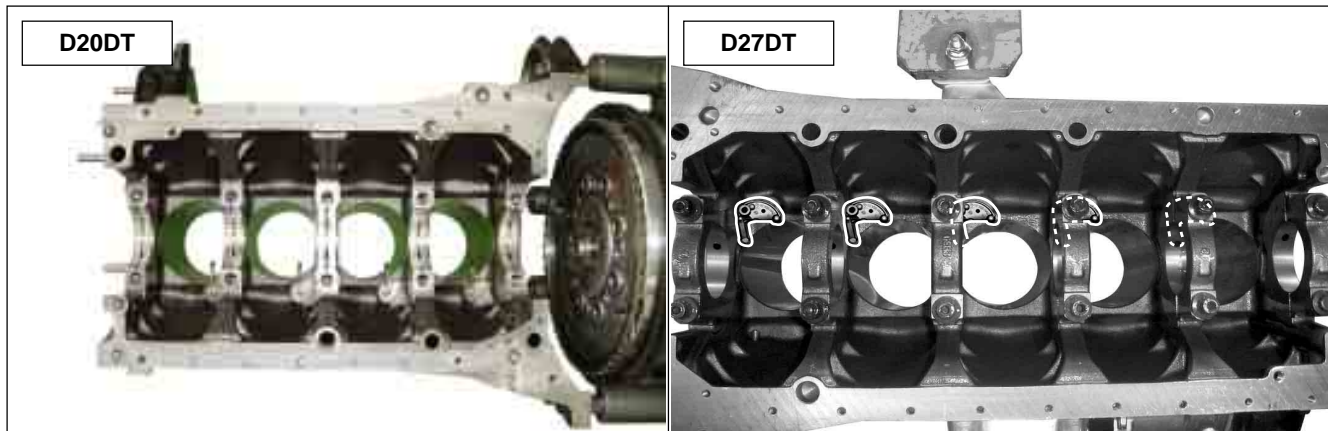
Installation Notice

Tightening torque	$55 \pm 5.0 \text{ Nm}$, $90^\circ + 10^\circ$
-------------------	--



NOTICE

- Remove the bearing cap bolts from inside to outside with a pair.
- Do not mix up the crankshaft bearing caps and shells.



NOTE

- Install in the reverse order of removal.
- Tighten the fasteners with the specified tightening torques.
- Replace the gaskets and bearings with new ones.
- Make sure to install the gaskets in correct direction.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

MEMO

Handwriting practice lines consisting of 28 horizontal dotted lines.

SECTION 02

ENGINE HOUSING

ENGINE HOUSING

TABLE OF CONTENTS

CYLINDER HEAD/CYLINDER BLOCK 2

Cylinder head 2

Camshaft assembly 24

Timing chain assembly 38

Cylinder block 42

CRANKSHAFT 46

Arrangement of thrust washers and bearings 47

Torsional vibration damper 52

Disassembly and reassembly 53

FLYWHEEL 58

Dual Mass Flywheel (DMF, manual transmission equipped vehicle) 58

PISTON AND CONNECTING ROD 60

Piston ring 61

Cylinder inner diameter and piston size 62

Disassembly and reassembly 63

HIGH PRESSURE PUMP (HPP) 67

Components locator 67


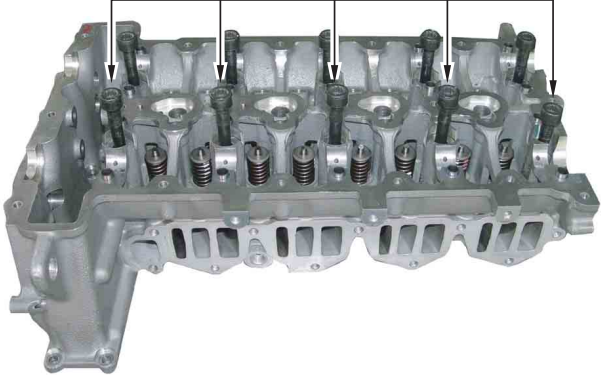
Disassembly and reassembly 68

CYLINDER HEAD/CYLINDER BLOCK

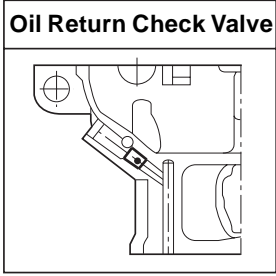
CYLINDER HEAD

D20DT

Cylinder head bolt


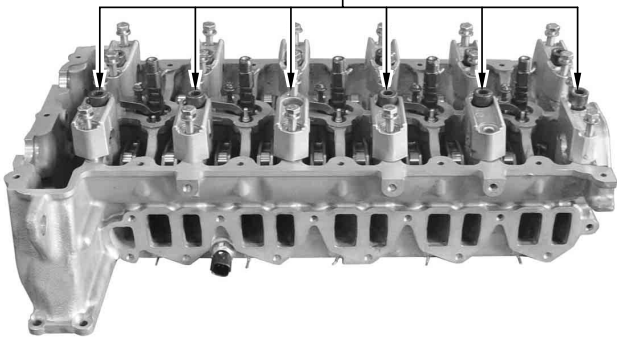


Oil Return Check Valve

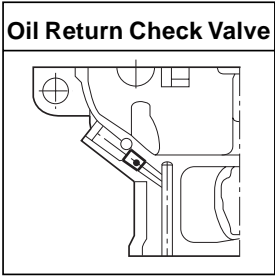


D27DT

Cylinder head bolt

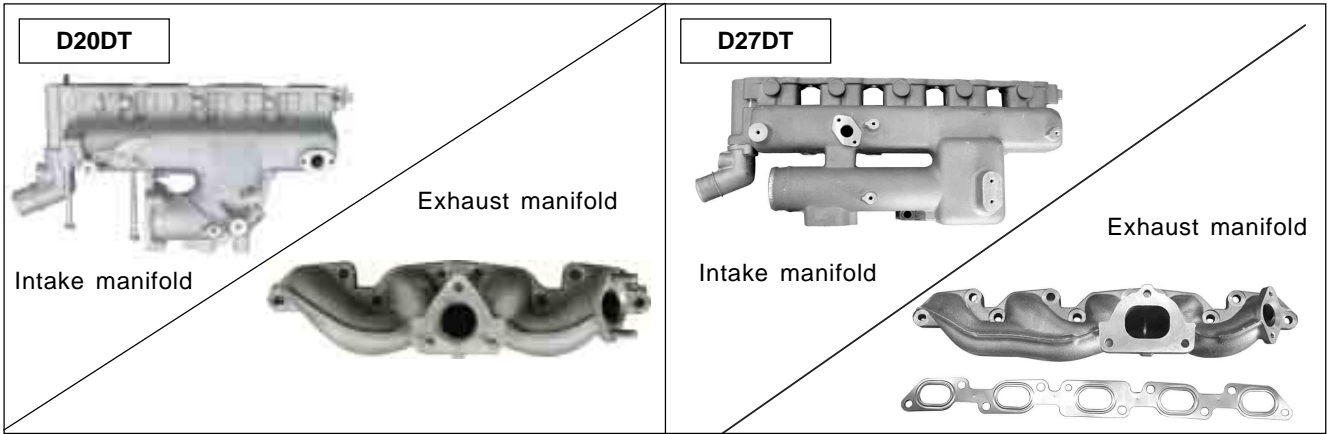


Oil Return Check Valve



► System Characteristics

- 1. 4-valve DOHC valve mechanism
- 2. Swirl and tangential port
- 3. 4-bolt type cylinder head bolt
- 4. Water jacket integrated casting
- 5. Integrated chain housing and cylinder head
- 6. Oil gallery: drilled and sealing with cap and screw plug



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

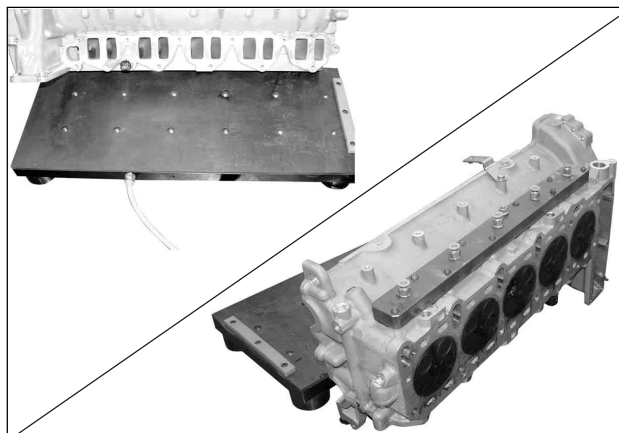
► Cylinder Head Pressure Leakage Test

※ Preceding Works:

1. Removal of cylinders
2. Removal of intake and exhaust manifold
3. Removal of valves

Test Procedures

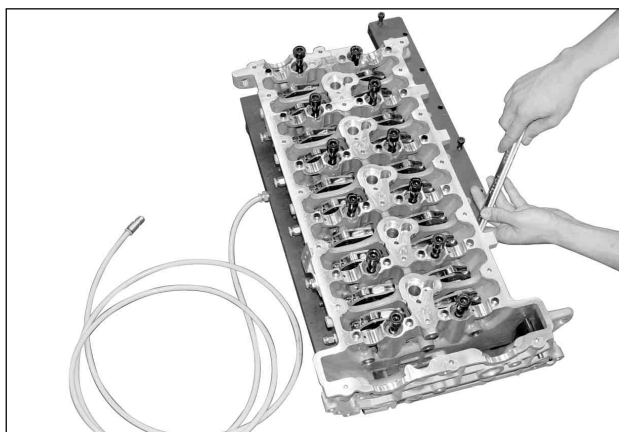
1. Place the pressure plate on a flat-bed work bench.



2. Install the cylinder head on the pressure plate.

Tightening torque	60 Nm
-------------------	-------

3. Immerse the cylinder head with the pressure plate into warm water (approx. 60°C) and pressurize with compressed air to 2 bar.



NOTICE

- Examine the cylinder head for air bubbling. If the air bubbles are seen, replace the cylinder head.

► Cylinder Head Mating Surface Check

Specifications

Height "A" (cylinder head parting surface - cylinder head cover parting surface)		140.9 ~ 141.1 mm
Minimum height after machining		140.9 mm
Flatness	In longitudinal direction	0.075 mm
	In transverse direction	0.075 mm
Permissible variation of parallelism of top parting surface to bottom in longitudinal direction		within 0.1 mm
Peak-to-valley height		0.004 mm
Valve recess "a"	Intake valve	0.74 ~ 0.86 mm
	Exhaust valve	-0.15 ~ 0.15 mm

Measurement

1. Measure the cylinder head height "A".

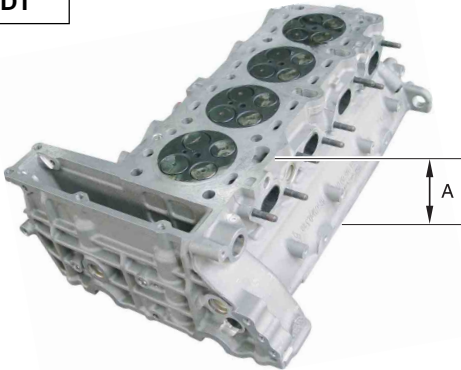
Limit	Over 140.9 mm
-------	---------------



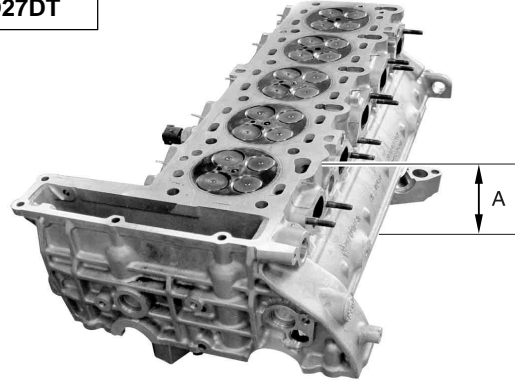
NOTICE

- If the height is less than the limit, the cylinder head must be replaced.

D20DT



D27DT



2. Insert the valves into the valve guides and measure the recesses.

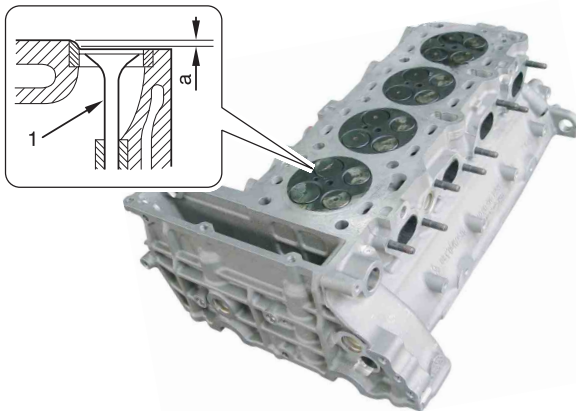
Valve recess "a"	Intake Valve 0.74 ~ 0.86 Exhaust Valve -0.15 ~ 0.15
------------------	--



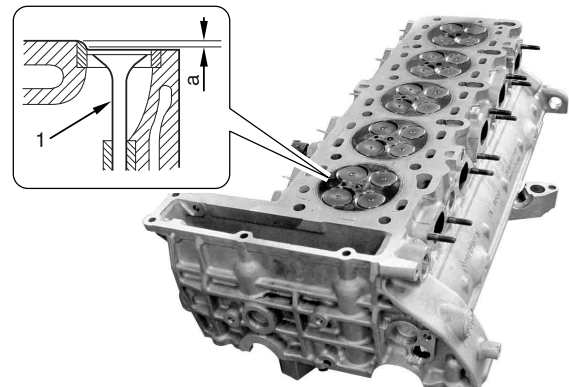
NOTICE

- If the measured value is out of the specified range, machine the valve seat as much as necessary until the specified value is achieved.

D20DT



D27DT



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Cylinder Head

► D20DT Engine

Disassembly

※ Preceding Works:

1. Disconnect the negative battery cable.
2. Apply the parking brake and place the chocks under the tires. (transmission "N" position)

1. Remove the EGR pipe.



2. Disconnect the injector fuel lines, connector and preglow plug connector. Remove the cylinder head cover.



CAUTION

- Cover the openings of fuel line with the protective caps.

3. Rotate the crankshaft pulley to align the OT marks.
 - 1) Align the mark (notch) on sprocket for cylinder No.1 (exhaust) and for cylinder No.6 (intake).
(align the cylinder No.1 OT)



4. Mark on the timing chain, intake camshaft sprocket and exhaust camshaft sprocket for timing setting during installation.



5. Remove the chain tensioner after removing the EGR pipe and oil dipstick.



6. Remove the high pressure pump and mark on the high pressure pump sprocket.



7. Remove the camshaft position sensor.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

8. Hold the camshafts and remove the intake camshaft sprocket and exhaust camshaft sprocket.



9. Remove the upper guide rail with a sliding hammer.

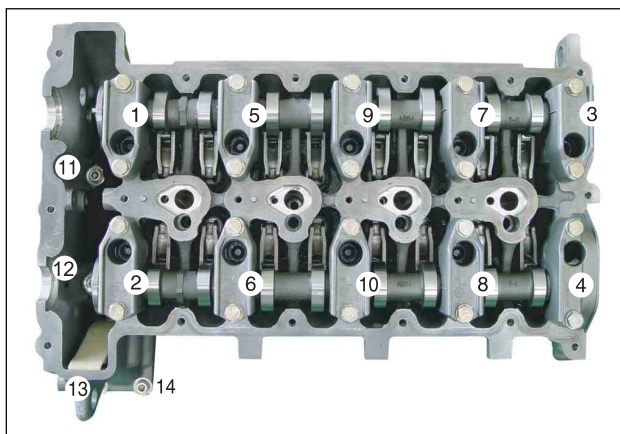


10. Remove the oil cooler and the intake manifold.



11. Remove the cylinder head bolts according to the numerical sequence.

- 1) M8 x 25: 2EA
- 2) M8 x 50: 2EA
- 3) M12 x 177: 9EA
- 4) M12 x 158: 1EA (vacuum pump side)



12. Remove the cylinder head.



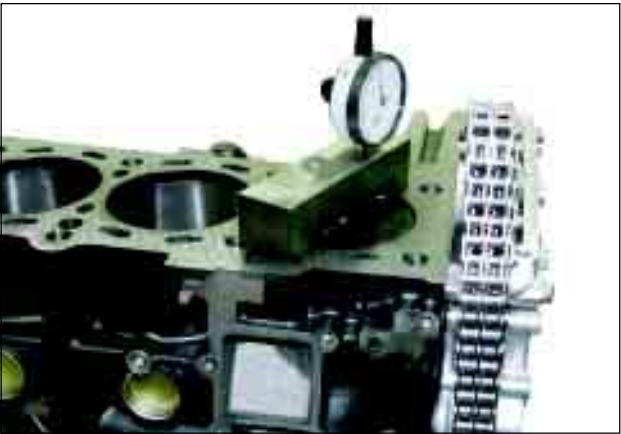
CAUTION

- Inspect the cylinder head mating surface.
- Store the removed injectors and glow plugs so that they will not be damaged.
- If there is a sign of oil leakage on the cylinder head gasket, replace it with new one.



13. Measure the piston protrusion from the mating surface.

Standard	0.765 ~ 1.055 mm
----------	------------------



GENERAL

ASSY

HOUSING

INTAKE

EXHAUST

LUB

COOLING

FUEL

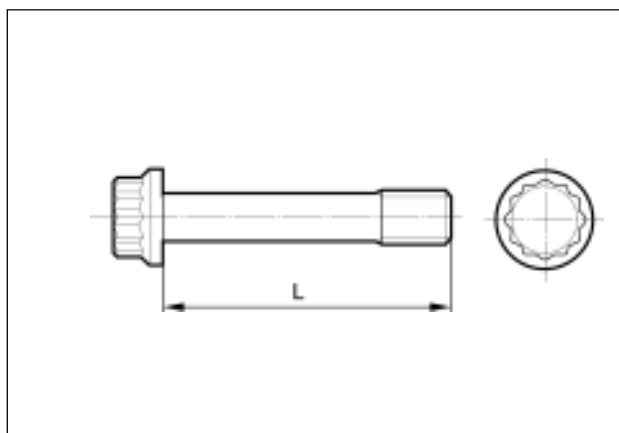
CONTROL

SENSOR

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Reassembly

1. Measure the length of cylinder head bolts.
 - 1) If the maximum length is exceeded by 2 mm, replace the cylinder head bolt.



2. Install the cylinder head with the steel gasket.



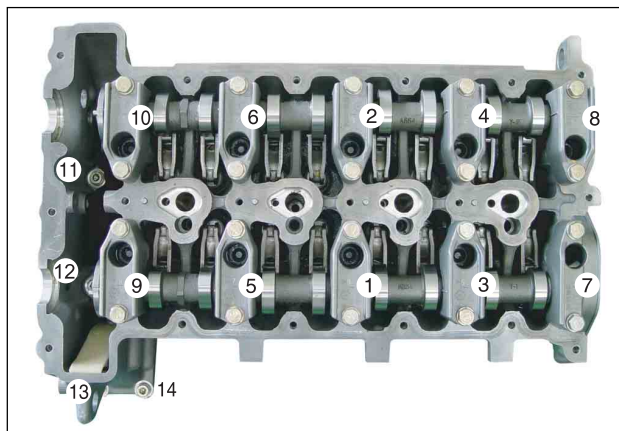
NOTICE

- Make sure to place the “TOP” mark upward.



3. Tighten the cylinder head bolts to specified torque and torque angle.

Tightening torque	Step 1: $20 \pm 2.0 \text{ Nm}$
	Step 2: $85 \pm 5.0 \text{ Nm}$
	Step 3: $360^\circ (120^\circ \times 3) + 10^\circ$



NOTICE

- Apply the oil on the bolt thread when installing.
- Always insert new washer first.
- The bolts at vacuum pump side are shorter than others.

4. Pull the timing chain over the cylinder head and install the upper guide rail.



NOTICE

- Make sure that the convex surface of upper guide rail faces to front side
- Be careful not to alter the timing point of high pressure pump.



5. Install the intake and exhaust camshaft sprockets and the timing chain.

Tightening torque	25 Nm + 90°
-------------------	-------------

**NOTICE**

- If the sprocket bolt is stretched over 0.9 mm, replace it with new one.
- Always install the intake camshaft sprocket first.



- 1) Make sure that the upper guide rail is installed with proper direction.



- 2) Make sure that the timing chain is securely seated on the guide rails.

**NOTICE**

- Make sure that the markings on camshaft sprocket and timing chain are aligned.



6. Install the chain tensioner.

Tightening torque	65 ± 5.0 Nm
-------------------	-------------

**NOTICE**

- Make sure that the EGR steel gasket is properly installed.



GENERAL

ASSY

HOUSING

INTAKE

EXHAUST

LUB

COOLING

FUEL

CONTROL

SENSOR

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

7. Rotate the crankshaft pulley two revolutions and ensure that the OT mark on the crankshaft pulley and the OT mark on the camshaft pulley are aligned.

**NOTICE**

- If the markings are not aligned, reinstall the cylinder head.



8. Install the cylinder head cover and the high pressure pump housing.

**NOTICE**

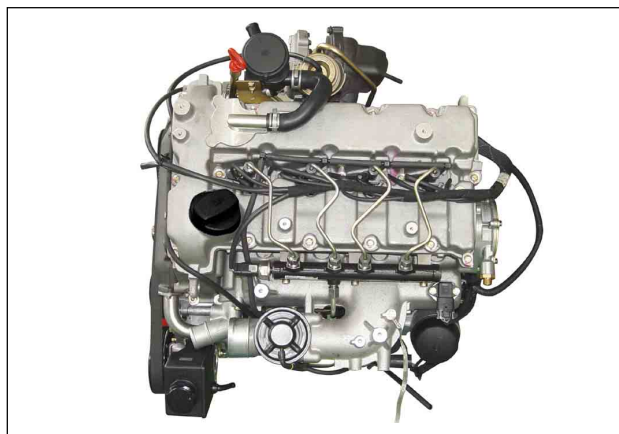
- Apply the sealant on the bolt threads when installing the high pressure pump.



9. Remove the protective caps from the injector and install the new fuel supply pipes.

**NOTICE**

- The fuel pipes are not reusable to keep the cleanliness and parts damage.



► D27DT Engine

Disassembly

※ Preceding Works:

1. Removal of fan belt
2. Removal of fuel supply and return lines
3. Removal of EGR related pipes and oil dipstick tube
4. Removal of intake manifold mounting bracket
5. Removal of injector fuel line and connector, and glow plug connector



NOTICE

- Plug the openings of injector holes and common rail with the protective caps.

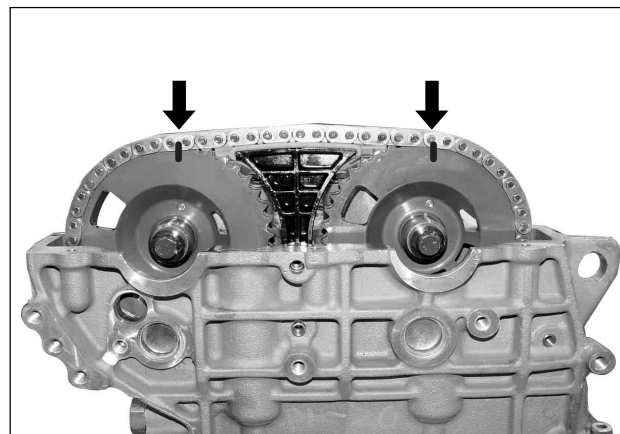
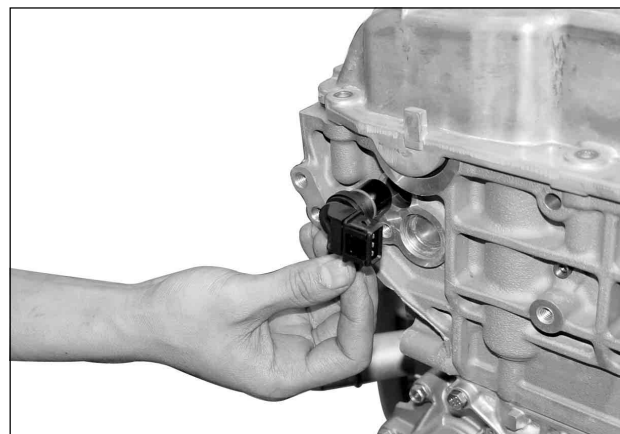
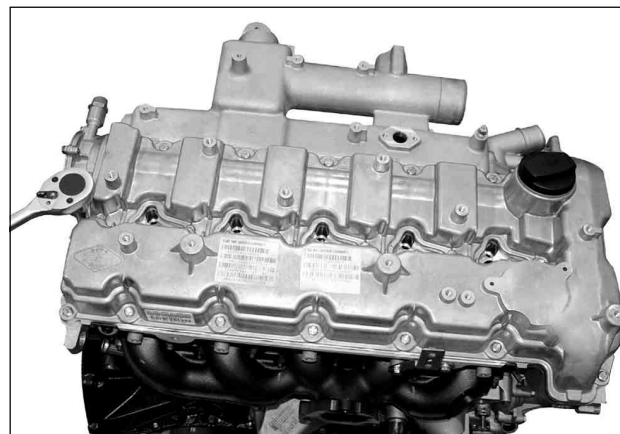
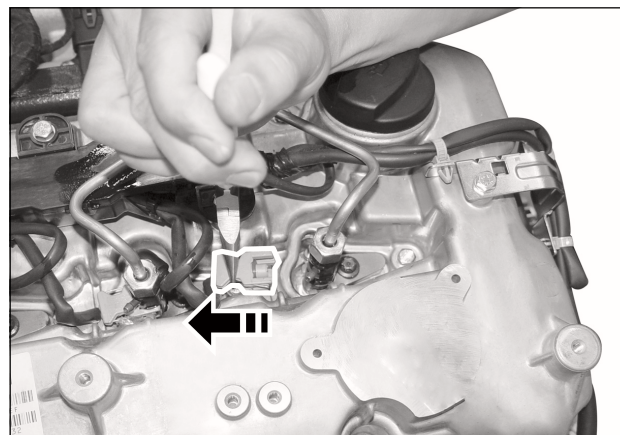
1. Remove the cylinder head cover.

2. Remove the camshaft position sensor.

Installation Notice

- *The intake manifold can be interfered by the sensor when installing.*

3. Mark on the intake camshaft sprocket and exhaust camshaft sprocket for timing setting during installation.



GENERAL

ASSY

HOUSING

INTAKE

EXHAUST

LUB

COOLING

FUEL

CONTROL

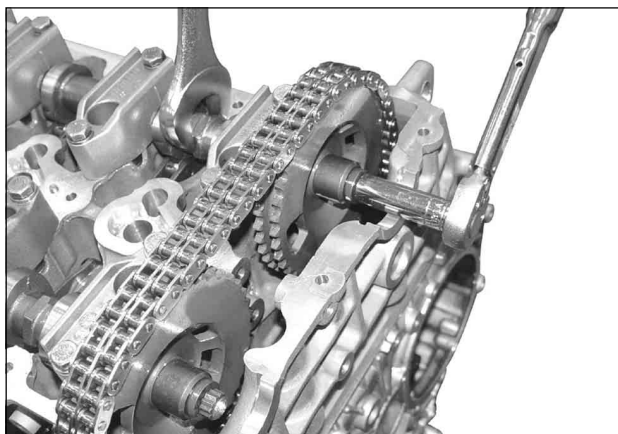
SENSOR

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

4. Remove the chain tensioner.



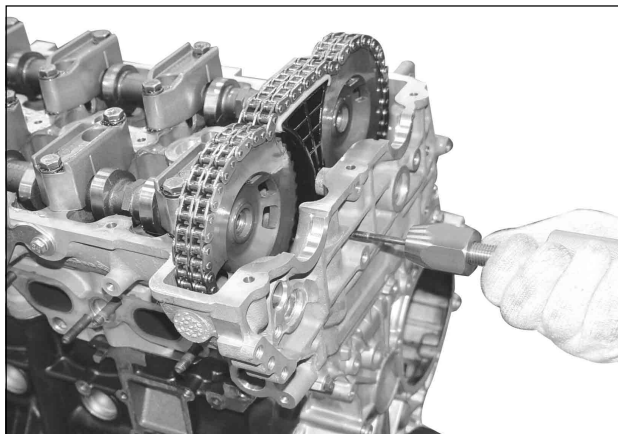
5. Hold the camshafts and remove the intake camshaft sprocket and exhaust camshaft sprocket.



6. Pull out the lock pins with a sliding hammer and remove the upper guide rail.

**NOTICE**

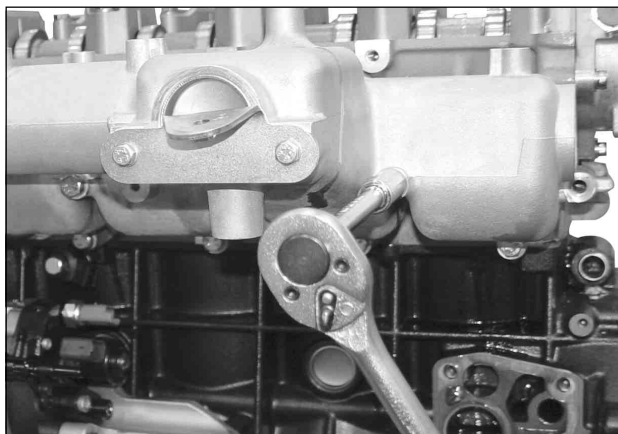
- Correctly align the electronic control module onto the shift plate by using two central pins when installing.



7. Remove the oil cooler, then remove the intake manifold.

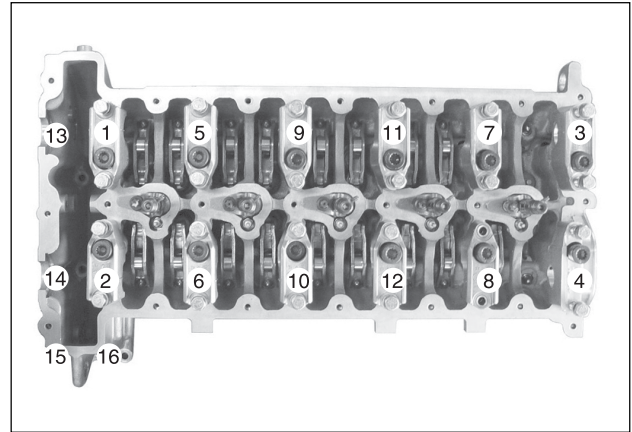
Installation Notice

- *The intake manifold can be interfered by the cylinder head bolt (M8 x 50).*



8. Remove the cylinder head bolts according to the numerical sequence.

- 1) M8 x 25: 2 EA
- 2) M8 x 50: 2 EA
- 3) M12 x 177: 11 EA
- 4) M12 x 158: 1 EA (Vacuum pump side)

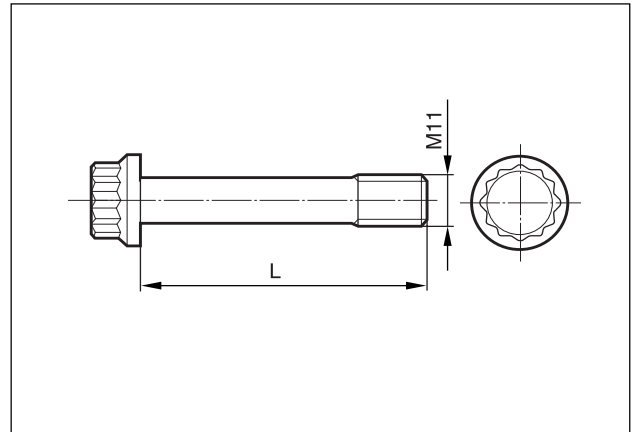


9. Measure the length of cylinder head bolts.

Installation Notice

- **If the maximum length is exceeded by 2 mm, replace the cylinder head bolt.**

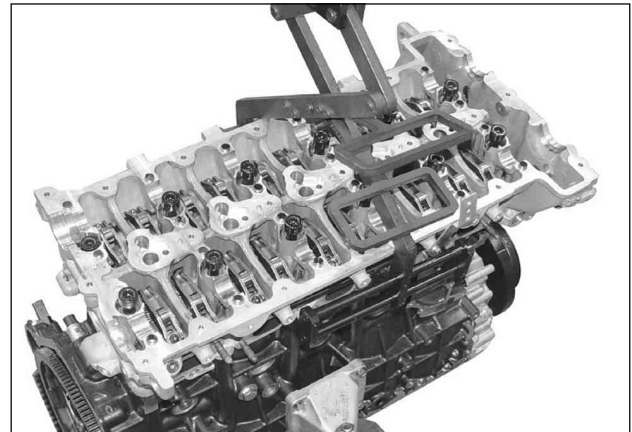
Length when new	Maximum Limit
177 mm	179 mm
158 mm	160 mm



10. Remove the cylinder head.

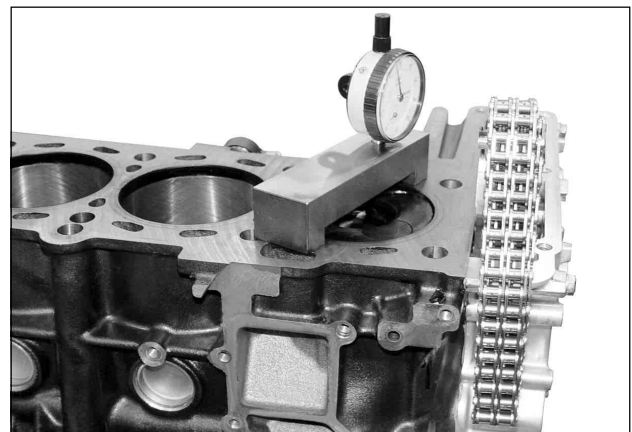
NOTICE

- **Inspect the cylinder head surface.**
- **Store the removed injectors and glow plugs so that they will not be damaged.**



11. Measure the piston protrusion from the mating surface.

Standard	0.765 ~ 1.055 mm
----------	------------------



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

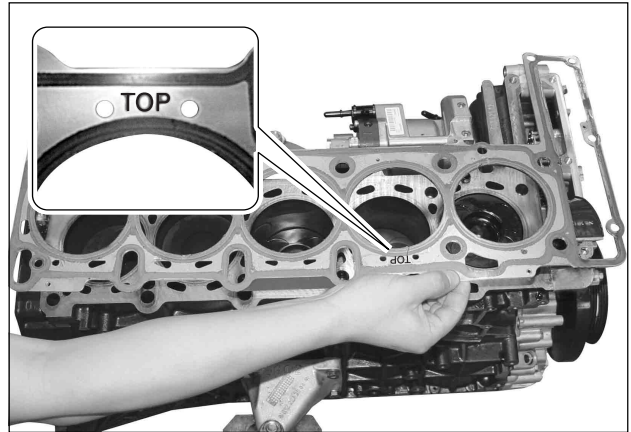
Reassembly

1. Install the cylinder head with the steel gasket.



NOTICE

- Make sure to place the “TOP” mark upward.

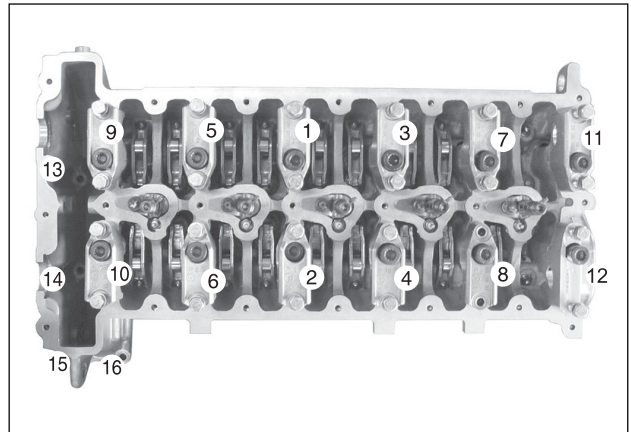


2. Tighten the cylinder head bolts to specified torque and torque angle.

Installation Notice

Tightening torque	Step 1	20 ± 2.0 Nm
	Step 2	85 ± 5.0 Nm
	Step 3	270° (90° x 3) + 10°

- **Apply the oil on the bolt thread when installing.**
- **Always insert new washer first.**
- **The bolts (11) at vacuum pump side are shorter than others.**

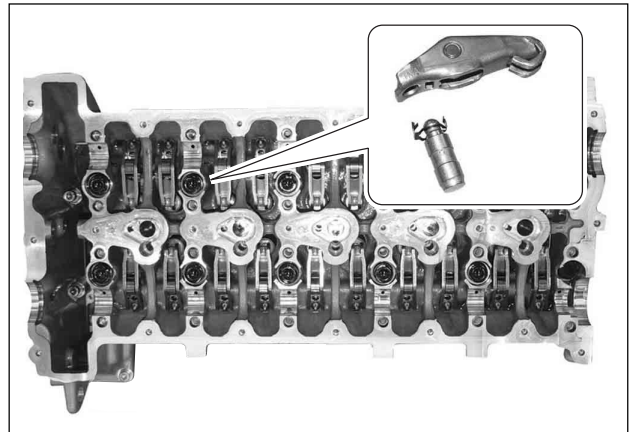


3. Install the HLA device and finger follower. Check the HLA device with the diagnosis procedures before installation.



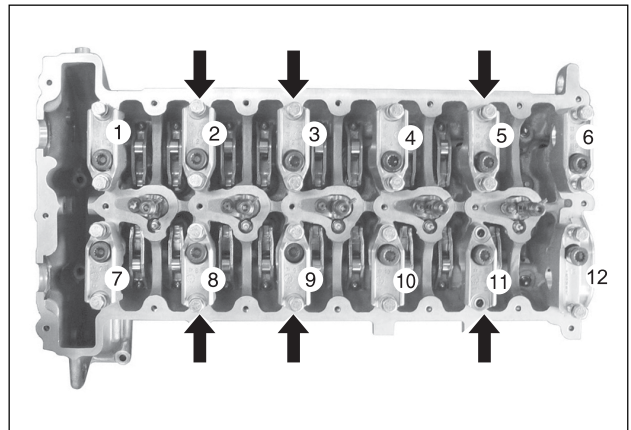
NOTICE

- Put the cylinder head on the locating pins.



4. Tighten the camshaft bearing cap bolts.

- 1) Intake: #8, #9, #11
- 2) Exhaust: #2, #3, #5



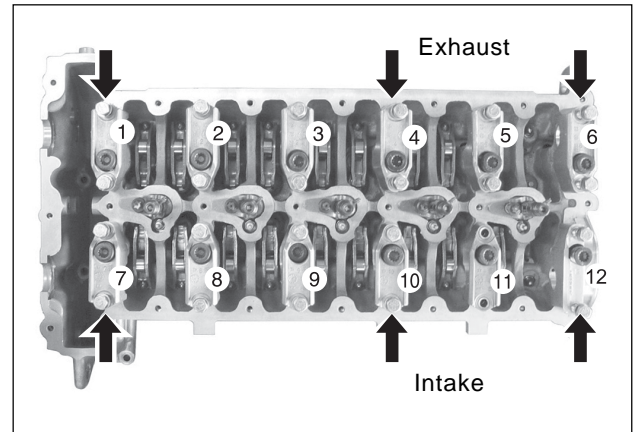
3) Intake: #7, #10, #12

4) Exhaust: #1, #4, #6

Installation Notice

Tightening torque	25 Nm
-------------------	-------

- **Check the finger follower positions and align if needed.**

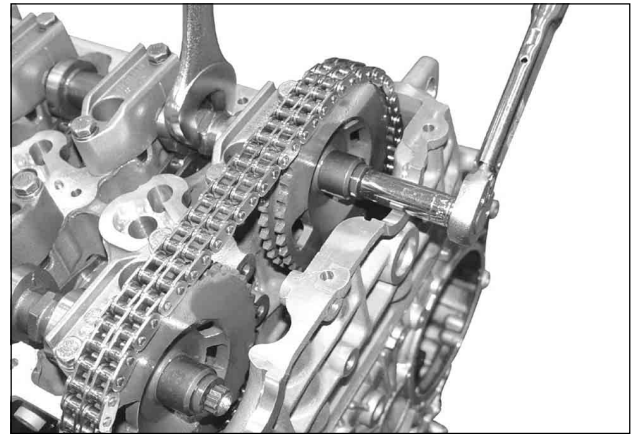


5. Install the intake and exhaust camshaft sprockets and the timing chain.

Installation Notice

Tightening torque	25 Nm + 90°
-------------------	-------------

- **If the sprocket bolt is stretched over 0.9 mm, replace it with new one.**
- **Always install the intake camshaft sprocket first.**
- **Ensure that the markings on camshaft sprocket and timing chain are aligned.**
- **Make sure that the timing chain is securely seated on the guide rail.**

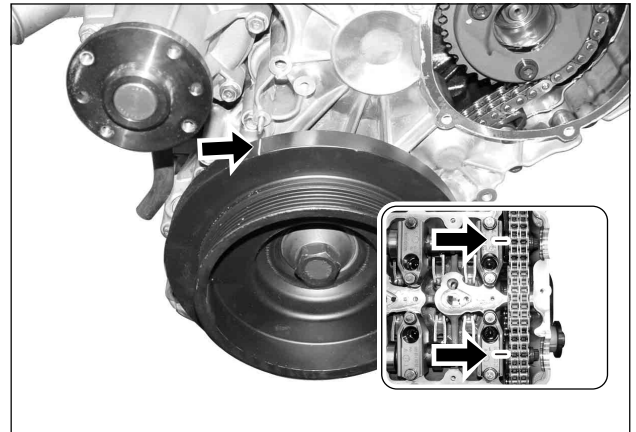


6. Rotate the crankshaft pulley two revolutions and ensure that the OT mark on the crankshaft pulley and the OT mark on the camshaft pulley are aligned.



NOTICE

- **If the markings are not aligned, reinstall the cylinder head.**

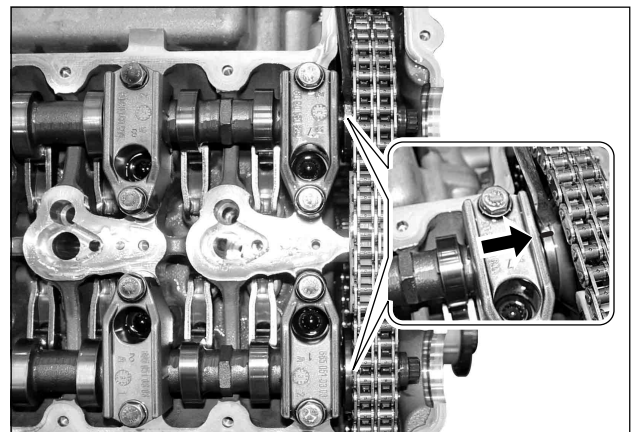


7. Place the bearing cap with the OT marks on both camshafts facing upward.



NOTICE

- **Apply the sealant on the cap (#12) for the vacuum pump when installing.**
- **Apply the oil on the bearing journals before installation.**

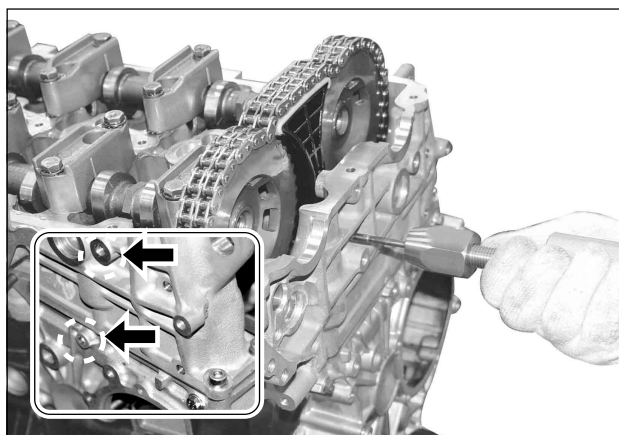


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

8. Fit the timing chain onto the camshaft sprockets and install the upper guide rail.
Install the clamping guide rail pin.

**NOTICE**

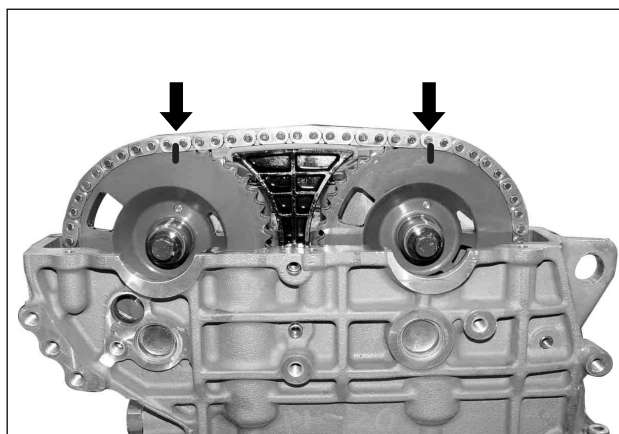
- Install the guide rail with slanted side facing forward.
- Be careful not to change the timing of HP pump when fitting the timing chain.



9. Tighten the intake and exhaust camshaft sprocket bolts.

Installation Notice

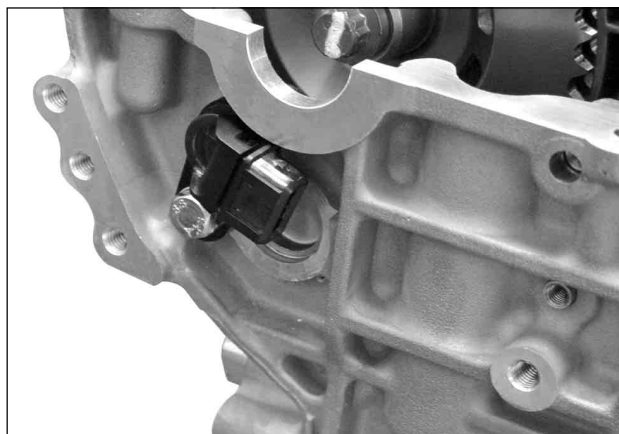
Tightening torque	$25 \pm 2.5 \text{ Nm}$, $90^\circ + 10^\circ$
-------------------	--



10. Install the camshaft position sensor.
11. Apply the Loctite to the bolt and tighten it.

Installation Notice

Tightening torque	10 Nm
-------------------	-------



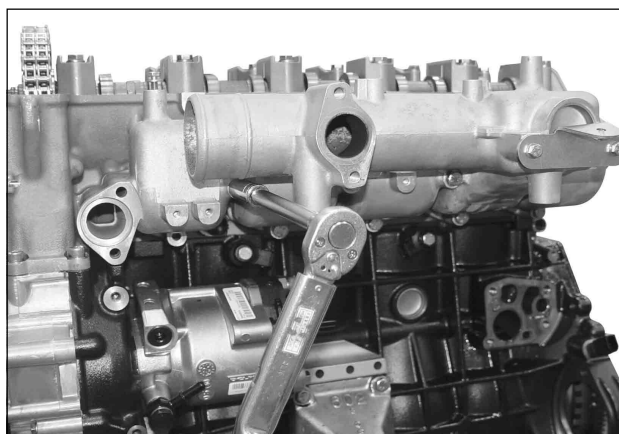
12. Check the intake camshaft before installing the vacuum pump.

13. Install the intake manifold. Install the oil cooler with new gasket.

Installation Notice

Tightening torque	25 Nm
-------------------	-------

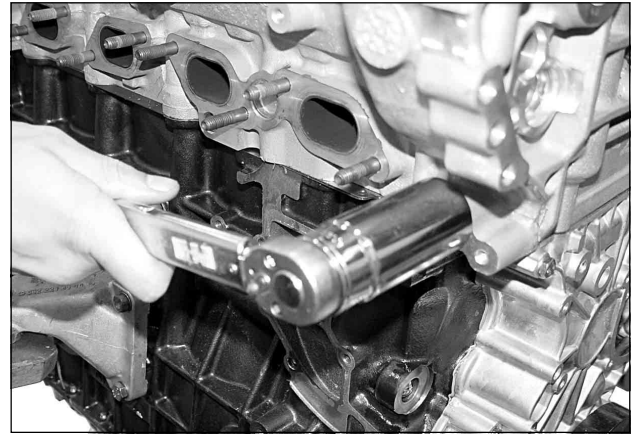
- *Ensure that there is no leaks around the coolant line for #1 cylinder*



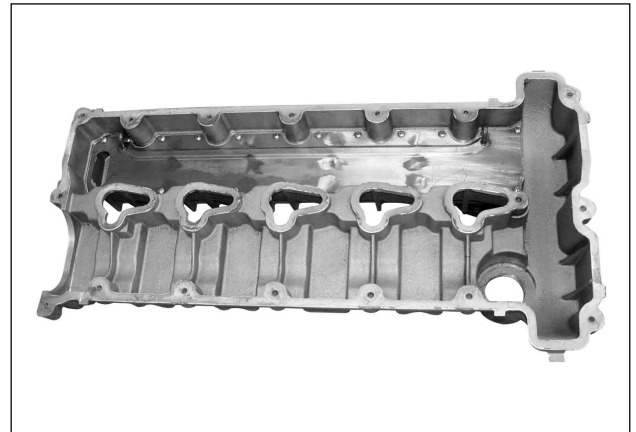
14. Install the chain tensioner.

Installation Notice

Tightening torque	65 ± 5 Nm
-------------------	---------------



15. Install the cylinder head cover assembly.
16. Install the rubber gasket.

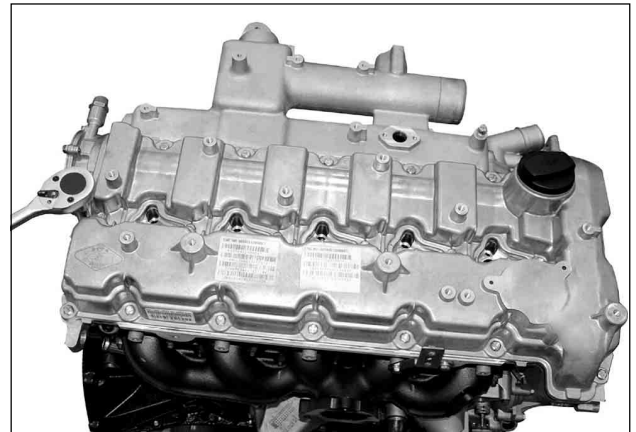


17. Tighten the cylinder head cover bolts.

Installation Notice

Tightening torque	10 ± 1.0 Nm
-------------------	-----------------

- **Apply the sealant to the bolts for the vacuum pump and the timing chain cover.**



18. Check the mating surface of the #12 bearing cap and the cylinder head for contacting.
19. Check if the O-ring is installed in the vacuum pump.
20. Install the vacuum pump with the key groove aligned.
21. Tighten the vacuum pump mounting bolts.

Installation Notice

Tightening torque	10 ± 1.0 Nm
-------------------	-----------------

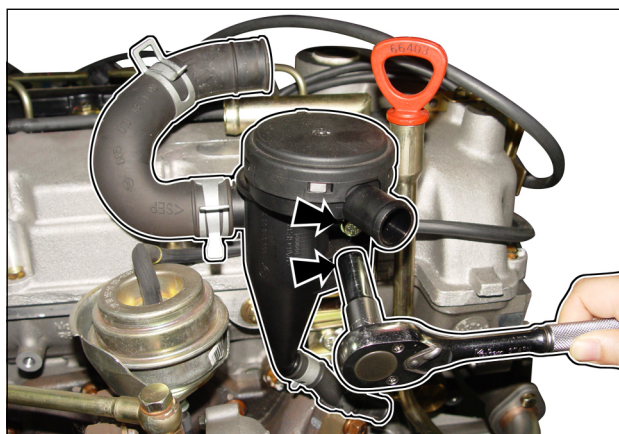


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

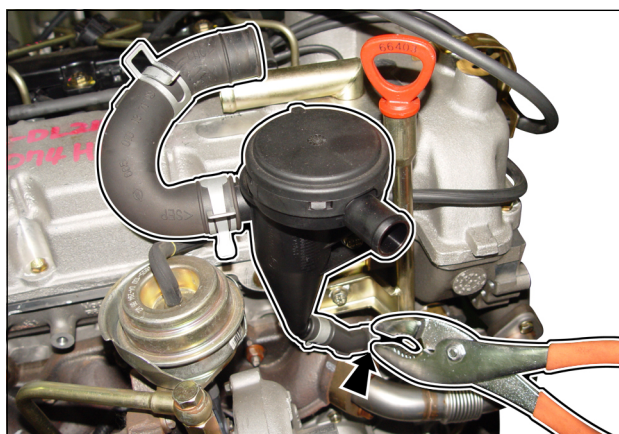
22. Install the PCV valve assembly on the cylinder head.

Installation Notice

Tightening torque	10 ± 1.0 Nm
-------------------	-------------



23. Engage the engine oil hose and the PCV valve hose.



24. Remove the protective caps and install the new fuel supply pipes.

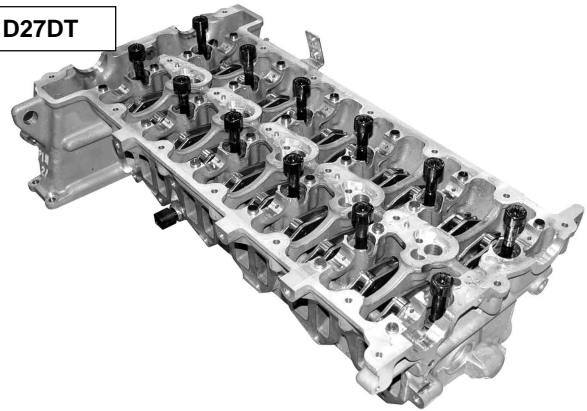
NOTICE

- To keep the cleanness and protect the components, the fuel pipes should be replaced with new ones.
- Be careful not to be mixed the fuel pipes because the pipe appearance of #1 and #3 cylinders and #2 and #4 are same each other.

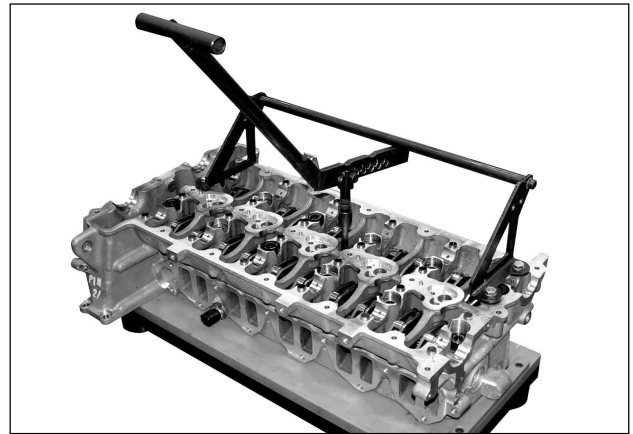


Intake/Exhaust-Removal/Installation

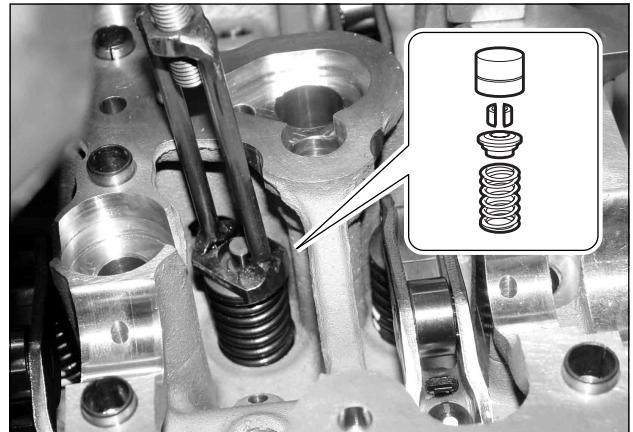
1. Remove the cylinder head assembly.

D20DT**D27DT**

2. Install the removed cylinder head on the assembly board (special tool) and set the supporting bar and lever (special tool) on the cylinder head.

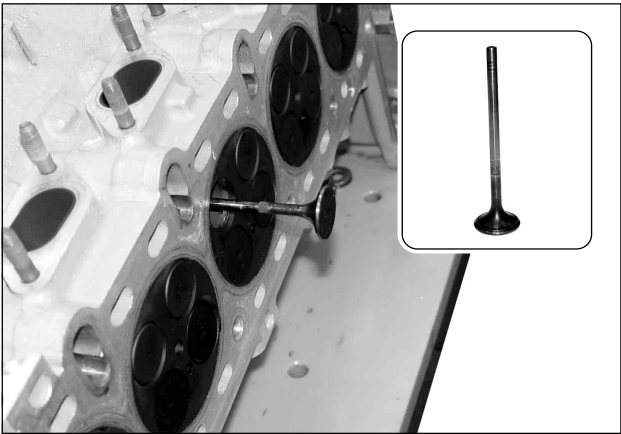


3. Push the valve spring seat down with the lever and remove the valve cotter, valve seat and valve spring.






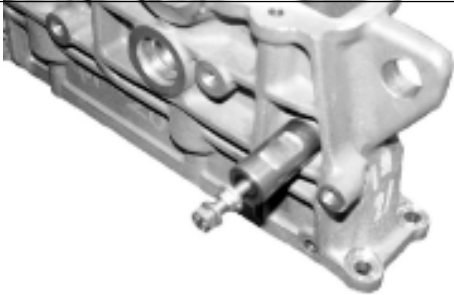

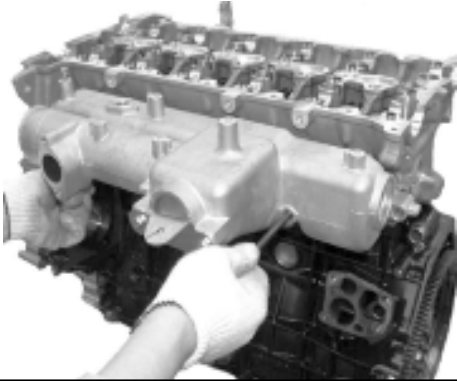


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

4. Remove the valves from the cylinder head.



► Special Tools and Equipment

Name and Part Number	Application
Y99220092B Compression pressure measuring adapter and gauge 	
Y99220082B Supporting bar and lever 	
Y99220162B Guide pin extractor 	
Y99220112B Intake manifold guide pin 	

GENERAL

ASSY

HOUSING

INTAKE

EXHAUST

LUB

COOLING

FUEL

CONTROL


SENSOR

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	


CAMSHAFT ASSEMBLY


※ Preceding Work: Removal of cylinder head cover

Finger Follower and HLA




Intake Camshaft and Exhaust Camshaft

D20DT


D27DT


Camshaft Sprockets




A

D20DT


D27DT


Cylinder Head

Camshaft Position Sensor



Chain Tensioner

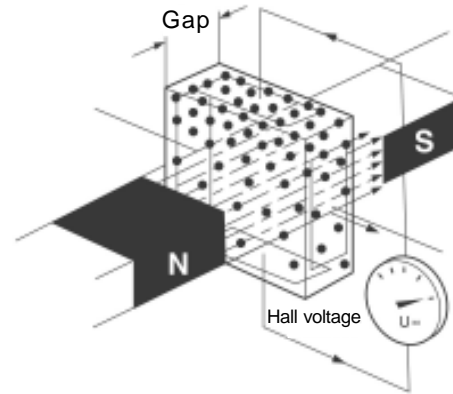
D20DT


D27DT


► Camshaft Position Sensor



<Location of Camshaft Position Sensor>



<Operation Principle of Hall Sensor>

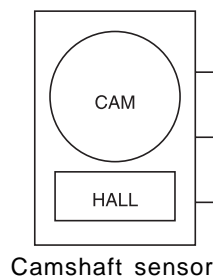
The camshaft position sensor uses hall-effect to set the camshaft position and metallic-magnetic-material sensor end is attached on the camshaft and then rotates with it. If sensor protrusion passes camshaft position sensor's semi-conductor wafer, magnetic field changes direction of electron on the semi-conductor wafer to the current flow direction that passes through wafer from the right angle. When operation power is supplied from camshaft position sensor, camshaft hall sensor generates signal voltage. The signal voltage will be 0V if protrusion and camshaft position sensor are near and 5 V if apart.

ECU can recognize that the No. 1 cylinder is under compression stroke by using this voltage signal (hall voltage).

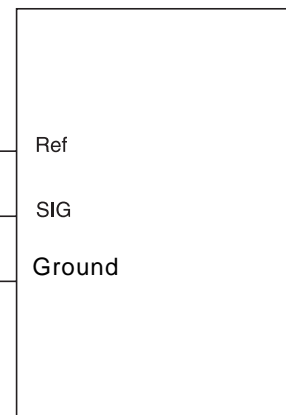
The rotating speed of camshaft is half of the crankshaft and controls engine's intake and exhaust valves. By installing sensor on the camshaft, can recognize specific cylinder's status, compression stroke or exhaust stroke, by using camshaft position when the piston is moving toward TDC (OT). Especially when started first, it is difficult to calculate the stroke of a specific cylinder with only crankshaft position sensor.

Accordingly, camshaft position sensor is necessary to identify the cylinders correctly during initial starting. However, when engine is started, ECU learns every cylinder of the engine with crankshaft position sensor signals so can run the engine even though the camshaft position sensor is defective during engine running.

Pulse generation	Cam angle $\pm 6^\circ$
Sensor air gap	0.45 ~ 1.80 mm
Tightening torque	10 ~ 14 Nm
Operating temperature	- 40 ~ 130°C



<Circuit Diagram of Camshaft Position Sensor>



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► D20DT Engine

Disassembly

※ Preceding Works:

1. Disconnect the negative battery cable.
2. Apply the parking brake and place the chocks under the tires. (transmission "N" position)

1. Remove the EGR pipe.



2. Disconnect the injector fuel lines, connector and preglow plug connector. Remove the cylinder head cover.



CAUTION

- Cover the openings of fuel line with the protective caps.

3. Rotate the crankshaft pulley to align the OT marks.
 - 1) Align the mark (notch) on sprocket for cylinder No.1 (exhaust) and for cylinder No.6 (intake). (align the cylinder No.1 OT)



4. Mark on the timing chain, intake camshaft sprocket and exhaust camshaft sprocket for timing setting during installation.



5. Remove the chain tensioner after removing the EGR pipe and oil dipstick.



6. Remove the high pressure pump and mark on the high pressure pump sprocket.



7. Remove the camshaft position sensor.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

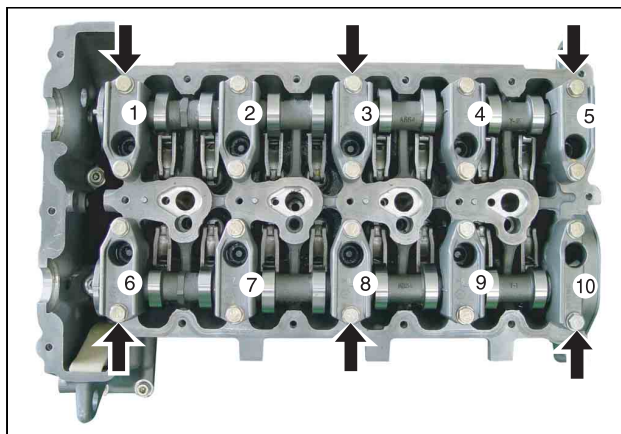
8. Hold the camshafts and remove the intake camshaft sprocket and exhaust camshaft sprocket.



9. Remove the camshaft bearing cap bolts so that the tightening force can be relieved evenly.

- 1) Exhaust: #1, #3, #5
- 2) Intake: #6, #8, #10

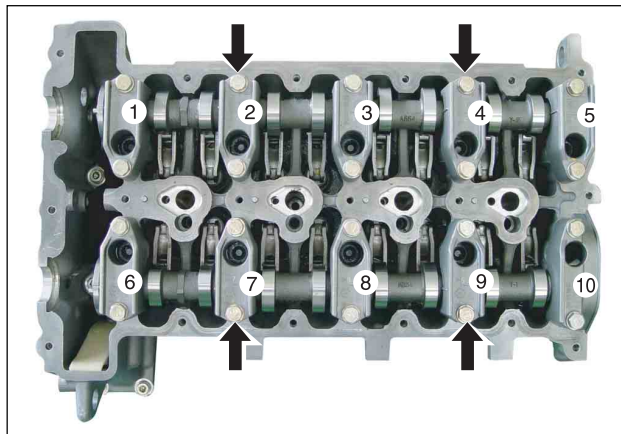
However, there is no specific removal sequence.



- 3) Do not remove the bolts at a time completely. Remove them step by step evenly or camshaft can be seriously damaged.

- 4) Remove the exhaust camshafts and then remove the intake camshaft.

- Exhaust: #2, #4
- Intake: #7, #9



10. Remove the finger follower and the HLA device.



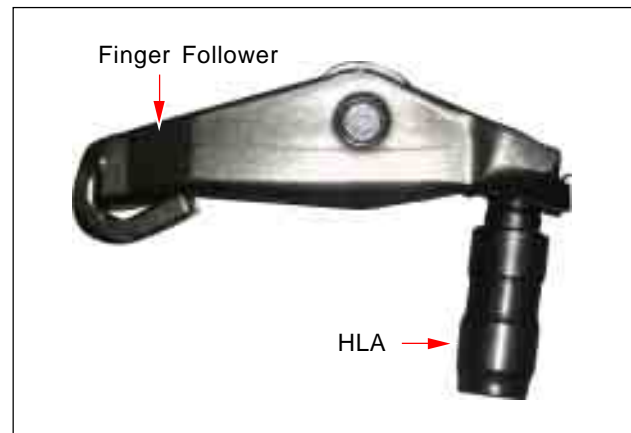
Reassembly

1. Install the HLA device and finger follower. Check the HLA device with the diagnosis procedures before installation.



NOTICE

- Perform the air bleeding process if it has been stored for a extended period of time.
- Make sure that it is properly installed on the locating pin.

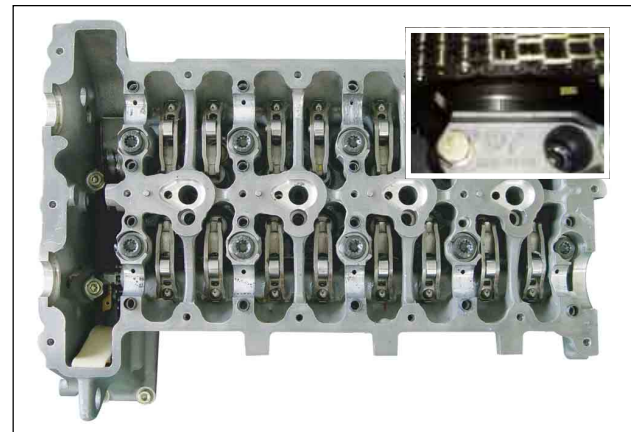


2. Place the bearing cap with the OT marks on both camshafts facing upward.



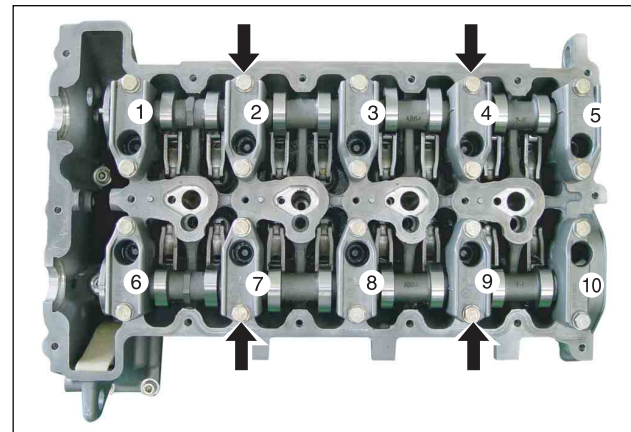
NOTICE

- Apply the sealant on the cap (#12) for the vacuum pump when installing.
Part number: 661 989 56 A0 (DB2210)
- Apply the oil on the bearing journals before installation.



3. Tighten the camshaft bearing cap bolts.

- 1) Intake: #7, #9
- 2) Exhaust: #2, #4



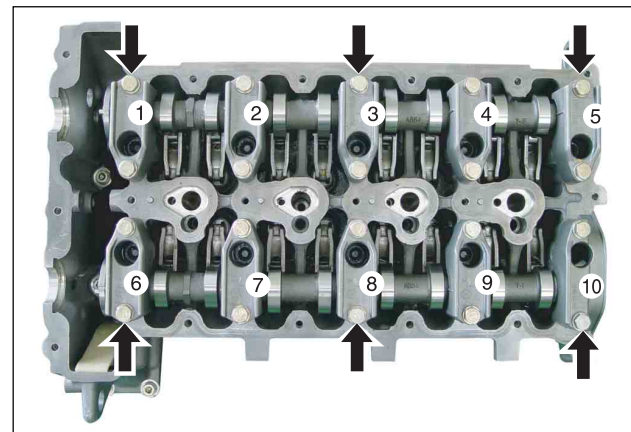
- 3) Intake: #6, #8, #10
- 4) Exhaust: #1, #3, #5

Tightening torque	25 Nm
-------------------	-------



NOTICE

- Check the finger follower positions and align if needed.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

4. Install the intake and exhaust camshaft sprockets and the timing chain.

Tightening torque	25 Nm + 90°
-------------------	-------------

**NOTICE**

- If the sprocket bolt is stretched over 0.9 mm, replace it with new one.
- Always install the intake camshaft sprocket first.



- 1) Make sure that the upper guide rail is installed with proper direction.



- 2) Make sure that the timing chain is securely seated on the guide rails.

**NOTICE**

- Make sure that the markings on camshaft sprocket and timing chain are aligned.

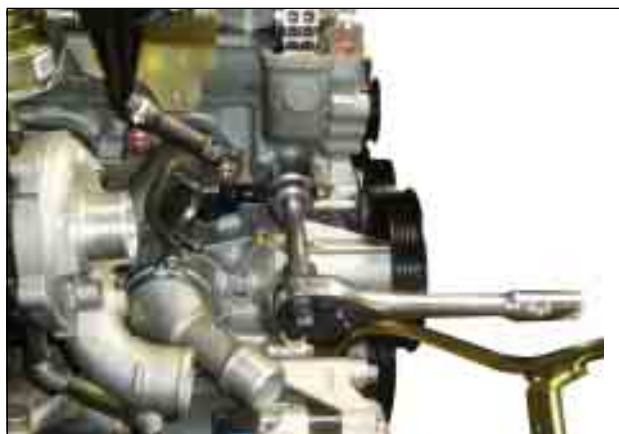


5. Install the chain tensioner.

Tightening torque	65 ± 5.0 Nm
-------------------	-------------

**NOTICE**

- Make sure that the EGR steel gasket is properly installed.



6. Rotate the crankshaft pulley two revolutions and ensure that the OT mark on the crankshaft pulley and the OT mark on the camshaft pulley are aligned.

**NOTICE**

- If the markings are not aligned, reinstall the cylinder head.



7. Install the cylinder head cover and the high pressure pump housing.

**NOTICE**

- Apply the sealant on the bolt threads when installing the high pressure pump.



8. Remove the protective caps from the injector and install the new fuel supply pipes.

**NOTICE**

- The fuel pipes are not reusable to keep the cleanliness and parts damage.



GENERAL

ASSY

HOUSING

INTAKE

EXHAUST

LUB

COOLING

FUEL

CONTROL

SENSOR

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► D27DT Engine

Removal

※ Preceding Works:

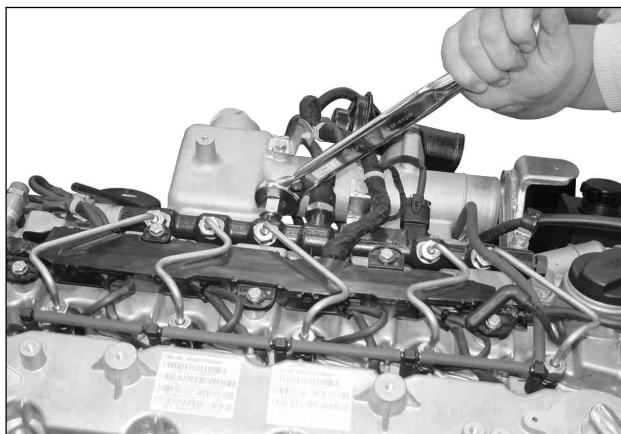
1. Removal of fan belt
2. Removal of fuel supply and return lines
3. Removal of intake manifold mounting bracket
4. Removal of EGR pipe and oil dipstick tube

1. Remove the injector fuel line and connector, and glow plug connector

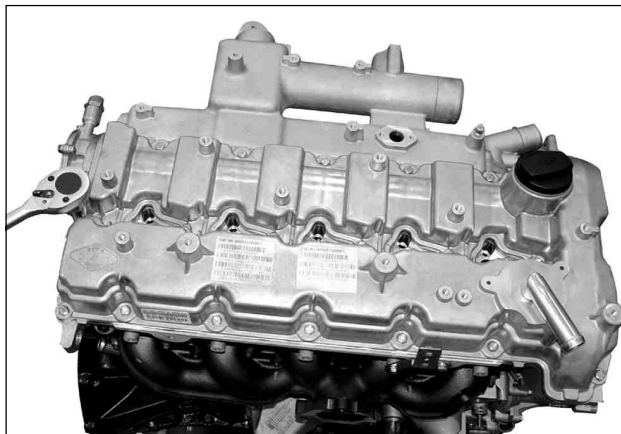


NOTICE

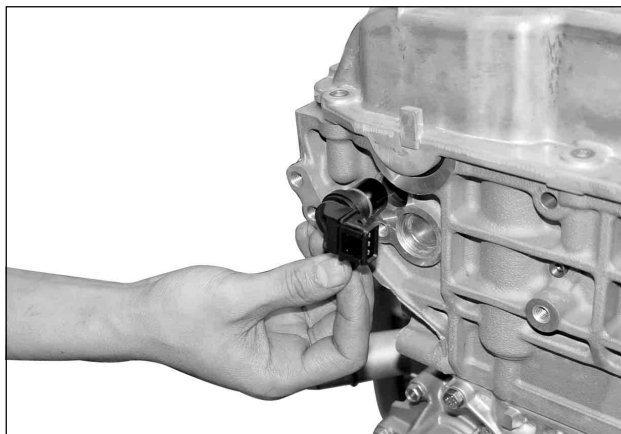
- Plug the openings of injector holes and common rail with the protective caps.



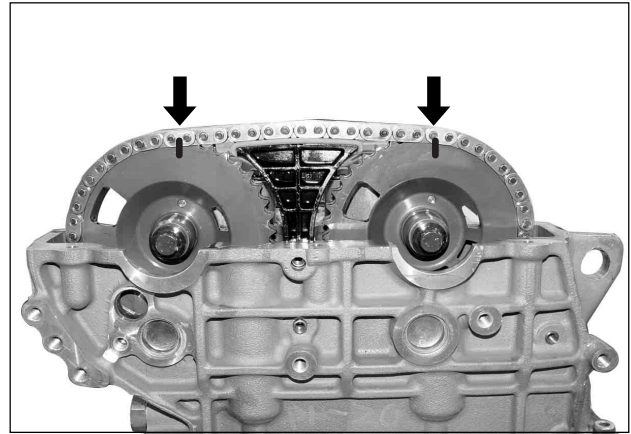
2. Remove the cylinder head cover.



3. Remove the camshaft position sensor.



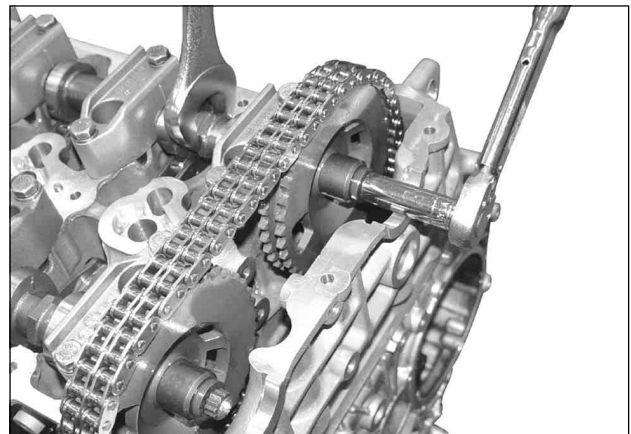
4. Mark on the intake camshaft sprocket and exhaust camshaft sprocket for timing setting during installation.



5. Remove the chain tensioner.



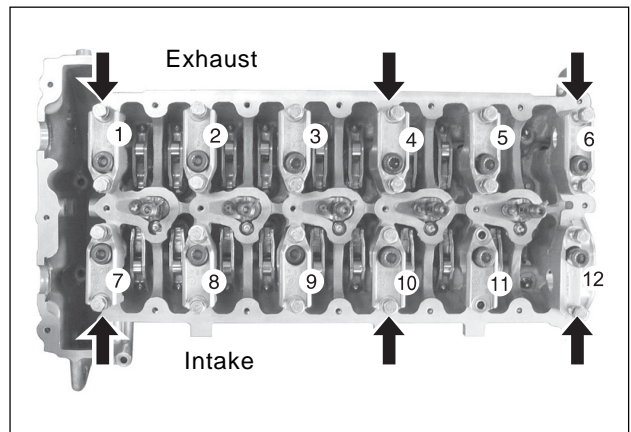
6. Hold the camshafts and remove the intake camshaft sprocket and exhaust camshaft sprocket.



7. Remove the camshaft bearing cap bolts so that the tightening force can be relieved evenly.

- 1) Intake: #7, #10, #12
- 2) Exhaust: #1, #4, #6

However, there is no specific removal sequence.



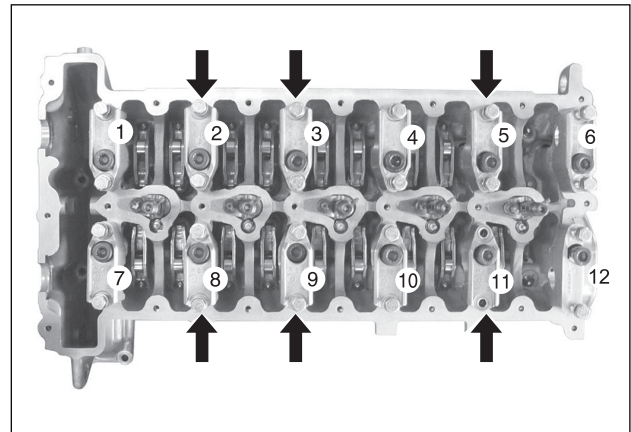
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

1) Intake: #8, #9, #11

2) Exhaust: #2, #3, #5

Do not remove the bolts at a time completely.
Remove them step by step evenly.

8. Remove the intake and exhaust camshafts from the cylinder head.

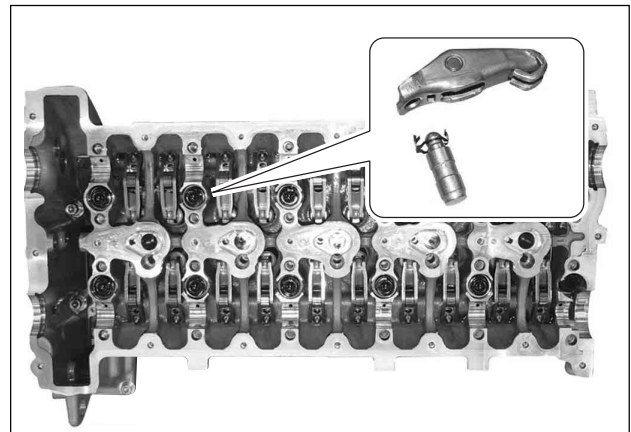


9. Remove the finger follower and the HLA device.



NOTICE

- Avoid contact with hot metal parts when removing the HLA device immediately after stopping the engine.



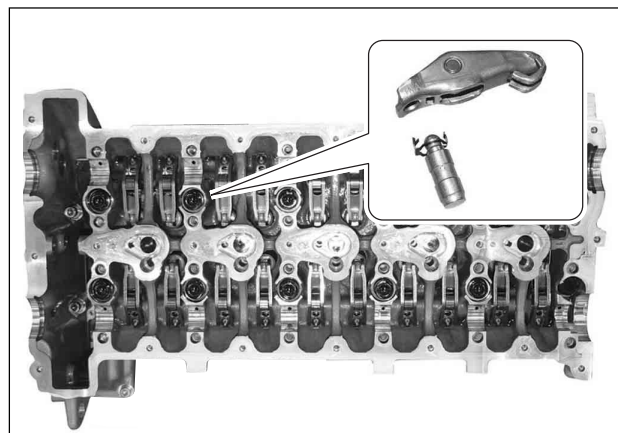
Installation

1. Install the HLA device and finger follower. Check the HLA device with the diagnosis procedures before installation.



NOTICE

- Put the cylinder head on the locating pins.

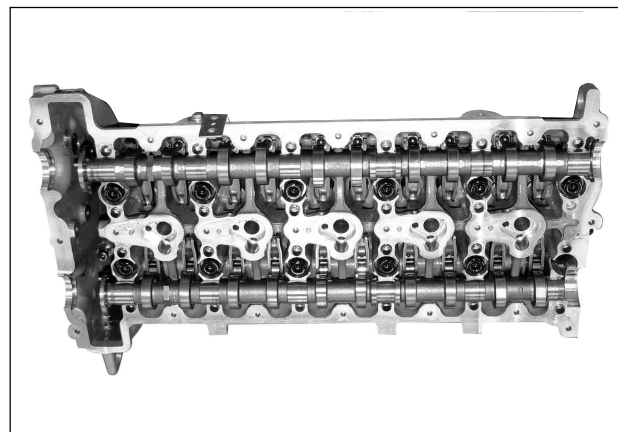


2. Place the bearing cap with the OT marks on both camshafts facing upward.



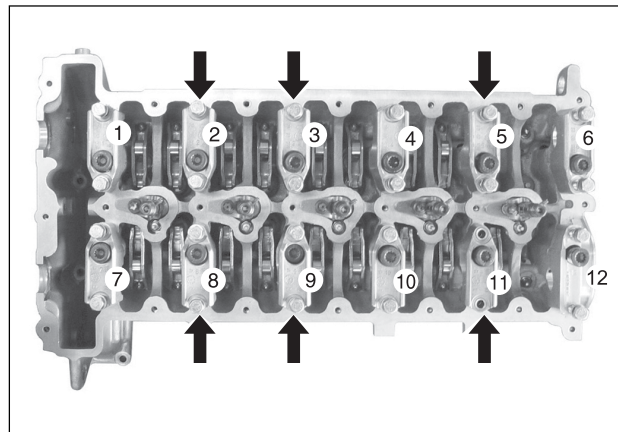
NOTICE

- Apply the sealant on the cap (#12) for the vacuum pump when installing.
- Apply the oil on the bearing journals before installation.

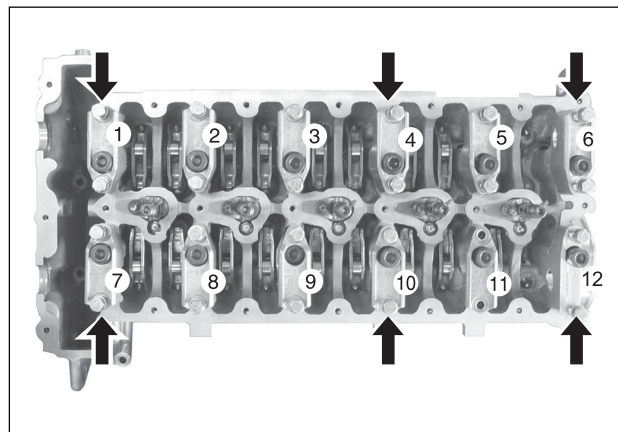


3. Tighten the camshaft bearing cap bolts.

- 1) Intake: #8, #9, #11
- 2) Exhaust: #2, #3, #5



- 3) Intake: #7, #10, #12
- 4) Exhaust: #1, #4, #6



Installation Notice

Tightening torque	25 Nm
-------------------	-------

- Check the finger follower positions and align if needed.

GENERAL

ASSY

HOUSING

INTAKE

EXHAUST

LUB

COOLING

FUEL

CONTROL

SENSOR

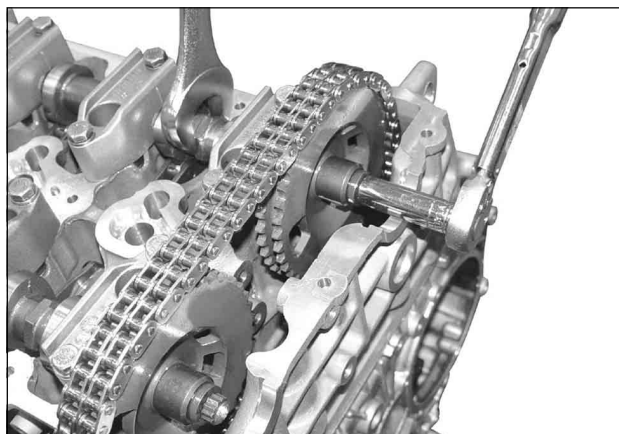
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

4. Install the intake and exhaust camshaft sprockets and the timing chain.

Installation Notice

Tightening torque	25 Nm + 90° + 10°
-------------------	-------------------

- *If the sprocket bolt is stretched over 0.9 mm, replace it with new one.*
- *Always install the intake camshaft sprocket first.*
- *Ensure that the markings on camshaft sprocket and timing chain are aligned.*
- *Make sure that the timing chain is securely seated on the guide rail.*

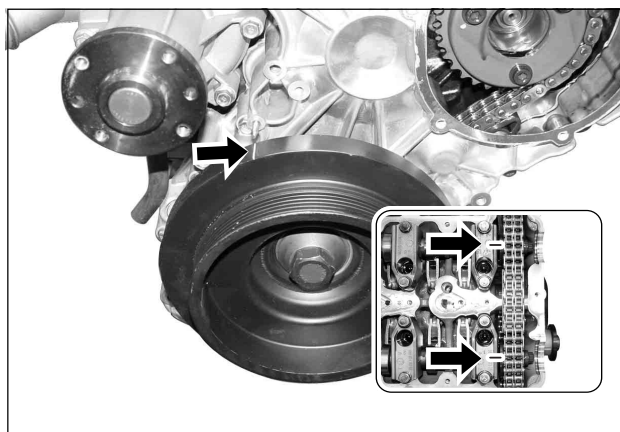


5. Rotate the crankshaft pulley two revolutions and ensure that the OT mark on the crankshaft pulley and the OT mark on the camshaft pulley are aligned.



NOTICE

- If the markings are not aligned, reinstall the cylinder head.




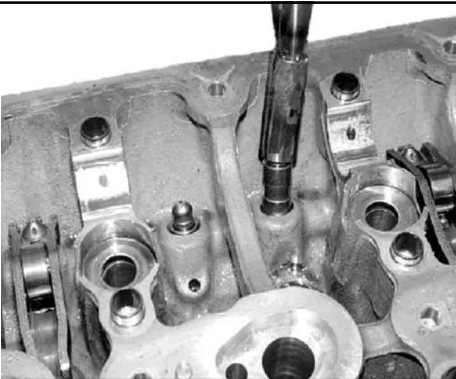


6. Install the chain tensioner.

Installation Notice

Tightening torque	65 ± 5.0 Nm
-------------------	-------------



► Special Tools and Equipment

Name and Part Number	Application
<div>Y99220152B</div> <div>HLA remover</div> <div></div>	
<div>Y99220142B</div> <div>Stem seal installer</div> <div></div>	

GENERAL

ASSY

HOUSING

INTAKE

EXHAUST

LUB

COOLING

FUEL

CONTROL

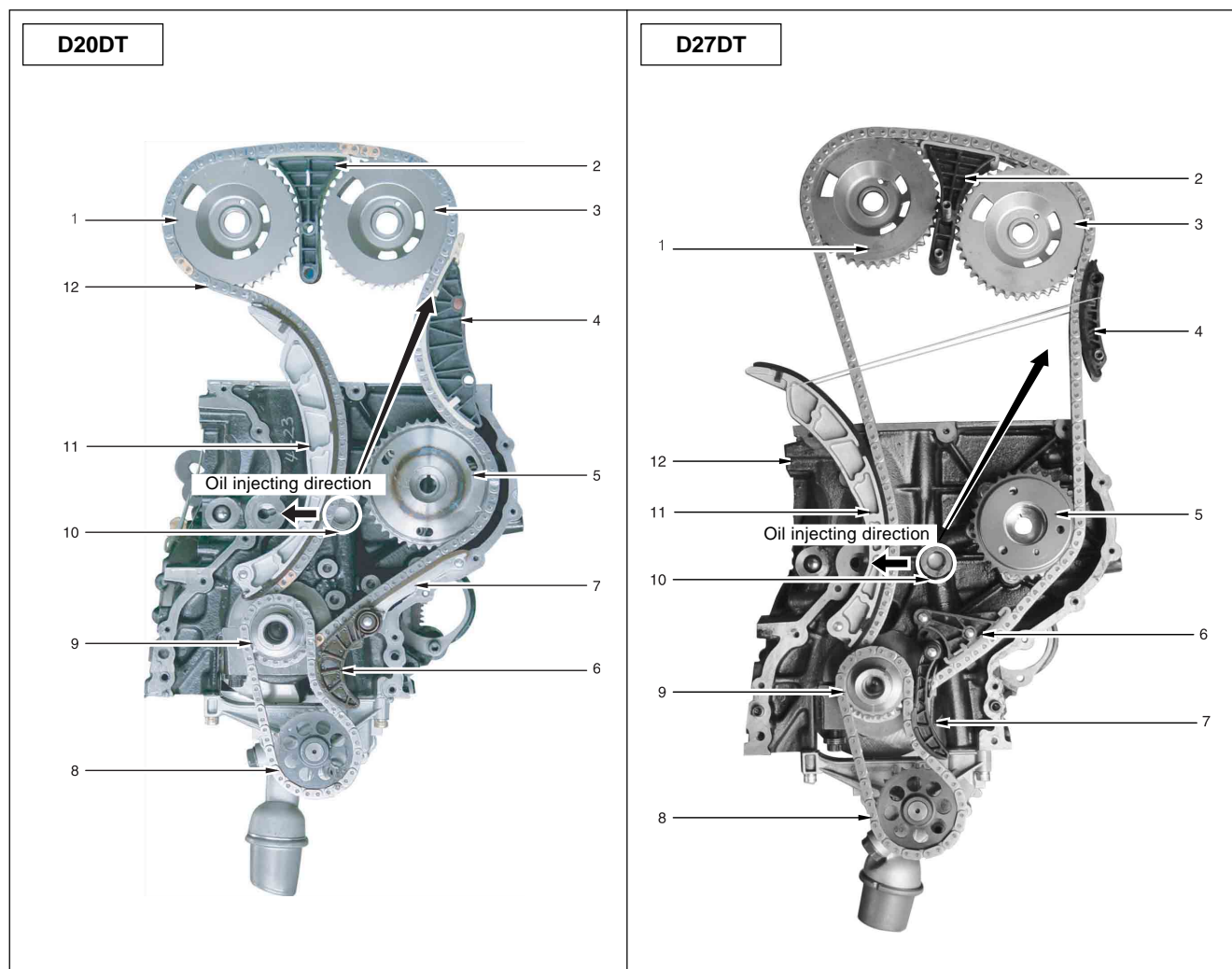
SENSOR

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

TIMING CHAIN ASSEMBLY

► Chain Drive System

System Layout



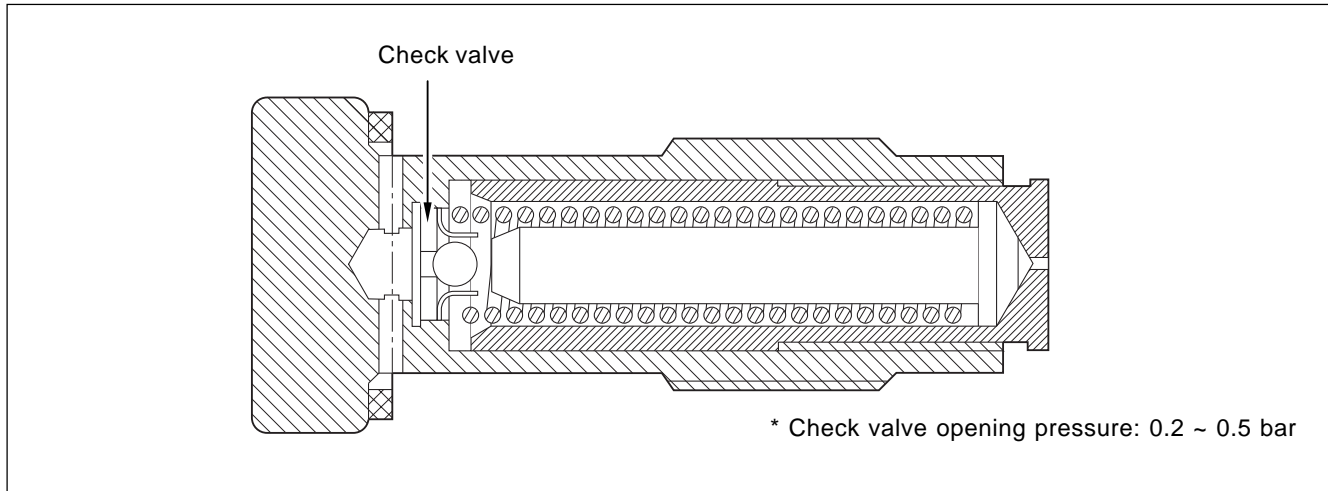
1. Exhaust camshaft sprocket
2. Upper guide rail
3. Intake camshaft sprocket
4. Clamping guide rail
5. HP pump sprocket
6. Lower guide rail

7. Oil pump tensioner
8. Oil pump sprocket
9. Crankshaft sprocket
10. Oil nozzle
11. Tensioner guide rail
12. Chain tensioner

Chain

1. Chain type: Double Bush
2. Pitch: 9.525 mm
3. Load limits: 19,000 N
4. No. of links: 148 EA (D20DT), 144 EA (D27DT)
5. Overall length: 1409.7 mm (D20DT), 1371.6 mm (D27DT)
6. Replace when the chain is extended by 0.5 % from overall length (Replace if extended by over 7.0485 mm (D20DT), 6.858 mm (D27DT))

Chain Tensioner



The major function of tensioner is optimizing the movement of chain drive system by using spring constant and oil pressure in the tensioner.

The tensioner performs function of adjusting chain tension to be always tight, not loose, while engine running. By doing so, can reduce wears of each guide rail and sprocket.

Tightening torque	65 ± 5.0 Nm (Installed on the cylinder head)
-------------------	---

Guide Rail

Guide rail is used to optimize the movement of chain drive system like tensioner.

Guide rail can prevent chain slap when chain is extended and reduce chain wears.

Guide rail is needed especially when the distance between the sprockets are too long.

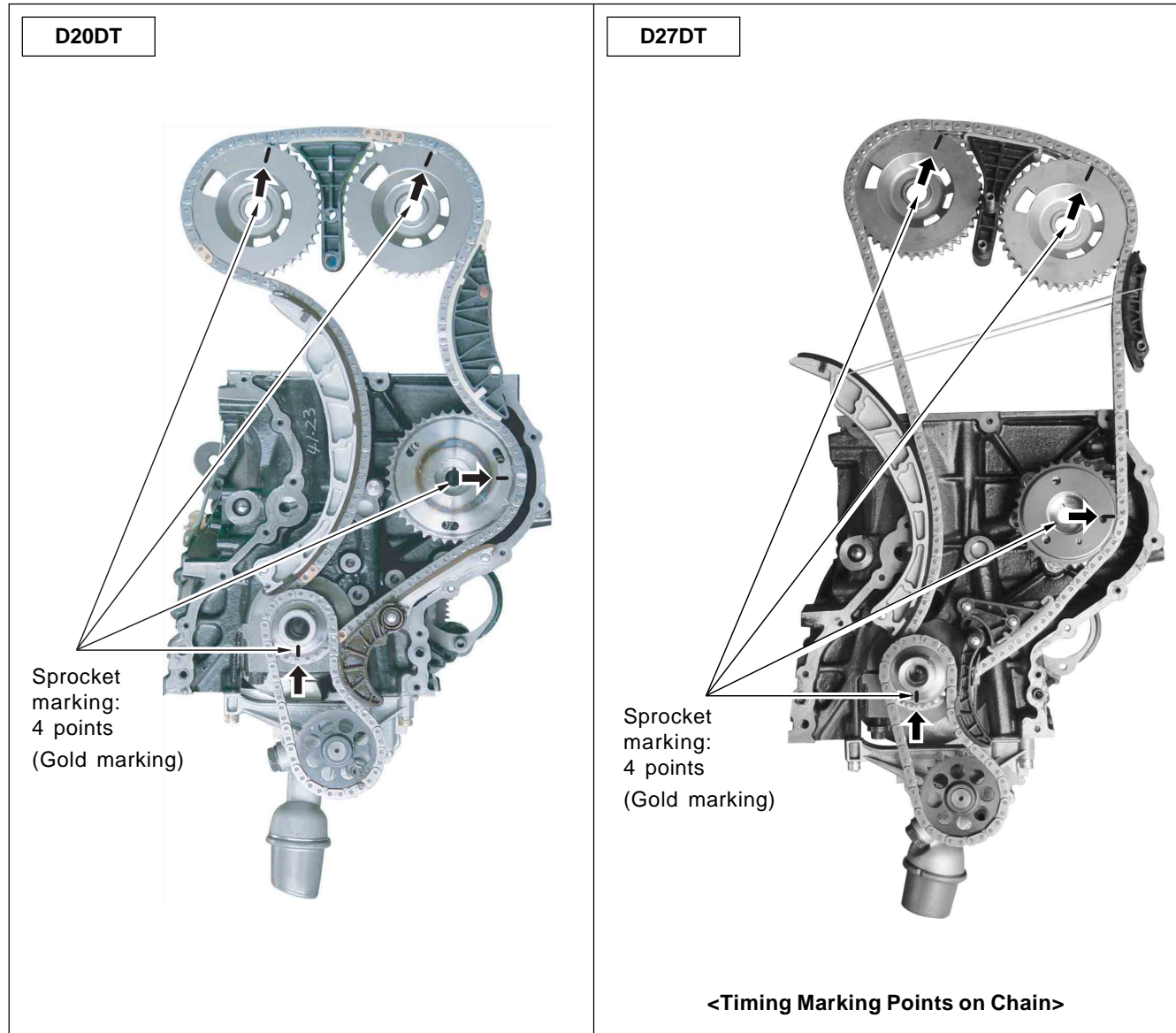
The material is plastic.

1. Location of guide rail

- 1) Tensioner guide rail: Between crankshaft sprocket and exhaust camshaft sprocket
- 2) Upper guide rail: Between exhaust camshaft sprocket and intake camshaft sprocket
- 3) Clamping guide rail: Between intake camshaft sprocket and HP pump sprocket
- 4) Lower guide rail: Between HP pump sprocket and crankshaft sprocket

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

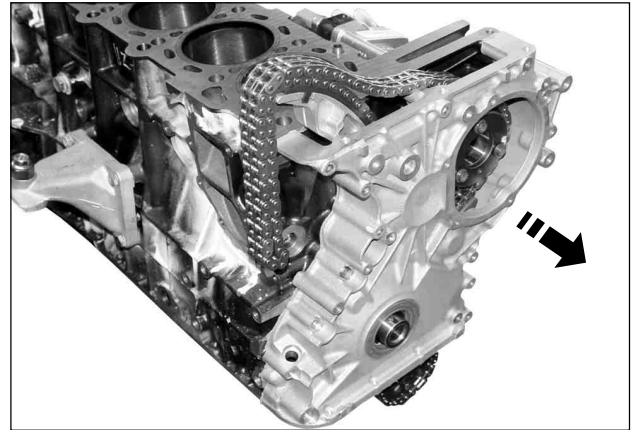
Timing Setting



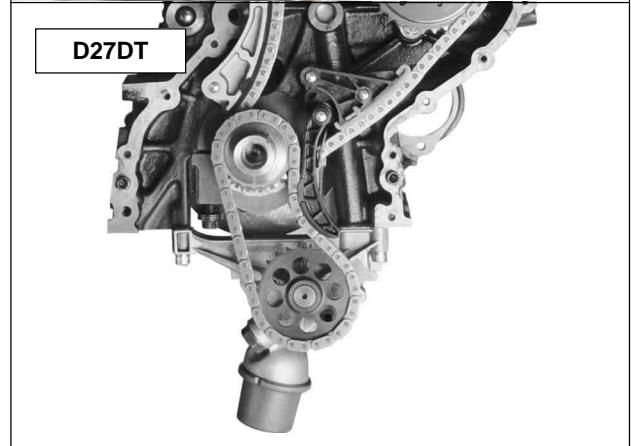
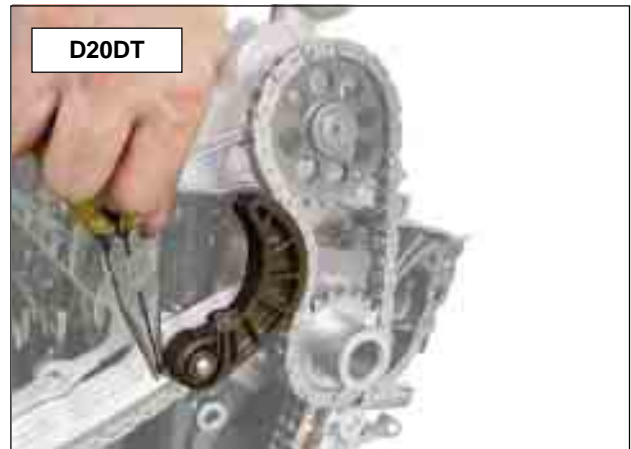
1. Check marking links on the chain (Gold marking)
2. Locate a point with two continuous marking links and align it to a marking on crankshaft sprocket (△)
3. Align respective marking link to each camshaft sprocket (intake and exhaust) marking (△)
4. Align another marking link to HP pump sprocket marking (△)

Removal and Installation

1. Remove the cylinder head assembly.
2. Remove the oil pan.
3. Remove the chain guide rail with a sliding hammer.
4. Remove the chain cover.



5. Remove the oil pump drive chain.
6. Remove the upper guide rail while pushing the retaining spring with a screwdriver.
7. Remove the lower guide rail.
8. Remove the oil pump drive chain.

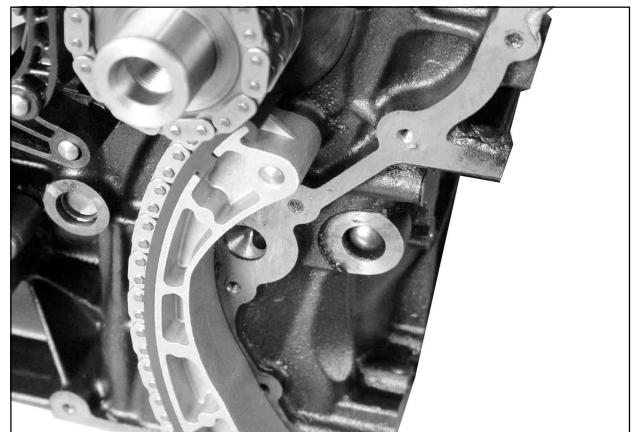


9. Remove the tensioner guide rail.
10. Remove the timing chain.
11. Install in the reverse order of removal.



NOTICE

- Thoroughly clean the removed components before installing.



GENERAL

ASSY

HOUSING

INTAKE

EXHAUST

LUB

COOLING

FUEL

CONTROL

SENSOR

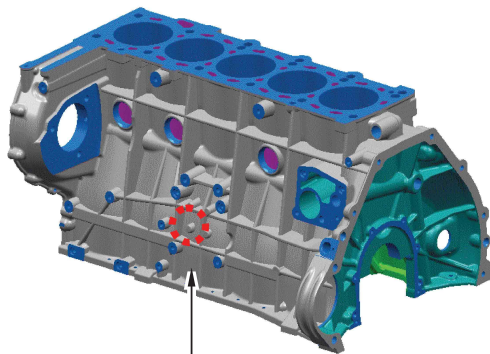
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

CYLINDER BLOCK

D20DT

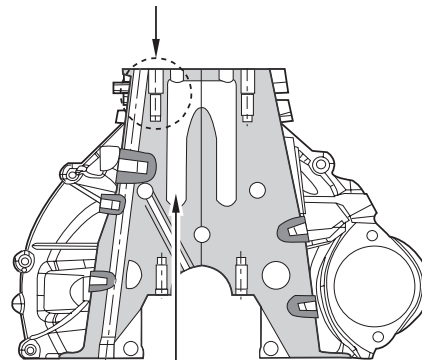


D27DT

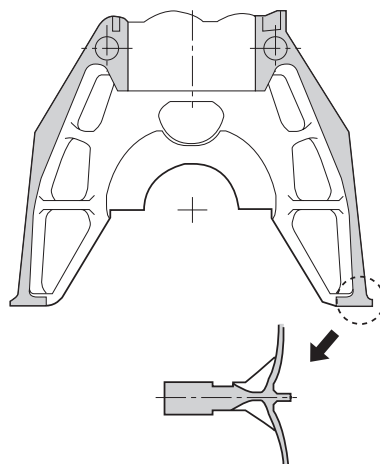


Internal and external ribs considered vibration and strength

Deep head bolt thread to prevent the deformation at cylinder bore surfaces



Water jacket design to increase the cooling efficiency



Cambering type skirt to reduce the noise

► System Characteristics

1. Rib design by considering strength against engine vibrations and weight
2. Cambering type skirt design on case housing wall to reduce the engine noise
3. Water jacket design to increase the cooling efficiency of cylinder bore bridge
4. Deep head bolt thread to prevent the deformation at cylinder bore surfaces
5. Reinforcement of strength
 - 1) Main bearing housing / Main bearing cap
 - 2) Extended main bearing cap bolt
6. Reducing the noise, vibration and harshness (NVH)
 - 1) Minimize the vibration by adding external ribs
 - 2) Adding the ribs around oil pan mating surface

► Knock Sensor

Two knock sensors are located on the cylinder block (intake manifold side).

To detect engine vibration under abnormal combustion, knock sensor has piezoelectric element fixed on the vibration plate and this vibration plate is fixed on the base. If happens knocking, pistons or connecting rods vibrate and occurs heavy sounds that hit metal. Knock sensor is used to detect those knockings caused by abnormal combustions. It controls idling stabilities and turns on the engine warning light when detects injector damages. And also controls pilot injection very precisely during MAP learning.

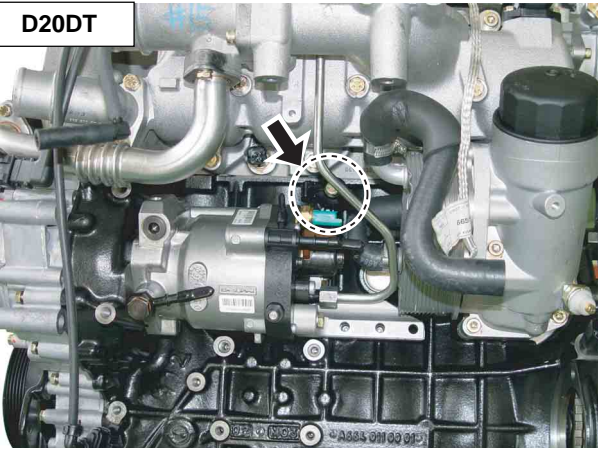
When knock sensor is defective, engine ECU corrects injection timing based on MAP values like engine speed, intake air volume and coolant temperature.

※ Before checking the knock sensor unit, be sure to check the tightening torque of the sensor and connector connecting conditions.

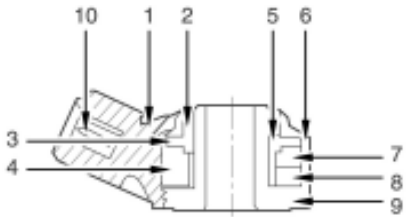

Insulating resistance	Min. 1 MΩ
Resonance frequency	25 kHz
Operating temperature	- 40 ~ 150°C
Output voltage	26 ± 8 mV/g (at 5 kHz)
	22 ~ 37 mV/g (3 ~ 10 kHz)
	22 ~ 57 mV/g (10 ~ 20 kHz)
Tightening torque	20 ± 5 Nm

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

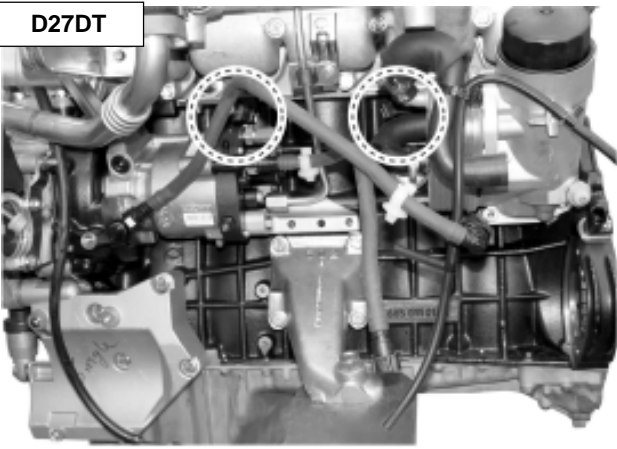
D20DT



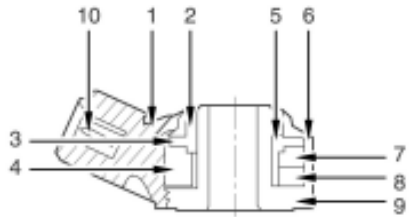

<Location of Knock Sensor>



D27DT



<Location of Knock Sensor>



1. Sensor housing

2. Nut

3. Disc spring

4. Weight
5. Insulation disc

6. Upper contact plate

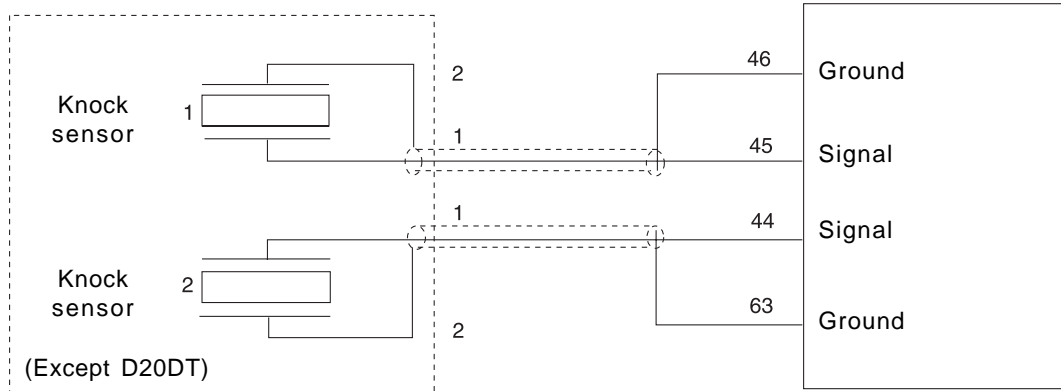
7. Piezo element
8. Lower contact plate

9. Body

10. Terminal

**NOTICE**

- The knock sensor should be tightened with the specified tightening torque. Otherwise, the engine output may be decreased and the “ENGINE CHECK” warning lamp may come on. The internal resistance of the sensor is approx. 4.7 kW.



<Circuit Diagram of Knock Sensor>

GENERAL

ASSY

HOUSING

INTAKE

EXHAUST

LUB

COOLING

FUEL

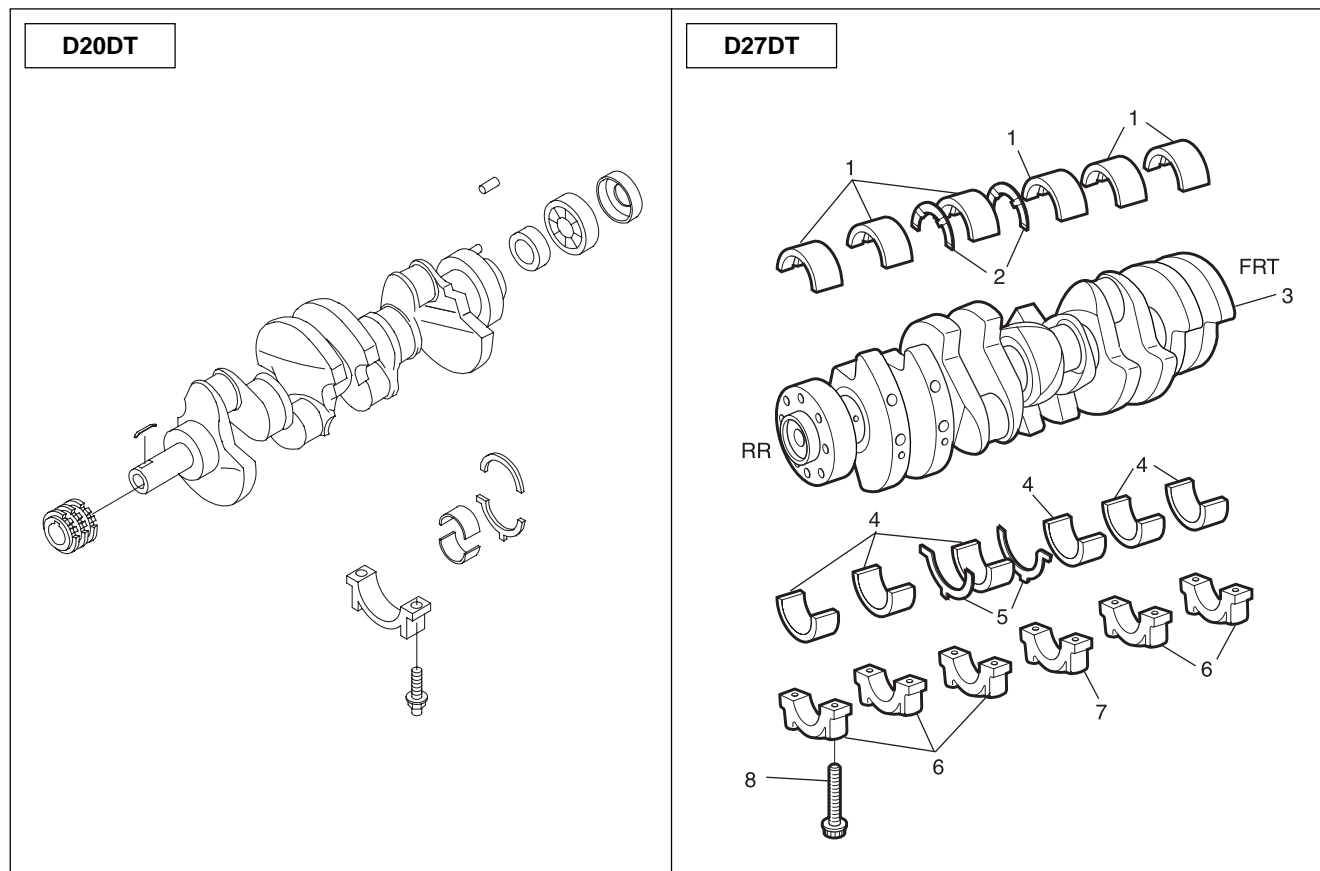
CONTROL

SENSOR

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

CRANKSHAFT

- ※ **Preceding Works:** Removal of end cover
 Removal of pistons
 Removal of crankshaft sprocket

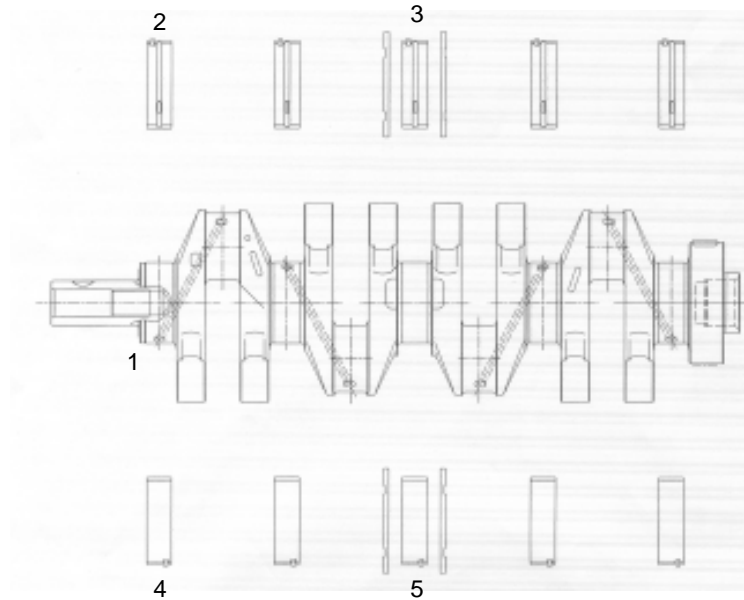


1. Crankshaft main bearing shells, upper
2. Upper thrust bearing
3. Crankshaft
4. Crankshaft main bearing shells, lower

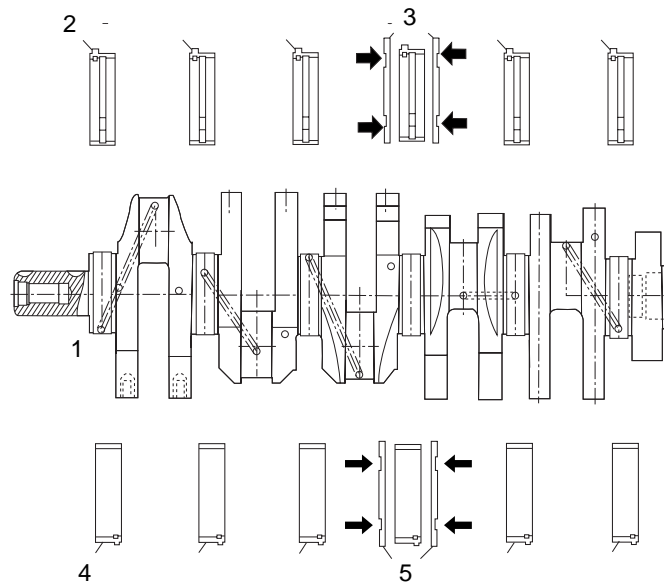
5. Lower thrust bearing
6. Crankshaft main bearing cap
7. Crankshaft thrust bearing cap
8. 12-sided stretch bolt $55 \pm 5.0 \text{ Nm}$, $90^\circ + 10^\circ$

ARRANGEMENT OF THRUST WASHERS AND BEARINGS

D20DT



D27DT



- | | |
|--|--|
| 1. Crankshaft | 4. Crankshaft main bearing shells, lower |
| 2. Crankshaft main bearing shells, upper | 5. Lower thrust bearing |
| 3. Upper thrust bearing | |



NOTICE

- The clearance between bearing shell and bore and between bearing shell and journal are various. Refer to the table on next page to select bearings when installing.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► Dimensions of Crankshaft Main Bearing

(mm)

Color	Crankshaft Journal	Upper Main Bearing	Lower Main Bearing
Blue	61.965 ~ 61.960	2.260 ~ 2.255	2.260 ~ 2.255
Yellow	61.960 ~ 61.955	2.265 ~ 2.260	2.265 ~ 2.260
Red	61.955 ~ 61.950	2.270 ~ 2.265	2.270 ~ 2.265
White	61.950 ~ 61.945	-	2.275 ~ 2.270
Violet	61.945 ~ 61.940	-	2.280 ~ 2.275

► Bearing Clearance

(mm)

Description		Crankshaft Bearing	Thrust Bearing
Radial clearance	When new	0.027 ~ 0.051	0.026 ~ 0.068
	Wear limit	Max. 0.070	Max. 0.080
Axial clearance	When new	0.100 ~ 0.254	-
	Wear limit	Max. 0.300	-

► Matching the Fit Bearing Journal Width to Thrust Washers

(mm)

Fit bearing Journal Width	Thrust Washer Thickness
26.300 ~ 26.333	2.15
26.400 ~ 26.433	2.20
26.500 ~ 26.533	2.25
26.700 ~ 26.733	2.35
26.800 ~ 26.833	2.40



NOTICE

- Measure the crankshaft axial clearance and correct if necessary with appropriate thrust washers.
- Thrust washers of the same thickness must be installed on both sides of the fit bearing.

► Matching the Crankshaft Bearing Shells to Basic Bearing Bore in Crankcase

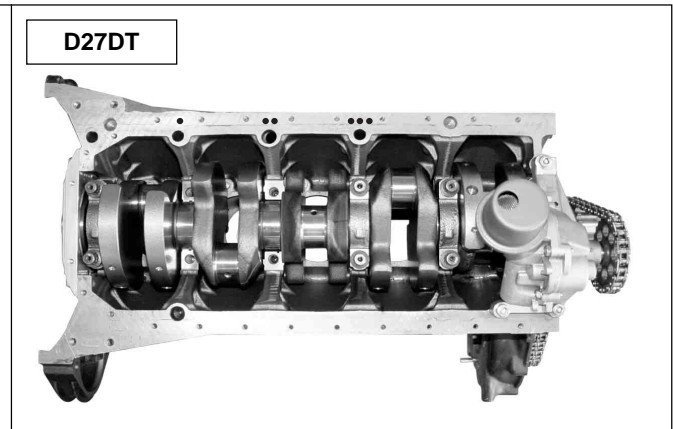
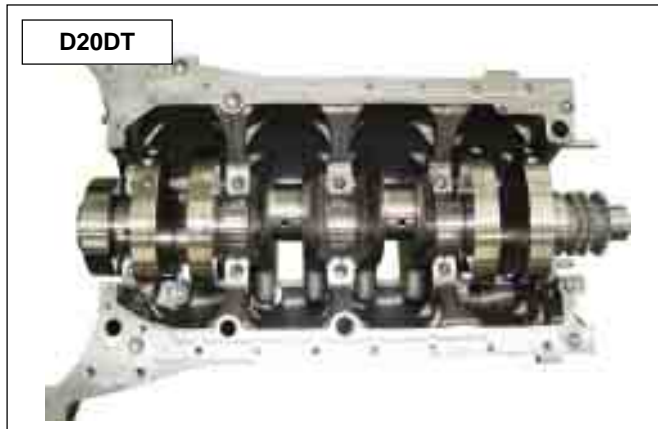
Marking of Basic Bearing Bore in Lower Mating Surface	Relevant Crankshaft Bearing Shell With Color Coding
1 punch mark or blue	blue or white - blue
2 punch marks or yellow	yellow or white - yellow
3 punch marks or red	red or white - red

► Matching Crankshaft Bearing Shells to Basic Bearing Journal of Crankshaft

Marking of Bearing Journals on Crank Webs	Relevant Crankshaft Bearing Shell With Color Coding
blue or white - blue	blue or white - blue
yellow or white - blue	yellow or white - yellow
red or white - blue	red or white - red

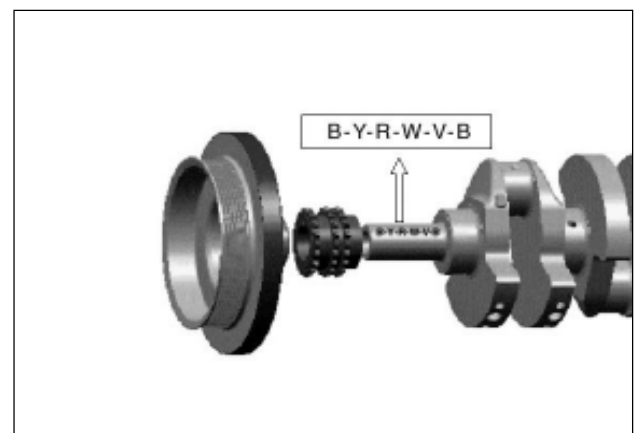
► Selection of Upper Main Bearing Shell

Punch Mark	Color
•	Blue
• •	Yellow
• • •	Red



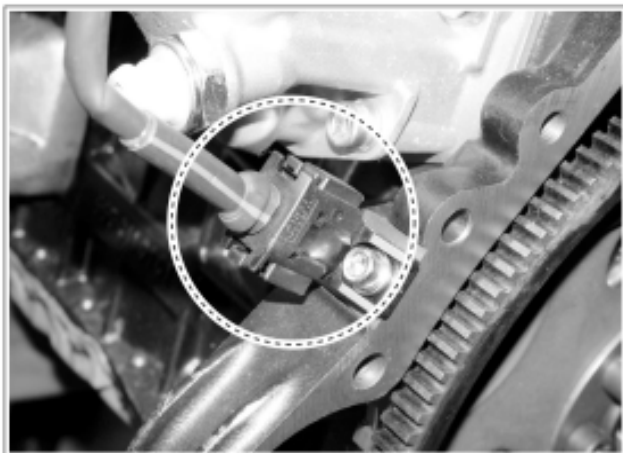
► Selection of Lower Main Bearing Shell

Mark	Color
B	Blue
Y	Yellow
R	Red
W	White
V	Violet

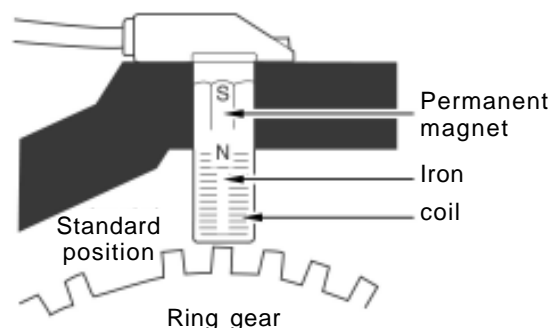


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► Crankshaft Position Sensor



<Location of Crankshaft Position Sensor>

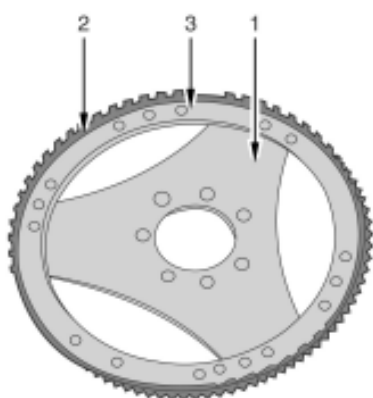


<Structure of Crankshaft Position Sensor>

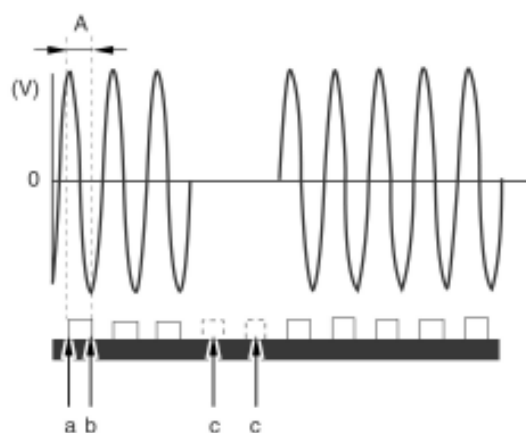
The crankshaft position sensor is located near to flywheel on the rear of cylinder block. It generates AC voltage between increment type driven plate that fixed on flywheel inside. The sensor consists of soft iron core that winded copper wire on permanent magnet and generates sign wave AC voltage when magnetism on the sensor wheel passes the sensor.

When the crankshaft rotates, '+' signal will be generated from near the front edge and '-' signal will be generated from near the rear edge among teeth on the driven plate near to crankshaft position. The AC voltage increases as the engine speed increases, however, no signal occurs from the 2-missing-tooth on the increment type driven plate. By using these teeth, ECU recognizes TDC of No. 1 and 5 cylinders.

ECU converts the alternative signals into digital signals to recognize crankshaft position, piston position and engine speed. The piston position that coupled with crankshaft is main factor in calculating injection timing. By analyzing the reference position and camshaft position sensor, can recognize No. 1 cylinder and calculate the crankshaft speed.



<Drive Plate>

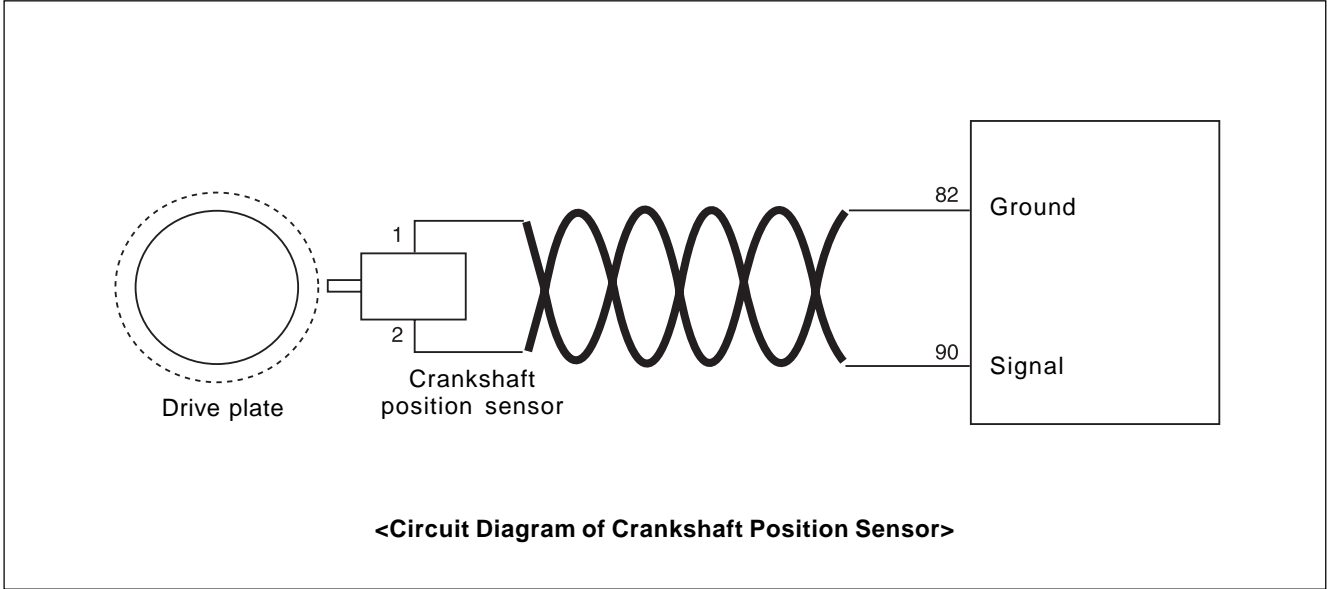


A. Distance between '+' max. voltage and '-' max. voltage

a. Front edge

b. Rear edge

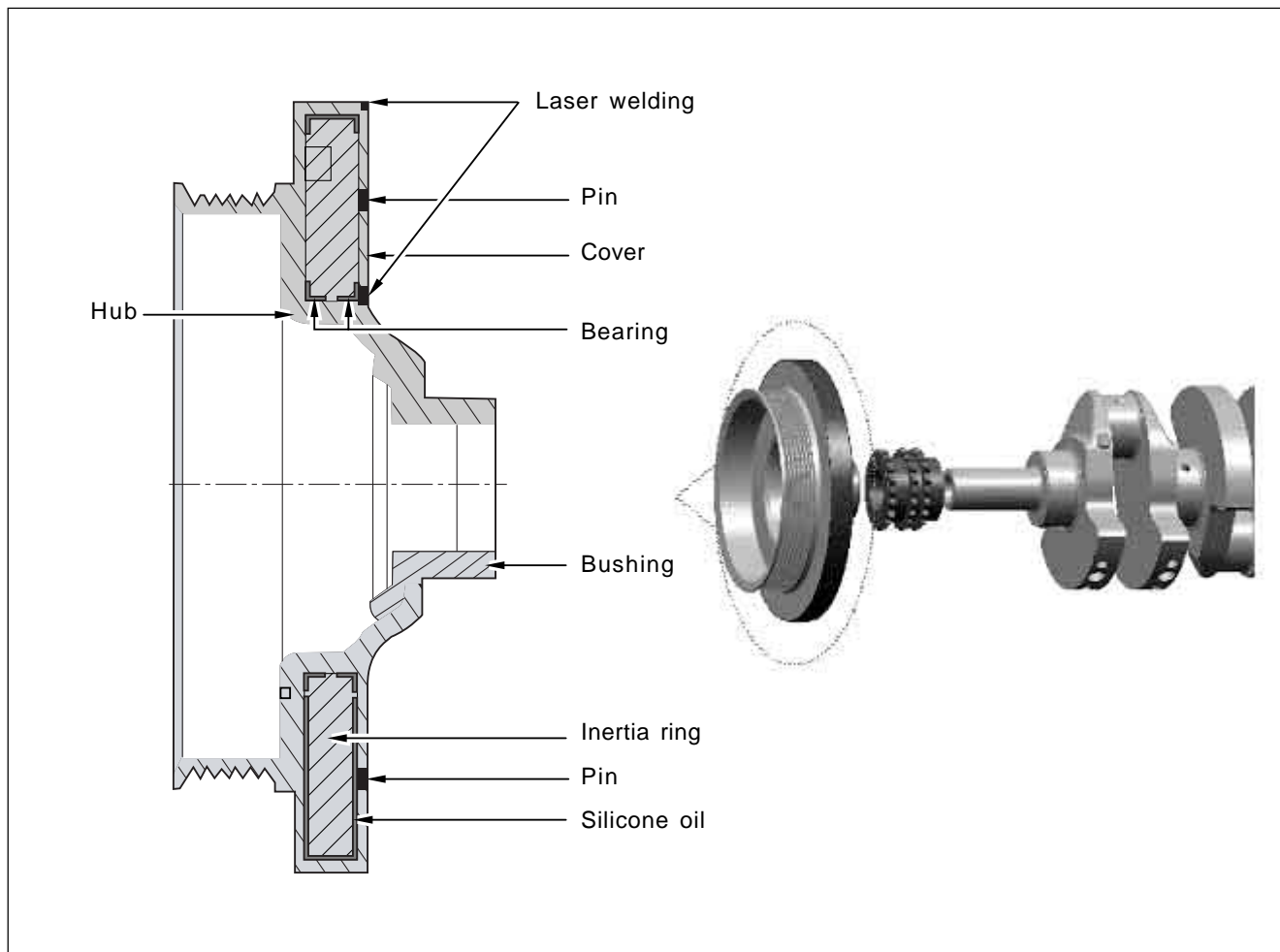
c. 2-missing-tooth



Output voltage (1 ~ 150 V)	Min. voltage: 1.0 V (40 rpm, air gap: 1.3 mm)
	Max voltage: 150 V (7000 rpm, air gap: 0.3 mm)
Sensor unit coil resistance (Ω)	1,090 ± 15 %
Sensor air gap	0.7 ~ 1.5 mm
Operating temperature	- 40 ~ 150°C
Tightening torque	6 ~ 8 Nm

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

TORSIONAL VIBRATION DAMPER



► System Description

1. Components: Hub, inertia ring, cover, bearing, bushing, silicone oil
2. Functions: The crankshaft pulley optimizes the drive system by reducing the amount of torsional vibration in crankshaft. Conventional rubber damper is limited in changing materials (rubbers) to absorb vibration, but this crankshaft pulley (viscous damper), using silicone oil, takes advantage of less changing viscosity according to the temperature.

DISASSEMBLY AND REASSEMBLY

1. Unscrew the bolts and remove the connecting rod journal bearing and bearing caps.



NOTICE

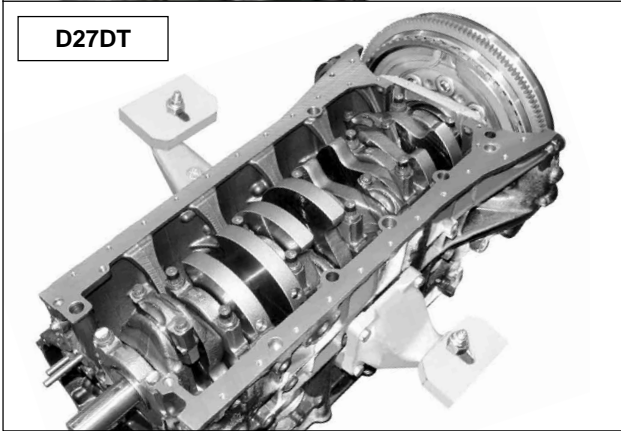
- Position the #1 piston at TDC and remove the piston connecting rod journal bearing caps.

2. Remove the bearing cap bolts.
3. Remove the bearing caps.

D20DT



D27DT

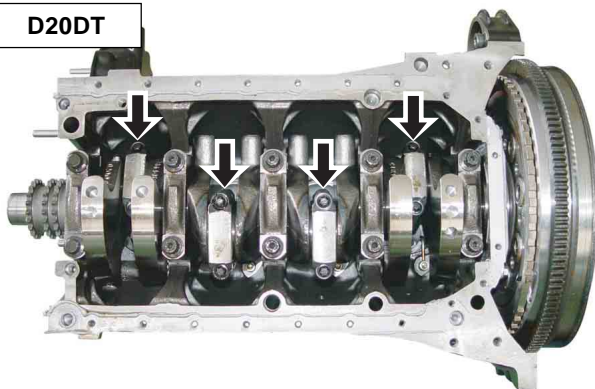


NOTICE

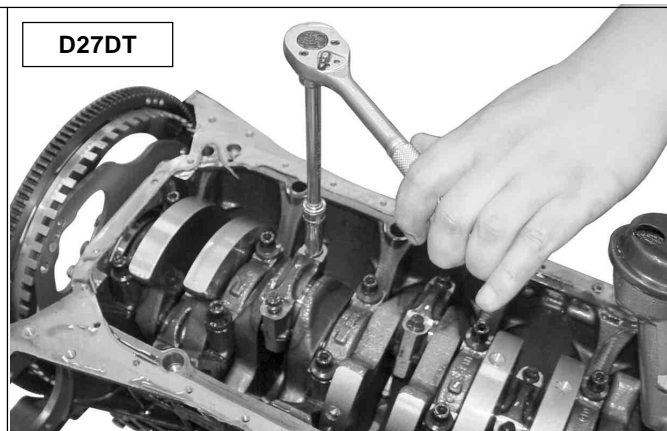
- The crankshaft bearing caps are marked with stamped numbers. Start to remove from the crankshaft pulley side.
- Do not mix up the bearing shells.

4. Remove the bearing caps and lower thrust bearing.
5. Separate the lower bearing shells from the bearing caps.

D20DT



D27DT

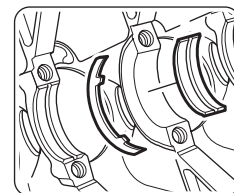
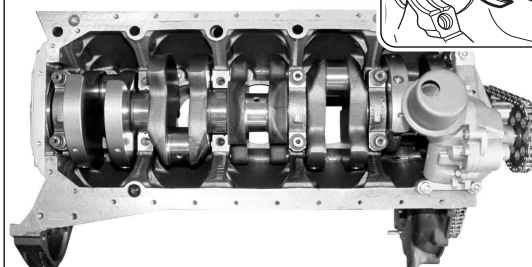
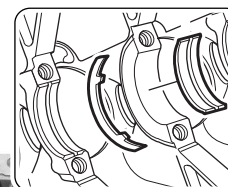
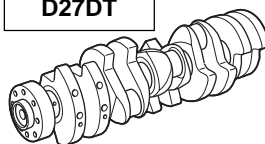


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

6. Remove the crankshaft.
7. Remove the upper thrust washers.
8. Remove the upper bearing shells from the crankcase.

**NOTICE**

- Do not mix up the bearing shells.

D20DT**D27DT**

Crankshaft - Reassembly

1. Thoroughly clean the oil galleries and check the journal section and bearings. Replace if necessary.

2. Coat the upper thrust washers with oil and insert into the crankcase so that the oil grooves are facing the crank webs (arrow).
3. Coat the lower thrust washers with oil and insert into the crankcase so that the oil grooves are facing the crank webs (arrow).



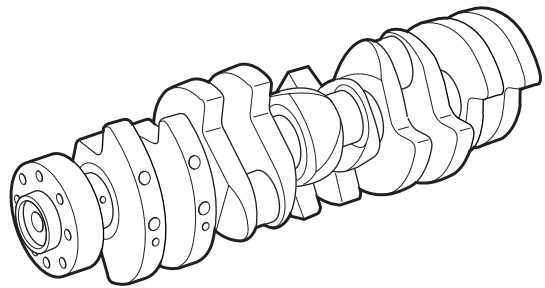
NOTICE

- The retaining lugs should be positioned in the grooves (arrow).

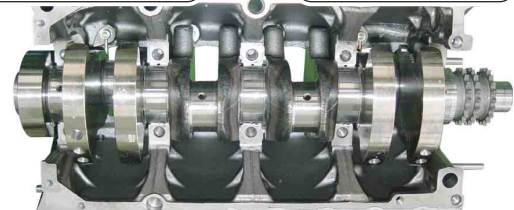
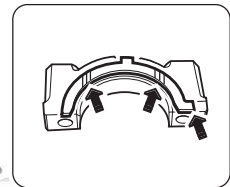
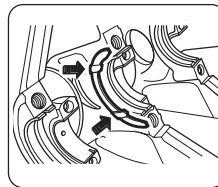
D20DT



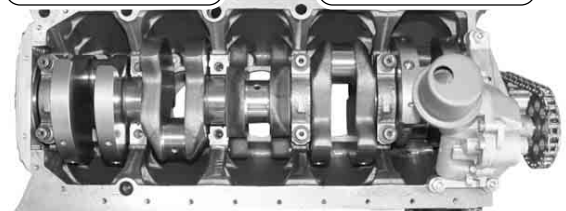
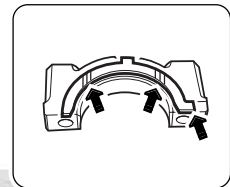
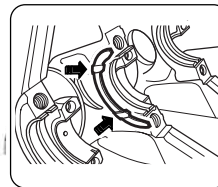
D27DT



D20DT



D27DT



GENERAL

ASSY

HOUSING

INTAKE

EXHAUST

LUB

COOLING

FUEL

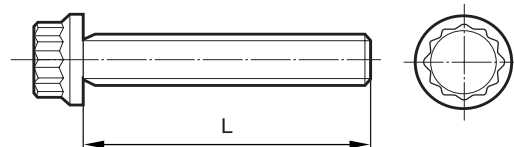
CONTROL

SENSOR

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

**NOTICE**

- If the maximum permissible length of $L = 63.8$ mm is exceeded, the 12-sided stretch bolts should be replaced.

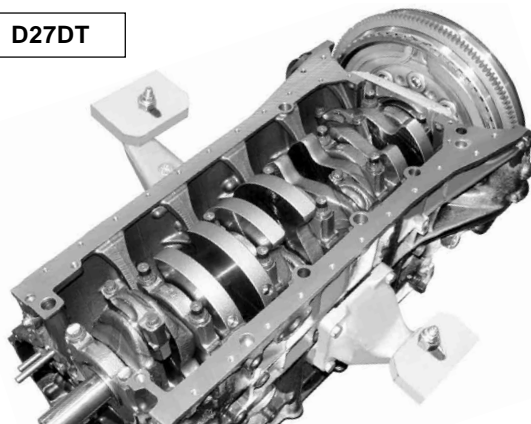


4. Coat the new crankshaft with engine oil and place it on the crankcase.
5. Install the crankshaft bearing caps according to the markings and tighten the bolts.

Installation Notice

Tightening torque	55 ± 5 Nm + 90° + 10°
-------------------	---------------------------

- **Install from #1 cap.**

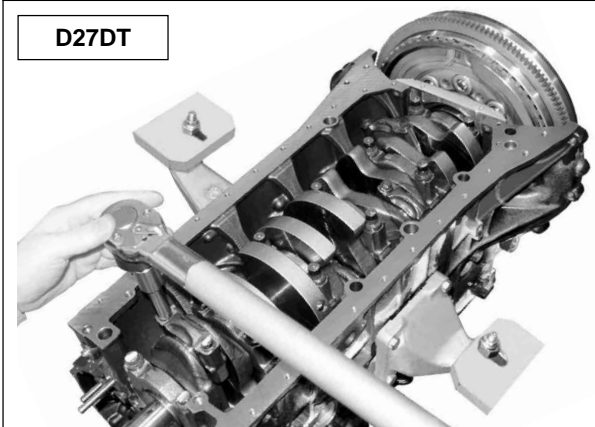
D20DT**D27DT**

6. Position the #1 piston at TDC and install the crankshaft.
7. Install the piston connecting rod journal to the crankshaft journal and tighten the bolts.
8. Measure the crankshaft bearing axial clearance.
 - 1) When new: 0.100 ~ 0.266 mm
 - 2) When used: 0.300 mm
9. Rotate the crankshaft by hand and check whether it rotates smoothly.

D20DT



D27DT



GENERAL

ASSY

HOUSING

INTAKE

EXHAUST

LUB

COOLING

FUEL

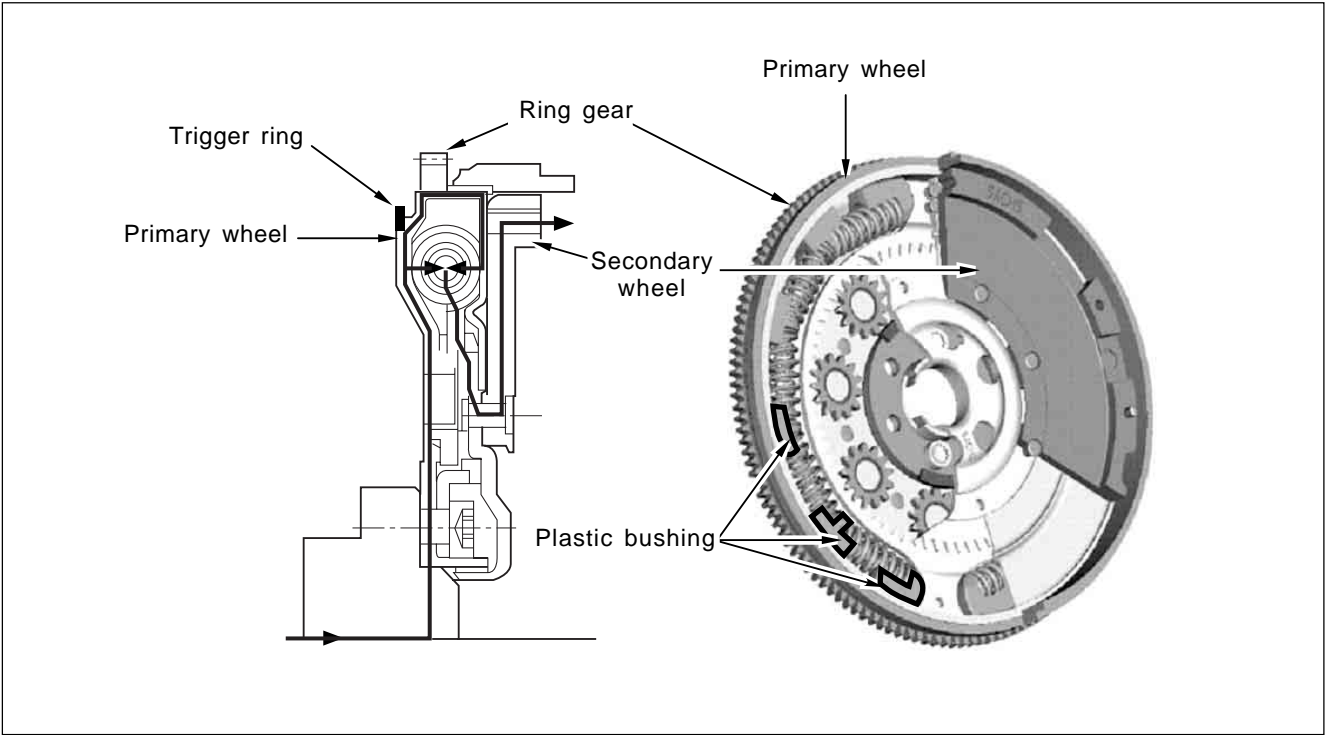
CONTROL

SENSOR

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

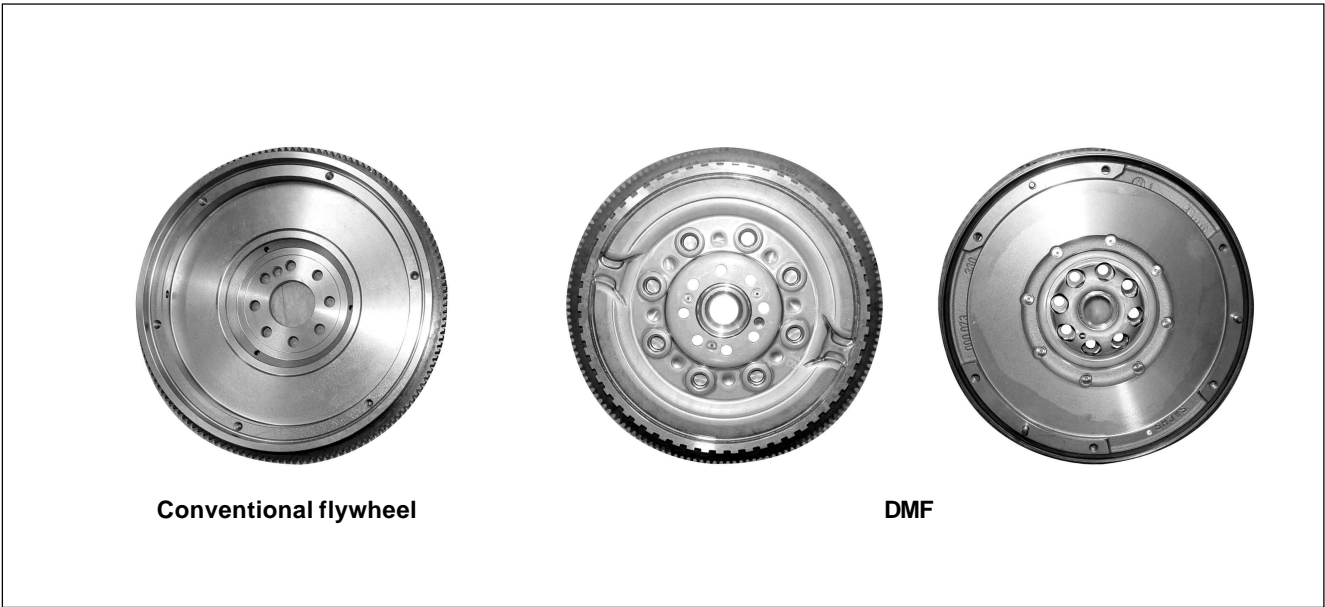
FLYWHEEL

DUAL MASS FLYWHEEL (DMF, MANUAL TRANSMISSION EQUIPPED VEHICLE)



► System Description

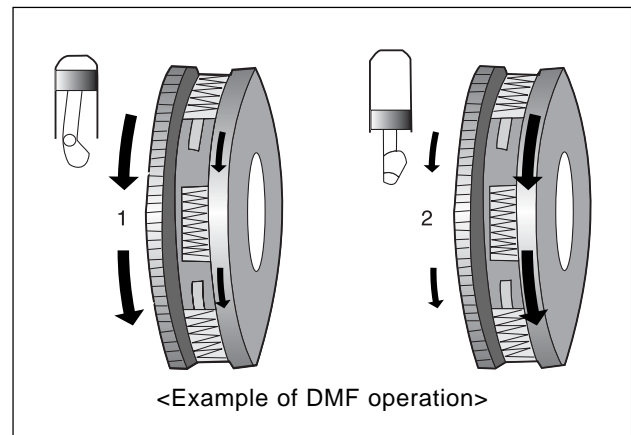
This flywheel is installed to the rear end of crankshaft and transfers the output from the engine to the power train mechanism. When starting the engine, this drive the crank train mechanism initially by using the power from the start motor. Also, DMF measure the crankshaft speed, sends the signals to ECU, and controls the ignition timing.



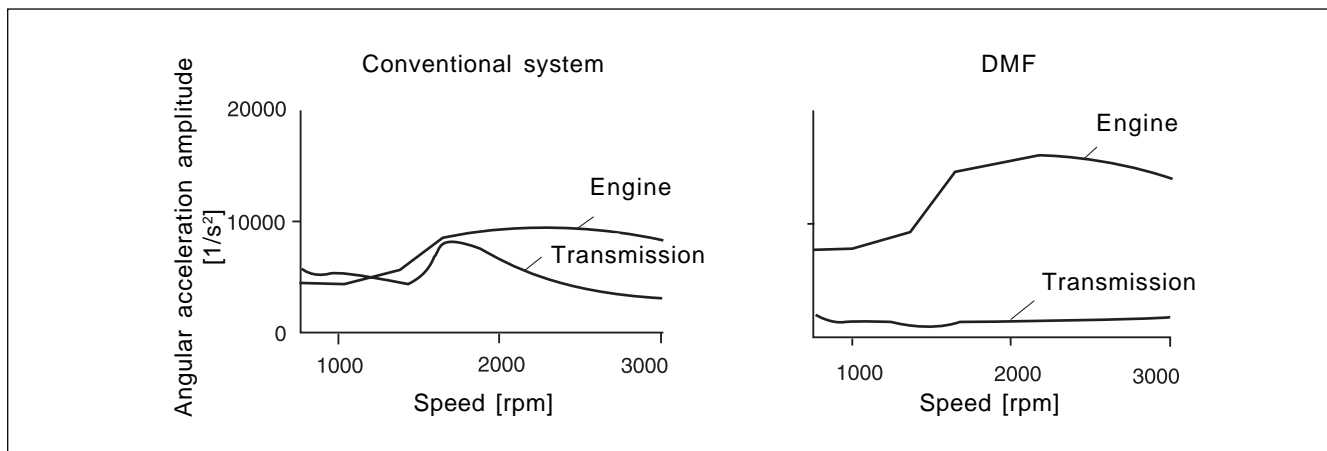
► Structure

Function and characteristics

1. When the output changes from the engine is high during power stroke (①): The damper absorbs the shocks to reduce the changes to transmission.
2. When the output changes from the engine is low during compression stroke (②): The damper increases the torque changes to clutch.



<Torque change curve of engine and drive shaft>



► System Characteristics

Function

1. Filters irregularities of engine: The secondary flywheel operates almost evenly so does not cause gear noises
2. The mass of the primary flywheel is less than conventional flywheel so the engine irregularity increases more (less pulsation absorbing effect)
3. Transmission protection function: Reduces the torsional vibration to powertrain (transmission) by reducing the irregularity of engine

Characteristics of DMF

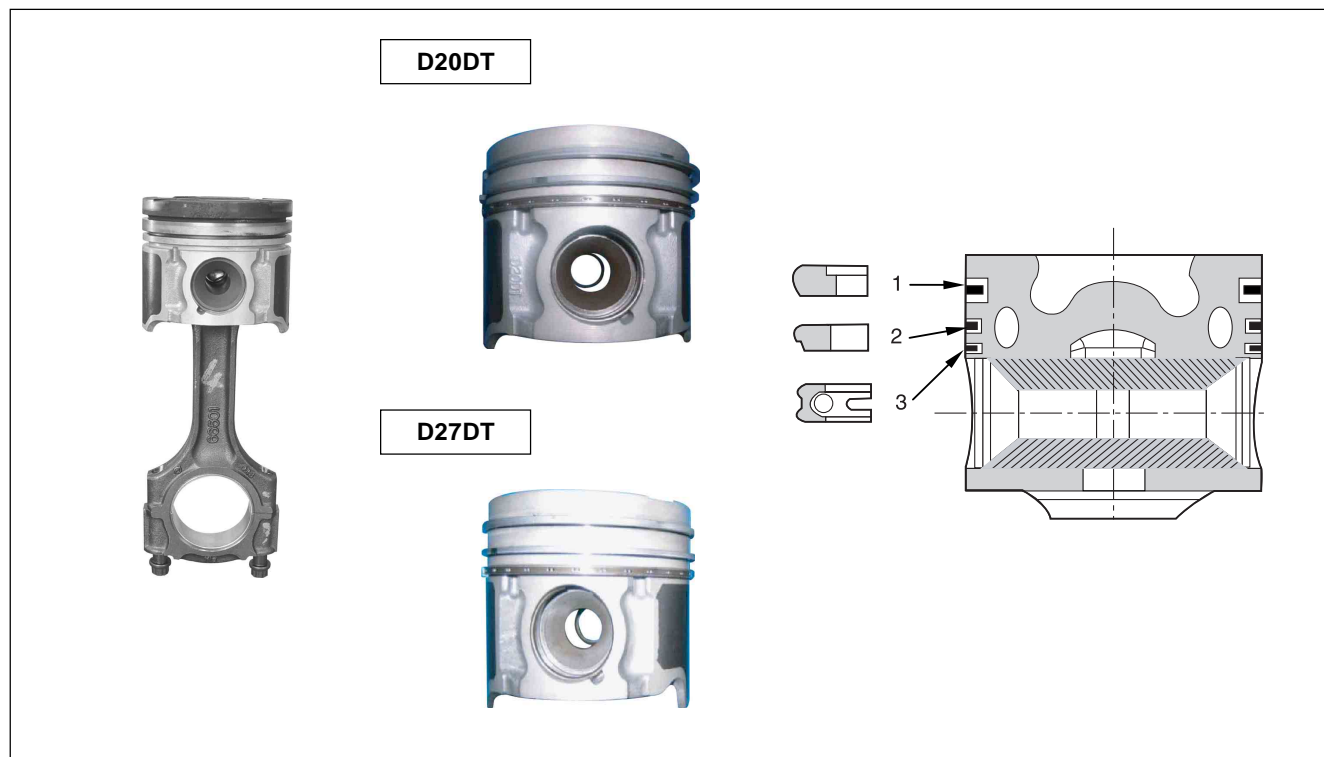
1. Reduced vibration noise from the powertrain by blocking the torsional vibrations
2. Enhanced vehicle silence and riding comforts: reduced engine torque fluctuation
3. Reduced shifting shocks
4. Smooth acceleration and deceleration

Advantages of DMF

1. Improved torque response by using 3-stage type spring: Strengthens the torque response in all ranges (low, medium, and high speed) by applying respective spring constant at each range.
2. Stable revolution of the primary and secondary wheel by using planetary gear: Works as auxiliary damper against spring changes
3. Less heat generation due to no direct friction against spring surface: Plastic material is covered on the spring outer surface
4. Increased durability by using plastic bushing (extends the lifetime of grease)

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

PISTON AND CONNECTING ROD



1. No.1 compression ring

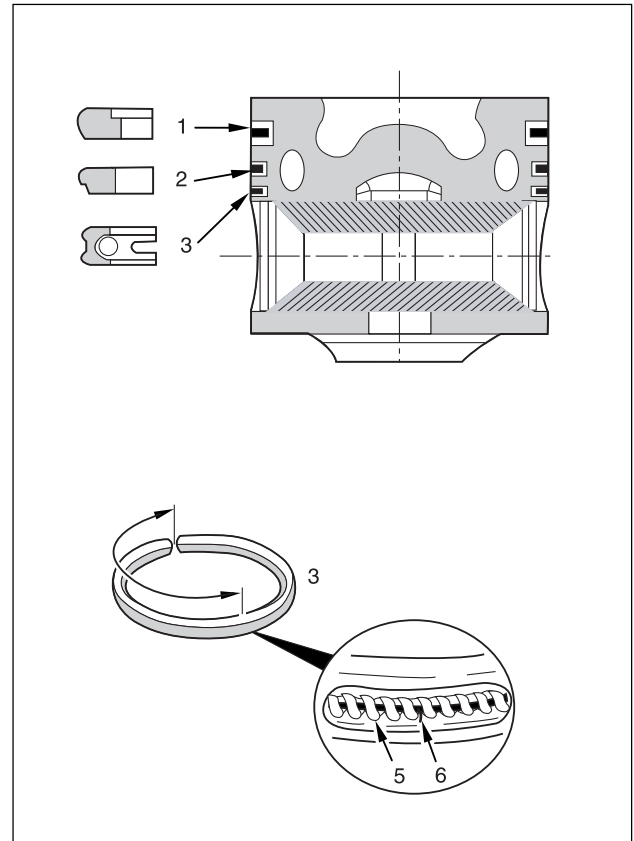
2. No.2 compression ring

3. Oil ring

Description	D20 DT ENG	D27 DT ENG
Cylinder bore diameter	$\phi 86.2_{(0-0.018)} \text{ mm}$	$\phi 86.2_{(0-0.018)} \text{ mm}$
Piston outer diameter (D1)	$\phi 86.133_{(\pm 0.009)} \text{ mm}$	$\phi 86.133_{(\pm 0.009)} \text{ mm}$
Clearance between bore and piston	74 μm	74 μm
Piston cooling gallery	Applied	Applied
Pin offset	0.15 mm (Thrust)	0.15 mm (Thrust)
Compression ratio	17.5 : 1	18 : 1
Length of piston pin	71.2 mm	71.2 mm
Material of top ring / coating	Steel / Gas nitride	DCI/Phosphated
Tightening torque of connecting rod bolt	40 \pm 5.0 Nm, 90° + 10°	40 \pm 5.0 Nm, 90° + 10°
Permissible weight difference of connecting rod	4 g	4 g
Thickness of connecting rod bearing (Red)	1.806 ~ 1.809 mm	1.806 ~ 1.809 mm
Thickness of connecting rod bearing (Yellow)	1.809 ~ 1.812 mm	1.809 ~ 1.812 mm
Thickness of connecting rod bearing (Blue)	1.812 ~ 1.815 mm	1.812 ~ 1.815 mm

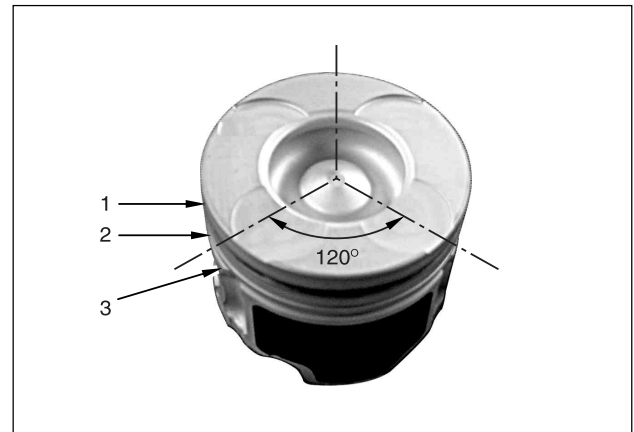
PISTON RING

1. No.1 compression ring
2. No.2 compression ring
3. Oil ring
5. Coil spring and oil control ring
6. Hook spring



► Replacement of Piston Ring

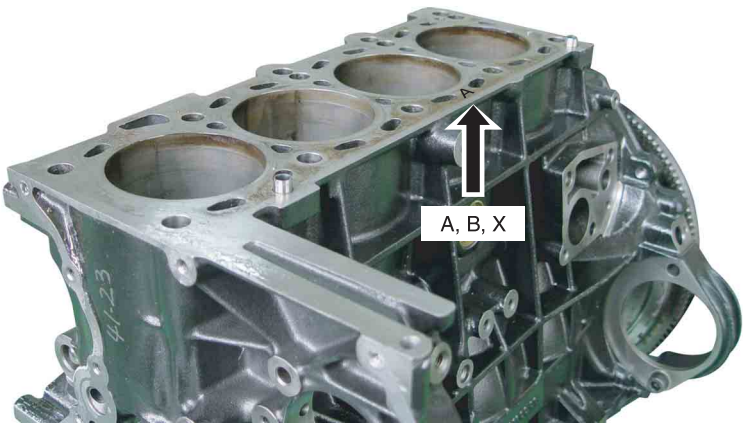
1. Measure piston ring end gap.
 - 1) Piston ring end gap (mm)
 - 1st groove: 0.20 ~ 0.35
 - 2nd groove: 0.20 ~ 0.35
 - 3rd groove: 0.20 ~ 0.40
 - 2) Clearance between piston ring and piston (mm)
 - 1st compression ring: 0.075 ~ 0.119
 - 2nd compression ring: 0.050 ~ 0.090
 - 3rd oil ring: 0.030 ~ 0.070
3. Install the piston so that "Y" marking on piston head is facing in the direction of travel. Arrange the piston ring ends to be 120° apart.
4. Adjust the hook spring joint in the oil ring 180° away from the ring end.



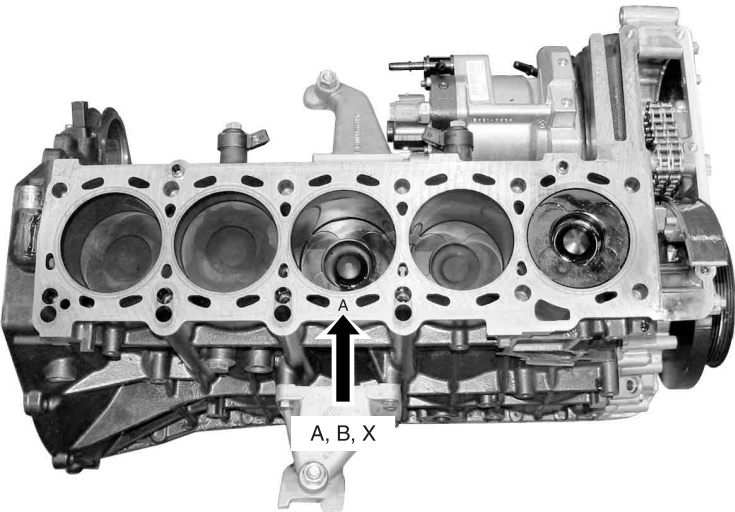
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

CYLINDER INNER DIAMETER AND PISTON SIZE

D20DT



D27DT

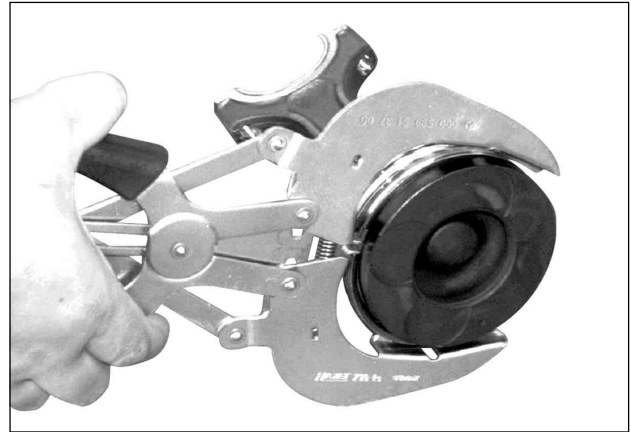


(Unit : mm)

Engine	Code	Used piston	Cylinder Diameter	Piston Diameter
D20DT/D27DT	A	A or X	86.200 ~ 86.206	86.124 ~ 86.130
	X	A, B or X	86.206 ~ 86.212	86.129 ~ 86.137
	B	B or X	86.212 ~ 86.218	86.136 ~ 86.142
	+ 5	+ 5	86.250 ~ 86.260	86.167 ~ 86.181
	+ 10	+ 10	86.300 ~ 86.310	86.217 ~ 86.231

DISASSEMBLY AND REASSEMBLY

1. Install the compression ring and oil ring on the piston with a special tool.

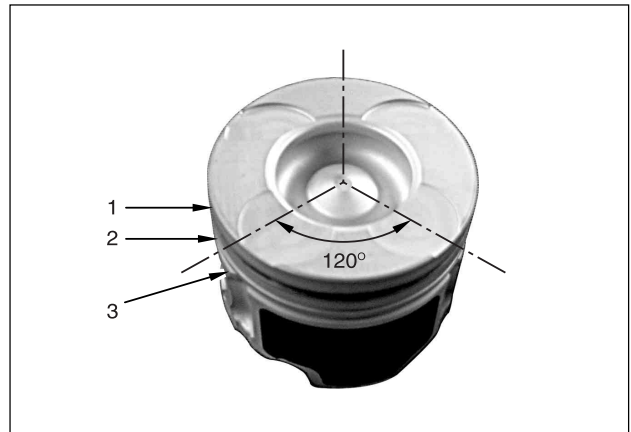


※ Arrange the piston ring ends to be 120° apart.



NOTICE

- Install the No.1 and No.2 pistons so that “Y” marking on piston head is facing upward.
- No.1 piston ring is thicker than No.2 piston ring.
- Arrange the oil ring end to opposite position of current ring end.
- Oil ring is not directional.
- Make sure that the piston ring end is not aligned to axial direction and lateral direction.



2. Check the clearance of piston oil ring and compression ring with a thickness gauge and adjust if necessary.

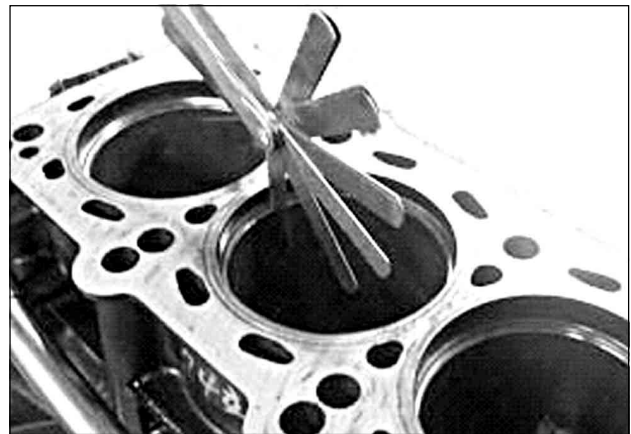
1st groove	0.20 ~ 0.35 mm
2nd groove	0.20 ~ 0.35 mm
3rd groove	0.20 ~ 0.40 mm

Piston ring end play (mm)

1st groove: 11.0 mm

2nd groove: 10.5 mm

3rd groove: 7.0 mm



3. Check the clearance of piston rings with a thickness gauge and adjust if necessary.

No.1 compression ring	0.075 ~ 0.119 mm
2nd compression ring	0.050 ~ 0.090 mm
3rd oil ring	0.040 ~ 0.080 mm



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

4. Fit the piston onto connecting rod so that the marking on piston crown and locking slot are facing to straight ahead direction.

NOTICE

- Install the piston so that the piston recess (marking) or the stamped surface of connecting rod is facing to straight ahead direction.



5. Lubricate piston pin and push in by hand.

NOTICE

- Do not heat up the piston.



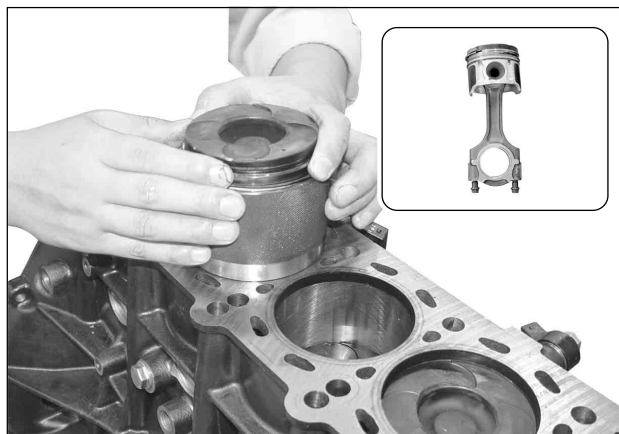
6. Place new snap rings into the grooves.

NOTICE

- The snap rings should be replaced with new one.

7. Lubricate the cylinder bore, connecting rod bearing journals, connecting rod bearing shells and pistons.

8. Push piston into the cylinder with a wooden stick.



9. Insert connecting rod bearing shells.

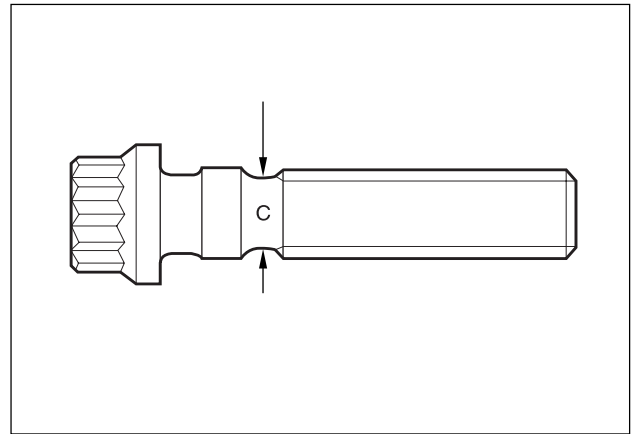
NOTICE

- The upper and lower connecting rod bearings have same appearance. Therefore, make sure to check the part number before replacing them.
- Install bearing rod bearing cap so that the retaining lugs are on the same side of the connecting rod bearing.



10. Measure stretch shaft diameter of the connecting rod bolts.

Limit "C"	7.1 mm
-----------	--------



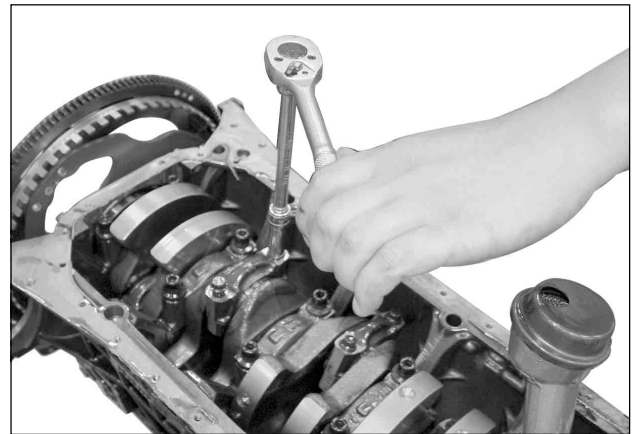
11. Lubricate the new connecting rod bolts and tighten.

Installation Notice

Tightening torque	$40 \pm 5.0 \text{ Nm}$, $90^\circ + 10^\circ$
-------------------	--

- End play of connecting rod cap

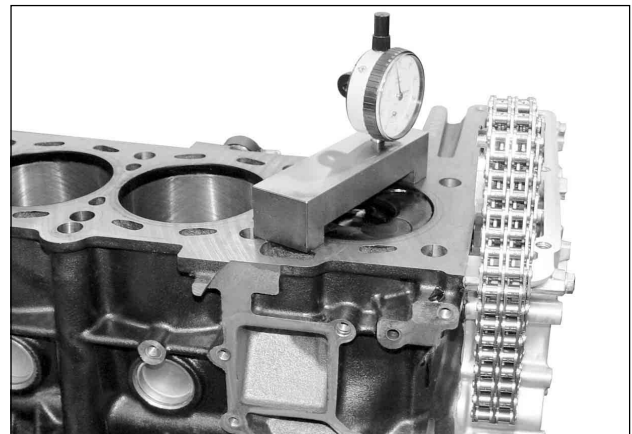
Specified value	0.5 ~ 1.5 mm
-----------------	--------------



12. Position piston to TDC and measure the distance between piston and mating surface of crankcase.

Permissible piston protrusion	0.765 ~ 1.055 mm
-------------------------------	------------------

- Measure at both ends of axial direction.



GENERAL

ASSY

HOUSING

INTAKE

EXHAUST

LUB

COOLING


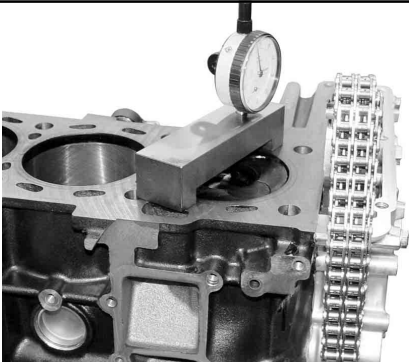

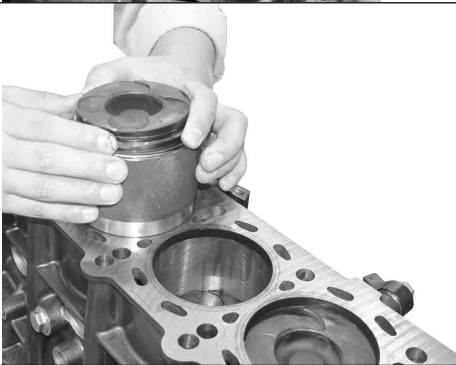
FUEL

CONTROL

SENSOR

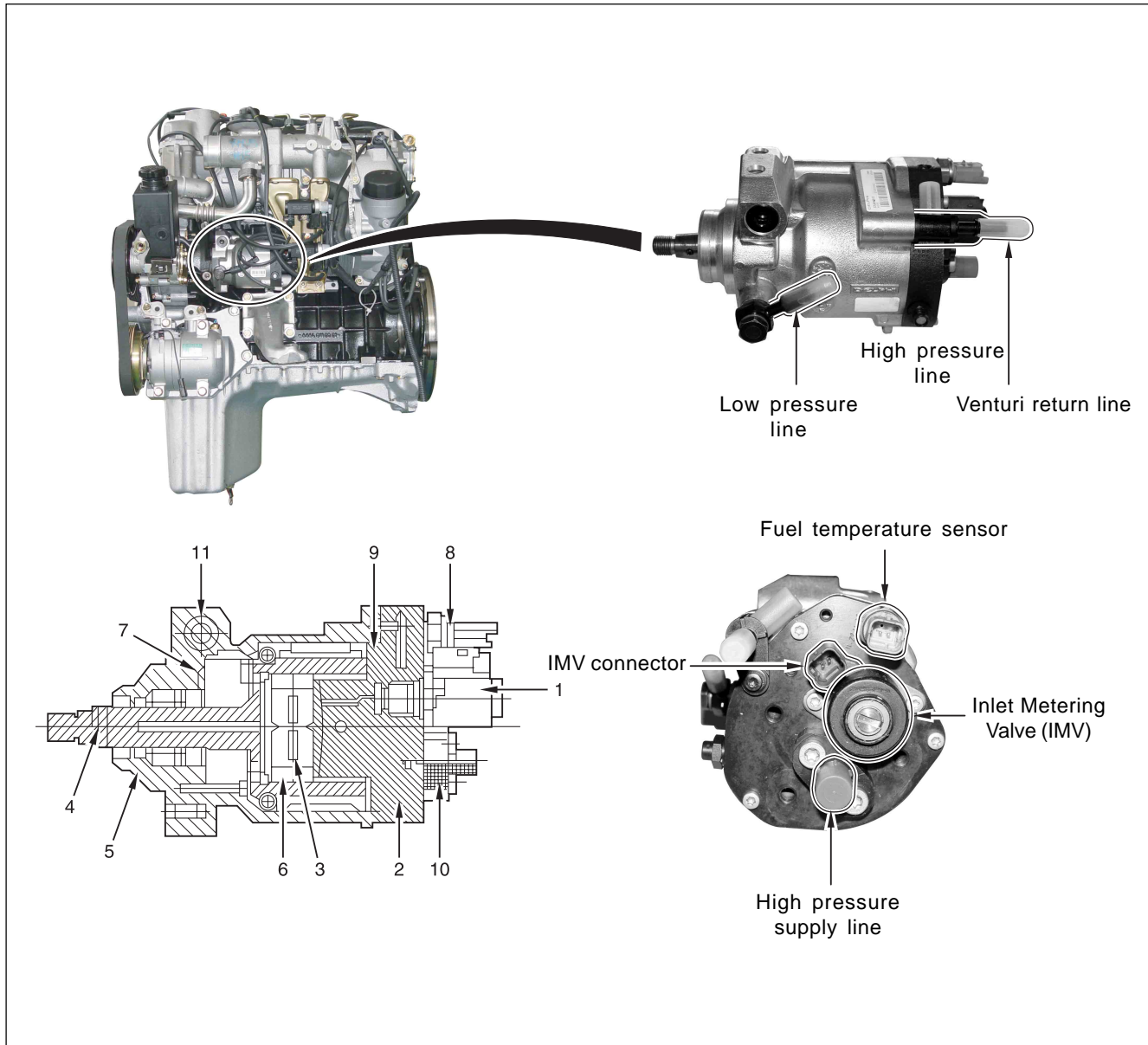
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► Special Tools and Equipment

Name and Part Number	Application
<p>Y99220122B Piston protrusion measuring jig</p> 	
<p>Y99220172B Piston insertion jig</p> 	

HIGH PRESSURE PUMP (HPP)

COMPONENTS LOCATOR

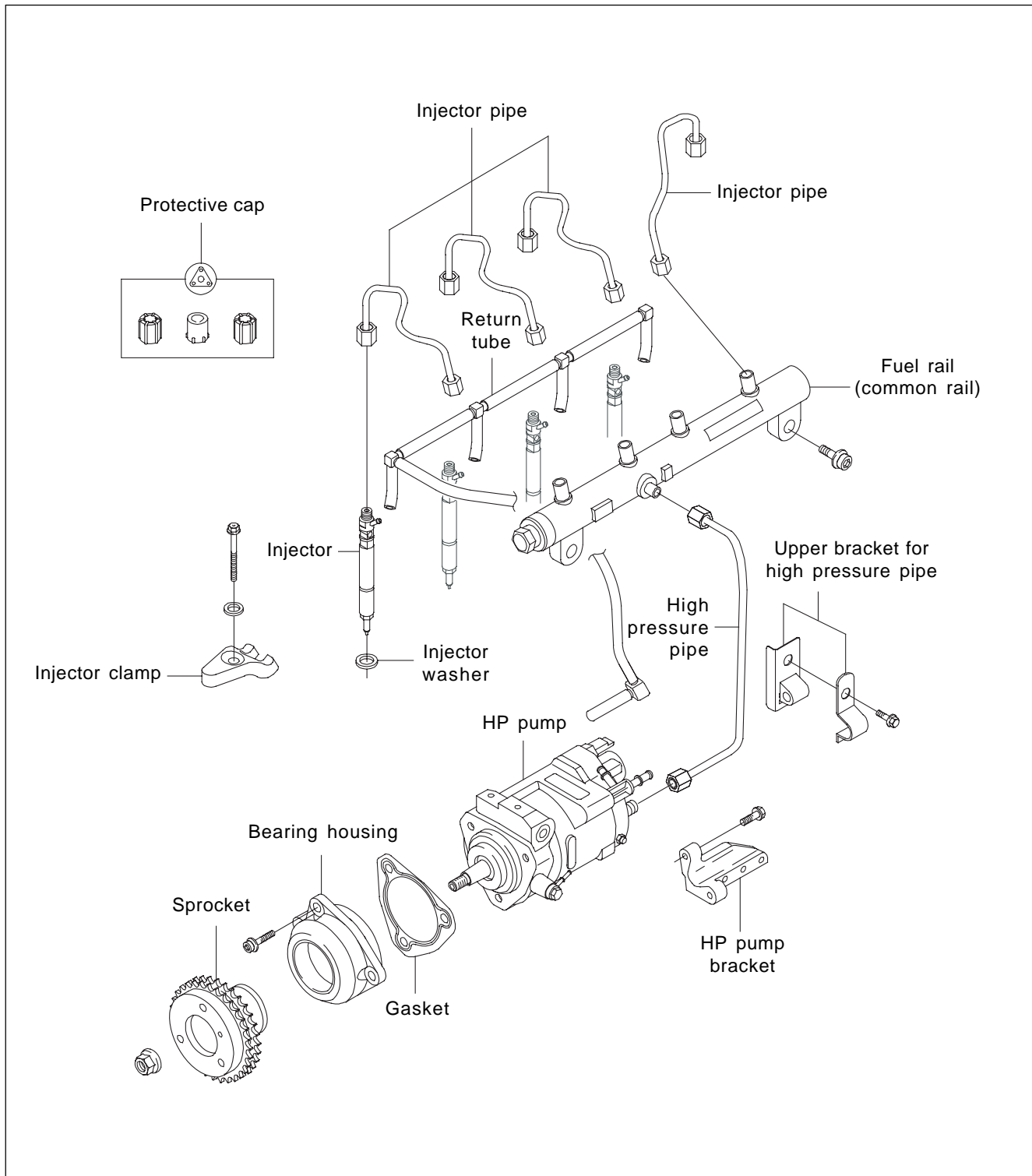


1. Inlet Metering Valve (IMV)
2. Hydraulic pressure head
3. Plunger
4. Drive shaft and cam ring
5. Housing
6. Roller and shoe

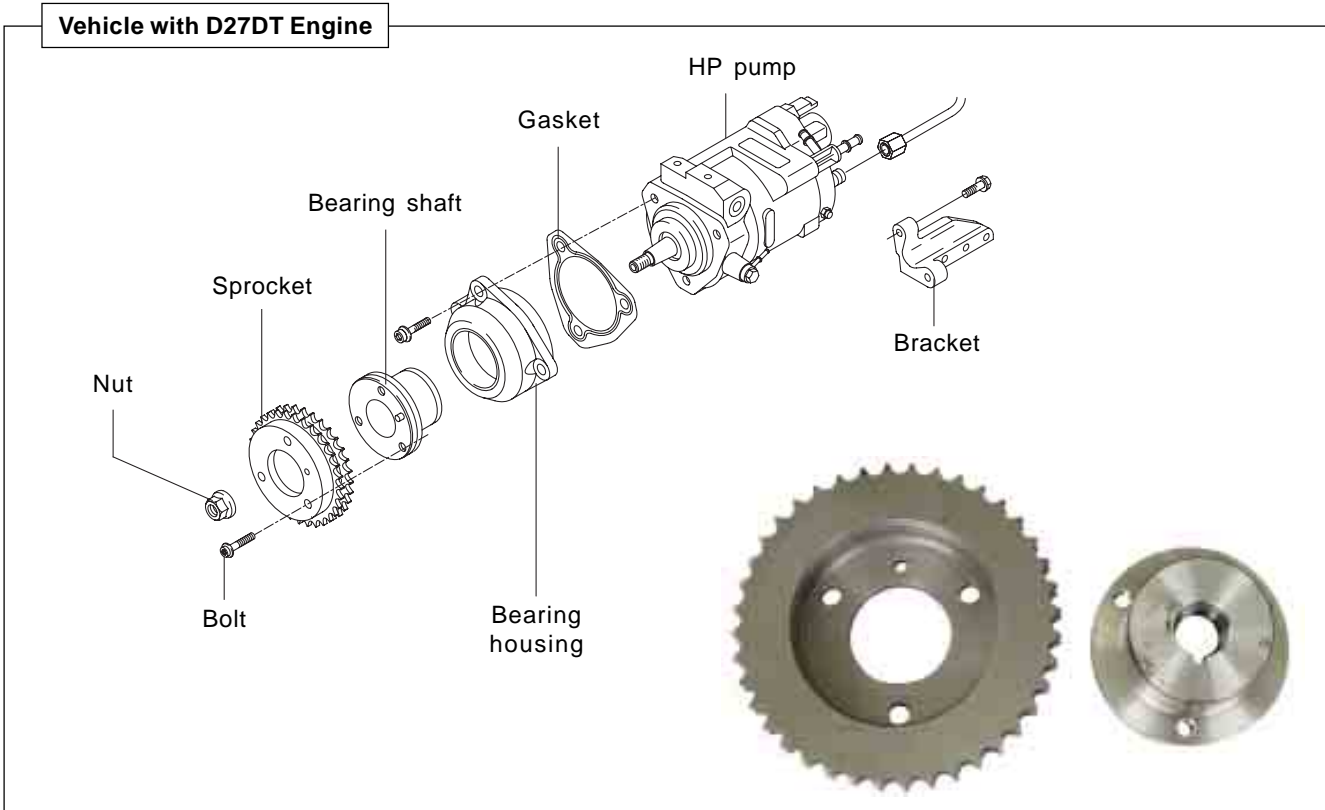
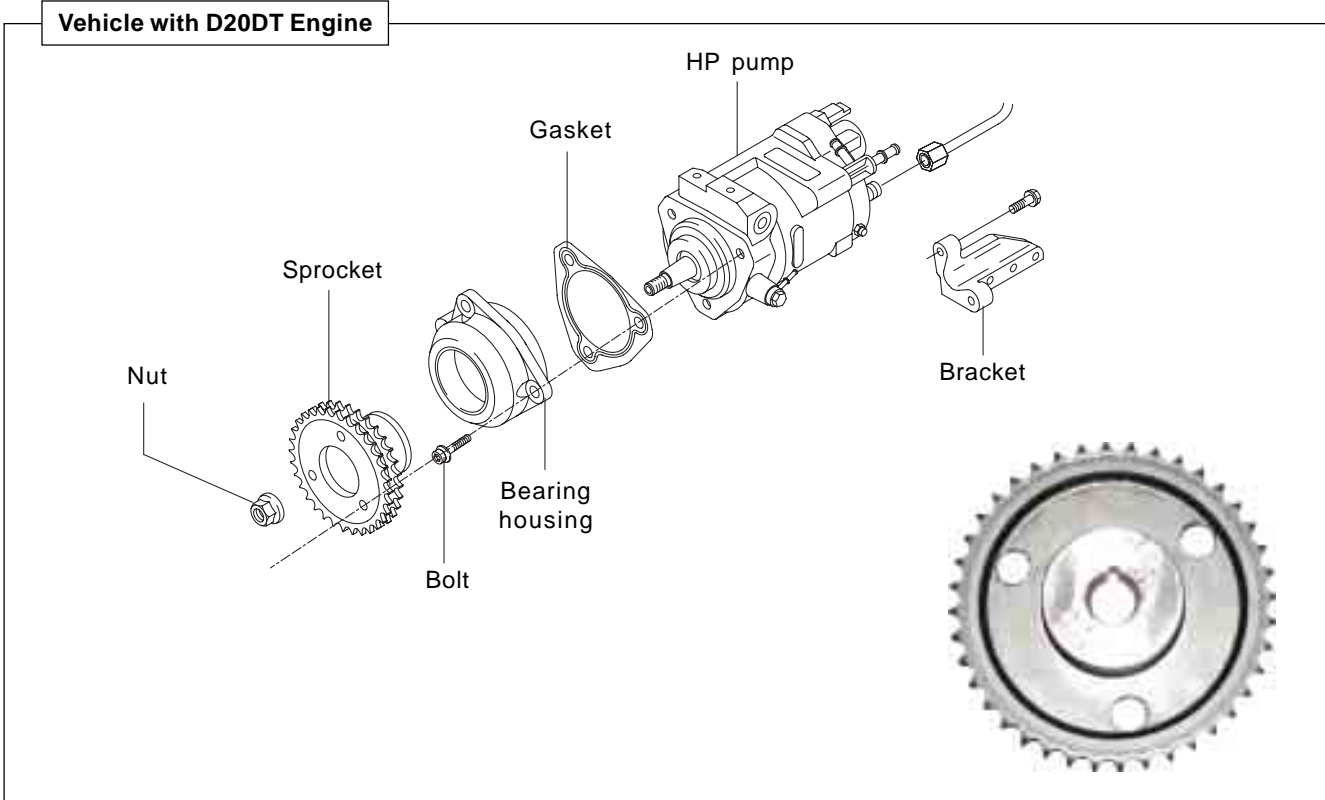
7. Low pressure pump
8. Fuel temperature sensor
9. Venting
10. High fuel pressure supply line
11. Pressure regulator

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► High Pressure Pump and Fuel System



► Installation of High Pressure Pump



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DISASSEMBLY AND REASSEMBLY

※ Preceding Works:

1. Removal of fan belt (including cooling fan and fan clutch) and fan shroud
2. Removal of intake manifold assembly
3. Removal of water pump pulley
4. Removal of auto tensioner
5. Removal of EGR pipe
6. Removal of oil dipstic gauge



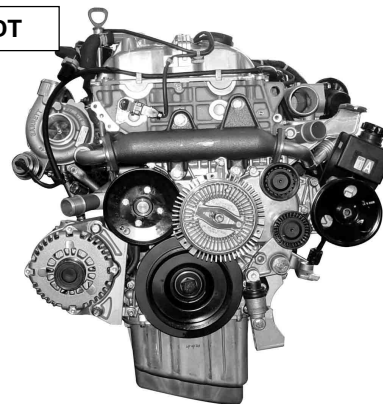
NOTICE

- To prevent oil leaks, store the removed auto tensioner it upright position.
- Be careful not to damage the rubber bellows.
- Plug the oil ports for HP pump with sealing caps.

D20DT



D27DT



► D20DT Engine (HP Pump) - (without SST)

Disassembly

※ Preceding Works:

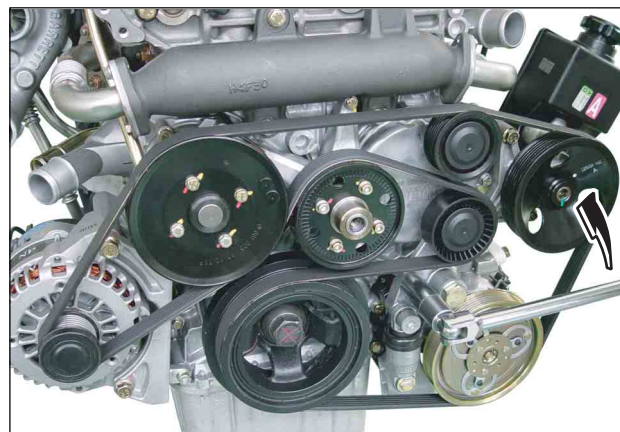
1. Disconnect the negative battery cable.
2. Apply the parking brake and place the chocks under the tires. (transmission "N" position)

1. Turn the auto tensioner counterclockwise and remove the fan belt.



NOTICE

- Slacken the pulley bolt.



2. Remove the engine belt pulleys.

- 1) Cooling fan pulley
- 2) Coolant pump pulley



3. Unscrew lower bolt (13 mm) and upper bolt (24 mm) and remove the auto tensioner.



NOTICE

- To prevent oil leaks, store the removed auto tensioner in upright position.
- Pump the auto tensioner several times before installing it.



GENERAL

ASSY

HOUSING

INTAKE

EXHAUST

LUB

COOLING

FUEL

CONTROL

SENSOR

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

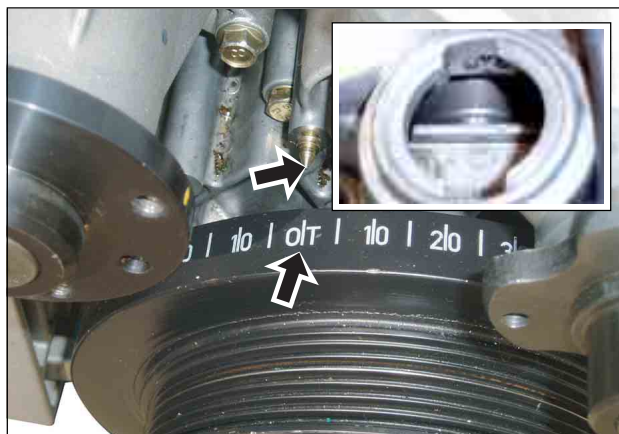
4. Remove the high pressure pump housing.

※ **Preceding Work:** Remove the No.2 EGR pipe.



5. Align the OT mark by rotating the crankshaft.

- 1) Open the oil filler cap and check if the OT mark on crankshaft is aligned to the notch on the camshaft.



6. Unscrew the bolts and remove the vacuum modulator bracket.

- 1) Disconnect the high pressure pump and vacuum modulator connector.
- 2) Disconnect the fuel lines to high pressure pump.
- 3) Plug the openings of pipes and ports with protective caps to keep the cleanness of the fuel system.
- 4) Remove the high pressure fuel pipe between HP pump and common rail.



7. Rotate the crankshaft clockwise so that the HP pump sprocket holes are aligned to the bolt holes.



8. Hold the HP pump sprocket and slacken the center bolt.



9. Slacken three HP pump mounting bolts until they rest on the sprocket.



10. Loosen the HP pump center nut by tapping it with a hammer.

**NOTICE**

- Tap the center bolt with a hammer after tightening.
- Make sure that the center bolt is securely tightened.



11. Remove the remaining bolts with the same manner and remove the high pressure pump.



GENERAL

ASSY

HOUSING

INTAKE

EXHAUST

LUB

COOLING

FUEL

CONTROL

SENSOR

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Reassembly

1. Replace the HP pump gasket with new one (cannot be reused).



2. Tighten the HP pump bolts.

Tightening torque	25 Nm
-------------------	-------



3. Hold the HP pump sprocket and tighten the center nut.

Tightening torque	65 Nm
-------------------	-------



NOTICE

- The center nut should be replaced once removed (cannot be reused).
- Tighten the center nut with the specified tightening torque.

4. Install the vacuum modulator bracket.

NOTICE

- Replace the fuel lines to HP pump with new ones (cannot be reused).
- Make sure that the connectors are installed to the correct locations. (RR: white tape)



5. Apply the sealant to the HP pump housing and tighten the bolts.

**NOTICE**

- Sealant (DB2210): 661 989 56 A0

6. Install the auto tensioner and belt pulleys.

Tightening torque	① 82 ± 6.0 Nm
	② 32 Nm

7. Rotate the crankshaft pulley two revolutions and ensure that the OT mark on the crankshaft pulley and the OT mark on the camshaft pulley are aligned.

**NOTICE**

- Open the oil filler cap and check if the OT mark on crankshaft is aligned to the notch on the camshaft.



GENERAL

ASSY

HOUSING

INTAKE

EXHAUST

LUB

COOLING

FUEL

CONTROL

SENSOR

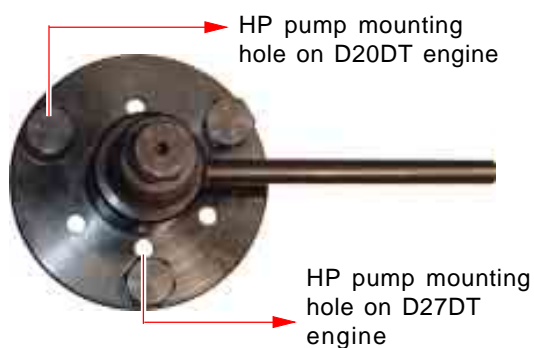
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► D20DT Engine (HP Pump) - (with SST)

Special Service Tool



SST Installation



HP Pump Installation



※ Preceding Works:

1. Disconnect the negative battery cable.
(If necessary, remove the battery.)
2. Remove the front air duct assembly.
3. Remove the PWM electric fan.



NOTICE

- To prevent from the oil leaking, put the removed auto tensioner in up-light position.
- Be careful not to damage the rubber bellows when removing the auto tensioner.
- Plug all fuel supply ports with seal caps (including removed ones).

Removal

1. Take off the fan belt while turning the auto tensioner counterclockwise.



2. Remove the auto tensioner from the engine.



* To prevent from the oil leaking, put the removed auto tensioner in up-light position.

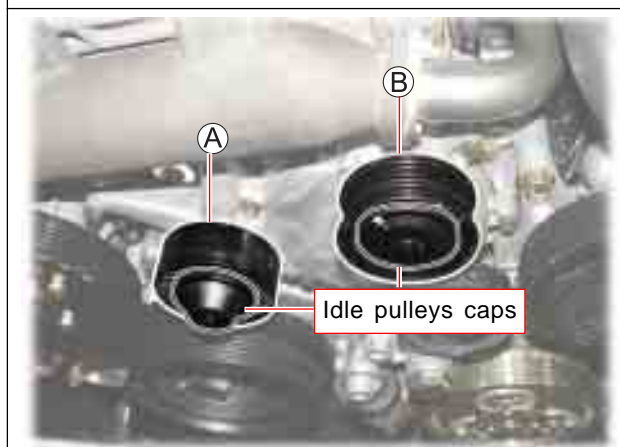
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

3. Unscrew four bolts and remove the water pump pulley.

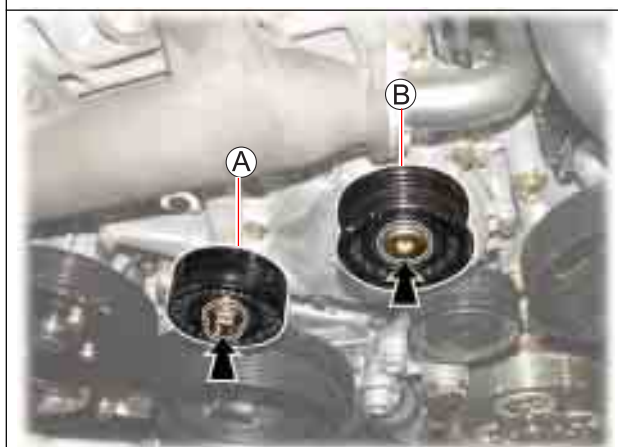


4. Open the caps (A, B) and unscrew the mounting bolts to remove the idle pulleys (A, B).

Open Caps



Unscrew Mounting Bolts



5. Remove the idle bracket.

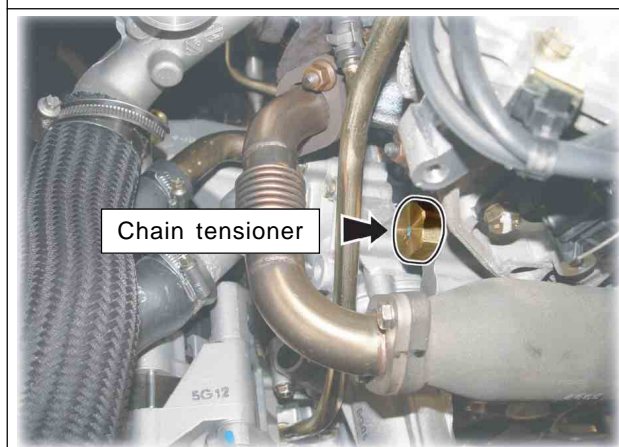
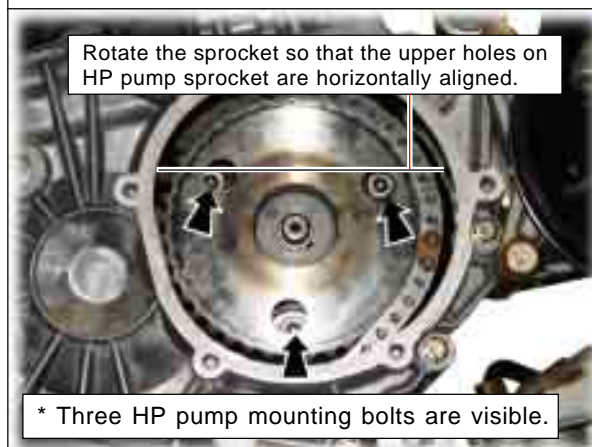
Unscrew Mounting Bolt



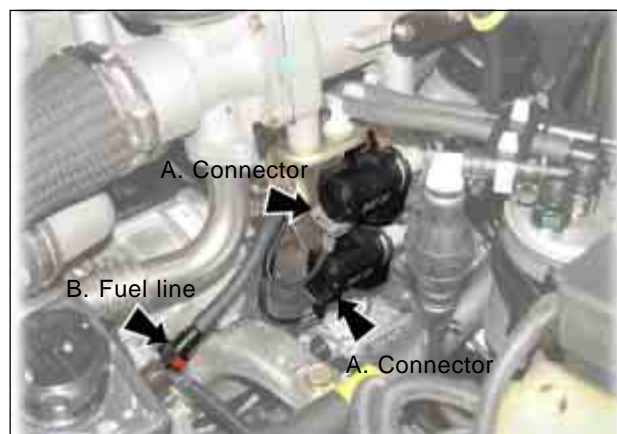
Remove Idle Bracket



6. Remove the oil separator and EGR cooler pipe. Remove the chain tensioner and rotate the crankshaft so that the upper holes on HP pump sprocket are horizontally aligned. (At this moment, the holes on sprocket are aligned to mounting bolts for HP pump.)

Remove Chain Tensioner**HP Pump Sprocket**

7. Remove the vacuum modulator bracket.
- Disconnect the vacuum modulator connector and fuel line.
 - Disconnect the fuel line to high pressure pump. (To keep cleanliness, plug the opening with a sealing cap.)



8. Remove the center nut on high pressure pump and loosen three hexagon bolts.

Center Nut**Mounting Bolts**

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

9. Install the special service tool on the high pressure pump sprocket.



10. Separate the sprocket from the high pressure pump by turning the center bolt on special service tool.

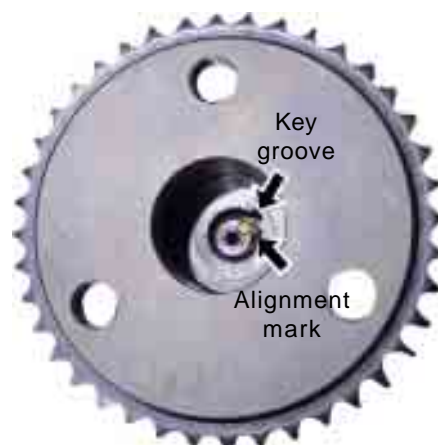


11. Remove the special service tool and unscrew three mounting bolts to remove the high pressure pump.



NOTE

1. The gasket for high pressure pump cannot be reused. It should be replaced with new one if removed.
2. Place an alignment mark on the high pressure pump shaft and key.



GENERAL

ASSY

HOUSING

INTAKE

EXHAUST

LUB

COOLING

FUEL

CONTROL

SENSOR

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	


Installation

- 1. Install in the reverse order of removal. (However, temporarily tighten three mounting bolts first, then fully tighten the center bolt, mounting bolts and center nut in order.

Tightening torque

Hexagon mounting bolt	25 ± 2.5 Nm
Center nut	65 ± 5 Nm

- 2. Install the vacuum modulator bracket.

**NOTICE**

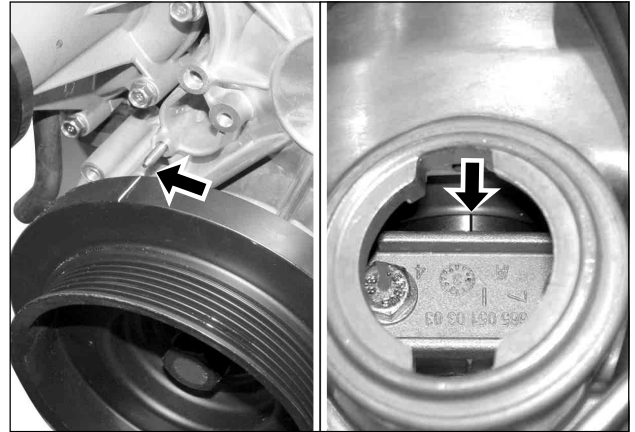
- The vacuum modulator connector and vacuum hose should be connected to correct positions. The wiring with white tape should face to the rear-end of engine.

- 3. Apply the specified sealant (DB2210: 661 989 56 A0) and tighten the bolts to the specified tightening torque.
- 4. Install the accessories.

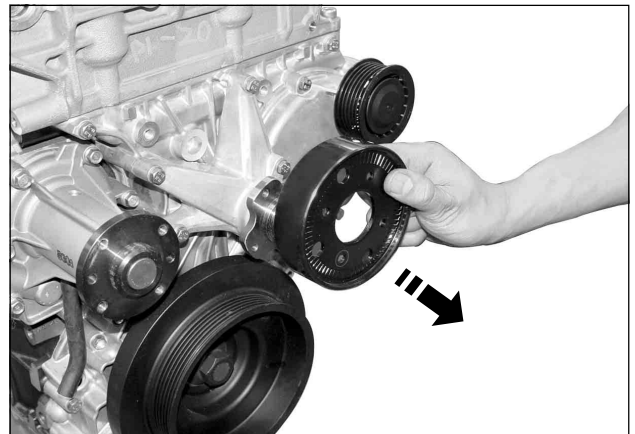


► D27DT Engine (HP Pump)

1. Set crankshaft pulley to OT point. Open the oil filler cap and check if the camshaft notch marking is aligned to OT point.



2. Remove the cooling fan idle pulley with a pulley holder (special tool).



3. Remove the cooling fan bracket assembly.



NOTICE

- Be careful not to get the sealant or foreign materials into the engine.



GENERAL

ASSY

HOUSING

INTAKE

EXHAUST

LUB

COOLING

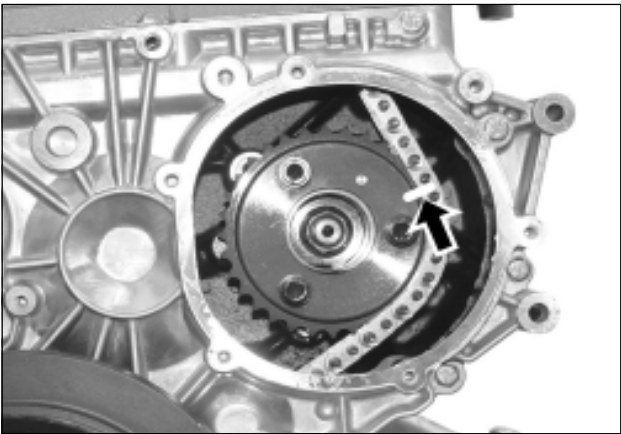
FUEL

CONTROL

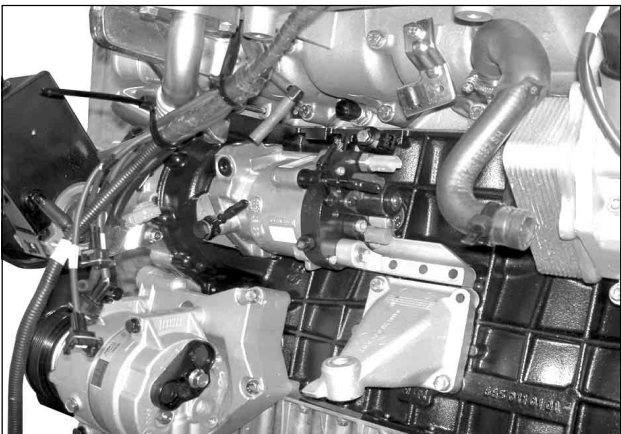
SENSOR

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

- 4. Place the marks on the chain and HP pump sprocket for installation.



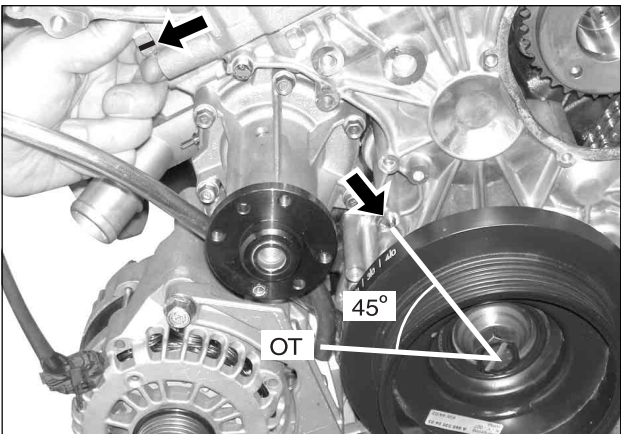
- 5. Remove the vacuum modulator bracket.
- 6. Remove the fuel pipes and wiring connectors which connected to fuel pump.



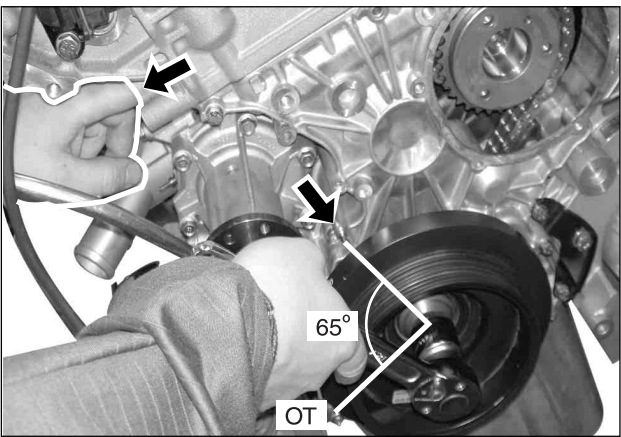
- 7. Turn the crankshaft pulley to the counter clockwise direction to ATDC 45° then remove the chain tensioner.

Installation Notice

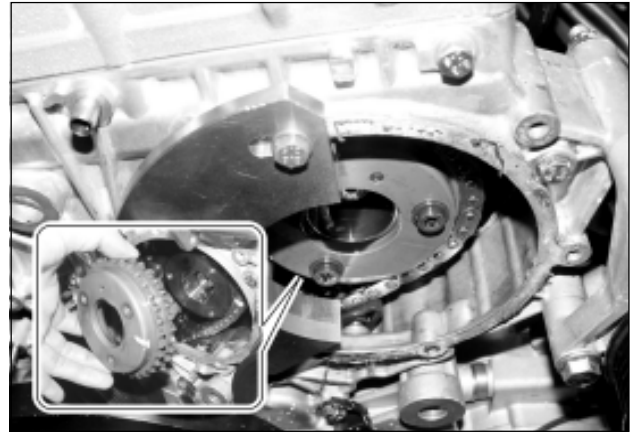
Tightening torque	65 ± 5 Nm
-------------------	-----------



- 8. While insert finger and push the chain guide backward direction and turn the crankshaft pulley to ATDC 65° by counter clockwise direction until feel the chain guide inclined backward.



9. Install a special tool into the cooling fan bracket hole to hold the sprocket.



10. Remove the sprocket bolts and center nut and after slightly lifted up the chain, remove the pump sprocket.

Installation Notice

Tightening torque	Nm
Sprocket bolt	20 Nm + 90°
Center nut	65 ± 5 Nm



11. Remove the HP pump bearing with HP pump bearing puller (special tool).

**NOTICE**

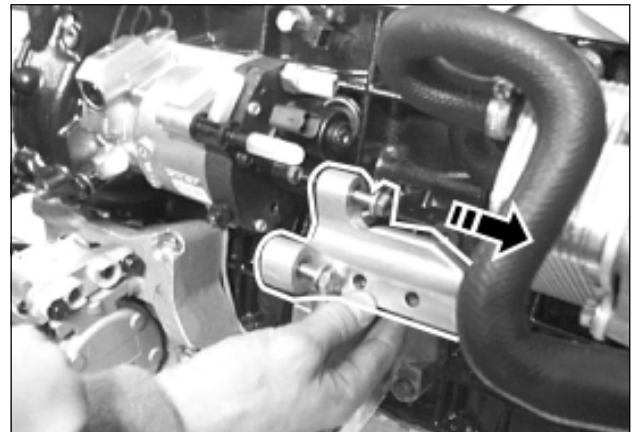
- Do not apply excessive force. The timing chain may deviates.



12. Remove the HP pump mounting bracket.

Installation Notice

Tightening torque	24 ± 2.4 Nm
-------------------	-------------



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

13. Unscrew the external bolts and remove the HP pump while rocking and tapping it with a rubber hammer.

**NOTICE**

- To prevent HP pump shaft damaging, do not apply excessive impact.
- Do not apply excessive force. The timing chain may deviates.



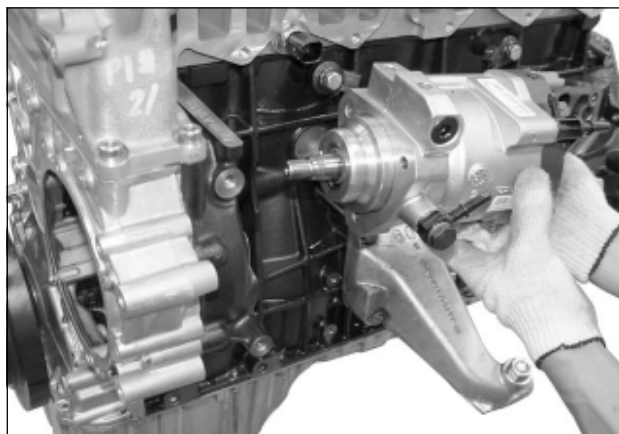
14. Remove the HP pump.

15. Install the new HP pump with sealing caps.

**NOTICE**

- Remove the sealing caps only when connecting the pipes and hoses.

16. When replaced the HP pump, initialize the fuel pressure by using SCAN-100. Refer to "Trouble Diagnosis" section in this manual.





NOTICE

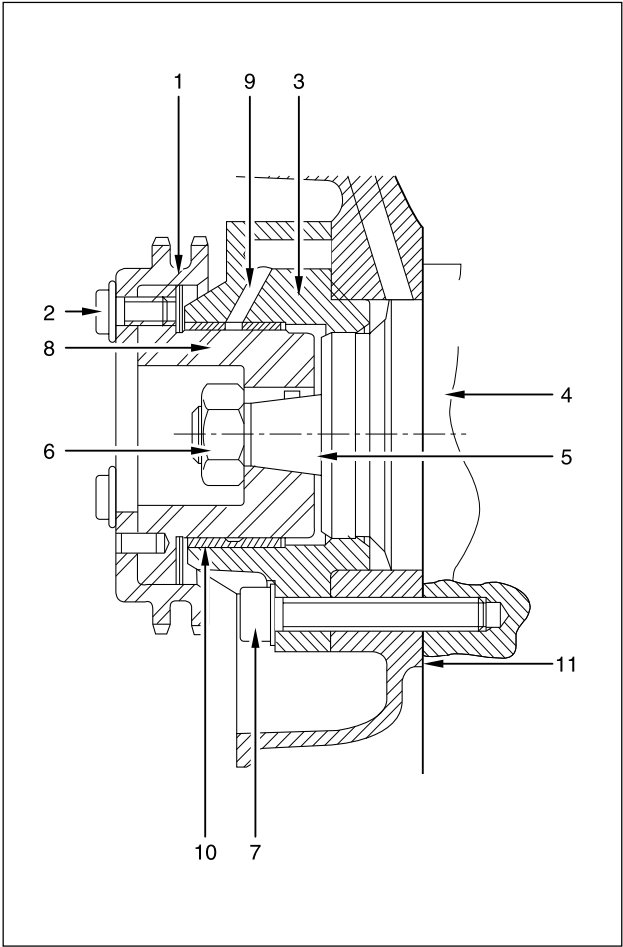
- If the initialization of fuel pressure has not been performed, the engine ECU controls new HP pump with the stored offset value. This may cause the poor engine output.

Install in the reverse order of removal and tighten the fasteners with the specified tightening torque.

1. HP pump sprocket
2. 12-sided sprocket mounting bolt
3. HP pump bearing housing
4. HP pump (High Pressure Pump)
5. HP pump shaft
6. HP pump center nut
7. HP pump outer bolt
8. HP pump bearing shaft
9. Oil gallery
10. Bearing bushing
11. Gasket

Tightening torque

Center nut (M14 x 1.5 - 1EA)	65 ± 5.0 Nm
Outer bolt (M8 x 55 - 3EA)	24 ± 2.4 Nm
Sprocket bolt (M7 x 13 - 3EA)	20 Nm ± 90°



GENERAL

ASSY

HOUSING

INTAKE

EXHAUST

LUB

COOLING

FUEL

CONTROL

SENSOR

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

MEMO

Lined area for writing the memo.

SECTION 03

INTAKE SYSTEM

INTAKE SYSTEM

TABLE OF CONTENTS

AIR FLOWS 2

INTAKE SYSTEM LAYOUT 3

 Components locator 3

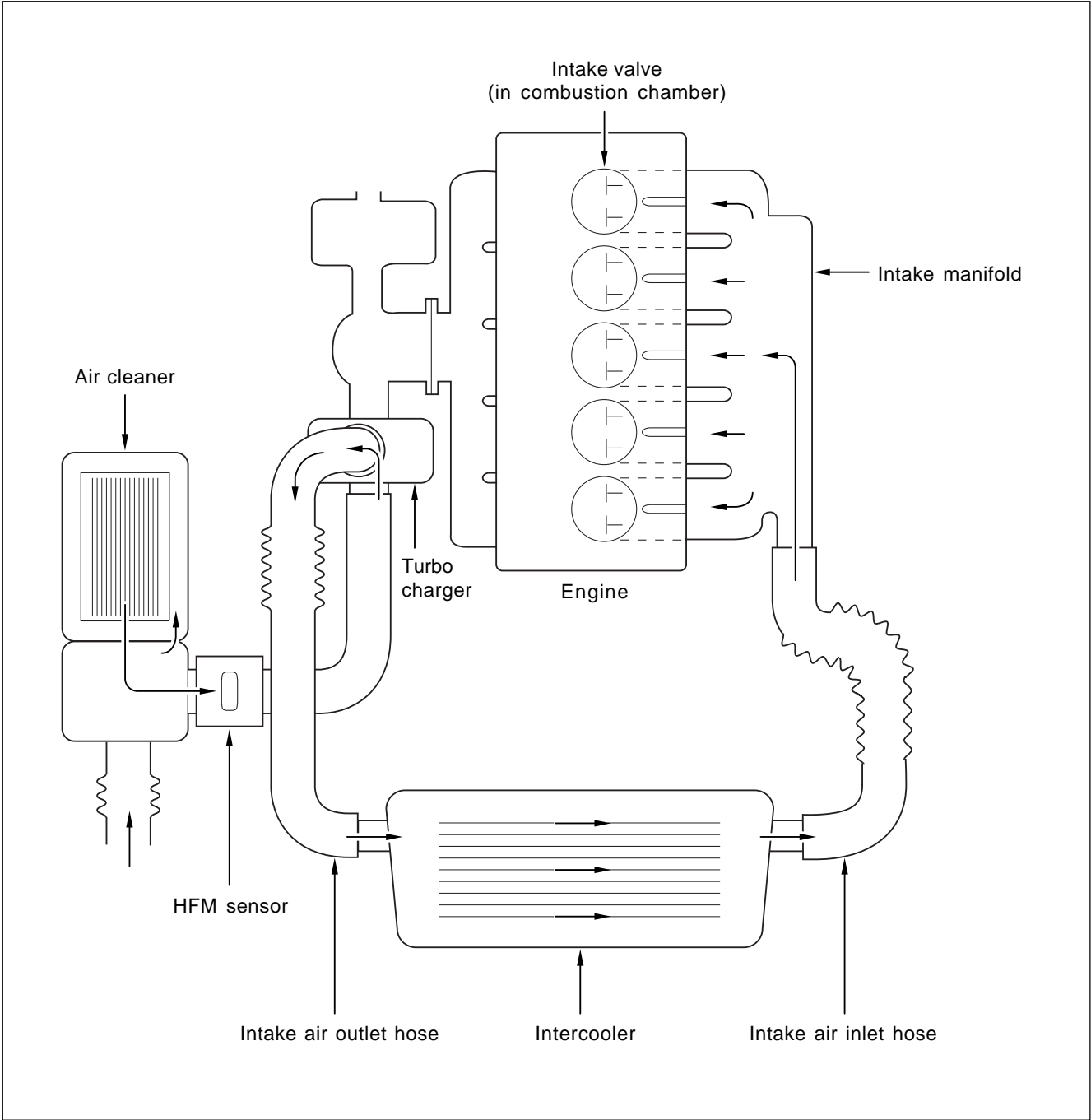
 Tightening torque of intake system 5

 Air flow sensor (hot film air mass sensor) 8

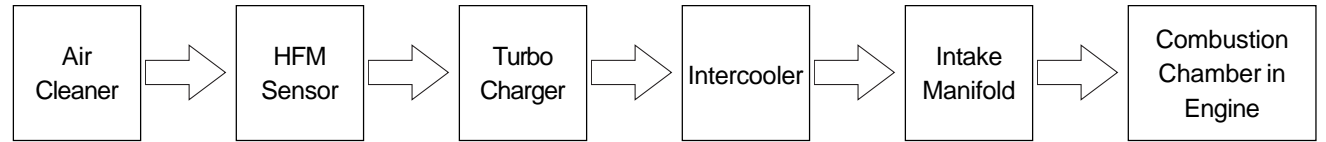
 Intercooler 12

 Intake manifold assembly 15

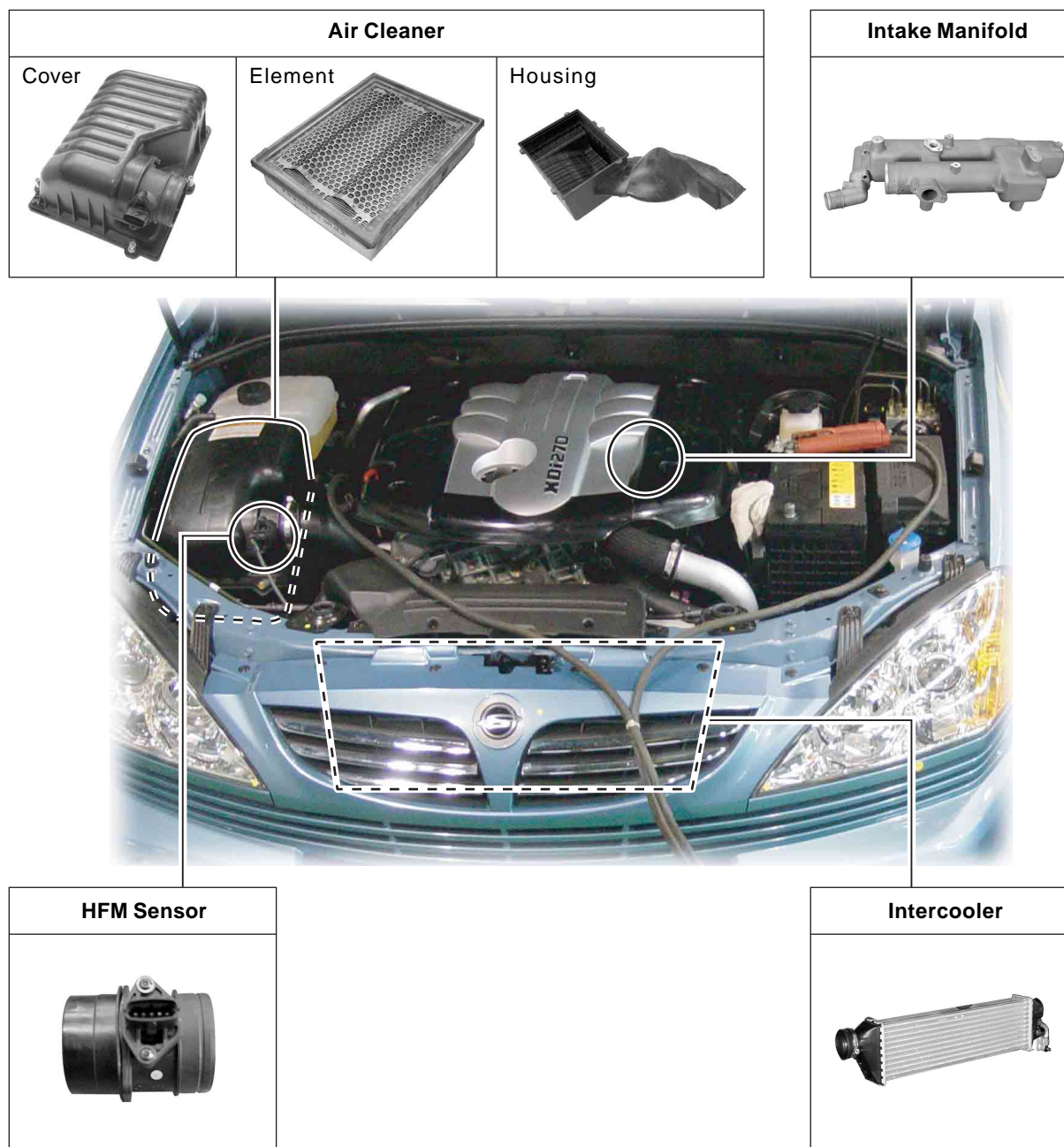
AIR FLOWS



► Work Flow of Intake System



► D27DT Engine



TIGHTENING TORQUE OF INTAKE SYSTEM



There is a possibility that the clamps of intercooler and related intake hoses are disconnected by the pressure of turbo charger, therefore it should be tightened with proper torque using torque wrench and ratchet.

Tightening torque	6 ~ 7 Nm
-------------------	----------

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

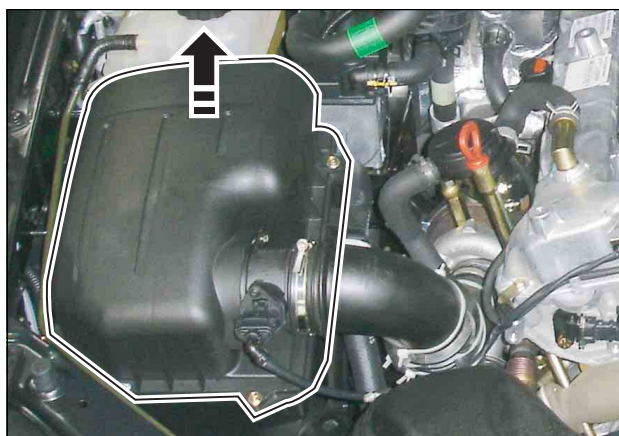
Air Cleaner Element - Replacement

※ **Preceding Work:** Disconnection of negative battery cable

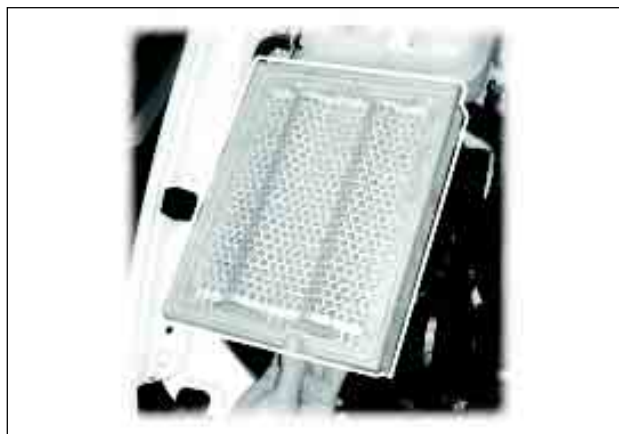
1. Disconnect the HFM sensor connector.
2. Loosen the locking clamp and remove the intake duct.



3. Unscrew the screws and remove the air cleaner cover.



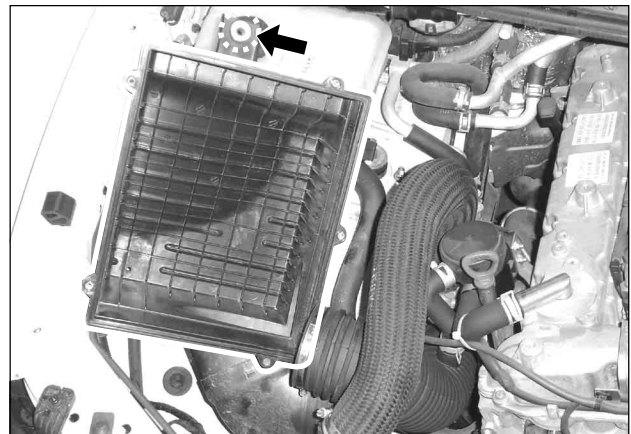
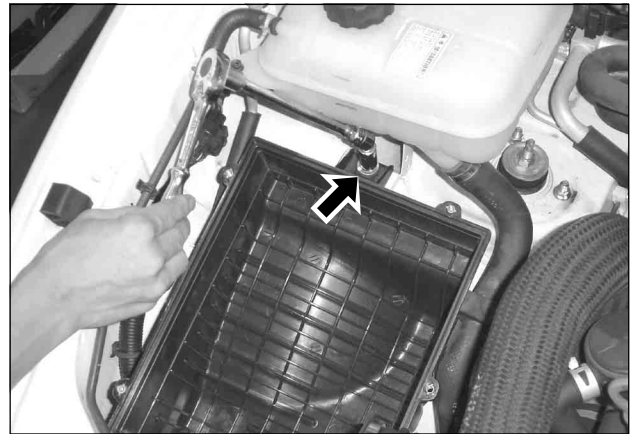
4. Remove the air cleaner element. Clean or replace the element as required.



Air Cleaner Housing - Removal and Installation

※ **Preceding Work:** Removal of air cleaner cover

1. Set aside the return hose and remove the coolant reservoir bolts.
2. Remove the air cleaner housing bolts.
3. Install in the reverse order of removal.



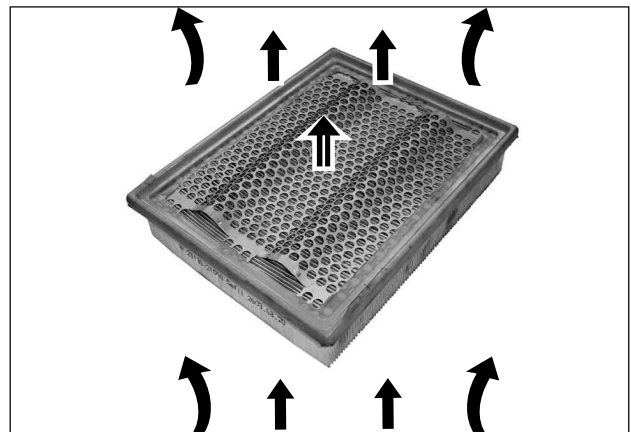
Air Cleaner Housing/Element - Check

1. Check the air cleaner body, cover and packing for deformation, corrosion and damage.
2. Check the air duct for damage.
3. Check the air cleaner element for clogging, contamination and damage. If the element is partially clogged, remove the dust or foreign materials with the compressed air. If the contamination is severe, replace it with new one. Also, be careful not to contaminate during the replacement.
4. Check the air cleaner housing for clogging, contamination and damage.
5. If the inside of housing is contaminated, remove the contaminants.



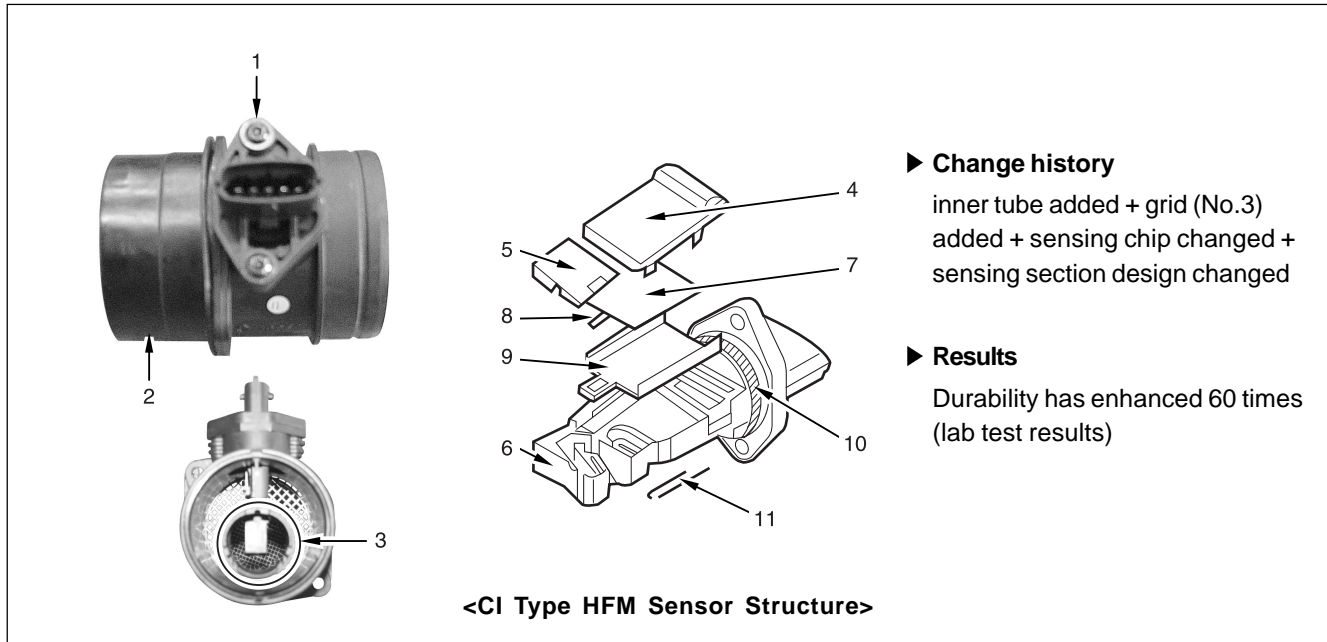
NOTICE

- When cleaning the air cleaner with compressed air, direct the air from inside (engine) to outside (ambient air). Otherwise, contaminants can get into the engine.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

AIR FLOW SENSOR (HOT FILM AIR MASS SENSOR)



- | | |
|-------------------------|------------------------|
| 1. Plug-in sensor | 7. Hybrid |
| 2. Cylinder housing | 8. Sensor |
| 3. Protection grid | 9. Mounting plate |
| 4. Hybrid cover | 10. O-ring |
| 5. Measuring duct cover | 11. Temperature sensor |
| 6. Housing | |

Air flow sensor is locating on the air intake passage between air cleaner and intake manifold and measures air volume flows to engine combustion chamber and intake air temperature.

And intake temperature sensor built-in the sensor detects intake temperature.

Internal circuit of the air flow sensor is being used to control the voltage value to control the temperature to maintain the heating resistance (Rh) to 160°C that is higher temperature than intake air temperature that is measured by resistance (RI).

Temperature sensor of the heating resistance (Rh) is measured by resistance (Rs).

If temperature changes occur due to increasing/decreasing intake air volume, voltage of the heating resistance changes to maintain the intake air temperature changes to set value (160°C).

Control unit computes intake air volume based on voltage changes of heating resistance.

Intake air temperature is measured by NTC integrated in the sensor.

Intake air temperature sensor is a part of HFM sensor and a thermister and resister and detects air temperature changes that flow into the engine. There occurs high resistance when temperature is low and low resistance when high (NTC type).

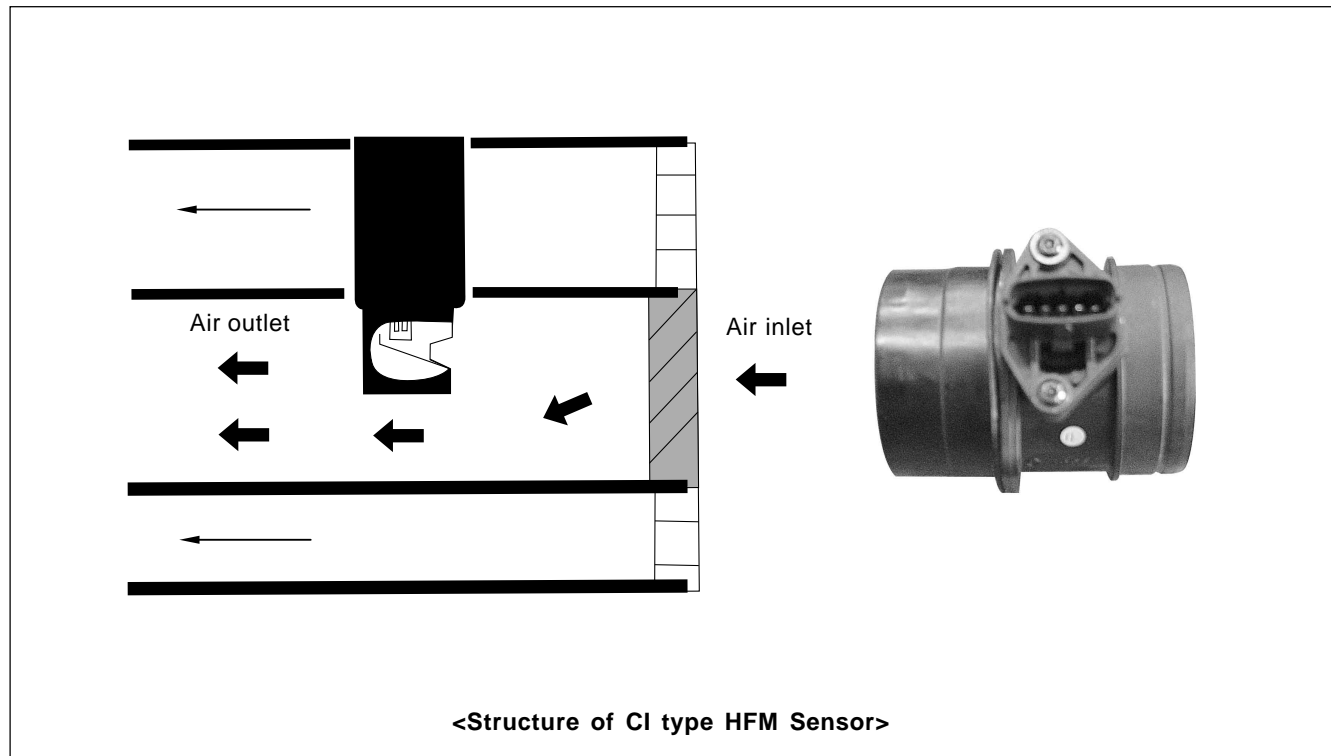
ECU supplies 5 V to intake air temperature sensor and then measures voltage changes to determine the intake air temperature. When air in the intake manifold is cold, the voltage is high and air is hot, the voltage is low.

The reason for using HFM sensor is that this sensor is most proper in controlling accurate air-fuel ratio to meet the legal emission regulations. This sensor measures actual intake air mass into engine very accurately during specific instant acceleration and deceleration, and determines engine loads and detects intake air pulsation and air flows.

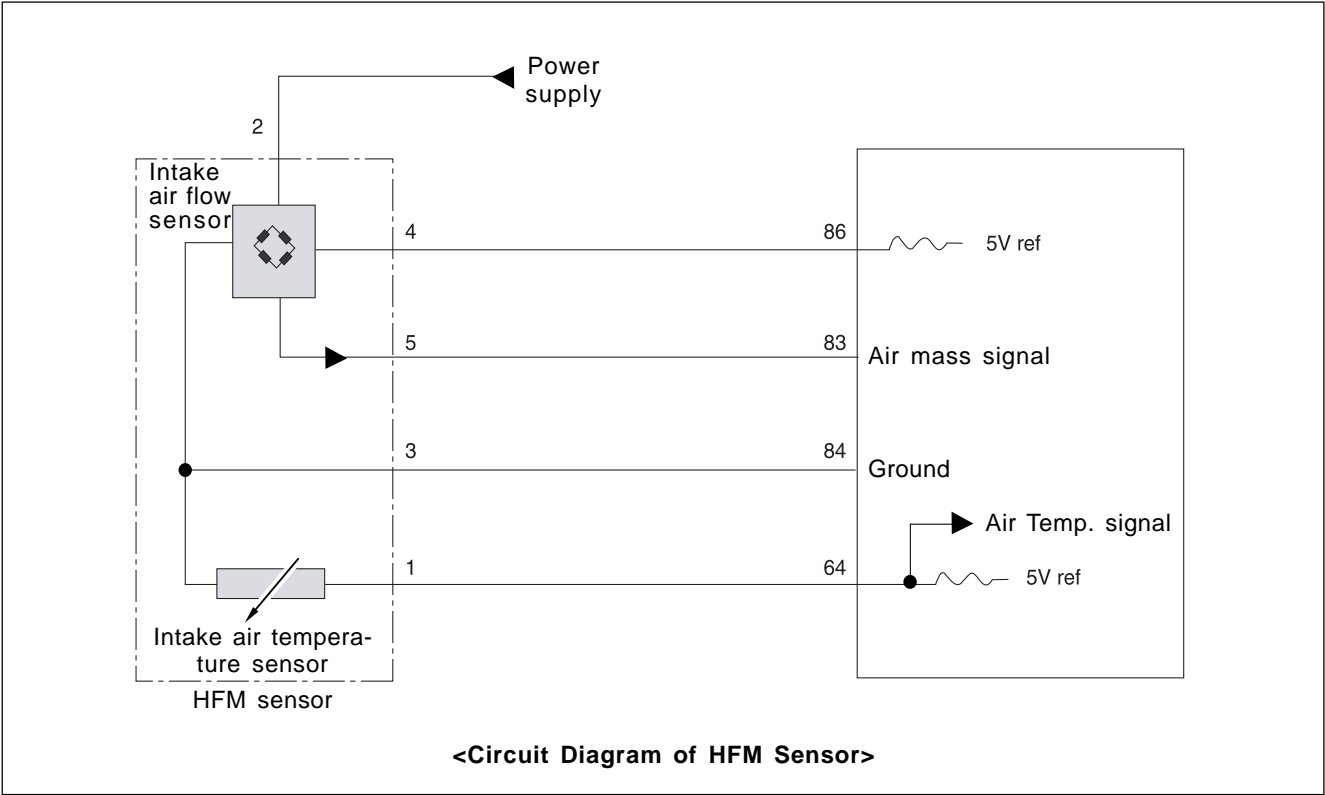
Main functions of HFM sensor are:

1. Using for EGR feedback control
2. Using for turbocharger booster pressure control valve control
3. Using for fuel injecting compensation

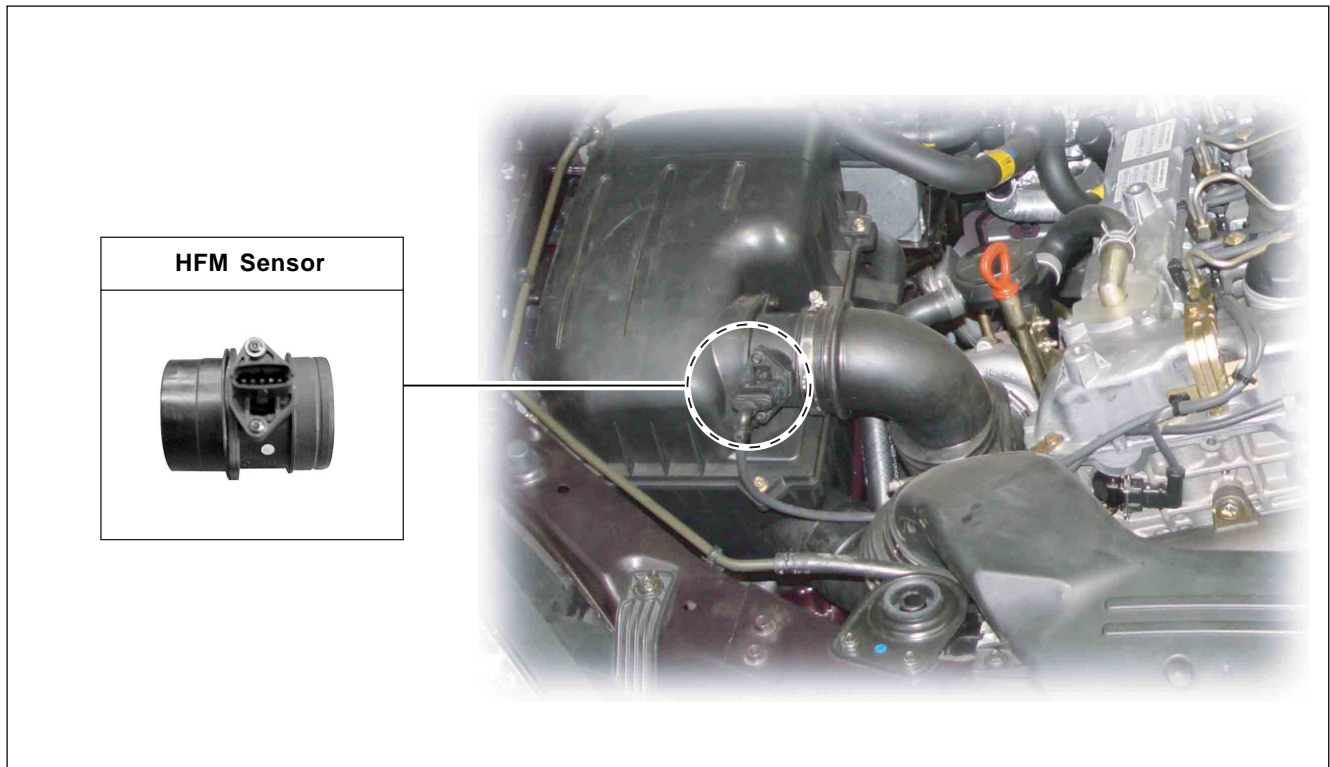
CI type HFM sensor: The air flowing the sensor does not directs toward sensing section but flows along with lower wall after passing protection grid to enhance durability of the sensor. Oil, water and dust less damage the sensor.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	



HFM Sensor - Removal and Installation



※ **Preceding Work:** Disconnection of negative battery cable

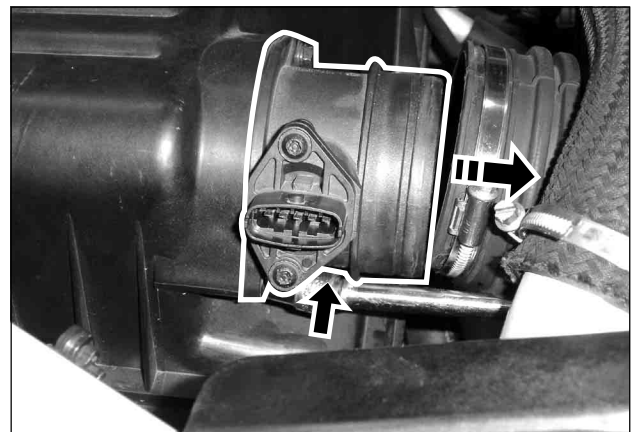
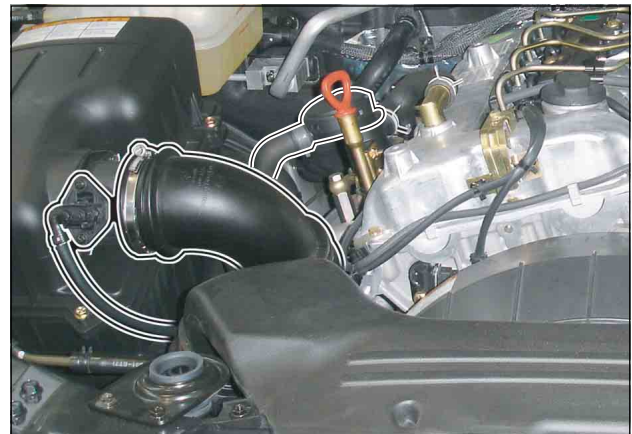
1. Disconnect the HFM sensor connector.
2. Loosen the clamps on the air cleaner and the turbo charger and remove the duct.

3. Unscrew the bolts and remove the HFM sensor assembly.

Installation Notice

Tightening torque	4 ~ 5 Nm
-------------------	----------

4. Install the reverse order of removal.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

INTERCOOLER

The turbo charger is designed to improve the engine power by introducing more air (oxygen) into the engine. However, the intake air is heated (100 ~ 110°C) during the compression process in turbo charger compressor and the density is lowered.

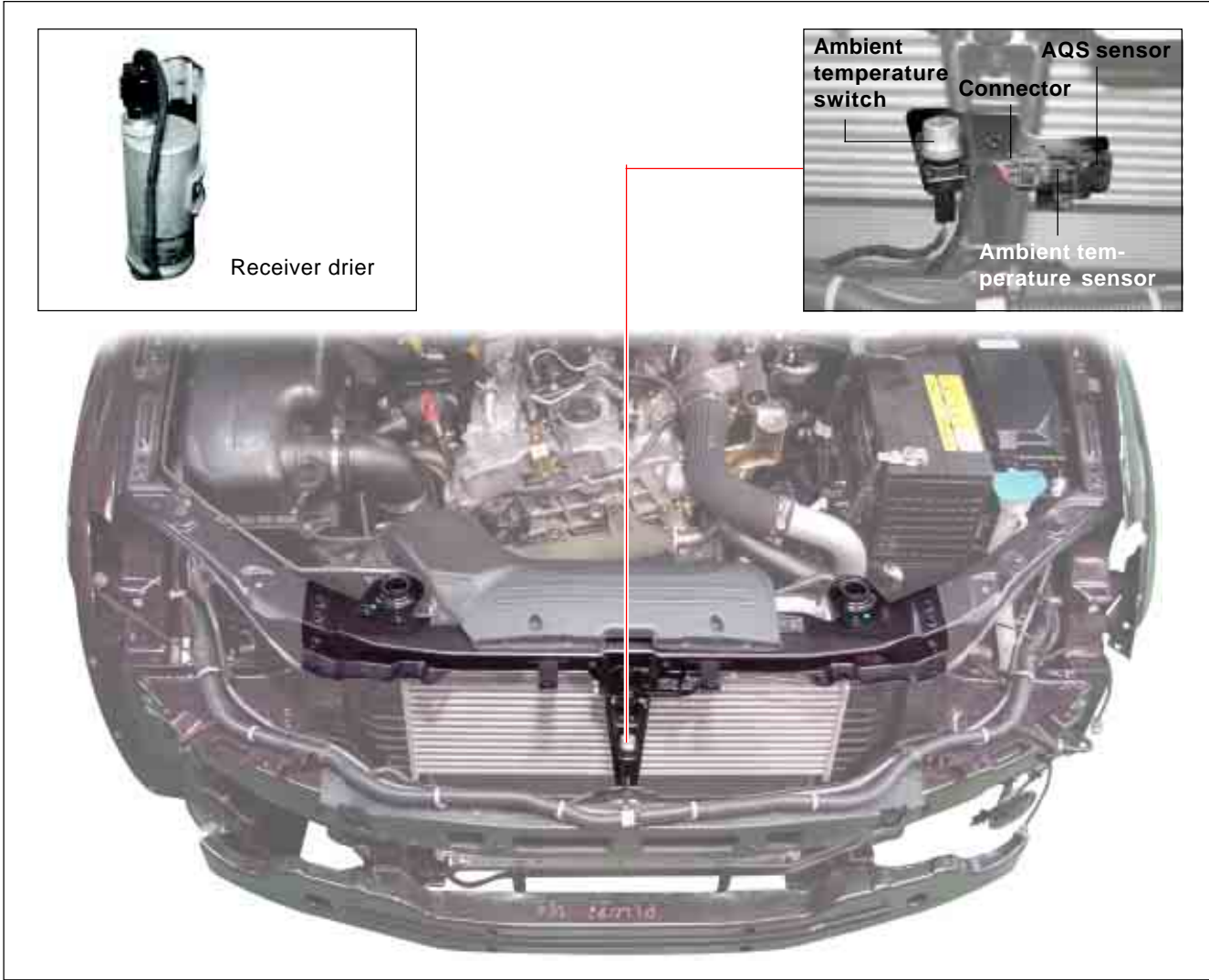
The intercooler is the device which cools (50 ~ 60°C) the air entering the engine. Cold air has more oxygen molecules than warm air. Thus cooler air gives more power and better fuel economy.



1. Intercooler

Intercooler - Removal and Installation

1. Disconnect all wiring harnesses and related connectors from the front side of radiator assembly.



2. Remove the front end center member.



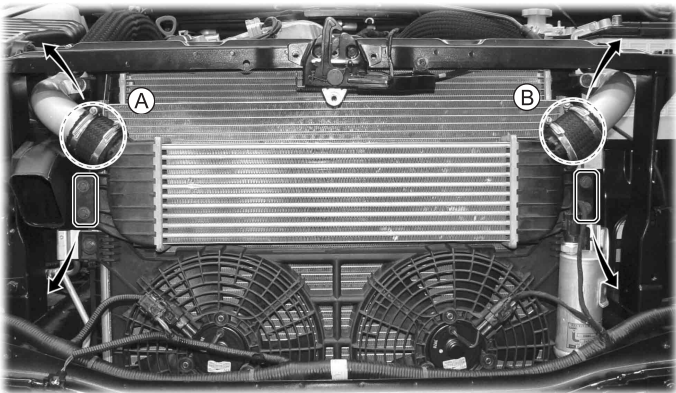
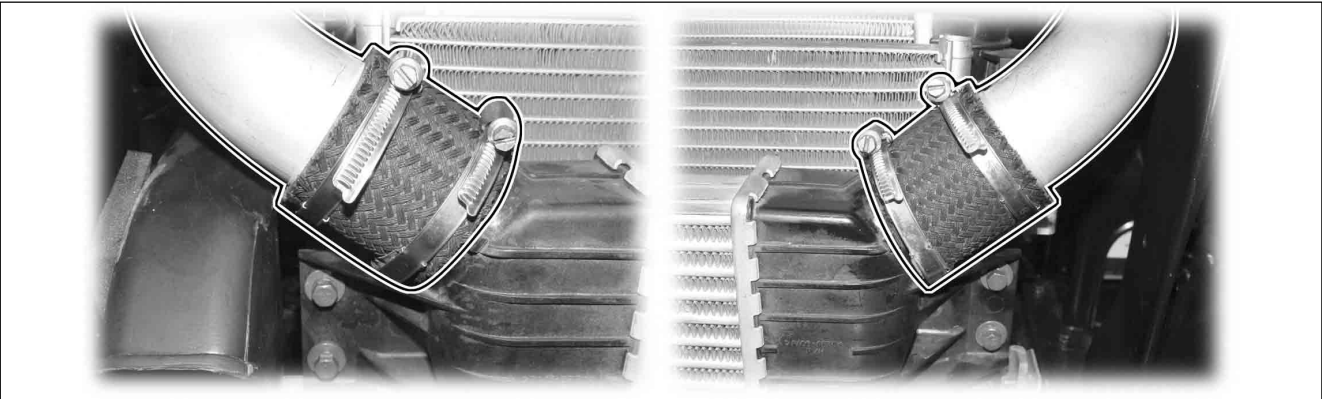
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

3. Remove the hood latch cable and remove the radiator support upper member.

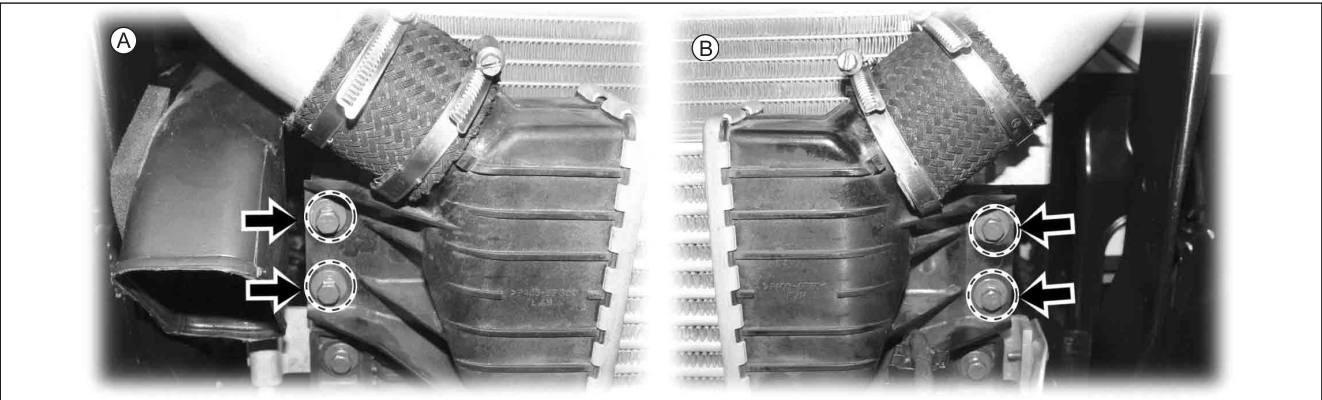


4. Remove the intercooler inlet hose and outlet hose.

Tightening torque	6 ~ 7 Nm
-------------------	----------

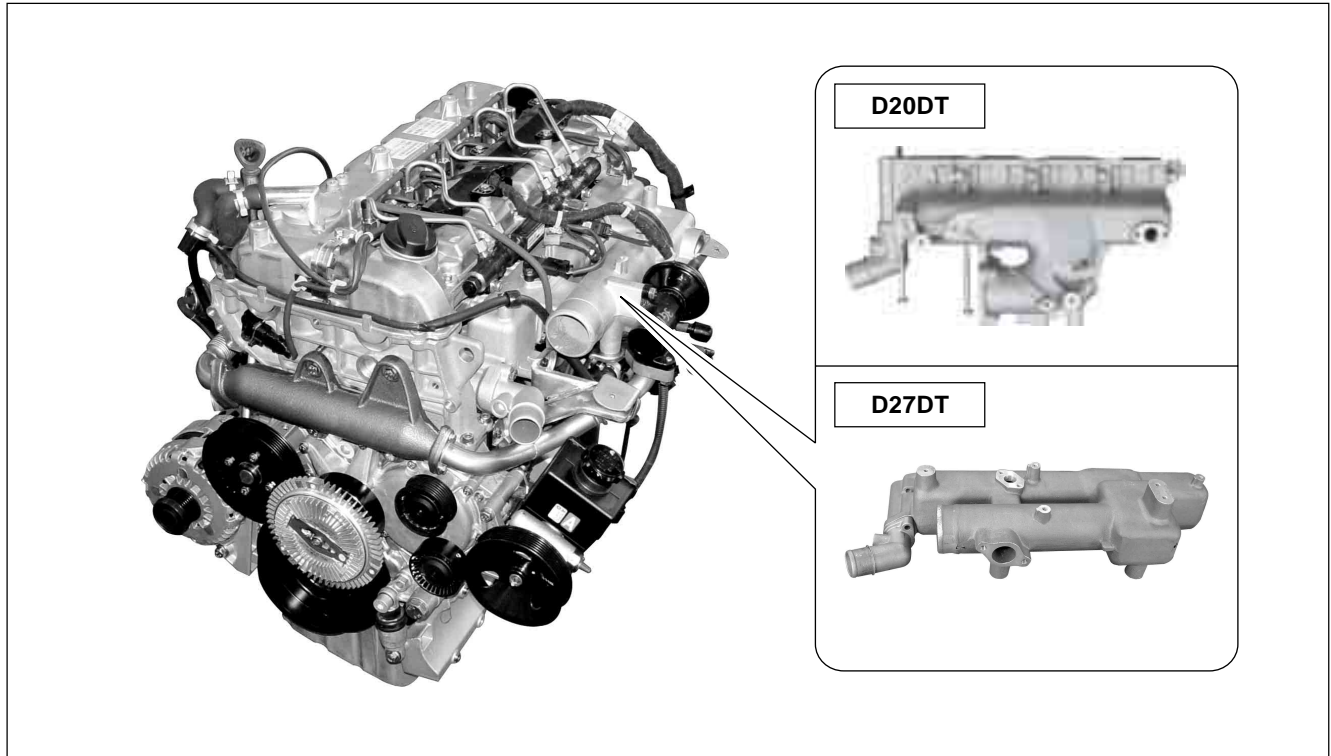


5. Unscrew the bolts and remove the intercooler assembly.



6. Install in the reverse order of removal.

INTAKE MANIFOLD ASSEMBLY


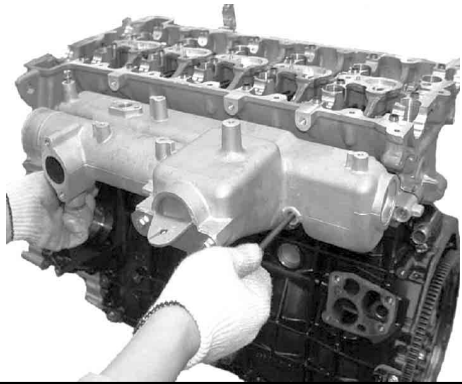


► System Characteristics

1. Shape that delivers the required capacity of compressed air from turbo charger to inlet port
2. Optimized EGR gas mixture in inlet chamber
3. Maximized intake efficiency with helical and tangential inlet port
 - 1) Improving the swirl ratio in low and mid operating range
 - 2) Improving the acceleration/fuel economy and reducing the maintenance in low and mid operating range
4. Integrated inlet port and coolant outlet port

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

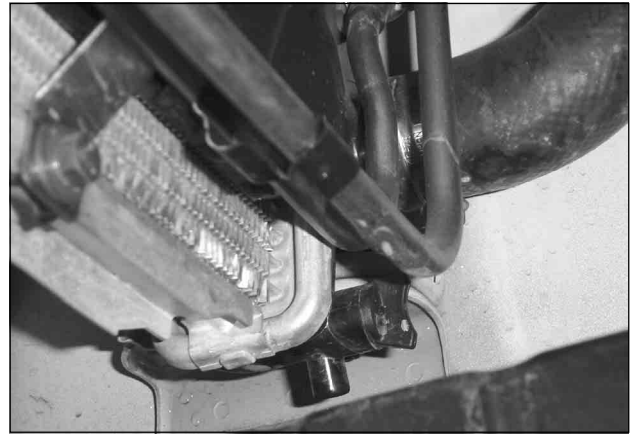
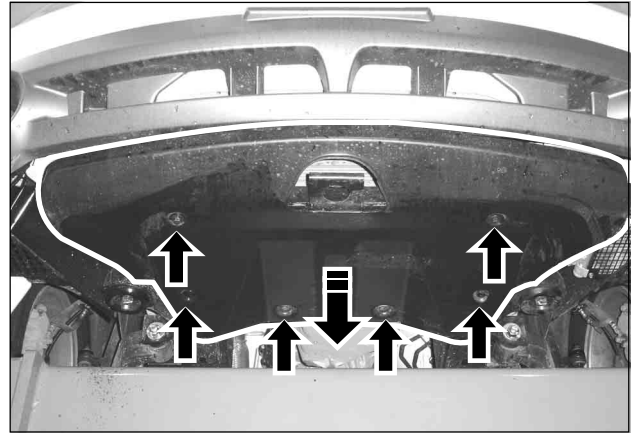
► Special Tools and Equipment

Name and Part Number	Application
<p>Y99220112B</p> <p>Intake manifold guide pin</p> 	<p>Installation of intake manifold</p> 

Intake Manifold - Removal/Installation

※ **Preceding Work:** Disconnection of negative battery cable

1. Lift up the vehicle and remove the skid plate.
2. Open the coolant reservoir cap and loosen the drain cock to drain the coolant.
3. Remove the air inlet hose (1) from intake manifold.
4. Loosen the clamp and remove the coolant inlet hose (2).



GENERAL

ASSY

HOUSING

INTAKE

EXHAUST

LUB

COOLING

FUEL

CONTROL

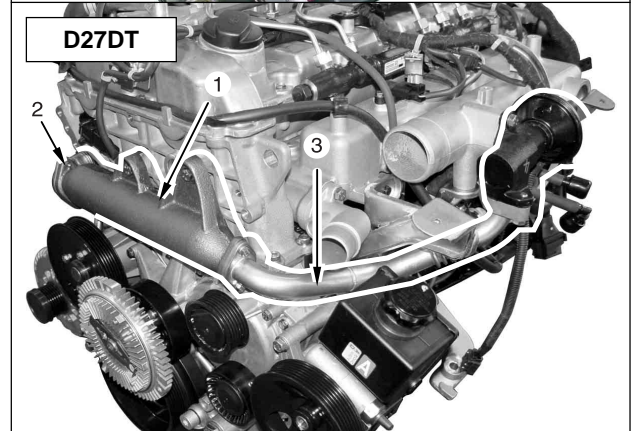
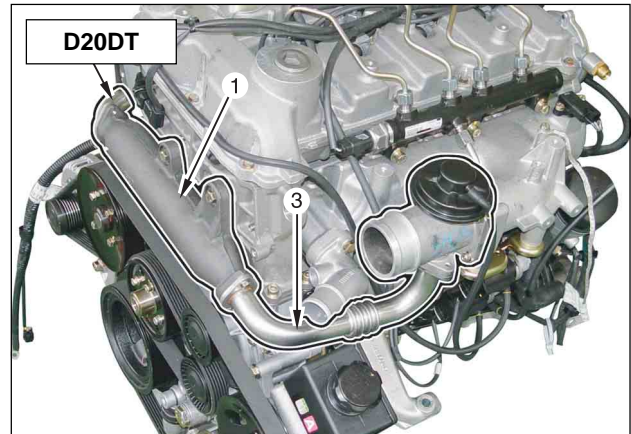
SENSOR

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

5. Remove the coolant inlet port housing.
6. Remove the vacuum hose from EGR valve.
7. Remove the EGR valve mounting bolts and gasket. Remove the EGR exhaust pipe (primary) mounting bolts and gasket.

**NOTICE**

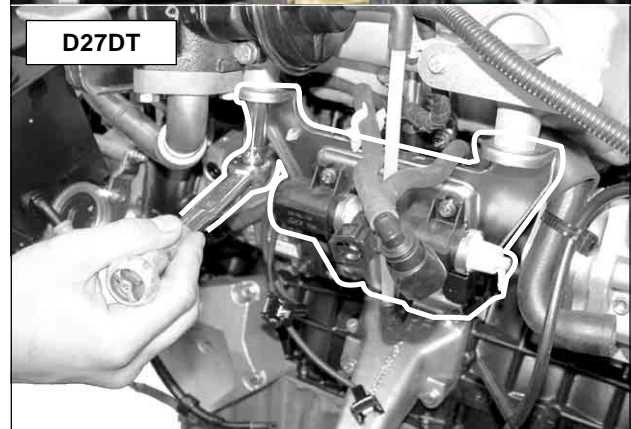
- Replace the pipes (2, 3) at both sides of EGR cooler (1) and gaskets with new ones.
- Make sure that the convex surface of gasket is facing to the pressurized direction.



8. Remove the brackets and connectors from top section of the engine.
 - 1) Vacuum hose bracket in turbo charger
 - 2) Booster pressure sensor
 - 3) Main wiring bracket
 - 4) Ground cable bracket
 - 5) Fuel pressure sensor connector
9. Unscrew the bolts and remove the vacuum modulator bracket.

Installation Notice

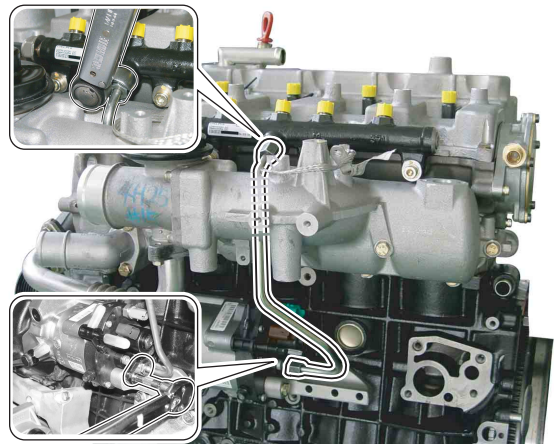
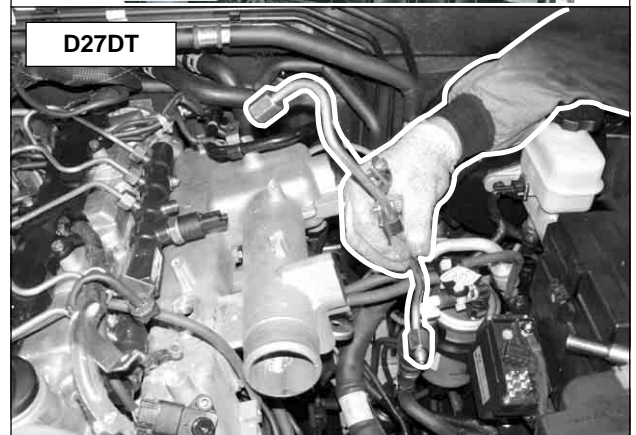
Tightening torque	9.0 Nm
-------------------	--------



10. Remove the HP pump fuel supply line bolts.
11. Remove the HP pump fuel supply line mounting bracket.
12. Remove the HP pump fuel return line at fuel filter.

**NOTICE**

- Plug the openings of pipes and ports with sealing caps to keep the cleanness of the fuel system.
- Replace the pipes with new one once removed.

D20DT**D27DT**

13. Remove the injector return line at HP pump.

**NOTICE**

- Be careful not to damage the pipes to HP pump.
- Plug the fuel return port of the HP pump with a sealing cap.



GENERAL

ASSY

HOUSING

INTAKE

EXHAUST

LUB

COOLING

FUEL

CONTROL

SENSOR

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

14. Remove the intake manifold mounting bolts.

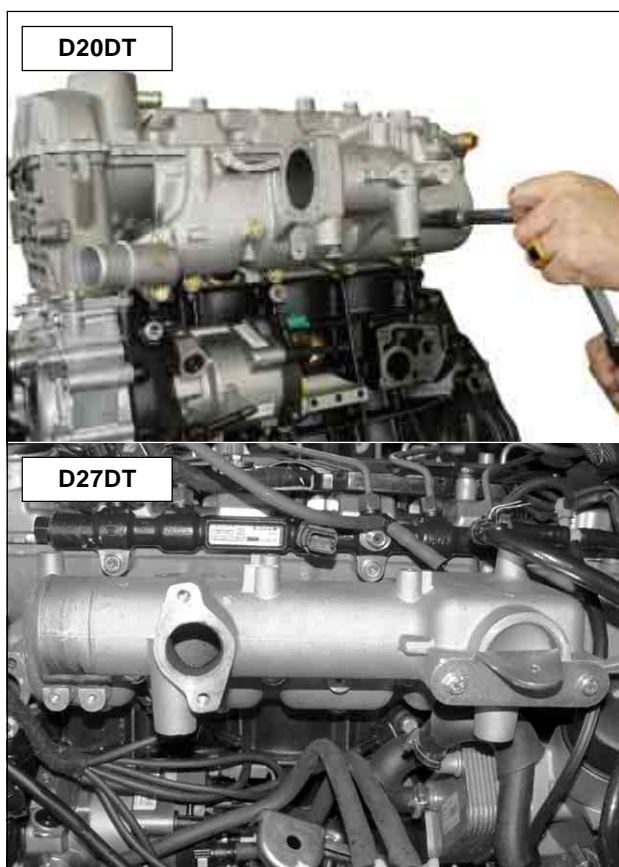
Installation Notice

Tightening torque	25 ± 2.5 Nm
-------------------	-------------

Check the length of the bolts before installation.

M8 x 45: 6EA

M8 x 130: 6EA



15. Lift up the vehicle and remove the propeller shaft joint bolts.
16. Unscrew the bolt in oil filter and remove the intake manifold and gasket.



NOTICE

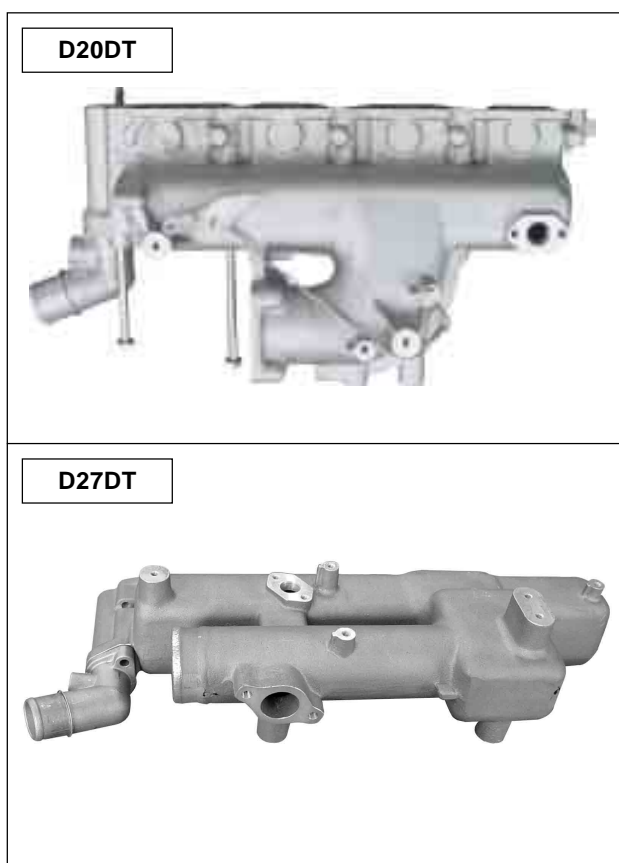
- Replace the gasket with new one.
- Make sure that the residual coolant in intake manifold gets into the inside of inlet port.

17. Install in the reverse order of removal.



NOTICE

- Replace the gasket with new one.
- If replaced only gasket without any other service operation, completely remove the coolant and other contaminants from the engine before installation.



SECTION 04

EXHAUST SYSTEM

EXHAUST SYSTEM

04

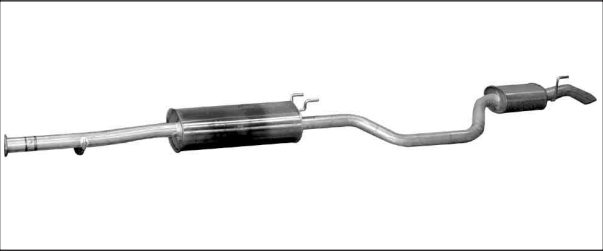


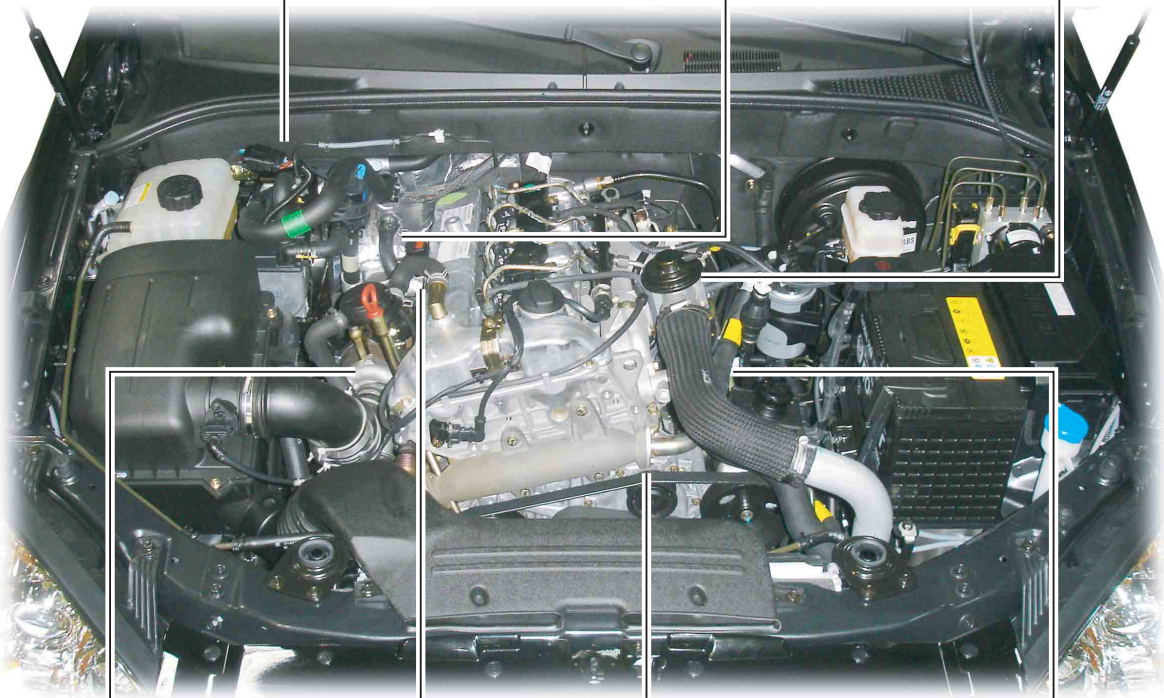

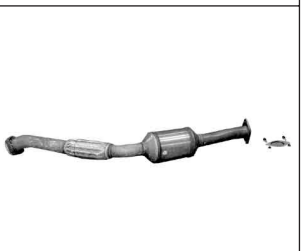
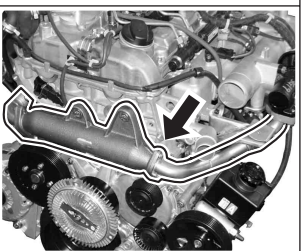
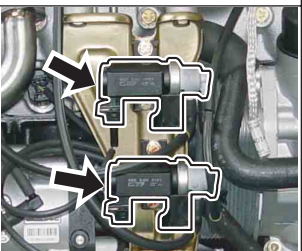
■ TABLE OF CONTENTS ■

EXHAUST SYSTEM LAYOUT	2
Components locator	2
Exhaust gas flows	4
Turbo charger assembly	7
VGT (Variable Geometry Turbocharger)	26
EGR VALVE AND VACUUM MODULATOR	41
EGR system	41
EGR valve and turbo charger actuator control vacuum circuit ...	42
EXHAUST SYSTEM AND MUFFLER	51
Muffler	51
System overview	52

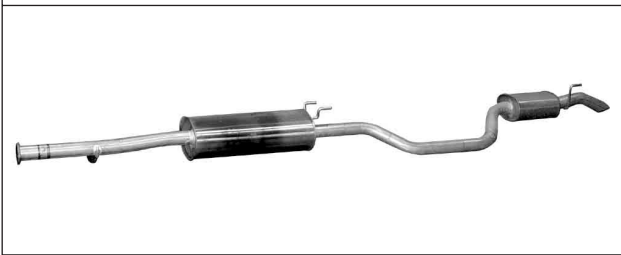


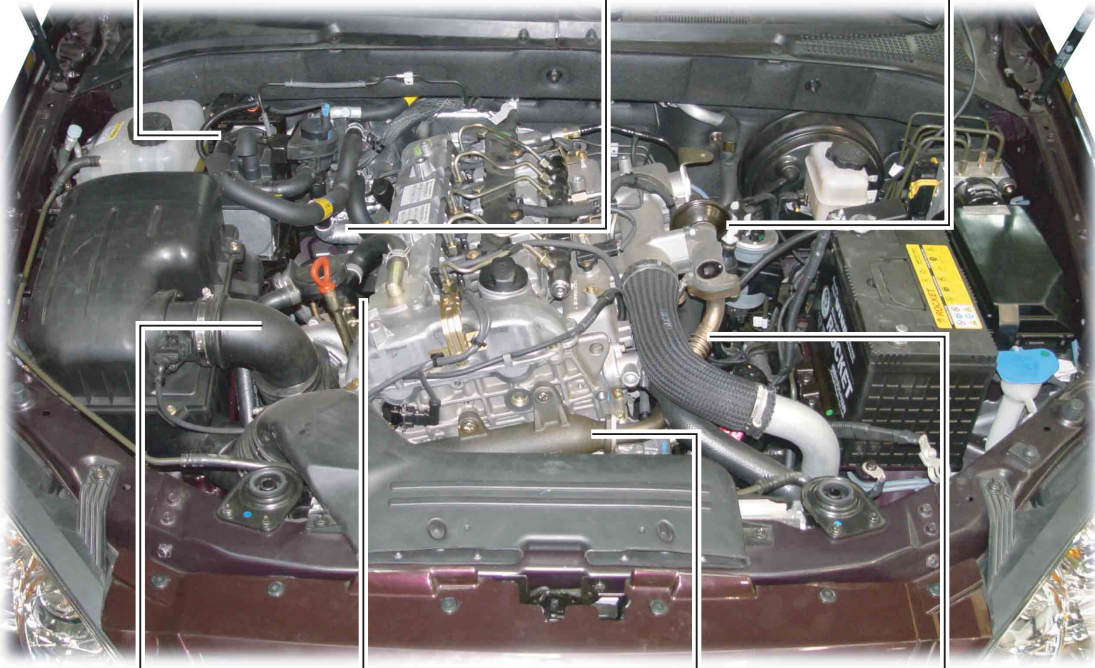

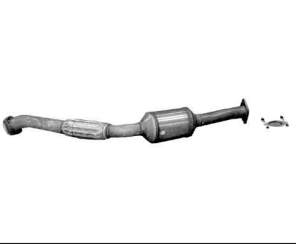
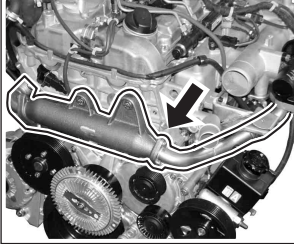
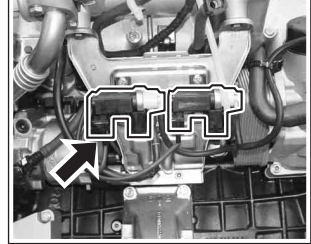
EXHAUST SYSTEM LAYOUT

COMPONENTS LOCATOR

► D20DT Engine

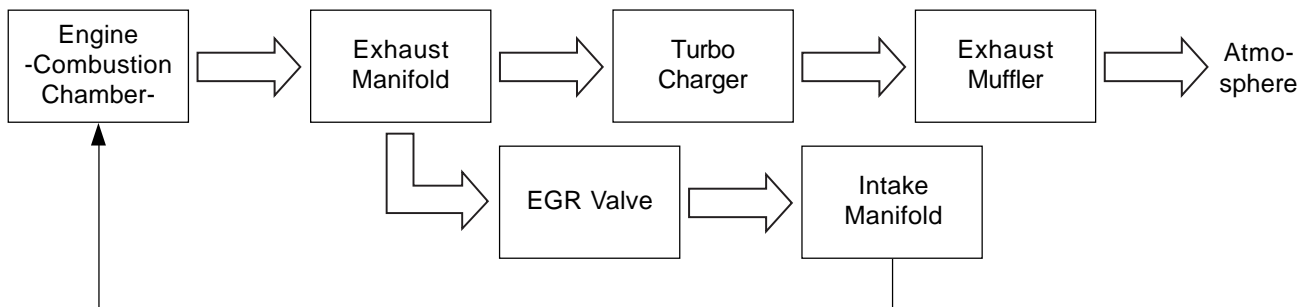
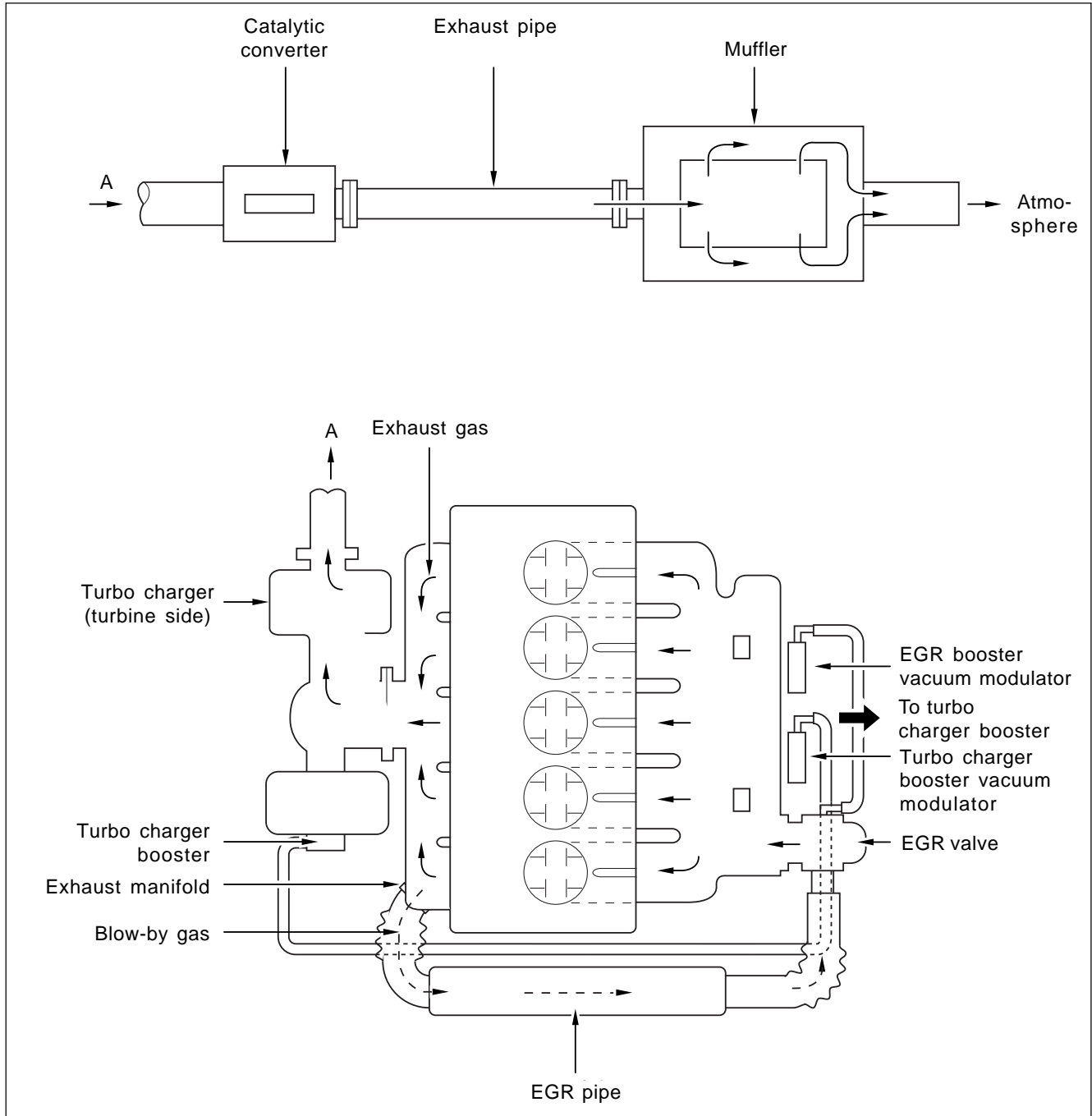
Muffler	Exhaust Manifold	EGR Valve	
			
			
Turbo Charger	Catalytic Converter (DOC)	EGR Pipe	Vacuum Modulator
			

► D27DT Engine

Muffler	Exhaust Manifold	EGR Valve	
			
			
Turbo Charger	Catalytic Converter (DOC)	EGR Pipe	Vacuum Modulator
			

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

EXHAUST GAS FLOWS



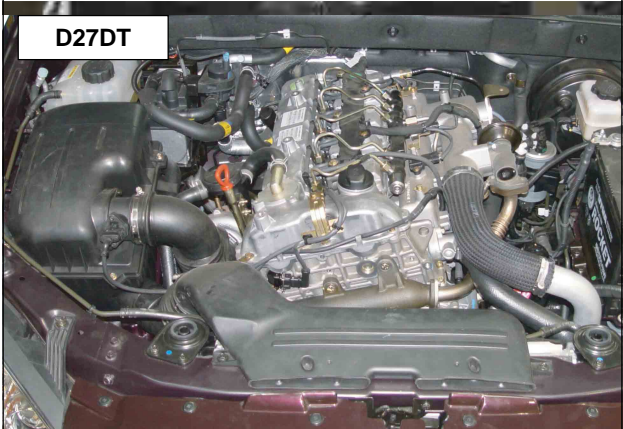
EXHAUST SYSTEM

KYRON SM - 2005.09

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Exhaust Manifold
- Removal and Installation

- 1. Remove the two intake hoses from the turbo charger.
- 2. Remove the turbo charger assembly (refer to Turbo Charger section).



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

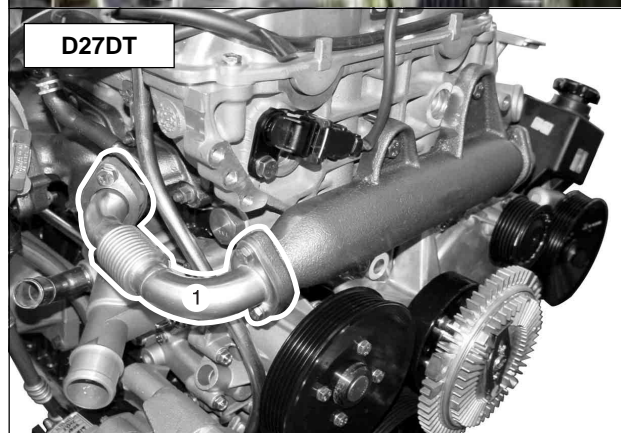
GENERAL
ASSY
HOUSING
INTAKE
EXHAUST
LUB
COOLING
FUEL
CONTROL
SENSOR

- Remove the #3 pipe of EGR valve from the exhaust manifold.

Installation Notice

Tightening torque	$35 \pm 3.5 \text{ Nm}$
-------------------	-------------------------

- The #3 pipe of EGR valve is exposed to the high temperature and pressure of exhaust gas. Replace the gasket and pipe with new ones. Otherwise, it may cause the leakage of exhaust gas.*



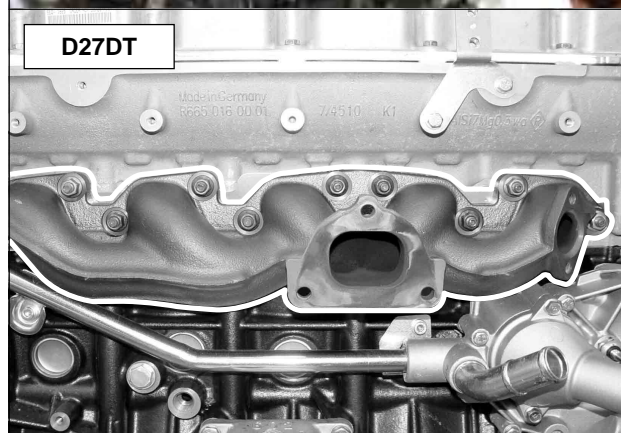
- Unscrew the nuts and remove the exhaust manifold and gasket.

Installation Notice

Tightening torque	$40 \pm 4.0 \text{ Nm}$
-------------------	-------------------------

- Replace the gasket with new one.*

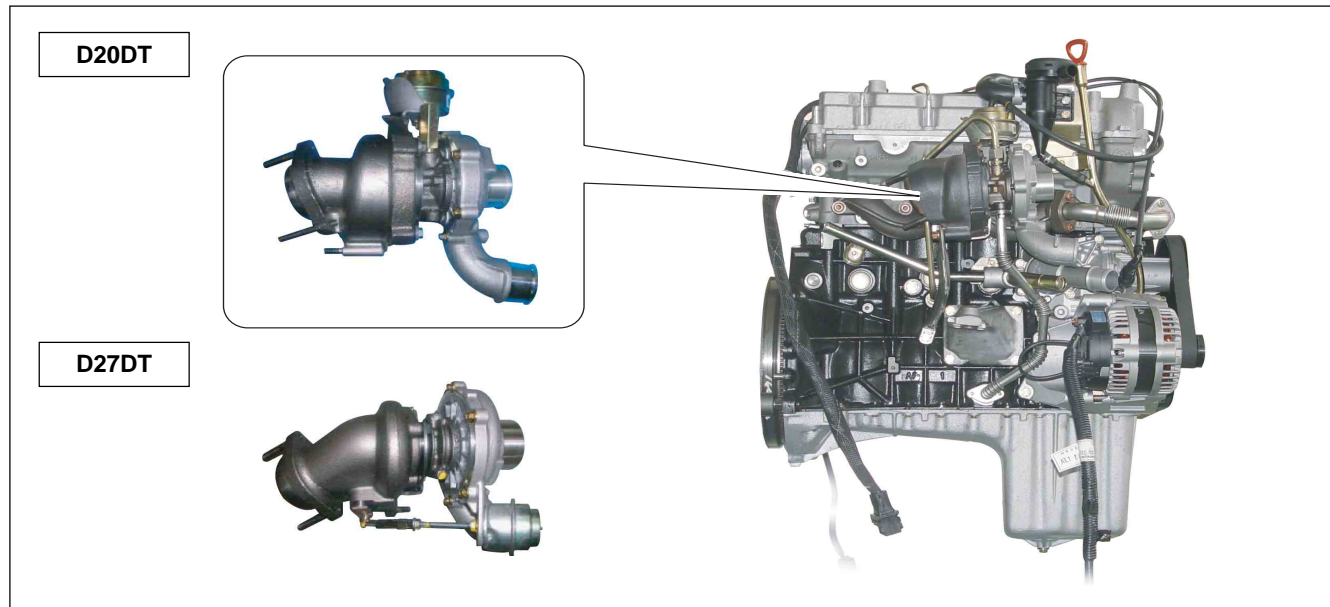
- Install in the reverse order of removal.



TURBO CHARGER ASSEMBLY

The turbo charger is an air pump installed on the intake manifold. It enhances power and increases torque power of engine to increase the fuel consumption rate. The engine without turbo charger cannot get as much power output as it inducts air by the means of vacuum being generated from descending strokes of the piston. Therefore, by installing the turbo charger on the intake manifold, it supplies great amounts of air to the cylinder increasing the volume efficiency and, subsequently, enhances output power.

Also, as the engine's power enhances, it increases the torque power and improves the fuel consumption rate. The regular turbo charger operates by utilizing the pressure from the exhaust gas and the other, called Super Charger, operates by utilizing power from the engine. When the turbo charger is installed, weight of the engine increases by 10 to 15 % whereas the output power increases by 35 to 45 %.

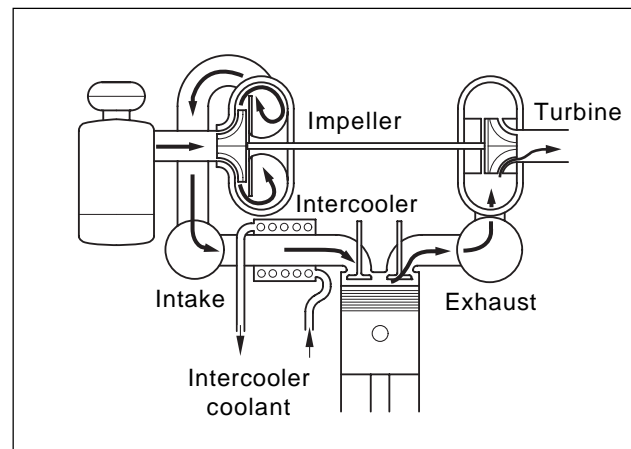


► Operating Principle of Turbo Charger

The turbo charger has one shaft where at each ends are installed with two turbines having different angles to connect one end of housing to the intake manifold and the other end to the exhaust manifold. As the turbine, at exhaust end, is rotated by exhaust gas pressure the impeller, at intake end, gets rotated to send air around center of the impeller, being circumferentially accelerated by the centrifugal force, into the diffuser.

The air, which has been introduced to the diffuser having a passage with big surface, transforms its speed energy into the pressure energy while being supplied to the cylinder improving the volume efficiency. Also, the exhaust efficiency improves as the exhaust turbine rotates. The turbo charger is often referred to as the exhaust turbine turbo charger.

Diffuser: With the meaning of spreading out it is a device that transforms fluid's speed energy into the pressure energy by enlarging the fluid's passage to slow down the flow.

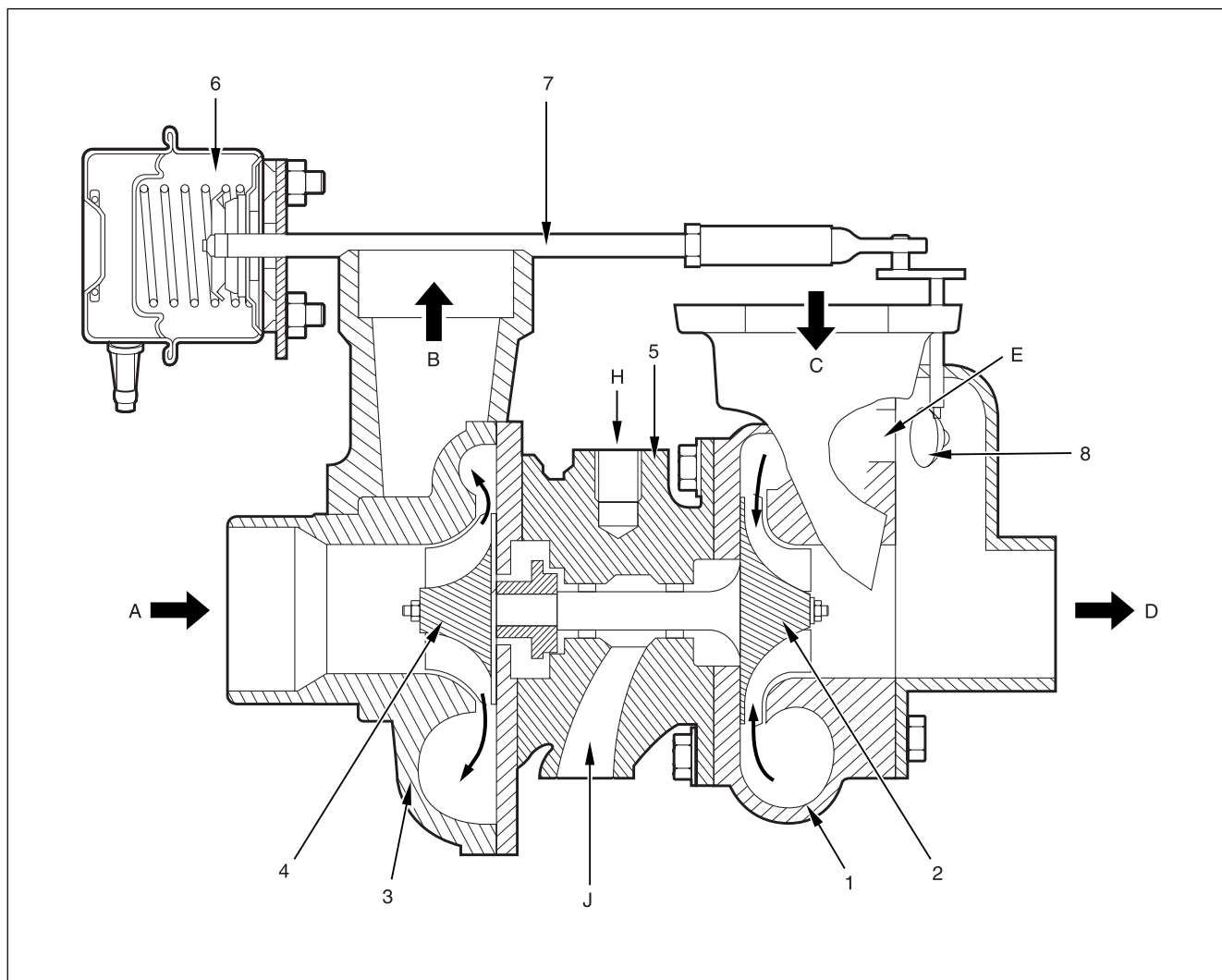


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► Construction of Turbo Charger

The turbine wheel in turbo charger and compressor wheel are installed at each side of the shaft. It is comprised with the shaft supporting center housing (supporting the compressor with two float journal bearings), the turbine side parts of turbine wheel, shroud and turbine housing, and the compressor side parts of compressor wheel, back plate and compressor housing.

1. The turbine rotates turbine wheel by receiving exhaust gas energy from the engine.
2. The compressor receives torque energy from the turbine and the compressor wheel inducts air to force it inside of the cylinder.

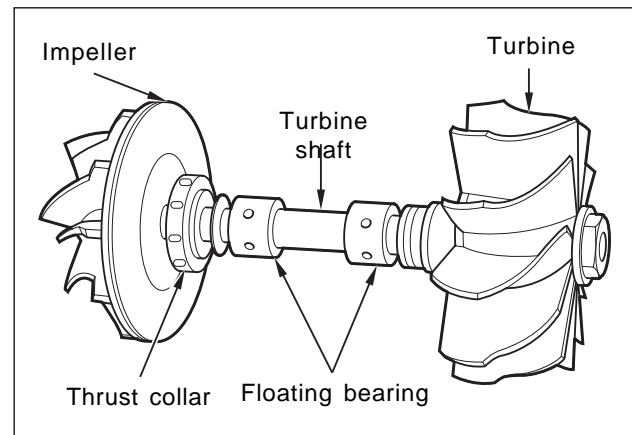


1. Turbine housing
2. Turbine wheel
3. Compressor housing
4. Compressor wheel
5. Center housing
6. Turbo charger booster pressure control valve
7. Control link
8. Bypass flap

- A. Air inlet (from atmosphere)
- B. Air flow
- C. Exhaust gas inlet (from cylinder)
- D. Exhaust gas outlet (to atmosphere)
- E. Exhaust gas bypass passage
- H. Oil supply opening
- J. Oil return line

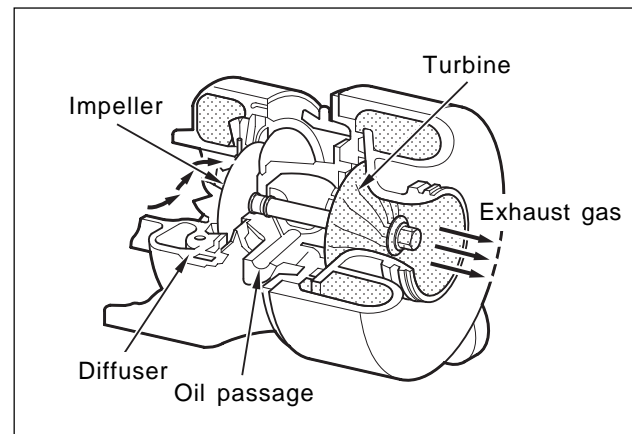
► Impeller

The impeller is wings (wheel) installed on the intake end and performs the role of pressurizing air into the cylinder.



The radial type has the impeller plate arranged in straight line at the center of shaft and, compared to the backward type, is being widely used as it is simple, easy to manufacture and appropriate for high speed rotation. As the impeller rotates in the housing with the diffuser installed in it, the air receives centrifugal force to be accelerated in the direction of housing's outer circumference and flows into the diffuser.

As surface of the passage increases, air flown into the diffuser transforms its speed energy into pressure energy and flows into the intake manifold where the pressurized air is supplied to cylinder each time the intake valve of cylinder opens up. Therefore, the efficiency of compressor is determined by the impeller and diffuser.



► Turbine

The turbine is wings installed at the exhaust end where, by the pressure of exhaust gas, it rotates the compressor and performs the role of transforming heat energy of exhaust gas into torque energy. The radial type is used as the turbine's wings. Therefore, during operation of the engine, the turbine receives temperature of exhaust gas and it rotates in high speed, it requires to have sufficient rigidity and heat resisting property.

During operation of the engine, exhaust gas discharged through the exhaust valve of each cylinder makes turbine rotate by coming in contact with the turbine's wings from the outer circumference within housing of the turbine and is exhausted through the exhaust manifold. At the same time, as the impeller is on the same shaft, it rotates.

► Floating Bearing

Floating Bearing is a bearing, which supports the turbine shaft that rotates at about 10,000 to 15,000 rpm. It could be rotated freely between the housing and the shaft as it gets lubricated by oil being supplied from the engine.



NOTICE

- Stopping the engine immediately after driving at high speed stops oil from being supplied to the bearing and may cause it to get burnt. Therefore, the engine must be stopped after cooling the turbo system by sufficiently idling the engine.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► Booster Pressure Control Valve Unit (Turbo Charger Actuator)

In order to reduce discharging of hazardous exhaust gas and to avoid the engine's overrun the turbo charger must be appropriately controlled. The maximum turbo charging pressure must be controlled as excessive increase in the pressure and power output can cause critical damages to the engine. In order to control these, the booster pressure control valve is installed on the turbo charger.

The difference of the booster pressure control between the existing IDI engine and DI engine is that in IDI engine, booster pressure of the intake manifold operates the booster pressure control valve connected directly to the turbo charger whereas in DI engine, the control is achieved by utilizing vacuum modulator (vacuum from a vacuum pump) designed to control the booster pressure control valve. It operates booster pressure control valve by supplying electrical power to the vacuum modulator having the amount of air being flown into the HFM sensor from the engine's ECU as the base signal.

Refer to the EGR section in following pages for the function of turbo charger and HFM sensor in exhaust system.

Booster pressure control valve unit and vacuum modulator

D20DT



Turbo charger booster



Turbo charger booster
vacuum modulator

D27DT



Turbo charger booster



Turbo charger booster
vacuum modulator

► Diagnosis and Maintenance for Turbo Charger System

Cautions During Driving

The following lists cautions to take during test drive and on the turbo charger vehicle, which must be considered during the operation;

1. It's important not to drastically increase the engine rpm starting the engine. It could make rotation at excessive speed even before the journal bearing is lubricated and when the turbo charger rotates in poor oil supply condition, it could cause damage of bearing seizure within few seconds.
2. If the engine is running radically after replacing the engine oil or oil filter brings poor oil supply condition. To avoid this, it's necessary to start off after idling the engine for about 1 minute allowing oil to circulate to the turbo charger after the replacement.
3. When the engine is stopped abruptly after driving at high speed, the turbo charger continues to rotate in condition where the oil pressure is at '0'. In such condition, an oil film between the journal bearing and the housing shaft journal section gets broken and this causes abrasion of the journal bearing due to the contact of metal parts. The repeat of such condition significantly reduces life of the turbo charger. Therefore, the engine should be stopped possibly in the idle condition.



NOTICE

- After string for long period of time during winter season or in the low temperature condition where the fluidity of engine oil declines, the engine, before being started, should be cranked to circulate oil and must drive after checking the oil pressure is in normal condition by idling the engine for few minutes.

Inspection of Turbo Charger

When problem occurs with the turbo charger, it could cause engine power decline, excessive discharge of exhaust gas, outbreak of abnormal noise and excessive consumption of oil.

1. Inspection when installed
 - 1) Check the bolts and nuts for looseness or missing
 - 2) Check the intake and exhaust manifold for looseness or damage
 - 3) Check the oil supply pipe and drain pipe for damages
 - 4) Check the housing for crack and deterioration
2. Inspection of turbine in turbo charger

Remove the exhaust pipe at the opening of the turbine and check, with a lamp, the existence of interference of housing and wheel, oil leakage and contamination (at blade edge) of foreign materials.

- 1) Interference: In case where the oil leak sign exists, even the small traces of interferences on the turbine wheel mean, most of times, that abrasion has occurred on the journal bearing. Must inspect after overhauling the turbo charger.
- 2) Oil Leakage: Followings are the reasons for oil leakage condition;
 - Problems in engine: In case where the oil is smeared on inner wall section of the exhaust gas opening.
 - Problems in turbo charger: In case where the oil is smeared on only at the exhaust gas outlet section.



NOTICE

- Idling for long period of time can cause oil leakage to the turbine side due to low pressure of exhaust gas and the rotation speed of turbine wheel. Please note this is not a turbo charger problem.

GENERAL

A S S Y

HOUSING

I N T A K E

E X H A U S T

L U B

C O O L I N G

F U E L

C O N T R O L

S E N S O R

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

3) Oil Drain Pipe Defect

In case where oil flow from the turbo charger sensor housing to the crank case is not smooth would become the reason for leakage as oil builds up within the center housing. Also, oil thickens (sludge) at high temperature and becomes the indirect reason of wheel hub section. In such case, clogging and damage of the oil drain pipe and the pressure of blow-by gas within the crank case must be inspected.

4) Damages from Foreign Materials

When the foreign materials get into the system, it could induce inner damage as rotating balance of the turbo charger gets out of alignment.

Inspection of Turbine

Thoroughly check the followings.



NOTICE

- **Must absolutely not operate the turbo charger with the compressor outlet and inlet opened as it could damage the turbo charger or be hazardous during inspection.**

1. Interference: In case where is trace of interference or smallest damage on the compressor wheel means, most of times, that abrasion has occurred on the journal bearing. Must inspect after the overhaul.
2. Oil Leakage: The reason for oil leakage at the compressor section is the air cleaner, clogged by substances such as dust, causes the compressor inlet negative pressure;
 - 1) Rotating in high speed at no-load for extended period of time can cause oil leakage to the compressor section as oil pressure within the center housing gets higher than pressure within the compressor housing.
 - 2) Overuse of engine break (especially in low gear) in down hill makes significantly low exhaust gas energy compared to the time where great amount of air is required during idling conditions of the engine. Therefore, amount of air in the compressor inlet increases but the turbo charge pressure is not high, which makes negative pressure at the compressor section causing the oil leakage within the center housing.



NOTICE

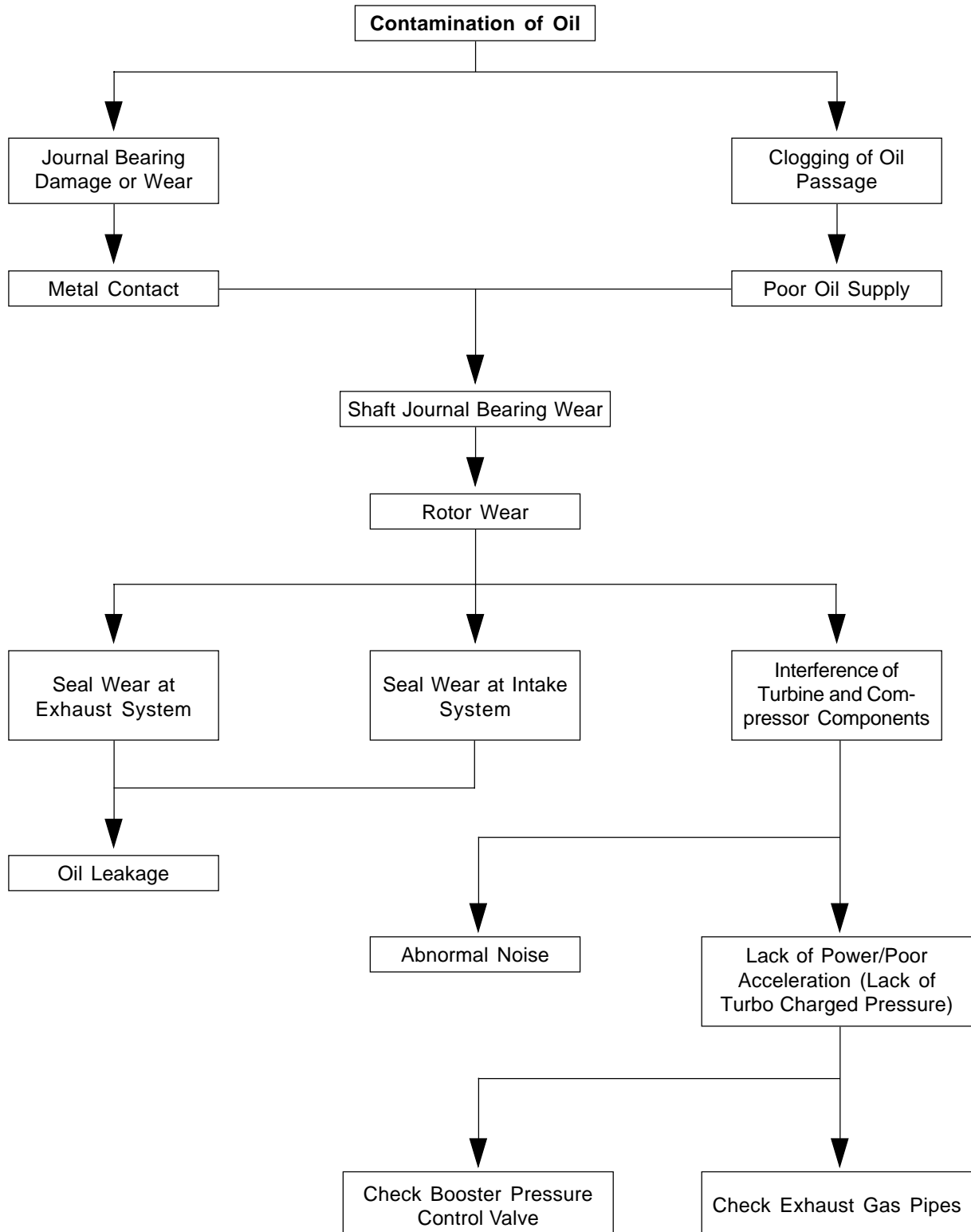
- **No problem will occur with the turbo charger if above conditions are found in early stage but oil leaked over long period of time will solidify at each section causing to breakout secondary defects.**

3. Damages by foreign materials: In case where the compressor wheel is damaged by foreign materials requires having an overhaul. At this time, it's necessary to check whether the foreign materials have contaminated intake/exhaust manifold or inside of engine.

Path of Turbo Charger Defect

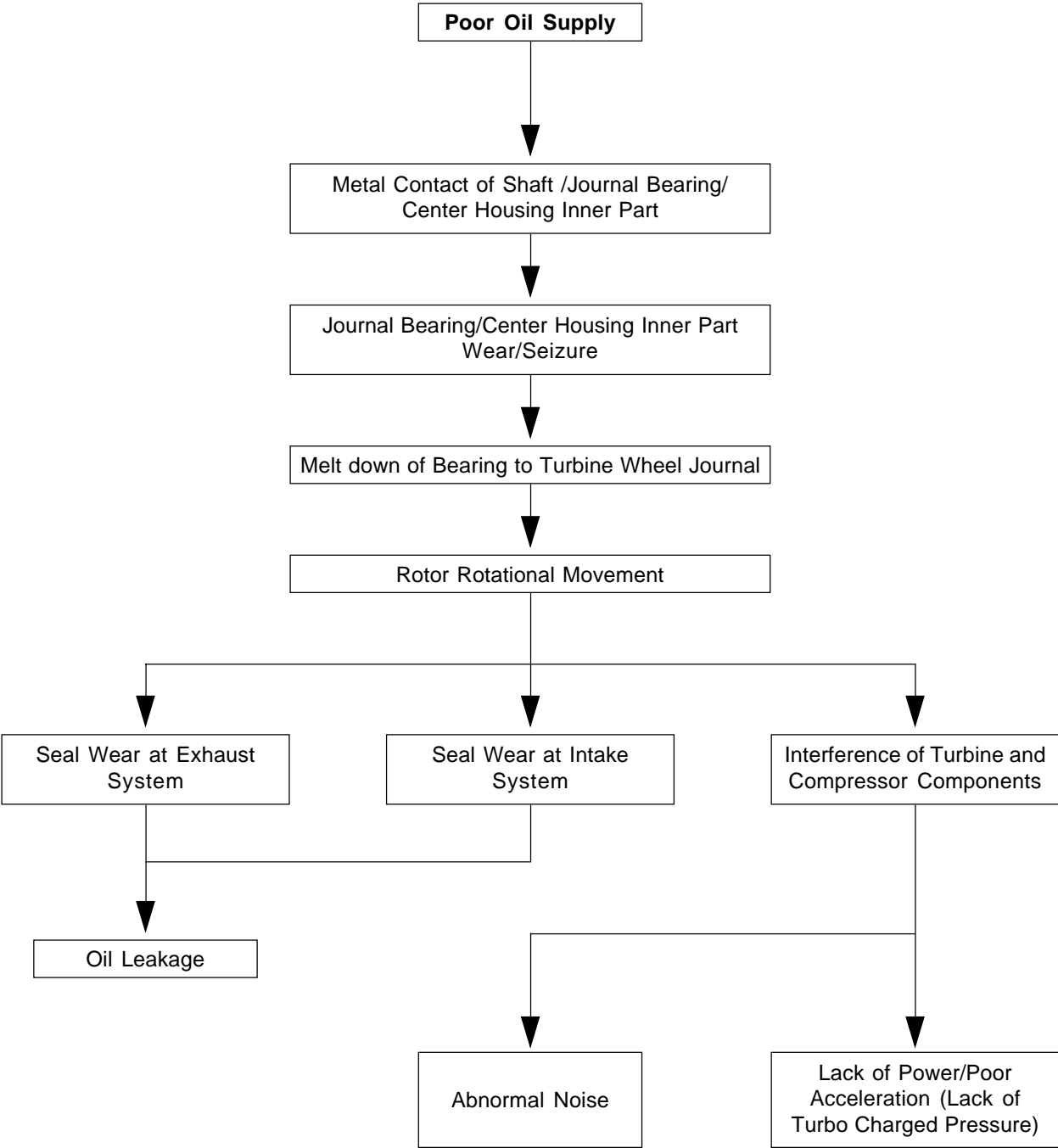
The following tries to understand the defects that can occur with vehicle installed with the turbo charger and to manage the reasons of such defects.

1. In case where oil pan/oil pipe has been contaminated, oil filter is defected and where adhesive of gaskets has been contaminated into the oil line.

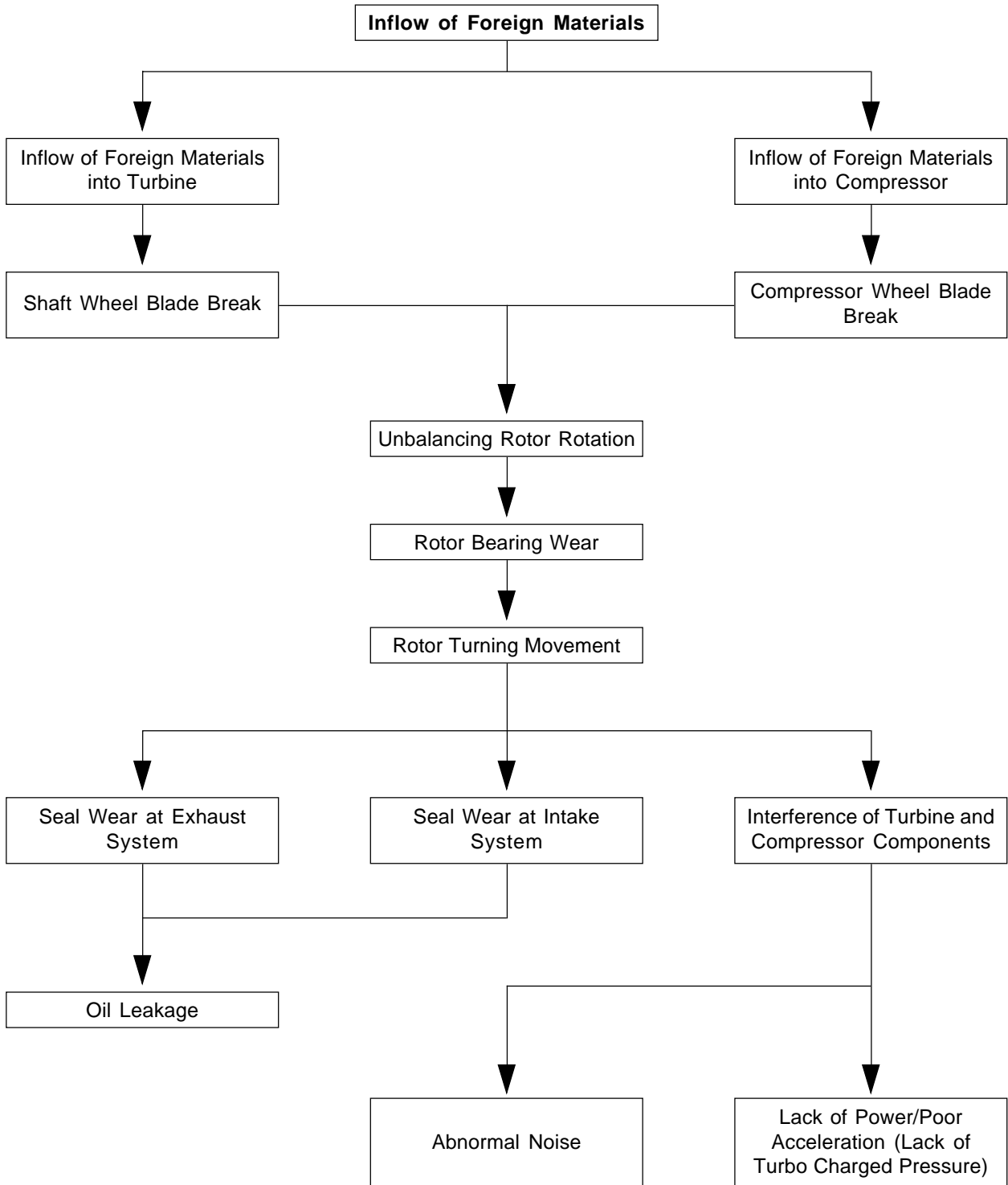


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

2. Oil Pump Defect: Rapid over-loaded driving after replacing oil filter and oil and clogging of oil line.

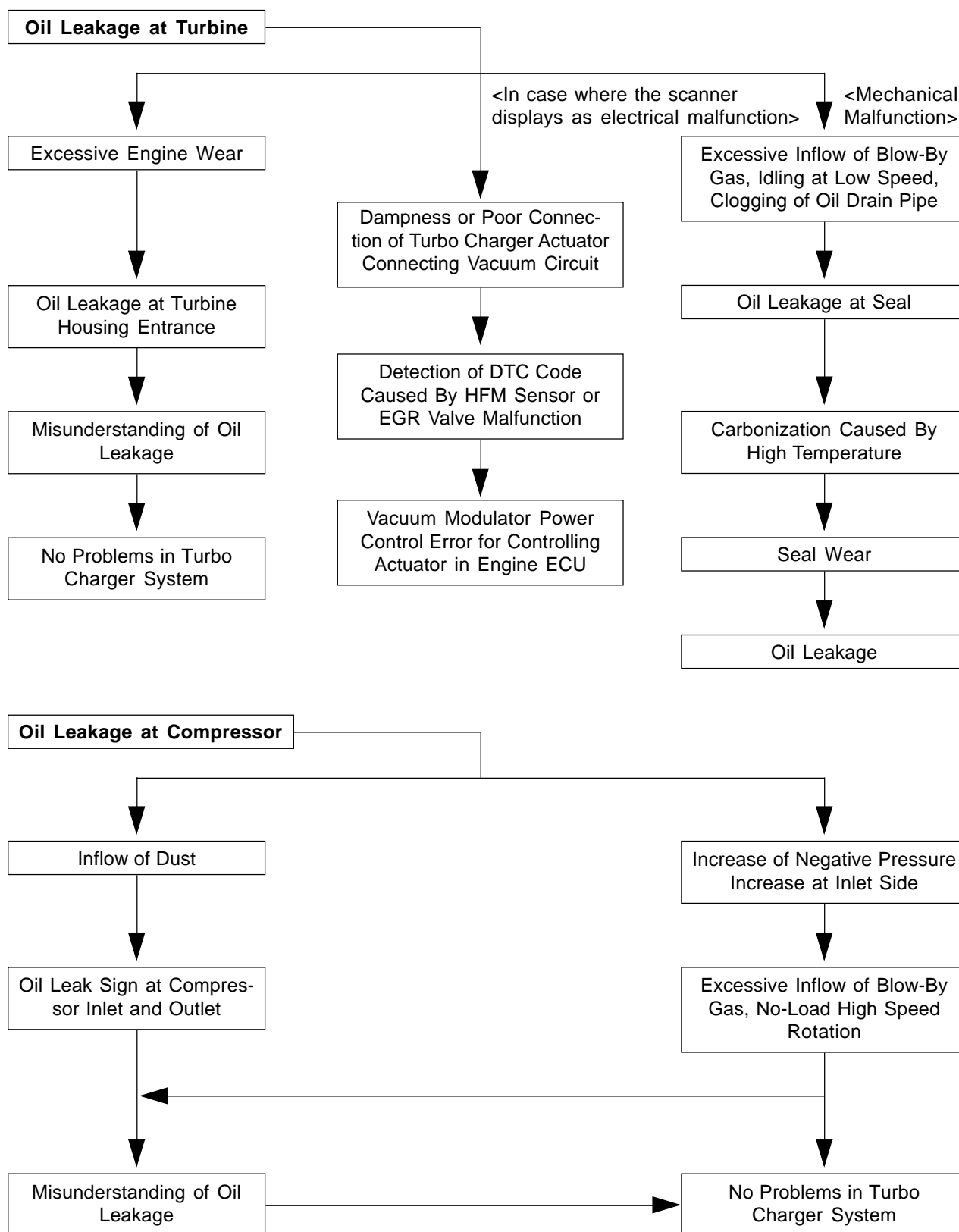


**3. Turbine Side: Inflow of foreign materials from engine
Compressor Side: such as air filter, muffler and nut**



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

4. Defects caused by reasons other than that of the turbo charger.



How to Diagnose

The followings are cautions to take in handling defects of turbo charger, which must be fully aware of;

Cautions When Examining the Defects:

1. After stopping the engine, check whether the bolts on pipe connecting section are loose as well as the connecting condition of vacuum port and modulator, which is connected to the actuator.
2. During idling of the engine, check for leakage in the connecting section of pipe (hoses and pipes, duct connections, after the turbo charger) by applying soap water. The leakage condition in the engine block and turbine housing opening can be determined by the occurrence of abnormal noise of exhaust.
3. By running the engine at idle speed, abnormal vibration and noise can be checked. Immediately stop the engine when abnormal vibration and noise is detected and make thorough inspection whether the turbo charger shaft wheel has any damages as well as checking the condition of connections between pipes.
4. In case where the noise of engine is louder than usual, there is possibility of dampness in the areas related with air cleaner and engine or engine block and turbo charger. And it could affect the smooth supply of engine oil and discharge.
5. Check for damp condition in exhaust gas when there is sign of thermal discoloration or discharge of carbon in connecting area of the duct.
6. When the engine rotates or in case where there is change in noise level, check for clogging of air cleaner or air cleaner duct or if there is any significant amount of dust in the compressor housing.
7. During the inspection of center housing, inspect inside of the housing by removing the oil drain pipe to check for sludge generation and its attachment condition at shaft area or turbine side.
8. Inspect or replace the air cleaner when the compressor wheel is damaged by inflow of foreign materials.
9. Inspect both side of the turbo charger wheel after removing inlet and outlet pipe of the turbo charger.
 - 1) Is the rotation smooth when the rotor is rotated by hand?
 - 2) Is the movement of bearing normal?
 - 3) Inspect whether there has been any signs of interference between two wheels.

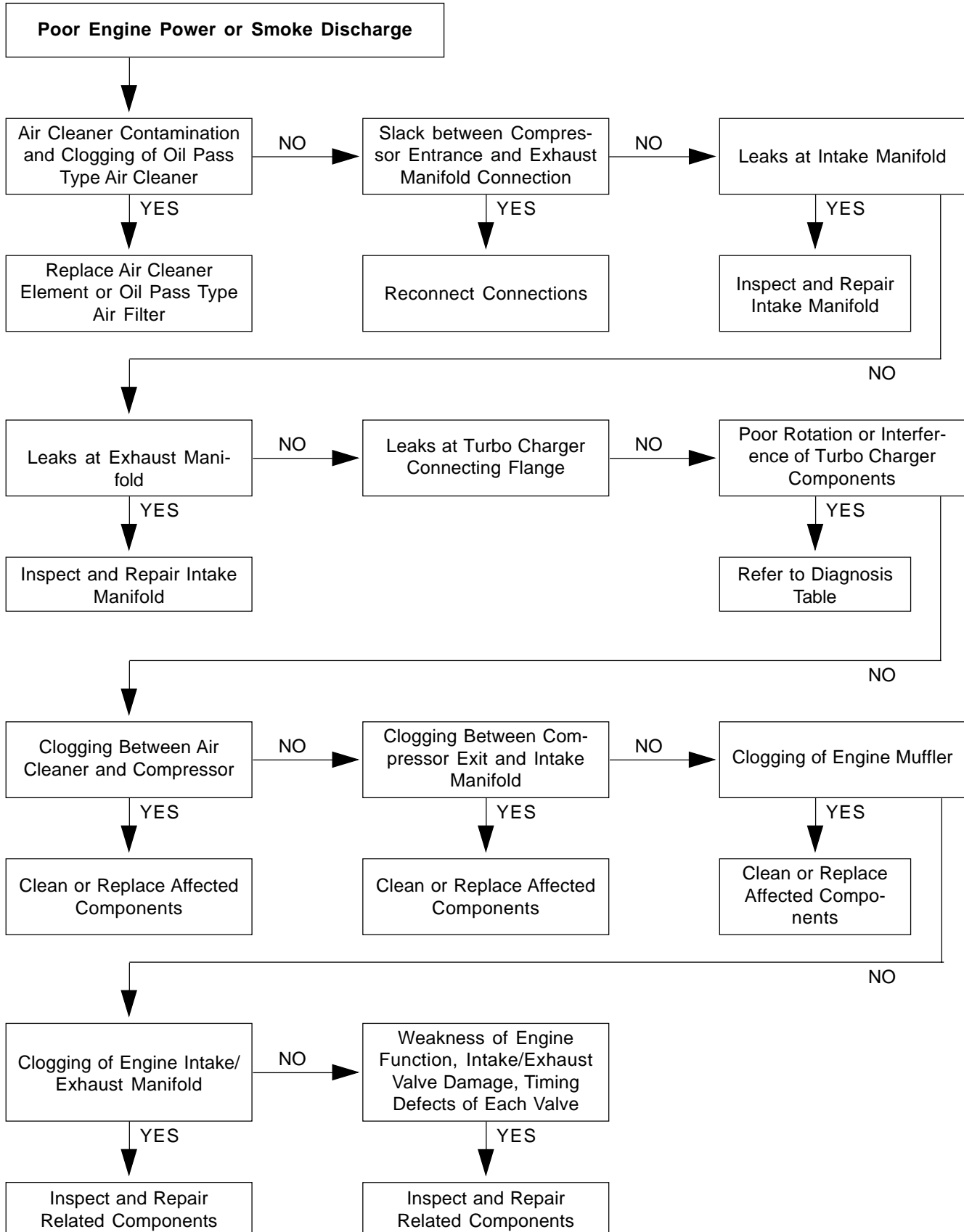


NOTICE

- It's important not to drive the engine when the intake manifold hose has been removed.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Diagnosis and Measure



► Before Diagnosis

The base of making diagnosis on the EGR related system is the inspection on the connections of the vacuum hoses in related system as the first priority. When abnormal condition occurs with the EGR system, the basic approach is, as described in prior sentence, making detail inspections of vacuum circuits of each system before connecting the scan tool or vacuum tester. It is necessary to manually check on the connections if there are any slacks or loose circuits even if the visual inspection shows vacuum hose as being connected. If there are not any problems then the next inspection area is the connections of the system connectors. Most problems with the occurrence of system malfunction are from conditions of vacuum line and connector connections and the causes from the malfunction of mechanical mechanism is actually very few.

For example, when there are no problems with basic components, let's assume that there is a vehicle having vacuum leak from connection slack in the vacuum line between EGR vacuum modulator and EGR valve. This vehicle, due to the driving condition or, according to the circumstances, smog or other conditions, could create customer's complaint and by connecting the scanning device could display as the malfunction of the EGR valve's potentiometer.

As previously explained, this car has a separate controller to control the HUBER EGR and, in accordance with various input element, the controller controls EGR valve by regulating the force of vacuum being applied to the EGR valve through PWM control. At this time, the controller has to receive feedback whether the EGR valve operates correctly according to the value sent to the EGR modulator and this role is performed by the EGR potentiometer located at top section of the EGR valve.

In other word, the controller sent correct output value to the EGR vacuum modulator but, due to the leakage of vacuum, signal of required value can not be received from the EGR potentiometer causing to display as malfunction of related parts.

As a reference, the EGR valve of diesel vehicle (DI Engine) controlling from the engine ECU to EGR system has different shape than the HUBER EGR valve because the EGR valve's operation signal in the DI engine is performed by the HFM sensor instead of the EGR potentiometer.

This principle is that when the EGR valve opens up to flow exhaust gas into the intake unit the amount of fresh air, comparatively, will be reduced. The DI engine ECU receives feedback signal of change in amount of air being passed through the HFM sensor according to the opening amount of the EGR valve.

D20DT



**HUBER EGR System for IDI Engine
(Including the EGR Valve Potentiometer)**

D27DT



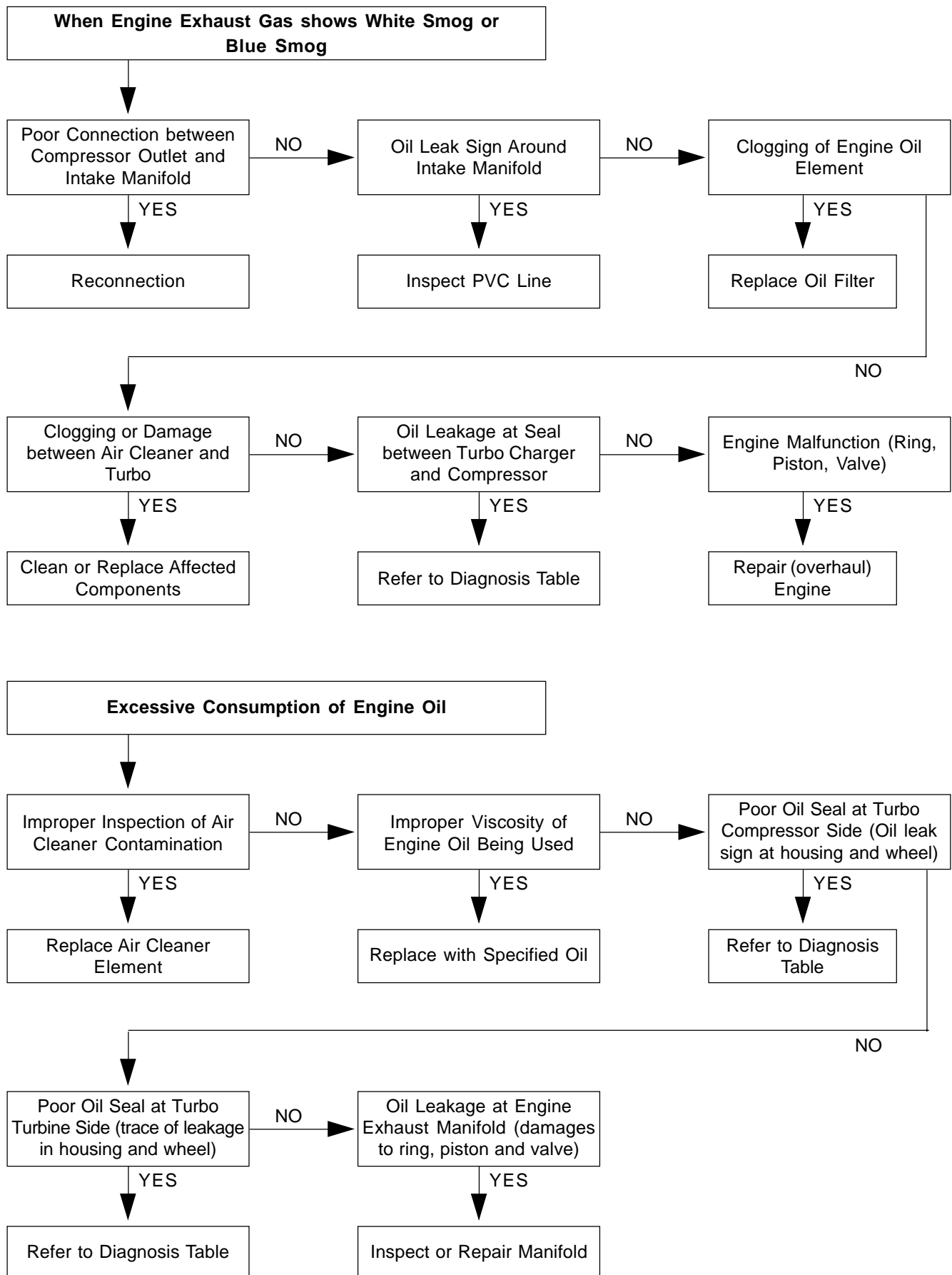
EGR System for DI Engine

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

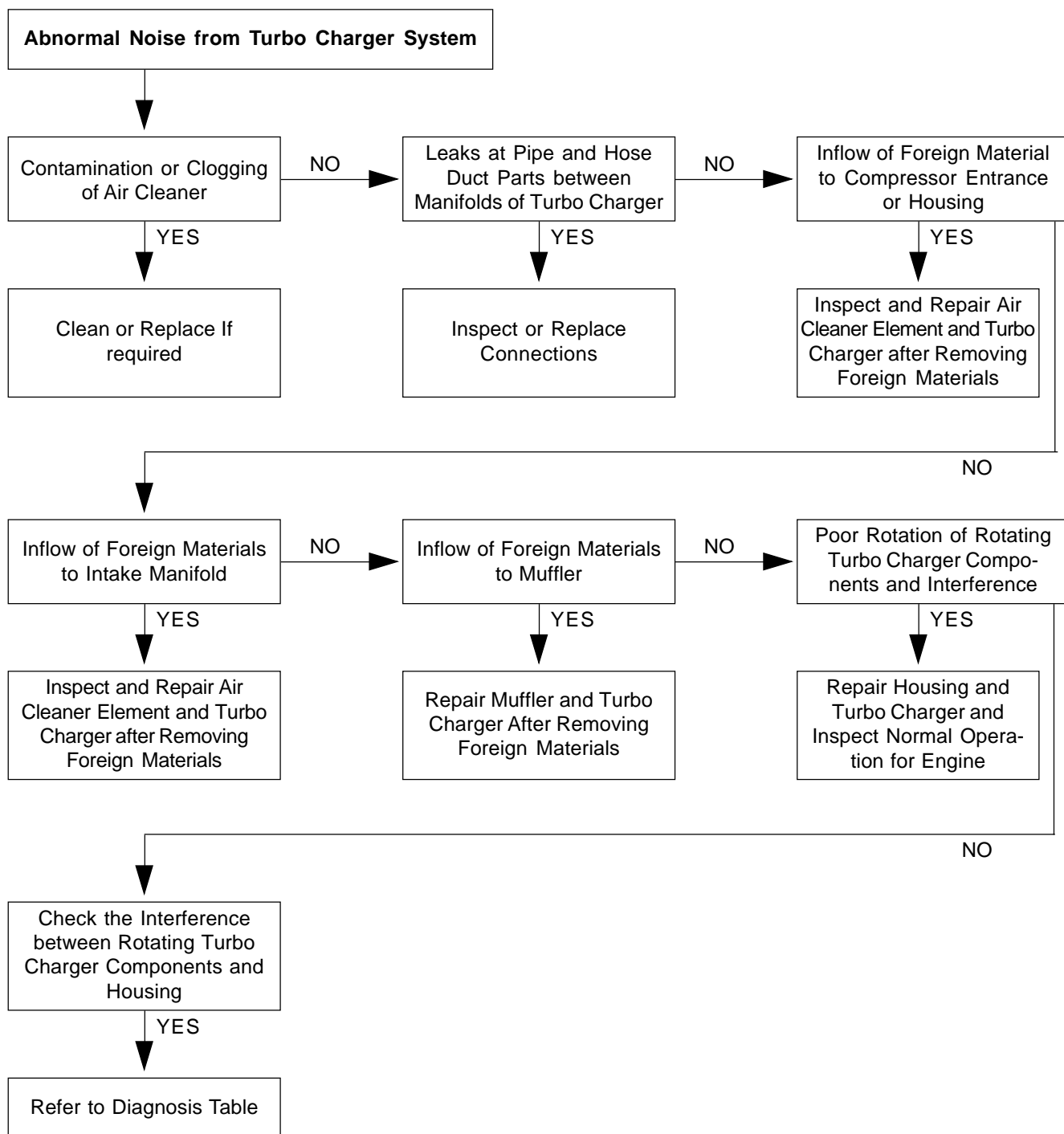
The other big difference between the HUBER EGR and EGR controller for DI engine is that from two vacuum modulator, one is same as being the modulator for EGR valve whereas the HUBER EGR system's the other modulator controls ALDA of injection pump and the DI engine's the other modulator controls waist gate of the turbo charger.

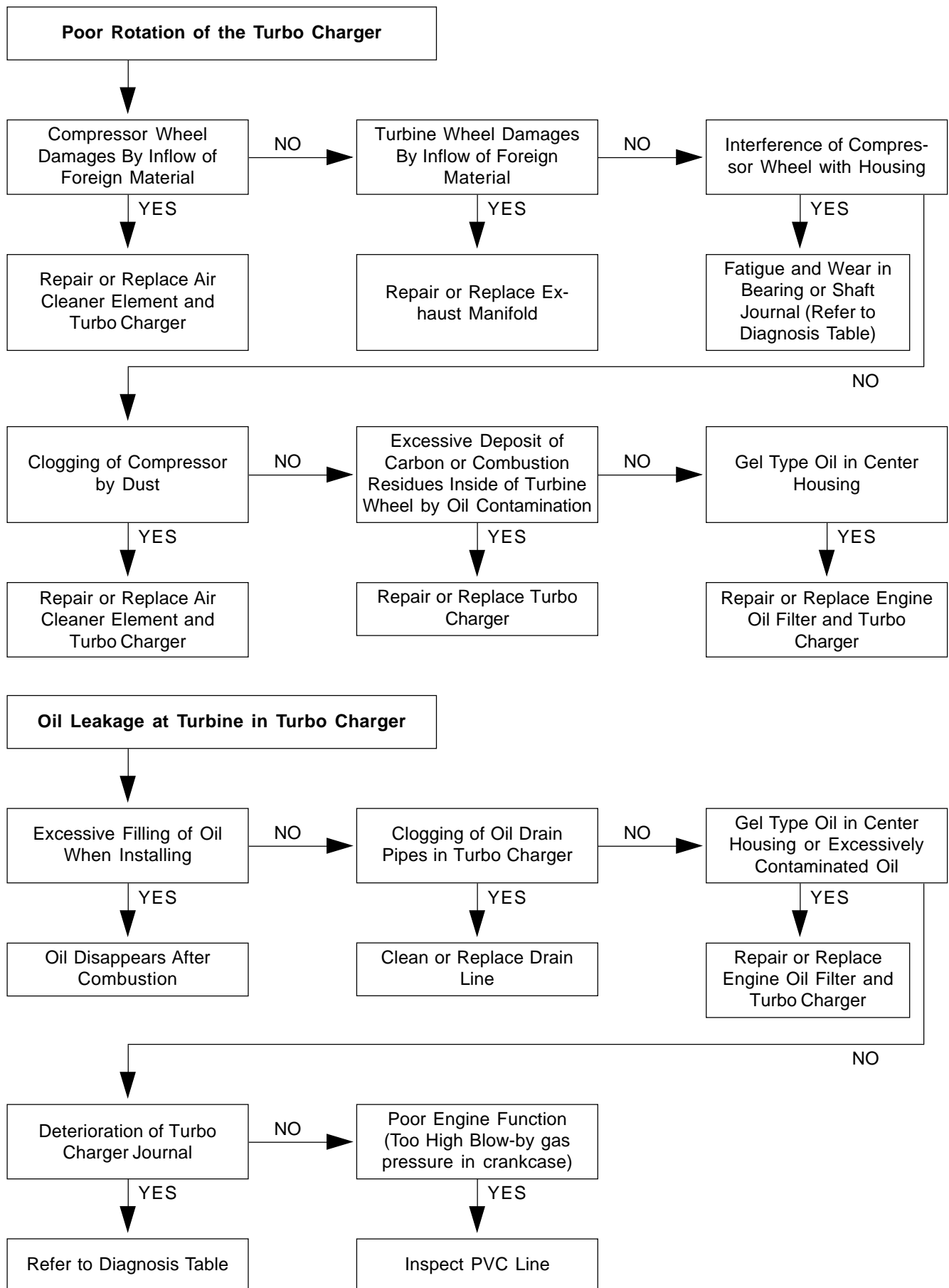
This difference is in accordance with the difference in fuel injection method where the IDI engine has mechanical injection system and DI engine is capable of making electronically controlled fuel injection.

In other word, to reduce the amount of the fuel injection in no-load rapid acceleration mode, the IDI engine's HUBER EGR utilizes solenoid valve to disconnect the connection circuit between intake manifold and ALDA causing negative pressure to occur in the vacuum modulator to reduce the amount of fuel injection. When DI engine, basing input signal from the related sensors such as acceleration pedal sensor and engine RPM, recognizes that current mode is the no-load rapid acceleration mode it reduces the amount of fuel injection by sending short electrical signal to the injector. Therefore, disregarding the modulator for the EGR valve in DI engine, one must keep in mind that the other modulator is used to control the booster pressure valve in turbo charger.

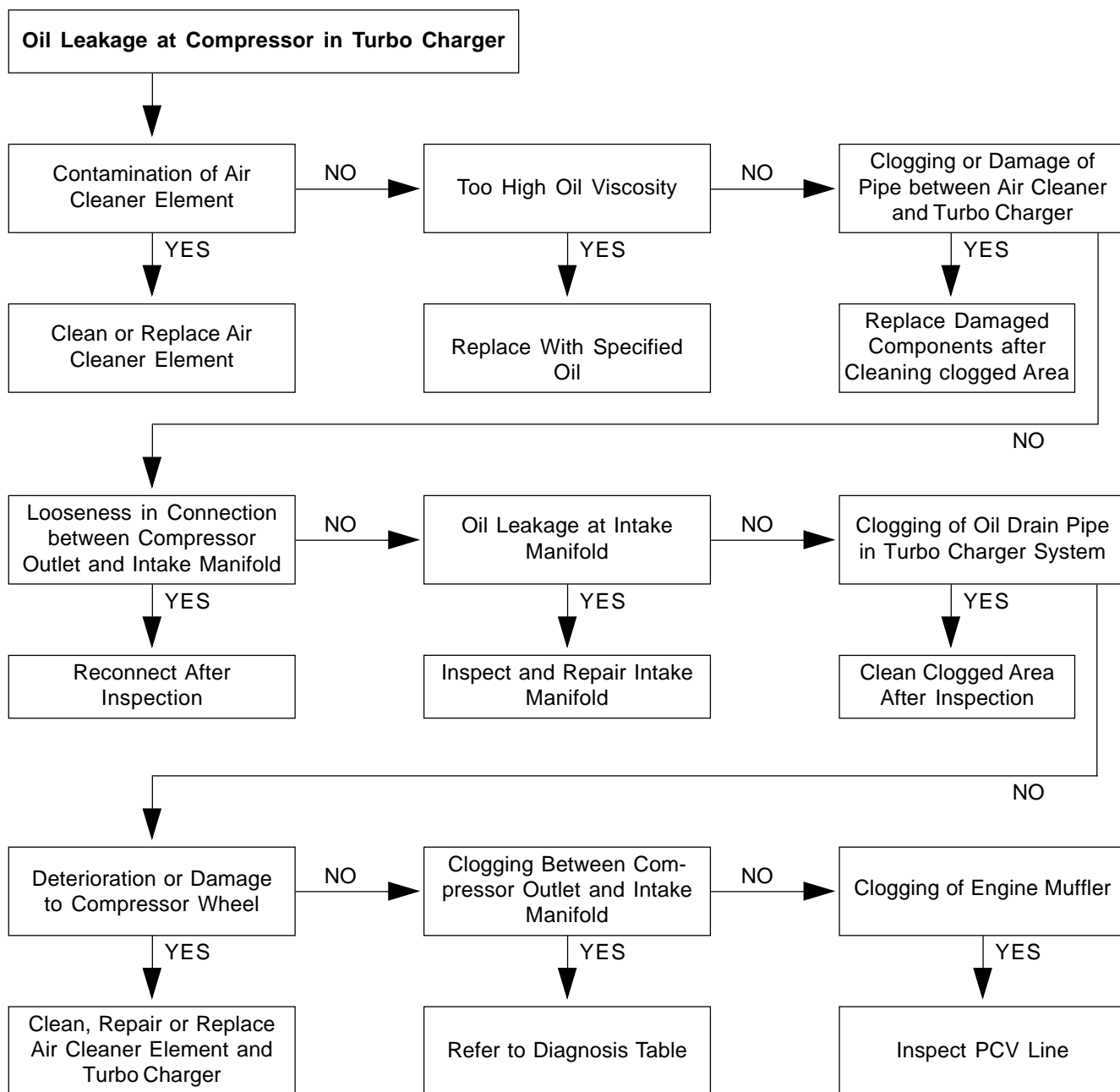


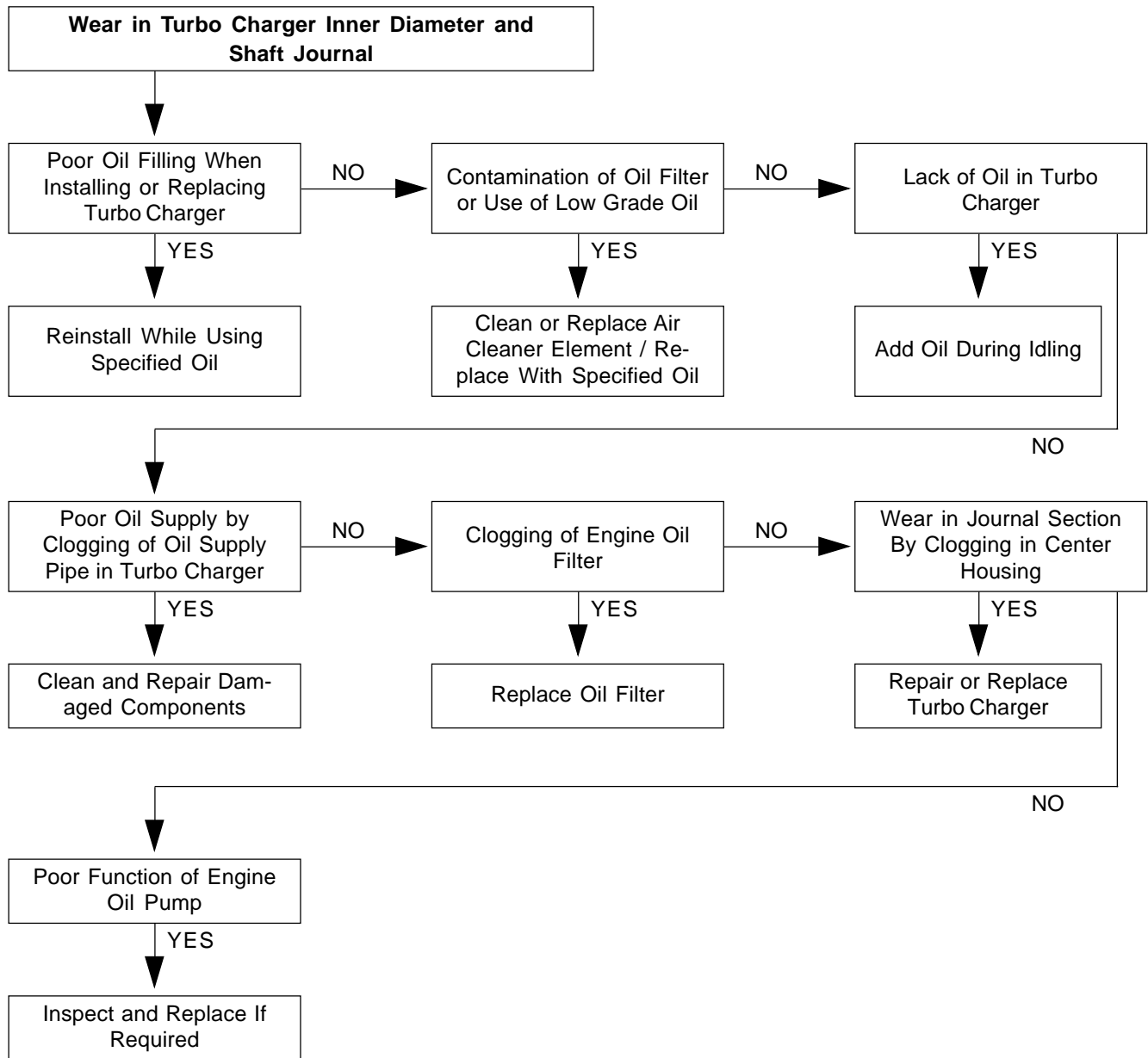
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	





CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	





※ For other diagnosis, refer to Diagnosis section.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

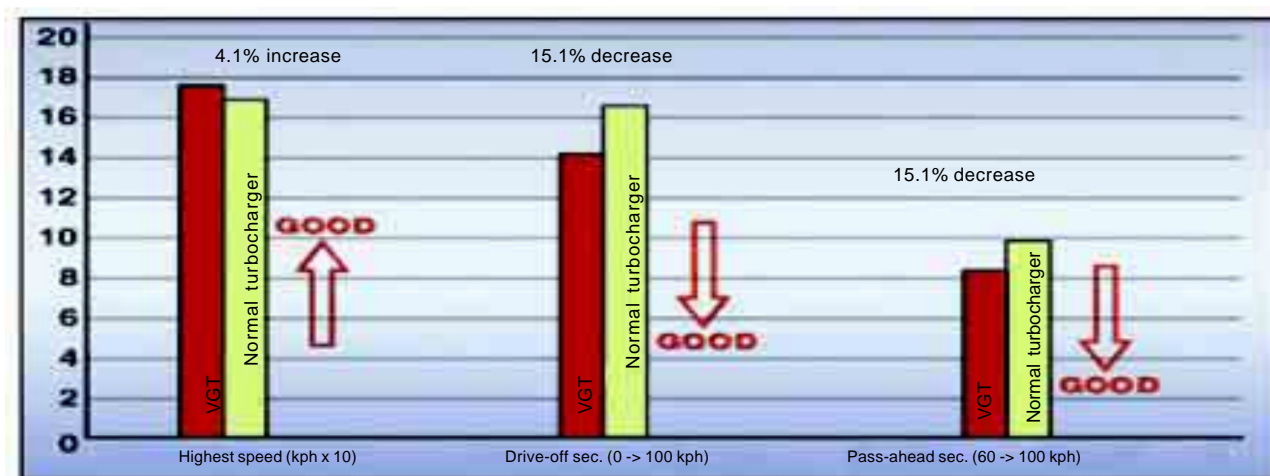
VGT (VARIABLE GEOMETRY TURBOCHARGER)

► Overview

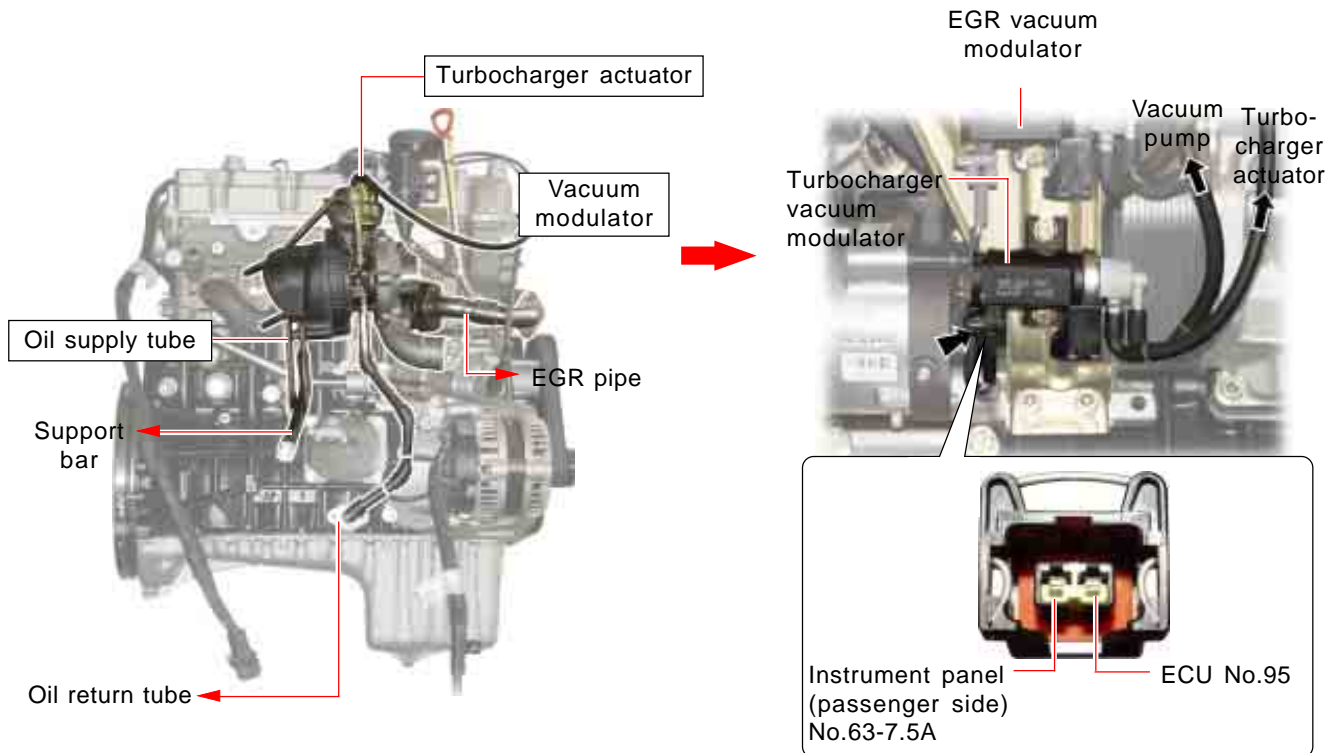
VGT is a certain type of turbocharger system that increases the intake air volume by using the exhaust air flow.

The following chart shows the comparison values between a normal turbocharger and VGT regarding highest speed, drive-off performance and pass-ahead acceleration.

1. Enhanced highest speed: 4.1% of the highest speed increases compared to normal turbocharger.
2. Enhanced drive-off performance: The time taken to reach from 0 kph to 100 kph decreases 15.1% compared to normal turbocharger.
3. Enhance pass-ahead performance: This is evaluated by measuring the time taken to reach from 60 kph to 100 kph. The shorter it is the better performance.



► Structure



Tightening Torque

Turbocharger assembly

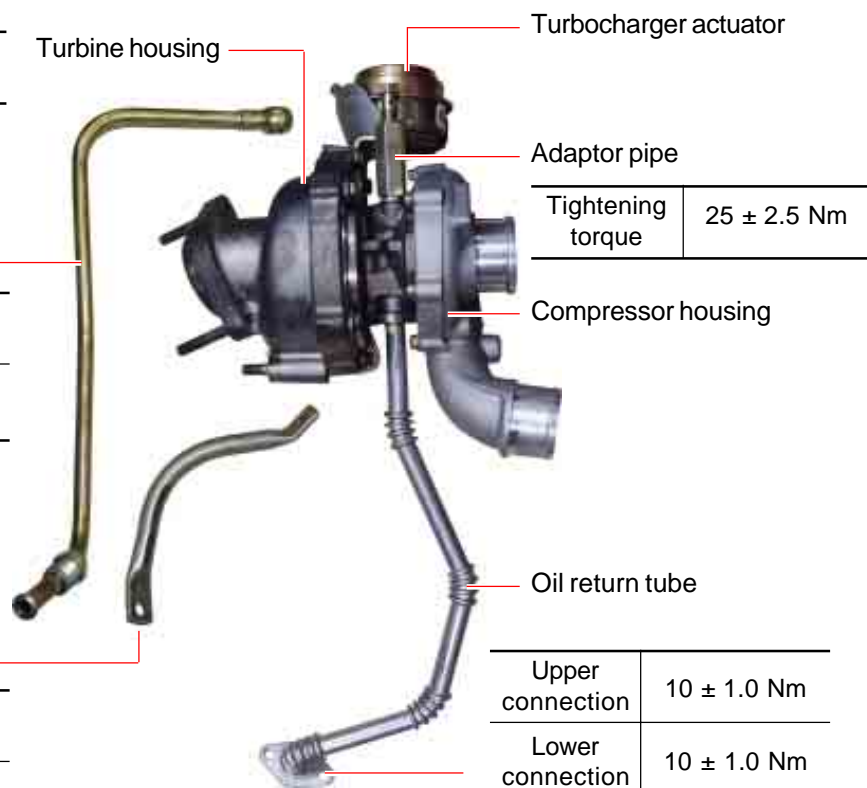
Tightening torque	$25 \pm 2.5 \text{ Nm}$
-------------------	-------------------------

Oil supply tube

Upper connection	$18 \pm 1.8 \text{ Nm}$
Lower connection	$18 \pm 1.8 \text{ Nm}$

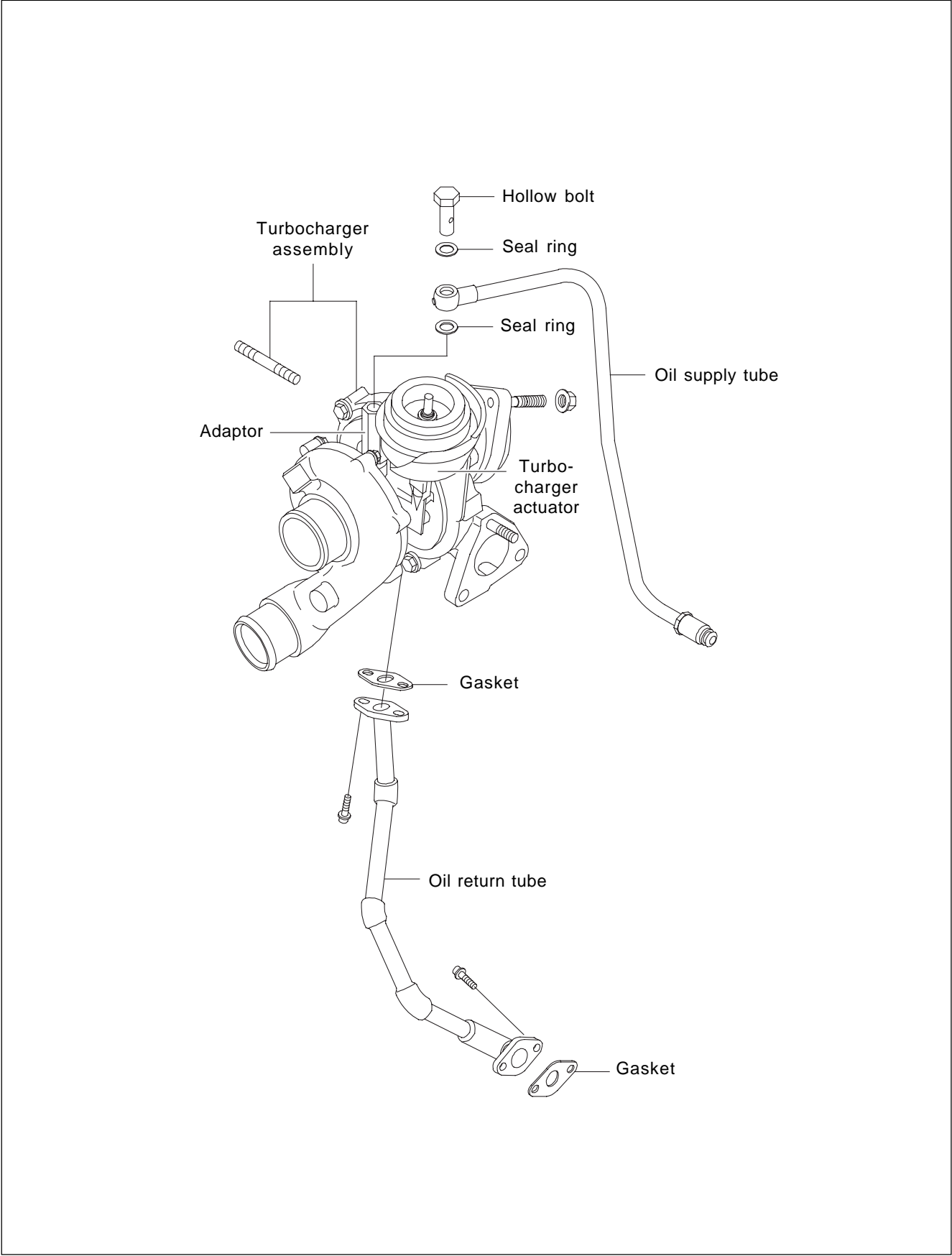
Support bar

Upper connection	$32 \pm 3.2 \text{ Nm}$
Lower connection	$32 \pm 3.2 \text{ Nm}$



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► Components of VGT



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Components

Bearing housing and center housing:

This encloses the bearing, seal, oil recirculation path and turbocharger shaft.

Turbine housing:

This is located on the exhaust manifold and encloses the turbine wheel.



VGT actuator:

This prevent the turbocharged pressure from increasing over the specified value.

Compressor housing:

This induces the fresh air to the compressor wheel and supplies the compressed air to the inter-cooler through the hose.

Turbine wheel:

This is rotated by exhaust gas and connected to the compressor wheel through turbocharger shaft.



Unison ring

Turbocharger shaft:

This is located within center housing and connects the turbine wheel to the compressor wheel.

Compressor wheel (Impeller):

This is rotated by turbine wheel connected through turbocharger shaft, and compresses and draws the fresh air.



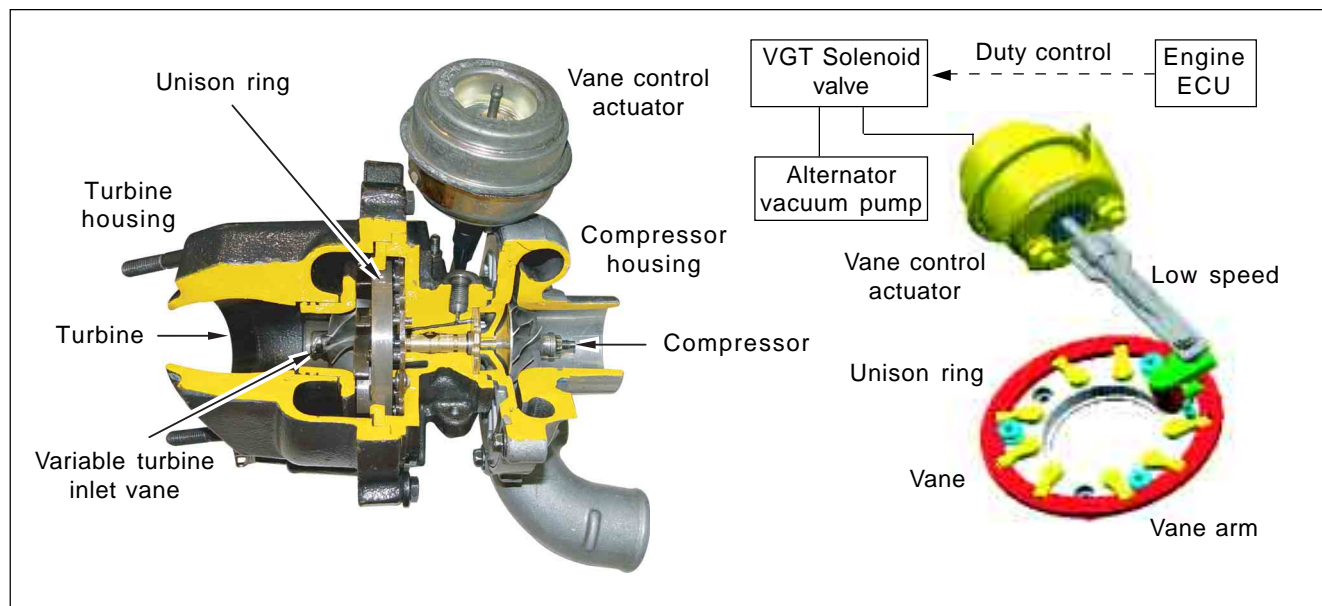
Floating bearing:

Turbocharger rotates at very high speed (100,000 ~ 150,000 rpm). To prevent the turbocharger from being damaged, floating bearing is used for this system. This is lubricated by engine oil. If the engine stops when the turbocharger is still hot, the bearing may be stuck because the oil cannot be supplied. After high speed driving, run the engine at idle speed until the turbocharger cools down.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► Components

In VGT system, the turbine and compressor are installed on a same shaft. And on the turbine shaft, 11 variable inlet vanes are installed to change the flow of exhaust gas. Also, the round unison ring is mounted behind vanes to activate all vanes concurrently. The turbine housing and compressor housing are installed to cover the turbine and compressor, and the vane control actuator is installed to activate the unison ring towards the turbine housing.



Unison ring

The unison ring is designed to be capable to rotate either clockwise or counterclockwise and to connect to the vane control actuator.

Variable turbine inlet vane

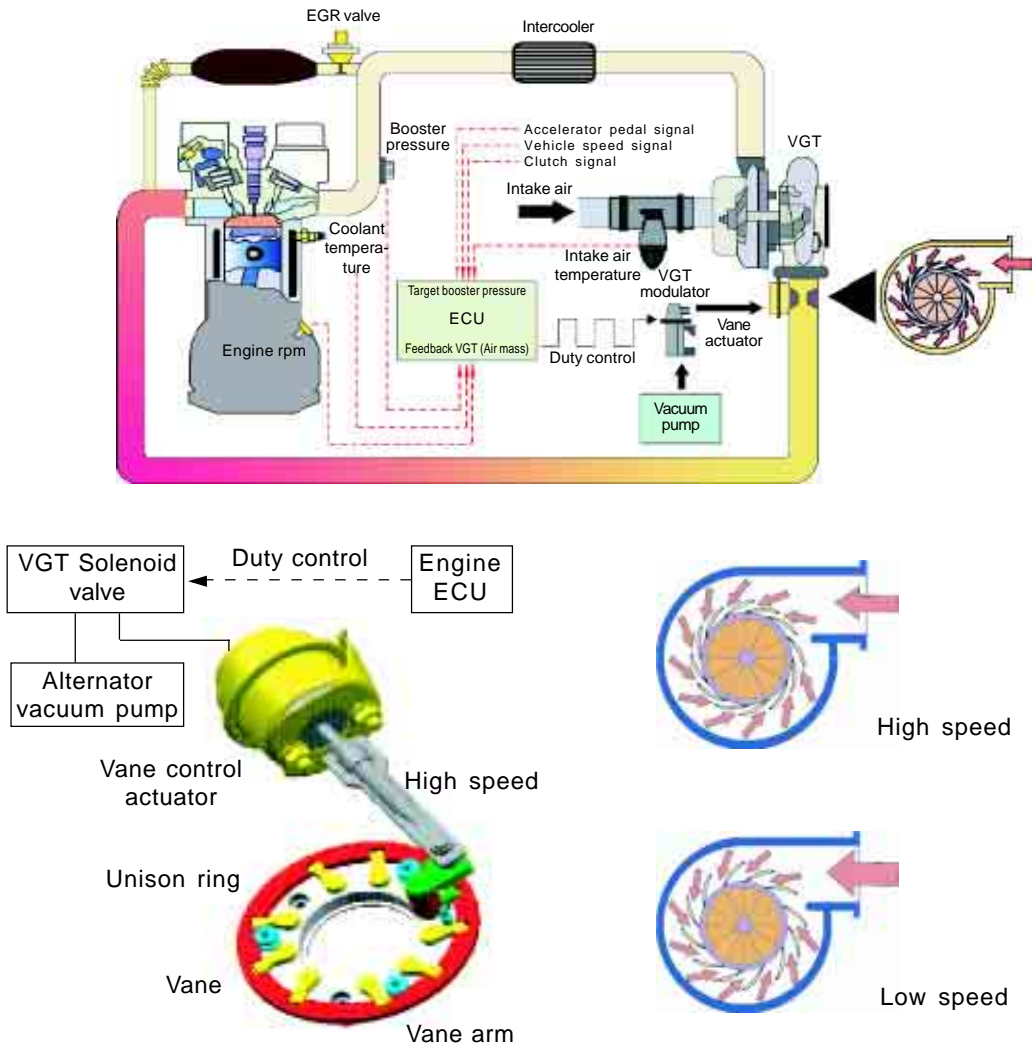
The variable turbine inlet vane is connected through the unison ring and vane arm, 11 vanes are rotated when the actuator is activated. 11 vanes are used as a passage for the exhaust gas led to the turbine inlet. According to their rotation, the flow passage area of exhaust gas varies. At low speed, the flow passage is narrowed and the flow speed of the exhaust gas increases, resulting in increasing the delivery energy of turbine. At high speed, the flow passage is widened and the much exhaust gas is generated, resulting in considerably increasing the delivery energy of turbine.

Vane control actuator

The vane control actuator is connected to the VGT solenoid valve duty-controlled by the engine computer (ECU) via the vacuum hose. Therefore, the duty rate of the solenoid valve is changed by ECU according to the operating conditions and accordingly the movement of the actuator is controlled.

How it works at low speed

In a high speed zone, the amount of exhaust gas increases and it is accompanied with a great force. Therefore, if the inner diameter of venturi is more widened, the turbine in the turbocharger by the releasing force of abundant exhaust gas can deliver a more increased energy to the compressor. The output will increase in submission to the increase of intake air volume.



Controlling VGT system

The VGT control system checks the engine revolution, accelerator pedal value, atmospheric pressure, booster pressure, water temperature, intake air temperature, vehicle speed and clutch switch signal to determine the driving conditions of a vehicle.

The booster pressure map that is targeted on according to the engine revolution and fuel injection volume is determined inside of ECU. The ECU drives the vane control actuator to control the booster pressure, by controlling the solenoid valve to 300 Hz of frequency and the duty value. This helps to maintain the engine at its optimum condition.

Take a note that the booster pressure sensor is adopted, which is designed to perform the feedback control for matching the booster pressure targeted by ECU by measuring the booster pressure actually. The feedback control allows more accurate controlling.

8 Conditions for inhibiting VGT operation

1. If the engine speed is less than 700 rpm
2. If the coolant temperature is below approx. 0?
3. If any part related to the EGR is defective
4. If the VGT actuator is defective
5. If the booster pressure sensor is defective
6. If the mass flow sensor is defective
7. If the throttle flap is defective
8. If the accelerator pedal sensor is defective

If any of above conditions is met, ECU will not control the VGT system.

GENERAL

A S S Y

HOUSING

I N T A K E

EXHAUST

L U B

COOLING

F U E L

CONTROL

SENSOR

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► Notes and Check for VGT

Notes When Handling VGT

1. The turbocharger is sensitive to excessive vibration coming from external impact. When exposed to excessive impact or vibration, the inside mechanism may be damaged even though the outside is intact.



2. The turbocharger should be kept horizontally. If there is much engine oil in the turbocharger and it is kept vertically with the turbine housing downward, the engine oil may be provided to variable mechanism assembled towards the turbine housing, which may lead to a malfunction of the variable mechanism.



3. Never re-adjust the adjusting screw marked with yellow paint or the axial end of actuator. Renew them if you found looseness of the screw or actuator axle, because they are shipped after precisely adjusting from the factory.
4. Do not move or assemble the actuator axle by grasping it in hands. The actuator axle may be deformed, which affects the precisely adjusted value.



5. After installing to the engine, replenish a small amount of clean engine oil to the inlet before connecting the oil inlet pipe of the turbocharger.
6. Do not let any metal debris enter when installing to the engine.
7. The engine oil may be provided to the compressor housing if you rapidly operate the turbocharger with excessive revolutions immediately after installing to the engine.
 - 1) Do not raise the engine rpm rapidly after starting the engine.
 - 2) Do not raise the engine rpm rapidly after renewing the engine oil and filter element.
 - 3) Do not stop the turbocharger rapidly after operating at high engine speed.



Check and Service

The turbocharger is rarely out of order or damaged unless the engine is operated in abnormal conditions. Therefore, it is not necessary to additionally check the turbocharger according to mileage or operation hours. It is sufficient to simply maintain or service the engine thoroughly.

The following symptoms occur if there is a fault in the turbocharger:

1. reduced engine output
2. noisy engine operation
3. excessive engine oil consumption
4. excessive exhaust gas emitting

The symptoms may be due to a fault of the engine, not the turbocharger. In most cases, you can check the cause of the fault visually before removing the turbocharger from the engine.

Check Procedures

1. Firstly, check conditions of the engine because the fault may be due to the engine, not the turbocharger.
2. Then, check conditions of the turbocharger as follows:
 - 1) whether the compressor is damaged by metal debris or foreign materials.
 - 2) whether the turbine is damaged by metal debris or foreign materials.
 - 3) whether there is no contact between the wheel and the housing (check the bearing for damage).
 - 4) whether there is damages or influences by hot temperature.

Diagnosis and Servicing

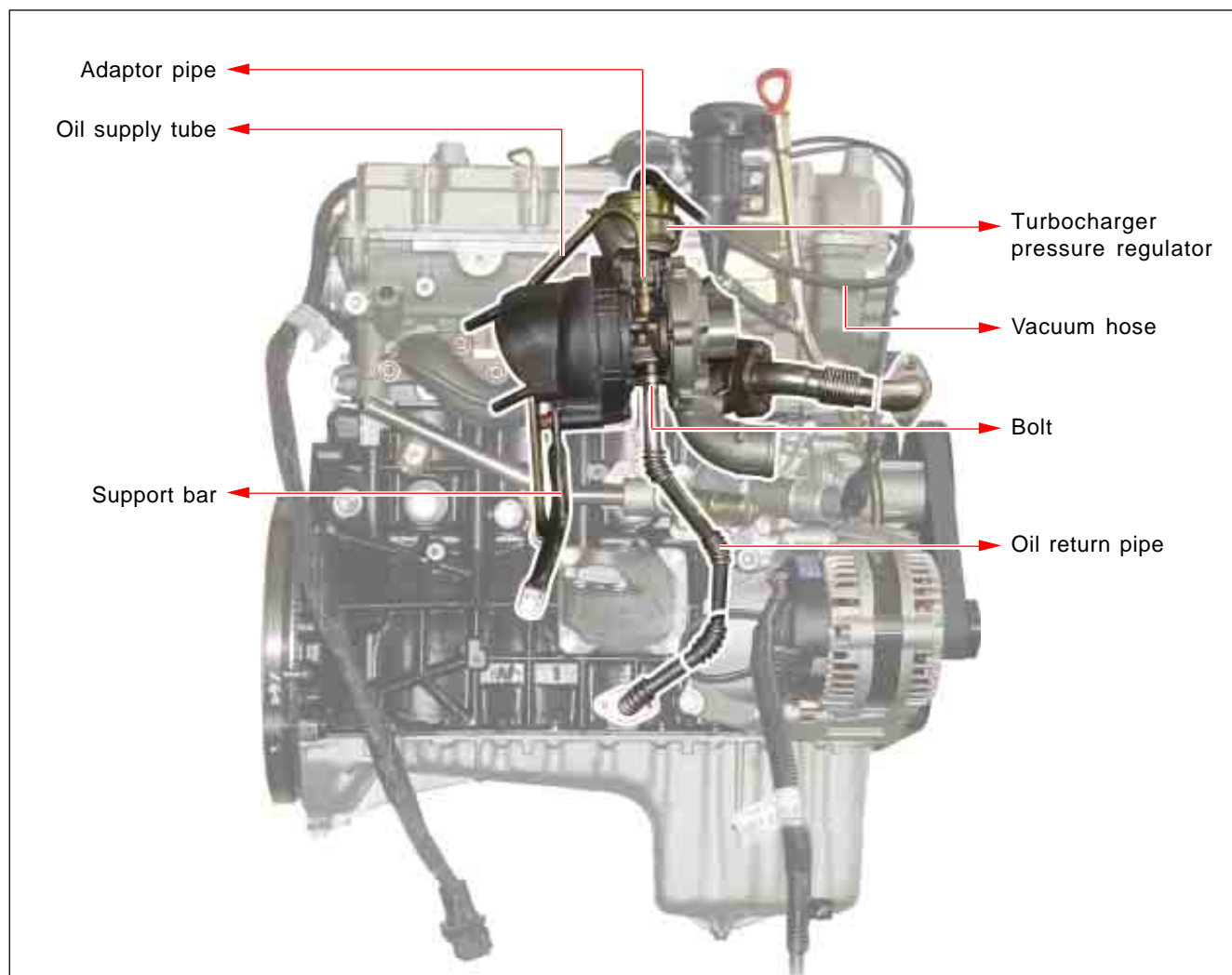
1. Operation conditions of actuator's diaphragm: It is impossible to control the turbocharger when the operation is poor.
2. Leaking of the turbocharger housing: More engine oil is consumed when leaking.
3. Damage on the turbocharger bearing: Noise can be heard during the turbocharger is operating (The whole turbocharger may be damaged when the bearing is damaged).

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► Removal and Installation

Basically, the turbocharger should be serviced at Ssangyong Authorized Service Center.

When eliminating the carbon deposit from the turbine wheel during the service procedure, use only soft brush or solvent other than sand paper or metallic tools.



Cautions When Removing/Installing

1. Use only the turbocharger with same specifications.
2. Replace the gasket and sealing with new ones once removed.
3. Tighten the fasteners with specified tightening torque.
4. Change the engine oil before starting the engine.
5. If suspected, check the oil supply pressure.
6. Check if the turbine nozzle actuator operates properly.

Turbo Charger Assembly - Removal and Installation

1. Remove the drain plug and drain the engine oil from the oil pan.

Installation Notice

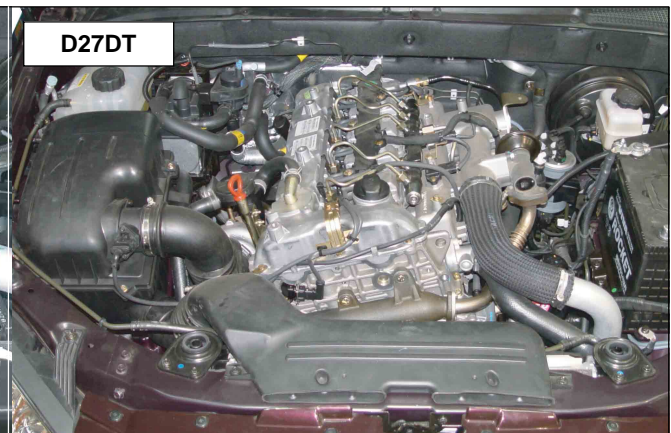
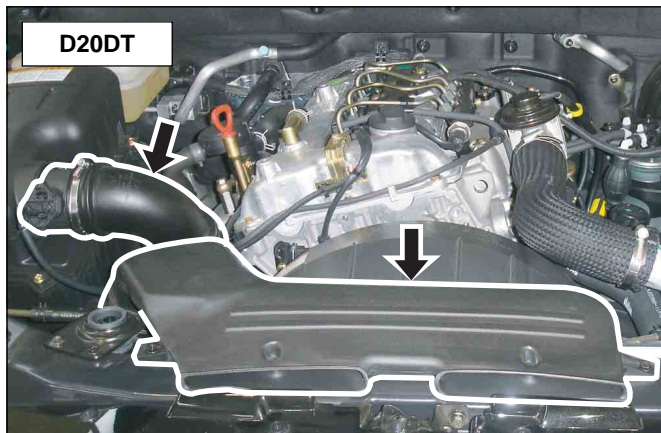
Tightening torque	25 ± 2.5 Nm
-------------------	-----------------



2. Remove the vacuum hose and inlet hose from the turbo charger.

Installation Notice

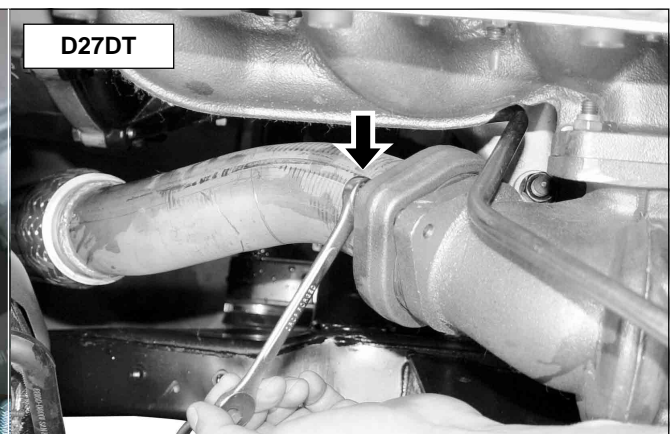
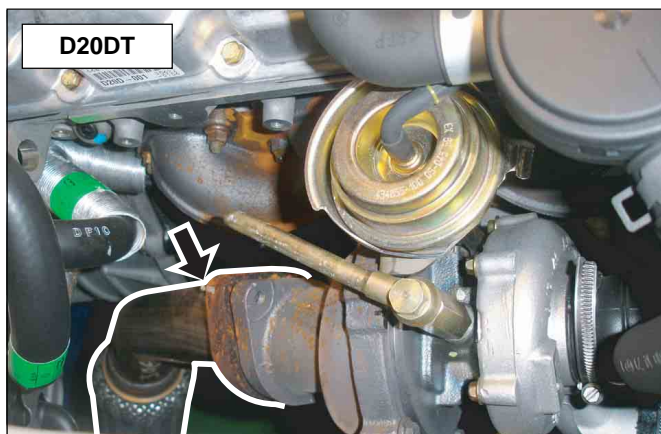
Tightening torque	6 ~ 7 Nm
-------------------	----------



3. Remove the bolts and nuts at the exhaust manifold in turbo charger.

Installation Notice

Tightening torque	25 ± 2.5 Nm
-------------------	-----------------

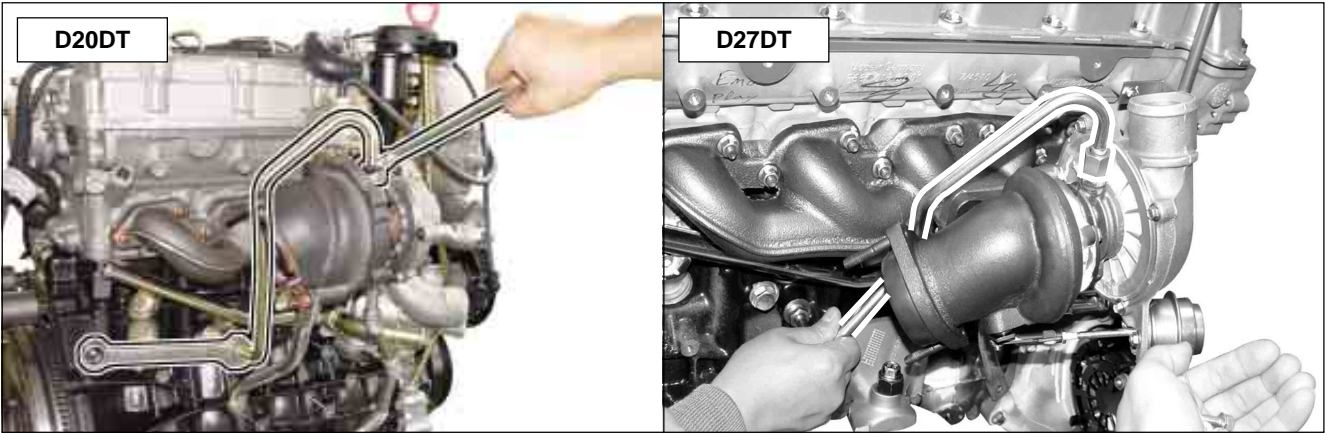


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

4. Remove the lower and upper bolts at turbo charger oil supply pipe.

Installation Notice

Tightening torque	18 ± 1.8 Nm
-------------------	-------------

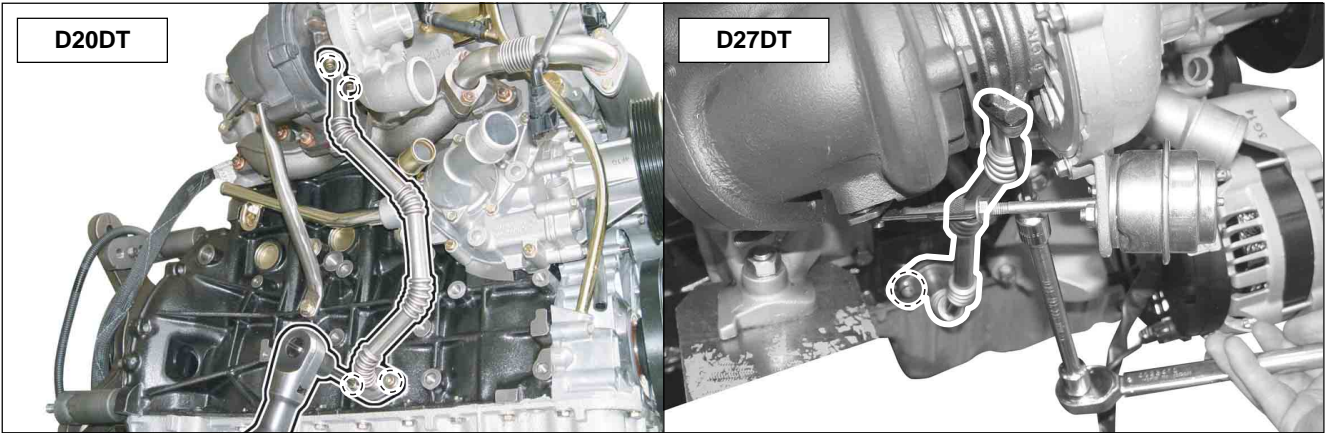


5. Remove the lower bolts at turbo charger oil return pipe.

Installation Notice

Tightening torque	10 ± 1.0 Nm
-------------------	-------------

- Replace the steel gasket with new one.

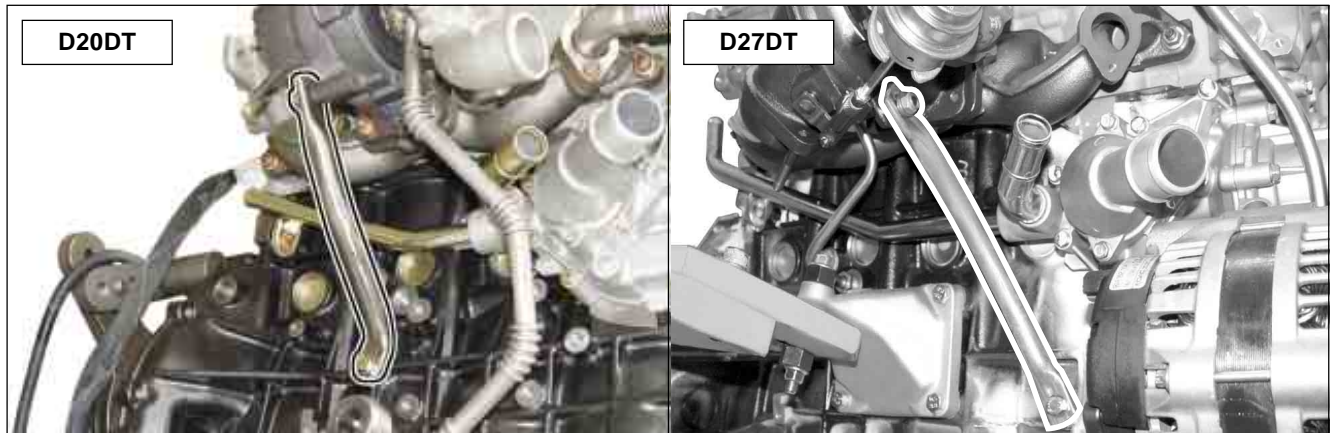


6. Remove the lower bolt at turbo charger bracket.
7. Remove the turbo charger bracket bolts.

Installation Notice

Tightening torque	32 ± 3.2 Nm
-------------------	-----------------

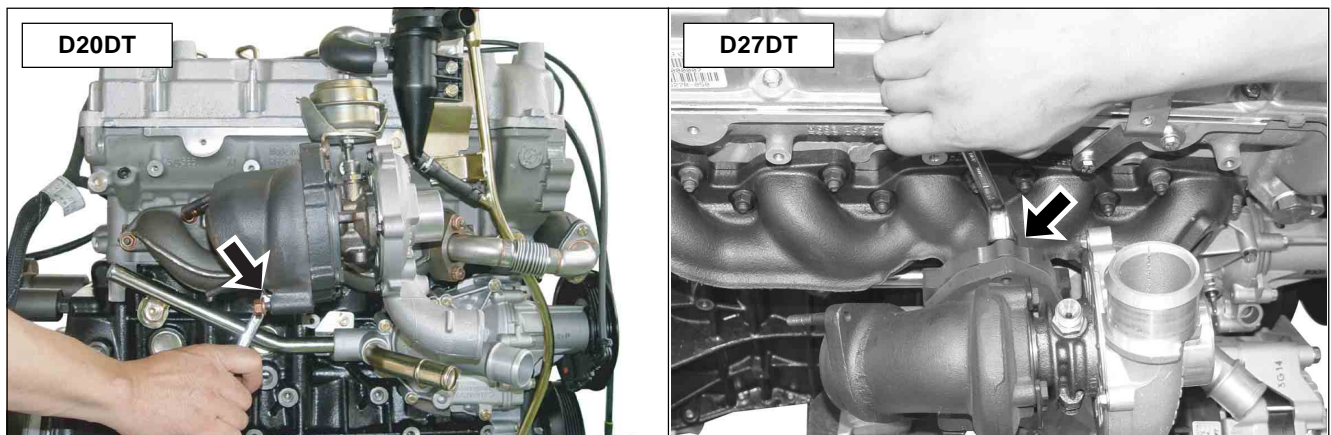
- *Use only 12 1/2" wrench.*



8. Remove the bolts and nuts at the turbo charger and the exhaust manifold.


Installation Notice

Tightening torque	25 ± 2.5 Nm
-------------------	-----------------

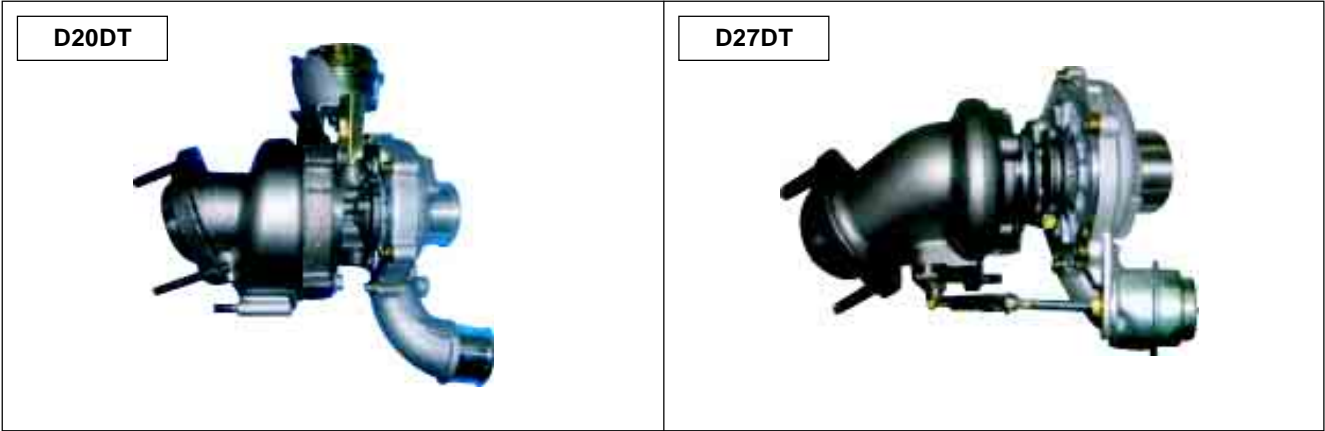


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

- 9. Remove the turbo charger assembly.
- 10. Install in the reverse order of removal.

**NOTICE**

- Replace the steel gasket with new one.
- To prevent gas leaks, tighten the fasteners with the specified tightening torques.

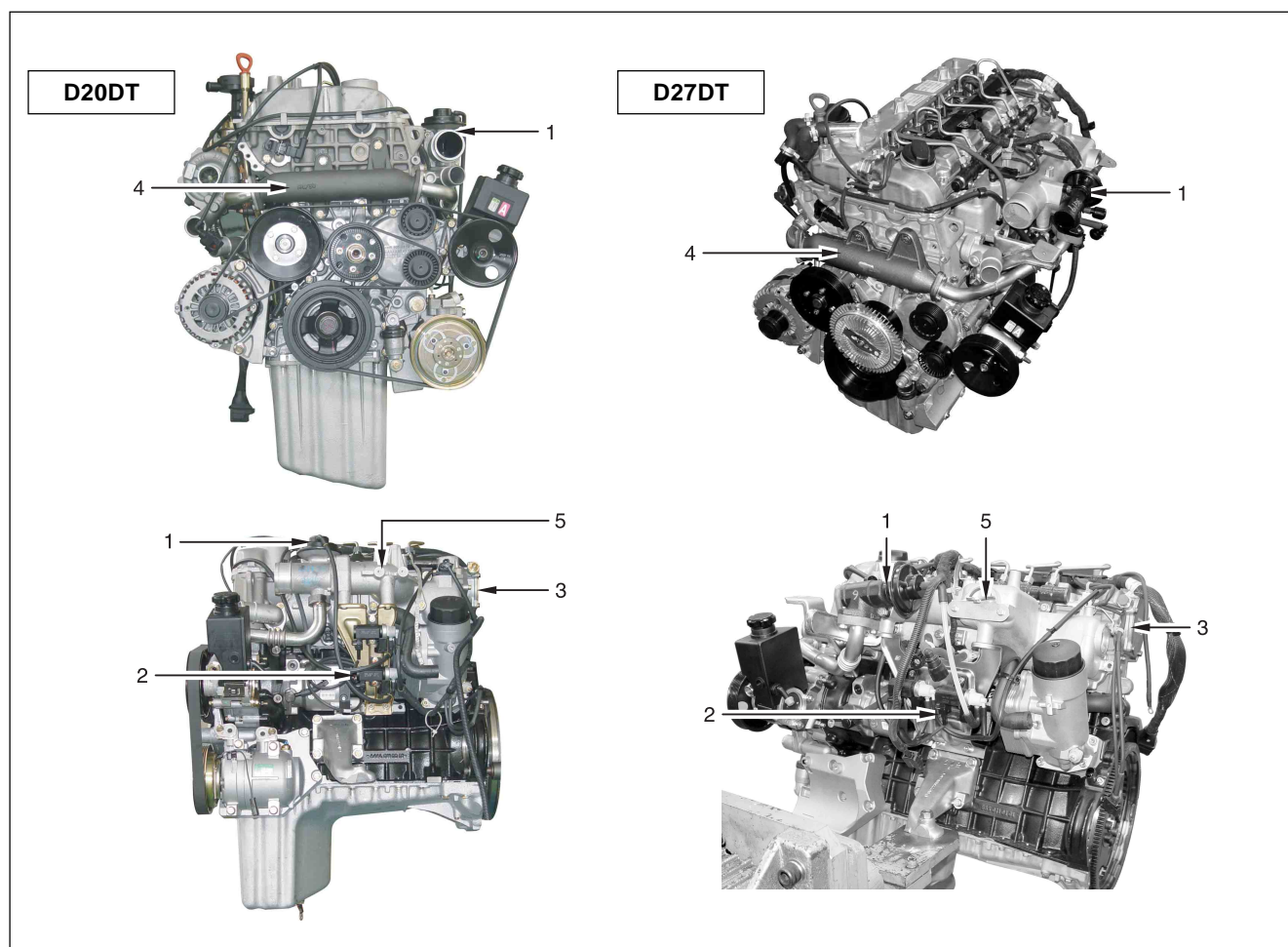
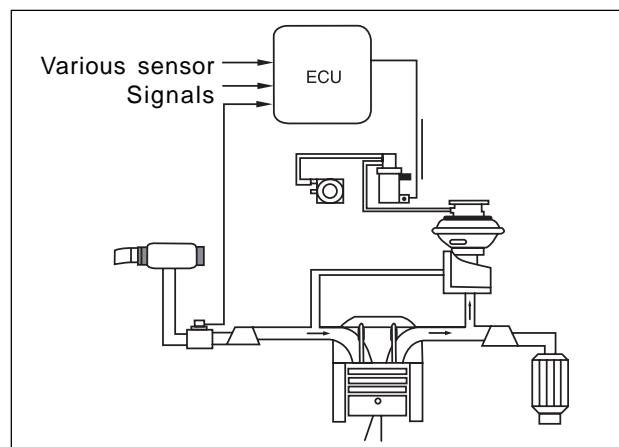


EGR VALVE AND VACUUM MODULATOR

EGR SYSTEM

► General Information

EGR system controls the opening value of EGR valve by transmitting electrical signal (PWM control) from the engine ECU to vacuum modulator. Also, the engine ECU receives the feedback signals of the amount of air flowing through the HFM sensor.



1. EGR valve
2. Vacuum modulator
3. Vacuum pump

4. EGR center pipe (EGR cooler)
5. Intake manifold

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

EGR VALVE AND TURBO CHARGER ACTUATOR CONTROL VACUUM CIRCUIT

► Vacuum Modulator

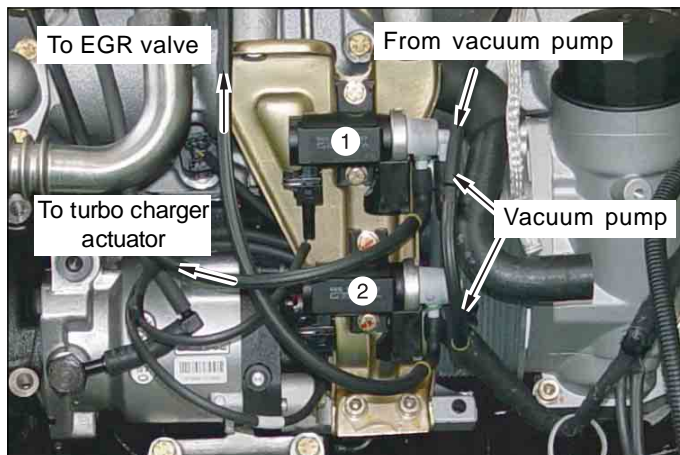
The biggest difference between the vacuum circuit and layout of the HUBER EGR system after K2004 has been introduced is the location of the vacuum modulator for EGR valve control and the function of the other modulator. In case of EGR equipped vehicle (IDI Engine), it performs the role of controlling the PLA of injection pump whereas, in DI engine, it controls the turbo charger actuator.

DI engine vacuum modulator

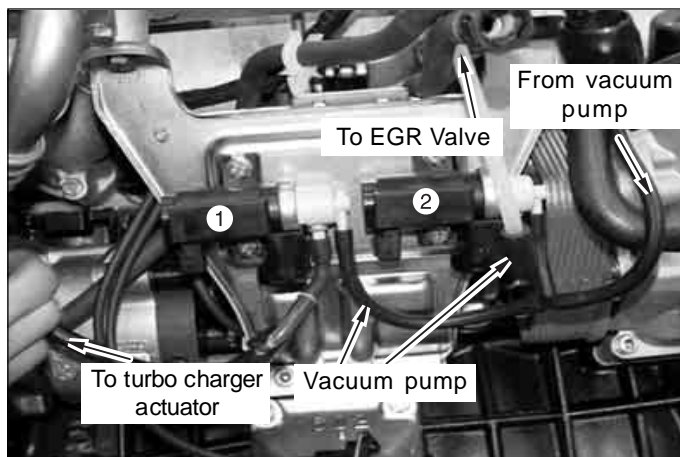
1. Turbo charger booster vacuum modulator
2. EGR valve vacuum modulator

- ① To Turbo Charger Actuator (Gray)
- ② To EGR Valve (Black)

D20DT



D27DT

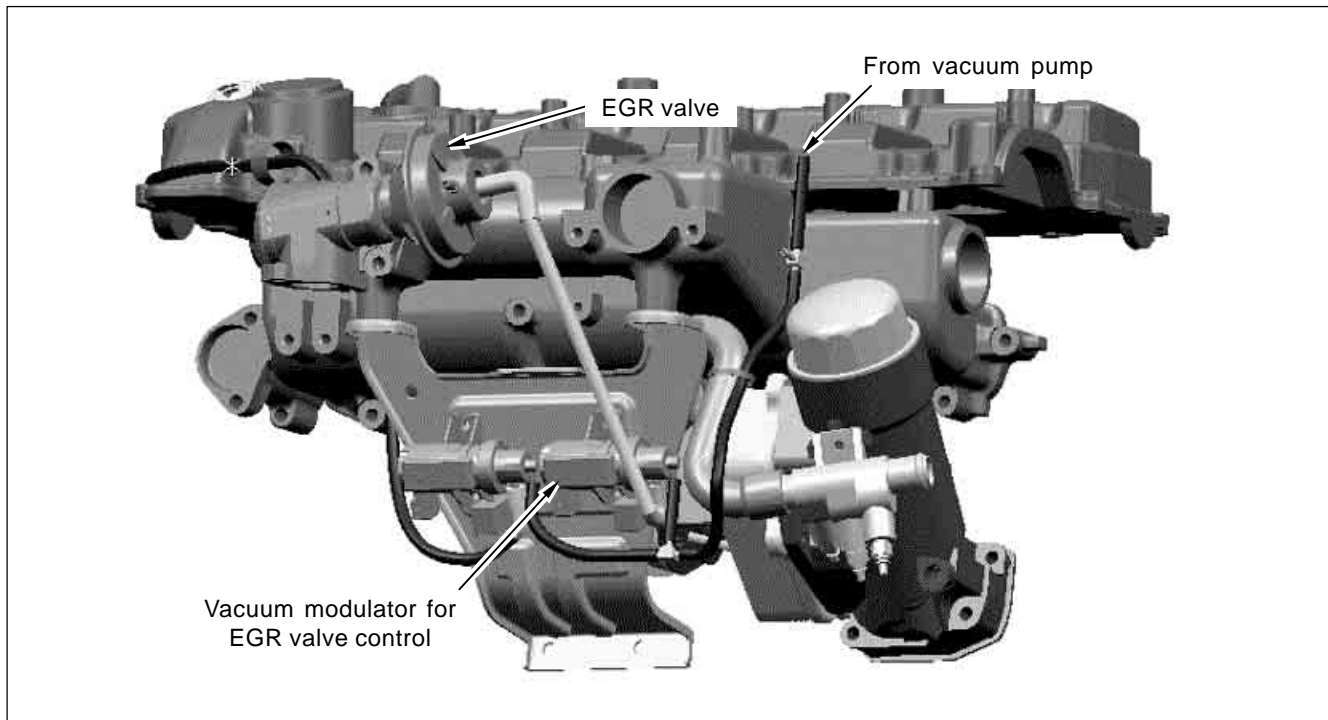


1. Vacuum modulator for EGR valve control
2. Vacuum modulator for injection pump PLA control

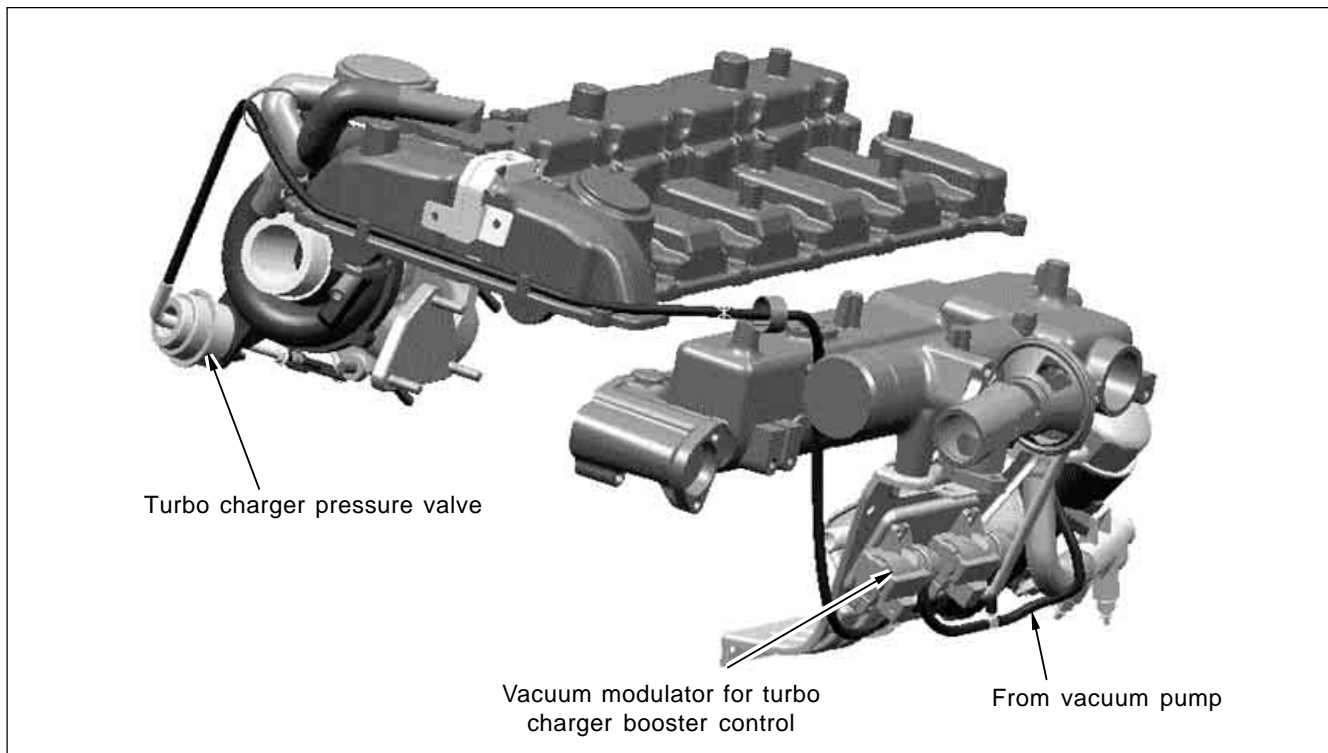
► Vacuum Modulator and Vacuum Hose

Below figures illustrate vacuum hoses and related parts of EGR or turbo where wrong or poor connection of vacuum hose would display condition of engine irregularity and defect diagnostic codes on the scan tool.

Related with EGR valve

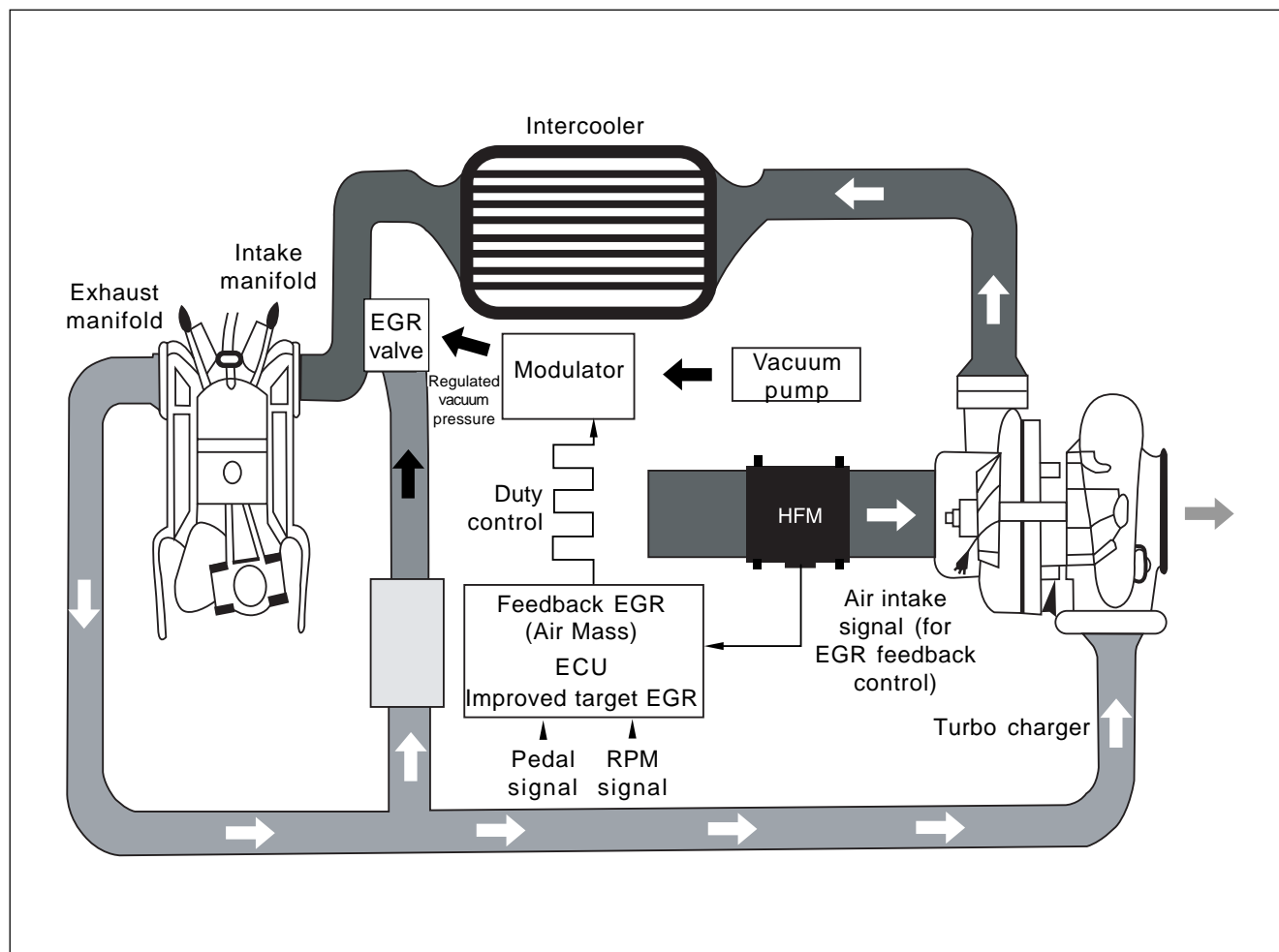


Related with turbo charger actuator



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► EGR System Diagram



EGR valve

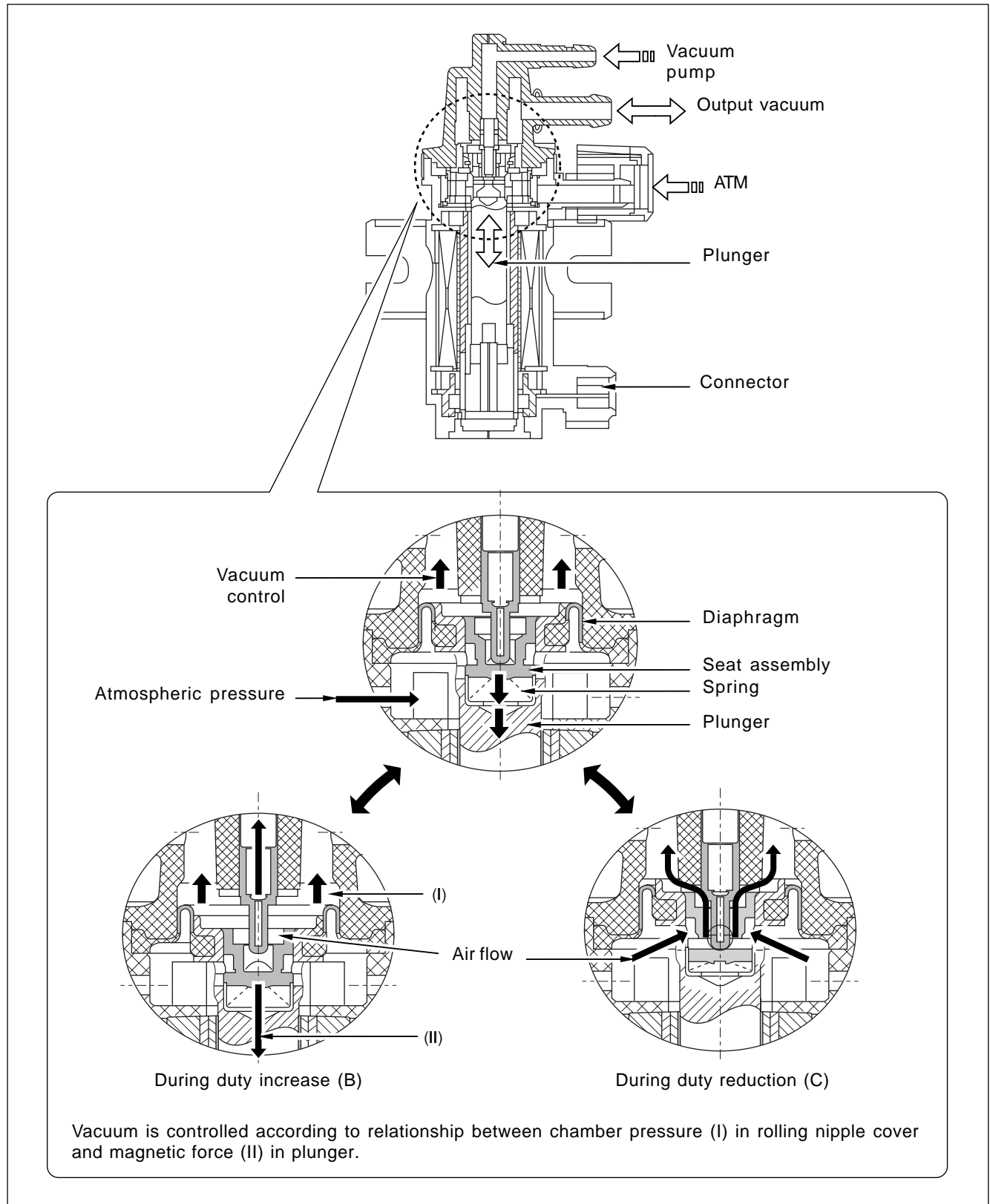
EGR valve recirculates some of exhaust gases to intake system to reduce toxic NO_x from engine according to ECU signals.

1. EGR valve opening point : -270 mmHg

EGR modulator

According to ECU signals, the vacuum modulator drives EGR valve by controlling vacuum pressure that is generated by vacuum pump with PWM type controls.

► Operation Principle of Vacuum Modulator

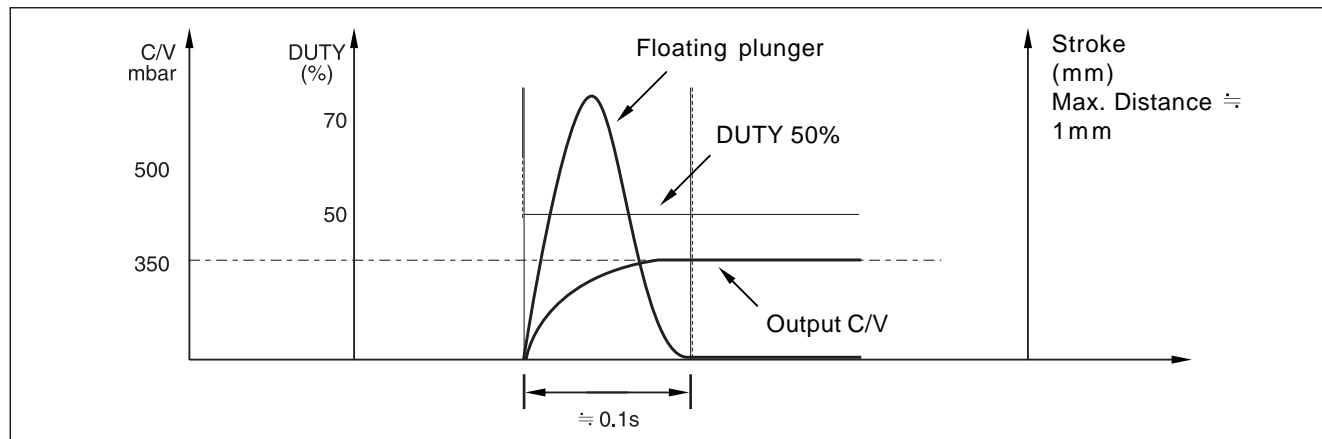


According to ECU signals, the solenoid valve controls the vacuum pressure that is generated by vacuum pump (-900 ± 20 mbar) with PWM type control and drives the mechanical EGR valve and turbo charger.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

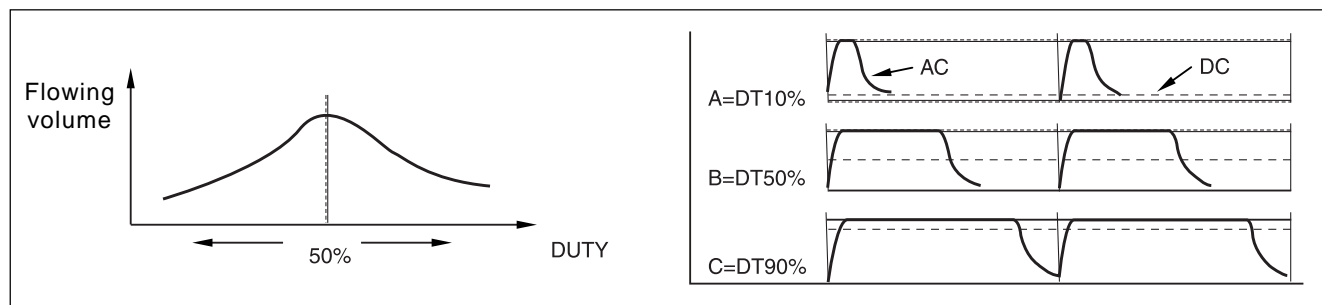
Operating principle: Balance between original vacuum pressure and magnetic forces (see aboe figure)

1. Normal state (Fig. A): Original vacuum and seat section, 3 stoppers keep sealing
2. Duty up state (Fig. B): Original vacuum pressure is connected to inside of diaphragm chamber
3. Duty down state (Fig. C): Increased diaphragm chamber pressure is connected to atmosphere to compensate the pressure.

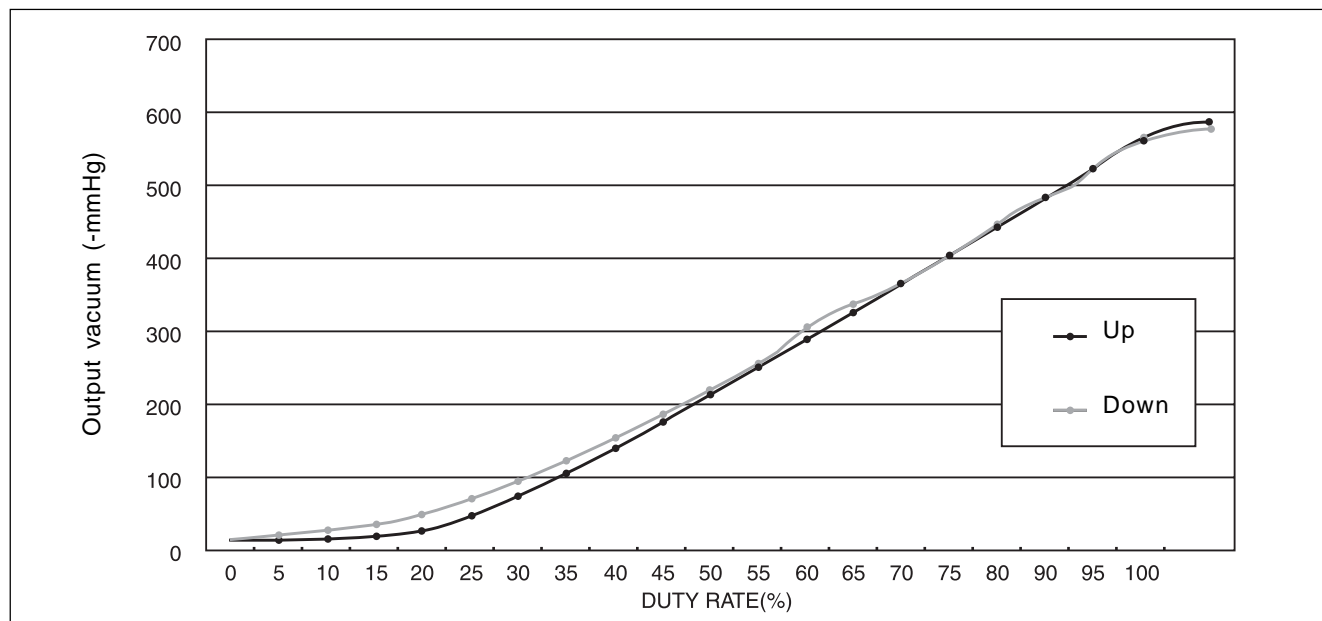


⇒ Operating principles when duty is applied from 0 to 50 %

Vacuum consumption: Compared to 50 % of duty, ON/OFF periods are most unstable and vacuum consumption is most high.



Output characteristics



Operating conditions

1. Engine is running
2. Engine RPM is within a specified range. (EGR OFF under high RPM range)
3. Engine torque is within a specified range. (EGR OFF under high torque range)
4. Vehicle speed is within a specified range. (EGR OFF under high speed range)
5. Atmospheric pressure is within a specified range. (EGR OFF under high altitude and low atmospheric pressure)
6. Coolant temperature is within a specified range. (EGR OFF under high or low temperature)
7. EGR OFF under extended period of idling.

Control logic

1. Main map: EGR volume is controlled based on intake air volume
2. Auxiliary map
 - 1) Coolant temperature (Coolant temperature sensor)
 - 2) Engine rpm (Crankshaft position sensor)
 - 3) Engine load (TPS): Detection of sharp acceleration
 - 4) Intake air temperature (HFM): Decreases when over 60°C
 - 5) Atmospheric pressure (Barometric sensor): Compensation of altitude
3. Compensation value of auxiliary map will be increased/decreased based on main map then ECU calculates EGR volume finally to regulate the vacuum duty that applies to the vacuum modulator to control EGR valve openings.

Shut-off conditions

1. Engine rpm: over 2,950 rpm
2. Vehicle speed: over 105 km/h
3. Coolant temperature: over 100°C or below 10°C
4. Idle period: over 50 seconds

GENERAL

ASSY

HOUSING

INTAKE

EXHAUST

LUB

COOLING

FUEL

CONTROL

SENSOR

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

EGR Valve and Pipe
- Removal and Installation

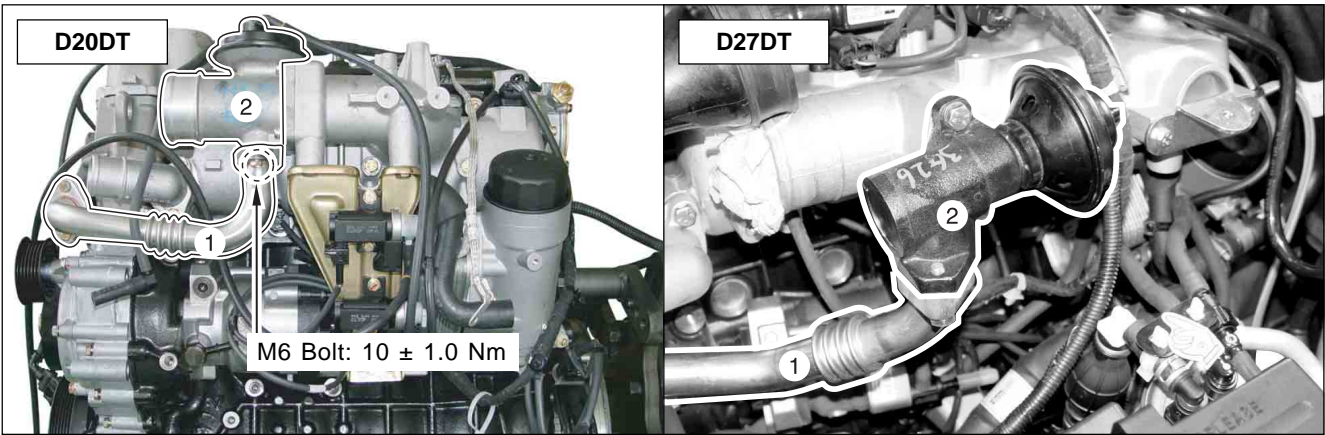
1. Remove the vacuum hose from the EGR valve.



2. Unscrew the bolts and remove the EGR valve (2), EGR valve #1 pipe (1) and gasket.

Installation Notice

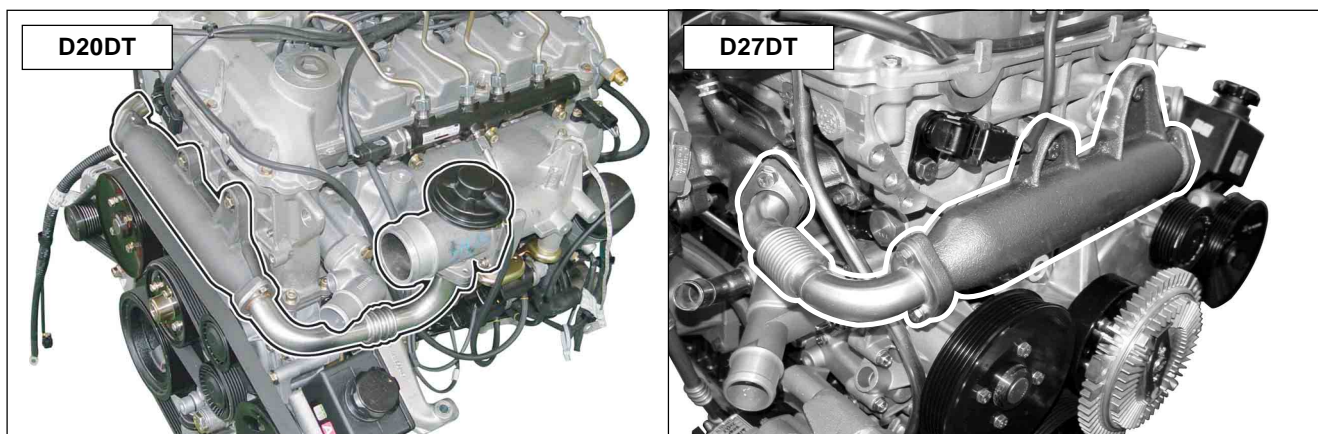
Tightening torque	25 ± 2.5 Nm
-------------------	-------------



3. Remove the EGR valve #1 pipe, #2 pipe, #3 pipe and gaskets from the engine.

Installation Notice

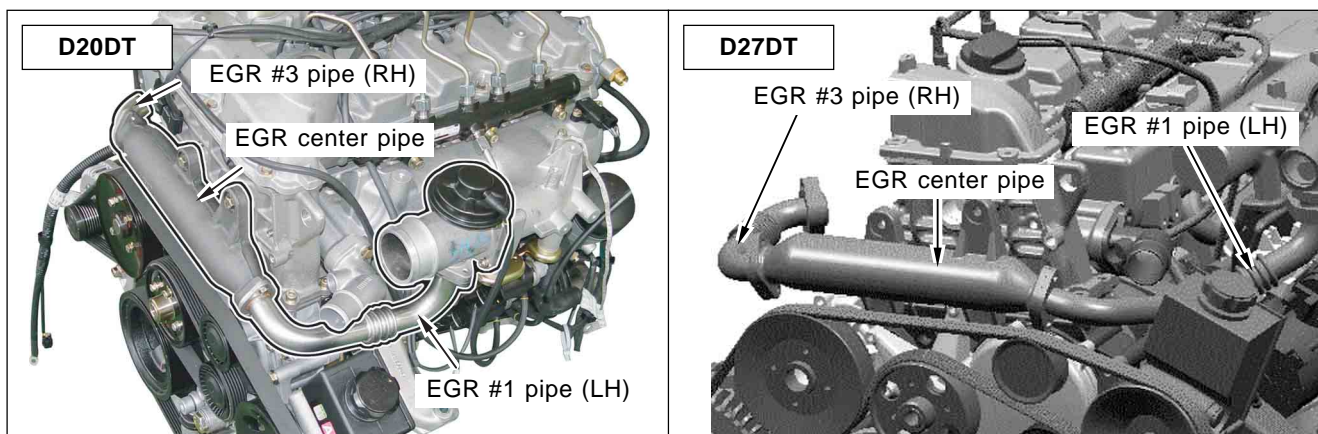
Tightening torque	25 ± 2.5 Nm
-------------------	-------------



4. Install in the reverse order of removal.

**NOTICE**

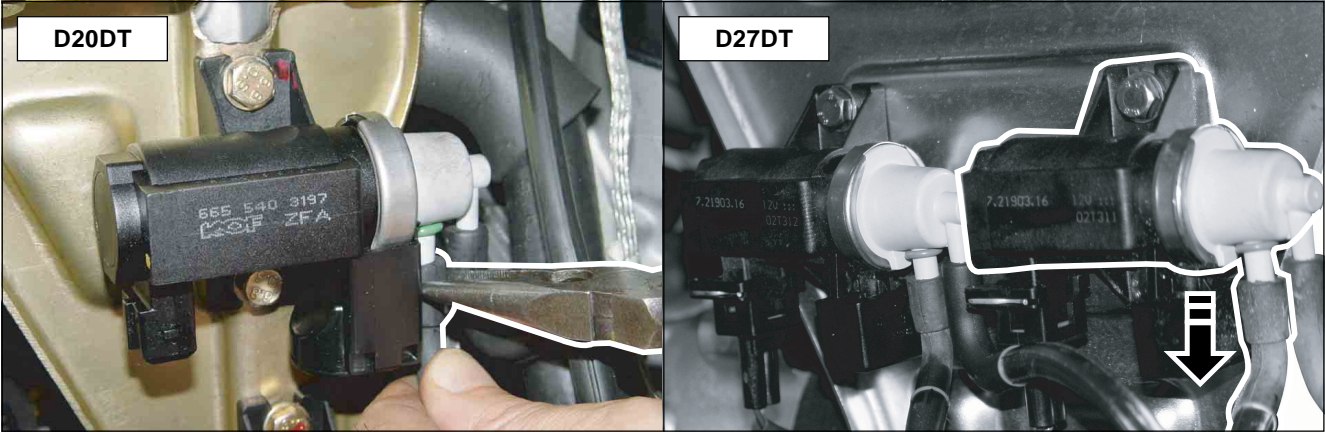
- Make sure to observe the specified tightening torques.
- Never reuse the EGR #1 pipe (intake) and #3 pipe (exhaust) once removed (only D27DT).
- Replace the gaskets with new ones.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Vacuum Modulator - Removal and Installation

1. Remove the vacuum hose from the vacuum modulator.




2. Remove the vacuum modulator from the bracket.

Installation Notice

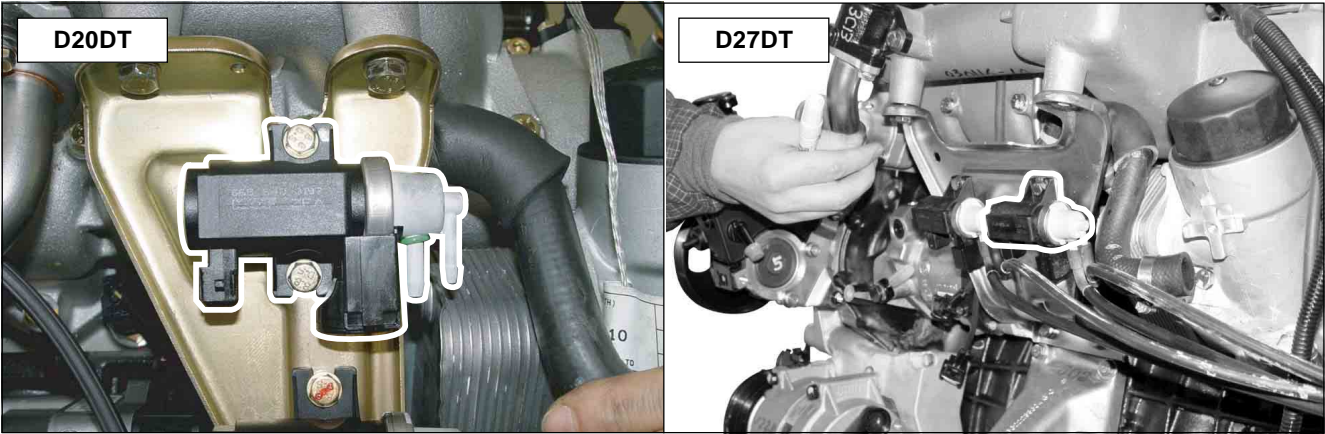
Tightening torque	10 ± 1.0 Nm
-------------------	-------------

3. Install in the reverse order of removal.



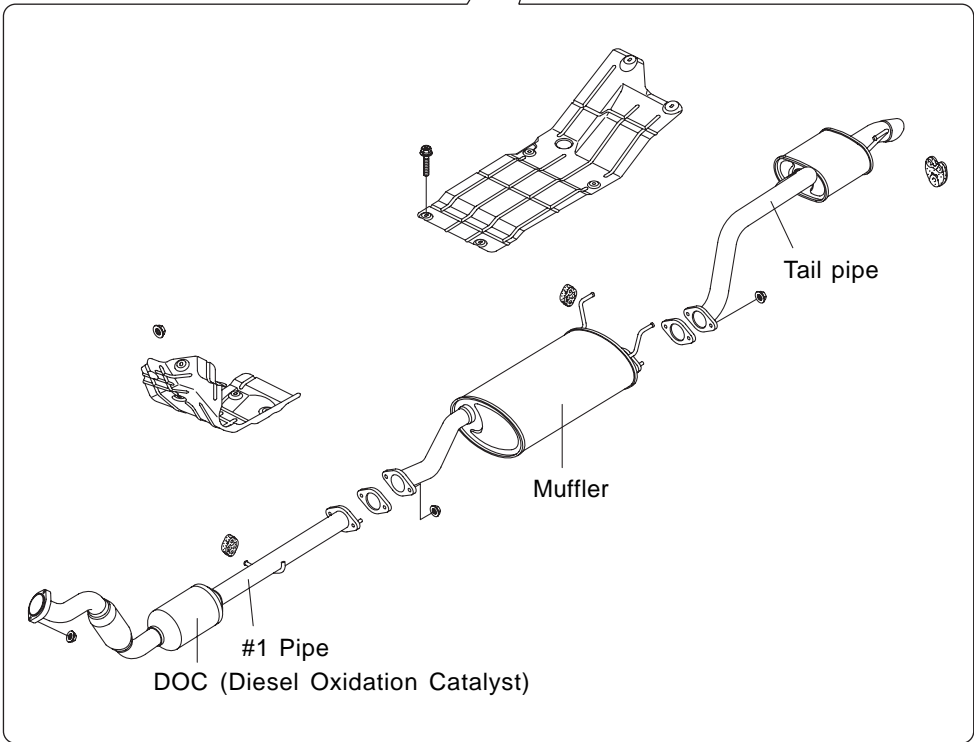
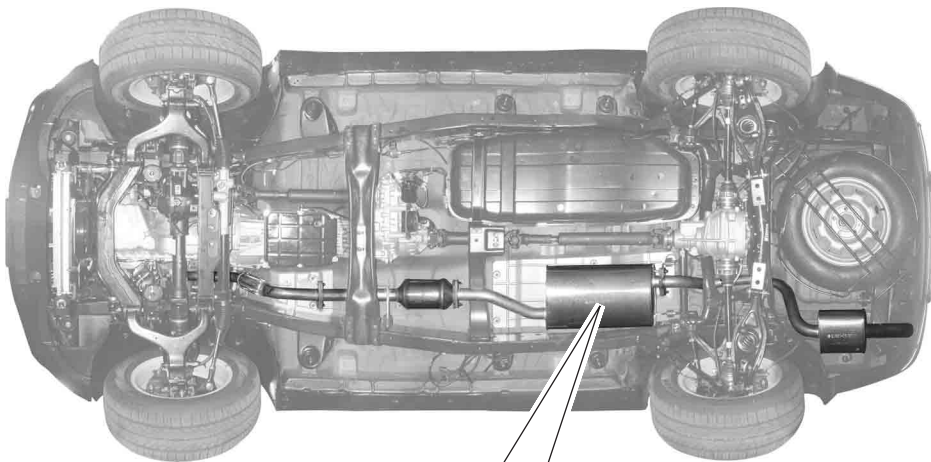
NOTICE

- Make sure that the vacuum hoses are connected to correct locations.



EXHAUST SYSTEM AND MUFFLER

GENERAL
ASSY
HOUSING
INTAKE
EXHAUST
LUB
COOLING
FUEL
CONTROL
SENSOR



MUFFLER

The muffler is located at the middle of the exhaust pipe and reduces the pulse noise and the tail pipe noise by eliminating the flowing resistance from the exhaust gas.

The important elements of the muffler are volume, construction and location.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

SYSTEM OVERVIEW

► Exhaust System

Check the complete exhaust system and the nearby body areas and trunk lid for broken, damaged, missing or mispositioned parts, open seams, holes, loose connections, or other deterioration which could permit exhaust fumes to seep into the trunk may be an indication of a problem in one of these areas. Any defects should be corrected immediately.



NOTICE

- When you are inspecting or replacing exhaust system components, make sure there is adequate clearance from all points on the underbody to avoid possible overheating of the floor panel and possible damage to the passenger compartment insulation and trim materials.

► DOC (Diesel Oxidation Catalyst)

DOC (Diesel Oxidation Catalyst) is the purification device to reduce the toxic emissions from the exhaust gas from the engine. By using the chemical reaction, the amount of toxic gas such as NOx can be reduced.



NOTICE

- To prevent damage of DOC, never contact the lift pad when lifting up the vehicle.

► Muffler

Aside from the exhaust manifold connection, the exhaust system uses a flange and seal joint design rather than a slip joint coupling design with clamp and U-bolts. If hole, open seams, or any deterioration is discovered upon inspection of the front muffler and pipe assembly, the complete assembly should be replaced. The same procedure is applicable to the rear muffler assembly. Heat shields for the front and rear muffler assembly and catalytic converter protect the vehicle and the environment from the high temperatures that the exhaust system develops.

► Heat Shield

The heat shield protects the vehicle and components from the high heat generated from the exhaust system.

In this vehicle, the heat shield to block the heat from DOC is installed to the underbody, and the heat shield to block the heat from the rear muffler is installed to the underbody between the fuel tank and the rear muffler.

► Hanger

The hanger is to support the components.

If the hanger is not properly installed, it may cause the vibration that is very difficult to diagnose. Therefore, install the hanger to the correct location so that the exhaust system cannot contact to the underbody and other components.

► DOC (Diesel Oxidation Catalyst)

System and principle

Oxidation catalytic technology for diesel engine is basically the same with it of gasoline engine used before development of 3 primary catalyst (2 primary catalyst), and its effect and performance were already proved.

DOC (Diesel Oxidation Catalyst) reduces HO and CO contained exhaust gas over 80 %, and removes SOF (Soluble Organic Fraction) over 50 ~ 80 %, but because its portion in total PM is low, it reduces approx, 20 ~ 40 % of TPM (Total Particulate Material).

Because of low reducing rate for PM of DOC, in order to guarantee safety rate of PM regulation, this technology is being used mainly. And it should keep over 80% of PM reducing rate, and at present it plays a role as a transition stage.

And also it reduces diesel odor and black smoke, platinum or palladium are being used as a catalyst.

On the other hand, it is a problem that it makes the reaction of oxidation, which SO_2 produce SO_3 and H_2SO_4 by reacting to oxygen in exhaust gas, if temperature of exhaust gas becomes over 300°C , and this produced gas is very harmful to human body. To prevent is, previously it is requested that the sulfur content rate of fuel should be below 0.05 %, and in the future it is being expected to keep it below 0.01 %.

Catalytic converter structure

The Catalytic converter of monolith type consists of 2 walled metal bodies which is made of Cordierite.

The principal element of converter consists of the materials like Alumina or oxidized Serume in order to apply to Ceramic Monolith. Washer coat operates first, and catalytic metal elements (Pt, Pd, Ph) operates to washer coat next.

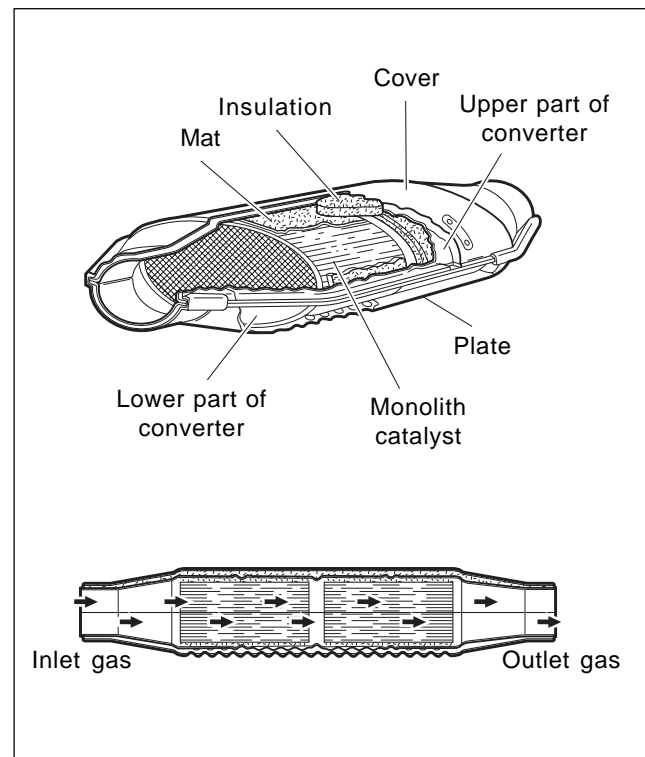
Monolith type is lighter than other types, easy to manufacture and quickly approaches to proper temperature.

Washer coat is used to make a contact surface with exhaust gas bigger by adhering closely to small holes of inner layer.

If a lead compound or phosphorus adheres to the surface and the temperature rises, its surface is decreased.

The total area of general monolith converter is about $45,000 \sim 500,000 \text{ ft}^3$. (10 times of a football field)

Generally Alumina (Al_2O_3) is used as a raw material and its 7 phases of gamma, delta, theta have big areas and high stability for the temperature, and nowadays gamma Alumina is used usually.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Catalytic converter and temperature

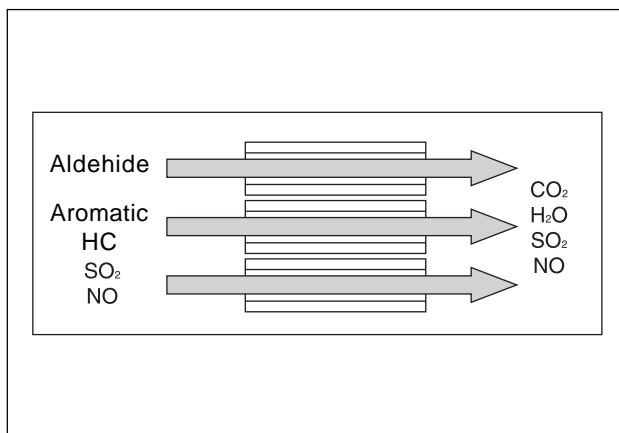
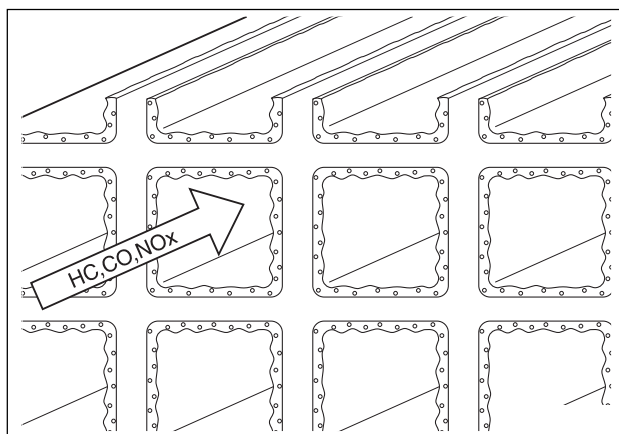
Catalytic converter has the normal function of purification at a range of the temperature. Because it has a weak point of decreasing of the purification rate in the condition of continuous high temperature, it should keep the temperature range of 400 to 500°C for normal condition. HC purification rate becomes better according to the increase of temperature in the normal range of temperature. CO purification rate becomes the best near the temperature of 450°C, and NOx does so near the temperature of 400 to 500°C.

Purification of catalytic converter

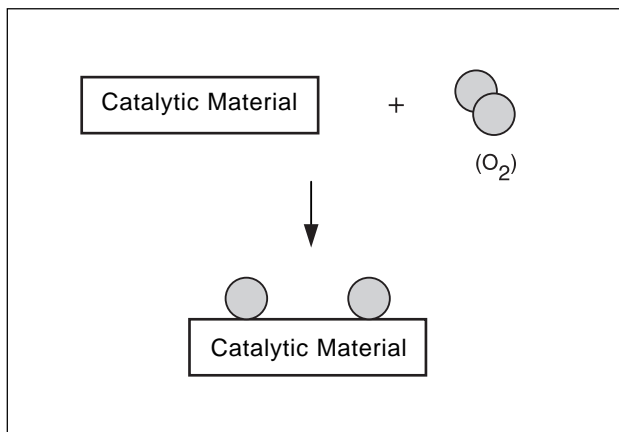
1. Adhesion of soluble organic fraction (SOF) below 180°C
2. Purification of soluble organic fraction (SOF) over 180°C

Chemical reaction formula

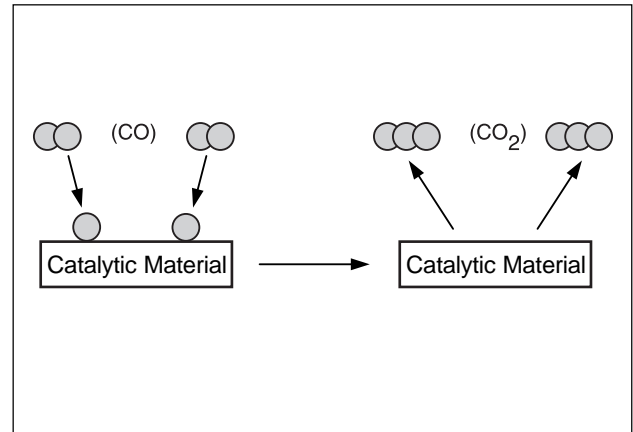
1. $\text{SOF (HC)} + \text{O}_2 \rightarrow \text{O}_2 + \text{H}_2\text{O}$
2. $2\text{CO} + \text{O}_2 \rightarrow 2\text{CO}_2$
3. $2\text{C}_2\text{H}_6 + 7\text{O}_2 \rightarrow 4\text{CO}_2 + 6\text{H}_2\text{O}$



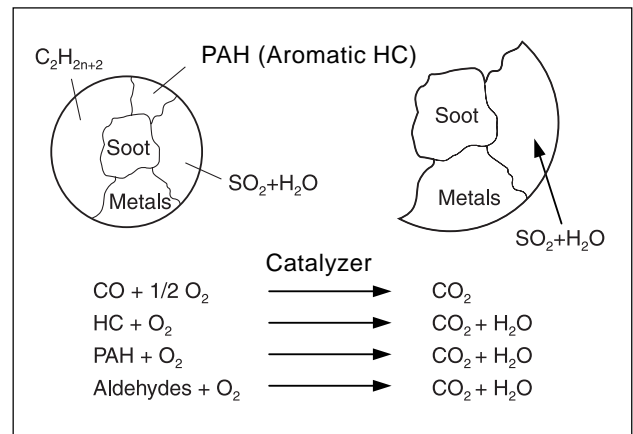
6. Oxygen adheres to catalytic material : below 180°C



5. Catalytic material supplies each CO and HC with O₂ for their oxidation : above 180°C



6. Catalytic material conversion process by DOC



Method for reduction of NO_x

NO_x is generated a great deal in case that combustion temperature and excess air factor are high. EGR valve can decrease NO_x (30 to 35% decrease) by making temperature of combustion chamber fall by means of exhaust gas re-circulation.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Exhaust Pipe - Removal and Installation

1. Remove the upper bolts at turbo charger.

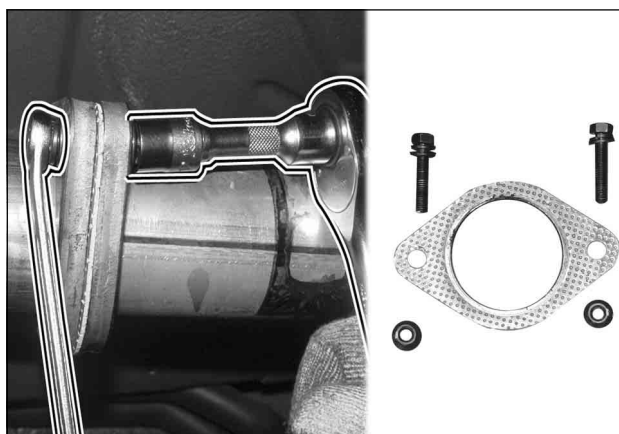


NOTICE

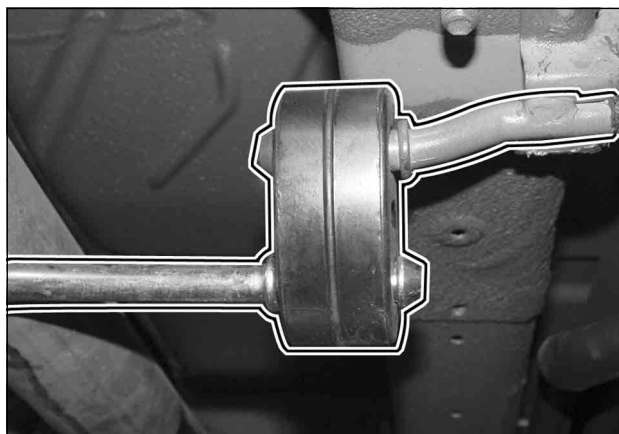
- Use the universal type wrench.



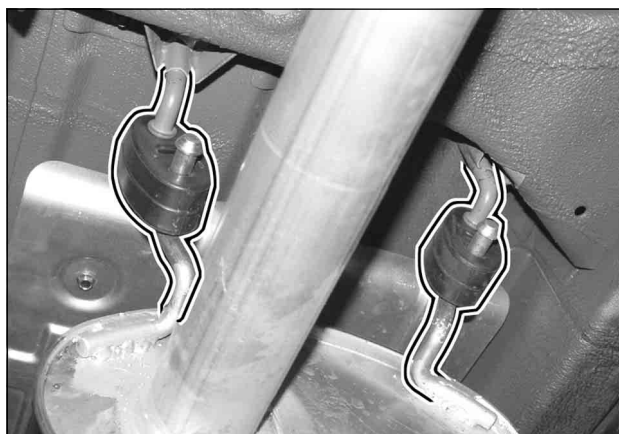
2. Remove the lower bolts and gasket.



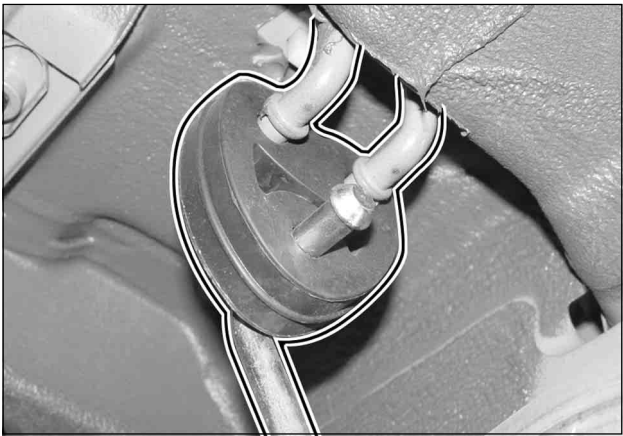
3. Remove the #1 hanger.



4. Remove the #2 hanger.



- 5. Remove the #3 hanger.
- 6. Remove the exhaust pipe.
- 7. Install in the reverse order of removal.



GENERAL
ASSY
HOUSING
INTAKE
EXHAUST
LUB
COOLING
FUEL
CONTROL
SENSOR

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

MEMO

SECTION 05

LUBRICATION SYSTEM

LUBRICATION SYSTEM

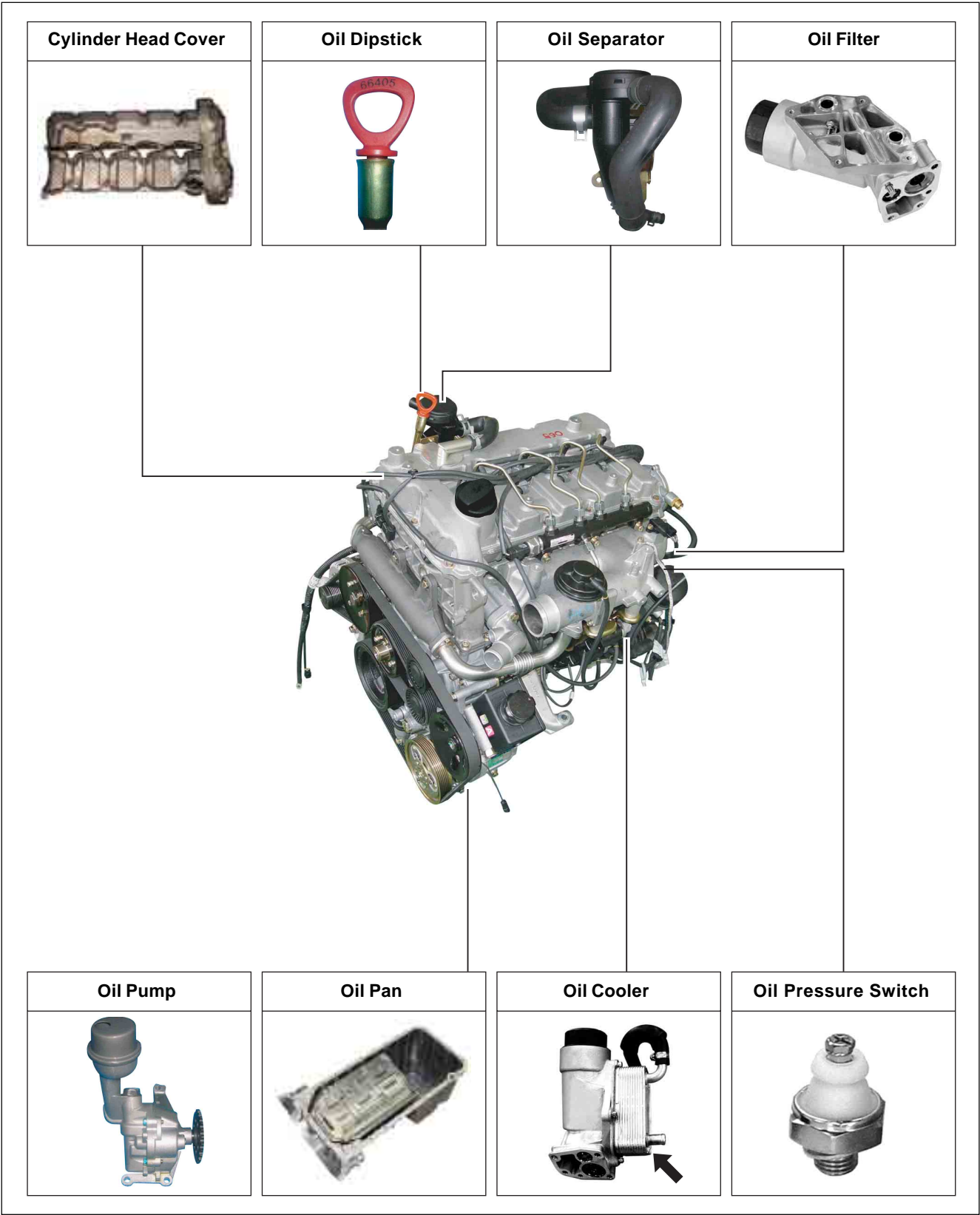
05

■ TABLE OF CONTENTS ■

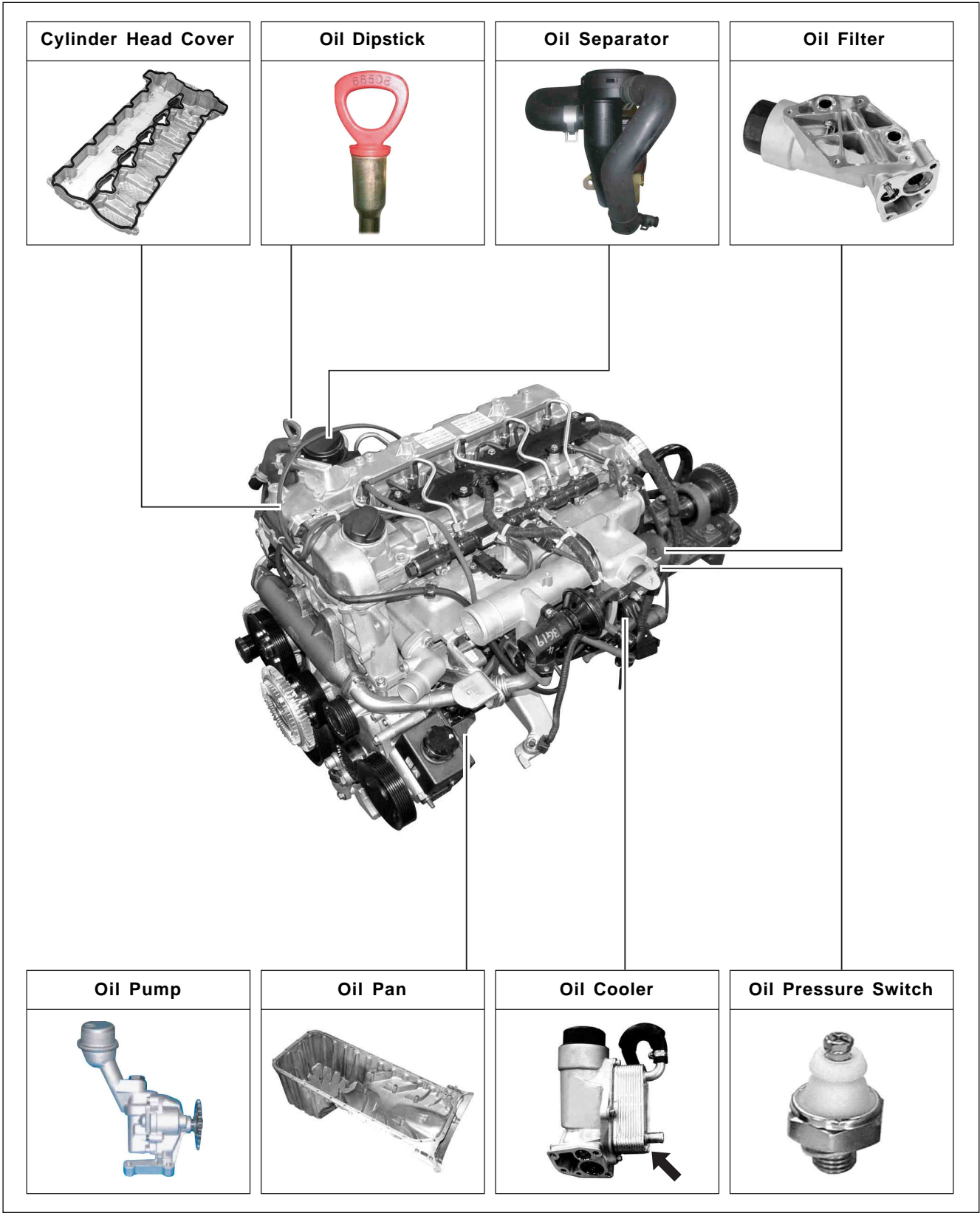
LUBRICATION SYSTEM	2
Lubrication system layout	4
Lubrication diagram	5
Specifications	6
Engine oil change	10
Oil pump	14
Oil spray nozzle	16
Oil pan assembly	17
Removal and installation of engine oil pan	18
TROUBLE DIAGNOSIS	20
SPECIAL TOOLS AND EQUIPMENT	21

LUBRICATION SYSTEM

► D20DT Engine



► D27DT Engine

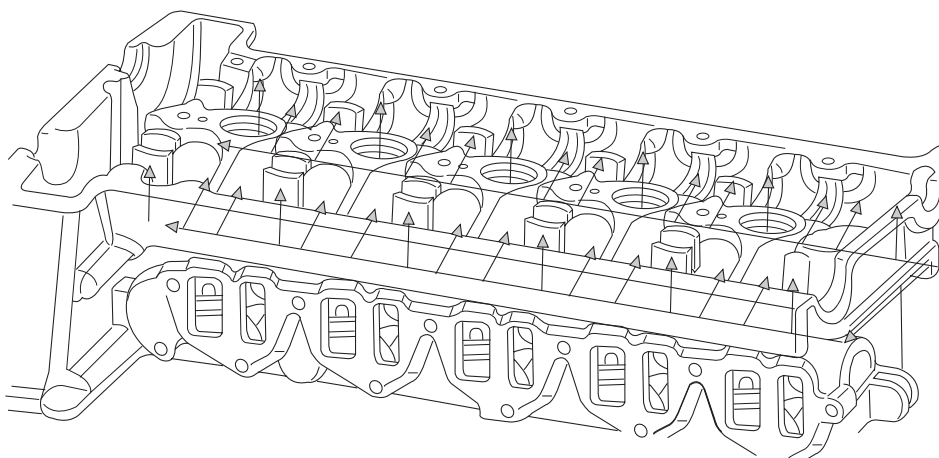


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

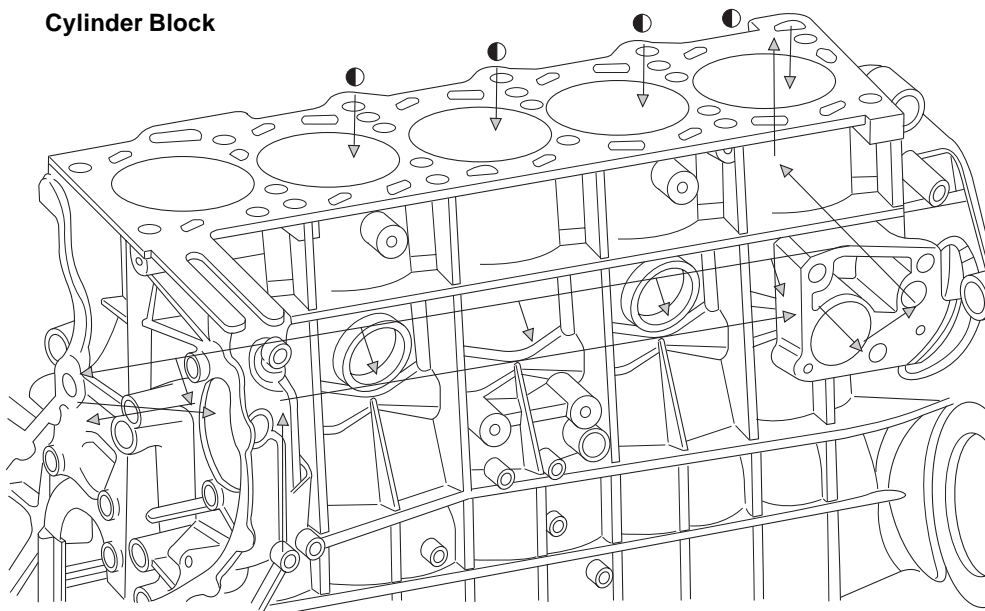
LUBRICATION SYSTEM LAYOUT

Cylinder Head

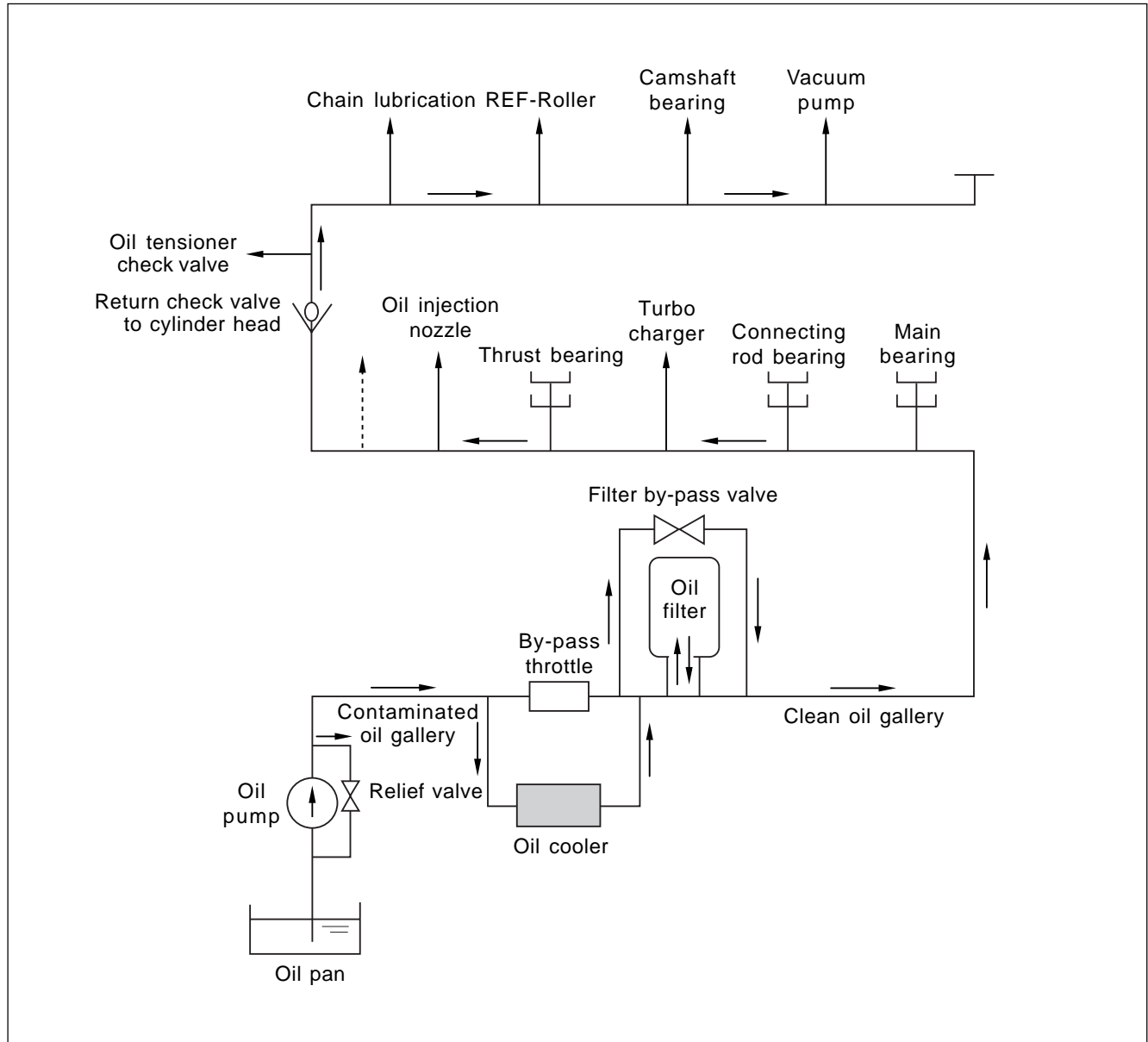
Main oil gallery: $\phi 16$
 Hole to cylinder head: $\phi 9$
 Main bearing hole: $\phi 7$
 Chain and injection pump: $\phi 7$
 Return hole: $\phi 14$
 Chain nozzle: $\phi 1$
 HP pump bearing: $\phi 6$



Cylinder Block



LUBRICATION DIAGRAM



- ※ 1. Opening pressure of by-pass valve in oil filter: 3 ± 0.4 bar
 2. To prevent instant oil shortage after stopping the engine, the return check valve is installed in oil supply line of cylinder head.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

SPECIFICATIONS

Engine oil	Specification	Approved by MB Sheet 229.1 or 229.3 Viscosity: See MB Sheet 224.1
	Capacity	6.8 ~ 8.3 liter
	Service interval	Initial change: 5,000 km, Change every 10,000 km or 12 months (Frequently check the oil level and add if needed. And, every 5,000 km or 6 months under severe conditions)
Engine oil filter		Same interval with engine oil
Oil relief valve opening pressure		5.8 ± 0.3 bar

※ Severe Condition:

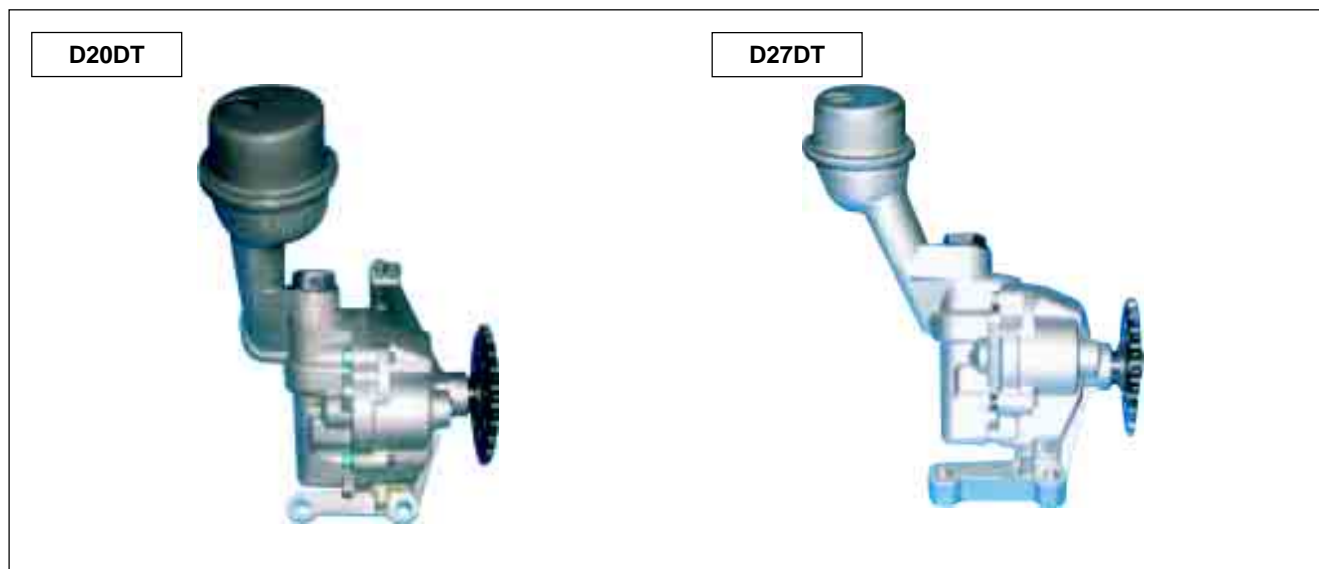
1. When most trips include extended idling and/or frequent low-speed operation as in stop-and-go traffic.
2. When most trips are less than 6 km (Operating when outside temperatures remain below freezing and when most trips are less than 16 km)
3. When operating in dusty, sandy and salty areas
4. In hilly or mountainous terrain
5. When doing frequent trailer towing

► Oil Pressure Switch

1. Operating temperature: -40 ~ 140°C
2. Operating pressure: 0.3 ~ 0.55 bar
3. Permissible pressure: 10 bar



► Oil Pump



Engine	Oil	Relief Valve Opening Pressure
D20DT, D27DT	MB SHEET 229.1/3 SAE 10W 40, 5W 40	5.8 ± 0.3 bar

1. Enlarged pump capacity: Width of tooth (pump gear): 33 mm
2. Increased number of teeth (sprocket): 26

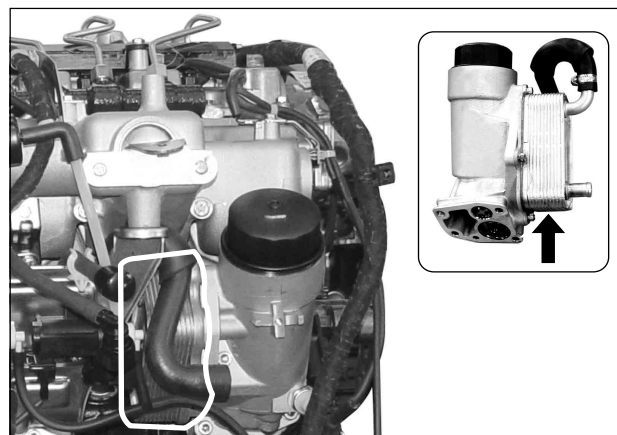
► Oil Cooler

1. Oil cooler mounting bolt: M6 x 16: 4

Installation Notice

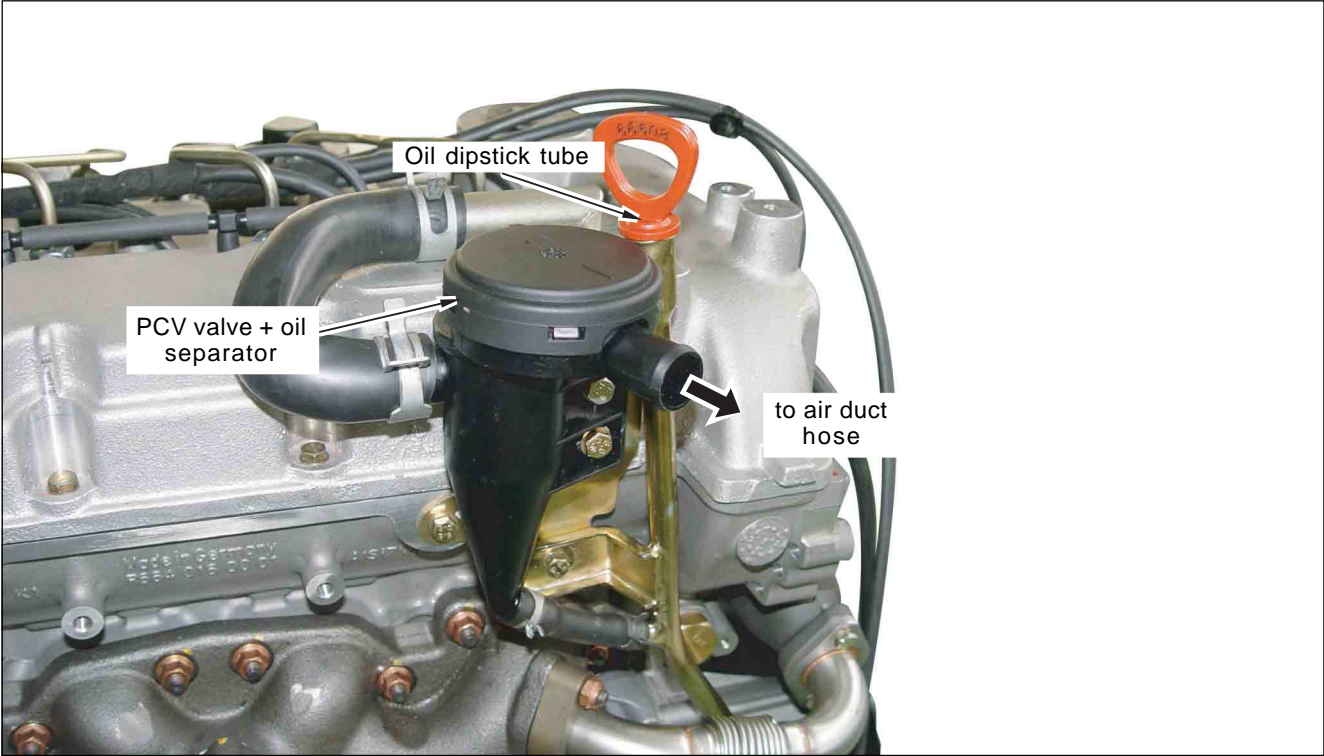
Tightening torque	10 Nm
-------------------	-------

2. Replace two oil cooler gaskets with new ones when the oil cooler has been removed.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► Blow-by Gas Reduction Device



► Cylinder Head Cover

D20DT

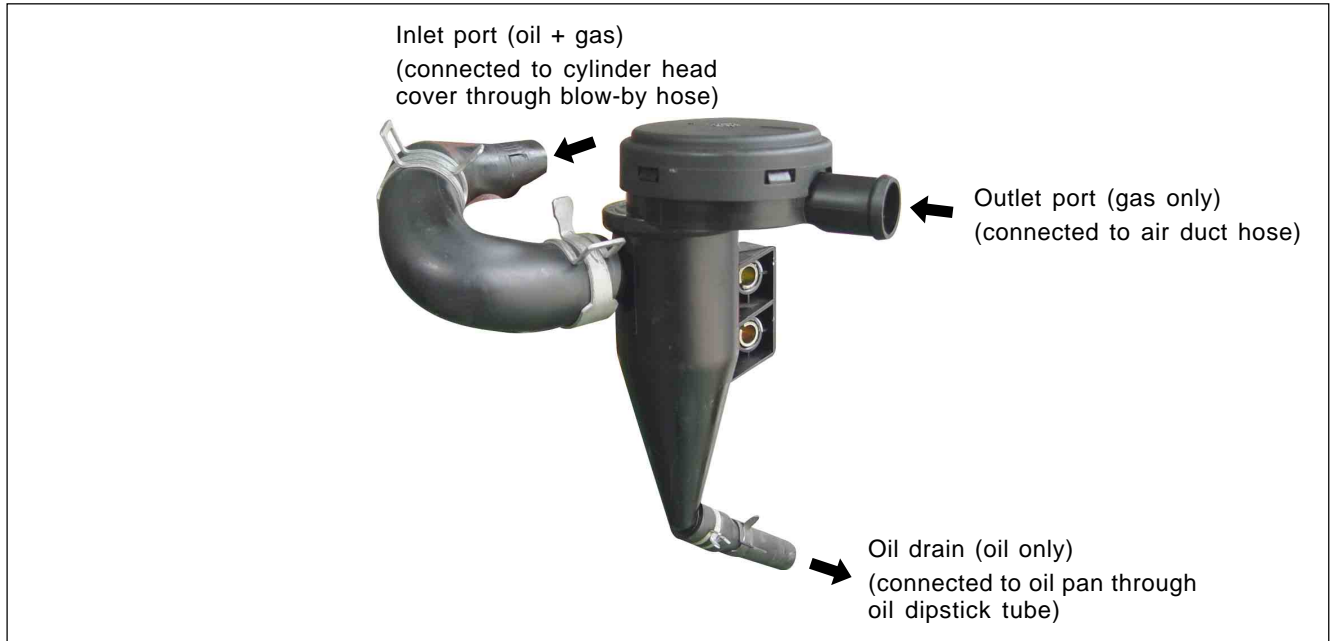
A photograph of the D20DT cylinder head cover, which is a dark, cast metal part. To its right is a cross-section diagram showing the internal structure. The diagram labels the 'Blow-by gas inlet port' at the front, a 'Baffle plate' in the middle, and a 'U-type oil drain pipe' at the bottom.

D27DT

A photograph of the D27DT cylinder head cover, which is a lighter, cast metal part. To its right is a cross-section diagram showing the internal structure. The diagram labels the 'Blow-by gas inlet port' at the front, a 'Baffle plate' in the middle, and a 'U-type oil drain pipe' at the bottom.

Baffle plate assembly: The baffle plates in cylinder head cover separates oil and gas from blow-by gas, and controls the blow-by gas speed to send only gas to separator.

► Oil Separator



The first separation will happen when blow-by gas passes through baffle plates in cylinder head cover; then oil and gas will be separated due to cyclone effect after entering the oil separator inlet port. Separated oil returns to oil pan via oil drain port and the gas will be burnt again after entering the combustion chamber through air duct hose via PCV valve that opens/closes due to pressure differences between the intake side and crankcase.

► Engine Oil Pressure Check

Check the oil level and quality before checking the oil pressure.

1. Drain the engine oil.
2. Disconnect the oil pressure switch connector and remove the switch.
3. Install the oil pressure gauge into the switch hole. Start the engine and let it run until the coolant temperature reaches at normal operating temperature (80 ~ 90°C).
4. Raise the engine speed by 2000 rpm and measure the engine oil pressure.

Specified oil pressure	2.5 ~ 3.0 kg/cm ² (2000 rpm)
------------------------	--

5. Install the switch and engage the connector.



NOTICE

- Apply the Loctite onto the thread of the switch and check for oil leaks.

Tightening torque	120 ~ 160 kg/cm ²
-------------------	------------------------------

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

ENGINE OIL CHANGE

Change interval: Initial change 5,000 km, Change every 10,000 km or 12 months

Frequently check and add if needed. Shorten the change interval under severe conditions.

Severe condition:

1. When most trips include extended idling and/or frequent low-speed operation as in stop-and-go traffic.
2. When most trips are less than 6 km (Operating when outside temperatures remain below freezing and when most trips are less than 16 km)
3. When operating in dusty, sandy and salty areas
4. In hilly or mountainous terrain
5. When doing frequent trailer towing



NOTICE

- Water separation from the fuel filter should be performed when changing the engine oil.

► Engine Oil Changing Procedures

1. Park the vehicle on the level ground and warm up the engine until it reaches normal operating temperature.
2. Stop the engine and wait around 5 minutes. Remove the oil filler cap, oil filter and oil drain plug to drain the oil.



NOTICE

- After driving, the engine oil temperature may be high enough to burn you. Wait until the oil is cooled down.

3. Install new oil filter and tighten the drain plug with specified tighten torque.

Oil drain plug	25 ± 2.5 Nm
----------------	-------------



NOTICE

- Over-tightening may cause oil leaks.
- Replace the drain plug washer with new one.

4. Fill the engine oil through the oil filler opening.



NOTICE

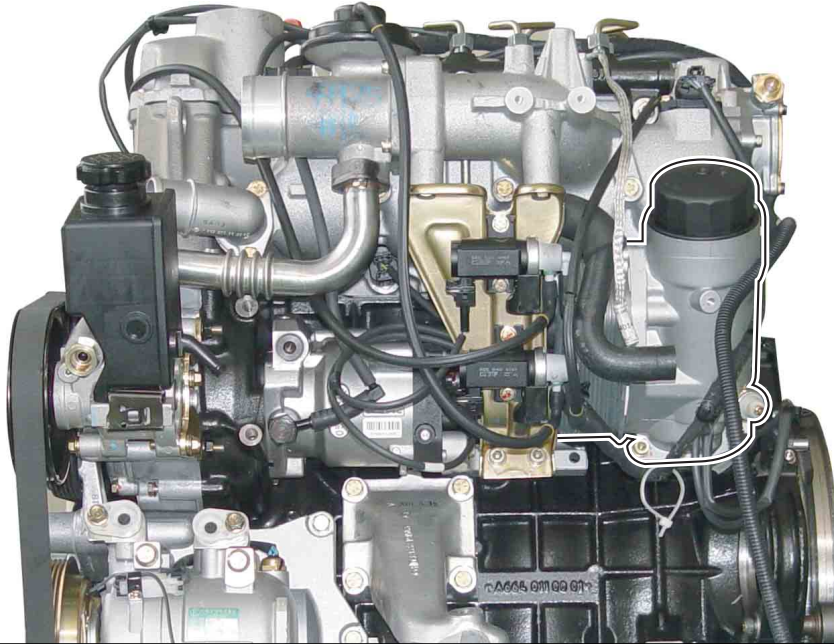
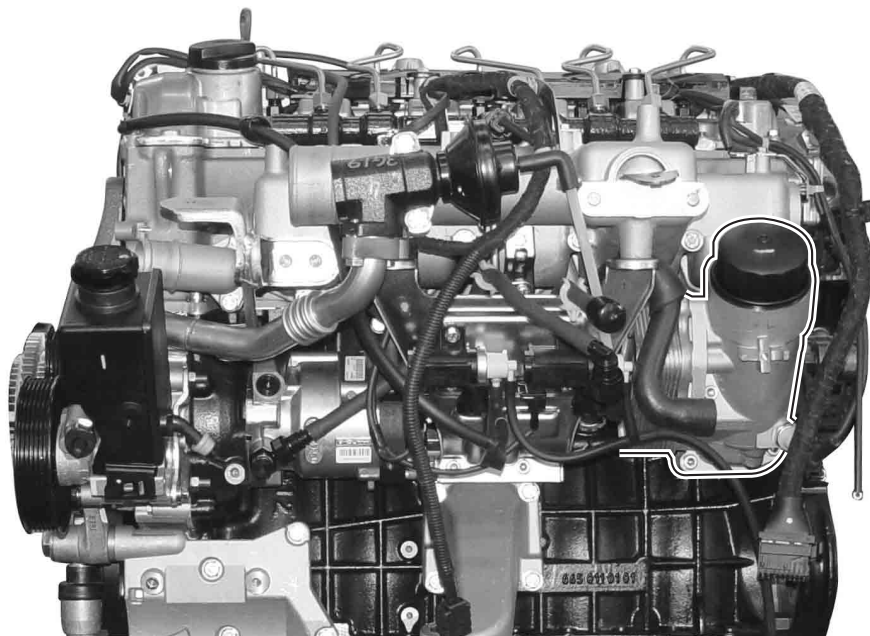
- The oil should not go above the upper mark on the dipstick. This would lead, for example, to increased oil consumption, fouling of the spark plugs and excessive formation of carbon residue.

5. Close the oil filler cap and start the engine.
6. Stop the engine again and check the oil level. Add the engine oil if needed and check for the oil leaks.

Engine oil filter change

1. For changing procedures, refer to the “Lubrication System” section in this manual.
 - 1) Lubricate the engine oil gasket with engine oil before installation.
 - 2) Tighten it with the specified tightening torque.

Oil filter	25 ± 2.5 Nm
------------	-------------

D20DT**D27DT**

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Oil Filter and Cooler - Removal and Installation

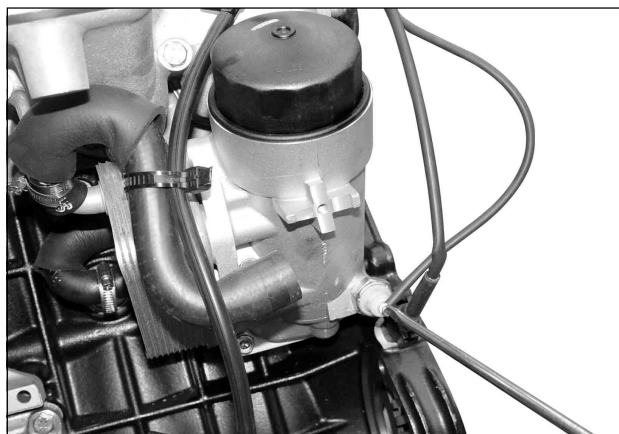
※ Preceding Works:

1. Draining of engine oil
2. Removal of EGR vacuum modulator bracket

1. Remove the oil cooler hoses (supply and return lines).



2. Disconnect the ground cable from the oil pressure switch.



3. Remove the oil cooler and filter mounting bolt.

Installation Notice

Tightening torque	$23 \pm 2.3 \text{ Nm}$
-------------------	-------------------------

- *Pay attention to the length of bolts.*



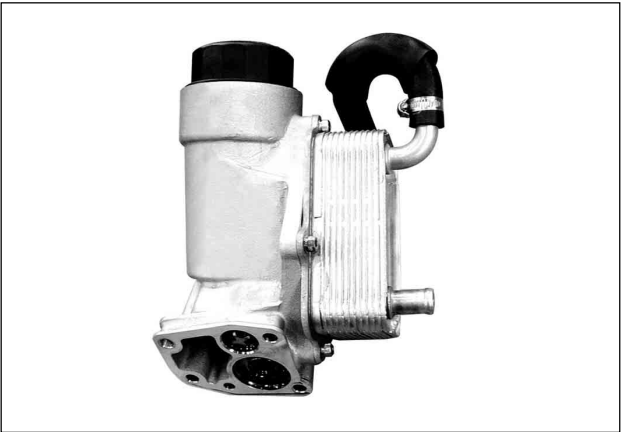
4. Remove the oil cooler and filter assembly from the cylinder block.



NOTICE

- The oil cooler and filter assembly cannot be re-placed separately.

5. Install in the reverse order of removal.



GENERAL

ASSY

HOUSING

INTAKE

EXHAUST

LUB

COOLING

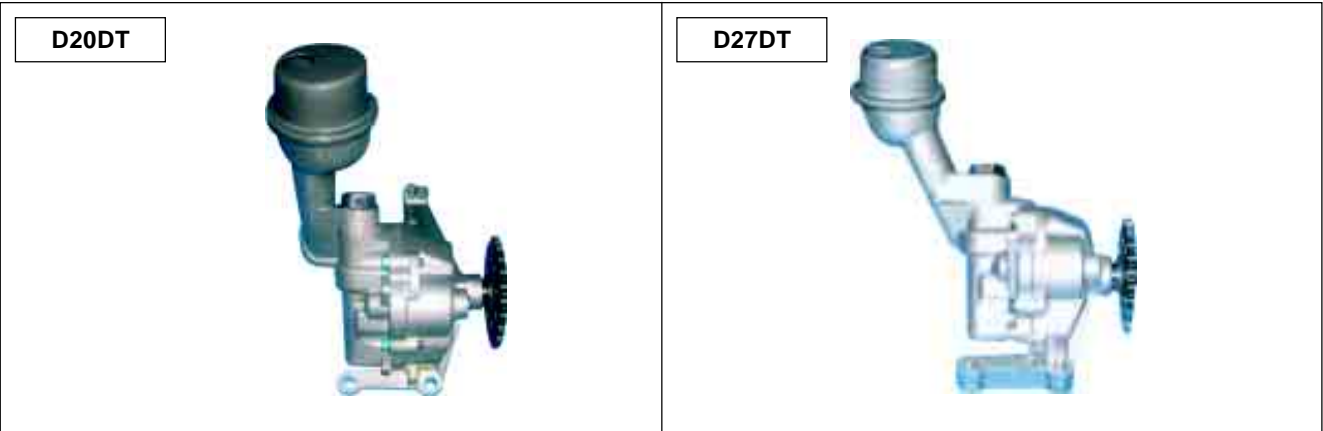
FUEL

CONTROL

SENSOR

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

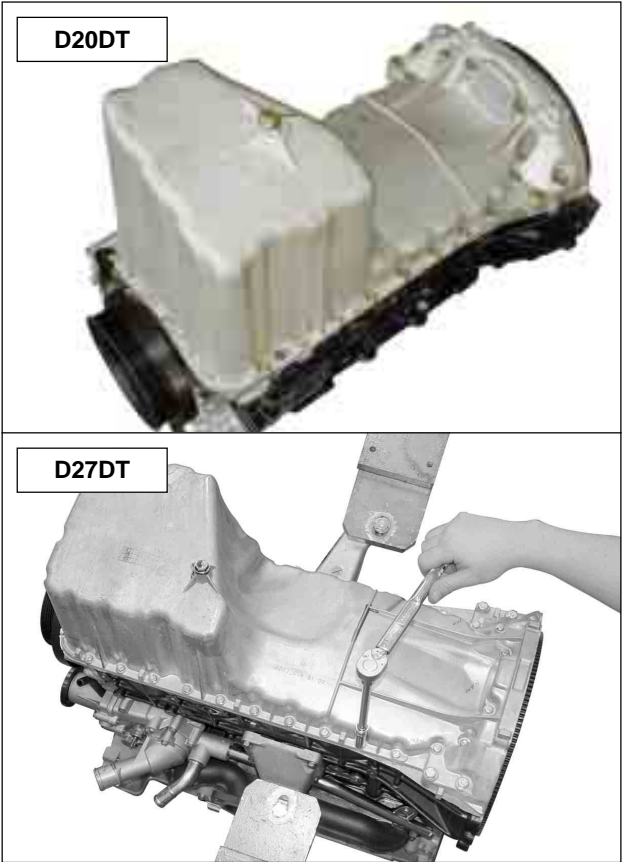
OIL PUMP



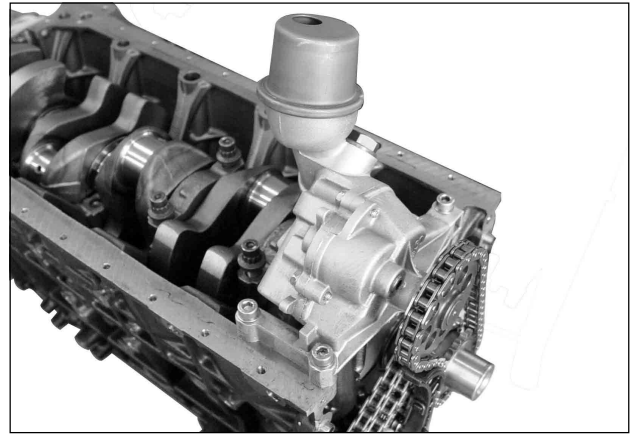
Oil Pump - Removal and

1. Remove the oil pan.

Tightening torque	Nm
M6 x 20	10 ± 1.0
M6 x 35	10 ± 1.0
M6 x 85	10 ± 1.0
M8 x 40	25 ± 2.5



2. Remove the oil pump.
3. Remove the screw plugs and the relief valve.
4. Install in the reverse order of removal.
5. Start the engine and check for oil leaks.



Oil Dipstick Guide Tube - Removal and Installation

1. Pull out the engine oil dipstick.
2. Remove the EGR valve pipe (No.3).

Installation Notice

Tightening torque	35 ± 3.5 Nm
-------------------	-------------

- **Replace the pipe with new one.**



3. Unscrew the bolt and remove the oil dipstick guide tube.

Installation Notice

Tightening torque	10 Nm
-------------------	-------

- **Replace the O-ring with new one.**

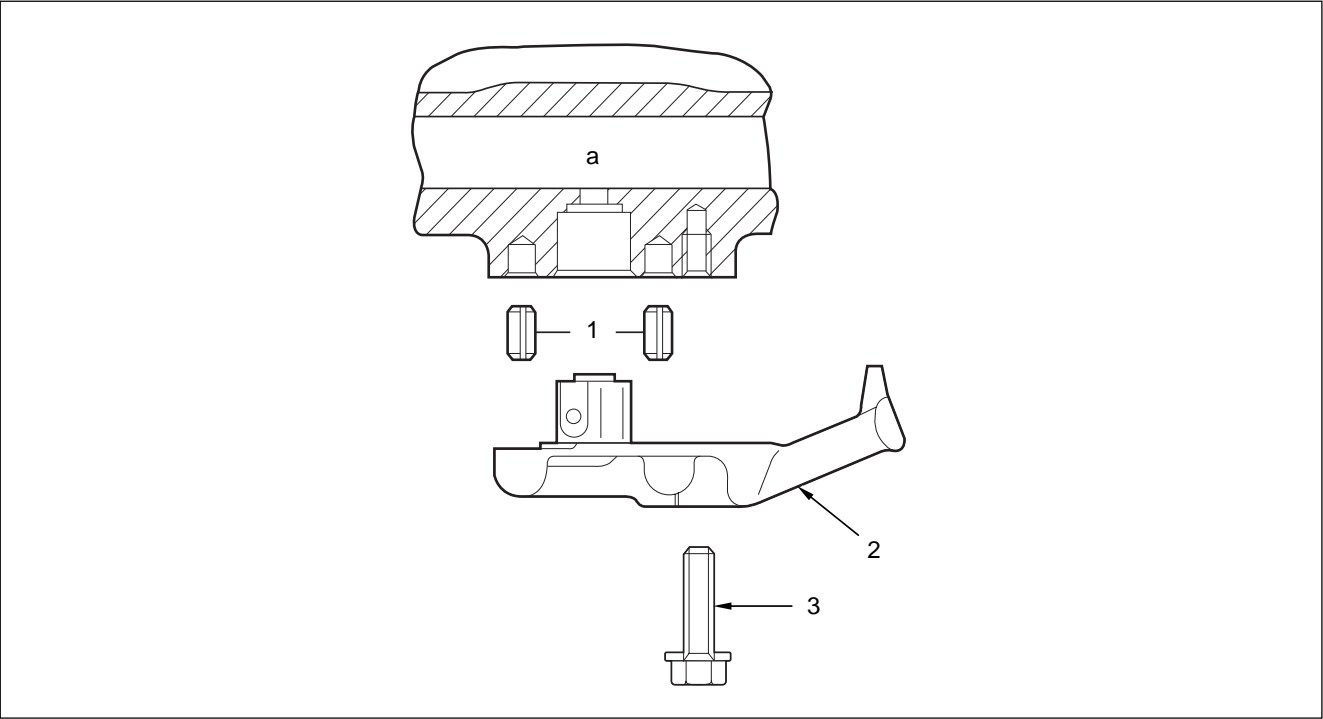
4. Install in the reverse order of removal.



NOTICE

- **After installation, check for oil leaks.**

OIL SPRAY NOZZLE

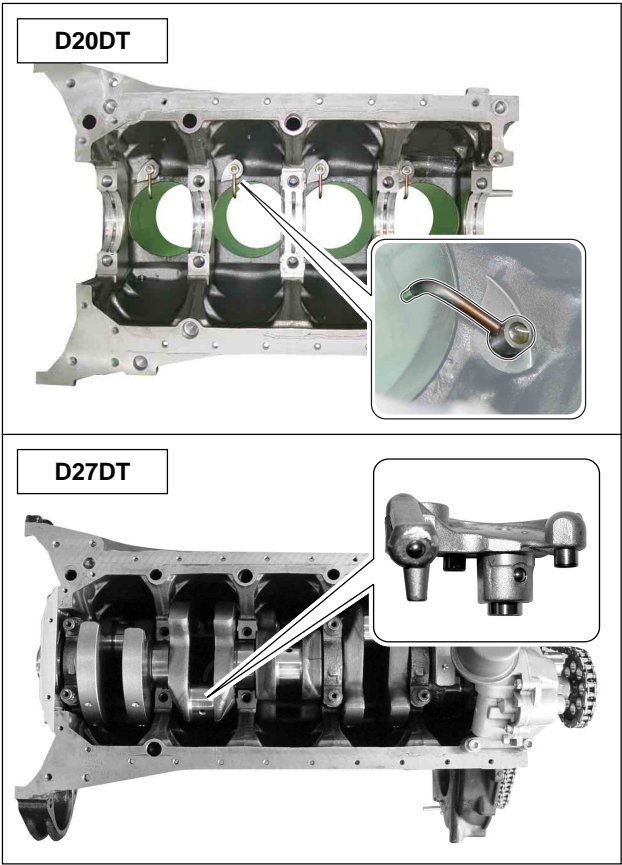


- 1. Fitting sleeve
- 2. Oil spray nozzle

- 3. Combination bolt 10 Nm
- a. Oil duct

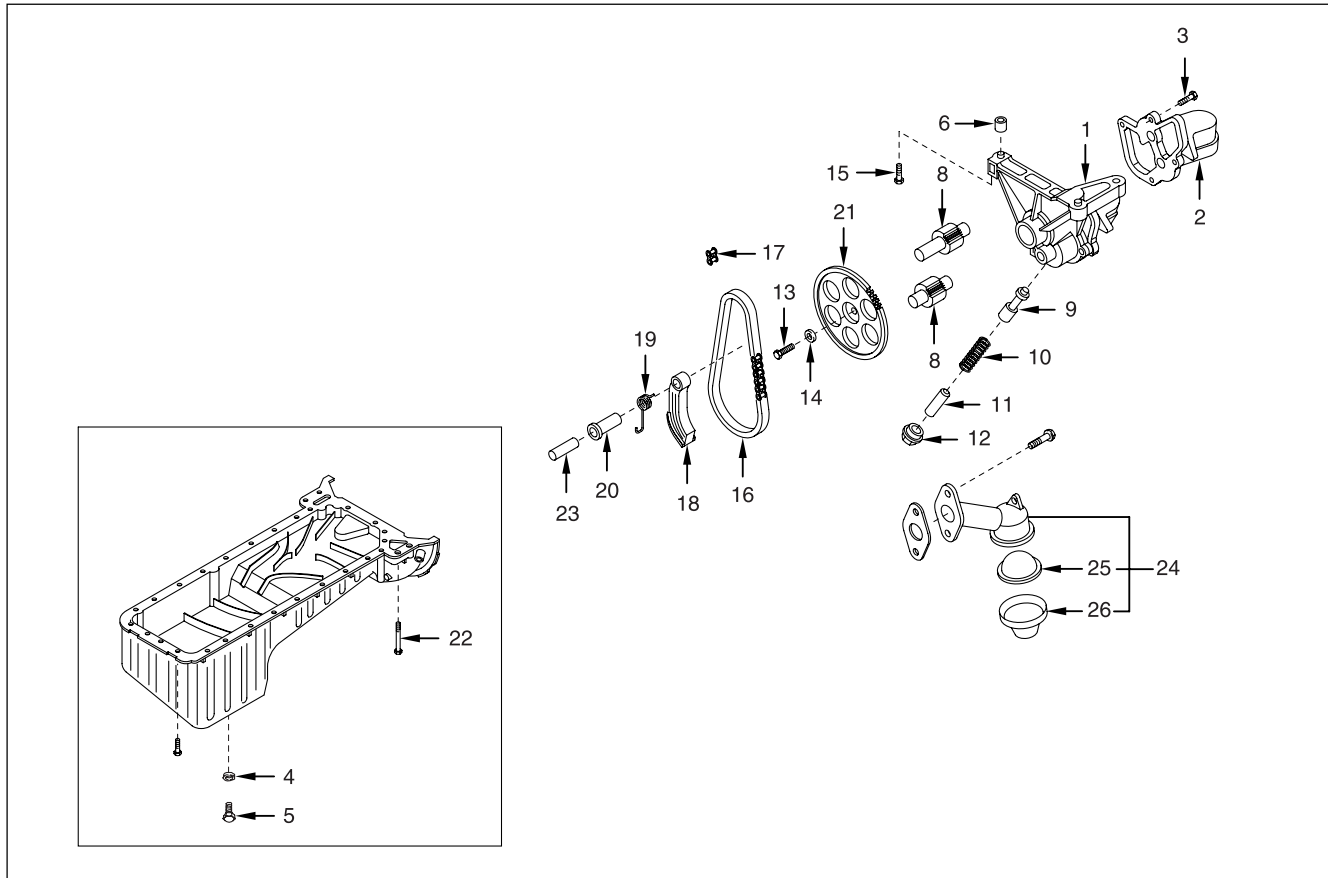
Disassembly

- 1. Remove the oil pan or crankshaft.
- 2. Unscrew the bolts and remove the nozzle.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

OIL PAN ASSEMBLY



- | | |
|--|------------------------------|
| 1. Oil pump | 14. Washer |
| 2. Oil pump cover | 15. Bolt |
| 3. Bolt | 16. Oil pump roller chain |
| 4. Drain plug washer | 17. Oil pump chain lock link |
| 5. Drain plug 25 ± 2.5 Nm (replace the washer) | 18. Oil pump chain tensioner |
| 6. Spring pin | 19. Oil pump chain spring |
| 7. Oil pump drive shaft | 20. Bush |
| 8. Oil pump driven shaft | 21. Oil pump sprocket |
| 9. Oil pump relief valve piston | 22. Bolt |
| 10. Spring | 23. Cylindrical pin |
| 11. Oil pump relief valve pin | 24. Oil pump sprocket assy |
| 12. Oil pump relief valve plug | 25. Oil pump screen assy |
| 13. Bolt 10 Nm | 26. Basket |

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

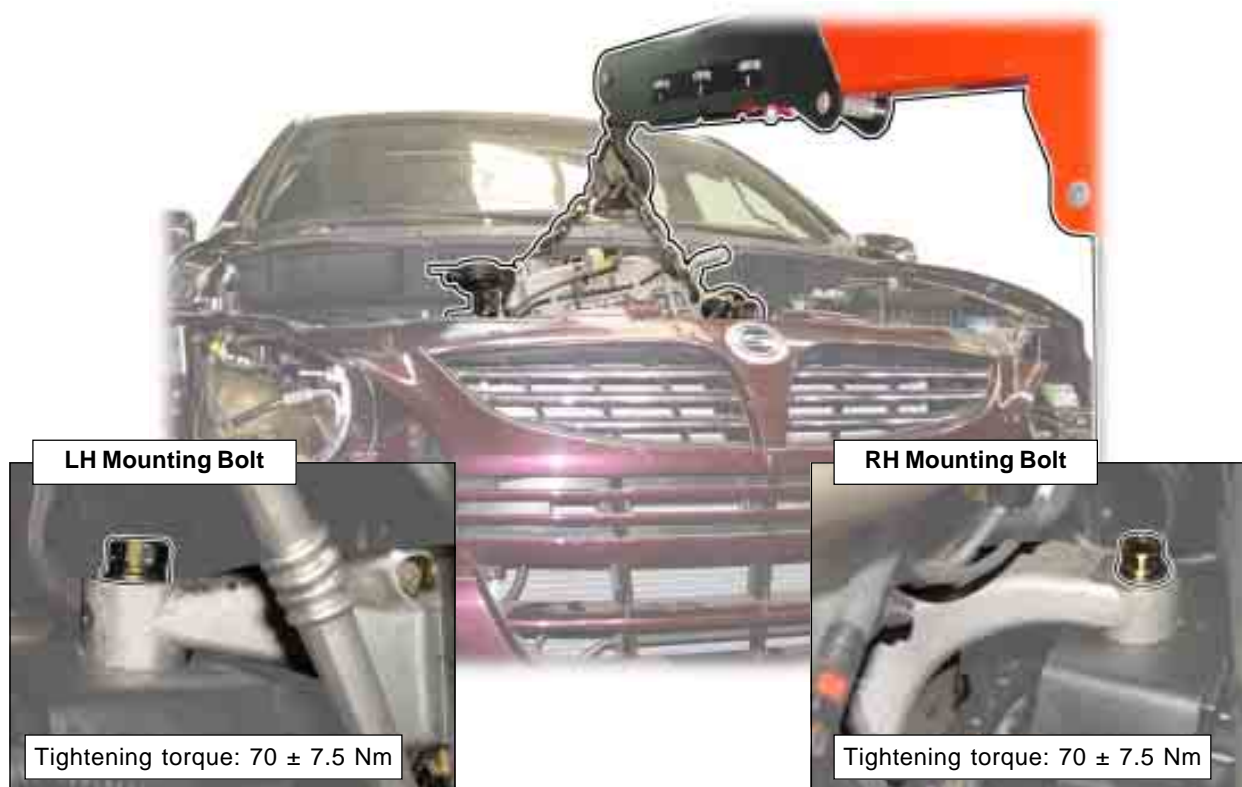
REMOVAL AND INSTALLATION OF ENGINE OIL PAN

※ **Preceding Work:** Remove the front axle assembly and drain the engine coolant.

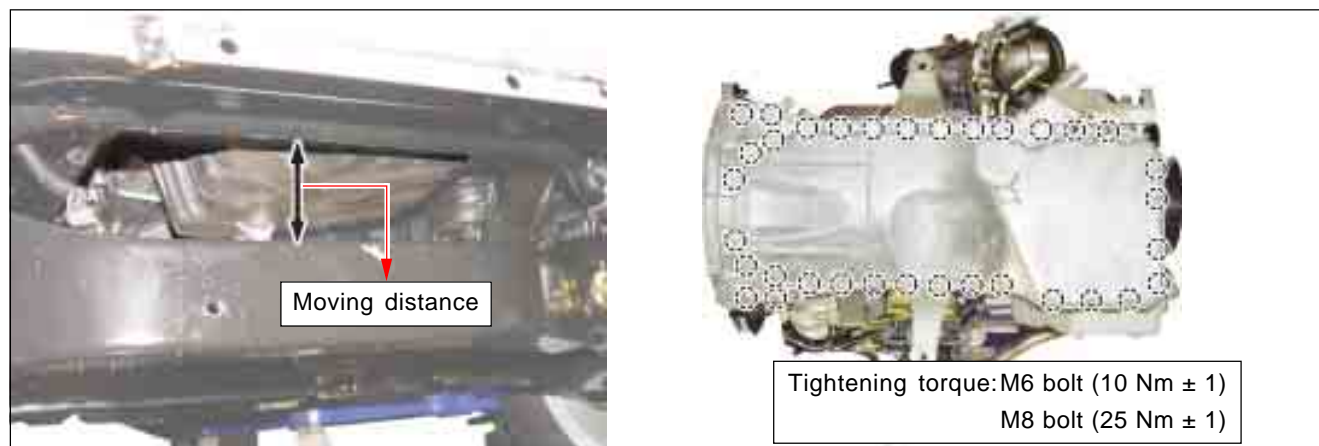
NOTICE

- For removing the oil pan, unscrew the engine mounting bolts and raise the engine assembly slightly. Otherwise, the oil strainer gets interfered with frame.
- Do not excessively raise the engine assembly. It may damage the pipes, hoses and wiring harnesses.

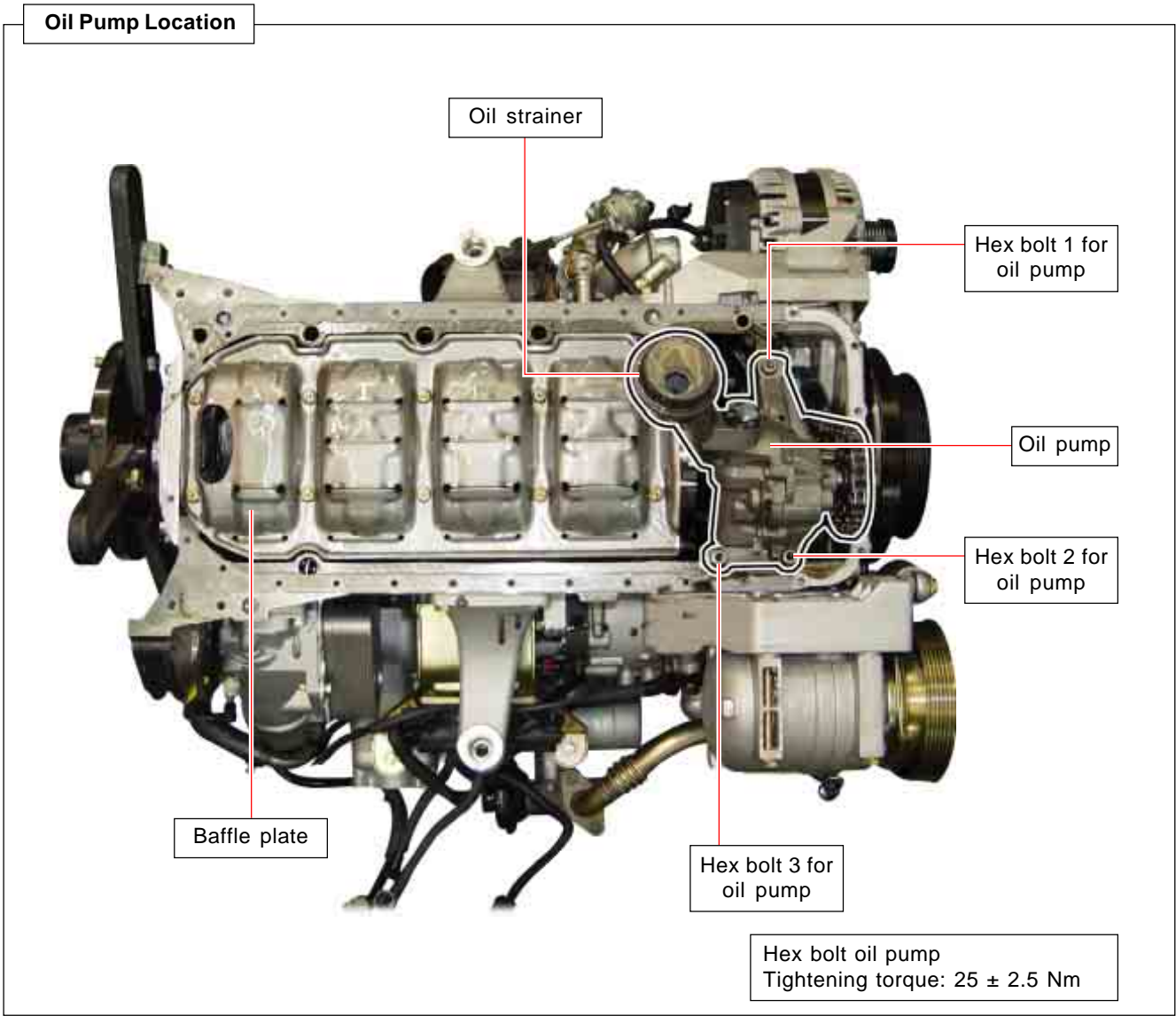
1. Unscrew the engine mounting bolts and raise the engine assembly slightly.



2. Unscrew the oil pan screws when the nearest distance between frame and oil is 13 to 15 cm.



3. Lower the engine oil pan and remove the oil pump assembly with oil pan. At this moment, the oil pan rests on the axle housing and front sub frame.

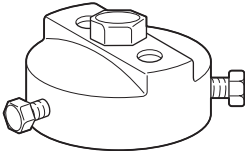


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

TROUBLE DIAGNOSIS

Symptom	Cause	Action
Excessive oil consumption	<ul style="list-style-type: none"> Loosened oil drain plug Loosened oil pan bolts Poor sealing at oil seal Loosened oil filter Loosened oil pressure switch Poor sealing at camshaft front oil seal Poor sealing at crankshaft front oil seal Poor sealing at crankshaft rear oil seal Poor sealing at cylinder head cover gasket Damaged cylinder head cover gasket Oil intrusion into combustion chamber Stuck piston ring Worn piston or cylinder Worn piston ring or ring groove Improper position of ring cut-outs Worn or damaged valve mechanism Oil leaks Defective turbo charger 	<ul style="list-style-type: none"> Retighten Retighten Replace Retighten Retighten Replace Replace Replace Replace Replace Clean Remove carbon or replace ring Boring or replace Replace piston and piston ring Adjust Replace Repair Check
Low engine oil pressure	<ul style="list-style-type: none"> Defective lubrication system Improper viscosity Loosened oil pressure switch Low engine oil level Poor oil pump Worn or damaged oil pump relief valve Clogged oil filter or oil strainer Oil leaks 	<ul style="list-style-type: none"> Replace with specified oil Retighten Add Replace Replace Replace or clean Repair

SPECIAL TOOLS AND EQUIPMENT

Name and Part Number	Application
<div>103 589 02 09 00</div> <div>Engine filter cap</div> <div></div>	

GENERAL

ASSY

HOUSING

INTAKE

EXHAUST

LUB

COOLING

FUEL

CONTROL

SENSOR

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

MEMO

SECTION 06

COOLING SYSTEM

COOLING SYSTEM

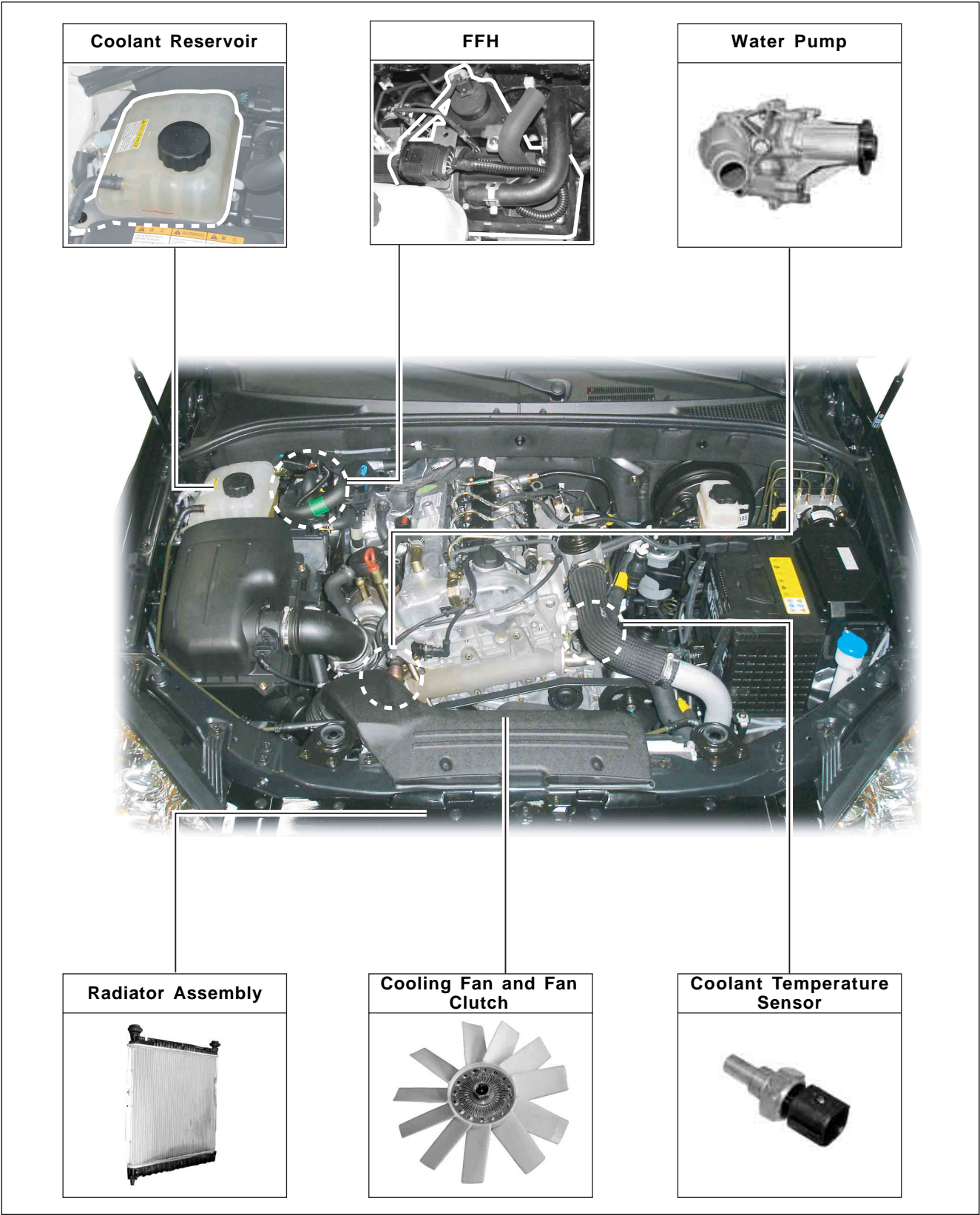
06

■ TABLE OF CONTENTS ■

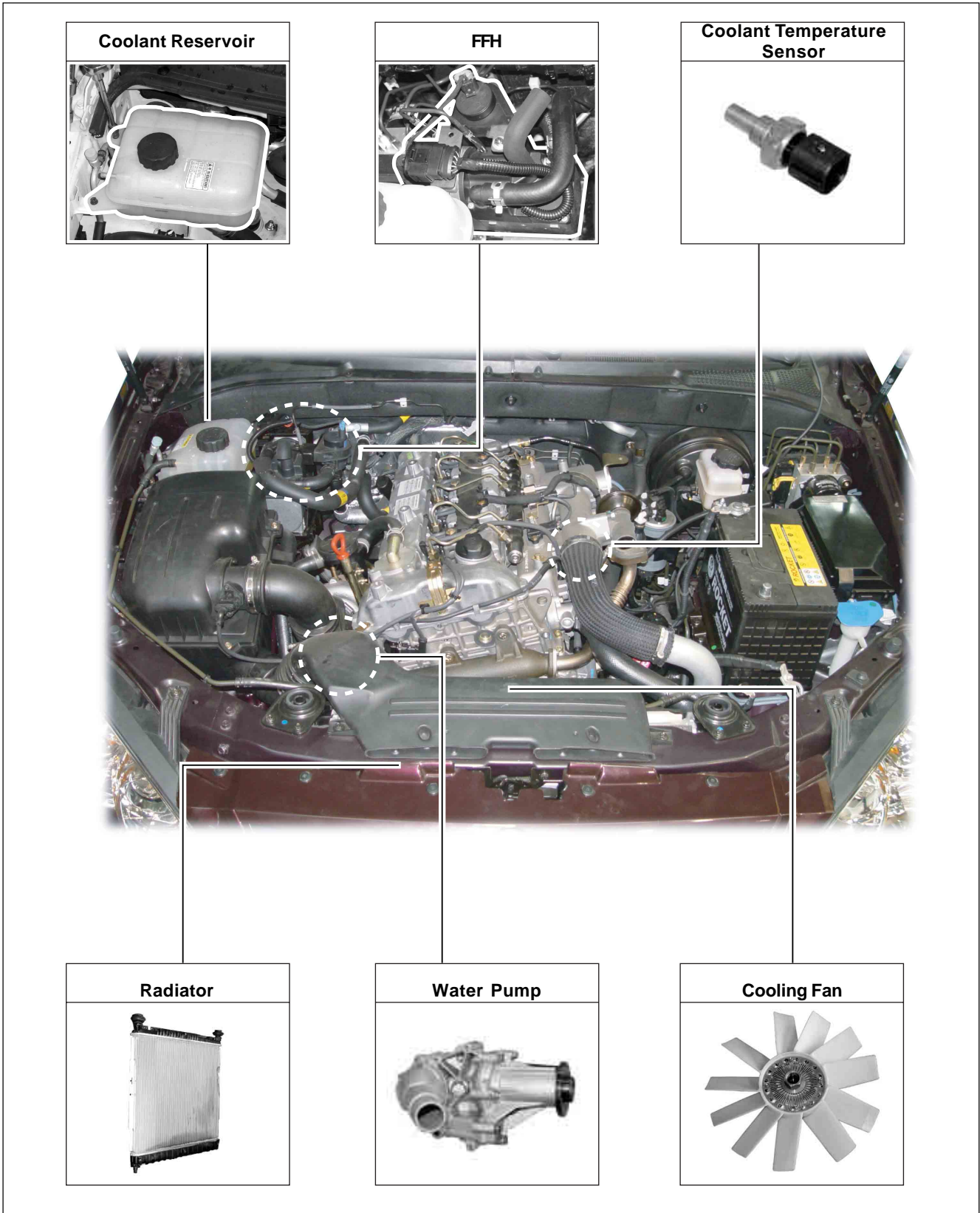
COOLING SYSTEM	2
ENGINE COOLING SYSTEM	4
Specifications	13
INSPECTION AND REPAIR	14
Insection	14
REMOVAL AND INSTALLATION	16
PREHEATING SYSTEM	36
Overview	37
Preheating relay	37
Preheating system diagram	38
Preglow plug	41
SPECIAL TOOLS AND EQUIPMENT	45

COOLING SYSTEM

► D20DT Engine



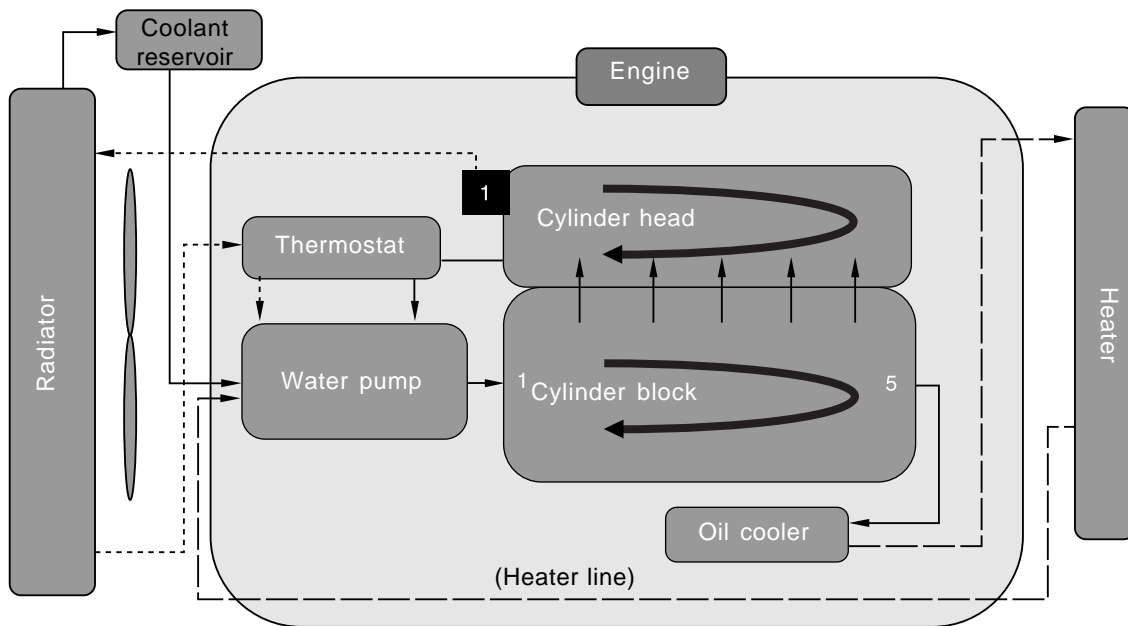
► D27DT Engine



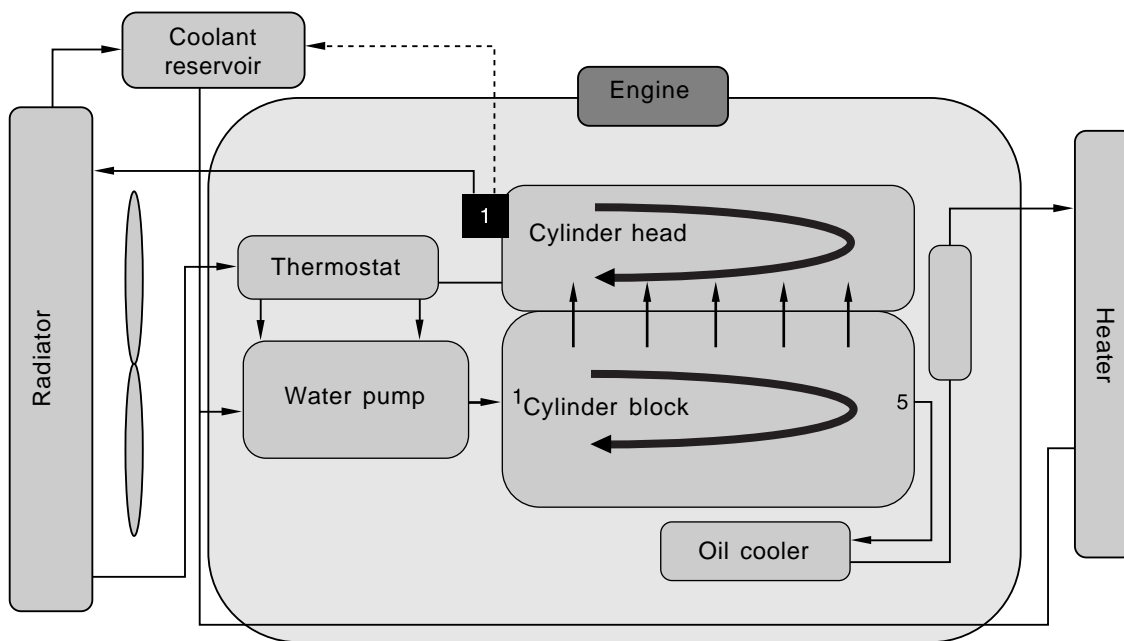
※ FFH (Fuel Fired Heater): refer to “FFH System” in this manual.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

ENGINE COOLING SYSTEM



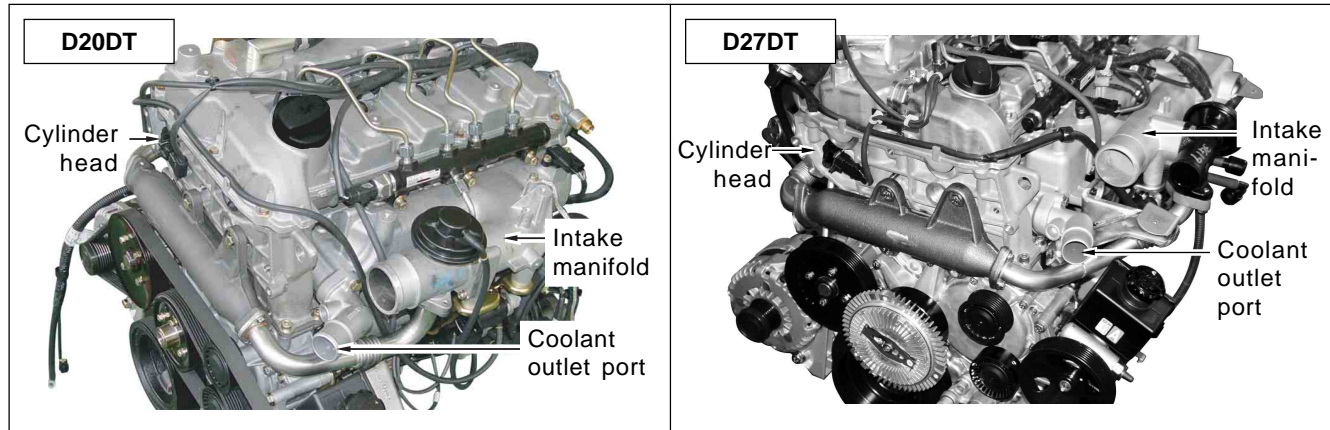
<PTC Engine Coolant Flows>



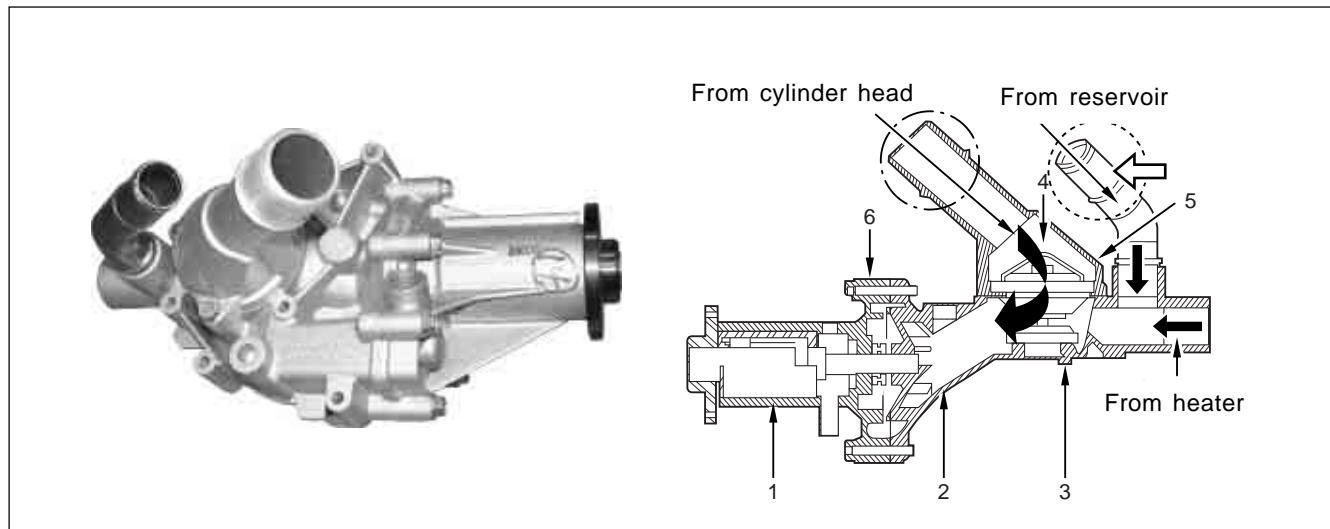
<FFH Engine Coolant Flows>

- Cylinder block side
Block #5 → Oil cooler → Heater → Heater water pump inlet pipe → Water pump
- Cylinder head side
Cylinder head → Coolant outlet port (intake #1) → Radiator → Water pump

► Function Description



1. Cylinder head coolant outlet port is integrated into intake manifold. (in front of cylinder #1)
: Improved shape and gasket material to prevent coolant from leaking



2. In OM 600 engine, coolant inflows through the heater line rear section (cylinder #4 and #5) of cylinder head. However, in D27DT engine, coolant inflows from cylinder block through oil cooler (refer to coolant flows layout in previous page).
: It prevents cooling efficiency from decreasing due to coolant separation between cylinder #4 and #5.
3. In OM 600 engine, the cooling fan is installed with water pump, however, in case of D27DT engine, it is connected to water pump with an additional pulley.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Radiator

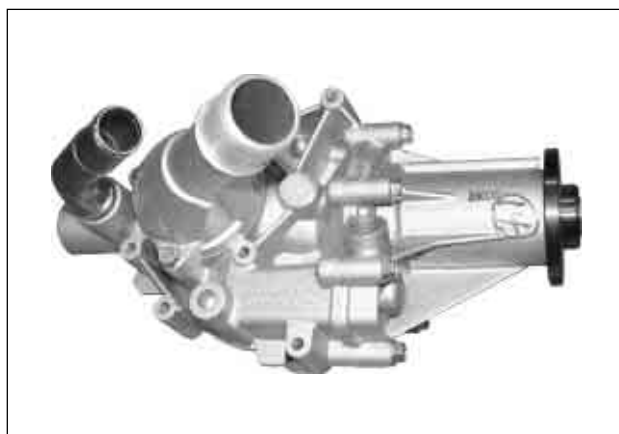
This vehicle has a lightweight tube-and-fin aluminum radiator. Be careful not to damage the radiator core when servicing.



Water pump

The belt-driven centrifugal water pump consists of an impeller, a drive shaft, and a belt pulley. The impeller is supported by a completely sealed bearing.

The water pump is serviced as an assembly and, therefore, cannot be disassembled.



Coolant reservoir

NOTICE

- Scalding hot coolant and steam could be blown out under pressure, which could cause serious injury. Never remove the coolant reservoir cap when the engine and radiator are hot.

The coolant reservoir is a transparent plastic reservoir, similar to the windshield washer reservoir. The coolant reservoir is connected to the radiator by a hose and to the engine cooling system by another hose. As the vehicle is driven, the engine coolant heats and expands. The portion of the engine coolant displaced by this expansion flows from the radiator and the engine into the coolant reservoir. The air trapped in the radiator and the engine is degassed into the coolant reservoir.

When the engine stops, the engine coolant cools and contracts. The displaced engine coolant is then drawn back into the radiator and the engine. This keeps the radiator filled with the coolant to the desired level at all times and increases the cooling efficiency. Maintain the coolant level between the MIN and MAX marks on the coolant reservoir when the system is cold.



► Thermostat

A wax pellet-type thermostat controls the flow of the engine coolant through the engine cooling system. The thermostat is mounted in the water pump housing. The thermostat stops the flow of the engine coolant from the engine to the radiator to provide faster warm-up, and to regulate the coolant temperature. The thermostat remains closed while the engine coolant is cold, preventing circulation of the engine coolant through the radiator. At this point, the engine coolant is allowed to circulate only throughout the heater core to warm it quickly and evenly. As the engine warms, the thermostat opens. This allows the engine coolant to flow through the radiator where the heat is dissipated. This opening and closing of the thermostat permits enough engine coolant to enter the radiator to keep the engine within proper engine temperature operating limits. The wax pellet in the thermostat is hermetically sealed in a metal case. The wax element of the thermostat expands when it is heated and contracts when it is cooled. As the vehicle is driven and the engine warms, the engine coolant temperature increases. When the engine coolant reaches a specified temperature, the wax pellet element in the thermostat expands and exerts pressure against the metal case, forcing the valve open. This allows the engine coolant to flow through the engine cooling system and cool the engine. As the wax pellet cools, the contraction allows a spring to close the valve. The thermostat begins to open at 85°C and is fully open at 100°C. The thermostat closes at 85°C.



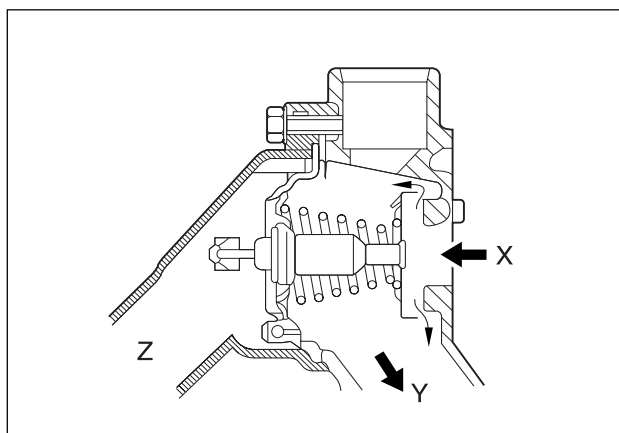
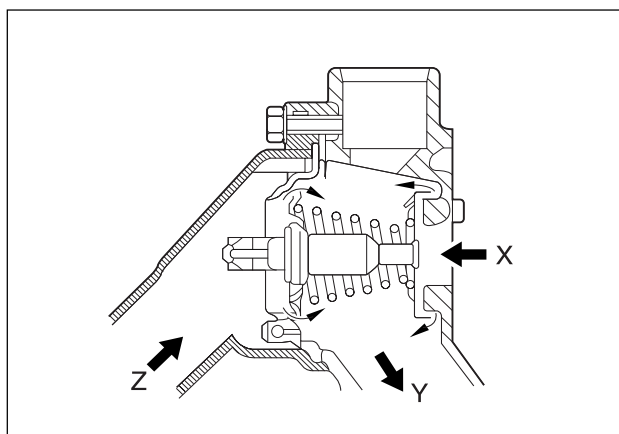
Thermostat	Operating Temperature (°C)	Opening Value (mm)
Begins to open	85°C	0.1 mm
Fully open	100°C	8 mm

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

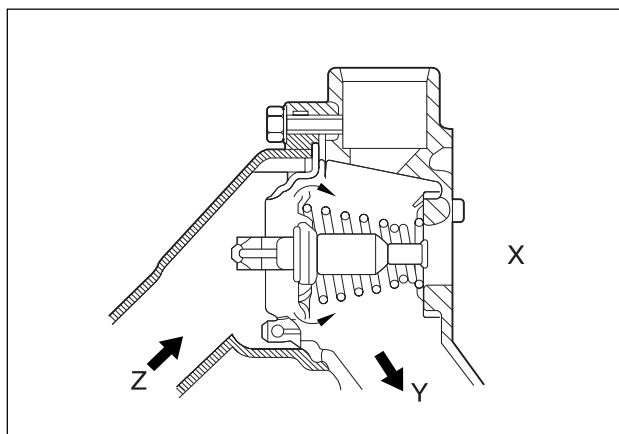
GENERAL
ASSY
HOUSING
INTAKE
EXHAUST
LUB
COOLING
FUEL
CONTROL
SENSOR

When closed (up to 85°C)

- X. from cylinder head
- Y. to crankcase
- Z. from radiator

**When partially opened (85°C ~ 100°C)****When fully opened (above 100°C)**

If the cooling system is fully filled with, the coolant is automatically bled through ball valve (arrow) in thermostat.



Viscous fan clutch

The cooling speed increases approx. 1,000 rpm with wind noise when the engine speed is 4,000 to 4,500 rpm and the coolant temperature is 90 to 95°C.



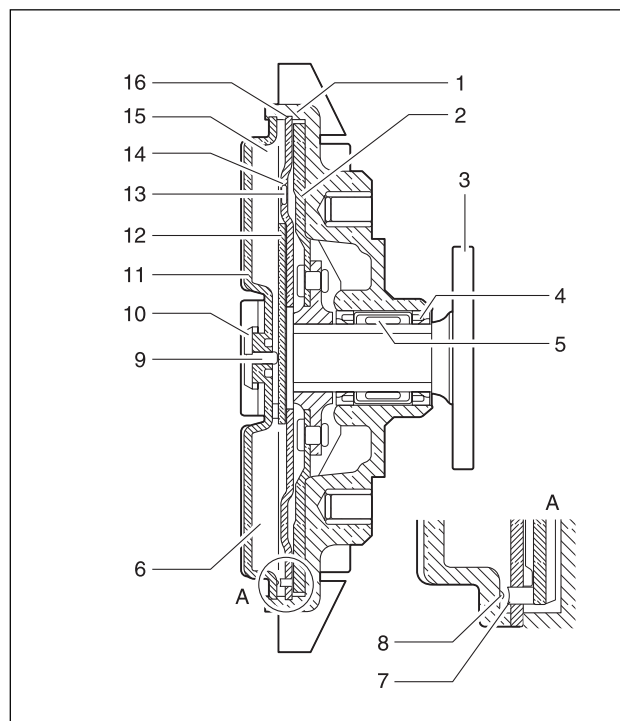
NOTICE

- Keep hands, tools, and clothing away from the engine cooling fans to help prevent personal injury. This fan is electric and can turn on even when the engine is not running.



NOTICE

- If a fan blade is bent or damaged in any way, no attempt should be made to repair or reuse the damaged part. A bent or damaged fan assembly should always be replaced with a new one to prevent possible injury.



- | | |
|-------------------|-----------------------|
| 1. Clutch housing | 9. Pin |
| 2. Drive disc | 10. Bi-metal |
| 3. Flange | 11. Bracket cover |
| 4. Seal ring | 12. Separator disc |
| 5. Needle bearing | 13. Supply port |
| 6. Cooling fan | 14. Lever valve |
| 7. Oil scraper | 15. Oil chamber |
| 8. Spring | 16. Operating chamber |

The cooling fans are mounted behind the radiator in the engine compartment. The electric cooling fans increase the flow of air across the radiator fins and across the condenser on air conditioner. The fan is 320 mm in diameter with five blades to aid the airflow through the radiator and the condenser. An electric motor attached to the radiator support drives the fan.

1. A/C Off or Non-AC Model

- 1) The cooling fan operates at low speed when the coolant temperature reaches 95°C and at high speed when the coolant temperature reaches 100°C.
- 2) The cooling fan is turned from high speed to low speed at 97°C and turns off at 90°C.

2. A/C On

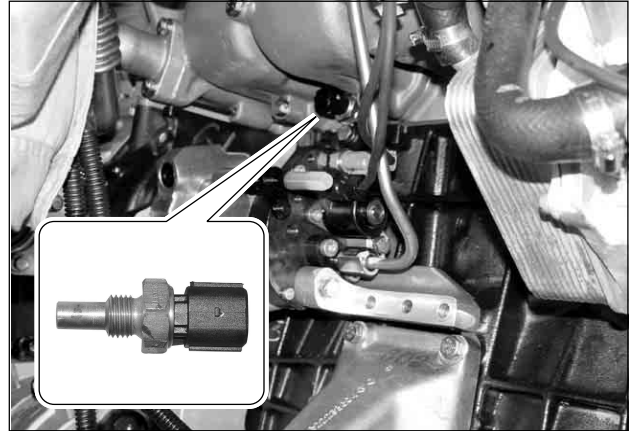
- 1) The ECU will turn the cooling fan on at high speed when the A/C system is on.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Engine coolant temperature sensor

The Engine Coolant Temperature (ECT) sensor uses a temperature to control the signal voltage to the Engine Control Unit (ECU).

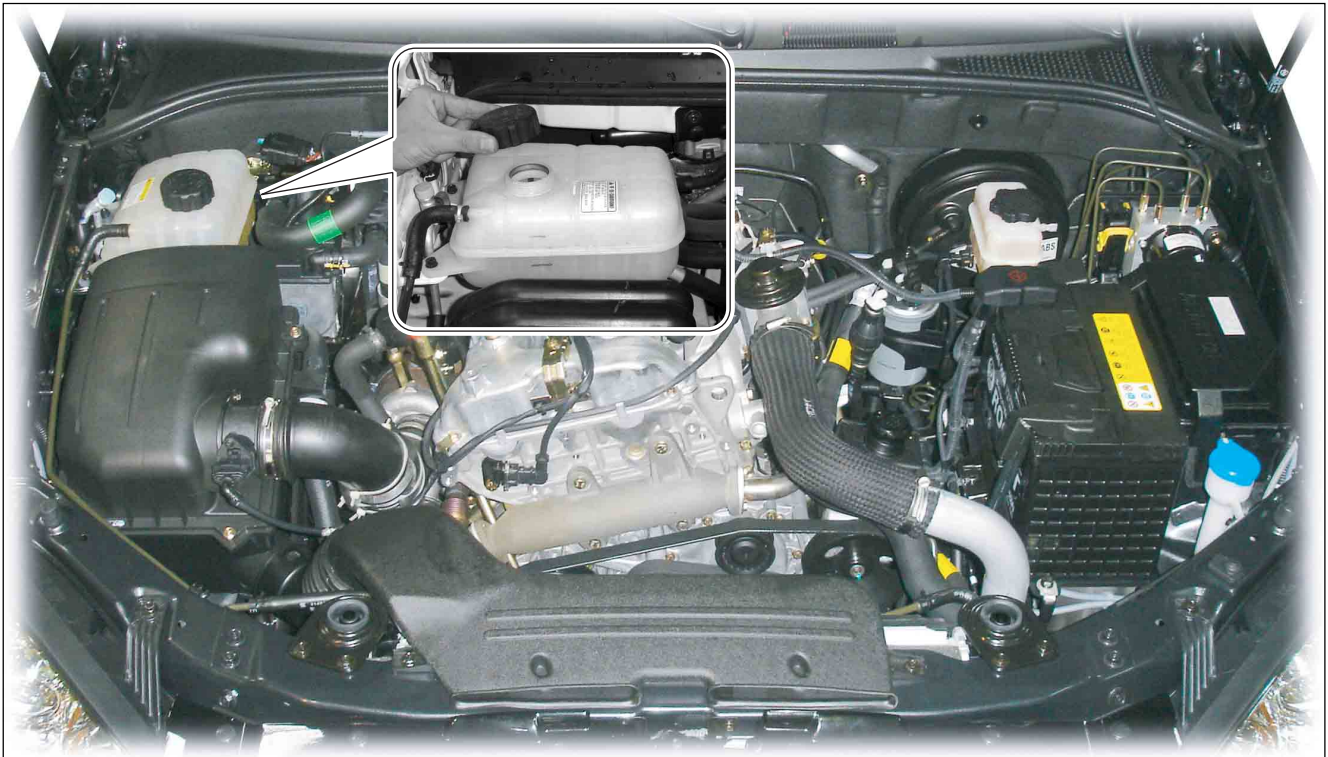


► Coolant Level Check

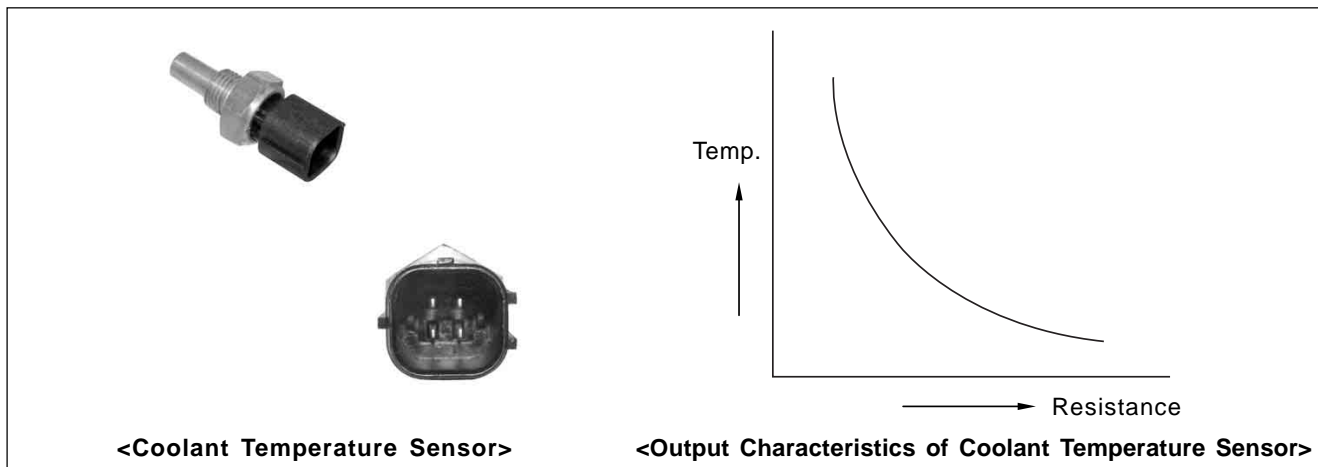
NOTICE

- Scalding hot coolant and steam could be blown out under pressure, which could cause serious injury. Never remove the coolant reservoir cap when the engine and radiator are hot.
- Take precautions to prevent antifreeze coming in contact with the skin, eyes or vehicle body. If contact happens, rinse affected areas immediately with plenty of water.

1. Place the vehicle on a level ground and check the coolant level through the coolant reservoir.
2. Add if needed. Change the coolant if necessary.



► Coolant Temperature Sensor



Coolant temperature sensor is a NTC resistor that sends coolant temperature to ECU.

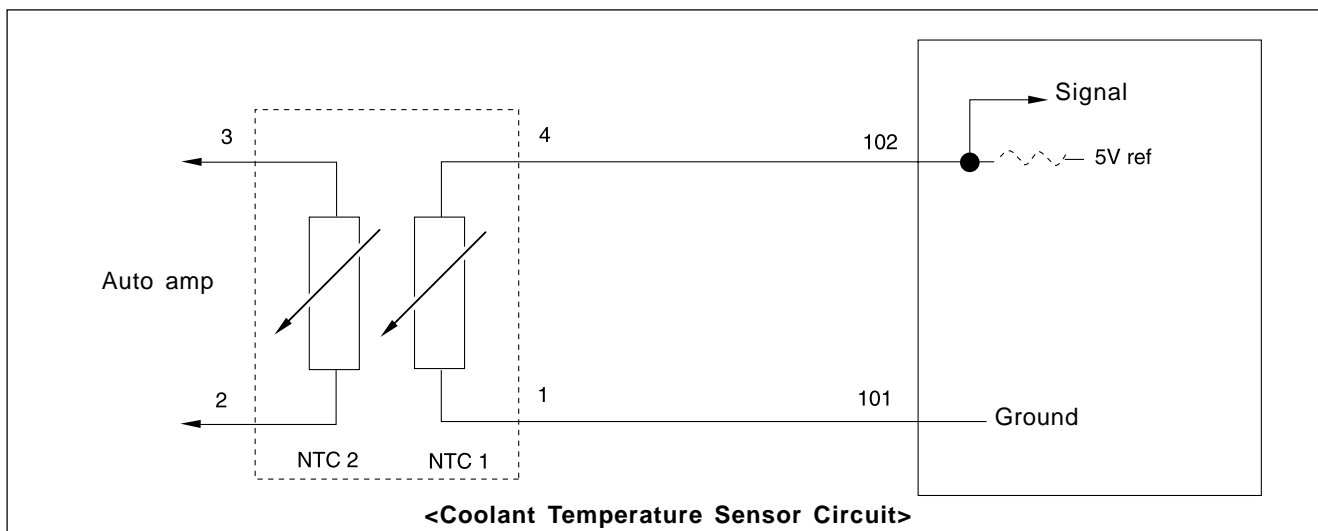
NTC resistor has characteristics that if the engine temperature rises, the resistance lowers so the ECU detects lowering signal voltages.

If the fuel injected into the engine through injector has more turbulence, then combusts very well. However, if engine temperature is too low, the fuel injected as foggy state forms big compounds causing incomplete combustion. So the sensor detects coolant temperature and changes coolant temperature changes into voltage then sends to ECU to increase the fuel volume during cold start for better starting. And detects engine overheating for fuel volume reduction to protect the engine.

ECU functions as below with coolant temperature sensor signals.

1. When engine is cold, controls fuel volume to correct idle speed
2. When engine is overheated, controls electrical fan and A/C compressor to protect the engine
3. Sends information for emission control

Temperature	NTC 1 Resistance (Ω)	NTC 2 Resistance (Ω)
20	2,550	6,062
50	826	1,800
80	321	638
120	123	200



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► Trouble Diagnosis

Symptom	Cause	Action
Low coolant level	<ul style="list-style-type: none"> Leaks in radiator Leaks in coolant reservoir Leaks in heater core 	<ul style="list-style-type: none"> Replace radiator Replace coolant reservoir Replace heater
	<ul style="list-style-type: none"> Leaks in hose connection Damaged coolant hose 	<ul style="list-style-type: none"> Reconnect hose or replace clamp Replace hose
	<ul style="list-style-type: none"> Leaks in water pump gasket Leaks in water pump internal seal 	<ul style="list-style-type: none"> Replace gasket Replace water pump
	<ul style="list-style-type: none"> Leaks in coolant inlet cap Leaks in thermostat housing 	<ul style="list-style-type: none"> Replace water inlet cap gasket Replace thermostat sealing
	<ul style="list-style-type: none"> Improper tightening torque of cylinder head Damaged cylinder head gasket 	<ul style="list-style-type: none"> Retighten Replace cylinder head gasket
Excessively high coolant temperature	<ul style="list-style-type: none"> Coolant leaks (too low coolant level) Improper coolant mixture ratio Kinked coolant hose 	<ul style="list-style-type: none"> Add coolant Check coolant concentration Repair or replace hose
	<ul style="list-style-type: none"> Defective thermostat Defective water pump Defective radiator Defective coolant reservoir and cap 	<ul style="list-style-type: none"> Replace thermostat Replace water pump Replace radiator Replace coolant reservoir or cap
	<ul style="list-style-type: none"> Cracks on cylinder head or cylinder block Clogged coolant passages in cylinder head or cylinder block 	<ul style="list-style-type: none"> Replace cylinder head or cylinder block Clean coolant passages
	<ul style="list-style-type: none"> Clogged radiator core 	<ul style="list-style-type: none"> Clean radiator core
	<ul style="list-style-type: none"> Improper operation of cooling fan 	<ul style="list-style-type: none"> Replace cooling fan or repair related circuit
	<ul style="list-style-type: none"> Faulty temperature sensor or defective harness 	<ul style="list-style-type: none"> Replace sensor or repair related circuit
Excessively low coolant temperature	<ul style="list-style-type: none"> Stuck thermostat (with open) 	<ul style="list-style-type: none"> Replace thermostat
	<ul style="list-style-type: none"> Improper operation of cooling fan 	<ul style="list-style-type: none"> Replace cooling fan or repair related circuit
	<ul style="list-style-type: none"> Faulty temperature sensor or defective harness 	<ul style="list-style-type: none"> Replace sensor or repair related circuit

SPECIFICATIONS

	Description	Unit	Specification
Cooling system	Type	-	Water cooling forced circulation
Coolant	Capacity	ℓ	11.3
Thermostat	Type	-	Wax pellet type
	Initial opening temperature	°C	85
	Fully opening temperature	°C	100
	Fully closing temperature	°C	83
	Stroke	mm	min. 8
Cooling fan	Blades		5
	Diameter	mm	320 (2)
	Low speed ON temp	°C	91
	Low speed OFF temp	°C	88
	High speed ON temp	°C	95
	High speed OFF temp	°C	92
	High speed ON temp. (By A/C pressure)	psi	270
Coolant reservoir	Pressure valve opening pressure	Kg/cm ²	1.2 ~ 1.5
	Vacuum valve opening pressure	Kg/cm ²	0.1
Water pump	Type	-	Centrifugal
	Impeller diameter	mm	72.3
	Impeller blades		10
Radiator	Type	-	Down-flow
	Core width	mm	701
	Core height	mm	372
	Core thickness	mm	18
	Minimum radiation capability	Kcal/h	45,000
Coolant temperature sensor	Resistance (at 20°C)	KΩ	3.33 ~ 3.78
	Resistance (at 80°C)	KΩ	0.32 ~ 0.35
Anti-freeze agent	Type	-	ALUTEC-P78
	Mixture ratio (water and anti-freeze)	-	50 : 50

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

INSPECTION AND REPAIR

INSPECTION

Cooling System

1. Release the pressure from coolant reservoir by loosening one notch of coolant reservoir cap, and then remove the cap.



NOTICE

- Scalding hot coolant and steam could be blown out under pressure, which could cause serious injury. Never remove the coolant reservoir cap when the before the temperature goes down below 90°C.

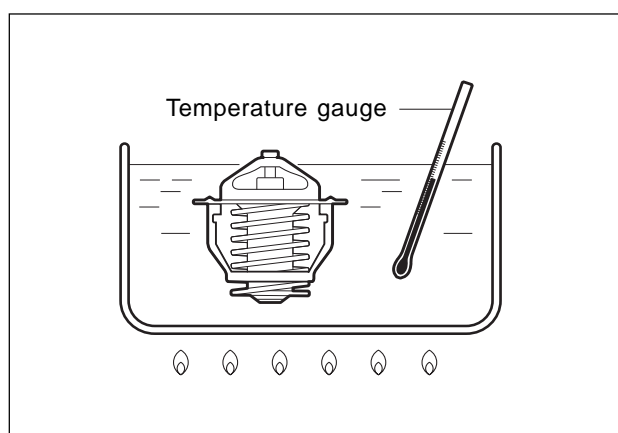
2. Add the coolant up to upper mark (arrow) on the reservoir.
3. Install the tester to the coolant reservoir and apply the pressure of 1.4 bar.
4. Check the coolant hoses, pipes and connections for leaks after the pointer of the tester drops. Replace or retighten as required.



Thermostat

Immerse the thermostat into the water. Heat the water and check the valve opening temperature.

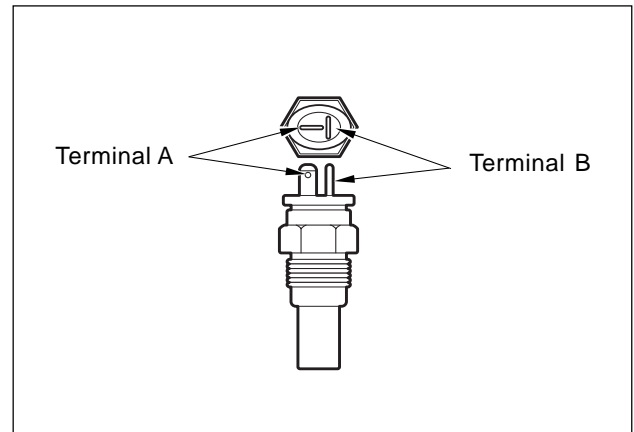
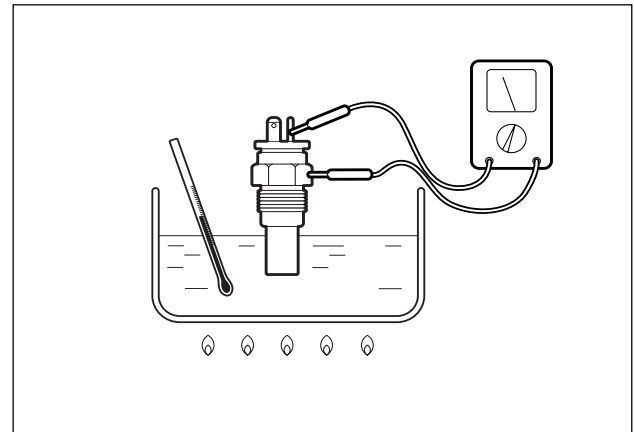
Valve opening temperature	DI Engine: 85 ± 2° C
---------------------------	----------------------



Coolant Temperature Gauge Unit

1. Immerse the sensor unit into the water. Heat the water and check the resistance.
2. If the measured resistance is out of specified value, replace the gauge unit.
3. Measure the resistance between terminal A and gauge unit housing, and terminal B and gauge unit housing.

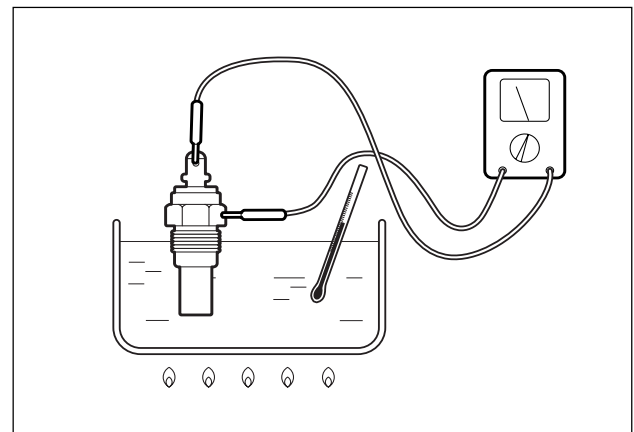
Terminal A (for coolant temp.)	0.4 Ω / 79° C
	23.8 Ω / 115° C
Terminal B (for glow plug)	24.8 Ω / -20° C
	3.25 Ω / 20° C



Thermostat

1. Immerse the thermostat into the oil. Heat the oil until it reaches the specified temperature and check if the coolant temperature switch is turned "OFF".

Coolant temperature at point A	113 \pm 3° C
Coolant temperature at point B	116° C



NOTICE

- Use only engine oil for this inspection. Stir the oil during heating it. Never heat the oil over required temperature.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

REMOVAL AND INSTALLATION

Coolant Hose (Inlet/Outlet)

※ **Preceding Work:** Draining of coolant

1. Loosen the clamp and remove the coolant outlet hose (engine to radiator).



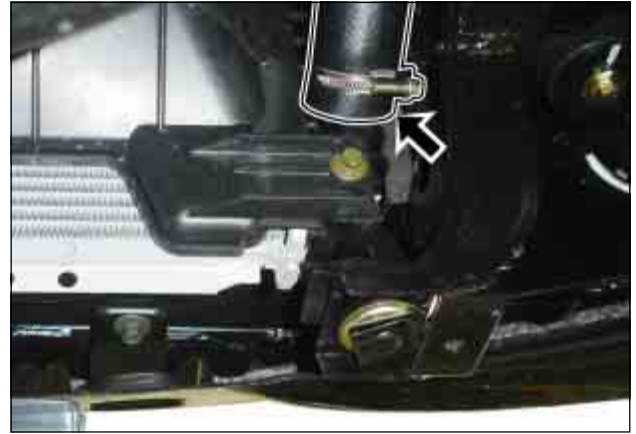
2. Disconnect the HFM sensor connector.
3. Remove the air intake duct from the air cleaner.



4. Loosen the clamp and remove the coolant inlet hose (radiator to thermostat housing).



5. Lift up the vehicle and remove the skid plate.
6. Loosen the clamp and remove the lower inlet hose.



Shroud and Cooling Fan/Clutch

※ Preceding Work:

1. Draining of coolant
 2. Removal of coolant inlet and outlet hose
1. Remove the air cleaner duct.
 2. Release the clamps and remove the intake hose.
 3. Unscrew the fan shroud mounting bolts.



GENERAL

ASSY

HOUSING

INTAKE

EXHAUST

LUB

COOLING

FUEL

CONTROL

SENSOR

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

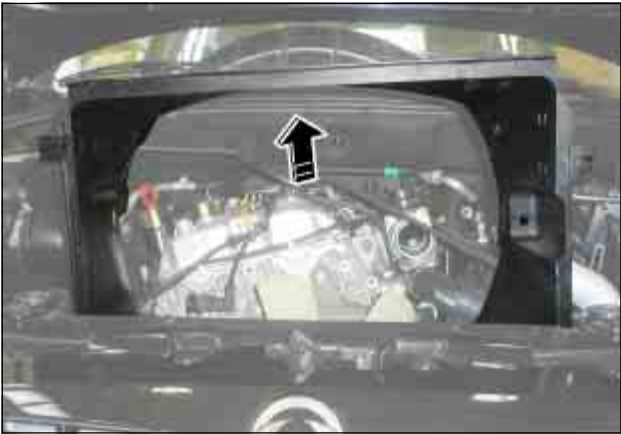
- 5. Unscrew the center bolt and remove the cooling fan clutch while holding the pulley with counter holder (special tool).

Installation Notice

Tightening torque	45 ± 4.5 Nm
-------------------	-------------



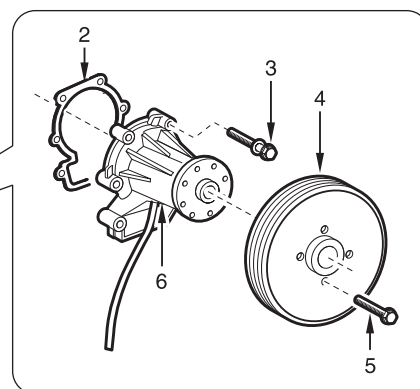
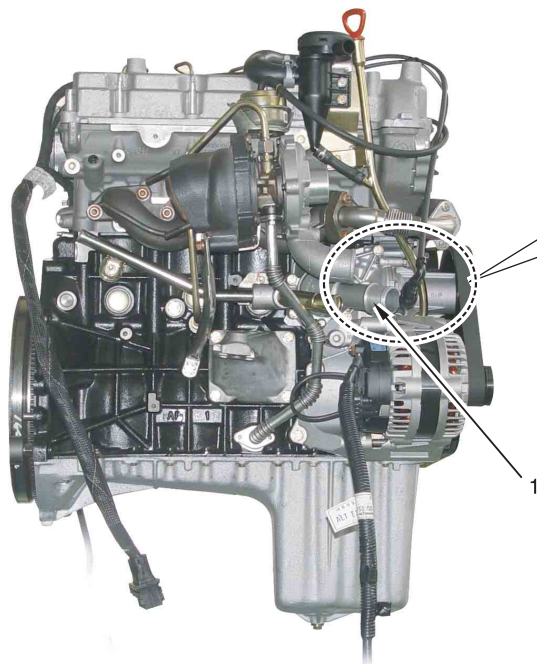
- 6. Remove the shroud.
- 7. Install in the reverse order of removal.



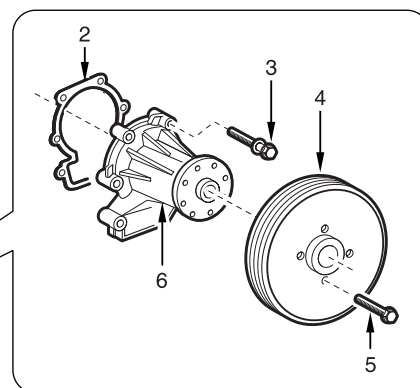
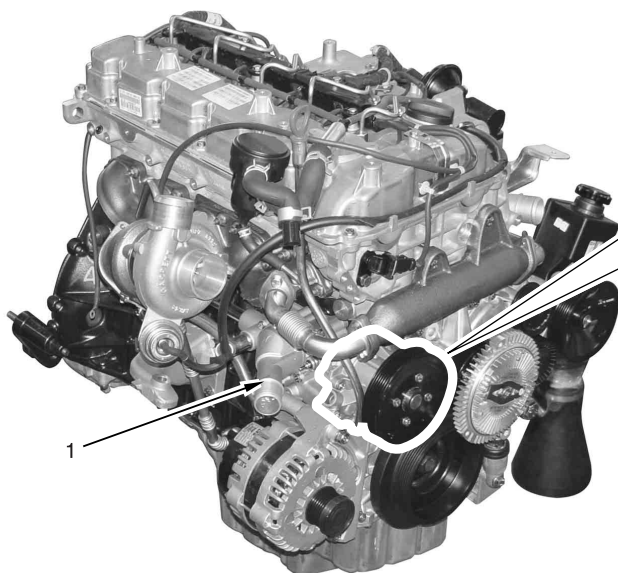
Water Pump - Assembly

- ※ **Preceding Works:**
1. Draining of coolant
 2. Removal of V-belt
 3. Removal of shroud
 4. Removal of cooling fan

D20DT



D27DT



- | | | | |
|-----------------------|---------|-------------------------------|-------|
| 1. Thermostat housing | | 4. Belt pulley | |
| 2. Gasket | Replace | 5. Bolt | 10 Nm |
| 3. Bolt | 10 Nm | 6. Water pump bearing housing | |

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

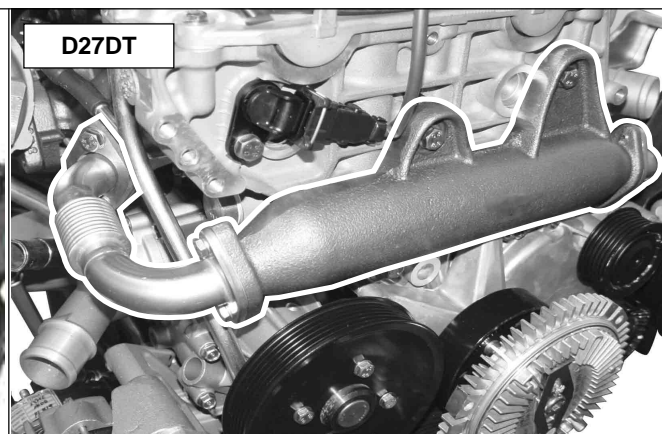
1. Remove the V-belt while pressing down the auto tensioner adjusting bolt.



2. Unscrew the bolts and remove the EGR pipe and bracket.

Installation Notice

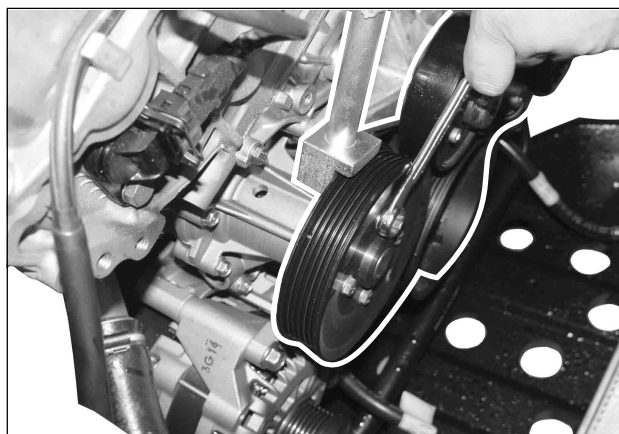
Tightening torque	23 ± 2.3 Nm
-------------------	-------------



3. Unscrew the bolts and remove the belt pulley while holding the belt pulley with a special tool.

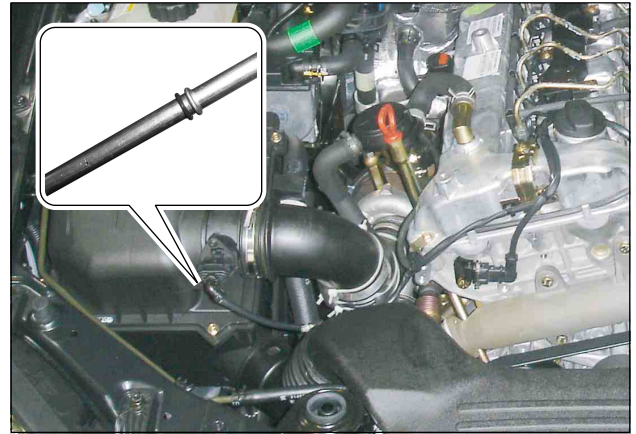
Installation Notice

Tightening torque	10 Nm
-------------------	-------



**NOTICE**

- Replace the O-ring in oil dipstick with new one.
- Plug the oil dipstick hole with a cap not to get the foreign materials into the engine.



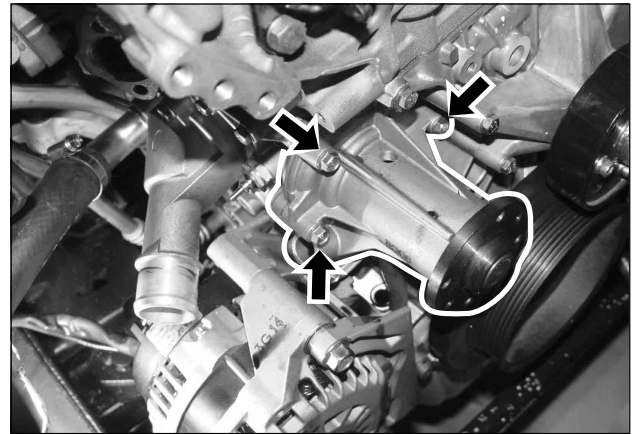
5. Unscrew the bolts and remove the water pump assembly.

Installation Notice

Tightening torque	10 Nm
-------------------	-------

**NOTICE**

- Remove the gasket residues from the sealing surface and replace the gasket with new one.



6. Install in the reverse order of removal.

GENERAL

ASSY

HOUSING

INTAKE

EXHAUST

LUB

COOLING

FUEL

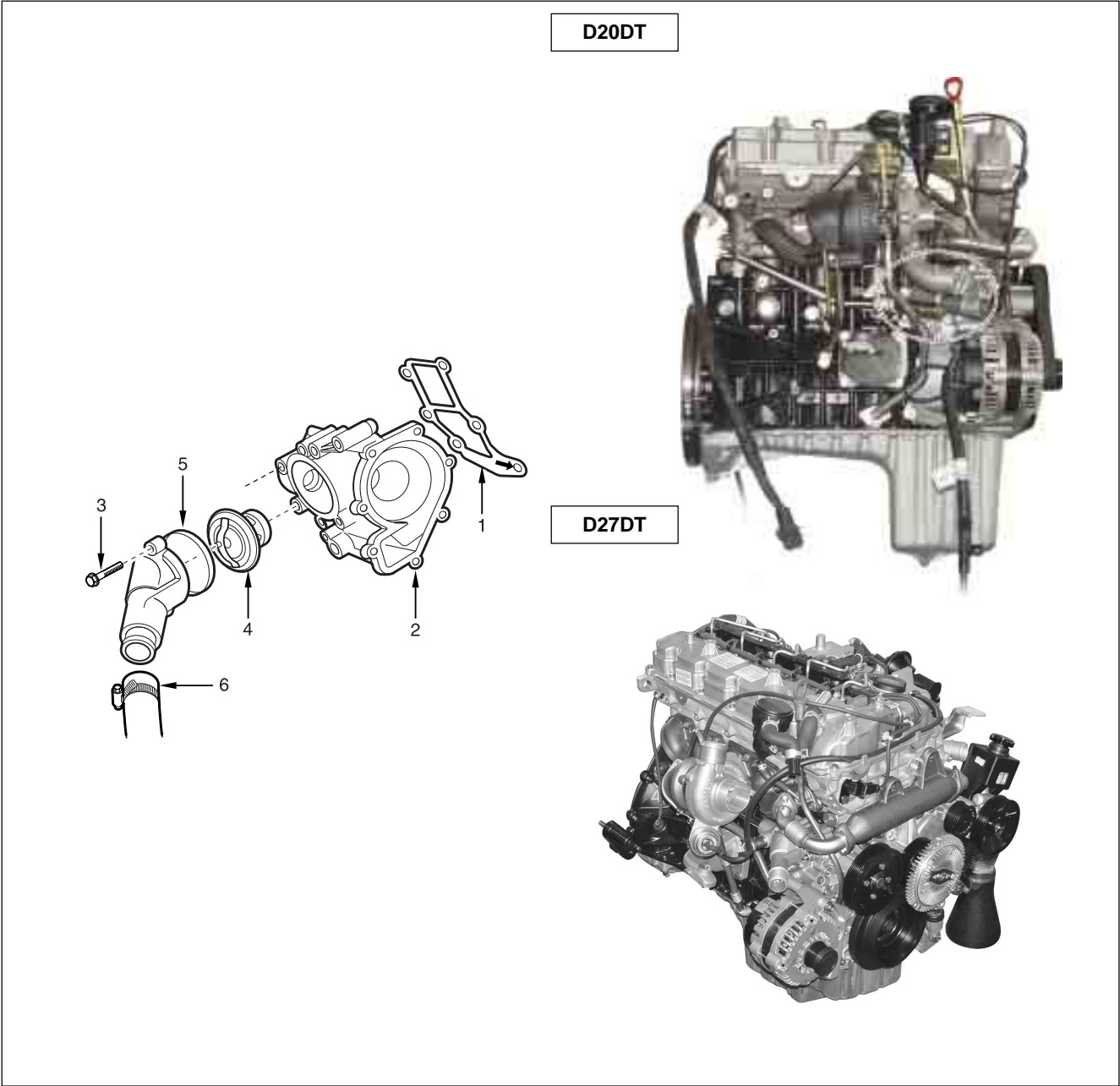
CONTROL

SENSOR

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Thermostat

- ※ **Preceding Works:**
- 1. Draining of coolant
 - 2. Removal of V-belt
 - 3. Removal of cooling fan
 - 4. Removal of intake duct (air cleaner to turbo charger)

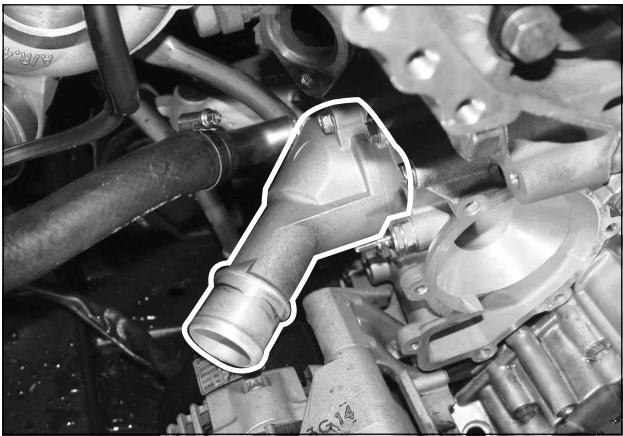


- | | | |
|-----------------------|---------|-----------------|
| 1. Gasket | Replace | 4. Thermostat |
| 2. Water pump housing | | 5. Seal |
| 3. Bolt | 10 Nm | 6. Coolant hose |

1. Unscrew the bolts and remove the thermostat housing.

Installation Notice

Tightening torque	10 ± 1.0 Nm
-------------------	-------------



2. Remove the thermostat.
3. Install in the reverse order of removal.



GENERAL
ASSY
HOUSING
INTAKE
EXHAUST
LUB
COOLING
FUEL
CONTROL
SENSOR

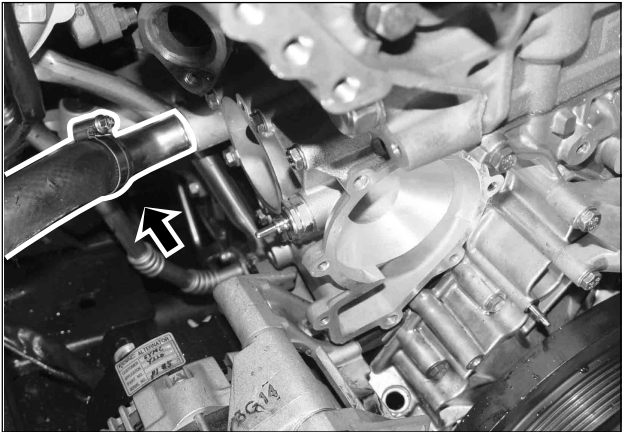
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Water Pump Housing

※ Preceding Works:

- 1. Removal of water pump assembly
- 2. Removal of thermostat assembly

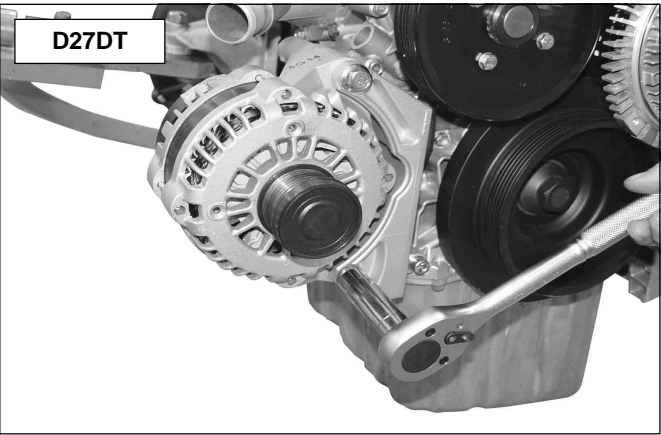
1. Remove the heater hose.



2. Unscrew the bolts and remove the alternator.

Installation Notice

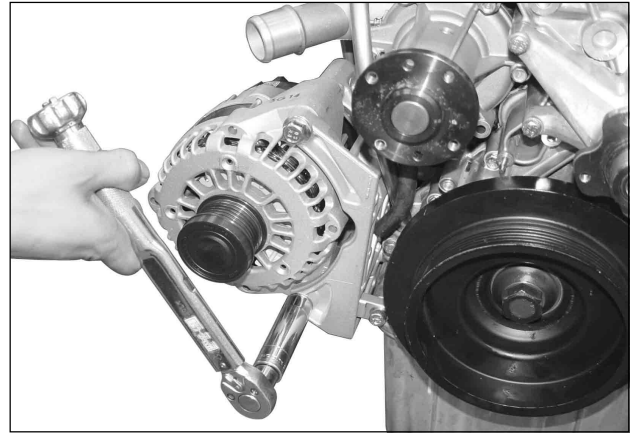
Tightening torque	46 ± 4.6 Nm
-------------------	-------------



3. Unscrew the bolts and remove the alternator bracket.

Installation Notice

Tightening torque	$25 \pm 2.5 \text{ Nm}$
-------------------	-------------------------



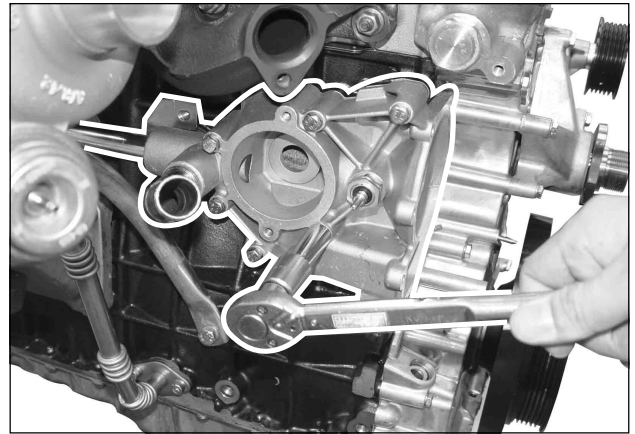
4. Unscrew the bolts and remove the water pump housing.

Installation Notice

Tightening torque	$10 \pm 1.0 \text{ Nm}$
-------------------	-------------------------

**NOTICE**

- Be careful not to damage the O-ring in coolant outlet pipe (cylinder head side).
- Remove the gasket residues from the sealing surface and replace the gasket with new one.



5. Install in the reverse order of removal.

GENERAL

ASSY

HOUSING

INTAKE

EXHAUST

LUB

COOLING

FUEL

CONTROL

SENSOR

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Radiator

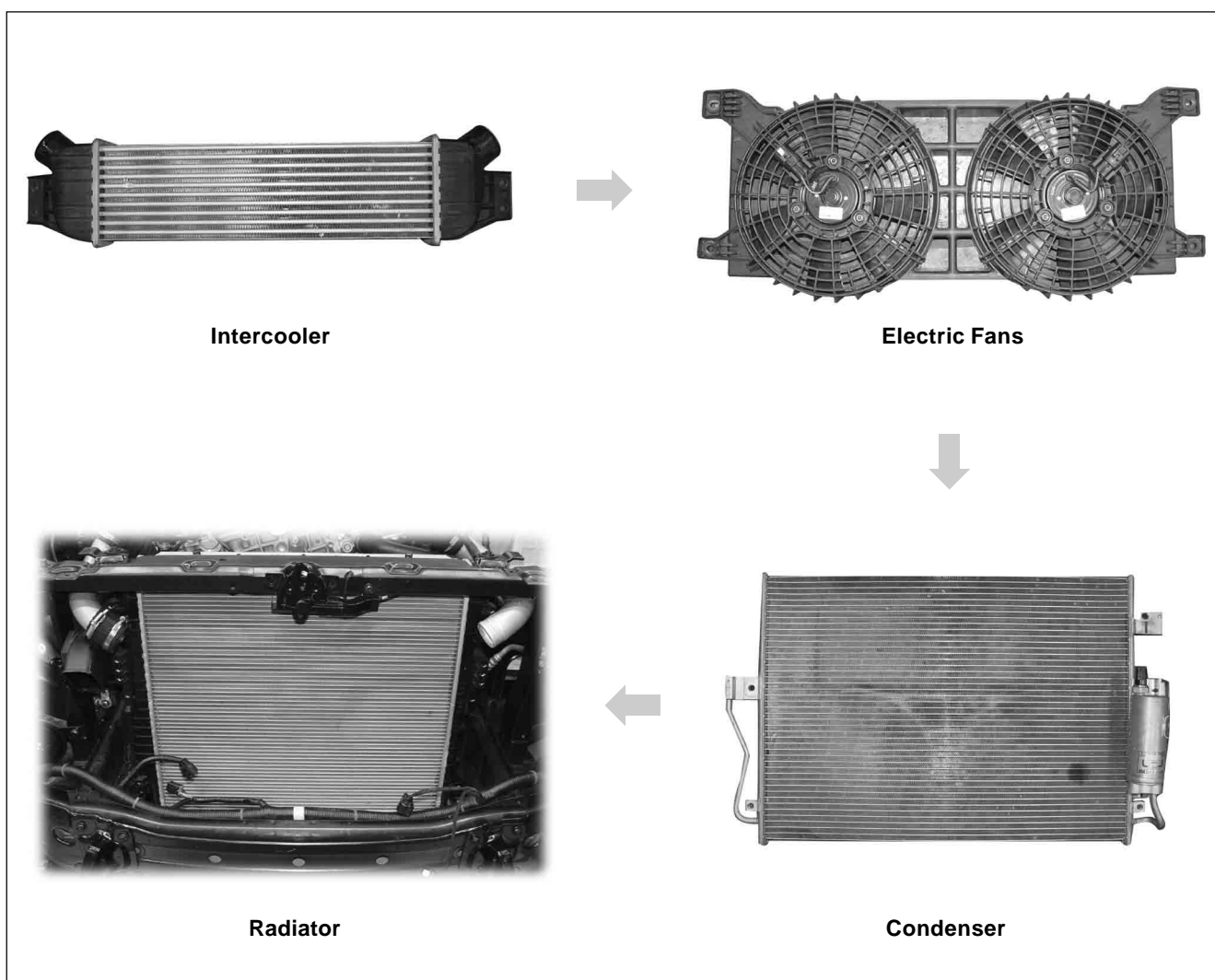
► Components of Radiator Module

Related Components (Assembly): Intercooler, Electric Fans, Condenser, Radiator

※ **Preceding Works:**

1. Disconnection of negative battery cable
2. Removal of front bumper assembly
3. Discharge of refrigerant
4. Draining of engine coolant

► Removal Procedure



Radiator and Intercooler

※ Preceding Works:

1. Collect the refrigerant from A/C system.
2. Remove the lower cover.
3. Drain the engine coolant into the designated container.



NOTICE

- Store the refrigerant and engine coolant in a safe place.



► Removal and Installation

1. Remove the air cleaner duct.

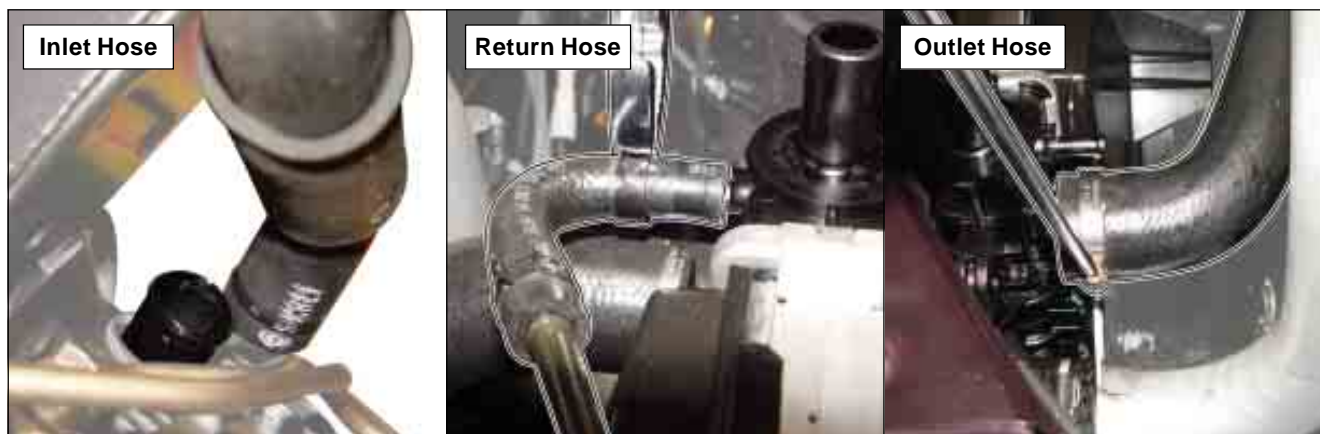


2. Disconnect the intercooler hoses.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

3. Remove the inlet, outlet and return hoses.



4. Remove A/C hose and condenser pipe.



NOTICE

- Plug the openings of the pipes with sealing caps.

5. Unscrew the bolts and remove the radiator brackets.



6. Remove the transmission oil cooler pipes.

Installation Notice

Tightening torque	25 ~ 35 Nm
-------------------	------------

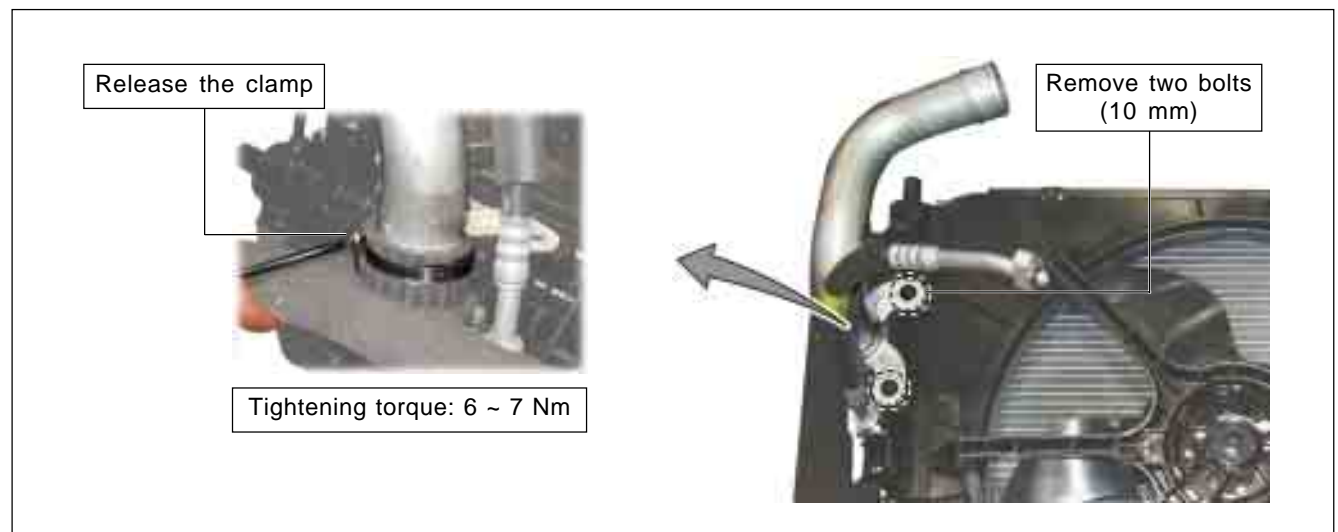


7. Pull out the fixing clips and remove the radiator.



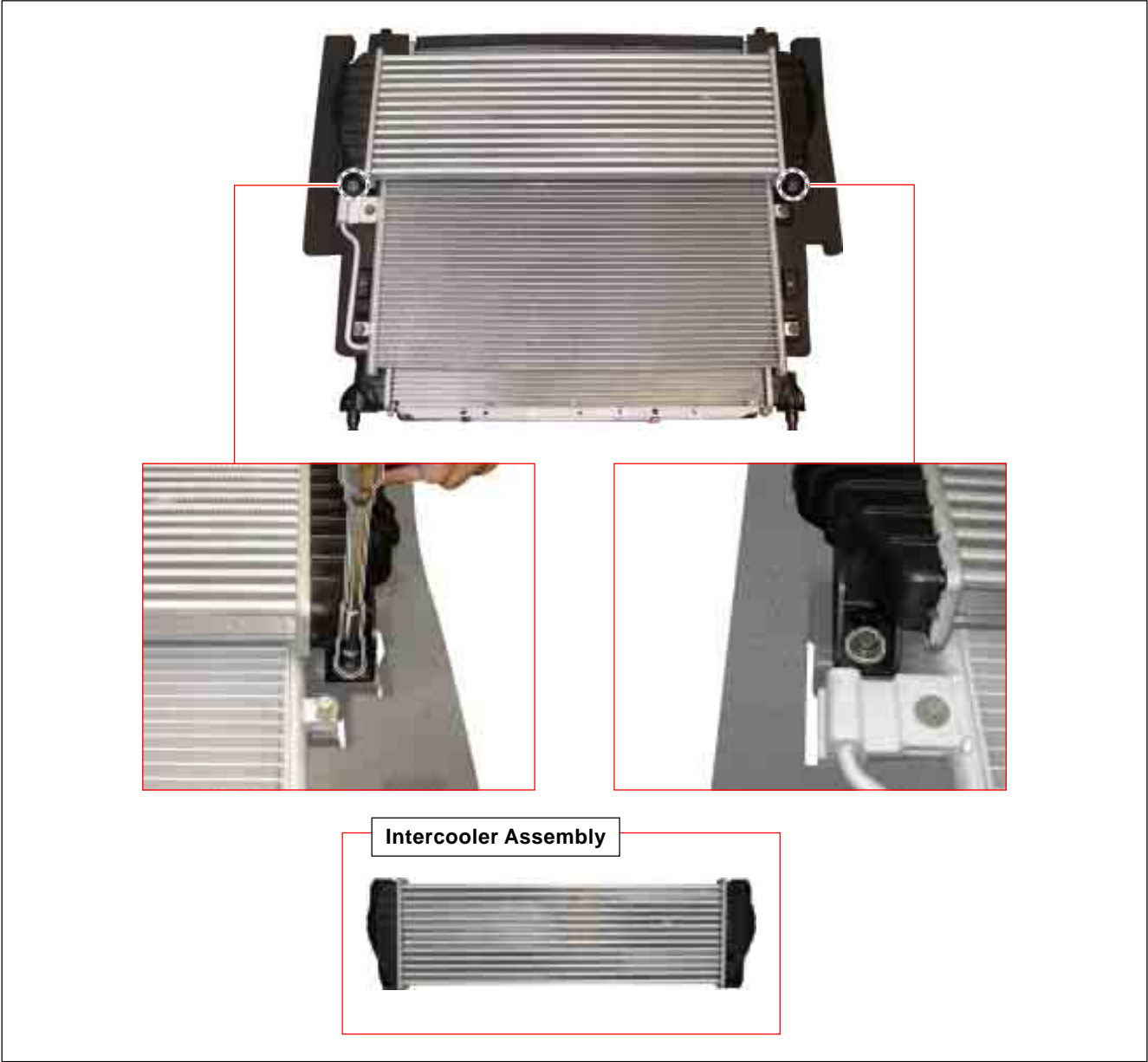
8. Remove the outlet pipe from the intercooler.

Tightening torque	6 ~ 7 Nm
-------------------	----------

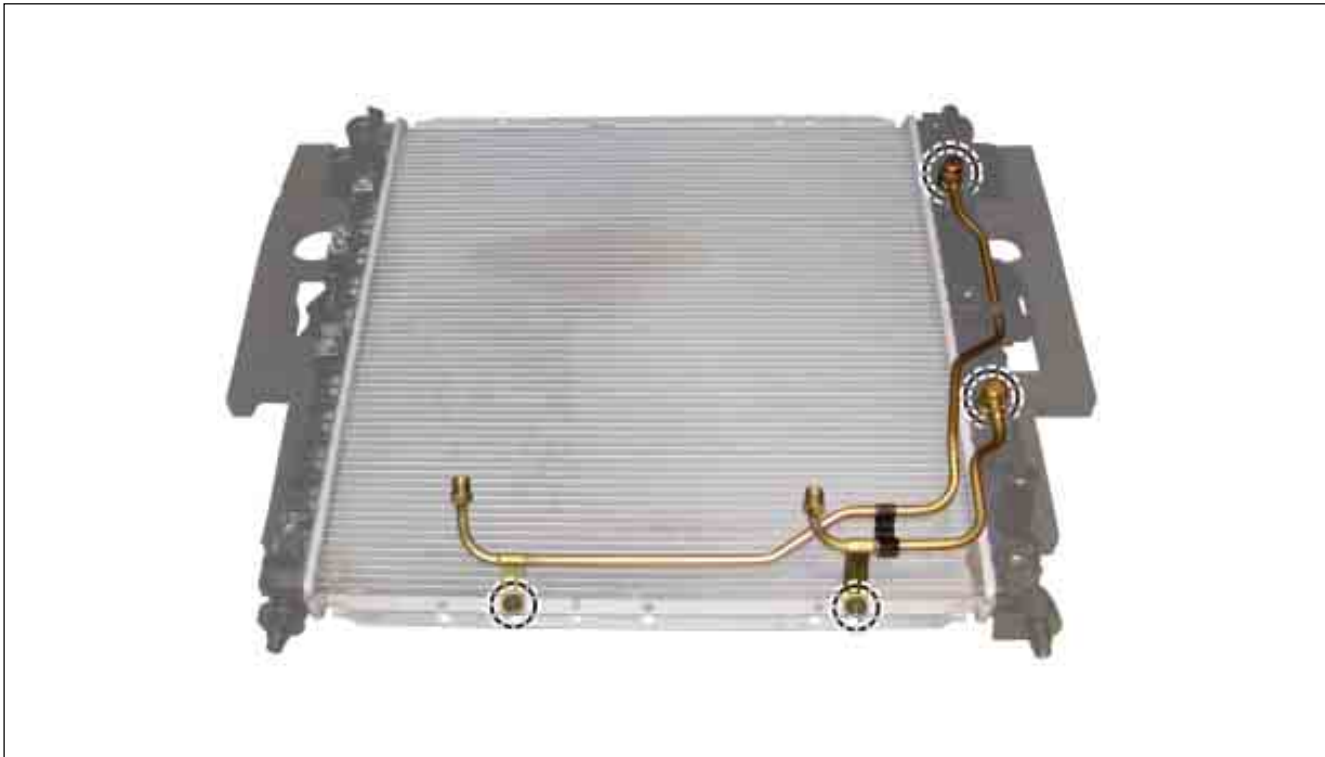


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

9. Unscrew the upper/lower mounting bolts (10 mm) and remove the intercooler from the radiator.



10. Remove the T/M oil cooler pipes from the radiator.



11. Unscrew five bolts (10 mm) and remove the condenser assembly from the radiator.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Replacement of Fan Belt

※ **Preceding Work:** Disconnect the negative battery cable.



1. Turn the fan belt adjusting bolt (19 mm) counterclockwise.



2. Remove the fan belt.



Fan Belt Arrangement

D20DT



D27DT



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Coolant Reservoir

- 1. Drain the coolant.
- 2. Remove the hoses.



- 3. Unscrew the bolts and remove the coolant reservoir.

Installation Notice

Tightening torque	7 Nm
-------------------	------



- 4. Install in the reverse order of removal.

Draining and Adding of Coolant

1. Release the pressure from coolant reservoir by loosening one notch of coolant reservoir cap, and then remove the cap.



NOTICE

- Scalding hot coolant and steam could be blown out under pressure, which could cause serious injury. Never remove the coolant reservoir cap when the before the temperature goes down below 90°C.



2. Loosen the drain plug in bottom of radiator and drain the coolant.



NOTICE

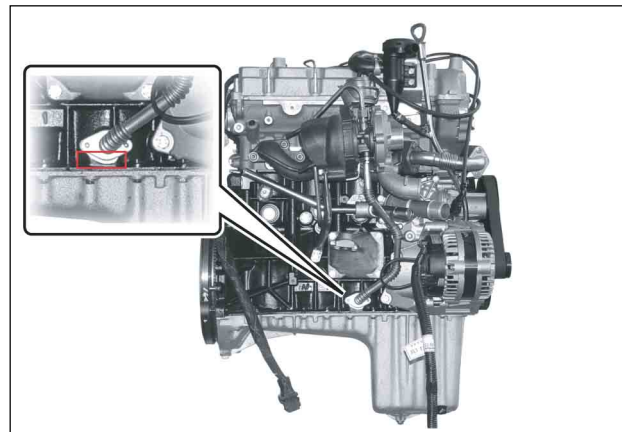
- Collect the drained coolant with a proper container.



3. Remove the drain plug and seal in the cylinder block and drain the coolant.
4. Replace the seal with new one and install the drain plug.

Installation Notice

Tightening torque	30 Nm
-------------------	-------



5. Install the drain plug in bottom of radiator.
6. Add the coolant through the coolant reservoir.



NOTICE

- Keep the coolant mixture ratio of 50:50 (water : anti-freezer).
- Add the coolant until the water flows out through the overflow hose.

7. Warm up the engine until the thermostat begins to open and check if the coolant level is at "FULL" mark on the reservoir. Add if necessary.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

PREHEATING SYSTEM

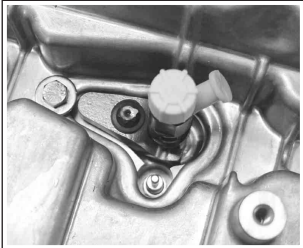
ECU



Glow Indicator (Meter Cluster)



Glow Glug



Preheating Relay



OVERVIEW

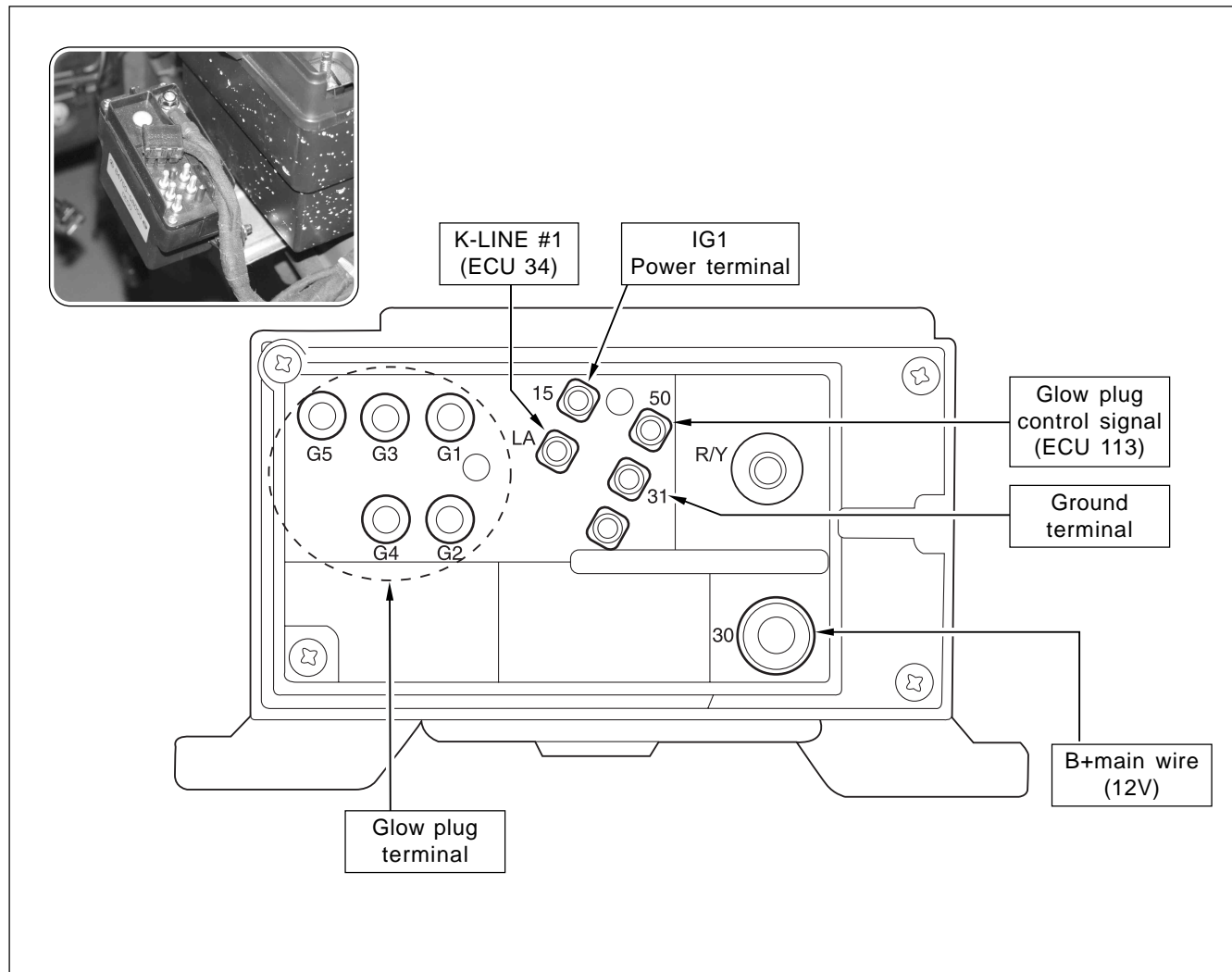
Glow plug is installed on the cylinder head (combustion chamber) in the D27DT preheating control unit system. Cold starting performance has improved and exhaust gas during cold starting has reduced.

ECU receives coolant temperature and engine speed to control; after monitoring the engine preheating/post heating and glow plug diagnosis function, the fault contents will be delivered to ECU.

1. Engine preheating/post heating functions
2. Preheating relay activation by ECU controls
 - 1) Senses engine temperature and controls the preheating/after heating time
 - 2) Glow indicator
3. K-LINE for information exchanges between preheating unit and ECU
 - 1) Transmits preheating unit self-diagnosis results to ECU
 - 2) Transmits glow plug diagnosis results and operating status to ECU

PREHEATING RELAY

► Structure



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Description	Specification
Rated voltage	DC 12 V
Operating voltage range	DC 8 ~ 15 V
Operating range	- 40 ~ + 100°C
Relay operating voltage	Over 6.5 V
Relay releasing voltage	Over 1.5 V
Relay coil resistance	11.3 Ω
Voltage drop	Below 150 mV at each glow plug (at 16A of current)
Parasitic current	MAX 1 mA

► Function

Preheating system controls and checks following functions and operating conditions.

Pre-Heating

1. The power will be supplied to the glow plugs by ECU controls when the power is supplied to the IG terminal from the battery and there are normal communications with ECU within 2 seconds. The surface of glow plug will be heated up to 850°C very quickly to aid combustion by vaporizing air-fuel mixture during compression stroke.
2. Preheating time is controlled by ECU.

Post-heating

1. When the engine is started, post-heating starts by ECU controls. The idle rpm will be increased to reduce toxic smoke, pollutants and noises.
2. Post-heating time is controlled by ECU.

Checking glow plugs

1. Check each glow plug for short in circuit
2. Check each glow plug for open in circuit due to overvoltage
3. Check glow plug for short to ground

Forceful relay shut-down

1. When glow plug is shorted to ground

K-Line communication

1. ECU sends the results to preheating time control relay through K-Line to start communication.
2. Preheating time control relay sends messages including self-diagnosis data for glow plugs to ECU.
3. Glow plug makes communication only as response to demand.
4. When power is supplied, ECU starts self-diagnosis within 2 seconds.
5. Under the following conditions, communication error occurs.
 - 1) When there is no response from glow plug module within 2 seconds
 - 2) When an error is detected in checksum
 - 3) Less byte is received

Error code of "P1720 - Pre heating control communication fail" will be reported.

Operating time

Pre-heating	Coolant Temp.	-35 °C	-25 °C	-20 °C	-10 °C	0 °C	10 °C	20 °C
	Operating Time	31 sec	29 sec	22 sec	17 sec	14 sec	0 sec	0 sec
	Operating Conditions	• IG: "ON" • B+ : below 15.2V			Release Conditions	• After operating time elapsed • IG: "OFF" • When engine cranking		
Post-heating	Coolant Temp.	-30 °C	-20 °C	-10 °C	0 °C	10 °C	20 °C	35 °C
	Operating Time	115 sec	80 sec	30 sec	19 sec	11 sec	11 sec	0 sec
	Operating Conditions	• After engine starting			Release Conditions	• After operating time elapsed • Torque : 190/170 Nm • Speed: 2100/2050 rpm		
Glow Indicator	Coolant Temp.	-30 °C	-25 °C	-20 °C	-10 °C	0 °C	10 °C	20 °C
	Operating Time	18 sec	16 sec	10 sec	5 sec	2 sec	0 sec	0 sec
	Operating Conditions	• IG: "ON"			Release Conditions	• When engine cranking		

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

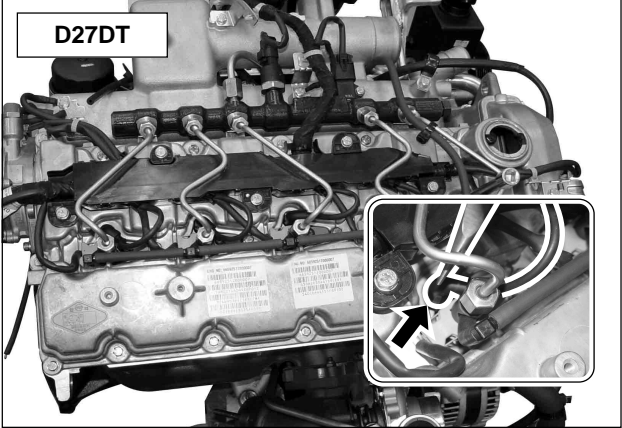
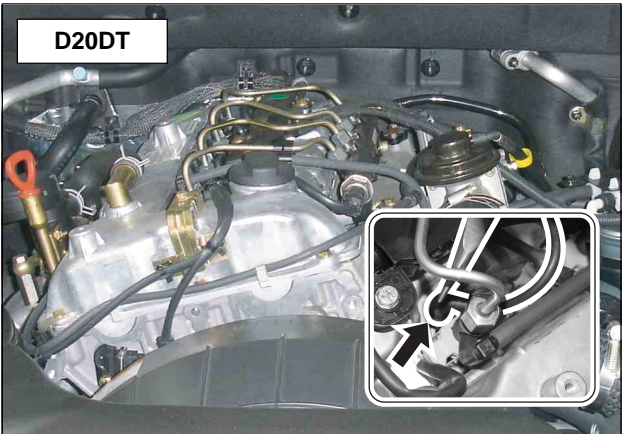
Removal and Installation

- 1. Turn the ignition switch to “OFF” position and disconnect the negative battery cable.
- 2. Set aside the harnesses on the cylinder head.

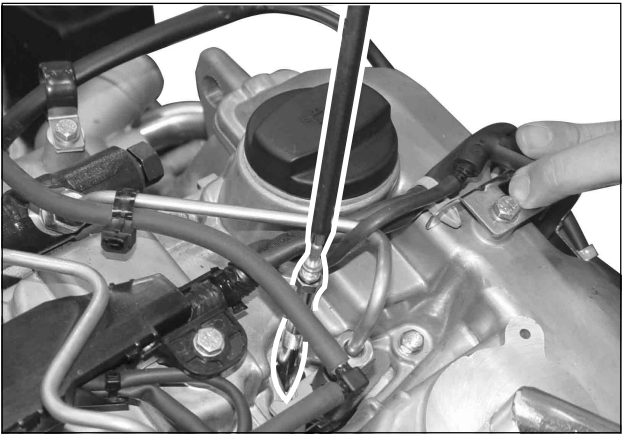
- 3. Disconnect the glow plug connectors and loosen the glow plugs.

Installation Notice

Tightening torque	15 Nm
-------------------	-------



- 4. Remove the glow plugs from the cylinder head with a special tool. Plug the openings of the glow plugs with sealing caps.



PREGLOW PLUG

Two versions of preglow plugs are used in this vehicle.

Always use only the designated version with correct color mark on insulator surface.

► Specifications

BERU version

Color mark on insulator surface: Green

Tip diameter: ϕ 4

Resistance: $680 \pm 110 \text{ m}\Omega$ at $20 \pm 2^\circ\text{C}$

NGK version

Color mark on insulator surface: Yellow

Tip diameter: ϕ 3.5

Resistance: $1400 \pm 300 \text{ m}\Omega$ at $20 \pm 2^\circ\text{C}$



Green



Yellow

The color mark on insulator surface may be invisible due to the carbon contamination. To check the color easily, disconnect the harness connector and clean the preglow plug mounting area with carbon cleaner.

Wait for a while and blow out the area with a compressed air.

Clean and Blow Out



Air gun

Check the Color Mark



Check the color mark

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

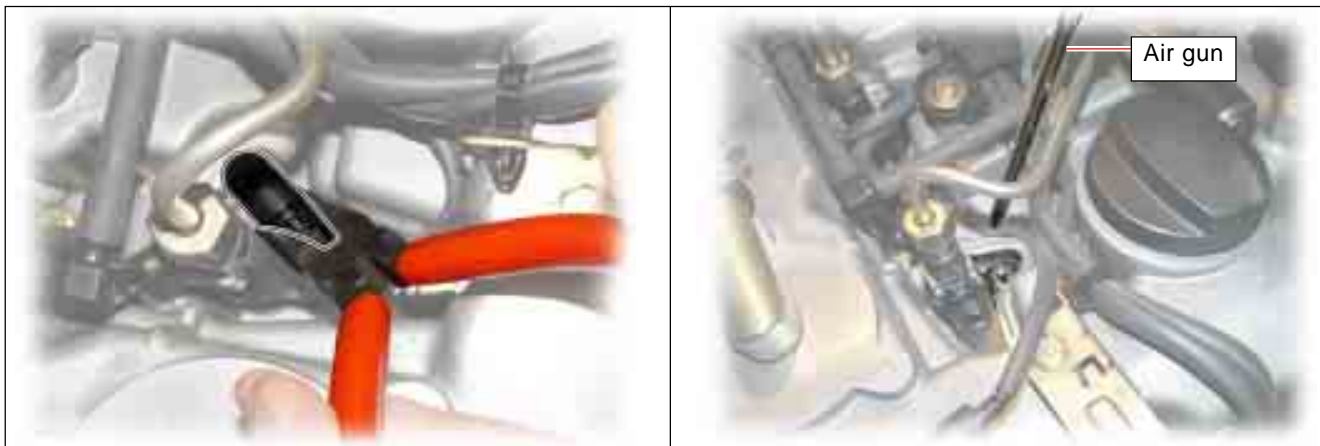
► Preparations for replacing preglow plug

Torque wrench, Air gun (small), Carbon cleaner (Product name: IPO CHOKE & CARBURATOR CLEANER, Model name: PRO NO 5007, Manufacturer: Sunbo), Engine oil, Preglow plug wrench (special service tool), Long nose pliers

► Removal and Installation of Preglow Plug

※ **Preceding Work:** Disconnect the negative battery cable.

1. Disconnect the wiring harness with long nose pliers and clean the preglow mounting area with the compressed air (using air gun).



2. Spray the carbon cleaner into the gap between preglow plug and cylinder head and wait for 10 minutes. Remove the dirt and foreign materials completely with the compressed air (using air gun)..



NOTICE

- At this moment, check the color mark on insulator surface and bring the same version of preglow plug for replacement. (BERU: Green, NGK: Yellow)

3. To avoid damage, apply the engine oil into the gap between preglow plug and cylinder head and wait for 5 minutes.



4. Remove the preglow plug with torque wrench. (tightening torque: 15 ± 3 Nm)

**NOTICE**

- To prevent the preglow plug from breaking, carefully turn the wrench with the torque below 20 Nm.
- Never use the air impact tool or other tools.



5. Thoroughly remove the foreign materials from the preglow plug hole. If needed, use the carbon cleaner or air gun.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

►Remarks

1.Required tools

<p>Carbon Cleaner</p> 	<p>Torque Wrench (max. 25 Nm)</p> 
	<p>Preglow plug wrench - Special Service Tool (10 mm) Part number: Y99220132B</p> 

2.Preglow plug circuit check

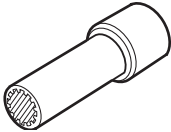
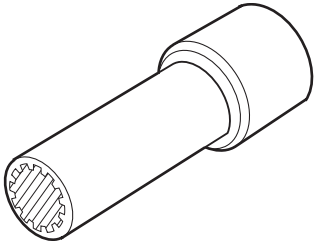
- 1) Check the preglow plug trouble code with SCAN-100.
- 2) SCAN-100 can display only one trouble code. Check whether each preglow plug circuit is open with multi-tester.



Color mark on insulator surface	BERU: Green NGK: Yellow
--	--

Tip diameter	BERU: 4 mm NGK: 3.5 mm
---------------------	---

SPECIAL TOOLS AND EQUIPMENT

Name and Part Number	Application
<p>Y9922 0132B</p> <p>Wrench-Preheating Plug</p> 	<p>Wrench for removing the preheating plug (10mm)</p> 

GENERAL

ASSY

HOUSING

INTAKE

EXHAUST

LUB

COOLING

FUEL

CONTROL

SENSOR

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

MEMO

SECTION 07

FUEL SYSTEM

FUEL SYSTEM

07

TABLE OF CONTENTS

CAUTIONS FOR DI ENGINE 2

FUEL SYSTEM 5

Fuel injection system 5

Fuel transfer line 11

Inlet Metering Valve (IMV) 13

High fuel pressure line 16

Injector 52

CAUTIONS FOR DI ENGINE

This chapter describes the cautions for DI engine equipped vehicle. This includes the water separation from engine, warning lights, symptoms when engine malfunctioning, causes and actions.

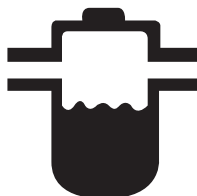
► DI Engine

Comparatively conventional diesel engines, DI engine controls the fuel injection and timing electrically, delivers high power and reduces less emission.

► System Safety Mode

When a severe failure has been occurred in a vehicle, the system safety mode is activated to protect the system. It reduces the driving force, restricts the engine speed (rpm) and stops engine operation. Refer to "Diagnosis" section in this manual.

► Water Separator Warning Light



When the water level inside water separator in fuel filter exceeds a certain level (approx. 39 cc), this warning light comes on and buzzer sounds.

Also, the driving force of the vehicle decreases (torque reduction). If these conditions occur, immediately drain the water from fuel filter.

For the draining procedures, please refer to "How to drain the water from fuel filter" section.

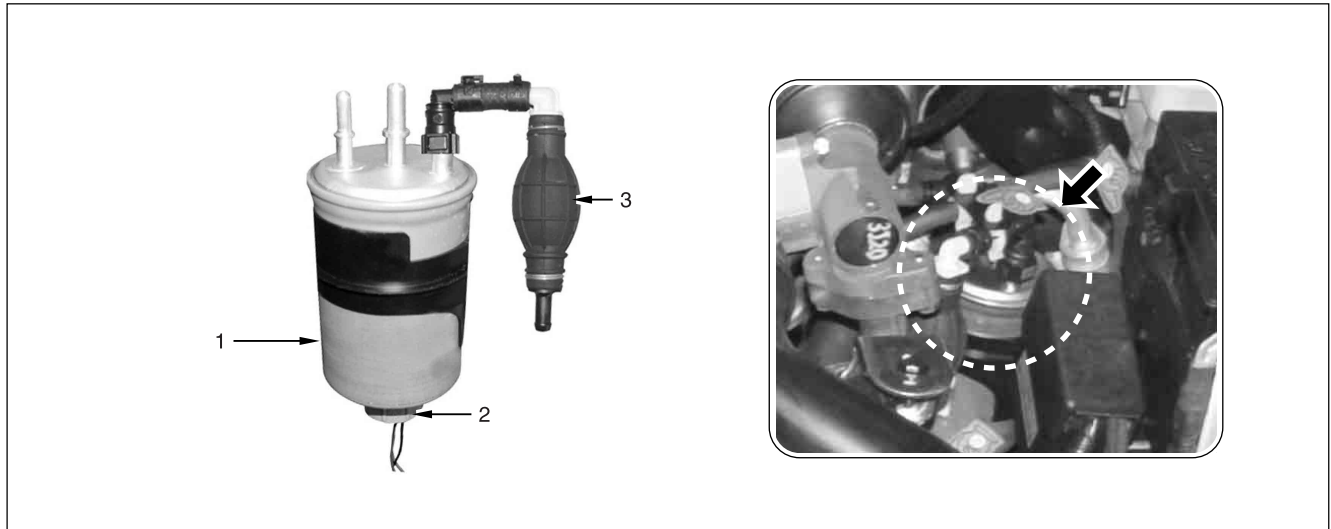
► Priming Pump

The priming pump installed in fuel pump is the device to fill the fuel into the fuel filter. When the vehicle is under the conditions as below, press the priming pump until it becomes rigid before starting the engine.

► Conditions for Using Priming Pump

1. After run out of fuel
2. After draining the water from fuel separator
3. After replacing the fuel filter

► Fuel Filter and Water Separator



1. Fuel filter

2. Water drain plug

(water separating operation: every 10,000 km)

3. Priming pump



NOTICE

- When replaced the fuel filter or drained the water from fuel filter, press the priming pump until it becomes rigid before starting the engine.
- The water drain from fuel filter should be performed whenever changing the engine oil.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► Draining the Water From Fuel Filter

1. Place the water container under the fuel filter.

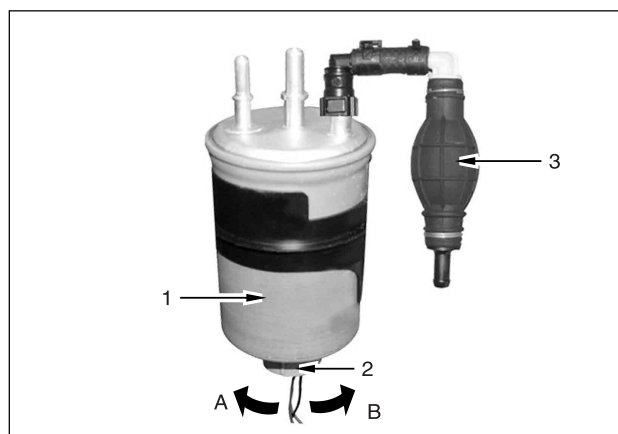


2. Turn the drain plug (2) to “A” direction to drain the water.
3. Wait until a certain amount of fuel gets out from the port, then turn the drain plug to “B” direction to tighten it.



NOTICE

- Be careful not to be injured by surrounding equipment during the working procedures.



4. Press the priming pump until it becomes rigid.
5. Start the engine and check the conditions.



WARNING

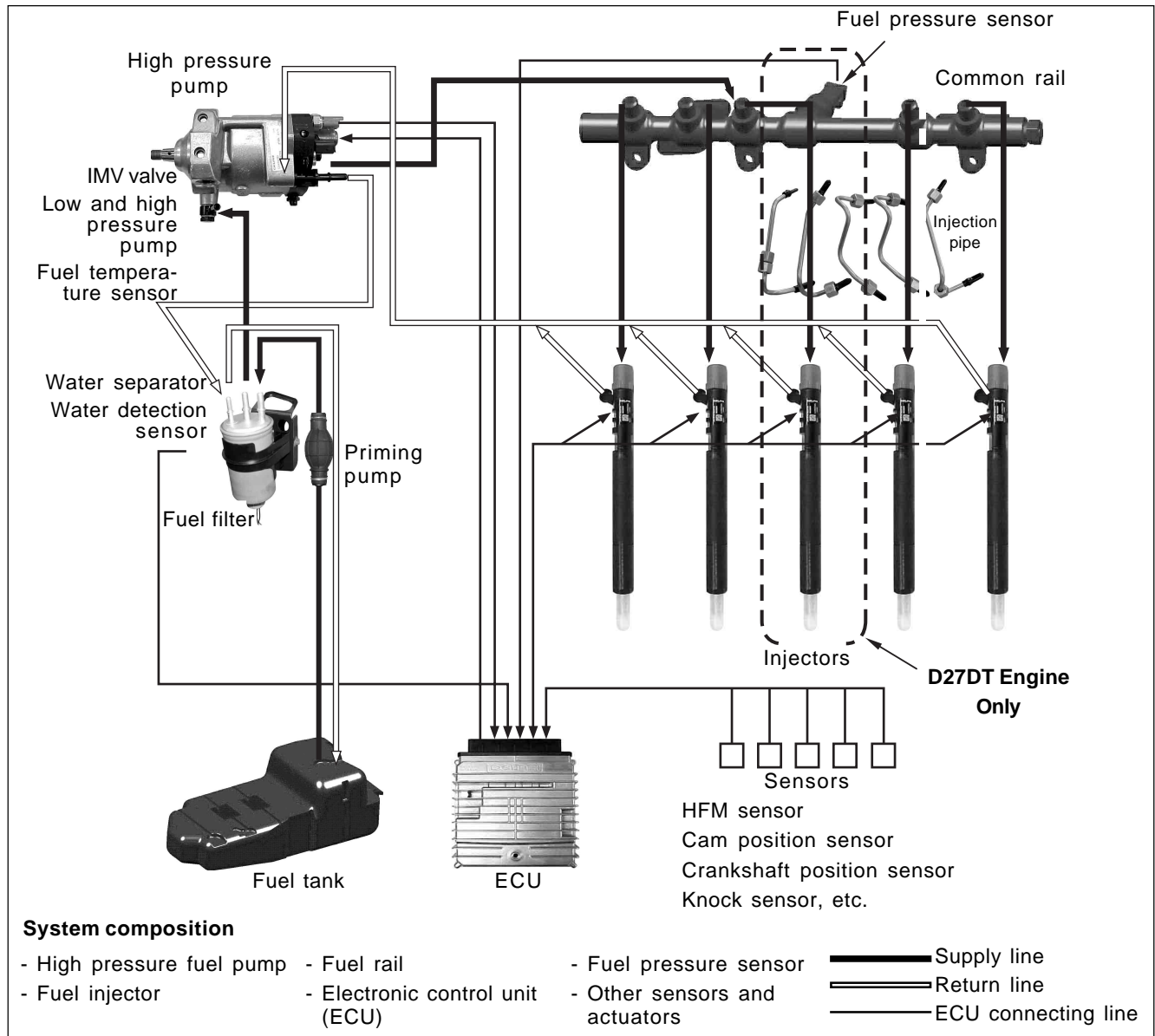
- If the priming pump is not properly operated, air may get into the fuel line. It may cause starting problem or fuel system problem. Make sure to perform the job in step 4.



FUEL SYSTEM

FUEL INJECTION SYSTEM

► Electronic Control of Fuel System



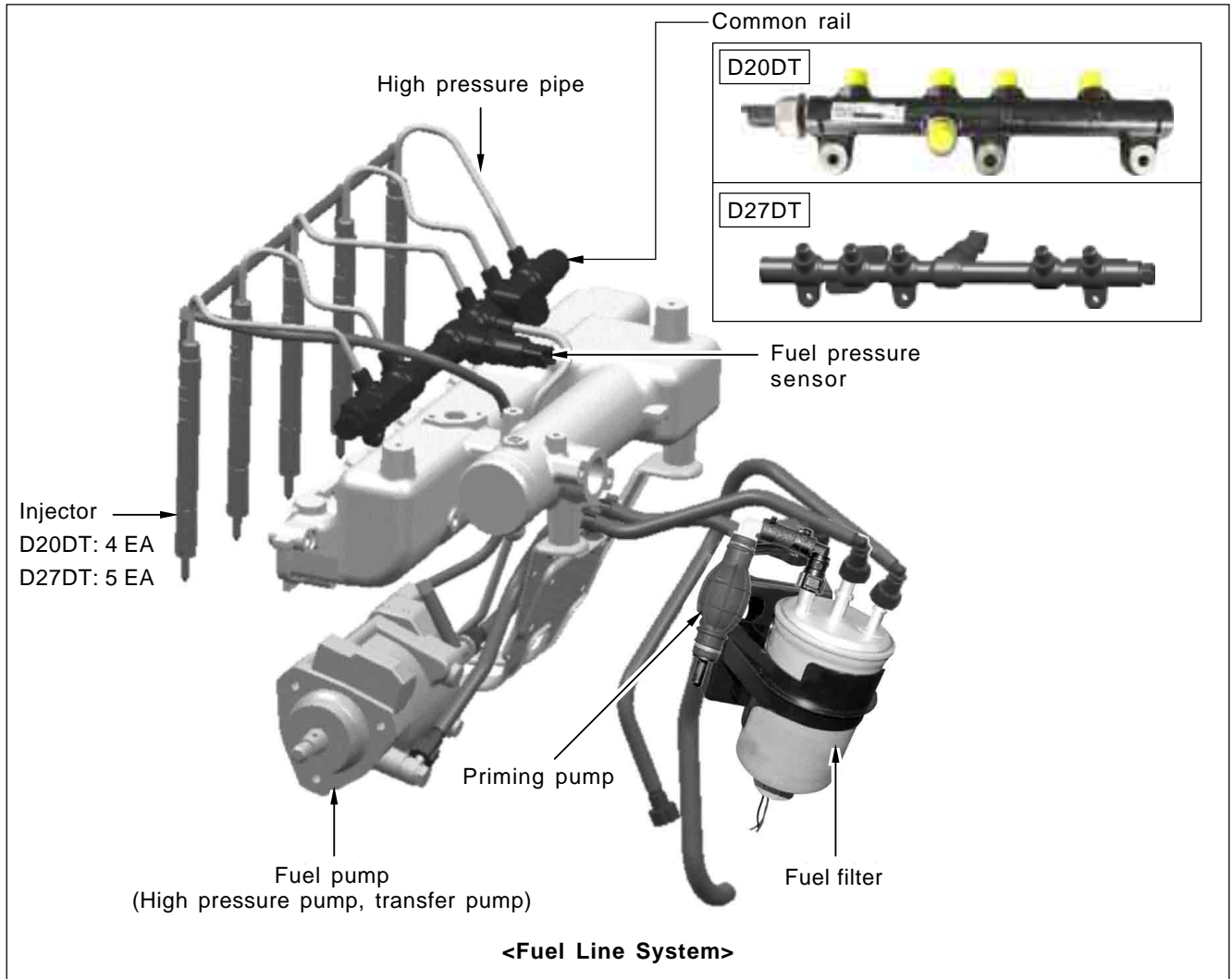
According to input signals from various sensors, engine ECU calculates driver's demand (position of the accelerator pedal) and then controls overall operating performance of engine and vehicle on that time.

ECU receives signals from sensors via data line and then performs effective engine air-fuel ratio controls based on those signals. Engine speed is measured by crankshaft speed (position) sensor and camshaft speed (position) sensor determines injection order and ECU detects driver's pedal position (driver's demand) through electrical signal that is generated by variable resistance changes in accelerator pedal sensor. Air flow (hot film) sensor detects intake air volume and sends the signals to ECU. Especially, the engine ECU controls the air-fuel ratio by recognizing instant air volume changes from air flow sensor to decrease the emissions (EGR valve control). Furthermore, ECU uses signals from coolant temperature sensor and air temperature sensor, booster pressure sensor and atmospheric pressure sensor as compensation signal to respond to injection starting, pilot injection set values, various operations and variables.

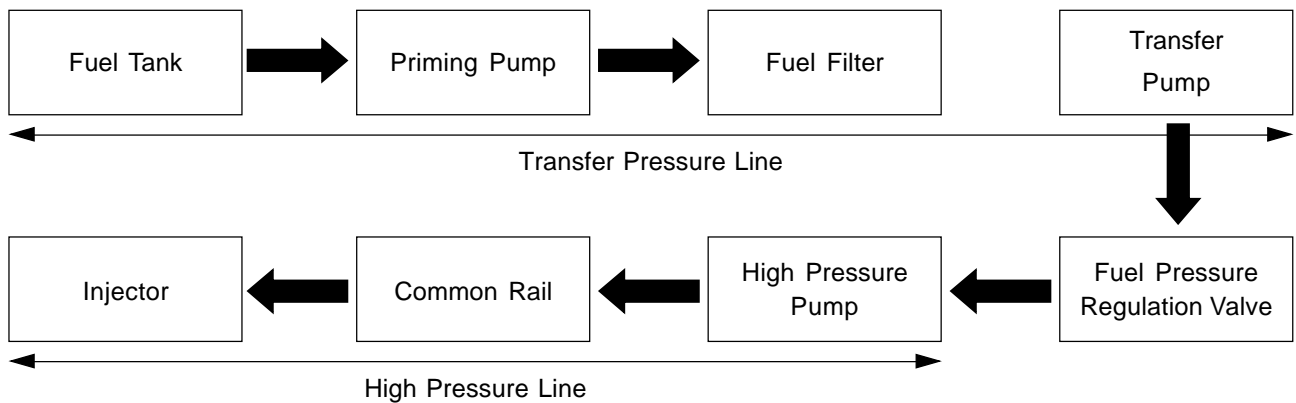
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► Composition of Fuel System

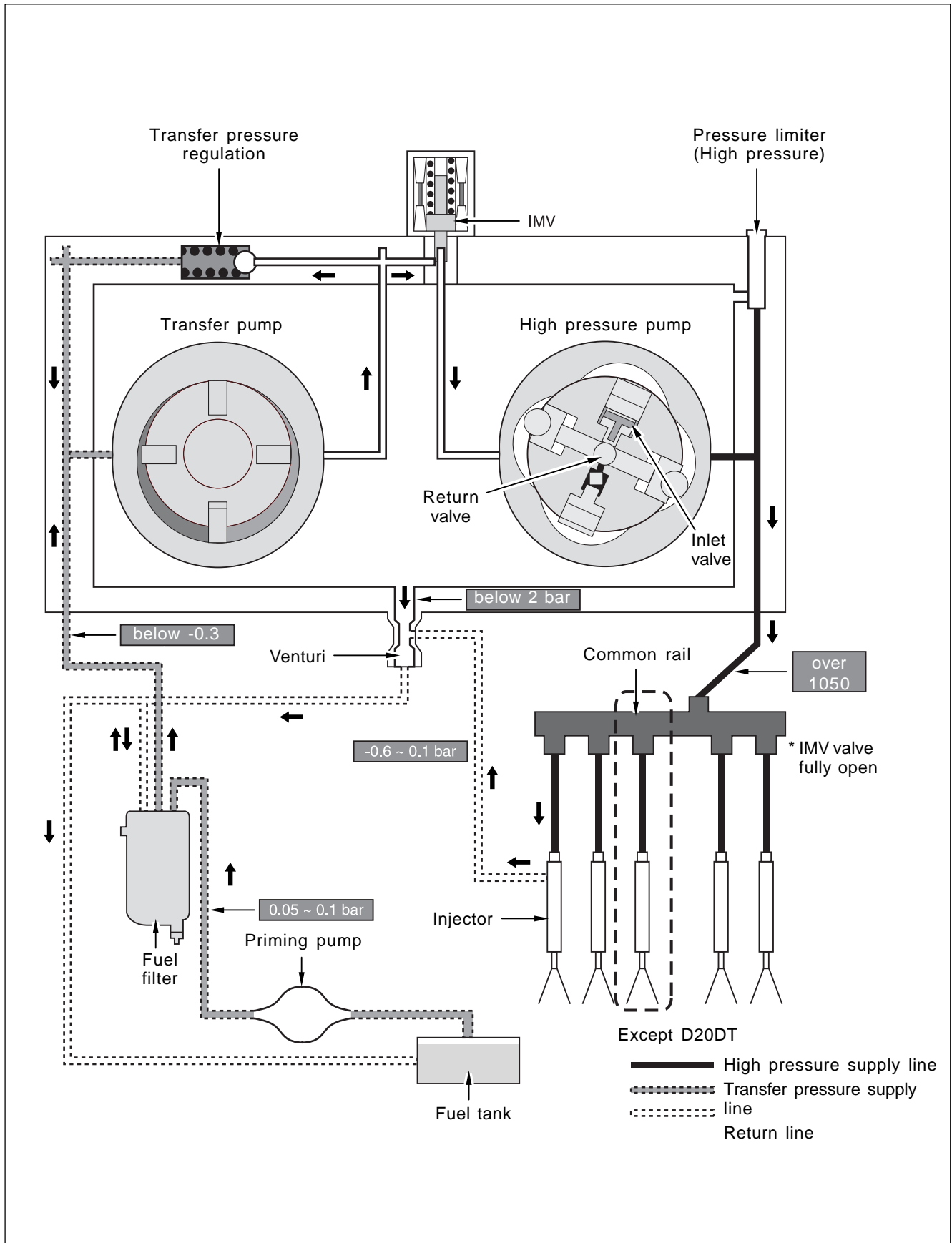
Components in fuel system are designed to generate and distribute high pressure, and they are controlled electronically by engine ECU. Accordingly, fuel system is completely different from injection pump type fuel supply system on the conventional Diesel engine. The fuel injection system in common rail engine is composed of transfer pressure section that transfers fuel in low pressure, high pressure section that transfers fuel in high pressure and ECU control section.



Fuel route



► Hydranlic Cycle in Fuel Line (Transfer and High Pressure Line)



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

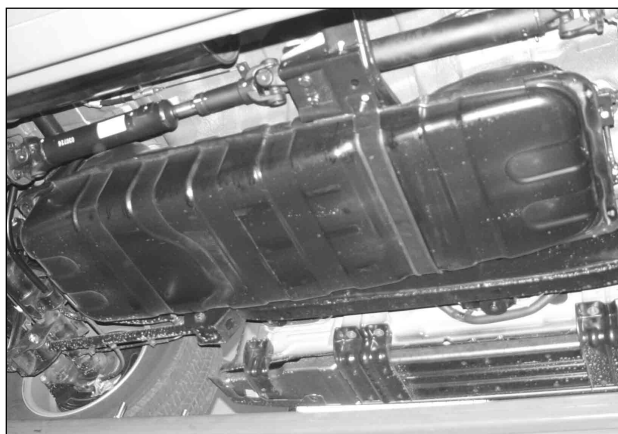
► Components of Low Pressure Transfer Line

Low pressure stage is to supply sufficient fuel to high pressure section and components are as below.

1. Fuel tank (including strainer)
2. Hand priming pump
3. Fuel filter
4. Transfer pump
5. Other low pressure fuel hoses

Fuel tank

Fuel tank is made of anti-corrosion material and its allowable pressure is 2 times of operating pressure (more than min. 0.3 bar). It has protective cap and safety valve to prevent excessive pressure building. Also, to supply fuel smoothly, it has structure to prevent fuel from leaking in shocks, slopes and corners and.



Priming pump

If fuel runs out during driving or air gets into fuel line after fuel filter replacement, it may cause poor engine starting or damage to each component. Therefore, the hand priming pump is installed to bleed air from transfer line.

When the vehicle is under the conditions as below, press the priming pump until it becomes rigid before starting the engine.

1. After run out of fuel
2. After draining the water from fuel separator
3. After replacing the fuel filter

Press the priming pump until it becomes rigid before starting the engine.



Fuel filter

It requires more purified fuel supply than conventional diesel engine. If there are foreign materials in the fuel, fuel system including pump components, delivery valve and injector nozzles may be damaged.

Fuel filter purifies fuel before it reaches to high pressure pump to help proper operations in high pressure pump. And more, it separates water from fuel to prevent water from getting into FIE system (high pressure line).



► Components of High Pressure Transfer Line

In the high pressure section, sufficient fuel pressure that injectors requires will be generated and stored. The components are as below:

1. High pressure pump
2. Rail pressure sensor
3. Pressure limit valve
4. Common rail
5. High pressure pipe
6. Injector
7. Fuel pressure regulating valve (IMV)

High pressure pump

This is plunger pump that generates high pressure; and driven by crankshaft with timing chain. The high pressure pump increases system pressure of fuel to approx. 1,600 bar and this compressed fuel is transferred to high pressure accumulator (common rail) in tube through high pressure line.



Common rail

It stores fuel transferred from high pressure pump and also stores actual high pressure of fuel. Even though the injectors inject fuel from the rail, the fuel pressure in the rail is maintained to a specific value. It is because the effect of accumulator is increased by unique elasticity of fuel. Fuel pressure is measured by rail pressure sensor. And the fuel pressure regulating valve (IMV, Inlet Metering Valve) included in high pressure pump housing keeps pressure to a desired level.

D20DT



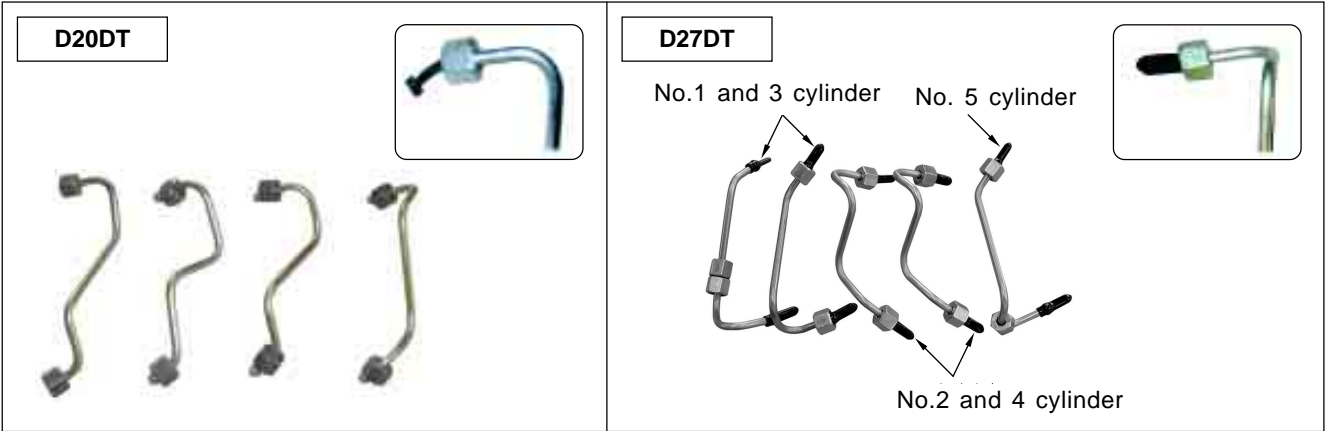
D27DT



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

High pressure pipe (fuel pipe)

Fuel line transfers high pressure fuel. Accordingly, it is made of steel to endure intermittent high frequency pressure changes that occur under maximum system pressure and injection stops. Injection lines between rail and injectors are all in the same length; it means the lengths between the rail and each injector are the same and the differences in length are compensated by each bending.



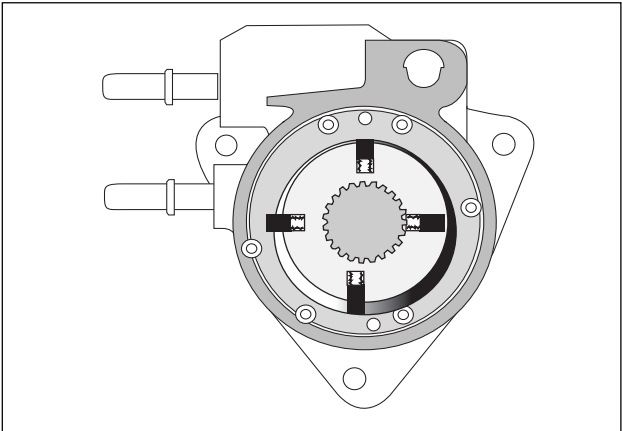
Injectors

The fuel injection device is composed of electrical solenoid valve, needle and nozzle and controlled by engine ECU. The injector nozzle opens when solenoid valve is activated to directly inject the fuel into combustion chamber in engine. When injector nozzle is open, remaining fuel after injection returns to fuel tank through return line. Pressure limit valve, fuel returned by low pressure and fuel used for high pressure pump lubrication also return to fuel tank through return line.



Transfer pump

The transfer pump is included in the housing of the high pressure pump. The transfer pump is the volumetric blade type pump. To deliver the continuously required fuel volume, the pump transfers fuel from the fuel tank to high pressure pump.



Fuel filter replacement

- 1. Fuel filter change interval: every 30,000 km
- 2. Water separation interval: every 10,000 km (same with engine oil change interval)
- 3. Never reuse the removed fuel filter

FUEL TRANSFER LINE

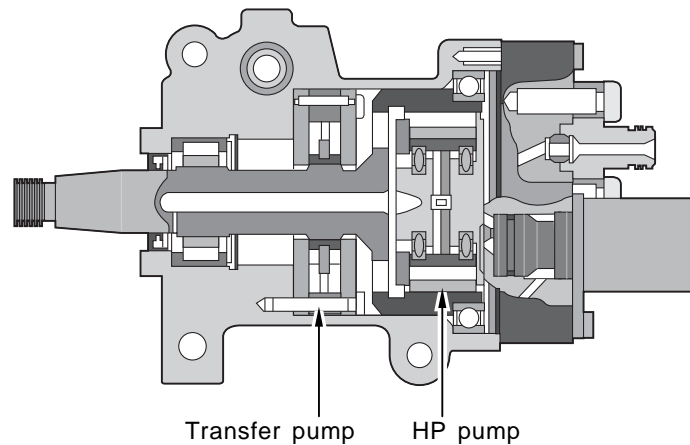
► Transfer Pump

Description

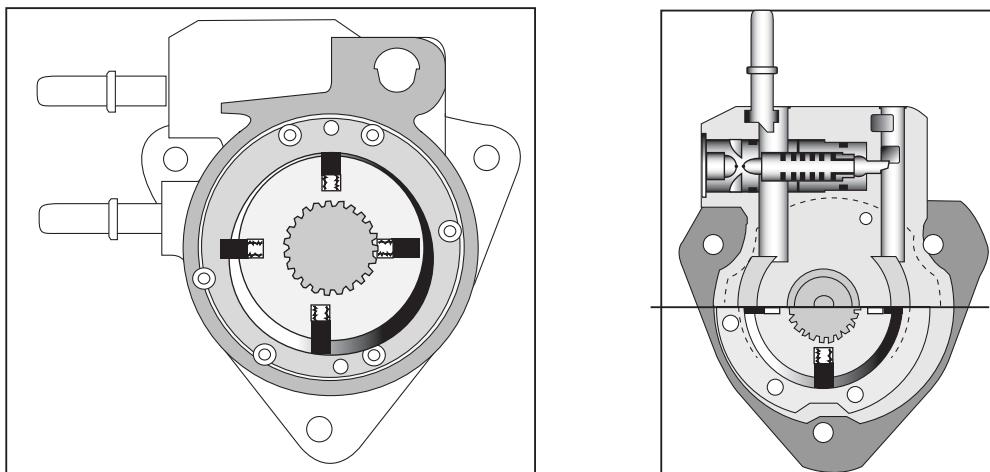
The transfer pump is the device to provide sufficient fuel to high fuel pressure line and is mechanical type feed pump that is driven by timing chain linked to crankshaft. This mechanical type feed pump is subject to air inflow, therefore, a hand priming pump is installed to bleed air from fuel transfer line.

The transfer pump is included in the housing of the HP pump. The transfer pump is the volumetric blade type pump and consists of the following components:

1. A rotor turned by the shaft of the HP pump. The connection is provided by splines.
2. An eccentric liner fixed to the housing of the HP pump by 6 Torx bolts. The liner is positioned by two off-set pins in order to prevent any assembly errors.
3. Four blades set at 90°. Each blade is held against the liner by a coil spring.
4. The inlet and outlet orifice.



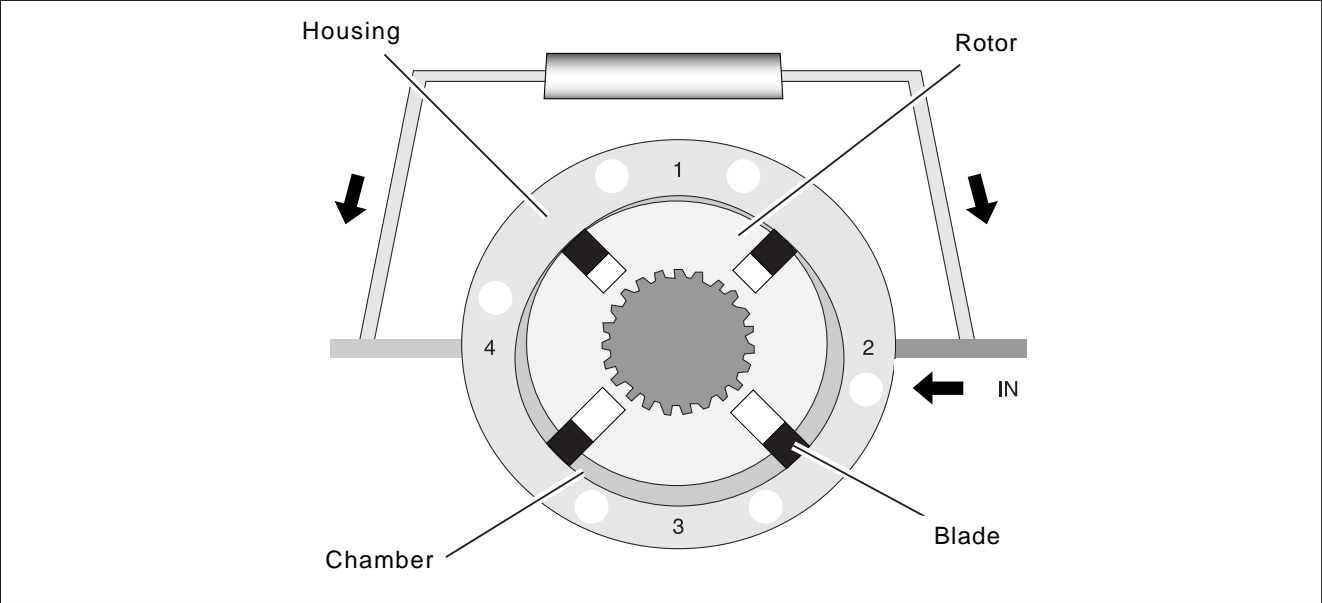
<Sectional Diagram of Fuel Pump>



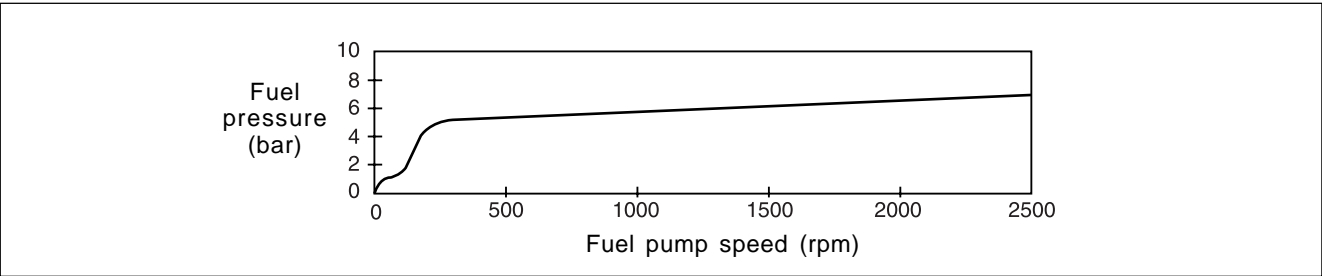
<Sectional Diagram of Transfer Pump>

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Principle of operation



- Consider the chamber between the rotor, the liner and two successive blades (refer to above figure).
1. When the chamber is in position 1, the volume of the chamber is minimal. The changes in volume according to the angle of rotation of the rotor are small.
 2. The rotor makes a quarter turn clockwise. The previous chamber is now in position 2. The inlet orifice is uncovered. The volume contained in the chamber quickly rises. The pressure inside the chamber drops sharply. Fuel is drawn into the chamber.
 3. The rotor continues to rotate. It is now in position 3. The inlet and outlet orifices are now sealed off. The volume area controlled by the rotor, the liner and the two blades is at the maximum. The changes in volume according to the angle of rotation of the rotor are small.
 4. The rotor continues to rotate. It is finally in position 4. The outlet orifice is uncovered. The volume area controlled by the rotor, the liner and the blades decreases quickly. The pressure inside the chamber rises sharply. The fuel is expelled under pressure. The depression caused by the transfer pump's rotation is sufficient to draw in diesel fuel through the filter. The transfer pump is driven by the shaft of the HP pump, transfer pressure thus rises with engine speed. A regulating valve allows the transfer pressure to be maintained at a practically constant level (about 6 bar) throughout the whole range of engine operations by returning some of the fuel to the pump inlet.



Characteristics of the transfer pump

Regulating pressure	6 bar
Volume controlled	5.6 cm³/revolution
Flow	90 ℓ /h at 300 rpm pump 650 ℓ /h at 2,500 rpm pump
Intake capacity	65 mbar at 100 rpm pump

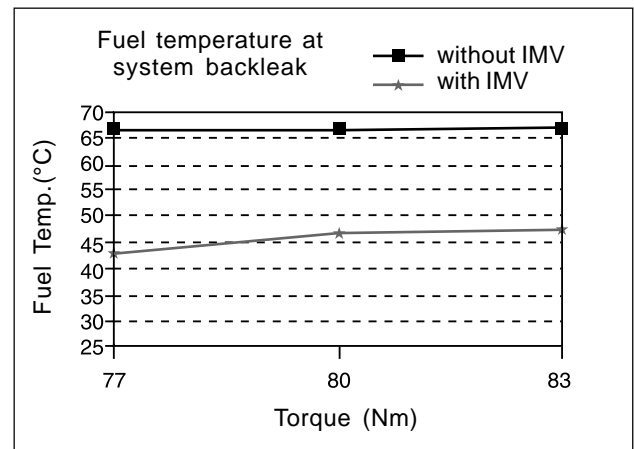
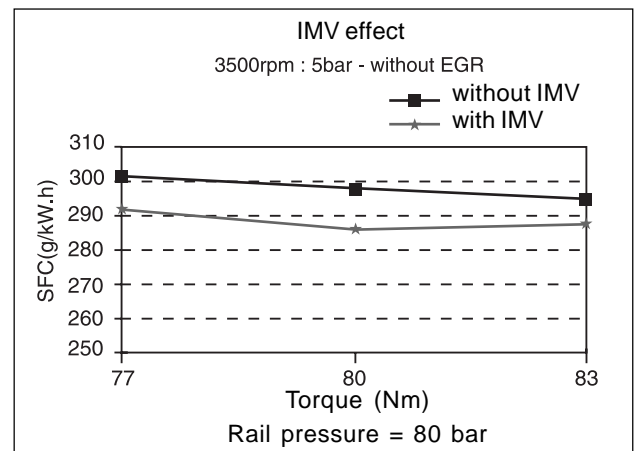
INLET METERING VALVE (IMV)

► Overview

The LP actuator, also called the inlet metering valve, is used to control the rail pressure by regulating the amount of fuel which is sent to the pumping element of the HP pump.

This actuator has two purposes:

1. Firstly, it allows the efficiency of the injection system to be improved, since the HP pump only compresses the amount of fuel necessary to maintain in the rail the level of pressure required by the system as a function of the engine's operating conditions.
2. Secondary, it allows the temperature to be reduced in the fuel tank. When the excess fuel is discharged into the back leak circuit, the pressure reduction in the fluid (from rail pressure down to atmospheric pressure) gives off a large amount of heat. This leads to a temperature rise in the fuel entering the tank. In order to prevent too high a temperature being reached, it is necessary to limit the amount of heat generated by the fuel pressure reduction, by reducing the back leak flow. To reduce the back leak flow, it is sufficient to adapt the flow of the HP pump to the engine's requirements throughout its operating range.



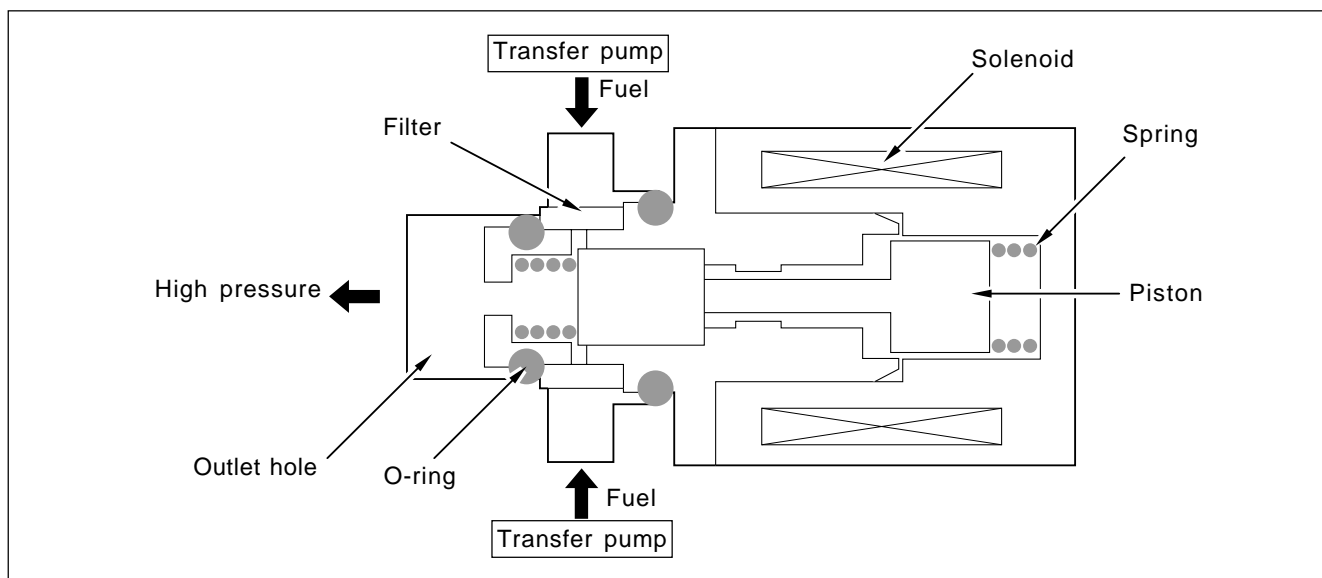
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► Composition of IMV

The IMV is located on the hydraulic head of the pump. It is fed with fuel by the transfer pump via two radial holes. A cylindrical filter is fitted over the feed orifices of the IMV. This makes it possible to protect not only the LP actuator, but also all the components of the injection system located downstream of the IMV.

The IMV consists of the following components:

1. A piston held in the fully open position by a spring.
2. A piston filter located at inlet.
3. Two O-rings ensuring pressure tightness between the hydraulic head and the body of the IMV.
4. A body provided with two radial inlet holes and an axial outlet hole.
5. Coil



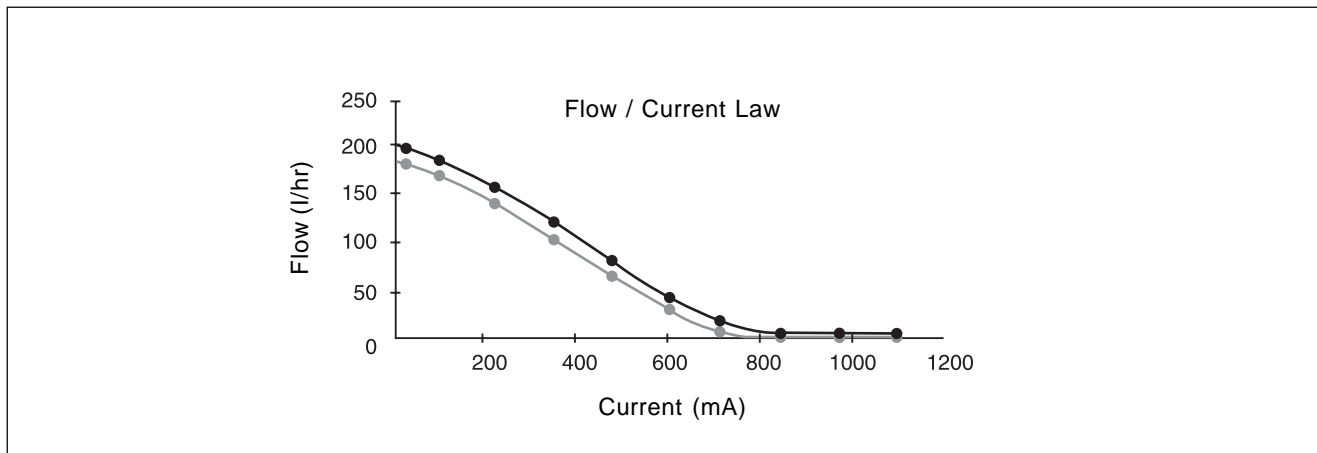
► Principle of Operation

The LP actuator is used to proportion the amount of fuel sent to the pumping element of the HP pump in such a way that the pressure measured by the HP sensor is equal to the pressure demand sent out by the ECU. At each point of operation, it is necessary to have:

- Flow introduced into the HP pump = Injected flow + Injector backleak flow + injector control flow

The IMV is normally open when it is not being supplied with fuel. It cannot therefore be used as a safety device to shut down the engine if required.

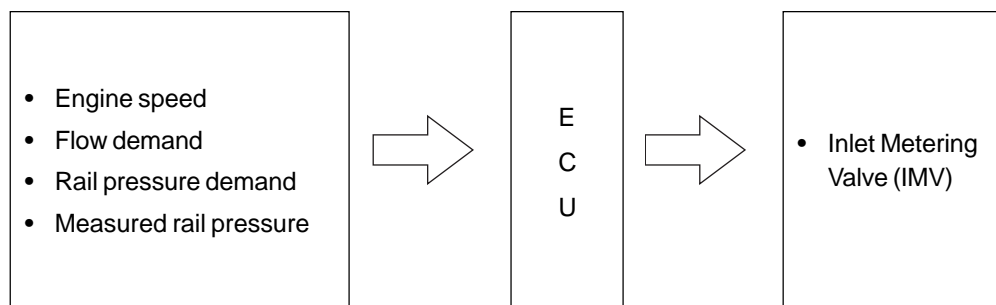
The IMV is controlled by current. The flow/current law is represented below.



Specifications

Piston stroke	1.4 mm
Diameter of holes	3.4 mm
Coil resistance	5.4 Ω (at 25°C)
Power supply	Battery voltage (It is prohibited to supply the IMV directly at the battery voltage during the diagnostic test)
Max. current	1 A
Weight	260 g
Operating temperature	40°C < T < 125°C
Fluid temperature	40°C < T < 90°C
Control logic	Normally open without power (The flow decreases as the current rises).

- ECU determines the value of the current to be sent to the IMV according to:



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

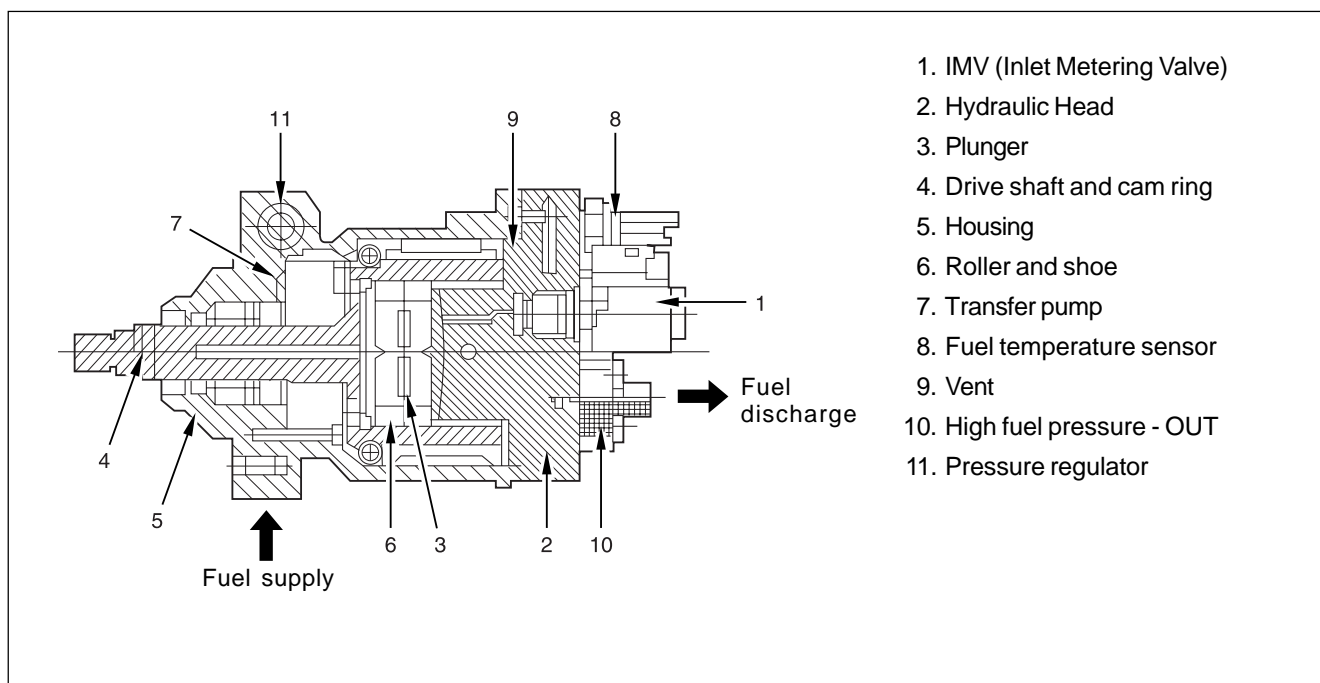
HIGH FUEL PRESSURE LINE

► High Pressure Pump

Description

This pump generates high fuel pressure and is driven by timing chain (radial plunger principle). This pump pressurizes the fuel to approx. 1600 bar and sends this high pressurized fuel to high pressure accumulator (common rail) via high pressure line.

It is possible to extend the pumping phase in order to considerably reduce drive torque, vibration and noise since the pump no longer determines the injection period. The differences from conventional rotary pumps lies in the fact that it is no longer the hydraulic head rotor which turns inside the cam, but the cam which turns around the hydraulic head. Thus, any problems of dynamic pressure tightness are eliminated because the high pressure is generated in the fixed part of the pump.

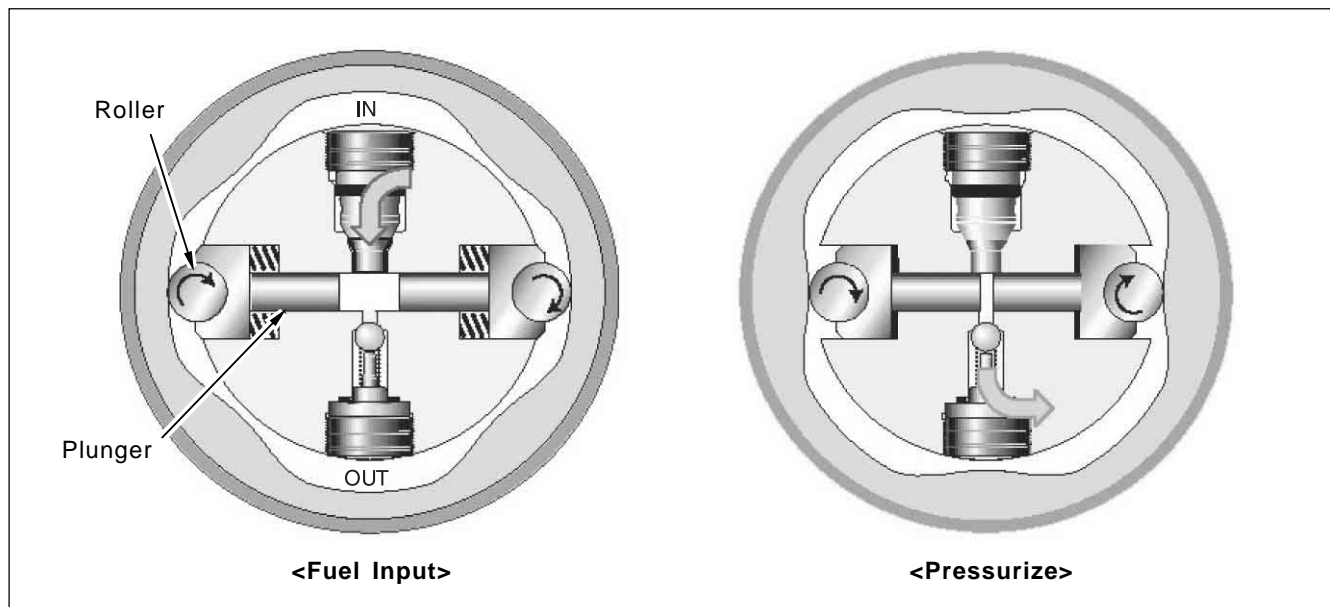


Specifications

1. Maximum operating pressure: 1600 ± 150 bar
2. Operating pressure limit: 2100 bar
3. Maximum sealing pressure: when using a plug instead of PRV, no leaks around pump outlet port (when applying 2500 bar of constant pressure)
4. Fuel pressure at inlet (pressure regulating valve): 6 bar
5. Operating temperature: Continuously operating within temperature range of -30°C ~ 120°C in engine compartment
6. Inflowing fuel temperature: The maximum inflowing fuel temperature is 85°C (continuously able to operate)
7. Pump inlet pressure: Relative pressure Max. 0.48 bar (to end of filter's lifetime)
8. Driving torque: 15 Nm / 1600 bar
9. Gear ratio (engine: pump): 0.625
10. Lubrication: - Inside lubrication (rear bearing): Fuel
 - Outside lubrication (front bearing): Engine oil

Principle of operation

1. During the filling phase, the rollers are kept in contact with the cam by means of coil springs mounted on either side of each shoe. The transfer pressure is sufficient to open the inlet valve and to move the pumping plungers apart. Thus, the dead volume between the two plungers fills with fuel.
2. When the diametrically opposite rollers simultaneously encounter the leading edge of the cam, the plungers are pushed towards each other.
3. As soon as the pressure becomes higher than the transfer pressure, the inlet valve closes. When the pressure becomes higher than the pressure inside the rail, the delivery valve opens. Consequently, the fuel is pumped under pressure into the rail.
4. During the input phase, transfer pressure pushes back the inlet valve. Fuel enters the body of the pumping element. The valve closes as soon as the pressure in the pumping element becomes higher than the transfer pressure.
5. During the input phase, the ball of the delivery valve is subject to the rail pressure on its outer face and to the transfer pressure on its inner face. Thus the ball rests on its seat, ensuring the pressure tightness of the body of the pumping element. When the pressure in the element becomes higher than the pressure in the rail, the ball is unbalanced and it opens. Fuel is then pumped into the rail at high pressure.

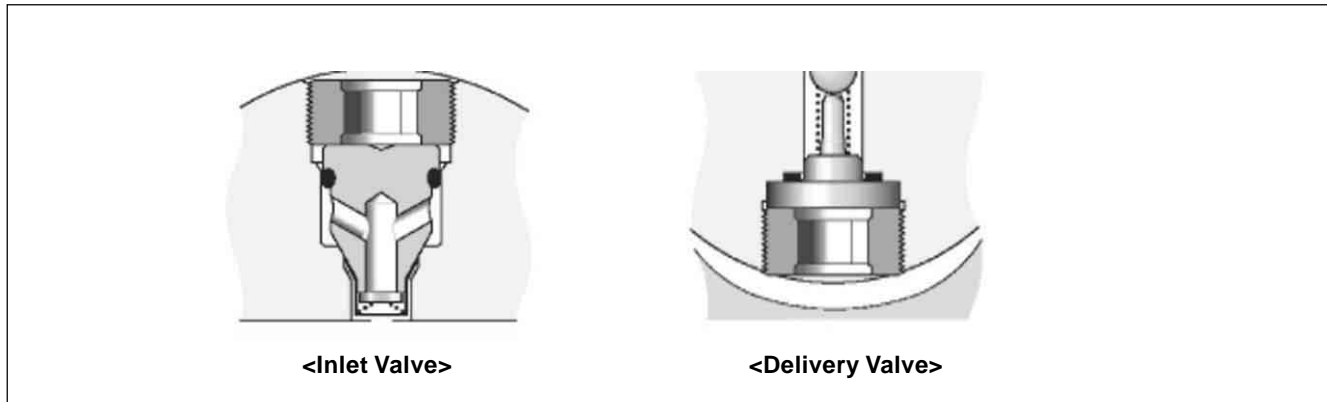


This high pressure pump generates the driving torque with low peak torque to maintain the stress to driving components. This torque is smaller than that of conventional injection pump, thus, only a small load will be applied to pump. The required power to drive pump is determined by set pressure for rail and pump speed (delivery flow). Note that the fuel leakage or defective pressure control valve may affect the engine output.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Inlet valve and delivery valve

During the input phase, transfer pressure pushes back the inlet valve. Fuel enters the body of the pumping element. Under the effect of the transfer pressure, the two plungers are forced apart. When the rollers simultaneously encounter the leading edge of the cam, pressure suddenly rises in the body of the pumping element. The valve closes as soon as the pressure in the pumping element becomes higher than the transfer pressure. During the input phase, the ball of the delivery valve is subject to the rail pressure on its outer face and to the transfer pressure on its inner face. Thus the ball rests on its seat, ensuring the pressure tightness of the body of the pumping element. When the two diametrically opposite rollers encounter the leading edges of the cam, the plungers are forced together and pressure quickly rises in the body of the pumping element. When the pressure in the element becomes higher than the pressure in the rail, the ball is unbalanced and it opens. The spring calibration is negligible compared with the pressure forces. Fuel is then pumped into the rail at high pressure.



Lubrication and cooling of the HP pump

Lubrication and cooling of the pump are provided by the fuel circulation. The minimum flow required to ensure adequate operation of the pump is 50 l/h.

Phasing of the HP pump

Conventional fuel injection pumps ensure pressurizing and distribution of the fuel to the different injectors. It is essential to set the pump in such a way that the injection occurs at the required place during the cycle. The HP pump of the common rail system is no longer used for the fuel distribution, it is therefore not necessary to set the pump in relation to the engine.

Nevertheless, the setting or phasing of the pump offers two advantages:

1. It allows the torque variations of the camshaft and the pump to be synchronized in order to reduce the stresses on the timing belt.
2. It allows pressure control to be improved by synchronizing peak pressures produced by the pump with pressure-drops caused by each injection.

This phasing allows pressure stability to be improved, which helps to reduce the difference in flow between the cylinders.

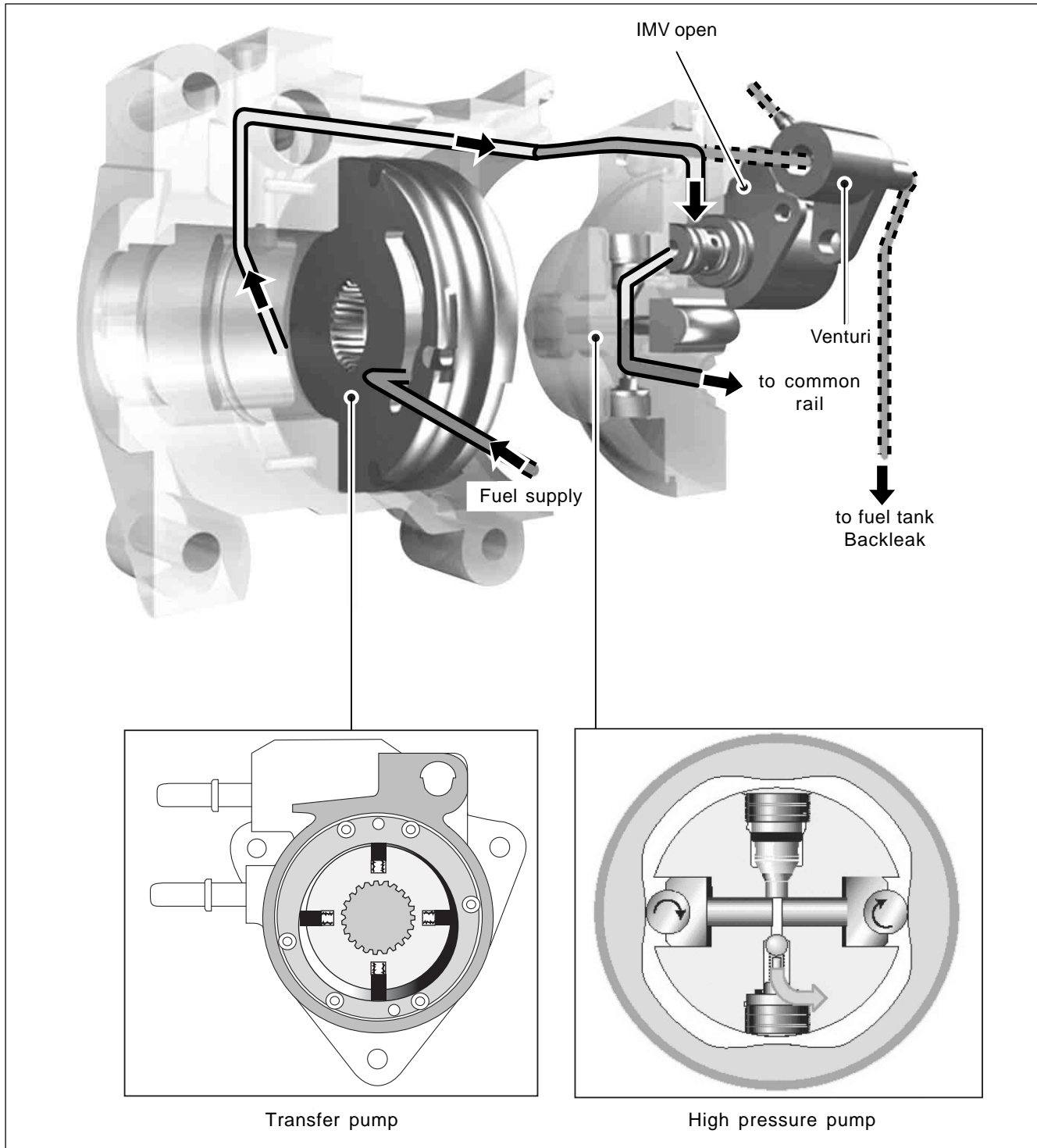
► HP Pump Fuel Route

The fuel passed through the fuel filter is sent to the transfer pump via the HP inlet pump. this fuel passes through the transfer pump by the transferring pressure and maintains the predefined value by the regulating valve in HP pump.

Also, this fuel gets into the IMV that controls only the fuel to the high pressure pump.

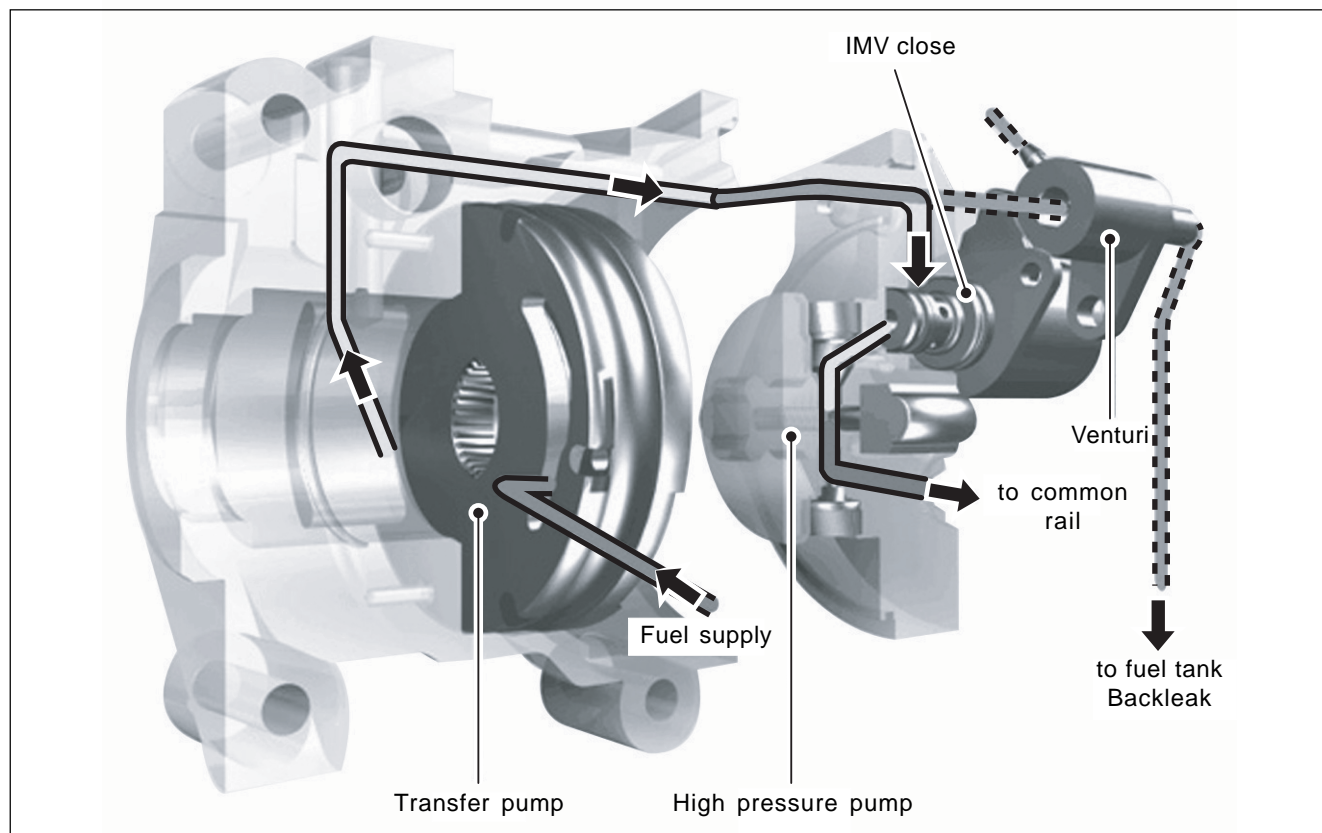
The below figure describes the pump operations when acceleration and deceleration.

When need high fuel pressure (acceleration)



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

When do not need high fuel pressure (deceleration)



The fuel is sent to the high pressure side (hydraulic head) and compressed by the plunger. And, goes into the common rail through the high pressure pipe.

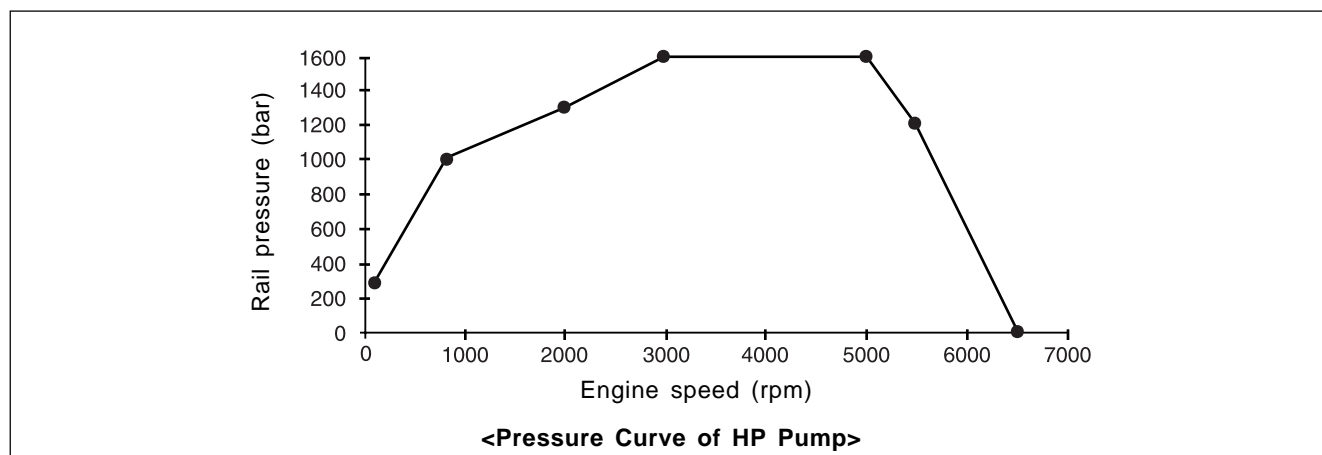
The IMV installed in the high pressure side (hydraulic head) of HP pump precisely controls the fuel amount and delivers the rail pressure feedback same as required amount.

The IMV is controlled by ECU.

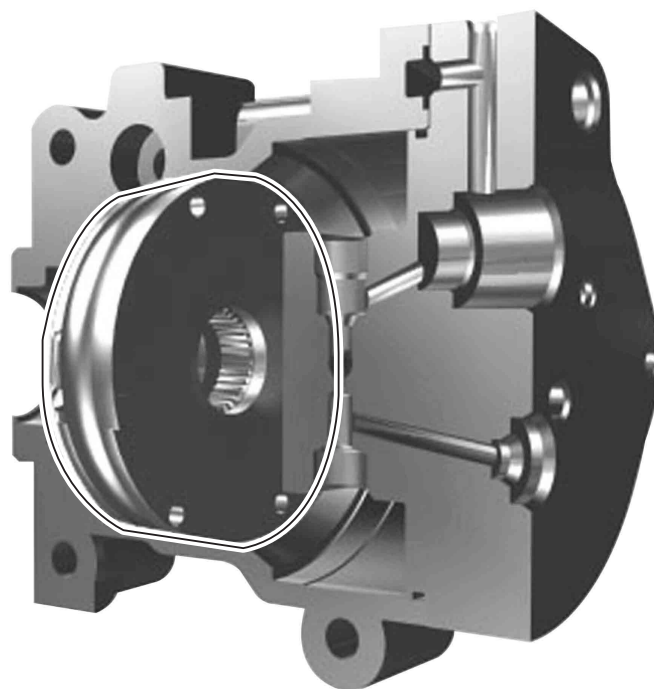
Performance curve of HP pump

The time required to obtain a sufficient pressure in the rail to enable the engine to start depends on the volume of the system (definition of the rail, length of the pipes, etc.). The aim is to reach a pressure of 200 bars in 1.5 revolutions (3rd compression).

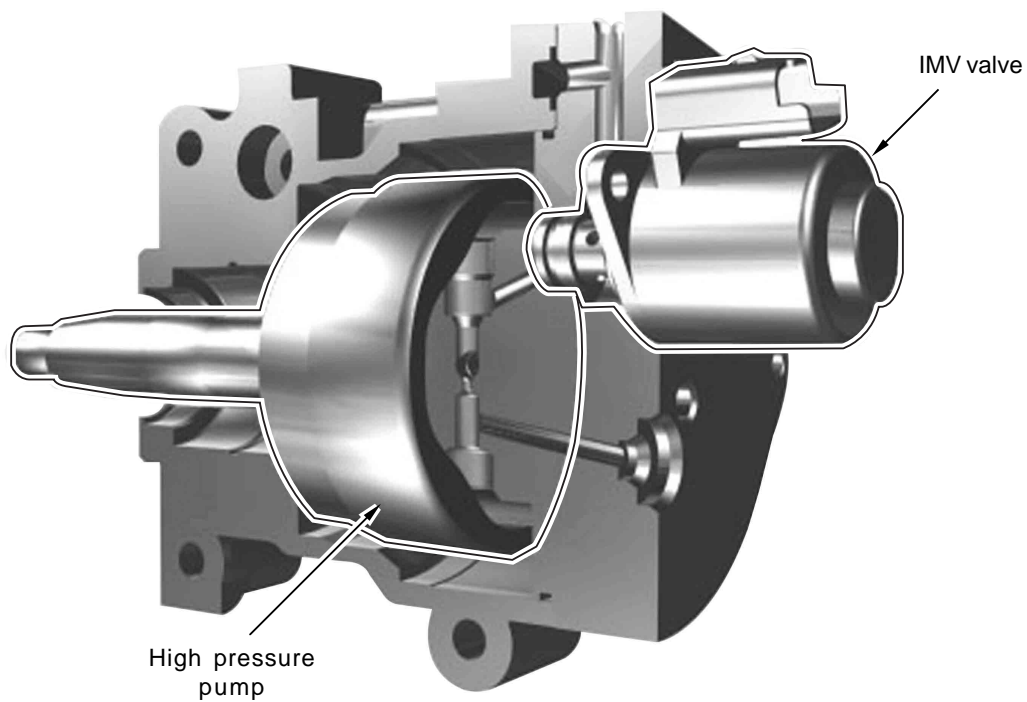
- Maximum operating pressure: 1600 ± 150 bar



► Sectional View of HP Pump

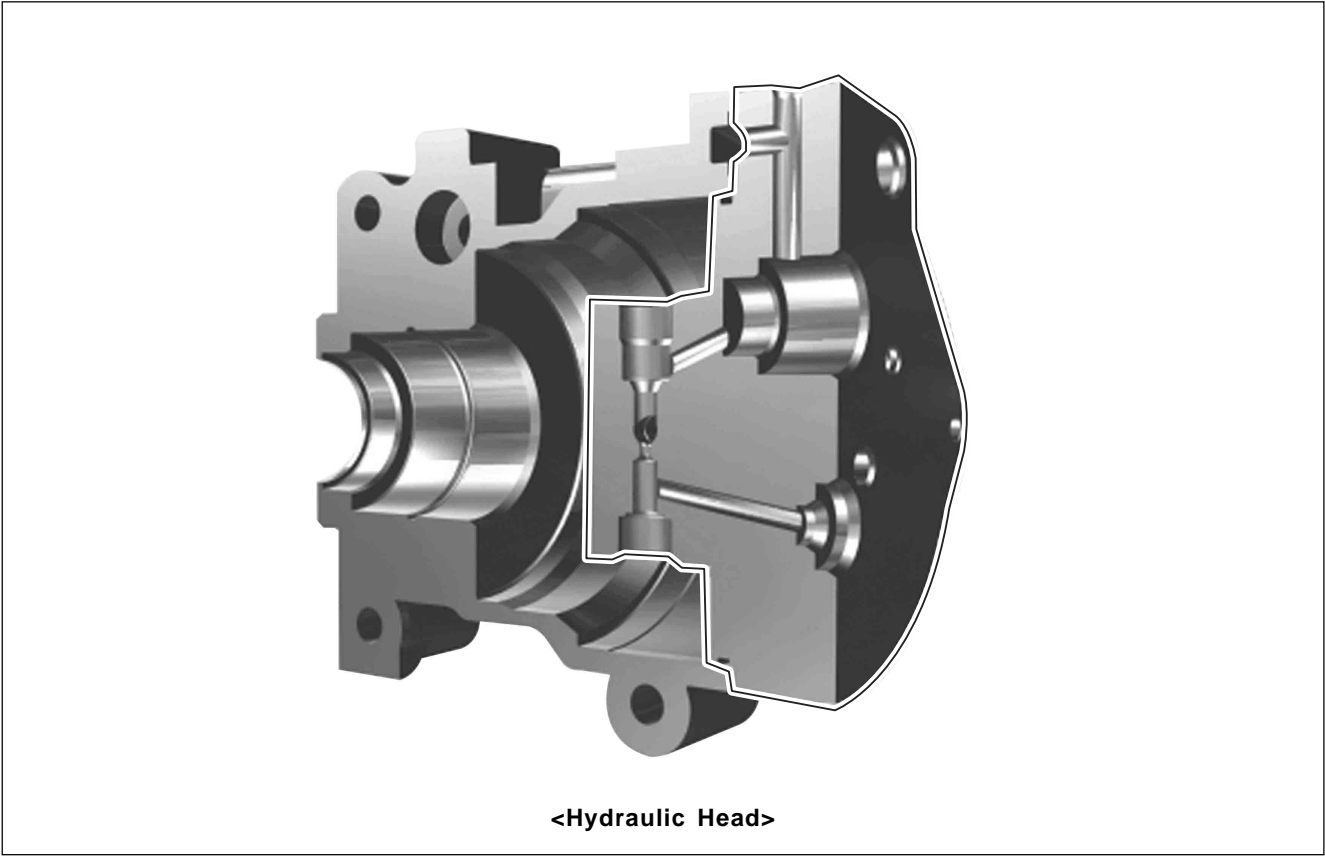
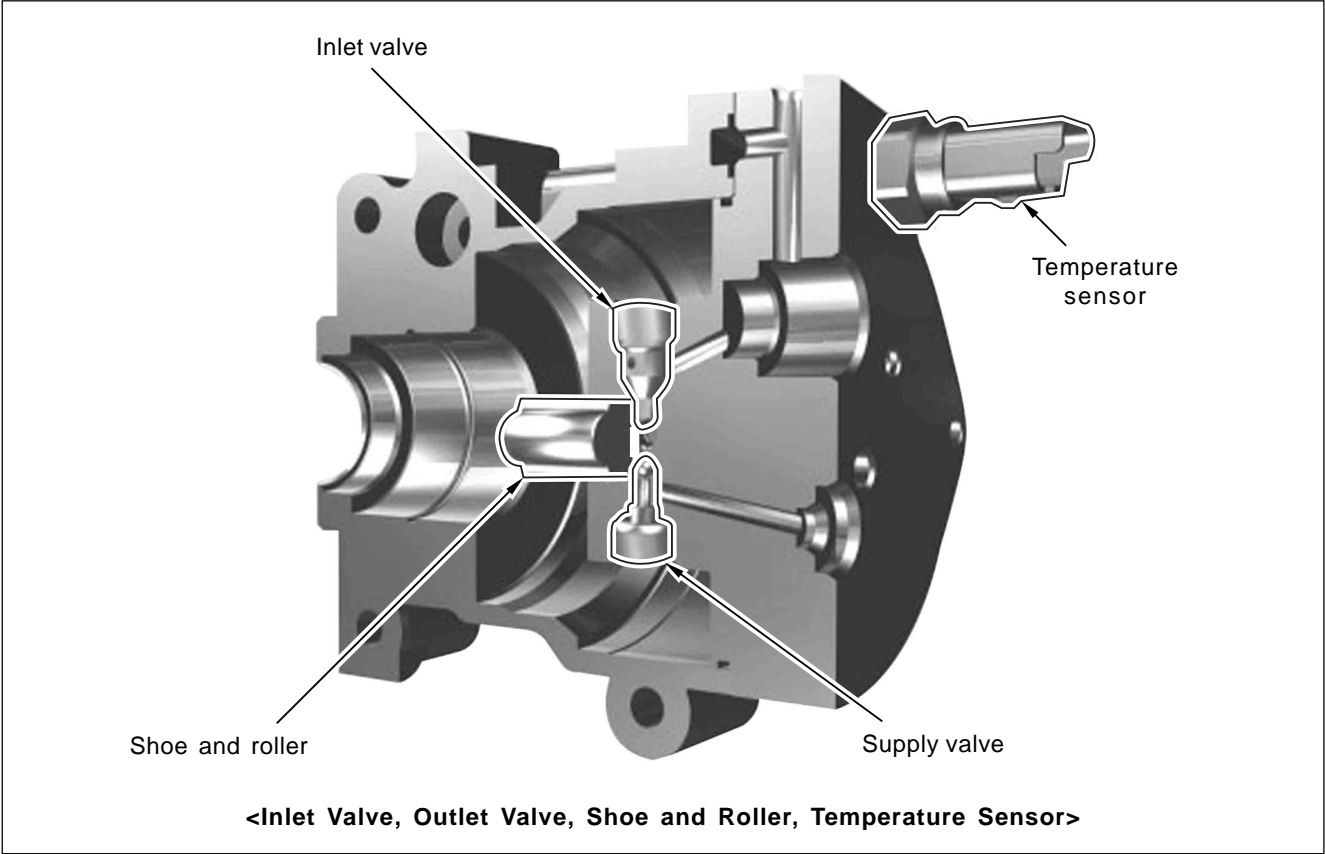


<Transfer Pump>



<IMV Valve and High Pressure Pump (Drive Shaft)>

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	



► Removal and Installation (D20DT Engine)

Removal

※ Preceding Works:

1. Disconnect the negative battery cable.
2. Apply the parking brake and place the chocks under the tires. (transmission "N" position)

1. Turn the auto tensioner counterclockwise and remove the fan belt.



NOTICE

- Slacken the pulley bolt.



2. Remove the engine belt pulleys.

- 1) Cooling fan pulley
- 2) Coolant pump pulley
- 3) Idle pulley



3. Unscrew lower bolt (13 mm) and upper bolt (24 mm) and remove the auto tensioner.



NOTICE

- To prevent oil leaks, store the removed auto tensioner in upright position.
- Pump the auto tensioner several times before installing it.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

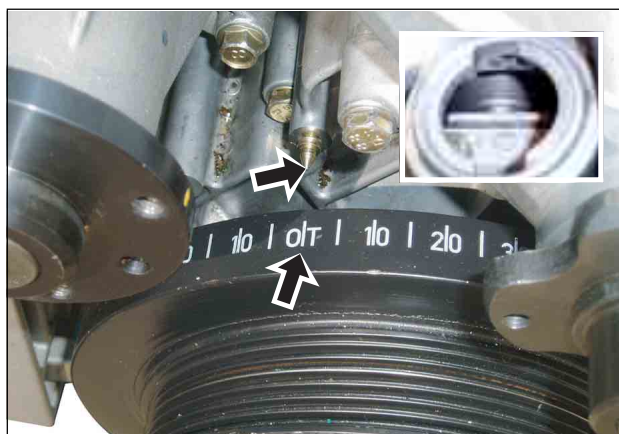
6. Remove the high pressure pump housing.

※ **Preceding Work:** Remove the No.2 EGR pipe.



7. Align the OT mark by rotating the crankshaft.

- 1) Open the oil filler cap and check if the OT mark on crankshaft is aligned to the notch on the camshaft.



8. Unscrew the bolts and remove the vacuum modulator bracket.

- 1) Disconnect the high pressure pump and vacuum modulator connector.
- 2) Disconnect the fuel lines to high pressure pump.
- 3) Plug the openings of pipes and ports with protective caps to keep the cleanness of the fuel system.
- 4) Remove the high pressure fuel pipe between HP pump and common rail.



9. Rotate the crankshaft clockwise so that the HP pump sprocket holes are aligned to the bolt holes.



8. Hold the HP pump sprocket and slacken the center bolt.



9. Slacken three HP pump mounting bolts until they rest on the sprocket.



10. Loose the HP pump center nut by tapping it with a hammer.

**NOTICE**

- Tap the center bolt with a hammer after tightening.
- Make sure that the center bolt is securely tightened.



11. Remove the remaining bolts with the same manner and remove the high pressure pump.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Installation

1. Replace the HP pump gasket with new one (cannot be reused).



2. Tighten the HP pump bolts.

Tightening torque	25 Nm
-------------------	-------



3. Hold the HP pump sprocket and tighten the center nut.

Tightening torque	65 Nm
-------------------	-------

NOTICE

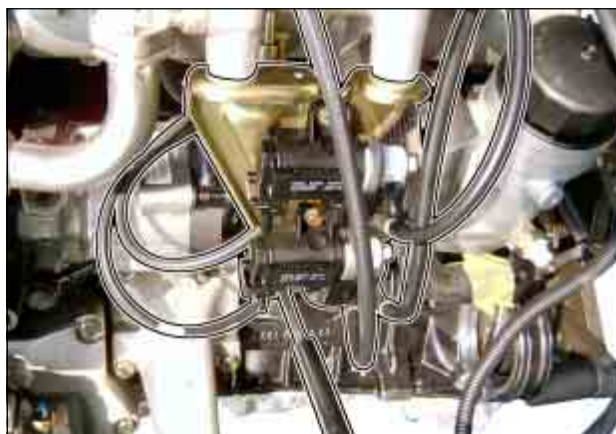
- The center nut should be replaced once removed (cannot be reused).
- Tighten the center nut with the specified tightening torque.



4. Install the vacuum modulator bracket.

NOTICE

- Replace the fuel lines to HP pump with new ones (cannot be reused).
- Make sure that the connectors are installed to the correct locations. (The wiring end with white tape)



5. Apply the sealant to the HP pump housing and tighten the bolts.

**NOTICE**

- Sealant (DB2210): 661 989 56 A0



6. Install the auto tensioner and belt pulleys.



7. Rotate the crankshaft pulley two revolutions and ensure that the OT mark on the crankshaft pulley and the OT mark on the camshaft pulley are aligned.

**NOTICE**

- Open the oil filler cap and check if the OT mark on crankshaft is aligned to the notch on the camshaft.



GENERAL

ASSY

HOUSING

INTAKE

EXHAUST

LUB

COOLING

FUEL

CONTROL

SENSOR

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► Engine Removal & Installation (D27DT Engine)

Removal

※ Preceding Works

1. Disconnection of negative battery cable
2. Removal of engine cover

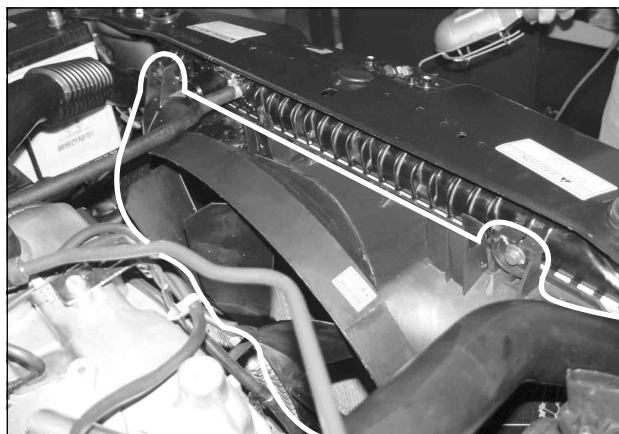
The trouble diagnosis should be performed before removing the HP pump. Refer to "Diagnosis" section.

1. Remove the bolts on the fan shroud. Disconnect the air intake duct from intake manifold and the coolant outlet port connecting hose.

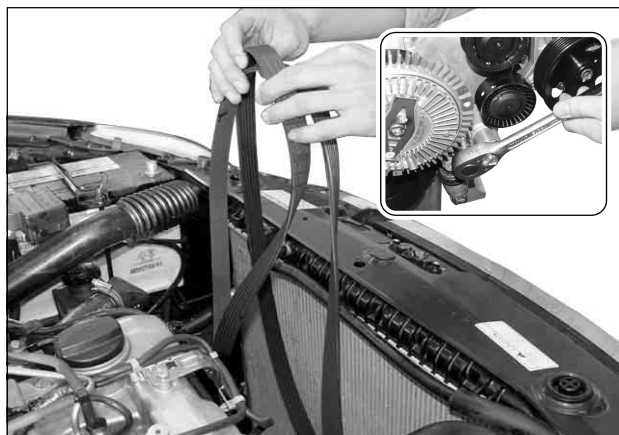


NOTICE

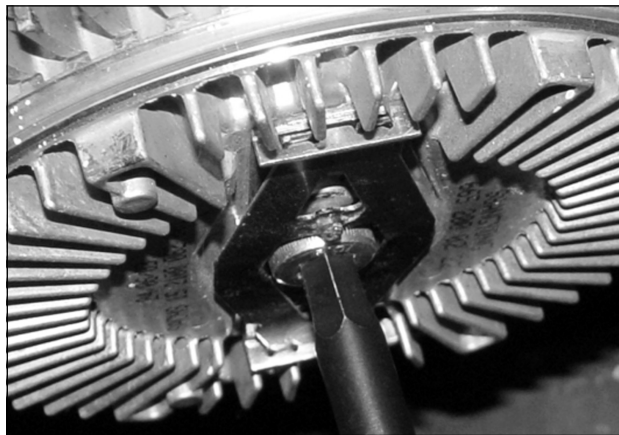
- Plug the coolant port not to get the coolant into the engine. Add the coolant as required when installing.



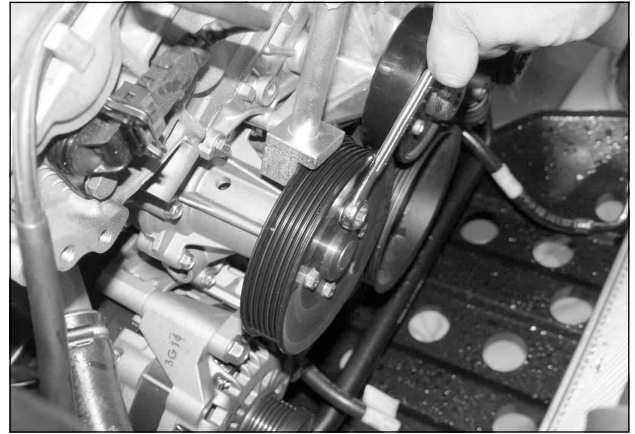
2. Remove the fan belt while pressing down the auto tensioner adjusting bolt.



3. Unscrew the center bolt and remove the cooling fan clutch while holding the pulley with counter holder (special tool).
4. Remove the fan shroud and fan clutch simultaneously.



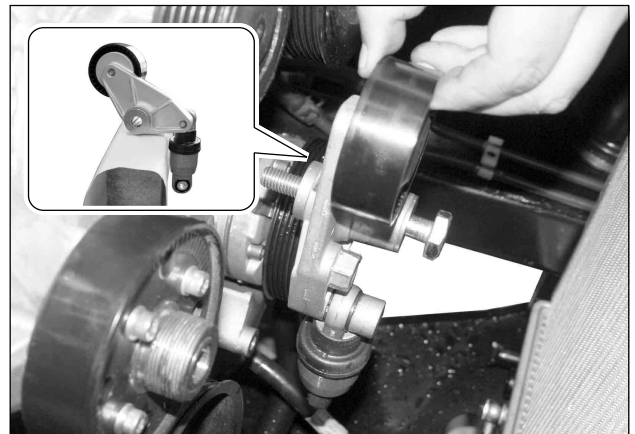
5. Unscrew the bolts and remove the belt pulley while holding the belt pulley with a special tool.



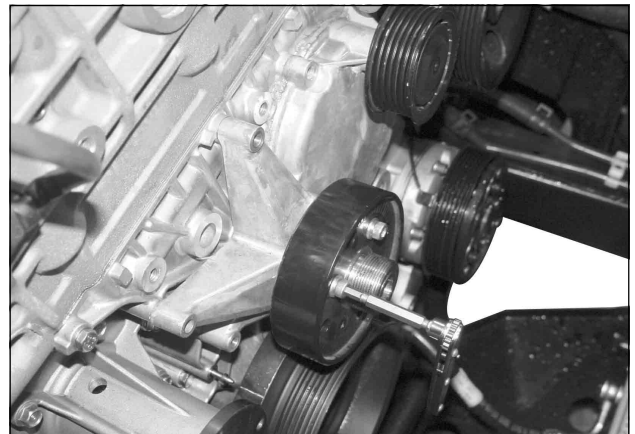
6. Unscrew the upper and lower bolts and remove the auto tensioner.

**NOTICE**

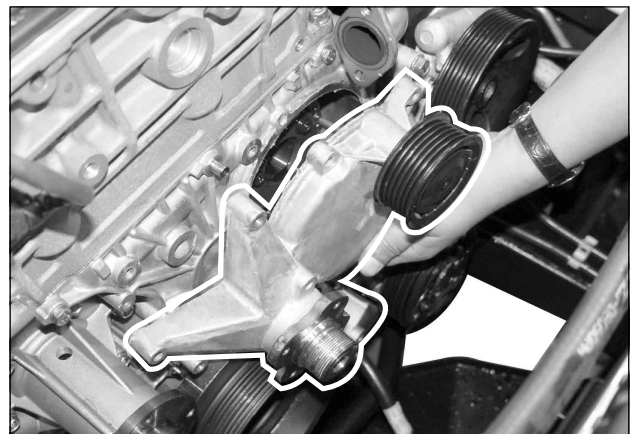
- To prevent oil leaks, store the removed auto tensioner in upright position.



7. Unscrew the bolts and remove the idle pulley.

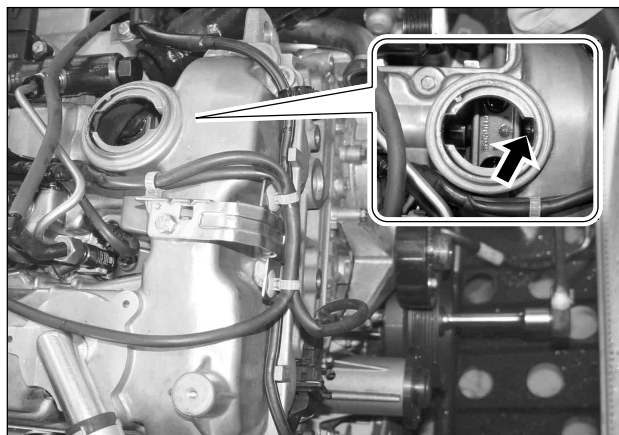


8. Unscrew the bolts and remove the cooling fan bracket (timing chain cover side).



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

9. Remove the engine oil filler cap and adjust the mark on camshaft to TDC position.



10. Align the TDC mark on the crankshaft pulley to the guide pin and rotate the pulley 720° counterclockwise. Check the mark on the camshaft again.

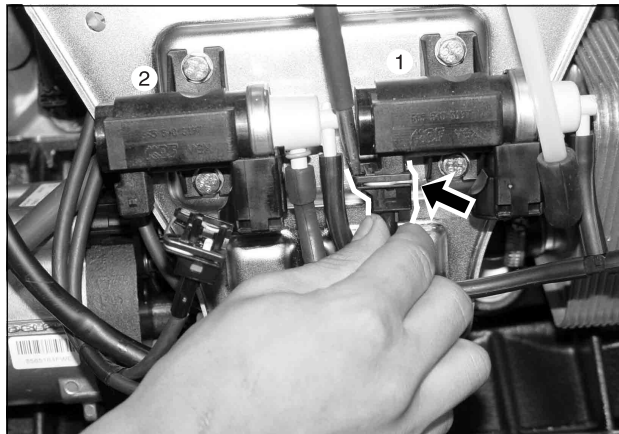


11. Disconnect the vacuum line of EGR vacuum modulator (1), the vacuum line of turbo charger vacuum modulator (2) vacuum line and connectors.

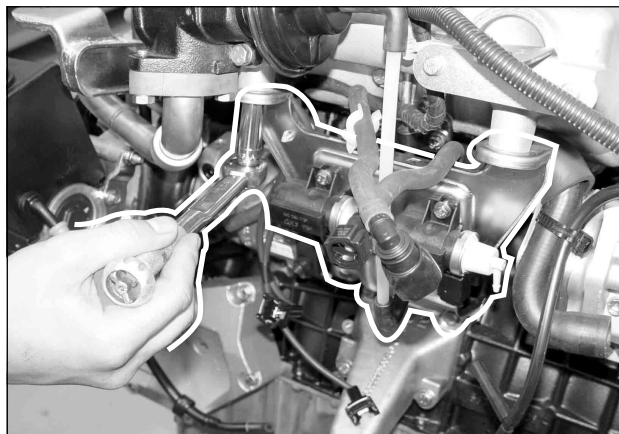


NOTICE

- Be careful not to be mixed the lines when installing.

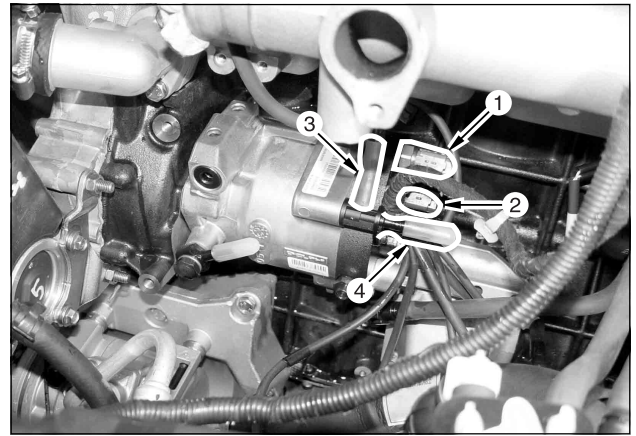


12. Unscrew the bolts and remove the intake manifold mounting bracket.



13. Disconnect the connector behind HP pump, fuel pipes and hose lines.

- 1) Fuel temperature sensor connector (green)
- 2) IMV connector
- 3) Fuel return hose (be careful not to break the HP pump connecting port)
- 4) Venturi hose

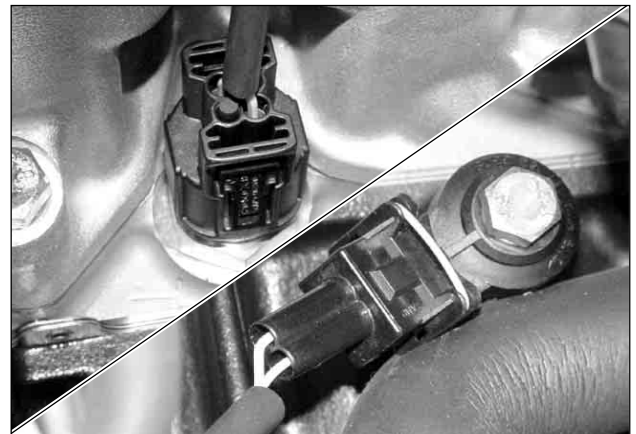


14. Remove the coolant temperature sensor and the knock sensor.



NOTICE

- Especially, the knock sensor should be tightened by the specified tightening torque. Otherwise, it may cause the poor engine output. For reference, the internal resistance of the sensor is approx. 4.7 k Ω .

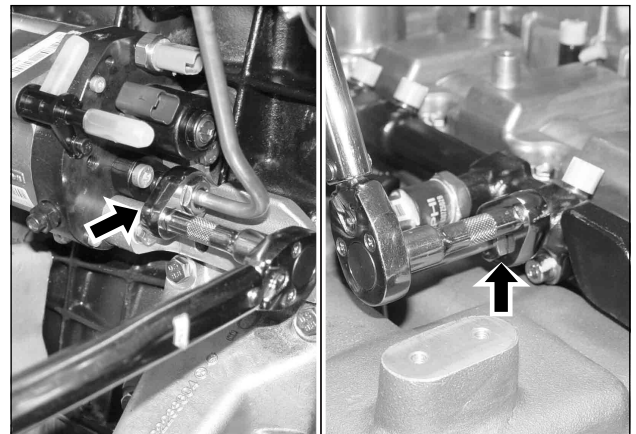


15. Unscrew the bolts and remove the high fuel pressure pipes at HP pump and common rail. Plug the openings with sealing caps.

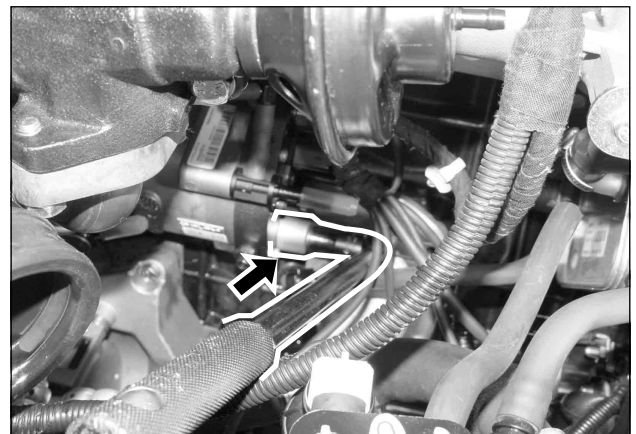


NOTICE

- Replace the fuel pipes with new ones.



16. Remove the HP pump mounting bracket at engine.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

17. Remove the intake EGR pipe and gasket.



NOTICE

- Replace the removed gasket with new one.
- Replace the removed #1 and #3 pipes with new ones.



18. Disconnect the HFM sensor connector.

19. Loosen the clamp and separate the hose from air cleaner.

20. Separate the connection lines from turbo charger and PCV separator.



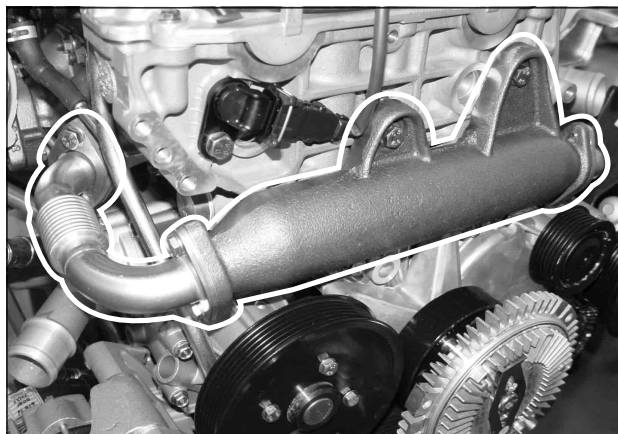
21. Remove the exhaust EGR pipe and gasket. Remove the center EGR pipe.



NOTICE

- Replace the removed gasket with new one.
- Replace the removed #1 and #3 pipes with new ones.

Replace the O-ring with new one.



22. Remove the oil dipstick mounting bracket and oil dipstick tube with O-ring.



NOTICE

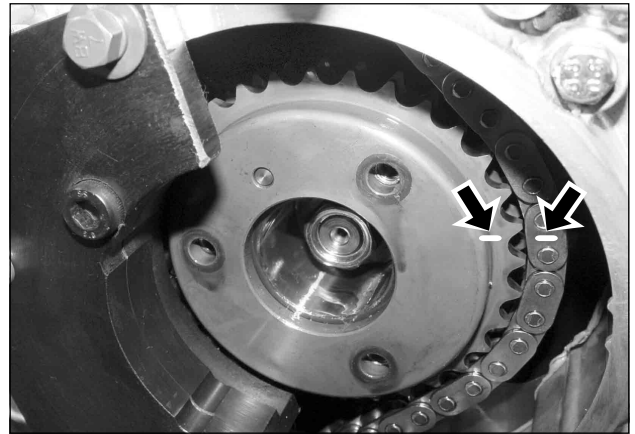
- Replace the O-ring with new one.



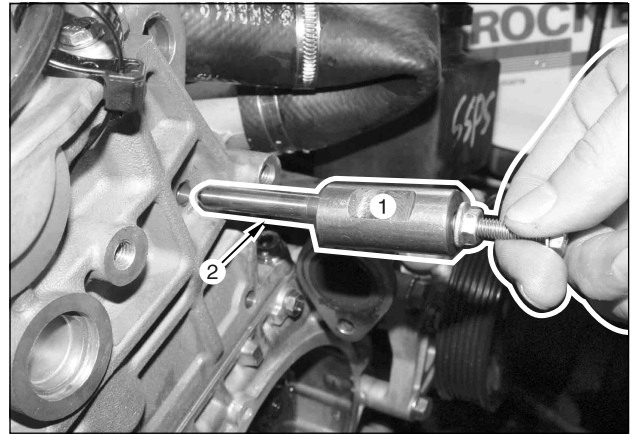
23. Remove the chain tensioner.



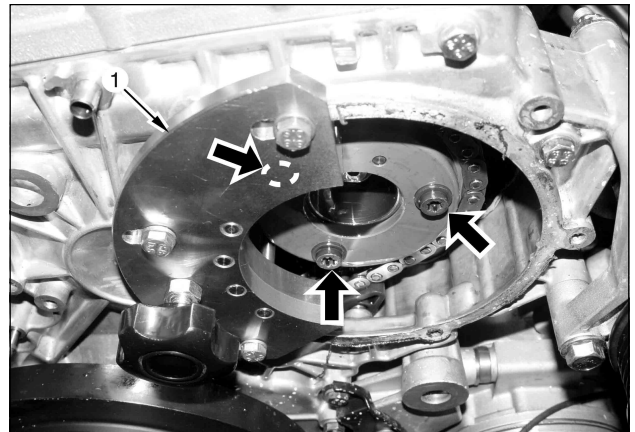
24. Mark on the HP pump sprocket and timing chain.



25. Remove the guide rail pins (lower and upper) with a special tool.

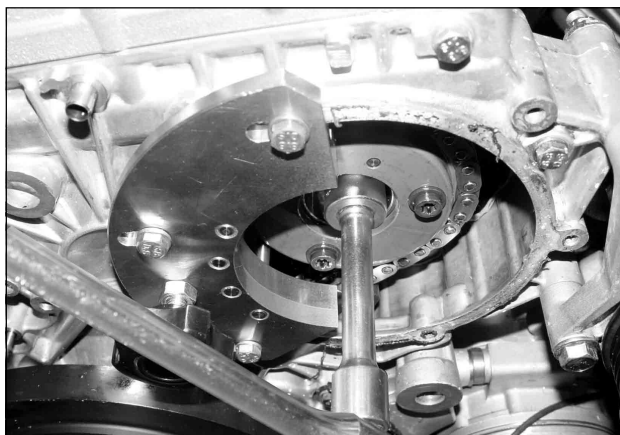


26. Install the special tool (1) for holding HP pump sprocket, unscrew the mounting bolts and remove the sprocket. At this time, rotate the crankshaft 30° to 45° counterclockwise to remove the sprocket.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

27. Remove the center nut for HP pump shaft.



28. Pull out the HP pump bearing with a special tool.



NOTICE

- Be careful not to damage the bearing.



29. Remove the HP pump bearing bracket.



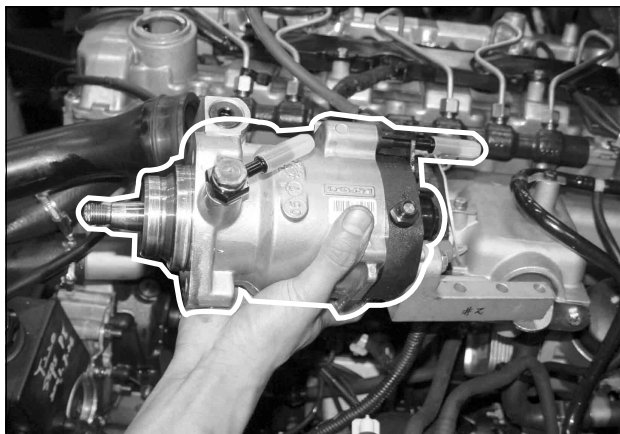
30. Remove the mounting bracket behind the HP pump.

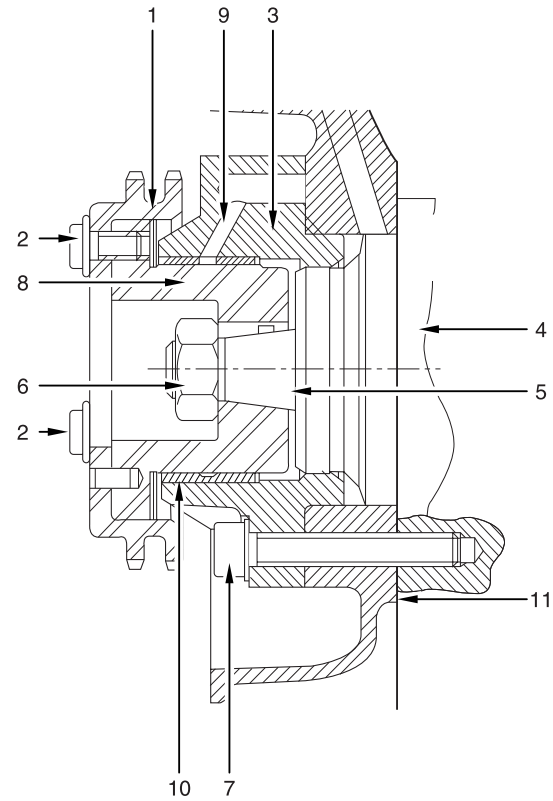
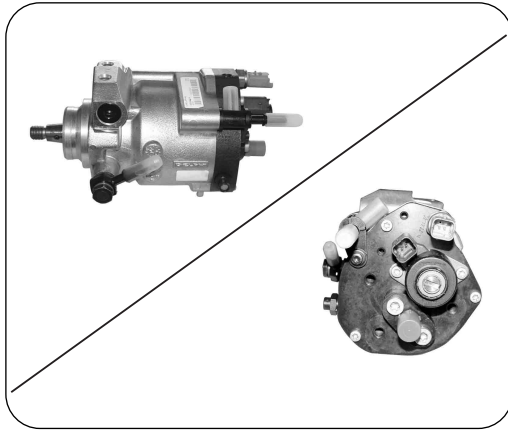
31. Slide the HP pump out rearward while holding it.



NOTICE

- Plug the openings of connecting hoses and pipes with sealing caps.





1. HP pump sprocket
2. 12-sided bolt ($20 \text{ Nm} \pm 90^\circ$)
3. HP pump bearing housing
4. HP pump (High pressure pump)
5. HP pump shaft
6. HP pump center nut ($65 \pm 5 \text{ Nm}$)

7. HP pump external bolt ($24 \pm 2.4 \text{ Nm}$)
8. HP pump bearing shaft
9. Oil gallery
10. Bearing bushing
11. Gasket

GENERAL

ASSY

HOUSING

INTAKE

EXHAUST

LUB

COOLING

FUEL

CONTROL

SENSOR

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Installation

1. Install the gasket and HP pump.



NOTICE

- Replace the removed gasket with new one.

2. Install the HP pump bearing bracket and HP pump to the cylinder block.

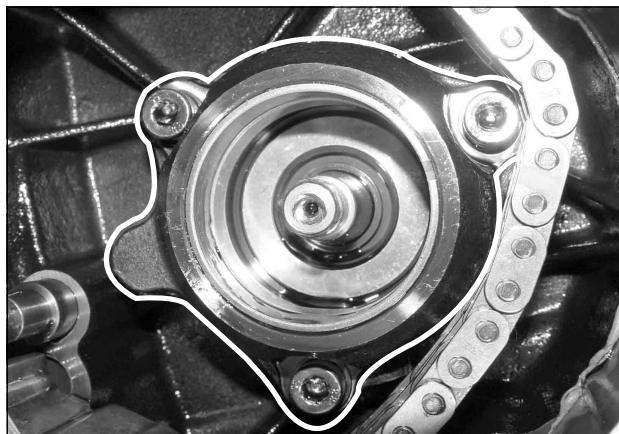
Tightening torque	$24 \pm 2.4 \text{ Nm}$
-------------------	-------------------------



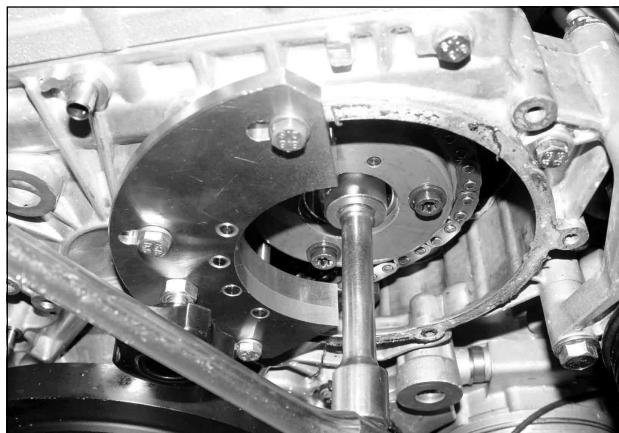
NOTICE

- Align the oil galleries in cylinder block and bearing bracket.

3. Install the bearing into the bracket.



4. Temporarily install the upper and lower guide rails to seat the chain.
5. Temporarily tighten the center nut for HP pump shaft.



NOTICE

- Be careful not to rotate the shaft.

6. Install the timing chain on the sprocket and lock the sprocket with a special tool.



NOTICE

- Do not apply excessive force to the timing chain. Otherwise, the TDC point deviates from correct position.



7. Tighten the center nut for HP pump.

Tightening torque	$65 \pm 5.0 \text{ Nm}$
-------------------	-------------------------

**NOTICE**

- Replace the center nut with new one.

8. Press the upper and lower guide pins into the guide.

**NOTICE**

- Check the timing chain and guide pin for contact.

9. Align the marks on the HP pump sprocket and the timing chain and tighten the bolts.

Tightening torque	$20 \text{ Nm} \pm 90^\circ$
-------------------	------------------------------

10. Remove the special tool.

11. Install the mounting bracket behind HP pump.

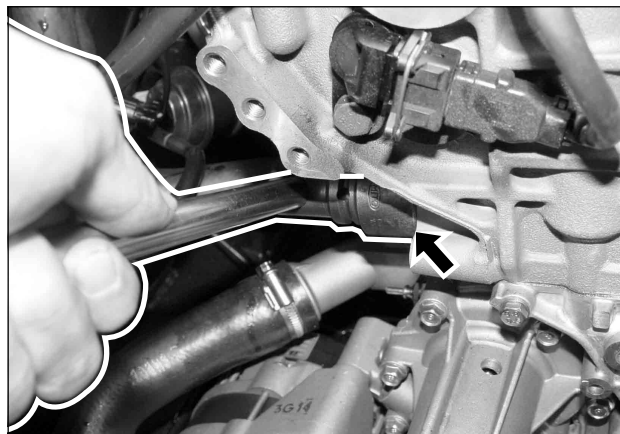
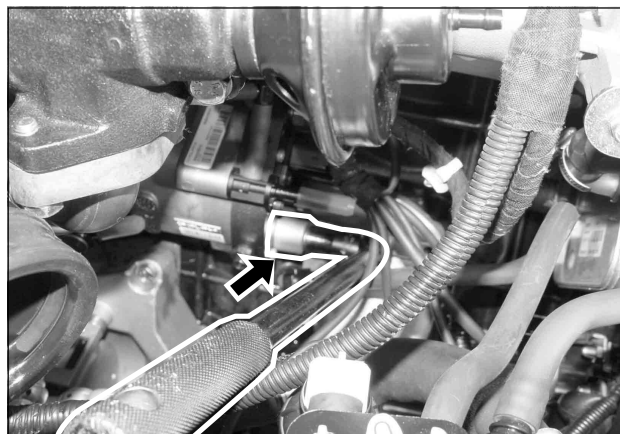
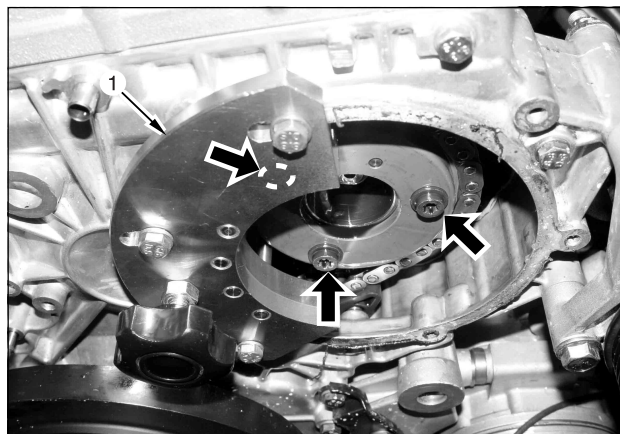
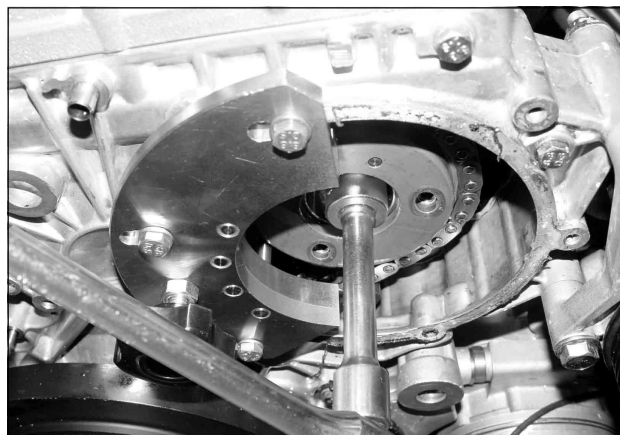
Tightening torque	$25 \pm 2.5 \text{ Nm}$
-------------------	-------------------------

12. Install the chain tensioner.

Tightening torque	$80 \pm 8 \text{ Nm}$
-------------------	-----------------------


**NOTICE**

- Replace the chain tensioner washer with new one.
- Be careful not to drop the washer into the hole.

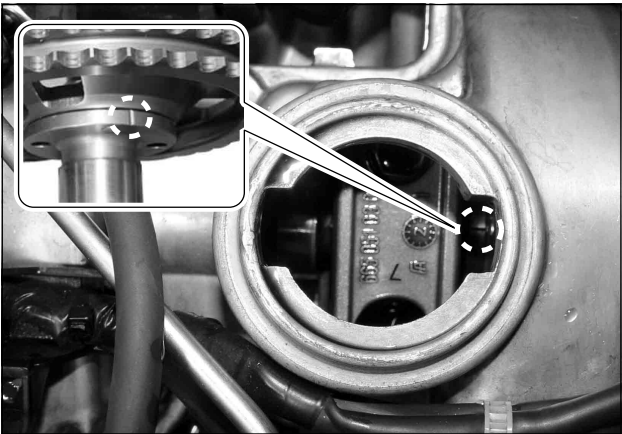


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

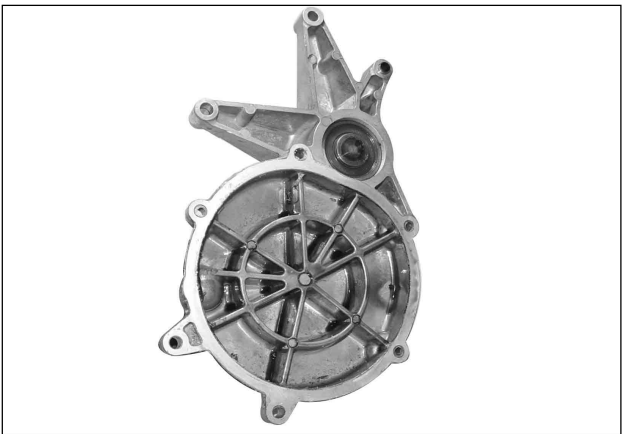
13. Check if the mark on the intake camshaft is at the correct position through oil filler opening.

**NOTICE**


- Rotate the bolt on crankshaft damper pulley two revolutions and check if the mark on the intake camshaft is at the correct position.



14. Clean the timing chain cover parting surface and apply the sealant on it.

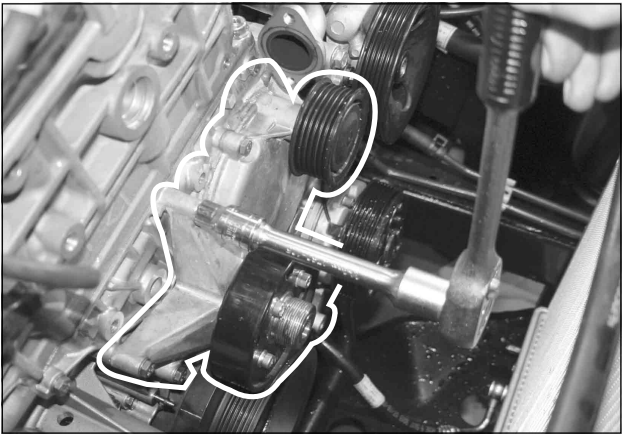


15. Install the timing chain cover.

**NOTICE**

- Align the cover and the guide pin.

Tightening torque	10 ± 1.0 Nm
-------------------	-------------



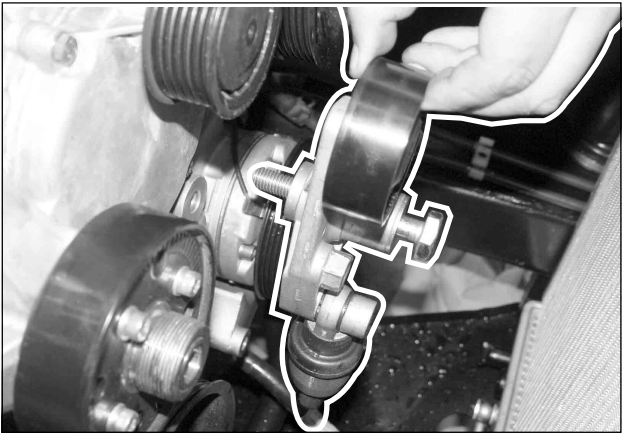
16. Install the auto tensioner assembly.

1) Upper bolt (24M):

Tightening torque	82 ± 6.0 Nm
-------------------	-------------

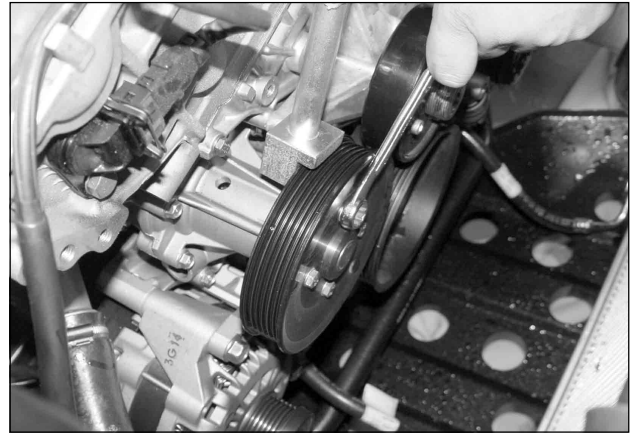
2) Lower bolt (13M):

Tightening torque	32 ± 3.0 Nm
-------------------	-------------



17. Install the coolant pump pulley.

Tightening torque	$10 \pm 1.0 \text{ Nm}$
-------------------	-------------------------



18. Install the fan clutch with a special tool.

Tightening torque	$10 \pm 1.0 \text{ Nm}$
-------------------	-------------------------



19. Install the oil dipstick tube and bracket.

Tightening torque	$10 \pm 1.0 \text{ Nm}$
-------------------	-------------------------

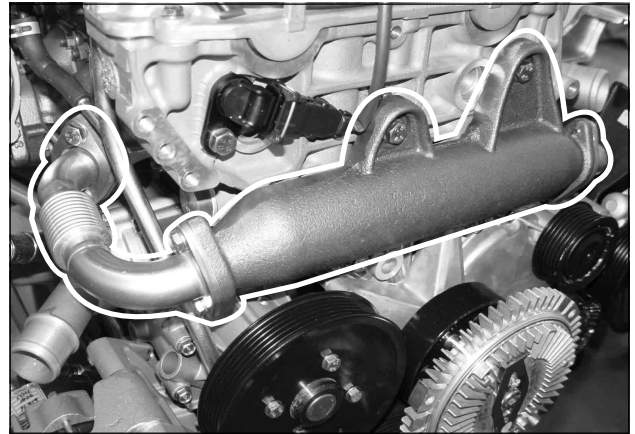
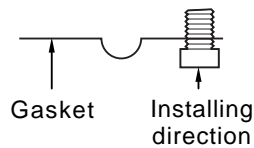
20. Install the exhaust EGR pipe and bracket.

Tightening torque	$10 \pm 1.0 \text{ Nm}$
-------------------	-------------------------



NOTICE

- Make sure that the convex surface of new steel gasket is facing the direction as shown in the figure.



21. Engage the turbo charger and PCV separator connecting lines.
 22. Engage the air cleaner hose and tighten the clamp.
 23. Connect the HFM sensor connector.
 24. Install the EGR center pipe.

Tightening torque	$25 \pm 2.5 \text{ Nm}$
-------------------	-------------------------

25. Connect the HP pump connectors and engage the hose lines.

- 1) Fuel temperature sensor connectors and IMV connector
- 2) Venturi hose and fuel return hose

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

26. Install the coolant temperature sensor and the knock sensor.
27. When replaced the HP pump, initialize the fuel pressure by using Scan-100. Refer to "Trouble Diagnosis" section in this manual.

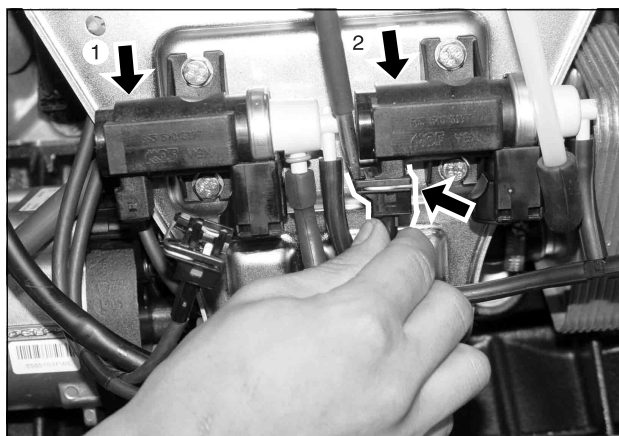
**NOTICE**

- If the initialization of fuel pressure has not been performed, the engine ECU controls new HP pump with the stored offset value. This may cause the poor engine output.

27. Install the vacuum modulator to the intake manifold bracket.
28. Connect the vacuum modulator connecting lines and connector.
 - 1) Vacuum modulator for turbo charger control
 - 2) Vacuum modulator for EGR valve control

**NOTICE**

- Ensure that the vacuum hoses are connected to correct positions.



29. Connect the hose to coolant outlet port and tighten the clamp.
30. Install the air intake duct.
31. Install the fan belt while pressing the auto tensioner adjusting bolt.



32. Place the fan shroud in its location and install the cooling fan by using an open end wrench.

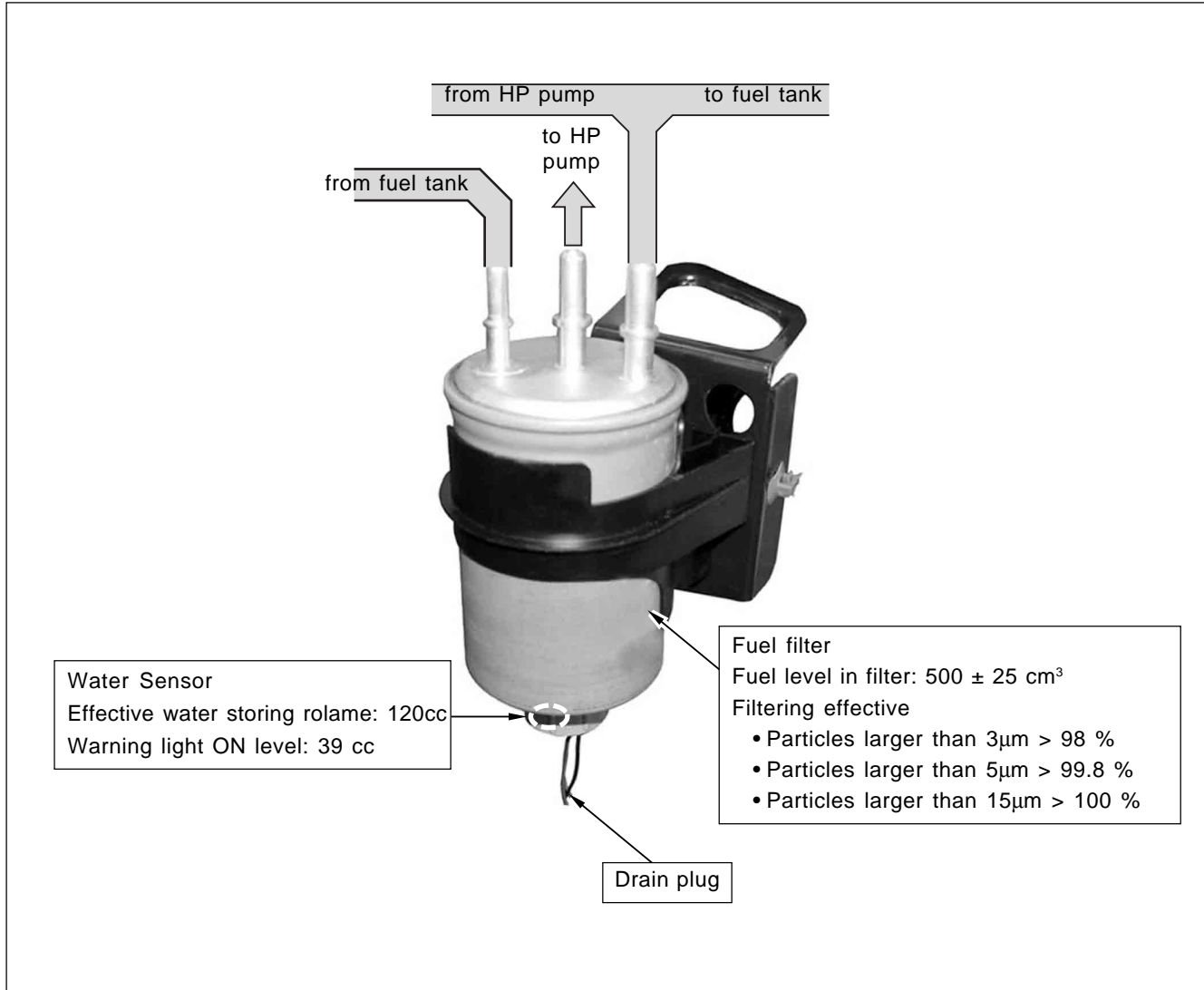
Tightening torque	10 ± 1.0 Nm
-------------------	-------------

33. Install the fan shroud.
34. Add the coolant.
35. Check all the connections for tightness and pump the priming pump to deliver the fuel to the transfer line of HP pump.
36. Start the engine and check if abnormality is present.

► Fuel Filter

Function

Foreign materials in fuel can damage the pump components, transfer valve and injectors. Therefore, the high pressure direct injection engine must use fuel filter. Otherwise, the operation performance will drop dramatically. And, diesel fuel may contain water due to condensation by temperature changes and this condensation water can damage the system by corroding the injection system. Thus, the common rail engine should have function that can drain water periodically.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Change Interval: 30,000 km

Water separation and storage function

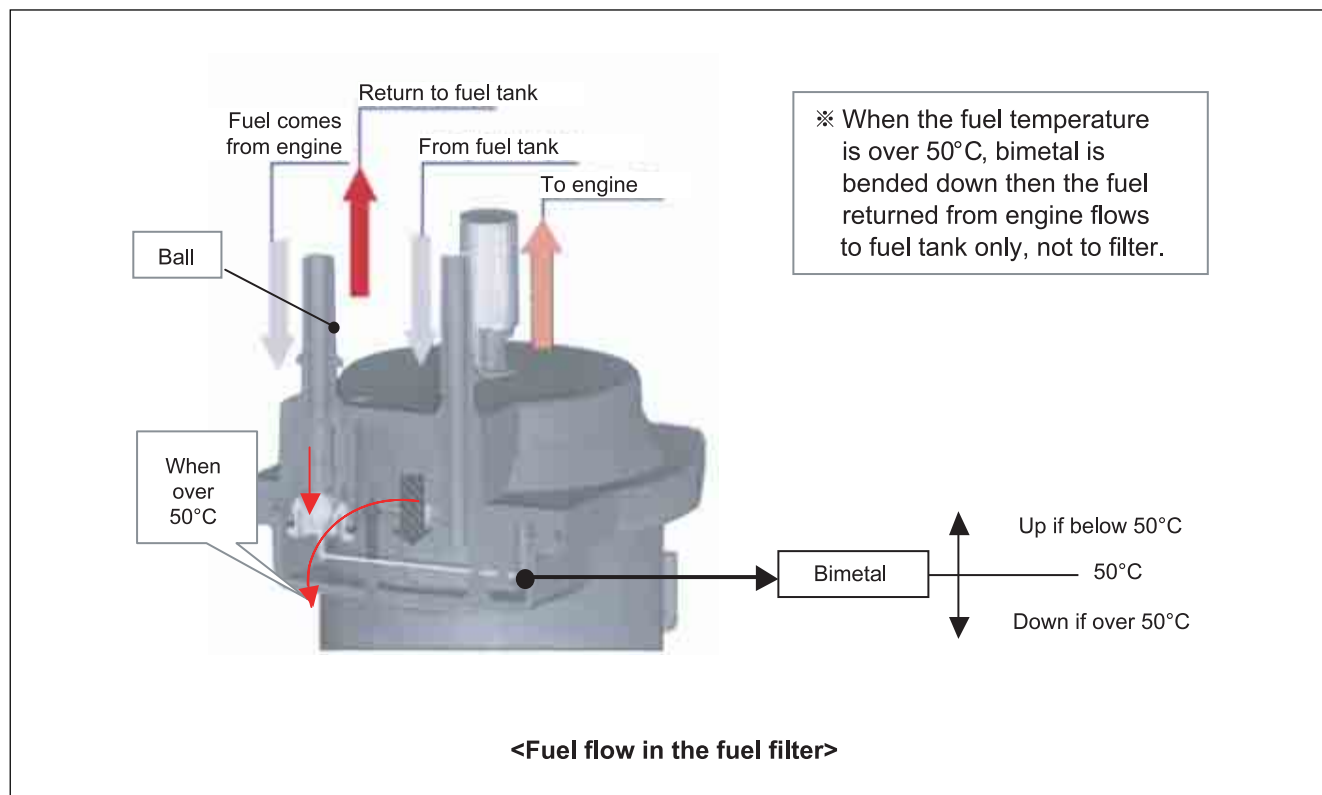
1. Function: It separates the condensation water from diesel fuel to prevent the water from getting into FIE system, and results in protection of FIE system. (manual drain)
2. Water reserve capacity: 124 cc
3. Water warning light turning on level: 39 cc
4. Water drain interval: When changing engine oil or every 20,000 km

Water sensor

It is integrated in the filter and sends signal to ECU when water level reaches at a specified value (over 75 cc) in the filter to let the driver drain the water.

Fuel De-Waxing – Improving starting performance in cold weather

Due to characteristics of diesel fuel, some of fuel components solidify during cold winter under below a specific temperature (-15°C). When those symptoms happen, engine may stall; however, some of the fuel (temperature rises due to high compression) in the HP pump in D27DT engine return to the filter to warm up fuel when temperature is below 50°C by improving cold start performance during cold winter.



Removal and Installation

1. Disconnect the fuel supply and return hoses.



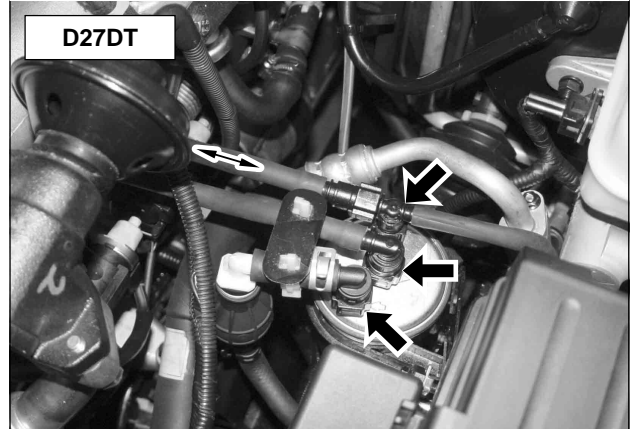
NOTICE

- Plug the openings of hoses and fuel filter with sealing caps.
- Ensure that the hoses are connected to correct positions.

D20DT



D27DT



2. Loosen the bracket bolts and disconnect the hose from the drain plug.
3. Remove the fuel filter.
4. Install in the reverse order of removal.
5. Press the priming pump until it becomes rigid to deliver the fuel to the transfer line of HP pump.



GENERAL

ASSY

HOUSING

INTAKE

EXHAUST

LUB

COOLING

FUEL

CONTROL

SENSOR

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

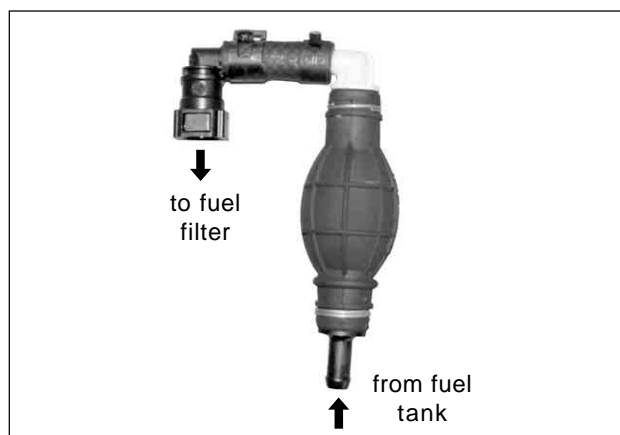
► Priming Pump

If fuel runs out during driving or air gets into fuel line after fuel filter replacement, it may cause poor engine starting or damage to each component. Therefore, the hand priming pump is installed to bleed air from transfer line.

When the vehicle is under the conditions as below, press the priming pump until it becomes rigid before starting the engine.

Conditions for using Priming Pump

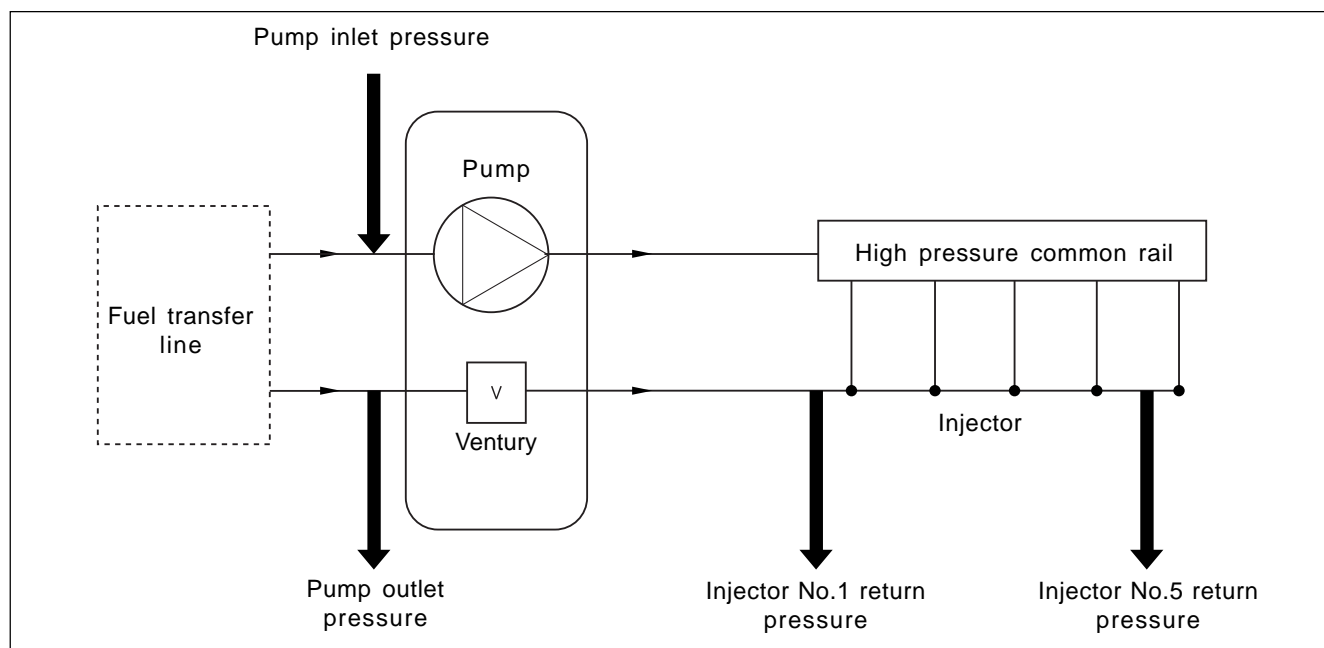
1. After run out of fuel
2. After draining the water from fuel separator
3. After replacing the fuel filter



NOTICE

- When the fuel filter is replaced, the fuel in the fuel tank should be transferred to the filter by using priming pump. So never transfer the fuel in the fuel tank to the filter by driving HP pump with cranking the engine.

► Relations Between Pressure and Temperature in Fuel Transfer Line



1. The fuel transfer line is the line between fuel tank and HP pump inlet port. The pressure on this line affects the lifetime of fuel filter.
2. Temperature of fuel transfer line
 - 1) Pump inlet temperature is less than 80°C.
 - 2) Above figure shows the temperature changes in each section caused by temperature changes in pump inlet section; the temperature of fuel pump inlet is up to 80°C.
And, diesel fuel has lubrication effects due to its viscosity. Thus, the fuel is also used for pump lubrication. However, this lubrication performance drops as the temperature rises. Accordingly, when the fuel temperature is over 50°C, 100% of fuel is returned to fuel tank to cool down the temperature and then increase the lubrication effects of fuel and prevent heat damage on each section of high fuel pressure line.

► High Pressure Accumulator (Common Rail)



Description

The high pressure accumulator reserves the high pressure fuel. Simultaneously, the pressure changes due to the delivery from HP pump and the fuel injection is diminished by rail volume. This high pressure accumulator is commonly used in all cylinders. Even when a large amount of fuel leaks, the common rail maintains its internal pressure. This ensures that the injection pressure can be maintained from when the injector opens.

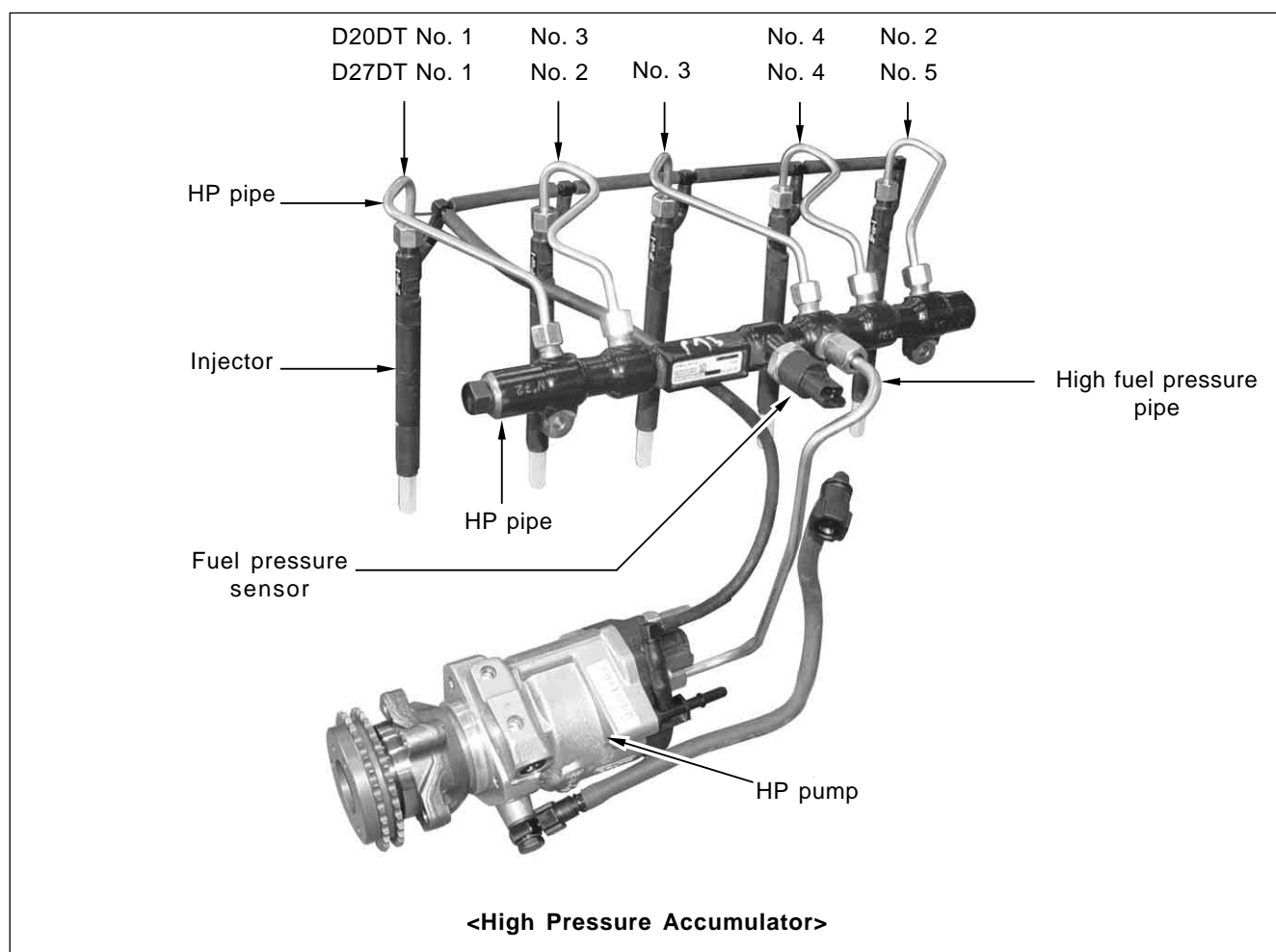
Function

1. Relieve the pressure pulsation
2. Provide pressure information to ECU (fuel pressure sensor)

Specifications

1. Material: Forged Steel
2. Dimension:
 - Volume: $19.5 \pm 1\text{cc}$ (D20DT), $22 \pm 1\text{cc}$ (D27DT)
 - Length: Max. 345.11 mm (D20DT), Max. 397.7 mm (D27DT)
 - Outer diameter: 27 mm (D20DT), 25.3 mm (D27DT)
3. Fuel pressure sensor Integrated type
 - 1) Sensor input voltage: $5 \pm 0.1\text{V}$
 - 2) Sensor output signal voltage:
 - $4.055 \pm 0.125\text{ V} \cong 1600 \pm 15\text{ bar}$
 - $0.5 \pm 0.04\text{ V} \cong 0\text{ bar}$
4. Operating pressure range
 - 1) Normal condition: 0 ~ 1800 bar
 - 2) Exceptional condition: available within 1800 ~ 2100 bar
 - 3) Bursting pressure: over 2500 bar
5. Ambient temperature:
 - 1) available within $-40^{\circ}\text{C} \sim 125^{\circ}\text{C}$
 - 2) Spontaneous max. temperature after engine stops: 140°C (acceptable against total 15 hours)
6. Fluid temperature: $-40 \sim 100^{\circ}\text{C}$ under normal operating conditions
7. Removal and installation: 10 times without any damage

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	



► High Fuel Pressure Pipe

1. Function: Resistant to pressure changes, tightness against surroundings, supplying fuel through pump, rail and injector with high pressure
2. Material: Steel (Zn Plated)
3. Common: Cylinder 1, 2, 3, 4 (D20DT), Cylinder 1 & 3, 2 & 4, 5 (D27DT)
4. Internal pressure
 - 1) Internal operating pressure: 0 ~ 1600 bar during its lifetime
 - 2) Spontaneous max. pressure when restoring: 2100 bar (max. total period: 20 hours)
 - 3) Bursting pressure: over 2500 bar
5. To keep cleanness and tightness, the high pressure pipe assembly should be used only once.



NOTICE

- Make sure to replace the removed high fuel pressure pipes.
- Tighten the fasteners with the specified tightening torque.

Removal and Installation

※ **Preceding Work:** Removal of engine cover

1. Disconnect the fuel pressure sensor connector.



NOTICE

- Replace the fuel pipes with new ones.
- Plug the openings of hole in the common rail with sealing caps.

2. Unscrew the nuts and remove the fuel supply main pipe from the fuel line.

Installation Notice

Tightening torque	40 ± 1.0 Nm
-------------------	-------------



NOTICE

- Replace the fuel pipes with new ones.
- Plug the openings of hole in the common rail with sealing caps.

3. Unscrew the high fuel pressure line nuts and remove the fuel pipes.

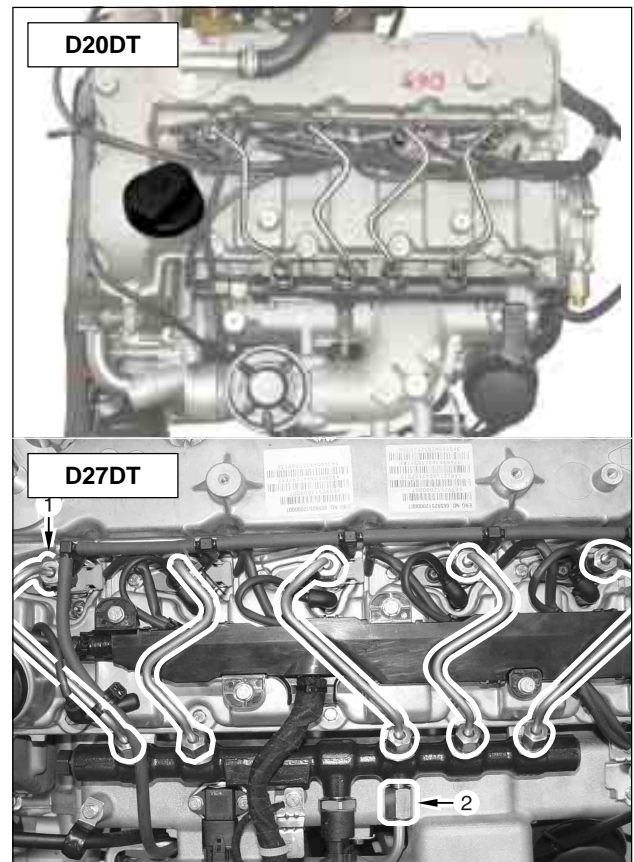
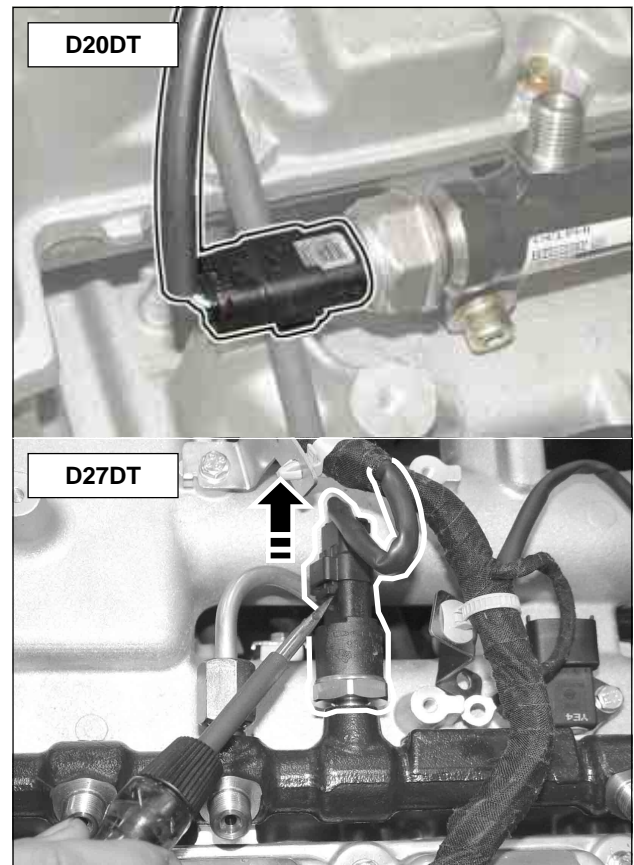
Installation Notice

Tightening torque	40 ± 1.0 Nm
-------------------	-------------



NOTICE

- Replace the fuel pipes with new ones.
- Plug the openings of hole in the common rail with sealing caps.




CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

4. Unscrew the bolts and remove the common rail assembly.

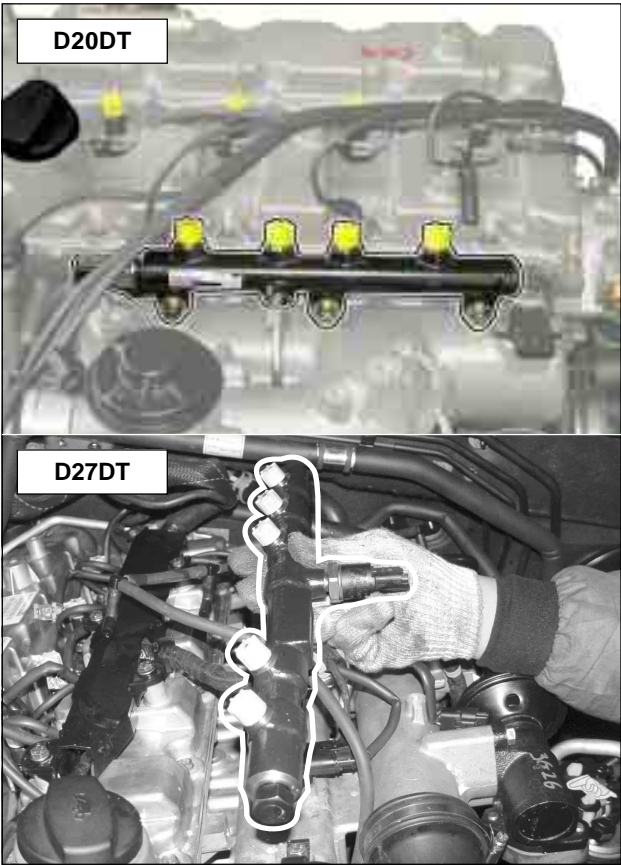
Installation Notice

Tightening torque	25 ± 2.5 Nm
-------------------	-------------

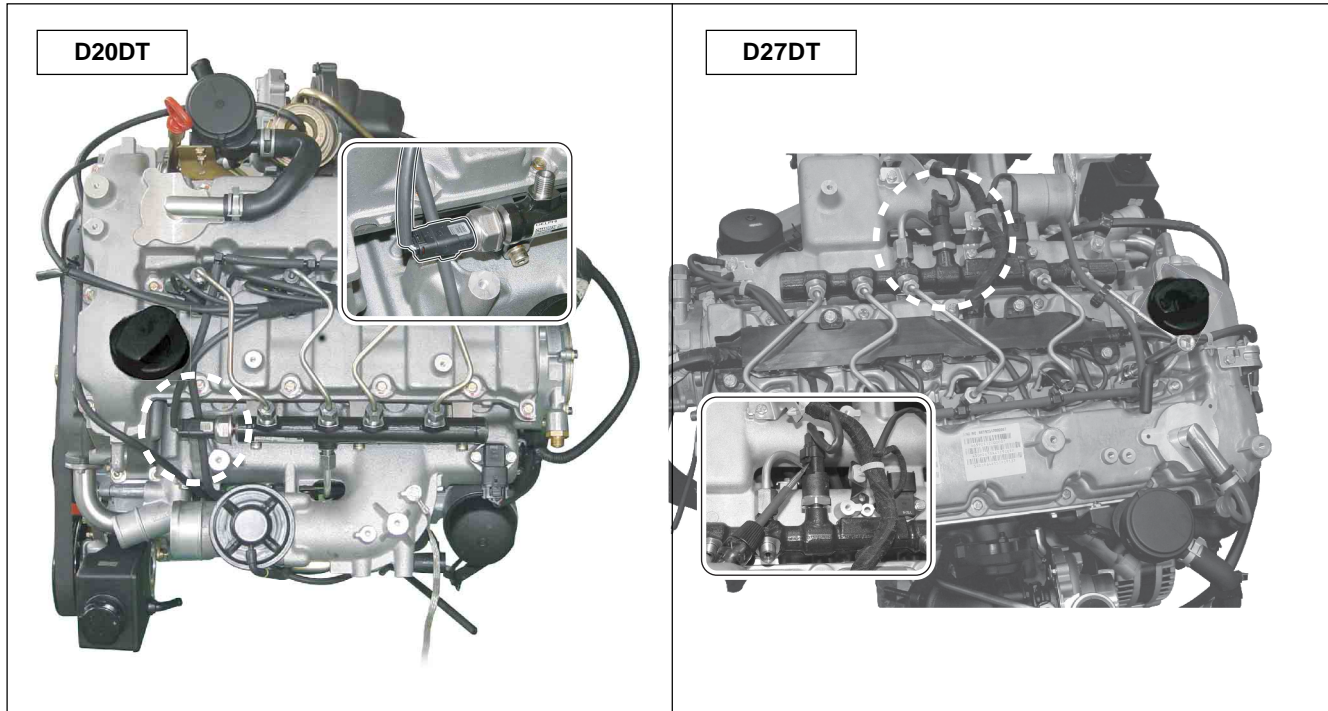
**NOTICE**

- Replace the fuel pipes with new ones.
- Plug the openings of hole in the common rail with sealing caps.

5. Install in the reverse order of removal.



► Fuel Pressure Sensor



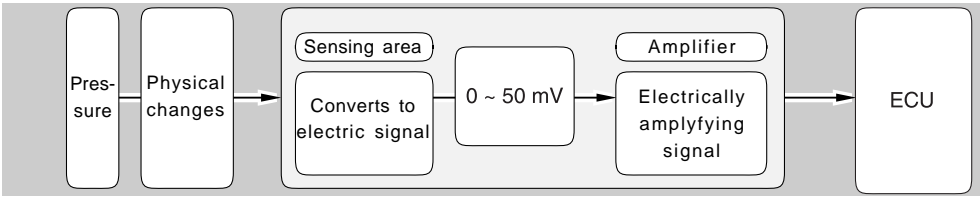
Fuel pressure sensor on the center of common rail detects instant fuel pressure changes and then sends to ECU. When received these signals, ECU uses them to control fuel volume and injection time.

The fuel in the rail reaches to sensor diaphragm via blind hole in the pressure sensor and the pressure signal converts to electrical signal. The signal measured by sensor will be amplified to input to ECU.

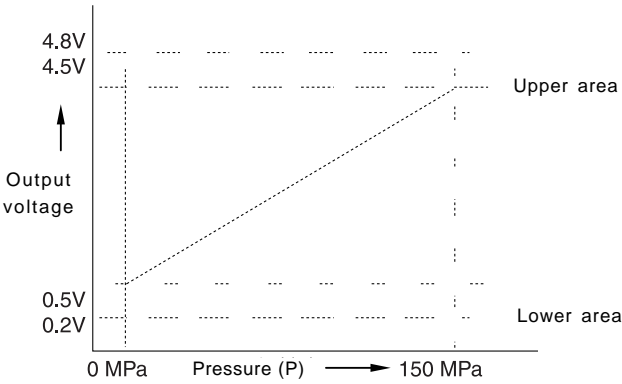
This piezo element type sensor changes pressure into electrical signal. Accordingly, when the shape of diaphragm changes, electrical resistance in the layers on the diaphragm changes then can measure 0.5 ~ 5 V.

1. Sensor input voltage: 5 ± 0.1 V
2. Output signal voltage of sensor
 - 1) 4.055 ± 0.125 V: 1600 ± 15 bar
 - 2) 0.5 ± 0.04 V: 0 bar

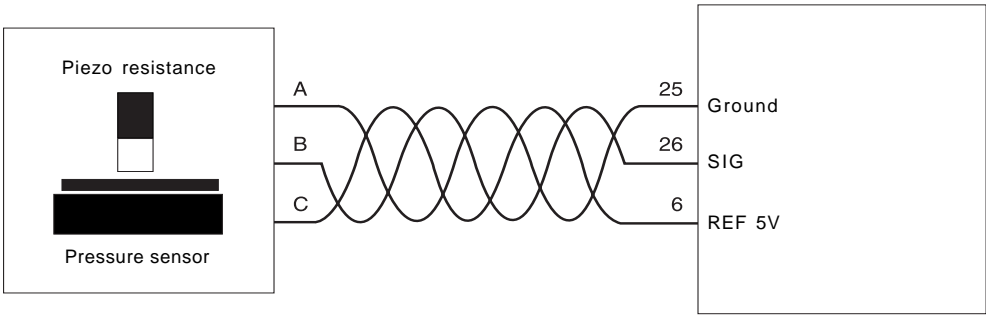
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	



<Operation Principle of Fuel Pressure Sensor>

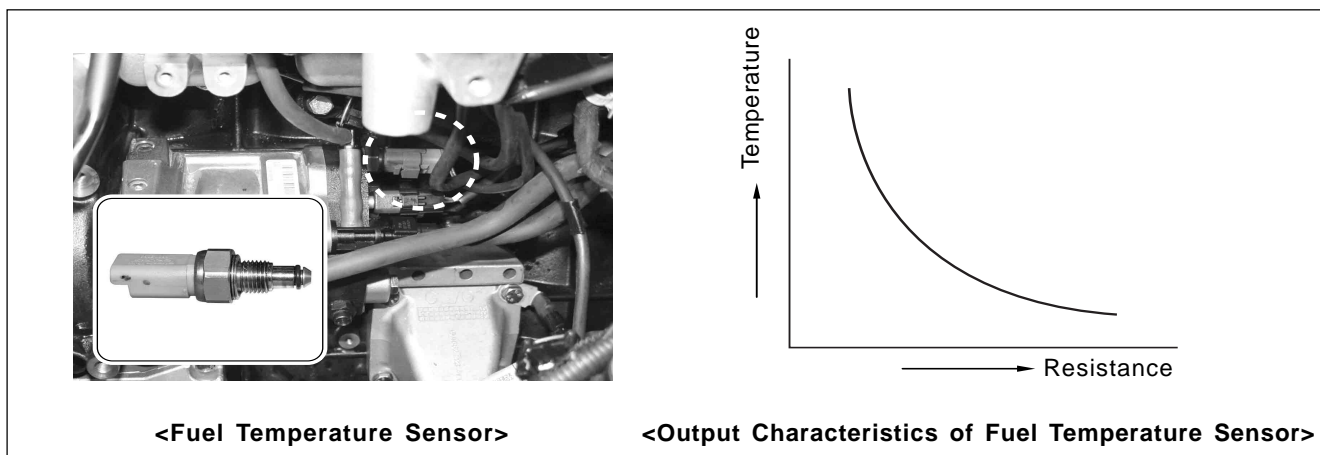


<Sensor Voltage>



<Circuit Diagram of Fuel Pressuer Sensor>

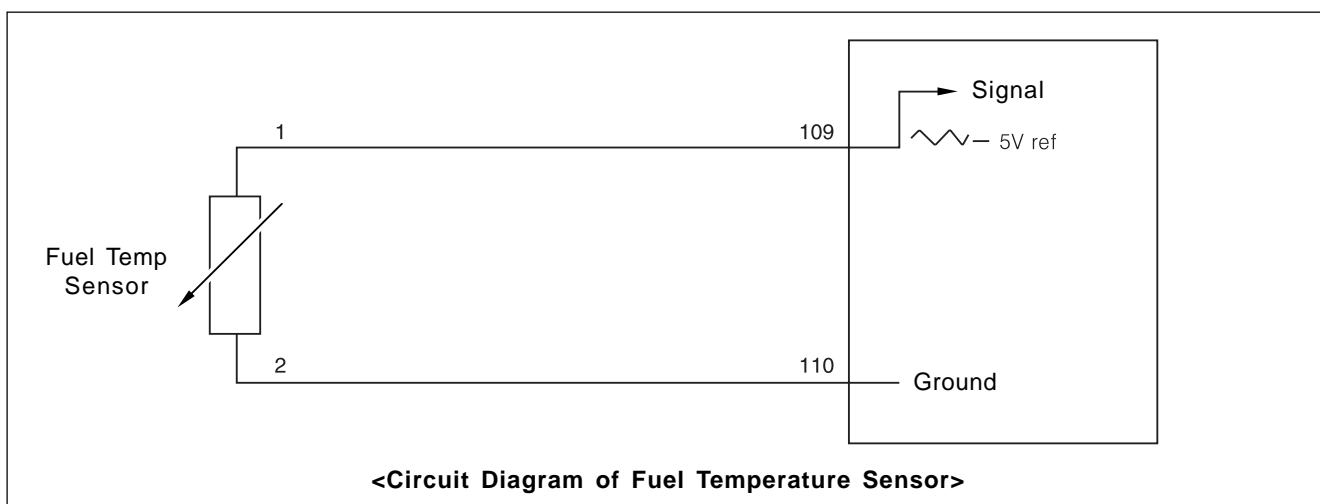
► Fuel Temperature Sensor



Fuel temperature sensor is a NTC resistor that sends fuel temperature to ECU.

In case of NTC resistor, the resistance lowers if engine temperature rises so the ECU detects lowering signal voltages.

Fuel temperature sensor is installed on the fuel return line to correct pressure after measuring fuel temperature. 5V is supplied to the sensor and voltage drop by temperature is delivered to ECU to measure the fuel temperature through analog-digital converter (ADC).



► HFM Sensor

Refer to "Intake System"

► Crankshaft Position Sensor

Refer to "Engine Assembly"

► Knock Sensor

Refer to "Engine Assembly"

► Camshaft Position Sensor

Refer to "Engine Assembly"

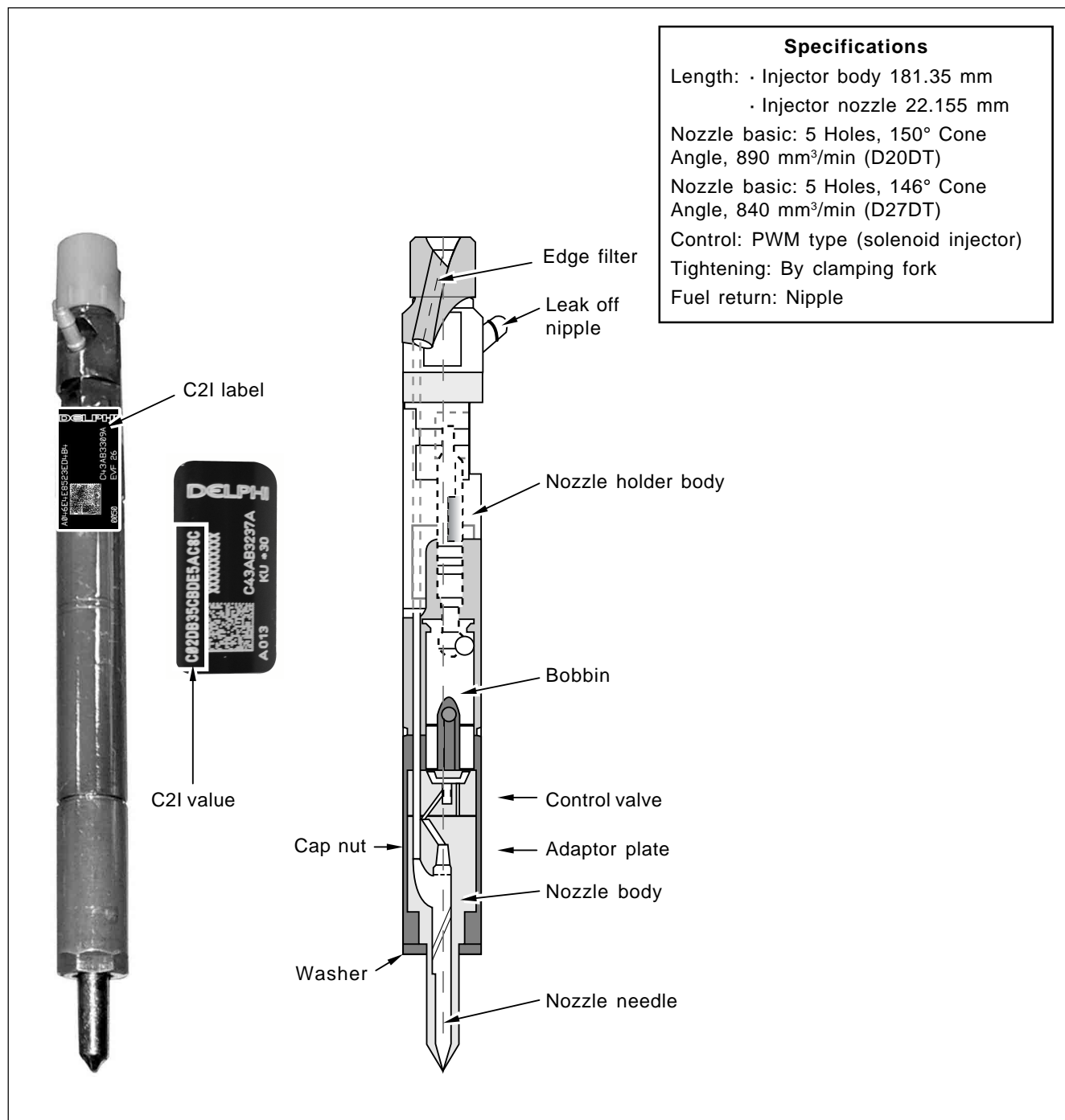
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

INJECTOR

The C21 labels including injector characteristics are attached in each injector. These C21 values should be input to ECU by using Scan-i when replacing the ECU or injectors.

Special cautions:

1. Plug the openings of hoses and pipes with the sealing caps.
2. Replace the copper washer in injector with new one.
3. Tighten the injector holder bolts with the specified tightening torque.
4. Be careful not to drop the injector.



The maximum injection pressures are approximately 1,600 bar. The forces to be overcome in order to lift the needle of the injector are therefore very large. Because of this, it is impossible to directly control the injector by using an electromagnetic actuator, unless very high currents are used, which would be incompatible with the reaction times required for the multiple injections. The injector is therefore indirectly controlled by means of a valve controlling the pressurizing or discharging of the control chamber located above the needle:

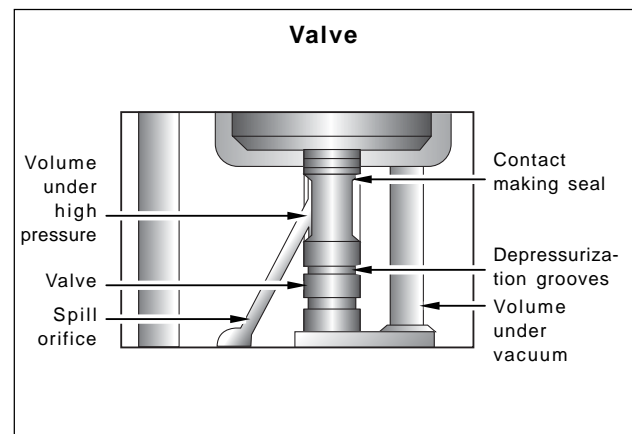
1. When the needle is required to lift (at the start of injection): the valve is opened in order to discharge the control chamber into the back leak circuit.
2. When the needle has to close (at the end of injection): the valve closes again so that pressure is re-established in the control chamber.

Valve

In order to guarantee response time and minimum energy consumption:

1. The valve must be as light as possible.
2. The valve stroke must be as short as possible.
3. The effort needed to move the valve must be minimal, which means that the valve must be in hydraulic equilibrium in the closed position.

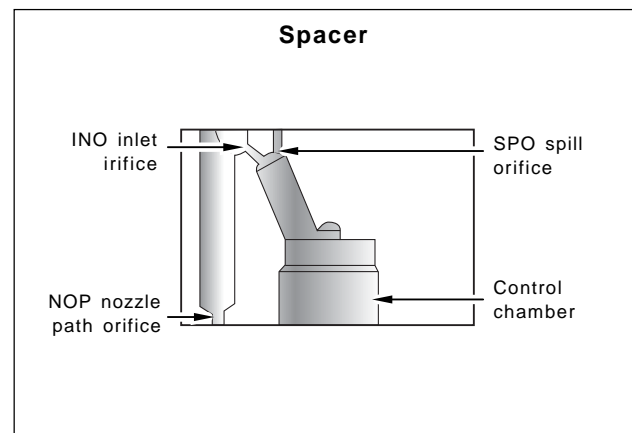
Spring pressure ensures contact between the valve and its seat. To lift the valve, it is therefore required to overcome the force being applied by this spring.



Spacer

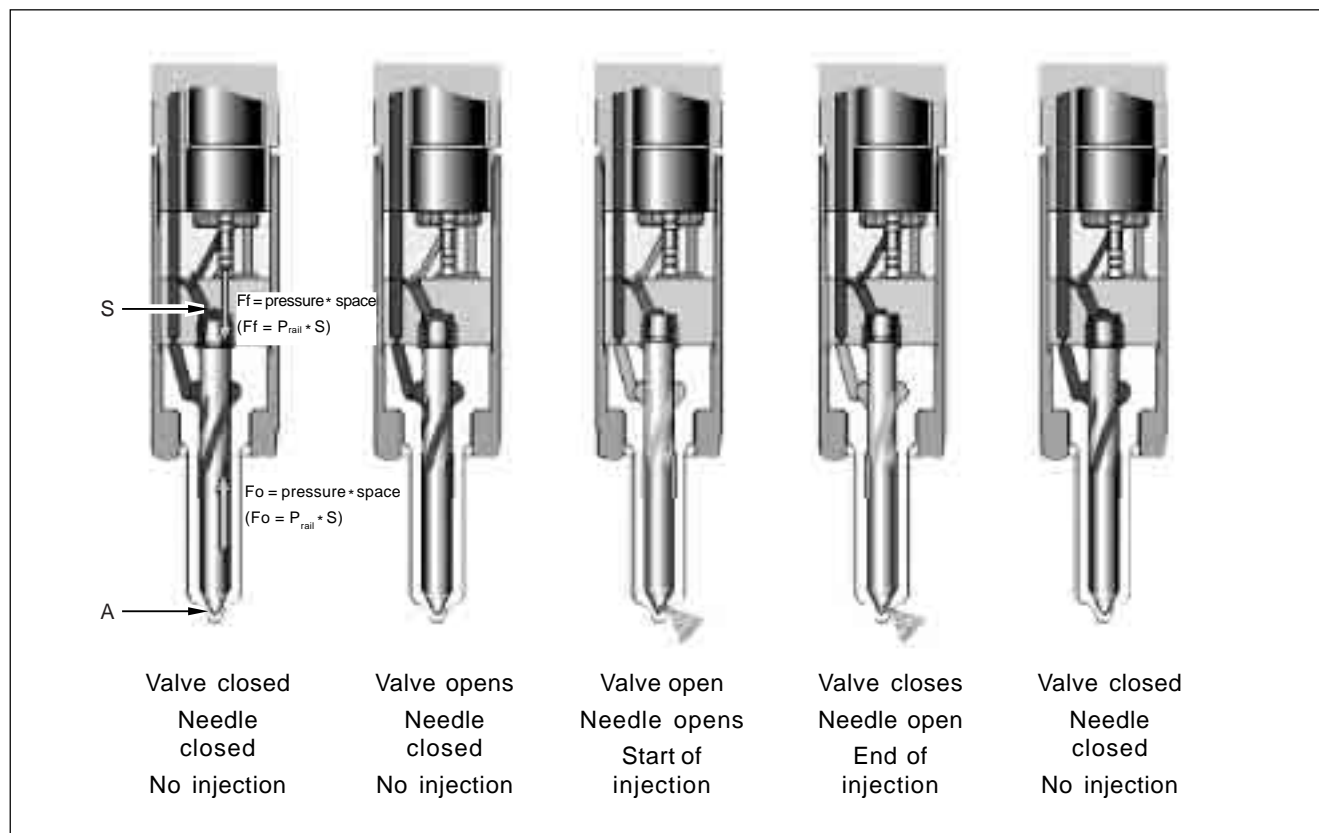
The spacer is situated underneath the valve support. It integrates the control chamber and the three calibrated orifice which allow operation of the injector. These orifices are:

1. The injector supply orifice (Nozzle Path Orifice: NPO)
2. The control chamber discharge orifice (Spill Orifice: SPO)
3. The control chamber filling orifice (Inlet Orifice: INO)



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► Principle of Operation



Injector at rest

The valve is closed. The control chamber is subject to the rail pressure.

The pressure force applied by the fuel onto the needle is:

$$F_f = S \times P_{\text{rail}}$$

The needle is closed and hence there is no fluid circulation through the NPO orifice. While static, the nozzle produces no pressure drop. The cone of the needle is therefore subject to the rail pressure. The force applied by the fuel to the needle is:

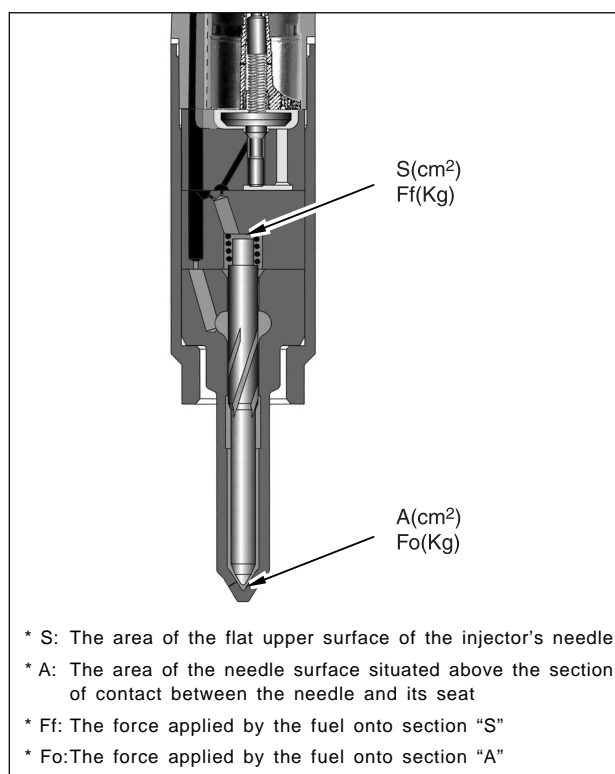
$$F_o = A \times P_{\text{rail}}$$

Since $F_f > F_o$, the needle is held in the closed position. There is no injection.

Solenoid valve control

When the solenoid valve is energized, the valve opens. The fuel contained in the control chamber is expelled through the discharge orifice known as the Spill Orifice (SPO).

As soon as $F_f > F_o$, the needle remains held against its seat and there is no injection.



Start of injection

As soon as $F_f < F_o$, or in other words:

$$P_{\text{control}} < P_{\text{rail}} * A/S$$

The needle lifts and injection begins. As long as the valve is open, the injector's needle remains lifted. When injection begins, fuel circulation is established to feed the injector. The passage of the fuel through the inlet orifice of the injector (similar to a nozzle) leads to a pressure drop which depends on the rail pressure.

When the rail pressure is at its highest (1600 bar), this pressure drop exceeds 100 bar. The pressure applied to the cone of the needle (the injection pressure) is therefore lower than the rail pressure.

End of injection

As soon as the solenoid valve is de-energized, the valve closes and the control chamber is filled. Since the needle is open, the thrust section areas situated on either side of the needle is therefore to apply different pressures to each of these faces. The pressure in the control chamber cannot exceed the rail pressure, so it is therefore necessary to limit the pressure applied to the needle's cone. This pressure limitation is achieved by the NPO orifice which produces a pressure drop when fuel is passing through it.

$$P_{\text{rail}} * S \geq (P_{\text{rail}} - \Delta P) * S$$

When static, this pressure drop is zero. When the pressure in the control chamber becomes higher than the pressure applied to the needle's cone, the injection stops.

GENERAL

A S S Y

HOUSING

I N T A K E

E X H A U S T

L U B

C O O L I N G

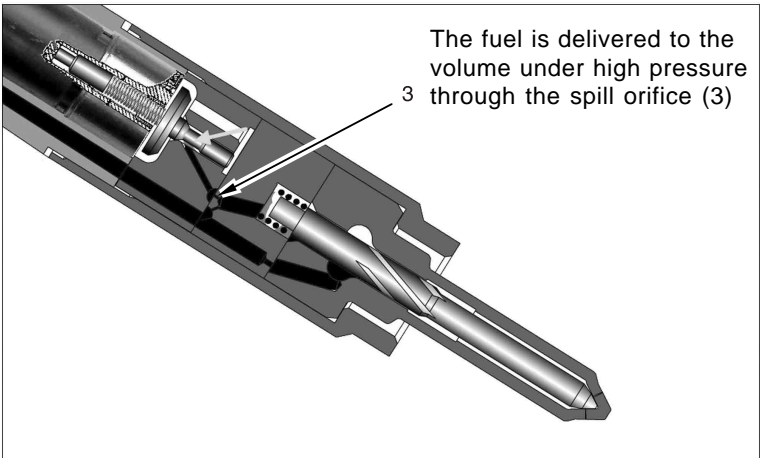
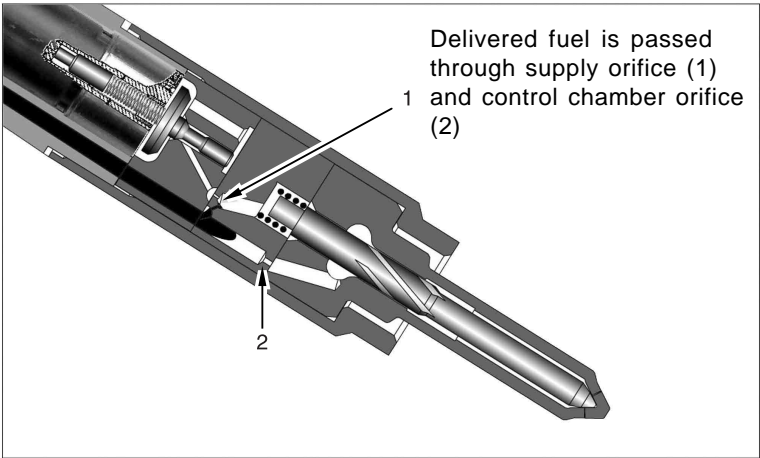
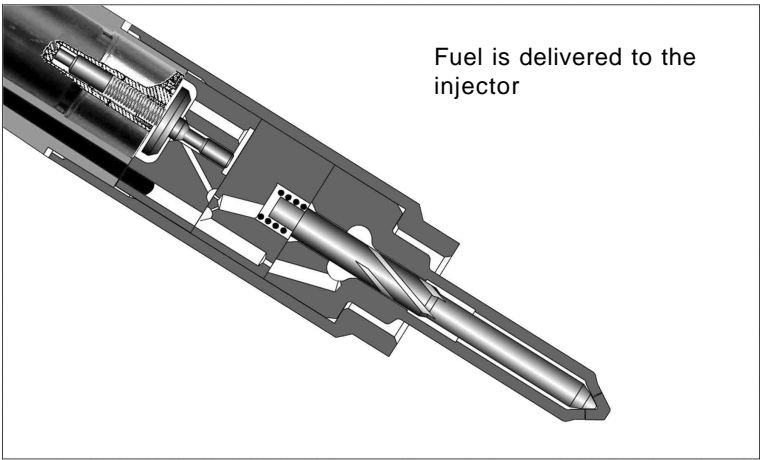
F U E L

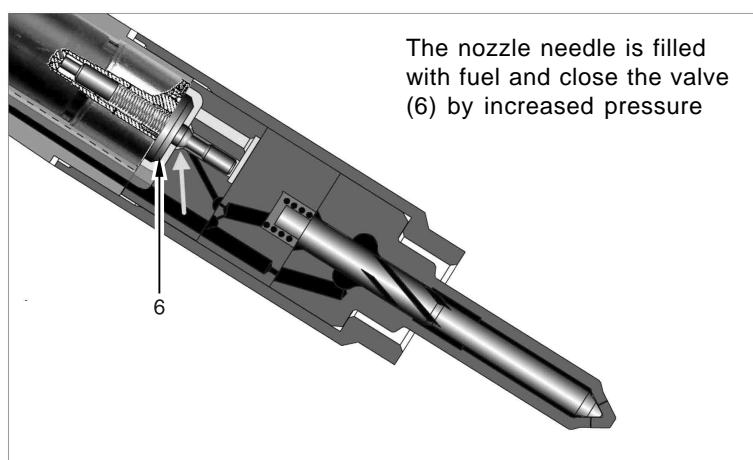
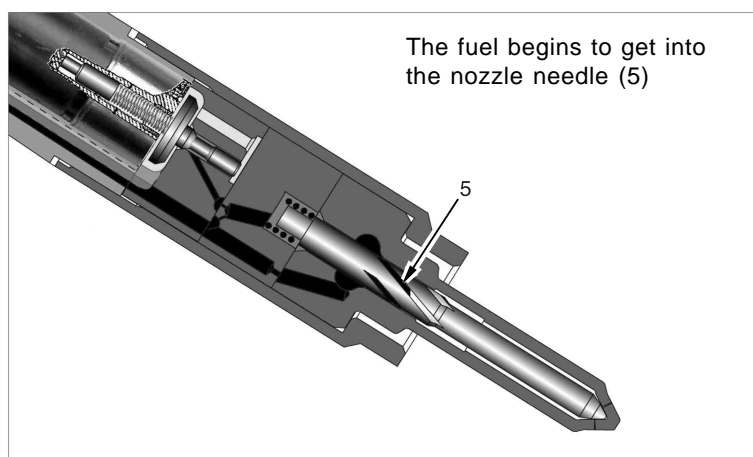
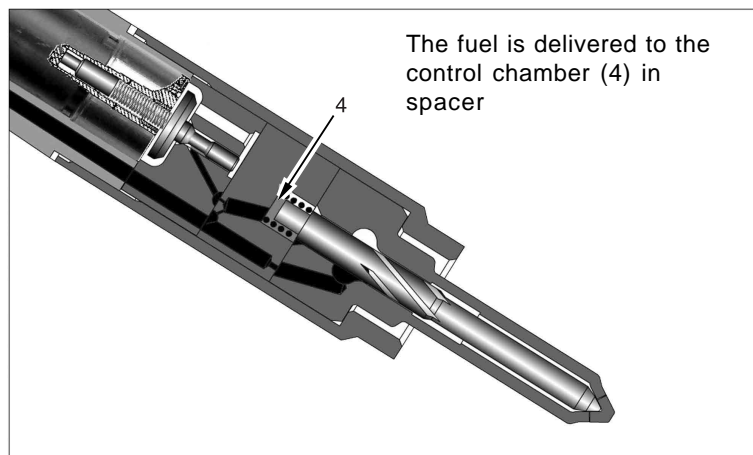
C O N T R O L

S E N S O R

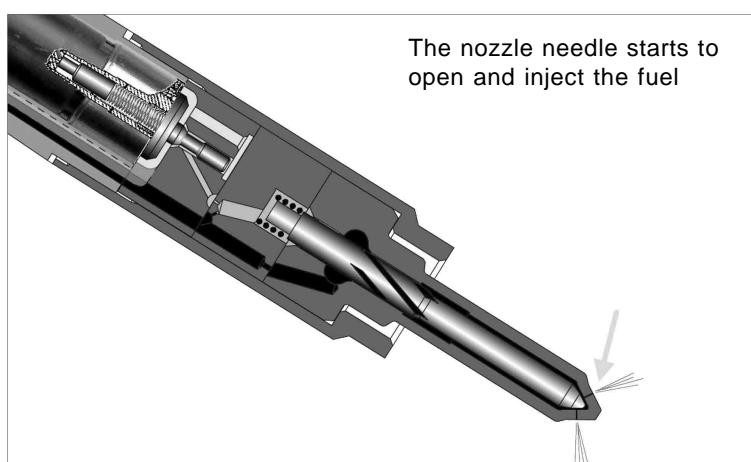
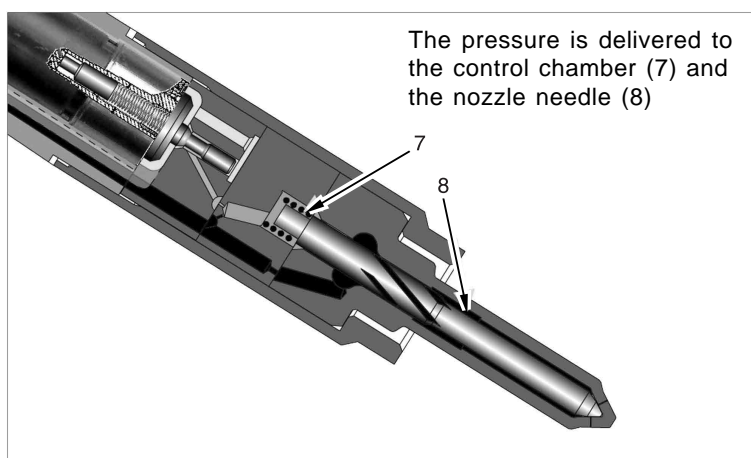
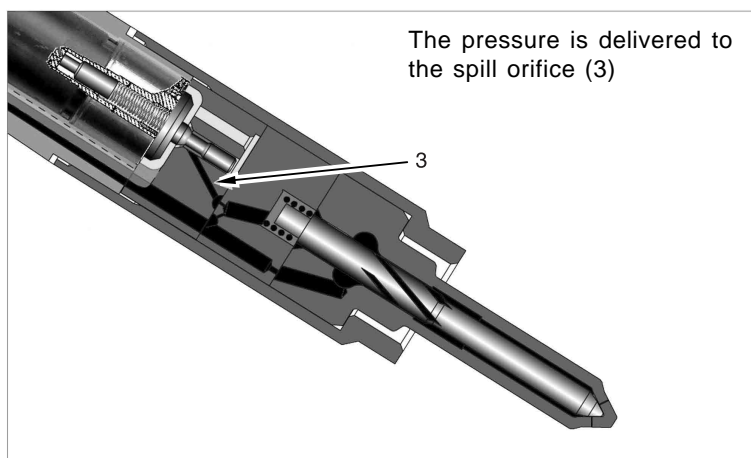
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

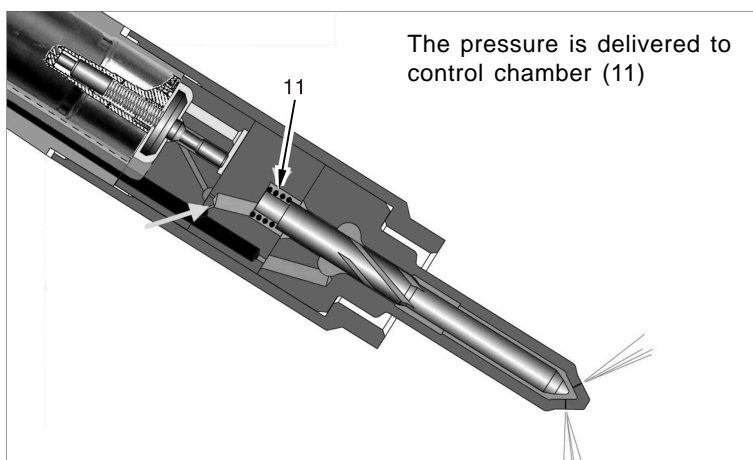
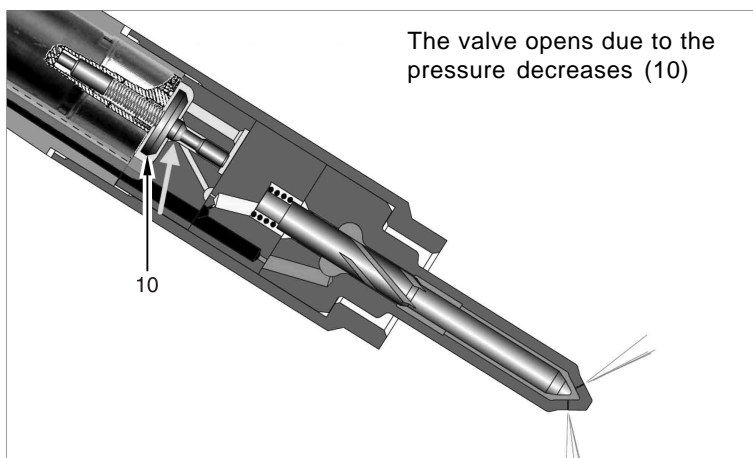
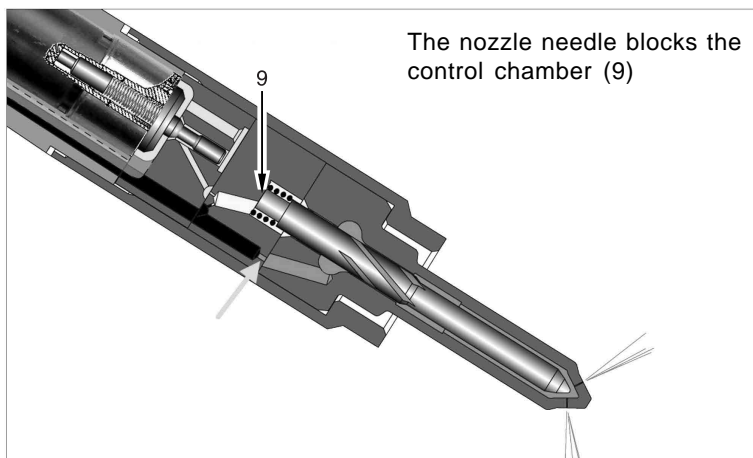
► Injecting Process





CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	





GENERAL

ASSY

HOUSING

INTAKE

EXHAUST

LUB

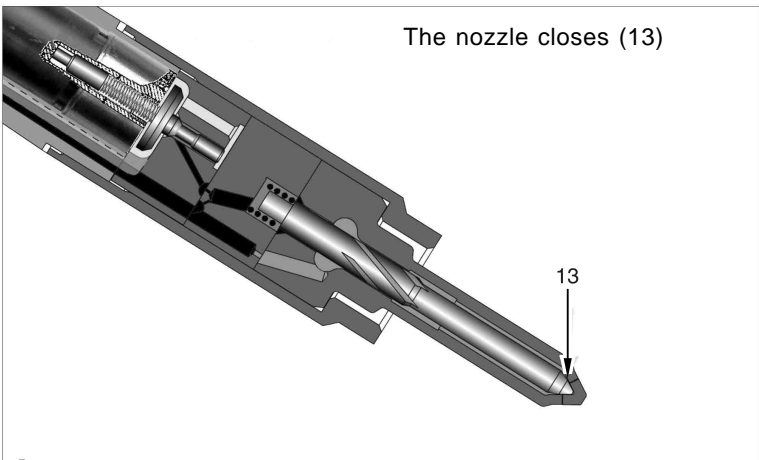
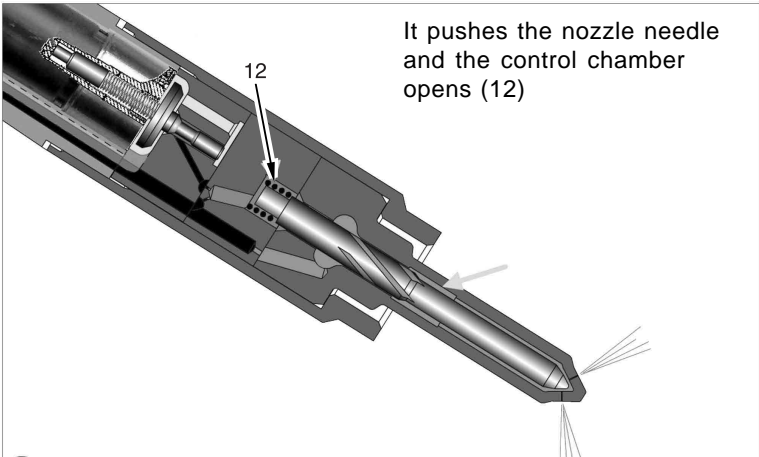
COOLING

FUEL

CONTROL

SENSOR

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	



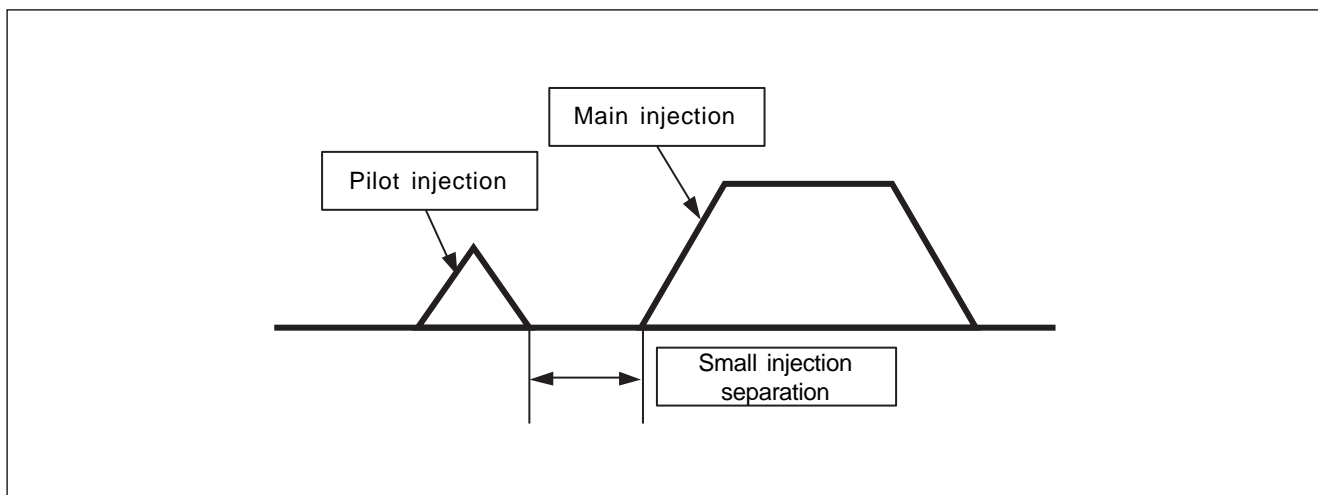
► Fuel Pressure

Fuel pressure

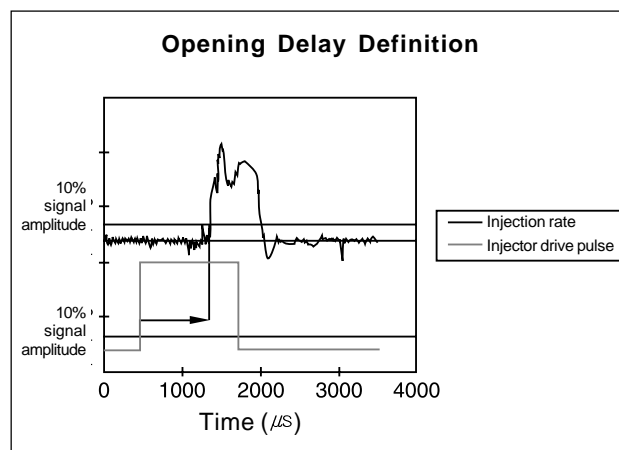
1. Minimum operating pressure: start injection over 100 bar
2. Maximum operating pressure: 1,600 bar (max. operating pressure in normal conditions)
3. Operating pressure limit: 2,100 bar

Maximum fuel volume at each injector cycle

1. Pilot Injection $\leq 5 \text{ mm}^3$
2. Main Injection $\leq 85 \text{ mm}^3$ (within 200 ~ 1,600 bar)

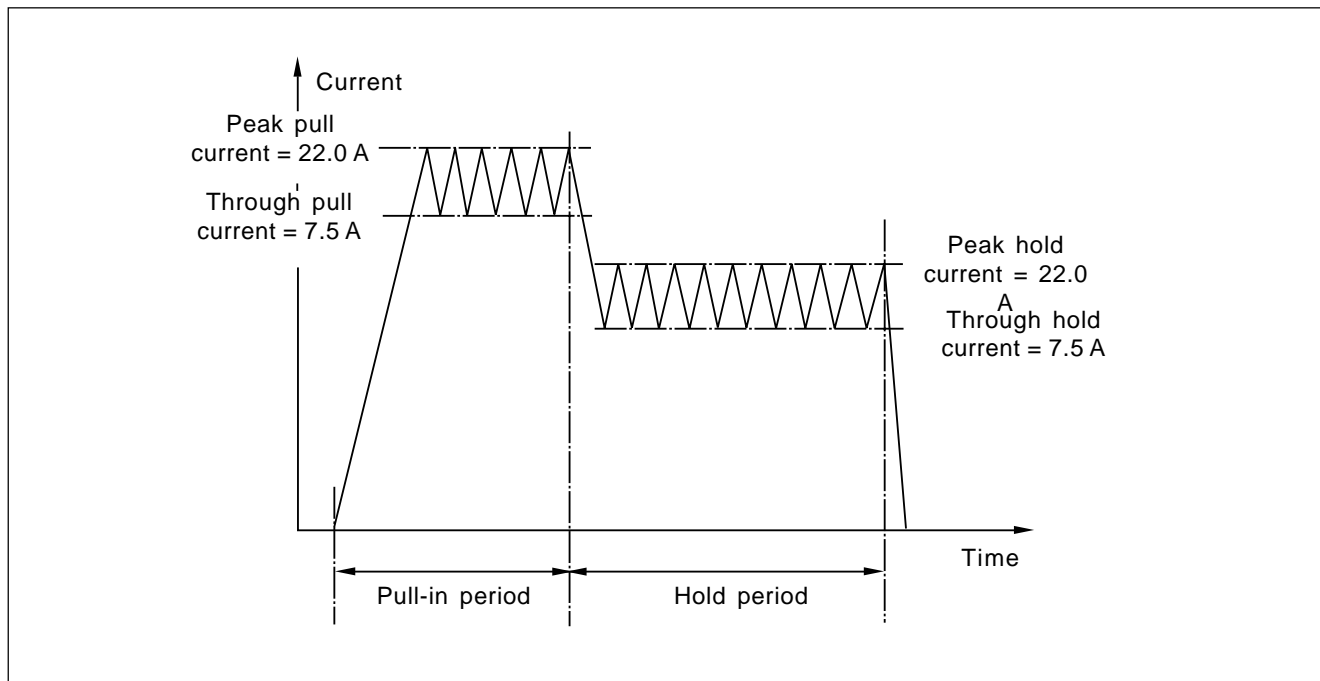


3. Small injection separation: min. $200 \mu\text{s}$
(duration between the end of pilot injection and start of main injection)
4. Opening Delay
: Delayed time from applying operating voltage to start of injection
5. Adjustment of feedback injection volume: C2I



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► Injector Control



The control current of the coil takes the following form:

1. The low current allows the Joule effect losses in the ECU and injector to be reduced. The call current is higher than the hold current because during the hold phase.
2. The air gap between the valve and the coil is reduced and the electromagnetic force to be applied to the valve can thus be reduced. It is no longer necessary to overcome the valve inertia.

NOTE

- Joule Effect: Heat capacity (H) = $0.24 I^2 RT$

► Fuel Injection

Other than conventional diesel engine, common diesel engine use two steps injection as follows:

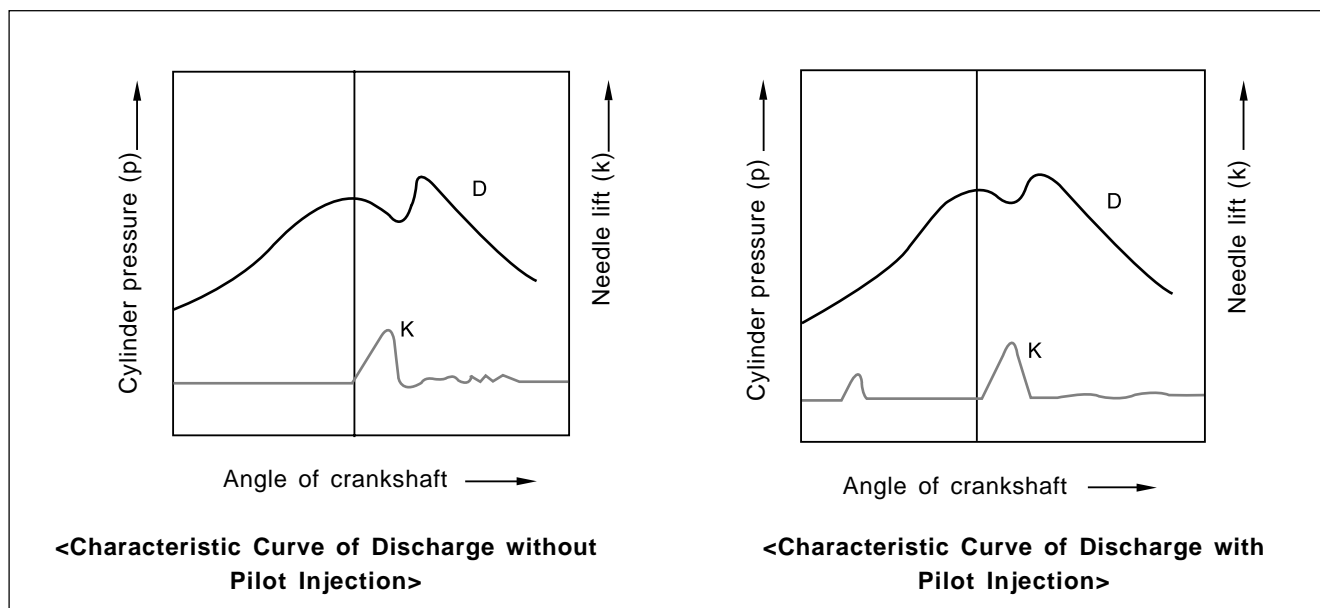
1. Pilot Injection
2. Main Injection

In above two step injection, the fuel injection volume and injection timing is calibrated according to fuel pressure and fuel temperature.

Pilot injection

Before starting main injection, a small amount of fuel is injected to help proper combustion. This injection is for reducing the engine noise and vibration.

In other words, it makes the pressure increase in combustion chamber during combustion smooth to reduce the engine noise and vibration (suppressing the surging). Basic values for pilot injection are adjusted according to the coolant temperature and intake air pressure.

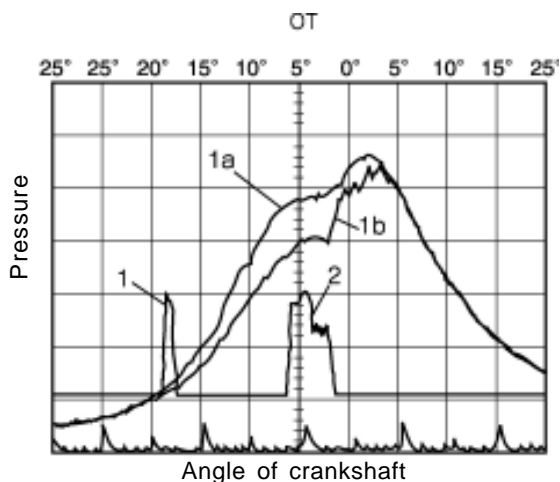


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Main injection

Actual output from engine is achieved by main injection.

The main injection determines the pilot injection has been occurred, then calculates the injection volume. Accelerator pedal sensor, engine rpm, coolant temperature, intake air temperature and atmospheric pressure are basic data to calculate the fuel injection volume in main injection.



- 1. Pilot injection
- 2. Main injection
- 1a. Ignition pressure with pilot injection
- 2a. Ignition pressure without pilot injection

<Characteristic Curve of Combustion Chamber Pressure During Pilot Injection>

Removal and Installation

※ **Preceding Work:** Removal of engine cover

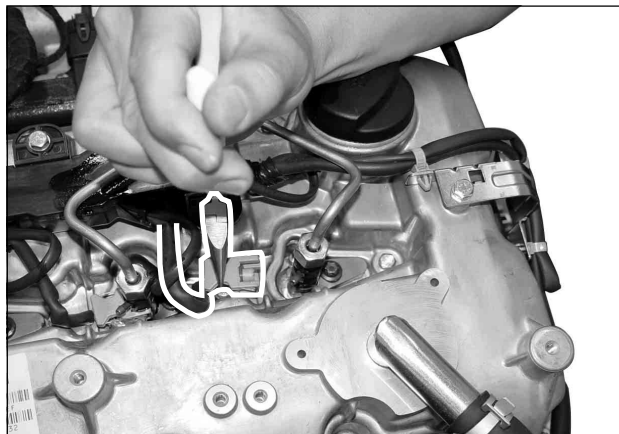
1. Disconnect the injector return hose.



NOTICE

- Plug the openings with sealing caps.

2. Remove the relevant connector for the injector.



3. Unscrew the bolts and remove the fuel pipes.

Installation Notice

Tightening torque	40 ± 4 Nm
-------------------	---------------



NOTICE

- Replace the fuel pipes with new ones.
- Plug the openings of the common rail with sealing caps.



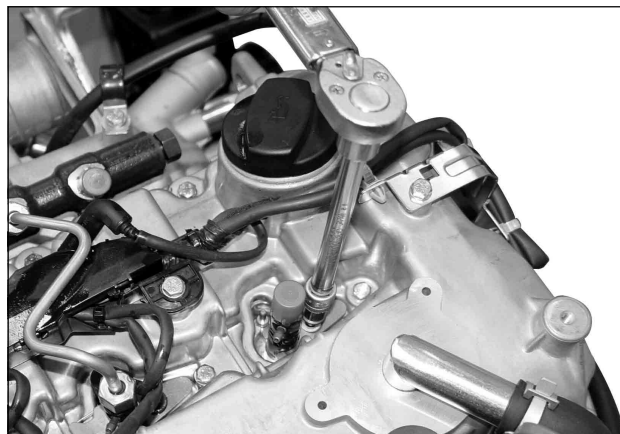
4. Unscrew the injector holder bolts.

Installation Notice

Tightening torque	9 ± 1.0 Nm
	$190^\circ \pm 10^\circ$

Replace the bolts with new ones.

5. Disconnect the injector holder.

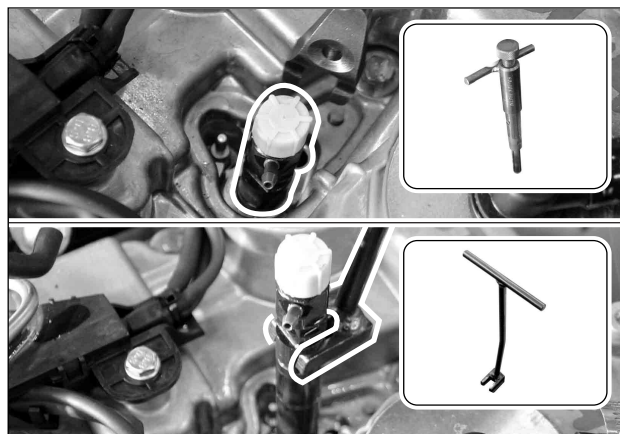


6. Remove the injectors with a special tool.



NOTICE

- Plug the openings of the injectors with sealing caps.
- Pull the dropped washer out from the engine with a special tool.



7. Install in the reverse order of removal.

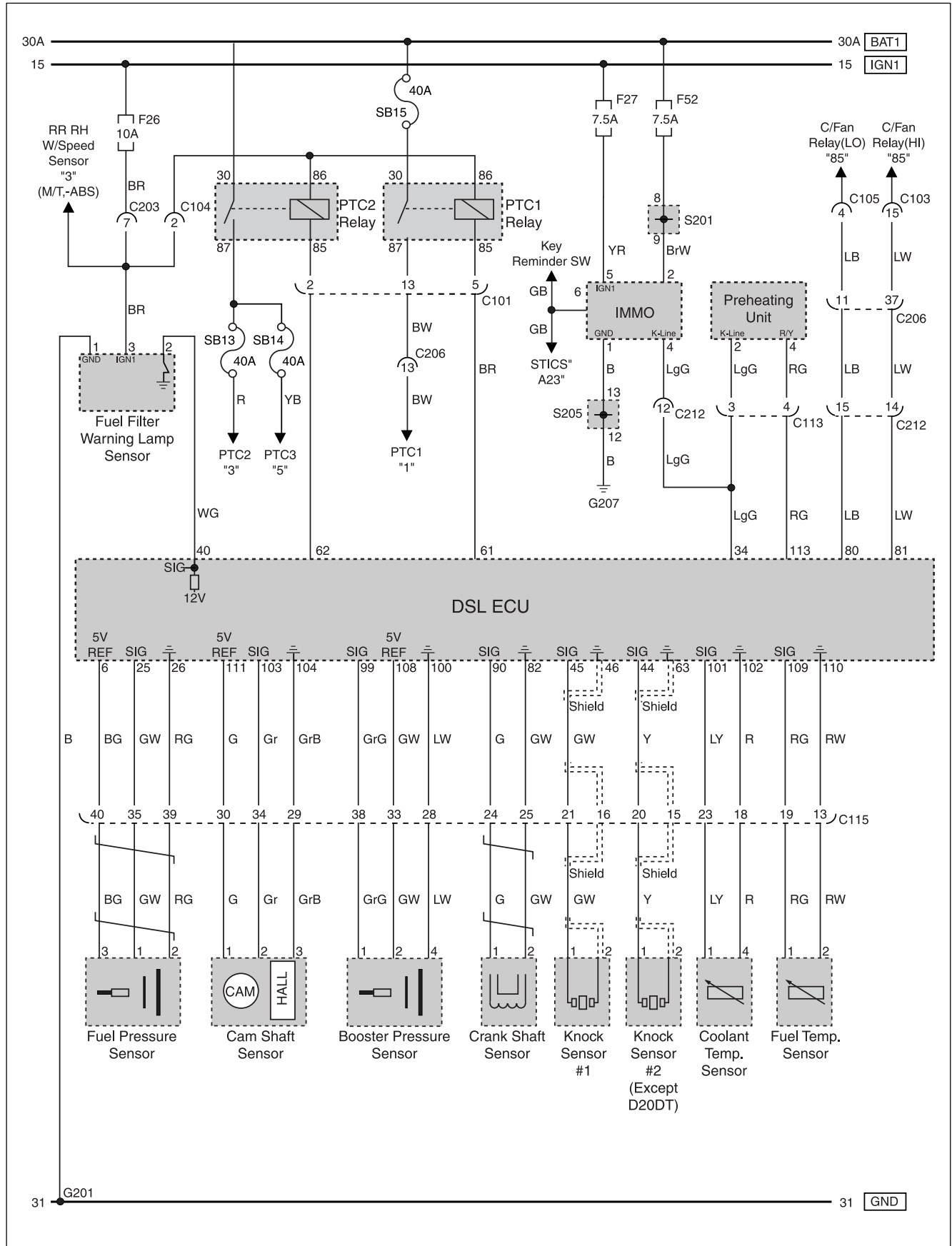


NOTICE

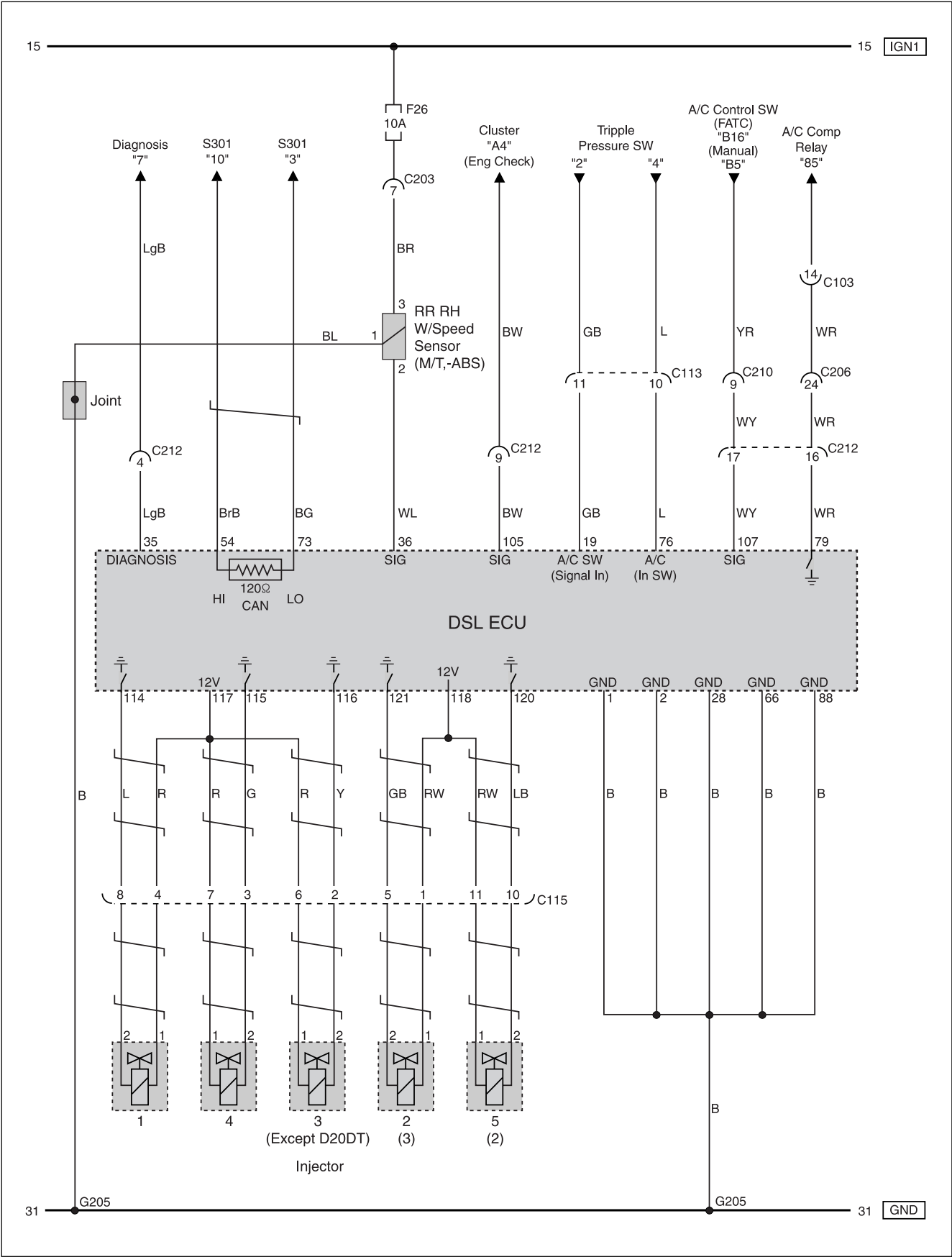
- Replace the copper washer, holder bolts and fuel supply pipes with new ones.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

SECTION 08

**ENGINE CONTROL
SYSTEM**

ENGINE CONTROL SYSTEM

08

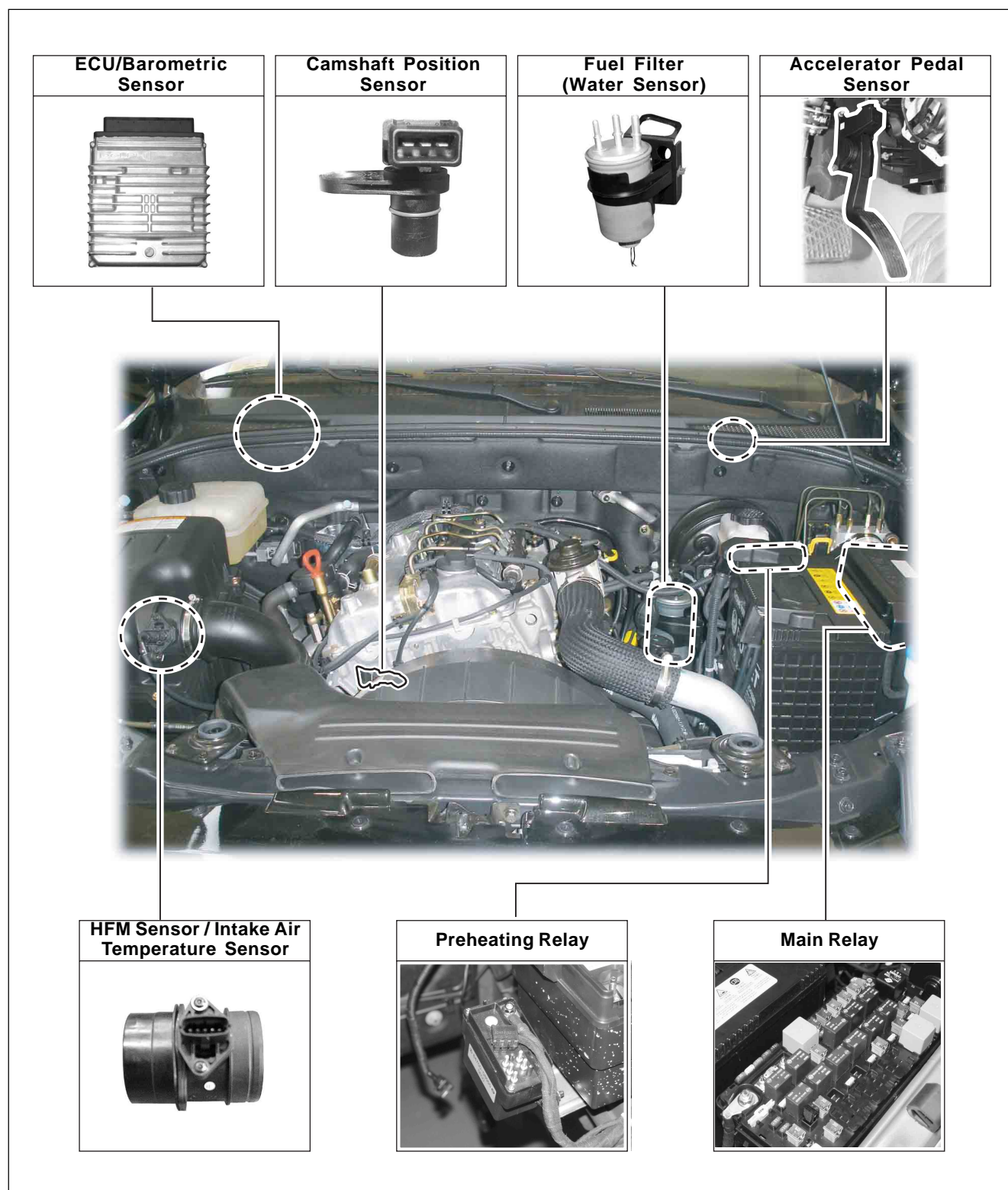
■ TABLE OF CONTENTS ■

SENSORS FOR DIAGNOSIS	2
Engine ECU and other components	2
Top view	4
Side view	6
ENGINE CONTROL SYSTEM	8
ECU	8
Fuel pressure control	14
Fuel injection control	15
Fuel flow control	16
Individual injector calibration (C2I)	21
Minimum Drive Pulse (MDP) learning	23

SENSORS FOR DIAGNOSIS


ENGINE ECU AND OTHER COMPONENTS

► D20DT Engine




► D27DT Engine


ECU/Barometric Sensor



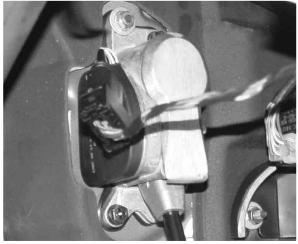
Camshaft Position Sensor

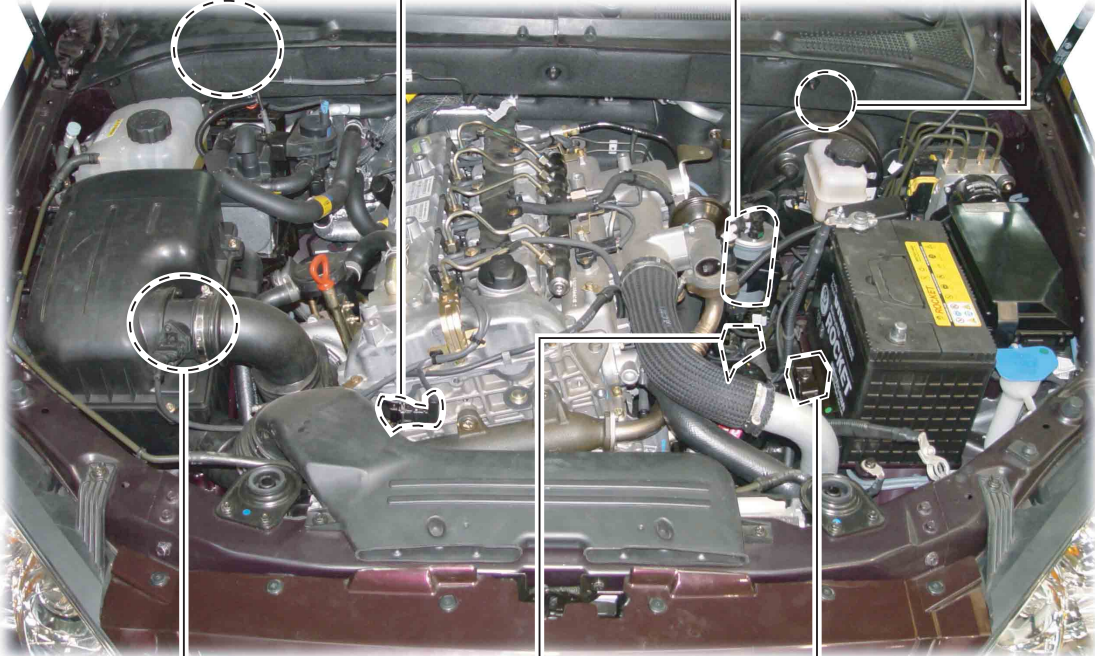


Fuel Filter (Water Sensor)




Accelerator Pedal Sensor







HFM Sensor / Intake Air Temperature Sensor



Preheating Relay



Main Relay



GENERAL
ASSY
HOUSING
INTAKE
EXHAUST
LUB
COOLING
FUEL
CONTROL
SENSOR

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

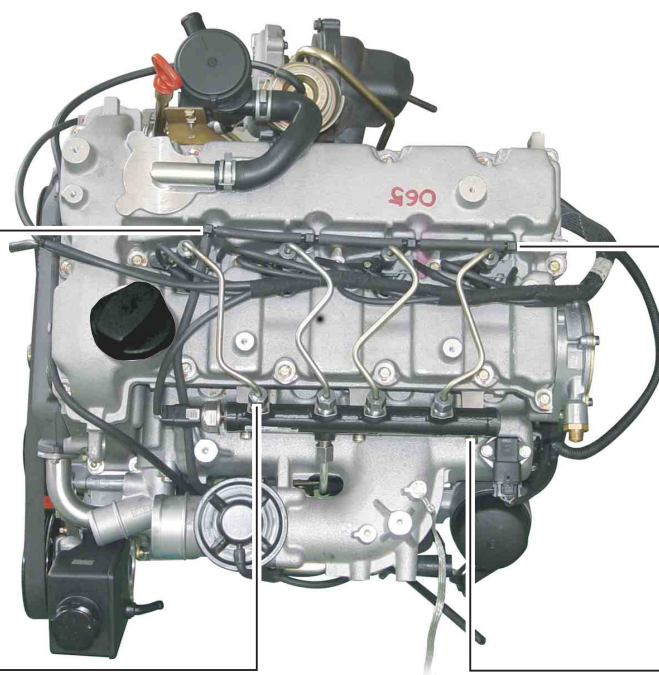
TOP VIEW

► D20DT Engine

Fuel Pressure Sensor



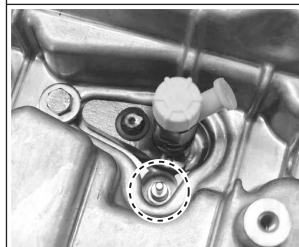
Booster Pressure Sensor



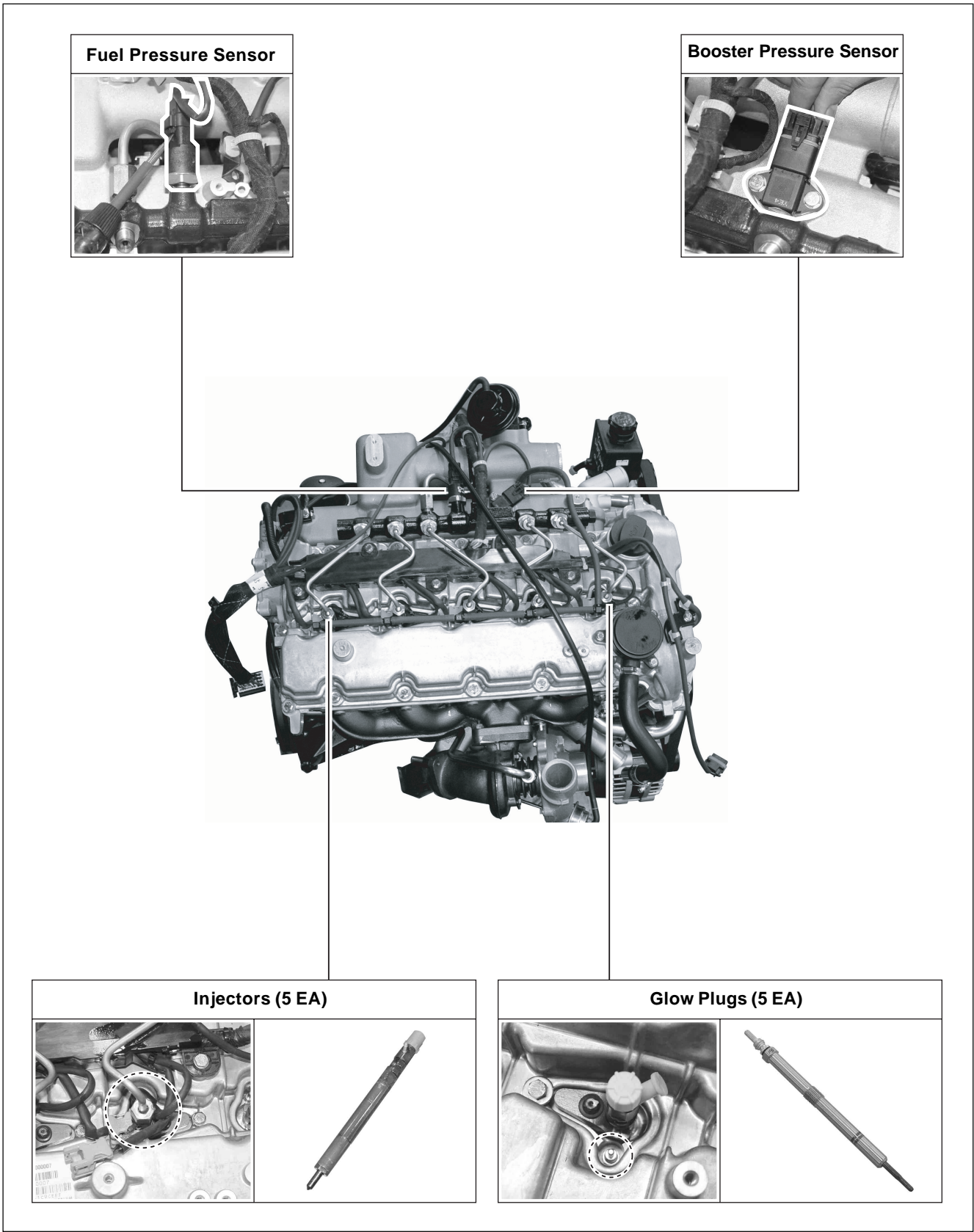
Injectors (4 EA)



Glow Plugs (4 EA)



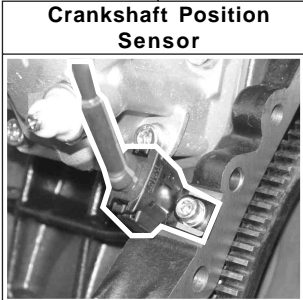
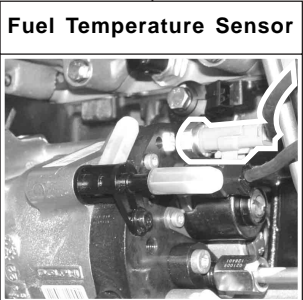
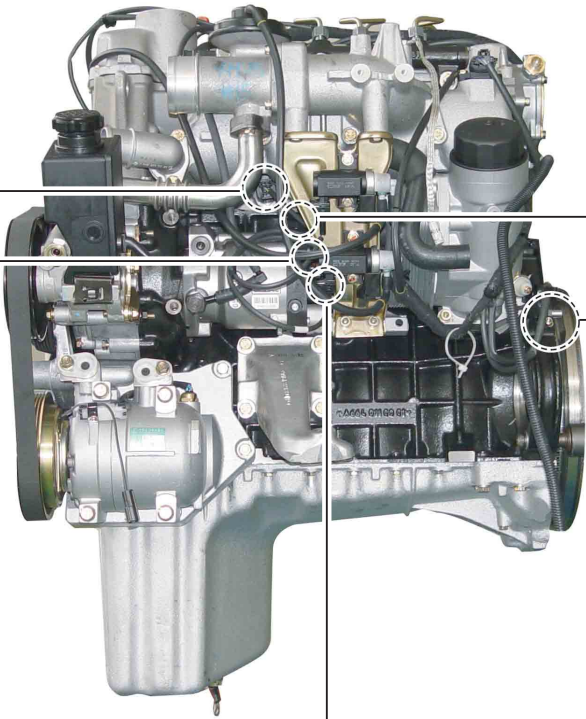
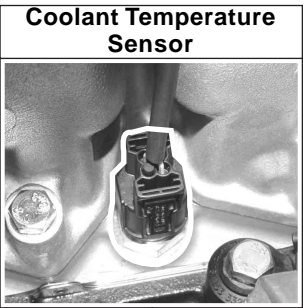
► D27DT Engine



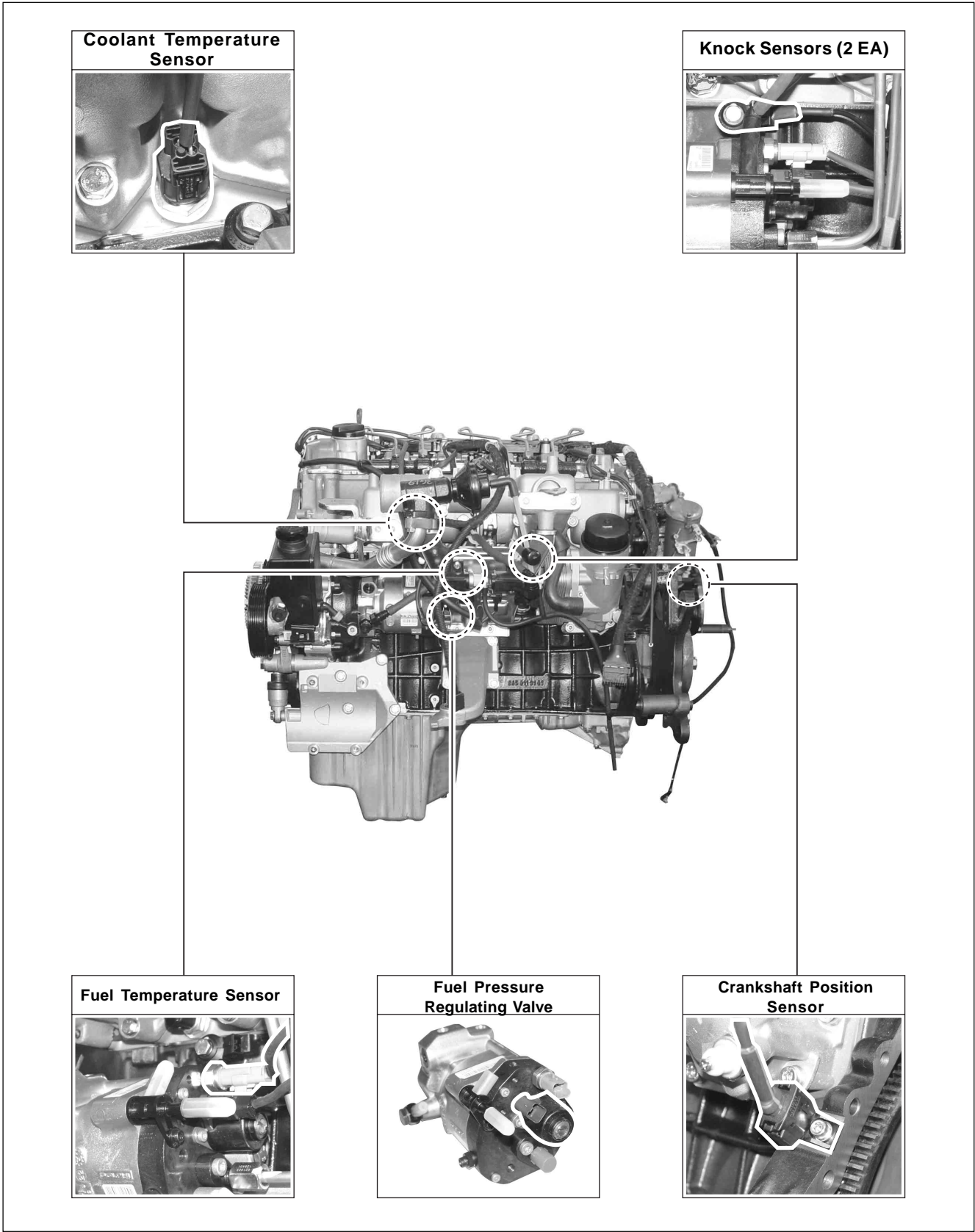
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

SIDE VIEW

► D20DT Engine



► D27DT Engine



GENERAL

ASSY

HOUSING

INTAKE

EXHAUST

LUB

COOLING

FUEL

CONTROL

SENSOR

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

ENGINE CONTROL SYSTEM

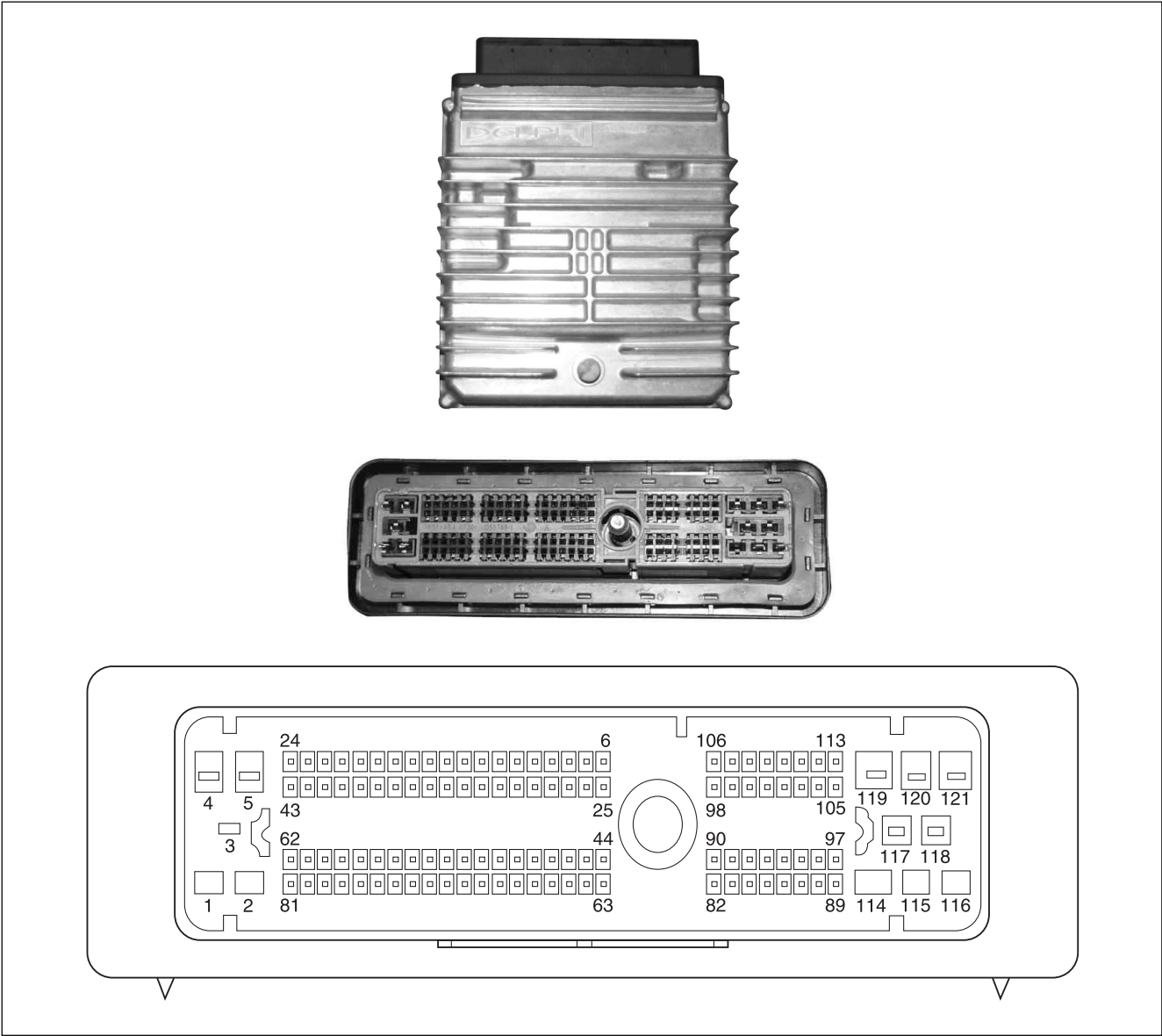
ECU

According to input signals from various sensors, engine ECU calculates driver’s demand (position of the accelerator pedal) and then controls overall operating performance of engine and vehicle on that time.

ECU receives signals from sensors through data line and then performs effective engine air-fuel ratio controls based on those signals.

Engine speed is measured by crankshaft speed (position) sensor and camshaft speed (position) sensor determines injection order and ECU detects driver’s pedal position (driver’s demand) through electrical signal that generated by variable resistance changes in accelerator pedal sensor.

Air flow (hot film) sensor detects intake air volume and then transmits to ECU. Especially, the engine ECU controls the air-fuel ratio by recognizing instant air volume changes through air flow sensor to pursue low emission gases (EGR valve control). Furthermore, the ECU uses signals from coolant temperature and air temperature sensor, booster pressure sensor and atmospheric pressure sensor as compensation signal to respond to injection start and pilot injection set values and to various operations and variables.



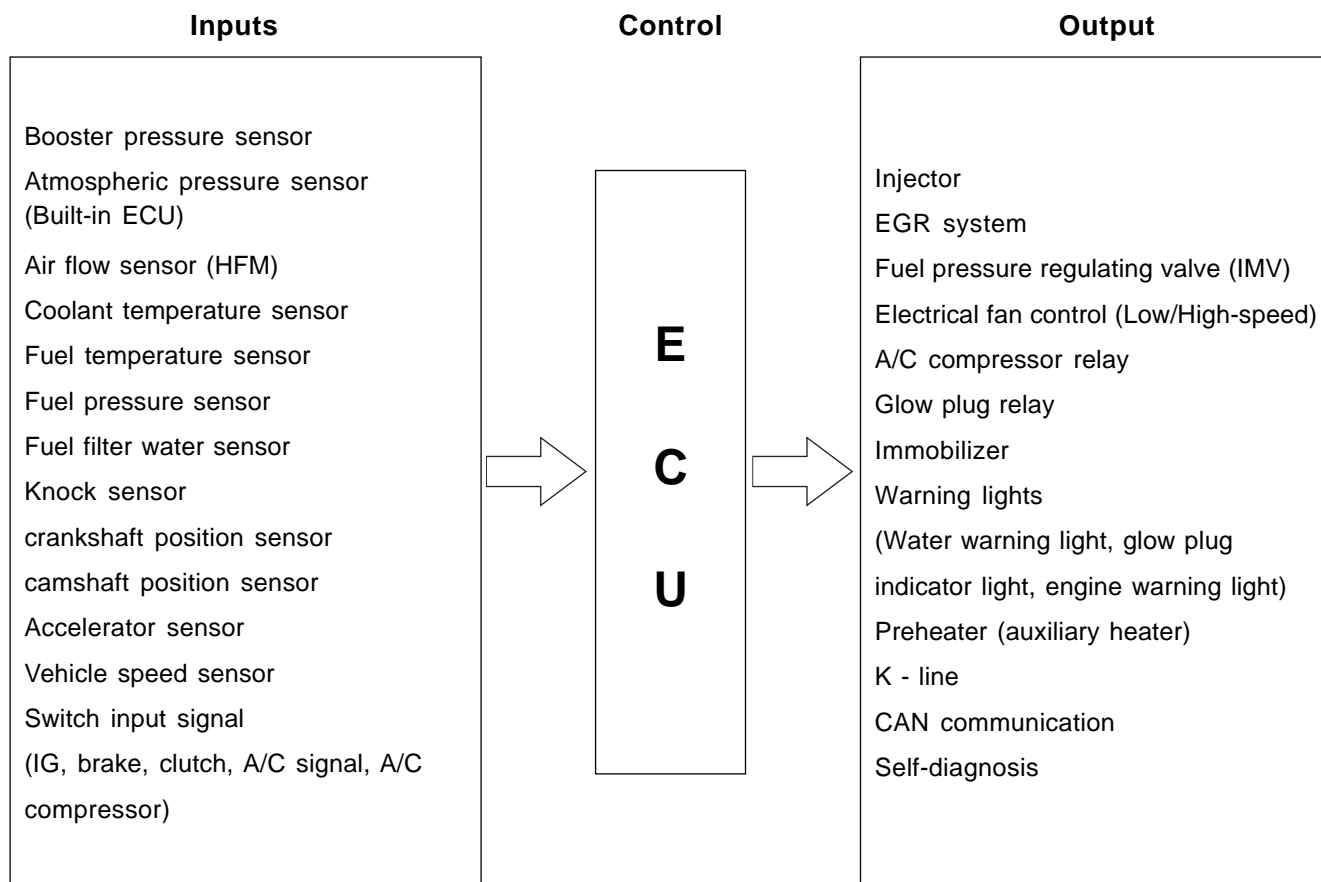
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Pin No.	Description	Pin No.	Description
1	Engine ground	40	Fuel filter water detection sensor
2	Engine ground	41	RPM signal output
3	Main power (IG 1)	42	
4	Main power (IG 1)	43	
5	Main power (IG 1)	44	Knock sensor signal (#2)
6	Rail pressure sensor power supply	45	Knock sensor signal (#1)
7		46	Knock sensor ground (#1)
8		47	
9	ECU power hold relay	48	
10		49	
11		50	Auto cruise result signal
12	ABD signal	51	
13		52	
14	ACC 2 sensor ground	53	ACC 1 sensor ground
15		54	CAN- H1
16		55	
17	Auto cruise OFF	56	
18	Auto cruise safety switch	57	ACC 2 sensor power supply
19	A/C pressure signal	58	Brake lamp switch
20	Fuel filter water detection warning lamp	59	
21	Remote starter output	60	Vehicle speed indication lamp
22	Glow plug control	61	Preheater #1
23	Glow plug warning lamp	62	Preheater #2
24		63	Knock sensor ground (#2)
25	Rail pressure sensor signal	64	HFM sensor (air temperature sensor)
26	Rail pressure sensor ground	65	
27		66	Engine ground
28	Engine ground	67	Auto cruise deceleration signal
29		68	
30		69	
31	Auto cruise acceleration signal	70	
32	ACC 2 sensor signal	71	ACC 1 sensor signal
33		72	ACC 1 sensor power supply
34	K-LINE #1	73	CAN -LO
35	K-LINE #2	74	
36	Vehicle speed sensor signal input	75	
37	IG 1	76	A/C cycling pressure switch
38	Clutch pedal switch	77	Brake pedal switch
39		78	Trip computer

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Pin No.	Description	Pin No.	Description
79	A/C relay	101	Coolant temperature signal
80	Cooling fan LOW	102	Coolant temperature sensor ground
81	Cooling fan HIGH	103	Camshaft position sensor signal
82	Crankshaft position sensor (-)	104	Camshaft position sensor ground
83	HFM sensor (air mass sensor)	105	Engine check warning lamp
84	HFM sensor (ground)	106	
85		107	Blower switch
86	HFM sensor (power supply)	108	Booster pressure sensor power supply
87	IMV (fuel pressure regulating valve)	109	Fuel temperature sensor signal
88	Engine ground	110	Fuel temperature sensor ground
89		111	Camshaft position sensor power supply
90	Crankshaft position sensor (+)	112	Immobilizer
91		113	Engine check warning lamp
92		114	Injector #1
93		115	Injector #4
94		116	Injector #3
95	Waste gate actuator	117	Injector ground (#1, 3, 4)
96	EGR valve	118	Injector ground (#2, 5)
97		119	
98		120	Injector #5
99	Booster pressure sensor signal	121	Injector #2
100	Booster pressure sensor ground		

► ECU Inputs-Outputs



► Structure and Function of ECU

Function of ECU

ECU receives and analyzes signals from various sensors and then modifies those signals into permissible voltage levels and analyzes to control respective actuators.

ECU microprocessor calculates injection period and injection timing proper for engine piston speed and crankshaft angle based on input data and stored specific map to control the engine power and emission gas.

Output signal of the ECU microprocessor drives pressure control valve to control the rail pressure and activates injector solenoid valve to control the fuel injection period and injection timing; so controls various actuators in response to engine changes. Auxiliary function of ECU has adopted to reduce emission gas, improve fuel economy and enhance safety, comforts and conveniences. For example, there are EGR, booster pressure control, autocruise (export only) and immobilizer and adopted CAN communication to exchange data among electrical systems (automatic T/M and brake system) in the vehicle fluently. And Scanner can be used to diagnose vehicle status and defectives.

Operating temperature range of ECU is normally -40 ~ +85°C and protected from factors like oil, water and electro-magnetism and there should be no mechanical shocks.

To control the fuel volume precisely under repeated injections, high current should be applied instantly so there is injector drive circuit in the ECU to generate necessary current during injector drive stages.

Current control circuit divides current applying time (injection time) into full-in-current-phase and hold-current-phase and then the injectors should work very correctly under every working condition.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► Control Function of ECU

1. Controls by operating stages

: To make optimum combustion under every operating stage, ECU should calculate proper injection volume in each stage by considering various factors.

2. Starting injection volume control

: During initial starting, injecting fuel volume will be calculated by function of temperature and engine cranking speed.

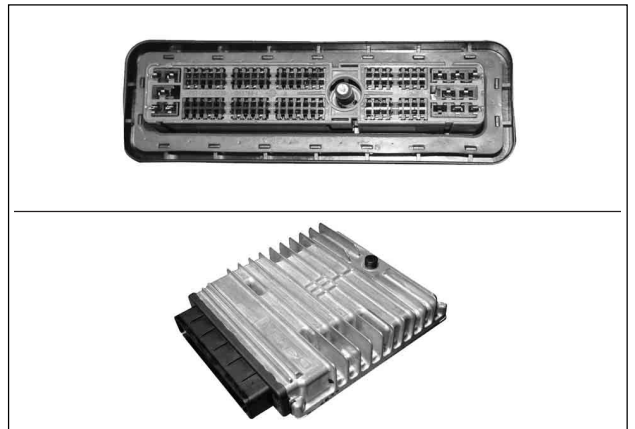
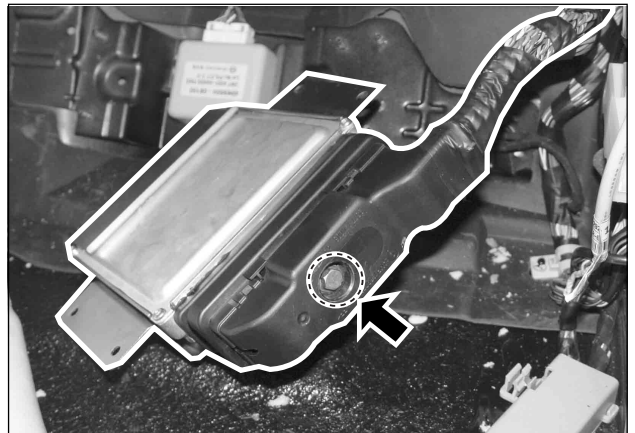
Starting injection continues from when the ignition switch is turned to ignition position to till the engine reaches to allowable minimum speed.

3. Driving mode control

: If the vehicle runs normally, fuel injection volume will be calculated by accelerator pedal travel and engine rpm and the drive map will be used to match the drivers inputs with optimum engine power.

ECU - Removal and Installation

1. Flip up the front passenger's seat and remove the ECU cover nuts.
2. Remove the ECU bracket nuts.
3. Unscrew the ECU connect bolt and remove the ECU assembly.
4. Install in the reverse order of removal.
5. Backup the below data with Scan-i when replacing the ECU.
 - 1) Current ECU data
 - 2) Vehicle Identification Number (VIN)
 - 3) Variant coding data
 - 4) Then, input the data into new ECU. For immobilizer equipped vehicle, additional coding operation is necessary.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

FUEL PRESSURE CONTROL

► Fuel Pressure Control Elements

Pressure control consists of 2 principle modules.

1. Determines rail pressure according to engine operating conditions.
2. Controls IMV to make the rail pressure to reach to the required value.

Pressure in the fuel rail is determined according to engine speed and load on the engine. The aim is to adapt the injection pressure to the engine's requirements.

1. When engine speed and load are high

: The degree of turbulence is very great and the fuel can be injected at very high pressure in order to optimize combustion.

2. When engine speed and load are low

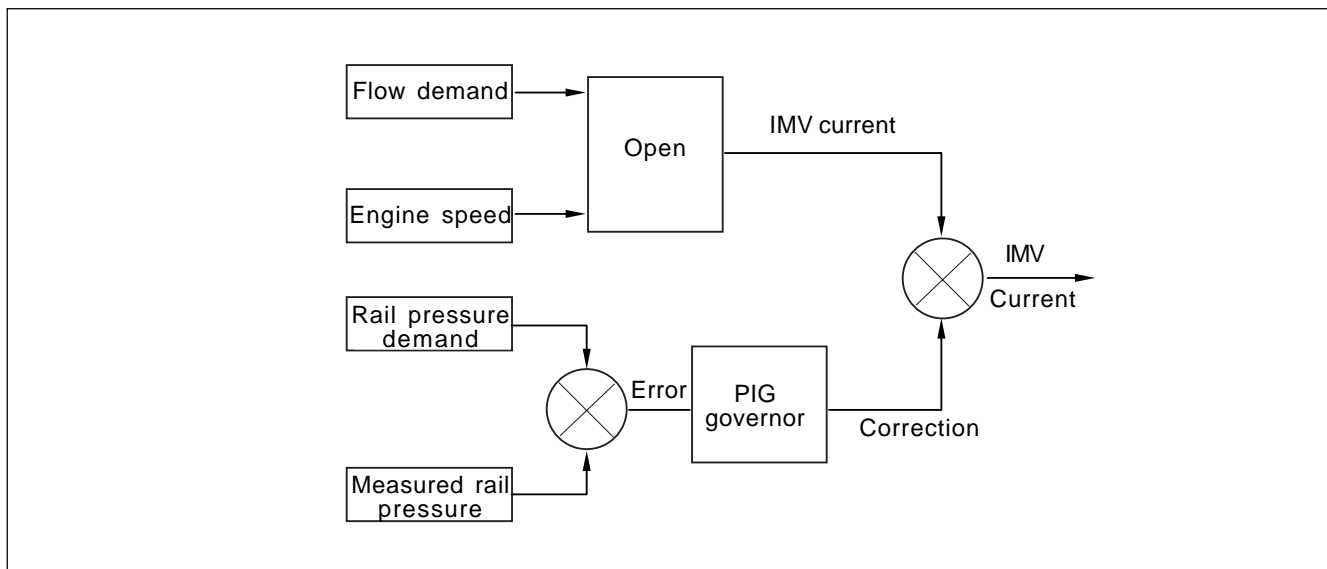
: The degree of turbulence is low. If injection pressure is too high, the nozzle's penetration will be excessive and part of the fuel will be sprayed directly onto the sides of the cylinder, causing incomplete combustion. So there occurs smoke and damages engine durability.

Fuel pressure is corrected according to air temperature, coolant temperature and atmospheric pressure and to take account of the added ignition time caused by cold running or by high altitude driving. A special pressure demand is necessary in order to obtain the additional flow required during starts. This demand is determined according to injected fuel and coolant temperature.

► Fuel Pressure Control

Rail pressure is controlled by closed loop regulation of IMV. A mapping system – open loop – determines the current which needs to be sent to the actuator in order to obtain the flow demanded by the ECU. The closed loop will correct the current value depending on the difference between the pressure demand and the pressure measured.

1. If the pressure is lower than the demand, current is reduced so that the fuel sent to the high pressure pump is increased.
2. If the pressure is higher than the demand, current is increased so that the fuel sent to the high pressure pump is reduced.



FUEL INJECTION CONTROL

► Fuel Injection Control

Injection control is used in order to determine the characteristics of the pulse which is sent to the injectors. Injection control consists as below.

1. Injection timing
2. Injection volume
3. Translating fuel injection timing and injection volume into values which can be interpreted by the injector driver.
 - 1) a reference tooth (CTP)
 - 2) the delay between this tooth and the start of the pulse (Toff)
 - 3) the pulse time (Ton)

Main injection timing control

The pulse necessary for the main injection is determined as a function of the engine speed and of the injected flow. The elements are;

1. A first correction is made according to the air and coolant temperatures.
This correction makes it possible to adapt the timing to the operating temperature of the engine. When the engine is warm, the timing can be retarded to reduce the combustion temperature and polluting emissions (NOx). When the engine is cold, the timing advance must be sufficient to allow the combustion to begin correctly.
2. A second correction is made according to the atmospheric pressure.
This correction is used to adapt the timing advance as a function of the atmospheric pressure and therefore the altitude.
3. A third correction is made according to the coolant temperature and the time which has passed since starting.
This correction allows the injection timing advance to be increased while the engine is warming up (initial 30 seconds). The purpose of this correction is to reduce the misfiring and instabilities which are liable to occur after a cold start.
4. A fourth correction is made according to the pressure error.
This correction is used to reduce the injection timing advance when the pressure in the rail is higher than the pressure demand.
5. A fifth correction is made according to the rate of EGR.
This correction is used to correct the injection timing advance as a function of the rate of exhaust gas recirculation. When the EGR rate increases, the injection timing advance must in fact be increased in order to compensate for the fall in temperature in the cylinder.

During starting, the injection timing must be retarded in order to position the start of combustion close to the TDC. To do this, special mapping is used to determine the injection timing advance as a function of the engine speed and of the water temperature. This requirement only concerns the starting phase, since once the engine has started the system must re-use the mapping and the corrections described previously.

Pilot injection timing control

The pilot injection timing is determined as a function of the engine speed and of the total flow. The elements are;

1. A first correction is made according to the air and coolant temperatures.
This correction allows the pilot injection timing to be adapted to the operating temperature of the engine.
2. A second correction is made according to the atmospheric pressure.
This correction is used to adapt the pilot injection timing as a function of the atmospheric pressure and therefore the altitude.

During the starting phase, the pilot injection timing is determined as a function of the engine speed and of the coolant temperature.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

FUEL FLOW CONTROL

► Main Flow Control

The main flow represents the amount of fuel injected into the cylinder during the main injection. The pilot flow represents the amount of fuel injected during the pilot injection.

The total fuel injected during 1 cycle (main flow + pilot flow) is determined in the following manner.

: The driver's demand is compared with the value of the minimum flow determined by the idle speed controller.

1. When the driver depress the pedal, it is his demand which is taken into account by the system in order to determine the fuel injected.
2. When the driver release the pedal, the idle speed controller takes over to determine the minimum fuel which must be injected into the cylinder to prevent the engine from stalling.

It is therefore the greater of these 2 values which is retained by the system. This value is then compared with the lower flow limit determined by the ASR trajectory control system. As soon as the injected fuel becomes lower than the flow limit determined by the ASR trajectory control system, the antagonistic torque (engine brake) transmitted to the drive wheels exceeds the adherence capacity of the vehicle and there is therefore a risk of the drive wheels locking. The system thus chooses the greater of these 2 values (main flow & pilot flow) in order to prevent any loss of control of the vehicle during a sharp deceleration.

This value is then compared with the flow limit determined by the cruise control. As soon as the injected fuel becomes lower than the flow limit determined by the cruise control, the vehicle's speed falls below the value required by the driver. The system therefore chooses the greater of these 2 values in order to maintain the speed at the required level.

This value is then compared with the flow limit determined by the flow limitation strategy. This strategy allows the flow to be limited as a function of the operating conditions of the engine. The system therefore chooses the smaller of these 2 values in order to protect the engine. This value is then compared with the fuel limit determined by the ASR trajectory control system.

As soon as the injected fuel becomes higher than the fuel limit determined by the ASR trajectory control system, the engine torque transmitted to the wheels exceeds the adhesion capacity of the vehicle and there is a risk of the drive wheels skidding. The system therefore chooses the smaller of the two values in order to avoid any loss of control of the vehicle during accelerations.

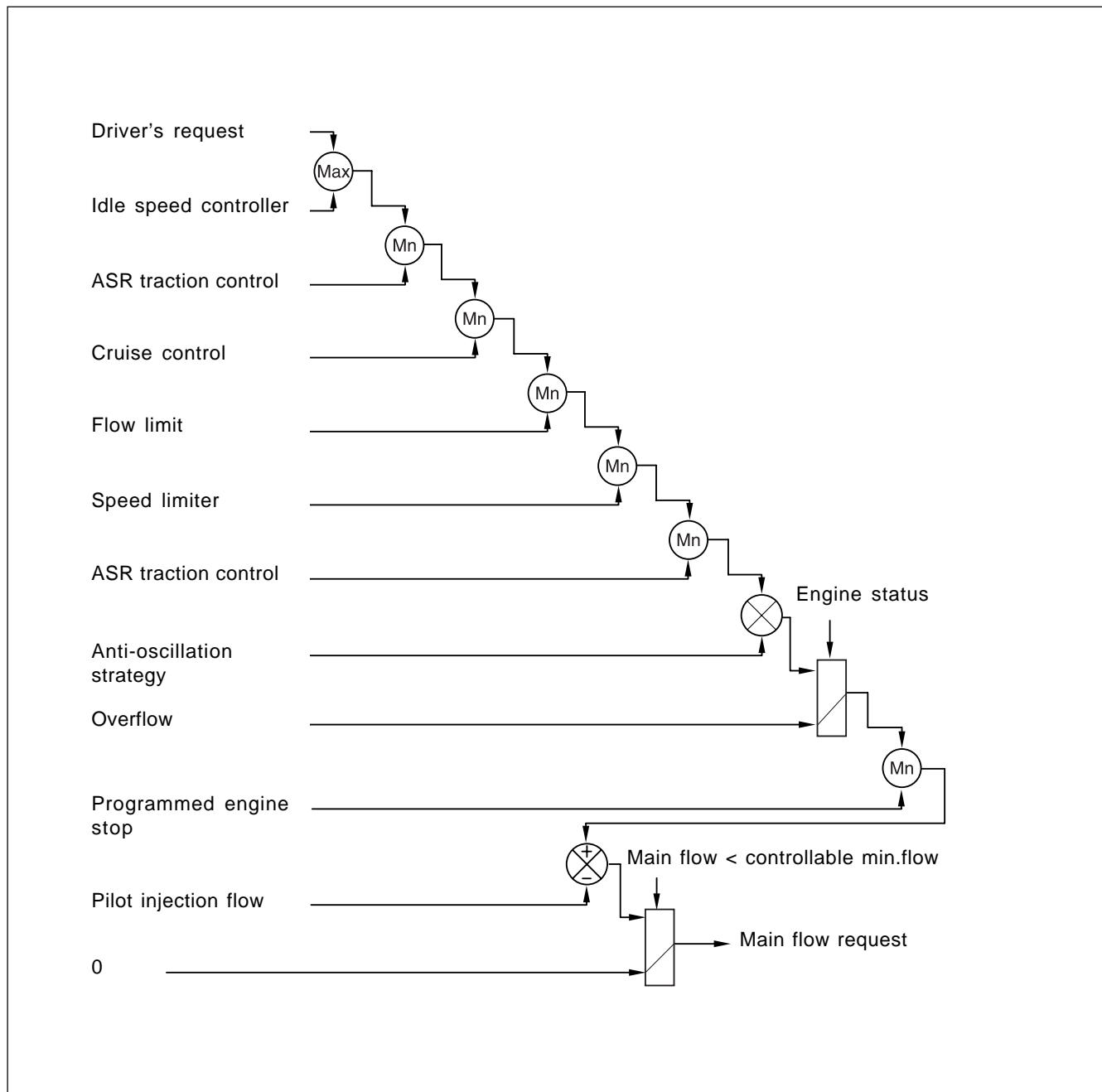
The anti-oscillation strategy makes it possible to compensate for fluctuations in engine speed during transient conditions. This strategy leads to a fuel correction which is added to the total fuel of each cylinder. The correction is determined before each injection as a function of the instantaneous engine speed.

A switch makes it possible to change over from the supercharge fuel to the total fuel according to the state of the engine.

1. Until the staling phase has finished, the system uses the supercharged fuel.
2. Once the engine changes to normal operation, the system uses the total fuel.

The main fuel is obtained by subtracting the pilot injection fuel from the total fuel.

A mapping determines the minimum fuel which can control an injector as a function of the rail pressure. As soon as the main fuel falls below this value, the fuel demand changes to 0 because in any case the injector is not capable of injecting the quantity demand.



► Driver Demand

The driver demand is the translation of the pedal position into the fuel demand. It is calculated as a function of the pedal position and of the engine speed. The driver demand is filtered in order to limit the hesitations caused by rapid changes of the pedal position. A mapping determines the maximum fuel which can be injected as a function of the driver demand and the rail pressure. Since the flow is proportional to the injection time and to the square root of the injection pressure, it is necessary to limit the flow according to the pressure in order to avoid extending the injection for too long into the engine cycle. The system compares the driver demand with this limit and chooses the smaller of the 2 values. The driver demand is then corrected according to the coolant temperature. This correction is added to the driver demand.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► Idle Speed Controller

The idle speed controller consists of 2 principal modules:

1. The first module determines the required idle speed according to:
 - 1) The operating conditions of the engine (coolant temperature, gear engaged)
 - 2) Any activation of the electrical consumers (power steering, air conditioning, others)
 - 3) The battery voltage
 - 4) The presence of any faults liable to interface with the rail pressure control or the injection control. In this case, the accelerated idle speed is activated to prevent the engine from stalling when operating in degraded mode.
 - 5) It is possible to increase or to reduce the required idle speed with the aid of the diagnostic tool.
2. The second module is responsible for providing closed loop control of the engine's idle speed by adapting the minimum fuel according to the difference between the required idle speed and the engine speed.

► Flow Limitation

The flow limitation strategy is based on the following strategies:

1. The flow limitation depending on the filling of the engine with air is determined according to the engine speed and the air flow. This limitation allows smoke emissions to be reduced during stabilized running.
2. The flow limitation depending on the atmospheric pressure is determined according to the engine speed and the atmospheric pressure. It allows smoke emissions to be reduced when driving at altitude.
3. The full load flow curve is determined according to the gear engaged and the engine speed. It allows the maximum torque delivered by the engine to be limited.
4. A performance limitation is introduced if faults liable to upset the rail pressure control or the injection control are detected by the system. In this case, and depending on the gravity of the fault, the system activates:
 - 1) Reduced fuel logic 1: Guarantees 75 % of the performance without limiting the engine speed.
 - 2) Reduced fuel logic 2: Guarantees 50 % of the performance with the engine speed limited to 3,000 rpm.
 - 3) Reduce fuel logic 3: Limits the engine speed to 2,000 rpm.

The system chooses the lowest of all these values.

A correction depending on the coolant temperature is added to the flow limitation. This correction makes it possible to reduce the mechanical stresses while the engine is warming up. The correction is determined according to the coolant temperature, the engine speed and the time which has passed since starting.

Supercharger Flow Demand

The supercharge flow is calculated according to the engine speed and the coolant temperature. A correction depending on the air temperature and the atmospheric pressure is made in order to increase the supercharge flow during cold starts. It is possible to alter the supercharge flow value by adding a flow offset with the aid of the diagnostic tool.

► Pilot Flow Control

The pilot flow represents the amount of fuel injected into the cylinder during the pilot injection. This amount is determined according to the engine speed and the total flow.

1. A first correction is made according to the air and water temperature.

This correction allows the pilot flow to be adapted to the operating temperature of the engine. When the engine is warm, the ignition time decreases because the end-of-compression temperature is higher. The pilot flow can therefore be reduced because there is obviously less combustion noise when the engine is warm.

2. A second correction is made according to the atmospheric pressure.

This correction is used to adapt the pilot flow according to the atmospheric pressure and therefore the altitude.

During starting, the pilot flow is determined on the basis of the engine speed and the coolant temperature.

► Cylinder Balancing Strategy

Balancing of the point to point flows

The pulse of each injector is corrected according to the difference in instantaneous speed measured between 2 successive injectors.

1. The instantaneous speeds on two successive injections are first calculated.
2. The difference between these two instantaneous speeds is then calculated.
3. Finally, the time to be added to the main injection pulse for the different injectors is determined. For each injector, this time is calculated according to the initial offset of the injector and the instantaneous speed difference.

Detection of an injector which has stuck closed

The cylinder balancing strategy also allows the detection of an injector which has stuck closed. The difference in instantaneous speed between 2 successive injections then exceeds a predefined threshold. In this case, a fault is signaled by the system.

► Accelerometer Strategy

Resetting the pilot injection

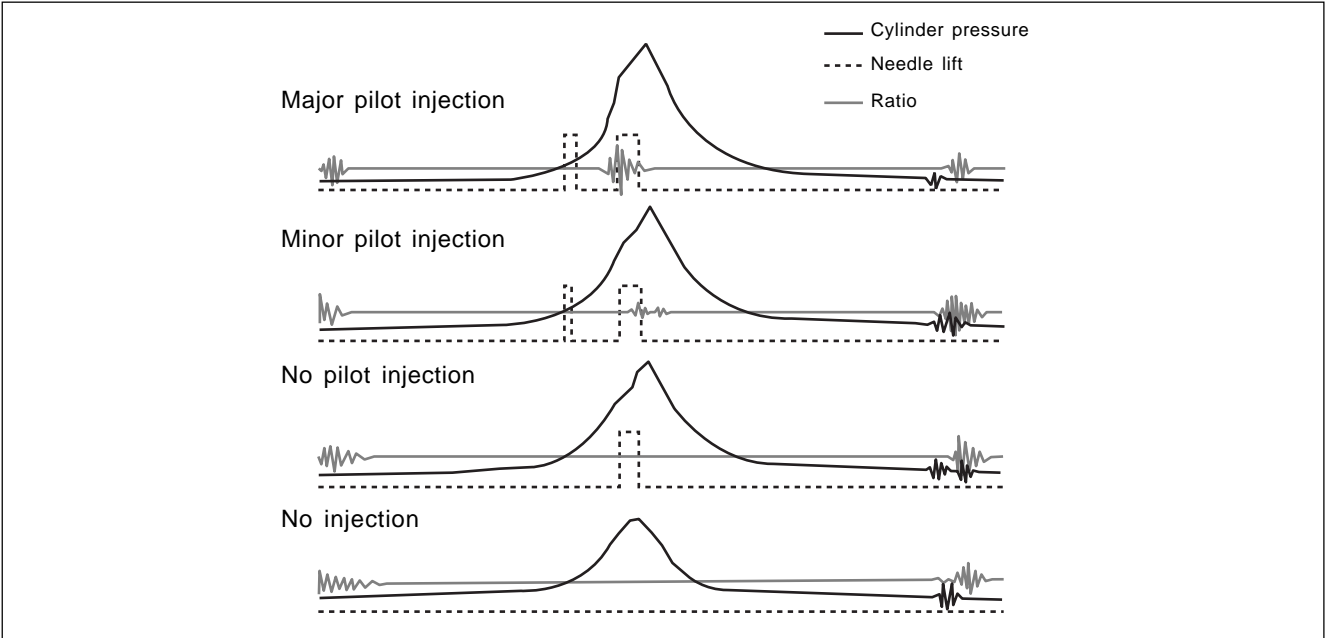
The accelerometer is used to reset the pilot injection flow in closed loop for each injector. This method allows the correction of any injector deviations over a period of time. The principle of use of the accelerometer is based on the detection of the combustion noises.

The sensor is positioned in such a way as to receive the maximum signal for all the cylinders. The raw signals from the accelerometer are processed to obtain a variable which quantifies the intensity of the combustion. This variable, known as the ratio, consists of the ratio between the intensity of the background noise and the combustion noise.

1. A first window is used to establish the background noise level of the accelerometer signal for each cylinder. This window must therefore be positioned at a moment when there cannot be any combustion.
2. The second window is used to measure the intensity of the pilot combustion. Its position is such that only the combustion noises produced by the pilot injection are measured. It is therefore placed just before the main injection.

The accelerometer does not allow any evaluation of the quantity injected. However, the pulse value will be measured when the injector starts injection and this pulse value is called the MDP (Minimum Drive Pulse). On the basis of this information, it is possible to efficiently correct the pilot flows. The pilot injection resetting principle therefore consists of determining the MDP, in other words the pulse corresponding to the start of the increase in value of the ratio (increase of vibration due to fuel combustion).

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	



This is done periodically under certain operating conditions. When the resetting is finished, the new minimum pulse value replaces the value obtained during the previous resetting. The first MDP value is provided by the C2I. Each resetting then allows the closed loop of the MDP to be updated according to the deviation of the injector.

Detection of leaks in the cylinders

The accelerometer is also used to detect any injector which may have stuck open. The detection principle is based on monitoring the ratio. If there is a leak in the cylinder, the accumulated fuel self-ignites as soon as the temperature and pressure conditions are favorable (high engine speed, high load and small leak).

This combustion is set off at about 20 degrees before TDC and before main injection.

The ratio therefore increases considerably in the detection window. It is this increase which allows the leaks to be detected. The threshold beyond which a fault is signaled is a percentage of the maximum possible value of the ratio. Because of the severity of the recovery process (engine shut-down), the detection must be extremely robust.

An increase in the ratio can be the consequence of various causes:

- 1. Pilot injection too strong
- 2. Main combustion offset
- 3. Fuel leak in the cylinder

If the ratio becomes too high, the strategy initially restricts the pilot injection flow and retards the main injection. If the ratio remains high despite these interventions, this shows that a real leak is present, a fault is signaled and the engine is shut down.

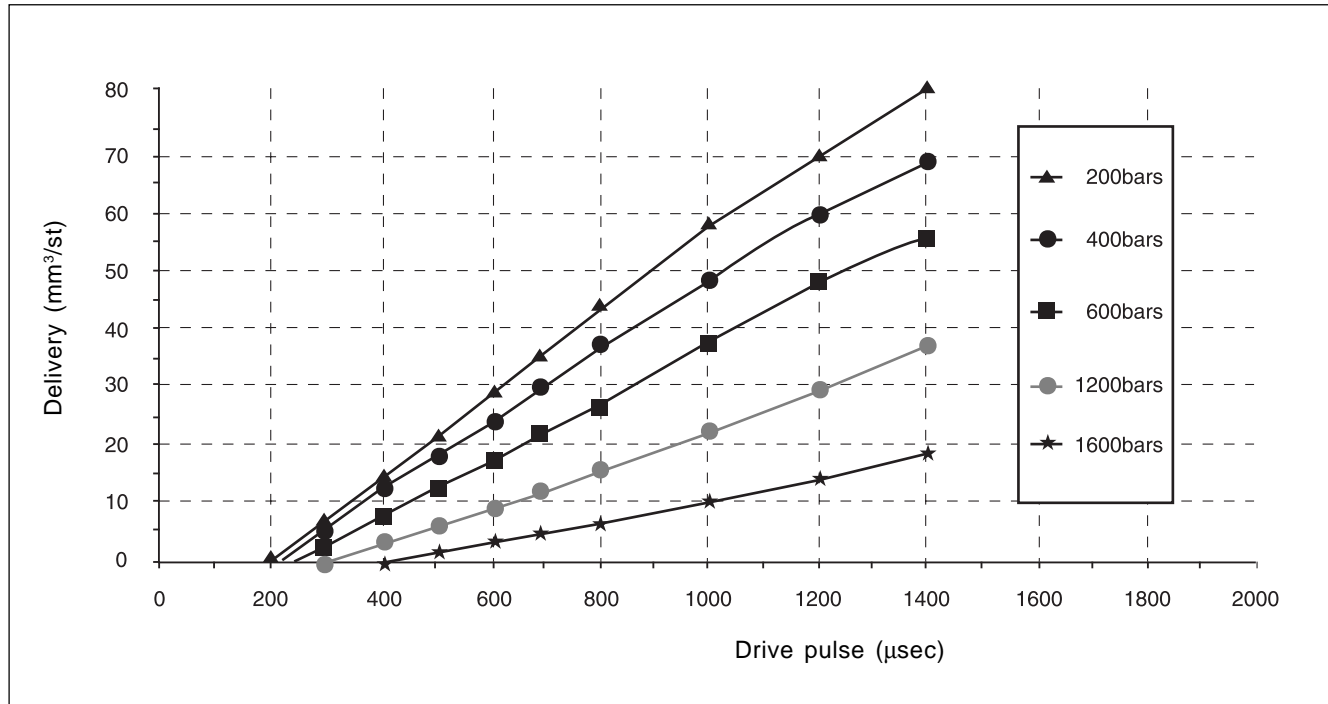
Detection of an accelerometer fault

This strategy permits the detection of a fault in the sensor or in the wiring loom connecting the sensor to the ECU. It is based on detection of the combustion. When the engine is idling, the detection window is set too low for the combustion caused by the main injection. If the ratio increases, this shows that the accelerometer is working properly, but otherwise a fault is signaled to indicate a sensor failure. The recovery modes associated with this fault consist of inhibition of the pilot injection and discharge through the injectors.

INDIVIDUAL INJECTOR CALIBRATION (C2I)

Injected fuel is proportional to square root of injection time and rail pressure.

It is function between pulse and rail pressure and fuel injection curve is called injector characteristics curve having the following shape.



Common rail injectors are very accurate components. They are able to inject fuel delivery between 0.5 to 100 mg/str under pressure varying from 150 to 1600 bar.

This high level of accuracy requires very low machining tolerances (few μm).

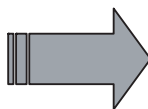
Nevertheless, due to the machining dispersion, the loss of charge through the functional orifices, the friction between moving parts and electromagnetic field level are different from one injector to the other. So, the difference of fuel delivery for the same pressure and the same pulse can reach 5 mg/str from one injector to the other. It is impossible to control efficiently the engine with such a dispersion between the different injectors. It is necessary to add a correction that allows injecting the demanded fuel delivery whatever the initial hydraulic characteristics of the injector is. The method consists in correcting the pulse that is applied to the injector with an offset that depends on the initial hydraulic map of the injector. So, the pulse should be corrected according to characteristics of each injector.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

C2I is composed of models on these characteristics of injectors.

C2I consists of 16-digit; composed of numbers from 1 to 9 and alphabets from A to F. ECU remembers C2I, characteristics of each injector, to make the most optimal fuel injection.

1. When replacing the injector, C2I code on the top of new injector should be input into ECU because the ECU is remembering the injector's C2I value. If C2I is not input, engine power drops and occurs irregular combustion.
2. When ECU is replaced, C2I code of every injector should be input. If not, cannot accelerate the vehicle even when the accelerator pedal is depressed.



※ For coding of C2I, refer to “Diagnosis” section

MINIMUM DRIVE PULSE (MDP) LEARNING

When the pulse value that the injector starts injection is measured, it is called minimum drive pulse (MDP). Through MDP controls, can correct pilot injections effectively. Pilot injection volume is very small, 1 ~ 2 mm³/str, so precise control of the injector can be difficult if it gets old. So there needs MDP learning to control the very small volume precisely through learning according to getting older injectors.

► Learning Conditions

Coolant temperature	> 75°C
Vehicle speed	> 50 Km/h (over 5 seconds)
Intake manifold pressure	> 0.7 bar
Engine speed	> 2,500 rpm
Battery voltage	10 V < MDP < 16 V
Fuel temperature	0 < fuel temperature < 80 °C
Initial MDP learning on each injector	5 seconds

► Trouble Codes


Trouble code	Description	Diagnosis
P1171	Fault MDP learning on injector No. 1	• Check each injector
P1172	Fault MDP learning on injector No. 2	
P1173	Fault MDP learning on injector No. 3	
P1174	Fault MDP learning on injector No. 4	
P1175	Fault MDP learning on injector No. 5	

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► Accelerator Pedal Sensor




<Location of Accelerator Pedal Sensor>



<When Depressing the Accelerator Pedal and Brake Pedal Simultaneously>

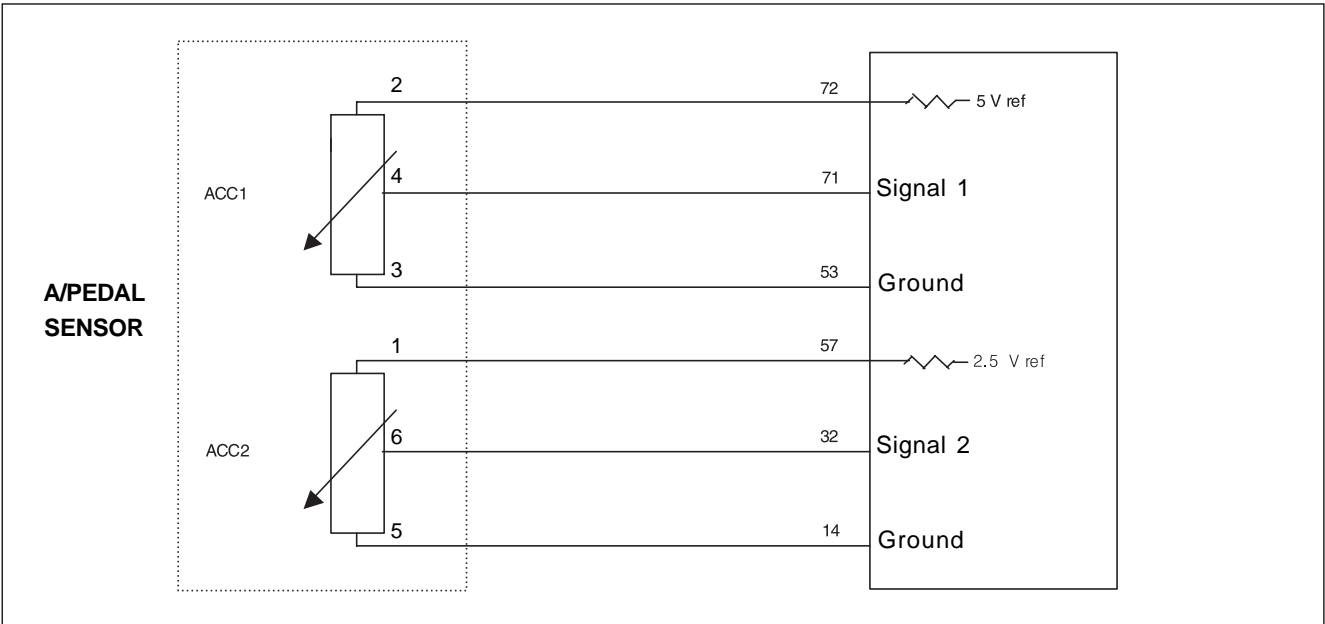
Accelerator pedal sensor changes accelerator pedal position into electrical signal and then sends to ECU to let know the driver's demand. There are 2 sensors in the accelerator pedal sensor. Accelerator pedal No.1 (ACC 1) sensor signal determines fuel injection volume and injection timing during driving, and accelerator pedal No. 2 (ACC 2) sensor signal compares whether the No. 1 sensor signal value is correct.

If accelerator pedal No. 1 and 2 sensors are defective, ECU remembers defect code, and acceleration responses are getting bad and engine rpm hardly increases.

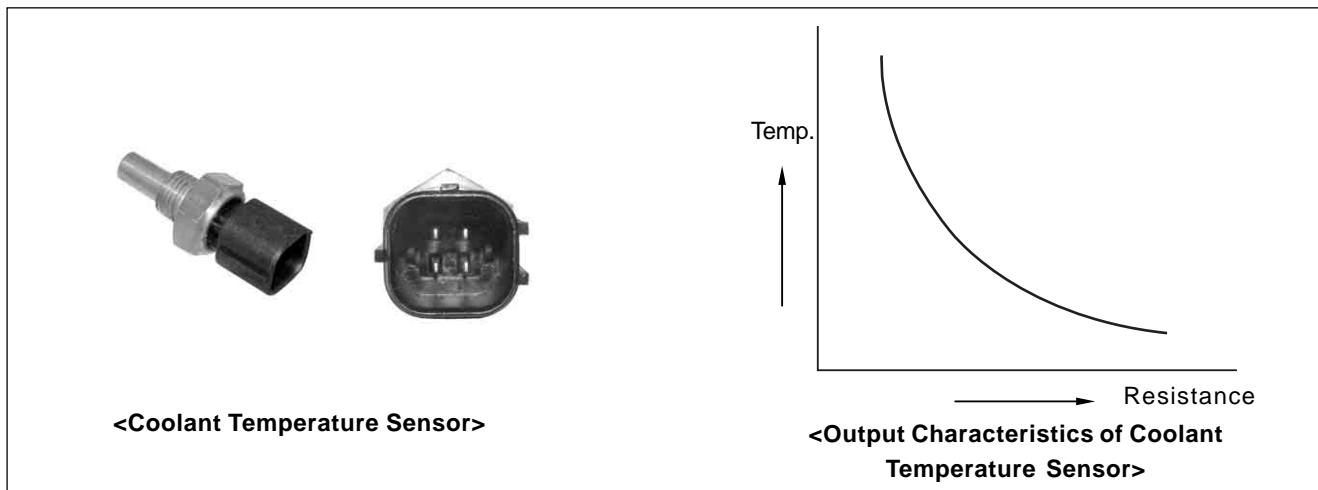


NOTICE

- When depressing the accelerator pedal and brake pedal simultaneously while driving, the acceleration response will be diminished abruptly and cannot drive with over 70 km/h even though depressing the accelerator pedal to its end. At this time, the trouble code of “P-1124 Accelerator pedal sensor stuck” is stored into ECU. If depressing the accelerator pedal over 3 times, it will be resumed to normal condition.
- For detailed information, refer to “Diagnosis” section in this manual.



► Coolant Temperature Sensor



Coolant temperature sensor is a NTC resister that sends coolant temperature to ECU.

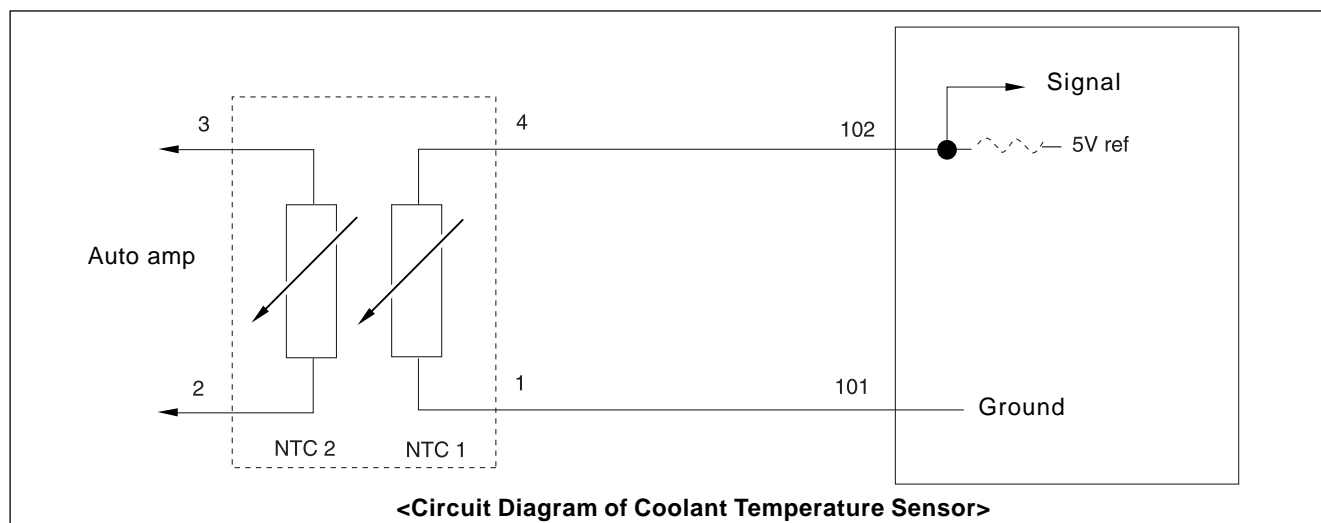
NTC resister has characteristics that if the engine temperature rises, the resistance lowers so the ECU detects lowering signal voltages.

If the fuel injected into the engine through injector has more turbulence, then combusts very well. However, if engine temperature is too low, the fuel injected as foggy state forms big compounds causing incomplete combustion. So the sensor detects coolant temperature and changes coolant temperature changes into voltage then sends to ECU to increase the fuel volume during cold start for better starting. And detects engine overheating for fuel volume reduction to protect the engine.

ECU functions as below with coolant temperature sensor signals.

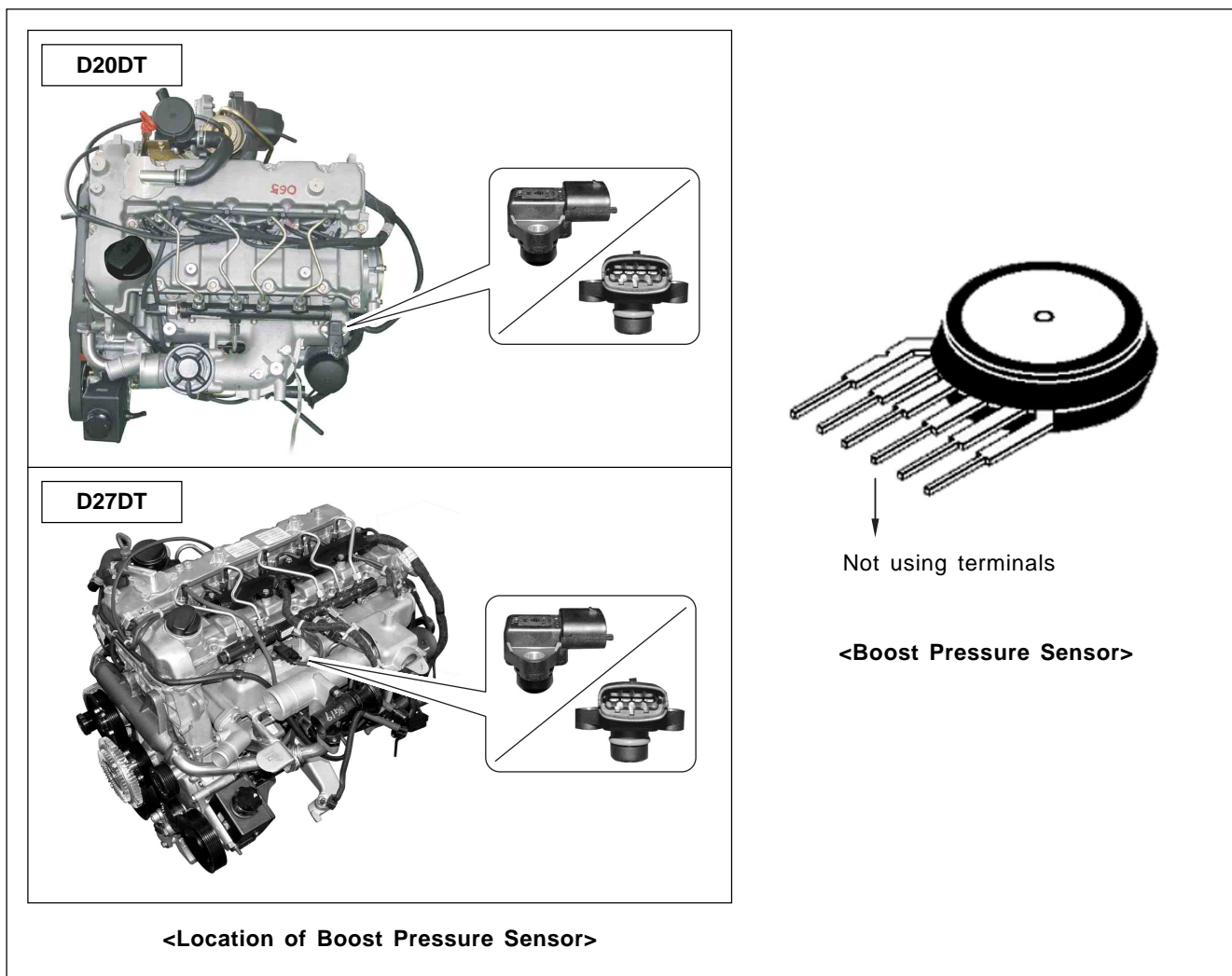
1. When engine is cold, controls fuel volume to correct idle speed.
2. When engine is overheated, controls electrical fan and A/C compressor to protect the engine.
3. Sends information for emission control.

Temperature (°C)	NTC 1 Resistance (Ω)	NTC 2 Resistance (Ω)
20	2,449	6,062
50	826	1,800
80	321	638
120	123	200



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► Boost Pressure Sensor



Boost pressure sensor uses piezo element and uses only 3 terminals out of 6.

It sets fuel injection timing and corrects fuel injection volume according to atmospheric pressure.

The other function is determining EGR operation stops.

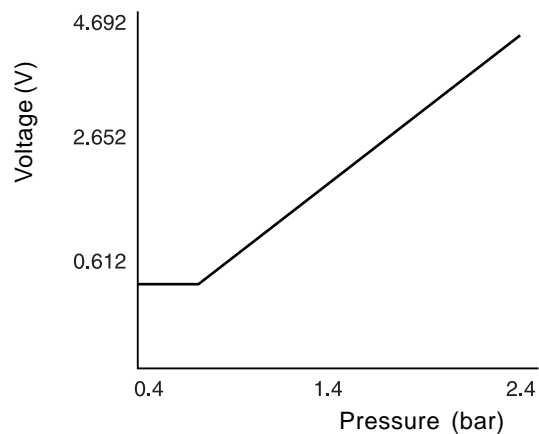
1. Output voltage calculation

$$V_o = V_s \times (P \times 0.004 - 0.04)$$

V_o : Output voltage

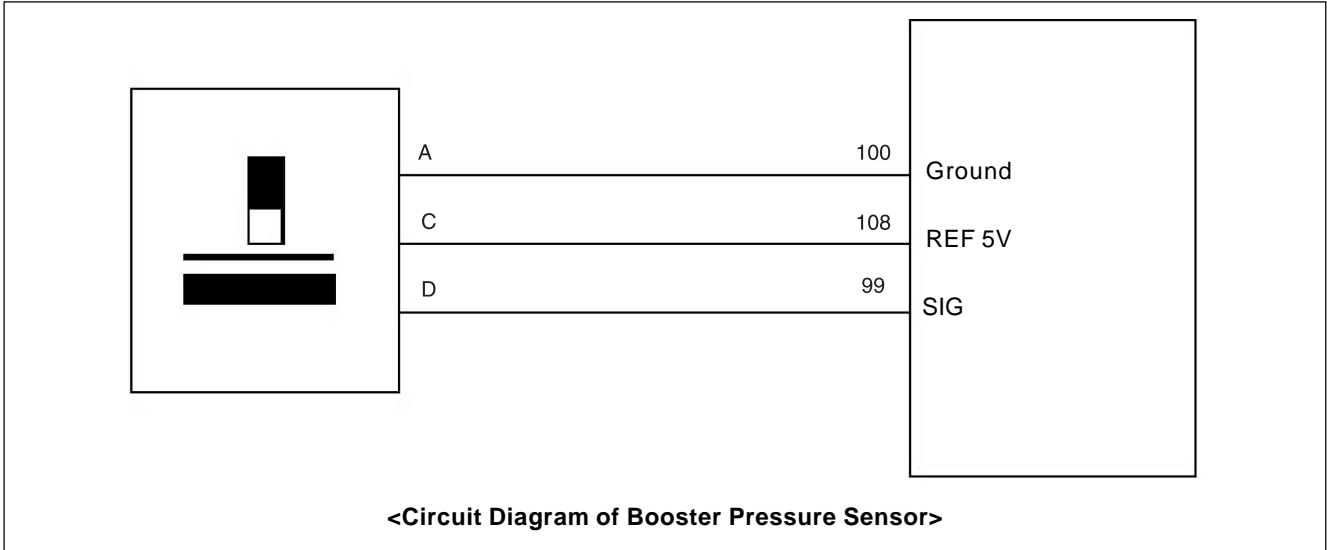
V_s : Supply voltage

P : Applying pressure



<Output Characteristics of Sensor>

Performance proofing pressure range	20 ~ 250 KPa
Performance proofing temperature range	- 40 ~ 110°C
Storage proofing temperature range	- 40 ~ 125°C
Performance proofing supply voltage	4.85 ~ 5.35 V
Max. consuming current	10 mA (supply voltage at 5.35 V)
Responsibility	$T_R \leq 7\text{ms}$
Tightening torque	10 Nm



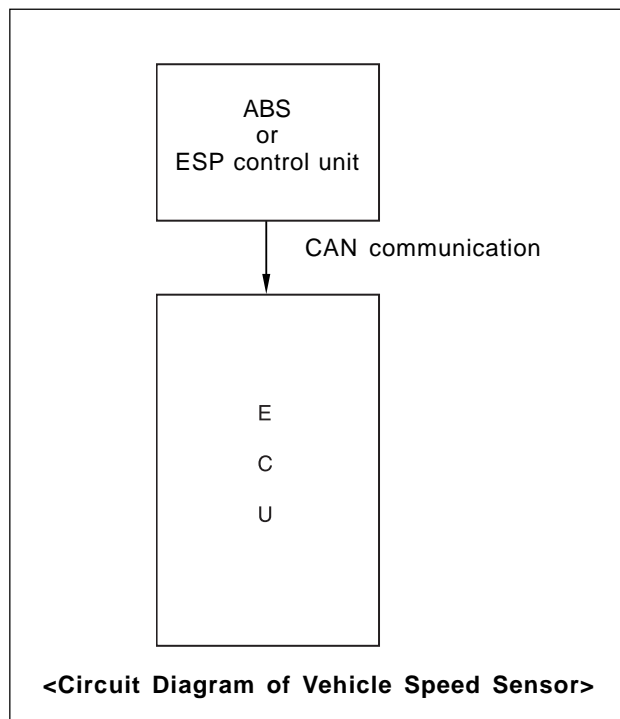
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► Vehicle Speed Sensor

The ABS or ESP control unit sends the vehicle speed signals to ECU. ECU uses these signals to calculate the vehicle speed and meter cluster shows signals as vehicle speed.

Function

1. Limits idle control correction duty range
2. Controls cooling fan
3. Cuts fuel injection if exceeds max. speed
4. Controls vehicle shifting feeling
5. Used for exhaust gas control mode



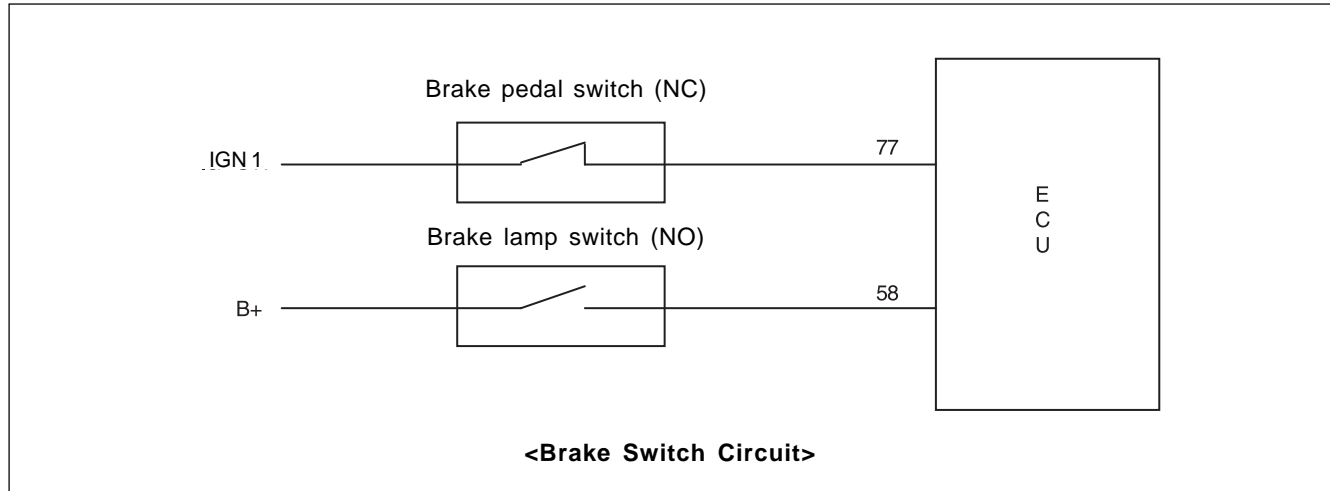
► Barometric Sensor

It is built-in the ECU and detects absolute pressure of atmosphere to correct fuel injection timing and injection volume according to altitude.

► Other switches

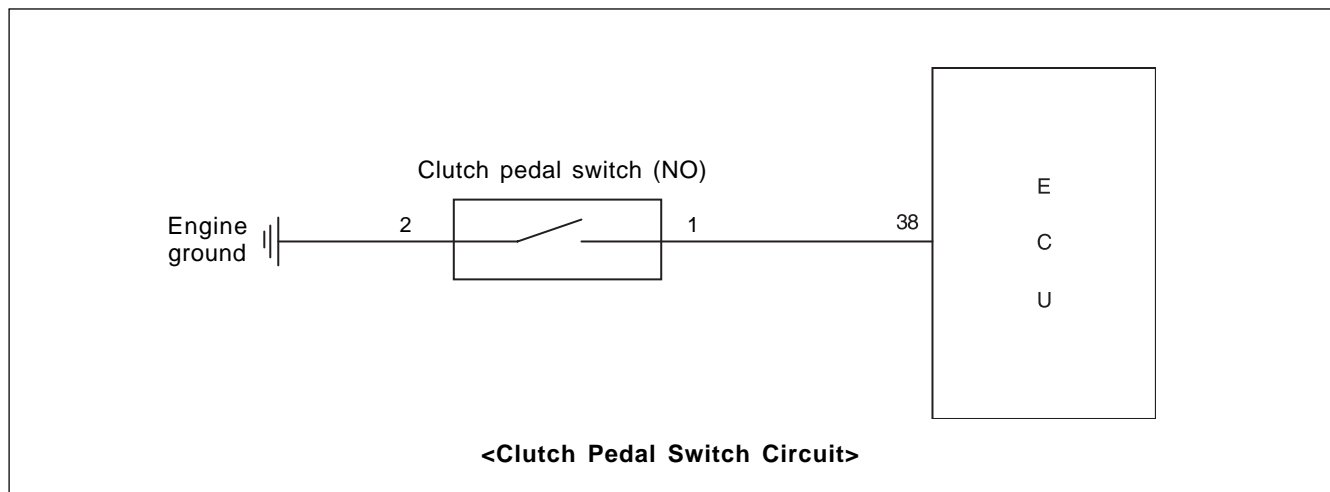
Brake switch

Brake switch detects brake pedal operations and then sends to engine ECU. It has dual structure with 2 combined switches and there are brake switch 1 and 2. When these 2 signals are input, engine ECU recognizes as normal brake signals. These switch signals are related with accelerator pedal sensor operations and used to control the fuel volume during braking. It means there are no problems in operating accelerator pedal when the brake pedal is operated but the fuel volume reduces if operates brake pedal while the accelerator pedal is depressed.



Clutch pedal switch

Clutch pedal switch is installed on the upper of the clutch and sends clutch pedal operations to engine ECU. Contact type switch allows engine ECU to recognize the shifting points to correct the fuel volume. It means it corrects fluctuation happens during gear shifting. Another different function is canceling auto cruise function if equipped (auto cruise control - equipped for export).



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

MEMO

SECTION 09

**ELECTRIC DEVICES
AND SENSORS**

ELECTRIC DEVICES AND SENSORS

09

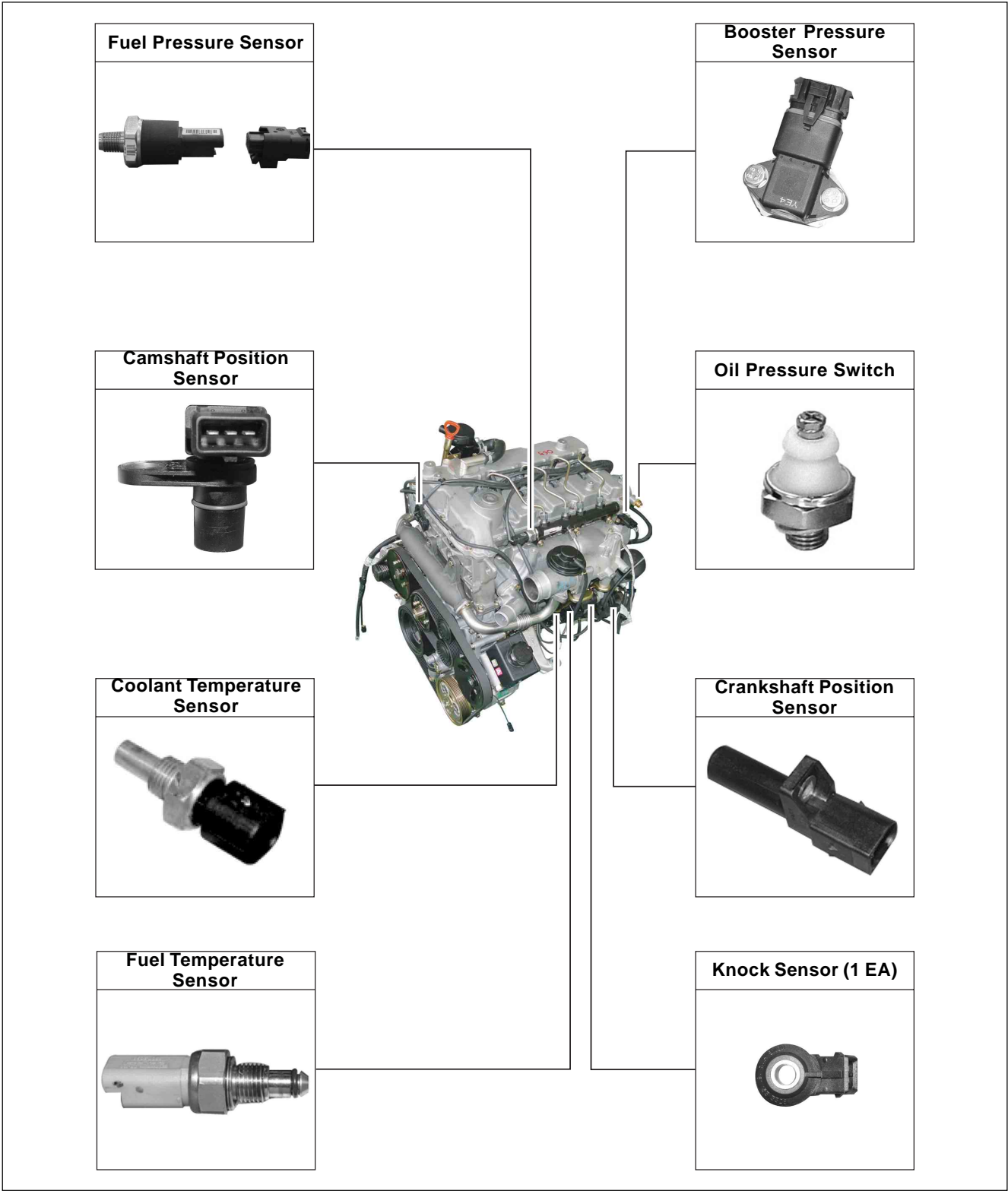
■ TABLE OF CONTENTS ■

ELECTRIC DEVICES AND SENSORS.....	2
Sensors in engine compartment	2
Electric devices in engine compartment	4
Specifications	6
Circuit diagram of preheating system	7
Circuit diagram of starting and alternator	8
TROUBLE DIAGNOSIS	9
General	9
Alternator	11
Starter	13

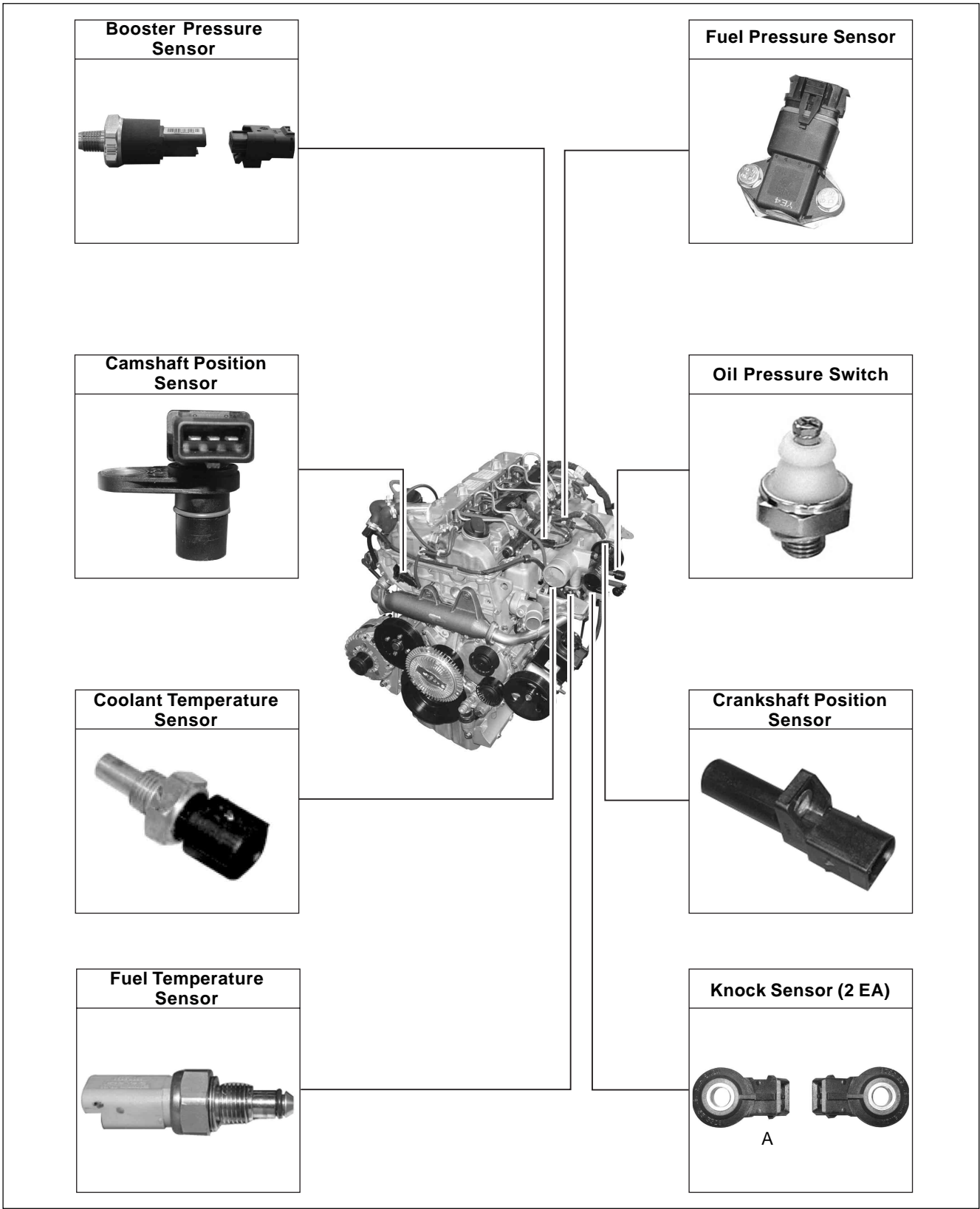
ELECTRIC DEVICES AND SENSORS

SENSORS IN ENGINE COMPARTMENT

► D20DT Engine



► D27DT Engine



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

ELECTRIC DEVICES IN ENGINE COMPARTMENT

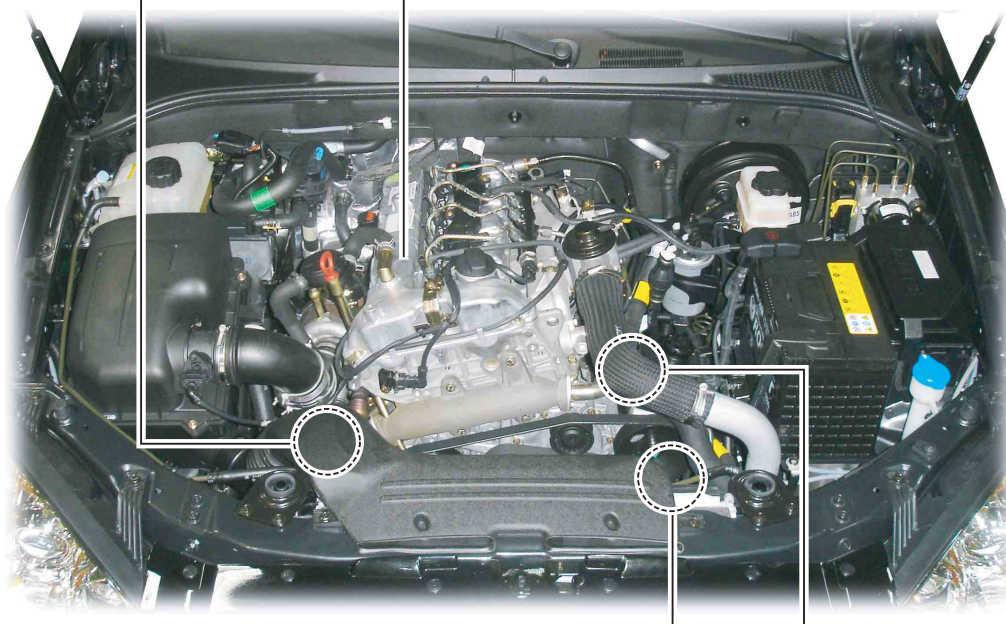
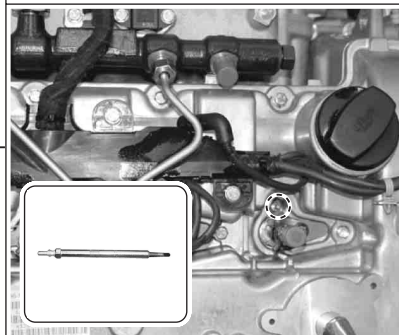
► D20DT Engine

Alternator



* Capacity
PTC equipped vehicle
: 12V - 140A
FFH equipped vehicle
: 12V - 115A

Glow Plug



Air Conditioner Compressor




Starter

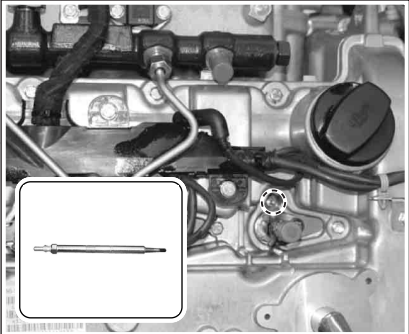


► D27DT Engine

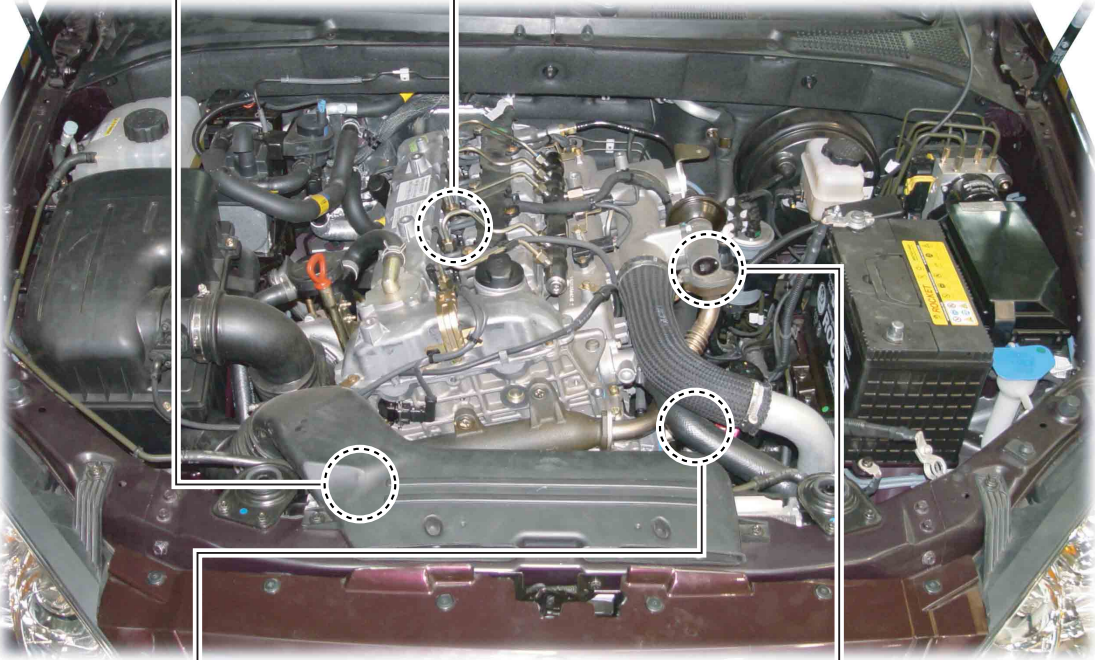
Alternator




Glow Plug



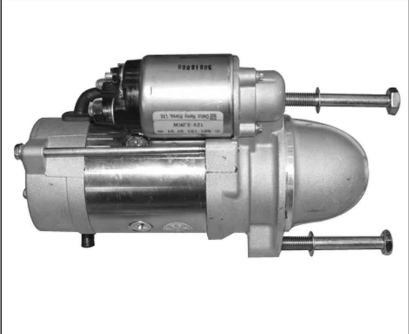
* Capacity
PTC equipped vehicle : 12V - 140A
FFH equipped vehicle : 12V - 115A



Air Conditioner Compressor



Starter



GENERAL
ASSY
HOUSING
INTAKE
EXHAUST
LUB
COOLING
FUEL
CONTROL
SENSOR

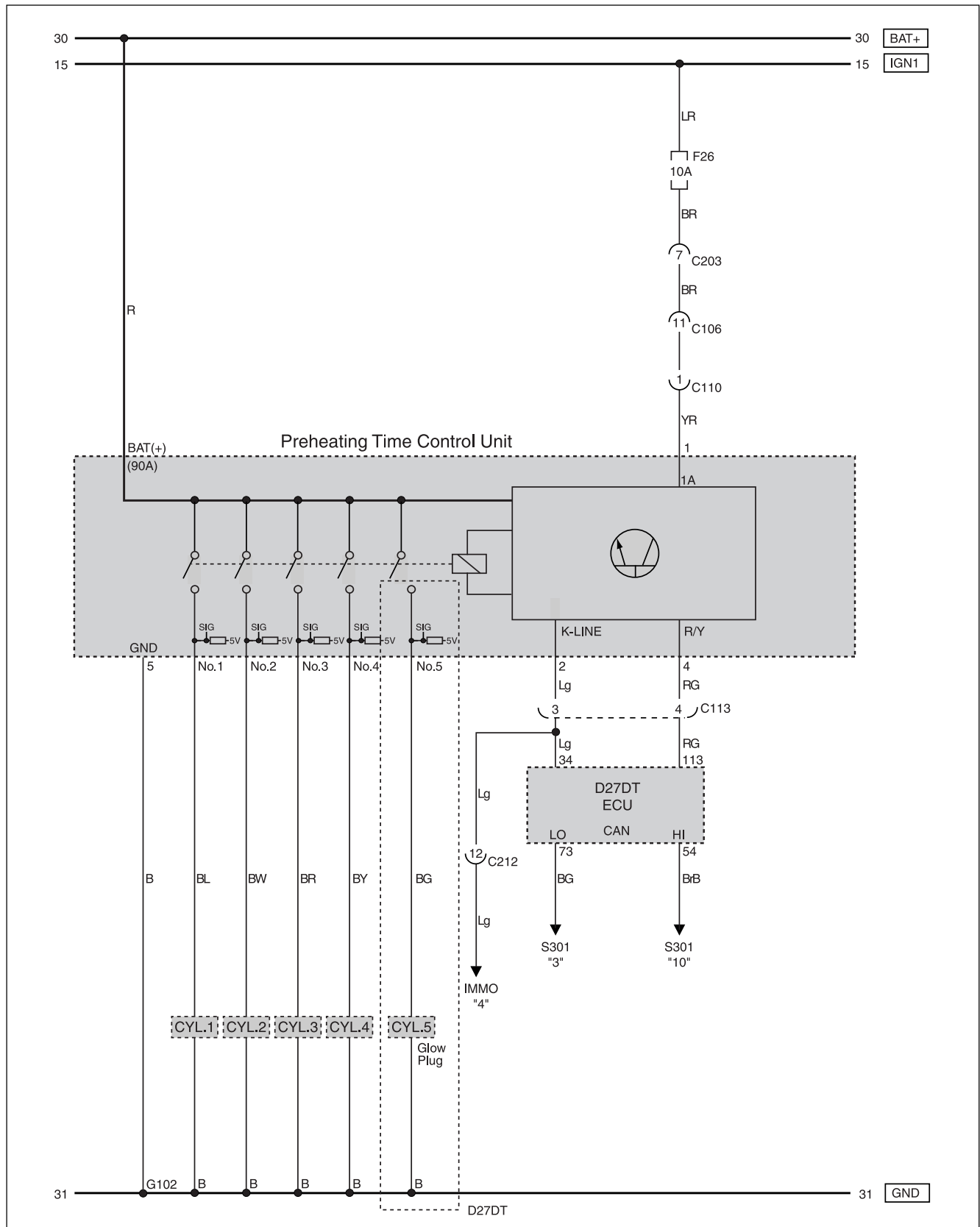
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

SPECIFICATIONS

Description		Unit	Specification
Starter	Type	-	WP220
	Output power	Kw	2.2
	No load test \cong 12 volts	A	160
	Drive pinion speed at no load	rpm	4500
	Drive pinion speed at load	rpm/A	1700/430
	Brush length	mm	18
	Armature diameter	mm	55
	Armature run-out	mm	0.1
	Segment groove depth	mm	21.7
Alternator	Type	-	CS128D
	Output voltage / current	V/A	PTC equipped vehicle: 12V-140A FFH equipped vehicle: 12V-115A
	Regulator type	-	←
	Regulating voltage	V	14.6
	Brush	Length	mm
		Quantity	-
		Wear limit	mm
Battery	Type	-	M F
	Capacity	AH	12V - 90AH
Glow plug	Reserved capacity	RC	160
	Type	-	Seized type
	Rated voltage	-	11.5
	Circuit connection	-	Parallel
	Preheating time	sec	Max. 60 (at -35°C)

CIRCUIT DIAGRAM OF PREHEATING SYSTEM

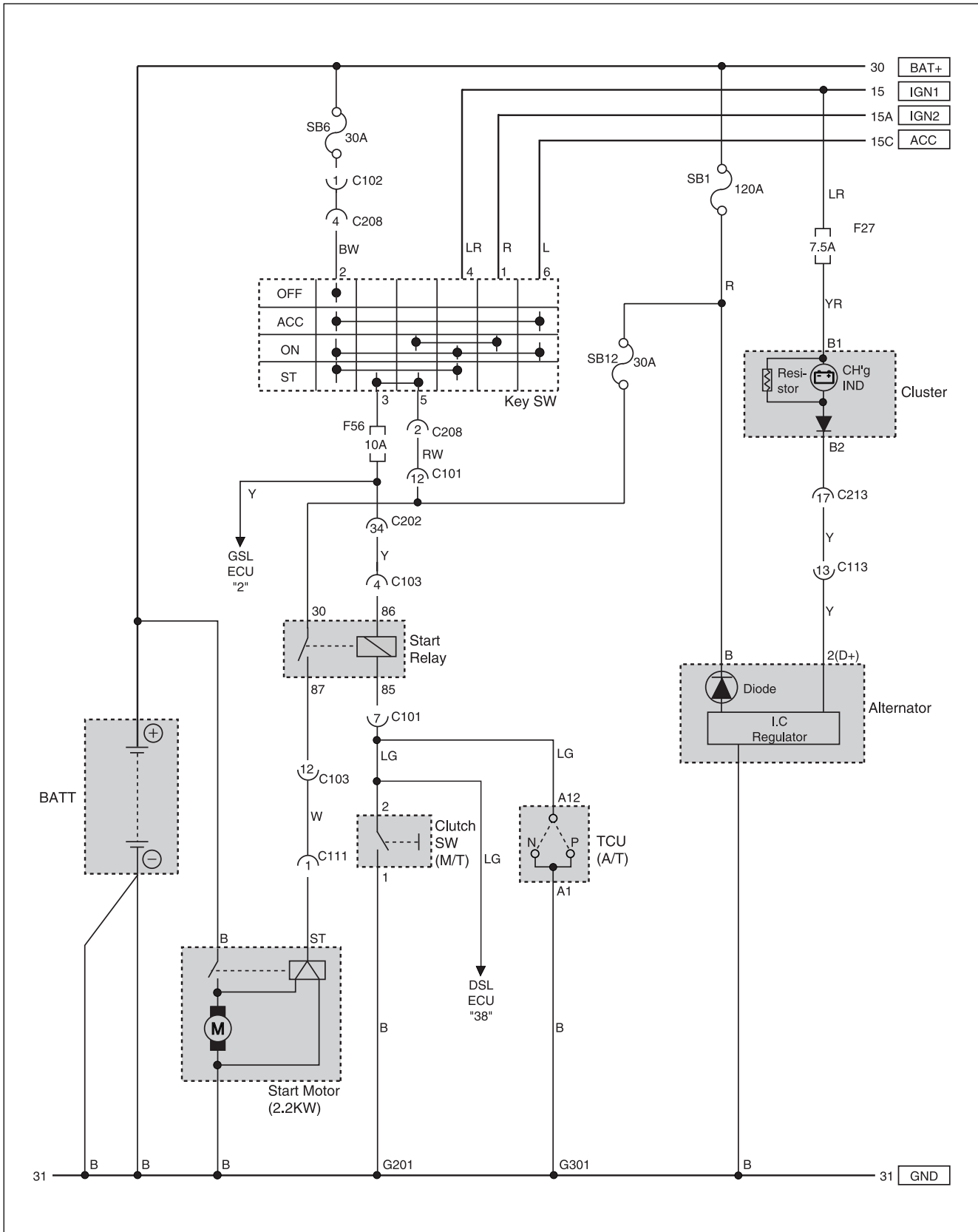
► PREHEATING



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

CIRCUIT DIAGRAM OF STARTING AND ALTERNATOR

► STARTING & CHARGING



TROUBLE DIAGNOSIS

GENERAL

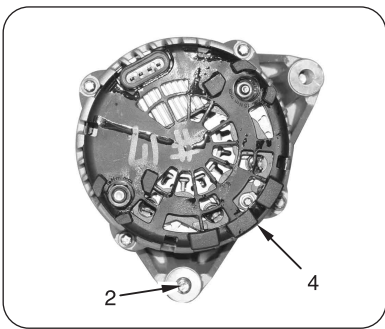
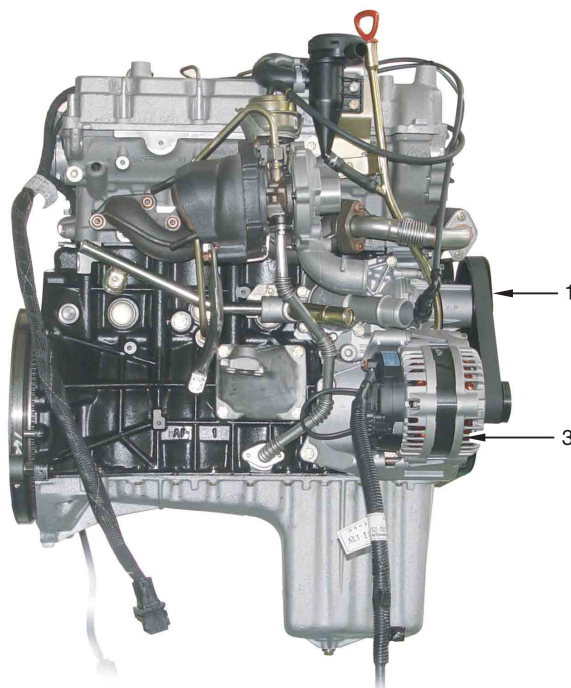
Condition	Probable Cause	Correction
No crank	• Low battery voltage.	• Charging the battery or replace the battery.
	• Battery cable is loose, corroded, or damaged.	• Repair or replace the battery cable.
	• Faulty starter motor or starter motor circuit is open.	• Repair or replace the starter motor/starter motor circuit.
	• Faulty ignition switch.	• Replace the ignition switch.
	• Ground short.	• Repair the ground short.
Crank ok, but too slow	• Low battery voltage.	• Charging the battery or replace the battery.
	• Battery.	• Repair or replace the battery cable.
	• Battery cables are loose, corroded, or damaged.	• Repair or replace the starter motor.
Starter motor does not stop	• Faulty starter motor.	• Repair or replace the starter motor.
	• Faulty ignition switch.	• Replace the ignition switch.
Starter motor running, but not cranking	• Broken the clutch pinion gear or faulty starter motor.	• Replace the starter motor.
	• Broken the flywheel ring gear.	• Replace the flywheel.
	• Connected circuit is open.	• Repair the open circuit.
Battery discharge	• Loosen the generator drive belt.	• Adjust the belt tension or replace the belt.
	• The circuit is open or a short.	• Repair the open or a short circuit.
	• Battery run down.	• Replace the battery.
	• Open ground circuit.	• Repair the open ground circuit.
Charging indicator lamp does not work when the ignition switch on (engine does not work)	• Charging indicator lamp is blown or fuse is blown.	• Repair or replace the charging indicator lamp/fuse.
	• Faulty ignition switch.	• Replace the ignition switch.
	• Generator ground circuit is open or a short.	• Repair the circuit.
Charging indicator lamp does not put out lights after starting the engine	• Battery cable is corroded or damaged.	• Repair or replace the battery cable.
	• Loosen the generator drive belt.	• Adjust the belt tension or replace the belt.
	• Faulty wiring harness.	• Repair the wiring harness.
Battery over charging	• Generator voltage regulator faulty	• Replace generator
	• Voltage detecting wiring faulty	• Repair wiring

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

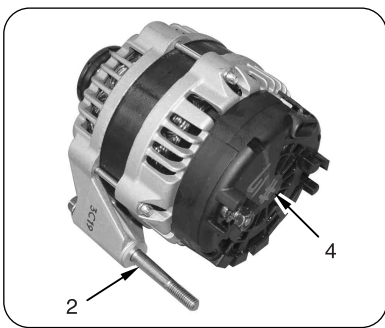
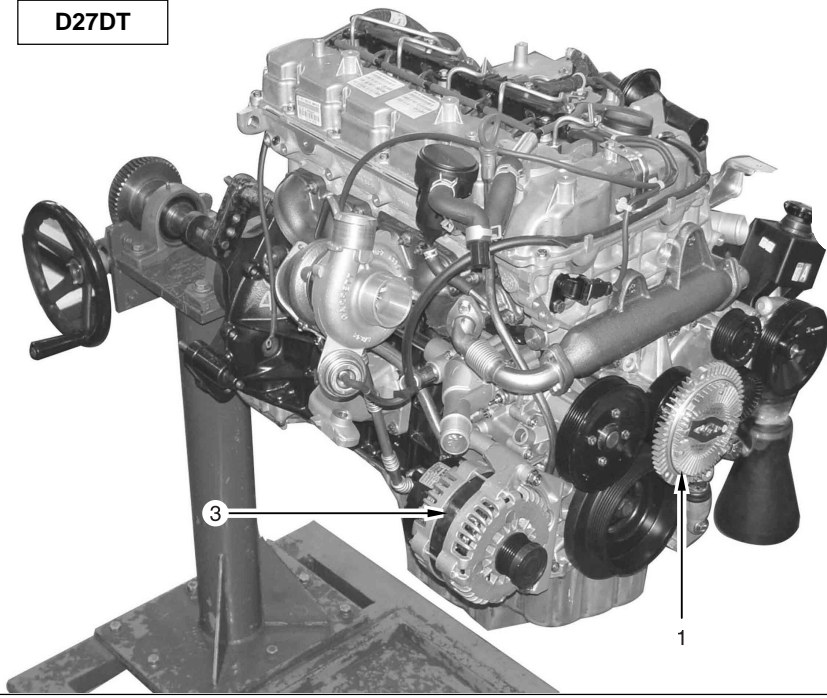
Symptom	Cause	Action
Hard engine starting	• Ignition coil faulty	• Replace ignition coil
	• Distributor (including optical sensor) faulty	• Replace distributor (or sensor)
	• Spark plug malfunction	• Replace spark plug or adjust clearance
	• Ignition timing faulty (spark plug light is normal)	• Resetting valve timing
Unstable engine idling	• Spark plug malfunction	• Replace spark plug or adjust clearance
	• Ignition coil faulty	• Replace ignition coil
	• Ignition timing faulty	• Resetting valve timing
Enging acceralation malfunction	• Ignition timing faulty	• Resetting valve timing

ALTERNATOR

D20DT



D27DT

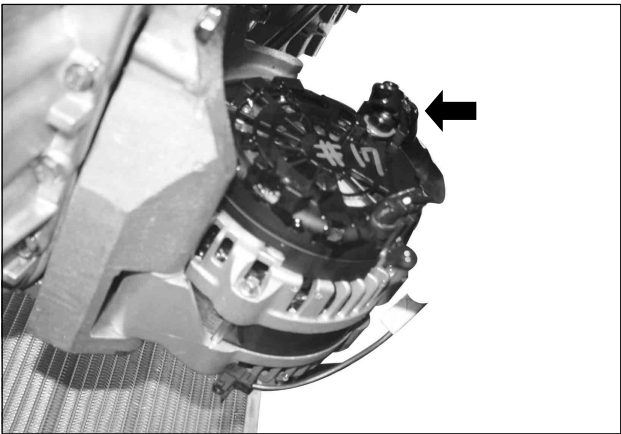


- | | |
|---------------------|--------------------|
| 1. Cooling fan | 3. Alternator |
| 2. Bolt 45 Nm | 4. Plug connection |

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Removal and Installation

- 1. Disconnect the negative battery cable.
- 2. Remove the plug connection.

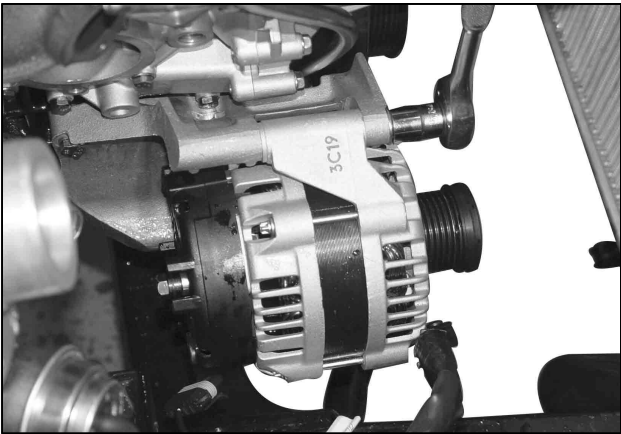


- 3. Unscrew the bolts and remove the alternator.

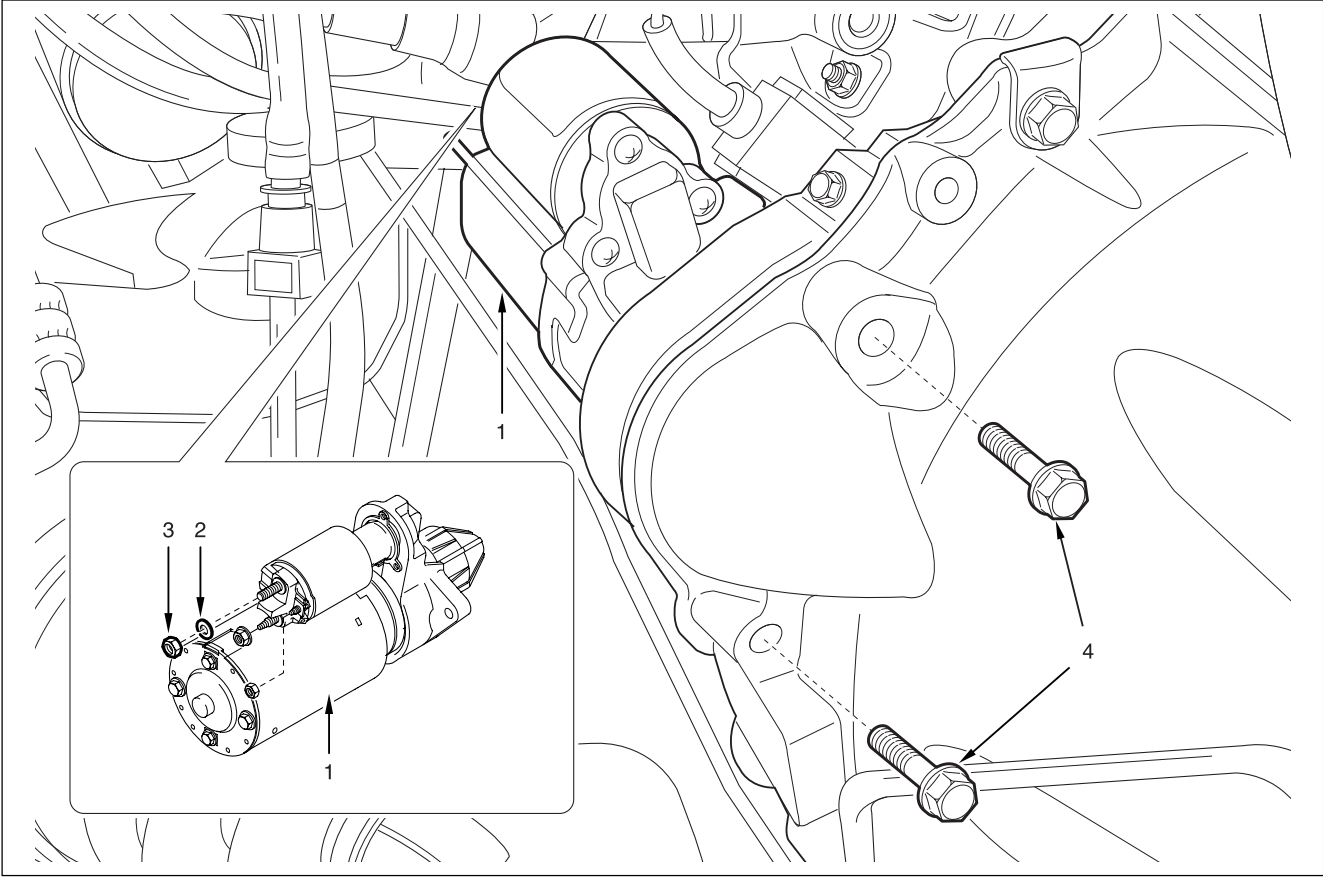
Installation Notice

Tightening torque	45 Nm
-------------------	-------

- 4. Install in the reverse order of removal.



STARTER



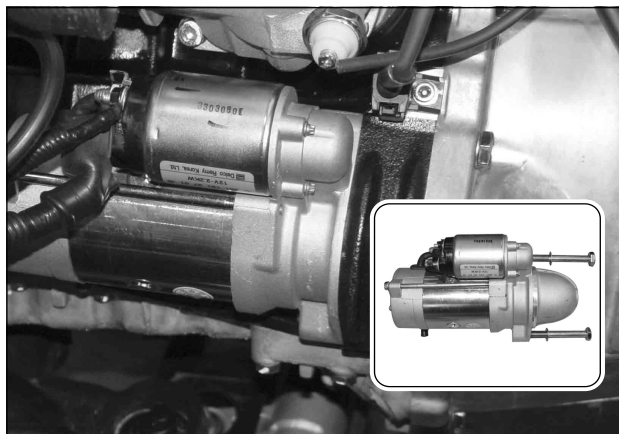
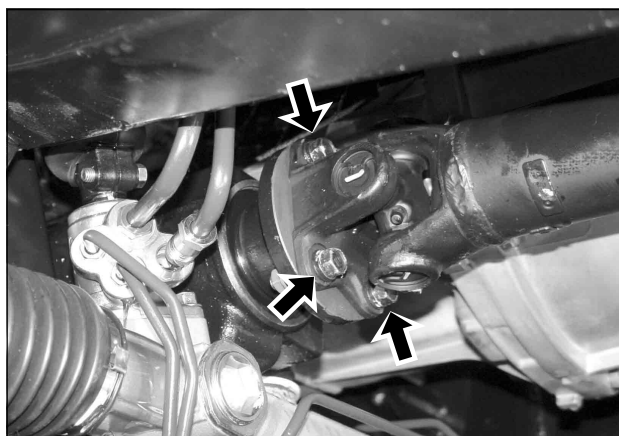
- 1. Starter
- 2. Washer

- 3. Nut 15 Nm
- 4. Bolt 48 Nm

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Removal and Installation

1. Disconnect the negative battery cable.
2. Disconnect the starter terminal.
3. Lift up the vehicle and remove the front propeller shaft mounting bolts.
4. Remove the upper and lower mounting bolts.
5. Install in the reverse order of removal.



DIAGNOSIS

CONTENTS

- ▶ **SCAN-100**
- ▶ **ECU**
- ▶ **TCU**
- ▶ **MANUAL TRANSMISSION**
- ▶ **TCCU**
- ▶ **CLUTCH**
- ▶ **BRAKE**
- ▶ **AIR BAG**
- ▶ **AIR CONDITIONING SYSTEM**
- ▶ **FFH**
- ▶ **RK-STICS**
- ▶ **RAIN SENSOR**
- ▶ **SUNROOF**

SCAN-100

TABLE OF CONTENTS

SCAN-100 OPERATING PROCEDURES	3
ENTERING DIAGNOSIS PROCEDURES	28
FUNCTION SELECTION	29

SCAN-100 GENERAL

SCAN LOAD

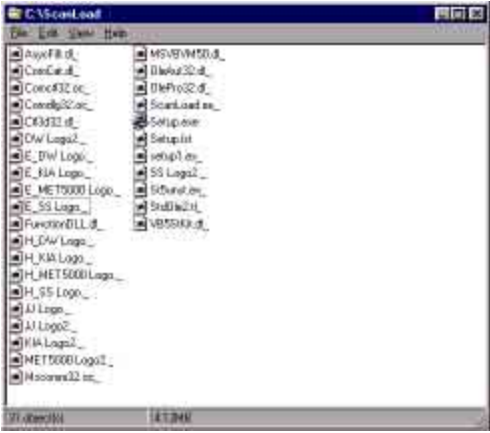




1. Introduction

This SCANLOAD program is designed to write an operating program to your program card of SCAN-100.

2. Installation

In order to install SCANLOAD, the previous requirements should be satisfied in your computer.

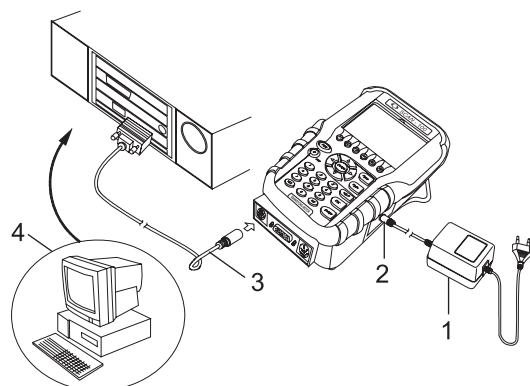
In addition, windows 98 also should be installed. If the windows configuration is not set up, Complete installing the windows, and then follow the procedure of the below.

Screen Flow	Description
 	<p>Make a directory "SCANLOAD" in hard disk. Copy a given program, and execute a "setup.exe".</p>  <p>Click the button , to install the program in the target directory.</p>
	<p>Execute the program, after finishing installing setup program.</p>

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

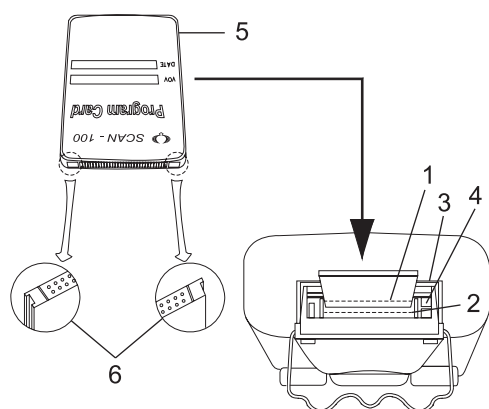
D-CARD DOWNLOAD

1. Connecting SCAN-100 to PC



1. AC/DC Power Supply
2. DC Power Jack
3. RS-232 communication cable
4. PC Terminal

2. Inserting Program Card into SCAN-100



1. Program Card Slot
2. Memory Card Slot
3. Hinged Body
4. Card Eject Button
5. Program Card
6. Notches

1. Inserting program card : Insert the card with label(SCAN-100 program card ver.) side up and to the direction of arrow. Push this card all the way to the end. And if the card is inserted in a wrong way, the card may not be set in the slot.

2. "PCMCIA" cards and memory capacities.

PCMCIA card is consist of FLASH memory. SCAN-100 has two kinds of PCMCIA card; program card and data memory card.

Program card: This card contains the operation program of SCAN-100.

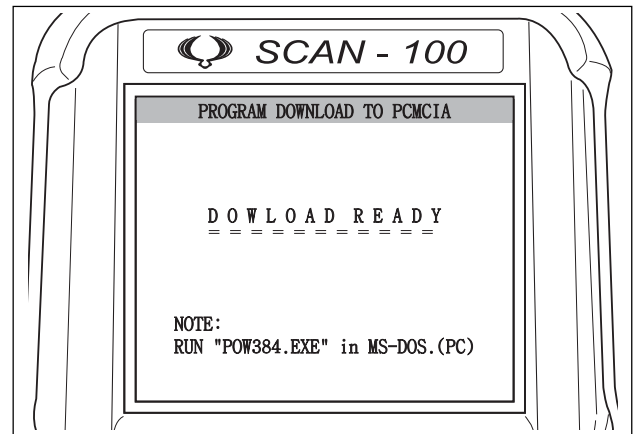
Data memory card: This is used for recording a traveling data, a wave data, etc.

Capacities of program card: It is able to extend its memory capacity up to 16MByte, and its basic memory is 2MByte.

Capacities of data memory card: It is able to extend its memory capacity up to 10MByte.

3. Selecting Download Mode of SCAN-100





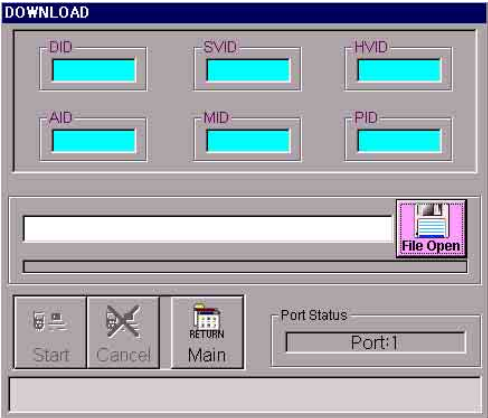




1. Connect communication port of PC to left input port of SCAN-100 by using a download communication cable.
2. Press "PWR" key after pushing a hotkey ("YES" + "NO" + "2").
3. Perform a SCANLOAD program.










SCAN
ECU
TCU
M/T
TCCU
CLUTCH
BRAKE
A/BAG
A/CON
FFH
RK-STICS
R/SENSOR
S/ROOF

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

4. Perform Scanload

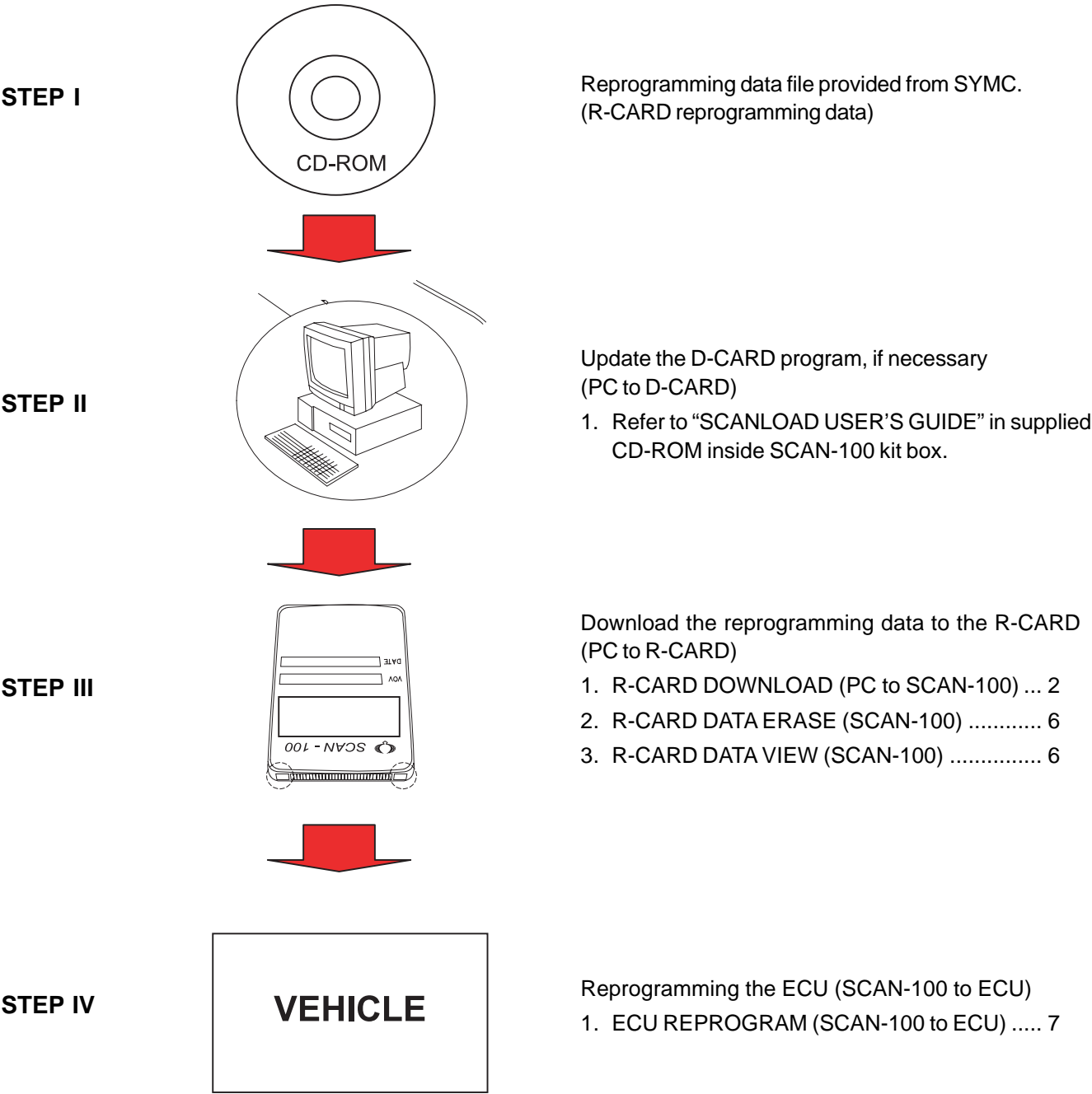
Screen Flow	Description
	 Click the button  , in an initial screen.
	Select the communication port connected to SCAN-100.
	Basic screen of download mode.  Click the button  .
	Select a file which you wish to write, and click the button  .

Screen Flow	Description
	 Click the button
	If the ID of a selecting file is same to the SCAN-100's ID, then ID OK! is indicated. if not, then it shows  message.
	Write a selecting file to program card of SCAN-100.
	If the download is completed,  Then you get a message.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

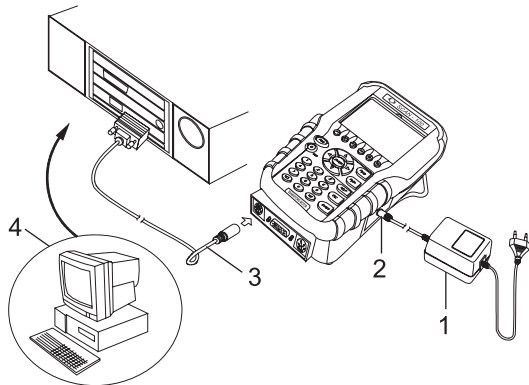
REPROGRAM

1. Reprogramming Flow Chart



2. R-Card Download (PC to SCAN-100)

- 1. Check and see if the D-Card exist in the upper slot (Slot "A") of SCAN-100.
- 2. Check and see if the R-Card exist in the lower slot (Slot "B") of SCAN-100.
- 3. Connecting the SCAN-100 to PC

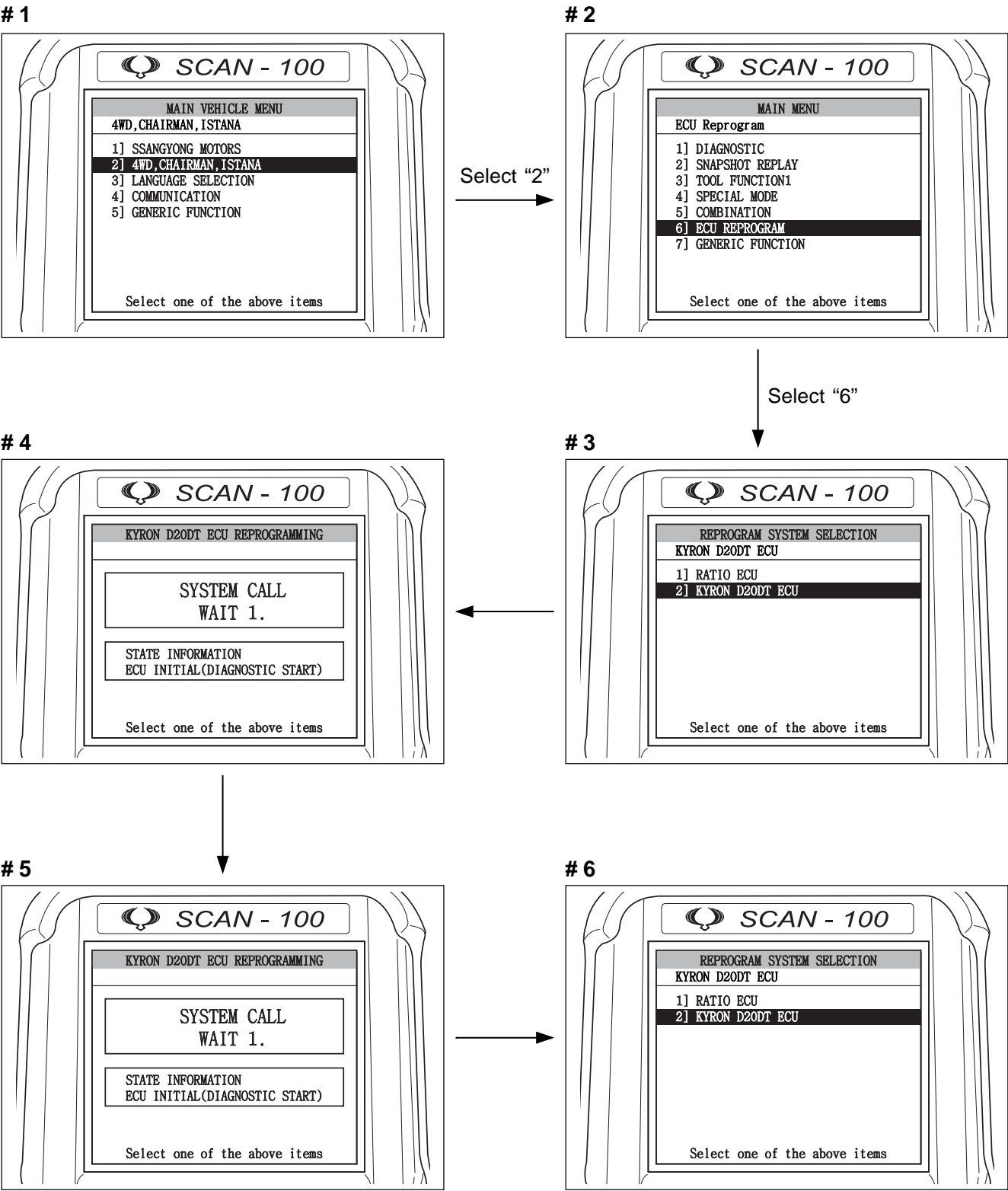


- 1. SCAN-100 AC/DC Power Supply
- 2. DC Power Jack
- 3. RS-232 communication cable
- 4. PC Terminal

SCAN
ECU
TCU
M/T
TCCU
CLUTCH
BRAKE
A/BAG
A/CON
FFH
RK-STICS
R/SENSOR
S/ROOF

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

4. Press the POWER ON the SCAN-100 and process the steps as below.

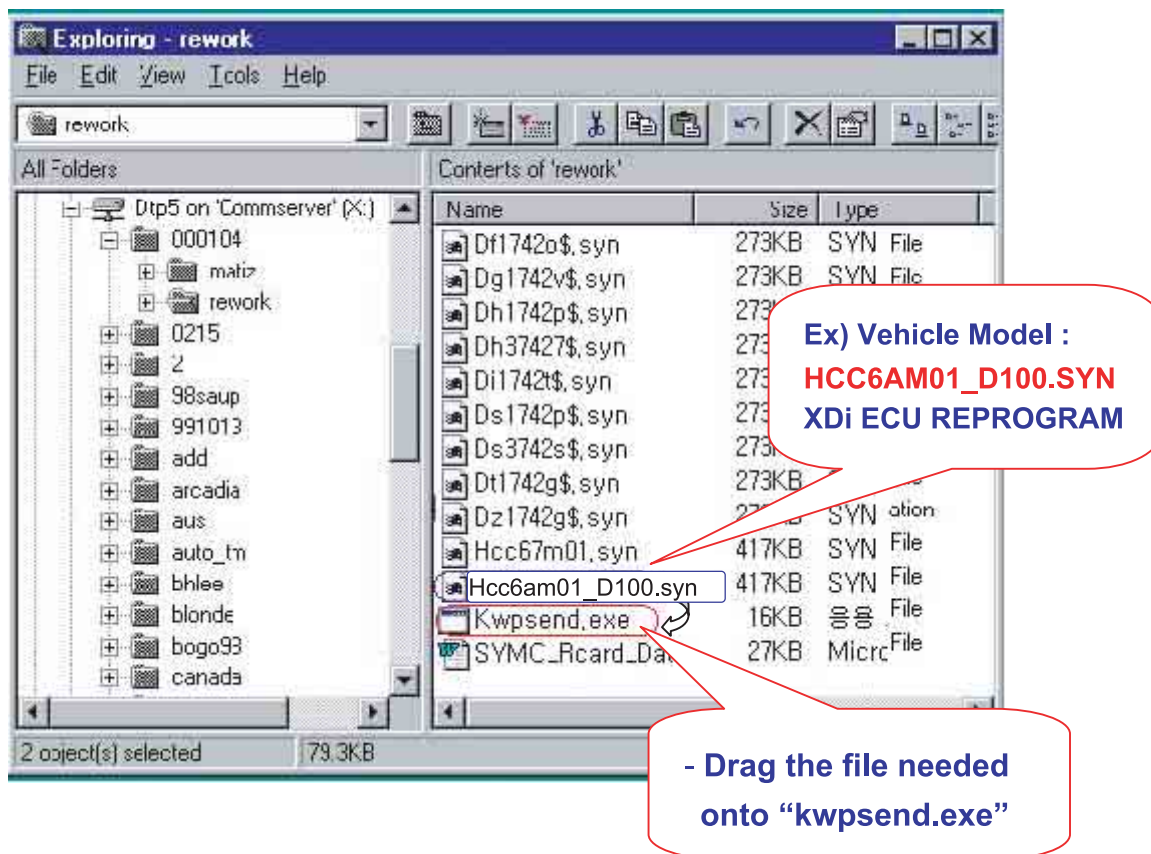


(Fig. 1-1)

If your SCAN-100 display above screen (fig.1-1), please go to the next step.

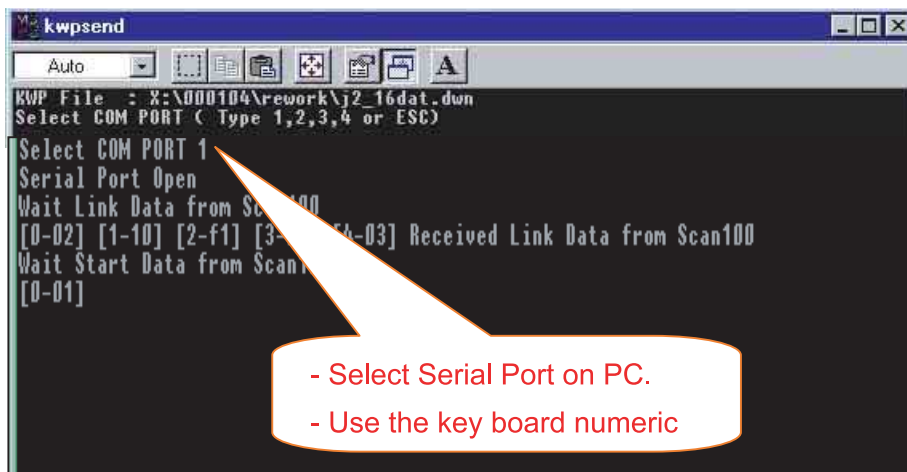
5. Select the file to be matched with your vehicle model and drag it onto the “KWPSSEND.EXE” file.

7



6. Key-in the number of the COM PORT connected with SCAN-100 in the key board

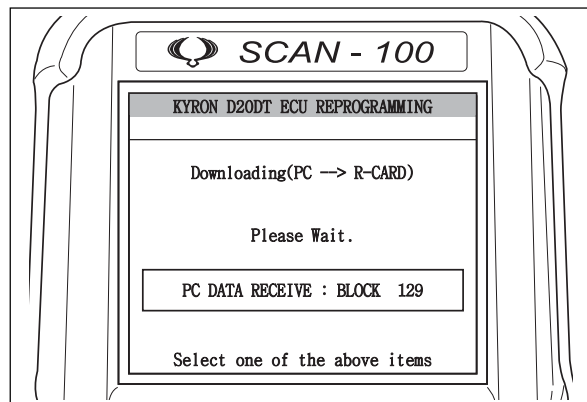
8



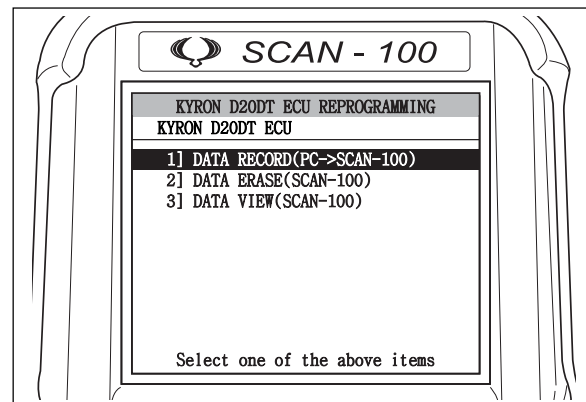
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

7. The SACN 100 shows below figure (Fig. 1-2) while successful downloading

1



2



(Fig. 1-2)

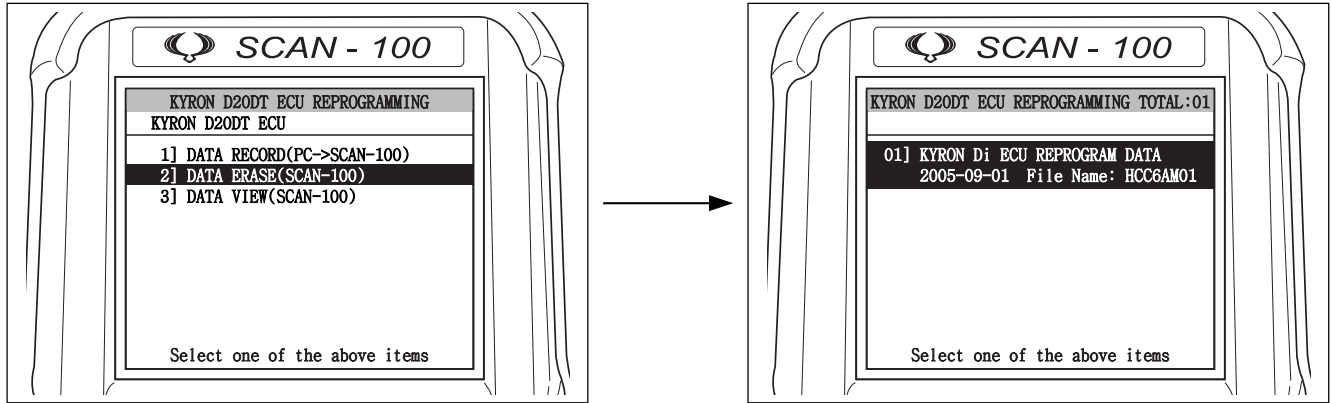
8. Repeat the Step 4 through Step 7 for downloading the reprogramming data of the other vehicle model.

No.	VEHICLE MODEL	FILE NAME	VEHICLE STATUS
1	CHAIRMAN 2.3 NAG (A/T)	DT1742G\$.SYN	T1
2	CHAIRMAN 2.3 BTRA (A/T)	DZ1742G\$.SYN	Z1
3	CHAIRMAN 2.8	DF1742O\$.SYN	F1
4	CHAIRMAN 3.2	DG1742V\$.SYN	G1
5	REXTON 2.8	DI1742T\$.SYN	I1
6	REXTON 3.2 GENERAL AREA	DH1742P\$.SYN	H1
7	REXTON 3.2 WESTERN EUROPE (EURO III REGULATION)	DH37427\$.SYN	H3
8	MUSSO/KORANDO 3.2 GENERAL AREA	DS1742P\$.SYN	S1
9	MUSSO/KORANDO 3.2 WESTERN EUROPE (EURO III REGULATION)	DS3742S\$.SYN	S3
10	KYRON D20DT ECU	HCC6AM01.SYN	

3. R-Card Data Erase (SCAN-100)

This mode is to erase the data saved in R-CARD of SCAN-100

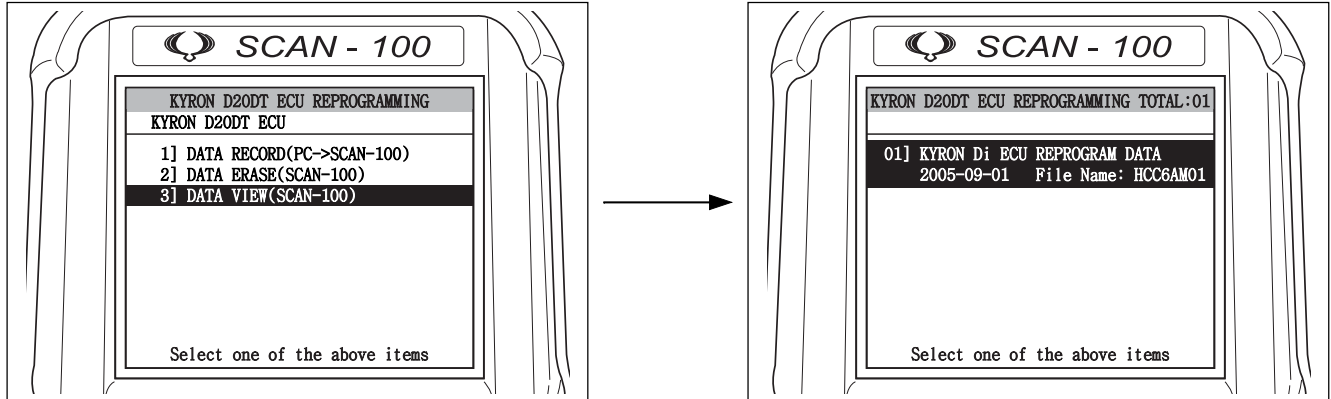
Input the number you want to erase directly or move the cursor to which you want to erase and press "ENTER" key.



It is possible data scroll using the “▲, ▼” key.

4. R-Card Data View (SCAN-100)

This mode is to confirm data which is saved in R-CARD of SCAN-100.

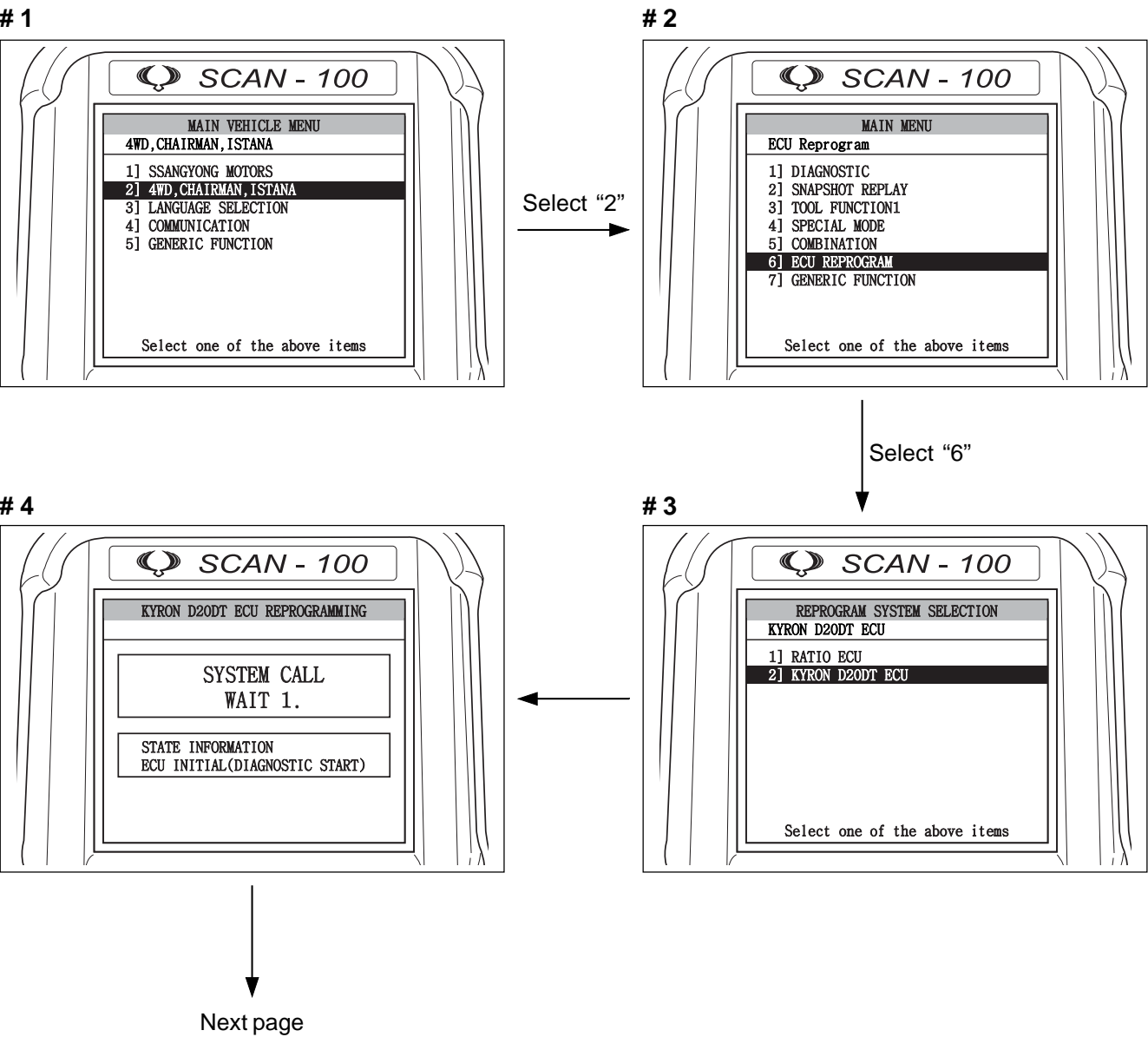


It is possible data scroll using the “▲, ▼” key.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

5. ECU Reprogram (SCAN-100 to ECU) - DSL

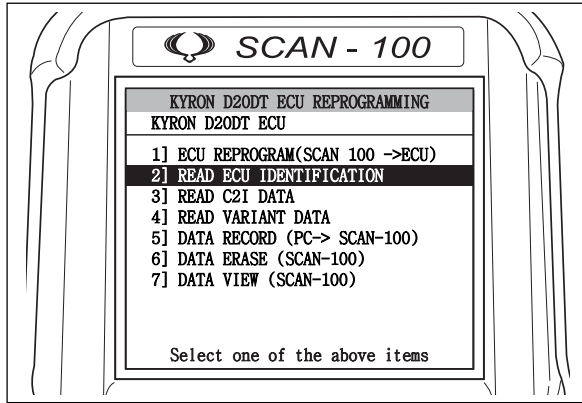
- 1. Check the vehicle to be reprogrammed.
- 2. Connect the SCAN-100 to the diagnostic connector of the vehicle.



Preceding page

after 1sec.

5

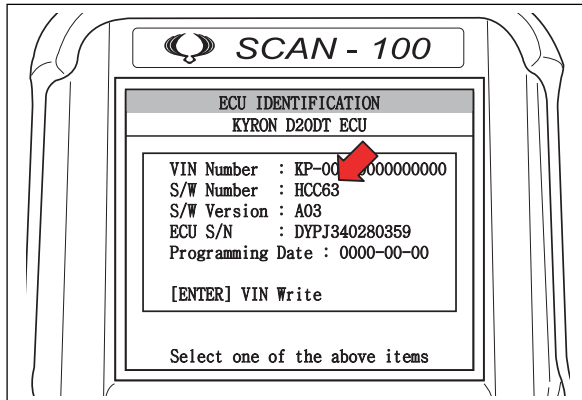


Check the ECU S/W Number

S/W Number: HCC63,
HCC67 or HCC69

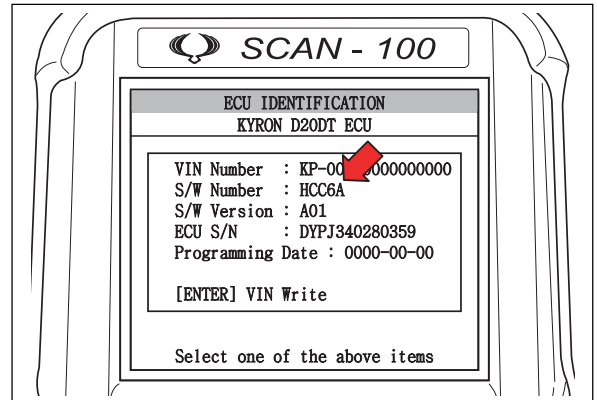
S/W Number: HCC6A

6



after 1sec.

Next page



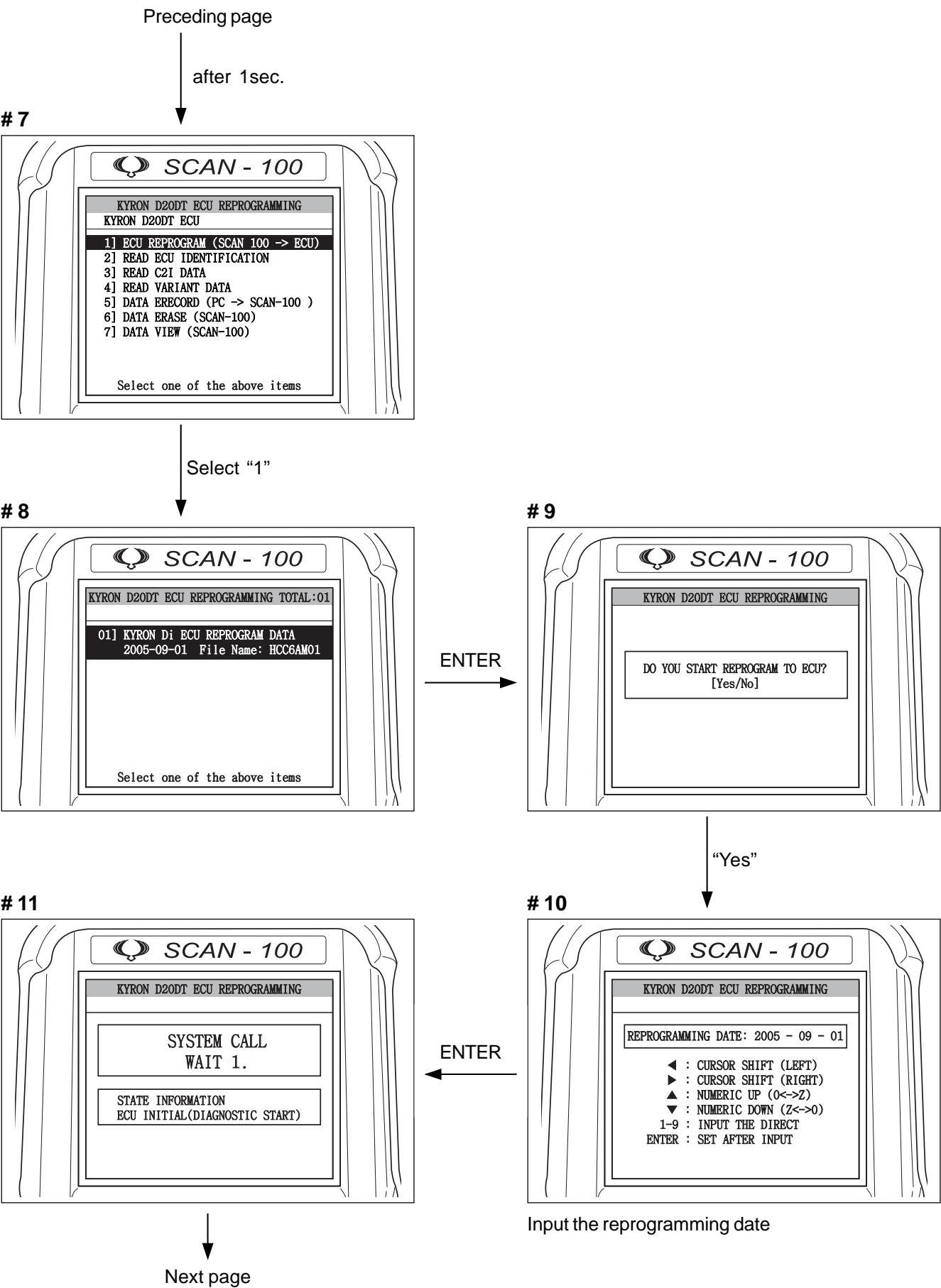
If the S/W Number is HCC6A,

Not necessary, already updated

Select "6"

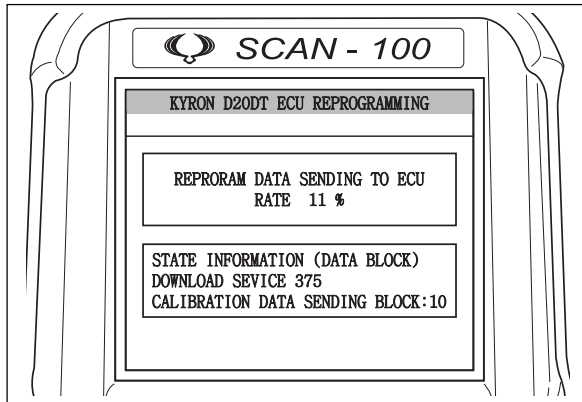
**Exit the ECU REPRORGRAMMING
PROCEDURE**

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	



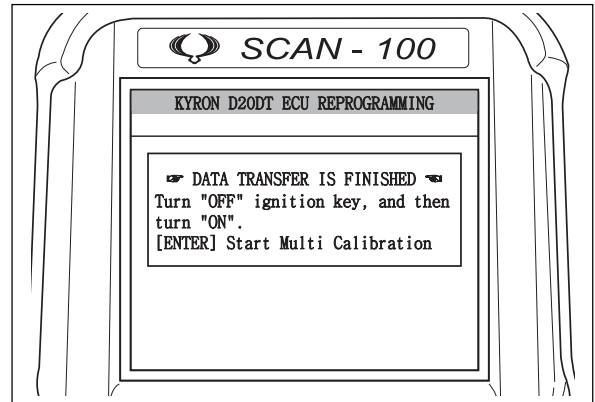
Preceding page

12



After
Finish

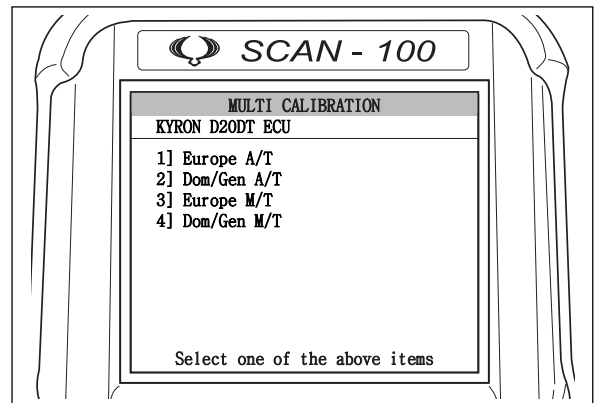
13



CAUTION

- Take care that do not power off and disconnect the scan tool when the boot block is reprogrammed. ECU can be damaged.

14

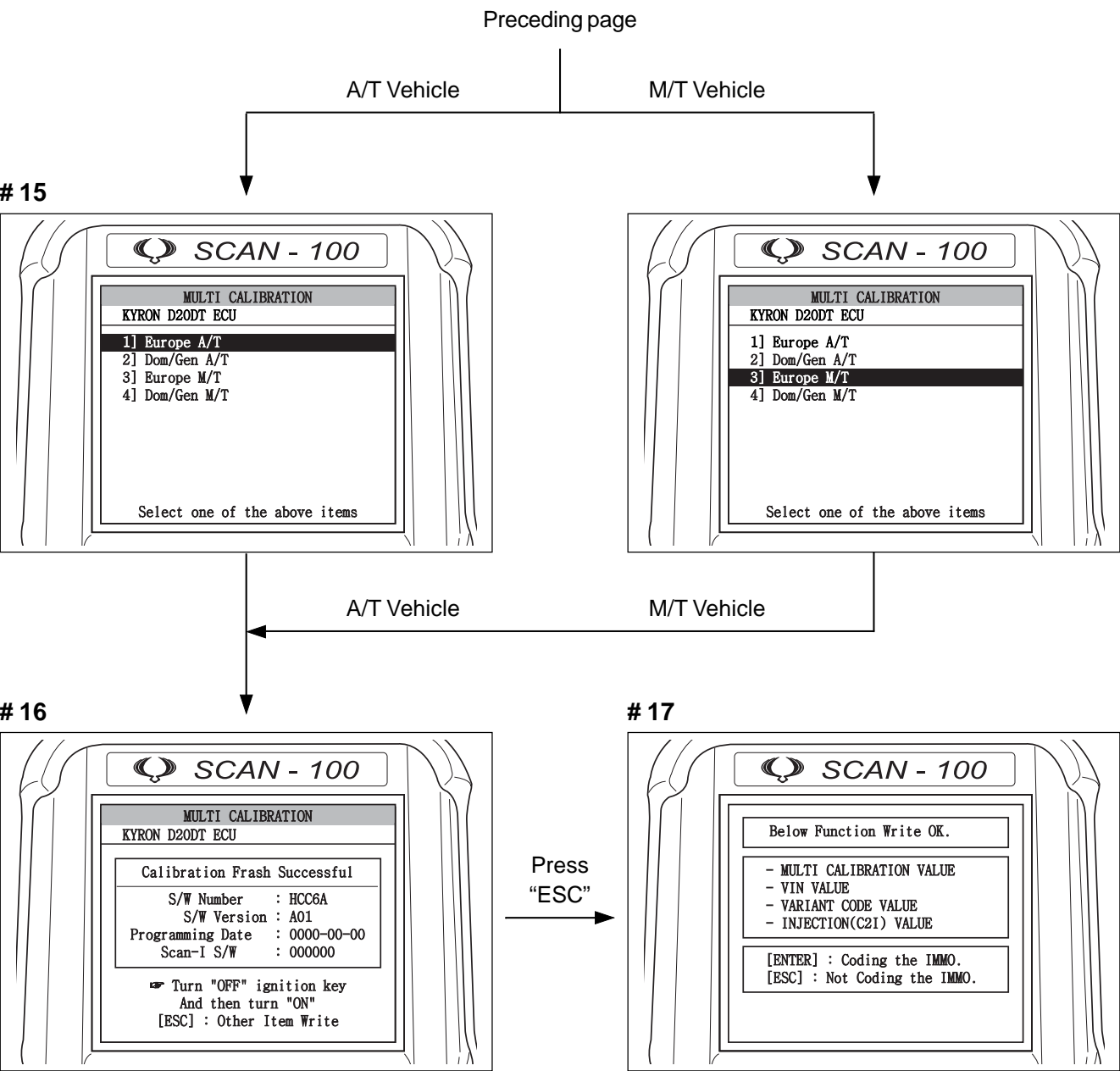


If the target vehicle has the automatic transmission, you have to select No. 1(Euro Ver.) or No.2 (Non Euro Ver.)

If the target vehicle has the manual transmission, you have to select No. 3 (Euro Ver.) or No.4 (Non Euro Ver.)

Next page

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

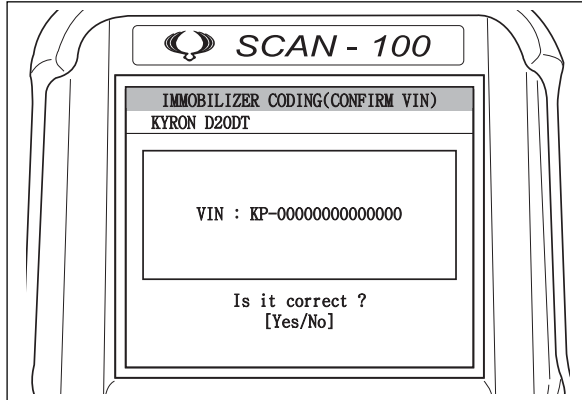


Preceding page

With Immobilizer system
=> Press "ENTER"

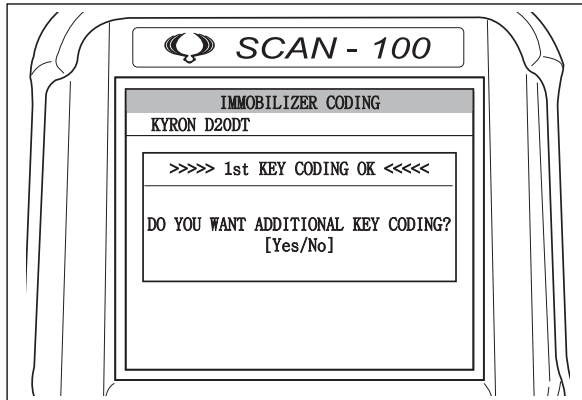
Without Immobilizer
System => Press "ESC"

18



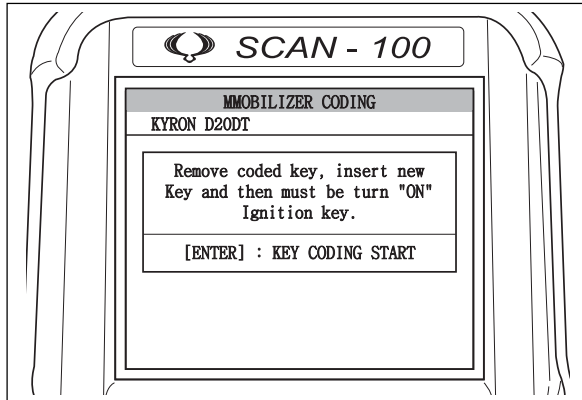
"Yes"

19



"Yes"

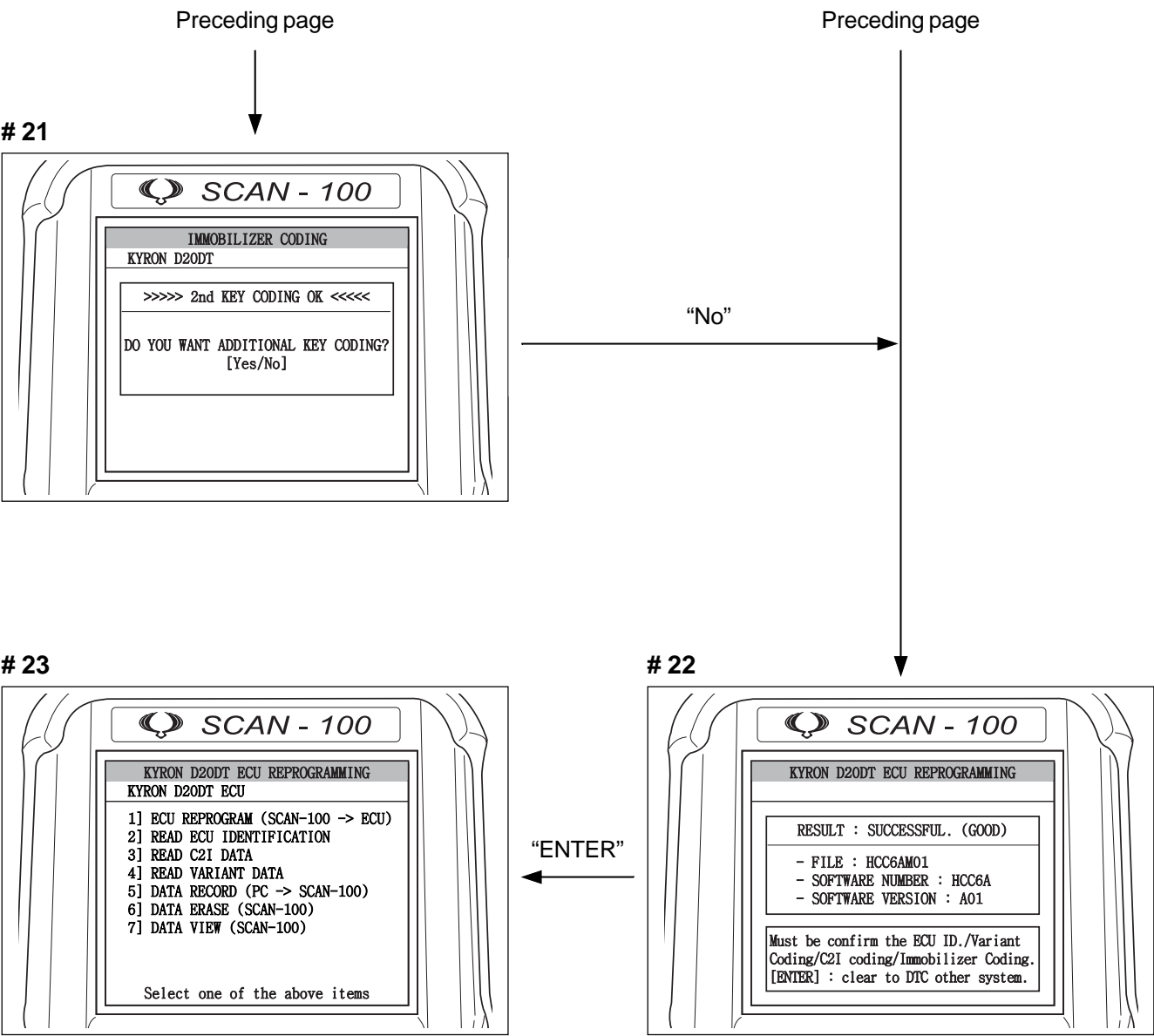
20



Next page

Next page

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

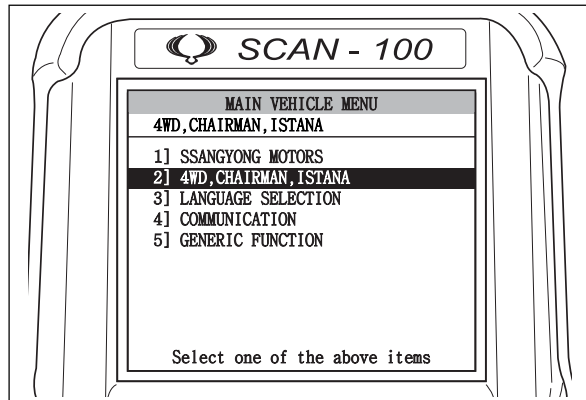


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

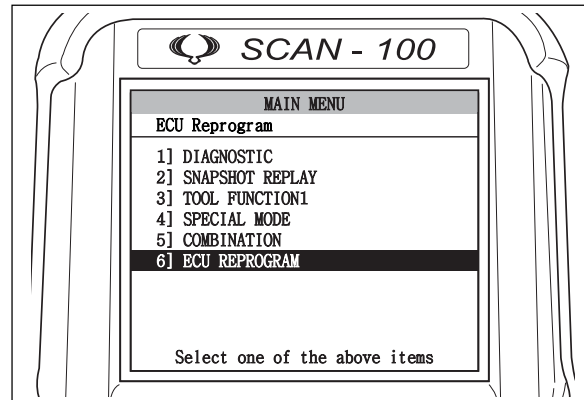
6. ECU Reprogram (SCAN-100 to ECU) - GSL

1. Check the vehicle to be reprogrammed.
2. Connect the SCAN-100 to the diagnostic connector of the vehicle.

1

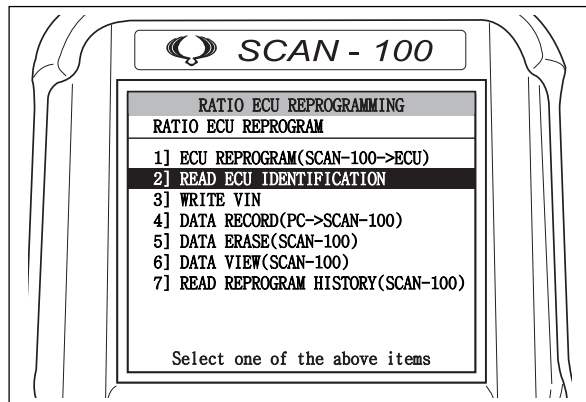


2

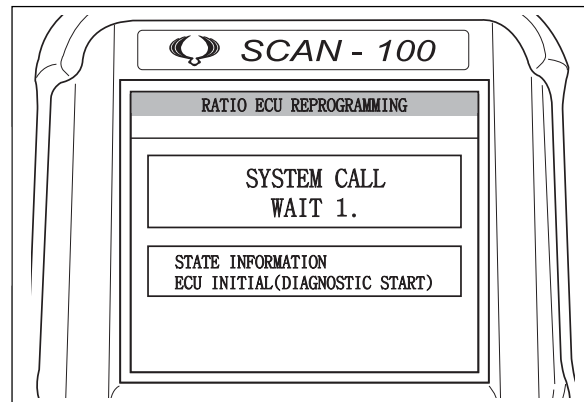


Select "2"

4



3



after 1sec.

Select "6"

Check the "Vehicle Status" is H1 or h1

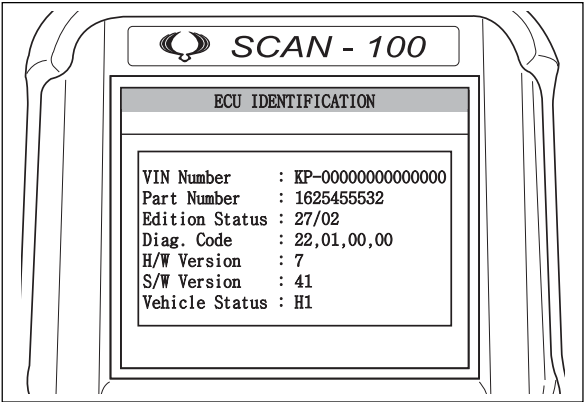
Next page

Next page

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

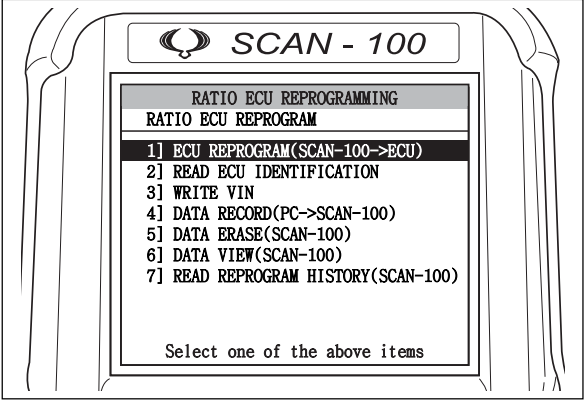
Preceding page

5



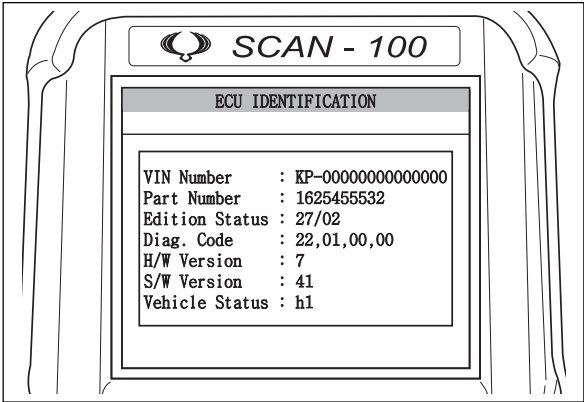
If vehicle status is H1 (Large Alphabet), start reprogram

6



Next page

Preceding page



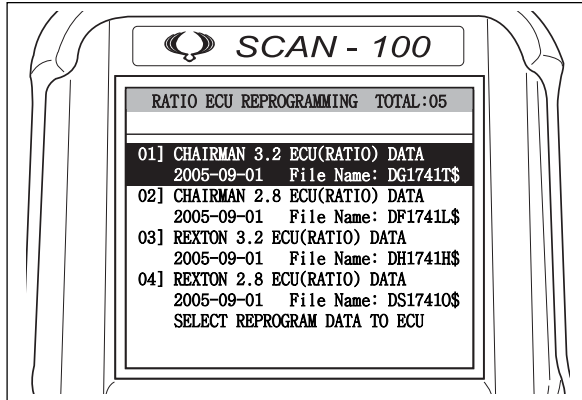
If the vehicle status is h1 (Small Alphabet),

DO NOT REPROGRAM !!!

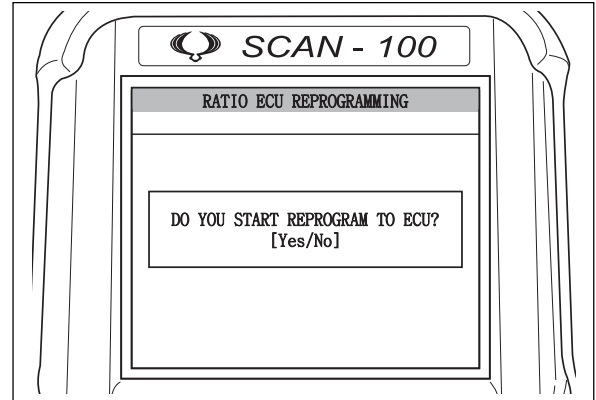
Exit the ECU REPRORGRAMMING
PROCEDURE

Preceding page

7



8

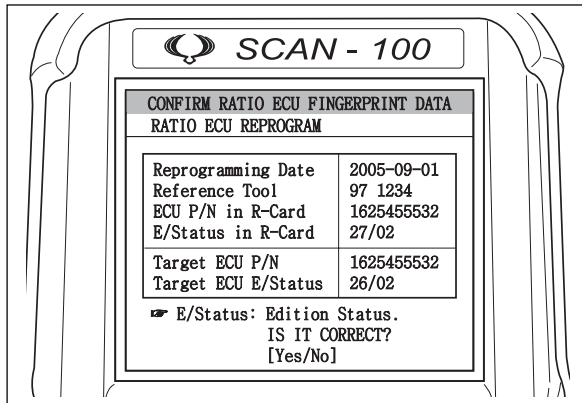


Select
Vehicle

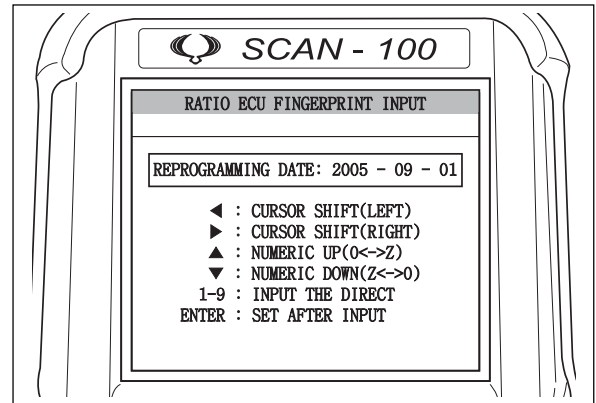
It is possible data scroll using the “▲, ▼” key.
05] MUSSO / KORANDO 3.2 ECU(RATIO)

Select “Yes”

10



9



“ENTER”

Confirm the P/N of ECU and Reprogramming

Input the reprogramming date

Date

ECU P/N	
- CHAIRMAN 2.8	: 162 545 7532
- CHAIRMAN 3.2	: 162 545 7332
- REXTON 2.8	: 162 545 7932
- REXTON 3.2	: 162 545 5532
- MUSSO/KORNAND 3.2	: 162 545 6232

Select “Yes”
Start to Reprogram

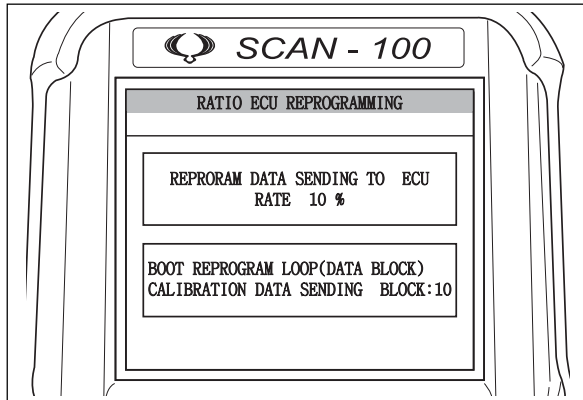
Select “No”
Select the correct ECU version

Next page

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

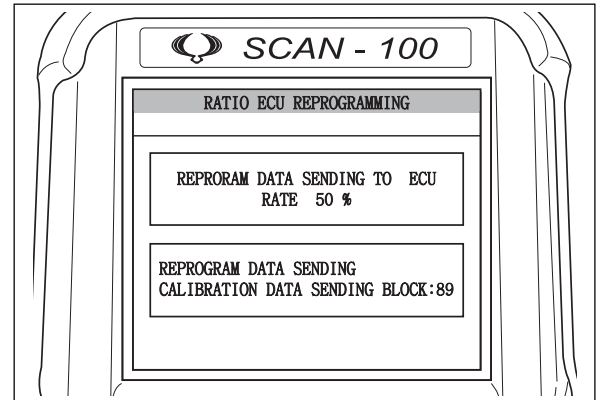
Preceding page

11



(BOOT BLOCK REPROGRAM)

12



(S/W BLOCK REPROGRAM)

After
Finish

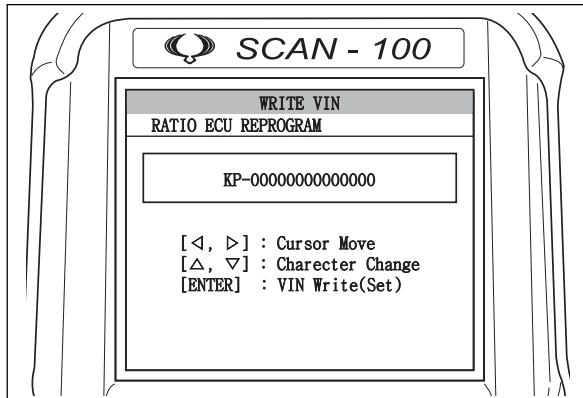


CAUTION

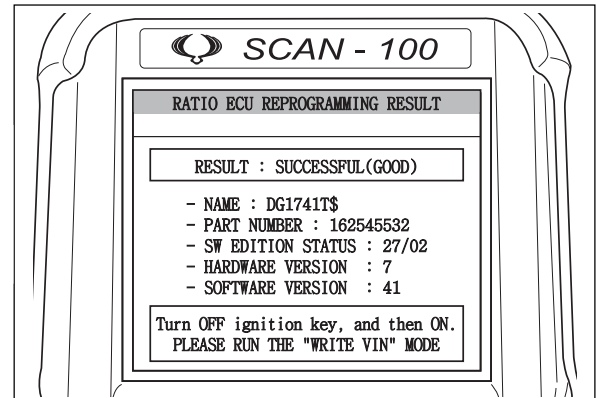
- Take care that do not power off and disconnect the scan tool when the boot block is reprogrammed. Error on boot block lead to replacement the ECU

Reprogram OK

14



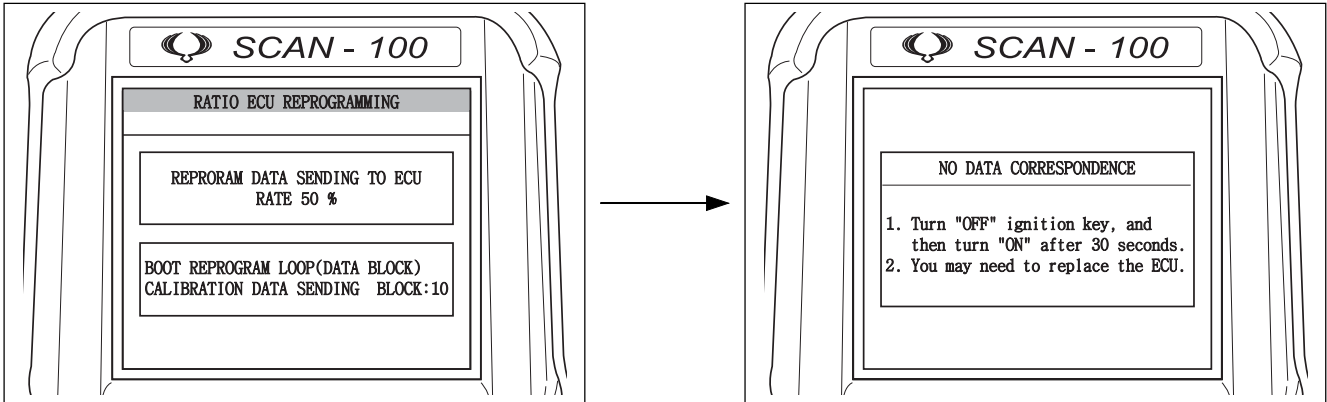
13



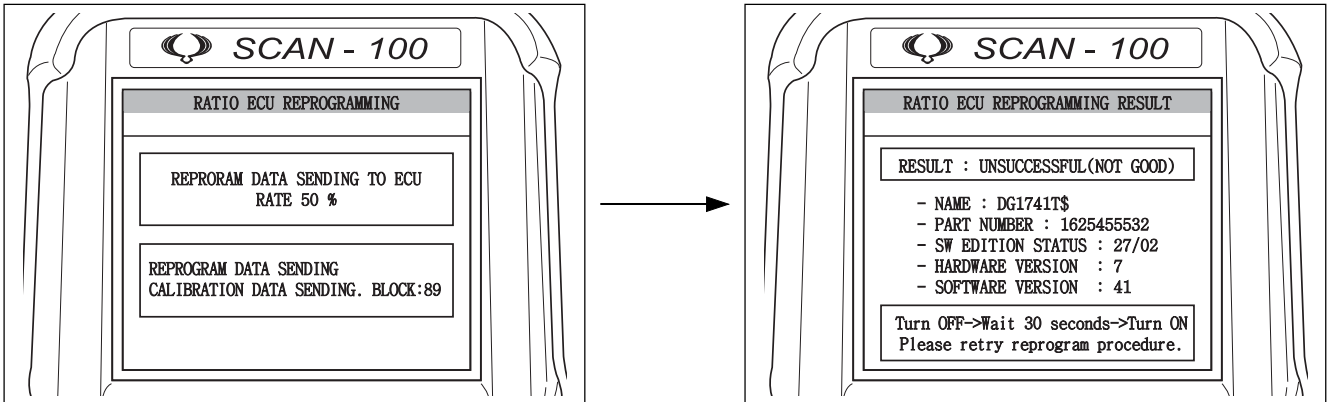
Press Any
Key

In Case of Unsuccessful (Not Good)

CASE 1: Error when “The Boot Block” is reprogrammed.



CASE 2: Error when “The S/W Block” is reprogrammed.

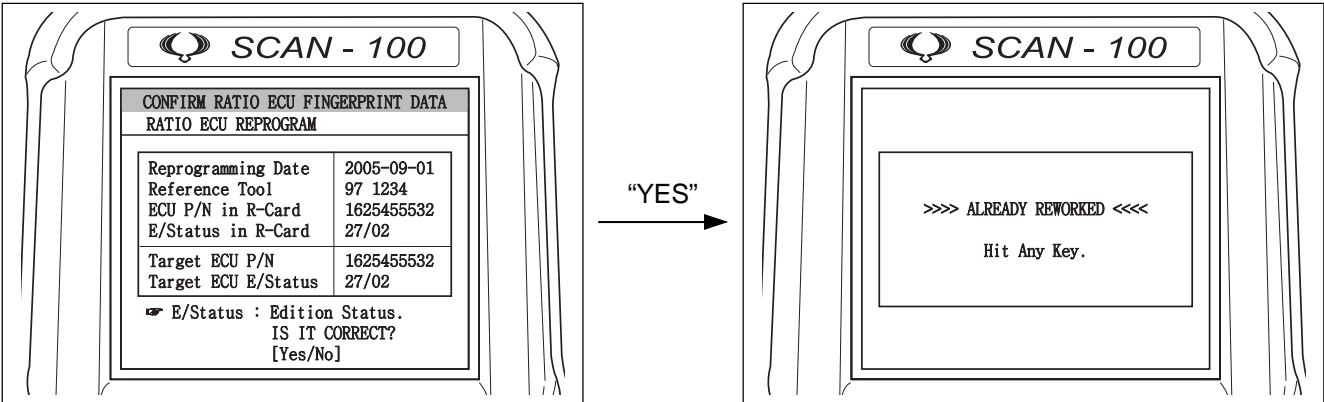


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

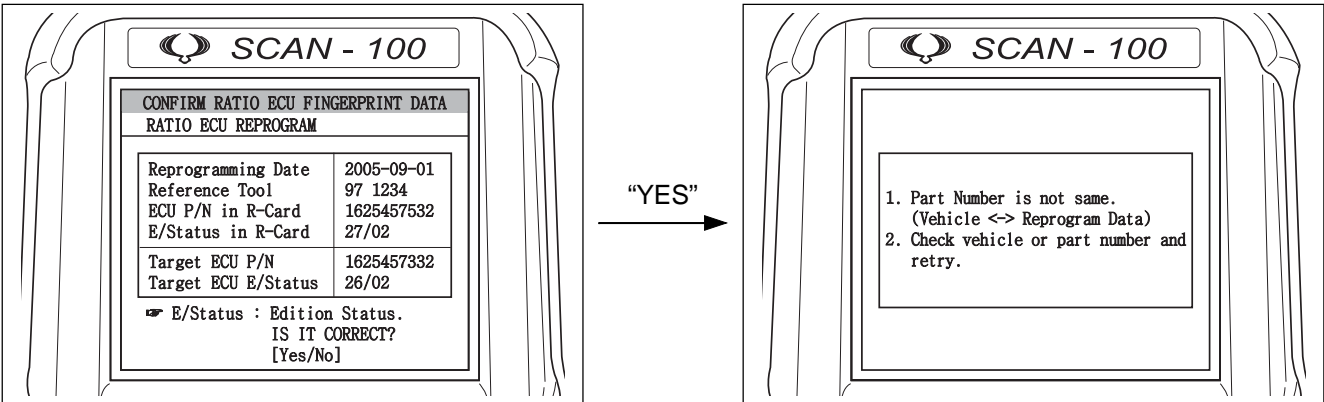
SCAN
ECU
TCU
M/T
TCCU
CLUTCH
BRAKE
A/BAG
A/CON
FFH
RK-STICS
R/SENSOR
S/ROOF

In Case of Reprogram not Allowed.

CASE 1: When ECU is already reprogrammed.



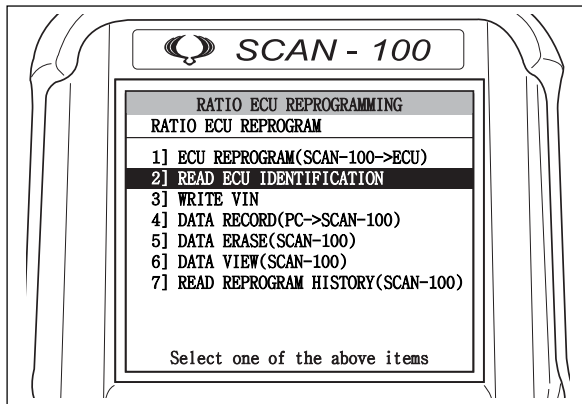
CASE 2: When Part Number(ECU S/W Type) is not same of ECU and selected data.



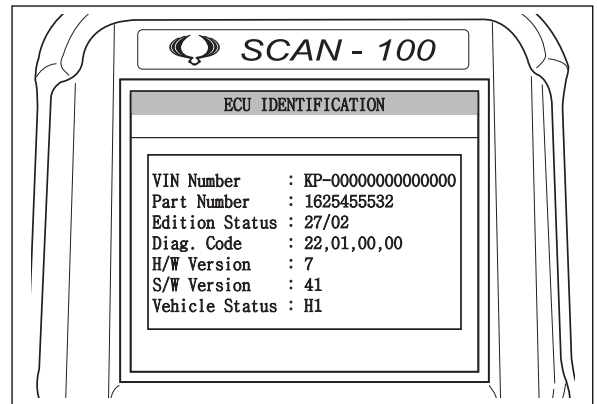
👉 When press “ESC” key, Return to main menu. 👈

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Read ECU Identification



Select "2"



VEHICLE STATUS

- CHAIRMAN 2.8 : F1

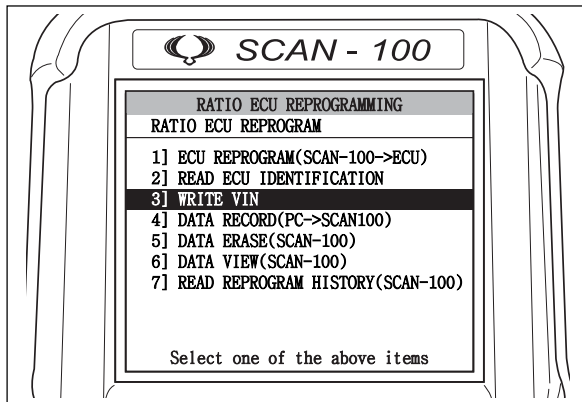
- CHAIRMAN 3.2 : G1

- REXTON 2.8 : I1

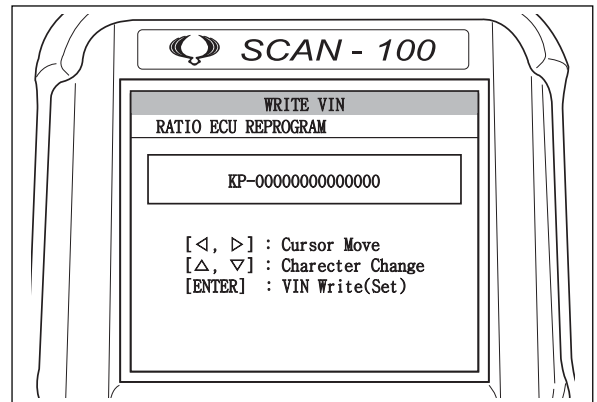
- REXTON 3.2 : H1

- MUSSO/KORNAND 3.2 : S1

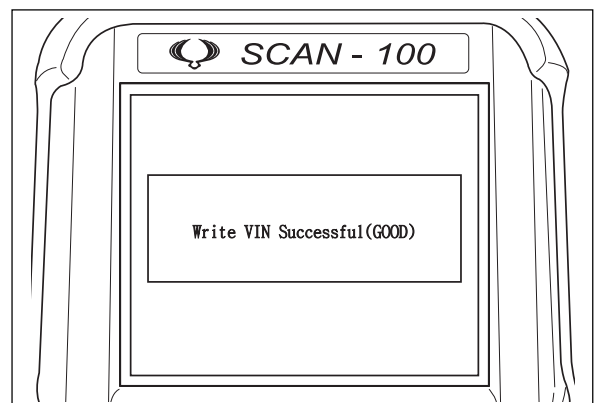
Write VIN



Select "3"



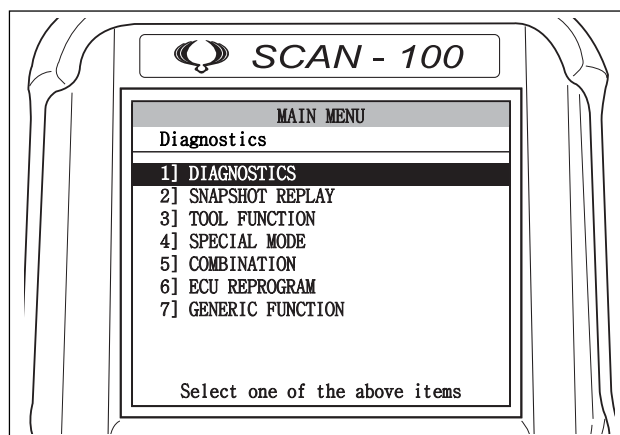
Select "Yes"



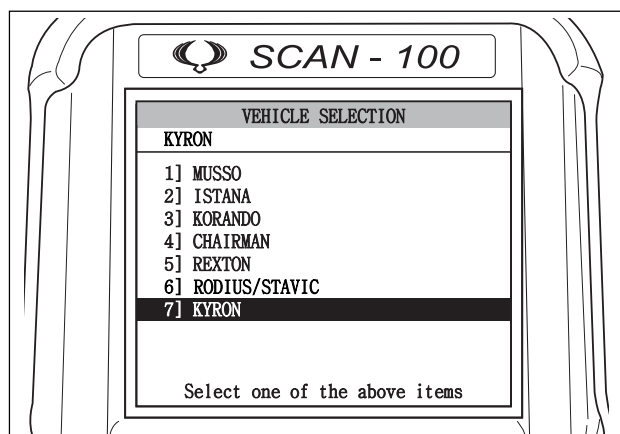
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

ENTERING DIAGNOSIS PROCEDURES

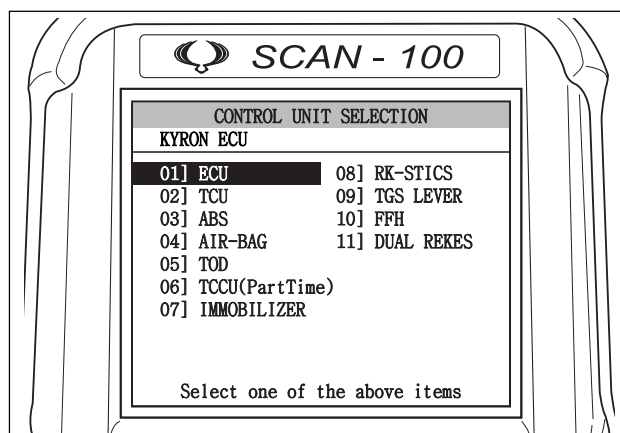
1. Select "1] DIAGNOSIS" and press "ENTER" in "MAIN MENU" screen.



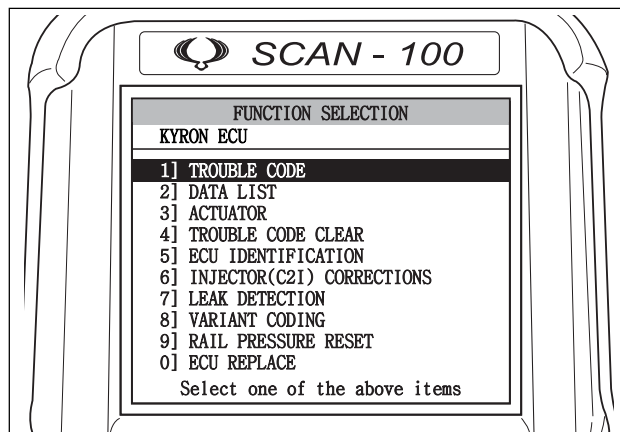
2. Select "7] KYRON" and press "ENTER" in "VEHICLE SELECTION" screen.



3. Select "1] ECU" and press "ENTER" in "CONTROL UNIT SELECTION" screen.



4. The "FUNCTION SELECTION" screen is displayed.



FUNCTION SELECTION

Check the Trouble Code

※ **Preceding Work:** Perform the “Entering Diagnosis Procedures”

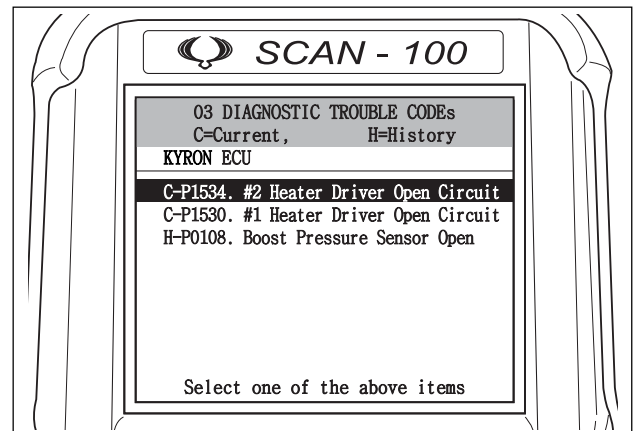
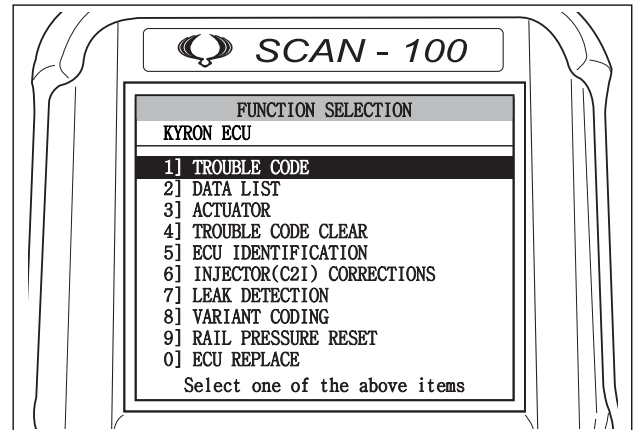
1. Select “1] TROUBLE CODE” and press “ENTER” in “FUNCTION SELECTION” screen.





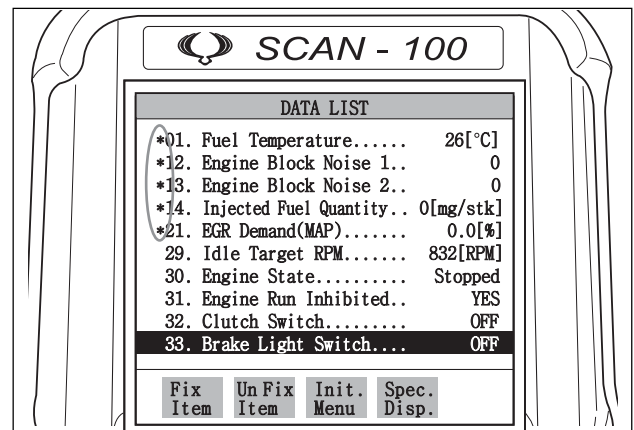
2. The “DIAGNOSTIC TROUBLE CODEs” screen is displayed and it shows the trouble.

NOTE

- If there is not any fault, “NO TROUBLE DETECTED” message appears.



3. When selecting a trouble code, then
 - if you press “”: Displays the sensor data for the detected trouble (Freeze Frame Mode).
 - if you press “”: Displays the help tips for the detected trouble.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

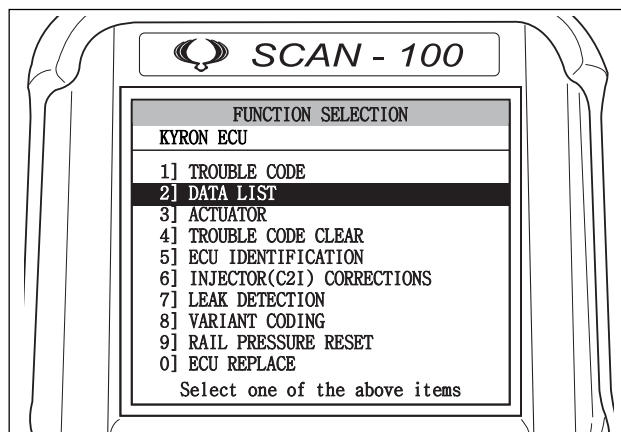
Sensor Data Check


- ※ **Preceding Work:** Perform the “Entering Diagnosis Procedures”

1. Select “2] DATA LIST” and press “” in “FUNCTION SELECTION” screen.



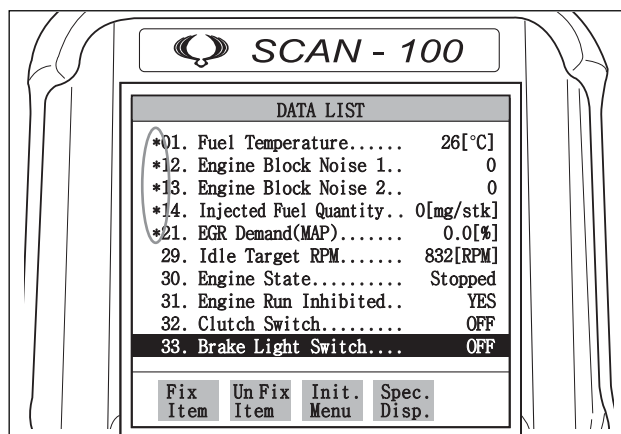
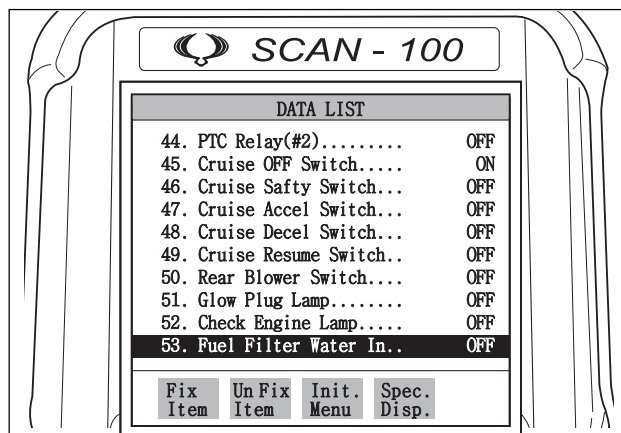
2. The screen shows approx. 58 sensor data.



3. Select the items you want to see and press “” to freeze them.

NOTE

- You can freeze up to 5 items (*: selected items).



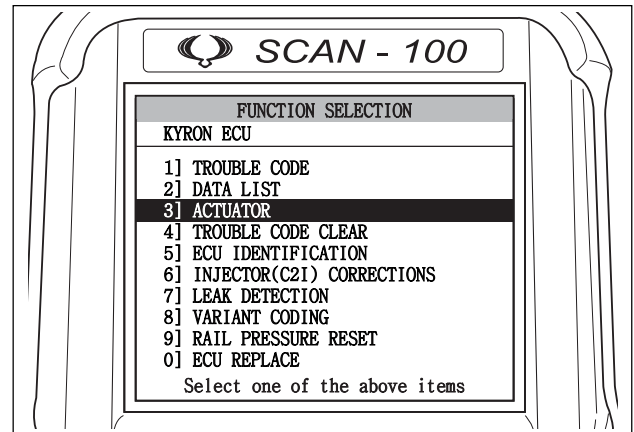
Actuator Check

※ **Preceding Work:** Perform the “Entering Diagnosis Procedures”

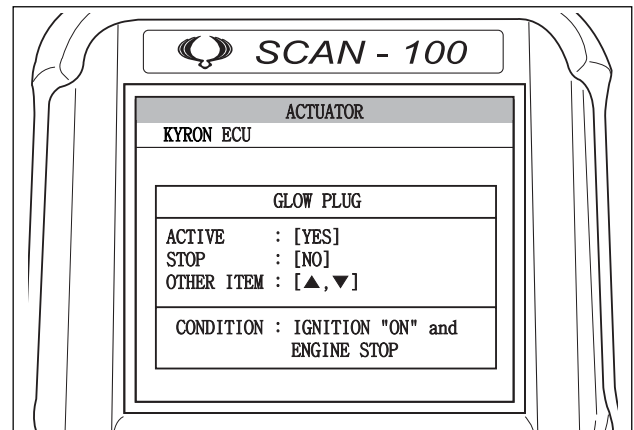
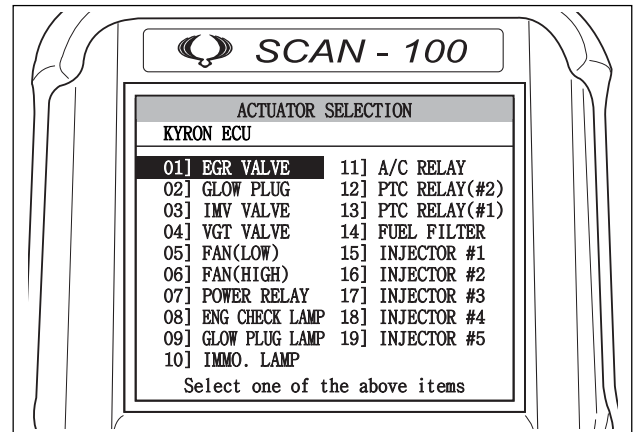
1. Select “3] ACTUATOR” and press “**ENTER**” in “FUNCTION SELECTION” screen.



2. The screen shows 19 items. Select the item you want to see and press “**ENTER**”.

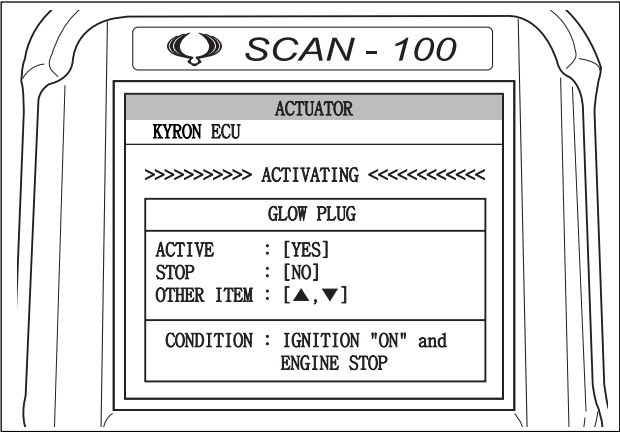


3. For example, if you select “02] GLOW PLUG” item and press “**ENTER**”, the screen as shown in figure is displayed.

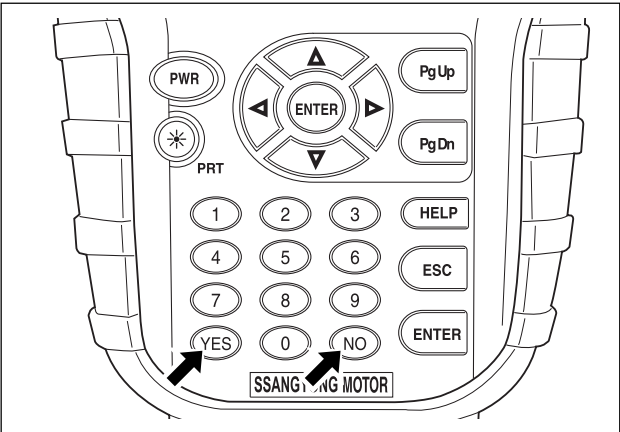


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

4. If you want to operate the glow plug relay, press “YES” key. The “OPERATING” message appears and the relay operation alarm sounds.



5. If you want to stop the operation press “NO” key in keyboard.



Trouble Code Clear

※ **Preceding Work:** Perform the “Entering Diagnosis Procedures”

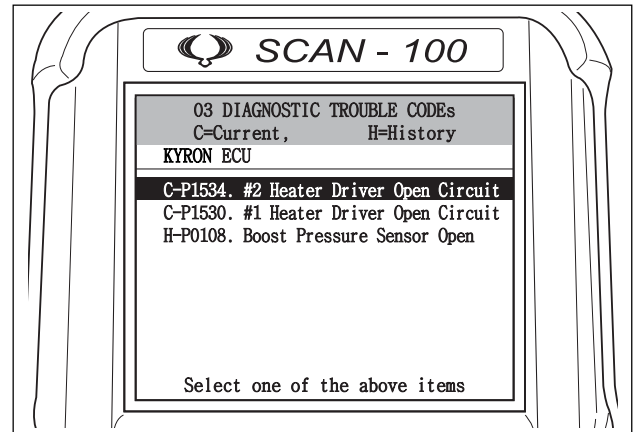
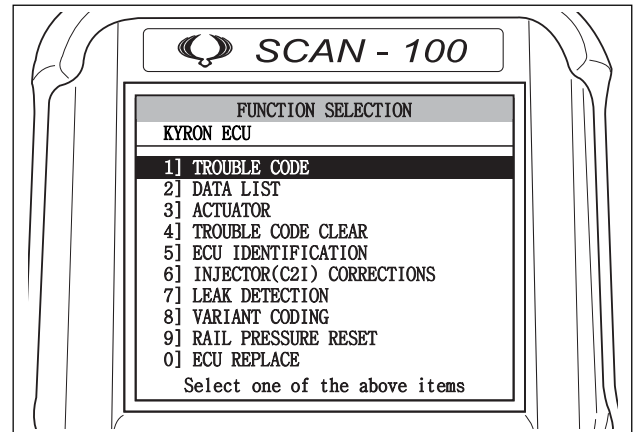
1. Select “1] TROUBLE CODE” and press “ENTER” in “FUNCTION SELECTION” screen.



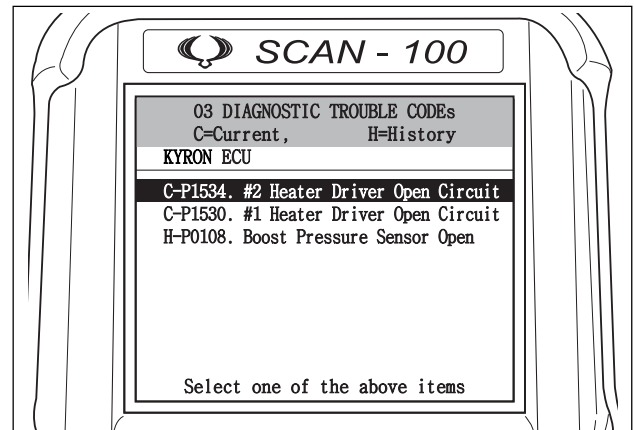
2. The “DIAGNOSTIC TROUBLE CODEs” screen is displayed and it shows the trouble.

NOTE



- C = Current trouble, H = History trouble

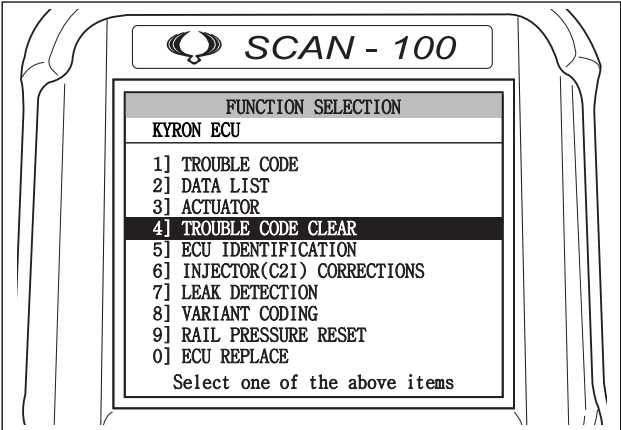



3. Fix the trouble and go back to “1] TROUBLE CODE” screen and check if the trouble has been changed to “H (History trouble code)” code.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

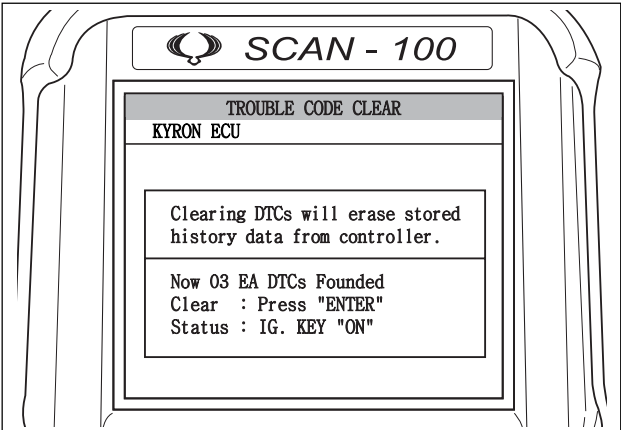
4. If the trouble has been change to “H (History trouble code)” code, press “” key to go back to “FUNCTION SELECTION” screen. In this screen, select “4] TROUBLE CODE CLEAR” and press “”.



5. The “TROUBLE CODE CLEAR” screen is displayed. If you press “”, only the history trouble codes will be cleared.

NOTE

- Current trouble codes will not be cleared.
- Check the trouble codes after clearing the trouble codes.



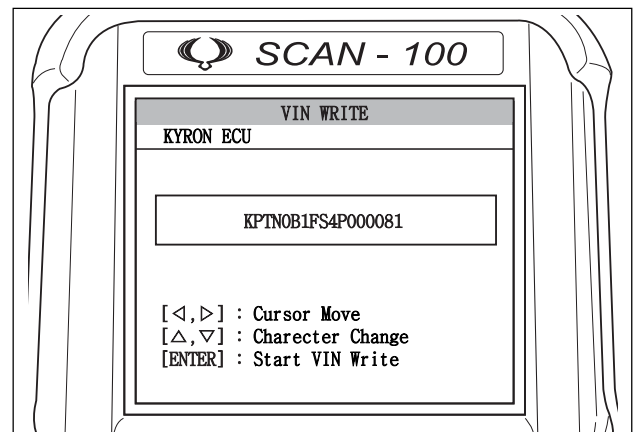
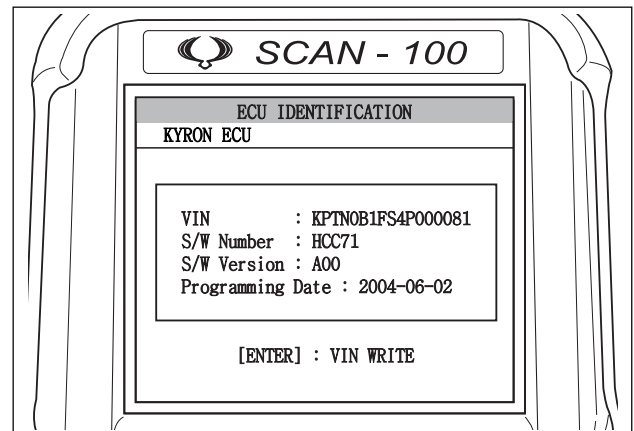
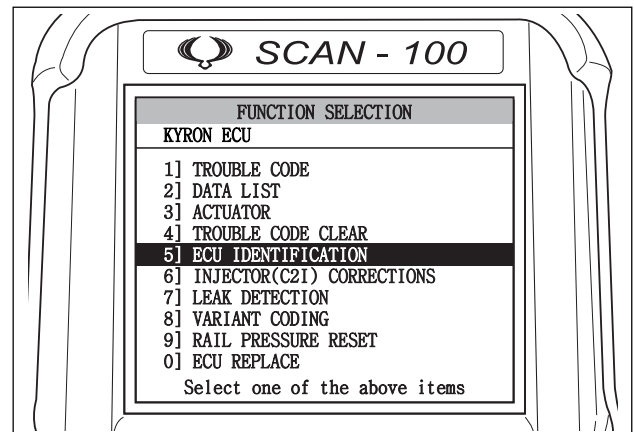
ECU Identification

※ **Preceding Work:** Perform the “Entering Diagnosis Procedures”

1. Select “5] ECU IDENTIFICATION” and press “**ENTER**” in “FUNCTION SELECTION” screen.

2. The “ECU IDENTIFICATION” screen that shows the VIN, ECU software number, ECU software version and programming date is displayed.

3. If you replaced the ECU, press “**ENTER**” to input the vehicle identification number.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Injector (C2I) Corrections

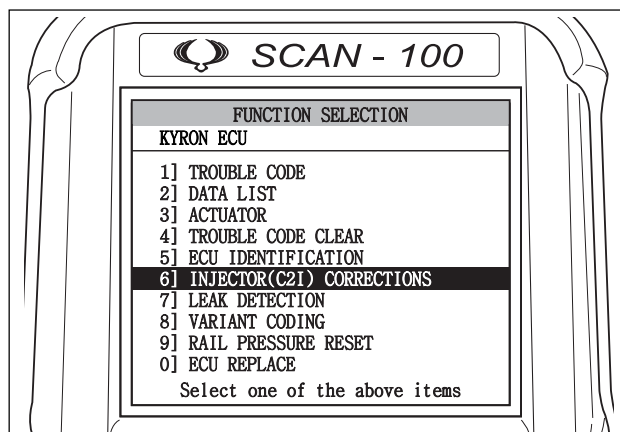
※ **Preceding Work:** Perform the “Entering Diagnosis Procedures”



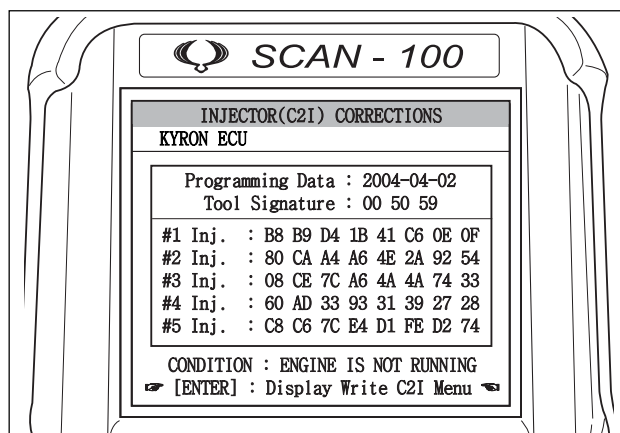
NOTICE

- If the injector/ECU has been replaced or the injector system defective is suspected, go to C2I Coding item and check the injector and coded injector C2I value.

1. Select “6] INJECTOR (C2I) CORRECTIONS” and press “ENTER” in “FUNCTION SELECTION” screen.



2. The “INJECTOR (C2I) CORRECTIONS” screen that shows current C2I coding values of #1 to #5 injector is displayed.
3. If you replaced the ECU, enter the C2I value of the relevant injector.




NOTE

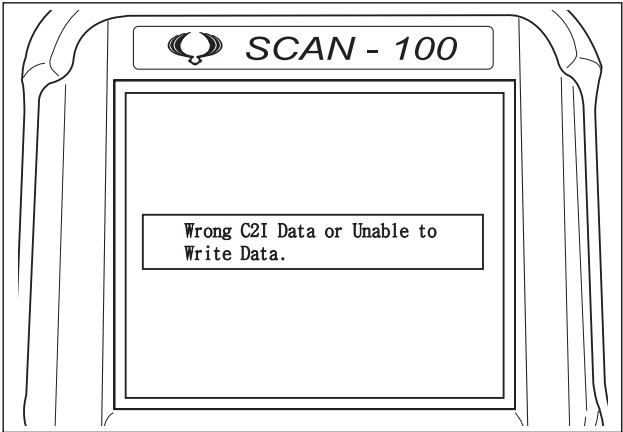
- The C2I value of replacing injector is recorded in the label.
- C2I coding number: 16 digits (ex, B1 B9 D4 1B 43 C6 0E 4F)



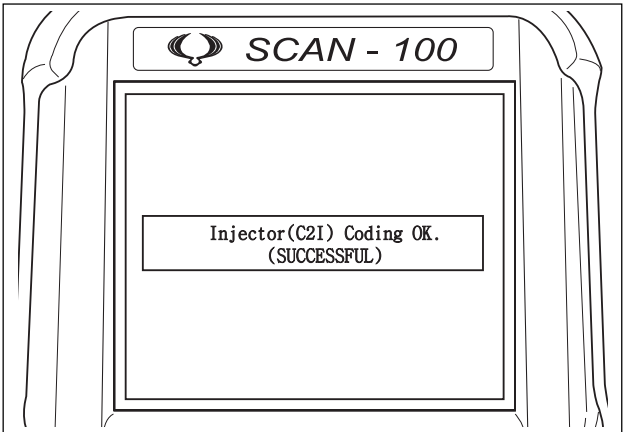
- 1) If you enter the invalid C2I value of the relevant injector, the message as shown in figure appears with alarm sound.

NOTE

- If you want to go back to previous screen, press “” key. You can see the previous C2I value.



- 2) If you enter the valid C2I value of the relevant injector, the message as shown in figure appears with alarm sound.



SCAN
ECU
TCU
M/T
TCCU
CLUTCH
BRAKE
A/BAG
A/CON
FFH
RK-STICS
R/SENSOR
S/ROOF

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Leak Detection

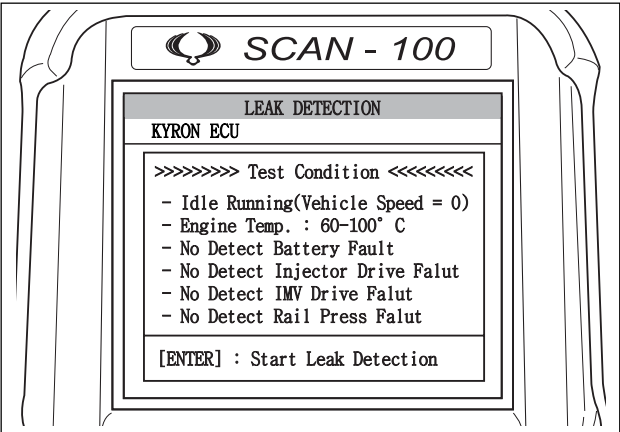
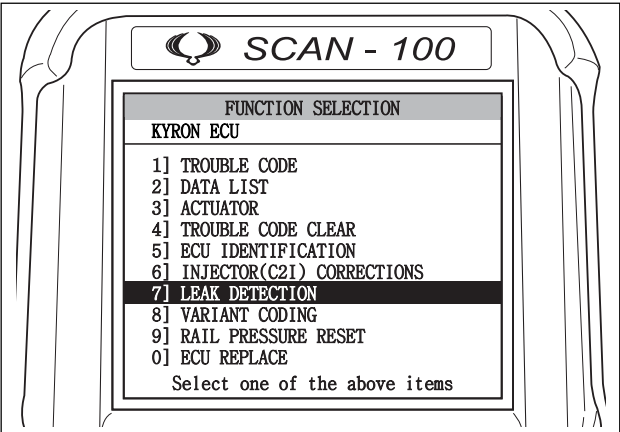
※ **Preceding Work:** Perform the “Entering Diagnosis Procedures”

NOTE

- This item is for checking the high fuel pressure after the IMV supply line of HP pump in DI engine fuel system. If you still suspect that the fuel pressure system is defective even after no trouble is detected, perform the fuel pressure test again by using a fuel pressure tool kit.

1. Select “7] LEAK DETECTION” and press “ENTER” in “FUNCTION SELECTION” screen.

2. The “LEAK DETECTION” screen that shows the checking conditions as shown in figure is displayed.



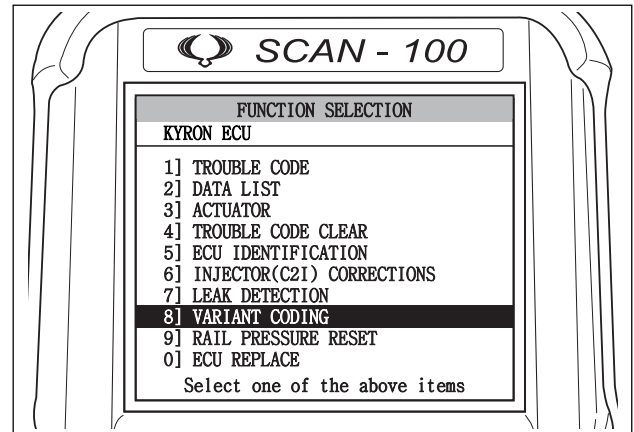
Variant Coding

※ **Preceding Work:** Perform the “Entering Diagnosis Procedures”

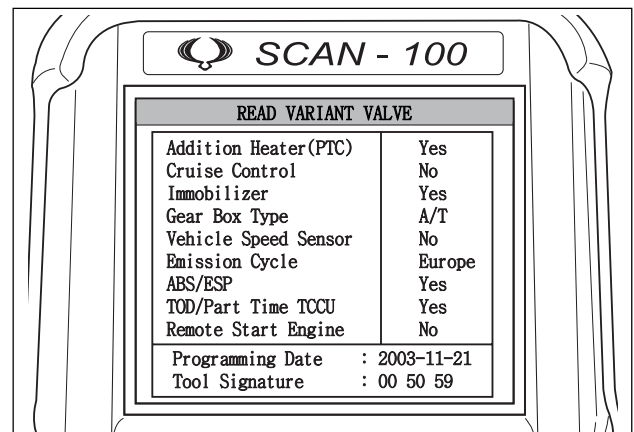
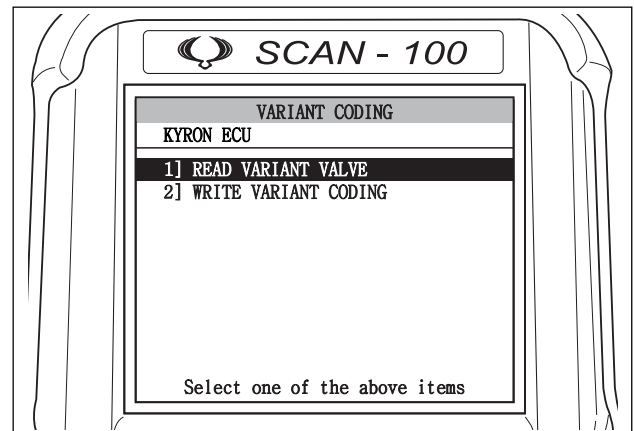
1. Select “8] VARIANT CODING” and press “ENTER” in “FUNCTION SELECTION” screen.



2. When the “VARIANT CODING” screen is displayed, select “1] READ VARIANT VALUE” and press “ENTER”.













3. The “VARIANT CODING” screen that shows currently equipped devices is displayed.




CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

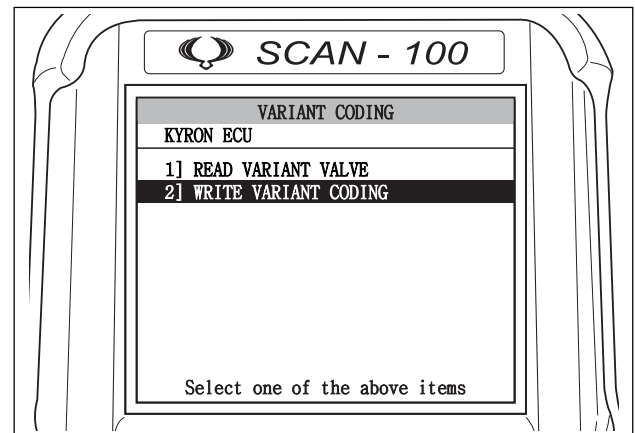
Engine Related Coding Item

Variant Coding Item	Selection	Description
ECU coding completed	NO/YES	"  is automatically selected.
Supplementary heater (PTC)	NO/YES	Select "  only for the vehicle with PTC type supplementary heater (in DI engine).
Auto cruise	NO/YES	Select "  only for the vehicle with auto cruise system.
Immobilizer	NO/YES	Select "  only for the vehicle with immobilizer system.
Remote starter	NO/YES	No remote starter system is applied to this model. However, must select "  to confirm that this vehicle doesn't have remote starter.
Vehicle speed sensor	NO/YES	Select "  for the vehicle without ABS or ESP system (conventional brake system).
ABS or ESP	NO/YES	Select "  only for the vehicle with ABS or ESP system.
Part time TC (4WD)	NO/YES	Select "  only for the vehicle with part time TC system.
Air conditioner	NO/YES	Select "  only for the vehicle with A/C system.
Neutral signal input (M/T "N" signal)	NO/YES	Select "  only for the vehicle with M/T neutral switch.

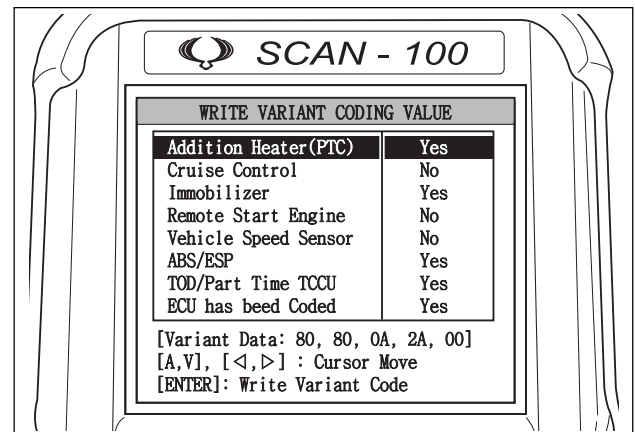
Chassis Related Coding Item

Variant Coding Item	Selection	Description
DOM/EXP	DOM/GENERAL/EU	Select the region.
Selector lever	BTRA/DC LEVER/DURA LEVER	Select the appropriate selector lever. (For DI engine equipped vehicle, select "DC LEVER")
EBS	NA/ABS/TCS/ESP	Select the appropriate system.
SSPS	NO/YES	Select "  only for the vehicle with ECPS system.
Transfer case (4WD)	NA/TOD/PT 4WD/AWD/PT 4WD (W/O 4L)	Select the appropriate system.
Transmission	MT/DC5AT/BTRAAT	Select the appropriate system.
Sedan/Limousine	SEDAN/LIMOUSINE	Select "SEDAN" - Automatic coding.
Vehicle type	KYRON	Select "KYRON" - Automatic coding.
Engine model	D20DT	Select the appropriate engine.
Coding	CODING COMPLETED	Select the coding status.

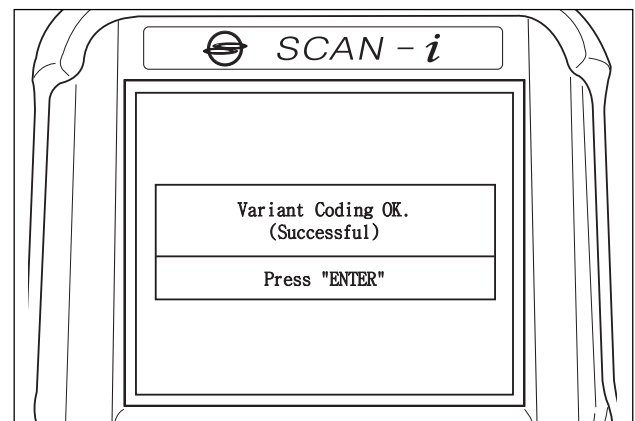
4. If you need to change the variant coding, press “**ESC**” key to go back to “VARIANT CODING” screen. In the screen, select “2] WRITE VARIANT CODING” and press “**ENTER**”.



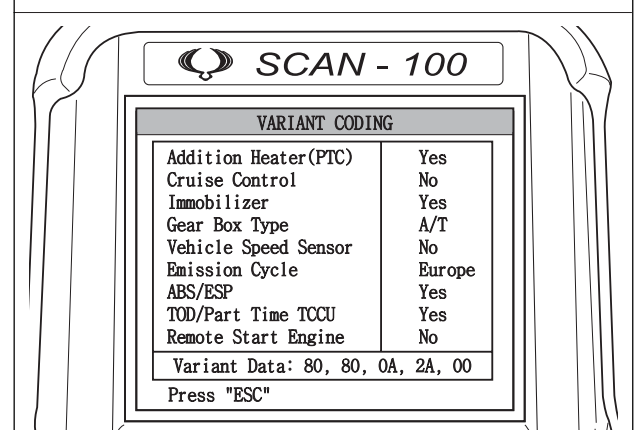
5. When the “WRITE VARIANT CODING VALUE” screen is displayed, change the item by using arrow keys.



6. If you press “**ENTER**”, the message as shown in figure appears. And, then “VARIANT CODING” screen is displayed.



7. Select “READ VARIANT VALUE” to see the coding coded value.

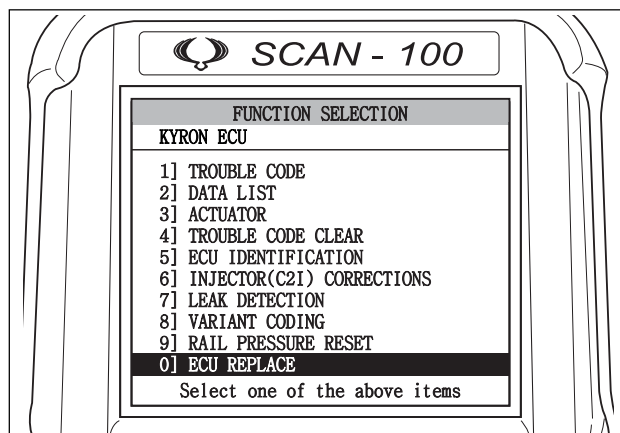


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

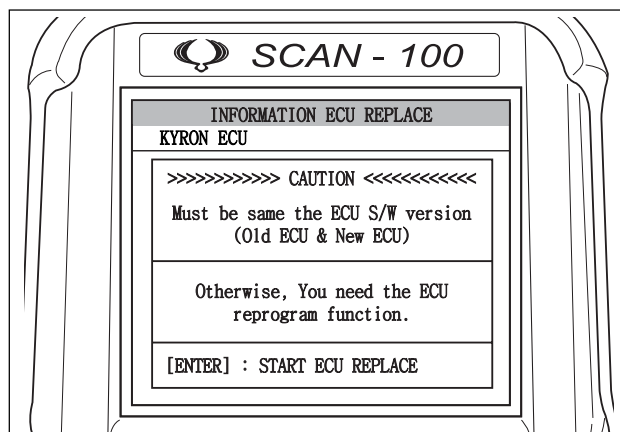
ECU Replace

※ **Preceding Work:** Perform the “Entering Diagnosis Procedures”

1. Select “0] ECU REPLACE” and press “**ENTER**” in “FUNCTION SELECTION” screen.



2. Before starting ECU replace, check the ECU S/W version of old ECU and new ECU.

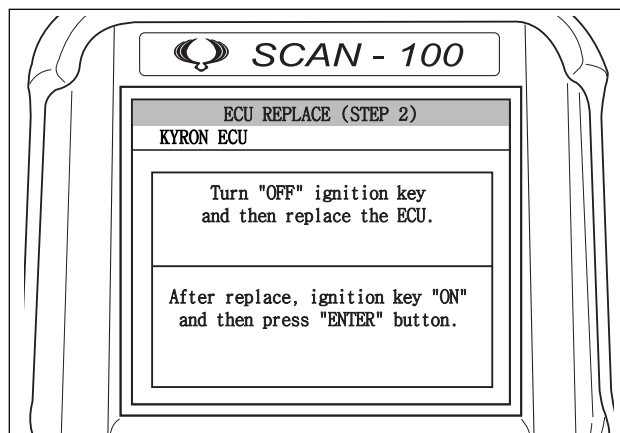


3. When the “ECU REPLACE (STEP 2)” screen is displayed followed by “ECU REPLACE (STEP 1)” screen, turn the ignition “OFF” and remove the currently installed ECU.

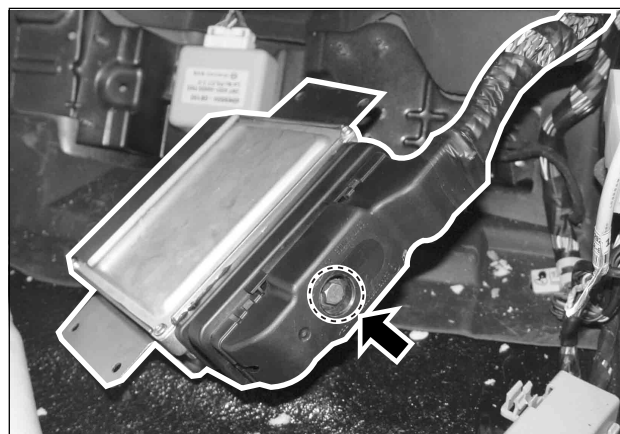


NOTICE

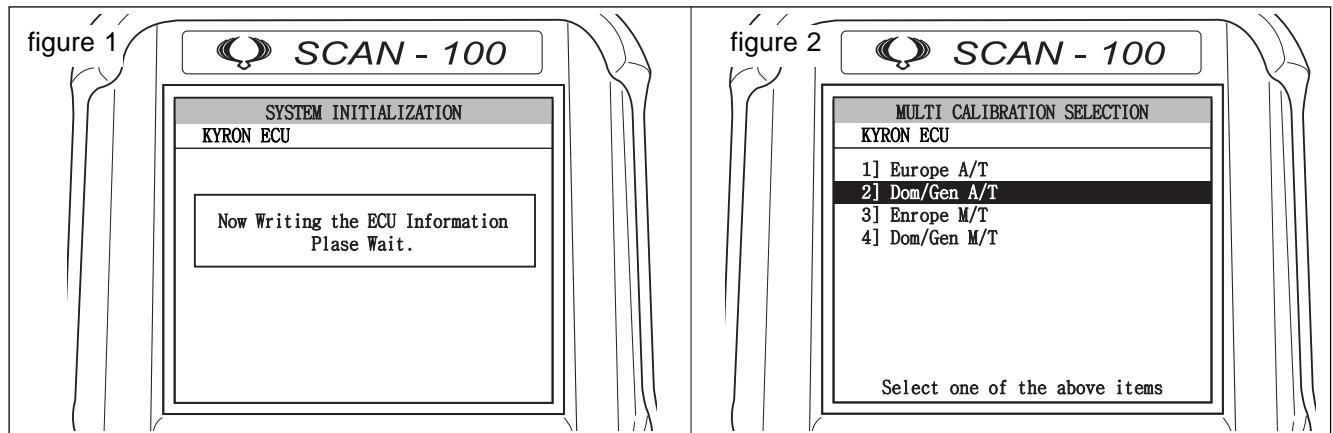
- Do not turn off the Scan-100 at this time.
- Record the below data:
 - 1) Vehicle identification number
 - 2) Variant coding value
 - 3) C2I coding value
 - 4) Multi calibration



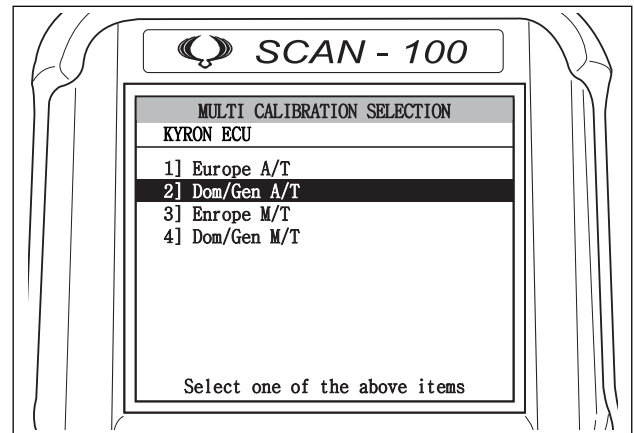
4. Install the new ECU.



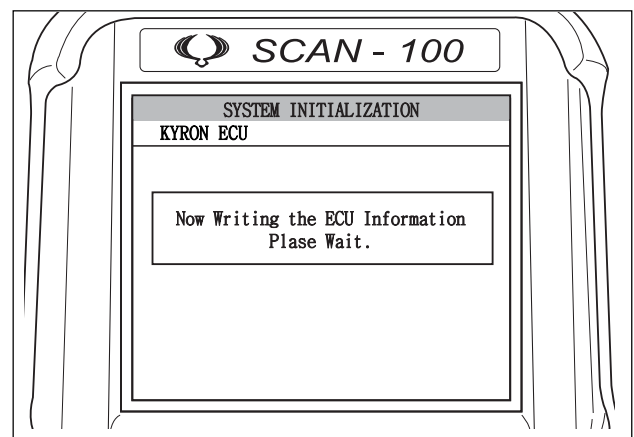
4. If you turn the ignition switch to “ON” position and press “**ENTER**”, the message as shown in figure 1 (system initialization) appears, and then “MULTI CALIBRATION” screen (figure 2) is displayed.



5. In “MULTI CALIBRATION” screen, select the relevent model.



6. When you press “**ENTER**”, the processing message as shown in figure appears.

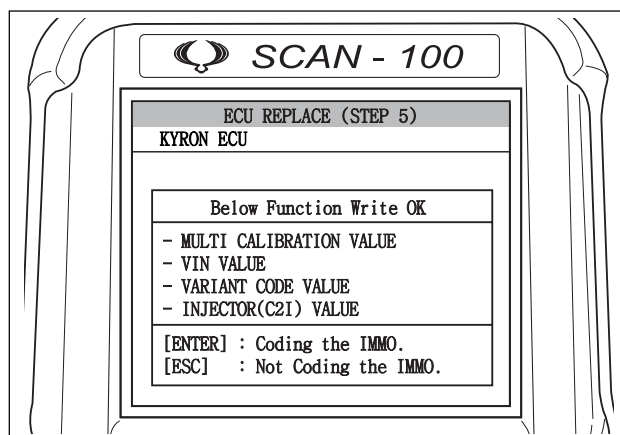


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

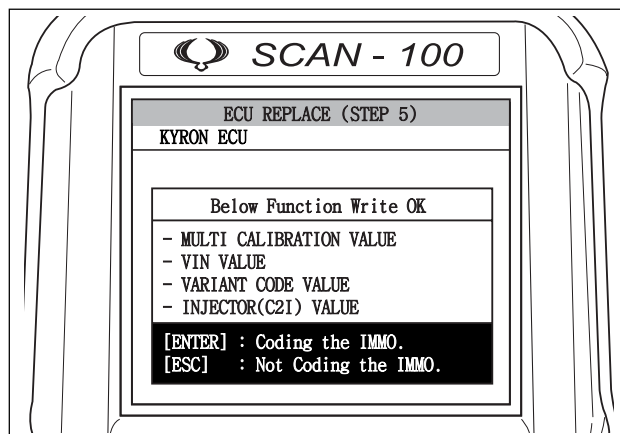
7. If the multi calibration is completed successfully, “ECU REPLACE (STEP 5)” screen is displayed.

Backup data:

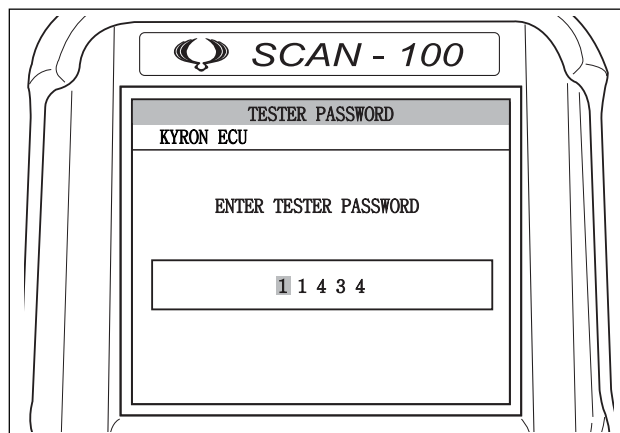
- 1) Multi calibration value
- 2) VIN value
- 3) Variant code value
- 4) Injector (C2I) value



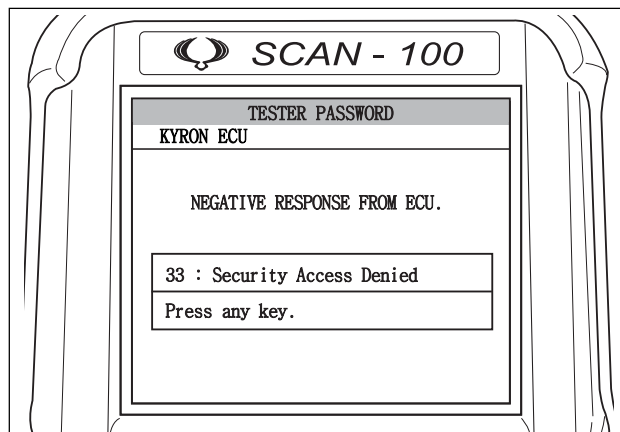
8. In immobilizer equipped vehicle, the immobilizer coding should be done after completed the multi calibration.



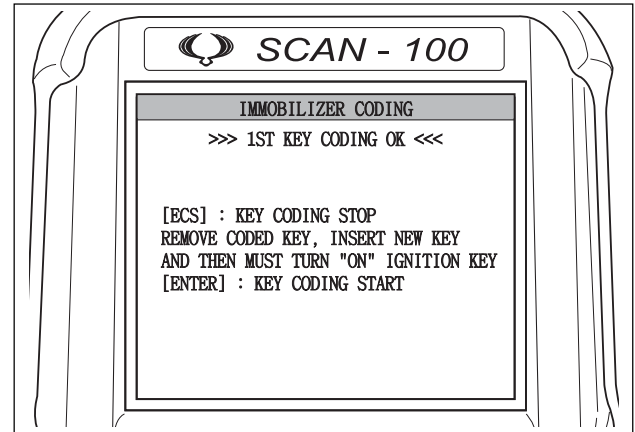
9. Press “” and enter the user password.



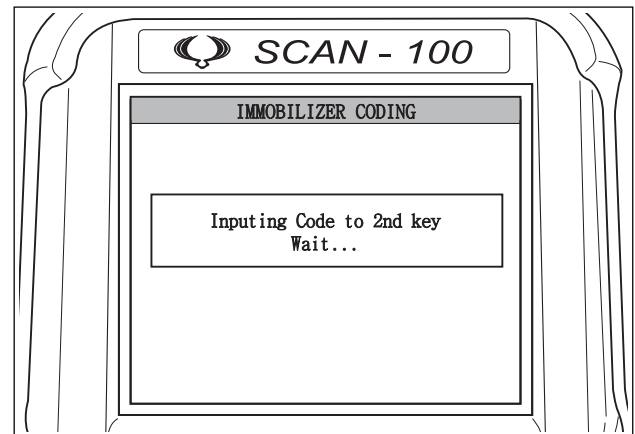
10. If the password is invalid, the “access denied” screen as shown in figure is displayed.



11. If the password is valid, an immobilizer coding is started.

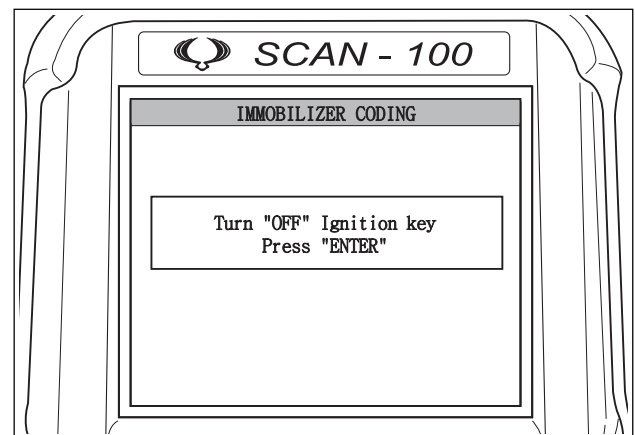


12. If you want to code for additional keys, remove the first key from key switch and insert the second key. Turn it to "ON" position and press "ENTER" to proceed.



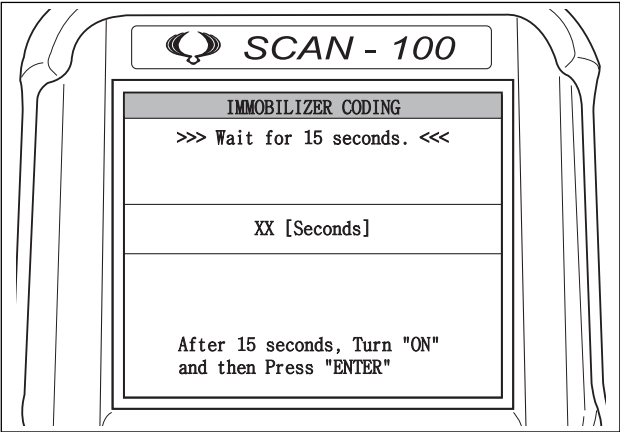
13. You can code up to five keys with same manner.

14. When the immobilizer coding is completed, press "ESC". The completion message as shown in figure appears.

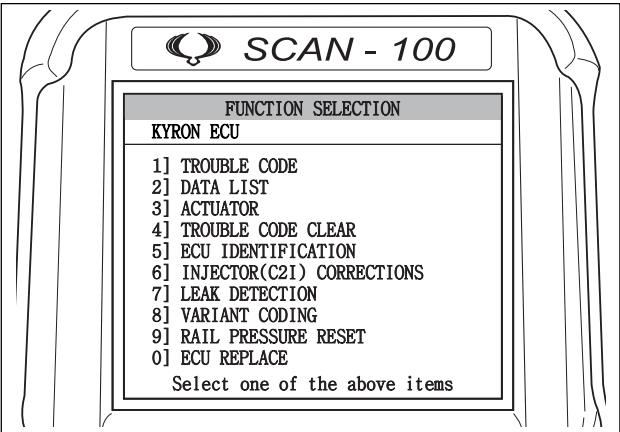


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

15. When you turn the ignition key to “OFF” position, the message screen as shown in figure is displayed. Wait for 15 seconds and turn the ignition key to “ON” position.



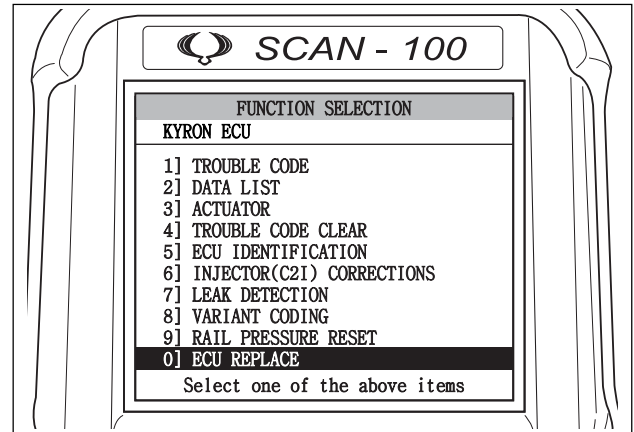
16. Press “ENTER” to return to “MAIN MENU” screen.



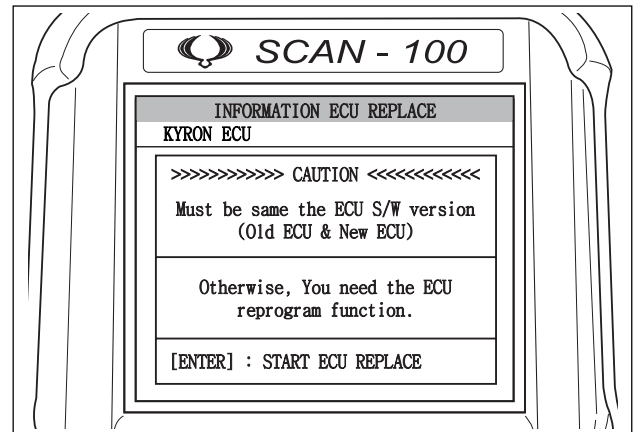
ECU Replace (Scan-100 Communication is not available)

If the Scan-100 communication is not available due to ECU failure, replace the ECU as follows.

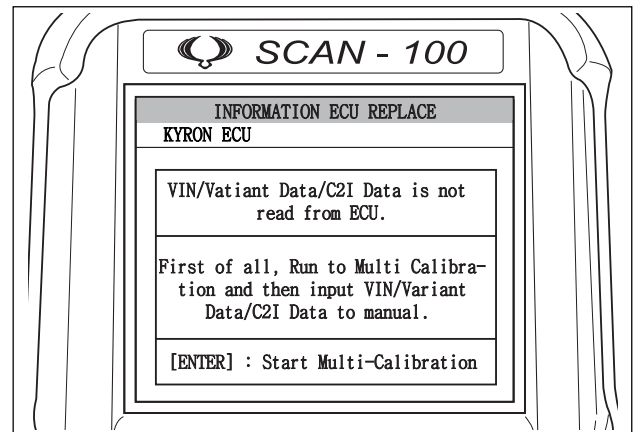
1. Replace the ECU with new one.
2. Select "0] ECU REPLACE" and press "ENTER" in "FUNCTION SELECTION" screen.



3. If the versions of ECUs are not matched, program the new ECU after replacement.

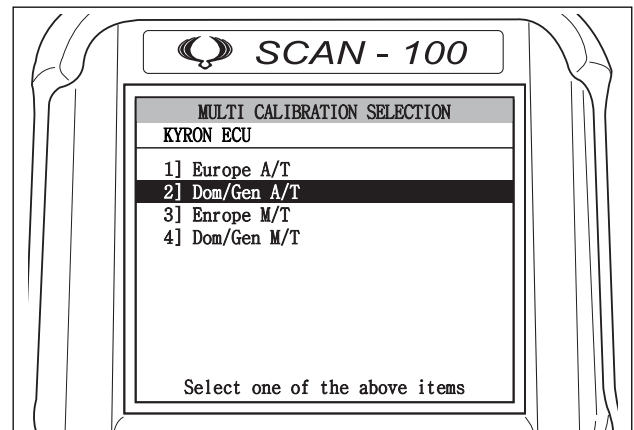


4. VIN/Variant Data/C2I Data is not read from ECU. Press "ENTER" to run the multi calibration.



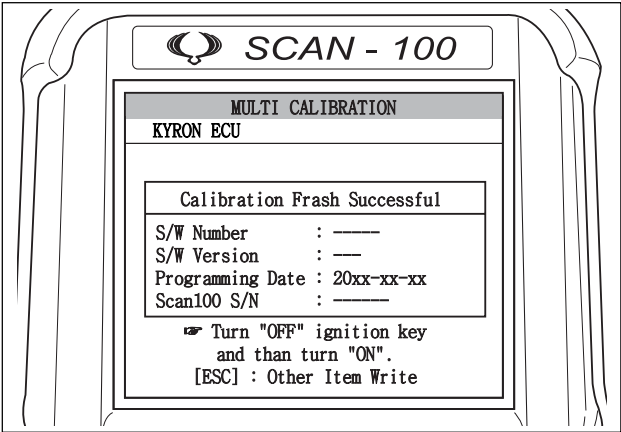
5. Select the appropriate model in "MULTI CALIBRATION SELECTION" screen.

- 1) Vehicle with A/T: 2] Dom/Gen A/T
- 2) Vehicle with M/T: 4] Dom/Gen M/T

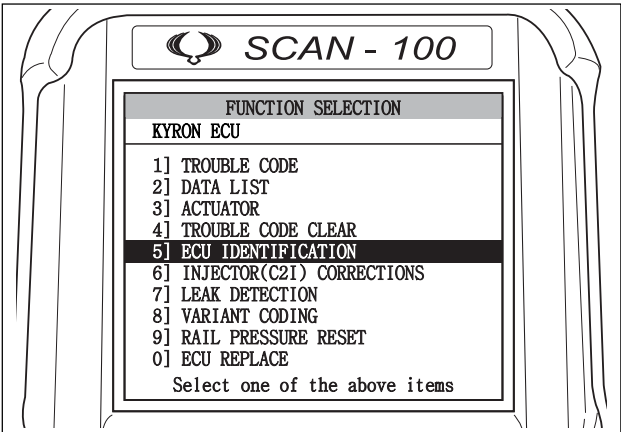


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

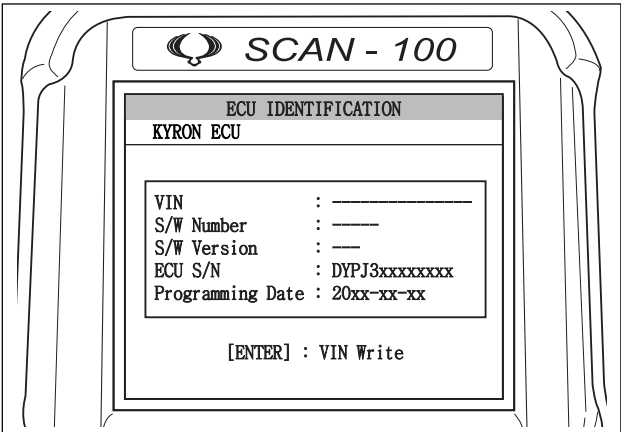
- 6. If the multi calibration is completed successfully, the message screen shown in the figure is displayed.
- 7. The VIN/Variant Data/C21 Data should be input manually.



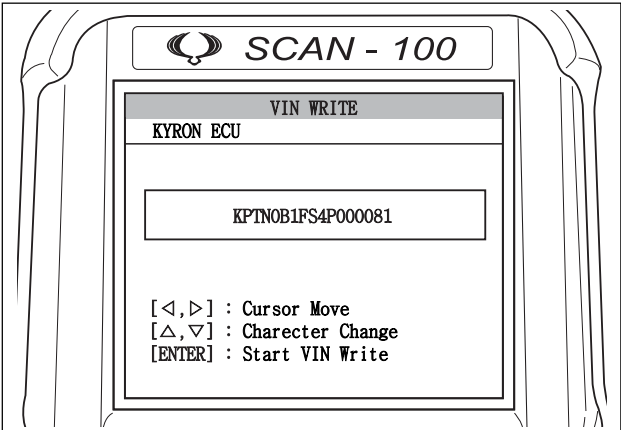
- 8. To enter the data, press “ESC” on the screen in Step 5 and go back to main screen.
- 9. To enter the VIN, select “5] ECU IDENTIFICATION” and press “ENTER”.



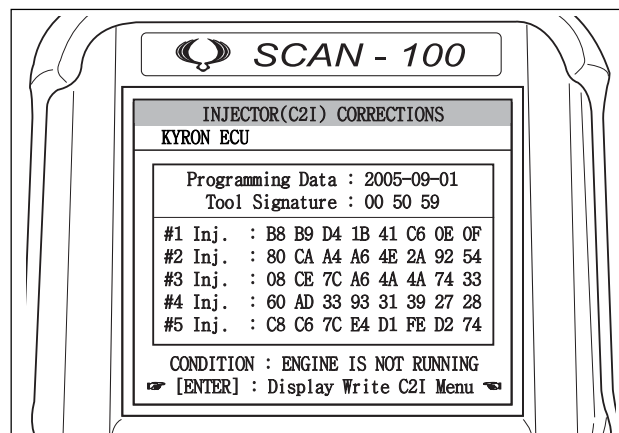
- 10. Press “ENTER” and enter the VIN again.



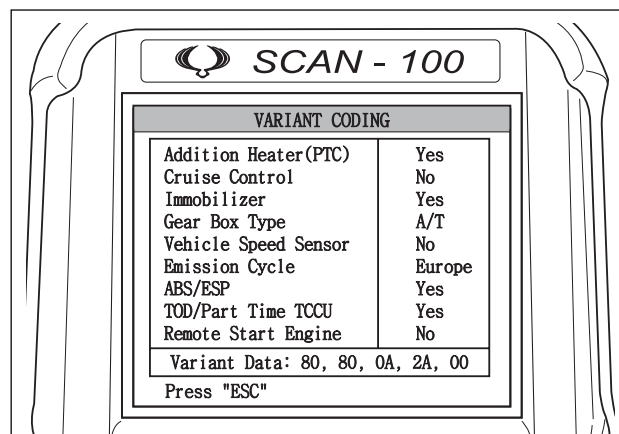
- 11. Enter the VIN into the number plate on the screen. To change the number to the character, use the arrow keys.



12. Select "6] INJECTOR (C2I) CORRECTIONS" and press "ENTER" in "FUNCTION SELECTION" screen. Remove the engine acoustic cover and enter the 16 digits code on each injector label for all of five injectors. If any of digits is wrong, you should enter full code again. Make sure that the VIN code is correct. The nearest injector from the radiator is number 1 and the number goes higher as it moves away.



13. Select "8] VARIANT CODING" and press "PRESS" in "FUNCTION SELECTION" screen. When the "VARIANT CODING" screen is displayed, select "2] WRITE VARIANT CODING" and press "PRESS". When the "WRITE VARIANT CODING" screen is displayed, change the item by using arrow keys.



SCAN

ECU

TCU

M/T

TCCU

CLUTCH

BRAKE

A/BAG

A/CON

FFH

RK-STICS

R/SENSOR

S/ROOF

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Rail Pressure Reset

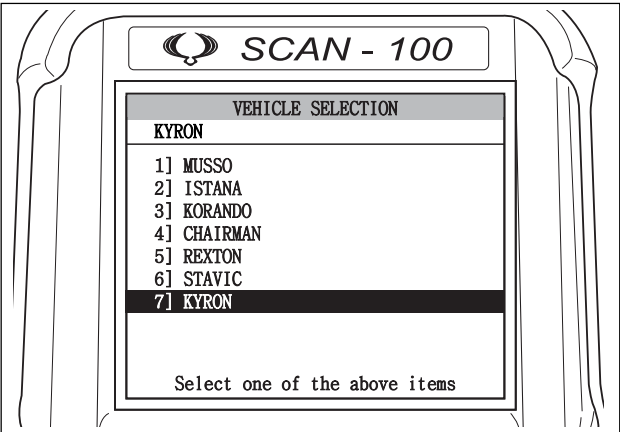
Rail Pressure Reset Procedures

The engine ECU needs a specific amount of fuel according to the fuel supply lines and vehicle driving conditions. However, if the fuel supply (pressure) is not achieved due to, for instance, defective fuel system, ECU designates the offset value to the high pressure pump to compensate it.

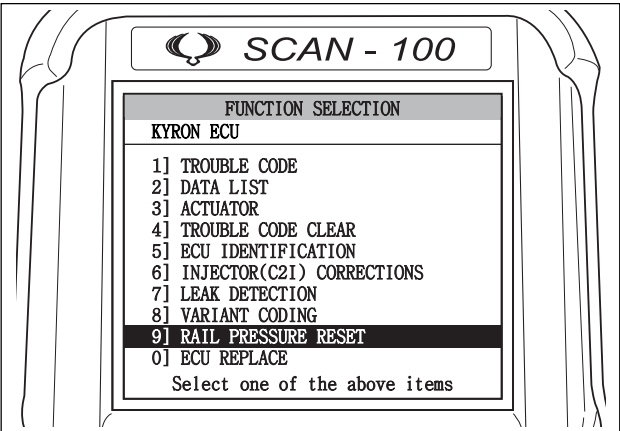
The fuel supply pressure varies according to the offset value and the engine output could be decreased due to this variation. When the engine output decreases, check whether all rail pressure offset values is set to 0 in the Rail Pressure Reset screen in SCAN-100. If the setting value is not 0, measure the fuel pressure with a tester. If any defective is found, repair the affected components and reset the rail pressure offset value to 0.

The rail pressure reset procedures should be done after replacing any high pressure pump and fuel system related components.

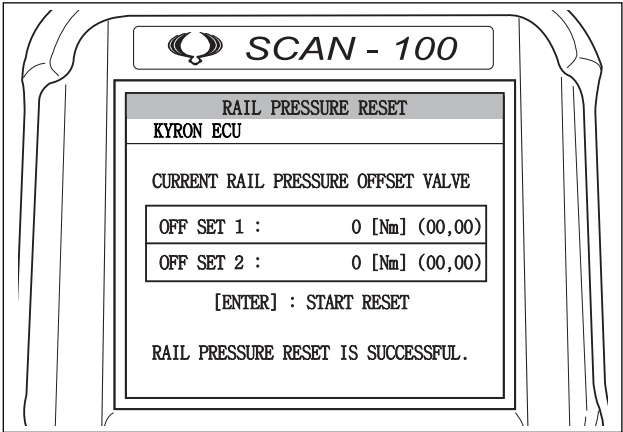
1. Select the vehicle model.



2. Select [RAIL PRESSURE RESET] in [FUNCTION SELECTION] screen.



3. Enter the current rail pressure value and press [ENTER] to reset the offset value.

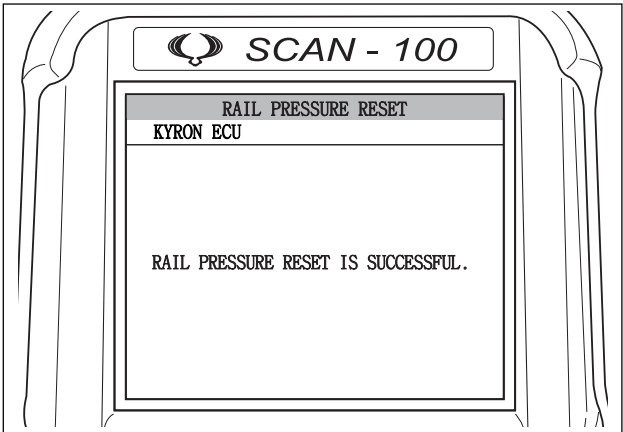


4. The screen returns back to step 3 after displaying the [RAIL PRESSURE RESET IS SUCCESSFUL] message.



NOTICE

- If the offset value is not set to 0, check the fuel pressure and other DTC generations before starting the rail pressure reset operation.



SCAN
ECU
TCU
M/T
TCCU
CLUTCH
BRAKE
A/BAG
A/CON
FFH
RK-STICS
R/SENSOR
S/ROOF

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

MEMO

ECU

TABLE OF CONTENTS

TROUBLE DIAGNOSIS TABLE	3
FUEL SYSTEM DIAGNOSIS.....	157

TROUBLE DIAGNOSIS TABLE

INDEX OF DTC 4, 53
Trouble diagnosis table 7
Trouble diagnosis table (update) 57

SCAN
ECU
TCU
M/T
TCCU
CLUTCH
BRAKE
A/BAG
A/CON
FFH
RK-STICS
R/SENSOR
S/ROOF

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

INDEX OF DTC

P0102 Low HFM Sensor Signal (Circuit Open)	7	P0118 Coolant Temperature Sensor Malfunction - Short ..	19
P0103 High HFM Sensor Signal (Circuit Short)	7	P0117 Coolant Temperature Sensor Malfunction - Open ...	20
P0100 Air Mass Flow (HFM) Malfunction (Vref)	8	P0115 Supply Voltage Fault to Coolant Temperature Sensor ..	20
P0344 Cam Position Sensor Malfunction (Cam Signal Missing)	8	P0685 Main Relay Malfunction	20
P0341 Cam Position Sensor Malfunction (Poor Synchronization)	8	P1405 EGR Solenoid Valve Malfunction - Short to ground ..	20
P0219 Too Small Clearance of Crank Angle Sensor	8	P1406 EGR Solenoid Valve Malfunction - Short to +Batt	20
P0336 Too Large Clearance of Crank Angle Sensor	9	P1480 Condenser Fan #1 Circuit Malfunction - Open	21
P0372 Crank Angle Sensor Malfunction	9	P1481 Condenser Fan #1 Circuit Malfunction - Short	21
P1107 Barometric Sensor (Low)	9	P1482 Condenser Fan #1 Circuit Malfunction - Short to Ground	21
P1108 Barometric Sensor (High)	9	P1526 Condenser Fan #2 Circuit Malfunction - Open	21
P1105 Barometric Sensor Circuit Short (Vref)	9	P1527 Condenser Fan #2 Circuit Malfunction - Short	21
P0562 Low Battery Voltage	10	P1528 Condenser Fan #2 Circuit Malfunction - Short to Ground	21
P0563 High Battery Voltage	10	P0325 Accelerometer #1 (Knock Sensor) Malfunction ...	22
P0560 Battery Voltage Malfunction	10	P0330 Accelerometer #2 (Knock Sensor) Malfunction (only D27DT)	22
P0109 Low Booster Pressure Sensor Signal	11	P1611 Injector Bank #1 Malfunction - Low Voltage	22
P0106 High Booster Pressure Sensor Signal	11	P1612 Injector Bank #1 Malfunction - High Voltage	23
P0107 Booster Pressure Sensor Open/GND Short	12	P1618 Injector Bank #2 Malfunction - Low Voltage	23
P0108 Booster Pressure Sensor Short	12	P1619 Injector Bank #2 Malfunction - High Voltage	23
P0105 Supply Voltage Fault to Booster Pressure Sensor	13	P0263 Injector #1 Balancing Fault	24
P1106 Booster Pressure Sensor Malfunction	13	P0266 Injector #2 Balancing Fault	24
P1109 Booster Pressure Sensor Initial Check Fault	14	P0272 Injector #4 Balancing Fault	24
P0571 Brake Pedal Switch Fault	14	P0275 Injector #5 Balancing Fault	24
P1572 Brake Lamp Signal Fault	15	P0269 Injector #3 Balancing Fault	24
P1571 Brake Lamp Signal Fault	15	P0201 Injector #1 Circuit Open	24
P1286 Low Resistance for Injector #1 wiring harness ..	15	P0202 Injector #2 Circuit Open	24
P1287 High Resistance for Injector #1 wiring harness .	16	P0204 Injector #4 Circuit Open	25
P1288 Low Resistance for Injector #2 wiring harness ..	16	P0205 Injector #5 Circuit Open (only D27DT)	25
P1289 High Resistance for Injector #2 wiring harness .	16	P0203 Injector #3 Circuit Open	25
P1292 Low Resistance for Injector #4 wiring harness ..	17	P1201 Injector #1 Circuit Short	25
P1293 High Resistance for Injector #4 wiring harness .	17	P1202 Injector #2 Circuit Short	25
P1294 Low Resistance for Injector #5 wiring harness (only D27DT)	17	P1204 Injector #4 Circuit Short	25
P1295 High Resistance for Injector #5 wiring harness (only D27DT)	18	P1205 Injector #5 Circuit Short (only D27DT)	25
P1290 Low Resistance for Injector #3 wiring harness ..	18	P1203 Injector #3 Circuit Short	26
P1291 High Resistance for Injector #3 wiring harness .	18	P0182 Fuel temperature sensor - Short to Ground	26
P0704 Clutch switch malfunction	18	P0183 Fuel temperature sensor - Short to B+	26
P1115 Coolant Temperature Sensor Malfunction	19	P0180 Fuel temperature sensor - Vref	27
		P1678 Glow Plug Drive Malfunction - Open	27

P1679 Glow Plug Drive Malfunction - Short	27	P0223 Accelerator Pedal Sensor #2 Malfunction - Short .	38	SCAN
P1680 Glow Plug Drive Malfunction - Short to Ground ...	27	P0220 Accelerator Pedal Sensor #2 Malfunction - Supply Voltage Fault.....	38	
P1530 #1 Heater operating circuit - Open	27	P0192 Fuel Rail Pressure Sensor Malfunction - Open ..	39	ECU
P1531 #1 Heater operating circuit - Short to B+	28	P0193 Fuel Rail Pressure Sensor Malfunction - Short...	39	
P1532 #1 Heater operating circuit - Short to Ground	28	P0190 Supply Voltage Fault to Fuel Rail Pressure Sensor .	39	TCU
P1534 #2 Heater operating circuit - Open	28	P0191 Fuel Rail Pressure Sensor Signal Fault	40	
P1535 #2 Heater operating circuit - Short to B+	28	P1192 Fuel Rail Pressure Sensor Initial Signal Fault - Low	40	M/T
P1536 #2 Heater operating circuit - Short to Ground	28	P1193 Fuel Rail Pressure Sensor Initial Signal Fault - High	40	
P1254 Maximum Rail Pressure Control Malfunction (IMV Fault)	29	P1190 Fuel Rail Pressure Sensor Initial Signal Fault....	41	TCCU
P1253 Minimum Rail Pressure Control Malfunction (IMV Fault)	29	P0215 Main Relay Fault - Stuck	41	
P1256 Too Small Transfer Pressure Fuel in Rail Pressure System	30	P1500 Vehicle Speed Fault	41	CLUTCH
P1257 Too Large Transfer Pressure Fuel in Rail Pressure System	30	P0642ECU Supply Voltage 1 Fault - Low (5 V)	41	
P1258 Too Small High Pressure Fuel in Rail Pressure System	31	P0643ECU Supply Voltage 1 Fault - High (5 V)	42	BRAKE
P1259 Too Large High Pressure Fuel in Rail Pressure System	31	P0641 ECU Supply Voltage 1 Fault (5 V)	42	
P1191 Pressure Build Up - Too Slow	32	P0652 ECU Supply Voltage 2 Fault - Low (5 V)	42	A/BAG
P0255 IMV Driver Circuit Malfunction - Open	32	P0653 ECU Supply Voltage 2 Fault - High (5 V)	42	
P0251 IMV Driver Circuit Malfunction - Short.....	32	P0651 ECU Supply Voltage 2 Fault (5 V)	42	A/CON
P0253 IMV Driver Circuit Malfunction - Short to Ground .	32	P0698 ECU Supply Voltage Fault - Low (2.5 V)	43	
P0112 Intake Air Temperature Circuit Malfunction - Open .	34	P0699 ECU Supply Voltage Fault - High (2.5 V)	43	FFH
P0110 Intake Air Temperature Circuit Malfunction - Source Power Problem	35	P0697 ECU Supply Voltage Fault (2.5 V)	43	
P1171 #1 Injector MDP Malfunction	35	P0245 Turbo Charger Actuator Circuit Fault - Short	43	RK-STICS
P1172 #2 Injector MDP Malfunction	35	P0246 Turbo Charger Actuator Circuit Fault - Short to B+ .	43	
P1174 #4 Injector MDP Malfunction	36	P0606 ECU Watchdog Fault.....	43	S/ROOF
P1175 #5 Injector MDP Malfunction (only D27DT)	36	P1607 ECU Injector Cut Fault	43	
P1173 #3 Injector MDP Malfunction	36	P1600 ECU Shut Down Fault	44	
P1252 Too High IMV Pressure	36	P1601 ECU Fault	44	
P1120 Accelerator Pedal Sensor #1 Malfunction	36	P1602 ECU Fault	44	
P1121 Accelerator Pedal Sensor #2 Malfunction	37	P1614 ECU C2I/MDP Fault	44	
P1122 Accelerator Pedal Sensor Malfunction (Limp Home Mode)	37	P1615 ECU Fault	44	
P1123 Accelerator Pedal Sensor Malfunction (Reducde Torque Mode)	37	P1616 ECU Fault	44	
P1124 Accelerator Pedal Sensor Malfunction - Stuck	37	P1606 ECU Fault	44	
P0122 Accelerator Pedal Sensor #1 Malfunction - Open .	37	P1620 ECU Fault	44	
P0123 Accelerator Pedal Sensor #1 Malfunction - Short .	37	P1621 ECU Fault	44	
P0120 Accelerator Pedal Sensor #1 Malfunction - Supply Voltage Fault.....	38	P1622 ECU Fault	44	
P0222 Accelerator Pedal Sensor #2 Malfunction - Open .	38	P1148 Accelerometer (Knock Sensor) Learning Fault ...	45	
		P0400 EGR Control Valve Fault	45	
		P1235 VGT Operation Fault	45	
		P1608 ECU Fault	45	
		P0335 No Crank Signals	45	
		P1170 Torque Trim Fault - High.....	45	
		P1676 Glow Plug Communication Fault	46	
		P1677 Glow Plug Controller Fault	46	

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

P0671 #1 Glow Plug Fault - Open	46	P1633 Immobilizer Fault (refer to immobilizer section) .	49
P0672 #2 Glow Plug Fault - Open	46	P0633 Immobilizer Fault (refer to immobilizer section) .	49
P0673 #3 Glow Plug Fault - Open	46	P1636 Immobilizer Fault (refer to immobilizer section) .	50
P0674 #4 Glow Plug Fault - Open	47	P1102 High HFM Sensor Signal	50
P0675 #5 Glow Plug Fault - Open	47	P1103 Low HFM Sensor Signal	50
P1671 #1 Glow Plug Fault - Short (B+)	47	P1501 Variant coding failure (vehicle speed)	50
P1672 #2 Glow Plug Fault - Short (B+)	47	P1503 Vehicle speed sensor input failure	50
P1673 #3 Glow Plug Fault - Short (B+)	47	P0600 CAN BUS failure	50
P1674 #4 Glow Plug Fault - Short (B+)	47	P0602 Vehicle speed sensor coding failure	50
P1675 #5 Glow Plug Fault - Short (B+)	48	P0608 ABS/ESP coding failure	50
P0700 TCU Signal Fault	48	P0613 TCU coding failure	50
P1540 Air Conditioner Operating Circuit Fault - Open	48	P0644 CAN cluster failure	50
P1541 Air Conditioner Operating Circuit Fault - Short	48	P1565 Auto cruise switch failure (Acceleration)	51
P1542 Air Conditioner Operating Circuit Fault - Short to Ground	48	P1566 Auto cruise switch failure (OFF)	51
P1149 Too High Water Level in Fuel Filter	48	P1567 Auto cruise switch failure	51
P1634 Immobilizer Fault (refer to immobilizer section) .	48	P1568 Auto cruise switch failure (Deceleration)	51
P1635 No response from Immobilizer (refer to immobi- lizer section)	48	P1569 Auto cruise switch failure (Safety)	51
P1630 Wrong response from Immobilizer (refer to immobilizer section)	49	P3040 ECU internal failure	51
P1631 Immobilizer Fault (refer to immobilizer section) .	49	P3041 ECU internal failure (only D27DT)	51
P1632 Immobilizer Fault (refer to immobilizer section) .	49	P1657 Engine mount control failure (Open)	51
		P1658 Engine mount control failure (Short to B+)	51
		P1659 Engine mount control failure (Short to ground) ...	51

DIAGNOSIS

KYRON SM - 2005.09

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

TROUBLE DIAGNOSIS TABLE

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P0102	Low HFM Sensor Signal (Circuit Open)	<ul style="list-style-type: none"> - HFM sensing values are lower than minimum sensing values. - Check the resistance in HFM sensor. - Check the ECU wiring harness (open and poor contact). <ul style="list-style-type: none"> • Check the ECU pin #83 and #84 for open circuit. - Actual air mass flow vs. Output voltages. <ul style="list-style-type: none"> • -20 Kg/h: 0.47 V • 0 Kg/h: 0.99 V • 10 Kg/h: 1.2226 ~ 1.2398 V • 15 Kg/h: 1.3552 ~ 1.3778 V • 30 Kg/h: 1.6783 ~ 1.7146 V • 60 Kg/h: 2.1619 ~ 2.2057 V • 120 Kg/h: 2.7215 ~ 2.7762 V • 250 Kg/h: 3.4388 ~ 3.5037 V • 370 Kg/h: 3.8796 ~ 3.9511 V • 480 Kg/h: 4.1945 ~ 4.2683 V • 640 Kg/h: 4.5667 ~ 4.6469 V - Replace the ECU if required. 						
P0103	High HFM Sensor Signal (Circuit Short)	<ul style="list-style-type: none"> - HFM sensing values are higher than maximum sensing values. - Check the resistance in HFM sensor. - Check the ECU wiring harness (open and poor contact). <ul style="list-style-type: none"> • Check the ECU pin #83 and #84 for open circuit. - Actual air mass flow vs. Output voltages. <ul style="list-style-type: none"> • -20 Kg/h: 0.47 V • 0 Kg/h: 0.99 V • 10 Kg/h: 1.2226 ~ 1.2398 V • 15 Kg/h: 1.3552 ~ 1.3778 V • 30 Kg/h: 1.6783 ~ 1.7146 V • 60 Kg/h: 2.1619 ~ 2.2057 V • 120 Kg/h: 2.7215 ~ 2.7762 V • 250 Kg/h: 3.4388 ~ 3.5037 V • 370 Kg/h: 3.8796 ~ 3.9511 V • 480 Kg/h: 4.1945 ~ 4.2683 V • 640 Kg/h: 4.5667 ~ 4.6469 V - Replace the ECU if required. 						

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P0100	Air Mass Flow (HFM) Malfunction (Vref)	<ul style="list-style-type: none"> - The external power supply is faulty. <ul style="list-style-type: none"> • Check the external power supply. • Check the sensor wiring harness (open, short, poor contact). - Actual air mass flow vs. Output voltages. <ul style="list-style-type: none"> • -20 Kg/h: 0.47 V • 0 Kg/h: 0.99 V • 10 Kg/h: 1.2226 ~ 1.2398 V • 15 Kg/h: 1.3552 ~ 1.3778 V • 30 Kg/h: 1.6783 ~ 1.7146 V • 60 Kg/h: 2.1619 ~ 2.2057 V • 120 Kg/h: 2.7215 ~ 2.7762 V • 250 Kg/h: 3.4388 ~ 3.5037 V • 370 Kg/h: 3.8796 ~ 3.9511 V • 480 Kg/h: 4.1945 ~ 4.2683 V • 640 Kg/h: 4.5667 ~ 4.6469 V - Replace the ECU if required. 						
P0344	Cam Position Sensor Malfunction (Cam Signal Missing)	<ul style="list-style-type: none"> - No cam recognition signal (missing events). - Check the source voltage of cam position sensor (ECU pin #111) (specified value: 4.5 ~ 12 V). - Check the sensor wiring harness for ECU pin #103 and #104 (open, short, poor contact). - Check the cam position sensor. - Measure the air gap: 0.2 ~ 1.8 mm - Replace the ECU if required. 						O
P0341	Cam Position Sensor Malfunction (Poor Synchronization)	<ul style="list-style-type: none"> - Not synchronized with Crank angle signal. - Check the source voltage of cam position sensor (specified value: 4.5 ~ 12 V). - Check the sensor wiring harness for ECU pin #103 and #104 (open, short, poor contact). - Check the cam position sensor. - Measure the air gap: 0.2 ~ 1.8 mm - Replace the ECU if required. 						O
P0219	Too Small Clearance of Crank Angle Sensor	<ul style="list-style-type: none"> - Crank angle signal faults or clearance too close. - Check the sensor wiring harness for ECU pin #90 and #82 (open, short, poor contact). - Check the resistance of crank angle sensor: $1090 \Omega \pm 15 \%$. - Measure the air gap: 0.3 ~ 1.3 mm <ul style="list-style-type: none"> • 1.3 mm of air gap: outputs 1.0 V at 40 rpm • 0.3 mm of air gap: outputs 150 V at 7000 rpm - Check the teeth condition. <ul style="list-style-type: none"> • Drive plate (A/T), DMF (M/T) - Replace the ECU if required. 						O

DIAGNOSIS

KYRON SM - 2005.09

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P0336	Too Large Clearance of Crank Angle Sensor	<ul style="list-style-type: none"> - Air gap of crank angle sensor is abnormal. - Check the sensor wiring harness for ECU pin #90 and #82 (open, short, poor contact). - Check the resistance of crank angle sensor: $1090 \Omega \pm 15 \%$. - Measure the air gap: 0.3 ~ 1.3 mm <ul style="list-style-type: none"> • 1.3 mm of air gap: outputs 1.0 V at 40 rpm • 0.3 mm of air gap: outputs 150 V at 7000 rpm - Check the teeth condition. <ul style="list-style-type: none"> • Drive plate (A/T), DMF (M/T) - Replace the ECU if required. 						O
P0372	Crank Angle Sensor Malfunction	<ul style="list-style-type: none"> - Even though cam position recognition is normal, no crank angle signal recognition (missing tooth). - Check the sensor wiring harness for ECU pin #90 and #82 (open, short, poor contact). - Check the resistance of crank angle sensor: $1090 \Omega \pm 15 \%$. - Measure the air gap: 0.3 ~ 1.3 mm <ul style="list-style-type: none"> • 1.3 mm of air gap: outputs 1.0 V at 40 rpm • 0.3 mm of air gap: outputs 150 V at 7000 rpm - Check the teeth condition. <ul style="list-style-type: none"> • Drive plate (A/T), DMF (M/T) - Replace the ECU if required. 						O
P1107	Barometric Sensor (Low)	<ul style="list-style-type: none"> - Out of range about barometric sensor (short to ground). - Actual barometric pressure vs. Output voltages. <ul style="list-style-type: none"> • 15 Kpa: 0 V 35 Kpa: 1.0 V • 55 Kpa: 2.0 V 80 Kpa: 3.0 V • 100 Kpa: 4.0 V 110 Kpa: 4.5 V - Replace the ECU. 						
P1108	Barometric Sensor (High)	<ul style="list-style-type: none"> - Out of range about barometric sensor (short to B+). - Actual barometric pressure vs. Output voltages. <ul style="list-style-type: none"> • 15 Kpa: 0 V 35 Kpa: 1.0 V • 55 Kpa: 2.0 V 80 Kpa: 3.0 V • 100 Kpa: 4.0 V 110 Kpa: 4.5 V - Replace the ECU. 						
P1105	Barometric Sensor Circuit Short (Vref)	<ul style="list-style-type: none"> - Out of range about barometric sensor (over voltage). - Actual barometric pressure vs. Output voltages. <ul style="list-style-type: none"> • 15 Kpa: 0 V 35 Kpa: 1.0 V • 55 Kpa: 2.0 V 80 Kpa: 3.0 V • 100 Kpa: 4.0 V 110 Kpa: 4.5 V - Replace the ECU. 						

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P0562	Low Battery Voltage	<ul style="list-style-type: none"> - Malfunction in recognition of system source voltage (Lower than threshold). <ul style="list-style-type: none"> • Less than minimum 8 Volts in 2000 rpm below • Less than 10 Volts in 2000 rpm above. - Check the battery wiring harness for ECU pin #3, #4 and #5 (open, short, poor contact). - Check the battery main relay and fuse. - Check the body ground. - Measure the resistance between body ground and ECU ground. <ul style="list-style-type: none"> • Repair the ECU ground if the resistance is high. - Replace the ECU if required. 	O					
P0563	High Battery Voltage	<ul style="list-style-type: none"> - Malfunction in recognition of system source voltage (Higher than threshold). <ul style="list-style-type: none"> • More than minimum 16 Volts in 2000 rpm below - Check the battery wiring harness for ECU pin #3, #4 and #5 (open, short, poor contact). - Check the alternator. - Check the body ground. - Measure the resistance between body ground and ECU ground. <ul style="list-style-type: none"> • Repair the ECU ground if the resistance is high. - Replace the ECU if required. 	O					
P0560	Battery Voltage Malfunction	<ul style="list-style-type: none"> - Malfunction in recognition of system source voltage (A/D converter faults). <ul style="list-style-type: none"> • Less than minimum 8 Volts in 2000 rpm below • Less than 10 Volts in 2000 rpm above. - Check the battery wiring harness for ECU pin #3, #4 and #5 (open, short, poor contact). - Check the battery main relay and fuse. - Check the body ground. - Measure the resistance between body ground and ECU ground. <ul style="list-style-type: none"> • Repair the ECU ground if the resistance is high. - Replace the ECU if required. 	O					

DIAGNOSIS

KYRON SM - 2005.09

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P0109	Low Booster Pressure Sensor Signal	<ul style="list-style-type: none"> - Out of signal range about boost pressure sensor at Ignition key-On and Engine Stop (Lower than specified values). - Check the supply voltage to sensor. - Actual boost pressure vs. Output voltages. <ul style="list-style-type: none"> • Raw Signal Range: 0.545 ~ 2.490 bar • 0.4 bar: 0.6120 V • 1.4 bar: 2.6520 V • 2.4 bar: 4.6920 V - Check the sensor wiring harness for ECU pin #99 and #100 (open, poor contact). - Visually check sensor and replace if required. - Replace the ECU if required. - Check whether existing or not about turbo boosting control malfunction (P1235) simultaneously. - If there is turbo boost control fault, Should be checked followings also; <ul style="list-style-type: none"> • Leakage before turbo system • Vacuum pump malfunction • Waste gate' solenoid valve • Turbo charger system defect or malfunction itself • Air inlet restriction • Exhaust system restriction 						
P0106	High Booster Pressure Sensor Signal	<ul style="list-style-type: none"> - Out of signal range about boost pressure sensor at Ignition key-On and Engine Stop (Higher than specified values). - Check the supply voltage to sensor. - Actual boost pressure vs. Output voltages. <ul style="list-style-type: none"> • Raw Signal Range: 0.545 ~ 2.490 bar • 0.4 bar: 0.6120 V • 1.4 bar: 2.6520 V • 2.4 bar: 4.6920 V - Check the sensor wiring harness for ECU pin #99 and #100 (open, poor contact). - Visually check sensor and replace if required. - Replace the ECU if required. - Check whether existing or not about turbo boosting control malfunction (P1235) simultaneously. - If there is turbo boost control fault, Should be checked followings also; <ul style="list-style-type: none"> • Leakage before turbo system • Vacuum pump malfunction • Waste gate' solenoid valve • Turbo charger system defect or malfunction itself • Air inlet restriction • Exhaust system restriction 						

SCAN

ECU

TCU

M/T

TCCU

CLUTCH

BRAKE

A/BAG

A/CON

FFH

RK-STICS

R/SENSOR

S/ROOF

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P0107	Booster Pressure Sensor Open/GND Short	<ul style="list-style-type: none"> - Out of signal range about boost pressure sensor at Engine running condition (Lower than specified values). - Check the supply voltage to sensor. - Actual boost pressure vs. Output voltages <ul style="list-style-type: none"> • Raw Signal Range: 0.545 ~ 2.490 bar • 0.4 bar: 0.6120 V • 1.4 bar: 2.6520 V • 2.4 bar: 4.6920 V - Check the sensor wiring harness for ECU pin #99 and #100 (open, poor contact). - Visually check sensor and replace if required. - Replace the ECU if required. - Check whether existing or not about turbo boosting control malfunction (P1235) simultaneously. - If there is turbo boost control fault, Should be checked followings also; <ul style="list-style-type: none"> • Leakage before turbo system • Vacuum pump malfunction • Waste gate' solenoid valve • Turbo charger system defect or malfunction itself • Air inlet restriction • Exhaust system restriction 						
P0108	Booster Pressure Sensor Short	<ul style="list-style-type: none"> - Out of signal range about boost pressure sensor at Engine running condition (Higher than specified values). - Check the supply voltage to sensor. - Actual boost pressure vs. Output voltages <ul style="list-style-type: none"> • Raw Signal Range: 0.545~2.490 bar • 0.4 bar: 0.6120 V • 1.4 bar: 2.6520 V • 2.4 bar: 4.6920 V - Check the sensor wiring harness for ECU pin #99 and #100 (open, poor contact). - Visually check sensor and replace if required. - Replace the ECU if required. - Check whether existing or not about turbo boosting control malfunction (P1235) simultaneously. - If there is turbo boost control fault, Should be checked followings also; <ul style="list-style-type: none"> • Leakage before turbo system • Vacuum pump malfunction • Waste gate' solenoid valve • Turbo charger system defect or malfunction itself • Air inlet restriction • Exhaust system restriction 						

DIAGNOSIS

KYRON SM - 2005.09

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P0105	Supply Voltage Fault to Booster Pressure Sensor	<ul style="list-style-type: none"> - Out of range of supply voltages about boost pressure sensor at Ignition key-On and Engine Stop (Higher than specified values). - Check the supply voltage to sensor. - Actual boost pressure vs. Output voltages <ul style="list-style-type: none"> • Raw Signal Range: 0.545 ~ 2.490 bar • 0.4 bar: 0.6120 V • 1.4 bar: 2.6520 V • 2.4 bar: 4.6920 V - Check the sensor wiring harness for ECU pin #100 and #108 (open, poor contact). - Visually check sensor and replace if required. - Replace the ECU if required. - Check whether existing or not about turbo boosting control malfunction (P1235) simultaneously. - If there is turbo boost control fault, Should be checked followings also; <ul style="list-style-type: none"> • Leakage before turbo system • Vacuum pump malfunction • Waste gate' solenoid valve • Turbo charger system defect or malfunction itself • Air inlet restriction • Exhaust system restriction 						
P1106	Booster Pressure Sensor Malfunction	<ul style="list-style-type: none"> - Out of range of supply voltages about boost pressure sensor at Ignition key-On and Engine Stop (Higher than specified values). - Check the supply voltage to sensor. - Actual boost pressure vs. Output voltages. <ul style="list-style-type: none"> • Raw Signal Range: 0.545 ~ 2.490 bar • 0.4 bar: 0.6120 V • 1.4 bar: 2.6520 V • 2.4 bar: 4.6920 V - Check the sensor wiring harness for ECU pin #99 and #100 (open, poor contact). - Visually check sensor and replace if required. - Replace the ECU if required. - Check whether existing or not about turbo boosting control malfunction (P1235) simultaneously. - If there is turbo boost control fault, Should be checked followings also; <ul style="list-style-type: none"> • Leakage before turbo system • Vacuum pump malfunction • Waste gate' solenoid valve • Turbo charger system defect or malfunction itself • Air inlet restriction • Exhaust system restriction 						

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1109	Booster Pressure Sensor Initial Check Fault	<ul style="list-style-type: none"> - Implausible signal values or range about boost pressure sensor at Engine running condition (Higher than specified values). - Check the supply voltage to sensor. - Actual boost pressure vs. Output voltages <ul style="list-style-type: none"> • Raw Signal Range: 0.545 ~ 2.490 bar • 0.4 bar: 0.6120 V • 1.4 bar: 2.6520 V • 2.4 bar: 4.6920 V - Check the sensor wiring harness for ECU pin #99 and #100 (open, poor contact). - Visually check sensor and replace if required. - Replace the ECU if required. - Check whether existing or not about turbo boosting control malfunction (P1235) simultaneously. - If there is turbo boost control fault, Should be checked followings also; <ul style="list-style-type: none"> • Leakage before turbo system • Vacuum pump malfunction • Waste gate' solenoid valve • Turbo charger system defect or malfunction itself • Air inlet restriction • Exhaust system restriction 						
P0571	Brake Pedal Switch Fault	<ul style="list-style-type: none"> - The brake pedal switch or light switch is faulty. <ul style="list-style-type: none"> • Brake pedal switch: Normal Close (NC) • Light switch: Normal Open (NO) • When operating the brake switch, one signal (NO) is sent to auto cruise and the other (NC) is sent to brake lamp. - Check the brake and light switch wiring harness. - Check the supply voltage to brake and light switch (12 V). - Check the brake and light switch for contact. - Check the ECU wiring harness for ECU pin #77 and #58 (short, poor contact). - Replace the ECU if required. 						

DIAGNOSIS

KYRON SM - 2005.09

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1572	Brake Lamp Signal Fault	<ul style="list-style-type: none"> - The brake pedal switch or light switch is faulty. <ul style="list-style-type: none"> • Brake pedal switch: Normal Close (NC) • Light switch: Normal Open (NO) • When operating the brake pedal switch, one signal (NO) is sent to auto cruise and the other (NC) is sent to brake lamp. - Check the brake pedal and light switch wiring harness. - Check the supply voltage to brake pedal and light switch (12 V). - Check the brake pedal and light switch for contact. - Check the ECU wiring harness for ECU pin #58 (open, short, poor contact). - Replace the ECU if required. 						
P1571	Brake Lamp Signal Fault	<ul style="list-style-type: none"> - The brake pedal switch is faulty. <ul style="list-style-type: none"> • Brake pedal switch: Normal Close (NC) • Light switch: Normal Open (NO) • When operating the brake pedal switch, one signal (NO) is sent to auto cruise and the other (NC) is sent to brake lamp. - Check the brake pedal switch wiring harness. - Check the supply voltage to brake pedal switch (12 V). - Check the brake pedal switch for contact. - Check the ECU wiring harness for ECU pin #77 (open, short, poor contact). - Replace the ECU if required. 						
P1286	Low Resistance for Injector #1 wiring harness	<ul style="list-style-type: none"> - Out of range about wiring harness resistance for Injector #1. <ul style="list-style-type: none"> • Low: Less than 0.115 Ω (injector circuit open) - Check the injector #1 wiring harness and electric isolation. - Check the injector #1 wiring harness for open circuit. <ul style="list-style-type: none"> • If the pin in injector #1 is defective, replace injector #1 and perform C2I coding, then check again. • If the pin in injector #1 is not defective, check the ECU wiring harness. - Replace the ECU if required. 						

SCAN
ECU
TCU
M/T
TCCU
CLUTCH
BRAKE
A/BAG
A/CON
FFH
RK-STICS
R/SENSOR
S/ROOF

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1287	High Resistance for Injector #1 wiring harness	<ul style="list-style-type: none"> - Out of range about wiring harness resistance for Injector #1. <ul style="list-style-type: none"> • High: More than 0.728 Ω (injector circuit short) - Check the injector #1 wiring harness and electric isolation. - Check the injector #1 wiring harness for short circuit. <ul style="list-style-type: none"> • If the trouble still exists after removing the injector connector, replace injector #1 and perform C2I coding, then check again. • If the trouble is fixed after removing the injector connector, check the wiring harness between ECU and injector. - Replace the ECU if required. 						
P1288	Low Resistance for Injector #2 wiring harness	<ul style="list-style-type: none"> - Out of range about wiring harness resistance for Injector #2. <ul style="list-style-type: none"> • Low: Less than 0.115 Ω (injector circuit open) - Check the injector #2 wiring harness and electric isolation. - Check the injector #2 wiring harness for open circuit. <ul style="list-style-type: none"> • If the pin in injector #2 is defective, replace injector #2 and perform C2I coding, then check again. • If the pin in injector #2 is not defective, check the ECU wiring harness. - Replace the ECU if required. 						
P1289	High Resistance for Injector #2 wiring harness	<ul style="list-style-type: none"> - Out of range about wiring harness resistance for Injector #2. <ul style="list-style-type: none"> • High: More than 0.728 Ω (injector circuit short) - Check the injector #2 wiring harness and electric isolation. - Check the injector #2 wiring harness for short circuit. <ul style="list-style-type: none"> • If the trouble still exists after removing the injector connector, replace injector #2 and perform C2I coding, then check again. • If the trouble is fixed after removing the injector connector, check the wiring harness between ECU and injector. - Replace the ECU if required. 						

DIAGNOSIS

KYRON SM - 2005.09

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1292	Low Resistance for Injector #4 wiring harness	<ul style="list-style-type: none"> - Out of range about wiring harness resistance for Injector #4. <ul style="list-style-type: none"> • Low: Less than 0.115 Ω (injector circuit open) - Check the injector #4 wiring harness and electric isolation. - Check the injector #4 wiring harness for open circuit. <ul style="list-style-type: none"> • If the pin in injector #4 is defective, replace injector #4 and perform C2I coding, then check again. • If the pin in injector #4 is not defective, check the ECU wiring harness. - Replace the ECU if required. 						
P1293	High Resistance for Injector #4 wiring harness	<ul style="list-style-type: none"> - Out of range about wiring harness resistance for Injector #4. <ul style="list-style-type: none"> • High: More than 0.728 Ω (injector circuit short) - Check the injector #4 wiring harness and electric isolation. - Check the injector #4 wiring harness for short circuit. <ul style="list-style-type: none"> • If the trouble still exists after removing the injector connector, replace injector #4 and perform C2I coding, then check again. • If the trouble is fixed after removing the injector connector, check the wiring harness between ECU and injector. - Replace the ECU if required. 						
P1294	Low Resistance for Injector #5 wiring harness (only D27DT)	<ul style="list-style-type: none"> - Out of range about wiring harness resistance for Injector #5. <ul style="list-style-type: none"> • Low: Less than 0.115 Ω (injector circuit open) - Check the injector #5 wiring harness and electric isolation. - Check the injector #5 wiring harness for open circuit. <ul style="list-style-type: none"> • If the pin in injector #5 is defective, replace injector #5 and perform C2I coding, then check again. • If the pin in injector #5 is not defective, check the ECU wiring harness. - Replace the ECU if required. 						

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1295	High Resistance for Injector #5 wiring harness (only D27DT)	<ul style="list-style-type: none"> - Out of range about wiring harness resistance for Injector #5. <ul style="list-style-type: none"> • High: More than 0.728 Ω (injector circuit short) - Check the injector #5 wiring harness and electric isolation. - Check the injector #5 wiring harness for short circuit. <ul style="list-style-type: none"> • If the trouble still exists after removing the injector connector, replace injector #5 and perform C2I coding, then check again. • If the trouble is fixed after removing the injector connector, check the wiring harness between ECU and injector. - Replace the ECU if required. 						
P1290	Low Resistance for Injector #3 wiring harness	<ul style="list-style-type: none"> - Out of range about wiring harness resistance for Injector #3. <ul style="list-style-type: none"> • Low: Less than 0.115 Ω (injector circuit open) - Check the injector #3 wiring harness and electric isolation. - Check the injector #3 wiring harness for open circuit. <ul style="list-style-type: none"> • If the pin in injector #3 is defective, replace injector #3 and perform C2I coding, then check again. • If the pin in injector #3 is not defective, check the ECU wiring harness. - Replace the ECU if required. 						
P1291	High Resistance for Injector #3 wiring harness	<ul style="list-style-type: none"> - Out of range about wiring harness resistance for Injector #3. <ul style="list-style-type: none"> • High: More than 0.728 Ω (injector circuit short) - Check the injector #3 wiring harness and electric isolation. - Check the injector #3 wiring harness for short circuit. <ul style="list-style-type: none"> • If the trouble still exists after removing the injector connector, replace injector #3 and perform C2I coding, then check again. • If the trouble is fixed after removing the injector connector, check the wiring harness between ECU and injector. - Replace the ECU if required. 						
P0704	Clutch switch malfunction	<ul style="list-style-type: none"> - The clutch switch is faulty (Manual Transmission Only). - Check the switch wiring harness. <ul style="list-style-type: none"> • Check the ECU pin #38 for open, short and poor contact. - Check the switch supply voltage and operations. - Replace the ECU if required. 						

DIAGNOSIS

KYRON SM - 2005.09

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1115	Coolant Temperature Sensor Malfunction	<ul style="list-style-type: none"> - Implausible values of coolant temperature (If the temperature is below the limits values after warm up). - If Fuel temperature is invalid, the previous coolant temperature is retained. - Check the supply voltage to sensor. - Actual coolant temp. vs. Resistance <ul style="list-style-type: none"> • 20°C: 2449 Ω • 50°C: 826.3 Ω • 80°C: 321.4 Ω • 100°C: 112.9 Ω - Check the wiring harness (open, short and poor contact). <ul style="list-style-type: none"> • ECU pin #101 and #102 - Visually check the sensor and replace if required. - Check the thermostat, water pump radiator related coolant route (thermostat stuck). - Replace the ECU if required. 						
P0118	Coolant Temperature Sensor Malfunction - Short	<ul style="list-style-type: none"> - Malfunction in recognition of coolant temperature <ul style="list-style-type: none"> • More than maximum values (Circuit Short) • External power supply malfunction - If Fuel temperature is invalid, the previous coolant temperature is retained. - Check the supply voltage to sensor. - Actual coolant temp. vs. Resistance <ul style="list-style-type: none"> • 20°C: 2449 Ω • 50°C: 826.3 Ω • 80°C: 321.4 Ω • 100°C: 112.9 Ω - Check the wiring harness (short and poor contact). <ul style="list-style-type: none"> • ECU pin #101 and #102 - Visually check the sensor and replace if required. - Replace the ECU if required. 						

SCAN

ECU

TCU

M/T

TCCU

CLUTCH

BRAKE

A/BAG

A/CON

FFH

RK-STICS

R/SENSOR

S/ROOF

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P0117	Coolant Temperature Sensor Malfunction - Open	<ul style="list-style-type: none"> - Malfunction in recognition of coolant temperature <ul style="list-style-type: none"> • Less than minimum values (Circuit Open) • External power supply malfunction - If Fuel temperature is invalid, the previous coolant temperature is retained. - Check the supply voltage to sensor. - Actual coolant temp. vs. Resistance <ul style="list-style-type: none"> • 20°C: 2449 Ω • 50°C: 826.3 Ω • 80°C: 321.4 Ω • 100°C: 112.9 Ω - Check the wiring harness (open and poor contact). <ul style="list-style-type: none"> • ECU pin #101 and #102 - Visually check the sensor and replace if required. - Replace the ECU if required. 						
P0115	Supply Voltage Fault to Coolant Temperature Sensor	<ul style="list-style-type: none"> - Check if the supply voltage of approx. 12 V is applied. 						
P0685	Main Relay Malfunction	<ul style="list-style-type: none"> - The the main relay is unexpectedly high/low state (ECU is supplied after 3 seconds). - Relay resistance: 92 ± 9 Ω (at 20°C) - Check the relay wiring harness (open, short and poor contact). <ul style="list-style-type: none"> • Check for open and short: ECU pin #9. - If the forced operation is not available, replace the ECU. 						
P1405	EGR Solenoid Valve Malfunction - Short to ground	<ul style="list-style-type: none"> - Out of range about EGR gas: High. <ul style="list-style-type: none"> • EGR controller circuit: Open or short to ground - Check the EGR actuator wiring harness. - Check the supply voltage to EGR solenoid valve. - Check the EGR solenoid valve. - Check the EGR valve for stick. - Check the resistance of EGR actuator: 15.4 Ω - Check the ECU wiring harness for open and short. <ul style="list-style-type: none"> • ECU pin #96 						
P1406	EGR Solenoid Valve Malfunction - Short to +Batt	<ul style="list-style-type: none"> - Out of range about EGR gas: Low. <ul style="list-style-type: none"> • EGR controller circuit: Short to battery - Check the EGR actuator wiring harness. - Check the supply voltage to EGR solenoid valve. - Check the EGR solenoid valve. - Check the EGR valve for stick. - Check the resistance of EGR actuator: 15.4 Ω - Check the ECU wiring harness for open and short. <ul style="list-style-type: none"> • ECU pin #96 						

DIAGNOSIS

KYRON SM - 2005.09

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1480	Condenser Fan #1 Circuit Malfunction - Open	<ul style="list-style-type: none"> - Condenser fan #1: Open - Check the relay and relay wiring harness. - Check the ECU wiring harness for open and short. <ul style="list-style-type: none"> • ECU pin #80 - If the forced operation is not available after replacing the relay, replace the ECU. 						
P1481	Condenser Fan #1 Circuit Malfunction - Short	<ul style="list-style-type: none"> - Condenser fan #1: Short - Check the relay and relay wiring harness. - Check the ECU wiring harness for open and short. <ul style="list-style-type: none"> • ECU pin #80 - If the forced operation is not available after replacing the relay, replace the ECU. 						
P1482	Condenser Fan #1 Circuit Malfunction - Short to Ground	<ul style="list-style-type: none"> - Condenser fan #1: Short to ground. - Check the relay and relay wiring harness. - Check the ECU wiring harness for open and short. <ul style="list-style-type: none"> • ECU pin #80 - If the forced operation is not available after replacing the relay, replace the ECU. 						
P1526	Condenser Fan #2 Circuit Malfunction - Open	<ul style="list-style-type: none"> - Condenser fan #2: Open - Check the relay and relay wiring harness. - Check the ECU wiring harness for open and short. <ul style="list-style-type: none"> • ECU pin #81 - If the forced operation is not available after replacing the relay, replace the ECU. 						
P1527	Condenser Fan #2 Circuit Malfunction - Short	<ul style="list-style-type: none"> - Condenser fan #2: Short - Check the relay and relay wiring harness. - Check the ECU wiring harness for open and short. <ul style="list-style-type: none"> • ECU pin #81 - If the forced operation is not available after replacing the relay, replace the ECU. 						
P1528	Condenser Fan #2 Circuit Malfunction - Short to Ground	<ul style="list-style-type: none"> - Condenser fan #2: Short to ground - Check the relay and relay wiring harness. - Check the ECU wiring harness for open and short. <ul style="list-style-type: none"> • ECU pin #81 - If the forced operation is not available after replacing the relay, replace the ECU. 						

SCAN
ECU
TCU
M/T
TCCU
CLUTCH
BRAKE
A/BAG
A/CON
FFH
RK-STICS
R/SENSOR
S/ROOF

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P0325	Accelerometer #1 (Knock Sensor) Malfunction	<ul style="list-style-type: none"> - The signal / noise ratio is too low about accelerometer # 1. - Check the accelerometer wiring harness and tightening torque. <ul style="list-style-type: none"> • Tightening torque: 20 ± 5 Nm - Check the ECU wiring harness for open and short. <ul style="list-style-type: none"> • ECU pin #45 and #46 - If the trouble still exists even after replacing the accelerometer, replace the ECU. 						
P0330	Accelerometer #2 (Knock Sensor) Malfunction (only D27DT)	<ul style="list-style-type: none"> - The signal / noise ratio is too low about accelerometer # 2. - Check the accelerometer wiring harness and tightening torque. <ul style="list-style-type: none"> • Tightening torque: 20 ± 5 Nm - Check the ECU wiring harness for open and short. <ul style="list-style-type: none"> • ECU pin #44 and #63 - If the trouble still exists even after replacing the accelerometer, replace the ECU. 						
P1611	Injector Bank #1 Malfunction - Low Voltage	<ul style="list-style-type: none"> - Malfunction of injector (#1, #4, #3) circuit (Low): Short to Ground or to Battery. - Operating voltage: 6 ~ 18 V - Check the injector bank #1: Open and poor contact - Check if the trouble recurs with the injectors removed and the ignition key "OFF". <ul style="list-style-type: none"> • If recurred, check the injector and ECU wiring harness. - Check if the trouble recurs while installing the injectors one by one with the ignition key "ON". <ul style="list-style-type: none"> • If recurred, replace the injector (perform C2I coding after replacement). • Check the other injectors with same manner. - Check the ECU wiring harness. - Replace the ECU if required. 						

DIAGNOSIS

KYRON SM - 2005.09

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1612	Injector Bank #1 Malfunction - High Voltage	<ul style="list-style-type: none"> - Malfunction of injector (#1, #4, #3) circuit (High): Short to Ground or to Battery. - Operating voltage: 6 ~ 18 V - Check the injector bank #1: Short and poor contact - Check if the trouble recurs with the injectors removed and the ignition key "OFF". <ul style="list-style-type: none"> • If recurred, check the injector and ECU wiring harness. - Check if the trouble recurs while installing the injectors one by one with the ignition key "ON". <ul style="list-style-type: none"> • If recurred, replace the injector (perform C2I coding after replacement). • Check the other injectors with same manner. - Check the ECU wiring harness. - Replace the ECU if required. 						O
P1618	Injector Bank #2 Malfunction - Low Voltage	<ul style="list-style-type: none"> - Malfunction of injector (#2, #5) circuit (Low): Short to Ground or to Battery. - Operating voltage: 6 ~ 18 V - Check the injector bank #2: Open and poor contact - Check if the trouble recurs with the injectors removed and the ignition key "OFF". <ul style="list-style-type: none"> • If recurred, check the injector and ECU wiring harness. - Check if the trouble recurs while installing the injectors one by one with the ignition key "ON". <ul style="list-style-type: none"> • If recurred, replace the injector (perform C2I coding after replacement). • Check the other injectors with same manner. - Check the ECU wiring harness. - Replace the ECU if required. 						
P1619	Injector Bank #2 Malfunction - High Voltage	<ul style="list-style-type: none"> - Malfunction of injector (#2, #5) circuit (High): Short to Ground or to Battery. - Operating voltage: 6 ~ 18 V - Check the injector bank #2: Short and poor contact - Check if the trouble recurs with the injectors removed and the ignition key "OFF". <ul style="list-style-type: none"> • If recurred, check the injector and ECU wiring harness. - Check if the trouble recurs while installing the injectors one by one with the ignition key "ON". <ul style="list-style-type: none"> • If recurred, replace the injector (perform C2I coding after replacement). • Check the other injectors with same manner. - Check the ECU wiring harness. - Replace the ECU if required. 						O

SCAN

ECU

TCU

M/T

TCCU

CLUTCH

BRAKE

A/BAG

A/CON

FFH

RK-STICS

R/SENSOR

S/ROOF

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P0263	Injector #1 Balancing Fault	<ul style="list-style-type: none"> - Injector #1 cylinder balancing faults (Injector stuck closed). - Check the injector circuit for open. - Check the glow plug. - Check the inlet tube for clogging. - Check the EGR. - Replace the ECU if required (perform C2I coding after replacement). 						
P0266	Injector #2 Balancing Fault	<ul style="list-style-type: none"> - Injector #2 cylinder balancing faults (Injector stuck closed). - Check the injector circuit for open. - Check the glow plug. - Check the inlet tube for clogging. - Check the EGR. - Replace the ECU if required (perform C2I coding after replacement). 						
P0272	Injector #4 Balancing Fault	<ul style="list-style-type: none"> - Injector #4 cylinder balancing faults (Injector stuck closed). - Check the injector circuit for open. - Check the glow plug. - Check the inlet tube for clogging. - Check the EGR. - Replace the ECU if required (perform C2I coding after replacement). 						
P0275	Injector #5 Balancing Fault (only D27DT)	<ul style="list-style-type: none"> - Injector #5 cylinder balancing faults (Injector stuck closed). - Check the injector circuit for open. - Check the glow plug. - Check the inlet tube for clogging. - Check the EGR. - Replace the ECU if required (perform C2I coding after replacement). 						
P0269	Injector #3 Balancing Fault	<ul style="list-style-type: none"> - Injector #3 cylinder balancing faults (Injector stuck closed). - Check the injector circuit for open. - Check the glow plug. - Check the inlet tube for clogging. - Check the EGR. - Replace the ECU if required (perform C2I coding after replacement). 						
P0201	Injector #1 Circuit Open	<ul style="list-style-type: none"> - Injector #1 circuit malfunction: Open. <ul style="list-style-type: none"> • If the injector pin is defective, perform C2I coding and check again. • If the injector pin is normal, check the ECU wiring harness (ECU pin: #117, #114). - Replace the ECU if required. 						O
P0202	Injector #2 Circuit Open	<ul style="list-style-type: none"> - Injector #2 circuit malfunction: Open. <ul style="list-style-type: none"> • If the injector pin is defective, perform C2I coding and check again. • If the injector pin is normal, check the ECU wiring harness (ECU pin: #118, #121). - Replace the ECU if required. 						O

DIAGNOSIS

KYRON SM - 2005.09

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P0204	Injector #4 Circuit Open	- Injector #4 circuit malfunction: Open. <ul style="list-style-type: none"> • If the injector pin is defective, perform C2I coding and check again. • If the injector pin is normal, check the ECU wiring harness (ECU pin: #117, #115). - Replace the ECU if required.						O
P0205	Injector #5 Circuit Open (only D27DT)	- Injector #5 circuit malfunction: Open. <ul style="list-style-type: none"> • If the injector pin is defective, perform C2I coding and check again. • If the injector pin is normal, check the ECU wiring harness (ECU pin: #118, #120). - Replace the ECU if required.						O
P0203	Injector #3 Circuit Open	- Injector #3 circuit malfunction: Open. <ul style="list-style-type: none"> • If the injector pin is defective, perform C2I coding and check again. • If the injector pin is normal, check the ECU wiring harness (ECU pin: #117, #116). - Replace the ECU if required.						O
P1201	Injector #1 Circuit Short	- Injector #1 circuit malfunction: Short. <ul style="list-style-type: none"> • If the trouble recurs with the injector removed, replace the injector. Perform C2I coding and check again. • If the trouble does not recur, check the wiring harness between the injector and ECU (ECU pin: #117, #114). - Replace the ECU if required.						
P1202	Injector #2 Circuit Short	- Injector #2 circuit malfunction: Short. <ul style="list-style-type: none"> • If the trouble recurs with the injector removed, replace the injector. Perform C2I coding and check again. • If the trouble does not recur, check the wiring harness between the injector and ECU (ECU pin: #118, #121). - Replace the ECU if required.						
P1204	Injector #4 Circuit Short	- Injector #4 circuit malfunction: Short. <ul style="list-style-type: none"> • If the trouble recurs with the injector removed, replace the injector. Perform C2I coding and check again. • If the trouble does not recur, check the wiring harness between the injector and ECU (ECU pin: #117, #115). - Replace the ECU if required.						
P1205	Injector #5 Circuit Short (only D27DT)	- Injector #5 circuit malfunction: Short. <ul style="list-style-type: none"> • If the trouble recurs with the injector removed, replace the injector. Perform C2I coding and check again. • If the trouble does not recur, check the wiring harness between the injector and ECU (ECU pin: #118, #120). - Replace the ECU if required.						

SCAN

ECU

TCU

M/T

TCCU

CLUTCH

BRAKE

A/BAG

A/CON

FFH

RK-STICS

R/SENSOR

S/ROOF

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1203	Injector #3 Circuit Short	<ul style="list-style-type: none"> - Injector #3 circuit malfunction: Short. <ul style="list-style-type: none"> • If the trouble recurs with the injector removed, replace the injector. Perform C2I coding and check again. • If the trouble does not recur, check the wiring harness between the injector and ECU (ECU pin: #117, #116). - Replace the ECU if required. 						
P0182	Fuel temperature sensor - Short to Ground	<ul style="list-style-type: none"> - The sensing values are higher than specified values for fuel temperature sensor. (More than maximum sensing values 140°C - Circuit Short) - Actual fuel temp. vs. Resistance <ul style="list-style-type: none"> • -40°C: 75.780 Ω -20°C: 21.873 Ω • -10°C: 12.462 Ω 0°C: 7.355 Ω • 10°C: 4.481 Ω 20°C: 2.812 Ω • 25°C: 2.252 Ω 30°C: 1.814 Ω • 40°C: 1.199 Ω 50°C: 0.811 Ω • 70°C: 0.394 Ω 90°C: 0.206 Ω • 120°C: 0.087 Ω - Recovery values when fuel temperature sensor failure: 95°C - Check the supply voltage to sensor. - Check the wiring harness for open, short and poor contact. <ul style="list-style-type: none"> • ECU pin: #109, #110 - Check the ECU wiring and replace the ECU if required. 						
P0183	Fuel temperature sensor - Short to B+	<ul style="list-style-type: none"> - The sensing values are lower than specified values for fuel temperature sensor. (Less than maximum sensing values - 40°C - Circuit Open) - Actual fuel temp. vs. Resistance <ul style="list-style-type: none"> • -40°C: 75.780 Ω -20°C: 21.873 Ω • -10°C: 12.462 Ω 0°C: 7.355 Ω • 10°C: 4.481 Ω 20°C: 2.812 Ω • 25°C: 2.252 Ω 30°C: 1.814 Ω • 40°C: 1.199 Ω 50°C: 0.811 Ω • 70°C: 0.394 Ω 90°C: 0.206 Ω • 120°C: 0.087 Ω - Recovery values when fuel temperature sensor failure: 95°C - Check the supply voltage to sensor. - Check the wiring harness for open, short and poor contact. <ul style="list-style-type: none"> • ECU pin: #109, #110 - Check the ECU wiring and replace the ECU if required. 						

DIAGNOSIS

KYRON SM - 2005.09

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P0180	Fuel temperature sensor - Vref	<ul style="list-style-type: none"> - The power source circuit is faulty for fuel temperature sensor. (Fuel temperature sensor is mounted in high pressure pump) - Actual fuel temp. vs. Resistance <ul style="list-style-type: none"> • -40°C: 75.780 Ω -20°C: 21.873 Ω • -10°C: 12.462 Ω 0°C: 7.355 Ω • 10°C: 4.481 Ω 20°C: 2.812 Ω • 25°C: 2.252 Ω 30°C: 1.814 Ω • 40°C: 1.199 Ω 50°C: 0.811 Ω • 70°C: 0.394 Ω 90°C: 0.206 Ω • 120°C: 0.087 Ω - Recovery values when fuel temperature sensor failure: 95°C - Check the supply voltage to sensor. - Check the wiring harness for open, short and poor contact. <ul style="list-style-type: none"> • ECU pin: #109, #110 - Check the ECU wiring and replace the ECU if required. 						
P1678	Glow Plug Drive Malfunction - Open	<ul style="list-style-type: none"> - Glow plug circuit malfunction: Open. - Check the glow plug wiring harness for open. <ul style="list-style-type: none"> • ECU pin #113 - Check the glow plug relay operations. - Check the glow plug power supply. - Check the ECU wiring and replace the ECU if required. 						
P1679	Glow Plug Drive Malfunction - Short	<ul style="list-style-type: none"> - Glow plug circuit malfunction: Short. - Check the glow plug wiring harness for open. <ul style="list-style-type: none"> • ECU pin #113 - Check the glow plug relay operations. - Check the glow plug power supply. - Check the ECU wiring and replace the ECU if required. 						
P1680	Glow Plug Drive Malfunction - Short to Ground	<ul style="list-style-type: none"> - Glow plug circuit malfunction: Short to ground. - Check the glow plug wiring harness for open. <ul style="list-style-type: none"> • ECU pin #113 - Check the glow plug relay operations. - Check the glow plug power supply. - Check the ECU wiring and replace the ECU if required. 						
P1530	#1 Heater operating circuit - Open	<ul style="list-style-type: none"> - #1 heater circuit malfunction: Open. - Check the wiring harness for open. <ul style="list-style-type: none"> • ECU pin #61 - Check the heater relay operations. - If the forced operation is not available, replace the ECU. - Check the ECU wiring and replace the ECU if required. 						

SCAN

ECU

TCU

M/T

TCCU

CLUTCH

BRAKE

A/BAG

A/CON

FFH

RK-STICS

R/SENSOR

S/ROOF

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1531	#1 Heater operating circuit - Short to B+	<ul style="list-style-type: none"> - #1 heater circuit malfunction: Short. - Check the wiring harness for short. <ul style="list-style-type: none"> • ECU pin #61 - Check the heater relay operations. - If the forced operation is not available, replace the ECU. - Check the ECU wiring and replace the ECU if required. 						
P1532	#1 Heater operating circuit - Short to Ground	<ul style="list-style-type: none"> - #1 heater circuit malfunction: Short to ground. - Check the wiring harness for short. <ul style="list-style-type: none"> • ECU pin #61 - Check the heater relay operations. - If the forced operation is not available, replace the ECU. - Check the ECU wiring and replace the ECU if required. 						
P1534	#2 Heater operating circuit - Open	<ul style="list-style-type: none"> - #2 heater circuit malfunction: Open. - Check the wiring harness for open. <ul style="list-style-type: none"> • ECU pin #62 - Check the heater relay operations. - If the forced operation is not available, replace the ECU. - Check the ECU wiring and replace the ECU if required. 						
P1535	#2 Heater operating circuit - Short to B+	<ul style="list-style-type: none"> - #2 heater circuit malfunction: Short. - Check the wiring harness for short. <ul style="list-style-type: none"> • ECU pin #62 - Check the heater relay operations. - If the forced operation is not available, replace the ECU. - Check the ECU wiring and replace the ECU if required. 						
P1536	#2 Heater operating circuit - Short to Ground	<ul style="list-style-type: none"> - #2 heater circuit malfunction: Short to ground. - Check the wiring harness for short. <ul style="list-style-type: none"> • ECU pin #62 - Check the heater relay operations. - If the forced operation is not available, replace the ECU. - Check the ECU wiring and replace the ECU if required. 						

DIAGNOSIS

KYRON SM - 2005.09

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1254	Maximum Rail Pressure Control Malfunction (IMV Fault)	<ul style="list-style-type: none"> - Rail pressure faults: Too high - Check the IMV wiring harness. - Check the ECU wiring harness. <ul style="list-style-type: none"> • Check the ECU pin #87 for open and short. - Check the high pressure fuel lines, fuel rails and high pressure pipes for leaks. - Check the rail pressure sensor. <ul style="list-style-type: none"> • Supply voltage: 5 ± 0.1 V • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the transfer pressure fuel pressure lines. <ul style="list-style-type: none"> • Check the fuel level in fuel tank. Check the fuel system for air influx. • Check the fuel filter specification. - Check the IMV resistance: 5.44Ω <ul style="list-style-type: none"> • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required. 						
P1253	Minimum Rail Pressure Control Malfunction (IMV Fault)	<ul style="list-style-type: none"> - Rail pressure faults: Too low - Check the IMV wiring harness. - Check the ECU wiring harness. <ul style="list-style-type: none"> • Check the ECU pin #87 for open and short. - Check the high pressure fuel lines, fuel rails and high pressure pipes for leaks. - Check the rail pressure sensor. <ul style="list-style-type: none"> • Supply voltage: 5 ± 0.1 V • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the transfer pressure fuel pressure lines. <ul style="list-style-type: none"> • Check the fuel level in fuel tank. Check the fuel system for air influx. • Check the fuel filter specification. - Check the IMV resistance: 5.44Ω <ul style="list-style-type: none"> • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required. 						O

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1256	Too Small Transfer Pressure Fuel in Rail Pressure System	<ul style="list-style-type: none"> - Rail pressure fault: IMV current trim too high, drift. - Check the IMV wiring harness. - Check the ECU wiring harness. <ul style="list-style-type: none"> • Check the ECU pin #87 for open and short. - Check the rail pressure sensor. <ul style="list-style-type: none"> • Supply voltage: 5 ± 0.1 V • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the transfer pressure fuel pressure lines. <ul style="list-style-type: none"> • Check the fuel level in fuel tank. Check the fuel system for air influx. • Check the fuel filter specification. - Check the high pressure fuel system. <ul style="list-style-type: none"> • Check the fuel rails and high pressure pipes for leaks. - Check the IMV resistance: 5.44Ω <ul style="list-style-type: none"> • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required. 						
P1257	Too Large Transfer Pressure Fuel in Rail Pressure System	<ul style="list-style-type: none"> - Rail pressure fault: IMV current trim too high, drift. - Check the IMV wiring harness. - Check the ECU wiring harness. <ul style="list-style-type: none"> • Check the ECU pin #87 for open and short. - Check the rail pressure sensor. <ul style="list-style-type: none"> • Supply voltage: 5 ± 0.1 V • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the transfer pressure fuel pressure lines. <ul style="list-style-type: none"> • Check the fuel level in fuel tank. Check the fuel system for air influx. • Check the fuel filter specification. - Check the high pressure fuel system. <ul style="list-style-type: none"> • Check the fuel rails and high pressure pipes for leaks. - Check the IMV resistance: 5.44Ω <ul style="list-style-type: none"> • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required. 						O

DIAGNOSIS

KYRON SM - 2005.09

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1258	Too Small High Pressure Fuel in Rail Pressure System	<ul style="list-style-type: none"> - Rail pressure fault: IMV current trim too high, drift. - Check the IMV wiring harness. - Check the ECU wiring harness. <ul style="list-style-type: none"> • Check the ECU pin #87 for open and short. - Check the rail pressure sensor. <ul style="list-style-type: none"> • Supply voltage: 5 ± 0.1 V • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the transfer pressure fuel lines. <ul style="list-style-type: none"> • Check the fuel level in fuel tank. Check the fuel system for air influx. • Check the fuel filter specification. - Check the high pressure fuel system. <ul style="list-style-type: none"> • Check the fuel rails and high pressure pipes for leaks. - Check the IMV resistance: 5.44Ω <ul style="list-style-type: none"> • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required. 						
P1259	Too Large High Pressure Fuel in Rail Pressure System	<ul style="list-style-type: none"> - Rail pressure fault: IMV current trim too high, drift. - Check the IMV wiring harness. - Check the ECU wiring harness. <ul style="list-style-type: none"> • Check the ECU pin #87 for open and short. - Check the rail pressure sensor. <ul style="list-style-type: none"> • Supply voltage: 5 ± 0.1 V • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the transfer pressure fuel lines. <ul style="list-style-type: none"> • Check the fuel level in fuel tank. Check the fuel system for air influx. • Check the fuel filter specification. - Check the high pressure fuel system. <ul style="list-style-type: none"> • Check the fuel rails and high pressure pipes for leaks. - Check the IMV resistance: 5.44Ω <ul style="list-style-type: none"> • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required. 						

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1191	Pressure Build Up - Too Slow	<ul style="list-style-type: none"> - The pressure build up during cranking is too slow. - Check the IMV wiring harness. - Check the ECU wiring harness. <ul style="list-style-type: none"> • Check the ECU pin #87 for open and short. - Check the rail pressure sensor. <ul style="list-style-type: none"> • Supply voltage: 5 ± 0.1 V • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the transfer pressure fuel lines. <ul style="list-style-type: none"> • Check the fuel level in fuel tank. Check the fuel system for air influx. • Check the fuel filter specification. - Check the high pressure fuel system. <ul style="list-style-type: none"> • Check the fuel rails and high pressure pipes for leaks. - Check the IMV resistance: 5.44Ω <ul style="list-style-type: none"> • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required. 						O
P0255	IMV Driver Circuit Malfunction - Open	<ul style="list-style-type: none"> - IMV driver circuit malfunction: Open - Check the IMV wiring harness. <ul style="list-style-type: none"> • Check the ECU pin #87 for open. - Check the ECU wiring harness. - Check the IMV resistance. <ul style="list-style-type: none"> • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required. 			O		O	
P0251	IMV Driver Circuit Malfunction - Short	<ul style="list-style-type: none"> - IMV driver circuit malfunction: Short - Check the IMV wiring harness. <ul style="list-style-type: none"> • Check the ECU pin #87 for short. - Check the ECU wiring harness. - Check the IMV resistance. <ul style="list-style-type: none"> • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required. 			O		O	
P0253	IMV Driver Circuit Malfunction - Short to Ground	<ul style="list-style-type: none"> - IMV driver circuit malfunction: Short to ground - Check the IMV wiring harness. <ul style="list-style-type: none"> • Check the ECU pin #87 for short to ground. - Check the ECU wiring harness. - Check the IMV resistance. <ul style="list-style-type: none"> • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required. 			O		O	O

DIAGNOSIS

KYRON SM - 2005.09

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
		<ul style="list-style-type: none"> - The intake air temperature sensing value is lower than maximum value of 150°C: Open - Check the supply voltage to sensor. <ul style="list-style-type: none"> • Actual air temperature vs. Voltages • 20°C: 2.65 Ω • 30°C: 2.18 Ω • 50°C: 1.40 Ω • Recovery values when intake air temperature sensor failure: 50°C - Check the sensor wiring harness. <ul style="list-style-type: none"> • Check the source power circuit for short to ground. - Check the sensor resistance. <ul style="list-style-type: none"> • Actual air temperature vs. Resistance • -40°C: 39.260 Ω • -20°C: 13.850 Ω • 0°C: 5.499 Ω • 20°C: 2.420 Ω • 40°C: 1.166 Ω • 60°C: 0.609 Ω • 80°C: 0.340 Ω • 100°C: 0.202 Ω • 120°C: 0.127 Ω • Recovery values when intake air temperature sensor failure: 50°C - Check the ECU wiring harness. <ul style="list-style-type: none"> • Check the ECU pin #64 and #84 for open. - Replace the ECU if required. 						

SCAN

ECU

TCU

M/T

TCCU

CLUTCH

BRAKE

A/BAG

A/CON

FFH

RK-STICS

R/SENSOR

S/ROOF

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P0112	Intake Air Temperature Circuit Malfunction - Open	<ul style="list-style-type: none"> - The intake air temperature sensing value is lower than maximum value of 150°C: Open - Check the supply voltage to sensor. <ul style="list-style-type: none"> • Actual air temperature vs. Voltages • 20°C: 2.65 Ω • 30°C: 2.18 Ω • 50°C: 1.40 Ω • Recovery values when intake air temperature sensor failure: 50°C - Check the sensor wiring harness. <ul style="list-style-type: none"> • Check the source power circuit for short to ground. - Check the sensor resistance. <ul style="list-style-type: none"> • Actual air temperature vs. Resistance • -40°C: 39.260 Ω • -20°C: 13.850 Ω • 0°C: 5.499 Ω • 20°C: 2.420 Ω • 40°C: 1.166 Ω • 60°C: 0.609 Ω • 80°C: 0.340 Ω • 100°C: 0.202 Ω • 120°C: 0.127 Ω • Recovery values when intake air temperature sensor failure: 50°C - Check the ECU wiring harness. <ul style="list-style-type: none"> • Check the ECU pin #64 and #84 for open. - Replace the ECU if required. 						

DIAGNOSIS

KYRON SM - 2005.09

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P0110	Intake Air Temperature Circuit Malfunction - Source Power Problem	<ul style="list-style-type: none"> - The intake air temperature sensing value is lower than minimum value or higher than maximum value, or the external power to HFM sensor is faulty. - Check the supply voltage to sensor. <ul style="list-style-type: none"> • Actual air temperature vs. Voltages • 20°C: 2.65 Ω • 30°C: 2.18 Ω • 50°C: 1.40 Ω • Recovery values when intake air temperature sensor failure: 50°C - Check the sensor wiring harness. <ul style="list-style-type: none"> • Check the source power circuit for short to ground. - Check the sensor resistance. <ul style="list-style-type: none"> • Actual air temperature vs. Resistance • -40°C: 39.260 Ω • -20°C: 13.850 Ω • 0°C: 5.499 Ω • 20°C: 2.420 Ω • 40°C: 1.166 Ω • 60°C: 0.609 Ω • 80°C: 0.340 Ω • 100°C: 0.202 Ω • 120°C: 0.127 Ω • Recovery values when intake air temperature sensor failure: 50°C - Check the ECU wiring harness. <ul style="list-style-type: none"> • Check the ECU pin #64 and #84 for open and short. - Replace the ECU if required. 						
P1171	#1 Injector MDP Malfunction	<ul style="list-style-type: none"> - The #1 injector MDP is faulty. - C2I coding check - Check fault code - No fault condition, vehicle speed 70 KPH - Coolant temp. 75°C above condition try again - Replace the injector and perform C2I coding again. 						
P1172	#2 Injector MDP Malfunction	<ul style="list-style-type: none"> - The #2 injector MDP is faulty. - C2I coding check - Check fault code - No fault condition, vehicle speed 70 KPH - Coolant temp. 75°C above condition try again - Replace the injector and perform C2I coding again. 						

SCAN
ECU
TCU
M/T
TCCU
CLUTCH
BRAKE
A/BAG
A/CON
FFH
RK-STICS
R/SENSOR
S/ROOF

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1174	#4 Injector MDP Malfunction	<ul style="list-style-type: none"> - The #4 injector MDP is faulty. - C2I coding check - Check fault code - No fault condition, vehicle speed 70 KPH - Coolant temp. 75°C above condition try again - Replace the injector and perform C2I coding again. 						
P1175	#5 Injector MDP Malfunction (only D27DT)	<ul style="list-style-type: none"> - The #5 injector MDP is faulty. - C2I coding check - Check fault code - No fault condition, vehicle speed 70 KPH - Coolant temp. 75°C above condition try again - Replace the injector and perform C2I coding again. 						
P1173	#3 Injector MDP Malfunction	<ul style="list-style-type: none"> - The #3 injector MDP is faulty. - C2I coding check - Check fault code - No fault condition, vehicle speed 70 KPH - Coolant temp. 75°C above condition try again - Replace the injector and perform C2I coding again. 						
P1252	Too High IMV Pressure	<ul style="list-style-type: none"> - The rail pressure is excessively high. - Check the IMV wiring harness. - Check the ECU wiring harness. <ul style="list-style-type: none"> • Check the ECU pin #87 for open and short. - Check the rail pressure sensor. <ul style="list-style-type: none"> • Supply voltage: 5 ± 0.1 V • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the transfer pressure fuel lines. <ul style="list-style-type: none"> • Check the fuel level in fuel tank. Check the fuel system for air influx. • Check the fuel filter specification. - Check the high pressure fuel system. <ul style="list-style-type: none"> • Check the fuel rails and high pressure pipes for leaks. - Check the IMV resistance: 5.44 Ω <ul style="list-style-type: none"> • When out of specified value: replace high pressure pump and IMV - Replace the ECU if required. 						
P1120	Accelerator Pedal Sensor #1 Malfunction	<ul style="list-style-type: none"> - The potentiometer 1 is not plausible with potentiometer 2. - Check the supply voltage to sensor. - Check the wiring harness. <ul style="list-style-type: none"> • Check the ECU pin #71, 53 and #32, 14 for open and short. - Check the accelerator pedal module. - Check the ECU wiring harness. - Replace the ECU if required. 	O					

DIAGNOSIS

KYRON SM - 2005.09

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1121	Accelerator Pedal Sensor #2 Malfunction	<ul style="list-style-type: none"> - The potentiometer 2 is not plausible with potentiometer 1. - Check the supply voltage to sensor. - Check the wiring harness. <ul style="list-style-type: none"> • Check the ECU pin #71, 53 and #32, 14 for open and short. - Check the accelerator pedal module. - Check the ECU wiring harness. - Replace the ECU if required. 	O					O
P1122	Accelerator Pedal Sensor Malfunction (Limp Home Mode)	<ul style="list-style-type: none"> - When triggering limp home mode. - Check the supply voltage to sensor. - Check the wiring harness. <ul style="list-style-type: none"> • Check the ECU pin #72, 71, 53 and #57, 32, 14 for open and short. - Check the accelerator pedal module. - Check the ECU wiring harness. - Replace the ECU if required. 					O	O
P1123	Accelerator Pedal Sensor Malfunction (Reduced Torque Mode)	<ul style="list-style-type: none"> - When triggering reduced torque mode. - Check the supply voltage to sensor. - Check the wiring harness. <ul style="list-style-type: none"> • Check the ECU pin #72, 71, 53 and #57, 32, 14 for open and short. - Check the accelerator pedal module. - Check the ECU wiring harness. - Replace the ECU if required. 	O					O
P1124	Accelerator Pedal Sensor Malfunction - Stuck	<ul style="list-style-type: none"> - The accelerator pedal sensor is stuck. - Check the brake switch wiring harness and operations. - Check the accelerator pedal operations. - Check the accelerator pedal module. - Check the ECU wiring harness. - Replace the ECU if required. 					O	
P0122	Accelerator Pedal Sensor #1 Malfunction - Open	<ul style="list-style-type: none"> - Out of range about potentiometer 1 of pedal sensor: lower than specified values - Check the supply voltage to sensor. - Check the wiring harness. <ul style="list-style-type: none"> • Check the circuit for open and short. • Check the ECU pin #71, #53 for open and poor contact. - Check the accelerator pedal. - Check the ECU wiring harness. - Replace the ECU if required. 	O					O
P0123	Accelerator Pedal Sensor #1 Malfunction - Short	<ul style="list-style-type: none"> - Out of range about potentiometer 1 of pedal sensor: higher than specified values - Check the supply voltage to sensor. - Check the wiring harness. <ul style="list-style-type: none"> • Check the circuit for open and short. • Check the ECU pin #71, #53 for short and poor contact. - Check the accelerator pedal. - Check the ECU wiring harness. - Replace the ECU if required. 	O					

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P0120	Accelerator Pedal Sensor #1 Malfunction - Supply Voltage Fault	<ul style="list-style-type: none"> - The 5 V supply voltage is faulty. - Check the supply voltage to sensor. - Check the wiring harness. <ul style="list-style-type: none"> • Check the circuit for open and short. • Check the ECU pin #72, #53 for open and short. - Check the accelerator pedal. - Check the ECU wiring harness. - Replace the ECU if required. 	O					
P0222	Accelerator Pedal Sensor #2 Malfunction - Open	<ul style="list-style-type: none"> - Out of range about potentiometer 2 of pedal sensor: lower than specified values - Check the supply voltage to sensor. - Check the wiring harness. <ul style="list-style-type: none"> • Check the circuit for open and short. • Check the ECU pin #32, #14 for open and poor contact. - Check the accelerator pedal. - Check the ECU wiring harness. - Replace the ECU if required. 	O					O
P0223	Accelerator Pedal Sensor #2 Malfunction - Short	<ul style="list-style-type: none"> - Out of range about potentiometer 2 of pedal sensor: higher than specified values - Check the supply voltage to sensor. - Check the wiring harness. <ul style="list-style-type: none"> • Check the circuit for open and short. • Check the ECU pin #32, #14 for short and poor contact. - Check the accelerator pedal. - Check the ECU wiring harness. - Replace the ECU if required. 	O					
P0220	Accelerator Pedal Sensor #2 Malfunction - Supply Voltage Fault	<ul style="list-style-type: none"> - The 2.5 V supply voltage is faulty. - Check the supply voltage to sensor. - Check the wiring harness. <ul style="list-style-type: none"> • Check the circuit for open and short. • Check the ECU pin #57, #14 for open and short. - Check the accelerator pedal. - Check the ECU wiring harness. - Replace the ECU if required. 	O					

DIAGNOSIS

KYRON SM - 2005.09

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P0192	Fuel Rail Pressure Sensor Malfunction - Open	<ul style="list-style-type: none"> - The fuel rail pressure sensing values are lower than specified values. <ul style="list-style-type: none"> • Minimum sensing values: - 112 bar (Open) - Check the supply voltage to sensor. <ul style="list-style-type: none"> • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the sensor and ECU wiring harness. <ul style="list-style-type: none"> • Check the ECU pin #25, #26 for open and poor contact. • Check the fuel rails and high pressure pipes for leaks. - Check the fuel rail pressure sensor. - Replace the ECU if required. 	O					
P0193	Fuel Rail Pressure Sensor Malfunction - Short	<ul style="list-style-type: none"> - The fuel rail pressure sensing values are higher than specified values. <ul style="list-style-type: none"> • Maximum sensing values: 1,600 bar (Short) - Check the supply voltage to sensor. <ul style="list-style-type: none"> • Output voltage at 1600 bar: 4.055± 0.125V • Output voltage at atmospheric pressure: 0.5±0.04V - Check the sensor and ECU wiring harness. <ul style="list-style-type: none"> • Check the ECU pin #25, #26 for short and poor contact. • Check the fuel rails and high pressure pipes for leaks. - Check the fuel rail pressure sensor. - Replace the ECU if required. 	O					
P0190	Supply Voltage Fault to Fuel Rail Pressure Sensor	<ul style="list-style-type: none"> - The supply voltage to fuel rail pressure sensor is faulty. - Check the supply voltage to sensor. <ul style="list-style-type: none"> • Output voltage at 1600 bar: 4.055± 0.125V • Output voltage at atmospheric pressure: 0.5±0.04V - Check the sensor and ECU wiring harness. <ul style="list-style-type: none"> • Check the ECU pin #6, #26 for open and short. • Check the fuel rails and high pressure pipes for leaks. - Check the fuel rail pressure sensor. - Replace the ECU if required. 	O					

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P0191	Fuel Rail Pressure Sensor Signal Fault	<ul style="list-style-type: none"> - The rail pressure drop is too high. - Check the supply voltage to sensor. <ul style="list-style-type: none"> • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the sensor and ECU wiring harness. <ul style="list-style-type: none"> • Check the ECU pin #6, #26 for open and short. • Check the fuel rails and high pressure pipes for leaks. - Check the fuel rail pressure sensor. - Replace the ECU if required. 	O					O
P1192	Fuel Rail Pressure Sensor Initial Signal Fault - Low	<ul style="list-style-type: none"> - The rail pressure sensor initial values are lower than specified values with the ignition "ON". <ul style="list-style-type: none"> • Minimum sensing values: - 9 0 bar (Open) - Check the supply voltage to sensor. <ul style="list-style-type: none"> • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the sensor and ECU wiring harness. <ul style="list-style-type: none"> • Check the ECU pin #25, #26 for open and poor contact. • Check the fuel rails and high pressure pipes for leaks. - Check the fuel rail pressure sensor. - Replace the ECU if required. 	O					
P1193	Fuel Rail Pressure Sensor Initial Signal Fault - High	<ul style="list-style-type: none"> - The rail pressure sensor initial values are higher than specified values with the ignition "ON". <ul style="list-style-type: none"> • Maximum sensing values: 90 bar (Short) - Check the supply voltage to sensor. <ul style="list-style-type: none"> • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the sensor and ECU wiring harness. <ul style="list-style-type: none"> • Check the ECU pin #25, #26 for short and poor contact. • Check the fuel rails and high pressure pipes for leaks. - Check the fuel rail pressure sensor. - Replace the ECU if required. 	O					

DIAGNOSIS

KYRON SM - 2005.09

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1190	Fuel Rail Pressure Sensor Initial Signal Fault	<ul style="list-style-type: none"> - The rail pressure sensor initial values are higher or lower than specified values with the ignition "ON". <ul style="list-style-type: none"> • Maximum sensing values: 90 bar (Short) • Minimum sensing values: - 90 bar (Open) - Check the supply voltage to sensor. <ul style="list-style-type: none"> • Output voltage at 1600 bar: 4.055 ± 0.125 V • Output voltage at atmospheric pressure: 0.5 ± 0.04 V - Check the sensor and ECU wiring harness. <ul style="list-style-type: none"> • Check the ECU pin #25, #26 for open and short. • Check the fuel rails and high pressure pipes for leaks. - Check the fuel rail pressure sensor. - Replace the ECU if required. 	O					O
P0215	Main Relay Fault - Stuck	<ul style="list-style-type: none"> - The main relay is stuck ; Shut down. - Resistance of main relay: 92 Ω ± 9 Ω (at 20°C) - Check the main relay wiring harness. - Check the ECU wiring harness. <ul style="list-style-type: none"> • Check the ECU pin #3, 4, 5 for open and short. - If the forced operation is not available, replace the ECU. - Check the fuse for main relay 						
P1500	Vehicle Speed Fault	<ul style="list-style-type: none"> - The vehicle speed signal through CAN communication is faulty. - Check the CAN communication line for open and short. - Check the ABS/ESP and TCU communication lines. - Check the ECU wiring harness. - Replace the ECU if required. 						
P0642	ECU Supply Voltage 1 Fault - Low (5 V)	<ul style="list-style-type: none"> - Malfunction reference supply voltage from ECU <ul style="list-style-type: none"> • Supply voltage: 5 V - Check the supply voltage to each sensor <ul style="list-style-type: none"> • Supply voltage (5 V): accelerator pedal sensor 1 - Check the wiring harnesses. - Replace the ECU if required. 						

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P0643	ECU Supply Voltage 1 Fault - High (5 V)	<ul style="list-style-type: none"> - Malfunction reference supply voltage from ECU <ul style="list-style-type: none"> • Supply voltage: 5 V - Check the supply voltage to each sensor <ul style="list-style-type: none"> • Supply voltage (5 V): accelerator pedal sensor 1 - Check the wiring harnesses. - Replace the ECU if required. 						
P0641	ECU Supply Voltage 1 Fault (5 V)	<ul style="list-style-type: none"> - Malfunction reference supply voltage from ECU <ul style="list-style-type: none"> • Supply voltage: 5 V - Check the supply voltage to each sensor <ul style="list-style-type: none"> • Supply voltage (5 V): accelerator pedal sensor 1 - Check the wiring harnesses. - Replace the ECU if required. 						
P0652	ECU Supply Voltage 2 Fault - Low (5 V)	<ul style="list-style-type: none"> - Malfunction reference supply voltage from ECU <ul style="list-style-type: none"> • Supply voltage: 5 V - Check the supply voltage to each sensor <ul style="list-style-type: none"> • Supply voltage (5 V): accelerator pedal sensor 1, HFM sensor, rail pressure sensor, booster pressure sensor, cam sensor - Check the wiring harnesses. - Replace the ECU if required. 			O		O	O
P0653	ECU Supply Voltage 2 Fault - High (5 V)	<ul style="list-style-type: none"> - Malfunction reference supply voltage from ECU <ul style="list-style-type: none"> • Supply voltage: 5 V - Check the supply voltage to each sensor <ul style="list-style-type: none"> • Supply voltage (5 V): accelerator pedal sensor 1, HFM sensor, rail pressure sensor, booster pressure sensor, cam sensor - Check the wiring harnesses. - Replace the ECU if required. 			O		O	
P0651	ECU Supply Voltage 2 Fault (5 V)	<ul style="list-style-type: none"> - Malfunction reference supply voltage from ECU <ul style="list-style-type: none"> • Supply voltage: 5 V - Check the supply voltage to each sensor <ul style="list-style-type: none"> • Supply voltage (5 V): accelerator pedal sensor 1, HFM sensor, rail pressure sensor, booster pressure sensor, cam sensor - Check the wiring harnesses. - Replace the ECU if required. 			O		O	

DIAGNOSIS

KYRON SM - 2005.09

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P0698	ECU Supply Voltage Fault - Low (2.5 V)	<ul style="list-style-type: none"> - Malfunction reference supply voltage from ECU <ul style="list-style-type: none"> • Supply voltage: 2.5 V - Check the supply voltage to each sensor <ul style="list-style-type: none"> • Supply voltage (2.5 V): accelerator pedal sensor 2 - Check the wiring harnesses. - Replace the ECU if required. 						
P0699	ECU Supply Voltage Fault - High (2.5 V)	<ul style="list-style-type: none"> - Malfunction reference supply voltage from ECU <ul style="list-style-type: none"> • Supply voltage: 2.5 V - Check the supply voltage to each sensor <ul style="list-style-type: none"> • Supply voltage (2.55 V): accelerator pedal sensor 2 - Check the wiring harnesses. - Replace the ECU if required. 						
P0697	ECU Supply Voltage Fault (2.5 V)	<ul style="list-style-type: none"> - Malfunction reference supply voltage from ECU <ul style="list-style-type: none"> • Supply voltage: 2.5 V - Check the supply voltage to each sensor <ul style="list-style-type: none"> • Supply voltage (2.55 V): accelerator pedal sensor 2 - Check the wiring harnesses. - Replace the ECU if required. 						
P0245	Turbo Charger Actuator Circuit Fault - Short	<ul style="list-style-type: none"> - The waste gate driver circuit is short to ground or open - Check the actuator wiring harness. - Check the solenoid valve. - Check the ECU wiring harness. <ul style="list-style-type: none"> • Check the ECU pin #95 for open and short. - Replace the ECU if required. 	O					
P0246	Turbo Charger Actuator Circuit Fault - Short to B+	<ul style="list-style-type: none"> - The turbo charger actuator power source circuit is short. - Check the actuator wiring harness. - Check the solenoid valve. - Check the ECU wiring harness for short and poor contact. - Replace the ECU if required. 	O					O
P0606	ECU Watchdog Fault	<ul style="list-style-type: none"> - The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required. 						O
P1607	ECU Injector Cut Fault	<ul style="list-style-type: none"> - The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required. 						O

SCAN

ECU

TCU

M/T

TCCU

CLUTCH

BRAKE

A/BAG

A/CON

FFH

RK-STICS

R/SENSOR

S/ROOF

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1600	ECU Shut Down Fault	<ul style="list-style-type: none"> - The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required. 						O
P1601	ECU Fault	<ul style="list-style-type: none"> - The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required. 						O
P1602	ECU Fault	<ul style="list-style-type: none"> - The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required. 						O
P1614	ECU C2I/MDP Fault	<ul style="list-style-type: none"> - The ECU is defective. - Check the chassis ground wiring harness. - Check C2I code - Check the ECU. - Replace the ECU if required. 					O	O
P1615	ECU Fault	<ul style="list-style-type: none"> - The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required. 					O	O
P1616	ECU Fault	<ul style="list-style-type: none"> - The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required. 					O	O
P1606	ECU Fault	<ul style="list-style-type: none"> - The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required. 					O	O
P1620	ECU Fault	<ul style="list-style-type: none"> - The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required. 					O	O
P1621	ECU Fault	<ul style="list-style-type: none"> - The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required. 					O	O
P1622	ECU Fault	<ul style="list-style-type: none"> - The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required. 					O	O

DIAGNOSIS

KYRON SM - 2005.09

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1148	Accelerometer (Knock Sensor) Learning Fault	<ul style="list-style-type: none"> - Check if the MDP is successful. - Check the accelerometer (knock sensor) sensor and wiring harness. - Replace the ECU if required. 		O				
P0400	EGR Control Valve Fault	<ul style="list-style-type: none"> - When the EGR emission is more than specified value. <ul style="list-style-type: none"> • The EGR controller circuit is open or short to ground. • The EGR controller is short to battery. - Check the EGR actuator wiring harness. - Check the supply voltage to EGR solenoid valve. - Check if the EGR valve is stuck. - Check the resistance of EGR valve: 15.4 Ω - Check the ECU wiring harness. <ul style="list-style-type: none"> • Check the ECU pin #96 for open and short. 						
P1235	VGT Operation Fault	<ul style="list-style-type: none"> - The boost pressure control is faulty. - Check the air intake system. - Check the supply voltage to sensor. - Check the wiring harness and the ECU wiring harness. - Replace the ECU if required. 	O					
P1608	ECU Fault	<ul style="list-style-type: none"> - The ECU is defective. - Check the chassis ground wiring harness. - Check the ECU. - Replace the ECU if required. 						O
P0335	No Crank Signals	- Refer to P0372.						O
P1170	Torque Trim Fault - High	- Refer to P0372.						

SCAN
ECU
TCU
M/T
TCCU
CLUTCH
BRAKE
A/BAG
A/CON
FFH
RK-STICS
R/SENSOR
S/ROOF

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1676	Glow Plug Communication Fault	<ul style="list-style-type: none"> - The communication between ECU and glow controller is faulty. - Check the communication line between ECU and glow controller. - Check the glow plug wiring harness. - Check the resistance of glow plug: below 1 Ω - Check the glow controller. - Check the ECU wiring harness. <ul style="list-style-type: none"> • Check the ECU pin #34 for short to ground. - Replace the ECU if required. 						
P1677	Glow Plug Controller Fault	<ul style="list-style-type: none"> - glow controller is faulty. - Check the communication line between ECU and glow controller. - Check the glow plug wiring harness. - Check the resistance of glow plug: below 1Ω. - Check the glow plug relay. - Check the ECU wiring harness. <ul style="list-style-type: none"> • Check the ECU pin #34 for short to ground. - Replace the ECU if required. 						
P0671	#1 Glow Plug Fault - Open	<ul style="list-style-type: none"> - The glow plug circuit is open. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1 Ω - Check or replace glow controller. - Check the ECU wiring harness. - Replace the ECU if required. 						
P0672	#2 Glow Plug Fault - Open	<ul style="list-style-type: none"> - The glow plug circuit is open. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1 Ω - Check or replace glow controller. - Check the ECU wiring harness. - Replace the ECU if required. 						
P0673	#3 Glow Plug Fault - Open	<ul style="list-style-type: none"> - The glow plug circuit is open. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1 Ω - Check or replace glow controller. - Check the ECU wiring harness. - Replace the ECU if required. 						

DIAGNOSIS

KYRON SM - 2005.09

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P0674	#4 Glow Plug Fault - Open	<ul style="list-style-type: none"> - The glow plug circuit is open. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1Ω - Check or replace glow controller. - Check the ECU wiring harness. - Replace the ECU if required. 						
P0675	#5 Glow Plug Fault - Open	<ul style="list-style-type: none"> - The glow plug circuit is open. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1 Ω - Check or replace glow controller. - Check the ECU wiring harness. - Replace the ECU if required. 						
P1671	#3 Glow Plug Fault - Short (B+)	<ul style="list-style-type: none"> - The glow plug circuit is short. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1 Ω - Check or replace glow controller. - Check the ECU wiring harness. - Replace the ECU if required. 						
P1672	#4 Glow Plug Fault - Short (B+)	<ul style="list-style-type: none"> - The glow plug circuit is short. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1 Ω - Check or replace glow controller. - Check the ECU wiring harness. - Replace the ECU if required. 						
P1673	#5 Glow Plug Fault - Short (B+)	<ul style="list-style-type: none"> - The glow plug circuit is short. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1 Ω - Check or replace glow controller. - Check the ECU wiring harness. - Replace the ECU if required. 						
P1674	#1 Glow Plug Fault - Short (B+)	<ul style="list-style-type: none"> - The glow plug circuit is short. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1 Ω - Check or replace glow controller. - Check the ECU wiring harness. - Replace the ECU if required. 						

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1675	#2 Glow Plug Fault - Short (B+)	<ul style="list-style-type: none"> - The glow plug circuit is short. - Check the communication line between ECU and each glow plug. - Check each glow plug wiring harness. - Check the resistance of each glow plug: below 1Ω - Check or replace glow controller. - Check the ECU wiring harness. - Replace the ECU if required. 						
P0700	TCU Signal Fault	<ul style="list-style-type: none"> - The communication between ECU and TCU is faulty. - Check the communication line between ECU and TCU. - Check the ECU pin #54, 73 for open and short. - Replace the ECU or TCU if required. 						
P1540	Air Conditioner Operating Circuit Fault - Open	<ul style="list-style-type: none"> - Check the air conditioner sensors and wiring harnesses. - Check the ECU wiring harness. - Check the ECU if required. 						
P1541	Air Conditioner Operating Circuit Fault - Short	<ul style="list-style-type: none"> - Check the air conditioner sensors and wiring harnesses. - Check the ECU wiring harness. - Check the ECU if required. 						
P1542	Air Conditioner Operating Circuit Fault - Short to Ground	<ul style="list-style-type: none"> - Check the air conditioner sensors and wiring harnesses. - Check the ECU wiring harness. - Check the ECU if required. 						
P1149	Too High Water Level in Fuel Filter	<ul style="list-style-type: none"> - Drain the water from fuel filter. 		O				
P1634	Immobilizer Fault (refer to immobilizer section)	<ul style="list-style-type: none"> - No response from immobilizer. - Perform the immobilizer coding again. - Check the ECU wiring harness. <ul style="list-style-type: none"> • Check the ECU pin #34 for open and short. - Check the immobilizer unit for open and short or check the supply voltage. - Check the immobilizer antenna. - Replace the ECU if required. 						
P1635	No response from Immobilizer (refer to immobilizer section)	<ul style="list-style-type: none"> - No response from immobilizer. - Perform the immobilizer coding again. - Check the ECU wiring harness. <ul style="list-style-type: none"> • Check the ECU pin #34 for open and short. - Check the immobilizer unit for open and short or check the supply voltage. - Check the immobilizer antenna. - Replace the ECU or immobilizer if required. 						

DIAGNOSIS

KYRON SM - 2005.09

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1630	Wrong response from Immobilizer (refer to immobilizer section)	<ul style="list-style-type: none"> - The invalid key is inserted or no communication between transponder and immobilizer (no response from transponder). - Perform the immobilizer coding again. - Check the ECU wiring harness. <ul style="list-style-type: none"> • Check the ECU pin #34 for open and short. - Check the immobilizer unit for open and short or check the supply voltage. - Check the immobilizer antenna and transponder for damage. - Replace the ECU if required. 						
P1631	Immobilizer Fault (refer to immobilizer section)	<ul style="list-style-type: none"> - The immobilizer is not operating. - Perform the immobilizer coding again. - Check the ECU wiring harness. <ul style="list-style-type: none"> • Check the ECU pin #34 for open and short. - Check the immobilizer unit for open and short or check the supply voltage. - Check the immobilizer antenna and transponder for damage. - Replace the ECU if required. 						
P1632	Immobilizer Fault (refer to immobilizer section)	<ul style="list-style-type: none"> - No response from immobilizer. - Perform the immobilizer coding again. - Check the ECU wiring harness. <ul style="list-style-type: none"> • Check the ECU pin #34 for open and short. - Check the immobilizer unit for open and short or check the supply voltage. - Check the immobilizer antenna and transponder for damage. - Replace the ECU if required. 						
P1633	Immobilizer Fault (refer to immobilizer section)	<ul style="list-style-type: none"> - No key coding. - Perform the immobilizer coding again. - Check the ECU wiring harness. <ul style="list-style-type: none"> • Check the ECU pin #34 for open and short. - Check the immobilizer unit for open and short or check the supply voltage. - Check the immobilizer antenna and transponder for damage. - Replace the ECU if required. 						
P0633	Immobilizer Fault (refer to immobilizer section)	<ul style="list-style-type: none"> - Key memory is not available (permissible - 5). - Perform the immobilizer coding again. - Check the ECU wiring harness. <ul style="list-style-type: none"> • Check the ECU pin #34 for open and short. - Check the immobilizer unit for open and short or check the supply voltage. - Check the immobilizer antenna and transponder for damage. - Replace the ECU if required. 						

SCAN

ECU

TCU

M/T

TCCU

CLUTCH

BRAKE

A/BAG

A/CON

FFH

RK-STICS

R/SENSOR

S/ROOF

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1636	Immobilizer Fault (refer to immobilizer section)	<ul style="list-style-type: none"> - Severe trouble is not defined. - Perform the immobilizer coding again. - Check the ECU wiring harness. <ul style="list-style-type: none"> • Check the ECU pin #34 for open and short. - Check the immobilizer unit for open and short or check the supply voltage. - Check the immobilizer antenna and transponder for damage. - Replace the ECU if required. 						
P1102	High HFM Sensor Signal	<ul style="list-style-type: none"> - HFM sensing values are higher than specified sensing values (not circuit failure but sensor failure). 						
P1103	Low HFM Sensor Signal	<ul style="list-style-type: none"> - HFM sensing values are lower than specified sensing values (not circuit failure but sensor failure). 						
P1501	Variant coding failure (vehicle speed)	<ul style="list-style-type: none"> - If the vehicle speed is below 15 km/h (even over 1,600 rpm of engine speed) when the "Vehicle speed sensor" coding is "YES" (Non-ABS vehicle), the vehicle speed input failure appears. - If the "Vehicle speed sensor" coding is "NO" (CAN, ABS/ESP vehicle), the trouble code does not appear. - Check the "Vehicle speed sensor" coding. 						
P1503	Vehicle speed sensor input failure	<ul style="list-style-type: none"> - If the pulse from speed pulse ring is more than specified value during the specified interval when the "Vehicle speed sensor" coding is "YES" (Non-ABS vehicle), the vehicle speed sensor failure appears. - Specified pulse: 52 pulses/1 revolution - Check the "Vehicle speed sensor" coding. 						
P0600	CAN BUS failure	<ul style="list-style-type: none"> - CAN related device in ECU is defective. - CAN communication between units is failure. 						
P0602	Vehicle speed sensor coding failure	<ul style="list-style-type: none"> - Even though the ESP or TCCU is not installed in the vehicle, the vehicle speed signal is sent through CAN communication. 						
P0608	ABS/ESP coding failure	<ul style="list-style-type: none"> - ABS/ESP variant coding is failure. - CAN communication is failure. 						
P0613	TCU coding failure	<ul style="list-style-type: none"> - TCU variant coding is failure. - CAN communication between units is failure. 						
P0644	CAN cluster failure	<ul style="list-style-type: none"> - CAN cluster is failure. - CAN communication between units is failure. 						

DIAGNOSIS

KYRON SM - 2005.09

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DTC	Trouble	Help	Torque Reduction (max.50%)	Torque Reduction (max.20%)	Delayed Engine Stop	Immediately Engine Stop	Limp Home Mode	MIL
P1565	Auto cruise switch failure (Acceleration)	- Auto cruise acceleration switch or related wiring harness is defective.						
P1566	Auto cruise switch failure (OFF)	- Auto cruise OFF switch or related wiring harness is defective.						
P1567	Auto cruise switch failure	- Auto cruise switch or related wiring harness is defective.						
P1568	Auto cruise switch failure (Deceleration)	- Auto cruise deceleration switch or related wiring harness is defective.						
P1569	Auto cruise switch failure (Safety)	- Auto cruise safety switch or related wiring harness is defective.						
P3040	ECU internal failure	- ECU internal failure						
P3041	ECU internal failure (only D27DT)	- ECU internal failure						
P1657	Engine mount control failure (Open)	- Engine mount level control circuit is failure.						
P1658	Engine mount control failure (Short to B+)	- Engine mount level control circuit is short to B+.						
P1659	Engine mount control failure (Short to ground)	- Engine mount level control circuit is short to ground.						

SCAN
ECU
TCU
M/T
TCCU
CLUTCH
BRAKE
A/BAG
A/CON
FFH
RK-STICS
R/SENSOR
S/ROOF

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

MEMO

Lined area for writing the memo.

INDEX OF DTC

HMf sensor Signal Fault (Electric Failure)	57	Brake Lamp Signal Fault	72
P0102	57	P1572	72
P0103	57	P1571	72
P0100	57	High Wiring Resistance (Injector #1)	73
Cam Position Sensor (missing event)	58	P1286	73
P0344	58	P1287	73
Cam Position Sensor Malfunction		High Wiring Resistance (Injector #2)	74
(Poor Synchronization of Crank and Cam)	59	P1288	74
P0341	59	P1289	74
Too Large Clearance of Crank Angle Sensor	60	High Wiring Resistance (Injector #3)	75
P0219	60	P1292	75
Too Small Clearance of Crank Angle Sensor	61	P1293	75
P0336	61	High Wiring Resistance (Injector #4)	76
Crank Angle Sensor Malfunction	62	P1294	76
P0372	62	P1295	76
Barometric Sensor Malfunction (Out of range, using		High Wiring Resistance (Injector #5)	77
strategy of restoring by MAP sensor)	63	P1290	77
P1107	63	P1291	77
P1108	63	Clutch Switch Malfunction	78
P1105	63	P0704	78
Battery Voltage Monitoring Signal Malfunction	64	Coolant Temperature Sensor Malfunction	
P0562	64	(Implausible Signal)	79
P0563	64	P1115	79
P0560	64	Coolant Temperature Sensor Malfunction	
Booster Pressure Sensor Malfunction		(Electric Fault)	80
(Out of range with Key ON)	65	P0117	80
P0109	65	P0118	80
P0106	65	P0115	80
Booster Pressure Sensor Malfunction		Too Fast or Low Main Relay Operation	81
(Out of range with Key ON)	67	P0685	81
P0107	67	EGR Actuator Malfunction	82
P0108	67	P1405	82
P0105	67	P1406	82
P1106	67	Condenser Fan Driving Signal Fault (Type 1)	83
Booster Pressure Malfunction (Implausible Signal)	69	P1480	83
P1109	69	P1481	83
Brake Pedal Switch Malfunction	71	P1482	83
P0571	71		

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Condenser Fan Driving Signal Fault (Type 2)	84	HSD Circuit Short to LSE (Injector #2)	102
P1526	84	P1202	102
P1527	84	HSD Circuit Short to LSE (Injector #4)	103
P1528	84	P1204	103
#1 Accelerometer Malfunction (Idling Signal/Too Small Noise Ratio)	85	HSD Circuit Short to LSE (Injector #5)	104
P0325	85	P1205	104
#2 Accelerometer Malfunction (Idling Signal/Too Small Noise Ratio)	86	HSD Circuit Short to LSE (Injector #3)	105
P0330	86	P1203	105
Injector Bank 1 Malfunction(Short to Ground or B+)	87	Fuel Temperature Sensor Malfunction	106
P1611	87	P0182	106
P1612	87	P0183	106
Injector Bank 2 Malfunction(Short to Ground or B+)	89	P0180	106
P1618	89	Glow Plug Malfunction (Driving Signal)	107
P1619	89	P1678	107
Cylinder Balancing Fault (Injector #1) = Clogged Air Intake System	91	P1679	107
P0263	91	P1680	107
Cylinder Balancing Fault (Injector #2) = Clogged Air Intake System	92	Heater 1 Malfunction (Driving Signal)	108
P0266	92	P1530	108
Cylinder Balancing Fault (Injector #4) = Clogged Air Intake System	93	P1531	108
P0272	93	P1532	108
Cylinder Balancing Fault (Injector #5) = Clogged Air Intake System	94	Heater 2 Malfunction (Driving Signal)	109
P0275	94	P1534	109
Cylinder Balancing Fault (Injector #3) = Clogged Air Intake System	95	P1535	109
P0269	95	P1536	109
Open Circuit (Injector #1)	96	Rail Pressure Control Fault (Too High Pressure)	110
P0201	96	P1254	110
Open Circuit (Injector #2)	97	P1253	110
P0202	97	Rail Pressure Control Fault (Too High IMV Current Trim, drift)	112
Open Circuit (Injector #4)	98	P1256	112
P0204	98	P1257	112
Open Circuit (Injector #5)	99	P1258	112
P0205	99	P1259	112
Open Circuit (Injector #3)	100	Rail Pressure Control Fault (Too Slow Pressure Build Up while Cranking)	114
P0203	100	P1191	114
HSD Circuit Short to LSE (Injector #1)	101	IMV Operation Fault (Electrical Fault)	116
P1201	101	P0255	116
		P0251	116
		P0253	116
		Intake Air Temperature Sensor Fault (Electric Fault)	117
		P0112	117
		P0113	117
		P0110	117

DIAGNOSIS

KYRON SM - 2005.09

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

MDP Fault (Injector #1)	118	Fuel Rail Pressure Sensor Malfunction(Out of Range when Key ON)	131
P1171	118	P1192	131
MDP Fault (Injector #2)	118	P1193	131
P1172	118	P1190	131
MDP Fault (Injector #4)	119	Main Relay Malfunction - Stuck	133
P1174	119	P0215	133
MDP Fault (Injector #5)	119	Vehicle Speed Fault	134
P1175	119	P1500	134
MDP Fault (Injector #3)	120	5V Supply Voltage 1 Fault	135
P1173	120	P0642	135
Rail Pressure Fault (Too High)	121	P0643	135
P1252	121	P0641	135
Accelerator Pedal Sensor Malfunction(Relationship between Track 1 and Track 2)	123	5V Supply Voltage 2 Fault	136
P1120	123	P0652	136
P1121	123	P0653	136
Accelerator Pedal Sensor Malfunction (Torque Reduction Mode Operation)	124	P0651	136
P1122	124	2.5V Supply Voltage Fault	137
Accelerator Pedal Sensor Malfunction (Limp Home Mode Operation)	125	P0698	137
P1123	125	P0699	137
Accelerator Pedal Sensor Malfunction (Electrical Fault, Pedal Stuck)	126	P0697	137
P1124	126	Turbo Charger Actuator Operation Fault (signal)	138
Accelerator Pedal Sensor Malfunction (Electrical Fault, Track 1)	127	P0245	138
P0122	127	P0246	138
P0123	127	ECU Watchdog Fault	139
P0120	127	P0606	139
Accelerator Pedal Sensor Malfunction (Electrical Fault, Track 2)	128	ECU Watchdog Fault (Injector Cut-off)	140
P0222	128	P1607	140
P0223	128	ECU Watchdog Fault (Watchdog Trip)	141
P0220	128	P1600	141
Fuel Rail Pressure Sensor Malfunction (Out of Range, ADC or Vref)	129	P1601	141
P0192	129	P1602	141
P0193	129	ECU Non-Volatile Memory Fault	142
P0190	129	P1614	142
P0191	129	P1615	142
		P1616	142
		P1606	142
		P1620	142
		P1621	142
		P1622	142
		Accelerometer Learning Fault	143
		P1148	143

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

EGR Valve Control Fault	144	TCU Signal Fault	153
P0400	144	P0700	153
VGT Operation Fault	145	Air Conditioner Operating Circuit Fault	154
P1235	145	P1540	154
TBD	147	P1541	154
P1608	147	P1542	154
No Crank Signal	148	Excessive Water in Fuel Filter	155
P0335	148	P1149	155
High Torque Trim	149	Immobilizer Malfunction	156
P1170	149	P1634	156
Glow Plug Module Communication Fault	150	P4335	156
P1676	150	P1630	156
P1677	150	P1631	156
Glow Plug Module Circuit Malfunction - Open	151	P1632	156
P0671	151	P1633	156
P0672	151	P0633	156
P0673	151	P1636	156
P0674	151		
P0675	151		
Glow Plug Module Circuit Malfunction - Short (B+)	152		
P1671	152		
P1672	152		
P1673	152		
P1674	152		
P1675	152		

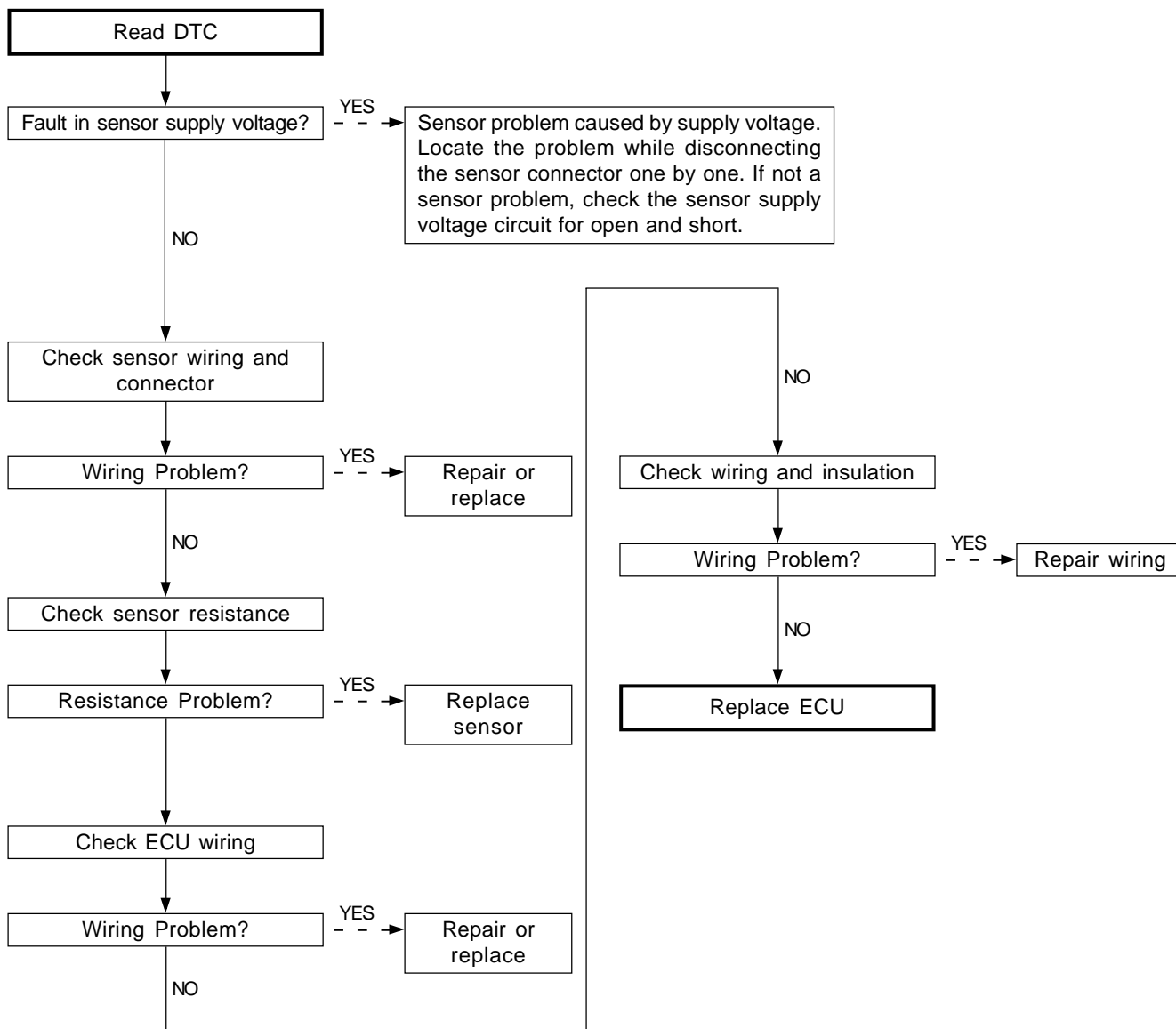
TROUBLE DIAGNOSIS PROCEDURES

HMF sensor Signal Fault (Electric Failure)

► Trouble Code and Symptom

Trouble Code		Symptom
P0102	Low Signal	
P0103	High Signal	Not available EGR control(Air flow)
P0100	Supply Voltage	

► Diagnosis Procedures



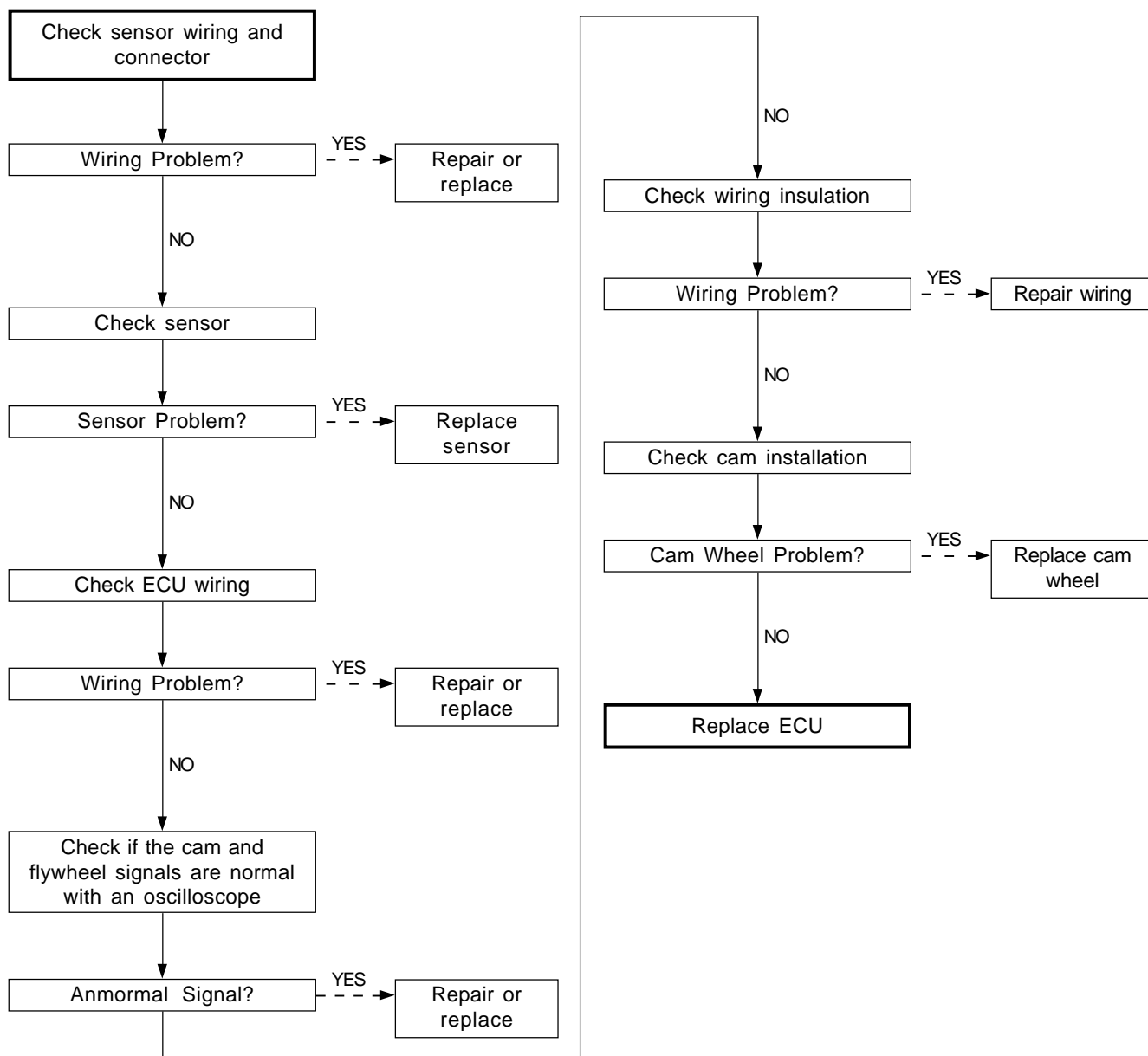
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Cam Position Sensor (missing event)

► Trouble Code and Symptom

Trouble Code		Symptom
P0344	Cam Position Sensor Malfunction	MIL ON
		Check Engine Lamp

► Diagnosis Procedures



DIAGNOSIS

KYRON SM - 2005.09

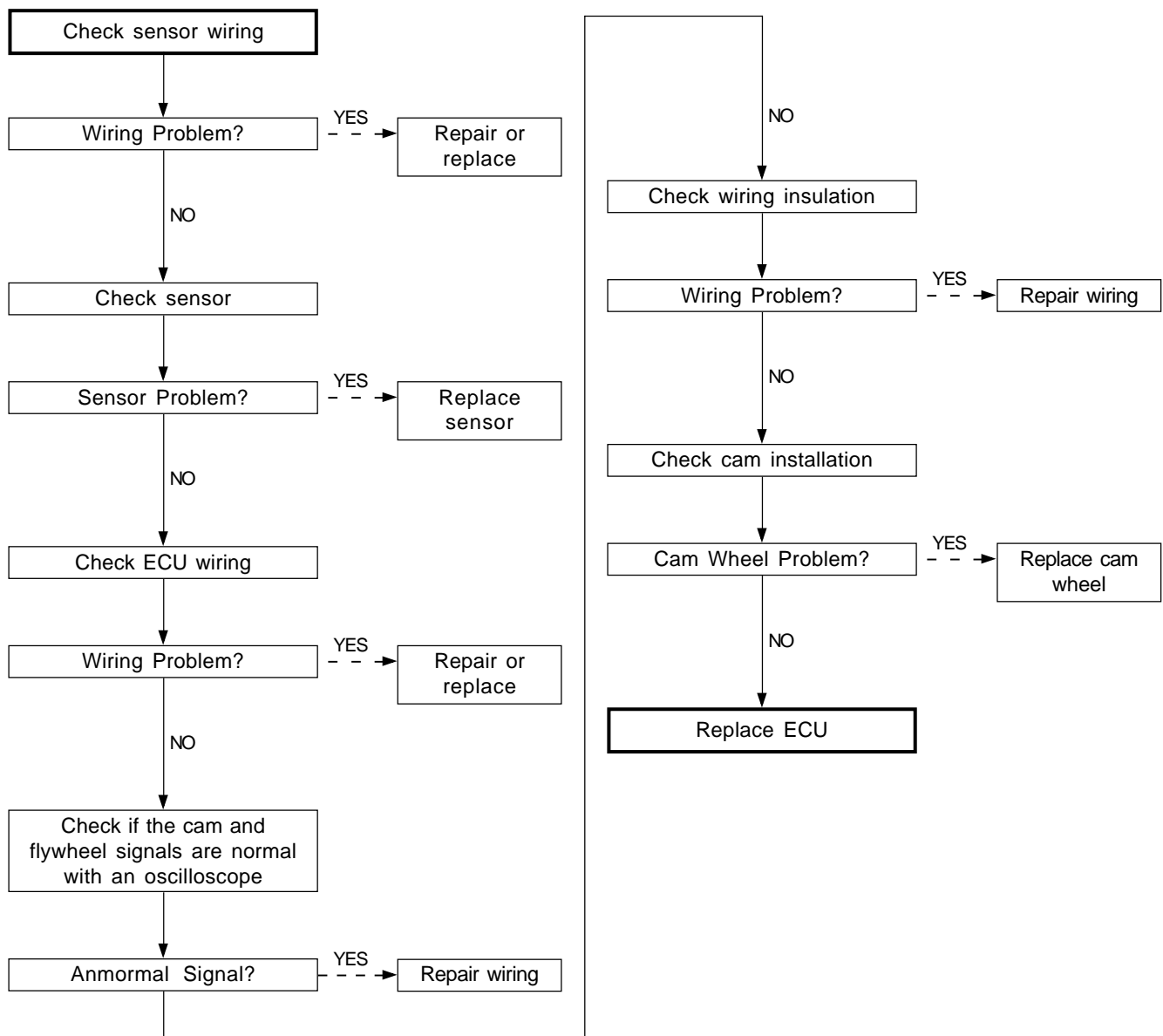
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Cam Position Sensor Malfunction (Poor Synchronization of Crank and Cam)

► Trouble Code and Symptom

Trouble Code		Symptom
P0341	Cam Position Sensor Malfunction - Poor Synchronization	MIL ON

► Diagnosis Procedures



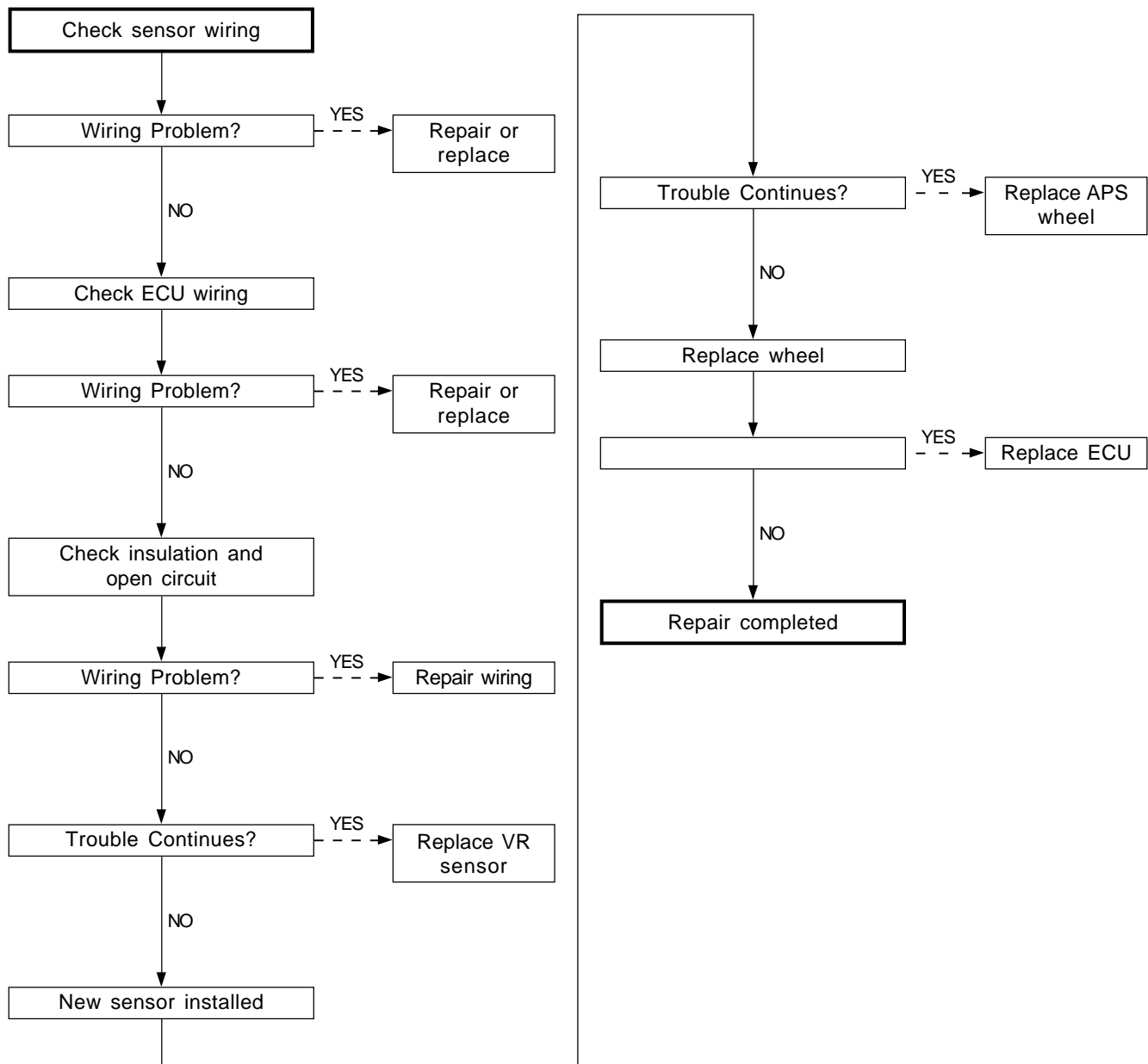
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Too Small Clearance of Crank Angle Sensor

► Trouble Code and Symptom

Trouble Code		Symptom
P0219	Too Small Clearance of Crank Angle Sensor	MIL ON

► Diagnosis Procedures



DIAGNOSIS

KYRON SM - 2005.09

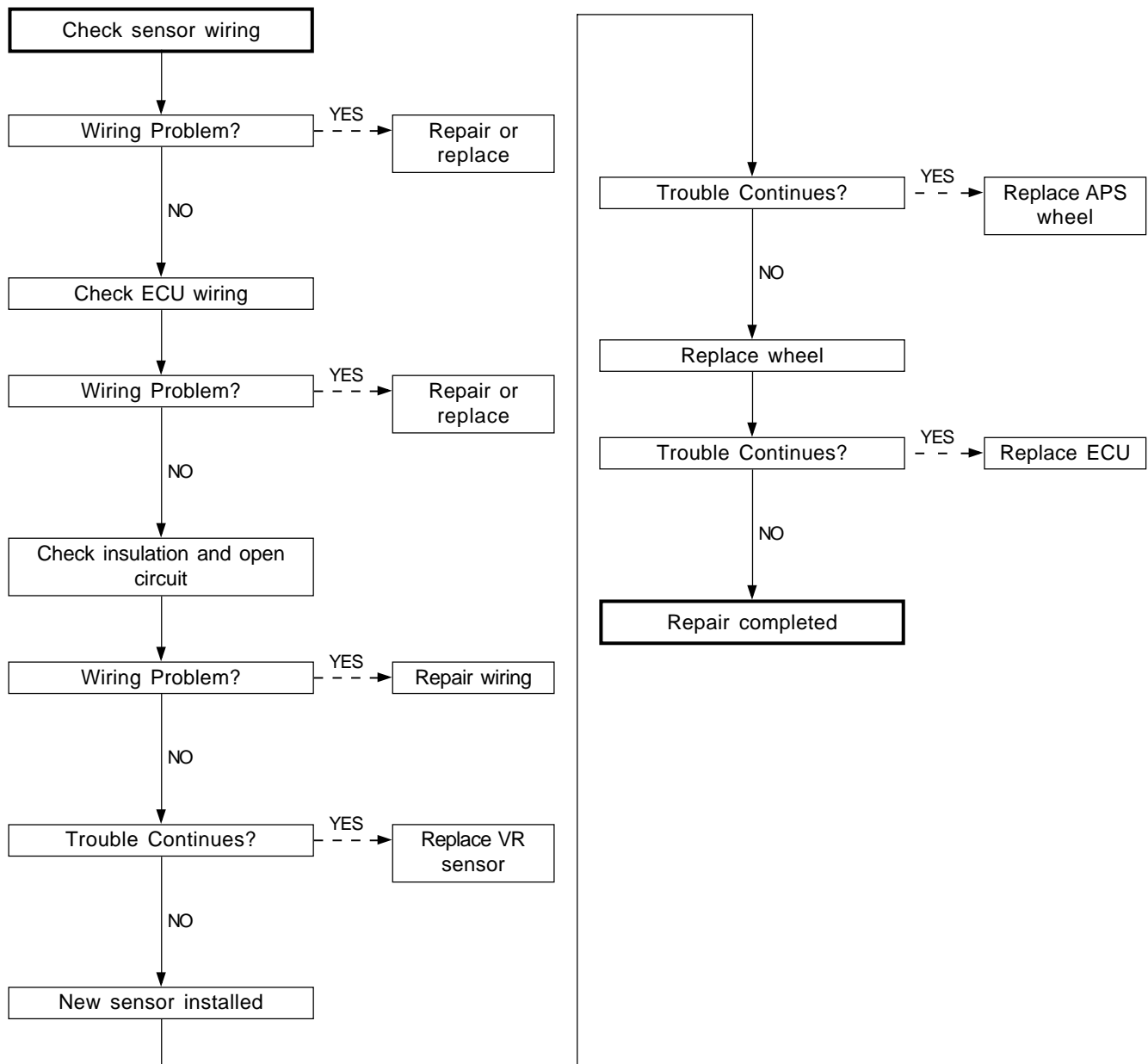
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Too Large Clearance of Crank Angle Sensor

► Trouble Code and Symptom

Trouble Code		Symptom
P0336	Too Large Clearance of Crank Angle Sensor	MIL ON

► Diagnosis Procedures



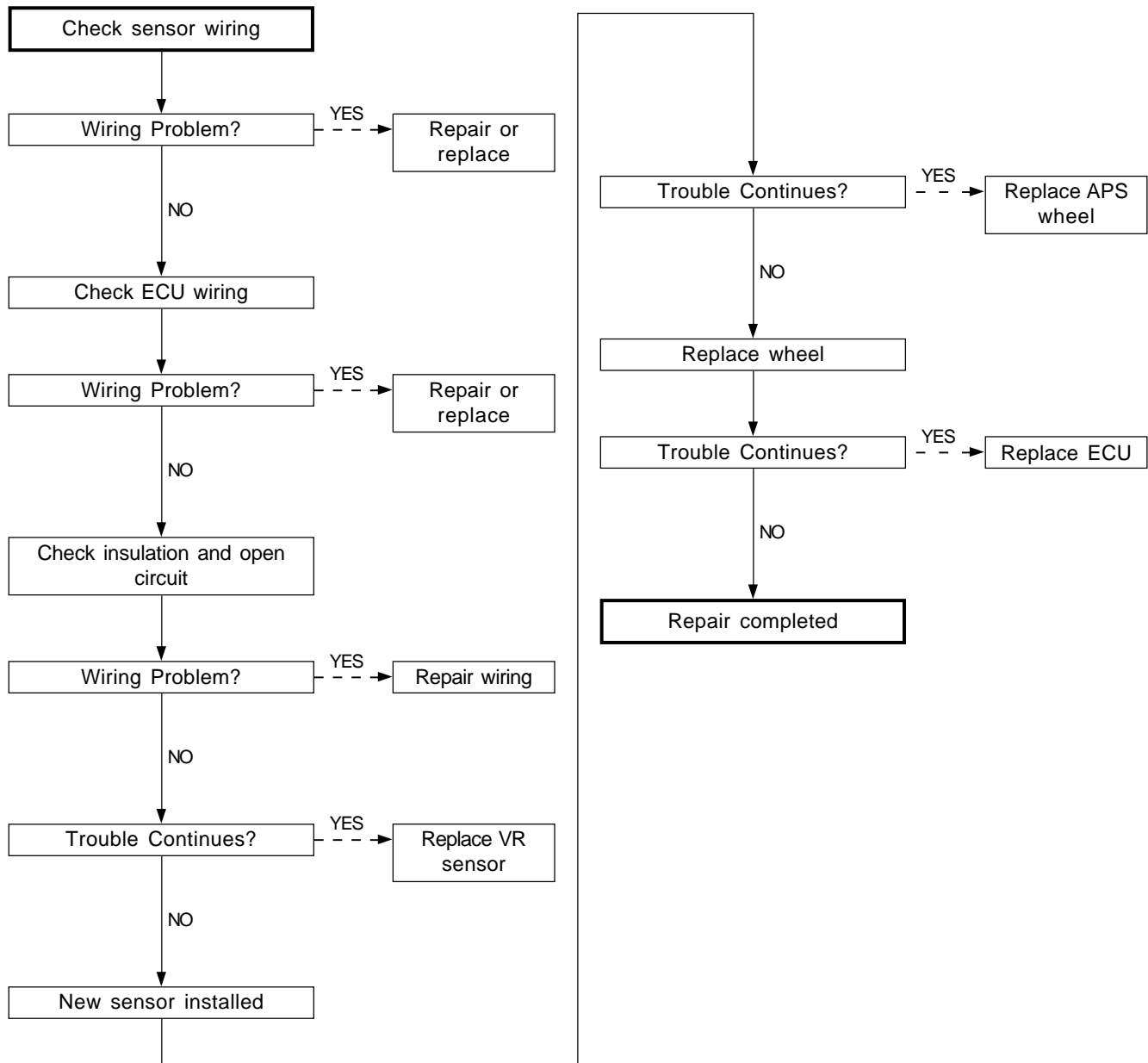
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Crank Angle Sensor Malfunction

► Trouble Code and Symptom

Trouble Code		Symptom
P0372	Crank Angle Sensor Malfunction 3	MIL ON

► Diagnosis Procedures



DIAGNOSIS

KYRON SM - 2005.09

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Barometric Sensor Malfunction
(Out of range, using strategy of
restoring by MAP sensor)

► Trouble Code and Symptom

Trouble Code		Symptom
P1107	Low Signal	
P1108	High Signal	
P1105	Supply Voltage (Vext)	

► Diagnosis Procedures

Replace ECU

SCAN
ECU
TCU
M/T
TCCU
CLUTCH
BRAKE
A/BAG
A/CON
FFH
RK-STICS
R/SENSOR
S/ROOF

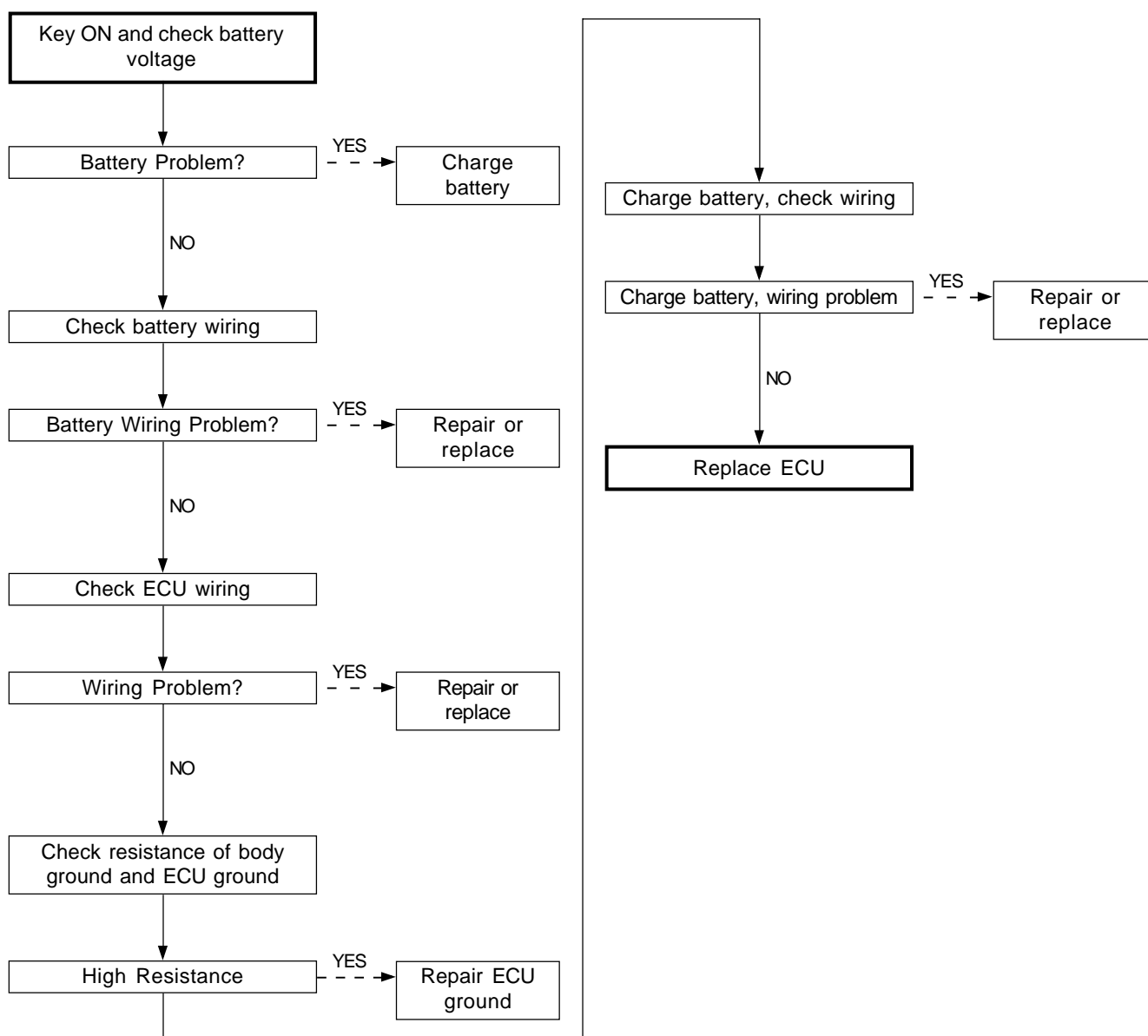
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Battery Voltage Monitoring Signal Malfunction

► Trouble Code and Symptom

Trouble Code		Symptom
P0562	Low Signal	Torque Reduction Mode Operation
P0563	High Signal	Torque Reduction Mode Operation
P0560	Supply Voltage	Torque Reduction Mode Operation

► Diagnosis Procedures



DIAGNOSIS

KYRON SM - 2005.09

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

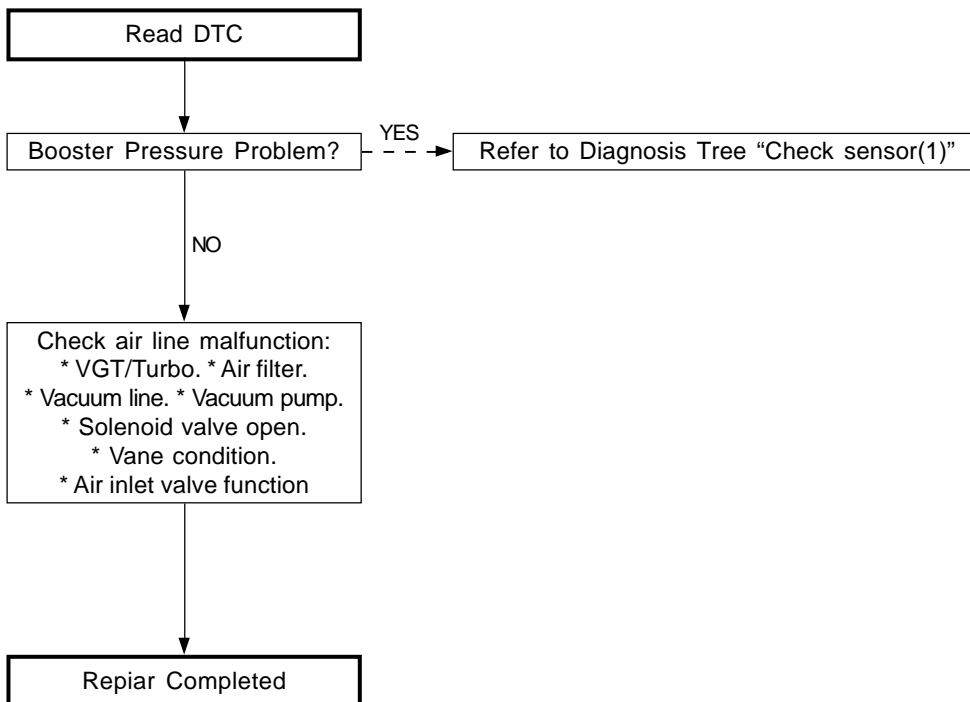
Booster Pressure Sensor Malfunction (Out of range with Key ON)

► Trouble Code and Symptom

Trouble Code		Symptom
P0109	Low	
P0106	High	Location demand=change the boost control to O.L. mode at f (boost demand, engine cycling speed)

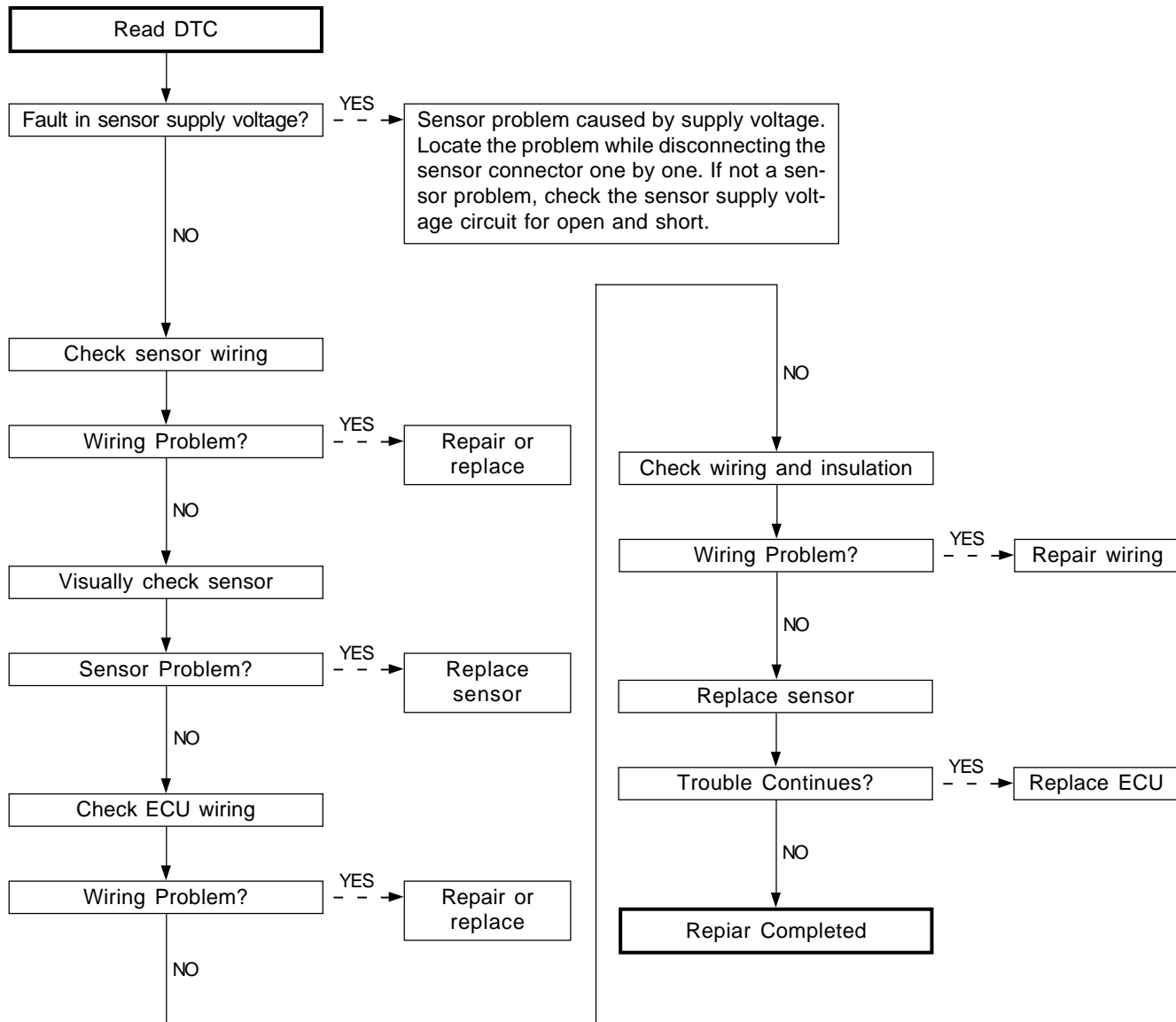
► Diagnosis Procedures

1. Diagnosis Procedures (Boost Pressure)



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

2. Diagnosis Procedure (Check sensor (1))



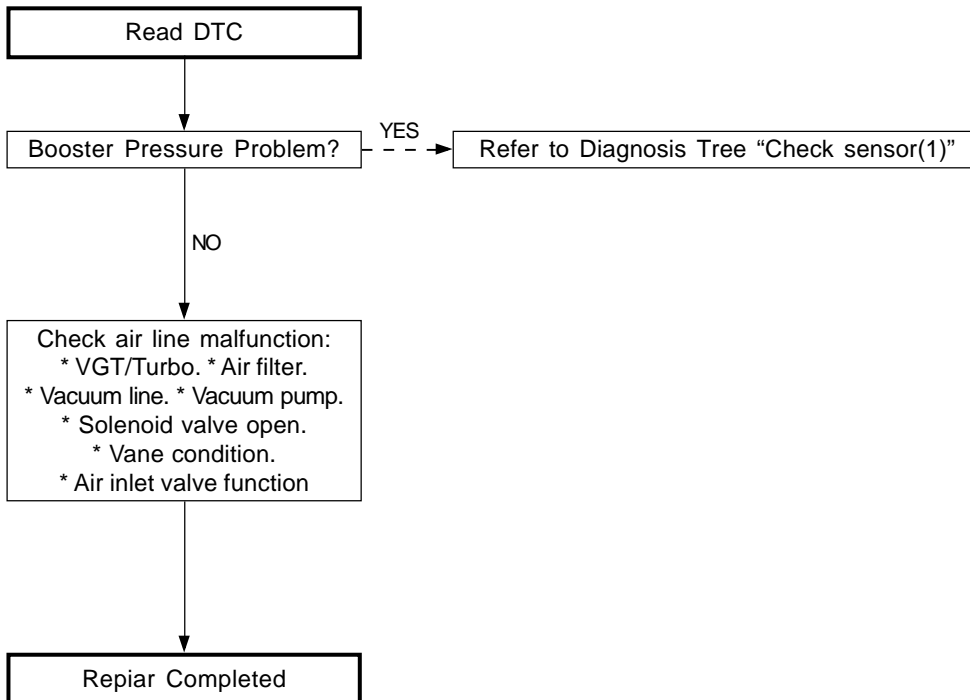
Booster Pressure Sensor Malfunction (Out of range with Key ON)

► Trouble Code and Symptom

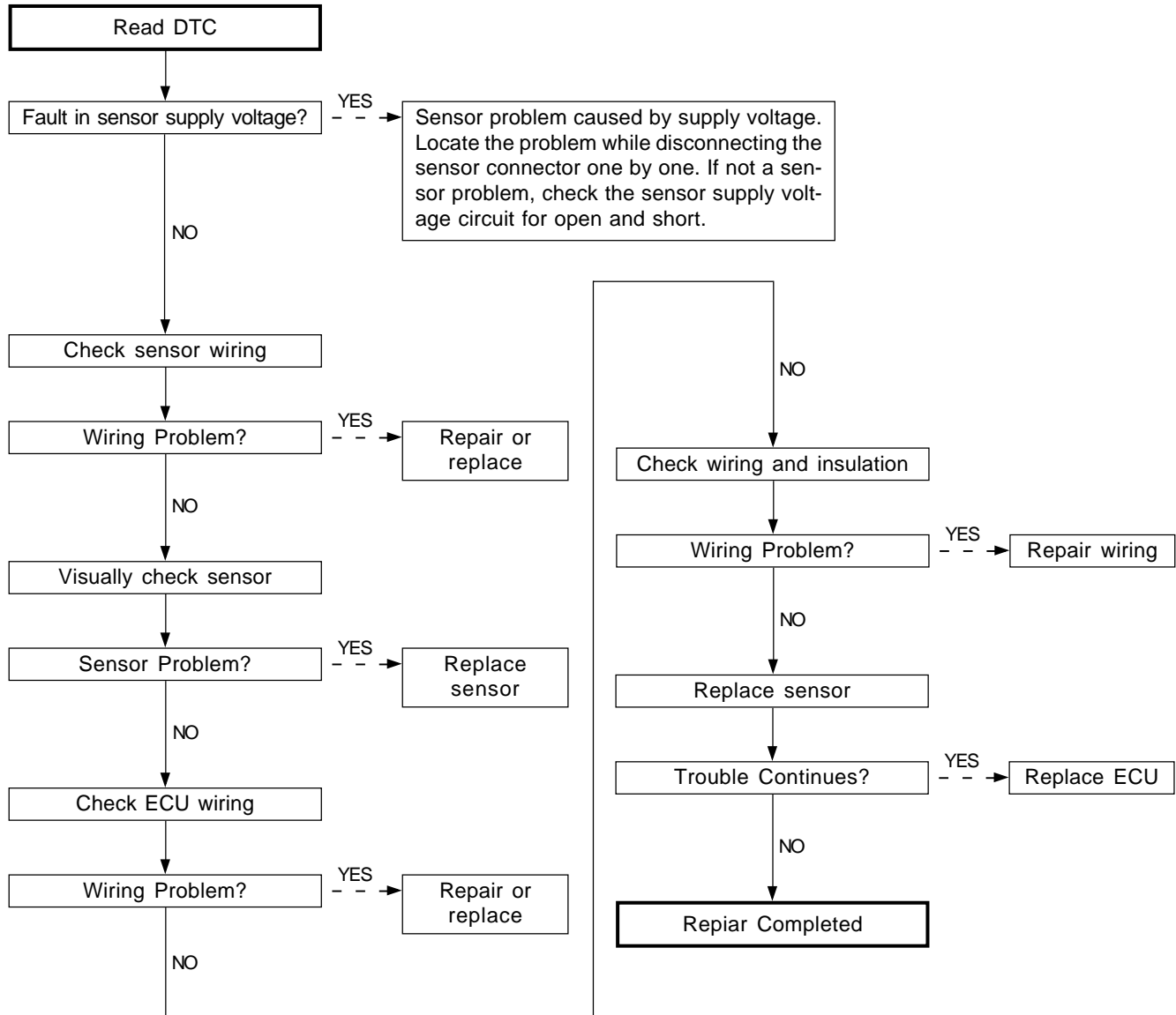
Trouble Code		Symptom
P0107	Low	
P0108	High	Location demand=change the boost control to O.L. mode at f (boost demand, engine cycling speed)
P0105	Supply Voltage	
P1106	GRAD	

► Diagnosis Procedures

1. Diagnosis Procedures (Boost Pressure)



2. Diagnosis Procedures (check sensor (1))



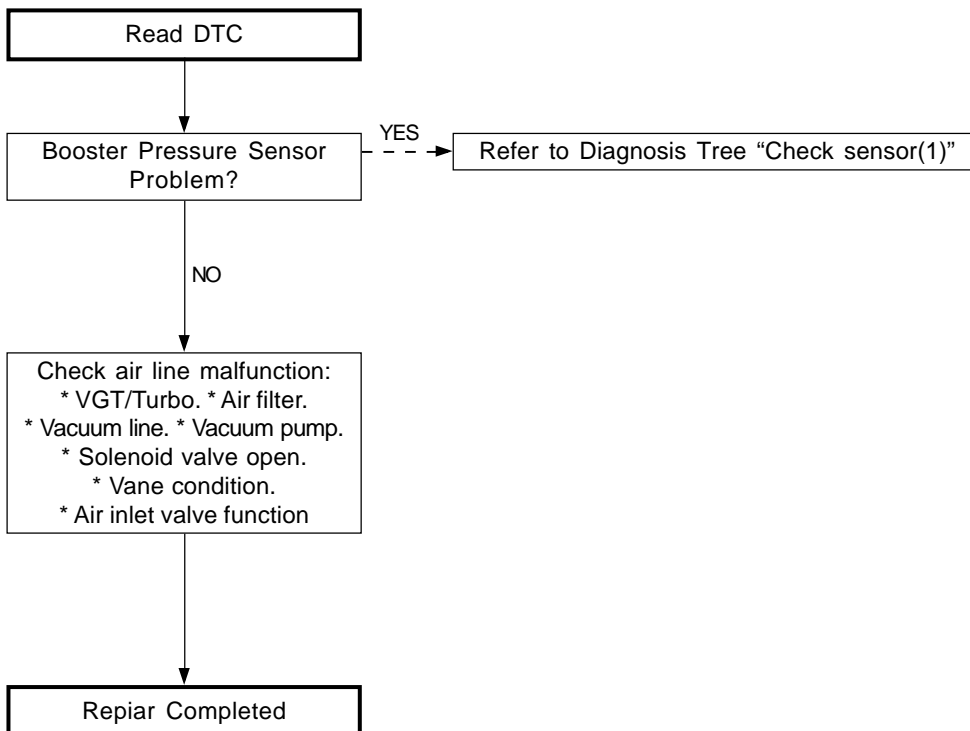
Booster Pressure Malfunction (Implausible Signal)

► Trouble Code and Symptom

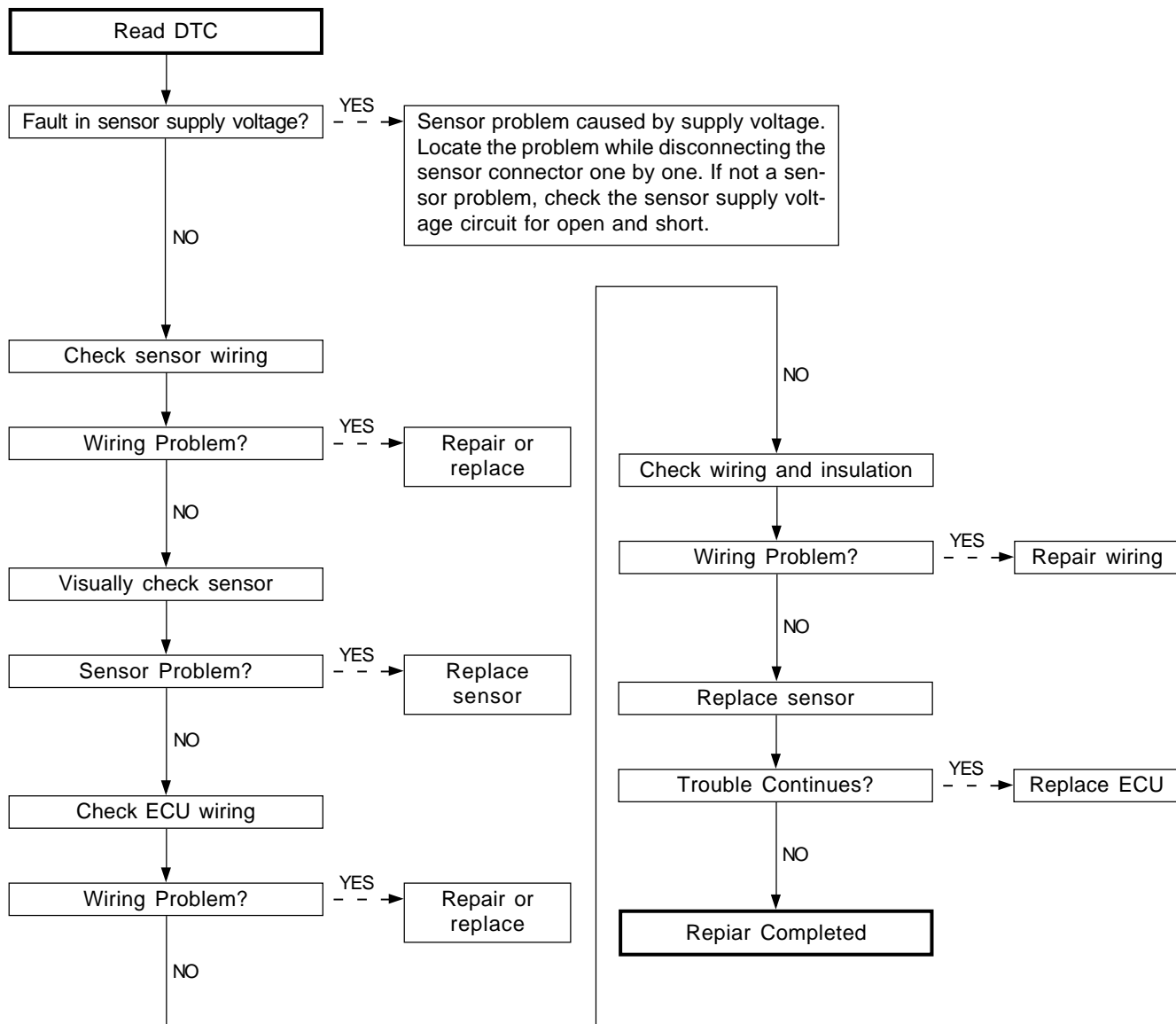
Trouble Code		Symptom
P1109	Booster Pressure Sensor Malfunction	
		Location demand=change the boost control to O.L. mode at f (boost demand, engine cycling speed)

► Diagnosis Procedures

1. Diagnosis Procedures (Boost Pressure)



2. Diagnosis Procedures (check sensor (1))

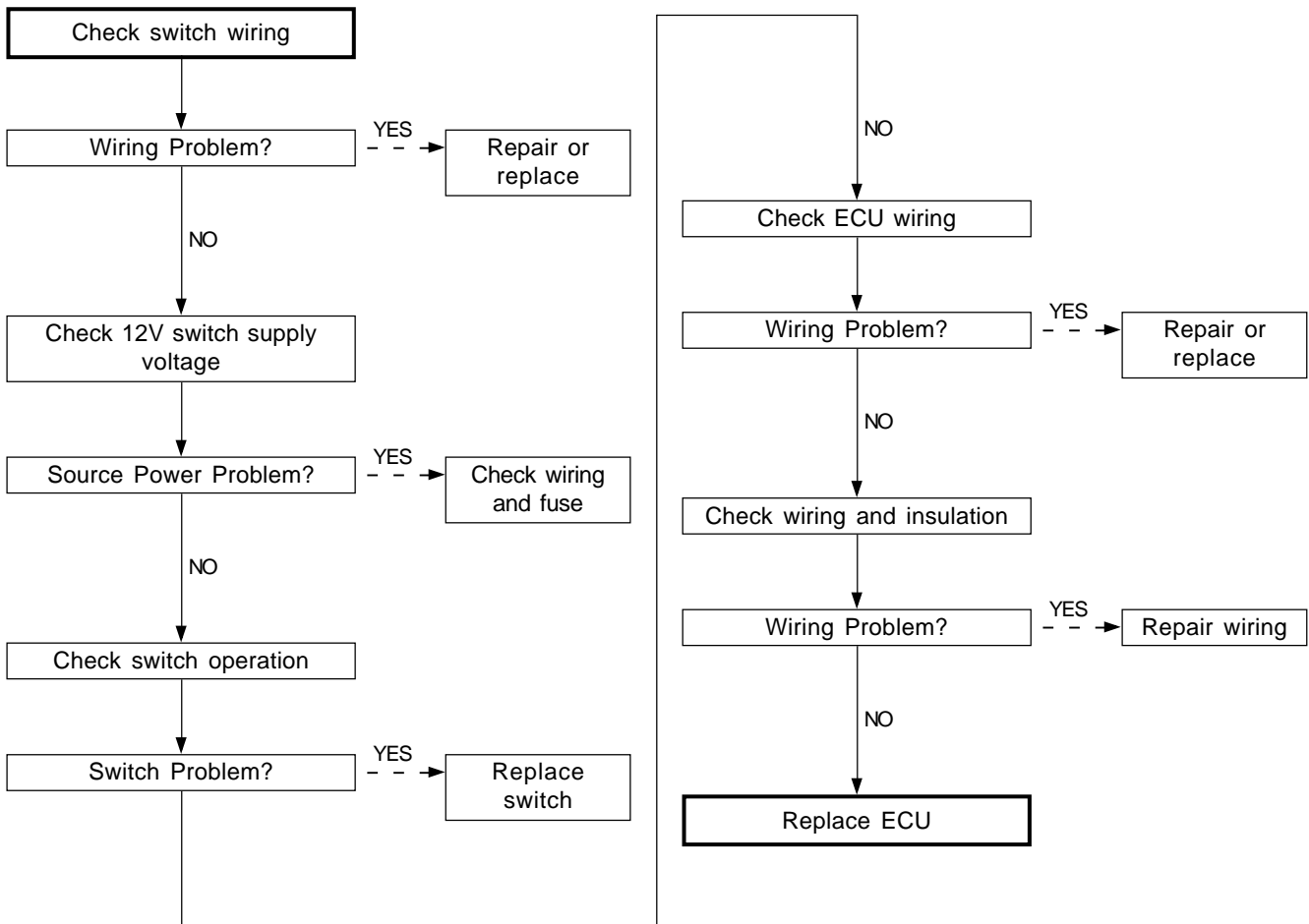


Brake Pedal Switch Malfunction

► Trouble Code and Symptom

Trouble Code		Symptom
P0571	Brake Pedal Switch Malfunction	Unable Cruise Control

► Diagnosis Procedures



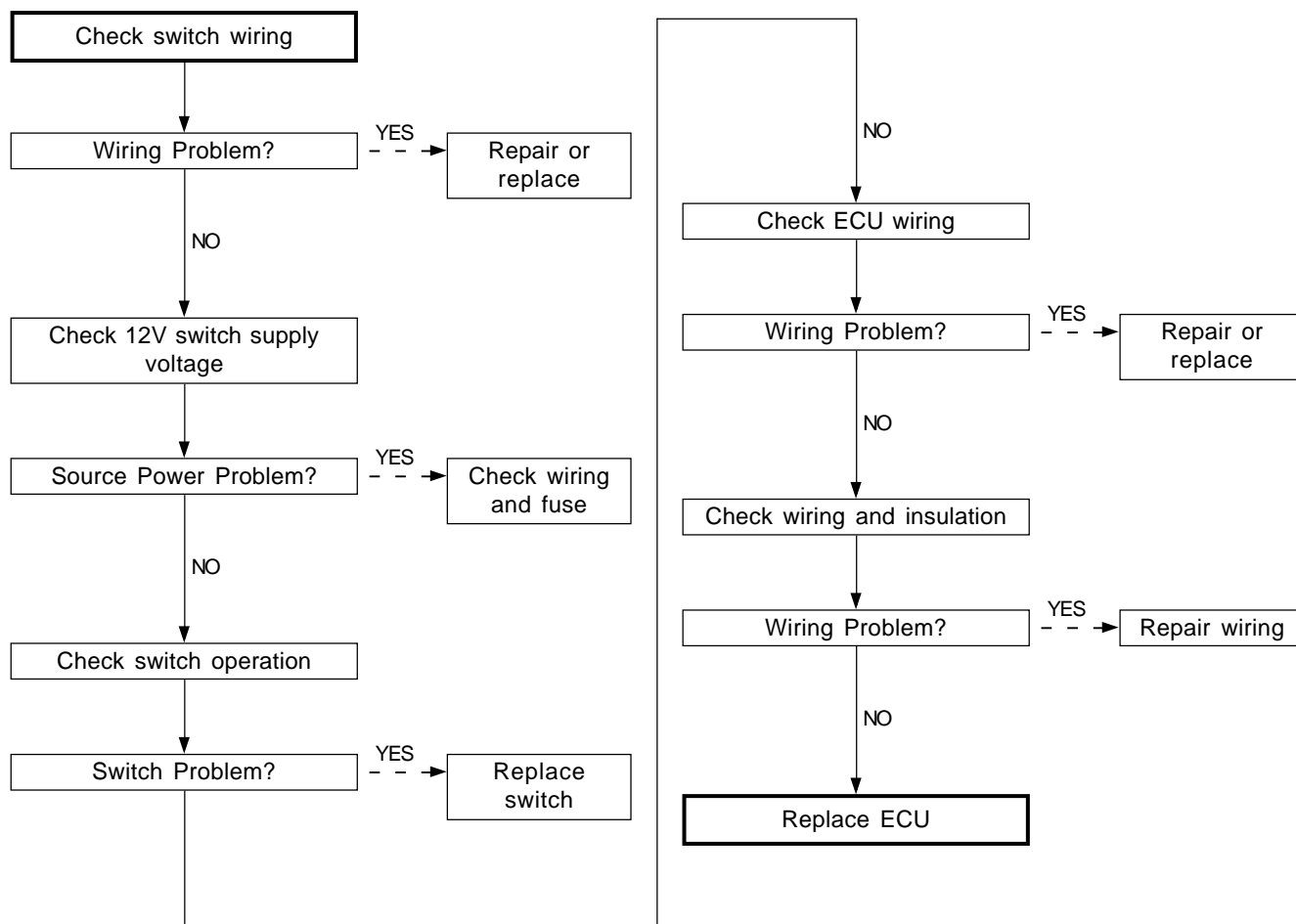
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Brake Lamp Signal Fault

► Trouble Code and Symptom

Trouble Code		Symptom
P1572	Brake Lamp Signal Fault	
P1571	Brake Lamp Signal Fault	

► Diagnosis Procedures



DIAGNOSIS

KYRON SM - 2005.09

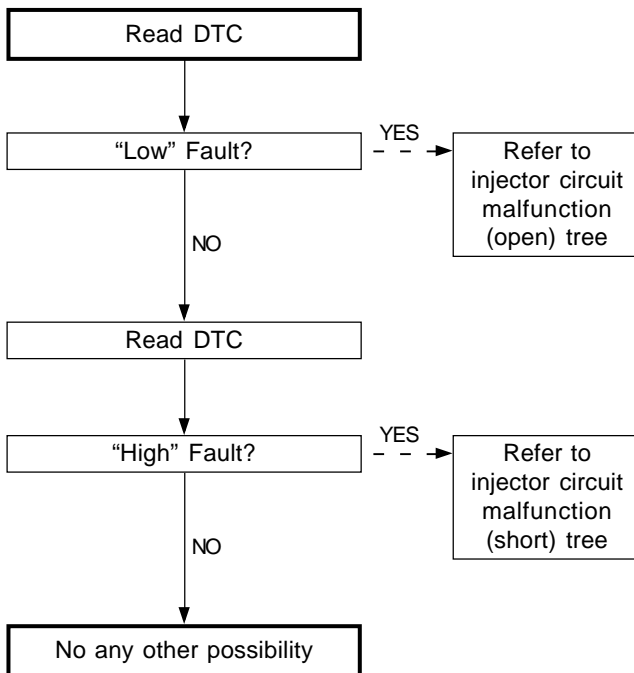
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

High Wiring Resistance (Injector #1)

► Trouble Code and Symptom

Trouble Code		Symptom
P1286	Low	Resistance of injector #1 fault. Use estimate resistance level.
P1287	High	Unable Dynamic Leak of Injector #1
		Unable Accelerometer Learning Strategy

► Diagnosis Procedures

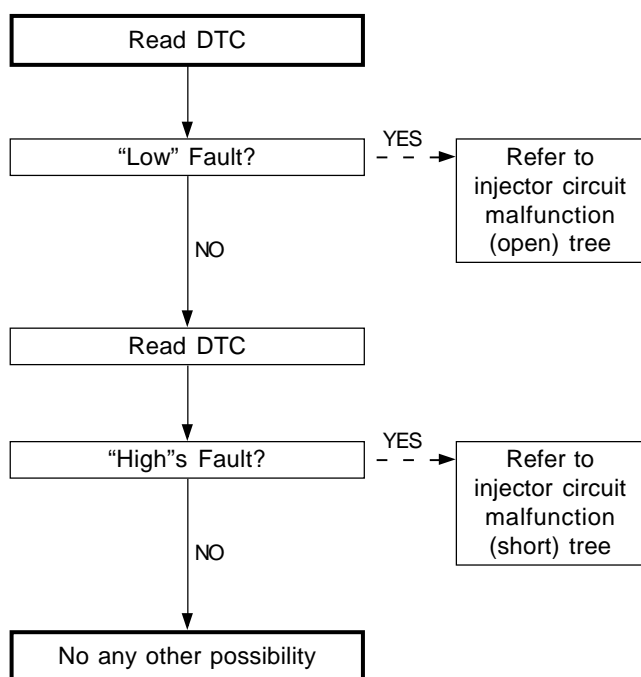


High Wiring Resistance (Injector #2)

► Trouble Code and Symptom

Trouble Code		Symptom
P1288	Low	Resistance of injector #2 fault. Use estimate resistance level.
P1289	High	Unable Dynamic Leak of Injector #2
		Unable Accelerometer Learning Strategy

► Diagnosis Procedures

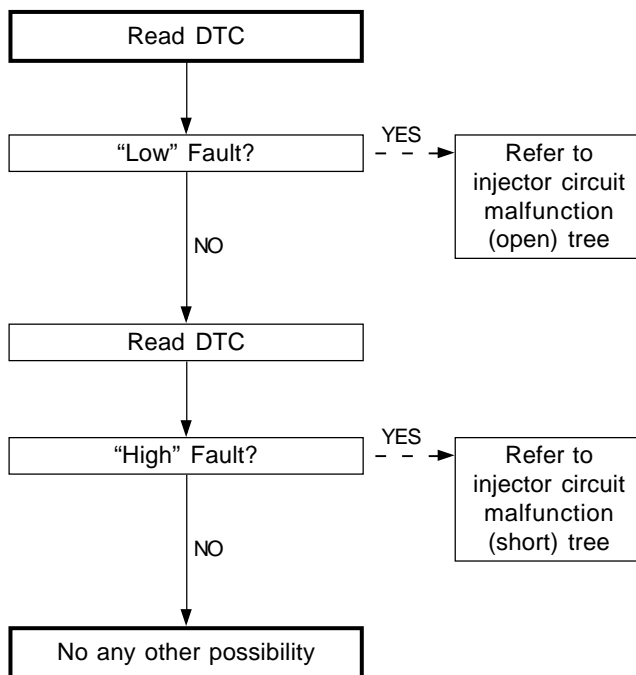


High Wiring Resistance (Injector #3)

► Trouble Code and Symptom

Trouble Code		Symptom
P1292	Low	Resistance of injector #4 fault. Use estimate resistance level.
P1293	High	Unable Dynamic Leak of Injector #4
		Unable Accelerometer Learning Strategy

► Diagnosis Procedures

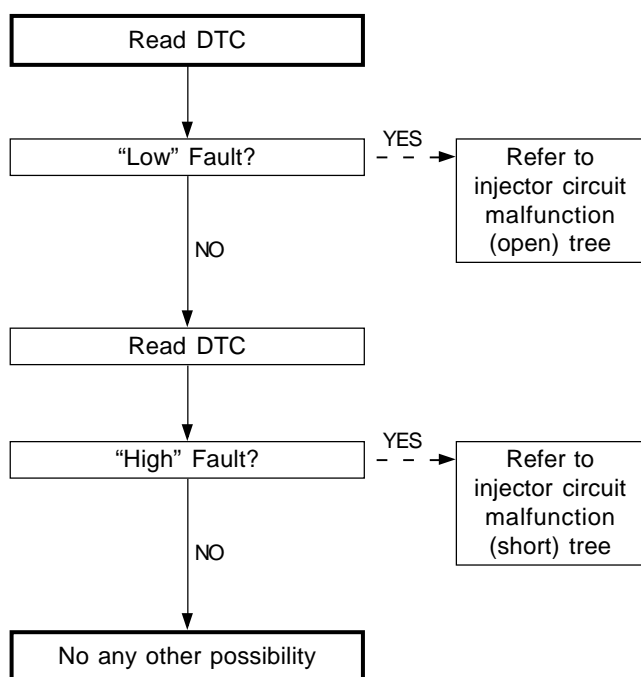


High Wiring Resistance (Injector #4)

► Trouble Code and Symptom

Trouble Code		Symptom
P1294	Low	Resistance of injector #5 fault. Use estimate resistance level.
P1295	High	Unable Dynamic Leak of Injector #5
		Unable Accelerometer Learning Strategy

► Diagnosis Procedures

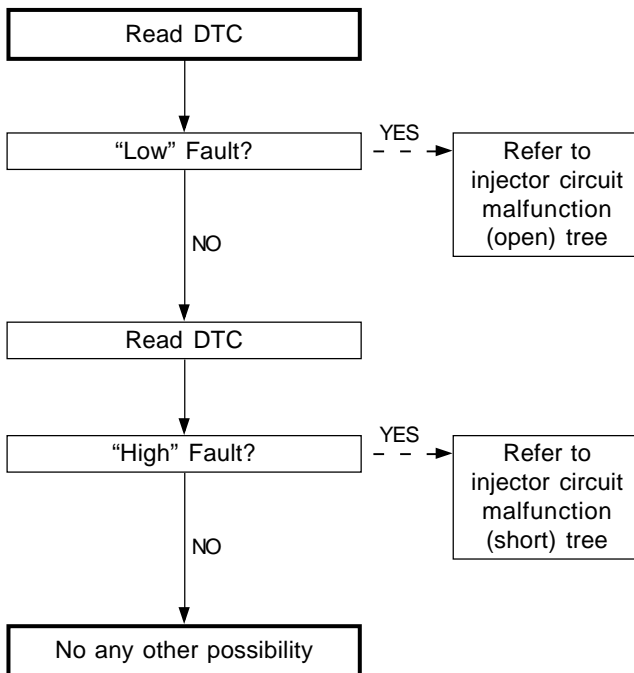


High Wiring Resistance (Injector #5)

► Trouble Code and Symptom

Trouble Code		Symptom
P1290	Low	Resistance of injector #3 fault. Use estimate resistance level.
P1291	High	Unable Dynamic Leak of Injector #3
		Unable Accelerometer Learning Strategy

► Diagnosis Procedures

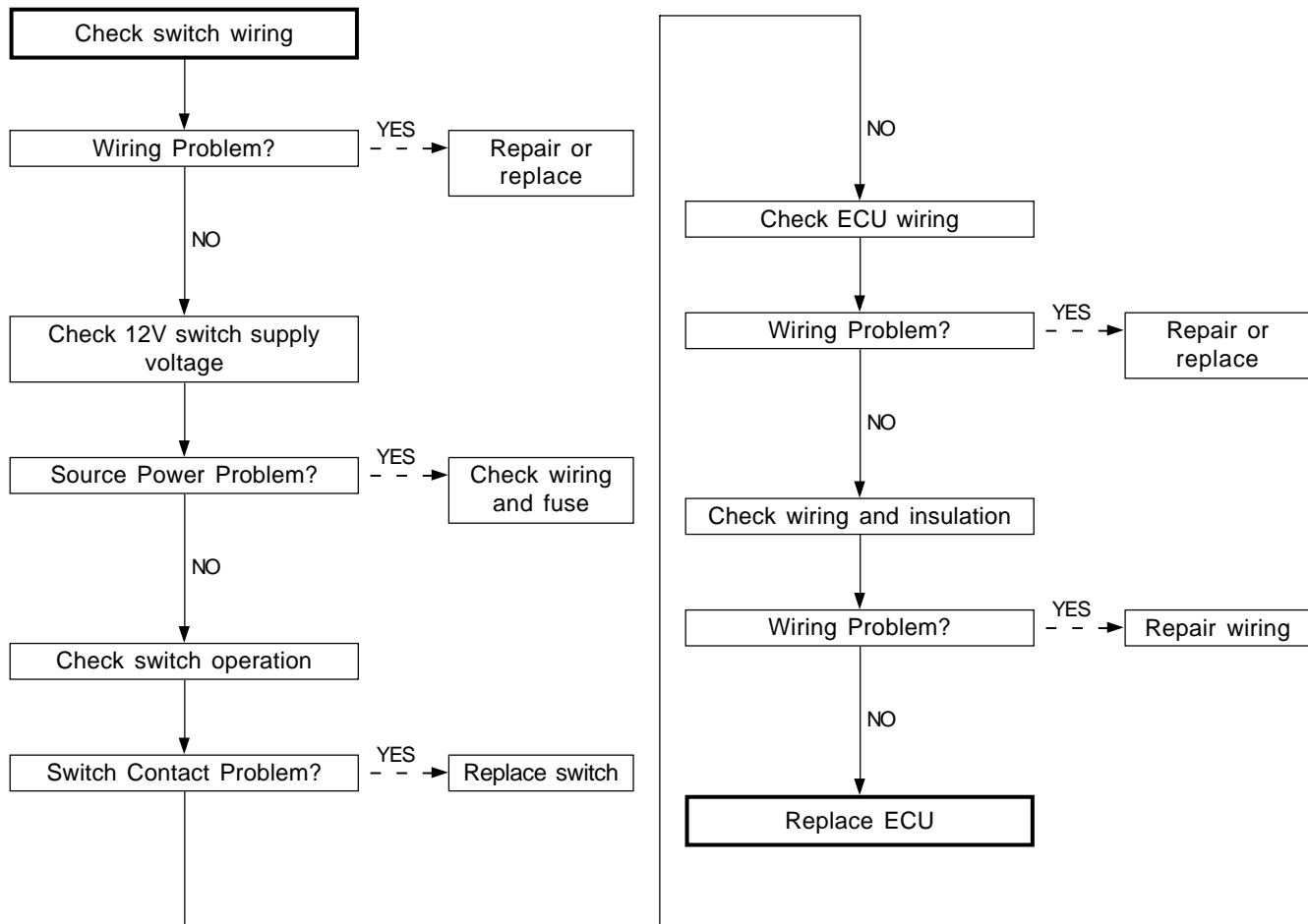


Clutch Switch Malfunction

► Trouble Code and Symptom

Trouble Code		Symptom
P0704	Clutch Switch Malfunction	

► Diagnosis Procedures

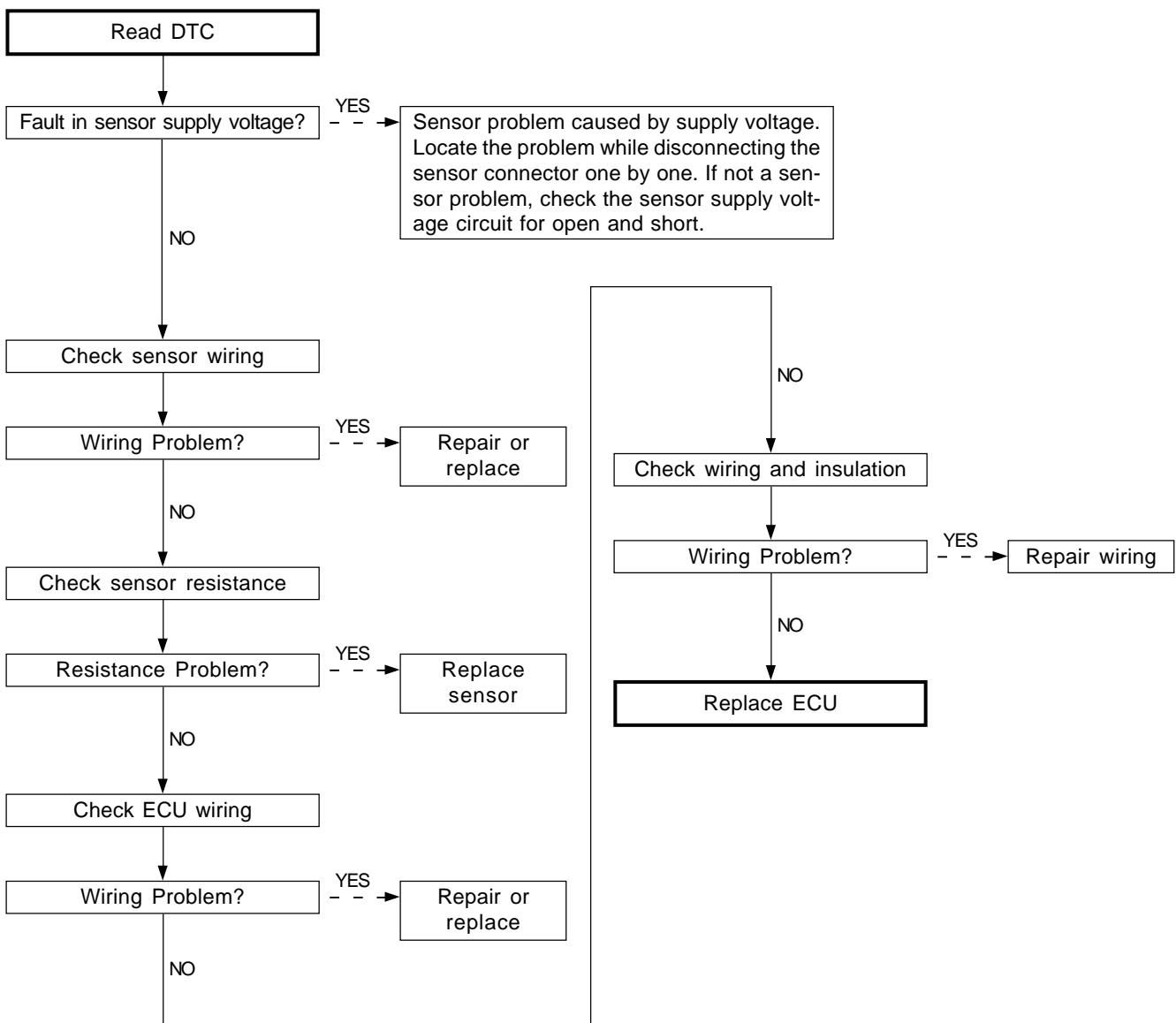


Coolant Temperature Sensor Malfunction (Implausible Signal)

► Trouble Code and Symptom

Trouble Code		Symptom
P1115	Coolant Temperature Sensor Malfunction	Below Limited Temperature of Engine Overheat Detection

► Diagnosis Procedures



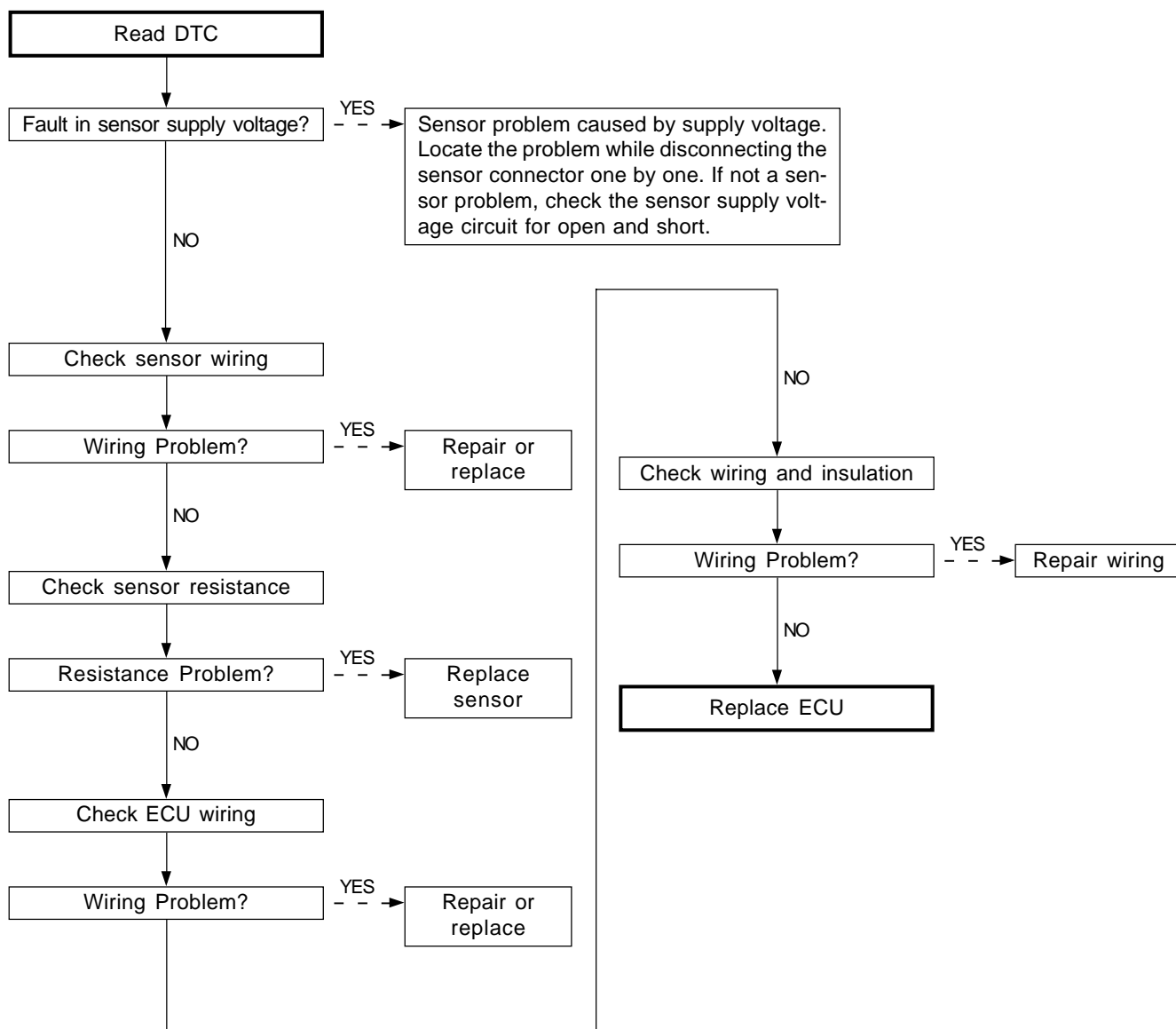
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Coolant Temperature Sensor Malfunction (Electric Fault)

► Trouble Code and Symptom

Trouble Code		Symptom
P0117	Low	
P0118	High	Below Limited Temperature of Engine Overheat Detection
P0115	Supply Voltage	

► Diagnosis Procedures



DIAGNOSIS

KYRON SM - 2005.09

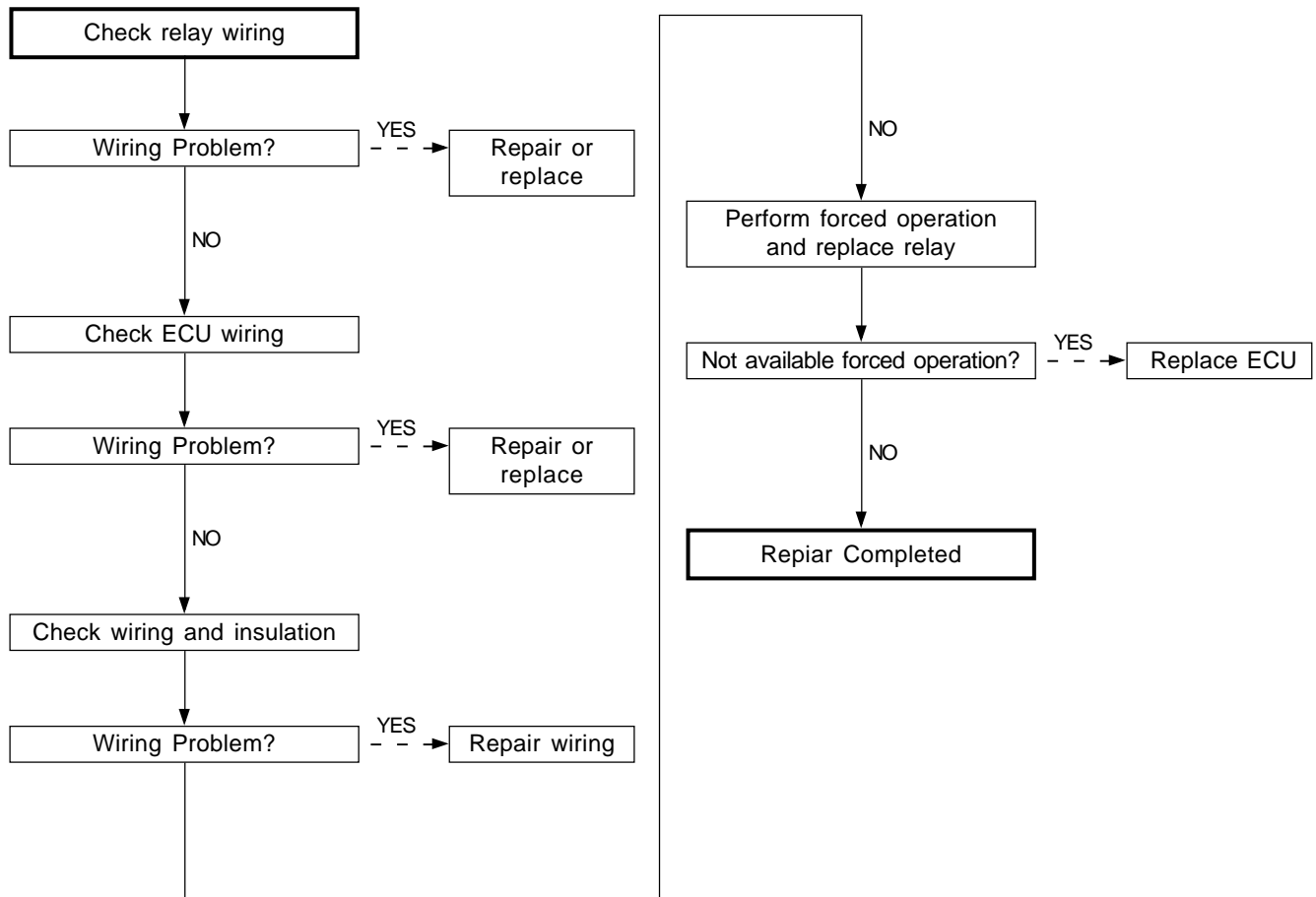
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Too Fast or Low Main Relay Operation

► Trouble Code and Symptom

Trouble Code		Symptom
P0685	Main Relay Malfunction	

► Diagnosis Procedures



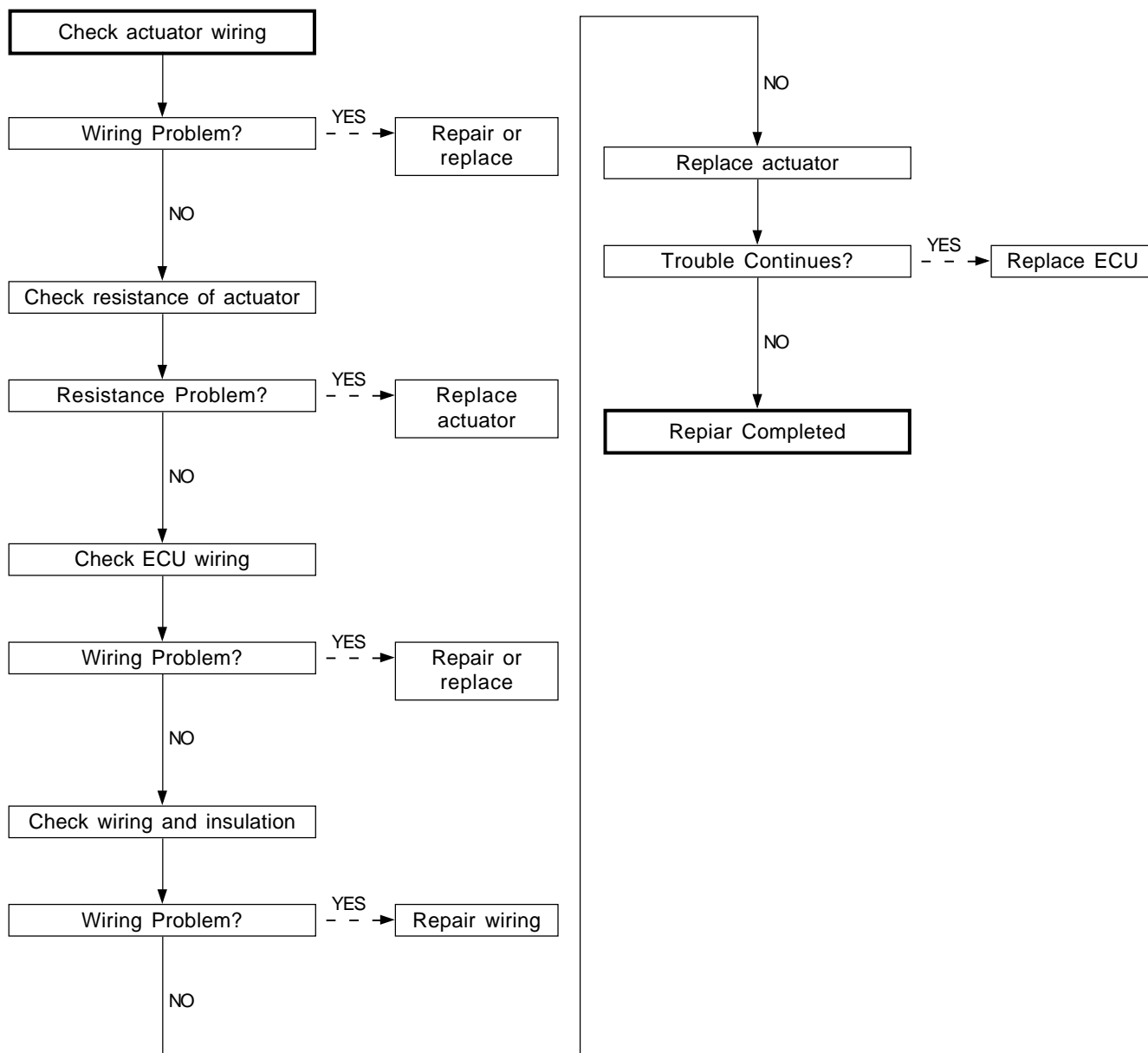
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

EGR Actuator Malfunction

► Trouble Code and Symptom

Trouble Code		Symptom
P1405	EGR Vacuum Modulator - Short to GND	
P1406	EGR Vacuum Modulator - Short to +Batt	Unable EGR Control (Air Flow)

► Diagnosis Procedures



DIAGNOSIS

KYRON SM - 2005.09

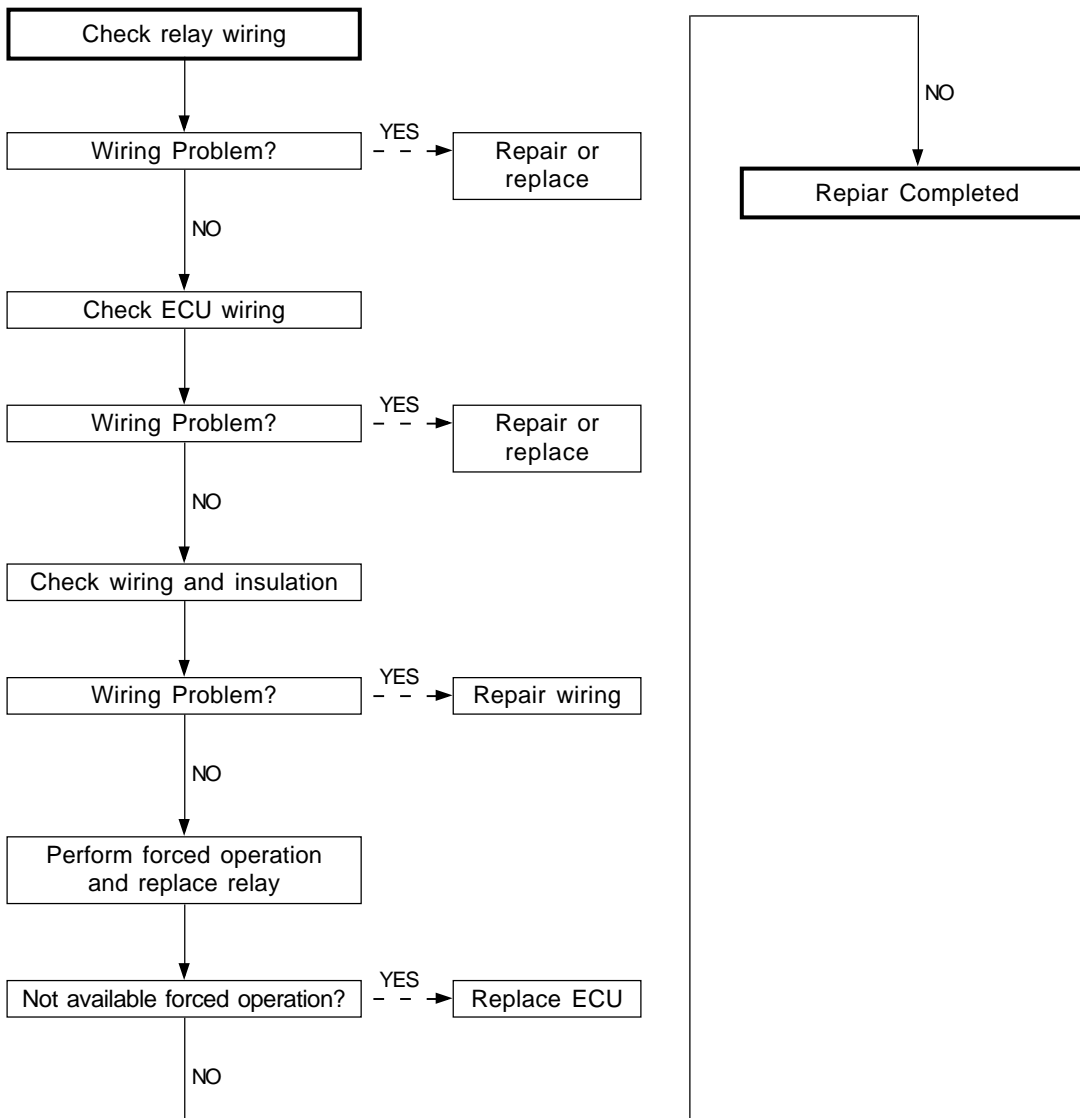
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Condenser Fan Driving Signal Fault (Type 1)

► Trouble Code and Symptom

Trouble Code		Symptom
P1480	Open Circuit	Unable Air Conditioner Operation
P1481	Short Circuit	
P1482	Short to Ground	Below Limited Temperature of Engine Overheat Detection

► Diagnosis Procedures



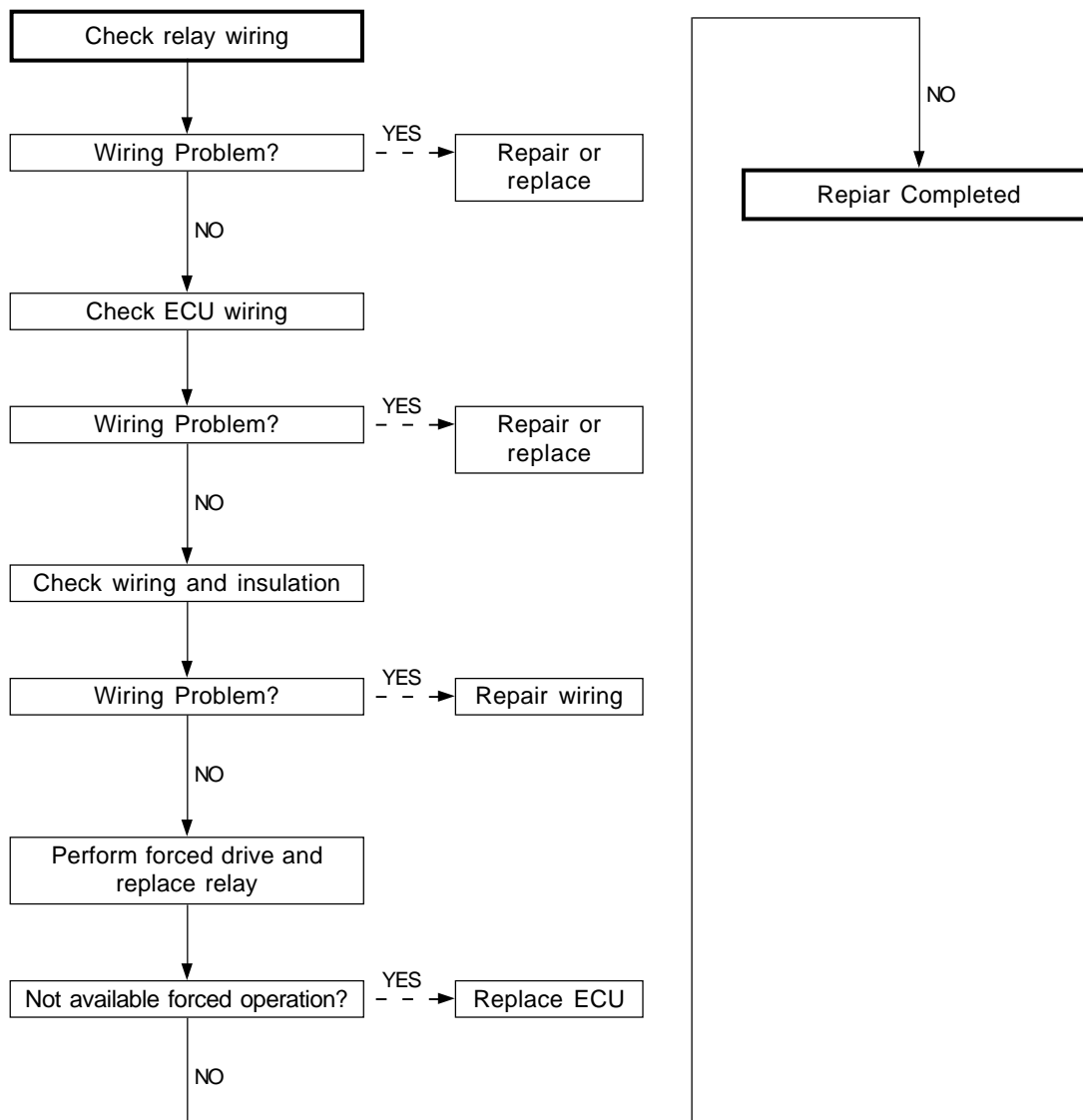
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Condenser Fan Driving Signal Fault (Type 2)

► Trouble Code and Symptom

Trouble Code		Symptom
P1526	Open Circuit	Unable Air Conditioner Operation
P1527	Short Circuit	
P1528	Short to Ground	Below Limited Temperature of Engine Overheat Detection

► Diagnosis Procedures



DIAGNOSIS

KYRON SM - 2005.09

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

#1 Accelerometer Malfunction (Idling Signal/Too Small Noise Ratio)

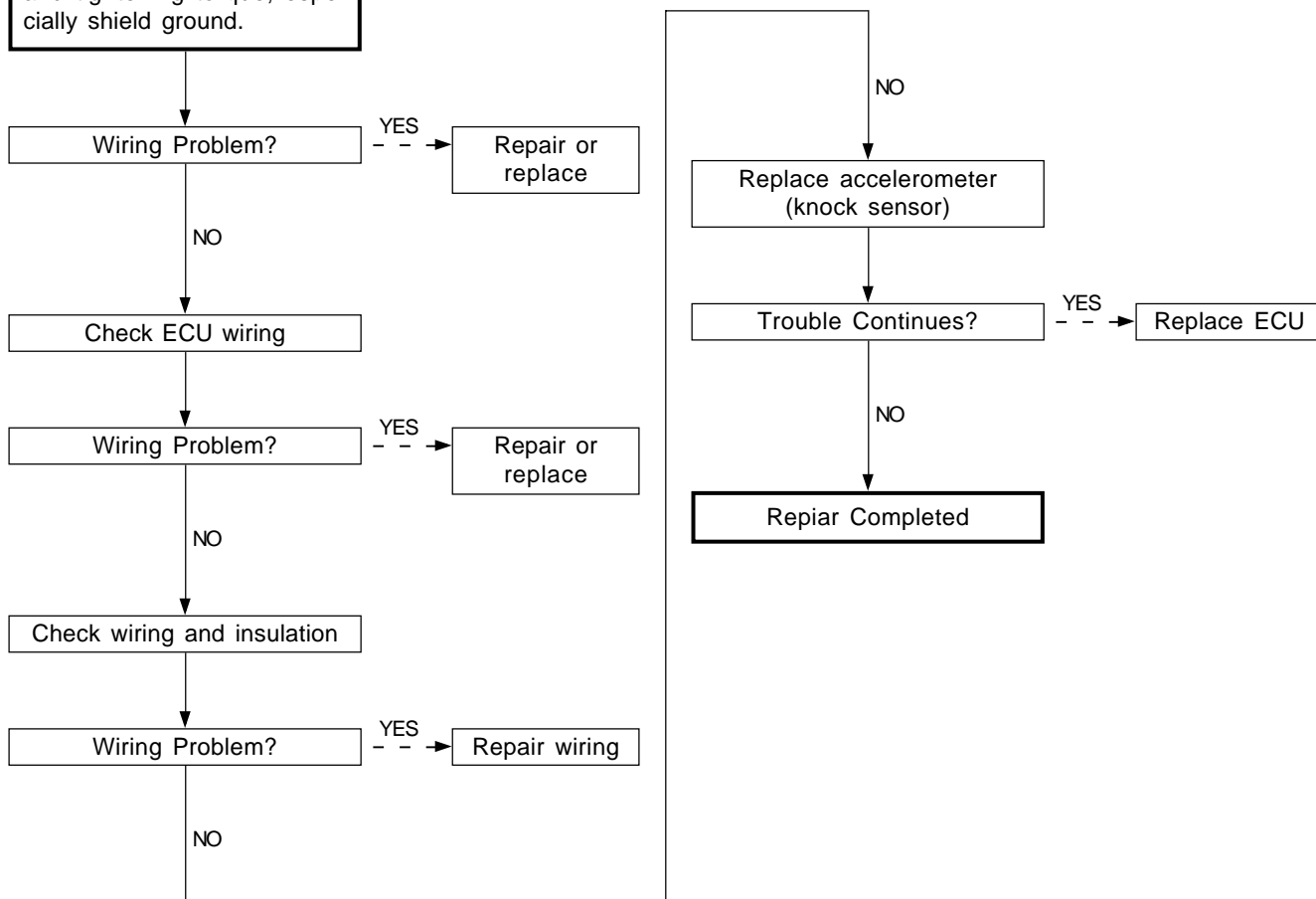
► Trouble Code and Symptom

Trouble Code		Symptom
P0325	#1 Accelerometer (Knock Sensor) Malfunction	Unable Accelerometer Learning Strategy

► Diagnosis Procedures

"Caution: Check the sensing value of coolant temp., intake air temp., fuel temp. barometric pressure. Incorrect default values of these sensors may cause wrong diagnosis."

Check accelerometer wiring and tightening torque, especially shield ground.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

#2 Accelerometer Malfunction (Idling Signal/Too Small Noise Ratio)

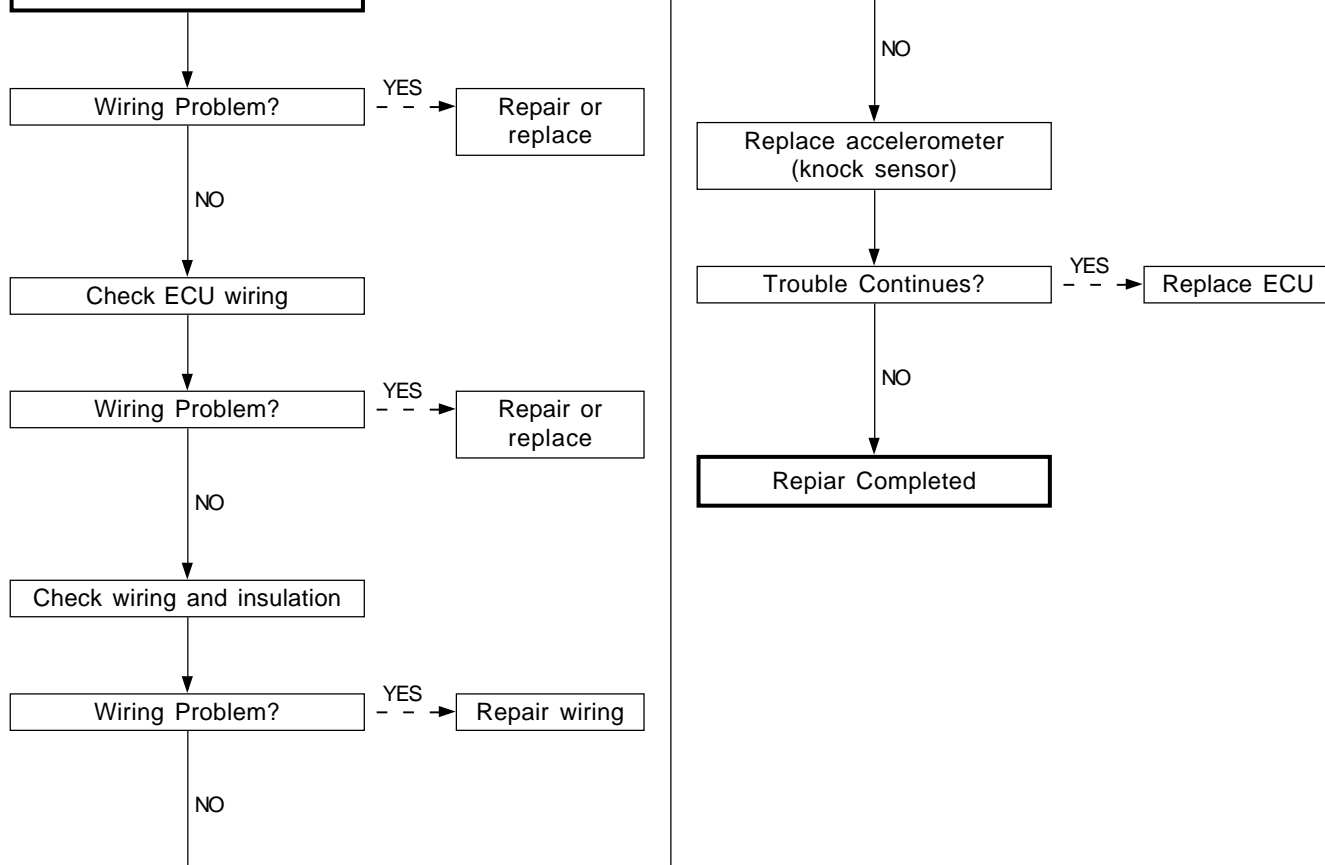
► Trouble Code and Symptom

Trouble Code		Symptom
P0330	#2 Accelerometer (Knock Sensor) Malfunction	Unable Accelerometer Learning Strategy

► Diagnosis Procedures

“Caution: Check the sensing value of coolant temp., intake air temp., fuel temp. barometric pressure. Incorrect default values of these sensors may cause wrong diagnosis.”

Check accelerometer wiring and tightening torque, especially shield ground.



Injector Bank 1 Malfunction (Short to Ground or B+)

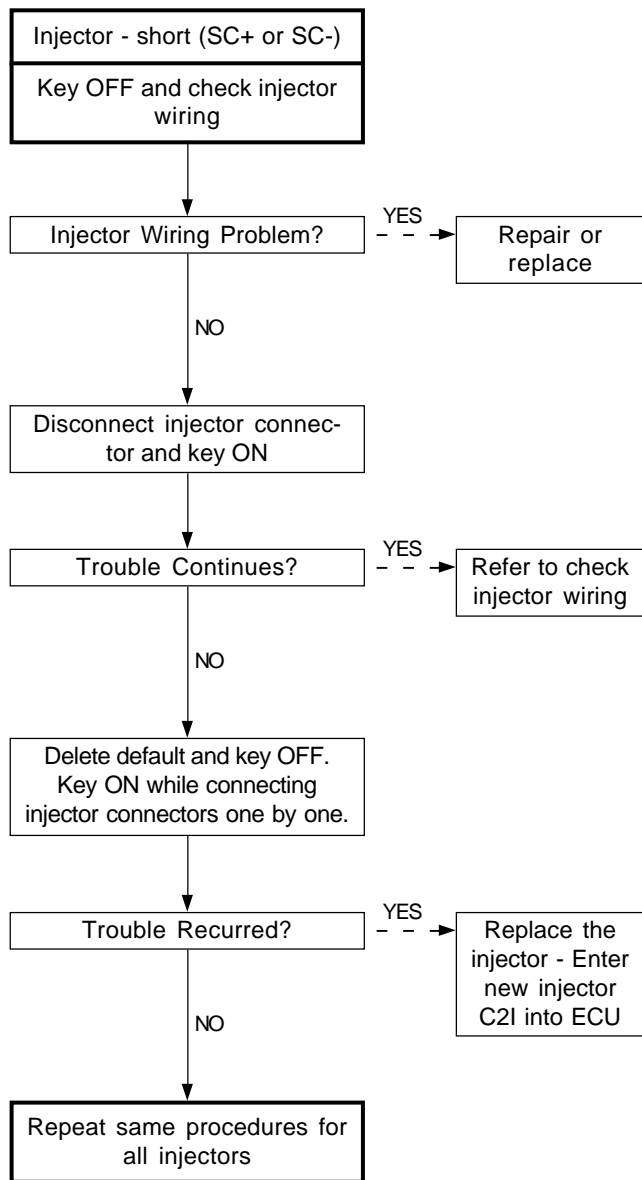
► Trouble Code and Symptom

Trouble Code		Symptom
P1611	Low Injector Bank 1 Voltage	Resistance of injector #1 fault. Use estimate resistance level.
P1612	High Injector Bank 1 Voltage	Resistance of injector #4 fault. Use estimate resistance level.
		Resistance of injector #3 fault. Use estimate resistance level.
		MIL ON
		Unable Dynamic Leak of Injector #1
		Unable Dynamic Leak of Injector #4
		Unable Dynamic Leak of Injector #3
		Unable Cylinder Balancing
		Unable Injector #1 Operation
		Unable Injector #4 Operation
		Unable Injector #3 Operation
		Unable High Pressure Leak Detection
		Unable Accelerometer Learning Strategy

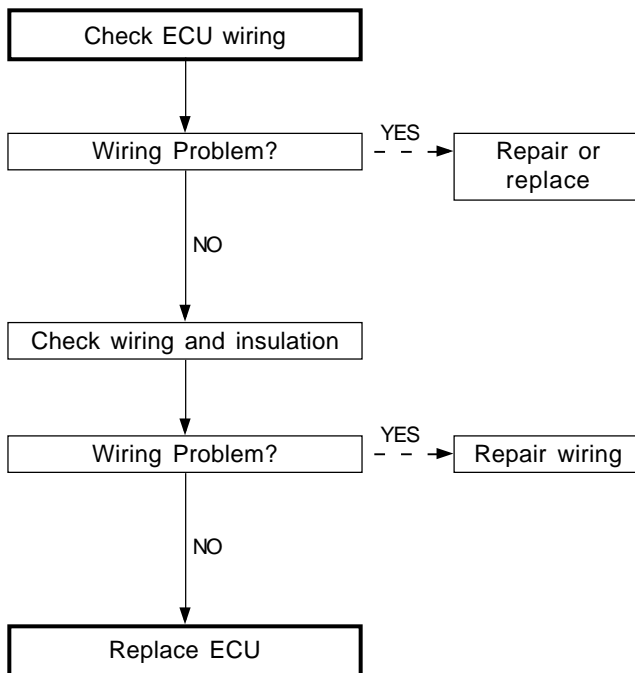
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► Diagnosis Procedures

1. Fuel Injection Bank 1/2



2. Check Injector Wiring



Injector Bank 2 Malfunction (Short to Ground or B+)

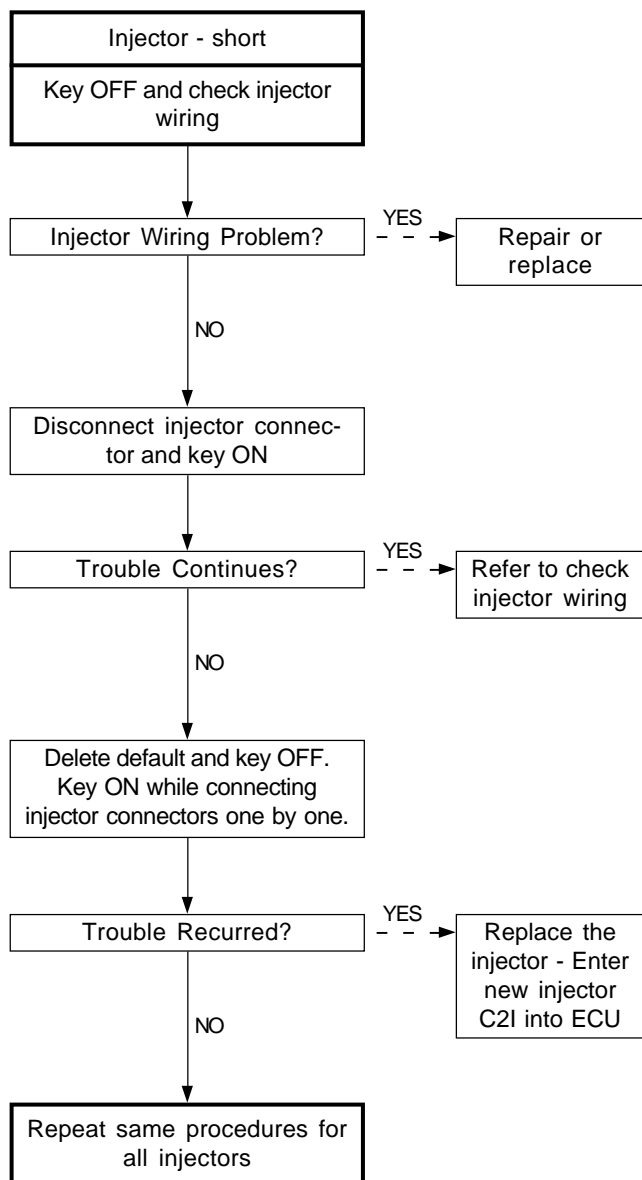
► Trouble Code and Symptom

Trouble Code		Symptom
P1618	Low Injector Bank 2 Voltage	Resistance of injector #2 fault. Use estimate resistance level.
P1619	High Injector Bank 2 Voltage	Resistance of injector #5 fault. Use estimate resistance level.
		MIL ON
		Unable Dynamic Leak of Injector #2
		Unable Dynamic Leak of Injector #5
		Unable Cylinder Balancing
		Unable Injector #2 Operation
		Unable Injector #5 Operation
		Unable High Pressure Leak Detection
		Unable Accelerometer Learning Strategy

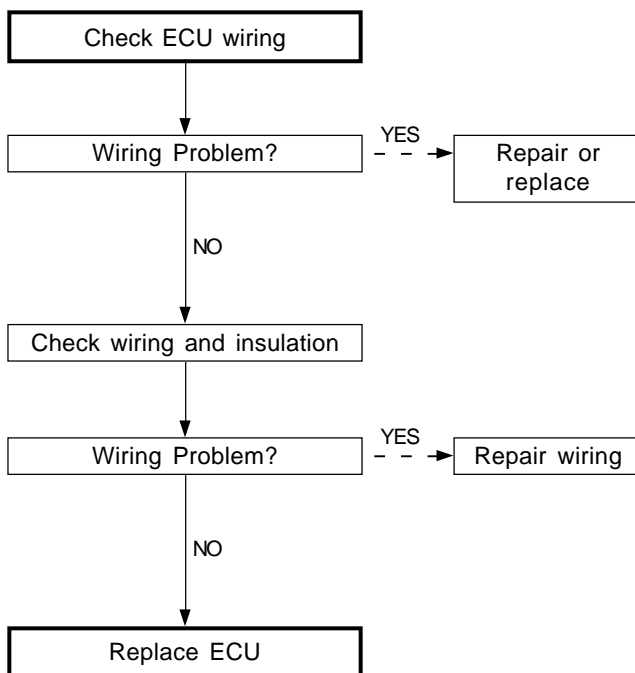
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► Diagnosis Procedures

1. Fuel Injection Bank 1/2



2. Check Injector Wiring

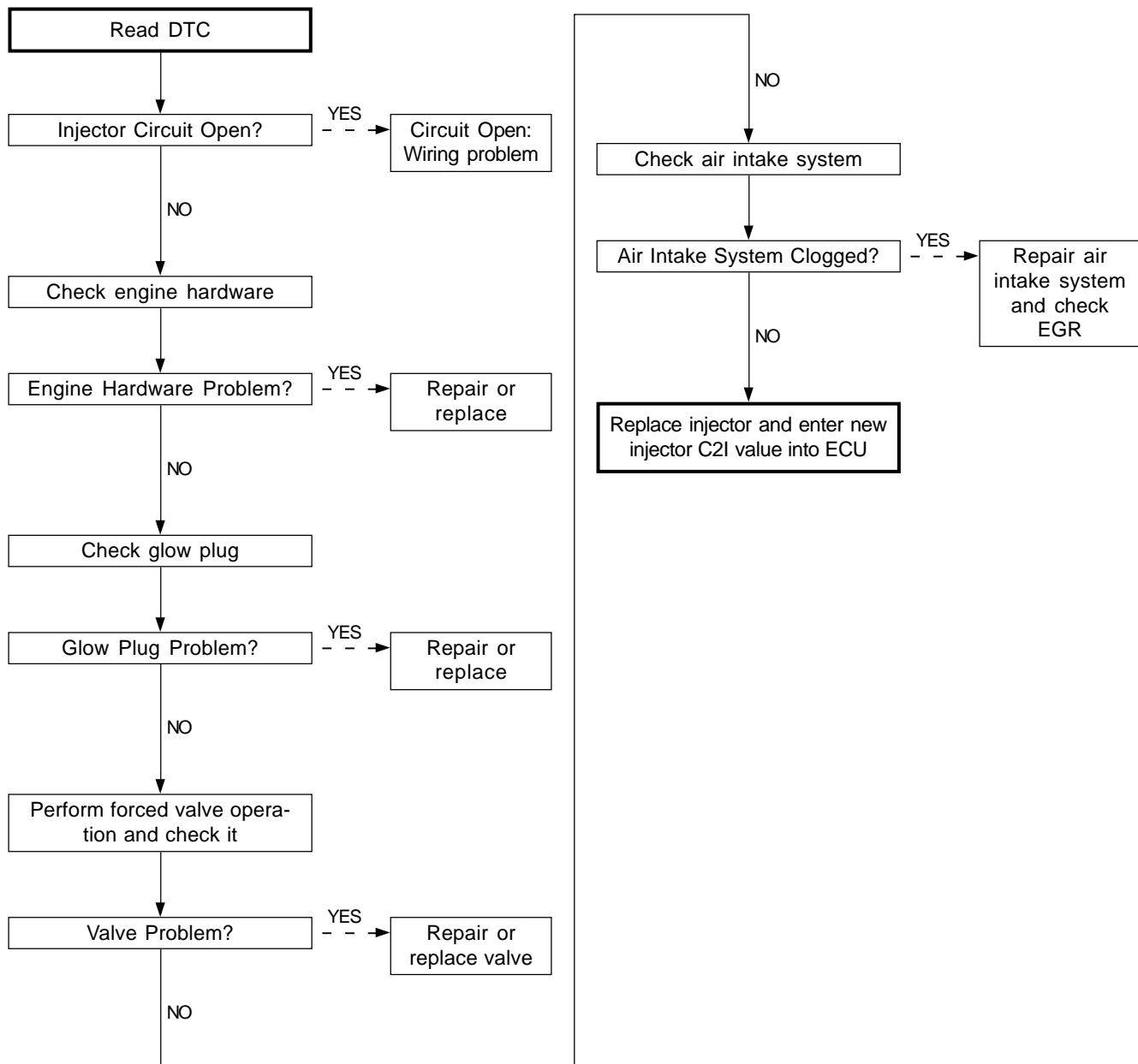


Cylinder Balancing Fault (Injector #1) = Clogged Air Intake System

► Trouble Code and Symptom

Trouble Code		Symptom
P0263	#1 Cylinder Balancing Fault	Unable Accelerometer Learning Strategy

► Diagnosis Procedures



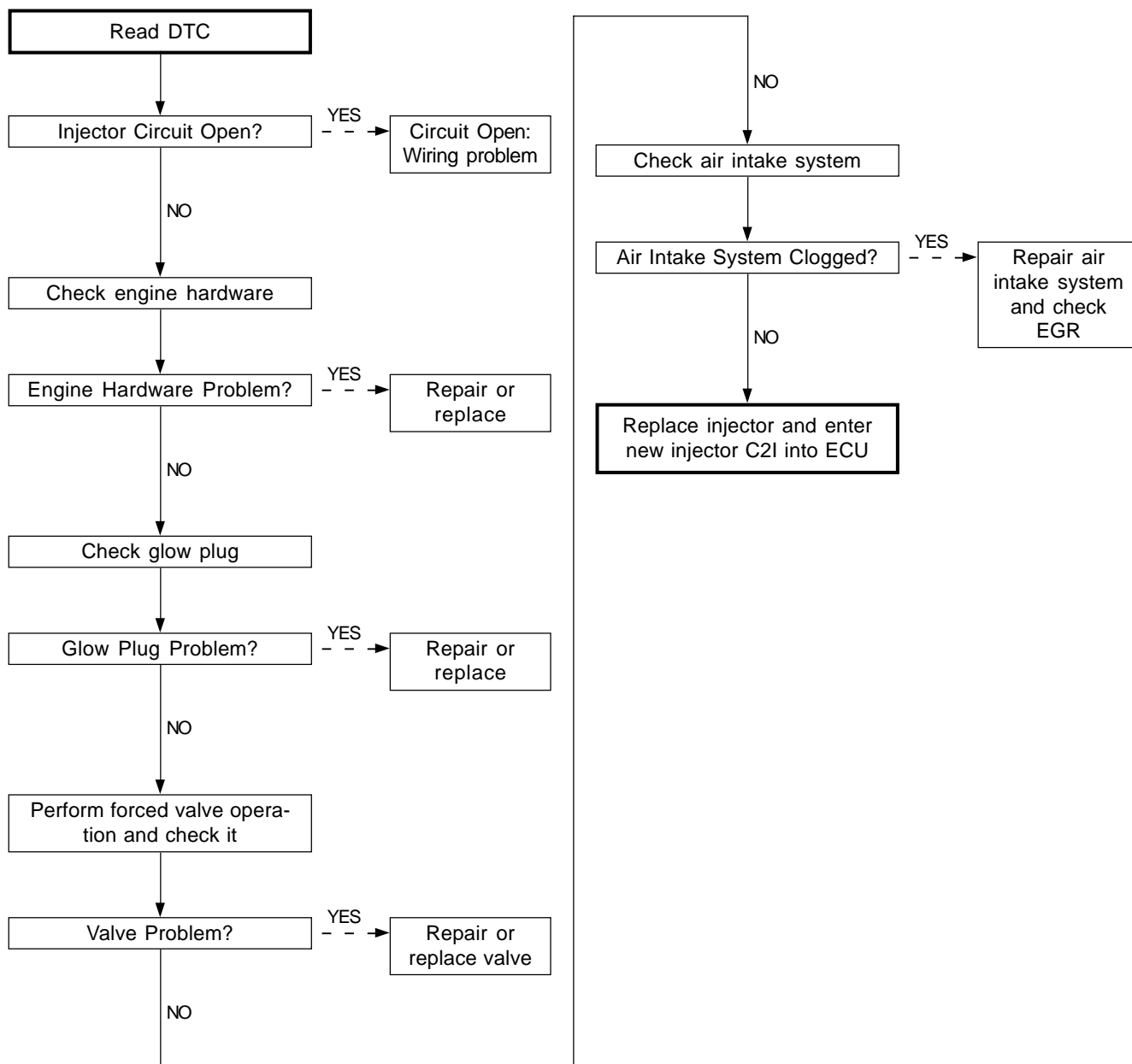
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Cylinder Balancing Fault (Injector #2) = Clogged Air Intake System

► Trouble Code and Symptom

Trouble Code		Symptom
P0266	#2 Cylinder Balancing Fault	Unable Accelerometer Learning Strategy

► Diagnosis Procedures



DIAGNOSIS

KYRON SM - 2005.09

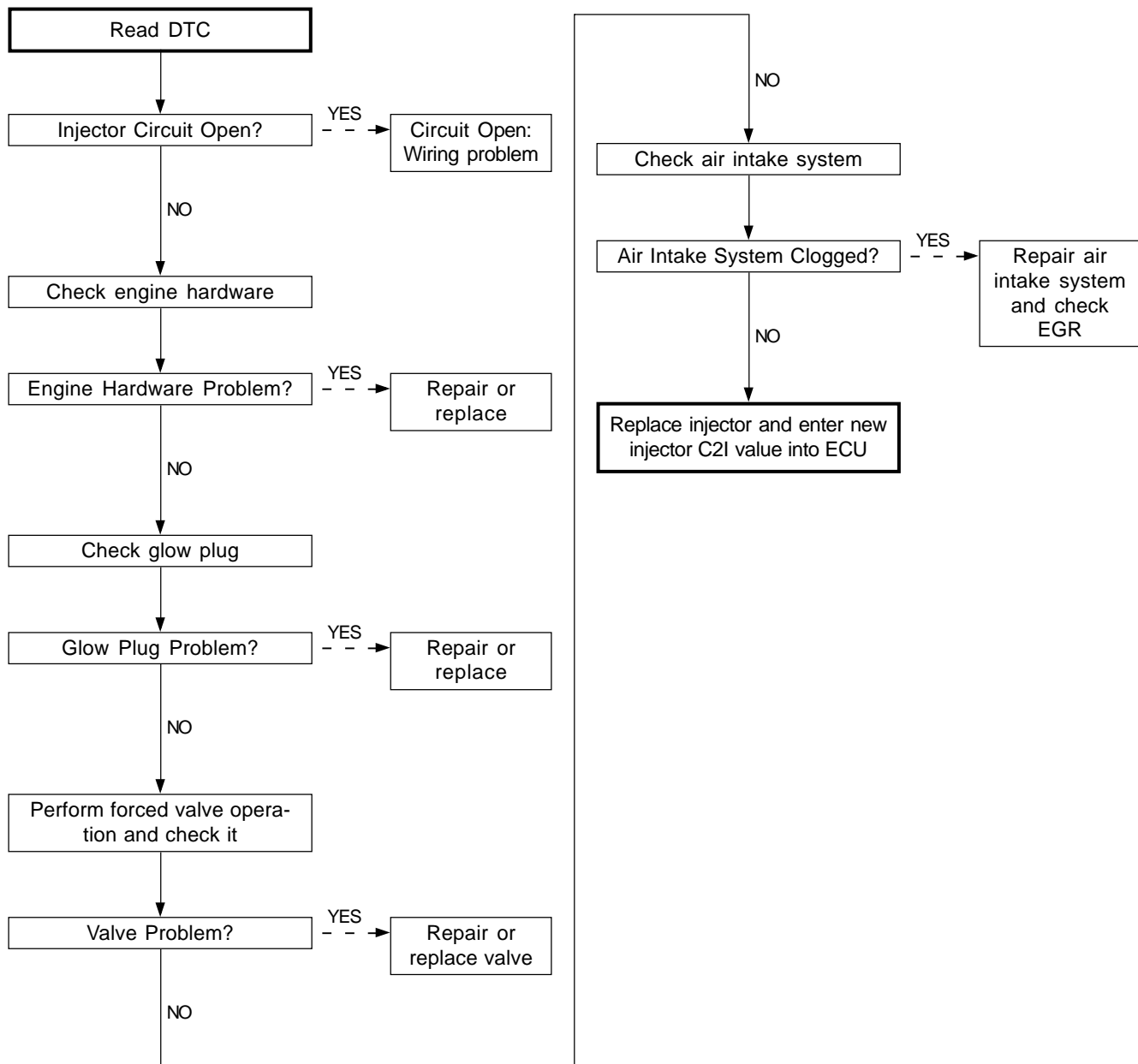
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Cylinder Balancing Fault (Injector #4) = Clogged Air Intake System

► Trouble Code and Symptom

Trouble Code		Symptom
P0272	#4 Cylinder Balancing Fault	Unable Accelerometer Learning Strategy

► Diagnosis Procedures



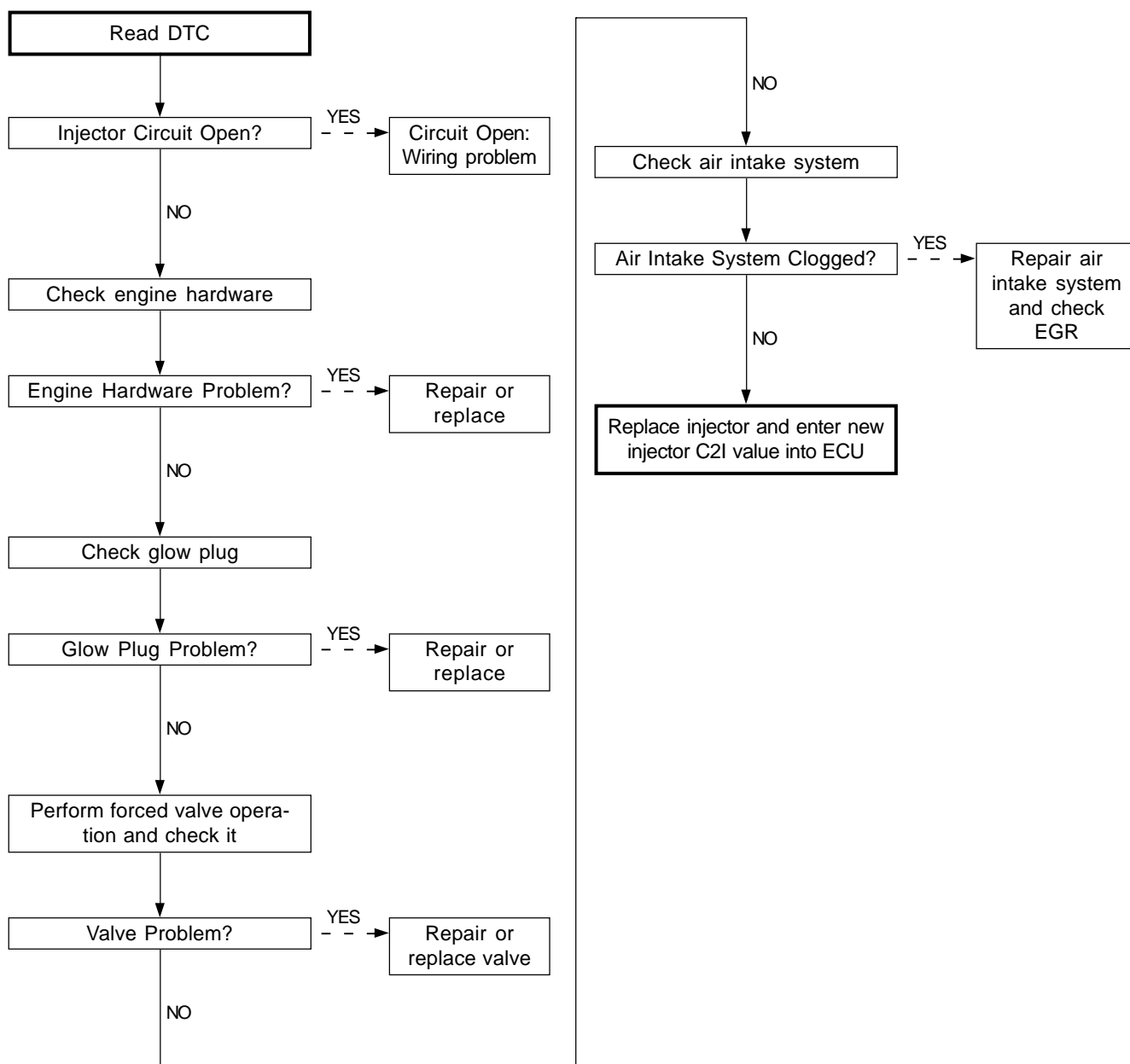
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Cylinder Balancing Fault (Injector #5) = Clogged Air Intake System

► Trouble Code and Symptom

Trouble Code		Symptom
P0275	#5 Cylinder Balancing Fault	Unable Accelerometer Learning Strategy

► Diagnosis Procedures



DIAGNOSIS

KYRON SM - 2005.09

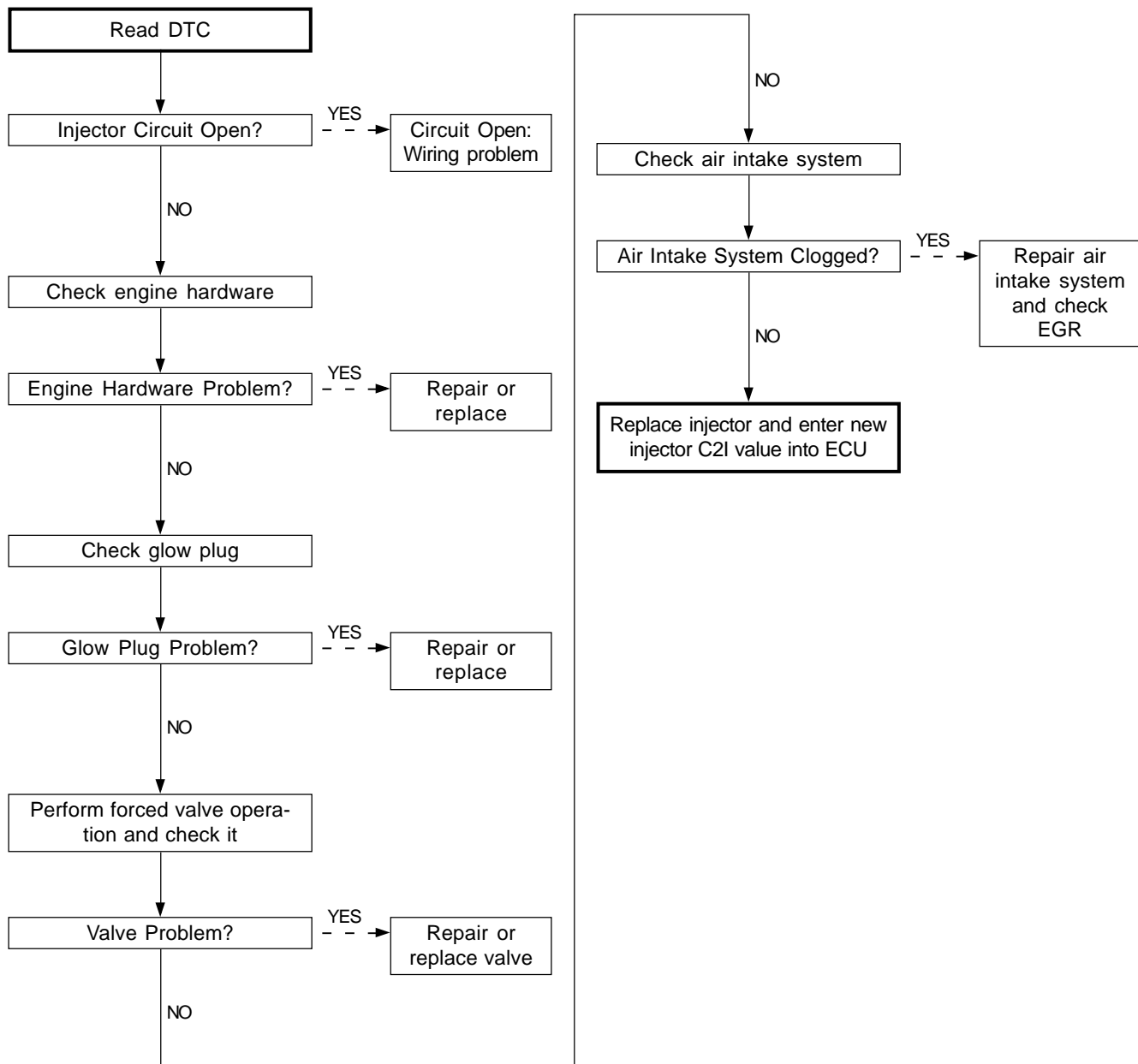
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Cylinder Balancing Fault (Injector #3) = Clogged Air Intake System

► Trouble Code and Symptom

Trouble Code		Symptom
P0269	#3 Cylinder Balancing Fault	Unable Accelerometer Learning Strategy

► Diagnosis Procedures



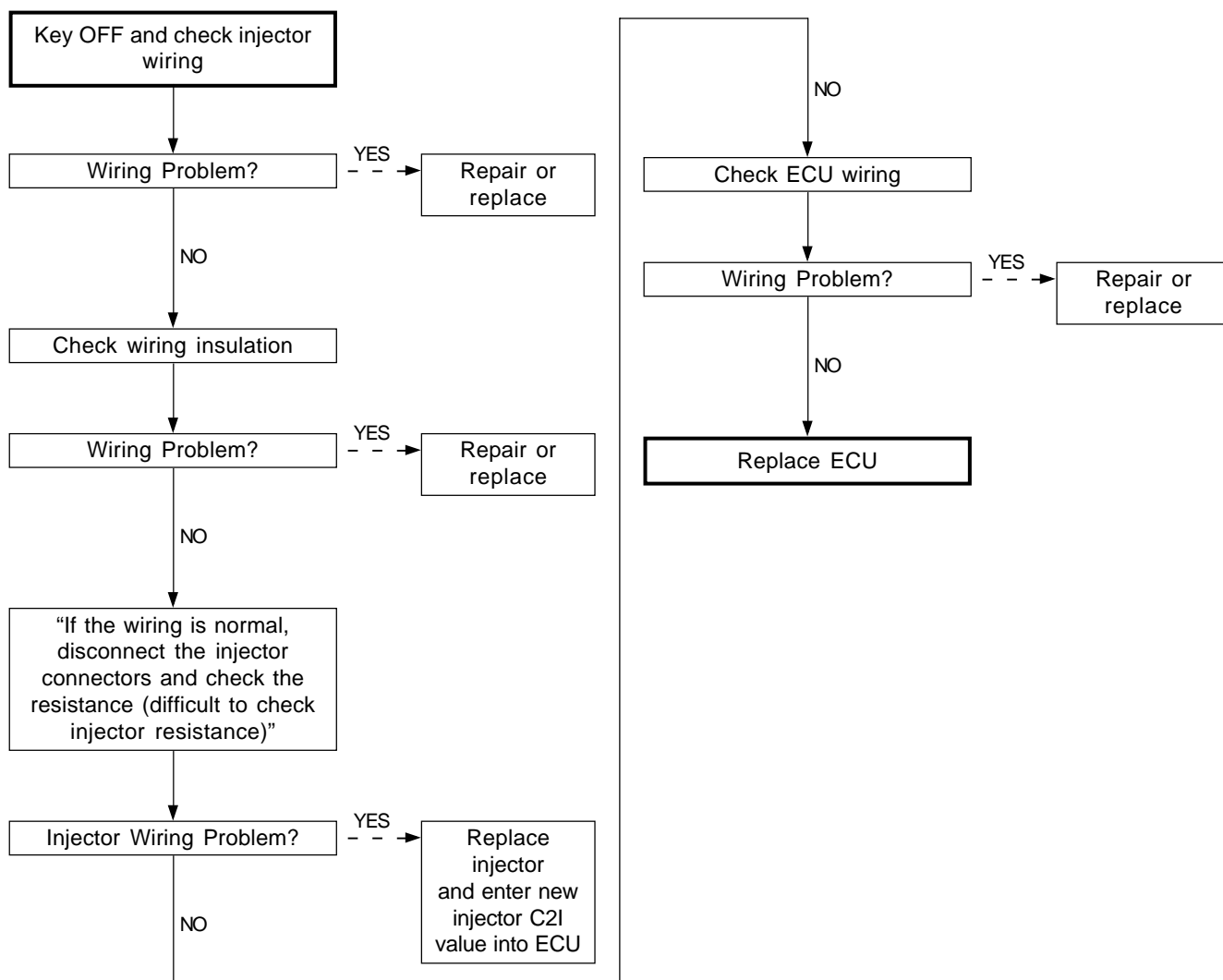
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Open Circuit (Injector #1)

► Trouble Code and Symptom

Trouble Code		Symptom
P0201	#1 Injector Circuit - Open	Unable RPC Trim Fault Detection
		Unable H/P Leak Detection
		Unable Accelerometer Learning Strategy
		MIL ON

► Diagnosis Procedures

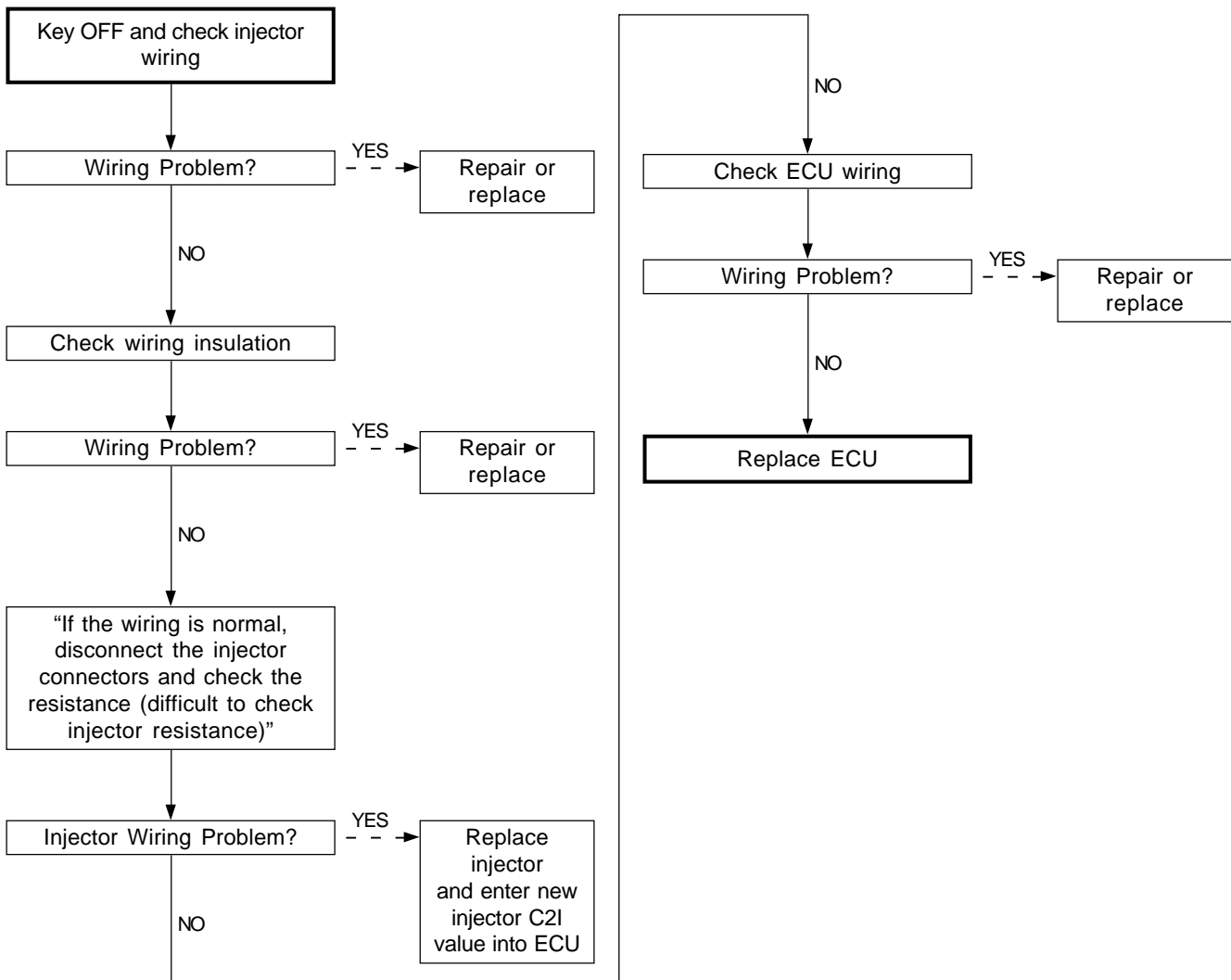


Open Circuit (Injector #2)

► Trouble Code and Symptom

Trouble Code		Symptom
P0202	#2 Injector Circuit - Open	Unable RPC Trim Fault Detection
		Unable H/P Leak Detection
		Unable Accelerometer Learning Strategy
		MIL ON

► Diagnosis Procedures



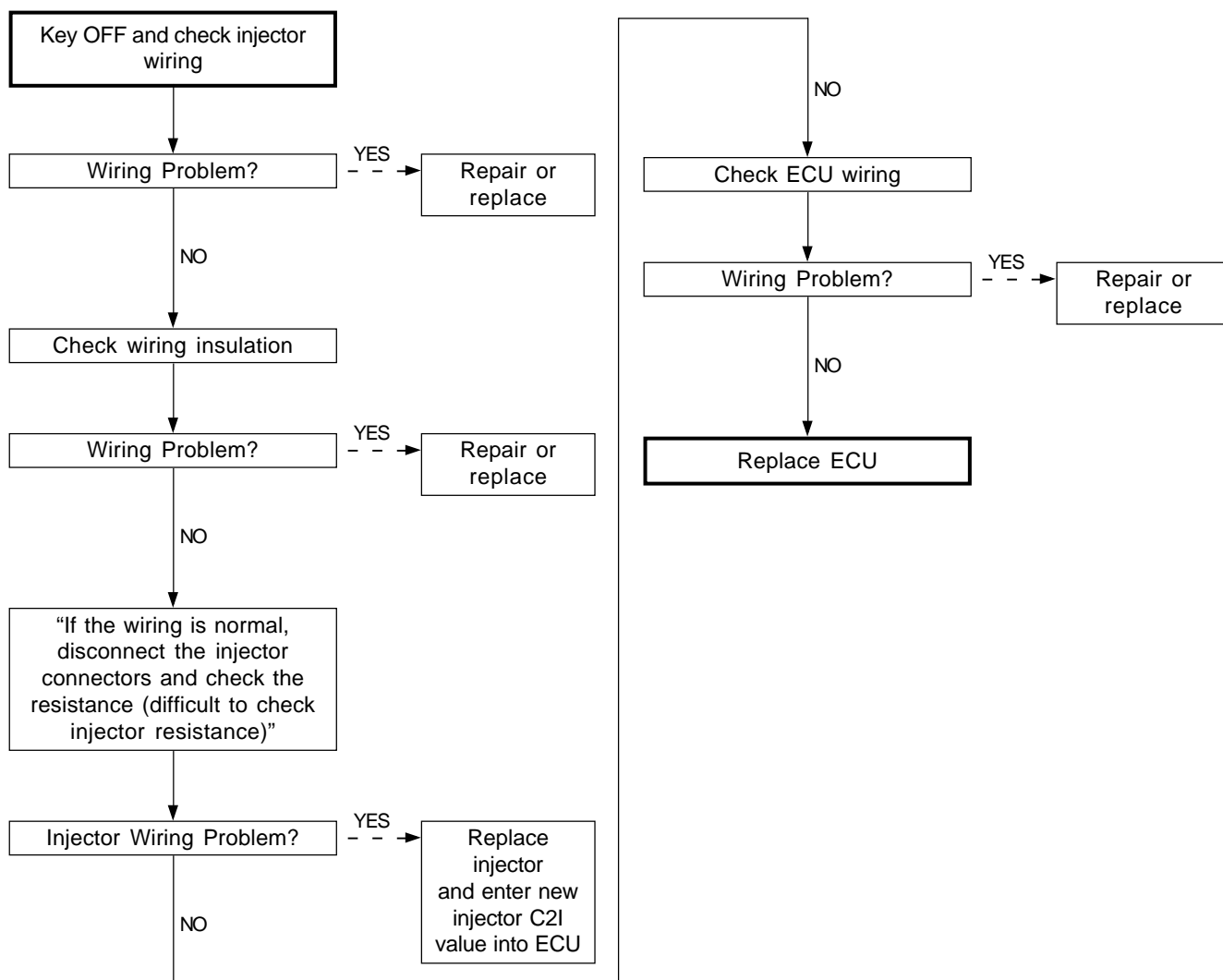
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Open Circuit (Injector #4)

► Trouble Code and Symptom

Trouble Code		Symptom
P0204	#4 Injector Circuit - Open	Unable RPC Trim Fault Detection
		Unable H/P Leak Detection
		Unable Accelerometer Learning Strategy
		MIL ON

► Diagnosis Procedures

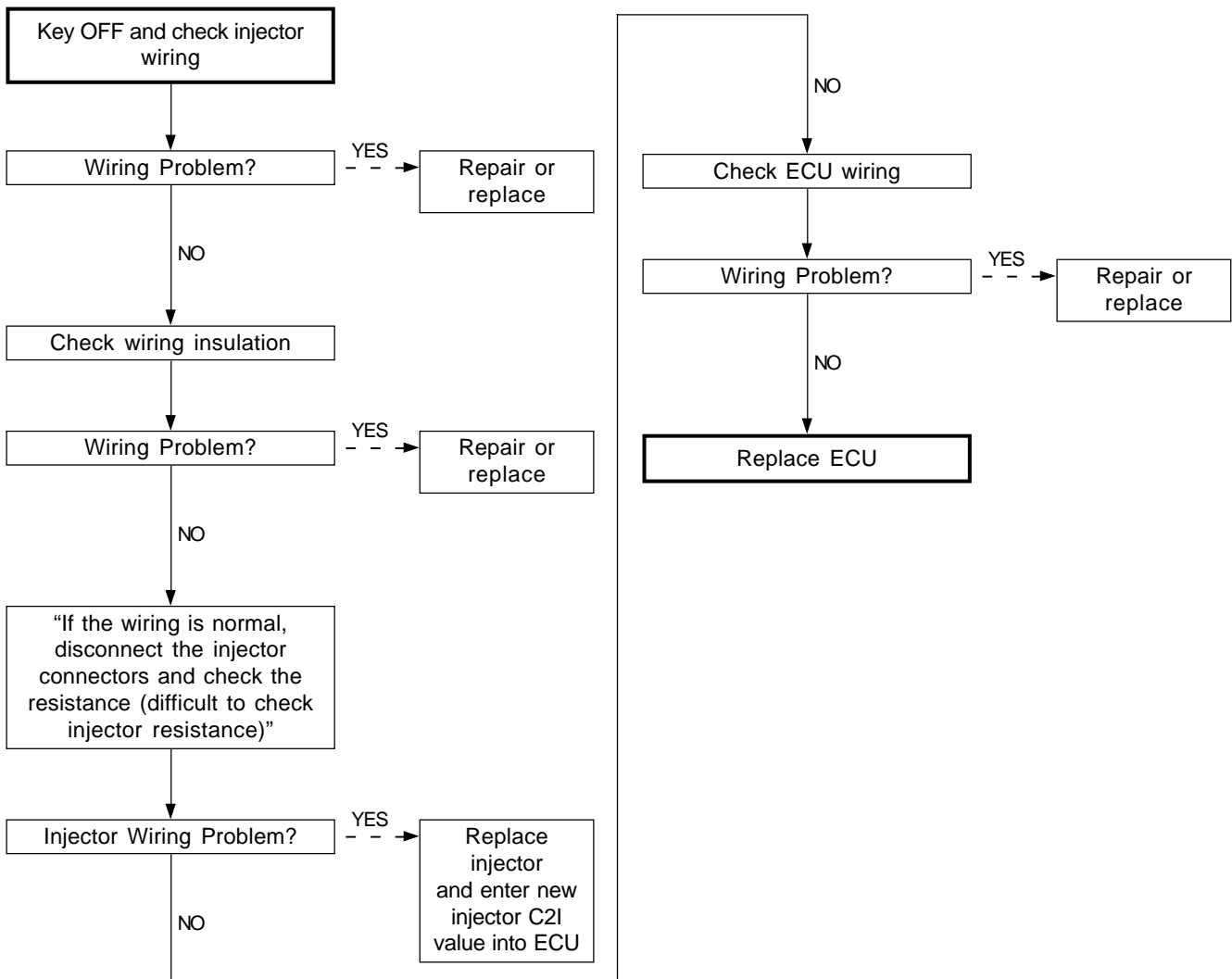


Open Circuit (Injector #5)

► Trouble Code and Symptom

Trouble Code		Symptom
P0205	#5 Injector Circuit - Open	Unable RPC Trim Fault Detection
		Unable H/P Leak Detection
		Unable Accelerometer Learning Strategy
		MIL ON

► Diagnosis Procedures



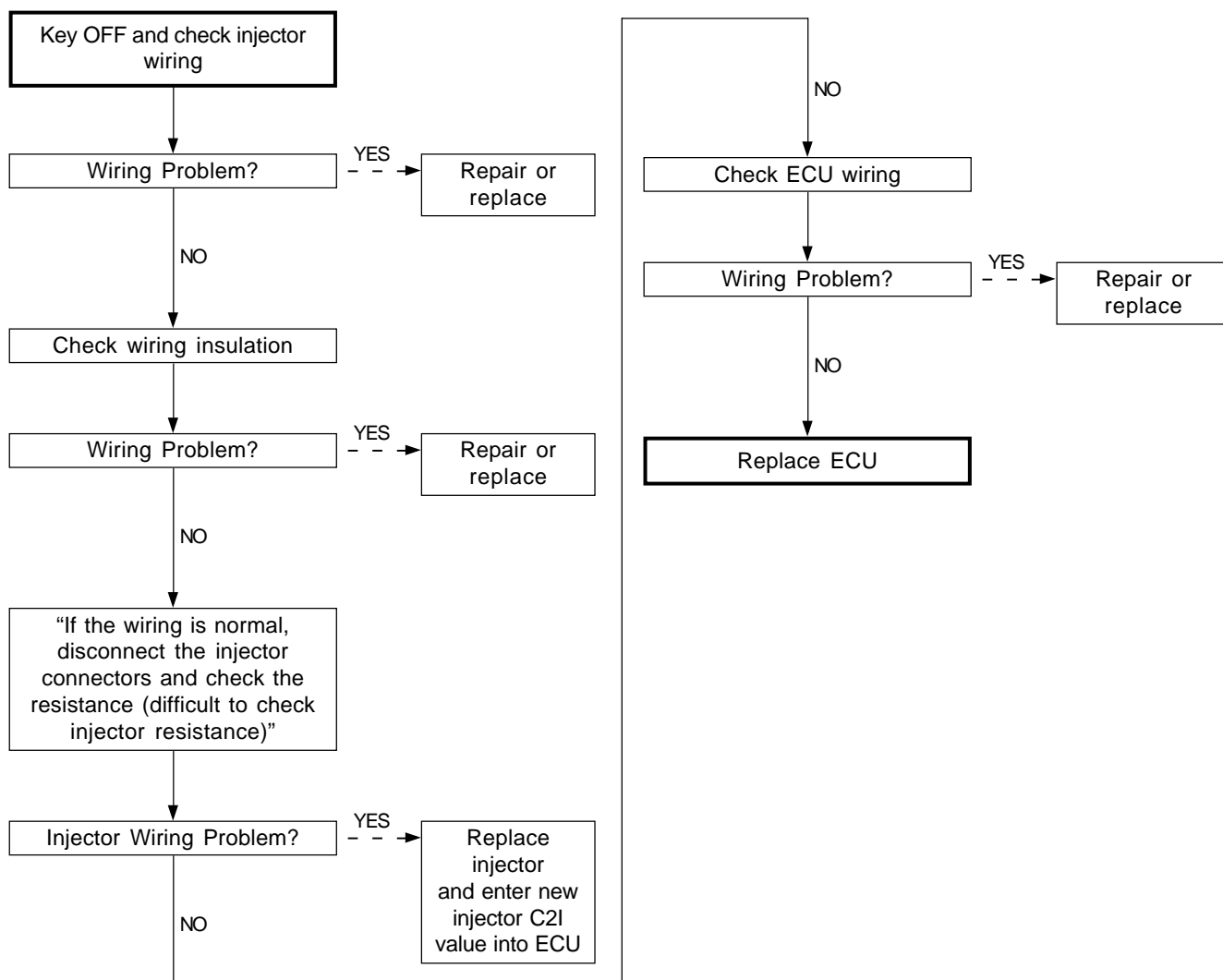
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Open Circuit (Injector #3)

► Trouble Code and Symptom

Trouble Code		Symptom
P0203	#3 Injector Circuit - Open	Unable RPC Trim Fault Detection
		Unable H/P Leak Detection
		Unable Accelerometer Learning Strategy
		MIL ON

► Diagnosis Procedures



DIAGNOSIS

KYRON SM - 2005.09

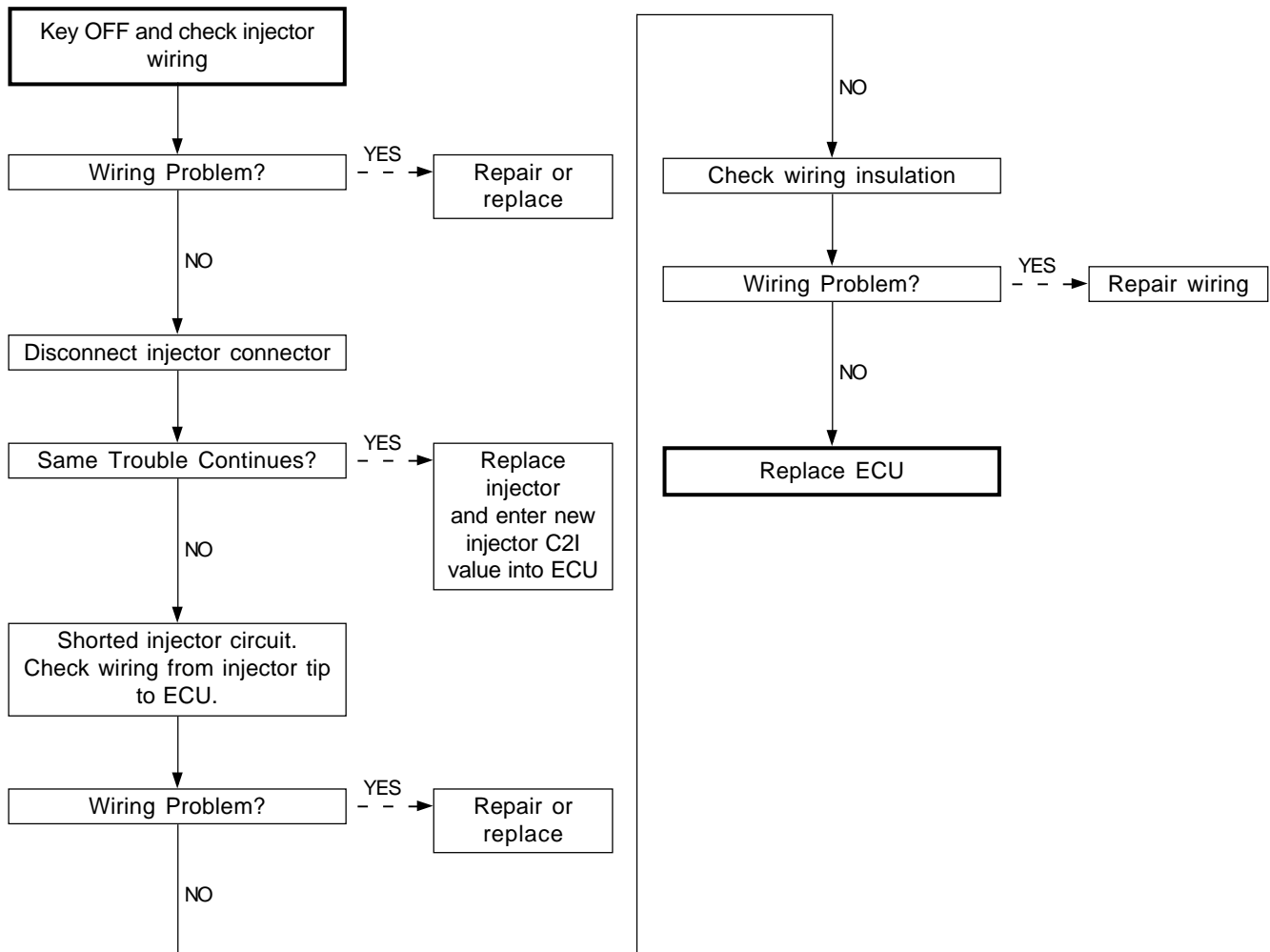
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

HSD Circuit Short to LSE (Injector #1)

► Trouble Code and Symptom

Trouble Code		Symptom
P1201	#1 Injector Circuit - Short	Unable RPC Trim Fault Detection
		Unable H/P Leak Detection
		Unable Accelerometer Learning Strategy

► Diagnosis Procedures



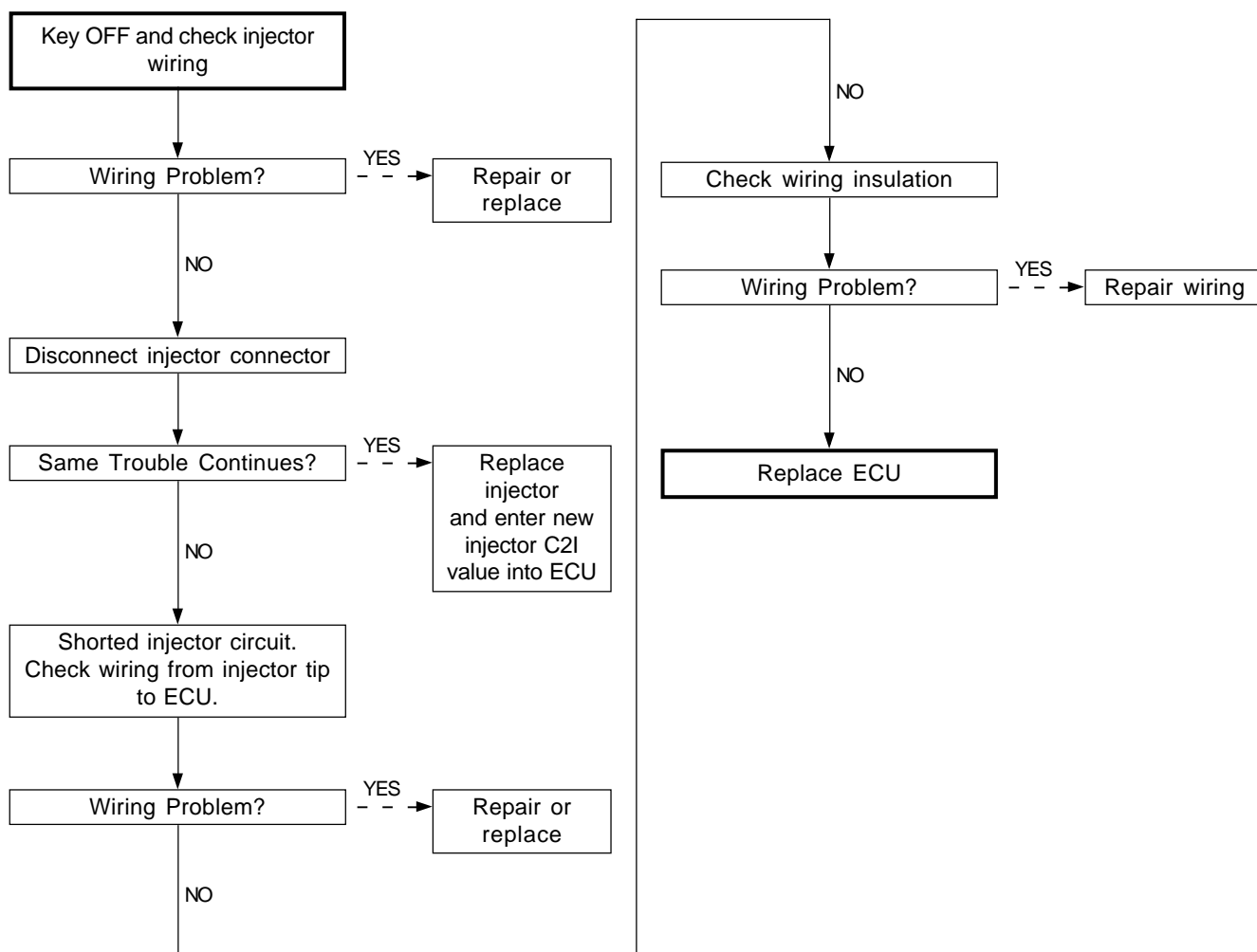
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

HSD Circuit Short to LSE (Injector #2)

► Trouble Code and Symptom

Trouble Code		Symptom
P1202	#2 Injector Circuit - Short	Unable RPC Trim Fault Detection
		Unable H/P Leak Detection
		Unable Accelerometer Learning Strategy

► Diagnosis Procedures



DIAGNOSIS

KYRON SM - 2005.09

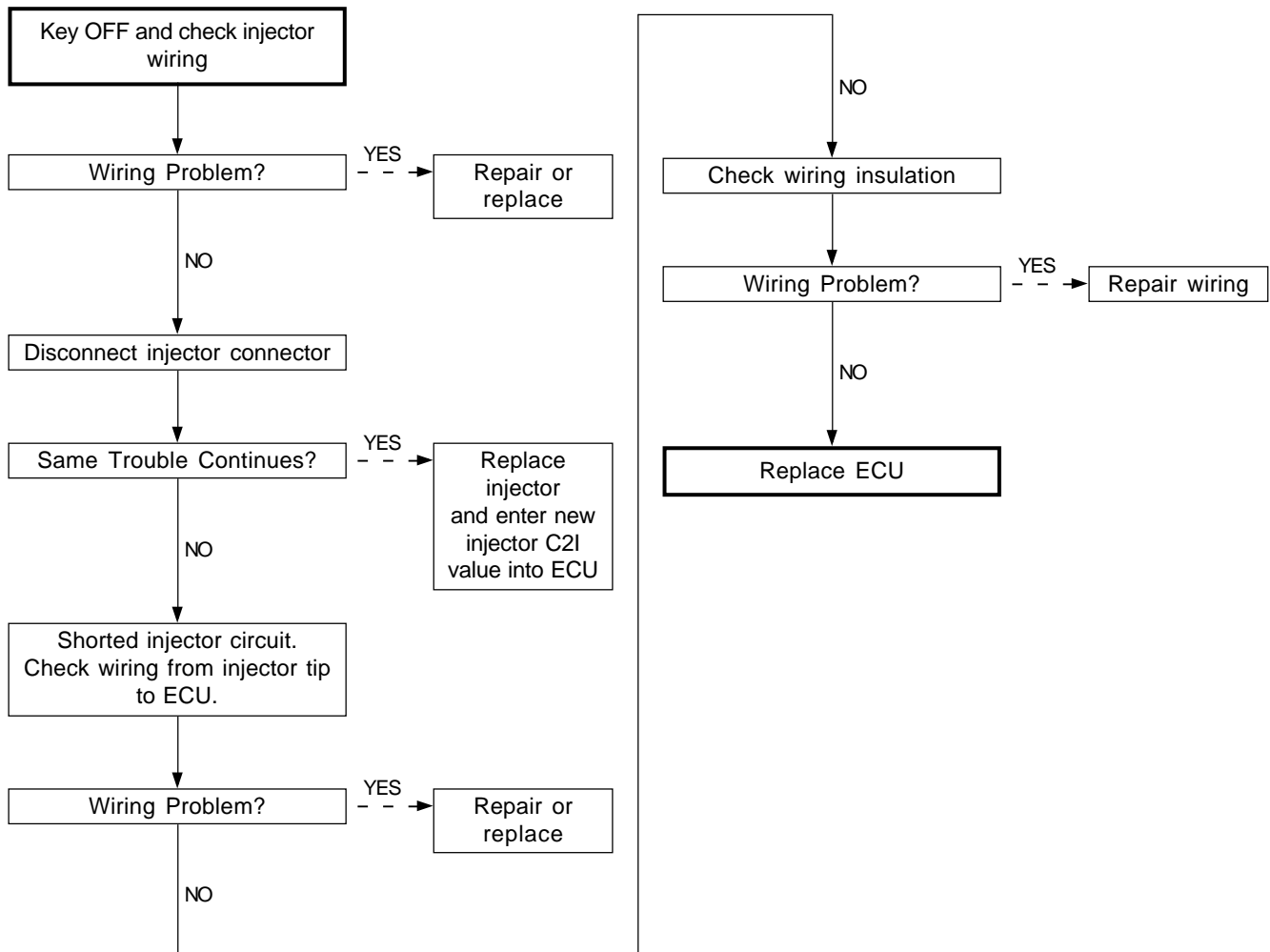
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

HSD Circuit Short to LSE (Injector #4)

► Trouble Code and Symptom

Trouble Code		Symptom
P1204	#4 Injector Circuit - Short	Unable RPC Trim Fault Detection
		Unable H/P Leak Detection
		Unable Accelerometer Learning Strategy

► Diagnosis Procedures



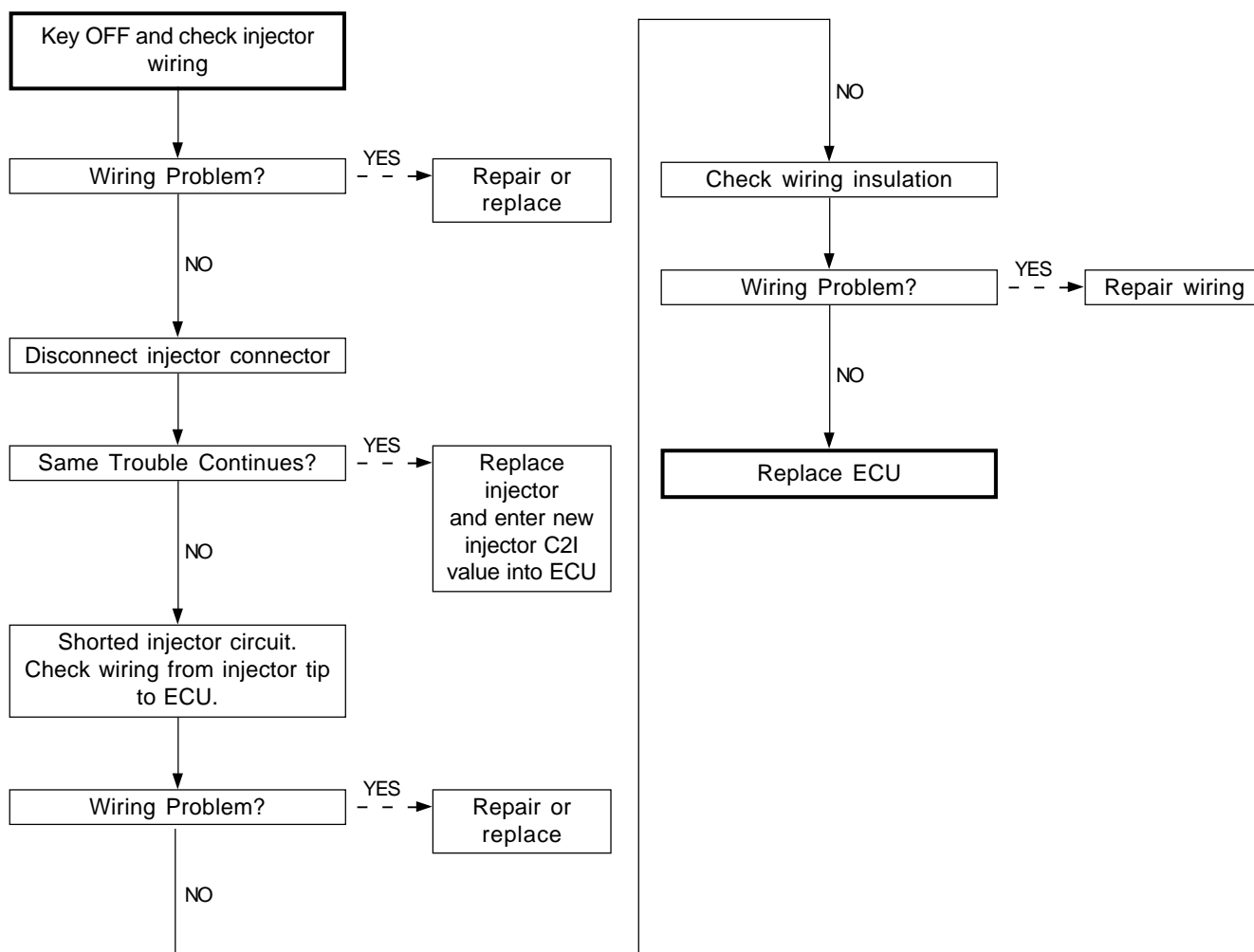
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

HSD Circuit Short to LSE (Injector #5)

► Trouble Code and Symptom

Trouble Code		Symptom
P1205	#5 Injector Circuit - Short	Unable RPC Trim Fault Detection
		Unable H/P Leak Detection
		Unable Accelerometer Learning Strategy

► Diagnosis Procedures



DIAGNOSIS

KYRON SM - 2005.09

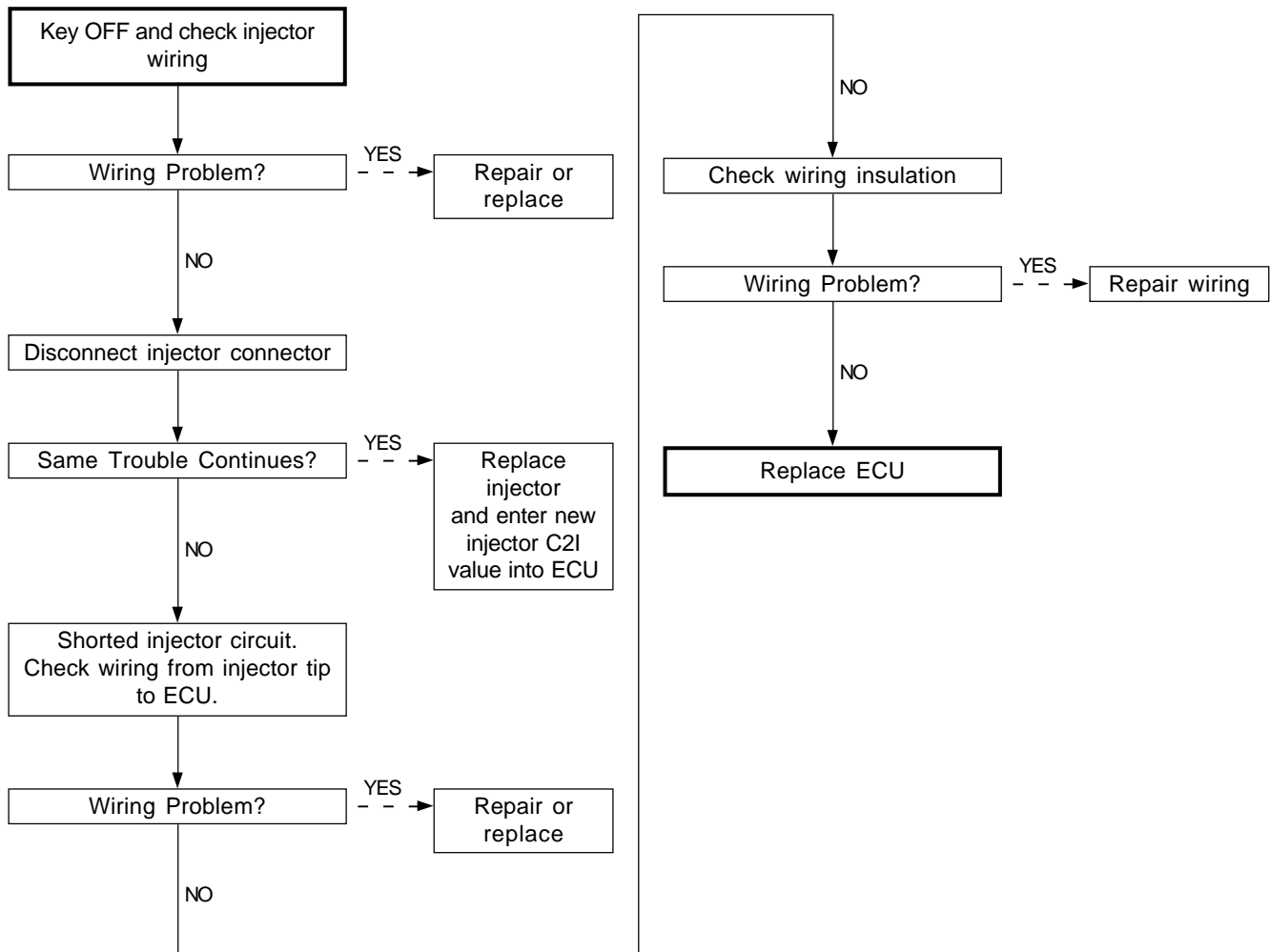
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

HSD Circuit Short to LSE (Injector #3)

► Trouble Code and Symptom

Trouble Code		Symptom
P1203	#3 Injector Circuit - Short	Unable RPC Trim Fault Detection
		Unable H/P Leak Detection
		Unable Accelerometer Learning Strategy

► Diagnosis Procedures



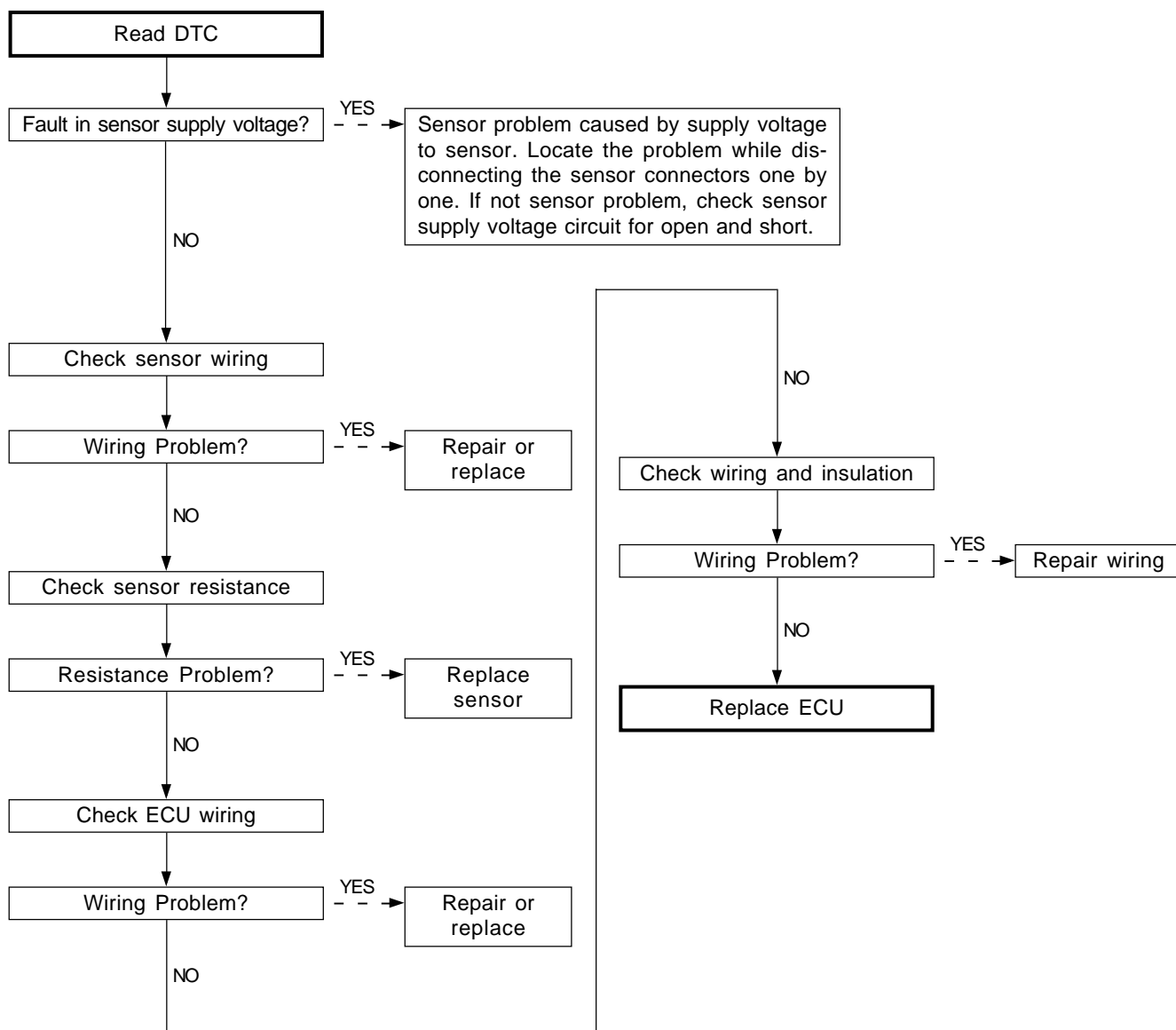
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Fuel Temperature Sensor Malfunction

► Trouble Code and Symptom

Trouble Code		Symptom
P0182	Low	
P0183	High	
P0180	Supply Voltage (Vref)	

► Diagnosis Procedures



DIAGNOSIS

KYRON SM - 2005.09

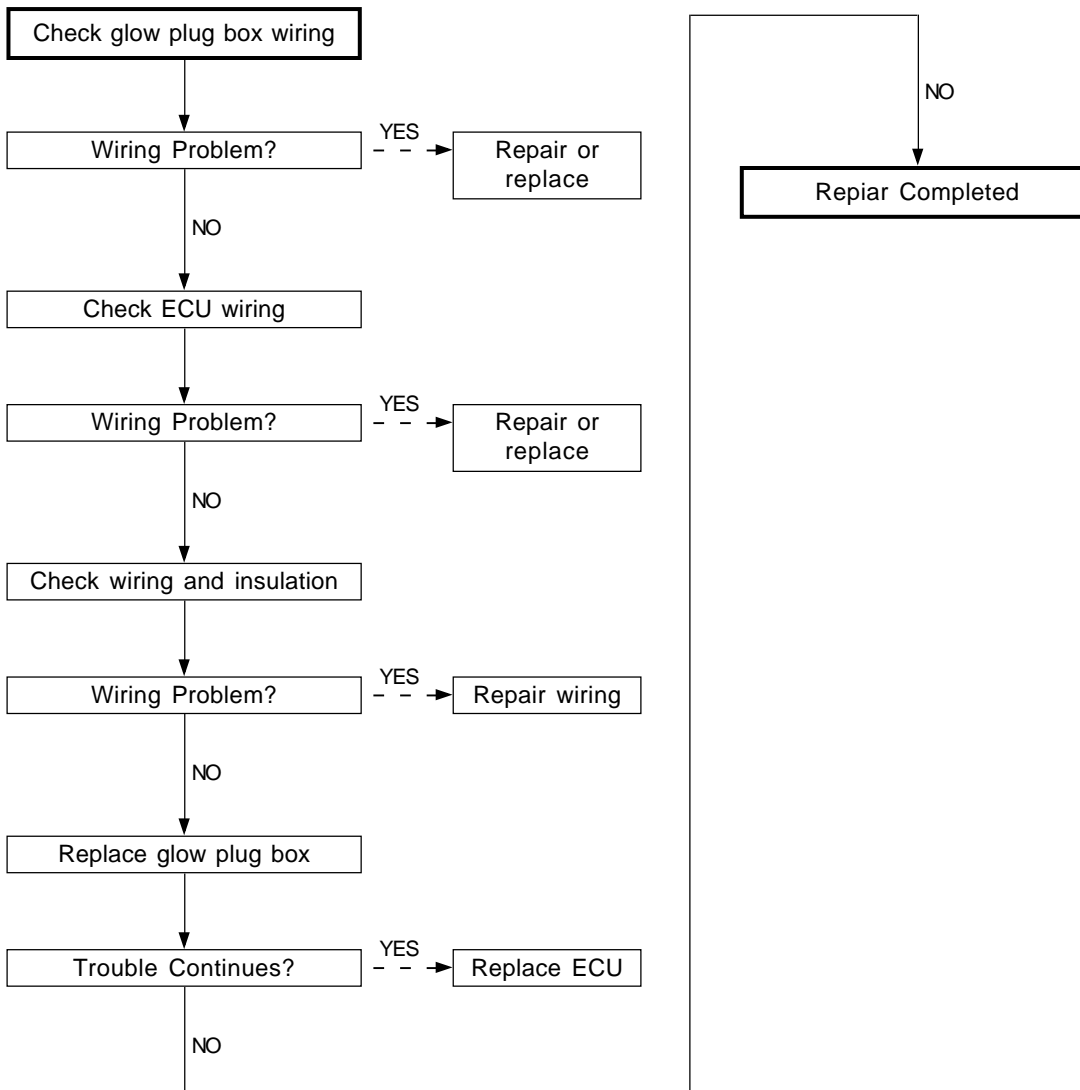
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Glow Plug Malfunction (Driving Signal)

► Trouble Code and Symptom

Trouble Code		Symptom
P1678	Open Circuit	
P1679	Short Circuit	Glow Plug Indicator ON
P1680	Short to Ground	

► Diagnosis Procedures

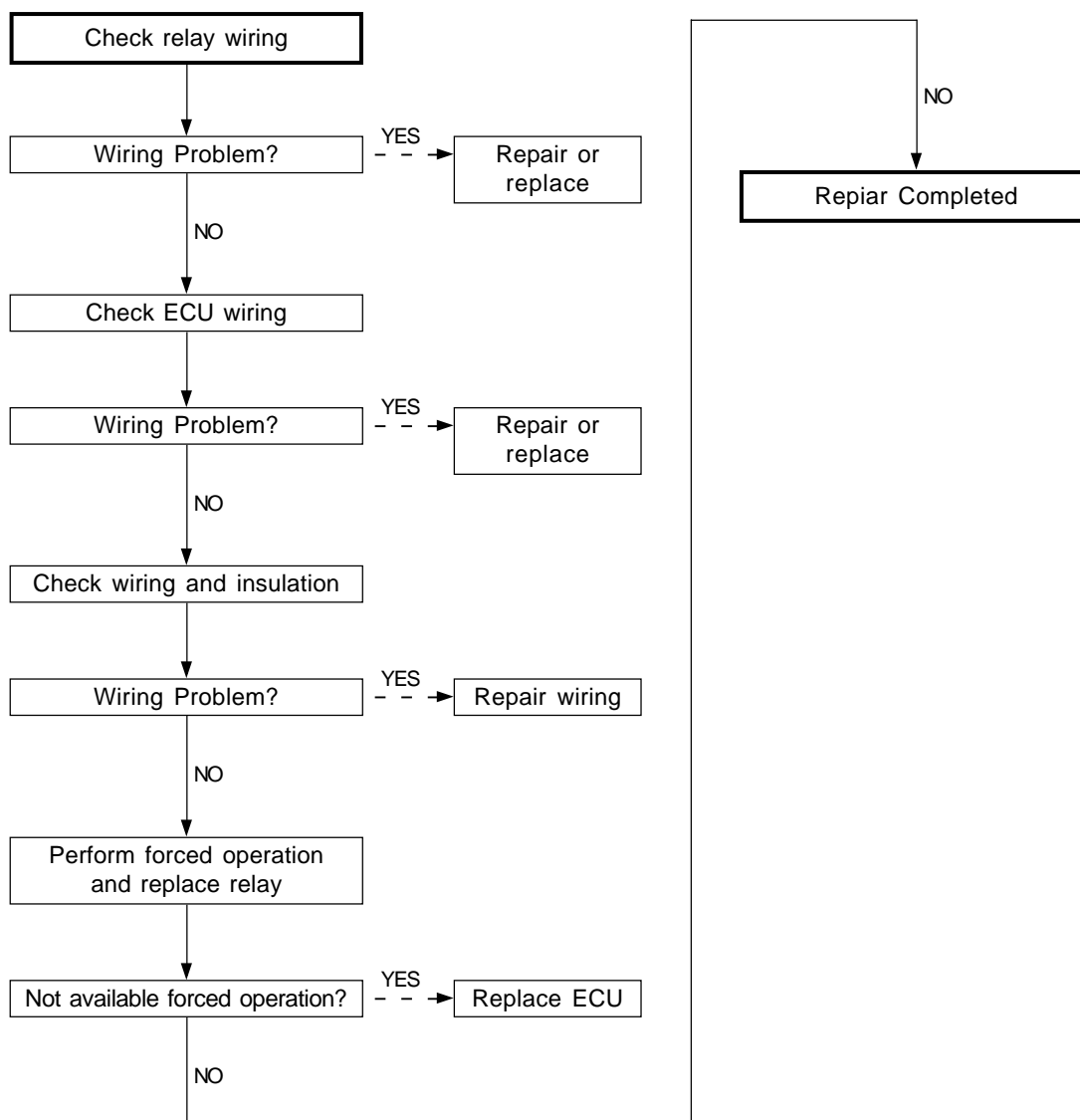


Heater 1 Malfunction (Driving Signal)

► Trouble Code and Symptom

Trouble Code		Symptom
P1530	Open Circuit	Unable Heater Operation
P1531	Short to +Batt	
P1532	Short to Ground	

► Diagnosis Procedures



DIAGNOSIS

KYRON SM - 2005.09

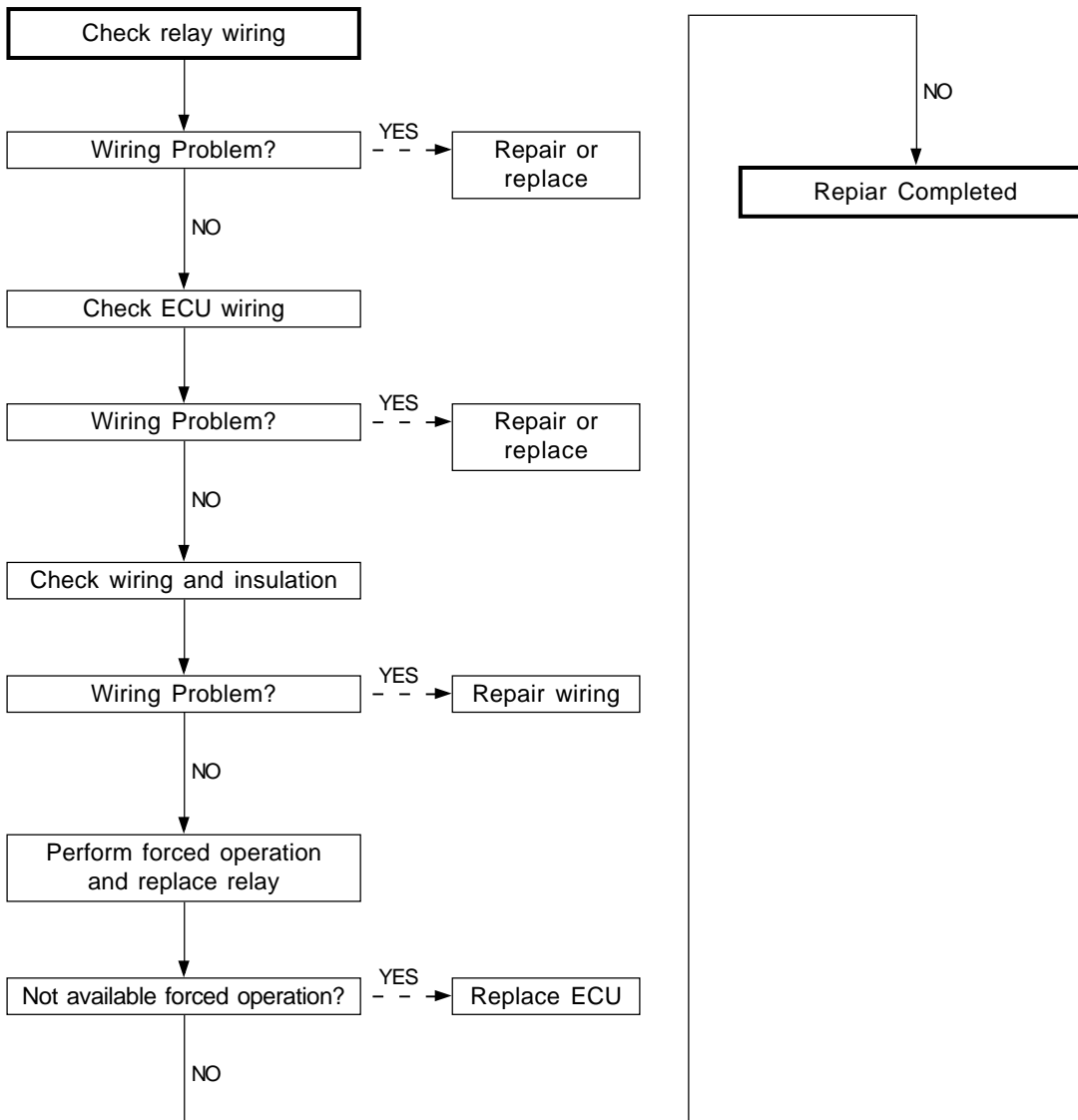
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Heater 2 Malfunction (Driving Signal)

► Trouble Code and Symptom

Trouble Code		Symptom
P1534	Open Circuit	Unable Heater Operation
P1535	Short to +Batt	
P1536	Short to Ground	

► Diagnosis Procedures



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

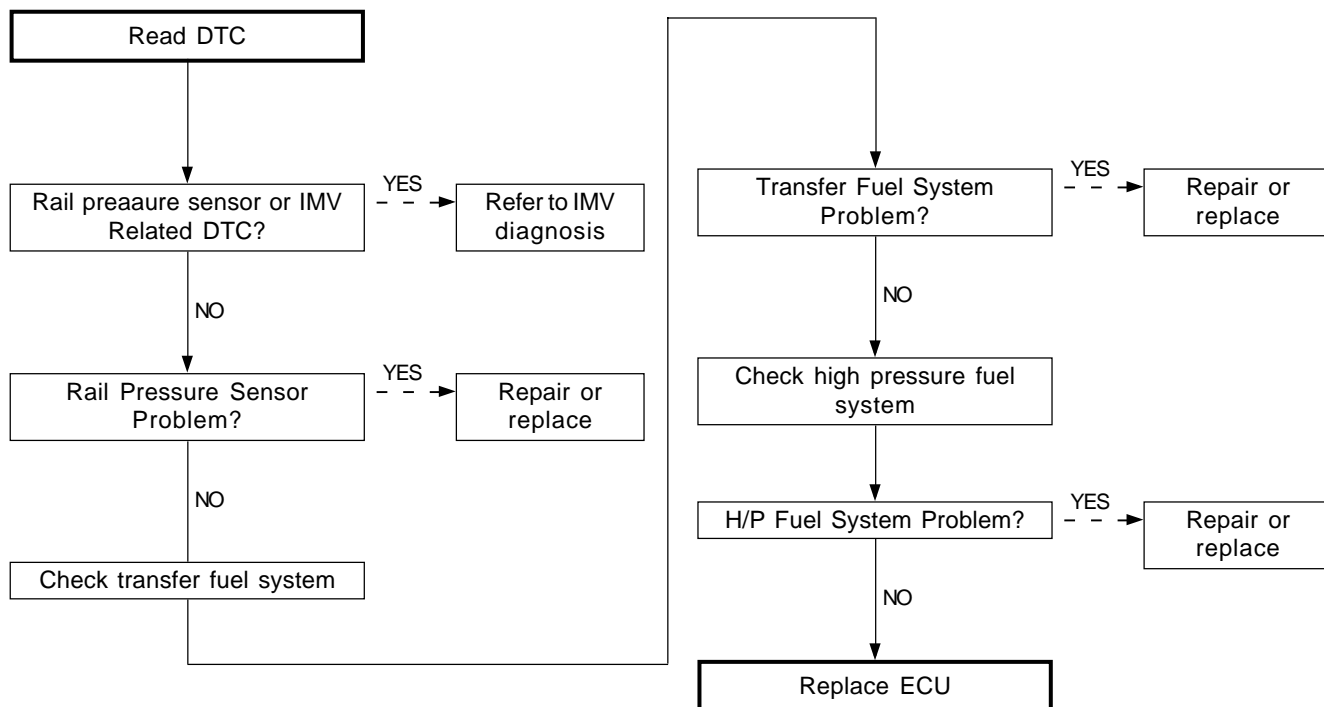
Rail Pressure Control Fault (Too High Pressure)

► Trouble Code and Symptom

Trouble Code		Symptom
P1254	Maximum Value	Unable Accelerometer Decoding
P1253	Minimum Value	MIL ON
		Unable Dynamic Leak of Injector #1
		Unable Dynamic Leak of Injector #2
		Unable Dynamic Leak of Injector #4
		Unable Dynamic Leak of Injector #5
		Unable Dynamic Leak of Injector #3
		Unable Cylinder Balancing
		Unable Accelerometer Learning Strategy

► Diagnosis Procedures

1. Rail Pressure Control

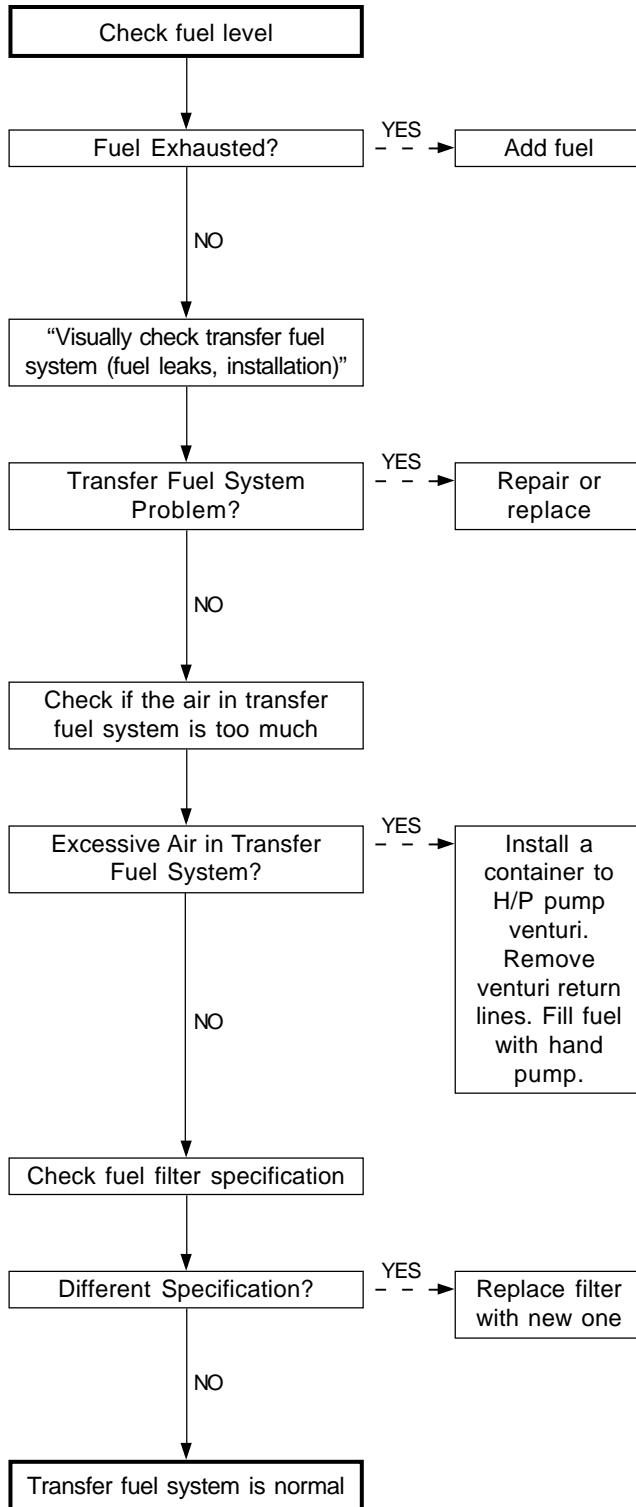


DIAGNOSIS

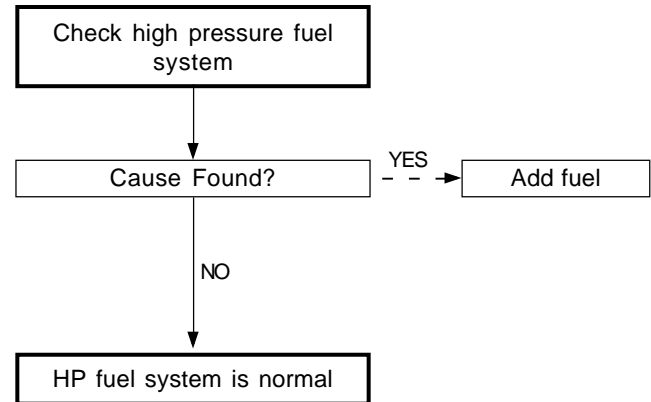
KYRON SM - 2005.09

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

2. Transfer Fuel System



3. High Pressyre Fuel System



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

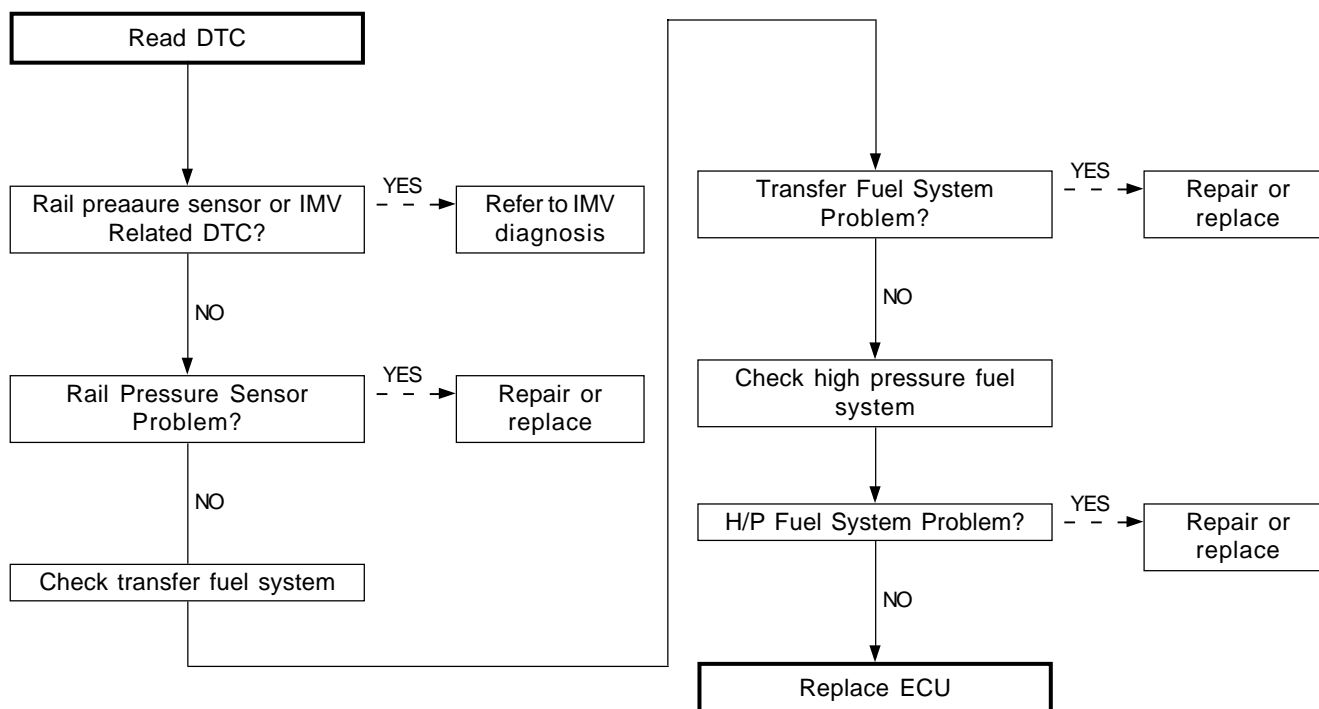
Rail Pressure Control Fault (Too High IMV Current Trim, drift)

► Trouble Code and Symptom

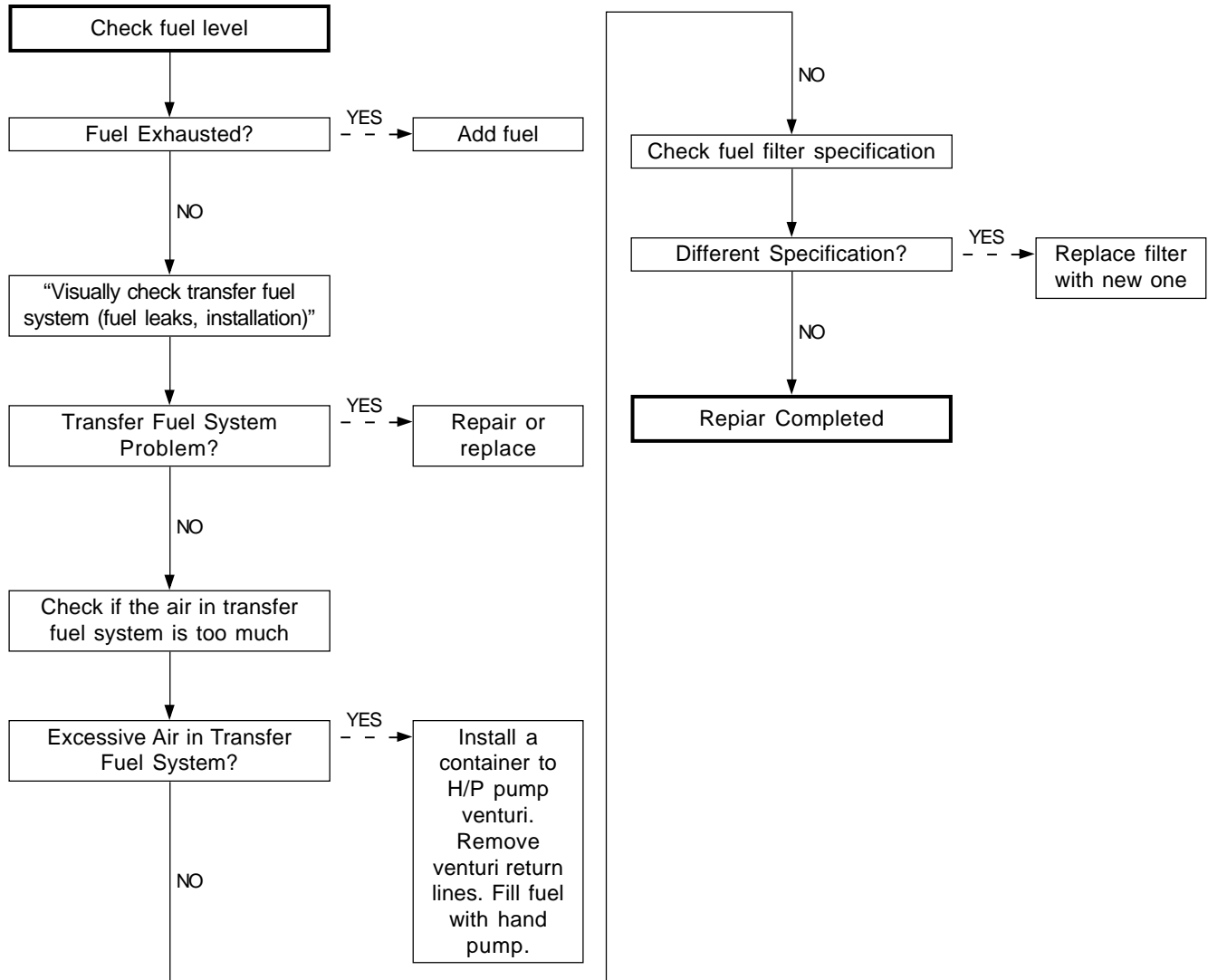
Trouble Code		Symptom
P1256	Small Delivery of Transfer Fuel	Unable Accelerometer Decoding
P1257	Large Delivery of Transfer Fuel	MIL ON
P1258	Small Delivery of High Pressure Fuel	Unable Dynamic Leak of Injector #1
P1259	Large Delivery of High Pressure Fuel	Unable Dynamic Leak of Injector #2
		Unable Dynamic Leak of Injector #4
		Unable Dynamic Leak of Injector #5
		Unable Dynamic Leak of Injector #3
		Unable Cylinder Balancing
		Unable Accelerometer Learning Strategy

► Diagnosis Procedures

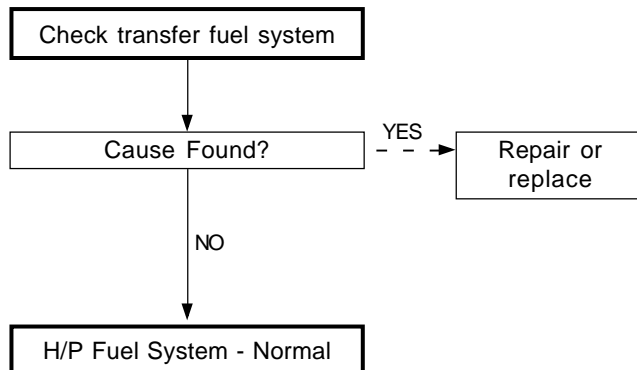
1. Diagnosis Procedures (Rail Pressure Control)



2. Diagnosis Procedures (Transfer Fuel System)



3. Diagnosis Procedures (High Pressure Fuel System)



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

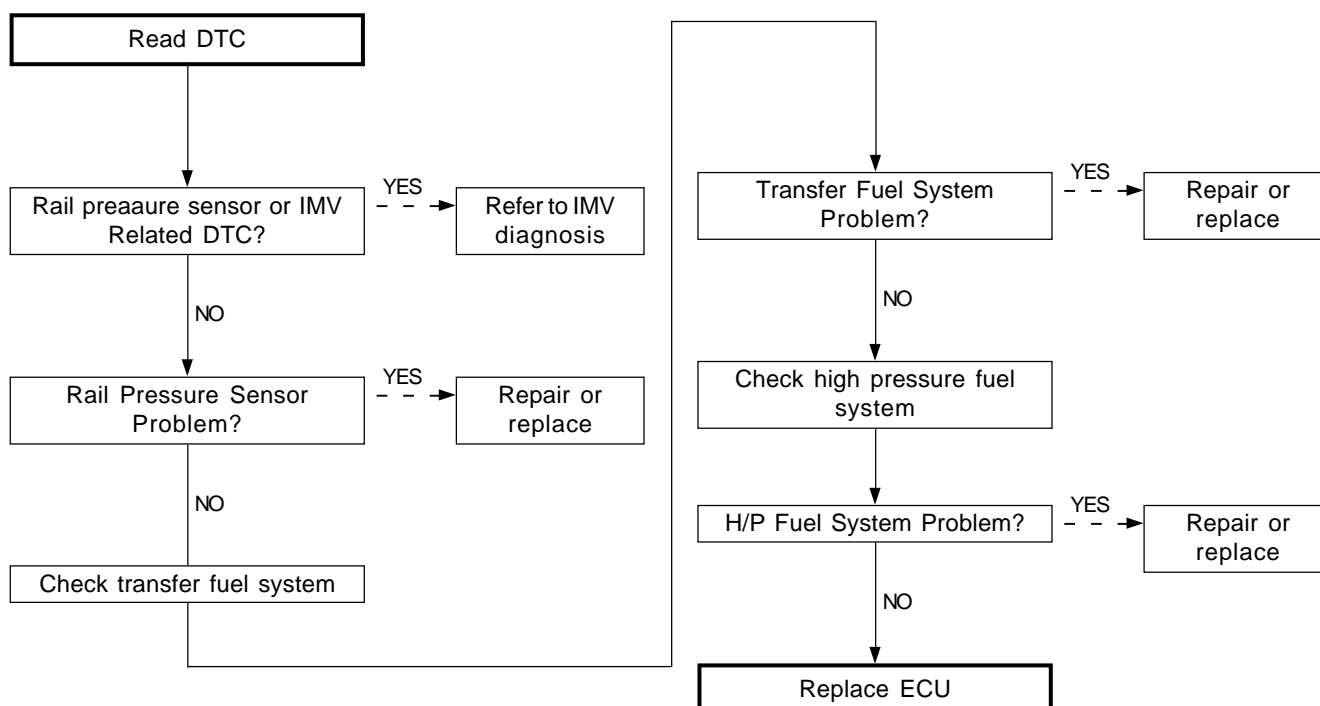
Rail Pressure Control Fault (Too Slow Pressure Build Up while Cranking)

► Trouble Code and Symptom

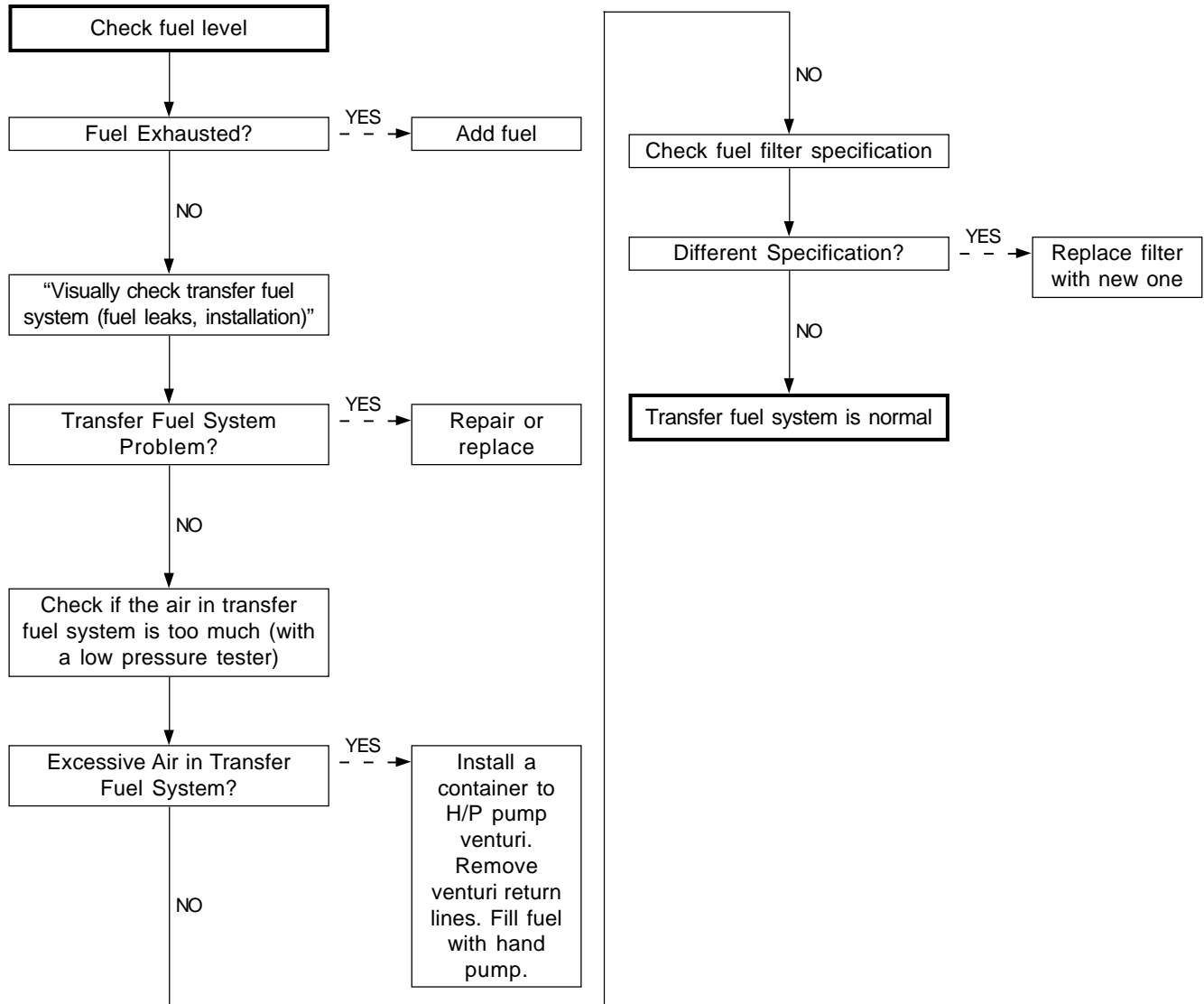
Trouble Code		Symptom
P1191	Rail Pressure Build Up - Too Slow	Unable Accelerometer Decoding
		Unable Dynamic Leak of Injector #1
		Unable Dynamic Leak of Injector #2
		Unable Dynamic Leak of Injector #4
		Unable Dynamic Leak of Injector #5
		Unable Dynamic Leak of Injector #3
		Unable Cylinder Balancing
		Unable Accelerometer Learning Strategy
		Limited Rail Pressure Mode Operation
		MIL ON

► Diagnosis Procedures

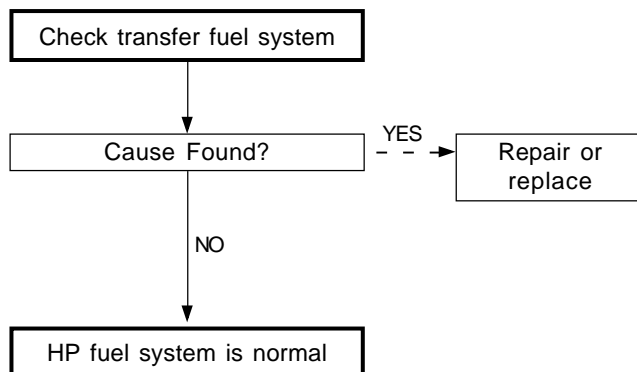
1. Diagnosis Procedures (Rail Pressure Control)



2. Diagnosis Procedures (Transfer Fuel System)



3. Diagnosis Procedures (High Pressyre Fuel System)



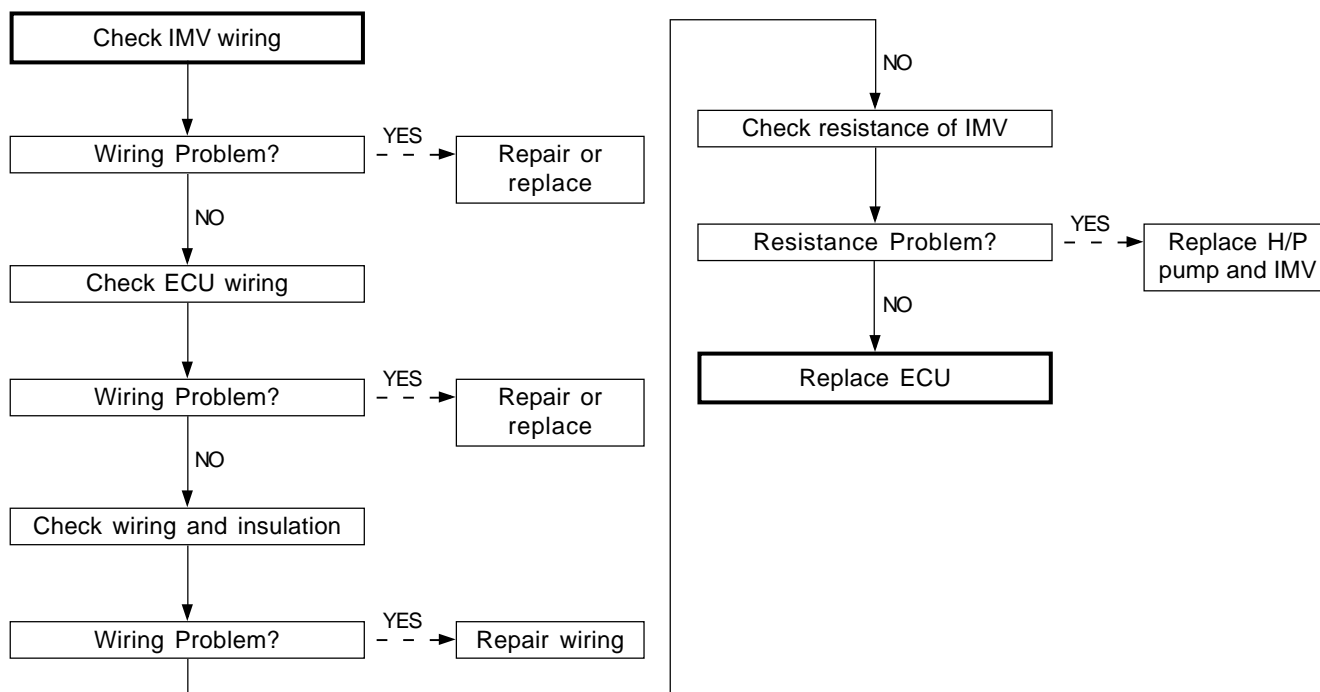
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

IMV Operation Fault (Electrical Fault)

► Trouble Code and Symptom

Trouble Code		Symptom
P0255	Open Circuit	Unable Accelerometer Decoding
P0251	Short Circuit	Delayed Engine Stop
P0253	Short to Ground	Unable Dynamic Leak of Injector #1
		Unable Dynamic Leak of Injector #2
		Unable Dynamic Leak of Injector #4
		Unable Dynamic Leak of Injector #5
		Unable Dynamic Leak of Injector #3
		Unable Cylinder Balancing
		Unable H/P Leak Detection
		Unable Accelerometer Learning Strategy
		Limited Rail Pressure Mode Operation
		MIL ON

► Diagnosis Procedures



DIAGNOSIS

KYRON SM - 2005.09

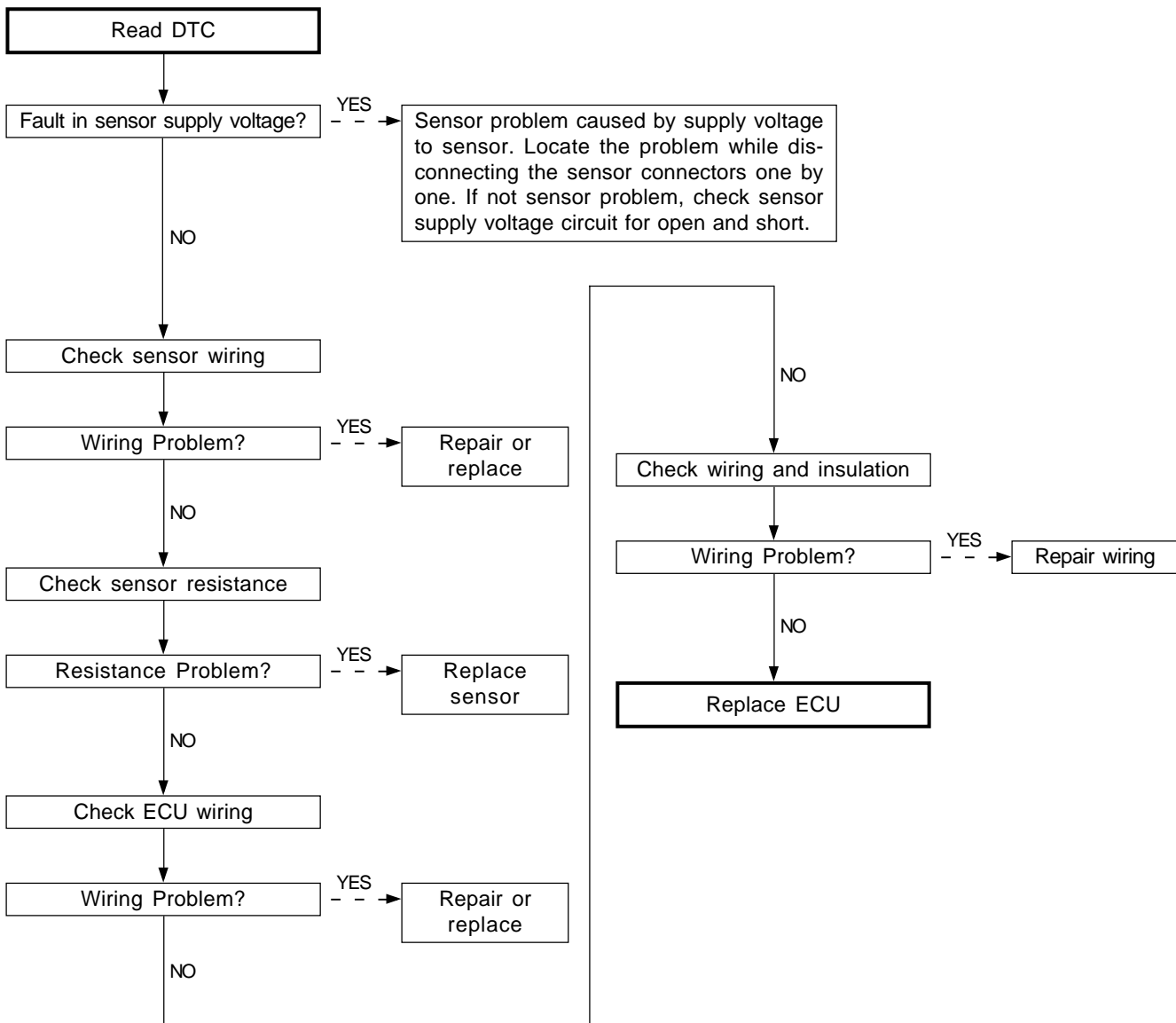
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Intake Air Temperature Sensor Fault (Electric Fault)

► Trouble Code and Symptom

Trouble Code		Symptom
P0112	High	
P0113	Low	
P0110	Supply Voltage	

► Diagnosis Procedures



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

MDP Fault (Injector #1)

► Trouble Code and Symptom

Trouble Code		Symptom
P1171	#1 Injector MDP Fault	Unable Accelerometer Decoding
		Unable Pilot and Post Injection
		Unable Dynamic Leak of Injector #1
		Torque Limit For Injector Drift
		Unable Accelerometer Learning Strategy

► Diagnosis Procedures

Enter the injector data into ECU after replacing injector

MDP Fault (Injector #2)

► Trouble Code and Symptom

Trouble Code		Symptom
P1172	#2 Injector MDP Fault	Unable Accelerometer Decoding
		Unable Pilot and Post Injection
		Unable Dynamic Leak of Injector #2
		Torque Limit For Injector Drift
		Unable Accelerometer Learning Strategy

► Diagnosis Procedures

Enter the injector data into ECU after replacing injector

MDP Fault (Injector #4)**► Trouble Code and Symptom**

Trouble Code		Symptom
P1174	#4 Injector MDP Fault	Unable Accelerometer Decoding
		Unable Pilot and Post Injection
		Unable Dynamic Leak of Injector #4
		Torque Limit For Injector Drift
		Unable Accelerometer Learning Strategy

► Diagnosis Procedures

Enter the injector data into ECU after replacing injector

MDP Fault (Injector #5)**► Trouble Code and Symptom**

Trouble Code		Symptom
P1175	#5 Injector MDP Fault	Unable Accelerometer Decoding
		Unable Pilot and Post Injection
		Unable Dynamic Leak of Injector #5
		Torque Limit For Injector Drift
		Unable Accelerometer Learning Strategy

► Diagnosis Procedures

Enter the injector data into ECU after replacing injector

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

MDP Fault (Injector #3)

► Trouble Code and Symptom

Trouble Code		Symptom
P1173	#3 Injector MDP Fault	Unable Accelerometer Decoding
		Unable Pilot and Post Injection
		Unable Dynamic Leak of Injector #3
		Torque Limit For Injector Drift
		Unable Accelerometer Learning Strategy

► Diagnosis Procedures

Enter the injector data into ECU after replacing injector

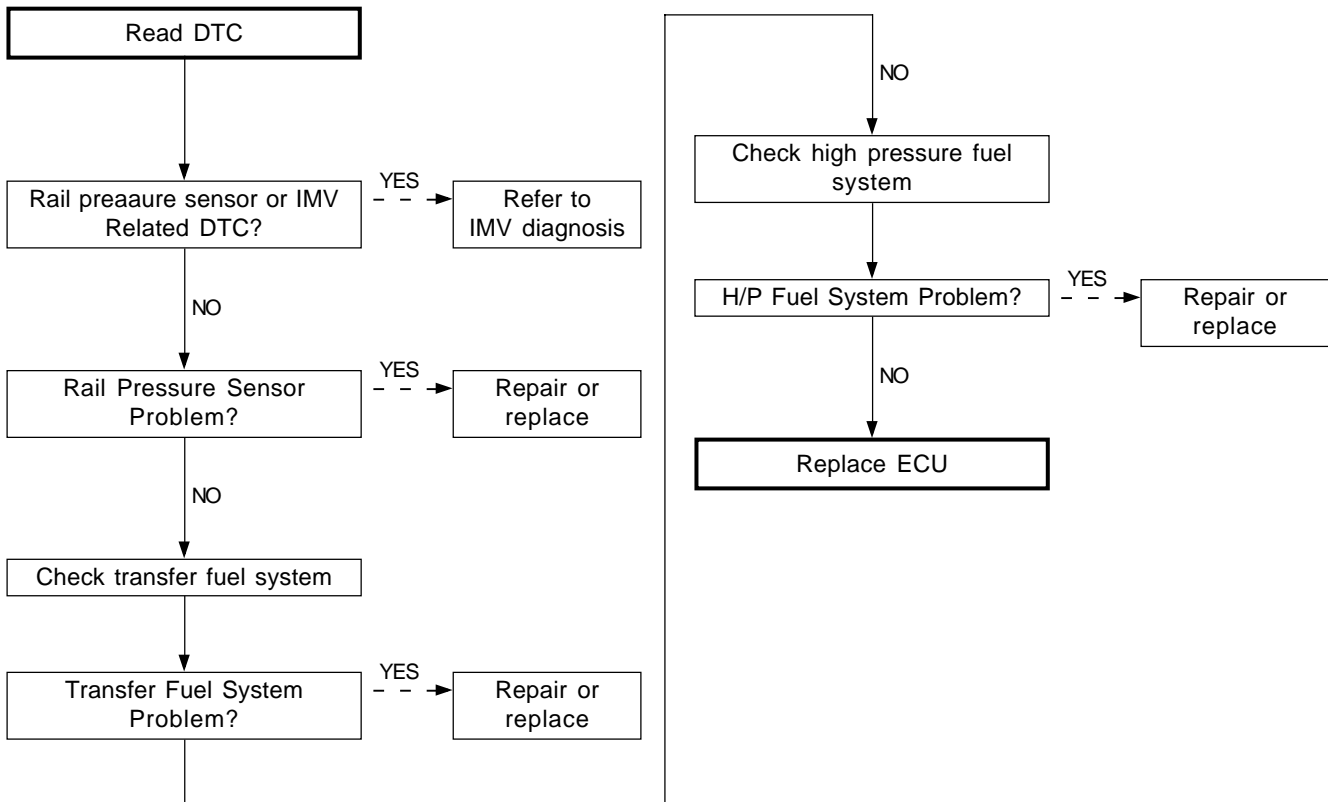
Rail Pressure Fault (Too High)

► Trouble Code and Symptom

Trouble Code		Symptom
P1252	Too High IMV Pressure	

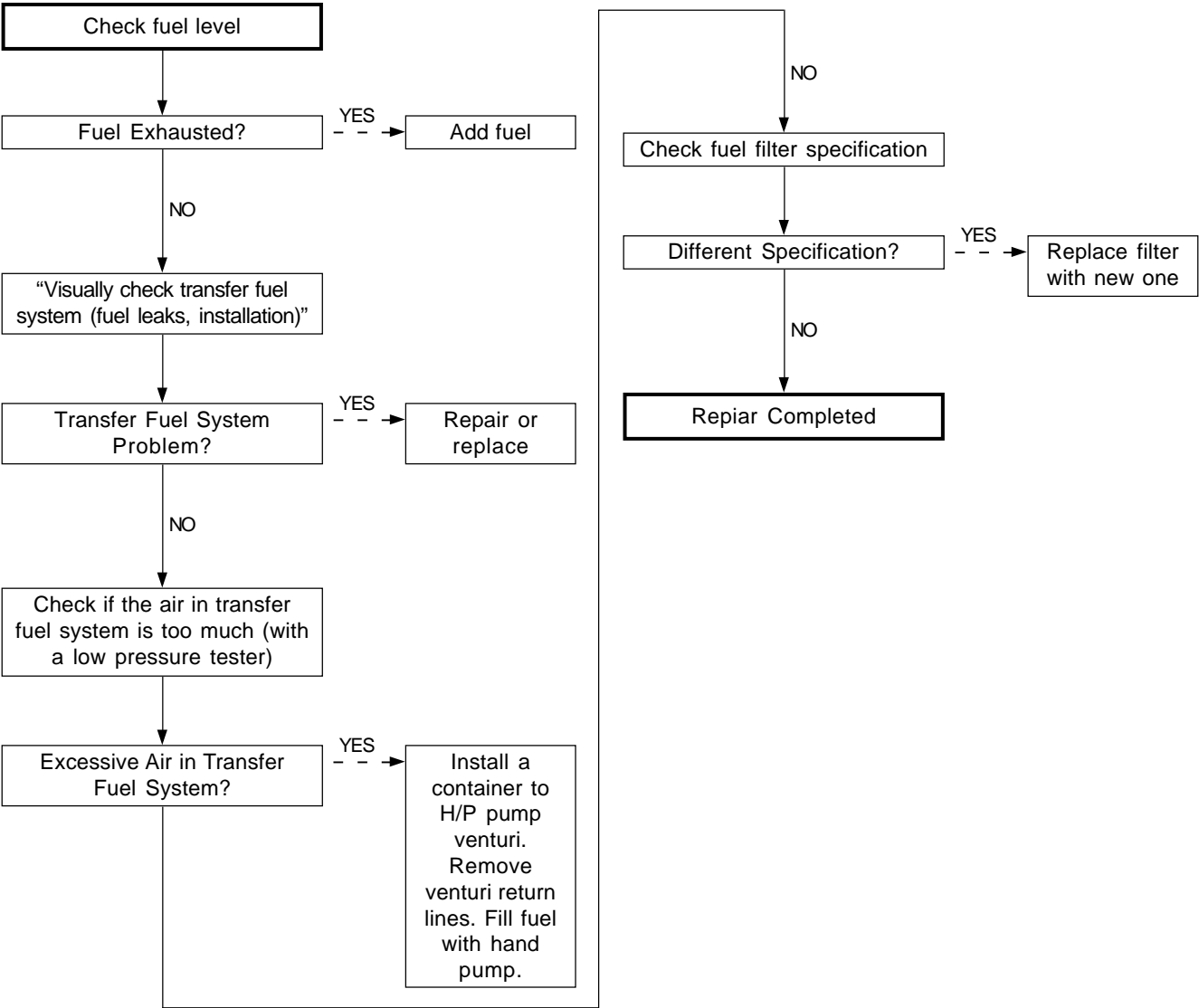
► Diagnosis Procedures

1. Diagnosis Procedures (Rail Pressure Control)

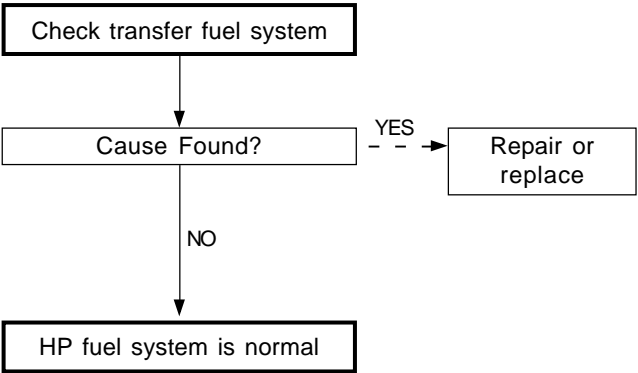


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

2. Diagnosis Procedures (Transfer Fuel System)



3. Diagnosis Procedures (High Pressyre Fuel System)



DIAGNOSIS

KYRON SM - 2005.09

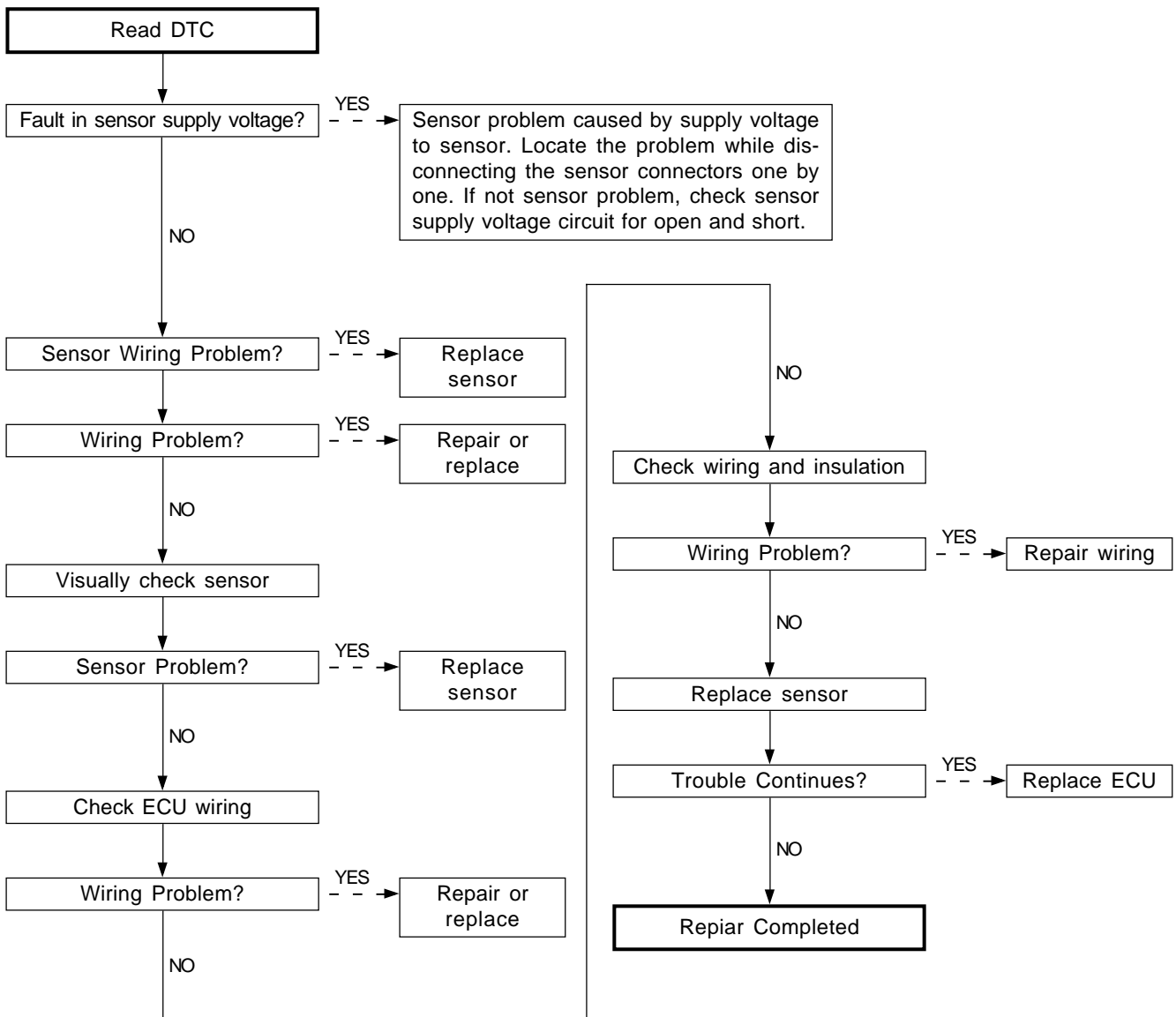
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Accelerator Pedal Sensor Malfunction (Relationship between Track 1 and Track 2)

► Trouble Code and Symptom

Trouble Code		Symptom
P1120	Accelerator Pedal Sensor 1 Malfunction	Unable Cruise Control
P1121	Accelerator Pedal Sensor 2 Malfunction	MIL ON
		Torque Reduction Mode Operation

► Diagnosis Procedures



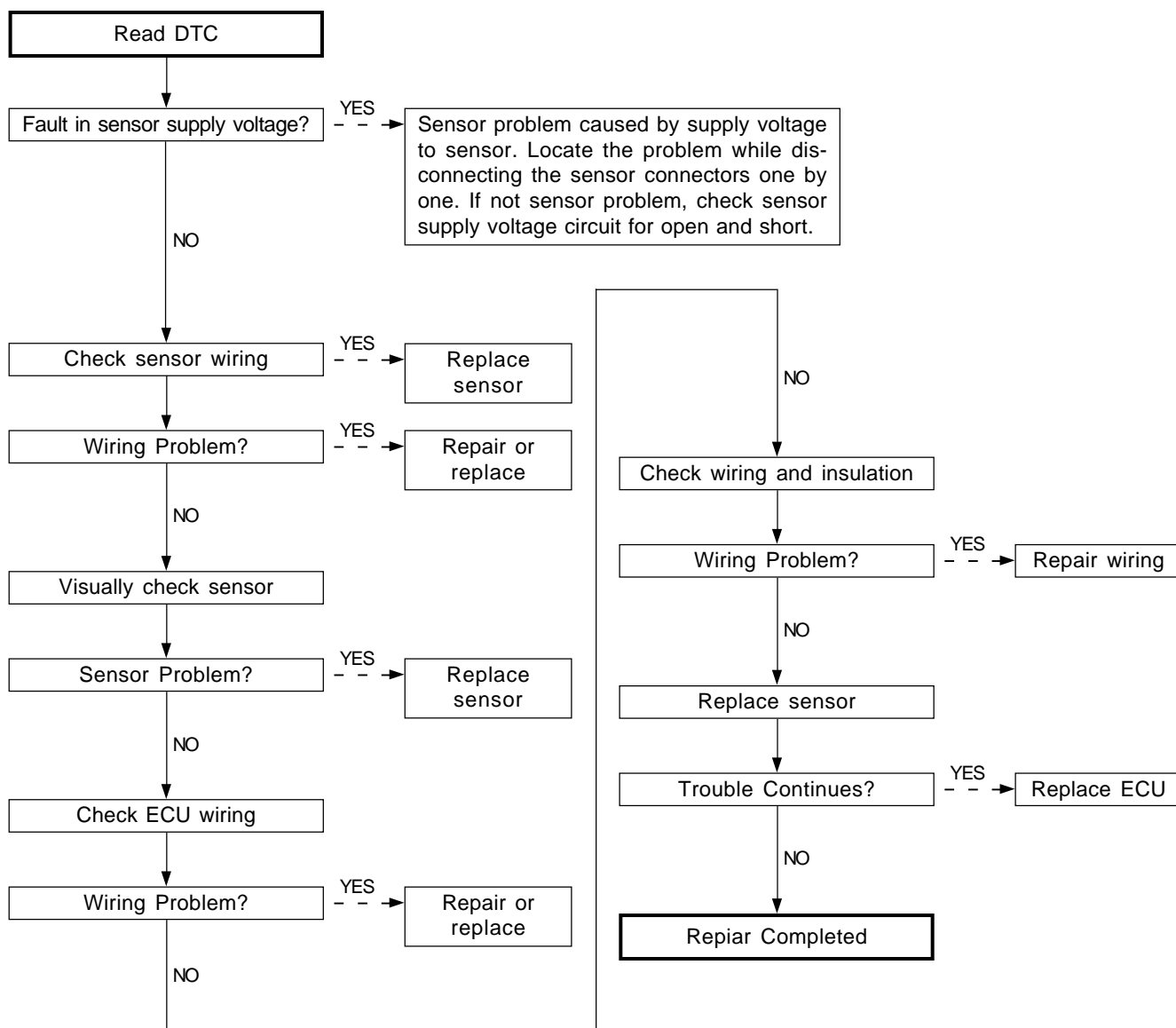
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Accelerator Pedal Sensor Malfunction (Limp Home Mode Operation)

► Trouble Code and Symptom

Trouble Code		Symptom
P1122	Accelerator Pedal Sensor Malfunction (Limp Home Mode)	MIL ON
		Limp Home Mode Operation

► Diagnosis Procedures



DIAGNOSIS

KYRON SM - 2005.09

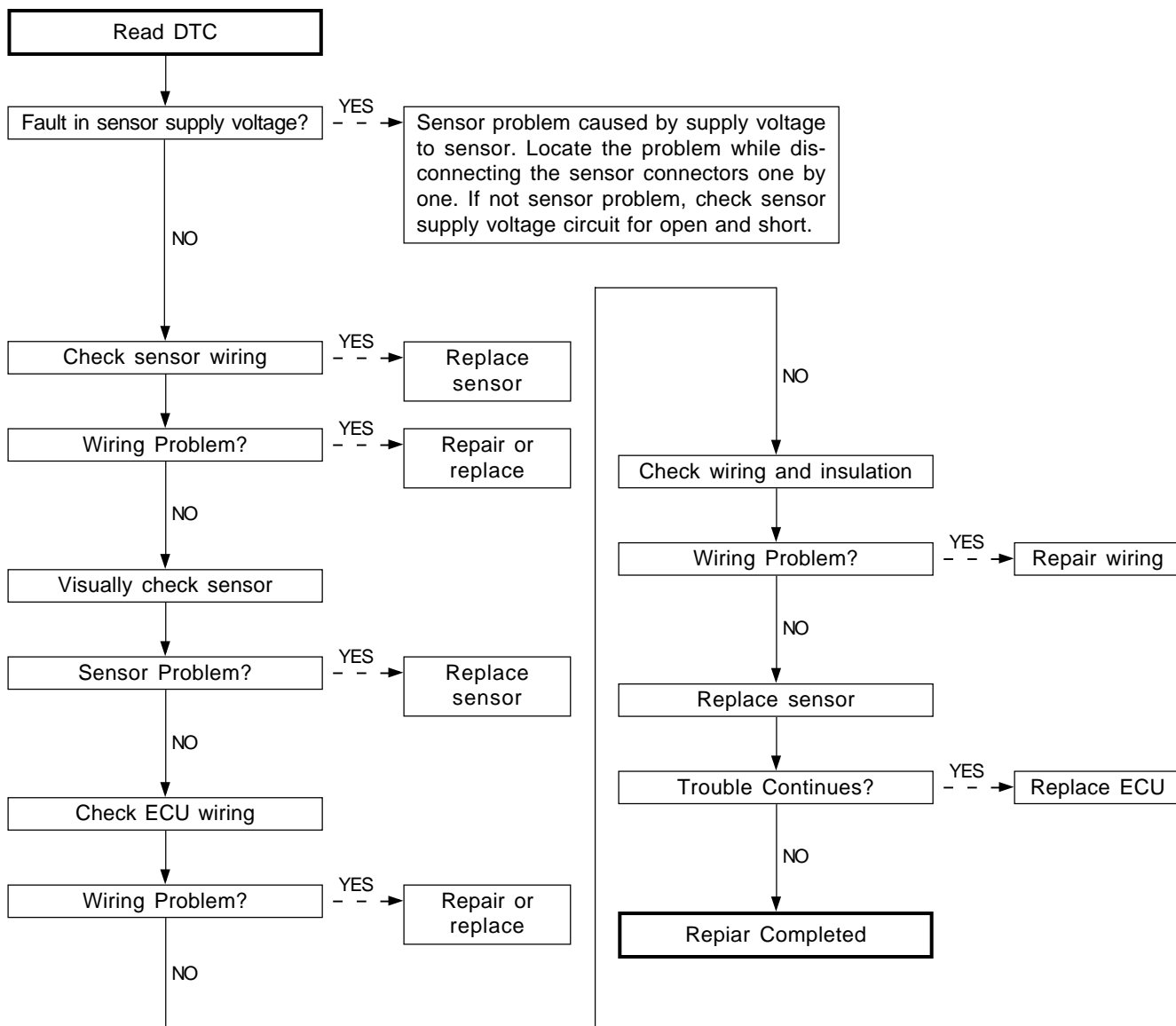
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Accelerator Pedal Sensor Malfunction (Torque Reduction Mode Operation)

► Trouble Code and Symptom

Trouble Code		Symptom
P1123	Accelerator Pedal Sensor Malfunction (Torque Mode)	MIL ON
		Torque Reduction Mode Operation

► Diagnosis Procedures



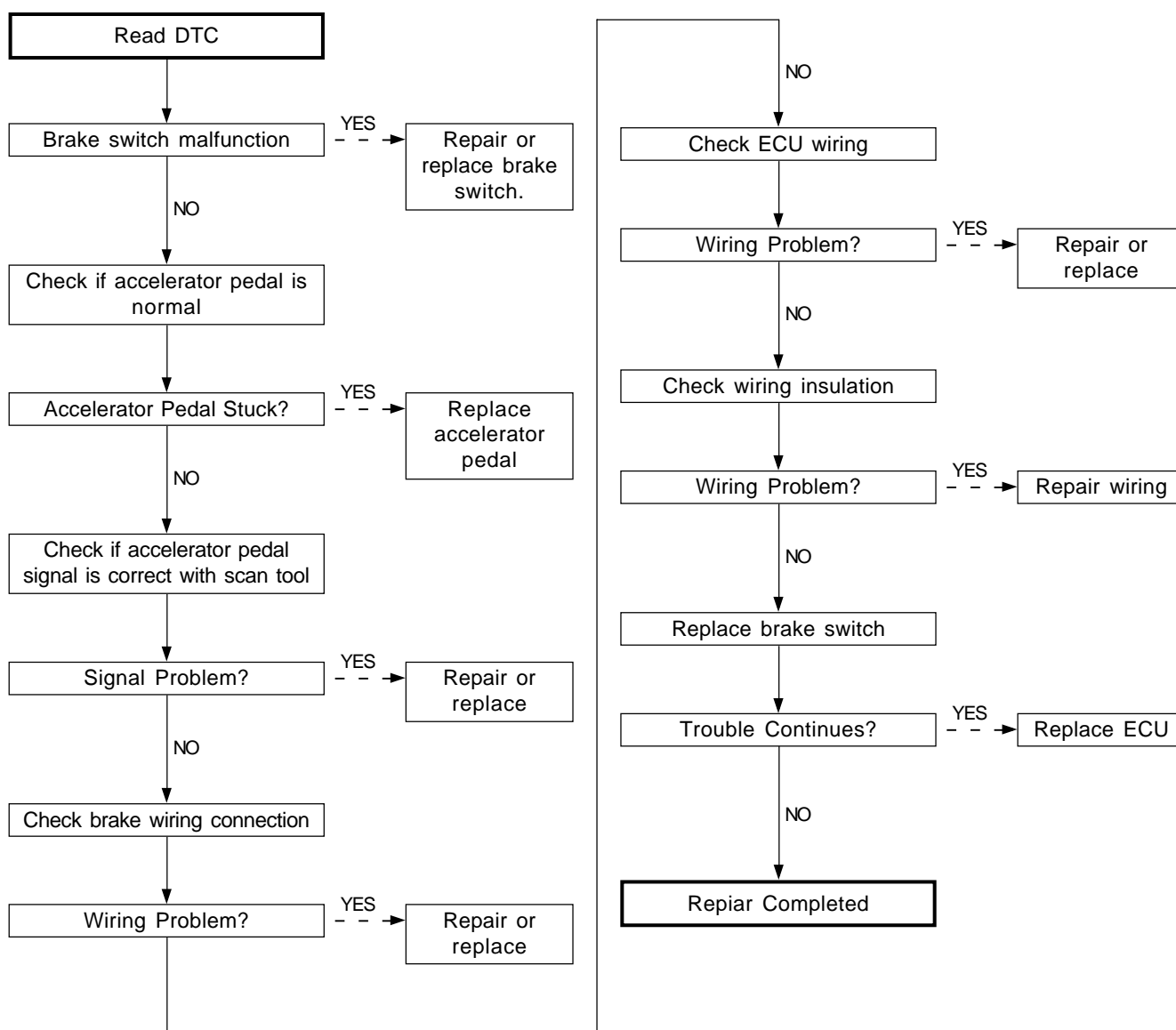
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Accelerator Pedal Sensor Malfunction (Electrical Fault, Pedal Stuck)

► Trouble Code and Symptom

Trouble Code		Symptom
P1124	Accelerator Pedal Sensor Malfunction - Stuck	Unable Cruise Control
		Limp Home Mode Operation

► Diagnosis Procedures



DIAGNOSIS

KYRON SM - 2005.09

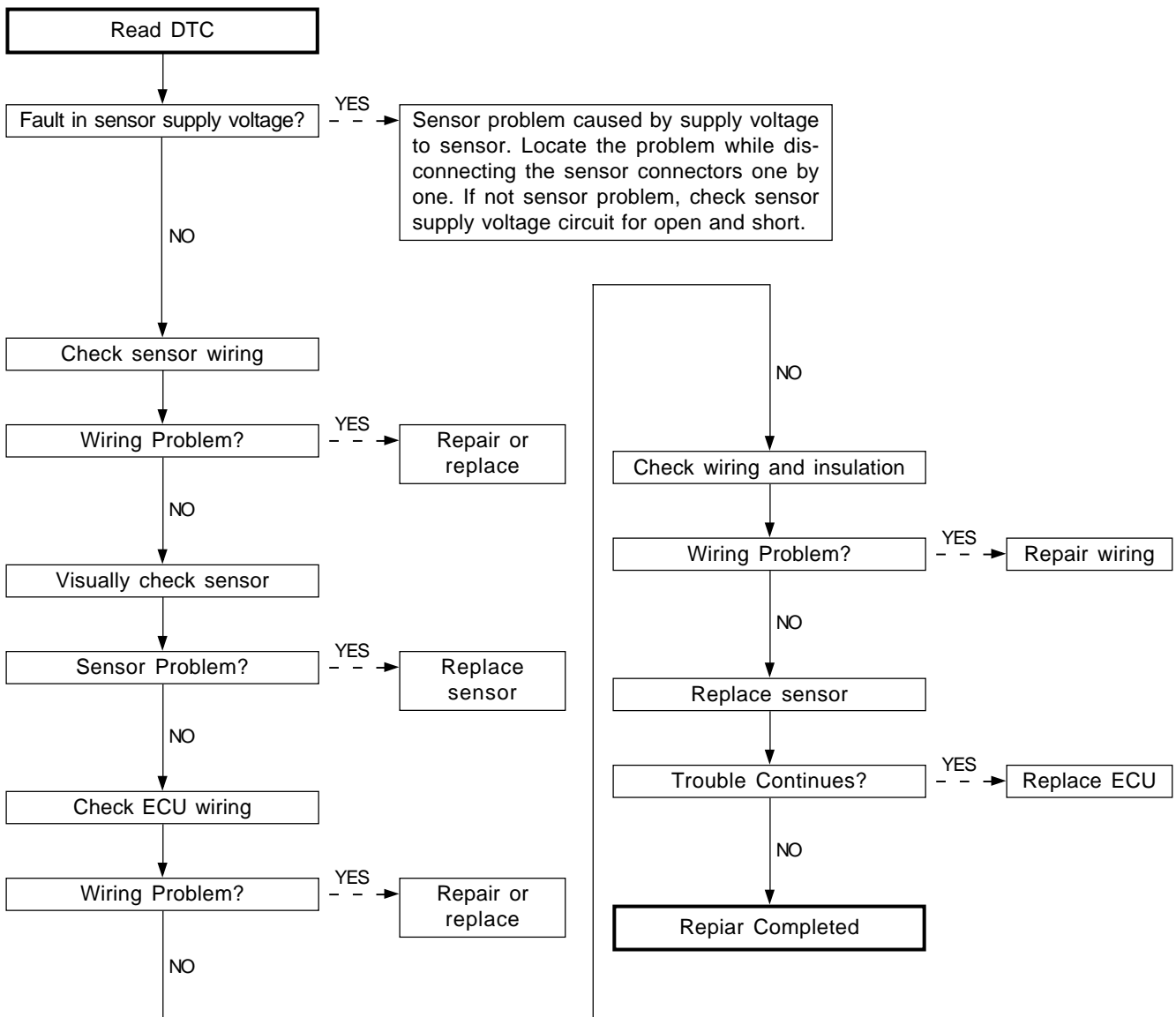
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Accelerator Pedal Sensor Malfunction (Electrical Fault, Track 1)

► Trouble Code and Symptom

Trouble Code		Symptom
P0122	Low	MIL ON
P0123	High	Unable Cruise Control
P0120	Supply Voltage	Torque Reduced Mode Operation

► Diagnosis Procedures



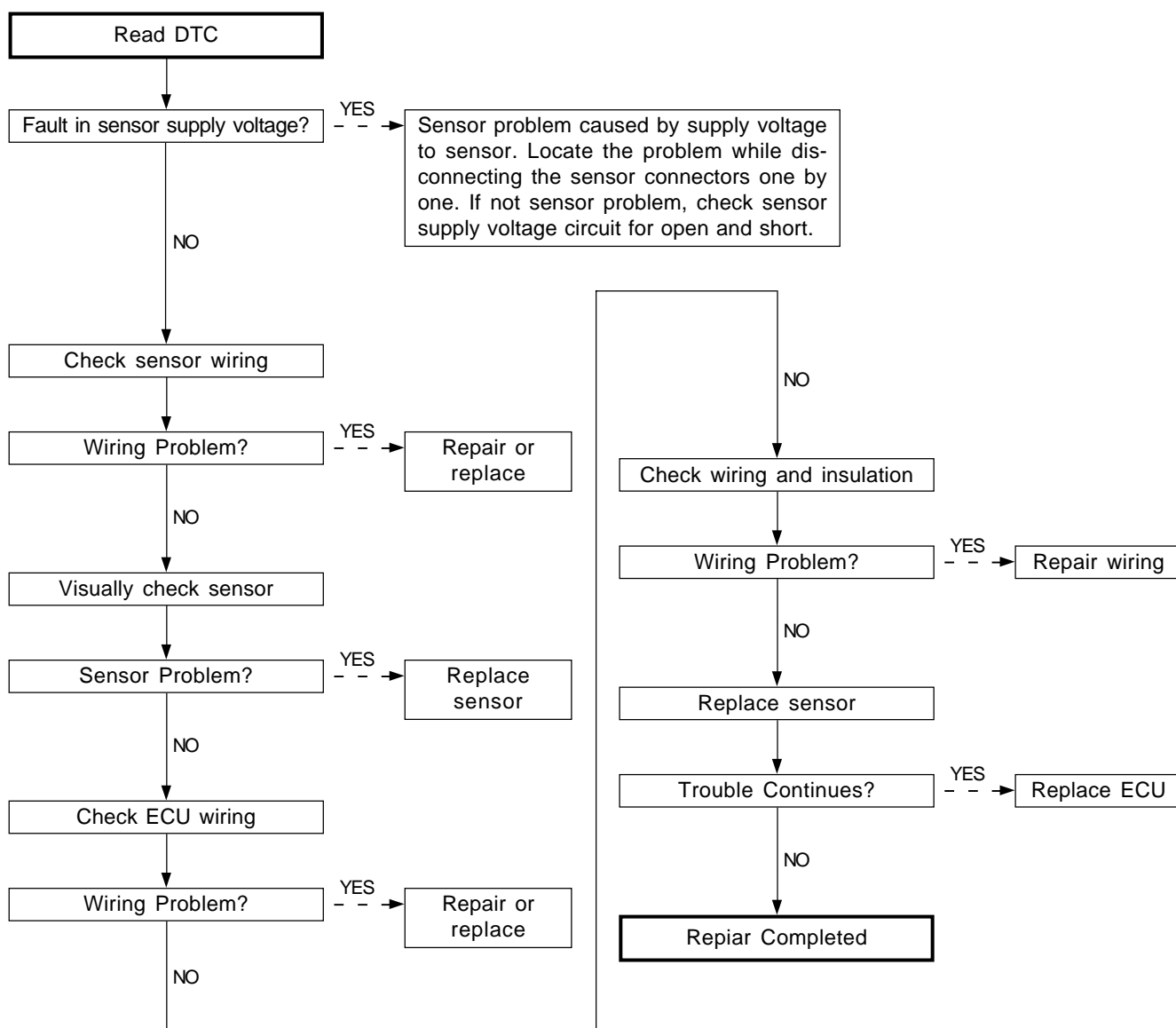
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Accelerator Pedal Sensor Malfunction (Electrical Fault, Track 2)

► Trouble Code and Symptom

Trouble Code		Symptom
P0222	Low	MIL ON
P0223	High	Unable Cruise Control
P0220	Supply Voltage	Torque Reduction Mode Operation

► Diagnosis Procedures



DIAGNOSIS

KYRON SM - 2005.09

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

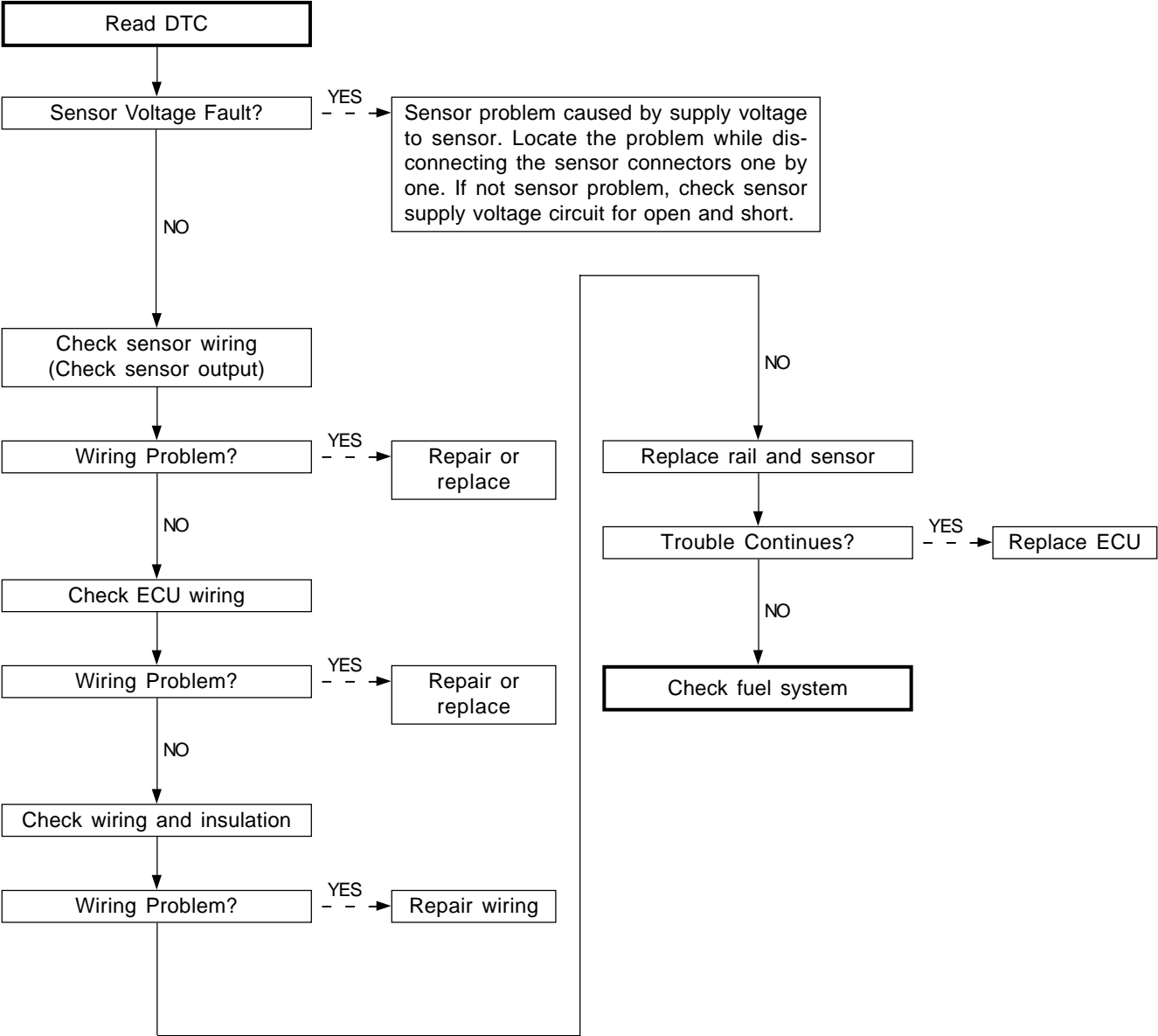
Fuel Rail Pressure Sensor Malfunction (Out of Range, ADC or Vref)

► Trouble Code and Symptom

Trouble Code		Symptom
P0192	Low	Unable Pilot and Post Injection
P0193	High	Unable Dynamic Leak of Injector #1
P0190	Supply Voltage	Unable Dynamic Leak of Injector #2
P0191	Excessive Pressure Drop	Unable Dynamic Leak of Injector #4
		Unable Dynamic Leak of Injector #5
		Unable Dynamic Leak of Injector #3
		Unable RPC Trim Fault Detection
		Unable Cylinder Balancing
		Unable H/P Leak Detection
		Unable Accelerometer Learning Strategy
		Fully Forced Open IMV
		Limited Rail Pressure Mode Operation
		Unable High Rail Pressure Detection
		Torque Reduction Mode Operation
		MIL ON

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► Diagnosis Procedures



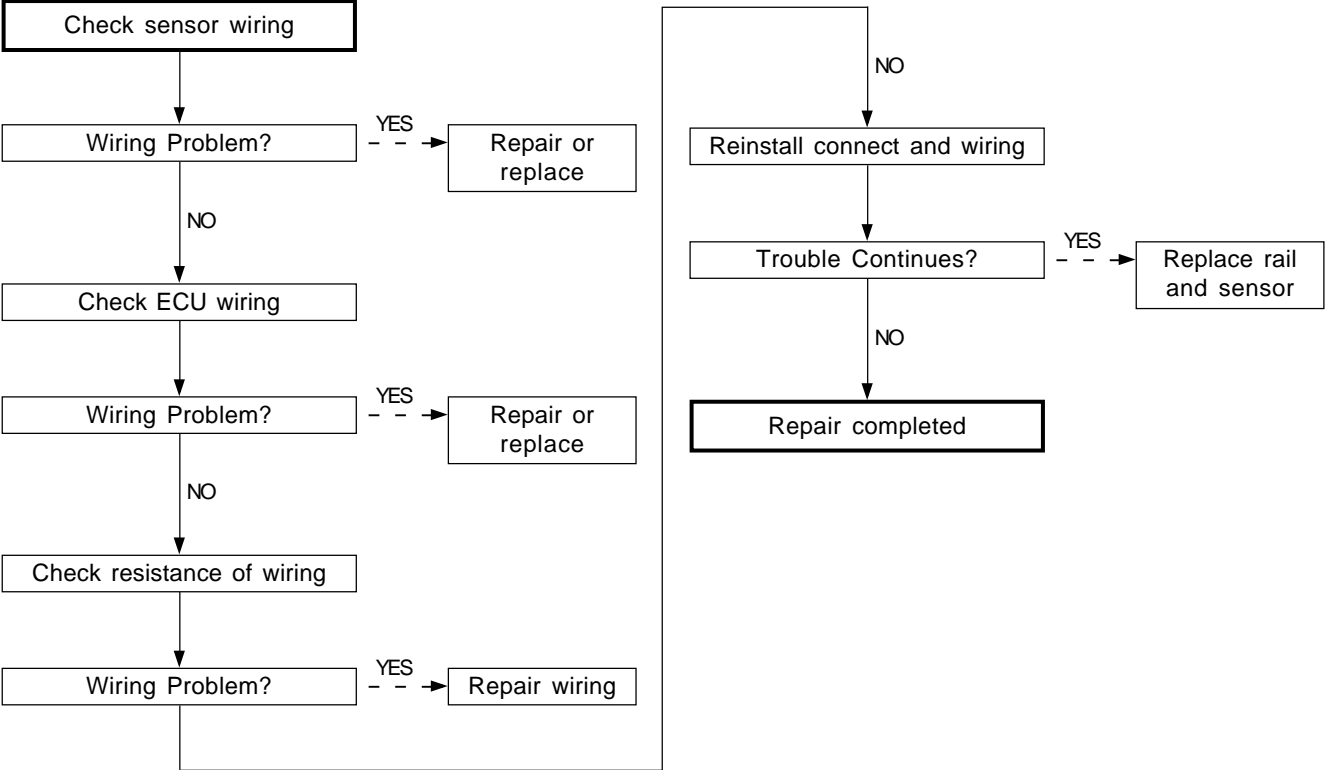
Fuel Rail Pressure Sensor Malfunction (Out of Range when Key ON)

► Trouble Code and Symptom

Trouble Code		Symptom
P1192	Low	Unable Pilot and Post Injection
P1193	High	Unable Dynamic Leak of Injector #1
P1190	Supply Voltage	Unable Dynamic Leak of Injector #2
		Unable Dynamic Leak of Injector #4
		Unable Dynamic Leak of Injector #5
		Unable Dynamic Leak of Injector #3
		Unable RPC Trim Fault Detection
		Unable Cylinder Balancing
		Unable H/P Leak Detection
		Unable Accelerometer Learning Strategy
		Fully Forced Open IMV
		Limited Rail Pressure Mode Operation
		Unable High Rail Pressure Detection
		Torque Reduction Mode Operation
		MIL ON

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► Diagnosis Procedures



DIAGNOSIS

KYRON SM - 2005.09

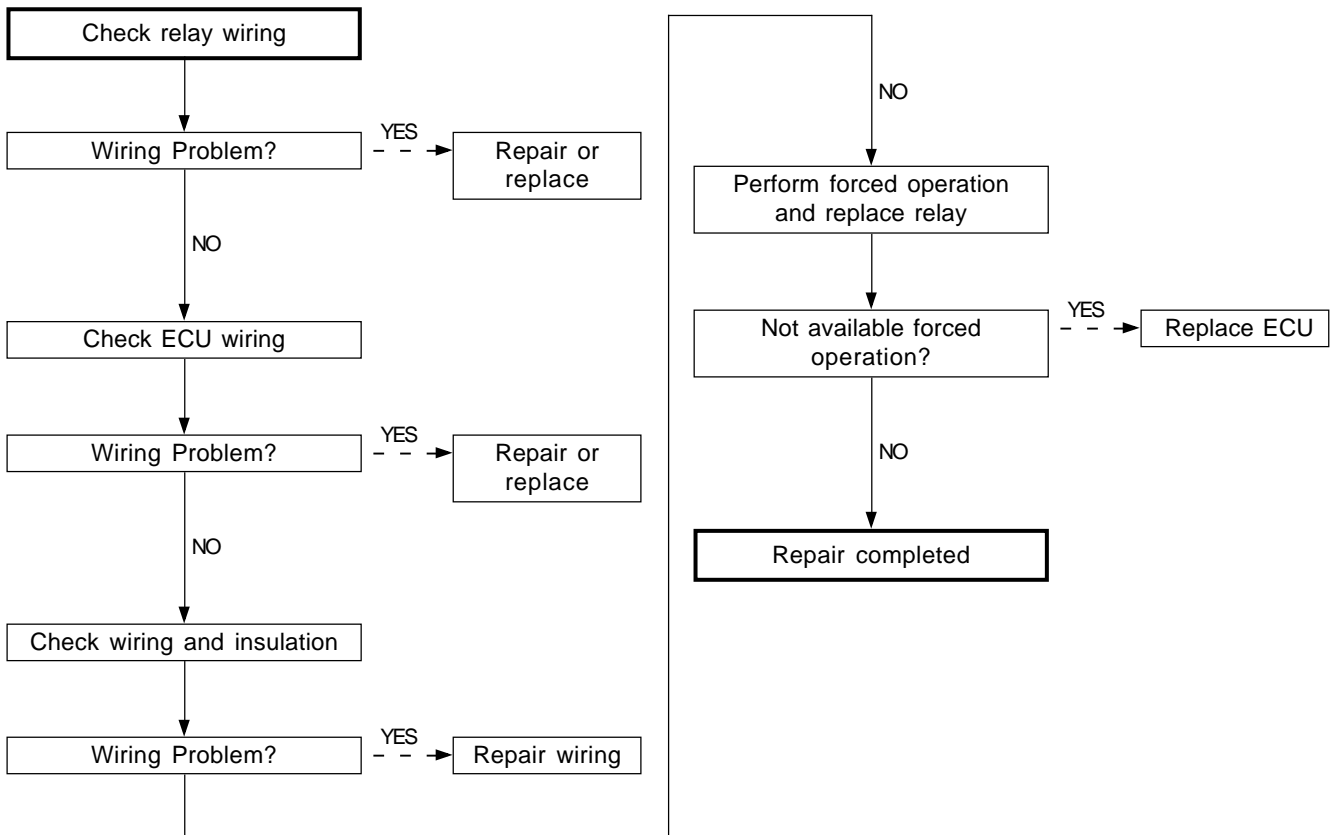
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Main Relay Malfunction - Stuck

► Trouble Code and Symptom

Trouble Code		Symptom
P0215	Main Relay Malfunction- Stuck	

► Diagnosis Procedures



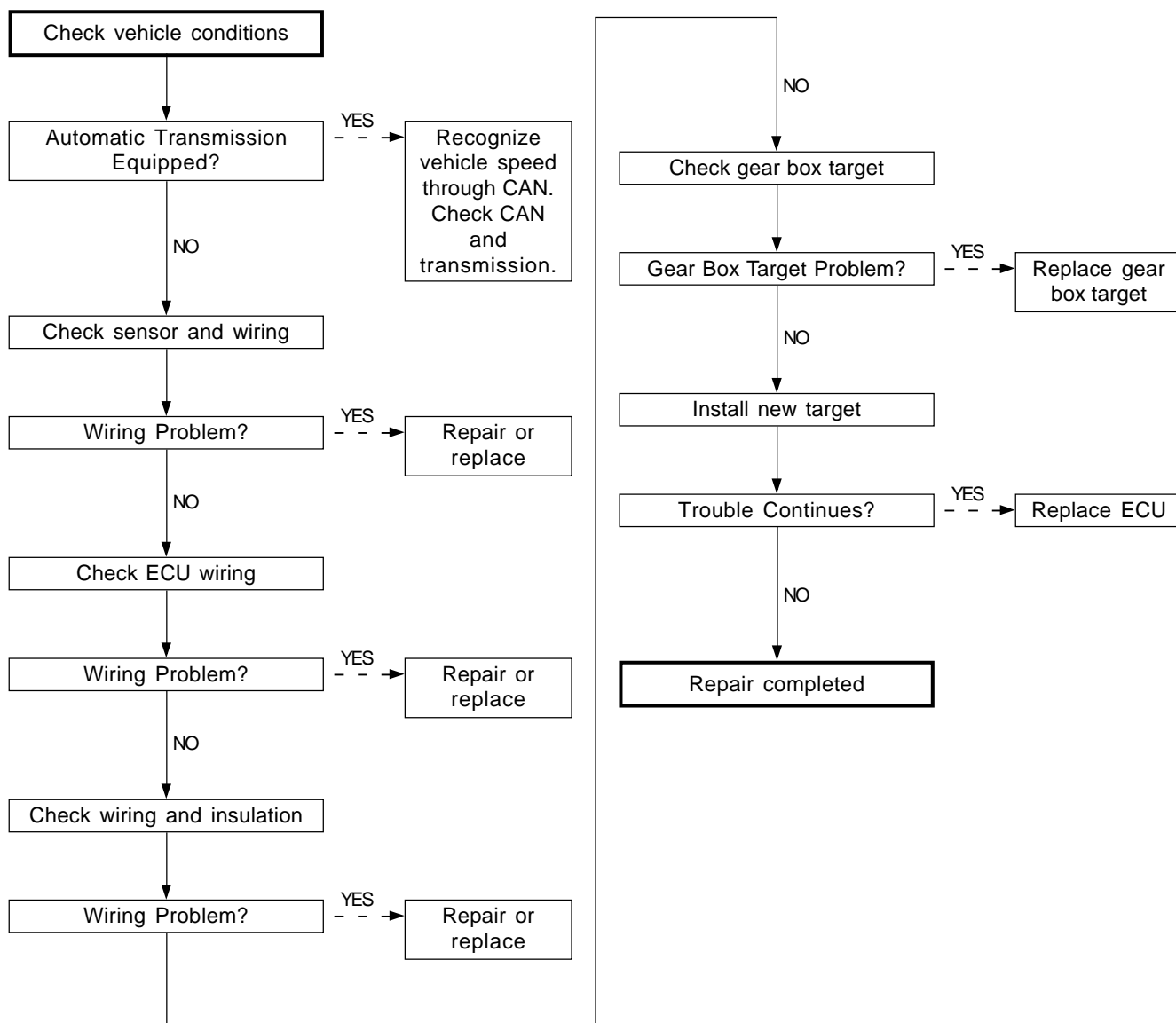
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Vehicle Speed Fault

► Trouble Code and Symptom

Trouble Code		Symptom
P1500	Vehicle Speed Fault	Unable Cruise Control

► Diagnosis Procedures



DIAGNOSIS

KYRON SM - 2005.09

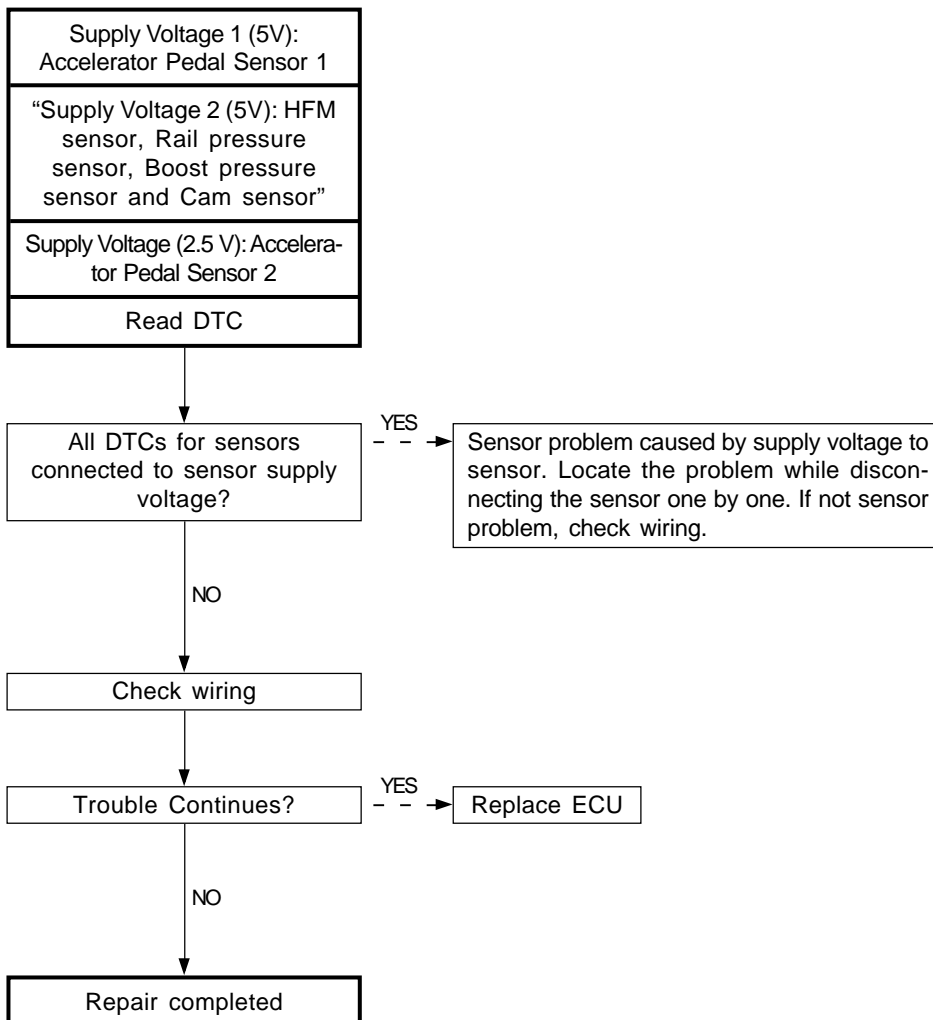
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

5V Supply Voltage 1 Fault

► Trouble Code and Symptom

Trouble Code		Symptom
P0642	Low	Unable Cruise Control
P0643	High	
P0641	Supply Voltage	

► Diagnosis Procedures



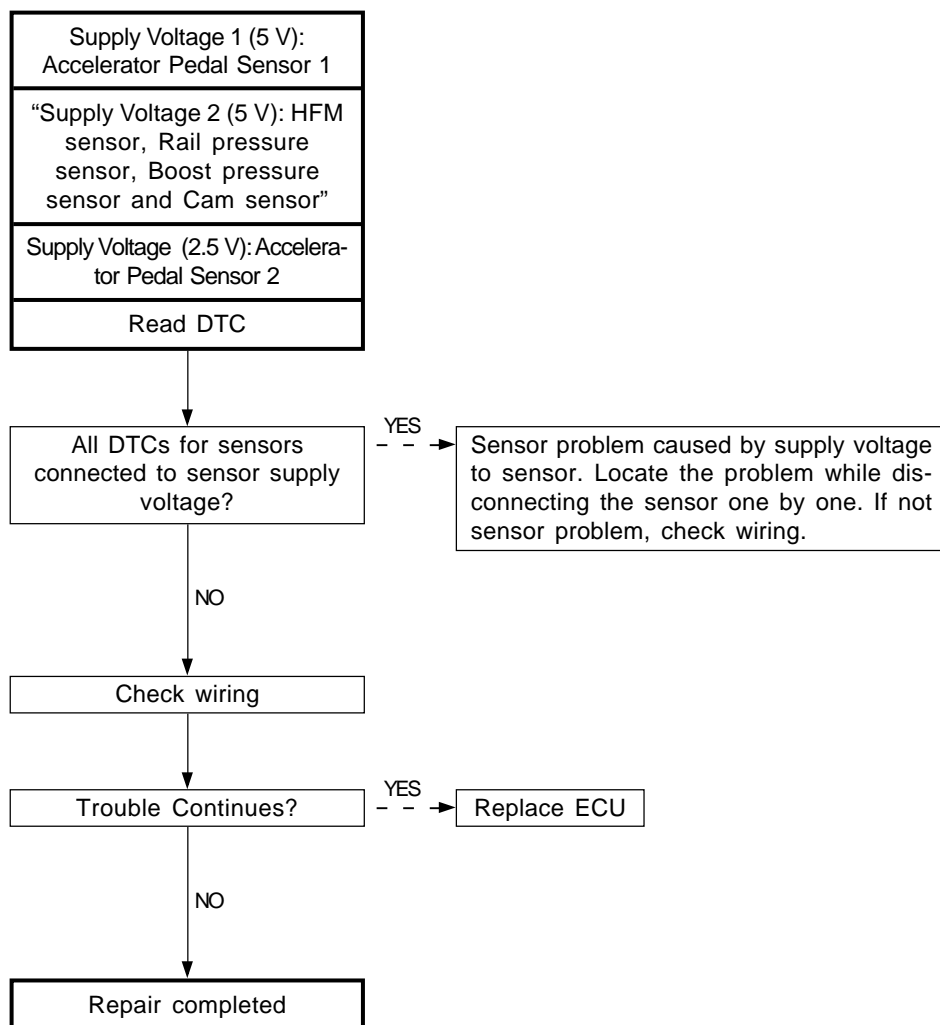
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

5V Supply Voltage 2 Fault

► Trouble Code and Symptom

Trouble Code		Symptom
P0652	Low	MIL ON
P0653	High	Limp Home Mode Operation
P0651	Supply Voltage	

► Diagnosis Procedures

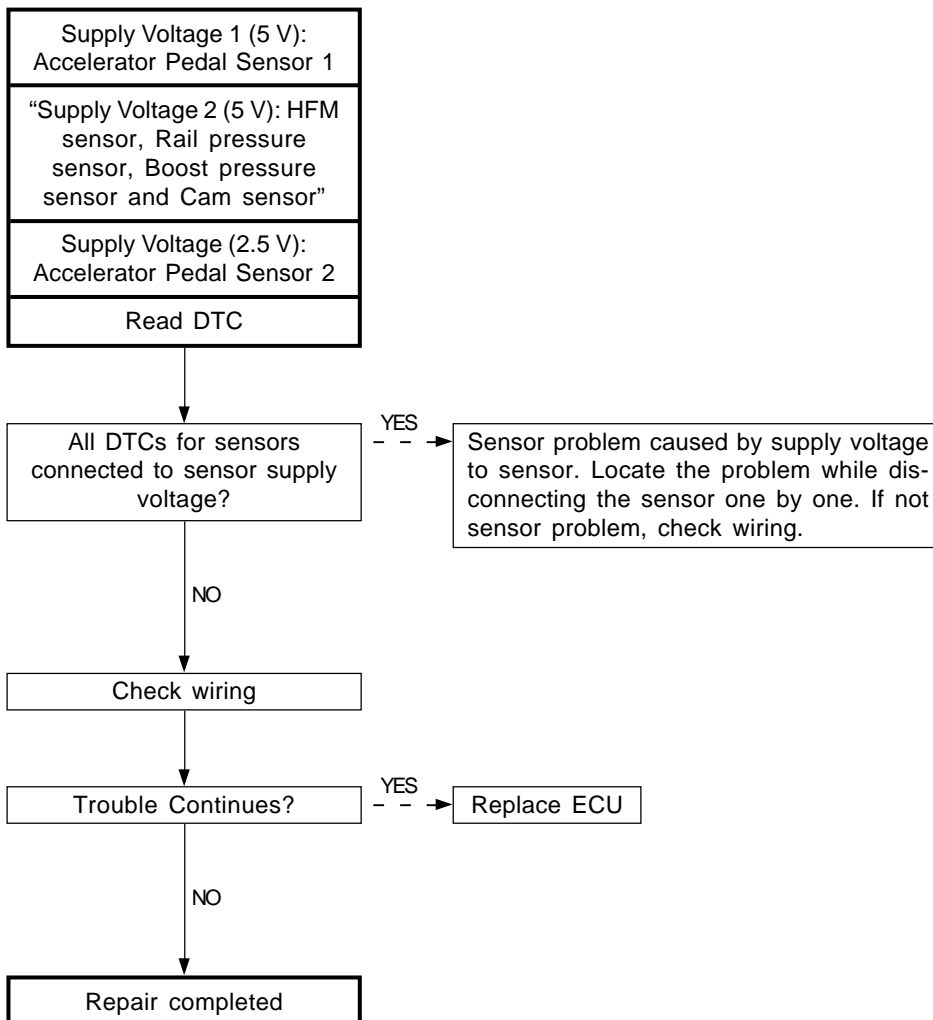


2.5V Supply Voltage Fault

► Trouble Code and Symptom

Trouble Code		Symptom
P0698	Low	Unable Cruise Control
P0699	High	
P0697	Supply Voltage	

► Diagnosis Procedures

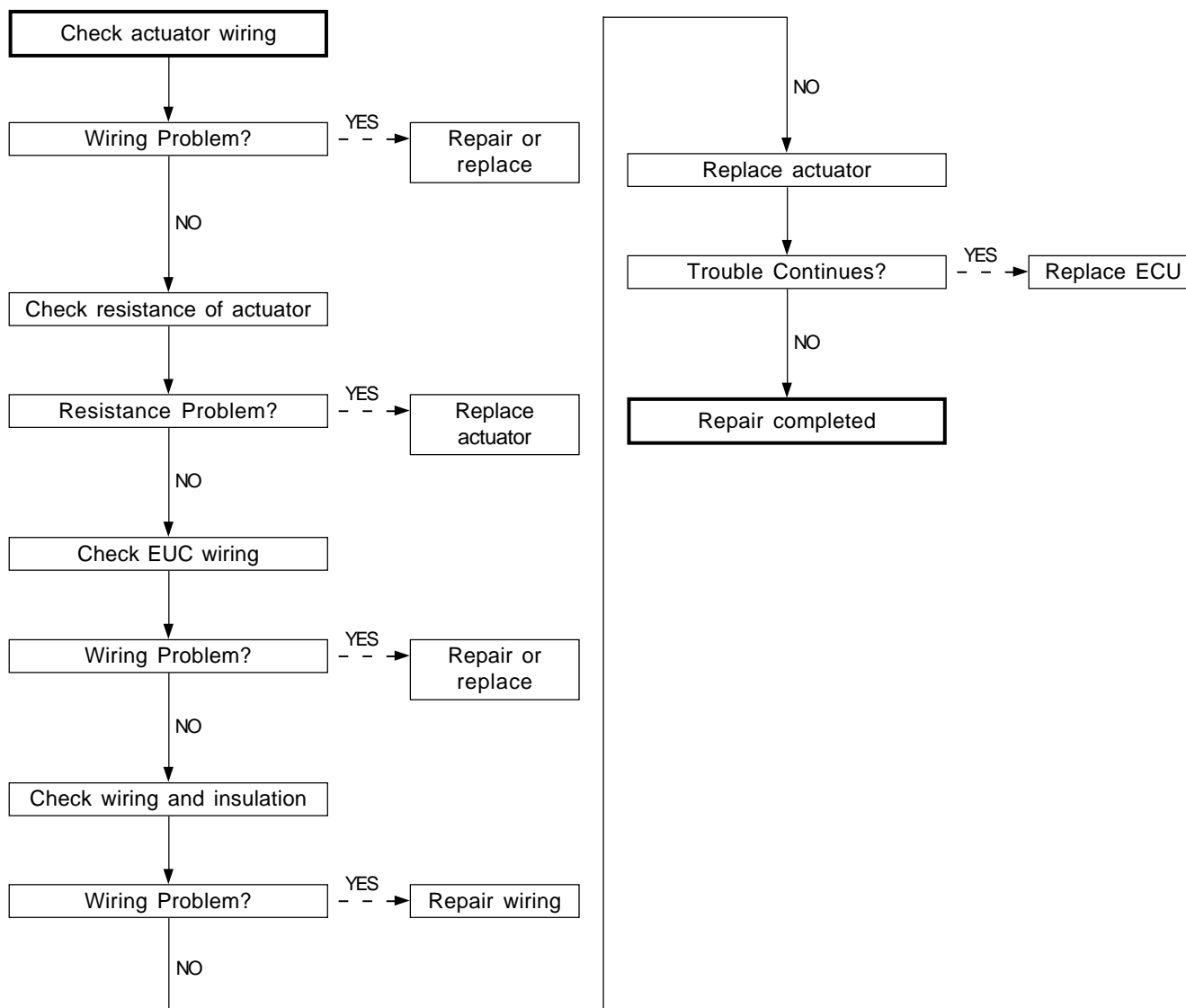


Turbo Charger Actuator Operation Fault (signal)

► Trouble Code and Symptom

Trouble Code		Symptom
P0245	Short to GND	Unable Cruise Control
P0246	Short Circuit to B+	Unable VGT Operation
		MIL ON
		Torque Reduced Mode Operation

► Diagnosis Procedures



DIAGNOSIS

KYRON SM - 2005.09

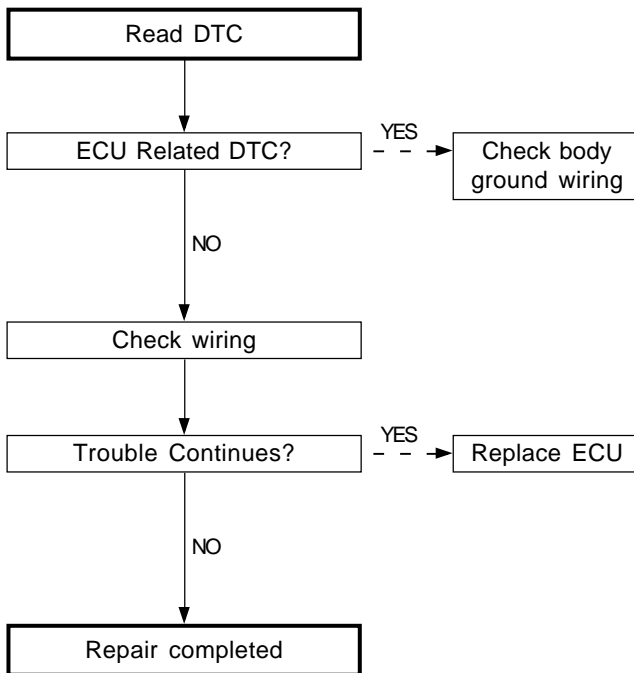
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

ECU Watchdog Fault

► Trouble Code and Symptom

Trouble Code		Symptom
P0606	ECU Watchdog Fault	MIL ON

► Diagnosis Procedures



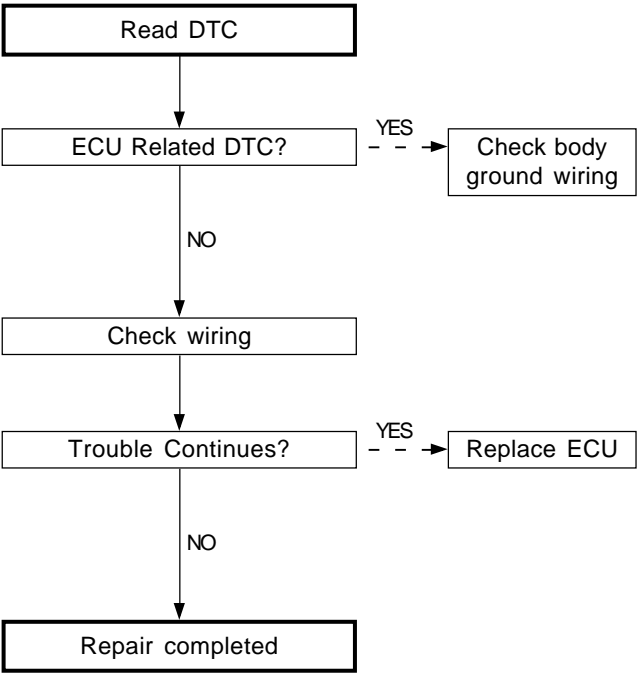
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

ECU Watchdog Fault (Injector Cut-off)

► Trouble Code and Symptom

Trouble Code		Symptom
P1607	ECU Injector Cut-off	MIL ON

► Diagnosis Procedures

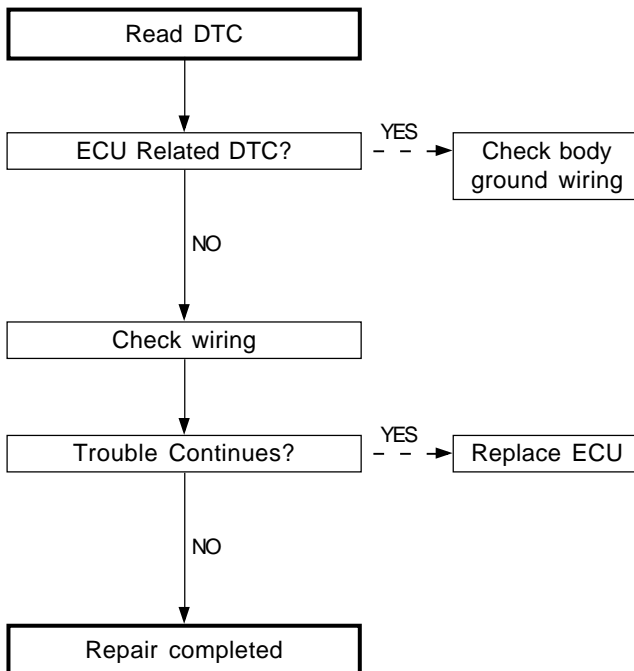


ECU Watchdog Fault (Watchdog Trip)

► Trouble Code and Symptom

Trouble Code		Symptom
P1600	Trip ECU Write Fault	MIL ON
P1601	Trip Shut Down Write Fault	MIL ON
P1602	Trip Noise Write Fault	MIL ON

► Diagnosis Procedures

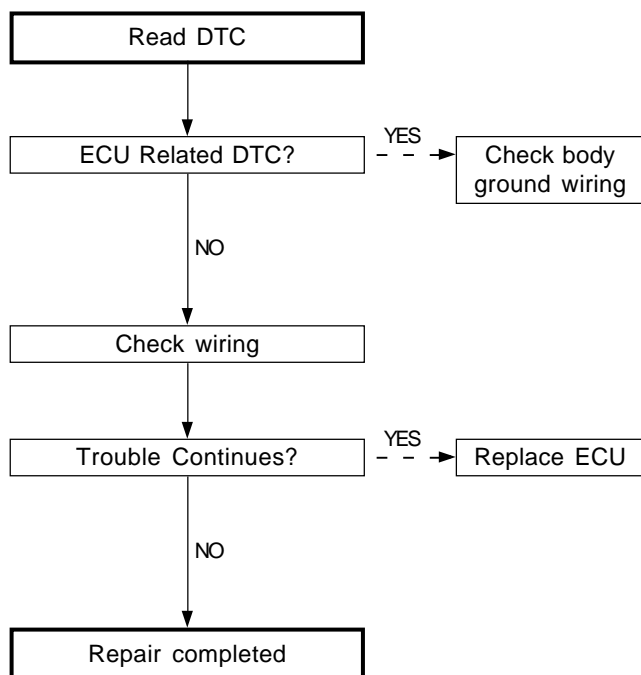


ECU Non-Volatile Memory Fault

► Trouble Code and Symptom

Trouble Code		Symptom
P1614	MDP	MIL ON/Limp Home Mode Operation
P1615	Tele-Coding	MIL ON/Limp Home Mode Operation
P1616	Watchdog	MIL ON/Limp Home Mode Operation
P1606	CAN	MIL ON/Limp Home Mode Operation
P1620	ECU Malfunction	MIL ON/Limp Home Mode Operation
P1621	ECU Malfunction	MIL ON/Limp Home Mode Operation
P1622	ECU Malfunction	MIL ON

► Diagnosis Procedures

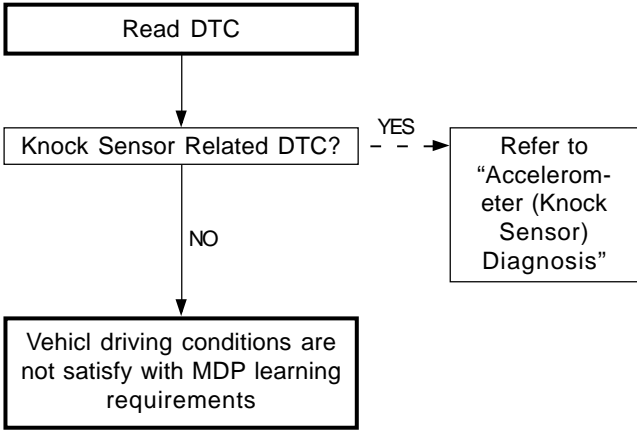


Accelerometer Learning Fault

► Trouble Code and Symptom

Trouble Code		Symptom
P1148	Accelerometer (Knock Sensor) Learning Fault	Torque Reduction Operation
		Unable Cruise Control

► Diagnosis Procedures

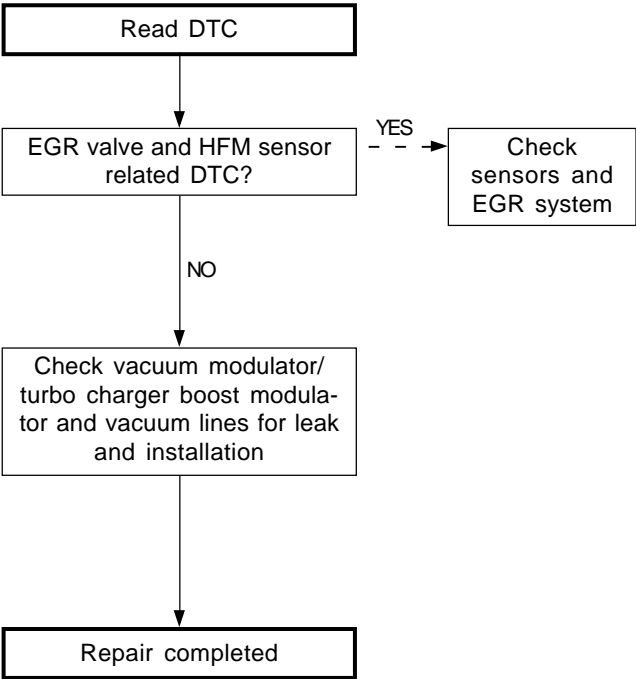


EGR Valve Control Fault

► Trouble Code and Symptom

Trouble Code		Symptom
P0400	EGR Valve Control Fault	Unable Cruise Control

► Diagnosis Procedures



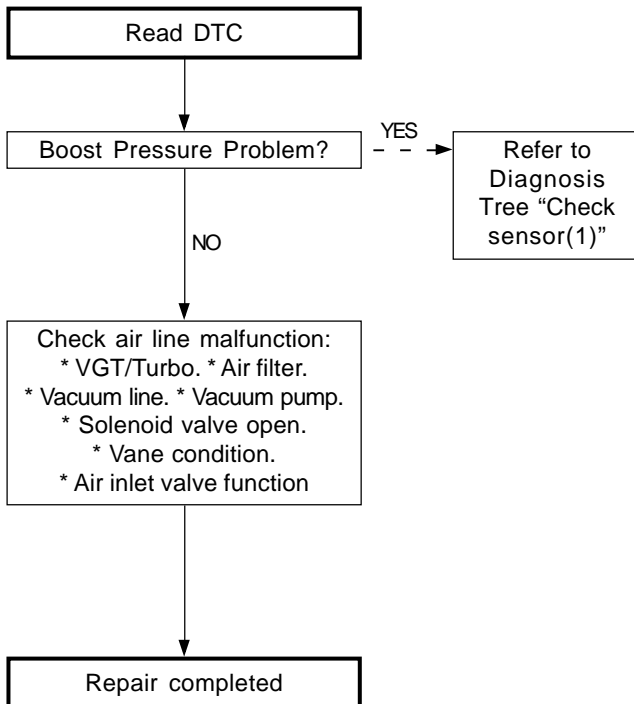
VGT Operation Fault

► Trouble Code and Symptom

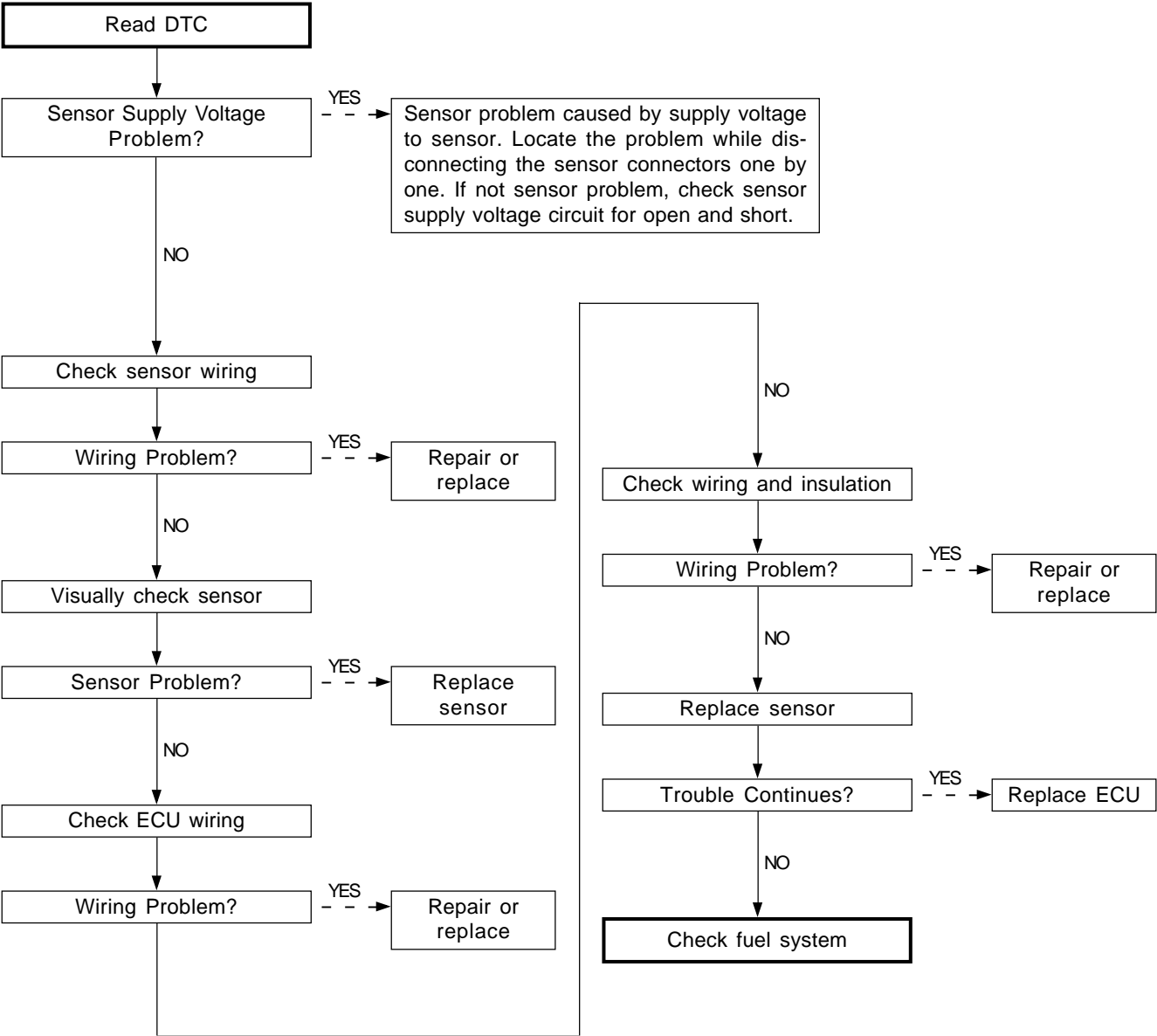
Trouble Code		Symptom
P1235	VGT Operation Fault	Unable Cruise Control
		Location demand=change the boost control to O.L. mode at f (boost demand, engine cycling speed)
		Torque Reduced Mode Operation

► Diagnosis Procedures

1. Diagnosis Procedures(Boost Pressure)

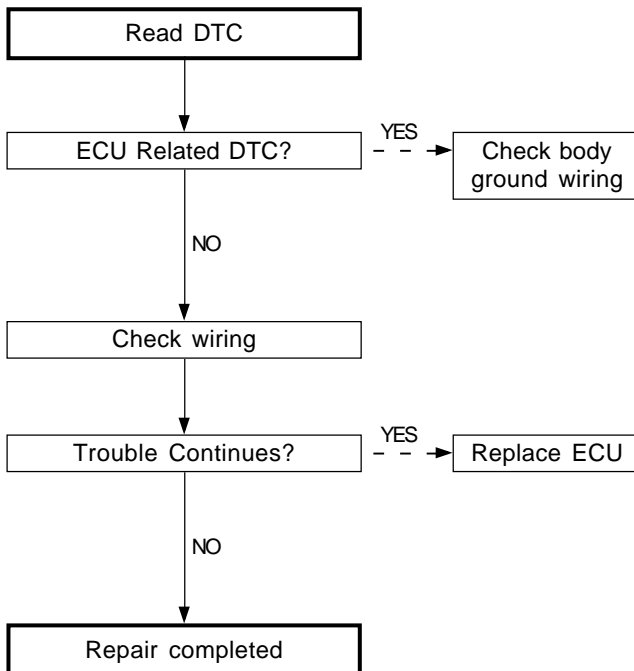


2. Diagnosis Procedures(Check sensor (1))



TBD**► Trouble Code and Symptom**

Trouble Code		Symptom
P1608	ECU Malfunction	MIL ON

► Diagnosis Procedures

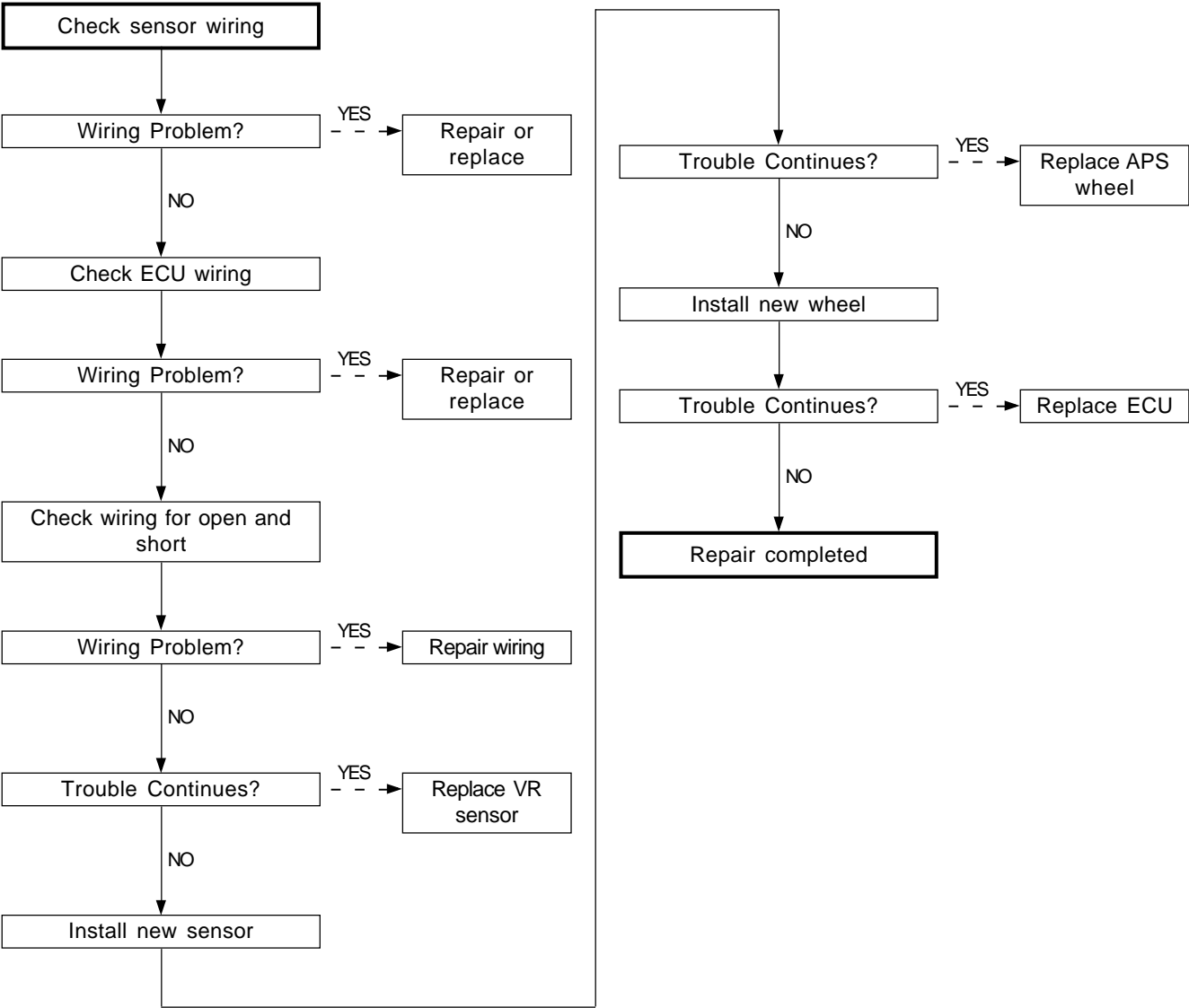
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

No Crank Signal

► Trouble Code and Symptom

Trouble Code		Symptom
P0335	No Crank Signal	MIL ON

► Diagnosis Procedures



DIAGNOSIS

KYRON SM - 2005.09

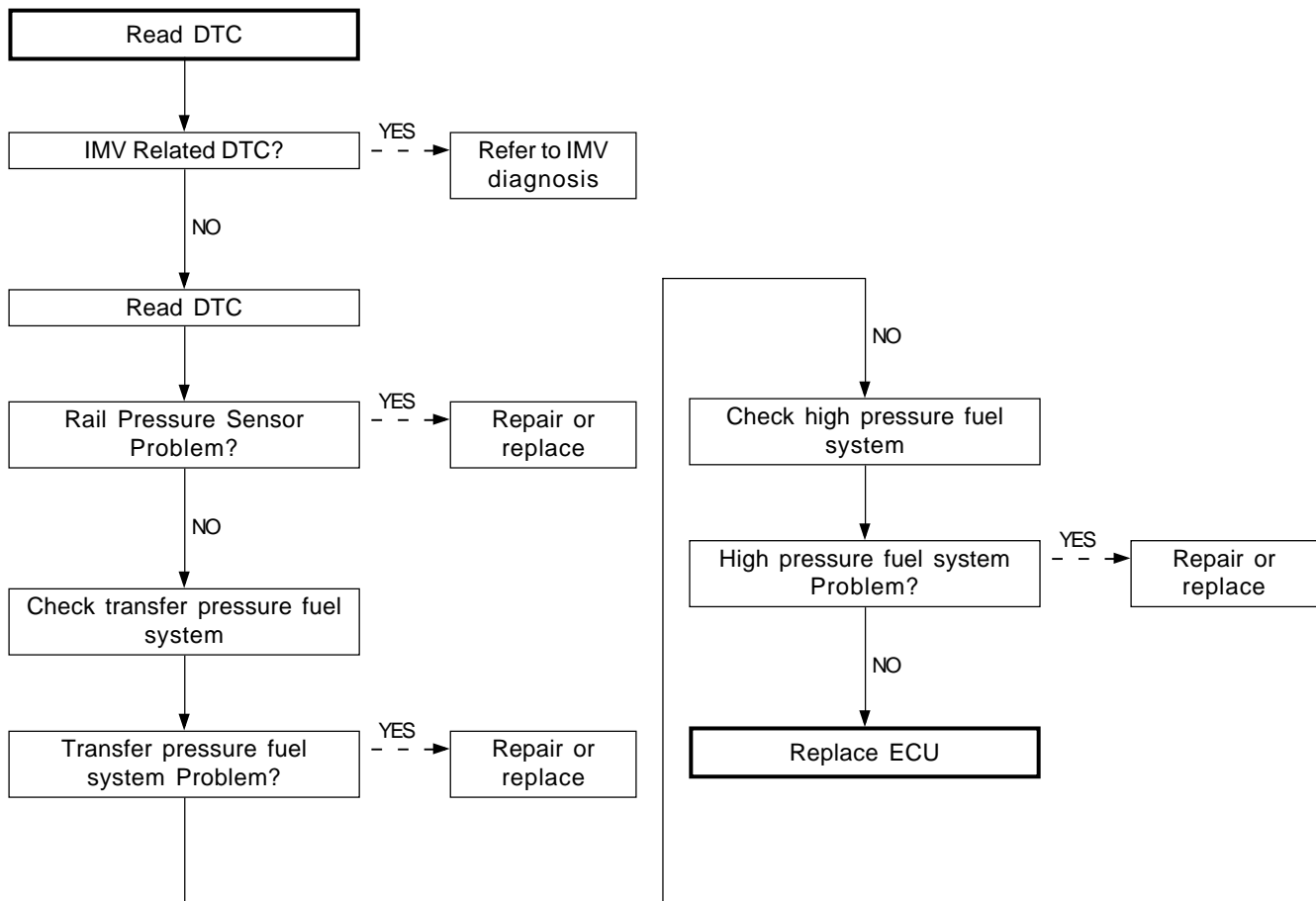
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

High Torque Trim

► Trouble Code and Symptom

Trouble Code		Symptom
P1170	High Torque Trim	

► Diagnosis Procedures



* Refer to "Check High and Transfer pressure system".

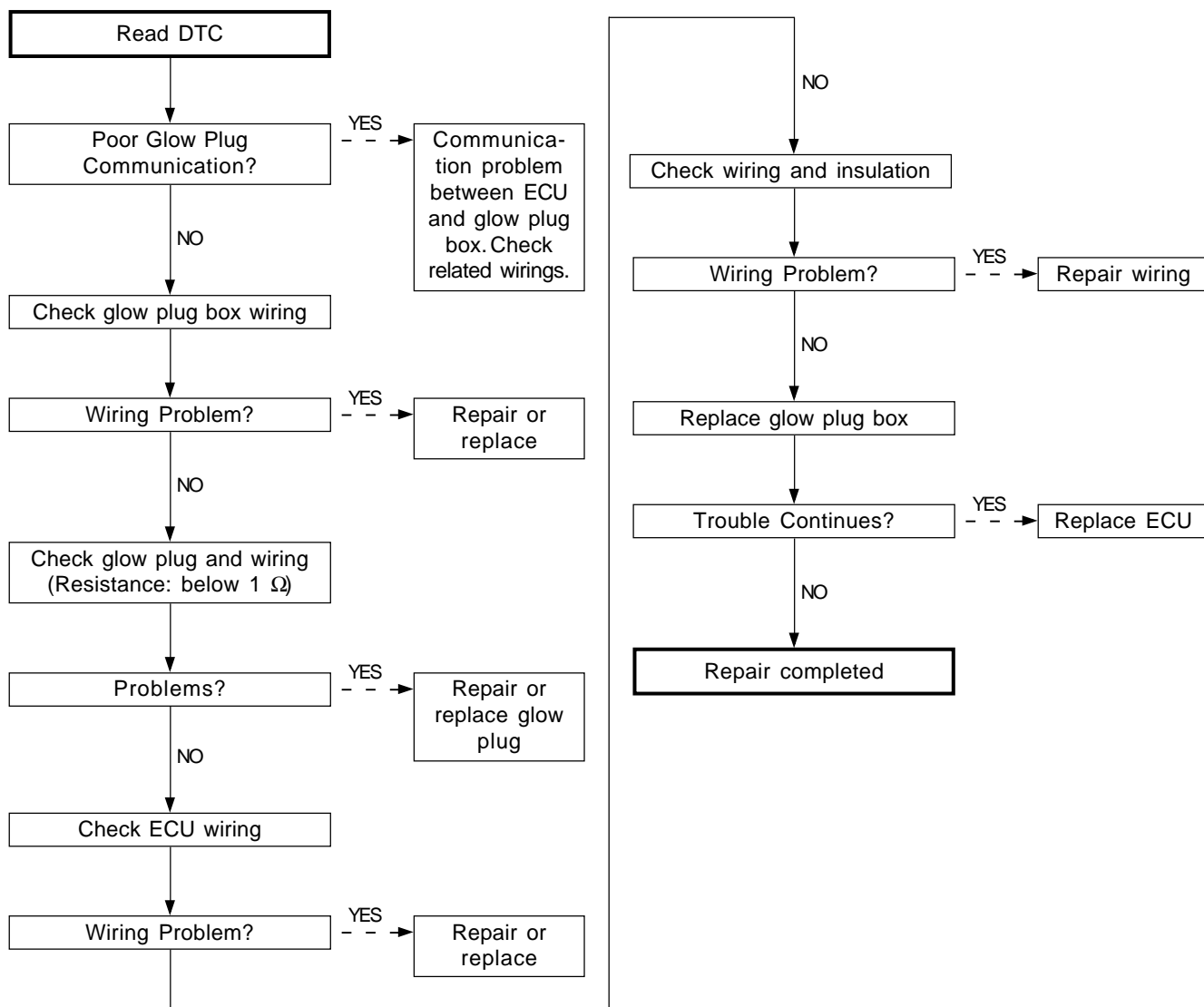
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Glow Plug Module Communication Fault

► Trouble Code and Symptom

Trouble Code		Symptom
P1676	Communication	Glow Lamp ON
P1677	Controller	Glow Lamp ON

► Diagnosis Procedures

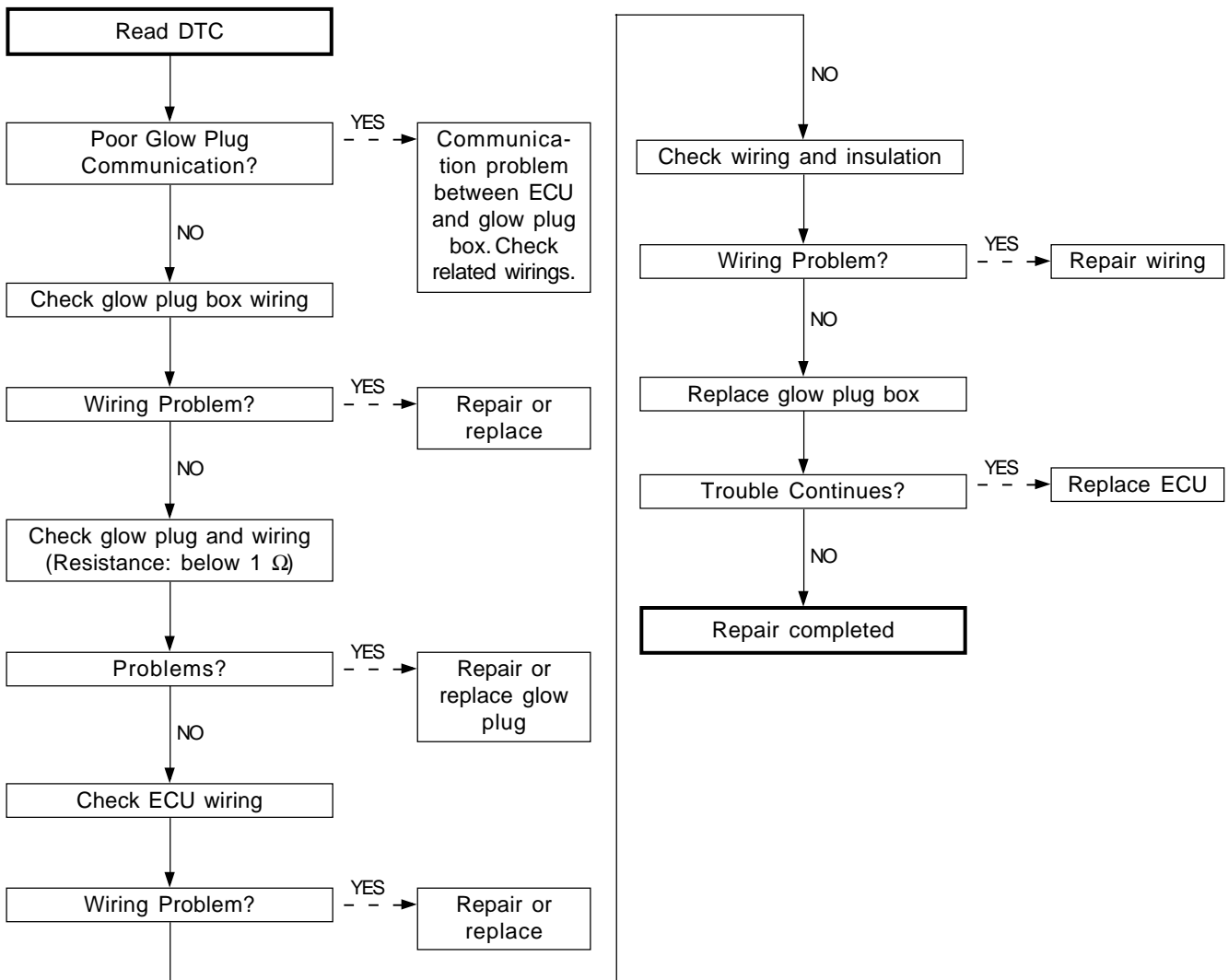


Glow Plug Module Circuit Malfunction - Open

► Trouble Code and Symptom

Trouble Code		Symptom
P0671	Glow Plug #1	Glow Lamp ON
P0672	Glow Plug #2	Glow Lamp ON
P0673	Glow Plug #3	Glow Lamp ON
P0674	Glow Plug #4	Glow Lamp ON
P0675	Glow Plug #5	Glow Lamp ON

► Diagnosis Procedures



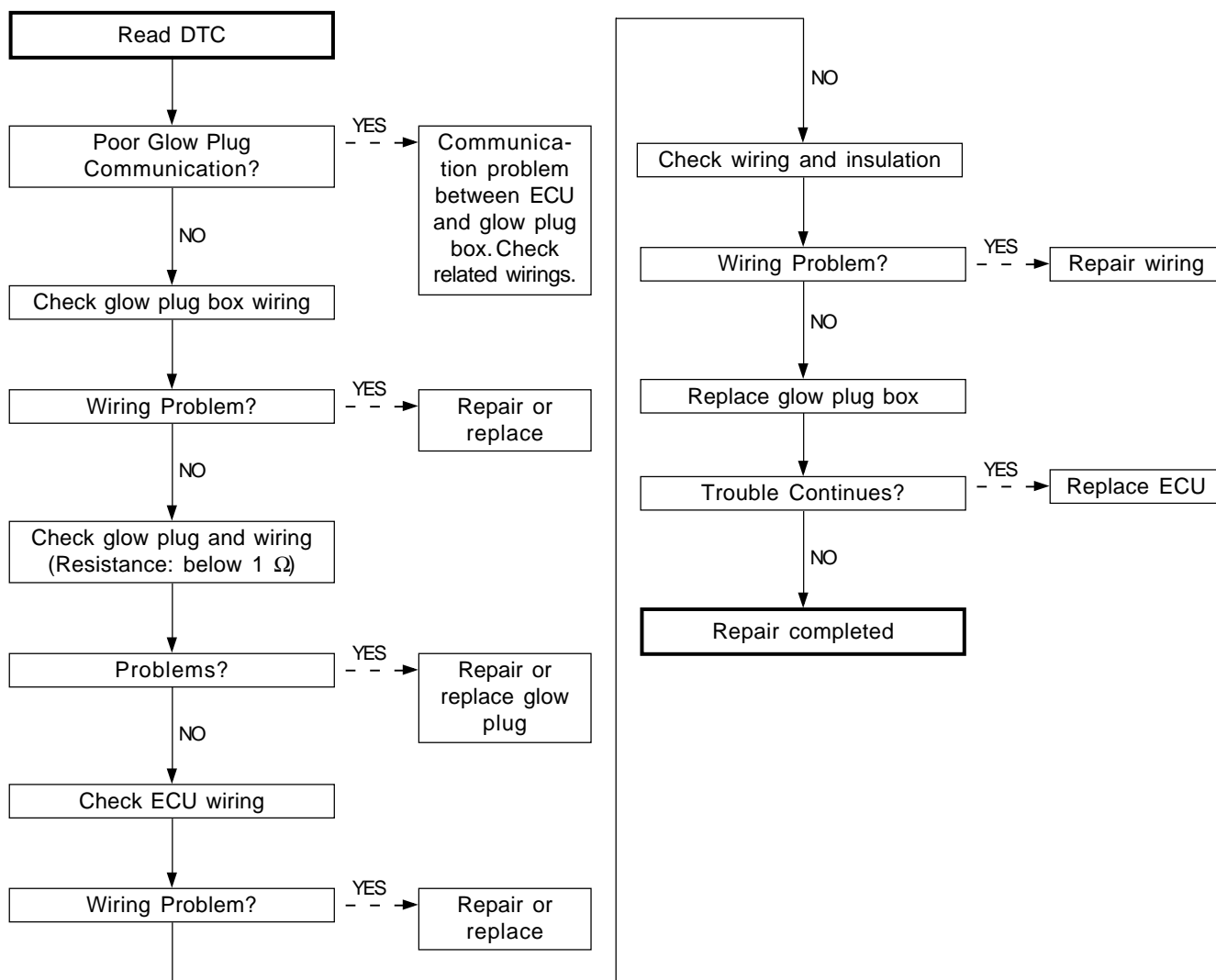
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Glow Plug Module Circuit Malfunction - Short (B+)

► Trouble Code and Symptom

Trouble Code		Symptom
P1671	Glow Plug #1	Glow Lamp ON
P1672	Glow Plug #2	Glow Lamp ON
P1673	Glow Plug #3	Glow Lamp ON
P1674	Glow Plug #4	Glow Lamp ON
P1675	Glow Plug #5	Glow Lamp ON

► Diagnosis Procedures



DIAGNOSIS

KYRON SM - 2005.09

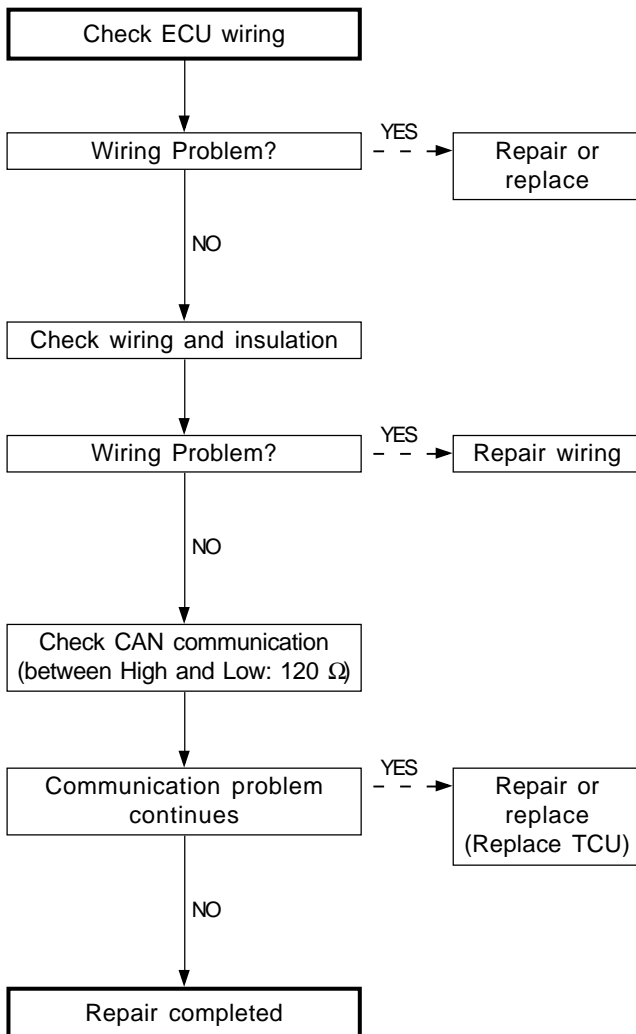
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

TCU Signal Fault

► Trouble Code and Symptom

Trouble Code		Symptom
P0700	TCU Signal Fault	

► Diagnosis Procedures



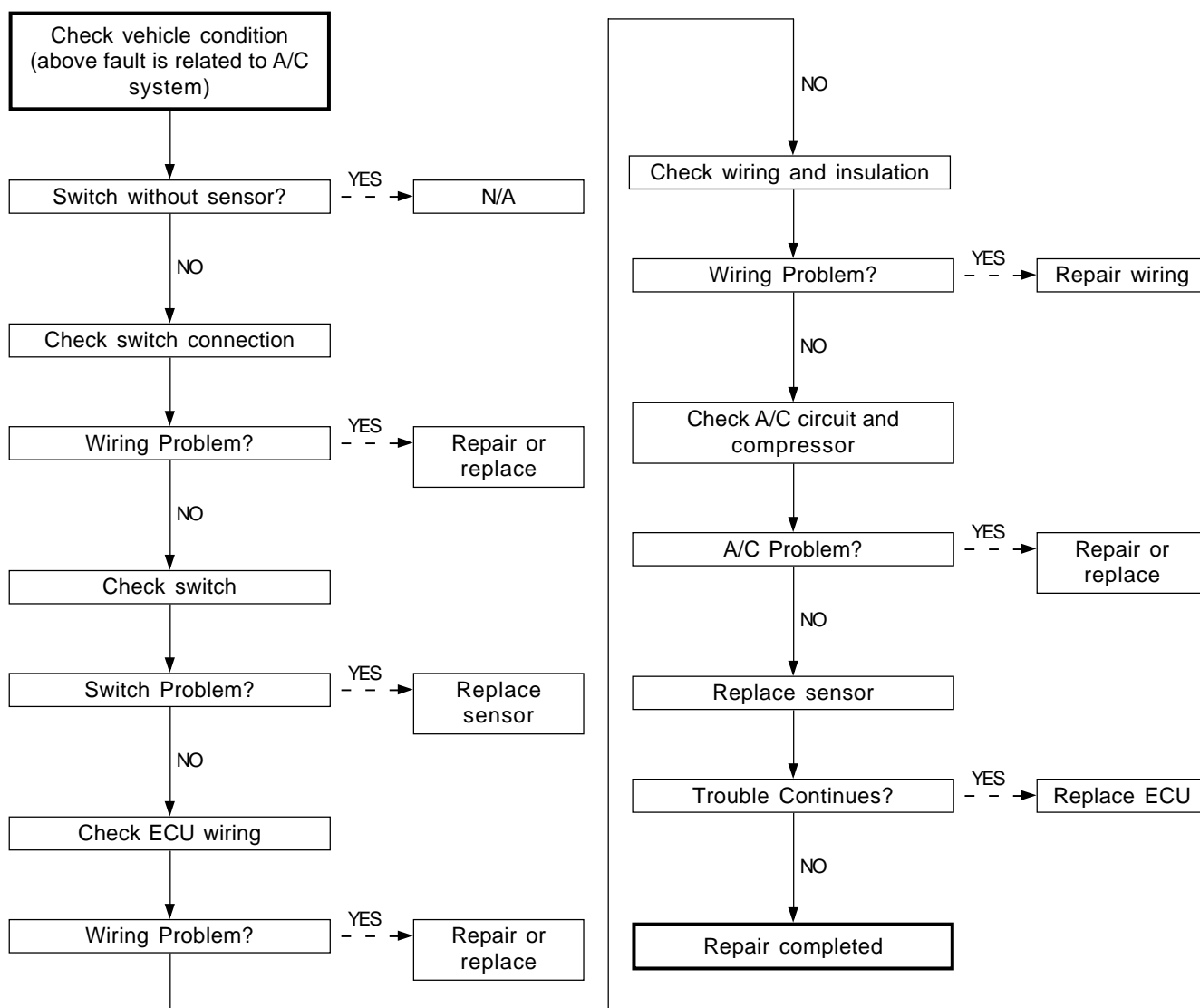
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Air Conditioner Operating Circuit Fault

► Trouble Code and Symptom

Trouble Code		Symptom
P1540	Open Circuit	Unable A/C Operation
P1541	Short to +Batt	Unable A/C Operation
P1542	Short to Ground	Unable A/C Operation

► Diagnosis Procedures

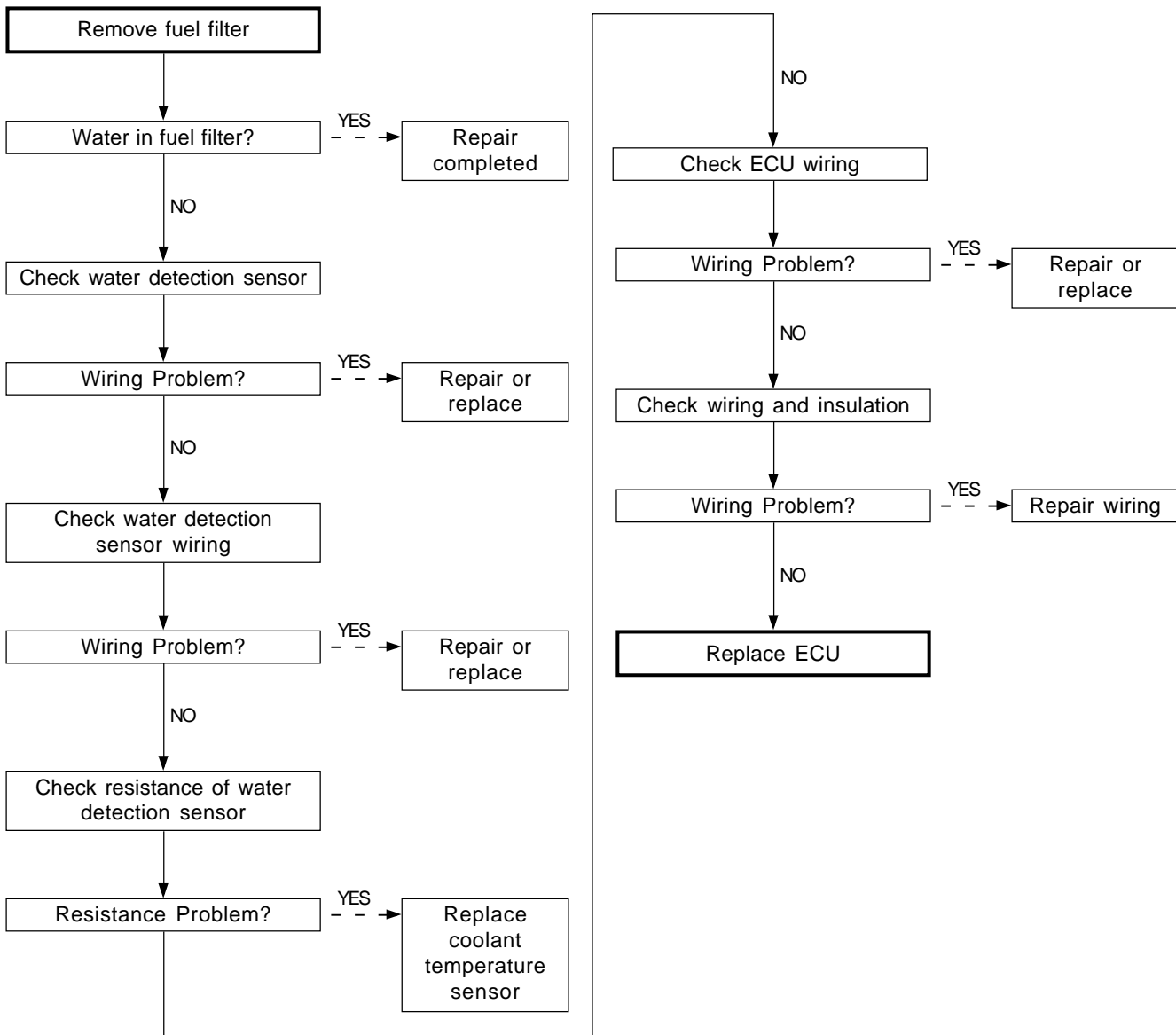


Excessive Water in Fuel Filter

► Trouble Code and Symptom

Trouble Code		Symptom
P1149	Excessive Water in Fuel Filter	Water Separator Warning Light ON Torque Reduction Mode Operation

► Diagnosis Procedures



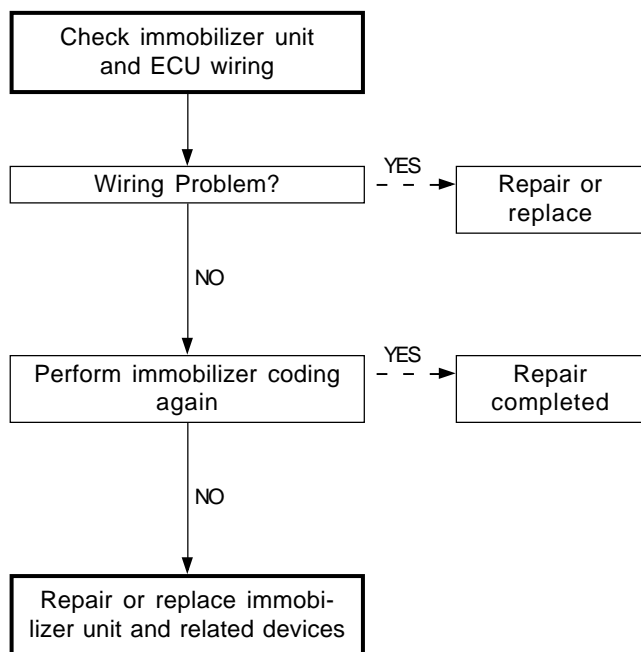
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Immobilizer Malfunction

► Trouble Code and Symptom

Trouble Code		Symptom
P1634	Immobilizer Malfunction	Immobilizer Warning Light ON
P4335	Immobilizer Malfunction	Immobilizer Warning Light ON
P1630	Immobilizer Malfunction	Immobilizer Warning Light ON
P1631	Immobilizer Malfunction	Immobilizer Warning Light ON
P1632	Immobilizer Malfunction	Immobilizer Warning Light ON
P1633	Immobilizer Malfunction	Immobilizer Warning Light ON
P0633	Immobilizer Malfunction	Immobilizer Warning Light ON
P1636	Immobilizer Malfunction	Immobilizer Warning Light ON

► Diagnosis Procedures



FUEL SYSTEM DIAGNOSIS

FUEL SYSTEM DIAGNOSIS..... 158

1. Overview 158

2. Fuel pressure system 159

3. Fuel system pressure test 162

4. Fuel system check process 164

PRESSURE LEAKAGE TEST WITH SCAN-100 173

SCAN
ECU
TCU
M/T
TCCU
CLUTCH
BRAKE
A/BAG
A/CON
FFH
RK-STICS
R/SENSOR
S/ROOF

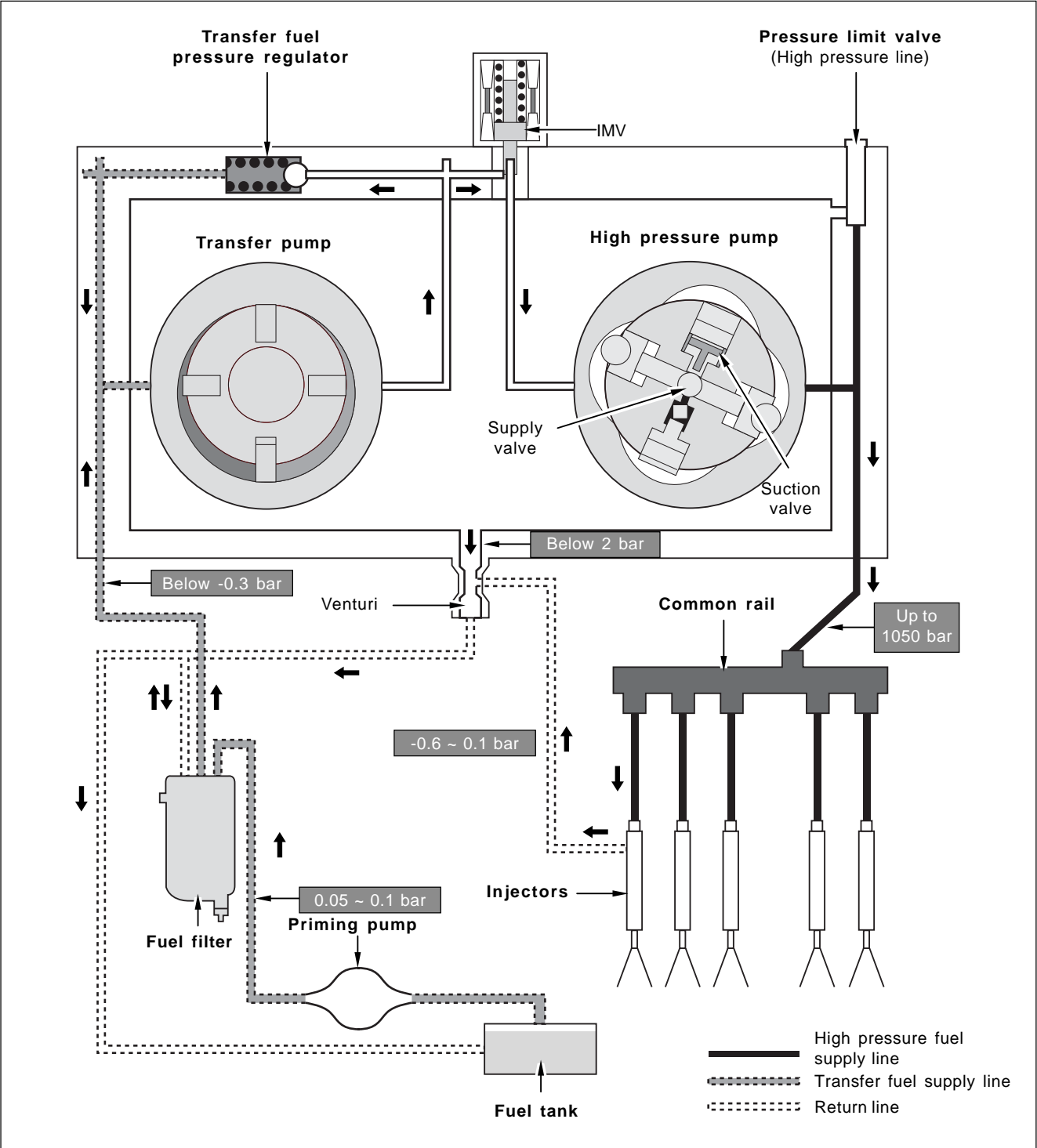
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

FUEL SYSTEM DIAGNOSIS

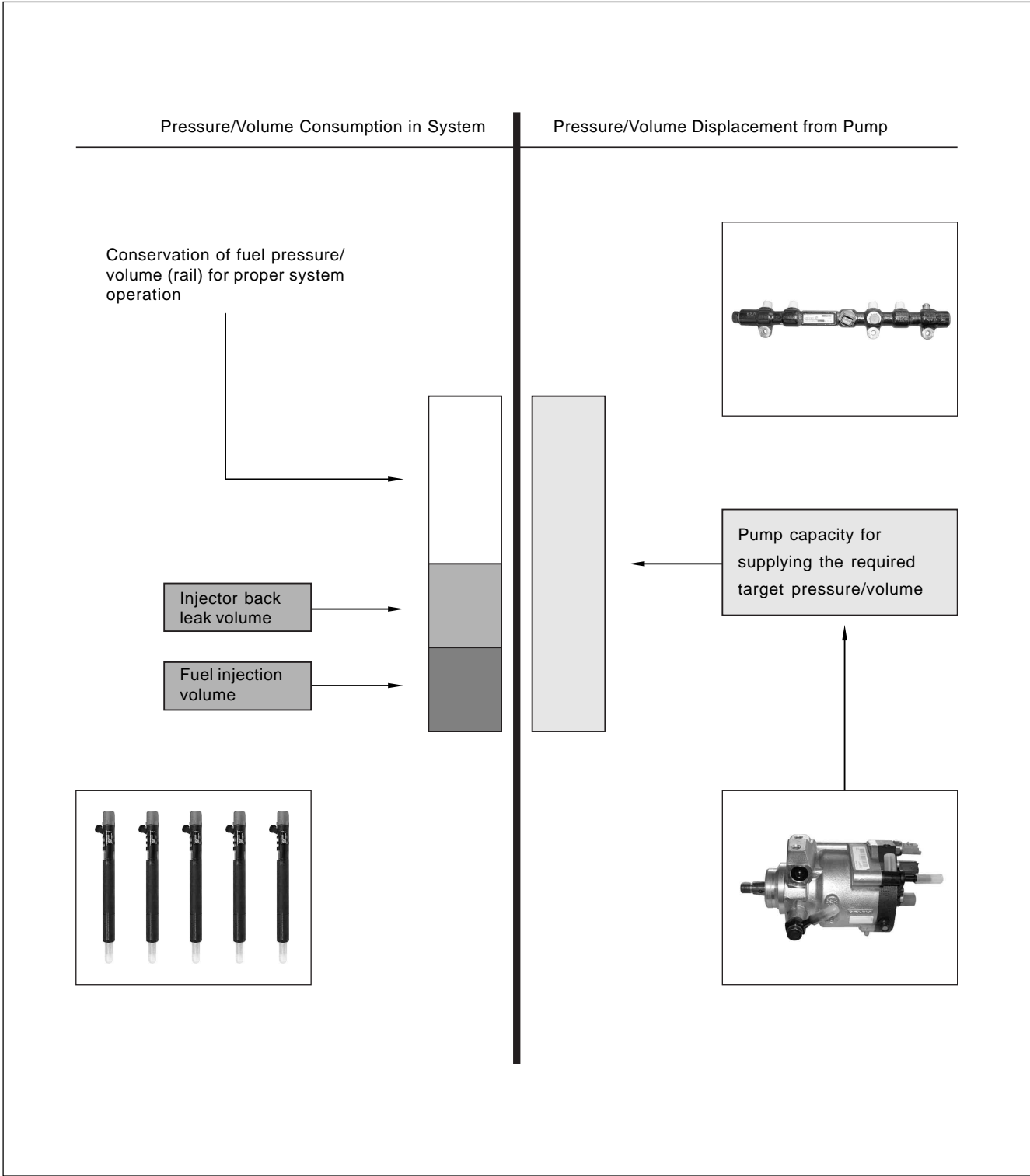
1. OVERVIEW

When the Diagnostic Trouble Code (DTC) is detected through scan tool, it's necessary to check the transfer and high pressure fuel lines in fuel system before replacing the components.

If the trouble continues even after the trouble has been fixed with scan tool, must perform the fuel pressure test. Below schematic diagram shows the specifications of pressure, flow mass and temperature in fuel system.



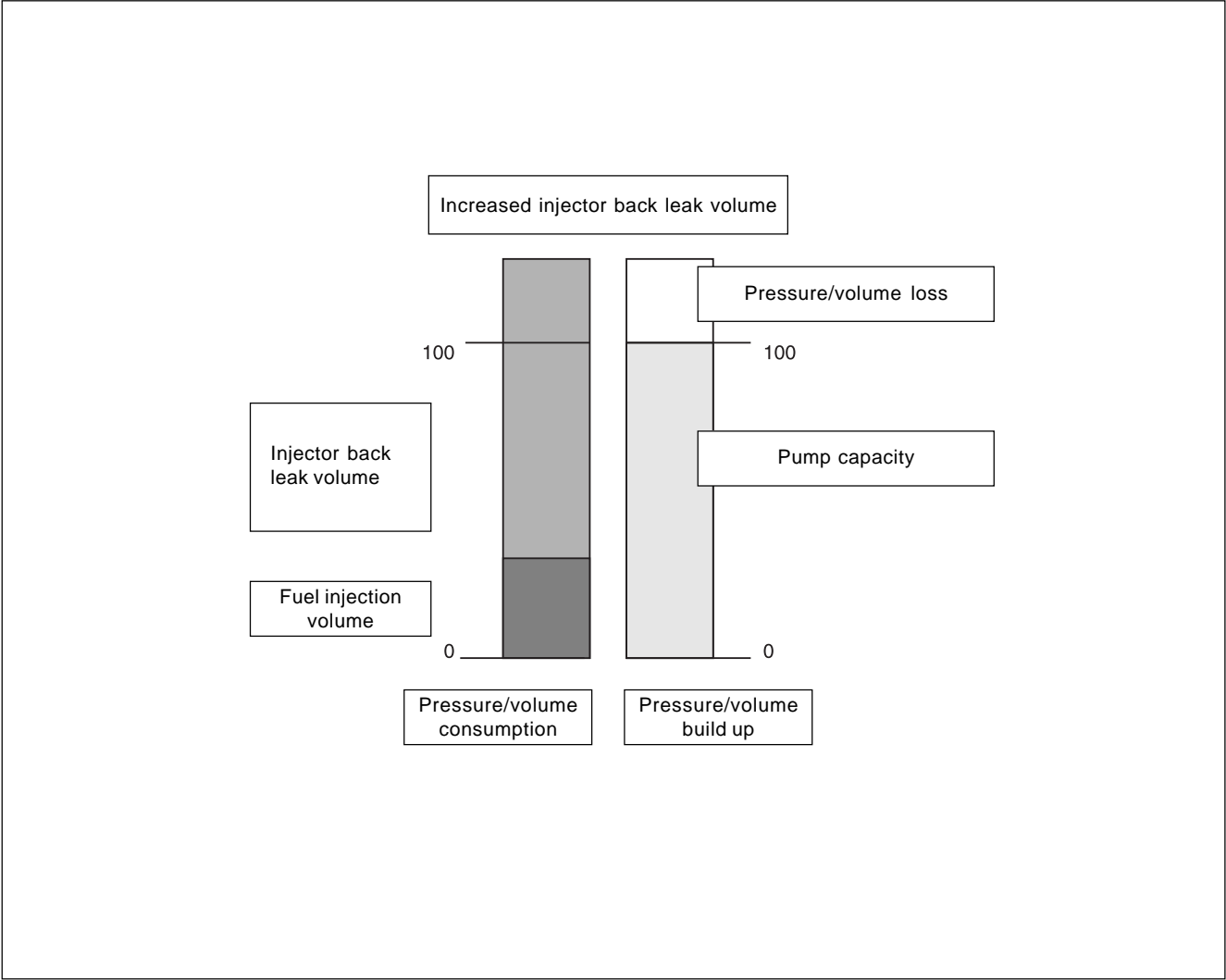
2. FUEL PRESSURE SYSTEM



SCAN
ECU
TCU
M/T
TCCU
CLUTCH
BRAKE
A/BAG
A/CON
FFH
RK-STICS
R/SENSOR
S/ROOF

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► Example of Too Much Injector Back leak



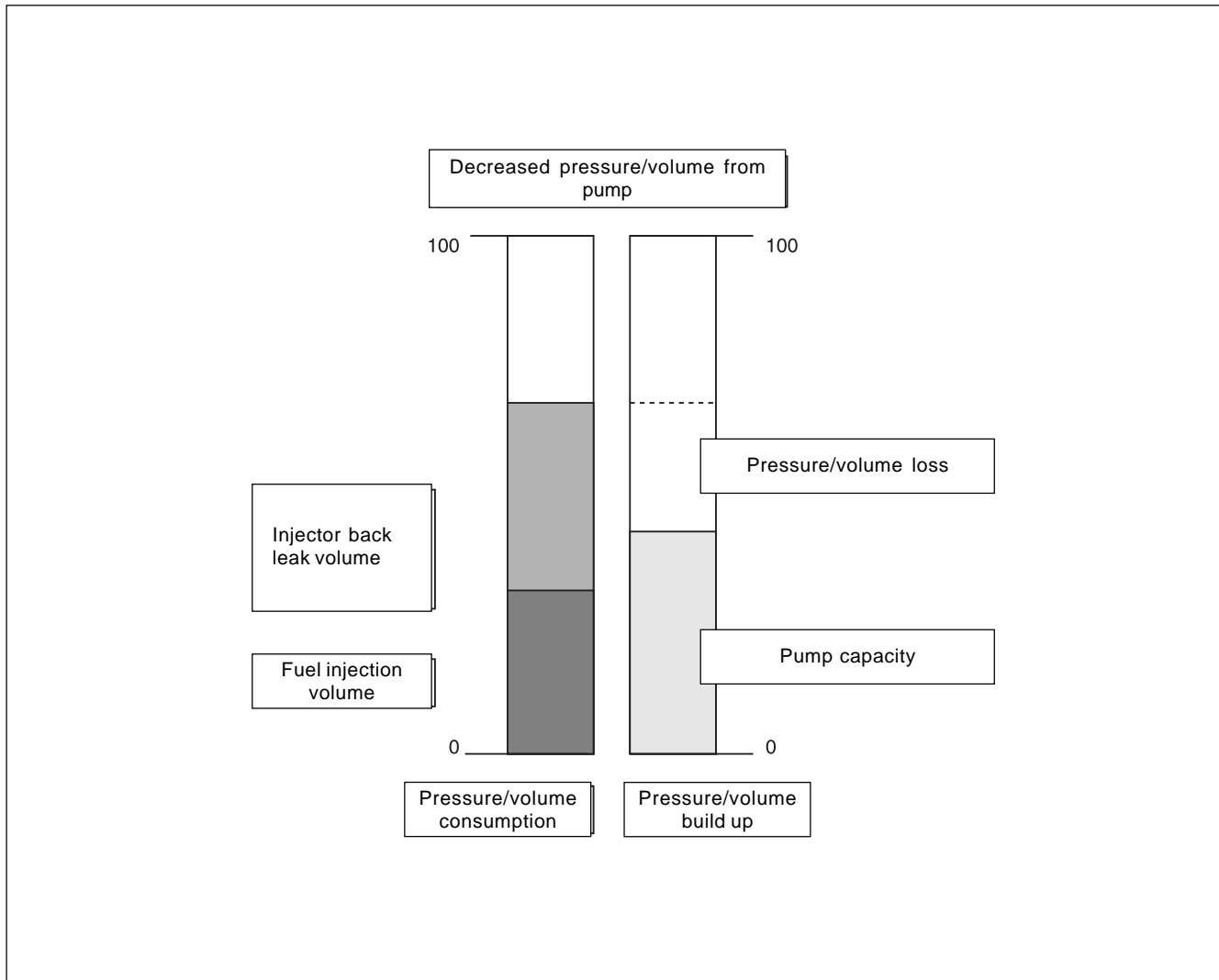
Too Much Injector Back leak

When the injector cannot be sealed due to entering the foreign materials

Example:

1. Foreign materials in fuel
2. Burnt out or worn high pressure pump
3. Mechanical damage in inside of injector

► Example of Pressure/Volume Loss in Pump



Pressure/Volume Loss in High Pressure Pump

When the required target pressure/volume cannot be delivered due to fuel supply line or pump damage

Example:

1. Air in fuel supply line
2. Excessive vacuum pressure in fuel supply line (-300 mbar)
3. Burnt out or mechanically damaged pump
4. Supply fuel with increased temperature ($> 65^{\circ}\text{C}$)

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

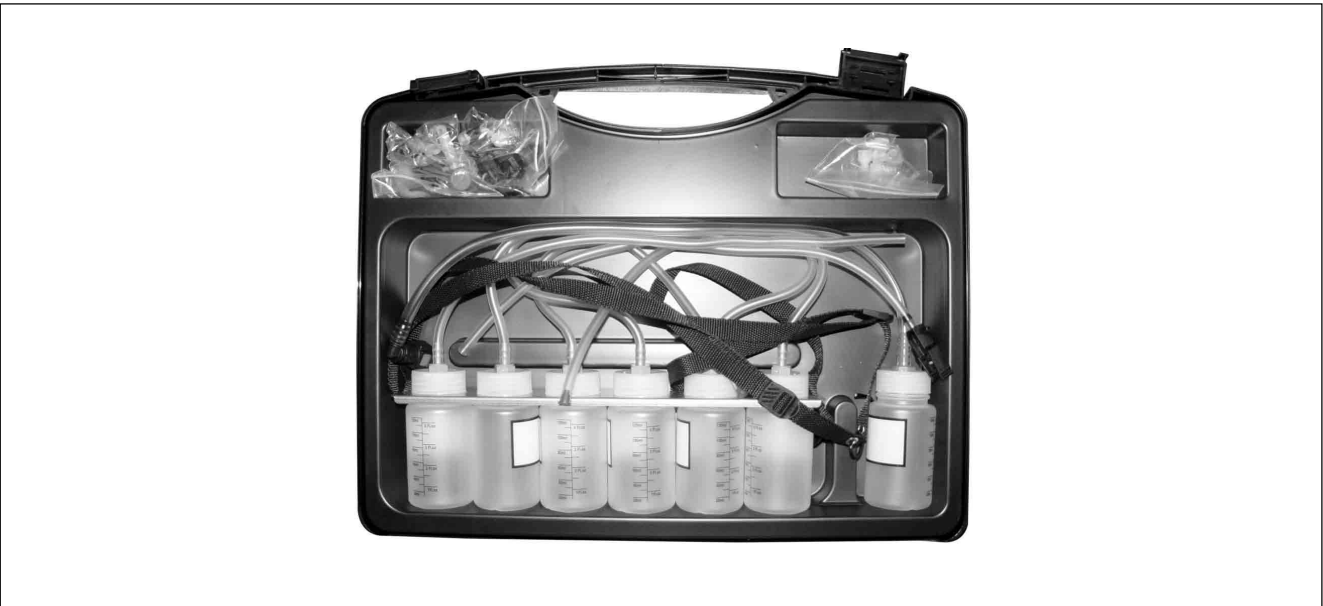
3. FUEL SYSTEM PRESSURE TEST

► Test Tool Kit

For High Pressure Line



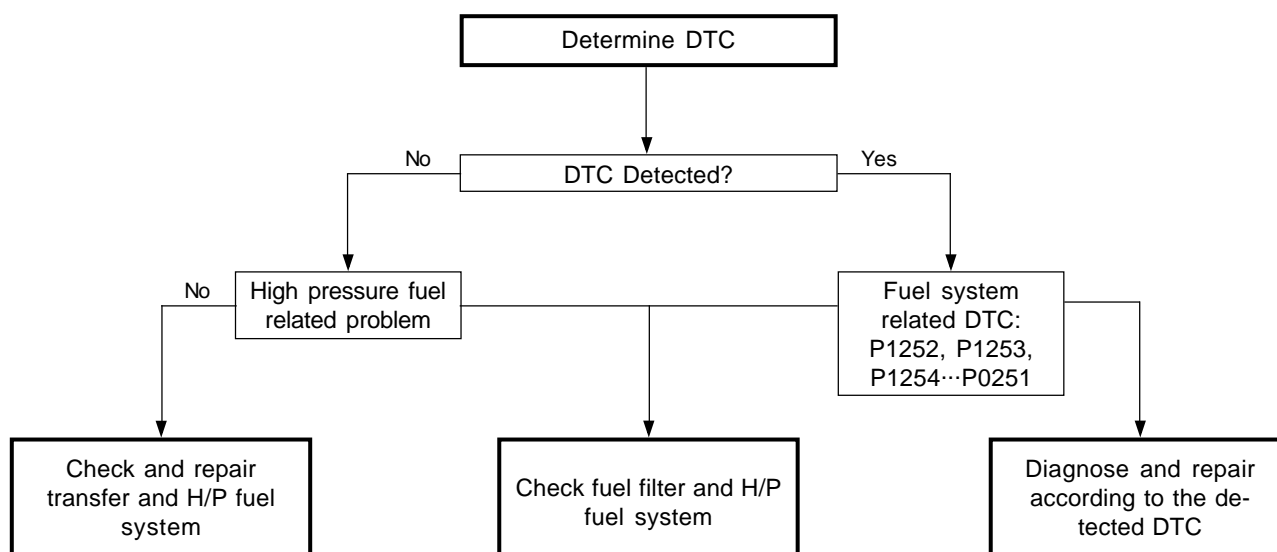
For Transfer Line



► Prerequisite

1. Check the connections in fuel supply lines.
2. Check the fuel level in fuel tank.
3. Check if the air exists in fuel supply lines (air bubbles in fuel supply lines or fuel with air bubbles).
4. Check the fuel supply lines for leaks (transfer and high pressure).
5. Check if the specified fuel is used.
6. Check the fuel filter for contamination and abnormality.

► Fuel System Test Process

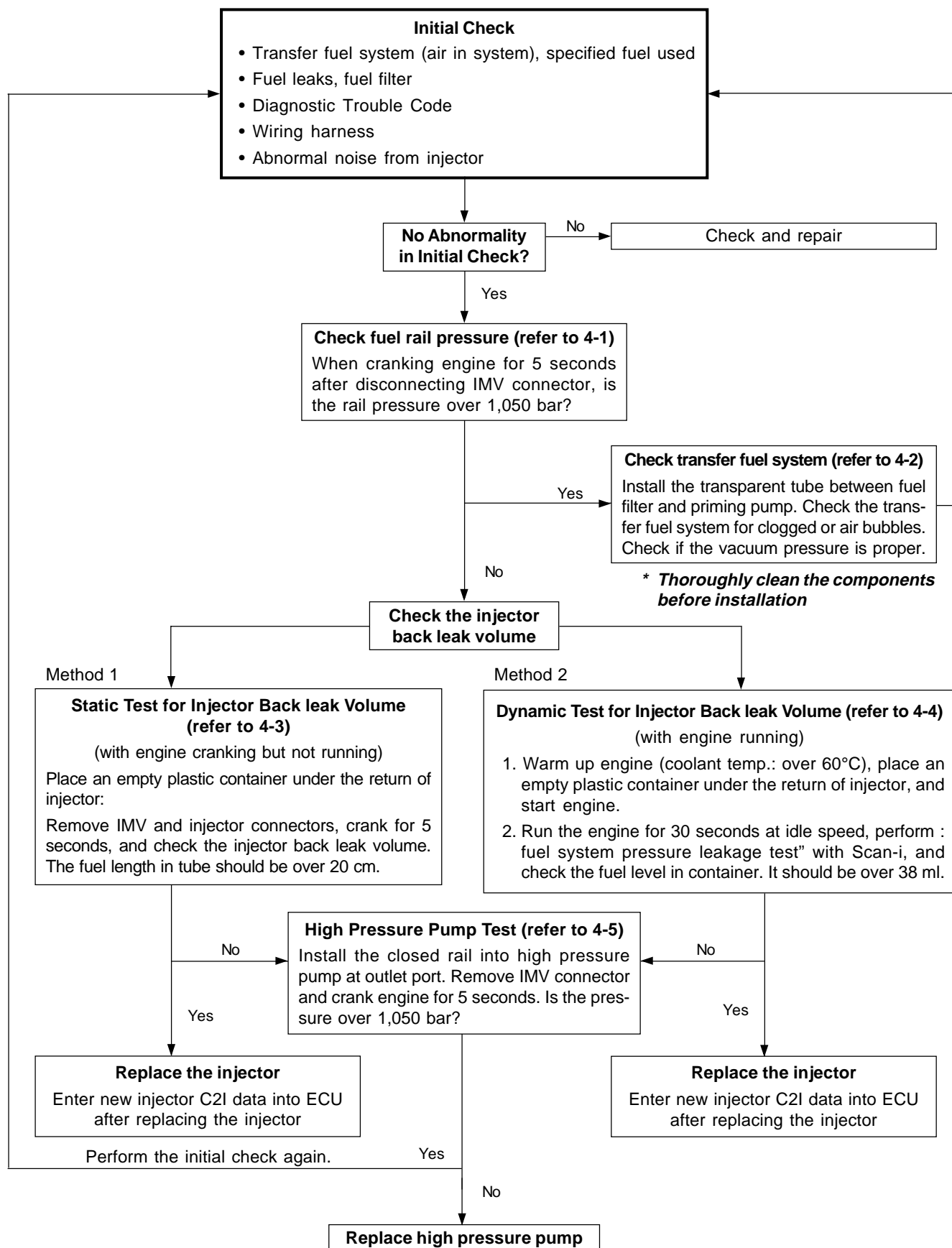


NOTICE

- If more than one DTC have been detected, check the wiring harness for open or short first.
- Check the transfer fuel system and fuel filter before proceeding the high pressure fuel system check in next page.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

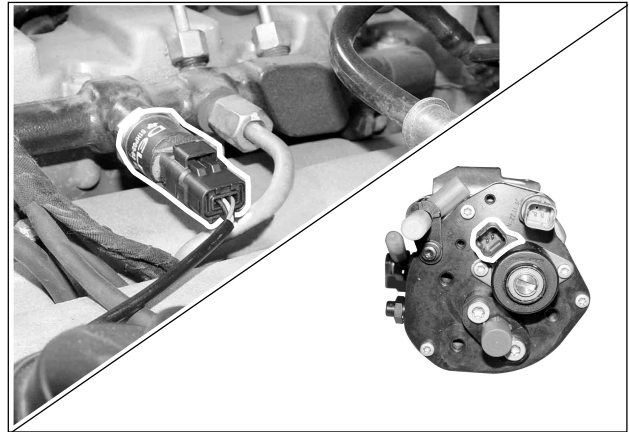
4. FUEL SYSTEM CHECK PROCESS



4-1. High Pressure System Pressure Test

► Fuel Rail Pressure Test

1. Disconnect the fuel rail pressure sensor connector and IMV connector.



2. Install the pressure tester in tool kit to the fuel rail pressure sensor connector.



3. Crank the engine for 5 seconds (twice).
 - 1) Read the maximum pressure displayed on the tester.
 - 2) If the maximum pressure is below 1,050 bar, refer to "Fuel System Check Process" section.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► How To Use Pressure Tester

1. Check if the “TEST?” is displayed on the display when pressing the “TEST” button.



2. The maximum pressure will be displayed when pressing the button while cranking the engine (around 4 seconds elapsed from 5 seconds).

NOTE

- The fuel rail pressure can be measured through the scan tool.

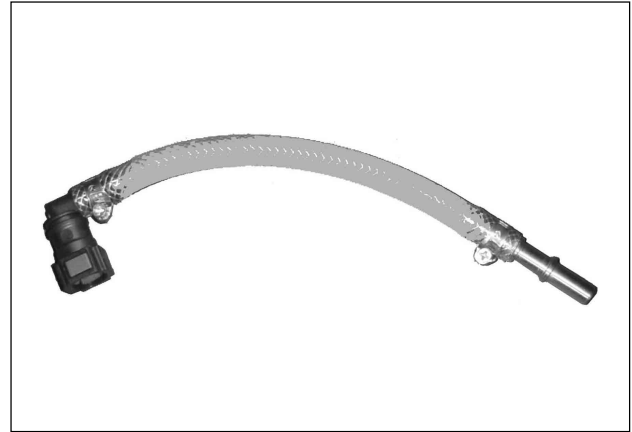


CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

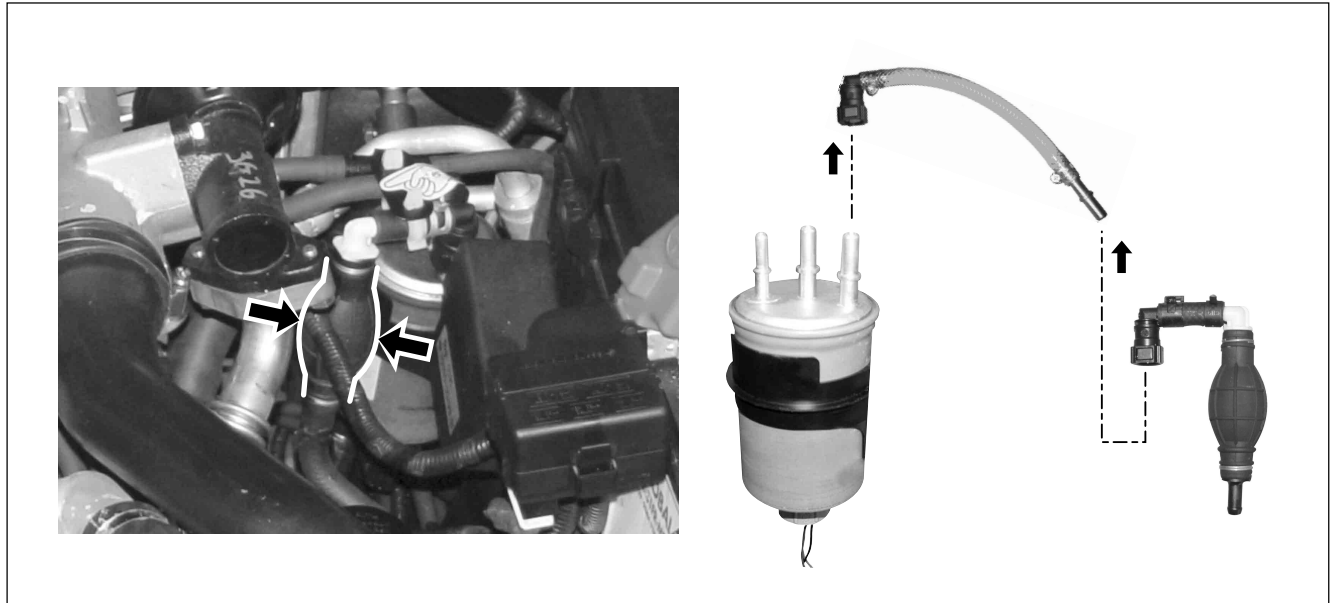
4-2. Transfer Fuel System Test

► Test Procedures

1. All wiring harnesses, connectors and fuel lines should be installed properly and the engine should be ready to start.
2. Prepare the special tools for transfer fuel system test and thoroughly clean the system.



3. Disconnect the key connector for connecting the priming pump to fuel filter and install both connectors of the special tool to the fuel pump and the priming pump hoses.

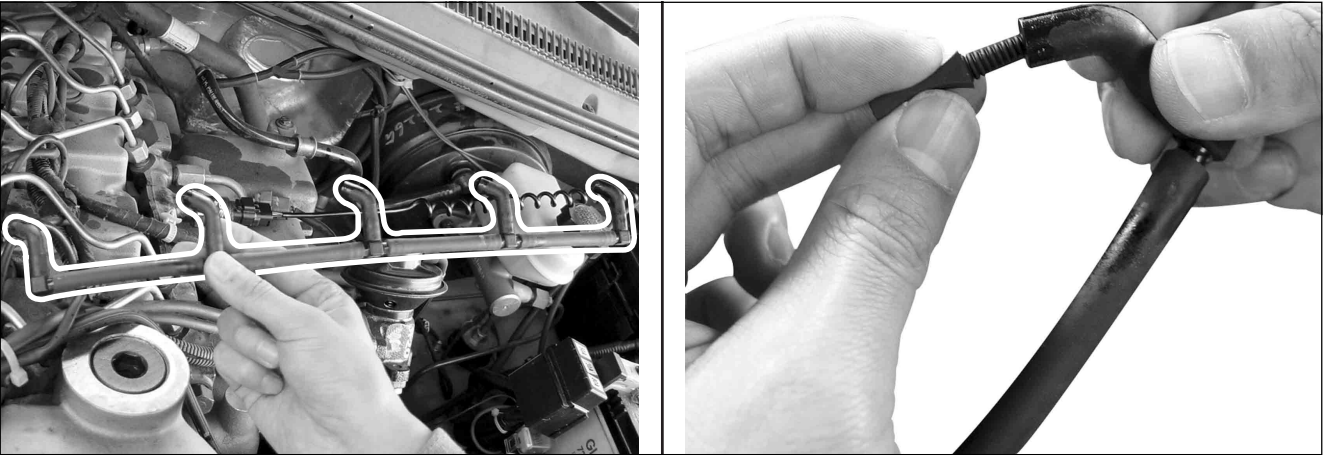


4. Start the engine and visually check the transfer line for clogged and air bubbles while running the engine at idle speed.
5. If the fuel flows are not smooth or air bubbles are found in fuel lines, locate the leaking area and correct it.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

4-3. Static Test for Injector Back leak Volume

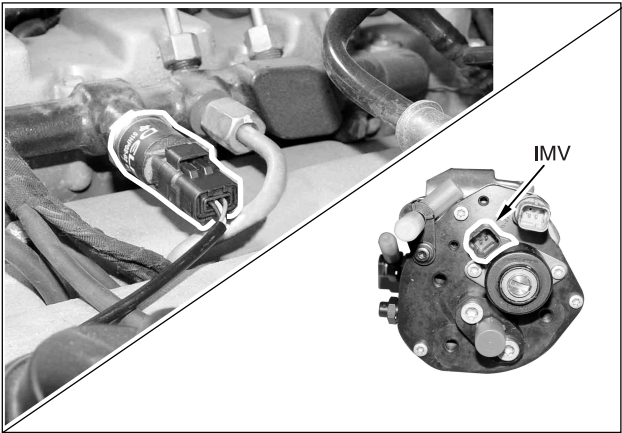
1. Remove the injector return hose and seal the openings with screw type caps (included in tool kit).



2. Install the hoses from back leak test containers to return nipples of injector.



3. Disconnect the IMV connector in H/P pump and the fuel pressure sensor connector.



DIAGNOSIS

KYRON SM - 2005.09

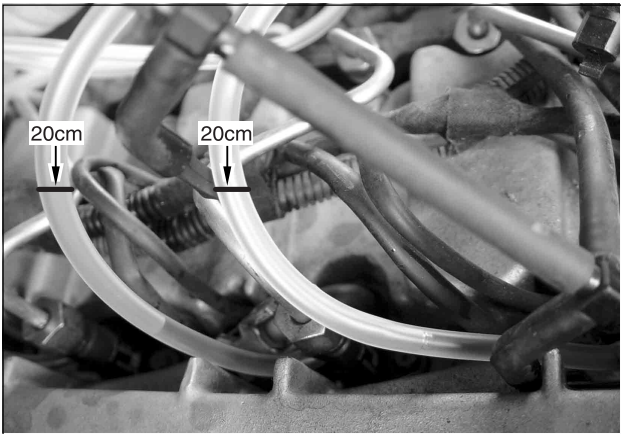
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

- 4. Crank the engine twice with 5 seconds of interval.
- 5. Check if the back leak volume meets the specification.

Specified value	Below 20 cm
-----------------	-------------

NOTE

- If the measured value is out of specified value, replace the injector.

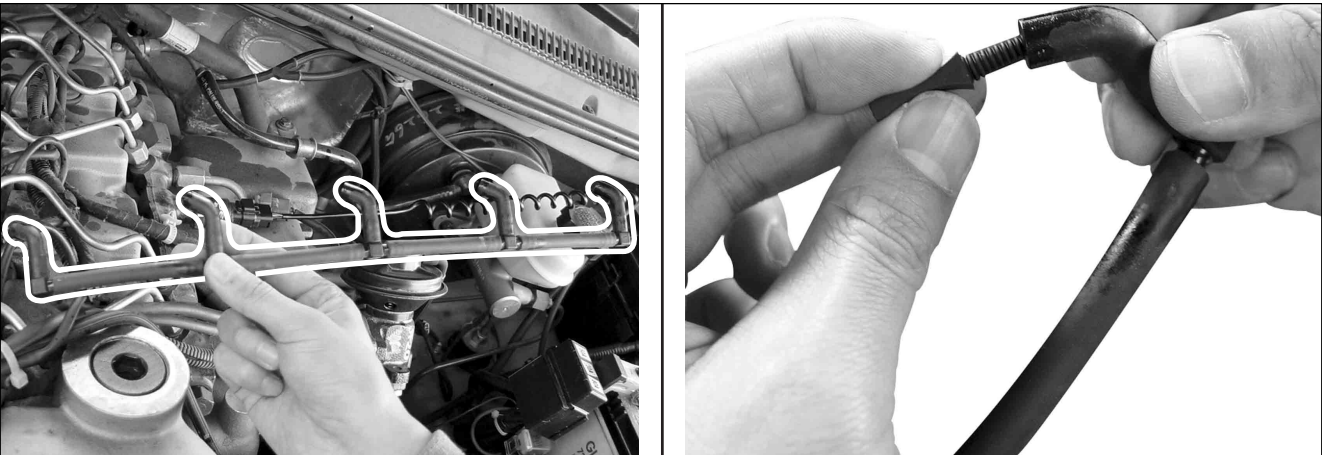


SCAN
ECU
TCU
M/T
TCCU
CLUTCH
BRAKE
A/BAG
A/CON
FFH
RK-STICS
R/SENSOR
S/ROOF

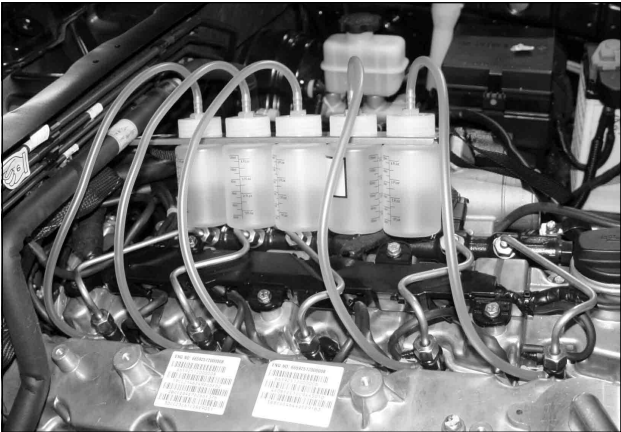
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

4-4. Dynamic Test for Injector Back leak Volume

- 1. Start the engine and warm up until the coolant temperature reaches to 60°C.
- 2. Remove the injector return hose and seal the openings with screw type caps (included in tool kit).



- 3. Install the hoses from back leak test containers to return nipples of injector.
- 4. Start the engine and let it run for 30 seconds at idle speed.
- 5. Launch injector leak detection cycles with SCAN-100.



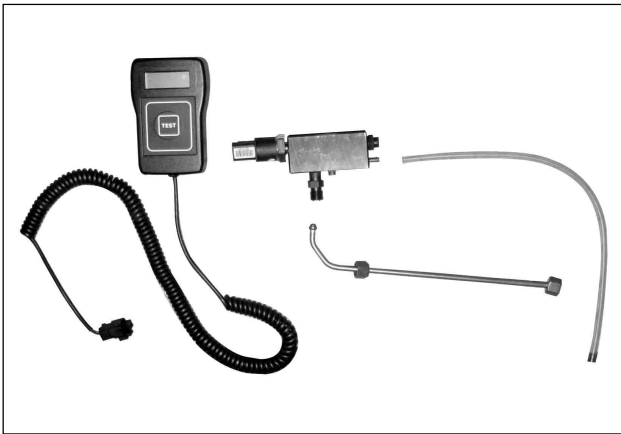
- 6. Check if the back leak volume meets the specification.

Specified value	Below 38 ml
-----------------	-------------



4-5 High Pressure Pump Test

1. Prepare the special tools for high pressure pump test and thoroughly clean the system.



2. Remove the high pressure fuel supply pipe and install the closed rail delivered with tool kit.

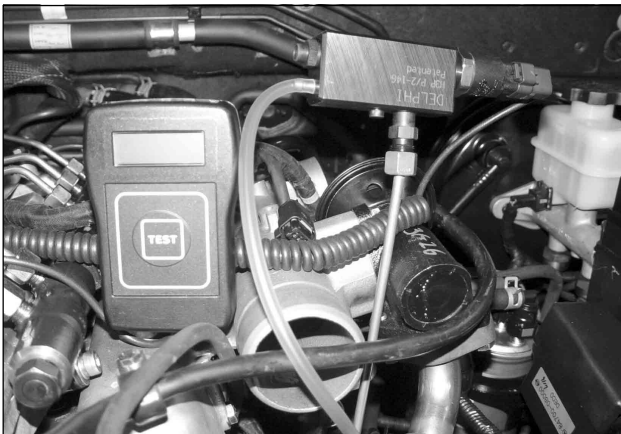
Specified value	40 Nm
-----------------	-------

The figure is to show the test method. However, the actual test operation should be done while the high pressure pump is installed in vehicle.

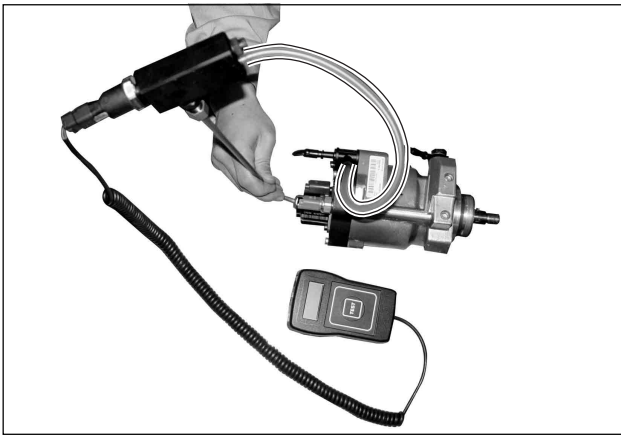


3. Install the opposite end of the closed rail into the fuel rail for test.

Specified value	40 Nm
-----------------	-------



4. Remove the high pressure fuel return hose and install the transparent tube between the high pressure pump and the return port of fuel rail for test.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

- 5. Connect the digital tester connector into the sensor connector of fuel rail for test.
- 6. Disconnect the IMV connector and the fuel rail pressure sensor connector.
- 7. Check if the measured value on the digital tester meets the specified value.

Specified value	Over 1,050 bar
-----------------	----------------



PRESSURE LEAKAGE TEST WITH SCAN-100

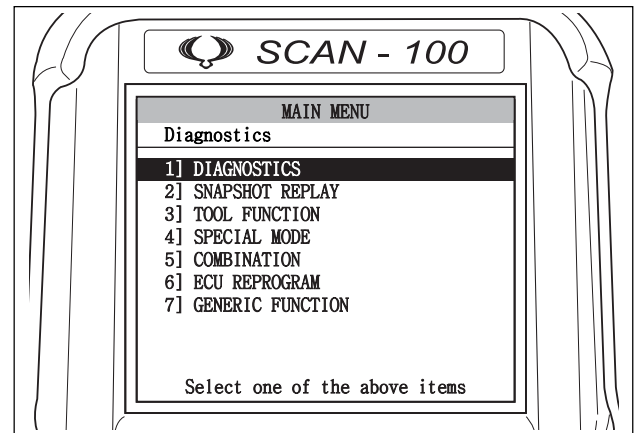
1. When performing the static test for injector back leak Volume, the fuel pressure leakage test with SCAN-100 should be done simultaneously. And, the fuel pressure leakage test with SCAN-100 can be done separately.

2. Test Conditions:

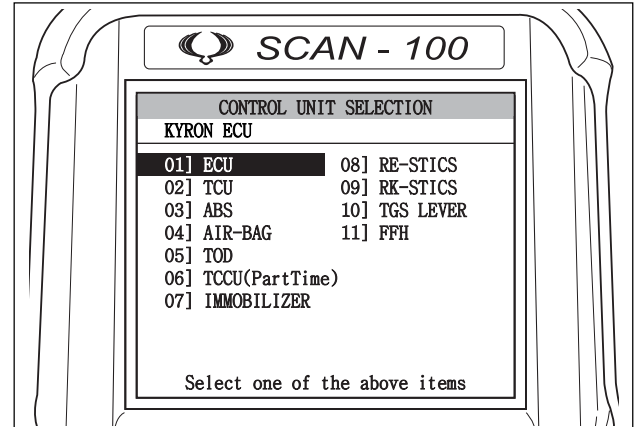
- 1) No defective or faulty sensors and components in fuel system: checked by Scan-100
- 2) Coolant temperature: over 60°C

3. The diagnosis procedures with SCAN-100 are as below:

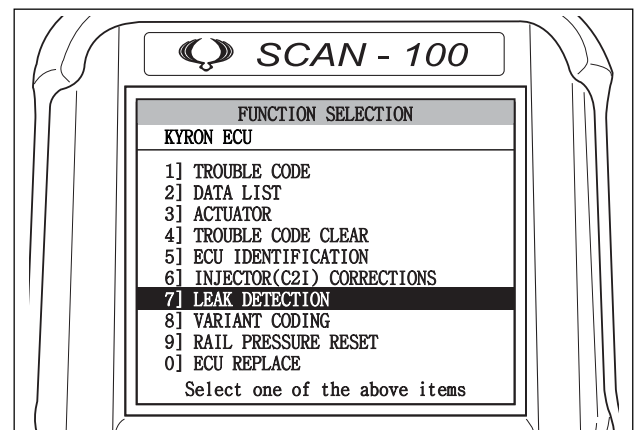
- 1) Install the SCAN-100 to the diagnostic connector. Select "DIAGNOSTICS" and press "ENTER" in "MAIN MENU" screen. Select "STAVIC" and press "ENTER" in "VEHICLE SELECTION" screen.



- 2) Select "ECU" and press "ENTER" in "CONTROL UNIT SELECTION" screen.

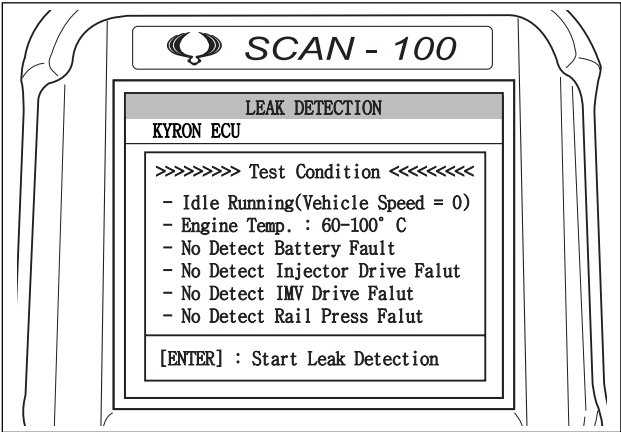


- 3) Select "LEAK DETECTION" and press "ENTER" in "FUNCTION SELECTION" screen.



CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

- 4) If there are not any troubled conditions in “TEST CONDITION” screen, press “ENTER”.



TCU

TABLE OF CONTENTS

DTC (DIAGNOSIS TROUBLE CODE) OF DC5AT	3
---	---

DTC (DIAGNOSIS TROUBLE CODE) OF DC5AT

Trouble Code	Defectives	Action
P2000	Faulty TCU internal watchdog test	<ul style="list-style-type: none"> Self-diagnosis with IGN ON. Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P2001	Faulty TCU internal watchdog function	<ul style="list-style-type: none"> Self-diagnosis. Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P2002	Faulty TCU external watchdog test	<ul style="list-style-type: none"> Self-diagnosis with IGN ON. Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P2003	Faulty TCU external watchdog function	<ul style="list-style-type: none"> Self-diagnosis. Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P2004	Faulty TCU Clock	<ul style="list-style-type: none"> Self-diagnosis. Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P2005	Faulty TCU RAM	<ul style="list-style-type: none"> Self-diagnosis with IGN ON. Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P2006	Faulty TCU RAM CAN-Controller 1	<ul style="list-style-type: none"> Self-diagnosis with IGN ON. Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P2007	Faulty TCU RAM CAN-Controller 2	<ul style="list-style-type: none"> Self-diagnosis with IGN ON. Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P2008	Faulty TCU ROM	<ul style="list-style-type: none"> Self-diagnosis with IGN ON. When the TCU internal checksum is different from scanner checksum. Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P200A	Faulty TCU EEPROM	<ul style="list-style-type: none"> Self-diagnosis with IGN ON. Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P200B	Faulty TCU CPU (internal)	<ul style="list-style-type: none"> Self-diagnosis. Check harness contact.
P200C	Faulty TCU program control	<ul style="list-style-type: none"> Self-diagnosis. Check harness contact.
P2010	No TCU variant coding	<ul style="list-style-type: none"> Self-diagnosis with IGN ON. When the TCU coding is not exist. Check again after TCU coding.
P2011	Faulty TCU variant coding	<ul style="list-style-type: none"> Self-diagnosis with IGN ON. When the TCU coding is faulty. Check again after TCU coding.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Trouble Code	Defectives	Action
P2012	Faulty TCU checksum	<ul style="list-style-type: none"> Self-diagnosis with IGN ON. Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P2013	Faulty TCU (internally)	<ul style="list-style-type: none"> Self-diagnosis with IGN ON. Cycle the IGN switch from OFF to ON. Check and replace TCU if the trouble still exists.
P2100	Defective 1-2, 4-5 shift solenoid valve	<ul style="list-style-type: none"> When 1-2 or 4-5 shift solenoid valve is defective. Measure the resistance of 1-2 or 4-5 shift solenoid valve (turn the IGN OFF, then and disconnect TCU connector). <ul style="list-style-type: none"> TCU connector terminals: B12 (14), B3 (38) Specified value: $3.8 \pm 0.2 \Omega$ Triggered emergency mode when the defective is detected. <ul style="list-style-type: none"> Fixed at 2nd gear in "D" range. Check the related harness for open, short and contact.
P2101	1-2, 4-5 shift solenoid valve - short	<ul style="list-style-type: none"> When 1-2 or 4-5 shift solenoid valve is defective. Measure the resistance of 1-2 or 4-5 shift solenoid valve (turn the IGN OFF, then disconnect TCU connector). <ul style="list-style-type: none"> TCU connector terminals: B12 (14), B3 (38) Specified value: $3.8 \pm 0.2 \Omega$ Triggered emergency mode when the defective is detected. <ul style="list-style-type: none"> Fixed at 2nd gear in "D" range. Check the related harness for open, short and contact.
P2102	Defective 2-3 shift solenoid valve	<ul style="list-style-type: none"> When 2-3 shift solenoid valve is defective. Measure the resistance of 2-3 shift solenoid valve (turn the IGN OFF, then disconnect TCU connector). <ul style="list-style-type: none"> TCU connector terminals: B12 (14), B3 (38) Specified value: $3.8 \pm 0.2 \Omega$ Triggered emergency mode when the defective is detected. <ul style="list-style-type: none"> Fixed at 2nd gear in "D" range. Check the related harness for open, short and contact.
P2103	2-3 shift solenoid valve - short	<ul style="list-style-type: none"> When 2-3 shift solenoid valve is defective. Measure the resistance of 2-3 shift solenoid valve (turn the IGN OFF, then disconnect TCU connector). <ul style="list-style-type: none"> TCU connector terminals: B12 (14), B3 (38) Specified value: $3.8 \pm 0.2 \Omega$ Triggered mechanical emergency mode when the defective is detected. <ul style="list-style-type: none"> Fixed at 2nd gear in "D" range. Check the related harness for open, short and contact.

DIAGNOSIS

KYRON SM - 2005.09

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Trouble Code	Defectives	Action
P2104	Defective 3-4 shift solenoid valve	<ul style="list-style-type: none"> When 3-4 shift solenoid valve is defective. Measure the resistance of 3-4 shift solenoid valve (turn the IGN OFF, then disconnect TCU connector). <ul style="list-style-type: none"> TCU connector terminals: B11 (15), B3 (38) Specified value: $3.8 \pm 0.2 \Omega$ Triggered mechanical emergency mode when the defective is detected. <ul style="list-style-type: none"> Fixed at 2nd gear in "D" range. Check the related harness for open, short and contact.
P2105	3-4 shift solenoid valve - short	<ul style="list-style-type: none"> When 3-4 shift solenoid valve is defective. Measure the resistance of 3-4 shift solenoid valve (turn the IGN OFF, then disconnect TCU connector). <ul style="list-style-type: none"> TCU connector terminals: B11 (15), B3 (38) Specified value: $3.8 \pm 0.2 \Omega$ Triggered mechanical emergency mode when the defective is detected. <ul style="list-style-type: none"> Fixed at 2nd gear in "D" range. Check the related harness for open, short and contact.
P2106	Defective lockup clutch solenoid valve	<ul style="list-style-type: none"> Measure the resistance of lockup clutch solenoid valve (turn the IGN OFF, then disconnect TCU connector). <ul style="list-style-type: none"> TCU connector terminals: B9 (17), B3 (38) Specified value: $2.5 \pm 0.2 \Omega$ Triggered emergency mode when the defective is detected. <ul style="list-style-type: none"> Fixed at 2nd gear in "D" range. Check the related harness for open, short and contact.
P2107	Defective modulator pressure solenoid valve	<ul style="list-style-type: none"> Measure the resistance of modulator pressure solenoid valve (turn the IGN OFF, then disconnect TCU connector). <ul style="list-style-type: none"> TCU connector terminals: B5 (36), B3 (38) Specified value: $5.0 \pm 0.2 \Omega$ Triggered emergency mode when the defective is detected. <ul style="list-style-type: none"> Fixed at 2nd gear in "D" range. Check the related harness for open, short and contact.
P2108	Defective shift pressure solenoid valve	<ul style="list-style-type: none"> Measure the resistance of shift pressure solenoid valve (turn the IGN OFF, then disconnect TCU connector). <ul style="list-style-type: none"> TCU connector terminals: B4 (37), B3 (38) Specified value: $5.0 \pm 0.2 \Omega$ Triggered emergency mode when the defective is detected. <ul style="list-style-type: none"> Electrical error: Fixed at 2nd gear in "D" range. Check the related harness for open, short and contact.

SCAN
ECU
TCU
M/T
TCCU
CLUTCH
BRAKE
A/BAG
A/CON
FFH
RK-STICS
R/SENSOR
S/ROOF

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Trouble Code	Defectives	Action
P2200	Faulty speed sensor N2 signal	<ul style="list-style-type: none"> When the speed sensor N2 detects 0 rpm of front sun gear speed. Check the related harness for open, short and contact. <ul style="list-style-type: none"> - TCU connector terminal B14: rectangular wave signal B8: signal ground B13: 6V
P2203	Faulty speed sensor N3 signal	<ul style="list-style-type: none"> When the speed sensor N3 detects 0 rpm of planetary gear carrier speed. Check the related harness for open, short and contact. <ul style="list-style-type: none"> - TCU connector terminal B6: rectangular wave signal B8: signal ground B13: 6V
P220A	Abnormal speed sensor output signal (N2, N3)	<ul style="list-style-type: none"> When the rpm difference between speed sensor N2 and N3 is over 150 rpm. Check the related harness for open, short and contact.
P2220	T/M Oil temperature sensor - short	<ul style="list-style-type: none"> Turn the IGN OFF, then disconnect TCU connector. Selector lever position: R or D T/M Measure the resistance of oil temperature sensor. TCU connector terminals B7, B8 Check the related harness for open, short and contact.
P2221	Abnormal T/M oil temperature sensor signal	<ul style="list-style-type: none"> Turn the IGN OFF, then disconnect TCU connector. Selector lever position: R or D Measure the resistance of T/M oil temperature sensor. TCU connector terminals: B7, B8 Check the related harness for open, short and contact.
P2222	Abnormal T/M oil temperature sensor signal	<ul style="list-style-type: none"> Turn the IGN OFF, then disconnect TCU connector. Selector lever position : R or D Measure the resistance of T/M oil temperature sensor. TCU connector terminals: B7, B8 Check the related harness for open, short and contact.
P2300	Faulty CAN communication	<ul style="list-style-type: none"> Turn the IGN OFF, then disconnect TCU connector. Check the communication line for open, short and contact. Measure the resistance of CAN line: B1, B2 Specified value : approx. 120 W
P2301	Faulty CAN communication	<ul style="list-style-type: none"> Turn the IGN OFF, then disconnect TCU connector. Check the communication line for open, short and contact. Measure the resistance of CAN line: B1, B2 Specified value : approx. 120 W
P2310	CAN: Faulty brake system communication	<ul style="list-style-type: none"> Check CAN communication line H and L. Check ABS/ESP unit. Check the related harness for open, short and contact.

DIAGNOSIS

KYRON SM - 2005.09

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Trouble Code	Defectives	Action
P2311	CAN: Faulty ECU communication	<ul style="list-style-type: none"> • Check CAN communication line H and L. • Check engine ECU. • Check the related harness for open, short and contact.
P2312	CAN: Faulty ECU communication	<ul style="list-style-type: none"> • Check CAN communication line H and L. • Check engine ECU. • Check the related harness for open, short and contact.
P2313	CAN: Faulty selector lever control communication	<ul style="list-style-type: none"> • Check CAN communication line H and L. • Check selector lever. • Check the related harness for open, short and contact.
P2315	CAN: Faulty instrument panel communication	<ul style="list-style-type: none"> • Check CAN communication line H and L. • Check instrument cluster. • Check the related harness for open, short and contact.
P2317	CAN: Faulty communication between TCCU/TOD and CAN (For 4WD only)	<ul style="list-style-type: none"> • Check CAN communication line H and L. • Check TCCU/TOD unit. • Check the related harness for open, short and contact.
P2330	CAN: Faulty brake system signal	<ul style="list-style-type: none"> • Check CAN communication line H and L. • Check ABS/ESP unit. • Check the related harness for open, short and contact.
P2331	CAN: Faulty ECU message	<ul style="list-style-type: none"> • Check CAN communication line H and L. • Check engine ECU. • Check the related harness for open, short and contact.
P2332	CAN: Faulty ECU message	<ul style="list-style-type: none"> • Check CAN communication line H and L. • Check engine ECU. • Check the related harness for open, short and contact.
P2333	CAN: Faulty selector lever signal	<ul style="list-style-type: none"> • Check CAN communication line H and L. • Check selector lever. Check selector lever. • Check the related harness for open, short and contact.
P2335	CAN: Faulty instrument cluster signal	<ul style="list-style-type: none"> • Check CAN communication line H and L. • Check instrument cluster. • Check the related harness for open, short and contact.
P2337	CAN: Faulty TCCU/TOD (For 4WD only)	<ul style="list-style-type: none"> • Check CAN communication line H and L. • Check TCCU/TOD unit. • Check the related harness for open, short and contact.
P2400	CAN: Faulty rear RH wheel speed sensor signal	<ul style="list-style-type: none"> • Check CAN communication line H and L. • Check ABS/ESP unit. <ul style="list-style-type: none"> - Check wheel speed sensor connector. - Check the air gap between tooth wheel and wheel speed sensor. (Air gap: 0.309 ~ 0.958 mm) - Check the numbers of tooth wheel: 48 • Check the related harness for open, short and contact.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Trouble Code	Defectives	Action
P2401	CAN: Faulty rear LH wheel speed sensor signal	<ul style="list-style-type: none"> • Check CAN communication line H and L. • Check ABS/ESP unit. <ul style="list-style-type: none"> - Check wheel speed sensor connector. - Check the air gap between tooth wheel and wheel speed sensor. (Air gap: 0.309 ~ 0.958 mm) - Check the numbers of tooth wheel: 48 • Check the related harness for open, short and contact.
P2402	CAN: Faulty front RH wheel speed sensor signal	<ul style="list-style-type: none"> • Check CAN communication line H and L. • Check ABS/ESP unit. <ul style="list-style-type: none"> - Check wheel speed sensor connector. - Check the air gap between tooth wheel and wheel speed sensor. (Air gap: 0.335 ~ 0.945 mm) - Check the numbers of tooth wheel: 48
P2403	CAN: Faulty front LH wheel speed sensor signal	<ul style="list-style-type: none"> • Check CAN communication line H and L. • Check ABS/ESP unit. <ul style="list-style-type: none"> - Check wheel speed sensor connector. - Check the air gap between tooth wheel and wheel speed sensor. (Air gap: 0.335 ~ 0.945 mm) - Check the numbers of tooth wheel: 48
P2404	CAN: No brake signal	<ul style="list-style-type: none"> • Check CAN communication line H and L. • Check ABS/ESP unit. • Check the related harness for open, short and contact.
P2405	CAN: No accelerator pedal signal	<ul style="list-style-type: none"> • Check CAN communication line H and L. • Check engine ECU. • Check the related harness for open, short and contact.
P2406	CAN: No engine torque signal	<ul style="list-style-type: none"> • Check CAN communication line H and L. • Check engine ECU. • Check the related harness for open, short and contact.
P2407	CAN: No ESP signal	<ul style="list-style-type: none"> • Check CAN communication line H and L. • Check engine ECU. • Check the related harness for open, short and contact.
P2408	CAN: No minimum engine torque signal	<ul style="list-style-type: none"> • Check CAN communication line H and L. • Check engine ECU. • Check the related harness for open, short and contact.
P2409	CAN: No maximum engine torque signal	<ul style="list-style-type: none"> • Check CAN communication line H and L. • Check engine ECU. • Check the related harness for open, short and contact.
P240A	CAN: No engine rpm signal	<ul style="list-style-type: none"> • Check CAN communication line H and L. • Check engine ECU. • Check the related harness for open, short and contact.

DIAGNOSIS

KYRON SM - 2005.09

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Trouble Code	Defectives	Action
P240B	CAN: No engine coolant temperature signal	<ul style="list-style-type: none"> • Check CAN communication line H and L. • Check engine ECU. • Check the related harness for open, short and contact.
P240C	CAN: No selector lever position signal	<ul style="list-style-type: none"> • Check CAN communication line H and L. • Check selector lever. • Check the related harness for open, short and contact.
P240D	CAN: No transfer case position signal (For 4WD only)	<ul style="list-style-type: none"> • Check CAN communication line H and L. • Check TCCU/TOD unit. • Check the related harness for open, short and contact.
P2500	Invalid transmission gear ratio	<ul style="list-style-type: none"> • Cycle the IGN switch from OFF to ON. Check A/T system again after a certain period of driving. • If the trouble still exists, replace A/T assembly. • To protect transmission, any shift is not available.
P2501	Excessive engine rpm	<ul style="list-style-type: none"> • Check CAN communication line H and L. • Check engine ECU. • Check the related harness for open, short and contact.
P2503	Faulty recognition of currently selected gear	<ul style="list-style-type: none"> • Check selector lever. • Check the related harness for open, short and contact.
P220B	Excessive N2, N3 rpm	<ul style="list-style-type: none"> • Check speed sensor N2 and N3.
P2510	Torque converter lockup clutch stuck	<ul style="list-style-type: none"> • Check the hydraulic lines for leaks (valve No.22 in valve body). • Check the resistance of lockup clutch solenoid valve (Turn the IGN OFF, then disconnect TCU connector). <ul style="list-style-type: none"> - TCU connector terminals B9 (17), B3 (18) - Specified value : 2.5 ± 0.2 W • Triggered emergency mode when the defective is detected. <ul style="list-style-type: none"> - Fixed at 2nd gear in "D" range. • Check the related harness for open, short and contact.
P2511	Faulty torque converter lockup heat control	<ul style="list-style-type: none"> • Check the hydraulic lines for leaks.
P2520	Faulty recognition of torque reduction	<ul style="list-style-type: none"> • Check ECU.
P2502	Poor gear mesh, transmission slip	<ul style="list-style-type: none"> • Check the hydraulic lines for leaks. • Check oil filter.
P2600	Too low TCU supply voltage	<ul style="list-style-type: none"> • Check TCU supply voltage.
P2601	Too high TCU supply voltage	<ul style="list-style-type: none"> • Check TCU supply voltage.
P2602	Abnormal solenoid valve supply voltage	<ul style="list-style-type: none"> • Check solenoid supply voltage.
P2603	Abnormal speed sensor supply voltage	<ul style="list-style-type: none"> • Check speed sensor supply voltage. <ul style="list-style-type: none"> - TCU connector terminals B13 (13) : 6V

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

MEMO

Lined area for writing the memo.

MANUAL TRANSMISSION

TABLE OF CONTENTS

DIAGNOSTIC INFORMATION AND PROCEDURES	3
▶ TROUBLE DIAGNOSIS	10
▶ DIAGNOSIS TABLE	11

DIAGNOSTIC INFORMATION AND PROCEDURES

► Trouble Diagnosis

Symptom	Cause	Action
Can not shift (control lever moves)	Control lever assembly broken or damaged.	Replace control lever and housing assembly.
	Damaged offset lever, shift fork, selector plate or selector arm.	Remove extension, adapter or case cover. Check or replace damaged parts.
Hard shift or control lever will not move into gear	Clutch not releasing.	Adjust or replace clutch.
	Improper or low transmission oil.	Add or replace with specified oil.
	Shift or shift rail binding.	Remove extension, adapter or case cover. Check or replace damaged parts.
	Binding of sliding synchronizers or gears.	Remove extension, adapter or case cover. Check synchronizers and gears and replace damaged parts.
	If reverse only, faulty backup switch.	Check or replace backup switch.
	Worn or damaged flywheel pilot bushing.	Replace pilot bushing.
Gears crash when shifting	Engine idle speed too high.	Adjust idle speed to specified speed.
	Damaged or faulty clutch.	Adjust or replace clutch.
	Pilot bearing between input shaft and output shaft binding.	Replace or check roller bearings.
	Damaged synchronizer.	Check or replace synchronizer parts.
	Bell housing misaligned.	Align bell housing and bore.
	Damaged gear(s).	Check or replace gear(s).
	Worn or damaged flywheel pilot bushing.	Replace pilot bushing.
Transmission jumps out	Loosened transmission or flywheel housing bolts, improper alignment.	Tighten bolts to specified value. Realign if necessary.
	Synchronizer damaged or excessively worn.	Check or replace synchronizer parts.
	Blocking ring damaged, worn index slots or friction surfaces worn or damaged.	Check or replace blocking ring.
	Excessive countershaft end play.	Check worn or damaged parts. Adjust shim thickness using roller bearings if necessary.
	Worn or damaged fork due to loosened shaft, rail or shifting fork.	Check for wear or damaged. Replace worn or damaged parts.
Transmission locked in one gear	Fork or offset lever loose on shaft or rail.	Replace extension, adapter or case cover. Check or replace loose parts on shaft or rail. Replace roll pin(s).
	Worn or damaged forks, offset lever, shaft or rail.	Remove extension, adapter or case cover. Check for wear or damaged. Replace damaged parts.
	Worn or damaged synchronizer.	Check worn or damaged synchronizer parts and replace if necessary.
	Worn or damaged gears.	Check worn or damaged gears and replace if necessary.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► Trouble Diagnosis (Cont'd)

Symptom	Cause	Action
Transmission noise	Improper or low transmission oil.	Add or drain and replace with proper oil.
	Loose bolts or other attaching parts.	Tighten as specified.
	Improper flywheel housing to engine crankshaft alignment.	Realign correctly.
	Noisy transmission bearing.	Check bearings, bearing rollers and parts for wear or damage. Replace if necessary.
	Noisy gears.	Check for worn or damaged gears (including speedometer gear). Replace if necessary.
Transmission leakage	Leakage from transmission.	Clean all exposed surfaces, then check for leaks.
	Vent or breather clogged.	Clean or replace vent or breather.
	Too much oil.	Check oil level.
	Loose bolts at sealing faces.	Tighten as specified.
	Improperly applied sealant.	Clean leaking surfaces. Reapply sealant.
	Worn or damaged oil seal.	Replace oil seal.

► **Diagnosis Table**

Application												
1 Shift Hop-out												
2 Shift Gear Crash												
3 Shift Block-out												
4 Hard Shift												
5 Noise in Reverse Gear												
6 Noise in 5th Gear												
7 Noise in 4th Gear												
8 Noise in 3rd Gear												
9 Noise in 2nd Gear												
10 Noise in 1st Gear												
11 Noise in All Speeds												
12 Leak at Transmission Rear Part												
13 Leak at Transmission Center Part												
14 Leak at Transmission Front												
Possible Faulty Part												
								●	●	Transmission Case		
								●	●	Extension Housing		
●		●						●	●	Shift Cover / Shift Shaft		
●		●						●		Shift Control Lever		
		●						●		Input Bearing Retainer		
								●		Input Gear Set		
●					●			●		3rd Speed Gear Set		
●					●			●		2nd Speed Gear Set		
		●								Reverse Speed Gear Set		
●							●	●		1st Speed Gear Set		
●								●		5th Speed Gear Set		
		●						●		Clutch Housing and Release Derive		
		●						●		Crankshaft Pilot Bushing and Release Bearing		
								●		Input Bearing		
								●		Main Shaft Input Bearing		
●								●		Main Shaft Thrust Bearing		
					●			●		3rd Speed Gear Bearing		
					●			●		2nd Speed Gear Bearing		
						●		●		1st Speed Gear Bearing		
		●								Reverse Idler Gear Bushing		
								●		Counter Shaft Front Bearing		
								●		Counter Shaft Rear Bearing		
●	●							●		Counter Shaft Thrust Bearing		
		●						●		5th Speed Drive Gear Bearing		
								●		Slip Yoke Bushing		
								●		Slip Yoke Seal		
								●		Speedometer Drive / Driven Gears		
								●		Speedometer Driven Gear Housing		
								●		Input Shaft Seal		
●	●	●				●	●	●		1 - 2 Synchronizer Assembly		
●	●	●			●	●		●		3 - 4 Synchronizer Assembly		
●	●	●			●			●		5th Synchronizer Assembly		

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

MEMO

Lined area for writing the memo.

TCCU

TABLE OF CONTENTS

GENERAL DIAGNOSIS	3
DIAGNOSTIC TROUBLE CODE	4

GENERAL DIAGNOSIS

Symptoms	Check	Action
Electric shift problems	• Faulty or damaged TCCU, speed sensor, motor, clutch or internal wirings	• Overhaul and check, replace if necessary
	• Damaged or worn shift cam, hub, fork and rail shift	• Overhaul and check for wear and damage.
	• Binding shift fork, hub collar or gear	• Check sliding parts, replace if necessary.
Cannot drive front wheel when shifting to 4H, 4L	• Broken drive chain	• Check internal parts and replace drive chain.
Noise in 4WD operation	• Improper or low oil	• Drain and replace with specified oil.
	• Loosened bolts or mounted parts	• Retighten as specified.
	• Noisy T/C bearing	• Disassemble bearings and parts and check for wear or damage. Replace if necessary.
Noise in 4H or 4L	• Gear abnormal noise	• Check for wear and damage including speedometer gear. Replace if necessary.
	• Worn or damaged sprockets or drive chain	• Disassemble and check for wear and damage. Replace if necessary.
	• Incorrect tire pressure	• Adjust tire pressure.
Transfer case oil leakage	• Cracked transfer case	• Replace the case.
	• Leakage from other parts	• Clean case and parts and check for leakage.
	• Breather clogging	• Remove breather hose and clean. Replace if necessary.
	• Improper or too much oil	• Use specified oil and adjust oil level.
	• Loosened sealing bolts	• Retighten.
	• Improperly applied sealant	• Use specified sealant and retighten.
	• Worn or damaged oil seal	• Replace oil seal.

TCCU periodically monitors the input and output while the system is in operation. When a fault is detected, the trouble code is stored into TCCU memory.

If the ignition switch is turned to "OFF", TCCU stops monitoring for input and output, however, when the ignition switch is turned to "OFF" before shifting completes, TCCU continues monitoring for input and output required for the shifting.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

DIAGNOSTIC TROUBLE CODE

Code	Description	Action
P1806	Detective CAN communication	<ul style="list-style-type: none"> • Check communication line. • Replace TCCU if necessary.
P1805	Defective mode switch	<ul style="list-style-type: none"> • When the mode switch is defective • Check TCCU pin No.4 and 16. • Mode change <ul style="list-style-type: none"> - 2H (Pin No. 4: Ground) - 4H (No contact: Open) - 4L (Pin No.16: Ground)
P1821	Open or short to ground in magnetic clutch coil circuit	<ul style="list-style-type: none"> • Voltage at TCCU pin No.11: 11 ~ 15 V • EMC resistance: 2.5 Ω • Check the relevant connectors for contact. • Replace TCCU if necessary.
P1822	Open or short to ground in hub control circuit	<ul style="list-style-type: none"> • When the hub control circuit is open or short to ground over 0.2 second • Replace TCCU if necessary.
P1841	Open to ground in shift motor circuit	<ul style="list-style-type: none"> • When TCCU detects the motor failure for 1 second • Check the relevant harnesses for contact. • Replace TCCU if necessary.
P1842	Short to ground in shift motor output circuit	<ul style="list-style-type: none"> • When TCCU detects the motor failure for 1 second • Check the relevant harnesses for contact. • Replace TCCU if necessary.
P1843	Defective position sensor in motor	<ul style="list-style-type: none"> • 2H-4H: after 1.5 seconds • 4H-4L: after 3 seconds • Check the relevant harnesses for contact. • Replace TCCU if necessary.
P1844	Stuck in 4L mode	<ul style="list-style-type: none"> • When no shifting operation from 4L to 4H, even though the shift conditions are satisfied and no error. • Replace TCCU if necessary.

DIAGNOSIS

KYRON SM - 2005.09

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Code	Description	Action
P1850	Defective position encoder	<ul style="list-style-type: none"> • When the position encoder is defective • Check the relevant harnesses. • Check the relevant connectors for contact. • Check the shift motor.
P1851	Short to ground for position encoder 1	<ul style="list-style-type: none"> • Short to ground for position encoder 1 in shift motor • Check the relevant harnesses for short. <ul style="list-style-type: none"> - TCCU pin No.18 • Check the relevant connectors for contact. • Check the shift motor.
P1852	Short to ground for position encoder 2	<ul style="list-style-type: none"> • Short to ground for position encoder 2 in shift motor • Check the relevant harnesses for short. <ul style="list-style-type: none"> - TCCU pin No.5 • Check the relevant connectors for contact. • Check the shift motor.
P1853	Short to ground for position encoder 3	<ul style="list-style-type: none"> • Short to ground for position encoder 2 in shift motor • Check the relevant harnesses for short. <ul style="list-style-type: none"> - TCCU pin No.19 • Check the relevant connectors for contact. • Check the shift motor.
P1854	Short to ground for position encoder 4	<ul style="list-style-type: none"> • Short to ground for position encoder 4 in shift motor • Check the relevant harnesses for short. <ul style="list-style-type: none"> - TCCU pin No.17 • Check the relevant connectors for contact. • Check the shift motor.
P1815	Abnormal CAN neutral signal	<ul style="list-style-type: none"> • No neutral signal from automatic transmission over 1 second through CAN. • Check CAN communication line. • Check TCU.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

MEMO

CLUTCH

TABLE OF CONTENTS

TROUBLE DIAGNOSIS 3

TROUBLE DIAGNOSIS

Check		Possible Cause	Action
Clutch slips		Excessive wear of facing	Replace
		Hard or oily facing	Adjust or replace
		Damaged diaphragm or flywheel	Replace
		Damaged or burnt diaphragm spring	Replace
		Insufficient clutch pedal free play	Adjust
		Faulty operation of clutch pedal	Repair or replace
		Worn or damaged clutch disc	Replace
Poor disengagement		Vibration or excessive run-out of disc	Replace
		Rust or wear of clutch disc spline	Repair or replace
		Oily facing	Adjust or replace
		Burnt diaphragm spring	Replace
		Excessive clutch pedal free play	Adjust
Hard to shift or will not shift		Excessive clutch pedal free play	Adjust pedal freeplay
		Faulty clutch release cylinder	Repair release cylinder
		Worn disc, excessive run-out, damaged lining	Repair or replace
		Dirty or burred splines on input shaft or clutch disc	Repair as necessary
		Damaged clutch pressure plate	Replace
Clutch chatters when starting		Oily facing	Repair or replace
		Hard or faulty facing	Replace
		Burnt cushion spring	Replace
		Faulty pressure plate	Replace
		Bent clutch diaphragm spring	Replace
		Hard or bent flywheel	Adjust or replace
		Engine mounts loose or burnt lever	Tighten or replace
Difficult pedal operation		Poor bleeding in hydraulic system	Bleed or replace
		Poor lubrication on pedal shaft	Lubricate or replace
		Poor lubrication on clutch pedal	Repair
Clutch noisy	Not using the clutch	Insufficient clutch pedal free play	Adjust
		Excessive wear of clutch disc facing	Replace
	After disengagement	Worn or damaged concentric slave cylinder	Replace
	When disengaging	Faulty installation of clutch assembly or bearing	Repair
	Clutch pedal is partially depressed and vehicle speed is reduced	Damaged pilot bushing	Replace

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

MEMO

BRAKE

TABLE OF CONTENTS

ABS/ESP TROUBLE DIAGNOSIS	3
▶ ABS/ESP SENSOR VALUE	10
▶ ABS/ESP FORCED OPERATION	11
▶ SENSOR INITIALZATION (ABS & ESP)	12
▶ ACTUATOR	13
▶ AIR BLEEDING BY USING SCAN-100	14
▶ CLEARING CODE	15

ABS/ESP TROUBLE DIAGNOSIS

o: Applied x: N/A

Function	Defective Components	Trouble Code	Descriptions	System	
Sensor Monitoring	Front LH Wheel speed sensor	C1011 (5011) C1012 (5012)	Wheel speed sensor front left-electrical Wheel speed sensor front left-other	ABS	ESP
	1. C1011 (5011) <u>Cause</u> <ul style="list-style-type: none"> - Defective front LH wheel speed sensor - Short or poor contact wire to sensor <u>Action</u> <ul style="list-style-type: none"> - Check the wheel speed sensor connector - Check HECU connector - Check the harness connection 				
	2. C1012 (5012) <u>Cause</u> <ul style="list-style-type: none"> - Defective front LH wheel speed sensor - No signals from wheel speed sensor and tooth wheel - Too large air gap between wheel speed sensor and tooth wheel - Different number of teeth in tooth wheel <u>Action</u> <ul style="list-style-type: none"> - Check the wheel speed sensor connector - Check HECU connector - Check air gap and tooth wheel mounting (Specified air gap: 0.335 ~ 0.945 mm) - Check the number of teeth (48) in tooth wheel 			O	O
	Front RH Wheel speed sensor	C1021 (5021) C1022 (5022)	Wheel speed sensor front right-electrical Wheel speed sensor front right-other		
	1.C1021 (5021) <u>Cause</u> <ul style="list-style-type: none"> - Defective front RH wheel speed sensor - Short or poor contact wire to sensor <u>Action</u> <ul style="list-style-type: none"> - Check the wheel speed sensor connector - Check HECU connector - Check the harness connection 				
	2.C1022 (5022) <u>Cause</u> <ul style="list-style-type: none"> - Defective front RH wheel speed sensor - No signals from wheel speed sensor and tooth wheel - Too large air gap between wheel speed sensor and tooth wheel - Different number of teeth in tooth wheel <u>Action</u> <ul style="list-style-type: none"> - Check the wheel speed sensor connector and HECU connector - Check air gap and tooth wheel mounting (Specified air gap: 0.335 ~ 0.945 mm) - Check the number of teeth (48) in tooth wheel 			O	O

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Function	Defective Components	Trouble Code	Descriptions	System	
Sensor Monitoring	Rear RH Wheel speed sensor	C1031 (5031) C1032 (5032)	Wheel speed sensor rear left-electrical Wheel speed sensor rear left-other	ABS	ESP
	1. C1031 (5031) <u>Cause</u> <ul style="list-style-type: none">- Defective rear RH wheel speed sensor- Short or poor contact wire to sensor <u>Action</u> <ul style="list-style-type: none">- Check the wheel speed sensor connector- Check the HECU connector- Check the harness connection			O	O
	2. C1032 (5032) <u>Cause</u> <ul style="list-style-type: none">- Defective rear RH wheel speed sensor- No signals from wheel speed sensor and tooth wheel- Too large air gap between wheel speed sensor and tooth wheel- Different number of teeth in tooth wheel <u>Action</u> <ul style="list-style-type: none">- Check the wheel speed sensor connector- Check the HECU connector- Check air gap and tooth wheel mounting (Specified air gap: 0.309 ~ 0.958 mm)- Check the number of teeth (48) in tooth wheel				
	Rear LH Wheel speed sensor	C1041 (5041) C1042 (5042)	Wheel speed sensor rear left-electrical Wheel speed sensor rear left-other		
1. C1041 (5041) <u>Cause</u> <ul style="list-style-type: none">- Defective rear LH wheel speed sensor- Short or poor contact wire to sensor <u>Action</u> <ul style="list-style-type: none">- Check the wheel speed sensor connector- Check the HECU connector- Check the harness connection			O	O	
2. C1042 (5042) <u>Cause</u> <ul style="list-style-type: none">- Defective rear LH wheel speed sensor- No signals from wheel speed sensor and tooth wheel- Too large air gap between wheel speed sensor and tooth wheel- Different number of teeth in tooth wheel <u>Action</u> <ul style="list-style-type: none">- Check the wheel speed sensor connector and HECU connector- Check air gap and tooth wheel mounting (Specified air gap: 0.309 ~ 0.958 mm)- Check the number of teeth (48) in tooth wheel					

Function	Defective Components	Trouble Code	Descriptions	System	
Sensor Monitoring	Pressure sensor	C1051 (5051)	Defective input sensor	ABS	ESP
	Cause <ul style="list-style-type: none"> - Abnormal signals from pressure sensor - Defective pressure sensor or harness Action <ul style="list-style-type: none"> - Check the pressure sensor connector 			X	O
	Steering wheel angle sensor	C1061 (5061)	Defective steering wheel angle sensor		
	Cause <ul style="list-style-type: none"> - Internally defective steering wheel angle sensor - Abnormal signals from steering wheel angle sensor - Short circuit between supplying voltage output and ground - Abnormal signal voltage from steering wheel angle sensor - Poor installation of steering wheel angle sensor and abnormal signal Action <ul style="list-style-type: none"> - Check the supplying voltage: (Specified voltage: 9 ~ 16 V) - Check the output voltage: Check voltage between ESP unit terminals with ignition ON <ul style="list-style-type: none"> • ST1 voltage check: between ESP unit terminal No. 5 and ground (Specified voltage: 1.3 ~ 4.1V) • ST2 voltage check: between ESP unit terminal No. 2 and ground (Specified voltage: 1.3 ~ 4.1V) • STN voltage check: between ESP unit terminal No.12 and ground (Specified voltage: 1.3 ~ 4.1V) 			X	O
	Sensor cluster	C1073 (5073) C1074 (5074)	Sensor cluster -electrical Sensor cluster-internal		
	1. C1073 (5073) Cause <ul style="list-style-type: none"> - Operating voltage exceeds specified range (Hi: 18.0 ± 1.0 V / Lo: 6.5 ± 0.5 V) - Poor contact or installation of harness Action <ul style="list-style-type: none"> - Check the sensor cluster connector - Replace the sensor cluster 2. C1074 (5074) Cause <ul style="list-style-type: none"> - Internally defective HECU - Abnormal A/D converter voltage: 5.0 ± 3 % - Abnormal supplying voltage (4.580 ~ 4.960 V) to sensor cluster <ul style="list-style-type: none"> →Short circuit between supplying voltage output of sensor cluster and ground - Poor ground of sensor cluster (0.0 ~ 0.5 V) <ul style="list-style-type: none"> →Short to ground on sensor cluster - Abnormal signals from lateral acceleration sensor - Abnormal signals from yawing sensor - Poor installation of sensor - Defective sensor cluster - Defective or short circuit of CAN communication line Action <ul style="list-style-type: none"> - Replace the sensor 			X	O

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Function	Defective Components	Trouble Code	Descriptions	System	
Battery Voltage Monitoring	Battery	C1101 (5101) C1102 (5102)	Battery under voltage Battery over voltage	ABS	ESP
	1. C1101 (5101) <u>Cause</u> - Low voltage out of specified range (9.7 ± 0.3 V) <u>Action</u> - Check the supplying voltage 2. C1102 (5102) <u>Cause</u> - Over voltage out of specified range (18.0 ± 1.0 V) <u>Action</u> - Check the supplying voltage			O	O
Brake Monitoring	Brake disc	C1111 (5111)	Disk temperature is high		
	<u>Cause</u> - Overheated brake disk due to braking force: over 500°C <u>Action</u> - Stop driving for a period of time after turning off the ESP			X	O
	Brake lamp switch ESP OFF switch	C1201 (5201) C1202 (5202)	Defective brake lamp switch Defective ESP OFF switch		
Valve Monitoring	1. C1201 (5201) <u>Cause</u> - Mechanical defective in brake switch - Defective brake switch harness <u>Action</u> - Check the harness and connector 2. C1202 (5202) <u>Cause</u> - Mechanical defective in ESP OFF switch - Defective ESP OFF switch harness (short to ground) <u>Action</u> - Check the harness and connector for ESP OFF switch			X	O
	Valve, valve relay	C1301 (5301)	Defective valve, valve relay in HECU		
Valve Monitoring	<u>Cause</u> - Abnormal supplying voltage to valve solenoid - Internally defective HECU <u>Action</u> - Replace the HECU - Check the battery voltage - Check the HECU connector			O	O

Function	Defective Components	Trouble Code	Descriptions	System	
Pump Monitoring	Motor pump	C1312 (5312)	Defective motor pump	ABS	ESP
	Cause <ul style="list-style-type: none"> - Too low (below 6.0 V) or no supplying voltage to pump motor - Over 0.93 V from pump motor voltage - Poor contact in pump motor connector - Poor ground Action <ul style="list-style-type: none"> - Check the supplying voltage - Check the HECU connector - Replace the HECU 			O	O
HECU and Sensor Monitoring	HECU	C1401 (5401)	HECU hardware		
	Cause <ul style="list-style-type: none"> - Internally defective HECU - Defective A/D converter, internal voltage regulator, and controller - Defective sensor and short to supplying voltage line - Abnormal temperature sensor signal Action <ul style="list-style-type: none"> - Replace the HECU 			O	O
	Sensor initialization	C1501 (5501)	Abnormal sensor initialization		
	Cause <ul style="list-style-type: none"> - Abnormal signals from sensors - Abnormal sensor data Action <ul style="list-style-type: none"> - Check the sensors - Initialize the sensors 			X	O
	Vehicle coding	C1170 (5170)	Variant coding error, or misinstallation HECU		
	Cause <ul style="list-style-type: none"> - Discrepancy between HECU coding and vehicle coding - Defective CAN communication line - Misinstallation HECU Action <ul style="list-style-type: none"> - Check the HECU coding and vehicle coding - Perform vehicle coding - Replace the exact HECU - Check engine ECU variant coding 			(O)	O

SCAN
ECU
TCU
M/T
TCCU
CLUTCH
BRAKE
A/BAG
A/CON
FFH
RK-STICS
R/SENSOR
S/ROOF

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Function	Defective Components	Trouble Code	Descriptions	System	
	CAN communication	C1601 (5601)	CAN communication error	ABS	ESP
	Cause <ul style="list-style-type: none"> - Short or open to CAN communication line - Poor connection of CAN communication line Action <ul style="list-style-type: none"> - Check the CAN communication line 			(O)	O
	CAN communication	C1602 (5602) C1603 (5603) C1604 (5604) C1605 (5605)	Communication error between engine ECU and HECU Communication error between TCU and HECU Communication error between TCCU (4WD) and HECU Communication error between cluster (Meter) and HECU		
	1. C1602 (5602) Cause <ul style="list-style-type: none"> - Short to CAN communication line - Overload to CAN communication Action Action <ul style="list-style-type: none"> - Check the engine ECU - Check the CAN communication line - Check the engine ECU connector 2. C1603 (5603) Cause <ul style="list-style-type: none"> - Short to CAN communication line - Overload to CAN communication Action Action <ul style="list-style-type: none"> - Check the TCU - Check the CAN communication line - Check the TCU connector 3. C1604 (5604) Cause <ul style="list-style-type: none"> - Short to CAN communication line - Overload to CAN communication Action Action <ul style="list-style-type: none"> - Check the TCCU - Check the CAN communication line - Check the TCCU connector 4. C1605 (5605) Cause <ul style="list-style-type: none"> - Short to CAN communication line - Overload to CAN communication Action Action <ul style="list-style-type: none"> - Check the cluster (meter) - Check the CAN communication line - Check the cluster (meter) connector 			X	O

Function	Defective Components	Trouble Code	Descriptions	System	
CAN Communica- tion Monitoring	CAN signal error EMS	C1612 (5612)	Signal from engine ECU is abnormal	ABS	ESP
	<u>Cause</u> <ul style="list-style-type: none">- Engine ECU is detective- Signal from engine ECU error <u>Action</u> <ul style="list-style-type: none">- Check engine ECU- Check ECU SW version			X	O

SCAN
ECU
TCU
M/T
TCCU
CLUTCH
BRAKE
A/BAG
A/CON
FFH
RK-STICS
R/SENSOR
S/ROOF

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► ABS/ESP Sensor Value

No	Content	Unit	ESP	ABS
1	Wheel Speed FR	1 km/h	O	O
2	Wheel Speed FL	1 km/h	O	O
3	Wheel Speed RR	1 km/h	O	O
4	Wheel Speed RL	1 km/h	O	O
5	Battery Voltage	0.1V	O	O
6	Longitudinal Acceleration Sensor	0.01 g-: Straight ahead	O	O
7	Lateral Acceleration Sensor	0.01 g +: Left Turn	O	X (Fixed Value: 0)
8	Yaw Rate Sensor	0.5 deg/s +: Left Turn	O	X (Fixed Value: 0)
9	Steering Wheel Angle sensor	5 deg +: Left Turn	O	X (Fixed Value: 0)
10	Pressure Sensor (Primary)	1 bar	O	X (Fixed Value: 0)
11	Pressure Sensor (Secondary)	1 bar	O	X (Fixed Value: 0)
12	EBD Control	Operation / Non-operation	O	O
13	BTCS Control	Operation / Non-operation	O	X
14	Engine TCS Control	Operation / Non-operation	O	X
15	ESP Control	Operation / Non-operation	O	X
16	ESP/TCS OFF Switch	ON / OFF	O	X
17	ABS Control	Operation / Non-operation	O	O
18	Stop Lamp Switch	ON / OFF	O	O

(O: Applied, X: N/A)

DIAGNOSIS

KYRON SM - 2005.09

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► ABS/ESP Forced Operation

No	Name	Operation
1	FL Inlet Valve	Operation / Non-operation
2	FL Outlet Valve	Operation / Non-operation
3	FR Inlet Valve	Operation / Non-operation
4	FR Outlet Valve	Operation / Non-operation
5	Rear (or RL) Inlet Valve (*1)	Operation / Non-operation
6	Rear (or RL) Outlet Valve (*1)	Operation / Non-operation
7	RR Inlet Valve (*2)	Operation / Non-operation
8	RR Outlet Valve (*2)	Operation / Non-operation
9	TCS Valve Primary (*3)	Operation / Non-operation
10	TCS Valve Secondary (*3)	Operation / Non-operation
11	ESV Valve Primary (*3)	Operation / Non-operation
12	ESV Valve Secondary (*3)	Operation / Non-operation
13	-	-
14	-	-
15	Motor Pump	Operation / Non-operation

SCAN

ECU

TCU

M/T

TCCU

CLUTCH

BRAKE

A/BAG

A/CON

FFH

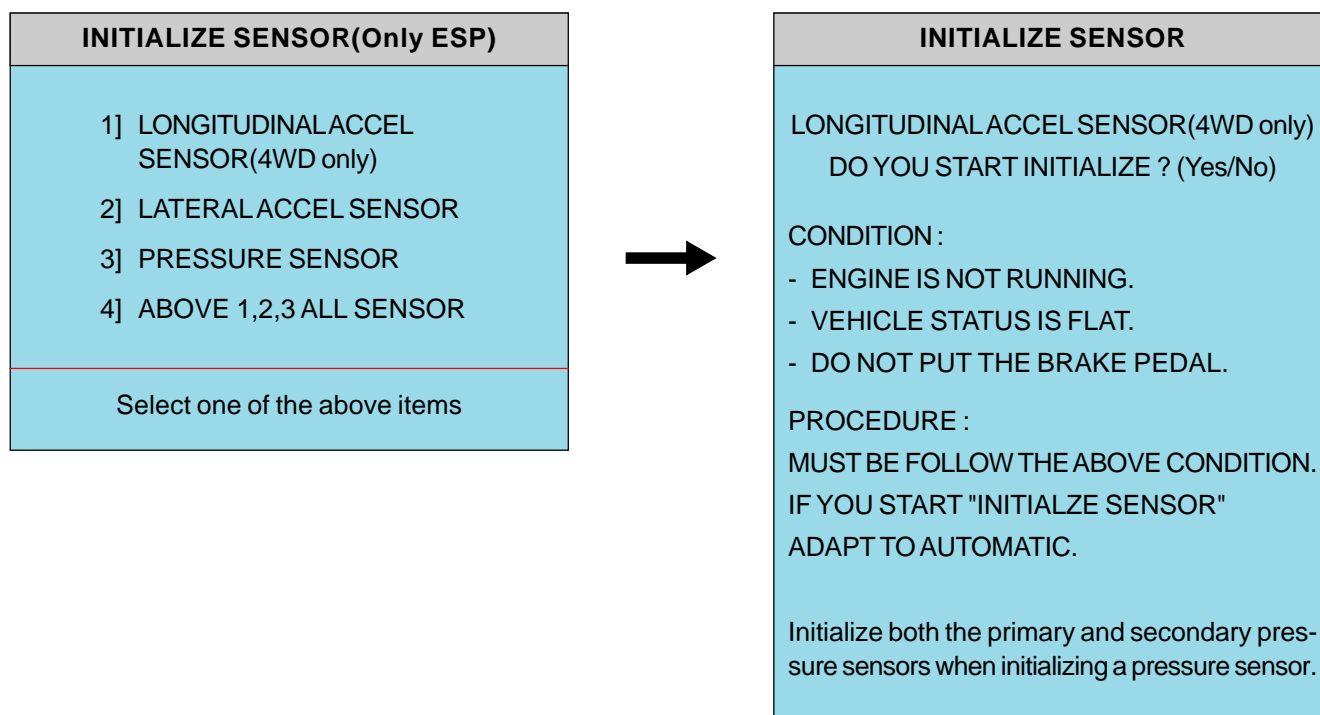
RK-STICS

R/SENSOR

S/ROOF

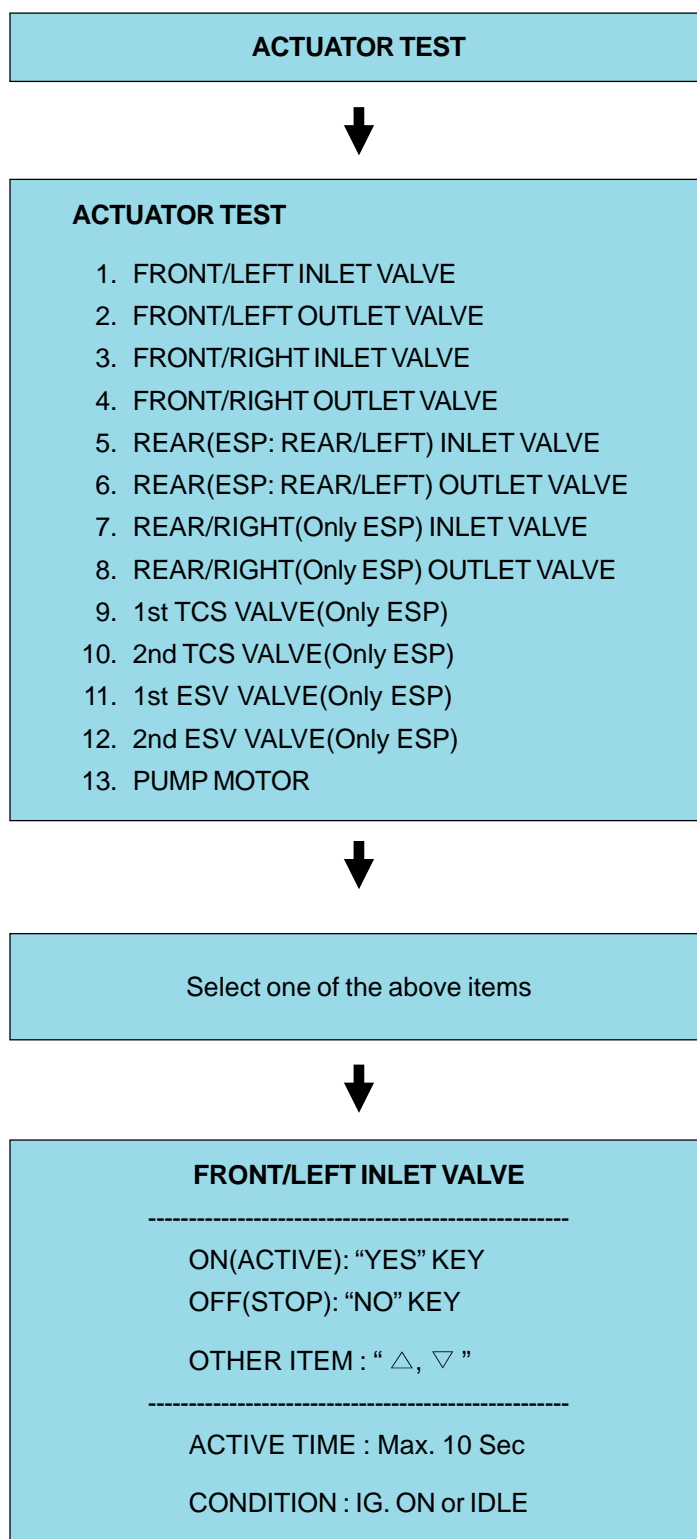
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► Sensor Initialization (ABS & ESP)



■ Steering wheel acceleration sensor

The steering wheel acceleration sensor automatically searches for a center position when the vehicle is driving straight forward with 20 km/h of driving speed (no additional diagnostic menu).

► Actuator

SCAN

ECU

TCU

M/T

TCCU

CLUTCH

BRAKE

A/BAG

A/CON

FFH

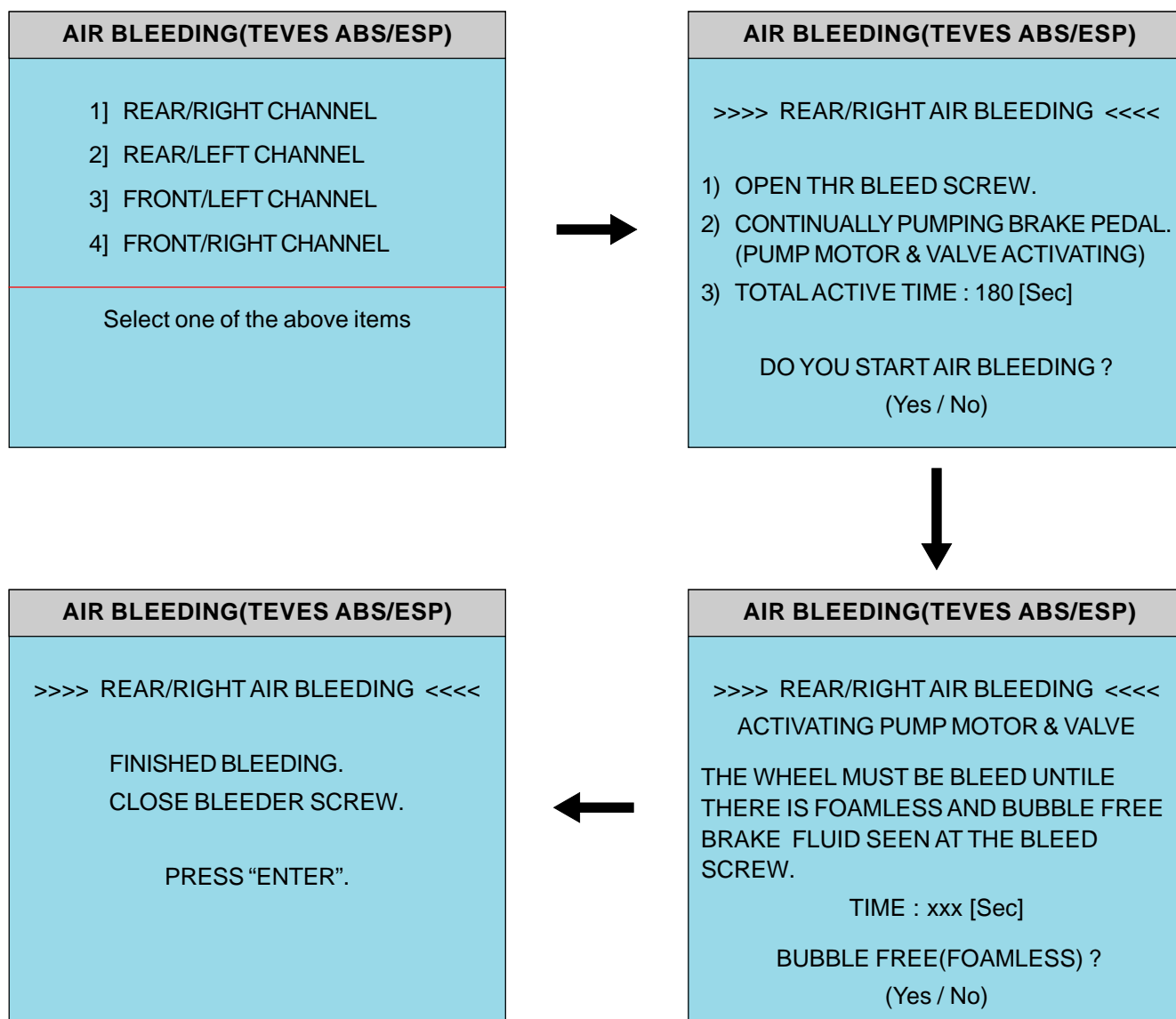
RK-STICS

R/SENSOR

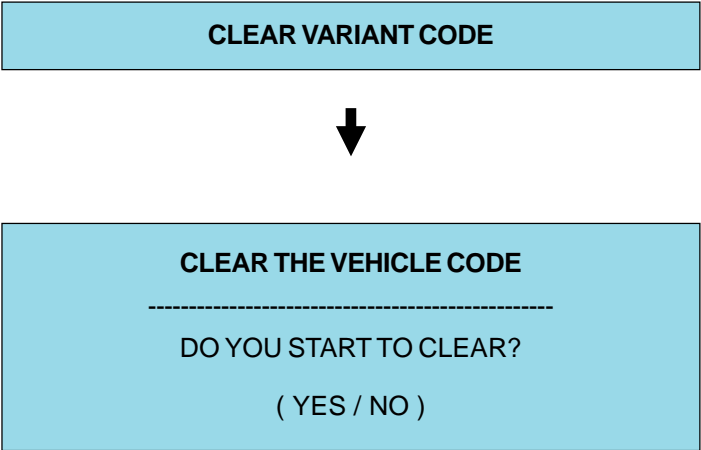
S/ROOF

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

► Air Bleeding by Using Scan-100



► Clearing Code



SCAN
ECU
TCU
M/T
TCCU
CLUTCH
BRAKE
A/BAG
A/CON
FFH
RK-STICS
R/SENSOR
S/ROOF

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

MEMO

AIR BAG

TABLE OF CONTENTS

DIAGNOSIS	3
-----------------	---

DIAGNOSIS

Trouble Code	Defections	Action
1101	High battery voltage	<ul style="list-style-type: none"> • Check alternator output voltage. • Check battery condition (over 21.4 V for 16 seconds). • Check air bag unit terminals for damage.
1102	Low battery voltage	<ul style="list-style-type: none"> • Check alternator output voltage. • Check battery condition (below 7.2 V for 16 seconds, resumes when the voltage is normal level for 9.6 seconds) • Check air bag unit terminals for damage.
1103	Low communication voltage for curtain air bag sensor	<ul style="list-style-type: none"> • Check curtain air bag sensor connector. • Check curtain air bag sensor wiring. • Check air bag unit terminals for damage. • Check if curtain air bag sensor is short to battery voltage or ground. • Check if curtain air bag sensor is defective. • Check battery condition (below 10.6 V for 16 seconds, resumes when the voltage is normal level for 9.6 seconds).
1346	Driver's air bag circuit resistance is too high	<ul style="list-style-type: none"> • Check driver air bag connector. • Check driver air bag wiring (including clock spring). • Check air bag unit terminals for damage. • Resistance of squib: over 6.1 Ω
1347	Driver's air bag circuit resistance is too low	<ul style="list-style-type: none"> • Check driver air bag connector. • Check driver air bag connector (including clock spring). • Check air bag unit terminals for damage. • Resistance of squib: below 1.1 Ω
1348	Driver's air bag circuit is short to ground	<ul style="list-style-type: none"> • Check driver air bag connector. • Check driver air bag wiring (including clock spring). • Check air bag unit terminals for damage. • Resistance of Firing Loop: below 2 kΩ
1349	Drivers air bag circuit is short to battery voltage	<ul style="list-style-type: none"> • Check driver air bag connector. • Check driver air bag wiring (including clock spring). • Check the air bag unit terminals for damage. • Resistance of Firing Loop: below 2 kΩ
1352	Passengers air bag circuit resistance is too low	<ul style="list-style-type: none"> • Check passenger air bag connector. • Check passenger air bag wiring. • Check the air bag unit terminals for damage. • Resistance of squib: below 0.8 Ω
1353	Passengers air bag circuit resistance is too high	<ul style="list-style-type: none"> • Check passenger air bag connector. • Check passenger air bag wiring. • Check air bag unit terminals for damage. • Resistance of squib: over 4.0 Ω
1354	Passengers air bag circuit is short to ground	<ul style="list-style-type: none"> • Check passenger air bag connector. • Check passenger air bag wiring. • Check the air bag unit terminals for damage. • Resistance of Firing Loop: below 2 kΩ

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Trouble Code	Defections	Action
1355	Passenger's air bag circuit is short to battery voltage	<ul style="list-style-type: none"> • Check passenger air bag connector. • Check passenger air bag wiring. • Check air bag unit terminals for damage. • Resistance of squib: below 2 kΩ
1361	Driver's pretensioner circuit resistance is too high	<ul style="list-style-type: none"> • Check driver pretensioner connector. • Check driver pretensioner wiring. • Check air bag unit terminals for damage. • Resistance of squib: over 4.2 Ω
1362	Driver's pretensioner circuit resistance is too low	<ul style="list-style-type: none"> • Check driver pretensioner connector. • Check driver pretensioner wiring. • Check air bag unit terminals for damage. • Resistance of squib: below 0.8 Ω
1363	Driver's pretensioner circuit is short to ground	<ul style="list-style-type: none"> • Check driver pretensioner connector. • Check driver pretensioner wiring. • Check air bag unit terminals for damage. • Resistance of squib: below 2 kΩ
1364	Driver's pretensioner circuit is short to battery voltage	<ul style="list-style-type: none"> • Check driver pretensioner connector. • Check driver pretensioner wiring. • Check air bag unit terminals for damage. • Resistance of squib: below 2 kΩ
1367	Passenger's pretensioner circuit resistance is too high	<ul style="list-style-type: none"> • Check passenger pretensioner connector. • Check passenger pretensioner wiring. • Check air bag unit terminals for damage. • Resistance of squib: over 4.2 Ω
1368	Passenger's pretensioner circuit resistance is too low	<ul style="list-style-type: none"> • Check passenger pretensioner connector. • Check passenger pretensioner wiring. • Check air bag unit terminals for damage. • Resistance of squib: below 0.8 Ω
1369	Passenger's pretensioner circuit is short to ground	<ul style="list-style-type: none"> • Check passenger pretensioner connector. • Check passenger pretensioner wiring. • Check air bag unit terminals for damage. • Resistance of squib: below 2 kΩ
1370	Passenger's pretensioner circuit is short to battery voltage	<ul style="list-style-type: none"> • Check passenger pretensioner connector. • Check passenger pretensioner wiring. • Check air bag unit terminals for damage. • Resistance of squib: below 2 kΩ
1378	Driver's curtain air bag circuit resistance is too high	<ul style="list-style-type: none"> • Check driver curtain air bag connector. • Check driver curtain air bag wiring. • Check the air bag unit terminals for damage. • Resistance of squib: over 4.3 Ω
1379	Driver's curtain air bag circuit resistance is too low	<ul style="list-style-type: none"> • Check driver curtain air bag connector. • Check driver curtain air bag wiring. • Check the air bag unit terminals for damage. • Resistance of squib: below 0.6 Ω

DIAGNOSIS

KYRON SM - 2005.09

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Trouble Code	Defections	Action
1380	Driver's curtain air bag is short to ground	<ul style="list-style-type: none"> • Check driver curtain air bag connector. • Check driver curtain air bag wiring. • Check air bag unit terminals for damage. • Resistance: below 2 kΩ
1381	Driver's curtain air bag is short to battery voltage	<ul style="list-style-type: none"> • Check driver curtain air bag connector. • Check driver curtain air bag wiring. • Check air bag unit terminals for damage. • Resistance: below 2 kΩ
1382	Passenger's curtain air bag circuit resistance is too high	<ul style="list-style-type: none"> • Check passenger curtain air bag connector. • Check passenger curtain air bag wiring. • Check air bag unit terminals for damage. • Resistance of squib: over 4.3 Ω
1383	Passenger's curtain air bag circuit resistance is too low	<ul style="list-style-type: none"> • Check passenger curtain air bag connector. • Check passenger curtain air bag wiring. • Check air bag unit terminals for damage. • Resistance of squib: below 0.6 Ω
1384	Passenger's curtain air bag is short to ground	<ul style="list-style-type: none"> • Check passenger curtain air bag connector. • Check passenger curtain air bag wiring. • Check air bag unit terminals for damage. • Resistance: below 2 kΩ
1385	Passenger's curtain air bag is short to battery voltage	<ul style="list-style-type: none"> • Check passenger curtain air bag connector. • Check passenger curtain air bag wiring. • Check air bag unit terminals for damage. • Resistance: below 2 kΩ
1395	Air bag connector problem	<ul style="list-style-type: none"> • Check passenger curtain air bag connector. • Check passenger curtain air bag wiring. • Check air bag unit terminals for damage.
1400	Driver's curtain air bag sensor problem	<ul style="list-style-type: none"> • Check driver curtain air bag connector. • Check driver curtain air bag wiring. • Check air bag unit terminals for damage.
1401	Driver's curtain air bag sensor circuit is short to ground	<ul style="list-style-type: none"> • Check driver curtain air bag connector. • Check driver curtain air bag wiring. • Check the air bag unit terminals for damage. • Resistance: below 250 Ω
1402	Driver's curtain air bag sensor circuit is short to battery voltage	<ul style="list-style-type: none"> • Check driver curtain air bag connector. • Check driver curtain air bag wiring. • Check air bag unit terminals for damage. • Resistance: below 25 Ω
1409	Communication error in driver's curtain air bag	<ul style="list-style-type: none"> • Check driver curtain air bag connector. • Check driver curtain air bag wiring. • Check air bag unit terminals for damage. • If the voltage drops below 10.6 V during normal system operation, the trouble code is generated. This trouble code is linked with B1 400, B1 401, B1 402, B1 414.

SCAN
ECU
TCU
M/T
TCCU
CLUTCH
BRAKE
A/BAG
A/CON
FFH
RK-STICS
R/SENSOR
S/ROOF

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Trouble Code	Defections	Action
1414	Wrong driver's curtain air bag sensor	<ul style="list-style-type: none"> • Check driver curtain air bag connector. • Check driver curtain air bag wiring. • Check air bag unit terminals for damage.
1403	Passenger's curtain air bag sensor	<ul style="list-style-type: none"> • Check passenger curtain air bag connector. • Check passenger curtain air bag wiring. • Check air bag unit terminals for damage.
1404	Passenger's curtain air bag sensor circuit is short to ground	<ul style="list-style-type: none"> • Check passenger curtain air bag connector. • Check passenger curtain air bag wiring. • Check air bag unit terminals for damage. • Resistance: below 250 Ω
1405	Passenger's curtain air bag sensor circuit is short to battery voltage	<ul style="list-style-type: none"> • Check passenger curtain air bag connector. • Check passenger curtain air bag wiring. • Check air bag unit terminals for damage. • Resistance: below 25 Ω
1410	Communication error in passenger's curtain air bag	<ul style="list-style-type: none"> • Check passenger curtain air bag connector. • Check passenger curtain air bag wiring. • Check the air bag unit terminals for damage. • If the voltage drops below 10.6 V during normal system operation, the trouble code is generated. This trouble code is linked with B1 403, B1 404, B1 405, B1 415.
1415	Wrong driver's curtain air bag sensor	<ul style="list-style-type: none"> • Check passenger curtain air bag connector. • Check passenger curtain air bag wiring. • Check air bag unit terminals for damage.
1620	SDM internal fault	<ul style="list-style-type: none"> • Replace SDM.
1650	Frontal impact record	<ul style="list-style-type: none"> • Replace SDM.
1651	Driver's curtain air bag impact record	<ul style="list-style-type: none"> • Replace SDM.
1652	Passenger's curtain air bag impact record	<ul style="list-style-type: none"> • Replace SDM.
1657	Belt pretensioner operation record	<ul style="list-style-type: none"> • Replace SDM.
2500	Warning lamp error	<ul style="list-style-type: none"> • Check wiring to warning lamp. • Check warning lamp bulb. • Check SDM unit terminal.

DIAGNOSIS

KYRON SM - 2005.09

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

AIR CONDITIONING SYSTEM

TABLE OF CONTENTS

SELF DIAGNOSIS (ONLY FOR FATC AIR CONDITIONER)	3
▶ SELF DIAGNOSIS CODE	3
▶ SELF DIAGNOSIS	4

SELF DIAGNOSIS (ONLY FOR FATC AIR CONDITIONER)

► Self Diagnosis

1. Starting Self Diagnosis

Turn the ignition switch to ON position and press OFF switch for more than 5 seconds within 10 seconds.

2) Check LED segments on the vacuum fluorescent display (VFD).



1) Press OFF switch more than 5 seconds.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

2. Set in Trouble Diagnosis Step 2

In this step, check the air mix door and sensors for defect.

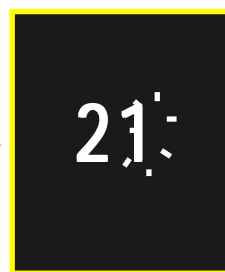
Once the system starts diagnosis step 2, the digit "2" is displayed, implying step 2, on the display window and the trouble diagnosis for sensors is executed. If no failure exists, "20" is displayed. If any failure exists, the appropriate trouble code is displayed as below.

- 1) Slightly turn the TEMP dial to the right to set in the trouble diagnosis step 2



- 2) Indication of Step 2.
Starting self diagnosis

10 ~ 20
seconds



- 3) Sensor failure
code blinking

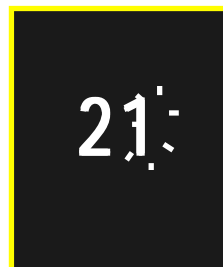
NOTICE

- The symbol "-" in front of step number "2" means a short circuit of the blinking sensor.

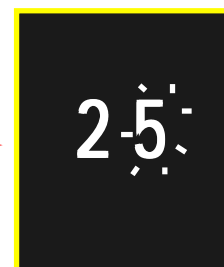


Short-circuit in the ambi-
ent air temperature sensor

When two sensors are
defective



First sensor failure
code blinks twice



Second sensor failure
code blinks twice

Trouble Code

Code	Malfunction	Remark	Code	Malfunction	Remark
0	VDF segments are OK		5	Defective sun sensor	
1	Defective ambient temperature sensor		6	Check Air mix door	
2	Defective interior temperature sensor		7	Defective humidity sensor	
3	Defective duct temperature sensor		8	-	
4	Defective intake sensor		9	-	

DIAGNOSIS

KYRON SM - 2005.09

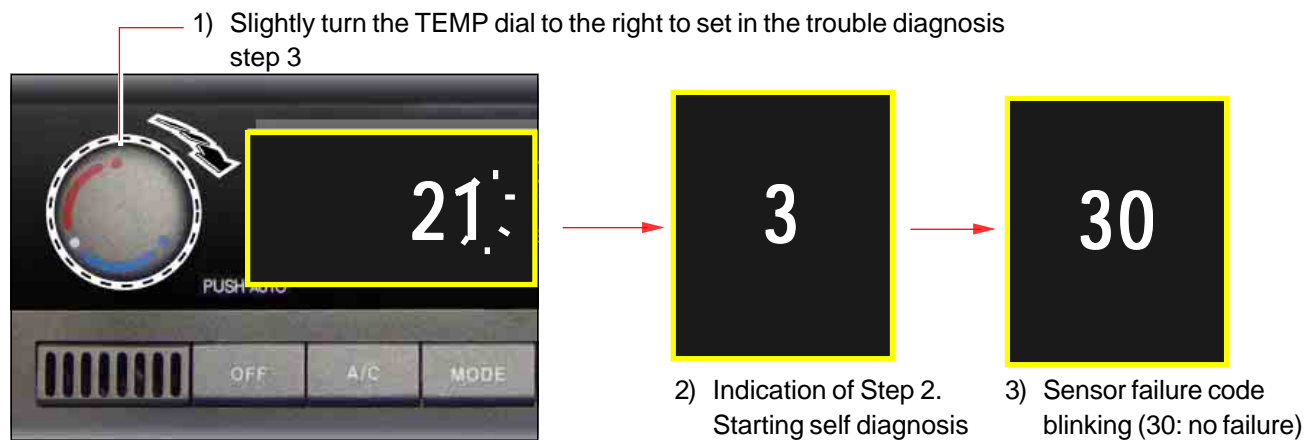
CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

3. Set in Trouble Diagnosis Step 3

In this step, check the position and conditions of recirculation air door and mode door.

Slightly turn the TEMP switch until "3" is displayed on the display window.

If no failure exists, "30" is displayed. If any failure exists, the appropriate trouble code is displayed.




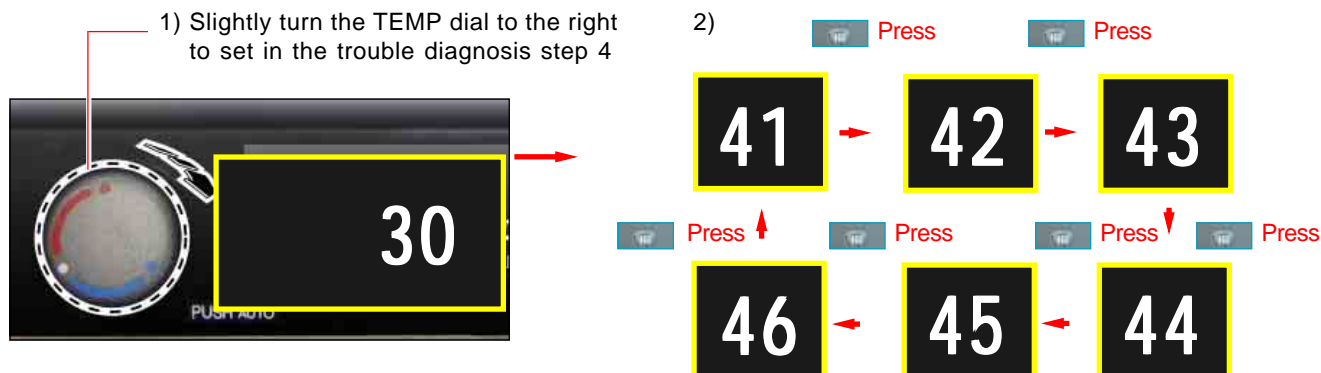
Trouble Code

Code	Malfunction	Remark	Code	Malfunction	Remark
1	Defective VENT		6	DEF	
2	Defective B/L		7	FRE	
3	-		8	20% FRE	
4	FOOT		9	REC	
5	D/F		0	All door OK	

4. Set in Trouble Diagnosis Step 4

In this step, check the position of actuator door, check the fan speed, and check the compressor operation.

Slightly turn the TEMP switch in step 3 until "41" is displayed on the display window. When pressing DEF switch , mode changes as shown below in turns to check each function.




CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

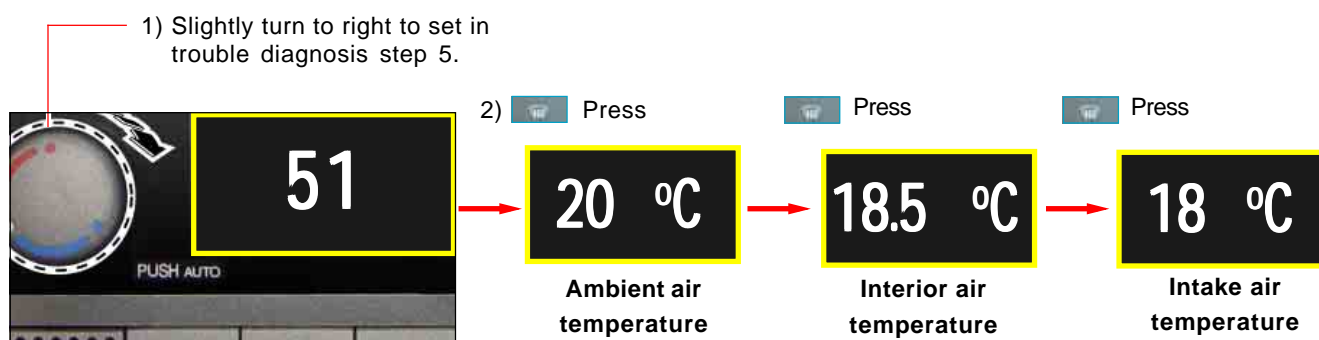
Function Check

Displayed Number	41	42	43	44	45	46
Mode door	VENT	B/L	B/L	FOOT	D/F	DEF
Interior/Ambient door	REC	REC	20%FRE	FRE	FRE	FRE
Air mix door	F/COOL	F/COOL	F/HOT	F/HOT	F/HOT	F/HOT
Blower	4.5 V	10.5 V	8.5 V	8.5 V	8.5 V	MAX
Compressor	ON	ON	OFF	OFF	ON	ON

5. Set in Trouble Diagnosis Step 5

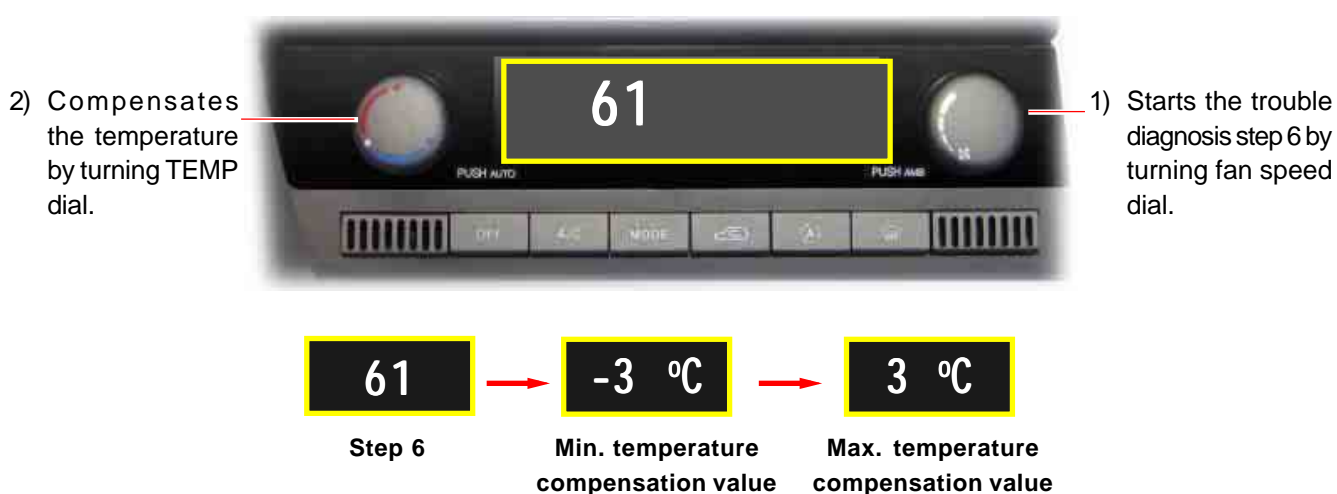
In this step, check the conditions of temperature related sensors.

Slightly turn the TEMP switch in step 4 until "51" is displayed on the display window. When pressing DEF switch , displayed temperature changes as shown below in turns.



6. Set in Trouble Diagnosis Step 6

In this step, the temperature can be compensated within the range of -3°C to 3°C in the control process according to the temperature to air conditioner controller. The step 6 initiates when slightly rotating the fan speed switch (other than TEMP switch) in step 5.



7. Canceling the Trouble Diagnosis

Turn the AUTO switch ON or turn the ignition key OFF.

FFH

TABLE OF CONTENTS

DIAGNOSIS	3
▶ TROUBLE DIAGNOSIS	5

DIAGNOSIS

Trouble Code	Trouble Description	Remedies
0	No faults	-
10	Shutdown for overvoltage	Measure battery voltage (must be < 15.9V). Check alternator and overvoltage.
11	Shutdown for undervoltage	Measure battery voltage (must be > 10.2V under load). Check alternator, wiring and undervoltage.
12	Overheating (abnormal reference value)	Temperature at overheating sensor > 125°C: check cooling system. Check temperature sensor and overheating sensor, replace if necessary.
14	Overheating (difference evaluation-1)	Difference in temperature values between surface sensor and control overheating sensor is too large. (Prerequisite for this trouble code display is that the heater is in operation and the water temperature at the overheating sensor has reached min. 80°C): check cooling system. Check temperature sensor and overheating sensor, replace if necessary
15	Overheating (abnormal heater operation)	Heater does not operate (The controller is locked.) Delete trouble code to release controller lock: check cooling system. Check temperature sensor and overheating sensor, replace if necessary
16	Overheating (difference evaluation-2)	If the surface sensor has a far higher temperature value than the control overheating sensor, then the system proceeds with a fault shutdown.
17	Overheating (defective hardware-2)	Temperature at control overheating sensor > 130°C: check cooling system Check temperature sensor and overheating sensor, replace if necessary.
20	Open glow plug circuit	Check plug cable for damage, replace if necessary
21	Overload or short circuit of glow plug	Check plug cable for damage, replace if necessary
22	Short circuit of glow plug	Check plug cable for damage, replace if necessary
23	-	-
24	-	-
25	Short circuit of communication line	Check the communication line.
30	Abnormal speed of combustion fan motor	Defective fan wheel or combustion air fan motor (frozen, contaminated, stiff, damaged cable)
31	Defective combustion fan motor	Check cable harness for damage, replace if necessary.
32	Overload or short circuit of combustion fan motor	Defective fan wheel or combustion air fan motor (contaminated, stiff) Check cable harness for damage, replace if necessary.
34	Abnormal output of combustion fan motor	Check the ground and short of combustion air fan motor circuit, replace if necessary.
36	-	-
38	-	-
39	-	-
41	Abnormal water pump operation	Check connector.
42	Overload or short circuit of water pump	Check connector.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Trouble Code	Trouble Description	Remedies
43	Abnormal output of water pump	-
47	Overload or short circuit of fuel pump	Check cable harness for damage, replace if necessary.
48	Abnormal fuel pump operation	Check cable harness for damage, replace if necessary. Check plug-in connection, replace if necessary.
49	Short circuit of fuel pump (B+)	Check cable harness for open to battery voltage, replace if necessary.
50	Improper operation	The controller is locked due to excessive starting problem.
51	Delayed heating time	During start (no flame formed yet), the flame sensor reports temperature value too high for too long, check exhaust gas, combustion air and flame sensor.
52	Time exceeded for cold blowing	Check exhaust gas and combustion air. Check fuel quantity and fuel supply. Clean or replace filter in fuel pump.
53	Flame aborted from "large" stage	Fault (no more starting attempt allowed). Check exhaust gas and combustion air system. Check fuel quantity and fuel supply. Check flame sensor - see trouble code 64 and 65.
54	Flame aborted from "small" stage	Fault (no more starting attempt allowed). Check exhaust gas and combustion air system. Check fuel quantity and fuel supply. Check flame sensor - see trouble code 64 and 65.
60	Abnormal overheating sensor operation	Check cable harness for damage, check plug-in connection, replace if necessary. Check sensor resistance value, replace if necessary.
61	Short circuit or ground of overheating sensor	Check cable harness, replace if necessary. Check sensor resistance value, replace if necessary.
64	Abnormal flame sensor operation	Check cable harness for damage, check plug-in connection, replace if necessary. Check sensor resistance value, replace if necessary.
65	Short circuit of flame sensor	Check cable harness, replace if necessary. Check sensor resistance value, replace if necessary.
71	Defective surface sensor	Check cable harness for damage, check plug-in connection, replace if necessary. Check sensor resistance value, replace if necessary.
72	Short circuit of surface sensor	Check cable harness, replace if necessary. Check sensor resistance value, replace if necessary.
74	Defective overheating prevention device	-
87	-	-
88	-	-
89	-	-
90	Watchdog reset	Replace controller.
91	Abnormal reset function	If too many resets occurs, replace controller
92	ROM error	Replace controller.
93	RAM error	Replace controller.
94	Defective transistor	Replace controller.

DIAGNOSIS

KYRON SM - 2005.09

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Trouble Code	Trouble Description	Remedies
95	Software error	Check cable harness for open to battery voltage, replace if necessary. Replace controller.
96	Abnormal process operation	Replace controller.
97	Wrong processor cycle	Replace controller.
98	Defective main relay	Replace controller.
99	EEPROM error	Replace controller.

► Trouble Diagnosis

	Causes	Remedies
Low coolant level	<ul style="list-style-type: none"> Leakage in radiator Leakage in coolant auxiliary tank Leakage in heater core 	<ul style="list-style-type: none"> Change radiator. Change coolant auxiliary tank Change heater core.
	<ul style="list-style-type: none"> Leakage in joint junction of coolant hose Leakage in defective coolant hose 	<ul style="list-style-type: none"> Check hose or replace clamp. Change hose.
	<ul style="list-style-type: none"> Leakage in water pump gasket Leakage in water pump sealing 	<ul style="list-style-type: none"> Change gasket. Change water pump.
	<ul style="list-style-type: none"> Leakage in water inlet cap Leakage in thermostat housing 	<ul style="list-style-type: none"> Change water inlet cap gasket. Change thermostat sealing.
	<ul style="list-style-type: none"> Insufficient tightening torque of cylinder head bolt Damaged cylinder head gasket 	<ul style="list-style-type: none"> Tighten bolt to specified torque. Change cylinder head gasket.
Abnormally high coolant temperature	<ul style="list-style-type: none"> The coolant leakage (Check the coolant level) Excessive anti-freezer Poor coolant hose condition 	<ul style="list-style-type: none"> Add coolant Check density of coolant (Anti-freezer). Check bent of hose, replace if necessary.
	<ul style="list-style-type: none"> Defective thermostat Defective water pump Defective radiator Defective coolant auxiliary tank or tank cap 	<ul style="list-style-type: none"> Change thermostat Change water pump. Change radiator. Change coolant auxiliary tank or tank cap.
	<ul style="list-style-type: none"> Crack in cylinder head or in cylinder block Clogged water flow in cylinder head or block 	<ul style="list-style-type: none"> Change cylinder head or cylinder block. Clean coolant flow line.
	<ul style="list-style-type: none"> Clogged water flow in radiator core 	<ul style="list-style-type: none"> Clean radiator core.
	<ul style="list-style-type: none"> Defective cooling fan 	<ul style="list-style-type: none"> Change or check cooling fan.
	<ul style="list-style-type: none"> Defective temp. sensor, wiring, and lamp cluster 	<ul style="list-style-type: none"> Change sensor or check relevant wiring.
Abnormally low coolant temperature	<ul style="list-style-type: none"> Defective thermostat 	<ul style="list-style-type: none"> Change thermostat.
	<ul style="list-style-type: none"> Defective cooling fan 	<ul style="list-style-type: none"> Change or check cooling fan.
	<ul style="list-style-type: none"> Defective temp. sensor, wiring, and lamp cluster 	<ul style="list-style-type: none"> Change sensor or check relevant wiring.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

MEMO

RK-STICS

TABLE OF CONTENTS

DIAGNOSIS TROUBLE CODE AND HELP TIPS	3
--	---

DIAGNOSIS TROUBLE CODE AND HELP TIPS

Fault Code	Malfunction	Descriptions
01	Dr Door Lock Knob	Driver's door lock knob is not operated when locking/unlocking doors.
02	Ps Door Lock Knob	Passenger's door lock knob is not operated when locking/unlocking doors.
03	Rr Door Lock Knob	Rear door lock knob is not operated when locking/unlocking doors.
04	T/Gate Lock Knob	Tailgate lock knob is not operated when locking/unlocking doors.
05	Door Lock Output	All door lock knob are not moved to lock position even when the door lock relay is activated.
06	Door Unlock Output	All door lock knob are not moved to unlock position even when the door unlock relay is activated.
07	C/DR Lock Output	Doors are locked by central door lock switch while the engine is running.
08	DR Lock Output	Doors are locked by driver's door lock switch while the engine is running.
09	PS Lock Output	Doors are locked by passenger's door lock switch while the engine is running.
10	Auto Door Lock Output	Door lock knob is not moved to lock position when the system outputs auto door lock signal while the ignition switch is in ON position and the vehicle speed is over 50 km/h.
11	Auto Door Unlock Output	Door lock knob is not moved to unlock position after receiving the output from collision sensor.
12	Wiper Output	The WIPER P-POS signal is not detected when the wiper relay is activated.
13	SPEED SIGNAL	The vehicle speed over 3 km/h is detected at the speed signal area while the ignition switch is in ON position and the alternator signal is "D" LOW.
14	INT WIPER Volume	The circuit is open (over 4.5 V) when changing the INT volume in the speed sensitive INT wiper (saved as history error).
15	SPEED SENSOR	The vehicle speed over 200 km/h is detected (saved as history error).
16	A/BAG COLLISION SENSOR INPUT	A signal is sent to the collision sensor input area while the ignition switch is in OFF position (saved as history error unconditionally).
17	A/BAG COLLISION SENSOR OUTPUT	The RKSTICS outputs UNLOCK signal after receiving collision sensor input while the ignition switch is in ON position (saved as history error).
18	A/BAG COLLISION MONITOR	The STICS outputs the Door Unlock signal due to the collision sensor and the feedback value is in proper range (saved as history error).
19	Door Ajar Warning IND	The door warning indicator blinks when the vehicle speed is over 10 km/h (saved as history error).
20	PARKING BRAKE IND	The parking brake indicator blinks when the vehicle speed is over 10 km/h (saved as history error).
21	Auto Washer Out	The auto washer output is not sent to the front washer (saved as history error).
22	WASHER RELAY	The front washer switch receives the input signal for more than 10 seconds (saved as history error).

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

Fault Code	Malfunction	Descriptions
23	REMOCON VOLTAGE CHECK	The voltage from remote control key is saved as history error.
24	SBR S/BELT SW (Only EU)	When the seat belt switch circuit is OPEN (HIGH) in KEY OUT & ARMED MODE, the system recognizes it as FAIL and saves it as History error (Normal Close (GND)).
25	SBR SENSOR (Only EU)	When the sensor value is recognized in KEY OUT & ARMED MODE, the system saves it as History error.
26	SBR CONNECTION (Only EU)	When the seat belt switch circuit maintains OPEN (HIGH) in KEY OUT & ARMED MODE while the vehicle speed is over 50 km/h, the system saves it as History error.

DIAGNOSIS

KYRON SM - 2005.09

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

RAIN SENSOR

TABLE OF CONTENTS

TROUBLE SHOOTING.....	3
-----------------------	---

TROUBLE SHOOTING

Symptom 1. The wiper does not operate one cycle when turning the multifunction wiper switch to the "AUTO" from the "OFF" position or starting the engine while the wiper switch is in the "AUTO" position.

1. When starting the engine with the multifunction wiper switch in the "AUTO" position, the wiper operates one cycle to remind a driver that the wiper switch is in the "AUTO" position.
2. When the wiper switch is turned to "AUTO" from "OFF", the wiper operates one cycle. It always operates one cycle for the initial operation, however, the wiper does not operate afterwards to prevent the wiper blade wear if not raining when turning the wiper switch to "AUTO" from "OFF". However, the wiper operates **up to 5 minutes** after rain stops. If this function does not occur, check No. 8 pin. If the pin is normal, check the wiper relay related terminals in the ICM box.

Symptom 2. It rains but the system does not work in the "AUTO" position.

1. Check whether the multifunction wiper switch is in the "AUTO" position.
2. Check the power to the sensor. Check the conditions of the pin 3 (Ground) and the pin 4 (IGN).
3. Check the wiper relay for defective.

Symptom 3. The wiper operates 3 or 4 times at high speed abruptly.

Check whether the variable resistance knob on the multifunction wiper switch is set in "FAST". The "FAST" is the highest stage of the sensitivity and very sensitive to small amount of rain drops. Therefore, change the knob to the low sensitivity.

Symptom 4. The wiper operates continuously even on the dry glass.

1. Check the wiper blade for wear. If the wiper blade cannot wipe the glass uniformly and clearly, this problem could be occurred. In this case, replace the wiper blade with a new one.
2. Check whether the variable resistance knob on the multifunction wiper switch is set in "FAST". The "FAST" is the highest stage of the sensitivity and very sensitive to small amount of rain drops. Therefore, change the knob to the low sensitivity.

Symptom 5. The wiper does not operate at high speed even in heavy rain.

Check if the wiper operates at high speed when grounding pin 1 and pin 2.

Symptom 6. The wiper responses are too fast or slow.

Check whether the variable resistance knob on the wiper switch is set in "FAST" or "SLOW".

Notify that the customer can select the sensitivity by selecting the variable resistance value. And, select a proper stage.

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

MEMO

SUNROOF

TABLE OF CONTENTS

TRouble SHOOTING.....	3
-----------------------	---

TROUBLE DIAGNOSIS

Symptom	Cause	Action
Leakage	Clogged or bent drain hose	Check and correct drain hose condition.
	Gap and clearance between panel and glass	Readjust glass location.
Wind noise	Gap and clearance between panel and glass	Readjust glass location.
Improper operations	Malfunction of wire, fuse and ground	Check and replace/repair.
	Malfunction of relay, motor and unit	Replace it.
	Damaged side cover by dislocation of sun shade	Reinstall sun shade and side cover. (Replace damaged parts.)
	Foreign material in rail	Remove foreign material.
Malfunction	Caught side cover by dislocation of sun shade	Reinstall sun shade and side cover. (Replace damaged parts.)
	Improper operation of anti-trap function	Check interference of body and wind deflector. (Relieve spring tension.)
	Improper operation of motor	Replace it.
Operation noise	Caught side cover by dislocation of sun shade	Reinstall sun shade and side cover.(Replace damaged parts.)
	Interference between drain hose and vehicle body	Install sponge to drain hose.
	Interference between vehicle body and roof panel	Apply sealant between vehicle body and roof panel.
	Gap and clearance between roof panel and glass	Readjust glass location.

SCAN

ECU

TCU

M/T

TCCU

CLUTCH

BRAKE

A/BAG

A/CON

FFH

RK-STICS

R/SENSOR

S/ROOF

CHANGED BY	
EFFECTIVE DATE	
AFFECTED VIN	

MEMO

EDITION HISTORY

No.	CODE NO.	PRINTING DATE	MODEL YEAR	REMARKS
1	KY-5SM1E-5H-50A	Sep. 2005	2005	교재
2	KY-5SM1E-5J-300A	Oct. 2005	2005	D-100

KYRON (2 OF 2) SERVICE MANUAL

ISSUED BY
OVERSEAS A/S TEAM
SSANGYONG MOTOR CO., LTD.

150-3, CHILGOI-DONG, PYUNGTAEK-SI
GYEONGGI-DO, 459-711 KOREA

TELEPHONE : 82-31-610-2740
FACSIMILE : 82-31-610-3762

NOTE: All rights reserved. Printed in SSANGYONG Motor Co., Ltd.
No part of this book may be used or reproduced without the
written permission of Overseas A/S Team.

