ENGINE

CHAPTER 2

ENGINE

— TABLE OF CONTENTS —

1.	EN	GINE IDENTIFICATION	. 2-3
	1.1	Engine EPA decal (A)	2-3
	1.2	Engine number	2-3
	1.3	Assignment standard for engine model code	2-4
2.	SPI	ECIFICATIONS	. 2-5
	2.1	General specifications	2-5
	2.2	Engine dimension	2-6
	2.3	Components	2-7
	2.4	Engine performance curve	2-8
	2.5	Engine performance curve analysis	2-9
		2.5.1 Torque	
		2.5.2 Brake horse power (HP)	2-9
		2.5.3 S.F.C (Specific Fuel Consumption)	0.40
	0.0	(for reference only)	
	2.6	Servicing specifications	
		2.6.1 Engine body	
		2.6.2 Lubricating system	
		2.6.3 Cooling system2.6.4 Tightening torques for engine	
3.	_	ERATING PRINCIPLE	-
	3.1	CRDI (Common Rail Direct Injection) system	
		3.1.1 ECU(Electronic Control Unit)	
		3.1.2 High pressure fuel pump (for injection)	
		3.1.3 Fuel rail(Common rail)	
		3.1.4 Injector [C3I]	
	3.2	Body and power train system	
		3.2.1 Cylinder head	
		3.2.2 Cylinder block	
		3.2.3 Cylinder honing	
		3.2.4 Crankshaft	
		3.2.5 Piston and piston ring	
		3.2.6 Connecting rod	
		3.2.7 Camshaft	
		3.2.8 Rocker arm assembly	. 2-34

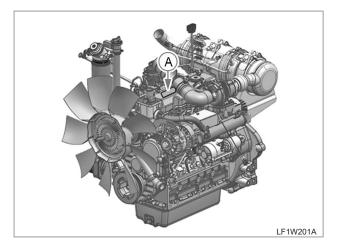
			~ ~ -
		Intake and exhaust valves	
)Timing gear	
		1 Flywheel	
	3.2.12	2 MLS cylinder head gasket	. 2-36
3.3	Lubri	cating system	. 2-37
	3.3.1	Engine oil flow	. 2-37
	3.3.2	Engine oil flow chart	. 2-38
	3.3.3	Function of lubricating system	. 2-39
3.4	Cooli	ng system	. 2-41
	3.4.1	Coolant flow route	. 2-41
	3.4.2	Water pump	. 2-42
	3.4.3	Thermostat	. 2-42
	3.4.4	Radiator	. 2-43
	3.4.5	Radiator cap	. 2-43
	3.4.6	Clutch fan	. 2-44
3.5	Fuel	system	. 2-46
	3.5.1	Overview for fuel supply	. 2-46
	3.5.2	Fuel flow route	. 2-46
	3.5.3	Fuel filter	. 2-48
	3.5.4	Bleeding the fuel system	. 2-49
	3.5.5	High pressure fuel pump	. 2-50
	3.5.6	Common rail (Fuel rail)	. 2-52
	3.5.7	Injector [C3I (Calibration Improved	
		Individual Injector)]	. 2-53
	3.5.8	Fuel heater and fuel cooler	. 2-54
3.6	Acce	leration system	. 2-55
3.7	Intake	e & Exhaust system	. 2-57
	3.7.1	Overview	. 2-57
	3.7.2	EGR cooler	. 2-59
	3.7.3	EGR valve	. 2-59
	3.7.4	Air control vavle	. 2-61
	3.7.5	CCRT (Catalyzed Continuously	
		Regenerating Trap)	. 2-62
	3.7.6	Turbo charger	. 2-67
3.8	Sens	or	. 2-68
	3.8.1	Sensors as input/output for ECU	2-71

— TABLE OF CONTENTS —

4.	TR	OUBLESHOOTING	2-72
5.	ME	ASUREMENT AND ADJUSTMENT	2-75
	5.1	Fan belt	2-75
	5.2	Piston compression pressure measurement.	2-75
	5.3	Valve clearance	2-76
		5.3.1 4 CYL.	2-76
	5.4	Valve lift (Deflection and worn condition of valv	е
		cam, tappet, push rod, rocker arm, etc.)	
		Oil pressure measurement	
		Bubble test for radiator	
	5.7	Turbo charger wastegate pressure check.	2-79
6.	EX	PLODED VIEW	2-80
	6.1	EH5-G111001 Cylinder block group	. 2-80
	6.2	EH5-G113003 Cylinder head group	. 2-81
	6.3	EH5-G114002 Gear case group	. 2-82
	6.4	EH5-G121001 Crank shaft group	. 2-83
	6.5	EH5-G122001 Piston connecting rod group	. 2-84
	6.6	EH5-G123001 Camshaft group	. 2-85
		EH5-G124002 Idle gear group	
		EH5-G125001 Rocker arm valve group	
		EH5-G131001 Intake manifold group	
	6.10) EH5-G134001 Turbo group	. 2-89
		EH5-G135001 Turbo pipe group	
		2 EH5-G141001 Oil pump group	
		3 EH5-G144001 Oil filter group	
		EH5-G151001 Fuel equipment group	
		5 EH5-G162001 Water flange group	
		6 EH5-G163003 Water pump group	
		7 EH5-G171001 EGR group	
		3 EH5-G172001 EGR cooler group	
		EH5-G191002 Glow plug group	
		0 EH5-G192001 Engine electrical group	
		1 EH5-G194001 ECU group	
		2 LF1-G012002 Cooling fan group	
	6.23	3 LF1-G014001 Aftertreatment group	2-102

7.	DISASSEMBLY, SERVICE AND ASSEMBLY	.2-103
	7.1 Engine removal	2-103
	7.2 Assembling the engine	
	7.3 Engine component removal	
	7.4 Engine disassembly	
	7.4.1 Head cover	
	7.4.2 Glow plug and injector	
	7.4.3 Rocker arm assembly	
	7.4.4 Cylinder head	
	7.4.5 Intake and exhaust valves	2-147
	7.4.6 High pressure fuel pump	2-149
	7.4.7 Gear case	2-150
	7.4.8 Gears in gear case	2-151
	7.4.9 Piston and connecting rod	2-160
	7.4.10 Flywheel and crankshaft	2-165
	7.4.11 Oil filter	2-174
	7.4.12 Oil pump	2-175
	7.4.13 Thermostat	2-177
	7.4.14 Water pump	2-178
	7.4.15 Fuel filter	2-180
	7.4.16 Turbo charger	2-180
8.	DIAGNOSIS	.2-184
	8.1 Diagnostic program	2-184
	8.2 DTC (Diagnostic Trouble Code)	2-210
	8.2.1 Composition	2-210
	8.2.2 Erorr code & action	2-211
	8.2.3 Fault diagnosis code description	. 2-225

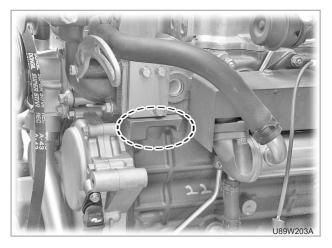
1. ENGINE IDENTIFICATION



1.1 ENGINE EPA DECAL (A)

This aluminum decal is riveted on the engine cylinder head cover. This provides the information such as engine model, rated output, etc.

1.2 ENGINE NUMBER



The engine number is recorded with a vibration pen on the surface of the cylinder block behind the alternator in case the barcode is damaged.

IMPOARTANT -

• The engine number is necessary information that is requested on the warranty registration form. This number should be on the form as well as the tractor number and the amount of time used.

1.3 ASSIGNMENT STANDARD FOR ENGINE MODEL CODE

Emission control catego	ory
3	Tier 3
4	Tier 4
5	Stage-V
← Engine type	
-	N/A type
Т	Turbo charger type
TI	Turbocharger + Intercooler
──► Stroke(행정)	
A	92.4 mm (3.638 in.)
В	102.4 mm (4.031 in.)
F, H	102.4 mm (4.031 in.), Ladder Frame Bloc
→ Number of cylinders	
,	
3	3 cylinders

2. SPECIFICATIONS

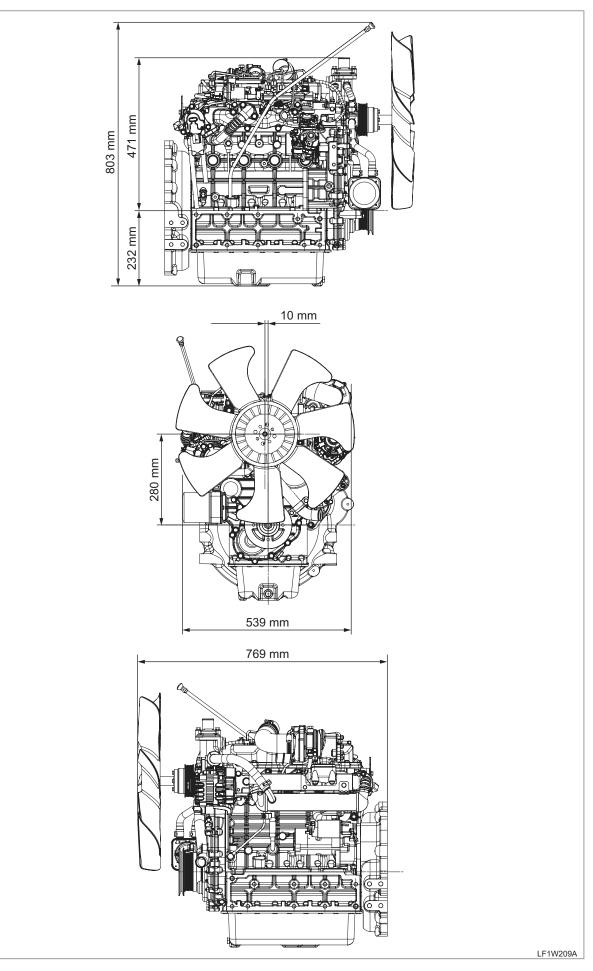
2.1 GENERAL SPECIFICATIONS

Engine mo	del	4HT5	4HTI4	
Bore I.D. X Stroke	(mm)	Ø 87×102.4		
Honing		PLATEAU	honing	
Number of cylinders		4		
Ignition sequence		1-3-4	l-2	
Displacement	(ℓ)	2.43	5	
Speed (rpm)		2,400		
Max. gross output	kW(HP)/rpm	49.5 (66.4) / 2,400	54.9 (73.6) / 2,400	
Max. torque	Nm/rpm	237/1700	274/1,500	
Compression ratio		17.4:1		
Combustion chamber type		Direct injection type Turbo charged		
High pressure fuel pump ty	vpe	Delphi DFP 4.6.18 TP		
Injection pressure bar		Max. 1,800		
Engine oil capacity (ℓ)		9.0 (with filter)		
Engine oil specification		SAE 15W 40, API Classification CJ or higher		
Coolant capacity (ℓ)		4.2 (Engine only)		
Anti-freeze		Ethylene glycol 50% with anti-corrosive agent		

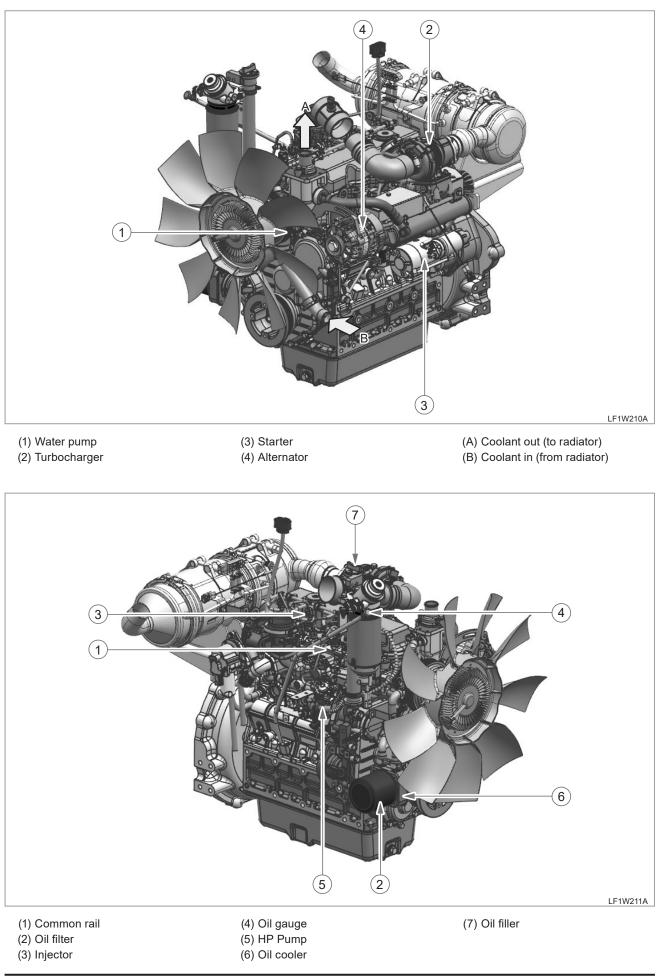
• The engine gross output is measured with the cooling fan removed.

- The cylinder number for ignition sequence is given from the cylinder on the engine cooling fan side.
- If the coolant level drops due to its evaporation, add only water. If the coolant lever drops due to the leakage, add coolant mixed with anti-freeze.
- The freezing point of the 50% coolant mixture is -37°C (-34°F) in a normal condition.
- When replacing the coolant with a different type of coolant, flush the cooling system thoroughly beforehand.

2.2 ENGINE DIMENSION

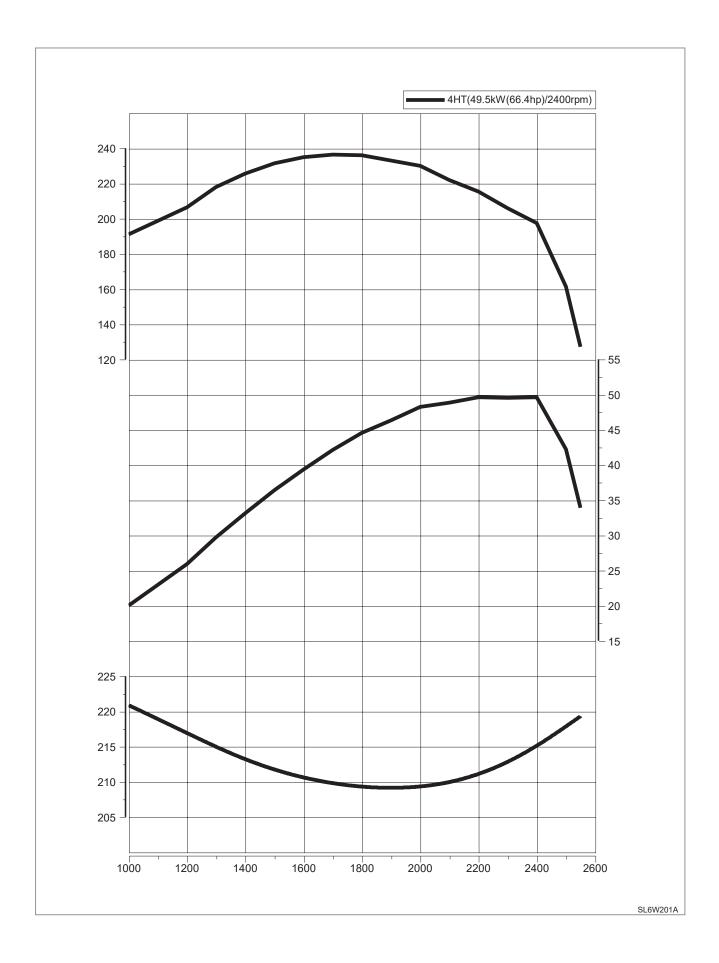


2.3 COMPONENTS



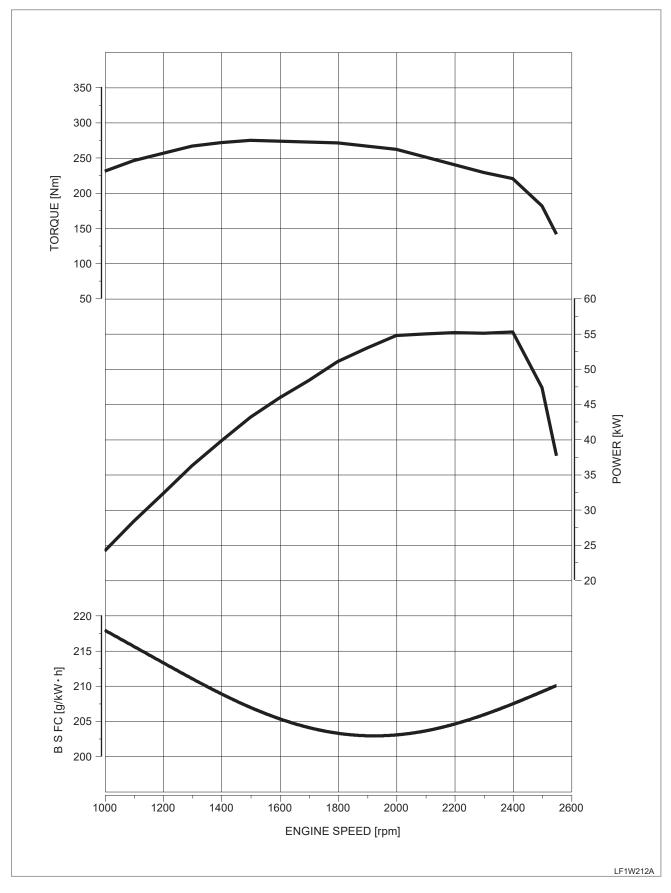
ENGINE

2.4 ENGINE PERFORMANCE CURVE (4TH5)



ENGINE - SPECIFICATIONS

ENGINE PERFORMANCE CURVE(4THI5)



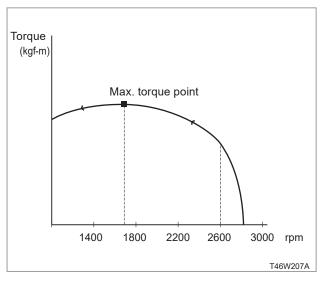
×

2.5 ENGINE PERFORMANCE CURVE ANALYSIS

2.5.1 TORQUE

When applying the rotating resistance to the flywheel, the engine speed drops and the rotating force of flywheel increases.

Torque curve shows this force as a graph.



When running the engine at full speed without load, the engine rotates at approx. 2,800 rpm as shown in the figure. When the resistance is applied to the flywheel by braking with some kind of dynomometer, the rotating force of the dynomometer increases (arrow direction) as shown in the figure. In this case, the engine speed gradually decreases. When the engine speed reaches approx. 1,700 rpm, the torque starts to decrease. In other words, this point (1,700 rpm) is the maximum torque point.

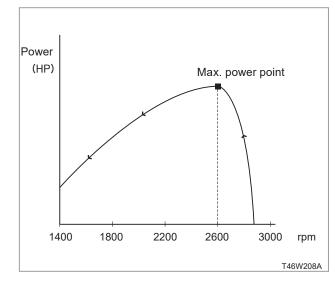
2.5.2 BRAKE HORSE POWER (HP)

The power is proportional to the rotating force (torque) and the rotating speed (RPM). Its formula is as follows:

Power	_	Torque(kgf-m) X rpm
(HP)	-	725.7

1 kW = 1.341 HP

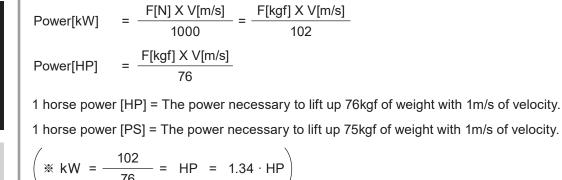
If substituting the torque and RPM in the left figure for the above formula and getting the power value, the below curve is provided. As shown in the below figure, when the power reaches the maximum point at 2,600 rpm, the power starts to drop. This is because the rpm drops sharply even the torque increases gradually.



ENGINE - SPECIFICATIONS

Work
Time=Force X Distance
Time=Force X Velocity



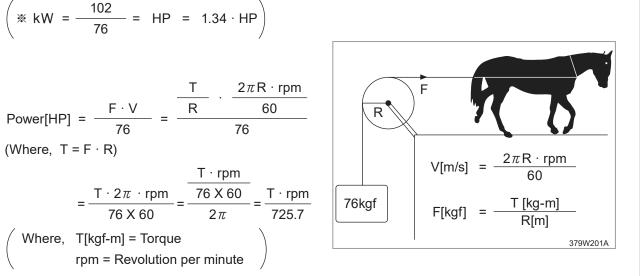


REMARKS -

= Force X Distance

Work

Power



2.5.3 S.F.C (SPECIFIC FUEL CONSUMPTION) (FOR REFERENCE ONLY)

The unit used here is "g/kW-hr".

For example, 208g/kW-hr means that 208g of fuel is consumed by 1kW when running the engine for 1 hour.

This can be converted as follows:

Since the fuel consumption at full power in the power curve [4HTI4] is 208g/kW-hr, the fuel consumption

for 54.9kW(73.6HP) is 208g x 54.9/hr = 11.419kg/hr.

When converting this value to volume value,

11.419 \div 0.835 ℓ/hr = 13.68 ℓ/hr

Because: Diesel fuel 1 l = 0.835 kg

However, the actual fuel consumption will be much less than this maximum fuel consumption in accordance with load factor of job. In general, the load factor could be 30~70% of maximum power.

Therefore the actual fuel consumption will also be 30~70% of this maximum fuel consumption.

2.6 SERVICING SPECIFICATIONS

2.6.1 ENGINE BODY

ITEM			SPECIFICATION	ALLOWABLE LIMIT
	Cylinder head surf	ace flatness	-	0.05 mm / 100 mm (0.002 in. / 3.94 in.)
	T.D.C clearance		0.32 ~ 0.7 mm (0.01250 ~ 0.02755 in.)	-
A. Cylinder Head	Gasket Thickness		Tightened 1.02 mm (0.040 in)	-
	Compression Pressure (When cranking with starter motor) Wariance of compression pressure among cylinders should be 10% or less.		3.24 ~ 3.73 MPa 33 ~ 38 kgf/cm² 470 ~ 541 psi	2.55 MPa 26 kgf/cm ² 370 psi
	Valve Clearance	IN.	0.20 mm (0.0079 in.)	-
	(Cold)	EX.	0.20 mm (0.0079 in.)	-
	Valve Seat	IN.	60° (1.047 rad.)	-
	Angle	EX.	45° (0.785 rad.)	-
	Valve Face	IN.	60° (1.047 rad.)	-
	Angle	EX.	45° (0.785 rad.)	-
B. Valves		IN.	0.4 ~ 0.8 mm (0.0157 ~ 0.0314 in.)	1.0 mm (0.0393 in.)
	Valve recess	EX.	0.2 ~ 0.6 mm (0.0079 ~ 0.0236 in.)	0.8 mm (0.0315 in.)
	Clearance Between Valve Stem and Valve Guide		0.040 ~ 0.043 mm (0.0016 ~ 0.0017 in.)	0.1 mm (0.0039 in.)
	Valve Stem O.D.		7.960 ~ 7.975 mm (0.31339 ~ 0.31398 in.)	-
	Valve Stem I.D.		8.015 ~ 8.030 mm (0.3156 ~ 0.3161 in.)	-
	Intake Valve	Open	0.14 rad (8°) before T.D.C	
C. Value Timing		Close	0.611 rad (35°) after B.D.C	-
C. Valve Timing	Exhaust Valve	Open	0.785 rad (45°) before B.D.C	
	Exhaust valve	Close	0.140 rad (8°) after T.D.C	-
D. Cylinder	Bore I.D.		87.000 ~ 87.022 mm (3.425 ~ 3.426 in.)	0.15 mm (0.0059 in.)
	Free length		46.1 ~ 46.9 mm (1.8150 ~ 1.8465 in.)	45.6 mm (1.7955 in.)
E. Valve spring	Load after assembled / Length after assembled		19.8 kgf / 35.15 mm (43.6 lbs / 1.3839 in.)	16.8 kgf / 35.15 mm (37.0 lbs / 1.3839 in.)
	Squareness		-	1.0 mm (0.0394 in.)
	Rocker arm shaft O.D.		18.955 ~ 18.980 mm (0.7463 ~ 0.7472 in.)	-
F. Rocker Arm	Rocker arm bushing I.D.		19.000 ~ 19.025 mm (0.7480 ~ 0.7490 in.)	-

ITEM			SPECIFICATION	ALLOWABLE LIMIT
	Clearance between tappet and guide		0.020 ~ 0.062 mm (0.00079 ~ 0.00244 in.)	0.07 mm (0.0028 in.)
G. Tappet	Tappet O.D.		23.959 ~ 23.980 mm (0.94327 ~ 0.94410 in.)	-
	Tappet guide I.D.		24.000 ~ 24.021 mm (0.94488 ~ 0.94571 in.)	-
	Camshaft deflectior	1	0.01 mm (0.0004 in.)	0.05 mm (0.0020 in.)
		IN.	33.59 mm (1.3224 in.)	33.54 mm (1.3205 in.)
	Cam height	EX.	33.69 mm (1.3264 in.)	33.64 mm (1.3244 in.)
	Journal oil clearanc	e	0.050 ~ 0.091 mm (0.00197 ~ 0.00358 in.)	0.15 mm (0.0059 in.)
H. Camshaft	Camshaft journal O	.D.	39.934 ~ 39.950 mm (1.57220 ~ 1.57283 in.)	39.88 mm (1.5701 in.)
	Camshaft counter b	oore I.D.	40.000 ~ 40.025 mm (1.57480 ~ 1.57579 in.)	-
	Camshaft gear shaft clearance		0.07 ~ 0.22 mm (0.003 ~ 0.009 in.)	-
	Timing gear backlash		0.04 ~ 0.10 mm (0.0016 ~ 0.0039 in.)	0.14 mm (0.0055 in.)
	Idle gear side clearance		0.050 ~ 0.250 mm (0.00196 ~ 0.00984 in.)	0.5 mm (0.0197 in.)
	Clearance between Idle gear 1 shaft and idle gear 1 bushing		0.025 ~ 0.066 mm (0.00098 ~ 0.00260 in.)	0.1 mm (0.0039 in.)
	ldle gear 1 shaft O.D.		42.959 ~ 42.975 mm (1.69130 ~ 1.69193 in.)	-
	Idle gear 1 bushing I.D.		43.000 ~ 43.025 mm (1.69291 ~ 1.69390 in.)	-
I. Timing Gear	ear Clearance between Idle gear 3 sh and idle gear 3 bushing		0.025 ~ 0.066 mm (0.00098 ~ 0.00260 in.)	0.1 (0.0039 in.)
	Idle gear 3 shaft O.	D	31.959 ~ 31.975 mm (1.25823 ~ 1.25886 in.)	-
	Idle gear 3 bushing	I.D.	32.000 ~ 32.025 mm (1.25984 ~ 1.26083 in.)	-
	Clearance between and idle gear 4 bus	-	0.025 ~ 0.066 mm (0.00098 ~ 0.00260 in.)	0.1 (0.0039 in.)
	Idle gear 4 shaft O.	D	27.967 ~ 27.980 mm (1.10106 ~ 1.10157 in.)	-
	Idle gear 4 bushing	I.D.	28.005 ~ 28.033 mm (1.10256 ~ 1.10366 in.)	-

NDEX

	ITEM	SPECIFICATION	ALLOWABLE LIMIT
	Piston pin bore I.D.	30.006 ~ 30.014 mm (1.18134 ~ 1.18165 in.)	-
	Clearance between Oil ring and ring groove	0.020 ~ 0.060 mm (0.00079 ~ 0.00236 in.)	0.15 mm (0.0059 in.)
	Oil ring groove width	3.01 ~ 3.03 mm (0.11850 ~ 0.11929 in.)	-
	Oil ring width	2.97 ~ 2.99 mm (0.11693 ~ 0.11772 in.)	-
J. Piston Ring	Clearance between 2nd ring and ring groove	0.04 ~ 0.08 mm (0.00157 ~ 0.00315 in.)	0.15 mm (0.0059 in.)
	2nd ring groove width	2.03 ~ 2.05 mm (0.07992 ~ 0.08071 in.)	-
	2nd ring width	1.97 ~ 1.99 mm (0.07756 ~ 0.07834 in.)	-
	Top ring, oil ring end gap	0.25 ~ 0.40 mm (0.00984 ~ 0.01575 in.)	1.25 mm (0.0492 in.)
	2nd ring end gap	0.40 ~ 0.55 mm (0.01575 ~ 0.02165 in.)	1.25 mm (0.0492 in.)
	Connecting rod deflection limit	-	0.05 mm (0.0020 in.)
K. Connecting	Clearance between piston and small end bushing	0.025 ~ 0.045 mm (0.00098 ~ 0.00177 in.)	-
Rod	Piston pin O.D.	29.995 ~ 30.000 mm (1.18090 ~ 1.18110 in.)	-
	Piston pin bushing I.D.	30.025 ~ 30.040 mm (1.18209 ~ 1.18268 in.)	-
	Crankshaft deflection limit	-	0.08 mm (0.0031 in.)
	Clearance between Crankshaft and crankshaft bearing 1	0.040 ~ 0.104 mm (0.00157 ~ 0.00400 in.)	0.20 mm (0.0079 in.)
	Crankshaft O.D.	59.921 ~ 59.940 mm (2.35909 ~ 2.35984 in.)	-
L. Crankshaft	Crankshaft bearing 1 I.D.	59.980 ~ 60.025 mm (2.36142 ~ 2.36319 in.)	-
L. Urankshan	Clearance between crank pin and crank pin bearing	0.017 ~ 0.073 mm (0.00067 ~ 0.00287 in.)	0.20 mm (0.0079 in.)
	Crankshaft pin O.D.	51.959 ~ 51.975 mm (2.04563 ~ 2.04626 in.)	-
	Crankshaft pin bearing I.D.	51.992 ~ 52.032 mm (2.04693 ~ 2.04850 in.)	-
	Crankshaft side clearance	0.15 ~ 0.31 mm (0.0059 ~ 0.0122 in.)	0.5 mm (0.020 in.)

GMW-0035

ENGINE · SPECIFICATIONS

2.6.2 LUBRICATING SYSTEM

	ITEM		SPECIFICATION	ALLOWABLE LIMIT
	Engine oil pressure	At idle speed (1,000 rpm)	68.6 kPa or more 0.7 kgf/cm ² 9.95 psi	-
	(oil temp. 85 ~ 95 °C)	At rated speed (2,600 rpm)	245.1 ~ 441.2 kPa 2.5 ~ 4.5 kgf/cm ² 35.5 ~ 64.0 psi	294.2 kPa 3.0 kgf/cm ² 42.7 psi
A. Oil Pump	Clearance between inner rotor and outer rotor		0.10 ~ 0.16 mm (0.0039 ~ 0.0063 in.)	0.2 mm (0.0079 in.)
	Clearance between out	er rotor and pump	0.11 ~ 0.19 mm (0.00433 ~ 0.00748 in.)	0.25 mm (0.0098 in.)
	Clearance between inner ro		0.105 ~ 0.150 mm (0.00413 ~ 0.00591 in.)	0.2 mm (0.00787 in.)

2.6.3 COOLING SYSTEM

	ITEM	SPECIFICATION	SPECIFICATION
A. Thermostat	Valve opening temperature at beginning	80.5 ~ 83.5°C (176.9 ~ 182.3°F)	-
	Opened completely (height: 8 mm)	95°C (203°F)	-
	Radiator hose tightness	No leak at 1.4 kgf/cm ² (137 kpa, 20 psi)	-
B. Radiator	Radiator cap tightness	10 seconds or more for pressure drop from $0.9 \rightarrow 0.6 \text{ kgf/cm}^2$ $(88 \rightarrow 59 \text{ kpa}, 13 \rightarrow 9 \text{ psi})$	-
C. Fan cooler	Fan belt tension [deflection at 78 N (8 kgf, 18 lbs) of force]	7 ~ 9 mm (0.28 ~ 0.35 in.)	-

2.6.4 TIGHTENING TORQUES FOR ENGINE

	SIZE X PITCH	TIGHTENING TORQUE						
ITEM		N	m	kg	f-m	lb	-ft	
Cylinder head bolt	M11×1.25	39.22+90°+70°		4+90°+70°		28.8+90°+70°		
Head cover bolt	M6×1.0	8.8	11.8	0.9	1.2	6.5	8.7	
Main bearing bolt	M12×1.25	90.2	93.2	9.2	9.5	66.5	68.7	
Ladder frame bolt	M10×1.25	47.1	52	4.8	5.3	34.7	38.3	
Piston cooling jet bolt	M12×1.25	29.4	34.3	3	3.5	21.7	25.3	
*Flywheel bolt	M12×1.25	98.1	107.9	10	11	72.3	79.6	
*Connecting rod bolt	M8×1.0	44.1	49	4.5	5	32.5	36.2	
Rocker arm support bolt	M10×1.25	60.8	70.6	6.2	7.2	44.8	52.1	
Injector clamp bolt	M8×1.25	27.5	31.4	2.8	3.2	20.3	23.1	
Hi-pressure pipe nut (pump side)	M14×1.5	24.5	29.4	2.5	3	18.1	21.7	
Hi-pressure pipe nut (rail side)	M14×1.5	27.5	31.4	2.8	3.2	20.3	23.1	
Crank shaft bolt	M16×1.5	320.7	343.2	32.7	35	236.5	253.2	
Glow plug	M10×1.25	19.6	24.5	2	2.5	14.5	18.1	
Eye-bolt (turbo side)	M10×1.25	27.5	31.4	2.8	3.2	20.3	23.1	
Eye-bolt (nut side)	M12×1.5	32.4	37.3	3.3	3.8	23.9	27.5	
Coolant temp sensor	PT3/8	34.3	44.1	3.5	4.5	25.3	32.5	
Oil pressure switch	PT1/8	14.7	19.6	1.5	2	10.8	14.5	

- For * marked screw, bolts and nuts on the table, apply engine oil to their threads and seats before tightening.
- The letter "M" in Size × Pitch means that the screw, bolt or nut dimension stands for metric. The size is the nominal
- outside diameter in mm of the threads. The pitch is the nominal distance in mm between two threads.

IMPOARTANT -

Tightening torque for cylinder head bolts
 Tightening order (using the angle controlled tightening method)

1st step: Tighten the bolts to 4.0 kgf-m (39.2 Nm, 28.8 lb-ft)

2nd step: Rotate the bolts additional 90°

- 3rd step: Rotate the bolts additional 70°
- For more details, refer to 7.3.4 "Cylinder head removal.

3. OPERATING PRINCIPLE

3.1 CRDI (COMMON RAIL DIRECT INJECTION) SYSTEM

The CRDI (Common Rail Direct Injection) engine is a high performance engine, featuring superior emission, acceleration, vibration and noise functions. The old version of diesel engines simply delivers fuel into the combustion chamber through its mechanical structure. On the other hand, in the CRDI engine, fuel sent from the fuel tank is pressurized to the necessary level by the highpressure fuel pump and it is stored in the common rail for use. Then, the ECU controls the injector according to the detected engine RPM, load and other factors to inject fuel into the combustion chamber in the optimum injection condition. It is hard to meet the optimum injection condition and achieve precise control on injection timing in a normal diesel engine of the cam injection type.

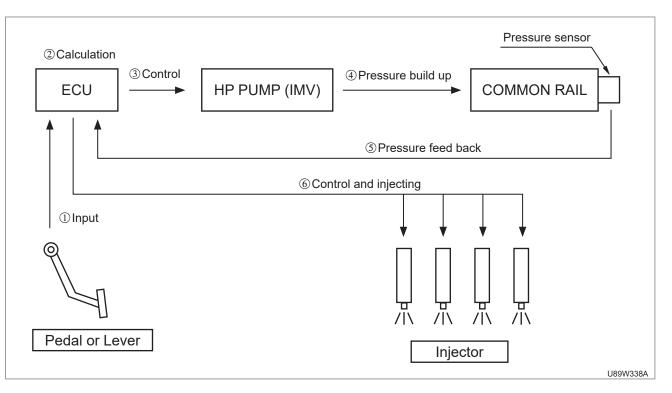
On the other hand, the common rail type engine stores highly pressurized fuel in the common rail to inject the necessary amount of fuel at the correct timing for optimal combustion, resulting in emission reduction and engine power increase.

The atomization level, injection timing and injection pressure of fuel have a huge impact on combustion performance.

Therefore, in the CRDI engine, as the injector injects highly pressurized fuel (under 1,800 bars) into the combustion chamber according to control from the ECU, it injects fuel as fast as possible to make fuel almost gaseous condition (atomization) at a high pressure.

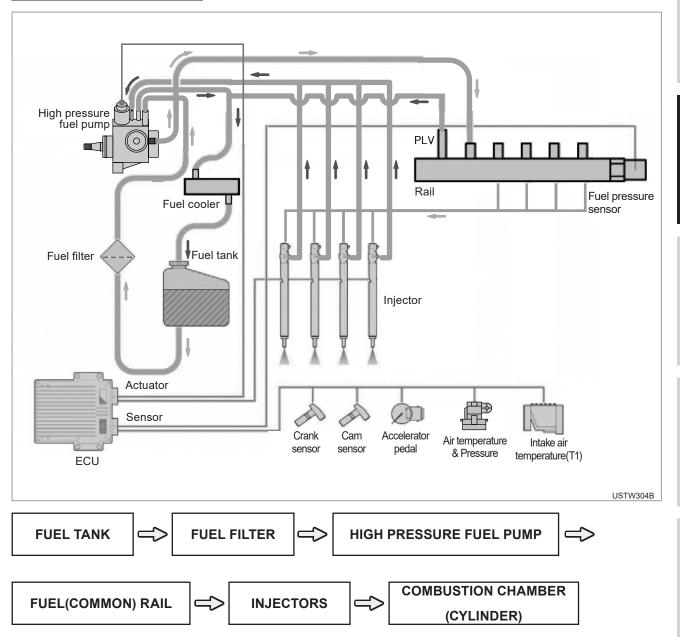
Also, as it is still possible to inject fuel at a high pressure while the engine is running at a low speed with high load, up to torque increase and power improvement can be achieved at a low speed.

The CRDI engine mainly consists of the high-pressure pump, pressure control valve, common rail, pressure sensor, injector, ECU and other sensors and actuators.



- The position information of the pedal intended by the driver (the amount of movement of the pedal or hand lever) is sent to the ECU as a signal.
- The ECU determines the required RPM according to this position information and calculates the correct injection pressure and injection timing (fuel injection amount) to achieve this target RPM.
- It controls the IMV of the HP pump to increase pressure in the common rail.
- It supplies high-pressure fuel to the common rail to increase the rail pressure to the pressure level demanded by the ECU.
- The pressure sensor in the common rail sends pressure information to the ECU to confirm whether the actual pressure matches the demanded pressure.
- When pressure in the rail is sufficiently built, the ECU controls the injector to inject fuel for a proper amount of time.
- The fundamental injection map is set by positions of the pedal or hand lever, and the rail pressure and injection timing are corrected, considering other several external factors, including the intake air temperature, coolant temperature and barometric pressure.





COMPONENTS

- HIGH PRESSURE FUEL PUMP : Supplies highly pressurized fuel to fuel rail
- FUEL(COMMON) RAIL : Stores fuel pressurized down to 1,800 bars before injection
- · INJECTOR : Performs pilot and post injections into each cylinder
- ECU(Electronic Control Unit) : Controls injection condition, such as injection timing, injection amount and injection pressure
- SENSOR & ACTUATOR : Detects fuel temperature, fuel pressure, intake air temperature, coolant temperature, engine RPM, etc.

3.1.1 ECU(ELECTRONIC CONTROL UNIT)

OVERVIEW



The ECU (Electronic Control Unit) is the most important information processor in the engine as it analyzes information sent from various sensors and takes an appropriate action for optimum engine performance.

The ECU is integrated with I/O devices, ROM and RAM. Various sensors, including the coolant temperature sensor, intake air temperature sensor, crank angle sensor, cam position sensor, throttle position sensor, air mass flow sensor and rail pressure sensor, check the engine condition and send the corresponding signals to the ECU.

Then, the ECU receives signals from these sensors, analyzes them and changes voltage to the permissible level based on these information to activate various actuators.

The ECU stores certain map values as standard. Its micro-processor calculates the injection duration and timing according to the piston speed and crankshaft angle to control the engine power and exhaust gas.

Also, the output signal from the ECU micro-processor is used to drive the IMV in order to control the pressure in the fuel rail suitable for the engine load condition for optimum performance without any power loss.

The engine ECU calculates the command from the driver (accelerator pedal position) and controls overall operating performance of the engine and vehicle instantly. The engine speed is detected by the crankshaft speed (position) sensor while the injection order is determined by the camshaft speed (position) sensor.

The MAF (Mass Air Flow) sensor detects the amount of

intake air and sends this information to the engine ECU which then determines the instant air volume change to control the air-fuel ratio for reduction of exhaust gas (EGR valve control). Also, the ECU receives signals from the coolant temperature sensor, air temperature sensor and booster pressure sensor and uses them for calibration to manage setting values, various variables and operating conditions for main injection and pilot injection.

FUNCTION

ENGINE CONTROL

1. Control for each operating phase

The ECU needs to calculate the proper fuel injection amount at each phase for optimum combustion. In this process, it takes numerous variables into consideration.

2. Fuel injection amount control for engine start

Fuel is injected from the moment that the ignition switch is turned to the START position until the permissible lower speed limit is achieved. The fuel injection amount is calculated by the specified function based on various temperature information and engine cranking speed.

3. Driving mode control

The fuel injection amount is calculated based on the position of the accelerator pedal and engine RPM and the ECU uses the drive map to obtain optimum engine power according to the driver's intention (accelerator pedal position).

ENGINE

AFETY FIRST

► FUEL SYSTEM CONTROL

- 1. Fuel pressure control
- It determines the fuel rail pressure according to the engine operating condition and adjusts the IMV accordingly to achieve necessary rail pressure.
- Pressure in the fuel rail is determined based on the engine RPM and engine load.
- The fuel pressure is calibrated based on the barometric pressure, coolant temperature and intake air temperature. When starting the engine in cold weather or at a high altitude, the added ignition time is additionally considered for calibration of the fuel pressure. When starting the engine, additional fuel injection is needed so pressure is consumed for this moment. Therefore, the fuel pressure is calibrated based on the temperature of the injected fuel or coolant.
- 2. Fuel injection control
- In the fuel injection control process, the ECU determines the characteristics of the current pulses to be sent to the injectors. It converts the fuel injection duration, injection amount and injection timing into values which can be recognized by the injector driver.
- The pulse required for the main injection is determined based on the engine RPM and pilot injection amount.
 - The first calibration is determined by the temperature of intake air and coolant. The fuel injection timing is adjusted according to the operating temperature of the engine. When the engine temperature is high, the fuel injection timing is retarded to reduce high combustion temperature and hazardous emissions (NOx). When the engine temperature is low, the fuel injection timing is advanced to achieve optimum combustion performance.

The second calibration is determined by the barometric pressure. This information is used to advance the injection timing in order to respond to the barometric pressure changes with altitudes. The third calibration is determined by the coolant temperature and time after the engine is started. When the engine is started, the fuel injection timing is advanced in the engine warmup period (30 seconds) to increase the amount of fuel injected and eliminate any possible misfire or unstable combustion.

The fourth calibration is determined by the pressure error. This calibration is to retard the injection timing to prevent diesel knocking when the fuel rail pressure is higher than the necessary level.

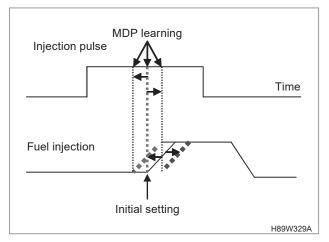
The fifth calibration is determined by the EGR ratio. When the EGR ratio increases, the fuel injection timing is retarded to compensate the combustion (cylinder) temperature drop.

The injection timing should be adjusted according to each factor to achieve combustion near at the TDC when the engine is started. The ECU is mapped to obtain optimal injection timing.

- The pilot injection timing is determined based on the engine RPM and overall fuel flow.
 - The first calibration is determined by the temperature of intake air and coolant. This calibration is to set the pilot timing according to the operating temperature of the engine.

The second calibration is determined by the barometric pressure. This calibration is to adjust the timing according to the barometric pressure changes with altitudes. The pilot injection timing is determined by the engine RPM and coolant temperature when the engine is started.

3. MDP(Minimum Dirve Pulse) LEARNING CONTROL



The MDP is the pulse value when the injector starts injecting fuel, and it is actually the period that power is supplied until the needle in the injector moves to the tip. The MDP is controlled to correct the pilot injection timing for aged injectors with relatively low precision. As shown in the figure, fuel injection is initiated at the learned MDP point based on the initial setting. Therefore, the fuel injection timing is retarded or advanced depending on the condition of the nozzle.

The MDP refers to the minimum pulse where power is supplied for fuel injection. When the MDP value is learned precisely, it is possible to control the precise amount of fuel injected by each injector. The knock sensor detects vibration generated from the engine after a small amount of fuel is injected by the injectors. The the MDP is learned by calculating the period from fuel injection to vibration detected from the engine. The MDP is to correct the injection timing for aged injectors in order to reduce engine vibration and emissions and prevent power reduction.

4. Fuel control

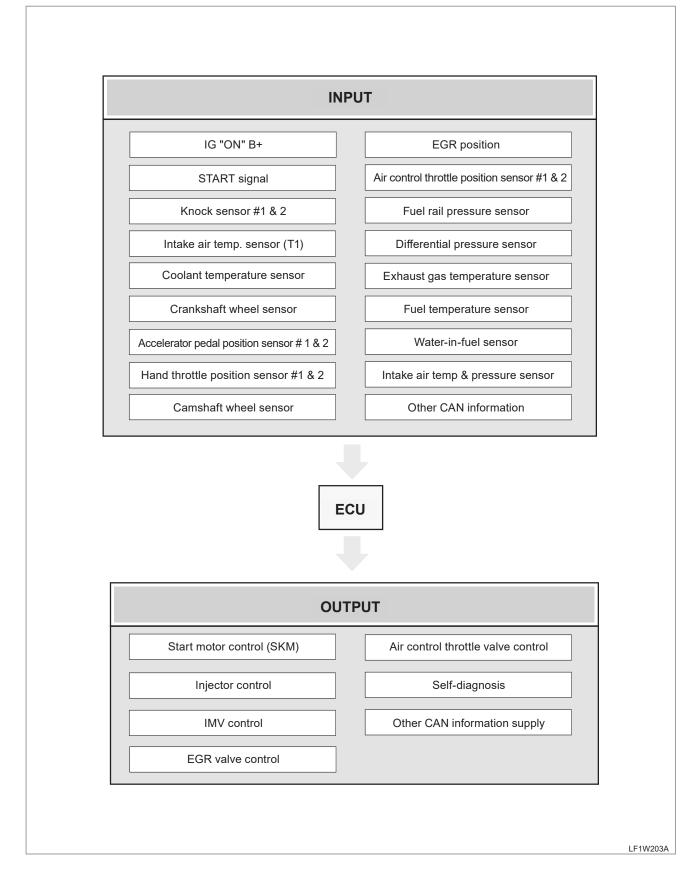
- The ECU controls the amount of fuel injected to the cylinder for the main injection process.
- The fuel demand amount is determined based on the driver's demand, i.e. displacement of the hand throttle lever or accelerator pedal.
- It controls the idle speed.
- It limits the fuel amount based on the engine speed and intake air amount.
- It controls the amount of fuel injected into the cylinder during the pilot injection process

ACTUATOR CONTROL [INJECTOR AND EGR VALVE]

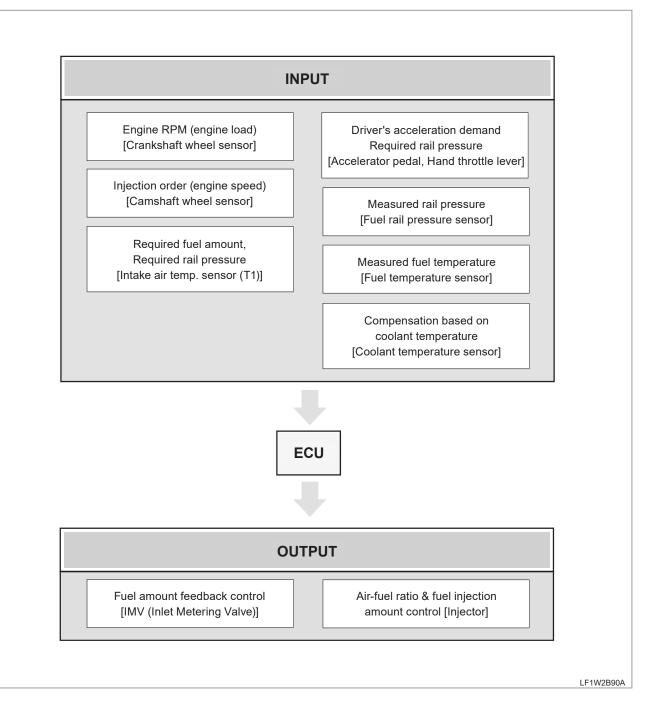
• It receives signals from various sensors to control the actuator for optimum combustion.

OPERATION

▶ INPUT/OUTPUT OF ECU ENGINE CONTROL SYSTEM

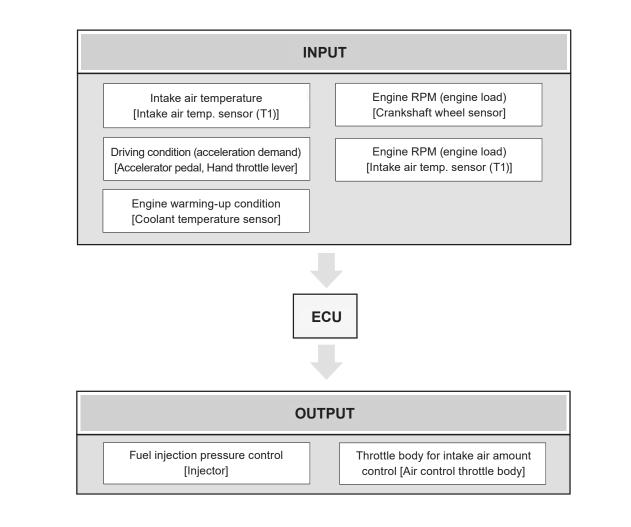


▶ INPUT/OUTPUT OF FUEL SUPPLY SYSTEM



GMW-0035

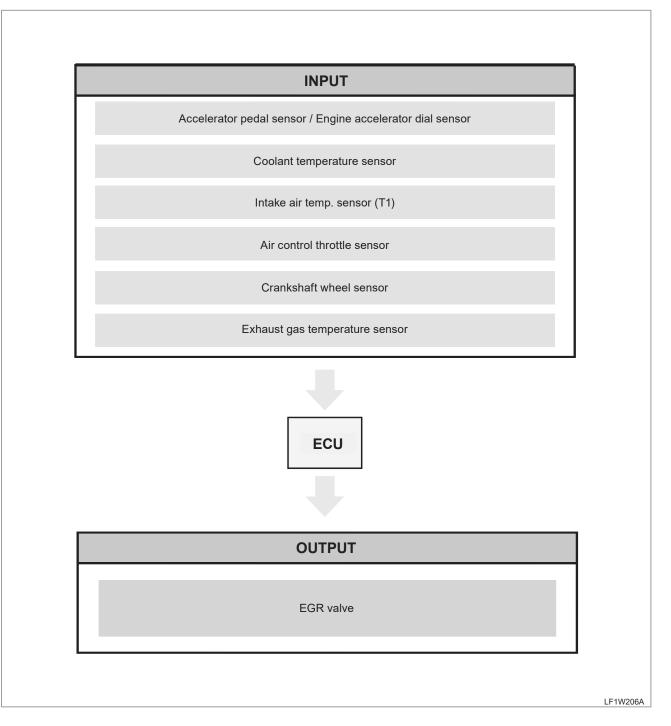
▶ INPUT/OUTPUT OF INTAKE SYSTEM



LF1W2B89A

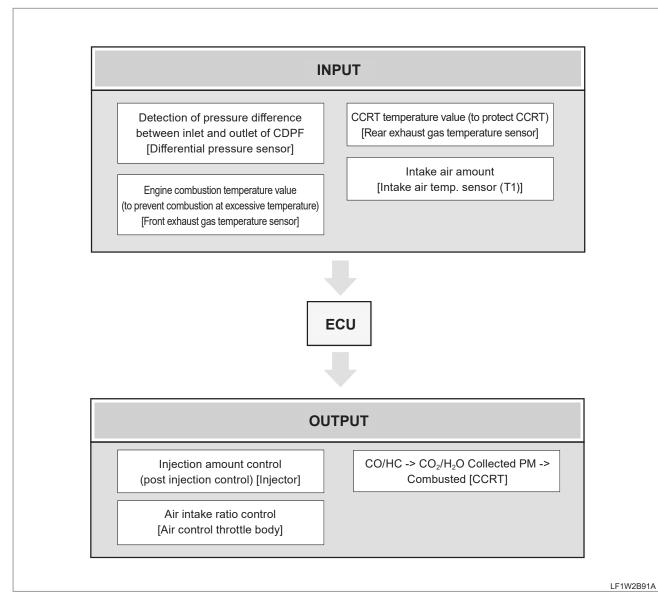
ENGINE

▶ INPUT/OUTPUT OF EGR VALVE (EXHAUST GAS CONTROL)



GMW-0035

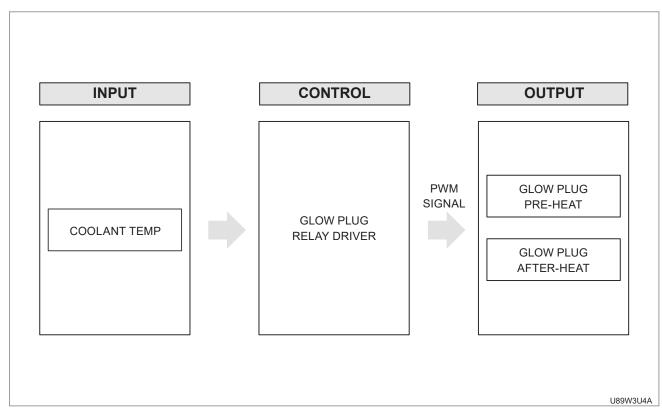
▶ INPUT/OUTPUT OF CCRT CONTROL



- Front exhaust gas temperature sensor: it is installed to the exhaust manifold to determine whether the DOC can burn (oxidize) injected fuel during the post-injection process.
- Rear exhaust gas temperature sensor: it is installed to the inlet of the DPF to monitor whether the temperature of exhaust gas is maintained at 600°C.
 - Excessive temperature (over 600°C), leading to reduction of CCRT life \rightarrow Decrease in fuel injection amount in post injection process
 - Insufficient temperature (below 600°C), leading to low efficiency of CCRT regeneration \rightarrow Increase in fuel injection amount in post injection process
- Differential pressure sensor: it detects the pressure difference between the inlet and outlet of the CCRT to calculate the PM amount.
- Air control throttle valve: it reduces the intake air amount to increase the exhaust gas temperature when the CCRT is activated with the engine idling.

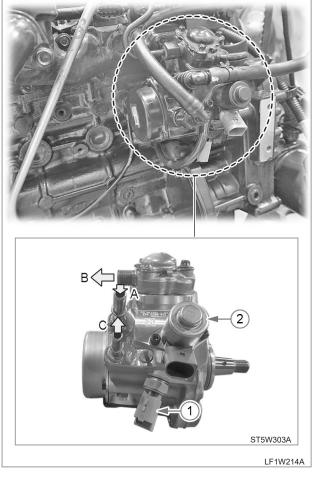
ENGINE

► INPUT/OUTPUT OF PLUG RELAY DRIVER



GMW-0035

3.1.2 HIGH PRESSURE FUEL PUMP (FOR INJECTION)



- (1) Fuel temperature sensor (A (2) IMV (f
- (A) From fuel filter (entrance)(B) To fuel rail (exit)(C) To fuel cooler (return)

The high-pressure fuel pump consists of the lowpressure pump (vane pump) which sucks fuel from the fuel tank, high-pressure pump which supplies fuel at a high pressure to the common rail, and IMV (Inlet Metering Valve) which controls the amount of fuel supplied to the high-pressure pump.

The high-pressure fuel pump is connected to and run by the idle gear which is driven by the crankshaft. It is also equipped with the pressure control valve and fuel temperature sensor, apart from the components mentioned above. The pressure control valve opens the oil passage to decrease pressure in the pump when pressure in the common rail rises excessively. Also, the fuel temperature sensor detects the temperature at the inlet of the high-pressure fuel pump and sends this information to the ECU. Since excessively hot fuel can damage the high-pressure fuel pump, the ECU limits the amount of injected fuel to prevent the engine RPM from rising over a certain level when the fuel temperature rises over the specified value.

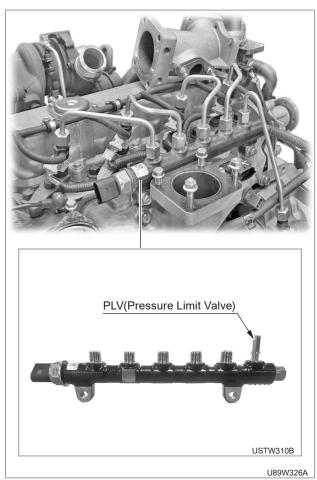
This high-pressure fuel pump is the high-pressure pump for the Delphi DFP 4.6.18 TP common rail and features compact and lightweight design.

REMARKS -

ADJUSTMENT OF HIGH-PRESSURE PUMP TIMING

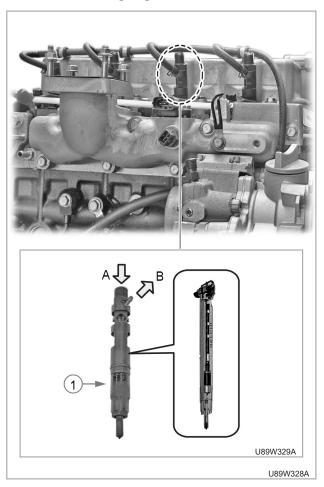
The conventional fuel injection pump pressurized and distributed fuel to each injector. In this case, the pump timing should be set as fuel is injected to the necessary position in a cycle. However, the high-pressure pump of the common-rail engine is not used for fuel injection, so it is not necessary to set its timing for the engine. However, it should be set and adjusted to synchronize the pressure drop by each injection with the peak pressure occurred by the pump in order to enhance pressure control performance. This phase setting enhances pressure stability and reduces fuel flow difference between the cylinders.

3.1.3 FUEL RAIL(COMMON RAIL)



- The Delphi DFR 4.18 PLV fuel rail stores fuel which is pressurized and sent by the highpressure fuel pump. This device is controlled by the ECU to help fuel rail pressurized fuel to be injected to the engine combustion chamber at a high pressure through all injectors in order to increase engine efficiency and decrease noise and emission.
- Over pressure protection is ensured by the PLV and it will mechanically maintain the rail pressure with a range 500 ~ 1,000 bar (depending on system size) for system safety reason in the event of an overpressure.

3.1.4 INJECTOR [C3I]

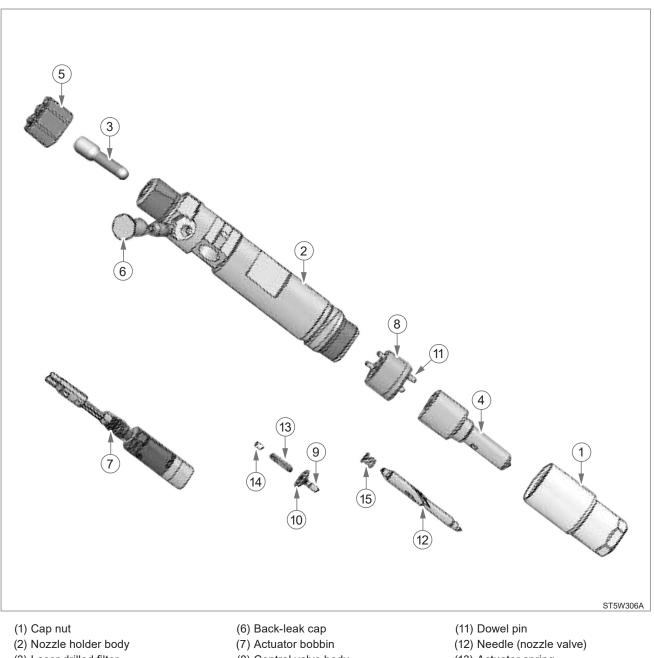


- (1) Injector assembly
- (A) Supplied fuel (from high-pressure pipe)
- (B) Surplus fuel (to overflow pipe)

The Delphi DFI 2.20S injector injects fuel into the combustion chamber according to the signal from the ECU.

The injector is supplied with fuel from the highpressure fuel pump through the high-pressure pipe and fuel rail. This fuel under high pressure is directly injected into the combustion chamber (on the top of the piston) through the multi-hole injector nozzle by activation of the solenoid valve of the nozzle (through a control signal from the engine ECU). The remainder of fuel after injection (back-leak fuel) is returned to the high-pressure pump through the fuel return line for reuse. Some of fuel supplied to the high-pressure pump is used as lubricant for the pump while fuel returned through the IMV (Inlet Metering Valve) flows back to the fuel tank through the return line.

INTERNAL VIEW

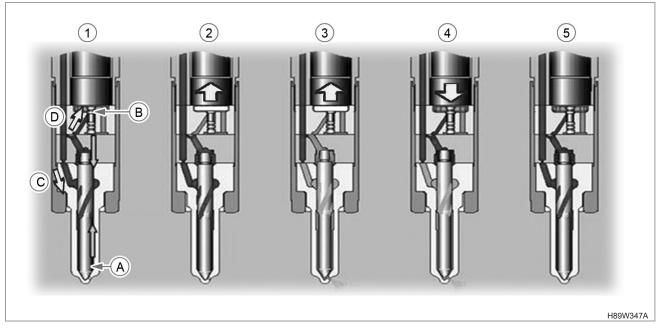


- (3) Laser drilled filter
- (4) Nozzle body
- (5) Blocking cap

- (8) Control valve body
- (9) Control valve step
- (10) Control valve amateur
- (13) Actuator spring
- (14) Adjust pin
- (15) Injector spring

ENGINE

ENGINE - OPERATING PRINCIPLE



(A) Needle (nozzle valve)

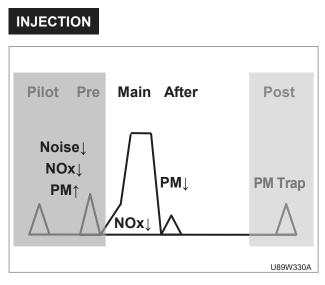
(B) Control valve

1	2	3	4	5
Valve closed	Valve open	Valve open	Valve closed	Valve closed
Nozzle closed	Nozzle closed	Nozzle open	Nozzle open	Nozzle closed
No injection	No injection	Starting injection	Completing injection	No injection

Basically, when the ignition switch is turned to the ON position, the solenoid actuator is energized and the solenoid is compressed, opening the control valve which is connected to the solenoid actuator. Then, fuel at a high pressure is continuously drawn into the combustion chamber through the injector and fuel rail.

- (1) When the control valve (B) is closed in the initial state, the pressure of fuel (C) drawn into the combustion chamber and pressure of fuel (D) drawn into the valve are the same, keeping the nozzle closed.
- (2) When the control valve is opened to start the engine, fuel drawn into the valve is drained to the control valve (B) so pressure of fuel drawn into the combustion chamber increases further.
- (3) As pressure on the valve side becomes lower than pressure in the combustion chamber, the needle (nozzle valve) is pushed up by pressure in the combustion chamber, opening the nozzle tip to initiate fuel injection.
- (4) When the ignition switch is turned to the OFF position, the valve is closed by force of the spring so pressure of fuel drawn to the valve rises gradually.
- (5) The control valve is completely closed and the needle (nozzle valve) is lowered due to increase in pressure of fuel on the valve side. When the needle reaches the bottom, pressure of fuel in the control valve and pressure of fuel in the combustion chamber become equal, completing the fuel injection operation.

After fuel is compressed under up to 1,800 bars by the fuel system of the CRDI (Common Rail Direct Injection) engine and is sent to the injector, the electrically controlled solenoid runs the valve to ensure the correct amount of fuel to be injected according to calculation by the ECU.



Also, fuel injection is performed in several steps, such as pilot, pre-, main, after- and post-injections, to generate explosive power in steps in order to decrease combustion noise at a low speed dramatically.

PILOT INJECTION

A very small amount of fuel is injected before main injection to facilitate combustion in the combustion chamber. This injection enables pressure in the combustion chamber to rise smoothly during combustion process to decrease NOx(Nitrogen Oxide) engine noise and vibration.

The default amount of fuel injected in the pilot injection process is adjusted according to the coolant temperature and intake air pressure.

► MAIN INJECTION

A very small amount of fuel is injected before main injection to facilitate combustion in the combustion chamber. This injection enables pressure in the combustion chamber to rise smoothly during combustion process to decrease NOx(Nitrogen Oxide) engine noise and vibration.

The default amount of fuel injected in the pilot injection process is adjusted according to the coolant temperature and intake air pressure.

POST INJECTION

This injection is performed after the main injection and does not produce actual power. This injection is to reduce PMs and smoke (fuel activation) by injecting fuel into unburned gas after the main injection.

CAUTION -

- As the injector is very sensitive to cleanness, make sure to seal any disconnected hose or pipe with the cap to prevent introduction of foreign materials.
- When removing the injector, make sure to replace the copper washer on its bottom with a new one.
- Tighten the mounting bolt of the injector mounting clamp to the specified torque.
- Be careful not to drop the injector. It is very sensitive to shock.



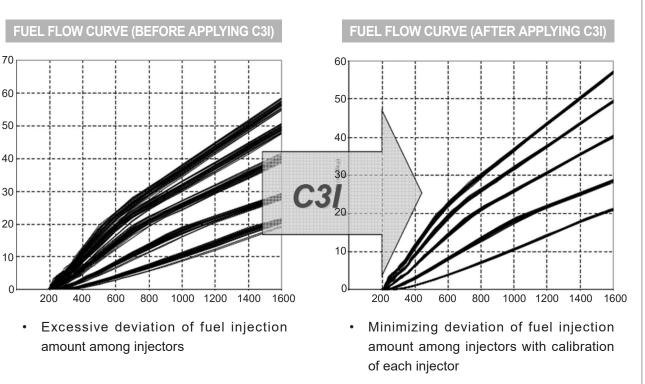
The injector of the common rail system is a highly precise part. The characteristics of injectors can vary by minute differences from their machining. Therefore, it is necessary to calibrate the fuel injection amount for each injector according to their initial characteristics.

The initial characteristics of injectors are coded as C3I. The ECU calibrates current applied to the injector according to this value, C3I.

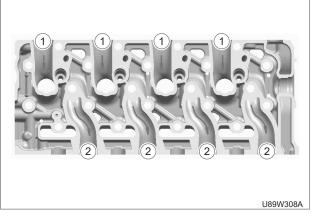
Also, the injector is controlled according to the fuel feed curve which is set according to various fuelrelated parameters for precise characterization of injection in order to reduce deviation.



► INJECTOR CHARACTERISTIC CURVE



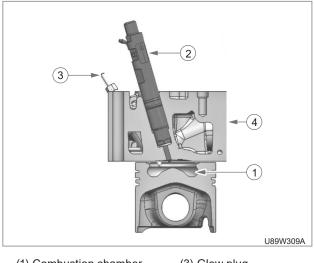
3.2 BODY AND POWER TRAIN SYSTEM 3.2.1 CYLINDER HEAD



(1) Intake port

(2) Exhaust port

The cylinder head is made of special alloy cast iron which can resist high temperature and pressure caused by combustion. The intake and exhaust ports are arranged cross-flow type to get high combustion efficiency by protecting the suction air from being heated and expanded by heated exhaust air.

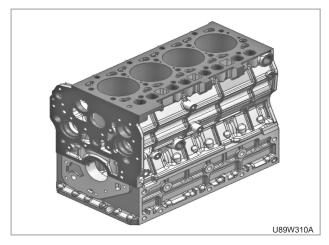


(1) Combustion chamber(3) Glow plug(2) Injection(4) Cylinder head

The HYUNDAI reentry type combustion chamber is designed for high combustion efficiency and reducing fuel consumption. The glow plug helps to start the engine even at $-20^{\circ}C$ (4°F).

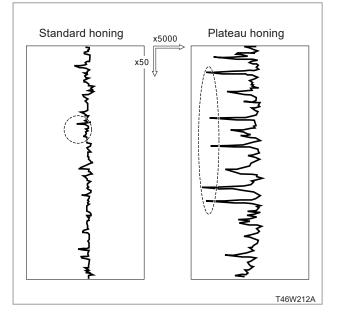
H89W346A

3.2.2 CYLINDER BLOCK



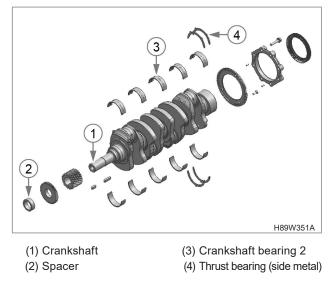
The cylinder block is a ladder frame type and it features superior serviceability and low vibration and noise compared to the conventional tunnel type.

3.2.3 CYLINDER HONING

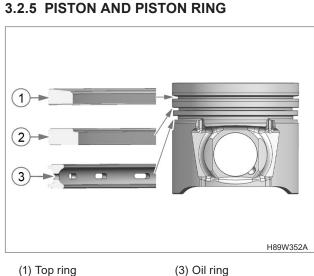


The HYUNDAI engine has adopted the plateau honing in manufacturing to enhance the oil tightness of the cylinder bore and the durability of the cylinder for the longer engine life time.

3.2.4 CRANKSHAFT



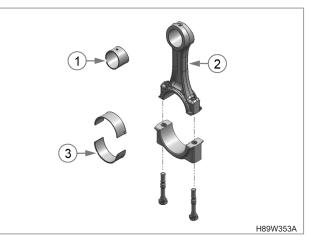
The crankshaft is made of forged steel and the journals, the crankpins and the bearing surface for the oil seal are inductionhardened to increase wear resistance. Each crankshaft journal is supported by the cylinder block. The crankshaft, crankshaft bearings 2 (3) have oil holes for lubricant.



(2) 2nd ring

The piston is made of an aluminum alloy that is temperature and pressure resistant. Three rings are installed in the grooves of the piston. The top ring (1) is a keystone type, which can withstand heavy loads, and the barrel face on the ring fits well to the cylinder wall. The second ring (2) is an undercut type, which prevents the oil from being carried up. The oil ring (3) has chamfered faces and an expander ring, which increase the pressure of the oil ring against the cylinder wall to scrape the oil. The top ring is plated with hard chrome to increase wear resistance.

3.2.6 CONNECTING ROD

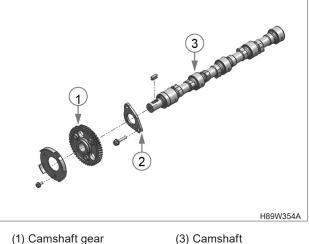


(1) Small end bushing(2) Connecting rod

(3) Crank pin bearing

The connecting rod (2), which converts the reciprocating motion of the pistons caused by the fuel combustion into the rotating motion of the crankshaft, is made of hard forged steel. The connecting rod has bearings at both ends. The small end has a cylinder type bearing (small end bushing (2)) and the big end has a split type bearing (crank pin bearing (3)).

3.2.7 CAMSHAFT

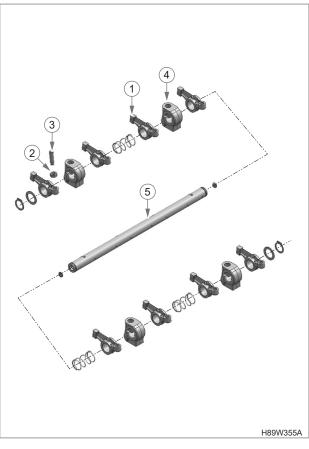


(1) Camshaft gear(2) Camshaft stopper

aft stopper

The camshaft (3) is made of forged steel and its journal and cams are hardened to increase wear resistance. The cams on the camshaft open and close the intake and exhaust valves with the push rods and rocker arms. The journals and their bearings are force-lubricated.

3.2.8 ROCKER ARM ASSEMBLY



(1) Rocker arm(2) Lock nut

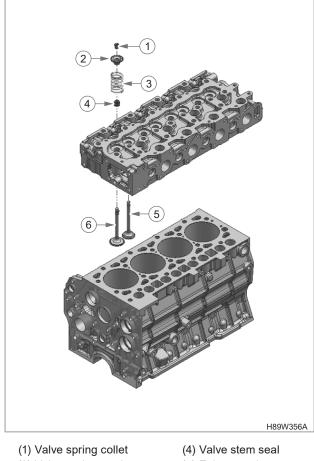
(4) Rocker arm bracket(5) Rocker arm shaft

(3) Adjusting screw

and the rocker arm shaft.

The rocker arm assembly includes the rocker arms (1) and an adjusting screw (3), which is at the end of rocker arm and rests on the push rod, rocker arm brackets (4) and rocker arm shaft (5). The rocker arms are activated by the reciprocating movement of the push rods and open or close the intake and exhaust valves. The rocker arm and other parts are lubricated through the drilled holes of the brackets

3.2.9 INTAKE AND EXHAUST VALVES

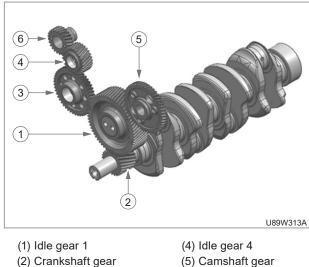


- (2) Valve spring retainer(3) Valve spring
- (4) Valve stem sea(5) Exhaust valve(6) Intake valve

The valve and its guide of the intake are different from those for the exhaust. Other parts, such as the spring, spring retainers, valve spring collets, valve stem seals are the same for both the intake and the exhaust.

The diameter of the intake valve is always larger than the that of the exhaust valve. The intake valve is located prior to exhaust valve when seeing them from the cooling fan side.

3.2.10 TIMING GEAR

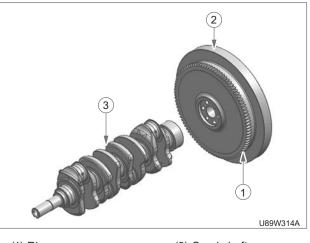


- (3) Idle gear 3
- (5) Camshaft gear(6) High pressure fuel pump gear

The crankshaft drives the camshaft, idle gear, hydraulic pump drive gear and high pressure fuel pump gear. The timings for opening and closing the valves is extremely important to achieve the effective air intake and sufficient gas exhaust. When assembling, the appropriate timing can be obtained by aligning the mark on the crankshaft gear (2) with idle gear 1 (1), idle gear 1 with camshaft gear (5). Valve can be opened and closed at the correct timing when the idle gear 1 is aligned with the idle gear 3 (3), the idle gear 3 is aligned with the idle gear 4 (4) and the idle gear (6) properly. AFETY FIRST

ENGINE

3.2.11 FLYWHEEL

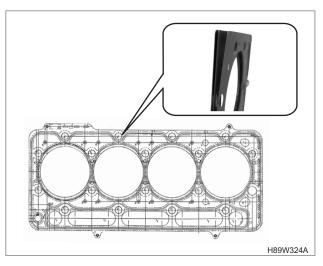


(1) Ring gear(2) Flywheel

(3) Crankshaft

The ring gear (1) for connecting the start motor is compressed in the flywheel. Therefore, it cannot be replaced separately.

3.2.12 MLS CYLINDER HEAD GASKET



The MLS (Multi Layer Steel) cylinder head gasket has a 4-layered steel structure complemented with non-asbestos gasket features.

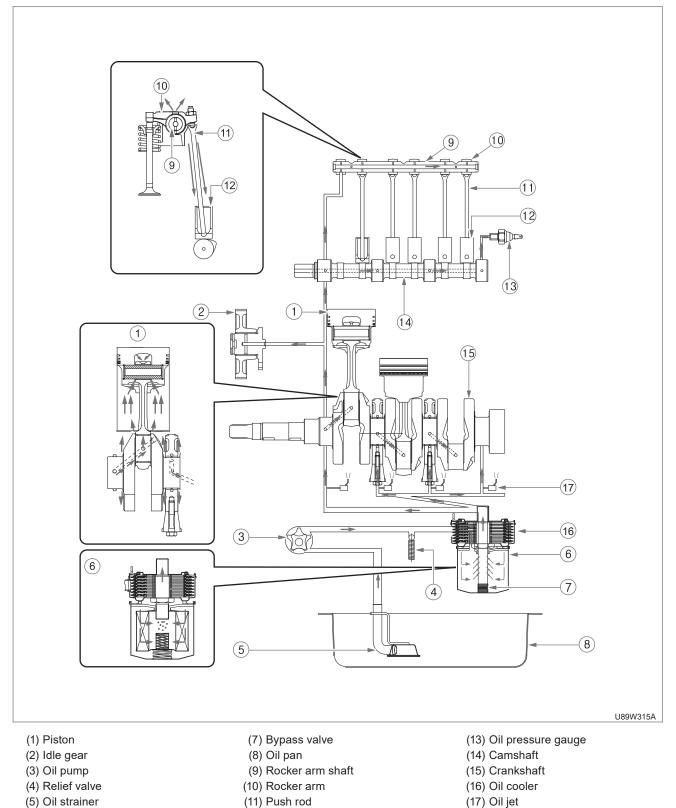
The top clearance variation is minimized and the thermal load is reduced while increasing durability.

– 🕂 CAUTION -

- When disassembling the cylinder head, its gasket should be replaced with a new one.
- Be sure that there is no scratch or foreign material between the cylinder head and the surface of the block.

3.3 LUBRICATING SYSTEM

3.3.1 ENGINE OIL FLOW

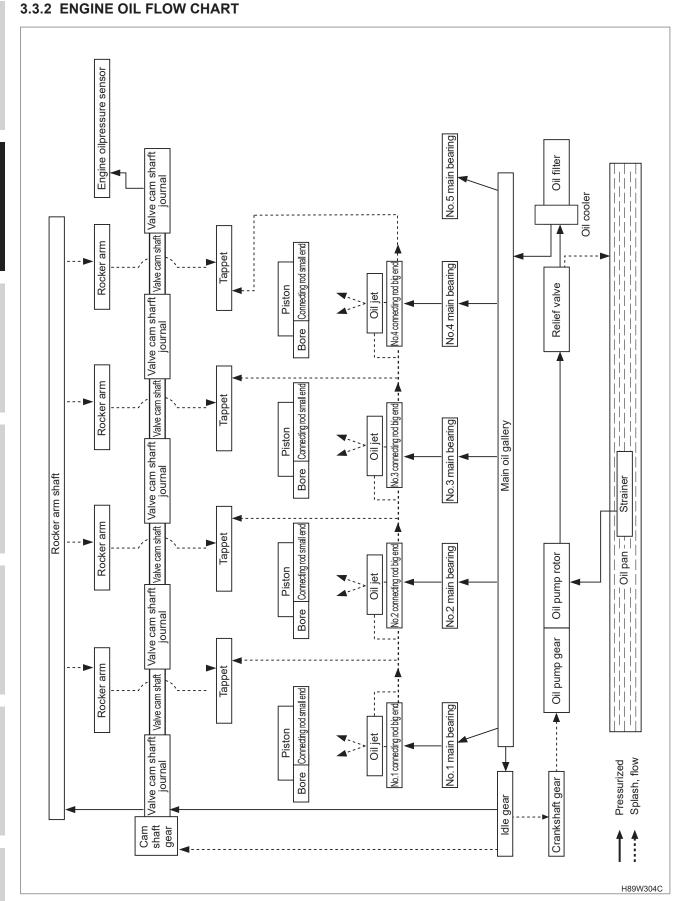


(12) Tappet

εl

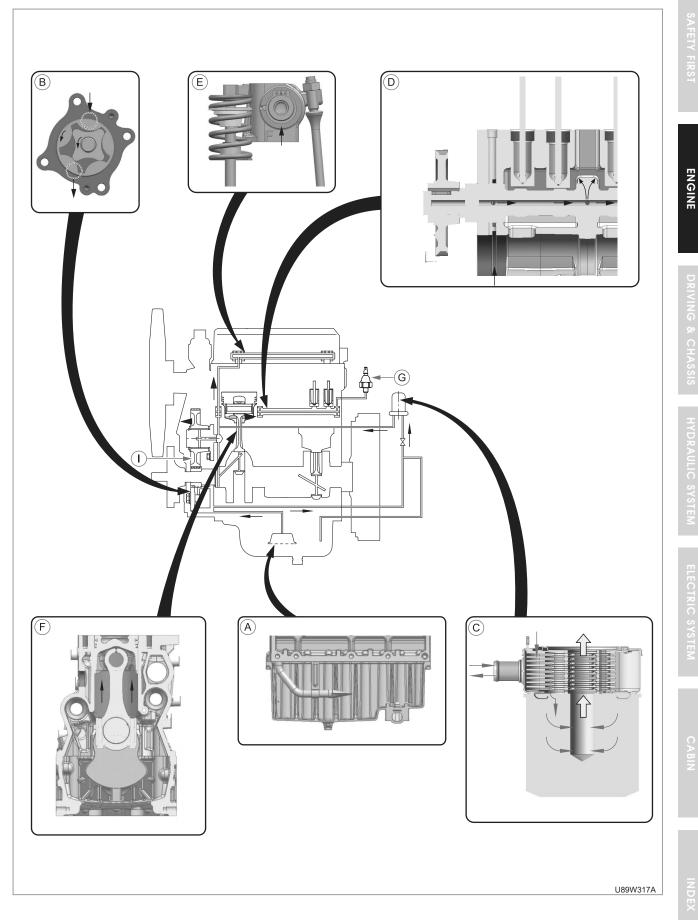
ENGINE

(6) Oil filter



2-38

3.3.3 FUNCTION OF LUBRICATING SYSTEM



OIL STRAINER (REFER TO FIGURE (A) ON 3.3.3)

OIL PUMP (REFER TO FIGURE (B) ON 3.3.3)

Type: Gerotor type

Oil: Tier2, Tier3 - CH grade or higher Tier4, Stage-V - CJ grade or higher SAE 10W30/10W40/15W40

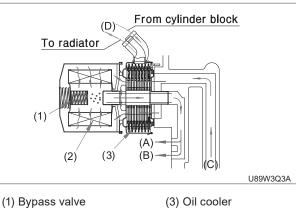
Standard oil temperature: 80°C

Discharge pressure: 4.5 kg/cm²

Displacement: Over 10.0 ℓ/min (1,000 rpm) Over 24.3 ℓ/min (2,000 rpm)

Drive gear speed ratio (oil pump drive gear/ oil pump gear) = 46/41 = 1.121

OIL FILTER AND RELIEF VALVE



(2) Filter element

(A) Oil filter outlet (to idle gear, camshaft and lock arm shaft)

(B) Oil filter outlet (to oil gallery, oil jet, crankshaft journal)(C) Oil filter inlet

(D) Coolant (Inlet - Outlet)

- Relief valve opening pressure: 4.0 ~ 4.5 kgf/cm² (57 ~ 64 psi)
- Oil filter

Filter paper fineness: Max.: 99 ± 5 microns, Average: 75 ± 5 microns

Filtered area: 1680 cm²

Bypass valve opening pressure (pressure difference between inner and outer side of filter paper): $1 \pm 0.2 \text{ kgf/cm}^2$

VALVE CAMSHAFT (REFER TO FIGURE (D) ON 3.3.3)

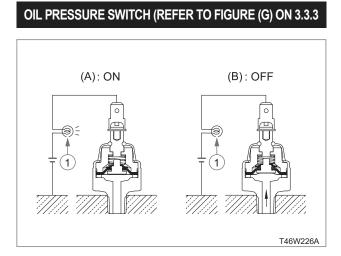
The oil enters the first journal bearing of the valve camshaft and is sent to each journal through the oil holes in the center of the camshaft. Then, it is sent to the oil pressure sensor through the last journal.

ROCKER ARM SHAFT (REFER TO FIGURE (E) ON 3.3.3)

The oil from the valve camshaft comes through the hole in the support bracket of rocker arm, supplied to each rocker arm through the hole in the center of rocker arm shaft. The oil drained from the hole on top of the rocker arm is used in lubrication on the contact surface of the valve and the rocker arm. Then, it flows along the push rod to lubricate the contact surface between the push rod and the tappet and between the tappet and the valve cam.

OIL FLOW (REFER TO FIGURE (F) ON 3.3.3)

The oil in the oil gallery flows to the main bearing and then to the connecting rod big end journal bearing. Oil is sprayed to the connecting rod (small end), piston interior and cylinder bore by the oil jet that is installed to the oil gallery.

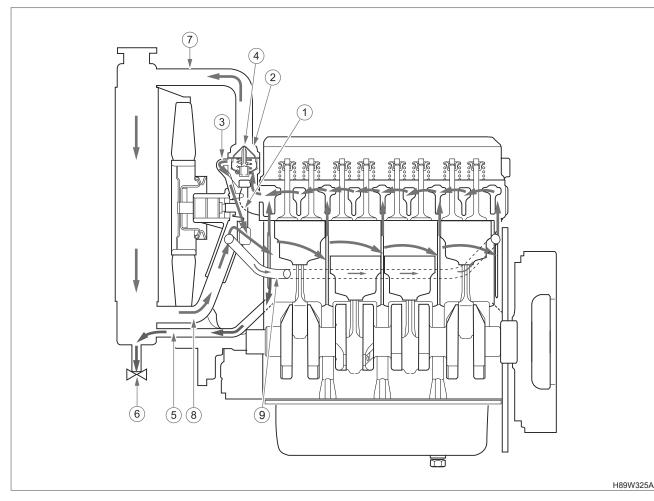


The oil pressure switch is installed on the cylinder block at the end of the valve camshaft and leads to the oil passage which is passing through the valve camshaft.

- A: When the oil pressure falls below the specified value, the circuit is connected by the diaphragm in the switch to turn on the warning lamp (1) on the instrument panel.
- B: When the key switch is turned to the "ON" position with the engine stopped, the warning lamp comes on. When the oil pressure rises, this lamp goes off.
- Oil switch operating pressure(min.):

 $0.5 \pm 0.1 \text{ kgf/cm}^2$ 7.1 ± 1.4 psi 49 ± 9.8 kPa

3.4 COOLING SYSTEM 3.4.1 COOLANT FLOW ROUTE



When the centrifugal water pump (1) connected to the cooling fan shaft rotates, the coolant in the cylinder block flows from the No. 1 cylinder to the No. 3 and No. 4 cylinders through the No. 2 cylinder, and also flows to the cylinder head (from lower to upper side). In the cylinder head, the coolant flows from the No. 4 cylinder to the No. 1 cylinder through the No. 2 and No. 3 cylinders (from rear to front side).

The coolant collected in the coolant flange (2) flows to the inlet of the water pump impeller through the return hose (3), and then returns to the cylinder block through the outlet of the impeller.

When the coolant temperature rises over $71^{\circ}C$ (160°F), the thermostat (4) opens and most coolant flows to the radiator through the thermostat. The coolant flowed to the top of the radiator through the top hose (7) is cooled down by the cooling air and sinks. Then, it flows to the inlet of the water pump impeller through the radiator lower hose (8) to return to the cylinder block.

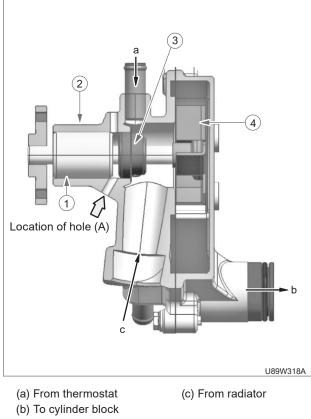
The drain hose (5) is to completely drain the coolant in the cylinder block when opening the radiator lower cock (6).

On the other hand, the vehicle equipped with the cabin heater has the cooling circuit that draws in hot water from the coolant flange (2) to heat the heater and drains it through the lower hose of the radiator.

Also, for the engine equipped with the engine oil cooler cools down the engine oil by connecting the water pump(1) drain line to the engine oil cooler.

Also, for the CRDI (Common Rail Direct Injection) engine, part of coolant escapes the impeller inlet passage of the water pump through the lower hose of the radiator and flows to the ERG cooler (9) to cool down some exhaust gas flowing to the intake manifold.

3.4.2 WATER PUMP



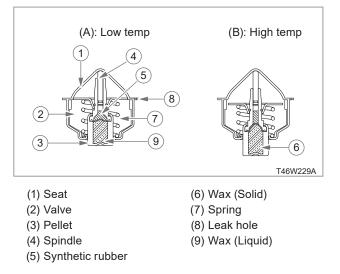
- (1) Bearing(2) Pump body
- (3) Mechanical seal
 - (4) Pump impeller

The water pump sucks the cooled water, forces it into the cylinder block and draws out the hot water to the radiator repeatedly. The mechanical seal (3) prevents the water from entering into the bearing (1).

REMARKS

• If the coolant is leaked from hole (A), it means that the mechanical seal is damaged. Therefore, the water pump assembly should be replaced.

3.4.3 THERMOSTAT



The thermostat is wax pellet type, which controls the flow of the cooling water to the radiator to keep the proper temperature. The case has a seat (1) and the pellet has a valve (2). The spindle attached to the case is inserted into the synthetic rubber in the pellet. The pellet is charged with wax.

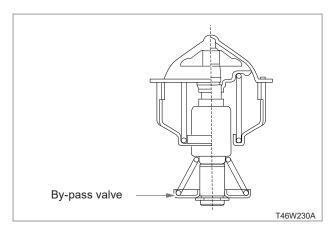
AT LOW TEMPERATURE: BELOW 82°C (180°F)

The valve (2) is seated by the spring (7) and the cooling water circulates in the engine through the water return pipe but does not enter the radiator.

AT HIGH TEMPERATURE: OVER 82°C (180°F)

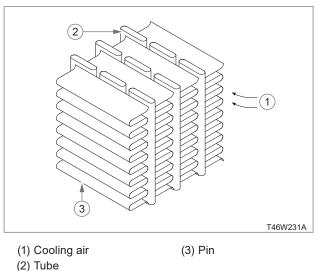
As the water temperature rises, the wax in the pellet (3) becomes liquid and it pushes out the spindle.

The pellet lowers and the valve (2) opens to send the cooling water to the radiator.



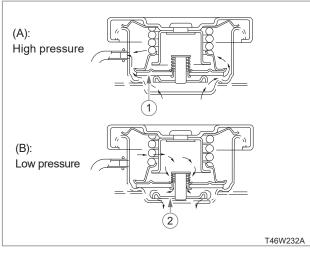
The bypass valve is equipped in the bottom of thermostat. Therefore, the cooling efficiency is enhanced as all coolant passes through the radiator since the internal circulation circuit is blocked as soon as the thermostat opens.

3.4.4 RADIATOR



The radiator core consists of water tubes (2) with fin (3) at a right angle to it. The water in the radiator is cooled down by the air flowing between the tube wall and the fin.

3.4.5 RADIATOR CAP



(1) Pressure valve

(2) Vacuum valve

The radiator cap is equipped with the pressure valve (1) and vacuum valve (2).

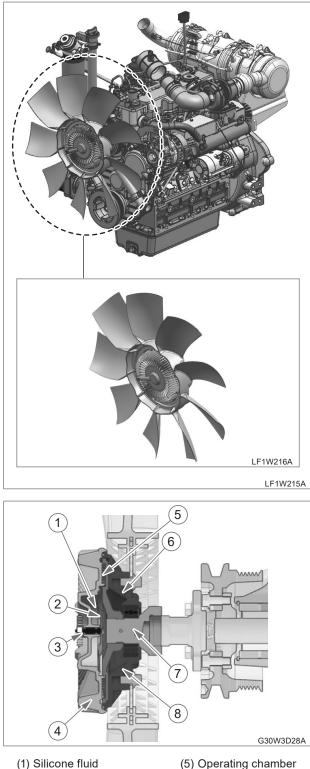
AT HIGH PRESSURE - OVER 88 kPa (0.9 kgf/cm², 13 psi)

When the water temperature rises and the pressure in the radiator increases above the specified value, the pressure valve (1) opens to drain the coolant to the reservoir tank to reduce the internal pressure.

AT LOW PRESSURE

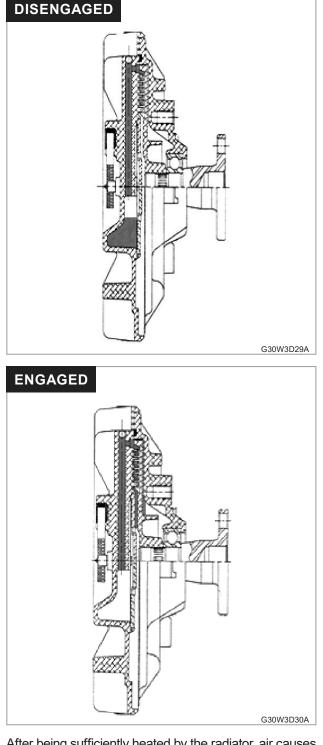
When the water temperature drops down and a vacuum is generated in the radiator, the vacuum valve (2) opens to allow the coolant in the reservoir tank to enter into the radiator.

3.4.6 CLUTCH FAN



- (2) Storage chamber
- (3) Bi-metalic coil (4) Cover
- (6) Clutch (7) Shaft (8) Body

The clutch fan uses a bi-metallic strip on the front of the clutch to reduce fuel consumption and fan noise by keeping the fan rpm low in cold weather and increasing the fan rpm in hot weather. The fan also speeds up the warm-up process of the machine by keeping the fan rpm low in winter or low load conditions.

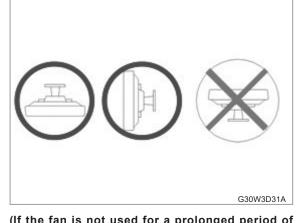


After being sufficiently heated by the radiator, air causes the bi-metallic strip to expand and the valve opens as silicone fluid stored in the storage chamber moves to the operating chamber and the clutch is rotated by the torque generated. Usually, in cold weather, the fan maintains a low rpm regardless of the engine rpm and maintains the maximum rpm when the temperature around the bi-metallic strip increases sufficiently.

Mechanical clutch fans which use silicone fluid have a slip rate of 5 - 10% of the normal input rpm.

- 🕂 CAUTION -

• When the clutch fan is placed in storage, silicone may leak if the part with the shaft mounted is facing downwards, so make sure to store it either facing the opposite direction or upright.



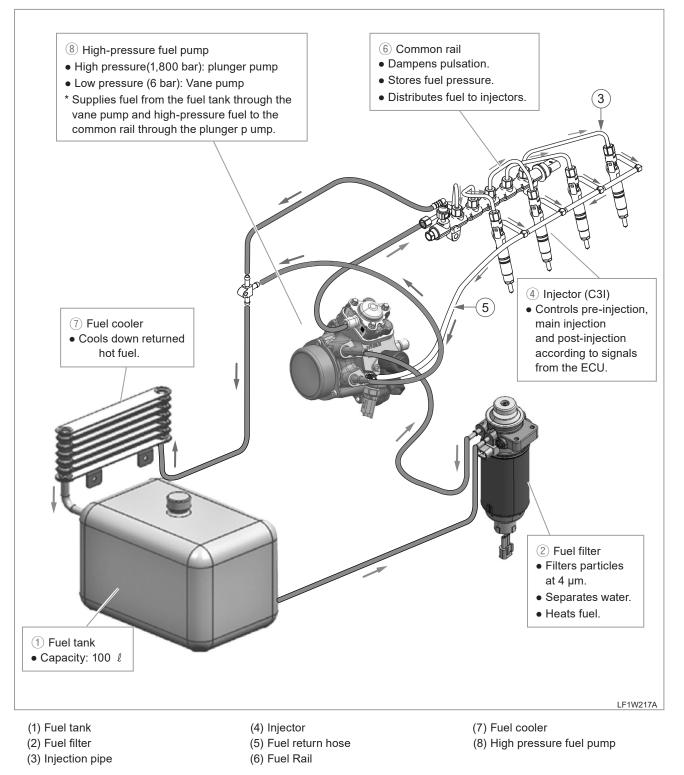
(If the fan is not used for a prolonged period of time, the rpm may temporarily appear higher than the disengaged rpm due to silicone in the storage chamber in low temperature conditions.)

3.5 FUEL SYSTEM

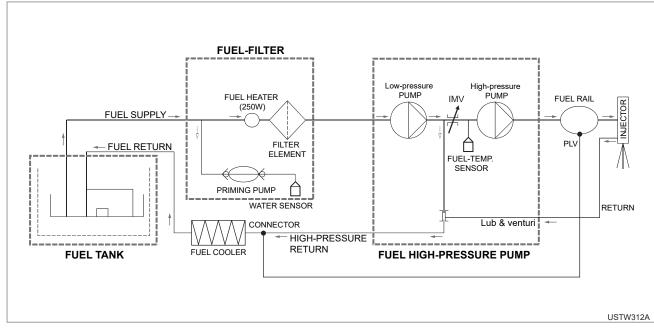
3.5.1 OVERVIEW FOR FUEL SUPPLY

The common rail fuel injection system is comprised of the fuel tank, fuel line, fuel filter, high-pressure fuel pump equipped with high/low pressure pumps for fuel supply, common rail to distribute/store high-pressure fuel, injector to inject high-pressure fuel precisely, and ECU (Electronic Control Unit) which calculates acceleration (position of the accelerator pedal) desired by the driver based on information from various sensors and controls instant performance of the engine and vehicle in general.

3.5.2 FUEL FLOW ROUTE



FUEL SYSTEM FLOW DIAGRAM

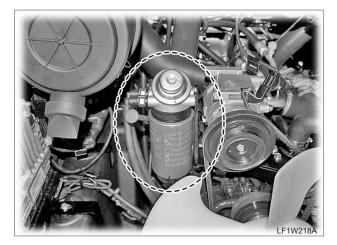


Fuel sucked from the fuel tank passes the fuel filter and flows into the high-pressure pump from the lowpressure pump in the high-pressure fuel pump. After it is pressurized in the high-pressure pump, it is flowed to the fuel rail and is injected through the injectors according to the fuel injection signal for each injector. The ECU controls the IMV to control the fuel flow according to the pressure needed for the fuel rail. Fuel in the injector is returned to the high-pressure pump and then is drawn into the fuel cooler through the return line to cool down and send this fuel back to the fuel tank. If pressure between the high-pressure pump and fuel rail rises abnormally, the PLV(Pressure Limit Valve) of the fuel rail (common rail) opens to release pressure.

REMARKS

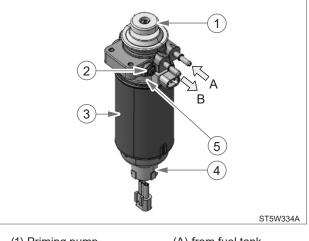
• For air bleeding, see the 3.5.4 BLEEDING THE FUEL SYSTEM.

3.5.3 FUEL FILTER



If water is mixed in fuel, fuel can be frozen in winter, making the engine hart to start or occurring wear, damage and corrosion across the fuel supply system, resulting in breakdown.

Therefore, water and foreign materials should be filtered thoroughly from fuel with the fuel filter.



- (1) Priming pump(2) Bleeding bolt
- (A) from fuel tank(B) to HP fuel pump
- (3) Filter ass'y
- (4) Water detection sensor
- (5) Fuel heater

As fuel from the fuel tank enters the fuel filter through its port (A), it flows through the filter element and then is supplied to the HP fuel pump through the port (B). The element in the fuel filter filters foreign materials over 4 microns in thickness at differential pressure of 10 kPa (0.1 kgf/cm², 1.45 psi). This fuel filter is not only to filter water and foreign materials from fuel, but also to preheat fuel. As diesel fuel tends to freeze on a low temperature condition, making the engine hard to start, this fuel filter is equipped with the fuel heater to avoid this situation.

► Water-in-fuel sensor

If a certain amount of water (45 cc or more) is accumulated in the filter, this sensor sends a signal to the ECU to turn on the corresponding warning lamp in order to inform the driver to drain water from the filter.

Fuel heater

When the ambient temperature is below $5^{\circ}F$ (- $15^{\circ}C$), some ingredients of diesel fuel start to gel, leading to engine stall. Therefore, the fuel heater is operated continuously to prevent engine stopping once the engine is started..

Priming pump

After the fuel tank becomes empty, removing water from the fuel filter or replacing the fuel filter, air remains in the fuel system. To remove this air, press the priming pump repeatedly with the bleeding bolt open until fuel is drained from the tank.

- 🕂 CAUTION –

 Fuel in the fuel tank should be sent to the filter by using the priming pump after replacing the fuel filter. Never crank the engine to operate the high-pressure pump in order to send fuel in the fuel tank to the filter after replacement.

IMPOARTANT -

- If water is collected in the fuel more than the specified, the corresponding warning lamp on the instrument cluster is illuminated. In this case, drain water from the filter.
- When replacing the fuel filter, replace it with the priming pump if possible.

3.5.4 BLEEDING THE FUEL SYSTEM

- 1. Make sure that the amount of fuel in the fuel tank is sufficient.
- If air is mixed in the fuel filter, unscrew its bleeding bolt (2), shown in the figure for the fuel filter, and press the priming pump continuously. Then, air in the fuel filter is bled through the bleeding bolt.

- 🕂 CAUTION -

 Avoid to run the start motor for over 5 consecutive seconds, but run it several times at shorter intervals.

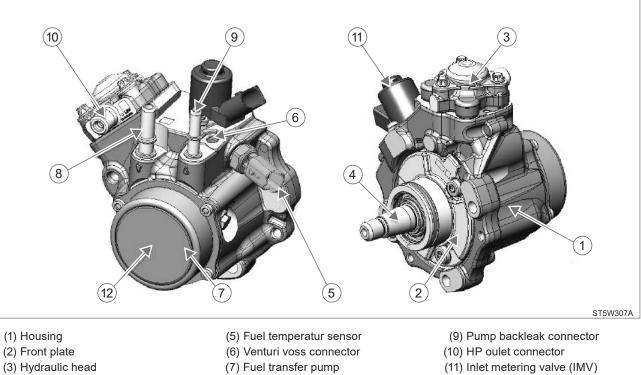
REMARKS -

• If filling the port with fuel before installing the fuel port, it is not necessary to bleed the filter.

3. If fuel is visible from the bleeding bolt, tighten it and start the engine.

3.5.5 HIGH PRESSURE FUEL PUMP

COMPONENT



- (3) Hydraulic head
- (4) Drive shaft

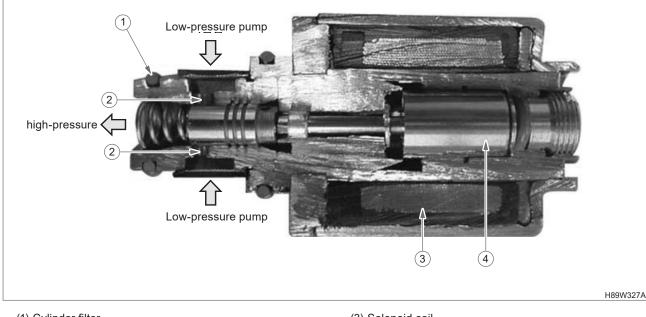
(12) Pump identification label

MAJOR COMPONENT SPECIFICATIONS

ITEM	FUNCTION	SPECIFICATION
Low pressure pump	Supplying fuel from fuel tank to high-pressure fuel pumpDriven by shaft of high-pressure fuel pump	Pumping capacity: 5.6 cc/rev
Pressure control valve (IMV)	 Controlling amount of fuel sent from low-pressure side to high-pressure fuel pump to match ECU-commanded pressure and actual fuel rail pressure 	-

(8) Pump inlet connector





(1) Cylinder filter(2) Radial hole

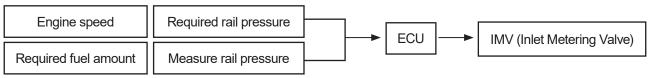
(3) Solenoid coil(4) Piston

The IMV (Inlet Metering Valve) is installed on the front of the high-pressure fuel pump and it is supplied with fuel from the transfer low-pressure pump through 2 radial orifices.

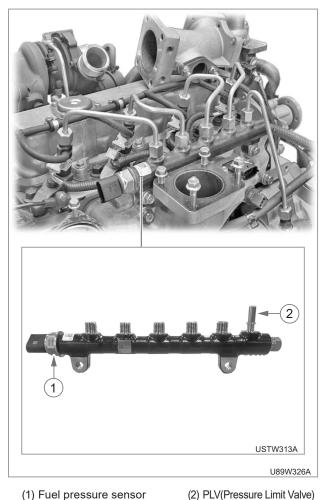
This valve is also called as low-pressure actuator and is used to control the rail pressure by adjusting fuel amount sent to the pumping section of the high-pressure pump.

It adjusts the fuel amount to keep pressure in the fuel rail constant for more effective injection system. It also limits the amount of fuel returned to the high-pressure pump to prevent excessively high temperature of fuel in the fuel tank due to excessively hot fuel sent from the injectors.

- Components: : piston, piston filter, O-ring, body and coil
- Function



3.5.6 COMMON RAIL (FUEL RAIL)



The Delphi DFR 4.18 PLV fuel rail stores and distributes high-pressure fuel to the injectors for fuel

Therefore, it is commonly used by all cylinders, and

it maintains its internal pressure continuously by itself even when the injectors open and pressure

Over pressure protection is ensured by the Pressure Limit Valve(PLV) located on the rail. PLV opening

ENGINE

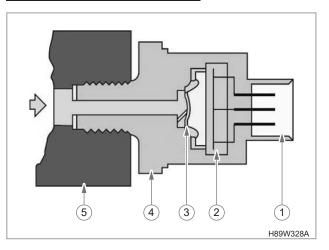
injection.

drops.

pressure is 2,350 ± 100 bar.

INDEX

FUEL PRESSURE SENSOR

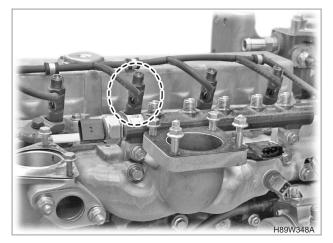


- (1) Connector
- (2) Measuring circuit
- (3) Sensor element (diaphragm)
- (4) Fuel rail pressure sensor assembly
- (5) Fuel rail

The fuel pressure sensor (1) with the capacity of 0 to 2,500 bars is installed to the side of the fuel rail. It detects the instant change in the fuel pressure, converts this information to a voltage signal and sends this to the ECU which then controls pressure of the fuel rail precisely.

The pressure in the fuel rail is determined by the engine RPM, engine torque, barometric pressure, coolant temperature and intake temperature. Also, the ECU receives and uses this information to adjust the fuel injection amount and injection timing for the injector of each cylinder.

3.5.7 INJECTOR [C3I (CALIBRATION IMPROVED INDIVIDUAL INJECTOR)]



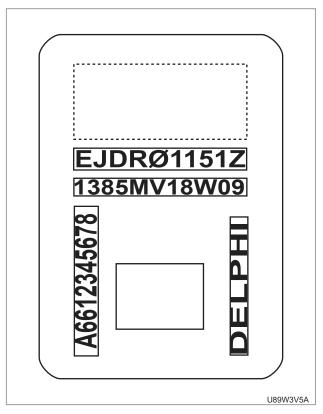
This Delphi DFI 2.20S solenoid type injector is capable of multiple injections for each injection timing within a short period of time with the maximum nozzle opening pressure of 1,800 bar (1,835 kgf/cm², 26,106 psi) and features low noise, low vibration and low fuel consumption through electronic control by the ECU.

The injector starts fuel injection at least at 300 bars and up to 1,800 bar.

INJECTOR CORDIFICATION



The code C3I is marked on the side of the injector and cylinder head cover. This code consists of 20 digits including numbers from 1 to 9 and alphabetic characters excluding I, O, Q and V.



- * 20 digits with combination of alphabetic characters and numbers
- Alphabetic characters: A, B, C, D, E, F, G, H, J, K, L, M, N, P, R, S, T, U, W, X, Y ,Z
- Numbers: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9

IMPOARTANT –

 When installing the injector (new) to the cylinder block, connect the ECU to the scan tool and enter the injector code (20 digits) specified on the top of the injector into the scan tool.

REMARKS -

MDP (MINIMUM DRIVE PULSE) LEARNING

 When the injector starts injecting fuel, this initial pulse value is measured to correct the pilot injection efficiently through the MDP control. Since the amount of fuel for pilot injection is very small (1 to 2 mm/st), it is hard to control the injectors precisely as they get aged. Therefore, injection amount and condition of the injectors are learned for consistent precise control over the injectors so that the ECU can adjust the pilot injection effectively. The MDP is learned by the knock sensor.

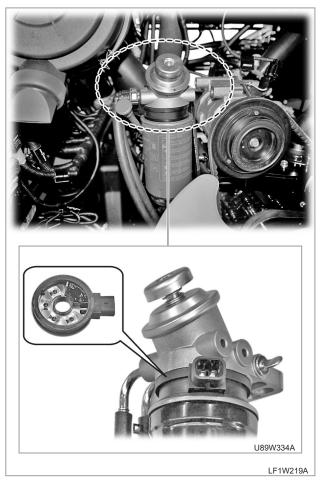
CAUTION -

To prevent damage to the fuel system:

- Use only genuine Diesel fuel. Low-quality fuel can clog (caulk) the nozzle.
- Drain water from the fuel filter when the waterin-fuel warning lamp comes on.
- Keep the fuel filter replacement schedule.
- Prevent introduction of any foreign material during disassembly and assembly.

3.5.8 FUEL HEATER AND FUEL COOLER

FUEL HEATER



The fuel heater is installed between the priming pump and filter body of the fuel filter. Diesel fuel contains paraffin, so it tends to solidify in a cold weather. In this case, fuel can block fuel passages, resulting in difficulty to start the engine or engine stall.

To prevent this, the filter is equipped with the heater which is operated to melt paraffin in fuel at temperatures below freezing.

When the bimetal in the heater reaches specified temperature, it is connected to the internal circuit and receives power from the external heater relay.

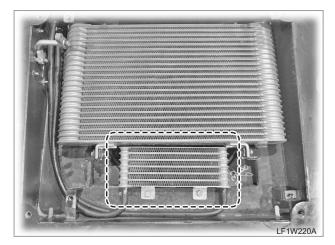
When the bimetal in the heater reaches specified temperature, it is connected to the internal circuit and receives power from the external heater relay.

When the switch contact is closed under sub-zero temperatures, the relay is turned ON to operate the heater which then heats fuel.

► RANGE OF BIMETAL OPERATION TEMP.

- ON : -3°C ± 4°C
- OFF : 17°C ± 4°C

FUEL COOLER



In the CRDI (Common Rail Direct Injection) engine, the temperature of returning fuel is increased high due to high pressure and multiple injection of the injectors.

If the temperature of diesel fuel becomes excessively high, its lubrication film breaks and its elements are transmuted. Then, some components using fuel as lubricant, such as the high-pressure pump, can be damaged easily.

Therefore, fuel returned from the injector to the high-pressure fuel pump through the return pipe is passed through the fuel cooler to be cooled before returning back to the fuel tank.

SPECIFICATION

- Air flow: 8 m/s
- Fuel flow: 2.6 LPM
- Fuel inlet temperature: 95°C (203°F)
- Fuel capacity: Approx. 0.15 L

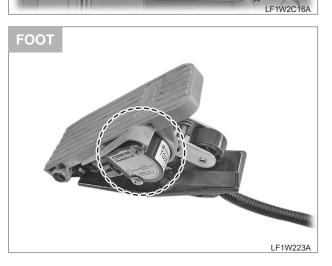
3.6 ACCELERATION SYSTEM



When depressing the accelerator pedal (1) or moving the engine throttle dial (2) to select a high speed, detects the amount of movement of the acceleration position sensor and sends this information to the ECU which then permits combustion in the chamber to increase the engine RPM and power.

HAND

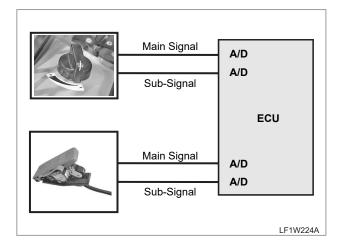
ACCELERATION POSITION SENSOR



The APS (Acceleration Position Sensor) detects the amount of accelerator pedal depression and engine throttle dial moving distance. It sends information regarding to displacement of the pedal and lever to the ECU. The engine ECU determines the fuel injection amount and injection timing based on the information from this sensor. This sensor consists of two potentiometers each for the hand throttle lever and accelerator pedal. Two separate sensors are integrated into this one sensor to complement for each other. The sensor 1 plays a major role in determination of the fuel injection amount and injection timing while the sensor 2 detects any defective signal from the sensor 1.

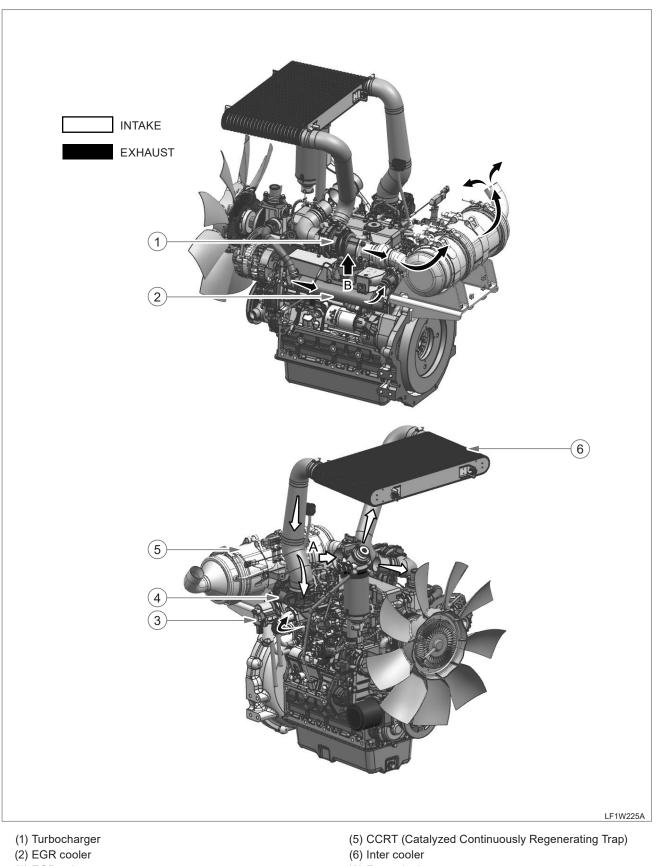
Therefore, safe engine operation is guaranteed through this dual tracking signal structure. In a normal condition, the ECU receives normal main and auxiliary signals. However, if any of these signals is faulty (signal value difference more 15%), the ECU does not change the engine operating condition but keeps the engine in this condition.

ENGINE SIGNAL STRUCTURE



3.7 INTAKE & EXHAUST SYSTEM

3.7.1 OVERVIEW



- (3) EGR valve
- (4) Air control valve

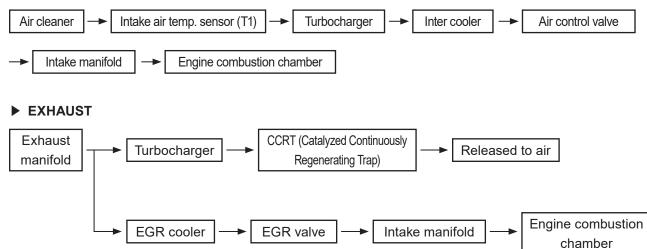
- (A) From air cleaner
- (B) To CCRT (Catalyzed Continuously Regenerating Trap)

As fresh air is drawn in to the system through the air cleaner, it flows to the compressor wheel side of the turbocharger (1) through the suction pipe to go through the compression process. Then, it is supplied to the intercooler through the connecting pipe, cools to the specified temperature, and it flows to the intake manifold flange through the air control valve (4).

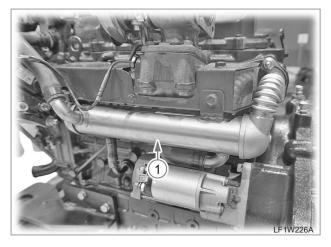
On the other side, exhaust gas discharged from the exhaust manifold enters the turbocharger to turn the turbine and it is discharged to the air through the CCRT (Catalyzed Continuously Regenerating Trap) (5). Its remainder is drawn into the EGR cooler (2) as illustrated.

This exhaust gas in the EGR cooler is moved to the passage in the cylinder head through the bellows, and it passes through the EGR valve (3) on the other side to enter the intake manifold flange through the connecting pipe. Finally, fresh air, which was compressed by the turbocharger, and exhaust gas are mixed together, flowing into the cylinder of the engine.

► INTAKE

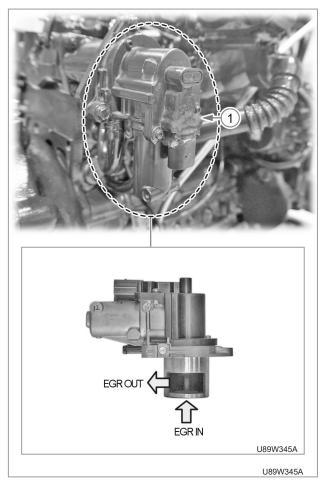


3.7.2 EGR COOLER



- Normally, when the combustion temperature in the combustion chamber is high, a lot of NOx (Nitrogen Oxide) is generated. To decrease this amount, some of exhaust gas is recirculated to decrease the oxygen density so the combustion temperature, and this method is called EGR (Exhaust Gas Recirculation).This EGR type supplies some of exhaust gas to the cylinder so the amount of intake air and fuel consumption are decreased, resulting in improvement of fuel efficiency.
- The EGR cooler (2) is a pipe type cooler as illustrated and is connected to the coolant flange and cylinder block. It is also connected to the exhaust manifold to flow coolant along the duct line of exhaust gas from the exhaust manifold through the cylinder head passage to the EGR valve to decrease the temperature of exhaust gas.

3.7.3 EGR VALVE

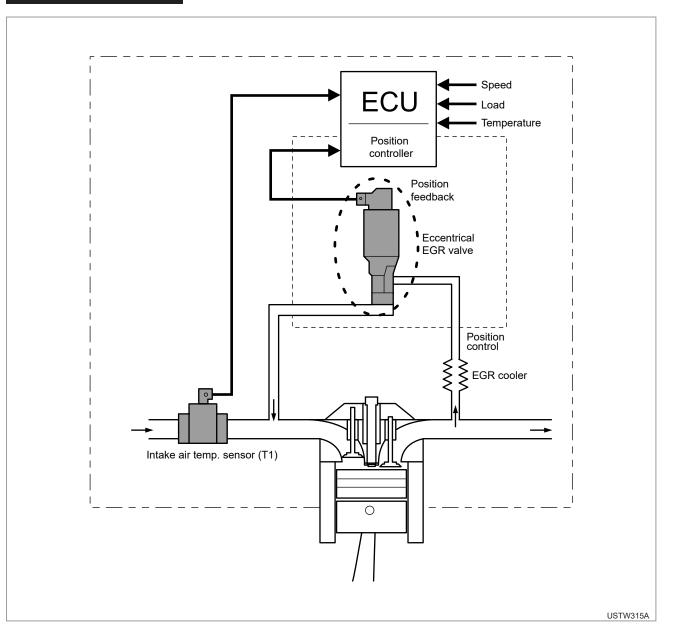


The EGR valve (1) supplies exhaust gas to the cylinder so the amount of recirculation intake air and fuel consumption are decreased, resulting in improvement of fuel efficiency. The EGR valve adjust the amount of exhaust gas supplied to the cylinder. It supplies a proper amount of exhaust gas through control of the ECU based on signals from the position sensor.

CHARACTERISTICS

- Enhanced responsiveness and accuracy by control from engine ECU: Solenoid in EGR valve activated by receiving signal directly from engine ECU
- Feedback function added : Feedback for exact position of EGR valve to ECU
- Chattering elimination and durability enhancement : Reinforced with 2 valve seats
- EGR valve cleaning : Chattering with valve seat and solenoid in housing to remove foreign materials

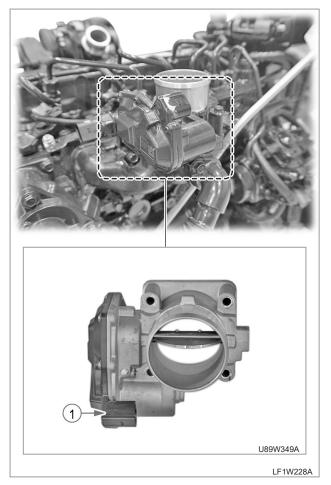
EGR SYSTEM DIAGRAM



ENGINE

GMW-0035

3.7.4 AIR CONTROL VAVLE



The air control valve is installed right before the intake manifold flange in order to control the amount of air before the air is drawn into the intake manifold through the turbocharger and intercooler after it is sucked through the air cleaner.

The inlet of the air control valve is equipped with a fan(throttle valve) to control the amount of intake air. This fan opens and closes according to the operation of the accelerator pedal to adjust the amount of air supplied into the cylinder.

Also, the air control valve has the throttle position sensor (1). This sensor detects the opening angle of the fan and sends this information to the ECU which then determines and controls the amount of injected fuel according to this value.

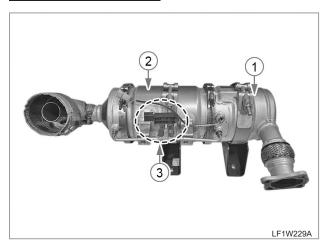
► Air control valve characteristics

- Prevention of dieseling and engine vibration by cutting off intake air with engine stopped
- · Intake air amount control synchronized with CCRT system
- Effective EGR control synchronized with EGR system

• When the ignition switch is turned to the OFF position, the throttle valve is completely closed and the output voltage (5 V) is activated for approx. 1.2 seconds.

3.7.5 CCRT (CATALYZED CONTINUOUSLY REGENERATING TRAP)

SYSTEM OVERVIEW



- (1) DOC (Diesel Oxidation Catalyst)
- (2) DPF (Diesel Particulate Filter)
- (3) Differential pressure sensor

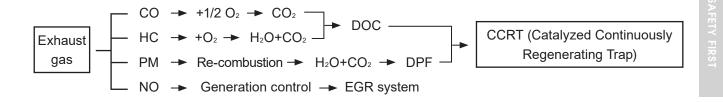
The conventional DOC (Diesel Oxidation Catalyst) equipped in a diesel engine features high purification performance for HC and CO but low reduction rate of PMs. To enhance the performance, the conventional DOC has been combined with the DPF. The DOC discharges harmless CO2 and H2O through oxidation of CO and HC while the DPF regenerates collected PMs (Particulate Materials). This system is called CCRT (Catalyzed Continuously Regenerating Trap).

Sulfur in diesel fuel combines with oxygen gas during combustion, promoting creation of PMs.

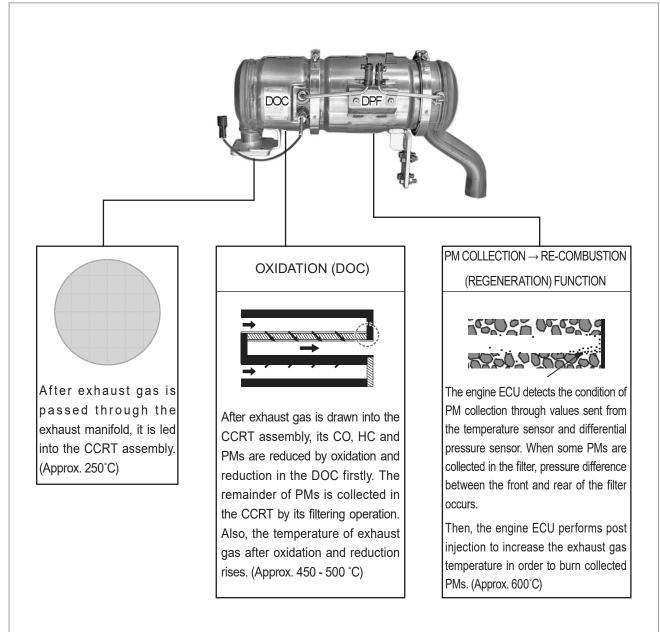
If an excessive amount of PMs is accumulated in the DPF (Diesel Particulate Filter), pressure difference between the front and rear sections of the DPF is detected by the differential pressure sensor (3), resulting in activation of regeneration process.

PMs are naturally combusted when the temperature of exhaust gas is high or there is a sufficient amount of NOx (Nitrogen Oxides).

Therefore, if regeneration is necessary, the ECU automatically controls the temperature of exhaust gas to activate the regeneration process. Alternatively, the driver can press the regeneration button until the corresponding indicator on the instrument cluster comes ON.



SYSTEM OPERATING PRINCIPLE



ENGINE

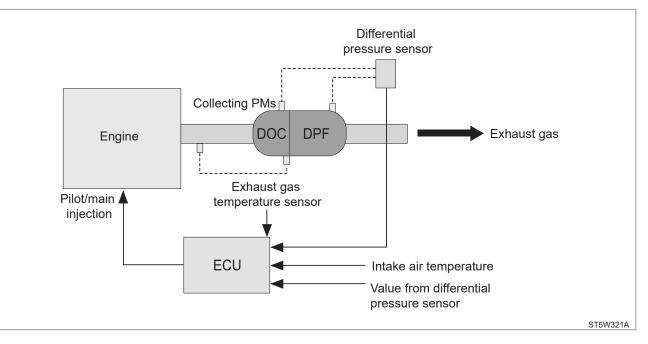
U89W3T1B

PM REGENERATION OF DPF

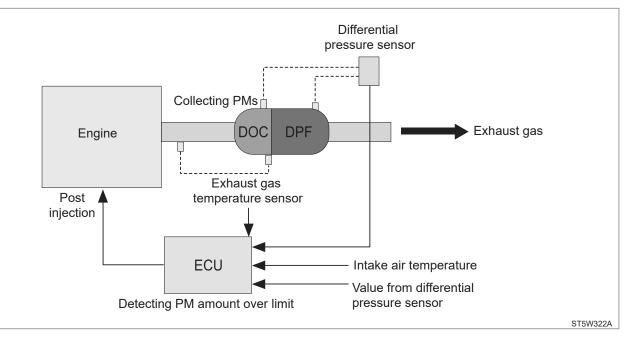
The DPF is equipped with the differential pressure sensor to detect the pressure at the inlet and outlet of the CCRT. The amount of PMs (Particulate Materials) in the filter of the CCRT is calculated based on the exhaust gas temperature, intake air temperature, booster pressure, etc.

When the weight of PMs in the filter becomes 21.1 g or higher, regenerating process is activated. The ECU commands post injection to increase the temperature in the CCRT up to 600°C during regeneration.

▶ SPECIFIED PM AMOUNT NOT DETECTED: THE DPF PERFORMS ONLY ITS FILTERING FUNCTION



SPECIFIED PM AMOUNT DETECTED: THE ECU COMMANDS THE INJECTORS TO POST-INJECT FUEL IN ORDER TO INCREASE THE EXHAUST GAS TEMPERATURE FOR REGENERATION (RE-COMBUSTION).

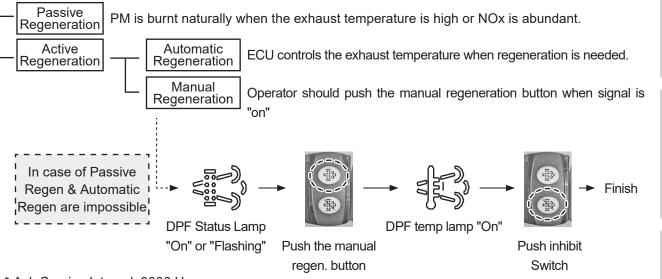


CAUTION -

PRECAUTIONS FOR MAINTENANCE OF CATALYTIC FILTER

- Make sure to use the genuine fuel.
- Keep the engine oil change schedule.
- Check and service the engine oil amount frequently.
- Avoid unnecessary idling of the engine.
- Never stop the engine during driving.
- Never place the shift lever in the neutral position on a a downhill.
- Do not use any kind of additive for engine oil and fuel.
- Avoid prolonged driving with the warning lamp illuminated.
- Make sure that any flammable material, such as dry grass or paper, gets to the catalytic filter while parked.

REGENERATION STRATEGY

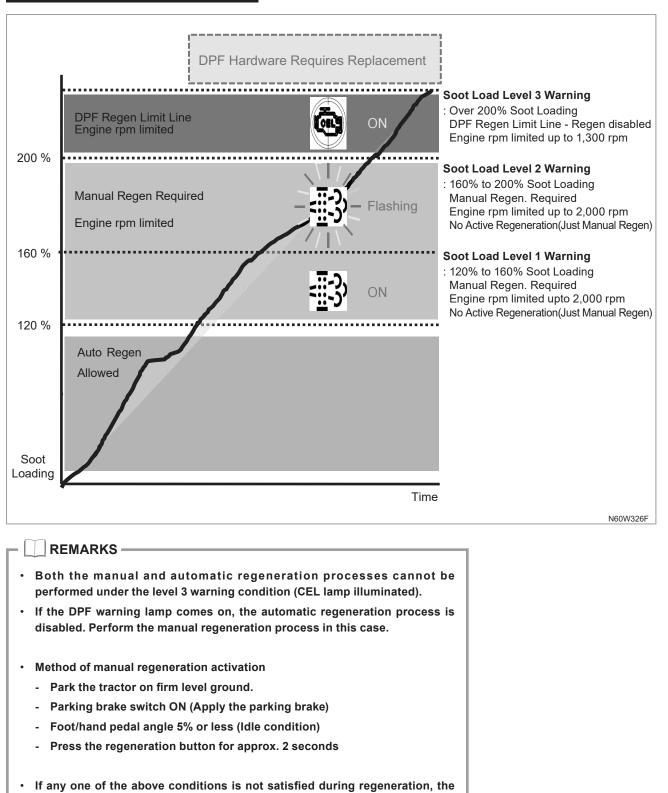


* Ash Service Interval: 3000 Hours



ENGINE

SOOT LOADING & WARNING LAMP



- In manual regeneration, the operation is impossible and regenerate the . following procedure.
 - 1st: Before Mode: 700 sec. at 1,500 rpm

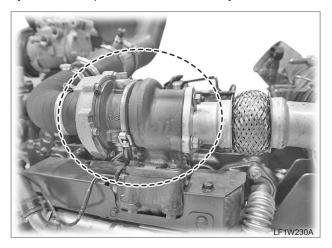
regeneration process is canceled.

- 2nd: Regen Mode: 1,500 sec. at 2,600 rpm
- 3rd: After Mode: 180 sec. at 1,600 rpm

3.7.6 TURBO CHARGER

SYSTEM OVERVIEW

The turbocharger is equipped with the turbine and compressor at a different angle at each end of one shaft. The compressor housing is connected to the intake manifold while the turbine housing is connected to the exhaust manifold. When the turbine starts to rotate by pressure of exhaust gas, the impeller on the intake side rotates as well. Then, air around the center of the impeller is applied with centrifugal force, accelerated outwards, and is drawn into the intake manifold through the intake connecting pipe. As the passage is large in volume, kinetic energy of supplied air is converted to pressure energy and this energy is supplied to the cylinder for superior volume efficiency. Also, exhaust efficiency is enhanced by rotation of the exhaust turbine.

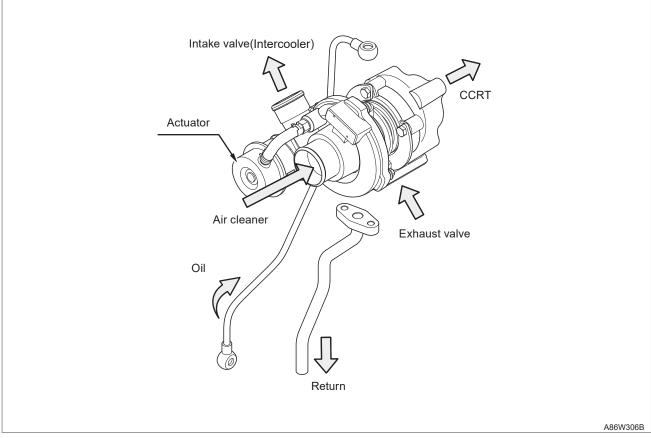


The turbocharger is installed between the exhaust manifold and intake manifold and it is driven by exhaust gas.

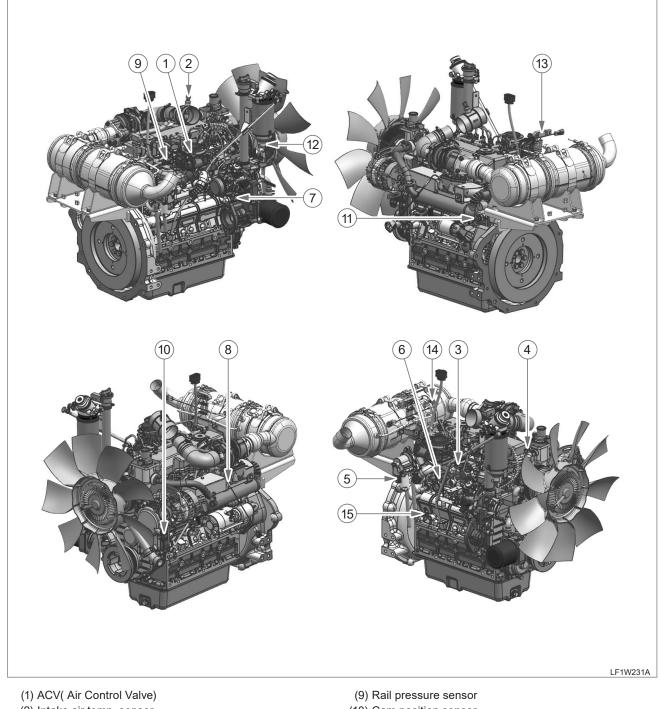
Its wheel on the turbine side is rotated at a high speed by exhaust gas while the compressor wheel on the other side is rotated by the connecting shaft. As fresh air is drawn through the air cleaner, it is compressed by the compressor wheel of the turbocharger under high pressure, higher than barometric pressure, and it flows to the intake valve.

The bearing in the turbocharger is lubricated by the engine oil from the engine cylinder block.

TURBOCHARGER STRUCTURE



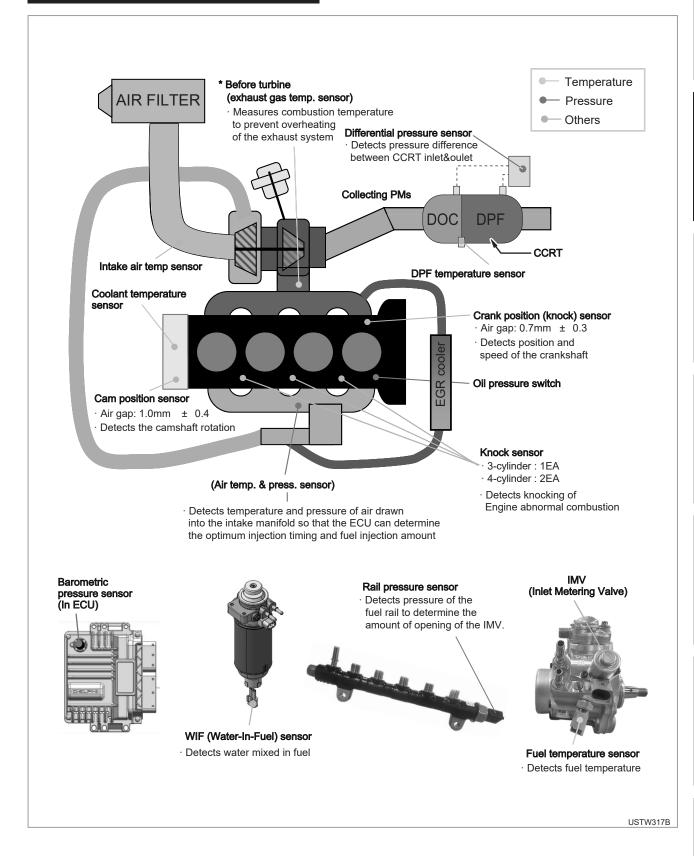
3.8 SENSOR



- (2) Intake air temp. sensor
- (3) Air temp. & pressure sensor
- (4) Water temp sensor
- (5) EGR valve
- (6) Knock sensor (1 for 3 Cyl, 2 for 4 Cyl)
- (7) Fuel temp. sensor
- (8) Exhaust temp. sensor(FRT)

- (10) Cam position sensor
- (11) Oil pressure switch
- (12) WIF(Water In Fuel) sensor
- (13) Differential pressure sensor(14) Exhaust temp sensor(RR)
- (15) Crank shaft wheel sensor

SENSOR AND ACTUATOR COMPONENTS



ENGINE

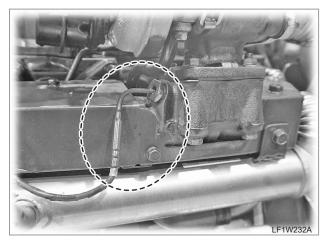
INTAKE AIR TEMPERATURE SENSOR (T1) (2)

The intake air temp. sensor is installed on the connection of the suction hose to detect temperature air flow. This information is used for determination of fuel injection amount as well as feedback control for EGR (Exhaust Gas Recirculation).

AIR TEMP. & PRESSURE SENSOR (3)

This sensor is installed on the intake manifold and its information is used as correction information for adjustment of the fuel amount, injection timing and fuel amount control at starting.

FRONT EXHAUST GAS TEMPERATURE SENSOR (8)



It is installed to the back of the exhaust manifold to measure the combustion temperature in order to prevent overheating of the exhaust system.

If the system is overheated, the combustion temperature is decreased by the EGR control.

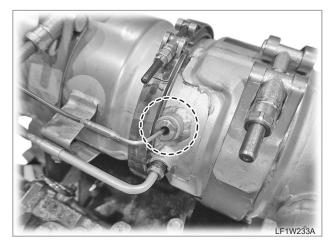
DIFFERENTIAL PRESSURE SENSOR (13)



This sensor is to measure the pressure difference between the inlet and outlet of the CCRT.

(If the pressure difference between the inlet and outlet is over the specification due to collected PMs, postinjection is performed to regenerate PMs forcibly.)

REAR EXHAUST GAS TEMPERATURE SENSOR (14)



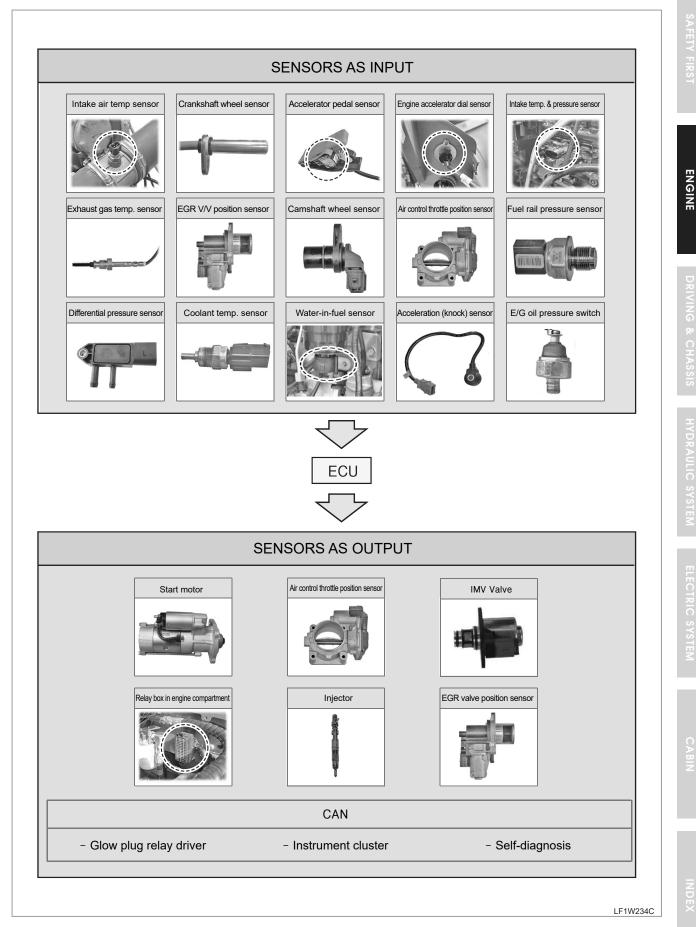
It is installed to the rear section of the DOC to determine overheating condition of the CCRT and fuel amount of the post-injection process.

The fuel amount for the post-injection process is adjusted by the exhaust gas temperature detected by this sensor. If the temperature is below 600°C, the fuel amount is increased to increase the regeneration temperature. If the temperature is over 600°C, the fuel amount is decreased or not adjusted.

When the engine is running in the low load range, the intake air amount is also adjusted to increase the regeneration temperature.

This process is used to add more fuel and reduce intake air amount simultaneously within the set control logic range in order to increase the combustion temperature during the postinjection process.

3.8.1 SENSORS AS INPUT/OUTPUT FOR ECU



4. TROUBLESHOOTING

SYMPTOM	CAUSES	REMEDY		
Engine Does	• No fuel	Add fuel		
Not Start	Air in fuel system	Bleed air		
	Water in fuel system	Change fuel and repair or flush fuel system		
	Clogged fuel pipe	Clean		
	Clogged fuel filter	Clean or replace		
	 Excessively high viscosity of fuel or engine oil at low temperature 	Use the specified fuel or engine oil		
	 Fuel with low cetane number 	Use the specified fuel		
	• Fuel leak due to loose injection pipe mounting nut	Tighten nut		
	Incorrect injection timing	Adjust		
	Defective fuel injection pump	Repair or replace		
	Defective fuel transfer pump	Repair or replace		
	 Seizure of transfer pump, defective piston, cylinder bore or bearing 	Repair or replace		
	Compression leak from cylinder	Replace head gasket, tighten cylinder head screws, glow plug and nozzle holder		
	Improper valve timing	Correct or replace timing gear		
	Worn piston ring and bore	Repair or replace		
	Excessive valve clearance	Adjust		
Start motor Does Not Run	Discharged battery	Charge		
	Defective start motor	Repair or replace		
	 Defective key switch 	Repair or replace		
	Disconnected wiring	Connect		
Engine	Clogged or dirty fuel filter	Clean or replace		
Running is Not	 Clogged Air cleaner 	Clean or replace		
Smooth	Fuel leak due to loose injection pipe mounting nut	Tighten nut		
	 Defective fuel injection pump 	Repair or replace		
	 Seized or clogged nozzle 	Repair or replace		
	 Clogged fuel overflow pipe 	Clean or replace		
Either White or	Excessive engine oil	Reduce to the specified level		
Blue Exhaust Smoke is	• Worn piston ring and bore or seized piston ring	Repair or replace		
Produced	Insufficient compression pressure	Adjust valve clearance		
Either Black	Overheat or overload	Reduce load		
or Dark Gray	Low grade fuel used	Use the specified fuel		
Exhaust Smoke is	Clogged fuel filter	Clean or replace		
Produced	Clogged Air cleaner	Clean or replace		
Insufficient	Seized engine components	Repair or replace		
Output	Uneven fuel injection	Repair or replace the fuel injection pump		
	 Insufficient nozzle injection 	Repair or replace the nozzle		
	Compression pressure leak	Replace cylinder head gasket, check tightness of cylinder head screws and nuts glow plug and nozzle holder		

IDEX

SYMPTOM	CAUSES	REMEDY
Excessive Engine Oil	Aligned gaps of piston rings	Change the ring gap direction
Consumption	Worn or seized oil ring	Replace
	Worn piston ring groove	Replace piston
	Worn valve stem and guide	Replace
	Worn crankshaft bearings and crank pin bearings	Replace
Water in	Defective cylinder head gasket	Replace
Engine Oil	Cracked cylinder block or cylinder head	Replace
Low Oil	Insufficient engine oil	Add
Pressure	Clogged oil strainer	Clean
	Clogged oil filter cartridge	Replace
	Relief valve stuck with dirt	Clean
	Weak or broken relief valve spring	Replace
	Excessive oil clearance of crankshaft bearings	Replace
	Excessive oil clearance of crank pin bearings	Replace
	Excessive oil clearance of rocker arm bushings	Replace
	Clogged oil passage	Clean
	Improper type of oil	Use the specified type of oil
	Defective oil pump	Repair or replace
	. Improper type of eil	Line the encoified type of ail
High Oil Pressure	Improper type of oilDefective relief valve	Use the specified type of oil Replace
Engine	Insufficient engine oil	Add
Overheating	 Damaged fan belt or improper tension 	Replace or adjust
	Insufficient coolant	Add
	Corroded radiator	Clean or replace
	Corroded coolant flow line	Clean or replace
	Defective radiator cap	Replace
	Damaged coolant pipe	Replace
	Defective thermostat	Replace
	Defective coolant pipe	Replace
	Overload running	Reduce load
	Defective cylinder head gasket	Replace
	Improper fuel used	Use the specified fuel
Coolant leakage	Damaged mechanical seal on water pump	Replace water pump
	Insufficient battery electrolyte	Add distilled water and charge
Frequently	Fan belt slip	Adjust fan belt tension or replace it
	Disconnected wiring	Connect
Discharged		
Discharged Battery	Defective regulator or alternator	Replace

REMARKS -

TURBOCHARGER TROUBLESHOOTING

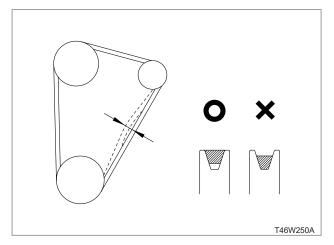
The chart below is given to assist in the correct diagnosis of turbocharger faults.

PROBLEMS			POSSIBLE CAUSES CODE NUMBERS					
Not enough power		1,4,5,6,7,8,9,10,11,18,20,21,22,25,27,28,34,35,36						
Black smoke			1,4,5,6,7,8,9,10,11,18,20,21,22,25,27,28,34,35,36					
Blue smoke			1,2,4,7,8,9,17,19,20,21,22,30,31,32,34					
ŀ	ligh lubricating oil consumption		2,8,15,17,19,20,28,29,31,32,34					
Т	oo much lubricating oil at turbine end		2,7,8,17,19,20,22,28,30,31,32					
Too much lubricating oil at compressor end			1,2,4,5,6,8,19,20,21,28,31,32					
٨	lot enough lubrication		8,12,14,15,16,23,2	4,29	,32,33,37,38			
L	ubricating oil in exhaust manifold		2,7,17,18,19,20),22,	28,31,32			
L	ubricating oil in intake manifold		1,2,4,5,6,8,10,11,17,1	8,19	,20,21,28,32,34			
C	Damaged compressor impeller		3,4,6,8,12,15,16,20,21,	23,2	4,29,32,33,37,38			
C	Damaged turbine rotor		7,8,12,13,14,15,16,18,20,22,	23,2	4,25,27,29,32,33,37,38			
Rotating assembly does not turn freely			3,6,7,8,12,13,14,15,16,18,20,21,22,23,24,29,32,33,37,38					
	Worn bearings, bearing bores, journals		6,7,8,12,13,14,15,16,23,24,29,33,37,38					
٩	Noisy turbocharger		1,3,4,5,6,7,8,9,10,11,12,13,14,15,16,18,20,21,22,23,24,29,32,33,34,37,38					
	Sludge or carbon deposit in bearing housing		2,11,13,14,15,17,18,24,29,33,37,38					
1. 2. 3.	Element of air filter dirty Restricted crankcase breather Element of air filter not fitted, improper sealing or loose connection to turbocharger	13. 14.	Delayed lubrication to turbocharger during engine starting Insufficient lubrication Dirty engine oil Incorrect engine oil	27. 28.	Defective high pressure fuel pump Valves burned Worn piston rings Lubricating oil leakage from supply pipe			
4.	Internal distortion or restriction in pipe from air filter to turbocharger	16.	Restricted lubricating oil supply pipe	30.	Excessive preservation fluid (on initia engine start)			
5.	Damaged/restricted crossover pipe, turbocharger to intake manifold		Restricted lubricating oil drain pipe Turbine housing damaged or	31.	Excessive engine idle period			
б.	Clogged air filter and turbocharger	10	restricted	32.	Restriction in turbocharger bearing housing			
7.	Restriction in exhaust system		Leakage from turbocharger seals	33.	Clogged oil filter			
3.	Loose turbocharger or clamps/		Worn turbocharger bearings Excessive dirt in compressor housing		Air cleaner: Restricted, dirty element			
).	setscrews loose or cracked intake manifold or distorted flange		Excessive carbon behind turbine rotor	35.	Waste-gate actuator faulty o damaged			
10.	Cracked or loose exhaust manifold or distorted flange		Engine speed raised too rapidly at initial start		Waste-gate valve not free Engine stopped too soon from hig			
11.	Restricted exhaust system	24.	24. Insufficient engine idle period		load			

38. Insufficient lubricating oil

5. MEASUREMENT AND ADJUSTMENT

5.1 FAN BELT



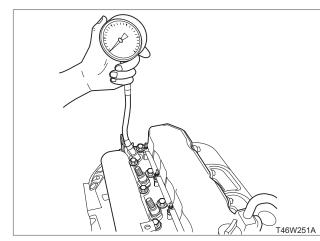
Measure the deflection by depressing the center of the belt between the fan drive pulley and the alternator pulley at 98 N (10 kgf, 22 lbs) of force.

If the deflection is out of the specified value, loosen the bolts and nuts and adjust the location of the alternator.

If the belt is damaged or worn (see figure), replace the belt.

Fan belt deflection...... 7 ~ 9 mm (0.28 ~ 0.35 in.)

5.2 PISTON COMPRESSION PRESSURE MEASUREMENT



- 1. Run the engine until it is warmed up.
- 2. Stop the engine and remove the air cleaner, the muffler and all nozzle holders.
- 3. Connect a compression tester to the nozzle holder hole.
- 4. Pull the stop lever or close the fuel filter with the cock to cut the fuel and crank the engine with the starter motor for 5 to 10 seconds.
- 5. Measure the maximum pressure several times while engine running.
- 6. If the pressure does not reach the allowable limit, apply few drops of oil to the cylinder wall through the nozzle holder hole and check the pressure again.
- 7. If the pressure rises after applying the oil, check the cylinder wall and piston ring for wear.
- 8. If the pressure is still low, check the top clearance, valve clearance and cylinder head.

Compression pressure	Specified value	3.24 ~ 3.73 MPa 33 ~ 38 kgf/cm² 469 ~ 540 psi
	Allowable lower limit	2.55 MPa 26 kgf/cm² 370 psi
Pressure difference between two cylinders	Allowable limit	10 %

• Check the compression pressure and adjust the valve clearance to the specified value.

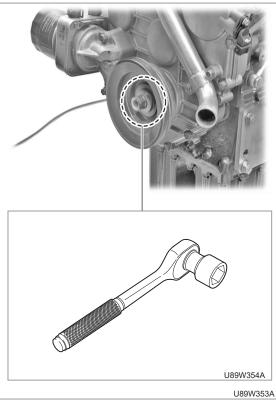
5.3 VALVE CLEARANCE

5.3.1 4 CYL.

- 1. The valve clearance should be measured only when the engine temperature is same to the ambient temperature.
- 2. Disconnect the battery cables.
- 3. Remove the cylinder head cover.
- 4. Turn the crankshaft slowly and then stop it when the No. 4 cylinder (flywheel side) is at the overlap period.

REMARKS -

Special socket for rotating crankshaft

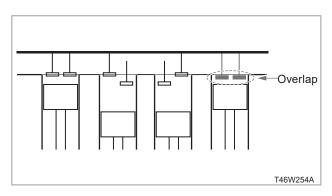


- When turning the crankshaft, use for bolt socket (B: 22 mm) with socket wrench.
- Turn the crankshaft clockwise viewed from the front of its bolt (bolt tightening direction).

5. Measure the clearance of the closed valves in the below table, which are the intake and exhaust valves of the No. 1 cylinder, the intake valve of the No. 2 cylinder and the exhaust valve of the No. 3 cylinder. Adjust the clearance if necessary.

WH	WHEN THE NO. 4 CYLINDER IS OVERLAPPED								
1		2		3		4			
IN	EX	IN	EX	IN	EX	IN	EX		
•			0	0	•	0	0		

•: closed, \bigcirc : open, •: Overlap



 Turn the crankshaft just one turn (360°) to position the No. 1 cylinder valves to the overlap period.

REMARKS

Overlap:

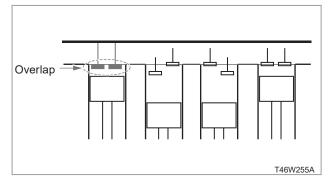
When the exhaust stroke is completed and the intake stroke is about to start, the exhaust valve is about to close, which is still open, and the intake valve starts to open. This period is called "overlap" and the center of the overlap period is when the height of the locker arms which push two valves is same. At this time, the clearance cannot be measured since the locker arms push the intake and exhaust valves.

NDEX

 Measure the clearance of the closed valves in the below table, which are the exhaust valve of No. 2 cylinder, the intake valve of the No. 3 cylinder and the intake and exhaust valves of the No. 4 cylinder. Adjust the clearance if necessary.

WH	WHEN THE NO. 1 CYLINDER IS OVERLAPPED								
1 2		2	3		4				
IN	EX	IN	EX	IN	EX	IN	EX		
0	0	0	•	•	0	•	•		

•: closed, \bigcirc : open, •: Overlap

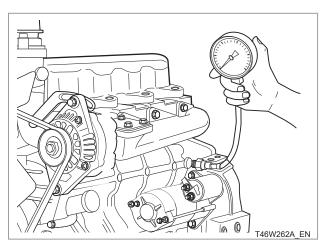


Valve clearance						
IN	EX					
0.20 mm	0.20 mm					
(0.00787 in.) (0.00787 in.)						

5.4 VALVE LIFT (DEFLECTION AND WORN CONDITION OF VALVE CAM, TAPPET, PUSH ROD, ROCKER ARM, ETC.)

- 1. Remove the cylinder head cover.
- 2. Adjust the valve clearance according to the section 5.3.
- Set the dial gauge so that its pointer is on the valve. The valve should be closed and the rocker arm should move as much as the free play.
- 4. Measure the max. valve movement while turning the crankshaft.
- 5. Measure the max. vertical movement of other valves according to the above process.
- 6. The vertical movement for all valves should be in the tolerance range of 0.5 mm (0.02 in.). If the measured value is out of the tolerance, check the corresponding valve for the deflection of the pushrod, worn condition, engagement with the tappet, worn tappet and worn valve cam.

5.5 OIL PRESSURE MEASUREMENT



- 1. Remove the oil pressure switch and install the adapter and the pressure tester.
- 2. Start and warm up the engine. Then, measure the oil pressure at idle and rated speed.
- 3. If the oil pressure is less than the allowable limit, check the oil level, oil filter, oil pump relief valve, oil passages and oil clearance.

Engine oil pressure	At idle speed	Specified value	over 49 kPa 0.5 kgf/cm² 7.11 psi
	At rated speed	Specified value	245 ~ 441 kPa 2.5 ~ 4.5 kgf/cm² 35.6 ~ 64.0 psi
		Allowable limit (lower limit)	245 kPa 2.5 kgf/cm² 35.6 psi

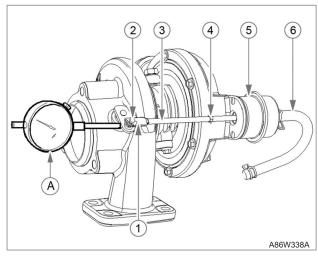
Oil pressure switch Tightening torque...... 14.7 ~ 19.6 Nm 1.5 ~ 2.0 kgf-m 10.8 ~ 14.5 lb-ft

5.6 BUBBLE TEST FOR RADIATOR

REMARKS -

- Checking if air is leaked through the crack on the cylinder wall
- 1. Check the coolant level of the radiator and the reservoir tank. Add the coolant if necessary.
- 2. Start the engine with the radiator cap closed and the reservoir tank cap open.
- Check if any bubble can be seen in the overflow hose on the bottom of the reservoir tank around 5 minutes later.
- If any bubble can be seen, remove the engine cylinder head to check the head gasket for damage, the cylinder bore for crack and the cylinder head for crack. Replace the components if necessary.

5.7 TURBO CHARGER WASTEGATE PRESSURE CHECK



The wastegate is a valve that automatically opens at a preset level of boost pressure in order to allow excess exhaust gas to bypass the turbine at high engine speeds. The wastegate allows the design of the turbocharger toA be more effective at lower engine speeds. The wastegate is controlled by a diaphragm. One side of this diaphragm is open to the atmosphere. The other side of this diaphragm is open to intake manifold boost pressure.

PRESSURE CHECKING METHOD

- Remove the boost line(6) from the wastegate actuator(5). Connect an air supply to the wastegate actuator that can be Aadjusted accurately.
- Install Tooling(A) to the turbocharger so that the end of the actuator rod(1) is in contact with Tooling(A). This will measure axial movement of the actuator rod(4).
- Slowly apply air pressure to the wastegate so that the actuator rod(4) moves 1.0 mm(0.039 in.). The air pressure should be within 61±3 kPa(8.89 psi) for 4B243T.

REMARKS -

- Ensure that the dial indicator returns to zero when the air pressure is released.
- Repeat the test several times. This will ensure that an accurate reading is obtained. If the operation of the wastegate is not correct,the actuator rod(4) can not be adjusted. The turbocharger must be renewed.

REMARKS

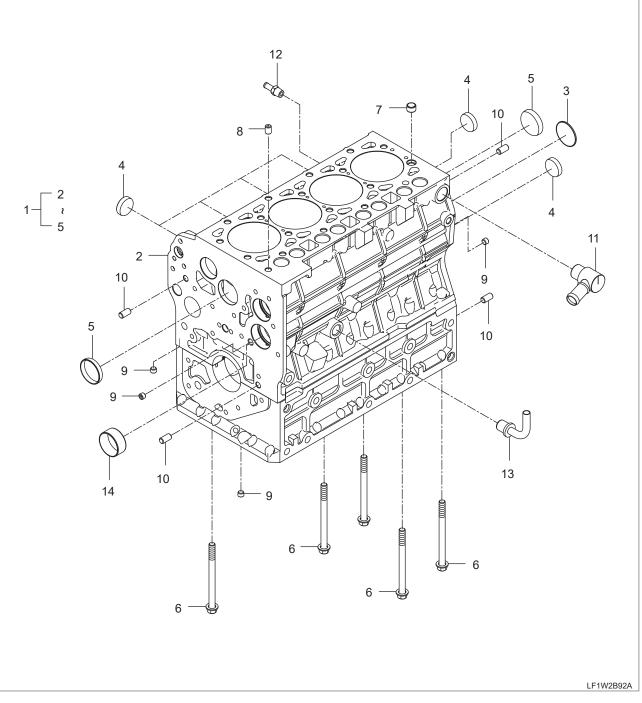
ACTUATOR FUNCTION

When pressure of intake air drawn by the turbocharger rises, so does its temperature, and high temperature of intake air can lead to incomplete combustion. To prevent this situation, the turbocharger is equipped with the actuator. There is a pipe connected between the actuator and intake manifold and this pipe detects intake air pressure continuously. When the intake air pressure is over the setting value of the diaphragm of the actuator, the wastegate is opened to release exhaust gas on the compressor side of the turbocharger Therefore, the turbine of the compressor is slowed down and so is the pressure of intake air. As a result, a proper amount of intake air is flowed into the cylinder through the intake manifold.

6. EXPLODED VIEW

The manufacturing parts are subject to change without notice. Therefore, check the parts catalog or electronic manual for latest information.

6.1 EH5-G111001 CYLINDER BLOCK GROUP



COMPONENTS

- (1) Assy Block, Cylinder
- (2) Cylinder Block Sub Assy
- (3) Plug

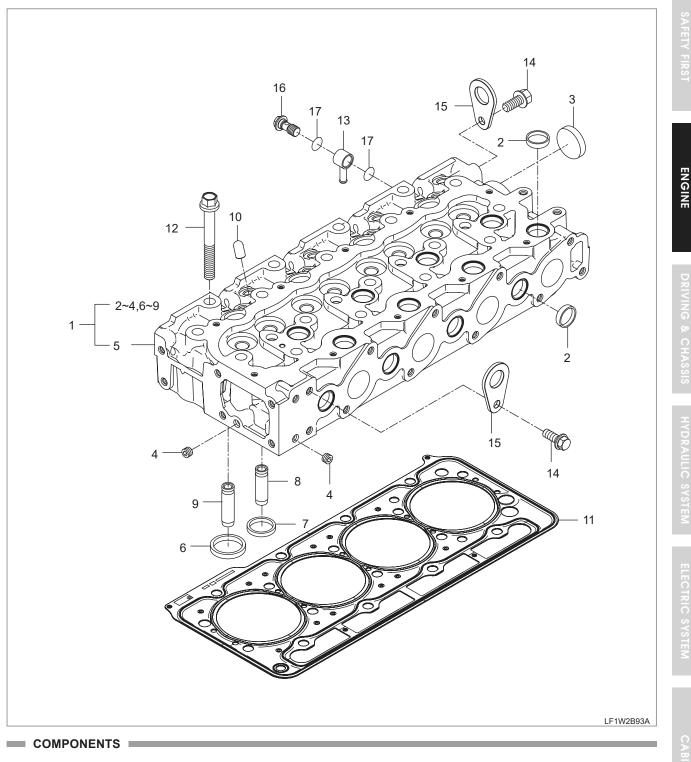
2-80

- (4) Cap, Sealing
- (5) Cap, Sealing

- (6) Bolt, Ladder Frame
- (7) Tube Pin
- (8) Pin
- (9) Plug
- (10) Straight Pin

- (11) Coolant Connector Assy
- (12) Joint, Hose
- (13) Pipe, Oil-3
- (14) Bushing, Balance Shaft

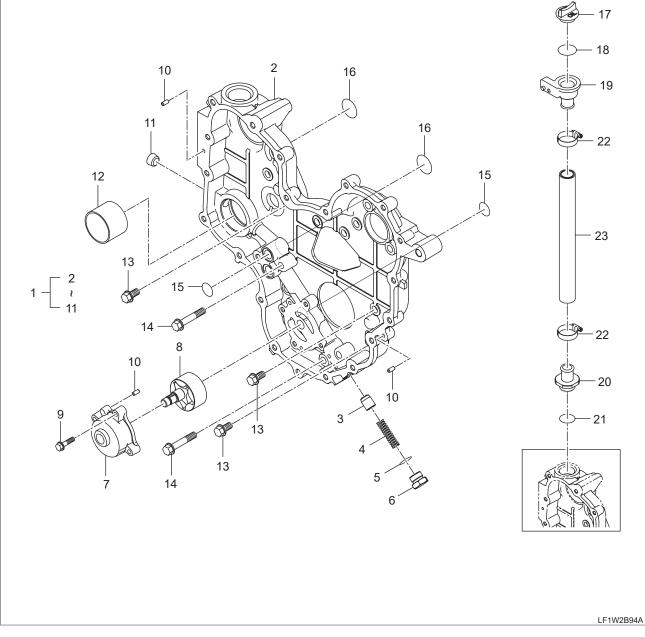
6.2 EH5-G113003 CYLINDER HEAD GROUP



- (1) Assy Head, Cylinder
- (2) Cap Sealing
- (3) Cap Sealing
- (4) Plug
- (5) Cylinder Head Sub Assy
- (6) Seat Intake Valve

- (7) Seat Exhaust Valve
- (8) Guide, Valve
- (9) Guide, Intake Valve
- (10) Hinge, Injector Clamp
- (11) Gasket,Head
- (12) Bolt,Cylinder Head
- (13) Connector, Coolant(14) Flange Bolt(15) Engine Hook
- (16) Joint Bolt
- (17) O Ring

6.3 EH5-G114002 GEAR CASE GROUP

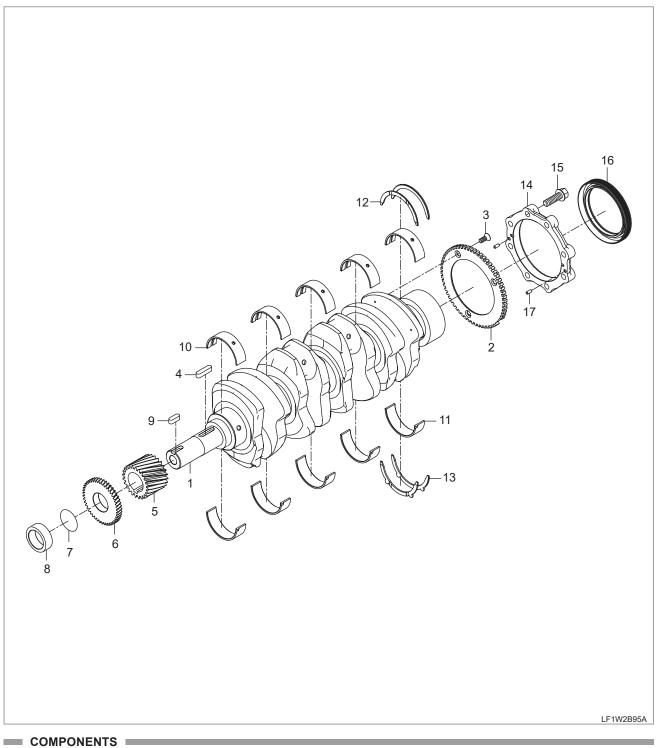


COMPONENTS

- (1) Assy Case,Gear
- (2) Gear Case
- (3) Plunger, Relief Valve
- (4) Spring Relief Valve
- (5) O Ring
- (6) Plug, Relief Valve
- (7) Cover, Oil Pump
- (8) Oil Pump Rotor Shaft Assy
- (9) Bolt, Flange (10) Pin,Straight
- (11) Plug
- (12) Bush, PTO Shaft
- (13) Flange Bolt
- (13) Flang (14) Bolt
- (14) BOIL (15) O Ring
- (15) O Ring (16) O Ring

- (17) Plug, Oil Filler (18) O Ring
- (19) Flange, Oil Filler-UPR
- (20) Flange, Oil Filler-LWR
- (21) O Ring
- (22) Band, Hose
- (23) Hose, Oil

6.4 EH5-G121001 CRANK SHAFT GROUP



- (1) Shaft, Crank
- (2) Wheel, Crank Position Sensor
- (3) Cross-Recessed Head Machine Screw
- (4) Feather Key
- (5) Gear, Crankshaft
- (6) Gear, Oil Pump Drive
- (7) O Ring
- (8) Spacer
- (9) Feather Key

- (10) Bearing-Crankshaft UPR
- (11) Bearing-Crankshaft LWR
- (12) Bearing, Crankshaft Thrust UPR
- (13) Bearing-Crankshaft Thrust LWR
- (14) Case, Oil Seal
- (15) Bolt
- (16) Oil Seal
- (17) Straight Pin

2-83

3

12

12

6

6.5 EH5-G122001 PISTON CONNECTING ROD GROUP

Δ

2

10

11

3

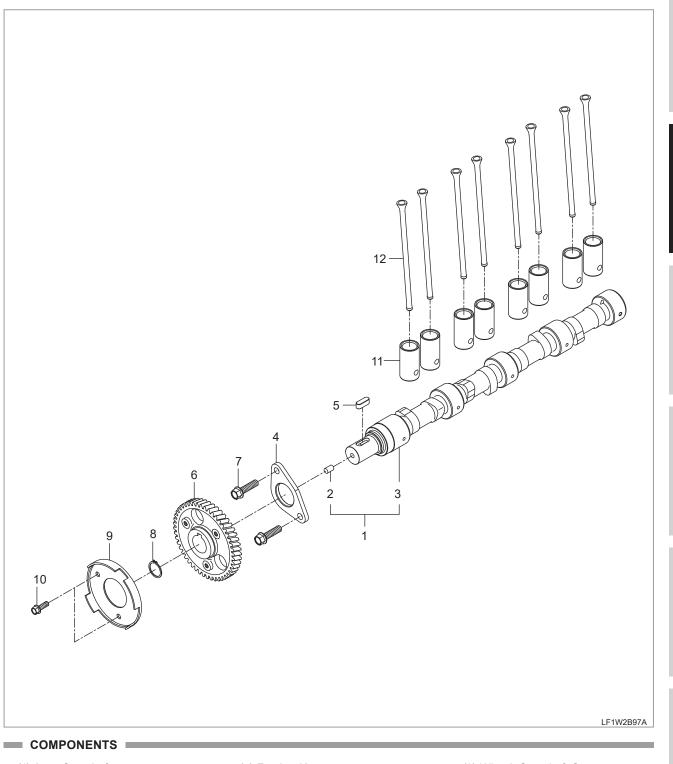
8

- COMPONENTS
 - (1) Piston
 - (2) Pin, Piston
 - (3) Snapring
 - (4) Piston Ring Assy

- (5) Assy,Oil Ring
- (6) Ring 1, Piston
- (7) Ring 2, Piston
- (8) Connecting Rod Assy
- (9) Connecting Rod Bush
- (10) Connectingrod
- (11) Connecting Rod Bolt
- (12) Bearing, Connecting Rod

LF1W2B96A

6.6 EH5-G123001 CAMSHAFT GROUP



- (1) Assy Camshaft(2) Plug, Set
- (3) Camshaft

GMW-0035

- (4) Stopper, Camshaft
- (5) Feather Key (6) Gear, Camshaft (7) Flange Bolt (8) Ring, Snap
- (9) Wheel, Camshaft Sensor
- (10) Flaner Bolt
- (11) Tappet
- (12) Rod, Push

2-85

15

16

8

12

13

() M

5

11

13

9

B

6

6.7 EH5-G124002 IDLE GEAR GROUP

14

10



- (1) Assy Idle Gear1
- (2) Shaft,Idlegear1
- (3) Bolt, Flange
- (4) Washer, Knock
- (5) Stopper 1, Idle Gear
- (6) With Washer Bolt

(7) Assy Idle Gear3

3

- (8) Shaft 3, Idle Gear(9) Stopper 2, Idle Gear
- (10) With Washer Bolt
- (10) With Washer Bo (11) Assy Idle Gear4
- (12) Shaft,Idlegear4

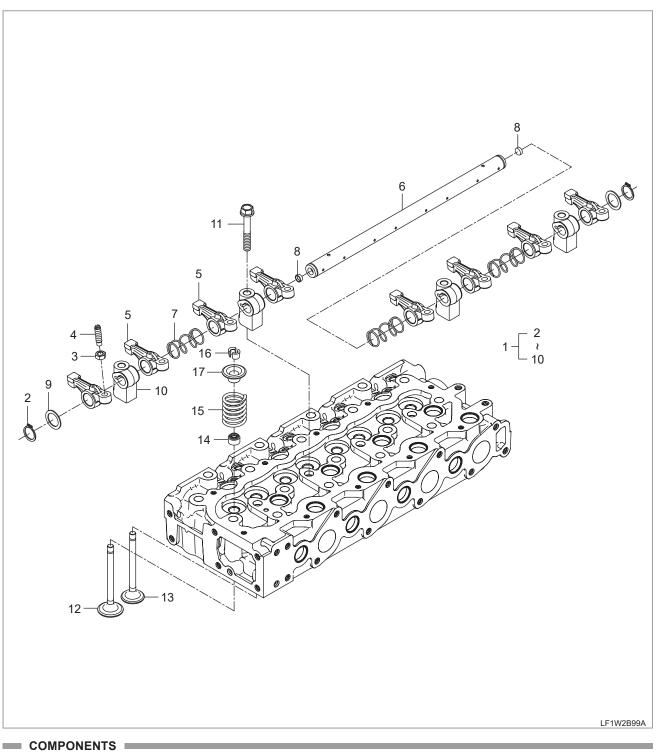
- (13) Bolt, Flange
- (14) Bolt, With Washer
- (15) Gear, Hp Fuel Pump
- (16) Flange Nut

LF1W2B98A





6.8 EH5-G125001 ROCKER ARM VALVE GROUP



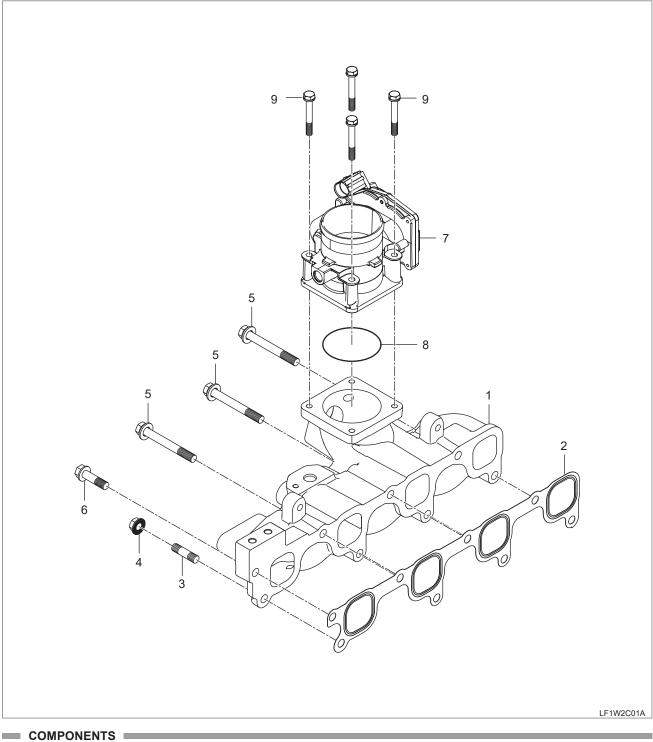
- (1) Assy Arm,Rocker
- (2) Snap Ring
- (3) Nut
- (4) Screw, Adjust
- (5) Arm, Rocker
- (6) Rockerarm Shaft

- (7) Rockerarm Spring
- (8) Cap, Sealing
- (9) Washer
- (10) Bracket, Rocker Arm
- (11) Bolt, Rocker Arm Support
- (12) Valve, Intake

- (13) Valve, Exhaust
- (14) Seal, Valve Stem
- (15) Spring, Valve
- (16) Collet,Valve Spring
- (17) Retainer, Velve Spring

NDEX

6.9 EH5-G131001 INTAKE MANIFOLD GROUP

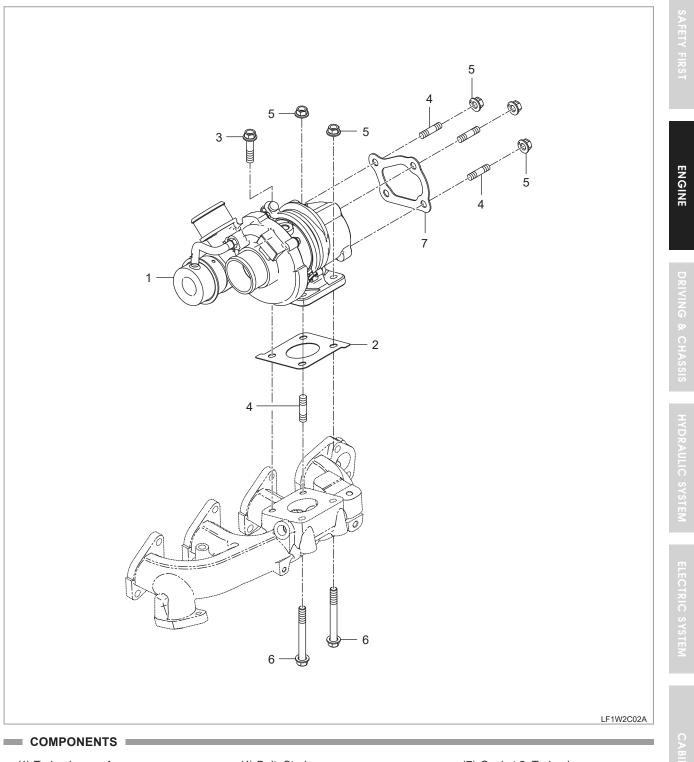


NDEX

- (1) Manifold, Inlet(2) Gasket, Intake Manifold
- (3) Stud Bolt

- (4) Flange Nut(5) With Washer Bolt(6) Flange Bolt
- (7) Air Control Valve Assy(8) O Ring-ACV(9) Bolt With Washer





(1) Turbocharger Assy(2) Gasket 1, Turbocharger

(3) Bolt, Flange

(4) Bolt, Stud(5) Nut, U(6) Flange Bolt

(7) Gasket 2, Turbocharger

NDEX

8

9

9

2

3

6.11 EH5-G135001 TURBO PIPE GROUP

5

10

6

4

12

(G

1

11

FO

COMPONENTS

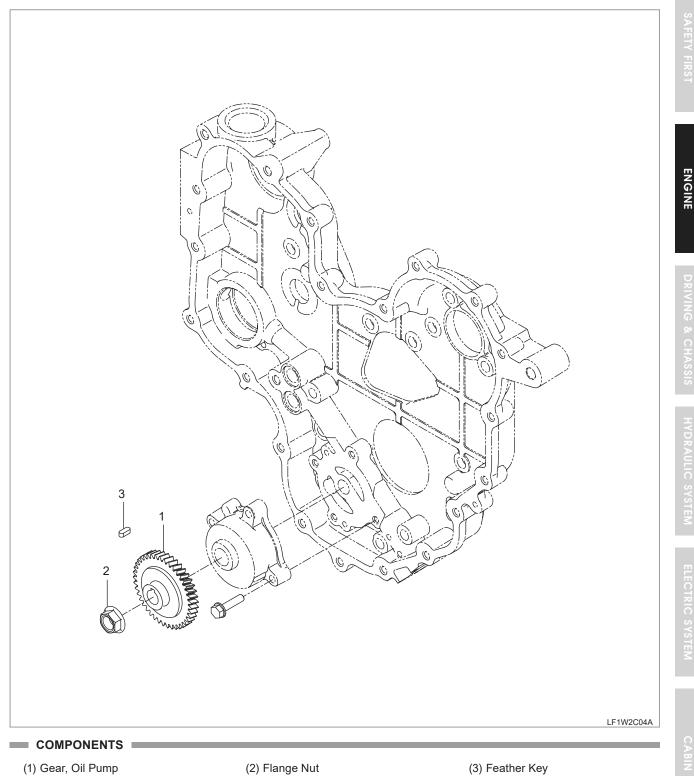
- (1) Oil Drain Pipe Assy
- (2) Gasket, Turbocharger-3
- (3) With Washer Bolt
- (4) Hose, Oil Ass`Y

- (5) Oil Feeding Pipe Assy
- (6) Eye Bolt
- (7) Packing
- (8) Connector 2

- (9) Gasket
- (10) Clamp 1, Tube
- (11) Clamp 2, Tube
- (12) With Washer Bolt

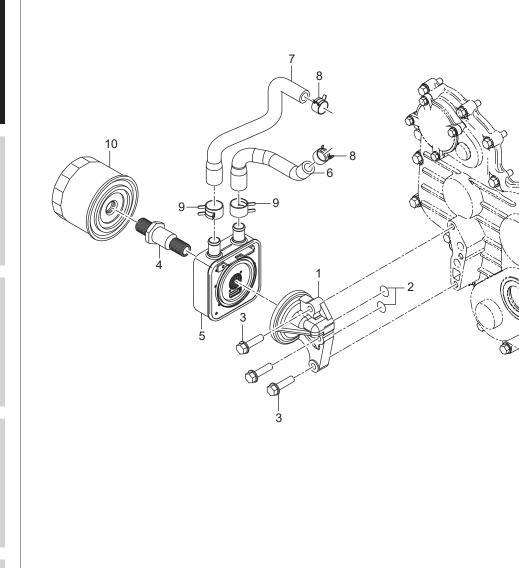
LF1W2C03A

6.12 EH5-G141001 OIL PUMP GROUP



ENGINE - EXPLODED VIEW

6.13 EH5-G144001 OIL FILTER GROUP

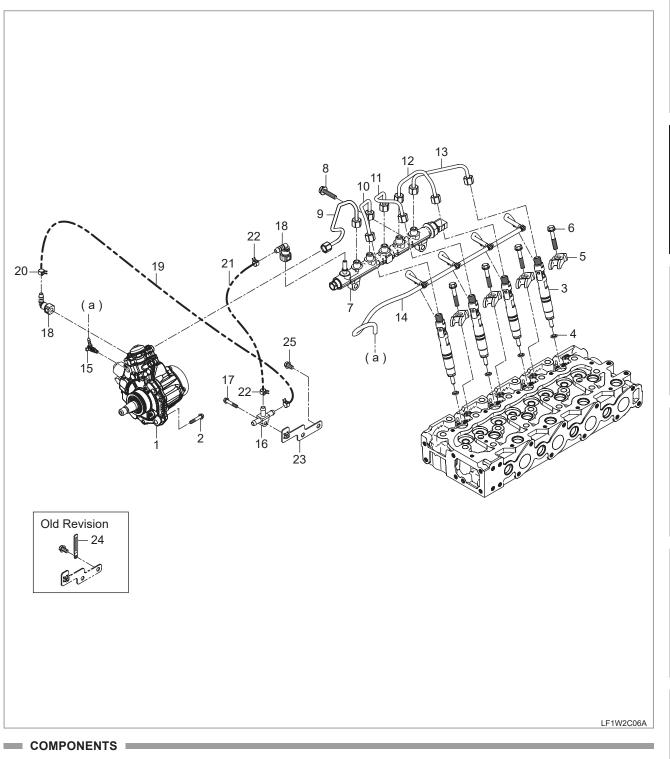


COMPONENTS

- (1) Support, Oil Filter
- (2) O Ring
- (3) Flange Bolt
- (4) Tube, Connecting
- (5) Cooler, Oil(6) Hose 1, Oil Cooler(7) Hose 2, Oil Cooler(8) Hose Clip
- (9) Hose Clip (10) Oil Filter

LF1W2C05A





- (1) Assy Pump, Hp Fuel
- (2) Flange Bolt
- (3) Assy Injector
- (4) Seat, Injector
- (5) Clmap, Injector
- (6) Bolt, Injector Clmap
- (7) Assy Rail, Fuel
- (8) Flange Bolt
- (9) Pipe, Rail

- (10) Pipe 1, Injection(11) Pipe, Injection-2
- (11) Pipe, injection-
- (12) Pipe, Injection-3
- (13) Pipe, Injection-4
- (14) Assy Tube, Injector Return
- (15) Connector
- (16) Joint, Fuel Hose
- (17) Flange Bolt
- (18) Connector, Quick-128-783-002
- (19) Hose, Fuel (20) Hose Clip (21) Hose, Fuel
- (22) Clip, Tube
- (23) Bracket-Fuel Hose
- (24) Clamp,Cord
- (25) Bolt

16

11

2

12

Ġ

6

16

14

15

13

- OF

10

7

Ø

9

10

3

6.15 EH5-G162001 WATER FLANGE GROUP

COMPONENTS

- (1) Plange, Water
- (2) Gasket, Cooling Water Flange
- (3) With Washer Bolt
- (4) Support, Alternator
- (5) Stud Bolt
- (6) Flange Nut

- (7) Bolt, Flange
- (8) Pipe, Water Return
- (9) Hose, Coolant Return
- (10) Hose Clip
- (11) Plug
- (12) Connector, Coolant
- (13) Thermostat Assembly

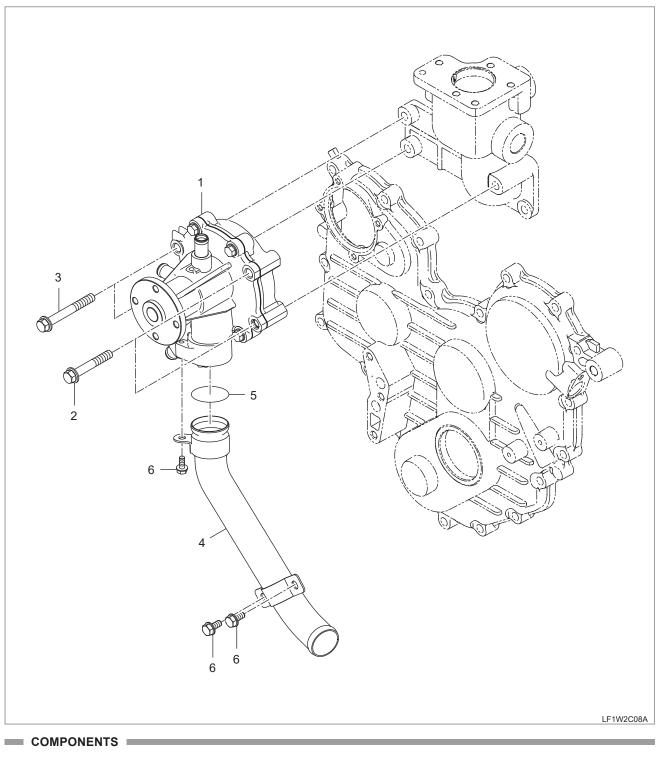
5

- (14) Thermostat Cover
- (15) Gasket
- (16) Flange Bolt



LF1W2C07A



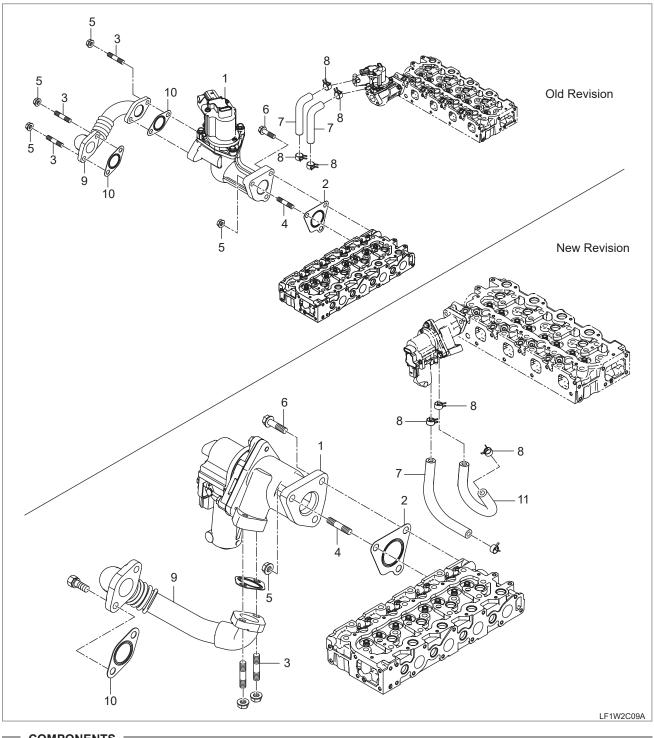


(1) Assy Pump, Water(2) Hex Head Bolt With Washer

(3) With Washer Bolt(4) Assy Pipe, Water Pump

(5) O Ring(6) Flange Bolt

6.17 EH5-G171001 EGR GROUP



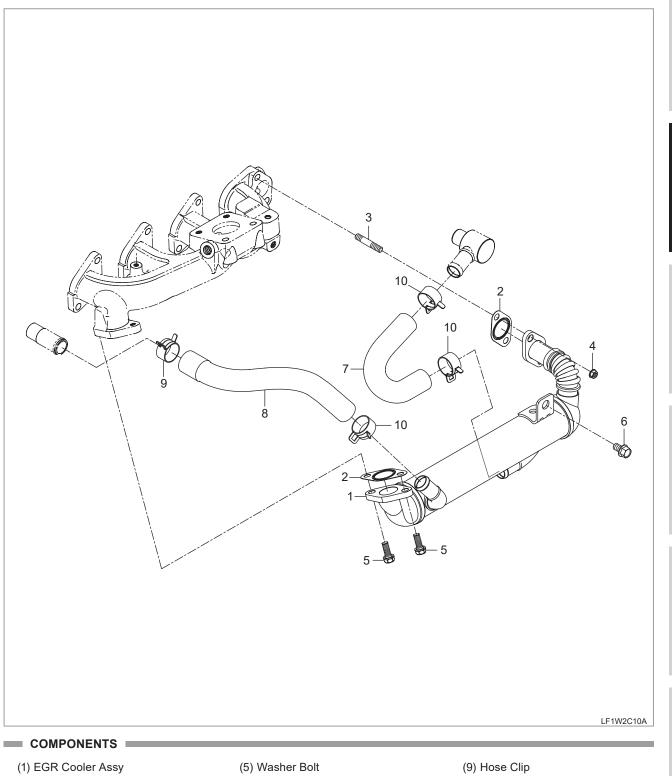
- COMPONENTS
 - (1) EGR Valve And Housing Assy(2) Gasket, EGR Housing

 - (3) Stud Bolt
 - (4) Stud Bolt

- (5) Flange Nut (6) Flange Bolt
- (7) Hose, Cooling
- (8) Hose Clip

- (9) Assy Pipe, EGR (10) Gasket, EGR
- (11) Cooling Hose



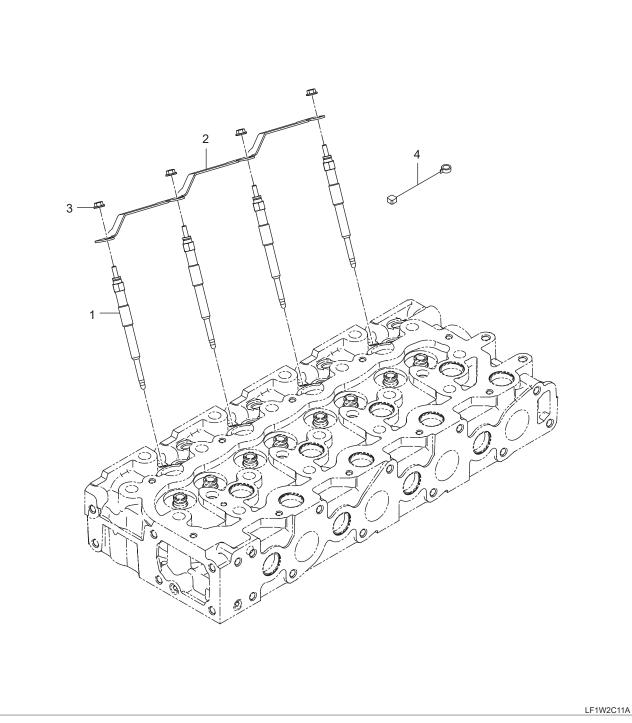


(2) Gasket, EGR (3) Stud Bolt (4) Nut, U

(6) Hex Head Cap Screw (7) Hose 1, EGR Cooler (8) Hose 2, EGR Cooler

(10) Hose Clip

6.19 EH5-G191002 GLOW PLUG GROUP

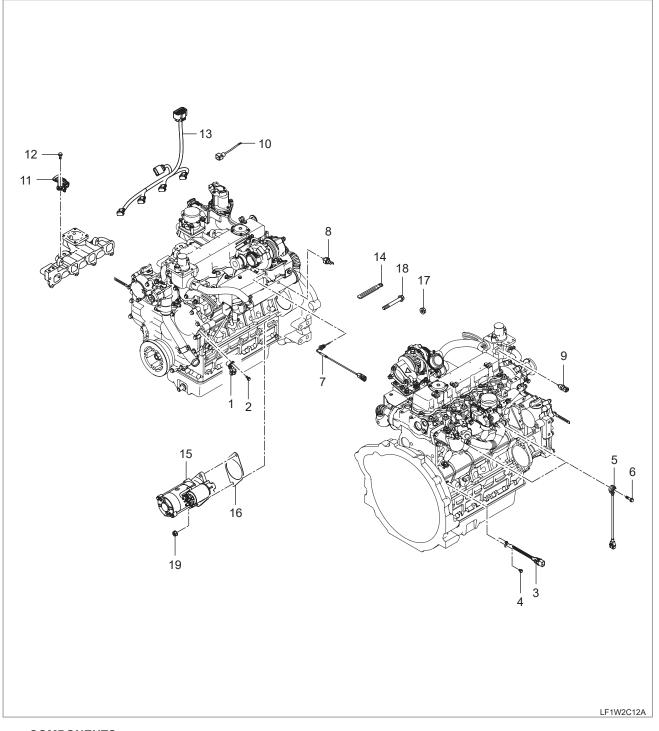


- COMPONENTS
 - (1) Plug,Glow(2) Cord, Glow Plug

(3) Flang Nut

(4) Glow Plug Connection Wire Harness Assay



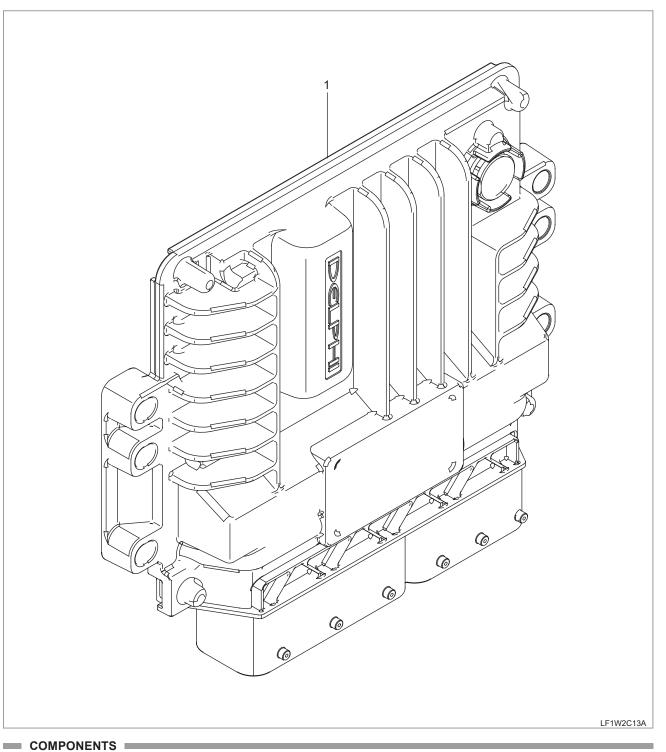


COMPONENTS

- (1) Sensor, Camshaft Wheel
- (2) Bolt, Flange
- (3) Sensor, Crankshaft Wheel
- (4) Flange Bolt
- (5) Sensor, Knock
- (6) Flange Bolt
- (7) Exhaust Gas Temperature Sensor
- (8) Switch,Oil
- (9) Temperature Sensor Assay
- (10) Wire Harness 3
- (11) Assy Sensor, Tmap
- (12) Bolt, Flange
- (13) Assy Injection Harness
- (14) Clamp,Cord

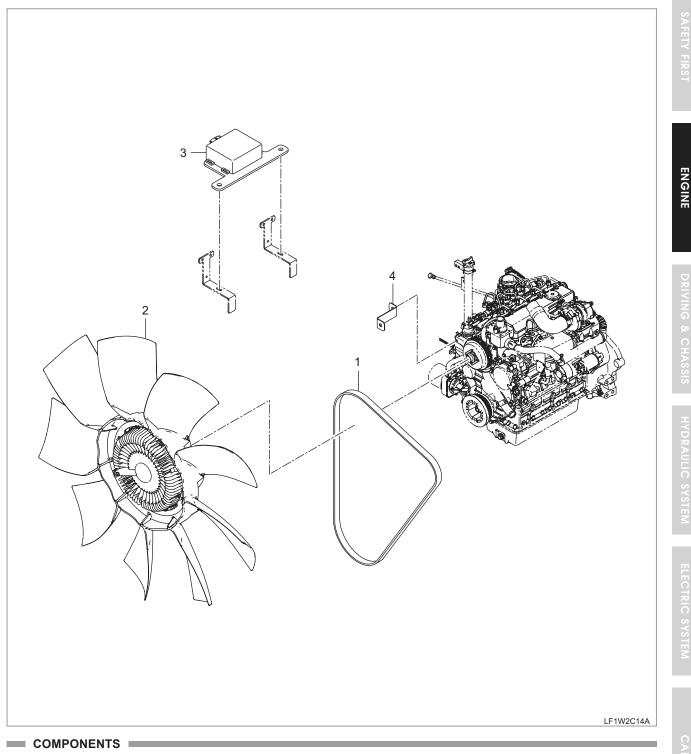
- (15) Assy Starter
- (16) Gasket
- (17) Flange Nut
- (18) With Washer Bolt
- (19) Flange Nut

6.21 EH5-G194001 ECU GROUP



(1) 050 - Controller, Engine





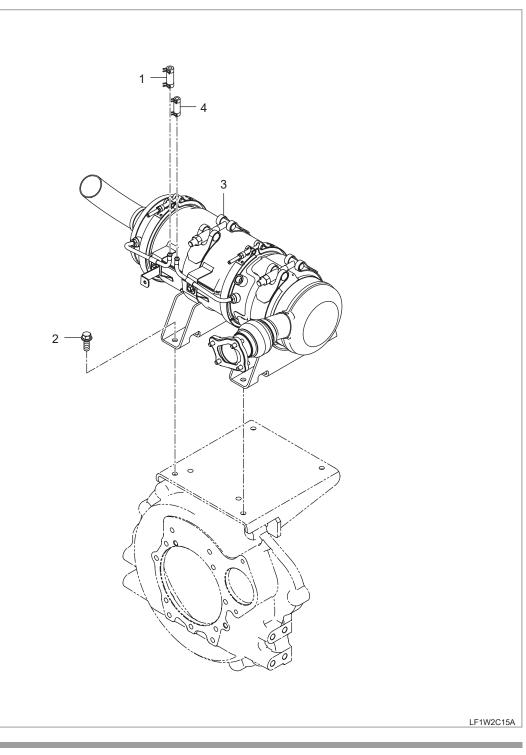


(2) Assy Fan, Clutch

(3) Controller-Fan Clutch

(4) Bracket

6.23 LF1-G014001 AFTERTREATMENT GROUP



(3) Assy Ccrt (4) Tube, 2

COMPONENTS

(2) Bolt, With Washer

(1) Tube, 1

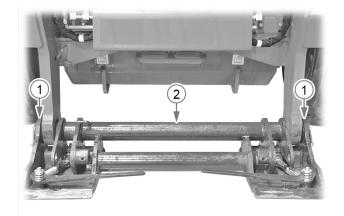
7. DISASSEMBLY, SERVICE AND ASSEMBLY

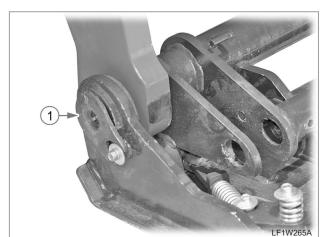
7.1 ENGINE REMOVAL

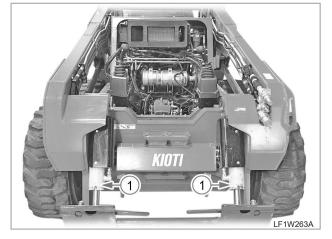
1. Park the vehicle on a flat surface, lower the boom lift onto the ground, turn off the engine, and then apply the parking brake.



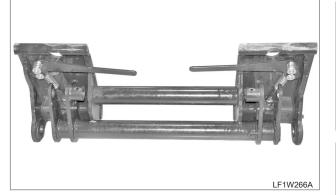
- 2. After opening the engine compartment rear cover, turn off the battery power cut-off switch (1).
- 3. Remove the cabin. (Refer to "Cabin removal" in Chapter 6, Cabin.)







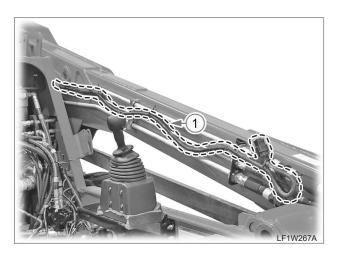
4. Remove the tilt cylinder (1).



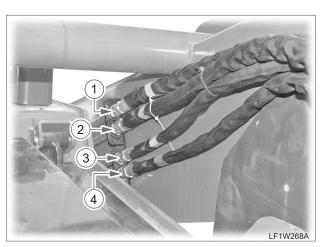
5. Pull out the bucket quick coupler retaining pins (1)(2EA). Then, remove the quick coupler (2).

GMW-0035

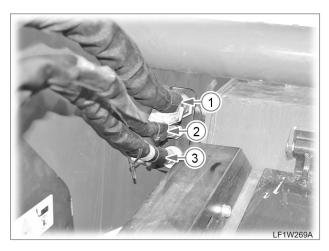
ENGINE



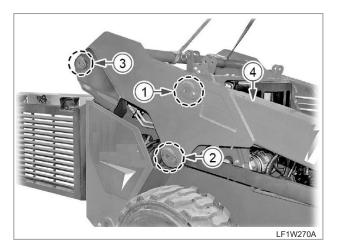
6. Disconnect the wiring (1) from the boom assembly.

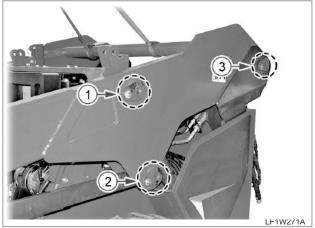


 Disconnect the hydraulic hoses (1, 2, 3 (brown) & 4 (green)) from the right rear side of the boom assembly.



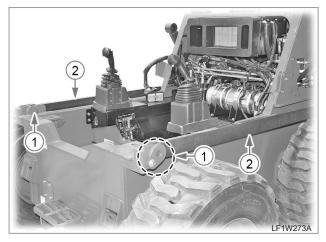
8. Disconnect the hydraulic hoses (1, 2 & 3 (brown)) from the left rear side of the boom assembly.



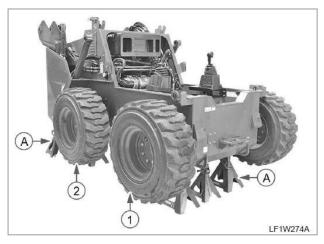




 Support the boom with a hoist. Then, remove the lift cylinder retaining pins (1), boom auxiliary support pins (2) and boom retaining pins (3) to remove the boom assembly (4).

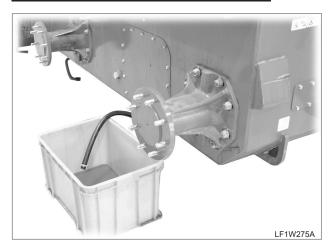


10. Pull out the boom support bar mounting pins (1) to remove the left-hand and right-hand boom support bars (2).

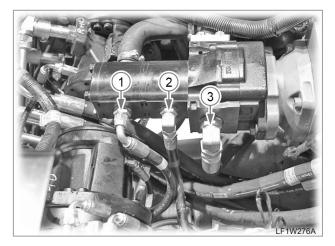


11. Place safety jacks (A) under the main frame firmly and remove the front and rear wheels.

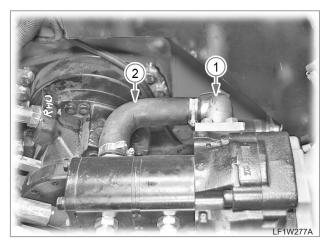
DISASSEMBLING THE MAIN PUMP



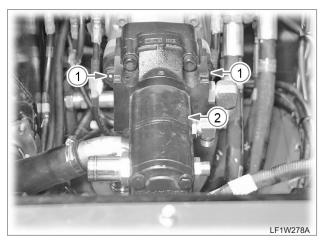
12. Drain the hydraulic oil from the oil tank.

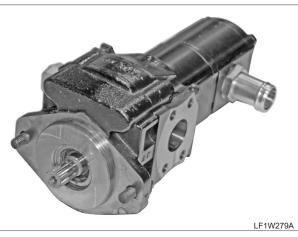


13. Disconnect the high-flow pump hydraulic hose(1), charge pump hydraulic hose (2) and main pump hydraulic hose (3).



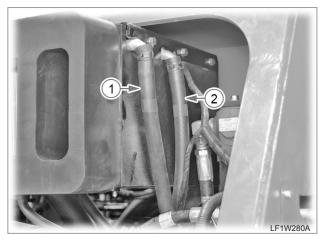
14. Disconnect the suction hose (1) from the main pump and the suction hose (2) from the highflow pump. ENGINE





15. Unscrew the main pump mounting bolts (1)(2EA) and remove the main pump assembly (2).

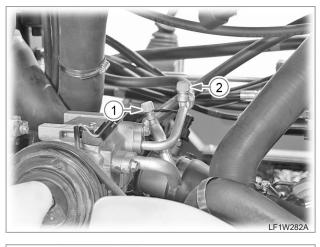
REMOVING THE A/C AND HEATER UNIT



16. Disconnect the heater hoses (1 & 2) from the heater unit.

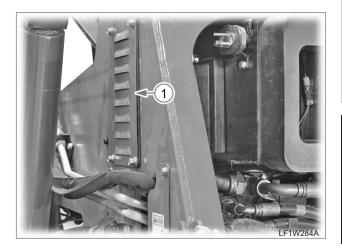


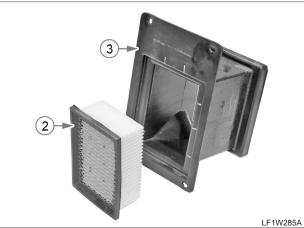
17. Disconnect the wiring connector (1).



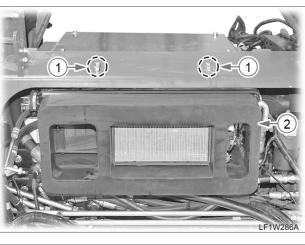


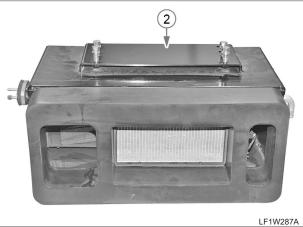
18. Install a refrigerant collector to the A/C hoses (1 & 2) and collect the refrigerant. Then, disconnect the A/C hoses (3 & 4).



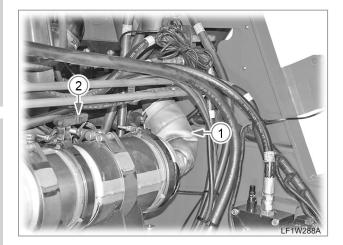


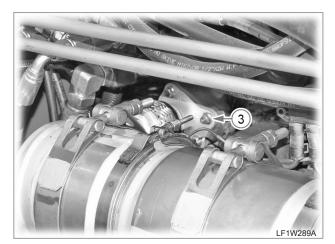
19. Remove the air inlet cover (1). Then, detach the A/C filter (2) and duct (3).

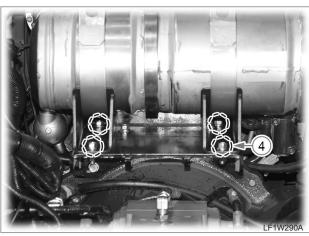


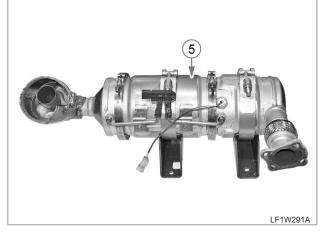


20. Unscrew the A/C and heater unit assembly mounting bolts (1)(4EA) on the main frame, and remove the A/C and heater unit assembly (2).





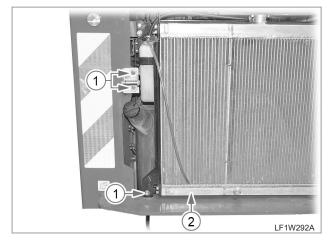




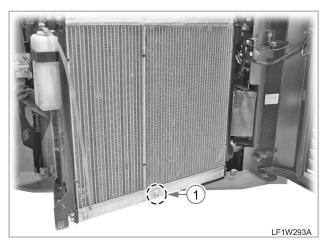
21. After removing the DPF heat shield cover (1) and disconnecting the sensor connector (2), unscrew the DPF connecting nuts (3)(4EA) (turbocharger) and DPF bracket mounting bolts (4)(4EA) to remove the DPF assembly (5).

REAR BODY SECTION

22. Open the rear door of the engine compartment.



23. Unscrew the radiator mounting bolts (1)(3EA) and open the radiator (2).

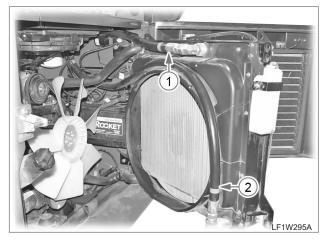


24. Unscrew the radiator drain plug (1) to drain the coolant.

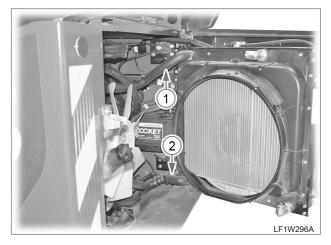
1)=>0

25. Unscrew the oil cooler hose cover mounting bolts (1)(6EA) and remove the oil cooler hose cover (2).

LF1W294A



26. Disconnect the oil cooler hoses (1 & 2) from the oil cooler.



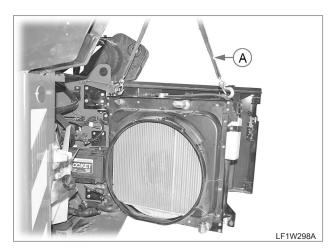
27. Disconnect the hoses (upper: 1, lower: 2) from the radiator.



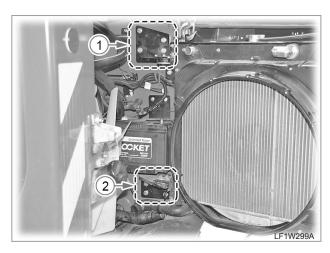
28. Remove the battery power cut-off switch (1).

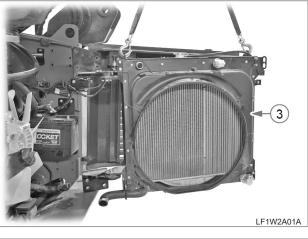
SAFETY FIRST

ENGINE



29. Install the disassembly jig (A) on the radiator and hang it with a hoist.



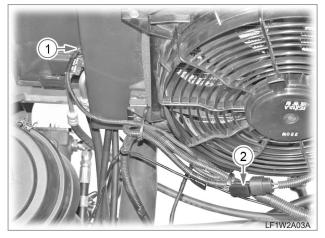




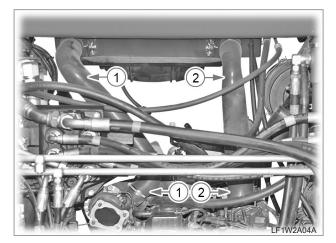
30. Detach the radiator mounting brackets (1 & 2) to remove the radiator.

ENGINE

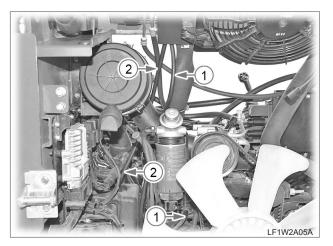
DISASSEMBLING THE CONDENSER AND INTERCOOLER



31. Disconnect the A/C condenser pressure switch connector (1) and fan motor connector (2).



32. Disconnect the intercooler hoses (1 & 2).





ENGINE

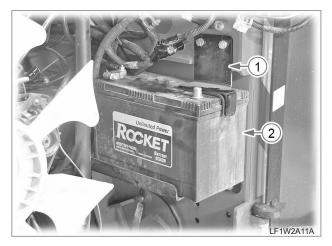
LF1W2A06A

2

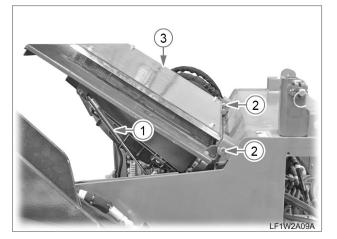
33. Disconnect the fuel cooler hoses (1 & 2).



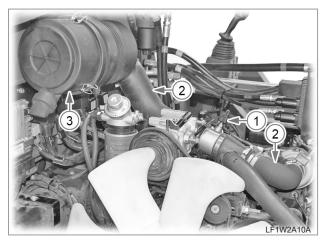
34. Disconnect the A/C hoses (1: high-pressure, 2: low-pressure) from the compressor.



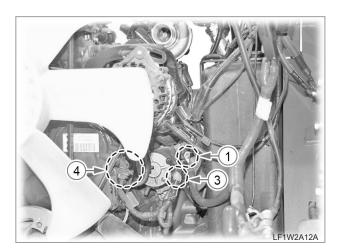
37. Remove the battery bracket (1) to remove the battery (2).

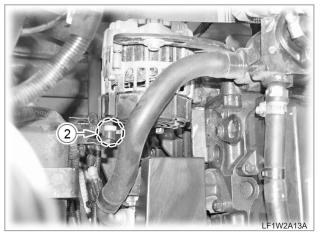


35. After removing the air cylinders (1) and condenser assembly connecting pins (2), remove the condenser, intercooler, and fuel cooler assembly (3).

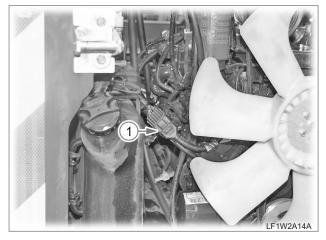


36. Disconnect the intake temperature sensor (T1) connector (1) and then remove the air cleaner hose (2) and air cleaner (3).

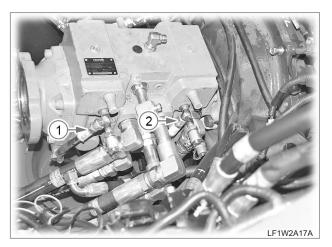




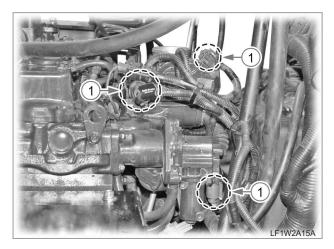
 38. Disconnect the start motor wiring connector (1), alternator wiring connector (2), exhaust temperature sensor connector (3) and camshaft wheel sensor connector (4).



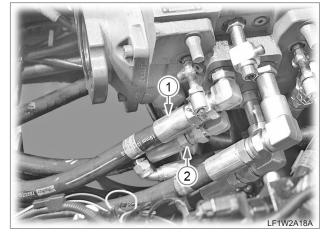
39. Disconnect the engine wiring connector (1) from the front left side of the engine.



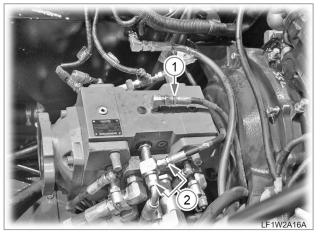
42. Disconnect the RCV (LH) (reverse driving-RH) hose (1) and RCV (LH) (reverse driving-LH) hose (2).



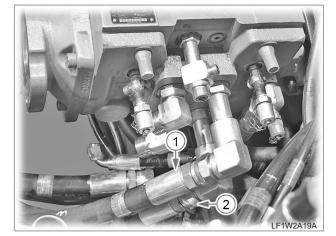
40. Disconnect the various engine sensor connectors(1) from the rear side of the engine.



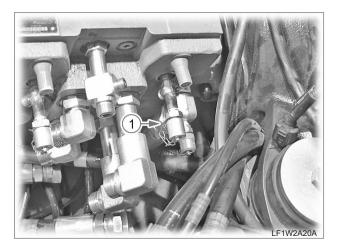
43. Disconnect the HST motor (RH) (reverse driving) hose (1) and HST motor (RH) (forward driving) hose (2).



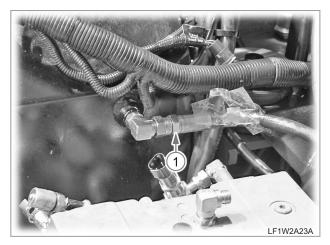
 Disconnect the pilot lock valve hose (1) from the top of the HST pump and the HST filter hose (2) from the left side of the HST pump.



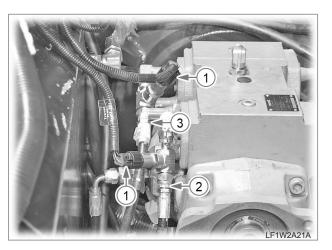
44. Disconnect the HST motor (LH) (reverse driving) hose (1) and HST motor (LH) (forward driving) hose (2).



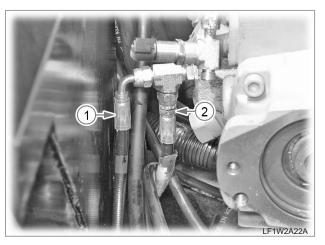
45. Disconnect the oil tank hose (1).



48. Disconnect the oil pressure tank hose (1).



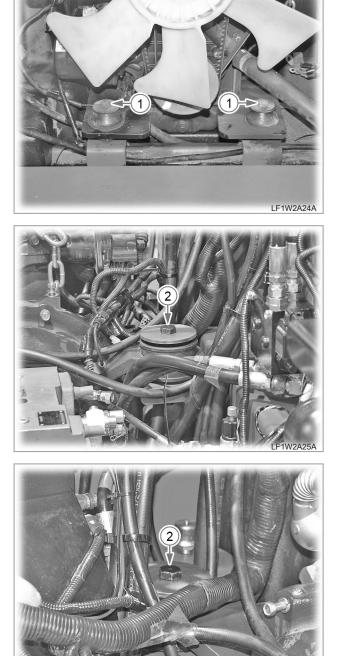
46. Disconnect each driving pressure sensor connector (1) from the RCV (LH) hydraulic hoses. Then, disconnect the RCV (LH) (forward driving-RH) hydraulic hose (2) and RCV (LH) (forward driving-LH) hydraulic hose (3).



47. Disconnect the soft shift valve hose (1) and parking valve hose (2).

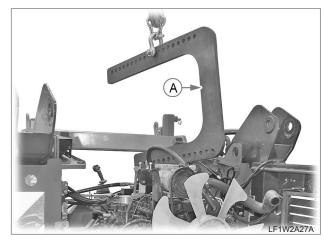
INDE

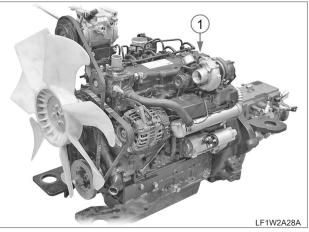




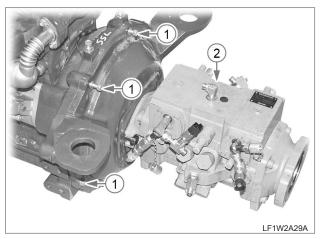
49. Loosen the two front engine mounting bolts (1) and two rear engine mounting bolts (2).

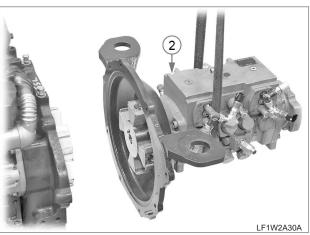
LF1W2A26A





50. Install a disassembly jig (A) on the engine and use a hoist to pull out and put aside the engine/ HST pump assembly (1) safely.





51. Unscrew the 7 housing mounting bolts (1) on the engine/HST pump assembly to remove the HST pump assembly (2).



52. Remove the coupling element (1) from the flywheel.



- REMARKS

 Mounting bolt B

 Mounting bolt B

 Straight pin

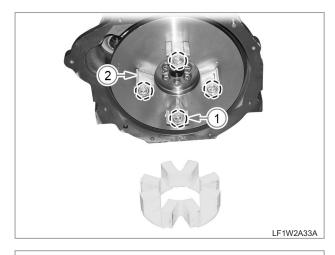
 Mounting bolt A

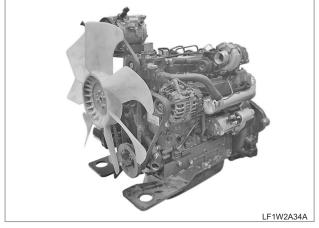
 Straight pin

 Mounting bolt A

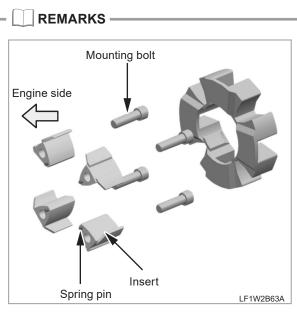
 LF1W2B62A
 - be careful not to miss the straight pin. Ensure to also tighten the mounting bolts A & B sequentially in a diagonal order.
 - Mounting bolts (A, B)(M10) tightening torque4.9 ~ 5.7 kgf-m

LF1W2A32A





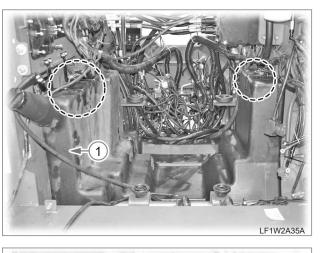
53. Loosen the insert mounting bolts (1) on the flywheel and remove the inserts (2)(4EA).

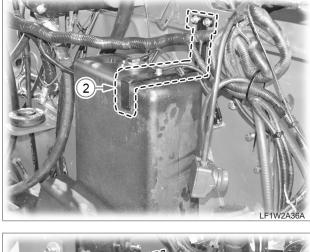


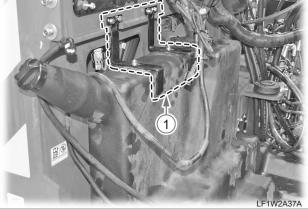
- When installing the coupling assembly, install its halves on the engine side and pump housing side separately, and then combine them together.
- When installing the inserts on the engine flywheel, be careful not to miss their spring pins and tighten the mounting bolts to the specified torque.
 - Mounting bolt tightening torque21 ~ 23 kgf-m

٠

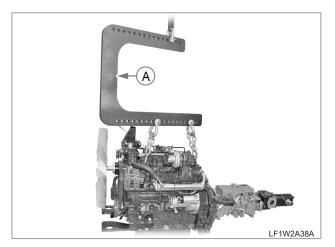
7.2 ASSEMBLING THE ENGINE





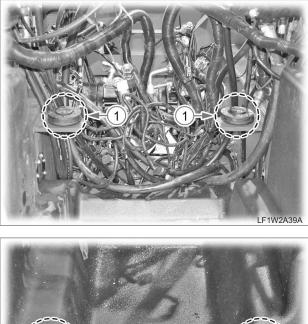


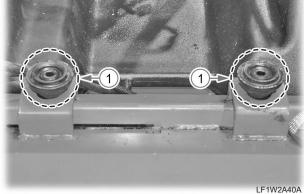
1. Place the fuel tank (1) on the main frame and fix it using the support brackets (2)(3EA).

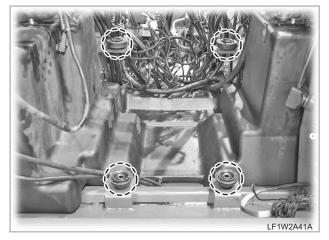


2. Install the specified jig (A) on the engine/HST pump assembly and hang it on a hoist.

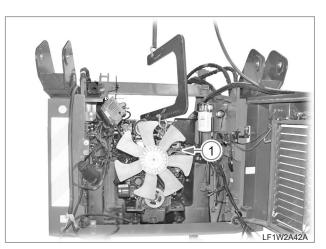
ENGINE



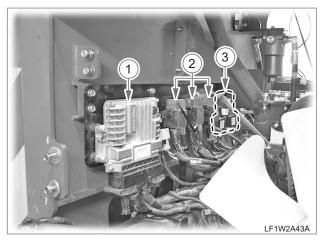




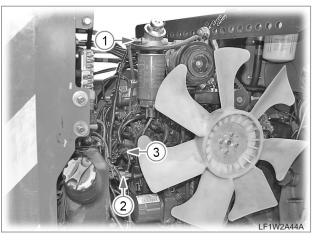
3. Install the engine mounting rubbers (1) on the front and rear sections of the main frame.

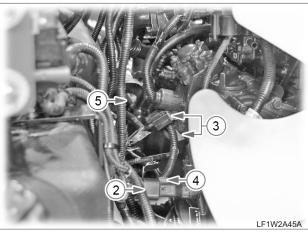


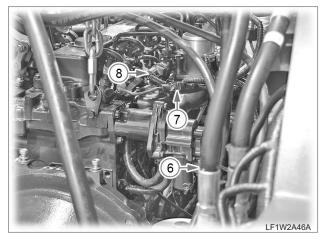
4. Using a hoist, lift the engine assembly (1), move it into the main frame, and place it on the engine mounting section.



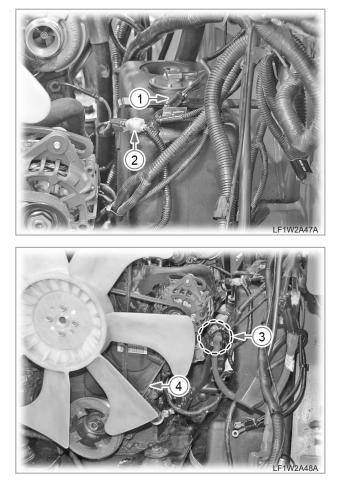
5. Install the engine ECU (1), fuses (2) and relays (3).



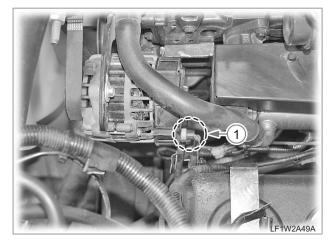




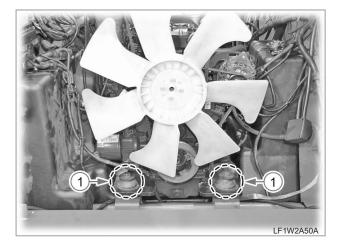
 Connect the connectors for the fuel heater (1), engine injector wiring (2), high-pressure fuel pump (3), knock sensor (4), crank wheel sensor (5), EGR sensor (6), glow plug sensor (7), and common rail pressure sensor (8) on the right side of the engine.

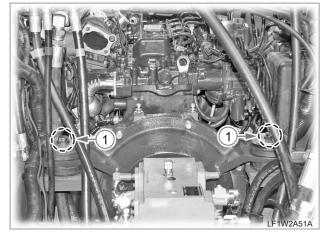


 Connect the connectors for the fuel sender (1), exhaust temperature (2), start motor (3), and camshaft wheel sensor (4) on the left side of the engine.



8. Install the alternator wiring (1).





9. After removing the engine assembly jig, tighten the engine mounting bolts (1)(4EA).

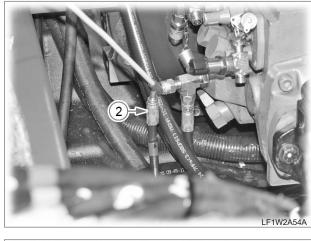
INSTALLING THE HST PUMP CONNECTING HOSE

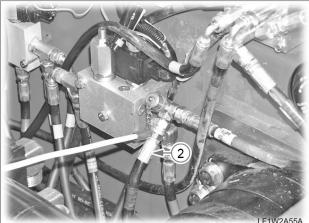




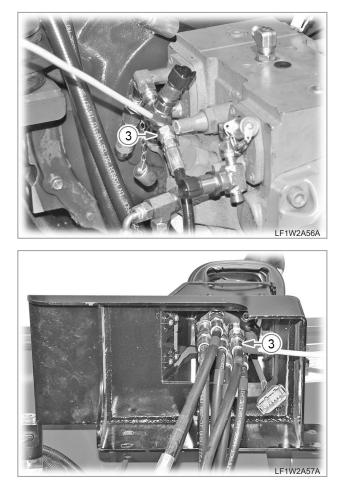
ENGINE

10. Connect the HST pump and parking valve with the hydraulic hose (1) on the right side of the HST pump.

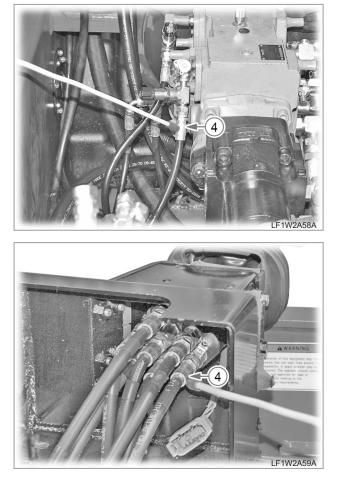




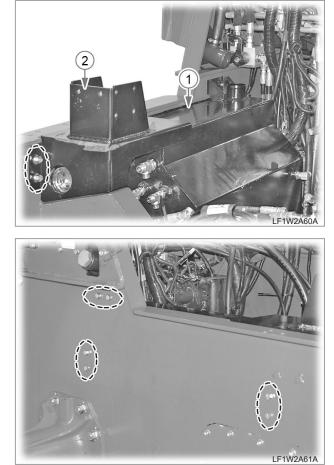
11. Connect the HST pump and pilot lock valve with the hydraulic hose (2).



12. Connect the hydraulic hose (3) from the HST pump to the left-hand RCV (forward driving-LH).



13. Connect the hydraulic hose (4) from the HST pump to the left-hand RCV (forward driving-RH).



14. Attach the oil tank (1) and RCV support (2) together.

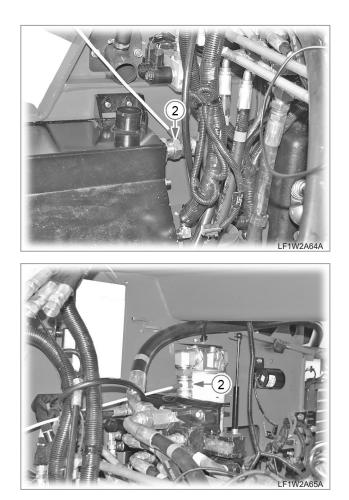


DRIVING & CHAS





15. Connect the return hose (1) from the HST pump to the oil tank.



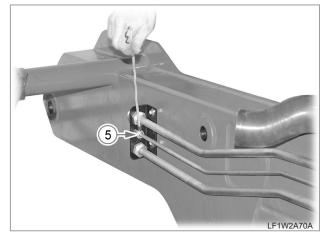
16. Connect the hydraulic hose (2) to the oil tank inlet and hydraulic return filter.



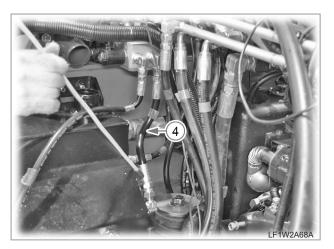


17. Install the return hose (3) between the main control valve and the oil tank.



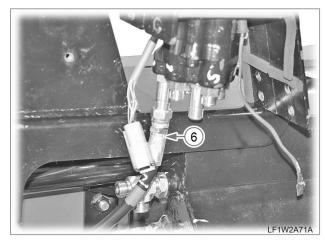


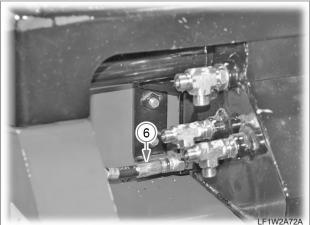
19. Install the external hydraulic oil return hose (5) on the oil tank.



18. Connect the return hose (4) between the quickattachment valve and the oil tank.

ENGINE



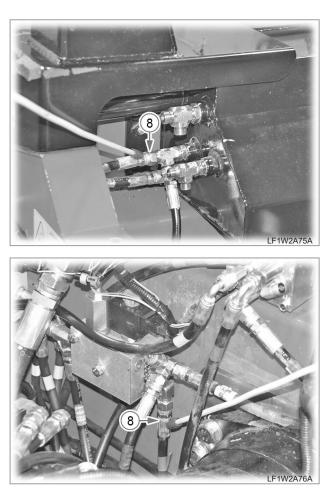


20. Install the right-hand RCV assembly return hose(6) on the oil tank.



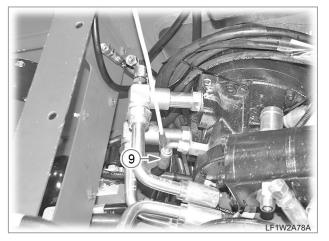
21. Install the left-hand RCV assembly return hose(7) on the oil tank.



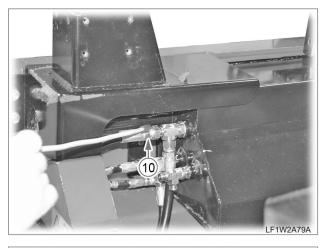


22. Install the soft shift valve return hose (8) on the oil tank.



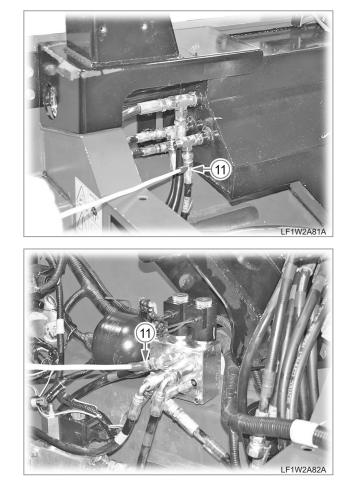


23. Install the return hose (9) between the HST motor (RH) and the oil tank.



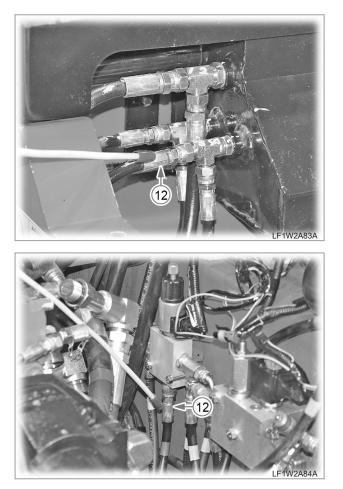


24. Install the return hose (10) between the HST motor (LH) and the oil tank.



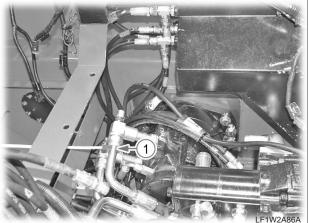
25. Install the pilot lock valve return hose (11) on the oil tank.



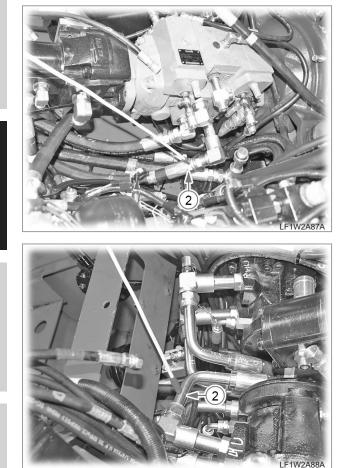


26. Install the parking valve return hose (12) on the oil tank.

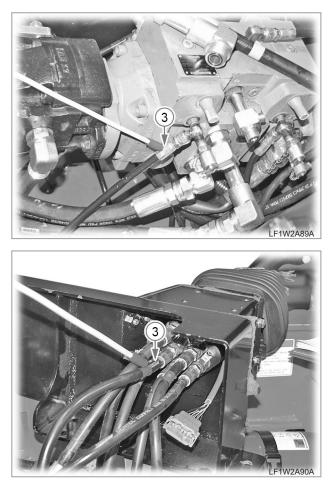




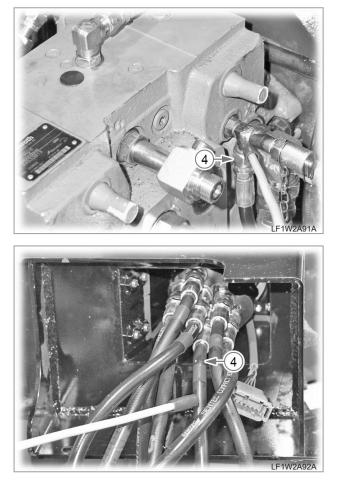
27. Connect the hydraulic hose (1) to the HST motor (RH) (forward driving) position on the left side of the HST pump.



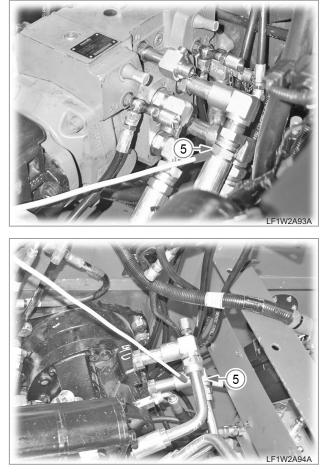
28. Connect the hydraulic hose (2) to the HST motor (LH) (forward driving) position on the HST pump.



29. Connect the hydraulic hose (3) to the RCV (LH) (reverse driving-RH) position on the HST pump.

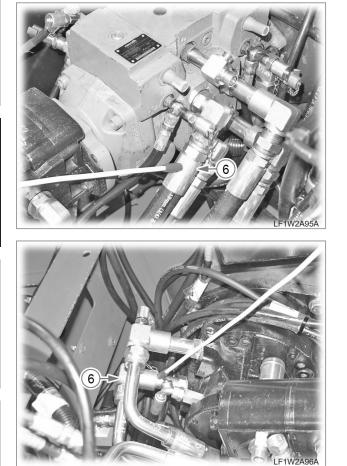


30. Connect the hydraulic hose (4) to the RCV (LH) (reverse driving-LH) position on the HST pump.

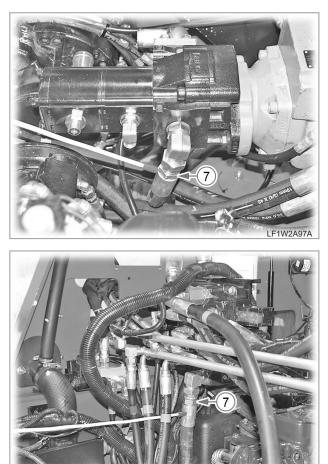


 Connect the hydraulic hose (5) to the HST motor (LH) (reverse driving) position on the HST pump.

GMW-0035

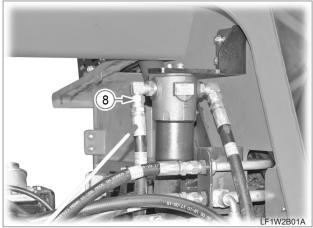


32. Connect the hydraulic hose (6) to the HST motor (RH) (forward driving) position on the HST pump.

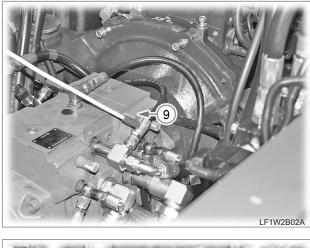


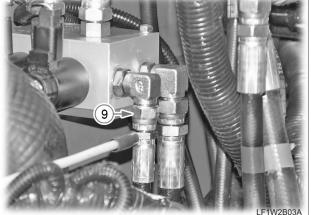
33. Connect the hydraulic hose (7) from the main pump to the main control valve position.



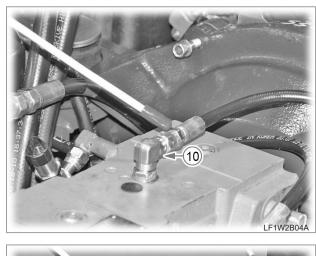


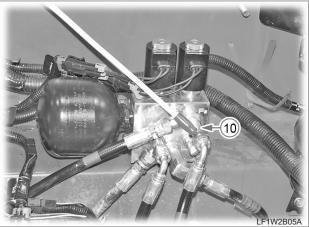
34. Connect the hydraulic hose (8) between the HST pump and HST filter.



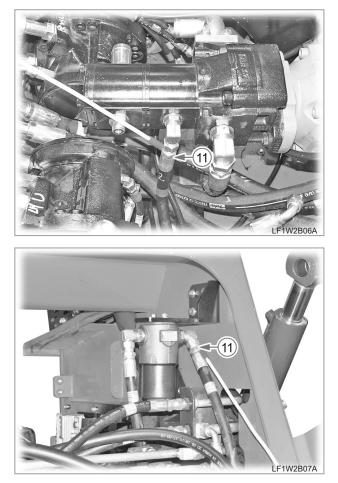


35. Connect the hydraulic hose (9) from the HST pump to the quick-attachment valve.



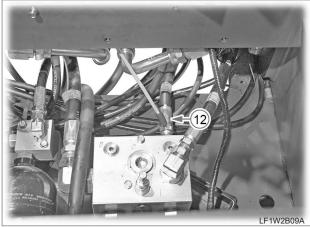


36. Connect the hydraulic hose (10) from the HST pump to the pilot lock valve.



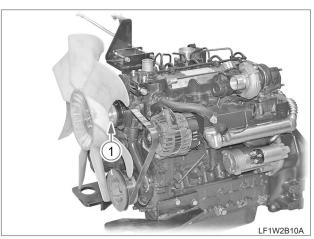
37. Connect the hydraulic hose (11) between the charge pump and HST filter.



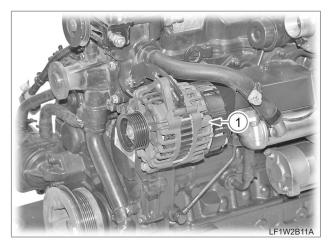


38. Connect the hydraulic hose (12) from the high-flow pump to the high-flow valve.

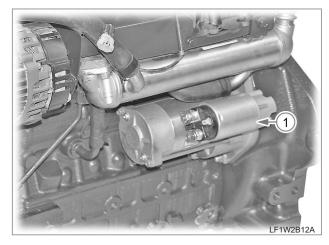
7.3 ENGINE COMPONENT REMOVAL



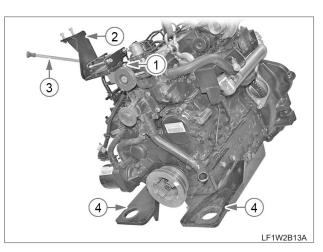
1. Unscrew the cooling fan mounting bolts (1) and then remove the cooling fan, fan collar, fan pulley, and fan belt in order.



2. Remove the alternator (1).



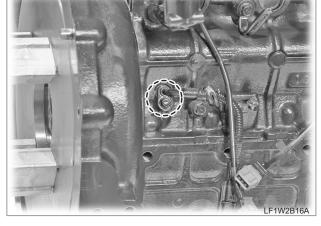
3. Remove the starter motor (1).



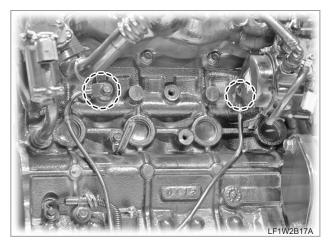
- 4. Unscrew the compressor support mounting bolt(1) and remove the compressor support (2), oil gauge guide (3) and engine mount bracket (4).
- 5. Remove sensors as necessary.



Coolant temperature sensor



Crankshaft wheel sensor



• Acceleration sensor (knock sensor)



• Fuel (common) rail pressure sensor

IRIC SYSTEM

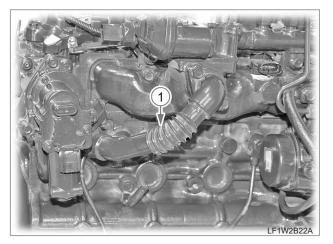


• Air temperature & pressure sensor

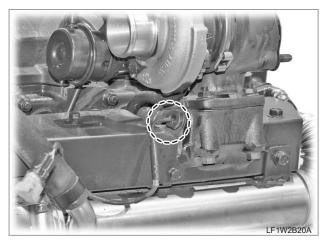
LF1W2B1



• Engine oil pressure sensor



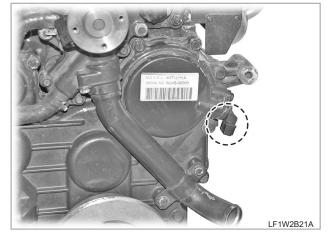
6. Disconnect the EGR pipe (1) on the intake manifold side.



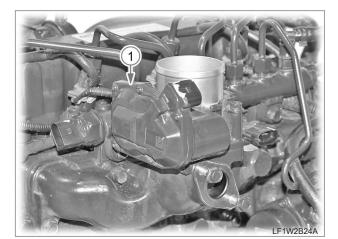
Exhaust gas temperature sensor



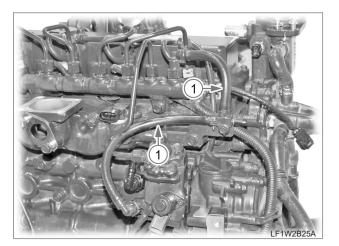
7. Remove the EGR valve assembly (1).



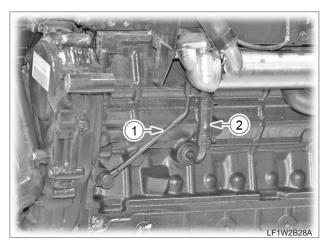
· Camshaft wheel sensor



8. Remove the air control valve (1).



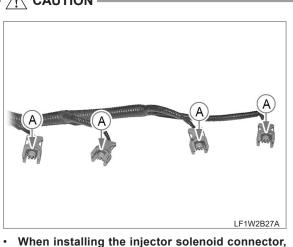
9. Disconnect fuel hose (1).



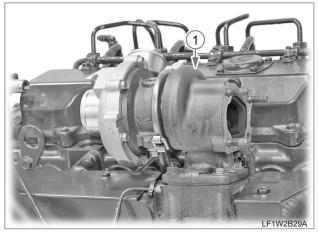
11. Disconnect the turbocharger oil supply pipe (1) and drain pipe (2).



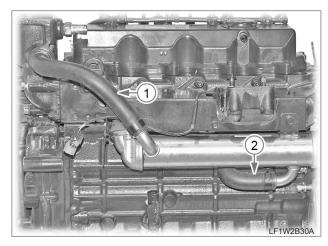
10. Disconnect injector solenoid connector (1).



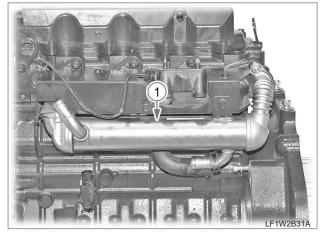
When installing the injector solenoid connector, be careful not to miss or damage the O-ring (A).



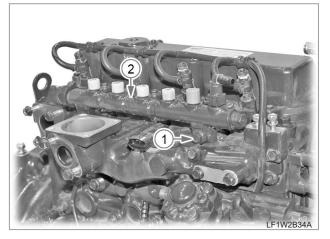
12. Remove the turbocharger assembly (1).



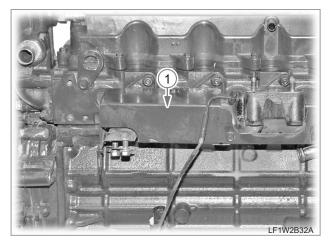
13. Disconnect the EGR cooler hoses 1 (1) and 2 (2).



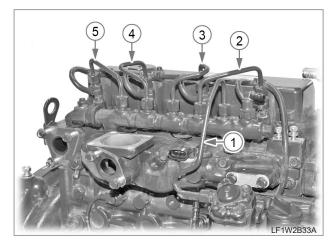
14. Remove the EGR cooler assembly (1).



17. Unscrew the fuel rail mounting bolts (1) to remove the fuel rail assembly (2).



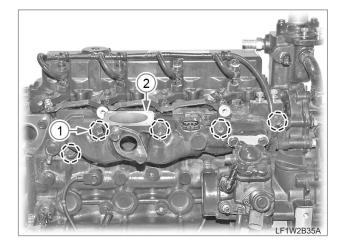
15. Remove the shield plate (1) on the exhaust manifold side.



16. Disconnect the fuel rail pipe (1) and injection pipes (2, 3, 4 & 5).

High-pressure pipe nut tightening torque 27.4 ± 31.4 Nm 2.8 ± 3.2 kgf-m 20.2 ± 23.0 lb-ft

GMW-0035



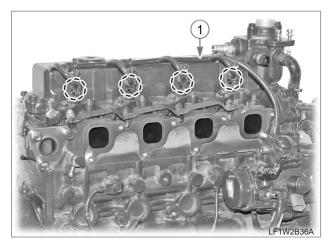
18. Unscrew the intake manifold mounting bolts (1) to remove the intake manifold (2).

Mounting bolt

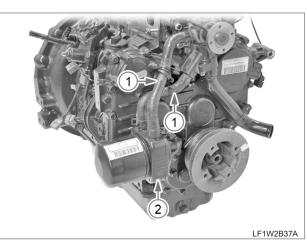
tightening torque 23.5 ± 27.4 Nm 2.4 ± 2.8 kgf-m 17.3 ± 20.2 lb-ft

N CAUTION -

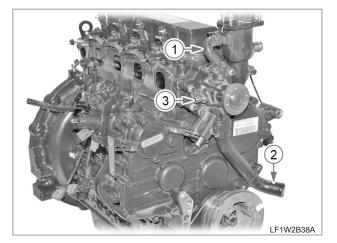
• When it is necessary to replace the fuel rail pressure sensor, the whole fuel rail assembly should be replaced.



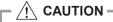
19. Remove the injector return tube assembly (1).



20. Disconnect the oil cooler connecting hose (1) and remove the oil cooler (2) with the oil filter.



21. Disconnect the coolant return hose (1) and remove the water pump pipe (2) and water pump assembly (3).

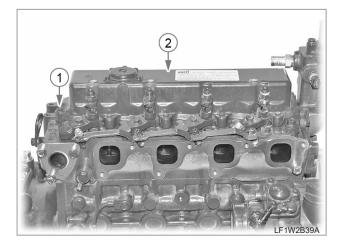


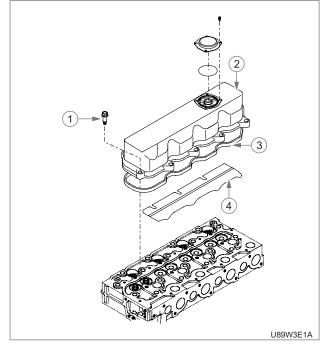
- If foreign materials are introduced into the fuel system in the direct injection type engine, major defect can occur between the high-pressure fuel pump and injector. When replacing or servicing any fuel connecting pipe or fuel system part, seal it to prevent introduction of any foreign material.
- Replace the fuel pipes between the highpressure fuel pump, fuel rail and injectors with new ones during reassembly.

7.4 ENGINE DISASSEMBLY

7.4.1 HEAD COVER

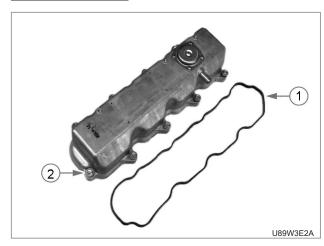
REMOVAL





- 1. Remove the cylinder head cover bolts (1).
- 2. Remove the head cover (2) and gasket (3).
- 3. Remove the oil baffle plate (4) if necessary.

INSTALLATION

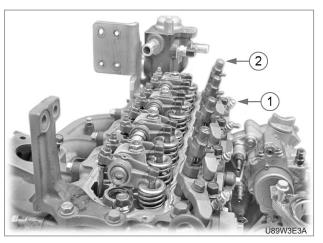


- 1. Make sure that the head cover gasket is well seated on the groove of the cylinder head cover.
- When installing the head cover, keep the specified tightening torque and tighten the bolts (2) gradually into 3 ~ 4 steps.
- 3. Ensure that the cylinder head cover gasket (1) is not defective.

Cylinder head cover bolt (M8)

tightening torque......8.8 ~ 11.8 Nm 0.9 ~ 1.2 kgf-m 6.5 ~ 8.7 lb-ft

7.4.2 GLOW PLUG AND INJECTOR



(1) Glow plug

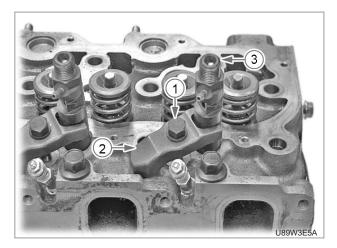
(2) Injector

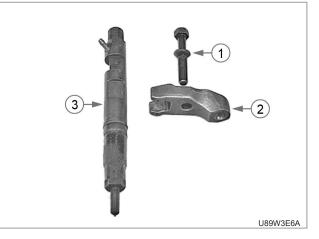


1. Screw out the glow plug (1) from the intake side of the cylinder head.

Glow plug

tightening torque...... 19.6 ± 24.5 Nm 2 ± 2.5 kgf-m 14.4 ± 18.0 lb-ft



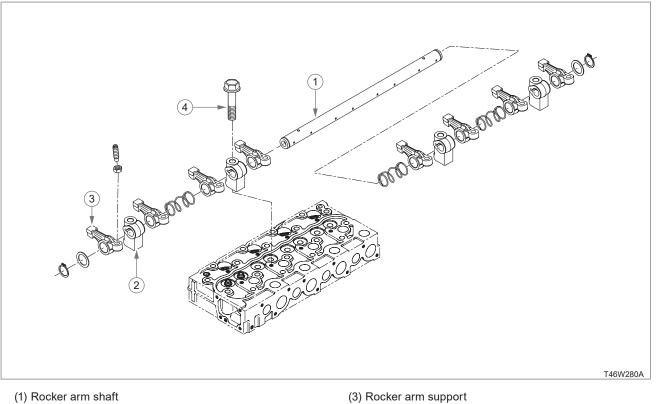


2. Unscrew the clamp mounting bolt (1) to remove the clamp (2) and injector (3).

– <u>/</u> CAUTION –

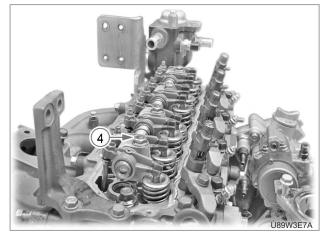
 When the injector is removed, it should be installed to the original position afterwards. When replacing the injector with a new one, connect the scan tool to the ECU and enter the injector code to the scan tool. (Refer to the instructions for injector code management in the Section 3.4.7.)

7.4.3 ROCKER ARM ASSEMBLY



(2) Rocker arm

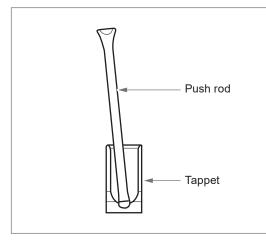
REMOVAL



- 1. Remove the rocker arm mounting bolts (4) by loosening them in several steps.
- 2. Remove the rocker arm assembly and the push rod.

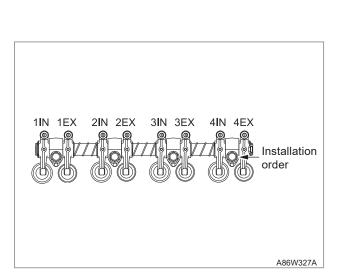
- (4) Rocker arm support bolt

INSTALLATION

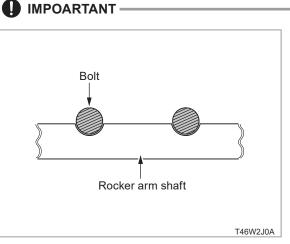


1. Make sure that the push rod is seated on the concaved area of the tappet.

T46W281A



- 2. Tighten the rocker arm support bolts to the specified torque in several steps with the specified sequence as shown in the figure.
- 3. Adjust the valve clearance after assembling the rocker arm assembly.

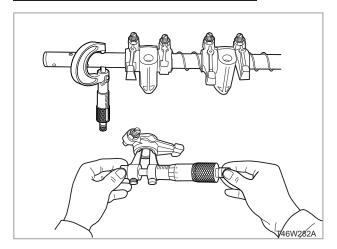


• To tighten the rocker arm support bolt, the groove on the rocker arm shaft should face the bolt.

Rocker arm mounting bolt

(M10)..... 60.8 ~ 73.5 Nm 6.2 ~ 7.2 kgf-m 44.8 ~ 54.2 lb-ft

ROCKER ARM ASSEMBLY CHECK

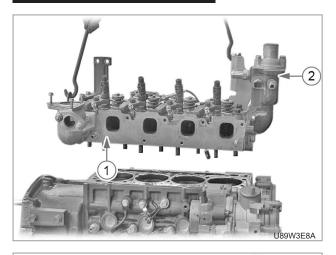


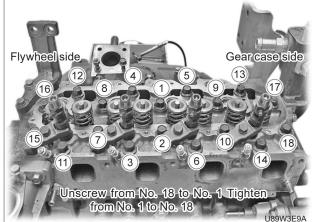
- 1. Measure the rocker arm I.D. with an inside micrometer.
- 2. Measure the rocker arm shaft O.D. with an outside micrometer.
- 3. If the clearance exceeds the allowable limit, replace the rocker arm.
- 4. If the clearance still exceeds the allowable limit after replacing the rocker arm, replace the rocker arm shaft.

Specified size	0.020 ~ 0.070 mm (0.00079 ~ 0.00276 in.)
Allowable limit	0.15 mm (0.0059 in.)
Specified size	18.955 ~ 18.980 mm (0.74626 ~ 0.74724 in.)
Specified size	19.000 ~ 19.025 mm (0.74803 ~ 0.74902 in.)
	size Allowable limit Specified size Specified

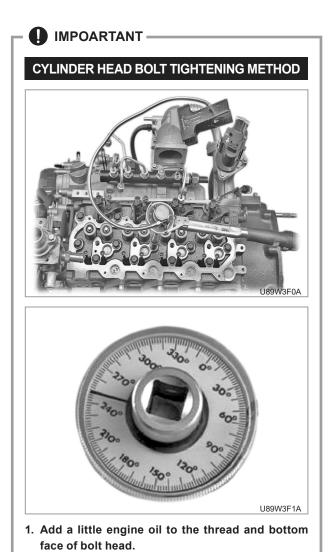
7.4.4 CYLINDER HEAD

CYLINDER HEAD REMOVAL





- 1. Loosen the head bolts in the reverse sequence as shown in the figure. (Follow the sequence in the figure when tightening them.)
- 2. Lift the head (1) slightly with a hoist by using the hook.
- 3. Remove the coolant flange (2) if necessary.
- 4. Remove the tappets from the cylinder block.
 - 🕂 CAUTION –
 - Mark the cylinder number to the tappets to prevent them from interchanging.



- 2. Tighten the head bolt to 4 kgf-m in accordance with head bolt tightening order.
- 3. Tighten every bolts 90° with angle torque wrench in accordance with tightening order.
- 4. Tighten bolts 70° more in accordance with tightening order.
- 5. Do not re-use old head bolts.

REMARKS -

- A, B seires engine: 4 kgf-m + 90° + 80°
- F, H seires engine : 4 kgf-m + 90° + 70°

ENGINE

CYLINDER HEAD INSTALLATION

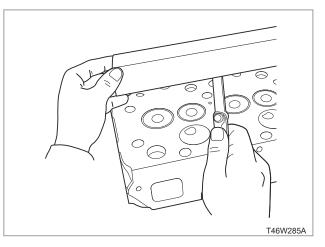
- 1. Apply the liquid gasket (Three bond 1215 or equivalent) on both sides of coolant flange gasket.
- 2. Always replace the head gasket with a new one. Pay particular attention to its direction and orientation.
- 3. Remove any gasket residue out of mating surfaces of the cylinder head and cylinder block before installing the new cylinder head gasket. Be careful not to get the residue enter into the block or the head. (Use a vacuum cleaner to clean the residue.)
- 4. Before installing the tappets, apply engine oil around them.

IMPOARTANT -

- Check the torque after 30 minutes operation of the assembled engine, and adjust valve clearance.
- Tightening torgue and angle.

1st Round	2nd Round	3rd Round
4 kgf-m	90°	70°

CYLINDER HEAD SURFACE FLATNESS CHECK



- 1. Thoroughly clean the cylinder head surface.
- 2. Place a straight edge on the cylinder head and measure the clearance with a feeler gage as shown in the figure.
- 3. If the measured value exceeds the allowable limit, replace the cylinder head.



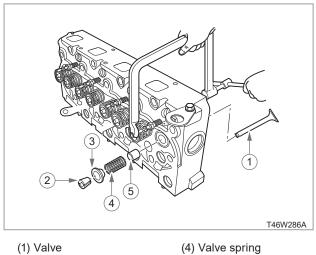
IMPOARTANT -

Do not place the straight edge on the combustion chamber.

Allowable limit 0.05 mm 0.0019 in.

7.4.5 INTAKE AND EXHAUST VALVES

VALVE REMOVAL



- (2) Collet
- (3) Retainer
- (5) Valve stem seal
- 1. Compress the valve spring with the replacer and remove the collet (2).
- 2. Remove the retainer (3), valve spring (4), valve stem seal (5) and the valve (1).

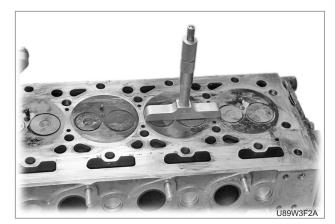
IMPOARTANT -D

- Be careful not to interchange the valves and related components.
- Mark the cylinder number on the valve and the • parts to prevent interchanging.

VALVE INSTALLATION

- 1. Apply oil to the stem of valve and install it into the cylinder head.
- 2. Lubricate the valve and its related parts after installation.

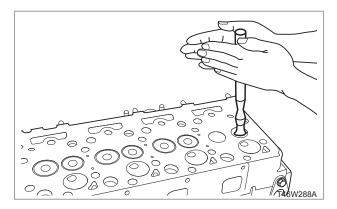
VALVE RECESS CHECK



- 1. Clean the cylinder head, the valve face and the valve seat.
- 2. Insert the valve into the valve guide.
- 3. Measure the valve recess with a depth gauge.
- 4. If the recess value exceeds the allowable limit, replace the valve and check the valve seat.

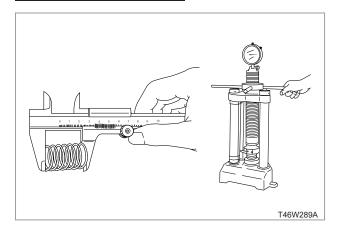
Valve recess	Specified value	0.2 ~ 0.5 mm 0.0078 ~ 0.0197 in.
	Allowable limit	0.8 mm 0.0315 in.

VALVE SEAT CHECK



- 1. Coat the valve face lightly with red lead and put the valve on its seat to check the contact.
- 2. If the valve does not seat all the way around the valve seat or the valve contact is less than 70%, correct the valve seating as follows.
- 3. Apply compound on the valve face evenly.
- 4. Put the valve on its seat and hold it with the valve flapper.
- 5. Turn the valve back and forth on the valve seat to lap.
- 6. Remove the compound and clean the valve and the seat.
- 7. Apply oil on the valve face and finish to complete fitting.
- 8. Repeat lapping until the valve seats correctly.

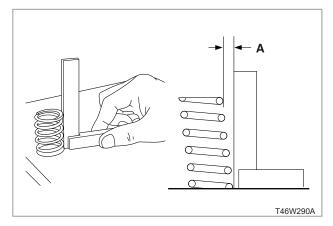
VALVE SPRING CHECK



- 1. Measure the free length of the spring with vernier calipers.
- 2. Place the spring on a spring compression tester and compress to the specified length to measure the tension.
- If the measured value is less than the allowable limit, replace the valve spring.

Tension	Specified value n Allowable limit	117 N / 35.15 mm 12.0 kgf / 35.15 mm 26.5 lbs / 1.3839 in.
Tension		100 N / 35.15 mm 10.2 kgf / 35.15 mm 22.5 lbs / 1.3839 in.
Free length	Specified value	41.7 ~ 42.2 mm 1.6417 ~ 1.6614 in.
Free length	Allowable limit	41.2 mm 1.622 in

VALVE SPRING SQUARENESS (TILT)

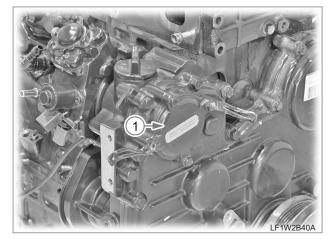


- 1. Place the spring on the flat plate and then put a square at its side.
- 2. Measure the maximum distance "A" while rotating the spring.
- 3. If the measurement exceeds the allowable limit, replace the spring.

Valve spring	Allowable	1.0 mm
squareness	limit	0.039 in.

7.4.6 HIGH PRESSURE FUEL PUMP

PUMP REMOVAL



1. Remove the cover (1) of the gear case on the high-pressure fuel pump gear side.



2. Remove the high-pressure fuel pump gear (2) from the gear case.

Mounting nut tightening torque...... 68.6 ~ 78.4 Nm

7 ~ 8 kgf-m 50.4 ` 57.6 lb-ft





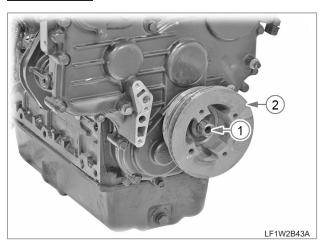
3. Unscrew the high-pressure fuel pump mounting bolts (3) to remove the high-pressure fuel pump assembly.

Mounting nut

tightening torque...... 23.5 ± 27.4 Nm 2.4 ± 2.8 kgf-m 17.3 ± 20.2 lb-ft

7.4.7 GEAR CASE

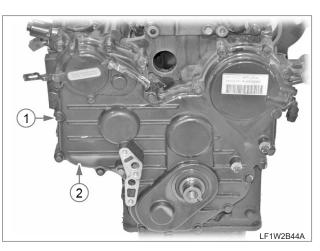
REMOVAL



1. Unscrew the crankshaft mounting bolt (1) to remove the fan drive pulley (2).

Crankshaft bolt

tightening torque....... 320.5 ~ 343.0 Nm 32.7 ~ 35.0 kgf-m 235.4 ~ 252.0 lb-ft

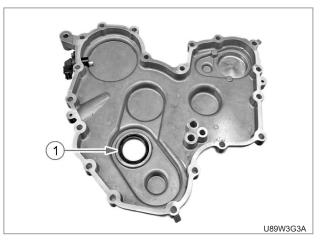


2. Unscrew the gear case cover mounting bolts (1) to remove the gear case cover (2).

Mounting bolt

tightening torque	23.5 ~ 27.4 Nm
	2.4 ~ 2.8 kgf-m
	17.3 ~ 20.2 lb-ft

INSTALLATION



- Apply the grease to the crankshaft oil seal (1) lip on the gear case cover and take care not to damage it when installing.
- 2. Make sure that the gear case cover mounting bolts are installed at correct locations.



- In general, the bolt should be screwed as 1.5 times as the diameter of the bolt in length.
- 3. nstall all bolts and increase the tightening torque gradually (in 2 to 3 steps).

M8 tightening torque... 23.5 ~ 27.4 Nm 2.4 ~ 2.8 kgf-m 17.3 ~ 20.2 lb-ft

SAFETY FIRS

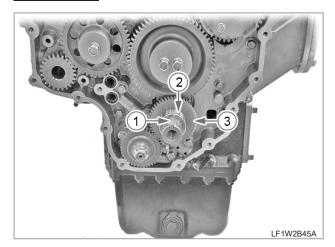
RIVING & CHAS

t sensor wheel (2).

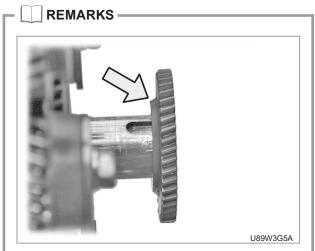
INDEX

7.4.8 GEARS IN GEAR CASE

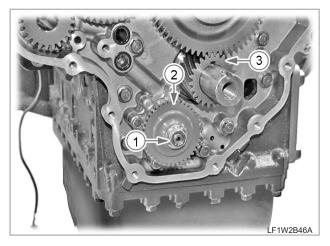
REMOVAL



1. Pull out the crankshaft key (1) and remove the spacer (2) and oil pump drive gear (3).



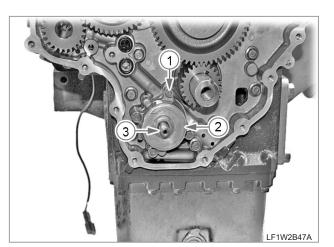
• When installing the oil pump drive gear, have its boss set toward the inside.



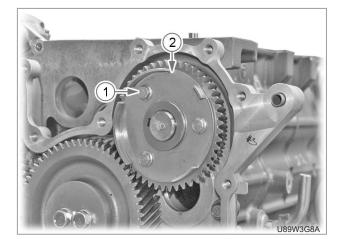
2. Unscrew the oil pump gear mounting nut (1) to remove the oil pump gear (2).

REMARKS -

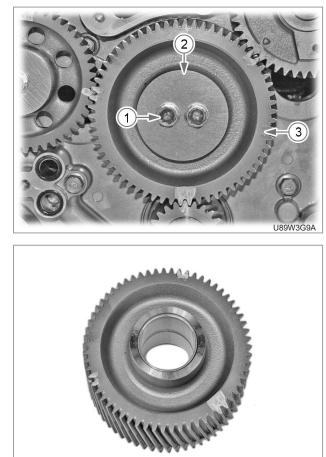
 The crankshaft gear (3) should be removed with a special puller when necessary. When installing the crankshaft gear, heat it to approx. 80°C (176°F) and insert it into the crankshaft.



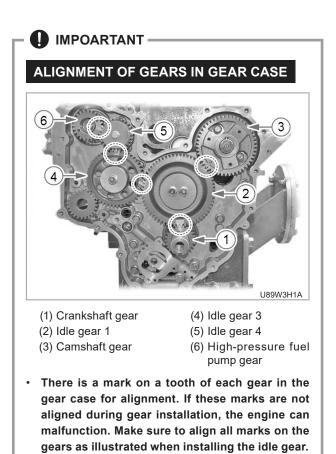
 Unscrew the oil pump cover mounting bolts (1) to remove the oil pump cover (2) and oil pump rotor shaft (3) together.

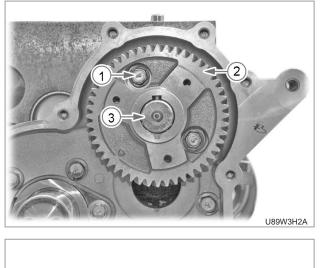


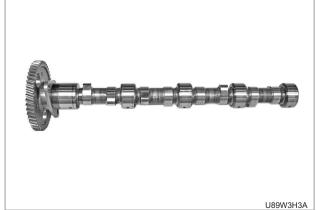
 Unscrew the camshaft sensor wheel mounting bolts (1) to remove the camshaft sensor wheel (2).



- U89W3H0A
- Unscrew the idle gear 1 mounting bolts (1) to remove the stopper (2) and idle gear assembly 1 (3) in order.



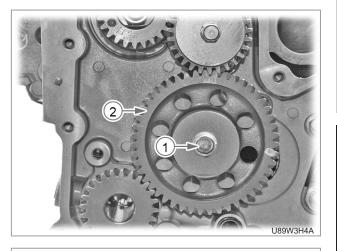


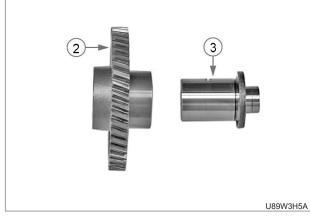


Unscrew the camshaft stopper mounting bolts (1) to remove the camshaft gear (2) and camshaft (3) together.

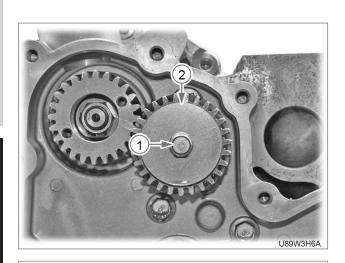
REMARKS -

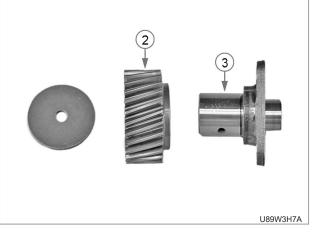
 When necessary, remove the camshaft gear (2) with a special puller. When installing it, heat it to approx. 80°C (176°F) and insert it into the crankshaft.



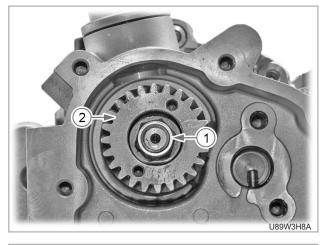


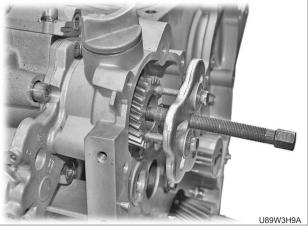
7. Unscrew the idle gear 3 stopper mounting bolt (1) to remove the idle gear 3 (2) and idle gear 3 shaft (3).





8. Unscrew the idle gear 4 stopper mounting bolt (1) to remove the idle gear 4 (2) and idle gear 4 shaft (3).

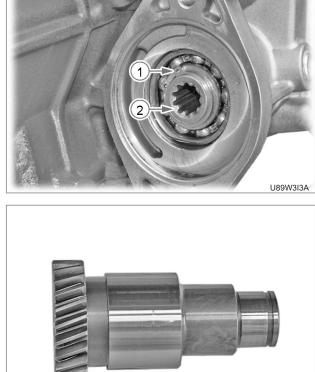




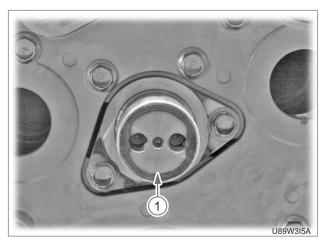


 Unscrew the high-pressure fuel pump gear mounting nut (1) and remove the high-pressure fuel pump gear (2) with a special puller.

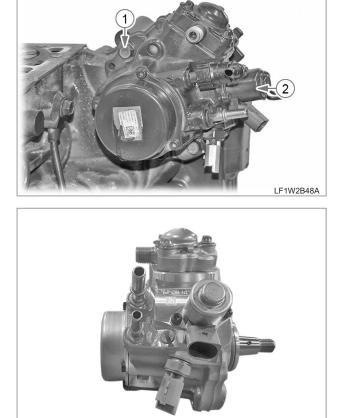




- U89W3I4A
- 11. Pull out the hydraulic pump drive gear mounting snap ring (1) to remove the hydraulic pump drive gear (2).



12. Remove the idle gear 1 shaft (1).

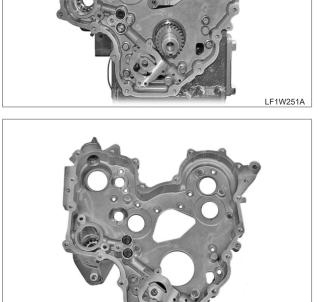


ST5W330A

10. Unscrew the high-pressure fuel pump mounting bolts (1) to remove the high-pressure fuel pump assembly (2).

2





13. Unscrew the gear case mounting bolts (1) (14 EA) to remove the gear case assembly (2)

U89W3I7A

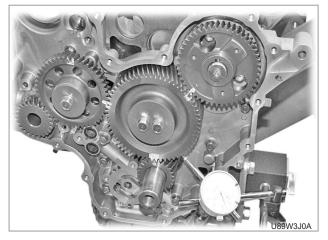


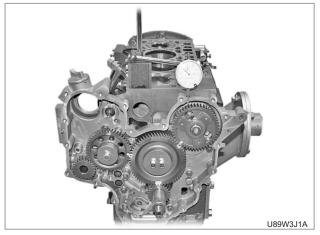
14. If necessary, remove the relief valve.

- REMARKS
 - Apply liquid gasket (LOCTITE #5902, #5900 or equivalent) to the mating surface of the gear case on the cylinder block side before installing the gear case.
 - Make sure that the O-ring is installed (sections with dotted circles) before installing the gear case. If any faulty O-ring is detected, install a new one and apply a proper amount of gear or engine oil on it.

CRANK GEARS AND SHAFTS CHECK

▶ IDLE GEAR & CAM SHAFT GEAR BACKLASH





- 1. Set a dial indicator (lever type) with its tip on the gear tooth.
- 2. Move the idle gear and camshaft gear to measure its backlash while holding the engaged gear to it.
- If the backlash exceeds the allowable limit, check the oil clearance of the shafts and the gear. (See next page)
- 4. If the oil clearance is OK but the backlash is over the allowable limit, replace the gear.

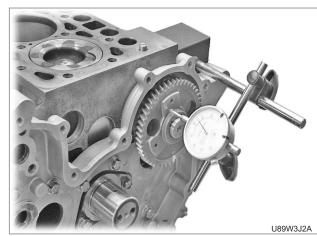
Backlash	Specified value	0.04 ~ 0.11mm 0.0016 ~ 0.0043 in.
Dackiasii	Allowable limit	0.15 mm 0.0059 in.

▶ IDLE GEAR SIDE CLEARANCE

- Install the dial gauge to be in contact with the gear surface. Then, measure the clearance while pushing and pulling the gear. (Refer to the measurement method of the valve camshaft gear side clearance below.)
- 2. If the clearance exceeds the allowable limit, replace the idle gear.

Side	Specified value	0.20 ~ 0.51 mm 0.0079~ 0.0201 in.
clearance	Allowable limit	0.9 mm 0.035 in.

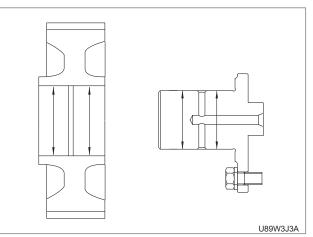
► VALVE CAMSHAFT GEAR SIDE CLEARANCE



- 1. Install the dial gauge so that its sensor tip is in contact with the camshaft gear surface slightly.
- 2. Pull the camshaft gear to measure the side clearance.
- 3. If the clearance exceeds the allowable limit, replace the camshaft stopper.

Side	Specified value	0.07 ~ 0.22 mm 0.0028 ~ 0.0087 in.
clearance	Allowable limit	0.3 mm 0.0118 in.

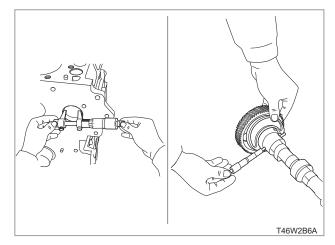
▶ IDLE GEAR OIL CLEARANCE MEASUREMENT



- 1. Measure the idle gear shaft O.D. with an outside micrometer.
- 2. Measure the idle gear bushings I.D. with an inside micrometer.
- 3. If the clearance exceeds the allowable limit, replace the bushing.

Oil	Specified value	0.025 ~ 0.066 mm 0.00098 ~ 0.00259 in.
clearance	Allowable limit	0.1 mm 0.004 in.
Shaft O.D.	Specified value	42.959 ~ 42.975 mm 1.69130 ~ 1.69193 in.
Bushing I.D.	Specified value	43.000 ~ 43.025 mm 1.69291 ~ 1.69390 in.

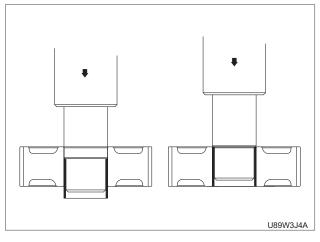
► VALVE CAMSHAFT OIL CLEARANCE MEASUREMENT



- 1. Measure the I.D. of the camshaft bore on the crankcase with an inside micrometer.
- 2. Measure the O.D. of the camshaft journal with an outside micrometer.
- 3. If the clearance exceeds the allowable limit, replace the shaft.

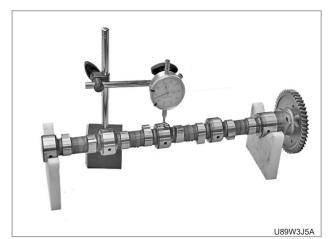
Oil	Specified value	0.050 ~ 0.091mm 0.00197 ~ 0.00358 in.
clearance	Allowable limit	0.15 mm 0.0059 in.
Journal O.D.	Specified value	39.934 ~ 39.950 mm 1.57221 ~ 1.57284 in.
Bore I.D.	Specified value	40.000 ~ 40.025 mm 1.57480 ~ 1.57579 in.

► IDLE GEAR BUSHING REPLACEMENT



- 1. Press out the bushing using replacing tool.
- 2. Clean the bore, and apply the oil on it.
- 3. Press in the new bushing using the replacing tool.

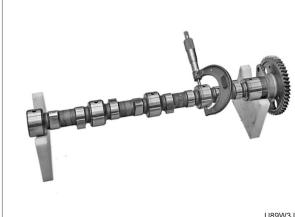
► VALVE CAMSHAFT DEFLECTION CHECK



- 1. Place the camshaft on V blocks with its journals supported and set a dial indicator with its tip on the intermediate journal.
- 2. Measure the eccentricity (half of the measured value) while turning the camshaft on the V blocks.
- 3. If the eccentricity exceeds the allowable limit, replace the camshaft.

Eccentricity	Allowable limit	0.05 mm 0.002 in.
--------------	--------------------	----------------------

► VALVE CAM HEIGHT MEASUREMENT



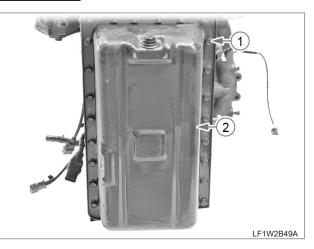
U89W3J6A

- 1. Measure the height of the camshaft lobe at largest O.D. with an outside micrometer.
- 2. If the measured value is below the allowable limit, replace the camshaft.

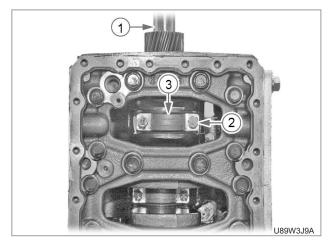
Cam height	IN.	Specification	33.59 mm 1.322 in.
		Allowable limit	33.54 mm 1.320 in.
	EX.	Specification	33.69 mm 1.326 in.
	⊏∧.	Allowable limit	33.64 mm 1.324 in.

7.4.9 PISTON AND CONNECTING ROD

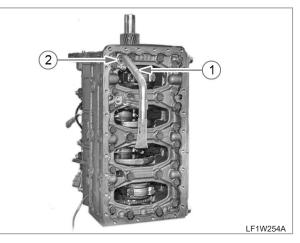
REMOVAL



1. With the engine block body supported, unscrew the oil pan mounting bolts (1) (26 EA) and remove the oil pan (2).

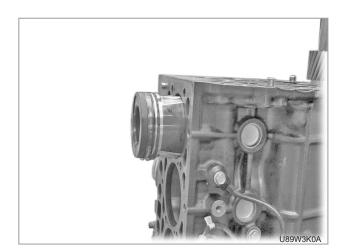


 Turn the crankshaft (1) to set the connecting rod cap to the lower side. Then, unscrew the connecting rod bolts (2) of each cylinder to remove the connecting rod cap (3).



2. Remove the oil strainer assembly (1).

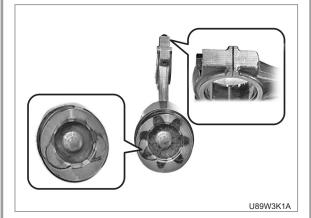
• When installing the oil strainer to the cylinder block, make sure to check the O-ring (2) on the mounting section.



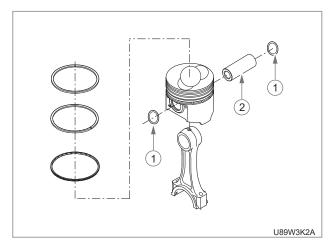
 Turn the crankshaft again to set the piston to the top of the engine block. Then, tap the connecting rod with a rubber hammer to remove the piston out of the cylinder block.

INSTALLATION

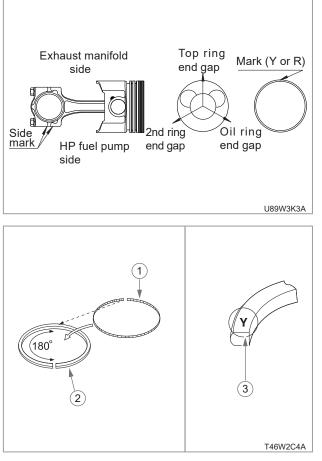
When removing the pistons, mark their installing positions by each cylinder so that they can be installed to their original positions later.



- When installing the piston and connecting rod, the combustion chamber groove of the piston head and the mark on the connecting rod should be set symmetrically.
- When installing the piston and connecting rod assembly to the cylinder block, set the mark on the connecting rod toward the high-pressure pump.



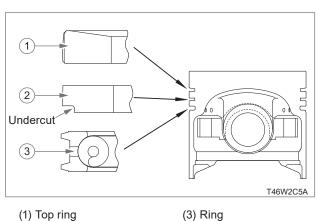
- 5. Remove the piston rings with a piston ring replacing tool.
- 6. Remove the piston pin snap ring (1) and then remove the piston pin (2).



- 1. Clean all the parts before installation.
- Warm up the piston by soaking it in hot oil (approx. 80 °C) for 10 to 15 minutes before inserting the piston pin into the piston.
- 3. With the casting marks on the connecting rods aligned vertically, set them toward the high-pressure pump and install the piston and connecting rod so that they are 180 degrees away from the combustion chamber groove on the piston head.
- 4. The manufacturer mark (Y or R) (3) on the top ring should face the top of the piston.
- 5. The cutout of expander (1) should face the opposite side of the oil ring (2) end gap.
- 6. The top ring end gap ring should be on the opposite side of the combustion chamber on piston.
- 7. The 2nd ring end gap and the oil ring end gap should be 120° far from the top ring end gap.

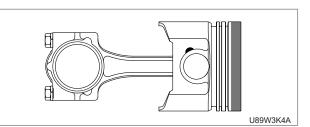
GMW-0035

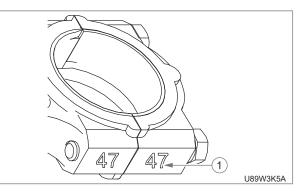
ENGINE



(1) Top ring (2) 2nd ring

- 8. Make sure that the undercut of the 2nd ring faces downward.
- 9. Apply the oil on the crankpin bearing, cylinder wall and connecting rod cap screw.





- 10. Insert the connecting rod and piston assembly with the stamped number (1) on the connecting rod facing the high pressure fuel pump using a piston ring compressor.
- 11. Apply the engine oil to the connecting rod cover bolts and hand tighten them all the way down. Then, tighten them with a torque wrench. If they would not be tightened to the specified torque, replace the bolts. The both stamped numbers should be seen from one side.

Connecting rod

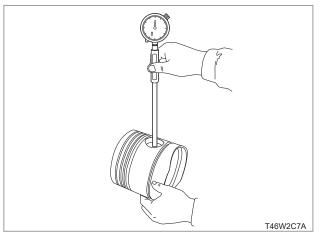
cover bolt	44.1 ~ 49.0 Nm
	4.5 ~ 5.0 kgf-m
	32.5 ~ 36.1 lb-ft



- Mark the cylinder number on the piston and connecting rod to prevent them from interchanging.
- Be careful not to damage the chrome-plate area on the piston ring when pressing the piston and ring assembly into the cylinder.

PISTON AND CONNECTING ROD CHECK

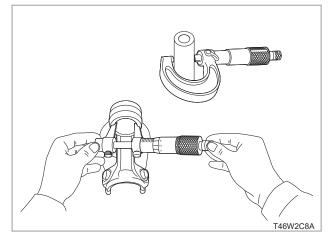
► PISTON PIN BORE



- 1. Measure the I.D. of piston pin bore (lengthwise and widthwise of the piston) with a cylinder gauge.
- 2. If the measured value exceeds the allowable limit, replace the piston.

Piston pin bore I.D.	Specified value	25.000 ~ 25.006 mm (0.9843 ~ 0.9845 in.)
	Allowable limit	25.03 mm (0.9854 in.)

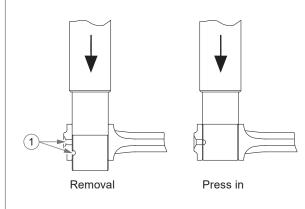
▶ PISTON PIN AND BUSHING CLEARANCE



- 1. Measure the piston pin O.D. with an outside micrometer.
- 2. Measure the piston pin busing I.D. with an inside micrometer.
- 3. If the clearance still exceeds the allowable limit after replacing the bushing with new one, replace the piston pin.

Clearance between piston pin and bushing	Specified value	0.025 ~ 0.045 mm (0.00098 ~ 0.00177 in.)
	Allowable limit	0.05 mm (0.0020 in.)
Piston pin O.D.	Specified value	29.995 ~ 30.000 mm (1.18090 ~ 1.18110 in.)
Bushing I.D.	Specified value	30.025 ~ 30.040 mm (1.18209 ~ 1.18268 in.)

▶ PISTON PIN BUSHING REPLACEMENT



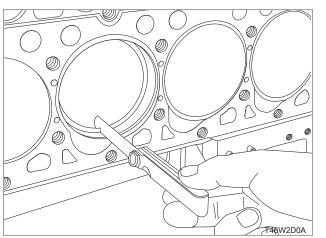
- T46W2C9A
- 1. Press out the bushing using a bushing replacing tool.
- 2. Clean the new bushing and the bore and apply the oil to them.
- 3. Press in the bushing using the replacing tool.

- 🚺 IMPOARTANT —

• Align the oil holes (1) of the connecting rod and the bushing.

PISTON RING MEASUREMENT

PISTON RING END GAP



- 1. Place the piston ring to be measured on the top face of piston in cylinder block and slightly push in the piston and piston ring. (Do not put the piston ring on the carbon layer.)
- 2. Measure the ring end gap with a feeler gauge.
- 3. If the gap exceed the allowable limit, replace the piston ring.

			-
Piston ring end gap	2nd ring	Specified value	0.40 ~ 0.55 mm (0.01575 ~ 0.02165 in.)
		Allowable limit	1.25 mm (0.0492 in.)
	Top ring, oil ring	Specified value	0.25 ~ 0.40 mm (0.00984 ~ 0.01575 in.)
		Allowable limit	1.25 mm (0.0492 in.)

4. If the gap is still over the allowable limit with even new ring, measure the diameter of bore (see page 3-137).

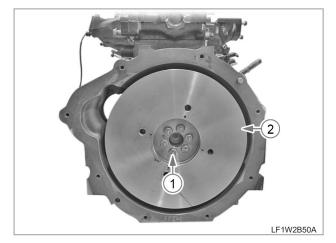
PISTON RING CLEARANCE



- 1. Clean the ring and ring grooves, and install each ring in its groove.
- 2. Measure the clearance between the ring and the ring groove with a feeler gauge.
- 3. If the clearance exceeds the allowable limit, replace the piston ring.
- 4. If the clearance still exceeds the allowable limit after removing the ring with new one, replace the piston.

Piston ring clearance	2nd ring	Specified value	0.04 ~ 0.08 mm (0.00157 ~ 0.00314 in.)
		Allowable limit	0.15 mm (0.0059 in.)
	Oil ring	Specified value	0.02 ~ 0.06 mm (0.00079 ~ 0.00236 in.)
	Oil ring	Allowable limit	0.15 mm (0.0059 in.)

7.4.10 FLYWHEEL AND CRANKSHAFT

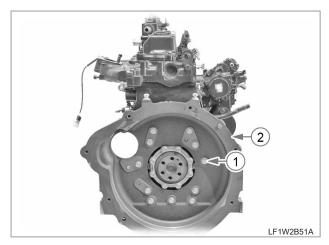


1. Unscrew the flywheel mounting bolts (1) to remove the flywheel (2).

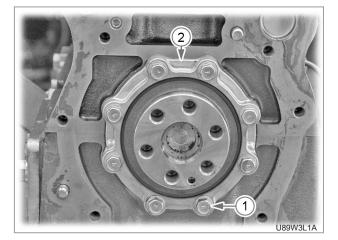


REMOVAL

 Use a crankshaft wrench or flywheel ring gear as a stopper to prevent the flywheel from rotating.



Unscrew the flywheel housing mounting bolts (1) (13 EA) to remove the flywheel housing (2).

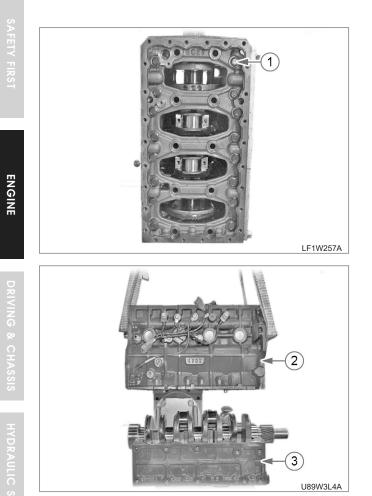


3. Unscrew the oil seal case mounting bolts (1) to remove the oil seal case (2).

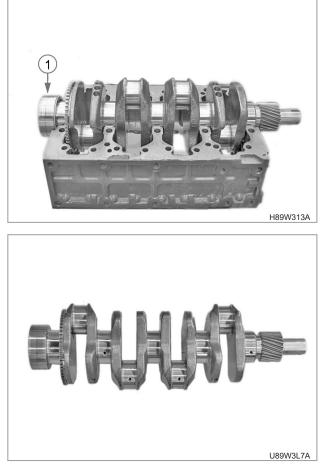


4. Unscrew the main bearing bolts (1) (10 EA) from the bottom of the cylinder block.

LF1W256A



5. Unscrew the ladder frame mounting bolts (1) (16 EA) to remove the cylinder block (2) and ladder frame (3).



6. Remove the crankshaft assembly (1).

GMW-0035

INSTALLATION

bearing (upper) (2).

REMARKS -

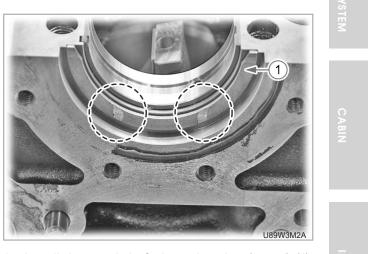
and hole on its center.





U89W3M0A

U89W3M1A



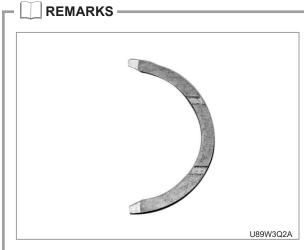
· The crankshaft bearing (upper) has an oil groove

1. Install the piston cooling jet valve (1) to the cylinder block. Then, install the crankshaft

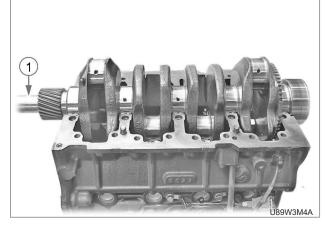
2. Install the crankshaft thrust bearing (upper) (1). Make sure to set its oil groove toward the outside.



7. Remove the piston cooling jet valve (1) from the cylinder block as necessary.



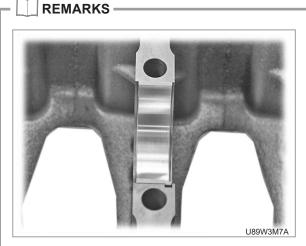
• The crankshaft thrust bearing (upper) does not have any protruded section.



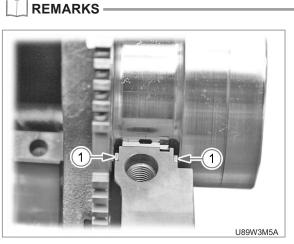
 Apply engine oil to the crankshaft bearings (upper) of the cylinder block. Then, put the crankshaft (1) on it.



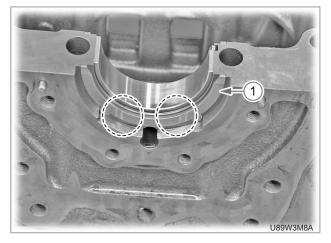
4. Install the crankshaft bearing (lower) (1) to the ladder frame..



• The crankshaft bearing (lower) does not have any oil groove and hole on its center.



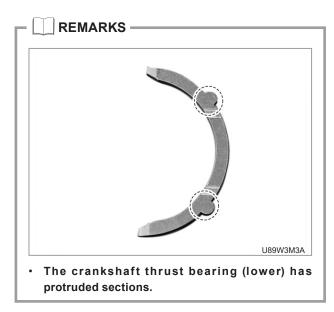
 Be careful not to lose the crankshaft thrust bearings (upper) (1) during installation of the crankshaft.



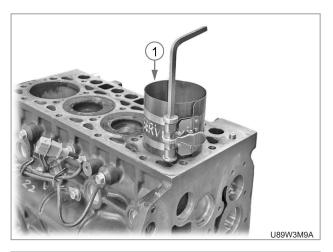
 Install the crankshaft thrust bearing (lower) (1). Make sure to set its oil groove toward the outside.

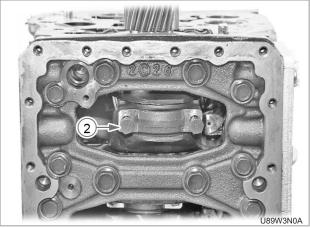
ETY FIRST

DRIVING & CH

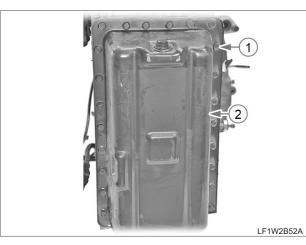


 Apply liquid gasket (LOCTITE #518 or equivalent) to the cylinder block face evenly and install the ladder frame.

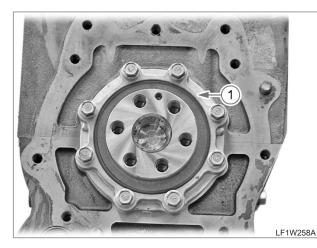




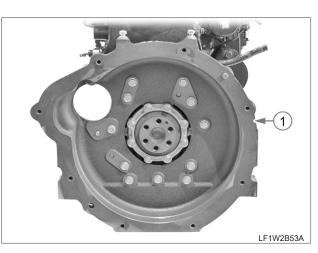
 Insert the piston into the cylinder using a piston inserting jig (1) and tighten the connecting rod cap mounting bolts (2).



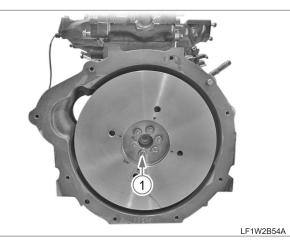
 Apply liquid gasket (LOCTITE #5902, #5900 or equivalent) to the mating surface of the oil pan evenly and tighten the oil pan mounting bolts (1) to install the oil pan (2) to the ladder frame.



9. Apply liquid gasket (LOCTITE #5902, #5900 or equivalent) to the oil seal case mating surface and install the oil seal case (1) to the cylinder block.



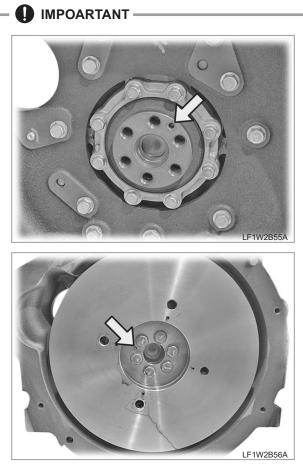
10. Apply liquid gasket (LOCTITE #5902, #5900 or equivalent) to the flywheel housing mating surface and install the flywheel housing (1) to the cylinder block.



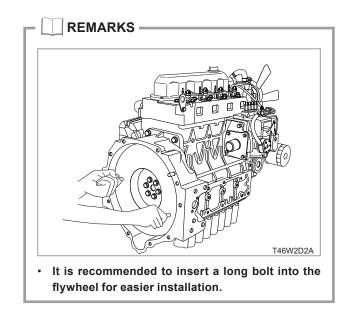
11. Install the flywheel. When installing the flywheel bolts (1), apply a small amount of oil to their threads, tighten them with a hand as far as possible and tighten them to the specified torque. Make sure to tighten the bolts diagonally in turn in several steps.

Flywheel bolt

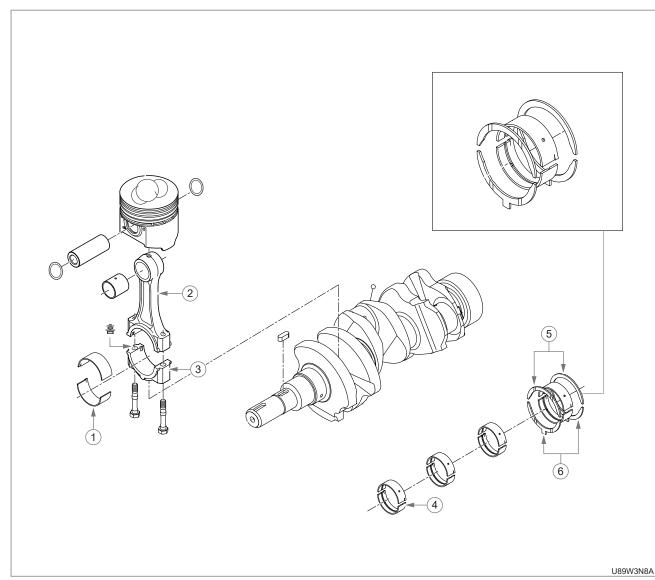
tightening torque	98.1 ~	107.9 Nm
	10.0 ~	11.0 kgf-m
	72.3 ~	79.6 lb-ft



 There are installation alignment holes (A) on the mounting surfaces of the crankshaft and flywheel. Make sure to align them during installation.



▶ PISTON PIN AND BUSHING CLEARANCE



 The connecting rod bearing (1) should be aligned with the mating notch of the connecting rod (2) or connecting rod cap (3) before installation.

• Apply sufficient amount of oil to the bearing before and after the installation.

- 2. The crankshaft bearing (4) should be aligned with the notch of the cylinder block and radder frame.
 - Apply sufficient amount of oil to the bearing before and after the installation.
- The crankshaft thrust bearing (upper) (5) and lower
 (6) can only be installed to the cylinder block and radder frame, which are right next to the flywheel.

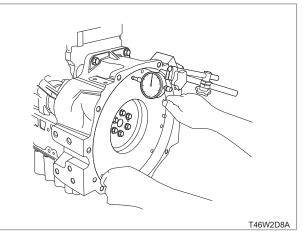
• Apply sufficient amount of oil before and after the installation.

IMPOARTANT -

- The oil groove of the thrust bearing (upper), (lower) should face outward. In other words, the oil groove should be seen after the thrust bearings are installed to the cylinder block and radder frame.
- If it is installed backwards, it can cause engine stall.
- The protrusion part of the thrust bearing (lower)
 (6) should face downward.

FLYWHEEL AND CRANKSHAFT CHECK

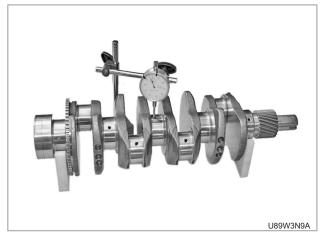
FLYWHEEL DEFLECTION AND CRANKSHAFT END PLAY



- 1. Set a dial indicator with its tip on the rear friction face of the flywheel near the edge.
- 2. Turn the flywheel to measure the deflection or the uneven wear.
- 3. If the measured value exceeds the allowable limit, remove the flywheel and check the mating faces of the crankshaft and flywheel.
- 4. If it is scored or worn excessively, regrind the surface of the flywheel or replace the flywheel.
- 5. Measure the end play while moving the crankshaft with flywheel back and forth to each end.
- 6. If the end play exceeds the allowable limit, replace the side bearing.

Deflection	Allowable limit	0.05 mm (0.0020 in.)
Find alou	Specified value	0.15 ~ 0.31 mm (0.0059 ~ 0.0122 in.)
End play	Allowable limit	0.5 mm (0.020 in.)

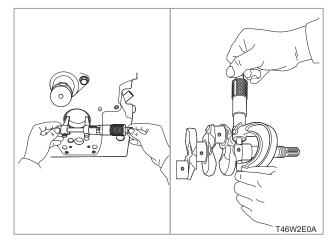
CRANKSHAFT DEFLECTION



- 1. Place the crankshaft on V blocks with its journals supported and set a dial indicator with its tip on the intermediate journal.
- 2. Measure the eccentricity (half of the measured value) while turning the crankshaft on the V blocks.
- 3. If the eccentricity exceeds the allowable limit, replace the crankshaft.

Eccentricity	Allowable limit	0.08 mm (0.0031 in.)
--------------	--------------------	-------------------------

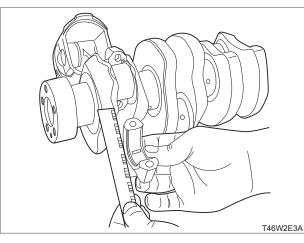
CRANKSHAFT JOURNAL AND BEARING 1 OIL CLEARANCE



- 1. Measure the I.D. of the crankshaft bearing 1 with an inside micrometer.
- 2. Measure the O.D. of the crankshaft journal with an outside micrometer.
- 3. If the clearance exceeds the allowable limit, replace the crankshaft metal bearing.

Oil	Specified value	0.040 ~ 0.104 mm (0.00153 ~ 0.00400 in.)
clearance	Allowable limit	0.20 mm (0.0079 in.)
Journal O.D.	Specified value	59.921 ~ 59.940 mm (2.35909 ~ 2.35984 in.)
Bearing 1 I.D.	Specified value	59.980 ~ 60.025 mm (2.36142 ~ 2.36319 in.)

CRANK PIN AND CONNECTING ROD BEARING OIL CLEARANCE

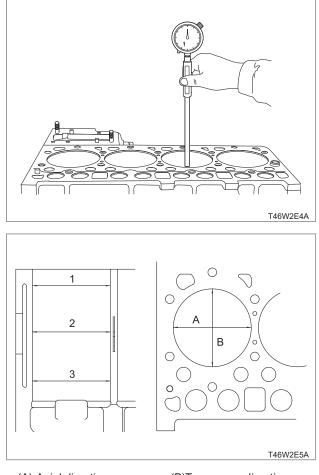


- 1. Place a plastigauge in lengthwise on the center of the crankpin.
- 2. Install the connecting rod, tighten the bolts to the specified torque once and remove the cap again.
- 3. Measure the amount of the flatness with the scale and get the oil clearance.
- 4. If the clearance exceeds the allowable limit, replace the bearing.

Specified value	0.017 ~ 0.073 mm (0.00067 ~ 0.00287 in.)
Allowable limit	0.20 mm (0.0079 in.)
Specified value	51.959 ~ 51.975 mm (2.04563 ~ 2.04626 in.)
Specified value	51.992 ~ 52.032 mm (2.04693 ~ 2.04850 in.)
	value Allowable limit Specified value Specified

► CYLINDER BORE CHECK

1. Check the worn condition of the honing groove on the bore.

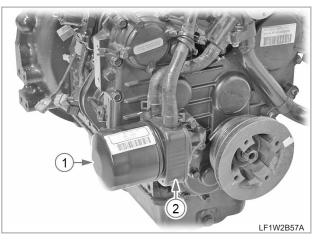


(A) Axial direction (1,2,3) Measuring Points (B)Transverse direction

- 2. Check the bore for scuffing or scoring.
- 3. Measure the cylinder liner I.D. at six locations as shown in the figure to find the largest worn area.

Cylinder liner I.D.	87.000 ~ 87.022 mm
Specified value	(3.425 ~ 3.4261 in.)

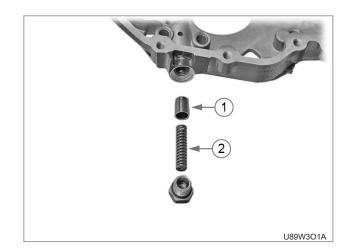
7.4.11 OIL FILTER



(1) Oil filter

(2) Oil cooler

Drain engine oil and remove the engine oil filter
 (1) and engine oil cooler (2) for inspection.

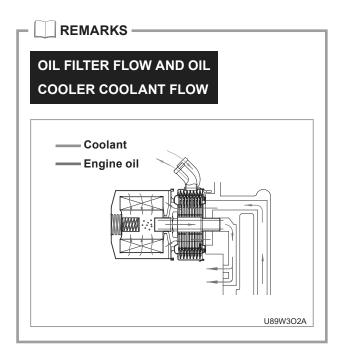


- Remove the relief valve from the side of the gear case and check the plunger (1) and spring (2) for deformation. If damaged, replace it with a new one.
- 3. Measure the free length of the spring. If the measurement is over the allowable limit, replace it with a new one

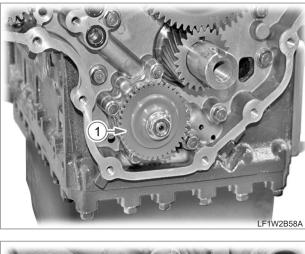
Spring Free length	Specified value	43.8 mm (1.7244 in.)
	Allowable limit	39.0 mm (1.5354 in.)

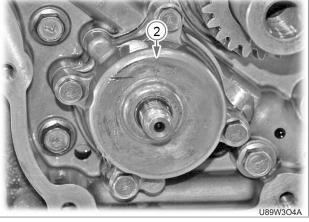
ENGINE

INDEX



7.4.12 OIL PUMP

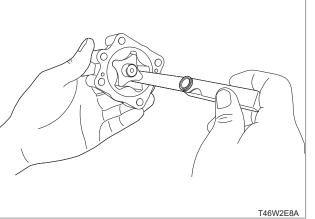




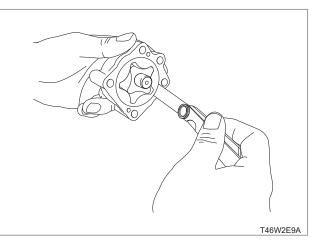
(1) Oil pump gear

(2) Oil pump ass'y

 Remove the oil pump gear (1) from the lower section of the gear case. Then, remove the oil pump assembly (2). OIL PUMP CHECK



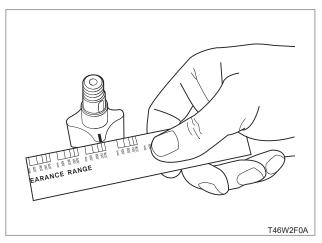
► CLEARANCE BETWEEN ROTOR AND LOBE



- 1. Measure the clearance between the outer rotor and inner rotor with a feeler gauge.
- 2. Measure the clearance between the outer rotor and the housing with a feeler gauge.
- 3. If the clearance exceeds the allowable limit, replace the pump.

Clearance between outer rotor and inner rotor	Specified value	0.10 ~ 0.16 mm (0.0039 ~ 0.0063 in.)
	Allowable limit	0.20 mm (0.0079 in.)
Clearance between outer	Specified value	0.11 ~ 0.19 mm (0.0043 ~ 0.0075 in.)
rotor and housing	Allowable limit	0.25 mm (0.0098 in.)

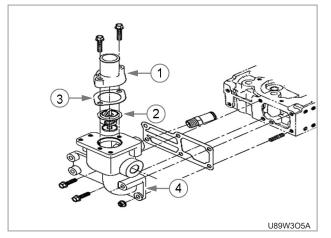
► END CLEARANCE OF ROTOR IN OIL PUMP



- 1. Place a plastigauge on the rotor and assemble the pump.
- 2. Disassemble the pump and measure the amount of the flatness with a scale to get the clearance.
- 3. If the clearance exceeds the allowable limit, replace the pump.

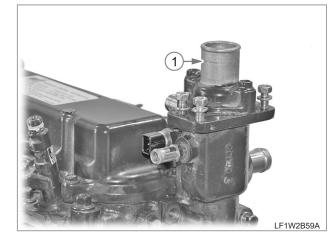
End clearance	Specified value	0.105 ~ 0.150 mm (0.00423 ~ 0.00591 in.)
	Allowable limit	0.20 mm (0.0079 in.)

7.4.13 THERMOSTAT

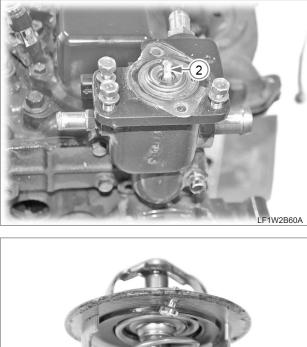


- (1) Thermostat cover(2) Thermostat
- (3) Thermostat cover gasket(4) Coolant flange

REMOVAL



1. Remove the thermostat cover (1).



- LF1W2B1A
- 2. Pull out the thermostat (2).

INSTALLATION

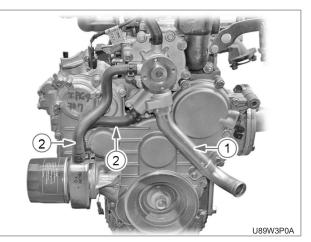
• Apply liquid gasket (Three Bond 1215 or equivalent) to the gasket.

OPENING TEMPERATURE OF THERMOSTAT V	ALVE
	ALVE
	6W2F2A
14	01121 ZA

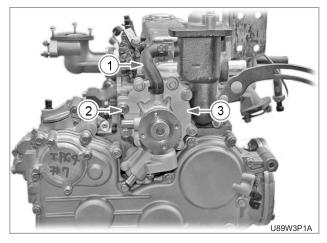
- 1. Suspend the thermostat in the water by a string with its end inserted between valve and seat.
- 2. While heating the water slowly, read the temperatures when the valve starts to open and when the valve opens for approx. 8 mm.
- 3. If the measured values are not within the specified value, replace the thermostat.

Opening temperature	Specified value	Initial opening temperature: 82 ± 1.5 °C (180 ± 3 °F)
		Below 95 °C (203 °F) at opening by 8 mm (0.315 in.)

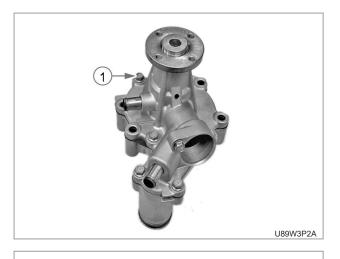
7.4.14 WATER PUMP

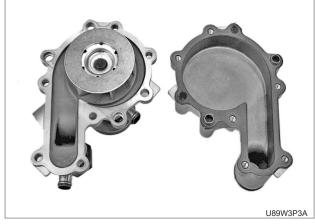


 Disconnect the water pump pipe (1) and oil cooler hoses (2) on the face of the gear case from the water pump side.

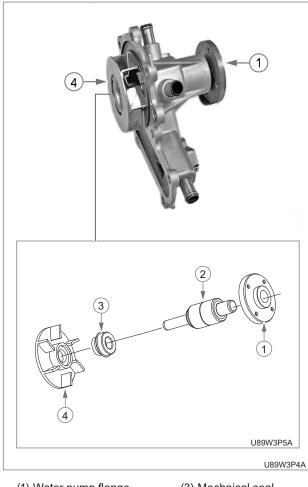


 Disconnect the coolant return hose (1) and unscrew the water pump case mounting bolts (2) to remove the water pump case assembly (3).





3. Unscrew the main case mounting bolts (1) from the removed water pump assembly to separate the case and cover.



(1) Water pump flange(2) Water pump shaft bearing

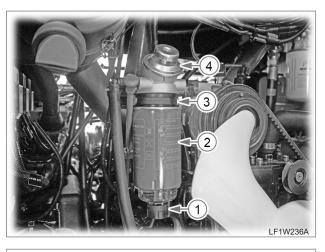
(3) Mechnical seal(4) Impeller

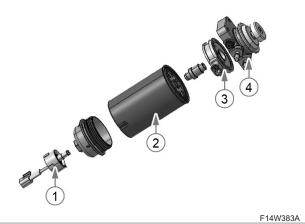
- 4. Remove the water pump flange (1) from the main case.
- 5. Remove the impeller (4) and mechanical seal (3) from the water pump shaft bearing (2).
- 6. If the mechanical seal is to be removed, replace it with a new one.

CAUTION -

 The components of the water pump is firmly assembled together and they cannot be easily disassembled or assembled without a special equipement. Therefore, it is recommended to replace the whole water pump assembly.

7.4.15 FUEL FILTER





 Rotate the water-in-fuel sensor (1) and filter body (2) to remove them from the removed fuel filter assembly. Then, remove the fuel heater (3) and priming pump (4).



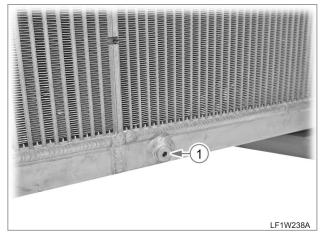
• When installing a new filter body for replacement, apply a thin film of oil onto the O-ring surface (A) and tighten the filter firmly with a hand.

7.4.16 TURBO CHARGER

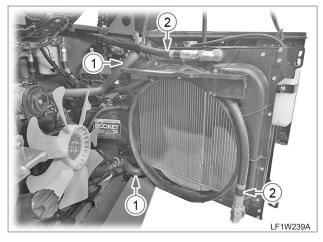
- As the turbocharger operates at a high speed and high temperature, there should be no tool or foreign materials around its inlet and outlet. Especially, be careful not to touch them with a finger or body.
- Lift up the cabin to open the engine compartment. (Refer to the instructions for engine removal in Chapter 2.)



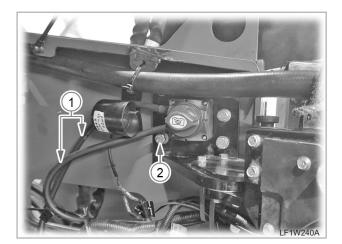
 Open the rear cover and disconnect the negative (-) battery cable.



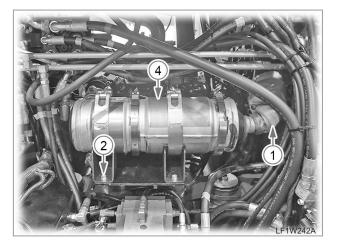
3. Unscrew the radiator drain plug (1) to drain the coolant.



4. After opening the radiator, disconnect the radiator cooling hose (1) and oil cooler connecting hose (2).



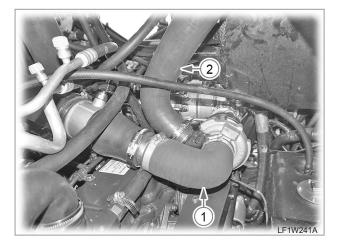
 Hang the radiator assembly on a hoist. Disconnect the power cut-off switch wiring (1) from the radiator support bracket side, unscrew the bracket mounting bolts (2) and lift up the radiator assembly to remove it.





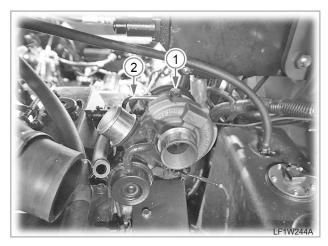
 After disconnecting the CCRT wiring connector and connecting rod (1), unscrew the CCRT mounting bolts (2) and nuts (3) to remove the CCRT assembly (4).

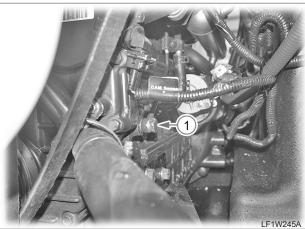
Mounting bolt & nut tightening torque...... 44.0 Nm 4.5 kgf-m 32.0 lb-ft

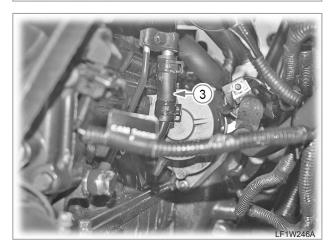


 Disconnect the air cleaner suction hose (1), intercooler connecting hose (2) and blowby hose from the turbocharger.

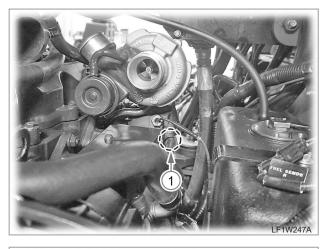
ENGINE

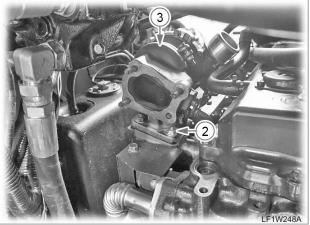






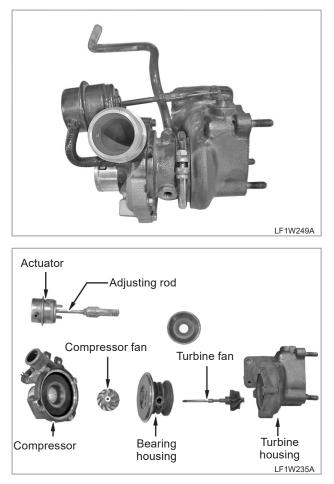
8. Loosen the oil feed pipe mounting bolt (1) to disconnect the oil feed pipe (2). Then, disconnect the return pipe connecting hose (3).



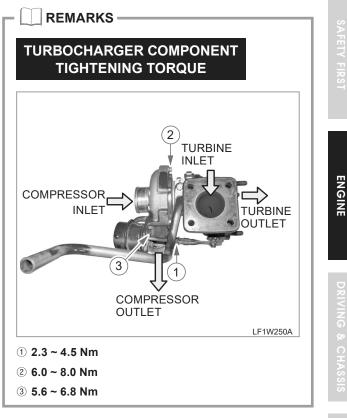


 Loosen the turbocharger mounting bolts (1) and nuts (2) to remove the turbocharger assembly (3).

Turbocharger mounting bolt tightening torque....... 47.0 Nm 4.8 kgf-m 34.0 lb-ft



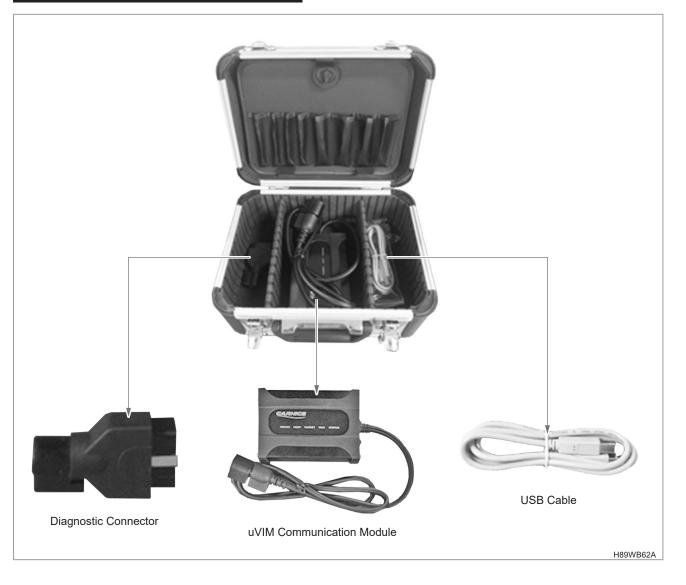
10. If necessary, remove the turbocharger assembly.



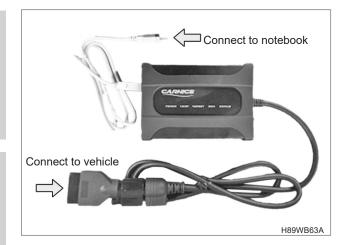
8. DIAGNOSIS

8.1 DIAGNOSTIC PROGRAM

UVIM COMMUNICATION MODULE PARTS



UVIM COMMUNICATION MODULE CONNECTING METHOD





INSTALL PROGRAM

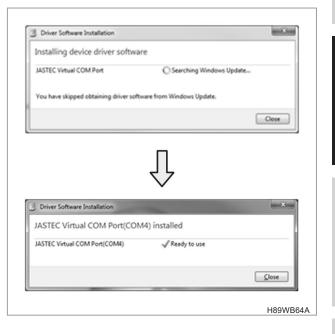
- INSTALL MICROSOFT VISUAL C++ 2008 SP1 REDISTRIBUTABLE PACKAGE
- 1. Copy vcredist_x64_eng.exe and vcredist_x86_eng. exe on laptop's wallpaper.
- 2. If you use 32bit's OS, Install vcredist_x86_eng.exe.
- 3. If you use 64bit's OS, Install vcredist_x64_eng.exe.
- 4. If you don't know OS type, Install vcredist_x86_eng. exe. If it doesn't install, Install vcredist_x64_eng.exe

► INSTALL FT4 DIAGNOSTIC PROGRAM

- 1. Copy Installation Program on laptop's wallpaper.
- 2. Run Installation Program.
- 3. Install Program.
- 4. Installation completed.
- 5. Icon will be shown on wallpaper.

UVIM USB DRIVER RECOGNITION

► WINDOWS 7 - AUTOMATICALLY INSTALLED



► WINDOWS XP

- 1. After installing the program, please progress as follows.
- 2. Connect deskuVIM to laptop by USB cable.
- 3. Progress as follows.

Found New Hardware Wizard Welcome to the Found New Hardware Wizard Windows will search for current and updated software by looking on your computer, on the hardware installation CD, or on the Windows Update Web site (with your permission). Read our privacy policy Can Windows connect to Windows Update to search for ○Yes, this time only O Yes, now and every time I connect a device No, not this time Click Next to continue. <<u>B</u>ack <u>N</u>ext > Cancel N60WCD2A Found New Hardware Wizard This wizard helps you install software for: JASTEC Virtual COM Port If your hardware came with an installation CD or floppy disk, insert it now. What do you want the wizard to do? Install the software automatically (Recommended) Install from a list or specific location (Advanced) Click Next to continue. < Back Next > ٦ Cancel N60WC

Found New Hardware Wizard Please wait while the wizard searches... JASTEC Virtual COM Port 91 < Back Next > Cancel N60WCD4A Found New Hardware Wizard Please select the best match for your hardware from the list below. (L) JASTEC Virtual COM Port Description Version Manufacturer Location JASTEC Virtual COM Port Unknown JASTEC c:\windows\inf\jastec_st JASTEC Virtual COM Port Unknown JASTEC c:\windows\inf\iastec st > < This driver is not digitally signed!
 <u>Tell me why driver signing is important</u> Kack Next > Cancel N60WCD5A

USER AUTHENTICATION AND LOGIN

► AUTHENTICATION

Program Authentication	
Origianl Number 052BC709 Input authentication number A780AF730A53D5C4 OK CANCEL	Enter the corresponding — number from Daedong Industry director
	H89WB70B

- 1. When you run the program, registration screen will be shown.
- 2. Original Number of installed laptop will be shown.
- 3. Transfer Original Number to HYUNDAI Industry administrator. Receive applicable Key value and enter applicable Key value.
- 4. Click OK button.
- LOGIN

Program Login	
ID leekiwook Enter ID	
PW XXXXXXXXX Enter Password	
OK CANCEL	
	H89WB71B

- 1. If it has been normally registered, Login screen will be shown.
- 2. Enter ID and PW that received from administrator.
- 3. Click OK button.

2-187

PROGRAM MANUAL

UPPER MENU

ENGINE

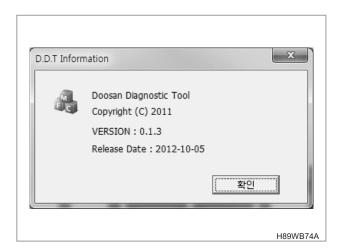


MENU(M)

- Exit : Exit the program.
- SETTING(S): Set the setting value for program.

Language	Temperature
• Korean C English	deg C 🗨
Communication Port	Pressure
COM4(USBSER00)	hPa 💌
Delay 500	
FlowControl Time 0 💌 ms	s
Consecutive Frame 2	Data Log

- Language : Korean/English choice
- Communication Port : uVIM USB Port
- Delay : Enter as 500. If reprogram time is over 5 minutes, enter as 0.
- FlowControl Time : Set as 0
- Consecutive Frame : Set as 2
- Temperature : Kelvin, °C, °F
- Pressure : bar, hPa
- Time : s(second), hour
- VIEW(V)
 - Application Shape : Change program screen as various types.



- HELP(H)
 - FT4Scan Information : Program version and Release Date will be shown.
 - Fault code : fault code list will be shown on screen.
 - Manual : Help will be shown on screen.

FT4 Diagnostic Tool	
MENU(M) SETTING(S) VIEW(V) HELP(H)	
Ů◮◨▫▧ᅷᄰ▣๏◑	Ŧ
Start/Stop	– Program Info.
Fault Codes	- ECU information
Data Monitoring	- Reprogramming
Shap Shot	- After Service
Engine Test	- Input/Output Test
	H89WBM1B

• If you click icon, run that function. If you move mouse's point to icon, display icon's short name.

MAIN MENU

START	STOP
25 FT4 Diagnostic Tool	25 FT4 Diagnostic Tool
Start Fault Codes	Stop Fault Codes
	H89WB75B

- Start Button: Starting communication between FT4Scan Program and Vehicle ECU.
- Stop Button: Closing communication between FT4Scan Program and vehicle ECU.

FAULT CO	 Faul	Stop t Codes nitoring		
1 - Era	se DTC	2 3 V Save as Excel + 10 Fault Detected.	6	7
4	Fault code	5-Description	Activity	Freeze Frame
01	P0001-13	IMV driver signal open circuit (OC) fault is detected	Present	Description
02	P0204-13	ACV FEEDBACK POSITION NOISE FAULT	Present	Description
03	P0203-13	ACV FEEDBACK POSITION & LEARNING FAULT	Present	Description
04	P0201-13	ACV FEEDBACK POSITION & LEARNING FAULT	Present	Description
05	P0202-13	ACV CURRENT FAULT	Present	Description
06	P0487-24	Throttle position feedback signal high fault	Present	Description
07	P2100-13	Throttle H-Bridge driver in ECU fault: OC	Present	Description
08	P1667-13	INJECTOR DRIVER CIRCUIT PERFORMANCE BANK 'A' FAULT	Present	Description
09	P1663-13	CYLINDER BALANCING FAULT (INJ 2): MISFIRE	Present	Description
10	P0685-00	DPF REGENERATION WARNING LAMP FAULT	Present	Description
				H89WB76B

- Click the Fault Codes button and failure information will be shown.
- (1) Erasing Fault Codes.
- (2) Save Fault Codes as Excel file.
- (3) Indicating current Fault Codes.
- (4) Indicating Fault Codes number.

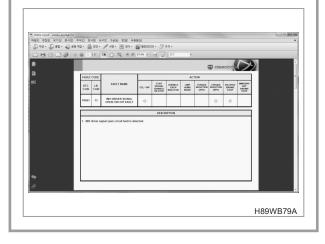
- (5) Indicating description of Fault.
- (6) Indicating Current DTC/History DTC.
- (7) Checking detailed description of applicable fault

P1663-13	ENGINE HOUR OPEN	CIRCUIT FAULT						
Fault Statu								
Cause of Fault St		ENGINE HOUR OPEN CIRCUIT F Present	AULT					
Warning	Lamp	OFF						
SnapShot D	ata							
Index		Sensor Da	ata	Value	Unit	-		
1	Engine Speed			3648	rpm	18		
2	Rail Press. Feedba	ick		2500	Bar			
3	Engine State			03				
4	Indicate Torque			8	Nm	13		
5	EGR Duty Cycle			-100	%			
6	Atmospheric Pres	sure		255	kPa			
7	Battery Voltage			0.0	v			
8	EGR Position			119.995	%			
9	Inlet meeting Val-	ve Drive Current Demand	m	2540	mA	-		
1 ·								
		HELP	Save Excel		100	OK		

• Click Description(7) button, checking detailed description of applicable fault is available.

napSho				
P0001	-13. IMV DRIVER SIGNAL			
	CIRCUIT PAULT			
Fault Sta Caur	itus ie of Fault IMV DRIVER SIGNAL			
	Status Present			
Wan	ing Lamp OFF			
SnapSho	d Data			
Ind	ex Sensor Data	Value	Unit	-n
1	Engine Speed	3648	rpm	
2	Rail Press. Feedback	2500	Bar	r.
3	Engine State	03		
4	Indicate Torque	8	Nm	
5	EGR Duty Cycle	-100	%	
6	Atmospheric Pressure	255	kPa	
			v	
7	Battery Voltage	0.0	v	
7 8	Battery Voltage EGR Position	0.0	5	

• Click HELP(1) button and Fault code help file will be opened.



		Dat	Stop Fault Codes a Monitoring I Monitoring				
			2 3	4	5	В	C
1-	SI SI	napsho	Auto Start Manual Start	Stop	Frame =		
6-	All		All Sel Graph	Save as Excel	+ Sav	e Selection O	pen Selection
			7 8 9	A			
_	Sel	Num	Service Data			Value	Unit
(D)—		001	Indicate Torque			0	Nm
		002	Atmospheric Pressure			99	kPa
		003	Fuel Demand			0.0	mg/stroke
		004	Rail Press. Demand			150	Bar
		006	Engine State			00	
		008	Engine Speed			0	rpm
		009	CAM Speed			0	rpm

- Click Data Monitoring, you can check Engine data value. ٠
 - (1) Activate Snapshot function.
 - (2) Start Auto Start function.
 - (3) Save Snapshot Data.
 - (4) Stop Data saving.
 - (5) Indicating saved Snapshot frame.
 - (6) Choose Data Group that will be indicated on screen.
 - (7) Indicating All data of chosen group.

- (8) Indicating checked data from D section only.
- (9) Indicating data indicated from Step 8 as Graph.
- (A) Save indicated data as Excel.
- (B) Save data list indicated from Step 8.
- (C) Open data saved from B.
- (D) Select/cancel each item.

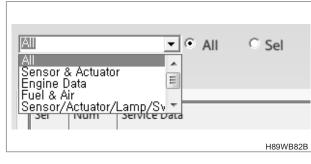
H89WB80B

A. SAVE SANPSHOT

Snapsh	not Ai	uto Start	Manual Start			Frame =
Snapsh	not A	uto Start	Manual Start		Stop	Frame =
	으로 저장					->
저장 위	위치((): 🚺 07.가	H발검증		•	⇔ € 🗗 🖬	•
(B)	이름		^		수정한 날짜	유형
최근 위	- C-4	셧_20121031.js	d		2012-10-31 오후	L5: JSD 파일
바탕 화	PE					
바탕 화 라이브리	1					
	- H2I					
2101년2 도년(15	- H2I					
2101년2 도년(15			m			
ZHOI MEZ ZHOI MEZ ZHRE C		(<u>N</u>): 스냅	배 1섯_20121031.jsd		<u> </u>	<u>제광(S</u>)

- Function that saves currently indicated data value.
 - Auto Start : Save data based on Before/After occurrence of Fault Codes.
 - Manual Start : Save data based on Before/After click button.
- 1. Check Snapshot and button will activate.
- 2. Click Start button and Stop button will activate.
- 3. Click Stop button and save file.
- 4. You can check saved Snapshot file by Snapshot function of main menu

B. GROUP SELECTION



Can select Data by Group.

ALL SELECT

Sel	Num	Service Data	Value	Unit
•	001	Indicate Torque	0	Nm
•	002	Atmospheric Pressure	102	kPa
	003	Fuel Demand	0.0	mg/stroke
	004	Rail Press. Demand	150	Bar
	005	EGR Duty Cycle	0	%
	006	Engine State	00	
	007	ACV Duty Cycle	0	%
•	008	Engine Speed	0	rpm
	009	CAM Speed	0	rpm
*	010	Pedal Position	0	%
•	011	Brake Switch	00	
	012	MDP Correction Data_Inj 1 (Zone 0)	0	us

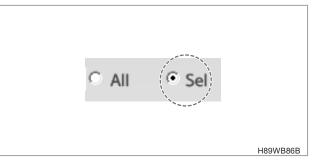
▼ ∩ All C Sel Save as Excel 🕂 Save Selection Graph Open Selection Num Service Data Ash Learn Succes Engine Run Time at Last Reger 9 0.0 Model Soot Mass_gran 063 DPF Regen Total Time 5 072 DDE Delta Prero kPa 148 Soot Mass_퍼센트 % 149 DPF Regen State 156 DPF In Temp °C H89WB84B

C. ALL/SELECT

C-1. SELECT DATA THAT WILL BE INDICATED

Sel	Num	Service Data	Value	Unit
	059	Ash Learn Failed	0	
	060	Ash Learn Success	0	-
	061	Engine Run Time at Last Regen.	0	s
	062	Model Soot Mass_gram	0.0	g
	063	DPF Regen Total Time	0	5
	072	DPF Delta Press.	0	kPa
. }	148	Soot Mass_퍼센트	0	%
	149	DPF Regen State	00	
	156	DPF In Temp.	1000	°C

C-2. CLICK SELECT BUTTON



• Can indicate selected data among displayed data.

C-3. INDICATE SELECTED ITEM

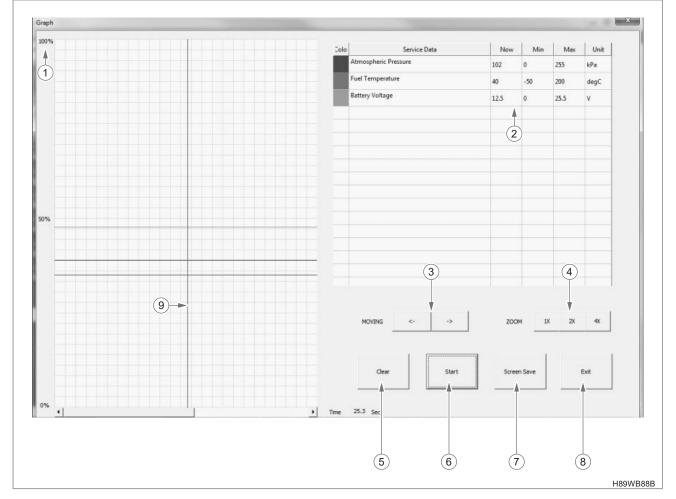
Sel	Num	Service Data	Value	Unit
~	059	Ash Learn Failed	0	-
v	061	Engine Run Time at Last Regen.	0	s
•	063	DPF Regen Total Time	0	5
~	148	Soot Mass_파센트	0	%

C-4. INDICATE ALL ITEM

- When you select 'All' from C-2, No.1 will be shown.
- Select 'All' again, checked item will be released.

D. GRAPH

• After progress until "C" of C-3, click graph button and selected item value can be seen as Graph



- Indicating min/max standard of sensor value as 0~100%. Sensor will be separated by color.
- (2) Indicate sensor value. Click min/max value and can change standard value.
- (3) When graph stops, move standard line no.(9) as left/right.
- (4) Can magnify no.1 screen double/ quadruple to Time axis.

	1.		-
Item	MIN	MAX	
ric Pressure	0	255	
erature	-50	200	
kage	0	25.5	
	nic Pressure terature	ric Pressure 0 ierature -50	ric Pressure 0 255 reroture -50 200

- (5) Delete graph screen.
- (6) Start/Stop : Start or stop indicating graph.
- (7) Save graph screen as image file.
- (8) Exit graph screen.

AFETY FIRST

E. SELECT ITEM

			C All @ Sel	Graph Jave as E	wool -	- Save Se	lection	Open Selectio
gine	Data	•				_		open selectio
iel	Num	Service Data	i				Value	Unit
2	001	Indicate Ton	que					0 Nm
	009	CAM Speed						0 rpm
	115	Indicated Me	ean Effective Pressure_Slow					0 kPa
	124	Water Status	in Fuel Line					00 FALSE/TRUE
3	다른 이	름으로 저	24					H89WB
3	10-11-11-1	름으로 저 위치(i):			•	+ 🗈 r	•	H89WB
3	10-11-11-1	름으로 저 위치([):)) 07.개발겸종		*	수 🗈 🖆 수정화 날짜	0.000	_x
9 :	73 20 20	위치(l):		· 일치하는 함드	_	수정한 날짜	0.000	H89WB
3	73 25 K	위치(l):)) 07.개발겸종	^ 일치하는 광목	_	수정한 날짜	0.000	_x
3	저정 신제 최근 바탕	위치([): 위치 위치 화면)) 07.개발겸종	^ 일치하는 황료	_	수정한 날짜	0.000	_x
	저정 상에는 화당 사망	위치([): 위치 위치 화면)) 07.개발겸종	^ 일치하는 함드	_	수정한 날짜	0.000	_x
	저장 최근 바탕 라이트	위치(): 위치 위치 화면 :러리)) 07.개발겸종	^ 일치하는 항목	_	수정한 날짜	0.000	_x
	저정 상에는 화망 (1)	위치(): 위치 위치 화면 :러리)) 07.개발겸종	~ 월지하는 황료	_	수정한 날짜	0.000	×

If you select/save frequent item, you can check se-• lected data by opening applicable file when you run next program. After select C-3, click Save Selection button. Save selected item as selectable name.

취소 H89WB91A

1		Graph Internet Save as Excel + Save S	election O	pen Selection
Sel	Num	Service Data	Value	Unit Nm
	001	Indicate Torque	0	Nm
	002	Atmospheric Pressure	102	k9a
	003	Fuel Demand	0.0	mg/stroke
	004	Rail Press. Demand	150	Bar
	005	EGR Duty Cycle	0	%
	006	Engine State	00	
	007	ACV Duty Cycle	0	%
	008	Engine Speed	0	rpm
	009	CAM Speed	0	rpm
	010	Pedal Position	0	%
	011	Brake Switch	00	
	012	MDP Correction Data Inj 1 (Zone 0)	0	us ,

))) 07.개발겸증		-	+ 🗈 🖆 🗊 •	
C.	이름	<u>^</u>		수정한 날짜	유형
최근 위치	엔진데이터_	select.jsf		2012-11-07 오전 11	JSF 파일
100					
바탕 화면					
A.K.ath					
15년보 045					
1					
1 컴퓨터					
0	<				
6	< [파일 이름(<u>N</u>):				열기(0)

igine	Data	All C Sel Graph All Save as Excel + Save S	election O	pen Selection
Sel	Num	Service Data	Value	Unit
4	001	Indicate Torque	0	Nm
	006	Engine State	00	
	008	Engine Speed	0	rpm
¥	009	CAM Speed	0	rpm
4	114	Indicated Mean Effective Pressure_Fast	0	kPa
Ū.	115	Indicated Mean Effective Pressure_Slow	0	kPa
l nc	116	<pre>Desired late Speed te_checked item</pre>	1376	rpm
			00	FALSE/TRUE
	143	Air-Con. Active	00	
	151	Battery Voltage	12.5	v
	153	Engine Load	0	%
	154	Engine Running Time	0	5
			ŀ	H89WB9

00	FALSE/TRUE	
	OOMPOSE	
н	89WB95B	

kPa

When you click Selection button, selected item will • be indicated only.

► SNAP SHOT

Data Monitoring CAN Monitoring Snap Shot ECU Test 3 4 1 File Selection Frame Save as Excel + 5 6 Sel Num Service Data	lue	Unit	
		ŀ	-189WB96B

• When you click Snap Shot button, Snap Shot screen will be displayed. You can check saved data.

- (1) Select data saving file.
- (2) Select wanted item from data items.
- (3) Frame number that is shown on screen.
- (4) Save Time of applicable frame.

- (5) Indicating selected item as graph.
- (6) Save current screen contents as axel.

A. SELECT FILE

CLICK		
File Selection	Frame 0 🗄 Time 🗌	
⊙ All ⊖ Sel	Graph 🛃 Save as Excel 🕂	
		H89WE

Click File Selection

Look in:	02.CHOIEH !	모니터링	•	+ € # ≣•	
e.	Name	^		Date modified	Туре
Recent Places	snapshot.j	d		2012-12-26 오후 3:	JSD File
Desktop					
Libraries					
Computer					
Network					
	File name:	1		•	Open
	Files of type:	jsd(*.jsd)		•	Cancel

Choose File.

ဖ
≫
- 11

File	Select	ion Frame 0 📑 Time			
• A	.II C	Sel Graph A Save as Excel +			
el	Num	Service Data	Value	Unit	
~	001	Indicate Torque	0	Nm	-
	002	Atmospheric Pressure	102	kPa	
	003	Fuel Demand	0.0	mg/stroke	
	004	Rail Press. Demand	150	Bar	
	005	EGR Duty Cycle	0	%	
	006	Engine State	00		
	007	ACV Duty Cycle	0	%	
	008	Engine Speed	0	rpm	
~	009	CAM Speed	0	rpm	
	010	Pedal Position	0	%	
	011	Brake Switch	00		
	012	MDP Correction Data_Inj 1 (Zone 0)	0	us	
	013	MDP Correction Data_Inj 1 (Zone 1)	0	us	

Indicate saved data.

B. FRAME CHANGE

File Selection	Frame 🕮 🕂 Time 🖓	4
c All ⊂ Sel	Graph Save as Excel	+

• When you click arrows next to Frame section, Frame will be changed. When Frame is changed, data value of applicable Frame will be indicated. Time of applicable Frame will be indicated on right.

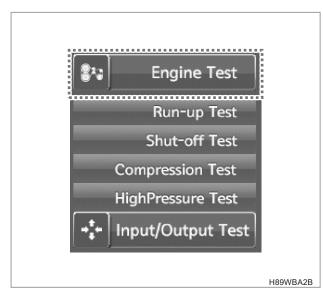
C. GRAPH

• Graph function is the same with Graph function of Data Monitoring.

D. SAVE AS EXCEL

Function of saving as excel is the same with Graph function of Data monitoring.

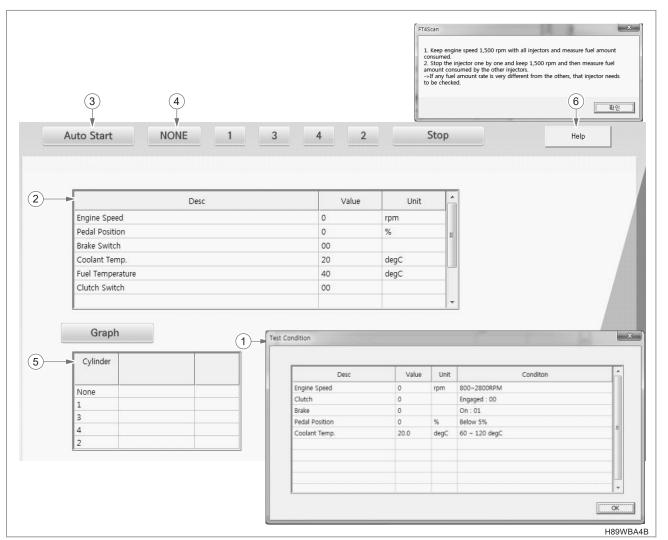
ENGINE TEST



A. RUN-UP TEST

- When you click Engine Test, Run-up Test, Shut-off Test, Compression Test and High Pressure Test will be shown at the bottom.
 - Run-up Test: Grasp the differences of individual cylinder's power ability.
 - Shut-off Test: Check injector efficiency of individual cylinder.
 - Compression Test: Check speed of pistons.
 - HighPressure Test: Check fuel rail pressure change.
- FT4Scan × Supply the same amount of fuel to all injectors and measure the time unti-engine speed goes up to 2,500 rpm.
 Stop the injector one by one and measure engine rpm during the time measured fist.
 If any injector rpm gradient is very different from the others, that injector needs to be checked. (4) (2) 확인 Help 3 Auto Start Stop n Speed D E (c) t Time (A)(B) (1)Test Con Color Cylinder Desi Value Unit Conditor (3) A(ms) B(ms) Engine Speed Clutch 800~2800RPM 0 none 940.000 1480.000 Engaged : 00 960.000 1000.000 1 Brake On : 01 edal Positio 2 920 000 1140 000 oolant Temp 20.0 60 ~ 120 degC 980 000 980 000 3 940.000 1080.000 OK H89WBA3B
- (1) Click Run-up Test, Test terms will be shown.
- (2) Click Auto Start button, Test will be started.
 - If it doesn't meet the terms, it will not be started.
 - It will be progressed from no.1 cylinder to no.4 cylinder in order.
- (3) When Test is completed, result value will be shown.
- (3) Each cylinder's gradient of rising section and falling section will be indicated.
- In case of normal, rising section should be indicated as the same gradient except Blue. In case of normal, all falling section should be shown as the same gradient.
- When gradient is different, you can expect there's error in cylinder.
- 4. Click "Help" button, Test description display.

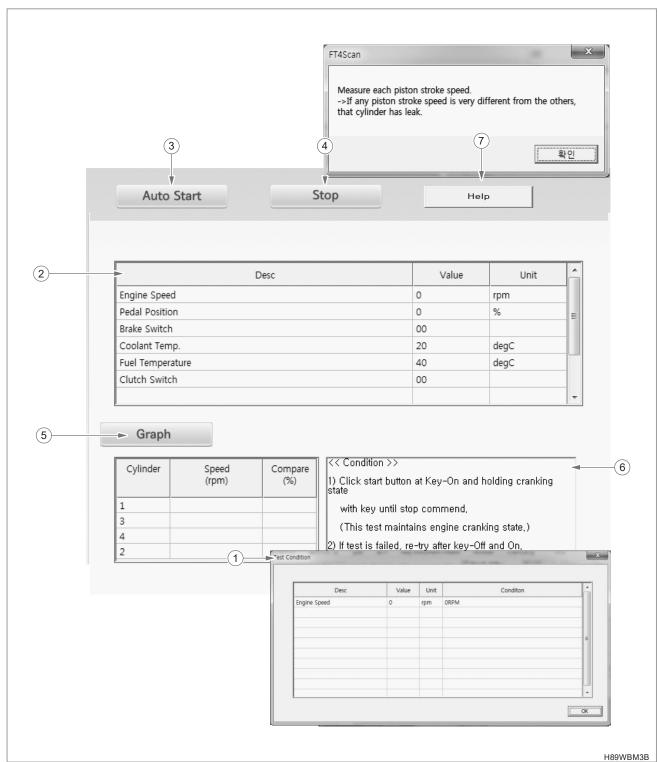
B. SHUT-OFF TEST



- (1) Click Shut-Off Test, Test terms will be indicated.
- (2) In case of testing, indicate sensor value.
- (3) Click Auto Start button, it will progress as NONE, 1, 3, 4, 2 order.
 - When it doesn't meet terms, it won't be started.
- (4) You can test individually by each cylinder.
- (5) Indicate Test Result.
 - In case of NONE, indicate Fuel injection quantity as (100%) based on Fuel injection ratio.
 - Indicate result in case of Auto Start only.
- (6) Click "Help" button, Test description display.

INDEX

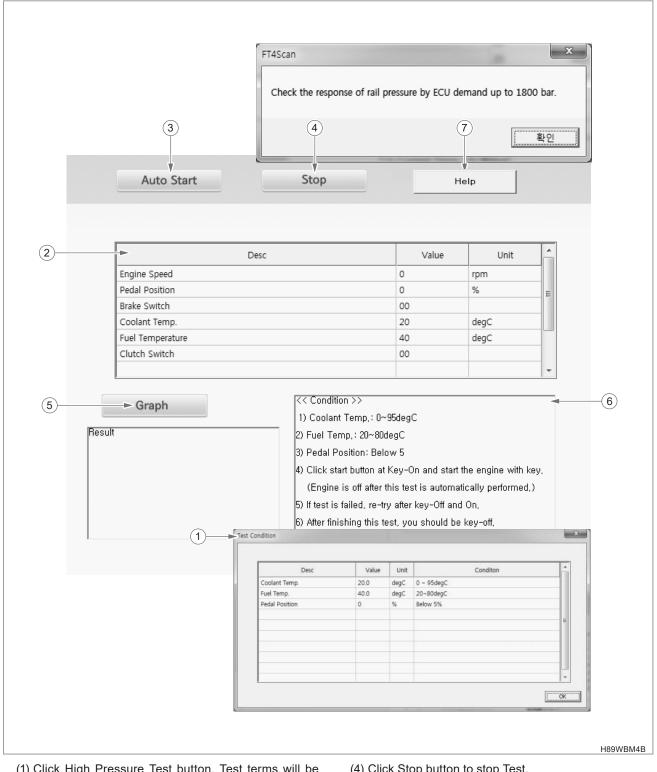
C. COMPRESSION TEST



- (1) Click Compression Test, Test terms will be shown.
- (2) In case of Testing, indicate related sensor value.
- (3) Click Auto Start button, Cranking until stop command appears.
 - When it doesn't meet terms, it won't be started.
- (4) Click Stop button to stop Test.

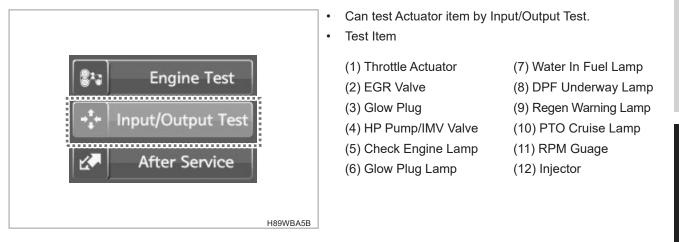
- (5) Indicate Test Result.
 - Indicate comparing value based on the highest Fuel injection time.
- (6) Explain Test terms.
- (7) Click "Help" button, Test description display.

D. HIGH PRESSURE TEST

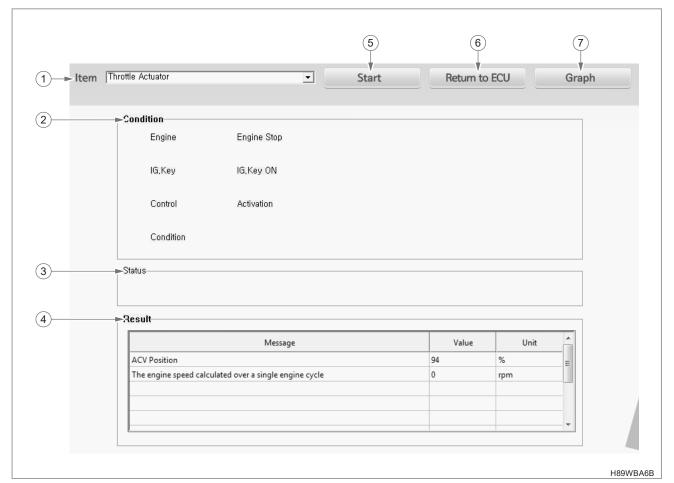


- (1) Click High Pressure Test button, Test terms will be shown.
- (2) In case of Testing, indicate related sensor value.
- (3) Click Auto Start button, Cranking. Then, engine will be on and test will be started.
 - When it doesn't meet terms, it won't be started.
- (4) Click Stop button to stop Test.
- (5) Indicate Test Result.
- (6) Explain Test terms.
- (7) Click "Help" button, Test description display.

► INPUT/OUTPUT TEST



A. SCREEN EXPLANATION



(1) Select Input/Output Test item.

(2) Indicate conditions for Test.

(3) Indicate Test status.

(4) Indicate Data value that needs to be checked for Test.

- (5) Start Test.
- (6) Stop Test.
- (7) Data value will be shown as Graph.

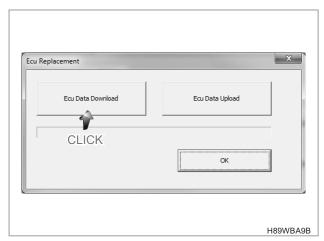
ut Test rvice ming		
H89WBA7B		
Apply O	DPF Change	Apply O
Apply O	DP Sensor	Apply O
Apply O		
Apply O	Cluster	Apply O
Apply O	r	
	Apply O Apply O Apply O Apply O	Apply O Apply O Apply O Apply O Cluster

- In case of replace Part Replacement item, Click Apply button and apply replacement issue to ECU.

- Progress After Service item in case of need.
- If you want to stop working, click Return button.

► AFTER SERVICE

A. ECU CHANGE



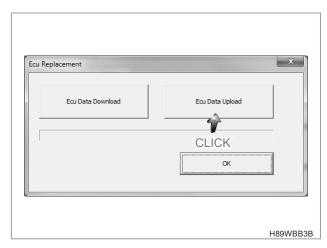
1. Click ECU Data Download Button.

Ecu Replacement	×	
Ecu Data Download	Ecu Data Upload	
	ОК	
	H89WI	3B1I

2. Download ECU Data.



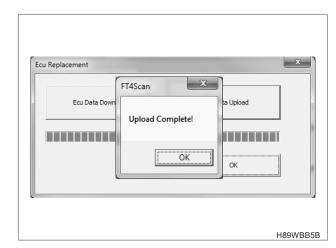
3. Save Download data as file.



4. After replacing ECU, click ECU Data Upload button.

Look in	02.EII.01EH 5	2니터링	-	← 🗈 🖆 🖛	
Ca.	Name	*		Date modified	Туре
Recent Places	abcd.edm			2012-12-26 오후 5:	EDM File
Desktop					
Libraries					
Computer					
Network					
	•	III			1
	File <u>n</u> ame:			•	<u>O</u> pen
	Files of type:	edm(*.edm)		-	Cancel

5. Select data file.

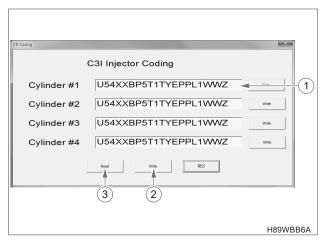


6. Upload Complete message will be shown.

REMARK -

 In case of replace ECU, download ECU Data on PC first. After the replacing ECU, please upload downloaded ECU Data.

B. INJECTOR CODING



- (1) Enter replaced injector number.
- (2) Click Write button.
- (3) Click Read button, check it.
- In case of replacing Injector, enter installed injector's No. (20 digits).

C. CLUSTER

Engine Lamp	Glow Plug Lamp	Water In Fuel Lamp
	DPF Underway Lamp	Regen Warning Lamp
PTO Cruise Lamp		RPM Guage
		OK CANCEL

- In case of replace Cluster, Please check whether Lamp operates normally.
- Click each item and applicable Lamp or Guage will be operated. At this moment, check the status of applicable Lamp or Guage by Cluster screen.

D. Others

ECU Change	Apply	0	DPF Change	Apply	0
C3I Injector Coding	Apply	0	DP Sensor	Apply	0
HP Pump	Apply	0			
IMV	Apply	0	Cluster	Apply	0

• Besides A ~ C items, it will immediately applied when you click Apply button.

E. DPF REGENERATION

• Click DPF Regeneration's Apply button, it will progress Regeneration.

X
and run engine, and then Press Yes Key
<u>Y</u> es <u>N</u> o

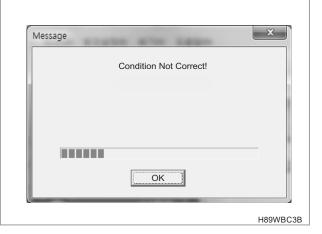
 Click DPF Regeneration Apply button, 'Run Engine' message will be shown.

Regeneration	x
Do you continue?	
<u>Y</u> es	No
	H89WBC1B

2. Click 'Yes' button to continue.

IN_Engine_cycle_speed 엔진스피드 0 rpm IN_Clutch_switch 플러지 0 IN_Brake_switch 브레이크 0
IN_Clutch_switch 물러지 0 IN_Brake_switch 브레이크 0
IN_Pedal_position 패달포지션 0 %
IN_Coolant_temperature 방각수운도 20.0 degC
e »

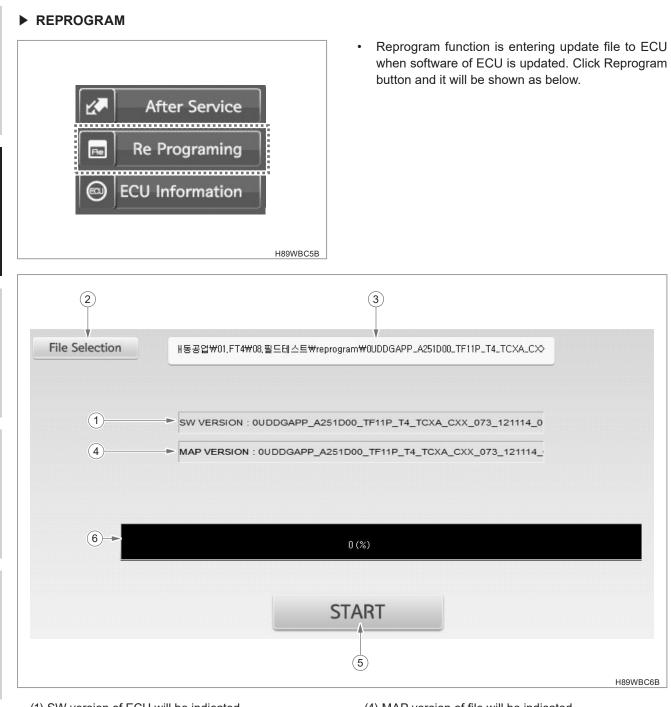
3. Test conditions will be shown.



4. If it doesn't meet Test conditions, Error message will be shown.

Message	the site later	×
	Appling is aborted!	
	ОК	
		H89WBC4E

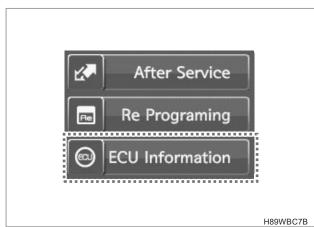
5. If it meets Test conditions, it will start DPF Regeneration. But when appling is aborted, Error message will be shown.



- (1) SW version of ECU will be indicated.
- (2) Select file.
- (3) Reprogram file route will be indicated.

- (4) MAP version of file will be indicated.
- (5) Start button will be activated.
- (6) Click Start button and rate of progress will be indicated.

► ECU INFORMATION



1109100070

Engine Company	KIOTI	After Treatment	DOC+CRT+SCR+AOC	
Engine Type	4F243T(A))	Date(YY/MM/DD)	17/04/04	
Emission	Tier4 Final / Stage IIIB	Flashing User Info	112233445502	
Induction System	Turbo charged	Last Programming Date	17/04/12	
H/W Variant	Z			
CU		DCU		
S/W Sequence	01	S/W Version	00 /05 / 02	
Calibration ID	6424-2584-001	Calibration ID	CE12_085_R0406_1	

8.2 DTC (DIAGNOSTIC TROUBLE CODE)

8.2.1 COMPOSITION

OVERVIEW

DTC and LB code

These are unified by SAE for errors occurred by use of the ECU.

SPN AND FMI CODE

Error code displayed in instrument panel.

► FAULT NAME

Fault name for the corresponding fault code

ACTION

Seven different operations that the ECU performs according to the error code

- 1. Illuminating Engine CHECK lamp: it turns on the engine CHECK lamp on the instrument cluster to warn the driver about the engine malfunction.
- 2. Engine stop: it stops the engine after a certain period of time to reduce stress applied to the engine.
- 3. Stopping/interrupting CCRT regeneration: it stops or interrupts the CCRT regeneration process (only for the vehicle model with the CCRT).
- 4. Increasing idle
- 5. Deactivating injector: it stops the faulty injector.
- 6. Limp home mode: it maintains the engine speed to 1,300 to 1,400 RPM enough to drive the vehicle back home.
- 7. Reducing torque it reduces the engine torque depending on the condition.

2-210

8.2.2 ERORR CODE & ACTION

	FAU	LT CO	DE							ACTION					EGR Inducemen	t
HMB LB	J19: SPN		LAMP CODE	CLUSTER CODE	FAULT NAME	DESCRIPTION	CEL"ON"	DELAYED ENGINE STOP (20s)	CCRT (DPF) REGEN DISABLE OR STOP	INCRE-ASED IDLE (1300 rpm)	DISABLE EACH INJECTOR	LIMP HOME (1400 rpm)	TORQUE REDUCTION (2200 rpm)	EMISSION FAILURE LAMP "ON"	SPEED REDUCTION Warn : N/A Low Level: N/A Severe Level : 60%	TORQUE REDUCTION Warn : N/A Low Level: 25% Severe Level: 50%
0001 13	1	18	241	E-ECU-001	IMV DRIVER SIGNAL OPEN CIRCUIT FAULT	1. IMV driver signal open circuit fault is detected.	0	0				0	0			
0002 23	2	8	353	E-ECU-002	RAIL PRESSURE CONTROL FAULT	1. Rail pressure control fault due to too much high (positive) or low (negative) IMV current trim.	0						0			
0002 24	2	9	354	E-ECU-003	RAIL PRESSURE CONTROL	1. Rail pressure control fault due to too much high (positive) or low (negative) IMV current trim.	0	0					0			
0002 1B	2	6	221	E-ECU-004	RAIL PRESSURE CONTROL HIGH FAULT	1. Rail pressure control fault due to too much high (positive) or low (negative) IMV current trim.	0	0				0	0			
0002 1A	2	5	222	E-ECU-005	RAIL PRESSURE CONTROL LOW FAULT	1. Rail pressure control fault due to too much high (positive) or low (negative) IMV current trim.	0	0				0	0			
0003 18	3	3	224	E-ECU-006	IMV FEEDBACK CURRENT LOW FAULT	 IMV driver short circuit to ground (sc2g) fault is detected. Rail pressure control feedback is too low. 	0									
0003 24	3	5	235	E-ECU-007	/ IMV CONTROL FAULT 2	 IMV driver short circuit to ground (sc2g) fault is detected. Rail pressure control feedback is too low. 	0									
0003 23	3	6	234	E-ECU-008	3 IMV CONTROL FAULT 2	 IMV driver short circuit to ground (sc2g) fault is detected. Rail pressure control feedback is too low. 	0									
0003 11	3	20	242	E-ECU-009	IMV DRIVER SC2G FAULT	 IMV driver short circuit to ground (sc2g) fault is detected. Rail pressure control feedback is too low. 	0	0				0	0			
0004 19	4	3	223	E-ECU-010	IMV FEEDBACK CURRENT HIGH FAULT	 IMV driver signal short circuit to battery (sc2vbatt) fault is detected. Rail pressure control feedback is too high. 	0	0				0	0			
0004 23	4	5	233	E-ECU-011	IMV CONTROL FAULT 2	 IMV driver signal short circuit to battery (sc2vbatt) fault is detected. Rail pressure control feedback is too high. 	0	0				0	0			
0004 24	4	6	232	E-ECU-012	2 IMV CONTROL FAULT 1	 IMV driver signal short circuit to battery (sc2vbatt) fault is detected. Rail pressure control feedback is too high. 	0					0				
0004 12	4	21	243	E-ECU-013	MV DRIVER SC2VBATT FAULT	 IMV driver signal short circuit to battery (sc2vbatt) fault is detected. Rail pressure control feedback is too high. 	0	0				0	0			
0004 1B	4	1	231	E-ECU-014	IMV CONTROL FAULT 2	 IMV driver signal short circuit to battery (sc2vbatt) fault is detected. Rail pressure control feedback is too high. 	0									
0087 00	135	16	334	E-ECU-015	RAIL PRESSURE BUILD FAULT	1. Rail Pressure Build Fault.	0									
0088 F4	136	16	312	E-ECU-016	OVER RAIL PRESSURE FAULT	1. Rail pressure control error during IMV control (over max calibrated system pressure).	0	0					0			
0088 00	136	17	311	E-ECU-017	OVER RAIL PRESSURE IMV FAULT	1. Rail pressure control error during IMV control (over max calibrated system pressure).	0	0					0			
0089 23	137	8	355	E-ECU-018	RAIL PRESSURE CONTROL FAULT	 Rail pressure control fault. Discharge pressure and error negative or positive. 	0						0			
0089 24	137	9	356	E-ECU-019	RAIL PRESSURE CONTROL FAULT	 Rail pressure control fault. Discharge pressure and error negative or positive. 	0	0					о			
0093 00	147	16	322	E-ECU-020	RAIL PRESSURE DROP FAULT	1. Rail pressure sensor electrical fault.	0	0					0			
0096 64	150	1	464	E-ECU-021	INTAKE AIR TEMP. SENSOR FAULT	1. Intake manifold temperature sensor plausibility fault.										
0097 23	151	20	462	E-ECU-022	INTAKE AIR TEMP. SENSOR SC2G FAULT	1. Intake manifold temperature sensor low fault.	0									
0098 24	152	18	461	E-ECU-023	INTAKE AIR TEMP. SENSOR OC OR SC2VBATT FAULT	1. Intake manifold temperature sensor high fault.	0									
0100 00	256	1	481	E-ECU-024	MAF SENSOR FAULT	1. MAF general fault. 2. MAF learning fault.	0									
0101 64	257	1	485		MAF SENSOR FAULT	1.			0							
0101 64	257	1	486	E-ECU-025	MAF SENSOR FAULT	1.			0							
0102 23	258	20	483	E-ECU-026	MAF SENSOR LOW FAULT	1.			0							

	FAULT CODE					ACTION							EGR Inducement			
DTC CODE	J193 SPN		LAMP CODE	CLUSTER CODE	FAULT NAME	DESCRIPTION	CEL"ON"	DELAYED ENGINE STOP (20s)	CCRT (DPF) REGEN DISABLE OR STOP	INCRE-ASED IDLE (1300 rpm)	DISABLE EACH INJECTOR	LIMP HOME (1400 rpm)	TORQUE REDUCTION (2200 rpm)	EMISSION FAILURE LAMP "ON"	SPEED REDUCTION Warn : N/A Low Level: N/A Severe Level : 60%	TORQU REDUCT Warn : I Low Level: Severe Level
P0103 24	259	18	482	E-ECU-027	MAF SENSOR HIGH FAULT	1.			0							
P0106 24	262	6	473	E-ECU-028	INTAKE AIR PRESS. SENSOR FAULT	1. Intake manifold pressure sensor signal drift fault.	0									
P0106 23	262	5	474	E-ECU-029	INTAKE AIR PRESS. SENSOR FAULT	1. Intake manifold pressure sensor signal drift fault.	0									
P0107 23	263	20	472	E-ECU-030	INTAKE AIR PRESS. SENSOR SC2G FAULT	1. Intake manifold pressure sensor plausibility fault.	0		0							
P0108 24	264	18	471	E-ECU-031	INTAKE AIR PRESS. SENSOR OC OR SC2VBATT FAULT	1. Intake manifold pressure sensor signal high or short to battery fault.	0		0							
P0112 23	274	20	488	E-ECU-032	INLET AIR TEMP. SENSOR SC2G FAULT	1. Inlet air temperature (MAF) sensor signal is low or electrical low.										
P0113 24	275	18	487	E-ECU-033	INLET AIR TEMP. SENSOR OC OR SC2VBATT HIGH FAULT	1. Inlet air temperature (MAF) sensor signal is high or electrical high.										
P0115 00	277	1	454	E-ECU-034	COOLANT TEMP. SENSOR PLAUSIBILITY	1. Coolant temp. sensor plausibility fault.	0		0							
P0117 23	279	20	456	E-ECU-035	COOLANT TEMP. SENSOR SC2G FAULT	1. Coolant temp. sensor signal low fault.			0							
P0118 24	280	18	455	E-ECU-036	COOLANT TEMP. SENSOR OC OR SC2VBATT FAULT	1. Coolant temp. sensor signal high fault.			0							
P0120 00	288	23	431	E-ECU-037	FOOT PEDAL SIGNAL TRACK1 FAULT	1. Foot pedal signal track 1 fault.	0					0				
P0182 23	386	20	452	E-ECU-038	FUEL TEMP. SENSOR SC2G FAULT	1. Fuel temperature sensor low fault.										
P0183 24	387	18	451	E-ECU-039	FUEL TEMP. SENSOR OC OR SC2VBATT FAULT	1. Fuel temperature sensor high fault.	0									
P0190 27	400	22	323	E-ECU-040	RAIL PRESSURE SENSOR SIGNAL GRADIENT FAULT	1. Rail pressure sensor signal gradient fault.	0	0					0			
P0191 0	401	1	321	E-ECU-041	RAIL PRESSURE SENSOR PLAUSIBILITY FAULT	 Rail Pressure Sensor electrical fault. Rail Pressure Sensor plausibility fault: too high, too low, sensor drift too big" 	0	0					0			
20191 23	401	6	331	E-ECU-042	RAIL PRESSURE SENSOR PLAUSIBILITY FAULT	 Rail Pressure Sensor electrical fault. Rail Pressure Sensor plausibility fault: too high, too low, sensor drift too big" 	0	0					0			
20191 23	401	5	332	E-ECU-043	RAIL PRESSURE SENSOR PLAUSIBILITY FAULT	 Rail Pressure Sensor electrical fault. Rail Pressure Sensor plausibility fault: too high, too low, sensor drift too big" 	0	0	0				0			
P0191 24	401	30	333	E-ECU-044	RAIL PRESSURE SENSOR PLAUSIBILITY FAULT	 Rail Pressure Sensor electrical fault. Rail Pressure Sensor plausibility fault: too high, too low, sensor drift too big" 	0	0	0				0			
P0192 23	402	20	325	E-ECU-045	RAIL PRESSURE SENSOR SIGNAL SC2G FAULT	1. Rail pressure sensor signal low fault.	0	0					0			
P0193 27	403	18	324	E-ECU-046	RAIL PRESSURE SENSOR SIGNAL OC OR SC2VATT FAULT	1. Rail pressure sensor signal high fault.	0	0					0			
P0201 13	513	18	151	E-ECU-047	INJECTOR 0 OPEN CIRCUIT FAULT	 Injector 0 short circuit to HSD to LSD. Injector 0 open circuit fault. * 4CYL Engine: Cylinder No.1// 3CYL Engine: Cylinder No.1 	0			0	0		0			
P0201 01	513	19	161	E-ECU-048	INJECTOR 0 SHORT CIRCUIT FAULT	 Injector 0 short circuit to HSD to LSD. Injector 0 open circuit fault. * 4CYL Engine: Cylinder No.1// 3CYL Engine: Cylinder No.1 	0			0	0		0			
P0202 13	514	18	154	E-ECU-049	INJECTOR 3 OPEN CIRCUIT FAULT	 Injector 3 short circuit to HSD to LSD. Injector 3 open circuit fault. * 4CYL Engine: Cylinder No.2 	о			0	o		0			
P0202 01	514	19	164	E-ECU-050	INJECTOR 3 SHORT CIRCUIT FAULT	1. Injector 3 short circuit to HSD to LSD. 2. Injector 3 open circuit fault. * 4CYL Engine: Cylinder No.2	0			0	0		0			
P0203 13	515	18	152	E-ECU-051	INJECTOR 1 OPEN CIRCUIT FAULT	1. Injector 1 short circuit to HSD to LSD. 2. Injector 1 open circuit fault. * 4CYL Engine: Cylinder No.3	0			0	0		0			
P0203 01	515	19	162	E-ECU-052	INJECTOR 1 SHORT CIRCUIT FAULT	 Injector 1 short circuit to HSD to LSD. Injector 1 open circuit fault. * 4CYL Engine: Cylinder No.3 	0			0	0		0			

ENGINE

NDEX

	FAULT CODE					ACTION								EGR Inducement							
отс сос нмв і	+	J193 SPN		LAMF						FAULT NAME	DESCRIPTION	CEL"ON"	DELAYED ENGIN STOP (20s)	E CCRT (DPF) REGEN DISABLE OR STOP	INCRE-ASED IDLE (1300 rpm)	DISABLE EACH INJECTOR	LIMP HOME (1400 rpm)	TORQUE REDUCTION (2200 rpm)	EMISSION FAILURE LAMP "ON"	SPEED REDUCTION Warn : N/A Low Level: N/A Severe Level : 60%	TORQUE REDUCTION Warn : N/A Low Level: 25% Severe Level : 50%
0204	13	516	18	153	E-ECU-053	INJECTOR 2 OPEN CIRCUIT FAULT	 Injector 2 short circuit to HSD to LSD. Injector 2 open circuit fault. * 4CYL Engine: Cylinder No.4// 3CYL Engine: Cylinder No.3 	0			0	0		0							
0204	01	516	19	163	E-ECU-054	INJECTOR 2 SHORT CIRCUIT FAULT	 Injector 2 short circuit to HSD to LSD. Injector 2 open circuit fault. * 4CYL Engine: Cylinder No.4// 3CYL Engine: Cylinder No.3 	0			0	0		0							
0220	00	544	24	432	E-ECU-055	FOOT PEDAL SIGNAL TRACK 2 FAULT	1. Foot pedal signal track 2 fault.	0					0								
0252	00	594	7	211	E-ECU-056	RAIL PRESSURE CONTORL FAULT	 Rail pressure control error . (The duty cycle applied to the inlet metering valve is clamped by an upper value). 	0					0								
P0261	1A	609	14	741		INJECTOR 0 & WIRING LSD RESISTANCE FAULT	 Injector 0 & wiring low side resistance drop. Injector 0 & wiring low side resistance level too high or low. * 4CYL Engine: Cylinder No.1// 3CYL Engine: Cylinder No.1 	0						0							
P0261	1A	609	14	745	- E-ECU-057	INJECTOR 0 & WIRING LSD RESISTANCE FAULT	 Injector 0 & wiring low side resistance drop. Injector 0 & wiring low side resistance level too high or low. * 4CYL Engine: Cylinder No.1// 3CYL Engine: Cylinder No.1 	0						0							
P0262	1В	610	15	731		INJECTOR 0 & WIRING HSD RESISTANCE FAULT	 Injector 0 & wiring high side resistance drop. Injector 0 & wiring high side resistance level too high or low. * 4CYL Engine: Cylinder No.1// 3CYL Engine: Cylinder No.1 	0						0							
P0262	1В	610	15	735	- E-ECU-058	INJECTOR 0 & WIRING HSD RESISTANCE FAULT	 Injector 0 & wiring high side resistance drop. Injector 0 & wiring high side resistance level too high or low. * 4CYL Engine: Cylinder No.1// 3CYL Engine: Cylinder No.1 	0						0							
P0264	1A	612	14	744		INJECTOR 3 & WIRING LSD RESISTANCE FAULT	 Injector 3 & wiring low side resistance drop. Injector 3 & wiring low side resistance level too high or low. * 4CYL Engine: Cylinder No.2 	0						0							
P0264	1A	612	14	748	- E-ECU-059	INJECTOR 3 & WIRING LSD RESISTANCE FAULT	 Injector 3 & wiring low side resistance drop. Injector 3 & wiring low side resistance level too high or low. * 4CYL Engine: Cylinder No.2 	0						0							
P0265	1B	613	15	734		INJECTOR 3 & WIRING HSD RESISTANCE FAULT	 Injector 3 & wiring high side resistance drop. Injector 3 & wiring high side resistance level too high or low. * 4CYL Engine: Cylinder No.2 	0						0							
P0265	1B	613	15	738	- E-ECU-060	INJECTOR 3 & WIRING HSD RESISTANCE FAULT	 Injector 3 & wiring high side resistance drop. Injector 3 & wiring high side resistance level too high or low. * 4CYL Engine: Cylinder No.2 	0						0							
P0267	1A	615	14	742		INJECTOR 1 & WIRING LSD RESISTANCE FAULT	 Injector 1 & wiring low side resistance drop. Injector 1 & wiring low side resistance level too high or low. * 4CYL Engine: Cylinder No.3// 3CYL Engine: Cylinder No.2 	0						0							
P0267	1A	615	14	746	- E-ECU-061	INJECTOR 1 & WIRING LSD RESISTANCE FAULT	 Injector 1 & wiring low side resistance drop. Injector 1 & wiring low side resistance level too high or low. * 4CYL Engine: Cylinder No.3// 3CYL Engine: Cylinder No.2 	0						0							
P0268	1B	616	15	732		INJECTOR 1 & WIRING HSD RESISTANCE FAULT	 Injector 1 & wiring high side resistance drop. Injector 1 & wiring high side resistance level too high or low. * 4CYL Engine: Cylinder No.3// 3CYL Engine: Cylinder No.2 	0						0							
P0268	1B	616	15	736	- E-ECU-062	INJECTOR 1 & WIRING HSD RESISTANCE FAULT	 Injector 1 & wiring high side resistance drop. Injector 1 & wiring high side resistance level too high or low. * 4CYL Engine: Cylinder No.3// 3CYL Engine: Cylinder No.2 	0						0							
P0270	1A	624	14	743		INJECTOR 2 & WIRING LSD RESISTANCE FAULT	 Injector 2 & wiring low side resistance drop. Injector 2 & wiring low side resistance level too high or low. * 4CYL Engine: Cylinder No.4// 3CYL Engine: Cylinder No.3 	0						0							
P0270	1A	624	14	747	- E-ECU-063	INJECTOR 2 & WIRING LSD RESISTANCE FAULT	 Injector 2 & wiring low side resistance drop. Injector 2 & wiring low side resistance level too high or low. * 4CYL Engine: Cylinder No.4// 3CYL Engine: Cylinder No.3 	0						0							

		FAU	LT CO	DE					ACTION							EGR Inducement			
отс со нмв		J19 SPN	1	LAMP CODE	CLUSTER CODE	FAULT NAME	DESCRIPTION	CEL"ON"	DELAYED ENGINE STOP (20s)	CCRT (DPF) REGEN DISABLE OR STOP	INCRE-ASED IDLE (1300 rpm)	DISABLE EACH INJECTOR	LIMP HOME (1400 rpm)	TORQUE REDUCTION (2200 rpm)	EMISSION FAILURE LAMP "ON"	SPEED REDUCTION Warn : N/A Low Level: N/A Severe Level : 60%	TORQU REDUCTI Warn : N Low Level: 2 Severe Level :		
P0271	1B	625	15	733	E-ECU-064	INJECTOR 2 & WIRING HSD RESISTANCE FAULT	 Injector 2 & wiring high side resistance drop. Injector 2 & wiring high side resistance level too high or low. * 4CYL Engine: Cylinder No.4// 3CYL Engine: Cylinder No.3 	0						0					
P0271	1B	625	15	737	E-ECU-004	INJECTOR 2 & WIRING HSD RESISTANCE FAULT	 Injector 2 & wiring high side resistance drop. Injector 2 & wiring high side resistance level too high or low. * 4CYL Engine: Cylinder No.4// 3CYL Engine: Cylinder No.3 	0						0					
P029A	00	666	6	171		INJECTOR 0 MDP TRIM HIGH FAULT	 Injector 0 MDP trim high fault. Injector 0 MDP trim exceeds the maximum calibrated threshold limit. * 4CYL Engine: Cylinder No.1// 3CYL Engine: Cylinder No.1 	0			0								
P029A	00	666	6	171	E-ECU-065	INJECTOR 0 MDP TRIM HIGH FAULT	 Injector 0 MDP trim high fault. Injector 0 MDP trim exceeds the maximum calibrated threshold limit. * 4CYL Engine: Cylinder No.1// 3CYL Engine: Cylinder No.1 	0			0								
P029A	00	666	6	171		INJECTOR 0 MDP TRIM HIGH FAULT	 Injector 0 MDP trim high fault. Injector 0 MDP trim exceeds the maximum calibrated threshold limit. * 4CYL Engine: Cylinder No.1// 3CYL Engine: Cylinder No.1 	0			0								
P029B	00	667	30	171	E-ECU-066	INJECTOR 0 LEARNING FAULT	 Injector 0 absolute MDP value is below a calibrated threshold. Injector 0 MDP trim low fault. * 4CYL Engine: Cylinder No.1// 3CYL Engine: Cylinder No.1 	0		0	0								
⊃029B	00	667	5	171		INJECTOR 0 LEARNING FAULT	 Injector 0 absolute MDP value is below a calibrated threshold. Injector 0 MDP trim low fault. * 4CYL Engine: Cylinder No.1// 3CYL Engine: Cylinder No.1 	0											
P029B	00	667	5	171	E-ECU-067	INJECTOR 0 LEARNING FAULT	 Injector 0 absolute MDP value is below a calibrated threshold. Injector 0 MDP trim low fault. * 4CYL Engine: Cylinder No.1// 3CYL Engine: Cylinder No.1 	0											
P029B	00	667	5	171		INJECTOR 0 LEARNING FAULT	 Injector 0 absolute MDP value is below a calibrated threshold. Injector 0 MDP trim low fault. * 4CYL Engine: Cylinder No.1// 3CYL Engine: Cylinder No.1 	0											
P029E	00	670	6	174		INJECTOR 3 MDP TRIM HIGH FAULT	 Injector 2 MDP trim high fault. Injector 2 MDP trim exceeds the maximum calibrated threshold limit. * 4CYL Engine: Cylinder No.4// 3CYL Engine: Cylinder No.3 	0			0								
P029E	00	670	6	174	E-ECU-068	INJECTOR 3 MDP TRIM HIGH FAULT	 Injector 2 MDP trim high fault. Injector 2 MDP trim exceeds the maximum calibrated threshold limit. * 4CYL Engine: Cylinder No.4// 3CYL Engine: Cylinder No.3 	0			0								
P029E	00	670	6	174		INJECTOR 3 MDP TRIM HIGH FAULT	 Injector 2 MDP trim high fault. Injector 2 MDP trim exceeds the maximum calibrated threshold limit. * 4CYL Engine: Cylinder No.4// 3CYL Engine: Cylinder No.3 	0			0								
P029F	00	671	30	174	E-ECU-069	INJECTOR 3 LEARNING FAULT	 Injector 2 absolute MDP value is below a calibrated threshold. Injector 2 MDP trim low fault. * 4CYL Engine: Cylinder No.4// 3CYL Engine: Cylinder No.3 	0		0	0								
P029F	00	671	5	174		INJECTOR 3 LEARNING FAULT	 Injector 2 absolute MDP value is below a calibrated threshold. Injector 2 MDP trim low fault. * 4CYL Engine: Cylinder No.4// 3CYL Engine: Cylinder No.3 	0											
P029F	00	671	5	174	E-ECU-070	INJECTOR 3 LEARNING FAULT	 Injector 2 absolute MDP value is below a calibrated threshold. Injector 2 MDP trim low fault. * 4CYL Engine: Cylinder No.4// 3CYL Engine: Cylinder No.3 	0											
P029F	00	671	5	174		INJECTOR 3 LEARNING FAULT	 Injector 2 absolute MDP value is below a calibrated threshold. Injector 2 MDP trim low fault. * 4CYL Engine: Cylinder No.4// 3CYL Engine: Cylinder No.3 	0											

		FAU	LT CO	DE							ACTION		
DTC CO	DDE	J19	39	LAMP	CLUSTER	FAULT NAME	DESCRIPTION	CEL"ON"	DELAYED ENGINE	CCRT (DPF) REGEN DISABLE	INCRE-ASED IDLE	DISABLE	LIMP H
НМВ	HMB LB		FMI	CODE	CODE			CEL ON	STOP (20s)	OR STOP	(1300 rpm)	EACH INJECTOR	(1400
P02A2	00	674	6	172		INJECTOR 1 MDP TRIM HIGH FAULT	 Injector 1 MDP trim high fault. Injector 1 MDP trim exceeds the maximum calibrated threshold limit. * 4CYL Engine: Cylinder No.3// 3CYL Engine: Cylinder No.2 	0			0		
P02A2	00	674	6	172	E-ECU-071	INJECTOR 1 MDP TRIM HIGH FAULT	 Injector 1 MDP trim high fault. Injector 1 MDP trim exceeds the maximum calibrated threshold limit. * 4CYL Engine: Cylinder No.3// 3CYL Engine: Cylinder No.2 	0			0		
P02A2	00	674	6	172		INJECTOR 1 MDP TRIM HIGH FAULT	 Injector 1 MDP trim high fault. Injector 1 MDP trim exceeds the maximum calibrated threshold limit. * 4CYL Engine: Cylinder No.3// 3CYL Engine: Cylinder No.2 	о			0		
P02A3	00	675	30	172	E-ECU-072	INJECTOR 1 LEARNING FAULT	 Injector 2 absolute MDP value is below a calibrated threshold. Injector 2 MDP trim low fault. * 4CYL Engine: Cylinder No.4// 3CYL Engine: Cylinder No.3 	0		о	0		
P02A3	00	675	5	172		INJECTOR 1 LEARNING FAULT	 Injector 2 absolute MDP value is below a calibrated threshold. Injector 2 MDP trim low fault. * 4CYL Engine: Cylinder No.4// 3CYL Engine: Cylinder No.3 	0					
P02A3	00	675	5	172	E-ECU-073	INJECTOR 1 LEARNING FAULT	 Injector 2 absolute MDP value is below a calibrated threshold. Injector 2 MDP trim low fault. * 4CYL Engine: Cylinder No.4// 3CYL Engine: Cylinder No.3 	0					
P02A3	00	675	5	172		INJECTOR 1 LEARNING FAUL	 Injector 2 absolute MDP value is below a calibrated threshold. Injector 2 MDP trim low fault. * 4CYL Engine: Cylinder No.4// 3CYL Engine: Cylinder No.3 	0					
P02A6	00	678	6	173		INJECTOR 2 MDP TRIM HIGH FAULT	 Injector 3 MDP trim high fault. Injector 3 MDP trim exceeds the maximum calibrated threshold limit. * 4CYL Engine: Cylinder No.2 	0			0		
P02A6	00	678	6	173	E-ECU-074	INJECTOR 2 MDP TRIM HIGH FAULT	 Injector 3 MDP trim high fault. Injector 3 MDP trim exceeds the maximum calibrated threshold limit. * 4CYL Engine: Cylinder No.2 	0			0		
P02A6	00	678	6	173		INJECTOR 2 MDP TRIM HIGH FAULT	 Injector 3 MDP trim high fault. Injector 3 MDP trim exceeds the maximum calibrated threshold limit. * 4CYL Engine: Cylinder No.2 	0			0		
P02A7	00	679	30	173	E-ECU-075	INJECTOR 2 LEARNING FAULT	 Injector 3 absolute MDP value is below a calibrated threshold. Injector 3 MDP trim low fault. * 4CYL Engine: Cylinder No.2 	0		о	0		
P02A7	00	679	5	173		INJECTOR 2 LEARNING FAULT	 Injector 3 absolute MDP value is below a calibrated threshold. Injector 3 MDP trim low fault. * 4CYL Engine: Cylinder No.2 	0					
P02A7	00	679	5	173	E-ECU-076	INJECTOR 2 LEARNING FAULT	 Injector 3 absolute MDP value is below a calibrated threshold. Injector 3 MDP trim low fault. * 4CYL Engine: Cylinder No.2 	0					
P02A7	00	679	5	173		INJECTOR 2 LEARNING FAULT	 Injector 3 absolute MDP value is below a calibrated threshold. Injector 3 MDP trim low fault. * 4CYL Engine: Cylinder No.2 	0					
P0325	00	805	1	121	E-ECU-077	KNOCK SENSOR 1 FAULT	1. Knock sensor 1 signal or noise ratio is too low in idle.	0					
P0330	00	816	1	122	E-ECU-078	KNOCK SENSOR 2 FAULT	1. Knock sensor 2 signal or noise ratio is too low in idle.	0					
P0335	85	821	27	424	E-ECU-079	CRANK SENSOR SIGNAL OVER SPEED FAULT	 Crank signal over speed fault. Crank signal gap lost fault. 	0			0		
P0335	31	821	2	425	E-ECU-080	CRANK SENSOR SIGNAL GAP MISSED FAULT	 Crank signal over speed fault. Crank signal gap lost fault. 	0			0		
P0340	54	832	30	415	E-ECU-081	CAM SENSOR SIGNAL LEARNING FAULT	1. Cam signal learning fault. 2. Cam signal erratic fault.	0			0		
P0340	2F	832	29	414	E-ECU-082	CAM SENSOR SIGNAL ERRATIC FAULT	 Cam signal learning fault. Cam signal erratic fault. 	0			0		

		E			
P HOME)0 rpm)	TORQUE REDUCTION (2200 rpm)	EMISSION FAILURE LAMP "ON"	SPEED REDUCTION Warn : N/A Low Level: N/A Severe Level : 60%	TORQUE REDUCTION Warn : N/A Low Level: 25% Severe Level : 50%	SAFETY FIRST
					ENGINE
					DRIVIN
					DRIVING & CHASSIS
					ASSIS
					HYDRA
					HYDRAULIC SYSTEM
					TEM
					ELECT
					ELECTRIC SYSTEM
					ĒM
					CABIN
	0				
	0				
	0				INDEX
	0				×

	FA	AULT C	ODE							ACTION					EGR Inducemen	t
DTC CODE		1939 N FM	LAMP CODE		FAULT NAME	DESCRIPTION	CEL"ON"	DELAYED ENGINE STOP (20s)	CCRT (DPF) REGEN DISABLE OR STOP	INCRE-ASED IDLE (1300 rpm)	DISABLE EACH INJECTOR	LIMP HOME (1400 rpm)	TORQUE REDUCTION (2200 rpm)	EMISSION FAILURE LAMP "ON"	SPEED REDUCTION Warn : N/A Low Level: N/A Severe Level : 60%	TORQUE REDUCTIC Warn : N/ Low Level: 2 Severe Level: 5
P0341 31	833	3 26	411	E-ECU-083	CAM SENSOR SIGNAL FAULT	 Cam signal drift high. Cam signal lost. Cam signal missing. 	0			0			0			
P0341 00	833	3 30	413	E-ECU-084	CAM SENSOR SIGNAL DRIFT FAULT	 Cam signal drift high. Cam signal lost. Cam signal missing. 	0			0			0			
P0341 31	833	3 29	412	E-ECU-085	CAM SENSOR SIGNAL FAULT	 Cam signal drift high. Cam signal lost. Cam signal missing. 	0			0			0			
P0371 00	881	1 27	423	E-ECU-086	CRANK SIGNAL FAULT 2	1. Crank signal is too close to the previous one.	0			0			0			
P0372 31	1 882	2 23	422	E-ECU-087	CRANK SIGNAL FAULT 3	1. Crankshaft signal missing fault.	0			0			0			
P0374 31	884	4 26	421	E-ECU-088	CRANK SIGNAL FAULT 4	1. Crank signal lost fault.	0			0			0			
P0380 11	896	6 20	753	E-ECU-089	GLOW PLUG RELAY SC2G FAULT	 Glow plug relay fault. Glow plug relay open circuit. 										
P0380 12	2 896	6 21	754	E-ECU-090	GLOW PLUG RELAY SC2VBATT FAULT	 Glow plug relay fault. Glow plug relay open circuit. 										
P0380 00	896	6 30	751	E-ECU-091	GLOW PLUG RELAY FAULT	 Glow plug relay fault. Glow plug relay open circuit. 										
P0380 13	896	6 18	752	E-ECU-092	GLOW PLUG RELAY OC FAULT	 Glow plug relay fault. Glow plug relay open circuit. 										
P0381 11	897	7 20	636	E-ECU-093	GLOW PLUG LAMP SC2G FAULT	1. Glow plug lamp driver open circuit fault.										
P0381 12	2 897	7 21	637	E-ECU-094	GLOW PLUG LAMP SC2VBATT FAULT	1. Glow plug lamp driver open circuit fault.										
P0381 13	897	7 18	635	E-ECU-095	GLOW PLUG LAMP OC FAULT	1. Glow plug lamp driver open circuit fault.										
P0400 23	3 1024	.4 5	518	E-ECU-096	EGR CONTROL AIR FLOW LOW FAULT	1.								0	0	0
P0401 24	102	.5 6	517	E-ECU-097	EGR CONTROL AIR FLOW HIGH FAULT	1.								0	0	0
P0403 00	0 102	27 1	514	E-ECU-098	EGR CONTROL AND SINAL FAULT	 EGR position control fault. EGR H-bridge driver open circuit (OC). EGR H-bridge driver short circuit to ground (SC2G). EGR H-bridge driver short circuit to battery voltage (SC2VBAT). 	o		0				O (1500rpm)	o	0	0
P0403 11	102	27 20	522	E-ECU-099	EGR SC2G FAULT	 EGR position control fault. EGR H-bridge driver open circuit (OC). EGR H-bridge driver short circuit to ground (SC2G). EGR H-bridge driver short circuit to battery voltage (SC2VBAT). 	0		0				O (1500rpm)	o	0	0
P0403 12	2 102	27 21	523	E-ECU-100	EGR SC2VBATT FAULT	 EGR position control fault. EGR H-bridge driver open circuit (OC). EGR H-bridge driver short circuit to ground (SC2G). EGR H-bridge driver short circuit to battery voltage (SC2VBAT). 	0		0				O (1500rpm)	o	0	0
P0403 04	102	27 3	526		EGR H-BRIDGE DRIVER FAULT	 EGR position control fault. EGR H-bridge driver open circuit (OC). EGR H-bridge driver short circuit to ground (SC2G). EGR H-bridge driver short circuit to battery voltage (SC2VBAT). 	0		0				O (1500rpm)	0	0	0
P0403 04	102	27 3	527	- E-ECU-101	EGR H-BRIDGE DRIVER FAULT	 EGR position control fault. EGR H-bridge driver open circuit (OC). EGR H-bridge driver short circuit to ground (SC2G). EGR H-bridge driver short circuit to battery voltage (SC2VBAT). 	0		0				O (1500rpm)	0	0	0
P0403 04	4 102	27 4	525	E-ECU-102	EGR H-BRIDGE DRIVER FAULT	 EGR position control fault. EGR H-bridge driver open circuit (OC). EGR H-bridge driver short circuit to ground (SC2G). EGR H-bridge driver short circuit to battery voltage (SC2VBAT). 	0		0				O (1500rpm)	0	0	0

-ELY FIKSI

ENGINE

IVING & CHA

NDEX

		FAU	JLT CO	DE							ACTION					EGR Inducemen	
DTC C		J19				-										SPEED	TORQUE
		SPN		CODE	CLUSTER CODE	FAULT NAME	DESCRIPTION	CEL"ON"	DELAYED ENGINE STOP (20s)	CCRT (DPF) REGEN DISABLE OR STOP	INCRE-ASED IDLE (1300 rpm)	DISABLE EACH INJECTOR	LIMP HOME (1400 rpm)	TORQUE REDUCTION (2200 rpm)	EMISSION FAILURE LAMP "ON"	REDUCTION Warn : N/A Low Level: N/A Severe Level : 60%	REDUCTION Warn : N/A Low Level: 25% Severe Level : 50%
P0403	13	1027	18	521	E-ECU-103	BGR H-BRIDGE DRIVER FAULT	 EGR position control fault. EGR H-bridge driver open circuit (OC). EGR H-bridge driver short circuit to ground (SC2G). EGR H-bridge driver short circuit to battery voltage (SC2VBAT). 	0		0				O (1500rpm)	0	0	0
P0403	04	1027	2	524	E-ECU-104	EGR H-BRIDGE DRIVER FAULT	 EGR position control fault. EGR H-bridge driver open circuit (OC). EGR H-bridge driver short circuit to ground (SC2G). EGR H-bridge driver short circuit to battery voltage (SC2VBAT). 	0		0				O (1500rpm)	0	0	0
P0404	00	1028	30	515	E-ECU-105	EGR POSITION LEARNING DRIFT FAULT	1. EGR position learning drift fault.	0		0				O (1500rpm)	0	О	0
P0405	23	1029	20	512	E-ECU-106	EGR POSITION FEEDBACK SIGNAL SC2G	1. EGR position feedback signal low fault.							O (1500rpm)	0	0	0
P0406	24	1030	21	511	E-ECU-107	EGR POSITION FEEDBACK SIGNAL OC OR SC2VBATT FAULT	1. EGR position feedback signal high fault.							O (1500rpm)	0	0	0
P0487	54	1159	30	551		ACV POSITION LEARNING FAULT	 Throttle position feedback signal low or high fault. Throttle learning position fault. 	0		0							
P0487	54	1159	30	552	- E-ECU-108	ACV POSITION LEARNING FAULT	 Throttle position feedback signal low or high fault. Throttle learning position fault. 	0		0							
P0487	23	1159	20	532	E-ECU-109	ACV POSITION FEEDBACK SIGNAL SC2G FAULT	 Throttle position feedback signal low or high fault. Throttle learning position fault. 	0		0							
P0487	24	1159	18	531	E-ECU-110	ACV POSITION FEEDBACK SIGNAL OC OR SC2VBATT FAULT	 Throttle position feedback signal low or high fault. Throttle learning position fault. 	0		0							
P049D	00	1181	30	516	E-ECU-111	EGR POSITION LEARNING RANGE FAULT	1. EGR position learning range fault.	0		0				O (1500rpm)	0	0	0
P0522	23	1314	5	658	E-ECU-112	ENGINE OIL PRESSURE LOW FAULT	1. At engine run, oil pressure remains low.	0					0				
P0544	00	1348	1	465	E-ECU-113	EXHAUST GAS TEMP.SENSOR FAULT	1. Exhaust manifold sensor fault.	0									
P0545	00	1349	20	467	E-ECU-114	EXHAUST GAS TEMP.SENSOR SC2G FAULT	1. Exhaust manifold temperature sensor circuit low.	0									
P0546	00	1350	18	466	E-ECU-115	EXHAUST GAS TEMP.SENSOR OC OR SC2VBATT FAULT	1. Exhaust manifold Temperature Sensor Circuit High.	0									
P0562	23	1378	4	712	E-ECU-116	BATTERY VOLTAGE LOW FAULT	1. Battery voltage low fault.										
P0563	24	1379	4	711	E-ECU-117	BATTERY VOLTAGE HIGH FAULT	1. Battery voltage high fault.	0						0			
P0602	00	1538	26	115	E-ECU-118	INJECTOR C3I RAM DATA FAULT	 C2I data not programmed. Multiple calibration faults - Non Volatile Memory fault. 	0					0	0			
P0602	F3	1538	13	114	E-ECU-119	INJECTOR 3 C3I DATA FAULT	 C2I data not programmed. Multiple calibration faults - Non Volatile Memory fault. 	0					0	0			
P0602	F2	1538	12	113	E-ECU-120	INJECTOR 2 C3I DATA FAULT	 C2I data not programmed. Multiple calibration faults - Non Volatile Memory fault. 	0					0	0			
P0602	F1	1538	11	112	E-ECU-121	INJECTOR 1 C3I DATA FAULT	 C2I data not programmed. Multiple calibration faults - Non Volatile Memory fault. 	0					0	0			
P0602	F0	1538	10	111	E-ECU-122	INJECTOR 0 C3I DATA FAULT	 C2I data not programmed. Multiple calibration faults - Non Volatile Memory fault. 	0					0	0			
P0603	00	1539	26	815	E-ECU-123	ECU MEMORY INTEGRITY DATA FAULT	1. ECU memory integrity fault (data / cal integrity).	0									
P0604	00	1540	26	816	E-ECU-124	ECU MEMORY INTEGRITY RAM FAULT	 ECU memory integrity fault (RAM integrity). Internal control module random access memory (RAM) error. 	0									
P0605	00	1541	26	814	E-ECU-12	ECU MEMORY INTEGRITY FAULT	 ECU memory integrity fault (code integrity). Internal control module read only memory (ROM) error. 	0									
P060B	00	1547	26	811	E-ECU-126	ECU ADC FAULT	1. Internal control module A/D convertor processing performance error.	0					0	0			
P061B	00	1563	26	831	E-ECU-127	ESM 0 TORQUE MONITORING	1. ESM 0 Torque Monitoring Fault.	0									
				1	1	1	1^	I	1	1	1	1		1	1	I	

AFETY FIRST

ENGINE

DRIVING & CHASSIS

HYDRAULIC SYSTEN

LECTRIC SYSTE

CABIN

INDEX

		FAULT C	ODE							ACTION					EGR Inducement	t
DTC COD	_	J1939 SPN FM	LAMF CODE		FAULT NAME	DESCRIPTION	CEL"ON"	DELAYED ENGINE STOP (20s)	CCRT (DPF) REGEN DISABLE OR STOP	INCRE-ASED IDLE (1300 rpm)	DISABLE EACH INJECTOR	LIMP HOME (1400 rpm)	TORQUE REDUCTION (2200 rpm)	EMISSION FAILURE LAMP "ON"	SPEED REDUCTION Warn : N/A Low Level: N/A Severe Level : 60%	TORQUE REDUCTION Warn : N/A Low Level: 25% Severe Level : 50%
P062D 1	11	1581 20	131	E-ECU-128	INJECTOR DRIVER CIRCUIT PERFORMANCE BANK 'A' FAULT	1. Injector bank A SC2G. 2. Injector bank A SC2V.	0			0	0		0			
P062D 1	12	1581 21	133	E-ECU-129	INJECTOR DRIVER CIRCUIT PERFORMANCE BANK 'A' FAULT	1. Injector bank A SC2G. 2. Injector bank A SC2V.	0			0	0		0			
P062D 0)4	1581 1	165	E-ECU-130	INJECTOR DRIVER CIRCUIT PERFORMANCE BANK 'A' FAULT	1. Injector bank A SC2G. 2. Injector bank A SC2V.	0					0	0			
P062E 1	11	1582 20	132	E-ECU-131	INJECTOR DRIVER CIRCUIT PERFORMANCE BANK 'B' FAULT	1. Injector bank B SC2V. 2. Injector bank B SC2G.	0			0	0		0			
P062E 1	12	1582 21	134	E-ECU-132	INJECTOR DRIVER CIRCUIT PERFORMANCE BANK 'B' FAULT	1. Injector bank B SC2V. 2. Injector bank B SC2G.	0			0	0		0			
P062E 0)4	1582 1	166	E-ECU-133	INJECTOR DRIVER CIRCUIT PERFORMANCE BANK 'B' FAULT	1. Injector bank B SC2V. 2. Injector bank B SC2G.	0					0	0			
P062F 0	00	1583 26	821	E-ECU-134	ECU DATA STORAGE FAULT	 ECU non volatile memory fault (C3I, MDP, ICV, INJ, CNT, APP, FM, CAN). Internal control module EEPROM error. 	0						0			
P0641 0	00	1601 26	721		ECU INTERNAL 5V SUPPLY 1 FAULT	1. ECU internal 5V supply 2 fault.	0		0				0			
P0641 4	в	1601 26	722	E-ECU-135	ECU INTERNAL 5V SUPPLY 1 FAULT	1. ECU internal 5V supply 2 fault.	0		0				0			
P0651 0	00	1617 26	723		ECU INTERNAL 5V SUPPLY 2 FAULT	1. ECU internal 5V supply 2 fault.	0		0				0			
P0651 4	B	1617 26	724	E-ECU-136	ECU INTERNAL 5V SUPPLY 2 FAULT	1. ECU internal 5V supply 2 fault.	0		0				0			
P0685 0	00	1669 26	713		MAIN ECU RELAY FAULT	 Main ECU relay stuck. Main relay unexpected high state. 										
P0685 0)1	1669 26	713	E-ECU-137	MAIN ECU RELAY FAULT	 Main ECU relay stuck. Main relay unexpected high state. 	0									
P0697 0	00	1687 26	725		ECU INTERNAL 5V AUXILLARY FAULT	1. ECU internal 5V supply to auxiliary fault.	0		0				0			
P0697 4	В	1687 26	726	E-ECU-138	ECU INTERNAL 5V AUXILLARY FAULT	1. ECU internal 5V supply to auxiliary fault.	0		0				0			
P1001 0	00	4097 25	583	E-ECU-139	DPF REDUCED TORQUE FAULT	1.	0		0				0			
P1219 0	00	4633 26	895	E-ECU-140	ESM VDG MONITORING FAULT	1. ESM VDG Monitoring Fault.	0									
P1221 0	00	4641 25	433	E-ECU-141	FOOT PEDAL LIMP HOME FAULT	 Foot pedal signal fault set (triggers limp home mode). 2. 	0					0				
P1224 0	00	4644 25	443	E-ECU-142	HAND PEDAL LIMP HOME FAULT	 Hand pedal signal fault set (triggers limp home mode). 2. 	0					0				
P1226 0	00	4646 25	447	E-ECU-143	PEDAL LIMP HOME FAULT	 Global pedal fault has triggered limp home mode. 2. 	0					0				
P1227 0	00	4647 25	448	E-ECU-144	PEDAL REDUCED TORQUE FAULT	 Global pedal fault has triggered reduced torque mode. 2. 	0						0			
P126A 1	11	4714 20	643	E-ECU-145	WATER IN FUEL SENSOR LAMP FAULT	 Water in fuel lamp driver global fault. Water in fuel lamp driver short circuit to battery voltage (SC2VBAT). Water in fuel lamp driver short circuit to ground (SC2G). Water in fuel lamp driver open circuit (OC). 	0									
P126A 1	12	4714 21	644	E-ECU-146	WATER IN FUEL SENSOR LAMP FAULT	 Water in fuel lamp driver global fault. Water in fuel lamp driver short circuit to battery voltage (SC2VBAT). Water in fuel lamp driver short circuit to ground (SC2G). Water in fuel lamp driver open circuit (OC). 	0									
P126A 1	3	4714 18	642	E-ECU-147	WATER IN FUEL SENSOR LAMP FAUL	 Water in fuel lamp driver global fault. Water in fuel lamp driver short circuit to battery voltage (SC2VBAT). Water in fuel lamp driver short circuit to ground (SC2G). Water in fuel lamp driver open circuit (OC). 	0									

INDE

		FAUL	тсо	DE		_					ACTION		
ртс со	DE	J193		LAMP	CLUSTER CODE	FAULT NAME	DESCRIPTION	CEL"ON"	DELAYED ENGINE STOP (20s)	CCRT (DPF) REGEN DISABLE OR STOP	INCRE-ASED IDLE (1300 rpm)	DISABLE EACH INJECTOR	LIMP F (1400
НМВ Р126А	LB	SPN 4714	FMI 30	641	E-ECU-148	WATER IN FUEL SENSOR LAMP FAULT	 Water in fuel lamp driver global fault. Water in fuel lamp driver short circuit to battery voltage (SC2VBAT). 				(1000 (piii)		
	00	47.14		041	2-200-140		 Water in fuel lamp driver short circuit to ground (SC2G). Water in fuel lamp driver open circuit (OC). 						
P1303	00	4867	30	182	E-ECU-149	INJECTOR LEARNING CONDITION FAULT	1. Injector Learning Condition Fault.	0			0		
P1311	00	4881	30	182	E-ECU-150	INJECTOR LEARNING CONDITION FAULT	1. Injector Learning Condition Fault.	0			0		
P1600	11	5632	20	623	E-ECU-151	DPF REGENERATION WARNING LAMP SC2G FAULT	 DPF regeneration warning lamp driver general fault. DPF regeneration warning lamp driver SC2G (short circuit to ground). DPF regeneration warning lamp driver SC2VBAT (short circuit to battery voltage). DPF regeneration warning lamp driver OC (open circuit). 	0					
P1600	12	5632	21	624	E-ECU-152	DPF REGENERATION WARNING LAMP SC2VBATT FAULT	 DPF regeneration warning lamp driver general fault. DPF regeneration warning lamp driver SC2G (short circuit to ground). DPF regeneration warning lamp driver SC2VBAT (short circuit to battery voltage). DPF regeneration warning lamp driver OC (open circuit). 	0					
P1600	13	5632	18	622	E-ECU-153	DPF REGENERATION WARNING LAMP OC FAULT	 DPF regeneration warning lamp driver general fault. DPF regeneration warning lamp driver SC2G (short circuit to ground). DPF regeneration warning lamp driver SC2VBAT (short circuit to battery voltage). DPF regeneration warning lamp driver OC (open circuit). 	0					
P1600	00	5632	30	621	E-ECU-154	DPF REGENERATION WARNING LAMP DRIVER FAULT	 DPF regeneration warning lamp driver general fault. DPF regeneration warning lamp driver SC2G (short circuit to ground). DPF regeneration warning lamp driver SC2VBAT (short circuit to battery voltage). DPF regeneration warning lamp driver OC (open circuit). 						
P1601	03	5633	26	855	E-ECU-155	ESM LEVEL 3 FAULT	 DPF regeneration underway lamp driver general fault. DPF regeneration underway lamp driver SC2G (short circuit to ground). DPF regeneration underway lamp driver SC2VBAT (short circuit to battery voltage). DPF regeneration underway lamp driver OC (open circuit). 	0					
P1601	11	5633	20	627	E-ECU-156	DPF REGENERATION UNDERWAY LAMP SC2G FAULT	 DPF regeneration underway lamp driver general fault. DPF regeneration underway lamp driver SC2G (short circuit to ground). DPF regeneration underway lamp driver SC2VBAT (short circuit to battery voltage). DPF regeneration underway lamp driver OC (open circuit). 						
P1601	12	5633	21	628	E-ECU-157	DPF REGENERATION UNDERWAY LAMP SC2VBATT FAULT	 DPF regeneration underway lamp driver general fault. DPF regeneration underway lamp driver SC2G (short circuit to ground). DPF regeneration underway lamp driver SC2VBAT (short circuit to battery voltage). DPF regeneration underway lamp driver OC (open circuit). 						
P1601	13	5633	18	626	E-ECU-158	DPF REGENERATION UNDERWAY LAMP OC FAULT	 DPF regeneration underway lamp driver general fault. DPF regeneration underway lamp driver SC2G (short circuit to ground). DPF regeneration underway lamp driver SC2VBAT (short circuit to battery voltage). DPF regeneration underway lamp driver OC (open circuit). 						
P1601	00	5633	30	625	E-ECU-159	DPF REGENERATION UNDERWAY LAMP FAULT	 DPF regeneration underway lamp driver general fault. DPF regeneration underway lamp driver SC2G (short circuit to ground). DPF regeneration underway lamp driver SC2VBAT (short circuit to battery voltage). DPF regeneration underway lamp driver OC (open circuit). 						
P1602	03	5634	26	854	E-ECU-160	ESM LEVEL 3 FAULT	1. ESM Level 3 Fault.	0					
P1604	03	5636	26	856	E-ECU-161	ESM LEVEL 3 FAULT	1. ESM Level 3 Fault.	0					
P1606	03	5638	26	834		ESM LEVEL 3 FAULT	1. ESM Level 3 Fault.	0					
P1606	03	5638	26	865	E-ECU-162	ESM LEVEL 3 FAULT	1. ESM Level 3 Fault.	0					
P1607	03	5639	26	835	E-ECU-163	ESM LEVEL 3 FAULT	1. ESM Level 3 Fault.	0					
P160B	03	5643	26	887	E-ECU-164	ESM LEVEL 3 FAULT	1. ESM Level 3 Fault.	0					
P160C	00	5644	26	842	E-ECU-165	ESM ENGINE OFF MONITORING FAULT	1.	0					
P160D	00	5645	26	867	E-ECU-166	ESM PEDAL MONITORING FAULT	1. ESM Pedal Monitoring Fault.	0					
P160E	00	5646	26	866	E-ECU-167	ESM HAND PEDAL MONITORING FAULT	1. ESM Hand Pedal Monitoring Fault.	0					

		E	EGR Inducemen	t	
P HOME 00 rpm)	TORQUE REDUCTION (2200 rpm)	EMISSION FAILURE LAMP "ON"	SPEED REDUCTION Warn : N/A Low Level: N/A Severe Level : 60%	TORQUE REDUCTION Warn : N/A Low Level: 25% Severe Level : 50%	SAFETY FIRST
					-
	0				
	0				EZ
					ENGINE
					DRIVIN
					DRIVING & CHASSIS
					HYDRAULIC SYSTEM
					YSTEM
					ELECTRIC
					ELECTRIC SYSTEM
					CABIN
					Ĩ
					INDEX
					×

			FAL		DDE							ACTION				E	GR Inducement	
SAFETY FI	DTC C			1	LAMP	CLUSTER CODE	FAULT NAME	DESCRIPTION	CEL"ON"	DELAYED ENGINE STOP (20s)	CCRT (DPF) REGEN DISABLE OR STOP	INCRE-ASED IDLE (1300 rpm)	DISABLE EACH INJECTOR	LIMP HOME (1400 rpm)	TORQUE REDUCTION (2200 rpm)	EMISSION FAILURE LAMP "ON"	SPEED REDUCTION Warn : N/A Low Level: N/A Severe Level : 60%	TORQUE REDUCTION Warn : N/A Low Level: 25% Severe Level: 50%
RST	P1611	03	3 5649	26	837	E-ECU-168	ESM LEVEL 3 FAULT	1. ESM Level 3 Fault.	0								Severe Lever . 00 /0	001010 10101
	P1612	+	-				ESM LEVEL 3 FAULT	1. ESM Level 3 Fault.	0									
	P161B	3 00	0 5659	25	893	E-ECU-170	ESM TORQUE REDUCTION FAULT	1. ESM Torque reduction fault	0									
	P1620	03	3 5664	26	859	E-ECU-171	ESM LEVEL 3 FAULT	1. ESM Level 3 Fault.	0									
EN	P1621	03	3 5665	26	861	E-ECU-172	ESM LEVEL 3 FAULT	1. ESM Level 3 Fault.	0									
ENGINE	P1622	2 03	3 5666	26	862	E-ECU-173	ESM LEVEL 3 FAULT	1. ESM Level 3 Fault.	0									
	P1623	8 03	3 5667	26	863	E-ECU-174	ESM LEVEL 3 FAULT	1. ESM Level 3 Fault.	0									
	P1624	+	-				ESM LEVEL 3 FAULT	1. ESM Level 3 Fault.	0									
	P1625	-					ESM LEVEL 3 FAULT	1. ESM Level 3 Fault.	0									
ORIV	P1626	5 03	3 5670	26	869	E-ECU-177	ESM LEVEL 3 FAULT	1. ESM Level 3 Fault.	0									
ING	P1627	03	3 5671	26	871	E-ECU-178	ESM LEVEL 3 FAULT	1. ESM Level 3 Fault.	0									
% ()	P1628	8 03	3 5672				ESM LEVEL 3 FAULT	1. ESM Level 3 Fault.	0									
HAS	P162B	3 03	3 5675	26	857	E-ECU-180	ESM LEVEL 3 FAULT	1. ESM Level 3 Fault.	0									
SIS	P1630) 00	0 5680	26			ESM PULSE CHECK FAULT	1. ESM Pulse Check Fault.	0									
	P1631	00	0 5681	26	874	E-ECU-182	ESM PULSE CHECK FAULT	1. ESM Pulse Check Fault.	0									
HYD	P1632	2 00	0 5682				ESM PULSE CHECK FAULT	1. ESM Pulse Check Fault.	0									
RAU	P1633	3 00	0 5683	26	876	E-ECU-184	ESM PULSE CHECK FAULT	1. ESM Pulse Check Fault.	0									
	P1634		0 5684	26	877	E-ECU-185	ESM PULSE CHECK FAULT	1. ESM Pulse Check Fault.	0									
SYST	P1635	5 00	0 5685	26	878	E-ECU-186	ESM PULSE CHECK FAULT	1. ESM Pulse Check Fault.	0									
EM	P1636	5 00	0 5686	26	879	E-ECU-187	ESM PULSE CHECK FAULT	1. ESM Pulse Check Fault.	0									
	P1637	, 00	0 5687	26	881	E-ECU-188	ESM PULSE CHECK FAULT	1. ESM Pulse Check Fault.	0									
E		+	0 5688				ESM PULSE CHECK FAULT	1. ESM Pulse Check Fault.	0									
ECTRIC			0 5702	+			PTO CRUISE SWITCH FAULT	 PTO cruise inc/resume & dec/set switch frequency fault. PTO cruise inc/resume & dec/set switch short circuit to ground (SC2G) fault. 										
SYSTEN	P1647	1	5703	1	662	E-ECU-191	PTO CRUISE DEC/SET SWITCH FAULT	 PTO cruise DEC frequency fault. PTO cruise DEC short circuit to ground (SC2G) fault. 										
2	P1647	2	5703	22	663	E-ECU-192	PTO CRUISE DEC/SET SWITCH FAULT	 PTO cruise DEC frequency fault. PTO cruise DEC short circuit to ground (SC2G) fault. 										
	P1647	11	1 5703	20	664	E-ECU-193	PTO CRUISE DEC/SET SWITCH FAULT	 PTO cruise DEC frequency fault. PTO cruise DEC short circuit to ground (SC2G) fault. 										
CABI	P1648	3 1	5704	1	665	E-ECU-194	PTO CRUISE INC/RESUME SWITCH FAULT	 PTO cruise inc frequency fault. PTO cruise inc short circuit to ground (SC2G) fault. 										
z	P1648	3 2	5704	22	666	E-ECU-195	PTO CRUISE INC/RESUME SWITCH FAULT	 PTO cruise inc frequency fault. PTO cruise inc short circuit to ground (SC2G) fault. 										
	P1648	3 11	1 5704	20	667	E-ECU-196	PTO CRUISE INC/RESUME SWITCH FAULT	 PTO cruise inc frequency fault. PTO cruise inc short circuit to ground (SC2G) fault. 										
IND	P1650) 11	1 5712	20	613	E-ECU-197	CHECK ENGINE LAMP SC2G FAULT	 Check engine lamp driver general fault. Check engine lamp driver SC2G (short circuit to ground) fault. Check engine lamp driver SC2V (short circuit to battery voltage) fault. Check engine lamp driver OC (open circuit) fault. 										
EX	P1650) 12	2 5712	21	614	E-ECU-198	CHECK ENGINE LAMP SC2VBATT FAULT	 Check engine lamp driver general fault. Check engine lamp driver SC2G (short circuit to ground) fault. Check engine lamp driver SC2V (short circuit to battery voltage) fault. Check engine lamp driver OC (open circuit) fault. 										

	,	FAUL	тсо	DE							ACTION		
DTC CO	DE	J193	39		CLUSTER	FAULT NAME	DESCRIPTION	CEL"ON"	DELAYED ENGINE	CCRT (DPF) REGEN DISABLE	INCRE-ASED	DISABLE	LIMP
нмв	LB	SPN	FMI	CODE	CODE				STOP (20s)	OR STOP	(1300 rpm)	EACH INJECTOR	(1400
P1650	00	5712	1	611	E-ECU-199	CHECK ENGINE LAMP FAULT	 Check engine lamp driver general fault. Check engine lamp driver SC2G (short circuit to ground) fault. Check engine lamp driver SC2V (short circuit to battery voltage) fault. Check engine lamp driver OC (open circuit) fault. 						
P1650	13	5712	18	612	E-ECU-200	CHECK ENGINE LAMP OC FAULT	 Check engine lamp driver general fault. Check engine lamp driver SC2G (short circuit to ground) fault. Check engine lamp driver SC2V (short circuit to battery voltage) fault. Check engine lamp driver OC (open circuit) fault. 						
P1660	00	5728	26	883	E-ECU-201	ESM PULSE CHECK FAULT	1. ESM Pulse Check Fault.	0					
P1661	00	5729	26	884	E-ECU-202	ESM PULSE CHECK FAULT	1. ESM Pulse Check Fault.	0					
P1662	00	5730	1	681	E-ECU-203	ENGINE HOUR METER FAULT	1. Engine hour meter fault.						
P1662	03	5730	26	885	E-ECU-204	ESM LEVEL 3 FAULT	1. Engine hour meter fault.	0					
P1663	13	5731	18	682	E-ECU-205	ENGINE HOUR METER OC FAULT	1. Engine hour meter open circuit (OC).						
P1663	03	5731	26	886	E-ECU-206	ESM LEVEL 3 FAULT	1. Engine hour meter open circuit (OC).	0					
P1664	11	5732	20	683	E-ECU-207	ENGINE HOUR METER SC2G FAULT	1. Engine hour meter short circuit to ground (SC2G).						
P1665	12	5733	21	684	E-ECU-208	ENGINE HOUR METER SC2VBATT FAULT	1. Engine hour meter short circuit to battery voltage (SC2VBAT)						
P1666	00	5734	1	685	E-ECU-209	ENGINE SPEED GAUGE FAULT	1. Engine speed gauge fault.						
P1667	13	5735	18	686	E-ECU-210	ENGINE SPEED GAUGE OC FAULT	1. Engine speed gauge open circuit (OC) fault.						
P1668	11	5736	20	687	E-ECU-211	ENGINE SPEED GAUGE SC2G FAULT	1. Engine speed gauge SC2G (short circuit to ground) fault.						
P1669	12	5737	21	688	E-ECU-212	ENGINE SPEED GAUGE SC2VBATT FAULT	1. Engine speed gauge SC2V (short circuit to battery voltage) fault.						
P1690	03	5776	26	888	E-ECU-213	ESM LEVEL 3 FAULT	1. ESM Level 3 Fault.	0					
P1691	03	5777	26	889	E-ECU-214	ESM LEVEL 3 FAULT	1. ESM Level 3 Fault.	0					
P1692	03	5778	26	891	E-ECU-215	ESM LEVEL 3 FAULT	1. ESM Level 3 Fault.	0					
P16D2	00	5842	26	892	E-ECU-216	ESM TORQUE REDUCTION MONITORING FAULT	1. ESM torque reduction monitoring fault	0					
P16D6	00	5846	26	841	E-ECU-217	ESM ENGINE SPEED FAULT	1. ESM Engine Speed Fault.	0					
P16D8	00	5848	26	848	E-ECU-218	ESM PEDAL TRACK FAULT	1. ESM Pedal Track Fault.	0					
P2002	00	8194	28	581	E-ECU-219	DPF OVERLOAD FAULT	1. DPF overload fault.			0			
P2031	00	8241	1	571	E-ECU-220	DPF IN TEMP. SENSOR SIGNAL FAULT	1. DPF in temperature sensor fault.	0		0			
P2031	64	8241	22	575	E-ECU-221	DPF IN TEMP. SENSOR SIGNAL FAULT	1. DPF in temperature sensor fault.	0		0			
P2032	23	8242	20	573	E-ECU-222	DPF IN TEMP. SENSOR SC2G FAULT	1. DPF in temperature sensor count low.			0			
P2033	24	8243	18	572	E-ECU-223	DPF IN TEMP. SENSOR OC OR SC2VBATT FAULT	1. DPF in temperature sensor count high.			0			
P2081	00	8321	22	469	E-ECU-224	EXHAUST GAS TEMP. SENSOR SIGNAL FAULT	1. Exhaust manifold temperature sensor plausibility fault.	0					
P2100	13	8448	18	541	E-ECU-225	ACV DRIVER OC FAULT	1. ACV H-bridge driver open circuit fault.	0		0			
P2101	04	8449	4	545	E-ECU-226	ACV H-BRIDGE DRIVER FAULT	 ACV h-bridge driver over temperature fault. ACV h-bridge driver under voltage. 	0		0			
P2101	04	8449	2	544	E-ECU-227	ACV H-BRIDGE DRIVER FAULT	 ACV h-bridge driver over temperature fault. ACV h-bridge driver under voltage. 	0		0			
P2102	11	8450	20	542		ACV H-BRIDGE DRIVER FAULT	1. ACV H-Bridge driver short to ground fault.	0		0			
P2103	12	8451	21	543	E-ECU-228	E-ECU-229	ACV H-BRIDGE DRIVER FAULT	0		0			

		E	EGR Inducemen	t i	
P HOME)0 rpm)	TORQUE REDUCTION (2200 rpm)	EMISSION FAILURE LAMP "ON"	SPEED REDUCTION Warn : N/A Low Level: N/A Severe Level : 60%	TORQUE REDUCTION Warn : N/A Low Level: 25% Severe Level: 50%	SAFETY FIRST
					-
					ENGINE
					DRIVIN
					DRIVING & CHASSIS
					HASSIS
					HYD
					HYDRAULIC SYSTEM
					SYSTEM
					m
					ELECTRIC SYSTEM
	0				SYSTEM
					с/
					CABIN
					INDEX

	FA	AULT	CODE							ACTION					EGR Inducemen	it
DTC CODE		J1939 PN FN	LAMP CODE		FAULT NAME	DESCRIPTION	CEL"ON"	DELAYED ENGINE STOP (20s)	CCRT (DPF) REGEN DISABLE OR STOP	INCRE-ASED IDLE (1300 rpm)	DISABLE EACH INJECTOR	LIMP HOME (1400 rpm)	TORQUE REDUCTION (2200 rpm)	EMISSION FAILURE LAMP "ON"	SPEED REDUCTION Warn : N/A Low Level: N/A Severe Level: 60%	TORQUE REDUCTIC Warn : N/A Low Level: 29 Severe Level: 5
P2118 04	847	72 3	3 546	E-ECU-230	ACV H-BRIDGE DRIVER FAULT	 ACV driver circuit fault. ACV H-bridge driver current limited fault. ACV H-bridge driver current reduced fault. 	0		0							
P2118 04	847	72 3	3 547		ACV H-BRIDGE DRIVER FAULT	 ACV driver circuit fault. ACV H-bridge driver current limited fault. ACV H-bridge driver current reduced fault. 	0		0							
P2119 00	847	73 7	7 534	E-ECU-231	ACV CONTROL FAULT	1. ACV control fault.	0		0							
P2120 00	848	80 23	3 441	E-ECU-232	HAND PEDAL SIGNAL TRACK1 FAULT	1. Hand pedal signal track 1 fault.	0					0				
P2125 00	848	85 24	4 442	E-ECU-233	HAND PEDAL SIGNAL TRACK2 FAULT	1. Hand pedal signal track 2 fault.	0					0				
P2135 00	850	01 1	435	E-ECU-234	FOOT PEDAL CORRELATION FAULT	 Foot pedal signal fault set (triggers limp home mode). 2. 	0					0				
P2138 00	850	04 1	445	E-ECU-235	HAND PEDAL CORRELATION FAULT	 Hand pedal signal fault set (triggers limp home mode). . 	0					0				
P2228 23	8 874	44 5	5 813	E-ECU-236	ATMOSPHERIC SENSOR LOW FAULT	1. Atmospheric sensor low fault.	0									
P2229 24	874	45 6	812	E-ECU-237	ATMOSPHERIC SENSOR HIGH FAULT	1. Atmospheric sensor high fault.										
P2264 24	880	04 8	3 492	E-ECU-238	WATER IN FUEL SENSOR FEEDBACK FAULT	 Water in fuel sensor feedback signal Short to circuit to ground fault. Water in fuel sensor feedback signal Short to circuit to battery fault. Water in fuel sensor feedback signal Open circuit fault. 	0						0			
P2264 23	880	04 9	9 491	E-ECU-239	WATER IN FUEL SENSOR FEEDBACK FAULT	 Water in fuel sensor feedback signal Short to circuit to ground fault. Water in fuel sensor feedback signal Short to circuit to battery fault. Water in fuel sensor feedback signal Open circuit fault. 	0						0			
P2269 64	880	09 1	493	E-ECU-240	WATER IN FUEL SENSOR DETECT FAULT	1. Water in fuel sensor detected.						0				
P242F 00	926	63 2			DPF PLUGGED FAULT	1. DPF plugged fault.	0		0				O (1500 rpm)			
P2453 00	929	99 1	565	E-ECU-242	DPF DIFF.PRESS SENSOR PLAUSIBILITY FAULT	1. side, DP sensor tubes inverted).	0		0							
P2453 64	929	99 2	2 564	E-ECU-243	DPF DIFF.PRESS SENSOR PLAUSIBILITY FAULT	1. side, DP sensor tubes inverted).	0		0							
P2454 23	930	00 2	0 562	E-ECU-244	DPF DIFF. PRESS SENSOR SC2G FAULT	1.	0		0							
P2455 24	930	01 1	8 561	E-ECU-245	DPF DIFF. PRESS SENSOR OC OR SC2VBATT FAULT	1.	0		0							
P246B 00	932	23 1	653	E-ECU-246	DPF REGENERATION SWITCH FAULT	1. DPF regeneration switch fault.	0									
P2485 00	934	49 2	9 563	E-ECU-247	DPF DIFF. PRESS LEAK FAULT	1.	0		0							
P2BC0 0	1120	200 0) 777	E-ECU-248	SCR INDUCEMENT_WARNING1 FAULT	 SCR Inducement State is Warning 1 Error. DEF Level Error. DEF Quality Error . DEF Dosing Failure Dosing Failure. EGR & SCR System Failure. CAN Failure" 										
P2BC1 0	1120	201 0) 778	E-ECU-249	SCR INDUCEMENT_WARNING2 FAULT	 SCR Inducement State is Warning 2 Error. DEF Level Error. DEF Quality Error . DEF Dosing Failure Dosing Failure. EGR & SCR System Failure. CAN Failure" 										

EIY HRSI

ENGINE

NG & CHASS

INDEX

		FAU	JLT CO	DDE							ACTION				1	EGR Inducemen	t
ртс со		J19		CODE	CLUSTER CODE	FAULT NAME	DESCRIPTION	CEL"ON"	DELAYED ENGINE STOP (20s)	CCRT (DPF) REGEN DISABLE OR STOP	INCRE-ASED IDLE (1300 rpm)	DISABLE EACH INJECTOR	LIMP HOME (1400 rpm)	TORQUE REDUCTION (2200 rpm)	EMISSION FAILURE LAMP "ON"	SPEED REDUCTION Warn : N/A Low Level: N/A	TORQUE REDUCTION Warn : N/A Low Level: 25%
НМВ	LB	SPN	FMI								(Severe Level : 60%	Severe Level : 50%
P2BC2	0	11202	0	779	E-ECU-250	SCR INDUCEMENT_WARNING3(LOW) FAULT	 SCR Inducement State is Warning 3 Error. DEF Level Error. DEF Quality Error . DEF Dosing Failure Dosing Failure. EGR & SCR System Failure. CAN Failure" 										
P2BC3	0	11203	0	780		E-ECU-251	SCR INDUCEMENT_WARNING4(SEVERE) FAULT										
P027F	0	639	0	942	E-ECU-252	CAN TIMEOUT FAULT	1. Loss Of Can Communication From DCU										
P027F	1	639	0	942		CAN TIMEOUT FAULT	1. Loss Of Can Communication From DCU										
P0003	7B	94	8	351	-	IMV CONTROL FAULT 2	 IMV driver short circuit to ground (sc2g) fault is detected. Rail pressure control feedback is too low. 	0									
P0004	7B	94	9	352	-	IMV CONTROL FAULT 1	 IMV driver signal short circuit to battery (sc2vbatt) fault is detected. Rail pressure control feedback is too high. 	0						0			
P0088	01	521015	5 31	357	-	RAIL PRESSURE OVER TIME FAULT	 Rail pressure control error during IMV control (over max calibrated system pressure). 	0									
P018F	00	521516	6 31	358	-	PRESSURE LIMIT VALVE OPEN FAULT	1. PLV(Pressure Limit Valve) Open Fault.	0			0			0			
P1219	01	16383	1	947	-	VDG RPM FAULT											

8.2.3 FAULT DIAGNOSIS CODE DESCRIPTION

CHECK DEVICE

CHECK POINT	REMARK
1. CHECK DTC CODE	1. Read diagnostic trouble code.
2. DEVICE HARDWARE CHECK	1. Visually check device hardware.
3. CHECK VEXT (Supply Voltage) Fault	 Disconnect sensor one by one checking if disappear to find which one is faulty. (Problem with one of the sensors causing loss of supply voltage) If none is found faulty, check short circuit or isolation of Vext lines of harness.
4. CHECK DEVICE CONNECTION	1. Pin to Pin check (Device Connector, ECU Connector, Wire Harness) (*) See the Attached Wire Harness Drawing

RELAY

CHECK POINT	REMARK
1. RELAY CHECK	 Relay shortage check. Pin to Pin Check (Sensor Connector, ECU Connector, Wire Harness) (*) See the Attached Wire Harness Drawings.

SWITCH

CHECK POINT	REMARK
1. SWITCH CHECK	 Check 12V supply from the battery. Pin to Pin Check (Sensor Connector, ECU Connector, Wire Harness) (*) See the Attached Wire Harness Drawings.
2. REPLACE THE SWITCH	1. Replace the switch.

ECU

CHECK POINT	REMARK
1. CHECK DTC CODE	 Read diagnostic trouble code. If other fault is present, first check corresponding fault.
2. ECU HARDWARE CHECK	1. Visually check ECU pins.
3. ECU CONNECTOR / WIRE HARNESS CHECK	 Pin to Pin Check. (Sensor Connector, ECU Connector, Wire Harness) Check electrical isolation.
4. CHECK GROUND CONNECTION OF VEHICLE CHASSIS	1. Check ground connection of vehicle chassis

ECU R&R

CHECK POINT	REMARK
1. ECU CONNECTOR / WIRE HARNESS CHECK	1. Pin to Pin Check. (Sensor Connector, ECU Connector, Wire Harness)
2. CHANGE THE ECU	 Change the ECU. When you change the ECU, you should follow scan tool's ECU change rules.(Current ECU has much engine information, so this information should be carried on new ECU by scan tool.)

2-226

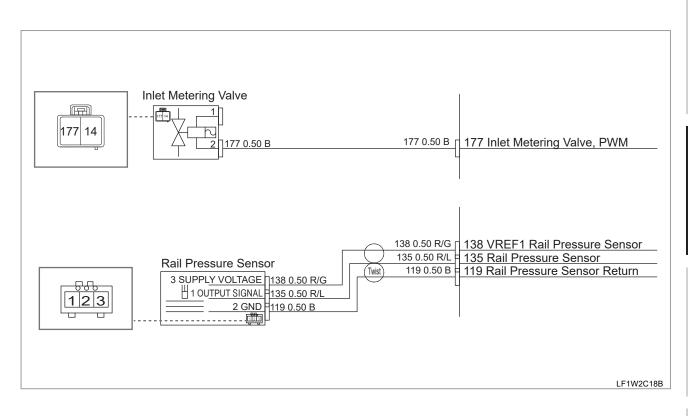
ECU DATA ERROR

CHECK POINT	REMARK
1. CHECK DTC CODE	 Read diagnostic trouble code. If other fault is present, first check corresponding fault.
2. ECU HARDWARE CHECK	1. Visually check ECU pins.
3. ECU CONNECTOR / WIRE HARNESS CHECK	 Pin to Pin Check. (Sensor Connector, ECU Connector, Wire Harness) Check electrical isolation.
4. CHECK GROUND CONNECTION OF VEHICLE CHASSIS	1. Check ground connection of vehicle chassis
5. REPROGRAM ECU SOFTWARE & REWRITE C3I CODE TRY TO FILTER MANUAL REGENERATION	 Reprogram ECU software. Rewrite Injector Code (C3I) Code. (20 Letters) (Please take care of injector position.) Try to filter manual regeneration. Move the vehicle to safety zone Lock the brake Warm engine (coolant over 60° C). Do Manual regeneration: Push the Manual regeneration switch during 2 sec. Or, do Manual regeneration using scan tool. It would take about 25min. After regeneration successful, fault would not be raised.
6. REPLACE ECU	1. If above no.5 is not available, replace the ECU.

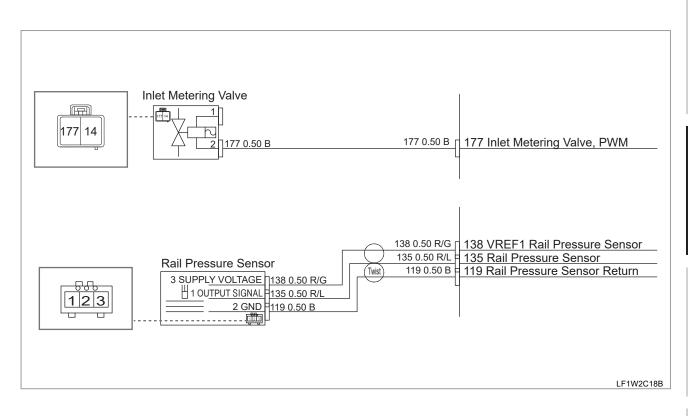
ENGINE

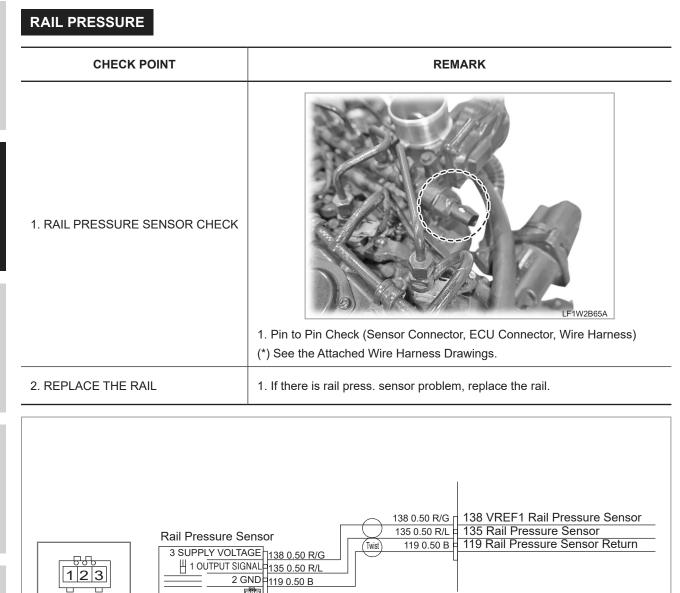
HIGH PRESSURE DIAGNOSTIC

CHECK POINT	REMARK
1. CHECK DTC CODE	 Read diagnostic code (DTC) in the scan tool . Find out which problem; IMV, HP pump, Rail press sensor.
2. FUEL, AIR AND CIRCUIT CHECK	 Check the enough fuel pressure pump. Check leak on the high pressure pump. Check diesel fuel of the correct quality and type.
3. RAIL PRESSURE CHECK	 (1) Fuel temp. sensor (2) IMV (Inlet Metering Valve) (3) IMV connector 1. Compare with rail pressure demand and feedback. 2. If there's no rail press, replace IMV (Inlet Metering Valve). 3. If there is hunting, replace IMV connector (contact failure).
4. BACKLEAK TEST	 Do Back Leak Test, if available. If back leak is above limit, replace corresponding injector.
5. IMV BUZZING TEST	 Do IMV Buzzing test using scan tool. If there is resistance problem, replace the IMV.



CHECK POINT	REMARK
1. IMV CONNECTOR/WARE HARNESS CHECK	 1. Pin to Pin Check (Sensor Connector, ECU Connector, Wire Harness) 2. Check electrical isolation. (*) See the Attached Wire Harness Drawings.
2. MEASURE IMV ELECTRICAL RESISTANCE	1. Check IMV electrical resistance. (Around 5.3Ω at 20° C) 2. If there is resistance problem, replace the IMV.
3. RAIL PRESSURE CHECK	 (1) Fuel temp. sensor (2) IMV (Inlet Metering Valve) (3) IMV connecto 1. Compare with rail pressure demand and feedback. 2. If there's no rail press, replace IMV (Inlet Metering Valve). 3. If there is hunting, replace IMV connector (contact failure).
4. IMV BUZZING TEST	 Do IMV Buzzing test using scan tool. If there is resistance problem, replace the IMV.





696 123

123

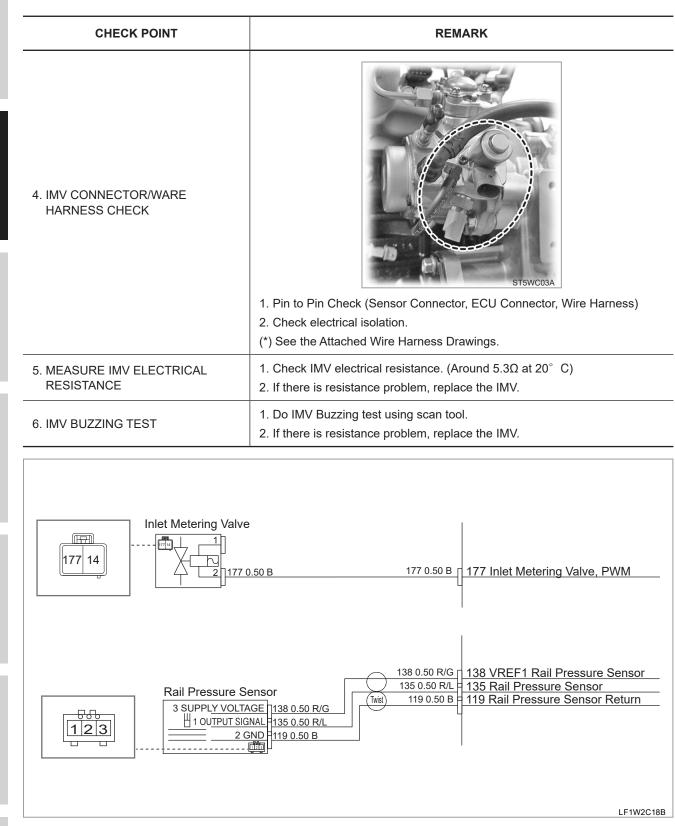
LF1W2C19B

	REMARK	ETY FIRST
1. RAIL PRESSURE CHECK		ENGINE
	 (1) Fuel temp. sensor (2) IMV (Inlet Metering Valve) (3) IMV connector 1. Compare with rail pressure demand and feedback. 2. If there's no rail press, replace IMV (Inlet Metering Valve). 3. If there is hunting, replace IMV connector (contact failure). 	DRIVING & CHASSIS
2. RAIL PRESSURE SENSOR CHECK		HYDRAULIC SYSTEM
	1. Pin to Pin Check (Sensor Connector, ECU Connector, Wire Harness) (*) See the Attached Wire Harness Drawings.	ELECTRIC SYSTEM

1. If there is rail press. sensor problem, replace the rail.

RAIL EXCESSIVE PRESURE

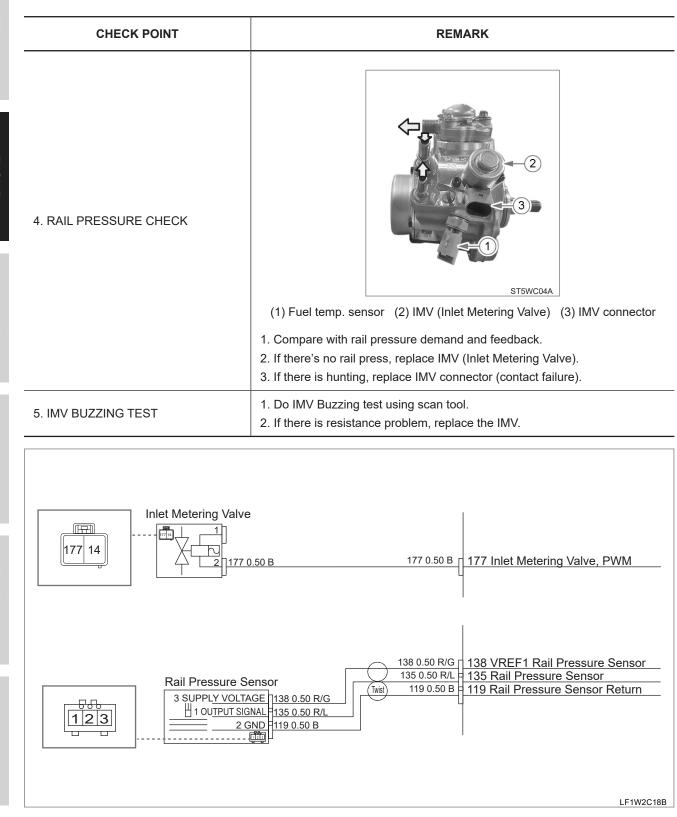
3. REPLACE THE RAIL



NDEX

RAIL PRESSURE CONTROL ERROR

CHECK POINT	REMARK
1. FUEL, AIR AND CIRCUIT CHECK	 1. Check the fuel feed circuit is in good condition. 2. Check diesel is in the system 3. Check the enough fuel pressure in the inlet pump. 5. Check leak on the high pressure pump.
2. IMV CONNECTOR/WARE HARNESS CHECK	 6. Check diesel fuel of the correct quality and type. 6. Check diesel fuel of the correct quality and type. 1. Pin to Pin Check (Sensor Connector, ECU Connector, Wire Harness) 2. Check electrical isolation. (*) See the Attached Wire Harness Drawings.
3. MEASURE IMV ELECTRICAL RESISTANCE	1. Check IMV electrical resistance. (Around 5.3 Ω at 20° C) 2. If there is resistance problem, replace the IMV.



NDEX

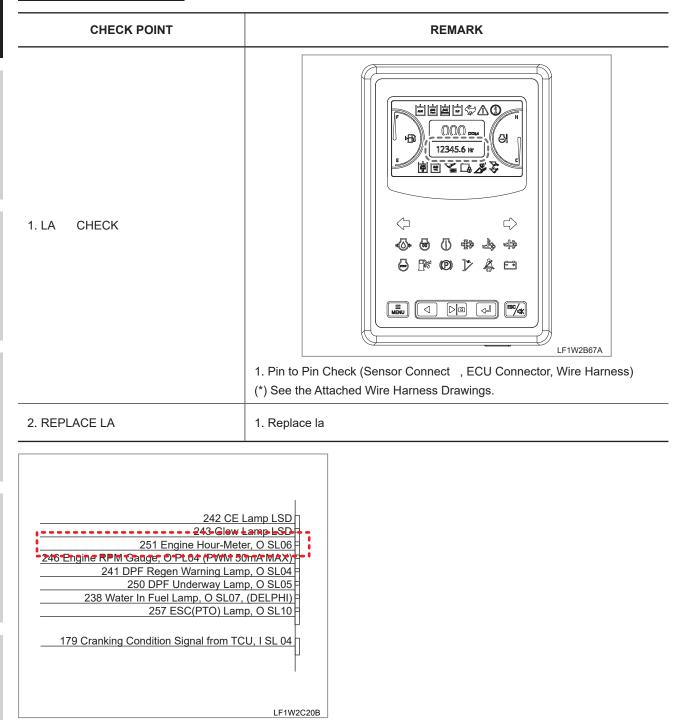
RAIL PRESSURE CALIBRATION

CHECK POINT	REMARK
1. POOR DETECTION	 This fault could be caused by pushing vehicle while engine is off. (Poor detection) Clear the fault.
2. SENSOR / WIRE HARNESS CHECK	1. Pin to Pin Check (Sensor Connector, ECU Connector, Wire Harness) (*) See the Attached Wire Harness Drawings.
	GE 138 0.50 R 119 0.50 BR 119 Rail Pressure Sensor Return NAL 135 0.50 W 119 0.50 BR 119 0.50 BR

SENSOR

CHECK POINT	REMARK
1. SENSOR CHECK	1. Pin to Pin Check (Sensor Connect , ECU Connector, Wire Harness)
2. REPLACE THE SENSOR	1. Replace the sensor.

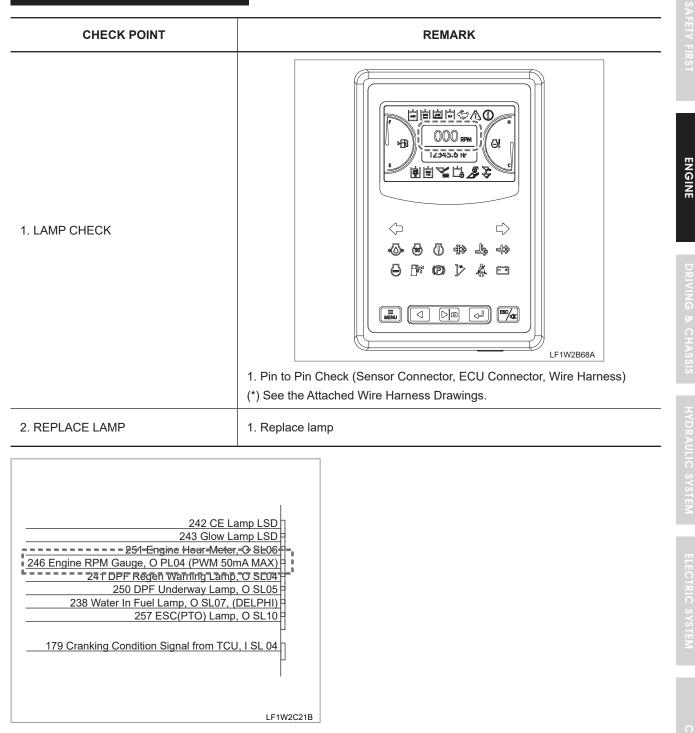
ENGINE HOUR METER

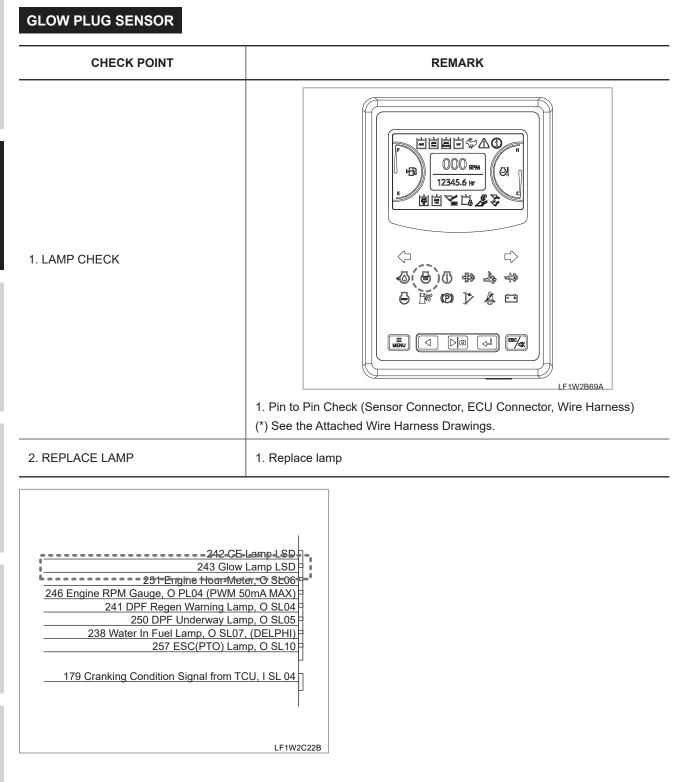


ENGINE

NDEX

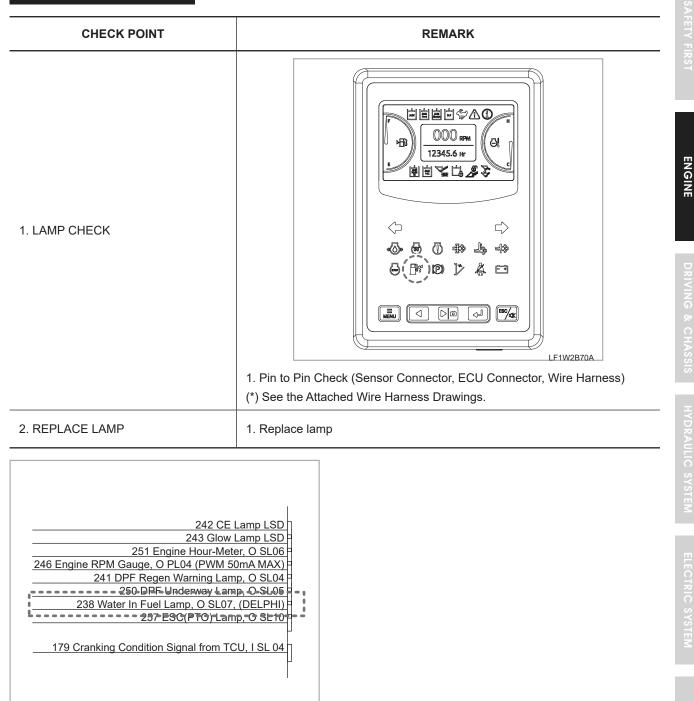
ENGINE SPEED GAUGE SENSOR



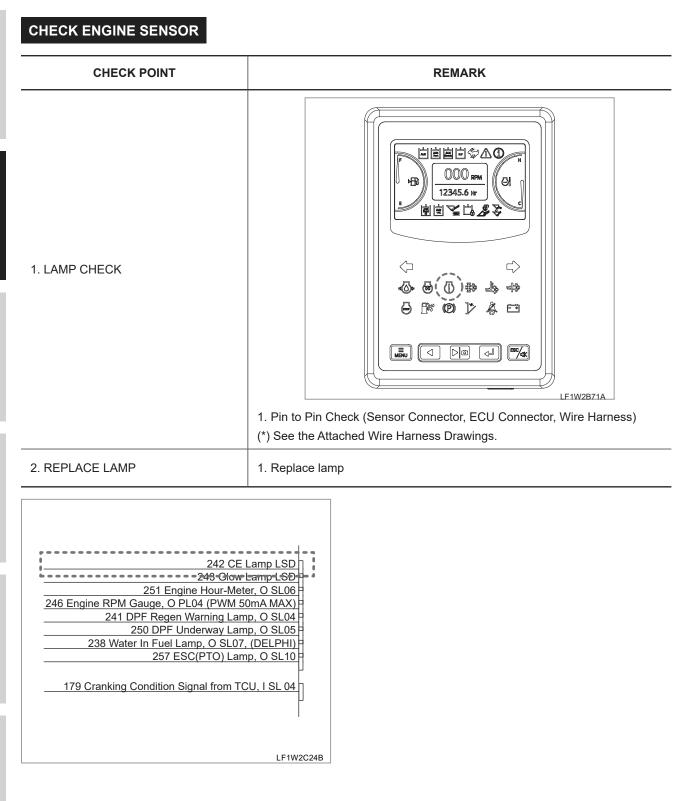


IDEX

WATER IN FUEL SENSOR

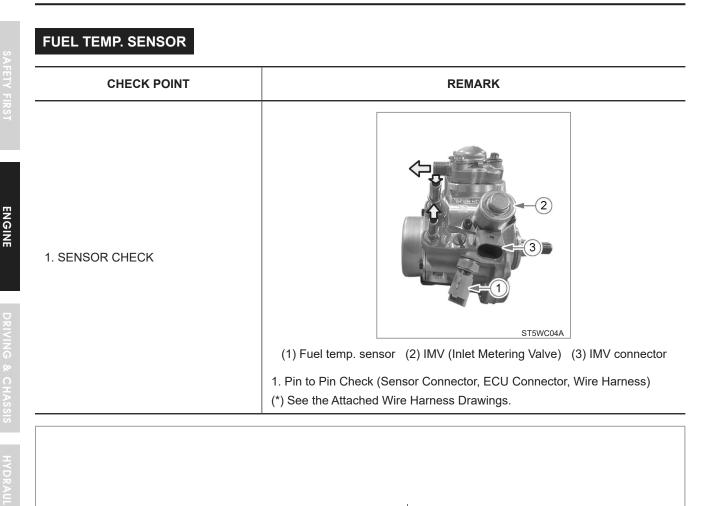


LF1W2C23B



ENGINE OIL SENSOR

CHECK POINT	REMARK
1. SENSOR CHECK	1. Pin to Pin Check (Sensor Connector, ECU Connector, Wire Harness) (*) See the Attached Wire Harness Drawings.
2. REPLACE THE SENSOR	1. Replace the sensor.
3. LOW OIL PRESSURE COMMON CHECK	1. See the workshop manual; TROUBLE SHOOTING
111 Oil Pressure S	tensor 100A 0.50 W/R No group of the same same same same same same same sam



110 0.50 G/R

146 0.50 B

110 Fuel Temperature Sensor

146 Sensor Return GND

Fuel Temperature Sensor

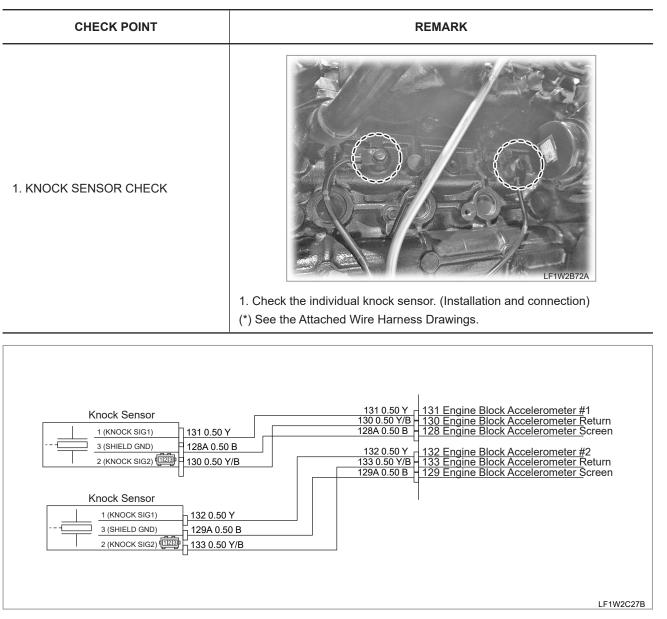
1 2

1 110 0.50 G/R

146 0.50 B

LF1W2C26B

KNOCK SENSOR



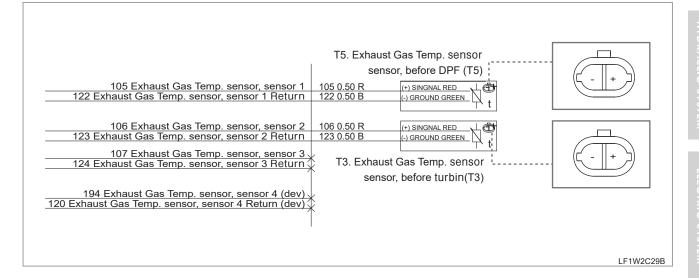
INTAKE MANIFOLD / TEMP. & PRESSURE SENSOR

CHECK POINT	REMARK
1. SENSOR CHECK	1. Pin to Pin Check (Sensor Connector, ECU Connector, Wire Harness) (*) See the Attached Wire Harness Drawings.
2. REPLACE THE SENSOR	1. Replace the sensor.

			ТМА	.P. T-MAP SE	INSOR
112 INTAKE MANIFOLD PRESSURE SENSOR	112 0.50 R/G		112 0.50 R/G	4. Pressure	
141 VREF2, INPRES	141 0.50 R/B	<u>1</u>	141 0.50 R/B	3. +5V	
134 INTAKE TEMPERATURE SENSOR	134 0.50 Y/R		134 0.50 Y/R	2. NTC	
168 INTAKE TEMPERATURE SENSOR RETURN	168 0.50 B		168 0.50 B	1. GND	
		E	ι.		<u>-</u>
					LF1W2C28B

EXHAUST MANIFOLD SENSOR

CHECK POINT	REMARK
1. CHECK SENSOR	1. Pin to Pin Check (Sensor Connector, ECU Connector, Wire Harness) (*) See the Attached Wire Harness Drawings.
2. REPLACE THE SENSOR	1. Replace the sensor.



ENGINE

CHECK POINT	REMARK	
I. CHECK SENSOR CONNECTION	Image: Constraint of the second of the se	
2. CRANK SENSOR CONNECTOR / WIRE HARNESS CHECK	 Pin to Pin Check (Sensor Connector, ECU Connector, Wire Harness) Check electrical isolation. (*) See the Attached Wire Harness Drawings. 	
3. CHECK CAM AND CRANK SIGNAL	1. Signal is unstable or strange, change the sensor.	
4. CHECK TARGET WHEEL	 Visually check the wheel damage. Check installation position of the wheel. If problem is still present, fit new crank position sensor wheel. 	

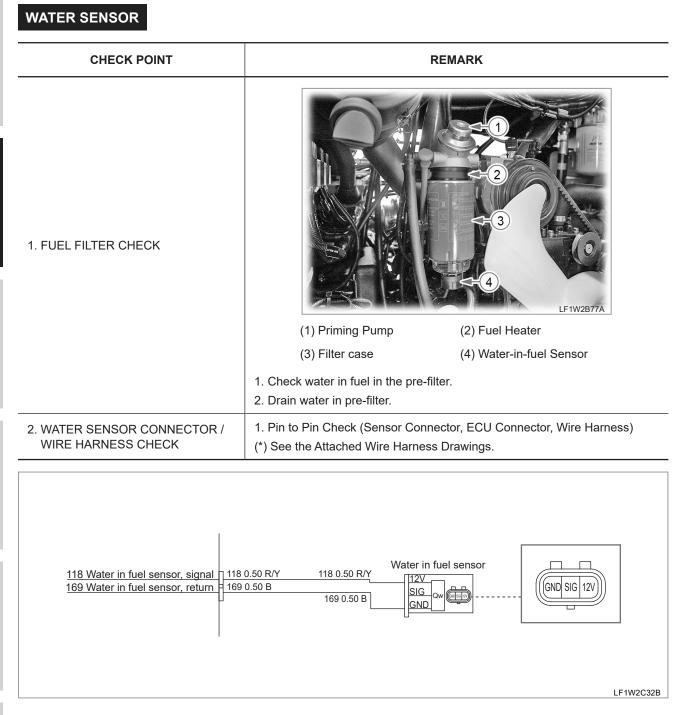


Crank Sensor 139 0.50 R/Y 139 0.50 R/Y 139 VREF1 Crank Sensor (2010.01.28 change) UU CRANK BOUTPUT (GREEN) 160 0.50 R/B 160 0.50 R/B 160 Crank Sensor Signal HALL CCOMMON (BLACK) 171 0.50 B (Wist) 171 0.50 B 171 Crank Sensor Return
--

LF1W2C30B

CAM SENSOR

CHECK POINT	REMARK
1. CHECK SENSOR CONNECTION	
1. CHECK SENSOR CONNECTION	 Pin to Pin Check (Sensor Connector, ECU Connector, Wire Harness) Check electrical isolation. (*) See the Attached Wire Harness Drawings.
3. CHECK CAM AND CRANK SIGNAL	 If scope is available, display the CAM and Crank signal. Signal is unstable or strange, change the sensor.
4. CHECK TARGET WHEEL	 1. Visually check the wheel damage. 2. Check installation position of the wheel. 3. If problem is still present, fit new crank position sensor wheel. Output Output Output <p< td=""></p<>
CAM Shaft Sensor	43 0.50 Y/R 159 0.50 R/Y 159 CAM Shaft Position Sensor 0.50 R/Y 147 0.50 B 147 CAM Shaft Position Sensor Return 0.50 B LF1W2C31B



GMW-0035

GLOW PLUG

HARNESS CHECK (1) Glow plug (2) Injector 1. Pin to Pin Check (Sensor Connector, ECU Connector, Wire Harness) (*) See the Attached Wire Harness Drawings. 1. Do the glow plug test using scan tool.	CHECK POINT	REMARK
1. Pin to Pin Check (Sensor Connector, ECU Connector, Wire Harness) (*) See the Attached Wire Harness Drawings. 2. GLOW PLUG WORKING TEST 1. Do the glow plug test using scan tool.	1. GLOW PLUG CONNECTOR / WIRE HARNESS CHECK	Contraction of the second seco
2. GLOW PLUG WORKING LEST		1. Pin to Pin Check (Sensor Connector, ECU Connector, Wire Harness)
	2. GLOW PLUG WORKING TEST	

256 Glow plug Relay driver			
	256 Glow plug Relay driver] 256 0.50 B (256)
			LF1W2C33B

OPEN CIRCUIT INJECTOR

103 Fuel Injector HSDA 103 0.85 R/G 125 Fuel Injector LSD2A 125 0.85 B

151 Fuel Injector HSDB 151 0.85 R/L 175 Fuel Injector LSD1B 175 0.85 B

 150 Fuel Injector HSDB
 150 0.85 W/B

 174 Fuel Injector LSD2B
 174 0.85 B

CHECK POINT	REMARK	
1. INJECTOR BUZZING TEST	 Do injector buzzing test. Listen buzzing sound. 	
2. INJECTOR CONNECTION AND WIREHARNESS CHECK	<image/> <image/>	
3. RESISTANCE CHECK	 It should be less than 1Ω If resistance is incorrect, replace the injector. 	
4. CONNECTION CHECK	 Swap the connection between 2 injectors. If the same problem still presents, replace the injector. Do not forget to write new individual injector code (C3I) using scan tool. 	

151 0.85 R/L Twist 175 0.85 B

150 0.85 W/B Twist 174 0.85 B

STwist

127 126

150 174

No.1 cylinder (C1)

No.2 cylinder (C2)

No.3 cylinder (C3)

No.4 cylinder (C4)

No.1 cylinder (C1)

-

No.2 cylinder (C3)

No.3 cylinder (C4)

LF1W2C34B

SHORT CIRCUIT INJECTOR

CHECK POINT	REMARK	
1. INJECTOR BUZZING TEST	 Do buzzing test using scan tool. Listen buzzing sound. 	
2. INJECTOR CONNECTION CHECK	 Key off and check the injector connection. Disconnect the injector. If fault disappeared, replace the injector. Do not forget to write new individual injector code (C3I) using scan tool. 	
3. CHECK INTEMEDIATE CONNECTOR	 Disconnect the intermediate connector. If fault disappeared, replace the intermediate connector. 	
4. SHORT CIRCUIT CHECK BEFORE INJECTOR	 Pin to Pin Check (Injector Connector, ECU Connector, Wire Harness) Check electrical isolation. (*) See the Attached Wire Harness Drawings. 	

127 Fuel Injector HSDA	127 0.85 R/B Twist 126 0.85 BHZ			
126 Fuel Injector LSD1A 126 0.85 B		PIN NO.	4 CYL ENG	3 CYL ENG
103 Fuel Injector HSDA 103 0.85 R/G 125 Fuel Injector LSD2A 125 0.85 B	103 0.85 R/G Twist 125 0.85 B TY Injector C2	127 126	No.1 cylinder (C1)	No.1 cylinder (C1)
	□	103 125	No.2 cylinder (C2)	-
151 Fuel Injector HSDB 151 0.85 R/L 175 Fuel Injector LSD1B 175 0.85 B	151 0.85 R/L Twist 175 0.85 B	151 175	No.3 cylinder (C3)	No.2 cylinder (C3)
		150 174	No.4 cylinder (C4)	No.3 cylinder (C4)
150 Fuel Injector HSDB 150 0.85 W/B 174 Fuel Injector LSD2B 174 0.85 B	150 0.85 W/B Twist 174 0.85 B Twist 174 0.85 B Twist 174 0.85 B		I	

AFETY FIRST

LF1W2C34B



CXI

CHECK POINT	REMARK
1. REWRITE C3I CODE	 1. Rewrite Injector Code (C3I) Code. (20 Letters) 2. Please take care of injector position.
2. CHECK POWER RELAY OPERATION	1. Check power relay operation
3. INJECTOR CONNECTOR / WIRE HARNESS CHECK	 Pin to Pin Check (Sensor Connector, ECU Connector, Wire Harness) Check electrical isolation. (*) See the Attached Wire Harness Drawings.

127 Fuel Injector HSDA 126 Fuel Injector LSD1A		127 0.85 R/B STwist 126 0.85 B 日子 Injector C1			
μ	1		PIN NO.	4 CYL ENG	3 CYL ENG
103 Fuel Injector HSDA 125 Fuel Injector LSD2A		103 0.85 R/G Twist 125 0.85 B TY Injector C2	127 126	No.1 cylinder (C1)	No.1 cylinder (C1)
· · · · ·			103 125	No.2 cylinder (C2)	-
		151 0.85 R/L Twist 175 0.85 B	151 175	No.3 cylinder (C3)	No.2 cylinder (C3)
⊔ 150 Fuel Injector HSDB] 150 0.85 W/B		150 174	No.4 cylinder (C4)	No.3 cylinder (C4)
		Twist 174 0.85 B STwist 174 0.85 B Injector C4			

LF1W2C34B

INJECTOR BALANCING

 Read diagnostic code (DTC) in the scan tool. Rewrite injector code (C3I)
2. Rewrite injector code (C3I)
<image/>
1. Read diagnostic code (DTC) in the scan tool.
127 0.85 R/B Injector Twist 126 0.85 B 103 0.85 R/G Injector 103 0.85 R/G 127
103 0.85 R/G Injector Twist 125 0.85 B 154 0.05 R/G Injector C2 154 0.05 R/G Injector C2 103 0.85 R/G Injector C2
131 USB K/L I Injector 151 No 3 cylinder (C3) No 2 cylinder (C3)
150 174 No.4 cylinder (C4) No.3 cylinder (C4)
150 0.85 W/B Injector Injector C4 131 0.50 Y 132 0.50 Y

Knock Sensor

1 (KNOCK SIG1) 3 (SHIELD GND)

132 0.50 Y

3 (SHIELD GND) 2 (KNOCK SIG2)

LF1W2C35B

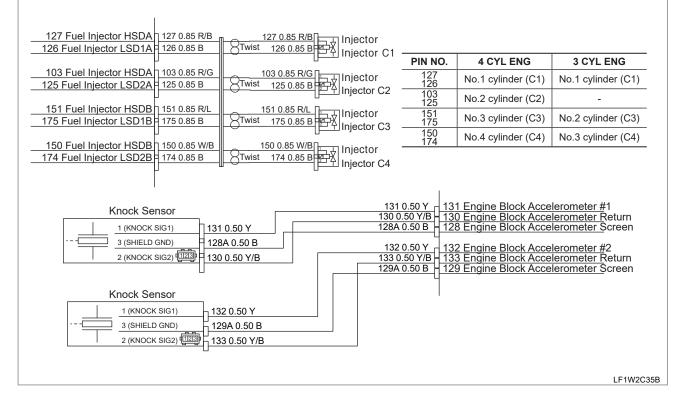
INJECTOR TRIM

CHECK POINT	REMARK
1. NEW SOFTWARE UPGRADE	1. New software upgrade
2. REWRITE INJECTOR CODE (C3I)	2. Rewrite injector code (C3I)
3. INDIVIDUAL INJECTOR CHECK	 Check the individual injector. 1. Check the individual injector. 2. Check the knock sensor for installation and connection. (*) See the Attached Wire Harness Drawings.
103 Fuel Injector HSDA 103 0.85 R/G 125 Fuel Injector LSD2A 125 0.85 B 151 Fuel Injector HSDB 151 0.85 R/L 175 Fuel Injector LSD1B 175 0.85 B 150 Fuel Injector HSDB 150 0.85 W/B	127 0.85 R/B Injector Injector C1 103 0.85 R/G Injector 103 0.85 R/G Injector 101 0.85 R/G Injector 101 0.85 R/G Injector 102 0.85 R/G Injector 1151 0.85 R/L Injector 1151 0.85 R/L Injector 1151 0.85 R/L Injector 1151 0.85 R/L Injector 151 0.85 R/L Injector 151 0.85 R/L Injector Injector 150 0.85 W/B 150 0.85 W/B Injector 150 0.85 W/B Injector Injector 150 0.85 W/B Injector 150 0.85 W/B Injector 150 0.85 W/B Injector 150 0.85 W/B Injector C4 150 0.85 W/B
Knock Sensor 1 (KNOCK SIG1) 3 (SHIELD GND) 2 (KNOCK SIG2) 130 0.50 Knock Sensor 131 0.50 128A 0.5 130 0.50 130 0.50 Knock Sensor 132 0.50 132 0.50 133 0.50	Y Y 131 0.50 Y 131 Engine Block Accelerometer #1 130 0.50 Y/B 130 Engine Block Accelerometer Return 128 Engine Block Accelerometer Screen 128 Engine Block Accelerometer #2 132 0.50 Y 133 0.50 Y/B 132 Engine Block Accelerometer #2 133 0.50 Y/B 133 0.50 B 132 Engine Block Accelerometer Screen 132 Engine Block Accelerometer Screen 132 Engine Block Accelerometer Screen 132 Engine Block Accelerometer Screen 132 Engine Block Accelerometer Screen 133 0.50 B

INDEX

CHECK POINT	REMARK	
1. CHECK DTC CODE	1. Read diagnostic code (DTC) in the scan tool.	
2. REWRITE INJECTOR CODE (C3I)	1. Rewrite injector code (C3I).	
3. INDIVIDUAL INJECTOR CHECK	 1. Check the individual injector. (Shut up test or Run up test using scan tool.) Image: A state of the s	
4. CHECK AIR CIRCUIT & AIR LEAK	1. Read diagnostic code (DTC) in the scan tool.	

CYLINDER COMBUSTION TOO LOW



ACV

o ACV Actuator test using scan tool. / position 20%, 80%, 5 times during 5 seconds)
Sate To
truesea teck ACV hardware problem.
n to Pin Check (Sensor Connector, ECU Connector, Wire Harness) neck electrical isolation. ee the Attached Wire Harness Drawings.
r

LF1W2C36B

BATTERY VOLTAGE

CHECK POINT	REMARK	
1. CHECK BATTERY VOLTAGE AT KEY-ON	LF1W2B81A	
	1. Check battery voltage key-on.	
2. BATTERY CONNECTOR / WIRE HARNESS CHECK	 Pin to Pin Check (Sensor Connector, ECU Connector, Wire Harness) Check resistance between vehicle chassis ground and ECU ground. (20m Ω) (*) See the Attached Wire Harness Drawings. 	
ECU_RELAY	201 2.00 R 201 Protected Battery 203 2.00 R 203 Protected Battery 205 2.00 R 205 Protected Battery	
Z216 5.0 B	202 2.00 B 202 Power Ground 204 2.00 B 204 Power Ground 206 2.00 B 206 Power Ground	
ECU_GND		

LF1W2C37B

ENGINE

EGR

CHECK POINT	REMARK
1. EGR ACTUATOR TEST	1. Do EGR Actuator test using scan tool. (EGR position 20%, 80%, 5 times during 5 seconds)
2. EGR HARDWARE CHECK	Image: constrained of the second of the se
3. EGR CONNECTOR / WIRE HARNESS CHECK	 Pin to Pin Check (Sensor Connector, ECU Connector, Wire Harness) Check electrical isolation. (*) See the Attached Wire Harness Drawings.
EGR Va	

<u>ן 193 0.85 W (wis</u>t

2 (DC-motor -)

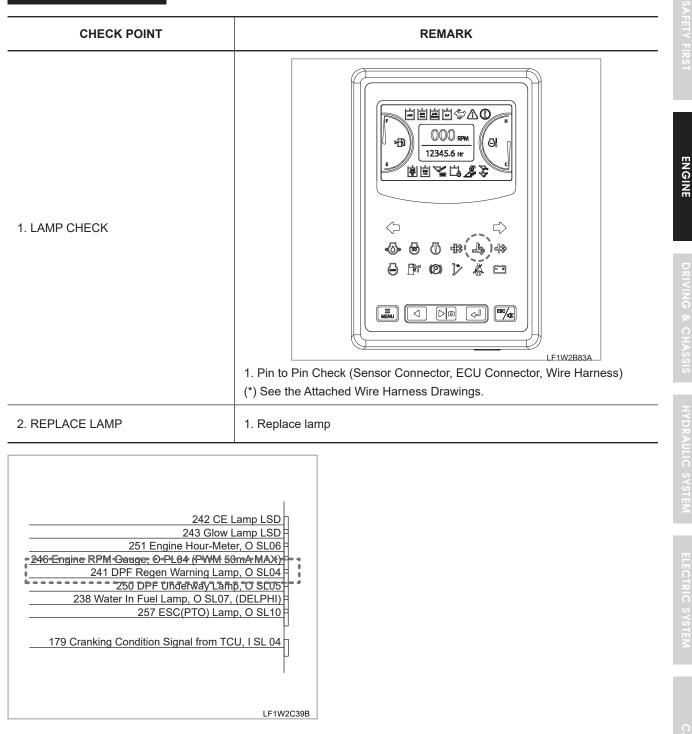
193 0.85 W [

193 EGR (H-Bridge Neg)

ENGINE

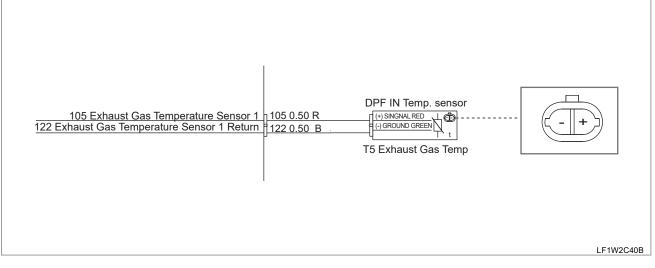
LF1W2C38B

DPF REGEN SENSOR



DPF TEMP. SENSOR

CHECK POINT	REMARK
1. SENSOR CHECK	1. Pin to Pin Check (Sensor Connector, ECU Connector, Wire Harness) (*) See the Attached Wire Harness Drawings.
2. REPLACE SENSOR	1. Replace sensor

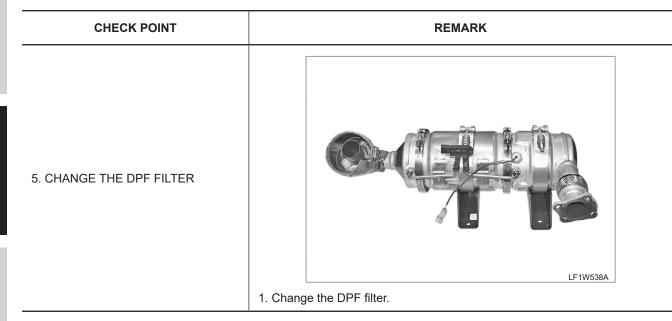


SAFETY FIRST

CHECK POINT	REMARK			
1. CHECK DTC CODE	1. Read diagnostic trouble code.			
2. LEAK FAULT DETECTED	1. Fix the leak on the exhaust system.(before DPF or DPF itself)			
3. CHECK OTHER FAULT	 First fix problem with other system.(It could have prevented regeneration of DPF causing this fault.) Pin to Pin Check (Sensor Connector, ECU Connector, Wire Harness) (*) See the Attached Wire Harness Drawings. 			
4. TRY TO FILTER MANUAL REGENERATION	 Move the vehicle to safety zone Lock the brake pedal (This should be done for Manual regeneration). Warm engine (coolant over 20° C). Do Manual regeneration: Push the Manual regeneration switch during 2 seconds. Or, do Manual regeneration using scan tool. It would take about 30 ~ 40min. After regeneration successful, fault would not be raised 			

GMW-0035

DPF



CHECK POINT	REMARK			
1. CHECK AIR INLET CIRCUIT	 1. Check air inlet leak in air intake system. (A) 2. If yes, repair it. 			
1. CHECK AIR INLET CIRCUIT	1. Read diagnostic trouble code.			
3. CHECK VEXT (Supply Voltage) Fault	 Disconnect sensor one by one checking if disappear to find which one is faulty. (Problem with one of the sensors causing loss of supply voltage) If none is found faulty, check short circuit or isolation of Vext lines of harness. 			
4. ECU CONNECTOR / WIRE HARNESS CHECK	 1. Pin to Pin Check (Sensor Connector, ECU Connector, Wire Harness) 2. Check electrical isolation. (*) See the Attached Wire Harness Drawings. 			

Inlet Manifold Temperature Sensor	215 0.50 W 221 0.50 B 221 0.50 B 221 AMF frequency. return
	LF1W2C41E

>

MEMO	 _	_	