1. Safety Regulations & Specifications

1.1. Safety Regulations

1.1.1. General notes

- Day-to-day use of power engines and the service products necessary for running them presents no problems if the persons occupied with their operation, maintenance and care are given suitable training and think as they work.
- This summary is a compilation of the most important regulations, These are broken down into main sections which contain the information necessary for preventing injury to persons, damage to property and pollution. In addition to these regulations those dictated by the type of engine and its site are to be observed also.

IMPORTANT:
If despite all precautions, an accident occurs, in particular through contact with caustic acids, fuel penetrating the skin, scalding from oil, antifreeze being splashed in the eyes etc, consult a doctor immediately.

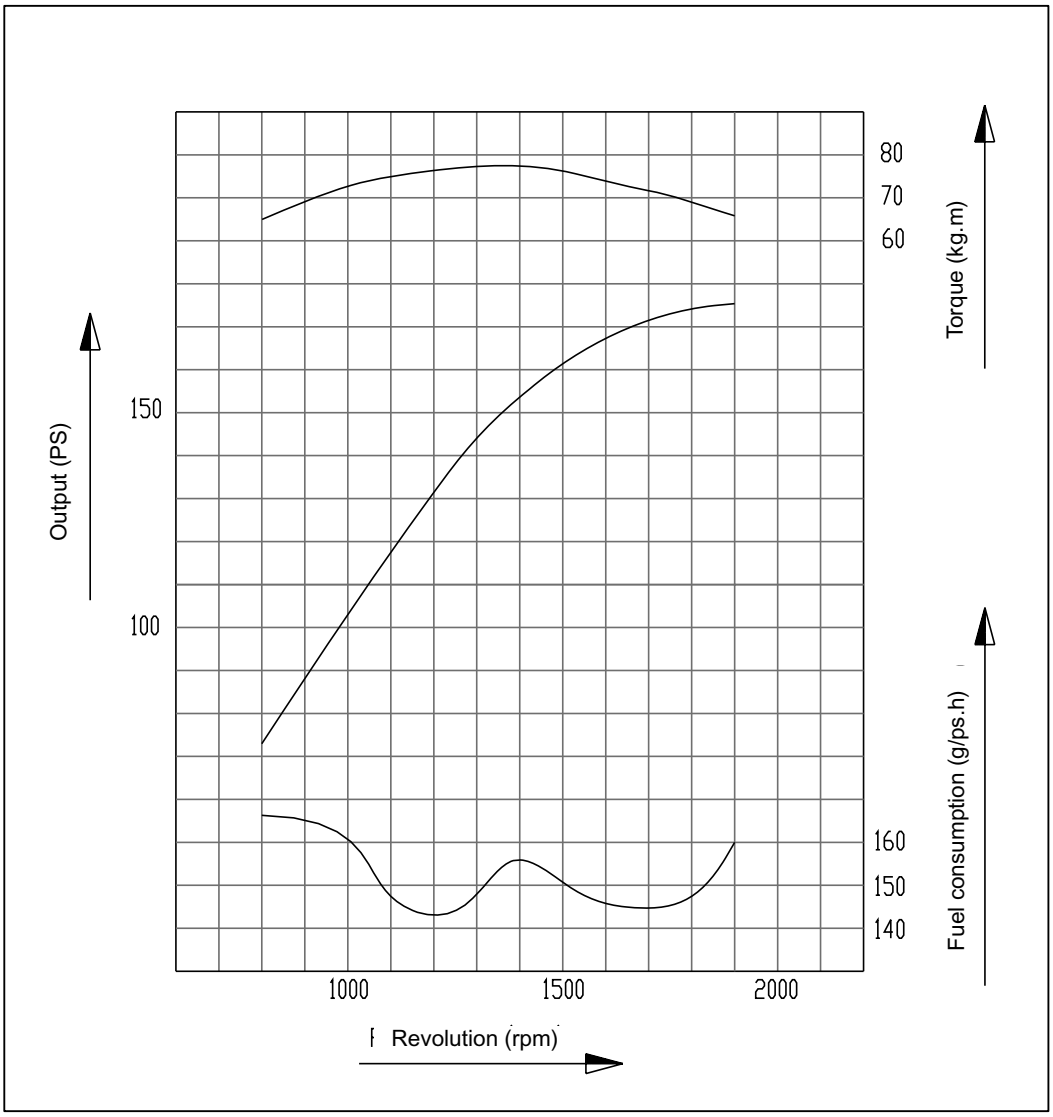
1.1.2. To prevent accidents with injury to persons

(1) Engine starting and operation

- Before putting the engine into operation for the first time, read the operating instructions carefully and familiarize yourself with the “critical” points. If you are unsure, ask your DOOSAN representative or service man.
- For reason of safety we recommend you attach a notice to the door of the engine room prohibiting the access of unauthorized persons and that you draw the attention of the operating personal to the fact that they are responsible for the safety of person who enter the engine room.
- The engine must be started and operated only by authorized personnel.
- Ensure that the engine cannot be started by unauthorized person.
- When the engine is running, do not get too close to the rotating parts.
- Do not touch the engine with bare hands when it is warm from operation risk of bums.
- Exhaust gases are toxic. If it is necessary to run an engine in an enclosed area, remove the exhaust gases from the area with an exhaust pipe extension.

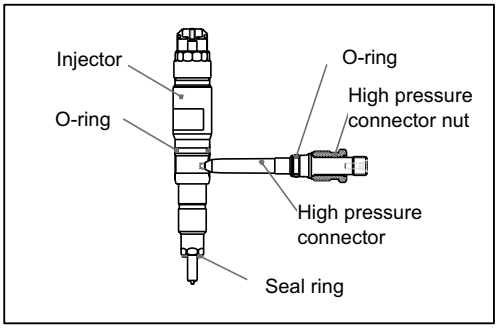
1.4. Engine Performance Curve

1.4.1. Performance curve (175 PS)



Performance		ISO 1585 (SAE J1349)
Output	(max.)	129 kW (175 PS) / 1,900 rpm
Torque	(max)	765 N.m (78 kg.m) / 1,400 rpm
Fuel consumption	(min.)	218 g/kW.h (160 g / PS.h)

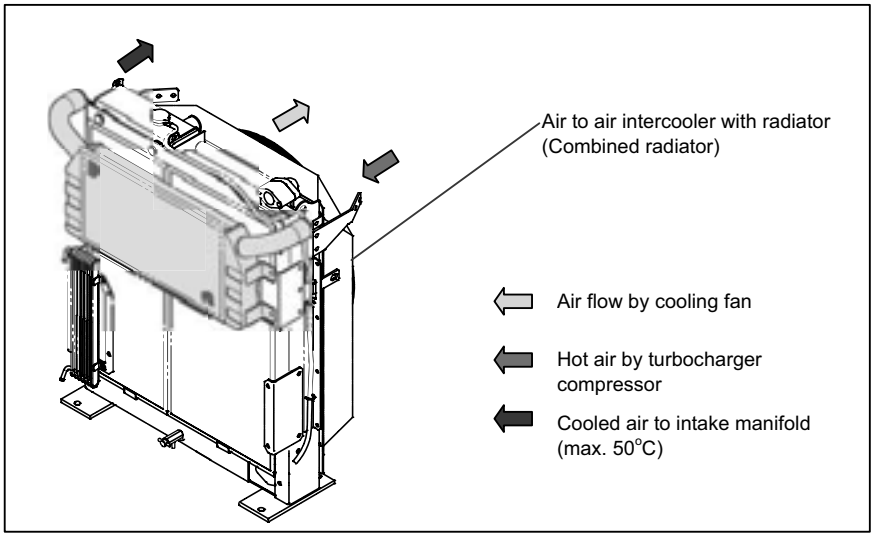
2.3.18. Injector & high pressure connector



- Be careful to mix the foreign matter into the injector and inside of the connector for connecting the high pressure at disassembly and check.
- O-ring and cupper washer should be changed with new one at reassembly.
- Assemble after coat the oil on the O-ring.
- Assemble after check serial number at replacement.
- Have to assemble according to assembly order refer to the chapter of the disassembly and reassembly.

2.3.19. Inter cooler

- The intercooler is air to air type and has a large cooling fan capacity. The intercooler life and performance depends on the intake air condition greatly.
- Fouled air pollutes and clogs the air fins of intercooler. As a result of this, the engine output is decreased and engine malfunction is occurred. So you always check whether the intake air systems like air filter element are worn or polluted.



Standard	Limit
0.05 mm	0.15 mm

3.2.5. Crankshaft

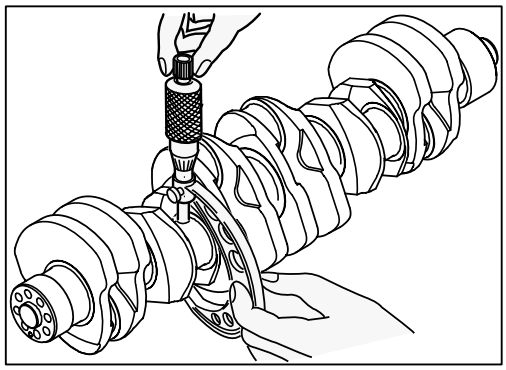
(1) Inspection of crankshaft

1) Defect check

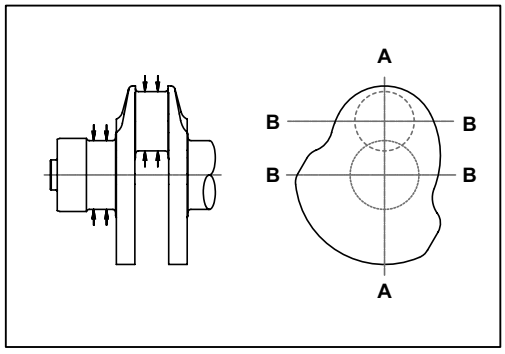
- By naked eyes, check for any scratch or damage on the crankshaft journal and crank pin.
- By means of magnetic particle test and color check, check the crankshaft for any crack and if found, replace it.

2) Wear measuring

- With an outside micrometer measure the diameter of the crankshaft journals and pins in the directions as shown, and compare the measured values to determine the amount of wear.



- If the amount of wear is beyond the limit, have the crankshaft ground and install undersize bearings. However, if the amount of wear is within the limit, you can correct the wear using an oil stone or oiled grinding paper of fine grain size. (Be sure to use grinding paper which has been immersed in oil.)



- Check the amount of backlash between gears using a feeler gauge.

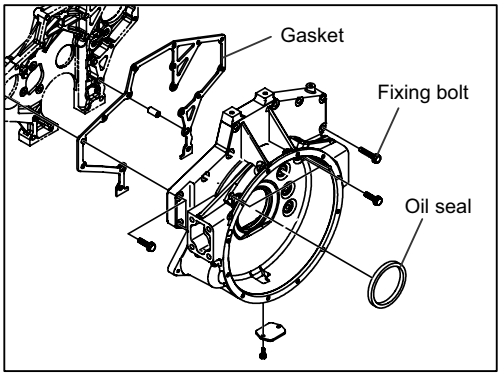
< Back lash >

Measuring position	Standard
Cam shaft gear & idle gear	0.074 ~ 0.163 mm
Fuel high pressure pump gear & idle gear	0.103 ~ 0.182 mm
Crankshaft gear & oil pump driving gear	0.073 ~ 0.239
Air compressor driving gear & cam gear	0.074 ~ 0.163

< End play >

Measuring position	Standard
Cam shaft gear	0.280 ~ 0.430 mm
Step idle gear	0.107 ~ 0.183 mm
Fuel high pressure pump idle gear	0.078 ~ 0.140 mm

3.3.9. Flywheel housing

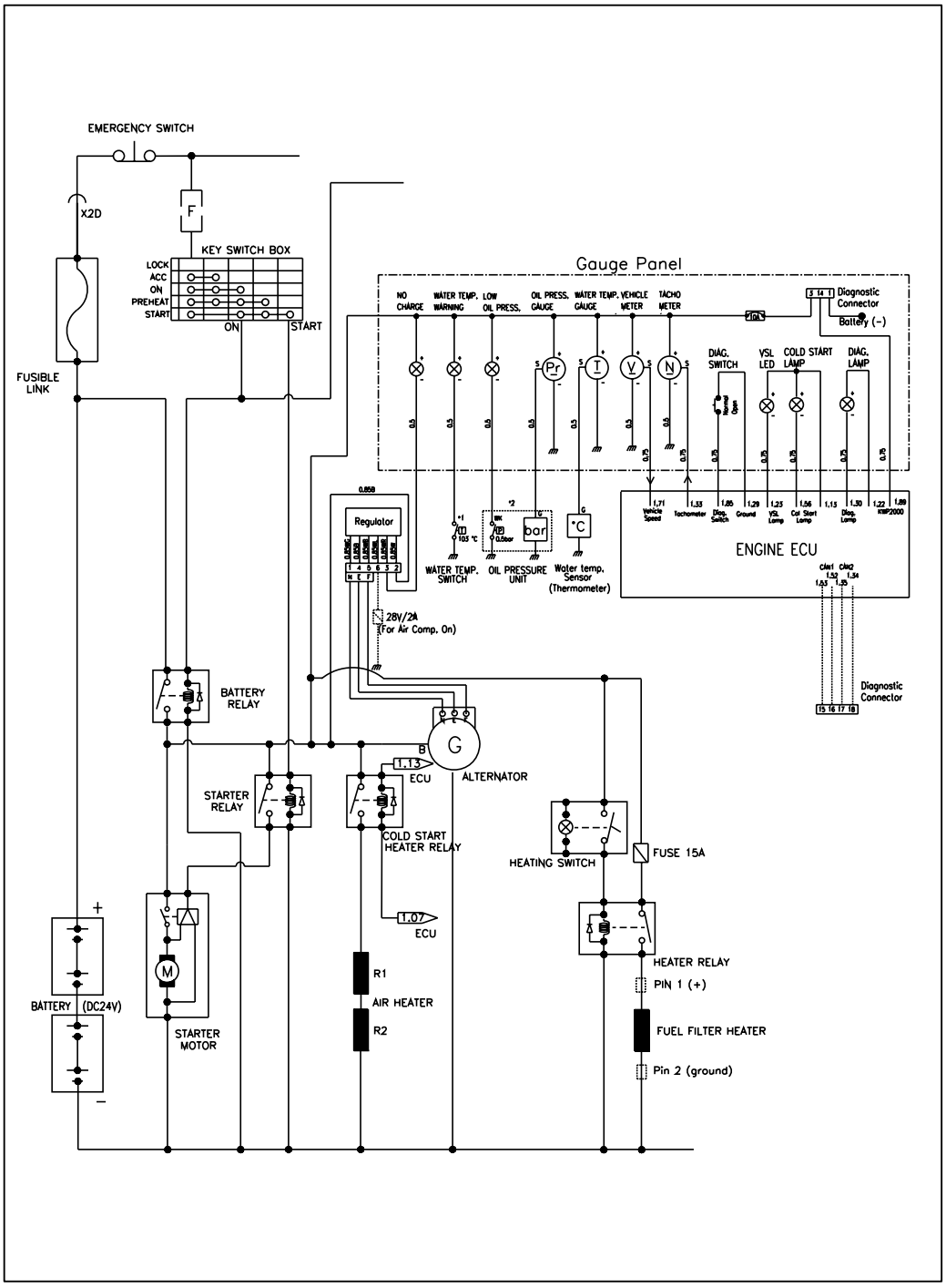


- Temporarily install the guide bar on the cylinder block.
- Apply gasket to the cylinder block.
- Using the dowel pin and guide bar, install the flywheel housing and tighten the fixing bolts in a diagonal sequence to specified torque. (Zigzag method)

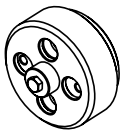
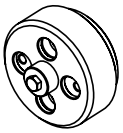
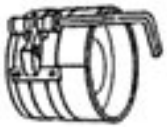
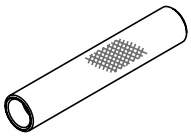
Torque	11.2 +1.0 kg.m

- When the bolts are tightened, remove the guide bar.
- Apply lubricating oil to the inside, outside of the oil seal and insert it to the flywheel housing using a press.

b) Harness of electrical control unit (B)

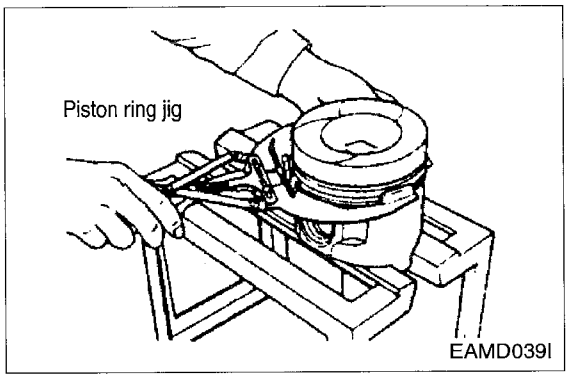


6. Special Tool List

No	Part no.	Figure	Tool name	Remark
1	EF.121-299		Oil seal insert assembly (Front)	
2	EF.121-300		Oil seal insert assembly jig (Rear)	
3	EF.123-065		Valve spring compression	
4	EF.123-365A		Cylinder liner puller	
5	EF.121-250		Piston insert	Only DL06 engine
	EF.120-208			All engine
6	EF.121-253		Valve stem seal punch	

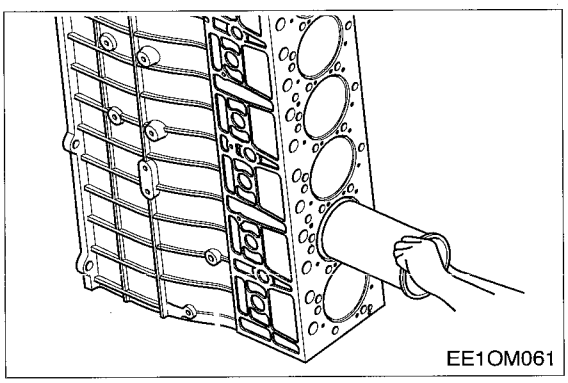
(3) Remove the piston ring with a pliers.

(4) Clean the piston thoroughly.



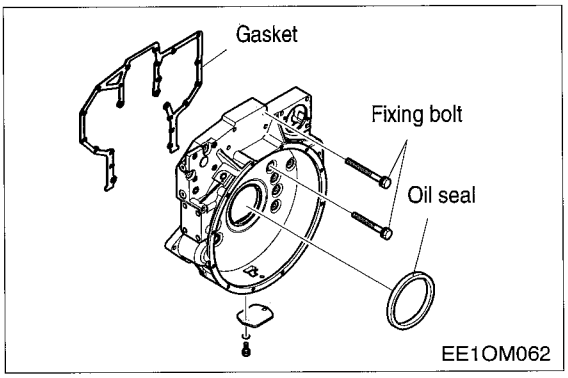
3.1.35. Cylinder liner

- Be careful not to generate any damage at cylinder block.
- Disassemble the cylinder liner with a special tool or hand.



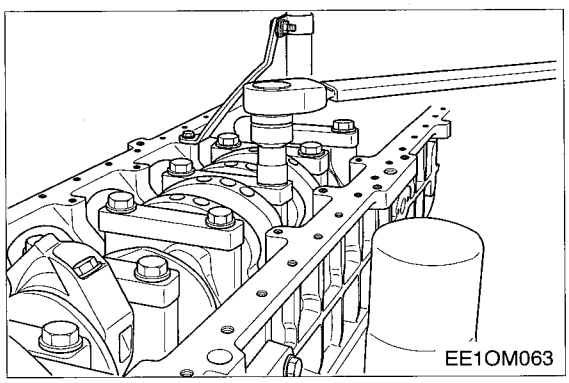
3.1.36. Flywheel housing

- Remove the flywheel housing fixing bolts and disassemble the flywheel housing.
- Disassemble the oil seal of flywheel housing.



3.1.37. Bearing cap

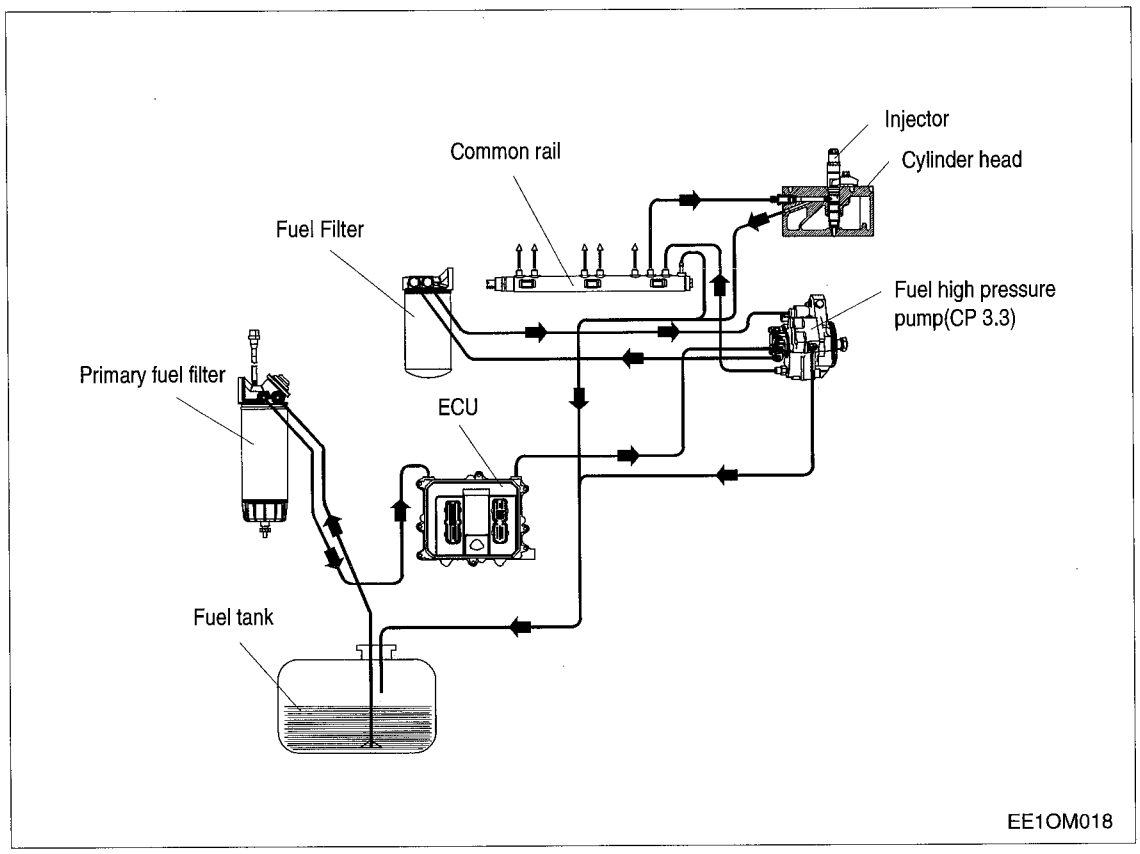
- Remove the bearing cap assembling bolts by the step in the reverse order of assembling, and disassemble the bearing cap. (Remove by the same way as the cylinder head bolts' removal.)
- Disassembled bearing caps are kept laid in order.



3.4. Fuel Injection System

3.4.1. Common rail fuel-injection system

- Pressure generation and fuel injection are completely decoupled from each other in the common rail injection system. The electric control unit(ECU) determine the fuel quantity, injection timing, and injection pressure in order to show the optimum performance on the condition for operation of the engine, then inject the fuel in the cylinder.
- The fuel is stored under pressure in the common rail ready for injection. The injected fuel quantity is defined by the driver, and the start of injection and injection pressure are calculated by the ECU on the basis of the stored map. The ECU then triggers the solenoid valves that the injector at each engine cylinder injects accordingly.



3.4.2. Major components of the common rail system

1) Electric control unit(ECU)
2) Crankshaft speed sensor
3) Camshaft speed sensor
4) Accelerator pedal sensor (Only loader)
5) Fuel temperature sensor
6) Boost pressure and temperature sensor
7) Common rail pressure sensor
8) Coolant temperature sensor
9) Oil pressure and temperature sensor

Fault code	Contents of trouble	Lamp	Condition of occurring
E048	Power supplying source is abnormal	N	Battery voltage is abnormal : ECU, battery and alternator is abnormal
E049	Supplying voltage of injector (#1,5,3) is abnormal	B	* Injector cable / connector is abnormal or ECU is trouble
E051	Supplying voltage of injector (#6,2,4) is abnormal	B	
E058	Relation to connecting of injector #1 harness is abnormal	B	* Injector cable / connector is abnormal
E059	Relation to connecting of injector #5 harness is abnormal	B	
E061	Relation to connecting of injector #3 harness is abnormal	B	
E062	Relation to connecting of injector #6 harness is abnormal	B	
E063	Relation to connecting of injector #2 harness is abnormal	B	
E064	Relation to connecting of injector #4 harness is abnormal	B	
E066	Relation to air heater lamp is abnormal	N	Lamp / harness is abnormal
E072	Air heater operation relay is abnormal	C	Air heater relay / harness is abnormal
E083	Relation to high pressure pump control is abnormal	C	Fuel metering unit of high pressure pump / harness is abnormal
E091	Abnormal starting	B	Starting procedure is abnormal, ECU is abnormal, power supplying is abnormal
E092	Ignition of #1 cylinder is not good c	C	*Injector is abnormal, compression pressure is a drop, camshaft / crankshaft speed sensor signal is abnormal
E093	Ignition of #5 cylinder is not good	C	
E094	Ignition of #3 cylinder is not good	C	
E095	Ignition of #6 cylinder is not good	C	
E096	Ignition of #2 cylinder is not good	C	
E097	Ignition of #4 cylinder is not good	C	
E098	Ignition of several cylinder is not good	C	
E099	Injector is opened too long	C	Opening time of injector is excessive from standard values

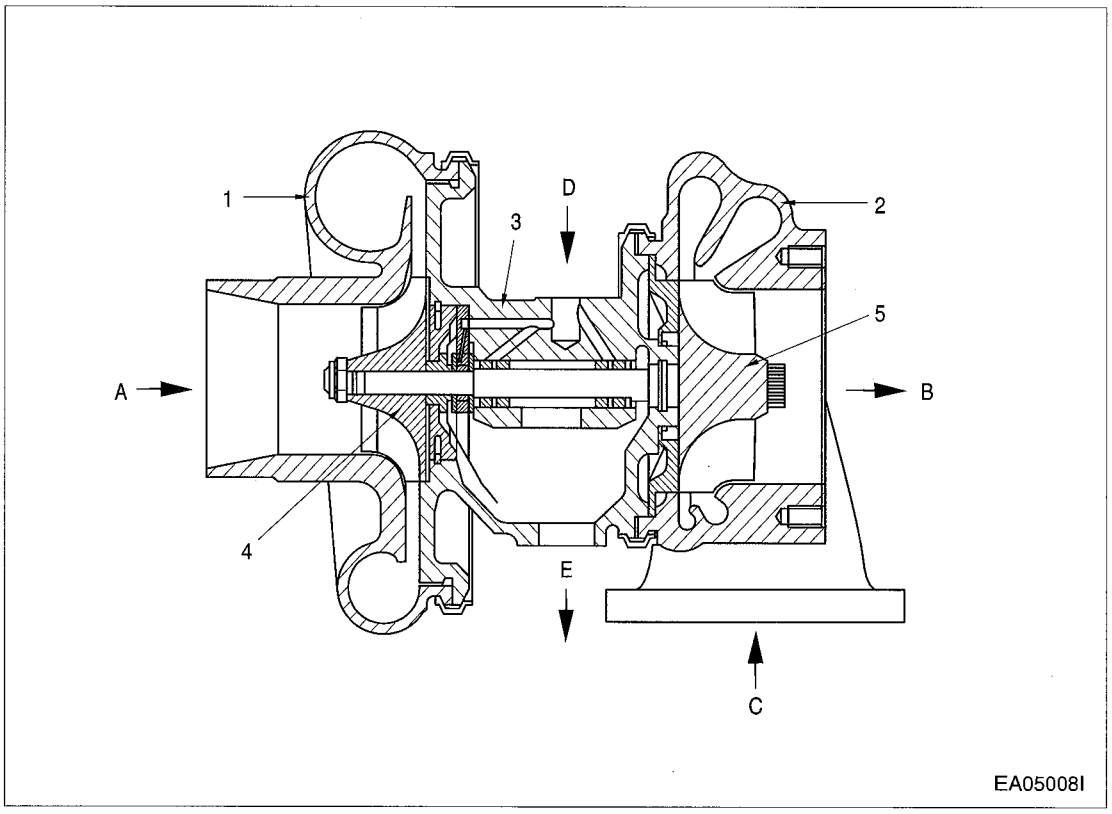
5.3. Turbo Charger

5.3.1. Specification and construction

1) Main data and specification

Specification		DL08
Model		Holset HX40W
At maximum output	Air pressure at compressor outlet	Approx.1.93 kgr/cm^2
	Air suction of turbine revolution	Approx.16.5 m^3/min
	Speed of turbine revolution	Approx. 98,000 rpm
Maximum allowable speed		130,000 rpm
Maximum allowable temperature of exhaust gas at turbine inlet		750°C
Lubricating system		External oil supply
Weight		Approx.9.5 kg

2) Construction



1. Impeller casing
2. Turbine casing
3. Bearing casing
4. Impeller
5. Turbine

A. Air inlet
B. Gas outlet
C. Gas inlet
D. Oil supply
E. Oil return

- Take into account the amount of oil in the sump. Use a vessel of sufficient size to ensure that the oil will not overflow.
- If change or refill the cooling water, disassemble the drain plug when the engine has cooled down. Heated cooling water has the risk of scalding and safety accidents.
- Neither tighten up nor open pipes and hoses (lube oil circuit, coolant circuit and any additional hydraulic oil circuit) during the operation. The fluids which flow out can cause injury.
- Fuel is inflammable. Do not smoke or use naked lights in its vicinity. The tank must be filled only when the engine is switched off.
- Keep service products (anti-freeze) only in containers which can not be confused with drinks containers.
- Comply with the manufacturer's instructions when handling batteries.

CAUTION:

Accumulator acid is toxic and caustic. Battery gases are explosive.

Therefore it should be done by an expert of the handling professionally.

3) When carrying out checking, setting and repair work

- Checking, setting and repair work must be carried out by authorized personnel only.
- Use only tools which are in satisfactory condition. Slip caused by the worn open-end wrench could lead to injury.
- When the engine is hanging on a crane, no-one must be allowed to stand or pass under it. Keep lifting gear in good condition.
- When do electric weld, stop the engine, power off, then remove the wire harness' connector which is connected to the ECU.
- Do not weld the electric control unit (ECU) absolutely, and do not damage on it by electrical or mechanical shock.
- When working on the electrical system disconnect the battery earth cable first. Connect it up again last in prevent short circuits.

• Amount of Anti-freeze in winter

Ambient Temperature (°C)	Cooling water (%)	Anti-freeze (%)
Over -10	85	15
-10	80	20
-15	73	27
-20	67	33
-25	60	40
-30	56	44
-40	50	50

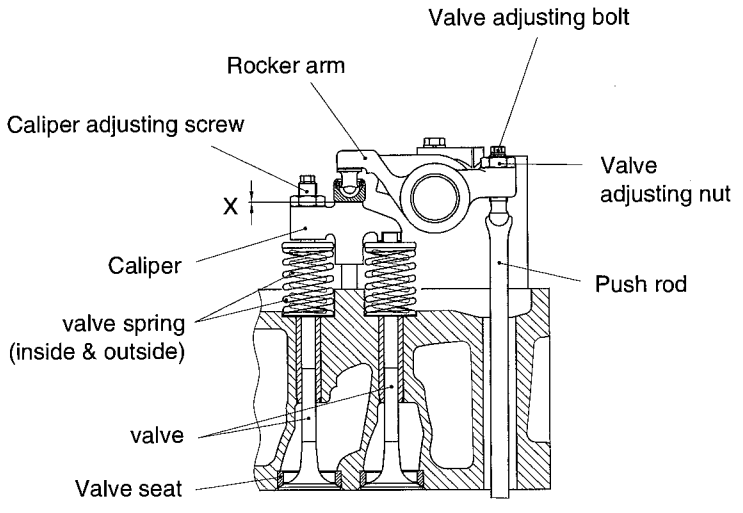
2.3.24. Valve clearance adjust procedure

• After letting the #1 cylinder's piston come at the compression top dead center by turning the crankshaft, adjust the valve clearances.

• Loosen the lock nuts of rocker arm adjusting screws and push the feeler gauge of specified value between a rocker arm and a valve stem and adjust the clearance with adjusting screw respectively and then tighten with the lock nut.

• As for the valve clearance, adjust it when in cold, as follows.

Engine model	Valve clearance (X)	
	Intake valve	Exhaust valve
DL08	0.3 mm	0.4 mm



Intake & Exhaust valve adjusting

FG000857

(3) Tappet and push rod

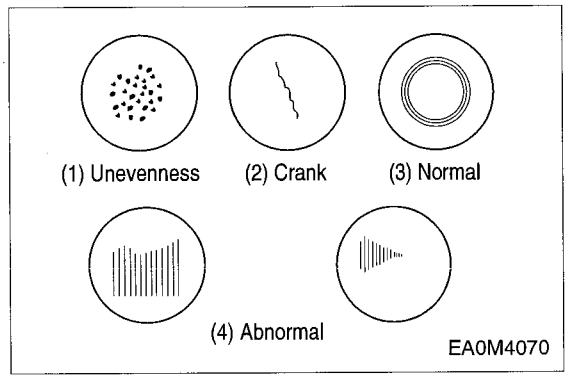
• Clearance

Measure the clearance of the tappet and tappet holes of the cylinder block. If the value is beyond the specified limit, replace tappets.

Standard	Limit
0.035 ~ 0.077 mm	0.13 mm

• Visual check of tappet

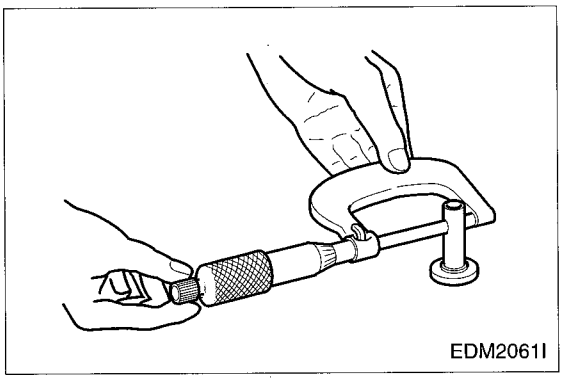
Visually check the face of the tappets in contact with the cam for pitting, scores or cracks, and replace if severely damaged.
If the amount of cracks or pitting is small, correct with an oil stone or grinding paper.



• Outside diameter of tappet

With an outside micrometer, measure the tappet outside diameter if the measured value is beyond the limit, replace tappets.

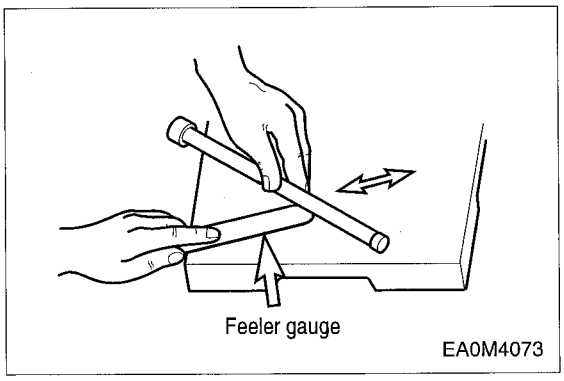
Standard	φ19.944 ~ φ19.965 mm



• Push rod run-out

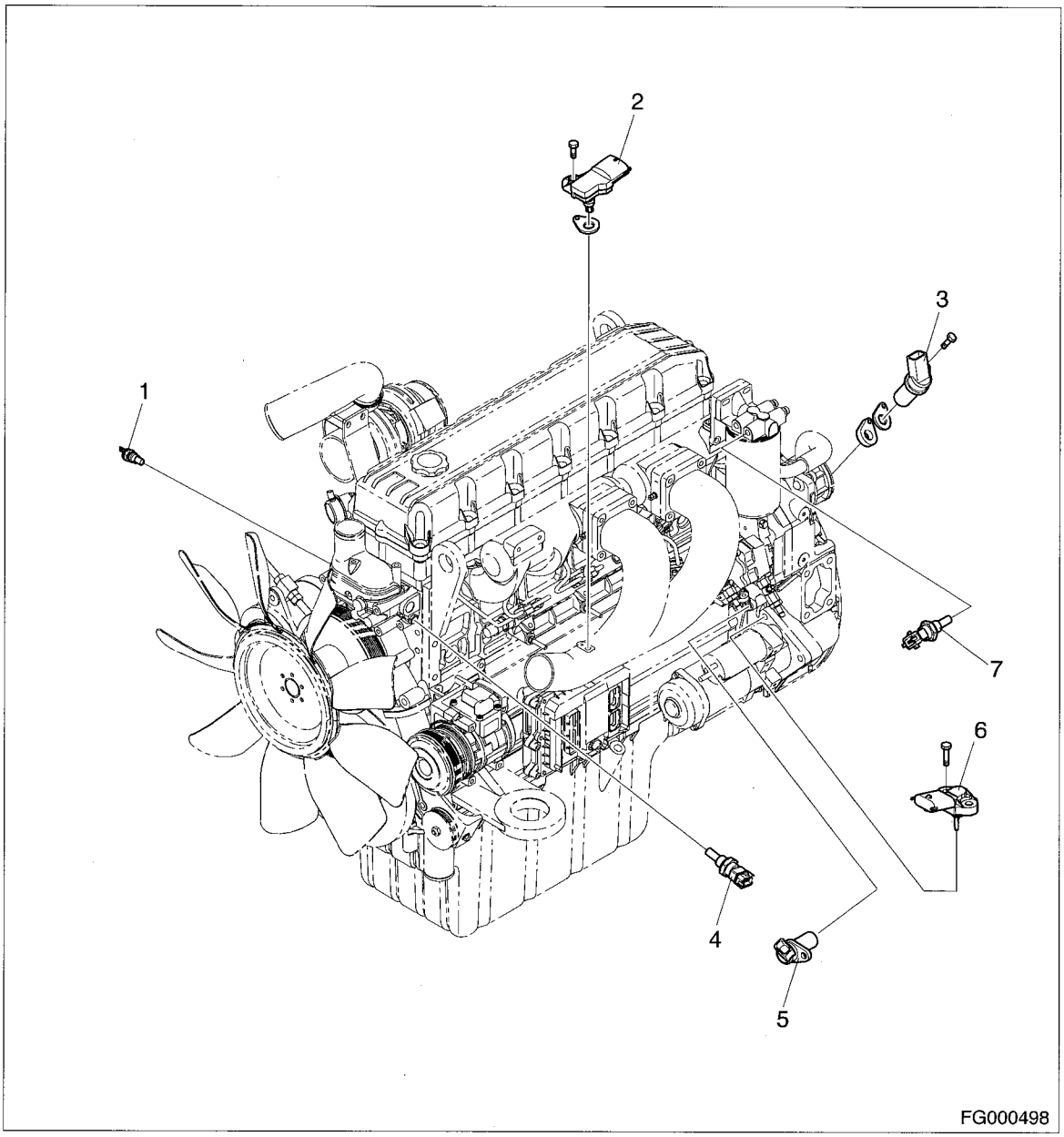
Use a feeler gauge to measure the push rod run-out.
Roll the push rod along a smooth flat surface as shown in the figure.

Limit	0.3 mm or less
Push rod length	327.5 mm



3.5. Electrical System

3.5.1. Electrical parts



1	Coolant temperature sensor (for gauge unit) - Only loader
2	Boost pressure & temperature sensor
3	Crankshaft speed sensor
4	Coolant temperature sensor
5	Camshaft speed sensor
6	Engine oil pressure & temperature sensor
7	Fuel temperature sensor