CONTENTS

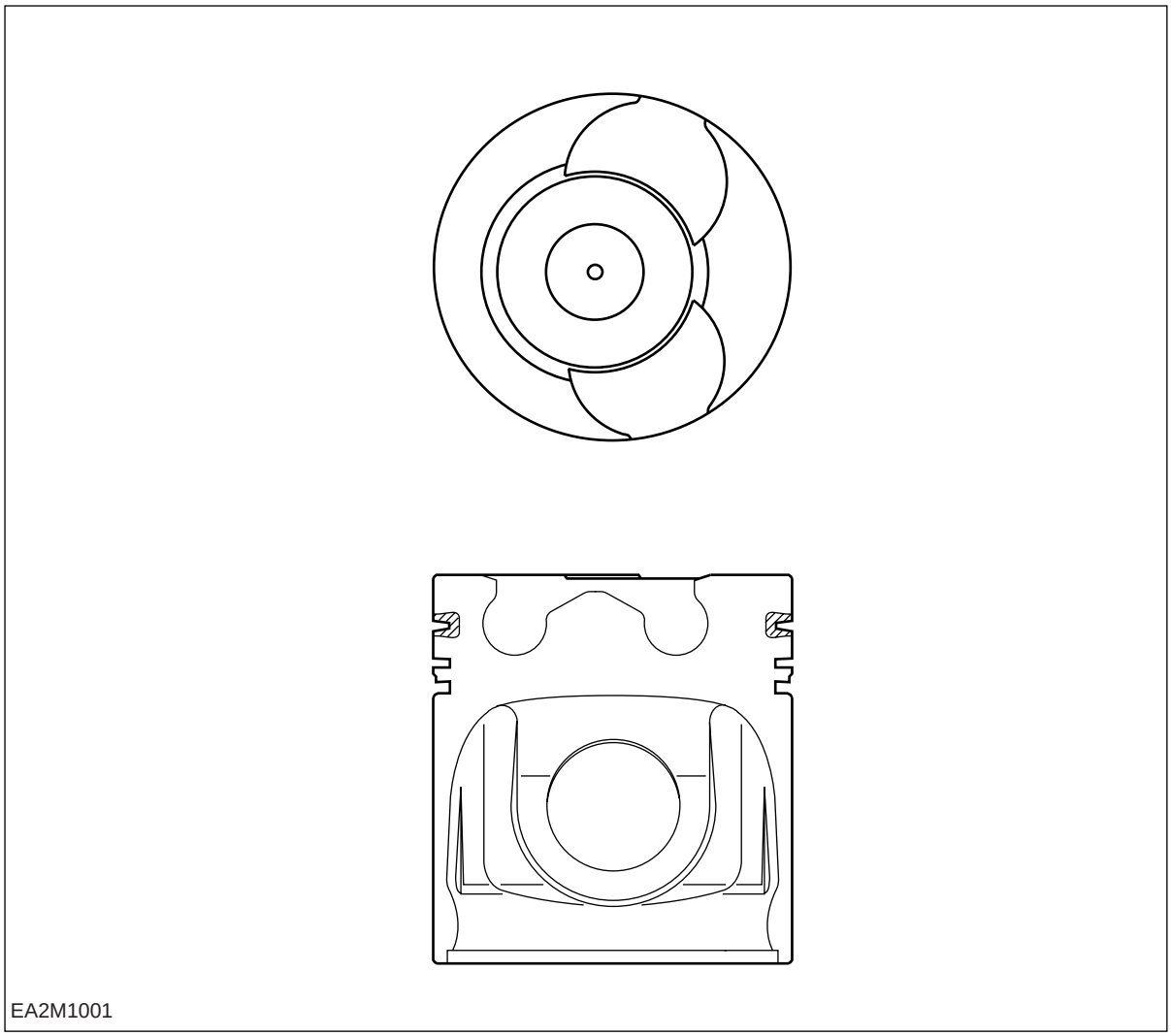
1. General information

1.1. Engine characteristics

1.1.1. OMEGA combustion bowl

The OMEGA combustion bowl is a unit designed to perform high-efficiency, low- emission combustion. As the rim around the combustion bowl port of the upper of the piston has been machined in a smaller size than the interior of the combustion bowl, strong swirl is produced in the combustion bowl and strong squish flow makes the fuel be mixed more sufficiently with air.

Due to the application of OMEGA combustion system and optimal ultilization of intake and exhaust port configuration within the cylinder head, the DE12 series engines discharge a very low level of hazardous exhaust gases such as smoke, nitrogen oxide, hydrocarbon, or carbon monoxide and thus ensure high performance and low fuel consumption.

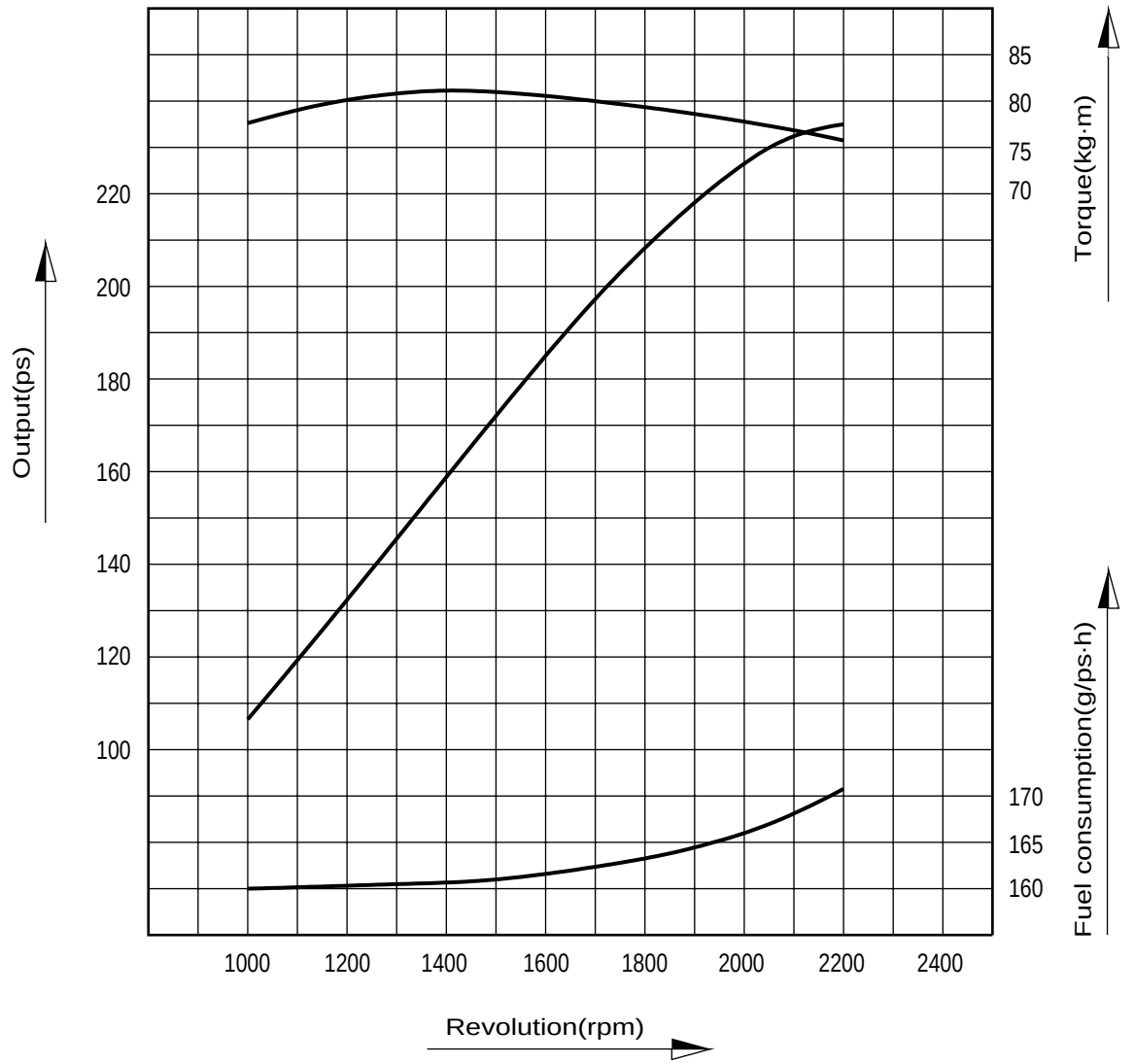


EA2M1001

<Figure. 1-1> OMEGA combustion bowl

1.4. Engine performance curve

1.4.1. DE12

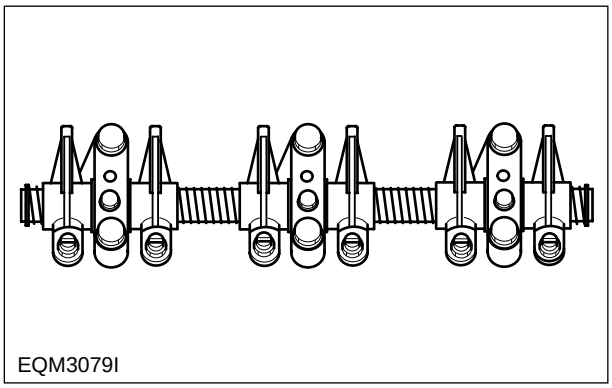


Performance criteria	ISO 1585(SAE J1349)
Output(Max.)	235 ps/2,200 rpm
Torque(Max.)	81.5 kg·m/1,400 rpm
Fuel consumption ratio(min.)	160 g/ps·h

EQM1004I

3.3.21. Rocker arm assembly

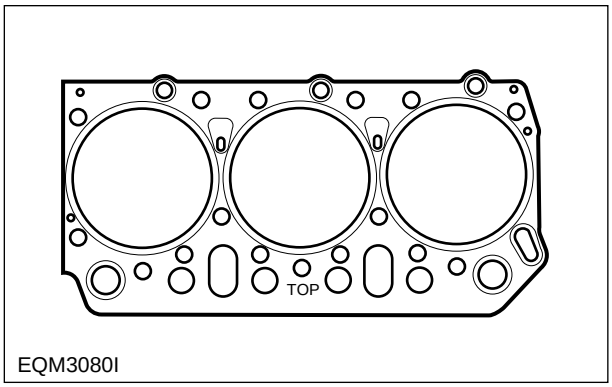
1) Apply lubricating oil to the rocker arm bush and shaft, and assemble the intermediate bracket with the rocker arm using fixing bolts.
2) Semi-install valve clearance adjusting bolts onto the rocker arm.
3) Install the washer, rocker arm, spring, rocker arm, washer, bracket, spring, washer, and snap ring in the described sequence.
4) Install the rocker arm and bracket in the same direction.



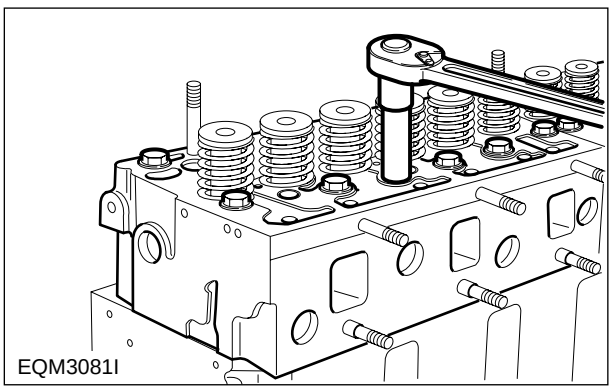
EQM3079I

3.3.22. Cylinder head

1) Install the injection nozzle fixing stud bolts and water pipe fixing stud bolts.
2) Clean the head bolt holes on the cylinder block with compressed air to remove foreign substances and thoroughly clean the gasket fitting face of the cylinder block.
3) Install head gasket, with 'TOP' mark facing upward, on the cylinder block by aligning the holes with dowels.
4) Check the inside of combustion chamber for foreign substances, and carefully mount the cylinder head assembly in the block by aligning the dowel pin with the dowel pin hole. Be careful not to damage the head gasket. If the dowel pin is not in alignment, lift the cylinder head again and then re-mount it.
5) Coat the head bolts with engine oil, then tighten them in proper sequence to the specified torque(24.5kg•m).



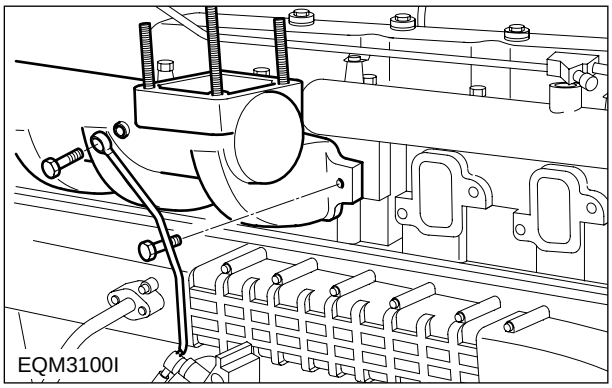
EQM3080I



EQM3081I

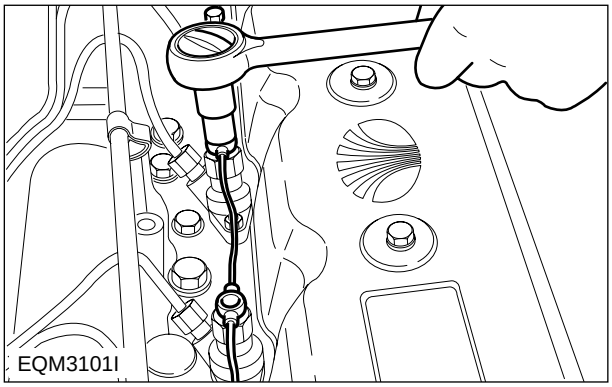
3.3.36. Intake manifold

1) Fit a gasket on the intake manifold before assembling the intake manifold.
2) Mount the air heater gasket on the intake manifold, then assemble the air heater with the intake manifold.
3) Connect the air hose to the boost compensator mounted on the fuel injection pump.


EQM3100I

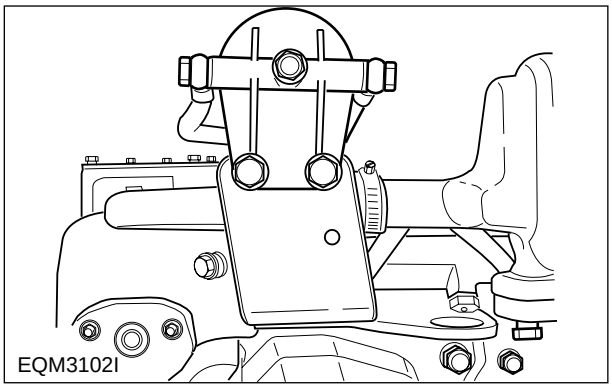
3.3.37. Injection pipe

1) Semi-assemble a nut at both ends of the fuel high pressure pipe and tighten them up one by one to specified torque.
2) Tighten hollow screws to assemble the fuel return pipe.
3) Assemble the fuel return hose with the fuel injection pump.


EQM3101I

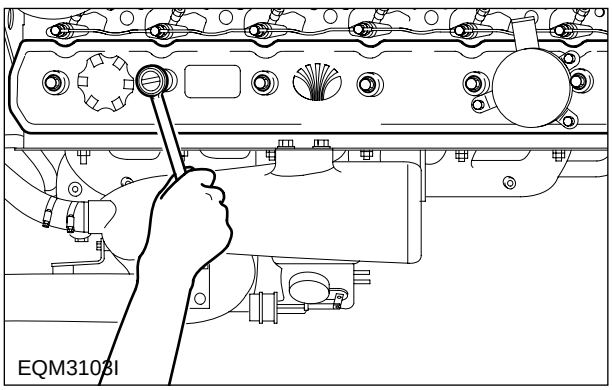
3.3.38. Fuel filter

1) Assemble the fuel filter at bracket.
2) Assemble the fuel hose.


EQM3102I

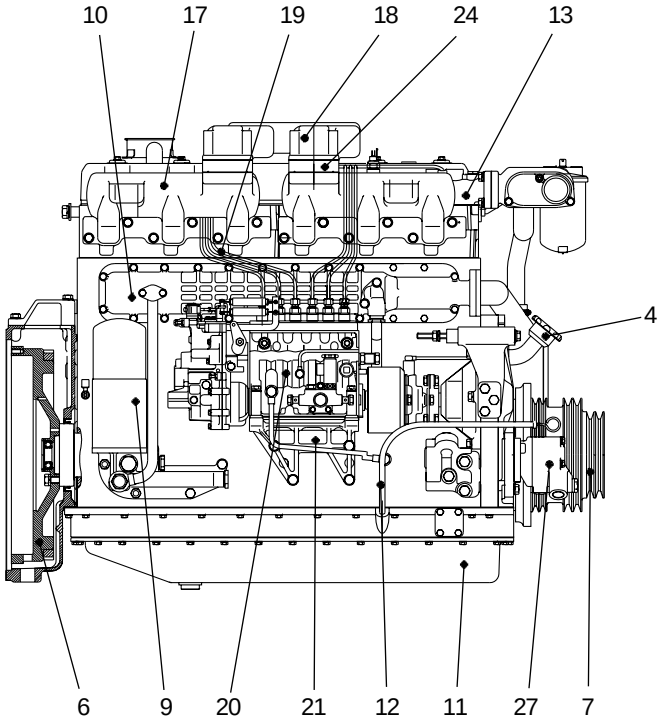
3.3.39. Cylinder head cover

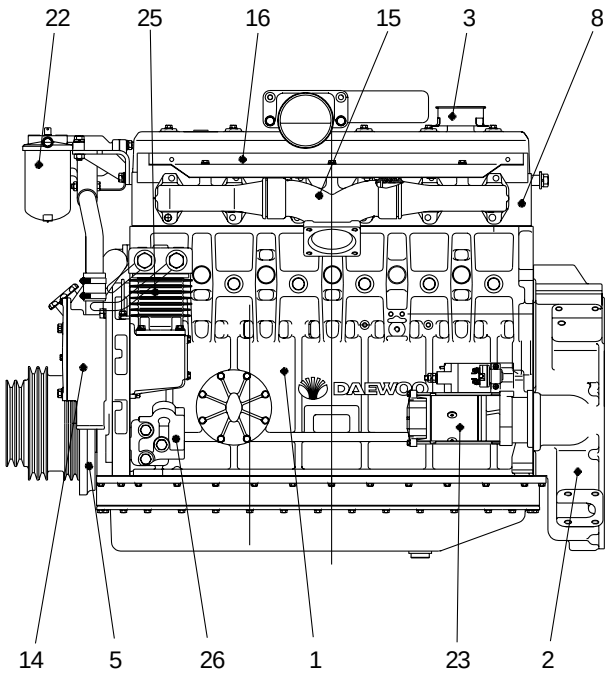
1) Assemble the cover packing with the cover, install the cover on the head, then tighten the fixing bolts in sequence to specified torque (1.5kg•m).
2) Assemble the breather hose with PCV valve.


EQM3103I

1.5. Exterior view of engine

1.5.1. DE12- for Bus

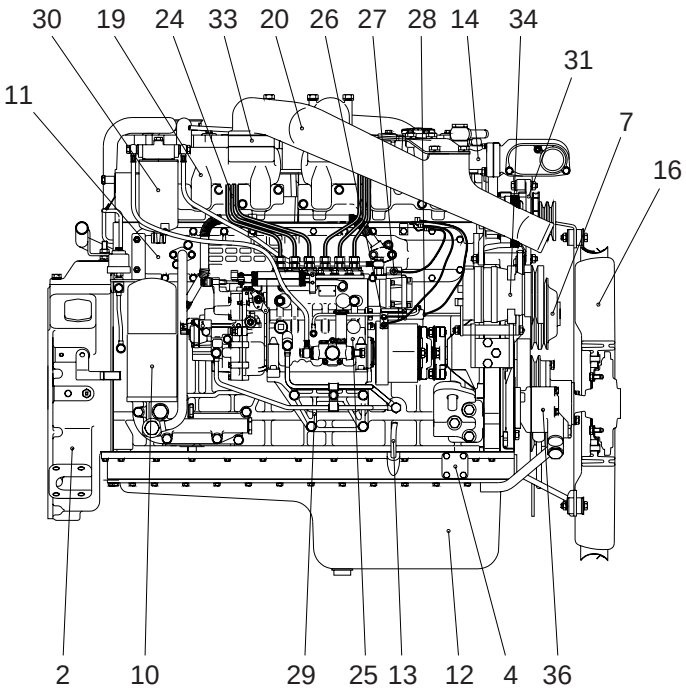


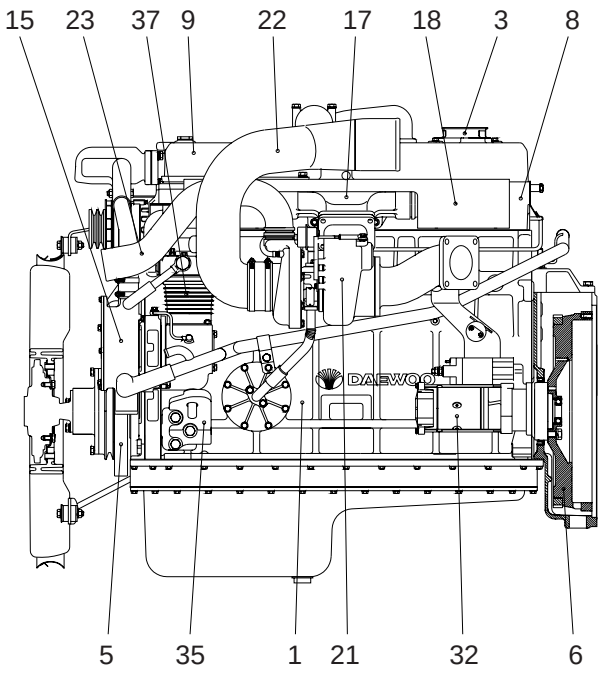


1. Cylinder block
2. Flywheel housing
3. Breather
4. Oil filler pipe
5. Vibration damper
6. Flywheel
7. V-pulley
8. Cylinder head
9. Oil filter
10. Oil cooler
11. Oil pan
12. Oil dipstick
13. Cooling water pipe
14. Water pump
15. Exhaust manifold
16. Heat shield
17. Intake manifold
18. Intake stake
19. Injection pipe
20. Injection pump
21. Injection pump bracket
22. Fuel filter
23. Starter
24. Air heater
25. Air compressor
26. Mounting bracket
27. Power steering pump

EQM1010I

1.5.9. DE12TIS - for Truck





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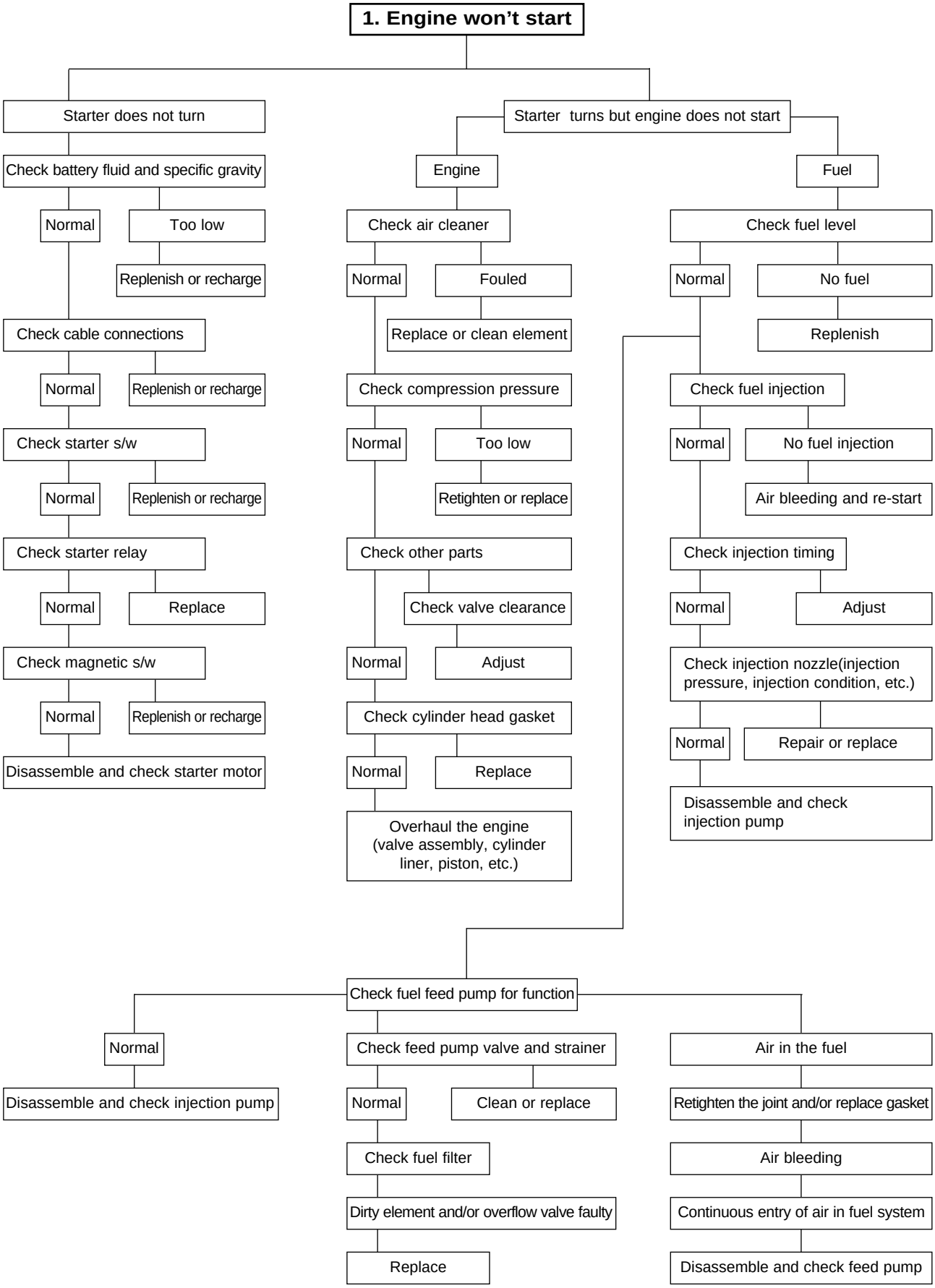
1. Cylinder block
2. Flywheel housing
3. Breather
4. Oil filler pipe
5. Vibration damper
6. Flywheel
7. Idle pulley
8. Cylinder head
9. Cylinder head cover
10. Oil filter
11. Oil cooler
12. Oil pan
13. Oil dipstick
14. Cooling water pipe
15. Water pump
16. Cooling fan
17. Exhaust manifold
18. Heat screen
19. Intake manifold
20. Intake stake
21. Turbocharger
22. Air pipe, A/C-T/C
23. Air pipe, T/C-I/C
24. Injection pipe
25. Injection pump
26. Pick-up sensor
27. Prestroke actuator sensor
28. Rack sensor
29. Injection pump bracket
30. Fuel filter
31. Alternator
32. Starter
33. Air heater
34. Air-conditioning compressor
35. Engine mounting bracket
36. Power steering pump
37. Air compressor

2.2. Diagnostics and trouble shooting for the engine

2.2.1. Diagnostics

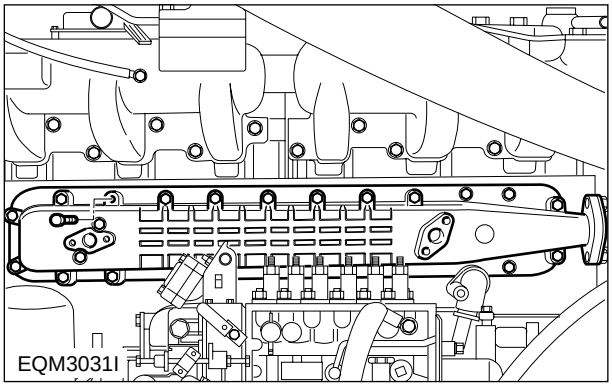


2.2.2. Trouble shooting

Complaint	Cause	Correction
1) Difficulty in engine starting		
(1) Trouble in starter	(See <2.2.1>)	
(2) Trouble in fuel system	(See <Section 4.3 Fuel system>)	Check valve and valve seat,
(3) Lack of compression pressure	① Valves holding open, skewed valve stem	then repair or replace
	② Valve springs damaged	Replace valve springs
	③ Leaky cylinder head gasket	Replace gasket
	④ Worn pistons, piston ring, or liner	Replace
2) Rough engine idling		
	① Wrong injection timing	Adjust
	② Air in injection pump	Air bleeding
3) Lack of engine power		
(1) Engine continues to lack power	① Valve clearance incorrect	Adjust
	② Valve poorly seated	Repair
	③ Leaky cylinder head gasket	Replace gasket
	④ Piston rings worn, sticking, or damaged	Replace piston rings
	⑤ Injection timing incorrect	Adjust
	⑥ Volume of fuel delivery insufficient	Adjust injection pump
	⑦ Nozzle injection pressure incorrect or nozzles seized	Adjust or replace nozzles
	⑧ Feed pump faulty	Repair or replace
	⑨ Restrictions in fuel pipes	Repair
	⑩ Volume of intake air insufficient	Clean or replace air cleaner
(2) Engine lacks power on acceleration	① Compression pressure insufficient	Overhaul engine
	② Injection timing incorrect	Adjust
	③ Volume of fuel delivery insufficient	Adjust injection pump
	④ Injection pump timer faulty	Repair or replace
	⑤ Nozzle injection pressure or spray angle incorrect	Repair or replace
	⑥ Feed pump faulty	Repair or replace
	⑦ Volume of intake air insufficient	Clean or replace air cleaner
4) Engine overheating		
	① Lack of engine oil or poor oil	Replenish or replace
	② Lack of coolant	Replenish or replace
	③ Fan belts slipping, worn or damaged	Adjust or replace
	④ Water pump faulty	Repair or replace
	⑤ Thermostat inoperative	Replace
	⑥ Valve clearance incorrect	Adjust
	⑦ Back pressure in exhaust line	Clean or replace

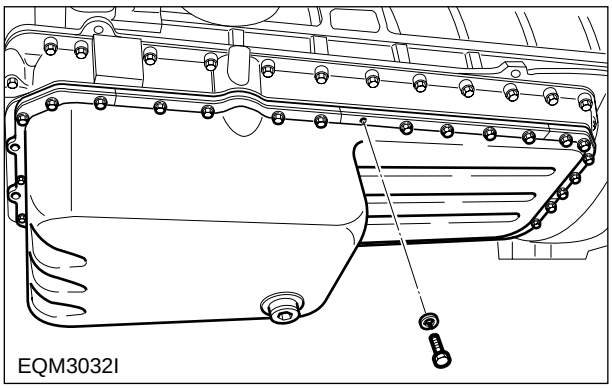
3.1.33. Oil cooler

1) Remove the water pipe connected to the water pump.
2) Unscrew the oil cooler cover fixing bolts and disassemble the oil cooler assembly from the cylinder block.
3) Unscrew the oil cooler fixing bolts and remove the oil cooler from the oil cooler cover.


EQM3031I

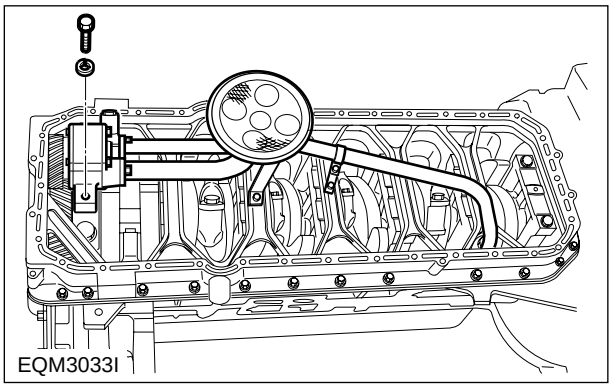
3.1.34. Oil pan

1) Stand the engine with the flywheel housing facing toward the bottom.
2) Release the oil pan fixing bolts, remove the stiffeners, then disassemble the oil pan.


EQM3032I

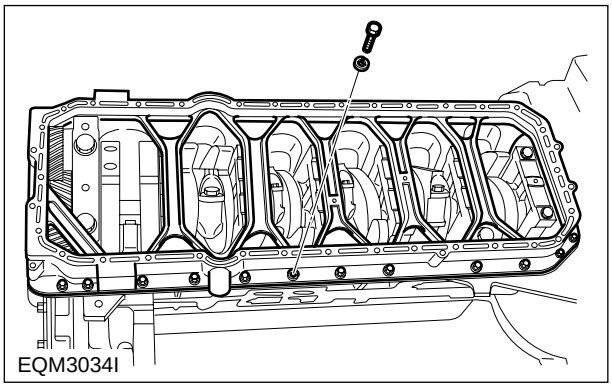
3.1.35. Oil pump and oil pipe

1) Unscrew the oil inlet pipe bracket bolts, releasing the pipe fixing bolts, then disassemble the oil suction pipe assembly.
2) Disassemble the oil pipe feeding oil from the oil pump to the cylinder block.
3) Unscrew the oil pump fixing bolts and disassemble the oil pump.


EQM3033I

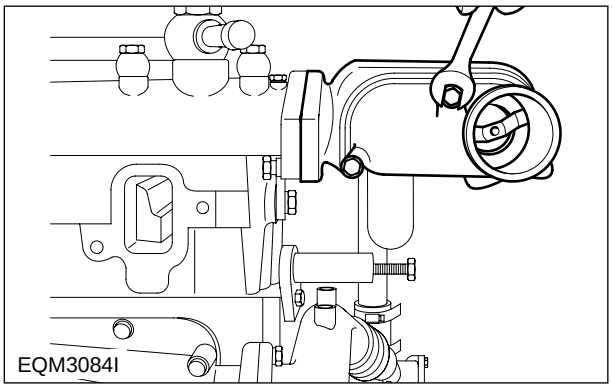
3.1.36. Ladder frame

1) Disassemble the ladder frame.


EQM3034I

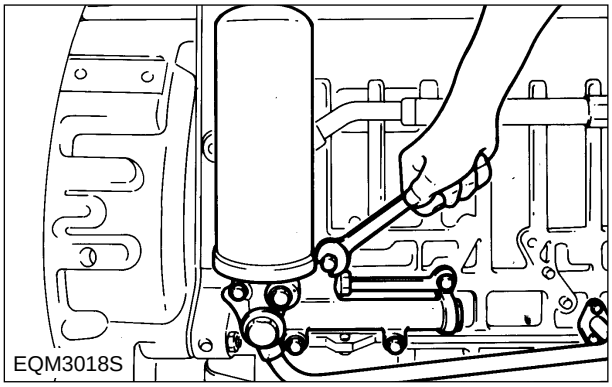
3.3.24. Water pipe and thermostat

1) Install the water pipe onto the cylinder head.
2) Install the thermostat in the housing.
3) With socket head bolts, install the thermostat housing onto the water pipe.


EQM3084I

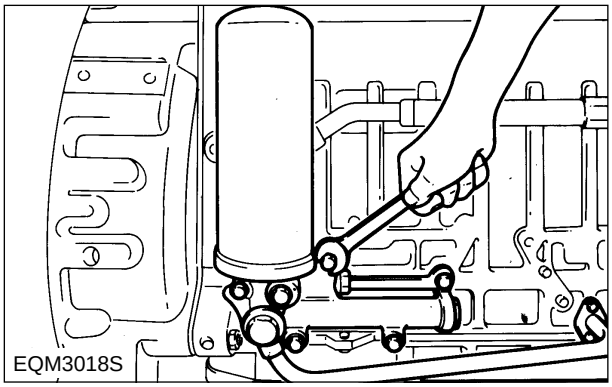
3.3.25. Oil cooler

1) Install the oil cooler onto the oil cooler cover.
   Carefully apply the gasket to prevent oil leakage.
2) Do not damage the gasket and install the cover onto the cylinder block.
3) Connect a connection pipe between the water pump and oil cooler.


EQM3018S

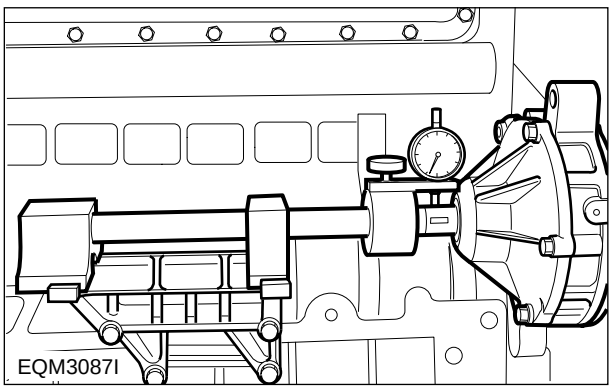
3.3.26. Oil filter

1) With the hollow screw, assemble the oil pipe connected between the oil cooler and cylinder block.
2) Install a connection pipe between the oil cooler and oil filter.
3) Install the oil cooler connecting pipe.
4) Install packing and assemble the oil filter using a filter assembling wrench.


EQM3018S

3.3.27. Injection pump

1) Install the fuel injection pump bracket in the cylinder block.
2) After measuring the amount of run-out with an alignment setting jig, disassemble the bracket, adjust the shims, then reassemble it.
3) Mount the top/bottom adjusting shims in the bracket and then mount the fuel injection pump.


EQM3087I

4. Maintenance of major components

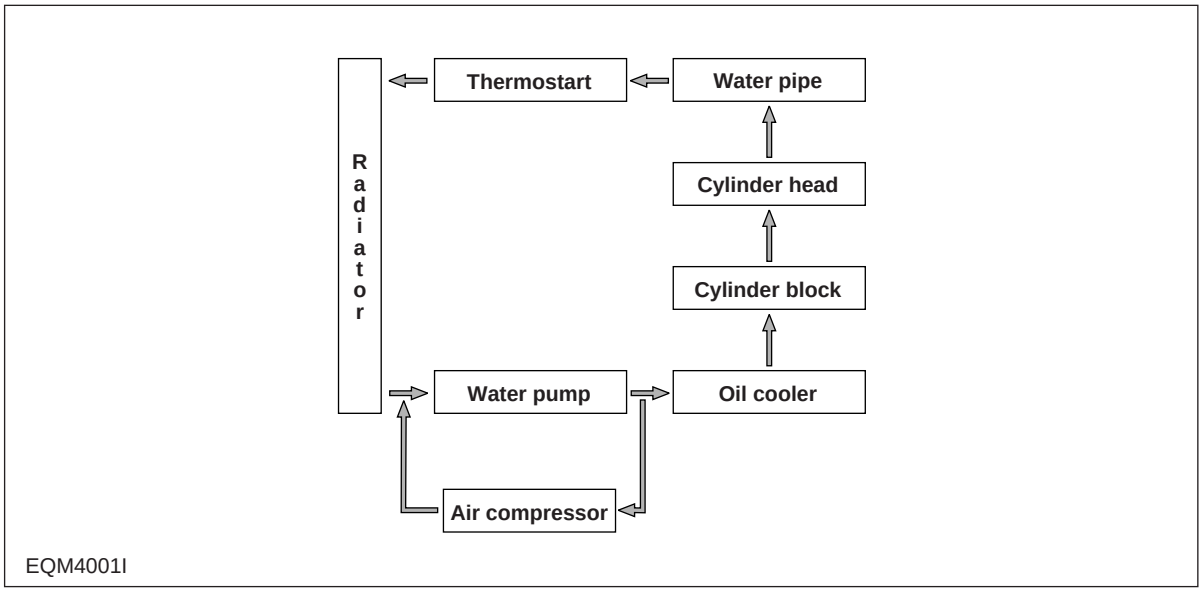
4.1. Cooling system

4.1.1. General descriptions and main data

This engine is water-cooling type. Heat from the combustion chamber and engine oil heat are cooled down by coolant and radiated to the outside, resulting in the normal operation of the engine.

Looking into the cooling system, the water pumped up by the water pump circulates around the oil cooler through the water pipe to absorb the oil heat, and then flows through the water jacket of the cylinder block and water passage of the cylinder head to absorb the heat of the combustion chamber.

The water absorbing the oil heat and combustion chamber heat goes on to the thermostat through the water pipe, and circulates to the water pump if water temperature is lower than the valve opening temperature on the thermostat, while circulating to the radiator at water temperature higher than the valve opening temperature. At the radiator, the heat absorbed in the coolant is radiated to cool down and the coolant recirculates to the water pump.



<Figure 4-1> Diagram of cooling system

● **Specifications**

Item	Specifications
1. Water pump	Centrifugal type
Type	
Delivery(ℓ/min)	About 350
Pumping speed	2,100 rpm
Pump back pressure	760mmHg
2. Thermostat	
Operating temperature(℃)	83~95
3. Cooling fan and belt	
Fan diameter × Number of blades	700 × 8
Fan belt tension	15mm/deflection by thumb

4) DE12TIS

(1)DE12TIS

(a) Main data and specifications

Part No. : 65.11101-7661(108622-4000)

Model : HD-TICS

Governor : RLD+J type

Timer : Dummy timer + electronically controled

Plunger :

Delivery valve : 65.11108-6009

Fuel feed pump : 65.12101-7013

Pre-stroke : 6.3±0.05mm

Rotating direction : C.W. at driving gear side

Injection order : 1-5-3-6-2-4

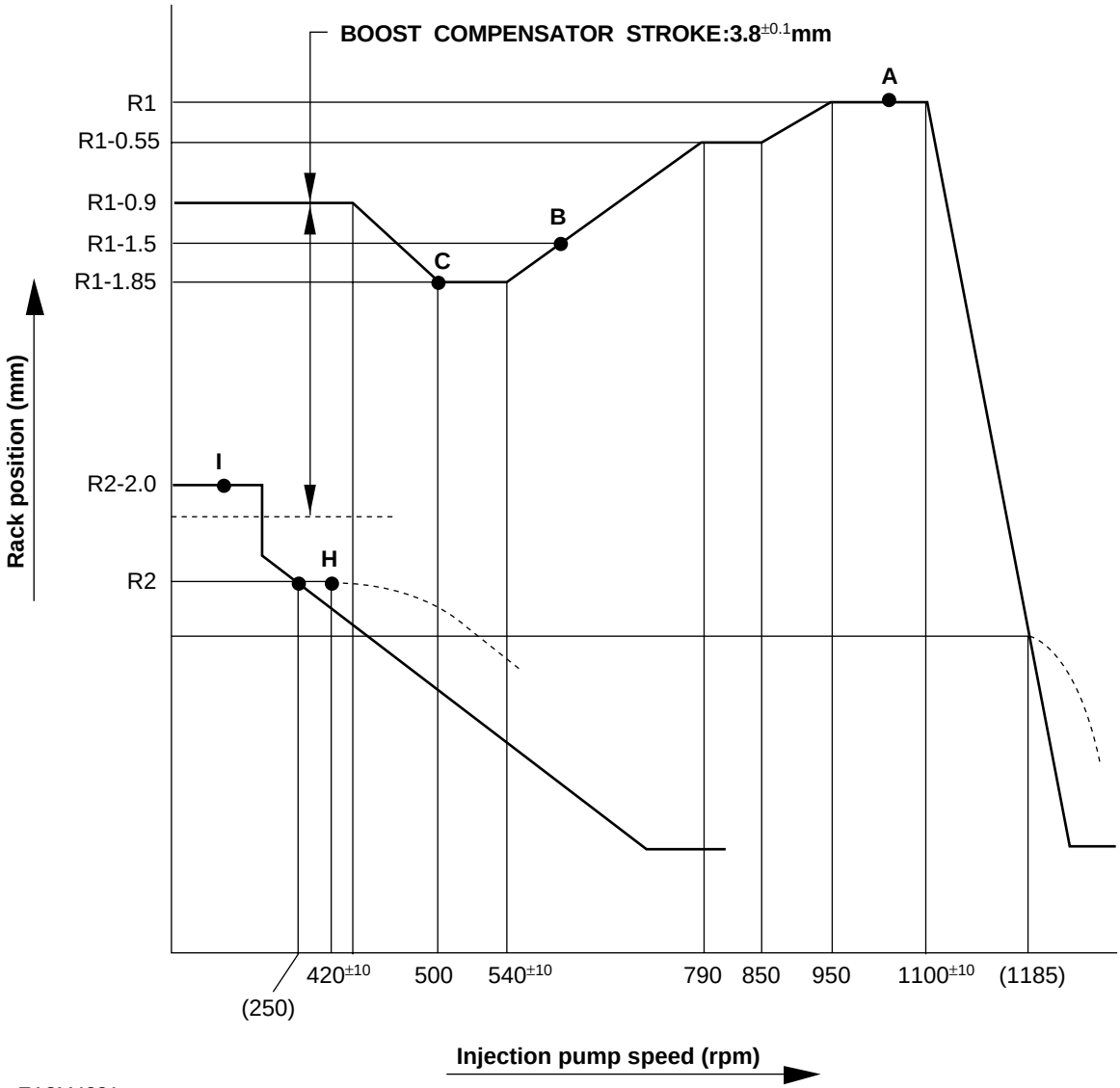
Injection timing : BTDC 1°

(b) Calibration data

Adjusting point	Rack position (mm)	Pump speed (rpm)	Injection volume (mm^3/1,000st)	Variation rate (%)	Basic point	Fixing point	Ref.
A	R1	1,050	158.0±2	±2	0		
B	R1-1.5	630	162.3±3	±15			
C	R1-1.85	500	173.8±3	-			
I	R2±2.0	100	45.8	-			
H	R2	300	2.3	-			

	Contents	Specifications	Engine application
Adjusting conditions	Nozzle holder assembly	105780-8250	65.10101-7298
	Nozzle	105780-0120	
	Nozzle holder	105780-0120	
	Opening pressure	220 kg/cm^2	1st : 160, 2nd : 220 kg/cm^2
	Injection pipe	ϕ8 × ϕ3 - 600mm	ϕ6 × ϕ2.2 - 600mm
	Fuel delivery pressure	2.6 kg/cm^2	
	Fuel temperature	35~45 ℃	

(c) Adjusting governor



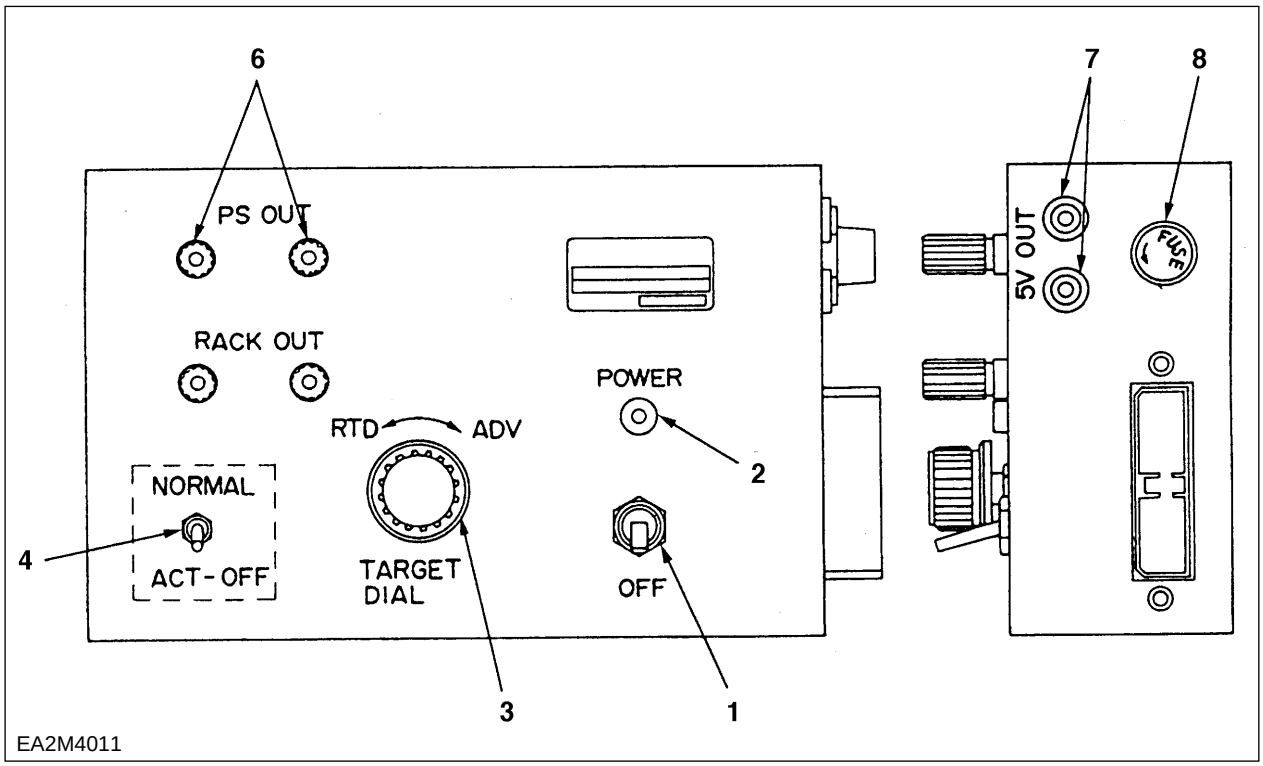
EA2M4001

4) Pre-stroke actuator adjustment

(1) Adjustment checker (including control unit)

This control unit is used especially for adjustment of TICS pumps. In addition to the control unit, a constant voltage power supply and a digital voltmeter(both commercially available) are necessary.

The figure below shows the names and functions of each control panel switch, dial and terminal.



EA2M4011

Key no	Name	Remarks
1	Power switch	Used to turn the checker's power ON add Off
2	Pilot lamp	
3	Target dial	Used to set the pre-stroke actuator's output voltage
4	Actuator operation switch	Switch to 'Normal' when operating the actuator, and 'Act-OFF' when not operating the actuator
5	Rack sensor output terminals	Used to connect the racd sensor to the digital voltmeter
6	Ps actuator output terminals	Used to connect the Ps actuator output terminals
7	5 Volt output terminals	Not used at present
8	Fuse	