SEBM023412

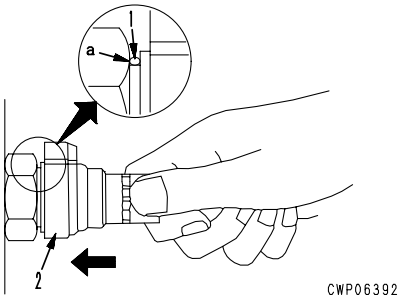
SHOP MANUAL

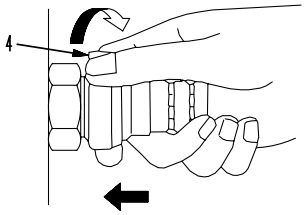
KOMATSU

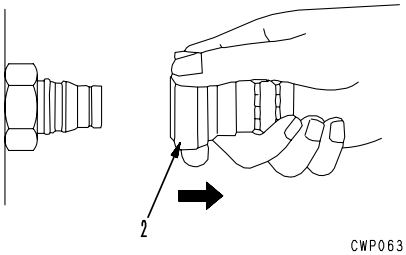
170-3 SERIES

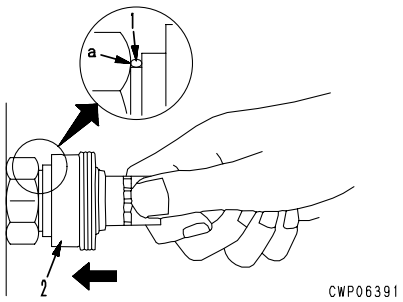
DIESEL ENGINE

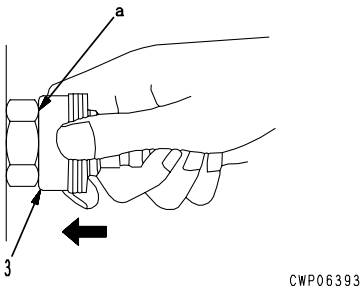
Printed in Japan 10-08(02)

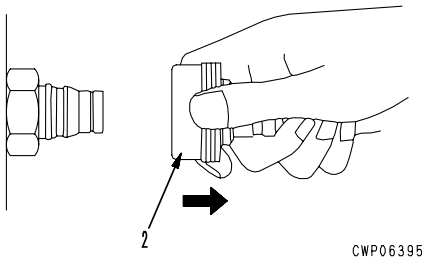
<table>
<tr><th></th><th>Type 2</th><th>Type 3</th></tr>
<tr><td>Disassembly</td><td>1) Hold the mouthpiece of the tightening portion and push body (2) in straight until sliding prevention ring (1) contacts contact surface a of the hexagonal portion at the male end.
 

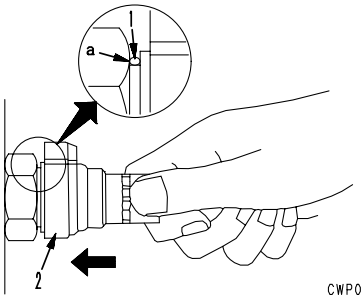
CWP06392
2) Hold in the condition in Step 1), and turn lever (4) to the right (clockwise).
 

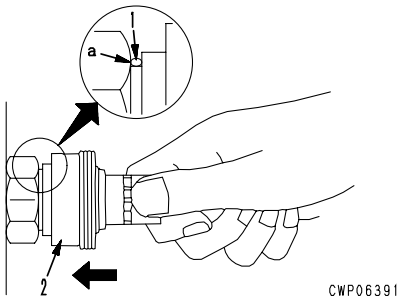
CWP06394
3) Hold in the condition in Steps 1) and 2), and pull out whole body (2) to disconnect it.
 

CWP06396</td><td>1) Hold the mouthpiece of the tightening portion and push body (2) in straight until sliding prevention ring (1) contacts contact surface a of the hexagonal portion at the male end.
 

CWP06391
2) Hold in the condition in Step 1), and push until cover (3) contacts contact surface a of the hexagonal portion at the male end.
 

CWP06393
3) Hold in the condition in Steps 1) and 2), and pull out whole body (2) to disconnect it.
 

CWP06395</td></tr>
<tr><td>Connection</td><td>• Hold the mouthpiece of the tightening portion and push body (2) in straight until sliding prevention ring (1) contacts contact surface a of the hexagonal portion at the male end to connect it.
 

CWP06392</td><td>• Hold the mouthpiece of the tightening portion and push body (2) in straight until sliding prevention ring (1) contacts contact surface a of the hexagonal portion at the male end to connect it.
 

CWP06391</td></tr>
</table>

kgm to ft. lb

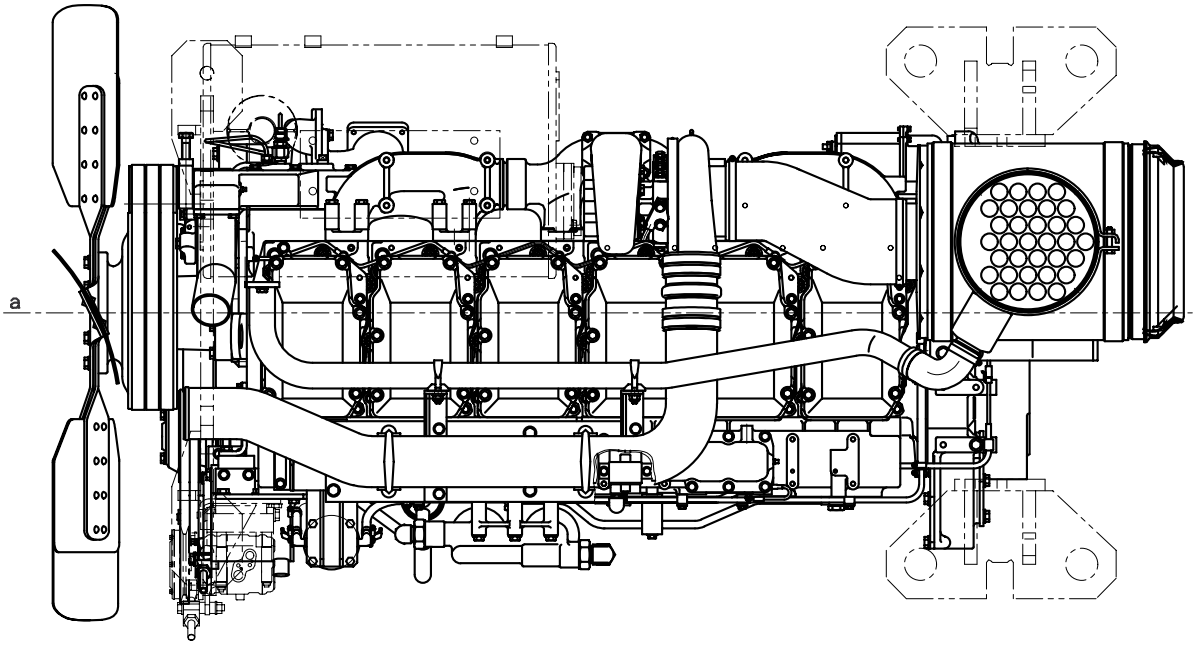
1 kgm = 7.233 ft. lb

	0	1	2	3	4	5	6	7	8	9
0	0	7.2	14.5	21.7	28.9	36.2	43.4	50.6	57.9	65.1
10	72.3	79.6	86.8	94.0	101.3	108.5	115.7	123.0	130.2	137.4
20	144.7	151.9	159.1	166.4	173.6	180.8	188.1	195.3	202.5	209.8
30	217.0	224.2	231.5	238.7	245.9	253.2	260.4	267.6	274.9	282.1
40	289.3	296.6	303.8	311.0	318.3	325.5	332.7	340.0	347.2	354.4
50	361.7	368.9	376.1	383.4	390.6	397.8	405.1	412.3	419.5	426.8
60	434.0	441.2	448.5	455.7	462.9	470.2	477.4	484.6	491.8	499.1
70	506.3	513.5	520.8	528.0	535.2	542.5	549.7	556.9	564.2	571.4
80	578.6	585.9	593.1	600.3	607.6	614.8	622.0	629.3	636.5	643.7
90	651.0	658.2	665.4	672.7	679.9	687.1	694.4	701.6	708.8	716.1
100	723.3	730.5	737.8	745.0	752.2	759.5	766.7	773.9	781.2	788.4
110	795.6	802.9	810.1	817.3	824.6	831.8	839.0	846.3	853.5	860.7
120	868.0	875.2	882.4	889.7	896.9	904.1	911.4	918.6	925.8	933.1
130	940.3	947.5	954.8	962.0	969.2	976.5	983.7	990.9	998.2	1005.4
140	1012.6	1019.9	1027.1	1034.3	1041.5	1048.8	1056.0	1063.2	1070.5	1077.7
150	1084.9	1092.2	1099.4	1106.6	1113.9	1121.1	1128.3	1135.6	1142.8	1150.0
160	1157.3	1164.5	1171.7	1179.0	1186.2	1193.4	1200.7	1207.9	1215.1	1222.4
170	1129.6	1236.8	1244.1	1251.3	1258.5	1265.8	1273.0	1280.1	1287.5	1294.7
180	1301.9	1309.2	1316.4	1323.6	1330.9	1338.1	1345.3	1352.6	1359.8	1367.0
190	1374.3	1381.5	1388.7	1396.0	1403.2	1410.4	1417.7	1424.9	1432.1	1439.4

SAA6D170E-P910	SAA6D170E-P970		
EGS950-6	EGS1050-7		
6 - 170 x 170 23.2 {23,150} 1 – 5 – 3 – 6 – 2 – 4			
2,667 1,061 1,790 —	2,667 1,061 1,790 —		
604{810}/1,500 (50Hz) (Net) — Max. 1,575 800 ± 100 (Rated output) 203 {151} (50Hz)	723{969}/1,500 (50Hz) (Net) — Max. 1,575 800 ± 100 (Rated output) 203 {151} (50Hz)		
2,565	2,565		
Trochoid gear pump (KOMATSU HPI system) Electronic control type			
141 (135)	141 (135)		
(Engine side: 47)	(Engine side: 47)		
24V, 35A 24V, 7.5kW 12V, 200Ah x 2	24V, 35A 24V, 7.5kW 12V, 200Ah x 2		
HOLSET HX82 — With air cooled aftercooler	HOLSET HX82 — With air cooled aftercooler		

SAA6D170E-3 VIEW FROM TOP (WA600-3)

★ The actual engine may be different because of modifications.

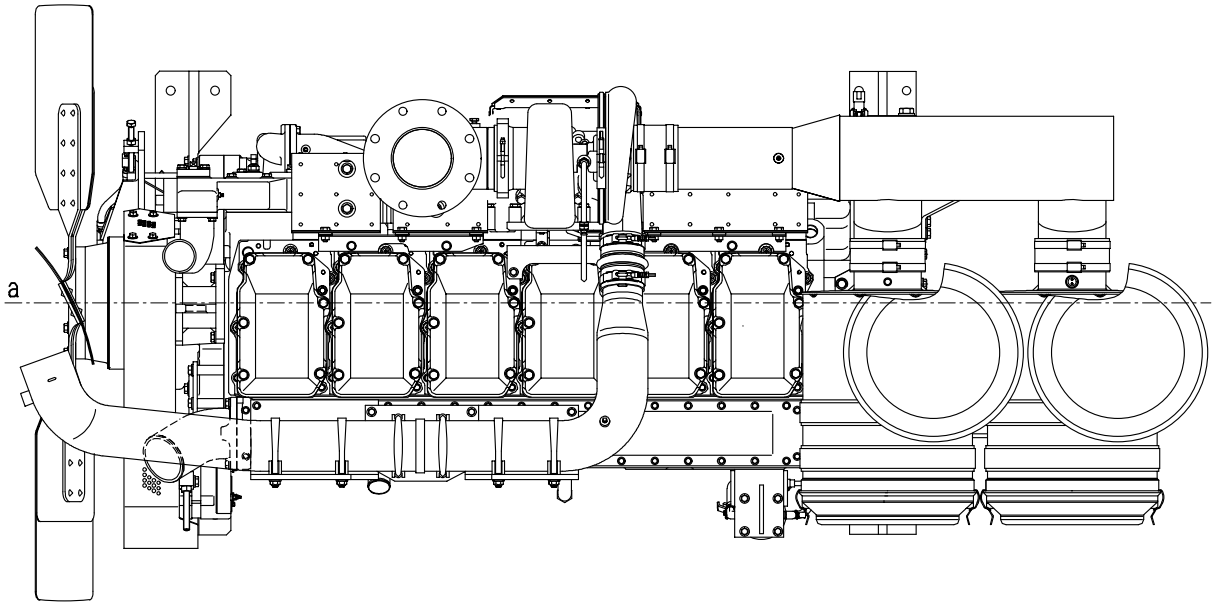


SXE01443

a. Center of cylinder liner

SAA6D170E2-3 VIEW FROM TOP (DCA-800SSK2, DENYO GENERATOR)

★ The actual engine may be different because of modifications.



9JS08654

a. Center of cylinder liner

11 STRUCTURE AND FUNCTION

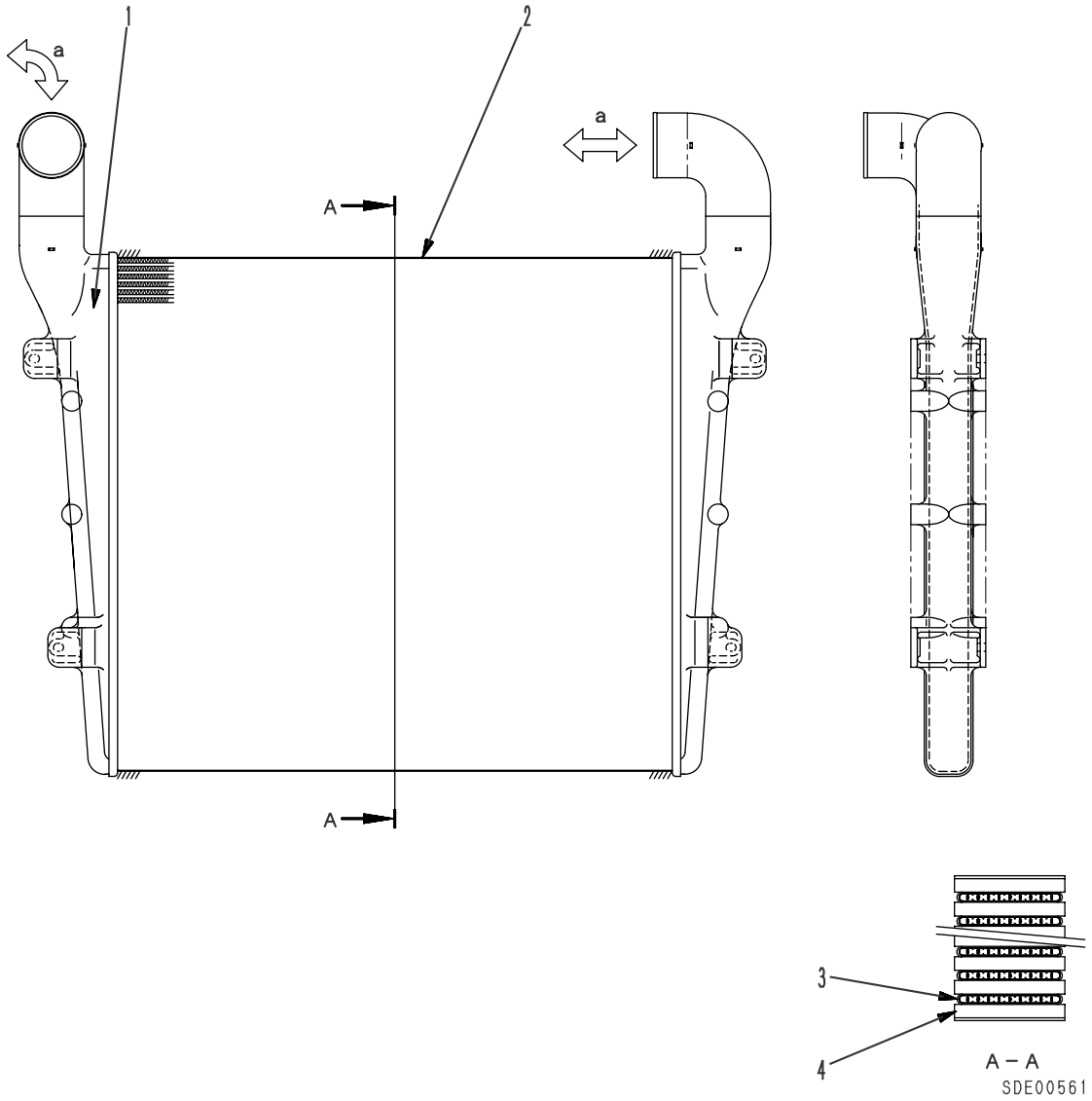
★ The illustration given in STRUCTURE AND FUNCTION are representative illustration.
Depending on the machine model, the actual, component may be different from the illustration.

AIR-COOLED TYPE

SAA6D170E-3 (Generator)

★ The specifications are subject to change according to modification etc.

★ The shape is subject to machine models.

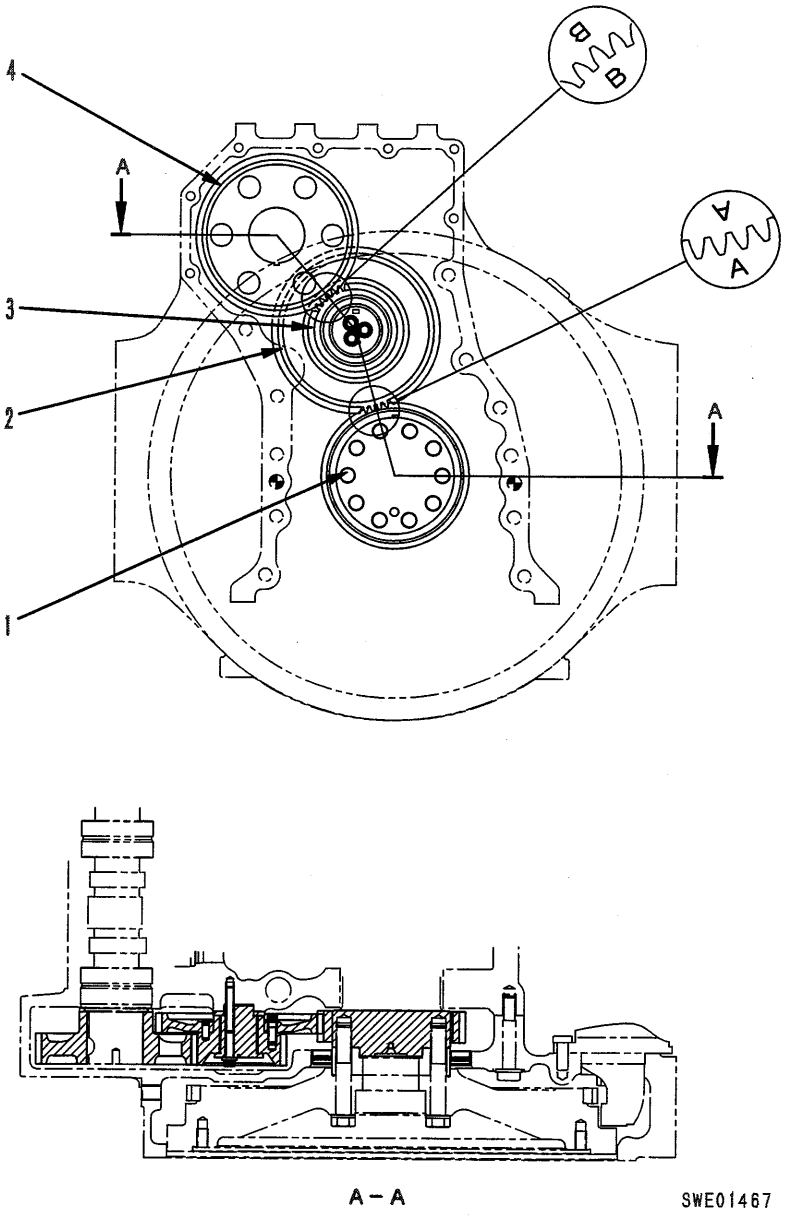


1. Tank
2. Side support
3. Tube
4. Fin

a. Intake air port
(Turbocharger ↔ Intake manifold)

TIMING GEAR

REAR SIDE (for driving camshaft)

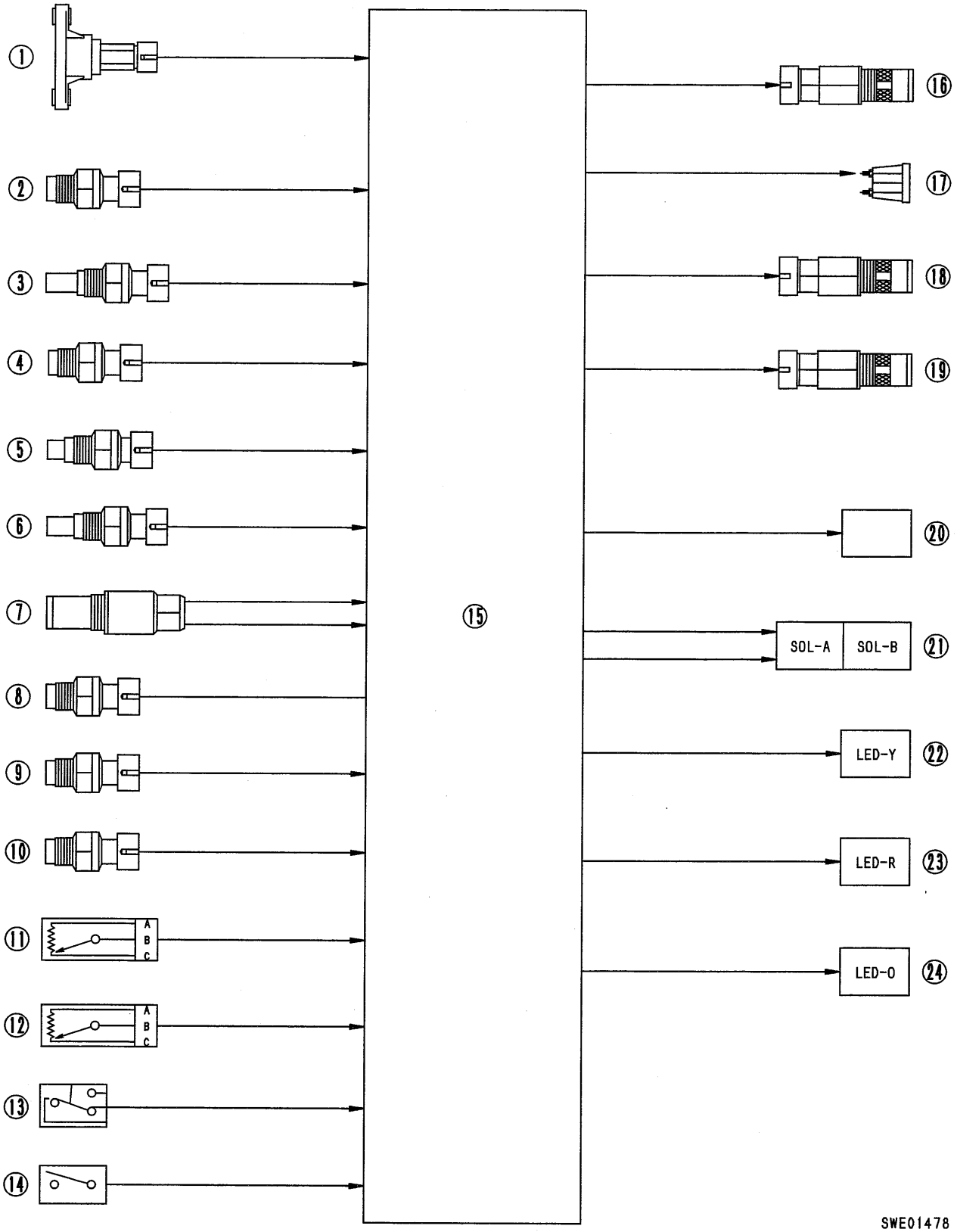


1. Crankshaft gear (No. of teeth: 63)
2. Idler gear (No. of teeth: 72)
3. Idler gear (No. of teeth: 40)
4. Camshaft gear (No. of teeth: 70)

A. Timing mark
(between crankshaft gear and idler gear)
B. Timing mark
(between idler gear and camshaft gear)

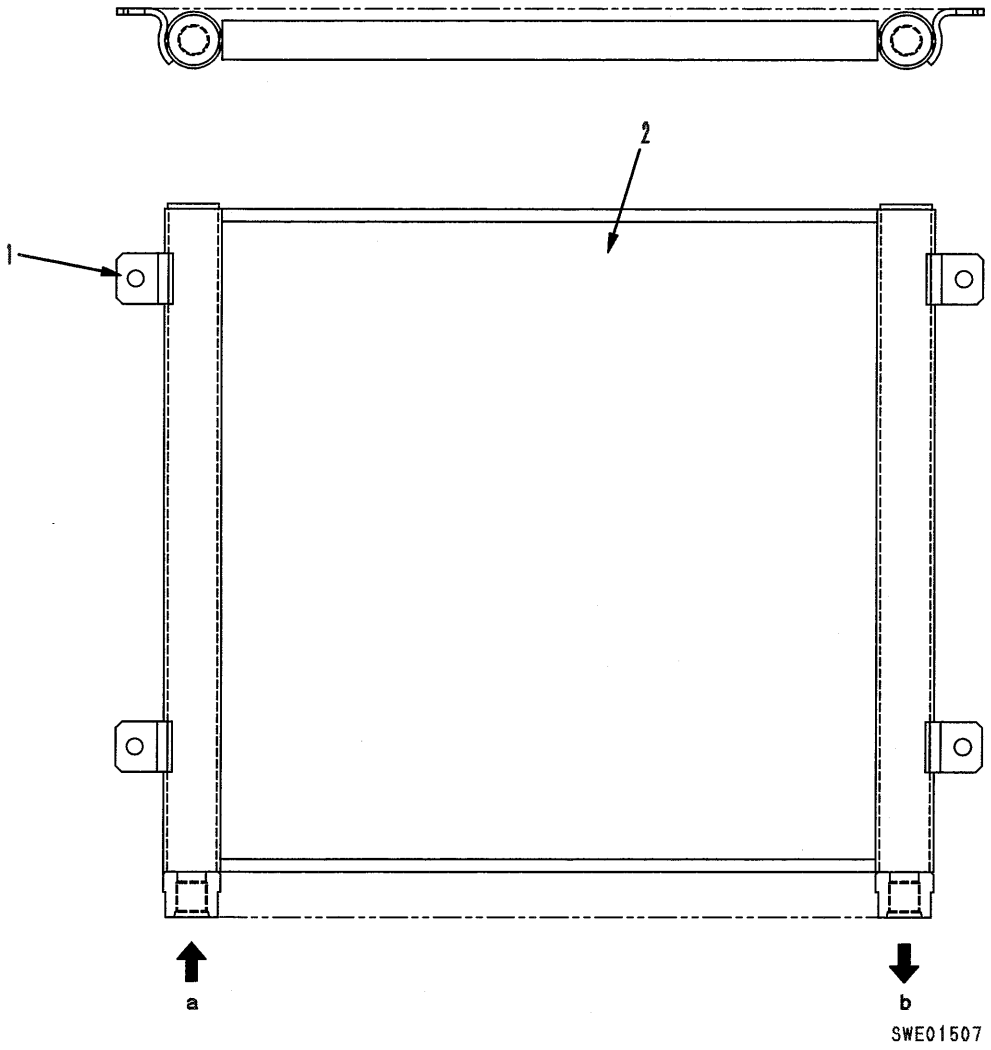
ENGINE CONTROLLER CONTROL SYSTEM

FUNCTION



FUEL COOLER

★ The actual engine may be different because of modifications.



1. Mount bracket
2. Core

a. From injector
b. To fuel tank

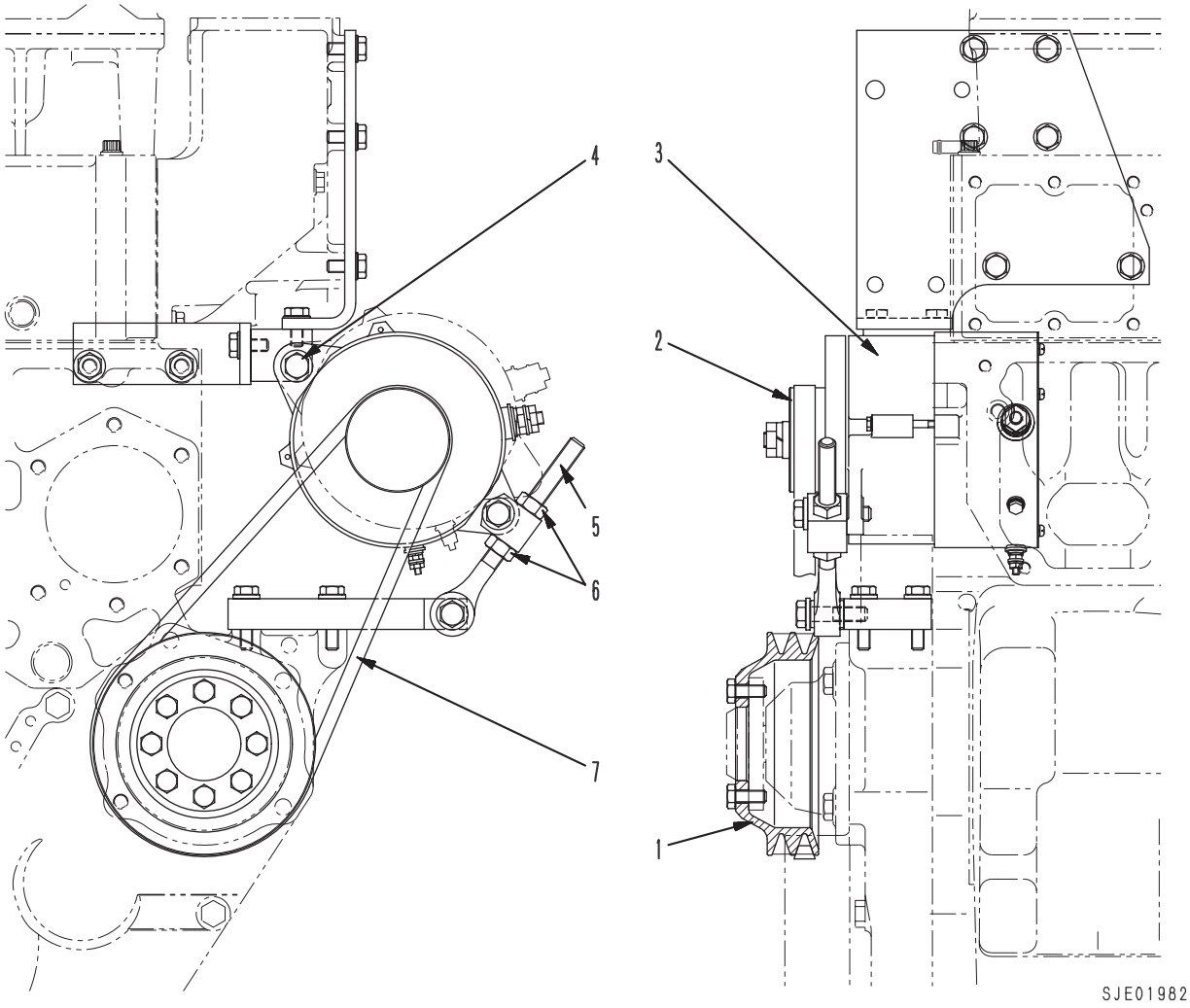
SPECIFICATIONS

Cooling method: Air cooled
Core type: CF40, (4.5/2P)
Heat dissipation surface: 6.45 m^2
Heat dissipation amount: 11.63 kW {10,000 kcal}/h
Fuel pressure: Max. 5.88 kPa {0.06 kg/cm^2}
(When fuel temperature at cooler inlet port is 100°C)

ALTERNATOR MOUNTING (WA600-3, WA700-3, WD600-3, PC1250-7, HD465-7, HD605-7)

★ The actual engine may be different because of modifications.

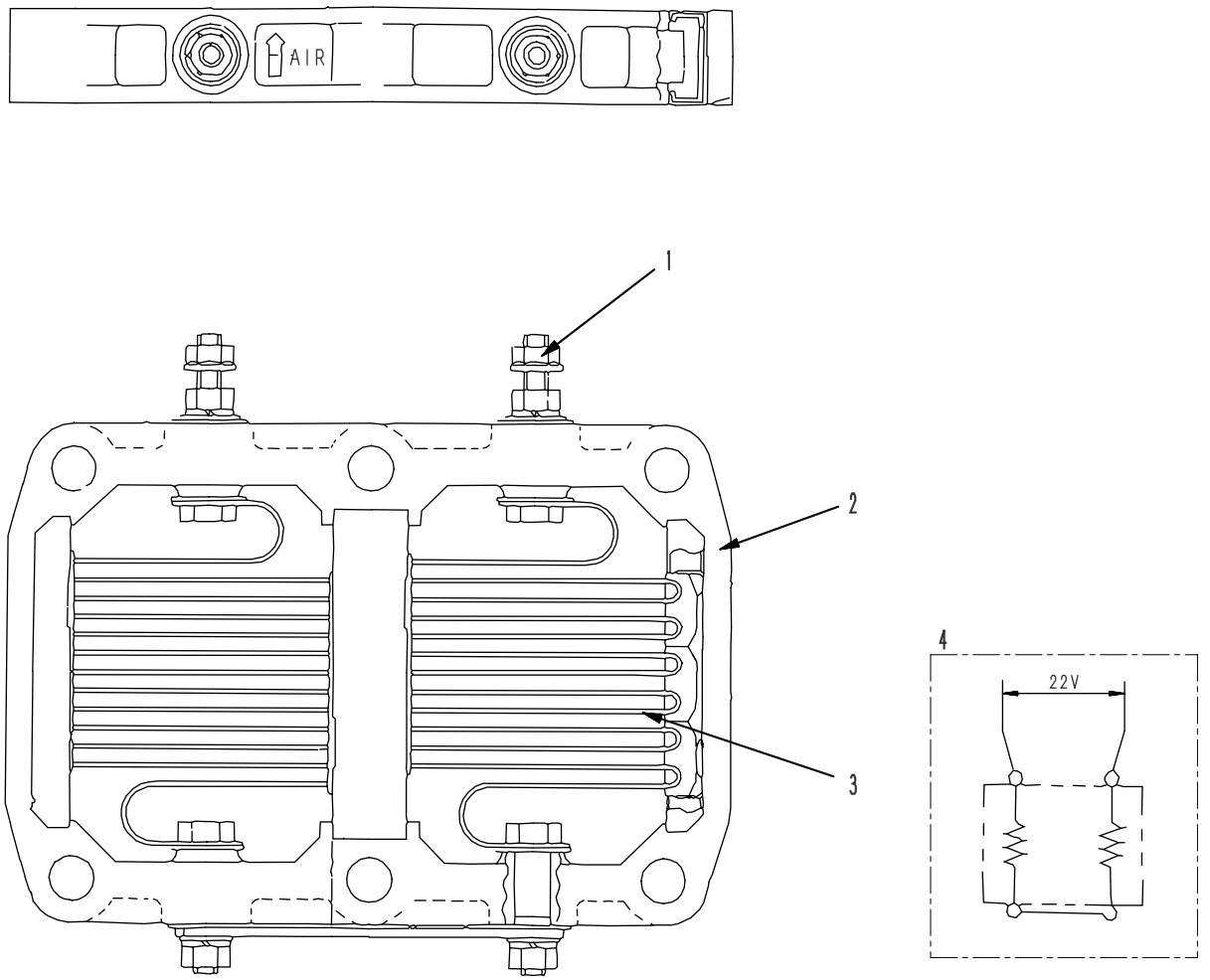
★ The specifications may be different from the following figure, depending on the type of machine.



1. Drive pulley (pulley outside diameter: 182 mm)
2. Alternator pulley (pulley outside diameter: 85 mm)
3. Alternator
4. Alternator mounting bolt
5. Adjustment bolt
6. Locknut
7. V-belt

ELECTRICAL HEATER (SAA6D170E-3)

★ The actual engine may be different because of modifications.



SXE01520

1. Terminal
2. Body
3. Heater coil
4. Connection diagram

SPECIFICATIONS

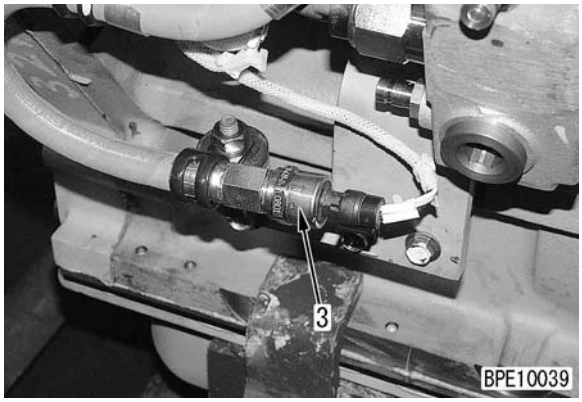
Heater type: Electrical intake air heater
Rated voltage: 22V (DC)
Rated current: 111 A

TOOLS FOR TESTING, ADJUSTING, AND TROUBLESHOOTING

Check, measurement item	Symbol		Troubleshooting tool	Part Number	Remarks
Intake resistance	A		Pressure test kit	799-203-2002	- 9.8 – 0 kPa{- 1,000 – 0 mmH_2O}
Intake pressure					0 – 200 kPa{0 – 1,500 mmH_2O}
Exhaust pressure					0 – 200 kPa{0 – 1,500 mmH_2O}
Blow-by pressure					0 – 9.8 kPa{0 – 1,000 mmH_2O}
Lubricant pressure					0 – 1.0 MPa{0 – 10 kg/cm^2}
Fuel pressure	B	1	Adapter	795-799-5550	For measuring fuel pressure
		2	Hose	799-101-5150	
		3	Oil pressure gauge	795-799-5560	-0.1 – 0 MPa{-1.0 – 0 kg/cm^2}
		4	Oil pressure gauge	799-101-5140	2.5 MPa{25 kg/cm^2}
Intake temperature, exhaust temperature	C		Digital temperature gauge	799-101-1502	-99.9 – 1,299°C
Oil temperature, water temperature					
Troubleshooting for injector	D		Heat gun (surface temperature gauge)	795-799-5510	For carry out troubleshooting of injector
Exhaust color	E		Handy smoke tester	799-201-9000	
			Smoke meter	Commercially available	
Compression pressure	F	1	Gauge assembly	795-502-1590	6.9 MPa{70kg/cm^2}
		2	Adapter	795-611-1210	For 170-3 engine
			O-ring	6560-11-8410	
			O-ring	6560-11-8310	
			O-ring	6560-11-8210	
			O-ring	6560-11-8510	
			Gasket	6560-11-7310	
Valve clearance	G		Barring device	6162-23-4500	
			Feeler gauge	Commercially available	Intake: 0.32 mm, Exhaust: 0.62 mm
Specific gravity of battery electrolyte	H		Battery, coolant tester	795-501-1001	Temperature: –5 to – 50°C
Coolant freezing temperature				799-202-9001	Specific gravity: 1,100 – 1,300
Pressure valve function	J		Radiator cap tester	799-202-9001	0 – 0.2 MPa{0 – 2 kg/cm^2}
Leakage from cooling system					
Quality of coolant	K		Water tester	799-202-7002	PH, nitrous acid ion density

3. Measuring fuel pump outlet pressure (with sensor)

1) Insert cable **N7** in the connector of fuel pump pressure sensor (3).



2) Start the engine and measure the power source voltage of the fuel pump pressure sensor.
   - ★ Check that the power source voltage is within the following range.
   - ★ Sensor power source voltage (between (A) and (B)): 4.75 – 5.25 V

3) Run the engine at each speed and measure the signal voltage of the fuel pump pressure sensor.
   - ★ Check that the power source voltage is within the following range.
   - ★ Sensor power source voltage (between (C) and (B)):

Engine speed (rpm)	Signal voltage (V)	Fuel pump outlet port pressure (reference) (MPa{kg/cm^2})
600	1.78±0.21	0.83±0.14 {8.45±1.41}
700	1.94±0.21	0.93±0.1 {9.50±1.41}
800	2.10±0.21	1.03±0.14 {10.53±1.41}
900	2.26±0.21	1.14±0.14 {11.60±1.41}
1,000	2.42±0.21	1.25±0.14 {12.70±1.41}
1,100	2.59±0.21	1.34±0.14 {13.70±1.41}
1,200	2.76±0.21	1.46±0.14 {14.90±1.41}

VISUAL INSPECTION OF RETURN FUEL

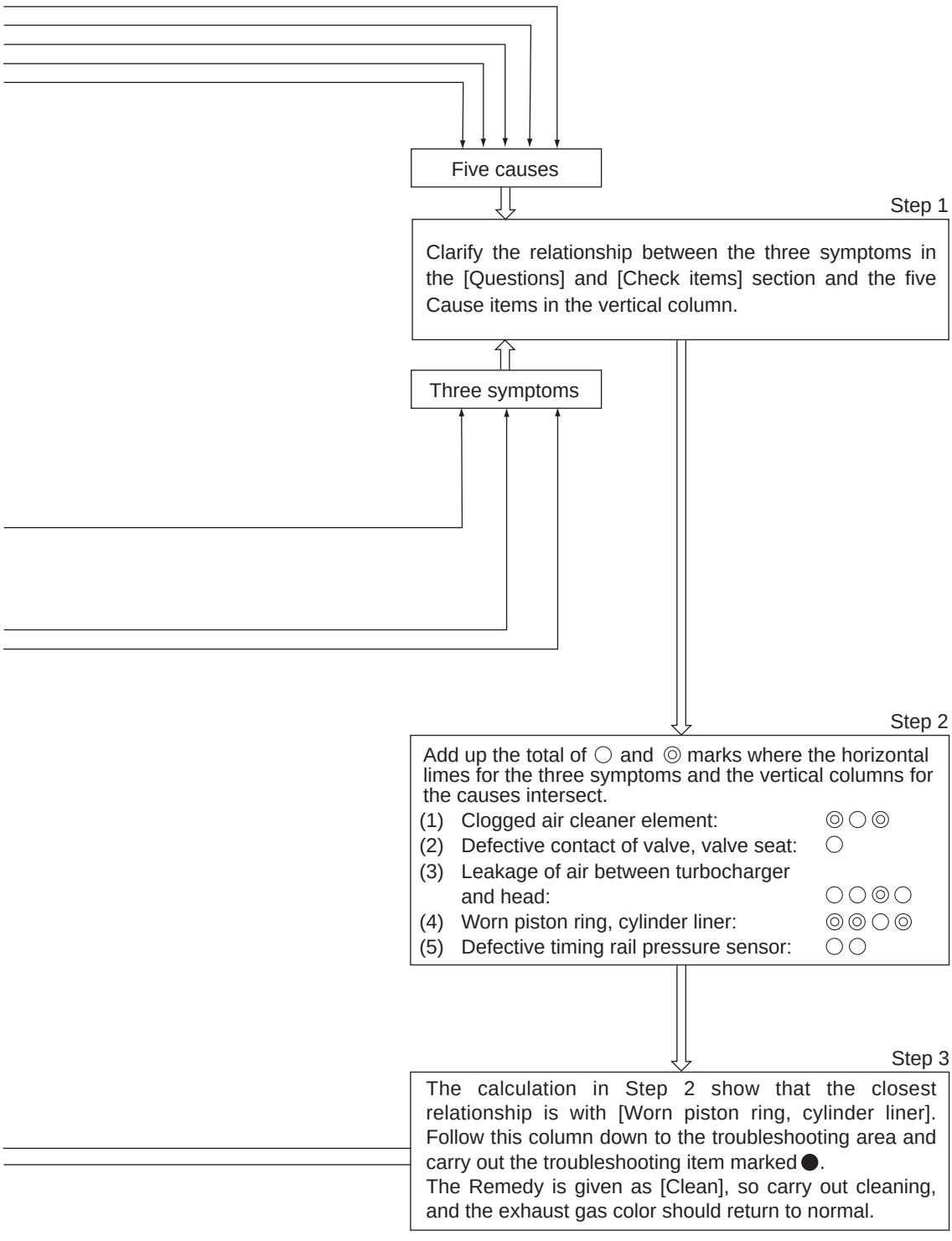
★ The fuel used for control of the timing rail in the fuel circuit and the excessive fuel that is not used injected in the fuel rail are returned from the injector through the fuel cooler to the fuel tank.
★ If the engine does not revolve normally or fuel consumption is abnormally high, inspect the return fuel according to the following procedure.

1. Disconnect the fuel return hose before the fuel tank.
   - ★ Plug the hole of the fuel tank.
   - ★ Keep the return hose open and receive the fuel with an oil pan, etc.

2. Start the engine and check that the fuel flows out of the fuel return hose smoothly.
   - ★ Fuel spillage (Reference)
     At low idling: 4 – 6 ℓ/min
     At high idling: 10 – 12 ℓ/min
   - ★ If the fuel spillage is extremely low, check the return piping and fuel cooler for clogging.

RUN-IN STANDARD

Engine	Machine model	Item		Item					
				1	2	3	4	5	6
SA6D170E-3	D375A-5	Operating time	min	3	6	3	3	10	5
		Engine speed	rpm	750	1,000	1,200	1,200	1,500	1,800
		Dynamometer load	N {kg}	0 {0}	310 {32}	690 {70}	1,470 {150}	2,190 {223}	2,890 {295}
		Output	kW {HP}	0 {0}	24 {32}	62 {83}	132 {177}	246 {330}	391 {525}
SAA6D170E-3	WA600-3	Operating time	min	3	6	3	3	10	5
		Engine speed	rpm	700	1,000	1,200	1,200	1,500	2,000
		Dynamometer load	N {kg}	0 {0}	295 {30}	590 {60}	1,180 {120}	1,765 {180}	2,355 {240}
		Output	kW {HP}	0 {0}	22 {30}	53 {71}	106 {142}	199 {266}	353 {473}
	WA700-3	Operating time	min	2	4	9	12	3	
		Engine speed	rpm	725	1,260	1,580	1,820	2,000	
		Dynamometer load	N {kg}	0 {0}	795 {81}	1,599 {163}	2,394 {244}	3,188 {325}	
		Output	kW {HP}	0 {0}	75 {10}	190 {254}	327 {438}	478 {641}	
	WD600-3	Operating time	min	3	6	3	3	10	5
		Engine speed	rpm	700	1,000	1,200	1,200	1,500	2,000
		Dynamometer load	N {kg}	0 {0}	305 {31}	620 {63}	1,275 {130}	1,885 {192}	2,470 {252}
		Output	kW {HP}	0 {0}	23 {31}	55 {74}	115 {154}	212 {284}	370 {497}
	PC1250-7	Operating time	min	2	8	2	3	5	
		Engine speed	rpm	900	1,000	1,200	1,500	1,800	
		Dynamometer load	N {kg}	0 {0}	680 {69}	1,750 {178}	2,810 {287}	3,600 {367}	
		Output	kW {HP}	0 {0}	51 {68}	164 {211}	316 {424}	485 {651}	
	HD465-7 HD605-7	Operating time	min	2	8	2	3	5	
		Engine speed	rpm	750	1,000	1,200	1,500	2,000	
		Dynamometer load	N {kg}	0 {0}	710 {72}	1,800 {184}	2,870 {293}	3,560 {363}	
		Output	kW {HP}	0 {0}	53 {71}	163 {218}	324 {434}	533 {715}	
	Generator	Operating time	min	3	6	3	3	10	5
		Engine speed	rpm	800	1,000	1,200	1,200	1,500	1,800
		Dynamometer load	N {kg}	0 {0}	540 {55}	1,080 {110}	2,160 {220}	3,240 {330}	4,310 {440}
		Output	kW {HP}	0 {0}	40 {54}	97 {130}	194 {260}	364 {488}	583 {781}
SAA6D170E2-3	DCA-800SSK2 (DENYO GENERATOR)	Operating time	min	3	6	3	3	10	5
		Engine speed	rpm	800	1,000	1,200	1,200	1,500	1,800
		Dynamometer load	N {kg}	0 {0}	698 {713}	1,396 {142}	2,791 {285}	4,187 {427}	5,570 {568}
		Output	kW {HP}	0 {0}	94 {126}	189 {253}	377 {505}	566 {758}	752 {1,009}


Five causes
Step 1
Clarify the relationship between the three symptoms in the [Questions] and [Check items] section and the five Cause items in the vertical column.
Three symptoms
Step 2
Add up the total of ○ and ◎ marks where the horizontal limes for the three symptoms and the vertical columns for the causes intersect.
(1) Clogged air cleaner element: ◎○◎
(2) Defective contact of valve, valve seat: ○
(3) Leakage of air between turbocharger and head: ○○◎○
(4) Worn piston ring, cylinder liner: ◎◎○◎
(5) Defective timing rail pressure sensor: ○○
Step 3
The calculation in Step 2 show that the closest relationship is with [Worn piston ring, cylinder liner]. Follow this column down to the troubleshooting area and carry out the troubleshooting item marked ●.
The Remedy is given as [Clean], so carry out cleaning, and the exhaust gas color should return to normal.

S-4 Engine stops during operations

General causes why engine stops during operations
- Seized parts inside engine
- There is overheating
  ★ See Troubleshooting S-14.
- Problem in power train (troubleshooting for machine)
  ★ See the manual for the machine.
- Defective HPI sensor
- Defective HPI actuator

			Causes													
			Broken dynamic valve system (valve, rocker arm, etc.)	Broken, seized piston, connecting rod	Broken, seized main bearing, connecting rod bearing	Broken, seized gear train	Insufficient fuel in tank	Clogged fuel tank cap	Loose piping, fuel filter, entry of air	Clogged fuel filter, strainer	Broken fuel pump drive shaft	Defective injector	Broken auxiliary equipment (pump, compressor, etc.)	Failure in power train (troubleshooting for machine)	Defective atmospheric pressure sensor
Questions	Confirm recent repair history															
	Degree of use of machine	Operated for long period								△						
	Condition when engine stopped	Abnormal noise was heard and engine stopped suddenly	◎	◎	◎	◎					◎		◎	◎	○
		Engine overheated and stopped		◎	○								○		
		Engine stopped slowly					◎			○					○
		There was hunting and engine stopped					◎	○		○					○
	Non-specified fuel is being used															
	Replacement of filters has not been carried out according to Operation Manual									○		◎			
Check items	Fuel level caution lamp lights up						◎								
	When fuel tank is inspected, it is found to be empty						◎								
	Air breather hole in fuel tank cap is clogged													◎	
	Rust and water are found when fuel tank is drained				◎					◎					
	Metal particles are found when oil is drained									○					
	When it is attempted to turn by hand using barring tool	Does not turn at all		◎	◎										
		Turns in opposite direction	◎												
		Moves amount of gear backlash				◎									
		Fuel pump shaft does not turn									◎				
	When engine is cranked with starting motor, and	Fuel pump outlet port coupler is pushed, almost no fuel comes out					◎			◎	◎				
		Fuel pump outlet port coupler is pushed, air comes out together with fuel						◎	◎						
	Engine turns, but stops when load is applied to machine														
Troubleshooting	Inspect dynamic valve system directly		●											Carry out troubleshooting of machine	
	Inspect piston, connecting rod directly			●											
	Inspect main bearing, connecting rod directly				●										
	Inspect gear train directly					●									
	When pressure at outlet port of fuel pump is measured, it is found to vary							●	●						
	Inspect fuel filter, strainer directly									●					
	When negative pressure at inlet port of fuel pump is measured, it is found to be high									●					
	When pressure at outlet port of fuel pump is measured, it is found to be low									●	●				
	When temperature of injector of each cylinder is measured, there are some cylinders that are low														
	Engine rotates when pump auxiliary equipment (pump, compressor, etc.) is removed											●			
	Inspect sensor directly (Output voltage and resistance)												●		
	Inspect actuator directly (Resistance and filter for clogging)														●
		Remedy	Replace	Replace	Replace	Replace	Add	Correct	Correct	Clean	Replace	Replace	Replace	—	Replace

S-10 Fuel consumption is excessive

General causes why fuel consumption is excessive
- Leakage of fuel
- Defective condition of fuel injection
- Excessive injection of fuel
- Defective HPI sensor

			Causes: Leakage of fuel inside head cover	Clogged fuel filter, strainer	Defective fuel pump	Defective injector	Cut, worn injector O-ring	Failure fuel rail pressure sensor	Failure timing rail pressure sensor	High resistance, clogged fuel return circuit	Defective atmospheric pressure sensor	Defective boost pressure sensor
Questions	Confirm recent repair history											
	Degree of use of machine	Operated for long period				△				△		
	Condition of fuel consumption	More than for other machines of same model										
		Gradually increased								◎		
		Suddenly increased	○			◎						
Check items	There is external leakage of fuel from engine		◎									
	Engine oil level rises and smells of diesel fuel											
	When engine is cranked with starting motor, and	Fuel pump outlet port coupler is pushed, almost no fuel comes out										
		Fuel pump outlet port coupler is pushed, air comes out together with fuel										
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low					◎						
	Exhaust smoke color	Black				◎	◎		◎			
		White	○									
Troubleshooting	Inspect inside of head cover directly		●									
	When negative pressure at inlet port of fuel pump is measured, it is found to be high			●								
	Inspect fuel pump directly				●							
	When temperature of injector of each cylinder is measured, there are some cylinders that are low					●						
	When pressure at outlet port of fuel pump is measured, it is found to be low						●					
	Abnormality in fuel rail pressure sensor system is indicated (*1)							●				
	Abnormality in timing rail pressure sensor system is indicated (*1)								●			
	When flow of return fuel is checked visually, it is found to be low									●		
	Inspect sensor directly (Output voltage)							●	●		●	●
		Remedy	Correct	Clean	Replace	Replace	Replace	Replace	Replace	Clean	Replace	Replace

* 1. If an error code of the fuel rail pressure sensor system or timing rail pressure sensor system is displayed, carry out the troubleshooting in "EA mode" or "EB mode".

5. **Troubleshooting**
   Use the results of the investigation and inspection in Items 2 – 4 to narrow down the causes of failure, then use the troubleshooting matrix or flowchart to locate the position of the failure more precisely.
   ★ The basic procedure for troubleshooting is as follows.
      1) Start from the simple points.
      2) Start from the most likely points.
      3) Investigate other related information.

6. **Measures to remove root cause of failure**
   Even if the failure is repaired, if the root cause of the failure is not repaired, the same failure will occur again.
   To prevent this, always investigate why the problem occurred. Then, remove the root cause.

User code	System with abnormality	Nature of abnormality	Condition when normal
222	Abnormality in atmospheric pressure sensor system low level	• Abnormality has occurred in atmospheric pressure sensor circuit ECMA (34): 0.20 V or less detected	• Voltage of atmospheric pressure sensor Between ECMA (6) and (17) (power source): 4.75 – 5.25 V Between ECMA (34) and (17) (signal): 0.42 – 0.58 V (engine stopped)
234	Overspeed	• Engine speed sensor has detected speed higher than set speed Judgment value (reference): D375A :2,400 rpm or more WA600 :2,500 rpm or more PC1100 :2,400 rpm or more Morita :2,550 rpm or more	—
254	Abnormality in fuel shut-off valve system voltage	• Abnormality has occurred in fuel shut-off valve circuit Between ECMA (30) and (8): Voltage of 6.0 V or less or resistance of 20 Ω or less detected	• Resistance of fuel shut-off valve Between FSO (+) and (-): 23 – 40 Ω
259	Abnormality in fuel shut-off valve	• Fuel shut-off valve remains open and does not close (even when electric power is turned off, engine does not stop)	—
261	Abnormal rise in fuel temperature	• Fuel temperature sensor has detected temperature higher than set temperature Judgment value (reference): 76°C or more	—
263	Abnormality in fuel temperature sensor system high level	• Abnormality has occurred in fuel temperature sensor circuit ECMA (26): 4.95 V or more detected	• Resistance of fuel temperature sensor Between FTS (A) and (B): 600 – 36k Ω
265	Abnormality in fuel temperature sensor system low level	• Abnormality has occurred in fuel temperature sensor circuit ECMA (26): 0.21 V or less detected	• Resistance of fuel temperature sensor Between FTS (A) and (B): 600 – 36k Ω
316	Abnormality in fuel pump actuator system current	• Abnormality has occurred in fuel pump actuator circuit Between ECMA (11) and (40) (reference value): Detected value outside range of 0.40±0.35A (engine stopped)	• Resistance of fuel pump actuator Between PUMP (A) and (C): 7 – 9 Ω
318	Abnormality in fuel pump actuator	• Excessive difference between fuel pump command pressure value and actual pressure Judgment value (reference): Difference more than ±2.11 MPa {2.1 kg/cm^2} (when coolant temperature is 38°C or above)	—
343	Abnormality in controller internal communication	• Microprocessor error inside controller	—
346	Abnormality in controller power down	• Error in data recorded in power-down internal memory of controller	—
384	Abnormality in preheating heater control system	• Abnormality has occurred in preheating heater control circuit ECMB (2): Circuit open or short circuit in circuit detected	• Resistance of heater relay Between relay coils: 000 – 000 Ω
415	Abnormal drop in oil pressure (level 2)	• Oil pressure sensor detected pressure lower than set oil pressure (level 2) Level 1 judgment value (reference) At 600 rpm Max. 0.04 MPa {0.4 kg/cm^2} At 1,000 rpm Max. 0.08 MPa {0.8 kg/cm^2} At 1,500 rpm Max. 0.13 MPa {1.3 kg/cm^2} At 1,800 rpm Max. 0.16 MPa {1.6 kg/cm^2} At 2,000 rpm Max. 0.18 MPa {1.8 kg/cm^2}	—

EA-5 Error code [116] (Abnormality in timing rail pressure sensor system high level)

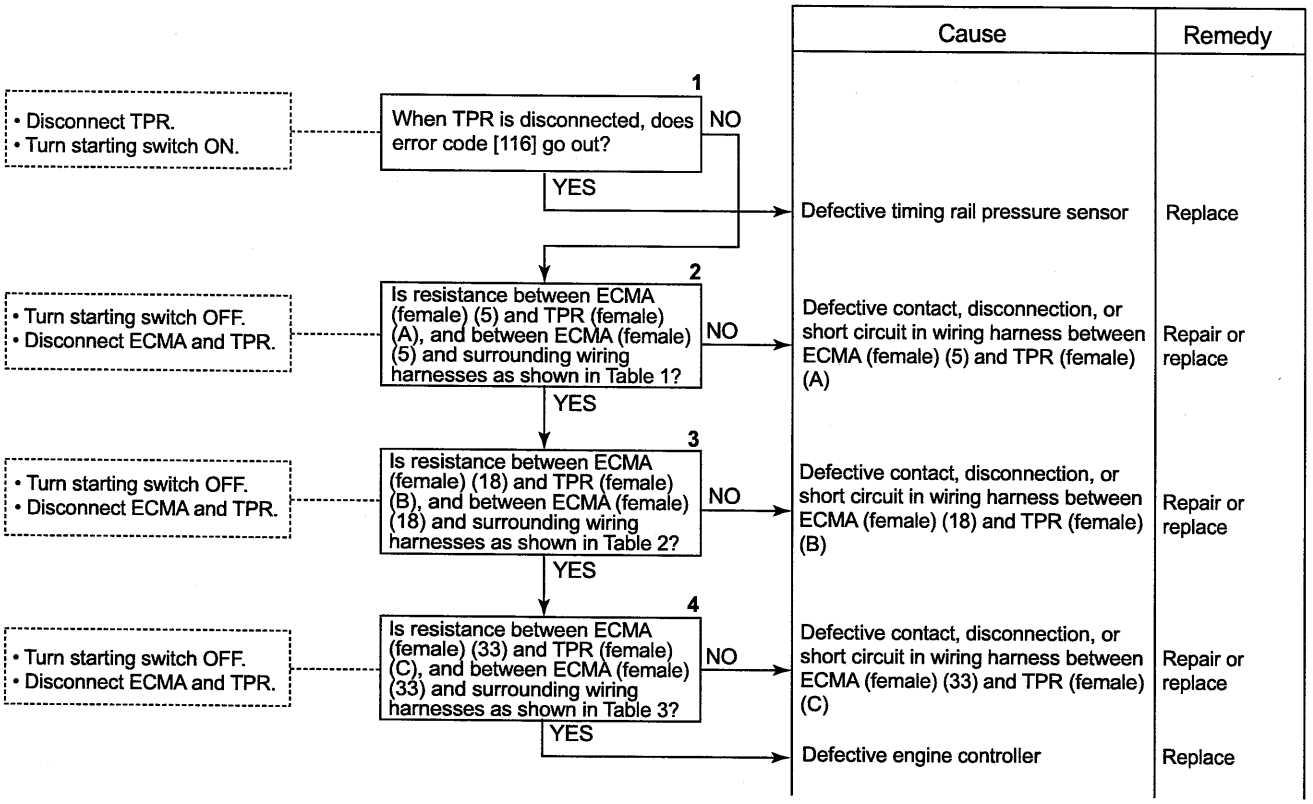


Table 1

ECMA (female), TPR (female)	Resistance value
Between ECMA (5) and TPR (A)	Max. 10Ω
Between ECMA (5) and surrounding wiring harnesses	Min. 1 MΩ

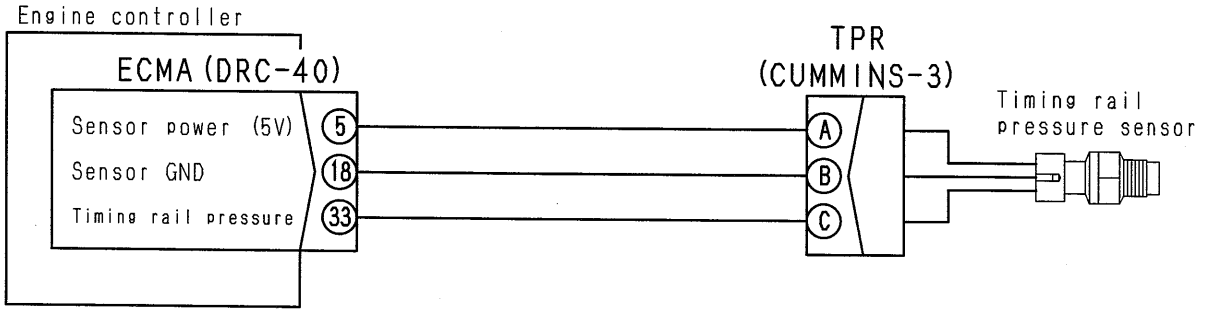
Table 2

ECMA (female), SP1 (female)	Resistance value
Between ECMA (18) and TPR (B)	Max. 10Ω
Between ECMA (18) and surrounding wiring harnesses	Min. 1 MΩ

Table 3

ECMA (female), TPR (female)	Resistance value
Between ECMA (33) and TPR (C)	Max. 10Ω
Between ECMA (33) and surrounding wiring harnesses	Min. 1 MΩ

EA-5 Related electrical circuit diagram



BXE00013

EA-16 Error code [135] (Abnormality in oil pressure sensor system high level)

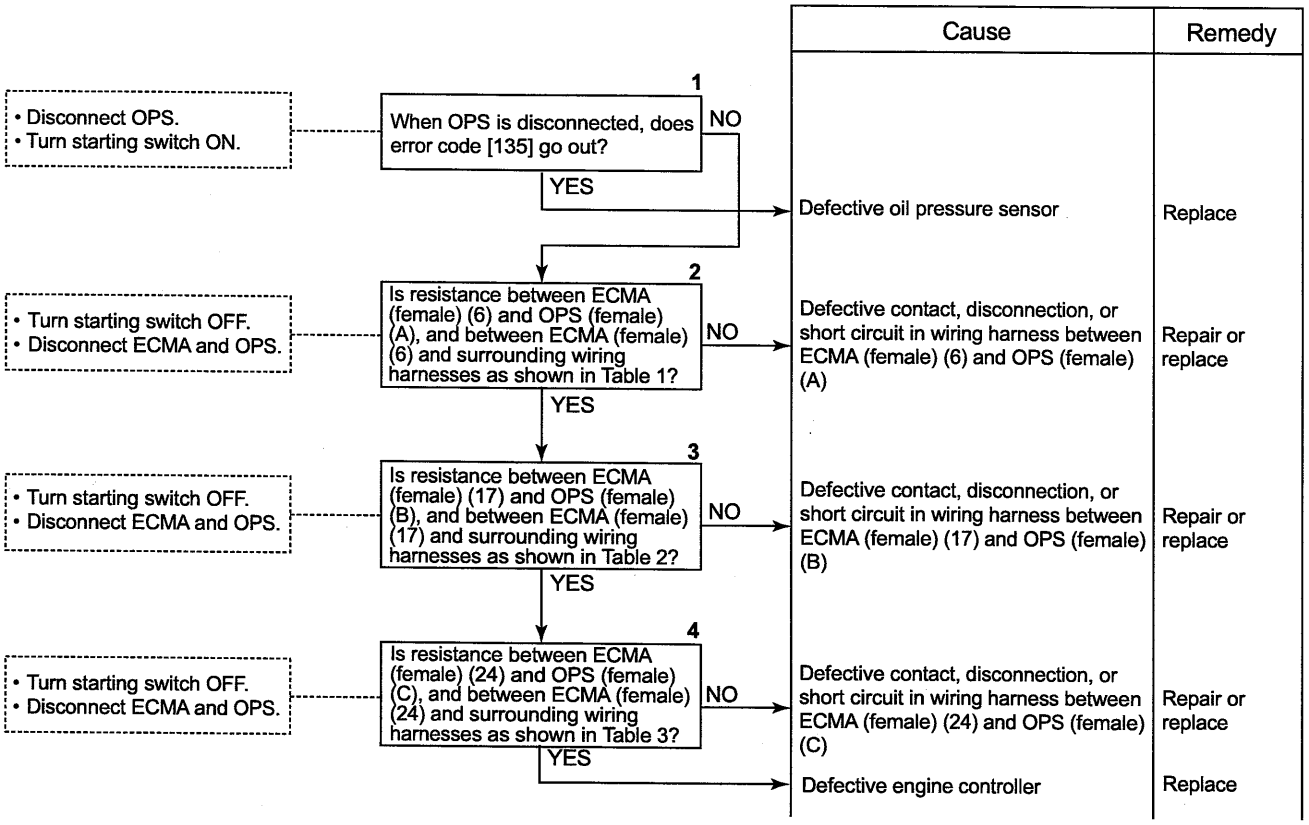


Table 1

ECMA (female), OPS (female)	Resistance value
Between ECMA (6) and OPS (A)	Max. 10Ω
Between ECMA (6) and surrounding wiring harnesses	Min. 1 MΩ

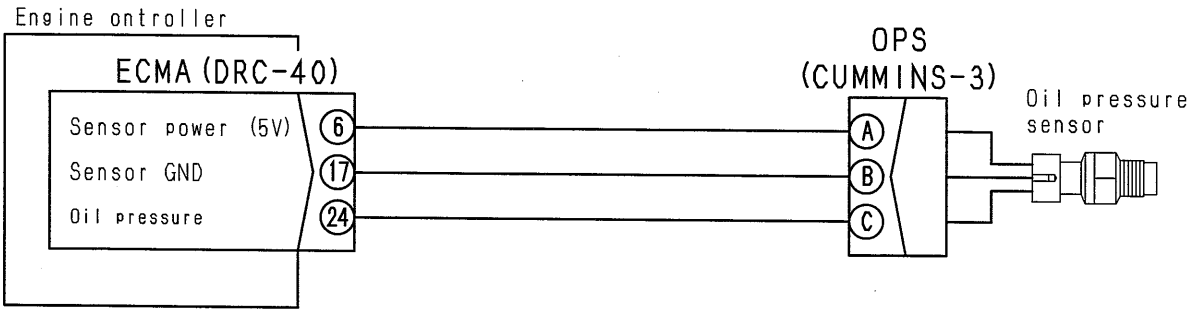
Table 2

ECMA (female), OPS (female)	Resistance value
Between ECMA (17) and OPS (B)	Max. 10Ω
Between ECMA (17) and surrounding wiring harnesses	Min. 1 MΩ

Table 3

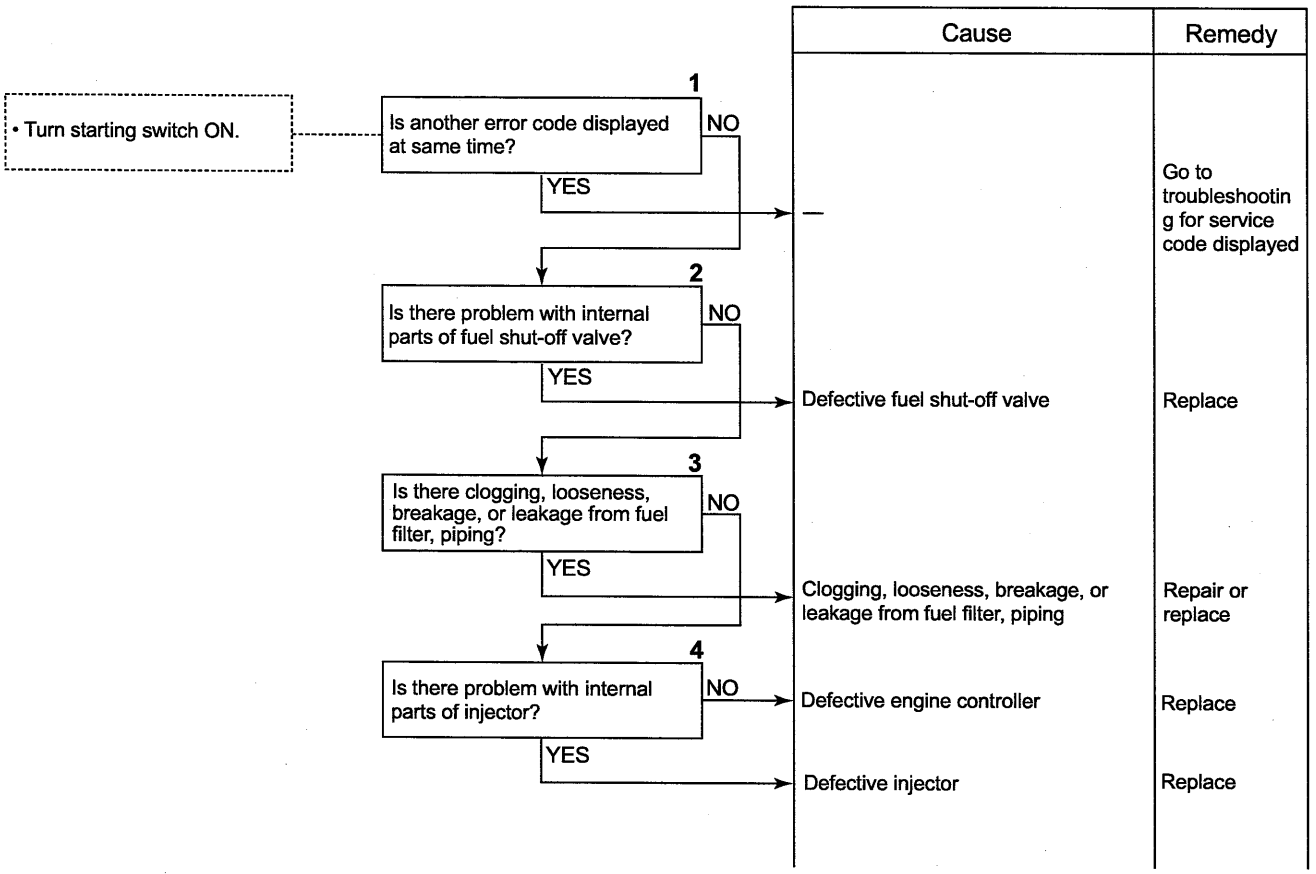
ECMA (female), OPS (female)	Resistance value
Between ECMA (24) and OPS (C)	Max. 10Ω
Between ECMA (24) and surrounding wiring harnesses	Min. 1 MΩ

EA-16 Related electrical circuit diagram

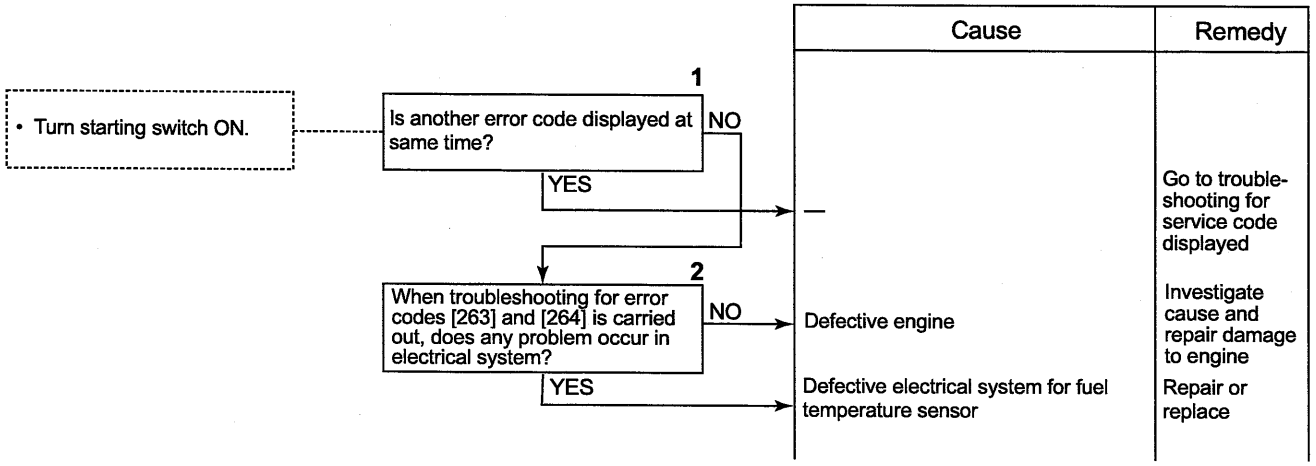


BXE00018

EA-28 Error code [259] (Abnormality in fuel shut-off valve)



EA-29 Error code [261] (Abnormal rise in fuel temperature)



EA-40 Error code [432] (Idling validation process error)

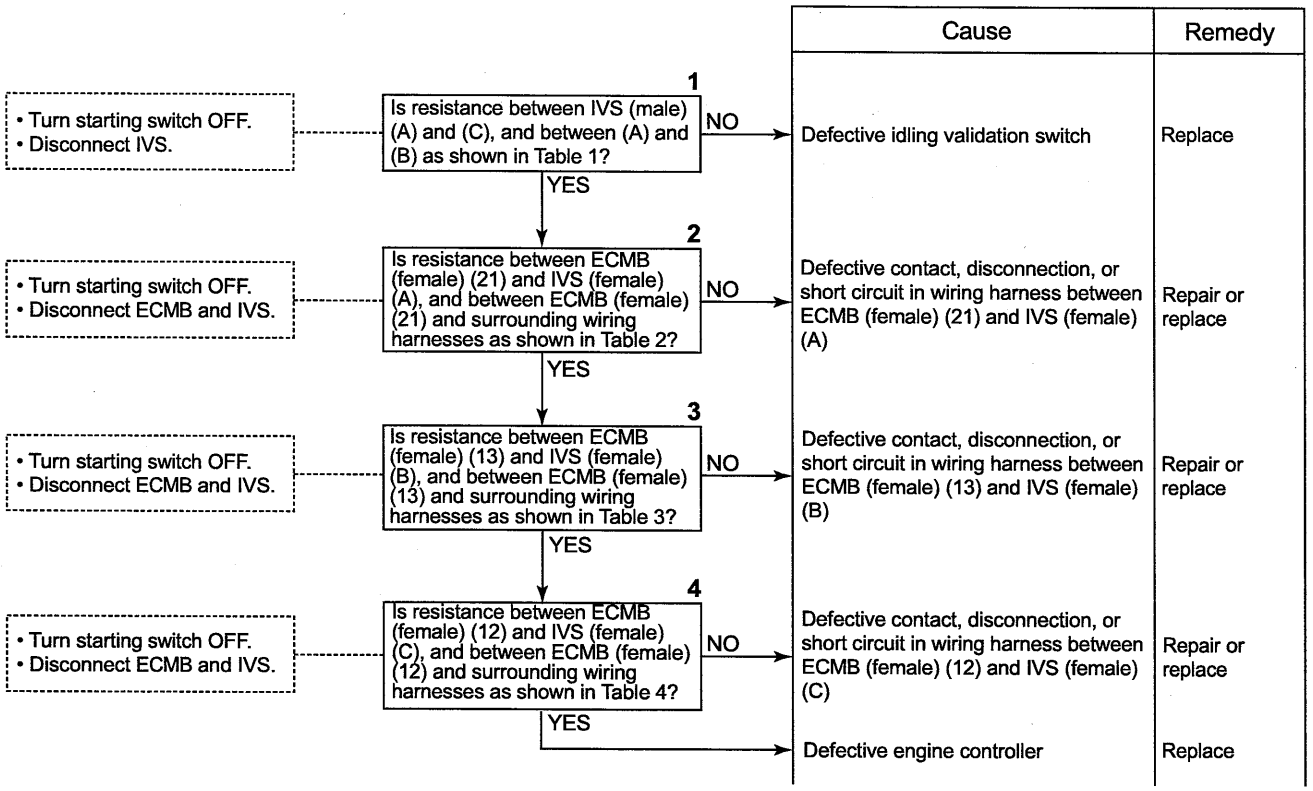


Table 1

IVS (male)	Pedal	Resistance value
Between (A) and (C)	Released or depressed	2,000 – 3,000Ω
Between (B) and (C)	Released (idling ON)	1,500 – 3,000Ω
	Depressed (idling OFF)	200 – 1,500Ω

Table 2

ECMB (female), IVS (female)	Resistance value
Between ECMA (21) and IVS (A)	Max. 10Ω
Between ECMB (21) and surrounding wiring harnesses	Min. 1 MΩ

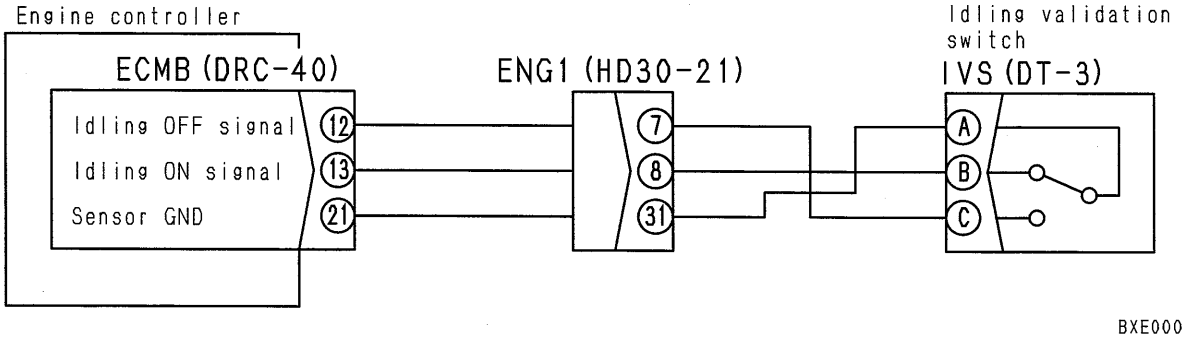
Table 3

ECMB (female), IVS (female)	Resistance value
Between ECMB (13) and IVS (B)	Max. 10Ω
Between ECMB (13) and surrounding wiring harnesses	Min. 1 MΩ

Table 4

ECMB (female), IVS (female)	Resistance value
Between ECMB (12) and IVS (C)	Max. 10Ω
Between ECMB (12) and surrounding wiring harnesses	Min. 1 MΩ

EA-40 Related electrical circuit diagram



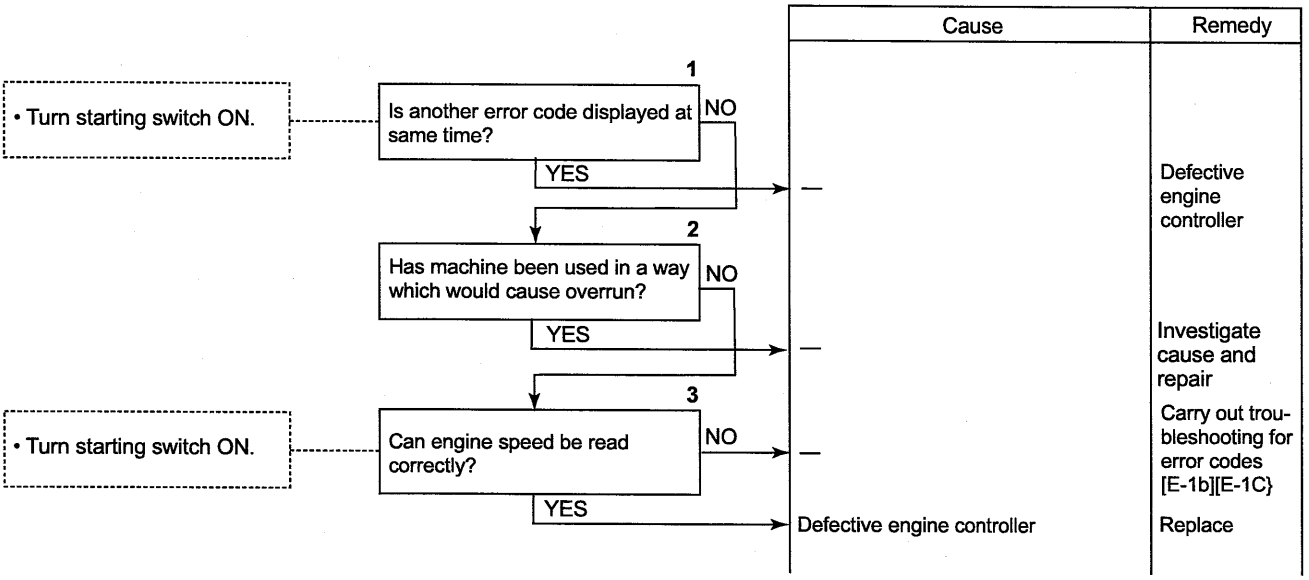
BXE00027

TROUBLESHOOTING OF CONTROLLER SYSTEM OF ENGINE FOR GENERATOR EQUIPMENT (EB MODE)

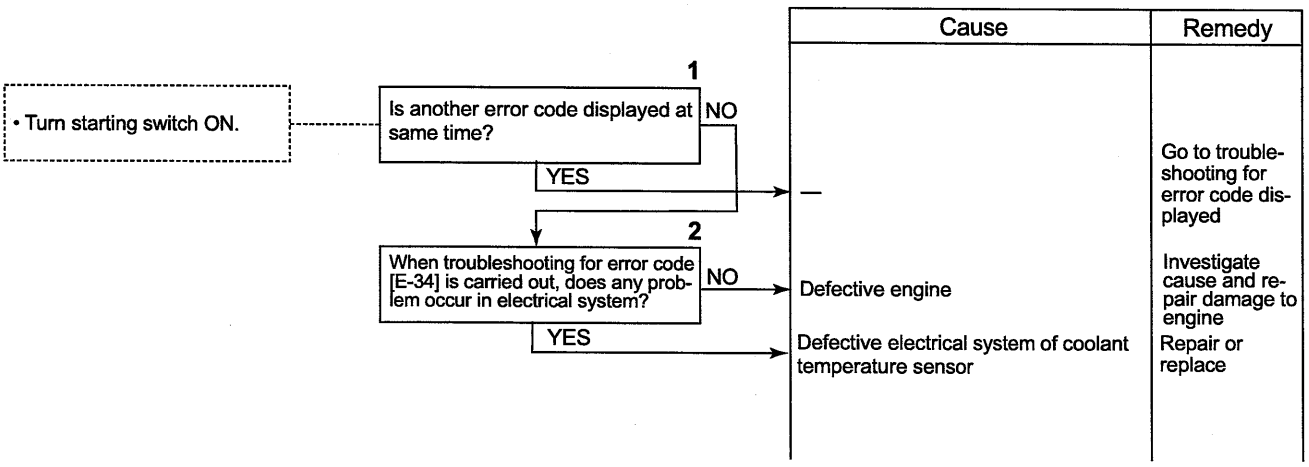
★ This section gives an outline of the troubleshooting procedures for the electrical systems related to the engine proper and the engine controller (for construction equipment).
When carrying out troubleshooting of the electrical system with the engine mounted on the machine, use this section and the shop manual for the machine.

Action by controller	Problem that appears on machine	Probable cause
• Controls injection rate open	—	• Defective fuel rail pressure sensor • Defective wiring harness and connector of fuel rail pressure sensor circuit • Defective engine controller
• Controls injection rate open	—	• Defective fuel rail pressure sensor • Defective wiring harness and connector of fuel rail pressure sensor circuit • Defective engine controller
• Controls injection rate open	—	• Defective engine • Leakage of fuel, clogging • Defective fuel rail actuator or clogged screen • Defective injector O-ring • Defective engine controller
• Stops engine • Outputs alarm	—	• Defective fuel rail actuator • Defective wiring harness and connector of fuel rail actuator circuit • Defective engine controller
• Controls injection rate open	—	• Defective timing rail pressure sensor • Defective wiring harness and connector of timing rail pressure sensor circuit • Defective engine controller
• Controls injection rate open	—	• Defective timing rail pressure sensor • Defective wiring harness and connector of timing rail pressure sensor circuit • Defective engine controller
• Controls injection rate open	—	• Defective timing rail pressure sensor • Defective wiring harness and connector of timing rail pressure sensor circuit • Defective engine controller
• Controls injection rate open	• Abnormal combustion sound or white smoke is produced	• Leakage of fuel, clogging • Defective timing rail actuator or clogged screen • Defective injector O-ring • Defective engine controller
• Stops engine • Outputs alarm	—	• Defective timing rail actuator • Defective wiring harness and connector of timing rail actuator circuit • Defective engine controller
• Carries out open control of fuel pump	—	• Defective fuel pump pressure sensor • Defective wiring harness and connector of fuel pump pressure sensor circuit • Defective engine controller
• Carries out open control of fuel pump	—	• Defective fuel pump pressure sensor • Defective wiring harness and connector of fuel pump pressure sensor circuit • Defective engine controller

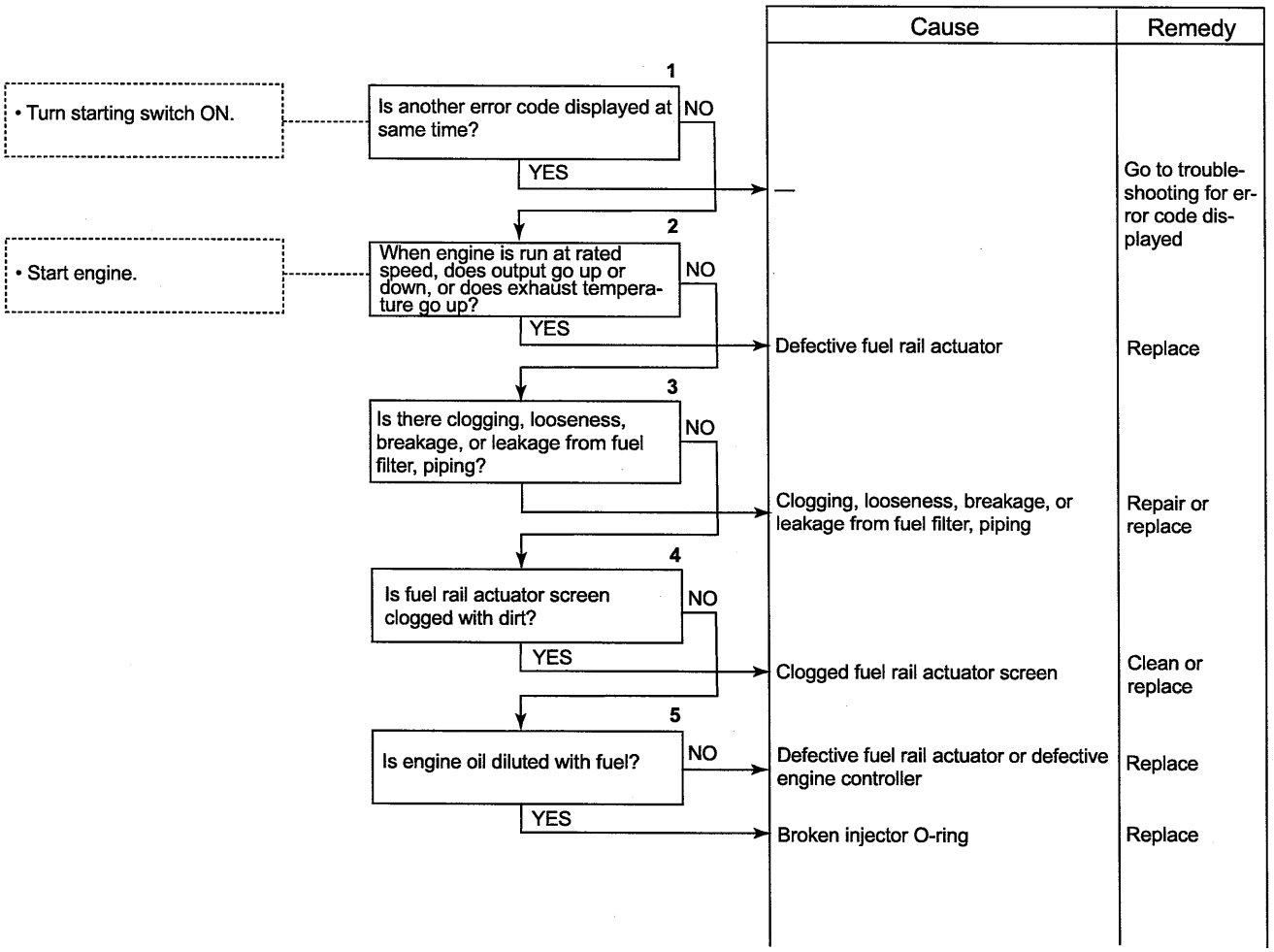
EB-6 Error code [E-22] (Overrun)



EB-7 Error code [E-23] (Overheat)



EB-17 Error code [E-73] (Abnormality in fuel rail actuator)



EB-25 Error code [E-91] (Abnormality in fuel pump pressure sensor system low level)

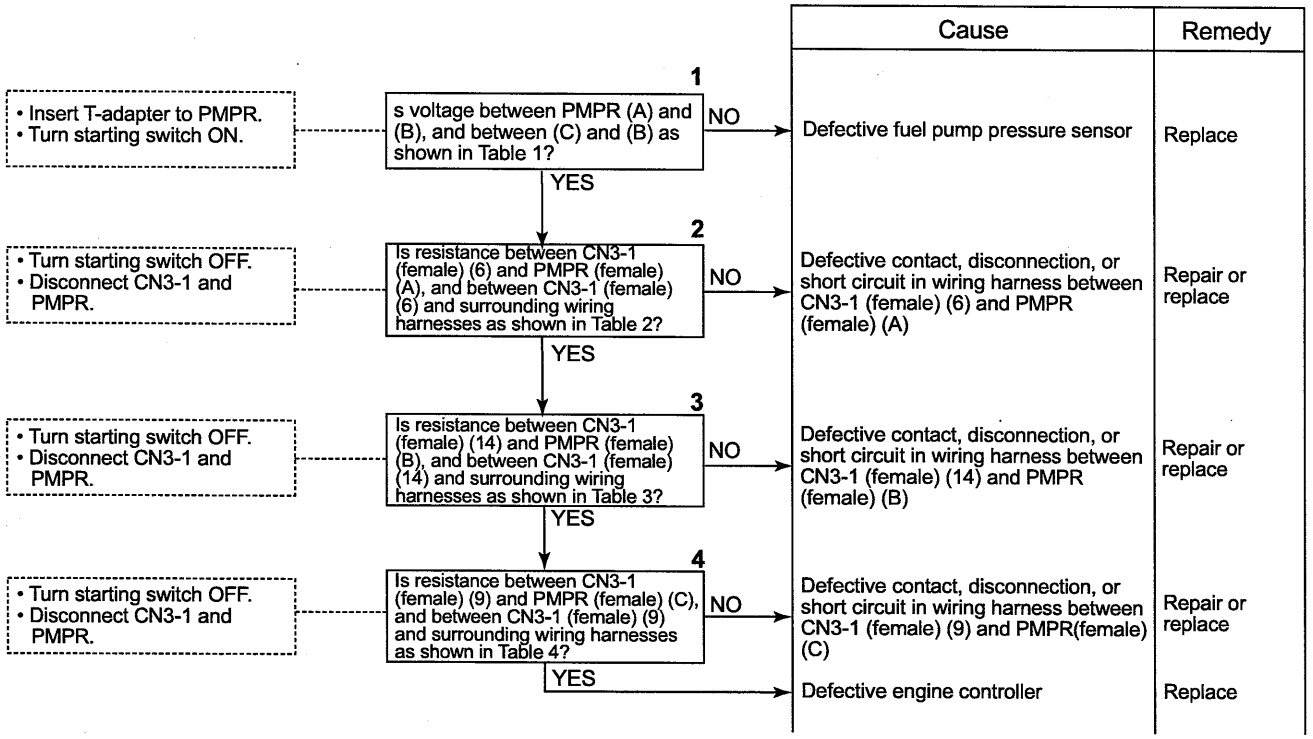


Table 1

PMPR	Voltage
Between (A) and (B)	4.75 – 5.25 V
Between (C) and (B)	0.42 – 0.58 V

Table 2

CN3-1 (female), PMPR (female)	Resistance value
Between CN3-1 (6) and PMPR (A)	Max. 10Ω
Between CN3-1 (6) and surrounding wiring harnesses	Min. 1 MΩ

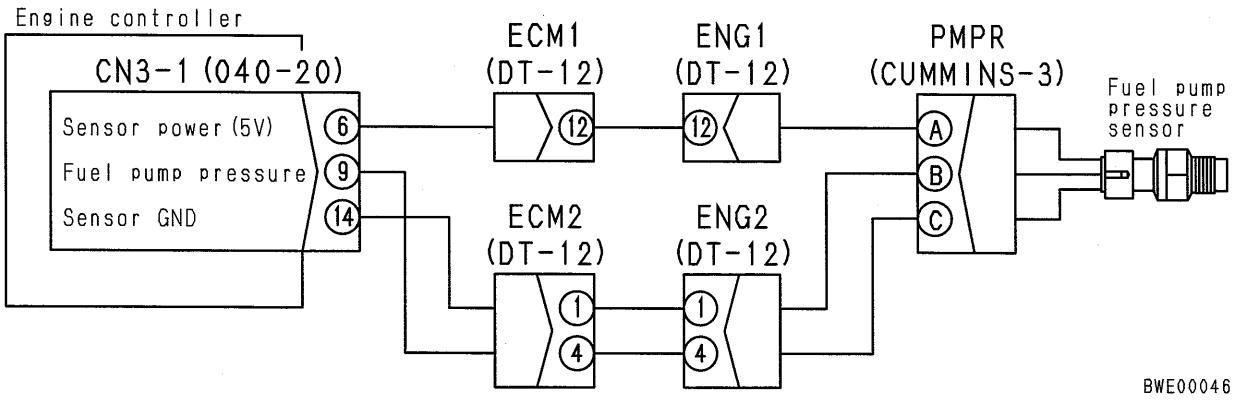
Table 3

CN3-1 (female), PMPR (female)	Resistance value
Between CN3-1(14) and PMPR (B)	Max. 10Ω
Between CN3-1 (14) and surrounding wiring harnesses	Min. 1 MΩ

Table 4

CN3-1 (female), PMPR (female)	Resistance value
Between CN3-1 (9) and PMPR (C)	Max. 10Ω
Between CN3-1 (9) and surrounding wiring harnesses	Min. 1 MΩ

EB-25 Related electrical circuit diagram



EB-35 Error code [E-b3] (Abnormality in boost air pressure sensor system low level)

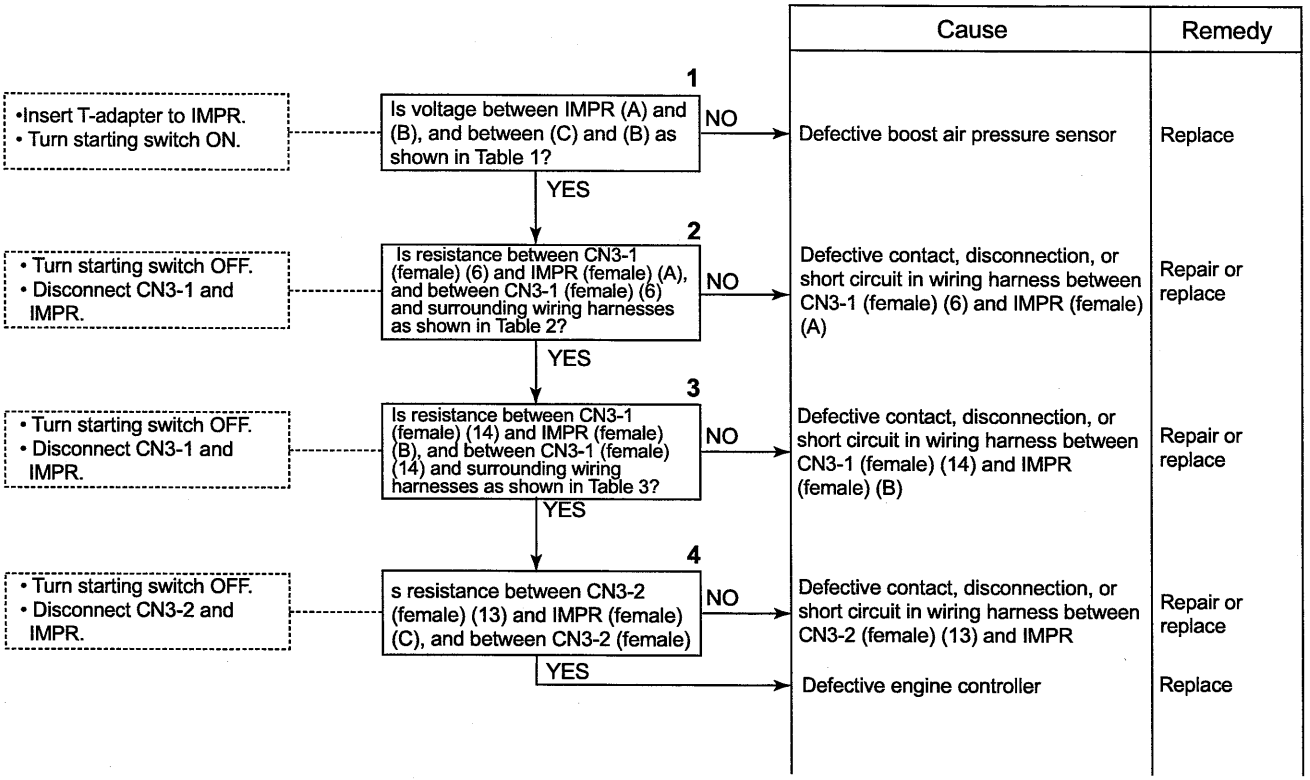


Table 1

IMPR	Voltage
Between (A) and (B)	4.75 – 5.25 V
Between (C) and (B)	0.42 – 0.58 V

Table 2

CN3-1 (female), IMPR (female)	Resistance value
Between CN3-1 (6) and IMPR (A)	Max. 10Ω
Between CN3-1 (6) and surrounding wiring harnesses	Min. 1 MΩ

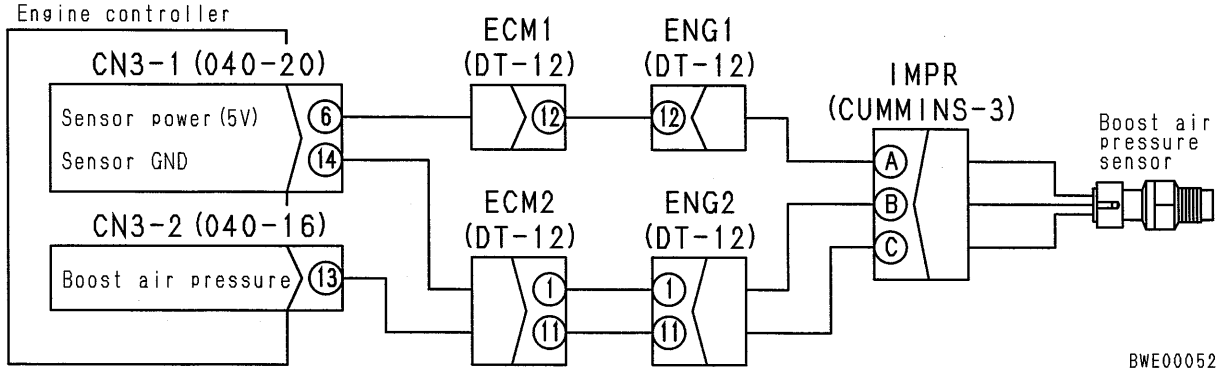
Table 3

CN3-1 (female), IMPR (female)	Resistance value
Between CN3-1 (14) and IMPR (B)	Max. 10Ω
Between CN3-1 (14) and surrounding wiring harnesses	Min. 1 MΩ

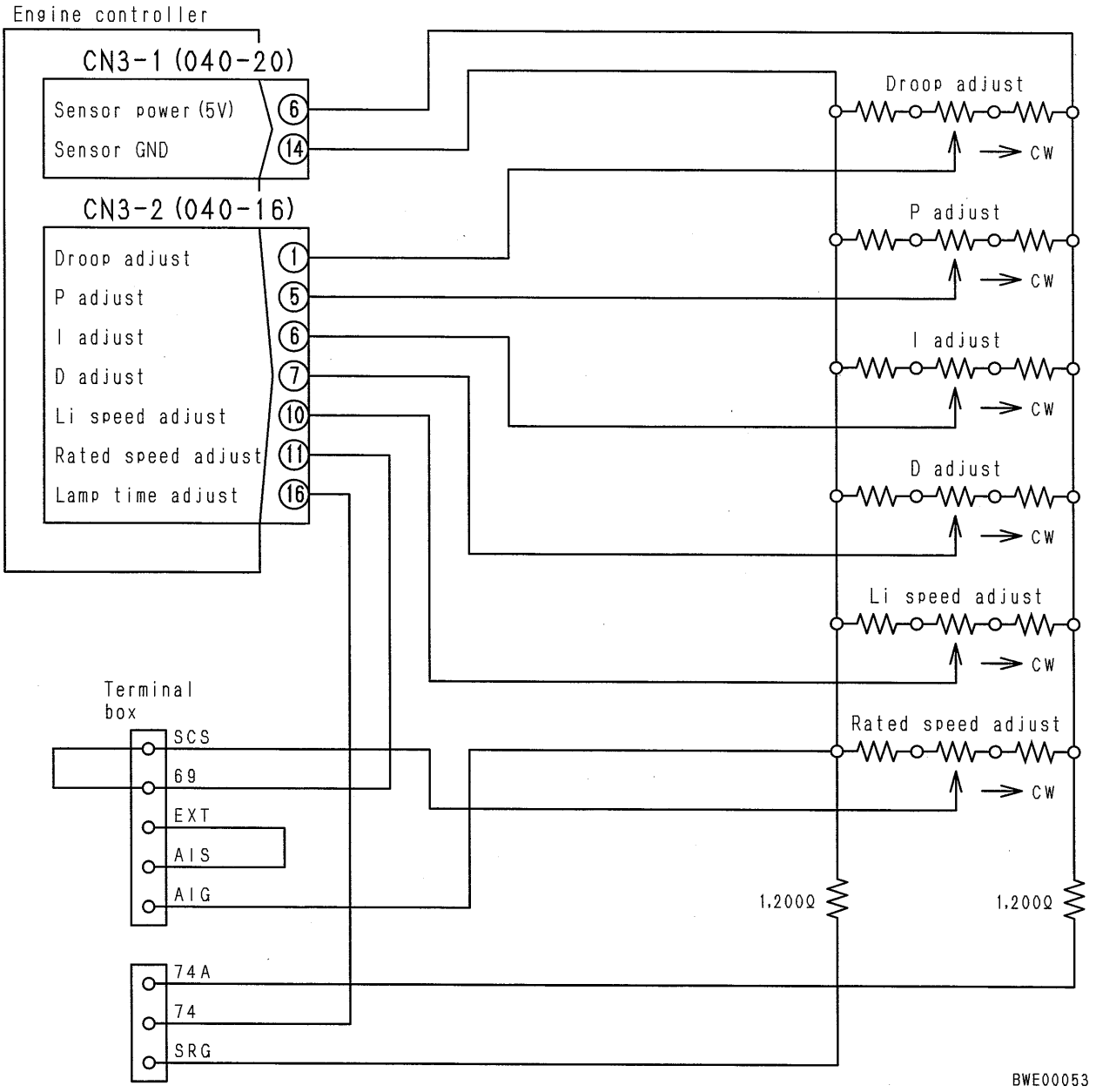
Table 4

CN3-2 (female), IMPR (female)	Resistance value
Between CN3-2 (13) and IMPR (C)	Max. 10Ω
Between CN3-2 (13) and surrounding wiring harnesses	Min. 1 MΩ

EB-35 Related electrical circuit diagram



EB-41 Related electrical circuit diagram



2. Precautions when carrying out installation work

- Tighten all bolts and nuts (sleeve nuts) to the specified (KES) torque.
- Install the hoses without twisting or interference.
- Replace all gaskets, O-rings, cotter pins, and lock plates with new parts.
- Bend the cotter pins and lock plates securely.
- When coating with adhesive, clean the part and remove all oil and grease, then coat the threaded portion with 2 – 3 drops of adhesive.
- When coating with gasket sealant, clean the surface and remove all oil and grease, check that there is no dirt or damage, then coat uniformly with gasket sealant.
- Clean all parts, and correct any damage, dents, burrs, or rust.
- Coat rotating parts and sliding parts with engine oil.
- When press fitting parts, coat the surface with anti-friction compound (LM-P).
- After fitting snap rings, check that the snap ring is fitted securely in the ring groove.
- When connecting wiring connectors, clean the connector to remove all oil, dirt, or water, then connect securely.
- When using eyebolts, check that there is no deformation or deterioration, screw them in fully, and align the direction of the hook.
- When tightening split flanges, tighten uniformly in turn to prevent excessive tightening on one side.

★ When operating the hydraulic cylinders for the first time after reassembling cylinders, pumps and other hydraulic equipment removed for repair, always bleed the air as follows:

1. Start the engine and run at low idling.
2. Operate the work equipment control lever to operate the hydraulic cylinder 4 – 5 times, stopping the cylinder 100 mm from the end of its stroke.
3. Next, operate the hydraulic cylinder 3 – 4 times to the end of its stroke.
4. After doing this, run the engine at normal speed.

★ When using the machine for the first time after repair or long storage, follow the same procedure.

3. Precautions when completing the operation

- If the coolant has been drained, tighten the drain valve, and add water to the specified level. Run the engine to circulate the water through the system. Then check the water level again.
- If the hydraulic equipment has been removed and installed again, add engine oil to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.
- If the piping or hydraulic equipment have been removed, always bleed the air from the system after reassembling the parts.
  - ★ For details, see TESTING AND ADJUSTING, Bleeding air.
  - Add the specified amount of grease (molybdenum disulphide grease) to the work equipment parts.

23. Cylinder head assembly

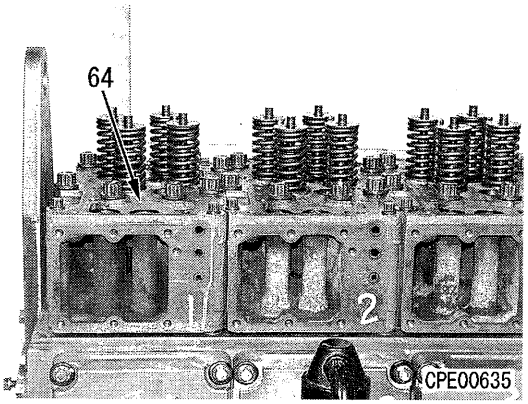
1) Lift off 6 cylinder head assemblies (64).

⚠ There is danger of damaging the thread, so never use an impact wrench to loosen the mounting bolts.

kg Cylinder head assembly: **60 kg**

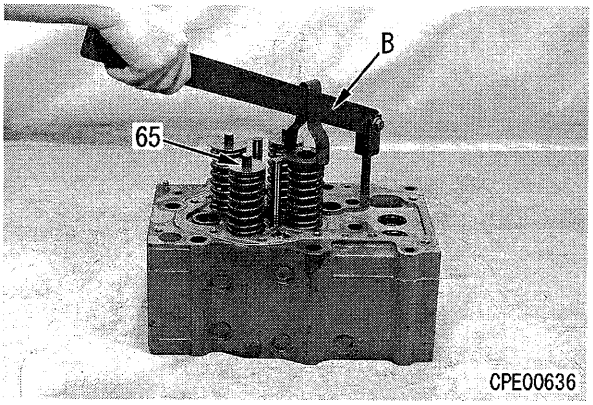
★ Fit tags and keep in sets for each cylinder No.

2) Remove 6 cylinder head gaskets.



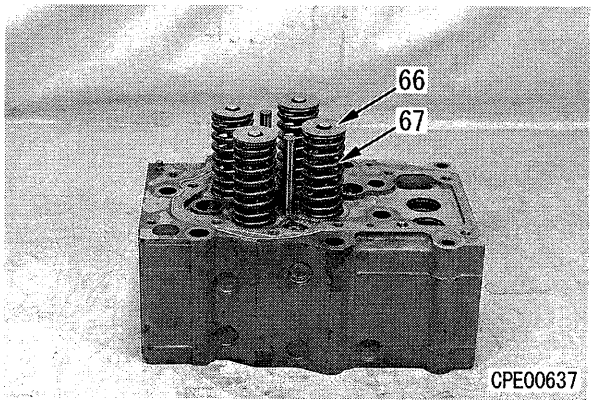
3) Disassemble cylinder head assembly as follows.

i) Using tool B, compress valve spring and remove 8 valve cotters (65).

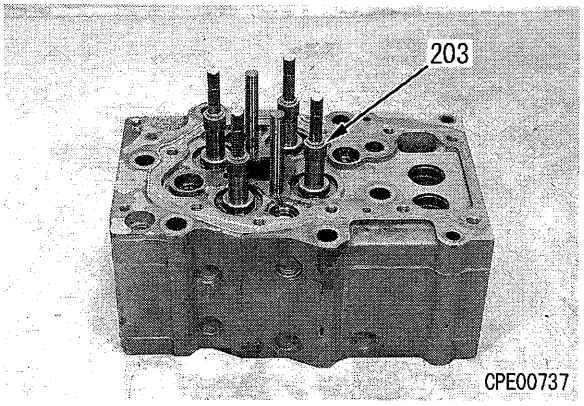


ii) Remove 4 spring seats (66).

iii) Remove 4 valve springs (67).

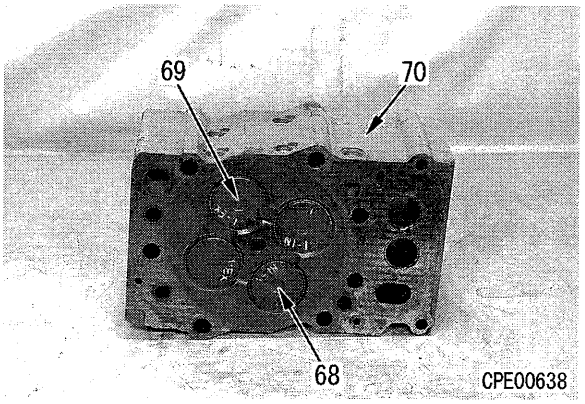


iv) Remove 4 valve stem seals (203).



v) Remove 2 intake valves (68) and 2 exhaust valves (69) from cylinder head (70).

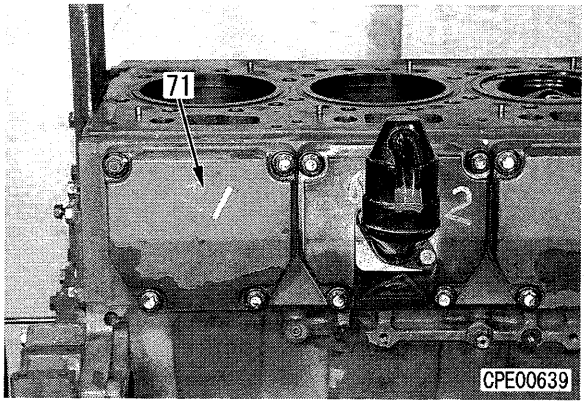
★ For details of the procedure for replacing the valve guide, valve seat, and plug, see REBUILDING AND REPLACING.



24. Cam follower cover

Remove 6 cam follower covers (71).

★ The position of the breather differs according to the machine it is mounted on.

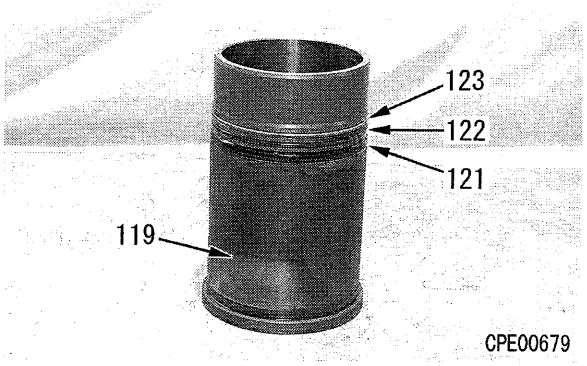


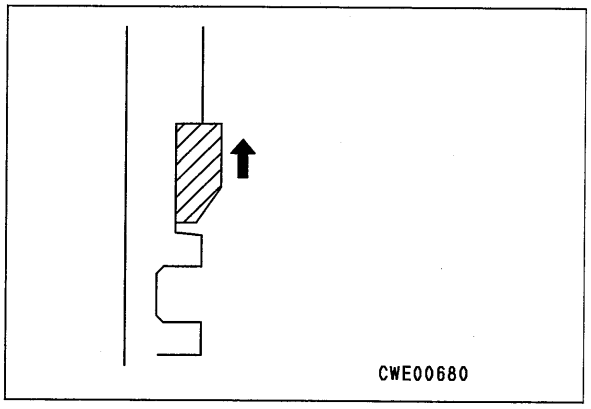
2. Cylinder liner

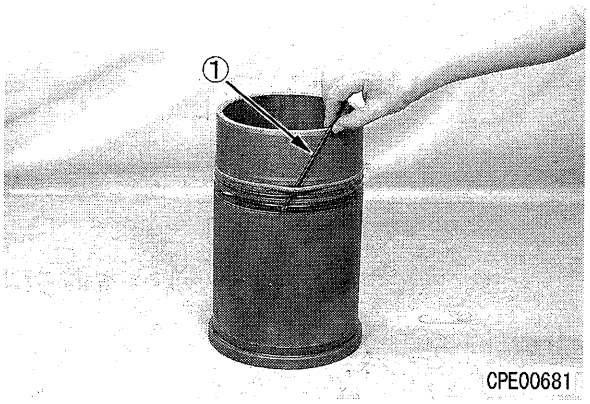
1) Insert clevis seal (121), O-ring [black] (122), and O- ring [red] (123) to cylinder liner (119).
   - ★ Check that there is not dirt or any burrs, flushes, or other damage to the liner O-ring groove.
   - ★ Assemble the clevis seal with the chamfered side facing down, and to prevent twisting, push the whole circumference down from the top so that it fits into the seal groove.

   O-ring: **Rubber lubricant (RF-1)**

   - ★ Immediately before installing, soak the part of the O- ring that is installed to the liner in rubber lubricant. Do not soak it for a long time.
   - ★ After installing the O-ring, check that it is not twisted. If any twisting is found, use a smooth bar ① (approx. ϕ 10 mm) to remove the twisting.
   - ★ Do not remove the twisting of the clevis seal.







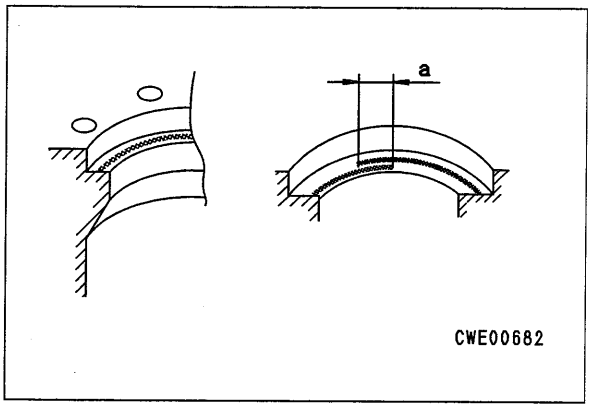
2) Coat the cylinder block with gasket sealant and rubber lubricant.
   - ★ Use compressed air or a cloth to wipe off all the dirt or oil from the surface of the cylinder block to be coated with gasket.

   Outside circumference of cylinder block deck: **Gasket sealant (LG-6)**

   - ★ Width of gasket sealant: ϕ 2 – 3 mm
     Gasket sealant overlap **a**: 6 ± 6 mm
   - ★ If the parts are left for a long time after coating with gasket sealant, the surface will start to become hard, so complete assembly to the cylinder block within 50 minutes of coating the cylinder liner with gasket sealant.

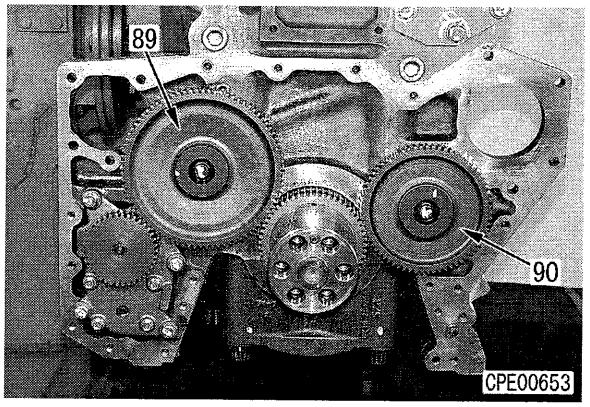
   Cylinder block O-ring guide, bore: Rubber lubricant **(RF-1)**

   - ★ Coat the cylinder block O-ring guide portion and O-ring bore uniformly with rubber lubricant.



2) Install idler gear [small] (90) and idler gear [large] (89).

kgm Mounting bolt:
245 – 309 Nm {25.0 – 31.5 kgm}



12. Measurement of gear backlash (front)

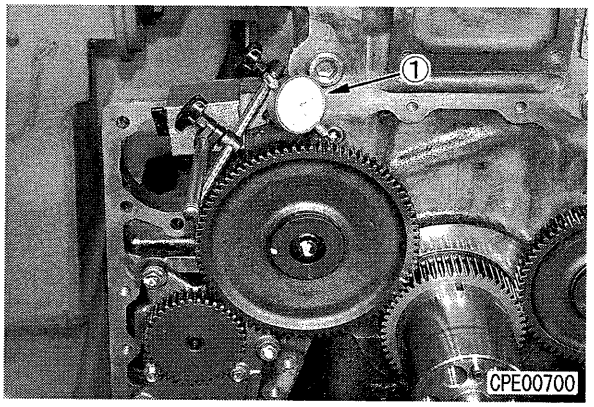
Using dial gauge ①, measure backlash of front accessory gear portion.

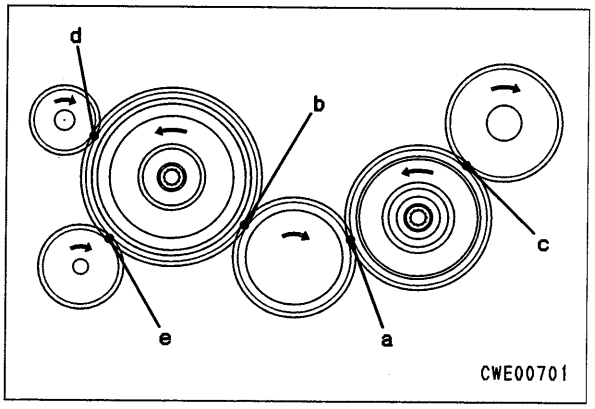
★ Set the dial gauge against the tip of the tooth of the gear to be measured, hold the other gear in position, and measure the backlash.

★ Standard value of backlash:

Measurement position	Backlash (mm)
a	0.144 – 0.320
b	0.134 – 0.362
c	0.114 – 0.320
d	0.121 – 0.333
e	0.121 – 0.333

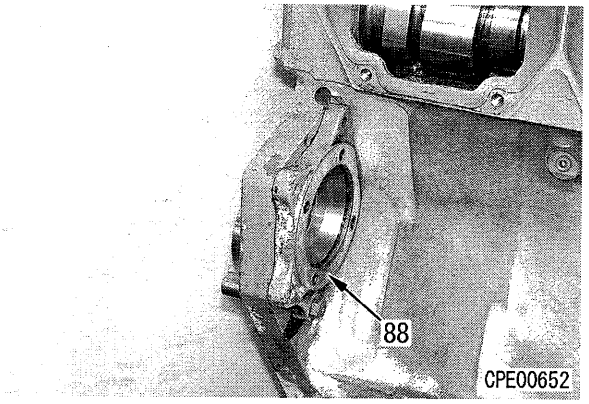
★ If it it not within the standard value, take the necessary action. For details, see MAINTENANCE STANDARD.





13. Front cover

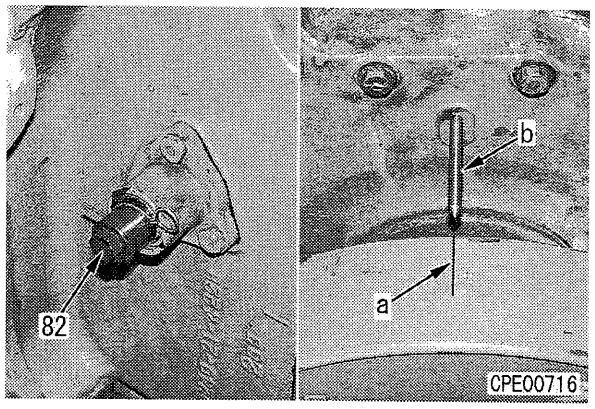
1) Fit O-ring and install bracket (88).



30. Adjustment of valve clearance

★ Adjustment of the valve clearance can be carried out at the same time as the next step (Adjustment of injector).

1) Crank the crankshaft with barring device (82), align 1.6 TOP line **a** on damper with pointer **b**, and set No. 1 cylinder to compression top dead center.
   ★ After aligning the line and pointer, rotate the crankshaft forward and backward and watch the movement of the push rod to check that the No. 1 cylinder is in the compression stroke. (If the push rod does not move, the cylinder is in the compression stroke.)



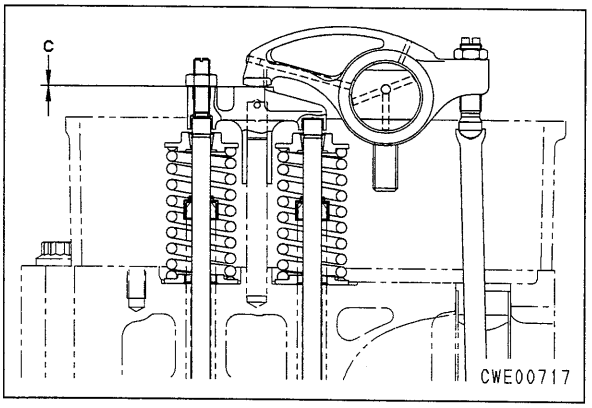
2) Insert specified thickness of tool **M** in clearance **c** between rocker arm and crosshead and adjust valve clearance.
   ★ Valve clearance (when cold)

Intake valve	Exhaust valve
0.32 ± 0.02 mm	0.62 ± 0.02 mm

   ★ Insert tool **M**, turn the adjustment screw, and adjust the adjustment screw so that tool **M** is a sliding fit.

3) Secure adjustment screw and tighten locknut.

   kgm Locknut:
   57.8 – 77.4 Nm {5.9 – 7.9 kgm}



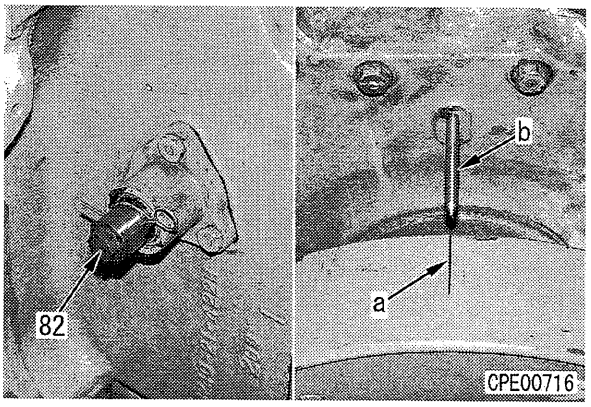
4) Crank the crankshaft 120° each time in the normal direction and repeat Steps 1) – 3) to adjust each cylinder according to the firing order.
   ★ Firing order: 1 – 5 – 3 – 6 – 2 – 4

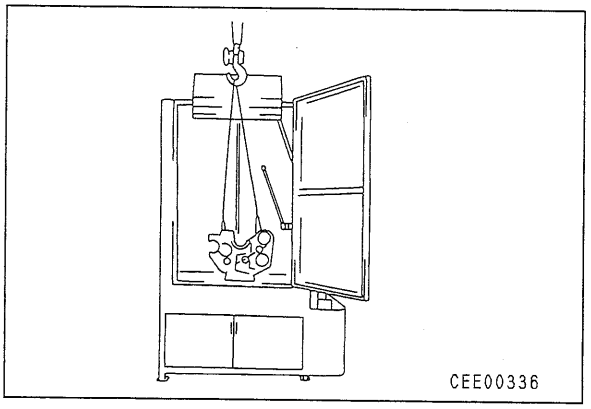
31. Adjustment of injector

★ Adjustment of the injector can be carried out at the same time as the previous step (Adjustment of valve clearance).

1) Crank the crankshaft with barring device (82), align 1.6 TOP line **a** on damper with pointer **b**, and set No. 1 cylinder to compression top dead center.
   ★ Watch the movement of the rocker arm to check that the No. 1 cylinder is in the compression stroke. (If the rocker arm has a play of only the amount of the valve clearance, the cylinder is in the compression stroke.)
   ★ The cylinder set to compression top dead center and the cylinder where the injector is adjusted are different, so check the table below when carrying out the work.
   ★ Cylinder at compression top dead center and cylinder where injector is adjusted:

Compression TDC	1	5	3	6	2	4
Injector to adjust	2	4	1	5	3	6

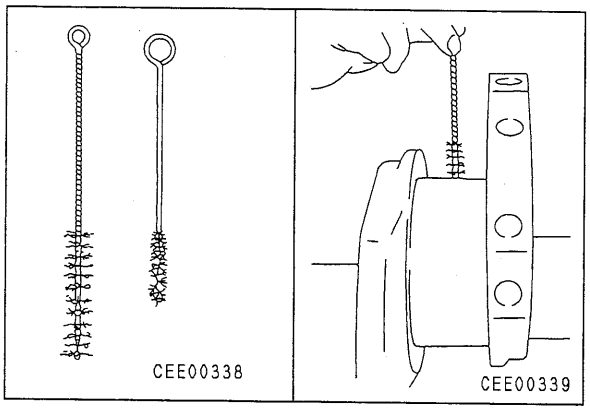


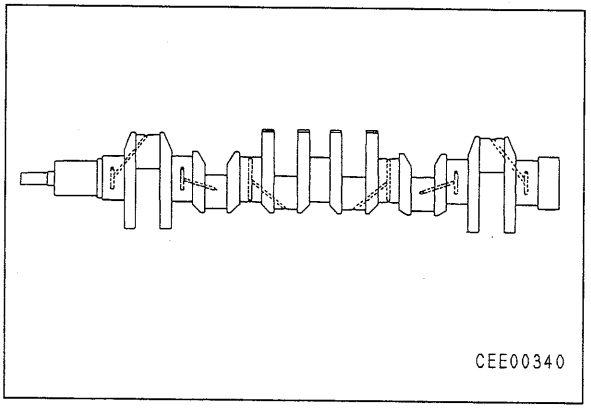


WASHING CRANKSHAFT

★ If the engine is disassembled, wash the crankshaft before inspecting the parts.

1. Clean the crankshaft with a steam cleaner, then use a wire brush like the one shown in the diagram to clean all the oil holes.
2. After washing, dry the cleaning fluid off thoroughly with compressed air.
3. Use a small magnet to completely remove all the metal particles from the oil holes.





MEASURING PARTS

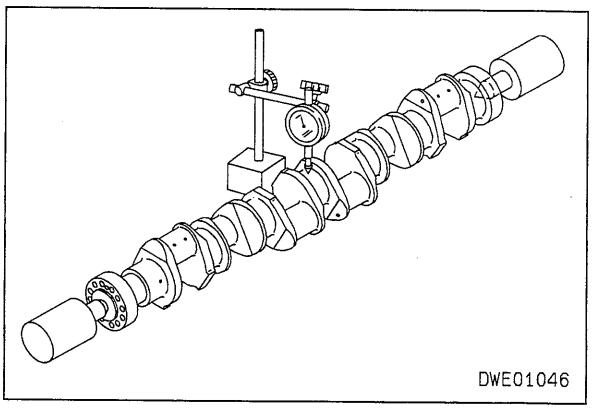
★ Before reassembling disassembled parts, check visually that there are no cracks, damage, or abnormal wear.

★ If no abnormalities are found during the visual inspection, use an accurate measuring device to measure the specified position precisely.

★ Action and judgement on whether the parts can be reused shall be in accordance with MAINTENANCE STANDARD.

MEASURING CURVATURE OF CRANKSHAFT

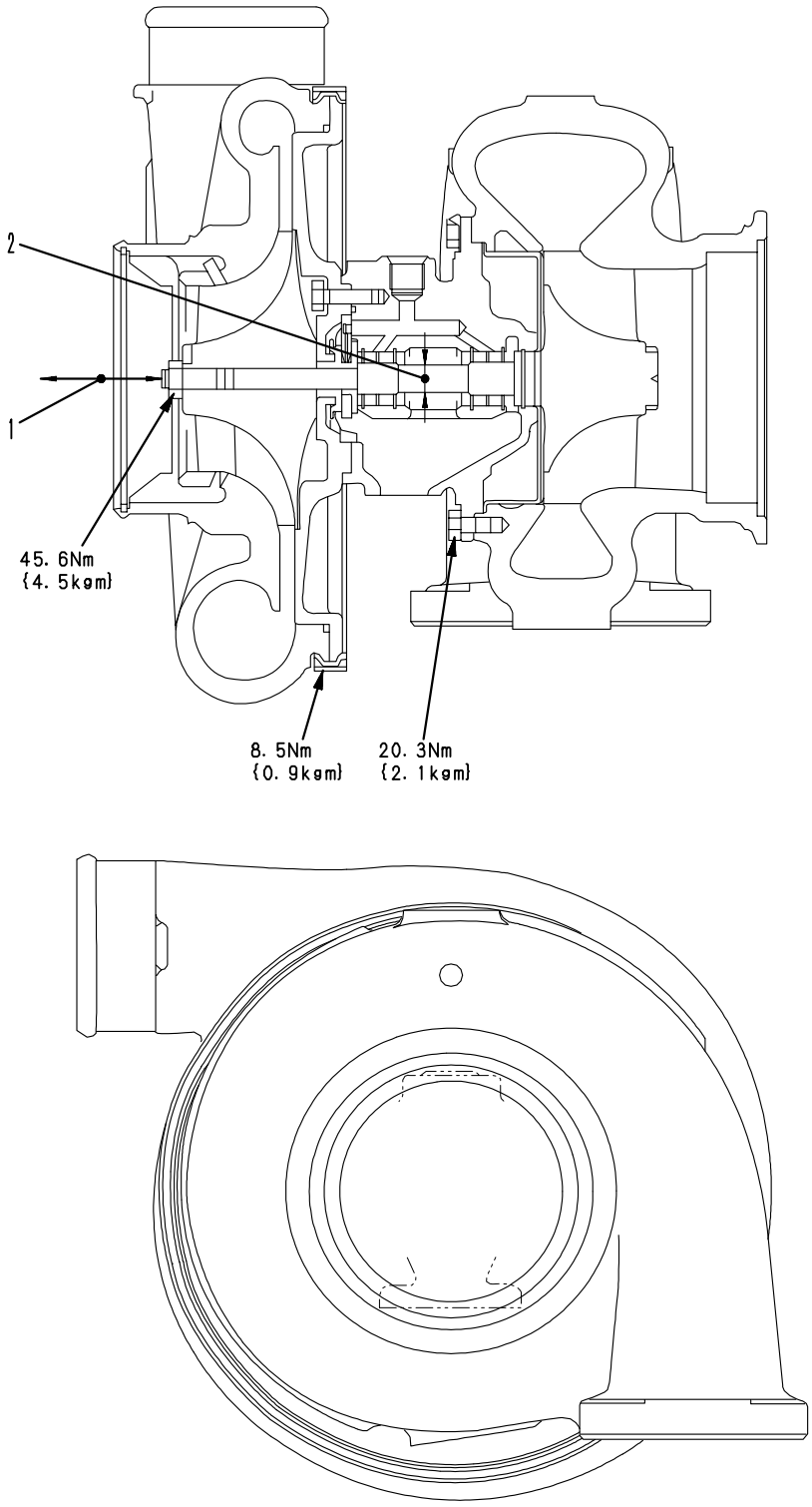
1. Support the center of both ends of the crankshaft with lathes, put the indicator of the dial gauge ② perpendicularly in contact with the journal at the center, and set it to 0.
2. Rotate the crankshaft one turn, and measure the maximum reading and minimum reading of the dial gauge.
   ★ Do not measure with both ends of the crankshaft supported on V blocks. This method produces an error because of the eccentric wear of the journal.



MEASURING OUTSIDE DIAMETER OF CRANKSHAFT JOURNAL

1. Using micrometer ③, measure the outside diameter of the main journal and crank pin journal in the X and Y directions.
   ★ Main journal portion **a**: Measure at 3 places
   Crank pin journal portion **b**: Measure at 5 places

HOLSET

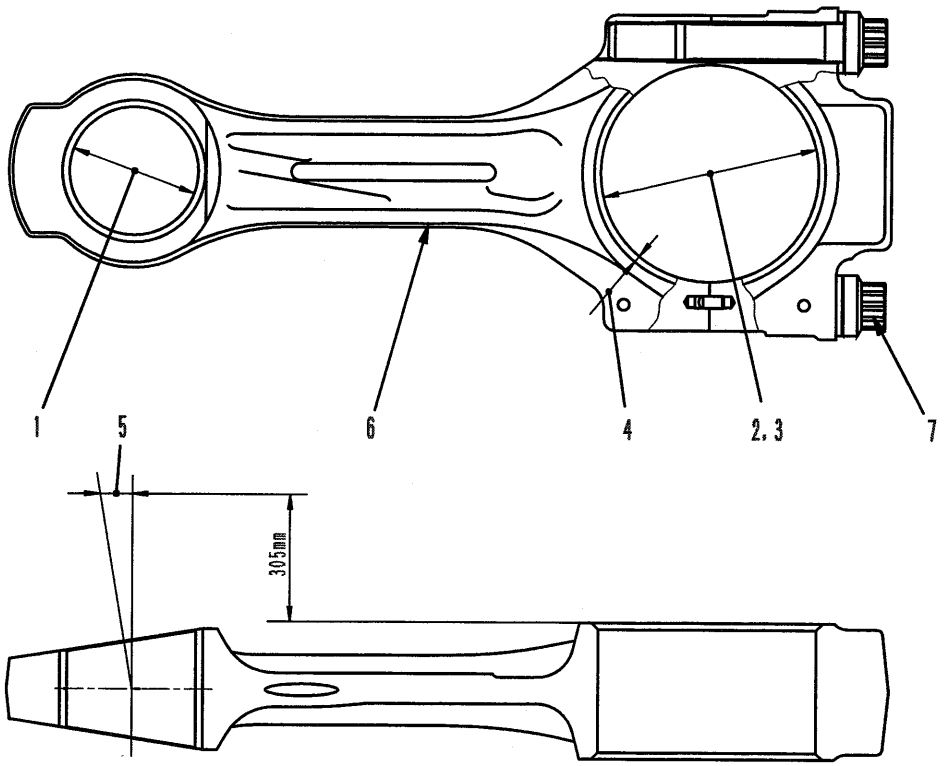


9JS08770

Unit: mm

<table>
<tr><th>No.</th><th>Check item</th><th colspan="6">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Clearance between cylinder block and liner</td><td rowspan="2">Standard size</td><td colspan="2">Tolerance</td><td rowspan="2">Standard clearance</td><td rowspan="2">Clearance limit</td><td rowspan="2">Replace liner or cylinder block</td></tr>
<tr><td>ID of block</td><td>OD of liner</td></tr>
<tr><td>190.4</td><td>0
–0.06</td><td>–0.11
–0.16</td><td>0.05 – 0.16</td><td></td></tr>
<tr><td rowspan="6">2</td><td rowspan="2">Inside diameter of main bearing mounting hole
(Tighten bolt to specified torque)</td><td colspan="2">Standard size</td><td colspan="2">Tolerance</td><td colspan="2">Repair limit</td><td rowspan="4">Replace</td></tr>
<tr><td colspan="2">148</td><td colspan="2">+0.025
–0.001</td><td colspan="2">–</td></tr>
<tr><td>Thickness of main bearing</td><td colspan="2">4.0</td><td colspan="2">–0.038
–0.051</td><td colspan="2">–</td></tr>
<tr><td>Inside diameter of main bearing</td><td colspan="2">140</td><td colspan="2">+0.127
+0.076</td><td colspan="2">140.20</td></tr>
<tr><td rowspan="2">Clearance between main bearing and crankshaft journal</td><td colspan="3">Standard clearance</td><td colspan="3">Clearance limit</td><td rowspan="6">Correct or replace</td></tr>
<tr><td colspan="3">0.076 – 0.152</td><td colspan="3">0.32</td></tr>
<tr><td>3</td><td>Interference between cap and cylinder block</td><td colspan="3">Standard interference</td><td colspan="3">Interference limit</td></tr>
<tr><td></td><td></td><td colspan="3">0.090 – 0.140</td><td colspan="3">0.05</td></tr>
<tr><td rowspan="4">4</td><td rowspan="2">Inside diameter of camshaft bushing</td><td colspan="2">Standard size</td><td colspan="2">Tolerance</td><td colspan="2">Repair limit</td></tr>
<tr><td colspan="2">105</td><td colspan="2">+0.094
+0.011</td><td colspan="2">105.10</td></tr>
<tr><td rowspan="2">Clearance from camshaft journal</td><td colspan="3">Standard clearance</td><td colspan="3">Clearance limit</td></tr>
<tr><td colspan="3">0.053 – 0.166</td><td colspan="3">0.22</td></tr>
<tr><td>5</td><td>Distortion of cylinder head mounting surface</td><td colspan="3">Tolerance</td><td colspan="3">Repair limit</td></tr>
<tr><td></td><td></td><td colspan="3">0.09</td><td colspan="3">0.15</td></tr>
<tr><td rowspan="4">6</td><td rowspan="4">Tightening torque for main bearing cap mounting bolt
(Coat thread and washer with engine oil)</td><td colspan="2">Sequence</td><td colspan="2">Target Nm{kgm}</td><td colspan="2">Range Nm{kgm}</td><td rowspan="4">Tighten</td></tr>
<tr><td colspan="2">1 st Step</td><td colspan="2">284 {29}</td><td colspan="2">270 – 299 {27.5 – 30.5}</td></tr>
<tr><td colspan="2">2 nd Step</td><td colspan="2">569 {58}</td><td colspan="2">559 – 579 {57.0 – 59.0}</td></tr>
<tr><td colspan="2">3 rd Step</td><td colspan="2">Tightening 90°</td><td colspan="2">$90°^{+30°}_{0}$</td></tr>
</table>

CONNECTING ROD



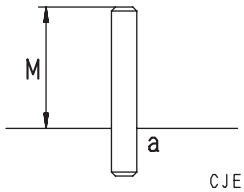
SXE01540

Unit: mm

<table>
<tr><th>No.</th><th>Check item</th><th colspan="6">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Clearance between connecting rod bushing and piston pin</td><td rowspan="2">Standard size</td><td colspan="2">Tolerance</td><td rowspan="2">Standard clearance</td><td rowspan="2">Clearance limit</td><td rowspan="2">Replace (the bushing is supplied as a semi-finished product)</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>68</td><td>–0.020
–0.026</td><td>+0.049
+0.010</td><td>0.030 – 0.075</td><td>0.11</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Inside diameter of connecting rod big end</td><td colspan="3">Standard size</td><td colspan="3">Tolerance</td><td rowspan="11">Replace</td></tr>
<tr><td colspan="3">115</td><td colspan="3">+0.026
0</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">Clearance between inside diameter of connecting rod big end and crankshaft journal</td><td colspan="3">Standard clearance</td><td colspan="3">Clearance limit</td></tr>
<tr><td colspan="3">0.058 – 0.132</td><td colspan="3">0.34</td></tr>
<tr><td rowspan="6">4</td><td rowspan="6">Connecting rod bearing thickness (Center)</td><td>Size</td><td colspan="2">Standard size</td><td>Tolerance</td><td colspan="2">Repair limit</td></tr>
<tr><td>S.T.D</td><td colspan="2">3.500</td><td rowspan="5">–0.029
–0.042</td><td colspan="2">3.41</td></tr>
<tr><td>0.25 US</td><td colspan="2">3.625</td><td colspan="2">3.54</td></tr>
<tr><td>0.50 US</td><td colspan="2">3.750</td><td colspan="2">3.66</td></tr>
<tr><td>0.75 US</td><td colspan="2">3.875</td><td colspan="2">3.79</td></tr>
<tr><td>1.00 US</td><td colspan="2">4.000</td><td colspan="2">3.91</td></tr>
<tr><td rowspan="2">5</td><td rowspan="2">Bend or twist of connecting rod</td><td colspan="6">Repair limit of bend: 0.10</td></tr>
<tr><td colspan="6">Repair limit of twist : 0.25</td></tr>
<tr><td>6</td><td>Connecting rod weight</td><td colspan="6">10.29 ± 0.03 kg</td></tr>
<tr><td rowspan="3">7</td><td rowspan="3">Tightening torque of connecting rod cap bolt (Coat bolt threads with engine oil)</td><td>Order</td><td colspan="2">Target value (Nm{kgm})</td><td colspan="3">Range (Nm{kgm})</td><td rowspan="3">Tighten</td></tr>
<tr><td>1 st</td><td colspan="2">196 {20}</td><td colspan="3">186 – 206 {19 – 21}</td></tr>
<tr><td>2 nd</td><td colspan="2">90°</td><td colspan="3">$90^{\circ}{}^{+15^{\circ}}_{0}$</td></tr>
</table>

Unit: mm

<table>
<tr><th>Inspection item</th><th>Judgement standards</th><th>Remedy</th></tr>
<tr><td>H. Abnormality in valve</td><td>• Check if head has become flat, check for cracks or dent of seat surface
• Airtightness test
• Check for play in cotter when new cotter is inserted in cotter groove.
• Check for eccentric wear or curvature of stem.
• Check for dent in stem end.</td><td>Replace</td></tr>
<tr><td>I. Outside diameter of valve</td><td>• Outside diameter
<table><tr><th>Standard size</th><th>Standard value</th><th>Repair limit</th></tr><tr><td>Exhaust 12</td><td>11.893 – 11.908</td><td>11.80</td></tr><tr><td>Intake 12</td><td>11.920 – 11.940</td><td>11.90</td></tr></table></td><td>Replace</td></tr>
<tr><td>J. Inside diameter of valve guide (after press fitted to head)</td><td><table><tr><th>Standard size</th><th>Standard value</th><th>Repair limit</th></tr><tr><td>12</td><td>11.981 – 11.999</td><td>12.10</td></tr></table></td><td rowspan="3">Replace</td></tr>
<tr><td>K. Protrution of valve guide (after press fitted to head)</td><td> 

CJE10305
Permissible range: 42.5 – 43.5</td></tr>
<tr><td>L. Outside diameter of crosshead guide</td><td><table><tr><th>Standard size</th><th>Standard value</th><th>Repair limit</th></tr><tr><td>13</td><td>13.028 – 13.039</td><td>13.00</td></tr></table></td></tr>
<tr><td>M. Protrution of crosshed guide</td><td> 

CJE10306
a: Cylinder head
Permissible range: 85.75 – 86.25</td><td>Replace</td></tr>
</table>

GRINDING VALVE

1. Grinding the seat surface

- Grind the seat sutface with valve refacer **I**.
  - ★ Angle of valve seat: intake valve: 30°
    EXhaust valve: 45°

2. Checking after grinding

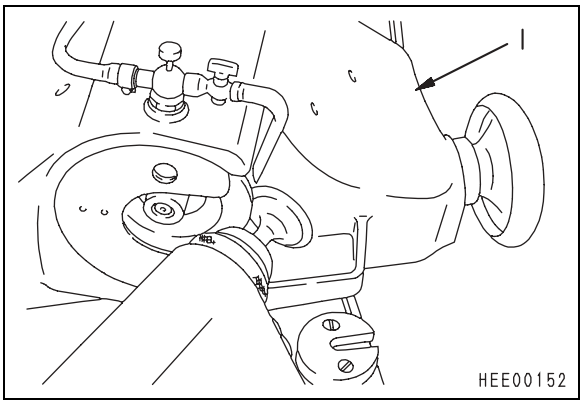
- Confirm that the thickness of the valve head, protrusion of the valve, and the contact surface of the valve seat are within specification.

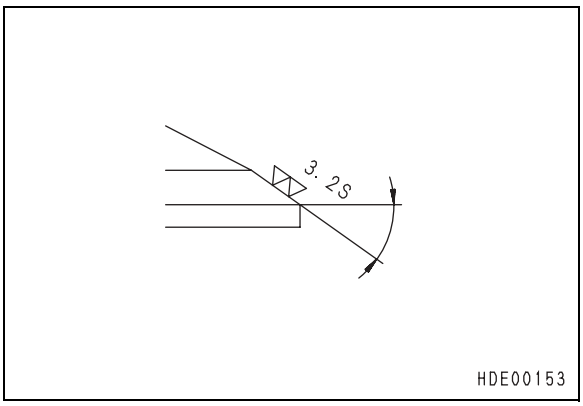
  - ★ Thickness of valve head
    Repair limit
    Intake valve: 2.7 mm
    (Standard size 3.2 mm)
    Exhaust valve: 2.9 mm
    (Standard size 3.3 mm)

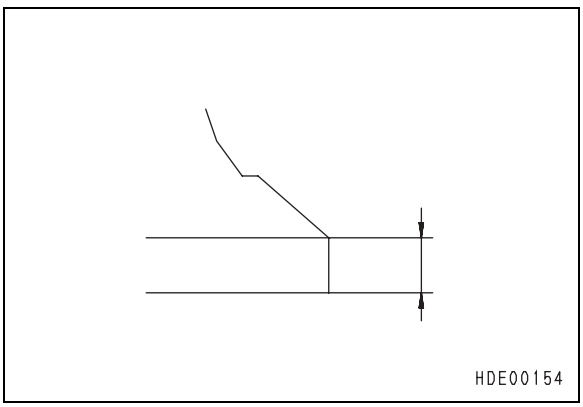
  - ★ Sinking of valve Standard:
    (sinking) 0.39 – (protrusion) 0.21 mm
    Repair limit: (sinking) 0.8mm

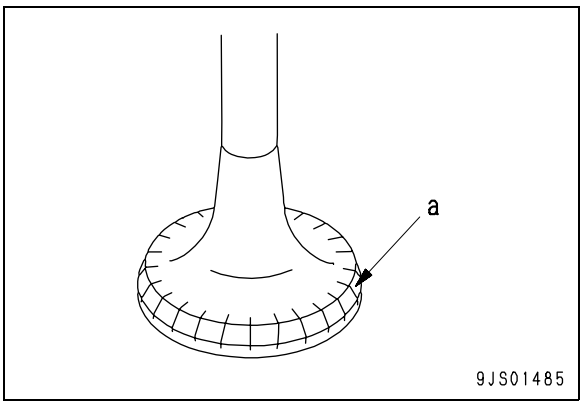
  - ★ Check the contact of the valve with the seat surface using one of the following methods.
    - Coat the seat surface of the ground valve thinly with red lead (minium), insert it in the valve guide, push lightly against the valve seat insert surface, and confirm that the contact is uniform without any breaks.

    - Make marks **a** with a pencil on the seat surface of the ground valve as shown in the diagram, insert it in the valve guide, push lightly against the valve seat insert surface, and rotate 10°. Check that the pencil marks have been erased uniformly around the whole circumference.









REPLACING MAIN BEARING CAP

★ When replacing the main bearing cap, machine the semi-finished part according to the following procedure.
- No. 1,2,3,4,5,7 Main cap 6240-29-1210
- No. 6 Main cap 6240-29-1250

1. Machining the bore of main bearing cap

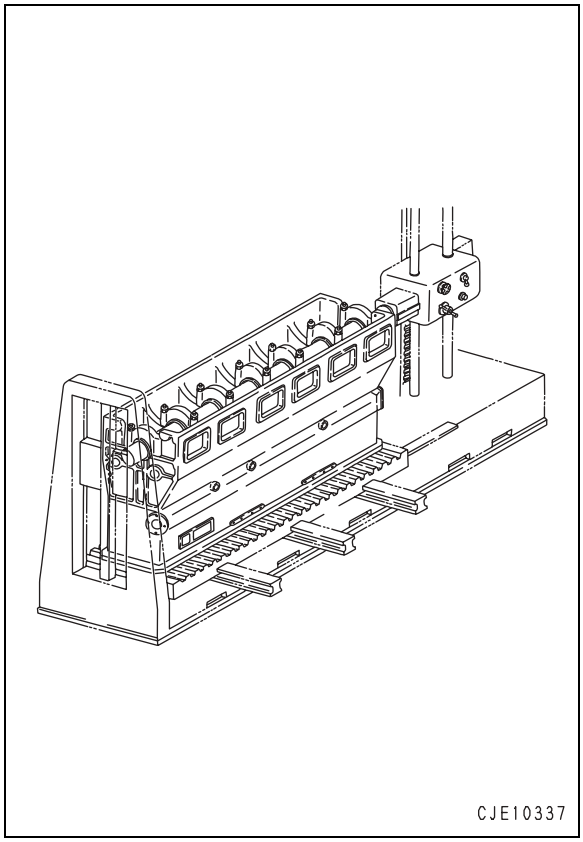
1) Remove the cylinder liner
2) Install the replacement bearing cap to the cylinder block and tighten it to specification.
   ★ Align the notches on the cylinder block and cap.
   ★ Coat the thread and seat with engine oil SAE30
   ★ Tighten the bolts at the 3rd time by angle tightening method.

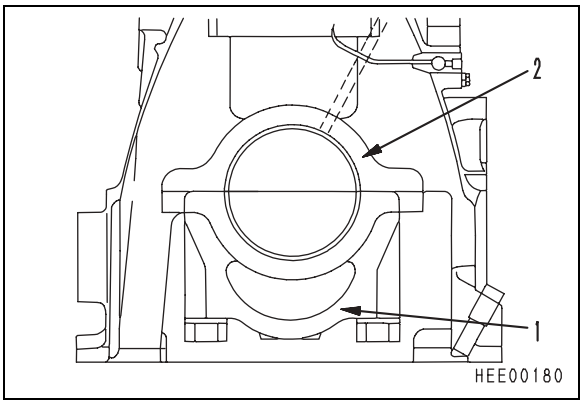
   Main bearing cap mounting bolt:

Step	Target	Range
1st	284Nm {29kgm}	269 – 299Nm {27.5 – 30.5kgm}
2nd	578Nm {58kgm}	568 – 588Nm {57 – 59kgm}
3rd	105°	120° – 90°

3) Set the jig for mounting the cylinder block to the table of a horizontal boring machine. Install the cylinder block by mounting its hole for the liner to the datum plug of the jig.
4) Center the arbor of the boring machine by applying a dial gauge to the inside wall of the two bearing caps which have the largest pitch in the caps to be used again.
5) Cut the inside of bearing cap (1) little by little while checking its inside diameter.
   ★ Cut until the cutting tool contacts the inside wall of cylinder block (2).
   ★ Inside diameter of main cap:

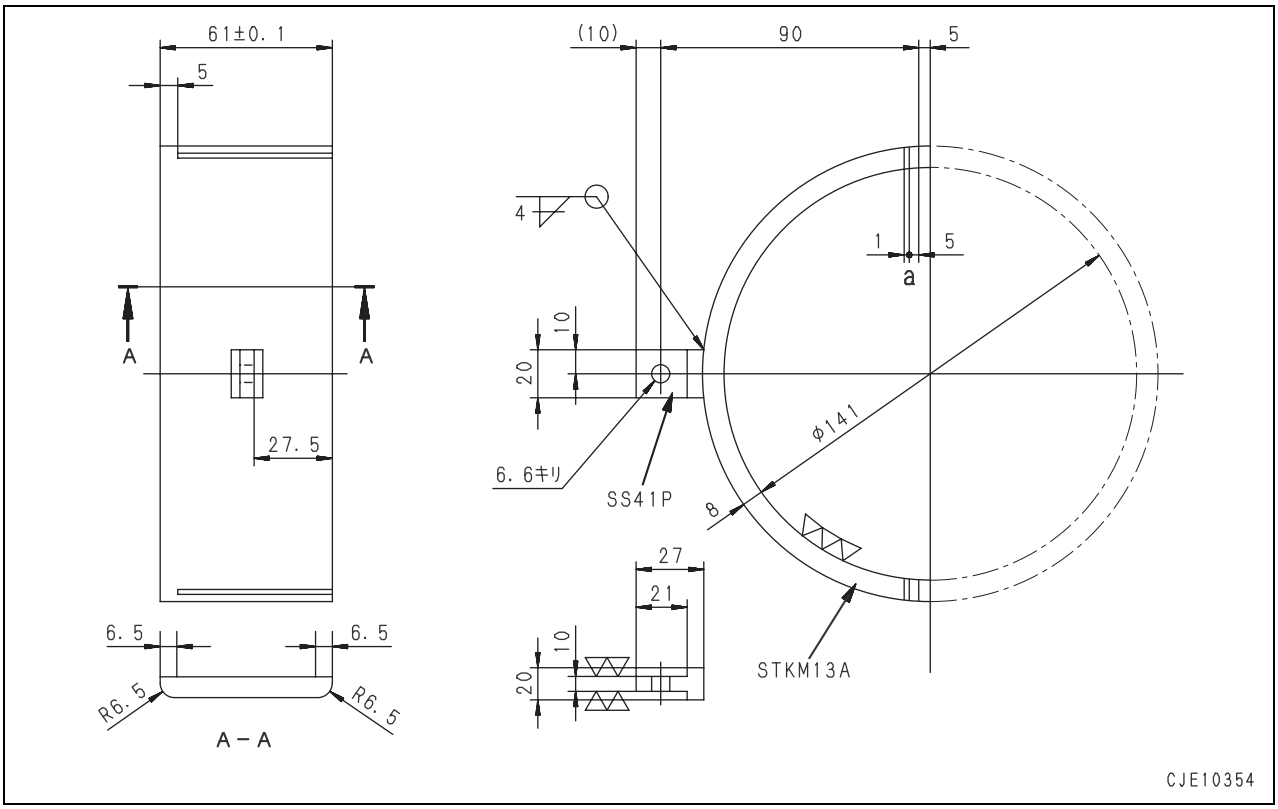
   Tolerance: $148\ ^{+0.025}_{0}$ mm
   ★ Surface roughness: Max. 12.5S
   ★ Never cut the inside wall of the cylinder block.





Clamp jig parts drawing (for main journal)

1) Plate (2 are used for each jig) (**a** : Width of slit) Unit: mm



2) Handle (2 are used for each jig) Unit: mm