

Mitsubishi 6M70

Workshop Manual

diesel engine

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APPLICABLE SERVICE BULLETINS FOR
THIS MANUAL INDEX

Applicable models
Mitsubishi 6M70

DIAGNOSIS CODES

1. Diagnosis Codes

- Diagnosis codes indicate the faulty sections of the vehicle.
- A fault can be repaired by reading out the diagnosis code(s) stored in the control unit and performing the remedy for that code(s).
- Diagnosis codes can be displayed in the following two methods. Select either of them according to the system to be diagnosed.
 - Using a Multi-Use Tester
 - Using flashing of a warning lamp on meter cluster
- The table below indicates the systems for which diagnosis codes can be displayed and the methods usable for individual systems.

1.1 Systems and diagnosis code displaying methods

Warning lamp	System	Diagnosis codes displaying methods		Reference Gr
		Multi-Use Tester	Flashing of warning lamp	
	Common rail	O	O	13
	Turbocharger			15
	Exhaust gas recirculation			17
	Starter continuous energizing preventing function			54
	Vehicle speed limiting (SLD)	O	O	54
	Auto cruise			
—	Full auto air conditioner	O	O	55

1.2 Types of diagnosis codes

- There are two types of diagnosis code output method depending on the system: one has a distinction of present and past codes, and the other does not have such a distinction.

System	Diagnosis code	
	With distinction of present and past	Without distinction
Except below	O	—
Full auto air conditioner	—	O

(1) The system that has a distinction of present and past diagnosis codes

(1.1) Present diagnosis code

- Fault developed in the vehicle after the starter switch is set to ON is indicated by corresponding diagnosis code.
- The fault warning lamp is lit at the same time.

(1.2) Past diagnosis code

- Past fault developed in the vehicle is indicated by corresponding diagnosis code stored in the memory of the electronic control unit.
- With the vehicle restored to its normal condition or the starter switch turned from OFF to ON after inspection or repair against present diagnosis codes, the present diagnosis code is stored as past diagnosis codes in the memory of the electronic control unit.
- When reading out the past diagnosis codes, the warning lamp does not illuminate as such codes do not indicate the current fault.

(2) The system that does not have a distinction of present and past diagnosis codes

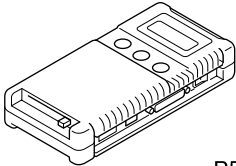
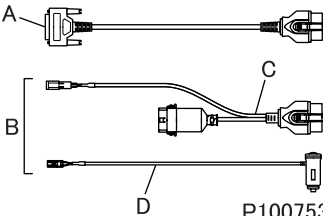
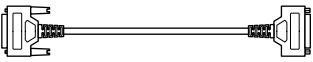
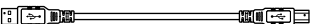
- The present and past diagnosis codes are displayed together without distinction.

2. Reading and Erasing the Diagnosis Code

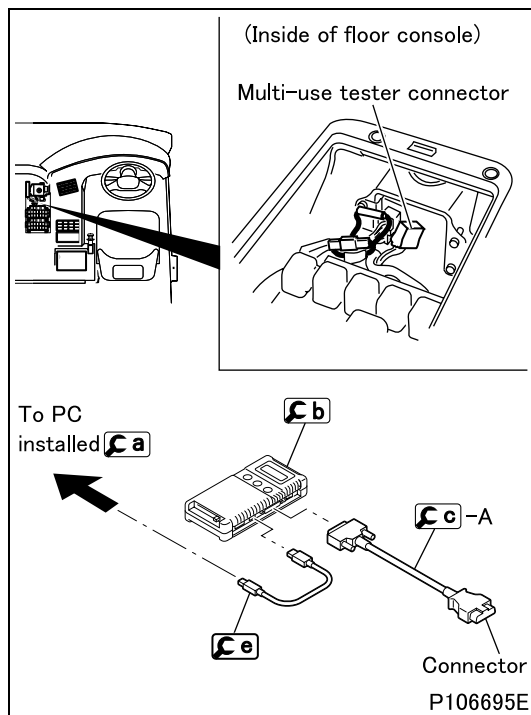
2.1 Using a Multi-Use Tester

(1) Connecting a Multi-Use Tester

Special tools

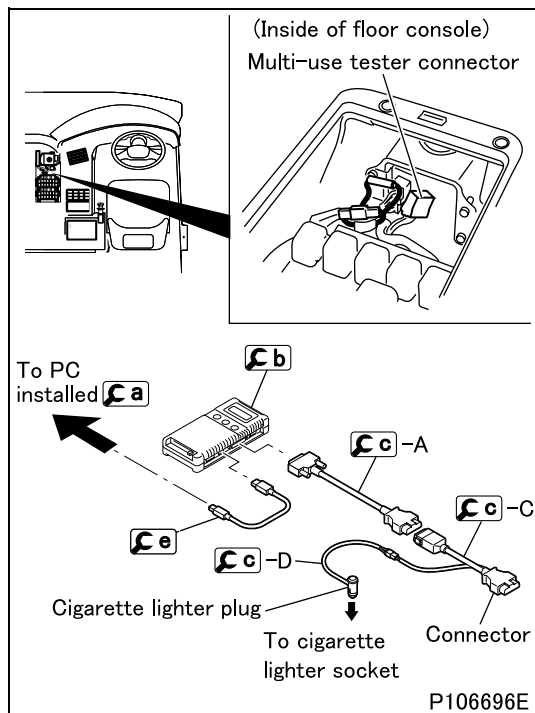
Mark	Tool name and shape	Part No.	Application
	Multi-Use Tester III SOFTWARE DISC  P100236	FMS-E07-3* (Multi-Use Tester-III ver- sion)	Installation of the Multi-Use-Tester-III or version-up of the current version into Multi-Use Tester-III SOFTWARE DISC (Pub. No. SG0705A)
	V.C.I.  P57296	MH062927	Data transmission between electronic control unit and PC
	Multi-Use Tester test Harness E A: Harness for inspec- tion and drive recorder B: Harness for drive re- corder C: Drive recorder har- ness D: Cigarette lighter plug harness  P100753	MH063659 A: MH063661 B: MH063663 C: MH063665 D: MH063666	Power supply to V.C.I. and communi- cation with electronic control unit
	Multi-Use Tester test harness D (used for extension)  P57299	MH062951	Multi-Use Tester test harness B ex- tension
	USB cable  P57300	MH063668	Communication between V.C.I. and PC

DIAGNOSIS CODES



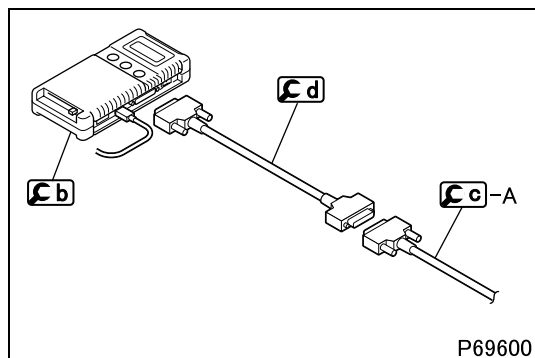
(1.1) To perform system inspection

- Move the starter switch to the LOCK position.
- Connect PC installed **a**, **b**, **c**-A and **e** as shown.
- Connect **c**-A connector to the Multi-Use Tester connector on the vehicle.



(1.2) To use drive recorder function

- Move the starter switch to the LOCK position.
- Connect PC installed **a**, **b**, **c**-A, **c**-C, **c**-D and **e** as shown.
- Connect **c**-C connector to the Multi-Use Tester connector on the vehicle.
- Connect the cigarette lighter plug of **c**-D to the cigarette lighter socket on the vehicle.



(1.3) To extend the Multi-Use Tester test harness

- Connect **d** to **c**-A to extend the test harness to use the Multi-Use Tester outside the vehicle.

(2) Access of diagnosis code

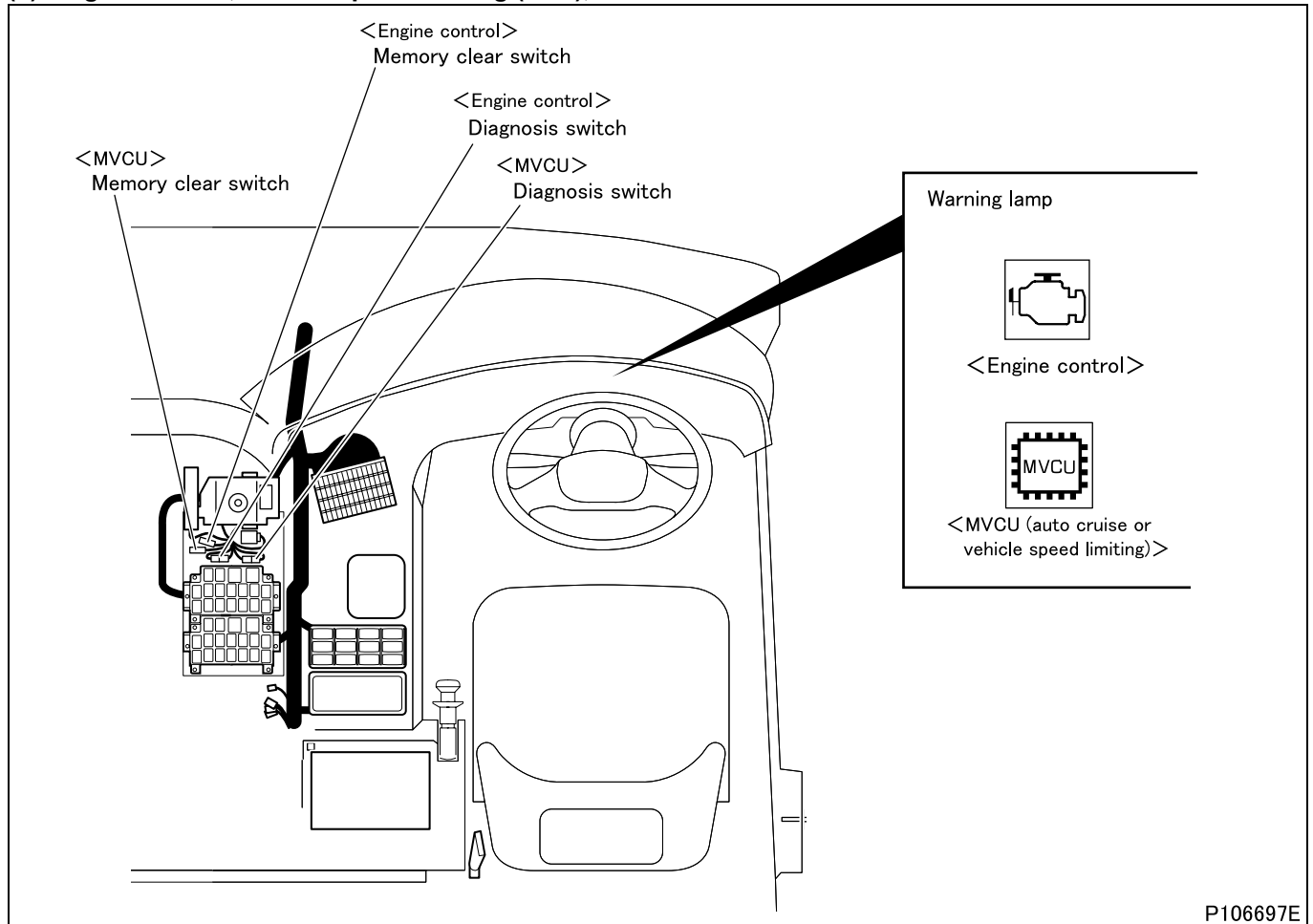
- Set the starter switch to ON.
- Operate the Multi-Use Tester for a display of necessary diagnosis code stored in the memory of the electronic control unit and identify the location of the fault.

(3) Clearing of diagnosis code

- Set the starter switch to ON (the engine not to be started).
- Operate the Multi-Use Tester to delete all the diagnosis codes stored in the memory of the electronic control unit.

2.2 Using flashing of a warning lamp on meter cluster

(1) Engine control, vehicle speed limiting (SLD), auto cruise

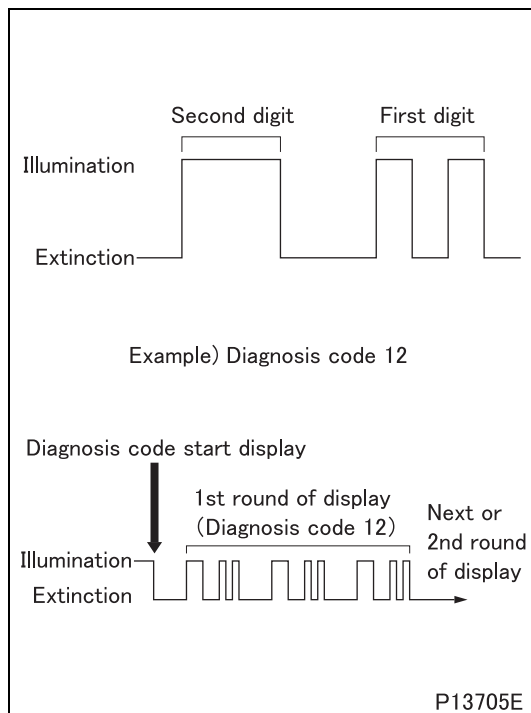


- Using the diagnosis and memory clear switches, display diagnosis codes.

CAUTION

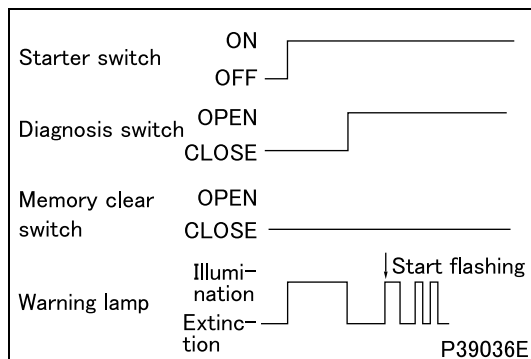
- Opening the memory clear switch followed by its reconnection will erase the stored diagnosis codes from the memory. To avoid inadvertently erasing necessary codes, be sure to read well the procedure described below before handling diagnosis codes.

DIAGNOSIS CODES



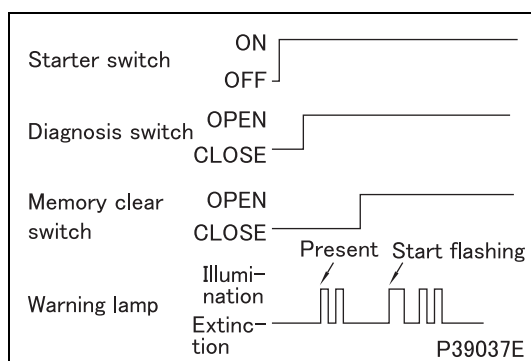
(1.1) Reading diagnosis codes

- To read a diagnosis code, observe how many times the warning lamp flashes and how long each illumination lasts.
- The duration of illumination differs between the first and second digits.
 - Second digit: 1.2 sec.
 - First digit: 0.4 sec.
- A diagnosis code consists of the flashing of second digit and the flashing of first digit in that order. If a diagnosis code has "0" in the second digit, only the first digit will be displayed.
- The diagnosis code 01 will be displayed if the system is normal.
- The same diagnosis code will be displayed 3 times in a row before moving to the display of the next code.
- After the last diagnosis code is displayed, the first code will be displayed again 3 times in a row and then the subsequent codes. This will be repeated.



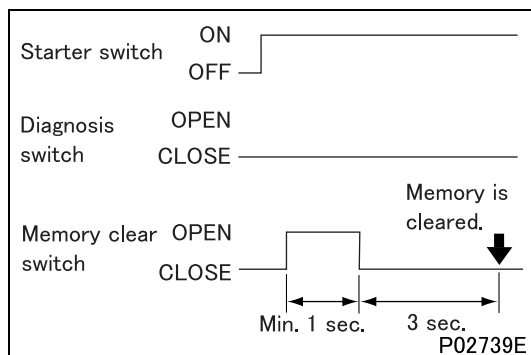
(1.2) Present diagnosis codes

- Turn the starter switch ON.
- Remove the diagnosis switch.
- Present diagnosis codes will be displayed by flashing of the warning lamp.
- When the diagnosis switch is connected, electronic control unit will stop (terminate) displaying diagnosis codes.



(1.3) Present and past diagnosis codes

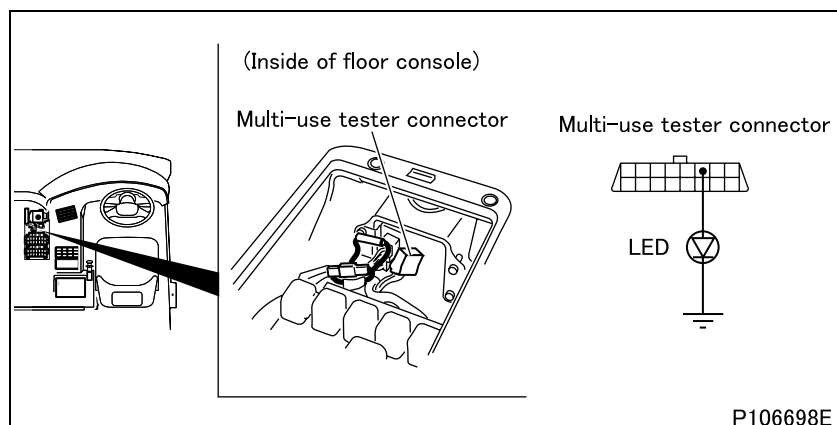
- Turn the starter switch to the ON position.
- Open the diagnosis switch.
- Present diagnosis codes will be displayed by flashing of the warning lamp.
- Open the memory clear switch.
- Present and past diagnosis codes will be displayed by flashing of the warning lamp.
- Turn the starter switch to the OFF position and connect the memory clear switch and diagnosis switch to terminate the diagnosis code displaying mode.



(1.4) Erasing diagnosis codes

- Turn the starter switch to the ON position (do not start the engine).
- Open the memory clear switch and reconnect it; all diagnosis codes stored in electronic control unit memory will be erased. To cancel diagnosis code erasure after opening the memory clear switch, turn the starter switch to the OFF position and then reconnect the memory clear switch.

(2) Full automatic air conditioner

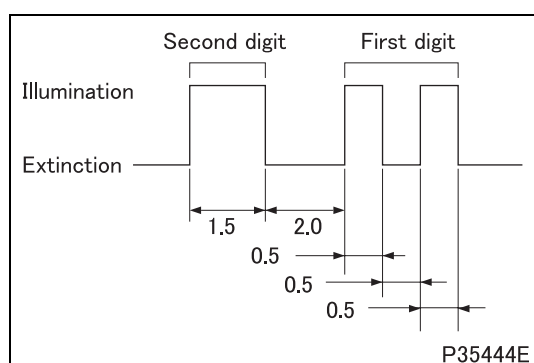


(2.1) Connection of LED for inspection

- Move the starter switch to the LOCK position.
- Connect the LED for inspection to the Multi-Use Tester connector.

CAUTION ⚠

- Air conditioner electronic control unit and control panel has a backup power supply to keep diagnostic check results in memory. If this power supply is cut off, with battery cables disconnected, for example, stored data are erased.
- Air conditioner electronic control unit and control panel enters into the mode of control during fault immediately a fault occurs. In this mode, control is effected to minimize trouble arising from the fault.



(2.2) Reading and erasing diagnosis codes

- To read a diagnosis code, observe how many times the LED for inspection flashes and how long each illumination lasts.
- The duration of illumination differs between the first and second digits.
 - Second digit: 1.5 sec.
 - First digit: 0.5 sec.
- A diagnosis code consists of the flashing of second digit and the flashing of first digit in that order. If a diagnosis code has "0" in the second digit, only the first digit will be displayed.
- When two or more faults occur at a time, relevant diagnosis codes are displayed repeatedly starting from the first Code.
- To erase a diagnosis code from the memory after inspection, disconnect negative (-) battery cable and leave it disconnected for more than 30 seconds.

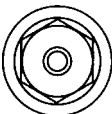
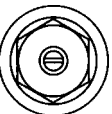
TABLE OF STANDARD TIGHTENING TORQUES

- Use specified bolts and nuts. Tighten them to the torques shown below as appropriate, unless otherwise specified.
- Threads and bearing surfaces shall be dry.
- If the mating nut and bolt (or stud bolt) are different in level of strength, tighten them to the torque specified for the bolt.

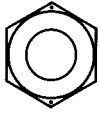
Hexagon Head Bolts and Stud Bolts (Unit: N·m {kgf·m})

Strength	4T		7T		8T	
Identification symbol Nominal diameter	 (stud)		 (stud)		 (stud)	
M5	2 to 3 {0.2 to 0.3}	—	4 to 6 {0.4 to 0.6}	—	5 to 7 {0.5 to 0.7}	—
M6	4 to 6 {0.4 to 0.6}	—	7 to 10 {0.7 to 1.0}	—	8 to 12 {0.8 to 1.2}	—
M8	9 to 13 {0.9 to 1.3}	—	16 to 24 {1.7 to 2.5}	—	19 to 28 {2.0 to 2.9}	—
M10	18 to 27 {1.8 to 2.7}	17 to 25 {1.8 to 2.6}	34 to 50 {3.5 to 5.1}	32 to 48 {3.3 to 4.9}	45 to 60 {4.5 to 6.0}	37 to 55 {3.8 to 5.7}
M12	34 to 50 {3.4 to 5.1}	31 to 45 {3.1 to 4.6}	70 to 90 {7.0 to 9.5}	65 to 85 {6.5 to 8.5}	80 to 105 {8.5 to 11}	75 to 95 {7.5 to 10}
M14	60 to 80 {6.0 to 8.0}	55 to 75 {5.5 to 7.5}	110 to 150 {11 to 15}	100 to 140 {11 to 14}	130 to 170 {13 to 17}	120 to 160 {12 to 16}
M16	90 to 120 {9 to 12}	90 to 110 {9 to 11}	170 to 220 {17 to 23}	160 to 210 {16 to 21}	200 to 260 {20 to 27}	190 to 240 {19 to 25}
M18	130 to 170 {14 to 18}	120 to 150 {12 to 16}	250 to 330 {25 to 33}	220 to 290 {23 to 30}	290 to 380 {30 to 39}	250 to 340 {26 to 35}
M20	180 to 240 {19 to 25}	170 to 220 {17 to 22}	340 to 460 {35 to 47}	310 to 410 {32 to 42}	400 to 530 {41 to 55}	360 to 480 {37 to 49}
M22	250 to 330 {25 to 33}	230 to 300 {23 to 30}	460 to 620 {47 to 63}	420 to 560 {43 to 57}	540 to 720 {55 to 73}	490 to 650 {50 to 67}
M24	320 to 430 {33 to 44}	290 to 380 {29 to 39}	600 to 810 {62 to 83}	540 to 720 {55 to 73}	700 to 940 {72 to 96}	620 to 830 {63 to 85}

Hexagon Head Flange Bolts (Unit: N·m {kgf·m})

Strength	4T		7T		8T	
Identification symbol Nominal diameter						
M6	4 to 6 {0.4 to 0.6}	—	8 to 12 {0.8 to 1.2}	—	10 to 14 {1.0 to 1.4}	—
M8	10 to 15 {1.0 to 1.5}	—	19 to 28 {2.0 to 2.9}	—	22 to 33 {2.3 to 3.3}	—
M10	21 to 31 {2.1 to 3.1}	20 to 29 {2.0 to 3.0}	45 to 55 {4.5 to 5.5}	37 to 54 {3.8 to 5.6}	50 to 65 {5.0 to 6.5}	50 to 60 {5.0 to 6.5}
M12	38 to 56 {3.8 to 5.5}	35 to 51 {3.5 to 5.2}	80 to 105 {8.0 to 10.5}	70 to 95 {7.5 to 9.5}	90 to 120 {9 to 12}	85 to 110 {8.5 to 11}

Hexagon Nuts (Unit: N·m {kgf·m})

Strength	4T		6T	
Identification symbol			   	
Nominal diameter	Standard screw thread	Coarse screw thread	Standard screw thread	Coarse screw thread
M5	2 to 3 {0.2 to 0.3}	—	4 to 6 {0.4 to 0.6}	—
M6	4 to 6 {0.4 to 0.6}	—	7 to 10 {0.7 to 1.0}	—
M8	9 to 13 {0.9 to 1.3}	—	16 to 24 {1.7 to 2.5}	—
M10	18 to 27 {1.8 to 2.7}	17 to 25 {1.8 to 2.6}	34 to 50 {3.5 to 5.1}	32 to 48 {3.3 to 4.9}
M12	34 to 50 {3.4 to 5.1}	31 to 45 {3.1 to 4.6}	70 to 90 {7.0 to 9.5}	65 to 85 {6.5 to 8.5}
M14	60 to 80 {6.0 to 8.0}	55 to 75 {5.5 to 7.5}	110 to 150 {11 to 15}	100 to 140 {11 to 14}
M16	90 to 120 {9 to 12}	90 to 110 {9 to 11}	170 to 220 {17 to 23}	160 to 210 {16 to 21}
M18	130 to 170 {14 to 18}	120 to 150 {12 to 16}	250 to 330 {25 to 33}	220 to 290 {23 to 30}
M20	180 to 240 {19 to 25}	170 to 220 {17 to 22}	340 to 460 {35 to 47}	310 to 410 {32 to 42}
M22	250 to 330 {25 to 33}	230 to 300 {23 to 30}	460 to 620 {47 to 63}	420 to 560 {43 to 57}
M24	320 to 430 {33 to 44}	290 to 380 {29 to 39}	600 to 810 {62 to 83}	540 to 720 {55 to 73}

Hexagon Flange Nuts (Unit: N·m {kgf·m})

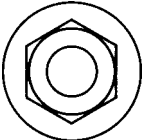
Strength	4T	
Identification symbol		
Nominal diameter	Standard screw thread	Coarse screw thread
M6	4 to 6 {0.4 to 0.6}	—
M8	10 to 15 {1.0 to 1.5}	—
M10	21 to 31 {2.1 to 3.1}	20 to 29 {2.0 to 3.0}
M12	38 to 56 {3.8 to 5.6}	35 to 51 {3.5 to 5.2}

TABLE OF STANDARD TIGHTENING TORQUES

Tightening Torque for General-Purpose Flare Nut (Unit: N·m {kgf·m})

Pipe diameter	φ4.76 mm	φ6.35 mm	φ8 mm	φ10 mm	φ12 mm	φ15 mm
Tightening torque	17 {1.7}	25 {2.6}	39 {4.0}	59 {6.0}	88 {9.0}	98 {10}

Tightening Torque for General-Purpose Air Piping Nylon Tube (DIN Type) (Unit: N·m {kgf·m})

Nominal diameter × wall thickness	6 × 1 mm	10 × 1.25 mm	12 × 1.5 mm	15 × 1.5 mm
Tightening torque	20 ⁺⁶ ₀ {2.0 ^{+0.6} ₀ }	34 ⁺¹⁰ ₀ {3.5 ^{+1.0} ₀ }	49 ⁺¹⁰ ₀ {5.0 ^{+1.0} ₀ }	54 ⁺⁵ ₀ {5.5 ^{+0.5} ₀ }

Tightening Torque for General-Purpose Air Piping Nylon Tube (SAE Type) (Unit: N·m {kgf·m})

Nominal diameter	1/4 in.	3/8 in.	1/2 in.	5/8 in.
Tightening torque	13 ⁺⁴ ₀ {1.3 ^{+0.4} ₀ }	29 ⁺⁵ ₀ {3.0 ^{+0.5} ₀ }	49 ⁺⁵ ₀ {5.0 ^{+0.5} ₀ }	64 ⁺⁵ ₀ {6.5 ^{+0.5} ₀ }

GROUP 11 ENGINE

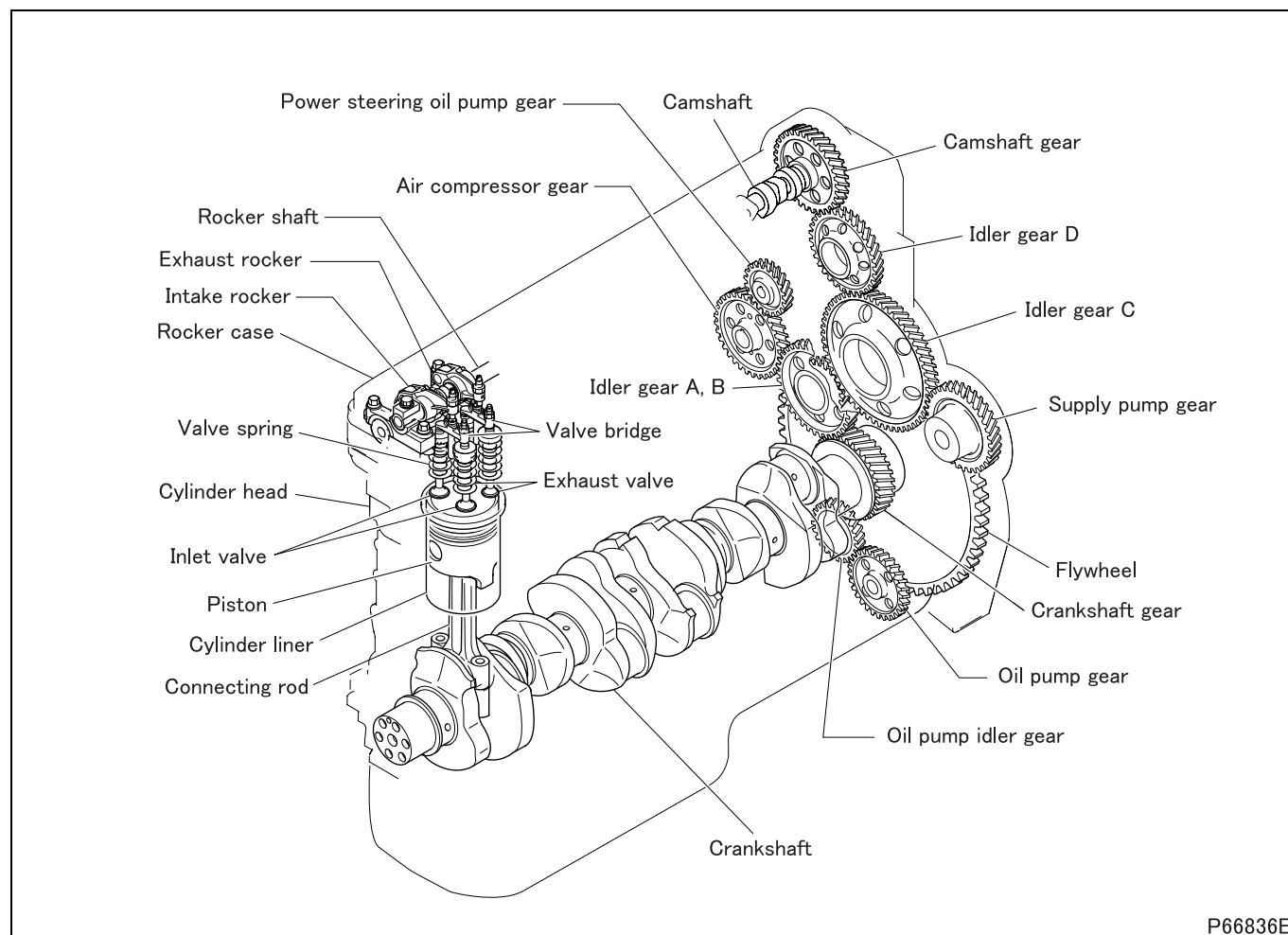
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SPECIFICATIONS

Item	Specifications	
Engine type	6M70T2	6M70T4
Type	6-cylinder, in-line, water-cooled, 4-cycle diesel engine	
Combustion chamber	Direct injection type	
Valve mechanism	Overhead camshaft (OHC) system	
Maximum output kW {PS} /rpm	257 {350} / 2000	309 {420} / 2000
Maximum torque N·m {kgf·m} /rpm	1620 {165} / 1100	1810 {185} / 1100
Cylinder bore × stroke mm	φ135 × 150	
Total displacement cm ³ {L}	12882 {12.882}	
Compression ratio	17.5	

Mitsubishi 6M70 Engine Parts contact:
 email: EngineParts@HeavyEquipmentRestorationParts.com
 Phone: 269 673 1638

1. Mitsubishi 6M70 Engine Proper

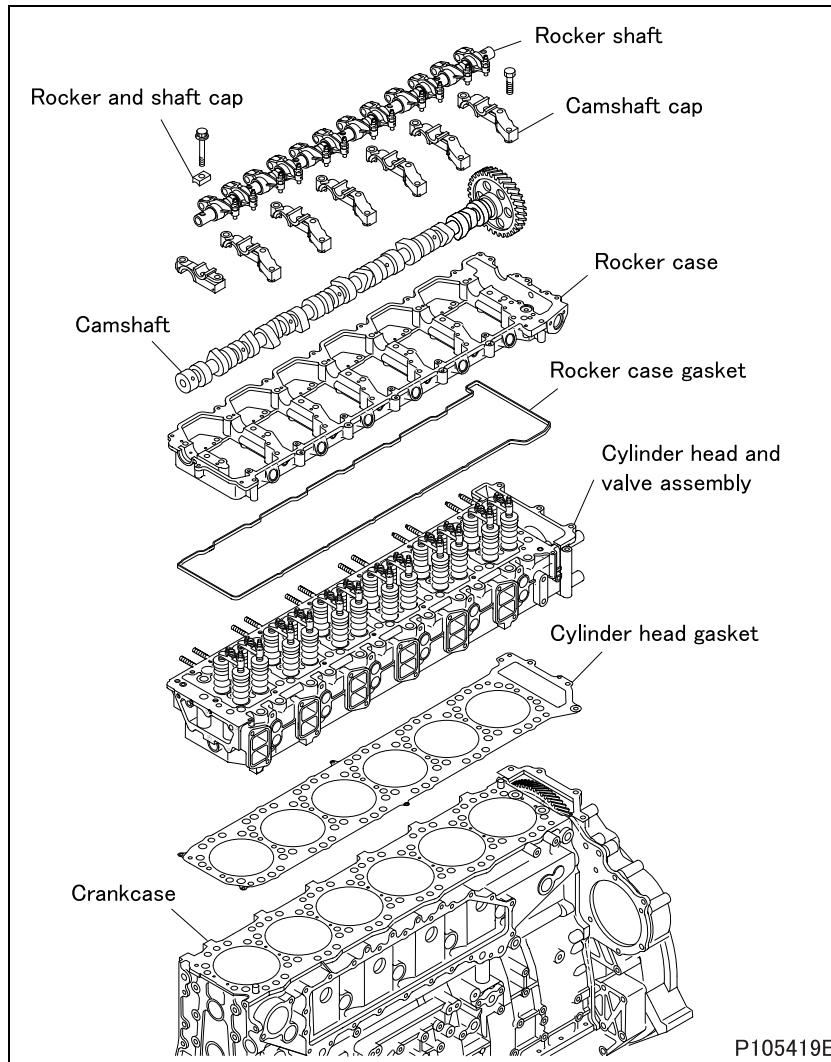


P66836E

- The 6M70 engine employs an overhead camshaft (OHC) system, with the valve mechanism and the timing gears arranged as shown above.

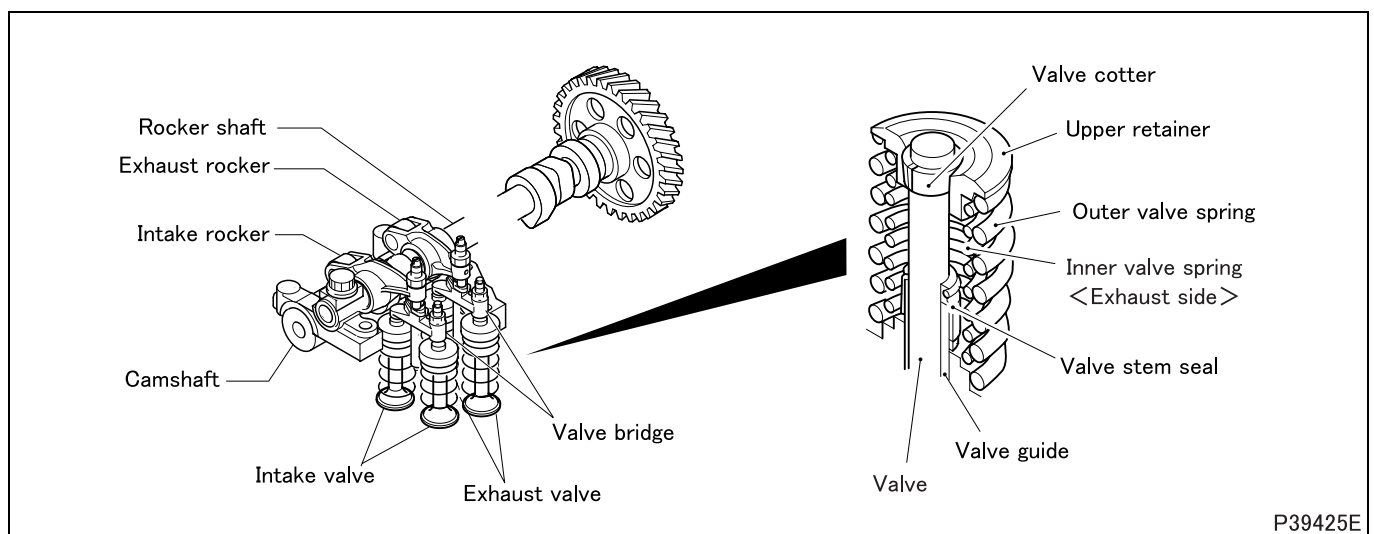
STRUCTURE AND OPERATION

2. Rocker and Shaft, Camshaft, Rocker Case and Cylinder Head Gasket



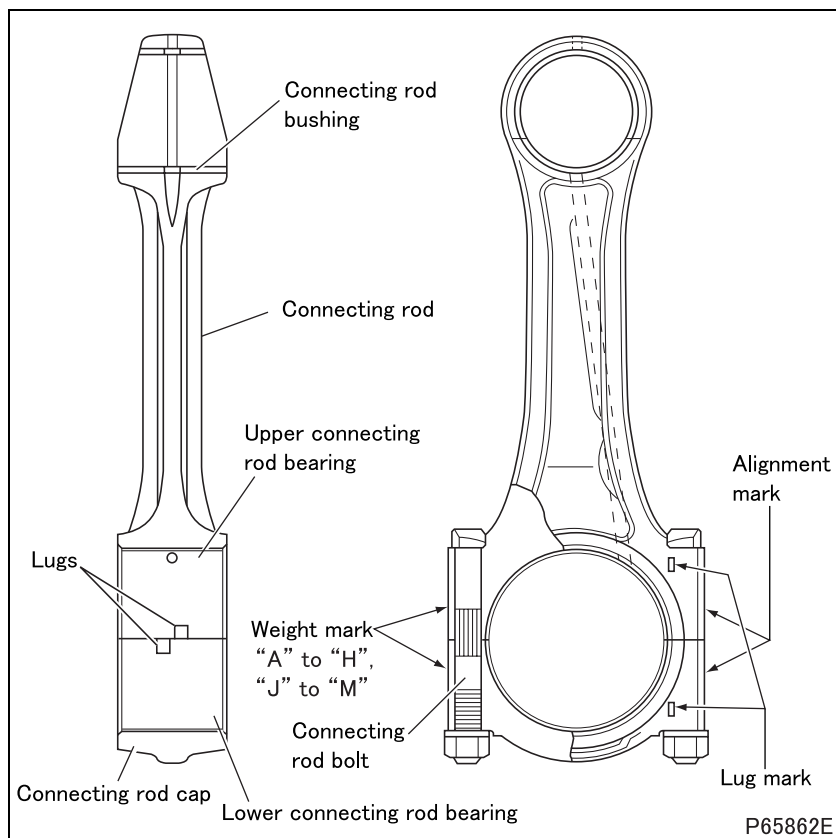
- The camshaft journals are directly supported by the rocker case and the camshaft cap, without using any camshaft bearings. The rocker case and camshaft caps have been machined together, meaning that they all need to be replaced for a new set when one of them becomes defective.

3. Valve Mechanism



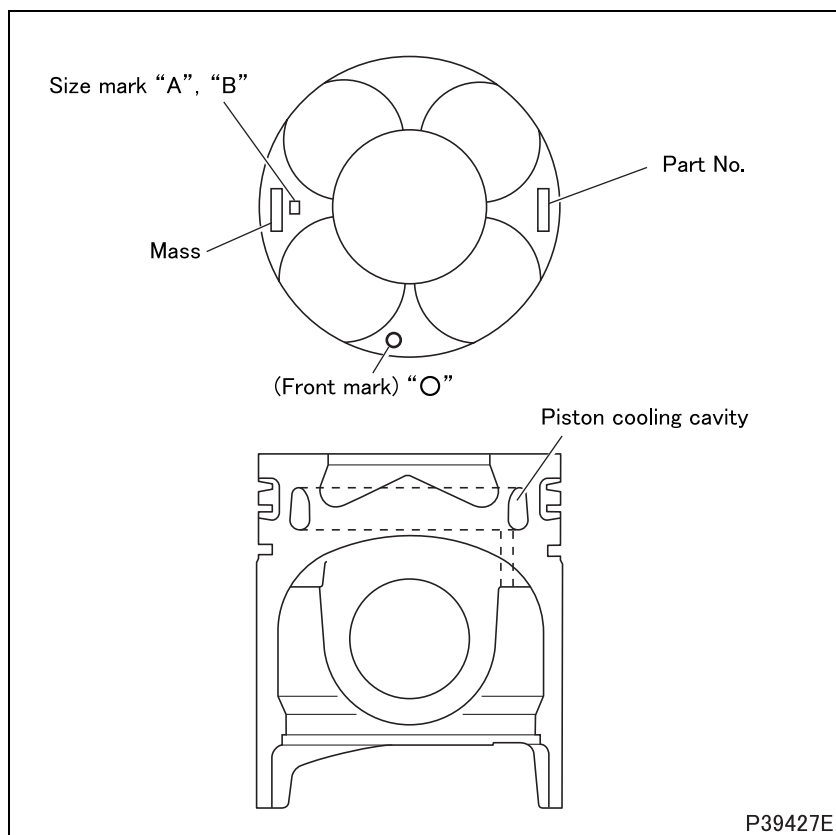
- Each valve has a valve stem seal, which regulates the flow of lubricating oil to the contact surface between the valve and the valve guide.
- The valve springs have a variable pitch to prevent abnormal vibration at high engine speed. The exhaust valves use a double spring, with the inner and outer springs coiled in different directions to prevent them from jamming each other.

4. Mitsubishi 6M60 Connecting Rod



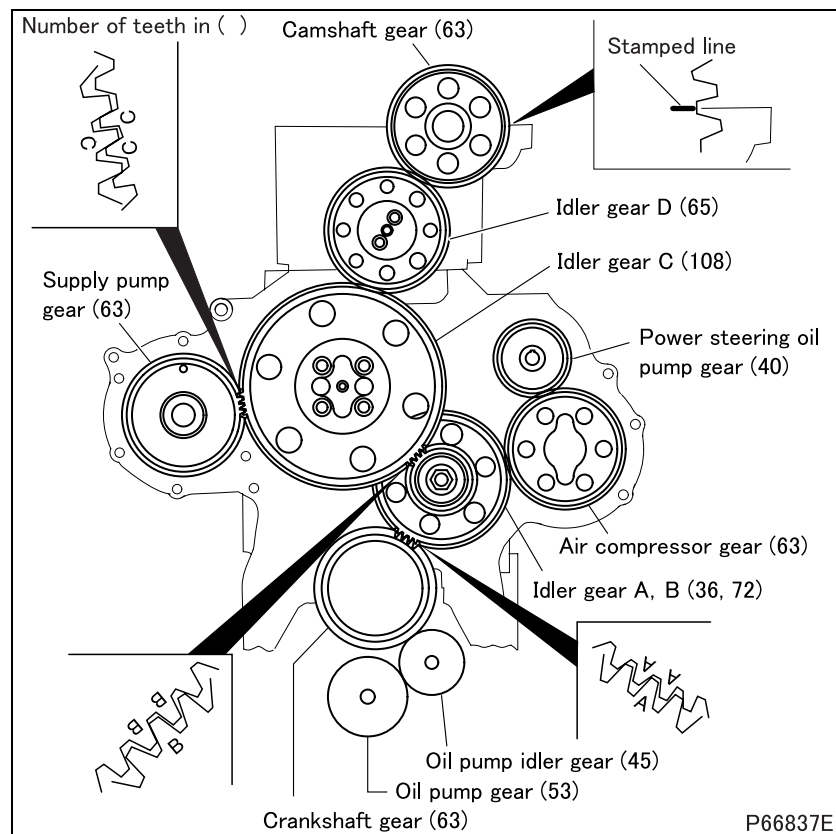
- Weight mark: "A" to "H", "J" to "M"
- "A" indicates the greatest connecting rod mass.

5. Mitsubishi 6M70 Piston



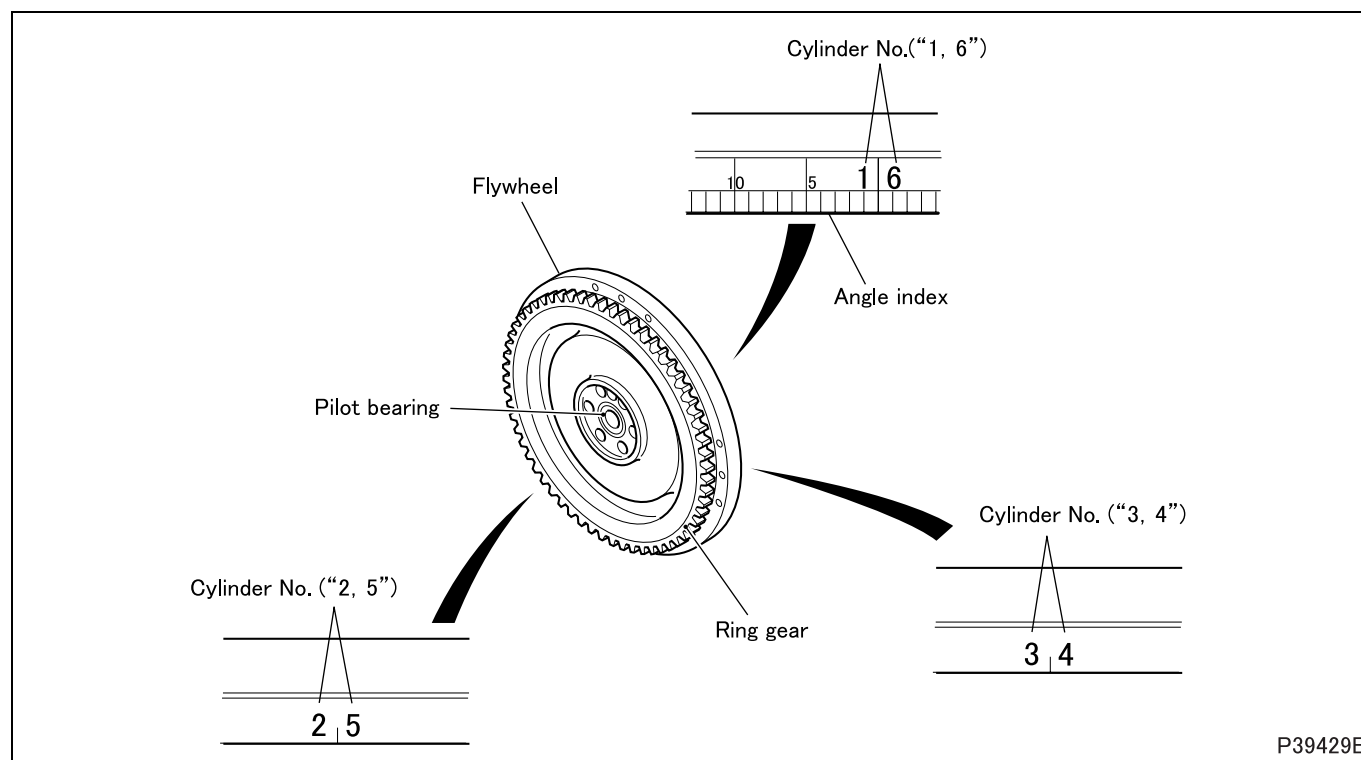
STRUCTURE AND OPERATION

6. Mitsubishi 6M70 Timing Gears

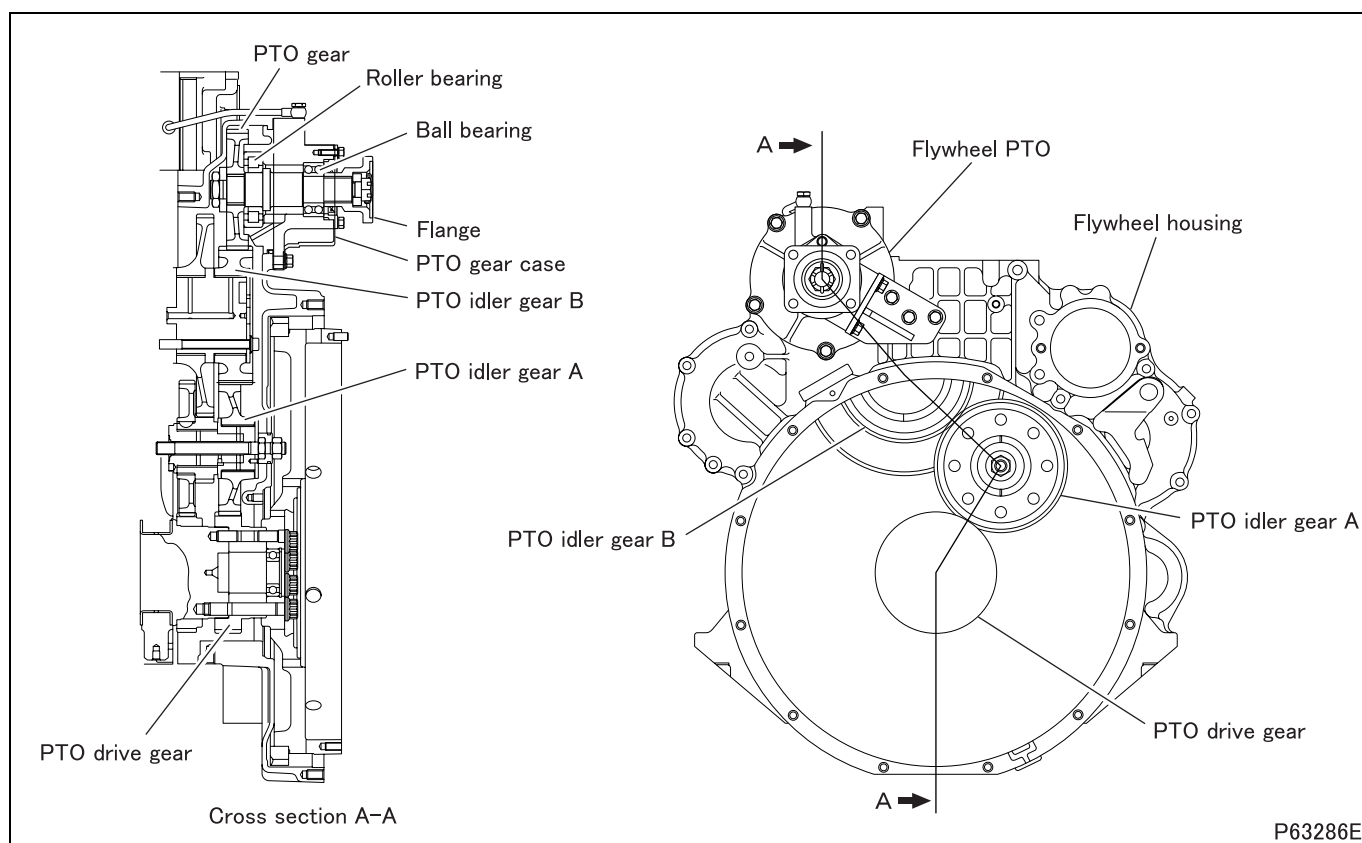


- The timing gears are provided with timing marks to help ensure correct assembly.
- Timing marks are provided on the following gears.
 - Camshaft gear: stamped line
 - Crankshaft gear: "A"
 - Idler gear A, B: "A", "B"
 - Idler gear C: "B", "C"
 - Supply pump gear: "C"

7. Flywheel



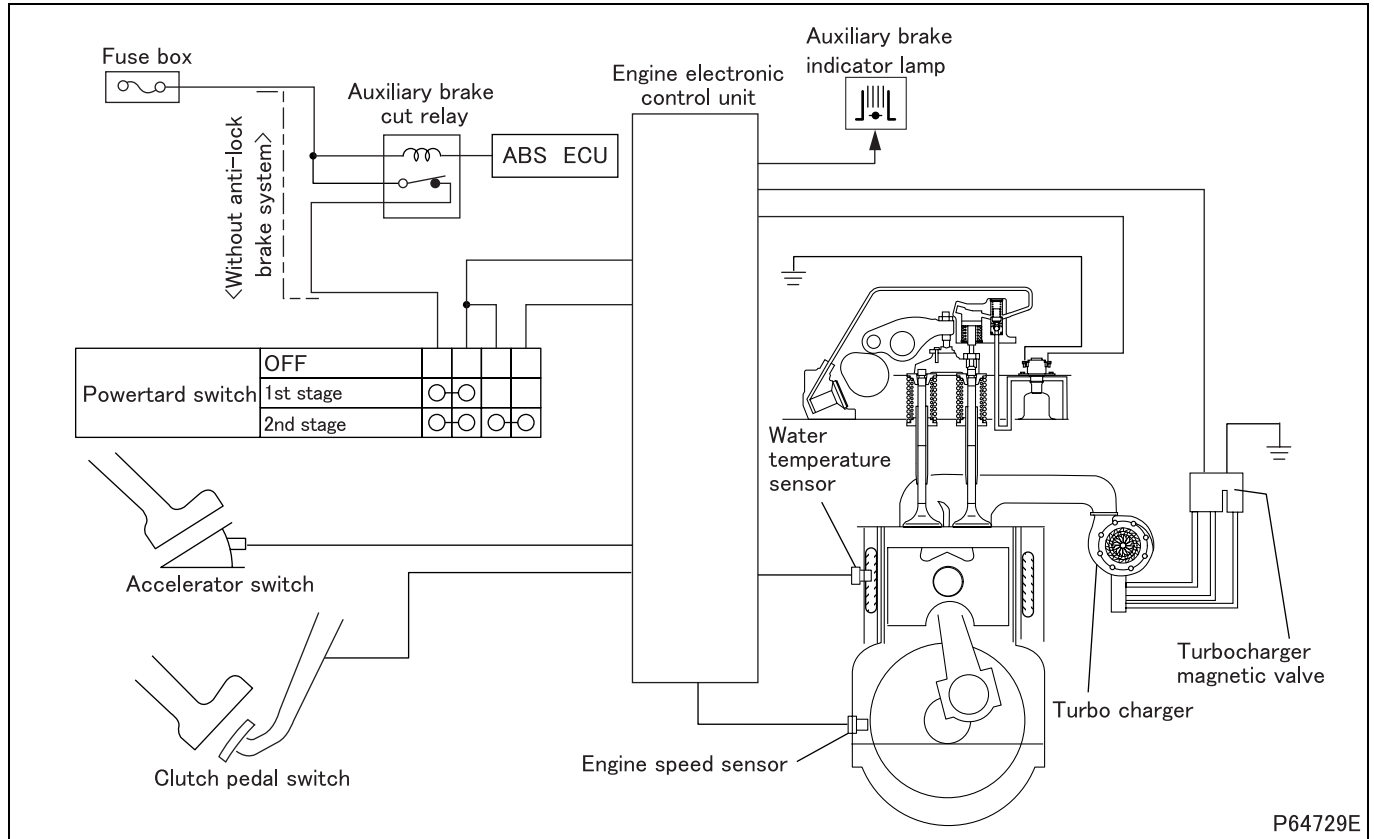
8. Flywheel PTO



- The flywheel PTO is located in the upper part of the flywheel housing and is driven by the PTO drive gear.

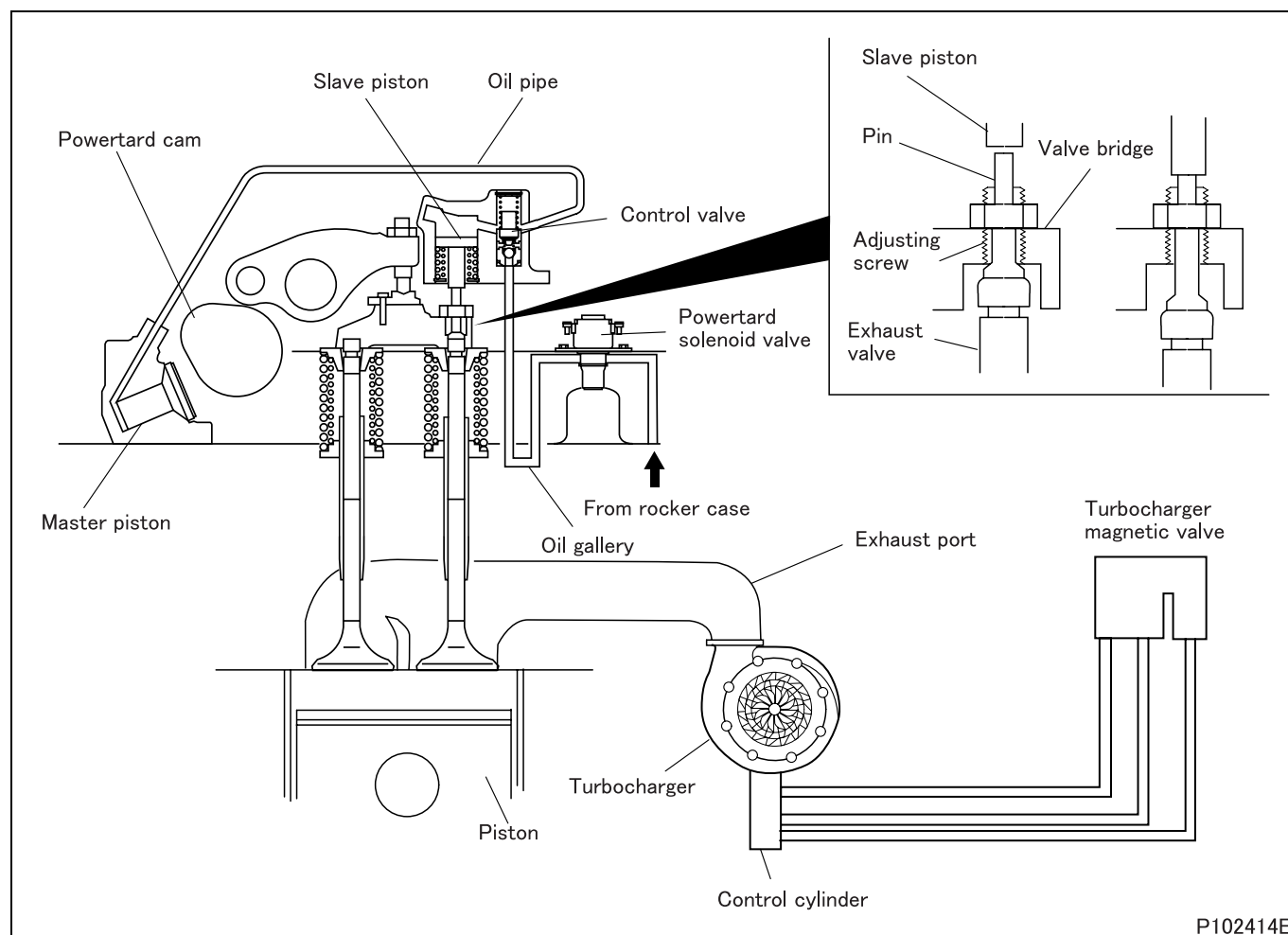
STRUCTURE AND OPERATION

9. Powertard Brake System



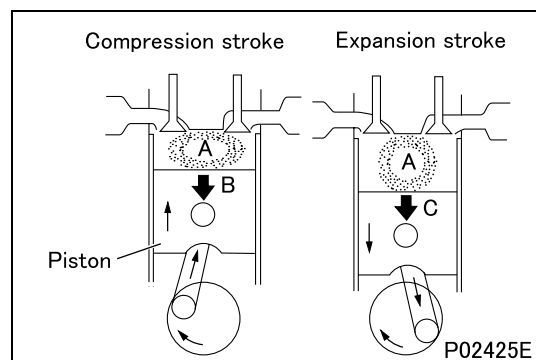
- The Powertard is activated when all of the following conditions are met with the combination switch placed in the first stage or second stage.
 - Engine speed: 800 to 2400 rpm
 - Clutch pedal released (clutch pedal switch: OFF)
 - Accelerator pedal released (accelerator pedal switch: ON)
 - Transmission in gear (transmission neutral switch: ON)
 - Anti-lock brake system not activated (ABS) (Control unit: OFF) (See Gr35E.)
- If any of the above conditions are not met, operation of the Powertard system will be temporarily canceled. If the engine speed is less than 700 rpm or higher than 2500 rpm although all the other conditions (clutch pedal, accelerator pedal, and transmission conditions) are met, operation of the Powertard system will be canceled.
- When the vehicle speed exceeds the auto cruise set vehicle speed during driving with the auto cruise engaged, the Powertard is activated by the control of the engine electronic control unit even if the Powertard switch (combination switch) is not turned ON. (See Gr13.)
- When the Powertard switch is placed in the first stage, the Powertard is activated to enhance the engine braking power.
- When the Powertard switch is placed in the second stage, the turbocharger magnetic valve is activated to control the turbocharger and generate stronger braking power than the first stage.

9.1 Operation of Powertard brake system



P102414E

- The Powertard brake system is a device to enhance the engine brake performance. It opens and closes the exhaust valve (one side only) to control the volume of compressed air in the combustion chamber in accordance with the movement of the piston, thereby providing a boosted braking force. Powertard components are located in the cylinder head.
- The valve bridge is provided with an adjusting screw and a pin that allow the exhaust valve to be opened and closed under the control of the Powertard, in addition to ordinary valve control.
- The pin is free to move in the adjusting screw. Its movement is controlled by the control valve.
- The adjusting screw is used to adjust the timing (Powertard clearance) for the control valve to press the pin.

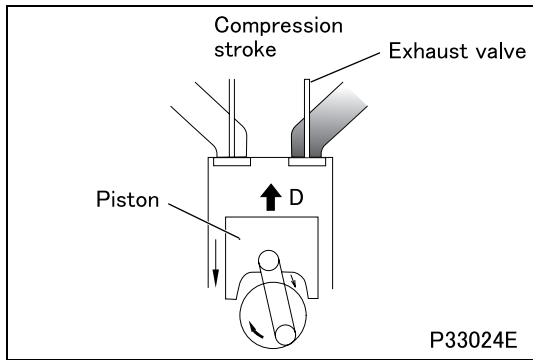
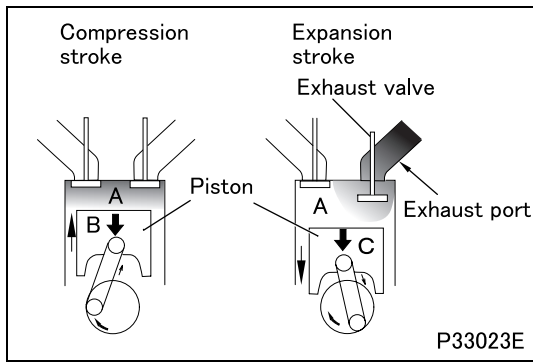


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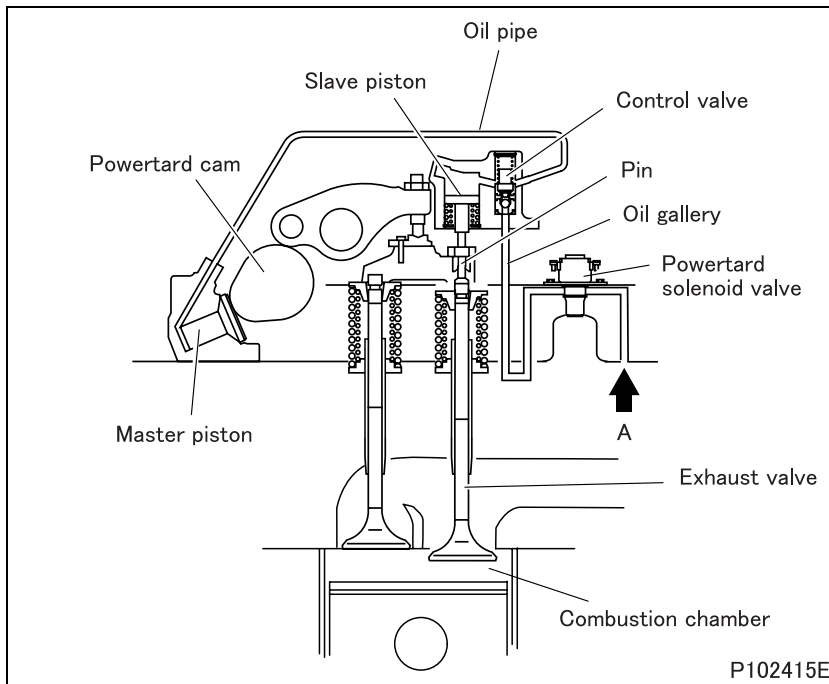
(1) Operating principle

- In the ordinary engine brake, the piston is forced up during its compression stroke when compressed air A develops a counter force B to press the piston. This force works as a braking force. However, the piston is forced down during its expansion stroke to let compressed air expand. This causes an accelerating force C to work on the piston downward, resulting in the braking force obtained during the compression period being lost largely.

STRUCTURE AND OPERATION

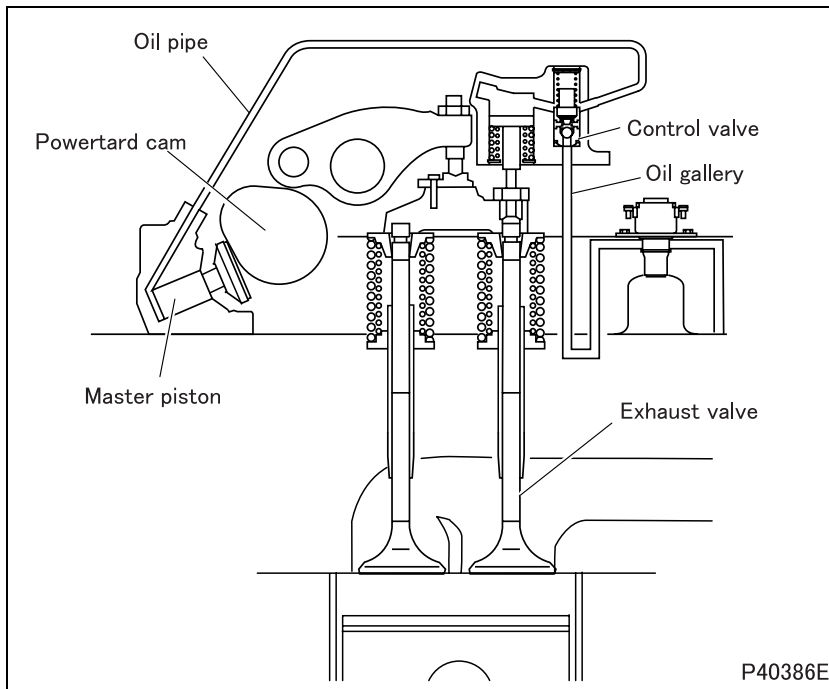


- When the Powertard system is activated, the piston pressing force works as a braking force during the compression stroke as when the Powertard system is not activated. During the expansion period, the exhaust valve is opened by the working of the system to let some of the compressed air out through the exhaust port.
- This causes the piston pressing force to be no longer generated. As a result, the braking force obtained during the compression period is maintained for effective use.
- After letting out more compressed air, the exhaust valve is closed, which causes the combustion chamber to be closed up. As a result, during the expansion period, a new force is generated which hinders the movement of piston when it goes down. This force, following the braking force obtained during the previous compression period, also acts as a braking force, enhancing greatly the vehicle's engine brake capacity. The operation of the system which causes the valve to be opened and closed in agreement with the successive piston strokes is called synchronized operation.
- As shown above, when the Powertard system is activated, the engine brake provides more power than the ordinary engine brake.

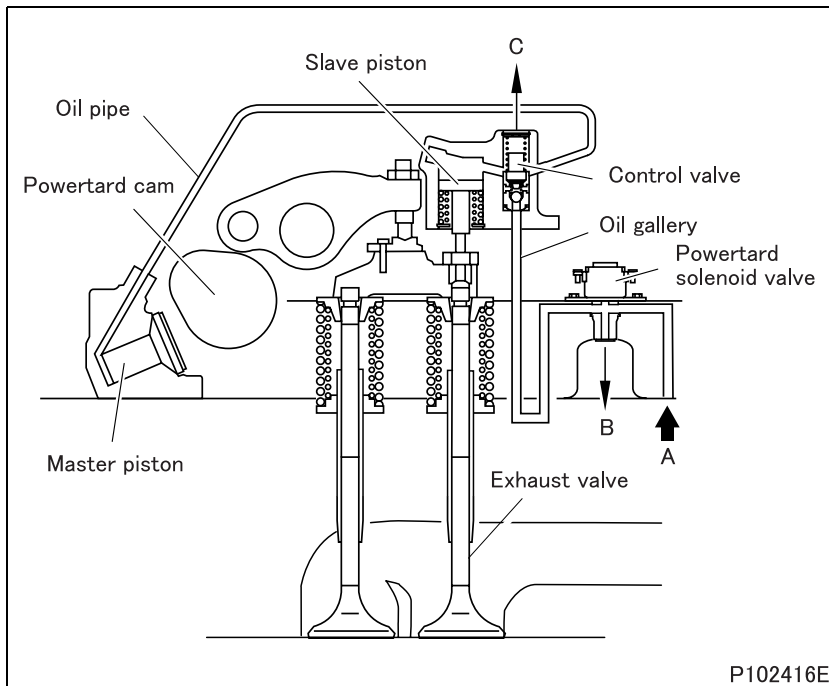


(2) Hydraulic pressure control

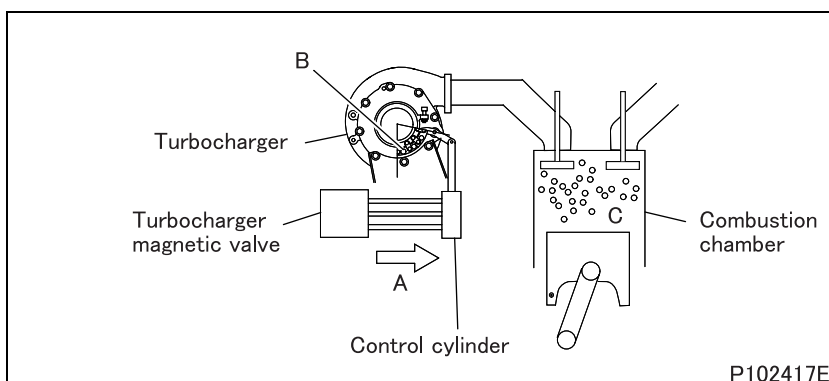
- When the solenoid valve is activated, engine oil (oil pressure produced by ordinary engine oil pump) is let in from A to flow through the oil passage and forces open the check valve in the control valve.
- Oil pressure proceeds through the oil passage to move the master piston into contact with the dedicated Powertard cam.
- This allows the rotation of the dedicated Powertard cam to be transmitted to the master piston. As the cam lobe top is reached, oil pressure in the oil passage further builds up, forcing the check valve in the control valve to close and working on the slave piston at the same time.
- The slave piston pushes the pin, which in turn forces the exhaust valve to open. As a result, the pressure in the combustion chamber is released to maintain effective braking force.



- As the Powertard cam further rotates and the cam lobe top leaves the master piston, the oil pressure in the oil passage is reduced.
- As a result, the exhaust valve is closed by its spring force, which allows the valve to open and close according to ordinary valve timing. At the same time, the check valve in the control valve opens to let engine oil (oil pressure produced by ordinary engine oil pump) work through the oil passages and, allowing the exhaust valve to be forced open again through the movement of the Powertard cam.



- When the Powertard release conditions are met, the following sequence of operation is followed.
- When the solenoid valve is de-energized, the control valve shuts the incoming path (A) for engine oil from the rocker case and opens the outgoing path (B) to the cylinder head.
- Engine oil in the oil passage is let out through B, relieving the control valve of oil pressure.
- The control valve opens the path (C) that has been closed by oil pressure to let out engine oil in the chamber of the slave piston and oil passage.
- As the oil pressure is removed, the master piston is lowered to leave the Powertard cam.
- At the same time, the slave piston is forced up by the spring force. As a result, the exhaust valve is closed and the Powertard is turned off.



(3) Powertard brake control (Powertard: Switch is placed in the second stage)

- The turbocharger magnetic valve feeds air A to the air cylinder, narrowing turbine vane B.
- The number of revolutions of the turbocharger increases, taking more air into the combustion chamber.
- Compressed air C increases and the braking force of the Powertard becomes stronger.

TROUBLESHOOTING

Symptoms		Low power output	Abnormal engine noise	Reference Gr
Possible causes				
Cylinder head and valve mechanism	Valve clearance incorrect	O	O	
	Defective cylinder head gasket	O	O	
	Valve and valve seat worn and carbon deposits	O	O	
	Valve spring fatigued	O	O	
	Defective rocker shaft and bracket		O	
	Poor lubrication of rocker shaft and bracket assembly		O	
Timing gears	Defective backlash between gears		O	
	Poor lubrication of gears and idler shaft		O	
Camshaft	Camshaft end play excessive		O	
	Camshaft worn		O	
Pistons and connecting rods	Piston ring groove(s) worn and damaged	O	O	
	Piston ring(s) worn and damaged	O	O	
	Piston pin and connecting rod small end worn		O	
Crankshaft	Crankshaft end play excessive		O	
	Fan pulley improperly mounted		O	
	Crankshaft pins and connecting rod bearings worn or damaged		O	
	Crankshaft journals and main bearings worn or damaged		O	
Fuel system	Defective supply pump	O	O	Gr13
	Defective injector	O	O	
	Air trapped in fuel system	O		
Cooling system	Cooling system malfunction	O		Gr14
	Belts loose/damaged		O	
Intake and exhaust system	Air cleaner clogged	O	O	Gr15
	Turbocharger malfunction	O	O	
	Diesel particulate filter clogged	O	O	Gr15
Oil viscosity unsuitable		O		Gr12
Improper fuel		O		
Incorrectly fitted piping and hoses			O	
Defective/incorrectly fitted alternator and other auxiliaries			O	Gr54

PowerTard Brake System

		Symptoms	PowerTard brake fails to operate	Turning PowerTard switch OFF does not cancel PowerTard braking	Reference Gr
		Possible causes			
Lubrication oil is cold and too viscous			O	O	
PowerTard clearance too large			O		
Electrical system	Blown fuse		O		Gr13
	Improper connection of harnesses and connectors		O		
	Defective clutch switch		O	O	
	Defective accelerator switch		O	O	
	Defective transmission neutral switch		O	O	
	Defective powerTard switch (combination switch)		O	O	
	Defective meter cluster		O	O	
	Defective engine speed sensor		O	O	
	Defective powerTard solenoid valve		O	O	
	Defective engine control unit		O	O	
	Defective ABS exhaust brake cut relay <ABS/ASR>		O	O	Gr35
Defective PowerTard			O	O	
Valve mechanism	Broken or weak exhaust valve springs		O		
	Exhaust valve sticky or not smooth in operation		O		
	Improperly adjusted powerTard clearance		O		
Oil leakage in PowerTard system			O		
Engine oil pressure too low			O		
Insufficient engine oil flow	Air present in engine oil		O		
	Oil leakage from around cylinder head and rocker case		O		
	Oil passage leading to powerTard assembly clogged		O		
	Oil leakage from powerTard brake system		O		Gr12
	Defective control valve		O		

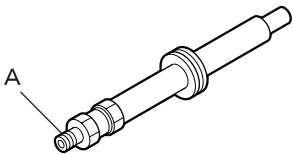
ON-VEHICLE INSPECTION AND ADJUSTMENT

1. Measuring Compression Pressure

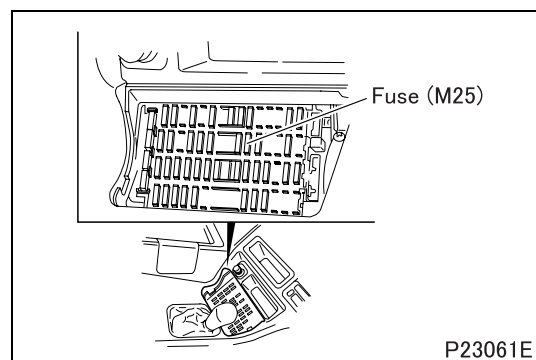
Service standards

Location	Maintenance item		Standard value	Limit	Remedy
—	Mitsubishi 6M70 Compression pressure	Each cylinder (at 200 rpm)	2,940 kPa {30 kgf/cm ² }	1,960 kPa {20 kgf/cm ² }	Inspect
		Pressure difference between each cylinder	—	390 kPa {4 kgf/cm ² } or less	Inspect

Special tools (Unit: mm)

Mark	Tool name and shape	Part No.	Application
	Compression gauge adapter  A M14 × 1.5 P13660	MH062180	Measuring of compression pressure

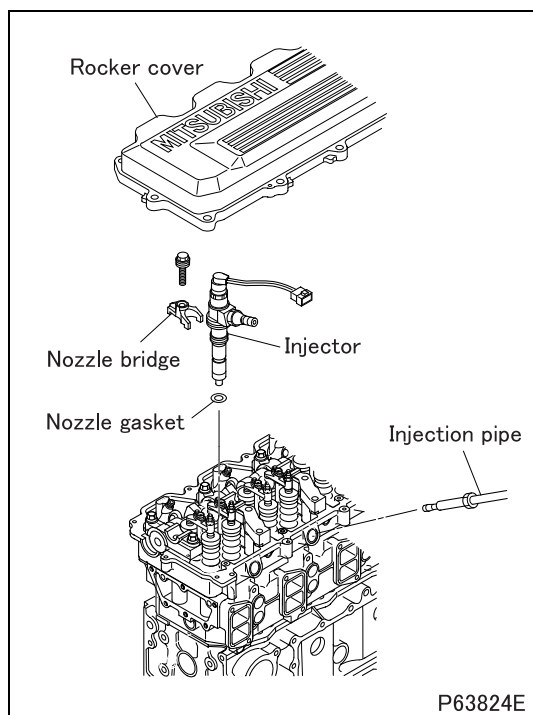
- A drop in compression pressure can be used as a guide to determine when the engine should be overhauled.
- Measure the compression pressure at regular intervals. Keeping track of its transitions can provide a useful tool for troubleshooting. On new vehicles and vehicles with newly replaced parts, the compression pressure will be somewhat higher depending on the break-in condition of piston rings, valve seats, etc., but this will return to normal as the parts wear down.
- Before the compression measurement, confirm that the engine oil, starter, and battery are in normal condition.
- Place the vehicle in the following conditions.
 - Warm up the engine until the coolant temperature reaches approximately 75 to 85°C.
 - Turn off the lights and accessories.
 - Place the transmission in N range.
 - Turn the steering wheel in neutral position.



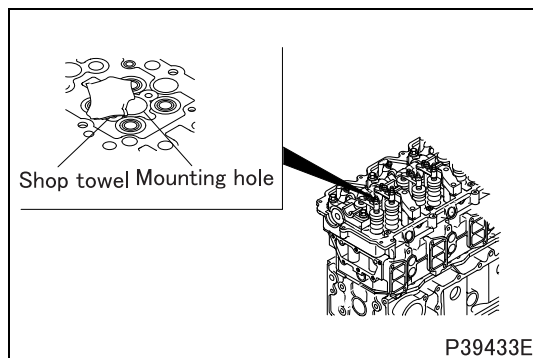
- Remove the fuse (M25) from the fuse box in the cab to prevent fuel from being injected while the engine is cranked using the starter.

CAUTION

- When cranking the engine, never shut off the power supplied to the engine electronic control unit by disconnecting the engine electronic control unit connector or other similar methods. If the engine is cranked with the power to the engine electronic control unit shut off, the supply pump will not be controlled by the electronic control unit, causing the supply pump to be malfunctioned.



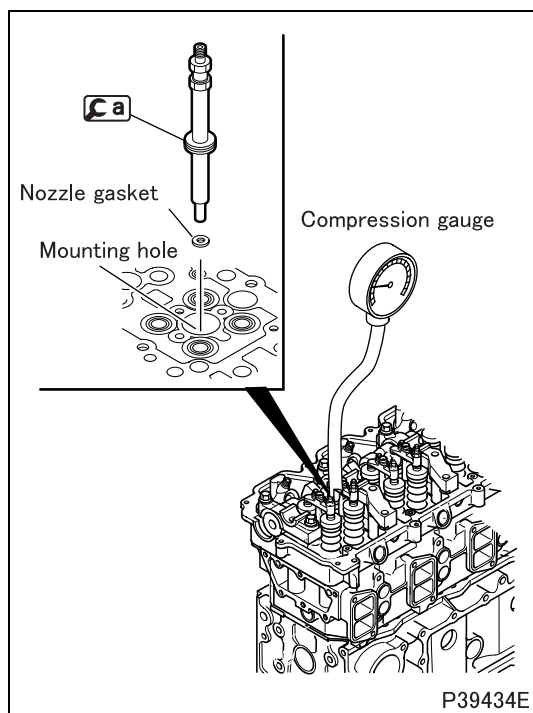
- Remove all the injectors. (See Gr13.)



- Cover the injector mounting holes with shop towels or other similar cloth. Crank the engine using the starter. Ensure that no foreign matter is attached on the shop towels.

CAUTION

- **If cracks or any other damage are evident in the cylinders, this means that the coolant, engine oil or fuel, or other substances, has entered the cylinders. If this is the case, it is extremely dangerous to crank the engine as these substances will gush out at high temperature from the injector mounting holes. Stay away from the engine when cranking it.**



- Attach the nozzle gasket and to one of the mounting holes. Then, connect a compression gauge to .
- Crank the engine and measure the compression pressure.
- Measure the compression pressure for all the cylinders one after another. Determine the compression pressure difference between the cylinders.
- If the compression pressure is below the limit or the pressure difference between each cylinder is not within the limit, pour a small amount of engine oil into the corresponding mounting hole and measure the compression pressure again.
 - If the compression pressure increases, the piston rings and inner surfaces of cylinder may be badly worn or otherwise damaged.
 - If the compression pressure remains unchanged, there may be seizure in the valves, the valves may be incorrectly seated or the cylinder head gasket may be defective.

- Install the injector. (See Gr13.)
- Install the rocker cover and the gasket. (See "ROCKER COVER, ROCKER AND SHAFT".)

ON-VEHICLE INSPECTION AND ADJUSTMENT

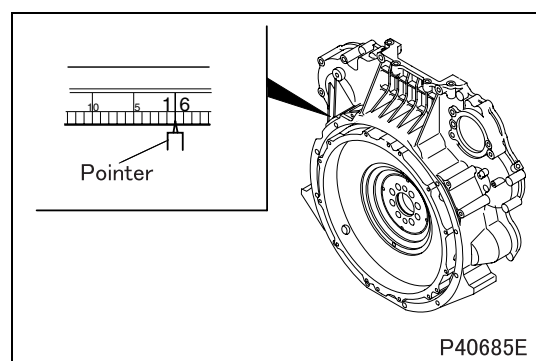
2. Mitsubishi 6M70 Inspection and Adjustment of Valve Clearances Service standards (Unit: mm)

Location	Maintenance item		Standard value	Limit	Remedy
-	Mitsubishi 6M70 Valve clearance (when engine is cold)	Intake side	0.4	-	Adjust
		Exhaust side	0.6	-	Adjust

Tightening torque (Unit: N·m {kgf·m})

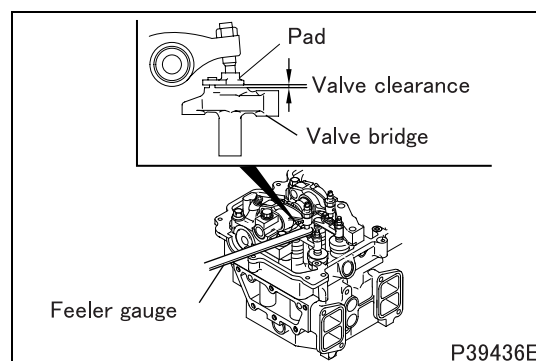
Mark	Parts to be tightened	Tightening torque	Remarks
-	Lock nut (6M70 valve bridge adjusting screw tightening)	68 {7}	-
-	Lock nut (6M70 rocker arm adjusting screw tightening)	60 {6}	-

- Mitsubishi 6M70 Valve clearances should be checked and adjusted as follows while the engine is still cold.



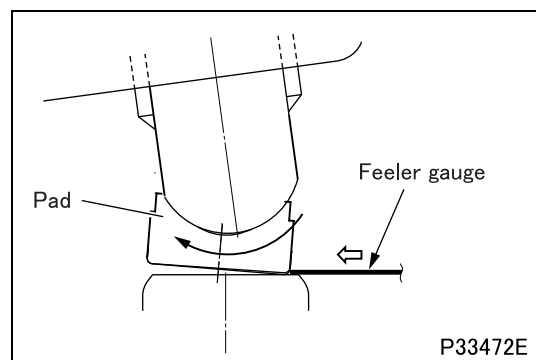
[Inspection]

- Remove the rocker cover.
- Bring the No. 1 or No. 6 cylinder piston to the top dead center (TDC) on the compression stroke according to the following procedure:
 - Crank the engine until the pointer is aligned with the "1 6" mark on the flywheel.
 - This will place either the No. 1 or No. 6 cylinder piston at TDC on the compression stroke. The cylinder in which the rocker arms for both the intake and exhaust valves can be pushed down by hand by the valve clearance amounts has its piston at TDC. Rotate the engine by one full turn to switch the TDCs of the No. 1 and No. 6 cylinder pistons.

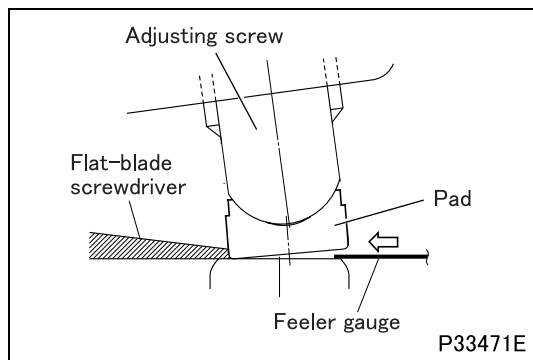


- With the No. 1 or No. 6 cylinder piston at TDC, measure the clearance of the valves (clearance between valve bridge and pad) marked with a circle in the table below.

Cylinder No.	1		2		3		4		5		6	
Valve	IN	EX	IN	EX	IN	EX	IN	EX	IN	EX	IN	EX
No. 1 cylinder piston at TDC on compression stroke	○	○	○	-	-	○	○	-	-	○	-	-
No. 6 cylinder piston at TDC on compression stroke	-	-	-	○	○	-	-	○	○	-	○	○



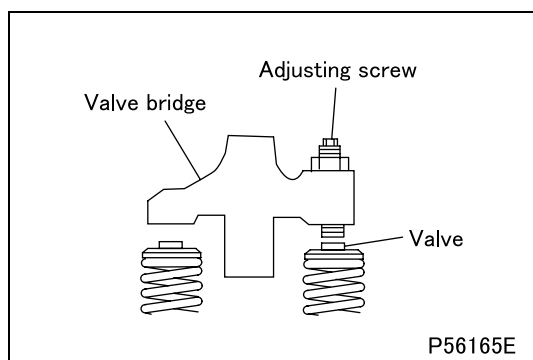
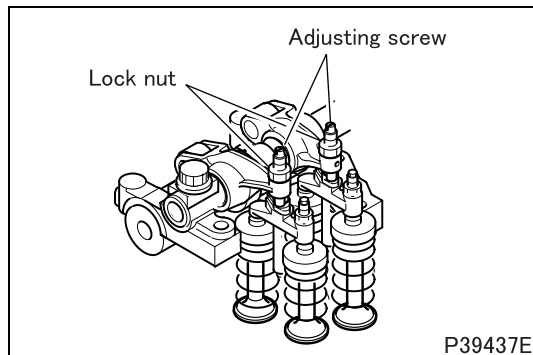
- Any attempt to insert a feeler gauge without first securing sufficient space, as described above, between the pad and the valve bridge will fail, as the pad will tilt as shown in the illustration, thus blocking the entry of a feeler gauge.



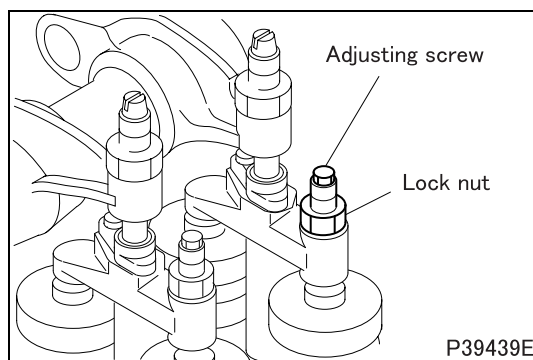
- Before inserting a feeler gauge, push the adjusting screw pad on the side opposite from where a feeler gauge is to be inserted, as shown in the illustration, using a flat-blade screwdriver or other similar tool. This will create space necessary for the gauge to be inserted.
- The measurement is correct when the feeler gauge feels slightly resisted as it is inserted.
- The measurement is not yet correct if the feeler gauge can still be inserted smoothly.
- If the measurement deviates from the standard value, adjust as follows.

[Adjustment]

- Loosen the lock nuts and adjusting screws on the valve bridge and rocker arm.



- While holding the valve bridge by hand, screw in the adjusting screw until it lightly contacts the valve stem end.
- Then, further screw in the adjusting screw by 45°.

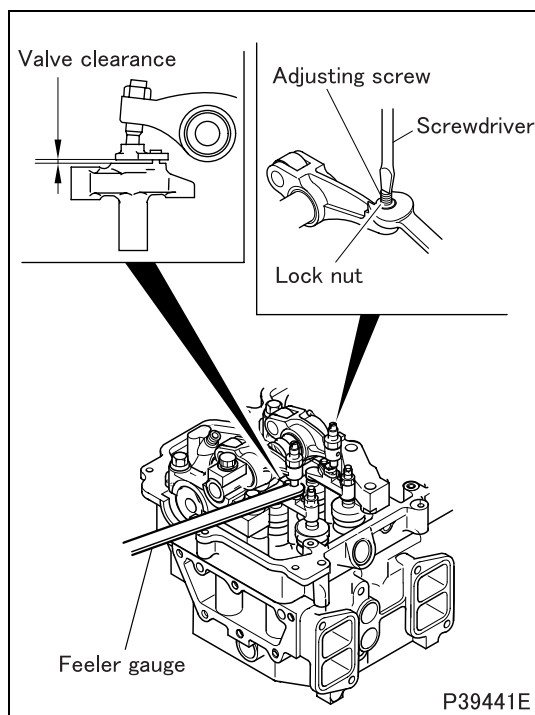


- While holding the adjusting screw in this position, tighten the lock nuts to the specified torque.

CAUTION

- After adjusting the adjusting screw, be sure to tighten the lock nut to the specified torque. Insufficient torquing will compromise the parallelism of the valve bridge, damaging the valve mechanism.

ON-VEHICLE INSPECTION AND ADJUSTMENT



- Screw in or out the adjusting screw on the rocker arm until the correct feeler gauge can be inserted with a slight resistance.
- After adjustment, while holding the adjusting screw in this position with a screwdriver, tighten the lock nuts to the specified torque.
- Recheck the valve clearance using the correct feeler gauge.

CAUTION ⚠

- **If the valve clearance has been adjusted, be sure to check and adjust the Powertard clearance. (See later section.)**
- After the adjustment is complete, install the rocker cover and the gasket. (See "ROCKER COVER, ROCKER AND SHAFT".)

Mitsubishi 6M70 Engine Parts contact:

email: EngineParts@HeavyEquipmentRestorationParts.com

Phone: 269 673 1638

M E M O

ON-VEHICLE INSPECTION AND ADJUSTMENT

3. Inspection and Adjustment of Powertard Clearances

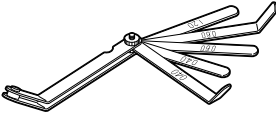
Service standards (Unit: mm)

Location	Maintenance item	Standard value	Limit	Remedy
–	Powertard clearance (when engine is cold)	1.0 ± 0.05	–	Adjust

Tightening torque (Unit: N·m {kgf·m})

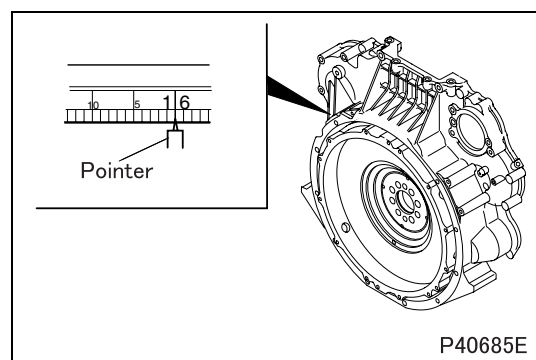
Mark	Parts to be tightened	Tightening torque	Remarks
–	Lock nut (for locking Powertard assembly adjusting screw)	25 {2.6}	–

Special tools (Unit: mm)

Mark	Tool name and shape	Part No.	Application
	Feeler gauge  P11605	MH063474	Adjustment of Powertard Clearances

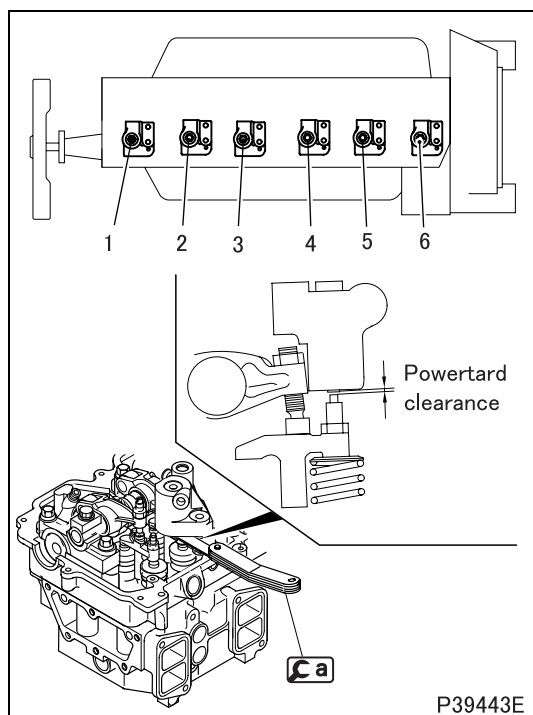
Inspection and adjustment of the Powertard clearance must be carried out after the inspection and adjustment of the valve clearance while the engine is cold.

Inspection and adjustment of valve clearances (See 2. “Inspection and Adjustment of Valve Clearances”).)



[Inspection]

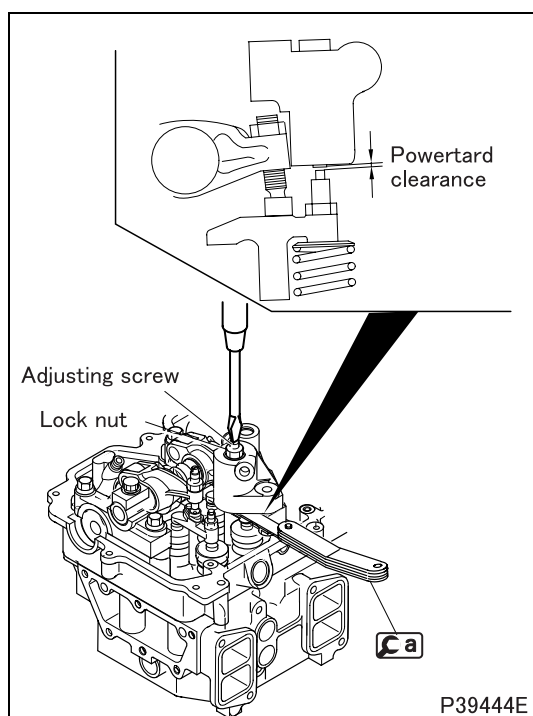
- Remove the rocker cover.
- Bring the No. 1 or No. 6 cylinder piston to the top dead center (TDC) on the compression stroke according to the following procedure:
 - Crank the engine until the pointer is aligned with the “1 6” mark on the flywheel.
 - This will place either the No. 1 or No. 6 cylinder piston at TDC on the compression stroke. The cylinder in which the rocker arms for both the intake and exhaust valves can be pushed down by hand by the valve clearance amounts has its piston at TDC. Rotate the engine by one full turn to switch the TDCs of the No. 1 and No. 6 cylinder pistons.



- When the No. 1 or No. 6 piston is at the TDC position of its compression stroke, measure Powertard clearance for the valve marked O in the following table.

Cylinder No.	1	2	3	4	5	6
Powertard clearance measuring point						
No. 1 piston at TDC of compression stroke	O		O		O	
No. 6 piston at TDC of compression stroke		O		O		O

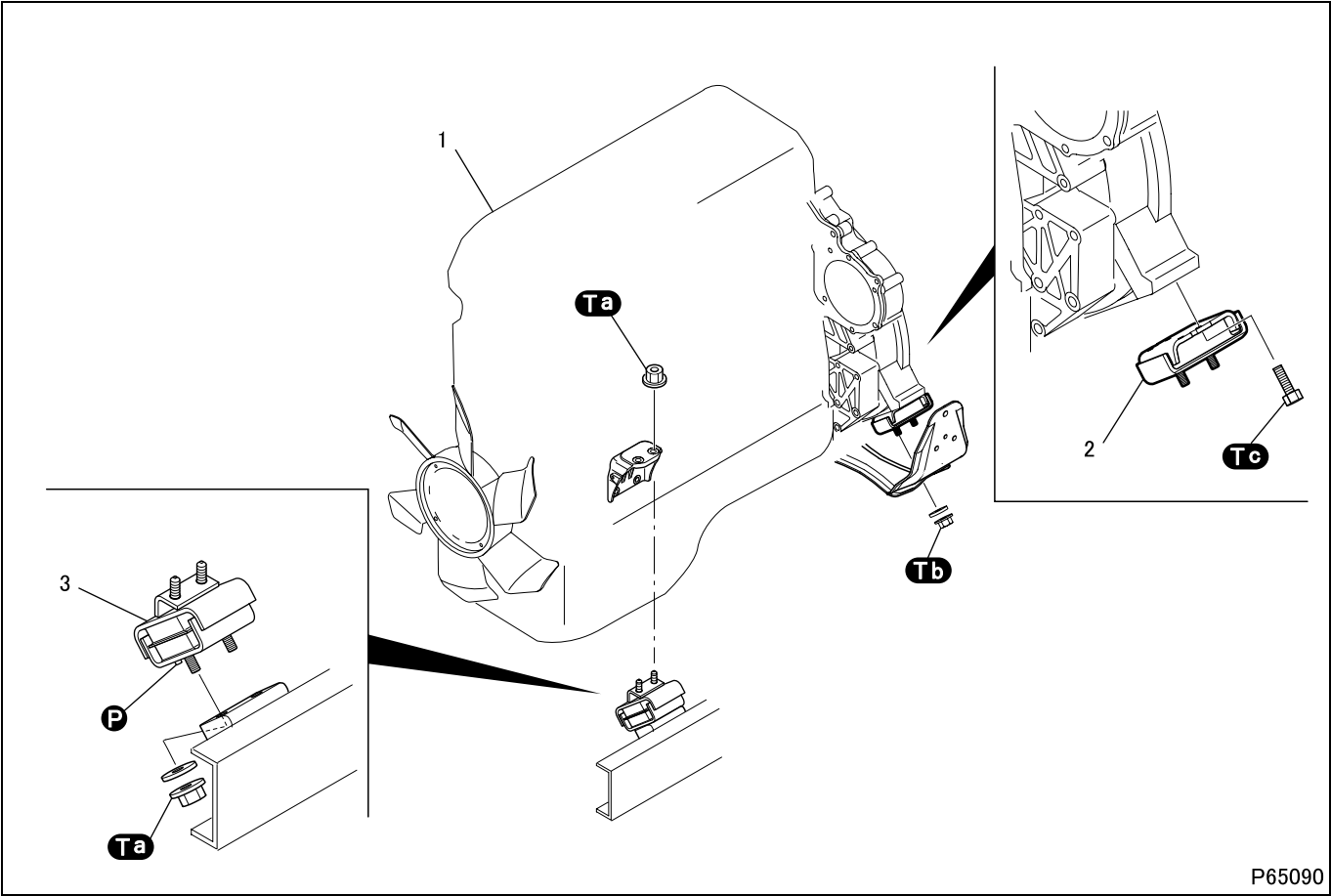
- For proper measurement, some resistance must be felt when inserting the **(Ca)** in the clearance.
- Accurate measurements cannot be expected if the gauge moves loosely in the clearance.
- If any measurement is out of specification, make adjustment as follows.



[Adjustment]

- To adjust Powertard clearance, loosen the lock nut, then tighten the adjusting screw until the **(Ca)** moves somewhat stiffly in the gap.
- Holding the adjusting screw in that position with a screwdriver, tighten the lock nut to lock the adjusting screw. Recheck the Powertard clearance using the **(Ca)**.

ENGINE REMOVAL AND INSTALLATION



● Removal sequence

- 1 Engine
- 2 Rear mounting
- 3 Front mounting

P: Locating pin

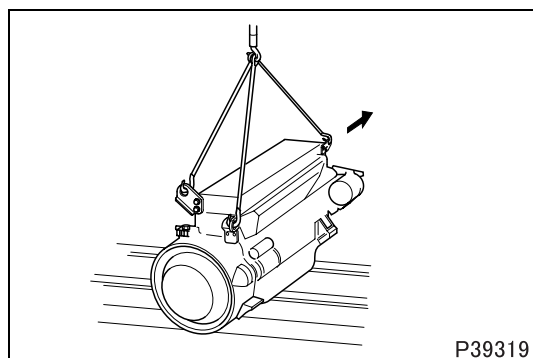
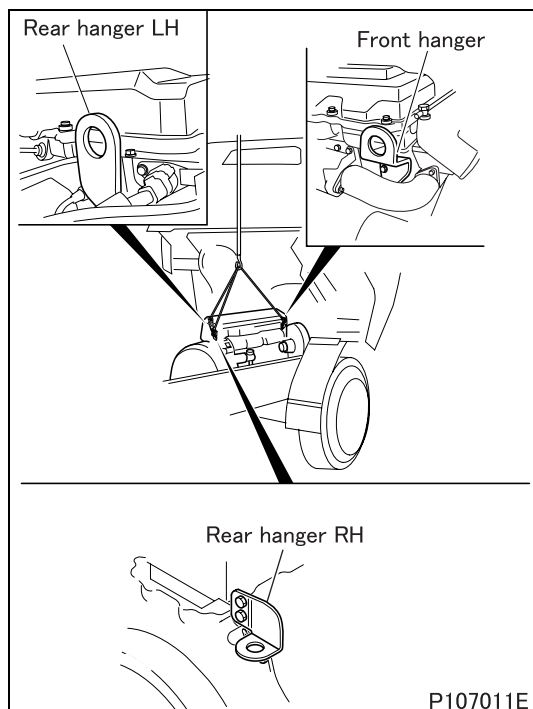
● Installation sequence

Follow the removal sequence in reverse.

Tightening torque (Unit: N·m {kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (front mounting installation)	300 to 400 {30 to 40}	—
Tb	Nut (rear mounting installation)	120 to 160 {12 to 16}	—
Tc	Bolt (rear mounting installation)	70 to 95 {7.0 to 9.5}	—

◆ Removal procedure ◆



■ Removal: Engine

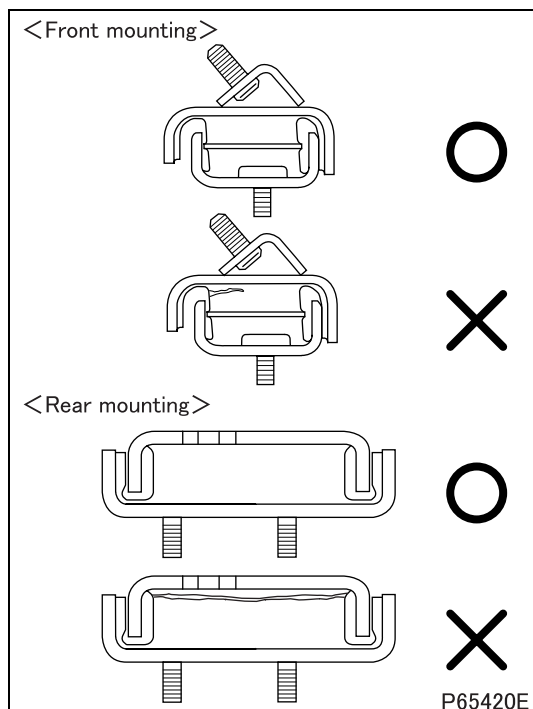
- Hook a lifting device onto front hanger, rear hanger RH and rear hanger LH, and lift the device with a crane until it is taut.

WARNING ⚠

- Use a lifting device that can comfortably withstand the mass of the engine (approx. 1000 kg).
- Ensure that the harnesses, piping and other relevant parts have been disconnected.

- Remove the bolts and nuts from the engine mounts. Slowly lift the engine, taking care not to hit the engine against the frame or cab.
- Once the bottom of the engine is out of the frame, turn the engine by 90° and remove it out of the vehicle.

◆ Inspection procedure ◆

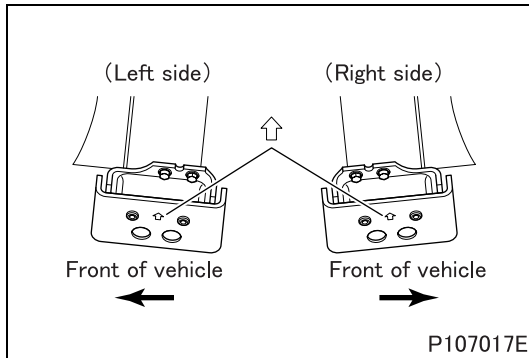


■ Inspection: Mounting

- Check the entire circumference of the rubber cushion of the mountings for a crack, breakage and adhesion of oil.
- If there is any abnormality, replace the mounting.

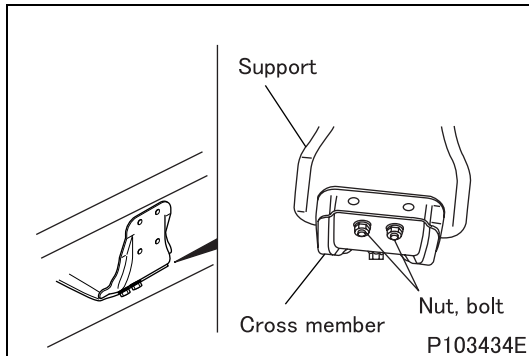
ENGINE REMOVAL AND INSTALLATION

◆ Installation procedure ◆



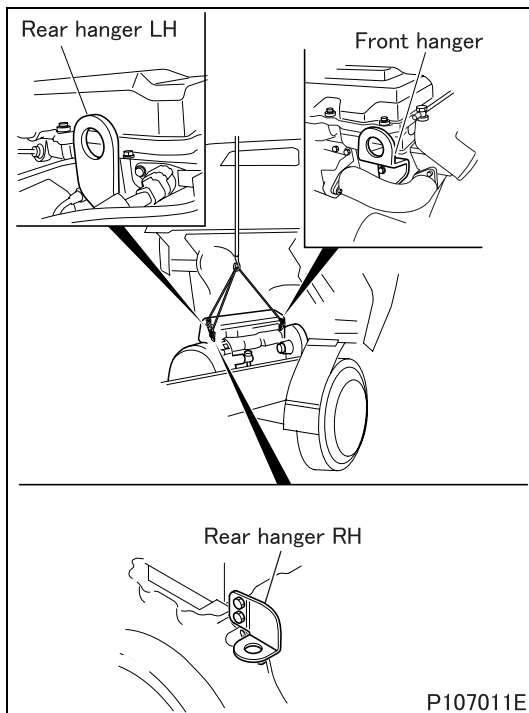
■ Installation: Rear mounting

- Install the rear mounting on the engine in the illustrated direction.

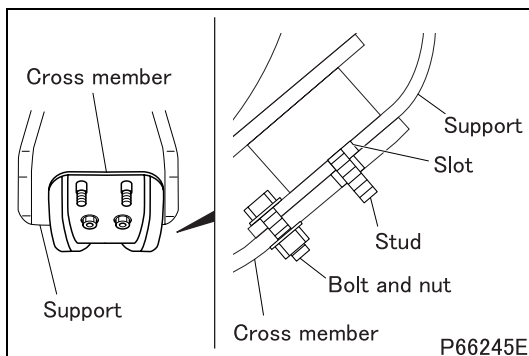


■ Installation: Engine

- Loosen cross member and support mounting bolts and nuts.



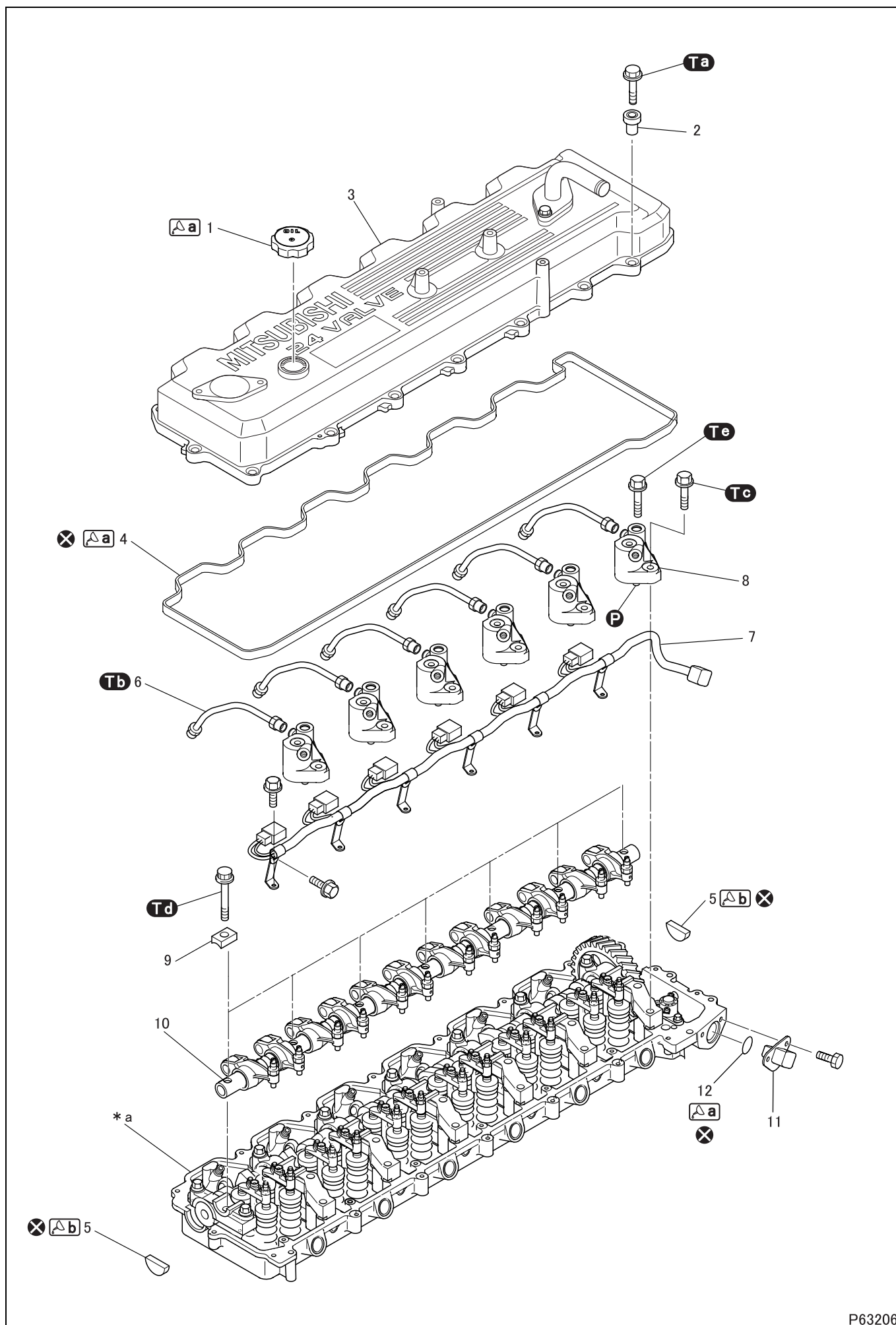
- Hook a lifting device onto front hanger, rear hanger RH and rear hanger LH, and lift the device with a crane to install the engine.



- Make sure that the stud of the rear mounting is placed at the illustrated position (lowermost part of the slot on the support side).
- The slot on the cross member side needs not necessarily be on the lowermost part.
- If the stud is not placed at the illustrated position, adjust the position with the cross member and support.
- Tighten cross member and support mounting bolts and nuts to the torque of 120 to 160 N·m {12 to 16 kgf·m}.
- Tighten front and rear mounting nuts to the specified torque.

M E M O

MITSUBISHI 6M70 ROCKER COVER, ROCKER AND SHAFT



P63206

● Disassembly sequence

- | | | |
|-----------------------|---|-----------------------|
| 1 Oil filler cap | 7 Harness | 12 O-ring |
| 2 Rubber | 8 Slave piston housing | |
| 3 Rocker cover | 9 Rocker shaft cap | *a: Rocker case |
| 4 Rocker cover gasket | 10 Rocker and shaft
(See later section.) | Ⓐ: Locating pin |
| 5 Packing | 11 Bushing connector | ⊗: Non-reusable parts |
| 6 Oil pipe | | |

● Assembly sequence

Follow the disassembly sequence in reverse.

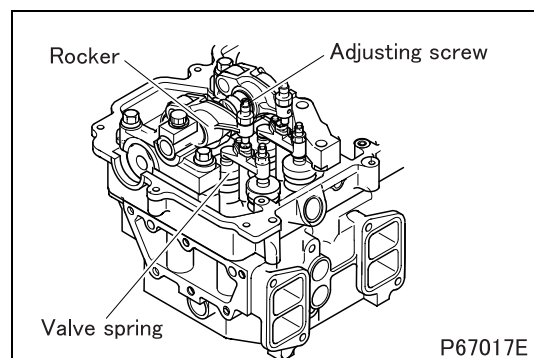
Tightening torque (Unit: N·m {kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (rocker cover mounting)	8.8 {0.9} 6.5 Ft Lbs	—
Tb	Oil pipe	44 {4.5}	—
Tc	M10 bolt (slave piston housing mounting)	55 {5.5}	—
Td	Bolt (rocker shaft mounting)	98 {10}	—
Te	M12 bolt (slave piston housing mounting)	80 {8.0}	—

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
Ⓐa	Rubber portion of oil filler cap	Engine oil	As required
	O-ring		
	Rocker cover gasket		
Ⓐb	Periphery and top surface of packing	ThreeBond 1211	As required

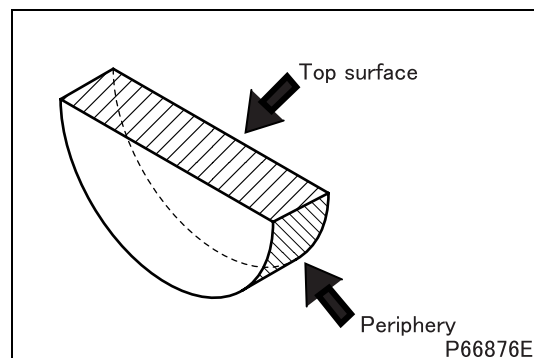
◆ Work before removal ◆



■ Releasing valve spring force

- Before loosening the rocker and shaft mounting bolts, check whether the valve springs are compressed by the rockers. If so, loosen the adjusting screws on the rockers to relieve the spring force. This will eliminate the possibility of compressed springs damaging parts when they are released.

◆ Installation procedure ◆



■ Installation: Packing

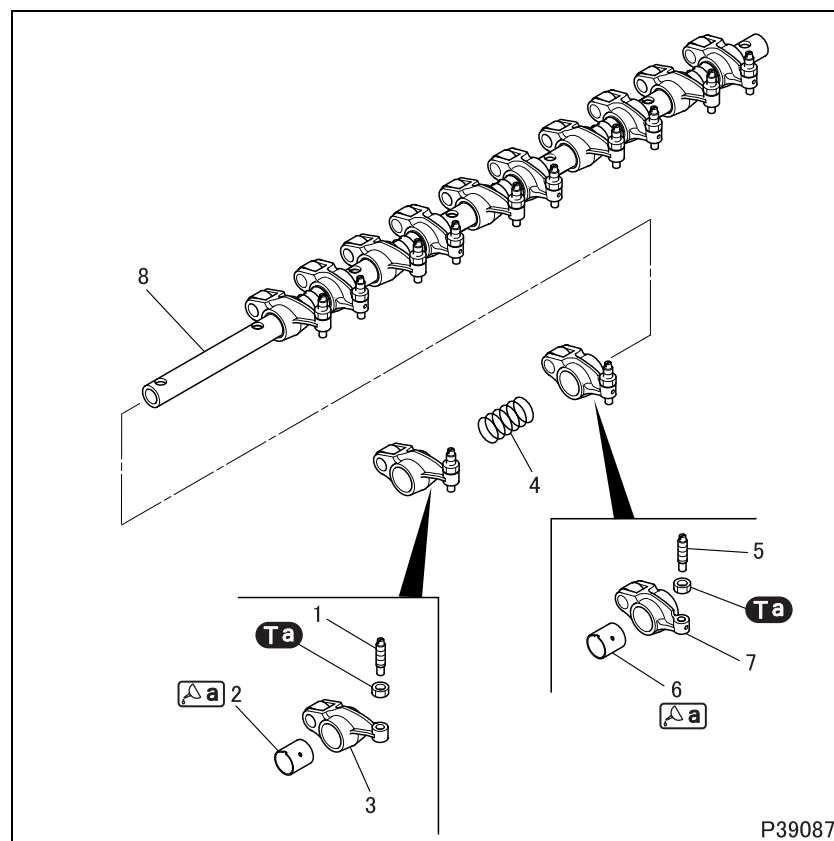
- Apply sealant over the periphery of the packing and immediately install it on the rocker case.
- After installing it on the rocker case, apply sealant over the top of the packing.
- Install the rocker gasket and rocker cover on it immediately after applying sealant.

CAUTION ⚠

- Never run the engine for one hour after installation.
- If the rocker cover is removed after installation, never fail to replace the packing and apply the sealant again.

ROCKER COVER, ROCKER AND SHAFT

Rocker and Shaft



● Disassembly sequence

- 1 Adjusting screw
- 2 Rocker bushing
- 3 Intake rocker
- 4 Rocker shaft spring
- 5 Adjusting screw
- 6 Rocker bushing
- 7 Exhaust rocker
- 8 Rocker shaft

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards (Unit: mm)

Location	Maintenance item	Standard value	Limit	Remedy
2, 6, 8	Clearance between rocker shaft and bushing	0.027 to 0.088	0.2	Replace
3, 7	Radial clearance of rocker (roller)	0.068 to 0.112	—	Replace

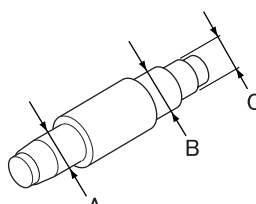
Tightening torque (Unit: N·m {kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Lock nut (adjusting screw tightening)	60 {6}	—

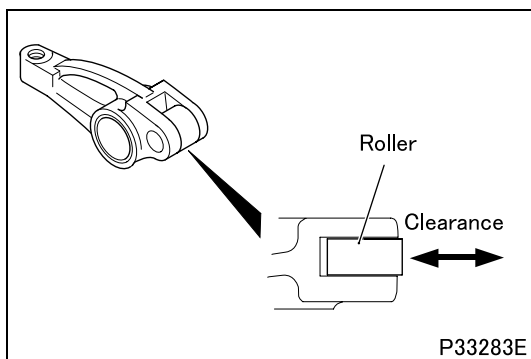
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Inside surface of rocker bushing	Engine oil	As required

Special tools (Unit: mm)

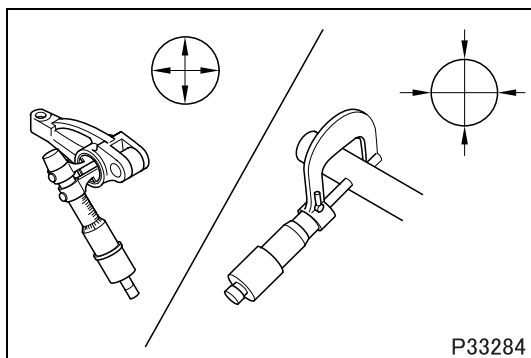
Mark	Tool name and shape	Part No.	Application							
	Rocker bushing puller <table border="1"><tr><td>A</td><td>B</td><td>C</td></tr><tr><td>φ 27.6</td><td>φ 30.5</td><td>φ 28</td></tr></table>	A	B	C	φ 27.6	φ 30.5	φ 28	 P01951	ME350053	Removal and installation of rocker bushing
	A	B	C							
φ 27.6	φ 30.5	φ 28								

◆ Inspection procedure ◆



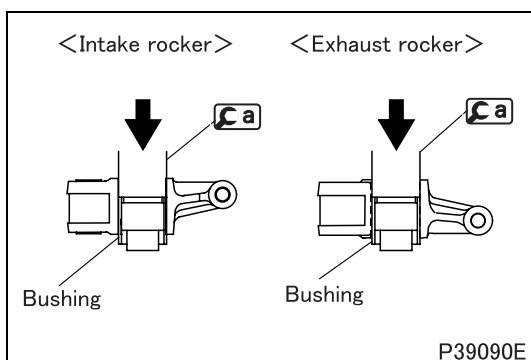
■ Inspection: Radial clearance of rocker (roller)

- If the measurement deviates from the standard value, replace the defective part(s).

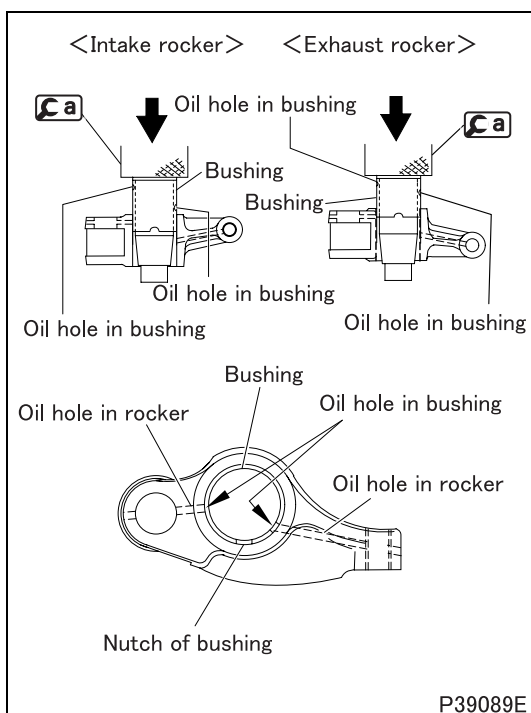


■ Inspection: Clearance between rocker shaft and bushing

- If the measurement exceeds the limit, replace the bushing.



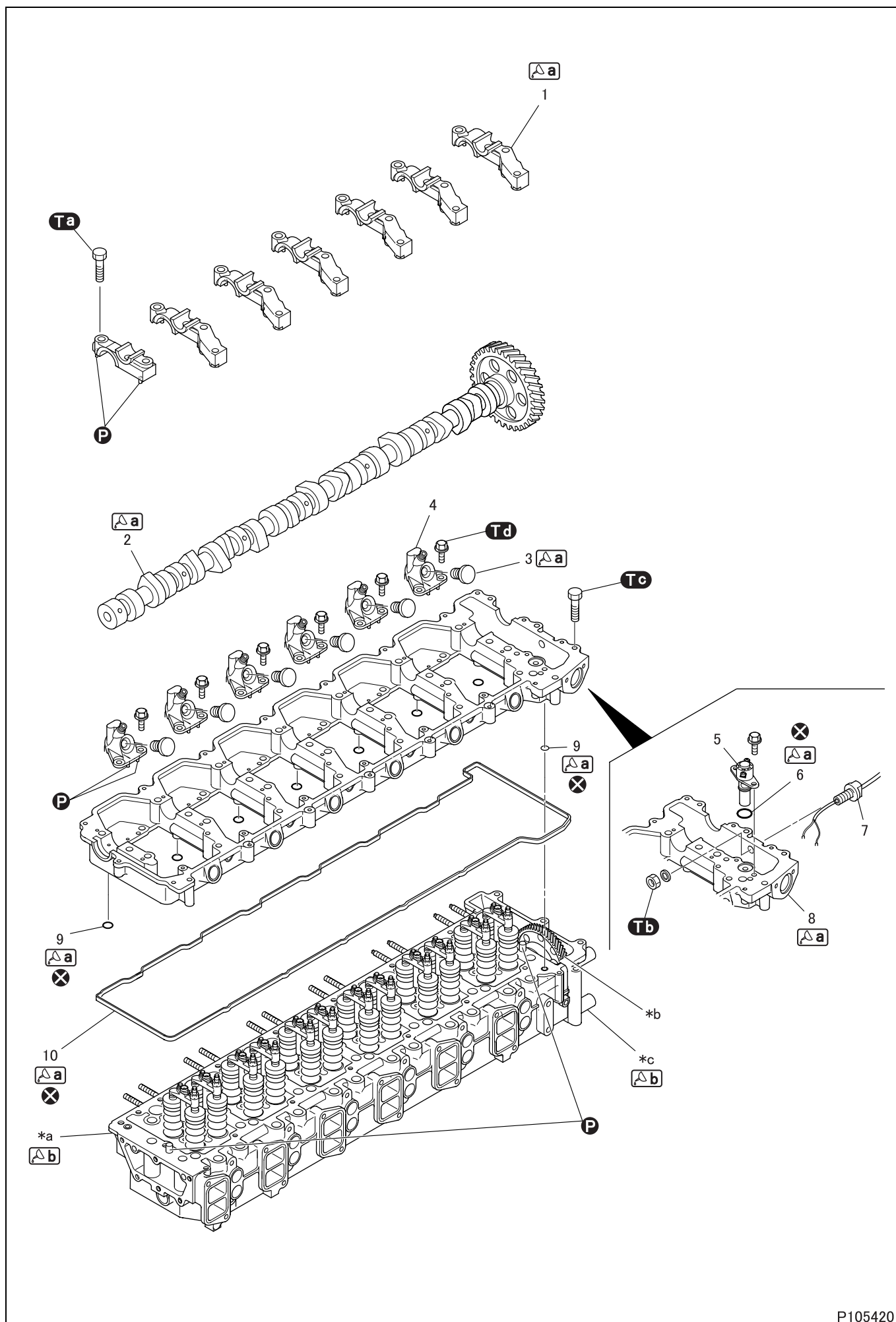
Replace of rocker bushing [Removal]



[Installation]

- Assemble the bushing onto the rocker such that the oil holes are aligned as shown in the illustration.
- After assembly, measure the clearance again.
- If the measurement is less than the standard value, ream the bushing.

MITSUBISHI 6M70 CAMSHAFT AND ROCKER CASE



P105420

● Disassembly sequence

- | | | |
|------------------------------------|-----------------------|-----------------------|
| 1 Camshaft cap | 6 O-ring | *a: Cylinder head |
| 2 Camshaft
(See later section.) | 7 Connector | *b: Idler gear D |
| 3 Master piston | 8 Rocker case | *c: Timing gear case |
| 4 Master piston housing | 9 O-ring | Ⓐ: Locating pin |
| 5 Powertard solenoid valve | 10 Rocker case gasket | ⊗: Non-reusable parts |

CAUTION

- The rocker case and the camshaft caps have been machined together, which means that they all must be replaced together. The removed camshaft caps must be identified by attaching tags with their cylinder numbers because they must be reinstalled to their original positions on the rocker case.

- Do not remove the Powertard solenoid valve unless necessary for replacement.

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards (Unit: mm)

Location	Maintenance item	Standard value	Limit	Remedy
–	Camshaft end play	0.1 to 0.2	0.4	Replace
2, *b	Backlash between idler gear D and camshaft gear	0.112 to 0.165	0.35	Replace
5	Powertard solenoid valve resistance (at temperature 25°C)	32.6 to 39.8 Ω	–	Replace

Tightening torque (Unit: N·m {kgf·m})

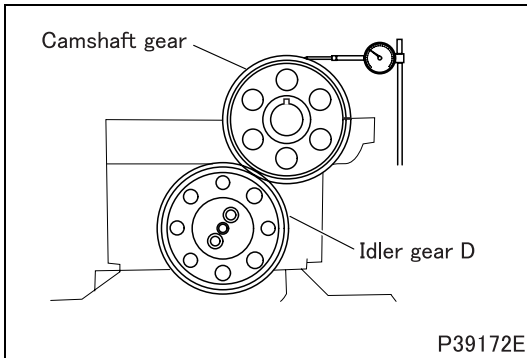
Mark	Parts to be tightened	Tightening torque	Remarks
Ⓐa	Bolt (camshaft cap mounting)	80 {8}	–
Ⓐb	Nut (connector mounting)	49 {5.0}	–
Ⓐc	Bolt (rocker case mounting)	19 {1.9}	–
Ⓐd	Bolt (master piston housing mounting)	54 {5.5}	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
Ⓐa	Camshaft journals and cams	Engine oil	As required
	Outer periphery of master piston		
	O-ring		
	Camshaft journal supports on rocker case		
	Camshaft journal supports on camshaft cap		
	Rocker case gasket		
Ⓐb	Top mating surfaces of cylinder head and timing gear case	ThreeBond 1211	As required

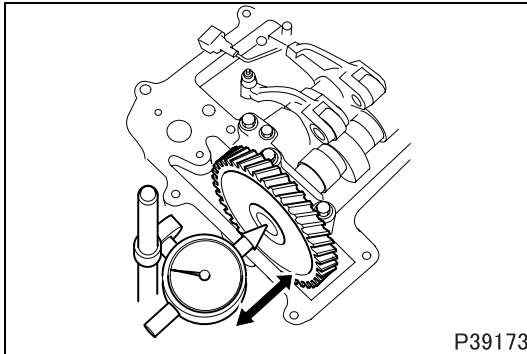
CAMSHAFT AND ROCKER CASE

◆ Work before removal ◆



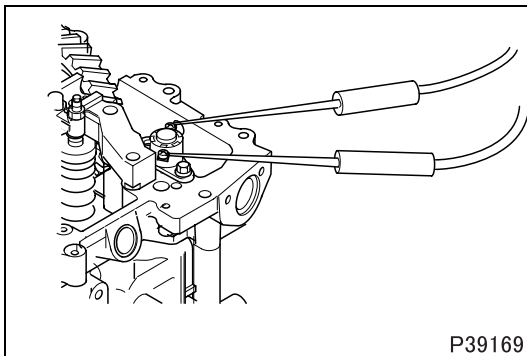
■ Inspection: Backlash between idler gear D and camshaft gear

- Measure the backlash at least at three different locations. If the measurement exceeds the limit, replace the defective part(s).



■ Inspection: Camshaft end play

- If the measurement exceeds the limit, replace the defective part(s).



■ Inspection: Resistance in Powertard solenoid valve

- If the measurement deviates from the standard value, replace the Powertard solenoid valve.

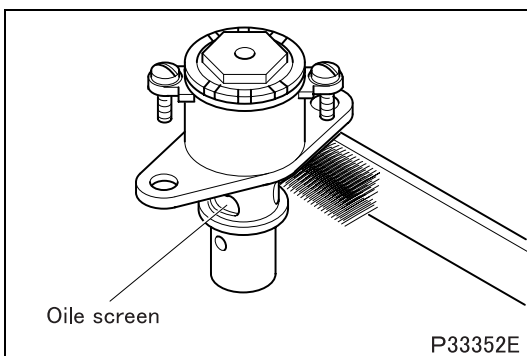
◆ Removal procedure ◆

■ Removal: Rocker case gasket

CAUTION ⚠

- Be careful not to scratch the cylinder head and timing gear case when removing the rocker case gasket.

◆ Cleaning procedure ◆



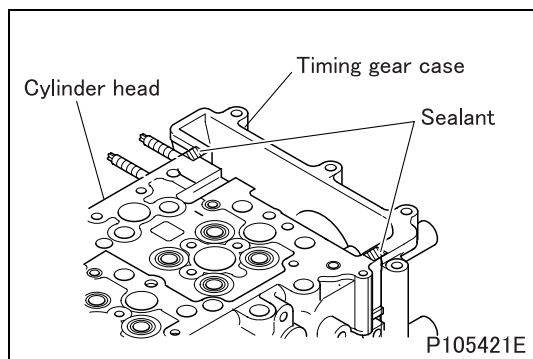
■ Cleaning: Powertard solenoid valve

- Brush the oil screen clean and dry it with compressed air.

CAUTION ⚠

- Do not use a wire brush for cleaning. It could damage the oil screen.

◆ Installation procedure ◆

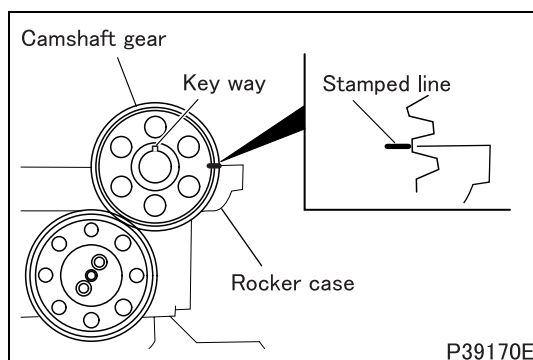


■ Installation: Rocker case

- Remove oil or any other contamination from the surfaces where sealant is to be applied.
- Apply sealant onto the areas (shown in the illustration) on the top surfaces of the cylinder head and timing gear case. Take care not to spread the sealant beyond the application areas during installation.
- Within three minutes following the application, install the rocker case together with the rocker case gasket on the cylinder head.

CAUTION ⚠

- **Do not start the engine for at least an hour after installation.**
- **Whenever the rocker case mounting bolts are subsequently loosened or removed, the rocker case gasket must be replaced and sealant reapplied upon reassembly.**

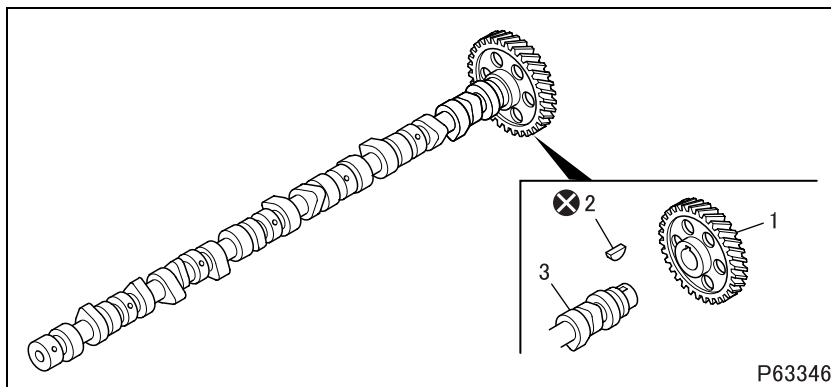


■ Installation: Camshaft

- Make sure that each alignment mark is aligned.
- Install the camshaft such that the stamped line on the camshaft gear is level with the top surface of the rocker case.

CAMSHAFT AND ROCKER CASE

Camshaft



● Disassembly sequence

- 1 Camshaft gear
- 2 Key
- 3 Camshaft

⊗: Non-reusable parts

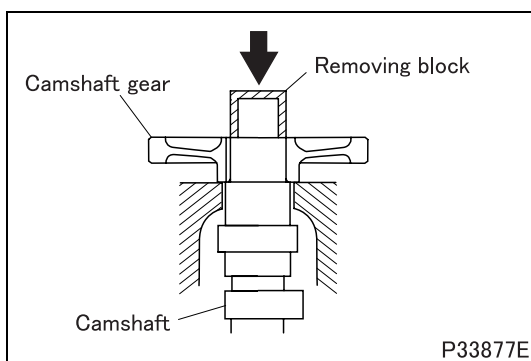
● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards (Unit: mm)

Location	Maintenance item				Standard value	Limit	Remedy
1, 3	Interference between camshaft gear and camshaft				0.017 to 0.058	—	Replace
3	Camshaft	Difference of cam lobe diameter and base circle diameter	Intake side	Lobe diameter : 61.233 Base circle diameter : 53.000	8.233	7.74	Replace
			Exhaust side	Lobe diameter : 61.367 Base circle diameter : 53.133	8.234	7.72	
			Powerward	Lobe diameter : 60.147 Base circle diameter : 53.130	7.017	6.52	
		Bend			0.05	0.08	Replace
		Oil clearance at journal			0.082 to 0.127	0.28	Replace

◆ Removal procedure ◆



■ Removal: Camshaft gear

- Remove the camshaft gear by pushing on the end of the camshaft with a press or other similar tool.

CAUTION ⚠

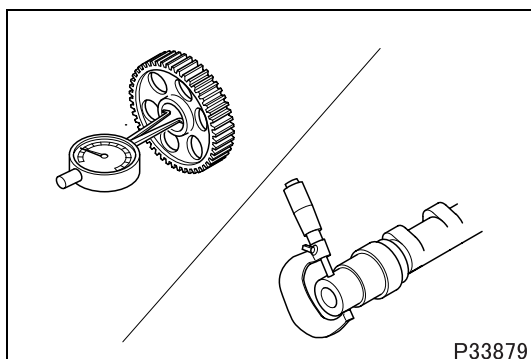
- Do not attempt to remove the camshaft gear with a hammer as damage will result. Use a press or other similar tool.

Mitsubishi 6M70 Engine Parts contact:

email: EngineParts@HeavyEquipmentRestorationParts.com

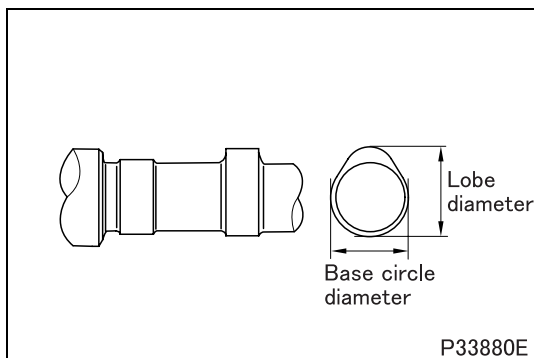
Phone: 269 673 1638

◆ Inspection procedure ◆



■ Inspection: Interference between camshaft gear and camshaft

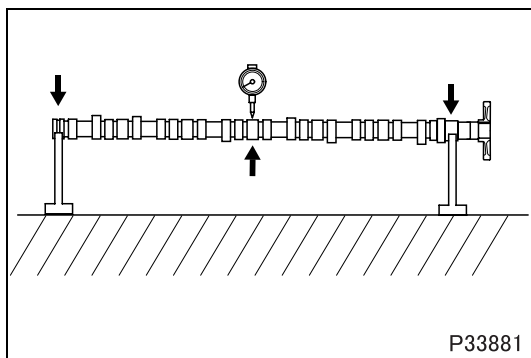
- If the measurement deviates from the standard value, replace the defective part(s).



■ Inspection: Camshaft

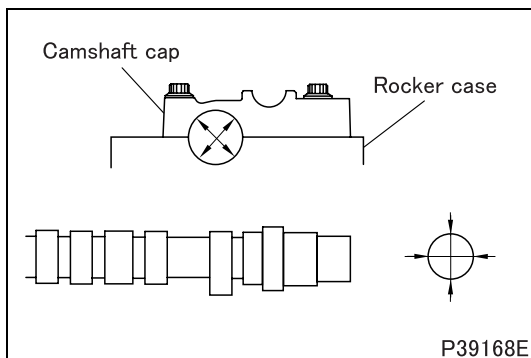
(1) Difference of cam lobe diameter and base circle diameter

- If the measurement is less than the limit, replace the camshaft.



(2) Bend

- Measure the camshaft at the center journal for bend while supporting the shaft at the end journals.
- A half of the dial gauge reading obtained as the camshaft is rotated by a full turn represents the bend of the camshaft.
- If the measurement exceeds the limit, replace the camshaft.



(3) Oil clearance at journal

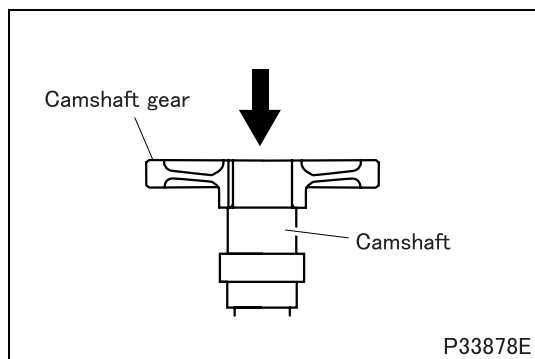
- If the measurement exceeds the limit, replace the defective part(s).

CAUTION ⚠

- The camshaft cap and rocker case have been machined together, which means that they all must be replaced together.

CAMSHAFT AND ROCKER CASE

◆ Installation procedure ◆



■ Installation: Camshaft gear

- Heat the camshaft gear to approximately 150°C using a gas burner.
- While facing the camshaft gear as shown in the illustration, press it onto the camshaft until it seats snugly on the camshaft.

WARNING ⚠

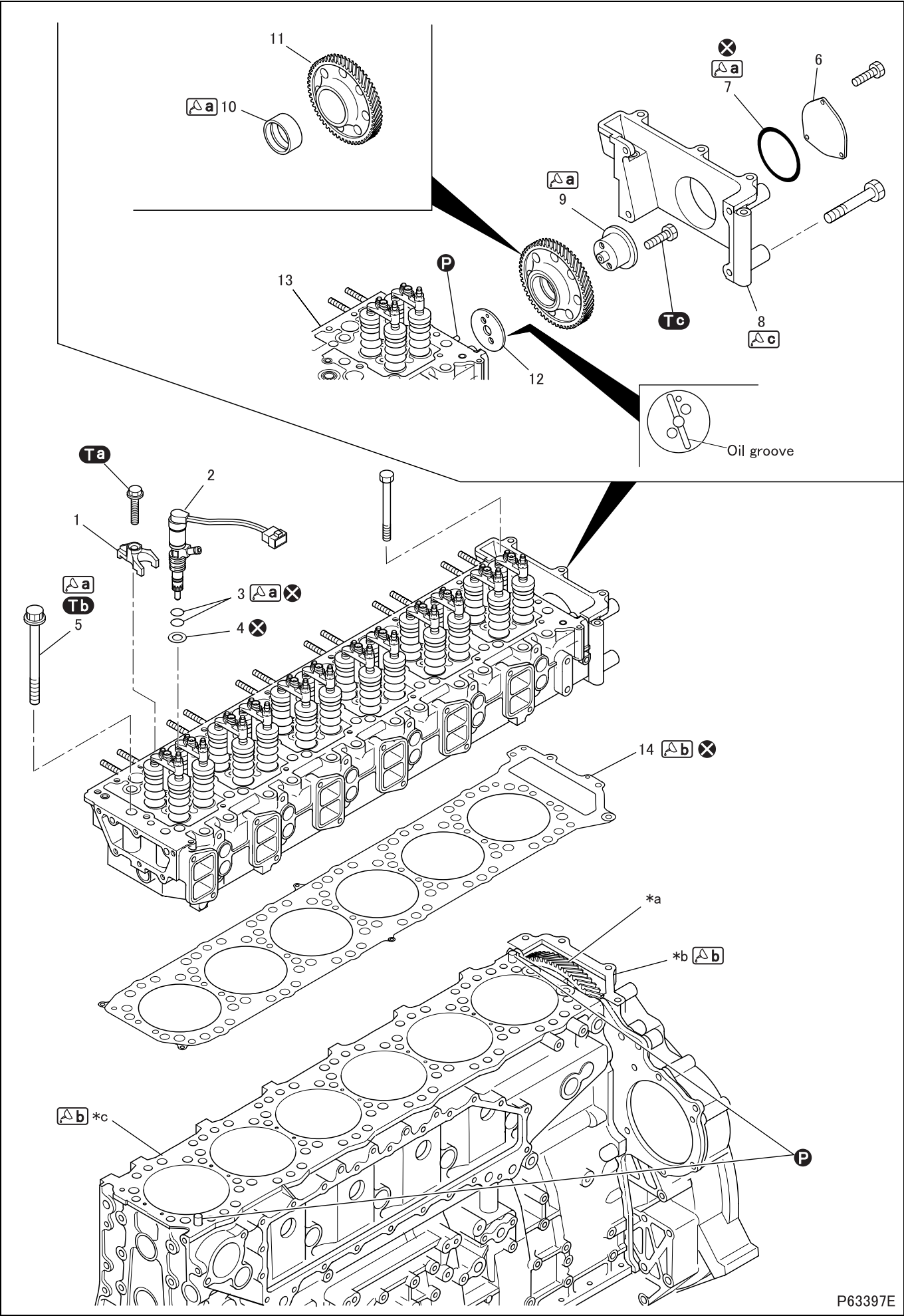
- You may burn yourself if you touch the heated camshaft gear.
-

CAUTION ⚠

- When installing the camshaft gear, be sure to apply the load with the press at the center of the gear. Apply the load on the gear may damage the gear.
-

M E M O

MITSUBISHI 6M70 CYLINDER HEAD AND VALVE MECHANISM



P63397E

● Disassembly sequence

- | | | |
|------------------------|-----------------------|------------------------------|
| 1 Nozzle bridge | 8 Timing gear case | 14 6M70 Cylinder head gasket |
| 2 Injector (See Gr13.) | 9 Idler shaft | *a: Idler gear C |
| 3 O-ring | 10 Idler gear bushing | *b: Flywheel housing |
| 4 Nozzle tip gasket | 11 Idler gear D | *c: Crankcase |
| 5 Cylinder head bolt | 12 Thrust plate | Ⓟ: Locating pin |
| 6 Plate | 13 Cylinder head | ⊗: Non-reusable parts |
| 7 O-ring | (See later section.) | |

● Assembly sequence

Follow the disassembly sequence in reverse.

CAUTION

- The cylinder head bolt is tightened within the plastic region. The number of punch marks indicates the number of times the bolt has been tightened. If there are 3 punch marks (tightened 3 times in the past), replace the bolt.

Service standards (Unit: mm)

Location	Maintenance item	Standard value	Limit	Remedy
9, 10	Clearance between idler shaft and idler gear bushing	0.03 to 0.068	0.2	Replace
11	Idler gear D end play	0.1 to 0.2	0.4	Replace
11, *a	Backlash between idler gear D and idler gear C	0.094 to 0.181	0.35	Replace

Mitsubishi 6M70 Tightening torque (Unit: N·m {kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
	Bolt (nozzle bridge mounting)	54 {5.5}	—
	Mitsubishi 6M70 Cylinder head bolt	180 NM {18 kgfm} 133 Ft Lbs Plus + 90°	- Wet - Can be reusable up to 3 times
	Bolt (idler shaft mounting)	55 {5.5}	—

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
	O-ring	Engine oil	As required
	Threaded of bolt		
	Outer periphery of idler shaft		
	Inside surface of idler gear bushing		
	Top mating surfaces of flywheel housing and crankcase	ThreeBond 1211	As required
	Mating surfaces of cylinder head on cylinder head gasket top surface and timing gear case		
	Mating surfaces of cylinder head and timing gear case	ThreeBond 1207C	As required

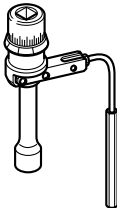
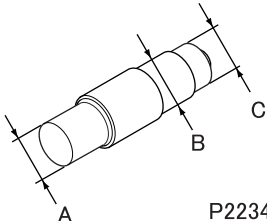
Mitsubishi 6M70 Engine Parts contact:

email: EngineParts@HeavyEquipmentRestorationParts.com

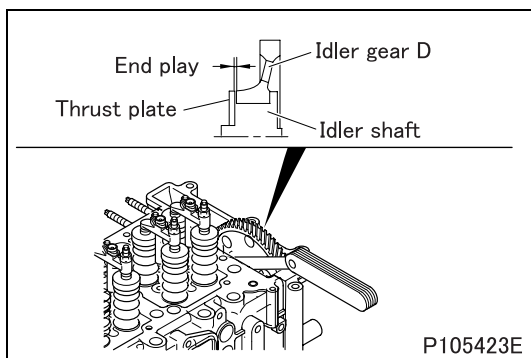
Phone: 269 673 1638

CYLINDER HEAD AND VALVE MECHANISM

Special tools (Unit: mm)

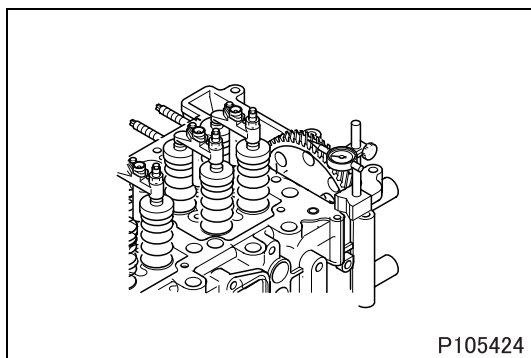
Mark	Tool name and shape	Part No.	Application						
 a	Socket wrench  P01984	MH063388	Installation of cylinder head						
 b	Idler gear bushing-puller <table border="1"><thead><tr><th>A</th><th>B</th><th>C</th></tr></thead><tbody><tr><td>φ 56</td><td>φ 62</td><td>φ 57</td></tr></tbody></table>  P22347	A	B	C	φ 56	φ 62	φ 57	ME350196	Removal and installation of idler gear bushing
A	B	C							
φ 56	φ 62	φ 57							

◆ Work before removal ◆



■ Inspection: Idler gear D end play

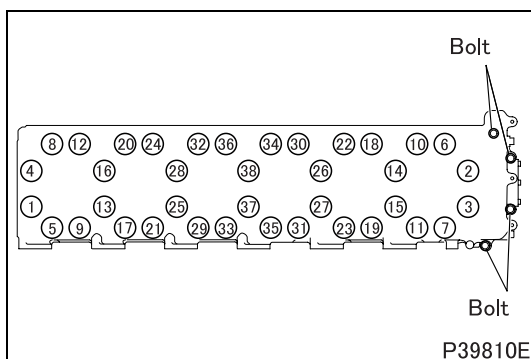
- If the measurement exceeds the limit, replace the defective part(s).



■ Inspection: Backlash between idler gear D and idler gear C

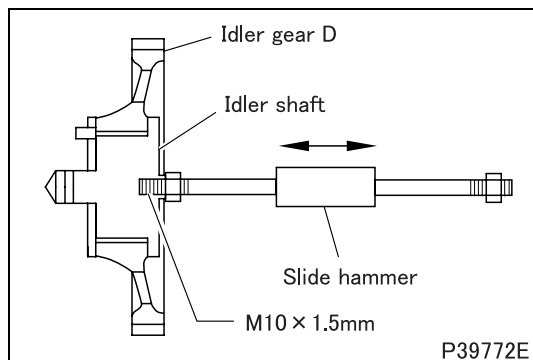
- If the measurement exceeds the limit, replace the defective part(s).

◆ Removal procedure ◆



■ Removal: Cylinder head

- Remove the bolts (× 4).
- Progressively loosen the cylinder head bolts in the order shown in the illustration, going over them several times, before eventually removing them.



■ Removal: Idler shaft

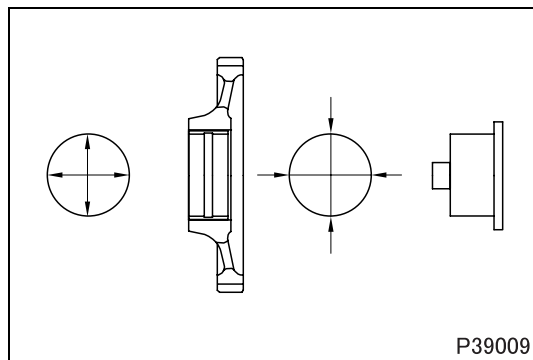
- Remove the idler shaft together with idler gear D as a unit with a slide hammer.

■ Removal: Cylinder head gasket

CAUTION

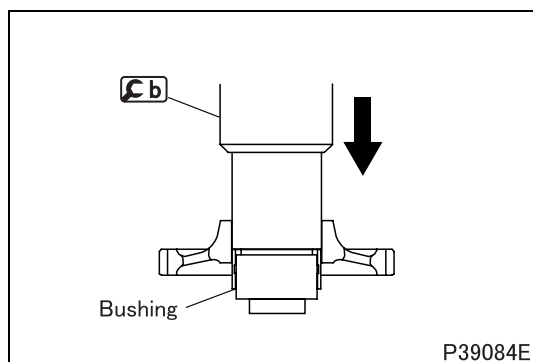
- Be careful not to scratch the cylinder head, crankcase and flywheel housing when removing the cylinder head gasket.

◆ Inspection procedure ◆

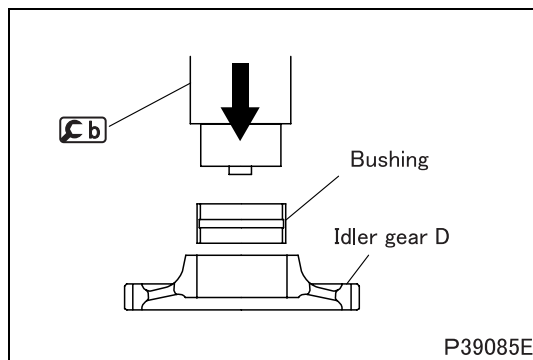


■ Inspection: Clearance between idler shaft and idler gear bushing

- If the measurement exceeds the limit, replace the bushing.



Replacement of idler gear bushing [Removal]

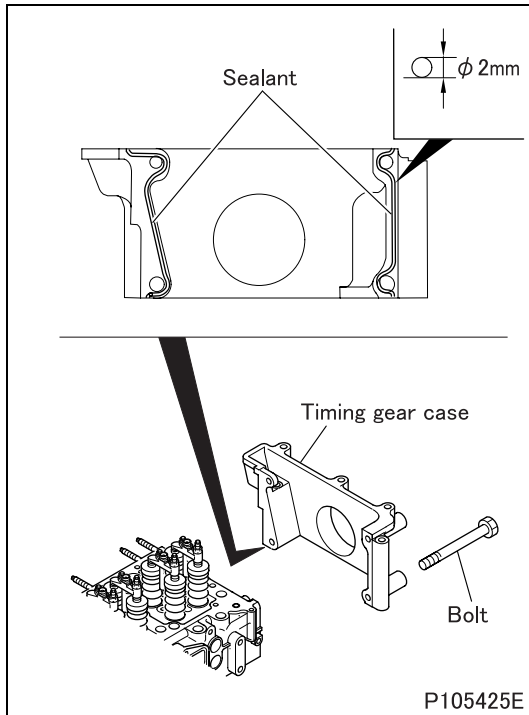


[Installation]

- Press in the bushing until  contacts the end face of idler gear D.
- After installation, measure the clearance again.
- If the measurement is less than the specified value, ream the bushing.

CYLINDER HEAD AND VALVE MECHANISM

◆ Installation procedure ◆

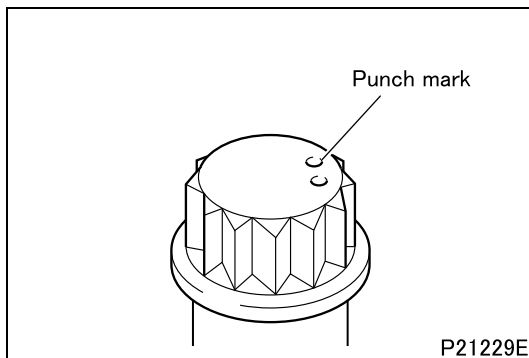


■ Installation: Timing gear case

- Remove oil or any other contamination from the surfaces where sealant is to be applied.
- Apply a sealant to the illustrated section of the timing gear case.
- Install the timing gear case to the cylinder head within 3 minutes following the application of the sealant. Take care not to spread the sealant beyond the application areas during installation.

CAUTION ⚠

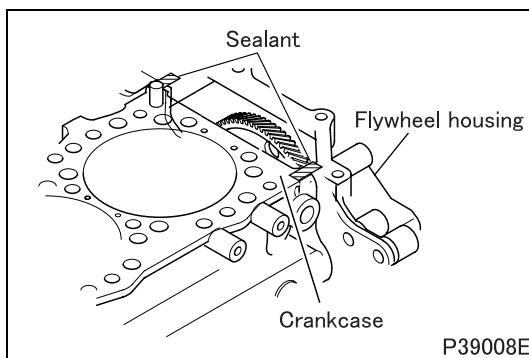
- Do not start the engine for at least an hour after installation.
- After reassembly, if the timing gear case mounting bolts are subsequently loosened or removed, be sure to apply sealant again upon reassembly.



■ Installation: Cylinder head

CAUTION ⚠

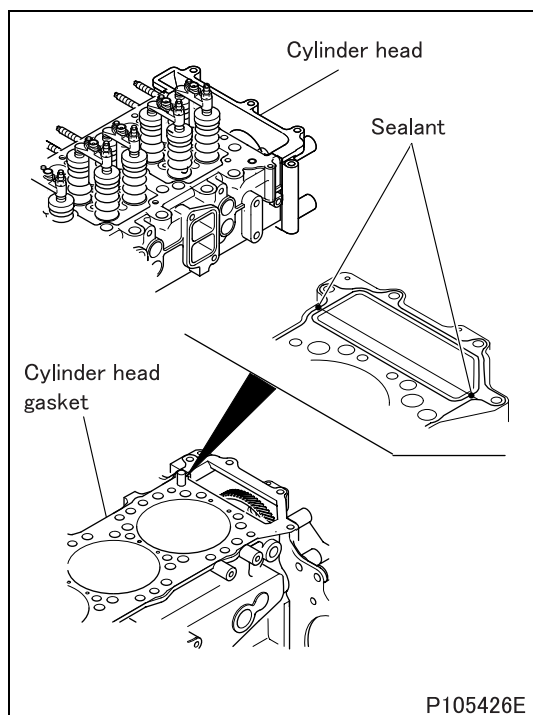
- Before installing the Mitsubishi 6M70 cylinder head bolt, check the number of punch marks on the bolt head. (Bolts with up to two punch marks can be reused.) The number of punch marks indicates the number of times the bolt has been tightened in the past within the plastic region. If there are three punch marks (tightened three times in the past), replace the bolt.



- Remove oil or any other contamination from the surfaces where sealant is to be applied.
- Apply sealant onto the areas (shown in the illustration) on the top surfaces of the flywheel housing and crankcase.
- Within three minutes following the application, install the cylinder head gasket onto the crankcase. Take care not to spread the sealant beyond the application areas during installation.

CAUTION ⚠

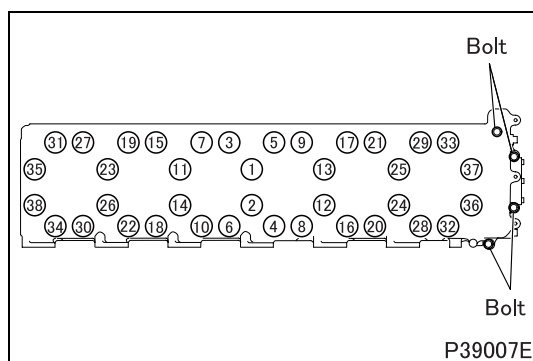
- Be careful not to scratch the cylinder head gasket when installing the cylinder head gasket.
- Do not start the engine for at least an hour after installation.
- After reassembly, if the cylinder head bolts are subsequently loosened or removed, be sure to replace the cylinder head gasket and apply sealant again upon reassembly.



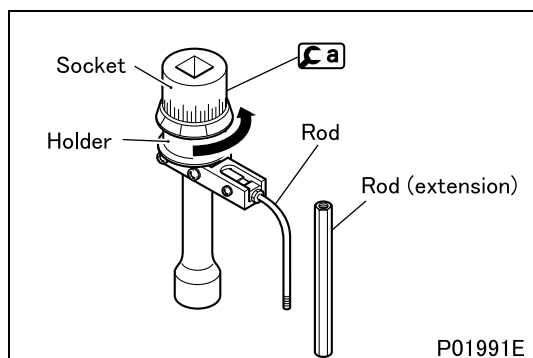
- Remove oil or any other contamination from the surfaces where sealant is to be applied.
- Install the cylinder head gasket onto the crankcase and apply sealant to the illustrated section of the cylinder head gasket.
- Within three minutes following the application, install the cylinder head onto the cylinder head gasket. Take care not to spread the sealant beyond the application areas during installation.

CAUTION

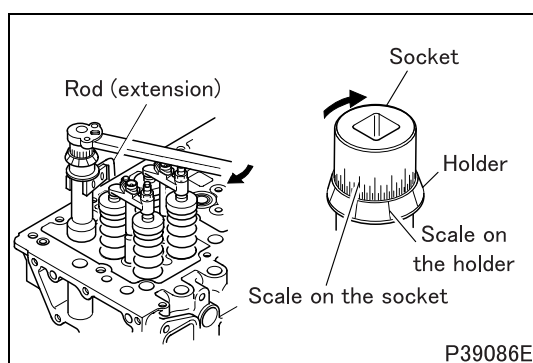
- **Do not start the engine for at least an hour after installation.**
- **Whenever the cylinder head bolts are subsequently loosened or removed, the cylinder head gasket must be replaced and sealant reapplied upon reassembly.**
- **If pistons, connecting rods or other relevant parts are replaced, measure to check the pistons for any change in protrusion. (See "PISTON, CONNECTING ROD AND CYLINDER LINER".)**



- Tighten the cylinder head bolts to a torque of 180 N·m {18 kgf·m} in the order shown in the illustration.
- Install the bolts.
- Further tighten the bolts, in the order shown and as follows.



- Turn the holder of  counterclockwise to pretension the internal spring.



- Set the tool such that the rod (extension) is pressed against the rocker shaft bracket by the force of the spring.
- Align any line on the holder scale with any line on the socket scale. (This will be used as the reference point = 0°.)
- From the reference point, turn the socket by 90° in the direction shown. Each division on the holder scale represents 5°.
- After tightening the cylinder head bolt within the plastic region, make a punch mark on the bolt head to record the number of times that they have been tightened.

CAUTION

- **The bolts should be tightened within the plastic region. Never tighten them further than the specified angle.**

Cylinder Head



- ## ● Assembly sequence

CAUTION

- Mitsubishi 6M70 Engine Parts contact:
email: EngineParts@HeavyEquipmentRestorationParts.com
Phone: 269 673 1638

Mitsubishi 6M70 Service standards (Unit: mm)

Location	Maintenance item		Standard value	Limit	Remedy
2, 11	6M70 Valve bridge-to-valve bridge guide clearance		0.01 to 0.048	0.1	Replace
6	6M70 Valve spring <Intake>, 6M70 outer valve spring <Exhaust>	Free length	89.3	87.9	Replace
		Installed load (Installed length 61.325)	$490.4 \pm 24.5 \text{ N}$ { $50.0 \pm 2.5 \text{ kgf}$ }	—	Replace
		Squareness	—	2.0	Replace
7	6M70 Inner valve spring <Exhaust>	Free length	76.0	74.9	Replace
		Installed load (Installed length 54.325)	$98.1 \pm 4.9 \text{ N}$ { $10.0 \pm 0.5 \text{ kgf}$ }	—	Replace
		Squareness	—	2.0	Replace
9	6M70 Exhaust valve	Stem outer diameter	9.925 to 9.940	9.85	Replace
		Sinkage from cylinder head bottom surface	0.2 ± 0.25	0.7	Replace
		Valve margin	2.5	2.0	Replace
		Seat angle	$45^\circ \pm 15^\circ$	—	Rectify
9, 12	6M70 Exhaust valve stem-to-valve guide clearance		0.07 to 0.10	0.2	Replace
10	6M70 Intake valve	Stem outer diameter	9.96 to 9.975	9.85	Replace
		Sinkage from cylinder head bottom surface	0.5 ± 0.25	1.0	Replace
		Valve margin	2.83	2.33	Replace
		Seat angle	$60^\circ \pm 15^\circ$	—	Rectify
10, 13	6M70 Intake valve stem-to-valve guide clearance		0.035 to 0.065	0.2	Replace
11	6M70 Outer diameter of valve bridge guide		10.989 to 11	10.988	Replace
14	6M70 Exhaust valve seat width		3.5 ± 0.2	4.2	Rectify or replace
15	6M70 Intake valve seat width		2.8 ± 0.2	3.5	Rectify or replace
18	6M70 Cylinder head	Bottom surface distortion	0.07	0.2	Rectify or replace
		Height from top surface to bottom surface	130 ± 0.05	129.5	Replace
		Valve seat hole diameter	$\phi 49^{+0.025}_0$	—	Replace

Tightening torque (Unit: N·m {kgf·m})

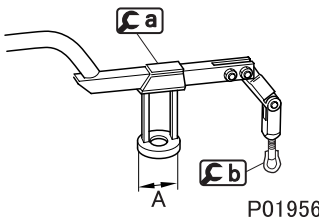
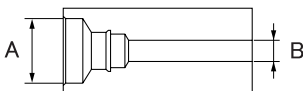
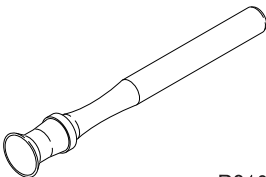
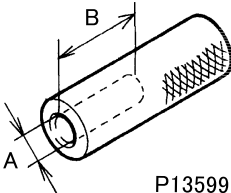
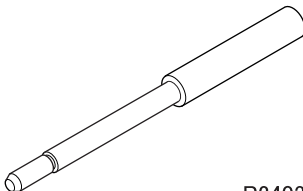
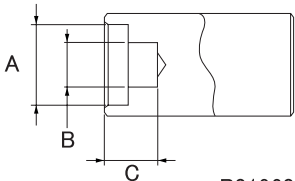
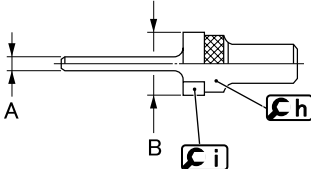
Mark	Parts to be tightened	Tightening torque	Remarks
 Ta	Lock nut (valve bridge adjusting screw tightening)	68 {7.0}	—
 Tb	Stud bolt	20 {2.0}	—

Lubricant and/or sealant

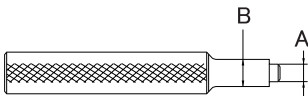
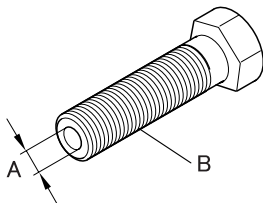
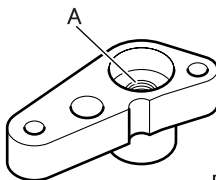
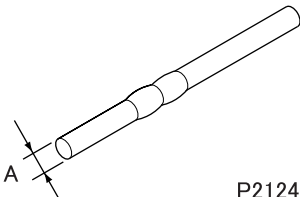
Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	Lip of valve stem seal	Engine oil	As required
	Stem and end of valve		
 b	Nozzle tube end	ThreeBond 1211	As required

CYLINDER HEAD AND VALVE MECHANISM

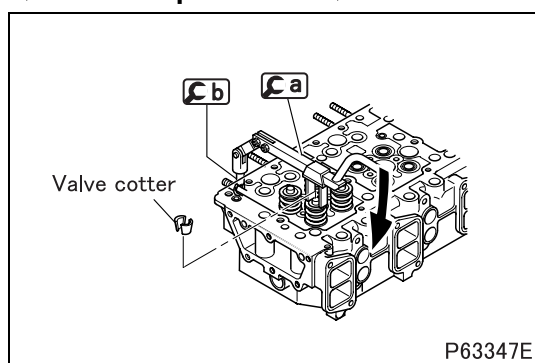
Special tools (Unit: mm)

Mark	Tool name and shape		Part No.	Application
	Valve lifter	 P01956	MH061668	Removal and installation of valve cot- ters
	Valve lifter hook		MH061679	
	Valve stem seal installer	 P01957	MH062806	Installation of valve stem seals
	Valve lapper	 P01958	30091-07500	Lapping valves and valve seats
	Valve bridge guide installer	 P13599	ME350051	Installation of valve bridge guides
	Valve guide remover	 P24035	MH062177	Removal of valve guides
	Valve guide installer	 P01960	ME350052	Installation of Mitsubishi 6M70 valve guides
	Caulking tool body	 P01961	MH062174	Installation of Mitsubishi 6M70 intake valve seats , exhaust valve seats ,
	Installer ring		MH062175	

Special tools (Unit: mm)

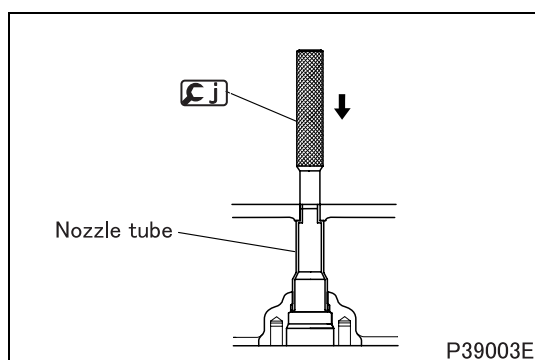
Mark	Tool name and shape	Part No.	Application				
	Nozzle tube remover <table border="1"><tr><td>A</td><td>B</td></tr><tr><td>φ 8.7</td><td>φ 12.5</td></tr></table>  P13597	A	B	φ 8.7	φ 12.5	MH061232	Removal of nozzle tube
A	B						
φ 8.7	φ 12.5						
	Nozzle tube installer bolt <table border="1"><tr><td>A</td><td>B</td></tr><tr><td>φ 8.5</td><td>M18 × 1.5</td></tr></table>  P21244	A	B	φ 8.5	M18 × 1.5	MH061231	Installation of Mitsubishi 6M70 nozzle tube
A	B						
φ 8.5	M18 × 1.5						
	Nozzle tube installer body <table border="1"><tr><td>A</td></tr><tr><td>M18 × 1.5</td></tr></table>  P40697	A	M18 × 1.5	ME350195			
A							
M18 × 1.5							
	Nozzle tube stamp <table border="1"><tr><td>A</td></tr><tr><td>φ 8</td></tr></table>  P21246	A	φ 8	MH061229			
A							
φ 8							

◆ Removal procedure ◆



■ Removal: Valve cotter

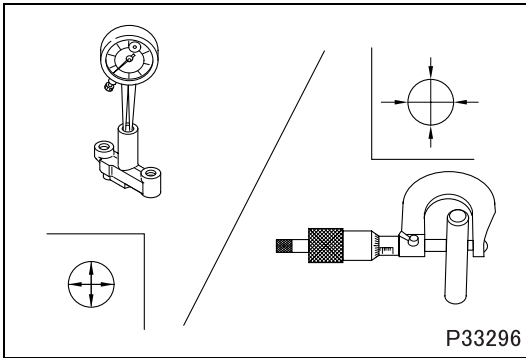
- Using **Ca** and **Cb**, evenly compress the valve cotter to remove so that the valve spring does not lean to one side.



■ Removal: Nozzle tube

CYLINDER HEAD AND VALVE MECHANISM

◆ Inspection procedure ◆



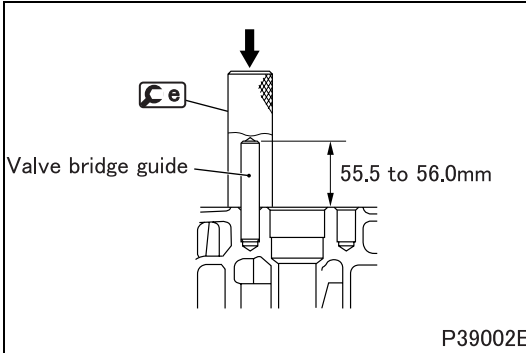
■ Inspection: Valve bridge and valve bridge guide

(1) Valve bridge-to-guide clearance

- If the measurement exceeds the limit, replace the defective part(s).

(2) Outer diameter of valve bridge guide

- If the measurement is less than the limit or if the parts are unevenly worn, replace the valve bridge guide.



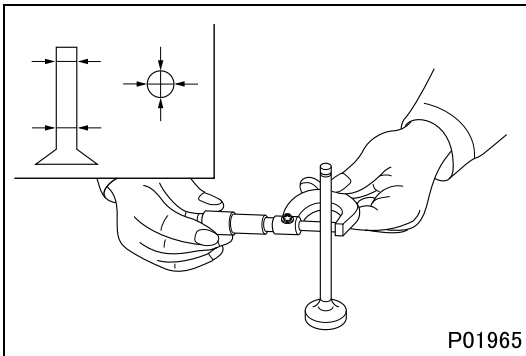
Replacement of valve bridge guide

[Installation]

- Before installation, ensure that no water, oil or other foreign matter is in the installation hole.
- Using , install the valve bridge guide until it securely contacts the cylinder head.

CAUTION

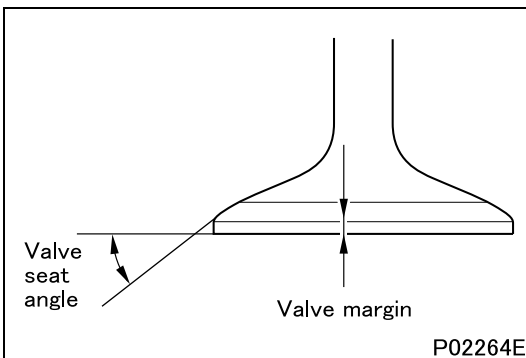
- The valve bridge guide must be installed to the specified depth of the cylinder head. Correct installation can only be possible by using .



■ Inspection: Mitsubishi 6M70 Intake and exhaust valve (1)

Valve stem outer diameter

- If the measurement is less than the limit or the valve is worn extremely unevenly, replace the valve.
- When the valve has been replaced with a new one, make sure to lap the valve and valve seat.

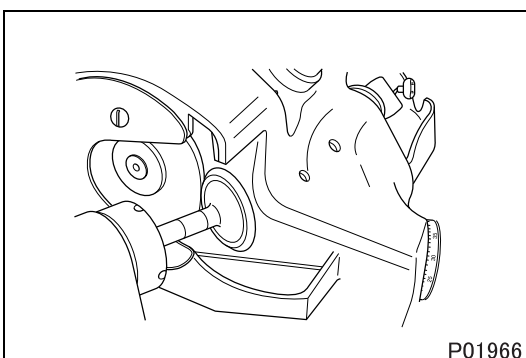


(2) Valve seat angle

- If the measurement deviates from the standard value, rectify the valve.

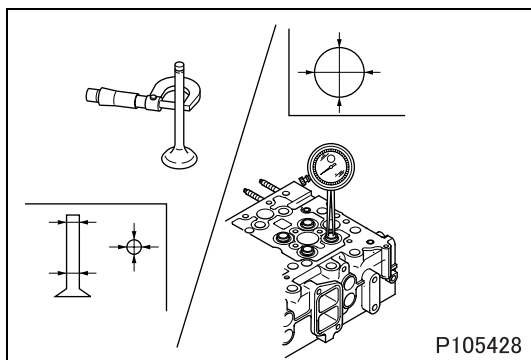
(3) Valve margin

- If the measurement is less than the limit, replace the valve.



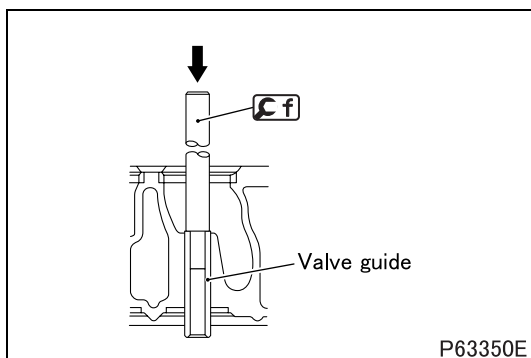
Refacing valve

- Limit grinding to a necessary minimum.
- If the valve margin is below the limit after grinding, replace the valve.
- After grinding, make sure to lap the valve and valve seat.



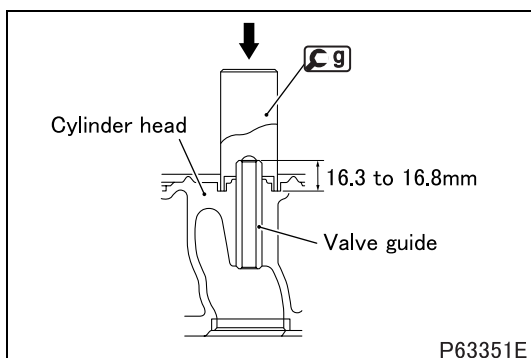
■ Inspection: Valve-to-valve guide clearance

- If the clearance exceeds the specified limit, replace the defective part(s).



Replacement of valve guides

[Removal]

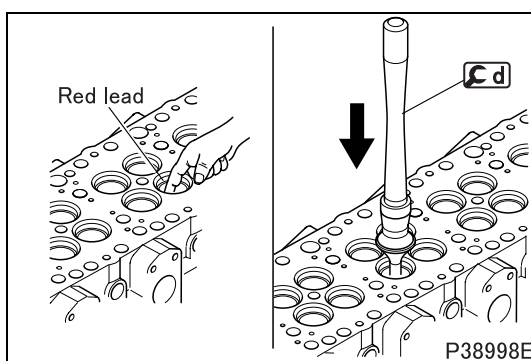


[Installation]

- Using **g**, install the valve guide until it securely contacts the cylinder head.

CAUTION ⚠

- The valve guide must protrude from the cylinder head by the specified amount. Correct installation can only be possible by using **g**.
- The valve guides for the exhaust valves are longer than the valve guides for the inlet valves.

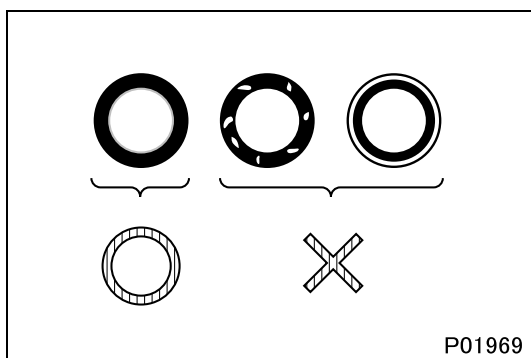


■ Inspection: Contact between valve and valve seat

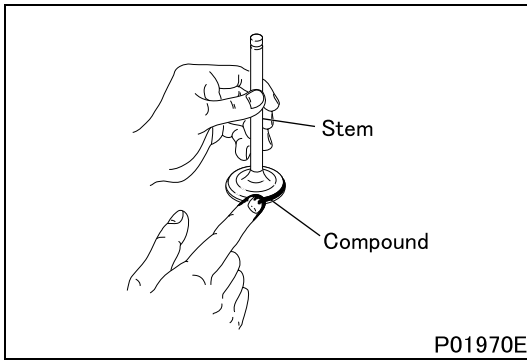
- Before starting inspection, check that the valve and valve guide are intact.
- Apply an even coat of red lead to the valve contact surface of the valve seat.
- Strike the valve once against the valve seat. Do not rotate the valve during this operation.

- If the red lead deposited on the valve indicates a poor contact pattern, take either of the following corrective actions.

Contact pattern	Corrective action
Minor defect	Lapping valve
Serious defect	Reface or replace valve and valve seat



CYLINDER HEAD AND VALVE MECHANISM

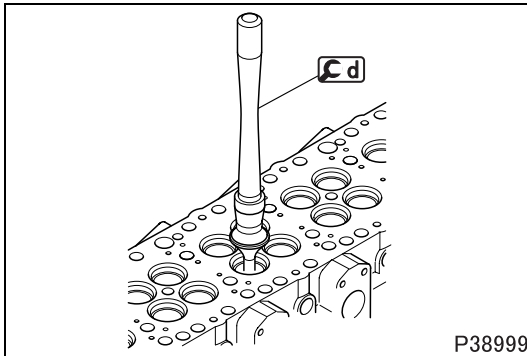


Lapping valve

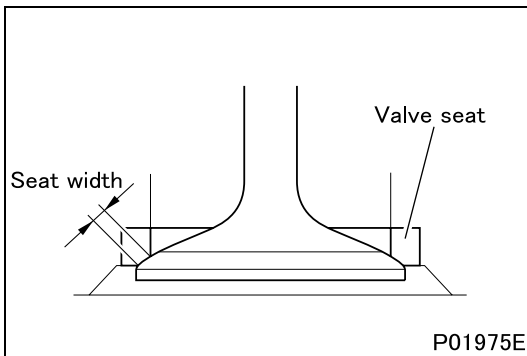
- Lap the valve in the following sequence.
- Apply a thin coat of lapping compound to the contact surface of the valve seat. Adding a small amount of engine oil to the lapping compound can facilitate even application.
- Start with an intermediate-grit compound (120 to 150 grit) and finish with a fine-grit compound (200 grit or more).

CAUTION

- **Do not put any compound on the stem.**



- Strike the valve several times against the valve seat while rotating the valve a little at a time.
- Wash away the compound with diesel fuel.
- Apply engine oil to the contact surface of the valve seat and rub in the valve and seat well.
- Inspect the contact pattern between valve and valve seat again.
- If the contact pattern is still defective, replace the valve seat.

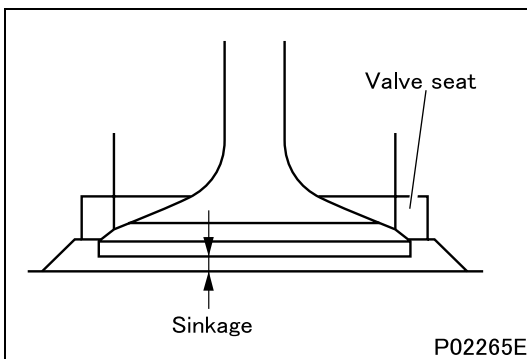


■ Inspection: Mitsubishi 6M70 Valve seats

- If the valve seat is refaced or replaced after performing the following inspection, make sure to lap the valve and valve seat.

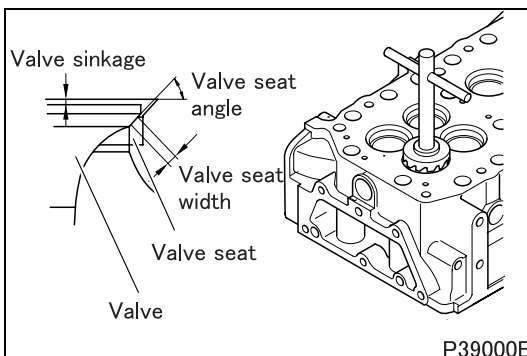
(1) Valve seat width

- If the measurement exceeds the limit, reface or replace the valve seat.



(2) Valve sinkage from cylinder head bottom surface

- Perform measurement keeping the valve in close contact with the valve seat.
- If the measurement exceeds the limit, reface or replace the defective part(s).



Refacing the valve seat

- Grind the valve seat using a valve seat cutter or valve seat grinder.
- Place a piece of sandpaper of approximately #400 between the cutter and valve seat and grind the valve seat lightly.
- Use a 15° or 75° cutter to cut the valve seat width within the standard range. Replace the valve seat if it cannot be refaced within the standard range.

CAUTION

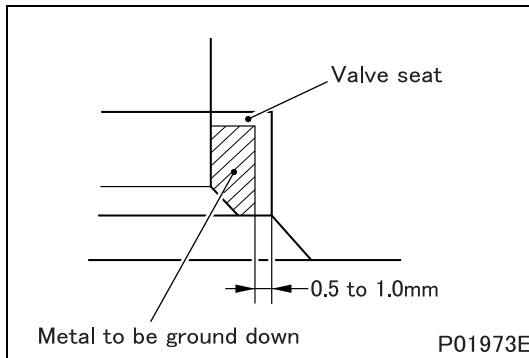
- **Make sure that the valve seat refacing does not cause the valve sinkage to exceed the limit.**

- After refacing, make sure to lap the valve and valve seat.

Replacement of valve seat

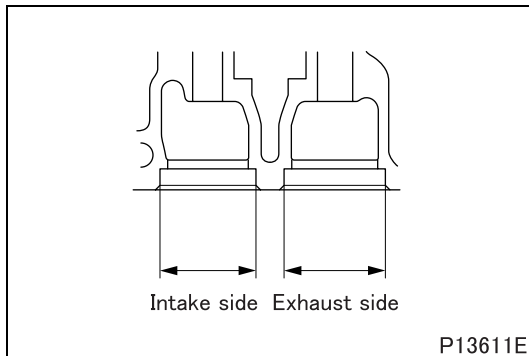
[Removal]

- The valve seats are installed by expansion fitting. To remove a valve seat, grind inside the metal stock to reduce the wall thickness, then remove the valve seat at room temperature.

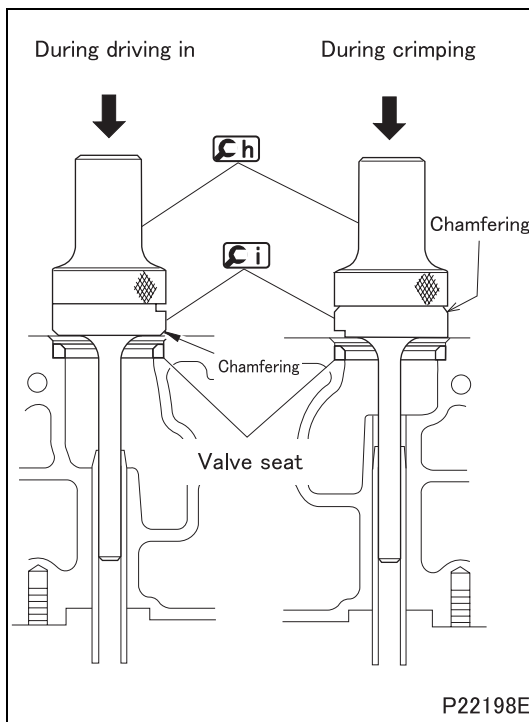


[Installation]

- Measure the diameter of the valve seat hole in the cylinder head.
- If the measurement deviates from the standard value, replace the cylinder head.



- Chill the valve seat thoroughly by immersing in it in liquid nitrogen.
- Drive in the valve seat using  with the chamfered side of  facing the cylinder head.
- After driving in, reverse the direction of  and crimp the valve seat.
- After reassembly, make sure to lap the valve and valve seat.

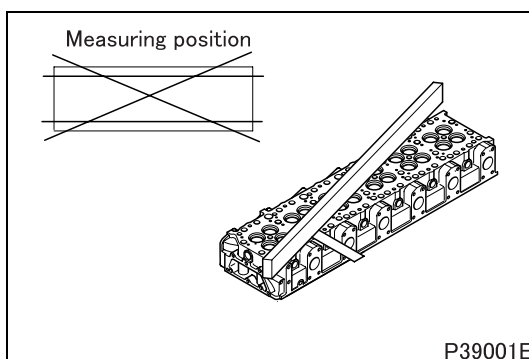


■ Inspection: Cylinder head bottom surface distortion

- If the distortion exceeds the limit, rectify it using a surface grinder.

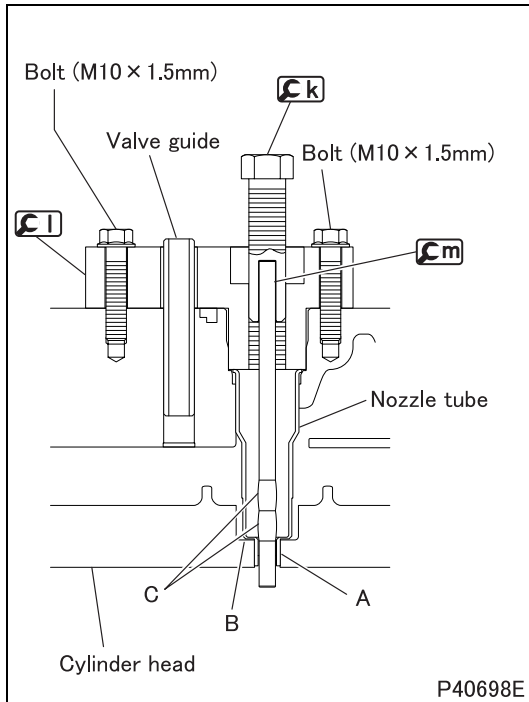
CAUTION

- Make sure that the height of the cylinder head from the top surface to the bottom surface is not reduced to a value below the limit.



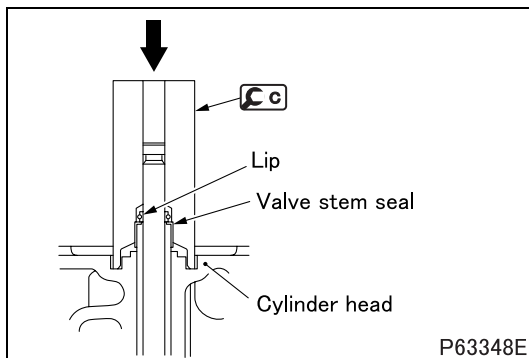
CYLINDER HEAD AND VALVE MECHANISM

◆ Installation procedure ◆



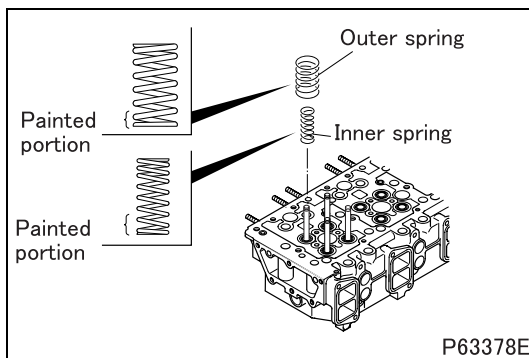
■ Installation: Mitsubishi 6M70 Nozzle tube

- Apply a sealant to the perimeter A of the tip of the nozzle tube.
- Push in the nozzle tube by hand until it contacts surface B of the cylinder head.
- Tighten **Ⓒk** with the bolt and press the nozzle tube onto surface B of the cylinder head.
- Apply engine oil to section C of **Ⓒm**.
- Screw in **Ⓒk** until **Ⓒm** can be pulled out from the bottom of the cylinder head.
- After installing the nozzle tube, be sure to perform a leak test to check for airtightness.



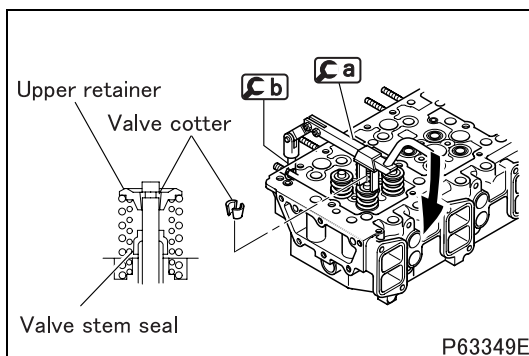
■ Installation: Mitsubishi 6M70 Valve stem seal

- Apply engine oil to the lip of the valve stem seal.
- Install the valve stem seal until **Ⓒc** sits snugly on the cylinder head.
- After assembly, check that its spring is not deformed or damaged.



■ Installation: Mitsubishi 6M70 Valve spring

- Install the outer and inner valve springs onto the cylinder head while facing them as shown in the illustration.



■ Installation: Mitsubishi 6M70 Valve cotter

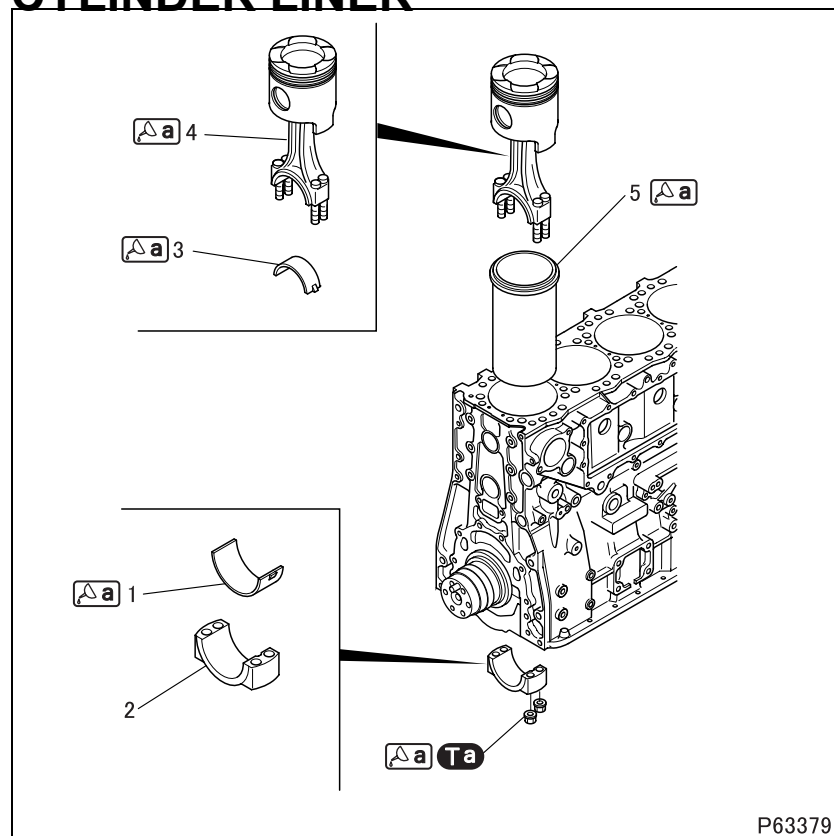
- Using **Ⓒa** and **Ⓒb**, install the valve cotter while compressing the valve spring(s) evenly.

CAUTION ⚠

- Do not compress the valve spring(s) too much, or the upper retainer will contact the valve stem seal and damage will result.

M E M O

MITSUBISHI 6M70 PISTON, CONNECTING ROD AND CYLINDER LINER



● Disassembly sequence

- 1 Lower connecting rod bearing
- 2 Connecting rod cap
- 3 Upper connecting rod bearing
- 4 Piston and connecting rod
(See later section.)
- 5 Cylinder liner

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards (Unit: mm)

Location	Maintenance item		Standard value	Limit	Remedy
–	Piston protrusion from crankcase top surface		–0.321 to –0.111	–	Replace
–	End play of connecting rod		0.2 to 0.5	1.0	Replace
1, 3	Connecting rod bearing	Oil clearance	0.06 to 0.122	0.25	Replace
		Span when free	–	90.5	
4, 5	Piston and cylinder liner clearance		0.247 to 0.277	–	Replace
5	Cylinder liner	Flange protrusion	0.01 to 0.07	–	Replace
		Inner diameter	φ135 to 135.03	φ135.25	
		Cylindricity	0.03 or less	–	
		Difference in protrusion of adjacent flange	0.04 or less	–	

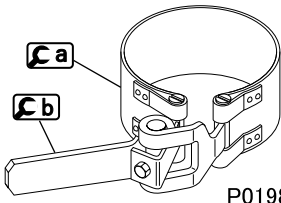
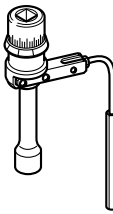
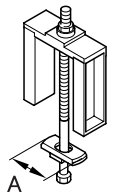
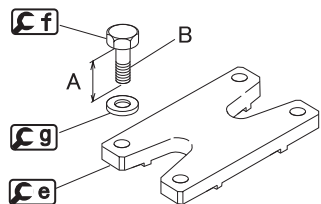
Tightening torque (Unit: N·m {kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (connecting rod cap mounting)	49 {5} + 120°	Wet

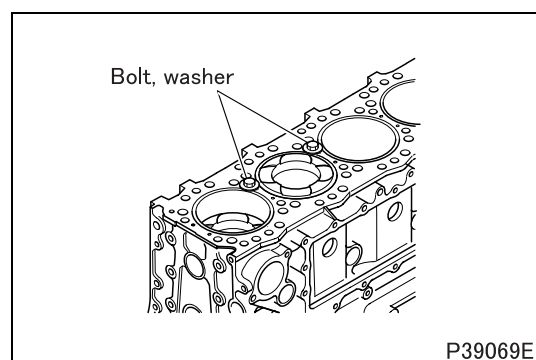
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Nut thread	Engine oil	As required
	Inside surface of connecting rod bearing		
	Outside periphery of cylinder liner		
	Outer periphery of piston		

Special tools (Unit: mm)

Mark	Tool name and shape		Part No.	Application			
 a	Piston guide clamp	 P01981	MH061667	Installation of piston and connecting rod			
 b	Piston guide lever		MH061658				
 c	 P01984		MH061560				
 d	Cylinder liner extractor <table border="1"><tr><td>A</td></tr><tr><td>φ134.5</td></tr></table>	A	φ134.5	 P13615	MH062194	Removal of cylinder liner	
A							
φ134.5							
 e	Adapter	 P22013	ME350054	Measurement of cylinder liner flange protrusion and step height between adjacent cylinder liners			
 f	Bolt		MF130651				
 g	Washer		<table border="1"><tr><td>A</td><td>B</td></tr><tr><td>40</td><td>M16 × 2</td></tr></table>		A	B	40
A	B						
40	M16 × 2						

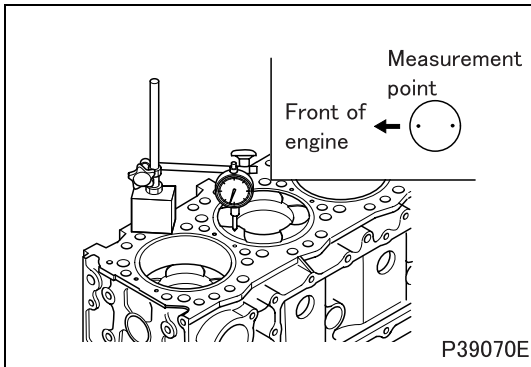
◆ Work before removal ◆



■ Retaining of cylinder liners

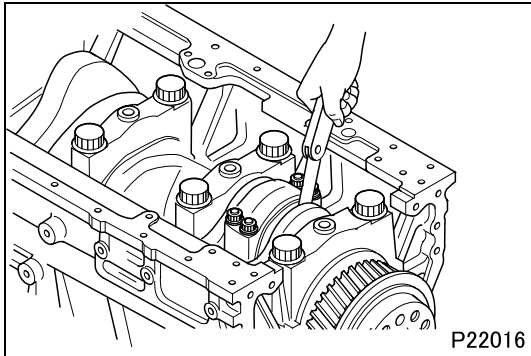
- The cylinder liners may move up when the crankcase is turned over, or the crankshaft is rotated after the pistons are installed. To prevent this, retain the cylinder liners by holding their flanges with bolts and washers.

PISTON, CONNECTING ROD AND CYLINDER LINER



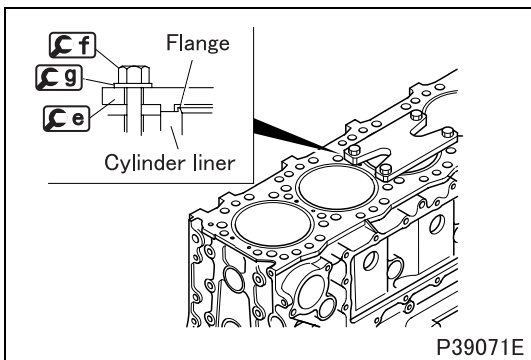
■ Inspection: Piston protrusion from crankcase top surface

- The amount of piston protrusion affects engine performance and must therefore be inspected without fail.
- Set the piston at the top dead center.
- Make the measurement at the two measurement points on the top face of the piston and calculate the average value.
- If the average value deviates from the standard value, check the clearances between all relevant parts.



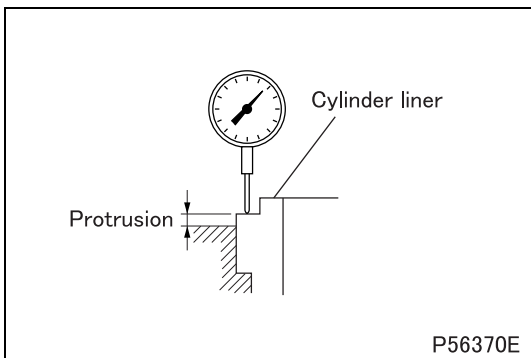
■ Inspection: Connecting rod end play

- Measure the end play for every connecting rod.
- If the measurement exceeds the limit, replace the defective part(s).



■ Inspection: Cylinder liner flange protrusion and step height between adjacent cylinder liners

- Install **f** so that it does not run onto the cylinder liner flange and tighten **f** and **g** to the torque of 49 N·m {5 kgf·m}.

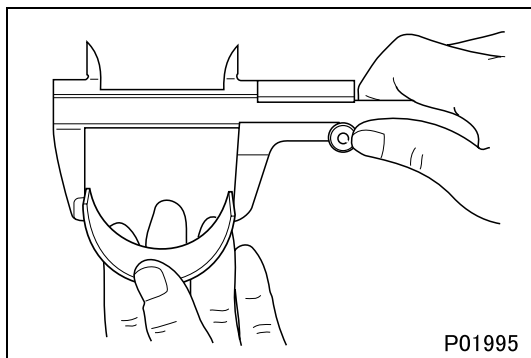


- Measure the cylinder liner flange protrusion.
- If the measurement deviates from the standard value, inspect the installation and replace the defective part(s).
- If the difference in the adjacent flange protrusion deviates from the standard value, replace the defective part(s) upon checking the installed condition.

CAUTION ⚠

- If the cylinder liner flange protrusion is not within the specified value, the contact pressure of the cylinder head gasket against the bore of the cylinder will not be high enough to prevent gas leakage.

◆ Inspection procedure ◆

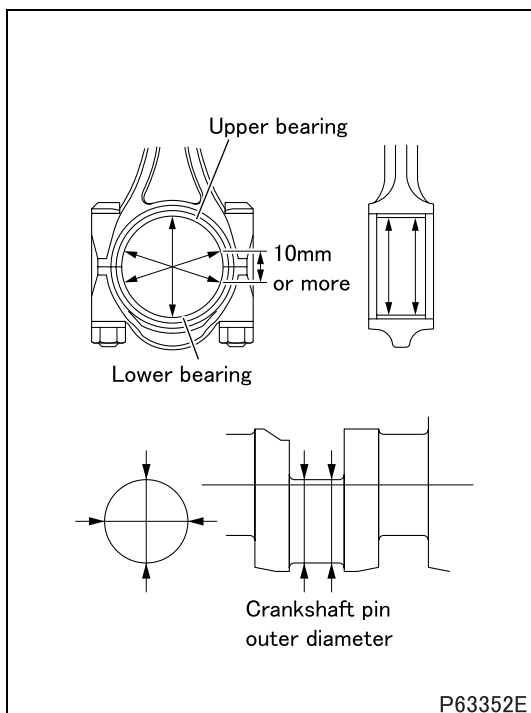


■ Inspection: Connecting rod bearing span when free

CAUTION ⚠

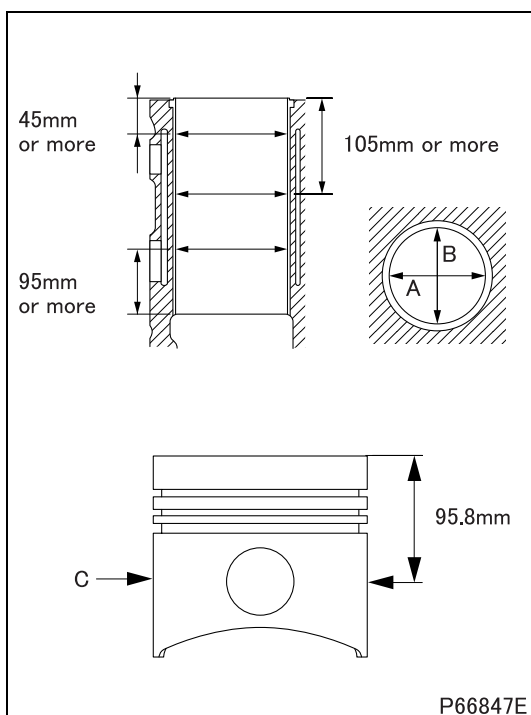
- Do not attempt to manually expand the bearings.

- If the measurement is less than the limit, replace the upper and lower connecting rod bearings.



■ Inspection: Connecting rod bearing-to-crankshaft clearance (oil clearance)

- Fit the lower bearing to the connecting rod cap and the upper bearing to the connecting rod, then tighten the nut to a torque of 115 N·m {12 kgf·m}.
- Measure the inner diameter of the bearing and the outer diameter of the crankshaft pin.
- If the clearance exceeds the limit, replace the defective part(s).
- If a bearing has to be replaced with an undersized one, machine the crankshaft pin to the specified undersize diameter. (See "CRANKSHAFT AND CRANKCASE".)



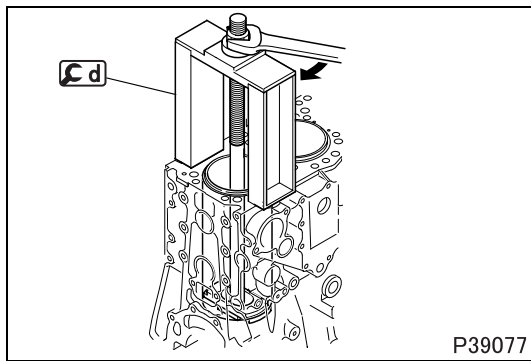
■ Inspection: Mitsubishi 6M70 Piston and cylinder liner clearance

- If the value calculated from the measurement deviates from the standard value, replace the defective part(s).
- A: Measuring point on the crankcase (in direction of the crankcase axis).
- B: Measuring point on the crankcase (vertical to the crankcase axis).
- C: Measuring point on the piston (vertical to the piston pin hole).

CAUTION ⚠

- Because the cylinder liner is a thin-walled liner, the boring process cannot be preformed on an oversized liner. Do not remove the cylinder liner except for replacement to prevent deformation.

PISTON, CONNECTING ROD AND CYLINDER LINER

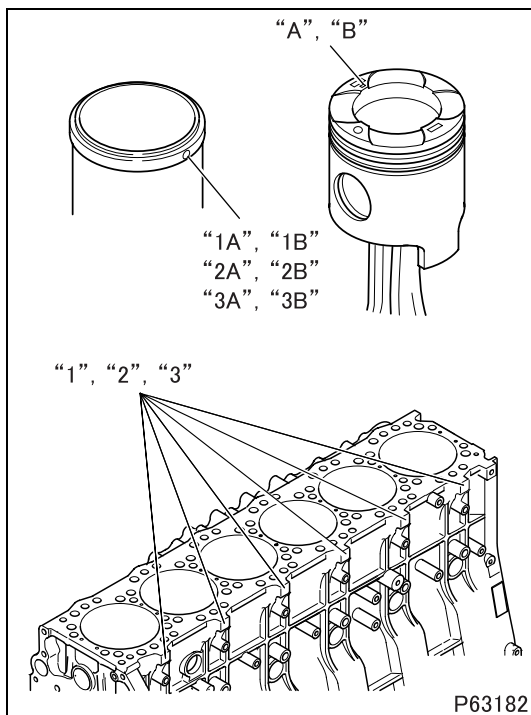


Replacement of cylinder liner

[Removal]

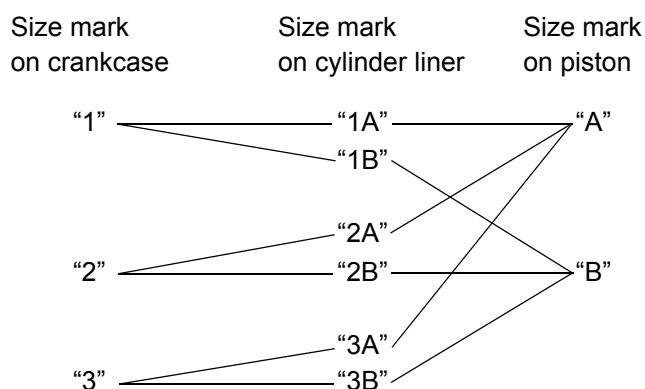
CAUTION ⚠

- If the cylinder liners will need to be reused for some reason or other, make alignment marks to ensure correct reassembly.



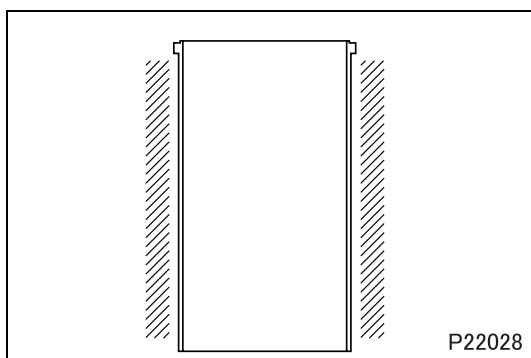
[Installation]

- When replacing the cylinder liner, use the size mark on the crankcase and the size mark on the piston to select the appropriate size of the cylinder liner.

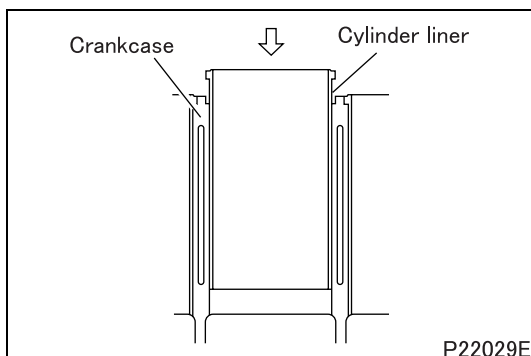


CAUTION ⚠

- Using a piston with the size mark different from the size mark of cylinder liner can lead to engine seizure.



- Apply a thin coat of engine oil onto the outer periphery (hatched area) of the cylinder liner.

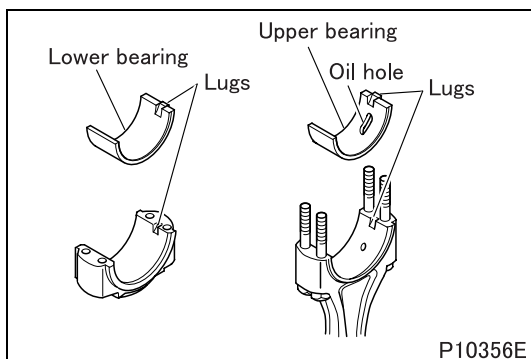


- While pushing the cylinder liner evenly with hands, gently insert the cylinder liner into the crankcase.

CAUTION ⚠

- Cylinder liners are thinly structured. Therefore, they must be handled with extreme care.

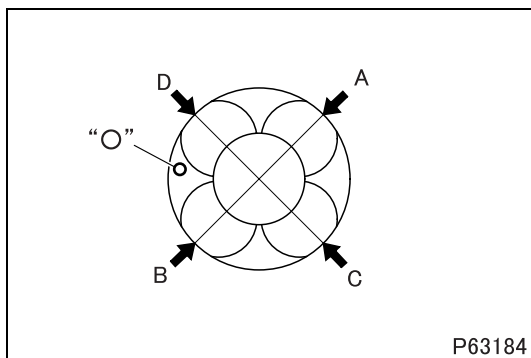
◆ Installation procedure ◆



■ Installation: Connecting rod bearings

CAUTION ⚠

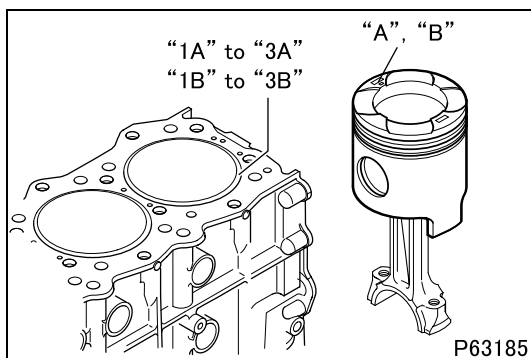
- Do not reverse the positions of the lower bearing and the upper bearing (with oil hole) when installing, as this may cause seizure in the engine.



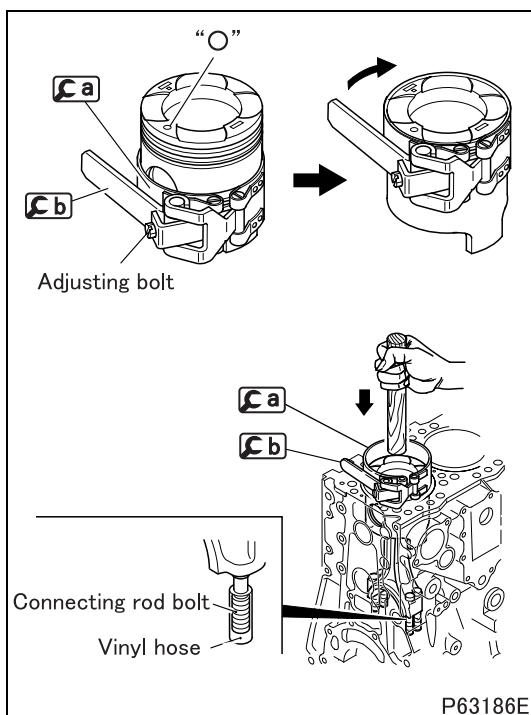
■ Installation: Piston and connecting rod

- Check that the piston ring end gaps are in their correct positions.
 - A: 1st compression ring gap
 - B: 2nd compression ring gap
 - C: Oil ring gap
 - D: Oil ring expander spring gap

“O”: Front mark on piston



- Ensure that the size mark (“A”, “B”) on the piston is the same as that on the cylinder liner.

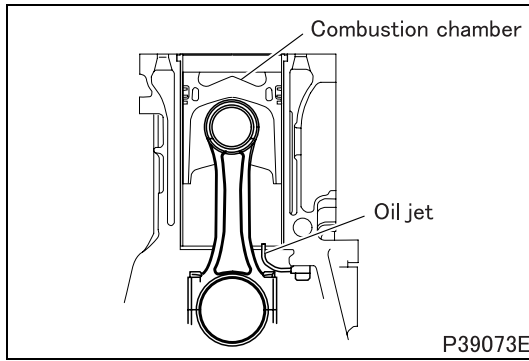


- Face the front mark “O” of the piston toward the front of the engine.
- With **a** and **b** installed around the piston skirt, tighten the adjusting bolt of **b** until the inside diameter of **a** matches the outside diameter of the piston skirt.
- After adjustment, remove **a** and **b** from the piston. Apply engine oil to the following areas. Then, install **a** and **b** over the rings of the piston.
 - Outer periphery of piston
 - Inner periphery of **a**
 - Inner periphery of cylinder liner

CAUTION ⚠

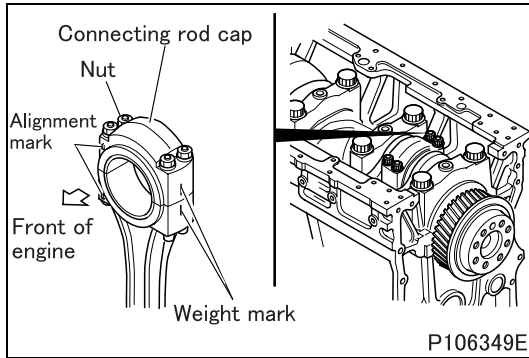
- Cover the connecting rod bolt with a vinyl hose to prevent the connecting rod bolt from damaging the inside surface of the cylinder and crankshaft.

PISTON, CONNECTING ROD AND CYLINDER LINER

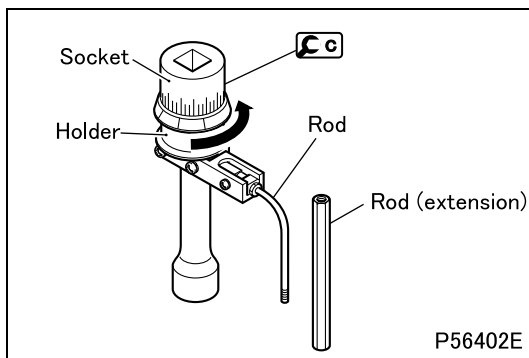


CAUTION

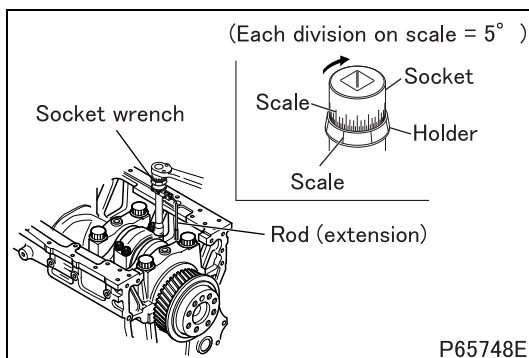
- Be careful not to scratch or damage head of the piston (a part of the combustion chamber).
- Make sure that the connecting rod does not hit oil jet.



- After installing the piston and connecting rod, install the connecting rod cap onto the connecting rod, ensuring that the their alignment marks (projection) are aligned with the weight mark. Then, tighten the nut to the torque of 49 N·m {5 kgf·m}.
- Further tighten the bolts in the following procedure.



- Turn the holder of  counterclockwise to pretension the internal spring.



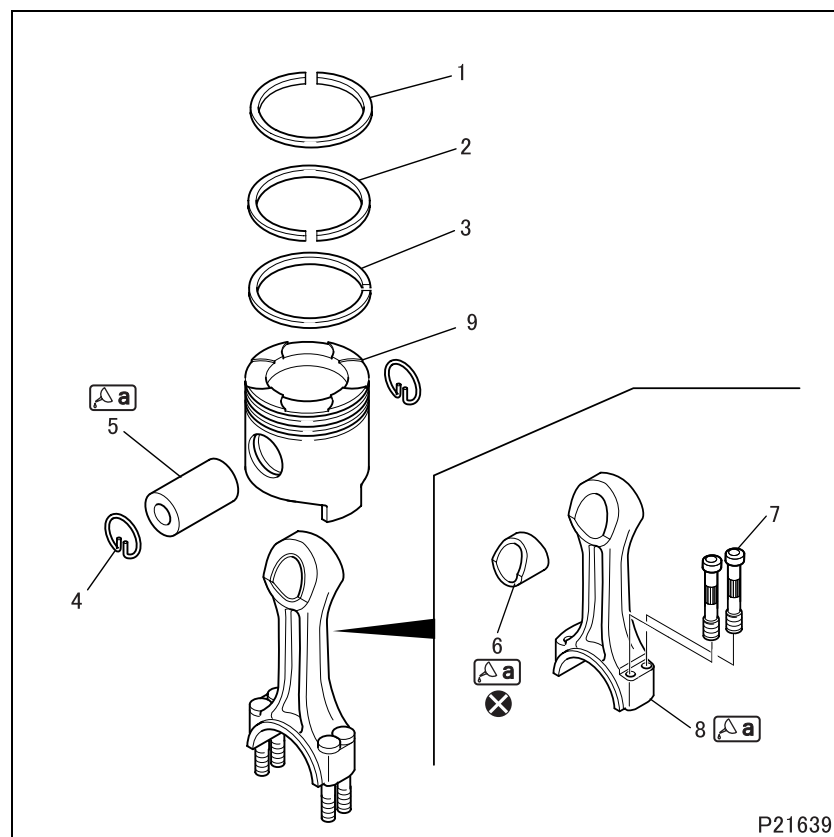
- Set the tool such that the rod (extension) is pressed against the crankshaft by the force of the spring.
- Align any line on the holder scale with any line on the socket scale. (This will be used as the reference point = 0°.)
- From the reference point, turn the socket by 120° in the direction shown. Each division on the socket scale represents 5°.
- After assembly of the connecting rod cap, perform the following test.
 - End play of connecting rod
 - Piston protrusion

Mitsubishi 6M70 Engine Parts contact:
 email: EngineParts@HeavyEquipmentRestorationParts.com
 Phone: 269 673 1638

M E M O

PISTON, CONNECTING ROD AND CYLINDER LINER

Mitsubishi 6M70 Piston and Connecting Rod



● Disassembly sequence

- 1 1st compression ring
- 2 2nd compression ring
- 3 Oil ring
- 4 Snap ring
- 5 Piston pin
- 6 Connecting rod bushing
- 7 Connecting rod bolt
- 8 Connecting rod
- 9 Piston

⊗: Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

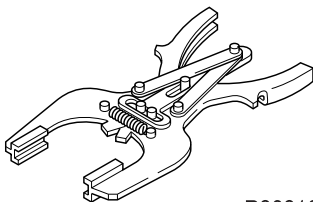
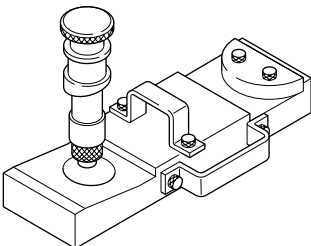
Mitsubishi 6M70 Service standards (Unit: mm)

Location	Maintenance item		Standard value	Limit	Remedy
1 to 3	Piston ring end gap	1st compression ring	0.4 to 0.55	1.5	Replace
		2nd compression ring	0.5 to 0.65		
		Oil ring	0.4 to 0.6		
1 to 3, 9	Clearance between piston ring and piston ring groove	1st compression ring	0.015 to 0.06	0.15	Replace
		2nd compression ring	0.085 to 0.125	0.25	
		Oil ring	0.025 to 0.065	0.15	
5, 6	Clearance between piston pin and connecting rod bushing		0.02 to 0.055	0.1	Replace
5, 9	Clearance between piston pin and piston		0.004 to 0.022	0.1	Replace
8	Connecting rod	Bend	—	0.05	Replace
		Twist	—	0.1	

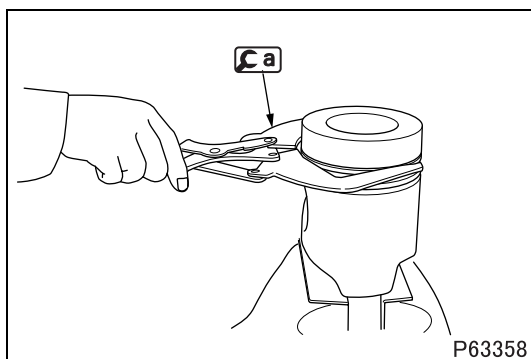
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Outer periphery of piston pin	Engine oil	As required
	Outer periphery of connecting rod bushing		
	Connecting rod bushing mounting surface of connecting rod		
	Connecting rod bolt mounting hole		

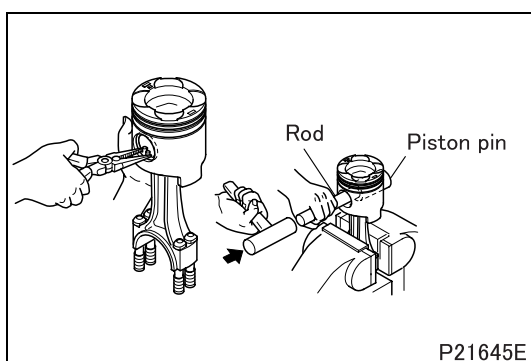
Special tools

Mark	Tool name and shape	Part No.	Application
	Piston ring tool  P02013	31191-02900	Removal and installation of piston rings
	Connecting rod bushing puller kit  P21640	MH062185	Removal and installation of connecting rod bushings

◆ Removal procedure ◆



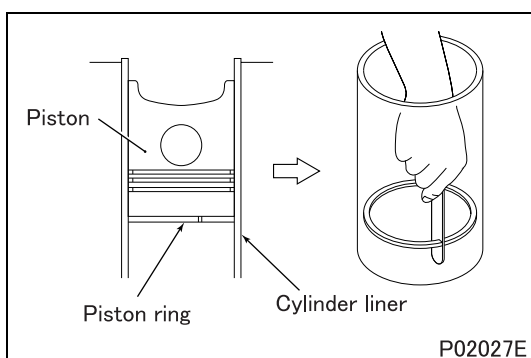
■ Removal: Piston ring



■ Removal: Piston pin

- Remove the piston pin by striking it with a rod and hammer.
- If the piston pin is difficult to remove, first heat the piston in hot water or with a piston heater.

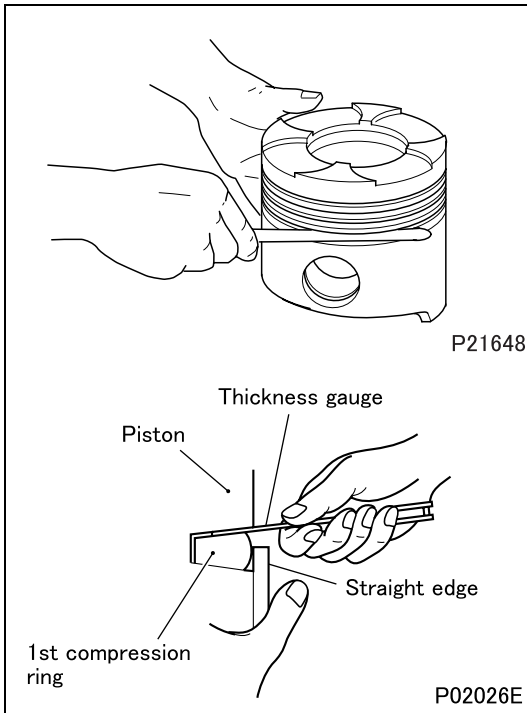
◆ Inspection procedure ◆



■ Inspection: Mitsubishi 6M70 Piston ring end gap

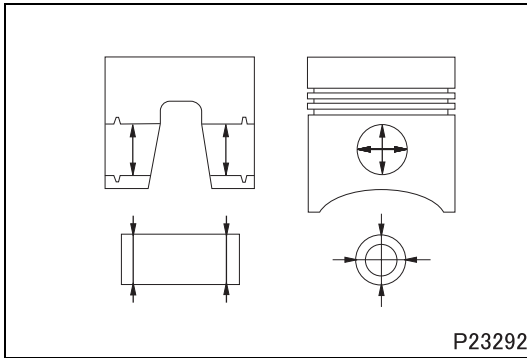
- Using the crown of a piston, push the piston ring horizontally into a cylinder in the crankcase until it reaches the lower part of the cylinder liner, where there is relatively small wear.
- Taking care not to move the piston ring, measure the end gap.
- If the measurement exceeds the limit, replace all the piston rings as a set.

PISTON, CONNECTING ROD AND CYLINDER LINER



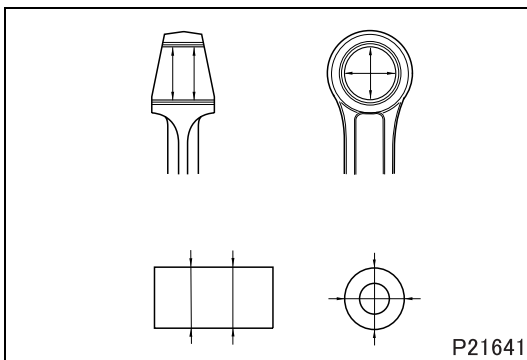
■ Inspection: Mitsubishi 6M70 Clearance between piston ring and piston ring groove

- Remove any carbon deposits from the ring groove in the piston.
- Measure the side clearance of each ring around the piston's entire periphery of the ring groove.
- If the measurement exceeds the limit, replace the defective part(s). If any of the piston rings is defective, replace all the piston rings as a set.
- The clearance of the 1st compression ring must be measured using a thickness gauge while holding the ring against the piston ring groove with a straight edge.



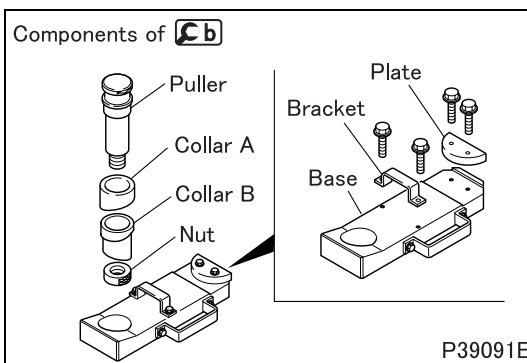
■ Inspection: Clearance between piston pin and piston

- If the measurement exceeds the limit, replace the defective part(s).



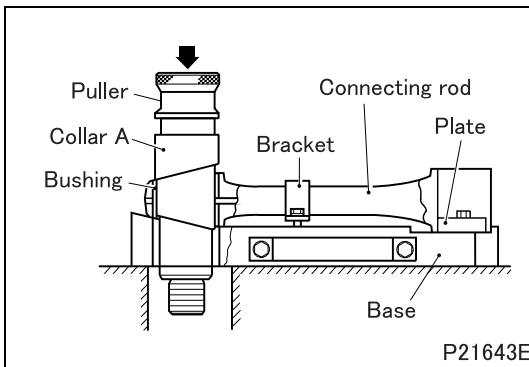
■ Inspection: Mitsubishi 6M70 Clearance between piston pin and connecting rod bushing

- If the measurement exceeds the limit, replace the bushing.



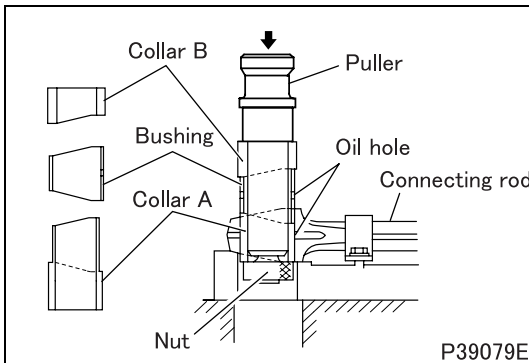
Replacement of connecting rod bushing

- Replace the connecting rod bushing using .



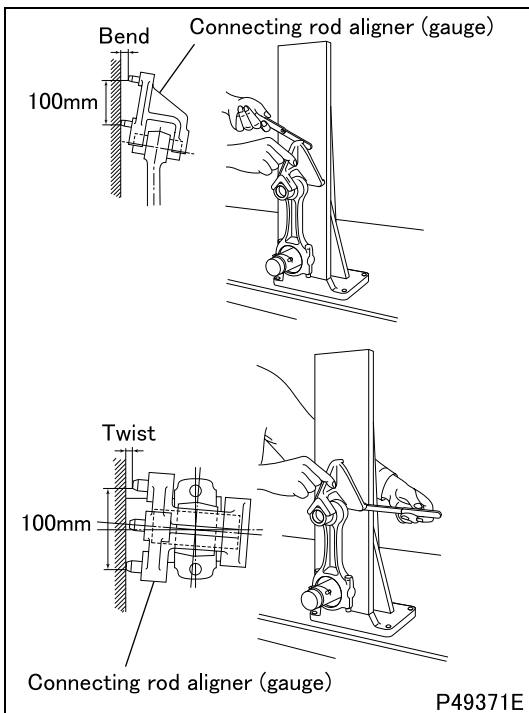
[Removal]

- If the upper connecting rod bearing is installed on the big end of the connecting rod, remove the bearing.
- Secure the connecting rod to the base with a bracket and plate.
- Set collar A on the puller in the direction shown in the illustration and gradually remove the bushing with a press load of approximately 49 kN {5000 kgf}.



[Installation]

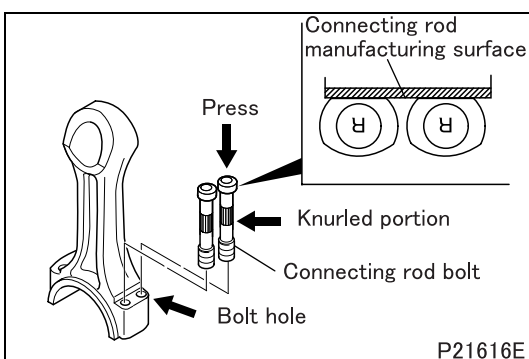
- Apply engine oil to the outer periphery of the connecting rod bushing and the bushing fitting surface of the connecting rod.
- Fit collar B, the bushing, and collar A over the puller in the direction shown in the illustration and lock this arrangement together with the nut.
- Align the oil holes in the bushing and the connecting rod. Then, use a press to slowly apply a pressure of approximately 49 kN {5,000 kgf} to the puller until the bushing is forced into place.
- After assembly, measure the clearance again.
- If the measurement is less than the standard value, ream the bushing.



■ Inspection: Connecting rod bend and twist

- Mount the connecting rod on the connecting rod aligner. Also mount the connecting rod bearings, piston pin, and connecting rod cap to create the same conditions as are expected when the connecting rod is mounted on a crankshaft. Tighten the nuts of the connecting rod cap to a torque of 115 N·m {12 kgf·m}.
- Measure the extent of bend and twist in the connecting rod.
- If either measurement exceeds the limit, replace the connecting rod.

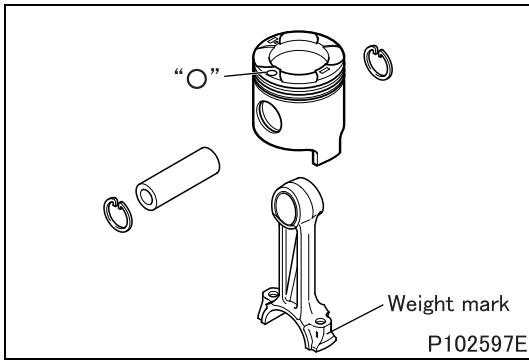
◆ Installation procedure ◆



■ Installation: Mitsubishi 6M70 Connecting rod bolt

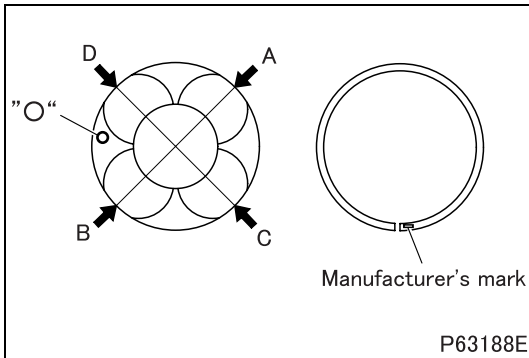
- Make sure that bolt holes of the connecting rod are free of flaws and burrs.
- Apply engine oil to the knurled portion of the connecting rod bolt and press fit it in the illustrated direction with the maximum press load of 5880 N {600 kgf}.

PISTON, CONNECTING ROD AND CYLINDER LINER



■ Installation: Mitsubishi 6M70 Piston and connecting rod

- When the piston and connecting rods are replaced, install each part as follows;
 - Select all the connecting rods with the same weight mark on the same engine ("A to H", "J to M").
 - Apply engine oil to the piston pin, and assemble the piston and connecting rod with their marks facing in the illustrated directions.
- "O": Front mark
- If the piston pin is difficult to insert, first heat the piston in hot water or with a piston heater. Then, install the piston.

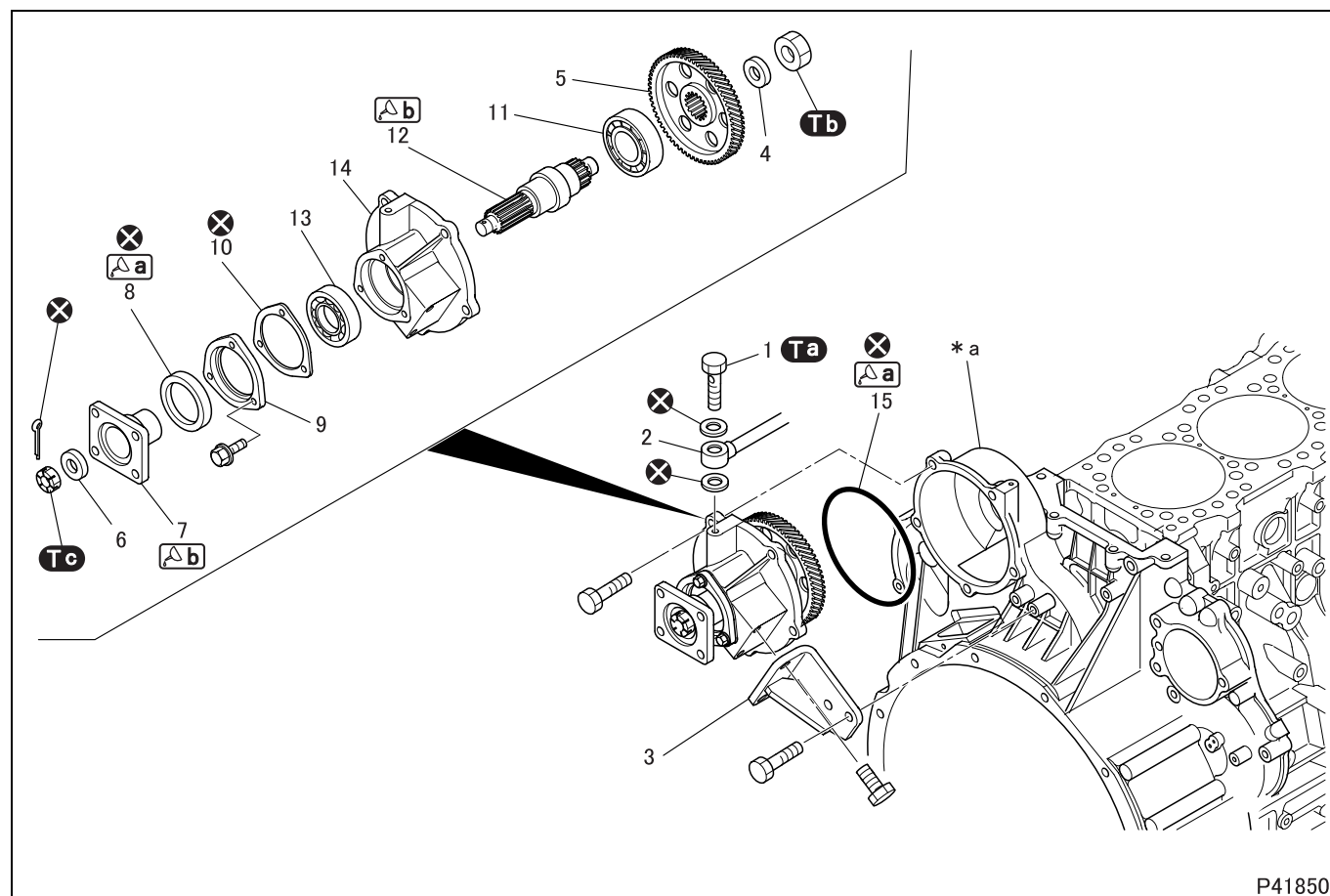


■ Installation: Mitsubishi 6M70 Piston rings

- With the manufacturer's marks (found near the piston ring end gaps) facing up, install the piston rings so that the end gap of each ring is positioned as shown in the illustration.
- A: 1st compression ring end gap
B: 2nd compression ring end gap
C: Oil ring end gap
D: Oil ring expander spring end gap
- "O": Front mark on piston
- The manufacturer's marks are present only on the 1st and 2nd compression rings.

M E M O

FLYWHEEL PTO <WITH FLYWHEEL PTO>



● Disassembly sequence

- | | | |
|---------------|-------------------|-----------------------|
| 1 Eyebolt | 7 Flange | 13 Ball bearing |
| 2 Oil pipe | 8 Oil seal | 14 PTO head |
| 3 PTO bracket | 9 Cover | 15 O-ring |
| 4 Washer | 10 Gasket | |
| 5 PTO gear | 11 Roller bearing | *a: Flywheel housing |
| 6 Washer | 12 PTO shaft | ⊗: Non-reusable parts |

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards (Unit: mm)

Location	Maintenance item	Standard value	Limit	Remedy
—	Total backlash of gears	0.19 to 0.62	0.8	Replace

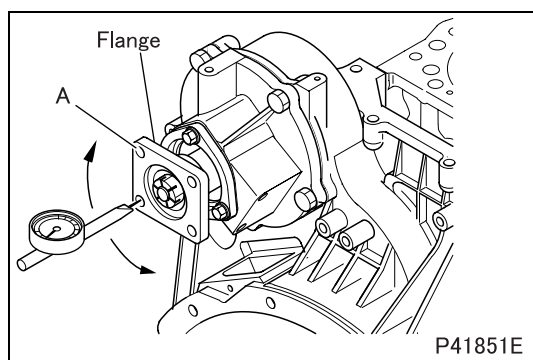
Tightening torque (Unit: N·m {kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Eyebolt	21 {2.1}	—
Tb	Nut (PTO gear installation)	220 {22}	—
Tc	Nut (flange installation)	178 {17.8}	—

Lubricant and/or sealant

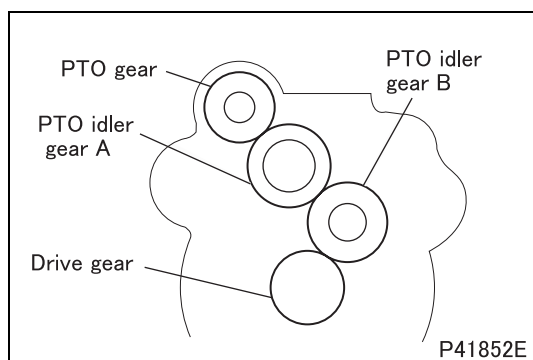
Mark	Points of application	Specified lubricant and/or sealant	Quantity
	O-ring	Engine oil	As required
	Oil seal lip		
	Sliding contact surfaces of flange and oil seal	Multipurpose grease [NLGI No.2 (Ca soap)]	As required
	Fitting surfaces of flange and PTO shaft	Multipurpose grease [NLGI No.2 (Ca soap)]	As required

◆ Inspection before removal ◆

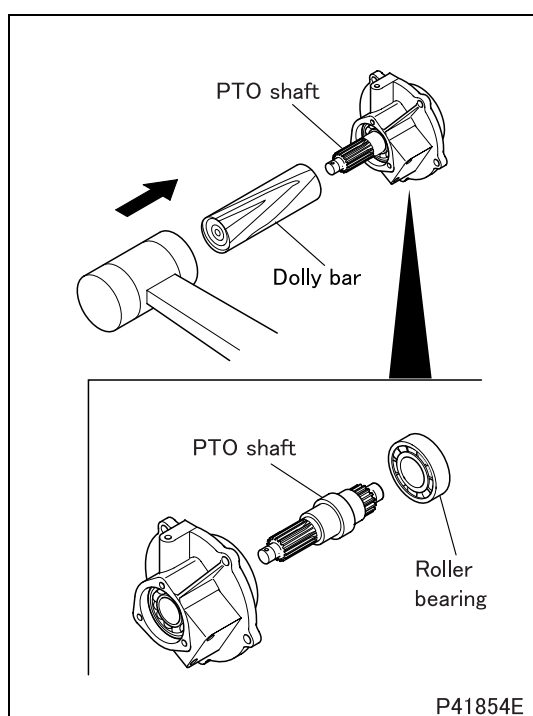


■ Inspection: Total backlash of gears

- “Total backlash of gears” is the gear backlash produced when the PTO gear, PTO idler gear A, PTO idler gear B and drive gear are all in mesh with each other.
- Measure the total backlash of gears by inserting a lever type dial gauge into the threaded holes A in the flange of the PTO head assembly.
- If the measurement is out of specification, check each gear for wear and replace if necessary.
- Check the PTO idler gear A, PTO idler gear B and drive gear for wear. (See TIMING GEARS <WITH FLYWHEEL PTO>.)



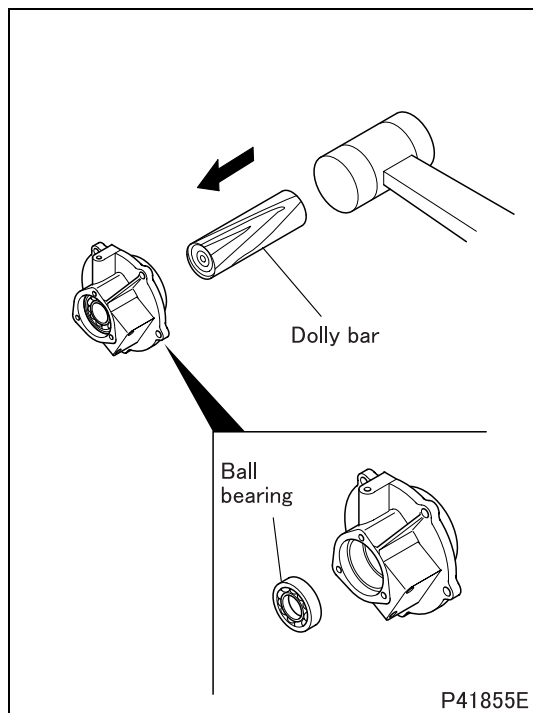
◆ Removal procedure ◆



■ Removal: Roller bearing and PTO shaft

- Remove the roller bearing and PTO shaft in the direction shown in the illustration.

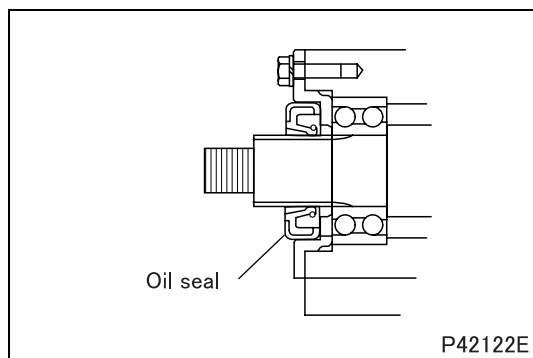
FLYWHEEL PTO <WITH FLYWHEEL PTO>



■ Removal: Ball bearing

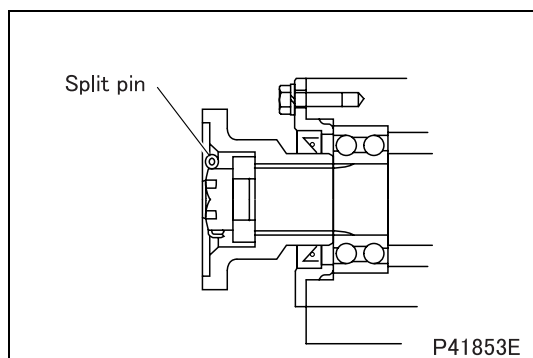
- Remove the ball bearing in the direction shown in the illustration.

◆ Installation procedure ◆



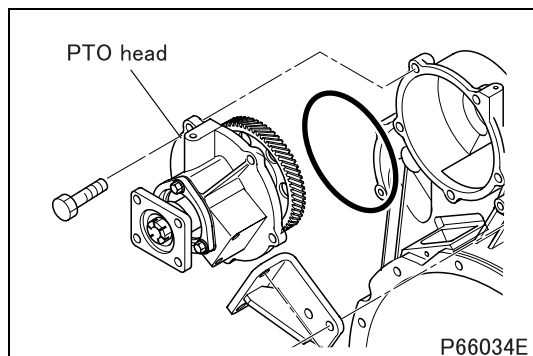
■ Installation: Oil seal

- Fit the oil seal oriented as shown in the illustration.



■ Installation: Split pin

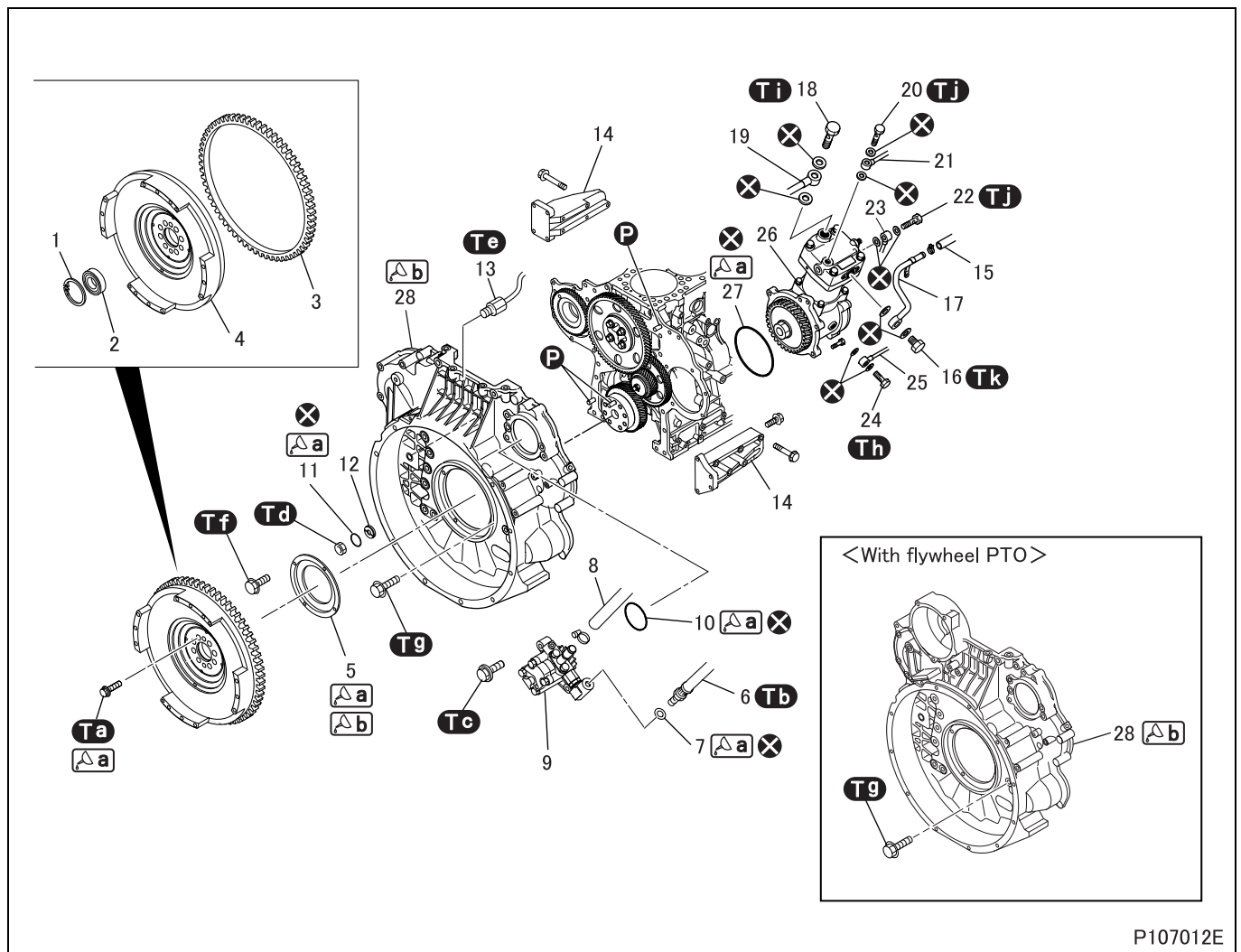
- After fitting, bend the split pin in the illustrated direction.



■ Installation: PTO head

- Make sure that the PTO shaft turns lightly by hand before installing the PTO head onto the flywheel housing.

M E M O



P107012E

● Disassembly sequence

- | | | |
|--|------------------------|---------------------|
| 1 Snap ring | 11 O-ring | 22 Eyebolt |
| 2 Pilot bearing | 12 Collar | 23 Water inlet pipe |
| 3 Ring gear | 13 Engine speed sensor | 24 Eyebolt |
| 4 Flywheel | 14 Stiffener | 25 Oil pipe |
| 5 Rear oil seal | 15 Air suction hose | 26 Air compressor |
| 6 Power steering oil hose | 16 Eyebolt | 27 O-ring |
| 7 O-ring | 17 Air suction pipe | 28 Flywheel housing |
| 8 Suction hose | 18 Eyebolt | |
| 9 Power steering oil pump
(See Gr37.) | 19 Air outlet pipe | |
| 10 O-ring | 20 Eyebolt | |
| | 21 Water outlet pipe | |
- P: Locating pin
 X: Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

CAUTION ⚠

- The flywheel mounting bolt is tightened within the plastic region. The number of punch marks indicates the number of times the bolt has been tightened. If there are 3 punch marks (tightened 3 times in the past), replace the bolt.

Service standards (Unit: mm)

Location	Maintenance item		Standard value	Limit	Remedy
4	Flywheel	Friction surface distortion	0.05	0.2	Rectify or replace
		Friction surface height	48 ± 0.2	49.5	Replace
		Friction surface runout (when fitted)	–	0.2	Rectify or replace
		Friction surface parallelism	0.1 or less	–	Rectify or replace
28	Eccentricity of flywheel housing measured at spigot joint section (when fitted)		–	0.2	Inspect or replace

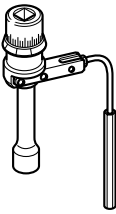
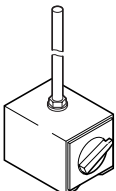
Tightening torque (Unit: N·m {kgf·m})

Mark	Parts to be tightened		Tightening torque	Remarks
Ta	Bolt (flywheel mounting)	Without PTO	100 {10} + 90°	• Wet • Can be reused up to 3 times
		With PTO	100 {10} + 150°	
Tb	Power steering oil hose		68 {7.0}	–
Tc	Bolt (power steering oil pump mounting)		74 {7.5}	–
Td	Nut (collar mounting)		100 {10}	–
Te	Engine speed sensor		25 {2.5}	–
Tf	Bolt (rear oil seal mounting)		12 {1.2}	–
Tg	Bolt (flywheel housing mounting)		80 {8.0}	–
Th	Eyebolt (oil pipe mounting)		21 {2.1}	–
Ti	Eyebolt (air outlet pipe mounting)		100 {10}	–
Tj	Eyebolt (water inlet pipe mounting)		50 {5.1}	–
	Eyebolt (water outlet pipe mounting)			
Tk	Eyebolt (air suction pipe mounting)		155 {16}	–

Lubricant and/or sealant

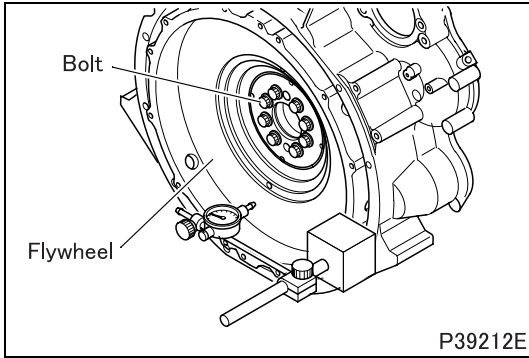
Mark	Points of application	Specified lubricant and/or sealant	Quantity
	Thread of bolts	Engine oil	As required
	O-ring		
	Rear oil seal lip		
	Rear oil seal surface to be mated with flywheel housing	ThreeBond 1207C	As required
	Engine mounting surface of flywheel housing		

Special tools

Mark	Tool name and shape	Part No.	Application
	Socket wrench  P01984	ME350193	Installation of flywheel
	Magnet base  P00471	MH062356	

FLYWHEEL

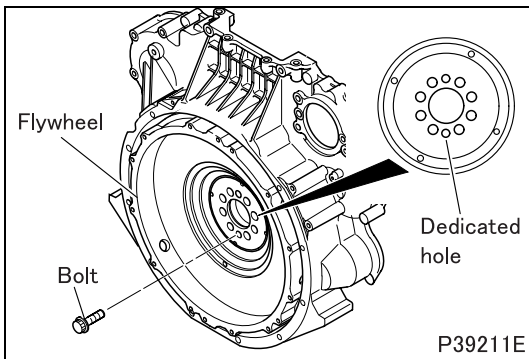
◆ Inspection before removal ◆



■ Inspection: Flywheel friction surface runout when fitted

- If the measurement exceeds the limit, check if the bolts are correctly tightened as well as the crankshaft mounting surface. Correct or replace the flywheel as required.

◆ Removal procedure ◆



■ Removal: Flywheel

- To remove the flywheel, use bolts inserted into the dedicated holes in the flywheel.

■ Removal: Ring gear

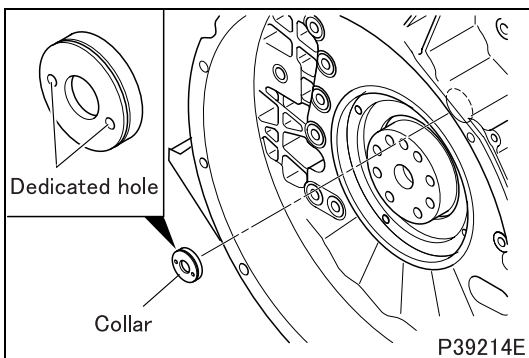
- Heat the ring gear evenly with a gas burner or the like until it reaches approximately 200°C, then remove it from the flywheel.

WARNING ⚠

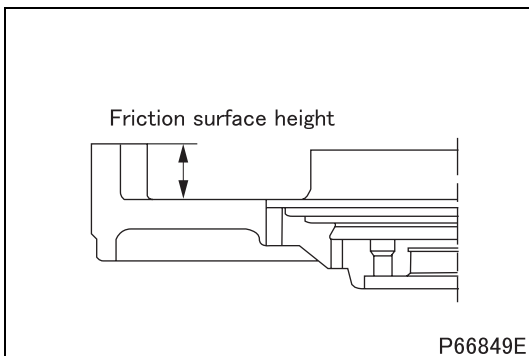
- You may burn yourself if you touch the heated ring gear.

■ Removal: Collar

- Install bolts (M4 x 0.7 mm) into the dedicated holes in the collar, and pull the bolts to remove the collar.



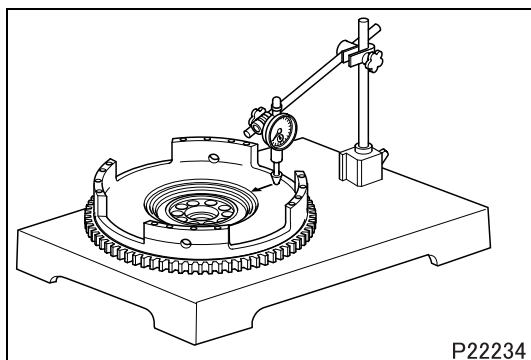
◆ Inspection procedure ◆



■ Inspection: Flywheel

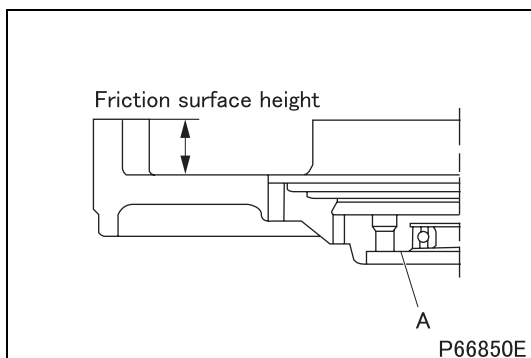
(1) Friction surface height

- If the measurement exceeds the limit, replace the flywheel.



(2) Friction surface distortion

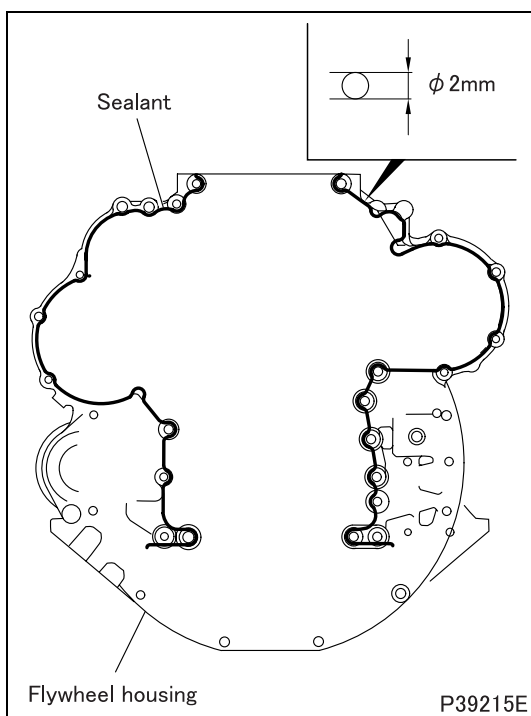
- If the measurement exceeds the limit, rectify or replace the flywheel.
- If the ring gear is evidently defective, replace the ring gear before inspecting the friction surface for distortion.



Rectification of friction surface

- Rectify the friction surface so that its height is not above the specified limit, and it is parallel with surface A within specification.

◆ Installation procedure ◆



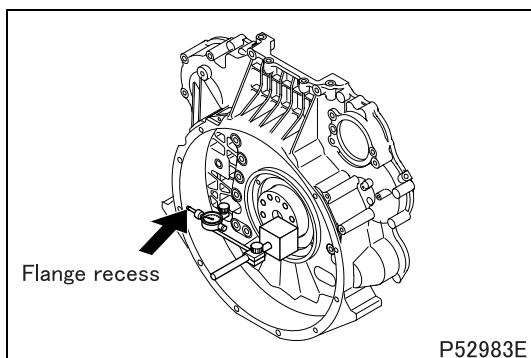
■ Installation: Flywheel housing

[Installation]

- Clean the flywheel housing surface where sealant is to be applied.
- Apply an even and continuous bead of sealant onto the flywheel housing surface where the crankcase is to be mounted.
- Within three minutes following the application, install the flywheel housing onto the crankcase. When installing the flywheel housing, take care not to spread the sealant beyond the application area.

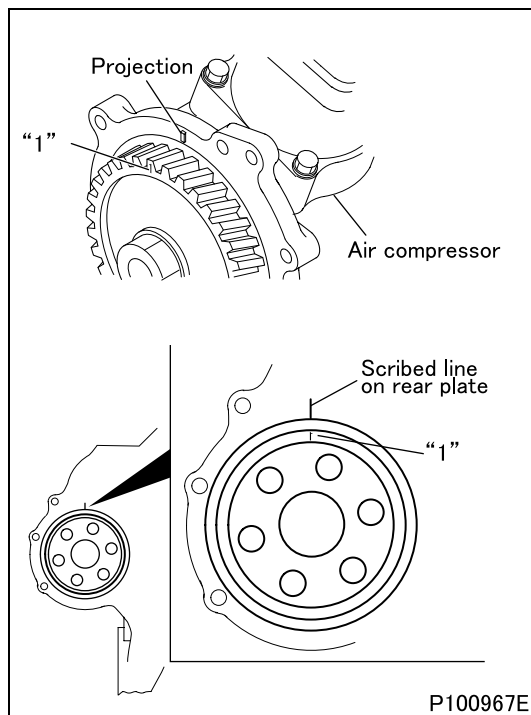
CAUTION ⚠

- Do not start the engine at least for an hour after the flywheel housing has been installed.
- If the flywheel housing mounting bolts are subsequently loosened, be sure to apply sealant again upon reassembly.



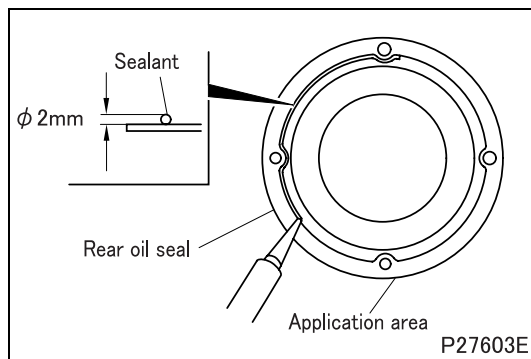
[Inspection]

- While turning the crankshaft, measure the flywheel housing for any eccentricity at the location indicated in the illustration.
- If the eccentricity exceeds the limit, reassemble the flywheel.
- If the eccentricity still exceeds the limit after reassembly, replace the defective part(s).



■ Installation: Air compressor

- Set the No. 1 cylinder piston at the top dead center of the compression stroke.
- Align the stamped mark "1" on the air compressor gear with the projection on the air compressor.
- While keeping this condition, align the stamped mark "1" with the scribed line on the rear plate and install the air compressor to the flywheel housing.

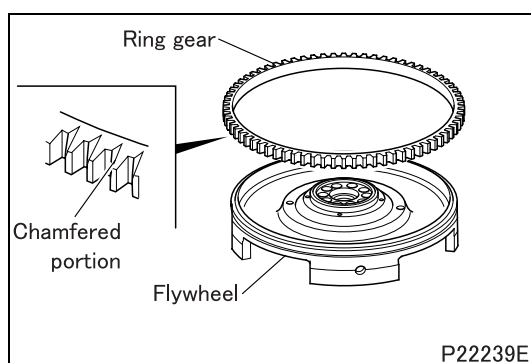


■ Installation: Rear oil seal

- Clean the rear oil seal surface where sealant is to be applied.
- Apply an even and continuous bead of sealant on the rear oil seal as shown in the illustration.
- Install the rear oil seal onto the flywheel housing within 3 minutes following the application of the sealant. Be careful not to dislodge the sealant.

CAUTION ⚠

- Do not start the engine at least for an hour after the rear oil seal has been installed.
- If the rear oil seal mounting bolts are subsequently loosened, be sure to apply sealant again upon reassembly.

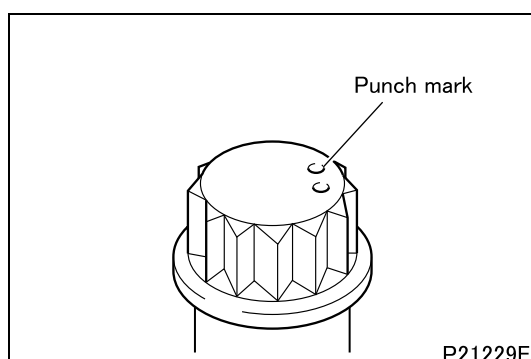


■ Installation: Ring gear

- Heat the ring gear evenly with a gas burner or the like until it reaches approximately 200°C.

WARNING ⚠

- You may burn yourself if you touch the heated ring gear.
- Fit the ring gear with the side having non-chamfered portions toward the flywheel.

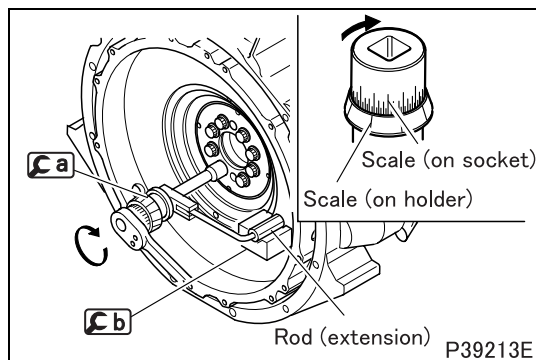


■ Installation: Flywheel

CAUTION ⚠

- Before installing a bolt, check the number of punch marks on the bolt head. (Bolts with up to two punch marks can be reused.)

The number of punch marks indicates the number of times the bolt has been tightened in the past within the plastic region. If there are three punch marks (tightened three times in the past), replace the bolt.



- Tighten the flywheel mounting bolts to a torque of 100 N·m {10 kgf·m}.
- Further tighten the bolts in the following procedure.
 - Turn the holder of **Ca** counterclockwise to preload the built-in spring.
 - Set the tool such that the rod (extension) is pressed against **Cb** by the force of the spring.
 - Align any line on the holder scale with any line on the socket scale. (This will be used as the reference point = 0°.)
 - From the reference point, turn the socket by 90° <Without flywheel PTO>, 150° <With flywheel PTO> clockwise. Each division on the socket scale represents 5°.
 - After tightening the bolt within the plastic region, make a punch mark on the bolt head for subsequent identification.

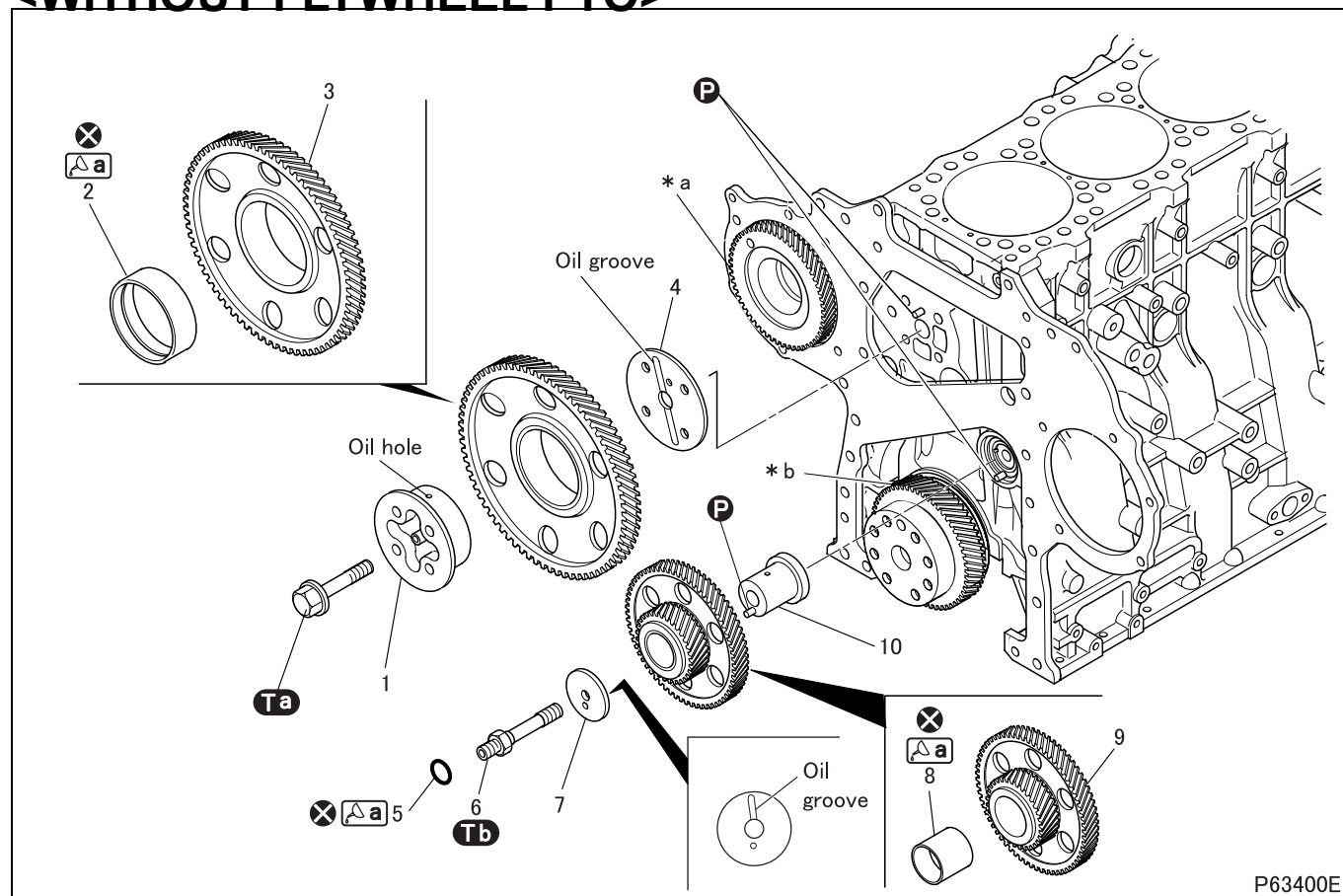
CAUTION

- The bolts should be tightened within the plastic region. Never tighten them further than the specified angle.

Mitsubishi 6M70 Engine Parts contact:
 email: EngineParts@HeavyEquipmentRestorationParts.com
 Phone: 269 673 1638

MITSUBISHI 6M70 TIMING GEARS

<WITHOUT FLYWHEEL PTO>



● Disassembly sequence

- | | | |
|----------------------|----------------------|-----------------------|
| 1 Idler shaft C | 6 Idler shaft bolt | *a: Supply pump gear |
| 2 Idler gear bushing | 7 Thrust plate A, B | *b: Crankshaft gear |
| 3 Idler gear C | 8 Idler gear bushing | ⊗: Non-reusable parts |
| 4 Thrust plate C | 9 Idler gear A, B | Ⓟ: Locating pin |
| 5 O-ring | 10 Idler shaft A, B | |

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards (Unit: mm)

Location	Maintenance item		Standard value	Limit	Remedy
-	Backlash between gears	Idler gear C and supply pump gear	0.096 to 0.198	0.35	Replace
		Idler gear C and idler gear A, B	0.089 to 0.181	0.35	Replace
		Idler gear A, B and crankshaft gear	0.076 to 0.196	0.35	Replace
1, 2	Clearance between idler shaft C and idler gear bushing		0.036 to 0.08	0.2	Replace
3, 9	Idler gear end play		0.1 to 0.2	0.4	Replace
8, 10	Clearance between idler shaft A, B and idler gear bushing		0.025 to 0.066	0.2	Replace

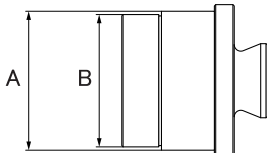
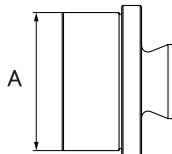
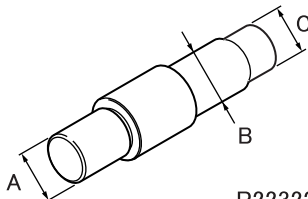
Tightening torque (Unit: N·m {kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ⓣa	Bolt (idler gear C mounting)	80 {8.0}	-
Ⓣb	Idler shaft bolt (idler gear A, B mounting)	155 {16}	-

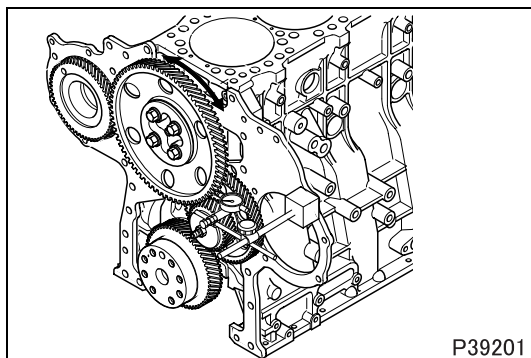
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	O-ring	Engine oil	As required
	Inside surface of bushing of gears		

Special tools (Unit: mm)

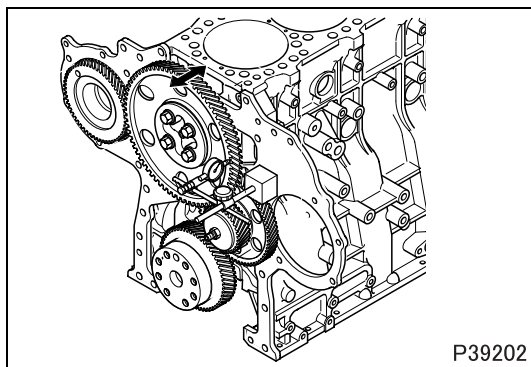
Mark	Tool name and shape	Part No.	Application						
 a	Idler gear bushing puller <table border="1"><tr><td>A</td><td>B</td></tr><tr><td>φ 105</td><td>φ 100</td></tr></table>  P40689	A	B	φ 105	φ 100	ME350197	Removal of idler gear bushing		
A	B								
φ 105	φ 100								
 b	Idler gear bushing installer <table border="1"><tr><td>A</td></tr><tr><td>φ 99.3</td></tr></table>  P40690	A	φ 99.3	ME350198	Installation of idler gear bushing				
A									
φ 99.3									
 c	Idler gear bushing puller <table border="1"><tr><td>A</td><td>B</td><td>C</td></tr><tr><td>φ 45.5</td><td>φ 50</td><td>φ 46</td></tr></table>  P22322	A	B	C	φ 45.5	φ 50	φ 46	MH062046	Removal and installation of idler gear bushing
A	B	C							
φ 45.5	φ 50	φ 46							

◆ Inspection before removal ◆



■ Inspection: Backlash between gears

- For each pair of gears, measure the backlash at more than three teeth.
- If any of the measurements exceeds the limit, replace the defective part(s).

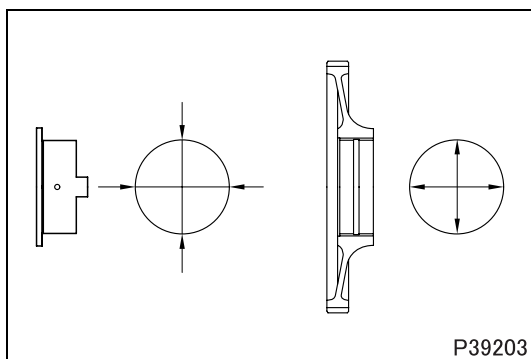


■ Inspection: Idler gear end play

- If the measurement exceeds the limit, replace the defective part(s).

TIMING GEARS <WITHOUT FLYWHEEL PTO>

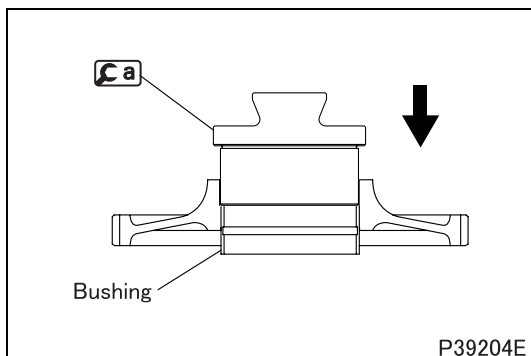
◆ Inspection procedure ◆



■ Inspection: Clearance between idler shaft C and idler gear bushing

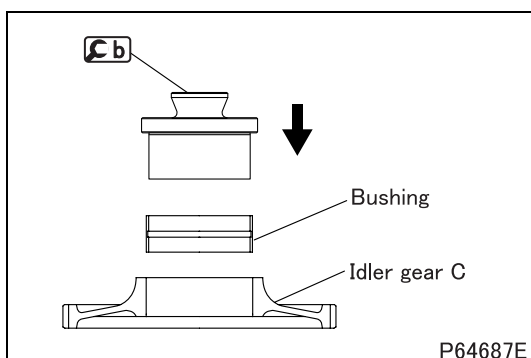
[Inspection]

- If the measurement exceeds the limit, replace the bushing.



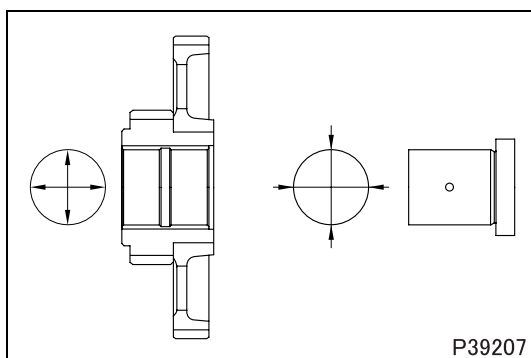
Replacement of idler gear bushing

[Removal]



[Installation]

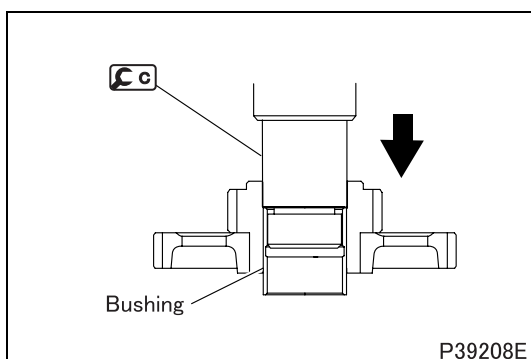
- Install **[Cb]** until it contacts the idler gear with idler gear C facing in the illustrated direction.
- After installation, measure the clearance again.
- If the measurement is less than the standard value, ream the bushing.



■ Inspection: Clearance between idler shaft A, B and idler gear bushing

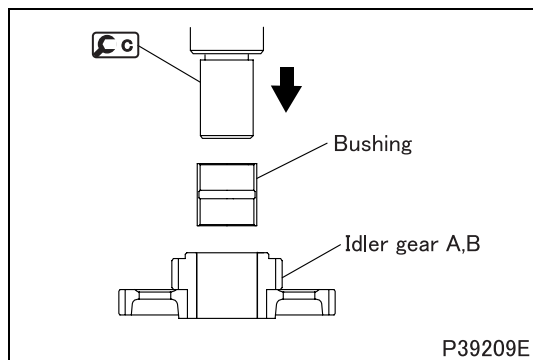
[Inspection]

- If the measurement exceeds the limit, replace the bushing.



Replacement of idler gear bushing

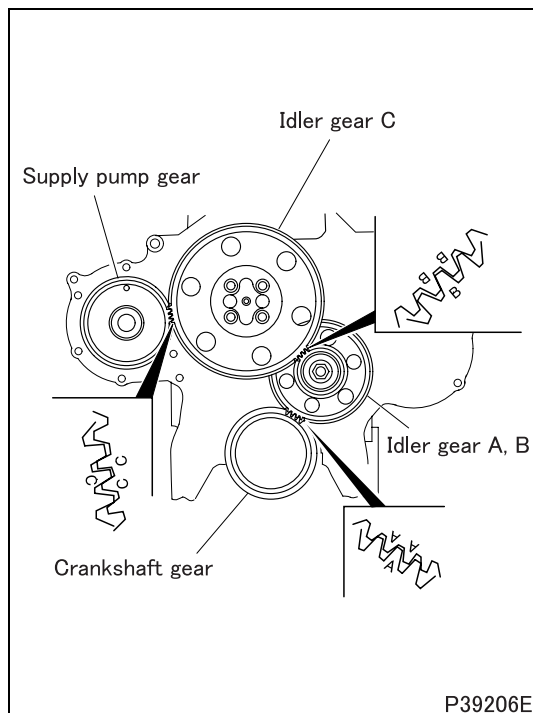
[Removal]



[Installation]

- Install  until it contacts the idler gear with idler gear A, B facing in the illustrated direction.
- After installation, measure the clearance again.
- If the measurement is less than the standard value, ream the bushing.

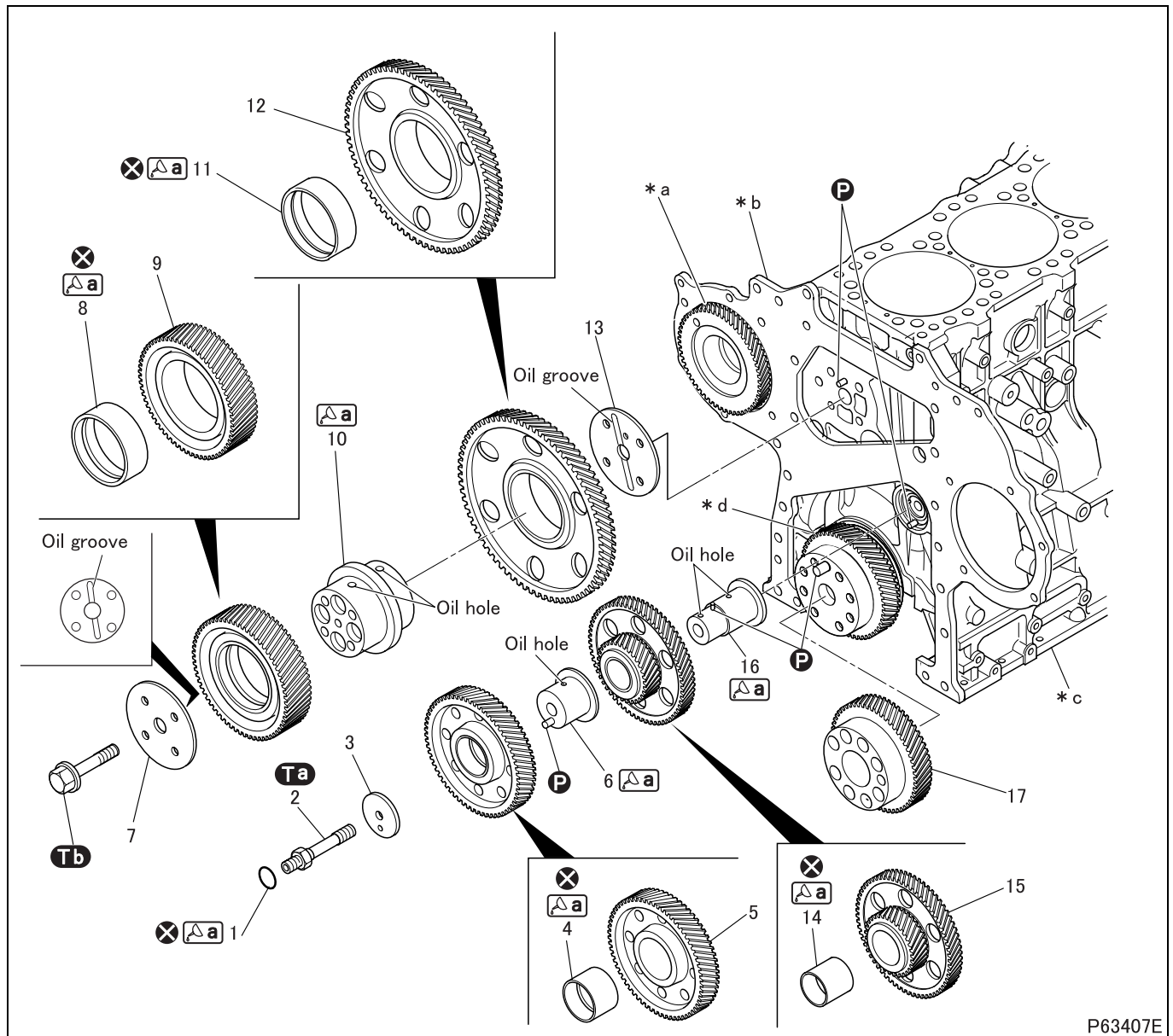
◆ Installation procedure ◆



■ Installation: idler gear

- Install idler gear A, B such that the alignment mark "A" on the gear is aligned with the alignment mark "A" on the crankshaft gear.
- When installing idler gear C, ensure that the alignment mark "B" on the gear is aligned with the alignment mark "B" on idler gear A, B and that the alignment mark "C" on idler gear C is aligned with the alignment mark "C" on the supply pump gear.

MITSUBISHI 6M70 TIMING GEARS <WITH FLYWHEEL PTO>



P63407E

● Disassembly sequence

- | | |
|--------------------------|-----------------------|
| 1 O-ring | 9 PTO idler gear B |
| 2 Idler shaft bolt | 10 Idler shaft C |
| 3 Thrust plate A, B | 11 Idler gear bushing |
| 4 PTO idler gear bushing | 12 Idler gear C |
| 5 PTO idler gear A | 13 Thrust plate C |
| 6 Idler shaft B | 14 Idler gear bushing |
| 7 Thrust plate C | 15 Idler gear A, B |
| 8 PTO idler gear bushing | 16 Idler shaft A |

- 17 PTO drive gear

- *a: Supply pump gear
 *b: Rear plate
 *c: Crankcase
 *d: Crankshaft gear
 P: Locating pin
 X: Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

Mitsubishi 6M70 Engine Parts contact:
 email: EngineParts@HeavyEquipmentRestorationParts.com
 Phone: 269 673 1638

Service standards (Unit: mm)

Location	Maintenance item		Standard value	Limit	Remedy
–	Gear backlash	Between idler gear C and supply pump gear	0.096 to 0.198	0.35	Replace
		Between idler gear C and idler gear A, B	0.089 to 0.181	0.35	Replace
		Between idler gear A, B and crank-shaft gear	0.076 to 0.196	0.35	Replace
		Between PTO idler gear A and PTO idler gear B	0.07 to 0.2	0.35	Replace
		Between PTO idler gear A and drive gear	0.07 to 0.2	0.35	Replace
4, 6	PTO idler gear bushing-to-idler shaft B clearance		0.03 to 0.068	0.2	Replace
5, 9, 12, 15	Idler gear end play		0.1 to 0.2	0.4	Replace
8, 10	PTO idler gear bushing-to-idler shaft C clearance		0.036 to 0.08	0.2	Replace
10, 11	Idler gear bushing-to-idler shaft C clearance		0.04 to 0.08	0.2	Replace
14, 16	Idler gear bushing-to-idler shaft A clearance		0.03 to 0.06	0.2	Replace

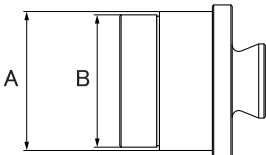
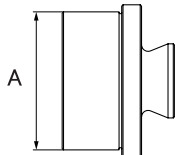
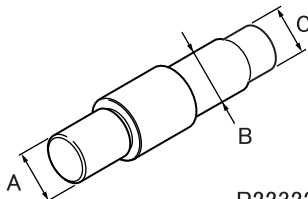
Tightening torque (Unit: N·m {kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Idler shaft bolt (for installing PTO idler gear A, idler gear A, B)	155 {16}	–
Tb	Bolt (for installing PTO idler gear B, idler gear C assembly)	80 {8.0}	–

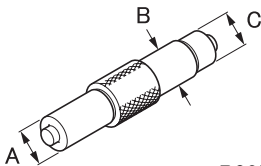
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	O-ring	Engine oil	As required
	Gear bushing inner surface		

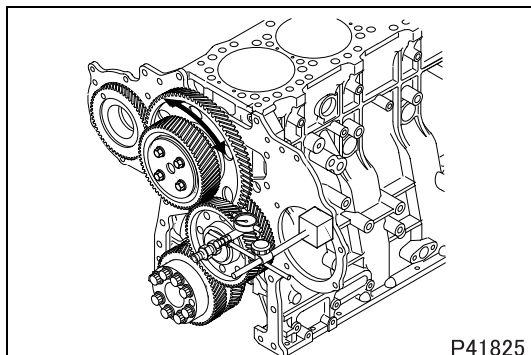
Special tools (Unit: mm)

Mark	Tool name and shape	Part No.	Application						
 a	Idler gear bushing puller <table border="1"><tr><td>A</td><td>B</td></tr><tr><td>φ 105</td><td>φ 100</td></tr></table>  P40689	A	B	φ 105	φ 100	ME350197	Removal of idler gear bushing		
A	B								
φ 105	φ 100								
 b	Idler gear bushing installer <table border="1"><tr><td>A</td></tr><tr><td>φ 99.3</td></tr></table>  P40690	A	φ 99.3	ME350198	Installation of idler gear bushing				
A									
φ 99.3									
 c	Idler gear bushing puller <table border="1"><tr><td>A</td><td>B</td><td>C</td></tr><tr><td>φ 45.5</td><td>φ 50</td><td>φ 46</td></tr></table>  P22322	A	B	C	φ 45.5	φ 50	φ 46	MH062046	Removal and installation of idler gear bushing
A	B	C							
φ 45.5	φ 50	φ 46							

TIMING GEARS <WITH FLYWHEEL PTO>

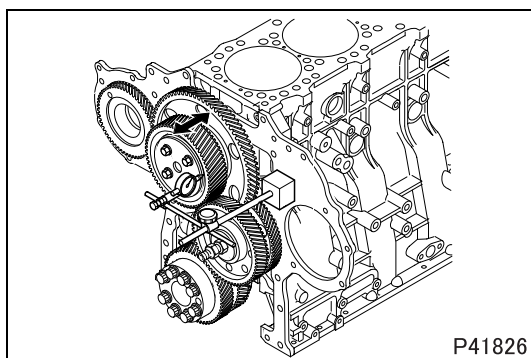
Mark	Tool name and shape	Part No.	Application						
	Idler gear bushing puller <table><tr><td>A</td><td>B</td><td>C</td></tr><tr><td>φ 57.3</td><td>φ 62</td><td>φ 58</td></tr></table>  P03532	A	B	C	φ 57.3	φ 62	φ 58	MH061256	Removal and installation idler gear bushings
A	B	C							
φ 57.3	φ 62	φ 58							

◆ Inspection before removal ◆



■ Inspection: Backlash between gears

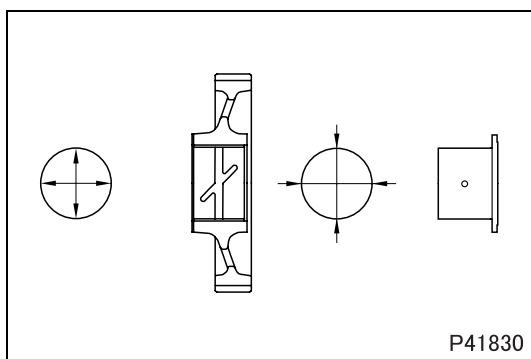
- For each pair of gears, measure the backlash at more than three teeth.
- If any of the measurements exceeds the limit, replace the defective part(s).



■ Inspection: Idler gear end play

- If the measurement exceeds the limit, replace the defective part(s).

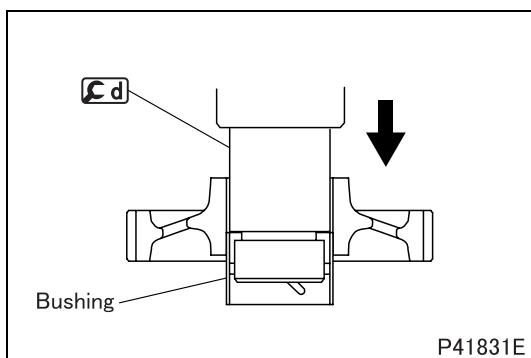
◆ Inspection procedure ◆



■ Inspection: Clearance between PTO idler gear bushing and idler shaft B

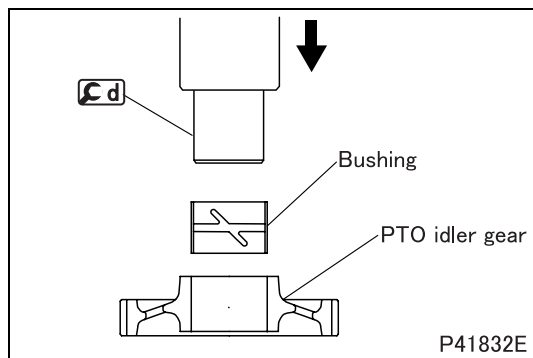
[Inspection]

- If the measurement exceeds the limit, replace the bushing.



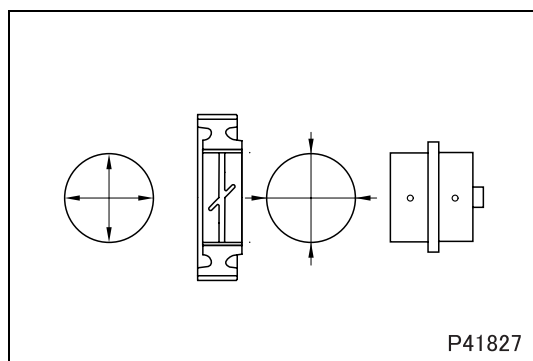
Replacement of PTO idler gear bushing

[Removal]



[Installation]

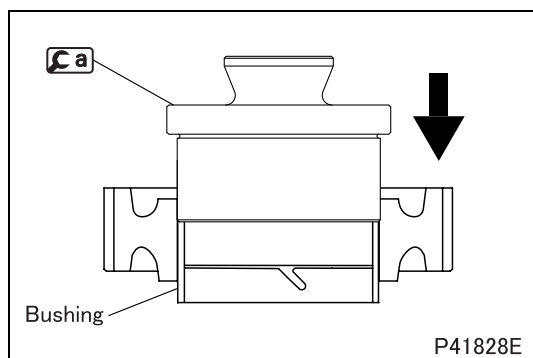
- Install  until it contacts the PTO idler gear A with PTO idler gear A facing in the illustrated direction.
- After installation, measure the clearance again.
- If the measurement is less than the standard value, ream the bushing.



■ Inspection: Clearance between PTO idler gear bushing and idler shaft C

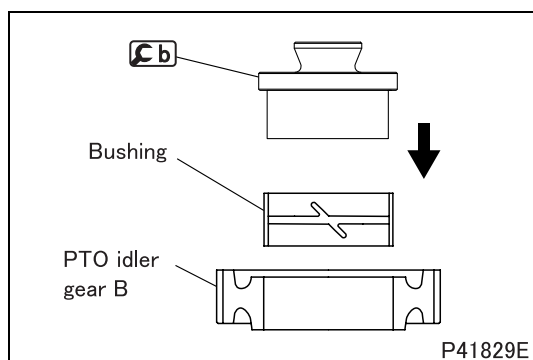
[Inspection]

- If the clearance exceeds the limit, replace the bushing.



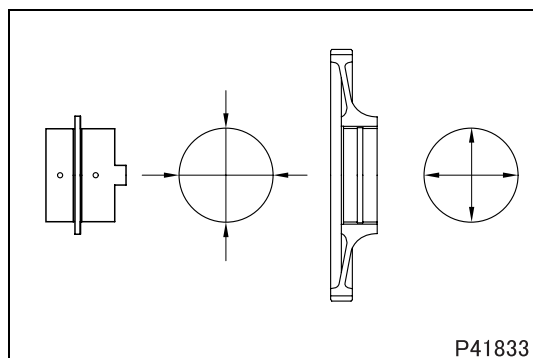
Replacement of PTO idler gear bushing

[Removal]



[Installation]

- Install  until it contacts the PTO idler gear B with PTO idler gear B facing in the illustrated direction.
- After installation, measure the clearance again.
- If the measurement is less than the standard value, ream the bushing.

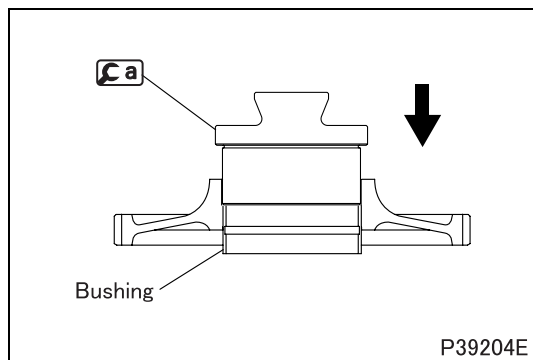


■ Inspection: Clearance between idler shaft C and idler gear bushing

[Inspection]

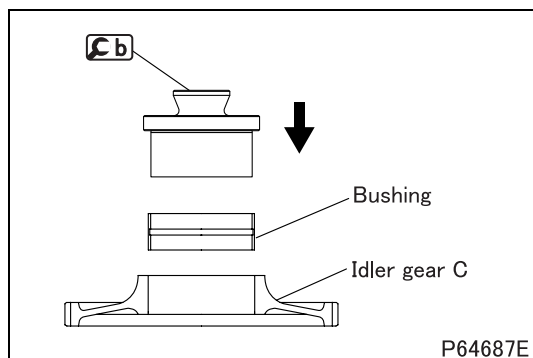
- If the clearance exceeds the limit, replace the bushing.

TIMING GEARS <WITH FLYWHEEL PTO>



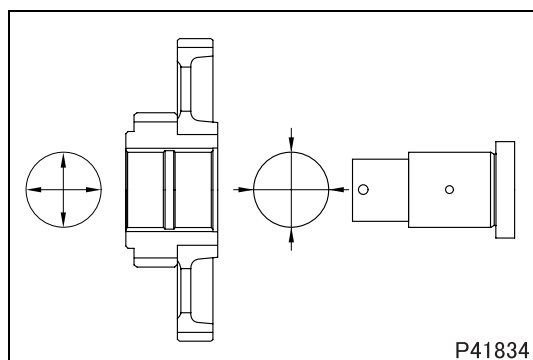
Replacement of idler gear bushing

[Removal]



[Installation]

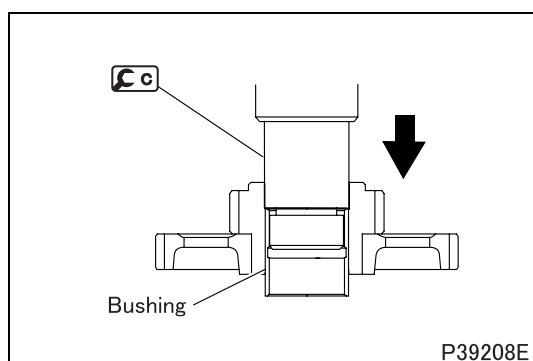
- Install **b** until it contacts the idler gear with idler gear C facing in the illustrated direction.
- After installation, measure the clearance again.
- If the measurement is less than the standard value, ream the bushing.



■ Inspection: Clearance between idler gear bushing and idler shaft A

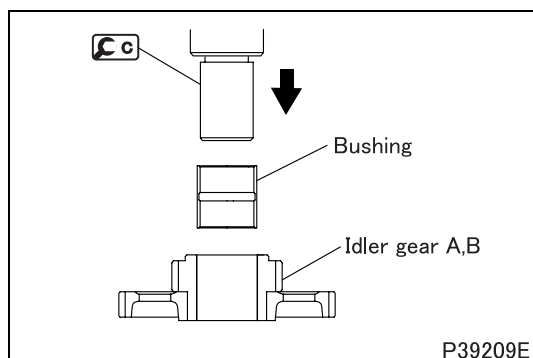
[Inspection]

- If the clearance exceeds the limit, replace the bushing.



Replacement of idler gear bushing

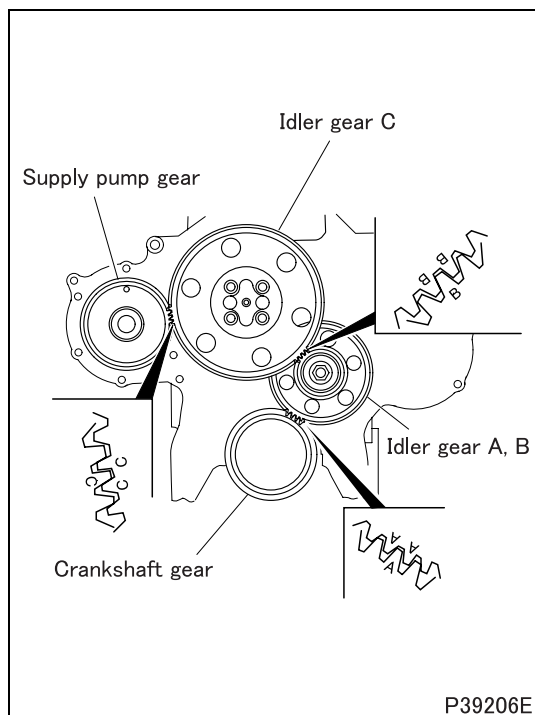
[Removal]



[Installation]

- Install **c** until it contacts the idler gear with idler gear A, B facing in the illustrated direction.
- After installation, measure the clearance again.
- If the measurement is less than the standard value, ream the bushing.

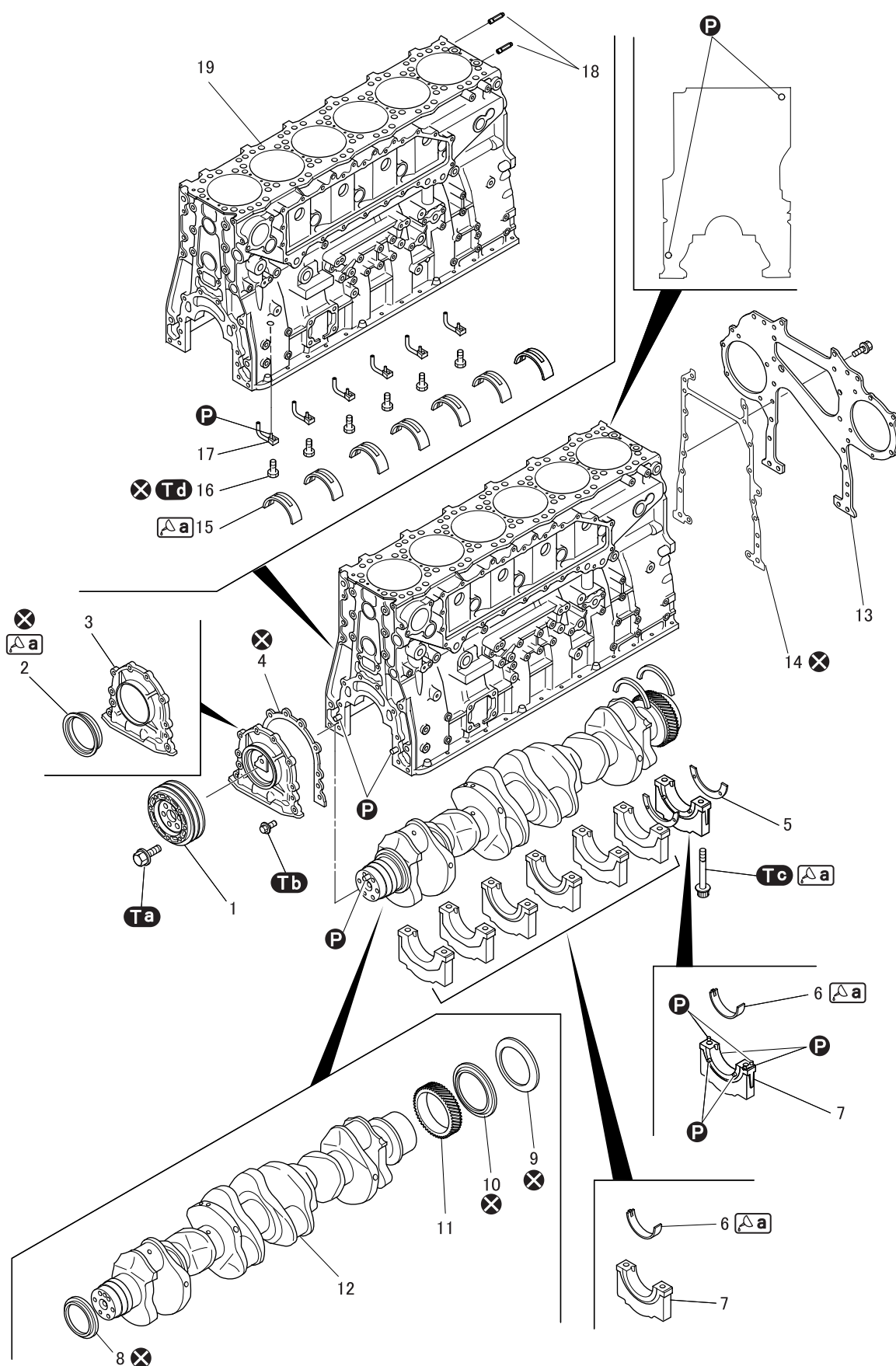
◆ Installation procedure ◆



■ Installation: Idler gear

- Install idler gear A, B such that the alignment mark “A” on the gear is aligned with the alignment mark “A” on the crankshaft gear.
- When installing idler gear C, ensure that the alignment mark “B” on the gear is aligned with the alignment mark “B” on idler gear A, B and that the alignment mark “C” on idler gear C is aligned with the alignment mark “C” on the supply pump gear.

MITSUBISHI 6M70 CRANKSHAFT AND CRANKCASE



P63189

● Disassembly sequence

- | | | |
|--------------------------|--------------------------|-----------------------|
| 1 Crankshaft pulley | 9 Ring | 17 Oil jet |
| 2 Front oil seal | 10 Rear oil seal slinger | 18 Oil spray plug |
| 3 Front cover | 11 Crankshaft gear | 19 Crankcase |
| 4 Front cover gasket | 12 Crankshaft | |
| 5 Thrust plate | 13 Rear plate | ⒫: Locating pin |
| 6 Lower main bearing | 14 Gasket | ⊗: Non-reusable parts |
| 7 Main bearing cap | 15 Upper main bearing | |
| 8 Front oil seal slinger | 16 Check valve | |

CAUTION

- The check valve has been tightened using thread-locking compound and so, may deform during removal. Once removed, the check valve must not be reused. Therefore, do not remove the check valve unless any fault is found.

● Assembly sequence

Follow the disassembly sequence in reverse.

CAUTION

- If overtightened, the check valve will not operate properly, leading to engine seizure. Be sure to tighten the check valve to the specified torque.
- The main cap bolt is tightened within the plastic region. The number of punch marks indicates the number of times the bolt has been tightened. If there are 3 punch marks (tightened 3 times in the past), replace the bolt.

Mitsubishi 6M70 Service standards (Unit: mm)

Location	Maintenance item		Standard value	Limit	Remedy	
6, 15	Main bearing	Oil clearance	0.06 to 0.122	0.25	Replace	
		Span when free	—	106.5	Replace	
12	Crankshaft	End play		0.09 to 0.23	0.4	Replace thrust plate
		Bend		0.04 or less	0.1	Replace
		Pins and journals	Roundness	0.01 or less	0.03	Rectify or replace
			Cylindricity	0.006 or less	—	Rectify or replace
		Center-to-center distance between the journal and pin		75 ± 0.07	—	Replace
		Journal width		42 ± 0.3	—	Replace
		Pin width		54 ^{+0.2} ₀	—	Replace
		Fillet		R5	—	Replace
19	Crankcase	Distortion of top surface		0.07 or less	0.2	Rectify or replace
		Cylinder block	Roundness	0.005 or less	—	Replace
			Cylindricity	0.015 or less	—	

Mitsubishi 6M70 Tightening torque (Unit: N·m {kgf·m})

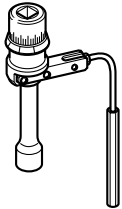
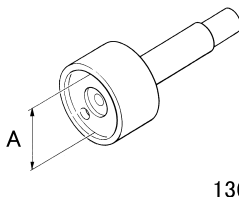
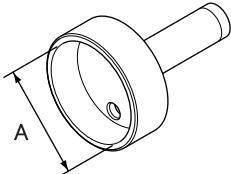
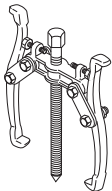
Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (crankshaft pulley installation)	240 {24}	—
Tb	Bolt (front cover installation)	45 {4.6}	—
Tc	Bolt (main bearing cap installation)	100 {10} + 130 ± 2°	- Wet - Can be reused up to 3 times
Td	Check valve	34 {3.5}	—

CRANKSHAFT AND CRANKCASE

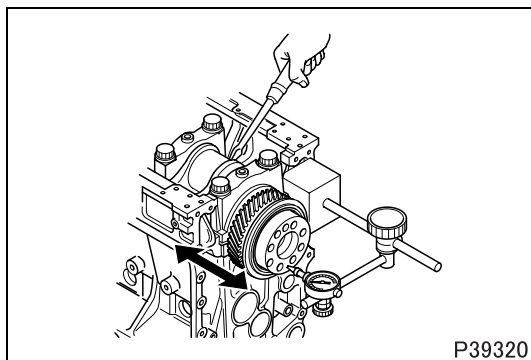
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
	Front oil seal lip	Engine oil	As required
	Thread of bolts		
	Inside surface of main bearing		

Special tools (Unit: mm)

Mark	Tool name and shape	Part No.	Application
	Socket wrench  P01984	MH063365	Installation of main bearing cap
	Front oil seal slinger installer  A φ 108 13625	MH061817	Installation of front oil seal slinger
	Rear oil seal slinger installer  A φ 123 P21766	MH061652	Installation of ring
	Gear puller  P21767	MH061061	Removal of crankshaft gear

◆ Inspection before disassembly ◆



■ Inspection: Crankshaft end play

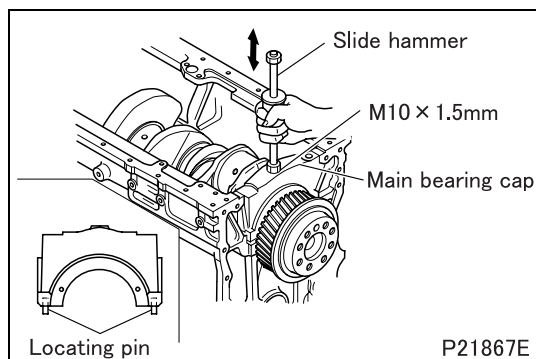
- If the measurement exceeds the specified limit, replace the oversized thrust plates.
Oversizes available: 0.15, 0.30, 0.45 mm
- Replace the crankshaft if the end play cannot be adjusted within the standard range.

Mitsubishi 6M70 Engine Parts contact:

email: EngineParts@HeavyEquipmentRestorationParts.com

Phone: 269 673 1638

◆ Removal procedure ◆



■ Removal: Main bearing caps

- The main bearing cap on the rearmost part is located by locating pins. Use a slide hammer to remove it.

■ Removal: Front oil seal slinger

- Taking care not to damage the crankshaft, split the slinger using a chisel or a similar tool.

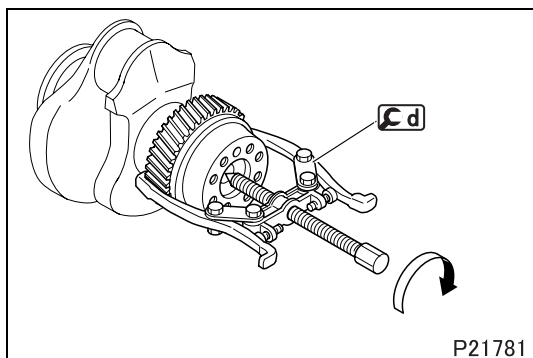
■ Removal: Ring

- Taking care not to damage the crankshaft, split the slinger using a chisel or a similar tool.

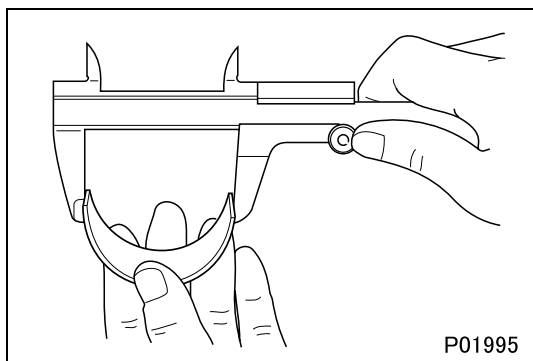
■ Removal: Crankshaft gear

CAUTION ⚠

- Do not tap off the crankshaft gear as this can damage it.



◆ Inspection procedure ◆



■ Inspection: Main bearing

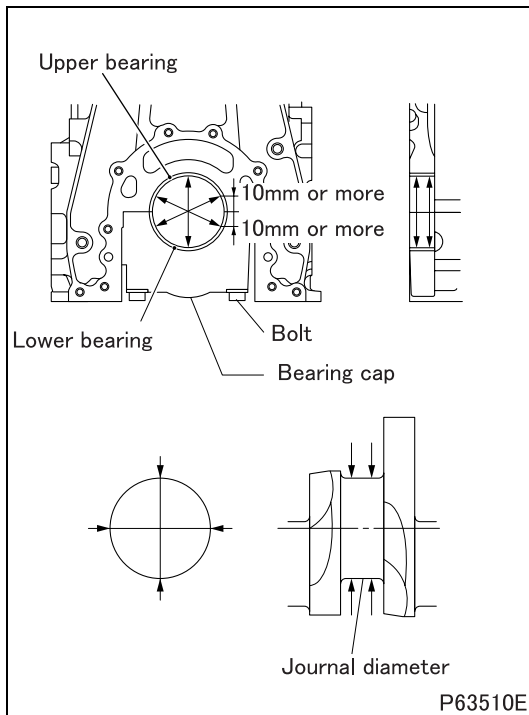
(1) Main bearing span when free

- If the measurement less than the limit, replace the upper and lower bearings as a set.

CAUTION ⚠

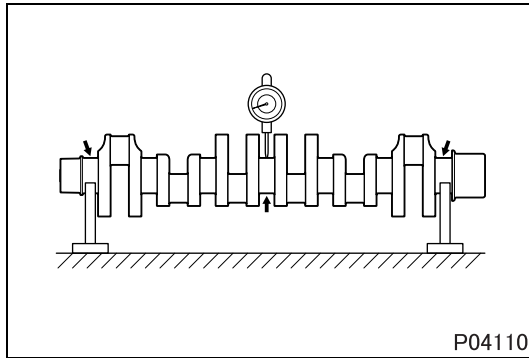
- Do not attempt to manually expand the bearings.

CRANKSHAFT AND CRANKCASE



(2) Main bearing oil clearance

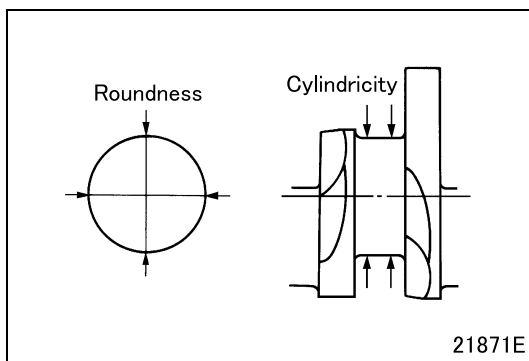
- Fit the upper main bearing into the crankcase and the lower main bearing into the main bearing cap.
- Tighten the bolts to a torque of 100 N·m {10 kgf·m}.
- Measure the inner diameter of the main bearing and the outer diameter of the corresponding crankshaft journal.
- If the difference between the measurements exceeds the specified limit, machine the crankshaft journal to one of the specified undersize dimensions.



■ Inspection: Crankshaft

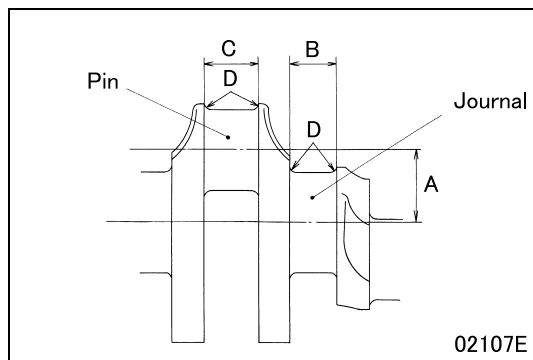
(1) Bend

- Measure the crankshaft at the center journal for bend while supporting the shaft at the end journals.
- A half of the dial gauge reading obtained as the crankshaft is rotated by a full turn represents the bend of the crankshaft.
- If the measurement exceeds the limit, replace the crankshaft.



(2) Roundness and cylindricity of crankshaft journals and pins

- If any of the measurements exceeds the limits, grind the crankshaft journal(s) and/or pin(s) to undersize(s) or replace the crankshaft.



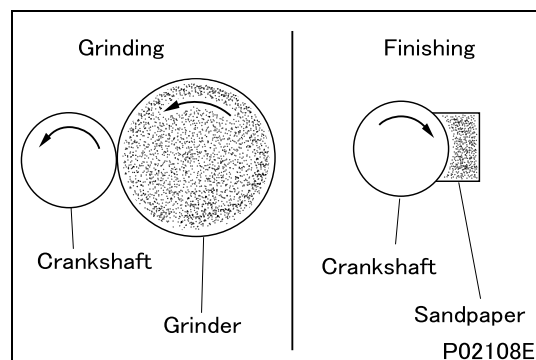
Grinding of crankshaft

CAUTION ⚠

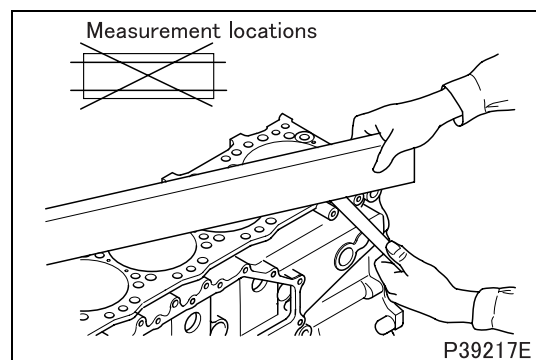
- If the crankshaft pins and journals are ground to undersizes, be sure to use bearings of corresponding undersizes.
- Check the measurement in the table of service standards and correct the crankshaft as follows.
 - Do not change the center-to-center distance A between the journal and pin.
 - Do not change the journal width B and the pin width C.
 - Finish the fillets D smoothly.
 - Carry out a magnetic inspection to check for cracks possibly caused by grinding. Also, check that the hardness of the surface has not dropped below Shore hardness number (Hs) 75.
- If there is any abnormality, replace the crankshaft.

Mitsubishi 6M70 Crankshaft undersize dimensions (Unit: mm)

	Undersizes			
	0.25	0.50	0.75	1.00
Finished journal outside diameter	99.75 $\begin{smallmatrix} -0.08 \\ -0.10 \end{smallmatrix}$	99.50 $\begin{smallmatrix} -0.08 \\ -0.10 \end{smallmatrix}$	99.25 $\begin{smallmatrix} -0.08 \\ -0.10 \end{smallmatrix}$	99.00 $\begin{smallmatrix} -0.08 \\ -0.10 \end{smallmatrix}$
Finished pin outer diameter	83.75 $\begin{smallmatrix} -0.06 \\ -0.09 \end{smallmatrix}$	83.50 $\begin{smallmatrix} -0.06 \\ -0.09 \end{smallmatrix}$	83.25 $\begin{smallmatrix} -0.06 \\ -0.09 \end{smallmatrix}$	83.00 $\begin{smallmatrix} -0.06 \\ -0.09 \end{smallmatrix}$
Roundness	0.01 or less			
Cylindricity	0.006 or less			



- When grinding, turn both the crankshaft and the grinder counter-clockwise as viewed from the crankshaft front end.
- When finishing the crankshaft with whetstone or sandpaper, rotate the crankshaft clockwise.



■ Inspection: Distortion of crankcase top surface

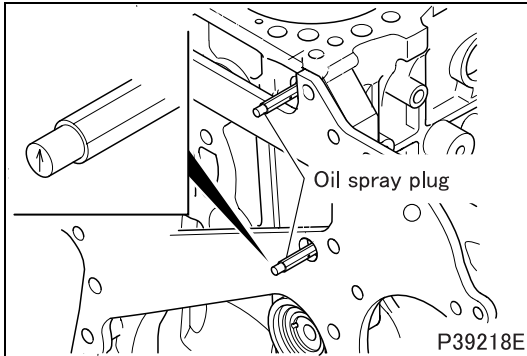
- If the measurement exceeds the limit, correct the crankcase top surface with a surface grinder.

CAUTION ⚠

- Do not grind the crankcase top surface so much as to compromise the correct piston protrusion.

CRANKSHAFT AND CRANKCASE

◆ Installation procedure ◆

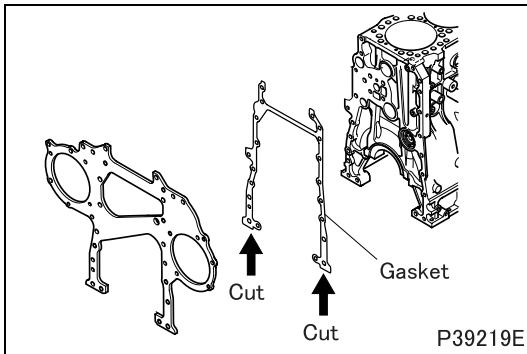


■ Installation: Oil spray plug

- Install the oil spray plug in the illustrated direction.

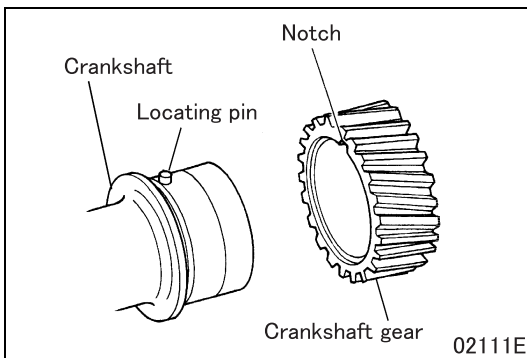
CAUTION ⚠

- Be careful that if the direction of the oil spray plug is not appropriate, oil supply to the timing gear becomes insufficient, causing seizure.



■ Installation: Gasket

- Lower parts of the gasket (oil pan mounting surface) protrude after installation. Cut the protruding parts after installing the fly-wheel housing.



■ Installation: Crankshaft gear

- Heat the crankshaft gear to approximately 100°C with a burner or the like.

WARNING ⚠

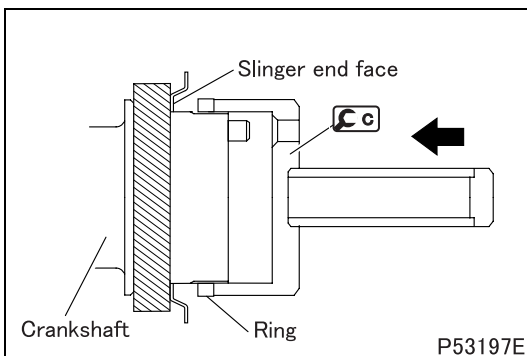
- You may burn yourself if you touch the heated crankshaft gear.
- Align the locating pin fitted in the crankshaft with the notch in the crankshaft gear. Drive the gear into position by lightly striking its end face with a plastic hammer.

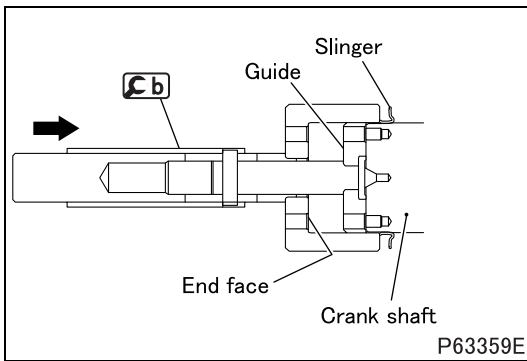
■ Installation: Rear oil seal slinger

- Install the rear oil seal slinger so that it is in close contact with the crankshaft gear.

■ Installation: Ring

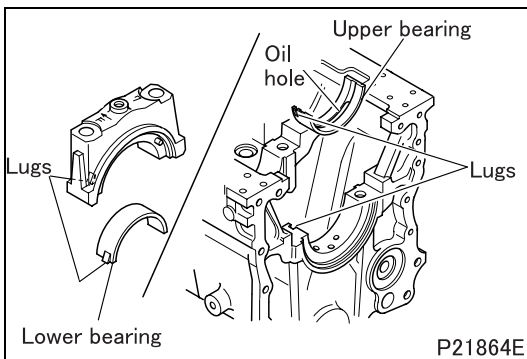
- To install the ring, push it in with  until it comes into positive contact with the slinger end face.





■ Installation: Front oil seal slinger

- Install the front oil seal slinger onto the crankshaft until the end of face of **b** securely contacts the guide.

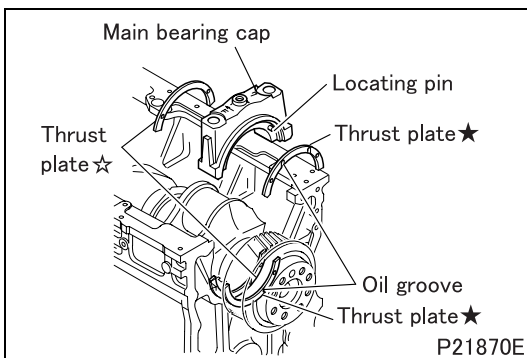


■ Installation: Mitsubishi 6M70 Main bearing

- Install the main bearings with their lugs aligned as shown in the illustration. When the crankshaft journals have been ground to an undersize, use undersized main bearings.
Undersizes available: 0.25 mm, 0.50 mm, 0.75 mm, 1.00 mm

CAUTION ⚠

- The upper main bearing has an oil hole. The lower main bearing has no oil hole. Do not confuse the upper and lower bearings, as this can cause seizure in the engine.

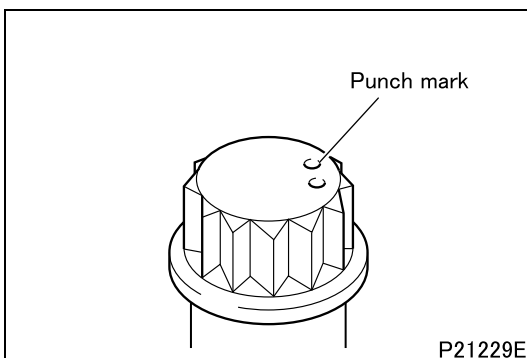


■ Installation: Mitsubishi 6M70 Thrust plate

- Install thrust plates on both sides of the main bearing cap and the rear end of the crankcase, ensuring that the oil grooves face outside.
- If oversized thrust plates are to be used, those with ★ and ☆ marks must be the same in size. Oversizes available: 0.15 mm, 0.30 mm and 0.45 mm.

CAUTION ⚠

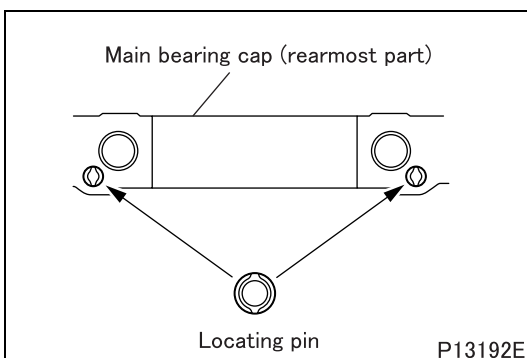
- If thrust plates are installed with the oil grooves facing inside, the engine may seize.



■ Installation: Main bearing cap

CAUTION ⚠

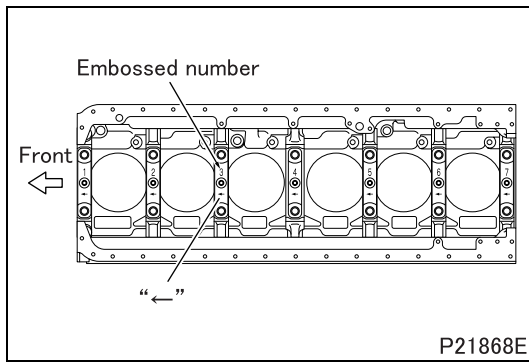
- Before installing bolts, check the number of punch marks on the bolt head. (Bolt with up to two punch marks can be reused.)
- The number of punch marks indicates the number of times the bolt has been tightened in the past within the plastic region. If there are three punch marks (tightened three times in the past), replace the bolt.



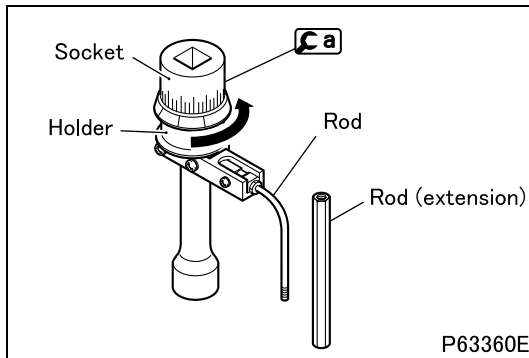
- Install locating pins in the illustrated direction for the main bearing cap on the rearmost part.

Mitsubishi 6M70 Engine Parts contact:
email: EngineParts@HeavyEquipmentRestorationParts.com
Phone: 269 673 1638

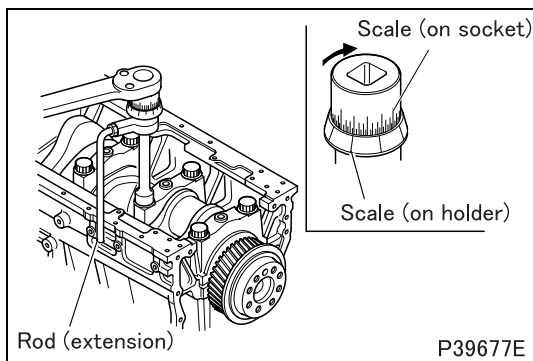
CRANKSHAFT AND CRANKCASE



- Starting at the front of the engine, fit the main bearing caps in the order of the embossed numbers with the embossed numbers and front marks facing in the illustrated direction.



- Tighten all the bolts to 100 N·m {10 kgf·m}, then additionally tighten them according in the following procedure.
- Turn the holder of **Ca** counterclockwise to pretension the internal spring.



- Set the tool such that the rod (extension) is pressed against the crankcase by the force of the spring.
- Align any line on the holder scale with any line on the socket scale. (This will be used as the reference point = 0°.)
- From the reference point, turn the socket by 130° in the direction shown. Each division on the socket scale represents 5°.
- After tightening the bolt within the plastic region, make a punch mark on the bolt head to record the number of times that they have been tightened

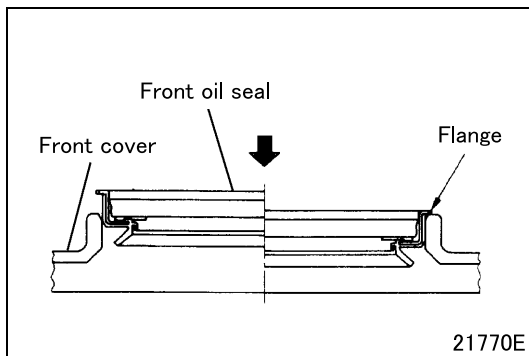
CAUTION ⚠

- The bolts should be tightened within the plastic region. Never tighten them further than the specified angle.**

- After tightening the bolt, rotate the crankshaft by hand. If it cannot be rotated smoothly, inspect the main bearing cap for mounting surface.

■ Installation: Mitsubishi 6M70 Front oil seal

- Install the front oil seal onto the front cover while pressing the seal's entire periphery evenly to prevent it from tilting.
- Install the front oil seal until its flange comes into positive contact with the front cover.



GROUP 12 LUBRICATION

SPECIFICATIONS	12-2
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STRUCTURE AND OPERATION

1. Lubrication System	12-3
2. Oil Pump	12-4
3. Oil Cooler	12-5
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5. Bypass Oil Filter	12-7
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TROUBLESHOOTING	12-11
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ON-VEHICLE INSPECTION AND ADJUSTMENT

1. Oil Filter Replacement	12-12
2. Engine Oil Replacement	12-14
3. Oil Pressure Measurement	12-15

OIL PAN, OIL JETS	12-16
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OIL PUMP, OIL STRAINER	12-18
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OIL FILTER	12-22
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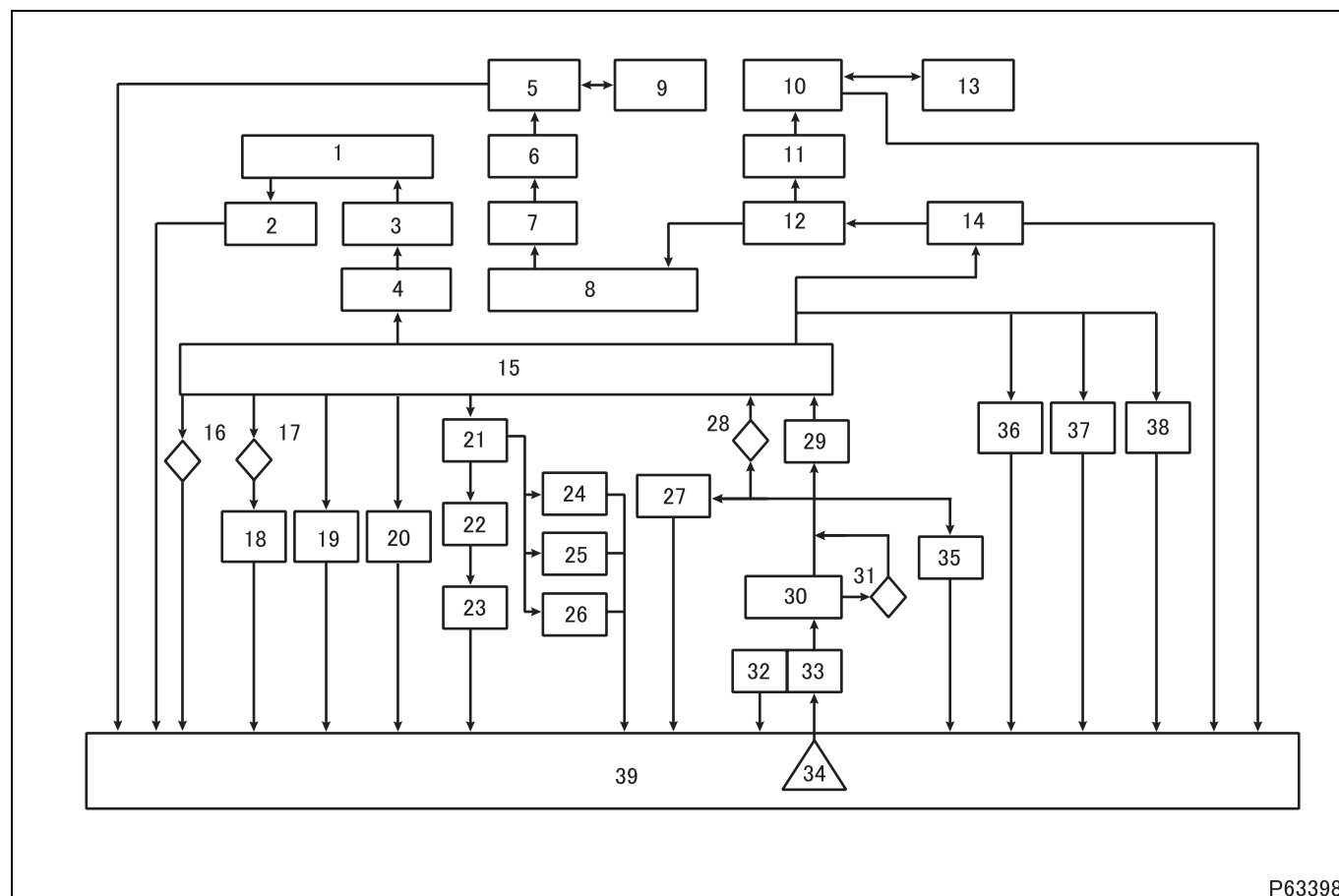
OIL COOLER	12-24
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REGULATOR VALVE	12-26
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SPECIFICATIONS

Item			Specifications
Method of lubrication			Oil pump type
Oil filter			Filter paper element center bolt type
Oil cooler			Shell and plate type (multiple-plate type)
Engine oil	Grade		API classification CD, CD/SF, CE, CE/SF, CF-4 or JASO classification DH-1, DH-2
	Quantity $\text{dm}^3 \{\text{L}\}$	Oil pan	Approx. 31.5 {31.5}
		Oil filter	4 to 4.5 {4 to 4.5}

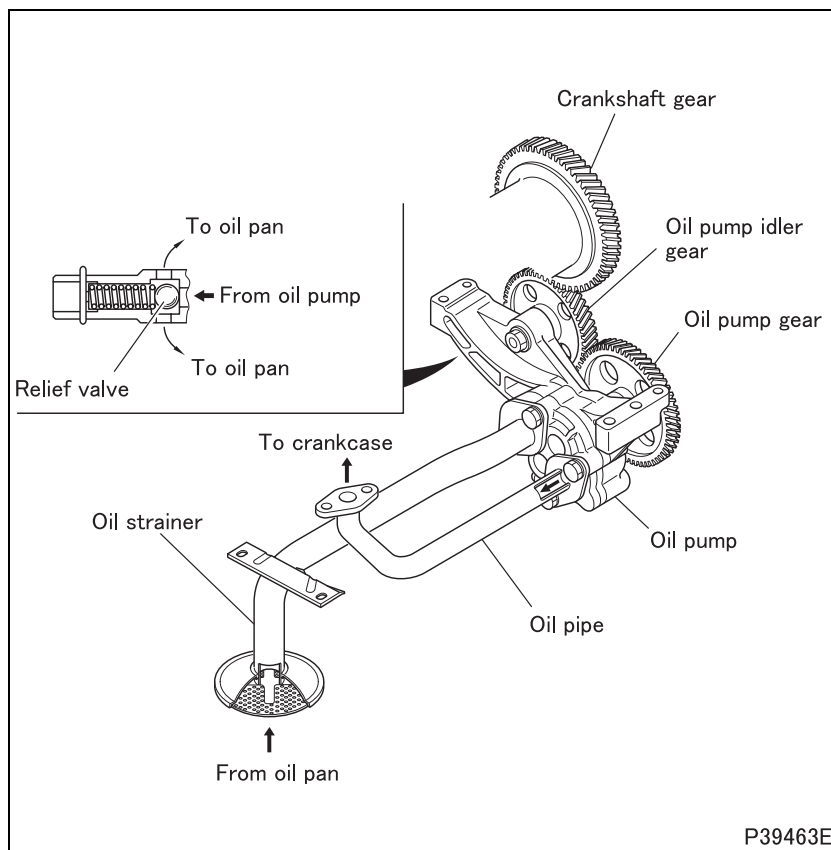
1. Lubrication System



- | | | |
|---------------------------------|-----------------------------|-----------------------------------|
| 1 Rocker shaft | 14 Powertard solenoid valve | 27 Bypass oil filter |
| 2 Camshaft journal (No.2 to 7) | 15 Main oil gallery | 28 Oil cooler bypass valve |
| 3 Camshaft journal (No.1) | 16 Regulator valve | 29 Oil cooler |
| 4 Rocker case (No.1) | 17 Check valve for oil jet | 30 Full-flow oil filter |
| 5 Slave piston (No.1 to 5) | 18 Piston | 31 Engine oil bypass alarm switch |
| 6 Camshaft cap (No.2 to 6) | 19 Air compressor | 32 Relief valve |
| 7 Rocker case (No.2 to 6) | 20 Turbocharger | 33 Oil pump |
| 8 Cylinder head sub oil gallery | 21 Main bearing | 34 Oil strainer |
| 9 Master piston (No.1 to 5) | 22 Connecting rod bearing | 35 Supply pump |
| 10 Slave piston (No.6) | 23 Connecting rod bushing | 36 Idler gear C |
| 11 Camshaft cap (No.7) | 24 Idler gear A, B | 37 Idler gear D |
| 12 Rocker case (No.7) | 25 Oil spray plug | 38 Flywheel PTO |
| 13 Master piston (No.6) | 26 Oil spray plug | 39 Oil pan |

STRUCTURE AND OPERATION

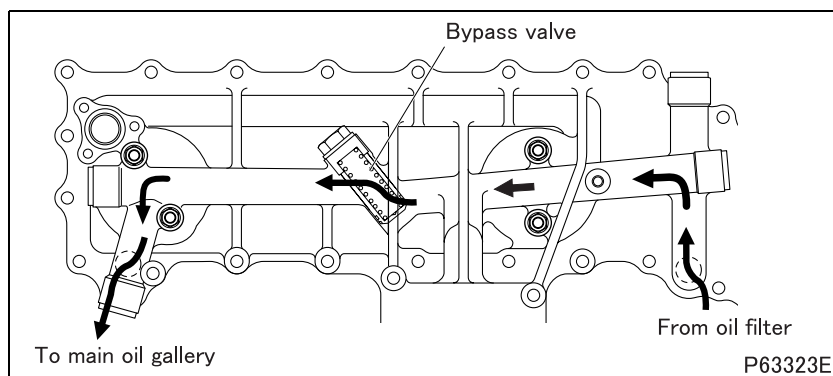
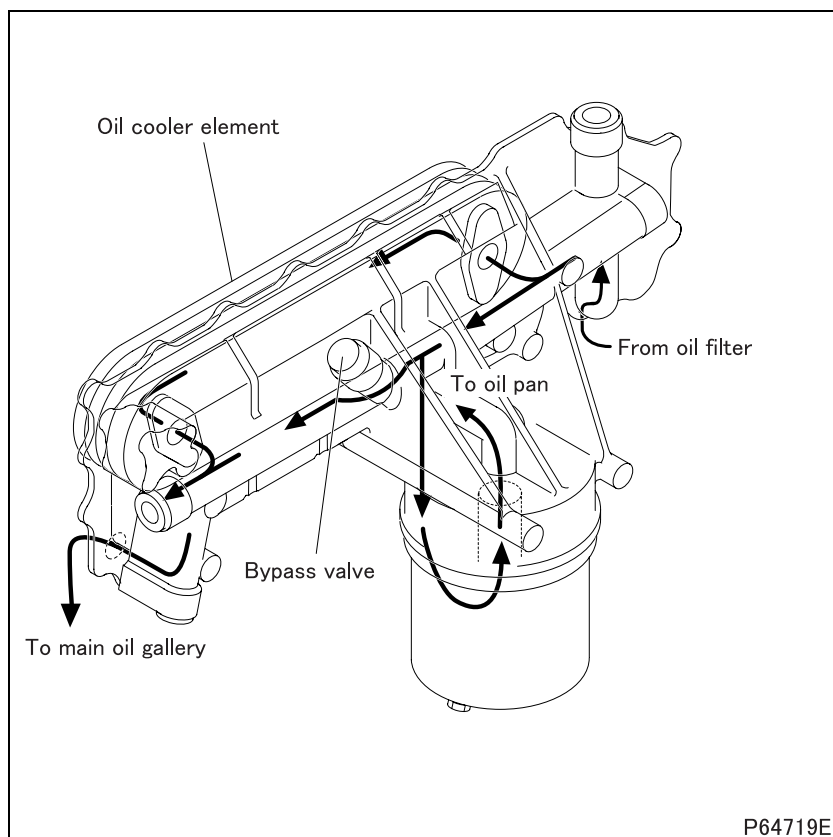
2. Mitsubishi 6M70 Oil Pump



- This engine uses a gear-type oil pump driven by the rotation of the crankshaft transmitted through the engagement of the crankshaft gear and the oil pump gear.

The oil pump has a relief valve, which prevents excessive pressure from building up inside the lubricating system by allowing part of the engine oil to escape to the oil pan when the oil pressure exceeds a specified level.

3. Mitsubishi 6M70 Oil Cooler

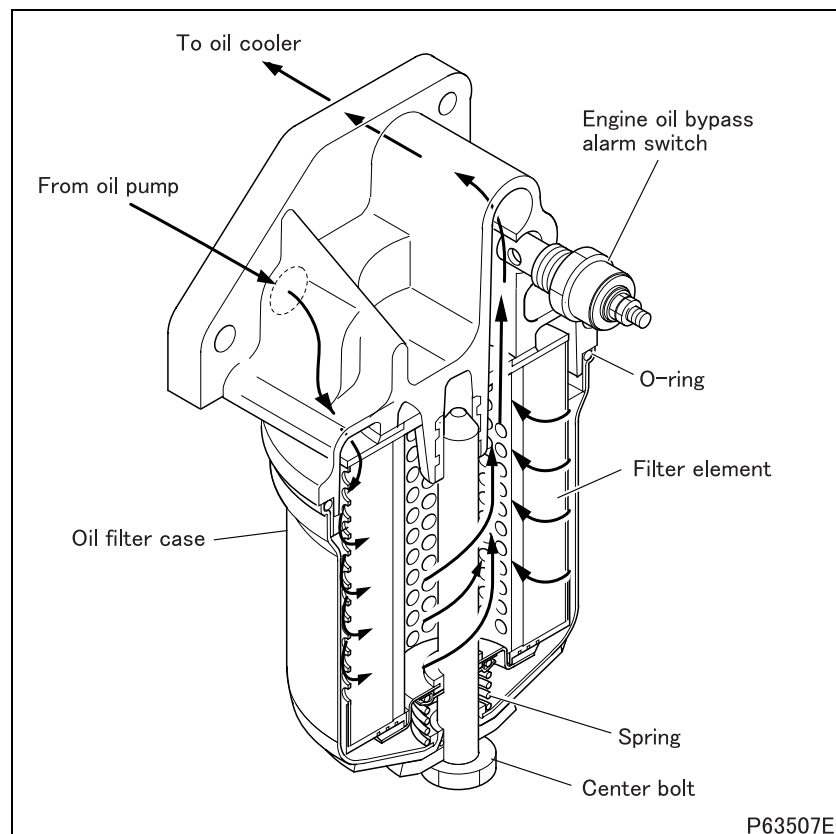


3.1 Mitsubishi 6M70 Bypass valve

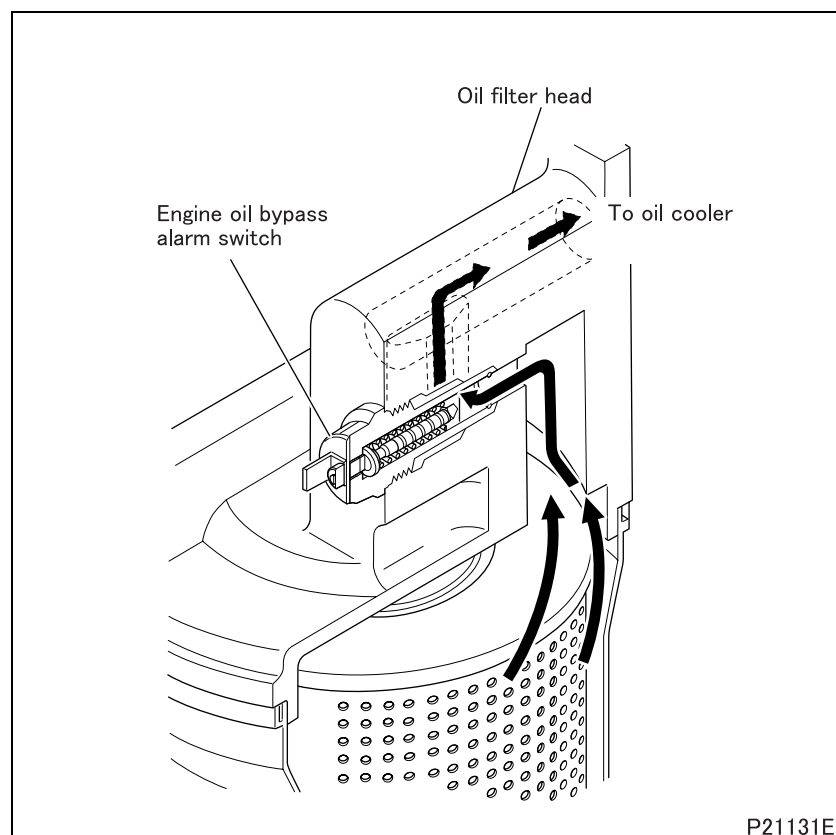
- When the engine oil is cool and its viscosity is high, or when the oil cooler element becomes clogged and restricts the flow of the engine oil, the bypass valve opens to let the engine oil bypass the oil cooler and flow directly to the main oil gallery.

STRUCTURE AND OPERATION

4. Full-flow Oil Filter



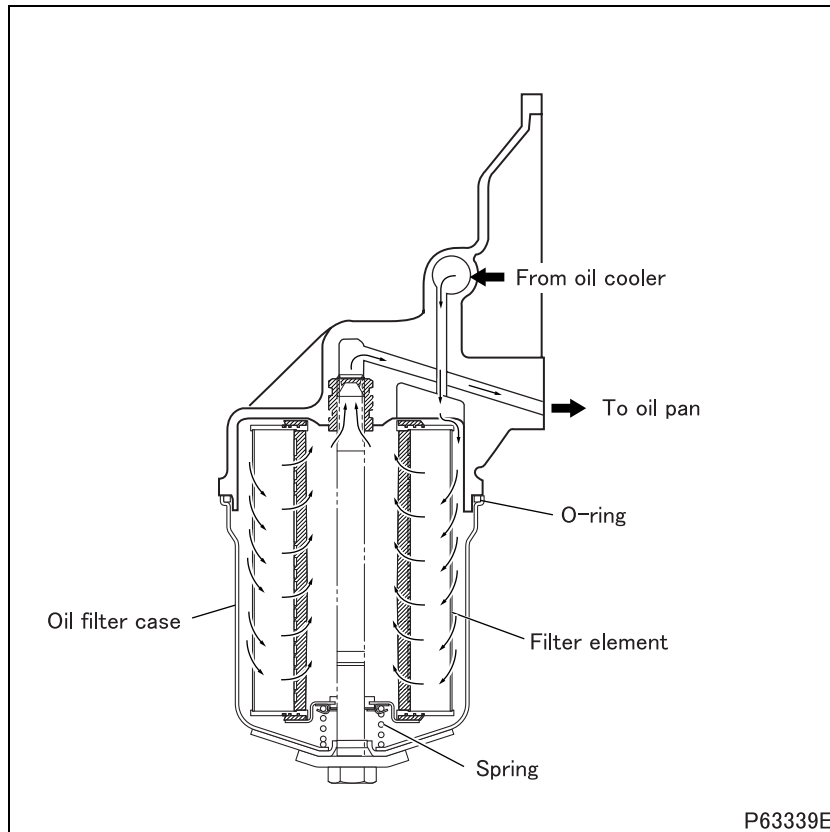
- The filter elements use elements made of filter paper.



4.1 Engine oil bypass alarm switch

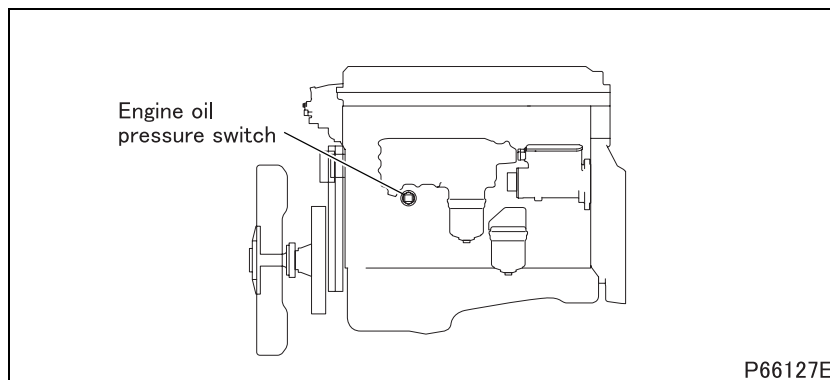
- If the full-flow oil filter elements clog up, this will restrict the flow of engine oil, causing various parts of the engine to seize. To prevent this, the engine oil bypass alarm switch is installed.
- If the full-flow oil filter clogs up, the engine oil bypass alarm switch trips in such a way as to direct the engine oil straight on to the oil cooler, bypassing the filter elements. When the engine oil bypass alarm switch trips, the relevant warning lamp illuminates to alert the operator to the clogged full-flow oil filter elements.

5. Bypass Oil Filter



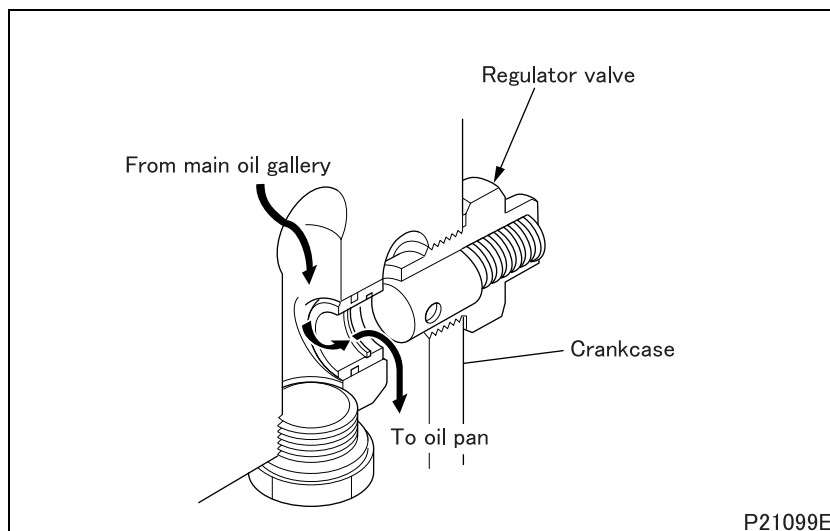
- The oil filter elements use elements made of filter paper.

6. Mitsubishi 6M70 Engine Oil Pressure Switch



- If the oil pressure of the engine oil fed to the main oil gallery drops below the specified value, the engine oil pressure switch trips and illuminates the relevant warning lamp to alert the operator to the abnormal oil pressure.

7. Mitsubishi 6M70 Regulator Valve



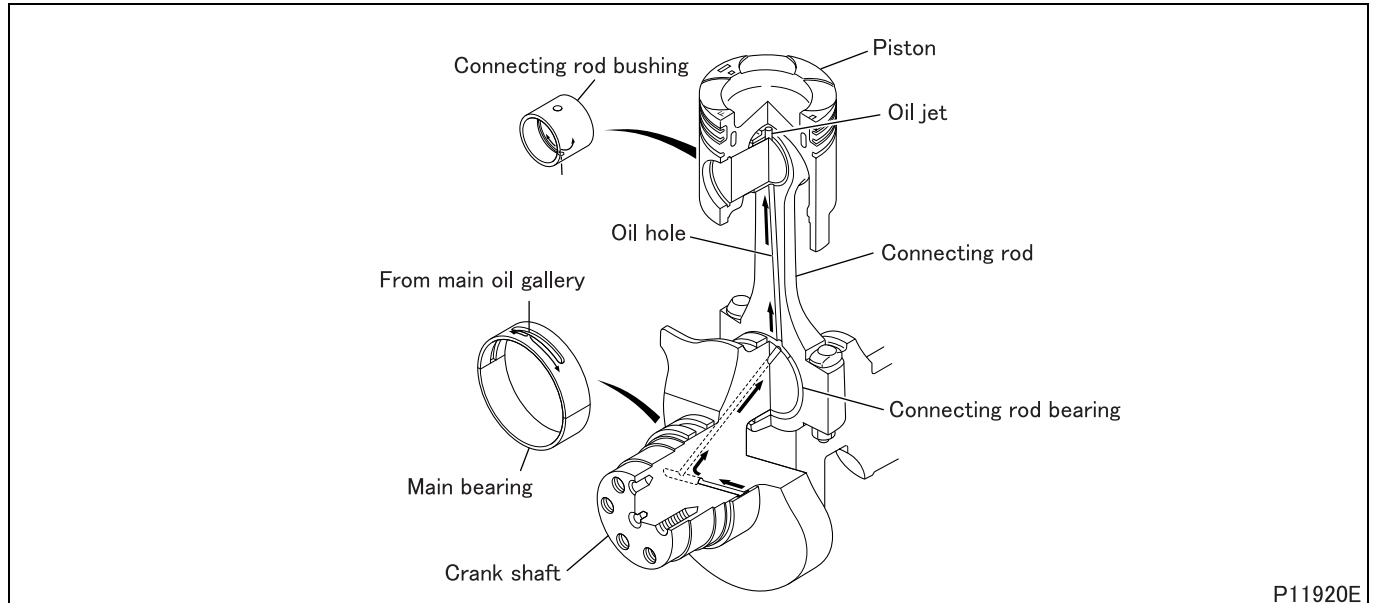
- If the oil pressure in the main oil gallery exceeds the specified value, the regulator valve opens and returns a portion of the engine oil to the oil pan to adjust the oil pressure.

STRUCTURE AND OPERATION

8. Lubrication of Engine Components

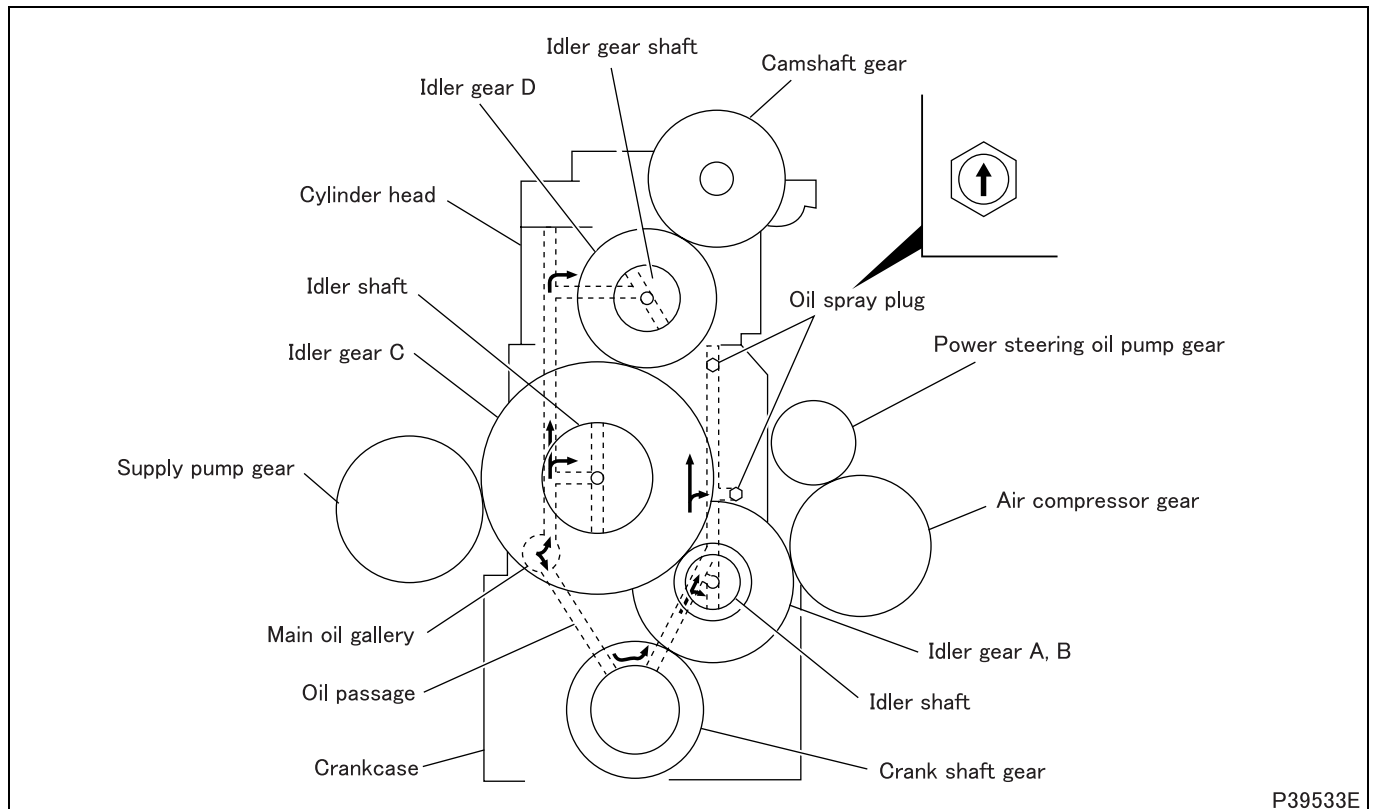
- The engine oil in the main oil gallery lubricates the engine components in the following ways.

8.1 Mitsubishi 6M70 Main bearing and connecting rod bearing



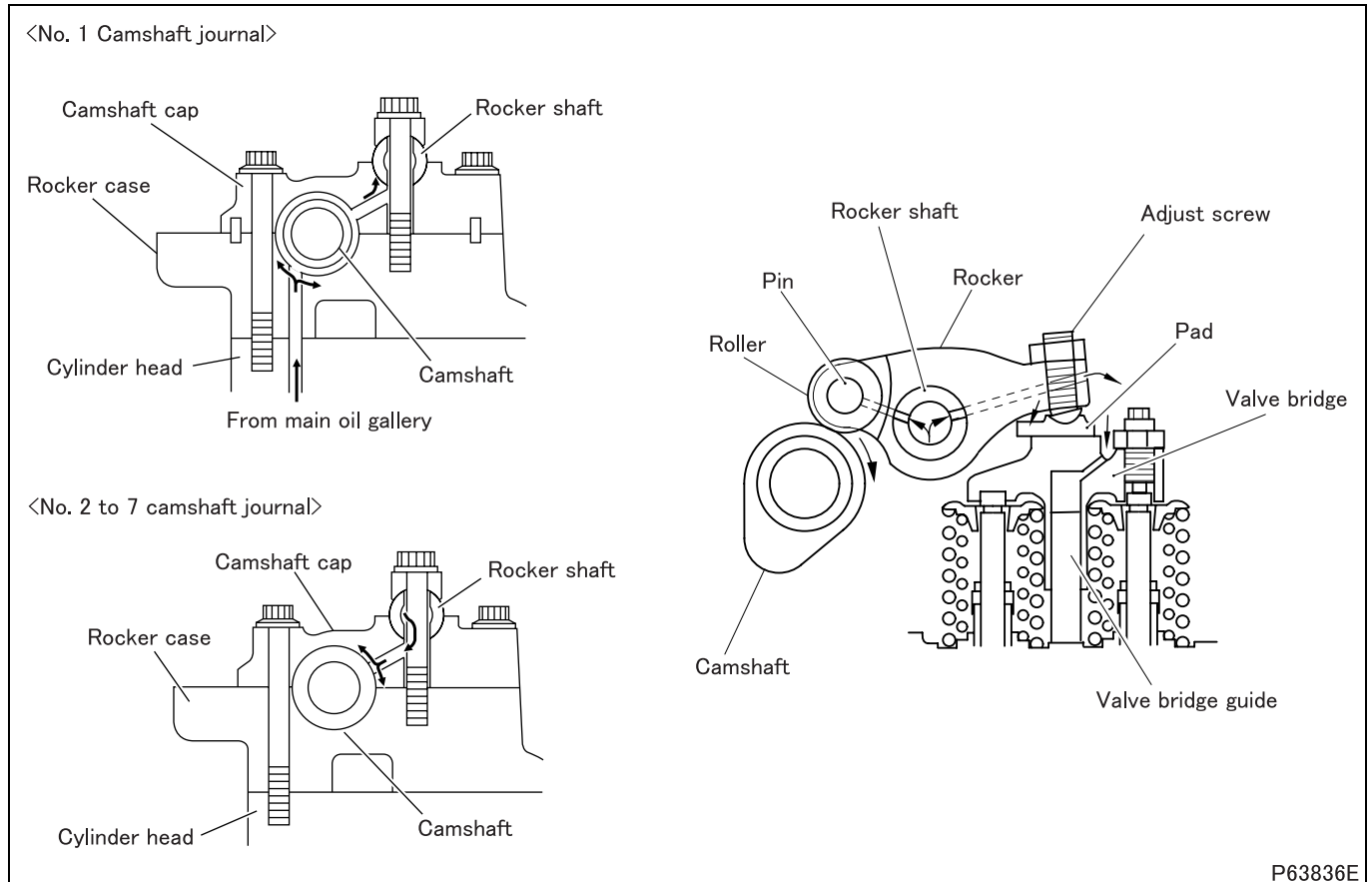
- Engine oil supplied through an oil passage in the crankshaft lubricates the big end (connecting rod bearing) of each connecting rod. Simultaneously, engine oil supplied through an oil passage in the connecting rod lubricates the connecting rod's small end (connecting rod bushing). Beside, engine oil is sprayed out of the oil jet in the head of the connecting rod into the piston to cool the piston.

8.2 Mitsubishi 6M70 Timing gears

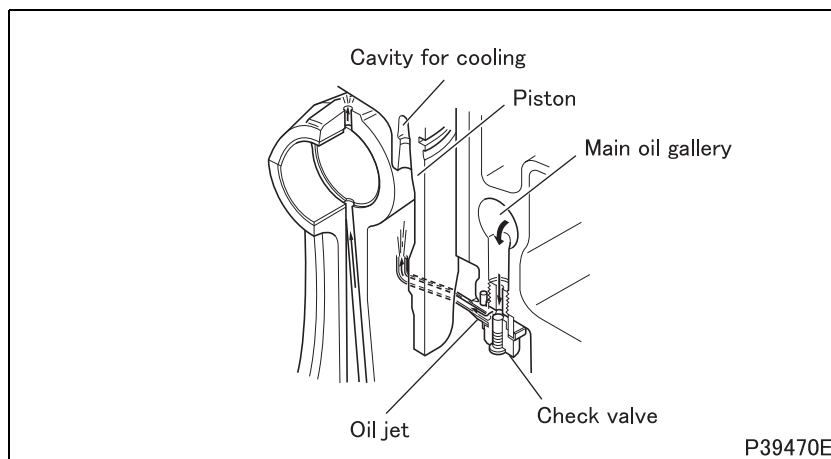


- Engine oil in the main oil gallery is directed through the oil passages in the crankcase and cylinder head and is used to lubricate the various gear shafts. After lubricating the gear shafts, the oil is used to lubricate the gears before returning the oil pan. Engine oil also lubricates the gears by the oil spray plugs. The oil spray plug has an arrow showing the installed direction on its head.

8.3 Mitsubishi 6M70 Valve mechanism



- Engine oil in the main oil gallery is directed through the oil passages in the cylinder head, rocker case and camshaft cap, and lubricates the No. 1 journal of the camshaft before being fed to the rocker shaft. The oil flowing through the oil passages in the rocker shaft lubricates No. 2 to No. 7 journals of the camshaft and also lubricates the rockers. The oil flowing to the adjusting screws on the rockers lubricates the valve bridges. After lubricating the various parts, the oil returns to the oil pan.

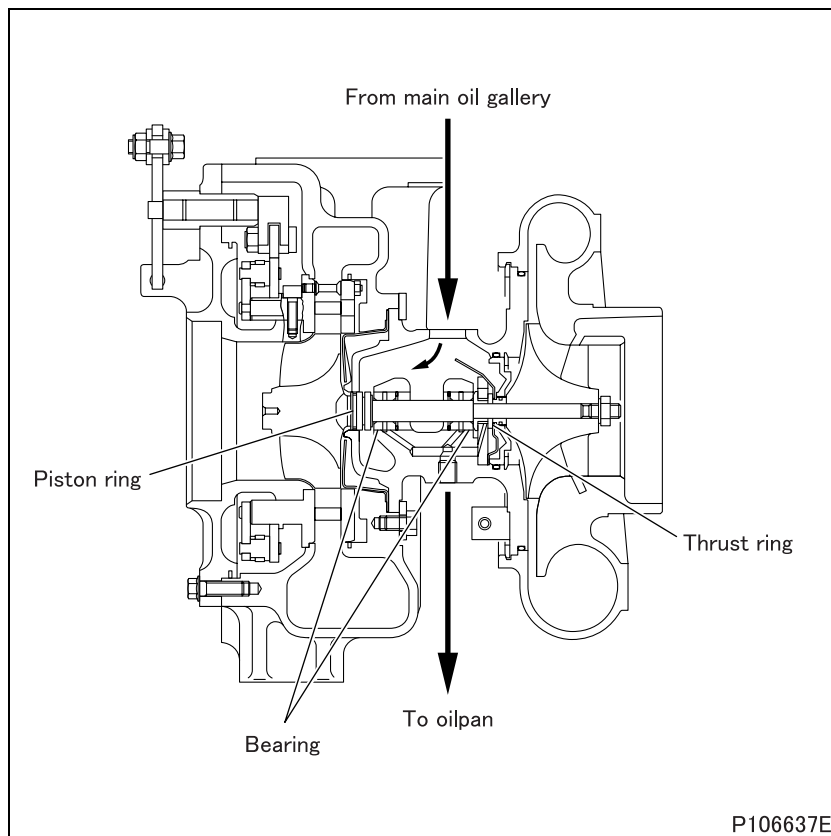


8.4 Mitsubishi 6M70 Check valves and oil jets

- An oil jet is fitted in the lower part of the main oil gallery for each cylinder.
- Engine oil is sprayed out of the oil jet into the piston to cool the piston.
- Each oil jet is fitted with a check valve that opens and closes at predetermined oil pressure levels. At low engine speeds, the check valve closes to maintain the required volume of oil in the lubrication system and prevent reductions in oil pressure.

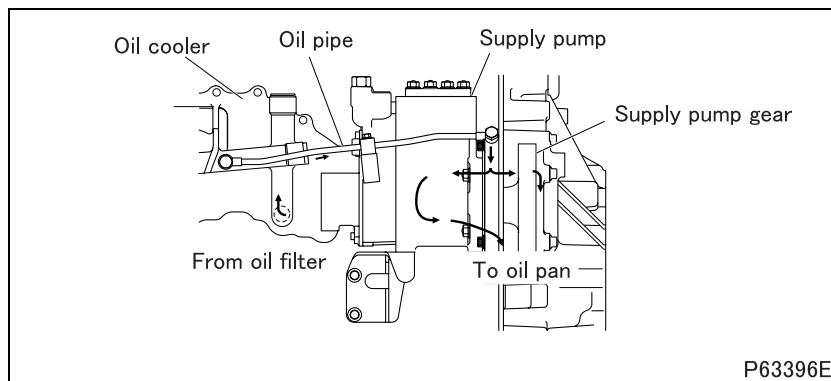
Mitsubishi 6M70 Engine Parts contact:
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Phone: 269 673 1638

STRUCTURE AND OPERATION



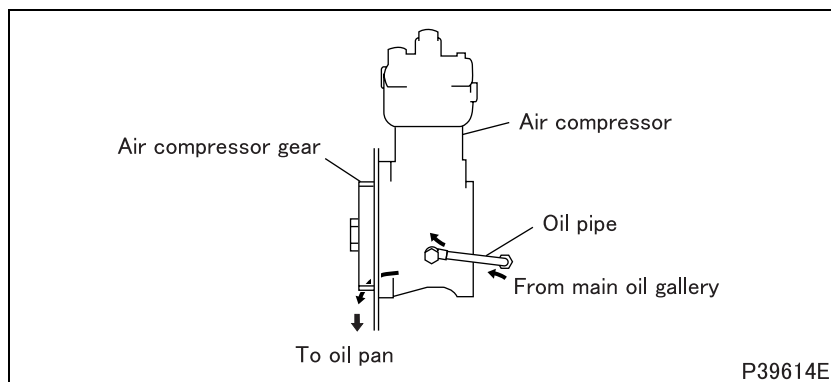
8.5 Mitsubishi 6M70 Turbocharger

- Engine oil in the main oil gallery is directed through a pipe to the bearing housing to lubricate the inner components.
- A piston ring is provided on each end of the turbine wheel shaft. The rings function as oil sealing.



8.6 Mitsubishi 6M70 Supply pump

- The engine oil supplied to the supply pump lubricates the inside of the pump and supply pump gear.
- After lubricating the inside of the pump, the oil is directed through the timing gear train from the rear of the pump and returns to the oil pan.



8.7 Mitsubishi 6M70 Air compressor

- The engine oil in the main oil gallery lubricates the inside of the air compressor, is directed through the timing gear train from the air compressor gear side, and returns to the oil pan.

Possible causes		Symptoms				Reference Gr
		Engine is difficult to start	Overheating	Low oil pressure	Excessive oil consumption (oil leakage)	
Oil cooler	Incorrectly mounted element		O	O	O	
	Defective gasket		O	O	O	
	Defective O-ring		O	O	O	
	Clogged element		O	O		
	Damaged element		O	O	O	
	Weakened bypass valve spring		O			
Oil pump	Malfunctioning oil pump		O	O		
	Interference between oil pump gear and oil pump case and/or cover	O		O		
	Incorrectly connected oil pipe		O	O		
	Clogged oil strainer		O	O		
	Weakened relief valve spring			O		
Oil filter	Incorrect installation				O	
	Clogged element		O	O		
	Defective O-ring			O		
Front cover	Defective front oil seal				O	Gr11
	Incorrectly mounted front cover				O	
Flywheel housing	Defective rear oil seal				O	
	Incorrectly mounted flywheel housing				O	
Weakened regulator valve spring				O		
Defective piston cooling oil jet(s)			O	O		
Oil working its way up into combustion chamber(s) through piston rings					O	Gr11
Oil working its way down into combustion chamber(s) through valves					O	
Too high oil viscosity		O				
Poor oil quality			O			
Deterioration of oil			O			
Excess of oil					O	
Fuel mixed with oil			O			

ON-VEHICLE INSPECTION AND ADJUSTMENT

1. Oil Filter Replacement

Tightening torque (Unit: N·m {kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
–	Drain plug (oil filter)	24.5 ± 4.9 {2.5 ± 0.5}	–
–	Center bolt	63.7 ± 4.9 {6.5 ± 0.5}	–

Lubricant and/or sealant

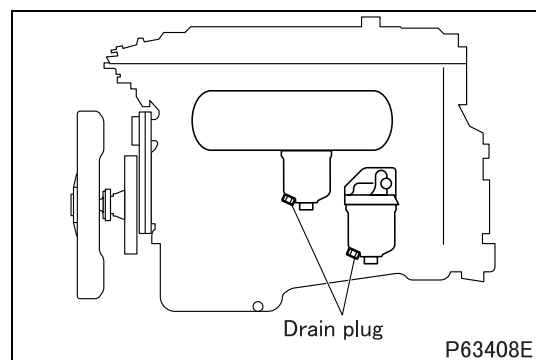
Mark	Points of application	Specified lubricant and/or sealant	Quantity
–	Oil filter	Engine oil API classification CD, CD/SF, CE, CE/SF, CF-4 or JASO classification DH-1, DH-2	4 to 4.5 dm ³ {4 to 4.5 L}

WARNING

- Wipe up any spilled engine oil, as it can cause fires.
- To avoid any risk of burns, take care not to touch the engine oil when the engine is hot.

CAUTION

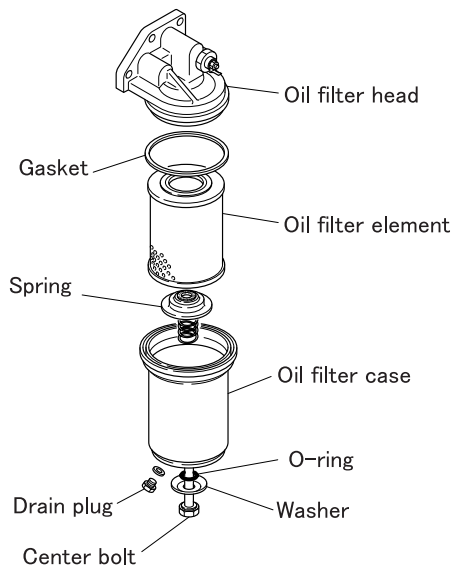
- Make sure not to put any engine oil on the belt when working on the oil filter. Belts soiled with oil or grease may easily slip, resulting in deteriorated performance of the cooling system.
- Do not reuse the oil filter elements by washing.
- Install the gasket, taking care not to twist it.



[Removal]

- Remove the drain plug and drain the oil out of the oil filter.

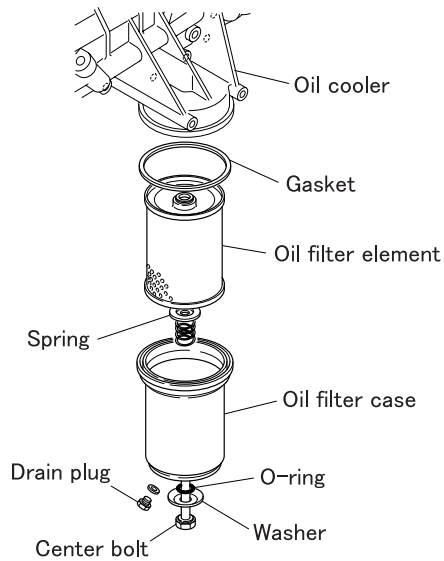
<Full-flow oil filter>



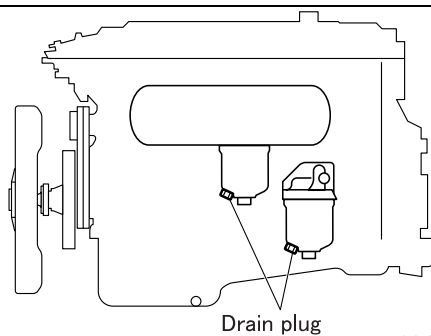
P63410E

- Clean other parts than the element, O-ring and gasket to be replaced with washing oil.

<Bypass oil filter>



P63409E



P63408E

[Installation]

- Replace the element, O-ring and gasket with new ones, respectively.
- Install the oil filter case so that the drain plug is positioned as shown in the illustration.
- With the oil filter installed, start the engine and ensure that there is no oil leakage through the gasket.
- If oil is leaking, remove and reinstall the oil filter.
- Stop the engine and check the engine oil level.
- Add engine oil if the engine oil level is low.

ON-VEHICLE INSPECTION AND ADJUSTMENT

2. Engine Oil Replacement

Tightening torque (Unit: N·m {kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
–	Drain plug (oil filter)	24.5 ± 4.9 { 2.5 ± 0.5 }	–
–	Drain plug (oil pan)	68 {7}	–

Lubricant and/or sealant

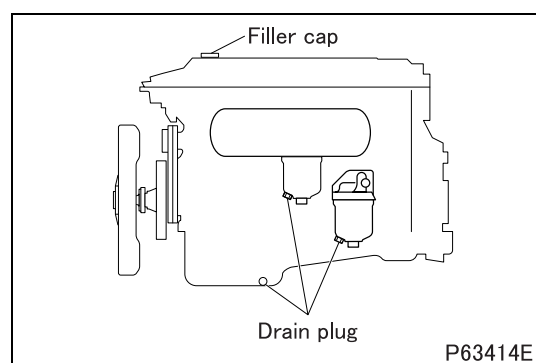
Mark	Points of application	Specified lubricant and/or sealant	Quantity
–	Oil filter	Engine oil API classification CD, CD/SF, CE, CE/SF, CF-4 or JASO classification DH-1, DH-2	4 to 4.5 dm ³ {4 to 4.5L}
–	Oil pan		Approx. 31.5 dm ³ {31.5L}

WARNING

- Wipe up any spilled engine oil, as it can cause fires.
- To avoid any risk of burns, take care not to touch the engine oil when the engine is hot.

CAUTION

- Make sure not to put any engine oil on the belt when working on the oil filter. Belts soiled with oil or grease may easily slip, resulting in deteriorated performance of the cooling system.



[Draining]

- Remove the filler cap.
- Remove the drain plugs of the oil filter or oil pan to drain out the engine oil.

[Refilling]

- Tighten the drain plug to the specified torque, then pour a specified amount of new engine oil into the engine.
- Wait at least for 6 minutes after installing the filler cap and check the engine oil level.
- Start the engine and ensure that there is no oil leakage.
- Stop the engine, wait at least for 30 minutes and check the engine oil level.
- Add engine oil if the engine oil level is low.

CAUTION

- Do not add engine oil too much. An excessive oil level can only lead to increased oil consumption or make the positive crankcase ventilation system less efficient.

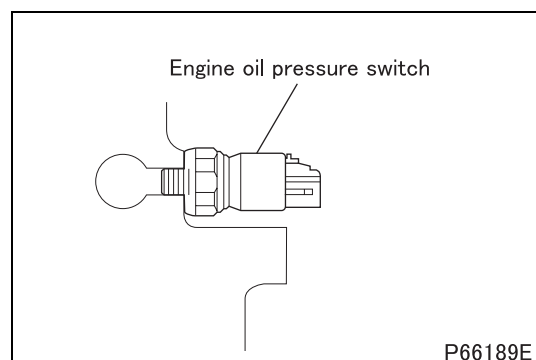
3. Oil Pressure Measurement

Service standards

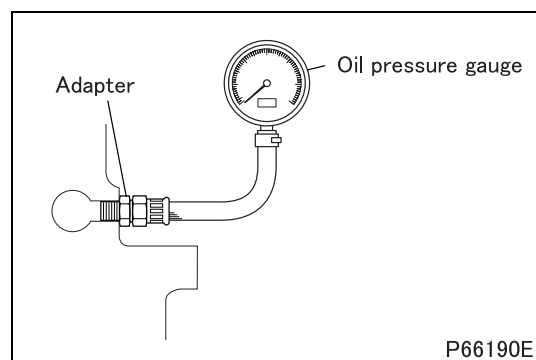
Location	Maintenance item		Standard value	Limit	Remedy
-	Oil pressure (oil temperature at 70 to 90°C)	No-load minimum speed	135 to 295 kPa {1.4 to 3 kgf/cm ² }	49 kPa {0.5 kgf/cm ² }	Inspect
		No-load maximum speed	295 to 490 kPa {3 to 5 kgf/cm ² }	195 kPa {2 kgf/cm ² }	

Tightening torque (Unit: N·m {kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
-	Engine oil pressure switch	24.5 ± 4.9 {2.5 ± 0.5}	With cold engine



- Remove the Mitsubishi 6M70 engine oil pressure switch.

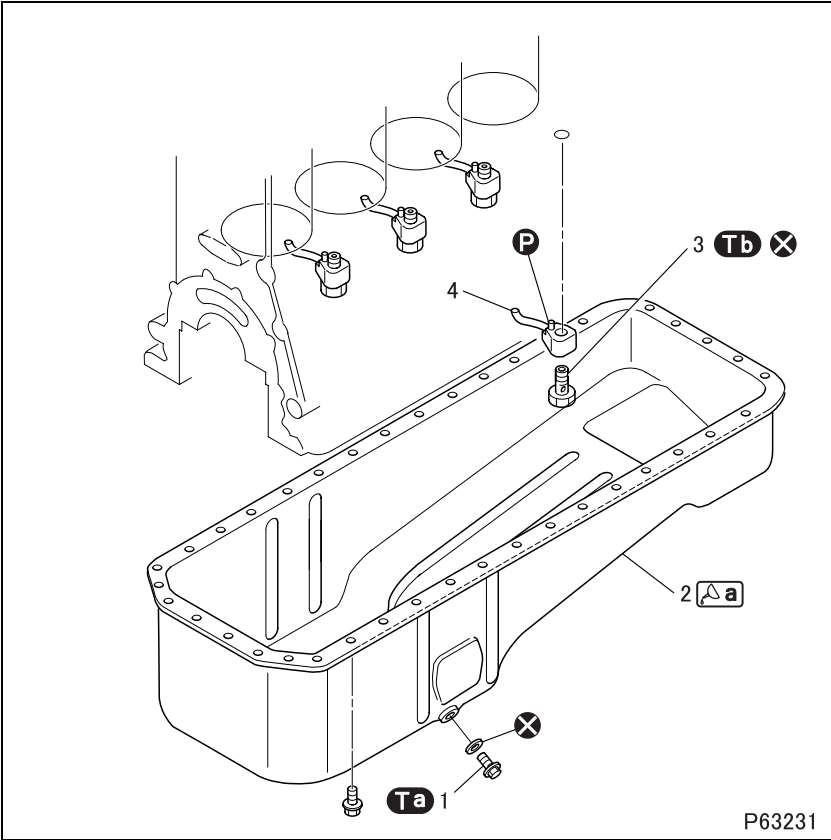


- Using an adapter, connect an oil pressure gauge to the engine oil pressure switch mounting hole.
- Warm up the engine until the oil temperature reaches 70 to 90°C.
- Measure the oil pressure while running the engine at a minimum speed and then at maximum speed, both under no load.
- If the measurements are below the specified limits, overhaul the lubrication system.

CAUTION

- Reinstall the oil pressure switch only when the engine is cold.

MITSUBISHI 6M70 OIL JETS, OIL PAN,



● Disassembly sequence

- 1 Drain plug
- 2 Oil pan
- 3 Check valve
- 4 Oil jet

Ⓟ: Locating pin
ⓧ: Non-reusable parts

CAUTION ⚠

- The check valve has been tightened using thread-locking compound and so, may deform during removal. Once removed, the check valve must not be reused. Do not remove the check valve unless defects are evident.

● Assembly sequence

Follow the disassembly sequence in reverse.

CAUTION ⚠

- If overtightened, the check valve will not operate properly, leading to engine seizure. Be sure to tighten the check valve to the specified torque.

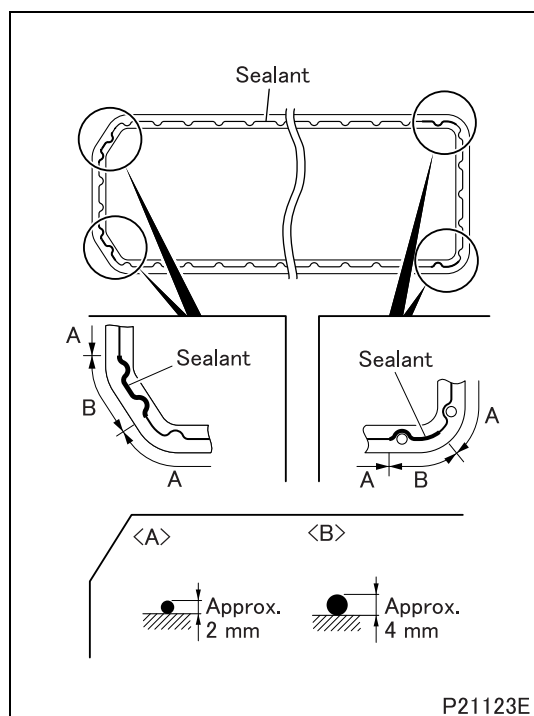
Tightening torque (Unit: N·m {kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
ⓐ	Drain plug	68 {7}	–
ⓑ	Check valve	34 {3.5}	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
ⓐ	Crankcase mounting surface of oil pan	ThreeBond 1207C	As required

◆ Installation procedure ◆



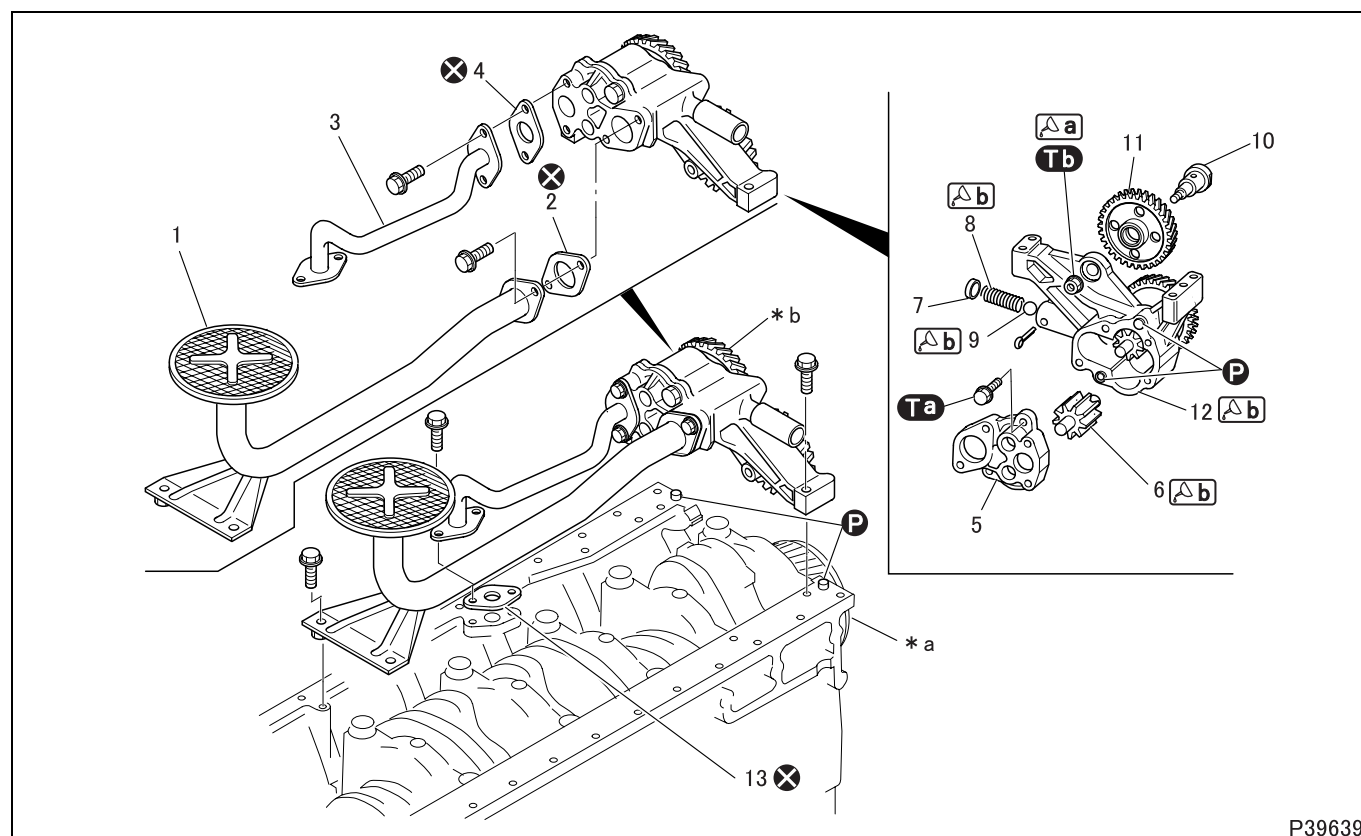
■ Installation: Oil pan

- Clean the mating surfaces of each part.
- Apply a bead of sealant to the mating surface of the oil pan evenly and without any breaks.
Change the amount of application to A and B at four locations shown in the illustration.
- Mount the oil pan within three minutes of applying the sealant.
Make sure that the sealant stays in place.

CAUTION ⚠

- **Do not start the engine less than an hour after installation. If the oil pan mounting bolts were loosened or removed, be sure to reapply sealant.**

MITSUBISHI 6M70 OIL PUMP, OIL STRAINER



P39639

● Disassembly sequence

- | | | |
|----------------|-----------------------|-----------------------|
| 1 Oil strainer | 8 Relief valve spring | *a: Crankshaft gear |
| 2 Gasket | 9 Relief valve | *b: Oil pump gear |
| 3 Oil pipe | 10 Idler shaft | |
| 4 Gasket | 11 Idler gear | |
| 5 Cover | 12 Gear and case | P: Locating pin |
| 6 Driven gear | 13 Gasket | ⊗: Non-reusable parts |
| 7 Ring | | |

- The oil strainer, the oil pipe and the oil pump must all be removed together as an assembly.
- Do not disassemble the oil pump unless defects are evident.
- The gear and case assembly is not serviceable. If the gear and case assembly appears defective, replace it.

● Assembly sequence

Follow the disassembly procedure in reverse.

Service standards (Unit: mm)

Location	Maintenance item	Standard value	Limit	Remedy
5, 12	Clearance between drive gear shaft and cover	0.04 to 0.07	0.15	Replace
5, 6, 12	Clearance between driven gear shaft and case, and that between the shaft and cover	0.04 to 0.07	0.15	Replace
6, 12	Clearance between case and tooth tips of each gear	0.2 to 0.29	0.35	Replace
	Difference between case depth and height of each gear	0.05 to 0.12	0.15	
8	Relief valve spring installed load (installed length 47.7)	190 ± 11 N {19.4 ± 1.1 kgf}	179 N {18.3 kgf}	Replace
9	Relief valve opening pressure	0.9 ^{+0.1} / ₋₁ MPa {9 ⁺¹ / ₀ kgf/cm ² }	0.9 MPa {9 kgf/cm ² }	Replace
10, 11	Clearance between idler shaft and idler gear	0.03 to 0.06	0.15	Replace
11, *a	Backlash between idler gear and crankshaft gear	0.08 to 0.2	0.35	Replace
11, *b	Backlash between idler gear and oil pump gear	0.076 to 0.196	0.35	Replace

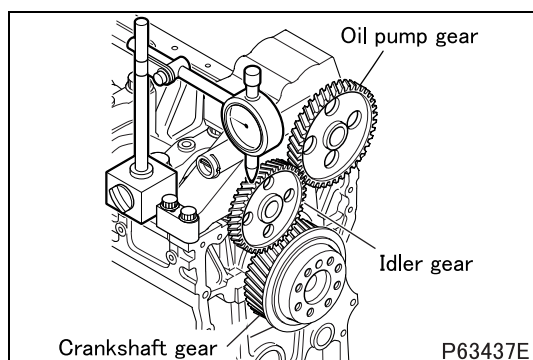
Tightening torque (Unit: N·m {kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (oil pump cover mounting)	44 ± 4.9 { 4.5 ± 0.5 }	—
Tb	Nut (idler shaft mounting)	69 ± 10 { 7 ± 1 }	Thread-locking compound

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Nut thread	Loctite 262	As required
b	Sliding parts of oil pump	Engine oil	As required

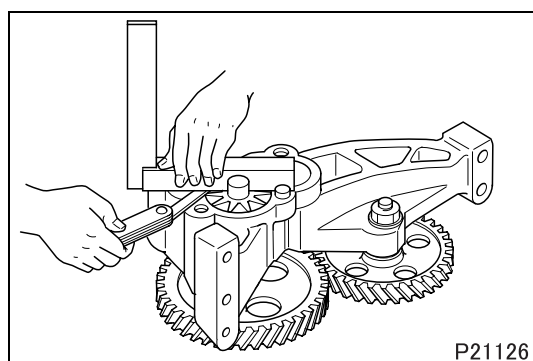
◆ Inspection before removal ◆



■ Inspection: Backlash of each gear

- If the measurement exceeds the limit, replace the defective part(s).

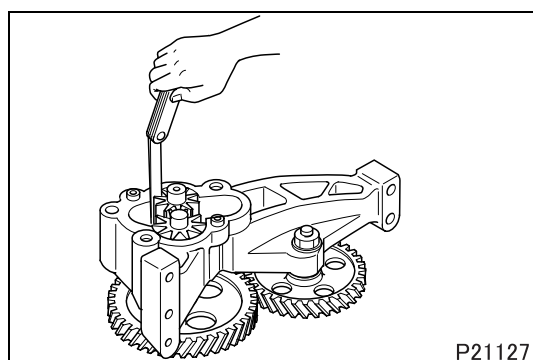
◆ Inspection procedure ◆



■ Inspection: Driven gear, Gear and case assembly

- Perform the following inspections. Replace the defective part(s) as required.

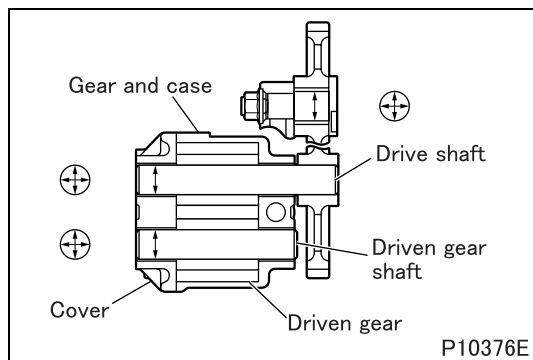
(1) Difference between case depth and height of each gear



(2) Clearance between case and tooth tips of each gear

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Phone: 269 673 1638

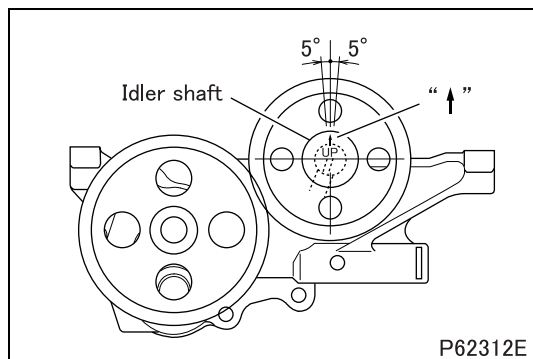
OIL PUMP, OIL STRAINER



(3) Clearance between drive gear shaft and cover

(4) Clearance between driven gear shaft and case, and that between the shaft and cover

◆ Installation procedure ◆

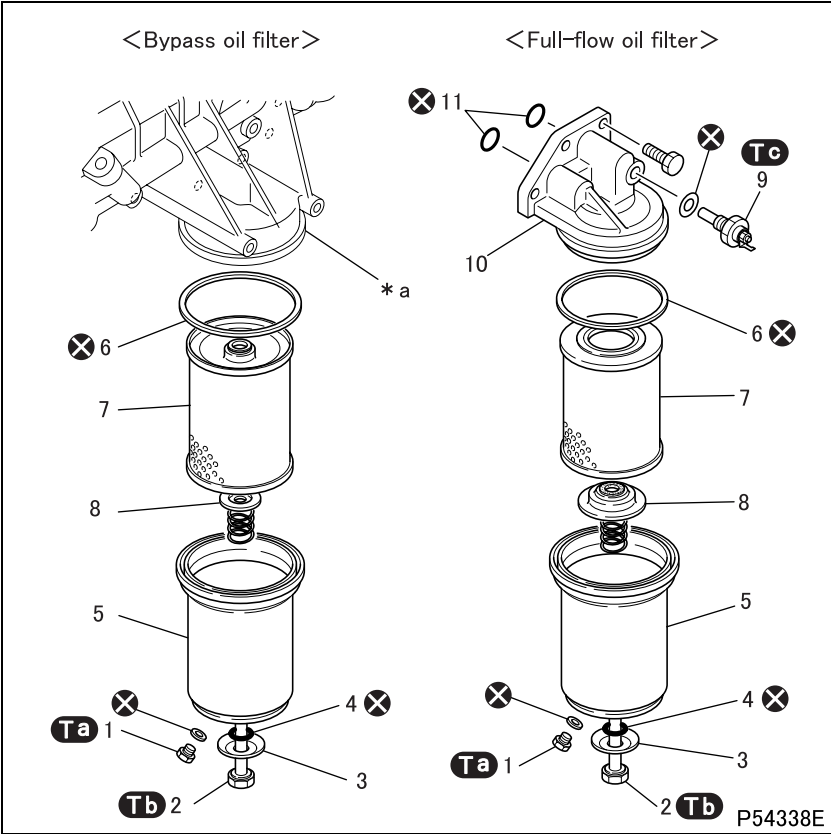


■ Installation: Idler shaft

- Install the idler shaft so that "↑" is positioned within the area shown in the illustration.

M E M O

OIL FILTER



Disassembly sequence

- 1 Drain plug
- 2 Center bolt
- 3 Washer
- 4 O-ring
- 5 Oil filter case
- 6 Gasket
- 7 Oil filter element
- 8 Spring
- 9 Engine oil bypass alarm switch
- 10 Oil filter head
- 11 O-ring

*a: Oil cooler
X: Non-reusable parts

Assembly sequence

Follow the disassembly sequence in reverse.

WARNING ⚠

- Wipe up any spilled engine oil, as it can cause fires.
- To avoid any risk of burns, take care not to touch the engine oil when the engine is hot.

CAUTION ⚠

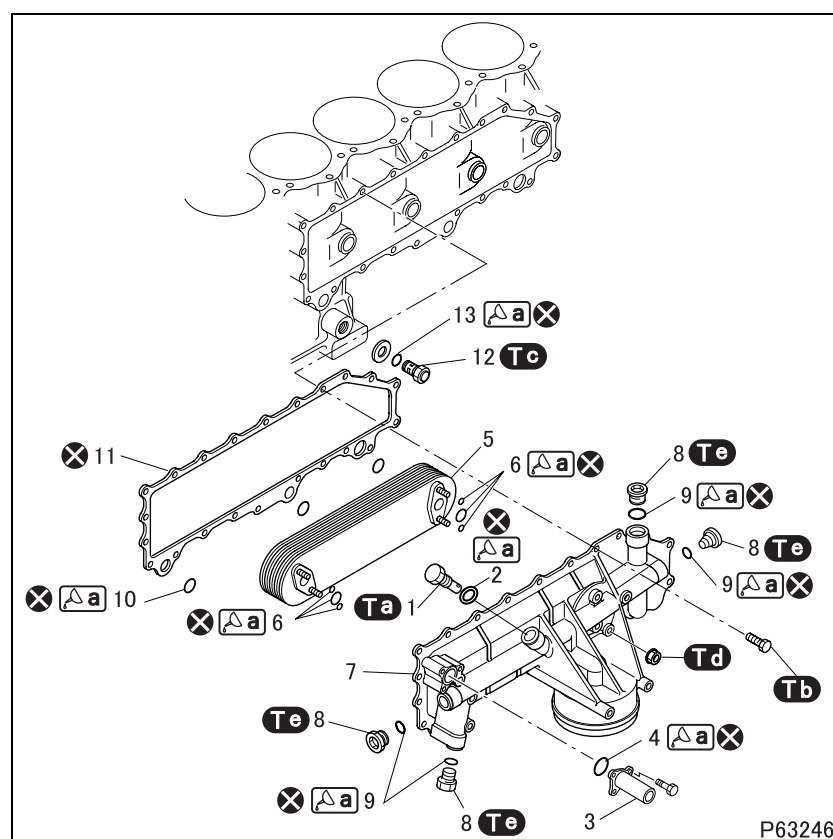
- When adding engine oil, be careful not to allow engine oil to smear the belt. A belt smeared with oil will slip, resulting in reduced cooling efficiency.
- Do not reuse the oil filter elements by washing.
- Install the gasket, taking care not to twist it.

Tightening torque (Unit: N·m {kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Drain plug	24.5 ± 4.9 {2.5 ± 0.5}	—
Tb	Center bolt	63.7 ± 4.9 {6.5 ± 0.5}	—
Tc	Engine oil bypass alarm switch	49 ± 4.9 {5.0 ± 0.5}	—

M E M O

MITSUBISHI 6M70 OIL COOLER



● Removal sequence

- 1 Bypass valve
- 2 O-ring
- 3 Water pipe
- 4 O-ring
- 5 Oil cooler element
- 6 O-ring
- 7 Oil cooler cover
- 8 Oil cooler plug
- 9 O-ring
- 10 O-ring
- 11 Gasket
- 12 Regulator valve
(See later section.)
- 13 O-ring

⊗: Non-reusable parts

● Installation sequence

Follow the removal sequence in reverse.

Service standards (Unit: mm)

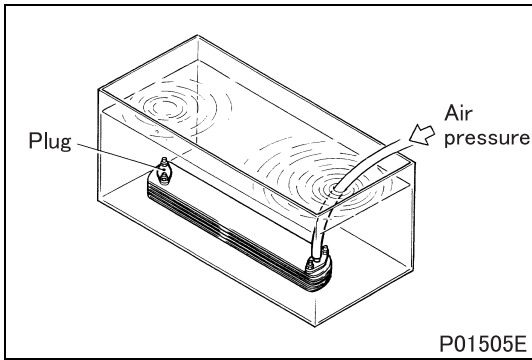
Location	Maintenance item	Standard value	Limit	Remedy
1	Bypass valve opening pressure	294 ± 50 kPa {3.0 ± 0.5 kgf/cm ² }	244 kPa {2.5 kgf/cm ² }	Replace
5	Air leakage from oil cooler element (air pressure: 1.47 MPa {15 kgf/cm ² }, 15 seconds)	0 cm ³ {0 mL}	—	Replace

Tightening torque (Unit: N·m {kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ⓐ	Bypass valve	15 to 20 {1.5 to 2.0}	—
Ⓑ	Bolt (oil cooler cover mounting)	54 {5.5}	—
Ⓒ	Regulator valve	98 to 118 {10 to 12}	—
Ⓓ	Nut (oil cooler element mounting)	24.5 to 32.3 {2.5 to 3.3}	—
Ⓔ	Oil cooler plug	21 {2.1}	—

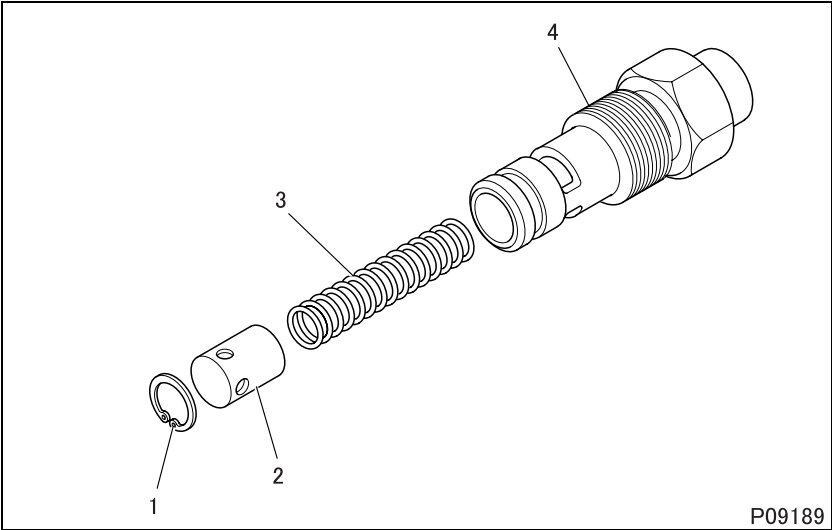
Lubricant and/or sealant

Mark	Points of application	Lubricant and/or sealant	Quantity
Ⓐ	O-ring	Engine oil	As required

◆ Inspection procedure ◆**■ Inspection: Oil cooler element**

- Plug the outlet of the oil cooler element and connect a hose to the engine oil inlet port. Then, immerse the oil cooler element in a tank of water.
- Apply a specified air pressure for 15 seconds through the hose, and check for any air leaks.
- Replace the element if it leaks air.

MITSUBISHI 6M70 REGULATOR VALVE



● **Disassembly sequence**

- 1 Snap ring
- 2 Valve
- 3 Spring
- 4 Body

● **Assembly sequence**

Follow the disassembly sequence in reverse.

Service standards (Unit: mm)

Location	Maintenance item	Standard value	Limit	Remedy
—	Regulator valve opening pressure	0.49 ± 0.03 MPa {5.0 ± 0.3 kgf/cm ² }	—	Replace
3	Spring installed load (installed length 48.3)	78 ± 2 N {8.0 ± 0.2 kgf}	—	Replace

GROUP 13

FUEL AND ENGINE CONTROL

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MITSUBISHI 6M70 FUEL SYSTEM SPECIFICATIONS

Item			Specifications
Supply pump	Manufacturer		Bosch
	Model		CP2L4
	Control method		Electronic
	Type		In-Line 4 barrel type
	Feed pump type		External gear
	Rail pressure control valve	Model	MPROP
		Rated voltage V	24
	Max. common rail pressure MPa {kgf/cm ² }		160 {1631}
Common rail	Manufacturer		Bosch
	Common rail volume cm ³ {mL}		20 {20}
	Pressure limiting valve opening pressure MPa {kgf/cm ² }		185 to 195 {1886 to 1988}
	Common rail pressure sensor supply voltage V		5
Injectors	Manufacturer		Bosch
	Control method		Electronic
	Max. operating pressure MPa {kgf/cm ² }		160 {1631}
	Min. operating pressure MPa {kgf/cm ² }		25 {255}
Common rail electronic control unit	Manufacturer		Bosch
	Rated voltage V		24

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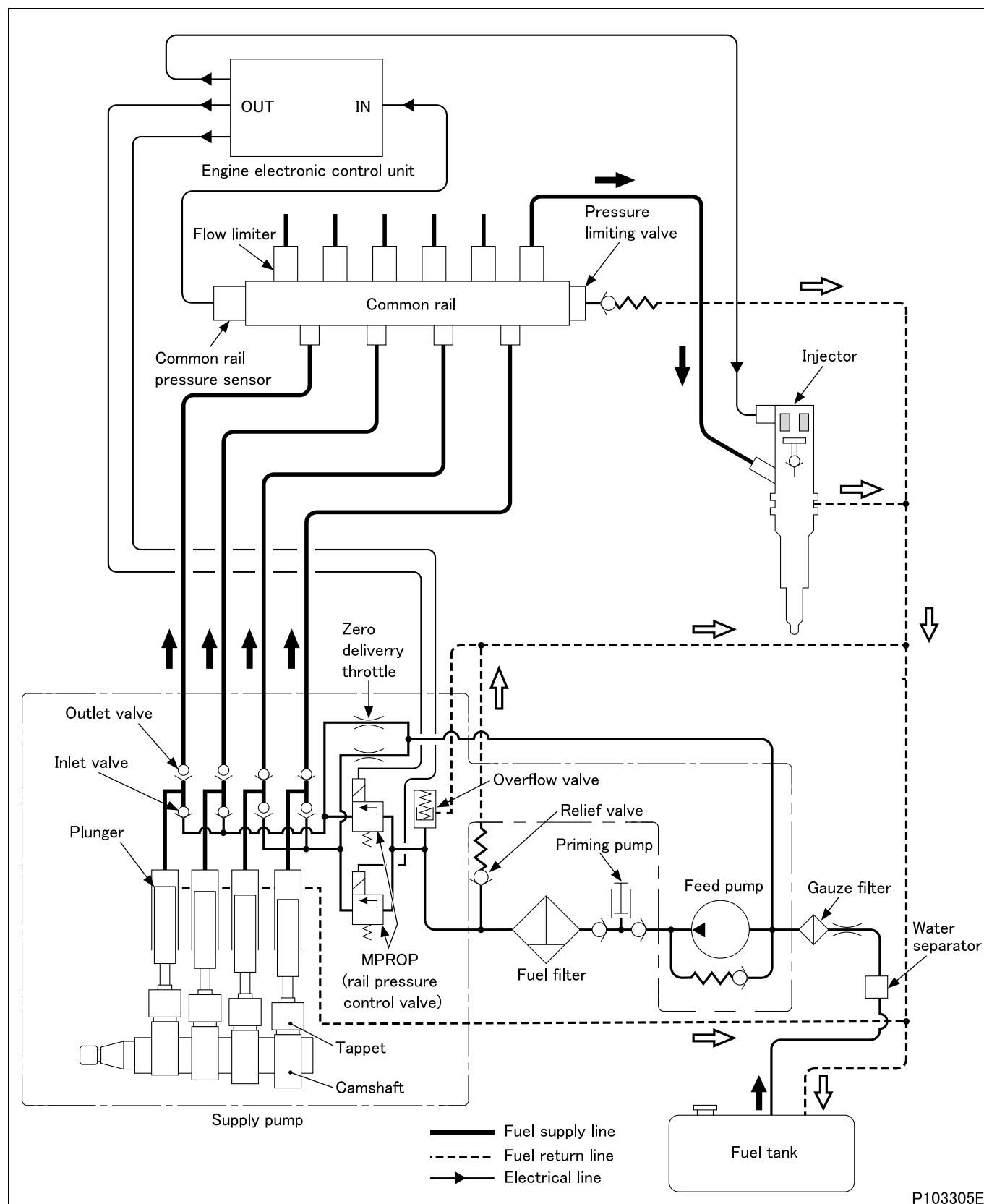
Phone: 269 673 1638

M E M O

STRUCTURE AND OPERATION

1. Mitsubishi 6M70 Common Rail System

- In the common rail system, an electronic control unit monitors various aspects of the engine (engine speed, accelerator position, coolant temperature, etc.) using information from sensors. In accordance with these data, the electronic control unit effects control over the fuel injection quantity, fuel injection timing, and fuel injection pressure in order to optimize the engine's operation.
- The electronic control unit has a diagnosis function that enables it to recognize abnormalities in the common rail system's major components and alert the driver to them.
- The common rail system consists mainly of an electronically controlled supply pump; injectors; a common rail; and the electronic control unit and sensors that are used to control the other components.

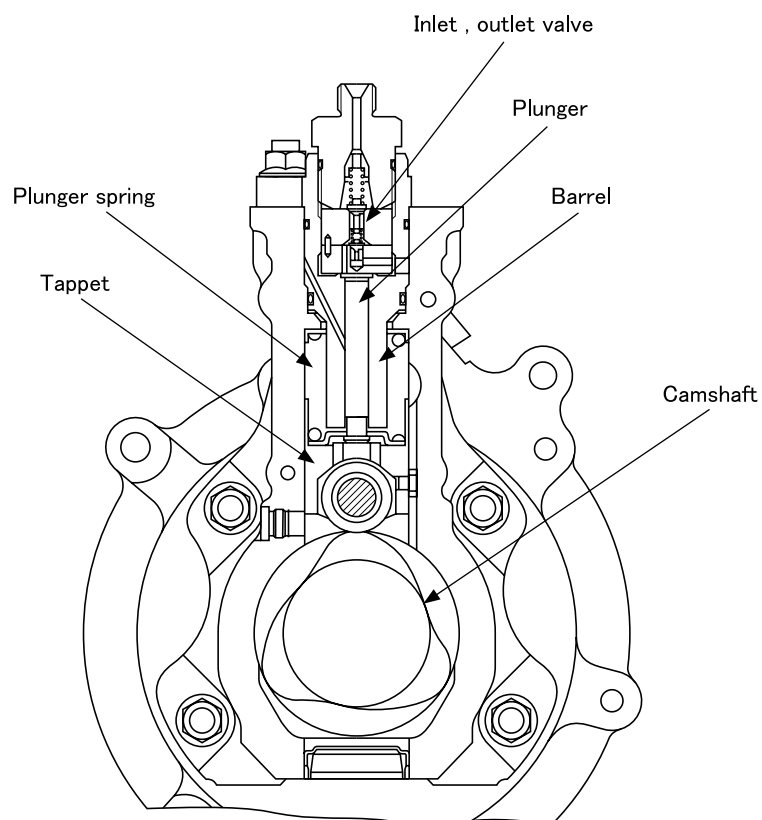
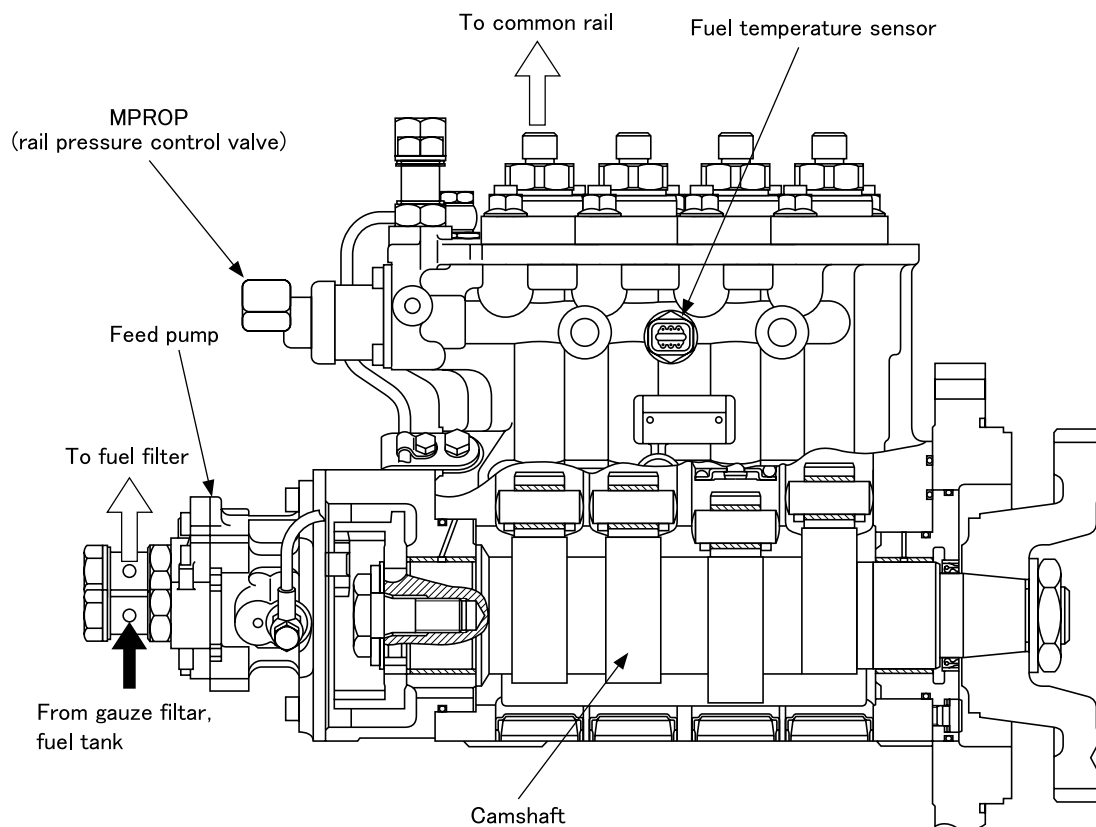


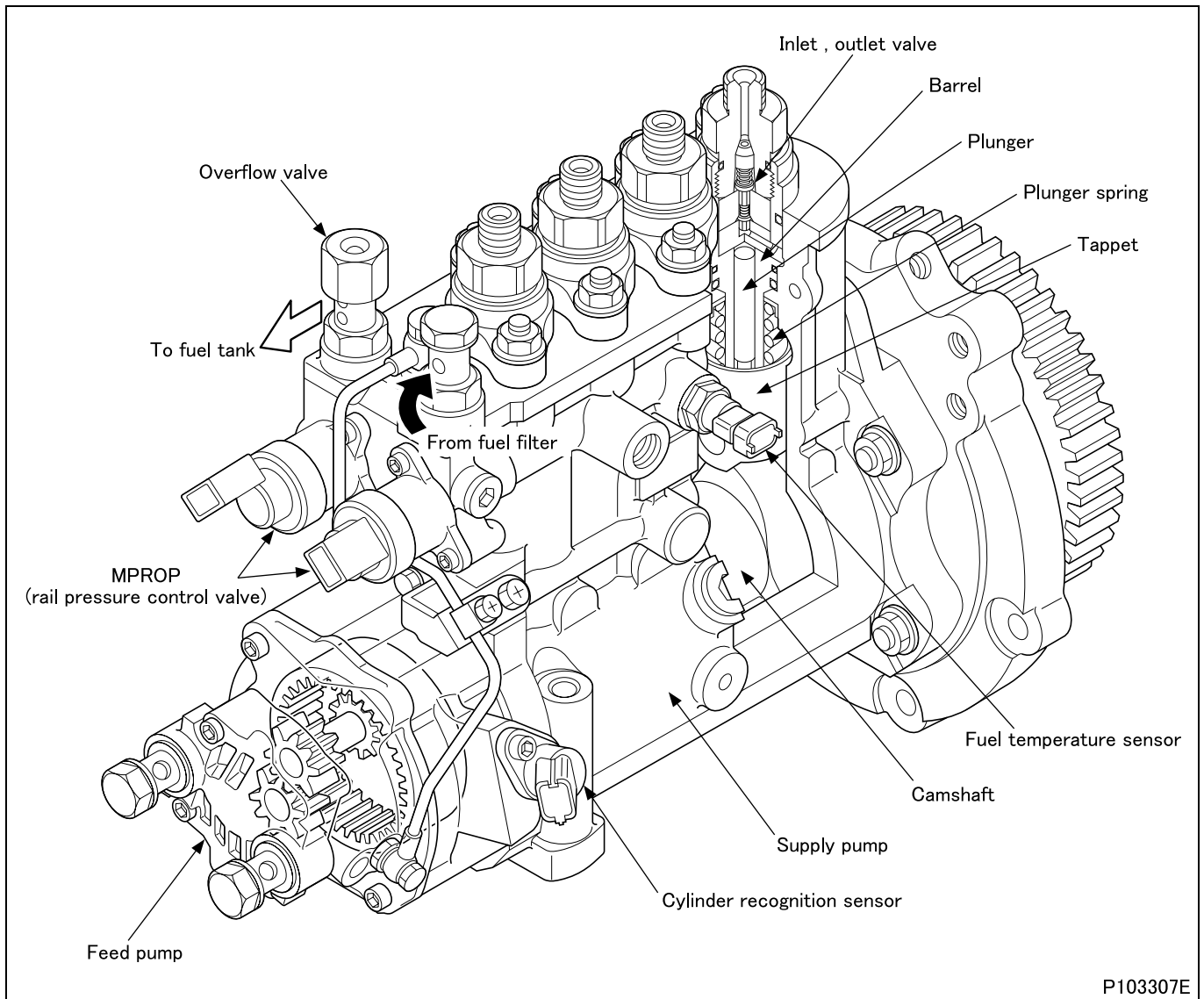
P103305E

- When the engine is cranked by means of the starter switch, the feed pump (this is located inside the supply pump) simultaneously draws fuel from the fuel tank and feeds it via the water separator, gauze filter and fuel filter to the MPROP (rail pressure control valve). A quantity of fuel metered by the MPROP is supplied via the inlet valves to the plunger chambers.
- The fuel in the plunger chambers is pressurized. The outlet valves are then opened, and the fuel is fed under pressure to the common rail.
- The pressurized fuel is held in the common rail and then uniformly fed to the injectors.
- In response to signals from the engine electronic control unit, a magnetic valve in each injector causes the injector to inject fuel into the relevant combustion chamber at the optimal timing and in the optimal quantity.
- If fuel leakage occurs through any of the fuel line connections between the common rail and injectors, the relevant flow limiter(s) will close, shutting off fuel supply and thus preventing any further fuel leakage out of the system.
- If the pressure of fuel in the common rail rises above the specified level, the pressure limiting valve opens to allow fuel to return to the fuel tank.
- If the pressure of fuel in the supply pump rises above the specified level, the overflow valve opens to allow fuel to return to the fuel tank.
- Excess fuel in the injector returns to the fuel tank through passages in the cylinder head.

STRUCTURE AND OPERATION

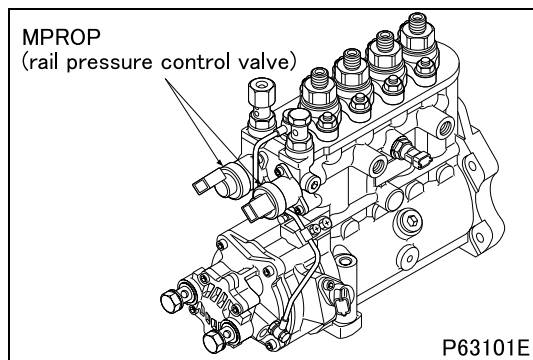
1.1 Mitsubishi 6M70 Supply pump





- The supply pump pressurizes fuel and supplies it in a highly pressurized state.
- Fuel drawn from the fuel tank by the feed pump is not supplied directly to the plungers. It is supplied first to the MPROP (rail pressure control valve), which controls the amount of fuel reaching the plungers.
- If the fuel pressure exceeds a certain level, the overflow valve returns fuel to fuel tank. This operation keeps the pressure of the fuel constant.
- Rotation of the camshaft causes (via the tappets) up-down movement of the plungers. Fuel in the plunger chambers is thus highly pressurized.

STRUCTURE AND OPERATION



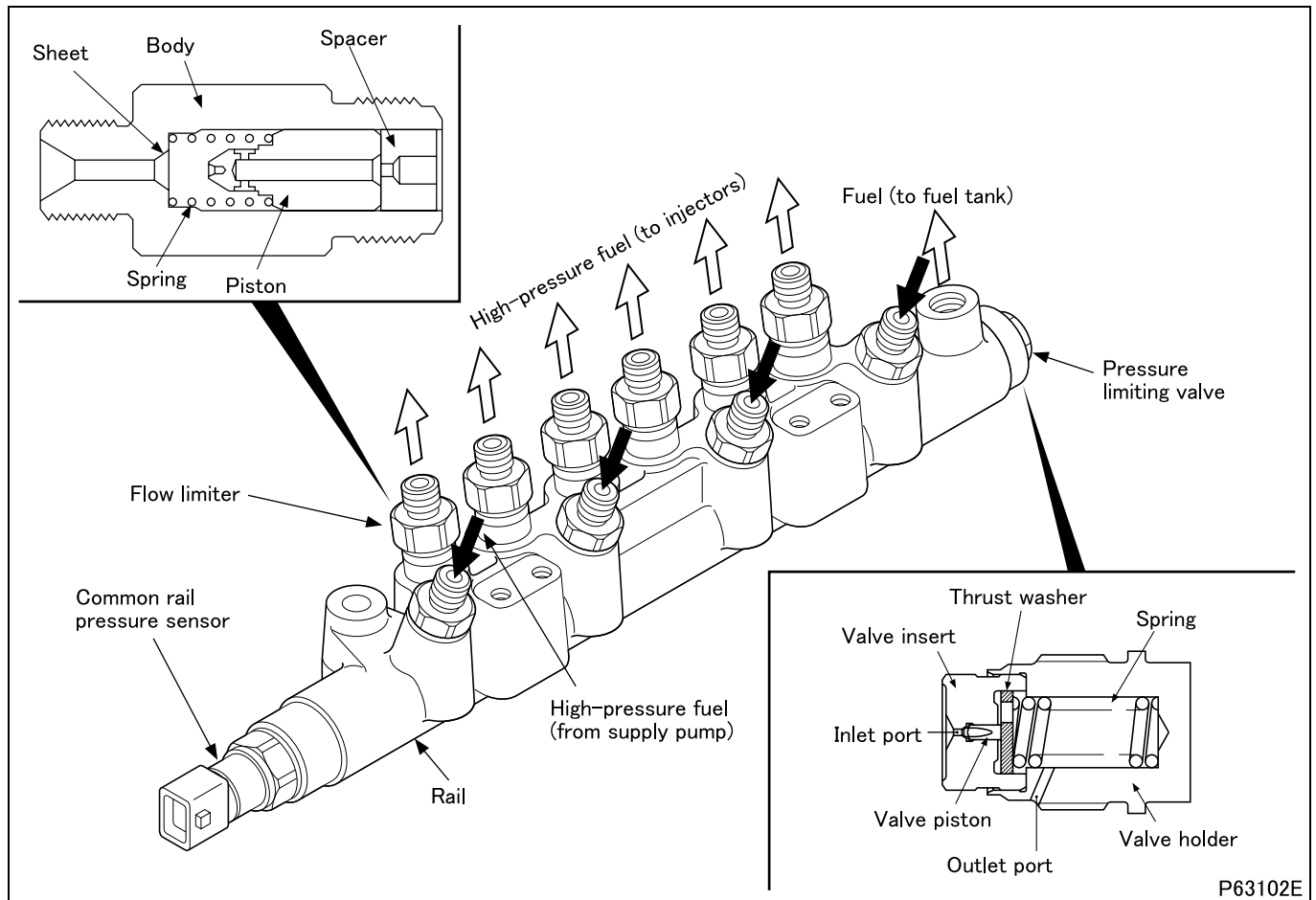
(1) MPROP (rail pressure control valve)

CAUTION

- Be sure to connect the MPROP (rail pressure control valve) connector to the engine harness before starting the engine. If the engine were started with the MPROP connector not connected, control of the supply pump by the engine electronic control unit would not be possible and a fault would ensue.
-
- The MPROP receives fuel from the feed pump and feeds fuel toward the plungers of the supply pump in such a quantity that the fuel pressure (target common rail pressure) corresponds to that required by the engine electronic control unit.
 - When the MPROP is not operating, i.e., when current is not flowing, fuel flows at its maximum rate. When current flows, the piston in the MPROP is pressed down such that fuel is not fed toward the plungers.
 - The engine electronic control unit controls the ratio of current-off time (duty ratio).

Mitsubishi 6M70 Engine Parts contact:
email: EngineParts@HeavyEquipmentRestorationParts.com
Phone: 269 673 1638

1.2 Mitsubishi 6M70 Common rail



- The common rail distributes to the injectors high-pressure fuel that has been fed from the supply pump.
- Each flow limiter prevents an abnormal outflow of fuel. It does so by blocking the fuel passage in the event of fuel leakage from the injection pipe or excessive injection of fuel from the injector.
- The common rail pressure sensor is used in feedback control. It senses the fuel pressure (actual common rail pressure) inside the common rail and feeds a corresponding signal to the electronic control unit.
- If the fuel pressure in the common rail exceeds a certain, set level, the piston in the pressure limiting valve pushes and compresses the spring such that fuel is able to escape. The pressure limiting valve thus prevents the fuel pressure from becoming higher than the set pressure. When the pressure limiting valve is activated, the common rail system is faulty and needs an inspection of fuel supply system.

(1) Flow limiter

- During normal operation, the piston moves (thus pushing and compressing the spring) to the extent necessary for one injection quantity to pass through. The piston does not make contact with the seat at this time. When injection is complete, the piston is returned to its initial position by the spring.
- If the amount of fuel passing through the flow limiter becomes excessively great, the piston presses against the seat, thereby closing the fuel passage and preventing an abnormal outflow of fuel. When the piston has pressed against the seat, it does not return to its original position until the engine has been stopped and the pressure in the common rail has come down.

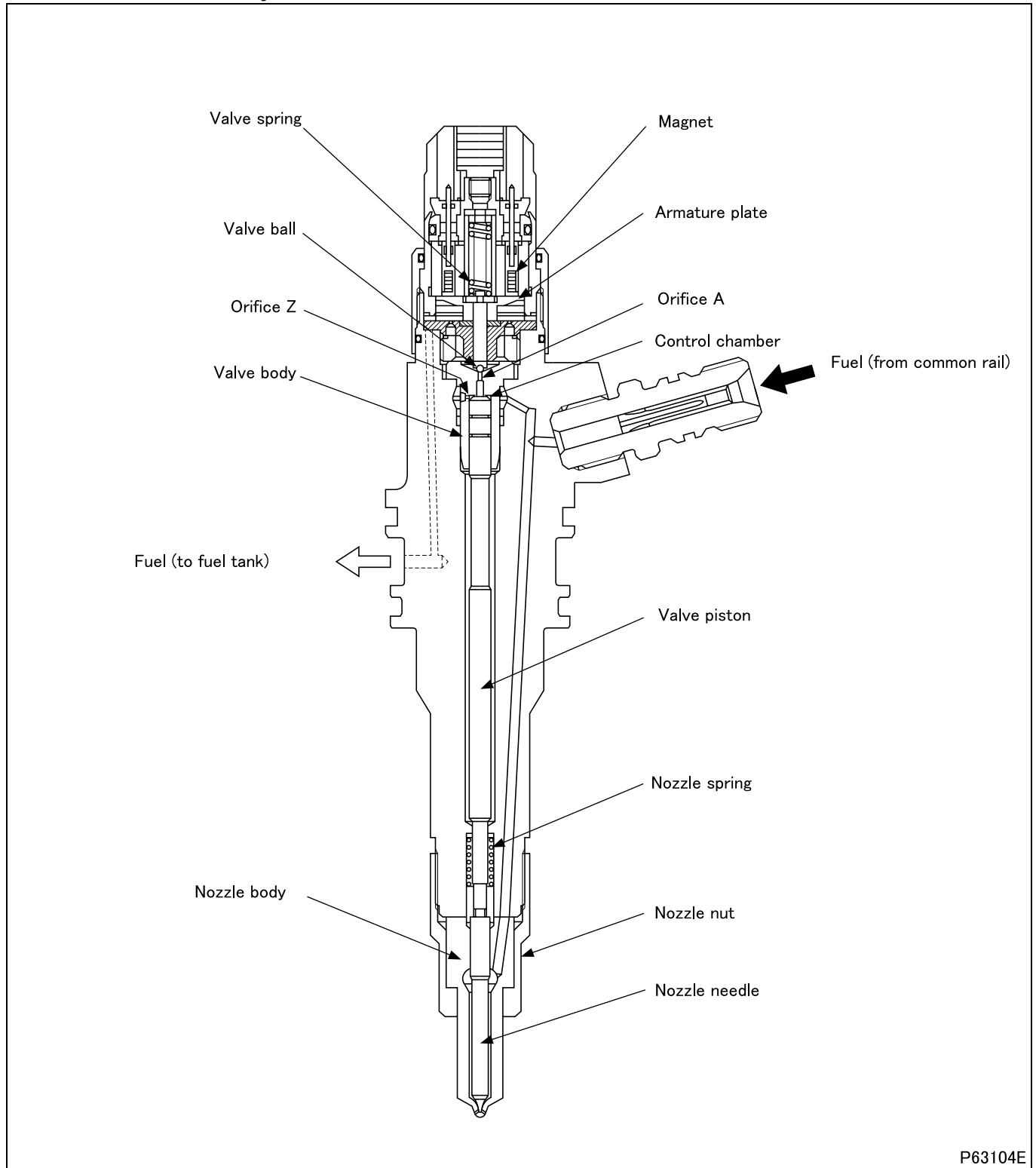
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Phone: 269 673 1638

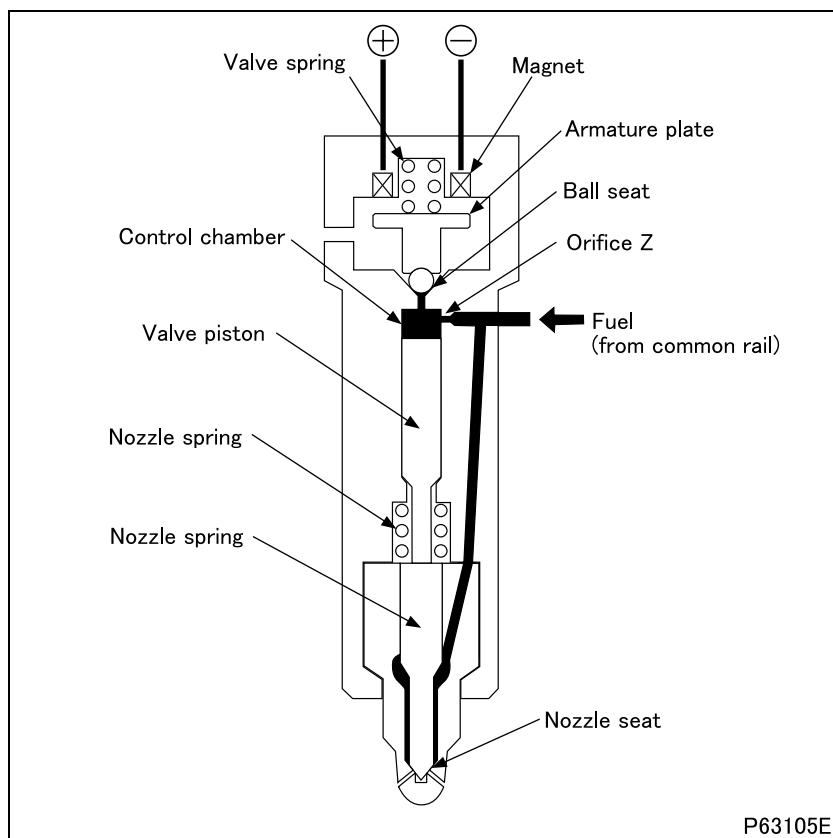
STRUCTURE AND OPERATION

1.3 Mitsubishi 6M70 Injector



- In accordance with electrical signals from the engine electronic control unit, each injector supplies high-pressure fuel from the common rail to the relevant combustion chamber of the engine at the optimal timing and in the optimal quantity.
- The Mitsubishi 6M70 injector is divided into the control section and the injector section.
 - The control section consists of the control chamber, magnet, valve spring, armature plate, valve ball, valve body, valve piston, orifice A, and orifice Z. The valve piston is located between the control section and the injection section.
 - The injection section consists of the nozzle body, nozzle needle, nozzle spring, and nozzle nut.

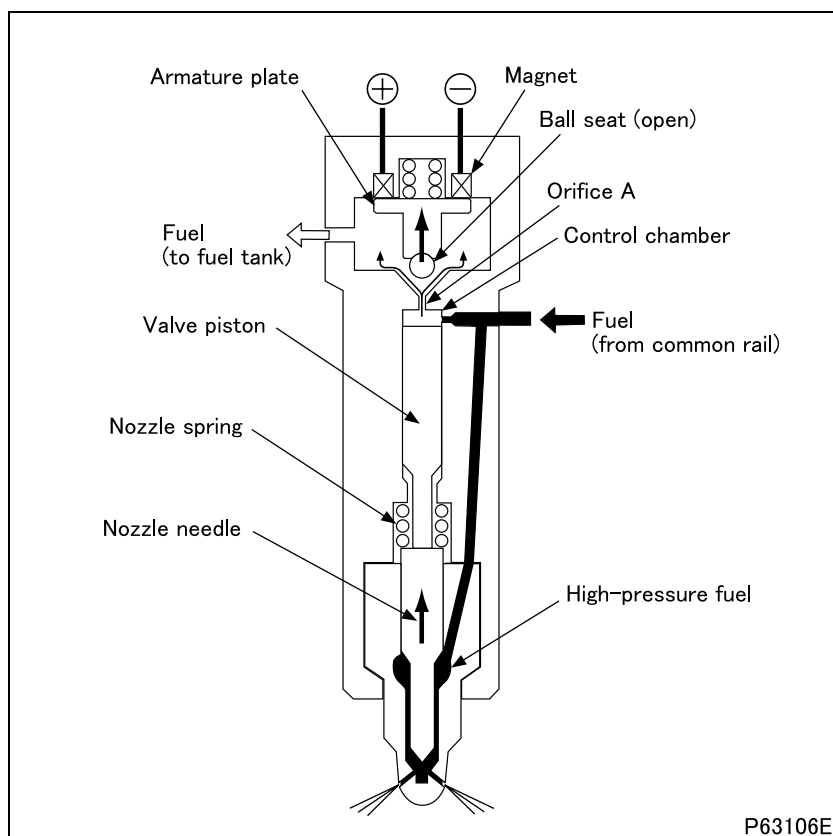
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Phone: 269 673 1638



(1) Operation

(1.1) Injection not taking place

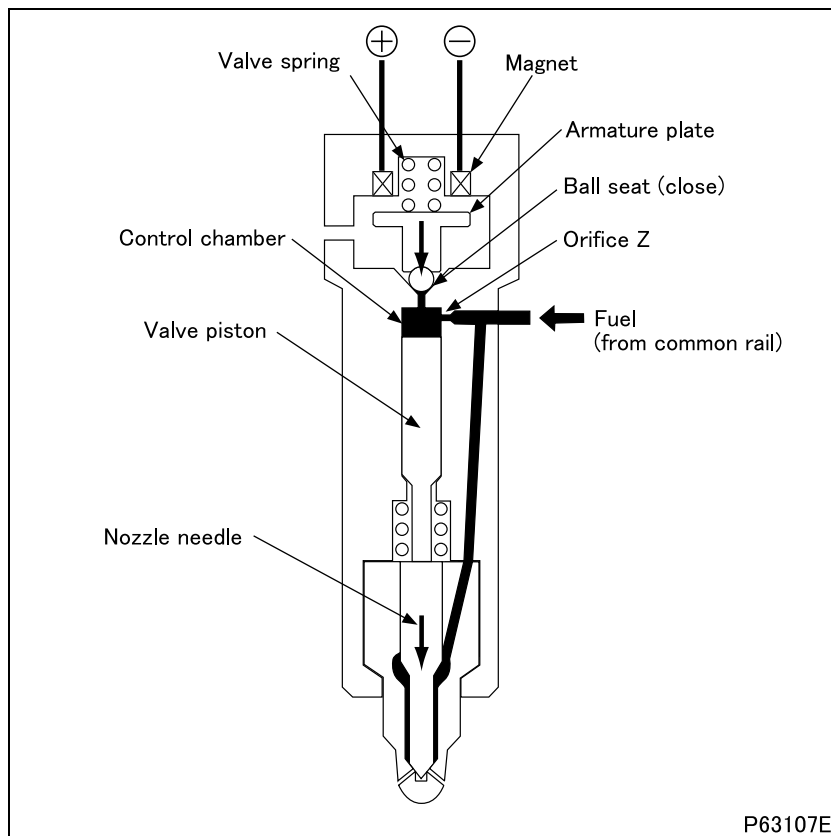
- With the magnet not energized, the armature plate is pushed down by the valve spring such that the ball seat is closed.
- The high-pressure fuel acts upon the control chamber via orifice Z. The same pressure acts upon the nozzle needle.
- The fuel pressure acting on the nozzle needle cannot overcome the valve piston and nozzle spring, so the nozzle needle stays in its downward-pushed position and injection does not take place.



(1.2) Start of injection

- When the magnet is energized, the resulting electromagnetic force draws the armature plate upward, causing the ball seat to open.
- Fuel in the control chamber passes through the orifice A and ball seat and flows to the fuel tank.
- With the pressure in the control chamber reduced, the fuel acting on the nozzle needle overcomes the valve piston and nozzle spring, pushing up the nozzle needle such that injection starts.
- If the magnet remains energized, the injection reaches its maximum level.

STRUCTURE AND OPERATION



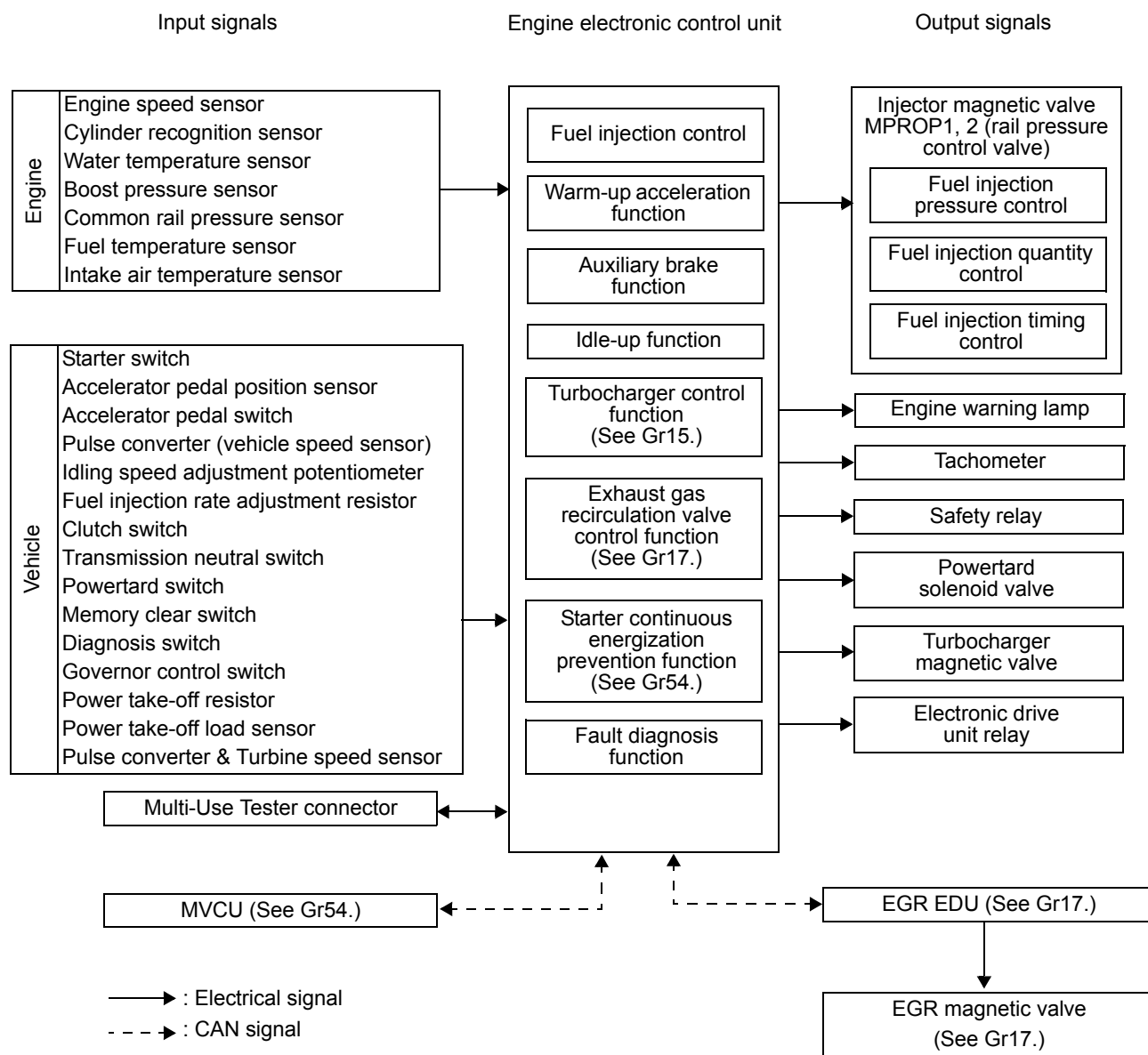
(1.3) End of injection

- When energization of the magnet is stopped, the armature plate is pushed downward by the valve spring such that the ball seat closes. At this time, fuel flows into the control chamber via orifice Z, pushing down the valve piston and nozzle needle such that injection finishes.

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email: EngineParts@HeavyEquipmentRestorationParts.com
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1.4 Electronic control system

(1) System block diagram



ABS: Anti-lock brake system

ASR: Anti spin regulator

CAN: Controller area network

ECU: Electronic control unit

EDU: Electronic drive unit

EGR: Exhaust gas recirculation

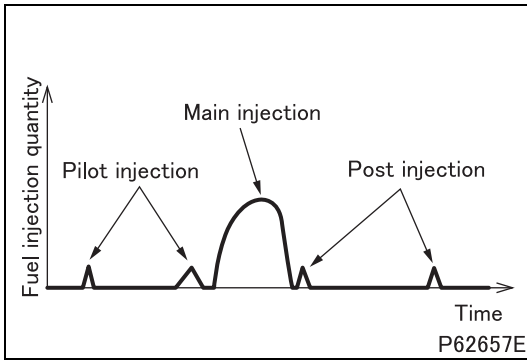
MVCU: Multifunction vehicle control unit

STRUCTURE AND OPERATION

Mitsubishi 6M70 Parts	Main function/operation
Engine speed sensor	Sensing of engine speed
Cylinder recognition sensor	Cylinder recognition
Water temperature sensor	Sensing of coolant temperature
Boost pressure sensor	Sensing of boost pressure
Common rail pressure sensor	Sensing of common rail pressure
Fuel temperature sensor	Sensing of fuel temperature
Intake air temperature sensor	Sensing of intake air temperature
Starter switch	Senses that the engine is in starting condition with the starter switch in START position.
Accelerator pedal position sensor	Sensing of extent of accelerator pedal depression
Accelerator pedal switch	Sensing of released/pressed condition of accelerator pedal (ON with pedal released)
Pulse converter (vehicle speed sensor)	Sensing of vehicle speed
Idling speed adjustment potentiometer	Acceleration of warm-up
Fuel injection rate adjustment resistor	Correction of fuel injection rate
Clutch switch	Sensing of released/Pressed condition of clutch pedal (OFF with pedal released)
Transmission neutral switch	Detection of transmission neutral condition
Powertard switch	Operation of auxiliary brake
Diagnosis switch	Output of diagnosis codes
Memory clear switch	Deletion of diagnosis codes; output of past diagnosis codes
Governor control switch	Idle up when power take-off is in operation
Power take-off resistor	Selection of power take-off map
Power take-off load sensor	Sensing of extent of accelerator pedal depression
Pulse converter & Turbine speed sensor	Sensing of turbine wheel speed
Injector magnetic valve	Control of fuel injection rate, fuel injection quantity, and fuel injection timing
MPROP1, 2 (rail pressure control valve)	Control of fuel injection pressure
Engine warning lamp	Indication of system abnormalities
Tachometer	Indication of engine speed (in meter cluster)
Powertard solenoid valve	ON/OFF control of Powertard magnetic valve
Turbocharger magnetic valve	Selection of turbocharger control
Safety relay	Control of starter continuous energization prevention function
Electronic drive unit relay	Supply of power to exhaust gas recirculation electronic drive unit
CAN communication (MVCU)	Engine data recognized by the engine electronic control unit are outputted to the CAN bus to enable systems to obtain data that they need for control. Multifunction Vehicle Control Unit system issues signals to the engine electronic control unit via the CAN bus to enable it to effect engine control appropriate for type of system control.
Multi-Use Tester connector	Communication between Multi-Use Tester and common rail system
CAN communication (EGR EDU)	Engine data recognized by the engine electronic control unit are outputted to the CAN bus to enable systems to obtain data that they need for control. Exhaust gas recirculation electronic drive unit issues signals to the engine electronic control unit via the CAN bus to enable it to effect engine control appropriate for type of system control.

EGR: Exhaust gas recirculation
EDU: Electronic drive unit
MVCU: Multifunction vehicle control unit

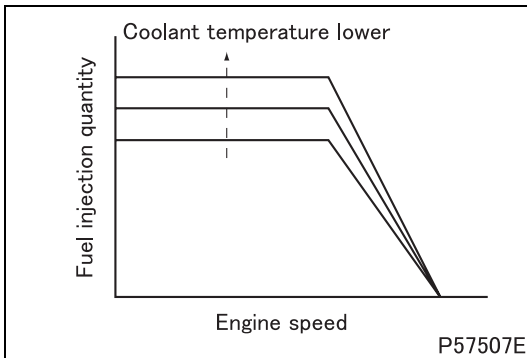
Mitsubishi 6M70 engine parts contact:
email:
EngineParts@HeavyEquipmentRestorationParts.com
phone: 269 673 1638



(2) Fuel injection control

(2.1) Pilot injection

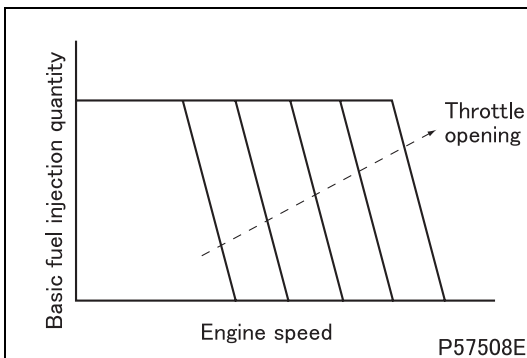
- Pilot injection entails the injection of an extremely small amount of fuel ahead of the main injection.
- This suppresses hasty heat generation early in the injection cycle and thus suppresses NOx generation and noise at the start of combustion.
- The post injection added after the main injection reduces particulate matter (PM) generation in the exhaust gas.



(3) Fuel injection quantity control

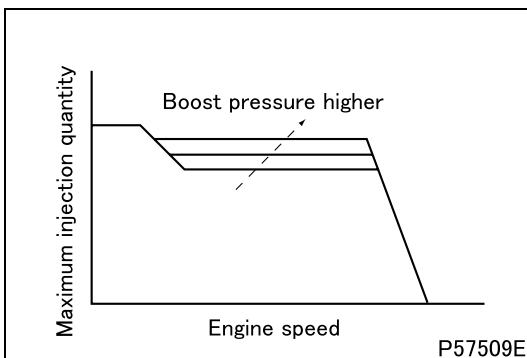
(3.1) Fuel injection quantity during engine startup

- During engine startup, the fuel injection quantity is determined in accordance with the engine speed and coolant temperature.



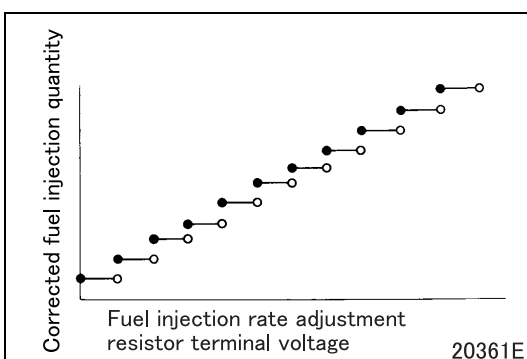
(3.2) Basic fuel injection quantity

- The basic fuel injection quantity is determined in accordance with the engine speed and throttle opening.



(3.3) Maximum injection quantity

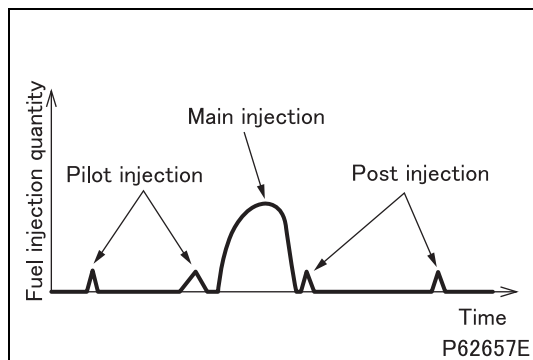
- The maximum injection quantity is calculated from the engine speed and boost pressure.



(3.4) Fuel injection rate adjustment resistor correction amount

- To limit inconsistency in the injection quantity, the injection quantity is corrected by the fuel injection rate adjustment resistor.

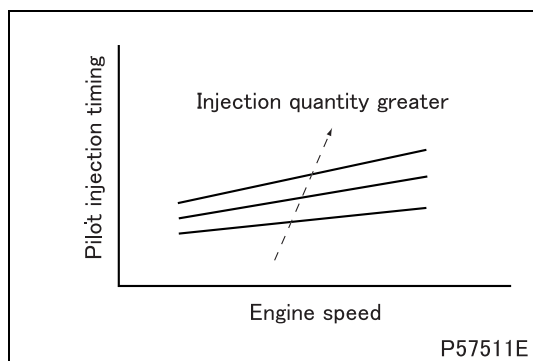
STRUCTURE AND OPERATION



(4) Fuel injection timing control

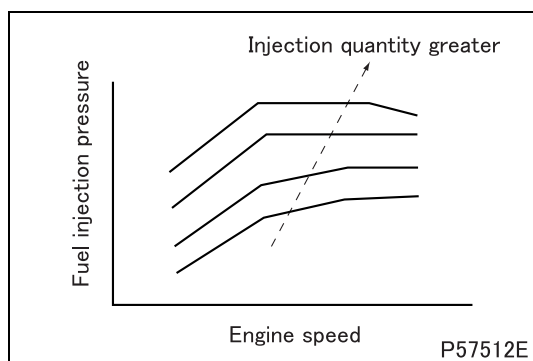
(4.1) Main injection timing

- The main injection timing is calculated from the fuel injection quantity and engine speed.



(4.2) Pilot injection timing (pilot interval)

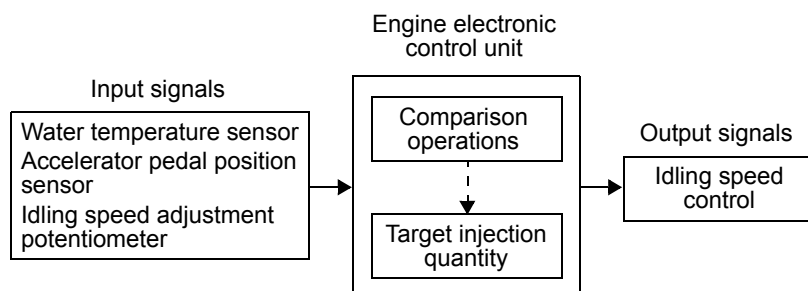
- The pilot injection timing is calculated from the fuel injection quantity and engine speed.



(5) Fuel injection pressure control

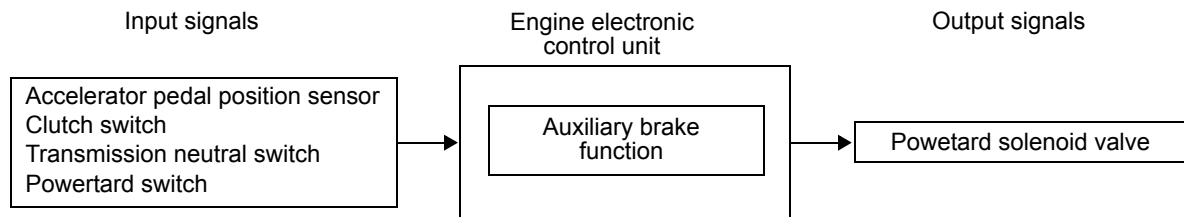
- The fuel injection pressure is calculated from the fuel injection quantity and engine speed.

(6) Warm-up acceleration function



- The warm-up acceleration function increases engine warm-up by varying the engine's idling speed in accordance with the engine's coolant temperature. It can operate either automatically or manually. Selection is made using the idling speed adjustment potentiometer.

(7) Auxiliary brake function



- The auxiliary brake function activates or deactivates the Powertard solenoid valve according to the vehicle condition to control the auxiliary brake.

(8) Idle-up function

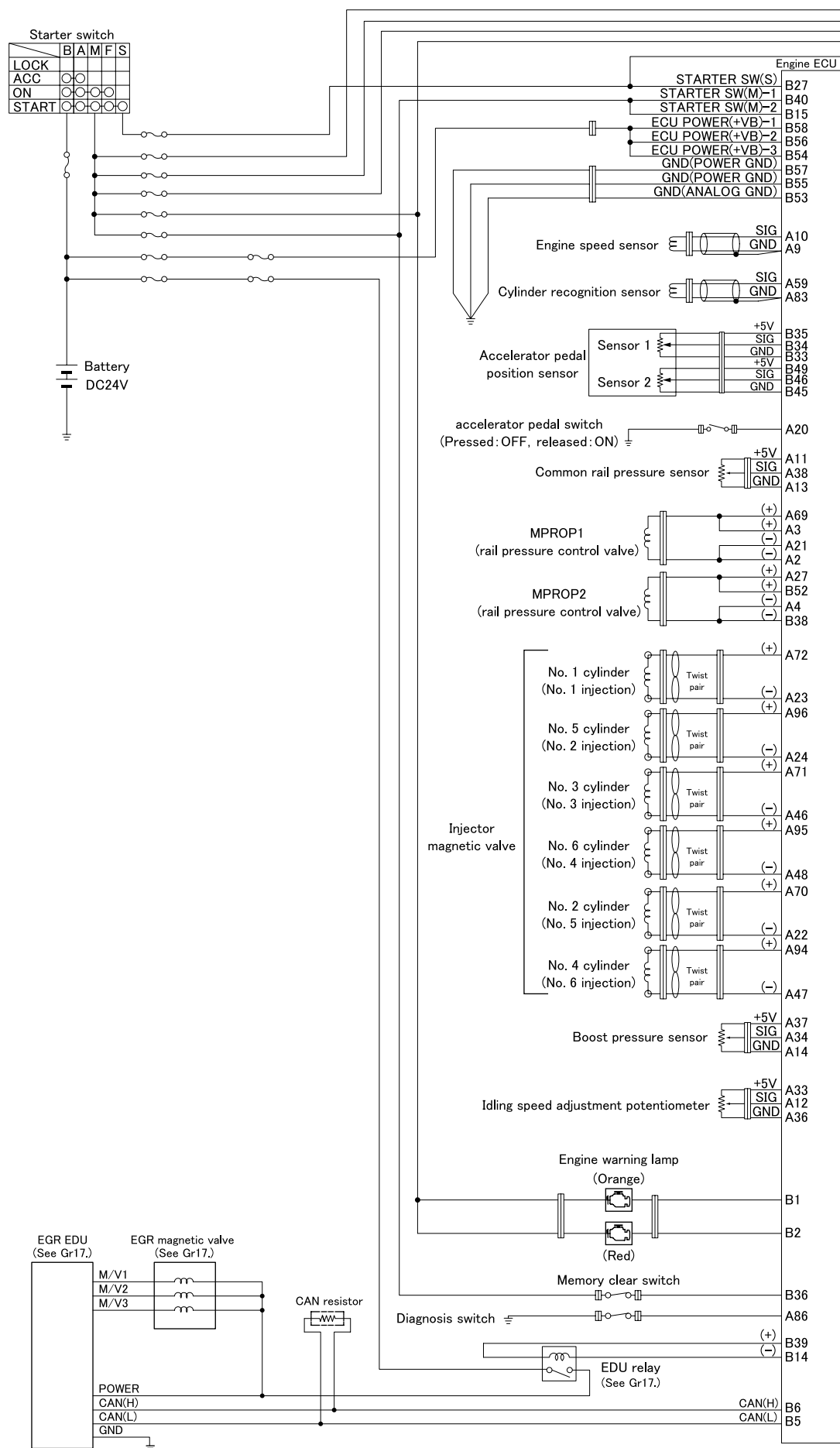
- The idle-up function increases the engine idling speed when a load is applied to the engine by other system or when the warm-up acceleration function is activated.

(9) Fault diagnosis function

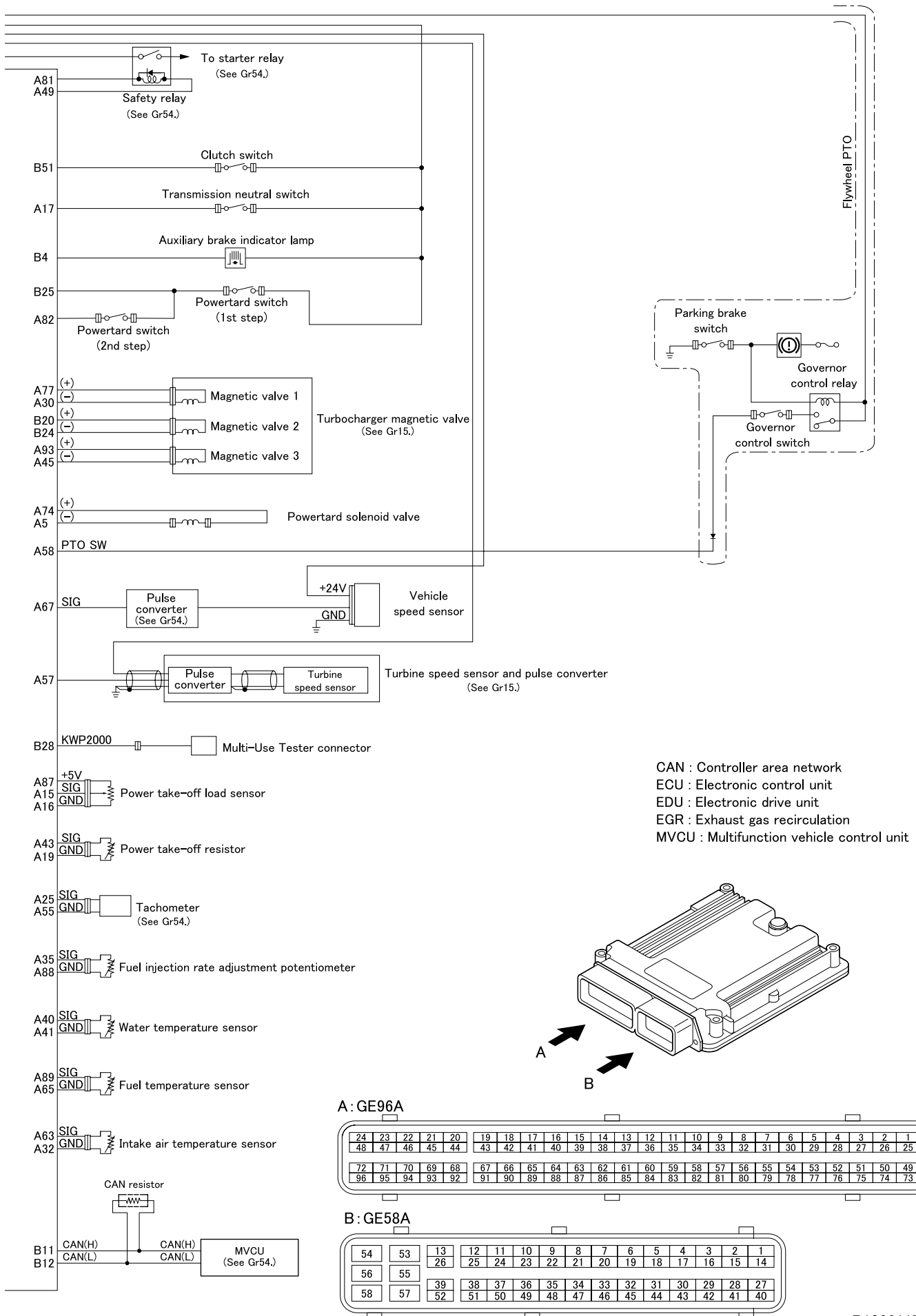
- When the starter switch is in the ON position, the system continuously monitors the sensors and other system components. If any fault is detected, the system warns the driver of this by displaying the relevant fault information on the meter cluster. At the same time, the system also stores a relevant diagnosis code in the memory and starts operation in the fault mode.
- While the control during fault is taking place, the system's functionality is limited to ensure vehicle and driver safety. It is possible to read the memorized diagnosis code using a Multi-Use Tester or from flashing of the warning lamp.
- Diagnosis codes shown by the Multi-Use Tester and those indicated by flashing of the warning lamp are different.
- The Multi-Use Tester is capable of showing more detailed diagnosis codes.

STRUCTURE AND OPERATION

(10)Electronic control unit connection diagram

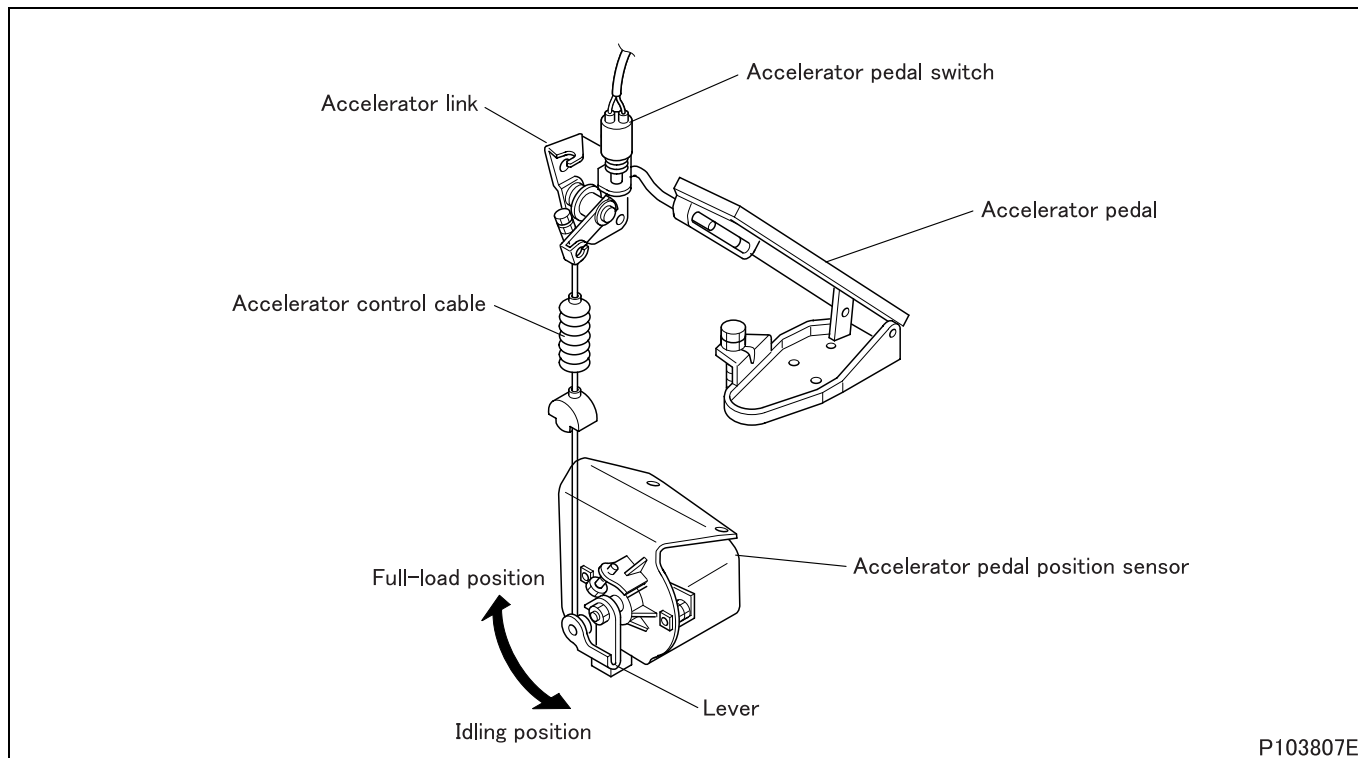


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STRUCTURE AND OPERATION

2. Engine Control



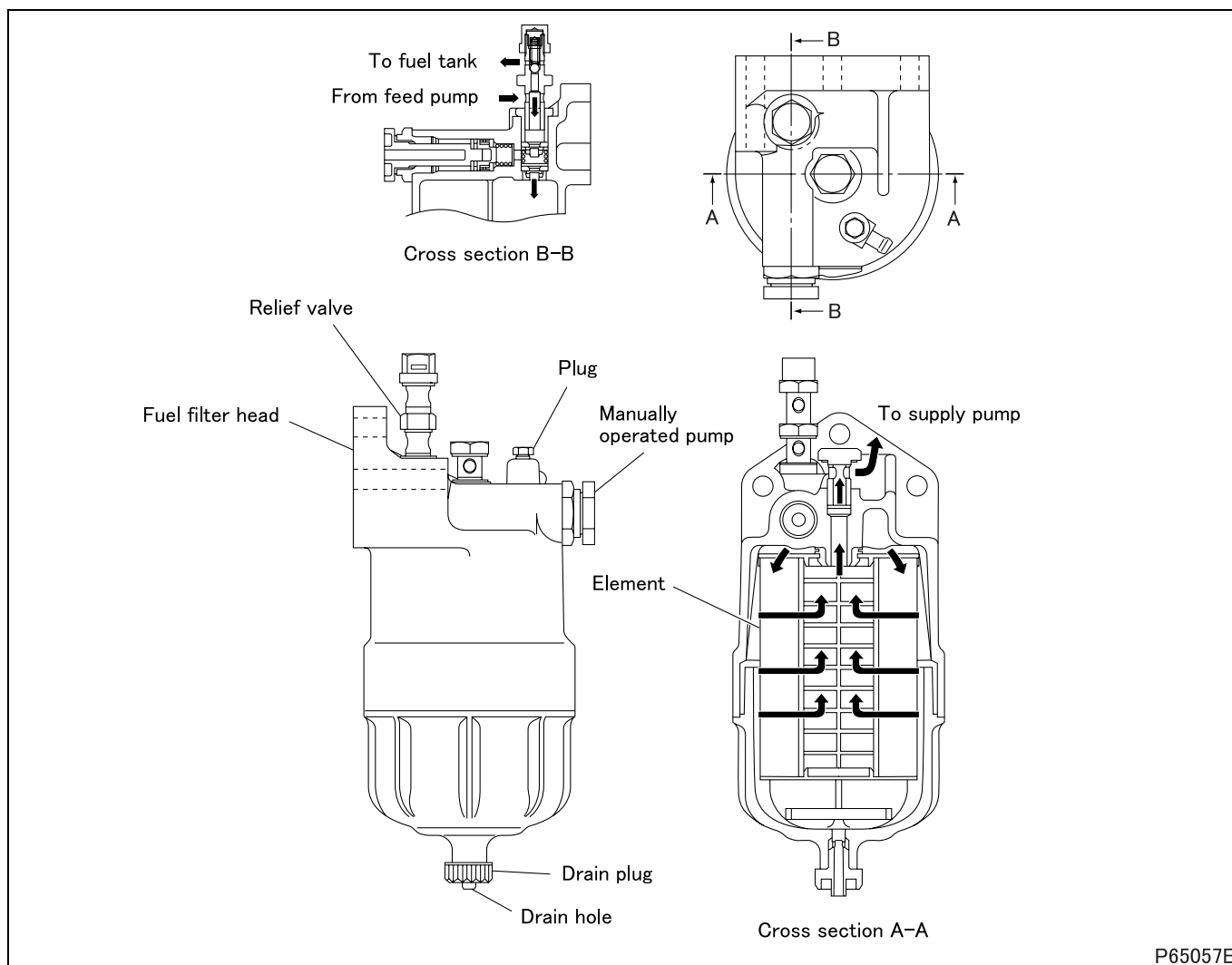
2.1 Accelerator pedal switch

- The accelerator pedal switch is used to monitor whether or not the accelerator pedal is pressed.

2.2 Accelerator pedal position sensor

- The accelerator pedal position sensor monitors for change in the position of the accelerator pedal and sends relevant electric signals to the common rail electronic control unit. The lever is constantly pulled towards the idling position by a return spring.

3. Fuel Filter

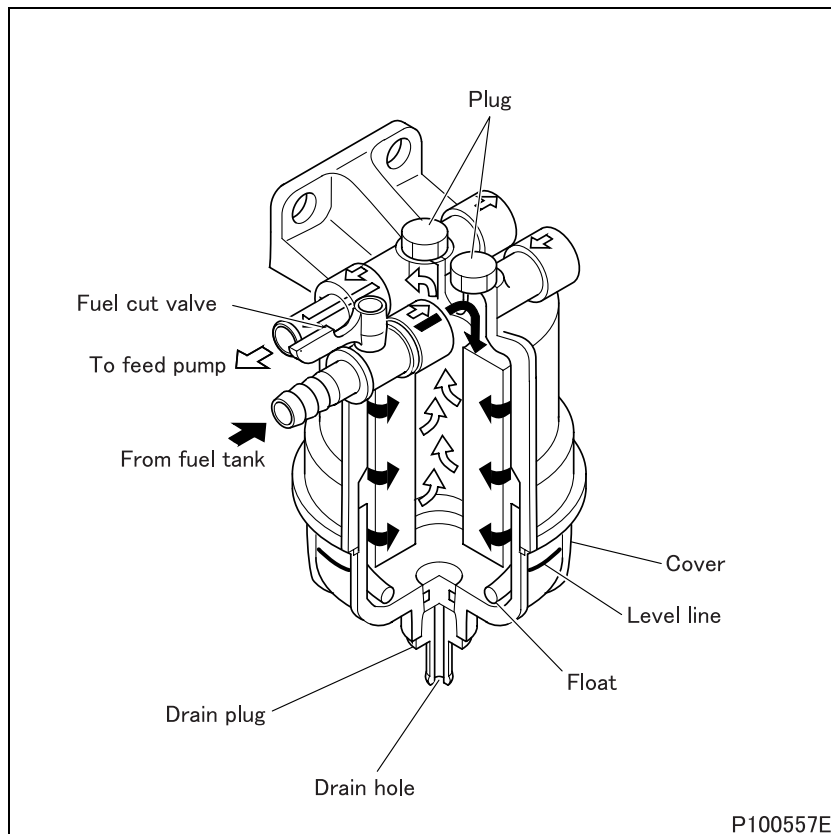


P65057E

- The fuel filter removes foreign matter from fuel via the filter element. The fuel filter also incorporates a water separator which separates any water from fuel.
- Water separated from fuel accumulates at the bottom of the fuel filter assembly.
- The water which has collected can be drained through the drain hole by loosening the drain plug.
- To bleed air from the fuel system, a manually operated pump and plug are provided on the fuel filter head.

STRUCTURE AND OPERATION

4. Water Separator



- A water separator is installed between the fuel tank and the feed pump. It is designed to remove impurities from fuel and also separates water from fuel.
- Water separated from fuel is collected at the bottom of the water separator and is drained when the float reaches the level line.
- To drain water collected, loosen the drain cock. This allows the water to be discharged through the drain hole.

M E M O

TROUBLESHOOTING <MITSUBISHI 6M70 FUEL SYSTEM>

Symptoms		Engine does not start	Engine hard to start	Engine knocks	Engine output inconsistent	Engine output not sufficient	Engine maximum speed too high	Engine idling unstable	Engine stalls immediately after start	Engine does not reach maximum speed	Engine does not stop	Fuel supply insufficient	Engine control warning lamp illuminates	Reference Gr
Possible causes														
Defective electronic control fuel system													O	
Supply pump	Defective feed pump		O			O			O		O			*
	Defective sealing of supply pump overflow valve		O			O			O		O			*
	Defective MPROP		O			O			O		O		O	
	Defective base supply pump		O			O			O		O			*
Common rail	Common rail pressure sensor open-circuited, short or intermittent connection; defective sensor	O	O		O	O			O				O	
	Pressure limiting valve malfunction			O		O							O	*
Incorrect injector fuel injection	Defective injector magnetic valve		O	O		O					O		O	
	Defective injector		O	O		O					O			*
Gauze filter clogged			O	O			O		O	O		O		
Fuel filter clogged			O			O			O	O				
Water separator clogged			O			O			O	O				
No fuel in fuel tank			O											
Fuel pipe clogged and fuel leak from joint			O											
Air or water in fuel system			O			O			O	O				
Poor quality fuel is used				O	O		O		O					
Fuel leak from high-pressure joint				O	O	O	O				O			
Engine control	Incorrectly adjusted accelerator pedal stopper bolt					O			O					
	Defective accelerator position sensor						O		O				O	
Engine speed sensor and cylinder recognition sensor open-circuited, short, or intermittent connection		O	O										O	
Boost pressure sensor open-circuited, short, or intermittent connection				O	O	O			O				O	
Water temperature sensor open-circuited, short, or intermittent connection		O	O										O	
Defective fuel injection volume adjusting resistor				O		O							O	
Idling speed adjustment knob intermittent connection				O				O					O	
Fuel pipe and hose cracked												O		

MPROP: Rail pressure control valve

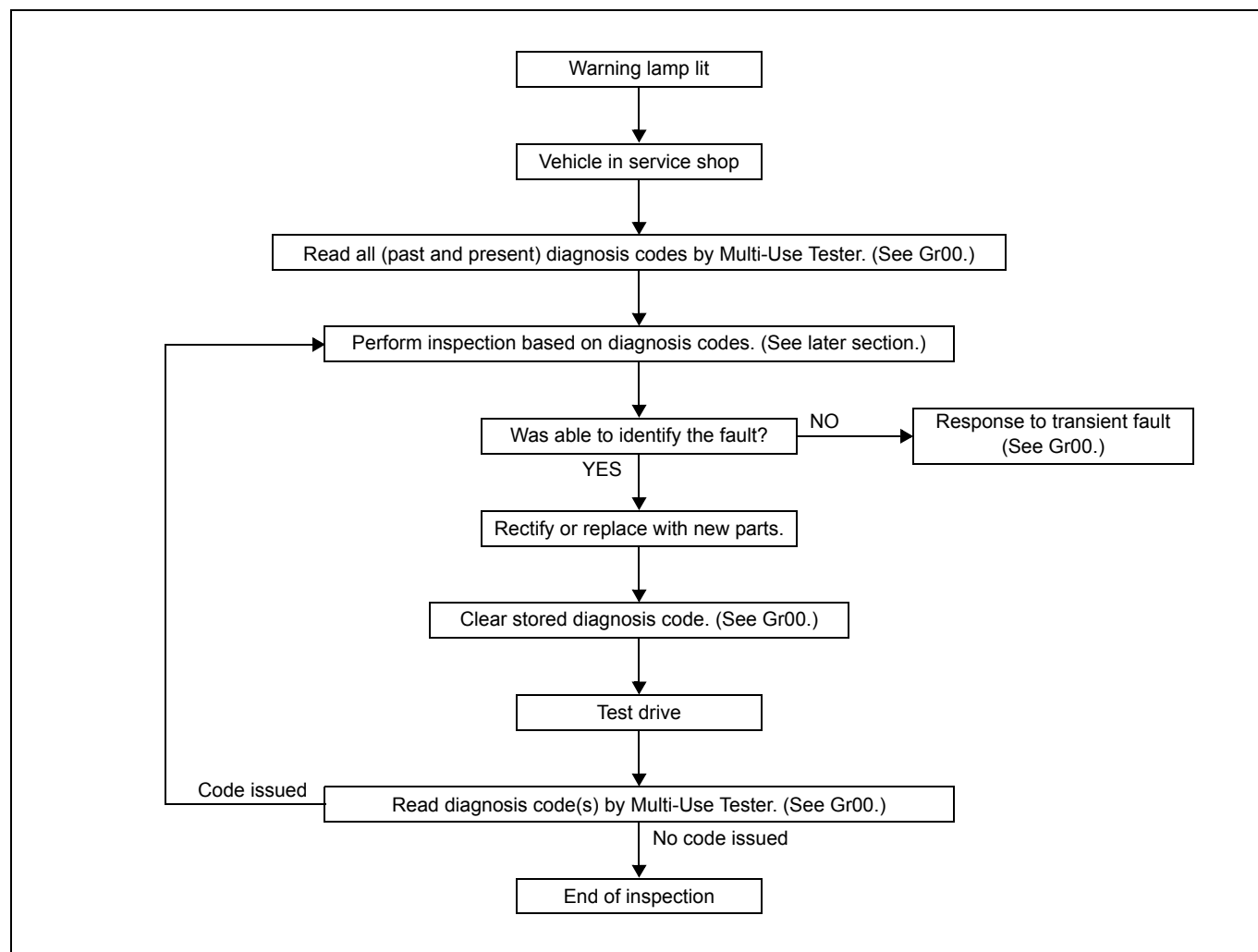
*: Contact Bosch Service Station for repair.

Possible causes	Symptoms												Reference Gr
	Engine does not start	Engine hard to start	Engine knocks	Engine output inconsistent	Engine output not sufficient	Engine maximum speed too high	Engine idling unstable	Engine stalls immediately after start	Engine does not reach maximum speed	Engine does not stop	Fuel supply insufficient	Engine control warning lamp illuminates	
Oil viscosity unsuitable		O					O						Gr12
Valve clearance incorrect		O					O						Gr11
Defective cylinder head gasket		O					O						
Valve and valve seat worn and carbon deposits		O					O						
Valve spring fatigued		O					O						
Piston ring worn and damaged		O					O						
Piston ring groove worn and damaged		O											
Piston and cylinder liner worn		O					O						Gr14
Cooling system malfunction		O					O						
Defective starter switch	O	O											Gr54
Blown fuse	O	O						O				O	Gr54

TROUBLESHOOTING <DIAGNOSIS USING Multi-Use Tester>

1. Diagnosis Procedure

- Perform the inspection in accordance with the following flowchart.



2. Diagnostic Precautions

- Before measuring voltage, check the battery for charged condition and specific gravity. If system inspection is performed with the battery uncharged or reduced in specific gravity, accurate measurements cannot be achieved.
- Before disconnecting battery cables, harnesses and connectors, set the starter switch to LOCK or OFF, then allow at least 20 seconds.
- To avoid having electrical parts damaged, set the starter switch and lighting switch to LOCK or OFF before reconnecting battery cables, harnesses and connectors.
- When performing measurement with the tester, handle the test bar carefully so that it does not damage internal circuit and other electrical parts of the electronic control unit to result in a short-circuit failure between terminals in connector or between connector and car body.
- Resistance is affected by temperature. Determine the necessity of resistance measurement following given temperature specification as a guide. Otherwise, use normal temperature (10 to 35°C) as the measuring condition.
- To start the engine, be sure to connect the connector of the MPROP (rail pressure control valve) to the engine harness. If the engine is started without connecting the MPROP connector, the engine electronic control unit cannot control the supply pump and the fault of the engine may result.

TROUBLESHOOTING <DIAGNOSIS USING Multi-Use Tester>

3. Inspections Based on Diagnosis Codes

3.1 Diagnosis code list

- Diagnosis codes shown by the Multi-Use Tester and those indicated by warning lamp display are different.
- The Multi-Use Tester is capable of showing more detailed diagnosis codes.

Code	Message	Warning lamp indication			Remarks
		Flashes	Red	Orange	
P0107	Atmospheric Pressure Sensor	19	–	O	
P0108	Atmospheric Pressure Sensor	19	–	O	
P0112	INT Air Temp SNSR (Low)	44	–	O	
P0113	INT Air Temp SNSR (High)	44	–	O	
P0117	Water Temp SNSR (Low)	21	–	O	
P0118	Water Temp SNSR (High)	21	–	O	
P0121	Accel Pedal Check (Plausibility)	58	–	O	
P0122	Accel Pedal Sensor 1	24	–	O	
P0123	Accel Pedal Sensor 1	24	–	O	
P0182	Fuel Temp Sensor (inlet) Low	41	–	O	
P0183	Fuel Temp Sensor (inlet) High	41	–	O	
P0192	CRS Pressure SNSR (Low)	11	–	O	
P0193	CRS Pressure SNSR (High)	11	–	O	
P0200	Injector Circuit 1	82	–	O	
P0201	Injector M/V-Cylinder 1 (Load)	37	–	O	
P0202	Injector M/V-Cylinder 2 (Load)	38	–	O	
P0203	Injector M/V-Cylinder 3 (Load)	39	–	O	
P0204	Injector M/V-Cylinder 4 (Load)	8	–	O	
P0205	Injector M/V-Cylinder 5 (Load)	46	–	O	
P0206	Injector M/V-Cylinder 6 (Load)	47	–	O	
P0219	Engine Overrunning	7	O	–	
P0222	Accel Pedal Sensor 2	16	–	O	
P0223	Accel Pedal Sensor 2	16	–	O	
P0227	PTO Accel Sensor	61	–	O	
P0228	PTO Accel Sensor	61	–	O	
P0234	Over Boost	54	–	O	Gr15
P0237	Boost Press SNSR (Low)	32	–	O	
P0238	Boost Press SNSR (High)	32	–	O	
P0251	Common Rail Pressure Defect	36	–	O	
P0253	Common Rail Pressure Defect	22	O	–	
P0254	Common Rail Pressure Defect	23	O	O	
P0335	Engine Revolution SNSR	15	–	O	
P0340	Camshaft Position SNSR	12	–	O	
P0500	Vehicle Speed Sensor	25	–	O	
P0506	Idle Volume	31	–	–	
P0507	Idle Volume	31	–	–	
P0510	Accel SW	65	–	–	
P0560	M/V Supply Voltage	79	–	O	
P0600	CAN Communication	–	O	–	
P0605	ECU System (Hardware)	33	O	O	
P0615	Starter Safety Relay (Over Load)	48	–	O	Gr54
P0616	Starter Safety Relay (Low)	48	–	O	Gr54

Code	Message	Warning lamp indication			Remarks
		Flashes	Red	Orange	
P0617	Starter Safety Relay (High)	48	–	O	Gr54
P1130	VGT 1	51	–	O	Gr15
P1132	VGT 1	51	–	O	Gr15
P1133	VGT 1	51	–	O	Gr15
P1135	VGT 2	52	–	O	Gr15
P1137	VGT 2	52	–	O	Gr15
P1138	VGT 2	52	–	O	Gr15
P1140	VGT 3	53	–	O	Gr15
P1142	VGT 3	53	–	O	Gr15
P1143	VGT 3	53	–	O	Gr15
P1171	Q Adjustment Resistor (Low)	34	–	O	
P1172	Q Adjustment Resistor (High)	34	–	O	
P1176	PTO Adjustment Resistor (Low)	62	–	O	
P1177	PTO Adjustment Resistor (High)	62	–	O	
P1200	Injector Circuit 2	82	–	O	
P1236	Turbine Revolution SNSR (Low)	57	–	O	Gr15
P1237	Turbine Revolution SNSR (High)	57	–	O	Gr15
P1238	Turbine Overrunning	59	–	O	Gr15
P1251	Common Rail Pressure M/V 1	63	–	O	
P1253	Common Rail Pressure M/V 2	63	–	O	
P1254	PRV Opening	36	–	O	
P1255	Common Rail Pressure M/V 1	63	–	O	
P1256	Common Rail Pressure M/V 1	63	–	O	
P1258	Common Rail Pressure M/V 2	63	–	O	
P1259	Common Rail Pressure M/V 2	63	–	O	
P125A	Rail Pressure M/V 1 (Over Load)	63	O	–	
P125B	Rail Pressure M/V 1 (Long Short)	63	O	–	
P125C	Rail Pressure M/V 2 (Over Load)	63	O	–	
P125D	Rail Pressure M/V 2 (Long Short)	63	O	–	
P1267	EGR 1	67	–	O	Gr17
P1268	EGR 1	67	–	O	Gr17
P1272	EGR 2	68	–	O	Gr17
P1273	EGR 2	68	–	O	Gr17
P1277	EGR 3	69	–	O	Gr17
P1278	EGR 3	69	–	O	Gr17
P1335	Revolution & Position Sensor	14	O	–	
P1460	Auxiliary Brake M/V 1	93	–	O	
P1462	Auxiliary Brake M/V 1	93	–	O	
P1463	Auxiliary Brake M/V 1	93	–	O	
P1562	Sensor Supply Voltage 1	81	–	–	
P1563	Sensor Supply Voltage 1	81	–	–	
P1567	Sensor Supply Voltage 2	81	–	–	
P1568	Sensor Supply Voltage 2	81	–	–	
P1572	Sensor Supply Voltage 3	81	–	O	
P1573	Sensor Supply Voltage 3	81	–	O	
P1605	ECU System (EEPROM)	33	–	O	
P1606	ECU System (Software)	33	O	–	
P1625	EDU Relay	84	–	O	Gr17

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Code	Message	Warning lamp indication			Remarks
		Flashes	Red	Orange	
P1630	CAN (EGR 1)	95	–	O	Gr17

3.2 Diagnosis code generation conditions and inspection items

P0107: Atmospheric Pressure Sensor (warning lamp flashes: 19)

Generation condition		Atmospheric pressure sensor (incorporated into engine electronic control unit) voltage remains less than 2 V for 3 seconds.
Recoverability		System recovers when atmospheric pressure sensor (incorporated into engine electronic control unit) remains 2 V or more for 1 second.
Control effected by electronic control unit		- Control is effected using backup value of 101.3 kPa {1.03 kgf/cm²}. (Exhaust emissions worsen.) - Exhaust gas recirculation control is stopped.
Inspection	Service data	30: Atmospheric Pressure
	Other	Replace engine electronic control unit.

P0108: Atmospheric Pressure Sensor (warning lamp flashes: 19)

Generation condition		Atmospheric pressure sensor (incorporated into engine electronic control unit) voltage remains higher than 4.7 V for 3 seconds.
Recoverability		System recovers when atmospheric pressure sensor (incorporated into engine electronic control unit) voltage remains 4.7 V or less for 1 second.
Control effected by electronic control unit		- Control is effected using backup value of 101.3 kPa {1.03 kgf/cm²}. (Exhaust emissions worsen.) - Exhaust gas recirculation control is stopped.
Inspection	Service data	30: Atmospheric Pressure
	Other	Replace engine electronic control unit.

P0112: INT Air Temp SNSR (Low) (warning lamp flashes: 44)

Generation condition		Intake air temperature sensor 1 voltage remains less than 0.15 V for 3 seconds.
Recoverability		System recovers when intake air temperature sensor 1 voltage remains 0.15 V or more for 1 second.
Control effected by electronic control unit		Control is effected using backup value (25°C).
Inspection	Service data	2B: Intake Air Temperature
	Electronic control unit connector	01 : Intake air temperature sensor 1
	Electrical equipment	#305: Intake air temperature sensor 1
	Electric circuit diagram	Intake air temperature sensor 1 system

P0113: INT Air Temp SNSR (High) (warning lamp flashes: 44)

Generation condition		Intake air temperature sensor 1 voltage remains higher than 4.85 V for 3 seconds.
Recoverability		System recovers when intake air temperature sensor 1 voltage remains 4.85 V or less for 1 second.
Control effected by electronic control unit		Control is effected using backup value (25°C).
Inspection	Service data	2B: Intake Air Temperature
	Electronic control unit connector	01 : Intake air temperature sensor 1
	Electrical equipment	#305: Intake air temperature sensor 1
	Electric circuit diagram	Intake air temperature sensor 1 system

P0117: Water Temp SNSR (Low) (warning lamp flashes: 21)

Generation condition		Water temperature sensor voltage remains less than 0.2 V for 3 seconds.
Recoverability		System recovers when water temperature sensor voltage remains 0.2 V or more for 1 second.
Control effected by electronic control unit		- Control is effected using backup value (at engine startup: -20°C; when engine is running: 80°C). - Exhaust gas recirculation control is stopped.
Inspection	Service data	2E: Water Temperature
	Electronic control unit connector	02 : Water temperature sensor
	Electrical equipment	#262: Water temperature sensor
	Electric circuit diagram	Water temperature sensor system

P0118: Water Temp SNSR (High) (warning lamp flashes: 21)

Generation condition		Water temperature sensor voltage remains higher than 4.85 V for 3 seconds.
Recoverability		System recovers when water temperature sensor voltage remains 4.85 V or less for 1 second.
Control effected by electronic control unit		- Control is effected using backup value (at engine startup: -20°C; when engine is running: 80°C). - Exhaust gas recirculation control is stopped.
Inspection	Service data	2E: Water Temperature
	Electronic control unit connector	02 : Water temperature sensor
	Electrical equipment	#262: Water temperature sensor
	Electric circuit diagram	Water temperature sensor system

P0121: Accel Pedal Check (Plausibility) (warning lamp flashes: 58)

Generation condition		The difference in output voltage between accelerator pedal position sensors 1 and 2 remains 70% or more for 6 seconds when the sensors are normal.
Recoverability		System recovers if difference in output voltage between accelerator pedal position sensors 1 and 2 remains less than 70% for 3 seconds when the sensors are normal.
Control effected by electronic control unit		– (Low output)
Inspection	Service data	22: Accel Pedal Position (unfiltered), 23: Accel Pedal Position (filtered) 24: Accel Pedal Sensor Voltage 1, 25: Accel Pedal Sensor Voltage 2
	Electronic control unit connector	03 : Accelerator pedal position sensor
	Electrical equipment	#324: Accelerator pedal position sensor
	Electric circuit diagram	Accelerator pedal position sensor system

P0122: Accel Pedal Sensor 1 (warning lamp flashes: 24)

Generation condition		Accelerator pedal position sensor 1 voltage remains less than 0.5 V for 1 second.
Recoverability		System recovers when accelerator pedal position sensor 1 voltage remains 0.5 V or more for 1 second.
Control effected by electronic control unit		- If accelerator pedal position sensor 1 alone is faulty Control is effected using accelerator pedal position sensor 2. - If both accelerator pedal position sensors 1 and 2 are faulty - Exhaust gas recirculation control is stopped. - Auto cruise control is stopped. - Turbocharger control is stopped. - Control is effected using backup value (when accelerator pedal switch is ON: accelerator pedal is not pressed (0%); when the switch is OFF: the pedal is pressed 30%).
Inspection	Service data	22: Accel Pedal Position (unfiltered), 23: Accel Pedal Position (filtered) 24: Accel Pedal Sensor Voltage 1
	Electronic control unit connector	03 : Accelerator pedal position sensor
	Electrical equipment	#324: Accelerator pedal position sensor
	Electric circuit diagram	Accelerator pedal position sensor 1 system

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P0123: Accel Pedal Sensor 1 (warning lamp flashes: 24)

Generation condition		Accelerator pedal position sensor 1 voltage remains higher than 4.5 V for 1 second.
Recoverability		System recovers when accelerator pedal position sensor 1 voltage remains 4.5 V or less for 1 second.
Control effected by electronic control unit		- If accelerator pedal position sensor 1 alone is faulty Control is effected using accelerator pedal position sensor 2. - If both accelerator pedal position sensors 1 and 2 are faulty - Exhaust gas recirculation control is stopped. - Auto cruise control is stopped. - Turbocharger control is stopped. - Control is effected using backup value (when accelerator pedal switch is ON: accelerator pedal is not pressed (0%); when the switch is OFF: the pedal is pressed 30%).
Inspection	Service data	22: Accel Pedal Position (unfiltered), 23: Accel Pedal Position (filtered) 24: Accel Pedal Sensor Voltage 1
	Electronic control unit connector	03 : Accelerator pedal position sensor
	Electrical equipment	#324: Accelerator pedal position sensor
	Electric circuit diagram	Accelerator pedal position sensor 1 system

P0182: Fuel Temp Sensor (inlet) Low (warning lamp flashes: 41)

Generation condition		Fuel temperature sensor voltage remains less than 0.15 V for 3 seconds.
Recoverability		System recovers when fuel temperature sensor voltage remains 0.15 V or more for 1 second.
Control effected by electronic control unit		Control is effected using backup value (40°C).
Inspection	Service data	2F: Fuel Temperature (Inlet)
	Electronic control unit connector	04 : Fuel temperature sensor
	Electrical equipment	#323: Fuel temperature sensor
	Electric circuit diagram	Fuel temperature sensor system

P0183: Fuel Temp Sensor (inlet) High (warning lamp flashes: 41)

Generation condition		Fuel temperature sensor voltage remains higher than 4.8 V for 3 seconds.
Recoverability		System recovers when fuel temperature sensor voltage remains 4.8 V or less for 1 second.
Control effected by electronic control unit		Control is effected using backup value (40°C).
Inspection	Service data	2F: Fuel Temperature (Inlet)
	Electronic control unit connector	04 : Fuel temperature sensor
	Electrical equipment	#323: Fuel temperature sensor
	Electric circuit diagram	Fuel temperature sensor system

P0192: CRS Pressure SNSR (Low) (warning lamp flashes: 11)

Generation condition		Common rail pressure sensor voltage remains less than 0.2 V for 0.25 second.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF (2 minutes or more) → ON.
Control effected by electronic control unit		- Common rail pressure open loop control is effected. (Output is reduced, and exhaust emissions worsen.) - Exhaust gas recirculation control is stopped. - Auto cruise control is stopped. - Actuator tests "B9: Fuel Leak Check, BB to C0: Injector Test, BA: VGT Test" are stopped.
Inspection	Service data	0C: Difference Common Rail Pressure
	Electrical equipment	#319: Common rail pressure sensor
	Electric circuit diagram	Common rail pressure sensor system

P0193: CRS Pressure SNSR (High) (warning lamp flashes: 11)

Generation condition		Common rail pressure sensor voltage remains higher than 4.8 V for 0.25 second.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF (2 minutes or more) → ON.
Control effected by electronic control unit		- Common rail pressure open loop control is effected. (Output is reduced, and exhaust emissions worsen.) - Exhaust gas recirculation control is stopped. - Auto cruise control is stopped. - Actuator tests "B9: Fuel Leak Check, BB to C0: Injector Test, BA: VGT Test" are stopped.
Inspection	Service data	0C: Difference Common Rail Pressure
	Electrical equipment	#319: Common rail pressure sensor
	Electric circuit diagram	Common rail pressure sensor system

P0200: Injector Circuit 1 (warning lamp flashes: 82)

Generation condition		Injector circuit (No. 1, 2 or 3 cylinder) is short-circuited, open-circuited, or overloaded.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF (2 minutes or more) → ON.
Control effected by electronic control unit		- Injector magnetic valve (No. 1, 2 or 3 cylinder) control is stopped. (Output is reduced due to three-cylinder operation, and exhaust emissions worsen.) - Exhaust gas recirculation control is stopped. - Auto cruise control is stopped. - Turbocharger control is stopped. - Actuator tests "B9: Fuel Leak Check, BB to C0: Injector Test, BA: VGT Test" are stopped.
Inspection	Actuator test	BB: Injector Test 1, BC: Injector Test 2, BD: Injector Test 3,
	Electronic control unit connector	05 : Injector magnetic valve
	Electrical equipment	#582: Injector magnetic valve
	Electric circuit diagram	Injector magnetic valve (No. 1, 2 or 3 cylinder) system

P0201: Injector M/V-Cylinder 1 (Load) (warning lamp flashes: 37)

Generation condition		Injector magnetic valve (No. 1 cylinder) is short-circuited, open-circuited or overloaded.
Recoverability		- When short-circuited or overloaded - System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF (2 minutes or more) → ON. - When open-circuited - System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		- Exhaust gas recirculation control is stopped. - Injector magnetic valves (No. 1, 2 and 3 cylinder) are stopped. (Output is reduced, and exhaust emissions worsen.) - Auto cruise control is stopped. - Actuator test "BA: VGT Test" is stopped.
Inspection	Actuator test	BB: Injector Test 1
	Electronic control unit connector	05 : Injector magnetic valve
	Electrical equipment	#582: Injector magnetic valve
	Electric circuit diagram	Injector magnetic valve (No. 1 cylinder) system

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P0202: Injector M/V-Cylinder 2 (Load) (warning lamp flashes: 38)

Generation condition		Injector magnetic valve (No. 5 cylinder) is short-circuited, open-circuited or overloaded.
Recoverability		- When short-circuited or overloaded - System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF (2 minutes or more) → ON. - When open-circuited - System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		- Exhaust gas recirculation control is stopped. - Injector magnetic valves (No. 4, 5 and 6 cylinder) are stopped. (Output is reduced, and exhaust emissions worsen.) - Auto cruise control is stopped. - Actuator test "BA: VGT Test" is stopped.
Inspection	Actuator test	BF: Injector Test 5
	Electronic control unit connector	05 : Injector magnetic valve
	Electrical equipment	#582: Injector magnetic valve
	Electric circuit diagram	Injector magnetic valve (No. 5 cylinder) system

P0203: Injector M/V-Cylinder 3 (Load) (warning lamp flashes: 39)

Generation condition		Injector magnetic valve (No. 3 cylinder) is short-circuited, open-circuited or overloaded.
Recoverability		- When short-circuited or overloaded - System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF (2 minutes or more) → ON. - When open-circuited - System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		- Exhaust gas recirculation control is stopped. - Injector magnetic valves (No. 1, 2 and 3 cylinder) are stopped. (Output is reduced, and exhaust emissions worsen.) - Auto cruise control is stopped. - Actuator test "BA: VGT Test" is stopped.
Inspection	Actuator test	BD: Injector Test 3
	Electronic control unit connector	05 : Injector magnetic valve
	Electrical equipment	#582: Injector magnetic valve
	Electric circuit diagram	Injector magnetic valve (No. 3 cylinder) system

P0204: Injector M/V-Cylinder 4 (Load) (warning lamp flashes: 08)

Generation condition		Injector magnetic valve (No. 6 cylinder) is short-circuited, open-circuited or overloaded.
Recoverability		- When short-circuited or overloaded - System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF (2 minutes or more) → ON. - When open-circuited - System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		- Exhaust gas recirculation control is stopped. - Injector magnetic valves (No. 4, 5 and 6 cylinder) are stopped. (Output is reduced, and exhaust emissions worsen.) - Auto cruise control is stopped. - Actuator test "BA: VGT Test" is stopped.
Inspection	Actuator test	C0: Injector Test 6
	Electronic control unit connector	05 : Injector magnetic valve
	Electrical equipment	#582: Injector magnetic valve
	Electric circuit diagram	Injector magnetic valve (No. 6 cylinder) system

P0205: Injector M/V-Cylinder 5 (Load) (warning lamp flashes: 46)

Generation condition		Injector magnetic valve (No. 2 cylinder) is short-circuited, open-circuited or overloaded.
Recoverability		- When short-circuited or overloaded - System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF (2 minutes or more) → ON. - When open-circuited - System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		- Exhaust gas recirculation control is stopped. - Injector magnetic valves (No. 1, 2 and 3 cylinder) are stopped. (Output is reduced, and exhaust emissions worsen.) - Auto cruise control is stopped. - Actuator test "BA: VGT Test" is stopped.
Inspection	Actuator test	BC: Injector Test 2
	Electronic control unit connector	05 : Injector magnetic valve
	Electrical equipment	#582: Injector magnetic valve
	Electric circuit diagram	Injector magnetic valve (No. 2 cylinder) system

P0206: Injector M/V-Cylinder 6 (Load) (warning lamp flashes: 47)

Generation condition		Injector magnetic valve (No. 4 cylinder) is short-circuited, open-circuited or overloaded.
Recoverability		- When short-circuited or overloaded - System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF (2 minutes or more) → ON. - When open-circuited - System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		- Exhaust gas recirculation control is stopped. - Injector magnetic valves (No. 4, 5 and 6 cylinder) are stopped. (Output is reduced, and exhaust emissions worsen.) - Auto cruise control is stopped. - Actuator test "BA: VGT Test" is stopped.
Inspection	Actuator test	BE: Injector Test 4
	Electronic control unit connector	05 : Injector magnetic valve
	Electrical equipment	#582: Injector magnetic valve
	Electric circuit diagram	Injector magnetic valve (No. 4 cylinder) system

P0219: Engine Overrunning (warning lamp flashes: 07)

Generation condition		Engine speed is 2900 rpm or higher.
Recoverability		System recovers if engine speed is 2500 rpm or less.
Control effected by electronic control unit		- No feed from MPROP (rail pressure control valve) - Exhaust gas recirculation control - Auto cruise control is stopped. - Turbocharger control is stopped.
Inspection	Other	- Check for occurrences of diagnosis code "P0335: Engine Revolution SNSR". - If the diagnosis code is redisplayed with the pointer of the tachometer not reaching the red zone, replace the engine electronic control unit.

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P0222: Accel Pedal Sensor 2 (warning lamp flashes: 16)

Generation condition		Accelerator pedal position sensor 2 voltage remains less than 0.5 V for 1 second.
Recoverability		System recovers when accelerator pedal position sensor 2 voltage remains 0.5 V or more for 1 second.
Control effected by electronic control unit		- If accelerator pedal position sensor 2 alone is faulty Control is effected using accelerator pedal position sensor 1. - If both accelerator pedal position sensors 1 and 2 are faulty - Exhaust gas recirculation control is stopped. - Auto cruise control is stopped. - Turbocharger control is stopped. - Control is effected using backup value (when accelerator pedal switch is ON: accelerator pedal is not pressed (0%); when the switch is OFF: the pedal is pressed 30%).
Inspection	Service data	22: Accel Pedal Position (unfiltered), 23: Accel Pedal Position (filtered) 25: Accel Pedal Sensor Voltage 2
	Electronic control unit connector	03 : Accelerator pedal position sensor
	Electrical equipment	#324: Accelerator pedal position sensor
	Electric circuit diagram	Accelerator pedal position sensor 2 system

P0223: Accel Pedal Sensor 2 (warning lamp flashes: 16)

Generation condition		Accelerator pedal position sensor 2 voltage remains higher than 4.5 V for 1 second.
Recoverability		System recovers when accelerator pedal position sensor 2 voltage remains 4.5 V or less for 1 second.
Control effected by electronic control unit		- If accelerator pedal position sensor 2 alone is faulty Control is effected using accelerator pedal position sensor 1. - If both accelerator pedal position sensors 1 and 2 are faulty - Exhaust gas recirculation control is stopped. - Auto cruise control is stopped. - Turbocharger control is stopped. - Control is effected using backup value (when accelerator pedal switch is ON: accelerator pedal is not pressed (0%); when the switch is OFF: the pedal is pressed 30%).
Inspection	Service data	22: Accel Pedal Position (unfiltered), 23: Accel Pedal Position (filtered) 25: Accel Pedal Sensor Voltage 2
	Electronic control unit connector	03 : Accelerator pedal position sensor
	Electrical equipment	#324: Accelerator pedal position sensor
	Electric circuit diagram	Accelerator pedal position sensor 2 system

P0227: PTO Accel Pedal Sensor (warning lamp flashes: 61)

Generation condition		Voltage of power take-off load sensor remains less than 0.5 V for 1 second when governor control switch is ON.
Recoverability		System recovers when voltage of power take-off load sensor remains 0.5 V or more for 1 second when governor control switch is ON.
Control effected by electronic control unit		- When governor control switch is ON - Engine warning lamp (orange) display - Control is effected using backup value (output: 0%).
Inspection	Service data	34: PTO Accel Position, 35: PTO Accel Sensor Voltage
	Electronic control unit connector	06 : Power take-off load sensor
	Electrical equipment	#317: Power take-off load sensor
	Electric circuit diagram	Power take-off load sensor system

P0228: PTO Accel Sensor (warning lamp flashes: 61)

Generation condition		Voltage of power take-off load sensor remains higher than 3.5 V for 1 second when governor control switch is ON.
Recoverability		System recovers when voltage of power take-off load sensor remains 3.5 V or less for 1 second when governor control switch is ON.
Control effected by electronic control unit		- When governor control switch is ON - Engine warning lamp (orange) display - Control is effected using backup value (output: 0%).
Inspection	Service data	34: PTO Accel Position, 35: PTO Accel Sensor Voltage
	Electronic control unit connector	06 : Power take-off load sensor
	Electrical equipment	#317: Power take-off load sensor
	Electric circuit diagram	Power take-off load sensor system

P0237: Boost Press SNSR (Low) (warning lamp flashes: 32)

Generation condition		Boost pressure sensor voltage remains less than 0.3 V for 3 seconds.
Recoverability		System recovers when boost pressure sensor voltage remains 0.3 V or more for 1 second.
Control effected by electronic control unit		- Control is effected using backup value of 101.3 kPa {1.03 kgf/cm²}. (Output is reduced, and fuel economy worsens.) - Actuator test "BA: VGT Test" is stopped.
Inspection	Service data	26: Boost Pressure
	Electrical equipment	#318: Boost pressure sensor
	Electric circuit diagram	Boost pressure sensor system

P0238: Boost Press SNSR (High) (warning lamp flashes: 32)

Generation condition		Boost pressure sensor voltage remains higher than 4.7 V for 3 seconds.
Recoverability		System recovers when boost pressure sensor voltage remains 4.7 V or less for 1 second.
Control effected by electronic control unit		- Control is effected using backup value of 101.3 kPa {1.03 kgf/cm²}. (Output is reduced, and fuel economy worsens.) - Actuator test "BA: VGT Test" is stopped.
Inspection	Service data	26: Boost Pressure
	Electrical equipment	#318: Boost pressure sensor
	Electric circuit diagram	Boost pressure sensor system

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P0251: Common Rail Pressure Defect (warning lamp flashes: 36)

Generation condition		Diagnosis code is generated under either of the following conditions. (1) MPROP (rail pressure control valve) power supply remains low for 1 second. (2) The difference between target common rail pressure and actual common rail pressure remains 30% or more for 10 seconds.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF (2 minutes or more) → ON.
Control effected by electronic control unit		- In the case of above problem (1) - No specific control is effected. - In the case of above problem (2) - Injection quantity is limited. (Output is reduced.) - Exhaust gas recirculation control is stopped. - Auto cruise control is stopped.
Inspection	Service data	0C: Difference Common Rail Pressure
	Actuator test	B9: Fuel Leak Check
	Other	- Air-bleeding of fuel system (See "ON-VEHICLE INSPECTION AND ADJUSTMENT".) - Inspection of fuel piping (See "COMMON RAIL".) - Fuel filter (See "FUEL FILTER".) - Gauze filter (See "ON-VEHICLE INSPECTION AND ADJUSTMENT".) - Supply pump (Have work performed by Bosch.) - Pressure limiting valve (Have work performed by Bosch.) - Injectors (Have work performed by Bosch.)

P0253: Common Rail Pressure Defect (warning lamp flashes: 22)

Generation condition		Diagnosis code is generated under either of the following conditions. (1) Common rail pressure sensor voltage remains less than 0.74 V for 30 seconds. (2) The difference between target common rail pressure and actual common rail pressure is 30% or more, and MPROP (rail pressure control valve) discharge rate remains above the specified value for 60 seconds.
Recoverability		- In the case of above problem (1) - System recovers when common rail pressure sensor voltage remains 0.74 V or more for 5 seconds. - In the case of above problem (2) - System recovers when the difference between target rail pressure and actual rail pressure is 30% or less, or MPROP (rail pressure control valve) discharge rate remains less than the specified value for 5 seconds.
Control effected by electronic control unit		Engine is stopped.
Inspection	Service data	C0: Difference Common Rail Pressure
	Actuator test	B9: Fuel Leak Check
	Other	- Air-bleeding of fuel system (See "ON-VEHICLE INSPECTION AND ADJUSTMENT".) - Inspection of fuel piping (See "COMMON RAIL".) - Fuel filter (See "FUEL FILTER".) - Gauze filter (See "ON-VEHICLE INSPECTION AND ADJUSTMENT".) - Supply pump (Have work performed by Bosch.) - Pressure limiting valve (Have work performed by Bosch.) - Injectors (Have work performed by Bosch.)

P0254: Common Rail Pressure Defect (warning lamp flashes: 23)

Generation condition		Diagnosis code is generated under either of the following conditions. (1) Common rail pressure sensor voltage remains 4.4 V or more for 10 seconds when common rail pressure is controlled without feedback value. (2) When above problem (1) is not occurred, common rail pressure sensor voltage remains 2.96 V or more for 10 seconds when common rail pressure is controlled without feedback value. (3) Common rail pressure sensor voltage remains 4.4 V or more for 5 seconds. (4) The difference between target common rail pressure and actual common rail pressure is 30% or more, and MPROP (rail pressure control valve) discharge rate remains above the specified value for 10 seconds.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF (2 minutes or more) → ON.
Control effected by electronic control unit		• In the case of above problems (1) and (2) • Engine warning lamp (red) display • Engine is stopped. • In the case of above problems (3) and (4) • Engine warning lamp (orange) display • Injection quantity is limited. (Output is reduced, and exhaust emissions worsen.) • Exhaust gas recirculation control is stopped. • Auto cruise control is stopped.
Inspection	Service data	C0: Difference Common Rail Pressure
	Other	Supply pump (Have work performed by Bosch.)

P0335: Engine Revolution SNSR (warning lamp flashes: 15)

Generation condition		Diagnosis code is generated under either of the following conditions. (1) Signals from engine speed sensor are not input while signals from cylinder recognition sensor are recognized. (2) Engine speed recognized by engine speed sensor is higher than 6000 rpm when engine speed is higher than 450 rpm.
Recoverability		• In the case of above problem (1) • System recovers if signals from engine speed sensor are input while signals from cylinder recognition sensor are recognized. • In the case of above problem (2) • System recovers if engine speed recognized by engine speed sensor is 6000 rpm or less when engine speed is higher than 450 rpm.
Control effected by electronic control unit		• Control is effected using cylinder recognition sensor. (Output decreases owing to reduced control accuracy.) • Auto cruise control is stopped.
Inspection	Service data	01: Engine Revolution
	Electronic control unit connector	07 : Engine speed sensor
	Electrical equipment	#263: Engine speed sensor
	Electric circuit diagram	Engine speed sensor system

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P0340: Camshaft Position SNSR (warning lamp flashes: 12)

Generation condition		Diagnosis code is generated under either of the following conditions. (1) Phase difference between cylinder recognition sensor and engine speed sensor deviates from the standard value when engine speed is 20 rpm or more. (2) No signal from the cylinder recognition sensor during the 132-pulse inputs of the engine speed sensor signal after recognition of the gap of the engine speed sensor. (3) Abnormal signal (timing) of cylinder recognition sensor signal during the 240-pulse inputs of the engine speed sensor signal.
Recoverability		- In the case of above problem (1) - System recovers when phase difference between cylinder recognition sensor and engine speed sensor is within the standard value when engine speed is 20 rpm or more. - In the case of above problem (2) - System recovers when signals from cylinder recognition sensor are input. - In the case of above problem (3) - System recovers when the signal (timing) of cylinder recognition sensor signal during the 240-pulse inputs of the engine speed sensor signal becomes normal.
Control effected by electronic control unit		- In the case of above problem (1) - Control is effected using engine speed sensor. - In the case of above problems (2) and (3) - Control is effected using engine speed sensor. - Auto cruise control is stopped.
Inspection	Service data	01: Engine Revolution
	Electronic control unit connector	08 : Cylinder recognition sensor
	Electrical equipment	#320: Cylinder recognition sensor
	Electric circuit diagram	Cylinder recognition sensor system

P0500: Vehicle Speed Sensor (warning lamp flashes: 25)

Generation condition		Vehicle speed remains 2 km/h or less for 20 seconds when engine speed is 1000 rpm or more, clutch pedal is released and transmission neutral signal indicates that transmission is in gear.
Recoverability		System recovers when vehicle speed remains 2 km/h or more for 3 seconds when engine speed is 1000 rpm or more, clutch pedal is released and transmission neutral signal indicates that transmission is in gear.
Control effected by electronic control unit		- Auto cruise control is stopped. - Vehicle speed limiting control is stopped. (Engine speed is also limited.)
Inspection	Service data	29: Vehicle Speed
	Electronic control unit connector	09 : Vehicle speed sensor
	Electrical equipment	#265: Vehicle speed sensor
	Electric circuit diagram	Vehicle speed sensor system

P0506: Idle Volume (warning lamp flashes: 31)

Generation condition		Idling speed adjustment potentiometer voltage remains less than 0.7 V for 3 seconds.
Recoverability		System recovers when idling speed adjustment potentiometer voltage remains 0.7 V or more for 1 second.
Control effected by electronic control unit		- Control is effected with auto idle permanently selected. - Actuator test "BA: VGT Test" is stopped.
Inspection	Service data	28: Idle Volume Voltage
	Electronic control unit connector	10 : Idling speed adjustment potentiometer
	Electrical equipment	#157: Idling speed adjustment potentiometer
	Electric circuit diagram	Idling speed adjustment potentiometer system

P0507: Idle Volume (warning lamp flashes: 31)

Generation condition		Idling speed adjustment potentiometer voltage remains higher than 4.6 V for 3 seconds.
Recoverability		System recovers when idling speed adjustment potentiometer voltage remains 4.6 V or less for 1 second.
Control effected by electronic control unit		- Control is effected with auto idle permanently selected. - Actuator test "BA: VGT Test" is stopped.
Inspection	Service data	28: Idle Volume Voltage
	Electronic control unit connector	10 : Idling speed adjustment potentiometer
	Electrical equipment	#157: Idling speed adjustment potentiometer
	Electric circuit diagram	Idling speed adjustment potentiometer system

P0510: Accel SW (warning lamp flashes: 65)

Generation condition		Accelerator pedal switch remains ON for 1 second when accelerator pedal position is higher than 30%.
Recoverability		System recovers if accelerator pedal switch is turned OFF when accelerator pedal position is 30% or lower.
Control effected by electronic control unit		No specific control is effected.
Inspection	Service data	73: Accel SW
	Electronic control unit connector	11 : Accelerator pedal switch
	Electrical equipment	#029: Accelerator pedal switch
	Electric circuit diagram	Accelerator pedal switch system

P0560: M/V Supply Voltage (warning lamp flashes: 79)

Generation condition		Magnetic valve power supply remains low for 0.5 second.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF (2 minutes or more) → ON.
Control effected by electronic control unit		- Turbocharger magnetic valve control is stopped. - Safety relay control is stopped. - Powertard magnetic valve control is stopped. - Electronic drive unit relay control is stopped. - Following controls are stopped by stopping electronic drive unit relay control. - Exhaust gas recirculation control is stopped.
Inspection	Other	Replace engine electronic control unit. (See "6. Registration or Change of the Engine Electronic Control Unit Information".)

P0600: CAN Communication (warning lamp flashes: –)

Generation condition		Diagnosis code is generated under either of the following conditions. - No controller area network signals from multi function vehicle control unit are received for 1.8 seconds. - Controller area network signal from MVCU indicating "vehicle speed limitation device (SLD) is abnormal" is received.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF (2 minutes or more) → ON.
Control effected by electronic control unit		- Engine speed is limited. - Vehicle speed limiting control is stopped.
Inspection	Electric circuit diagram	Controller area network communication system between engine electronic control unit and multi function vehicle control unit
	Other	Check the combination of engine electronic control unit and multi function vehicle control unit

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P0605: ECU System (Hardware) (warning lamp flashes: 33)

Generation condition	Diagnosis code is generated under either of the following conditions. (1) Power supply circuit or power supply in electronic control unit is abnormal. (2) Devices (analog-digital converter, IC for driving injector or timer IC) in electronic control unit or CPU gate array communication are abnormal.	
Recoverability	- In the case of above problem (1) - System recovers if power supply circuit or power supply in electronic control unit becomes normal. - In the case of above problem (2) - System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.	
Control effected by electronic control unit	- In the case of above problem (1) - Engine warning lamp (orange) display - In the case of above problem (2) - Engine warning lamp (red) display - Engine is stopped.	
Inspection	Other	Replace the engine electronic control unit.

P1171: Q Adjustment Resistor (Low) (warning lamp flashes: 34)

Generation condition	Fuel injection rate adjustment resistor voltage remains less than 0.2 V for 3 seconds.	
Recoverability	System recovers when fuel injection rate adjustment resistor voltage remains 0.2 V or more for 1 second.	
Control effected by electronic control unit	Control is effected using backup value (No. 1). (Output is slightly reduced.)	
Inspection	Service data	33: Q Adjustment Resistor No.
	Electronic control unit connector	12 : Fuel injection rate adjustment resistor
	Electrical equipment	#828: Fuel injection rate adjustment resistor
	Electric circuit diagram	Fuel injection rate adjustment resistor system

P1172: Q Adjustment Resistor (High) (warning lamp flashes: 34)

Generation condition	Fuel injection rate adjustment resistor voltage remains higher than 4.8 V for 3 seconds.	
Recoverability	System recovers when fuel injection rate adjustment resistor voltage remains 4.8 V or less for 1 second.	
Control effected by electronic control unit	Control is effected using backup value (No. 1). (Output is slightly reduced.)	
Inspection	Service data	33: Q Adjustment Resistor No.
	Electronic control unit connector	12 : Fuel injection rate adjustment resistor
	Electrical equipment	#828: Fuel injection rate adjustment resistor
	Electric circuit diagram	Fuel injection rate adjustment resistor system

P1176: PTO Adjustment Resistor (Low) (warning lamp flashes: 62)

Generation condition	Power take-off resistor voltage remains less than 0.2 V for 3 seconds when governor control switch is ON.	
Recoverability	System recovers when power take-off resistor voltage remains 0.2 V or more for 1 second when governor control switch is ON.	
Control effected by electronic control unit	Control is effected using backup value (not resistor).	
Inspection	Service data	36: PTO Adjustment Resistor No.
	Electronic control unit connector	13 : Power take-off resistor
	Electrical equipment	#828: Power take-off resistor
	Electric circuit diagram	Power take-off resistor system

P1177: PTO Adjustment Resistor (High) (warning lamp flashes: 62)

Generation condition		Power take-off resistor voltage remains higher than 4.8 V for 3 seconds when governor control switch is ON.
Recoverability		System recovers when power take-off resistor voltage remains 4.8 V or less for 1 second when governor control switch is ON.
Control effected by electronic control unit		Control is effected using backup value (not resistor).
Inspection	Service data	36: PTO Adjustment Resistor No.
	Electronic control unit connector	13 : Power take-off resistor
	Electrical equipment	#828: Power take-off resistor
	Electric circuit diagram	Power take-off resistor system

P1200: Injector Circuit 2 (warning lamp flashes: 82)

Generation condition		Injector circuit 2 (No. 4, 5 or 6 cylinder) is short-circuited, open-circuited, or overloaded.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF (2 minutes or more) → ON.
Control effected by electronic control unit		• Injector magnetic valve (No. 4, 5 or 6 cylinder) control is stopped. (Output is reduced due to three-cylinder operation, and exhaust emissions worsen.) • Exhaust gas recirculation control is stopped. • Auto cruise control is stopped. • Turbocharger control is stopped. • Actuator tests "B9: Fuel Leak Check, BB to C0: Injector Test, BA: VGT Test" are stopped.
Inspection	Actuator test	BE: Injector Test 4, BF: Injector Test 5 C0: Injector Test 6
	Electronic control unit connector	05 : Injector magnetic valve
	Electrical equipment	#582: Injector magnetic valve
	Electric circuit diagram	Injector magnetic valve (No. 4, 5 or 6 cylinder) system

P1251: Common Rail Pressure M/V 1 (warning lamp flashes: 63)

Generation condition		Current flowing to MPROP1 (rail pressure control valve) remains above the specified value for 0.3 second.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF (2 minutes or more) → ON.
Control effected by electronic control unit		• Injection quantity is limited. (Output is reduced, and exhaust emissions worsen.) • Exhaust gas recirculation control is stopped. • Auto cruise control is stopped.
Inspection	Actuator test	B9: Fuel Leak Check
	Electronic control unit connector	14 : MPROP1 (rail pressure control valve)
	Electrical equipment	#574: MPROP1 (rail pressure control valve)
	Electric circuit diagram	MPROP1 (rail pressure control valve) system

P1253: Common Rail Pressure M/V 2 (warning lamp flashes: 63)

Generation condition		Current flowing to MPROP2 (rail pressure control valve) remains above the specified value for 0.3 second.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF (2 minutes or more) → ON.
Control effected by electronic control unit		• Injection quantity is limited. (Output is reduced, and exhaust emissions worsen.) • Exhaust gas recirculation control is stopped. • Auto cruise control is stopped.
Inspection	Actuator test	B9: Fuel Leak Check
	Electronic control unit connector	14 : MPROP2 (rail pressure control valve)
	Electrical equipment	#574: MPROP2 (rail pressure control valve)
	Electric circuit diagram	MPROP2 (rail pressure control valve) system

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P1254: PRV Opening (warning lamp flashes: 36)

Generation condition		Diagnosis code is generated under either of the following conditions - Common rail pressure is abnormally large. (except forced opening of pressure limiting valve by electronic control unit control) - Pressure limiting valve is faulty. (Limiting valve opens even though the common rail pressure is normal.) - Abnormal common rail pressure due to leakage or clogging of fuel system
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF (2 minutes or more) → ON.
Control effected by electronic control unit		- Injection quantity is limited. (Output is reduced, and exhaust emissions worsen.) - Exhaust gas recirculation control is stopped. - Auto cruise control is stopped.
Inspection	Service data	0C: Difference Common Rail Pressure
	Actuator test	B9: Fuel Leak Check
	Electronic control unit connector	14 : MPROP (rail pressure control valve)
	Electrical equipment	#574: MPROP (rail pressure control valve)
	Electric circuit diagram	MPROP (rail pressure control valve) system
	Other	- Air-bleeding of fuel system (See "ON-VEHICLE INSPECTION AND ADJUSTMENT".) - Inspection of fuel piping (See "COMMON RAIL".) - Fuel filter (See "FUEL FILTER".) - Gauze filter (See "ON-VEHICLE INSPECTION AND ADJUSTMENT".) - Supply pump (Have work performed by Bosch.) - Pressure limiting valve (Have work performed by Bosch.) - Injectors (Have work performed by Bosch.)

P1255: Common Rail Pressure M/V 1 (warning lamp flashes: 63)

Generation condition		MPROP1 (rail pressure control valve) circuit shorted to ground or open-circuited (low level when turned OFF) as detected for 0.3 second.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF (2 minutes or more) → ON.
Control effected by electronic control unit		- Injection quantity is limited. (Output is reduced, and exhaust emissions worsen.) - Exhaust gas recirculation control is stopped. - Auto cruise control is stopped.
Inspection	Actuator test	B9: Fuel Leak Check
	Electronic control unit connector	14 : MPROP1 (rail pressure control valve)
	Electrical equipment	#574: MPROP1 (rail pressure control valve)
	Electric circuit diagram	MPROP1 (rail pressure control valve) system

P1256: Common Rail Pressure M/V 1 (warning lamp flashes: 63)

Generation condition		Diagnosis code is generated under either of the following conditions. (1) MPROP1 (rail pressure control valve) circuit shorted to battery (high level when turned ON) as detected for 0.3 second. (2) MPROP1 (rail pressure control valve) driving voltage remains abnormal for 1 second.
Recoverability		- In the case of above problem (1) - System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF (2 minutes or more) → ON. - In the case of above problem (2) - MPROP1 (rail pressure control valve) driving voltage remains normal for 1 second.
Control effected by electronic control unit		- In the case of above problem (1) - Injection quantity is limited. (Output is reduced, and exhaust emissions worsen.) - Exhaust gas recirculation control is stopped. - Auto cruise control is stopped. - In the case of above problem (2) - No specific control is effected.
Inspection	Actuator test	B9: Fuel Leak Check
	Electronic control unit connector	14 : MPROP1 (rail pressure control valve)
	Electrical equipment	#574: MPROP1 (rail pressure control valve)
	Electric circuit diagram	MPROP1 (rail pressure control valve) system

P1258: Common Rail Pressure M/V 2 (warning lamp flashes: 63)

Generation condition		Diagnosis code is generated under either of the following conditions. (1) MPROP2 (rail pressure control valve) circuit shorted to battery (high level when turned ON) as detected for 0.3 second. (2) MPROP2 (rail pressure control valve) driving voltage remains abnormal for 1 second.
Recoverability		- In the case of above problem (1) - System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF (2 minutes or more) → ON. - In the case of above problem (2) - MPROP2 (rail pressure control valve) driving voltage remains normal for 1 second.
Control effected by electronic control unit		- In the case of above problem (1) - Injection quantity is limited. (Output is reduced, and exhaust emissions worsen.) - Exhaust gas recirculation control is stopped. - Auto cruise control is stopped. - In the case of above problem (2) - No specific control is effected.
Inspection	Actuator test	B9: Fuel Leak Check
	Electronic control unit connector	14 : MPROP2 (rail pressure control valve)
	Electrical equipment	#574: MPROP2 (rail pressure control valve)
	Electric circuit diagram	MPROP2 (rail pressure control valve) system

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P1259: Common Rail Pressure M/V 2 (warning lamp flashes: 63)

Generation condition		MPROP2 (rail pressure control valve) circuit shorted to ground or open-circuited (low level when turned OFF) as detected for 0.3 second.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF (2 minutes or more) → ON.
Control effected by electronic control unit		- Injection quantity is limited. (Output is reduced, and exhaust emissions worsen.) - Exhaust gas recirculation control is stopped. - Auto cruise control is stopped.
Inspection	Actuator test	B9: Fuel Leak Check
	Electronic control unit connector	14 : MPROP2 (rail pressure control valve)
	Electrical equipment	#574: MPROP2 (rail pressure control valve)
	Electric circuit diagram	MPROP2 (rail pressure control valve) system

P125A: Rail Pressure M/V 1 (Over load) (warning lamp flashes: 63)

Generation condition		MPROP1 (rail pressure control valve) driving current value remains higher than 2A for 10 seconds.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF (2 minutes or more) → ON.
Control effected by electronic control unit		- Injection quantity is limited. (Output is reduced, and exhaust emissions worsen.) - Exhaust gas recirculation control is stopped. - Auto cruise control is stopped.
Inspection	Service data	0C: Difference Common Rail Pressure
	Actuator test	B9: Fuel Leak Check
	Electronic control unit connector	14 : MPROP1 (rail pressure control valve)
	Electrical equipment	#574: MPROP1 (rail pressure control valve)
	Electric circuit diagram	MPROP1 (rail pressure control valve) system

P125B: Rail Pressure M/V 1 (Long Short) (warning lamp flashes: 63)

Generation condition		MPROP1 (rail pressure control valve) circuit remains shorted to ground as detected for 10 seconds.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF (2 minutes or more) → ON.
Control effected by electronic control unit		Engine is stopped 50 seconds after the diagnosis code is generated.
Inspection	Service data	0C: Difference Common Rail Pressure
	Actuator test	B9: Fuel Leak Check
	Electronic control unit connector	14 : MPROP1 (rail pressure control valve)
	Electrical equipment	#574: MPROP1 (rail pressure control valve)
	Electric circuit diagram	MPROP1 (rail pressure control valve) system

P125C: Rail Pressure M/V 2 (Over Load) (warning lamp flashes: 63)

Generation condition		MPROP2 (rail pressure control valve) driving current value remains higher than 2A for 10 seconds.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF (2 minutes or more) → ON.
Control effected by electronic control unit		- Injection quantity is limited. (Output is reduced, and exhaust emissions worsen.) - Exhaust gas recirculation control is stopped. - Auto cruise control is stopped.
Inspection	Service data	0C: Difference Common Rail Pressure
	Actuator test	B9: Fuel Leak Check
	Electronic control unit connector	14 : MPROP2 (rail pressure control valve)
	Electrical equipment	#574: MPROP2 (rail pressure control valve)
	Electric circuit diagram	MPROP2 (rail pressure control valve) system

P125D: Rail Pressure M/V 2 (Long Short) (warning lamp flashes: 63)

Generation condition		MPROP2 (rail pressure control valve) circuit remains shorted to ground as detected for 10 seconds.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF (2 minutes or more) → ON.
Control effected by electronic control unit		Engine is stopped 50 seconds after the diagnosis code is generated.
Inspection	Service data	0C: Difference Common Rail Pressure
	Actuator test	B9: Fuel Leak Check
	Electronic control unit connector	14 : MPROP2 (rail pressure control valve)
	Electrical equipment	#574: MPROP2 (rail pressure control valve)
	Electric circuit diagram	MPROP2 (rail pressure control valve) system

P1335: Revolution & Position Sensor (warning lamp flashes: 14)

Generation condition		No signal from engine speed sensor and cylinder recognition sensor while starter switch (S signal) is input for 10.2 seconds.
Recoverability		System recovers when signals are input from engine speed sensor or cylinder recognition sensor.
Control effected by electronic control unit		No specific control is effected.
Inspection	Service data	01: Engine Revolution
	Electronic control unit connector	07 : Engine speed sensor, 08 : Cylinder recognition sensor
	Electrical equipment	#263: Engine speed sensor, #320: Cylinder recognition sensor
	Electric circuit diagram	Engine speed sensor and cylinder recognition sensor systems

P1460: Auxiliary Brake M/V 1 (warning lamp flashes: 93)

Generation condition		Current flowing to Powertard solenoid valve remains above the specified value for 1 second.
Recoverability		System recovers when the current flowing to Powertard solenoid valve remains below the specified value for 1 second.
Control effected by electronic control unit		• Operation of auxiliary brake is stopped. • Auto cruise control is stopped.
Inspection	Service data	80: Powertard M/V
	Actuator test	AC: Powertard M/V
	Electronic control unit connector	15 : Powertard solenoid valve
	Electrical equipment	#571: Powertard solenoid valve
	Electric circuit diagram	Powertard solenoid valve system

P1462: Auxiliary Brake M/V 1 (warning lamp flashes: 93)

Generation condition		Powertard solenoid valve circuit shorted to ground or open-circuited (driving terminal is at low level when turned OFF) as detected for 1 second.
Recoverability		System recovers when Powertard solenoid valve circuit remains normal (driving terminal is at high level when turned OFF) for 1 second.
Control effected by electronic control unit		• Operation of auxiliary brake is stopped. • Auto cruise control is stopped.
Inspection	Service data	80: Powertard M/V
	Actuator test	AC: Powertard M/V
	Electronic control unit connector	15 : Powertard solenoid valve
	Electrical equipment	#571: Powertard solenoid valve
	Electric circuit diagram	Powertard solenoid valve system

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P1463: Auxiliary Brake M/V 1 (warning lamp flashes: 93)

Generation condition		Powertrain solenoid valve circuit shorted to battery (driving terminal is at high level when turned ON) as detected for 1 second.
Recoverability		System recovers when Powertrain solenoid valve circuit remains normal (driving terminal is at low level when turned ON) for 1 second.
Control effected by electronic control unit		- Operation of auxiliary brake is stopped. - Auto cruise control is stopped.
Inspection	Service data	80: Powertrain M/V
	Actuator test	AC: Powertrain M/V
	Electronic control unit connector	15 : Powertrain solenoid valve
	Electrical equipment	#571: Powertrain solenoid valve
	Electric circuit diagram	Powertrain solenoid valve system

P1562: Sensor Supply Voltage 1 (warning lamp flashes: 81)

Generation condition		Circuit voltage (sensor supply voltage 1) in electronic control unit remains abnormally low for 0.5 second.
Recoverability		System recovers when circuit voltage (sensor supply voltage 1) in electronic control unit becomes normal.
Control effected by electronic control unit		No specific control is effected. Failure occurs only to circuit abnormality.
Inspection	Service data	24: Accel Pedal Sensor Voltage 1, 28: Idle Volume Voltage
	Electronic control unit connector	03 : Accelerator pedal position sensor 1, 10 : Idling speed adjustment potentiometer
	Electrical equipment	#157: Idling speed adjustment potentiometer, #324: Accelerator pedal position sensor 1
	Electric circuit diagram	Accelerator pedal position sensor 1 and idling speed adjustment potentiometer systems

P1563: Sensor Supply Voltage 1 (warning lamp flashes: 81)

Generation condition		Circuit voltage (sensor supply voltage 1) in electronic control unit remains abnormally high for 0.5 second.
Recoverability		System recovers when circuit voltage (sensor supply voltage 1) in electronic control unit becomes normal.
Control effected by electronic control unit		No specific control is effected. Failure occurs only to circuit abnormality.
Inspection	Service data	24: Accel Pedal Sensor Voltage 1, 28: Idle Volume Voltage
	Electronic control unit connector	03 : Accelerator pedal position sensor 1, 10 : Idling speed adjustment potentiometer
	Electrical equipment	#157: Idling speed adjustment potentiometer, #324: Accelerator pedal position sensor 1
	Electric circuit diagram	Accelerator pedal position sensor 1 and idling speed adjustment potentiometer systems

P1567: Sensor Supply Voltage 2 (warning lamp flashes: 81)

Generation condition		Circuit voltage (sensor supply voltage 2) in electronic control unit remains abnormally low for 0.5 second.
Recoverability		System recovers when circuit voltage (sensor supply voltage 2) in electronic control unit becomes normal.
Control effected by electronic control unit		No specific control is effected. Failure occurs only to circuit abnormality.
Inspection	Service data	25: Accel Pedal Sensor Voltage 2, 26: Boost Pressure
	Electronic control unit connector	03 : Accelerator pedal position sensor 2
	Electrical equipment	#318: Boost pressure sensor, #324: Accelerator pedal position sensor 2
	Electric circuit diagram	Boost pressure sensor and accelerator pedal position sensor 2 systems

P1568: Sensor Supply Voltage 2 (warning lamp flashes: 81)

Generation condition		Circuit voltage (sensor supply voltage 2) in electronic control unit remains abnormally high for 0.5 second.
Recoverability		System recovers when circuit voltage (sensor supply voltage 2) in electronic control unit becomes normal.
Control effected by electronic control unit		No specific control is effected. Failure occurs only to circuit abnormality.
Inspection	Service data	25: Accel Pedal Sensor Voltage 2, 26: Boost Pressure
	Electronic control unit connector	03 : Accelerator pedal position sensor 2
	Electrical equipment	#318: Boost pressure sensor, #324: Accelerator pedal position sensor 2
	Electric circuit diagram	Boost pressure sensor and accelerator pedal position sensor 2 systems

P1572: Sensor Supply Voltage 3 (warning lamp flashes: 81)

Generation condition		Circuit voltage (sensor supply voltage 3) in electronic control unit remains abnormally low for 0.5 second.
Recoverability		System recovers when circuit voltage (sensor supply voltage 3) in electronic control unit becomes normal.
Control effected by electronic control unit		No specific control is effected. Failure occurs only to circuit abnormality.
Inspection	Service data	0C: Difference Common Rail Pressure, 35: PTO Accel Sensor Voltage
	Electronic control unit connector	06 : Power take-off load sensor
	Electrical equipment	#317: Power take-off load sensor, #319: Common rail pressure sensor
	Electric circuit diagram	Power take-off load sensor and common rail pressure sensor systems

P1573: Sensor Supply Voltage 3 (warning lamp flashes: 81)

Generation condition		Circuit voltage (sensor supply voltage 3) in electronic control unit remains abnormally high for 0.5 second.
Recoverability		System recovers when circuit voltage (sensor supply voltage 3) in electronic control unit becomes normal.
Control effected by electronic control unit		No specific control is effected. Failure occurs only to circuit abnormality.
Inspection	Service data	0C: Difference Common Rail Pressure, 35: PTO Accel Sensor Voltage
	Electronic control unit connector	06 : Power take-off load sensor
	Electrical equipment	#317: Power take-off load sensor, #319: Common rail pressure sensor
	Electric circuit diagram	Power take-off load sensor and common rail pressure sensor systems

P1605: ECU System (EEPROM) (warning lamp flashes: 33)

Generation condition		Reading or writing error occurs during access.
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON.
Control effected by electronic control unit		No specific control is effected. Failure occurs only to circuit abnormality.
Inspection	Other	Replace engine electronic control unit.

P1606: ECU System (Software) (warning lamp flashes: 33)

Generation condition		Diagnosis code is generated under either of the following conditions. • System overload occurs. • Data processing time of engine electronic control unit has exceeded time-out period (0.0655 second).
Recoverability		System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF (2 minutes or more) → ON.
Control effected by electronic control unit		Engine is stopped.
Inspection	Other	Replace engine electronic control unit.

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4. Multi-Use Tester Service Data

- It is possible to see service data and actuator tests simultaneously.

No.	Item	Data	Inspection condition	Requirement
01	Engine Revolution	■■■■■.rpm	Racing (engine running)	Engine speed after engine warm-up: 500 ± 25 rpm
02	Reference Injection Quantity	■■■■.■ %	Engine idling	5 to 20%
0C	Difference Common Rail Pressure	■■■■.■ %	Engine idling	Fuel injection quantity after engine warm-up: Less than 30%
20	Actual EGR Position 1	■■■■.■	See Gr17.	—
21	VGT Position	■■■■.■ %	See Gr15.	—
22	Accel Pedal Position (unfiltered)	■■■■.■ %	Accelerator pedal not pressed	0%
			Accelerator pedal gradually pressed	Value gradually increases.
			Accelerator pedal fully pressed	100%
23	Accel Pedal Position (filtered)	■■■■.■ %	Accelerator pedal not pressed	0%
			Accelerator pedal gradually pressed	Value gradually increases.
			Accelerator pedal fully pressed	100%
24	Accel Pedal Sensor Voltage 1	■.■■■■ V	Accelerator pedal gradually pressed from released position	0.85 to 4.15 V
25	Accel Pedal Sensor Voltage 2	■.■■■■ V	Accelerator pedal gradually pressed from released position	0.85 to 4.15 V
26	Boost Pressure	■■■■.■ kPa	Starter switch ON (engine is stopped)	Value matches atmospheric pressure indication.
			Accelerator pedal pressed after engine has started	Value gradually increases.
27	Boost Pressure Sensor Voltage	■.■■■■ V	Starter switch ON (engine is stopped)	1 V <altitude: 0 m> 0.92 V <altitude: 600 m>
			Accelerator pedal pressed after engine has started	Value gradually increases.
28	Idle Volume Voltage	■.■■■■ V	SLOW to FAST	3 to 1 V
29	Vehicle Speed	■■■■.■ km/h	Vehicle in motion	Value matches speedometer indication.
2A	Turbine Revolution	■■■■■.rpm	See Gr15.	—
2B	Intake Air Temperature	■■■■.■ °C	Engine cold	Value matches ambient temperature indication.
2E	Water Temperature	■■■■.■ °C	Engine cold	Value matches ambient temperature indication.
			Engine in process of warming up	Value gradually increases.
			Engine stopped after warming up	Value gradually decreases.
2F	Fuel Temperature (Inlet)	■■■■.■ °C	Engine cold	Value matches ambient temperature indication.
			Engine in process of warming up	Value gradually increases.
			Engine stopped after warming up	Value gradually decreases.
30	Atmospheric Pressure	■■■■.■ kPa	Altitude: 0 m	101 kPa
			Altitude: 600 m	95 kPa
33	Q Adjustment Resistor No.	1/2/3/4/5/6/7/8/9/10/11/NON	—	Number matches number marked on fuel injection rate adjustment resistor.
34	PTO Accel Position	■■■■.■ %	When power take-off is used (MIN to MAX)	0 to 100%
35	PTO Accel Sensor Voltage	■.■■■■ V	When power take-off is used (MIN to MAX)	1 to 3.0 V
36	PTO Adjustment Resistor No.	1/2/3/4/5/6/7/8/NON	Governor control switch ON	Number matches number marked on power take-off resistor.
37	Power Supply Voltage	■■■■.■ V	Starter switch ON	Value matches battery voltage.

No.	Item	Data	Inspection condition	Requirement
71	Starter SW (S)	ON/OFF	Engine cranked by means of starter switch	ON
			Starter switch in position except START	OFF
72	Starter SW (M)	ON/OFF	Starter switch in ON position	ON
			Starter switch in position except ON	OFF
73	Accel SW	ON/OFF	Accelerator pedal not pressed	ON
			Accelerator pedal pressed	OFF
74	Powertard SW 1	ON/OFF	Powertard switch (1st step): ON	ON
			Powertard switch (1st step): OFF	OFF
75	Powertard SW 2	ON/OFF	Powertard switch (2nd step): ON	ON
			Powertard switch (2nd step): OFF	OFF
76	Clutch SW	ON/OFF	Clutch pedal pressed	ON
			Clutch pedal not pressed	OFF
77	Neutral SW	ON/OFF	Transmission not in neutral	ON
			Transmission in neutral	OFF
78	Idle Up Cancel SW	ON/OFF	Actuator test is performed	ON (5 times, for 1.5 sec. each)
			Actuator test is not performed	OFF
			[Actuator test] B8: Idle Up Cancel SW	
7C	PTO SW	ON/OFF	Governor control switch ON	ON
			Governor control switch OFF	OFF
7D	Diagnosis SW	ON/OFF	Diagnosis switch OFF (with connector connected)	ON
			Diagnosis switch ON (with connector disconnected)	OFF
7E	Memory Clear SW	ON/OFF	Memory clear switch OFF (with connector connected)	ON
			Memory clear switch ON (with connector disconnected)	OFF
7F	Auxiliary Brake SW 1	ON/OFF	Operated under following conditions • Accelerator and clutch pedals are pressed • Transmission in neutral position	ON
			Other than above conditions	OFF
80	Powertard M/V	ON/OFF	Powertard operating	ON
			Powertard not operating	OFF
			[Actuator test] A6: Powertard M/V	
82	VGT M/V 1	ON/OFF	See Gr15.	—
83	VGT M/V 2	ON/OFF	See Gr15.	—
84	VGT M/V 3	ON/OFF	See Gr15.	—
85	Auxiliary Brake Indicator Lamp	ON/OFF	Auxiliary brake operating	ON
			Auxiliary brake not operating	OFF
			[Actuator test] AE: Auxiliary Brake Indicator Lamp	
88	Starter Safety Relay	ON/OFF	See Gr54.	—
89	EDU Power Relay	ON/OFF	See Gr17.	—
8A	MIL LAMP	ON/OFF	Starter switch ON (engine not started)	ON
			No error after engine startup	OFF
			[Actuator test] B3: MIL Lamp	
8B	Diagnosis Lamp	ON/OFF	Starter switch ON (engine not started)	ON
			No error after engine startup	OFF
			[Actuator test] B4: Diagnosis Lamp	

TROUBLESHOOTING <DIAGNOSIS USING Multi-Use Tester>

5. Actuator Tests Performed Using Multi-Use Tester

- It is possible to see service data and actuator tests simultaneously.

No.	Item	Explanation	Confirmation method
A1	EGR 1	See Gr17.	—
A2	EGR 2		
A3	EGR 3		
A9	VGT M/V 1	See Gr15.	—
AA	VGT M/V 2		
AB	VGT M/V 3		
AC	Powertard M/V	Repeatedly turn each valve ON and OFF (5 times, for 1.5 sec. each). [Can be executed when the following conditions are satisfied] - Vehicle: stationary (vehicle speed 0 km/h) - Starter switch: ON - Engine: stopped	Check by the operating sound when Powertard solenoid valve is turned ON/OFF. [Service data] 80: Powertard M/V
AE	Auxiliary Brake Indicator Lamp	Repeatedly turn Auxiliary brake indicator lamp ON and OFF (5 times, for 1.5 sec. each). [Can be executed when the following conditions are satisfied] - Vehicle: stationary (vehicle speed 0 km/h) - Starter switch: ON - Engine: stopped	Check that the indicator lamp surely illuminates or goes out as commanded. [Service data] 85: Auxiliary Brake Indicator Lamp
B1	Starter Safety Relay	See Gr54.	—
B2	EDU Relay	See Gr17.	—
B3	MIL LAMP	Repeatedly turn the engine control warning lamp ON and OFF (5 times, for 1.5 sec. each). [Can be executed when the following conditions are satisfied] - Starter switch: ON - Engine: stopped	ON/OFF condition of warning lamp (orange) [Service data] 8A: MIL LAMP
B4	Diagnosis Lamp		ON/OFF condition of warning lamp (red) [Service data] 8B: Diagnosis Lamp
B8	Idle Up Cancel SW	Repeatedly turn idle up cancel switch ON and OFF (5 times, for 1.5 sec. each). [Can be executed when the following conditions are satisfied] - Vehicle: stationary (vehicle speed 0 km/h) - Transmission: Neutral	Check that the engine idling speed remains at low idling. [Service data] 78: Idle Up Cancel SW
B9	Fuel Leak Check	Increase rail pressure for a certain period of time [Can be executed when the following conditions are satisfied] - Vehicle: stationary (vehicle speed 0 km/h) - Transmission: Neutral - Engine: idling	Check that no fuel leaks from fuel system (pipe and hose).
BA	VGT Test	See Gr15.	—
BB	Injector Test 1	Selected injector magnetic valve forcibly deactivated [Can be executed when the following conditions are satisfied] - Vehicle: stationary (vehicle speed 0 km/h) - Engine speed: Below 1500 rpm - Transmission: Neutral - No active diagnosis code generated	Check that injector magnetic valve for No. 1 cylinder stops operating.
BC	Injector Test 2		Check that injector magnetic valve for No. 2 cylinder stops operating.
BD	Injector Test 3		Check that injector magnetic valve for No. 3 cylinder stops operating.
BE	Injector Test 4		Check that injector magnetic valve for No. 4 cylinder stops operating.
BF	Injector Test 5		Check that injector magnetic valve for No. 5 cylinder stops operating.
C0	Injector Test 6		Check that injector magnetic valve for No. 6 cylinder stops operating.

M E M O

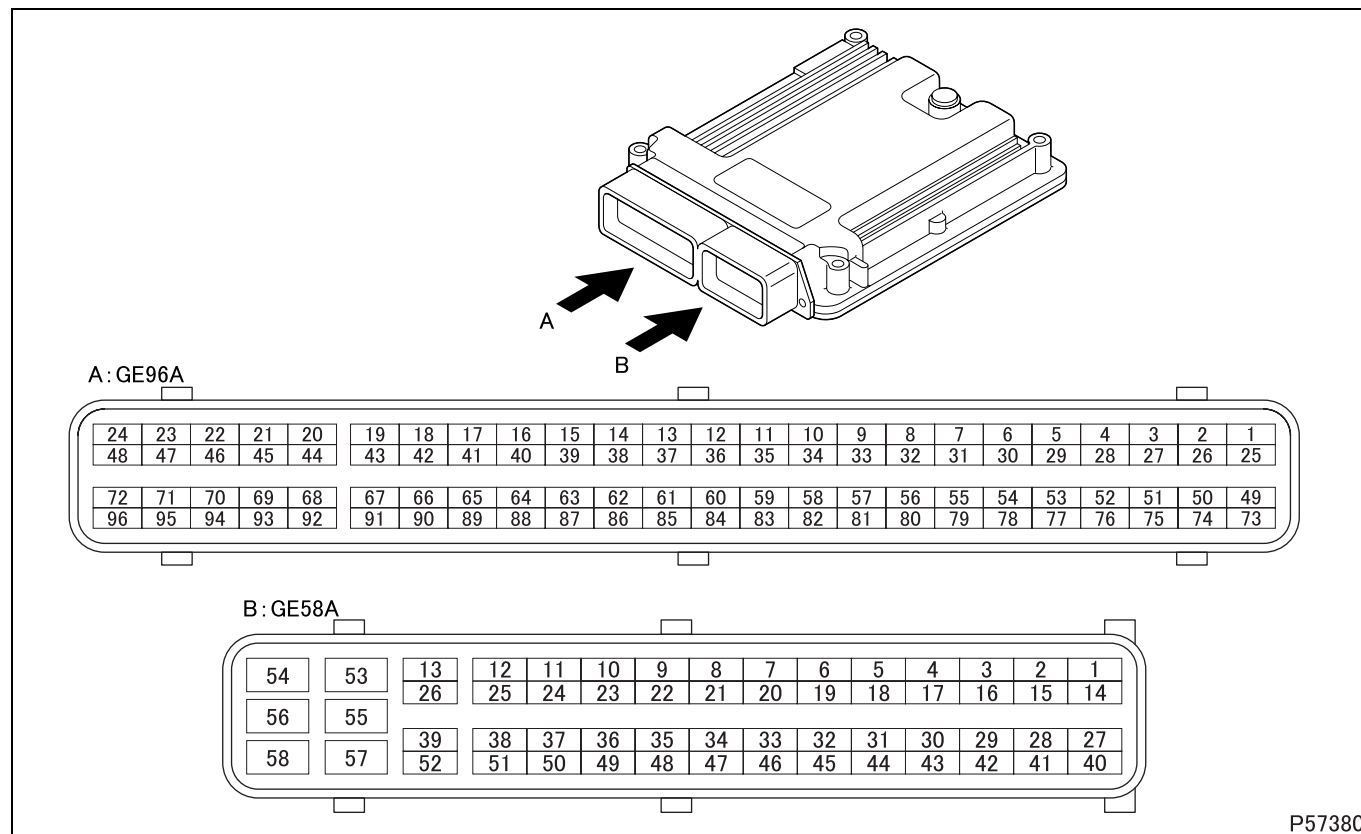
TROUBLESHOOTING <DIAGNOSIS USING Multi-Use Tester>

6. Inspections Performed at Electronic Control Unit Connectors

- These inspections aid troubleshooting by enabling you to check whether electronic control unit signals are being correctly transmitted via the vehicle harness and connectors.

The white-on-black numbers (**01**, **02**, and so on) correspond to the similarly printed reference numbers in section "3. Inspections Based on Diagnosis Codes".

6.1 Electronic control unit connector terminal layout



6.2 Inspection instructions

- Some inspections are performed with the connectors removed. Others are performed with the connectors fitted. Observe the following caution:

CAUTION

- Do not touch any terminal except those specified for the inspection. Be particularly careful not to cause short circuits between terminals using the tester probes.

Check item	Measurement method
01 Resistance of intake air temperature sensor 1	[Conditions] - Starter switch OFF - Disconnect connector. Perform inspection on vehicle-side connector. [Requirements] Terminals: A63-A32 0°C: 15^{+3.78}_{-2.94} kΩ 20°C: 6.514^{+1.437}_{-1.147} kΩ 80°C: 0.874^{+0.136}_{-0.115} kΩ

Check item	Measurement method
02 Resistance of water temperature sensor	[Conditions] - Starter switch OFF - Disconnect connector. Perform inspection on vehicle-side connector. [Requirements] Terminals: A40-A41 20°C: $2.45 \pm 0.14 \text{ k}\Omega$ 80°C: $0.32 \text{ k}\Omega$ (reference value) 110°C: $147.1 \pm 2 \text{ k}\Omega$
03 Output voltage of accelerator pedal position sensor	[Conditions] - Starter switch ON - Vehicle-side harness connected (Perform inspection on back of connector.) [Requirements] Terminals (+)-(-): B34-B33 (accelerator pedal position sensor 1) B46-B45 (accelerator pedal position sensor 2) - With accelerator pedal not pressed: $0.85 \pm 0.1 \text{ V}$ - With accelerator pedal pressed: $4.15 \pm 0.1 \text{ V}$
04 Resistance of fuel temperature sensor	[Conditions] - Starter switch OFF - Disconnect connector. Perform inspection on vehicle-side connector. [Requirements] Terminals: A89-A65 20°C: $2.5 \pm 0.25 \text{ k}\Omega$ 80°C: $0.32 \pm 0.02 \text{ k}\Omega$ 110°C: $0.144 \pm 0.01 \text{ k}\Omega$
05 Resistance of injector magnetic valve	[Conditions] - Starter switch OFF - Disconnect connector. Perform inspection on vehicle-side connector. [Requirements] Terminals: A72-A23 (injector magnetic valve: No. 1 cylinder) A70-A22 (injector magnetic valve: No. 2 cylinder) A71-A46 (injector magnetic valve: No. 3 cylinder) A94-A47 (injector magnetic valve: No. 4 cylinder) A96-A24 (injector magnetic valve: No. 5 cylinder) A95-A48 (injector magnetic valve: No. 6 cylinder) $0.21 \text{ to } 0.295 \text{ }\Omega$
06 Output voltage of Power take-off load sensor	[Conditions] - Starter switch ON - Vehicle-side harness connected (Perform inspection on back of connector.) [Requirements] Terminals (+)-(-): A15-A16 - Idling: $0.85 \pm 0.1 \text{ V}$ - Full-load: $3.0 \pm 0.1 \text{ V}$
07 Resistance of engine speed sensor	[Conditions] - Starter switch OFF - Disconnect connector. Perform inspection on vehicle-side connector. [Requirements] Terminals: A10-A9 $2.2 \pm 0.2 \text{ }\Omega$ (25°C)
08 Resistance of cylinder recognition sensor	[Conditions] - Starter switch OFF - Disconnect connector. Perform inspection on vehicle-side connector. [Requirements] Terminals: A59-A83 $860 \pm 86 \text{ }\Omega$
09 Output voltage of vehicle speed sensor	[Conditions] - Starter switch ON - Vehicle-side harness connected (Perform inspection on back of connector.) - Turn wheels slowly using chassis dynamometer. [Requirements] Terminals (+)-(-): A67-chassis ground - High pulse voltage: $8 \pm 1 \text{ V}$ - Low pulse voltage: 0.5 V or lower

TROUBLESHOOTING <DIAGNOSIS USING Multi-Use Tester>

10 Output voltage of idling speed adjustment potentiometer	[Conditions] • Starter switch ON • Vehicle-side harness connected (Perform inspection on back of connector.) [Requirements] Terminals (+)-(-): A12-A36 • AUTO position: 4.0 ± 0.1 V • SLOW position: 3.0 ± 0.2 V • FAST position: 1.0 ± 0.1 V
11 Operating voltage of accelerator pedal switch	[Conditions] • Starter switch OFF • Disconnect connector. Perform inspection on vehicle-side connector. [Requirements] Terminals (+)-(-): A20-chassis ground • With accelerator pedal pressed: There is no continuity. • With accelerator pedal not pressed: There is continuity.
12 Resistance of fuel injection rate adjustment resistor	[Conditions] • Starter switch OFF • Disconnect connector. Perform inspection on vehicle-side connector. [Requirements] Terminals: A35-A88 • No. 1 resistor: 270 ± 13.5 Ω • No. 2 resistor: 510 ± 25.5 Ω • No. 3 resistor: 820 ± 41 Ω • No. 4 resistor: 1300 ± 65 Ω • No. 5 resistor: 2000 ± 100 Ω • No. 6 resistor: 3300 ± 165 Ω • No. 7 resistor: 5600 ± 280 Ω • No. 8 resistor: 15000 ± 750 Ω • No. 9 resistor: 390 ± 19.5 Ω • No. 10 resistor: 4300 ± 215 Ω • No. 11 resistor: 9100 ± 455 Ω
13 Resistance of Power take-off resistor	[Conditions] • Starter switch OFF • Disconnect connector. Perform inspection on vehicle-side connector. [Requirements] Terminals: A43-A19 • No. 1 resistor: 270 ± 13.5 Ω • No. 2 resistor: 510 ± 25.5 Ω • No. 3 resistor: 820 ± 41 Ω • No. 4 resistor: 1300 ± 65 Ω • No. 5 resistor: 2000 ± 100 Ω • No. 6 resistor: 3300 ± 165 Ω • No. 7 resistor: 5600 ± 280 Ω • No. 8 resistor: 15000 ± 750 Ω
14 Resistance of MPROP (rail pressure control valve)	[Conditions] • Starter switch OFF • Disconnect connector. Perform inspection on vehicle-side connector. [Requirements] Terminals: • A69-A21, A69-A2, A3-A21, A3-A2 (MPROP1) • A27-A4, A27-B38, B52-A4, B52-B38 (MPROP2) • 2.6 to 3.15 Ω
15 Voltage of Powertard solenoid valve	[Conditions] • Starter switch OFF • Disconnect connector. Perform inspection on vehicle-side connector. [Requirements] Terminals: A74-A5 • 32.6 to 39.8 Ω (engine oil temperature: 25°C)
16 Resistance of controller area network resistor	[Conditions] • Starter switch OFF • Disconnect connector. Perform inspection on vehicle-side connector. [Requirements] Terminals: B11-B12, B5-B6 • 120 $\pm$ 6 Ω

M E M O

ON-VEHICLE INSPECTION AND ADJUSTMENT

1. Inspecting No-load Minimum and Maximum Speeds

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
–	No-load minimum speed (idling speed)	450 to 500 rpm	–	Inspect
–	No-load maximum speed	2330 to 2370 rpm	–	Inspect

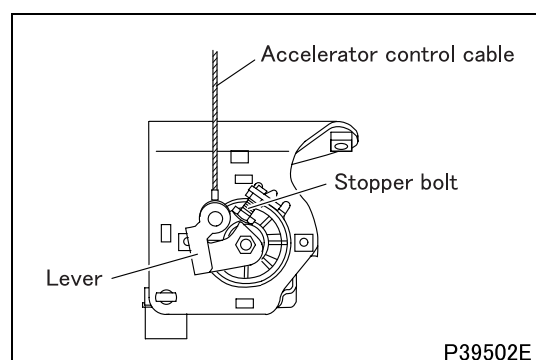
1.1 Work before inspection

- Before starting the inspection and adjustment, carry out the following preparatory steps.
- Put the transmission in neutral.
- Turn the steering wheel in neutral position.
- Turn off all lamps and accessories.
- Attach a Multi-Use Tester.
- Warm up the engine until the engine coolant temperature is approximately 80 to 95°C.
(Verify from Service Data “2E: Water Temperature”)

1.2 No-load minimum speed

[Inspection]

- With the accelerator pedal released, measure the engine speed.
- If the measurement deviates from the standard value, check for an installed condition of the accelerator control cable and accelerator link. (See “ENGINE CONTROL”.)
- If the cable and link are found to be normal, check for the accelerator pedal switch^{*a}, accelerator pedal position sensor^{*a}, supply pump^{*b} and engine electronic control unit^{*b}.
(*a: See “ENGINE CONTROL”, *b: Contact Bosch Service Station for repair.)



1.3 No-load maximum speed

[Inspection]

- Measure the engine speed with the accelerator pedal pressed against the stopper bolt.
- If the measurement deviates from the standard value, check for an installed condition of the accelerator control cable and accelerator link. (See “ENGINE CONTROL”.)
- If the cable and link are found to be normal, check for the accelerator pedal switch^{*a}, accelerator pedal position sensor^{*a}, supply pump^{*b} and engine electronic control unit^{*b}.
(*a: See “ENGINE CONTROL”, *b: Contact Bosch Service Station for repair.)

[Adjustment]

- If the measurement deviates from the standard value, adjust the stopper bolt to change the accelerator pedal travel until the optimum engine speed is reached with the pedal pressed.
- If it cannot be adjusted within the standard value by using the stopper bolt, check for an installed condition of the accelerator control cable and accelerator link. (See “ENGINE CONTROL”.)
- If the cable and link are found to be normal, check for the accelerator pedal switch^{*a}, accelerator pedal position sensor^{*a}, supply pump^{*b} and engine electronic control unit^{*b}.
(*a: See “ENGINE CONTROL”, *b: Contact Bosch Service Station for repair.)
- After the adjustment, make sure that the accelerator pedal moves smoothly by firmly pressing the pedal 10 to 15 times until it contacts the stopper bolt.

- If it does not move smoothly, check for an installed condition of the accelerator control cable and accelerator link. (See “ENGINE CONTROL”.)

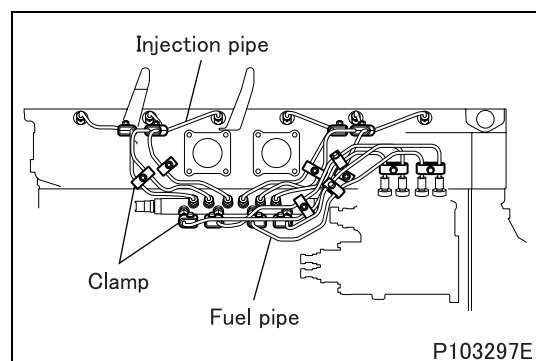
2. Inspection of Fuel Leakage

- Check if there is no fuel leakage from the fuel tank, fuel filter, supply pump, common rail, injector and fuel piping. If there is a fuel leakage, replace the pipe or hose and tighten to the specified torque. If fuel leaks from joint, retighten the bolts, nuts and clamps to the specified torque. (See later section.)

3. Inspection of Injection Pipe and Fuel Pipe Mounting Clamp

Tightening torque (Unit: N·m {kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
–	Bolt or nut (clamp mounting)	17.6 to 21.6 {1.8 to 2.2}	–



- Visually check the clamp appearance and make sure there is no cracks or damages at the rubber part of the clamps.
- If there is any abnormality, replace the clamp.
- Check for looseness in the clamp mounting bolt or nuts. If there is looseness, tighten the bolts and nuts to the specified torque.

4. Draining of Deposit in Fuel Tank

DANGER ⚠

- Do not allow any flames or sources of heat near the fuel tank, as it may explode.

WARNING ⚠

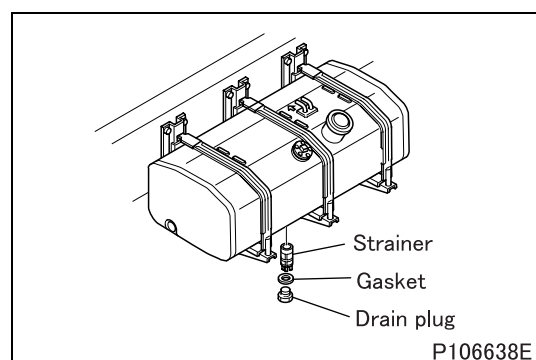
- Fuel is highly flammable. Keep it away from flames and sources of heat.
- Thoroughly wipe up any spilled fuel, otherwise it may catch fire.

Tightening torque (Unit: N·m {kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
–	Drain plug	127 {13}	Sealant

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
–	Seat surface of drain plug	Seal end No. 22	As required



[Removal]

- Drain the deposit in the fuel tank by removing the drain plug, gasket and strainer from the fuel tank.

[Installation]

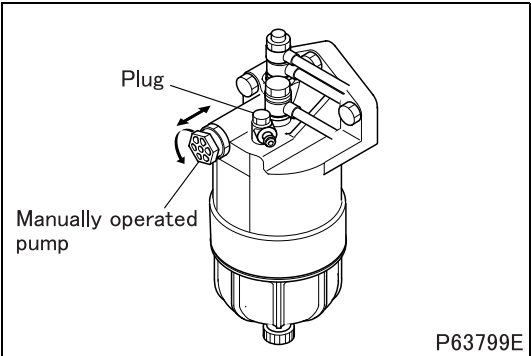
- Install the strainer and gasket to the fuel tank. Tighten the drain plug to the specified torque.

ON-VEHICLE INSPECTION AND ADJUSTMENT

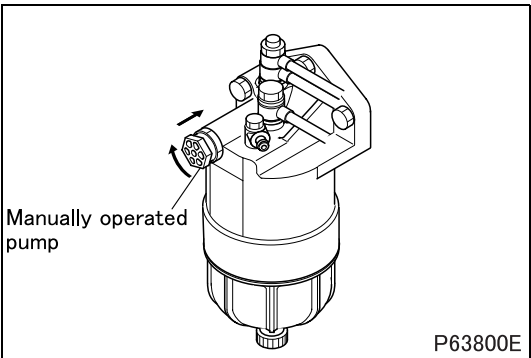
5. Air-bleeding of Fuel System

Tightening torque (Unit: N·m {kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
—	Plug	9.8 ± 2.0 {1.0 ± 0.2}	—



- Loosen one of the plugs on the fuel filter.
- Turn the knob of the manually operated pump counterclockwise. When the knob jumps out, push the knob to feed fuel.
- Continue pumping until fuel with no bubbles of air comes out of the plug.
- With no air bubbles coming out with fuel, tighten the plug to the specified torque.
- Continue operating the pump until there is strong pumping resistance.



- While pushing the knob of the manually operated pump, screw it in to the right to fix.
- Wipe up all spilled fuel, then start the engine.
- Check that no fuel leakage occurs.

WARNING ⚠

- **Fuel is highly flammable. Keep it away from flames and sources of heat.**
- **Be sure to wipe up all spilled fuel. Unless it is wiped up, it could catch fire.**

6. Fuel Filter Replacement

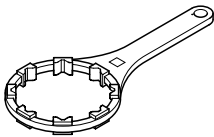
Tightening torque (Unit: N·m {kgf·m})

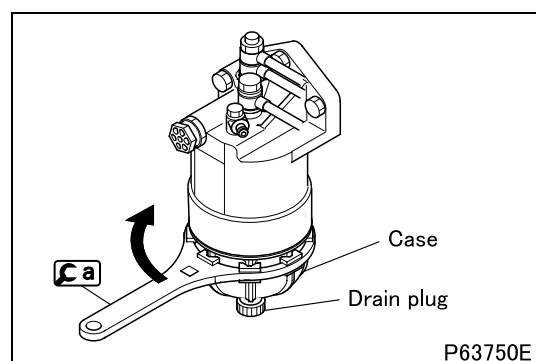
Mark	Parts to be tightened	Tightening torque	Remarks
–	Drain plug	2 ± 0.5 { 0.2 ± 0.05 }	–
–	Case	18 to 20 {1.8 to 2.0}	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
–	O-ring	Engine oil	As required

Special tools

Mark	Tool name and shape	Part No.	Application
	Filter wrench  P40018	MH063201	Removal and installation of case



[Removal]

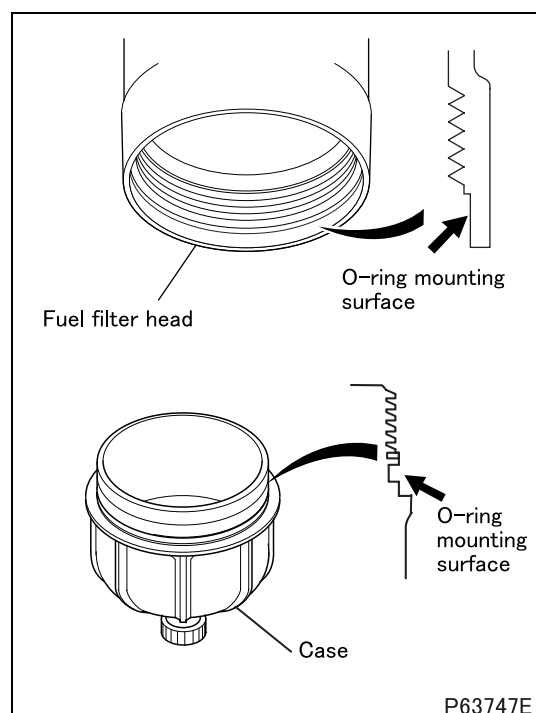
- Drain fuel from the case by loosening the drain plug.
- Using , remove the case.

WARNING

- Fuel is highly flammable. Keep it away from flames and sources of heat.
- Thoroughly wipe up any spilled fuel. Otherwise, it may catch fire.

CAUTION

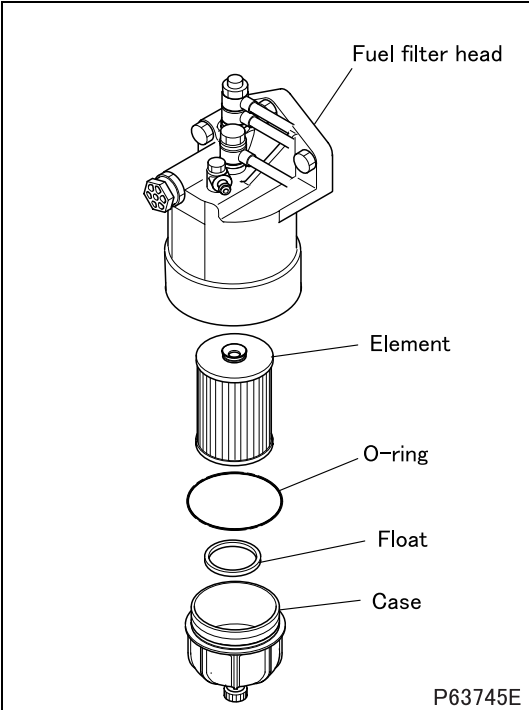
- Be careful not to damage the case.



[Installation]

- Clean the surface of the fuel filter head and case where the O-ring is to be mounted.

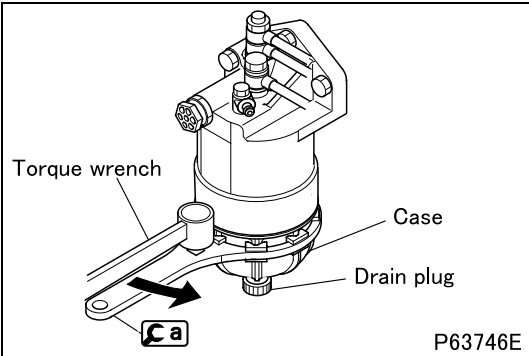
ON-VEHICLE INSPECTION AND ADJUSTMENT



- Replace the filter element and O-rings with new parts.
- Apply a thin coat of engine oil to the O-rings. Install the O-rings onto the case.

CAUTION ⚠

- The use of non-genuine filter elements will lead to engine problems. Be sure to use only genuine parts.
- To help prevent fuel injection problems, keep the fuel filter and hoses free from contamination.

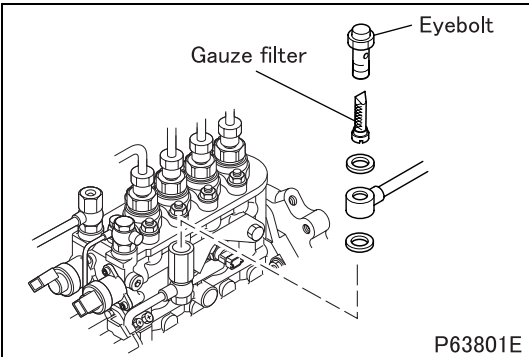


- Install a torque wrench to **Ca** and tighten the case to the specified torque.
- Tighten the drain plug to the specified torque. With the plug correctly installed, bleed air from the fuel system.
- Start the engine and ensure that there is no fuel leakage.
- If there is fuel leakage, remove and install the fuel filter correctly.

7. Cleaning of Gauze Filter

Tightening torque (Unit: N·m {kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
—	Eyebolt	25 to 29 {2.5 to 3.0}	—



- Remove the eyebolt in the middle of fuel piping.
- Pull out the gauze filter from the removed eyebolt.
- Wash the gauze filter with light oil.
- After washing, install the gauze filter in the reverse order.
- Bleed air from the fuel system.
- Start the engine and check for fuel leakage.

WARNING ⚠

- Thoroughly wipe up any spilled fuel, otherwise it may catch fire.
- Fuel is highly flammable. Keep it away from flames and sources of heat.

8. Water Separator Element Replacement

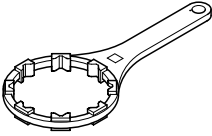
Tightening torque (Unit: N·m {kgf·m})

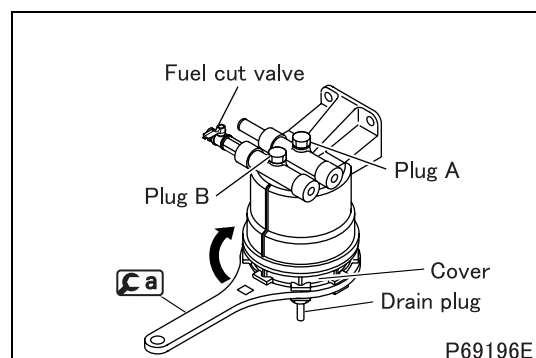
Mark	Parts to be tightened	Tightening torque	Remarks
–	Drain plug	1.47 ± 0.3 { 0.15 ± 0.03 }	–
–	Cover	19.6 ± 2.5 { 2.0 ± 0.3 }	–
–	Plug A	12.3 ± 2.5 { 1.25 ± 0.3 }	–
–	Plug B	17.2 ± 2.5 { 1.75 ± 0.3 }	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
–	O-ring	Engine oil	As required

Special tools

Mark	Tool name and shape	Part No.	Application
	Filter wrench  P40018	MH063201	Removal and installation of cover



[Removal]

- Loosen plugs A and B and then loosen the drain plug. Next, discharge fuel from the water separator.
- Using , remove the cover.

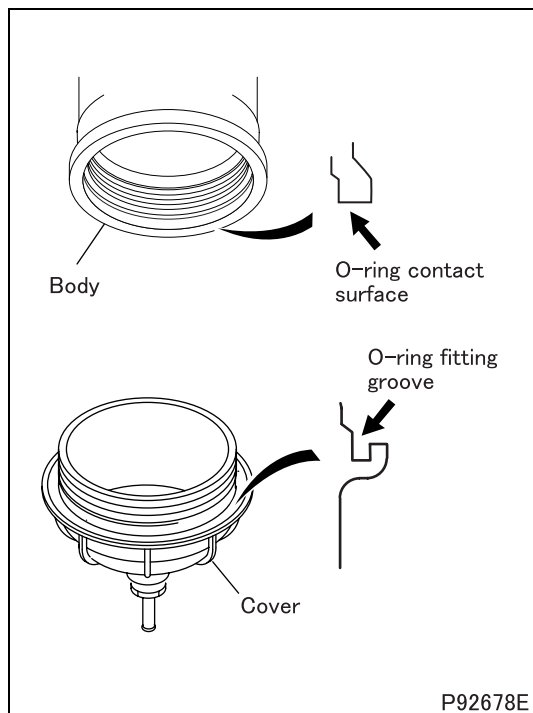
WARNING

- Fuel is highly flammable. Keep it away from flames and sources of heat.
- Thoroughly wipe up any spilled fuel. Otherwise, it may catch fire.

CAUTION

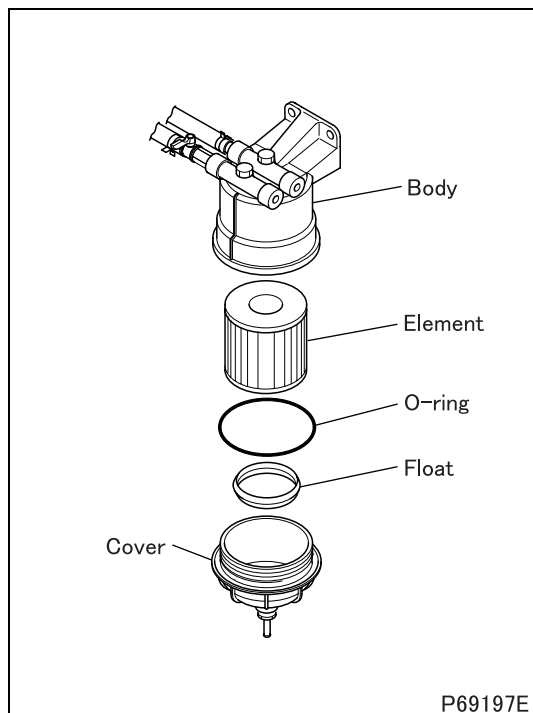
- Use care not to damage the cover.

ON-VEHICLE INSPECTION AND ADJUSTMENT



[Installation]

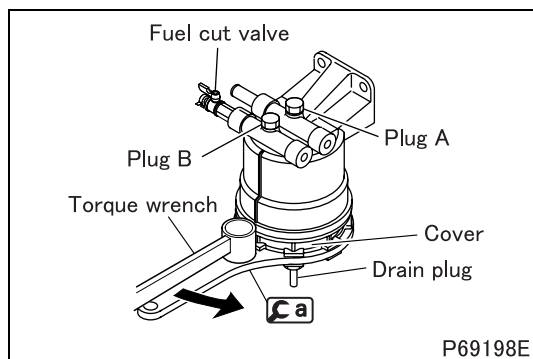
- Clean the surface of the water separator body, against which O-ring abuts, and the O-ring groove in the cover.



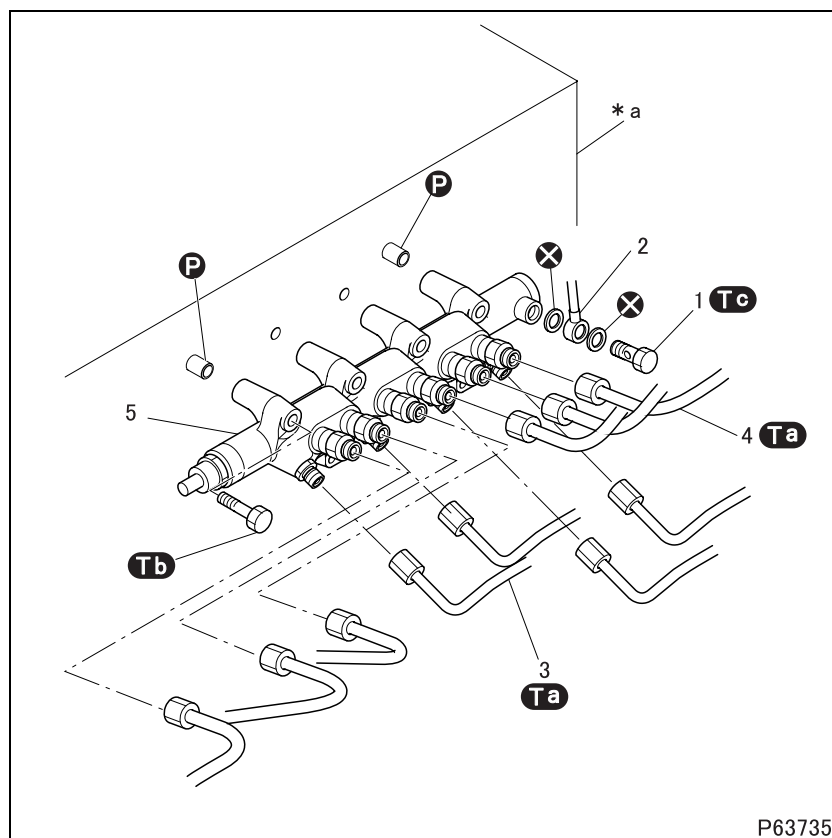
- Replace the filter element and O-ring with new parts.
- Apply a thin coat of engine oil to the O-ring. Install the O-ring onto the case.

CAUTION ⚠

- The use of non-genuine filter elements will lead to engine problems. Be sure to use only genuine parts.
- To help prevent fuel injection problems, keep the water separator and fuel hoses free from contamination.



- Install torque wrench to **Ca** and tighten the case to the specified torque.
- Tighten the drain plug and plugs A, B to the specified torque. With the plug correctly installed, bleed air from the fuel system.
- Start the engine and ensure that there is no fuel leakage.
- If there is fuel leakage, remove and install the water separator correctly.



● Removal sequence

- 1 Eyebolt
- 2 Fuel return pipe
- 3 Fuel pipe
- 4 Injection pipe
- 5 Common rail

*a: Crankcase

⊗: Non-reusable parts

P: Locating pin

WARNING ⚠

- Fuel is highly flammable. Do not handle it near flames or heat.
- Spilled fuel may catch fire and therefore, must be wiped off completely.

CAUTION ⚠

- Any contamination of the common rail, even if it is minor, will greatly affect the performance of the engine. After removing pipes or other parts, plug the openings with covers. Wash eyebolts and gaskets in light oil and keep them away from contaminants.

- Contact Bosch Service Station for any service needs of the common rail.

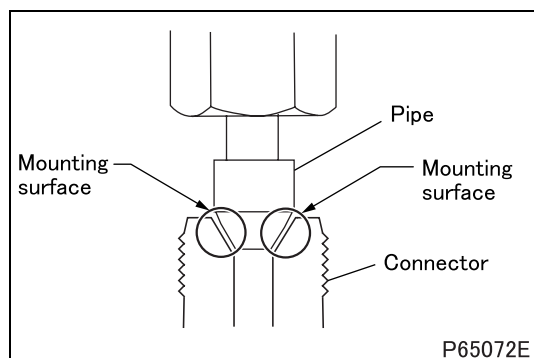
● Installation sequence

Follow the removal sequence in reverse.

Tightening torque (Unit: N·m {kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Fuel pipe	29 to 34 {3.0 to 3.5}	—
	Injection pipe		
Tb	Bolt (common rail mounting)	54 {5.5}	—
Tc	Eyebolt (fuel return pipe mounting)	30 to 35 {3.1 to 3.6}	—

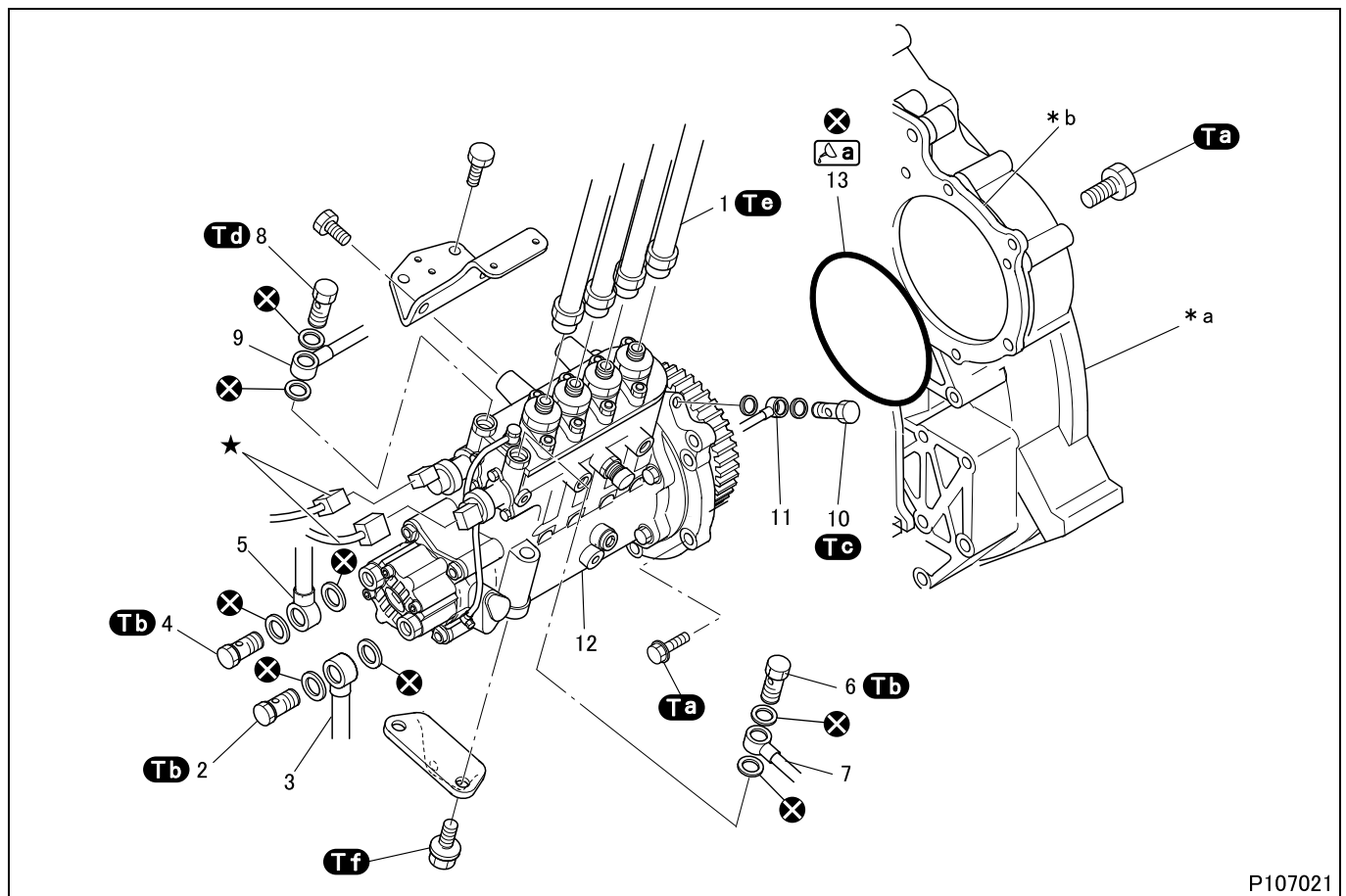
◆ Installation procedure ◆



■ Installation: Mitsubishi 6M70 Fuel pipe and injection pipe

- Ensure that the pipe and mounting surfaces of the connector are flat and free from damage.
- Bring the pipe into intimate contact with mounting surfaces of the connector evenly, and temporarily tighten it without applying an excessive force.
- Tighten it to the specified torque after temporary tightening.

MITSUBISHI 6M70 FUEL SUPPLY PUMP



P107021

● Removal sequence

- | | | |
|---------------------|--------------------|-----------------------|
| 1 Fuel pipe | 7 Fuel feed pipe | 13 O-ring |
| 2 Eyebolt | 8 Over flow valve | |
| 3 Fuel suction pipe | 9 Fuel return pipe | *a: Flywheel housing |
| 4 Eyebolt | 10 Eyebolt | *b: Rear plate |
| 5 Fuel feed pipe | 11 Oil pipe | ⊗: Non-reusable parts |
| 6 Eyebolt | 12 Supply pump | |

WARNING ⚠

- Fuel is highly flammable. Do not handle it near flames or heat.
- Spilled fuel may catch fire and therefore, must be wiped off completely.

CAUTION ⚠

- Any contamination of the supply pump, even if it is minor, will greatly affect the performance of the engine. After removing pipes, hoses, or other parts, plug the openings with covers. Wash eyebolts and new gaskets in light oil and keep them away from contaminants.

- Contact Bosch Service Station for any service needs of the supply pump.

● Installation sequence

Follow the removal sequence in reverse.

CAUTION ⚠

- Make sure that the harness (marked with "★") of MPROP (rail pressure control valve) is connected to the supply pump before starting the engine. Starting the engine without connection causes a malfunction.

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
8	Overflow valve	0.23 ± 0.07 MPa { 2.3 ± 0.7 kgf/cm ² }	—	Replace

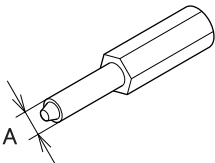
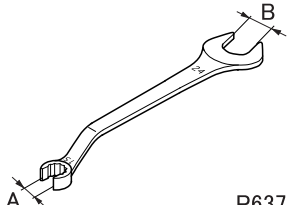
Tightening torque (Unit: N·m {kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (supply pump mounting)	54 {5.5}	—
Tb	Eyebolt (fuel suction pipe mounting)	25 to 29 {2.6 to 3.0}	—
	Eyebolt (fuel feed pipe mounting)		
Tc	Eyebolt (oil pipe mounting)	21 {2.1}	—
Td	Overflow valve mounting	30 to 40 {3.1 to 4.1}	—
Te	Fuel pipe	29 to 35 {3.0 to 3.6}	—
Tf	Bolt (supply pump mounting)	125 {12.7}	—

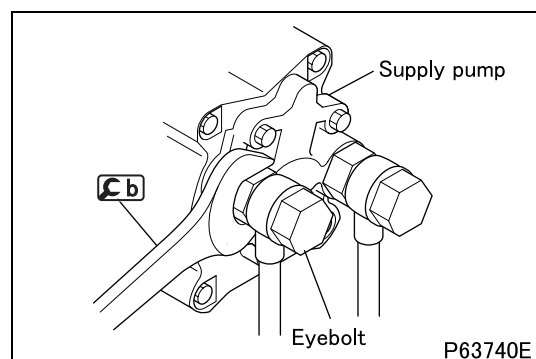
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	O-ring	Engine oil	As required

Special tools (Unit: mm)

Mark	Tool name and shape	Part No.	Application			
a Timing bolt <table><tr><td>A</td></tr><tr><td>φ10</td></tr></table>  P40712	A	φ10	ME350296	Installation of supply pump		
A						
φ10						
b Open end spanner <table><tr><td>A</td><td>B</td></tr><tr><td>15</td><td>24</td></tr></table>  P63739	A	B	15	24	ME355665	Removal and installation of fuel suction pipe and fuel feed pipe
A	B					
15	24					

◆ Removal procedure ◆



■ Removal: Fuel suction pipe and fuel feed pipe

- Apply **Cb** (width across flats: 24 mm) to the connector of the supply pump as a stopper, and then loosen the eyebolt to remove the fuel suction pipe and fuel feed pipe.

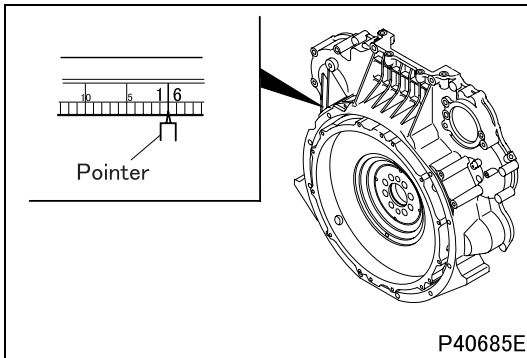
CAUTION ⚠

- Do not use **Cb** except for a stopper of the fuel suction pipe and fuel feed pipe, otherwise the open end section may be broken.

Mitsubishi 6M70 Engine Parts contact:
 email: EngineParts@HeavyEquipmentRestorationParts.com
 Phone: 269 673 1638

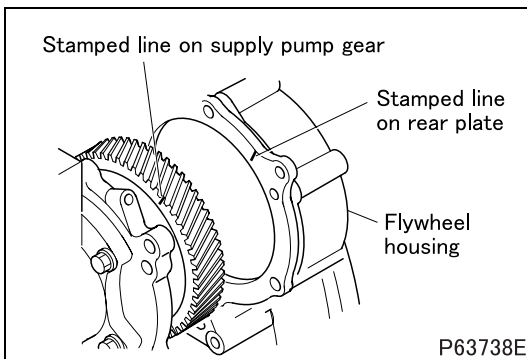
SUPPLY PUMP

◆ Installation procedure ◆

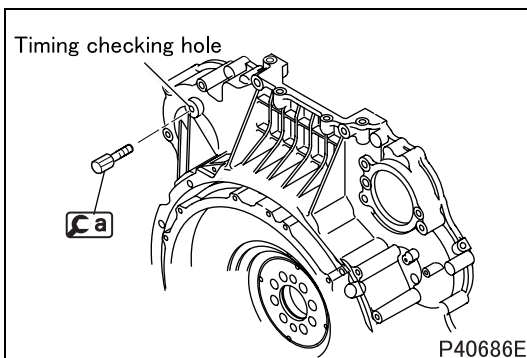


■ Installation: Mitsubishi 6M70 Fuel Supply pump

- Position the No. 1 piston to the top dead center in the compression stroke in the following manner.
 - Crank the engine to align the pointer with the "1 6" mark on the flywheel.
 - This will bring either the No. 1 piston or the No. 6 piston to the top dead center in the compression stroke. If both the inlet and exhaust rockers can be moved by hand by the amount of valve clearance, that cylinder is at the top dead center in the compression stroke. From that position, every turn of the crankshaft will alternately bring the No.1 and No. 6 pistons to the top dead center in the compression stroke. (See Gr11.)



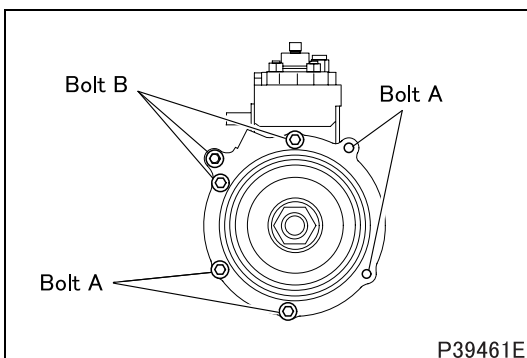
- Install the supply pump while ensuring that the stamped line on the supply pump gear is aligned with the stamped line on rear plate.



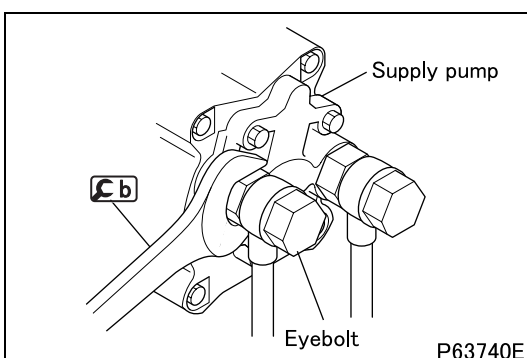
- Insert **Ca** into the timing checking hole of the flywheel housing.
- If the seat surface of **Ca** is securely fitted, the timing is aligned. If the seat surface lifts, the gears are not properly engaged. Re-install the supply pump.

CAUTION ⚠

- Remember to remove **Ca** after it is used.



- Install bolt A from the supply pump side and bolt B from the fly-wheel housing side.

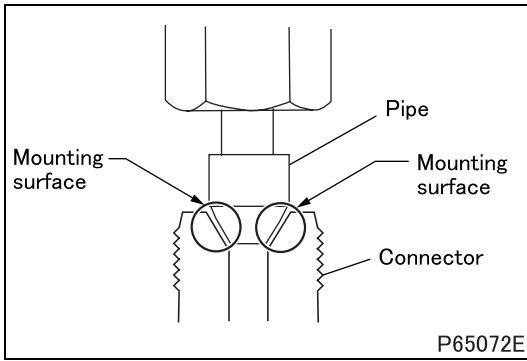


■ Installation: Fuel suction pipe and fuel feed pipe

- Apply **Cb** (width across flats: 24 mm) to the connector of the supply pump as a stopper, and then tighten the eyebolt to install the fuel suction pipe and fuel feed pipe.

CAUTION ⚠

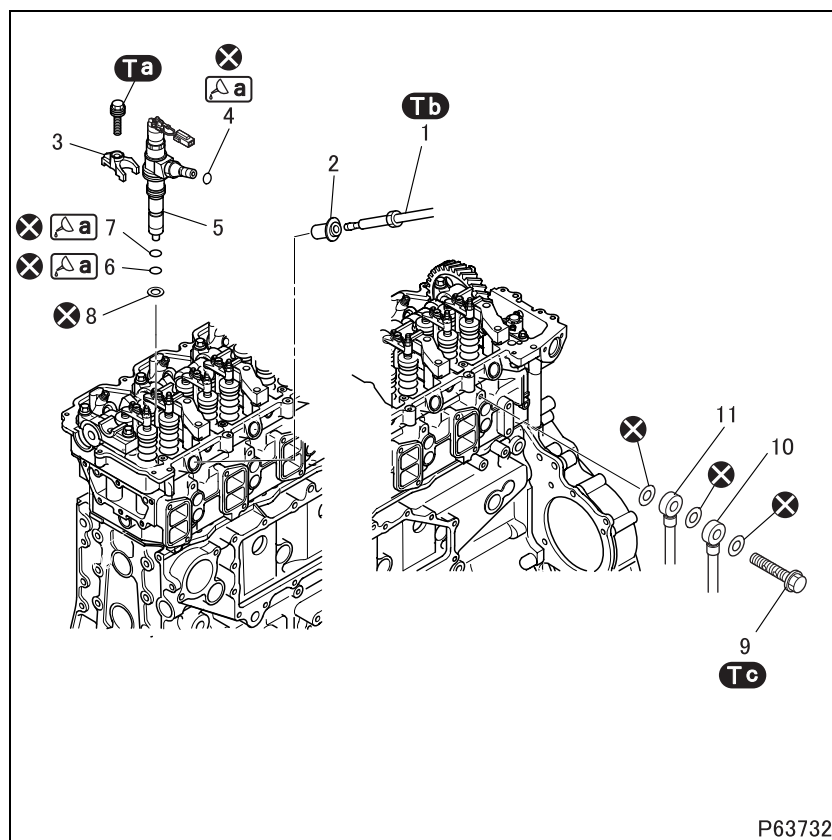
- Do not use **Cb** except for a stopper of the fuel suction pipe and fuel feed pipe, otherwise the open end section may be broken.

**■ Installation: Fuel pipe**

- Ensure that the pipe and mounting surfaces of the connector are flat and free from damage.
- Bring the pipe into intimate contact with mounting surfaces of the connector evenly, and temporarily tighten it without applying an excessive force.
- Tighten it to the specified torque after temporary tightening.

Mitsubishi 6M70 Engine Parts contact:
email: EngineParts@HeavyEquipmentRestorationParts.com
Phone: 269 673 1638

MITSUBISHI 6M70 INJECTOR



● Removal sequence

- 1 Injection pipe
- 2 Injection pipe seal
- 3 Nozzle bridge
- 4 O-ring
- 5 Injector
- 6 O-ring
- 7 O-ring
- 8 Nozzle tip gasket
- 9 Eyebolt
- 10 Fuel return pipe
- 11 Fuel return pipe

⊗: Non-reusable parts

WARNING ⚠

- Fuel is highly flammable. Do not handle it near flames or heat.
- Spilled fuel may catch fire and therefore, must be wiped off completely.

CAUTION ⚠

- The harnesses and connectors between the injectors and common rail electronic control unit are under high voltage. Be careful not to receive an electric shock. Before attempting to remove the injectors, turn the starter switch to the LOCK position.
- Carefully handle the injector, taking care not to damage the threaded portion and nozzle as high pressure is applied to the injector.
- To eliminate fuel injection and other problems, protect the injectors and pipes, that have been removed, from the ingress of contaminants.

- Contact Bosch Service Station for any service needs of the injector.

● Installation sequence

Follow the removal sequence in reverse.

CAUTION ⚠

- Do not attempt to clean the nozzle hole with a wire brush or other similar tools, or the hole can be damaged.
- Be sure to tighten the nozzle bridge bolts to the specified torque. Overtightening the bolts can deform the injectors, resulting in incorrect fuel injection.

Tightening torque (Unit: N·m {kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (nozzle bridge mounting)	54 nm {5.5 kgfm} 40 Ft Lbs	—
Tb	Mitsubishi 6M70 Injection pipe	29 to 34 {3.0 to 3.5}	—
Tc	Eyebolt (fuel return pipe mounting)	40 {4}	—

Mitsubishi 6M70 Engine Parts contact:

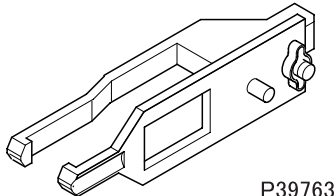
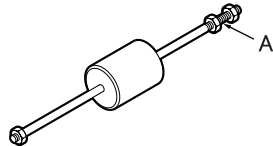
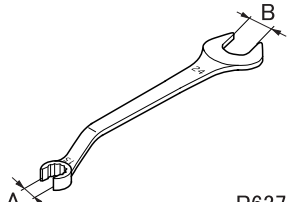
email: EngineParts@HeavyEquipmentRestorationParts.com

Phone: 269 673 1638

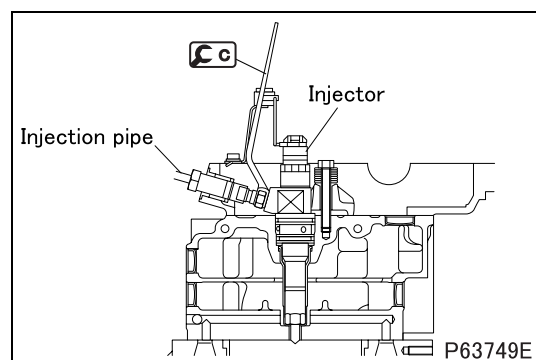
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	O-ring	Engine oil	As required

Special tools (Unit: mm)

Mark	Tool name and shape	Part No.	Application				
	Injector extractor adapter  P39763	ME165088	Removing injector (use with MH061071)				
	Nozzle extractor <table border="1"><tr><td>A</td></tr><tr><td>M8 × 1.25</td></tr></table>  P13523	A	M8 × 1.25	MH061071	Removing injector		
A							
M8 × 1.25							
	Open end spanner <table border="1"><tr><td>A</td><td>B</td></tr><tr><td>15</td><td>24</td></tr></table>  P63739	A	B	15	24	ME355665	Removal and installation of injection pipe
A	B						
15	24						

◆ Removal procedure ◆



■ Removal: Mitsubishi 6M70 Injection pipe

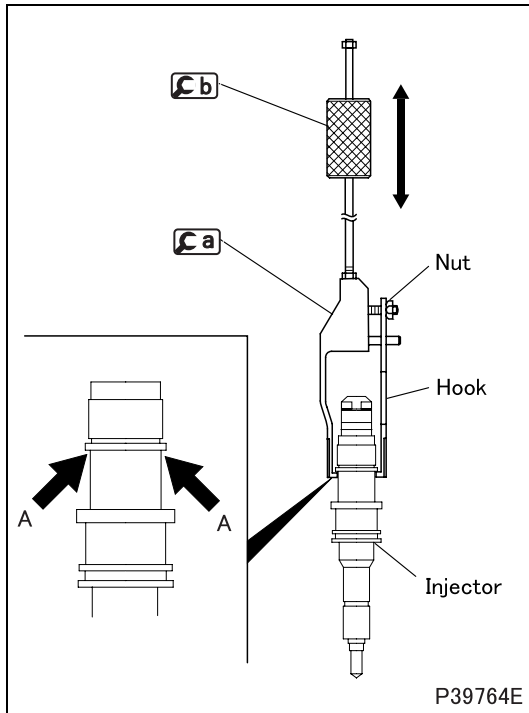
- Apply  c (width across flats: 15 mm) to the connector of the injector as a stopper, and then loosen the union nut to remove the injection pipe.

CAUTION

- Do not use  c except for a stopper of the injection pipe, otherwise the open end section may be broken.

Mitsubishi 6M70 Engine Parts contact:
 email: EngineParts@HeavyEquipmentRestorationParts.com
 Phone: 269 673 1638

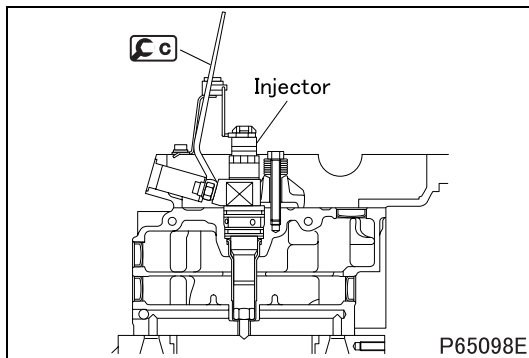
INJECTOR



■ Removal: Mitsubishi 6M70 Injector

- Tighten the nut so that a hook of **a** can be hung on section A of the injector.
- Attach **b** to **a** and remove the injector.

◆ Installation procedure ◆

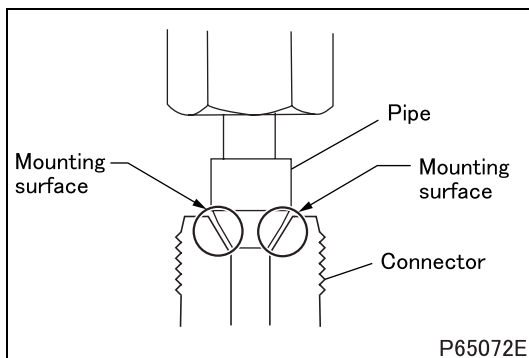


■ Installation: Mitsubishi 6M70 Injection pipe

- Apply **c** (width across flats: 24 mm) to the connector of the injector as a stopper.

CAUTION ⚠

- Do not use **c** except for a stopper of the injection pipe, otherwise the open end section may be broken.



- Ensure that the pipe and mounting surfaces of the connector are flat and free from damage.
- Bring the pipe into intimate contact with mounting surfaces of the connector evenly, and temporarily tighten it without applying an excessive force.
- Tighten it to the specified torque after temporary tightening.

M E M O



- **Removal sequence**

- | | | |
|--------------------------|----------------------------|-----------------------------|
| 1 Drain plug | 6 Fuel level sensor | 10 Fuel tank |
| 2 Strainer | 7 Fuel tank strap | 11 Fuel tank bracket |
| 3 Connecting plug | 8 Fuel tank strap | 12 Fuel tank bracket |
| 4 Suction hose | <Except FV51> | <Except FV51> |
| 5 Return hose | 9 Fuel tank strap | 13 Fuel tank bracket |

● Installation sequence

Follow the removal sequence in reverse.

DANGER

- **Do not allow any flames or sources of heat near the fuel tank, as it may explode.**

WARNING

- Fuel is highly flammable. Keep it away from flames and sources of heat.
- Thoroughly wipe up any spilled fuel, otherwise it may catch fire.

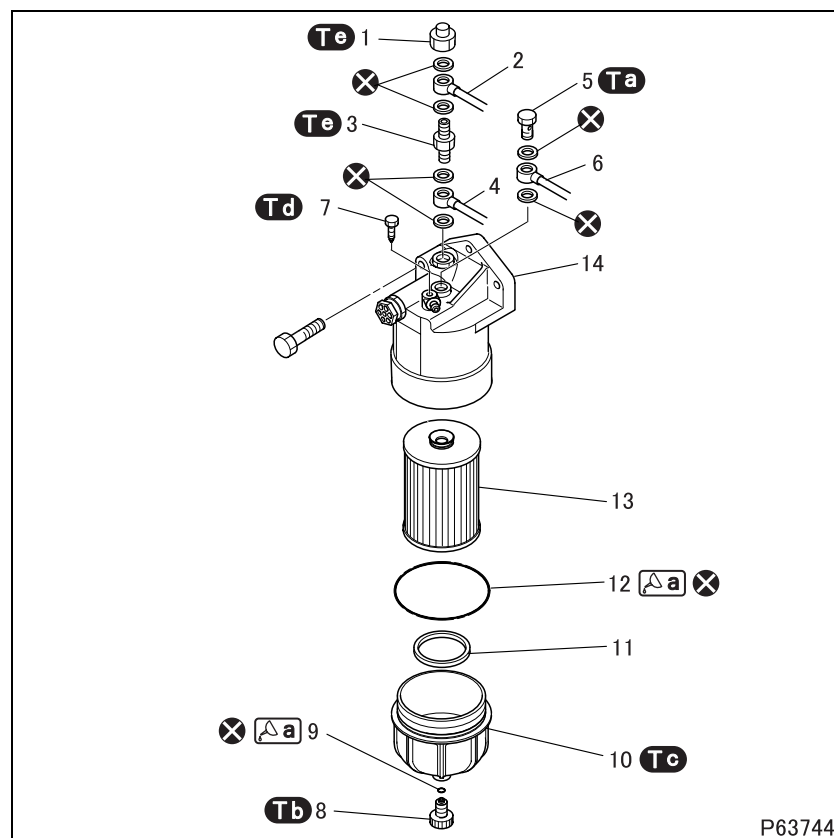
Tightening torque (Unit: N·m {kgf·m})

Mark	Parts to be tightened		Tightening torque	Remarks
Ta	Drain plug		127 {13}	—
Tb	Connecting plug		20 {2.0}	—
Tc	Nut (fuel tank strap mounting)		11.7 to 12.7 {1.2 to 1.3}	—
Td	Bolt (fuel tank bracket mounting)		54 to 72 {5.5 to 7.3}	Wet
Te	Bolt (fuel tank bracket mounting)	FV51	54 to 72 {5.5 to 7.3}	Wet
		Except FV51	150 to 204 {15 to 21}	

Lubricant and/or sealant

Location	Points of application	Specified lubricant and/or sealant	Quantity
 a	Seat surface of drain plug	Seal end No. 22	As required
 b	Contact area between fuel tank strap and fuel tank	Soapy water	As required
 c	Thread area of bolt	Engine oil	As required

FUEL FILTER



● Disassembly sequence

- 1 Cap
- 2 Fuel return pipe
- 3 Overflow valve
- 4 Fuel feed pipe
- 5 Eyebolt
- 6 Fuel feed pipe
- 7 Plug
- 8 Drain plug
- 9 O-ring
- 10 Case
- 11 Float
- 12 O-ring
- 13 Element
- 14 Fuel filter head

⊗: Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

WARNING ⚠

- Fuel is highly flammable. Keep it away from flames and sources of heat.
- Thoroughly wipe up any spilled fuel. Otherwise, it may catch fire.

CAUTION ⚠

- Be careful not to damage the case.

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
3	Overflow valve	$1.14 \pm 0.03 \text{ MPa}$ $\{12 \pm 0.3 \text{ kgf/cm}^2\}$	—	Replace

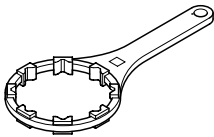
Tightening torque (Unit: N·m {kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ⓐ	Eyebolt	30 {3.0}	—
Ⓑ	Drain plug	$2 \pm 0.5 \{0.2 \pm 0.05\}$	—
Ⓒ	Case	18 to 20 {1.8 to 2.0}	—
Ⓓ	Plug	$9.8 \pm 2.0 \{1.0 \pm 0.2\}$	—
Ⓔ	Overflow valve	20 to 29 {2.0 to 3.0}	—
	Cap		

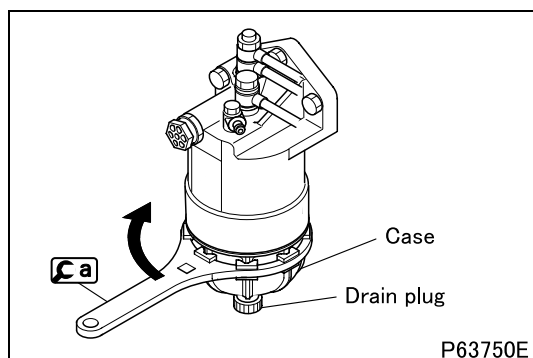
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
Ⓐ	O-ring	Engine oil	As required

Special tools

Mark	Tool name and shape	Part No.	Application
	Filter wrench  P40018	MH063201	Removal and installation of case

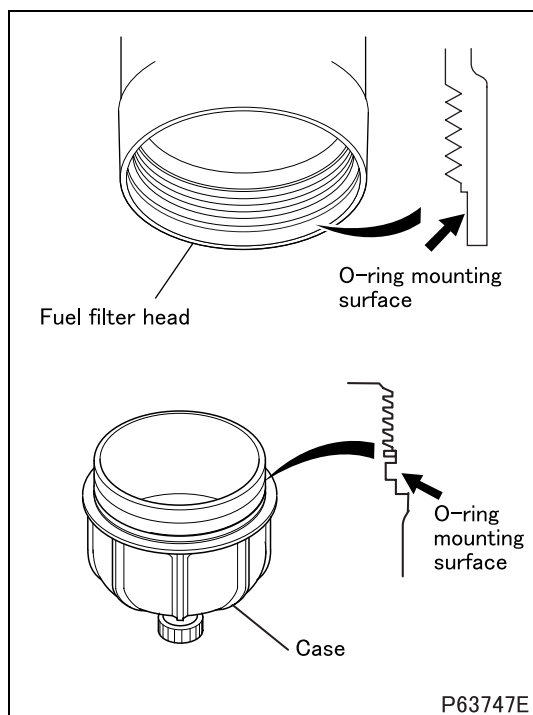
◆ Removal procedure ◆



■ Removal: Case

- Drain fuel from the case by loosening the drain plug.
- Using , remove the case.

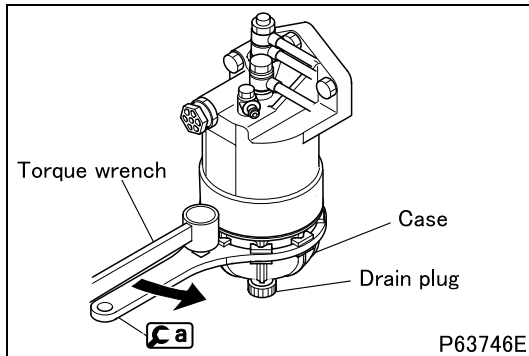
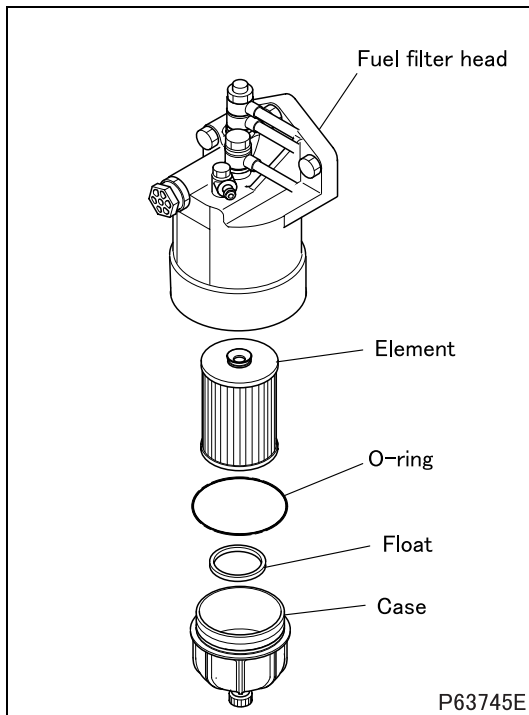
◆ Installation procedure ◆



■ Installation: Case

- Clean the surface of the fuel filter head and case where the O-ring is to be mounted.

FUEL FILTER



- Replace the filter element and O-rings with new parts.
- Apply a thin coat of engine oil to the O-rings. Install the O-rings onto the case.

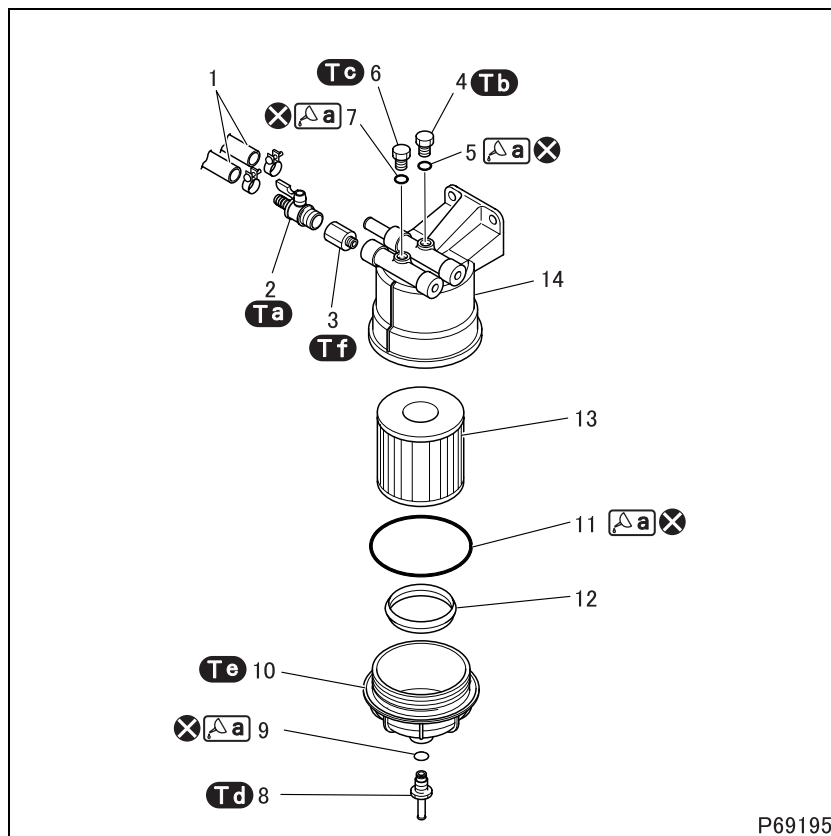
CAUTION

- The use of non-genuine filter elements will lead to engine problems. Be sure to use only genuine parts.
- To help prevent fuel injection problems, keep the fuel filter and hoses free from contamination.

- Install a torque wrench to  and tighten the case to the specified torque.
- Tighten the drain plug to the specified torque. With the plug correctly installed, bleed air from the fuel system.
- Start the engine and check that there is no fuel leakage.
- If there is fuel leakage, remove and install the fuel filter correctly.

M E M O

WATER SEPARATOR



● Disassembly sequence

- 1 Fuel hose
- 2 Fuel cut valve
- 3 Connector
- 4 Plug A
- 5 O-ring
- 6 Plug B
- 7 O-ring
- 8 Drain plug
- 9 O-ring
- 10 Cover
- 11 O-ring
- 12 Float
- 13 Element
- 14 Body

⊗: Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

WARNING

- Fuel is highly flammable. Keep it away from flames and sources of heat.
- Thoroughly wipe up any spilled fuel. Otherwise, it may catch fire.

CAUTION

- Be careful not to damage the case.

Tightening torque (Unit: N·m {kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Fuel cut valve	35 {3.6}	—
Tb	Plug A	12.3 ± 2.5 {1.3 ± 0.3}	—
Tc	Plug B	17.2 ± 2.5 {1.8 ± 0.3}	—
Td	Drain plug	1.47 ± 0.3 {0.15 ± 0.03}	—
Te	Cover	19.6 ± 2.5 {2.0 ± 0.25}	—
Tf	Connector	40 {4.0}	—

Lubricant and/or sealant

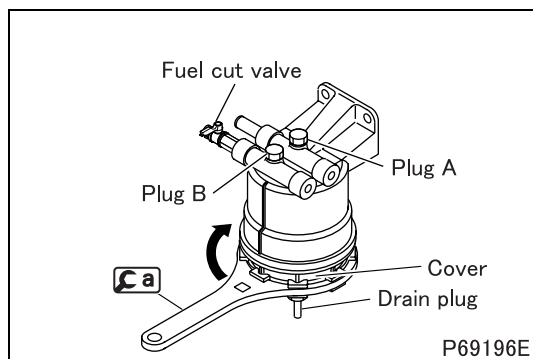
Mark	Points of application	Specified lubricant and/or sealant	Quantity
	O-ring	Engine oil	As required

Special tools

Mark	Tool name and shape	Part No.	Application
	Filter wrench	MH063201	Removal and installation of cover

P40018

◆ Removal procedure ◆



■ Removal: Cover

- Loosen plugs A and B and then loosen the drain plug. Next, discharge fuel from the water separator.
- Using **(a)**, remove the cover.

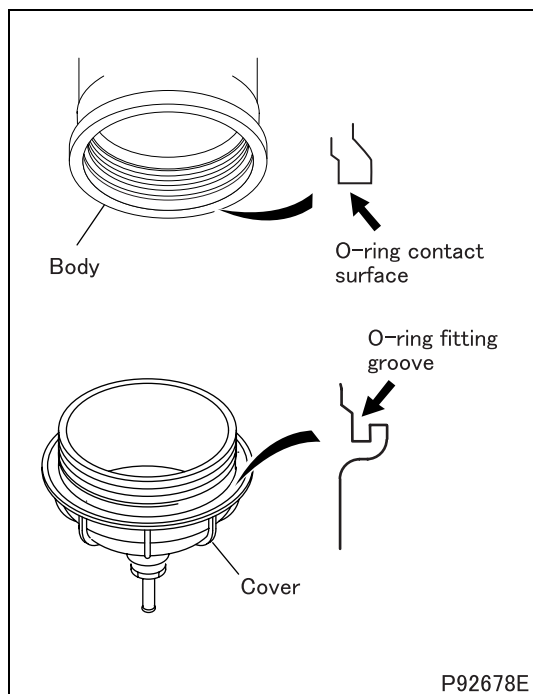
WARNING ⚠

- Do not bring an open flame or heat near to fuel, which can catch fire easily.
- Thoroughly wipe the surface clean of spilled fuel that could otherwise lead to a fire.

CAUTION ⚠

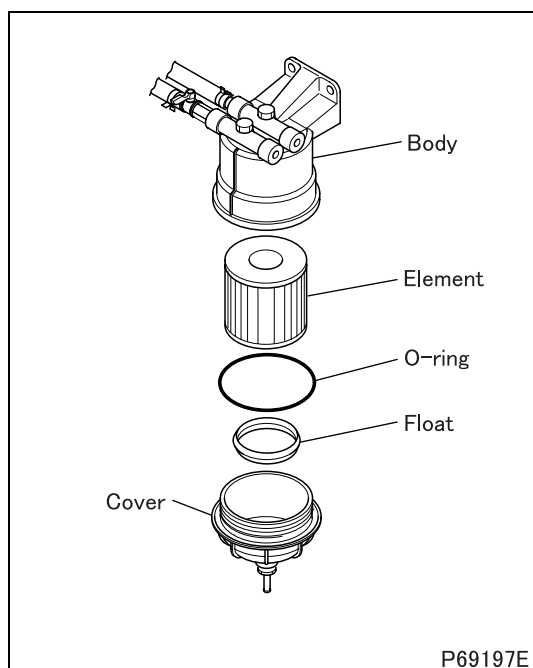
- Use care not to damage the cover.

◆ Installation procedure ◆



■ Installation: Cover

- Clean the surface of the water separator body, against which O-ring abuts, and the O-ring groove in the cover.

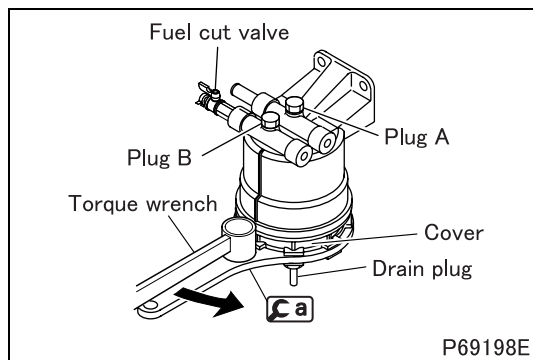


- Replace the filter element and O-ring with new parts.
- Apply a thin coat of engine oil to the O-ring. Install the O-ring onto the case.

CAUTION ⚠

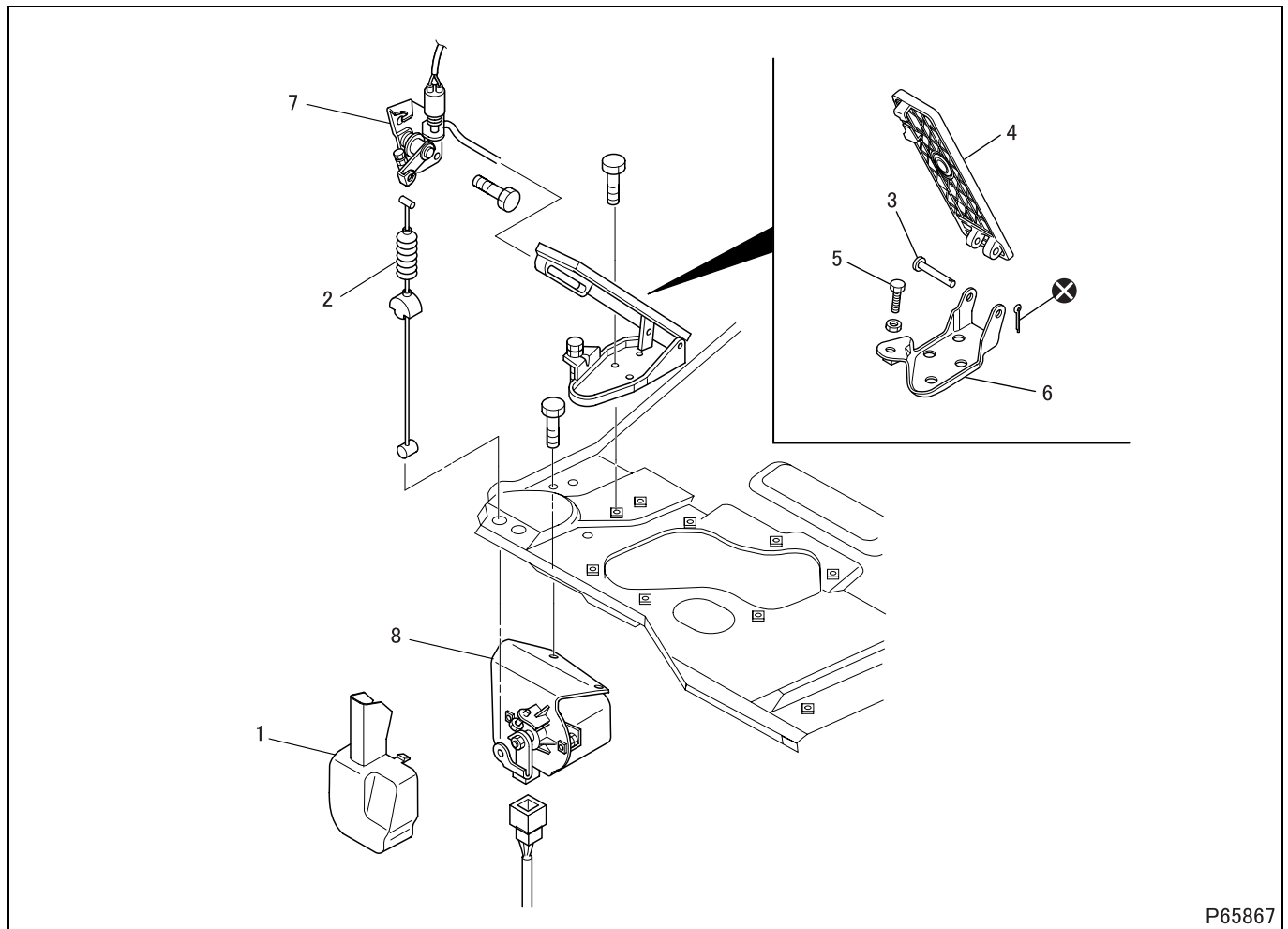
- The use of non-genuine filter elements will lead to engine problems. Be sure to use only genuine parts.
- To help prevent fuel injection problems, keep the water separator and fuel hoses free from contamination.

WATER SEPARATOR



- Install torque wrench to **Ca** and tighten the case to the specified torque.
- Tighten the drain plug and plugs A, B to the specified torque. With the plug correctly installed, bleed air from the fuel system.
- Start the engine and ensure that there is no fuel leakage.
- If there is fuel leakage, remove and install the water separator correctly.

M E M O



P65867

● Removal sequence

- | | |
|-----------------------------------|---|
| 1 Cover | 6 Accelerator pedal bracket |
| 2 Accelerator pedal control cable | 7 Accelerator link (See later section.) |
| 3 Accelerator pedal pin | 8 Accelerator pedal position sensor |
| 4 Accelerator pedal | |
| 5 Stopper bolt | |

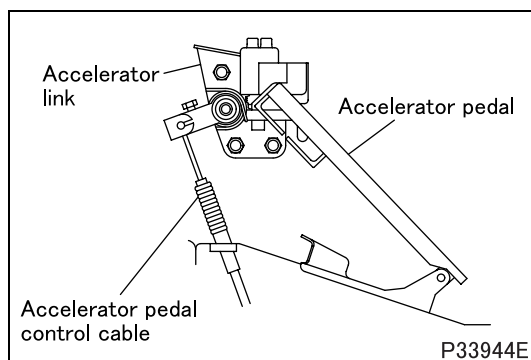
⊗: Non-reusable parts

● Installation sequence

Follow the removal sequence in reverse.

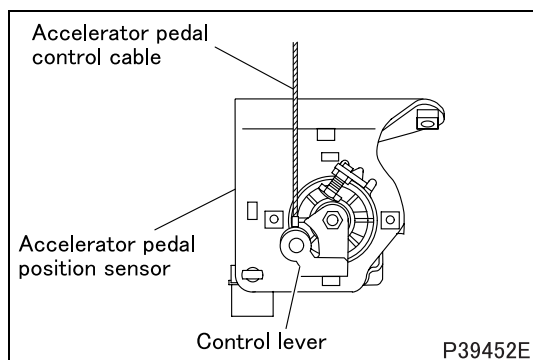
- After the installation, check the no-load minimum speed and no-load maximum speed for normal state and adjust them if required. (See “ON-VEHICLE INSPECTION AND ADJUSTMENT”.)
- Make sure that the accelerator pedal moves smoothly.

◆ Installation procedure ◆

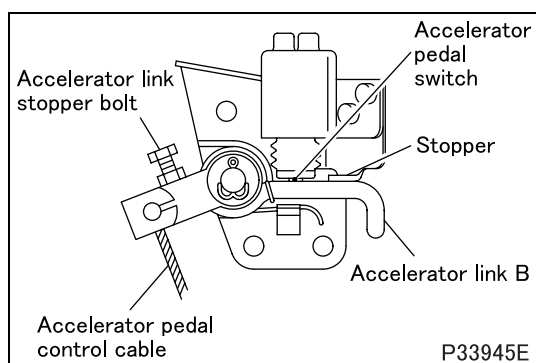


■ Installation: Accelerator pedal control cable

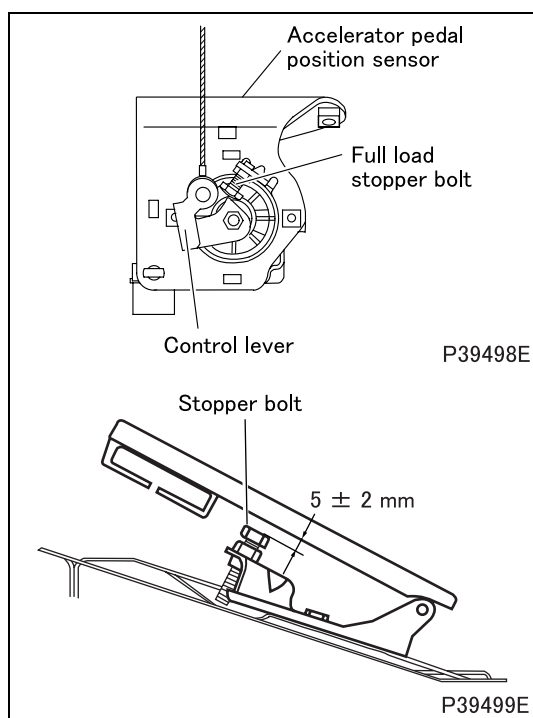
- Connect the accelerator pedal control cable to the accelerator link.



- Install the other end of the accelerator pedal control cable onto the accelerator position sensor control lever.



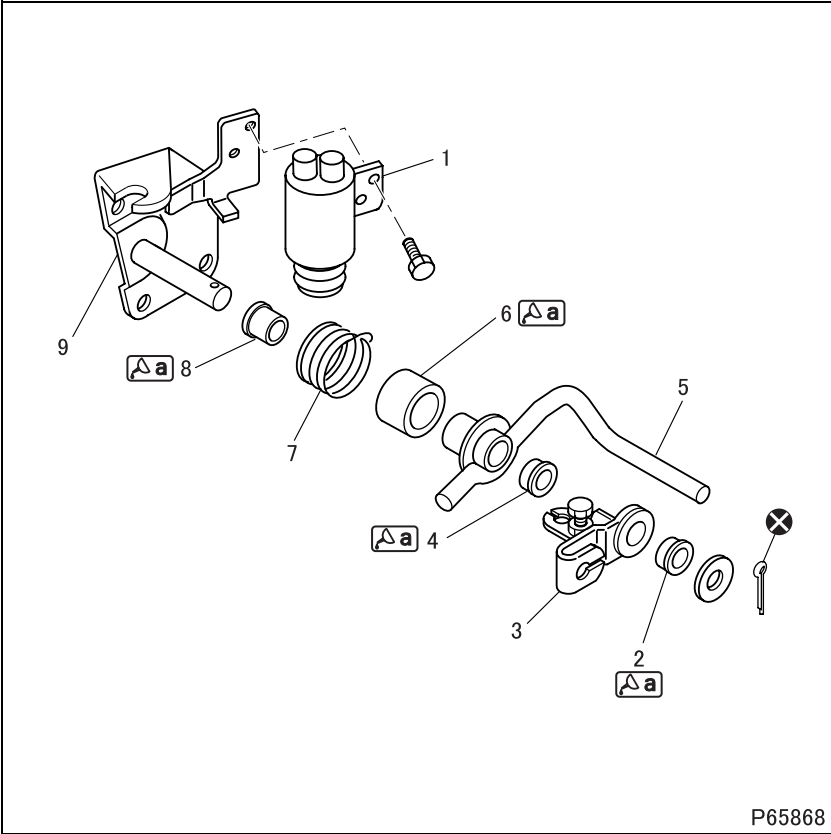
- Adjust tension of the accelerator pedal control cable with the accelerator link stopper bolt so that accelerator link B contacts the stopper.



- Press the accelerator pedal until the control lever of the accelerator pedal position sensor contacts the full load stopper bolt.
- Adjust the stopper bolt so that clearance between the accelerator pedal and stopper bolt is to the dimension shown in the illustration.

ENGINE CONTROL

Accelerator Link



● Removal sequence

- 1 Accelerator pedal switch
- 2 Bushing
- 3 Accelerator link A
- 4 Bushing
- 5 Accelerator link B
- 6 Collar
- 7 Return spring
- 8 Bushing
- 9 Accelerator link bracket

⊗: Non-reusable parts

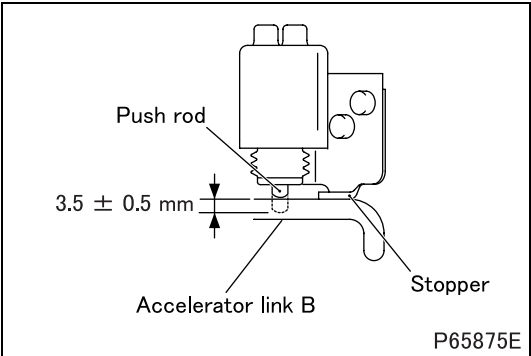
● Installation sequence

Follow the removal sequence in reverse.

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
	Sliding surfaces of bushing and accelerator link bracket	Chassis grease [NLGI No. 1 (Li soap)]	As required
	Sliding surfaces of collar and return spring		

◆ Installation procedure ◆

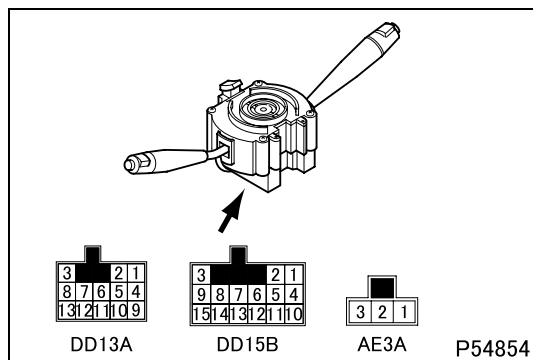


■ Installation: Accelerator pedal switch

- Place accelerator link B against the stopper.
- Place the push rod of the accelerator pedal switch against accelerator link B and install the accelerator pedal switch so that the stroke of the push rod is to the dimension shown in the illustration.

M E M O

INSPECTION OF MITSUBISHI 6M70 ELECTRICAL PARTS

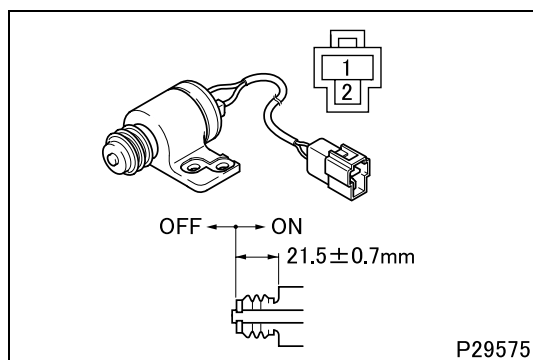


#001 Inspection of combination switch

DD15B connector connection table

Switch position		Terminals with continuity
Powertard switch	OFF	–
	1st step	6 – 11
	2nd step	6 – 11, 3 – 9

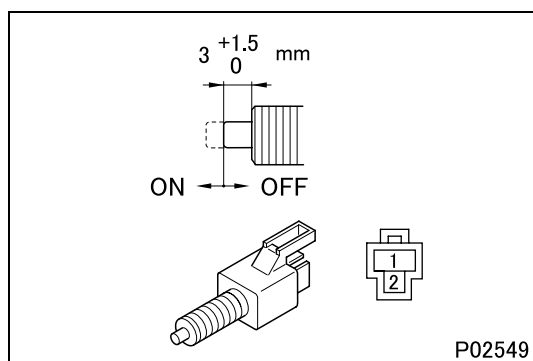
- For other inspections than shown above, see Gr54.
- If there is any abnormality, replace the switch.



#029 Inspection of accelerator pedal switch

Switch position		Terminals with continuity
OFF		–
ON		1 – 2

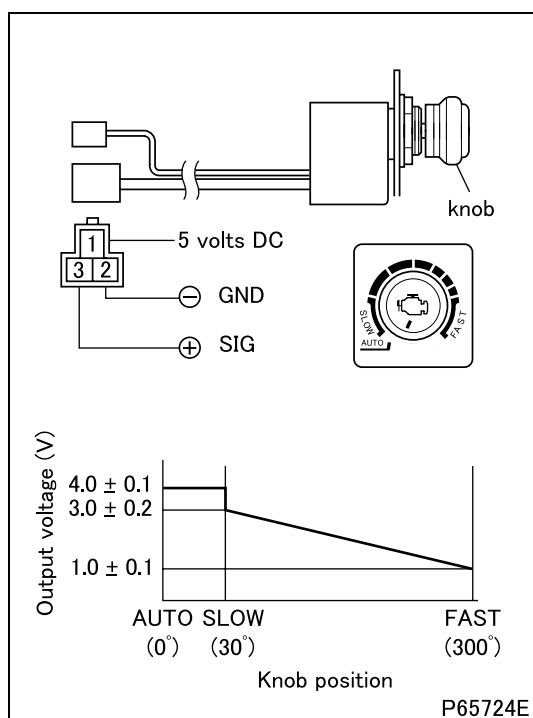
- If there is any abnormality, replace the switch.



#031 Inspection of clutch switch

Switch position		Terminals with continuity
OFF		–
ON		1 – 2

- If there is any abnormality, replace the switch.

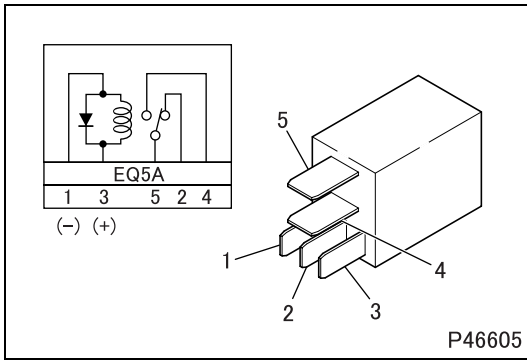


#157 Inspection of idling speed adjustment potentiometer

- Apply 5 volts DC to terminals 1 and 2 of the idling speed adjustment potentiometer.
- Turn the knob fully counterclockwise. Then, measure the output voltage across terminals 2 and 3 (see the diagrams on the left) while slowly turning the knob clockwise.

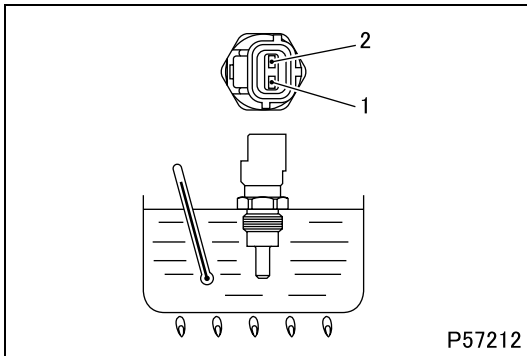
Standard value	Knob position	Output voltage
	AUTO (0°)	4.0 ± 0.1 V
	SLOW (30°)	3.0 ± 0.2 V
	FAST (300°)	1.0 ± 0.1 V

- If any measurement is out of specification, replace the idling speed adjustment potentiometer.



#201 Inspection of relay (normally open 5-pin)

- Check continuity and operating condition of the relay. Replace the relay if necessary.

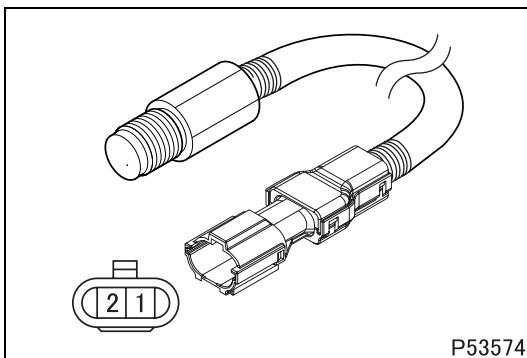


#262 Inspection of Mitsubishi 6M70 water temperature sensor

- Place the water temperature sensor in a container filled with engine oil.
- Heat the oil to each of the specified temperatures. Stir the oil well while doing so.
- Measure the resistance between terminals 1 and 2.

Standard value	20°C	$2.45 \pm 0.14 \text{ k}\Omega$
	80°C	0.32 kΩ (reference value)
	110°C	$147.1 \pm 2 \Omega$

- If either measurement is out of specification, replace the sensor.



#263 Inspection of Mitsubishi 6M70 engine speed sensor

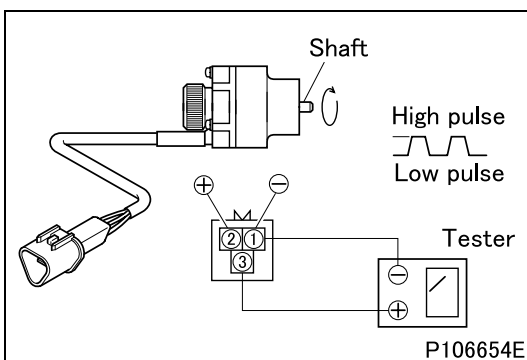
- Measure the resistance between terminals 1 and 2.

Standard value (at 25°C)	$2.2 \pm 0.2 \text{ k}\Omega$
--------------------------	-------------------------------

- If the measurement is out of specification, replace the sensor.

CAUTION

- The signal may not output if the sensor tightening torque is insufficient. Check if the sensor is tightened with the correct tightening torque. (See Gr11.)



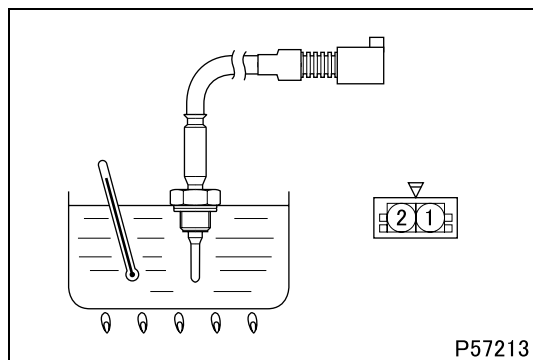
#265 Inspection of vehicle speed sensor

- With the 24 volts DC applied to terminals 1 and 2, slowly turn the shaft of the vehicle speed sensor.
- Measure the maximum voltage (high pulse voltage) and minimum voltage (low pulse voltage) occurring at each specified pair of terminals.

Standard value	Low pulse voltage	0.5 V or lower
	High pulse voltage	$8 \pm 1 \text{ V}$

- If any measurement is out of specification, replace the sensor.

INSPECTION OF ELECTRICAL EQUIPMENT

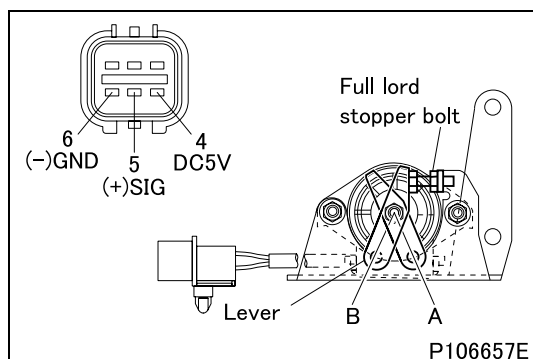


#305 Inspection of Mitsubishi 6M70 intake air temperature sensor

- The intake air temperature sensor 1 may output false signals if its tip is contaminated. Clean it if necessary. (See Gr15.)
- Place the sensor in a container filled with engine oil.
- Heat the oil to each of the specified temperatures. Stir the oil well while doing so.
- Measure the resistance between terminals 1 and 2.

Standard value	0°C	15 ^{+3.78} / _{-2.94} kΩ
	20°C	6.514 ^{+1.437} / _{-1.147} kΩ
	80°C	0.874 ^{+0.136} / _{-0.115} kΩ

- If either measurement is out of specification, replace the sensor.

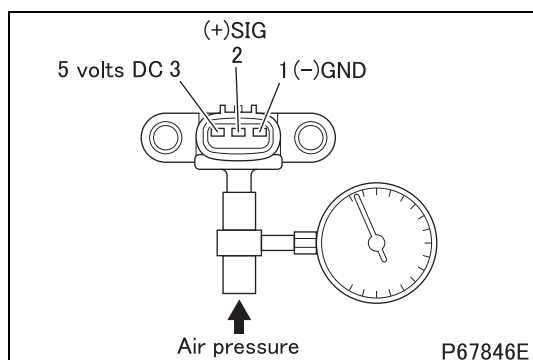
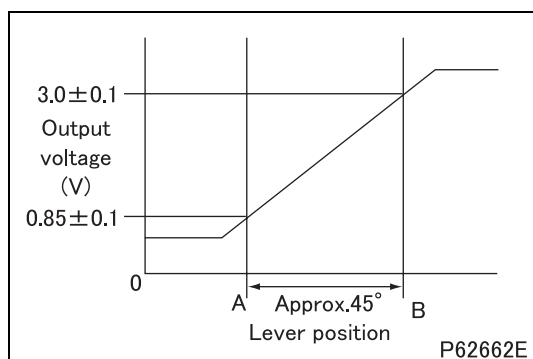


#317 Inspection of power take-off load sensor

- Apply 5 volts DC to terminals 4 and 6.
- Measure the output voltage across terminals 5 and 6 with the lever at idling position A and at full-load position B.

Standard value	Lever position	Output voltage
	Idling position A	0.85 ± 0.1 V
	Full-load position B	3.0 ± 0.1 V

- If measurement of full-load position B deviates from standard value, adjust with full load stopper bolt.
- If measurement of idling position A deviates from standard value, replace the sensor.



#318 Inspection of Mitsubishi 6M70 boost pressure sensor

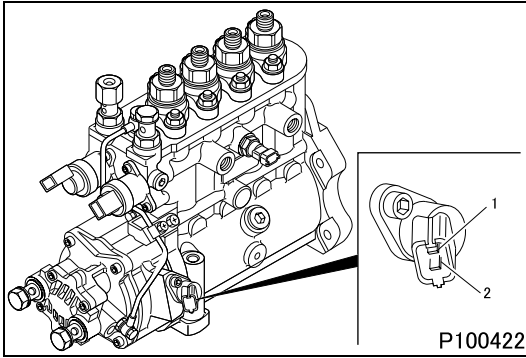
- Apply 5 volts DC to terminals 3 and 1.
- Apply air pressure. Gradually increase it and, while doing so, measure the output voltage occurring at terminals 2 and 1.

Standard value	Air pressure (gauge pressure)	Voltage
	99 kPa {1.0 kg/cm ² }	Approx. 2.5 V
	232.2 kPa {2.3 kg/cm ² }	Approx. 4.5 V

- If any measurement is out of specification, replace the sensor.

#319 Inspection of Mitsubishi 6M70 common rail pressure sensor

- The sensor cannot easily be inspected in isolation, so you must evaluate it indirectly by inspection of system harnesses and related parts.
- If there is no abnormality in any related part but the system is abnormal, replace the common rail.

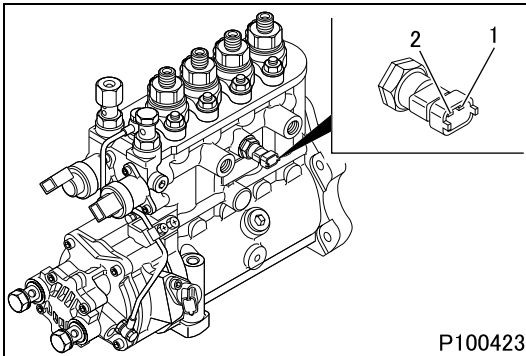


#320 Inspection of Mitsubishi 6M70 cylinder recognition sensor

- Measure the resistance between terminals 1 and 2.

Standard value	$860 \pm 86 \Omega$
----------------	---------------------

- If the measurement is out of specification, replace the sensor.

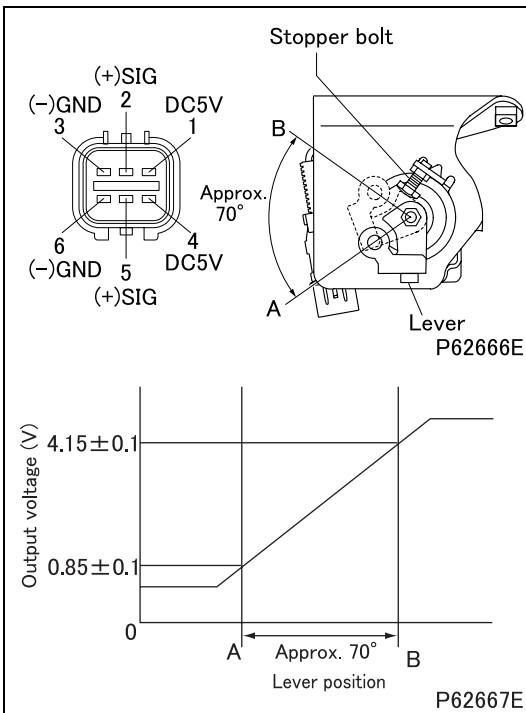


#323 Inspection of Mitsubishi 6M70 fuel temperature sensor

- Place the fuel temperature sensor in a container filled with engine oil.
- Heat the oil to each of the specified temperatures. Stir the oil well while doing so.
- Measure the resistance between terminals 1 and 2.

Standard value	20°C	$2.5 \pm 0.25 \text{ k}\Omega$
	80°C	$0.32 \pm 0.02 \text{ k}\Omega$
	110°C	$0.144 \pm 0.01 \text{ k}\Omega$

- If any measurement is out of specification, replace the sensor.



#324 Inspection of accelerator pedal position sensor

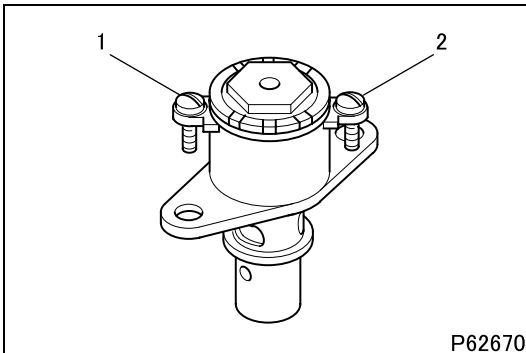
- Apply 5 volts DC to terminals 4 and 6 and terminals 1 and 3 of the accelerator pedal position sensor connector.
- Measure the output voltage at terminals 5 and 6 (sensor 1) and the output voltage at terminals 2 and 3 (sensor 2) with the lever in each specified position.

Standard value	Lever position	Output voltage
	Idling position A	$0.85 \pm 0.1 \text{ V}$
	Full load position B	$4.15 \pm 0.1 \text{ V}$

A: Position in which accelerator pedal switch is fully pushed in by lever

B: Position in which lever is touching stopper bolt

- If any output voltage is out of specification, make an adjustment.
- If any output voltage is still out of specification when you have made an adjustment, replace the sensor.



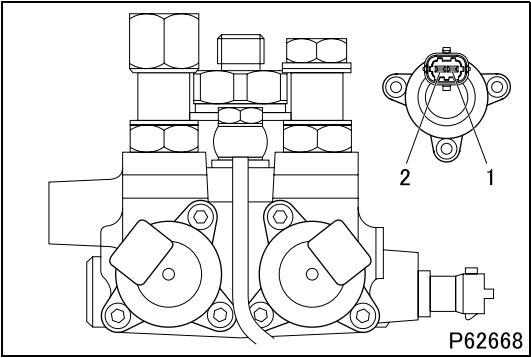
#571 Inspection of Powertard solenoid valve

- Measure the resistance between terminals 1 and 2.

Standard value	Engine oil temperature: 25°C	$32.6 \text{ to } 39.8 \Omega$
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- If the measurement is out of specification, replace the Powertard solenoid valve.

INSPECTION OF ELECTRICAL EQUIPMENT

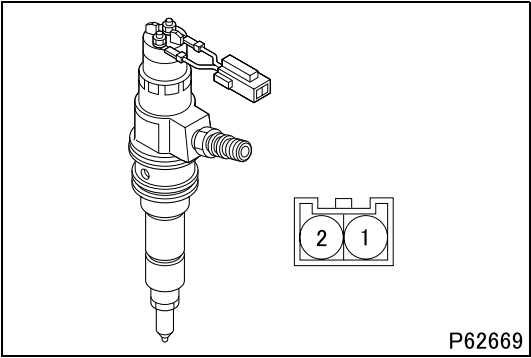


#574 Inspection of MPROP (rail pressure control valve)

- Measure the resistance between terminals 1 and 2. Identify MPROP1 and 2 by “M/P-1” and “M/P-2” labeled on the harness.

Standard value (at 20°C)	2.6 to 3.15 Ω
-----------------------------	---------------

- If the measurement is out of specification, replace the supply pump.

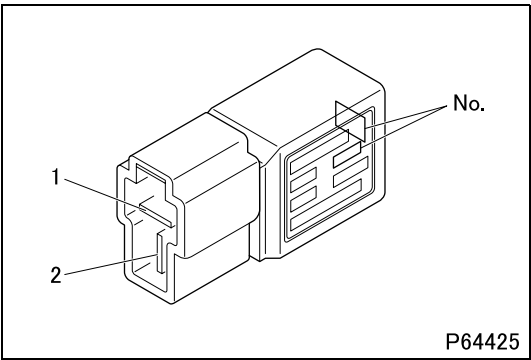


#582 Inspection of Mitsubishi 6M70 injector magnetic valve

- Measure the resistance between terminals 1 and 2.

Standard value (at 20 to 70°C)	0.21 to 0.295 Ω
--------------------------------	-----------------

- If the measurement is out of specification, replace the injector.



#828 Inspection of fuel injection rate adjustment resistor

- Measure the resistance of the resistor number marked on the fuel injection rate adjustment resistor.

Standard value (at 20°C)	Resistor No.	1	270 ± 13.5 Ω
		2	510 ± 25.5 Ω
		3	820 ± 41 Ω
		4	1300 ± 65 Ω
		5	2000 ± 100 Ω
		6	3300 ± 165 Ω
		7	5600 ± 280 Ω
		8	15000 ± 750 Ω
		9	390 ± 19.5 Ω
		10	4300 ± 215 Ω
		11	9100 ± 455 Ω

- If the measurement is out of specification, replace the fuel injection rate adjustment resistor with one that has the same resistor number and same specified resistance.

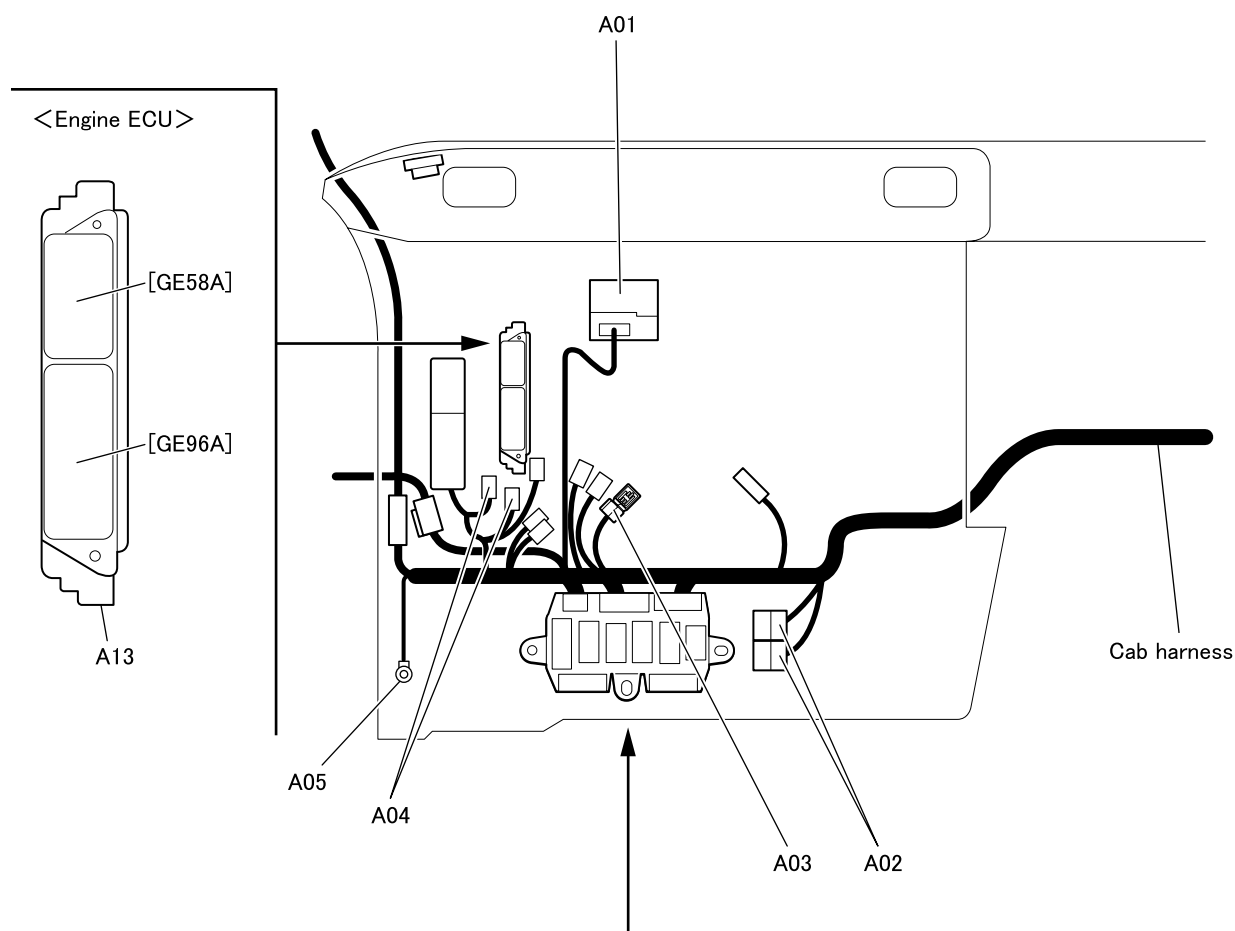
CAUTION ⚠

- The fuel injection rate adjustment resistor is matched to the engine. If you replace it, be sure to replace it with one that has the same resistor number.

M E M O

INSTALLED LOCATIONS OF PARTS

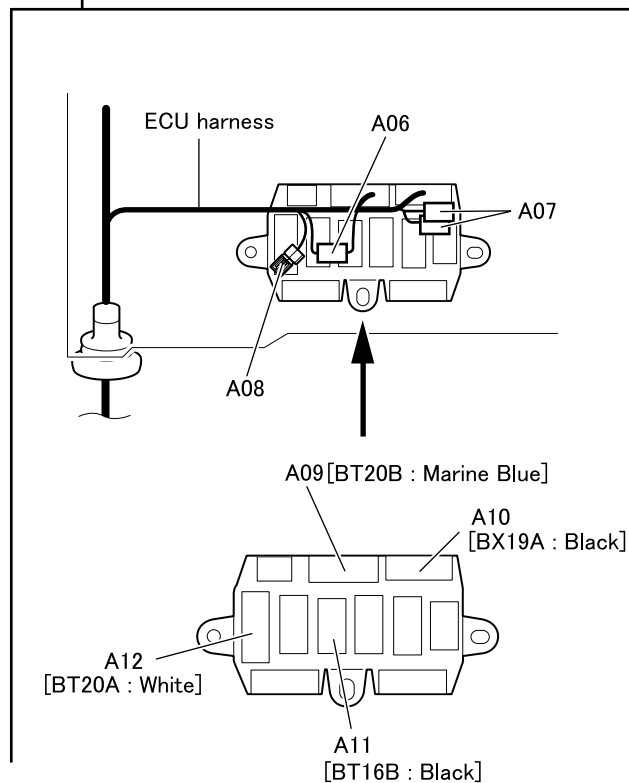
A01 - 13



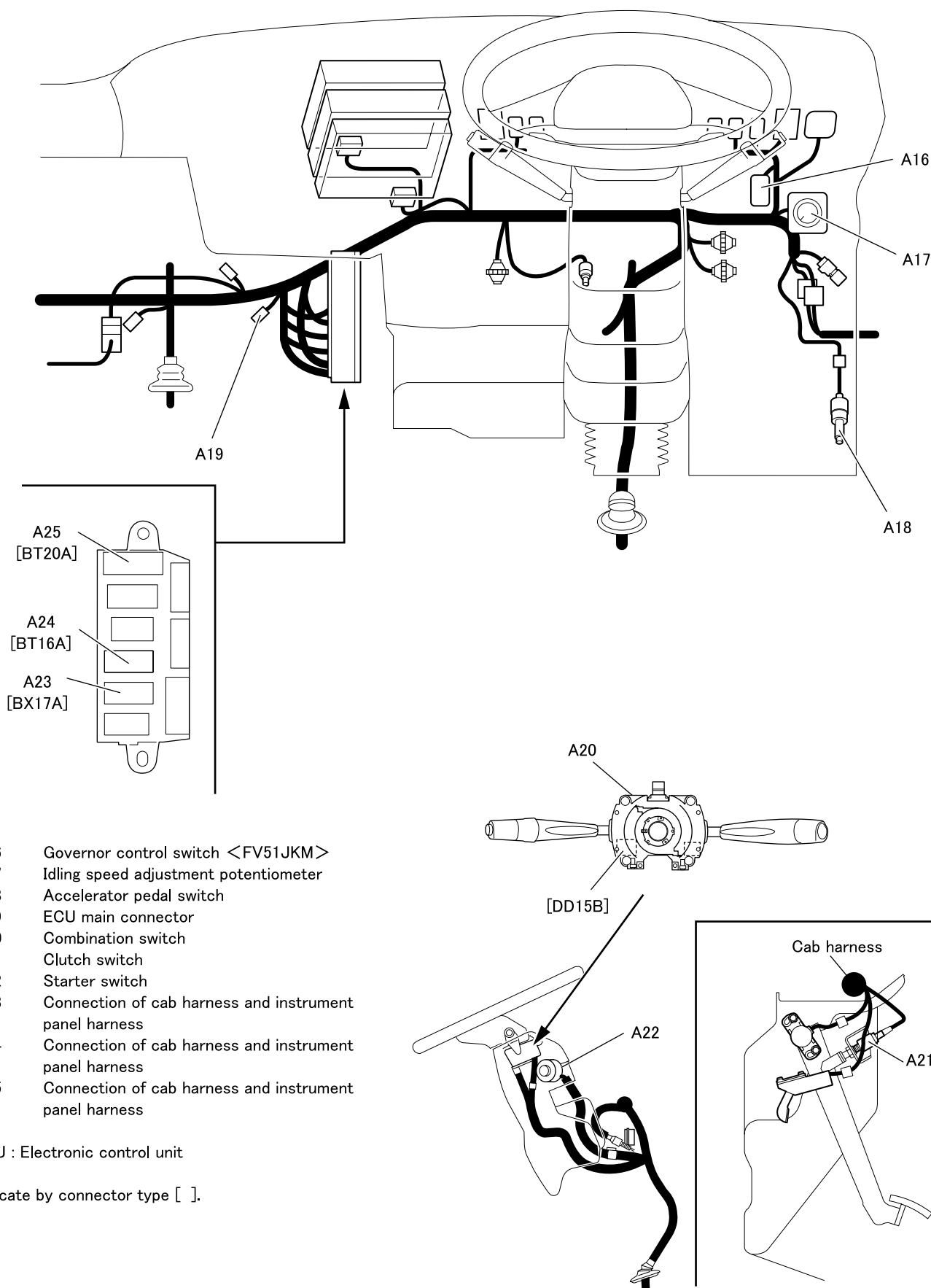
- A01 Pulse converter
- A02 Connection of cab harness and ECU harness
- A03 CAN resistor
- A04 Diode unit (for PTO) <except FK51JKM>
- A05 Ground
- A06 PTO connector
- A07 Fuel injection rate adjustment resistor, PTO resistor
- A08 CAN resistor
- A09 Connection of cab harness and ECU harness
- A10 Connection of cab harness and ECU harness
- A11 Connection of cab harness and chassis harness
- A12 Connection of cab harness and chassis harness
- A13 Engine ECU

ECU : Electronic control unit
CAN : Controller area network
PTO : Power take-off

Indicate by connector type and connector color [].

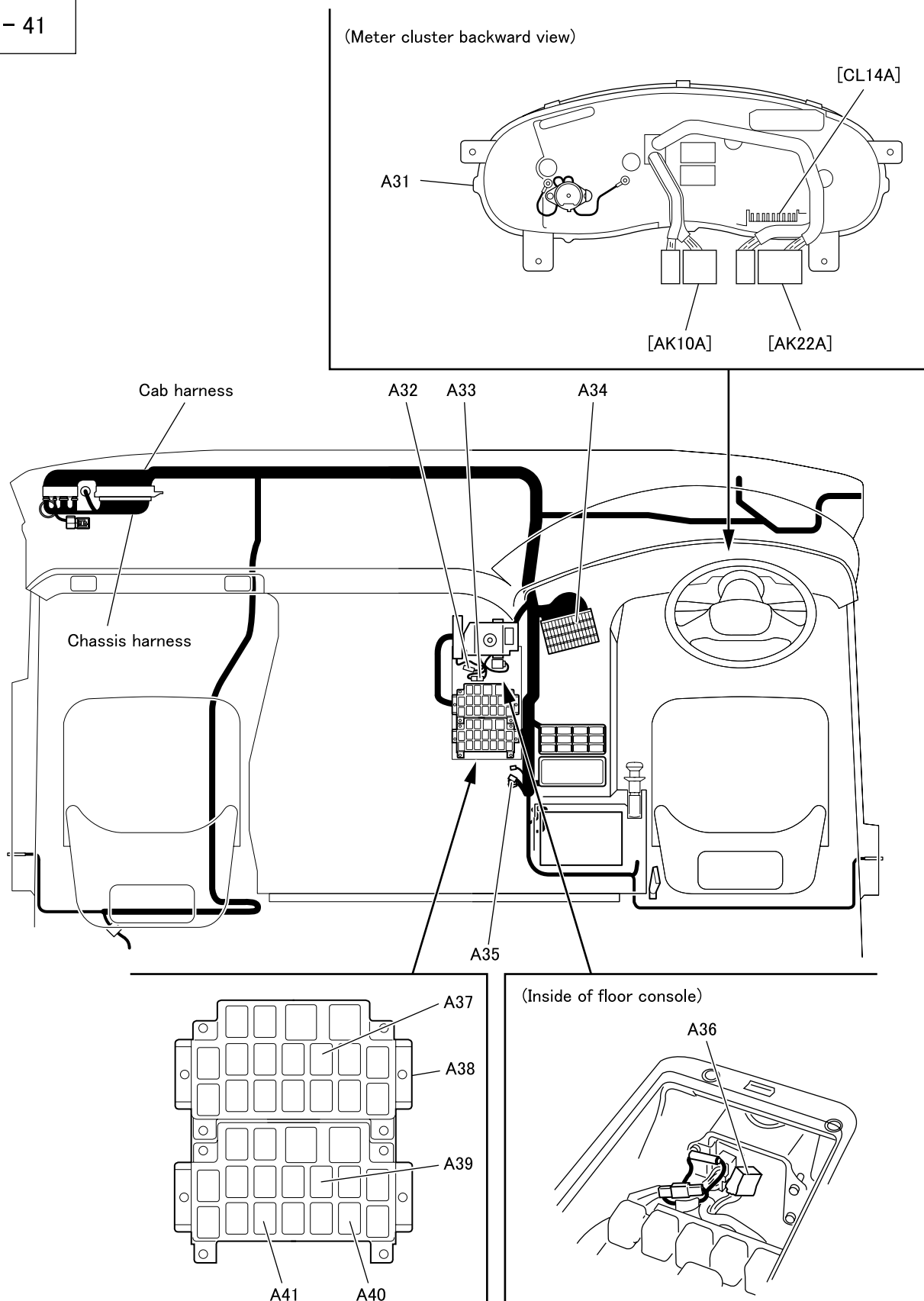


A16 – 25



INSTALLED LOCATIONS OF PARTS

A31 - 41



- A31 Meter cluster
- A32 Memory clear switch
- A33 Diagnosis switch
- A34 Fuse box
- A35 Diode unit
- A36 MUT connector
- A37 Transmission neutral relay
- A38 Relay box

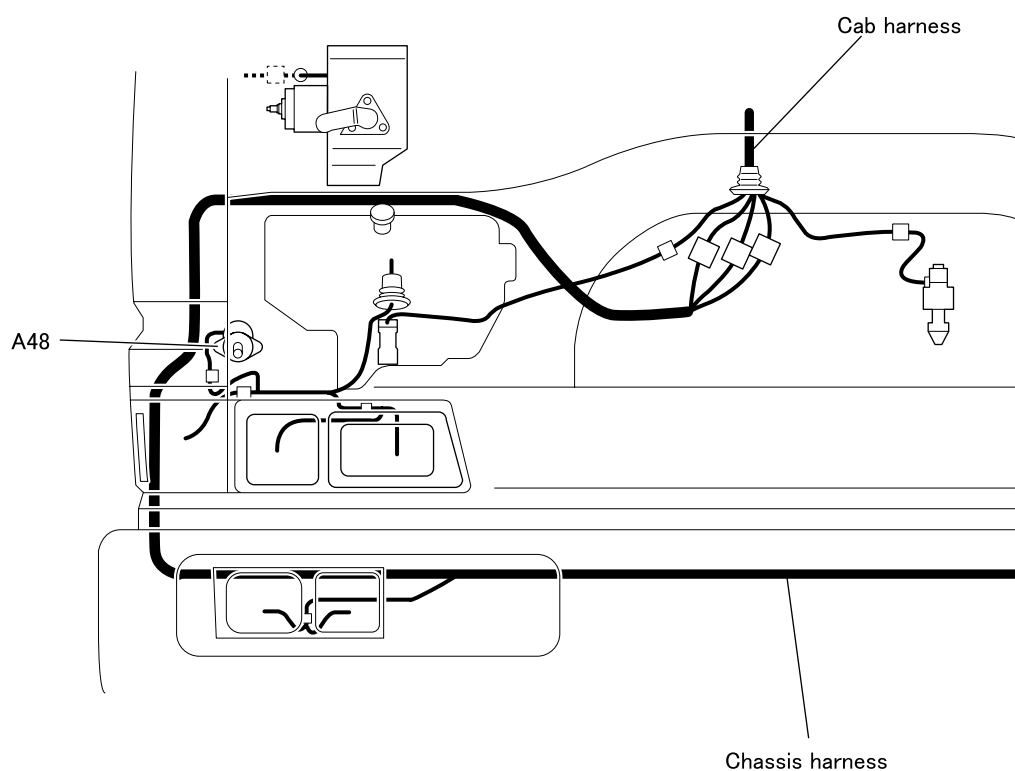
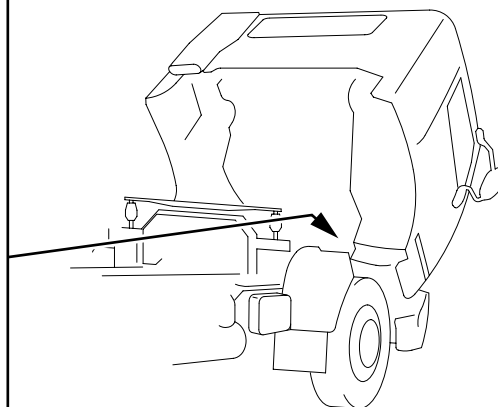
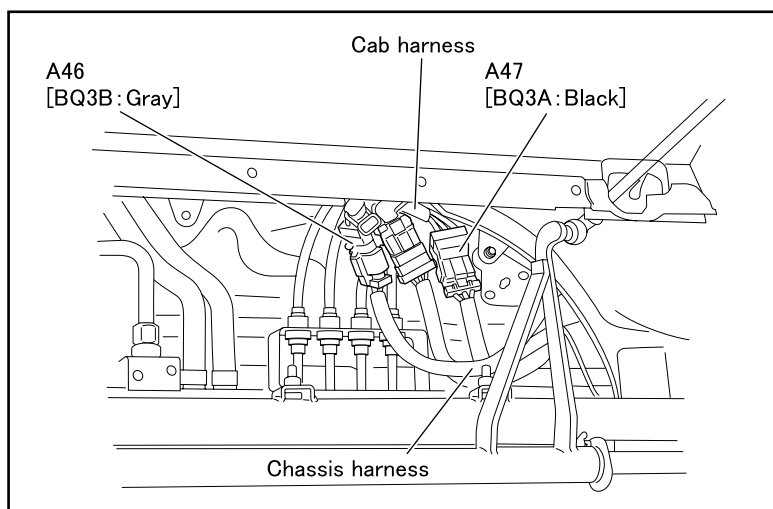
- A39 Governor control relay <FV51JKM>
- A40 Safety relay
- A41 EDU relay

ECU : Electronic control unit
MUT : Multi-Use Tester
EDU : Electronic drive unit

Indicate by connector type [].

L03267

A46 – 48

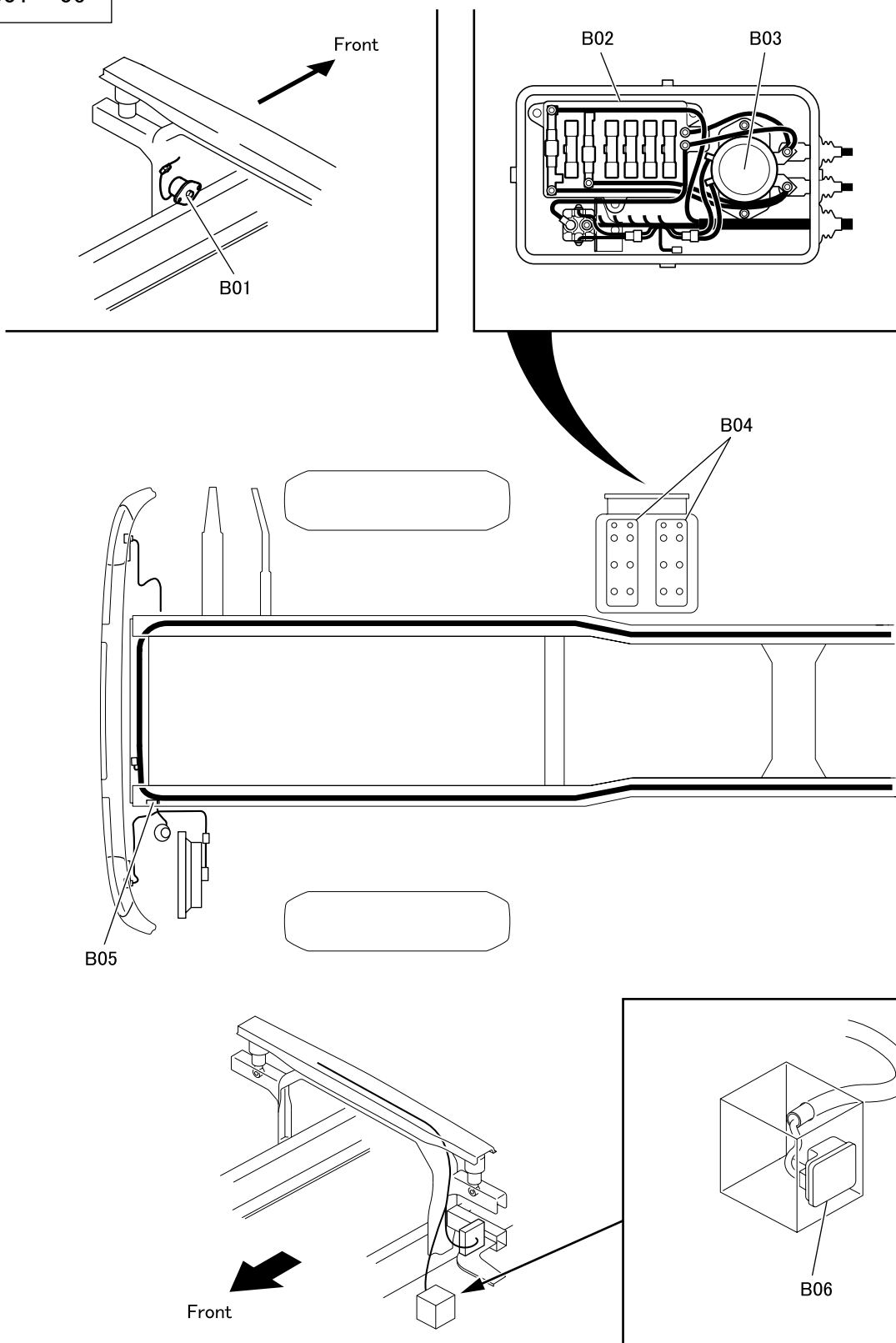


- A46 Connection of cab harness and chassis harness
- A47 Connection of cab harness and chassis harness
- A48 Accelerator pedal position sensor

Indicate by connector type and connector color [].

INSTALLED LOCATIONS OF PARTS

B01 - 06

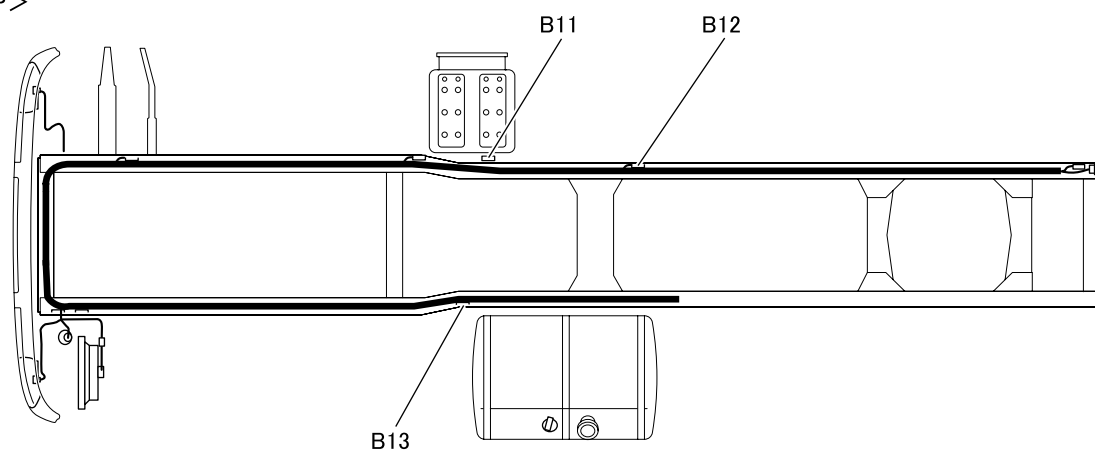


- B01 PTO load sensor <mixer>
- B02 High-current fuse box
- B03 Main power relay
- B04 Battery
- B05 Ground
- B06 EGR EDU

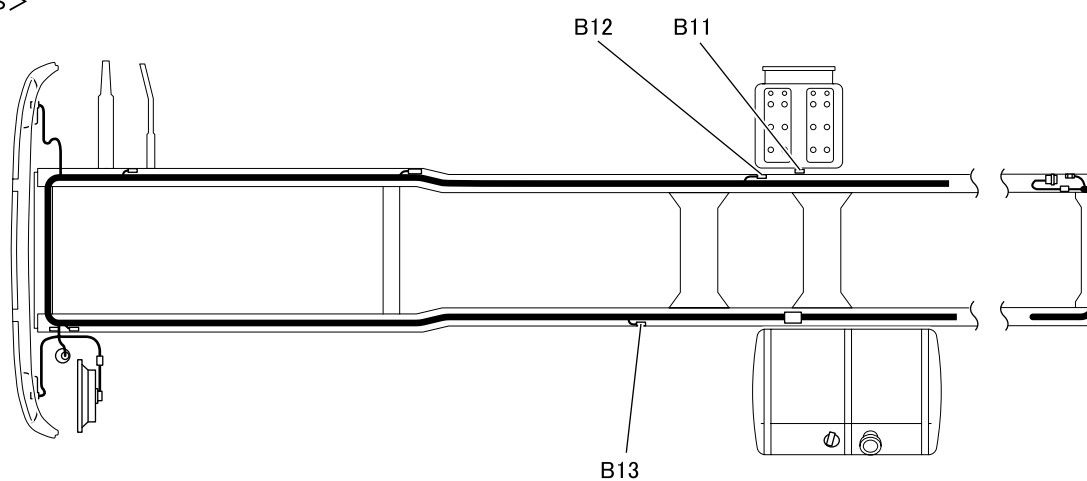
PTO : Power take-off
 EGR : Exhaust gas recirculation
 EDU : Electronic drive unit

B11 - 13

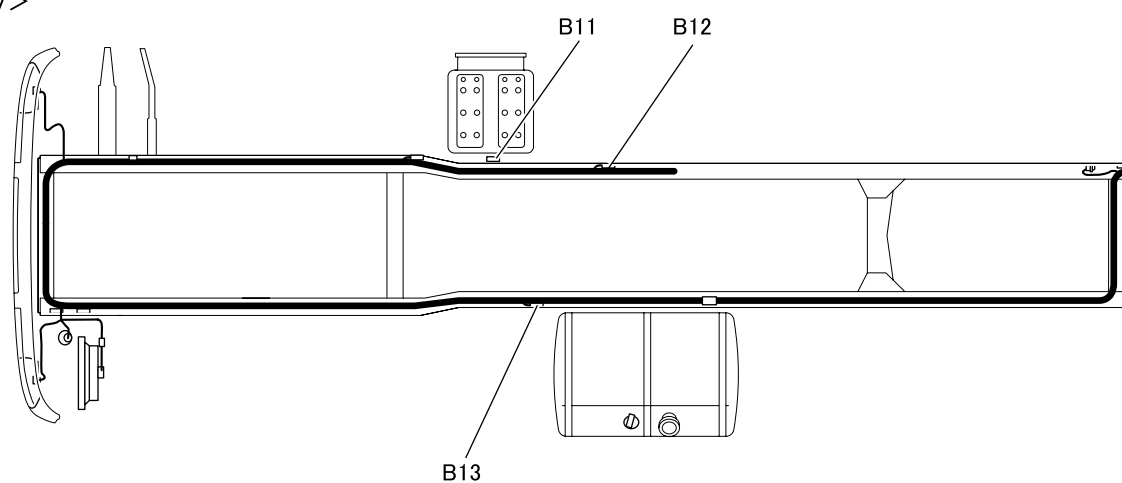
<FP>



<FS>



<FV>

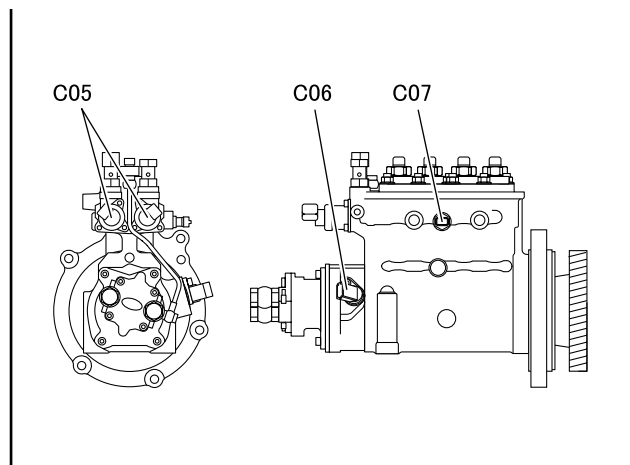
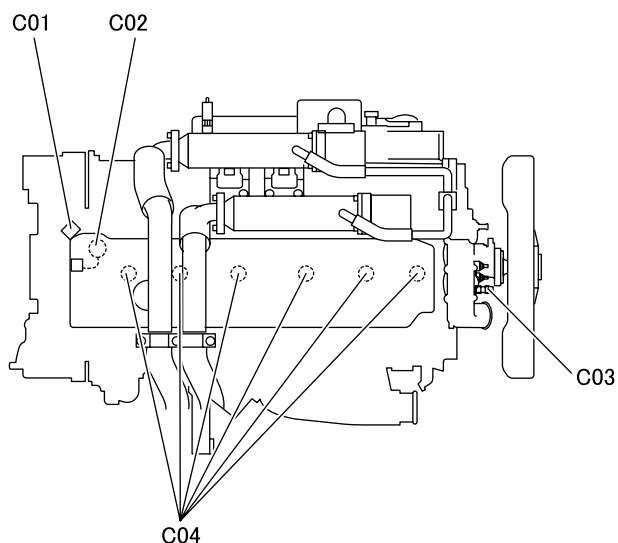


B11 Ground
B12 Ground
B13 Ground

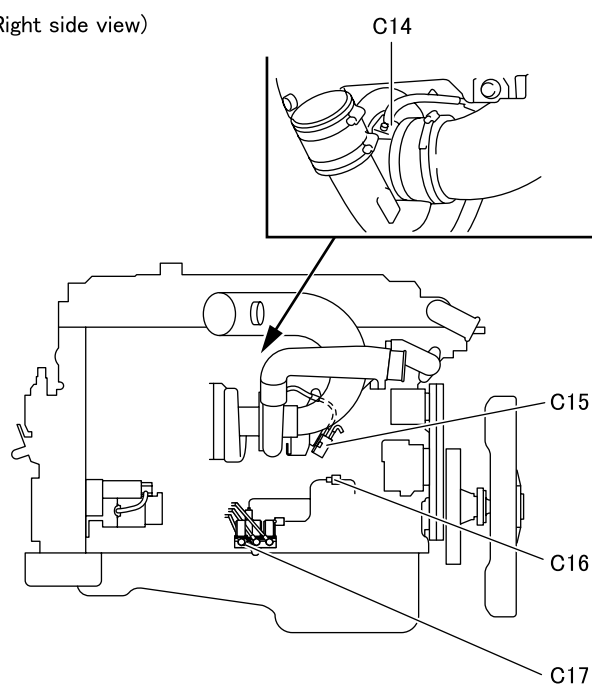
MITSUBISHI 6M70 INSTALLED LOCATIONS OF PARTS

C01 - 17

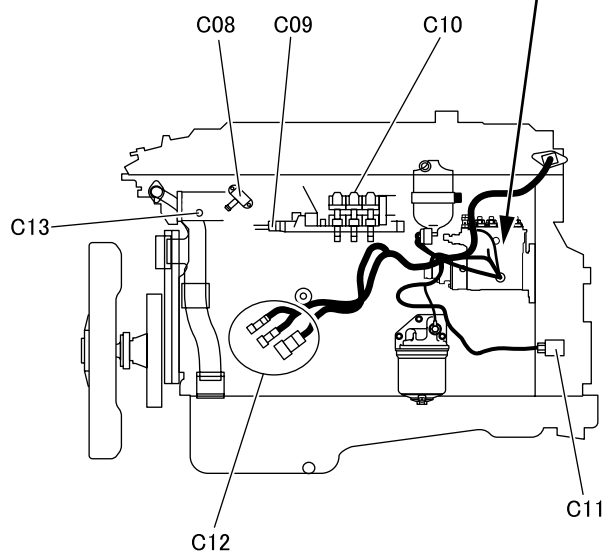
(Upper view)



(Right side view)



(Left side view)



- C01 Connection of injector harness and engine harness
- C02 Powertard solenoid valve
- C03 Water temperature sensor
(connects to engine electronic control unit)
- C04 Injector magnetic valve
- C05 MPROP (rail pressure control valve)
- C06 Cylinder recognition sensor
- C07 Fuel temperature sensor
- C08 Boost pressure sensor
- C09 Common rail pressure sensor
- C10 EGR solenoid valve
- C11 Engine speed sensor

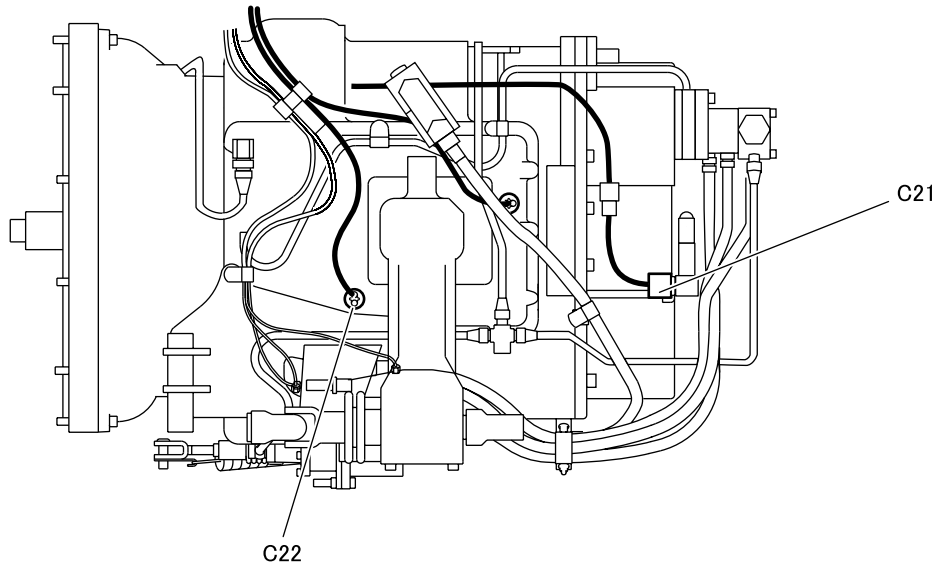
- C12 Connection of engine harness and chassis harness, ECU harness
- C13 Intake air temperature sensor
- C14 Turbine speed sensor
- C15 Pulse converter
- C16 Connection of ECU harness and VGT harness
- C17 Turbocharger magnetic valve

EGR : Exhaust gas recirculation
ECU : Electronic control unit
VGT : Variable geometry turbocharger

C21 - 22

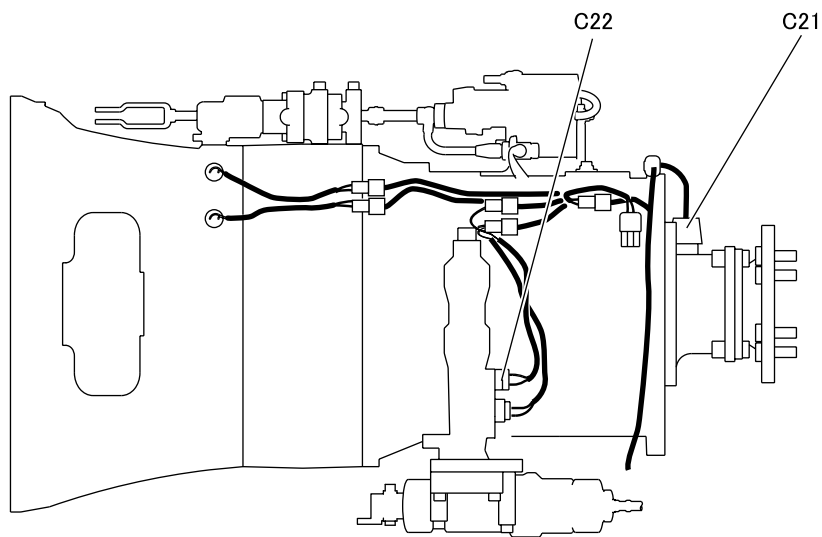
<FULLER>

(Upper view)



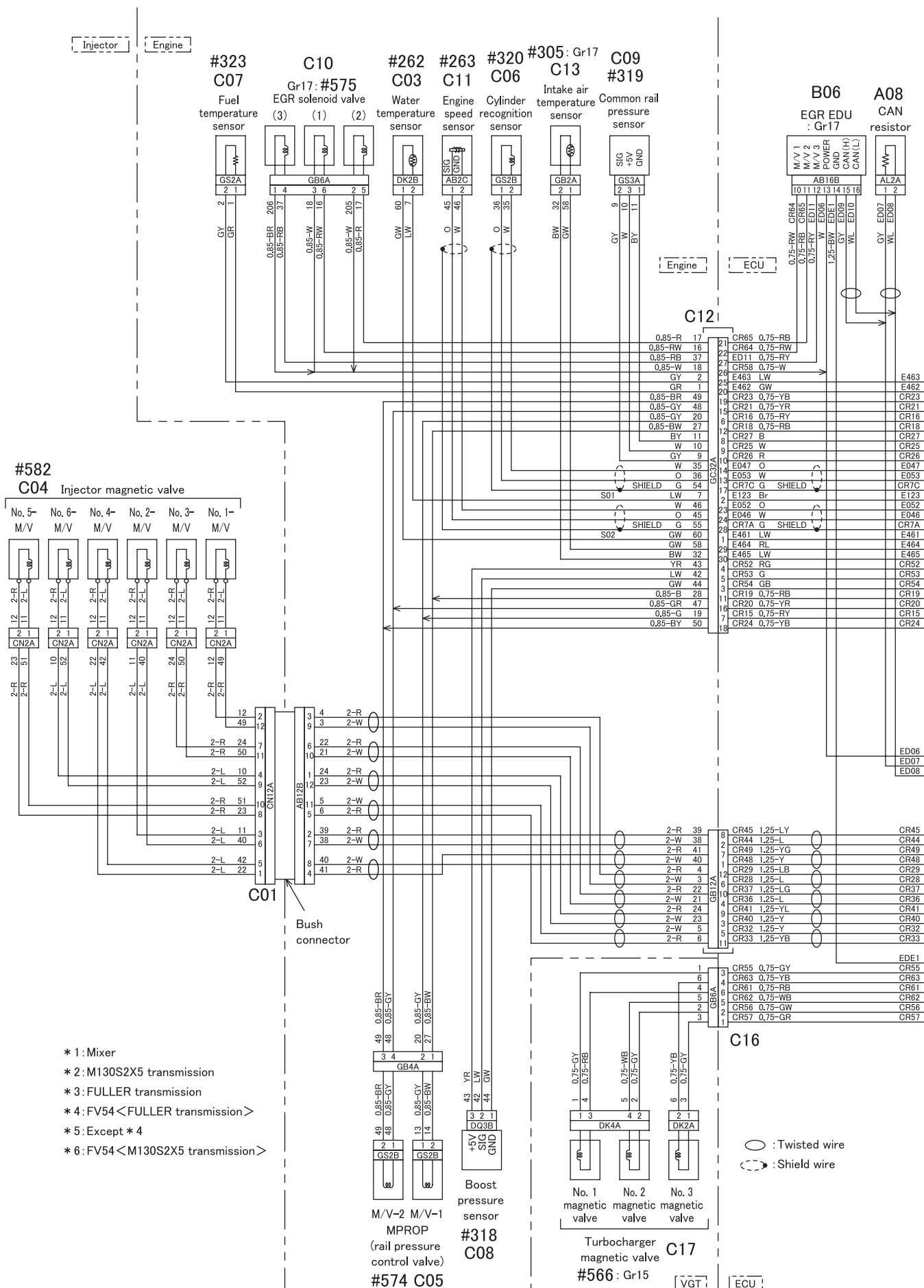
<M130S2 × 5>

(Upper view)

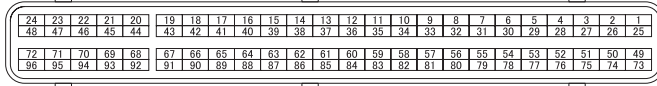


- C21 Vehicle speed sensor
C22 Transmission neutral switch

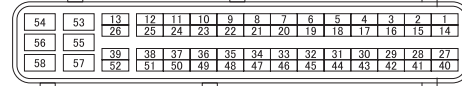
ELECTRIC CIRCUIT DIAGRAM



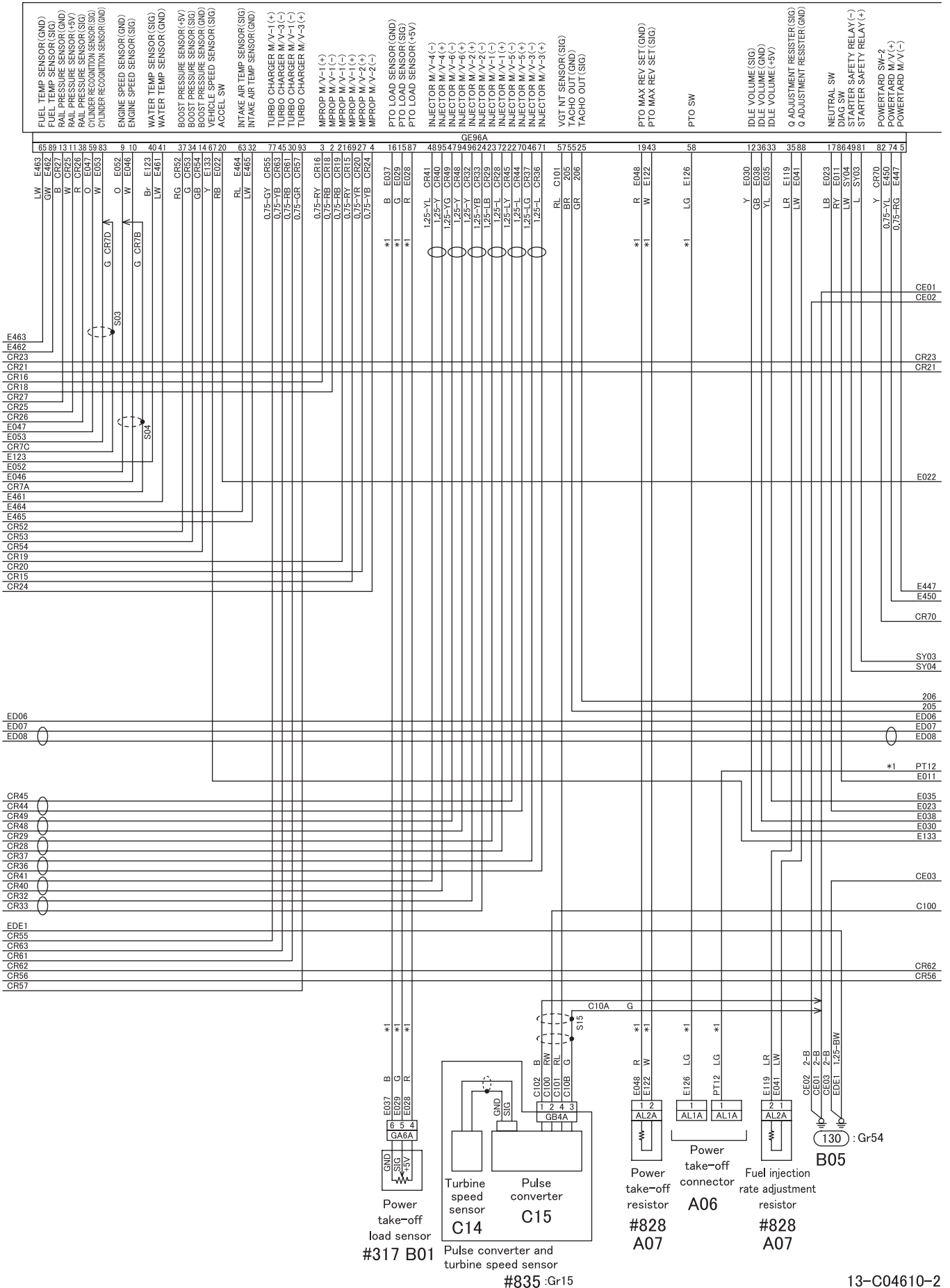
GE96A



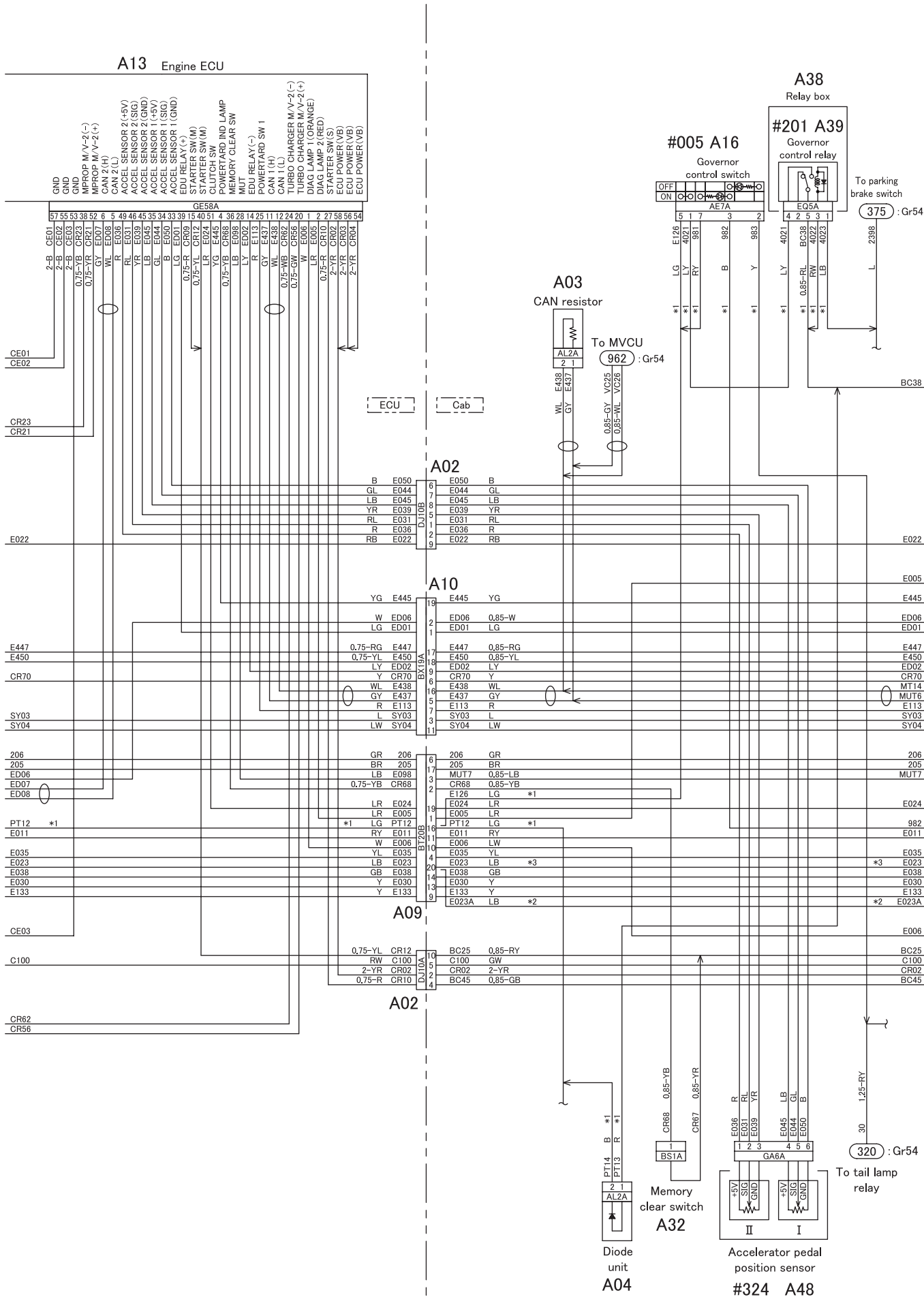
GE58A

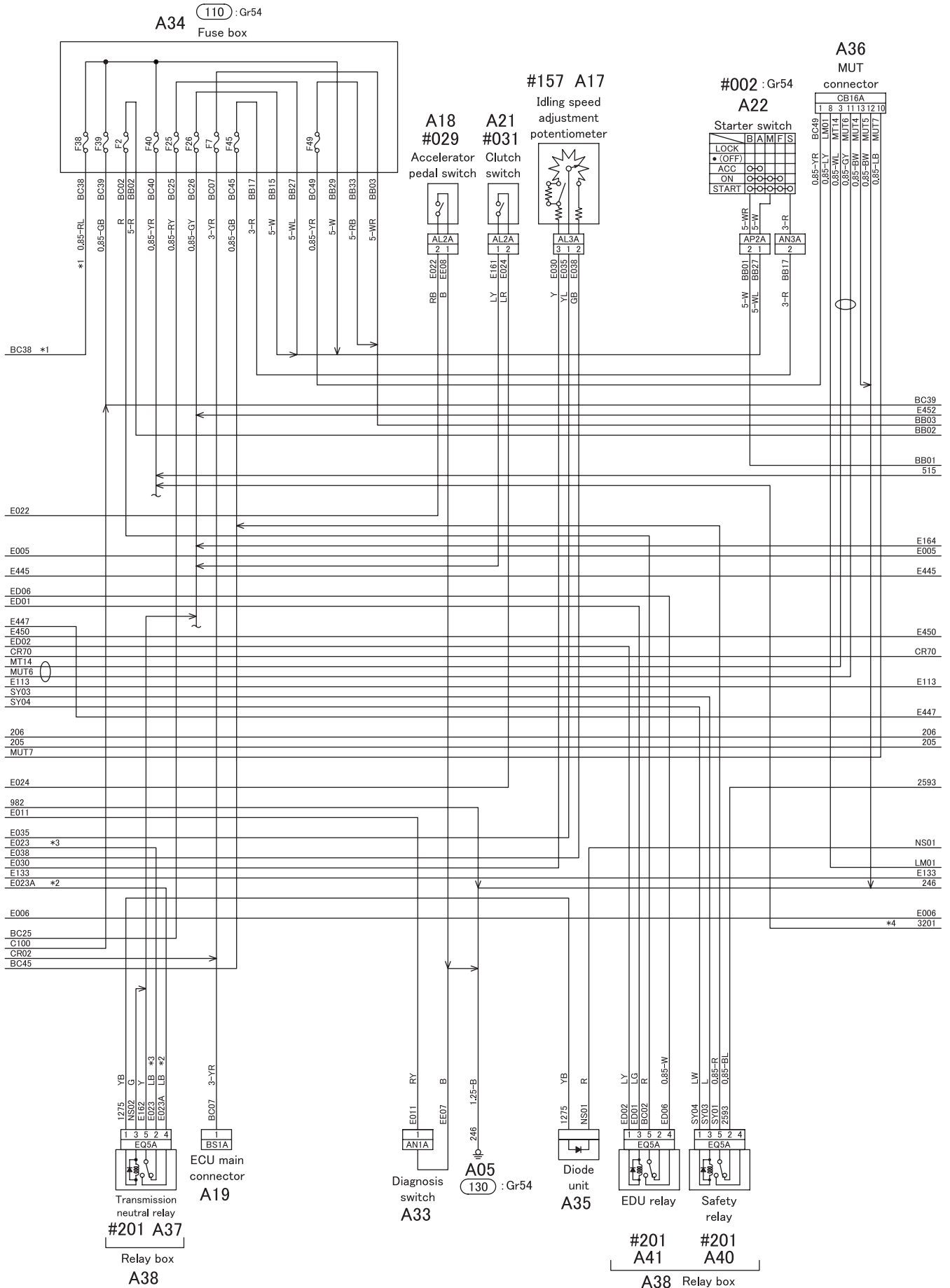


A13 Engine ECU

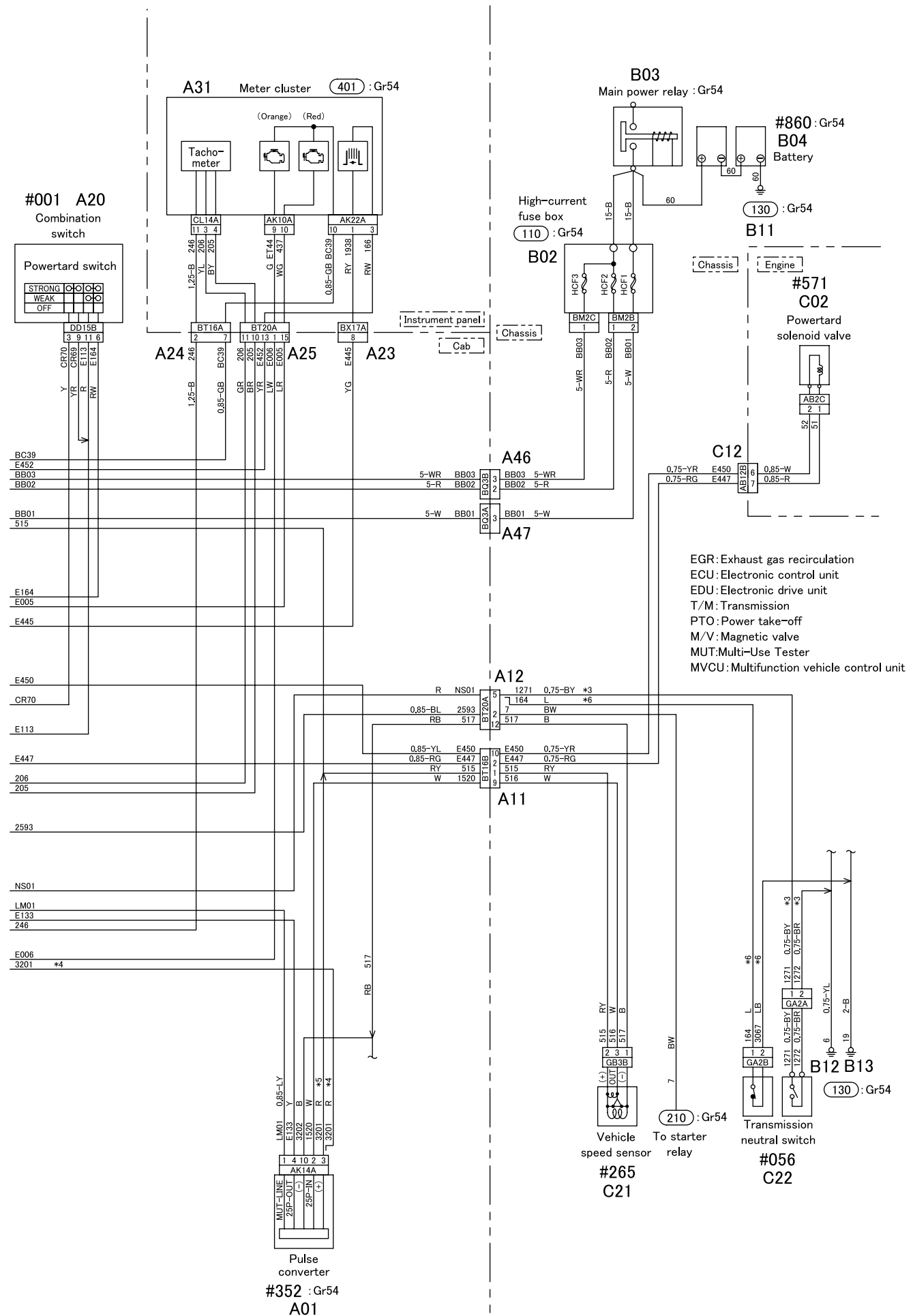


ELECTRIC CIRCUIT DIAGRAM





ELECTRIC CIRCUIT DIAGRAM



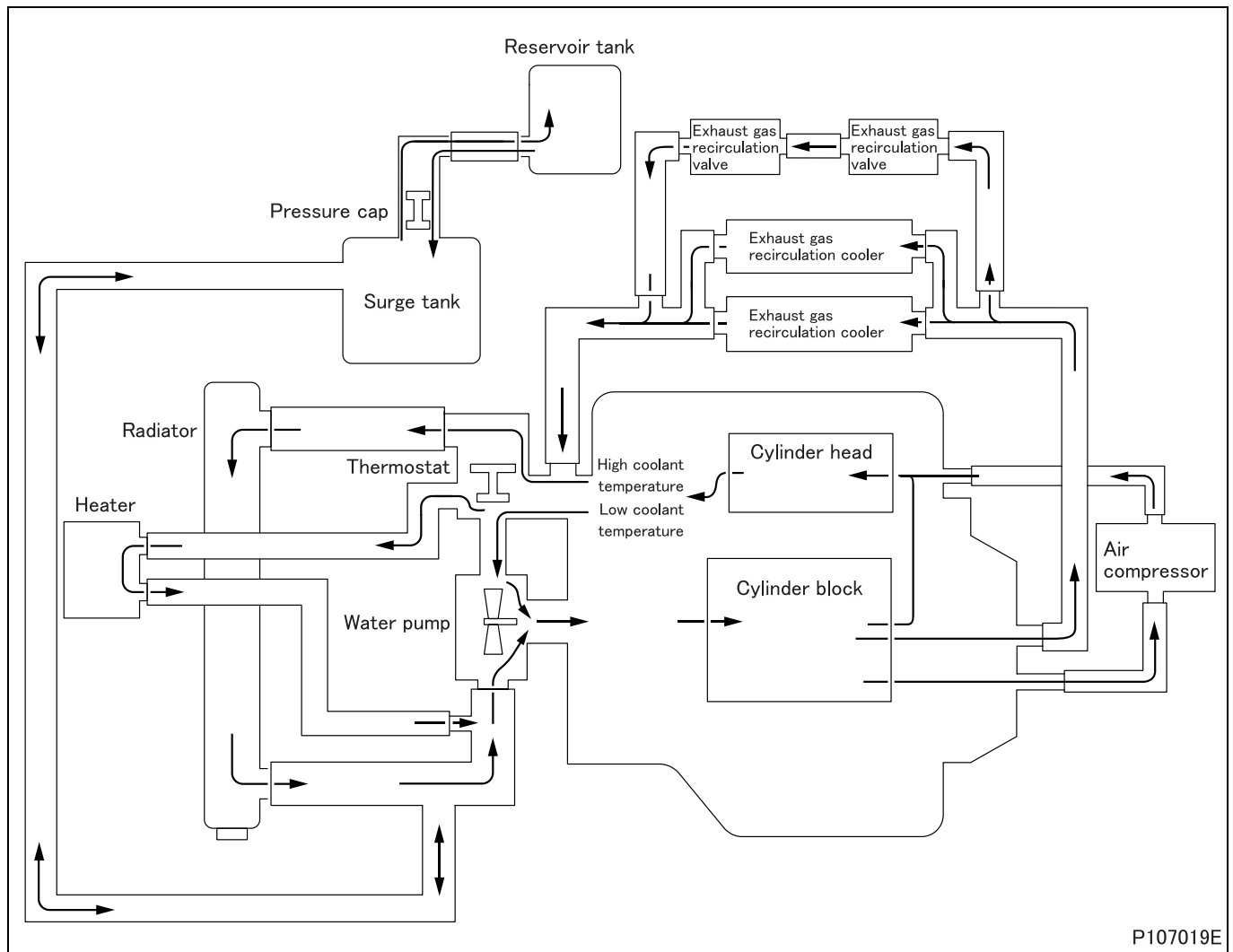
GROUP 14 COOLING

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SPECIFICATIONS

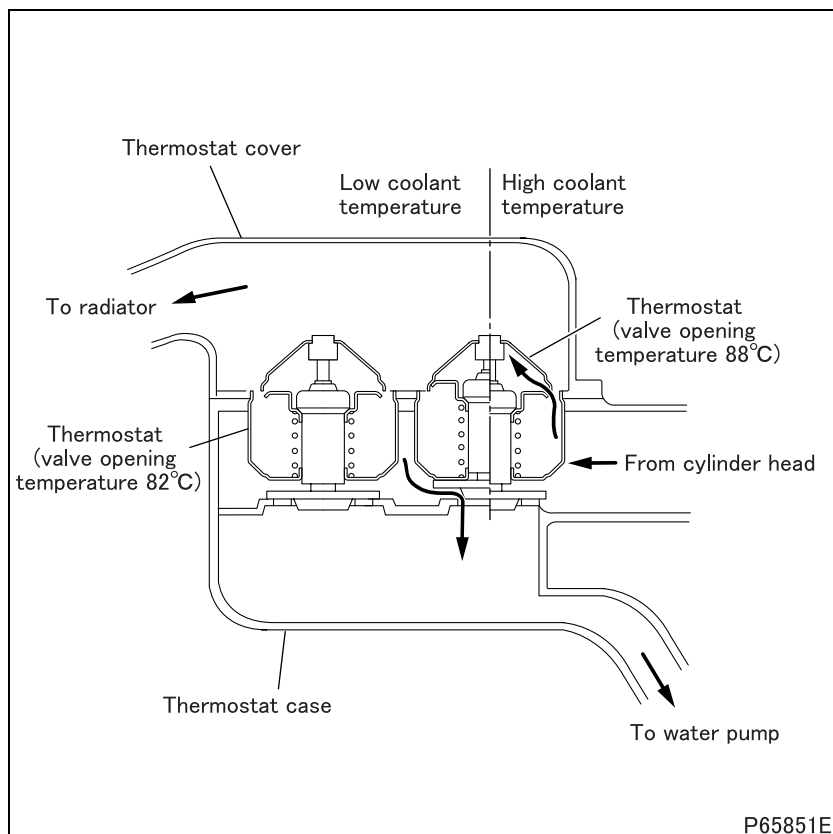
Item	Specifications
Cooling system	Forced water circulation system
Water pump	Belt-driven type
Thermostat	Wax pellet, bottom bypass type (with jiggle valve)
Automatic cooling fan coupling	Continuous control type
Radiator	Tube and corrugated fin type
Coolant capacity	dm ³ {L} 41 {41}

1. Mitsubishi 6M70 Cooling System (Flow of Coolant)



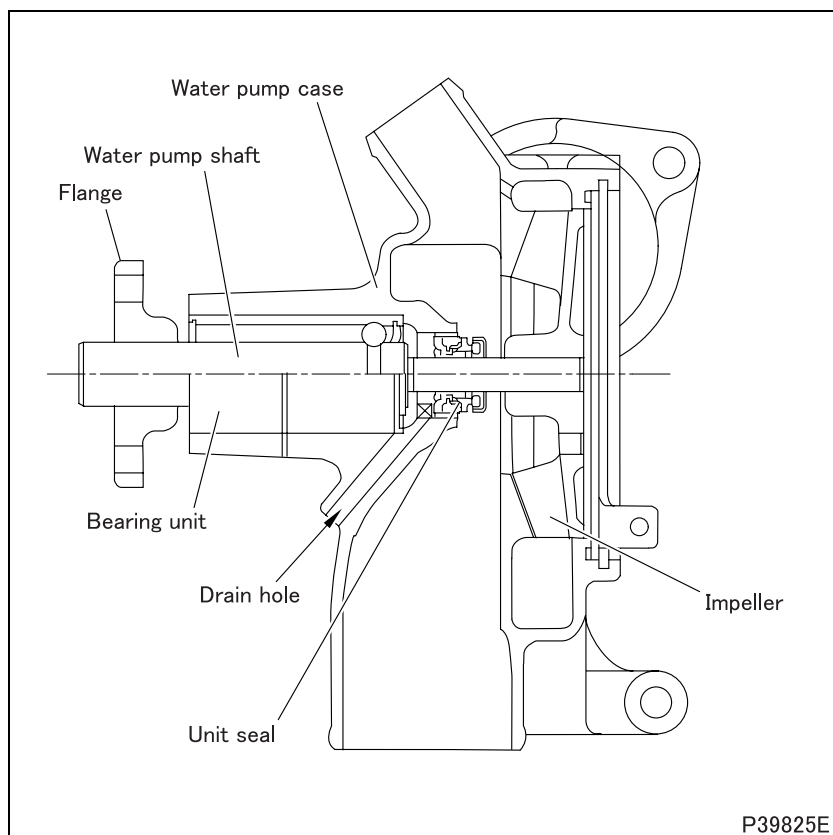
STRUCTURE AND OPERATION

2. Mitsubishi 6M70 Thermostat



- The thermostat is a bottom bypass type that uses a wax-filled pellet as its flow-regulating element. When the wax is heated, it melts from solid to liquid, changing its total volume. This allows the valve to open or close in accordance with the coolant temperature, regulating and adjusting the flow of coolant to the radiator and to the water pump (bypassing the radiator).

3. Mitsubishi 6M70 Water Pump



- The water pump has a drain hole to prevent coolant from entering the unit bearing in case of a defect in the unit seal.

Symptoms		Overheating (poor cooling)	Overcooling	Abnormal noise	Excessive coolant loss	Reference Gr
Possible causes						
Belt	Loose or damaged	O		O		
	Excessive tension			O		
	Oil on belt	O				
Water pump	Incorrectly mounted water pump	O			O	
	Defective gasket	O			O	
	Defective bearing unit	O		O		
	Defective impeller	O				
	Defective unit seal	O			O	
	Fit of bearing unit on flange and impeller too loose	O		O		
Thermostat	Incorrectly mounted case	O			O	
	Defective gasket	O			O	
	Valve opening temperature too high (valve remains closed)	O				
	Valve opening temperature too low (valve remains open)		O			
	Leakage from coolant temperature sensor	O			O	
Radiator	Clogged core	O				
	Cracked core and/or separation in welds	O			O	
Automatic cooling fan coupling	Defective bearing	O		O		
	Damaged bimetal	O				
	Contaminated bimetal	O	O			
	Silicon oil leakage	O		O		
Oil cooler	Incorrectly mounted oil cooler	O			O	Gr12
	Defective gasket	O			O	
Cylinder head	Incorrectly mounted cylinder head	O			O	Gr11
	Defective gasket	O			O	
Poorly airtight pressure cap		O				
Insufficient coolant amount, contaminated coolant		O				
Clogged or scaled coolant passage		O				
Incorrectly connected hoses		O			O	
Excessively low exterior temperature			O			
Exhaust gas recirculation related	Defective gasket	O			O	Gr17
	Incorrectly mounted exhaust gas recirculation piping	O			O	
Air compressor	Defective gasket	O			O	Gr11
	Incorrectly mounted water pipe	O			O	

ON-VEHICLE INSPECTION AND ADJUSTMENT

1. Inspection and Adjustment of Belt Tension

CAUTION

- Be careful not to allow engine oil to smear the belt. A belt smeared with oil slips, resulting in reduced cooling efficiency.
- When replacing the belts, replace them as a set to prevent differences in tension between the two belts.

Service standards (Unit: mm)

Location	Maintenance item		Standard value	Limit	Remedy
–	Belt tension	For air conditioner	15 to 20	–	Adjust
		For alternator	When new	–	Adjust
			When reused		

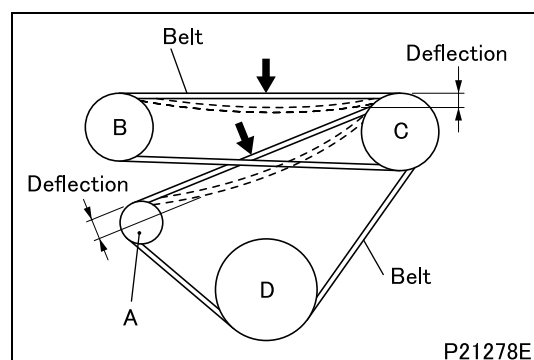
Tightening torque (Unit: N·m {kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
–	Nut (for alternator retention)	82 {8.4}	–
–	Bolt (for cooler compressor retention)	19.6 to 24.5 {2.0 to 2.5}	–

Special tools

Mark	Tool name and shape	Part No.	Application
	Belt tension gauge  P03612	MH062345	Measurement of tension of belt

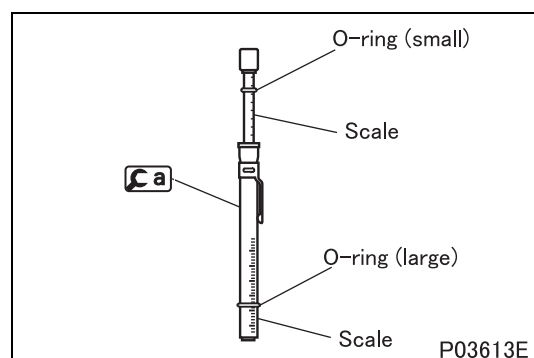
◆ Inspection after installation ◆



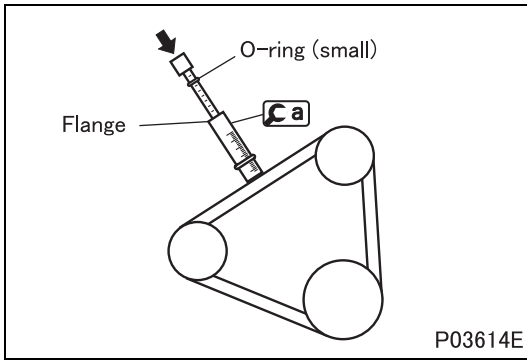
■ Inspection: Tension of belts

- Press each belt at a central portion between pulleys with a force of approximately 98 N {10 kgf} as shown in the illustration and measure the amount of deflection of the belt.

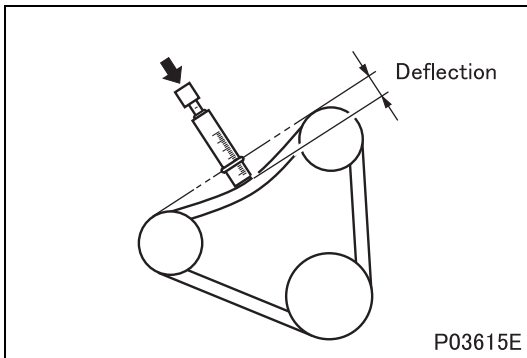
A: Alternator pulley
B: Compressor pulley (for air conditioner)
C: Water pump pulley
D: Crankshaft pulley



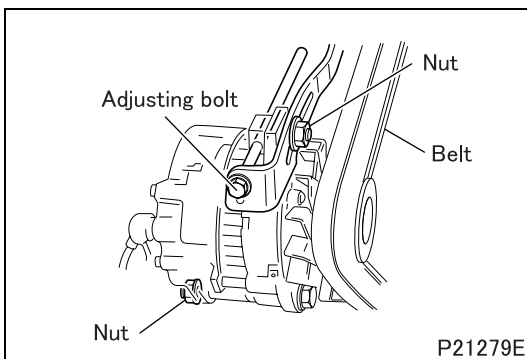
- Place the small O-ring on  at the scale mark corresponding to 98 N {10 kgf} (press force).
- Place the large O-ring on  at the scale mark corresponding to the maximum permissible deflection value specified for the belt.



- Place **Ca** at a central portion between pulleys of the V-belt and push the handle (indicated by the arrow in the illustration) until **Ca** indicated by arrow touches the O-ring.



- Measure the amount of deflection of the V-belt.
- If the measurement deviates from the standard value, adjust as follows.



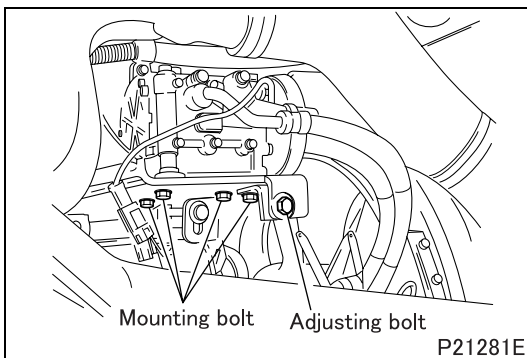
Adjustment of belt

(1) Belt for alternator

- Loosen the alternator mounting nuts (2 locations) and adjust the tension of the belt with the adjusting bolt.
- When the adjustment is completed, tighten the bolts and nuts securely.

CAUTION ⚠

- Excessive tension in belts may damage the belts and related bearings.



(2) Belts for air conditioner

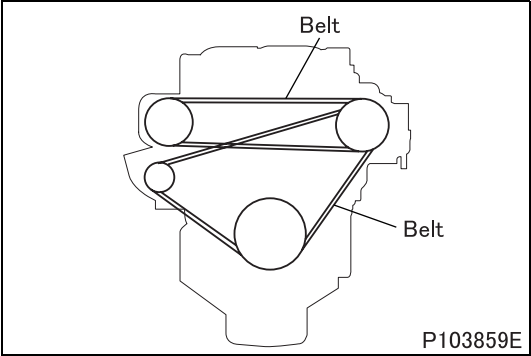
- Loosen the cooler compressor mounting bolts (4 places) and adjust the tension of the belt with the adjusting bolt.
- When the adjustment is completed, tighten the bolts securely.

CAUTION ⚠

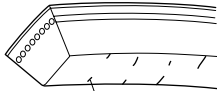
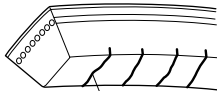
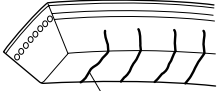
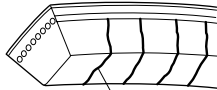
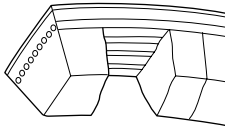
- Excessive tension in belts may damage the belts and related bearings.

ON-VEHICLE INSPECTION AND ADJUSTMENT

2. Inspection of Belts



- Visually check the belt for a crack or damage.
- If there is any abnormality, replace the belt.

Belt condition	Remaining service life (reference)
 Wrinkled P69698E	• The driving distance over the which the belt can still be used is at least as long as that over which the belt has been used since the vehicle was new or since the belt was replaced (whichever is more recent).
 Cracks on belt surface P69699E	• The driving distance over the which the belt can still be used is about half of that over which the belt has been used since the vehicle was new or since the belt was replaced (whichever is more recent).
 Cracks extending to base rubber P69700E	• The driving distance over the which the belt can still be used is about a quarter of that over which the belt has been used since the vehicle was new or since the belt was replaced (whichever is more recent).
 Cracks extending to cords P69701E  P69702	• The belt has reached the end of its service life and must be replaced.

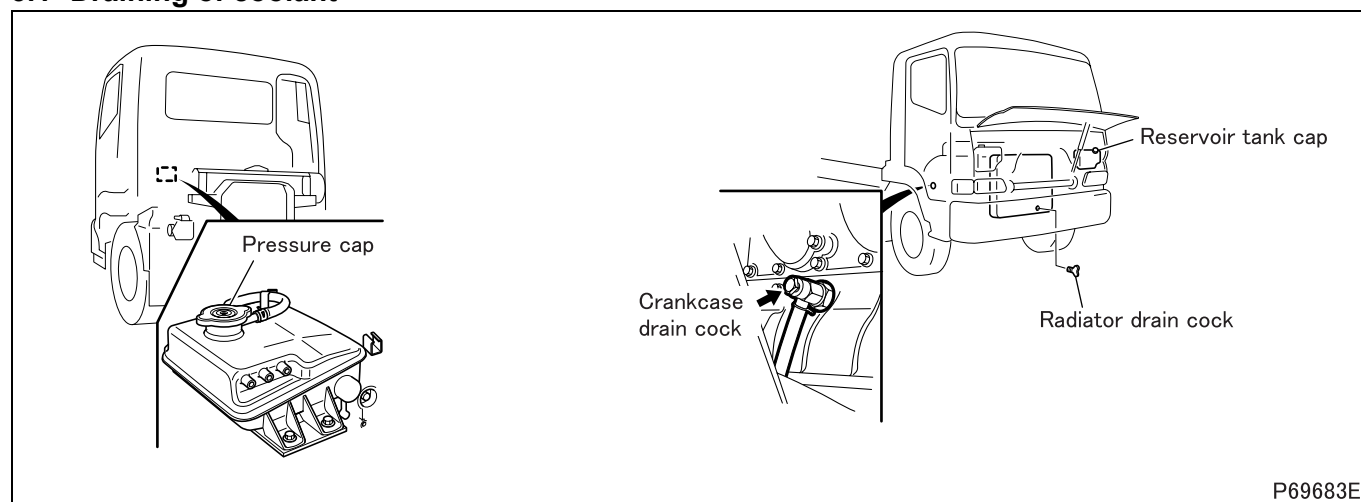
3. Coolant Replacement and Cleaning of Cooling System

Tightening torque (Unit: N·m {kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
—	Radiator drain cock	2.0 {0.2}	—
—	Crankcase drain cock	37 {3.8}	—

- Using the radiator for extended periods of time without cleaning can increase chance of rust and scale formation, which may cause engine overheating. The cooling system must be cleaned periodically. Use a coolant containing the FUSO DIESEL LONGLIFE COOLANT additive and soft water in the specified proportions. (See the Owner's Handbook for instructions on the use of the additive.)

3.1 Draining of coolant



- Before draining the coolant, loosen the pressure cap to reduce the pressure in the cooling system. Remember to drain the coolant out of the reservoir tank as well.

WARNING

- Drain the coolant only after it has cooled sufficiently to avoid getting scalded.
- Opening the pressure cap while the coolant temperature is still high can cause hot coolant to spray out. Cover the pressure cap with a cloth, and loosen it slowly to let the pressure out before opening it fully.

3.2 Cleaning procedure

CAUTION

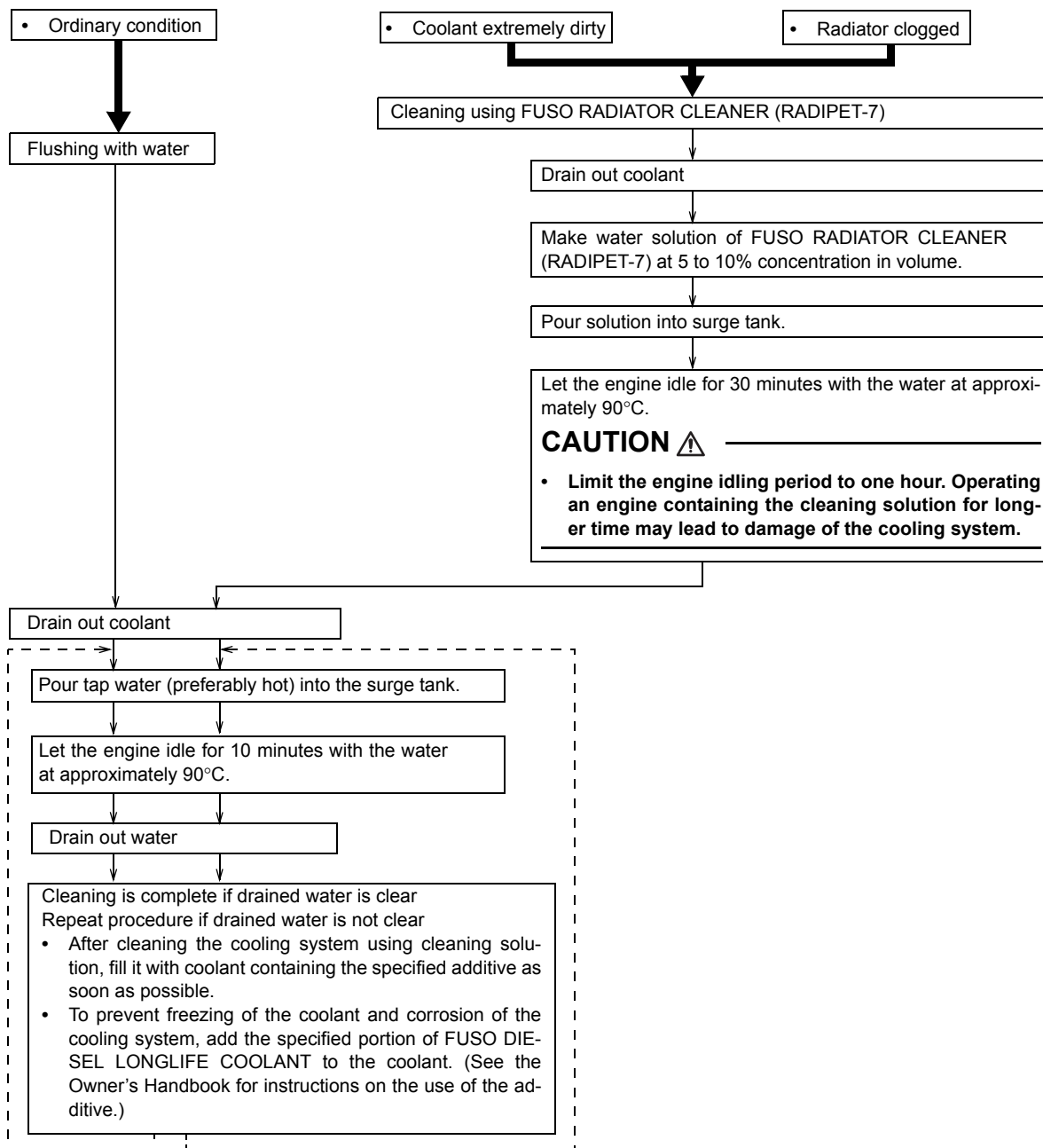
- Water used for flushing the cooling system must be soft water that has a property meeting the requirements indicated below. Using hard water will cause scale and rust to form in the system.

Required properties of soft water

Total hardness	300 ppm or less
Sulfate SO_4^-	100 ppm or less
Chloride Cl^-	100 ppm or less
Total dissolved solids	500 ppm or less
pH	6 to 8

- Keep the coolant temperature at approximately 90°C so that the thermostat valve remains open and coolant continues to circulate in the radiator.
- For the sake of convenience you can raise the coolant temperature quickly by covering the front of the radiator with corrugated cardboard or something similar.
- In cases where a great amount of rust has accumulated it is common for the radiator to leak as a result of cleaning. Conduct a through check for leakage after cleaning.
- Select an appropriate cleaning method according to the condition of the cooling system as shown below.

ON-VEHICLE INSPECTION AND ADJUSTMENT



WARNING ⚠

- FUSO DIESEL LONGLIFE COOLANT is flammable. Keep it away from heat and flames.

CAUTION ⚠

- If you accidentally splash FUSO DIESEL LONGLIFE COOLANT in your eyes, wash it out immediately with water and seek medical attention.

4. Air Bleeding of Cooling System

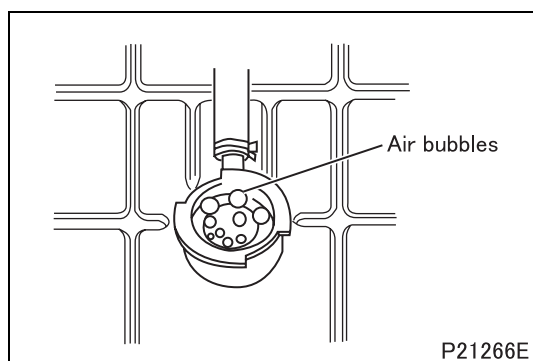
- If the engine is started with the coolant filled up to the neck of the surge tank, the coolant temperature rises and the expanded coolant overflows from the neck little by little. To avoid this, fill the surge tank with a slightly smaller quantity of the coolant.
- With the pressure cap removed and the coolant temperature at 90°C, let the engine idle in order to bleed air completely out of the cooling system.
- After air bleeding is completed, refill the reservoir tank with coolant as needed.

5. Gas Leakage Test

- Presence of air or exhaust gas in coolant accelerates corrosion of the cooling system components. To prevent this, carry out air/gas leakage tests in accordance with the following procedure.
- Remove the pressure cap.

WARNING

- **If the engine is hot, boiling coolant may spurt out from the filler port when the pressure cap is loosened. To avoid burning yourself, make sure to remove the pressure cap only when the coolant is cold.**



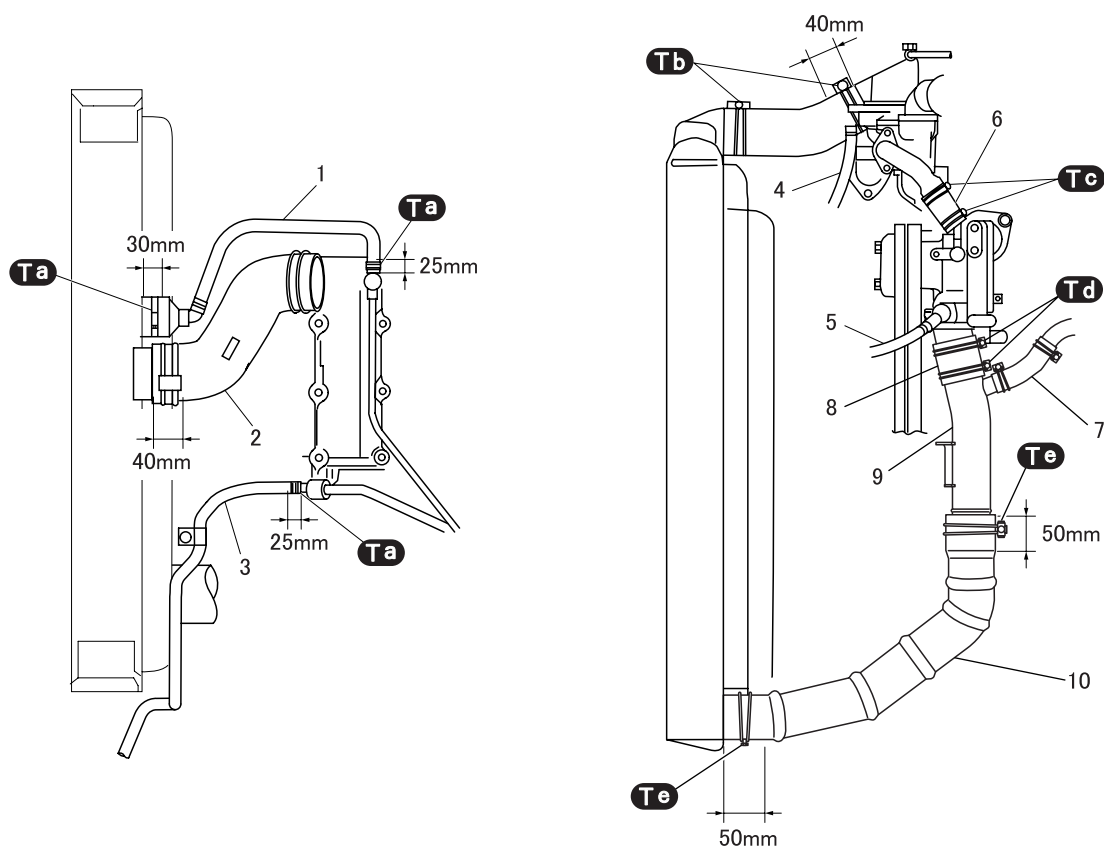
- Run the engine until the coolant temperature rises to approximately 90°C.
- If air bubbles appear continuously through the filler port, there is air or exhaust gas penetrating into the cooling system.
- Presence of air in coolant can be an indication of loose cylinder head bolts, loose water pump mounting bolts, loose hose connections, and/or a damaged hose.
- Presence of exhaust gas in coolant can be an indication of a damaged cylinder head gasket and/or cracks in the cylinder head.

6. Coolant Leakage Test

- Ensure that there is no coolant leakage from coolant system during idling.
- If any leakage is found, check for the mounting condition. If there is looseness, tighten the part to the specified torque. If there are cracks or damages, replace the defective part with a new one. (See later section.)

DISCONNECTION AND CONNECTION OF HOSES AND PIPES

Periphery of Radiator



P106640

● Removal sequence

- 1 Supply hose
- 2 Inlet hose
- 3 Overflow hose
- 4 Heater hose
- 5 Heater hose

- 6 Water hose
- 7 Hose
- 8 Water hose
- 9 Water pipe
- 10 Outlet hose

● Installation sequence

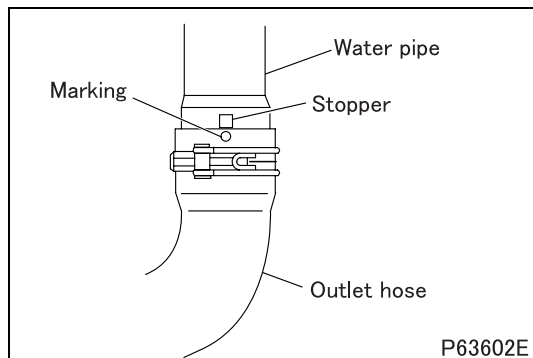
Follow the removal sequence in reverse.

- Install each hose clamp to the angle indicated in the illustration so that sufficient clearance is assured between the hose clamp and its surrounding parts.

Tightening torque (Unit: N·m {kgf·m})

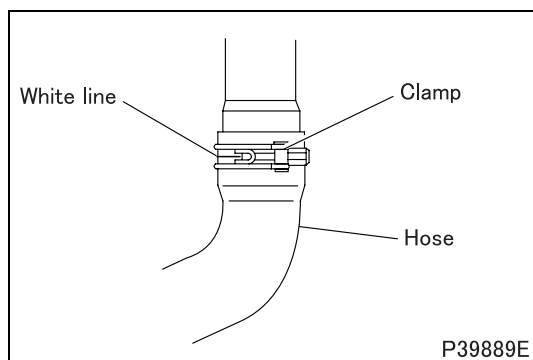
Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Hose clamp	4.0 ± 0.5 { 0.4 ± 0.05 }	—
Tb	Hose clamp	5.0 ± 0.5 { 0.5 ± 0.05 }	—
Tc	Hose clamp	3.5 to 4.5 {0.35 to 0.45}	—
Td	Hose clamp	4.4 {0.45}	—
Te	Hose clamp	6.5 ± 0.5 { 0.7 ± 0.05 }	—

◆ Installation procedure ◆



■ Installation: Outlet hose

- Install the outlet hose so that its marking faces the stopper of the water pipe.

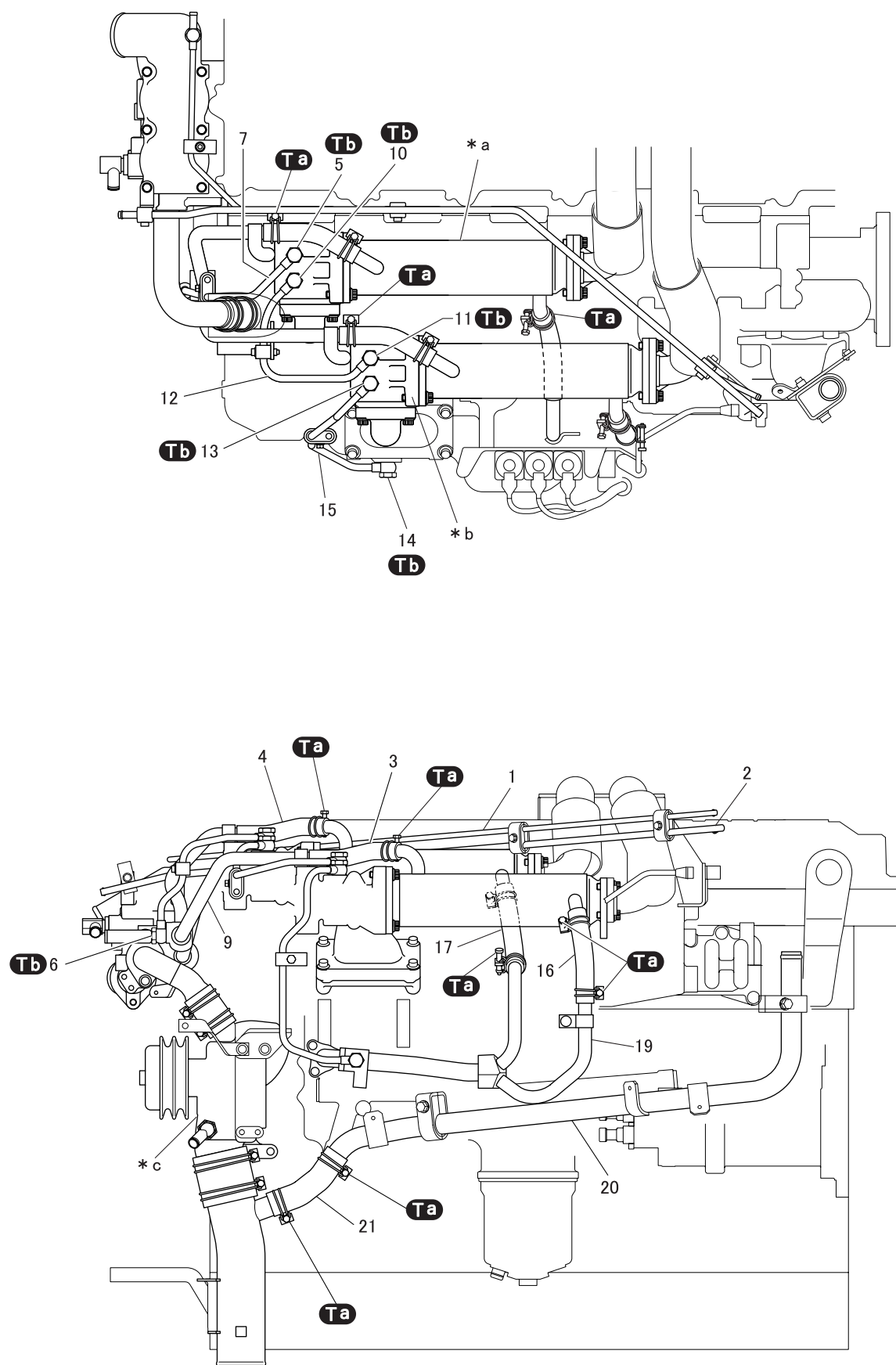


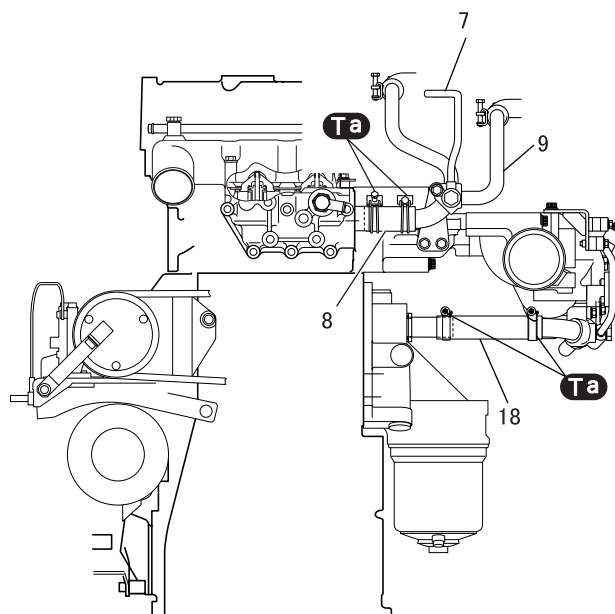
■ Installation: Hose

- Install the hose marked with a white line so that this white line is placed in the center of the clamp.

DISCONNECTION AND CONNECTION OF HOSES AND PIPES

Periphery of Engine





P106642

● Removal sequence

- | | | |
|--------------|---------------|--------------------------------------|
| 1 Air pipe | 10 Eyebolt | 19 Water pipe |
| 2 Water pipe | 11 Eyebolt | 20 Water pipe |
| 3 Water hose | 12 Water pipe | 21 Water hose |
| 4 Water hose | 13 Eyebolt | *a: Exhaust gas recirculation cooler |
| 5 Eyebolt | 14 Eyebolt | *b: Exhaust gas recirculation valve |
| 6 Eyebolt | 15 Water pipe | *c: Water pump |
| 7 Water pipe | 16 Water hose | |
| 8 Water hose | 17 Water hose | |
| 9 Water pipe | 18 Water hose | |

● Installation sequence

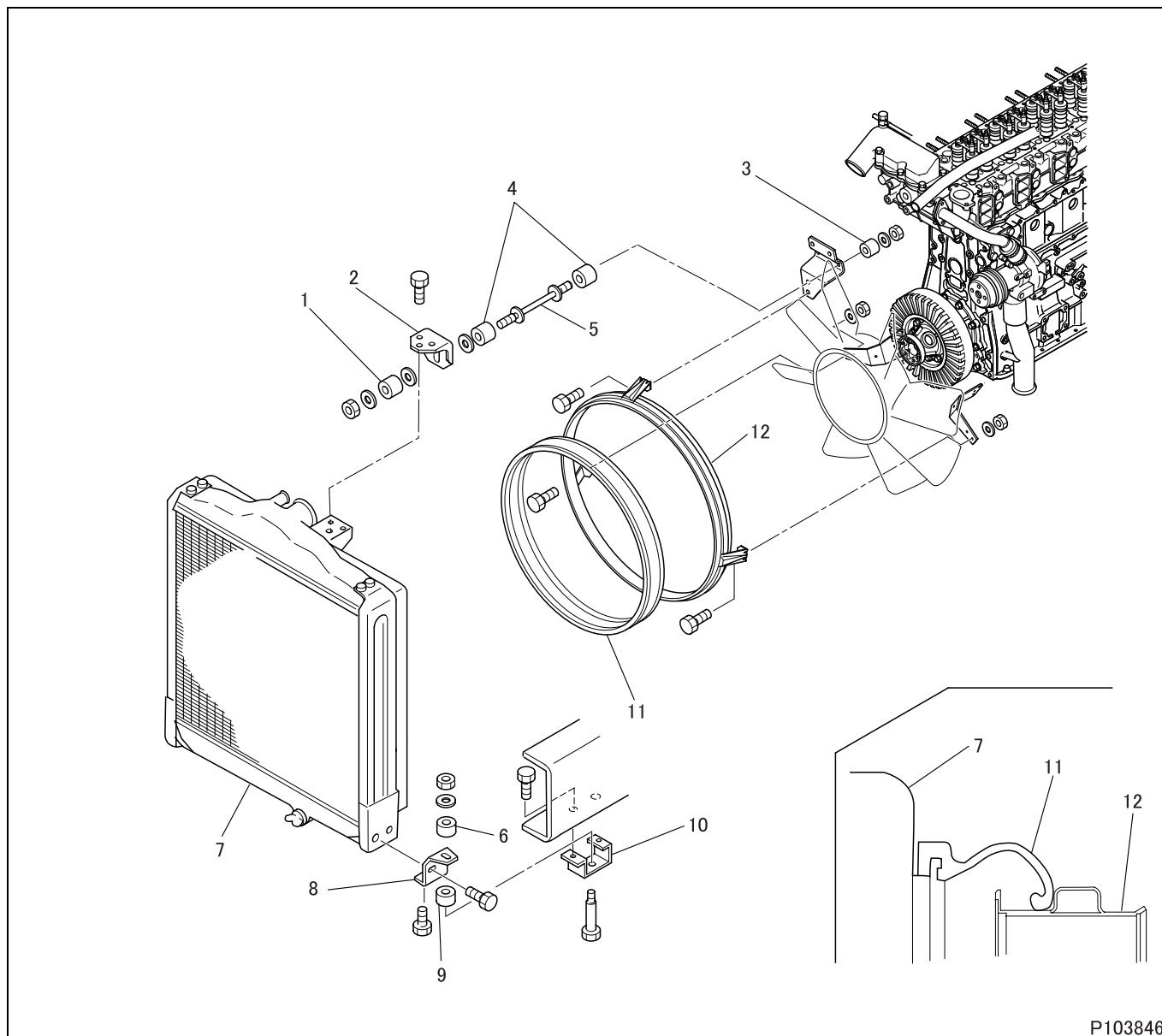
Follow the removal sequence in reverse.

- Install each hose clamp to the angle indicated in the illustration so that sufficient clearance is assured between the hose clamp and its surrounding parts.

Tightening torque (Unit: N·m {kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Clamp	3.9 {0.4}	—
Tb	Eyebolt (water pipe mounting)	39 {4.0}	—

RADIATOR AND FAN SHROUD



● Removal sequence

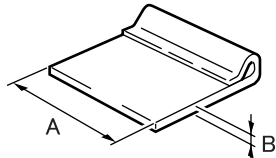
- | | | |
|----------------------------|------------------------------------|---------------------|
| 1 Cushion rubber | 6 Cushion rubber | 10 Radiator support |
| 2 Front thrust rod bracket | 7 Radiator
(See later section.) | 11 Shroud seal |
| 3 Cushion rubber | 8 Radiator bracket | 12 Fan shroud |
| 4 Cushion rubber | 9 Cushion rubber | |
| 5 Thrust rod | | |

● Installation sequence

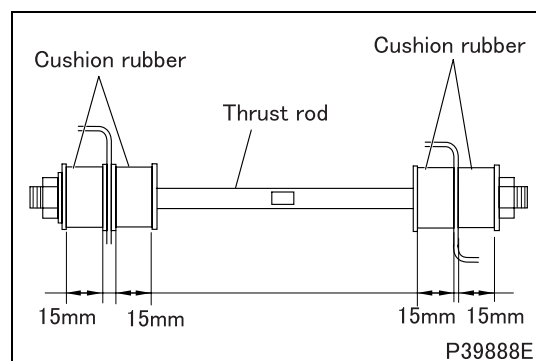
Follow the removal sequence in reverse.

- Refer to the previous section “**DISCONNECTION AND CONNECTION OF HOSES AND PIPES**” for the correct insertion depth of radiator hoses into the pump as well as the correct tightening torque of clamps.

Special tools (Unit: mm)

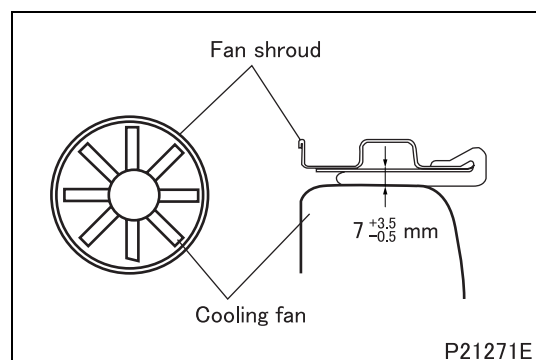
Mark	Tool name and shape	Part No.	Application				
	Tip clearance spacer <table border="1"><tr><td>A</td><td>B</td></tr><tr><td>50</td><td>7</td></tr></table>  P00189	A	B	50	7	ME294842	Adjusting clearance between fan shroud and cooling fan blades
A	B						
50	7						

◆ Installation procedure ◆



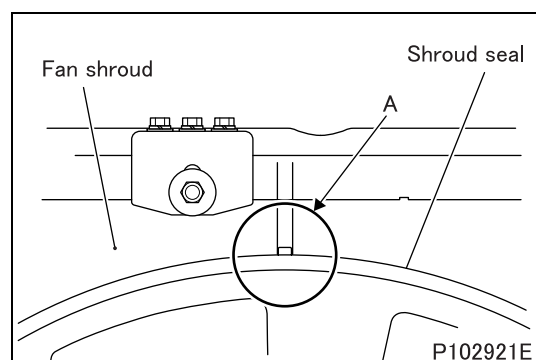
■ Installation: Thrust rod

- Tighten nuts so that the thickness of cushion rubbers on both ends of the thrust rod is to the dimension shown in the illustration.



■ Installation: Fan shroud

- Using , adjust the clearance between the fan shroud and cooling fan blades to the dimension shown in the illustration over the entire circumference.

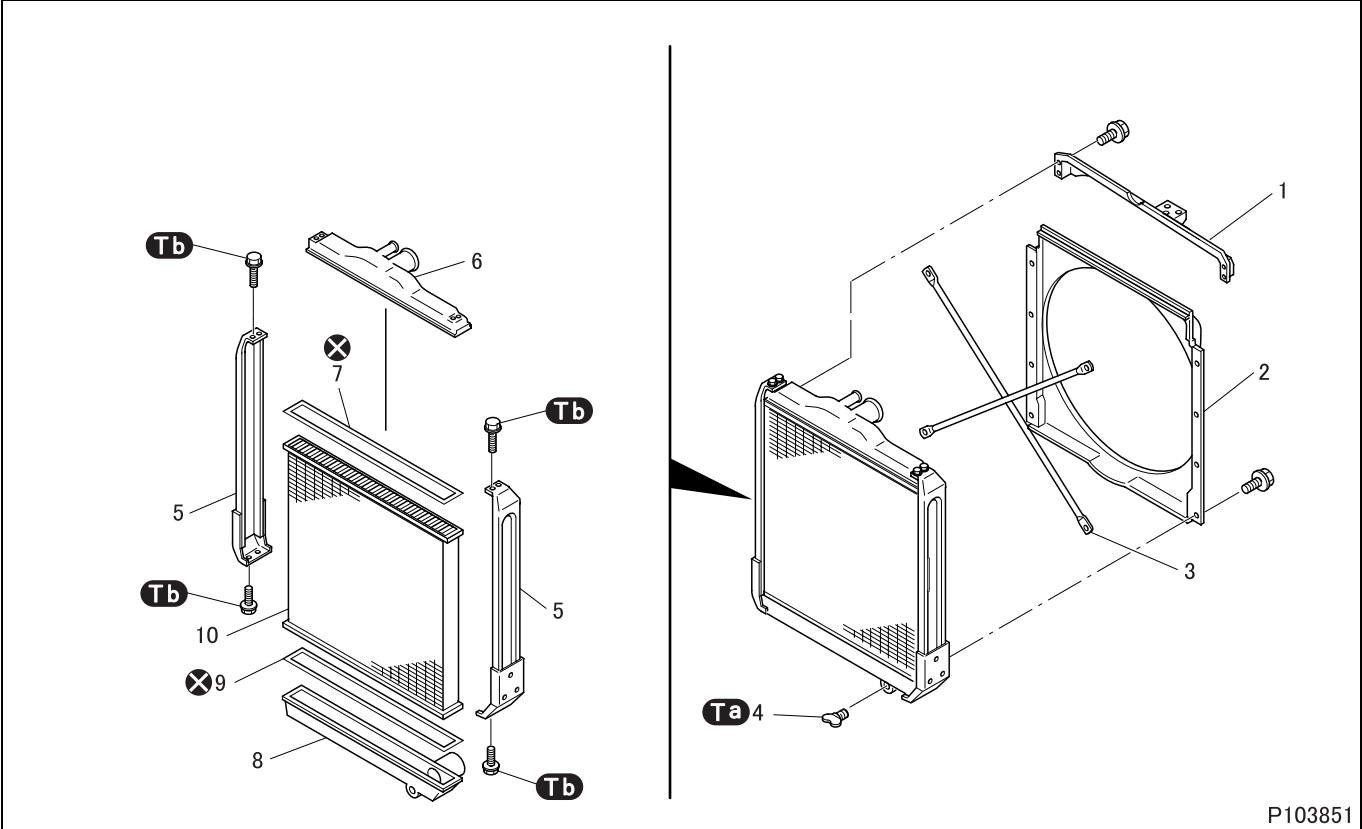


■ Installation: Shroud seal and fan shroud

- Install the shroud seal and fan shroud while aligning the section A as shown in the illustration.

RADIATOR AND FAN SHROUD

Radiator



● Disassembly sequence

- | | | |
|----------------------|---------------|-----------------------|
| 1 Thrust rod bracket | 5 Side member | 9 Packing |
| 2 Radiator shroud | 6 Upper tank | 10 Core |
| 3 Cross stay | 7 Packing | |
| 4 Drain cock | 8 Lower tank | ⊗: Non-reusable parts |

CAUTION ⚠

- Gently handle upper tank and lower tank, since they are made of a resin that can break on impact.
- If there are two paint marks on the joint between the core and upper tank or on the joint between the core and lower tank (which indicates that the tank retaining tabs have been crimped twice before), replace the core with a new part.

- Do not disassemble radiator unless there is an abnormality.

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards

Location	Maintenance item	Standard value	Limit	Remedy
—	Air leakage from radiator (air pressure: 177 kPa {1.8 kgf/cm ² })	0 cm ³ {0 mL}	—	Rectify or replace

Tightening torque (Unit: N·m {kgf·m})

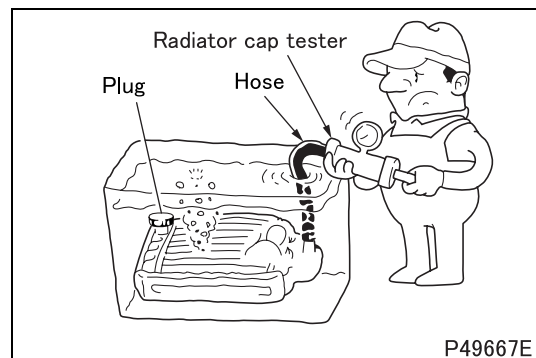
Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Drain cock	2 {0.2}	—
Tb	Bolt (side member mounting)	13 {1.3}	—

Special tools

Mark	Tool name and shape	Part No.	Application
	Lock-and-break tool	J94-Z013 -10000	Removal of upper and lower tanks

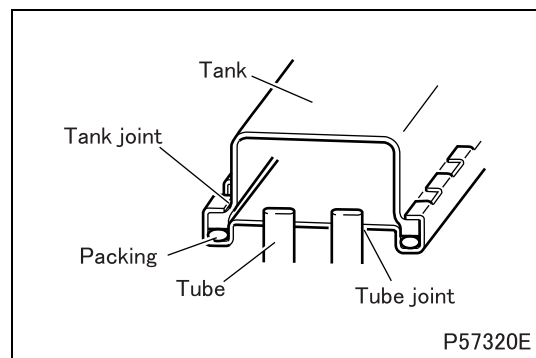
The indicated part number is T.RAD's part number.

◆ Inspection before removal ◆



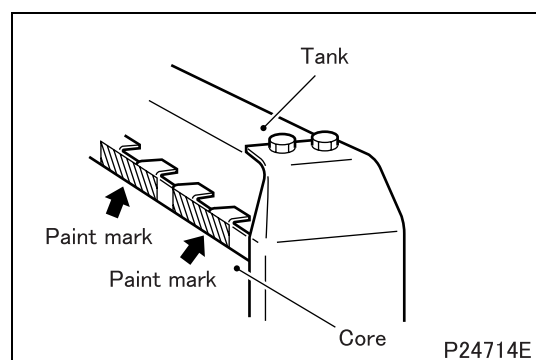
■ Inspection: Air leakage from radiator

- Install hose and radiator cap tester and plug to upper tank.
- Insert plug in lower tank, and immerse the entire body of the radiator in water.
- Apply a specified air pressure using radiator cap tester, and check for any air leakage.
- If any leakage is found, repair or replace radiator.



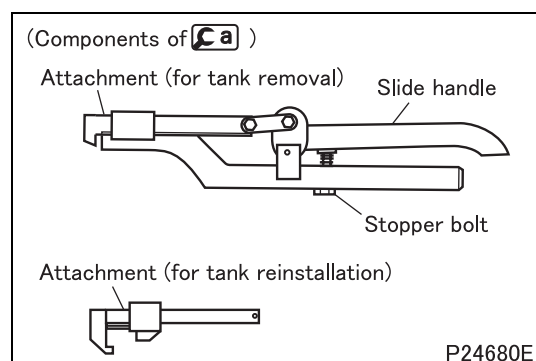
- Replace the following parts according to the leakage location.

Area of leakage		Cause
Upper tank Lower tank	Tank	Cracked tank
	Tank joint	Defective crimping Defective packing Cracked tank
Tube; Tube joint		Cracked tube



- If there are two paint marks on the joint between the core and upper tank or on the joint between the core and lower tank (which indicates that the tank retaining tabs have been crimped twice before), replace the core with a new part.
- Paint a mark for each core replacement. The upper and lower core replacement should be counted and marked separately.

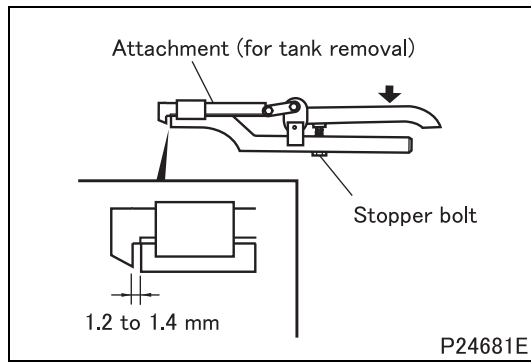
◆ Removal procedure ◆



■ Removal: Upper tank and lower tank

- Use , for removal and reinstallation of the tanks.

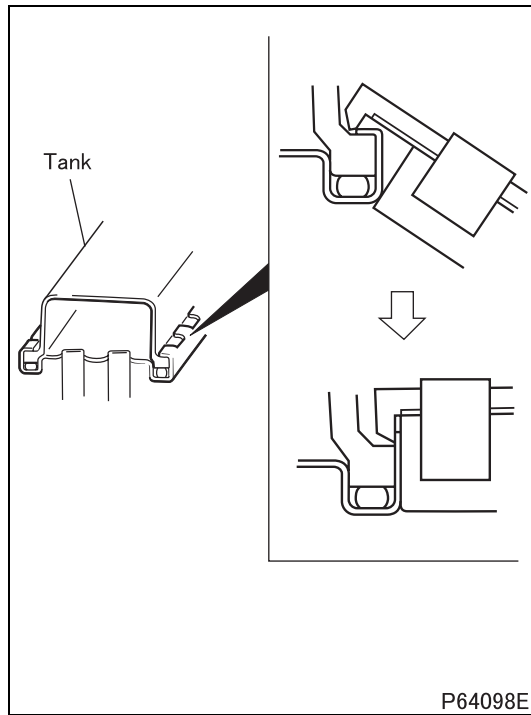
RADIATOR AND FAN SHROUD



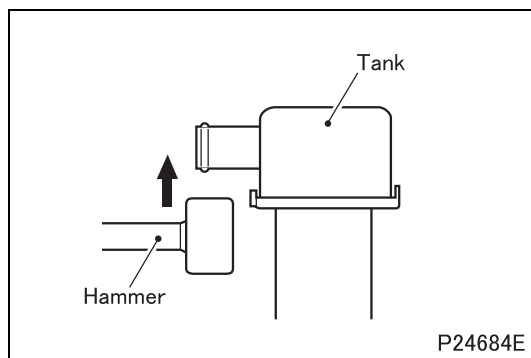
- Adjust the stopper bolt until the gap dimension shown in the illustration is obtained on the attachment of **[Ca]**.

CAUTION

- Before using **[Ca]**, be sure to set the gap to the specified dimension by adjusting the stopper bolt. Otherwise, damaged **[Ca]** will result.



- Use **[Ca]** to bend open tabs of retain tank in place.
- After tabs are bent open, squeeze the handle of **[Ca]** to straighten tabs as illustrated.
- After straightening all tabs in the perimeter, hold the pipes connected to the inlet/outlet, and remove tank.

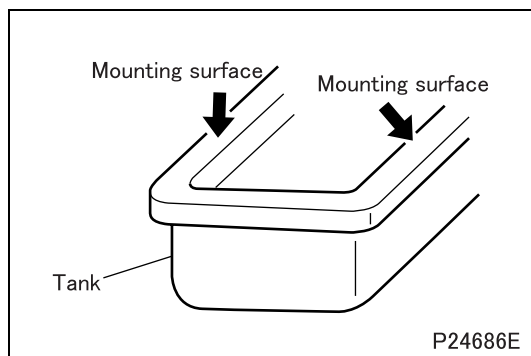


- If it is difficult to remove tank lightly hit with rubber hammer (or plastic hammer) to remove.

CAUTION

- Gently handle tanks, since they are made of a resin that can break on impact.

◆ Inspection procedure ◆

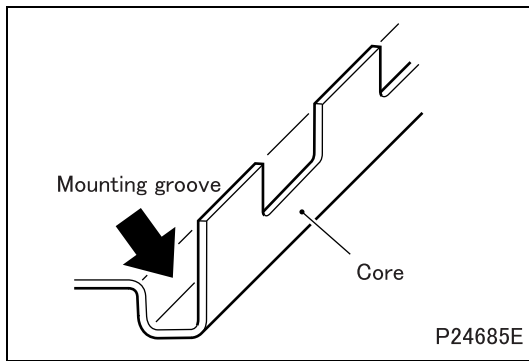


■ Inspection: Tank surface where core is to be mounted

- Check and clean the tank surface where the core is to be mounted for cleanliness, damage, etc.
- If any abnormality is found, replace the tank.

CAUTION

- To prevent adhesion of foreign substances on mounting surface, conduct work with bare hands.

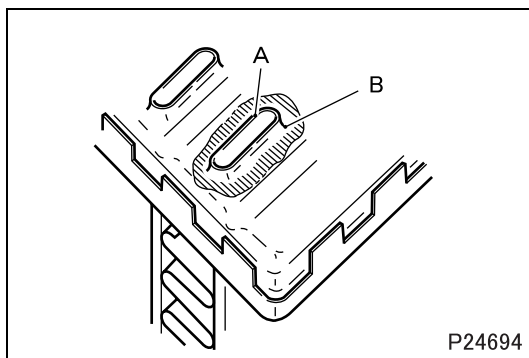


■ Inspection: Core groove where tank is to be mounted

- Check the groove on the core where the tank is to be mounted for adhesion of foreign substances or cracks.
- If foreign substances are found, rub the area with #1000 sandpaper or the like gently so as to avoid scratching the surface, or use compressed air to remove them.
- If there are cracks in the groove, repair or replace.

CAUTION ⚠

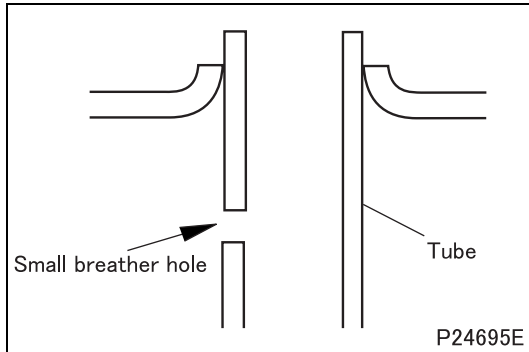
- If the packing and tank are installed onto the core without removing foreign substances from the groove, coolant leakage will result. Be sure to inspect and clean the tank mounting groove along the entire periphery (even a hair can cause leakage).



Repairing core

CAUTION ⚠

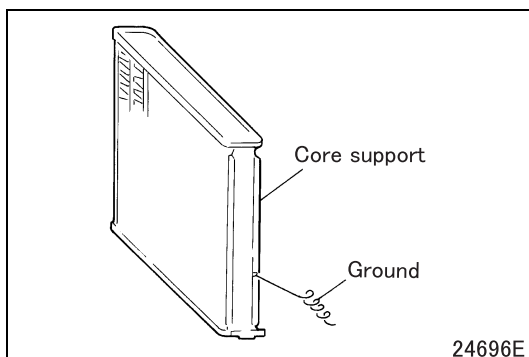
- The core is repaired by means of tungsten inert-gas arc welding (TIG welding), which should only be performed by a skilled welder.
- It is extremely dangerous to weld on a wet core. Before welding, ensure that the core is completely dry.



- Using a stainless wire brush, brush both ends A of the leaky tube and the areas B around the tube ends until the base aluminum is exposed.
- Before closing the tube at both ends by welding, drill a small breather hole in the tube.

CAUTION ⚠

- If a breather hole is not provided, the tube may develop small pinholes due to escaping air.

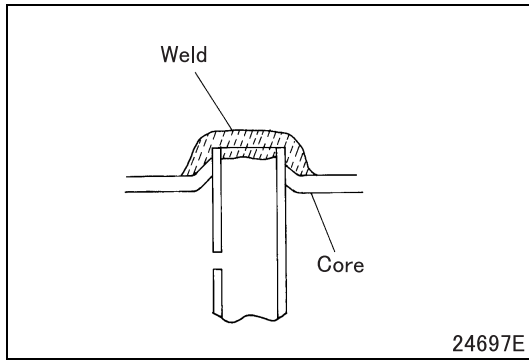


- Ground the core at the support.

CAUTION ⚠

- If welding is performed without the core properly grounded, this can lead to short-circuit where the base metal may melt.

RADIATOR AND FAN SHROUD

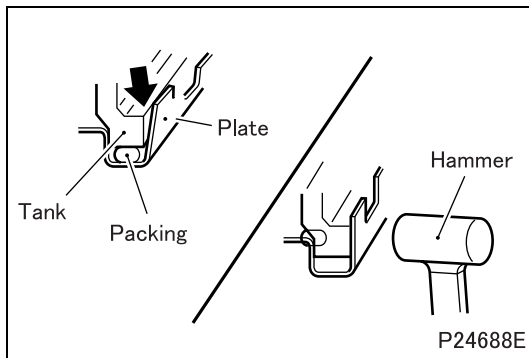


- Close both end of the tube by tungsten inert-gas arc welding (TIG welding).
Welding conditions
 - Welding rod: A4043 (approx. $\phi 2$ mm)
 - Welding current: AC80A
- After welding, check for the following problems. If any of them exist, repair again or replace the core.
 - Undercut
 - Bead crack
 - Base metal crack

CAUTION

- Improper weld can lead to recurrence of coolant leakage.

◆ Installation procedure ◆

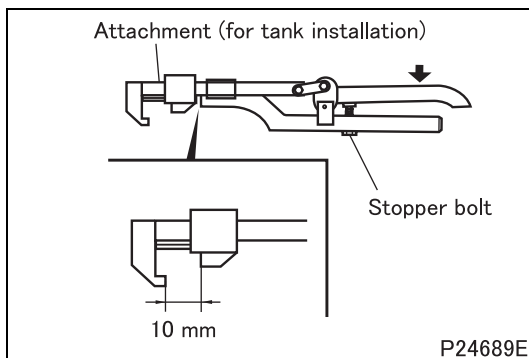


■ Installation: Upper tank, Lower tank

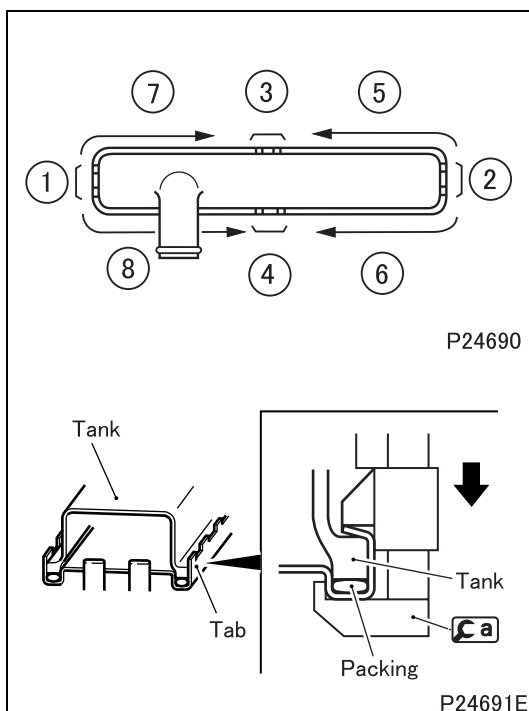
- With the tank installed, eliminate any clearance between the tank and core plate by tapping with a rubber (or plastic) hammer.

CAUTION

- To prevent adhesion of foreign substances, use bare hands to install the packing and tank.



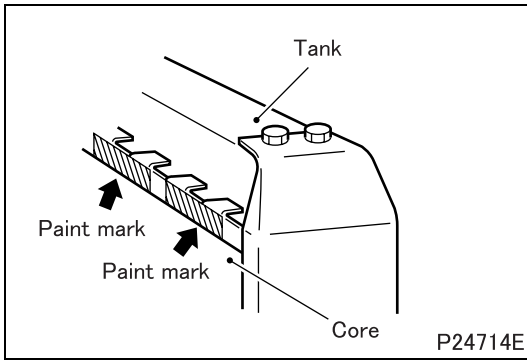
- Adjust the stopper bolt until the gap dimension shown in the illustration is obtained on the attachment of .



- Follow the sequence shown in the diagram, bend tabs for crimping tank.
1 to 4: Bend two tabs at the center.
5 to 8: Bend other tabs following the direction of the arrow.

CAUTION

- Since  cannot be used to crimp sides 1 and 2, use pliers with the tips wrapped in vinyl tape.
- After crimping the tabs onto the tank, check for coolant leakage.

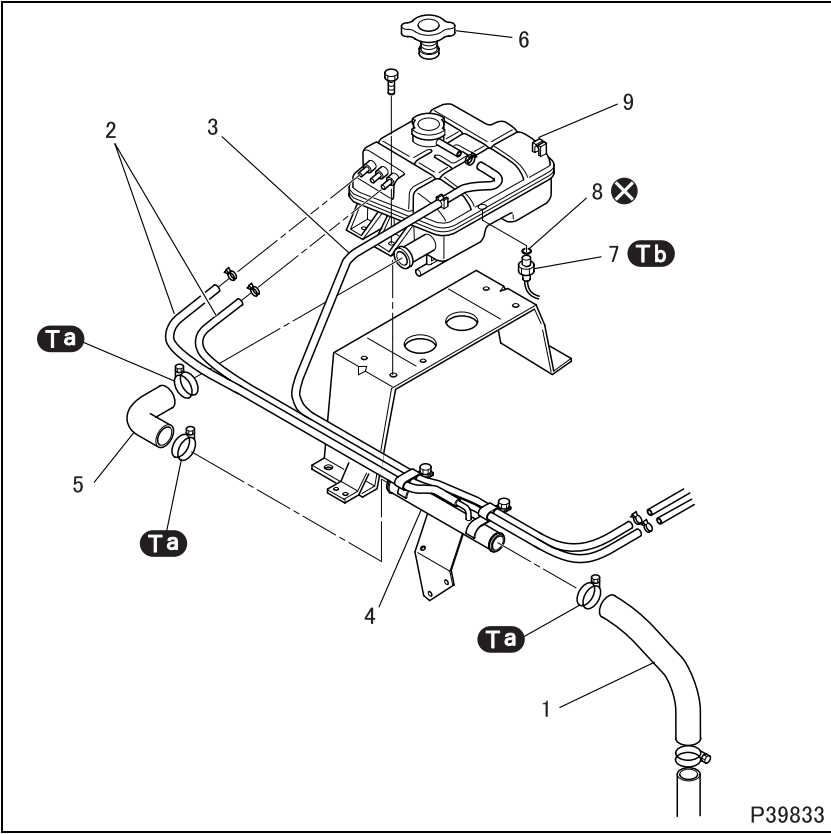


- Paint a mark on the core where it can be easily noticed to indicate that the core has been crimped.

CAUTION ⚠

- Paint a mark on the core where it can be easily noticed to indicate that the core has been crimped.

SURGE TANK



Disassembly sequence

- 1 Supply hose
- 2 Air bleeder hose
- 3 Overflow hose
- 4 Supply pipe
- 5 Supply hose
- 6 Pressure cap
- 7 Water level sensor
- 8 O-ring
- 9 Surge tank

⊗: Non-reusable parts

Assembly sequence

Follow the disassembly sequence in reverse.

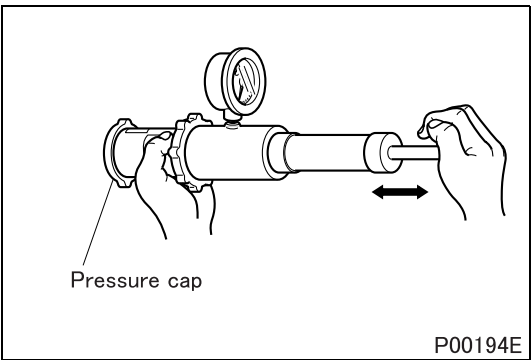
Service standards (Unit: mm)

Location	Maintenance item	Standard value	Limit	Remedy
6	Pressure valve opening pressure	$49 \pm 9.8 \text{ kPa}$ { $0.5 \pm 0.1 \text{ kgf/cm}^2$ }	—	Replace

Tightening torque (Unit: N·m {kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Clamp	3 to 5 {0.3 to 0.5}	—
Tb	Water level sensor	3 to 4 {0.3 to 0.4}	—

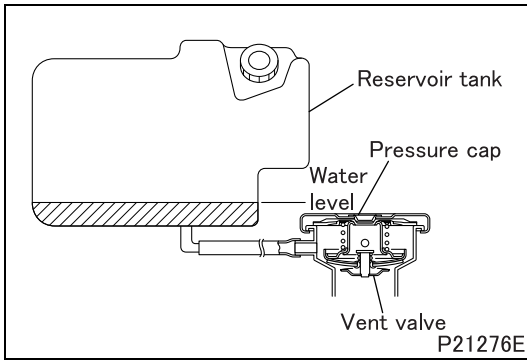
Inspection procedure



Inspection: Pressure cap

(1) Pressure valve opening pressure

- If the measurement deviates from the standard value, replace the pressure cap.



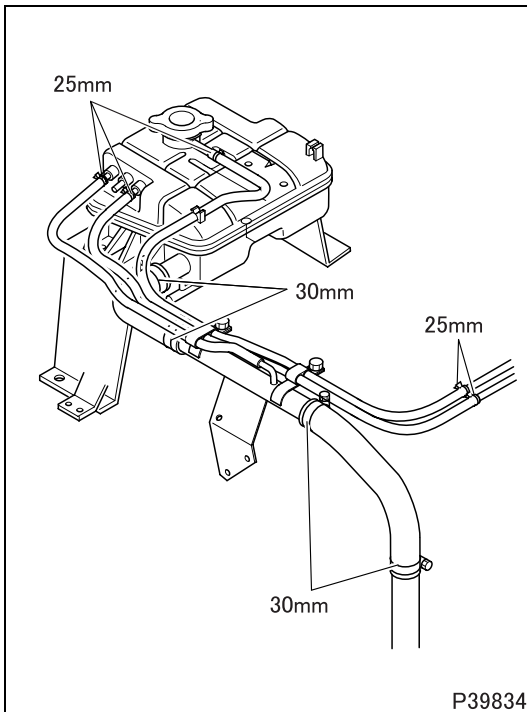
(2) Inspection of vent valve

- Check the water level of the reservoir tank in advance.
- Run the engine at high rpm. When the engine coolant overflows to the reservoir tank to some extent, stop the engine.
- Leave the engine in this condition for a while. When the engine coolant temperature becomes the atmospheric temperature, check that the water level in the reservoir tank returns to the water level before the engine start.
- If the water level does not lower, the vent valve is defective. Replace the pressure cap.

CAUTION

- **Do not remove the pressure cap before the engine coolant temperature drops to the atmospheric temperature. Otherwise, vacuum in the radiator is lost and the engine coolant cannot return to the reservoir tank.**

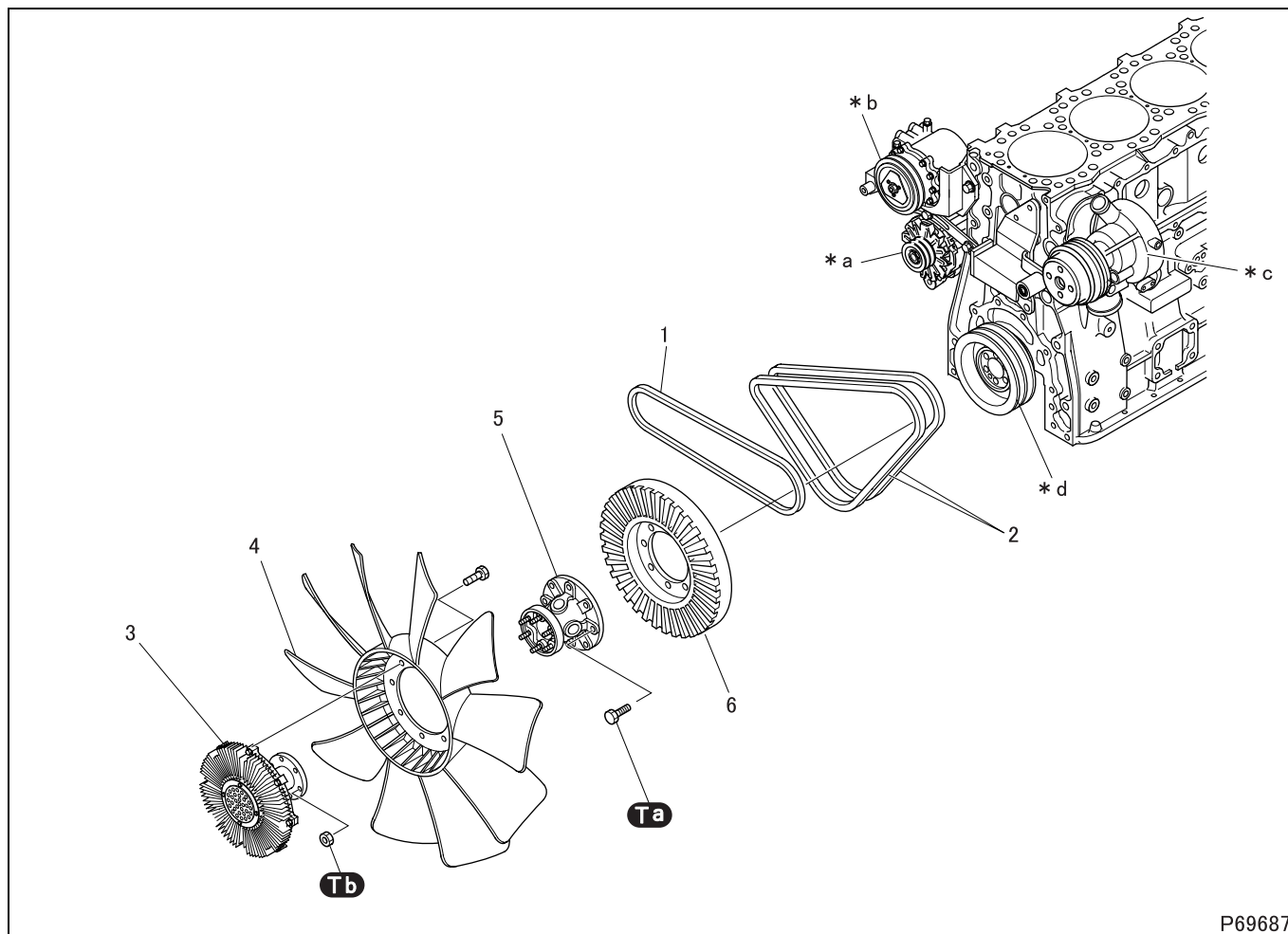
◆ Installation procedure ◆



■ Installation: Hose

- The insertion depth of each hose is as shown in the illustration.

MITSUBISHI 6M70 COOLING FAN AND BELT



● Removal sequence

- 1 Belt (for air conditioner)
- 2 Belt (for alternator)
- 3 Automatic cooling fan coupling
- 4 Cooling fan
- 5 Fan coupling
- 6 Torsional damper

- *a: Alternator
*b: Cooler compressor
(for air conditioner)
*c: Water pump
*d: Crankshaft pulley

- The automatic cooling fan coupling cannot be disassembled. If it is found faulty, replace the whole assembly.

● Installation sequence

Follow the removal sequence in reverse.

CAUTION

- Be careful not to allow engine oil to smear the belt. A belt smeared with oil slips, resulting in reduced cooling efficiency.
 - When replacing the belts, replace them as a set to prevent differences in tension between the two belts.
-
- After installation, perform the inspection and adjustment of belt tension. (See “ON-VEHICLE INSPECTION AND ADJUSTMENT.”)

Mitsubishi 6M70 Engine Parts contact:

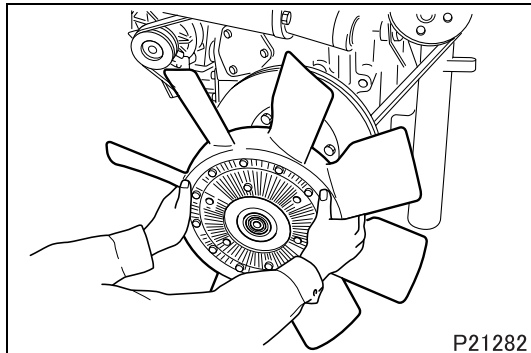
email: EngineParts@HeavyEquipmentRestorationParts.com

Phone: 269 673 1638

Tightening torque (Unit: N·m {kgf·m})

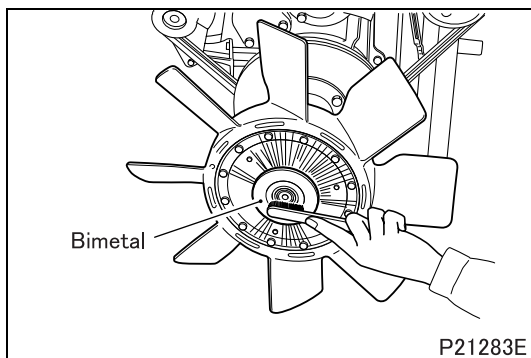
Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (fan coupling mounting)	115 {12}	—
Tb	Nut (automatic cooling fan coupling mounting)	50 {5.0}	—

◆ Inspection and cleaning procedure ◆



■ Inspection: Automatic cooling fan coupling

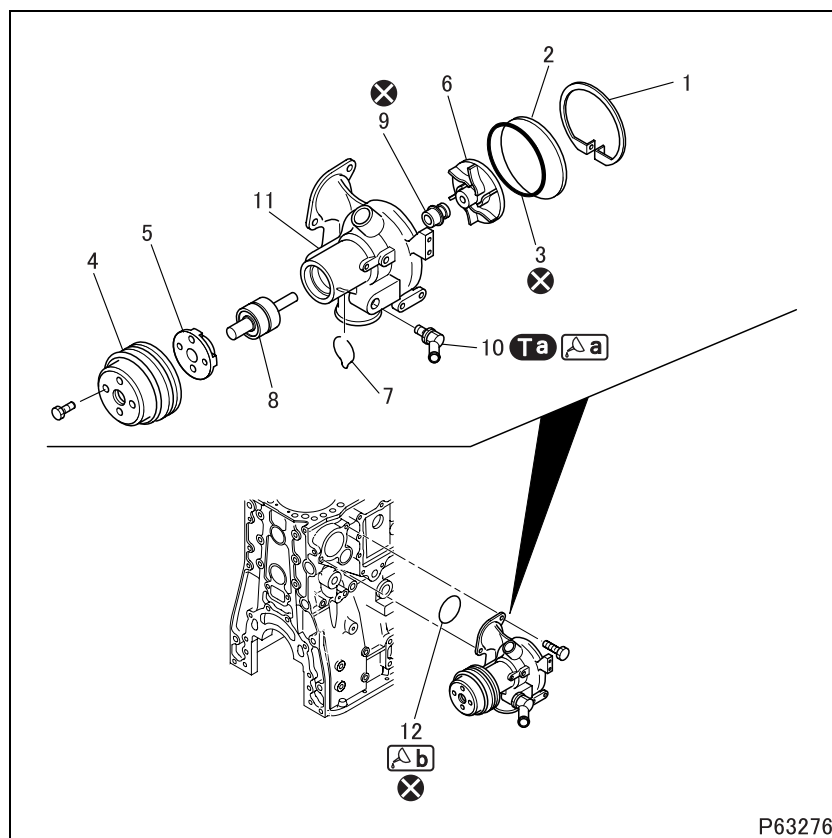
- Perform the following inspection. If any abnormality is found, replace the automatic cooling fan coupling.
 - Check for leakage of oil from the coupling body.
 - Rotate the automatic cooling fan coupling by hand and check for irregular movement or abnormal noise caused by a defect in the bearing.
 - Check for excessive axial play in the automatic cooling fan coupling when the engine is cool.



■ Cleaning: Automatic cooling fan coupling

- If any foreign particles have adhered to the bimetal, remove them carefully without applying excessive force.

MITSUBISHI 6M70 WATER PUMP



● Disassembly sequence

- 1 Snap ring
- 2 Water pump cover
- 3 O-ring
- 4 Water pump pulley
- 5 Flange
- 6 Impeller
- 7 Wire
- 8 Bearing unit
- 9 Unit seal
- 10 Connector
- 11 Water pump case
- 12 O-ring

⊗: Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse except for the following.

11 → 8 → 7 → 9 → 6

- See the previous section “DISCONNECTION AND CONNECTION OF HOSES AND PIPES” for the correct insertion depth of water pump hoses into the pump as well as the correct tightening torque of clamps.

Service standards (Unit: mm)

Location	Maintenance item	Standard value	Limit	Remedy
5, 8	Interference between flange and bearing unit	0.05 to 0.08	—	Reassembly allowed only twice
6, 8	Interference between impeller and bearing unit	0.03 to 0.06	—	Reassembly allowed only twice

Tightening torque (Unit: N·m {kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Connector	39 {4.0}	—

Lubricant and/or sealant

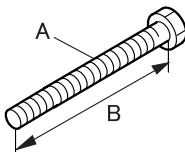
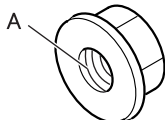
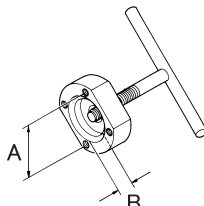
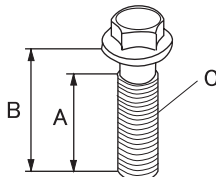
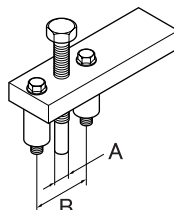
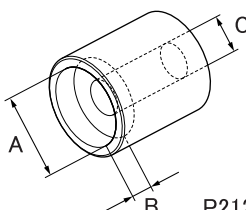
Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Thread of connector	Threebond Sealock 2310	As required
b	O-ring	Engine oil	As required

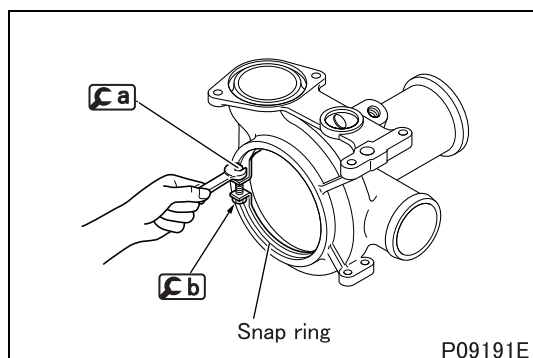
Mitsubishi 6M70 Engine Parts contact:

email: EngineParts@HeavyEquipmentRestorationParts.com

Phone: 269 673 1638

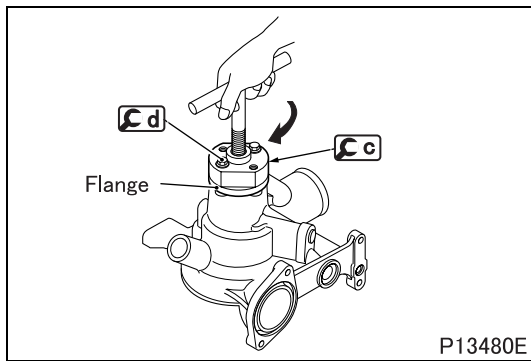
Special tools (Unit: mm)

Mark	Tool name and shape	Part No.	Application						
	Bolt <table border="1"><tr><td>A</td><td>B</td></tr><tr><td>M6 × 1</td><td>60</td></tr></table>  P21285	A	B	M6 × 1	60	MH001102	Removal and installation of snap ring		
A	B								
M6 × 1	60								
	Nut <table border="1"><tr><td>A</td></tr><tr><td>M6 × 1</td></tr></table>  P21286	A	M6 × 1	MF434103					
A									
M6 × 1									
	Water pump pully puller <table border="1"><tr><td>A</td><td>B</td></tr><tr><td>60</td><td>13</td></tr></table>  21287	A	B	60	13	MH062411	Removal of flange		
A	B								
60	13								
	Bolt <table border="1"><tr><td>A</td><td>B</td><td>C</td></tr><tr><td>26</td><td>35</td><td>M10 × 1.5</td></tr></table>  P21288	A	B	C	26	35	M10 × 1.5	MH000715	
A	B	C							
26	35	M10 × 1.5							
	Impeller puller <table border="1"><tr><td>A</td><td>B</td></tr><tr><td>φ 10</td><td>48</td></tr></table>  P21289	A	B	φ 10	48	MH062192	Removal of impeller		
A	B								
φ 10	48								
	Unit seal installer <table border="1"><tr><td>A</td><td>B</td><td>C</td></tr><tr><td>φ 28</td><td>9.6 ± 0.03</td><td>φ 12.5 ± 0.1</td></tr></table>  P21290	A	B	C	φ 28	9.6 ± 0.03	φ 12.5 ± 0.1	MH062195	Installation of unit seal
A	B	C							
φ 28	9.6 ± 0.03	φ 12.5 ± 0.1							

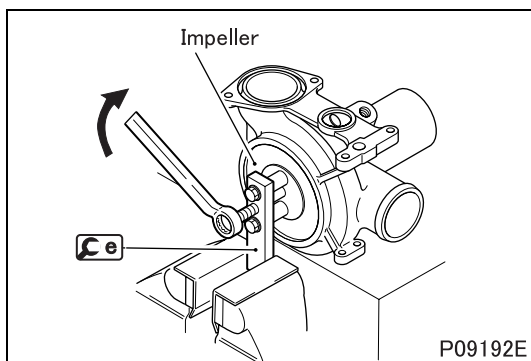
◆ Removal procedure ◆

■ Removal: Snap ring

- Install the **C a** and **C b** into bolt hole of snap ring, then tighten **C a** and remove the snap ring.

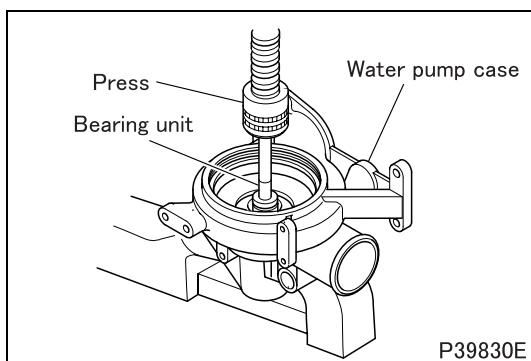
WATER PUMP



■ Removal: Flange



■ Removal: Impeller



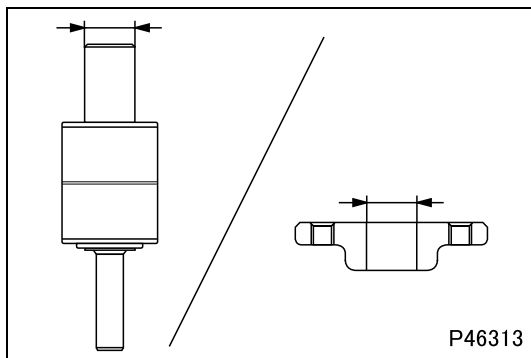
■ Removal: Bearing unit

- Remove the bearing unit using a press. Heating the water pump case to approximately 80°C will facilitate the removal.

CAUTION ⚠

- The ram load applied to remove the bearing unit should not exceed 9800 N {1000 kgf}.
- When the bearing unit is replaced, always replace the unit seal.

◆ Inspection procedure ◆

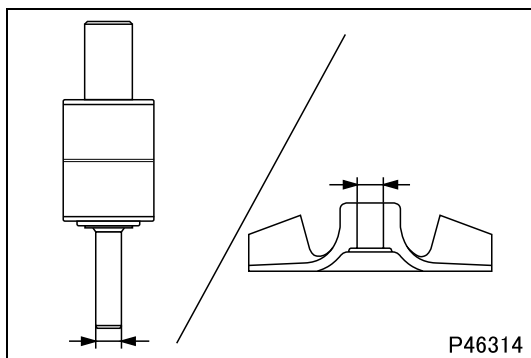


■ Inspection: Interference between flange and bearing unit

- If the measurement deviates from the standard value, replace the defective part(s).

CAUTION ⚠

- Even if the measurement complies with the standard value, reassembly must not be carried out more than twice.



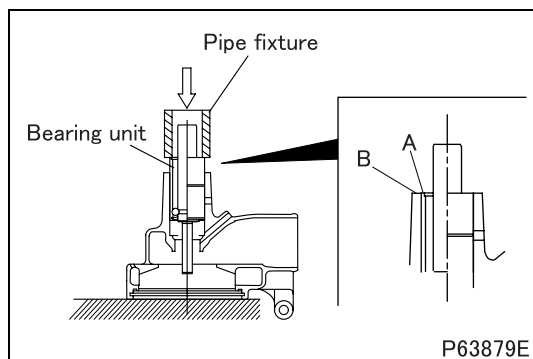
■ Inspection: Interference between impeller and bearing unit

- If the measurement deviates from the standard value, replace the defective part(s).

CAUTION ⚠

- Even if the measurement complies with the standard value, reassembly must not be carried out more than twice.

◆ Installation procedure ◆

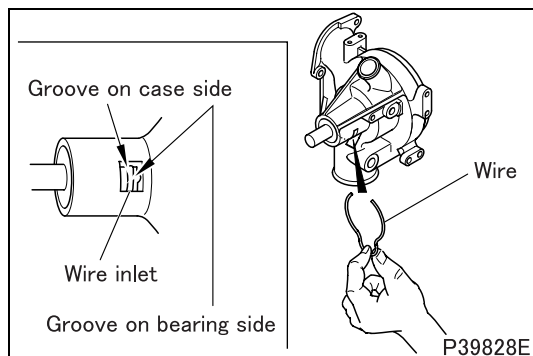


■ Installation: Bearing unit

- Install the bearing unit by ramming down its outer race with the press until the end face A of the outer race and the end face B of water pump case meet flush.

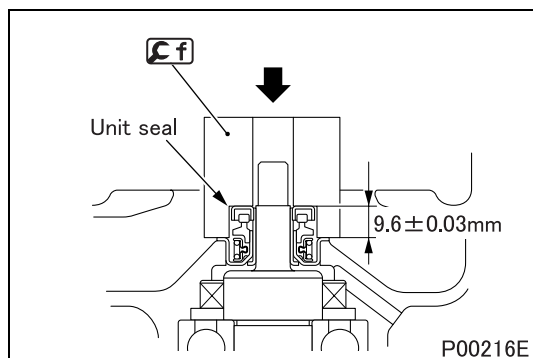
CAUTION ⚠

- Before installing, check the rotating condition of the bearing unit.
- When installing, do not press the shaft end of the bearing unit.



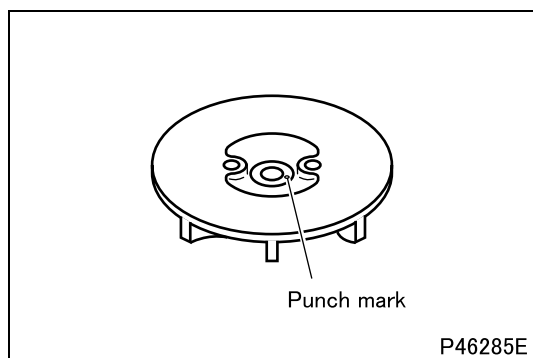
■ Installation: Wire

- Align the groove on the water pump case side with the groove on the bearing side at the wire inlet before inserting the wire into the water pump case.



■ Installation: Unit seal

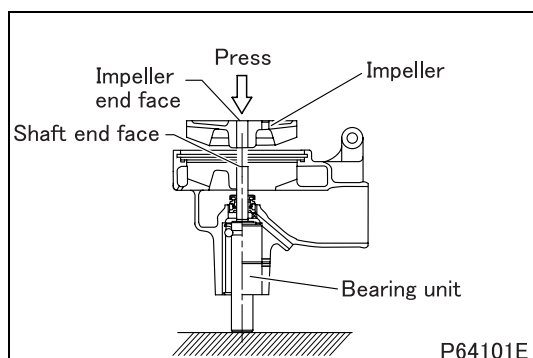
- Using , install the unit seal until it securely contacts the water pump case.



■ Installation: Impeller

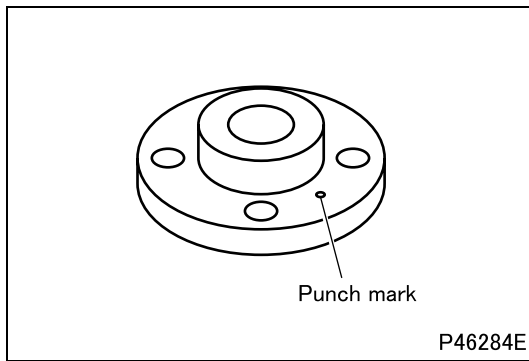
CAUTION ⚠

- Before installing an impeller, make sure that there is no or only one punch mark in the shown location on the impeller. Make an additional punch mark on the flange to indicate that it undergoes the disassembly and reassembly process you are doing now.
- Punch mark(s) indicate the number of times the impeller was disassembled and reassembled in the past. If there are two marks, the impeller must be replaced.



- With a press installed against the impeller end face, press fit the impeller onto the bearing unit until the impeller end face is flush with the shaft end face of the bearing unit.

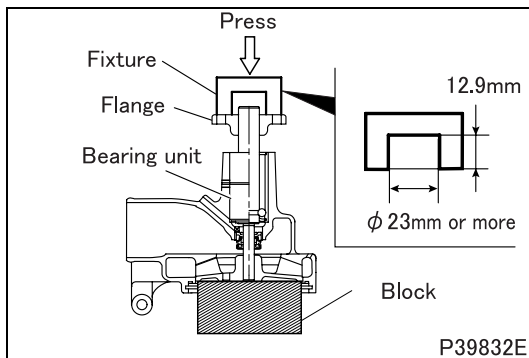
WATER PUMP



■ Installation: Flange

CAUTION ⚠

- Before installing a flange, make sure that there is no or only one punch mark in the shown location on the flange. Make an additional punch mark on the flange to indicate that it undergoes the disassembly and reassembly process you are doing now.
- Punch mark(s) indicate the number of times the flange was disassembled and reassembled in the past. If there are two marks, the flange must be replaced.

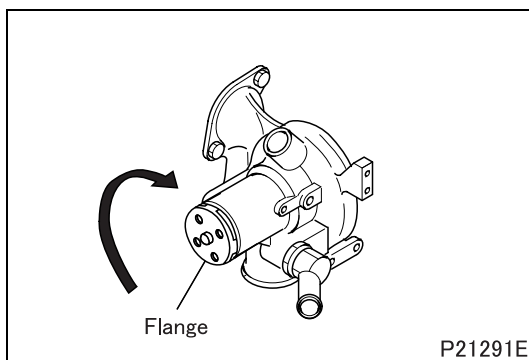


- Stand the shaft of the bearing unit on a block as illustrated.
- Place a fixture on the flange and apply the load of a press to it.
- Press the fixture down until the shaft of the bearing unit contacts the fixture.

CAUTION ⚠

- If the flange is installed without the fixture, the water pump case will be damaged.

◆ Inspection after assembly ◆

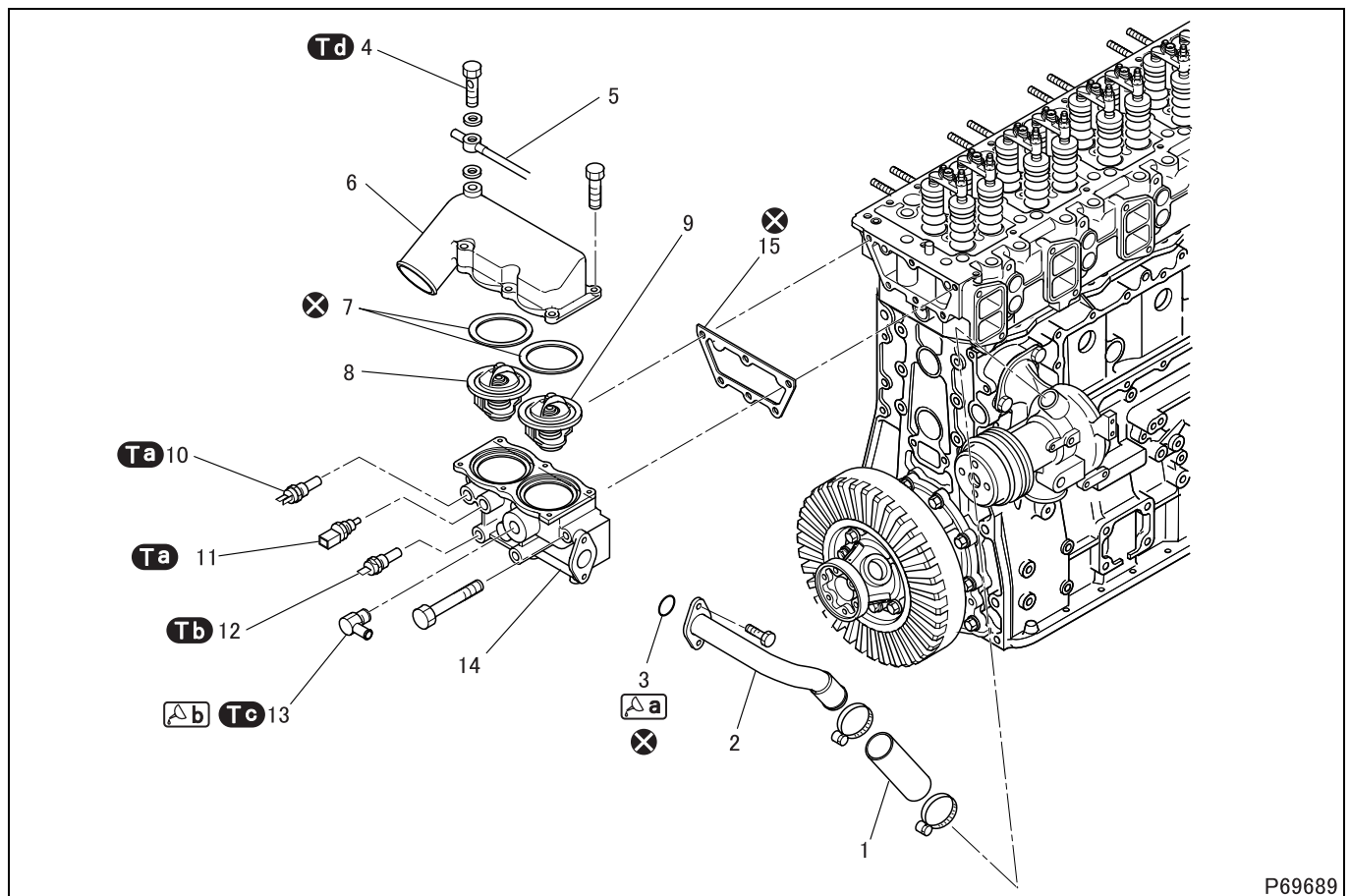


■ Inspection: Flange rotation

- Rotate the flange by hand. The flange should rotate smoothly without any binding.
- If the flange does not rotate freely, disassemble and check.

M E M O

MITSUBISHI 6M70 THERMOSTAT



● Disassembly sequence

- | | | |
|---------------------|---|--|
| 1 Water hose | 8 Thermostat
(Valve opening temperature
82°C) | 11 Water temperature sensor
<for thermometer> |
| 2 Bypass pipe | 9 Thermostat
(Valve opening temperature
88°C) | 12 Overheat switch |
| 3 O-ring | 10 Water temperature sensor
(for engine control) | 13 Water joint |
| 4 Eyebolt | | 14 Thermostat case |
| 5 Air bleeding pipe | | 15 Gasket |
| 6 Thermostat cover | | |
| 7 Rubber ring | | |
- ⊗: Non-reusable parts

- Do not remove the thermostat case unless it has a water leak or any other defect.

● Installation sequence

Follow the disassembly sequence in reverse.

- Refer to the previous section “**DISCONNECTION AND CONNECTION OF HOSES AND PIPES**” for the correct insertion depth of thermostat cover and case hoses into the pump as well as the correct tightening torque of clamps.

Mitsubishi 6M70 Engine Parts contact:
email: EngineParts@HeavyEquipmentRestorationParts.com
Phone: 269 673 1638

Service standards (Unit: mm)

Location	Maintenance item		Standard value	Limit	Remedy
8	Thermostat	Valve opening temperature	$82 \pm 2^{\circ}\text{C}$	—	Replace
		Valve lift/temperature	10 or more/ 95°C	—	
9	Thermostat	Valve opening temperature	$88 \pm 2^{\circ}\text{C}$	—	
		Valve lift/temperature	10 or more/ 100°C	—	

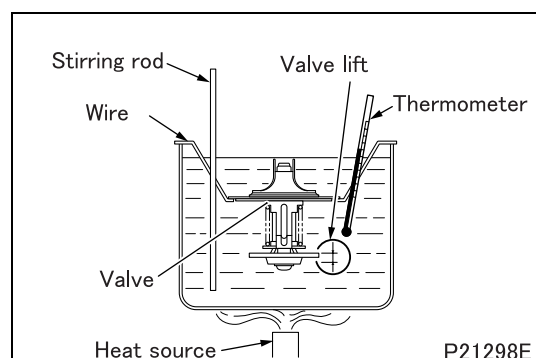
Tightening torque (Unit: N·m {kgf·m})

Mark	Parts to be tightened		Tightening torque	Remarks
Ta	Water temperature sensor	For engine control	39 {40}	—
		For thermometer		
Tb	Overheat switch		27 to 41 {2.8 to 4.2}	—
Tc	Water joint		34 {3.5}	Sealant
Td	Eyebolt		25 {2.6}	—

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	O-ring	Engine oil	As required
b	Winding around threaded portion of water joint	Teflon tape	3.5 turns

◆ Inspection procedure ◆



■ Inspection: Thermostat

- Stir the water using a stirring rod to maintain an even water temperature in the container, then conduct the tests indicated below.
- If the measurement deviates from the standard value, replace the thermostat.

(1) Valve opening temperature

- Hold the thermostat with wire to keep it away from the heat source.
- Heat the water gradually to the valve opening temperature.
- Maintain this temperature for five minutes and make sure that the valve is completely open.
- Make sure that the valve closes completely when the water temperature drops below 65°C .

(2) Valve lift

- Maintain the coolant temperature at the specified temperature for five minutes to keep the valve fully open.
- Measure the valve lift.

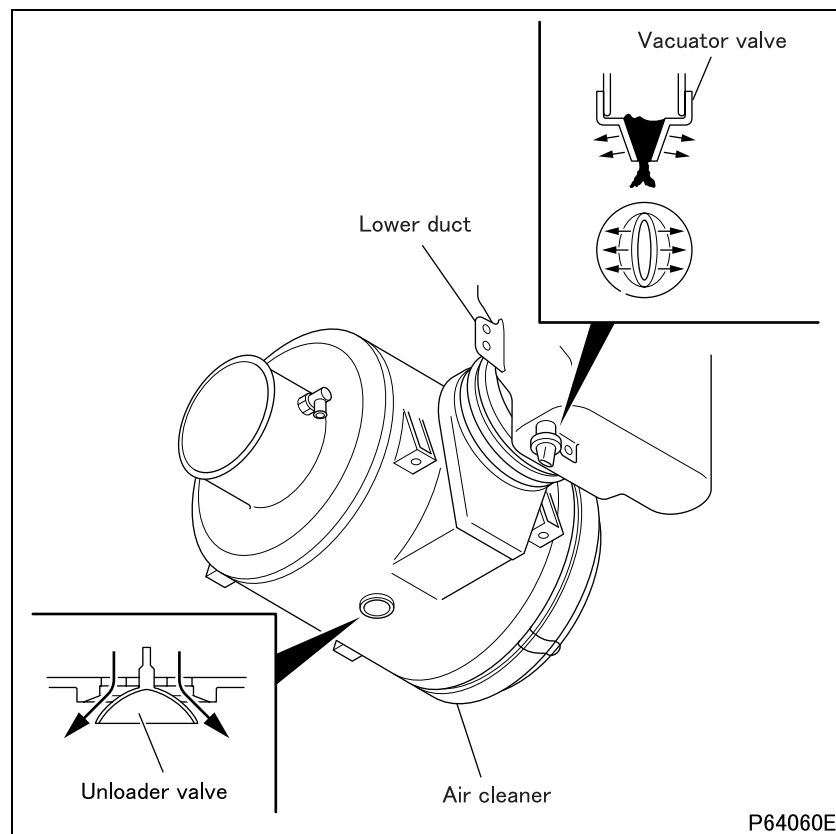
GROUP 15 MITSUBISHI 6M70 INTAKE AND EXHAUST

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8. Electric Circuit Diagram	15-30		

SPECIFICATIONS

Item		Specifications
Air cleaner element		Cyclone filter paper type
Dust indicator type		Mechanical
Turbocharger	Model	TF08 (VG (Variable Geometry: Variable nozzle vane type) Turbocharger)
	Manufacturer	Mitsubishi Heavy Industries
Intercooler type		Tube and corrugated fin (air cooled)
DPF (Diesel Particulate Filter)		Continuous regeneration type

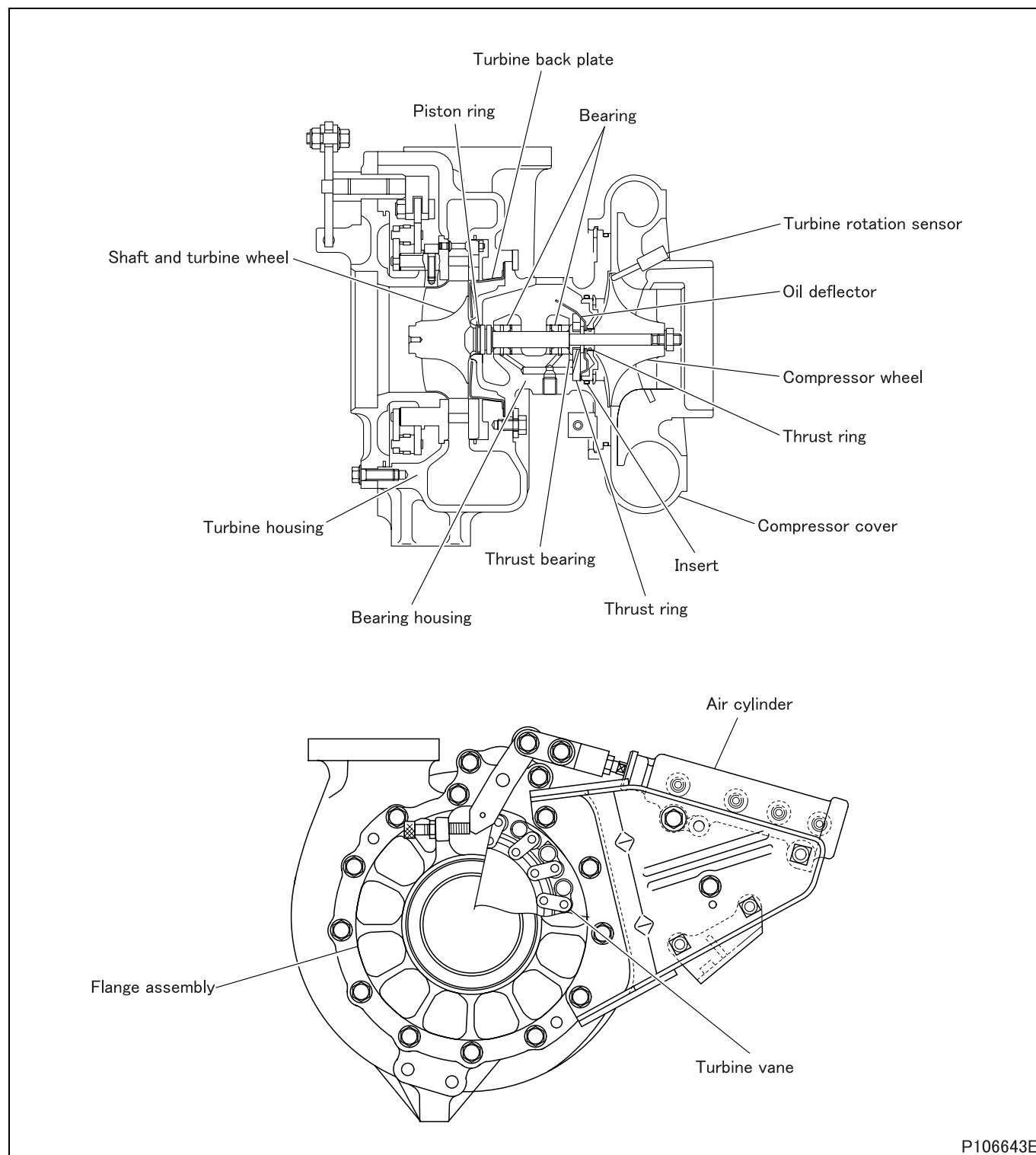
1. Air Cleaner



- The air cleaner is a single element type.
- The air cleaner is provided with an unloader valve and a vacuator valve.
- When the engine speed drops below a specified level, the vacuator and unloader valves are shaken by a consequent change in internal vacuum to automatically force out accumulated water and dust.

STRUCTURE AND OPERATION

2. Mitsubishi 6M70 Turbocharger



- TF08 model is equipped with turbocharger, which is a variable nozzle vane type turbocharger with adjustable, heat-resistive alloy turbine vanes provided at the turbine exhaust gas inlet port.

Mitsubishi 6M70 Engine Parts contact:

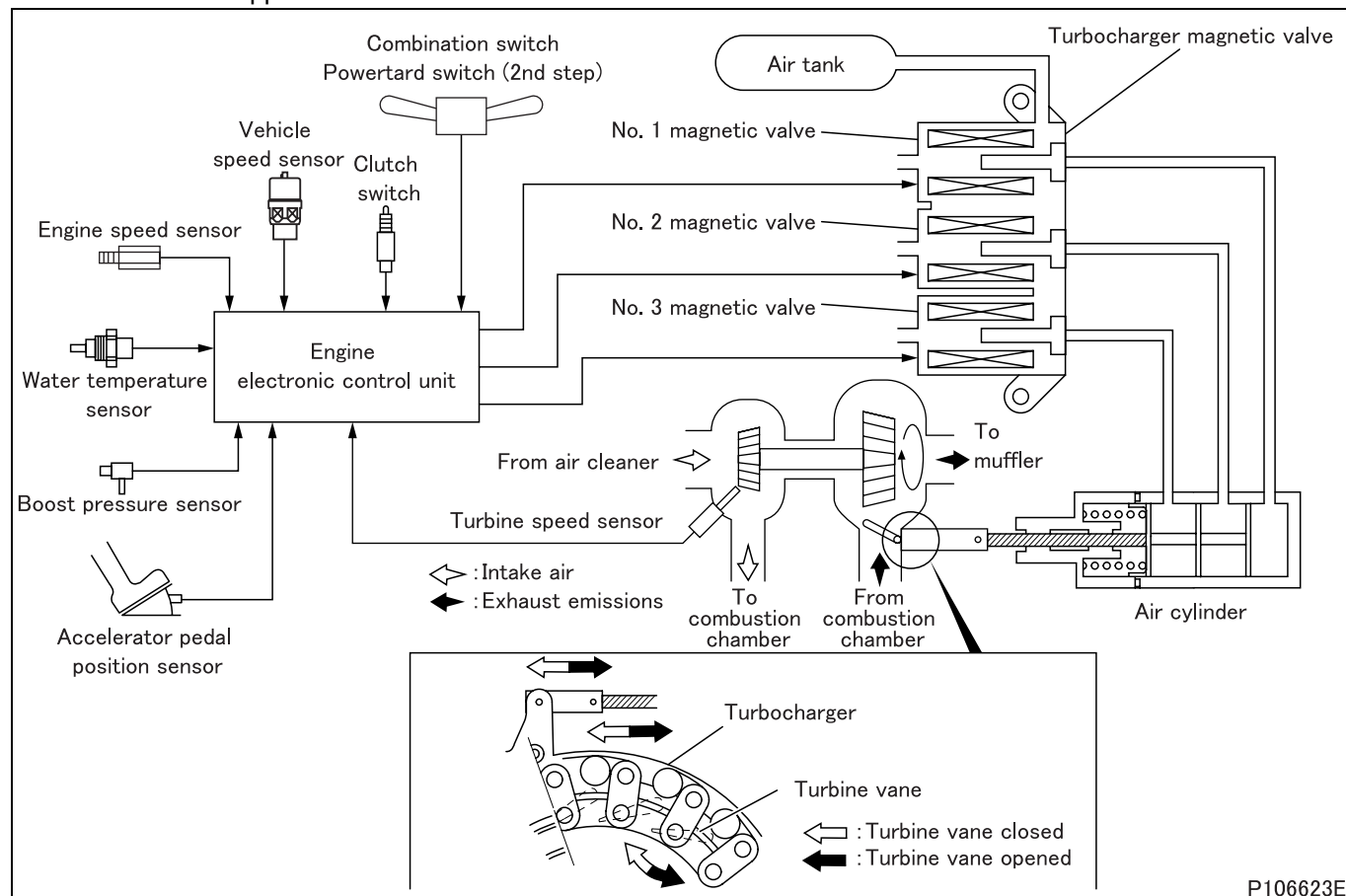
email: EngineParts@HeavyEquipmentRestorationParts.com

Phone: 269 673 1638

3. Turbocharger Control System

3.1 General description

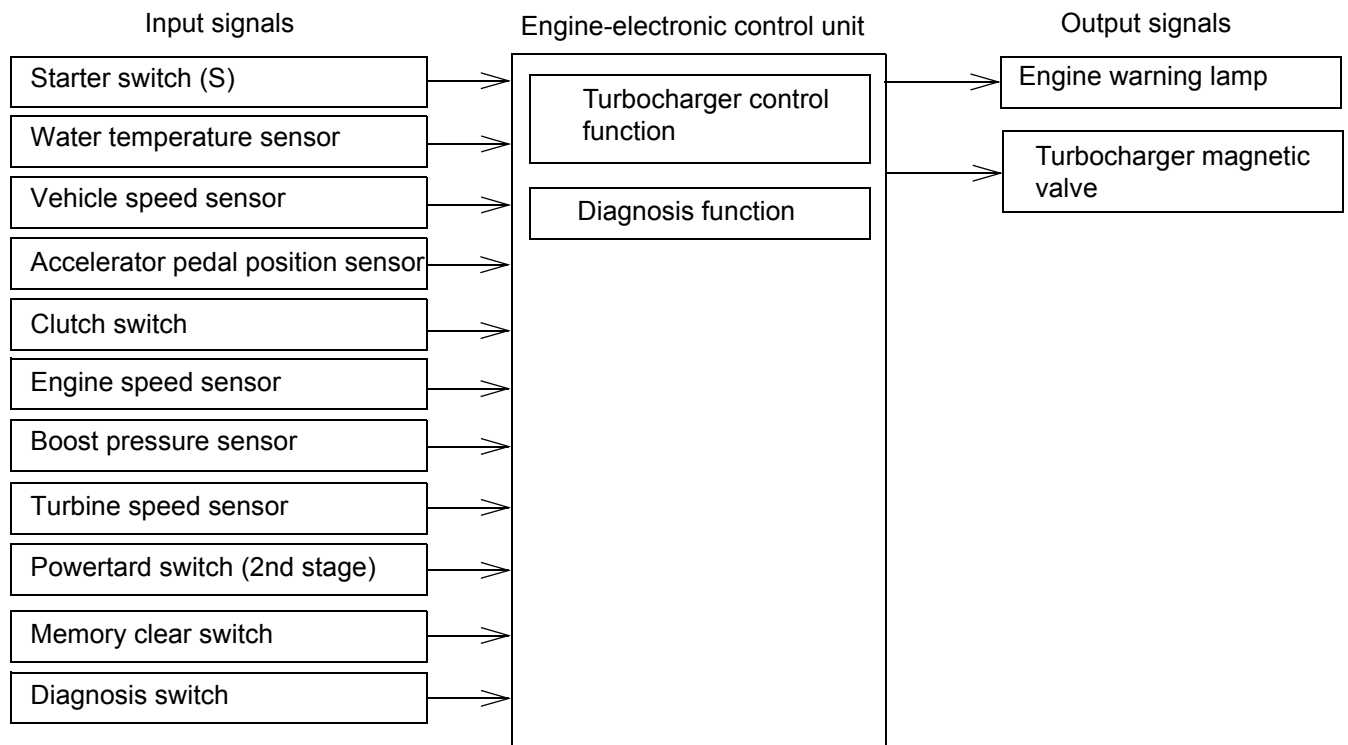
- The turbocharger control system uses various sensors to detect the status of the engine and controls the turbocharger magnetic valves according to sensor output data by means of the engine electronic control unit.
- The turbocharger magnetic valves control the air cylinder movement to optimize the opening of the turbine vanes according to operating conditions.
- When powertard brake (2nd step) is activated, the turbine vanes are closed, the turbocharger speed is increased and more air is supplied to the combustion chamber.



STRUCTURE AND OPERATION

3.2 Electronic Control System

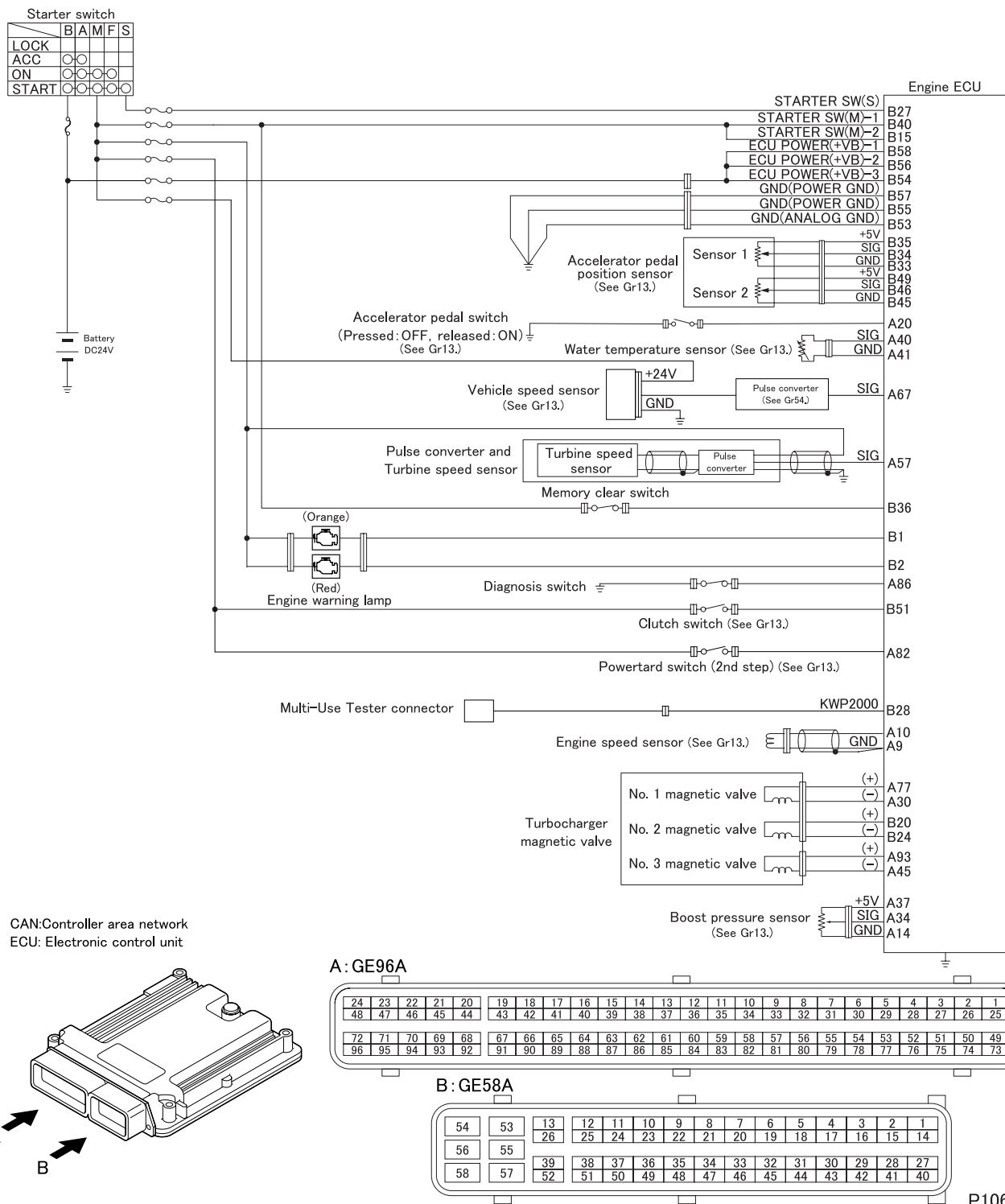
(1) System block diagram



(2) Diagnosis function

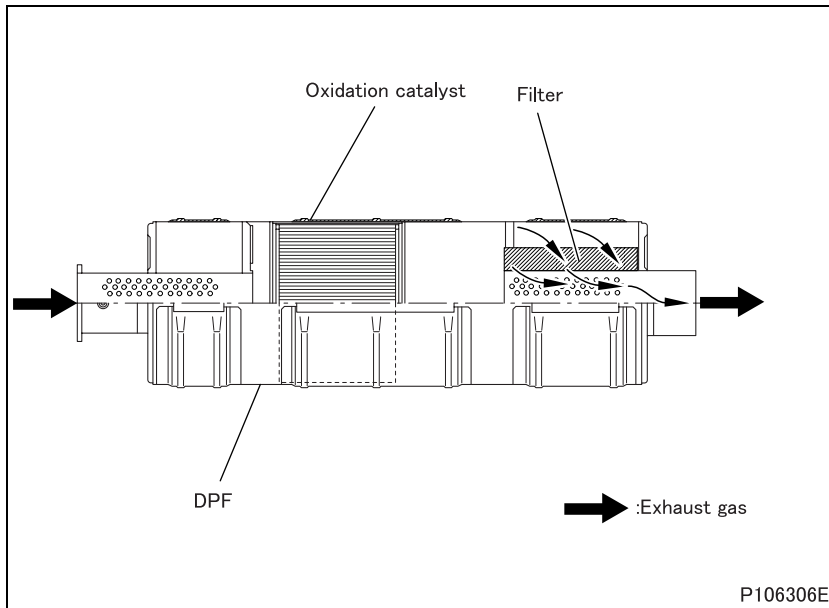
- While the starter switch is on, the diagnosis function is constantly activated to find faults in various sensors. Upon any sensor being found faulty, the driver is informed of the fault through the display in the meter cluster. At the same time, the fault is memorized in the form of a diagnosis code and the system starts to effect necessary at-fault control(s).
- During at-fault control(s), the system is limited in the workings to ensure the safety of the vehicle and driver. The memorized diagnosis code can be accessed on the Multi-Use Tester screen or through blinking of warning lamp.
- Diagnosis codes are different in the way of indication between the Multi-Use Tester and blinking of the warning lamp.
- The Multi-Use Tester provides more specific diagnosis codes.

3.3 Electronic control unit connection diagram



STRUCTURE AND OPERATION

4. Diesel Particulate Filter



- Diesel particulate filter is a large-capacity system consisting of an ultra-efficient oxidation catalyst and a filter. Diesel particulate filter is designed to efficiently break and capture PM emitted by engines running on low-sulfur fuel, and the filter is continuously regenerated.
- The new environmentally-friendly engine has drastically-reduced PM emission levels. In addition, the ultra-efficient oxidation catalyst breaks and treats most of PM emitted from the engine, minimizing PM loading/deposit onto the subsequent filter. As a result, the filter is unlikely to clog up even under the driving conditions that require long hours of drive with relatively low exhaust gas temperature. Also, active regeneration, which increases fuel consumption, is not required.
- The size of the filtration openings has been optimized to eliminate the deposit of ash (product of combustion) generated in the engine. The filter requires no maintenance, including periodical cleaning.

Symptoms		Engine hard to start	Black exhaust gas	White exhaust gas	Poor engine power	Excess oil consumption	Abnormal noise or vibration in intake/exhaust system	Reference Gr
Possible causes								
Air cleaner		Clogged air cleaner element	O	O	O	O		
Turbocharger	Cartridge assembly	Defective bearing		O		O		O
		Carbon deposits on shaft and turbine wheel unit		O		O		
		Interference between shaft and turbine wheel unit and turbine back plate		O		O		O
		Interference between shaft and turbine wheel unit and turbine housing		O		O		O
		Bent shaft and turbine wheel unit		O		O		O
		Damaged shaft and turbine wheel unit		O		O		O
		Interference between compressor wheel and compressor cover		O		O		O
		Seized thrust sleeve and/or thrust bearing		O		O		O
		Damaged compressor wheel		O		O		O
		Oil leakage due to worn piston ring and/or insert		O	O		O	
		Piston ring fitted poorly					O	
		Defective sliding action between parts due to clogged lubrication oil pipe and eyebolt		O		O		O
		Oil seals damaged due to clogged oil return pipe			O		O	
		Compressor cover fitted poorly		O		O	O	O
		Turbine housing fitted poorly				O		O
Intercooler	Foreign substances deposited on intercooler front core				O			
Front pipe/DPF/tail pipe deformed					O		O	
Front pipe/DPF/tail pipe fitted poorly					O		O	
Incorrect valve clearances			O					Gr11
Head gasket defective			O					
Wear/carbon deposits on valves and valve seats			O					
Valve spring weakened			O					
Piston rings worn/damaged				O		O		
Piston ring grooves worn/damaged				O		O		
Cooling system malfunctioning			O					Gr14
Engine oil quantity excessive				O				Gr12
Major moving parts seized			O		O			Gr11
Uneven or excessive fuel injection			O					Gr13

ON-VEHICLE INSPECTION AND ADJUSTMENT

1. Measurement and Adjustment of Turbocharger Boost Pressure

Service standards

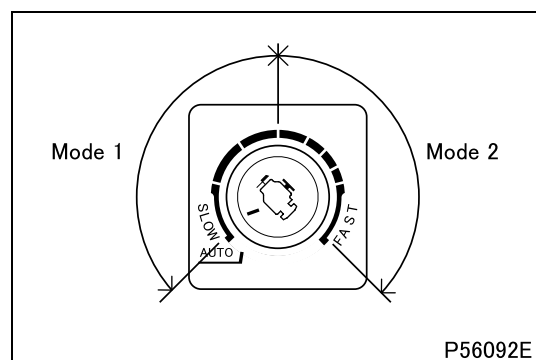
Location	Maintenance item	Standard value	Limit	Remedy
—	Boost pressure (when VGT test performed with ambient temperature at 25°C and atmospheric pressure at 101.5 kPa)	157 ± 7 kPa	—	Adjust

(1) Preparation

- Put the transmission in N range.
- Turn the steering wheel in neutral position.
- Turn off all lamps and accessories.
- Connect the Multi-Use Tester.
- Check diagnosis code of each electronic control system. If any fault exists, rectify it.
- Warm up the engine until the engine coolant has been heated to more than 60°C. (verify from Service Data “2E: Water Temperature”)
- Check that the non-load minimum speed (idling speed) is as specified. (See Gr13.)

(2) Measurement and correction of boost pressure

- Turn the idle adjust dial to any position within the illustrated range of Mode 1.
- Select [Engine Control] on the system select screen of the Multi-Use Tester, then execute [BA: VGT Test] from [Actuator Tests].
- When [BA: VGT Test] is executed, the engine speed should be automatically increased to 1600 rpm (No. 2 magnetic valve activated).
- Maintain the state of [BA: VGT Test] having been executed (for 5 to 15 minutes) until boost pressure is stabilized.
- Measure the following items from among [Service Data].
 - 26: Boost pressure (actual boost pressure)
 - 2B: Intake air temperature (actual intake air temperature)
 - 30: Atmospheric pressure (actual atmospheric pressure)
- Obtain corrected boost pressure by calculating above Service Data.



[Correction with intake air temperature]

Corrected boost pressure [kPa] = Measured boost pressure + 0.43
(measured intake air temperature - 25)

[Correction with boost temperature (Exhaust gas recirculation temperature)]

Corrected boost pressure [kPa] = Measured boost pressure + 0.02
(measured boost temperature - 33)

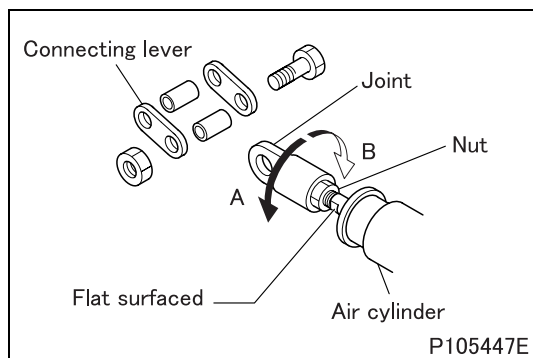
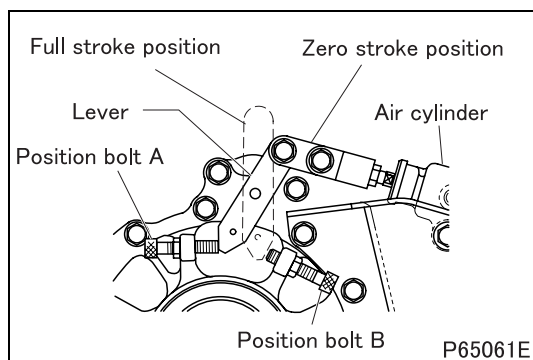
[Correction with atmospheric pressure]

Corrected boost pressure [kPa] = Measured boost pressure -
(measured atmospheric pressure - 101.5)

- If corrected boost pressure in any case above deviates from the standard value, adjust the turbocharger.

CAUTION

- If the adjusting range of the air cylinder shaft exceeds ±1.5 turns, check the turbocharger.



(3) Adjustment of turbocharger

WARNING

- The turbocharger is hot for a while after the engine is stopped. Take care not to burn yourself during adjustment work.

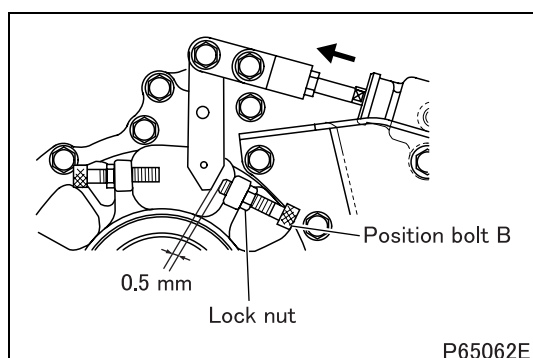
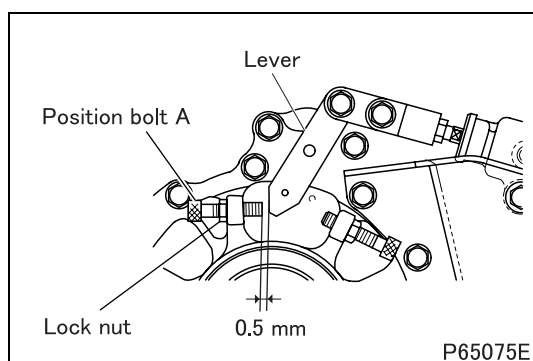
- To adjust the turbocharger, turn the joint.
- Make sure that the air cylinder is in the state of zero stroke when the engine is stopped.
- Loosen the position bolts A and B.

- Remove the connecting levers from the air cylinder joint.
- With a wrench put on the flats of the air cylinder shaft, loosen the nut.
- Turning the joint part of the air cylinder, adjust the length of the shaft.

Adjusting guide: One turn (with engine speed at 1600 rpm)	Direction A	Decreased by approx. 17 kPa
	Direction B	Increased by approx. 17 kPa

CAUTION

- If boost pressure exceeds the standard value, the engine may malfunction or break down. Boost pressure must be within the specified range.



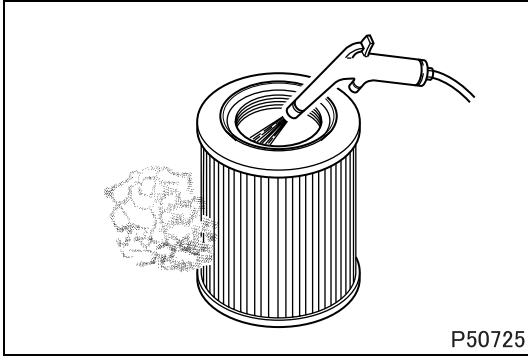
- After adjustment, secure the shaft with nut and refit the levers to the joint.
- Measure boost pressure again.
- If the boost pressure deviates from the standard value, readjust it.

- Make sure that the air cylinder is in the state of zero stroke when the engine is stopped.
- Tighten the position bolt A for the illustrated clearance between the bolt and lever.
- After adjustment, secure the bolt with the lock nut.

- Introduce specified pressure in the air cylinder from the port A, B, C to bring the air cylinder into the state of full stroke.
- Tighten the position bolt B for the illustrated clearance between the bolt and lever.
- After adjustment, secure the bolt with the lock nut.

ON-VEHICLE INSPECTION AND ADJUSTMENT

2. Cleaning and Inspection of Air Cleaner Element

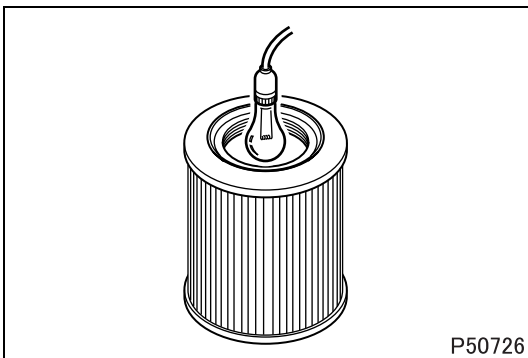


[Cleaning: Element]

- Blow a jet of compressed air at a pressure not higher than 685 kPa {7 kgf/cm²} against the inside surfaces of the element.

CAUTION

- For the frequency and timing of cleaning, refer to the relevant instruction manual. More frequent cleaning than necessary could damage the element or cause dust and foreign matter to be sucked into the engine.
- Do not strike the element or hit it against another object to remove dust.
- Do not blow compressed air against outside surfaces of the element.



[Inspection: Element]

- Shine some electric light inside the element.
 - Replace the element if thin spots or broken parts are evident in the filter paper, or if the packing at the top of the element is damaged.
- Also replace the element if the dust on the element is damp with oily smoke or soot, regardless of the replacement schedule.

3. Check for Looseness in Intake Manifold Mounting Bolts and Nuts

- Check for looseness in the intake manifold and air inlet pipe mounting bolts and nuts. If there is looseness, tighten the bolts and nuts to the specified torque. (See "INTAKE MANIFOLD".)

4. Check for Cracks and Gas Leakage in Exhaust Manifold

- Inspect the exhaust manifold visually. If there is any trace of gas leakage or cracks, replace the exhaust manifold. (See "EXHAUST MANIFOLD".)
- Check for looseness in the exhaust manifold mounting nuts. If there is looseness, tighten the nuts to the specified torque. (See "EXHAUST MANIFOLD".)

5. Check for Cracks and Gas Leakage in Turbocharger

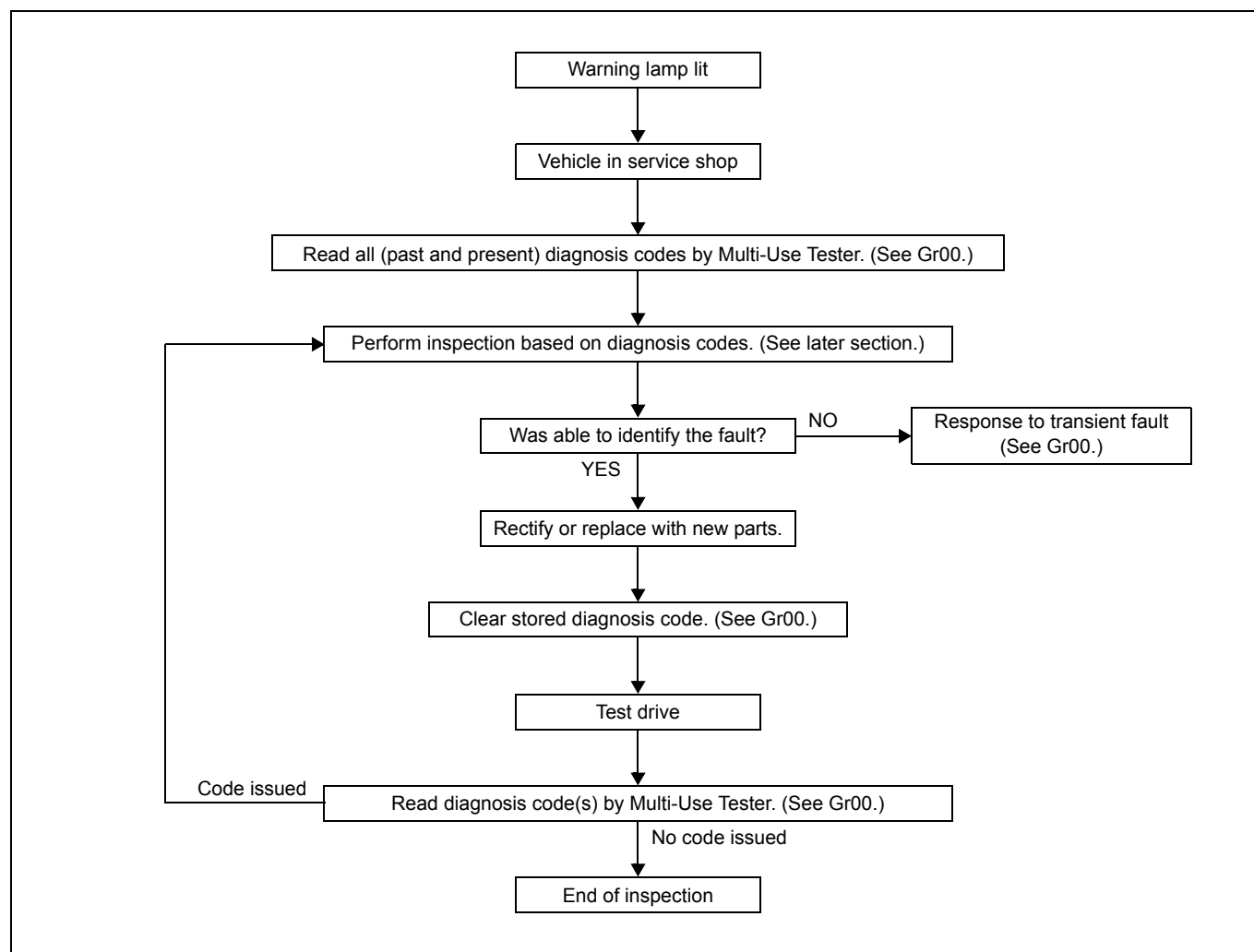
- Inspect the turbocharger visually. If there is any trace of gas leakage or cracks, replace the turbocharger. (See "TURBOCHARGER".)
- Check for looseness in the turbocharger mounting bolts and nuts. If there is looseness, tighten the bolts and nuts to the specified torque. (See "TURBOCHARGER".)

M E M O

TURBOCHARGER CONTROL SYSTEM

1. Diagnosis Procedure

- Perform the inspection in accordance with the following flowchart.



2. Diagnostic Precautions

- Before measuring voltage, check the battery for charged condition and specific gravity. If system inspection is performed with the battery uncharged or reduced in specific gravity, accurate measurements cannot be achieved.
- Before disconnecting battery cables, harnesses and connectors, set the starter switch to LOCK or OFF, then allow at least 20 seconds.
- To avoid having electrical parts damaged, set the starter switch and lighting switch to LOCK or OFF before reconnecting battery cables, harnesses and connectors.
- When performing measurement with the tester, handle the test bar carefully so that it does not damage internal circuit and other electrical parts of the electronic control unit to result in a short-circuit failure between terminals in connector or between connector and car body.
- Resistance is affected by temperature. Determine the necessity of resistance measurement following given temperature specification as a guide. Otherwise, use normal temperature (10 to 35°C) as the measuring condition.

3. Inspections Based on Diagnosis Codes

3.1 Diagnosis code list

- Diagnosis codes shown by the Multi-Use Tester and those indicated by flashing of the warning lamp are different.
- The Multi-Use Tester is capable of showing more detailed diagnosis codes.

Code	Message	Warning lamp indication		
		Flashes	Red	Orange
P0234	Over Boost	54	—	O
P1130	VGT1	51	—	O
P1132	VGT1	51	—	O
P1133	VGT1	51	—	O
P1135	VGT2	52	—	O
P1137	VGT2	52	—	O
P1138	VGT2	52	—	O
P1140	VGT3	53	—	O
P1142	VGT3	53	—	O
P1143	VGT3	53	—	O
P1236	Turbine Revolution SNSR (Low)	57	—	O
P1237	Turbine Revolution SNSR (High)	57	—	O
P1238	Turbine Overrunning	59	—	O

3.2 Diagnosis code generation conditions and inspection items

P0234: Over Boost (warning lamp flashes: 54)

Generation condition		Boost pressure remaining above the specified value for 10 seconds is repeated five times when engine speed is at 600 rpm up to 2300 rpm.
Recoverability		• In the case of above problem • System recovers if boost pressure is below the specified value when engine speed is at 600 rpm up to 2300 rpm. • In the case where above problem is repeated five more times • System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF (2 minutes or more) → ON.
Control effected by electronic control unit		• In the case of above problem • No specific control is effected. • In the case where above problem is repeated five more times • Injection quantity is limited. (Output is reduced, and exhaust emissions worsen.)
Inspection	Service data	26: Boost Pressure
	Other	Turbocharger

TURBOCHARGER CONTROL SYSTEM

P1130: VGT1 (warning lamp flashes: 51)

Generation condition		Current flowing in the turbocharger magnetic valve (No. 1 magnetic valve) remains above the specified value for 1 second.
Recoverability		System recovers when current flowing in the turbocharger magnetic valve (No. 1 magnetic valve) becomes normal for 1 second.
Control effected by electronic control unit		• Turbocharger control is stopped. • Exhaust gas recirculation control is stopped. • Auto cruise control is stopped. • Injection quantity is limited. (Output is reduced, and exhaust emissions worsen.) • Actuator test "BA: VGT Test" is stopped.
Inspection	Service data	21: VGT position, 82: VGT M/V1
	Actuator test	A9: VGT1
	Electrical equipment	#566: Turbocharger magnetic valve
	Electric circuit diagram	Turbocharger magnetic valve (No. 1 magnetic valve) system

P1132: VGT1 (warning lamp flashes: 51)

Generation condition		Turbocharger magnetic valve (No. 1 magnetic valve) circuit shorted to ground or open-circuited (low level when turned OFF) as detected for 1 second.
Recoverability		System recovers when current flowing in the turbocharger magnetic valve (No. 1 magnetic valve) becomes normal (high level when turned OFF) for 1 second.
Control effected by electronic control unit		• Turbocharger control is stopped. • Exhaust gas recirculation control is stopped. • Auto cruise control is stopped. • Injection quantity is limited. (Output is reduced, and exhaust emissions worsen.) • Actuator test "BA: VGT Test" is stopped.
Inspection	Service data	21: VGT position, 82: VGT M/V1
	Actuator test	A9: VGT1
	Electrical equipment	#566: Turbocharger magnetic valve
	Electric circuit diagram	Turbocharger magnetic valve (No. 1 magnetic valve) system

P1133: VGT1 (warning lamp flashes: 51)

Generation condition		Turbocharger magnetic valve (No. 1 magnetic valve) circuit shorted to battery (high level when turned ON) as detected for 1 second.
Recoverability		System recovers when current flowing in the turbocharger magnetic valve (No. 1 magnetic valve) becomes normal (low level when turned ON) for 1 second.
Control effected by electronic control unit		• Turbocharger control is stopped. • Exhaust gas recirculation control is stopped. • Auto cruise control is stopped. • Injection quantity is limited. (Output is reduced, and exhaust emissions worsen.) • Actuator test "BA: VGT Test" is stopped.
Inspection	Service data	21: VGT position, 82: VGT M/V1
	Actuator test	A9: VGT1
	Electrical equipment	#566: Turbocharger magnetic valve
	Electric circuit diagram	Turbocharger magnetic valve (No. 1 magnetic valve) system

P1135: VGT2 (warning lamp flashes: 52)

Generation condition		Current flowing in the turbocharger magnetic valve (No. 2 magnetic valve) remains above the specified value for 1 second.
Recoverability		System recovers when current flowing in the turbocharger magnetic valve (No. 2 magnetic valve) becomes normal for 1 second.
Control effected by electronic control unit		• Turbocharger control is stopped. • Exhaust gas recirculation control is stopped. • Auto cruise control is stopped. • Injection quantity is limited. (Output is reduced, and exhaust emissions worsen.) • Actuator test "BA: VGT Test" is stopped.
Inspection	Service data	21: VGT position, 83: VGT M/V2
	Actuator test	AA: VGT2
	Electrical equipment	#566: Turbocharger magnetic valve
	Electric circuit diagram	Turbocharger magnetic valve (No. 2 magnetic valve) system

P1137: VGT2 (warning lamp flashes: 52)

Generation condition		Turbocharger magnetic valve (No. 2 magnetic valve) circuit shorted to ground or open-circuited (low level when turned OFF) as detected for 1 second.
Recoverability		System recovers when current flowing in the turbocharger magnetic valve (No. 2 magnetic valve) becomes normal (high level when turned OFF) for 1 second.
Control effected by electronic control unit		• Turbocharger control is stopped. • Exhaust gas recirculation control is stopped. • Auto cruise control is stopped. • Injection quantity is limited. (Output is reduced, and exhaust emissions worsen.) • Actuator test "BA: VGT Test" is stopped.
Inspection	Service data	21: VGT position, 83: VGT M/V2
	Actuator test	AA: VGT2
	Electrical equipment	#566: Turbocharger magnetic valve
	Electric circuit diagram	Turbocharger magnetic valve (No. 2 magnetic valve) system

P1138: VGT2 (warning lamp flashes: 52)

Generation condition		Turbocharger magnetic valve (No. 2 magnetic valve) circuit shorted to battery (high level when turned ON) as detected for 1 second.
Recoverability		System recovers when current flowing in the turbocharger magnetic valve (No. 2 magnetic valve) becomes normal (low level when turned ON) for 1 second.
Control effected by electronic control unit		• Turbocharger control is stopped. • Exhaust gas recirculation control is stopped. • Auto cruise control is stopped. • Injection quantity is limited. (Output is reduced, and exhaust emissions worsen.) • Actuator test "BA: VGT Test" is stopped.
Inspection	Service data	21: VGT position, 83: VGT M/V2
	Actuator test	AA: VGT2
	Electrical equipment	#566: Turbocharger magnetic valve
	Electric circuit diagram	Turbocharger magnetic valve (No. 2 magnetic valve) system

TURBOCHARGER CONTROL SYSTEM

P1140: VGT3 (warning lamp flashes: 53)

Generation condition		Current flowing in the turbocharger magnetic valve (No. 3 magnetic valve) remains above the specified value for 1 second.
Recoverability		System recovers when current flowing in the turbocharger magnetic valve (No. 3 magnetic valve) becomes normal for 1 second.
Control effected by electronic control unit		• Turbocharger control is stopped. • Exhaust gas recirculation control is stopped. • Auto cruise control is stopped. • Injection quantity is limited. (Output is reduced, and exhaust emissions worsen.) • Actuator test "BA: VGT Test" is stopped.
Inspection	Service data	21: VGT position, 84: VGT M/V3
	Actuator test	AB: VGT3
	Electrical equipment	#566: Turbocharger magnetic valve
	Electric circuit diagram	Turbocharger magnetic valve (No. 3 magnetic valve) system

P1142: VGT3 (warning lamp flashes: 53)

Generation condition		Turbocharger magnetic valve (No. 3 magnetic valve) circuit shorted to ground or open-circuited (low level when turned OFF) as detected for 1 second.
Recoverability		System recovers when current flowing in the turbocharger magnetic valve (No. 3 magnetic valve) becomes normal (high level when turned OFF) for 1 second.
Control effected by electronic control unit		• Turbocharger control is stopped. • Exhaust gas recirculation control is stopped. • Auto cruise control is stopped. • Injection quantity is limited. (Output is reduced, and exhaust emissions worsen.) • Actuator test "BA: VGT Test" is stopped.
Inspection	Service data	21: VGT position, 84: VGT M/V3
	Actuator test	AB: VGT3
	Electrical equipment	#566: Turbocharger magnetic valve
	Electric circuit diagram	Turbocharger magnetic valve (No. 3 magnetic valve) system

P1143: VGT3 (warning lamp flashes: 53)

Generation condition		Turbocharger magnetic valve (No. 3 magnetic valve) circuit shorted to battery (high level when turned ON) as detected for 1 second.
Recoverability		System recovers when current flowing in the turbocharger magnetic valve (No. 3 magnetic valve) becomes normal (low level when turned ON) for 1 second.
Control effected by electronic control unit		• Turbocharger control is stopped. • Exhaust gas recirculation control is stopped. • Auto cruise control is stopped. • Injection quantity is limited. (Output is reduced, and exhaust emissions worsen.) • Actuator test "BA: VGT Test" is stopped.
Inspection	Service data	21: VGT position, 84: VGT M/V3
	Actuator test	AB: VGT3
	Electrical equipment	#566: Turbocharger magnetic valve
	Electric circuit diagram	Turbocharger magnetic valve (No. 3 magnetic valve) system

P1236: Turbine Revolution SNSR (Low) (warning lamp flashes: 57)

Generation condition		Turbine speed remains 3000 rpm or less for 10 seconds when engine speed is 1000 rpm or more.
Recoverability		System recovers if turbine speed remains higher than 3000 rpm for 1 second when engine speed is 1000 rpm or more.
Control effected by electronic control unit		No specific control is effected.
Inspection	Service data	2A: Turbine Revolution
	Electrical equipment	#835: Turbine speed sensor and pulse converter
	Electric circuit diagram	Turbine speed sensor and pulse converter system

P1237: Turbine Revolution SNSR (High) (warning lamp flashes: 57)

Generation condition		Turbine speed remains 125000 rpm or more for 10 seconds.
Recoverability		System recovers when turbine speed remains less than 125000 rpm for 1 second.
Control effected by electronic control unit		Turbocharger control is stopped.
Inspection	Service data	2A: Turbine Revolution
	Electrical equipment	#835: Turbine speed sensor and pulse converter
	Electric circuit diagram	Turbine speed sensor and pulse converter system

P1238: Turbine Overrunning (warning lamp flashes: 59)

Generation condition		Turbine speed remains 105000 rpm or more for 1 second.
Recoverability		System recovers if signal becomes normal when starter switch is turned from OFF (2 minutes or more) to ON (power supply resumed to electronic control unit).
Control effected by electronic control unit		• Injection quantity is stopped. (Output is reduced, and exhaust emissions worsen.) • Exhaust gas recirculation control is stopped.
Inspection	Service data	2A: Turbine Revolution
	Electrical equipment	#835: Turbine speed sensor and pulse converter
	Electric circuit diagram	Turbine speed sensor and pulse converter system
	Other	Turbocharger unit

TURBOCHARGER CONTROL SYSTEM

4. Multi-Use Tester Service Data

- It is possible to see service data and actuator tests simultaneously.

No.	Item	Data	Inspection condition	Requirement
21	VGT Position	■■■■.■%	VGT opening degrees displayed according to VGT M/V operations shown below.	
26	Boost Pressure	■■■■.■ kPa	Starter switch ON (engine is stopped)	Value matches atmospheric pressure indication.
			Accelerator pedal pressed after engine has started	Value gradually increases.
2A	Turbine Revolution	■■■■.rpm	Engine speed: 2280 to 2320 rpm	50000 to 80000 rpm
82	VGT M/V1	ON/OFF	No. 1 magnetic valve ON	ON
			No. 1 magnetic valve OFF	OFF
			[Actuator test] A9: VGT1	
83	VGT M/V2	ON/OFF	No. 2 magnetic valve ON	ON
			No. 2 magnetic valve OFF	OFF
			[Actuator test] AA: VGT2	
84	VGT M/V3	ON/OFF	No. 3 magnetic valve ON	ON
			No. 3 magnetic valve OFF	OFF
			[Actuator test] AB: VGT3	

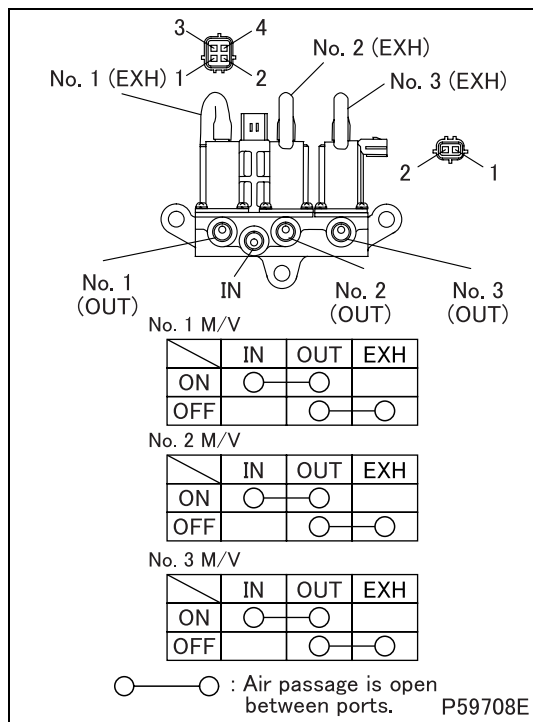
VGT opening (%)	0 to 12.5	to 25	to 37.5	to 50	to 62.5	to 75	to 87.5	to 100
M/V1	ON	OFF	ON	OFF	ON	OFF	ON	OFF
M/V2	ON	ON	OFF	OFF	ON	ON	OFF	OFF
M/V3	ON	ON	ON	ON	OFF	OFF	OFF	OFF

5. Actuator Tests by Multi-Use Tester

- It is possible to see service data and actuator tests simultaneously.

No.	Item	Description	Check method
A9	VGTM/V1	No. 1 magnetic valve activated	Magnetic valve operating sound [Service data] 82: VGT M/V1
AA	VGTM/V2	No. 2 magnetic valve activated	Magnetic valve operating sound [Service data] 83: VGT M/V2
AB	VGTM/V3	No. 3 magnetic valve activated	Magnetic valve operating sound [Service data] 84: VGT M/V3
BA	VGT Test	Used for turbo boost pressure measurement/adjustment	See On-Vehicle Inspection and Adjustment.

6. Inspection of Electrical Equipment



#566 Inspection of turbocharger magnetic valve

- Perform the following tests on the turbocharger magnetic valve. Replace the valve if found faulty.

(1) Valve activation test

- Gradually increasing from 0 V, apply voltage to the turbocharger magnetic valve between the following terminals.

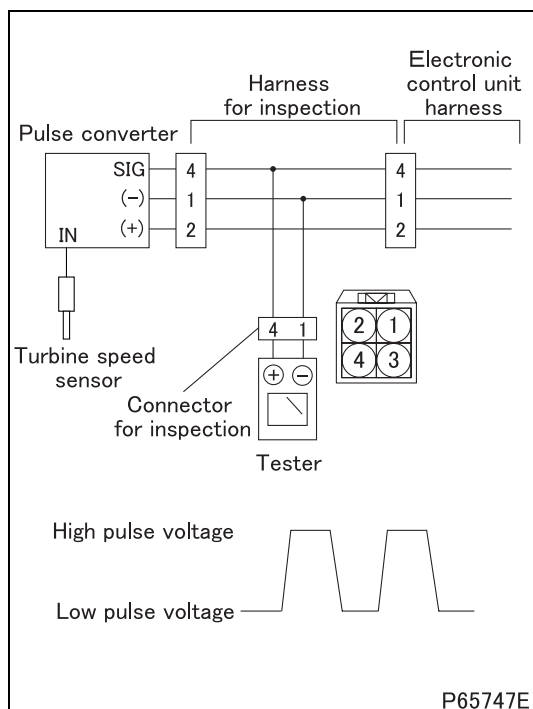
Terminals	4-pin connector	1-3	No. 1 magnetic valve
		2-4	No. 2 magnetic valve
	2-pin connector	1-2	No. 3 magnetic valve

- Measure voltage when turbocharger magnetic valve is activated. (Listen to the operating sound for ON/OFF of the magnet valve.)

Reference value (minimum activation voltage)	18 V or less
---	--------------

(2) Continuity and air tight test

- Test air pressure: 981 kPa {10 kgf/cm²}



#835 Inspection of turbine speed sensor and pulse converter unit

- Test the turbine speed sensor and pulse converter unit as connected to the turbocharger.
- Disconnect the turbine speed sensor and pulse converter unit from the electronic control unit harness at connectors. Then, prepare and fit the test harness in place.
- The sensor does not respond to manual rotation of the turbocharger compressor wheel. To make the sensor responsive, start the engine to be idling.
- Measure the maximum level (high-pulse voltage) and minimum level (low-pulse voltage) of voltage appearing between test connector terminals 4 and 1.

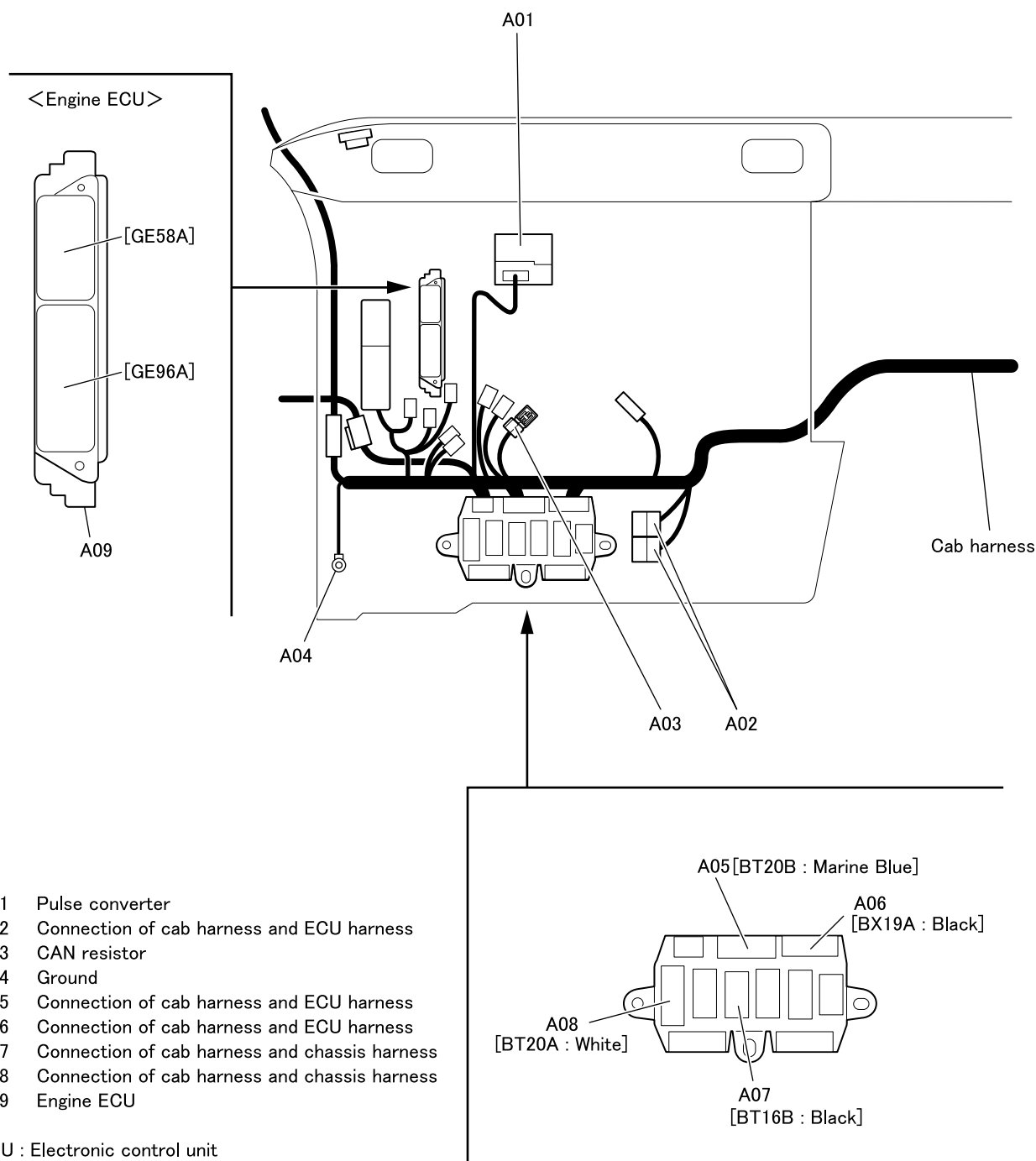
Standard value	Low-pulse voltage	0 V
	High-pulse voltage	5 V

- If the measurement deviates the standard value, replace the turbine speed sensor and pulse converter unit.

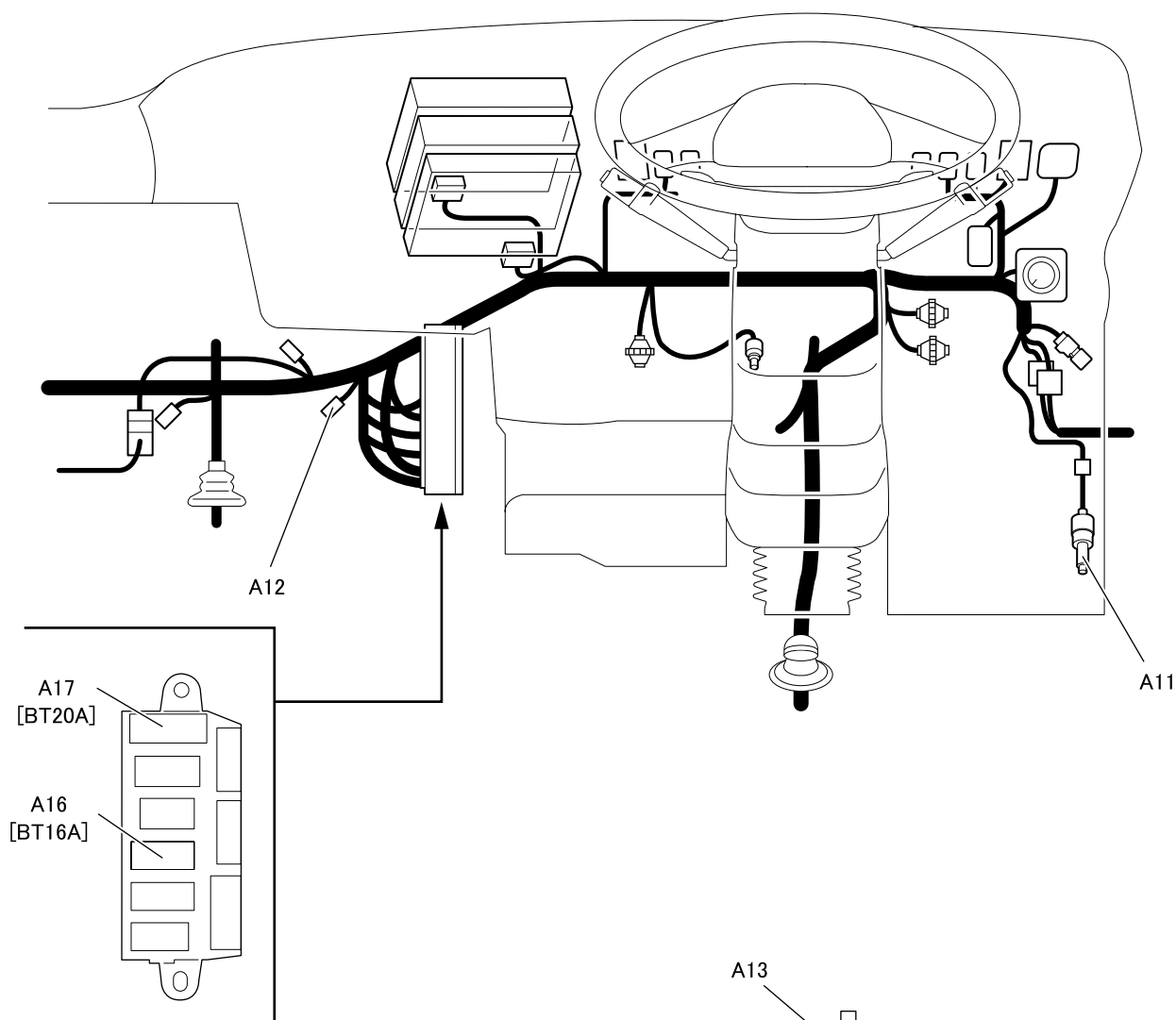
TURBOCHARGER CONTROL SYSTEM

7. Installed Locations of Parts

A01 – 09



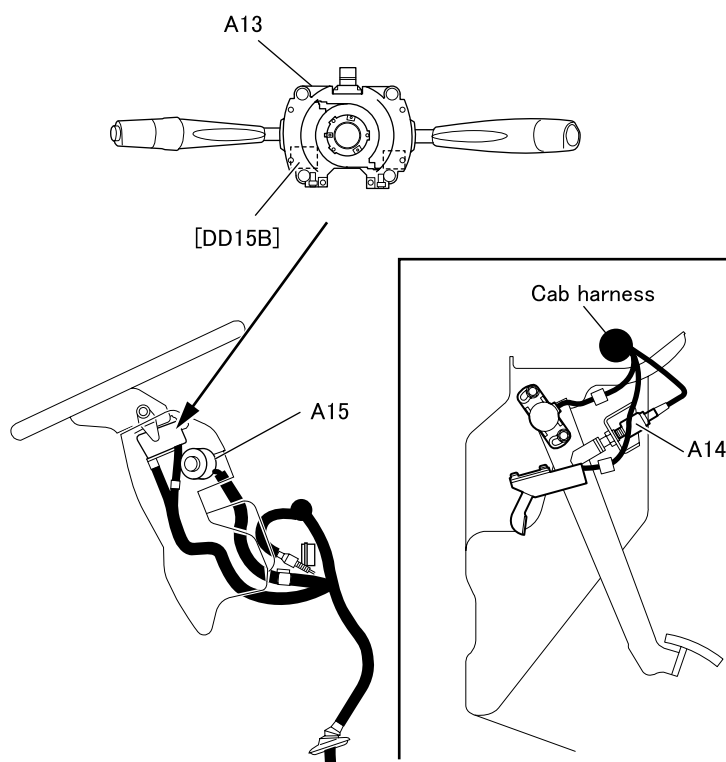
A11 - 17



- A11 Accelerator pedal switch
- A12 ECU main connector
- A13 Combination switch
- A14 Clutch switch
- A15 Starter switch
- A16 Connection of cab harness and instrument panel harness
- A17 Connection of cab harness and instrument panel harness

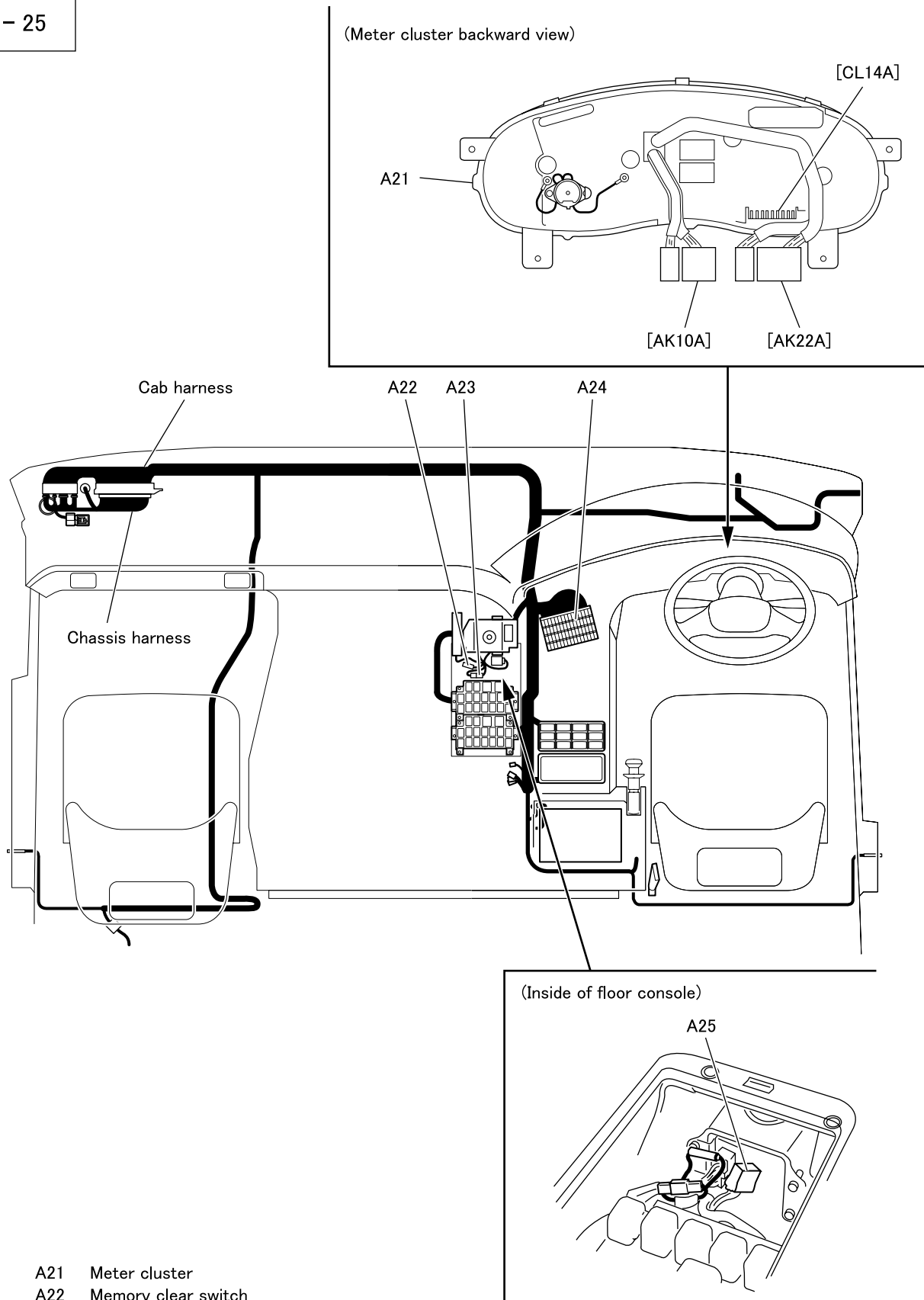
ECU : Electronic control unit

Indicate by connector type [].



TURBOCHARGER CONTROL SYSTEM

A21 – 25

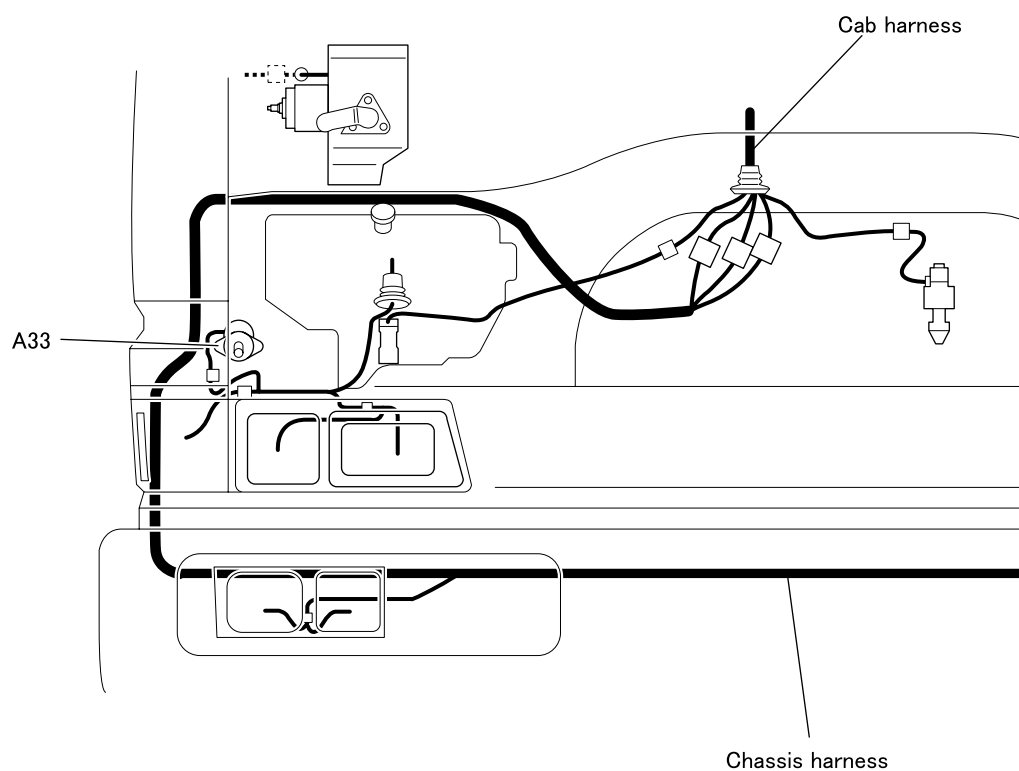
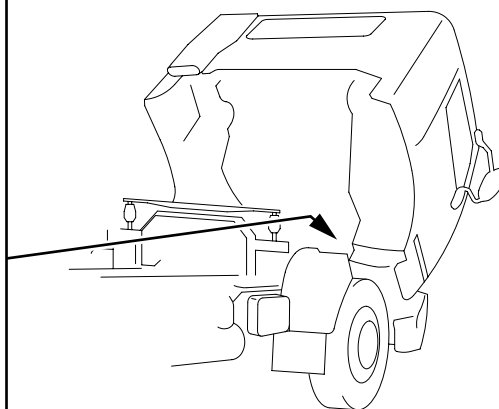
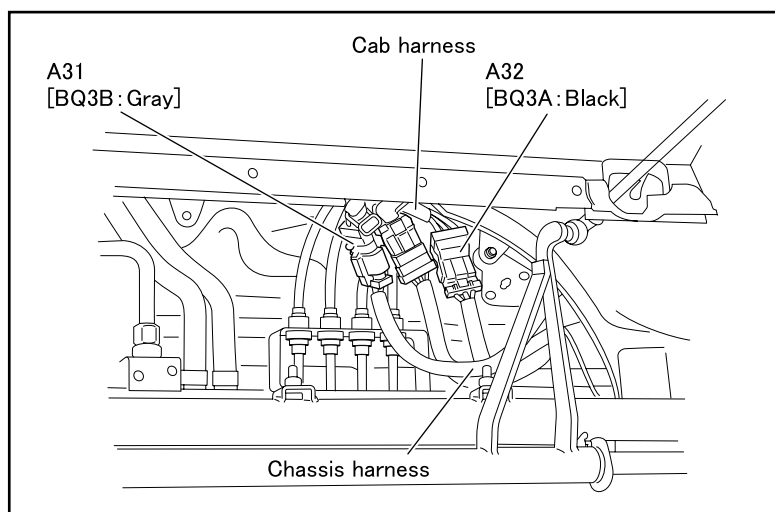


- A21 Meter cluster
- A22 Memory clear switch
- A23 Diagnosis switch
- A24 Fuse box
- A25 MUT connector

ECU : Electronic control unit
MUT : Multi-Use Tester

Indicate by connector type [].

A31 - 33



- A31 Connection of cab harness and chassis harness
- A32 Connection of cab harness and chassis harness
- A33 Accelerator pedal position sensor

Indicate by connector type and connector color [].

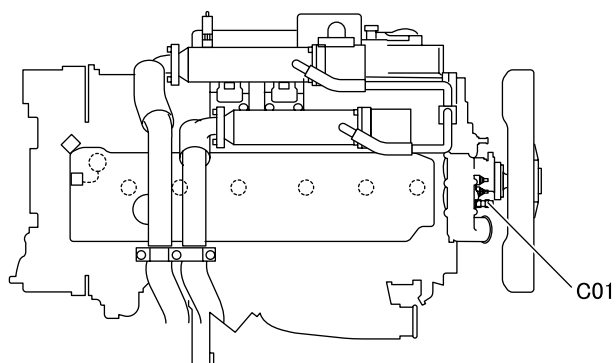
B01 - 05



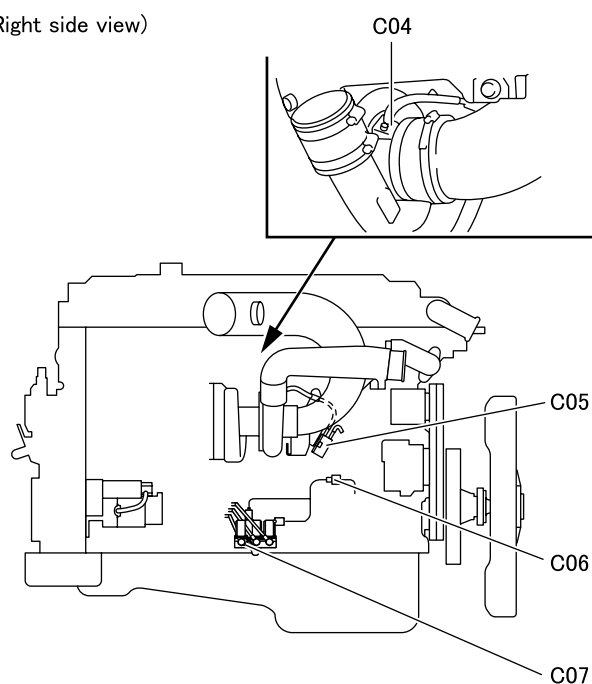
- | | |
|-----|-----------------------|
| B01 | High-current fuse box |
| B02 | Main power relay |
| B03 | Battery |
| B04 | Ground |
| B05 | Ground |

C01 - 07

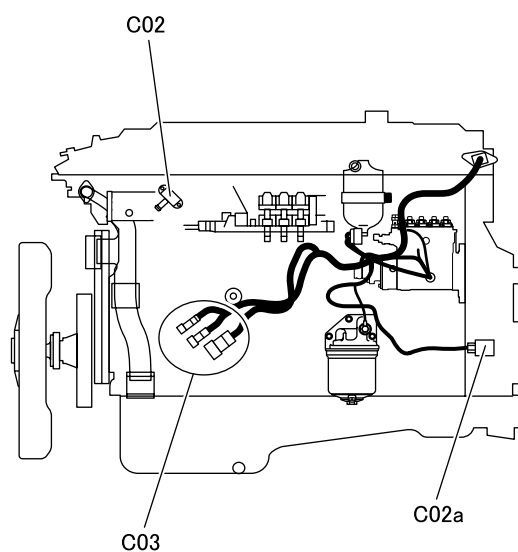
(Upper view)



(Right side view)



(Left side view)



- C01 Water temperature sensor
(connects to engine electronic control unit)
- C02 Boost pressure sensor
- C02a Engine speed sensor
- C03 Connection of engine harness and ECU harness
- C04 Turbine speed sensor
- C05 Pulse converter
- C06 Connection of ECU harness and VGT harness
- C07 Turbocharger magnetic valve

ECU : Electronic control unit

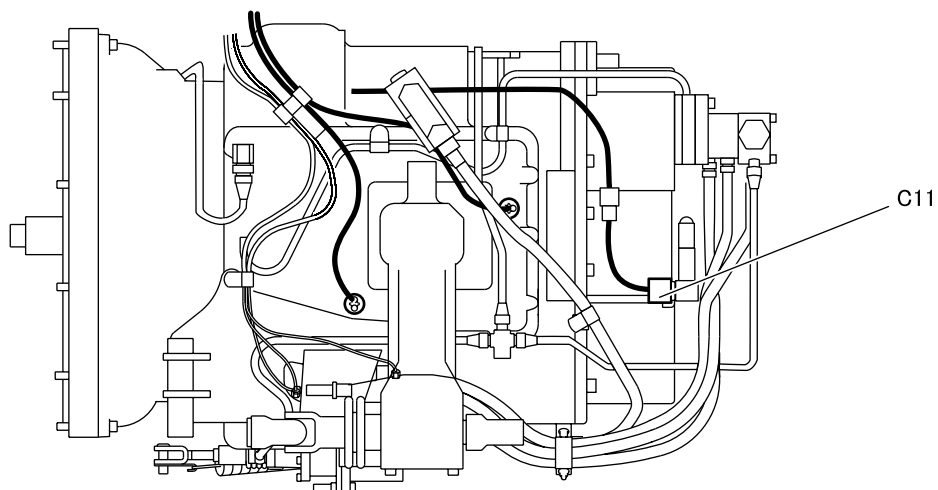
VGT : Variable geometry turbocharger

TURBOCHARGER CONTROL SYSTEM

C11

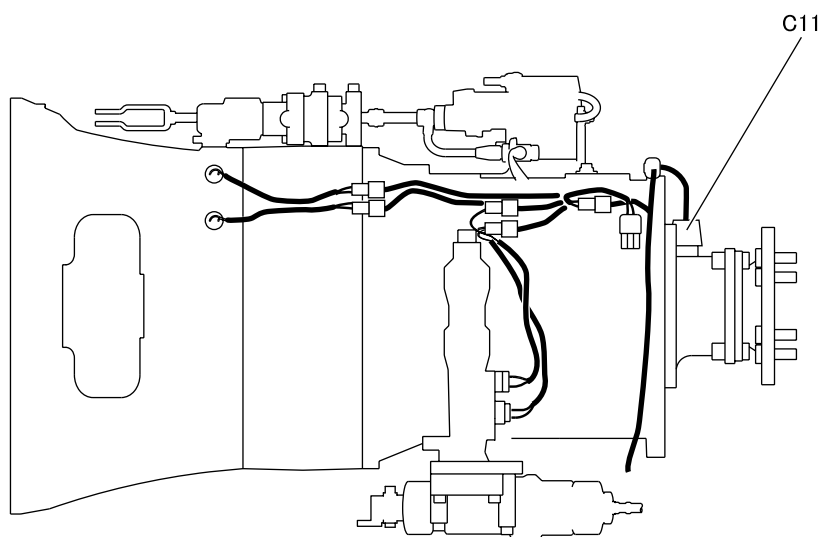
<FULLER>

(Upper view)



<M130S2 × 5>

(Upper view)

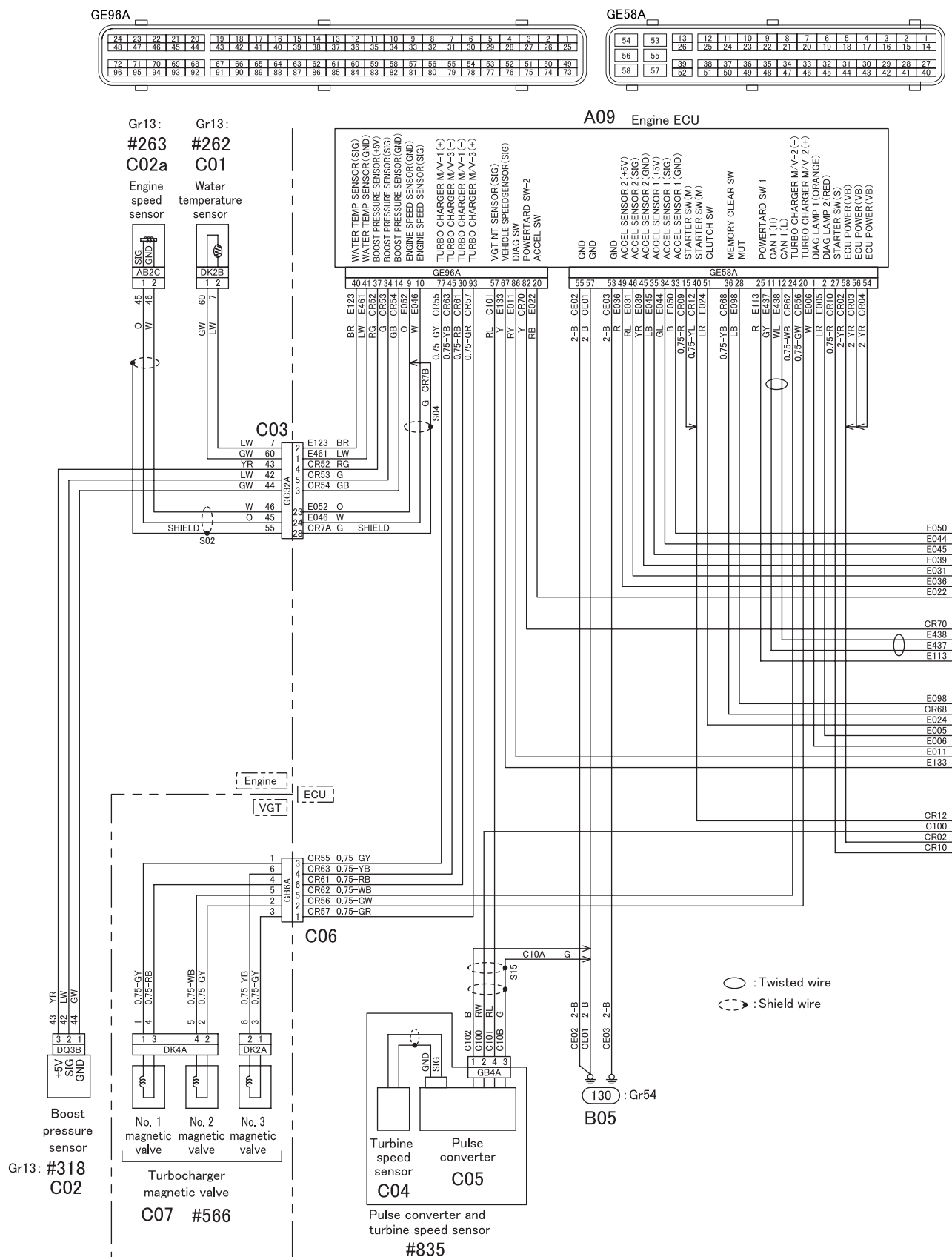


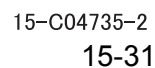
C11 Vehicle speed sensor

M E M O

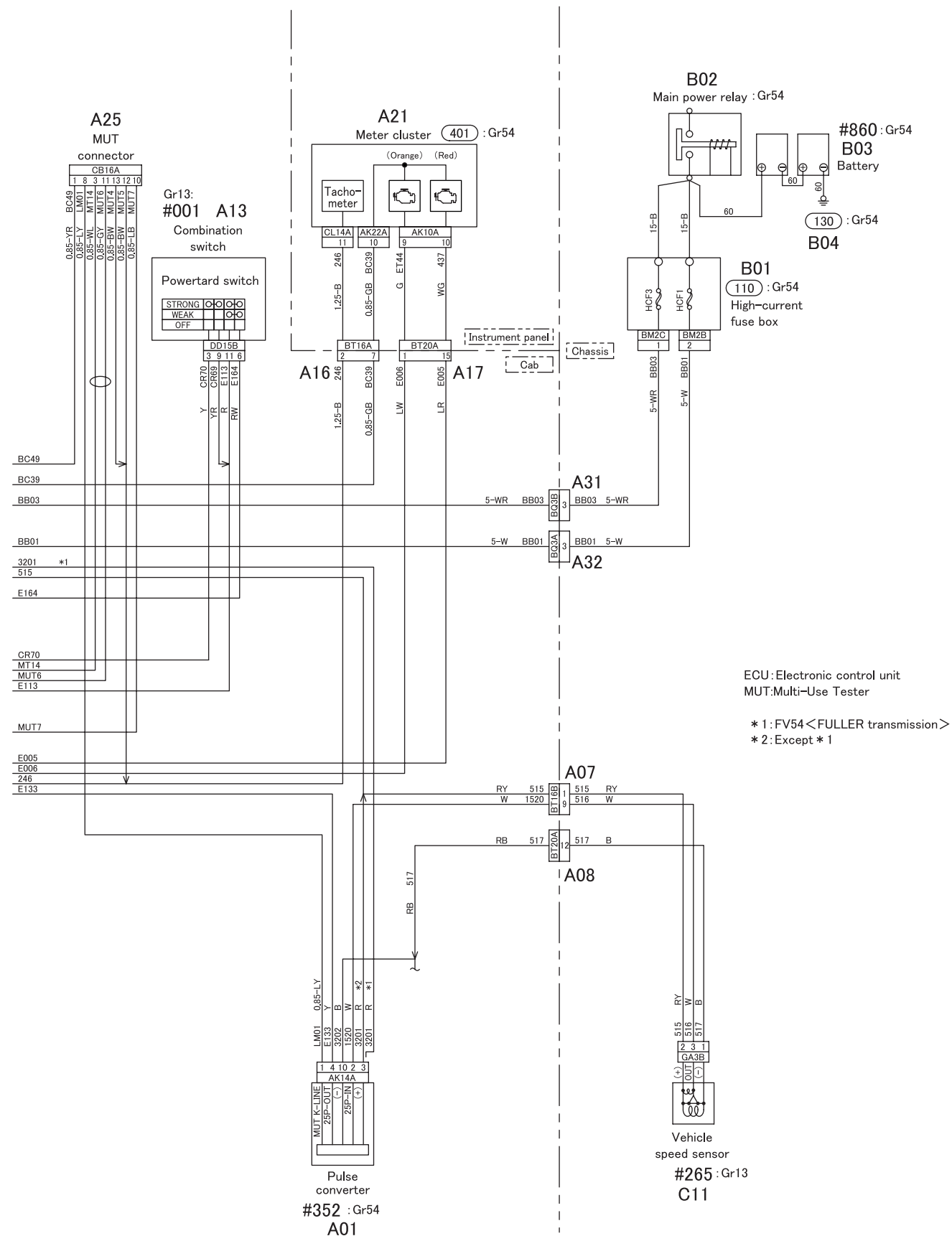
TURBOCHARGER CONTROL SYSTEM

8. Electric Circuit Diagram



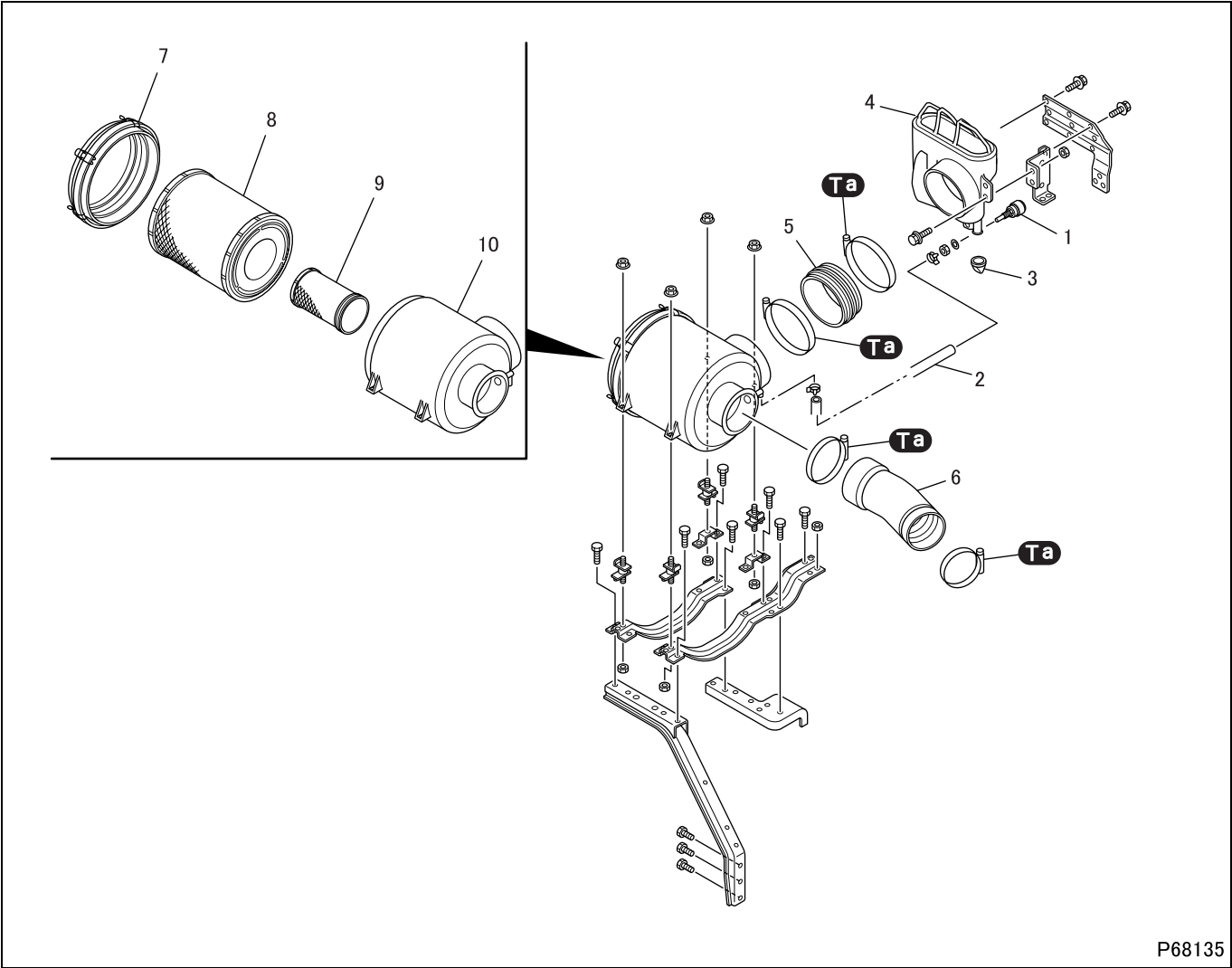


TURBOCHARGER CONTROL SYSTEM



M E M O

AIR CLEANER



● Removal sequence

- | | | |
|------------------|-------------------|------------------|
| 1 Dust indicator | 5 Duct joint hose | 9 Safety element |
| 2 Air tube | 6 Air intake hose | 10 Body |
| 3 Vacuator valve | 7 Cover | |
| 4 Lower air duct | 8 Outer element | |

CAUTION

- Do not remove the safty element except for replacement.
- Never clean the safty element.

● Installation sequence

Follow the removal sequence in reverse.

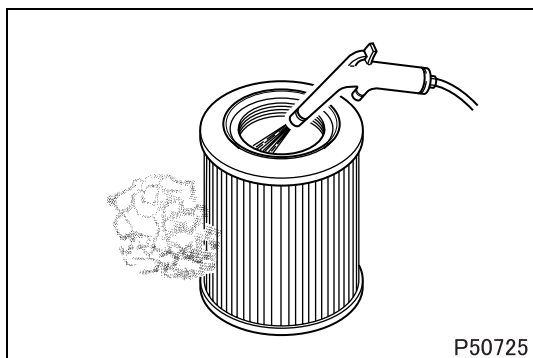
Service standards

Location	Maintenance item	Standard value	Limit	Remedy
1	Dust indicator activating negative pressure	9.12 ± 0.69 kPa {930 ± 70 mmH ₂ O}	—	Replace

Tightening torque (Unit: N·m {kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
	Clamp	3.0 to 3.5 {0.3 to 0.35}	—

◆ Cleaning procedure ◆



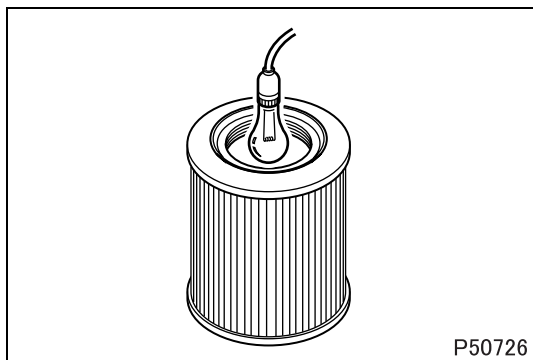
■ Cleaning: Element

- Blow a jet of compressed air at a pressure not higher than 685 kPa {7 kgf/cm²} against the inside surfaces of the element.

CAUTION ⚠

- For the frequency and timing of cleaning, refer to the relevant instruction manual. More frequent cleaning than necessary could damage the element or cause dust and foreign matter to be sucked into the engine.
- Do not strike the element or hit it against another object to remove dust.
- Do not blow compressed air against outside surfaces of the element.

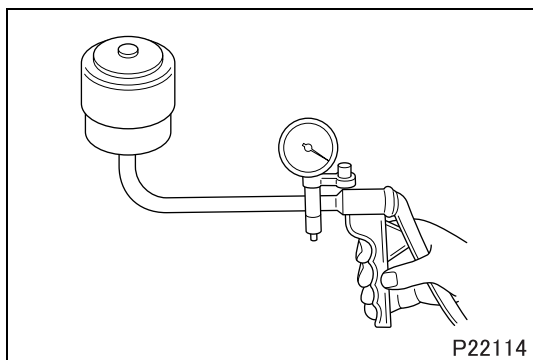
◆ Inspection procedure ◆



■ Inspection: Element

- Shine some electric light inside the element.
- Replace the element if thin spots or broken parts are evident in the filter paper, or if the packing at the top of the element is damaged.

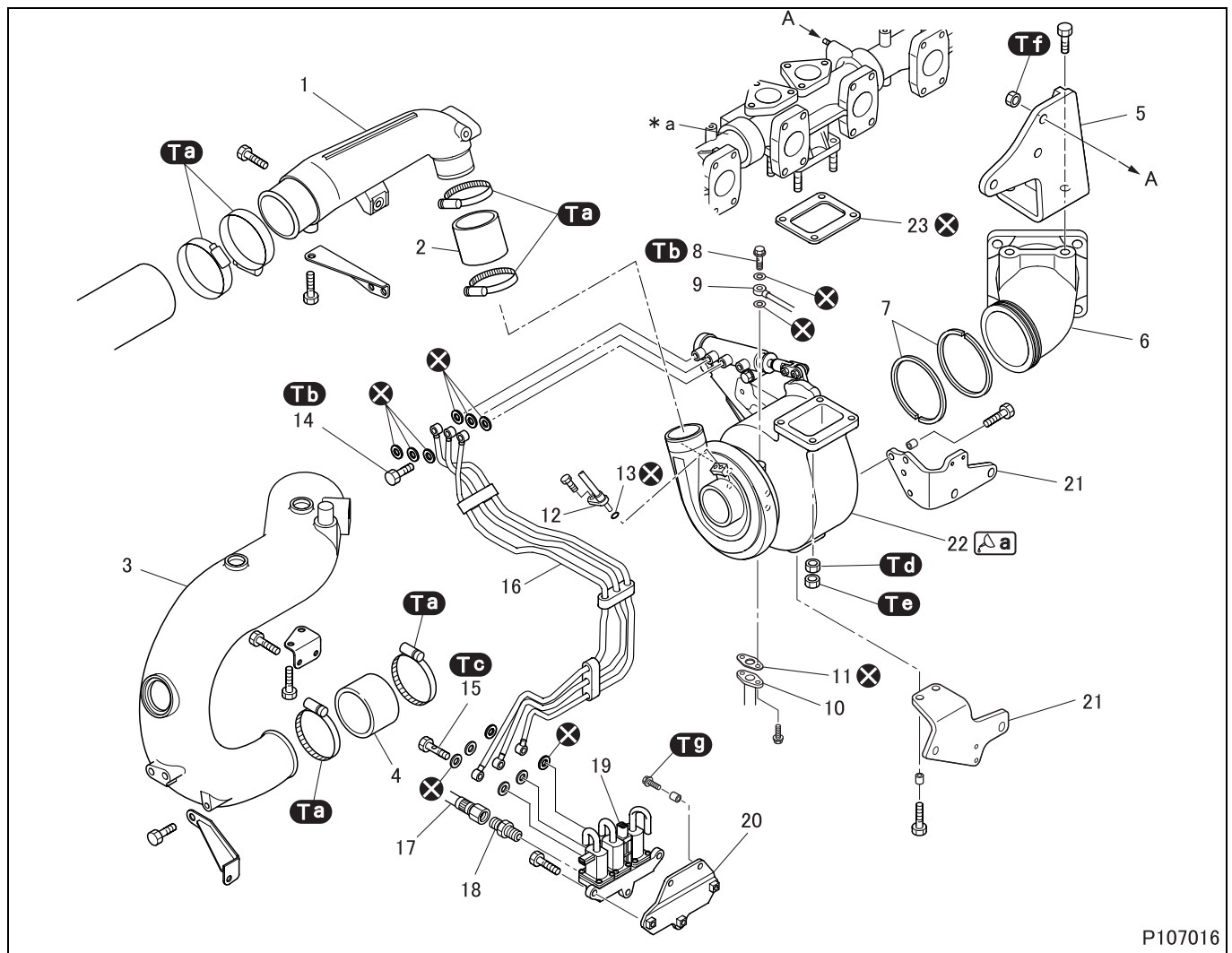
Also replace the element if the dust on the element is damp with oily smoke or soot, regardless of the replacement schedule.



■ Inspection: Operation of dust indicator under specified negative pressure

- Apply negative pressure to the dust indicator, and take the reading when the red signal appears in the dust indicator window.
- Replace the dust indicator if found faulty.

MITSUBISHI 6M70 TURBOCHARGER ATTACHING PARTS



● Removal sequence

- | | | |
|--------------------------------|--------------------------------|--|
| 1 Air inlet pipe | 11 Gasket | 20 Turbocharger magnetic valve bracket |
| 2 Air hose | 12 Turbine speed sensor | 21 Bracket |
| 3 Air pipe | 13 O-ring | 22 Turbocharger (See later section.) |
| 4 Air hose | 14 Eyebolt | 23 Gasket |
| 5 Turbocharger coupler bracket | 15 Eyebolt | |
| 6 Turbocharger coupler | 16 Air pipe | |
| 7 Seal ring | 17 Air hose | |
| 8 Eyebolt | 18 Connector | |
| 9 Oil feed pipe | 19 Turbocharger magnetic valve | |
| 10 Oil return pipe | | |
- *a: Exhaust manifold
 X: Non-reusable parts

● Installation sequence

Follow the removal sequence in reverse.

Mitsubishi 6M70 Engine Parts contact:
 email: EngineParts@HeavyEquipmentRestorationParts.com
 Phone: 269 673 1638

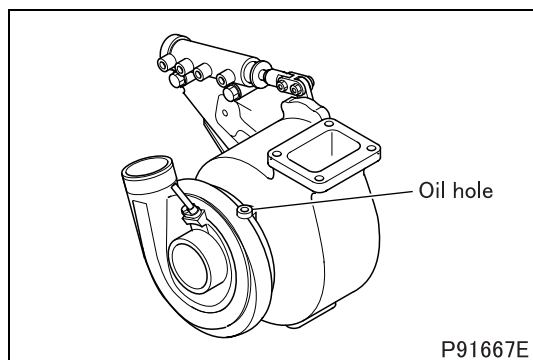
Mitsubishi 6M70 Tightening torque (Unit: N·m {kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Clamp	7.0 to 8.0 {0.7 to 0.8}	—
Tb	Eyebolt (oil pipe mounting)	21 {2.1}	—
	Eyebolt (air pipe mounting)		
Tc	Eyebolt (air pipe mounting)	25 {2.5}	—
Td	Nut (turbocharger mounting)	36 {3.7}	—
Te	Nut (turbocharger mounting)	45 {4.6}	—
Tf	Nut (turbocharger coupler bracket mounting)	90 {9.0}	—
Tg	Bolt (turbocharger magnetic valve bracket mounting)	75 {7.6}	—

Lubricant and/or sealant

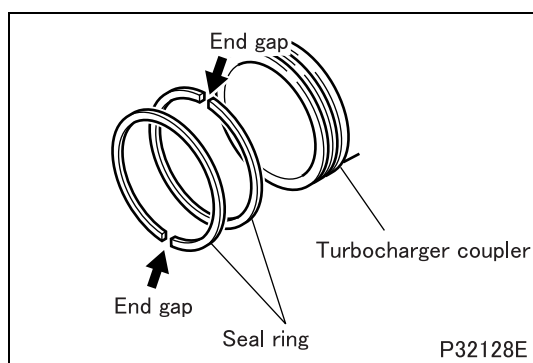
Mark	Points of application	Specified lubricant and/or sealant	Quantity
	Turbocharger (to be filled with engine oil)	Engine oil	As required

◆ Installation procedure ◆



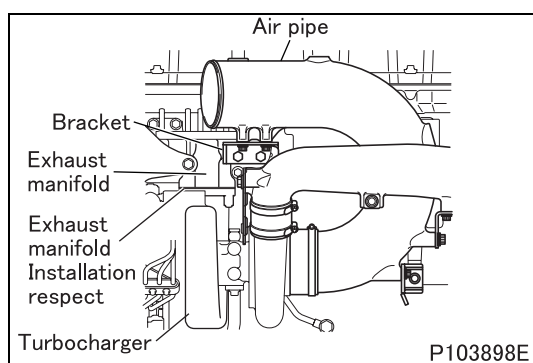
■ Installation: Mitsubishi 6M70 Turbocharger

- Before installing the turbocharger assembly, pour engine oil into the oil hole of the bearing housing to ensure smooth operation of the internal parts.



■ Installation: Mitsubishi 6M70 Seal ring

- Fit the seal rings onto the turbocharger coupler, with their end gaps positioned 180 degrees apart from each other.



■ Installation: Bracket

- Temporarily tighten the bracket on the air pipe and exhaust manifold.
- Tighten the bolts after temporary tightening while ensuring that there is no clearance at the joints between the bracket and air pipe, and bracket and exhaust manifold.
- After installing the bracket, ensure that there is no gas leakage from the joint of turbocharger with exhaust manifold.

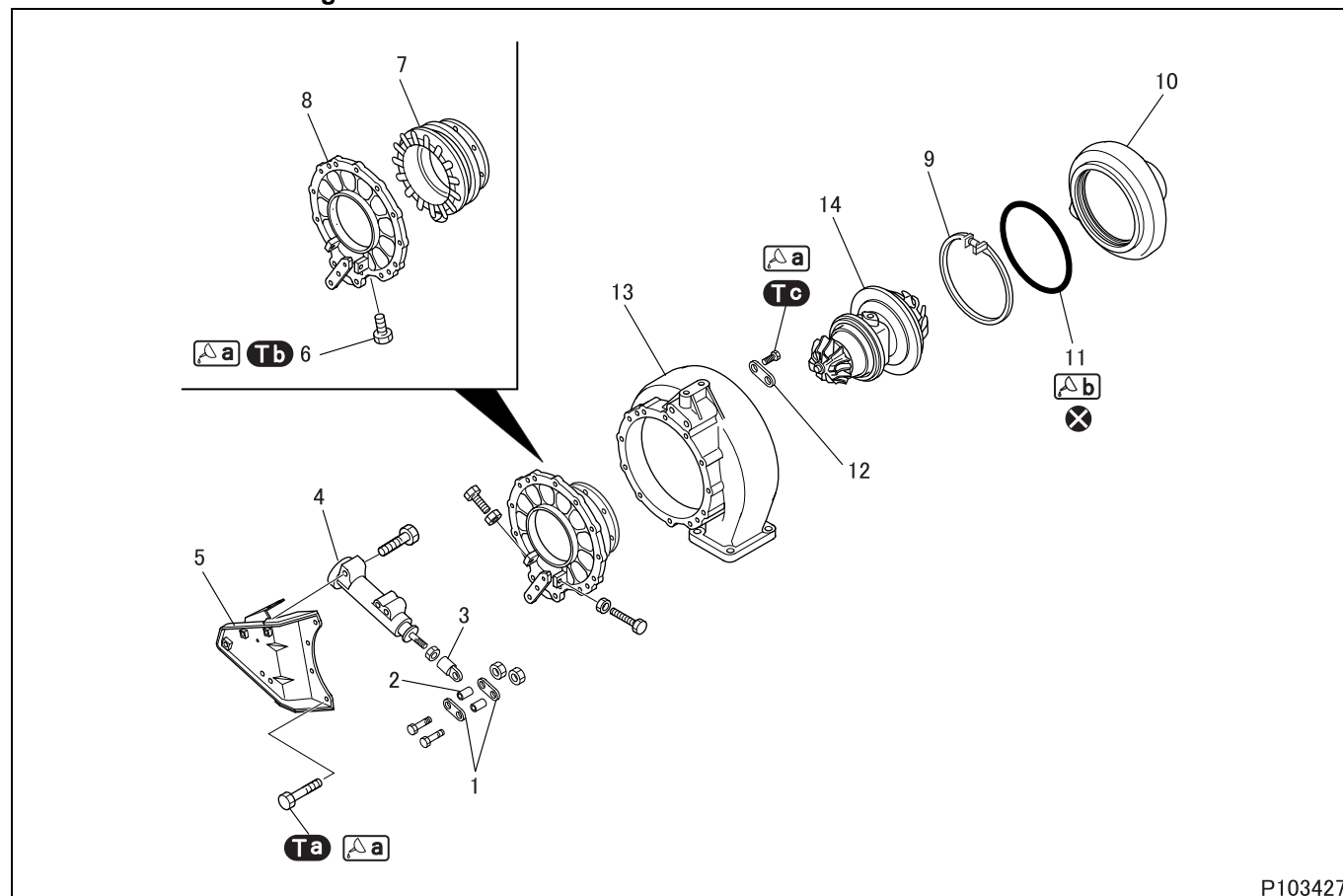
Mitsubishi 6M70 Engine Parts contact:

email: EngineParts@HeavyEquipmentRestorationParts.com

Phone: 269 673 1638

TURBOCHARGER

Mitsubishi 6M70 Turbocharger



P103427

● Disassembly sequence

- | | | |
|--------------------|---------------------|---|
| 1 Connecting lever | 7 Nozzle | 13 Turbine housing |
| 2 Spacer | 8 Flange | 14 Cartridge assembly
(See later section.) |
| 3 Joint | 9 Snap ring | |
| 4 Air cylinder | 10 Compressor cover | |
| 5 Bracket | 11 O-ring | ⊗: Non-reusable parts |
| 6 Clamp bolt | 12 Clamp plate | |

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards (Unit: mm)

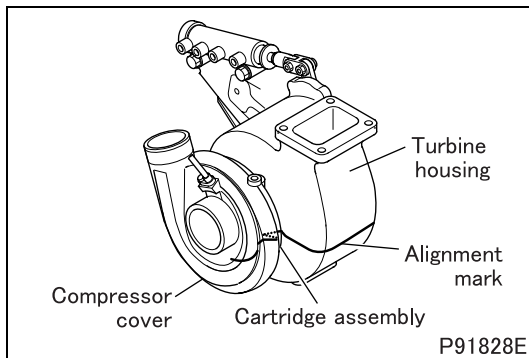
Location	Maintenance item			Standard value	Limit	Remedy
2	Spacer outside diameter			—	φ11.5	Replace
3	Joint inside diameter			—	φ12.5	Replace
4	Air cylinder	Stroke (operating air pressure: 390 to 785 kPa {4 to 8 kgf/ cm ² } when compressed air introduced)	Port A	12	—	Replace
			Port B	6	—	
			Port C	3	—	
		Airtight test (390 to 785 kPa {4 to 8 kgf/cm ² })	No air leakage of 25 cm ³ {25 mL} for 1 minute		—	
7	Play between nozzle lever plate and link			0.05 to 0.40	1.0	Replace
10, 14	Clearance between compressor cover and compressor wheel			0.08 to 0.28	—	Check parts
14	Cartridge as- sembly	Play in axial direction of shaft and tur- bine wheel	0.075 to 0.155		—	Check parts
		Shaft and turbine wheel-to-turbine back plate clearance	0.48 to 0.92		—	Check parts

Tightening torque (Unit: N·m {kgf·m})

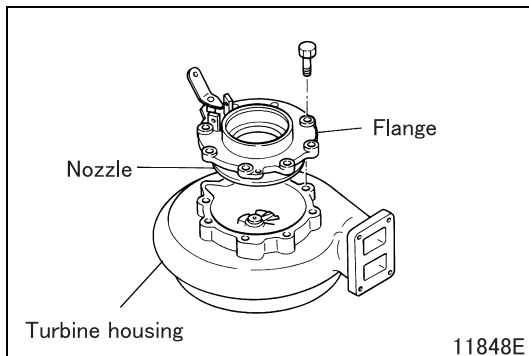
Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (bracket mounting)	34 to 38 {3.5 to 3.9}	Wet
Tb	Clamp bolt	6.4 to 7.4 {0.65 to 0.75}	Wet
Tc	Bolt (clamp plate mounting)	25.5 to 27.4 {2.6 to 2.8}	Wet

Lubricant and/or sealant

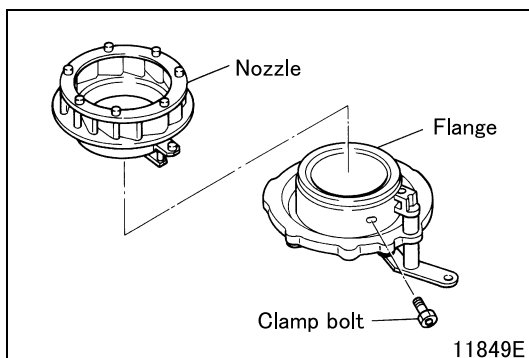
Mark	Points of application	Specified lubricant and/or sealant	Quantity
	Threads of clamp bolt	Seizure preventive compound (FEL-PRO CA-5)	As required
	Threads of mounting bolt		
	O-ring	Engine oil	As required

◆ Work before removal ◆**■ Alignment mark**

- Put alignment marks on the coupling, turbine housing, compressor cover and cartridge assembly.

◆ Removal procedure ◆**■ Removal: Nozzle**

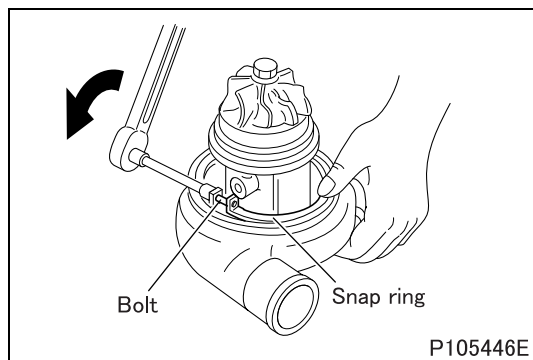
- Remove the flange and nozzle in one unit from the turbine housing.



- Remove the clamp bolt, then remove the nozzle from the flange.

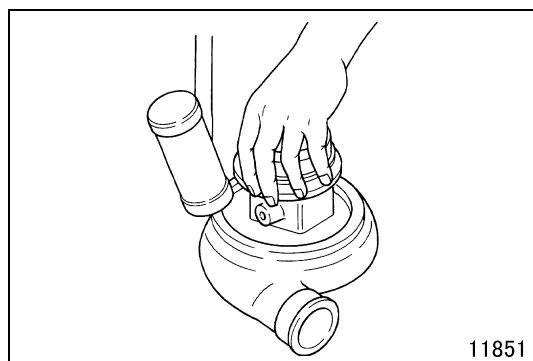
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TURBOCHARGER



■ Removal: Snap ring

- Tighten the bolt to contract the snap ring and remove the ring.

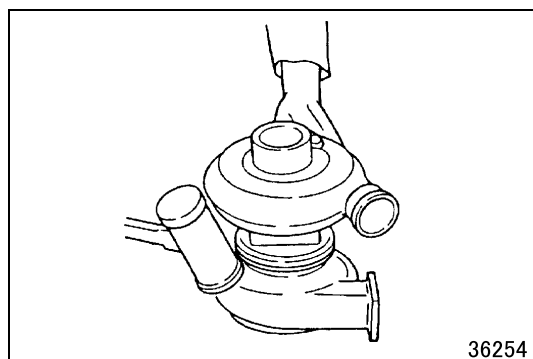


■ Removal: Compressor cover

- Lightly tap around the entire periphery of the compressor cover with a rubber-faced hammer, taking care not to cause damage.

CAUTION ⚠

- The blades on the cartridge assembly are easily bent. Make sure that they do not strike the compressor cover.



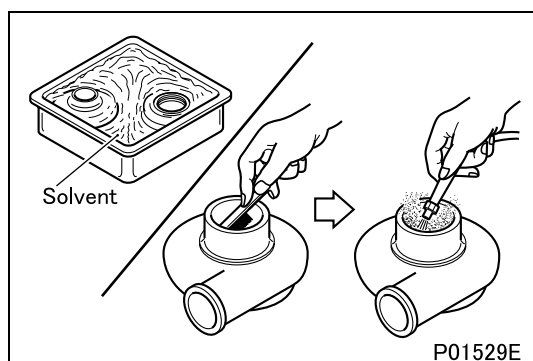
■ Removal: Turbine housing

- Lightly tap around the entire periphery of the turbine housing with a rubber-faced hammer, taking care not to cause damage.

CAUTION ⚠

- The blades of the turbine wheel on the cartridge assembly are easily bent. Make sure that they do not strike the turbine housing.

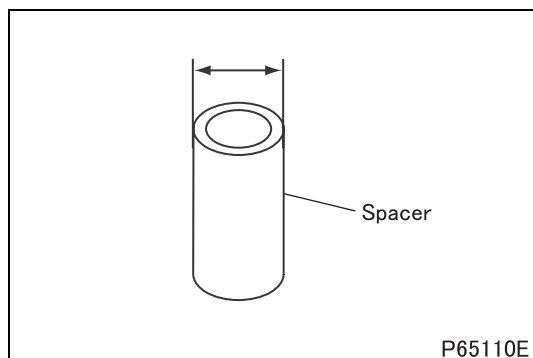
◆ Work after disassembly ◆



■ Cleaning

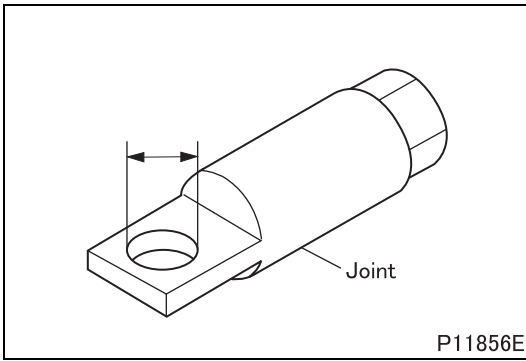
- Before cleaning, visually check the disassembled parts for scorchs, abrasion and other marks that may be difficult to see after cleaning. Replace any part that appears defective.
- Immerse the disassembled parts in a non-flammable solvent (a 5 to 10 aqueous solution of Oil Clean from New Hope Co., Ltd.). Take out the parts and blow them dry with compressed air. Remove any hard deposits with a stiff brush or plastic scraper.
- Again, immerse the parts in the solvent.
- Blow them dry using compressed air.

◆ Inspection procedure ◆



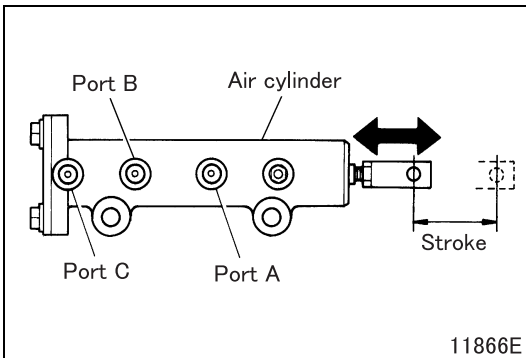
■ Inspection: Spacer outside diameter

- If the measurement is less than the specified limit, replace the spacer.



■ Inspection: Joint inside diameter

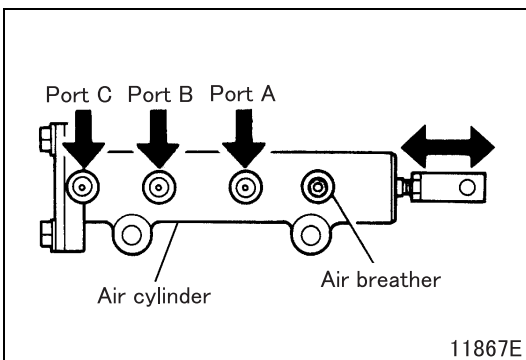
- If the measurement exceeds the specified limit, replace the joint.



■ Inspection: Air cylinder

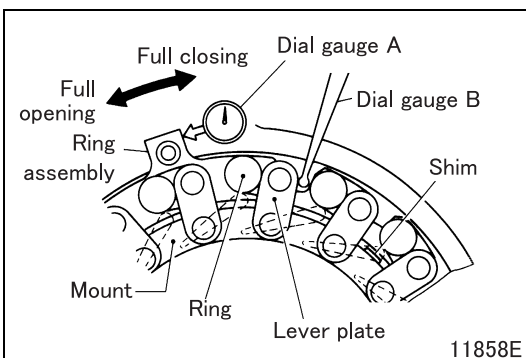
(1) Stroke

- Apply specified air pressure to the ports (A to C) in the air cylinder, one at a time, and measure the corresponding strokes of the air cylinder.
- If the measurement deviates from the standard value, replace the air cylinder.



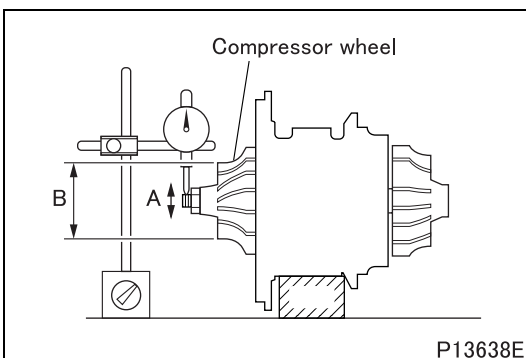
(2) Airtight test

- Apply specified air pressure to the ports (A to C) in the air cylinder, one at a time, and measure air leakage per minute using an air breather.
- If the measurement exceeds the standard value, replace the air cylinder.



■ Inspection: Nozzle

- Move the ring assembly of the nozzle all the way by hand from "full opening" to "full closing" and measure its travel with a dial gauge A.
- Position the ring assembly roughly in the middle of measured length of its travel.
- To center and hold the ring assembly and mount in place, use appropriate shims equally spaced at 3 places between them.
Type of shim
 - Width × length: 5 mm × 10 mm
 - Thickness: 0.1 mm to 0.4 mm
- Measure the play between each lever plate and ring with the dial gauge B. If any of the measurements exceeds the specified limit, replace the nozzle.



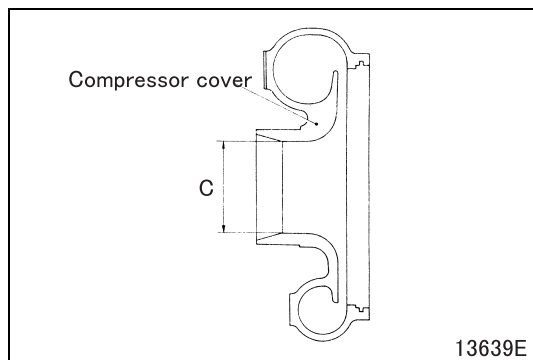
■ Inspection: Clearance between compressor cover and compressor wheel

- Measure the maximum runout A of the compressor wheel when the wheel is moved in vertical direction.
- Measure the outside diameter B of the compressor wheel.

CAUTION ⚠

- Do not rotate the compressor wheel for axial play measurement.

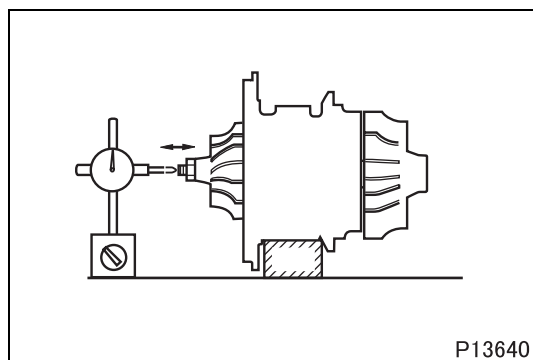
TURBOCHARGER



- Measure the inside diameter C of the compressor cover.
- Calculate the clearance between compressor wheel and compressor cover as follows.

$$\text{Clearance} = \frac{C-B-A}{2}$$

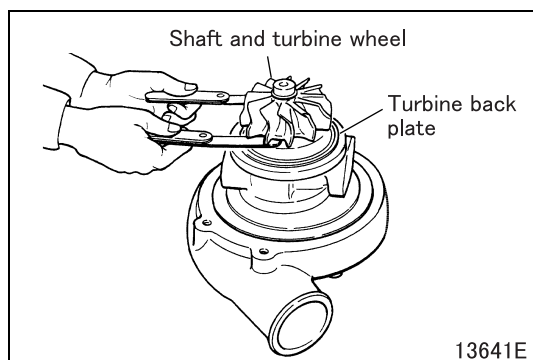
- If the clearance deviates from the specified standard value range, disassemble and correct.



■ Inspection: Cartridge assembly

(1) Play in axial direction of shaft and turbine wheel

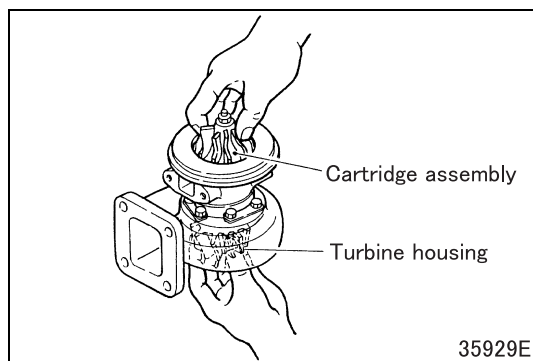
- If the measurement exceeds the specified limit, disassemble and check the parts.



(2) Shaft and turbine wheel-to-turbine back plate clearance

- Measure the clearance between the turbine back plate and shaft and turbine wheel unit.
- Be sure to measure the clearance at the periphery of the blades using two feeler gauges.
- If the measurement deviates from the standard value, disassemble the cartridge assembly, inspect and check the parts.

◆ Installation procedure ◆

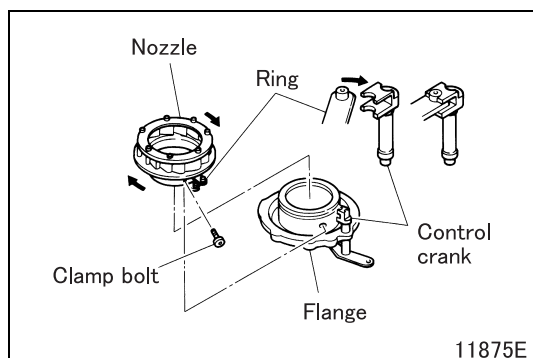


■ Installation: Turbine housing

- Install the cartridge assembly into the turbine, then perform the following test.

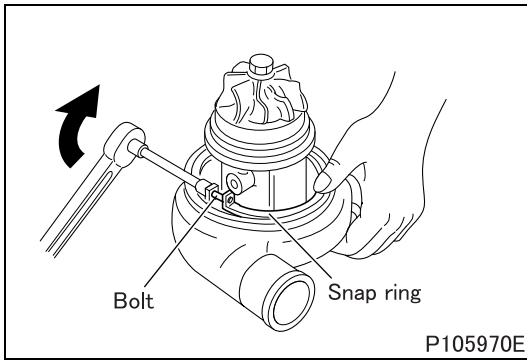
(1) Rotating condition of cartridge assembly

- Turn the wheels of the cartridge assembly. They should turn smoothly.
- If not, disassemble the cartridge assembly, inspect and check the parts.



■ Installation: Nozzle

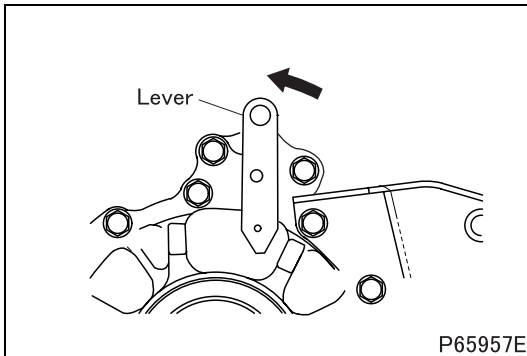
- Fit the nozzle in the flange.
- In fitting, turn the nozzle and flange so that the control crank and ring properly engage each other



■ Installation: Snap ring

- Turn the snap ring in its mounting groove to confirm proper seating of the ring. After confirmation, loosen the bolt and fit the ring securely.

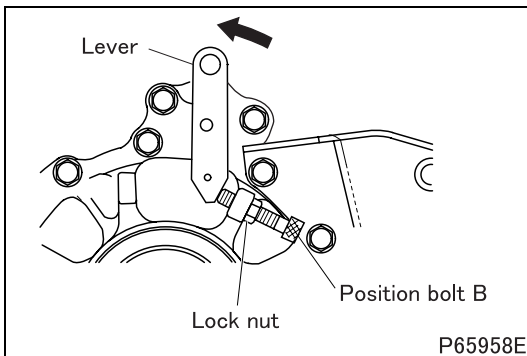
◆ Work after installation ◆



■ Adjustment: Positioning of air cylinder

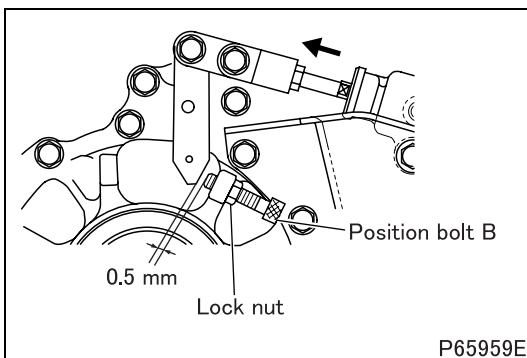
(1) Full closing position

- Remove the position bolt B, then move the lever all the way in the illustrated direction.



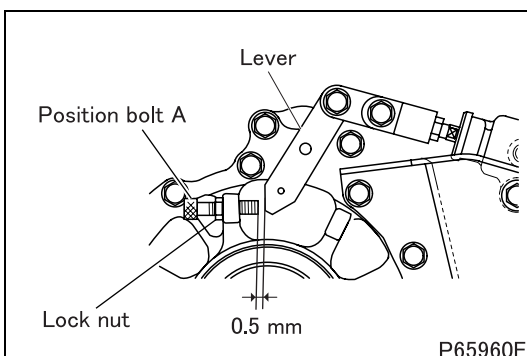
(2) Temporary tightening of position bolt

- Reinstall the position bolt B, and drive it in until it contacts the lever.
- Mark the position bolt B at that position, give it 5 and half turns, then tighten the lock nut to secure the position bolt B.



(3) Readjustment for full closing position

- Introduce specified pressure in the air cylinder from the port A, B, C and bring the air cylinder into the state of full stroke, then connect the lever to the joint.
- Make sure that the lever is in slight contact with the position bolt B. If there is an open space between the lever and position bolt B or the lever is pushing the position bolt B, loosen the lock nut and make necessary adjustment by turning the shaft. Then, tighten the lock nut.
- Back up the position bolt B a half turn for a clearance of approximately 0.5 mm between the bolt and lever, then tighten the lock nut to secure the position bolt B in that position.

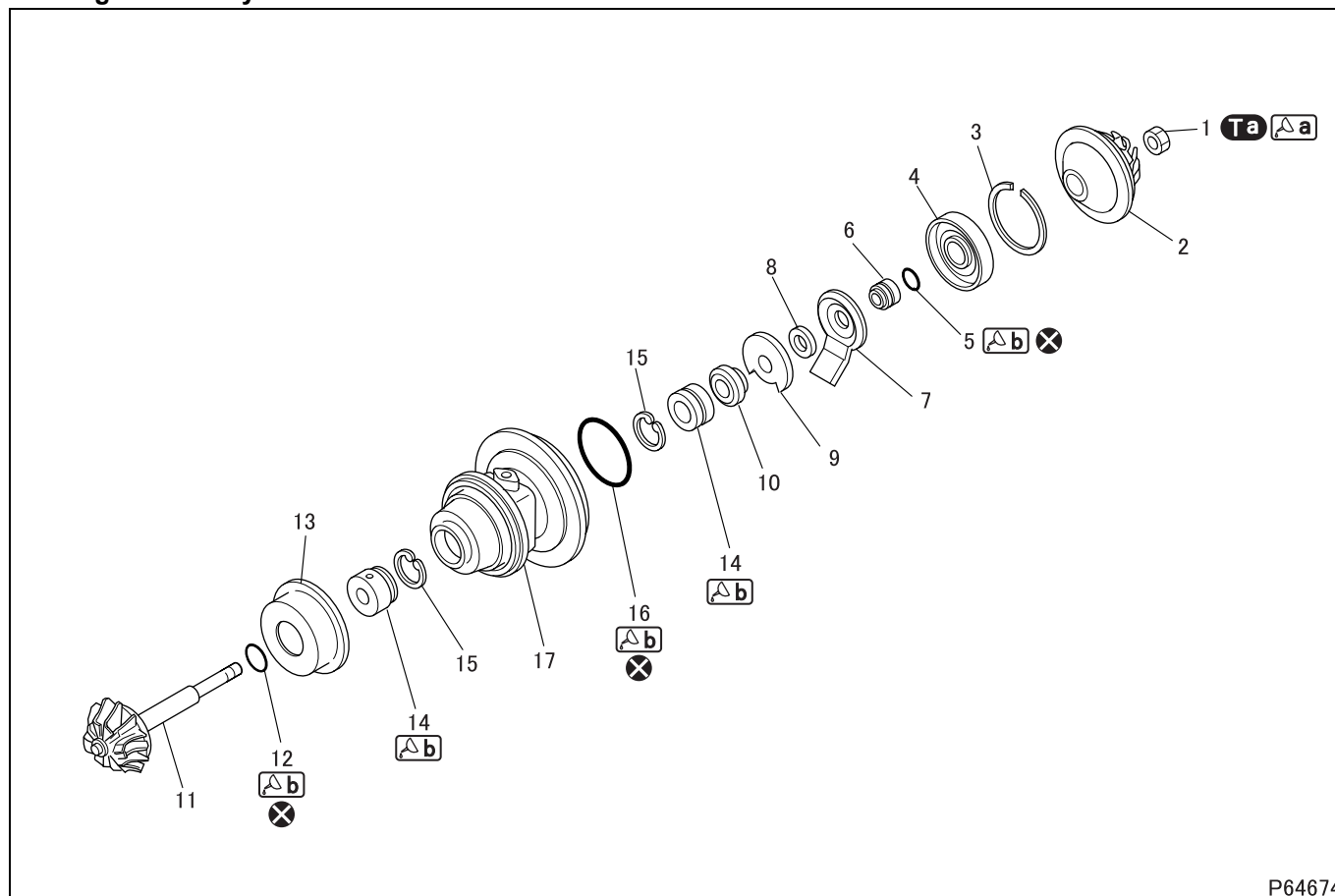


(4) Full opening position

- Release compressed air to bring the air cylinder into the state of zero stroke. Adjust the position bolt A for a clearance of 0.5 mm between the bolt and lever, then tighten the lock nut to secure the bolt in that position.

MITSUBISHI 6M70 TURBOCHARGER PARTS

Cartridge Assembly



P64674

Disassembly sequence

- | | | |
|--------------------|----------------------------|-----------------------|
| 1 Lock nut | 8 Thrust ring | 15 Snap ring |
| 2 Compressor wheel | 9 Thrust bearing | 16 O-ring |
| 3 Snap ring | 10 Thrust ring | 17 Bearing housing |
| 4 Insert | 11 Shaft and turbine wheel | |
| 5 Piston ring | 12 Piston ring | ⊗: Non-reusable parts |
| 6 Thrust sleeve | 13 Turbine back plate | |
| 7 Oil deflector | 14 Bearing | |

Assembly sequence

Follow the disassembly sequence in reverse.

Service standards (Unit: mm)

Location	Maintenance item		Standard value	Limit	Remedy
11	Shaft and turbine wheel	Turbine housing-to-shaft and turbine wheel clearance	0.39 to 1.0	—	Replace
		Bearing journal outside diameter	—	11.996	Replace
		Shaft bend	—	0.015	Replace
14	Bearing	Outside diameter	—	20.382	Replace
		Inside diameter	—	12.042	Replace
		Length	—	11.94	Replace
17	Inside diameter of bearing insertion bore in bearing housing		—	20.506	Replace

Mitsubishi 6M70 Engine Parts contact:

email: EngineParts@HeavyEquipmentRestorationParts.com

Phone: 269 673 1638

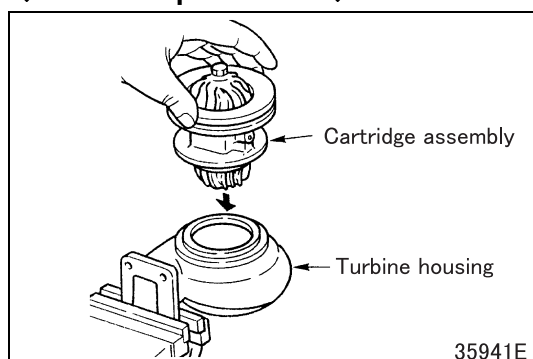
Tightening torque (Unit: N·m {kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Lock nut	20 {2.0}	Thread-locking compound

Lubricant and/or sealant

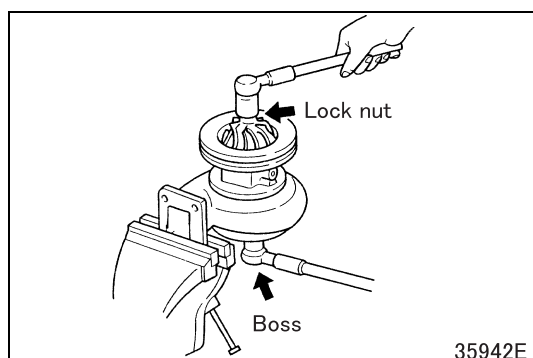
Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Thread of lock nut	Molykote BR-2 Plus	As required
b	O-ring	Engine oil	As required
	Piston ring		
	Bearing		

◆ Removal procedure ◆

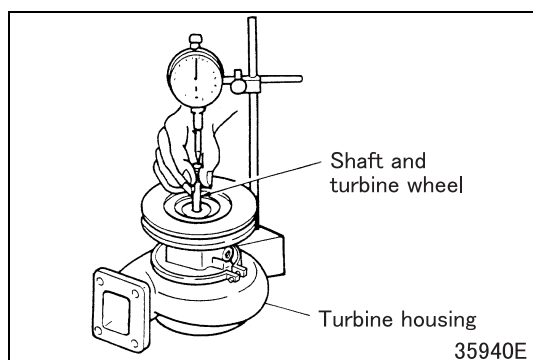


■ Removal: Compressor wheel

- Secure the turbine housing in a vise.
- Fit the turbine wheel side of the cartridge assembly into the turbine housing.

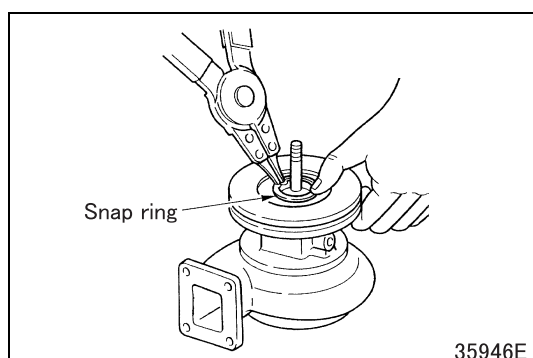


- Hold the boss on the shaft and turbine wheel unit to prevent the cartridge assembly from turning.
- Loosen and remove the lock nut.



■ Inspection: Turbine housing-to-shaft and turbine wheel clearance

- If the measurement deviates from the standard value, replace the defective part.



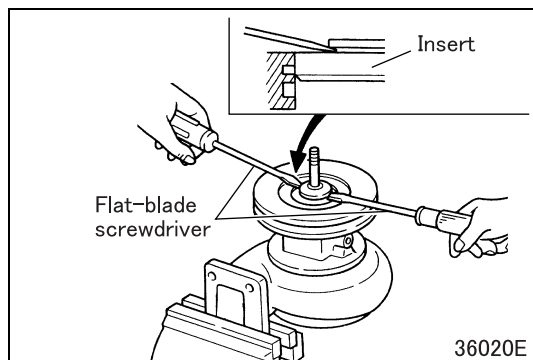
■ Removal: Snap ring

- Remove the snap ring.

CAUTION ⚠

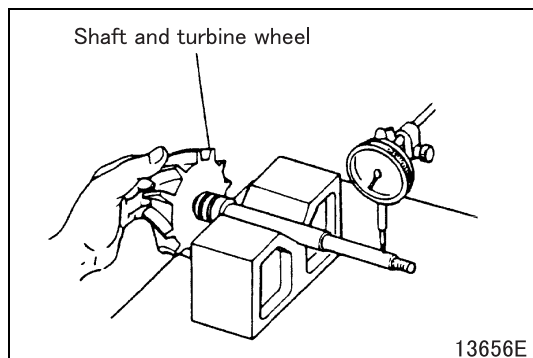
- Remove the snap ring while holding it with your hand to prevent it from springing off.

TURBOCHARGER



■ Removal: Insert

◆ Inspection procedure ◆

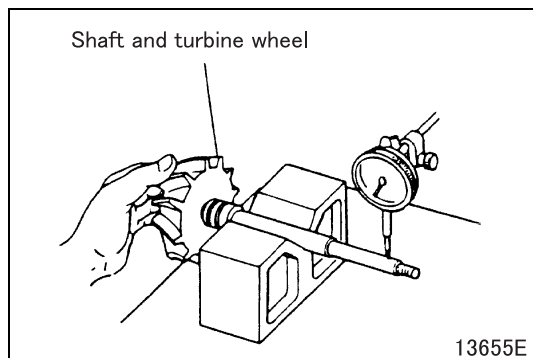


■ Inspection: Shaft and turbine wheel

[Inspection]

(1) Journal outside diameter

- If the measurement exceeds the specified limit or uneven wear is excessive, replace the shaft and turbine wheel unit.
- Inspect the journal visually and recondition it if roughened.



(2) Shaft bend

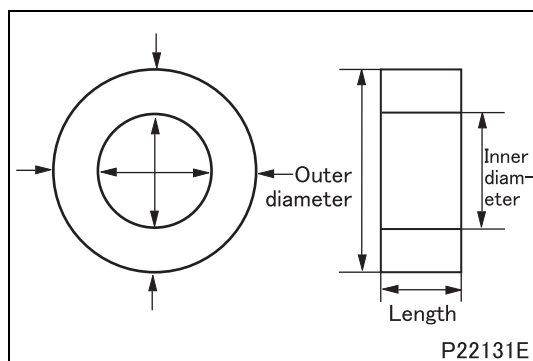
- Set a dial gauge at the illustrated position on the shaft. Turning the shaft slowly, measure the extent of bending.
- If the measurement exceeds the specified limit, replace the shaft and turbine wheel unit.

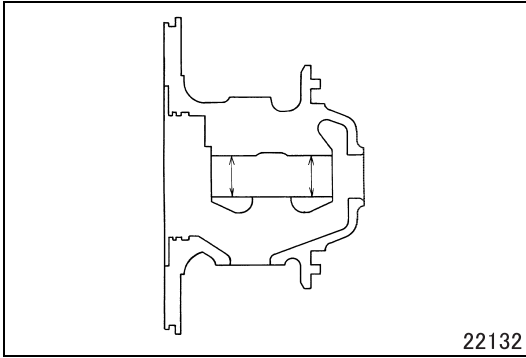
[Reconditioning]

- Attach the shaft and turbine wheel unit to a lathe, supporting it at both centers.
- With the shaft and turbine wheel unit turning at 300 to 600 rpm, smooth the journal using sandpaper (#400) and engine oil.
- Measure the outside diameter of the bearing contact portion. If the measurement exceeds the specified limit, replace the shaft and turbine wheel unit.

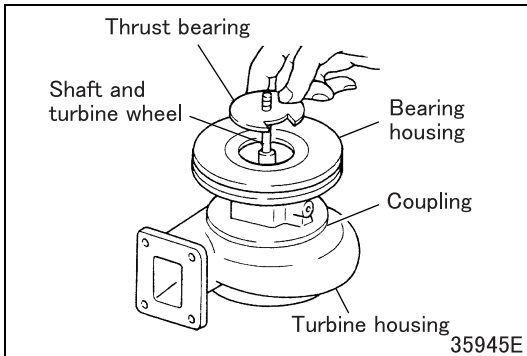
■ Inspection: Bearing

- If the measurement exceeds the specified limit, replace the bearing.





◆ Installation procedure ◆



■ Inspection: Bearing housing

- If the measurement exceeds the specified limit, replace the bearing housing.

■ Installation: Thrust bearing

- Install the shaft and turbine wheel unit, fitted in the bearing housing, in the turbine housing. Fasten it in place temporarily with the coupling.

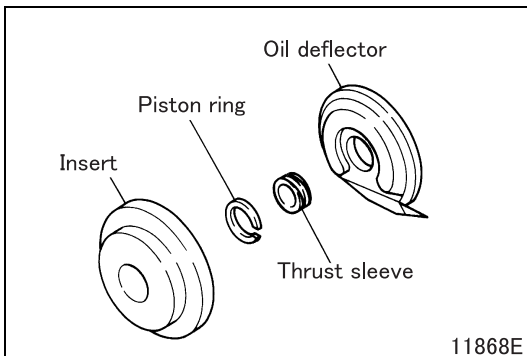
CAUTION ⚠

- When installing the shaft and turbine wheel unit, make sure that its blades are not damaged by striking the turbine housing because they are easily bent.

- Fit the thrust bearing onto the shaft and turbine wheel unit.

CAUTION ⚠

- Before installing the thrust bearing, wipe off dirt and oily substance completely from the stepped area of the shaft and both sides of the thrust ring using dry tissue paper or the like.



■ Installation: Insert

- Fit the piston ring onto the thrust sleeve, then fit it into the insert, its end gap first, taking care that it is not damaged.

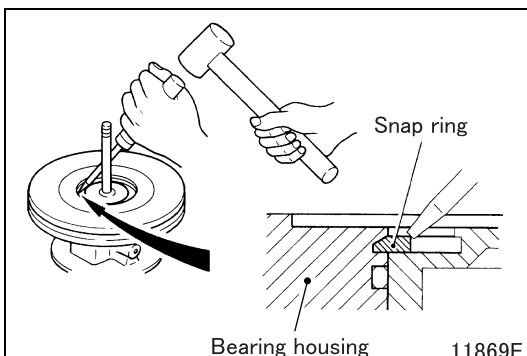
CAUTION ⚠

- When fitting the piston ring, use care not to open it excessively or twist its end gap portion.

- Fit necessary parts in the insert first, then fit the insert into the bearing housing.

CAUTION ⚠

- Before installing the insert, wipe off dirt and oily substance completely from both end faces of the thrust sleeve using dry tissue paper or the like.



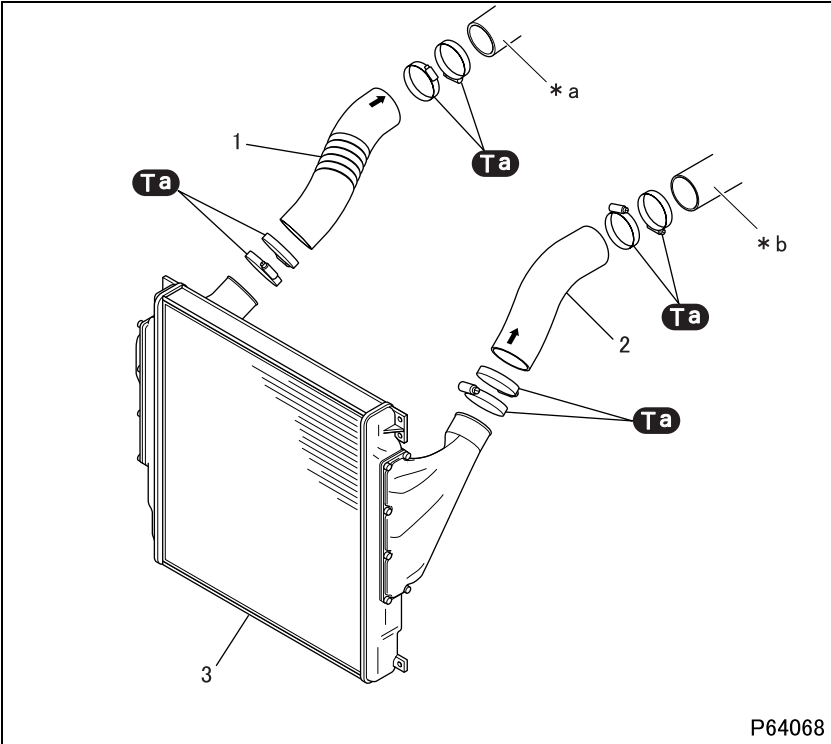
■ Installation: Snap ring

- Place the snap ring in the bearing housing in the illustrated direction using a pair of snap ring pliers.
- Then, using a screwdriver, tap the snap ring at its break ends into place in the mating groove of the bearing housing.

CAUTION ⚠

- Fit the snap ring while holding it with your hand to prevent it from springing off.

INTERCOOLER



● Removal sequence

- 1 Air inlet hose
- 2 Air outlet hose
- 3 Intercooler

*a: Turbocharger
*b: Intake throttle

● Installation sequence

Follow the removal sequence in reverse.

CAUTION ⚠

- When removing the air inlet hose, do not try to pry it off with strong force using a screwdriver or other similar tools. Doing that can damage the fluorolayer on the inner surface of the hose, possibly compromising the oil resistance of the hose.

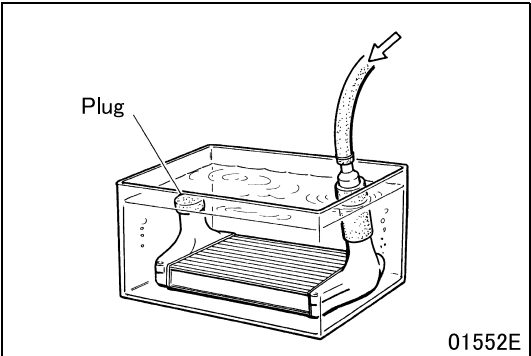
Service standards

Location	Maintenance item	Standard value	Limit	Remedy
3	Intercooler air leakage (at air pressure of 147 kPa {1.5 kgf/cm ² })	0 cm ³ {0 mL}	—	Replace

Tightening torque (Unit: N·m {kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Clamp	7 to 8 {0.7 to 0.8}	—

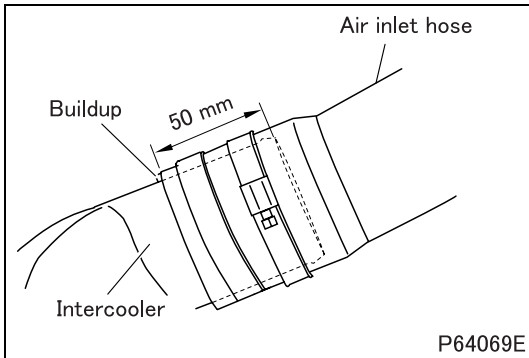
◆ Inspection procedure ◆



■ Inspection: Intercooler

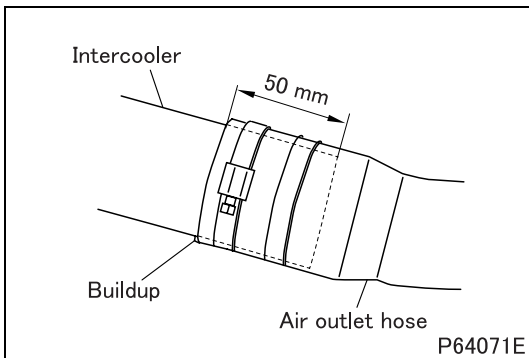
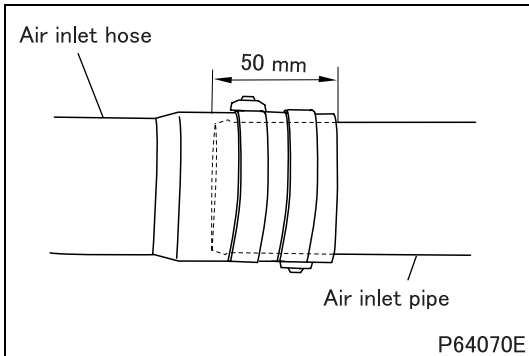
- Plug one of the air ports of the intercooler and immerse it in a tank of water. Apply the specified air pressure to the intercooler through the other air port.
- If leakage is apparent, replace the intercooler.

◆ Installation procedure ◆



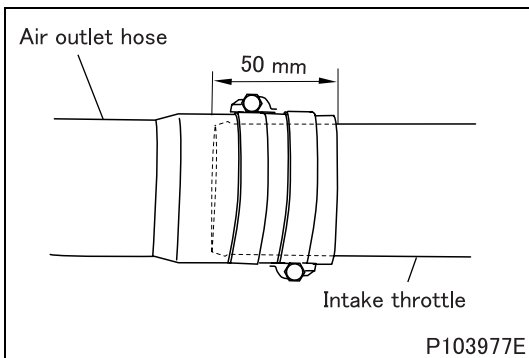
■ Installation: Air inlet hose

- Fit the air inlet hose to the intercooler and air inlet pipe to the illustrated dimension.

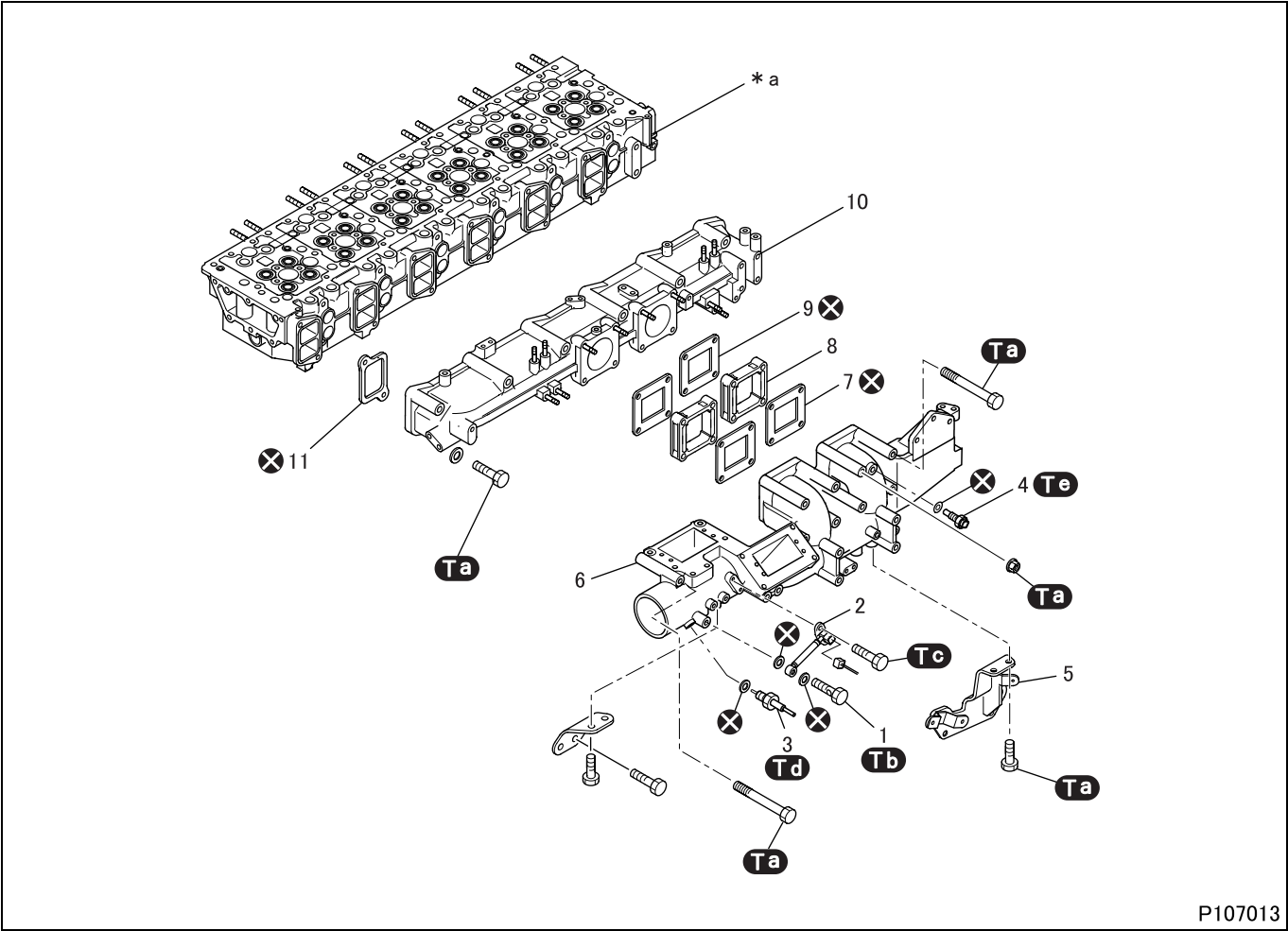


■ Installation: Air outlet hose

- Fit the air outlet hose to the intercooler and air inlet pipe to the illustrated dimension.



MITSUBISHI 6M70 INTAKE MANIFOLD



P107013

● Disassembly sequence

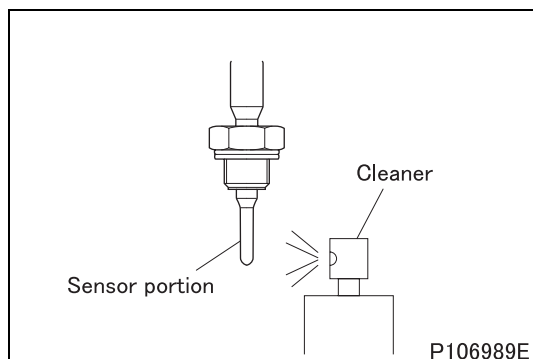
- | | | |
|---|------------------|-------------------------------|
| 1 Eyebolt | 5 Bracket | 10 Intake manifold |
| 2 Boost pressure sensor | 6 Air inlet pipe | 11 Gasket |
| 3 Intake air temperature sensor | 7 Gasket | |
| 4 Intake air temperature sensor (dummy) | 8 Spacer | *a: Cylinder head (See Gr11.) |
| | 9 Gasket | ⊗: Non-reusable parts |

● Assembly sequence

Follow the disassembly sequence in reverse.

Tightening torque (Unit: N·m {kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (intake manifold mounting)	54 {5.5}	—
	Bolt (air inlet pipe mounting)		
	Bolt (bracket mounting)		
	Nut (air inlet pipe mounting)		
Tb	Eyebolt	21 {2.1}	—
Tc	Bolt (boost pressure sensor mounting)	4 to 6 {0.4 to 0.6}	—
Td	Intake air temperature sensor 1	20 {2.0}	—
Te	Intake air temperature sensor 2	25 ± 5 {2.5 ± 0.5}	—

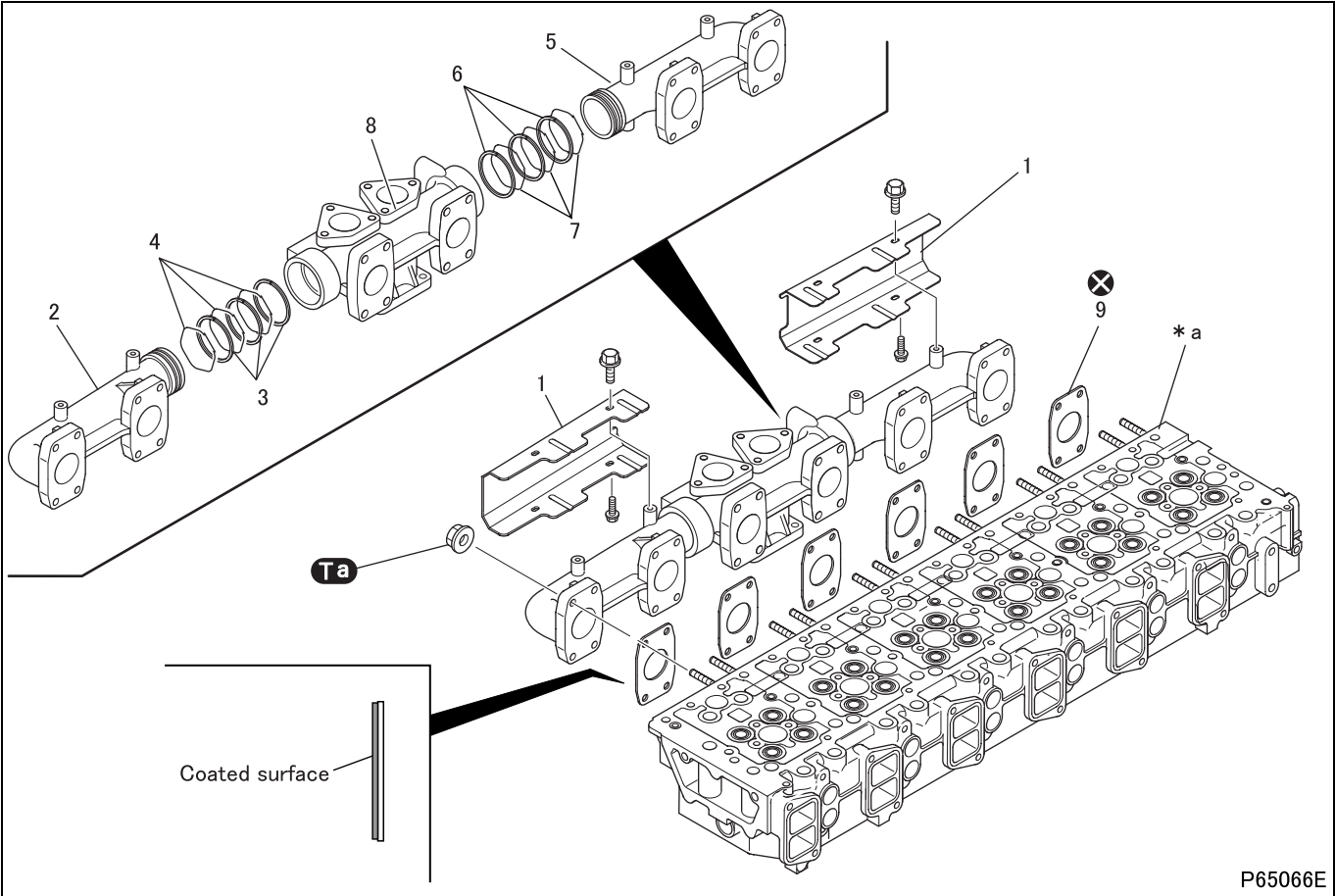
◆ Inspection procedure ◆**■ Inspection: Intake air temperature sensor**

- Check that the sensor portion is free of soot, oily substance, etc.
- If not, clean the sensor portion as follows.
- Spray a cleaner on the sensor portion from 2 or 3 cm away.
Recommended cleaners:
Wako Chemical brake and parts cleaner from Wako Chemical
Trusco Nakayama brake and parts cleaner ALP-BP
Chemsearch Lexite LO
- In 20 to 30 seconds after spraying, wipe the sensor portion clear of the sprayed cleaner using a soft waste cloth or the like.

CAUTION ⚠

- **Be sure to wait for 20 or 30 seconds before wiping. It takes the cleaner that long to dissolve foreign matter.**
- If the sensor portion is fouled excessively, the positive crankcase ventilation (PCV) may be faulty. Inspect the PCV valve and filter to locate the cause and remove it.

MITSUBISHI 6M70 EXHAUST MANIFOLD



● **Disassembly sequence**

- 1 Insulator

2 Front exhaust manifold

3 Seal ring

4 Exhaust Manifold Expansion rings
- 5 Rear exhaust manifold

6 Seal ring

7 Expansion ring

8 Center exhaust manifold

9 Exhaust Manifold Gaskets

- *a: Cylinder head (See Gr11.)
- ⊗: Non-reusable parts

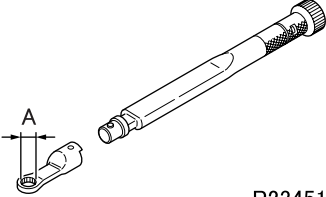
● **Assembly sequence**

Follow the disassembly sequence in reverse.

Mitsubishi 6M70 Tightening torque (Unit: N·m {kgf·m})

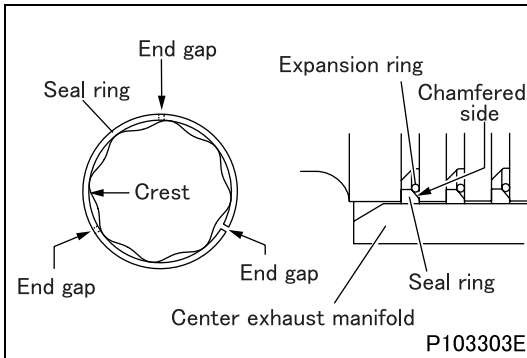
Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (exhaust manifold mounting)	42 {4.2}	—

Special tools (Unit: mm)

Mark	Tool name and shape	Part No.	Application
Ca	Torque wrench A Double flat surfaced 14  P23451	MH063080	Installation of exhaust manifold

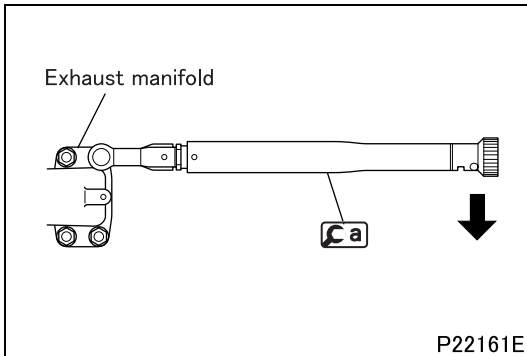
Mitsubishi 6M70 Engine Parts contact:
email: EngineParts@HeavyEquipmentRestorationParts.com
Phone: 269 673 1638

◆ Installation procedure ◆



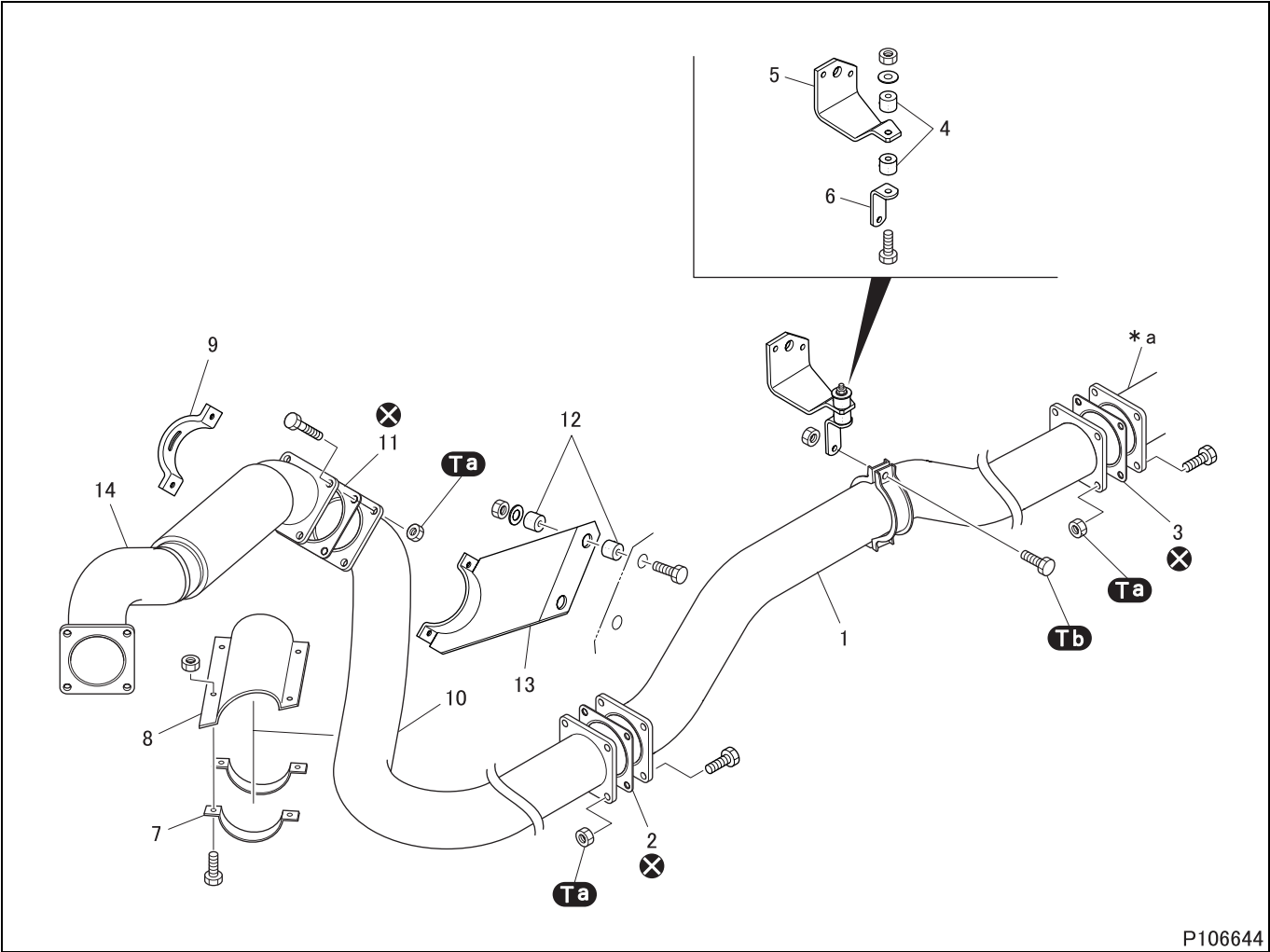
■ Installation: Mitsubishi 6M70 Expansion rings and seal rings

- Fit the seal rings with their end gaps positioned 120 degrees apart from each other.
- Fit the expansion rings so that their crests do not meet the end gaps of the seal rings.
- Fit the seal rings with their chamfered sides facing the center exhaust manifold.



■ Installation: Mitsubishi 6M70 Exhaust manifold

EXHAUST PIPE <FS>



P106644

● Disassembly sequence

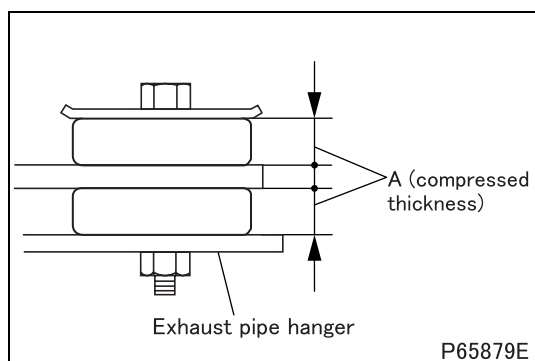
- | | | |
|-----------------------|----------------------|-------------------------------|
| 1 Lower front pipe | 7 Clamp | 13 Clamp |
| 2 Gasket | 8 Exhaust pipe cover | 14 Upper front pipe |
| 3 Gasket | 9 Clamp | |
| 4 Rubber cushion | 10 Center front pipe | *a: Diesel Particulate Filter |
| 5 Exhaust pipe hanger | 11 Gasket | ⊗: Non-reusable parts |
| 6 Stay | 12 Rubber cushion | |

● Installation sequence

Follow the removal sequence in reverse.

Tightening torque (Unit: N·m {kgf·m})

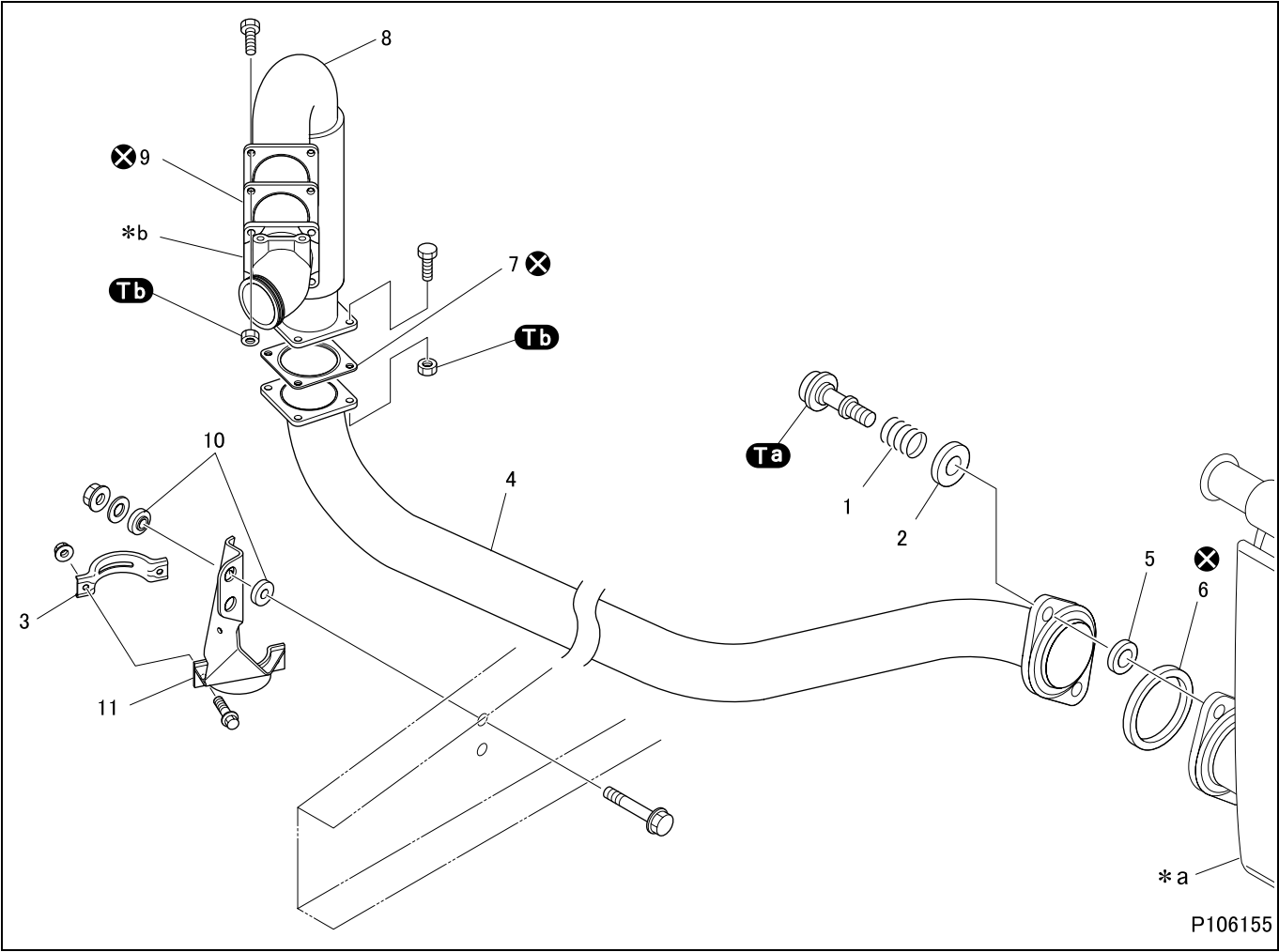
Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (upper front pipe mounting)	85 to 110 {8.7 to 11.0}	—
	Nut (center front pipe mounting)		
	Nut (lower front pipe mounting)		
Tb	Bolt (clamp mounting)	20 ± 3 {2.1 ± 0.3}	—

◆ Installation procedure ◆**■ Installation: Rubber cushions**

- Tighten the rubber cushions until they are compressed to the thickness A.

Location of rubber cushion	Compressed thickness
Upper front pipe	10 mm
Lower front pipe	23 mm

EXHAUST PIPE <EXCEPT FS>



Disassembly sequence

- | | | |
|--------------------|--------------------|-------------------------------|
| 1 Spring | 6 Seal ring | 11 Exhaust pipe clamp bracket |
| 2 Washer | 7 Gasket | |
| 3 Clamp | 8 Upper front pipe | *a: Diesel Particulate Filter |
| 4 Lower front pipe | 9 Gasket | *b: Turbocharger coupler |
| 5 Washer | 10 Rubber cushion | X: Non-reusable parts |

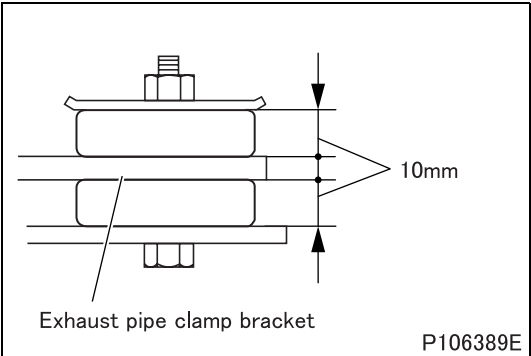
Installation sequence

Follow the removal sequence in reverse.

Tightening torque (Unit: N·m {kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (lower front pipe mounting)	44 ± 10 {4.5 ± 1.0}	—
Tb	Nut (upper front pipe mounting)	85 to 110 {8.7 to 11.0}	—

Installation procedure

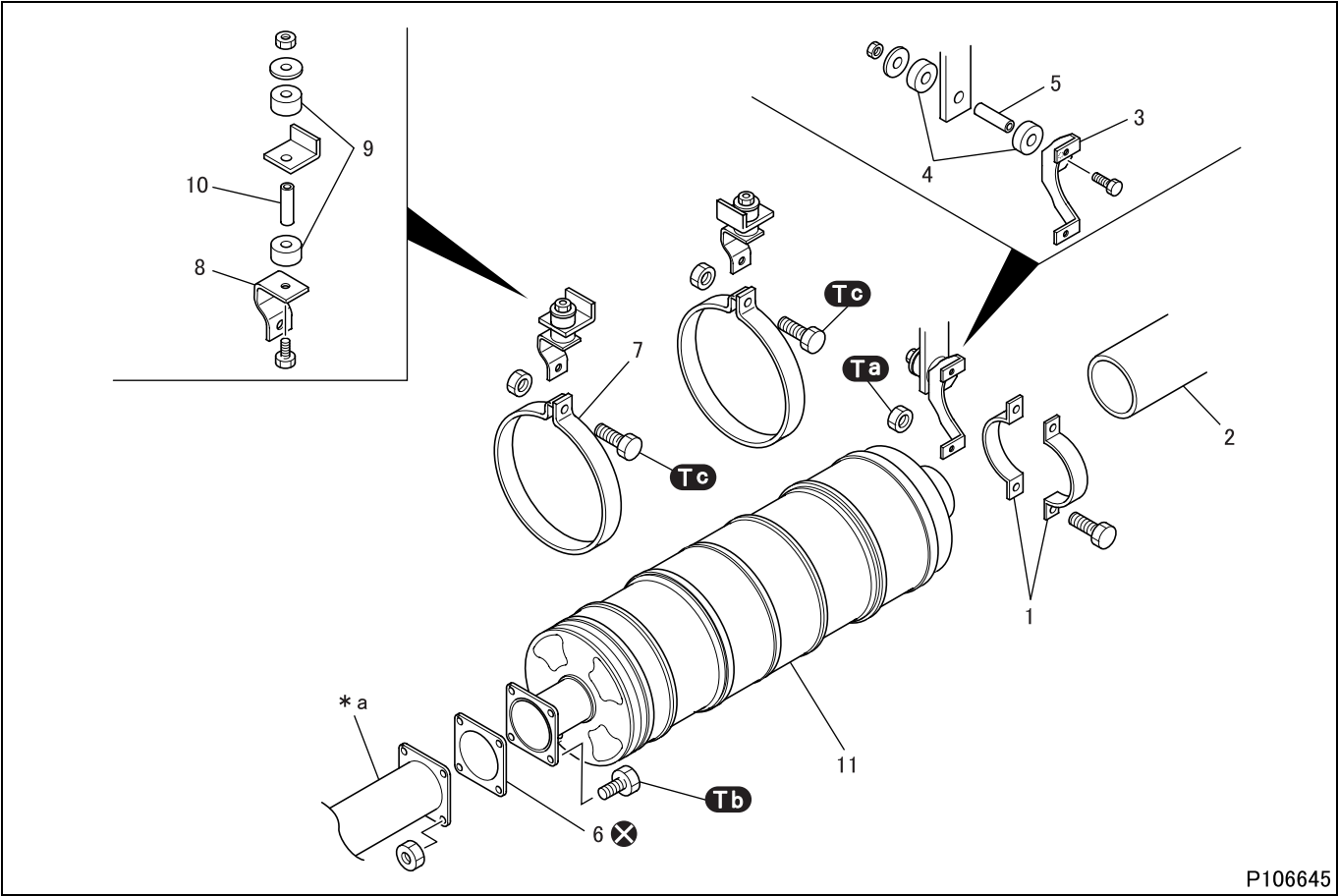


Installation: Rubber cushions

- Tighten the rubber cushions until they are compressed to the illustrated dimension.

M E M O

DIESEL PARTICULATE FILTER <FS>



Disassembly sequence

- | | | |
|------------------|------------------|--------------------------------|
| 1 Clamp | 6 Gasket | 11 DPF |
| 2 Tail pipe | 7 DPF band | |
| 3 Stay | 8 Stay | *a: Front pipe |
| 4 Rubber cushion | 9 Rubber cushion | X: Non-reusable parts |
| 5 Collar | 10 Collar | DPF: Diesel Particulate Filter |

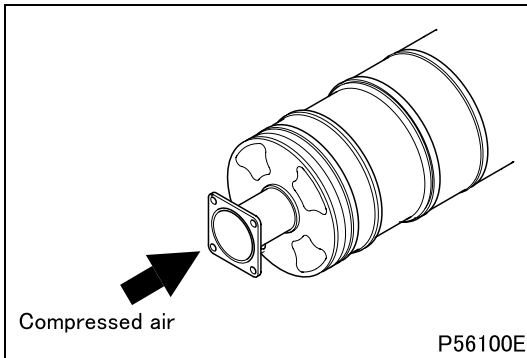
Assembly sequence

Follow the disassembly sequence in reverse.

Tightening torque (Unit: N·m {kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (clamp tightening)	54 ± 10 {5.5 ± 1.0}	—
Tb	Nut (front pipe mounting)	85 to 110 {8.6 to 11.0}	—
Tc	Bolt (clamp tightening)	20 ± 3 {2.1 ± 0.3}	—

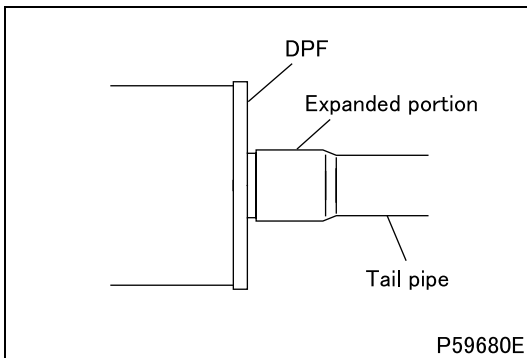
◆ Inspection procedure ◆



■ Inspection: DPF

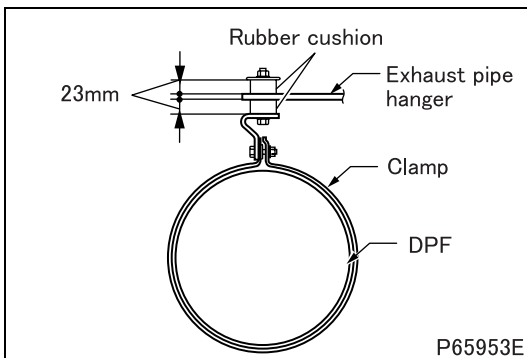
- Check the inner exhaust channel of DPF for clogging with foreign material.
- If clogged, the inner exhaust channel must be cleaned with compressed air or DPF must be replaced.
- If DPF is clogged, this may be due to problems with the engine. Check the engine and adjust as required. Also check the engine oil and fuel.

◆ Installation procedure ◆



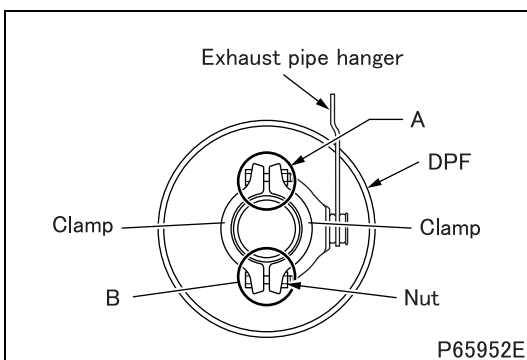
■ Installation: DPF

- Insert the DPF pipe into the tail pipe until the DPF pipe bottoms out against the expanded portion of the tail pipe.



■ Installation: Rubber cushions

- Compress the rubber cushions until the dimensions shown in the illustration are achieved.



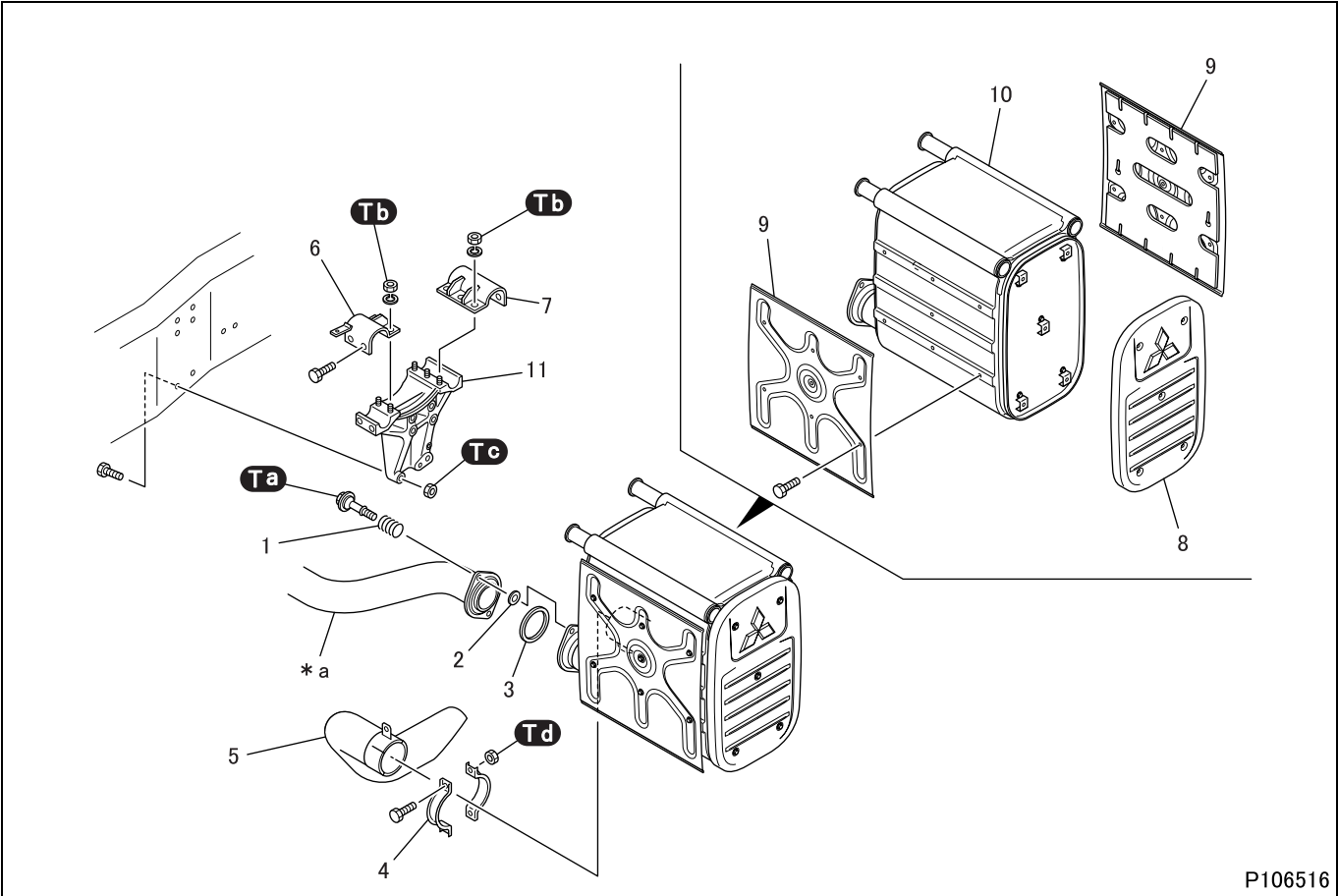
■ Installation: Clamps

- Tighten the nuts just enough to loosely retain the clamps so that they can easily be moved.
- Tighten the nut at A until the ends of the clamps at A contact with each other.
- Completely tighten the nut at B.

CAUTION ⚠

- Do not overtighten the nut at B, or the clamps and DPF may become damaged.

DIESEL PARTICULATE FILTER <EXCEPT FS>



Disassembly sequence

- | | |
|-----------------|-----------------|
| 1 Spring | 7 Muffler plate |
| 2 Washer | 8 DPF cover |
| 3 Seal ring | 9 DPF insulator |
| 4 Clamp | 10 DPF |
| 5 Tail pipe | 11 Bracket |
| 6 Muffler plate | |

- *a: Front pipe
⊗: Non-reusable parts

DPF: Diesel Particulate Filter

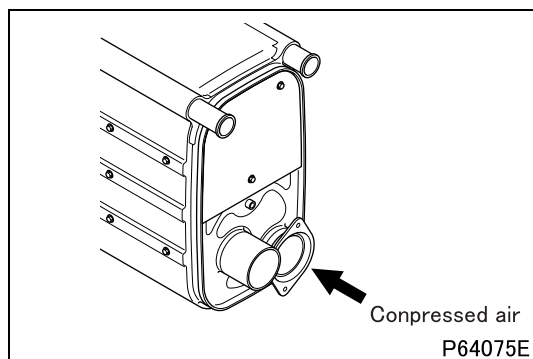
Assembly sequence

Follow the disassembly sequence in reverse.

Tightening torque (Unit: N·m {kgf·m})

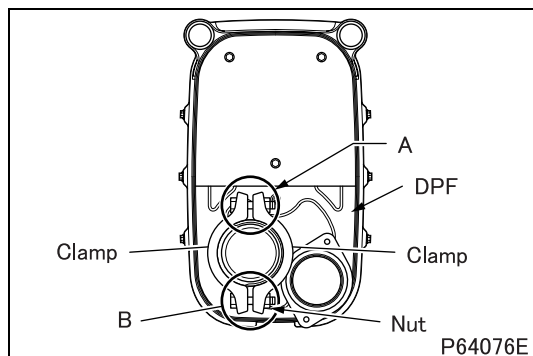
Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (front pipe mounting)	34 to 54 {3.5 to 5.5}	—
Tb	Nut (DPF mounting)	70 to 95 {7.1 to 9.7}	—
Tc	Nut (bracket mounting)	306 to 360 {31 to 37}	—
Td	Nut (bracket mounting)	20 ± 3 {2.1 ± 0.3}	—

◆ Inspection procedure ◆



■ Inspection: DPF

- Check the inner exhaust channel of DPF for clogging with foreign material.
- If clogged, the inner exhaust channel must be cleaned with compressed air or DPF must be replaced.
- If DPF is clogged, this may be due to problems with the engine. Check the engine and adjust as required. Also check the engine oil and fuel.



■ Installation: Clamps and rubber cushions

- Tighten the nuts just enough to loosely retain the clamps so that they can easily be moved.
- Tighten the nut at A until the ends of the clamps at A contact with each other.
- Completely tighten the nut at B.

CAUTION ⚠

- **Do not overtighten the nut at B, or the clamps and DPF may become damaged.**

GROUP 17 MITSUBISHI 6M70

EMISSION CONTROL

STRUCTURE AND OPERATION

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- 2. Blowby Gas Return System 17-7

ON-VEHICLE INSPECTION AND ADJUSTMENT

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- 2. Check for Cracks and Damages in Piping of Blowby Gas
Return System 17-8
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EXHAUST GAS RECIRCULATION SYSTEM

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- 2. Diagnostic Precautions 17-10
- 3. Inspections Based on Diagnosis Codes17-11
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EGR VALVE, EGR MAGNETIC VALVE, EGR PIPE AND
EGR COOLER..... 17-26

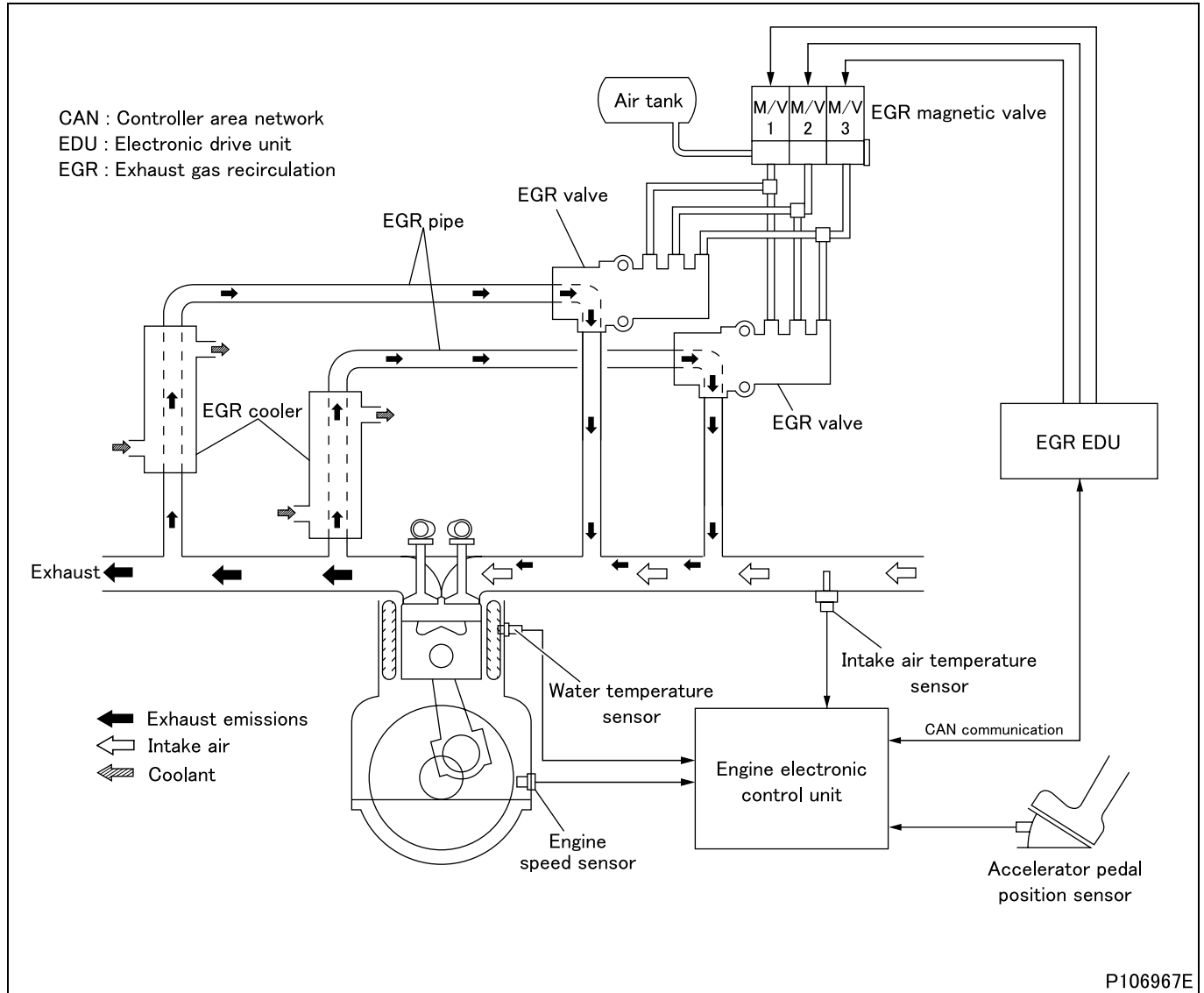
BLOWBY GAS RETURN SYSTEM 17-29

STRUCTURE AND OPERATION

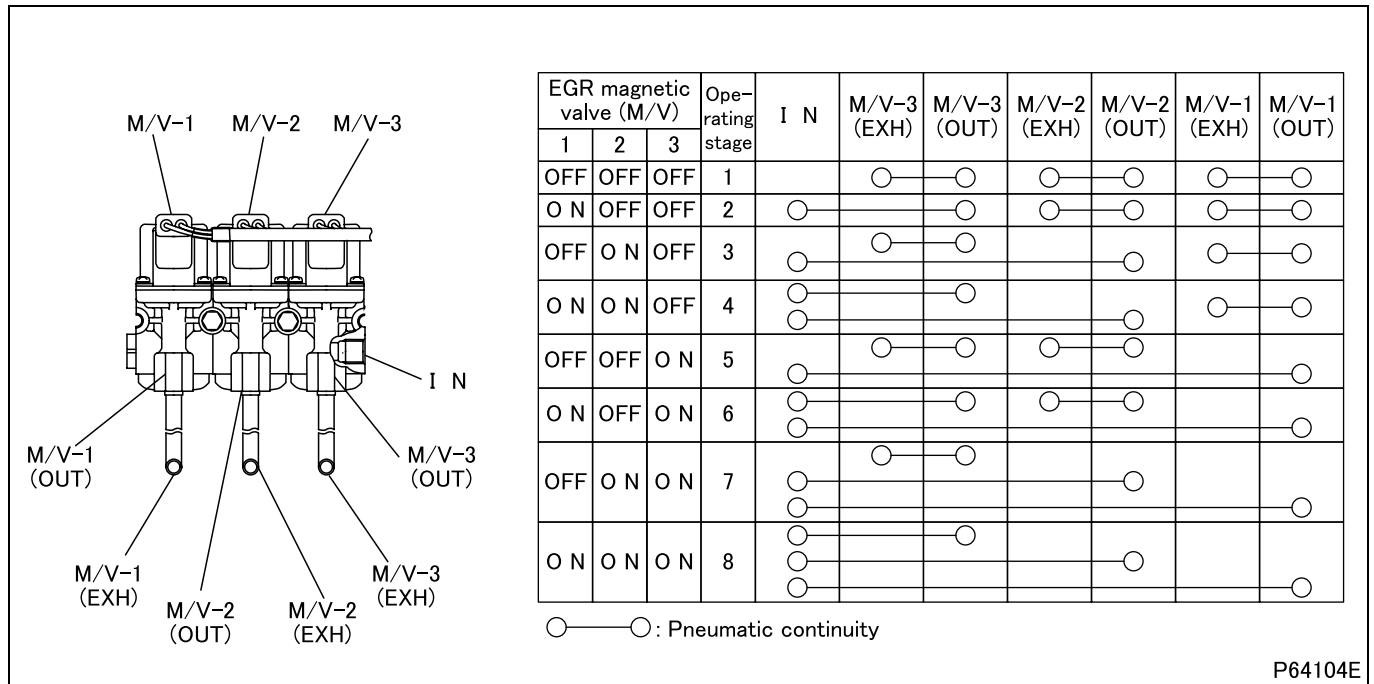
1. Exhaust Gas Recirculation System

1.1 Overview

- In the exhaust gas recirculation system, various engine-related information (engine speed, water temperature, accelerator position) is collected by the relevant sensors and is sent to the engine electronic control unit and EGR EDU which then control the EGR magnetic valves based on the information received.
- EGR achieves lower combustion temperatures by reintroducing combusted exhaust gas (which contains inert gases) into the intake manifold. This has the effect of reducing the amount of harmful NO_x (nitrogen oxides) formed in the engine. The EGR cooler enhances the NO_x (nitrogen oxides) reducing performance of the EGR system by cooling the mixed exhaust gas to lower maximum combustion temperature.

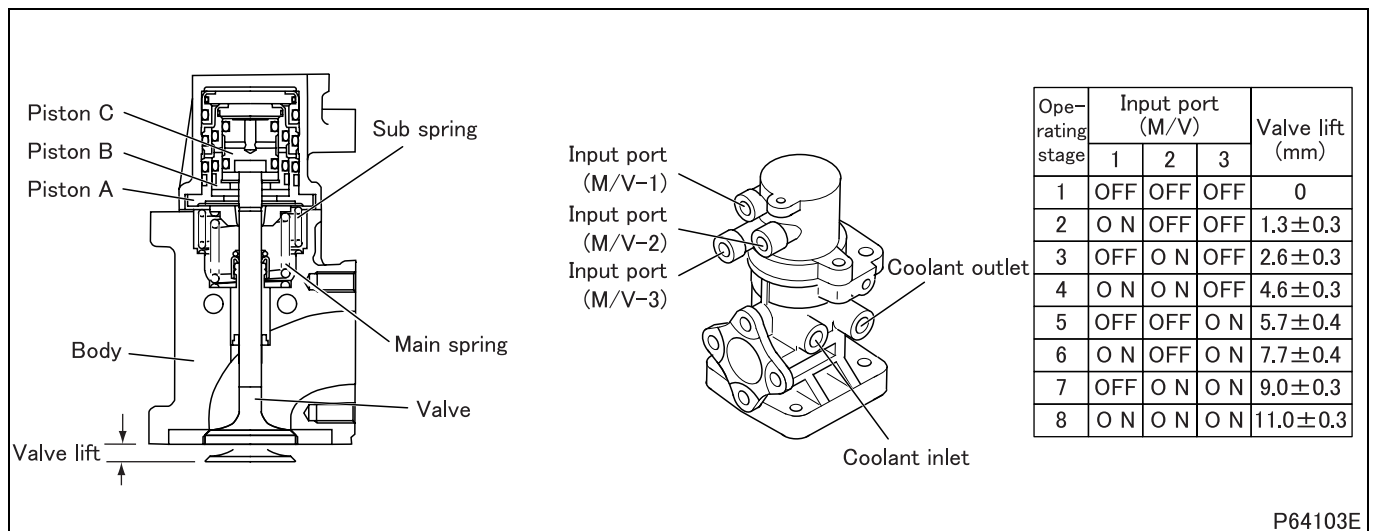


(1) EGR magnetic valves



- The EGR magnetic valves are each turned ON/OFF by drive signals from the engine electronic control unit to realize a 7-stage supply of air to the EGR valve.

(2) Mitsubishi 6M70 EGR valve

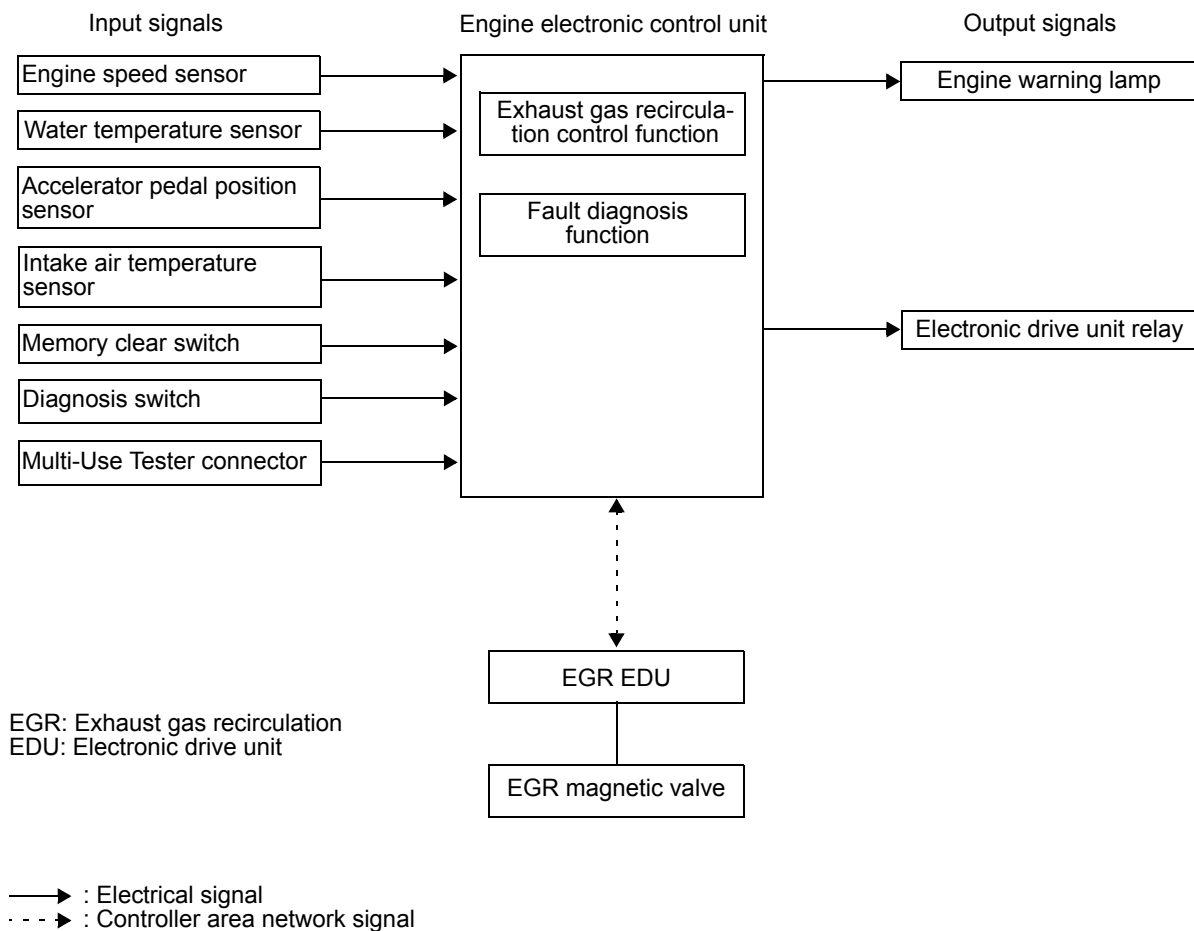


- The EGR valve realizes 7 stages of valve lift in accordance with the supply of air to its input ports from the EGR magnetic valves.

STRUCTURE AND OPERATION

1.2 Electronic control system

(1) System block diagram



(2) Exhaust gas recirculation valve control function

- Based on inputs from various sensors, the engine electronic control unit determines the degree of opening of the exhaust gas recirculation valve and sends corresponding control signals to the exhaust gas recirculation electronic drive unit to activate the exhaust gas recirculation magnetic valve.

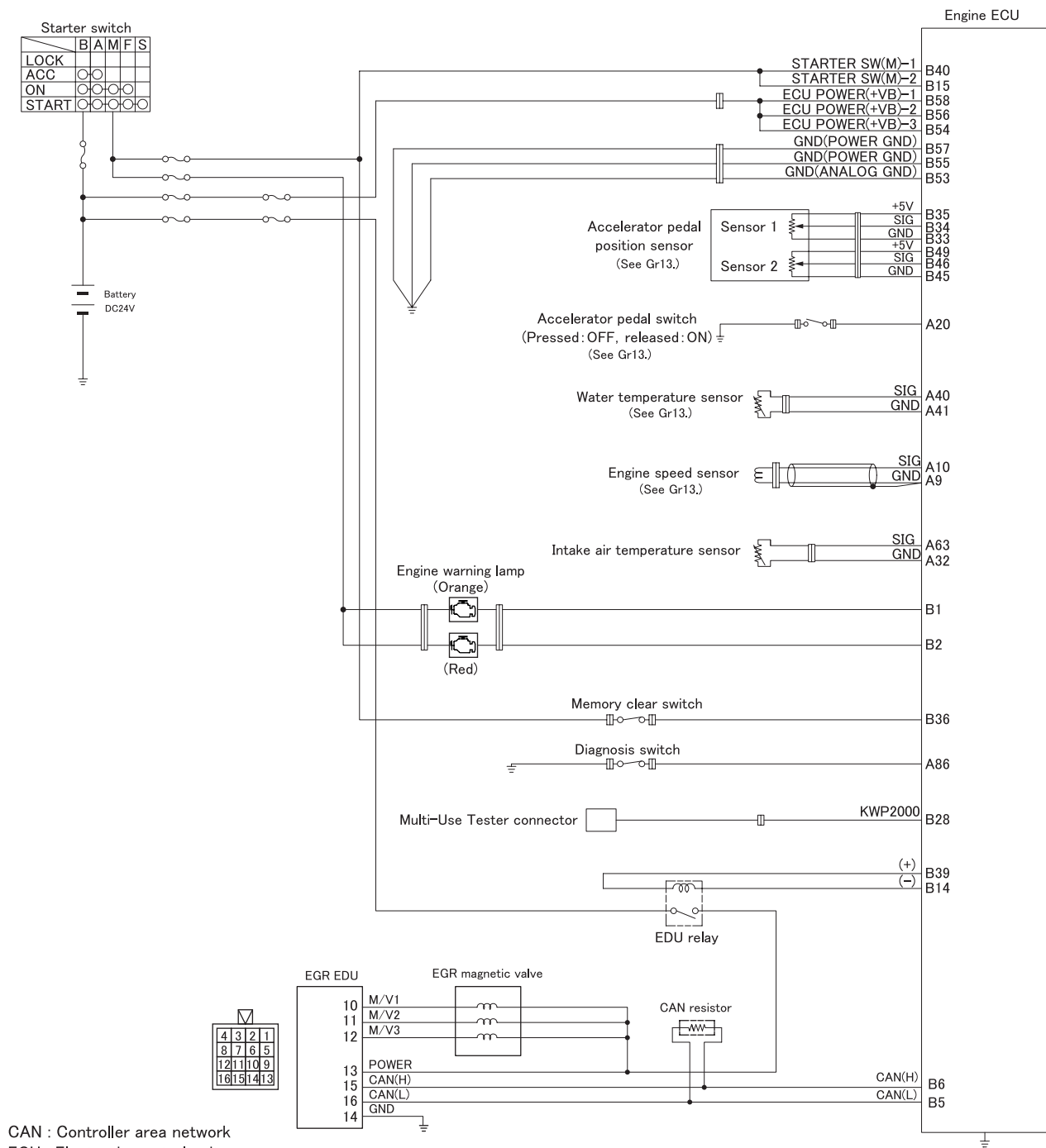
In the case of black smoke emission or engine speed instability, which may occur when the engine is heavily loaded or lightly loaded, or when the auxiliary brake is operating, the engine electronic control unit stops exhaust gas recirculation valve control.

(3) Fault diagnosis function

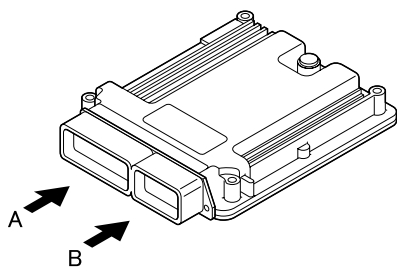
- While the starter switch is in the ON position, the engine electronic control unit continuously monitors exhaust gas recirculation electronic drive unit, the sensors and other control elements for faults. In the event that the engine electronic control unit finds a component faulty, it causes an indication to be made in the meter cluster to alert the driver. At the same time, it memorizes the fault location in the form of a diagnosis code.
- While the engine is running, the exhaust gas recirculation electronic drive unit continuously monitors the status of communication with the exhaust gas recirculation magnetic valve and engine electronic control unit. When the exhaust gas recirculation electronic drive unit detects a fault, it sends the information to the engine electronic control unit.
- While the control during fault is taking place, the system's functionality is limited to ensure vehicle and driver safety. It is possible to read the memorized diagnosis code using a Multi-Use Tester or from flashing of the warning lamp.
- Diagnosis codes shown by the Multi-Use Tester and those indicated by flashing of the warning lamp are different.
- The Multi-Use Tester is capable of showing more detailed diagnosis codes.

STRUCTURE AND OPERATION

1.3 Electronic control unit connection diagram



CAN : Controller area network
ECU : Electronic control unit
EDU : Electronic drive unit
EGR : Exhaust gas recirculation



A: GE96A

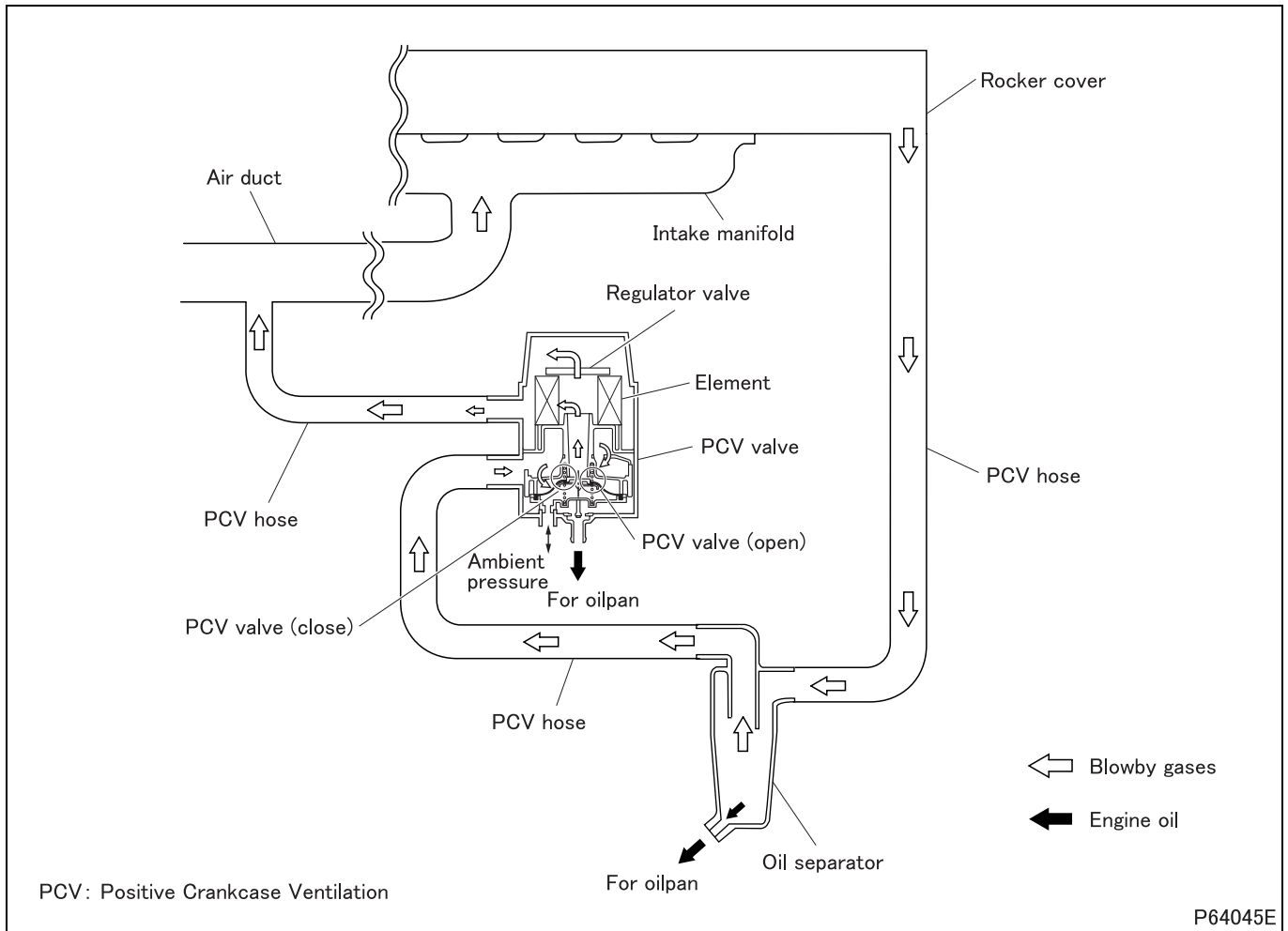
24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25
72	71	70	69	68	67	66	65	64	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49
96	95	94	93	92	91	90	89	88	87	86	85	84	83	82	81	80	79	78	77	76	75	74	73

B: GE58A

54	53	13	12	11	10	9	8	7	6	5	4	3	2	1
56	55	26	25	24	23	22	21	20	19	18	17	16	15	14
58	57	39	38	37	36	35	34	33	32	31	30	29	28	27
		52	51	50	49	48	47	46	45	44	43	42	41	40

P106651E

2. Blowby Gas Return System



- The blowby gas return system is designed to introduce blowby gases into the intake air duct for reburning, thus preventing the gases from being released to the atmosphere.
- The positive crankcase ventilation valve keeps constant the pressure inside the crankcase.
- The oil in the blowby gas is separated by the wire mesh and the element in the oil separator and the positive crankcase ventilation valve and is returned to the oil pan.
- When the element is clogged, the regulator valve opens and the blowby gas flows to the positive crankcase ventilation hose without passing through the element.

ON-VEHICLE INSPECTION AND ADJUSTMENT

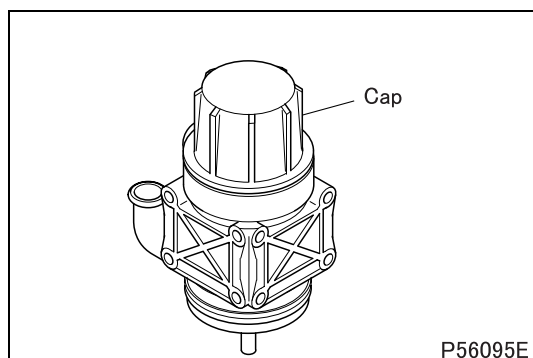
1. Replacement of Positive Crankcase Ventilation Valve Element

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
—	O-ring	Engine oil	As required

CAUTION

- For information on the element replacement interval, refer to the element instruction manual. If the element is used beyond its replacement interval, it may become clogged, causing the pressure inside the engine to increase such that oil leakage occurs.

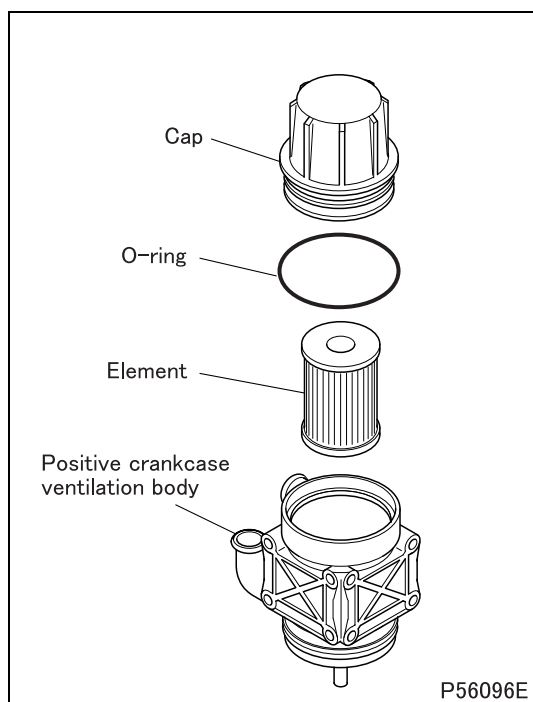


[Removal]

- Loosen the cap by hand.

CAUTION

- Do not use any tools to loosen the cap. Otherwise, the cap may become damaged.



[Installation]

- Clean the thread on the cap.
- Lightly smear the O-ring with engine oil and fit it on the cap.
- Securely tighten the cap until it stops slightly above the positive crankcase ventilation body.

CAUTION

- Be sure to use a genuine Mitsubishi Fuso element. Using an inappropriate element could result in engine trouble.
- When replacing the element, be sure to replace the O-ring also.

2. Check for Cracks and Damages in Piping of Blowby Gas Return System

- Inspect the piping of blowby gas return system visually. If there is any cracks or damages, replace the piping. (See "BLOWBY GAS RETURN SYSTEM".)

3. Check for Cracks, Damages and Looseness in Piping of Exhaust Gas Recirculation System

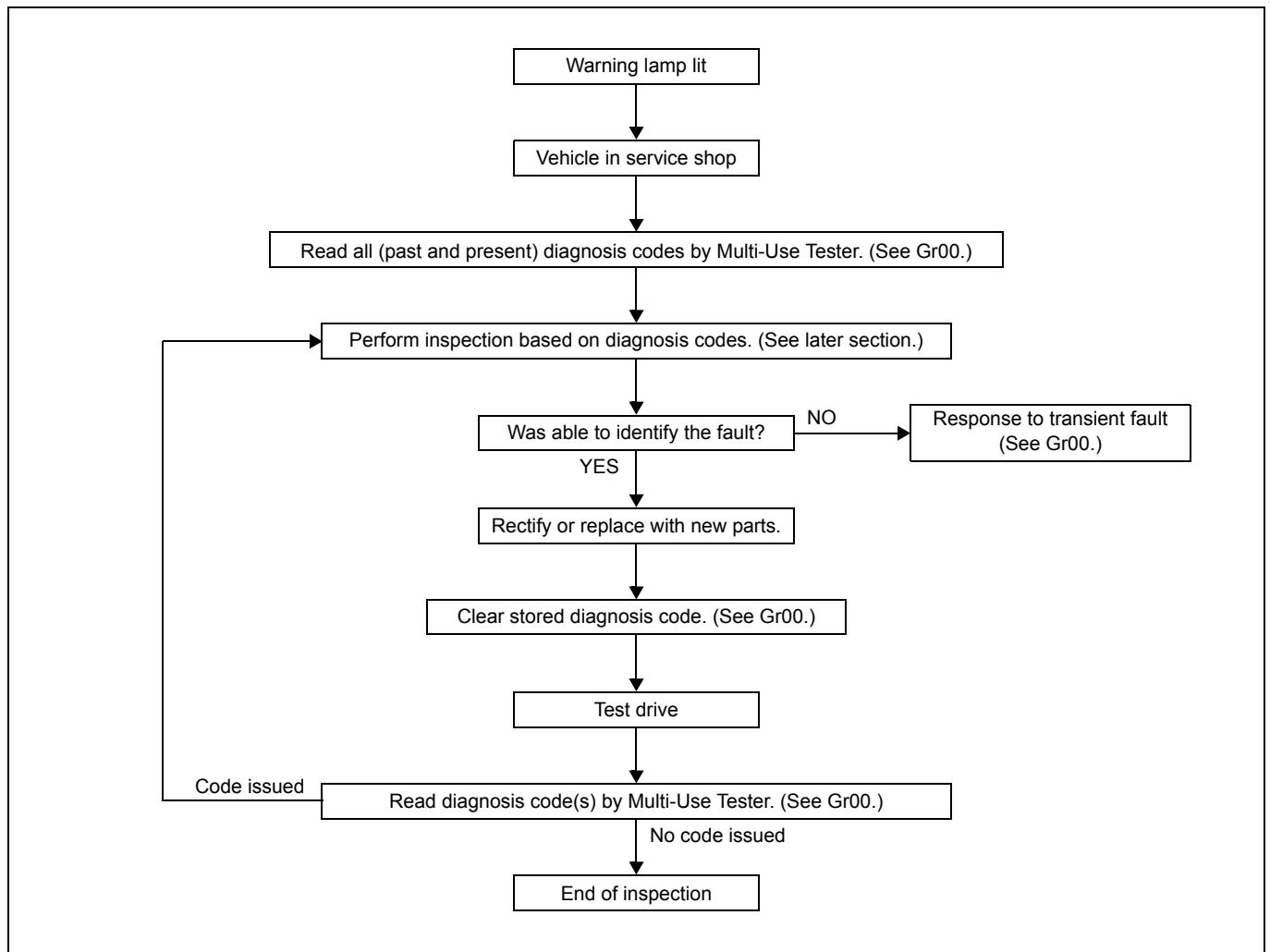
- Inspect the exhaust gas recirculation pipe visually. If there is any cracks or damages, replace the pipe. (See "EGR VALVE, EGR PIPE AND EGR COOLER".)
- Check for looseness in the exhaust gas recirculation pipe mounting bolts and nuts. If there is looseness, tighten the bolts and nuts to the specified torque. (See "EGR VALVE, EGR PIPE AND EGR COOLER".)

M E M O

EXHAUST GAS RECIRCULATION SYSTEM

1. Diagnosis Procedure

- Perform the inspection in accordance with the following flowchart.



2. Diagnostic Precautions

- Before measuring voltage, check the battery for charged condition and specific gravity. If system inspection is performed with the battery uncharged or reduced in specific gravity, accurate measurements cannot be achieved.
- Before disconnecting battery cables, harnesses and connectors, set the starter switch to LOCK or OFF, then allow at least 20 seconds.
- To avoid having electrical parts damaged, set the starter switch and lighting switch to LOCK or OFF before reconnecting battery cables, harnesses and connectors.
- When performing measurement with the tester, handle the test bar carefully so that it does not damage internal circuit and other electrical parts of the electronic control unit to result in a short-circuit failure between terminals in connector or between connector and car body.
- Resistance is affected by temperature. Determine the necessity of resistance measurement following given temperature specification as a guide. Otherwise, use normal temperature (10 to 35°C) as the measuring condition.

3. Inspections Based on Diagnosis Codes

3.1 Diagnosis code list

- Diagnosis codes shown by the Multi-Use Tester and those indicated by warning lamp display are different.
- The Multi-Use Tester is capable of showing more detailed diagnosis codes.

Code	Message	Warning lamp indication		
		Flashes	Red	Orange
P0112	INT Air Temp SNSR (Low)	44	—	O
P0113	INT Air Temp SNSR (High)	44	—	O
P1267	EGR 1	67	—	O
P1268	EGR 1	67	—	O
P1272	EGR 2	68	—	O
P1273	EGR 2	68	—	O
P1277	EGR 3	69	—	O
P1278	EGR 3	69	—	O
P1625	EDU Relay	84	—	O
P1630	CAN (EGR 1)	95	—	O

3.2 Diagnosis code generation conditions and inspection items

P0112: INT Air Temp SNSR (Low) (warning lamp flashes: 44)

Generation condition		Intake air temperature sensor 1 voltage remains lower than 0.15 V for 3 seconds.
Recoverability		System recovers if intake air temperature sensor 1 voltage remains higher than 0.15 V for 1 second.
Control effected by electronic control unit		Carries out control using a backup value (25°C).
Inspection	Service data	2B: Intake Air Temperature
	Electronic control unit connector	01 : Intake air temperature sensor 1
	Electrical equipment	#305: Intake air temperature sensor
	Electric circuit diagram	Intake air temperature sensor 1 system

P0113: INT Air Temp SNSR (High) (warning lamp flashes: 44)

Generation condition		Intake air temperature sensor 1 voltage remains higher than 4.85 V for 3 seconds.
Recoverability		System recovers if intake air temperature sensor 1 voltage remains lower than 4.85 V for 1 second.
Control effected by electronic control unit		Carries out control using a backup value (25°C).
Inspection	Service data	2B: Intake Air Temperature
	Electronic control unit connector	01 : Intake air temperature sensor 1
	Electrical equipment	#305: Intake air temperature sensor
	Electric circuit diagram	Intake air temperature sensor 1 system

P1267: EGR1 (warning lamp: 67)

Generation condition		Controller area network signal from exhaust gas recirculation electronic drive unit indicating "magnetic valve (M/V-1) circuit shorted to ground or open" remains being received for 2 seconds.
Recoverability		System recovers if controller area network signal from exhaust gas recirculation electronic drive unit indicating "magnetic valve (M/V-1) is normal" remains being received for 1 second.
Control effected by electronic control unit		Exhaust gas recirculation control is stopped.
Inspection	Service data	20: Actual EGR Position
	Actuator test	A1: EGR1
	Electrical equipment	#530: Exhaust gas recirculation magnetic valve
	Electric circuit diagram	Exhaust gas recirculation magnetic valve system

EXHAUST GAS RECIRCULATION SYSTEM

P1268: EGR1 (warning lamp: 67)

Generation condition		Controller area network signal from exhaust gas recirculation electronic drive unit indicating "magnetic valve (M/V-1) circuit shorted to power source" remains being received for 2 seconds.
Recoverability		System recovers if controller area network signal from exhaust gas recirculation electronic drive unit indicating "magnetic valve (M/V-1) is normal" remains being received for 1 second.
Control effected by electronic control unit		Exhaust gas recirculation control is stopped.
Inspection	Service data	20: Actual EGR Position
	Actuator test	A1: EGR1
	Electrical equipment	#530: Exhaust gas recirculation magnetic valve
	Electric circuit diagram	Exhaust gas recirculation magnetic valve system

P1272: EGR2 (warning lamp: 68)

Generation condition		Controller area network signal from exhaust gas recirculation electronic drive unit indicating "magnetic valve (M/V-2) circuit shorted to ground or open" remains being received for 2 seconds.
Recoverability		System recovers if controller area network signal from exhaust gas recirculation electronic drive unit indicating "magnetic valve (M/V-2) is normal" remains being received for 1 second.
Control effected by electronic control unit		Exhaust gas recirculation control is stopped.
Inspection	Service data	20: Actual EGR Position
	Actuator test	A2: EGR2
	Electrical equipment	#530: Exhaust gas recirculation magnetic valve
	Electric circuit diagram	Exhaust gas recirculation magnetic valve system

P1273: EGR2 (warning lamp: 68)

Generation condition		Controller area network signal from exhaust gas recirculation electronic drive unit indicating "magnetic valve (M/V-2) circuit shorted to power source" remains being received for 2 seconds.
Recoverability		System recovers if controller area network signal from exhaust gas recirculation electronic drive unit indicating "magnetic valve (M/V-2) is normal" remains being received for 1 second.
Control effected by electronic control unit		Exhaust gas recirculation control is stopped.
Inspection	Service data	20: Actual EGR Position
	Actuator test	A2: EGR2
	Electrical equipment	#530: Exhaust gas recirculation magnetic valve
	Electric circuit diagram	Exhaust gas recirculation magnetic valve system

P1277: EGR3 (warning lamp: 69)

Generation condition		Controller area network signal from exhaust gas recirculation electronic drive unit indicating "magnetic valve (M/V-3) circuit shorted to ground or open" remains being received for 2 seconds.
Recoverability		System recovers if controller area network signal from exhaust gas recirculation electronic drive unit indicating "magnetic valve (M/V-3) is normal" remains being received for 1 second.
Control effected by electronic control unit		Exhaust gas recirculation control is stopped.
Inspection	Service data	20: Actual EGR Position
	Actuator test	A3: EGR3
	Electrical equipment	#530: Exhaust gas recirculation magnetic valve
	Electric circuit diagram	Exhaust gas recirculation magnetic valve system

P1278: EGR3 (warning lamp: 69)

Generation condition		Controller area network signal from exhaust gas recirculation electronic drive unit indicating "magnetic valve (M/V-3) circuit shorted to power source" remains being received for 2 seconds.
Recoverability		System recovers if controller area network signal from exhaust gas recirculation electronic drive unit indicating "magnetic valve (M/V-3) is normal" remains being received for 1 second.
Control effected by electronic control unit		Exhaust gas recirculation control is stopped.
Inspection	Service data	20: Actual EGR Position
	Actuator test	A3: EGR3
	Electrical equipment	#530: Exhaust gas recirculation magnetic valve
	Electric circuit diagram	Exhaust gas recirculation magnetic valve system

P1625: EDU Relay (warning lamp flashes: 84)

Generation condition		Either of the following occurs. (1) Current flowing in the electronic drive unit relay remains exceeds the specified value for 1 second. (2) Electronic drive unit relay circuit remains shorted to ground or open (driving terminal low level when turned OFF) as detected for 1 second. (3) Electronic drive unit relay circuit remains shorted to power supply (high level when turned ON) as detected for 1 second.
Recoverability		- In the case of above problem (1) - System recovers if current flowing in the electronic drive unit relay remains lower than the specified value. - In the case of above problem (2) - System recovers if current flowing in the electronic drive unit relay remains normal (driving terminal high level when turned OFF) for 1 second. - In the case of above problem (3) - System recovers if current flowing in the electronic drive unit relay remains normal (driving terminal low level when turned ON) for 1 second.
Control effected by electronic control unit		Exhaust gas recirculation control is stopped.
Inspection	Service data	89: EDU Power Relay
	Actuator test	B2: EDU Relay
	Electronic control unit connector	02 : Electronic drive unit relay
	Electrical equipment	#201: Inspection of relay
	Electric circuit diagram	Electronic drive unit relay system

P1630: CAN (EGR 1) (warning lamp flashes: 95)

Generation condition		Any of the following occurs. (1) Controller area network signal from exhaust gas recirculation electronic drive unit 1 indicating "target exhaust gas recirculation opening received from engine electronic control unit is wrong" remains being received for 2 seconds. (2) No controller area network signal from exhaust gas recirculation electronic drive unit is received for 1 second. (3) Engine controller area network signal abnormal state lasts for 0.5 second.
Recoverability		- In the case of above problem (1) - System recovers if controller area network signal from exhaust gas recirculation electronic drive unit 1 indicating "target exhaust gas recirculation opening received from engine electronic control unit is normal" remains being received for 1 second. - In the case of above problem (2) - System recovers if controller area network signal from exhaust gas recirculation electronic drive unit remains being received for 0.5 second. - In the case of above problem (3) - System recovers if normal engine controller area network signal lasts for 0.5 second.
Control effected by electronic control unit		Exhaust gas recirculation control is stopped.
Inspection	Service data	20: Actual EGR Position 1
	Actuator test	A1: EGR 1
	Electrical equipment	Exhaust gas recirculation electronic drive unit and engine electronic control unit
	Electric circuit diagram	Controller area network communication system between engine electronic control unit and exhaust gas recirculation electronic drive unit

EXHAUST GAS RECIRCULATION SYSTEM

4. Multi-Use Tester Service Data

- It is possible to see service data and actuator tests simultaneously.

No.	Item	Data	Inspection condition	Requirement
20	Actual EGR Position	■■■■■.	Perform actuator test [Actuator test] A1: EGR 1	Position as commanded by actuator test
2B	Intake Air Temperature	■■■■. ■°C	On a cold engine	Equal to ambient temperature
89	EDU Power Relay	ON/OFF	Starter switch ON	ON
			Starter switch OFF	OFF
			[Actuator test] B2: EDU relay	

5. Actuator Tests Performed Using Multi-Use Tester

- It is possible to see service data and actuator tests simultaneously.

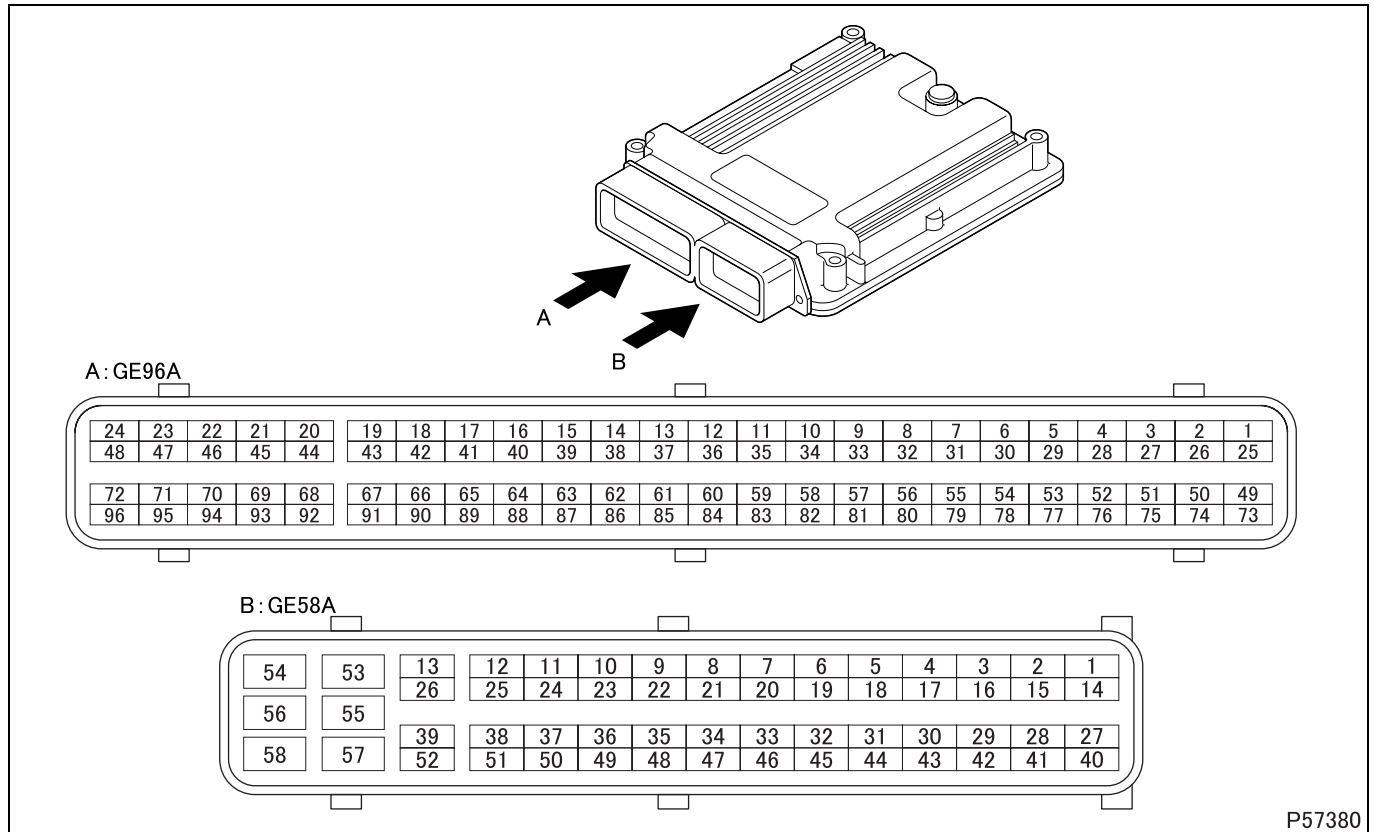
No.	Item	Explanation	Confirmation method
A0	EGR 1	Maintain exhaust gas recirculation valve 1 opening indicated by Multi-Use Tester.	Actual position of service data matches target value commanded by actuator test [Service data] 20: Actual EGR Position
A1	EGR 2	[Can be executed when the following conditions are satisfied] • Vehicle: stationary (vehicle speed 0 km/h)	
A3	EGR 3	• Starter switch: ON • Engine: stopped	
AC	EDU Relay	ON/OFF switchover of electronic drive unit relay (automatically reset after 15 seconds) [Can be executed when the following conditions are satisfied] • Vehicle: stationary (vehicle speed 0 km/h) • Starter switch: ON • Engine: stopped	Operating sound of electronic drive unit relay [Service data] 89: EDU Power Relay

6. Inspections Performed at Electronic Control Unit Connectors

- These inspections aid troubleshooting by enabling you to check whether electronic control unit signals are being correctly transmitted via the vehicle harness and connectors.

The white-on-black numbers (**01** , **02** , and so on) correspond to the similarly printed reference numbers in section “3. Inspections Based on Diagnosis Codes”.

6.1 Electronic control unit connector terminal layout



6.2 Inspection instructions

- Some inspections are performed with the connectors removed. Others are performed with the connectors fitted. Observe the following caution:

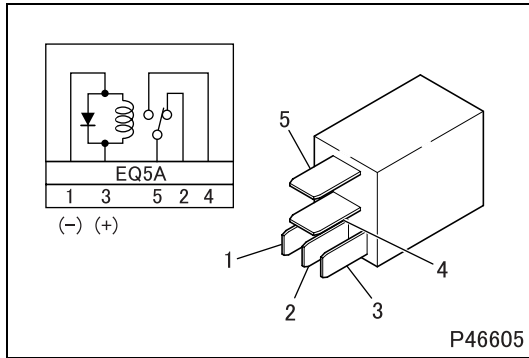
CAUTION

- Do not touch any terminal except those specified for the inspection. Be particularly careful not to cause short circuits between terminals using the tester probes.

Check item	Measurement method
01 Resistance of intake air temperature sensor 1	[Conditions] - Starter switch OFF - Disconnect connector. Perform inspection on vehicle-side connector. [Requirements] Terminals: A63-A32 0°C: $15^{+3.78}_{-2.94}$ kΩ 20°C: $6.514^{+1.437}_{-1.147}$ kΩ 80°C: $0.874^{+0.136}_{-0.115}$ kΩ
02 Voltage of electronic drive unit relay	[Conditions] - Starter switch ON - Vehicle-side harness connected (Perform inspection on back of connector.) [Requirements] Terminals (+)-(-): B14-ground - With relay operating: 0 V - With relay not operating: Corresponding to battery voltage

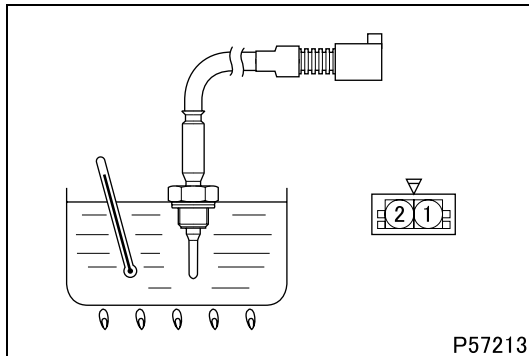
EXHAUST GAS RECIRCULATION SYSTEM

7. Inspection of Electrical Equipment



#201 Inspection of relay (normally open, 5 pins)

- Perform a continuity check and an operation check. If there is any abnormality, replace the relay.

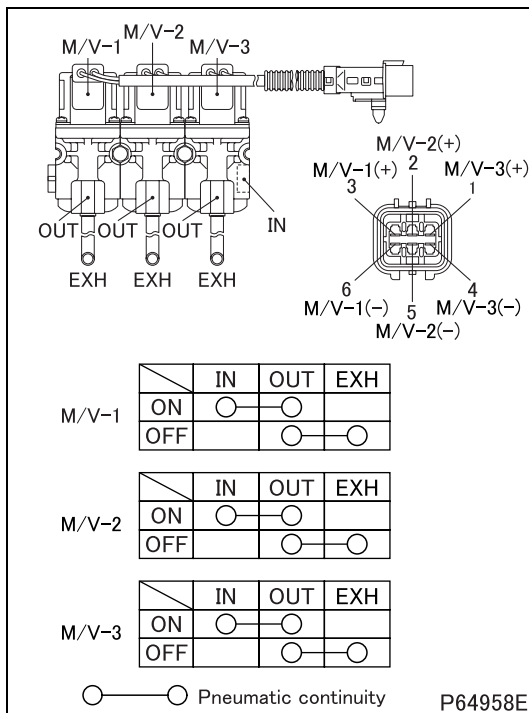


#305 Inspection of intake air temperature sensor

- Place the sensor in a container filled with engine oil.
- Heat the oil to each of the specified temperatures. Stir the oil well while doing so.
- Measure the resistance between terminals 1 and 2.

Standard value	0°C	$15^{+3.78}_{-2.94} \text{ k}\Omega$
	20°C	$6.514^{+1.437}_{-1.147} \text{ k}\Omega$
	80°C	$0.874^{+0.136}_{-0.115} \text{ k}\Omega$

- If either measurement is out of specification, replace the sensor.



#530 Inspection of exhaust gas recirculation magnetic valve

- Perform the following checks. If there is any abnormality, replace the exhaust gas recirculation magnetic valve.

(1) Check of operation

- Gradually increase from zero the voltage applied to terminals 3 and 6 (magnetic valve 1), 2 and 5 (magnetic valve 2) and 1 and 4 (magnetic valve 3).
- Observe the voltage when the exhaust gas recirculation magnetic valve operates.

(Determine the magnetic valve's OFF-ON operation from the operating sound.)

Standard value (min. operating voltage)	18 V or lower
--	---------------

(2) Check of continuity and airtightness

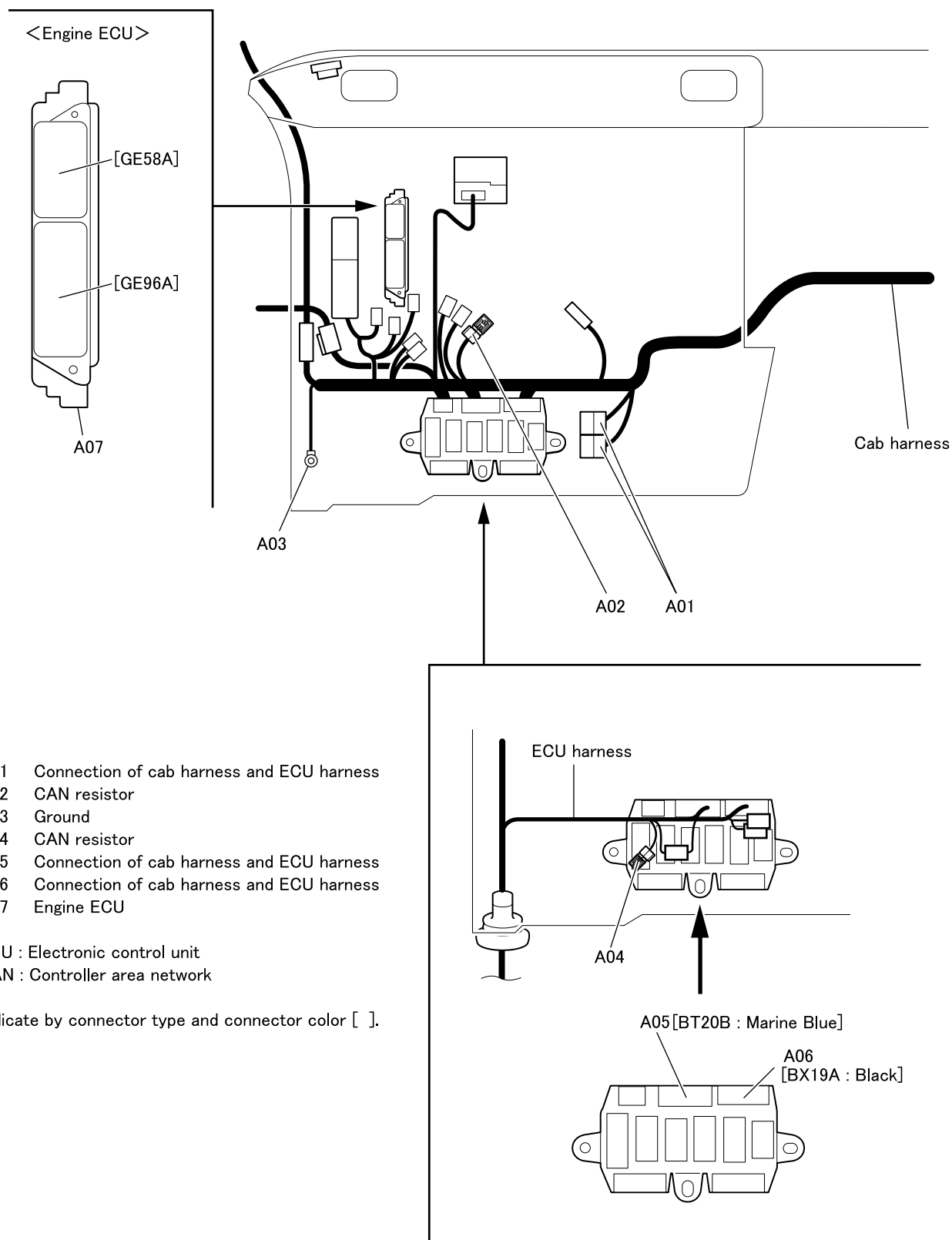
- Air pressure applied during check: 930 kPa {9.5 kgf/cm²}

M E M O

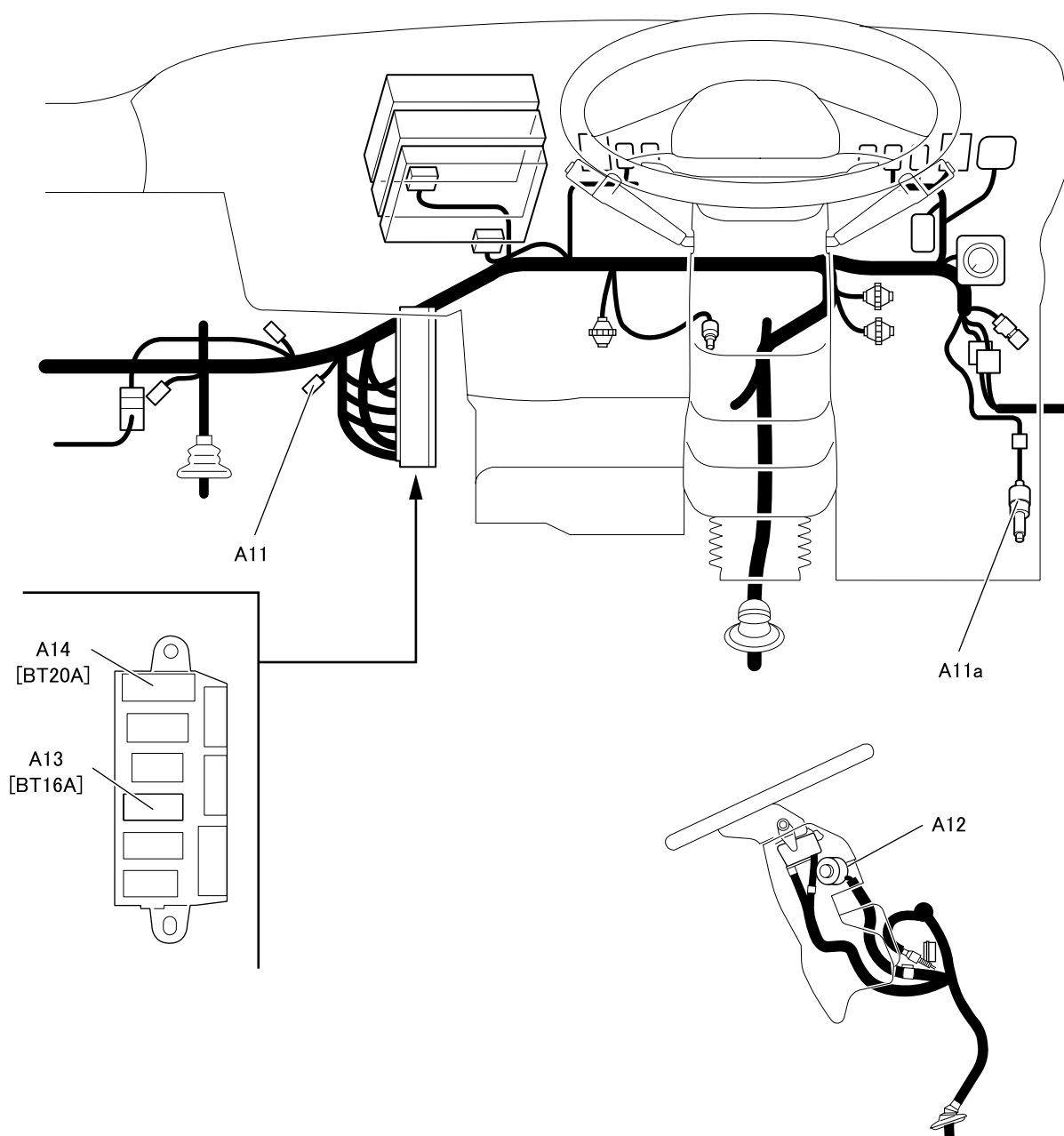
EXHAUST GAS RECIRCULATION SYSTEM

8. Installed Locations of Parts

A01 – 07



A11 - 14



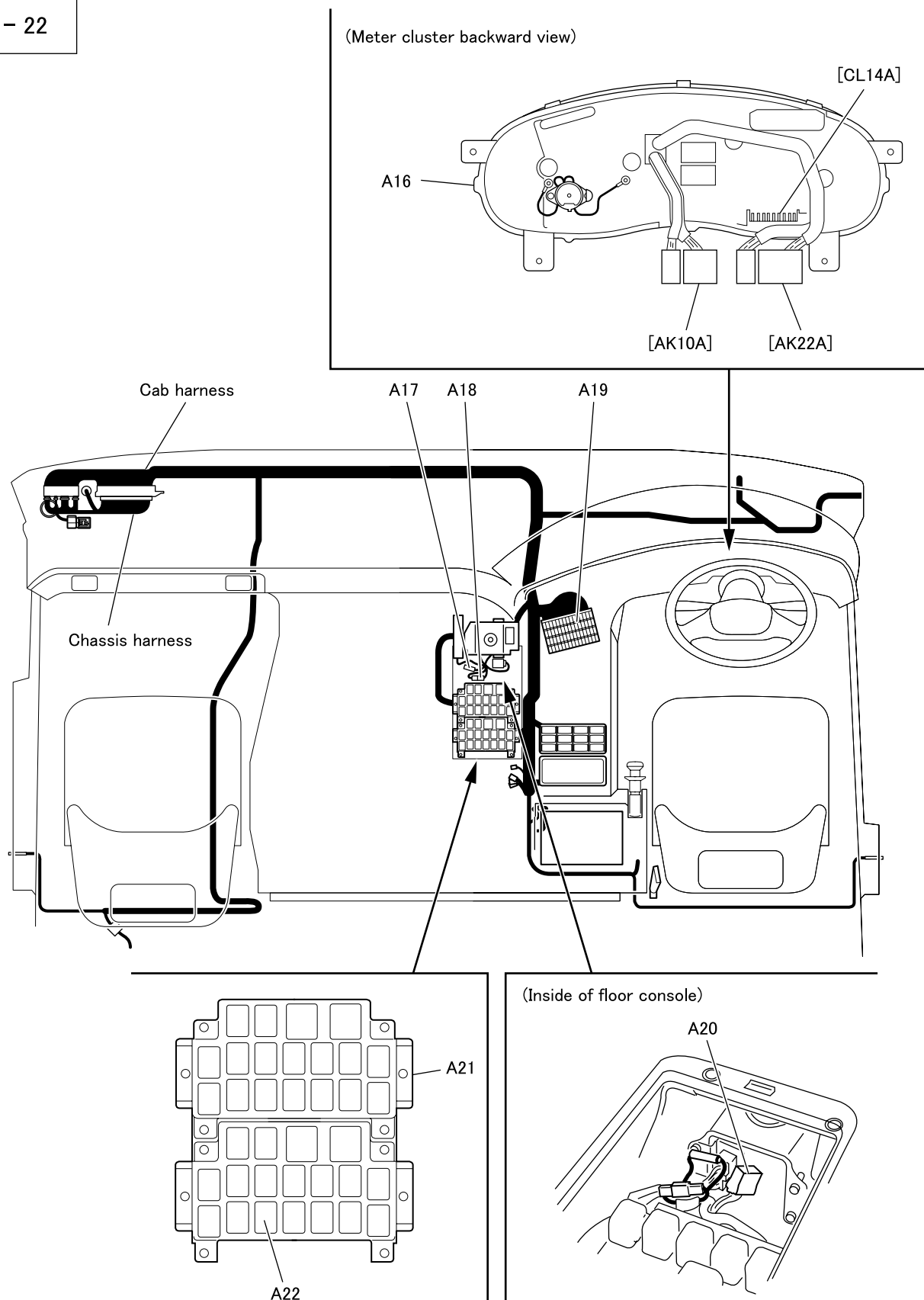
- A11 ECU main connector
- A11a Accelerator pedal switch
- A12 Starter switch
- A13 Connection of cab harness and instrument panel harness
- A14 Connection of cab harness and instrument panel harness

ECU : Electronic control unit

Indicate by connector type [].

EXHAUST GAS RECIRCULATION SYSTEM

A16 - 22

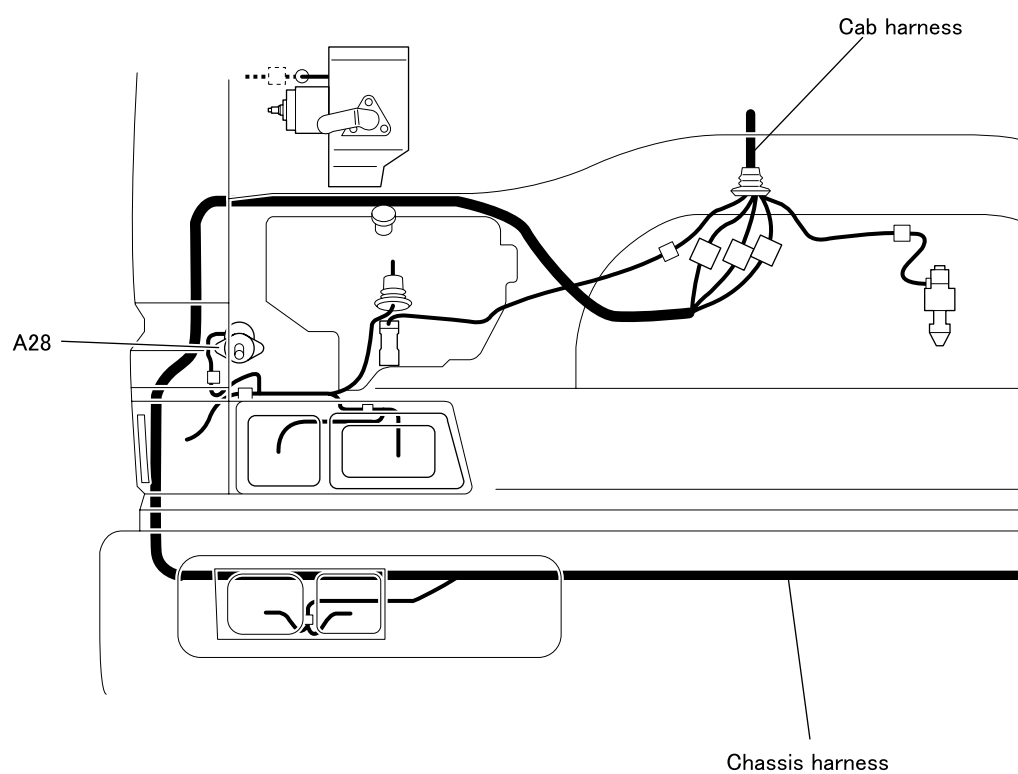
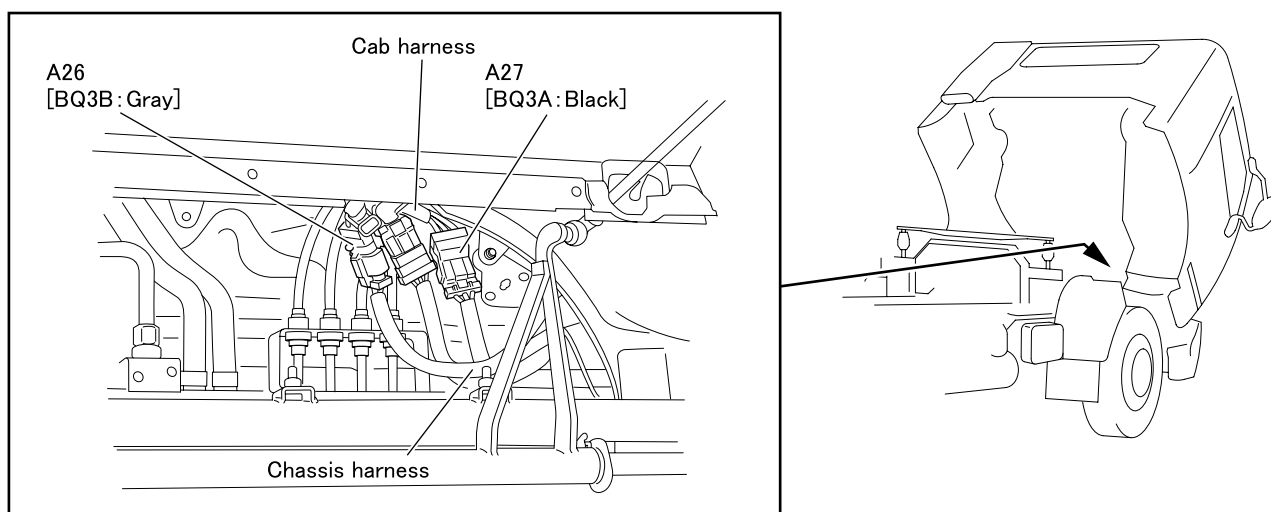


- A16 Meter cluster
- A17 Memory clear switch
- A18 Diagnosis switch
- A19 Fuse box
- A20 MUT connector
- A21 Relay box
- A22 EDU relay

ECU : Electronic control unit
 MUT : Multi-Use Tester
 EDU : Electronic drive unit

Indicate by connector type [].

A26 - 28

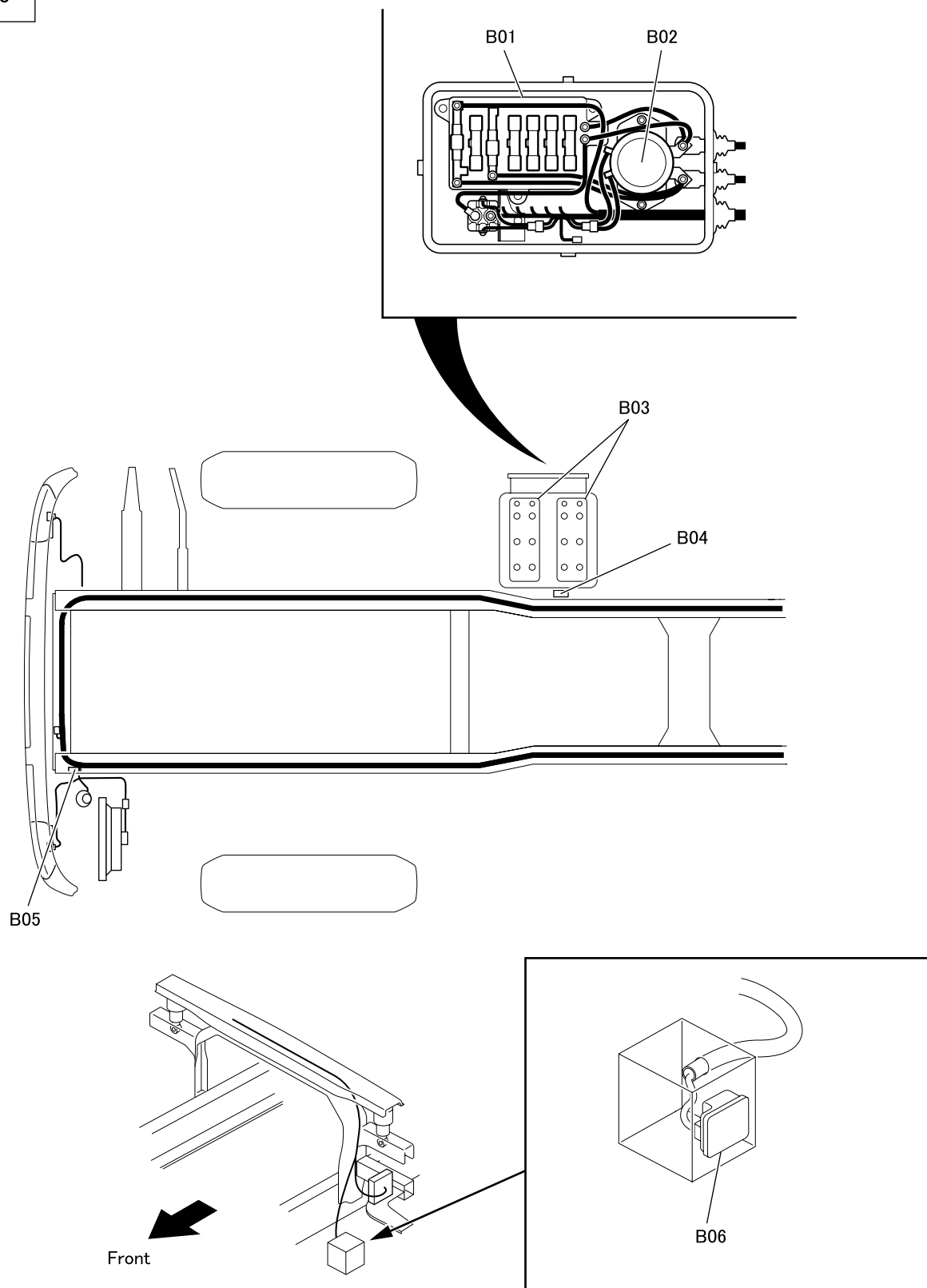


- A26 Connection of cab harness and chassis harness
- A27 Connection of cab harness and chassis harness
- A28 Accelerator pedal position sensor

Indicate by connector type and connector color [].

EXHAUST GAS RECIRCULATION SYSTEM

B01 - 06

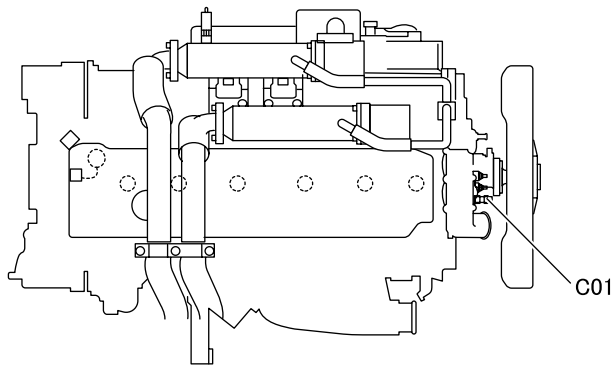


- B01 High-current fuse box
- B02 Main power relay
- B03 Battery
- B04 Ground
- B05 Ground
- B06 EGR EDU

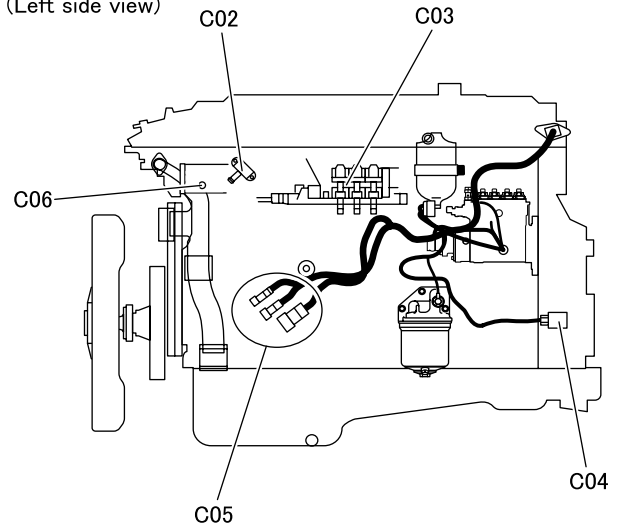
EGR : Exhaust gas recirculation
EDU : Electronic drive unit

C01 - 06

(Upper view)



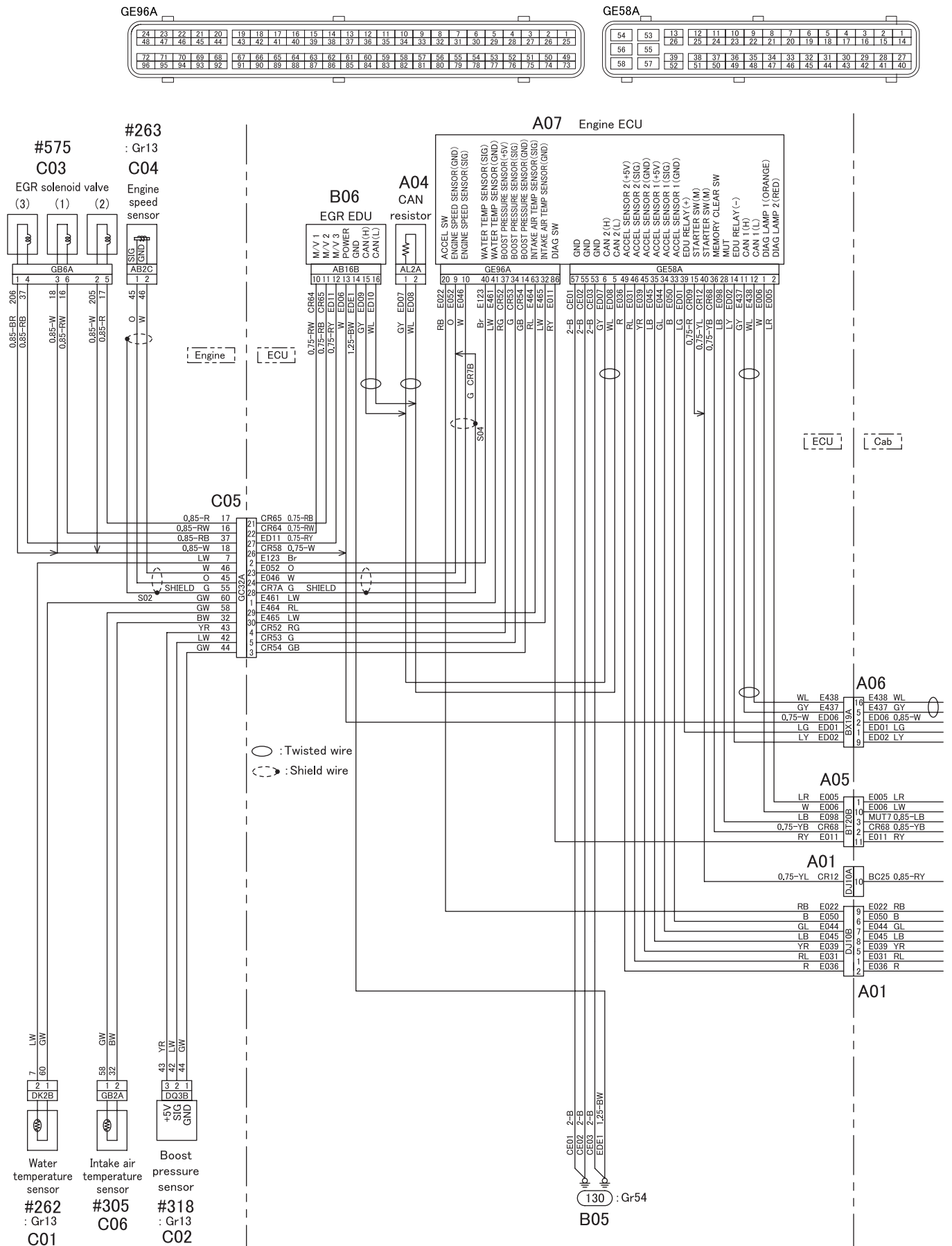
(Left side view)

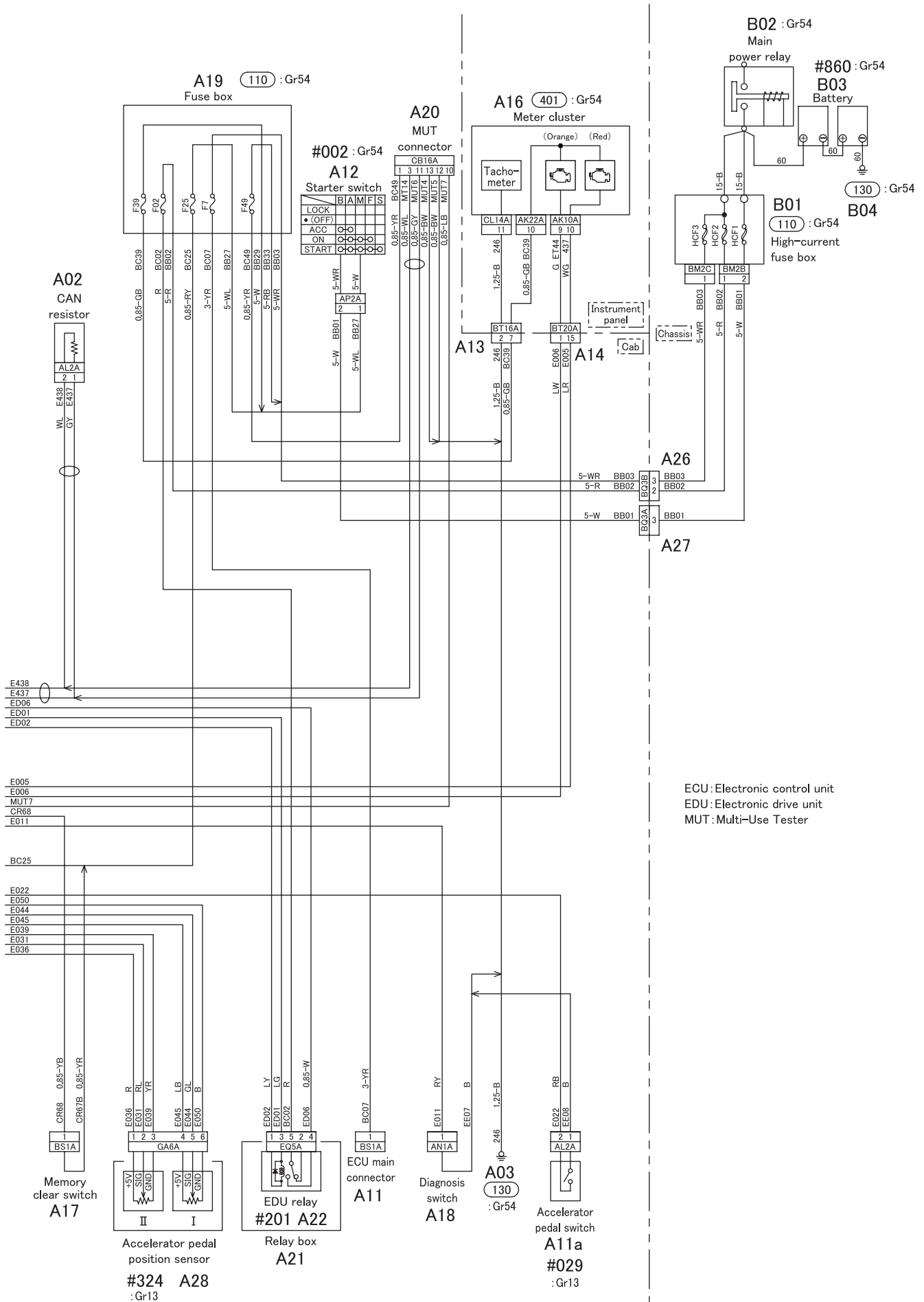


- C01 Water temperature sensor
(connects to engine electronic control unit)
- C02 Boost pressure sensor
- C03 EGR solenoid valve
- C04 Engine speed sensor
- C05 Connection of engine harness and ECU harness
- C06 Intake air temperature sensor

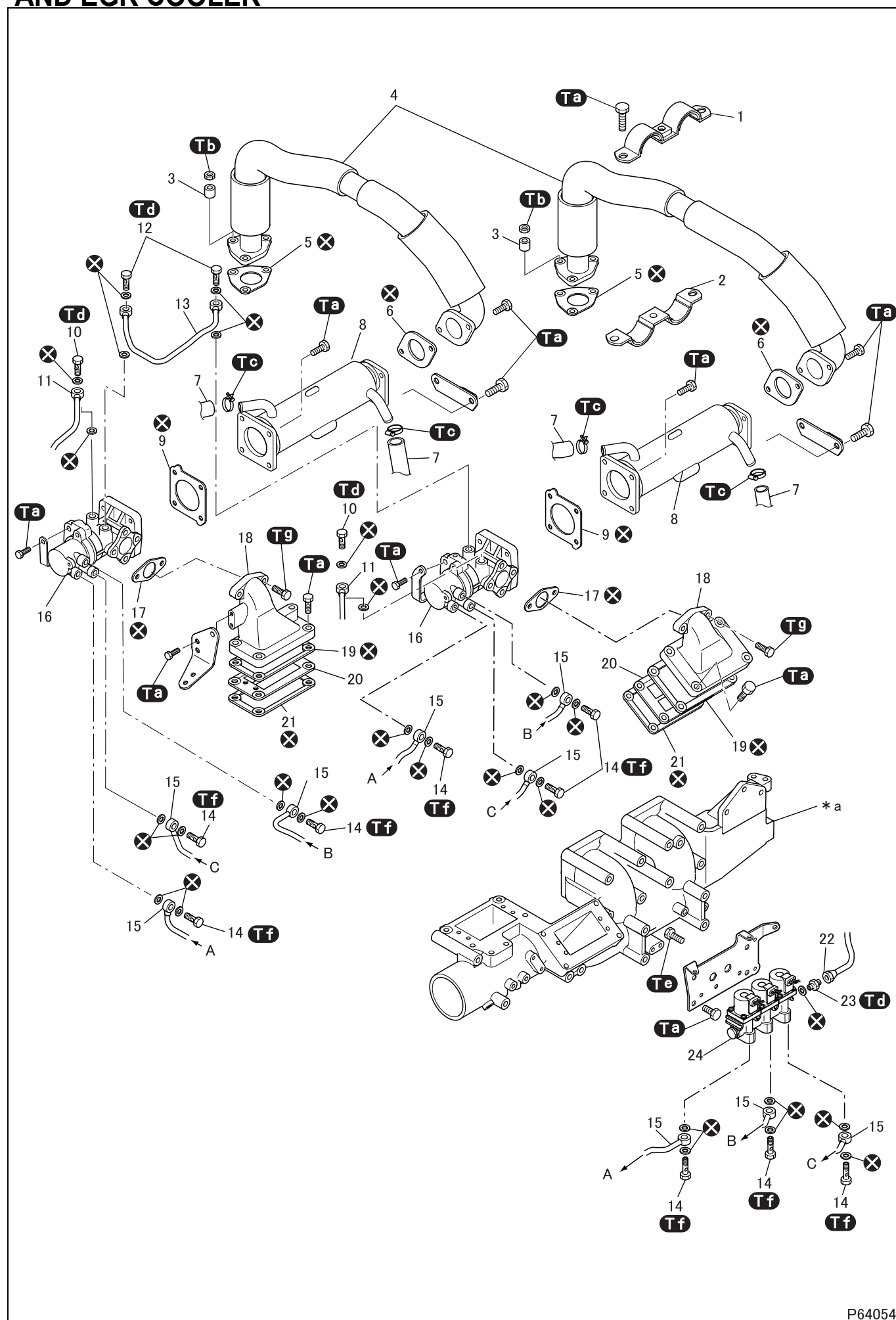
EGR : Exhaust gas recirculation
ECU : Electronic control unit

9. Electric Circuit Diagram





MITSUBISHI 6M70 EGR VALVE, EGR MAGNETIC VALVE, EGR PIPE AND EGR COOLER



P64054

● Removal sequence

- | | | |
|------------------------|-------------------|-------------------------------------|
| 1 Upper EGR pipe clamp | 11 EGR water pipe | 21 Gasket |
| 2 Lower EGR pipe clamp | 12 Eyebolt | 22 Air pipe |
| 3 Spacer | 13 EGR water pipe | 23 Connector |
| 4 EGR pipe | 14 Eyebolt | 24 EGR magnetic valve |
| 5 Gasket | 15 EGR air pipe | |
| 6 Gasket | 16 EGR valve | |
| 7 Rubber hose | 17 Gasket | ★a: Air inlet pipe (see Gr15.) |
| 8 EGR cooler | 18 EGR pipe | ⊗: Non-reusable parts |
| 9 Gasket | 19 Gasket | Arrows A to C indicate points to or |
| 10 Eyebolt | 20 Plate | from which pipes are connected. |

● Installation sequence

Perform installation by following the removal sequence in reverse.

Service standards (Unit: mm)

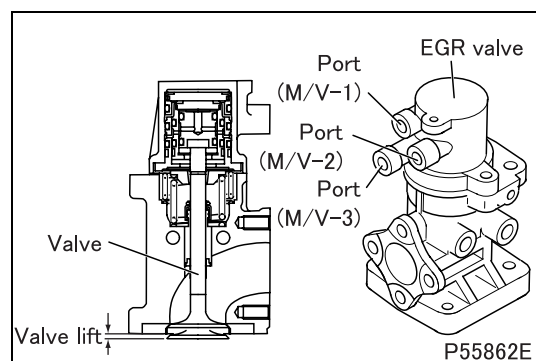
Location	Maintenance item			Standard value	Limit	Remedy
8	Air leakage of EGR cooler	Exhaust gas passage side (Air pressure: 400 kPa {4 kgf/ cm ² })		0 cm ³ {0mL}	—	Replace
		Coolant passage side (Air pressure: 300 kPa {3 kgf/ cm ² })		0 cm ³ {0mL}	—	Replace
16	EGR valve lift (Air pressure: 637 to 932 kPa {6.5 to 9.5 kgf/ cm ² })	Operating stage	1	0	—	Replace
			2	1.3 ± 0.3	—	
			3	2.6 ± 0.3	—	
			4	4.6 ± 0.3	—	
			5	5.7 ± 0.4	—	
			6	7.7 ± 0.4	—	
			7	9.0 ± 0.3	—	
			8	11.0 ± 0.3	—	

Tightening torque (Unit: N·m {kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (EGR pipe clamp mounting)	54 {5.5}	—
	Bolt (EGR pipe mounting)		
	Bolt (Bracket mounting)		
	Bolt (EGR cooler mounting)		
Tb	Nut (EGR pipe mounting)	42 {4.2}	—
Tc	Clamp (water hose mounting)	3.9 {0.4}	—
Td	Eyebolt (EGR water pipe mounting)	40 {4.1}	—
	Connector (air pipe mounting)		
Te	Bolt (EGR magnetic valve mounting)	24 {2.4}	—
Tf	Eyebolt (EGR air pipe mounting)	25 {2.6}	—
Tg	Bolt (EGR pipe mounting)	59 {6.0}	—

EGR VALVE, EGR MAGNETIC VALVE, EGR PIPE AND EGR COOLER

◆ Inspection procedures ◆



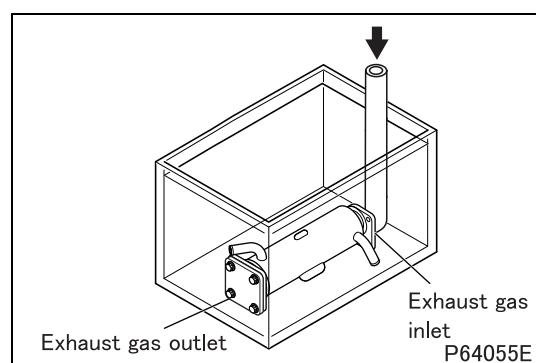
■ Inspection: EGR valve lift

- While applying specified air pressure to the ports in accordance with the table below, measure the valve lift in operating steps 1 to 8 on each valve.
- Replace the EGR valve if it does not conform to the standard value.

Operating step	Input port		
	M/V-1	M/V-2	M/V-3
1	—	—	—
2	O	—	—
3	—	O	—
4	O	O	—
5	—	—	O
6	O	—	O
7	—	O	O
8	O	O	O

O: Air applied

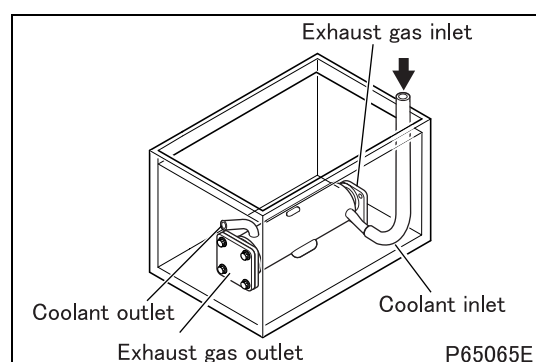
—: Air not applied



■ Inspection: EGR cooler

(1) Exhaust gas passage side

- Fit a cover over the exhaust gas outlet of the EGR cooler, and connect a hose to the exhaust gas inlet. Then, submerge the EGR cooler in a container of water. Make sure the coolant passage is full of water.
- Apply specified air pressure through the hose. Check that air does not leak from any part.
- If there is any leakage, replace the EGR cooler.



(2) Coolant passage side

- Fit covers over the EGR cooler's exhaust gas inlet, exhaust gas outlet, and coolant outlet, and connect a hose to the coolant inlet. Then, submerge the EGR cooler in a container of water.
- Apply specified air pressure through the hose. Check that air does not leak from any part.
- If there is any leakage, replace the EGR cooler.



1 PCV hose	7 PCV hose	13 Element
2 PCV pipe	8 Oil hose	14 PCV body
3 PCV hose	9 Oil separator	*a: Rocker cover
4 PCV hose	10 Oil hose	: Non-reusable parts
5 PCV pipe	11 Cap	PCV: Positive crankcase ventilation
6 O-ring	12 O-ring	

- For information on the element replacement interval, refer to the element instruction manual. If the element is used beyond its replacement interval, it may become clogged, causing the pressure inside the engine to increase such that oil leakage occurs.

Perform installation by following the removal sequence in reverse.

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Clamp	4.0 {0.4}	—
Tb	Bolt (PCV pipe mounting)	54 {5.5}	—
	Bolt (oil separator mounting)		
Tc	Bolt (PCV valve mounting)	24 {2.4}	—

BLOWBY GAS RETURN SYSTEM

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
 a	O-ring	Engine oil	As required

Mitsubishi 6M70 Engine Parts contact:
email: EngineParts@HeavyEquipmentRestorationParts.com
Phone: 269 673 1638