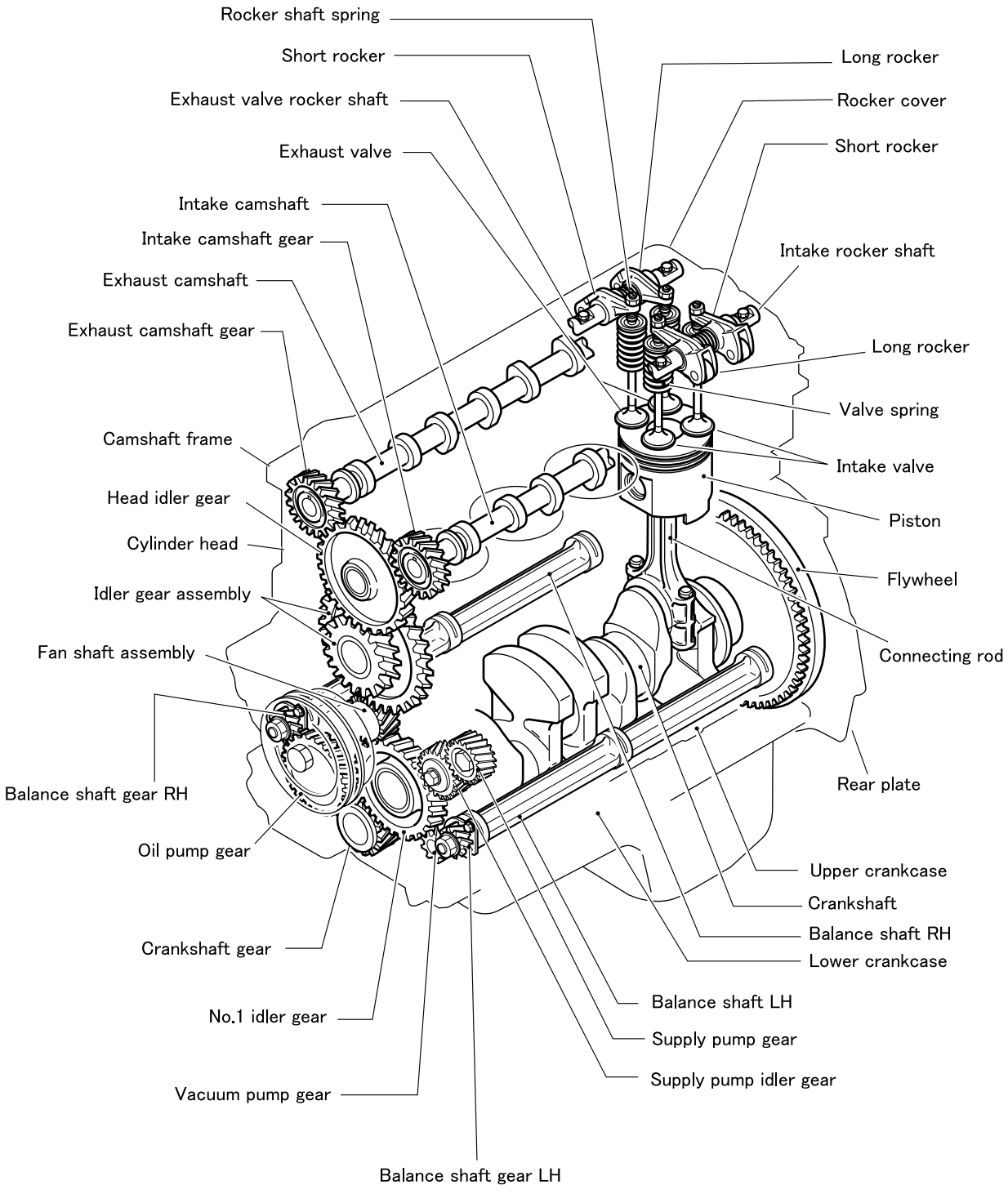
Mitsubishi 4M50 Engine Workshop Manual

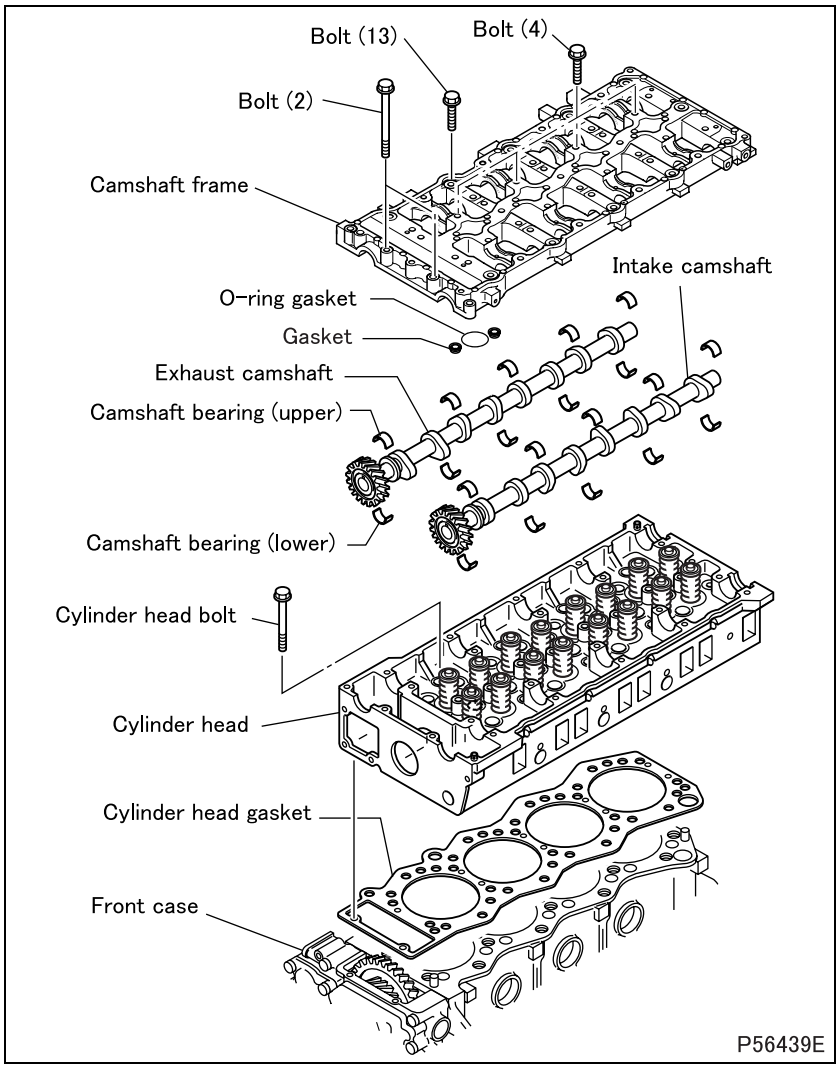
MITSUBISHI 4M50 SPECIFICATIONS

Item	Specifications
Engine model	4M50
Type	4-cylinder, in-line, water-cooled, 4-cycle diesel engine
Combustion chamber	Direct injection type
Valve mechanism	Double overhead camshaft (DOHC)
Bore × stroke mm {in.}	ϕ114 × 120 {ϕ4.49 × 4.72}
Total displacement L {qts}	4.899 {4899}
Compression ratio	17.5

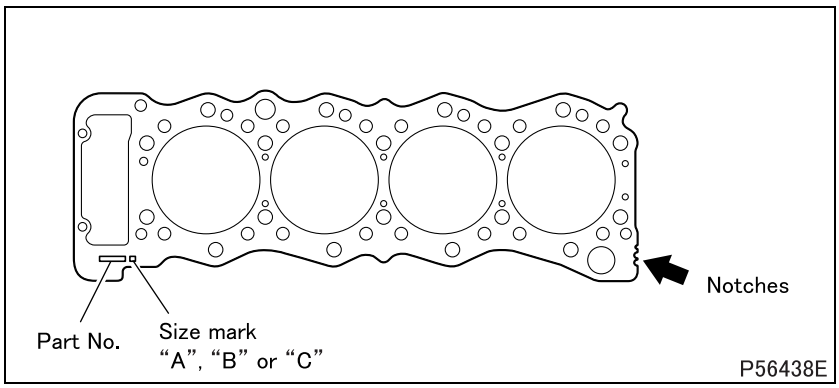
1. Exploded View



2. Mitsubishi 4M50 Cylinder Head, Cylinder Head Gasket, Camshaft, and Camshaft Frame



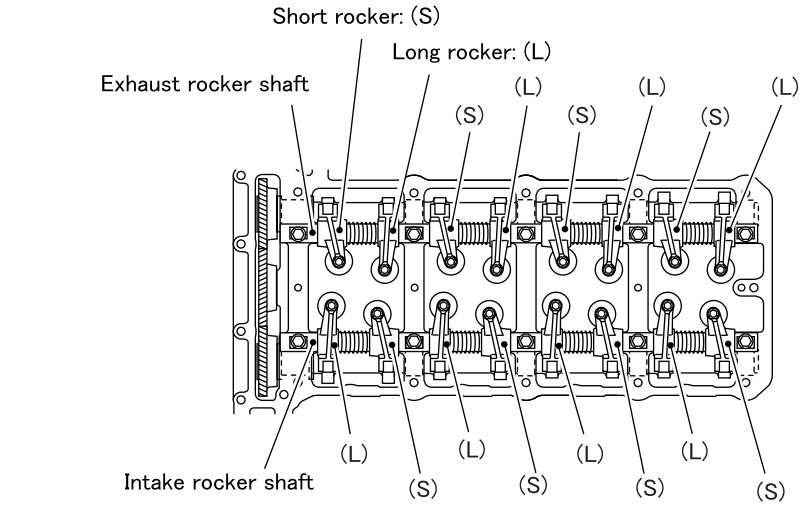
- The camshaft is supported at its journals from below by the cylinder head and retained from above by the camshaft frame.
- The upper and lower camshaft bearings are identical, but cannot be interchanged when they are reinstalled.
- The exhaust camshaft and the intake camshaft have identical gears but different cams.
- The thirteen shortest bolts and four shorter bolts fasten the camshaft frame onto the cylinder head.
- The two long bolts fasten the camshaft frame to the front case.

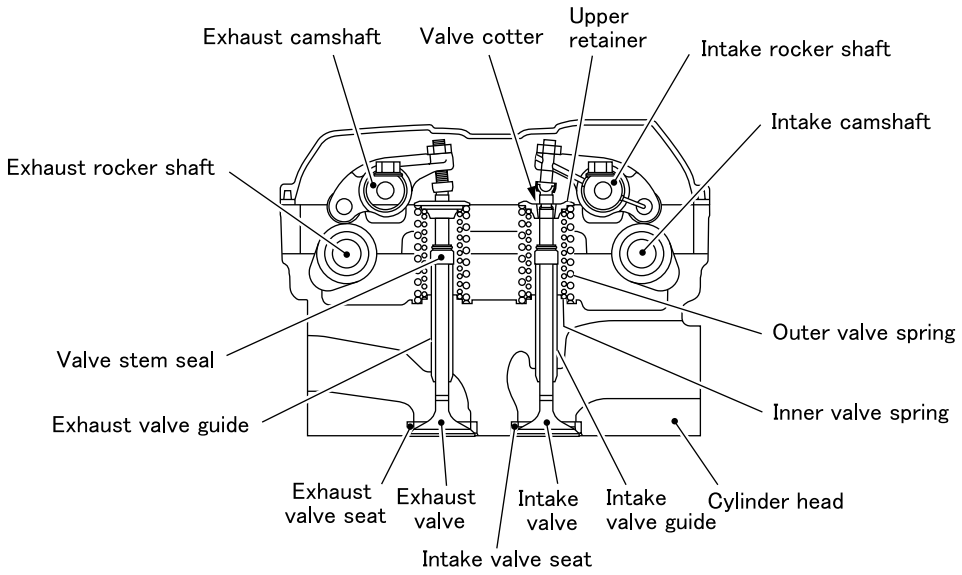


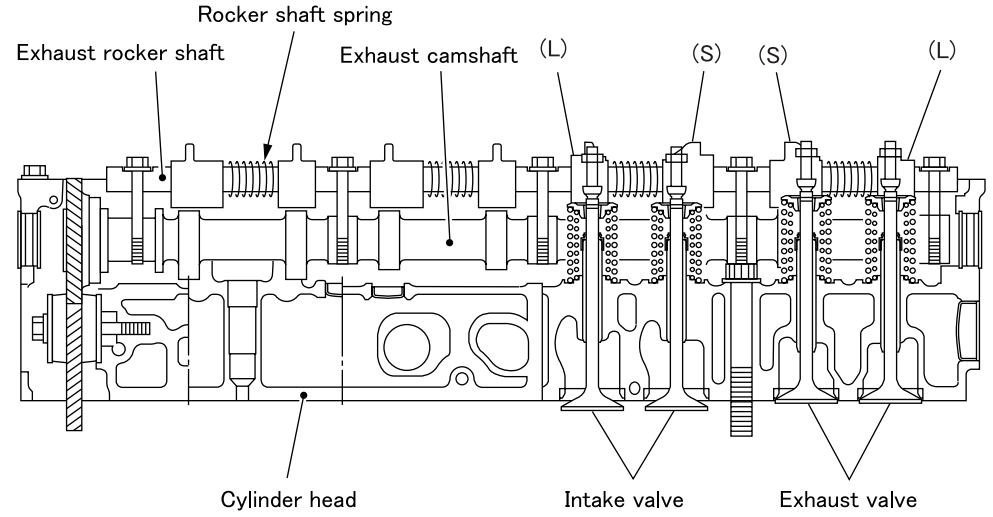
2.1 Cylinder head gasket

- Select and use a cylinder head gasket of a thickness that can accommodate the piston projection.
- The size (thickness) class of the gasket can be identified by the shape of the notches and size mark cut on the edge of each gasket.

3. Mitsubishi 4M50 Valve Mechanism







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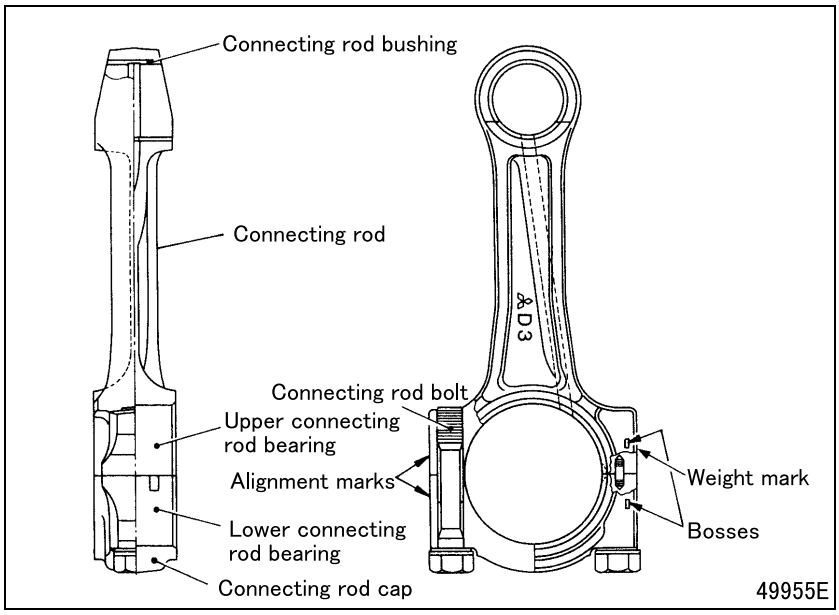
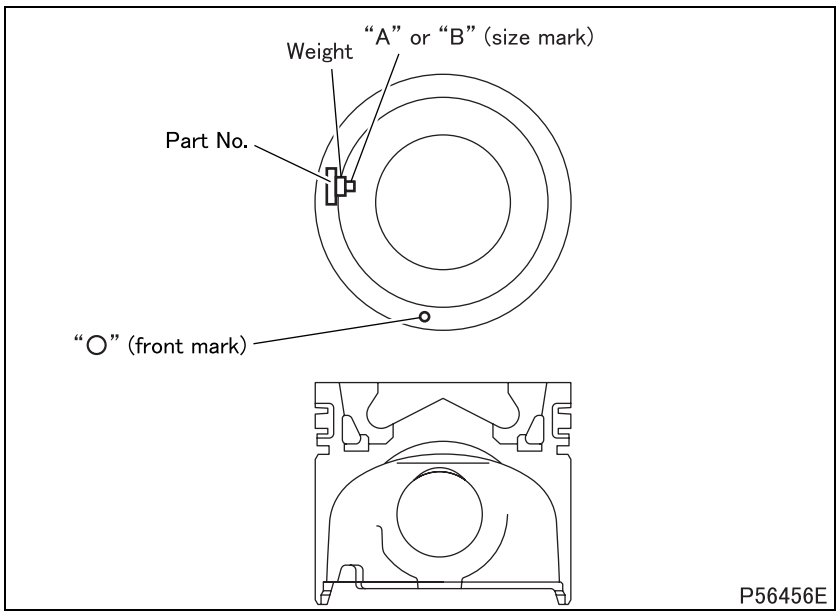
- The short rockers and the long rockers are installed differently, as shown in the illustration.
- Each valve has an inner valve spring and an outer valve spring.

4. Mitsubishi 4M50 Connecting Rod



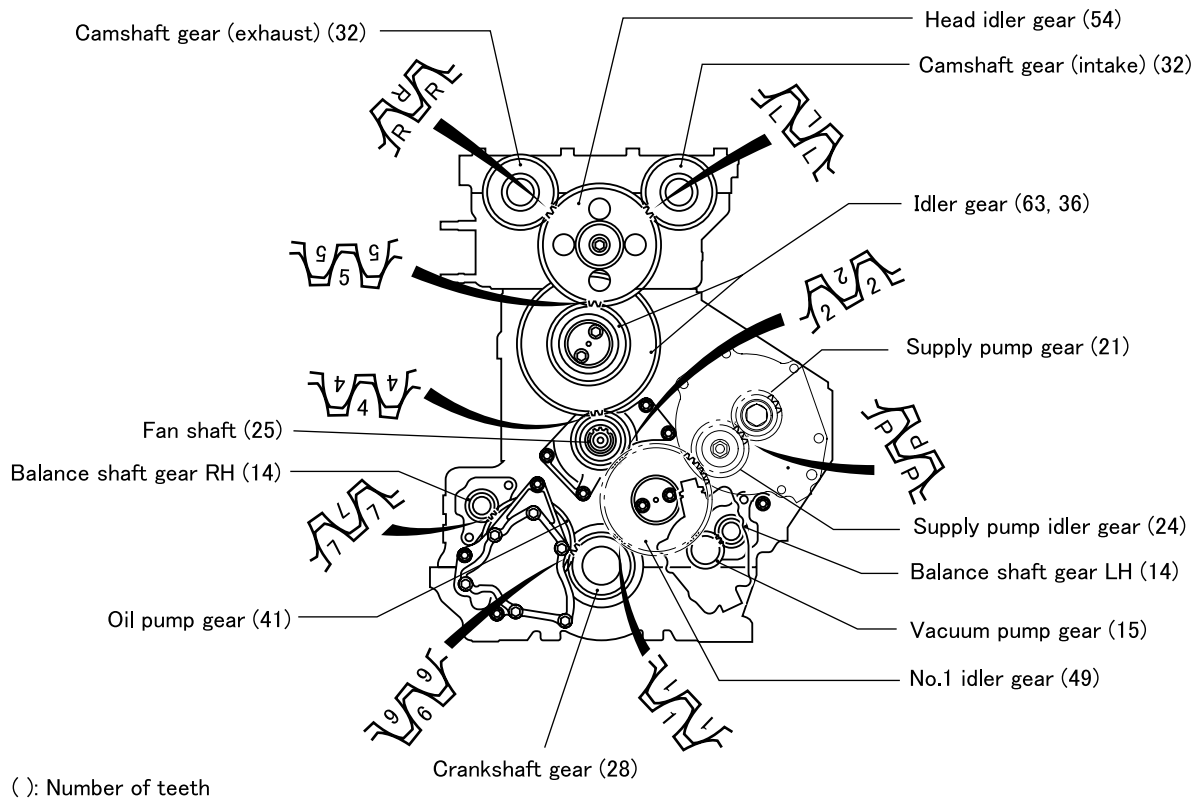
Weight mark:
"C" to **"G"**
(with **"G"** as the maximum)

5. Mitsubishi 4M50 Piston



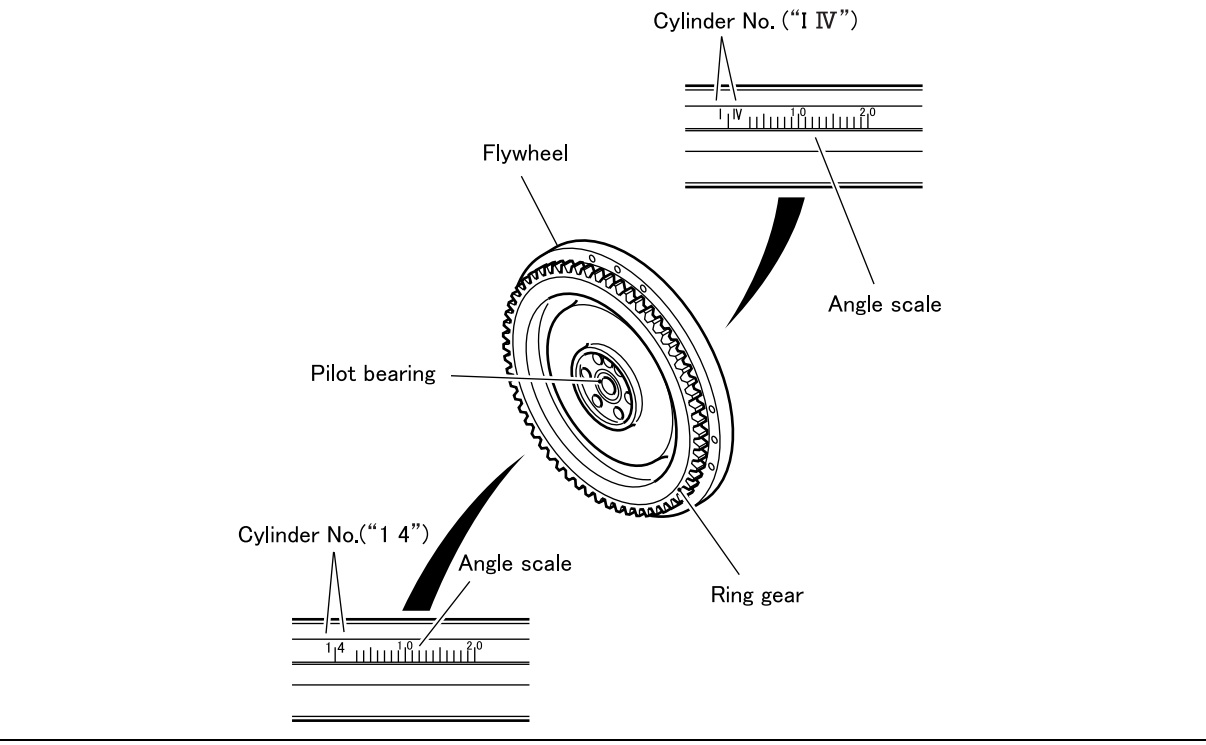
- Each piston must be mated with a cylinder in the upper crankcase that has the same size mark as the piston. The pistons are marked with either **"A"** or **"B"**, where **"B"** stands for the larger and **"A"** for the smaller of the two available diameters.
- The pistons have been made lightweight by use of a special aluminum alloy, as well as by the reduction of their height.

6. Mitsubishi 4M50 Timing Gears

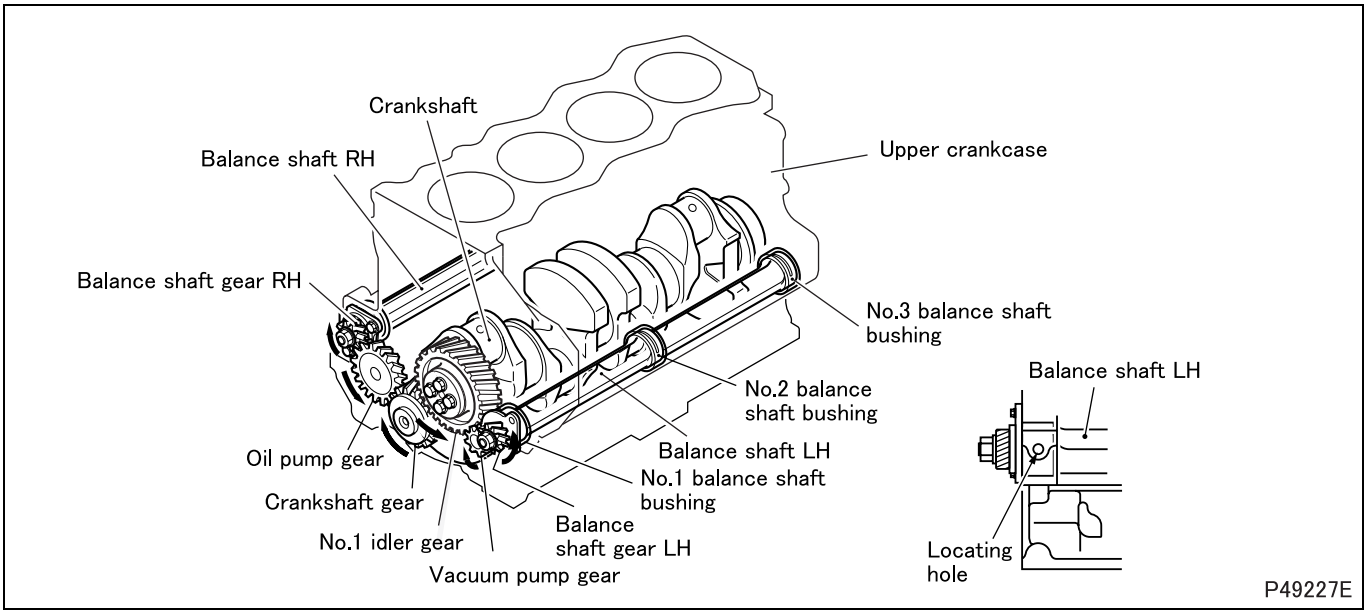


- All gears, except the vacuum pump gear, each has timing mark(s) to ensure correct engagement during assembly.

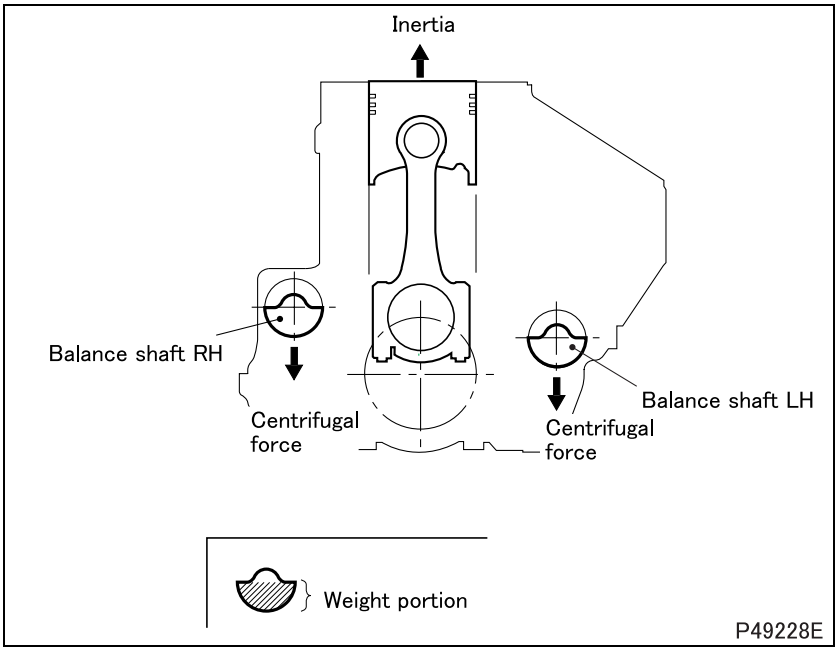
7. Flywheel



8. Mitsubishi 4M50 Balance Shafts



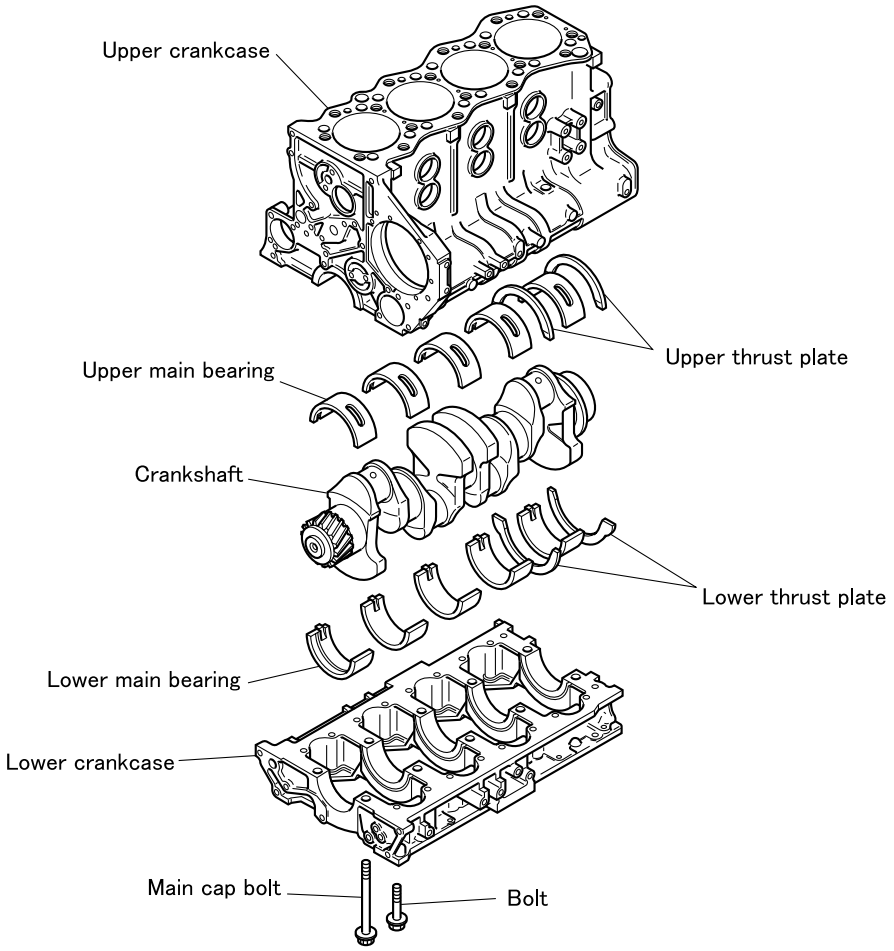
- The balance shaft RH and balance shaft LH are mounted in the upper crankcase on the right and left sides of the crankshaft. The balance shafts reduce the vibration of the engine caused by the rotation of the crankshaft.
- The balance shaft RH and balance shaft LH are both driven by timing gears. Each balance shaft is held in the upper crankcase by way of three balance shaft bushings.
- The balance shaft LH has a locating hole to enable correct installation.

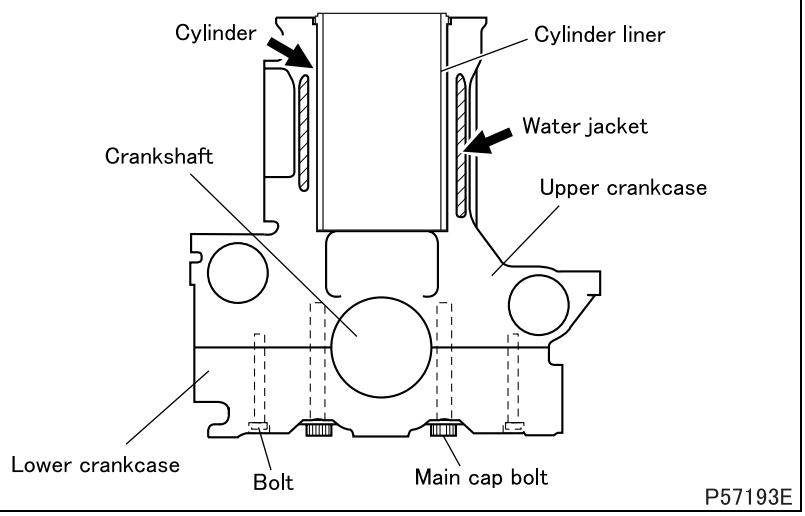


8.1 Reduction of vertical vibration (secondary vibration element)

- When the piston moves up and down, vertical vibrations are generated at the top dead center (TDC) and bottom dead center (BDC) due to inertia.
- The balance shaft LH and the balance shaft RH rotate so that their weight portions are at the bottom positions when a piston is at TDC and at the top positions when the piston is at BDC, i.e., the weight portions are always on the opposite side to the piston head.
- This creates centrifugal forces in the balance shaft RH and balance shaft LH, the total of which is equal in amount to the inertia force that the piston creates when it is at TDC or BDC. These centrifugal forces in the balance shafts cancel out the inertia forces resulting from piston's movements and reduce the amount of vertical vibration.
- The balance shafts also reduce the moment created around the crankshaft (which constitutes secondary vibration elements) when the engine is running in the middle-to-high speed range.

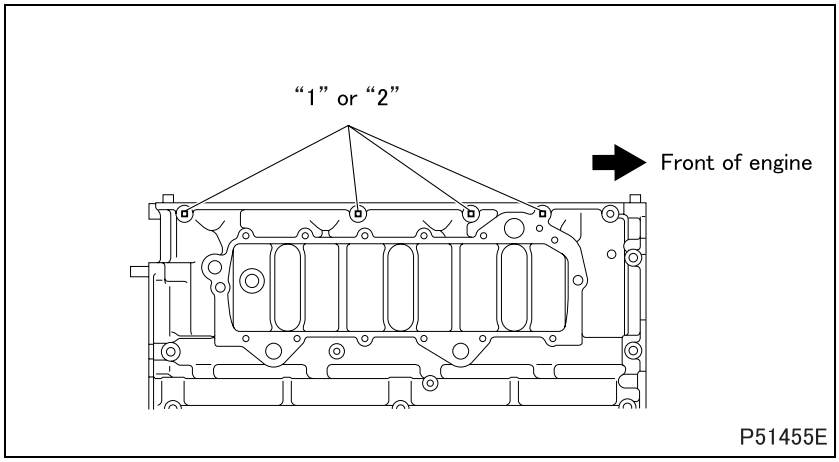
9. Mitsubishi 4M50 Crankcase and Main Bearings



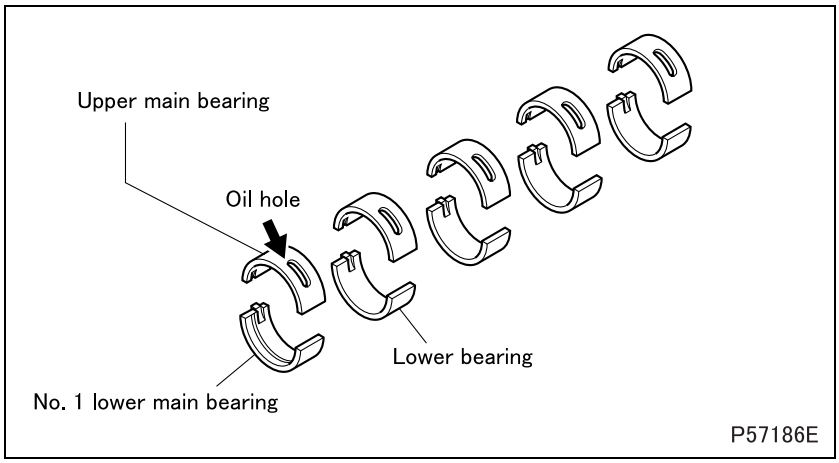


9.1 Crankcase

- The crankcase is a two-piece type consisting of an upper crankcase and a lower crankcase, which hold the crankshaft in between.
- Cylinder liners are inserted into the cylinder bores in the upper crankcase.
- An water jacket is formed in the walls of these cylinders to cool them down.
- The main cap bolts and the bolts that fasten the upper and lower crankcases together are tightened using a special method.

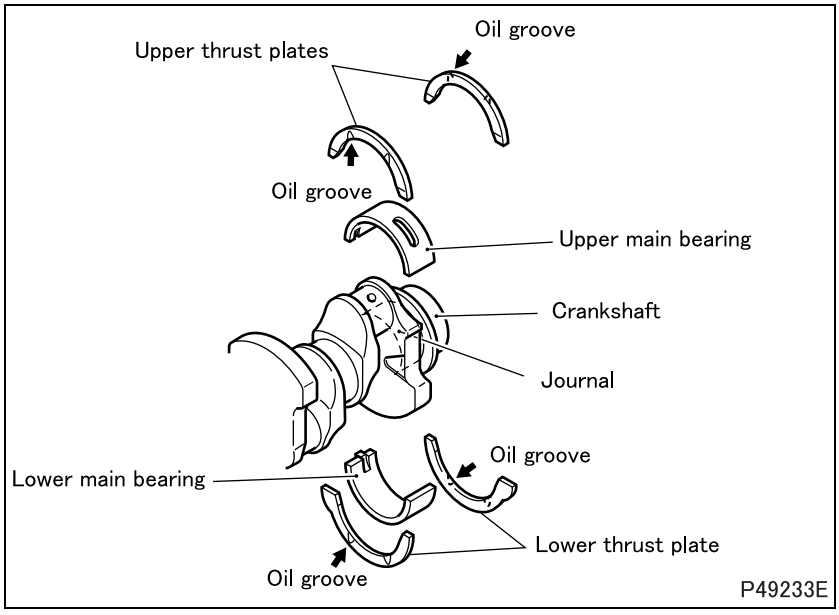


- The upper crankcase is marked with a size mark (**"1"** or **"2"**) to be used as a reference in selecting cylinder liners.
- The first to forth size marks from the front of the engine correspond to the No. 1 to No. 4 cylinders.



9.2 Main bearing

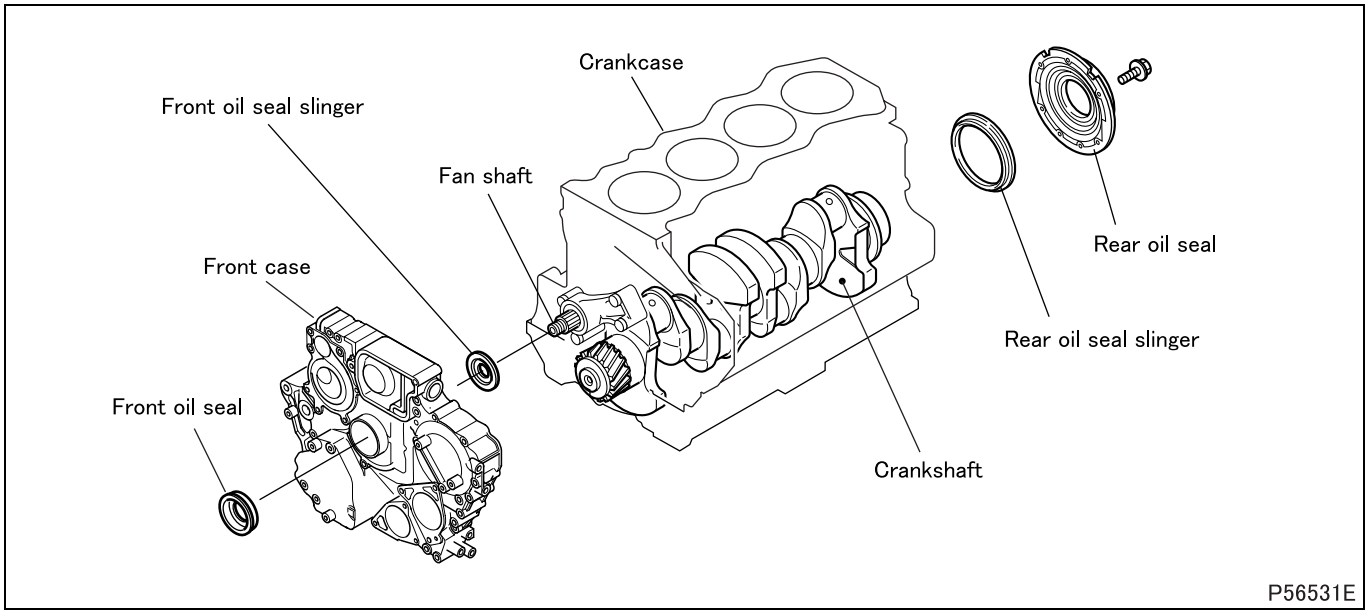
- The upper main bearings have oil holes through which engine oil is supplied to the crankshaft journals.
- An oil groove is provided in the No. 1 lower bearing.

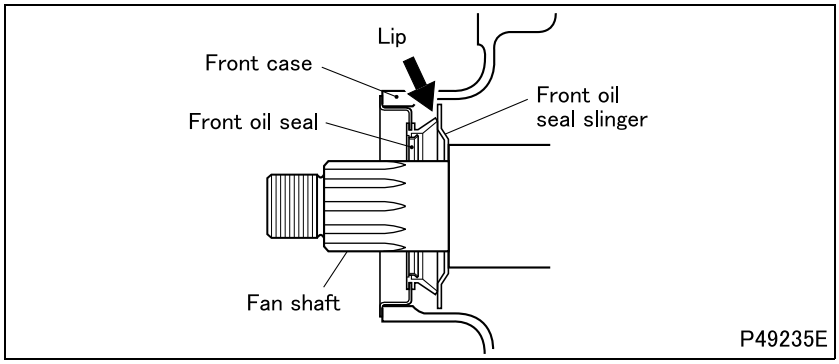


9.3 Thrust plates

- Two upper and lower thrust plate pairs are installed on both sides of the upper and lower main bearings at the rearmost journal of the crankshaft.
- Select the thrust plates of a thickness that can accommodate the crankshaft end play. The thrust plates each have two oil grooves, which assures their minimum friction against the crankshaft journal.

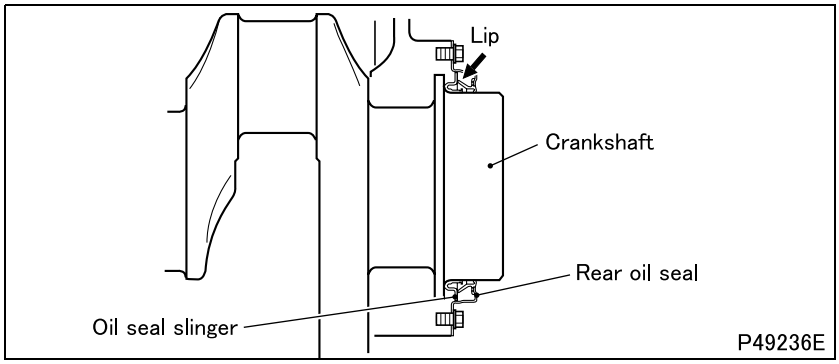
10. Mitsubishi 4M50 Oil Seals





10.1 4M50 Front oil seal

- The front oil seal is fitted in the front case and prevents oil from leaking by contact of its lip with the front oil seal slinger.
- The front oil seal slinger is press-fitted onto the fan shaft.



10.2 4M50 Rear oil seal

- The rear oil seal is fitted in the crankcase assembly and prevents oil from leaking by contact of its lip with the rear oil seal slinger.
- The rear oil seal slinger is press-fitted onto the rear end of the crankshaft.

Possible causes / Symptoms		Low power output	Abnormal engine noise	Reference Gr
Cylinder head and valve mechanism	Incorrect valve clearance	O	O	
	Defective cylinder head gasket	O	O	
	Worn valve and valve seat; carbon deposits	O	O	
	Weakened valve spring	O	O	
	Defective rocker shaft and camshaft frame		O	
	Poor lubrication of rocker shaft and camshaft frame		O	
Timing gears	Incorrect backlash in timing gears		O	
	Poor lubrication of timing gears and idler shaft		O	
Camshaft	Excessive end play in camshaft		O	
	Worn camshaft		O	
Pistons and connecting rods	Worn/damaged piston ring groove(s)	O	O	
	Worn/damaged piston ring(s)	O	O	
	Worn piston pin and connecting rod small end		O	
Crankshaft	Excessive end play in crankshaft		O	
	Incorrectly fitted crankshaft		O	
	Worn/damaged crankshaft pins and connecting rod bearings		O	
	Worn/damaged crankshaft journals and main bearings		O	
Fuel system	Defective supply pump	O	O	Gr13E
	Faulty fuel spray from injector	O	O	Gr13A
	Air trapped in fuel system	O		
Cooling system	Malfunctioning cooling system components	O		Gr14
	Loose/damaged V-belts		O	
Intake and exhaust system	Clogged air cleaner	O	O	Gr15
	Clogged muffler	O	O	
Incorrect oil viscosity		O		Gr12
Improper fuel		O		
Incorrectly fitted piping and hoses			O	
Defective/incorrectly fitted alternator and other auxiliaries			O	

M E M O

ON-VEHICLE INSPECTION AND ADJUSTMENT

1. Measuring Compression Pressure

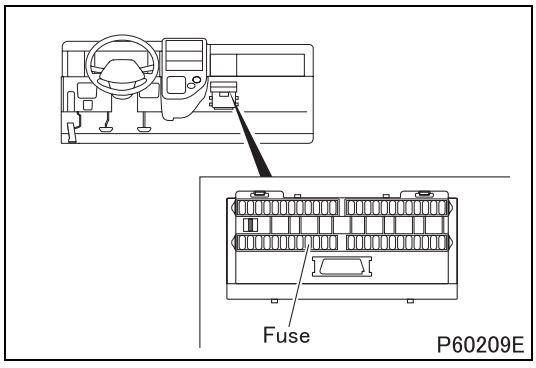
Service standards

Location	Maintenance item		Standard value	Limit	Remedy
–	Compression pressure	Each cylinder (at 200 rpm)	2550 kPa {370 psi, 26 kgf/cm^2}	1960 kPa {285 psi, 20 kgf/cm^2}	Inspect
		Cylinder-to-cylinder pressure difference	–	390 kPa {57 psi, 4 kgf/cm^2} or less	Inspect

Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application
a	Compression gauge adapter  f580413	MH063434	Measuring compression pressure

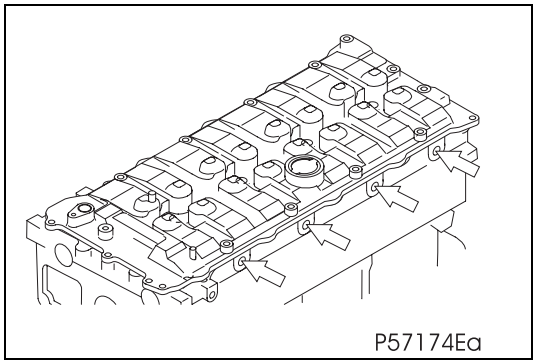
- A drop in compression pressure can be used as a guide to determine when the engine should be overhauled.
- Measure the compression pressure at regular intervals. Keeping track of its transitions can provide a useful tool for troubleshooting. On new vehicles and vehicles with newly replaced parts, the 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 {167 to 185°F}.
  - Turn off the lights and auxiliaries.
  - Place the transmission in neutral (in the parking range P for automatic transmissions).
  - Place the steering wheel in the straight-ahead position.



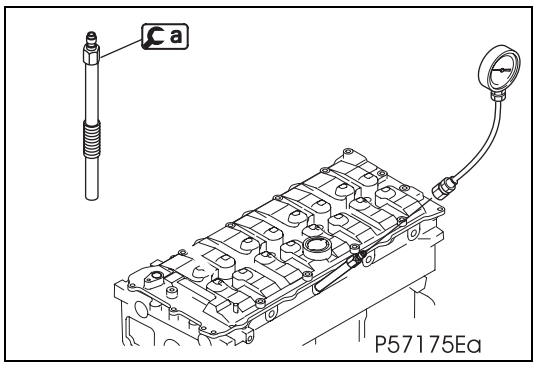
- Remove the fuse (M9) to prevent fuel from being injected when the engine is cranked by the starter.

CAUTION ⚠

- **When cranking the engine, never shut off the power to the engine ECU by disconnecting the engine ECU connector or the like.**
- **If the engine is cranked while shutting off the power to the engine ECU, the ECU cannot control the supply pump and this may cause failure to the pump.**



- Disconnect the glow plug connecting plate and remove all the glow plugs.
- Cover the glow plug mounting holes with shop towels. After cranking the engine by the starter, check that no foreign substances are deposited on the shop towels.
- If there are deposits (such as engine oil or coolant) on the shop towels, the following may be the cause:
  - Deposits of engine oil alone can mean a defective piston ring seal; the piston rings must be inspected.
  - Deposits of both engine oil and coolant can mean cracks in the cylinders; the crankcase must be replaced.



WARNING ⚠

- **When coolant and engine oil deposits are evident, cranking the engine could be dangerous as these substances, heated to high temperatures, will blow out from the glow plug mounting holes. Make sure to stay away from the glow plug mounting holes when the engine is being cranked.**

CAUTION ⚠

- **Never cut off the engine electronic control unit power supply when cranking the engine.**

- Install [a] in one of the glow plug mounting holes. Then, connect a compression gauge to [a].
- Crank the engine and 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 cylinder-to-cylinder pressure differences are not within the limit, pour a small amount of engine oil into the corresponding glow plug mounting hole and remeasure the compression pressure.
  - If the compression pressure increases, the piston rings and cylinder surfaces 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.

2. Inspection and Adjustment of Mitsubishi 4M50 Valve Clearances

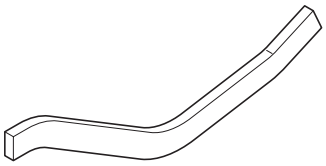
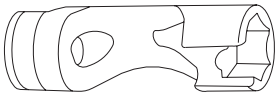
Service standards (Unit: mm {in.})

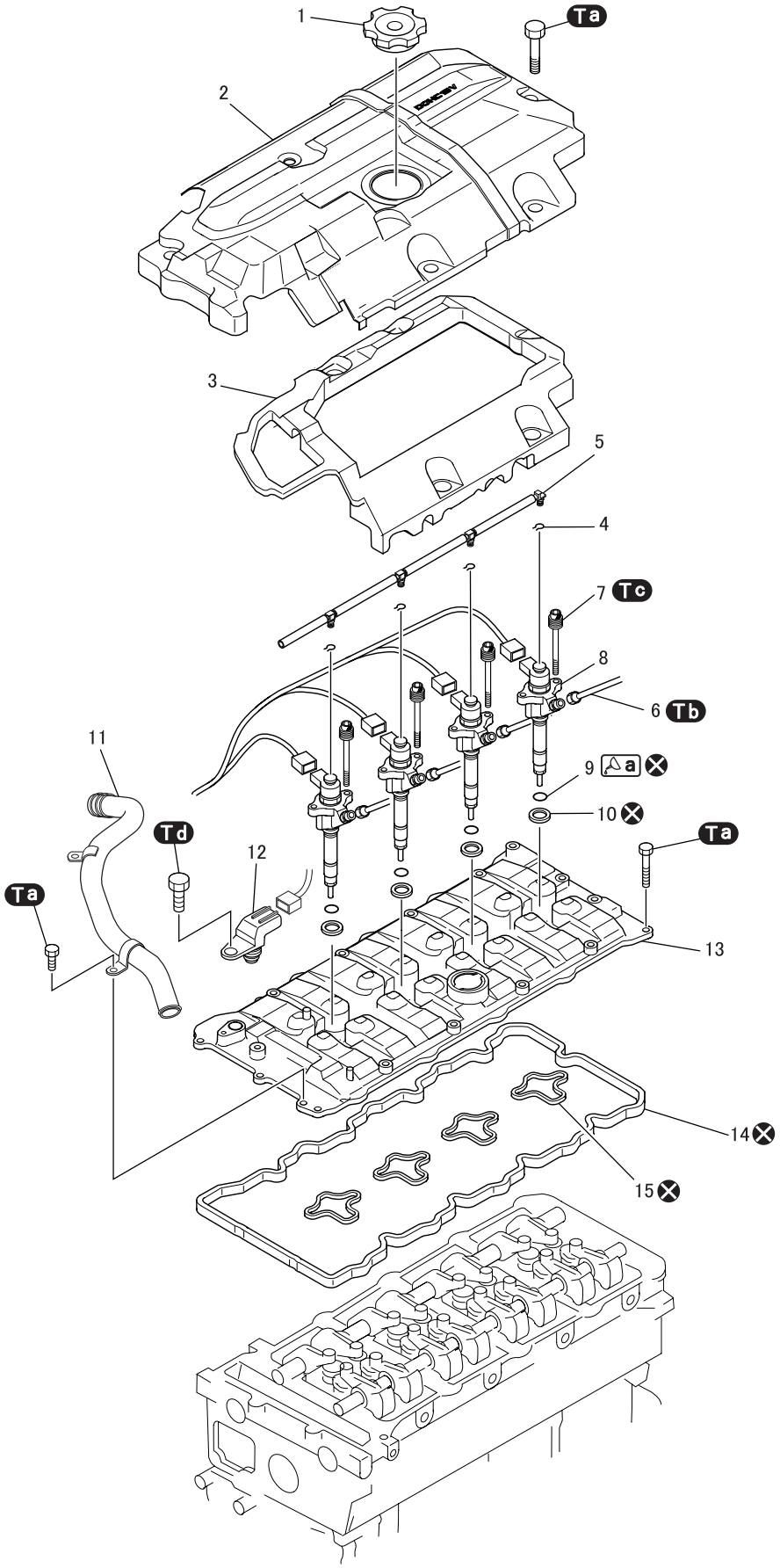
Location	Maintenance item		Standard value	Limit	Remedy
–	Valve clearance (when cold)	Intake valve	0.4 {0.016}	–	Adjust
		Exhaust valve	0.5 {0.020}	–	

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

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (cover installation)	23.2 {17, 2.4}	–
	Bolt (rocker cover installation)		
	Bolt (PCV pipe installation)		
Tb	Injection pipe (union nut installation)	30.4 to 35 {22 to 26, 3.1 to 3.6}	–
Tc	Bolt (injector installation)	5.2 to 7.2 {3.8 to 5.3, 0.53 to 0.73}	–
Td	Bolt (cylinder sensor installation)	8 {5.9, 0.82}	–
–	Lock nut (adjusting screw stopping)	20.6 {15, 2.1}	–

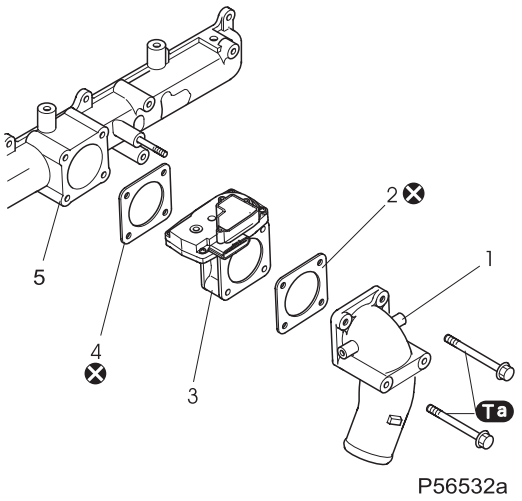
Special tools

Mark	Tool name and shape	Part No.	Application
Ca	Cranking handle (design may vary)  P58299	MH063704	Turning the fan pulley
Cb	Fuel line wrench  02/23/2006 f544802	HAZET 4550-1 SnapOn FRXM17	Tightening the fuel lines


1
Ta
2
3
5
4
7 Tc
8
6 Tb
11
9 a
10
Td
12
Ta
Ta
13
14
15
P67426

1 Oil filler cap
2 Cover
3 Rocker cover rubber
4 Snap ring
5 Fuel return hose
6 Fuel line
7 Bolt (with hexagonal hole)
8 Injector
9 O-ring
10 Tip gasket
11 PCV pipe
12 Cylinder sensor
13 Rocker cover
14 Rocker cover gasket A
15 Rocker cover gasket B

⊗: Non-reusable parts
PCV: Positive Crankcase Ventilation



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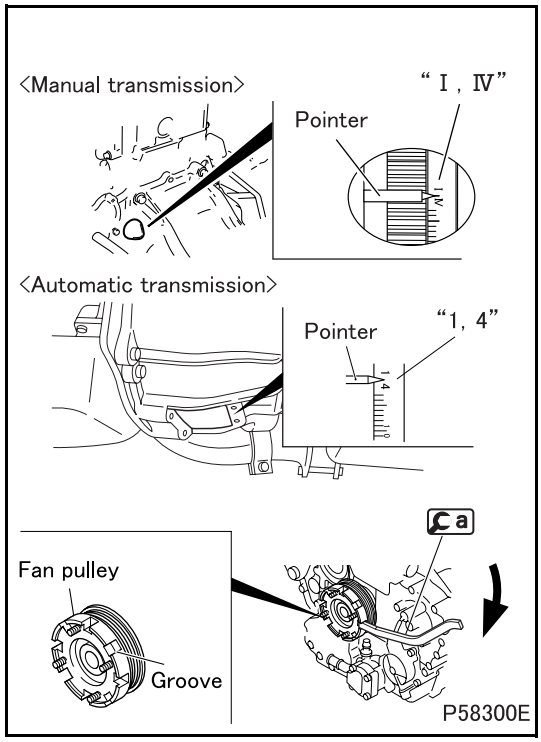
1 Air inlet duct
2 Gasket
3 Intake throttle
4 Gasket
5 Intake manifold

Adjust the valves when the engine is cold.
1. Blank
2. Disconnect the EGR harness at the throttle body.
3. Remove the air inlet duct mounting bolts and remove the intake throttle.
4. Remove the oil cap.
5. Remove the cover.
6. Remove the rocker cover rubber.
7. Using compressed air, blow any debris from around the injectors.
8. Disconnect the fuel return lines.
9. Disconnect the wire harness from the injectors.
10. Remove the fuel return line mount bolts (one on the valve cover and one on the side of the engine). Carefully move the return line out of the way.
11. Remove the fuel lines.
12. Remove the injectors.
13. Disconnect the PCV pipe at the left of the engine and move it out of the way.
14. Remove the cylinder sensor.
15. Remove the rocker cover.
16. Using the cranking handle tool, rotate the engine until the number one cylinder is at TDC. The timing mark on the left camshaft will line up. Verify that the flywheel is also showing the "I, IV" mark.
NOTE: Mark the flywheel for easy access later.



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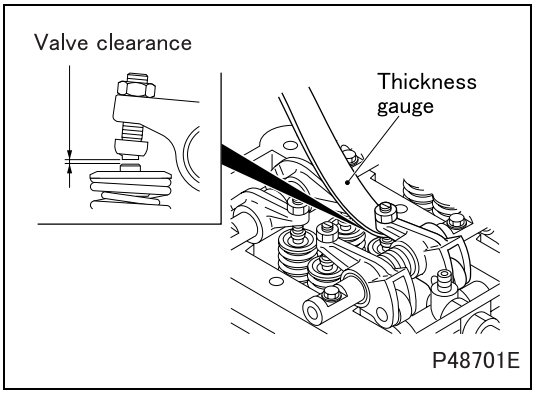
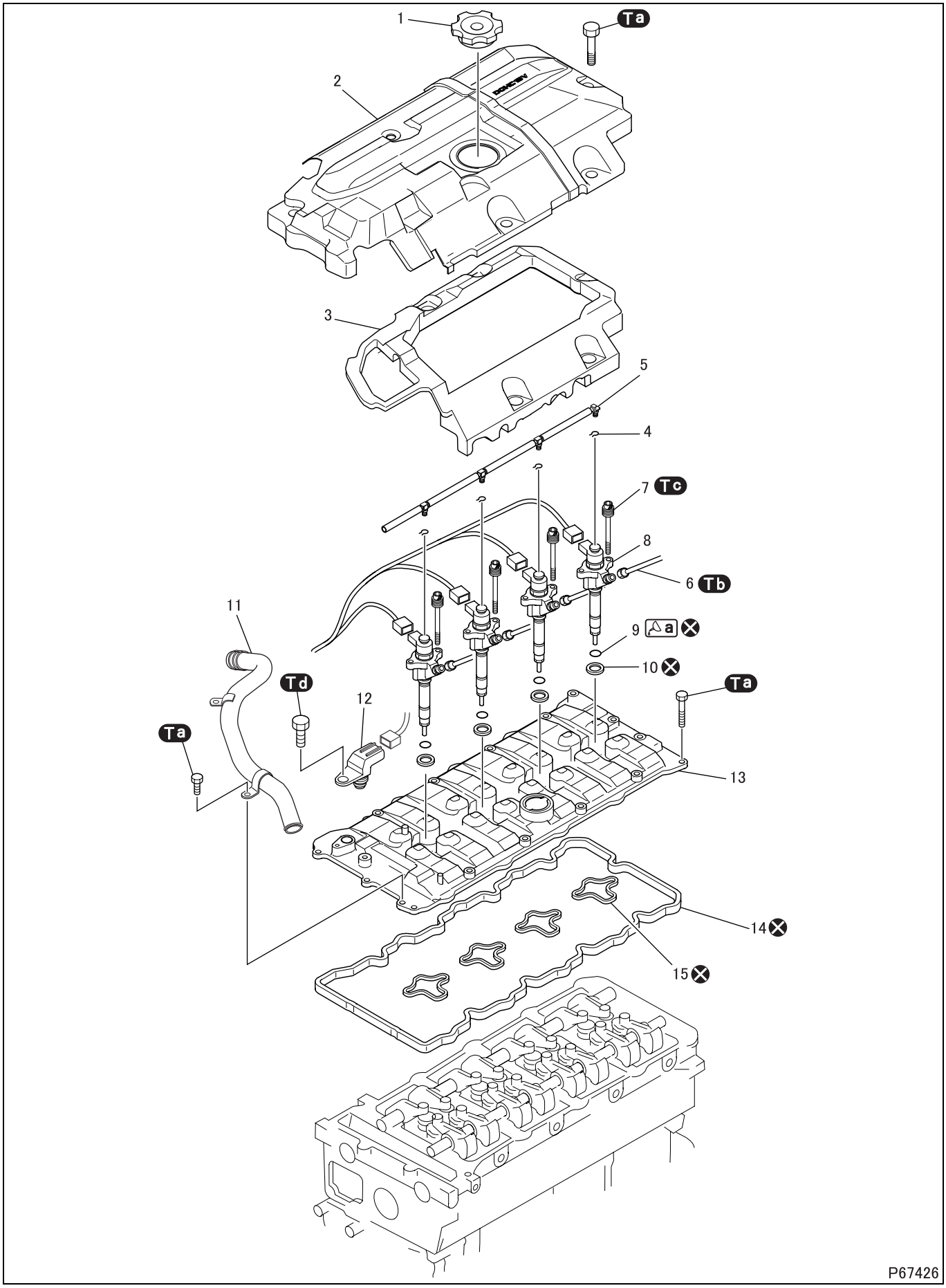
Cylinder No.	1		2		3		4	
Valve	IN	EX	IN	EX	IN	EX	IN	EX
No. 1 cylinder piston at TDC on compression stroke	O	O	O	–	–	O	–	–
No. 4 cylinder piston at TDC on compression stroke	–	–	–	O	O	–	O	O



17. Adjust the valve clearances.
- Loosen the lock nut.
- Back off the adjuster screw and insert the feeler gauge under the rocker.
- Tighten the adjuster screw until the feeler gauge drags slightly.
- Hold the adjuster screw in position and tighten the lock nut. See tightening table.
- Recheck the valve clearance with the thickness gauge, and re-adjust if the measurements are not within the specified value range.
- Repeat for each valve.
- Rotate the engine one turn to the #4 position, and adjust remaining valves.

18. Make sure that all gaskets are securely in place and install the rocker cover.
19. Install the injectors.
20. Connect the fuel return lines.
21. Install the fuel return line mount bolts.
22. Install the fuel lines.
23. Position and connect the PCV pipe.
24. Install the rubber.
25. Install the cover.
26. Install the throttle body and air inlet duct.
27. Connect the EGR harness at the throttle body.
28. Start the engine and verify proper operation.

MITSUBISHI 4M50 ROCKER COVER



● **Disassembly sequence**

1 Oil filler cap
2 Cover
3 Rocker cover rubber
4 Snap ring
5 Fuel return hose
6 Injection pipe
7 Bolt (with hexagonal hole)
8 Injector
9 O-ring
10 Tip gasket
11 PCV pipe
12 Cylinder sensor
13 Rocker cover
14 Rocker cover gasket A
15 Rocker cover gasket B

⊗: Non-reusable parts
PCV: Positive Crankcase Ventilation

● **Assembly sequence**

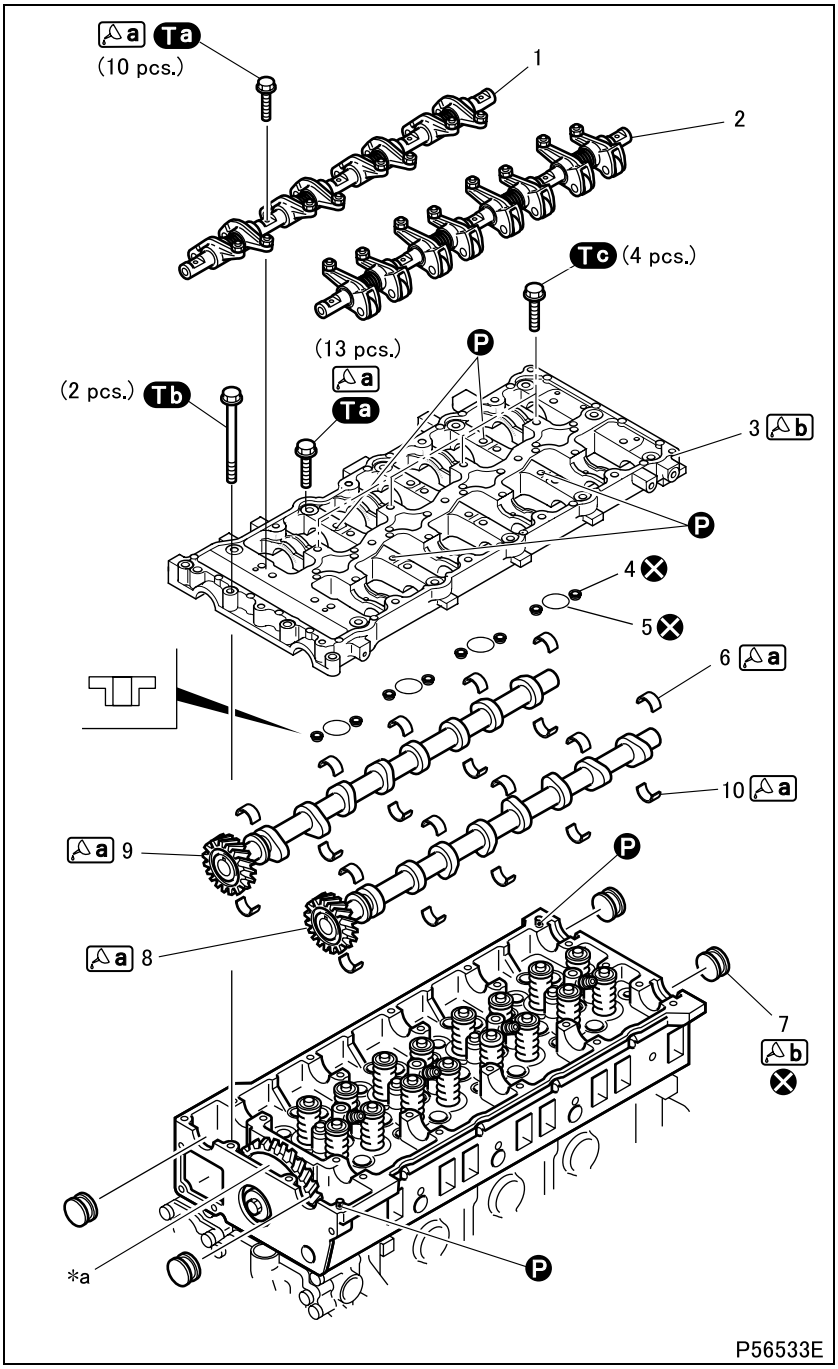
Follow the disassembly sequence in reverse.

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

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (cover installation)	23.2 {17, 2.4}	–
	Bolt (rocker cover installation)		
	Bolt (PCV pipe installation)		
Tb	Injection pipe (union nut installation)	30.4 to 35 {22 to 26, 3.1 to 3.6}	–
Tc	4M50 Injector Bolt (injector installation)	5.2 to 7.2 {3.8 to 5.3, 0.53 to 0.73}	–
Td	Bolt (cylinder sensor installation)	8 {5.9, 0.82}	–

Lubricant and/or sealant

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



● Disassembly sequence

1 Exhaust rocker shaft
(See later sections.)
2 Intake rocker shaft
(See later sections.)
3 Camshaft frame
4 Gasket
5 O-ring
6 Upper camshaft bearing
7 Packing
8 Intake camshaft
(See later sections.)
9 Exhaust camshaft
(See later sections.)
10 Lower camshaft bearing

***a**: Head idler gear
Ⓟ: Locating pin
⊗: Non-reusable parts

CAUTION ⚠

- **The camshaft frame and cylinder head are manufactured as a matched set. Never replace the camshaft frame or the cylinder head individually.**
- **Do not change the upper and lower camshaft bearing combinations. Do not interchange the position of an upper and lower camshaft bearing set with that of another.**

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards (Unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
–	Backlash	Head idler gear-to-camshaft gear	0.080 to 0.126 {0.0031 to 0.0050}	0.3 {0.012}	Replace
		Head idler gear-to-idler gear	0.103 to 0.158 {0.0041 to 0.0062}	0.3 {0.012}	
–	End play	Camshaft	0.10 to 0.20 {0.0039 to 0.0079}	0.3 {0.012}	Inspect
		Head idler gear	0.10 to 0.20 {0.0039 to 0.0079}	0.3 {0.012}	
6, 8, 10	Camshaft bearing-to-intake camshaft clearance		0.07 to 0.12 {0.0028 to 0.0047}	0.16 {0.024}	Replace
6, 8, 10	Camshaft bearing-to-exhaust camshaft clearance		0.07 to 0.12 {0.0028 to 0.0047}	0.16 {0.024}	Replace
6, 10	Camshaft bearing span (when free)		–	35.5 {1.40} or less	Replace

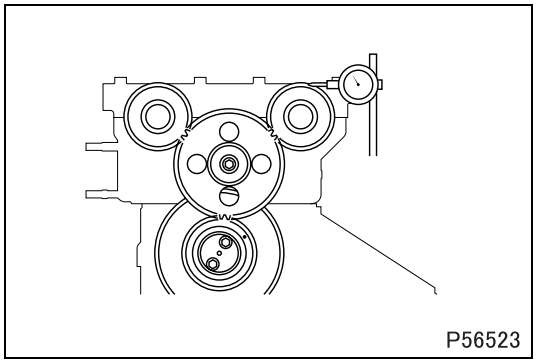
Tightening torque (Unit: N·m {lbf·ft, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (rocker shaft installation: 10 places)	27.5 {20, 2.8}	Wet
	Bolt (camshaft frame installation: 13 places)		
Tb	Bolt (camshaft installation: 2 places)	23.5 {17, 2.4}	–
Tc	Bolt (camshaft frame installation: 4 places)	23.2 {17, 2.4}	–

Lubricant and/or sealant

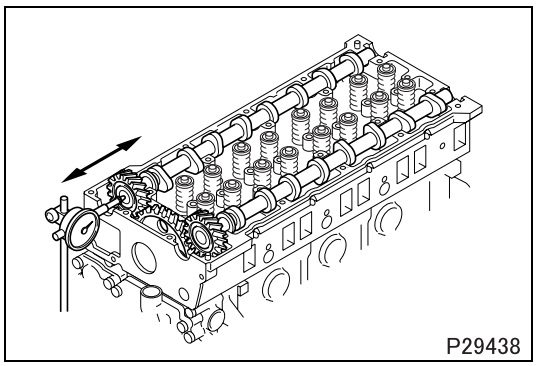
Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Bolt threads and seat	Engine oil	As required
	Camshaft bearing inner surface		
	Camshaft journals and cams		
b	Cylinder head mounting surface of camshaft frame	ThreeBond 1207C or D	As required
	Entire periphery of packing		

◆Work before removal◆



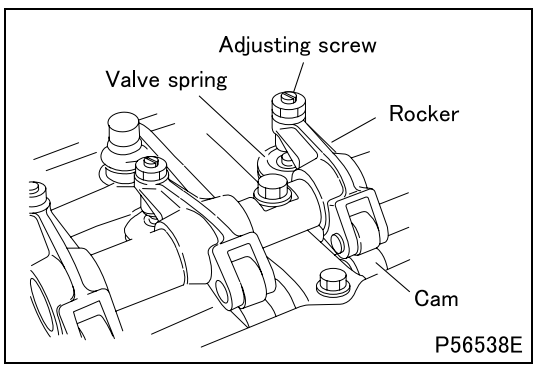
■ Inspection: Backlash between gears

- Measure the backlash at three or more locations for each pair of gears.
- If any of the measurements exceeds the specified limit, replace the defective part(s).



■ Inspection: Camshaft end play

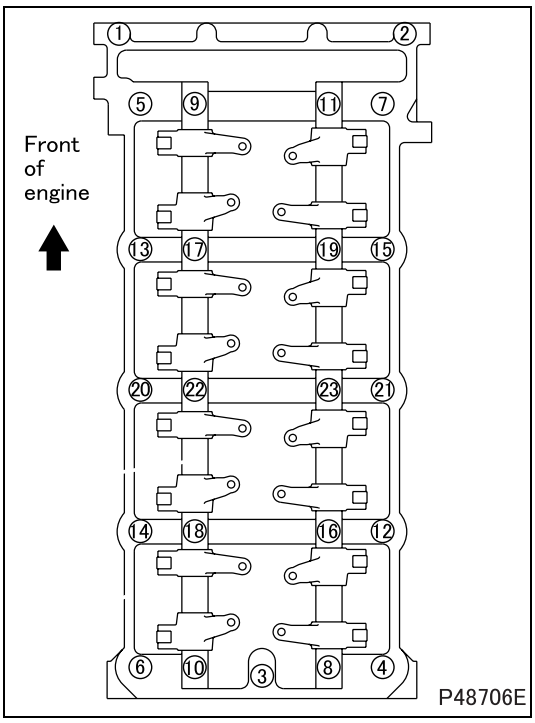
- If the end play exceeds the specified limit, replace the defective part(s).



■ Releasing valve spring tension

- Before removing the bolts in the next process, loosen the adjusting screws on the rockers whose valve springs are compressed (due to the cams lifting these rockers). This operation is necessary to release the tension in the valve springs, thus preventing other parts from undue forces when the bolts are removed.

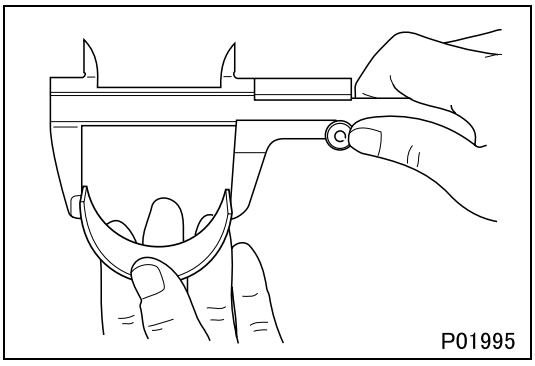
◆Removal procedure◆



■ Removal: Rocker shafts and camshaft frame

- Loosen the rocker shaft installation bolts (10 places) and the camshaft frame installation bolts (13 places) in several passes in the order indicated in the illustration (1 to 23). Then, remove the rocker shafts and the camshaft frame.

◆Inspection procedure◆

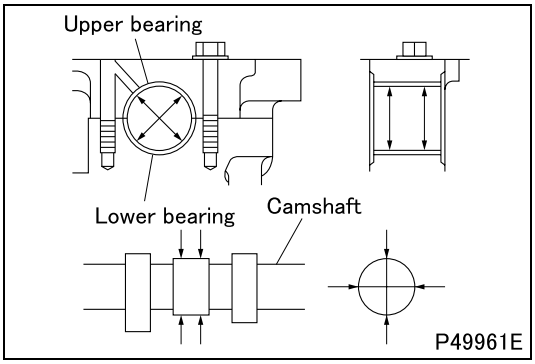


■ Inspection: Camshaft bearing free span

CAUTION ⚠

- **Do not force the bearings open.**
- **When replacing the bearings, always replace the upper and lower bearings as a set.**

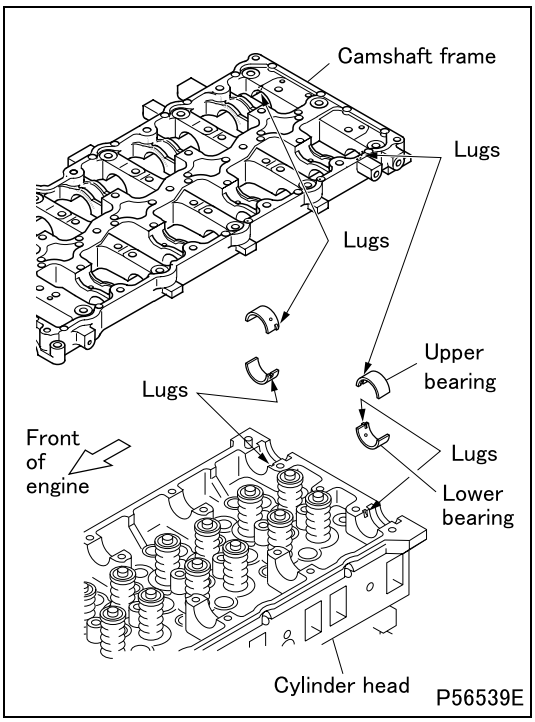
- Replace the bearings if the measurement is not within the standard value range.



■Inspection: Camshaft bearing-to-camshaft clearance

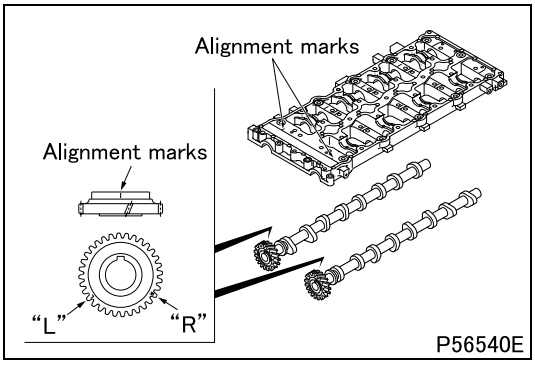
- If the measurement is not within the standard value range, replace the defective part(s).

◆Installation procedure◆



■ **Installation: Mitsubishi 4M50 Camshaft**

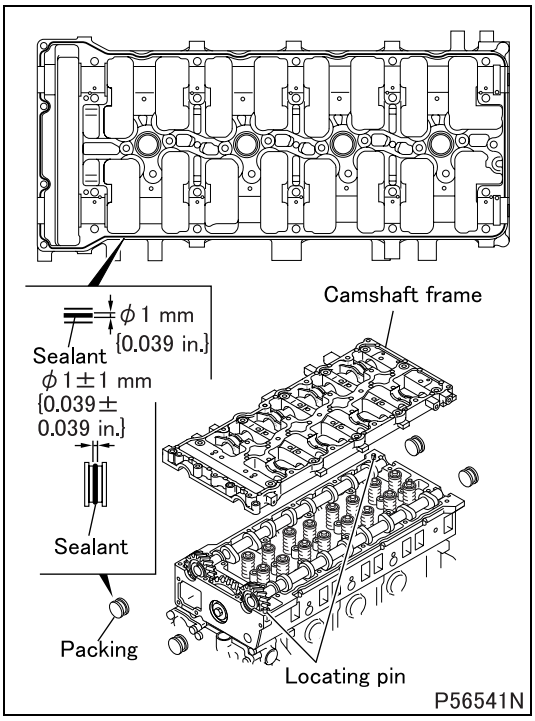
- Install the upper camshaft bearing on the camshaft frame and the lower camshaft bearing on the cylinder head by fitting their lugs into the notches in the camshaft frame and cylinder head.



- Place the No. 1 cylinder piston at the top dead center on the compression stroke.
- Align the mating marks on the camshaft gears with those on the camshaft frame when installing the camshafts.

NOTE

- **Each camshaft gear also has mating mark "L" or "R" for alignment with the head idler gear. This mark may not be exactly aligned with that on the head idler gear, as the position that the head idler gear takes when it is installed may make it impossible to align them. Such a misalignment does not lead to any undesirable consequences.**

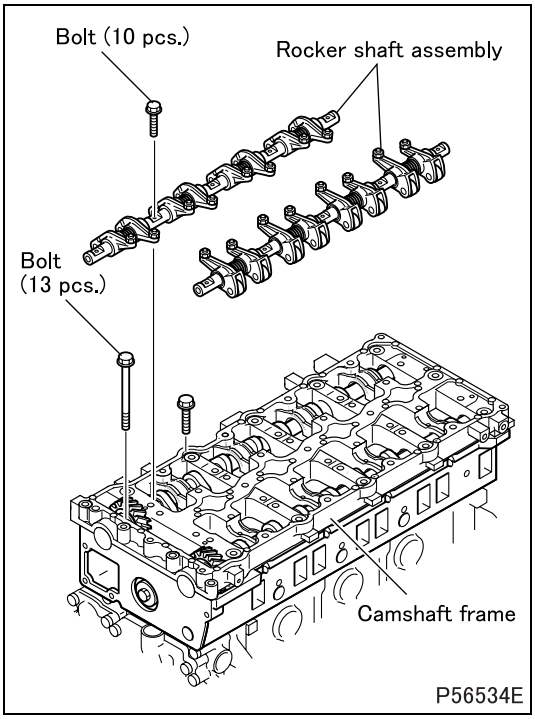


■ **Installation: Rocker shafts and camshaft frame**

- Clean the sealant application surfaces on each part.
- Apply sealant to the entire periphery of the four packings evenly and without any breaks.
- Apply sealant to the camshaft frame evenly and without any breaks.
- Mount the camshaft frame and packing on the cylinder head within three minutes of applying the sealant, being careful not to dislodge the sealant in the process.

CAUTION ⚠

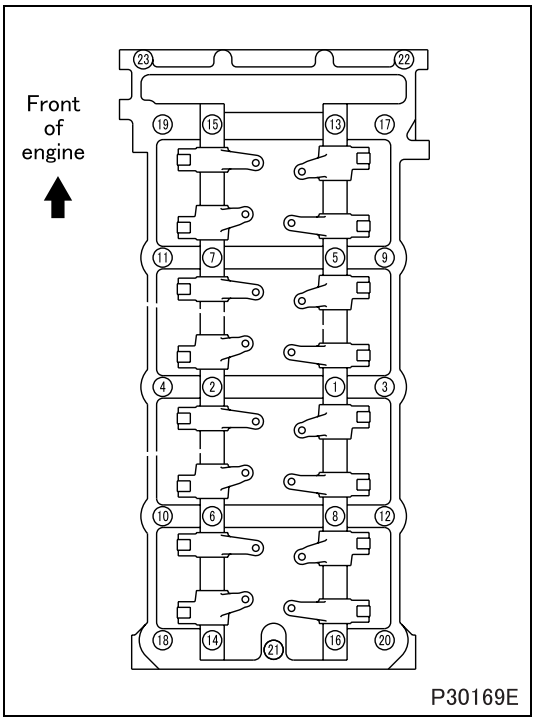
- **Do not run the engine within one hour of installing the rocker shafts and camshaft frame.**



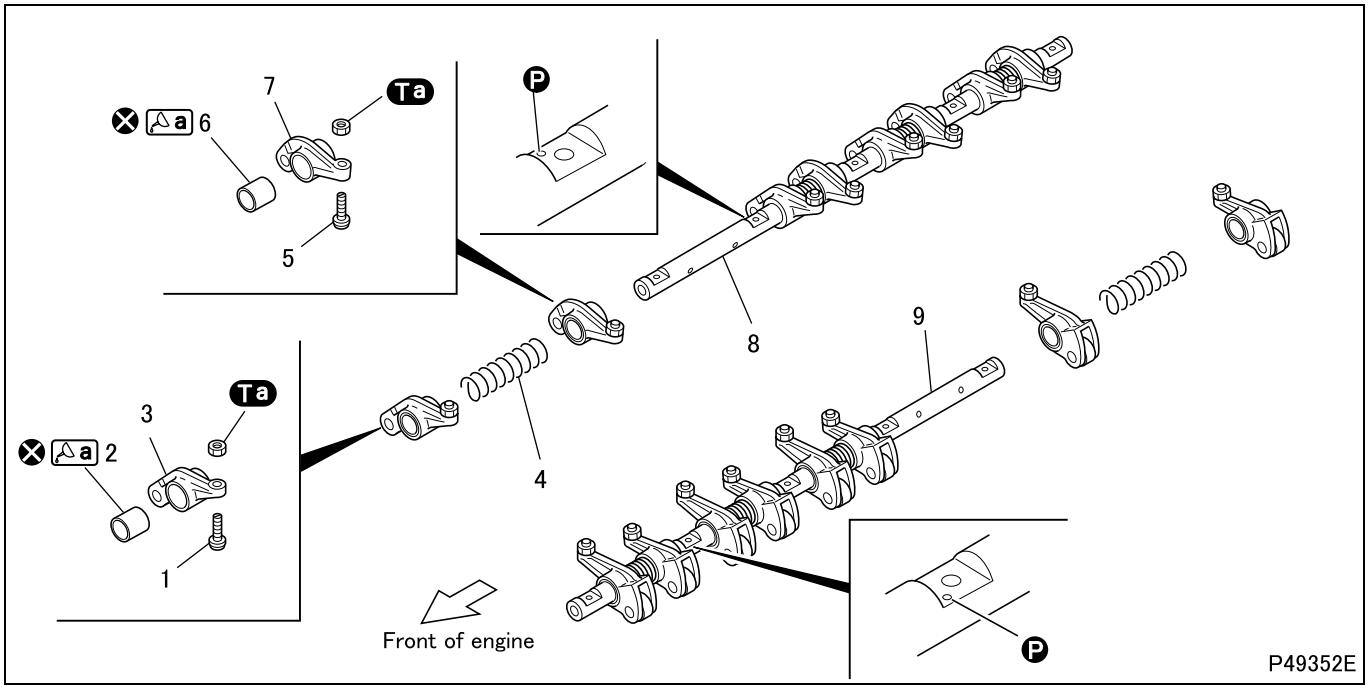
- When installing the camshaft frame on the cylinder head, also install the rocker shafts. Then, tighten the rocker shaft bolts (10 places) and the camshaft frame bolts (13 places) in the order indicated below.

CAUTION ⚠

- **Reapply sealant to the areas specified above if any of the bolts is loosened or removed after the rocker shafts and camshaft frame are installed.**



- Tighten the bolts (1 to 23) to the specified torque in the order indicated in the illustration.



● **Disassembly sequence**

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

Ⓟ: Hole for camshaft frame locating pin
⊗: Non-reusable parts

● **Assembly sequence**

Follow the disassembly sequence in reverse.

CAUTION ⚠

- **The short rockers and long rockers must be installed alternately. Be aware that the order of installation for the intake rockers is different from the order of installation for the exhaust rockers.**

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
3, 7	Rocker (roller) radial play	0.038 to 0.100 {0.0015 to 0.0039}	–	Replace
2, 6, 8, 9	Rocker bushing-to-rocker shaft clearance	0.01 to 0.08 {0.00039 to 0.0031}	0.12 {0.0047}	Replace

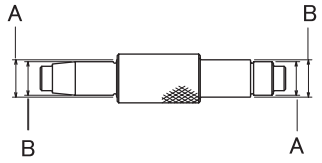
Tightening torque (Unit: N·m {lbf·ft, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Lock nut (adjusting screw stopping)	20.6 {15, 2.1}	–

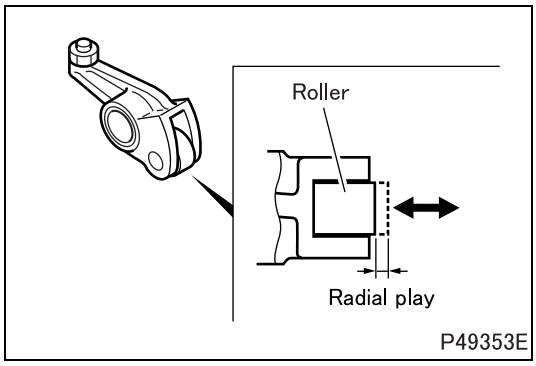
Lubricant and/or sealant

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

Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application
a	Rocker bushing puller A: ϕ22 {ϕ0.87}, B: ϕ24.5 {ϕ0.96}  P29932	MH062536	Removal and installation of rocker bushing

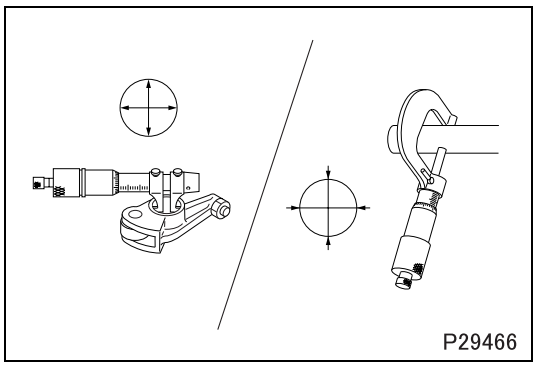
◆Inspection procedure◆



P49353E

■ Inspection: Mitsubishi 4M50 Rocker (roller) radial clearance

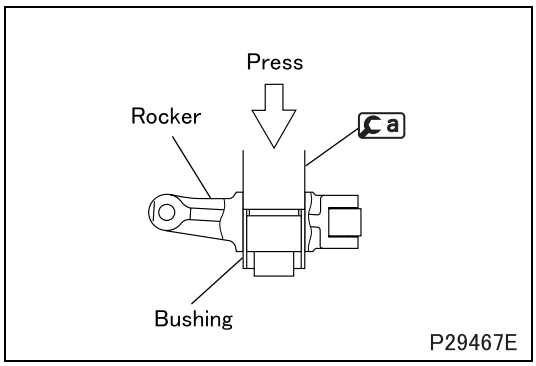
- Replace the rocker if the radial play measurement is not within the standard value range.


P29466

Inspection: Mitsubishi 4M50 Rocker bushing-to-rocker shaft clearance

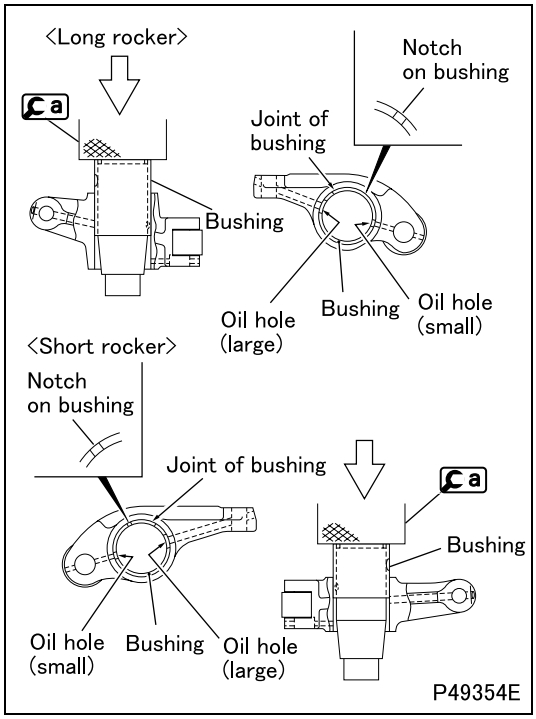
■

- Replace the bushing if the measurement exceeds the specified limit.



P29467E

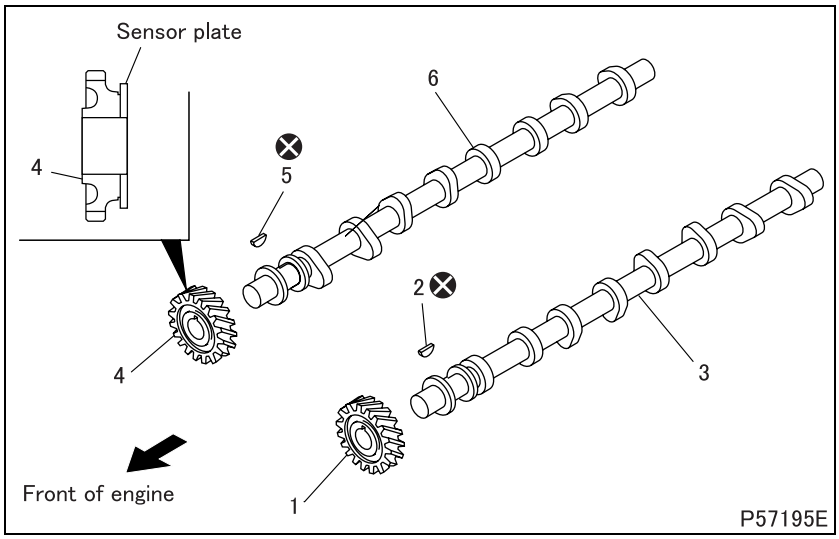
Replacement of Mitsubishi 4M50 rocker bushing [Removal]



[Installation]

- Press-fit each rocker bushing in the rocker with its ends facing in the illustrated directions.

Camshafts



● Disassembly sequence

1 Intake camshaft gear
2 Key
3 Intake camshaft
4 Exhaust camshaft gear
5 Key
6 Exhaust camshaft

⊗: Non-reusable parts

NOTE

- **Do not remove the camshaft gears unless defects are evident.**

● Assembly sequence

Follow the disassembly sequence in reverse.

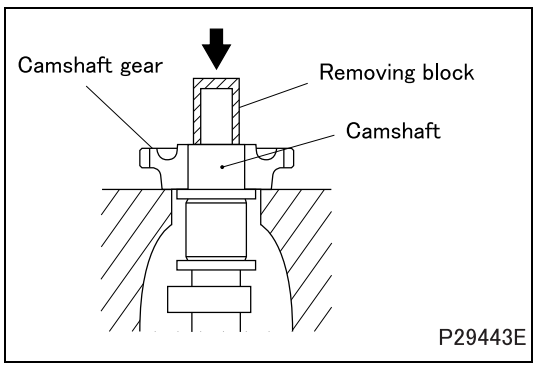
NOTE

- **The exhaust camshaft gear has the sensor plate. Do not mistake it for the intake camshaft gear. If the gears are incorrectly installed, engine malfunction will occur.**

Service standards (Unit: mm {in.})

Location	Maintenance item			Standard value	Limit	Remedy	
1, 3, 4, 6	Camshaft gear-to-camshaft interference			0.007 to 0.041 {0.00028 to 0.0016}	–	Replace	
3	Mitsubishi 4M50 Intake camshaft	Cam lift	Cams for long rockers	7.21 {0.284}	7.16 {0.282}	Replace	Lobe height: 42.219 {1.66} Base circle diameter: 35.009 {1.38}
			Cams for short rockers	9.269 {0.365}	9.219 {0.363}		Lobe height:44.281 {1.74} Base circle diameter: 35.012 {1.38}
		Bend		0.01 {0.00039}	0.03 {0.0012}	Replace	
6	Mitsubishi 4M50 Exhaust camshaft	Cam lift	Cams for long rockers	7.184 {0.283}	7.134 {0.281}	Replace	Lobe height: 42.279 {1.66} Base circle diameter: 35.095 {1.38}
			Cams for short rockers	9.242 {0.364}	9.192 {0.362}		Lobe height: 44.359 {1.75} Base circle diameter: 35.117 {1.38}
		Bend		0.01 {0.00039}	0.03 {0.0012}	Replace	

◆Removal procedure◆



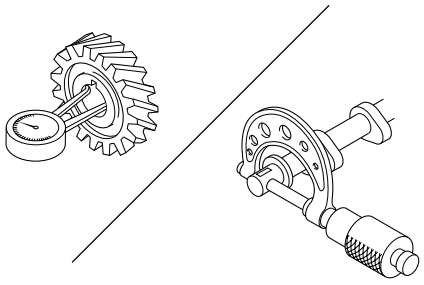
■ Removal: Camshaft gears

- Remove the camshaft gear by pushing on the camshaft using a press.

CAUTION ⚠

- **Do not use a hammer to remove the camshaft gear. Be sure to use a press for this purpose.**

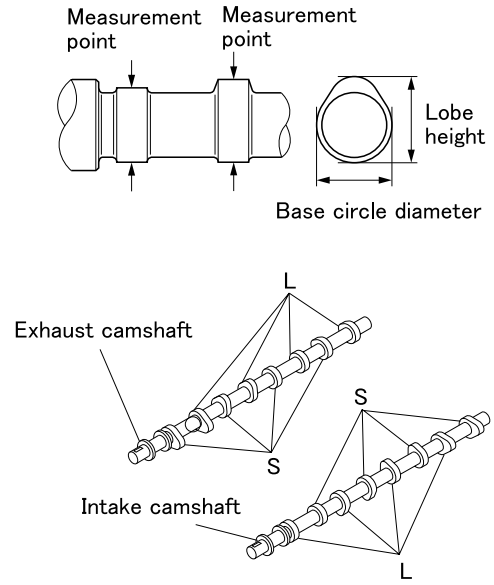
◆Inspection procedure◆



P29446

■ **Inspection: Camshaft gear-to-camshaft interference**

- If the measurement is not within the standard value range, replace the defective part(s).



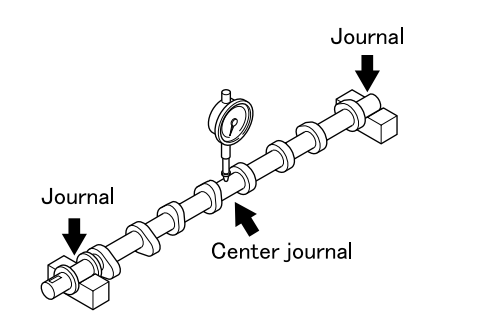
P56536E

■ **Inspection: Mitsubishi 4M50 Camshaft (1) Cam lift**

- Replace the camshaft if the difference between the cam lobe height and base circle diameter measurements is less than the specified limit.

NOTE

- **The cams for the long rockers (L) are different from the cams for the short rockers (S).**



P29448E

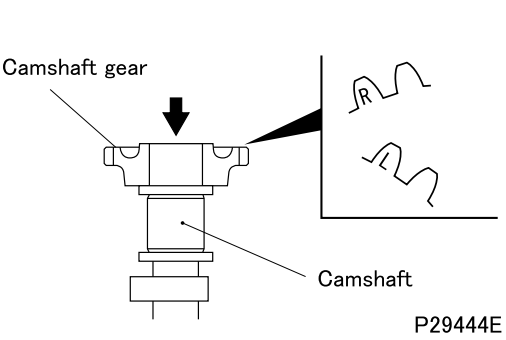
(2) Bend

- Place supports under the journals at the ends of the camshaft and measure the bend of the camshaft at the central journal.
- If the measurement exceeds the specified limit, replace the camshaft.

NOTE

- **Turn the camshaft by one turn and read the dial gauge. Divide the reading by two to obtain the amount of camshaft bend.**

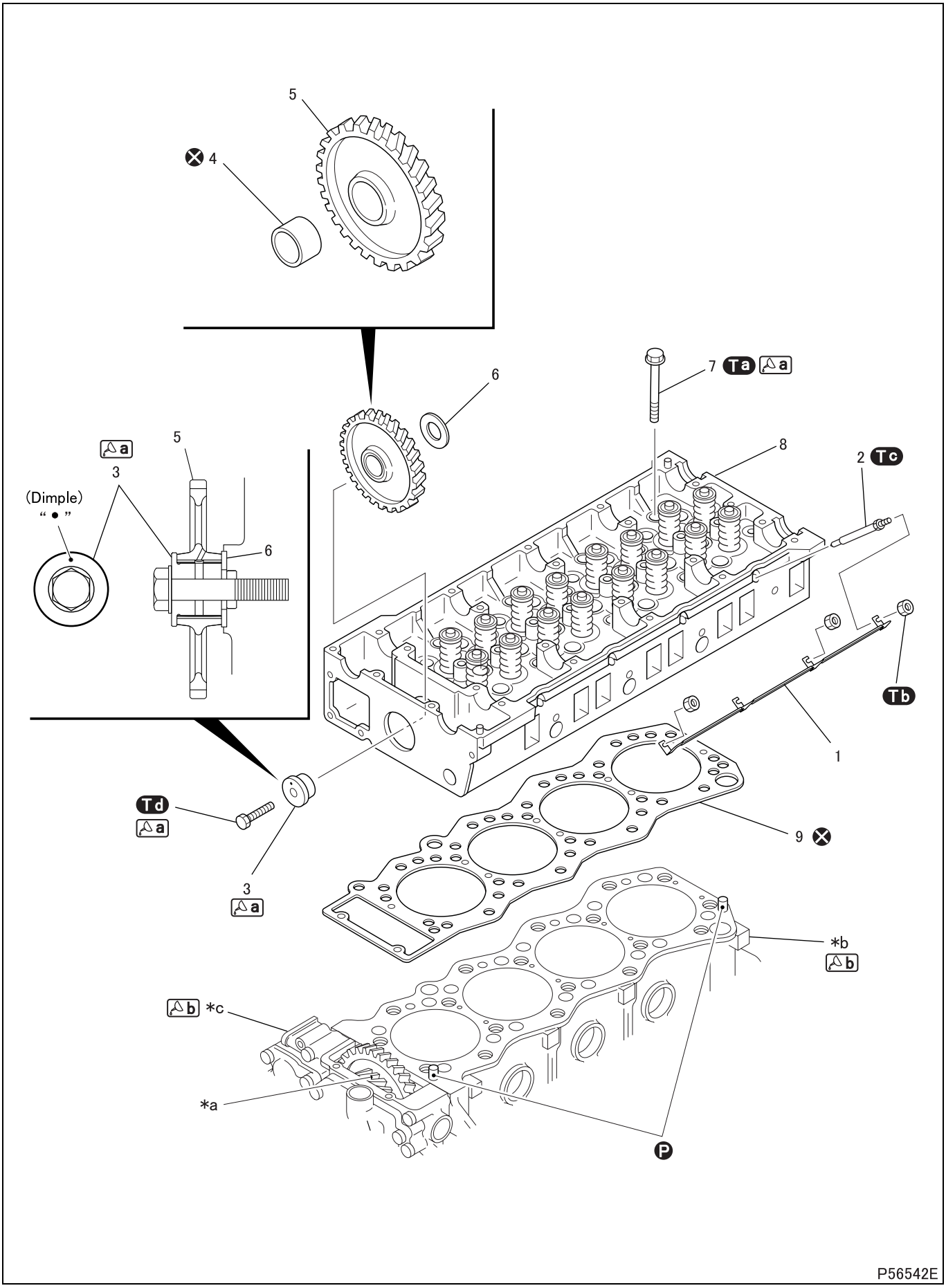
◆Installation procedure◆



P29444E

■ **Installation: Camshaft gears**

- Heat the camshaft gears to approximately 150°C {302°F} with a gas burner.
- Install the camshaft gear on the camshaft with a mating mark (“R” or “L”) facing in the illustrated direction.
- Press the gear until its end comes in close contact with the flange on the camshaft.


5
4
6
7 Ta a
5
a
3
(Dimple)
" ● "
6
8
2 Tc
Tb
1
Td
a
9
3
a
*b
b
b *c
*a
P
P56542E

● **Disassembly sequence**

1 Connection plates
2 Glow plug
3 Head idler shaft
4 Head idler gear bushing
5 Head idler gear
6 Thrust plate
7 Cylinder head bolt
8 Cylinder head (See later sections.)
9 Cylinder head gasket
∗a: Idler gear
∗b: Upper crankcase
∗c: Front case
Ⓟ: Locating pin
⊗: Non-reusable parts

CAUTION ⚠

- **Be careful not to damage the glow plugs and injectors when placing the cylinder head on the worktable, as they are protruding out of the bottom of the cylinder head.**
- **The cylinder head bolts are tightened using the torque-turn method. Any cylinder head bolt that has three marks indicating that the bolt has been tightened three times already must be replaced with a new one.**

● **Assembly sequence**

Follow the disassembly sequence in reverse.

CAUTION ⚠

- **Do not forget to install the thrust plate.**

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
–	Head idler gear end play	0.1 to 0.2 {0.0039 to 0.0079}	0.3 {0.012}	Replace
3, 4	Head idler shaft-to-head idler gear bushing clearance	0.01 to 0.05 {0.00039 to 0.0020}	0.1 {0.0039}	Replace

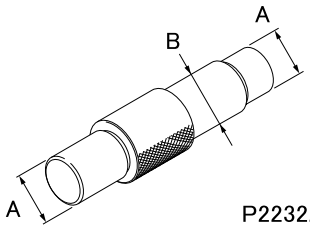
Tightening torque (Unit: N·m {lbf·ft, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ⓣa	Mitsubishi 4M50 Cylinder head bolt	147 {110, 15} + 90°	Wet
Ⓣb	Nut (connection plate installation)	1.0 to 1.5 {0.7 to 1.1, 0.1 to 0.15}	–
Ⓣc	Mitsubishi 4M50 Glow plug	19.6 to 24.5 {14 to 18, 2 to 2.5}	–
Ⓣd	Bolt (head idler shaft installation)	40.2 {30, 4.1}	Wet

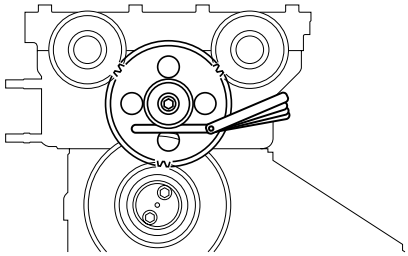
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
△a	O-ring	Engine oil	As required
	Bolt (head idler gear installation) threads and seating surface under head		
	Head idler shaft outer peripheral surface		
	Cylinder head bolt threads		
△b	Top surfaces of joints between upper crankcase and front case	ThreeBond 1207C	As required

Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application
Ca	Idler gear bushing puller A: ϕ32 {ϕ1.26}, B: ϕ35 {ϕ1.38}  P22322	MH061779	Removal and installation of idler gear bushing

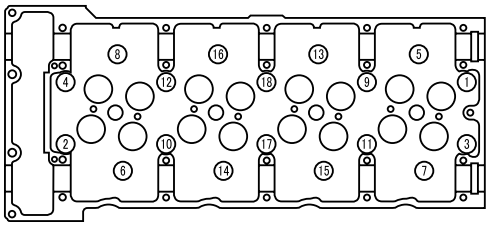
◆Inspection before removal◆


P56522

■ **Inspection: Head idler gear end play**

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

◆Removal procedure◆



P49359

■ **Removal: Cylinder head**

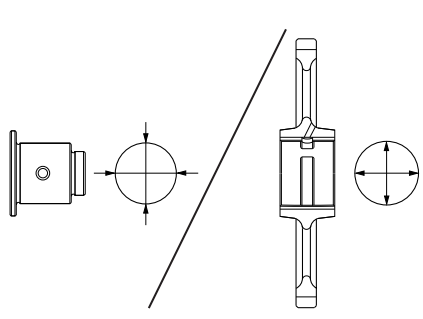
- Loosen the cylinder head bolts (1 to 18) in several passes in the order indicated in the illustration and remove the cylinder head.

■ **Removal: Cylinder head gasket**

CAUTION ⚠

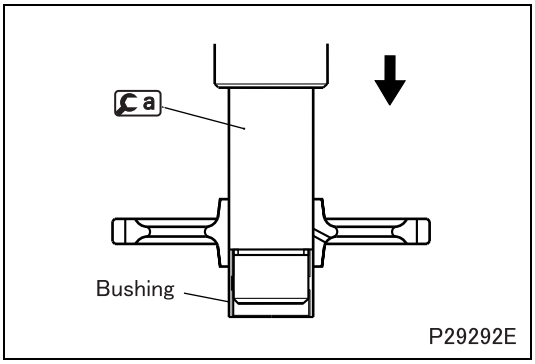
- **When removing the cylinder head gasket, be careful not to scratch the cylinder head, the upper crankcase and the front case.**

◆Inspection procedure◆

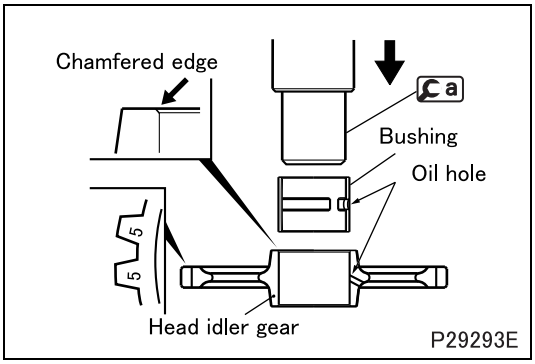

P29291

■ **Inspection: Head idler shaft-to-head idler gear bushing clearance**

- Replace the bushing if the measurement exceeds the specified limit.



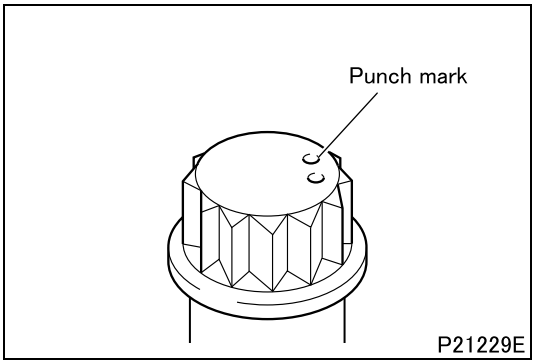
Replacement of Mitsubishi 4M50 head idler gear bushing [Removal]



[Installation]

- Position the bushing on the head idler gear with their ends facing the illustrated directions and their oil holes on the same line.
- Using Ca, press the bushing into the head idler gear until it is flush with the lower edge of the chamfer on the head idler gear.
- Remeasure the clearance between the bushing and head idler shaft.
- Ream the bushing if the measurement is less than the standard value.

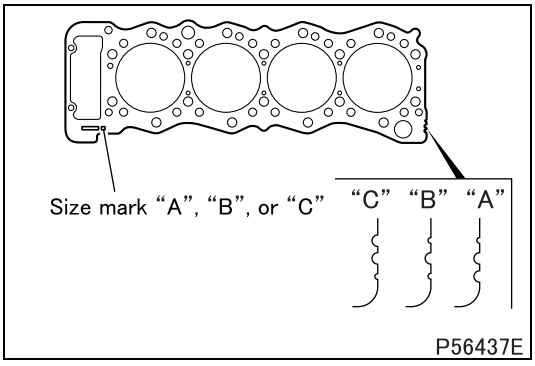
◆Installation procedure◆



■Installation: Cylinder head

CAUTION ⚠

- **Before fitting the cylinder head bolts, check the punch marks on each bolt's head. Do not use the bolt if there are three punch marks.**
- **The punch marks indicate the number of times each bolt has been tightened using the torque-turn tightening method. Any bolt that already has three punch marks must be replaced.**



- The cylinder head gasket comes in three sizes. Choose the gasket appropriate for the cylinder head by the following procedure.
  - Measure the amount of piston projection for every cylinder. (See the "**PISTONS, CONNECTING RODS AND CYLINDER LINERS**" section.)
  - Select a cylinder head gasket with the appropriate thickness for the average of the piston projection measurements from the table below.
  - If any of the piston projection measurements is more than 0.05 mm {0.0020 in.} larger than the average value, then use the gasket one class higher than that class (A→B, B→C).

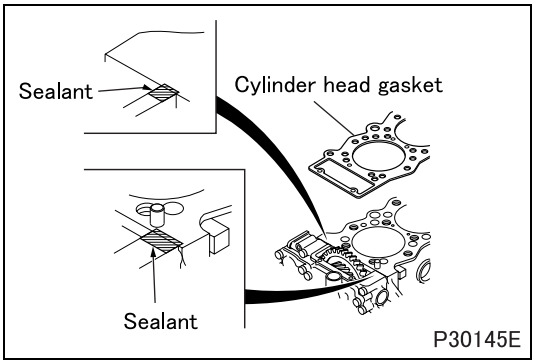
Unit: mm {in.}

Piston projection	Cylinder head gasket	
	Size	Thickness when tightened
–0.088 to –0.027 {–0.0035 to –0.0011}	"A"	0.75 ± 0.03 {0.030 ± 0.0012}
–0.027 to 0.033 {–0.0011 to 0.0013}	"B"	0.80 ± 0.03 {0.031 ± 0.0012}
0.033 to 0.094 {0.0013 to 0.0037}	"C"	0.85 ± 0.03 {0.033 ± 0.0012}

- The size class of the cylinder head gasket can be determined from the size mark or the shape of the notches cut on the gasket edge.

CAUTION ⚠

- **Replacement of the piston or connecting rod alters the piston projection. Always measure the amount of piston projection after either or both of them are replaced.**

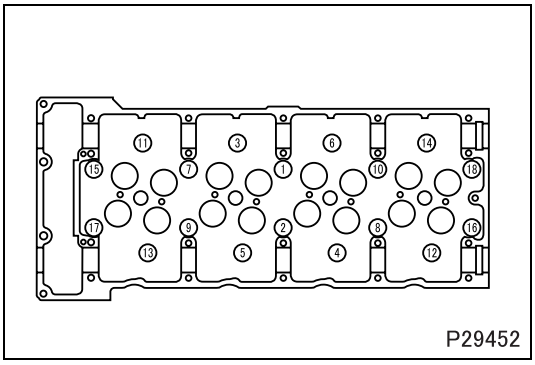


- Clean the sealant application surfaces of each part.
- Apply sealant to the top surfaces of the joints between the upper crankcase and front case (at two places).
- Install the cylinder head and its gasket on the upper crankcase within three minutes of applying the sealant, being careful not to dislodge the sealant.

CAUTION ⚠

- **Do not run the engine within one hour of mounting the cylinderhead. If any cylinder head bolts are loosened or removed, be sure to reapply sealant to the surfaces specified above.**

Mitsubishi 4M50 Head Bolt Tightening Sequence

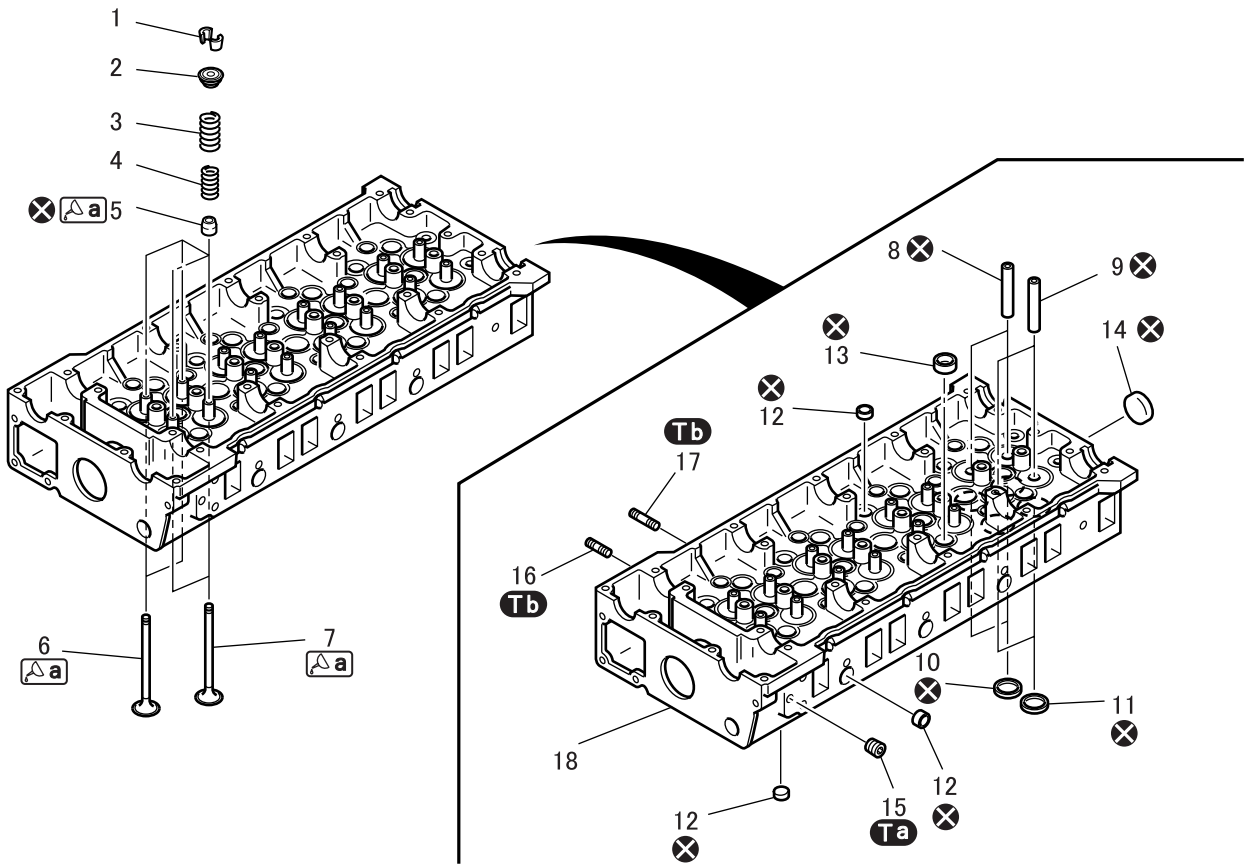


- Tighten the cylinder head bolts (1 to 18) to a torque of 147 N·m {110 lbf·ft, 15 kgf·m} (wet) in the order indicated in the illustration. Then, tighten them further by 90° in the same order.
- After tightening each bolt, make a punch mark on the head of the bolt to indicate the number of times that it has been used.

CAUTION ⚠

- **Cylinder head bolts that have been tightened using the torque-turn method must never be additionally tightened after the final angular tightening.**

Mitsubishi 4M50 Cylinder Head Parts



● **Disassembly sequence**

1 4M50 Valve cotter
2 4M50 Upper retainer
3 4M50 Outer valve spring
4 4M50 Inner valve spring
5 4M50 Valve stem seal
6 4M50 Exhaust valve
7 4M50 Intake valve
8 4M50 Exhaust valve guide
9 4M50 Intake valve guide
10 4M50 Exhaust valve seat
11 4M50 Intake valve seat
12 4M50 Soft plug
13 4M50 Soft plug
14 4M50 Soft plug
15 Taper plug
16 4M50 Exhaust Stud (short)
17 4M50 Exhaust Stud (long)
18 Cylinder head

⊗: Non-reusable parts

● **Assembly sequence**

Follow the disassembly sequence in reverse.

CAUTION ⚠

- **When an intake valve or exhaust valve have been removed, make sure to replace the valve stem seal.**

Service standards (Unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
3	Mitsubishi 4M50 Outer valve spring	Free length	87.8 {3.46}	–	Replace
		Installed load (57 {2.24} in installed length)	360 N {81 lbs, 36.7 kgf}	–	
		Squareness	–	2.5 {0.098}	
4	Mitsubishi 4M50 Inner valve spring	Free length	78.8 {3.10}	–	Replace
		Installed load (52.3 {2.06} in installed length)	168 N {38 lbs, 17.1 kgf}	–	
		Squareness	–	2.5 {0.098}	
6	Mitsubishi 4M50 Exhaust valve	Stem outside diameter	$\phi 8\ ^{-0.060}_{-0.075}$ {$\phi 0.31\ ^{-0.0024}_{-0.0030}$}	–	Replace
		Sinkage from cylinder head bottom surface	1.5 ± 0.25 {0.059 ± 0.0098}	–	Inspect
		Valve margin	1.5 {0.059}	–	Reface or replace
		Seat angle	45° ± 15'	–	Reface
6, 8	4M50 Exhaust valve stem-to-valve guide clearance		0.07 to 0.10 {0.0028 to 0.0039}	0.2 {0.0079}	Replace
7	Mitsubishi 4M50 Intake valve	Stem outside diameter	$\phi 8\ ^{-0.025}_{-0.040}$ {$\phi 0.31\ ^{-0.00098}_{-0.0016}$}	–	Replace
		Sinkage from cylinder head bottom surface	1.5 ± 0.25 {0.059 ± 0.0098}	–	Inspect
		Valve margin	1.5 {0.059}	–	Reface or replace
		Seat angle	45° ± 15'	–	Reface
7, 9	4M50 Intake valve stem-to-valve guide clearance		0.03 to 0.06 {0.0012 to 0.0024}	0.2 {0.0079}	Replace
10	Mitsubishi 4M50 Exhaust valve seat width		2.5 ± 0.2 {0.098 ± 0.0079}	3.5 {0.14}	Correct or replace
11	Mitsubishi 4M50 Intake valve seat width		2 ± 0.2 {0.079 ± 0.0079}	2.8 {0.11}	Correct or replace
18	Cylinder head	Bottom surface distortion	0.05 {0.0020} or less	0.2 {0.0079}	Correct or replace
		Height from top surface to bottom surface	107 ± 0.5 {4.21± 0.020}	106.5 {4.19}	Replace

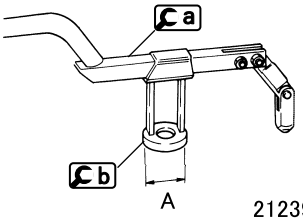
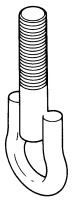
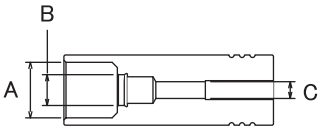
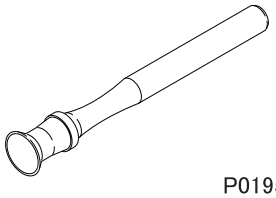
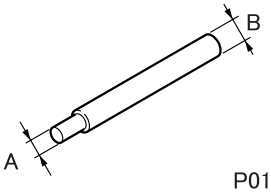
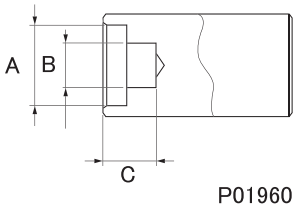
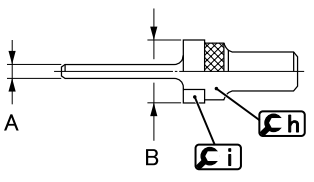
Tightening torque (Unit: N·m {kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Tapered plug	14 {10, 1.4}	–
Tb	Stud	20 {15, 2.0}	–

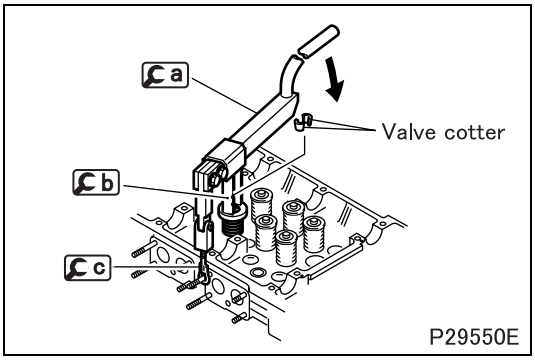
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Lip of valve stem seal	Engine oil	As required
	Valve stem and valve end		

Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application
a	Valve lifter	MH061668	Removal and installation of valve cotters
b	Valve lifter seat A: ϕ38 {ϕ1.50}	MH061772	
a b A	 21239		
c	Valve lifter hook	MH061679	
	 21240		
d	Valve stem seal installer A: ϕ26.5 {ϕ1.04} B: ϕ14.7 {ϕ0.58} C: ϕ8 {ϕ0.31}	MH063607	Installation of valve stem seals
	 P29931		
e	Valve lapper	30091-07500	Lapping valves and valve seats
	 P01958		
f	Valve guide remover A: ϕ8 {ϕ0.31} B: ϕ12 {ϕ0.47}	31391-10500	Removal of valve guides
	 P01959		
g	Valve guide installer A: ϕ25.5 {ϕ1.00} B: ϕ13 {ϕ0.51} C: 29 {1.14}	MH063604	Installation of valve guides
	 P01960		
h	Caulking tool body A: ϕ8 {ϕ0.31}	31391-13100	Installation of valve seat
i	Installer ring B: ϕ38 {ϕ1.50}	MH063605	
	 P01961B		

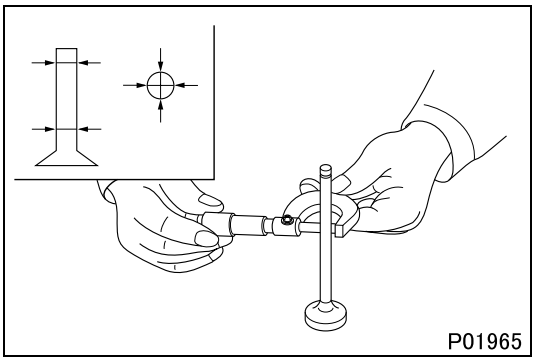
◆Removal procedure◆



■ Removal: Valve cotters

- Remove the valve cotters by evenly compressing the valve springs.

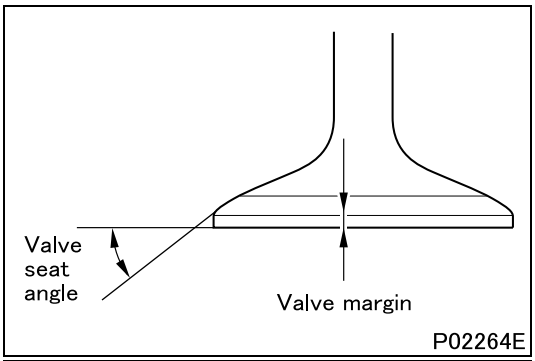
◆Inspection procedure◆



■ Inspection: Intake valves and exhaust valves

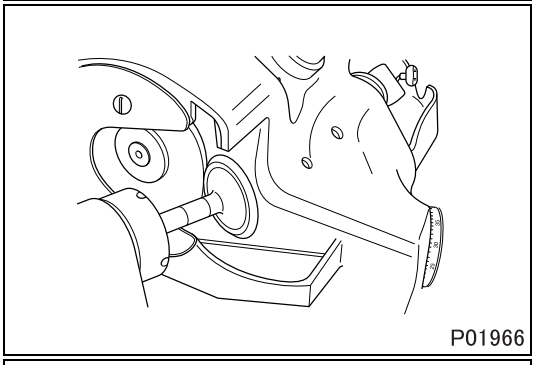
(1) Inspection of valve stem

- Replace the valve if the stem's outside diameter is below the limit or is severely worn.
- When the valve has been replaced with a new one, make sure to lap the valve and valve seat.



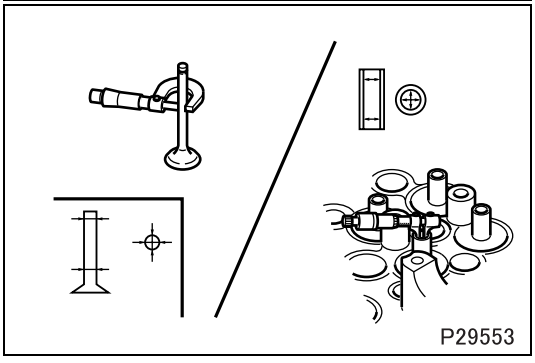
(2) Valve seat angle and valve margin

- Reface or replace the valve if the valve seat angle or valve margin exceeds the specified limits.



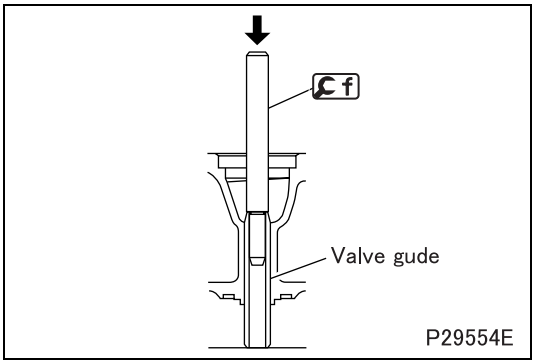
Refacing

- 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.

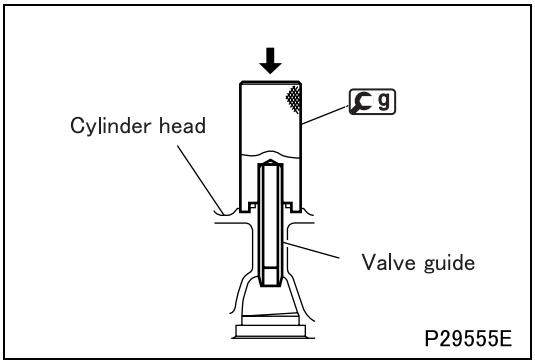


■ Inspection: Valve-to-valve guide clearance

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



Replacement of Mitsubishi 4M50 valve guides [Removal]

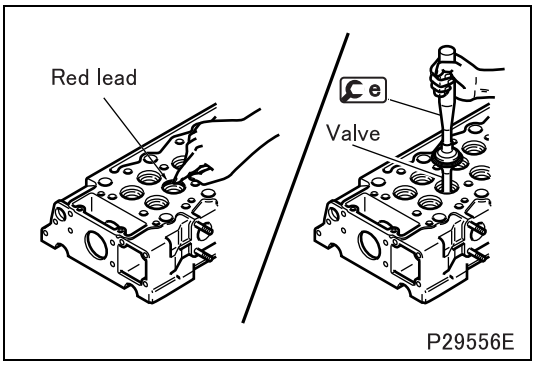


[Installation]

- Install the valve guide until g sits snugly on the cylinder head.

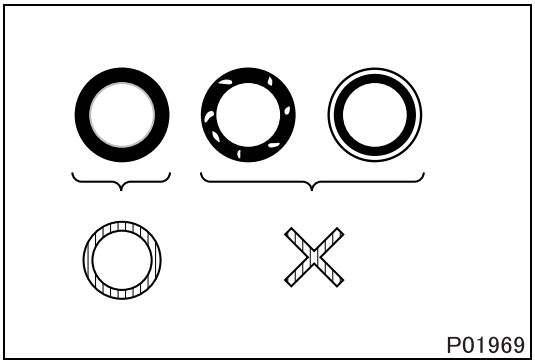
CAUTION ⚠

- **The valve guides must be pressed to the specified depth. Be sure to use g for this operation.**
- **Exhaust valve guides are longer than intake valve guides. Make sure to install the correct type of guide in each location.**



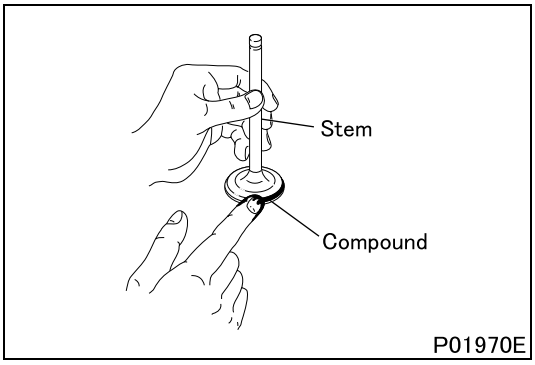
■ Inspection: Contact between valve and valve seat

- 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.

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

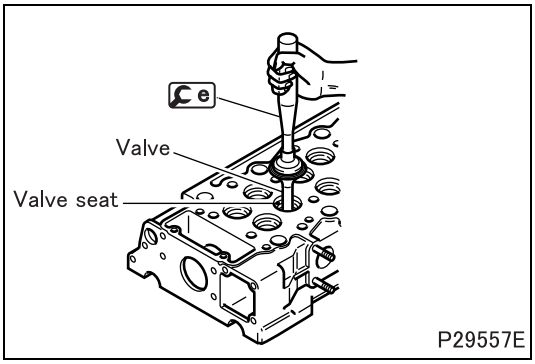


Lapping

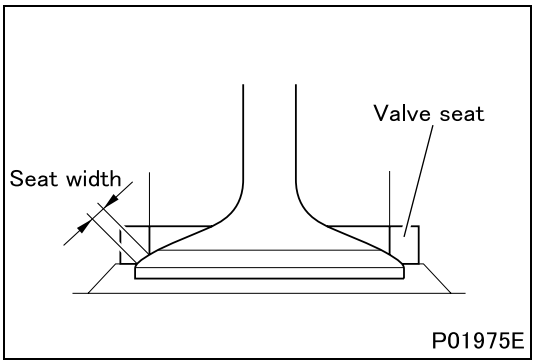
- Perform the valve lapping in the following procedure.
- Apply a thin coat of lapping compound to the seat contact surface of the valve.

CAUTION ⚠

- **Do not put any compound on the stem.**
- **Start with an intermediate-grit compound (120 to 150 grit) and finish with a fine-grit compound (200 grit or more). Do not put any compound on the stem.**
- **Adding a small amount of engine oil to the lapping compound can facilitate even application.**



- 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 valve contact surface of the valve seat and rub in the valve and seat well.
- Inspect the contact pattern of the valve and valve seat again.
- If the contact pattern is still defective, replace the valve seat.

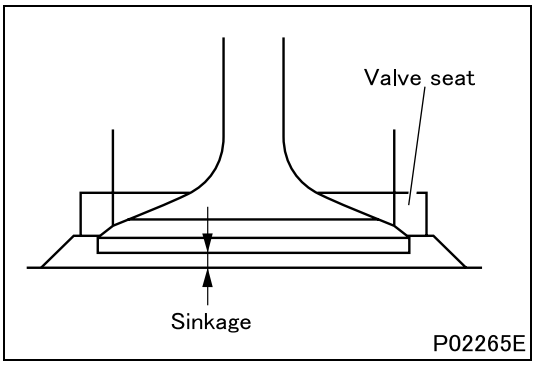


■ Inspection: Mitsubishi 4M50 Valve seats (1) Valve seat width

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

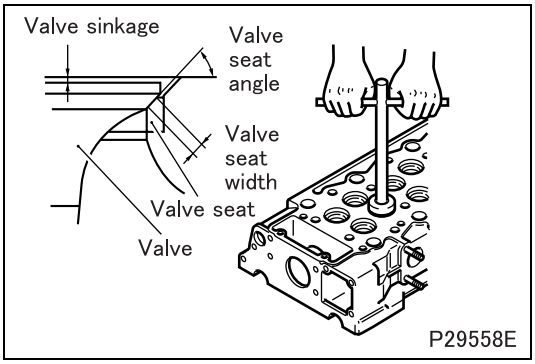
CAUTION ⚠

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



(2) Valve sinkage from cylinder head bottom surface

- Make sure that the valve and valve seat are pressed together tightly when measuring the sinkage.
- If the measurement exceeds the limit, reface or replace the defective part(s).



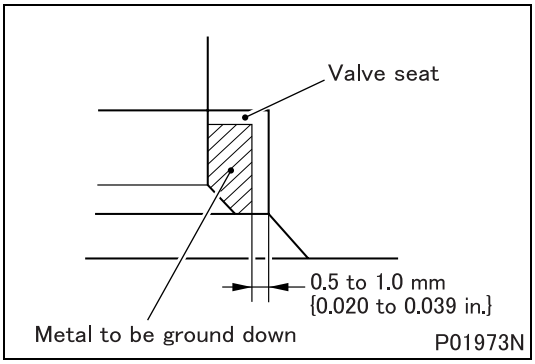
Refacing the valve seat

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

CAUTION ⚠

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

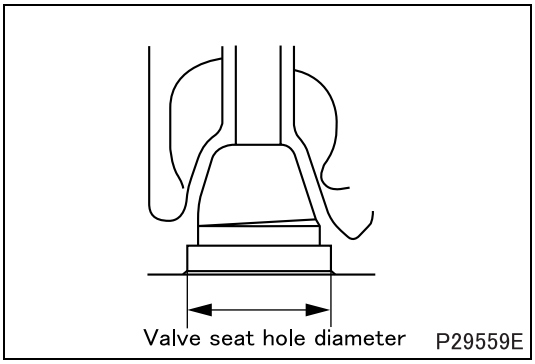
- Lap the valve and valve seat.



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.

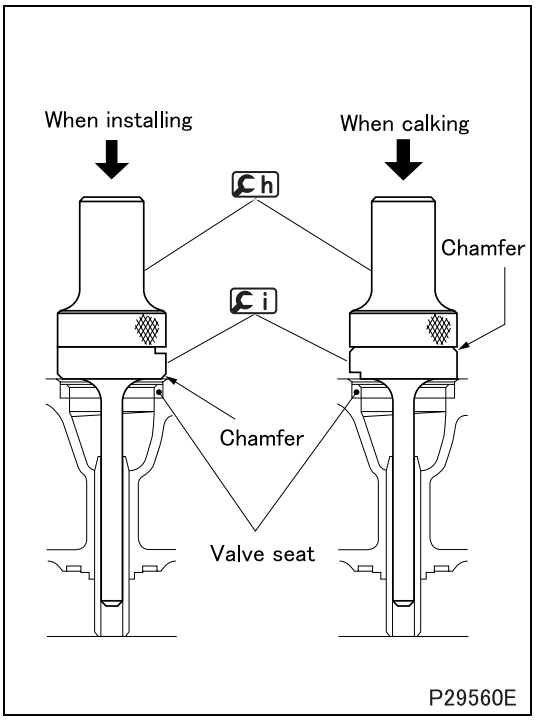


[Installation]

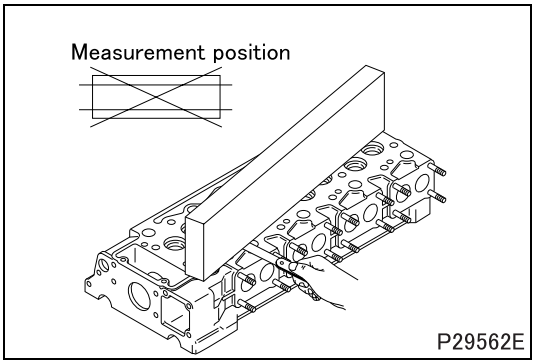
- Check that the diameter of the valve seat hole in the cylinder head conform with the value shown below.

Valve seat hole diameter	$\phi 38\ ^{+0.025}_{0}$ mm {$\phi 1.50\ ^{+0.00098}_{0}$ in.}

- Replace the cylinder head if the measurement deviates from specification.



- Chill the valve seat thoroughly by immersing in it in liquid nitrogen.
- Install the valve seat in the cylinder head using h and i, with the chamfered edge of i toward the valve seat.
- Turn i over so that its chamfered edge is toward h, and calk the valve seat.
- Lap the valve seat and valve.



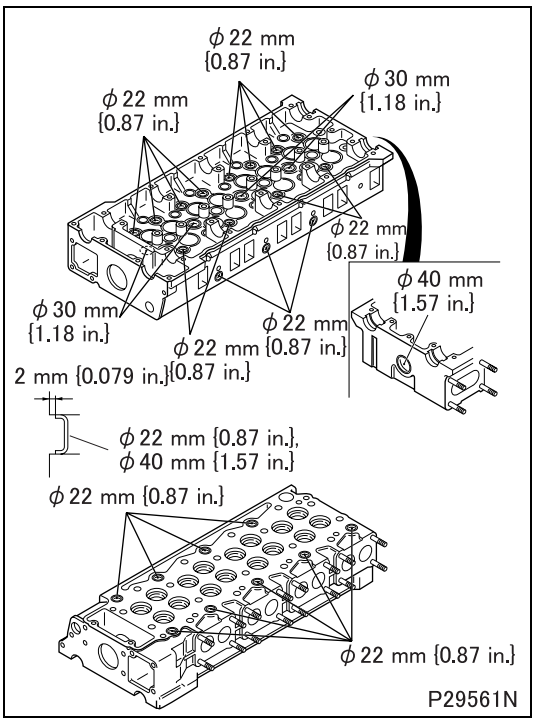
■ Inspection: Cylinder head bottom surface distortion

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

CAUTION ⚠

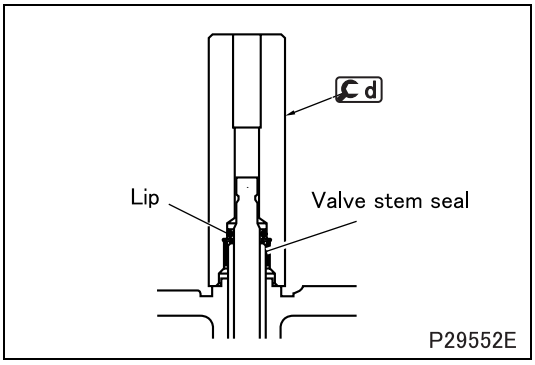
- **When grinding the cylinder head bottom surface, make sure that the height of the cylinder head (from the top surface to the bottom surface) is not reduced to a value below the specified limit.**

◆Installation procedure◆



■Installation: Sealing caps

- Drive the sealing caps into the cylinder head to the specified depth.



■Installation: Valve stem seal

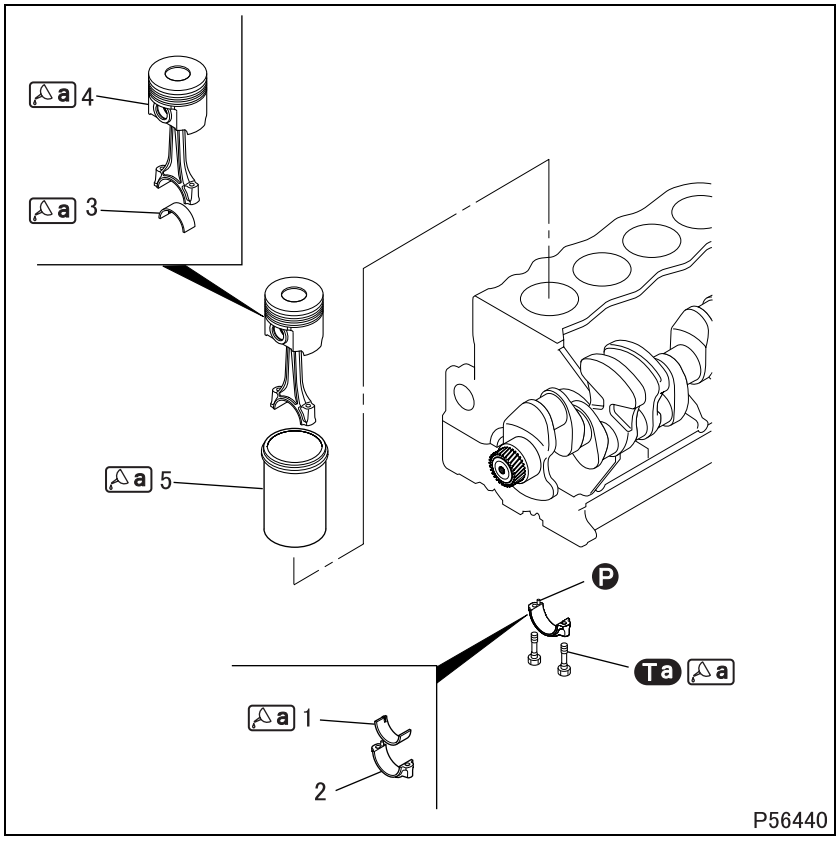
- Apply engine oil to the lip of the valve stem seal.
- Install the valve stem seal until d sits snugly on the cylinder head.

CAUTION ⚠

- **After installing the valve stem seal, check that its spring is not deformed or damaged.**

■Installation: Mitsubishi 4M50 Valve cotter

- To install the valve cotter, follow the removal procedure. (See **"■ Removal: Valve cotter"**.)



● **Disassembly sequence**

1 Lower connecting rod bearing
2 Connecting rod cap
3 Upper connecting rod bearing
4 Mitsubishi 4M50 Piston and connecting rod assembly (See later sections.)
5 Cylinder liner

Ⓟ: Locating pin

● **Assembly sequence**

Follow the disassembly sequence in reverse.

Service standards (Unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
–	Piston projection from crankcase top surface (average value)		–0.088 to 0.094 {–0.0035 to 0.037}	–	Inspect
–	Mitsubishi 4M50 Connecting rod end play		0.15 to 0.45 {0.0059 to 0.018}	0.6 {0.024}	Inspect
1, 3	Connecting rod bearing	Span when free	–	Less than 69.5 {2.74}	Replace
		Oil clearance	0.034 to 0.093 {0.0013 to 0.0037}	0.2 {0.0079}	
4, 5	Mitsubishi 4M50 Piston-to-cylinder liner clearance		0.181 to 0.201 {0.0071 to 0.0079}	–	Replace

Location	Maintenance item		Standard value	Limit	Remedy
5	Mitsubishi 4M50 Cylinder liner	Flange projection above crankcase top surface	0.01 to 0.07 {0.00039 to 0.0028}	–	Replace
		Bore diameter	ϕ114 to 114.02 {ϕ4.4881 to 4.4889}	ϕ114.25 {ϕ4.50}	
		Out-of-roundness	0.08 {0.0031} or less	–	
		Taper	0.03 {0.0012} or less	–	
		Difference in flange projection from neighboring cylinder liner	0.04 {0.0016} or less	–	

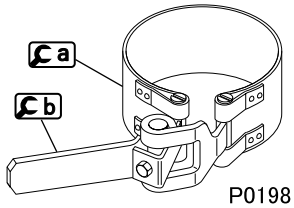
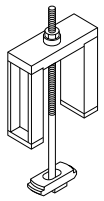
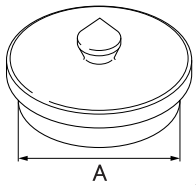
Tightening torque (Unit: N·m {lbf·ft, kgf·m})

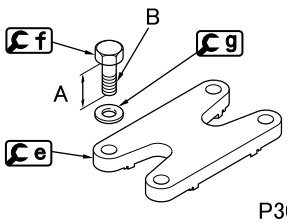
Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Mitsubishi 4M50 Bolt (connecting rod cap installation)	29 {21, 3.0} + 90° ± 5°	Wet

Lubricant and/or sealant

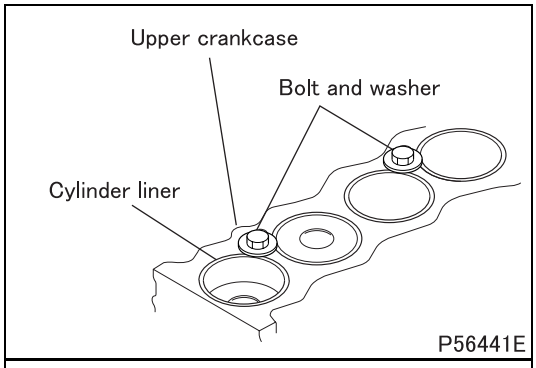
Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Bolt threads	Engine oil	As required
	Connecting rod bearing inside surface		
	Upper crankcase contact surface of cylinder liner		
	Piston outside surface		
	Cylinder liner wall surface		

Special tools (Unit: mm {in.})

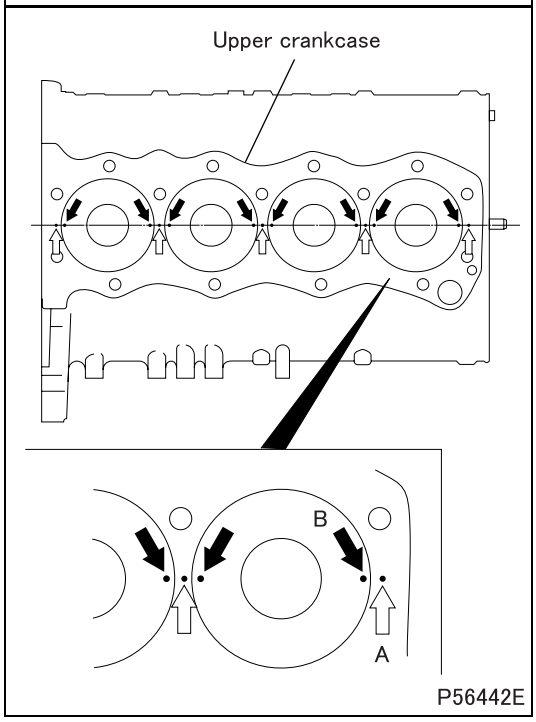
Mark	Tool name and shape		Part No.	Application
a	Piston guide clamp	 P01981	MH064332	Installation of piston and connecting rod assembly
b	Piston guide lever		MH061658	
c	Cylinder liner extractor	 P30008	MH062537	Removal of cylinder liner
d	Cylinder liner installer A: ϕ113.5 {ϕ4.47}	 A P30010	MH063606	Installation of cylinder liner

e	Adapter	 P30009	MH063433	Measurement of cylinder liner flange projection above upper crankcase top surface and difference in flange projection between neighboring cylinder liners
f	Bolt A: 40 {1.57}, B: M14 × 2		MF130625	
g	Washer		MH005012	

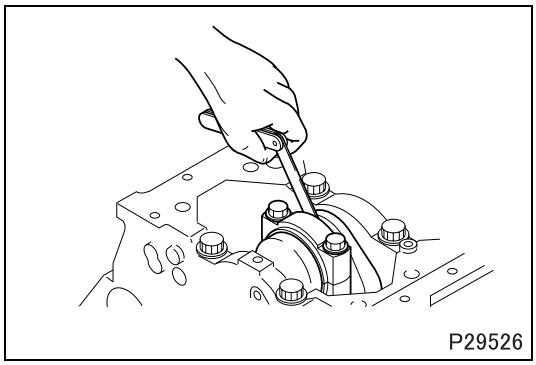
◆Inspection before removal◆



P56441E



P56442E


P29526

■ Retaining cylinder liners

- The cylinder liners slips out of the upper crankcase easily when the upper crankcase is turned over or the crankshaft is rotated with pistons inside liners. To prevent this from happening, retain the flange of each cylinder liner in position with a bolt and washer.

■ Inspection: Mitsubishi 4M50 Piston projection from upper crankcase top surface

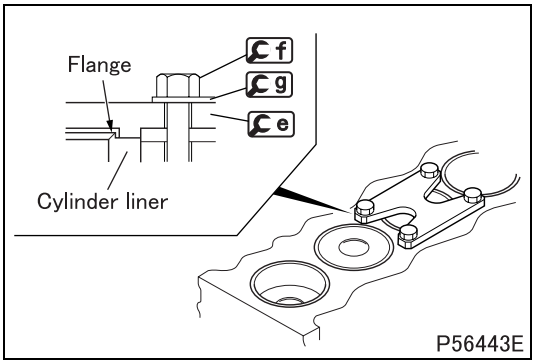
CAUTION ⚠

- **The amount of piston projection affects engine performance and must therefore be inspected without fail.**

- Set the piston at the top dead center.
- Mark reference points **A** (five points in total) on the top surface of the upper crankcase as shown in the illustration. Using each of the marks as a zero point, measure the amount of piston projection relative to the zero point (height of measurement point **B** – height of reference point **A**).
- Make the measurements at the two measurement points **B** for each cylinder (eight points in total) using the reference point **A** nearest to each measurement point, and calculate the average value of all the measurements.
- If the average value is out of the standard value range, check the clearances between all relevant parts.
- Select and use a cylinder head gasket that can accommodate the average piston projection (average value of the eight measurements).

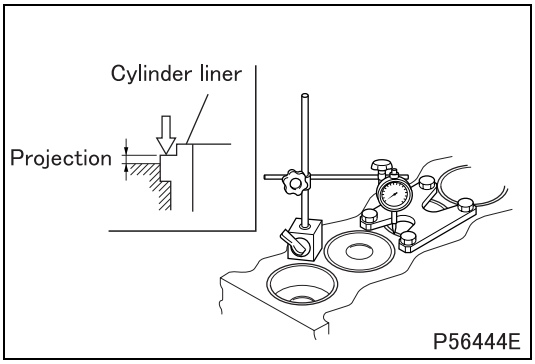
■ Inspection: Mitsubishi 4M50 Connecting rod end play

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



■ **Inspection: Difference in flange projection between neighboring cylinder liners**

- Install e on the upper crankcase so that it is not lying on top of any part of the flanges. Tighten f to a torque of 49 N·m {36 lbf·ft, 5 kgf·m}.

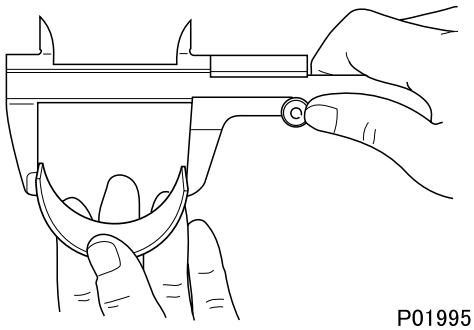


- Measure the amount of projection of the cylinder liner flange above the upper crankcase top surface.
- If the measurement is not within the standard value range, inspect the state of installation of the cylinder liner and then replace the defective part(s).

CAUTION ⚠

- **Insufficient projection of the flange can lead to a reduced pressure around the bore of the cylinder head gasket, causing gas leakage.**

◆Inspection procedure◆

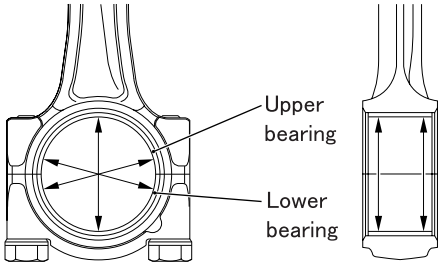

P01995

■ **Inspection: Connecting rod bearing span when free**

CAUTION ⚠

- **Do not attempt to manually expand the bearings.**
- **The upper and lower connecting rod bearings must be replaced as a set.**

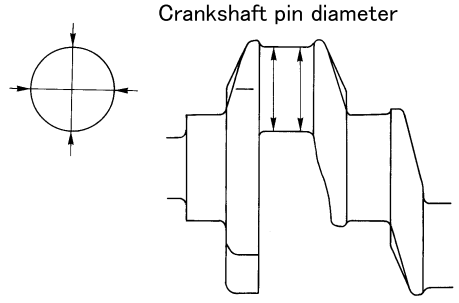
- If the span is less than the specified limit, replace both the upper and lower bearings.



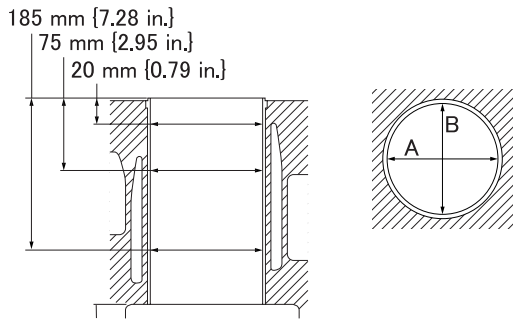
P29530E

■ **Inspection: Mitsubishi 4M50 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 bolts to a torque of 30 N·m {22 lbf·ft, 3.1 kgf·m}.
- Measure the inside diameter of the bearing and the 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.



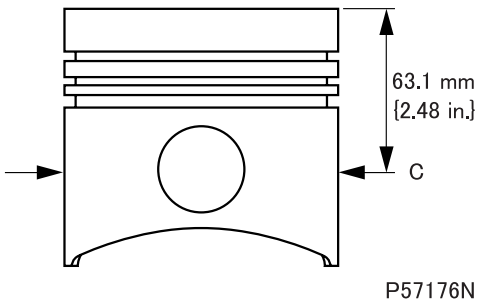
03627E



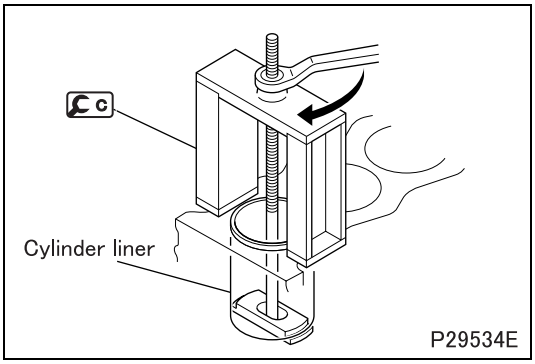
P49976N

■ **Inspection: Mitsubishi 4M50 Piston-to-cylinder liner clearance**

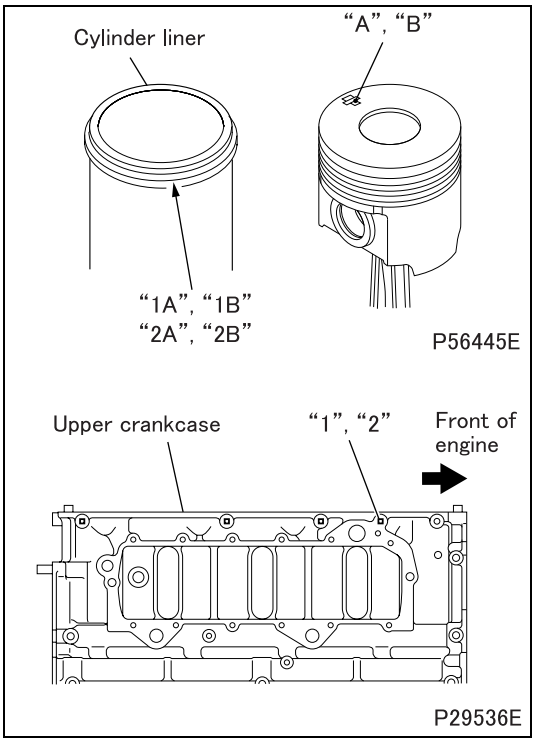
- If the measurement is not within the standard value range, replace the defective part(s).
  - **A:** Cylinder bore measurement (in direction of crankshaft axis)
  - **B:** Cylinder bore measurement (in direction perpendicular to crankshaft axis)
  - **C:** Piston diameter measurement (in direction perpendicular to piston pin hole)



P57176N

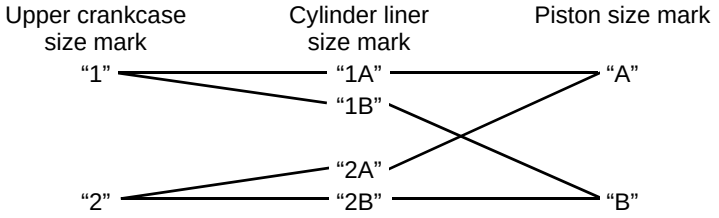


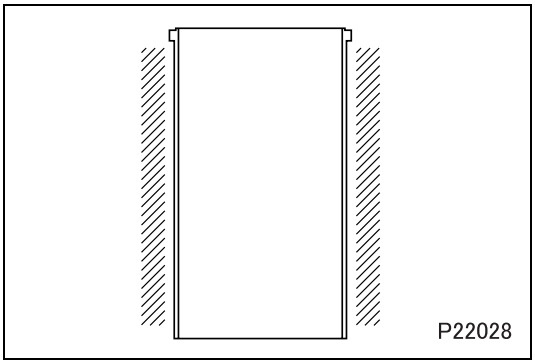
Replacement of cylinder liner
[Removal]



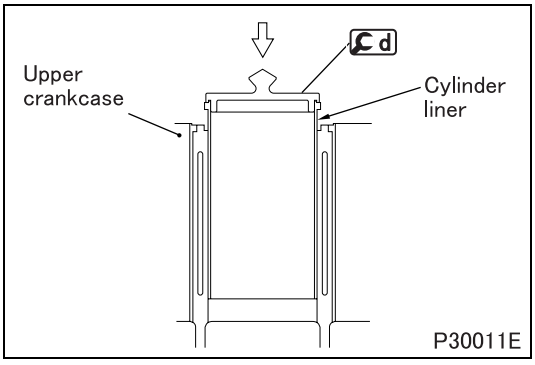
[Installation]

- Select cylinder liners with the same size marks as those on the upper crankcase and the pistons.
- The size marks on the upper crankcase are marked in the order of No. 1 cylinder, No. 2 cylinder, No. 3 cylinder and No. 4 cylinder starting with the front of the engine.





- Apply a thin coat of engine oil to the surfaces surrounding the cylinder liner of the upper crankcase (the shaded areas in the illustration).

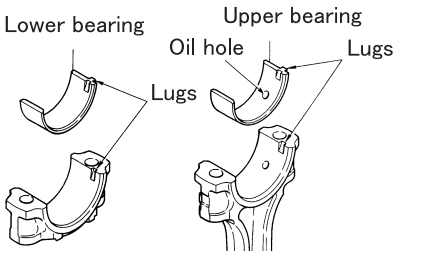


- Insert the cylinder liner into the upper crankcase by pushing down on d by hand slowly and evenly.

CAUTION ⚠

- **Handle the cylinder liner extremely carefully, as its wall is relatively thin and can be easily damaged.**

◆Installation procedure◆

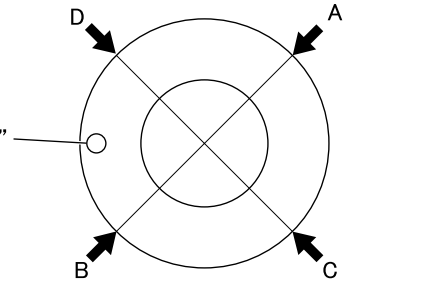


49975E

■ **Installation: Mitsubishi 4M50 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.**

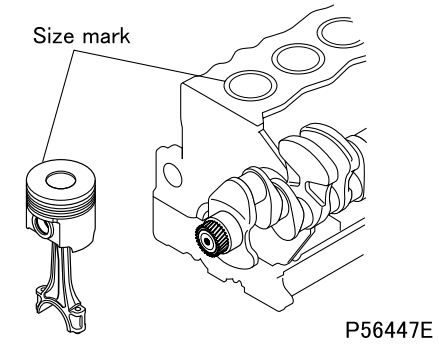


P56446

■ **Installation: Mitsubishi 4M50 Piston and connecting rod assembly**

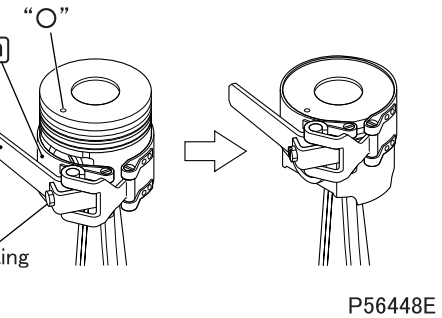
- Check that the piston ring end gaps are in their correct positions.
  A: 4M50 1st compression ring gap
  B: 4M50 2nd compression ring gap
  C: 4M50 Oil ring gap
  D: 4M50 Oil ring expander spring gap

"○": Front mark on piston

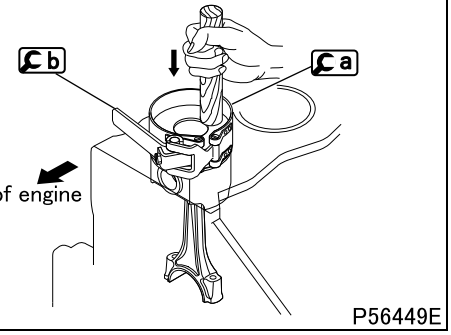


P56447E

- Check that the pistons and the cylinder liners have identical size marks (**"A"** or **"B"**).
- Install the pistons in the cylinder liners. Be careful not to scratch the inner surface of the liner and the crankshaft pins.

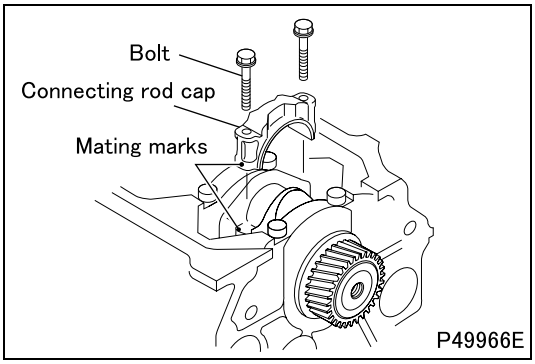


P56448E



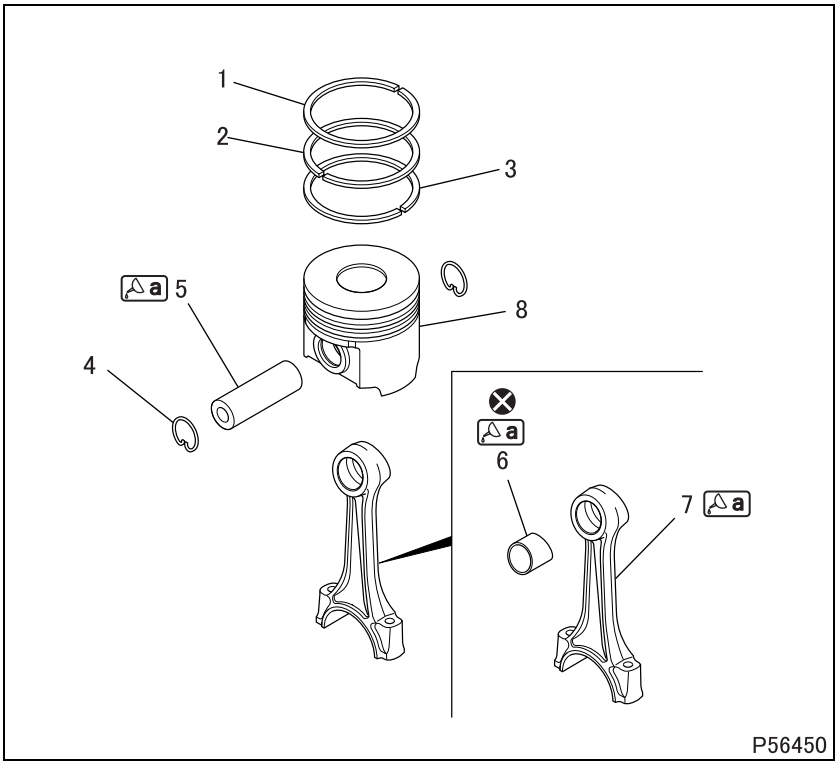
P56449E

- Face the front mark "○" of the piston toward the front of the engine.
- Using the adjusting bolt of b, adjust the inside diameter of a such that it matches the piston's skirt diameter.
- Remove the tools from the piston and apply engine oil to the following parts before reinstalling the tools around the piston rings:
  - Outside surface of piston
  - Inside surface of a
  - Inside surface of cylinder liner



- After installing the piston and connecting rod assembly, align the mating marks on the connecting rod and connecting rod cap and tighten the bolts alternately in the following manner.
  - First tighten the 4M50 rod bolt to a torque of 29 N·m {21 lbf·ft, 3.0 kgf·m}.
  - Tighten the bolt further by turning it clockwise by 90° ± 5°.

Mitsubishi 4M50 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
8 Piston

⊗: Non-reusable parts

● **Assembly sequence**

Follow the disassembly sequence in reverse.

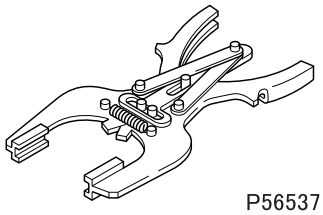
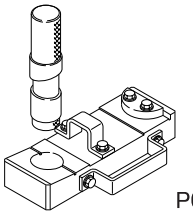
Service standards (Unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
1 to 3	Mitsubishi 4M50 Piston ring end gap	1st compression ring	0.3 to 0.45 {0.012 to 0.018}	1.5 {0.059}	Replace
		2nd compression ring	0.4 to 0.55 {0.016 to 0.022}		
		Oil ring	0.3 to 0.5 {0.012 to 0.020}		
1 to 3, 8	Mitsubishi 4M50 Piston ring side clearance in piston groove	1st compression ring	0.129 to 0.178 {0.0051 to 0.0070}	0.2 {0.0079}	Replace
		2nd compression ring	0.065 to 0.105 {0.0026 to 0.0041}	0.15 {0.0059}	
		Oil ring	0.025 to 0.065 {0.00098 to 0.0026}		
4, 6	Piston pin-to-connecting rod bushing clearance		0.020 to 0.055 {0.00079 to 0.0022}	0.1 {0.0039}	Replace
4, 8	Piston pin-to-piston clearance		0.004 to 0.022 {0.00016 to 0.00087}	0.05 {0.0020}	Replace
7	Mitsubishi 4M50 Connecting rod	Bend	–	0.05 {0.0020}	Replace
		Twist	–	0.1 {0.0039}	

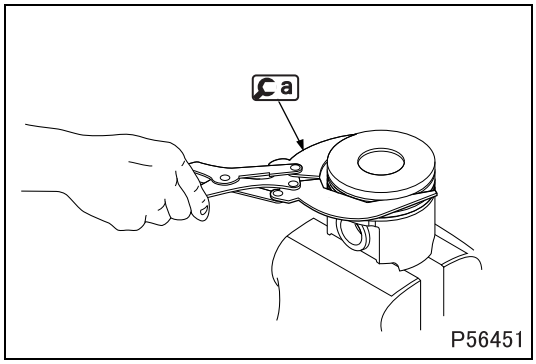
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Piston pin outside surface	Engine oil	As required
	Connecting rod bushing outside surface		
	Connecting rod bushing fitting surface of connecting rod		

Special tools

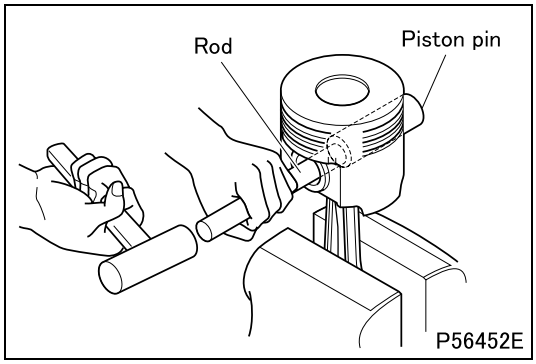
Mark	Tool name and shape	Part No.	Application
a	Piston ring tool  P56537	MH060014	Removal and installation of piston rings
b	Connecting rod bushing puller kit  P02015	MH062225	Removal and installation of connecting rod bushings

◆Removal procedure◆



P56451

■ Removal: Piston ring

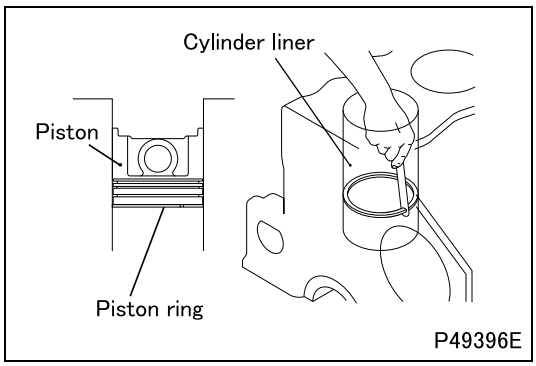


P56452E

■ 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.

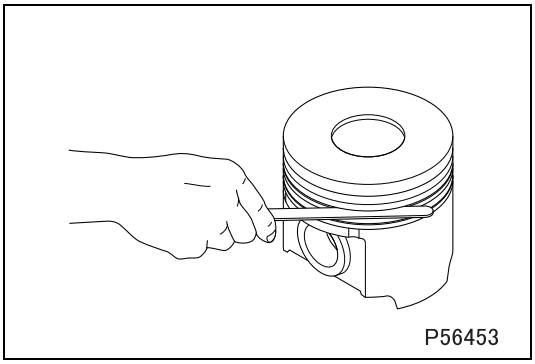
◆Inspection procedure◆



P49396E

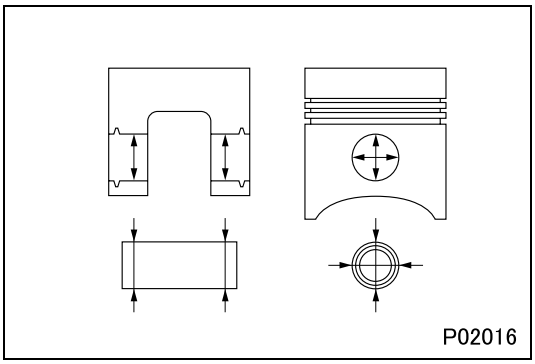
■ Inspection: Mitsubishi 4M50 Piston ring end gap

- Using the crown of a piston, push the piston ring horizontally into a cylinder in the cylinder liner 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 any of the rings has a gap exceeding the specified limit, replace all the piston rings as a set.


P56453

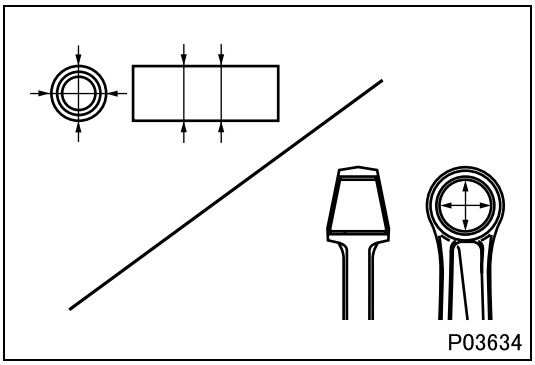
■ **Inspection: Piston ring side clearance in piston groove**

- Remove any carbon deposits from the ring groove in the piston.
- Measure the side clearance of each ring around the piston's entire periphery.
- If any of the measurements exceeds the specified limit, replace the defective part(s). If any of the piston rings is defective, replace all the rings on the piston as a set.


P02016

■ **Inspection: Piston pin-to-piston clearance**

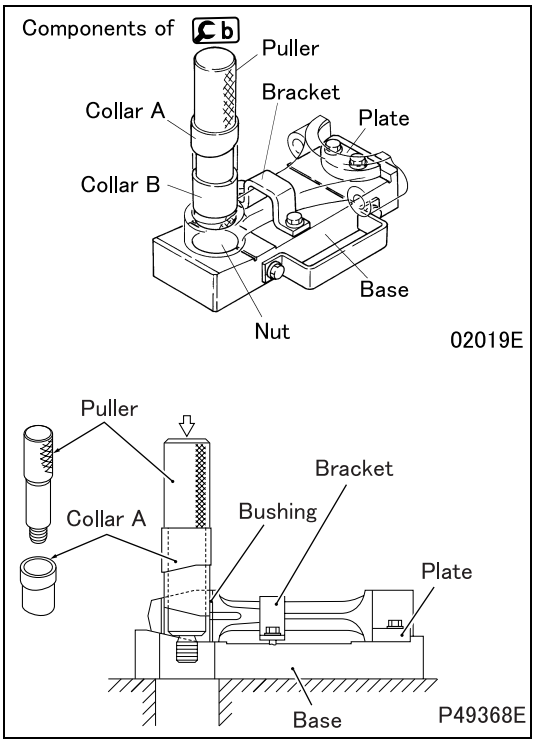
- If the measurement exceeds the specified limit, replace the defective part(s).


P03634

Inspection: Mitsubishi 4M50 Piston pin-to-connecting rod bushing clearance

■

- If any of the measurements exceeds the specified limit, replace the bushing.

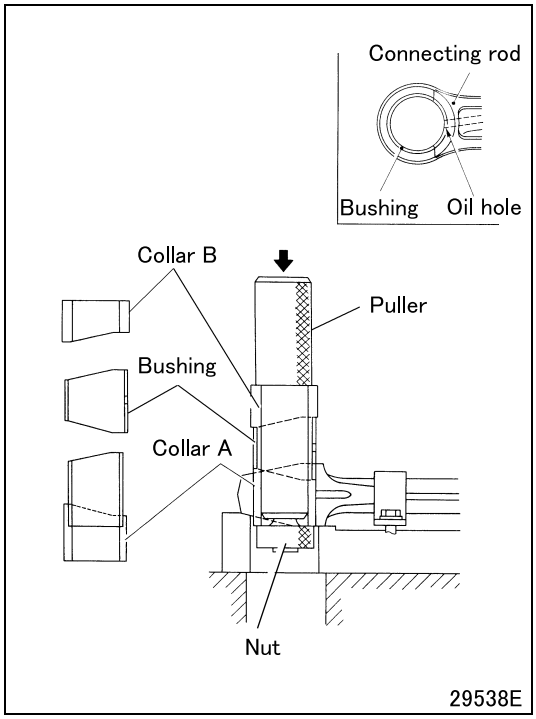


Replacement of Mitsubishi 4M50 connecting rod bushing

- Replace the connecting rod bushing using b.

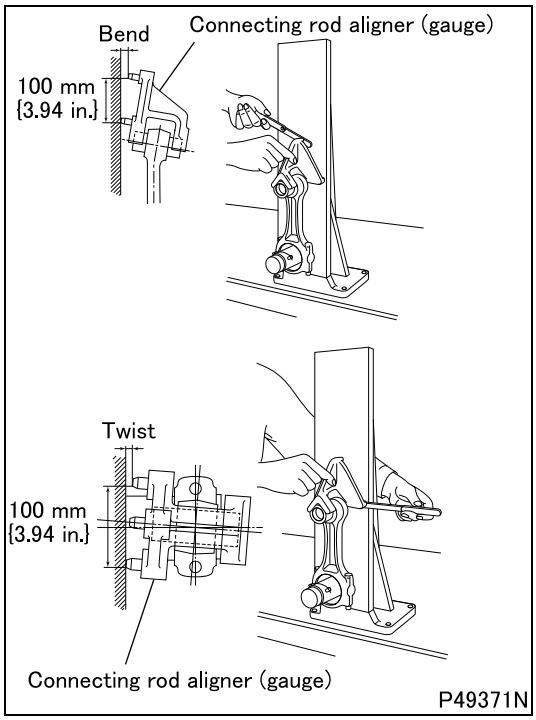
[Removal]

- Remove the upper bearing (if fitted) from the big end of the connecting rod.
- Mount the connecting rod on the base and lock it in position with the bracket and plate.
- Fit collar A over the puller with its ends facing in the illustrated directions. Then, slowly apply a pressure of approximately 49 kN {11020 lbs, 5000 kgf} to the puller with a press to force out the connecting rod bushing.



[Installation]

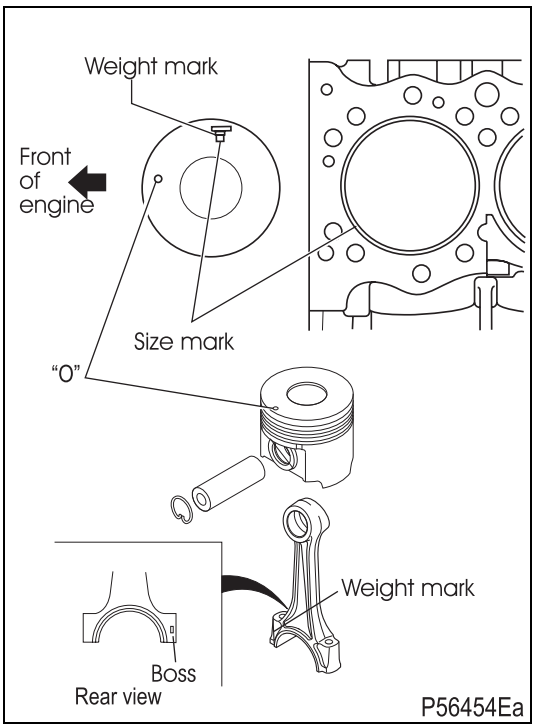
- Apply engine oil to the outside surface of the connecting rod bushing and the bushing fitting surface of the connecting rod.
- Fit collar B, the bushing, and collar A over the puller in the illustrated directions and lock this arrangement together with the nut.
- Align the oil holes in the connecting rod bushing and the connecting rod. Then, use a press to slowly apply a pressure of approximately 49 kN {11020 lbs, 5000 kgf} to the puller until the bushing is forced into place.
- After press-fitting the connecting rod bushing, measure the clearance between the piston pin and connecting rod bushing.
- If the measurement is less than the standard clearance range, ream the bushing.

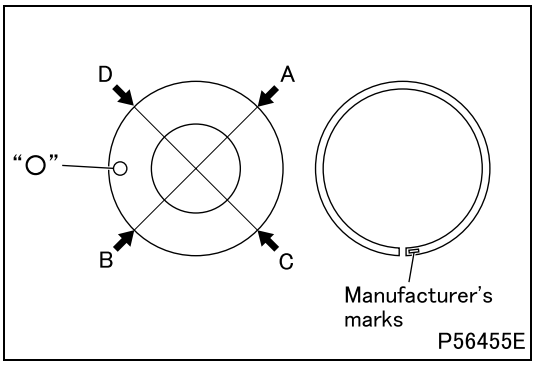


■Inspection: Connecting rod bend and twist

- 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 bolts of the connecting rod bearing cap to a torque of 30 N·m {22 lbf·ft, 3.1 kgf·m}.
- Measure the extent of bend and twist in the connecting rod.
- If either measurement exceeds the specified limit, replace the connecting rod.

◆Installation procedure◆





■ Installation: Mitsubishi 4M50 Piston and connecting rod

- When replacing a piston and connecting rod assembly, select and install a new piston and connecting rod by the following procedure.
- Choosing pistons
  - Choose pistons of the same weight for all cylinders.
  - Check that the size marks (**"A"** or **"B"**) on the piston and cylinder liner are identical.

CAUTION ⚠

- **Make sure to use pistons and cylinder liners of the same size. Failure to do so may result in seizures in the engine.**

- Choose connecting rod of the same weight for every cylinder.

NOTE: Weight mark: **"C"** to **"G"** (with **"G"** as the maximum)

- Apply engine oil to the piston pin, and assemble the piston and connecting rod with their marks facing in the illustrated directions.

"○": Front mark

- If the piston pin is difficult to insert, heat the piston in hot water or with a piston heater.

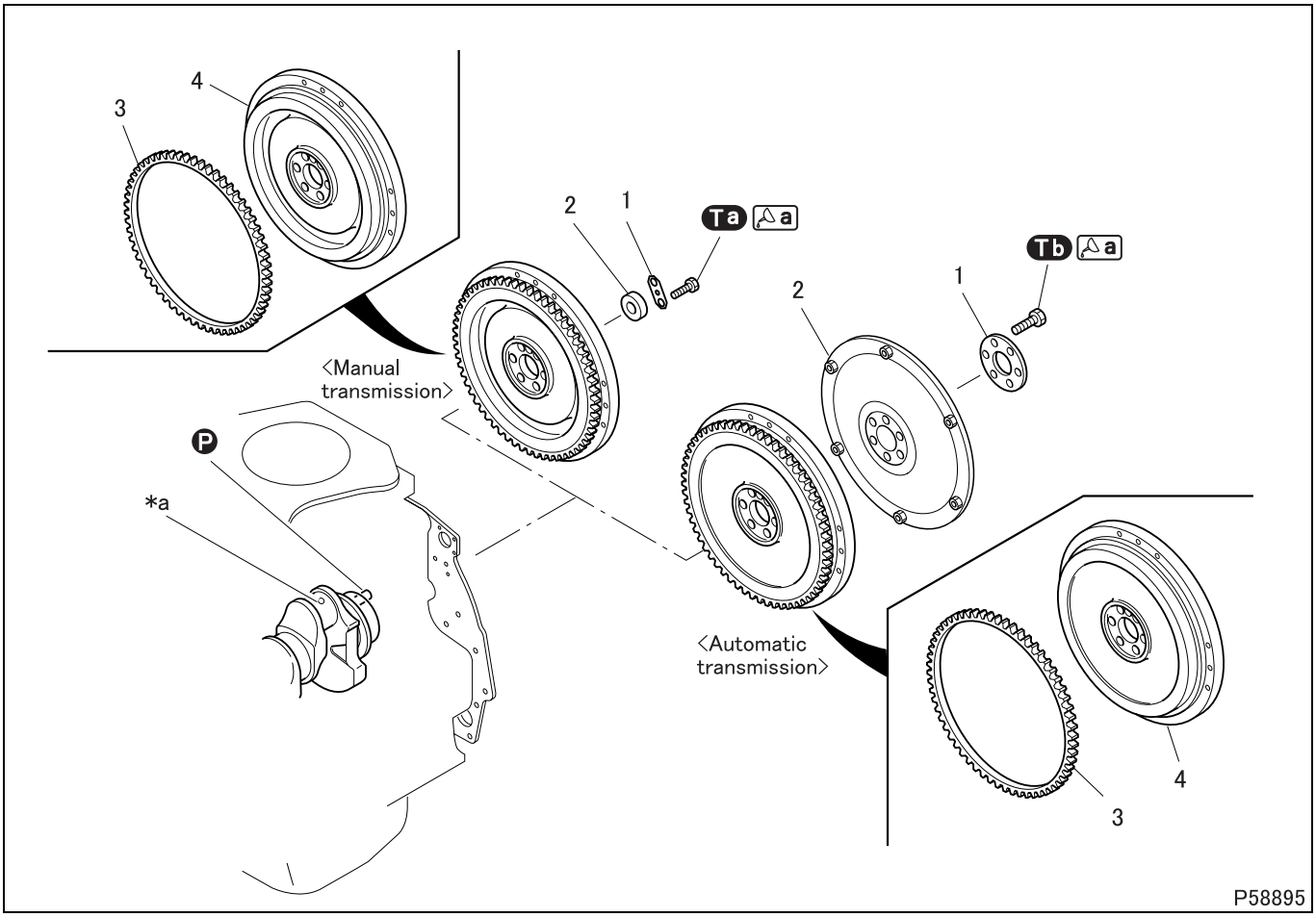
■ Installation: Mitsubishi 4M50 Piston rings

- 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 illustrated.
  - **A:** 1st compression ring end gap
  - **B:** 2nd compression ring end gap
  - **C:** Oil ring end gap
  - **D:** Oil ring's expander spring end gap

"○": Front mark on piston

The manufacturer's marks are present only on the 1st and 2nd compression rings.

FLYWHEEL



● Disassembly sequence

1 Plate <Manual transmission>
Wear plate <Automatic transmission>
2 Bearing <Manual transmission>
Drive plate <Automatic transmission>
3 Mitsubishi 4M50 Flywheel Ring gear
4 Flywheel assembly

***a**: Crankshaft
P: Locating pin

● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards (Unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
4	Flywheel assembly <Manual transmission>	Friction surface runout (when fitted)	–	0.2 {0.0079}	Rectify or replace
		Friction surface height	19.5 {0.77}	18.5 {0.73}	
		Friction surface distortion	0.05 {0.0020} or less	0.2 {0.0079}	

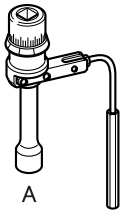
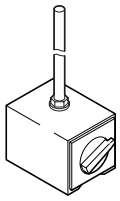
Tightening torque (Unit: N·m {lbf·ft, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (flywheel assembly installation)	39 {44, 6.0} + 40°	Wet
Tb	Bolt (flywheel assembly installation)	118 {87, 12} + 90°	Wet

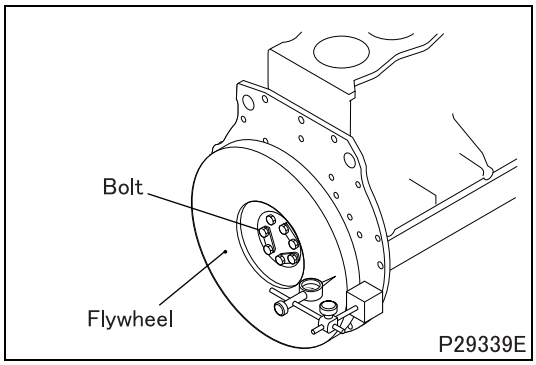
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Bolt threads	Engine oil	As required

Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application
a	Socket wrench A: Bolt head width across flats: 22 {0.87}  P01984	MH062183	Installation of flywheel assembly
b	Magnet base  P00471	MH062356	

◆Inspection before removal◆



P29339E

■ **Inspection: Flywheel runout <Manual transmission>**

- If the runout exceeds the specified limit, check that the bolts are tightened correctly and that there are no abnormalities on the crankshaft mounting surface. If the runout is still excessive even after necessary steps have been taken according to the check results, rectify or replace the flywheel assembly.

◆Removal procedure◆

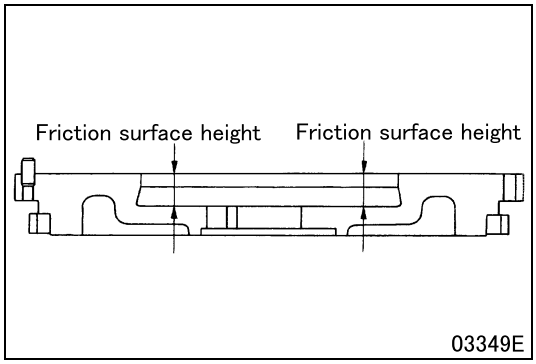
■ **Removal: Ring gear**

- Heat the ring gear evenly with a gas burner or the like until it reaches approximately 200°C {390°F}, then remove it from the flywheel assembly.

WARNING ⚠

- **You could get burnt if you touch the heated ring gear.**

◆Inspection procedure◆

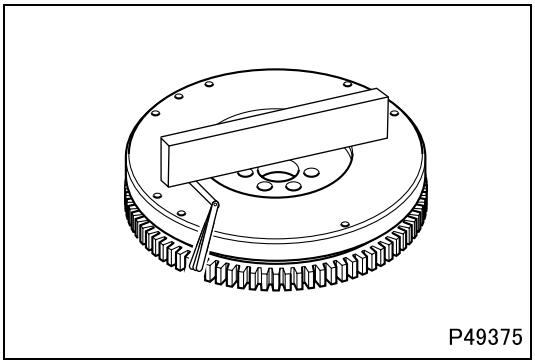


03349E

■ **Inspection: Flywheel assembly <Manual transmission>**

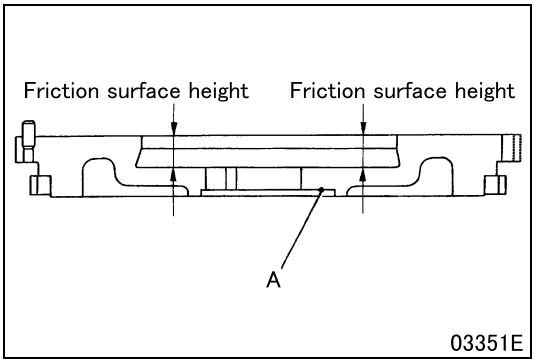
(1) Friction surface height

- If the height is below the specified limit, rectify or replace the flywheel assembly.


P49375

(2) Friction surface distortion

- If the measured amount of distortion is above the specified limit, rectify or replace the flywheel assembly.

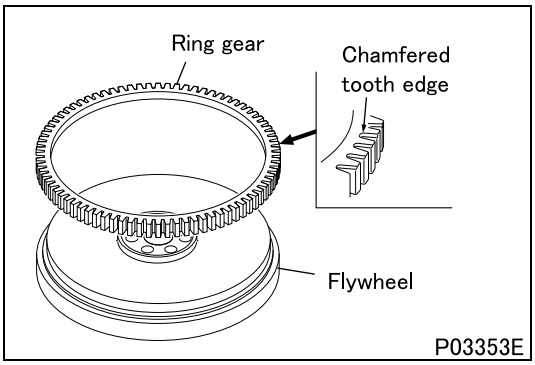


03351E

Rectification of friction surface

- Rectify the friction surface so that its height is not below the specified limit, and it is parallel with surface **A** with an error not exceeding 0.1 mm {0.0039 in.}.

◆Installation procedure◆



P03353E

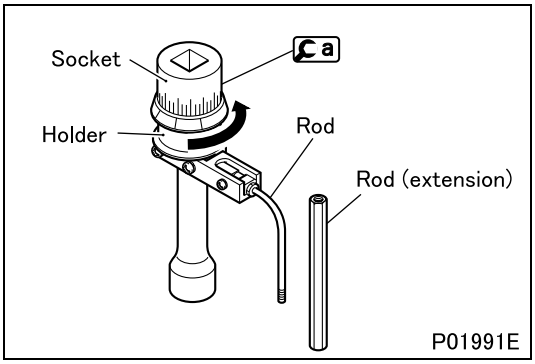
■ Installation: Ring gear

- Heat the ring gear evenly with a gas burner or the like until it reaches approximately 200°C {390°F}.

WARNING ⚠

- **You could get burnt if you touch the heated ring gear.**

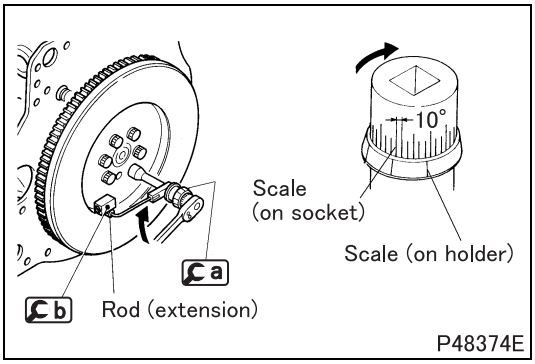
- Fit the ring gear with the side having non-chamfered tooth edges toward the flywheel.



P01991E

■ Installation: Flywheel <Manual transmission>

- Tighten all the bolts to 59 N·m {44 lbf·ft, 6.0 kgf·m} and then additionally tighten them by the following procedure.
- Rotate the holder of a counterclockwise to pretension the internal spring.

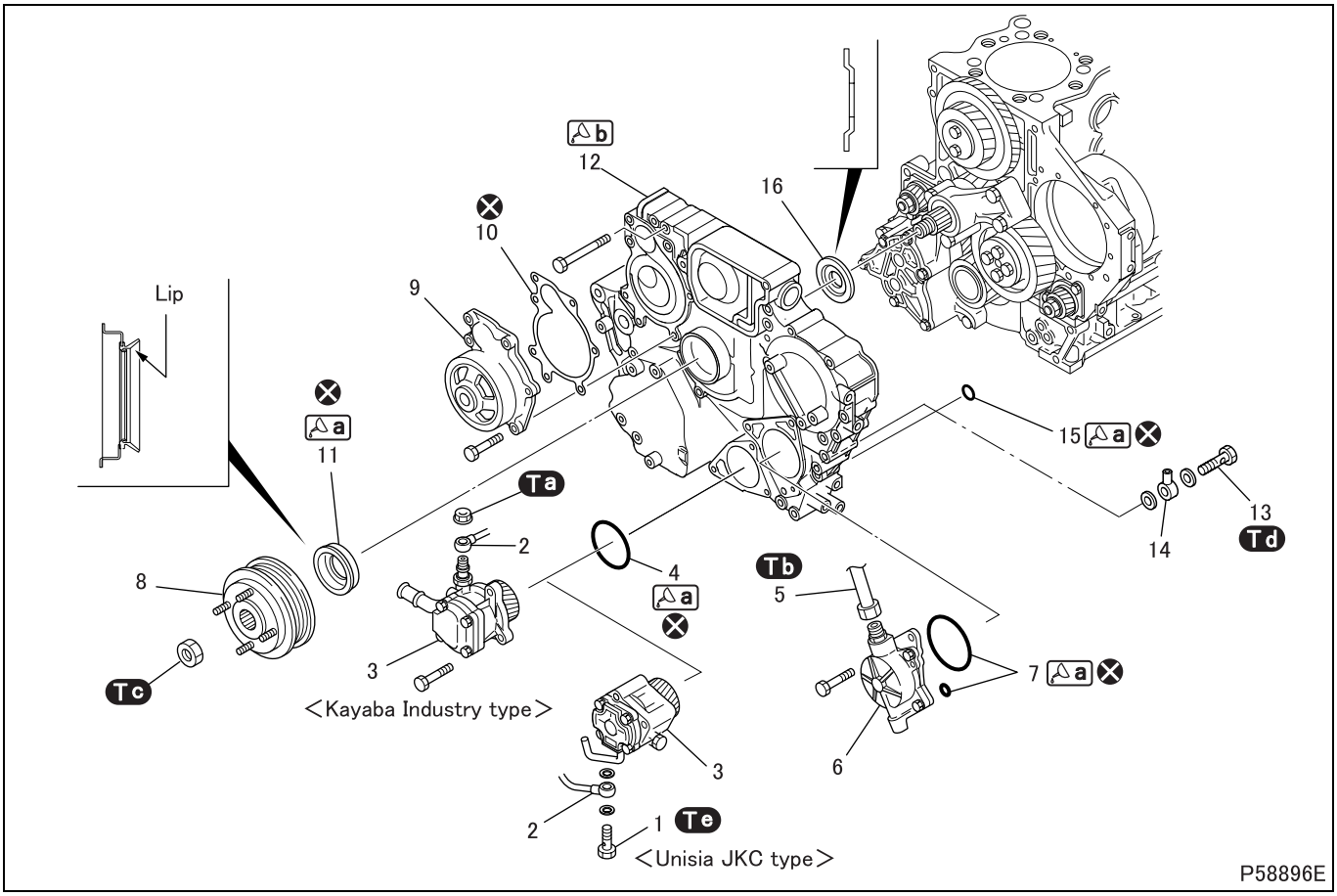


P48374E

- Fit a on the bolt and set b so that the rod (extension) is held pressed against it by the spring force.
- Align a scale mark on the socket with a scale mark on the holder. (This point will be the point of reference, or the 0° point.)
- Starting with this point of reference, turn the socket clockwise with a wrench by 40° ± 5° (one graduation on the socket scale represents 10°).

M E M O

MITSUBISHI 4M50 FRONT CASE



● **Disassembly sequence**

1 Eyebolt <Unisia JKC type>
2 Power steering pipe
3 Power steering oil pump (See Gr37)
4 O-ring
5 Vacuum pipe
6 Vacuum pump (See Gr35A)
7 O-ring
8 Fan pulley
9 Water pump (See Gr14)
10 Gasket
11 Front oil seal
12 Front case
13 Eyebolt
14 Oil jet
15 O-ring
16 Front oil seal slinger

⊗: Non-reusable parts

CAUTION ⚠

- **Do not remove the front oil seal unless defects are evident.**

● **Assembly sequence**

Follow the disassembly sequence in reverse.

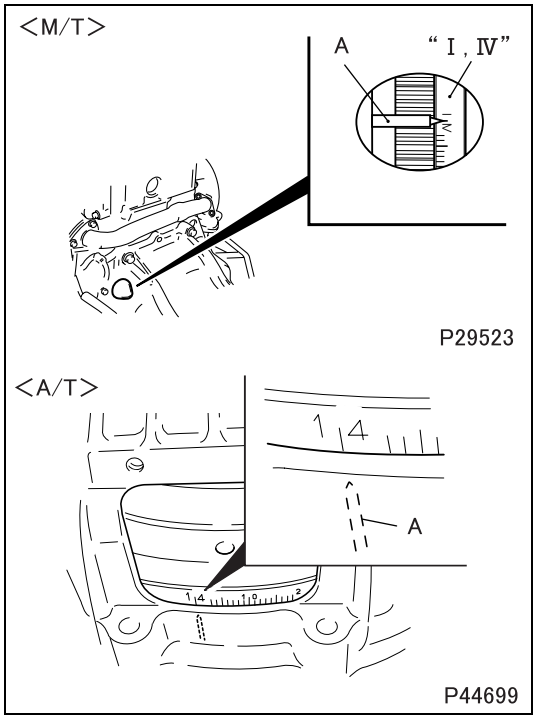
Tightening torque (Unit: N·m {lbf·ft, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (power steering pipe installation)	29.4 to 39.2 {22 to 29, 3 to 4}	–
Tb	Vacuum pipe	29.4 {22, 3.0}	–
Tc	Nut (fan pulley installation)	196.1 {145, 20.0}	–
Td	Eyebolt (oil jet installation)	10 {7.4, 1.0}	–
Te	Eyebolt (power steering pipe installation)	49.0 to 63.7 {36 to 47, 5.0 to 6.5}	–

Lubricant and/or sealant

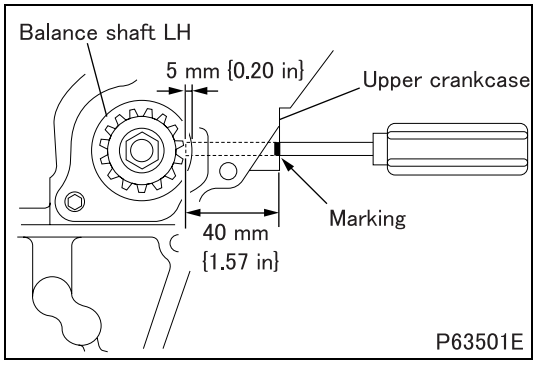
Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	O-ring	Engine oil	As required
	Front oil seal lip		
b	Front case installation surfaces	ThreeBond 1207C or D	As required

◆Removal procedure◆



■ **Removal: Vacuum pump**

- The vacuum pump also serves for positioning the balance shaft LH. Therefore, before removing the vacuum pump, hold the balance shaft in position by the following procedure.
- Align the pointer A to between the inscribed lines (**Ⅰ** and **Ⅳ** or **1** and **4**) on the flywheel. (Place No.1 cylinder piston at the top dead center on compression stroke.)



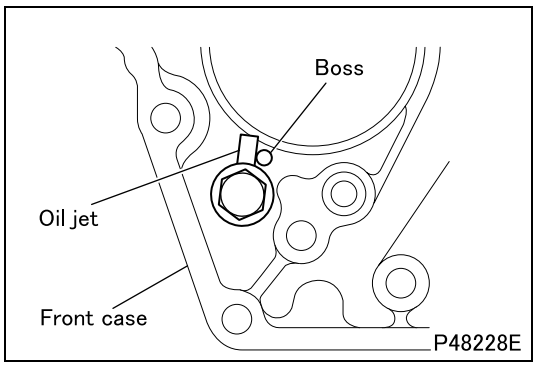
- Remove the upper crankcase plug.
- Mark a screwdriver or the like (ϕ4.5 mm {0.18 in} or less) at a point 40 mm {1.57 in} apart from its tip.
- Insert the screwdriver or the like (ϕ4.5 mm {0.18 in} or less) into the plug hole until it lightly touches the balance shaft LH.

CAUTION ⚠

- **Do not press the screwdriver hard against the balance shaft LH, as this may damage No.1 journal of the balance shaft.**

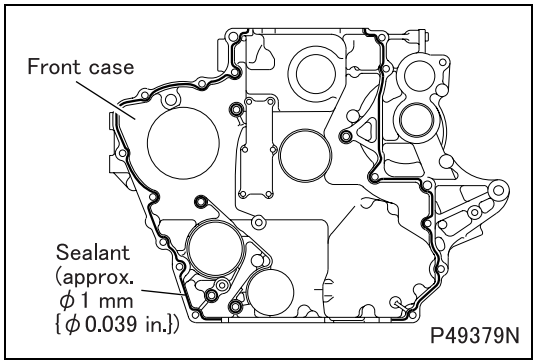
- Put the tip of the screwdriver or the like into the shaft supporting hole at No.1 journal of the balance shaft.
- This insertion depth of the screwdriver or the like into the shaft supporting hole should be 5 mm.
- Remove the vacuum pump with the screwdriver or the like inserted in the hole.

◆Installation procedure◆



■ **Installation: Mitsubishi 4M50 Oil jet**

- When installed, the oil jet must be in contact with the front case and its nozzle must face in the illustrated direction.

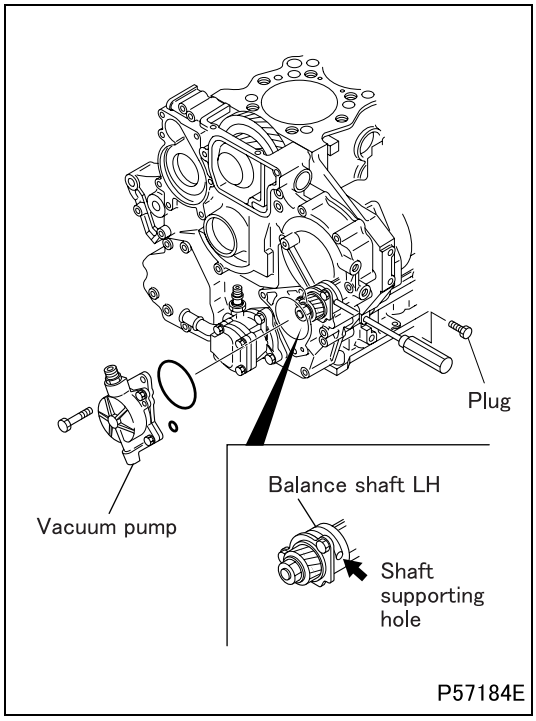


■ **Installation: Front case**

- Clean the sealant application surfaces of each part.
- Apply evenly thick beads of sealant to the upper crankcase mounting surface of the front case without any breaks.
- Mount the front case within three minutes of applying the sealant, being careful not to dislodge the sealant.

CAUTION ⚠

- **Do not run the engine within one hour of installing the front case.**
- **If the front case mounting bolts are loosened or removed, be sure to reapply sealant to the front case.**



■ **Installation: Vacuum pump**

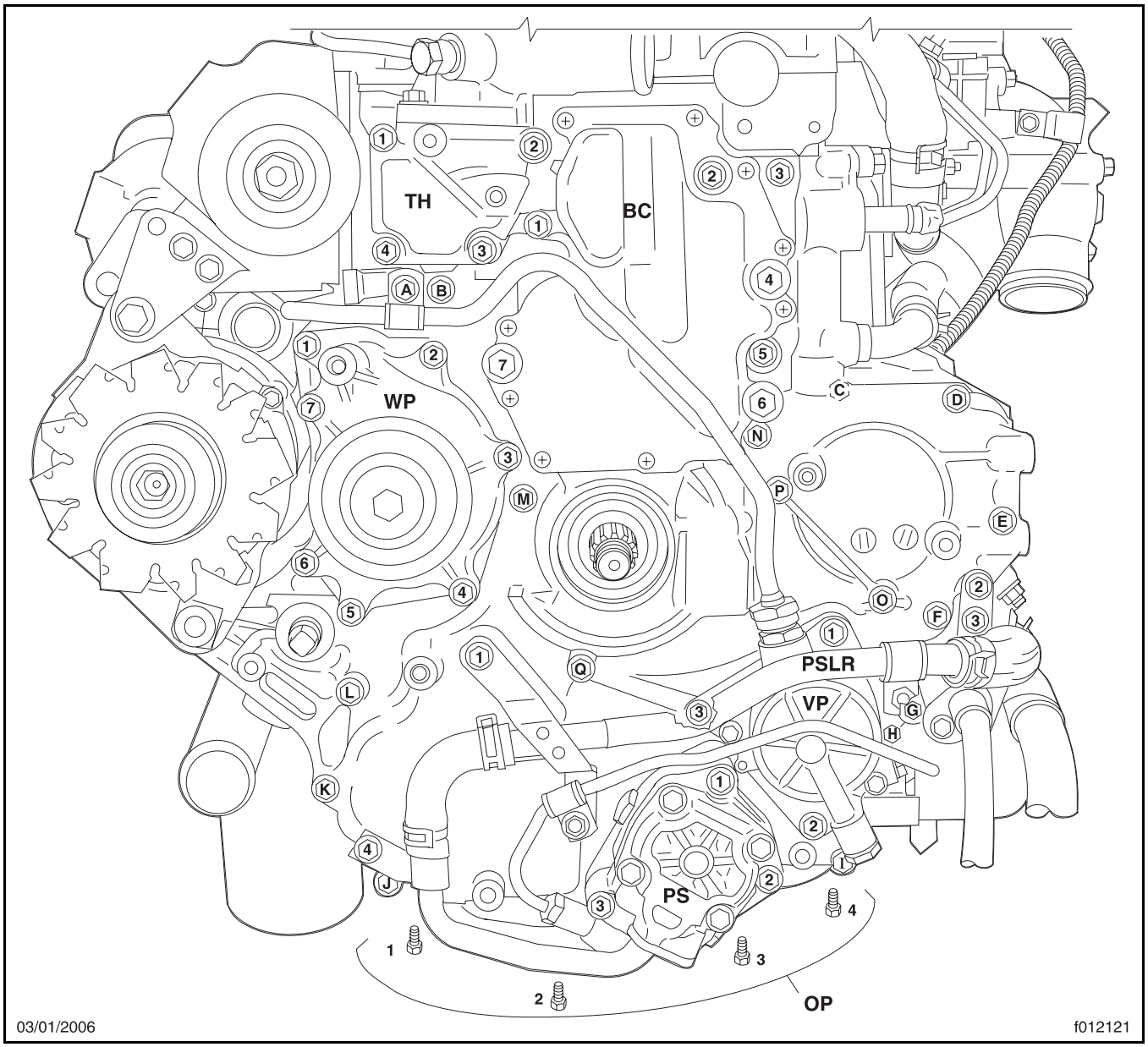
- The vacuum pump also serves as an element holding the balance shaft LH in place. Therefore, before installing the vacuum pump, hold the balance shaft LH in the correct position by the following procedure.
  - Place the No. 1 cylinder piston at the top dead center on compression stroke.
  - Remove the upper crankcase plug.
  - Insert a screwdriver or a similar tool into the plug hole until it lightly touches the balance shaft LH.

CAUTION ⚠

- **Do not press the screwdriver strongly against the balance shaft LH, as this may damage the No. 1 journal of the balance shaft.**

  - Turn the balance shaft LH slowly until the screwdriver aligns with the shaft support hole at the No. 1 journal and insert the screwdriver into the hole.
- Install the vacuum pump.
- After installing the vacuum pump, remove the screwdriver and reinstall the plug.

Mitsubishi 4M50 Bolt identification



Bolt identification (Unit: MM)

Breather cover (bc)	
Bolt #	**Bolt diameter and length**
1	M8 x 30
2	M8 x 20
3	M8 x 20
4	M8 x 100 (with spacer & washer)
5	M8 x 70
6	M8 x 35 (with spacer & washer)
7	M8 x 35 (with spacer & washer)

Water pump (wp)	
Bolt #	**Bolt diameter and length**
1	M8 x 80
2	M8 x 80
3	M8 x 25
4	M8 x 80
5	M8 x 85
6	M8 x 25
7	M8 x 25

Noise suppression shield	
Bolt #	**Bolt diameter and length**
1	M8 x 20 (with spacer & washer)
2	M8 x 20 (with spacer & washer)
3	M8 x 20 (with spacer & washer)
4	M8 x 80 (with spacer & washer)
5	M8 x 20 (with spacer & washer)

Power steering pump (ps)	
Bolt #	**Bolt diameter and length**
1	M8 x 80
2	M8 x 130
3	M8 x 80

Power steering return line brackets (psrl)	
Bolt #	**Bolt diameter and length**
1	M8 x 15
2	M8 x 15
3	M8 x 15
4	M8 x 15

Vacuum pump (vp)	
Bolt #	**Bolt diameter and length**
1	M8 x 75
2	M8 x 75
3	M8 x 20

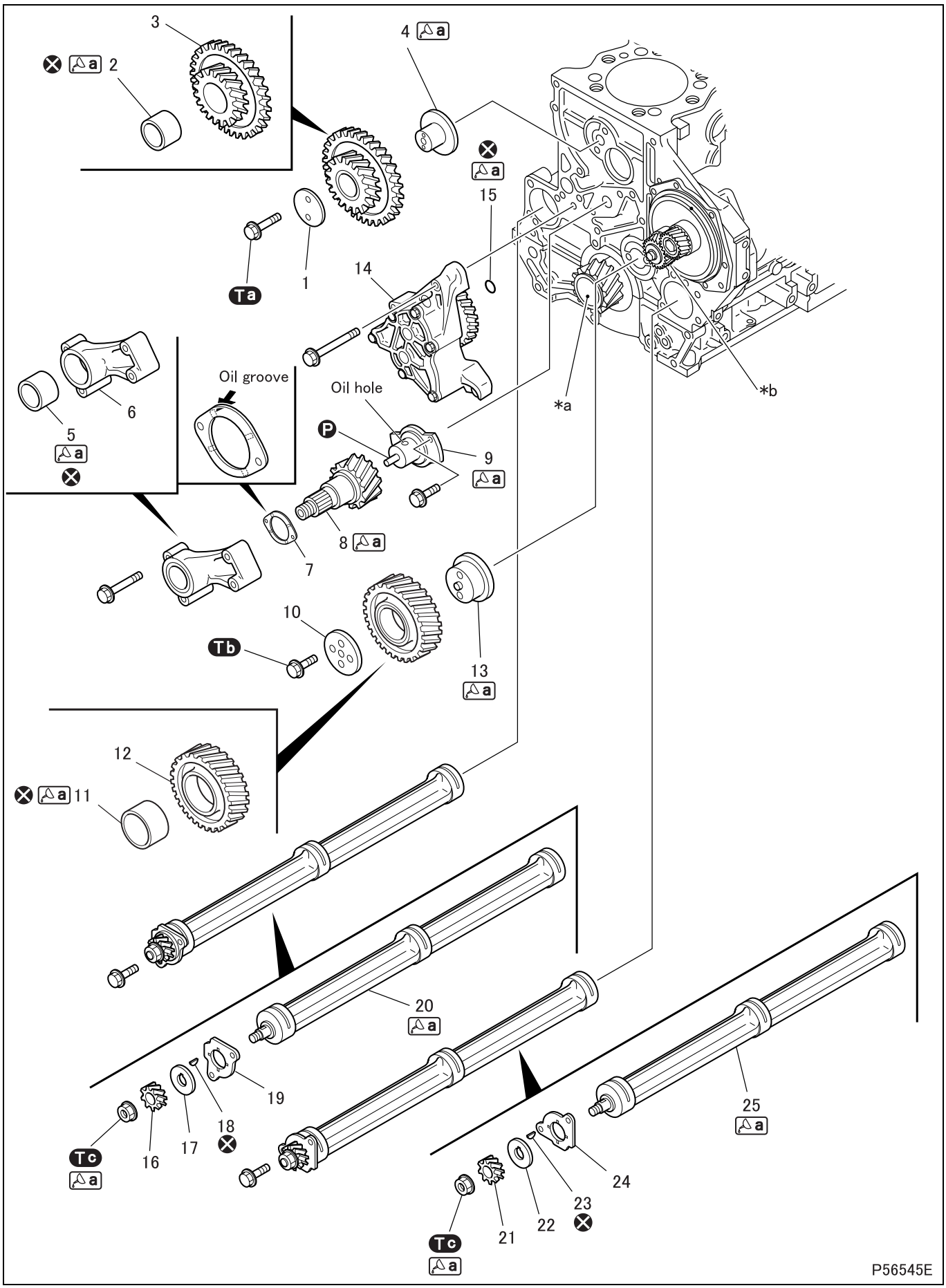
Thermostat housing (th)	
Bolt #	**Bolt diameter and length**
1	M8 x 15
2	M8 x 55
3	M8 x 15
4	M8 x 15

Oil pan (op)	
Bolt #	**Bolt diameter and length**
1	M8 x 10
2	M8 x 10
3	M8 x 10
4	M8 x 10

Front cover	
Bolt #	**Bolt diameter and length**
a	M8 x 25
b	M8 x 75
c	M8 x 100
d	M8 x 100
e	M8 x 100
f	M8 x 100
g	M8 x 65
h	M8 x 45
i	M8 x 65
j	M8 x 75
k	M8 x 75
l	M8 x 75
m	M8 x 60
n	M8 x 100
o	M8 x 75
p	M8 x 75
q	M8 x 75

M E M O

MITSUBISHI 4M50 TIMING GEARS AND BALANCE SHAFTS



● Mitsubishi 4M50 Disassembly sequence

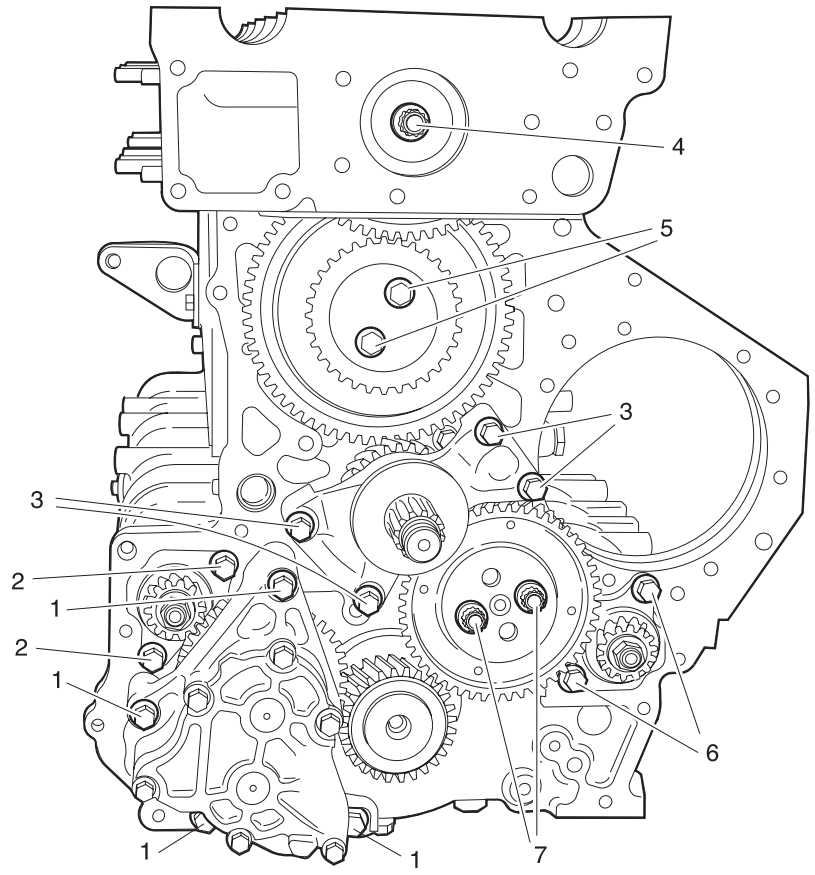
1 Thrust plate
2 Idler gear bushing
3 Idler gear
4 Idler shaft
5 Fan shaft case bushing
6 Fan shaft case
7 Thrust plate
8 Fan shaft
9 Fan gear shaft
10 Thrust plate
11 No. 1 idler gear bushing
12 No. 1 idler gear
13 No. 1 idler shaft
14 Oil pump (See Gr12)
15 O-ring
16 Balance shaft gear RH
17 Thrust spacer
18 Key
19 Thrust plate
20 Balance shaft RH
21 Balance shaft gear LH
22 Thrust spacer
23 Key
24 Thrust plate
25 Balance shaft LH

***a**: Crankshaft gear
***b**: Supply pump idler gear

Ⓟ: Locating pin
⊗: Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.



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1 Oil pump bolts Td
2 Right balance shaft thrust plate bolts Tf
3 Fan shaft case bolts Te
4 Head idler bolt Tg
5 Idler shaft bolts Ta
6 Left balance shaft thrust plate bolts Tf
7 No. 1 idler shaft bolts Tb

Service standards (Unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
–	Backlash between gears	Idler gear and fan shaft	0.09 to 0.14 {0.0035 to 0.0055}	0.3 {0.012}	Replace
		Fan shaft and No. 1 idler gear	0.06 to 0.10 {0.0024 to 0.0039}	0.3 {0.012}	
		No. 1 idler gear and crankshaft gear	0.11 to 0.13 {0.0043 to 0.0051}	0.3 {0.012}	
		No. 1 idler gear and supply pump idler gear	0.12 to 0.15 {0.0047 to 0.0059}	0.3 {0.012}	
		Oil pump gear and crankshaft gear	0.12 to 0.15 {0.0047 to 0.0059}	0.3 {0.012}	
		Oil pump gear and balance shaft gear RH	0.19 to 0.22 {0.0075 to 0.0087}	0.3 {0.012}	
–	End play of gears and shafts	Idler gear	0.10 to 0.20 {0.0039 to 0.0079}	0.3 {0.012}	Replace
		Fan shaft	0.07 to 0.19 {0.0028 to 0.0075}	0.3 {0.012}	
		No. 1 idler gear	0.15 to 0.25 {0.0059 to 0.0098}	0.3 {0.012}	
		Balance shaft RH	0.1 to 0.2 {0.0039 to 0.0079}	0.3 {0.012}	
		Balance shaft LH	0.1 to 0.2 {0.0039 to 0.0079}	0.3 {0.012}	
2, 4	Idler gear bushing-to-idler shaft clearance		0.02 to 0.06 {0.00079 to 0.0024}	0.1 {0.0039}	Replace
5, 8	Fan shaft case bushing-to-fan shaft clearance		0.03 to 0.07 {0.0012 to 0.0028}	0.1 {0.0039}	Replace
8, 9	Fan shaft-to-fan gear shaft clearance		0.01 to 0.05 {0.00039 to 0.0020}	0.1 {0.0039}	Replace
11, 13	No. 1 idler gear bushing-to-No. 1 idler shaft clearance		0.03 to 0.07 {0.0012 to 0.0028}	0.1 {0.0039}	Replace
20	Balance shaft RH bend		0.025 {0.00098}	0.05 {0.0020}	Replace
25	Balance shaft LH bend		0.025 {0.00098}	0.05 {0.0020}	Replace

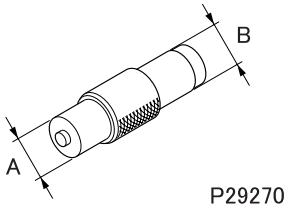
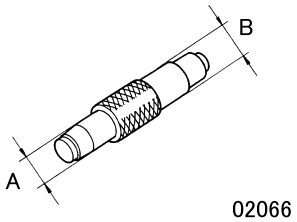
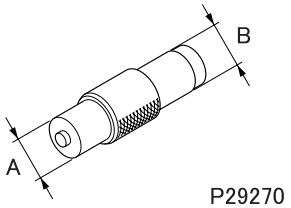
Mitsubishi 4M50 Tightening torque (Unit: N·m {lbf·ft, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (idler shaft installation)	32.3 {24, 3.3}	–
Tb	Bolt (No. 1 idler shaft installation)	53.9 {40, 5.5}	–
Tc	Nut (balance shaft gear installation)	96.1 {71, 9.8}	Wet
Td	Bolt (oil pump cover mounting)	27.4 {20, 2.8}	–
Te	Bolt (fan shaft case)	29 {21, 3.0}	–
Tf	Bolt (balance shaft thrust plate)	29 {21, 3.0}	–
Tg	Bolt (head idler shaft installation)	40.2 {30, 4.1}	Wet

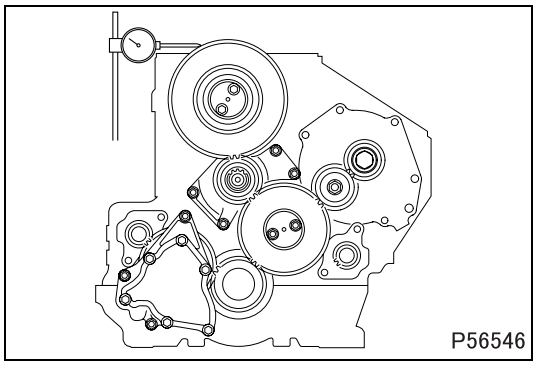
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Inner surface of every bushing	Engine oil	As required
	Outside surface of every shaft		
	O-rings		
	Nut threads		
	Balance shaft journals		

Special tools (Unit: mm {in.})

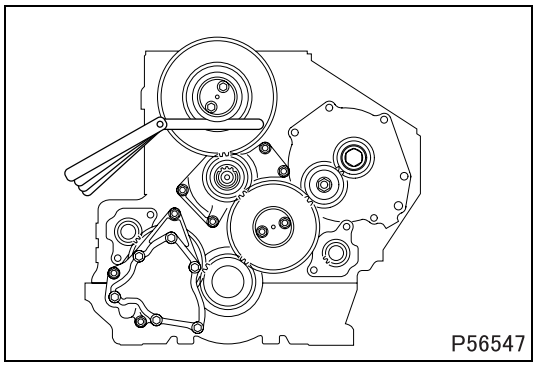
Mark	Tool name and shape	Part No.	Application
a	Idler gear bushing puller A: ϕ46.5 {ϕ1.83}, B: ϕ50 {ϕ1.97} 	MH062540	Removal and installation of idler gear bushing
b	Idler gear bushing puller A: ϕ37 {ϕ1.46}, B: ϕ40 {ϕ1.57} 	MH062601	Removal and installation of fan shaft case bushing
c	Idler gear bushing puller A: ϕ54.5 {ϕ2.15}, B: ϕ58 {ϕ2.28} 	MH062541	Removal and installation of No. 1 idler gear bushing

◆Inspection before removal◆



■ Inspection: Backlash between gears

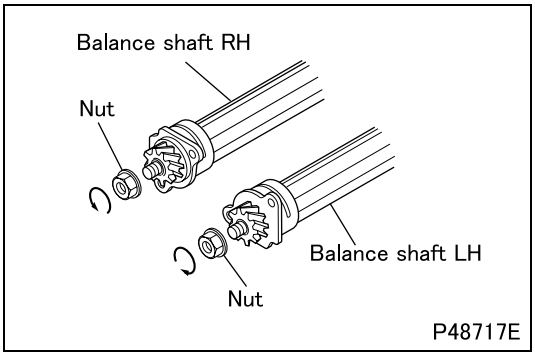
- For each pair of gears, measure the backlash at more than three teeth.
- If any of the measurements exceeds the specified limit, replace the defective part(s).



■ Inspection: End play of each gear and shaft

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

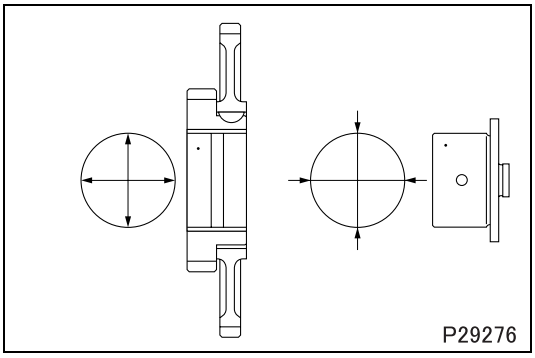
◆Removal procedure◆



■ Removal: Balance shaft

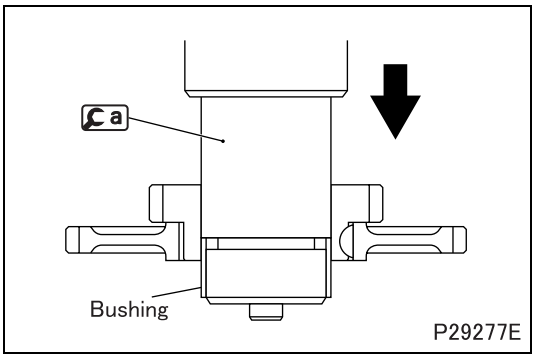
- Remove the balance shaft RH by turning its nut counterclockwise, and the balance shaft LH by turning its nut clockwise.

◆Inspection procedure◆

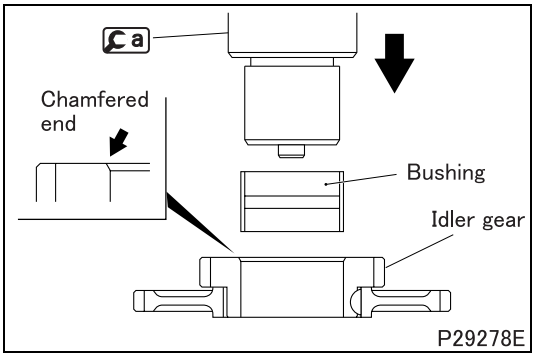


■ Inspection: Idler gear bushing-to-idler shaft clearance

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

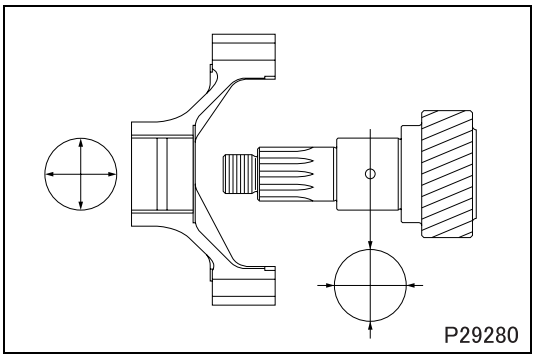


Replacement of idler gear bushing
[Removal]



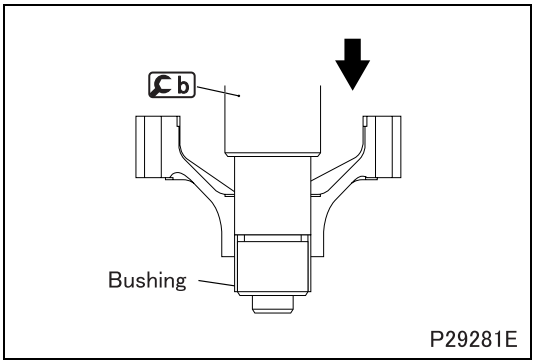
[Installation]

- Place the idler gear with its ends facing as illustrated.
- Press-fit the idler gear bushing until a sits snugly on the chamfered end of the idler gear.
- After press-fitting the bushing, measure the clearance.
- If the measurement is less than the minimum of the standard value range, ream the idler gear bushing until the clearance falls within the standard value range.

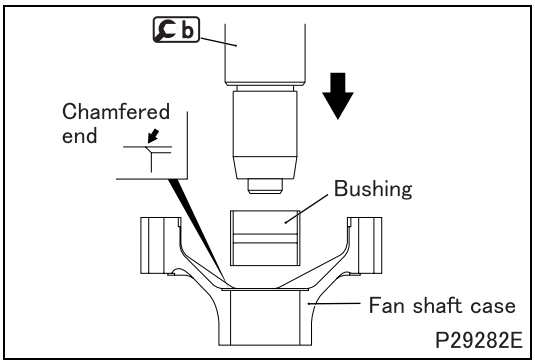


■ Inspection: Fan shaft case bushing-to-fan shaft clearance

- Replace the fan shaft case bushing if the measurement exceeds the specified limit.

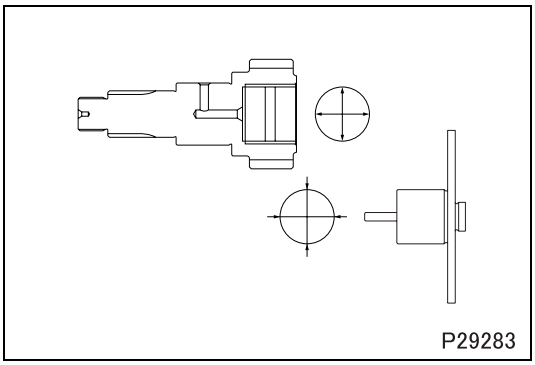


Replacement of fan shaft case bushing
[Removal]



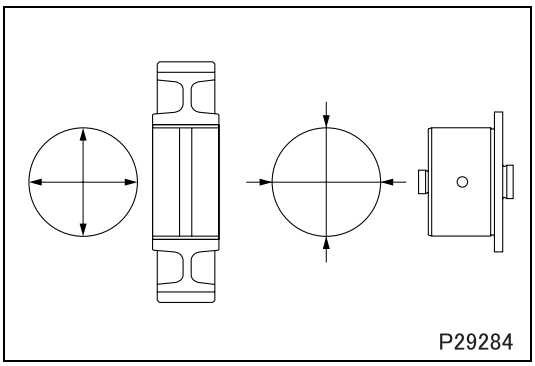
[Installation]

- Position the fan shaft case with its ends facing in the illustrated directions.
- Press in the bushing until b rests snugly on the chamfered end of the fan shaft case.
- After press-fitting the bushing, remeasure the clearance between it and the fan shaft.
- Ream the bushing if the measurement is below the standard value range.



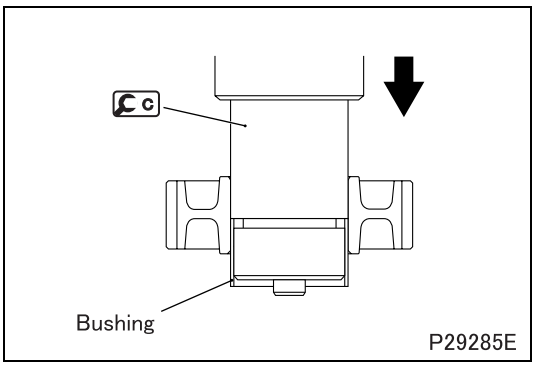
■ Inspection: Fan shaft-to-fan gear shaft clearance

- Replace the fan shaft if the measurement exceeds the specified limit.

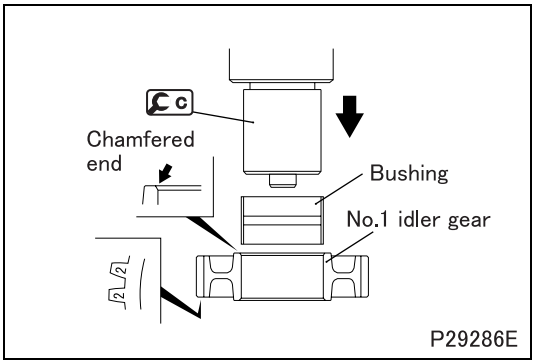


■ Inspection: No. 1 idler gear bushing-to-No. 1 idler shaft clearance

- Replace the bushing if the measurement exceeds the specified limit.

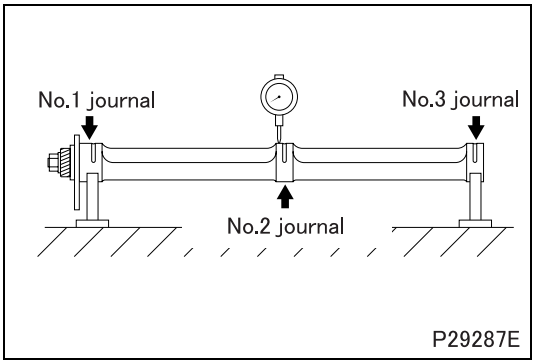


Replacement of No. 1 idler gear bushing
[Removal]



[Installation]

- Position the No. 1 idler gear with its ends facing in the illustrated directions.
- Press in the gear bushing until C sits snugly on the chamfered end of the No. 1 idler gear.
- After press-fitting the bushing, remeasure the clearance between it and the No. 1 idler shaft.
- Ream the busing if the measurement is below the standard value range.



■ Inspection: Balance shaft bend

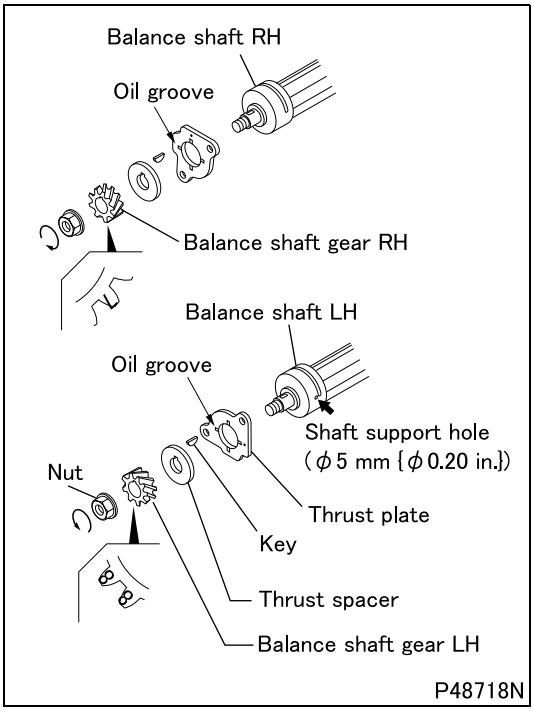
- Place supports under the No. 1 and No. 3 journals of the balance shaft and measure the bend of the balance shaft at the No. 2 journal.

NOTE

- **Turn the balance shaft by one turn and read the dial gauge. Divide the reading by two to obtain the balance shaft bend.**

- If the measurement exceeds the specified limit, replace the balance shaft.

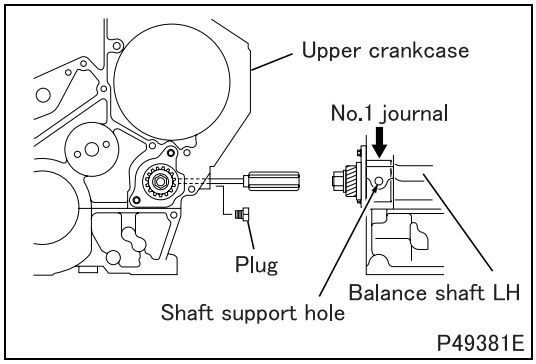
◆Installation procedure◆



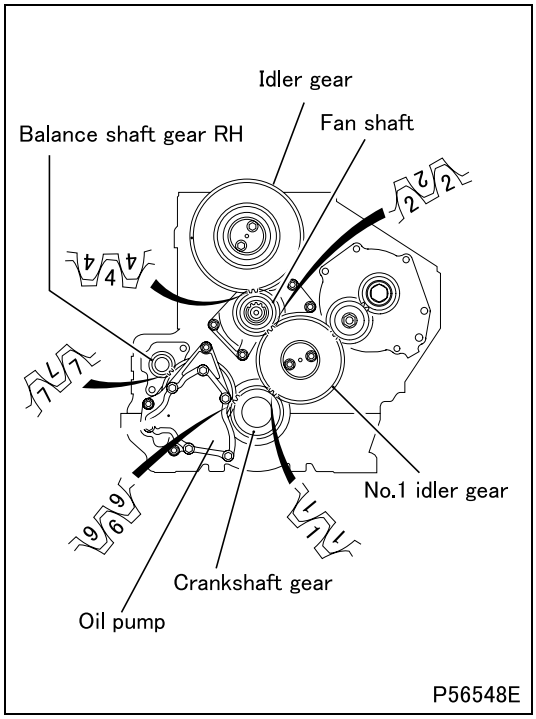
■ Installation: Balance shafts

- Install all the indicated parts on each balance shaft with their ends facing in the illustrated directions.
- Install the balance shaft RH by turning its nut clockwise, and the balance shaft LH by turning its nut counterclockwise.

- Install the balance shaft RH assembly and the balance shaft LH assembly into the crankcase according to the following procedures, which include different instructions between the two balance shafts.
  - The balance shaft RH can be installed in the crankcase without following any special procedure. (The positioning of the gear of the balance shaft RH will be finally determined by installing the oil pump.)

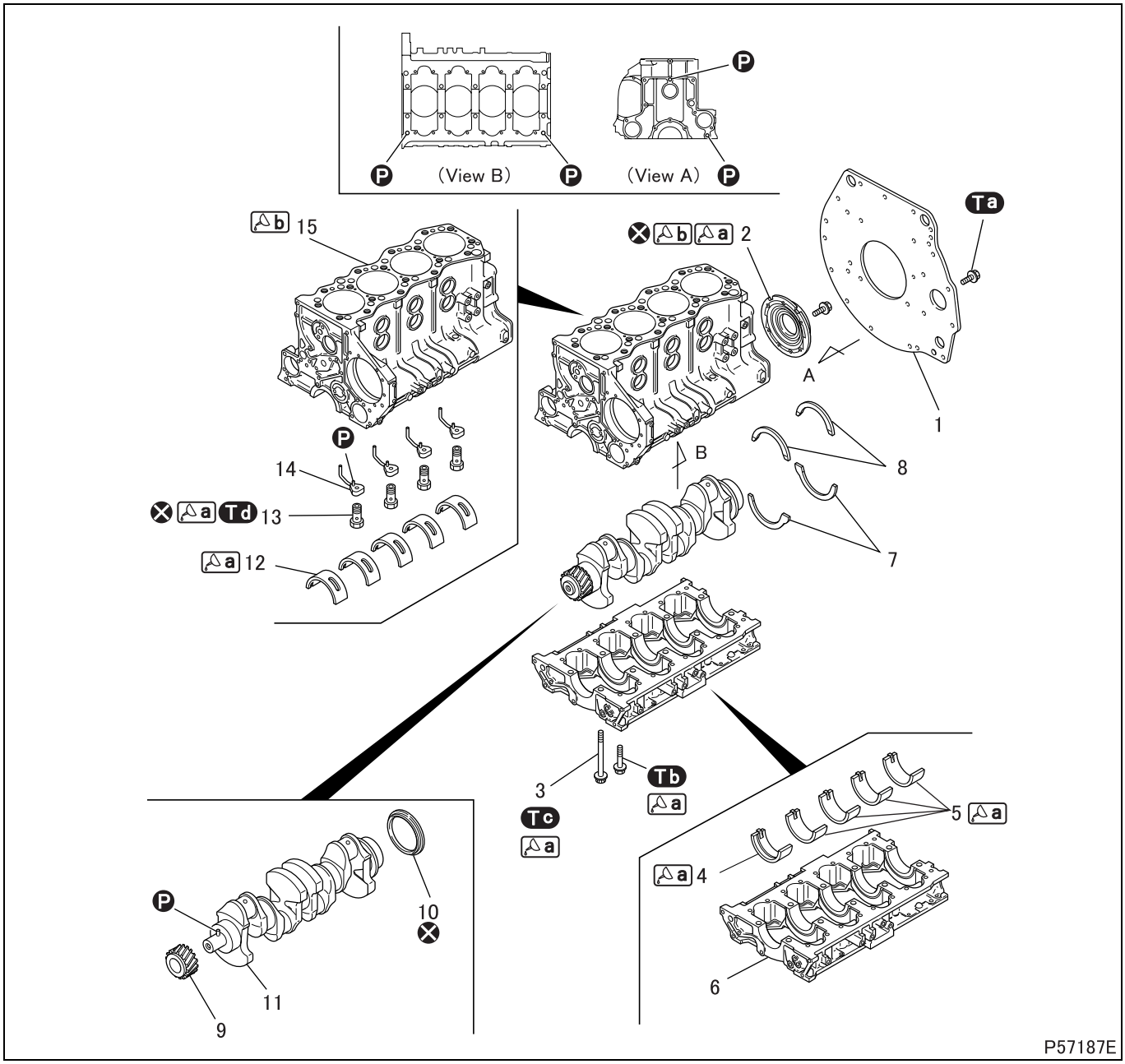


- The gear of the balance shaft LH can be engaged with other gears only after the front case is installed and then the vacuum pump is installed on the crankcase. This necessitates performing the following steps before installing the front case and vacuum pump. (The balance shaft LH cannot be rotated to adjust the gear position after the front case is installed on the crankcase.)
- Remove the plug on the upper crankcase.
- Insert a screwdriver through the plug hole and into the shaft support hole (diameter: 5 mm {0.20 in.}) on the No. 1 journal of the balance shaft LH to hold the shaft against rotation.
- Align the mating marks on each timing gear.
- This positions the balance shaft LH correctly. Leave the balance shaft in this state until installation of the front case and vacuum pump is completed.



■ Installation: Timing gears

- Place the No. 1 cylinder piston at top dead center to position the crankshaft gear.
- Install the oil pump gear by aligning mating mark **"6"** with that on the crankshaft gear, and mating mark **"7"** with that on the balance shaft gear RH.
- Install the No. 1 idler gear by aligning mating mark **"1"** with that on the crankshaft gear.
- Install the fan shaft by aligning mating mark **"2"** with that on the No. 1 idler gear.
- Install the idler gear by aligning mating mark **"4"** with that on the fan shaft.



● **Disassembly sequence**

1 Rear plate
2 Rear oil seal
3 Main bearing cap bolt
4 No.1 Lower bearing
5 Lower main bearing
6 Lower crankcase
7 Lower thrust plate
8 Upper thrust plate
★ **9** Crankshaft gear
★ **10** Rear oil seal slinger
11 Crankshaft
12 Upper main bearing
13 Check valve
14 Oil jet
15 Upper crankcase

Ⓟ: Locating pin
⊗: Non-reusable parts

NOTE

- **Do not remove the parts marked ★ unless defects are evident.**
- **The lower crankcase and the upper crankcase are machined as a matched set, and cannot be replaced individually.**

● **Assembly sequence**

Follow the disassembly sequence in reverse.

CAUTION ⚠

- **The main bearing cap bolts are tightened using the torque-turn tightening method. Any bolt that has three punch marks must be replaced.**
- **Do not overtighten the check valve. If it is tightened to a torque exceeding the specification, the check valve may malfunction, resulting in seizures in the engine.**
- **The No. 1 lower bearing has a oil groove. Be sure to install it in the correct position, otherwise a crankshaft seizure may result.**

Service standards (Unit: mm {in.})

Location	Maintenance item			Standard value	Limit	Remedy
–	Mitsubishi 4M50 Crankshaft end play			0.10 to 0.28 {0.0039 to 0.011}	0.4 {0.016}	Replace thrust plate
4, 5, 12	Main bearing	Oil clearance	All except No. 3	0.038 to 0.1 {0.0015 to 0.0039}	0.15 {0.0059}	Replace
			No. 3	0.058 to 0.12 {0.0023 to 0.0047}		
		Span when free		–	Less than 91.5 {3.60}	
11	Mitsubishi 4M50 Crankshaft	Bend		0.02 {0.00079} or less	0.05 {0.0020}	Replace
		Pins and journals	Out-of-roundness	0.01 {0.00039} or less	0.03 {0.0012}	Rectify or replace
			Taper	0.006 {0.00024} or less	–	
15	Distortion of upper crankcase top surface			0.07 {0.0028} or less	0.2 {0.0079}	Rectify or replace

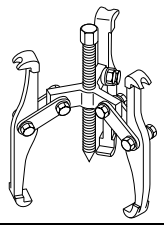
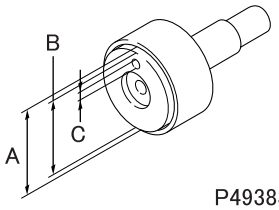
Tightening torque (Unit: N·m {lbf·ft, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (rear plate installation)	63.7 {47, 6.5}	–
Tb	Bolt (lower crankcase installation)	23.5 {17, 2.4}	Wet
Tc	Main cap bolt (lower crankcase installation)	49 {36, 5.0} +90°	Wet Reusable up to 3 times
Td	Check valve	29.4 {22, 3.0}	Wet

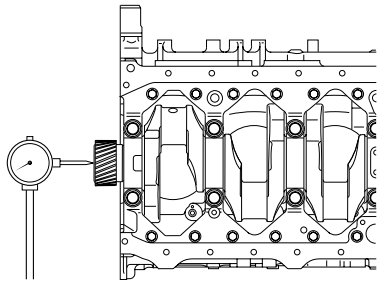
Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Rear oil seal lip	Engine oil	As required
	Bolt and main bearing cap bolt threads and seating surface of head		
	Main bearing inside surface		
	Check valve threads		
b	Upper and lower crankcase mating surface of rear oil seal	ThreeBond 1207C or D	As required
	Lower crankcase mounting surface of upper crankcase		

Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application
a	Gear puller  P02065	MH061326	Removal of crankshaft gear
b	Rear oil seal slinger installer A: φ103 {φ4.06}, B: φ100 {φ3.94}, C: φ15 {φ0.59}  P49383	MH062677	Installation of rear oil seal slinger

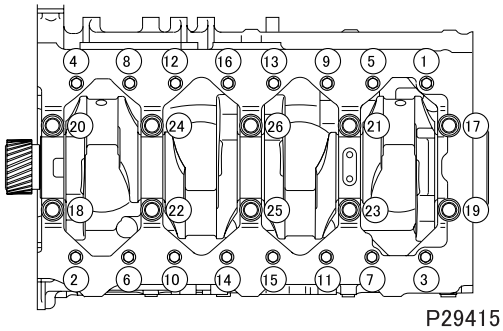
◆Inspection before removal◆


P29413

■ Inspection: Crankshaft end play

- If the measurement exceeds the specified limit, replace the thrust plates with oversize ones.
- Available oversizes:
  +0.15 mm, +0.30 mm, +0.45 mm {0.0059, 0.012, 0.018 in.}
- Replace the crankshaft if the end play is too large to adjust using oversize thrust plates.

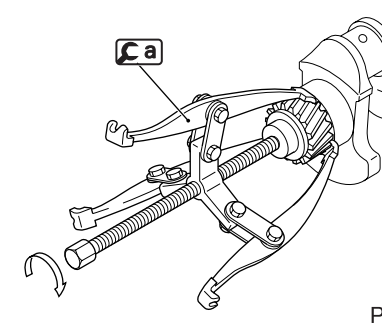
◆Removal procedure◆



P29415

■ Removal: Lower crankcase

- Loosen the bolts little by little in the order indicated in the illustration (1 to 16).
- After loosening the bolts, loosen the main cap bolts little by little in the order indicated in the illustration (17 to 26), then remove the main cap bolts.



P29422

■ Removal: Crankshaft gear

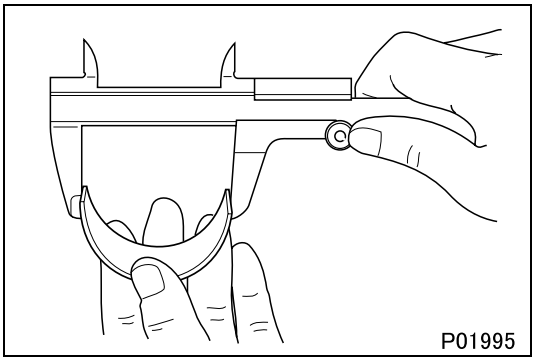
CAUTION ⚠

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

■ Removal: Rear oil seal slinger

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

◆Inspection procedure◆

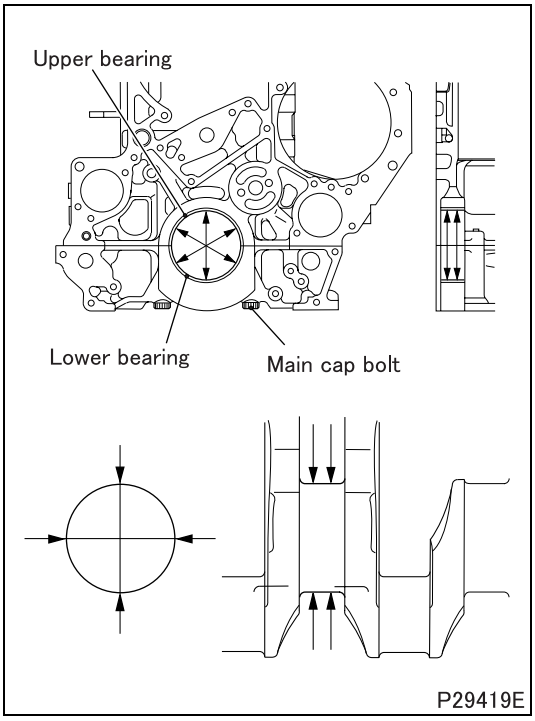


■ **Inspection: Main bearing span when free**

CAUTION ⚠

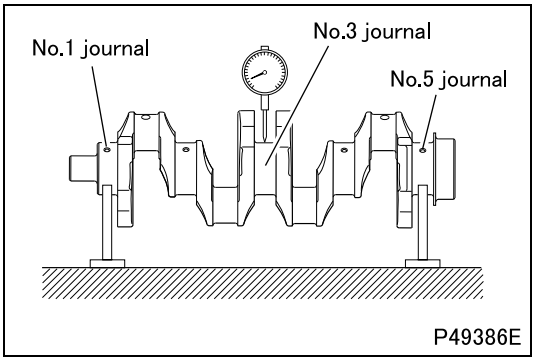
- **Do not attempt to manually expand the bearings.**
- **Always replace the upper and lower bearings as a set.**

- If the measurement exceeds the specified limit, replace the bearing.



■ **Inspection: Main bearing-to-crankshaft clearance**

- Fit the upper bearing into the upper crankcase and the lower bearing into the lower crankcase.
- Tighten the main bearing cap bolts to a torque of 49 N·m {36 lbf·ft, 5.0 kgf·m}.
- Measure the inside diameter of the main bearing and the 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 indicated on the next page.



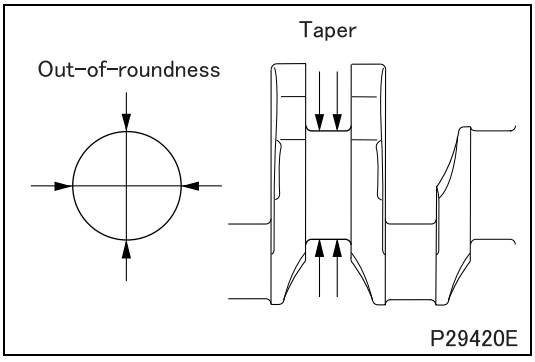
■ **Inspection: Mitsubishi 4M50 Crankshaft**

(1) Bend

- Support the crankshaft at its No. 1 journal and No. 5 journal. Measure the extent of bending in the crankshaft at the center of the No. 3 journal.
- If the measurement exceeds the specified limit, replace the crankshaft.

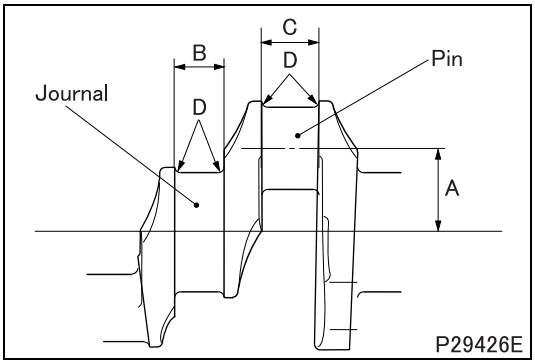
NOTE

- **Turn the crankshaft through one revolution. One-half of the dial indicator reading represents the extent of bending.**



(2) Out-of-roundness and taper of crankshaft journals and pins

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



Grinding of crankshaft

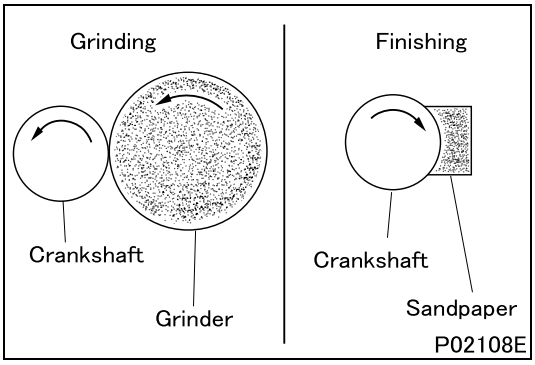
CAUTION ⚠

- **If the crankshaft is ground to an undersize, the main bearings must be replaced with the undersize ones of the corresponding undersize.**

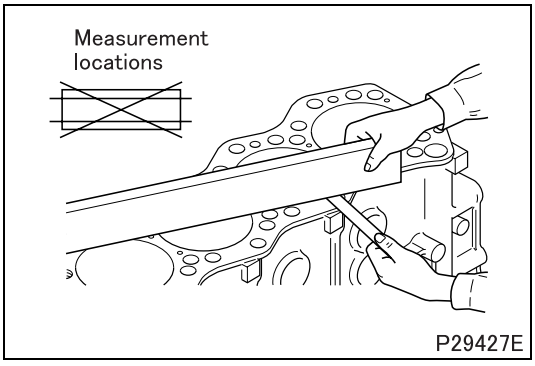
- Do not change the center-to-center distance **A** between the journal and pin.
  A: 60 ± 0.05 mm {2.36 ± 0.0020 in.}
- Do not change the journal width **B** and the pin width **C**.
  B: 33.5 mm {1.32 in.} (No. 1 journal)
  35 mm {1.38 in.} (No. 2 to No. 4 journals)
  $35\ ^{+0.039}_{0}$ mm {$1.38\ ^{+0.0015}_{0}$ in.} (No. 5 journal)
  C: $41\ ^{+0.2}_{0}$ mm {$1.61\ ^{+0.0079}_{0}$ in.} (No. 5 journal)
- Finish the fillets **D** smoothly.
  D: R4 mm {R0.16 in.}
- Carry out a magnetic inspection to check for cracks possibly caused by grinding. Also, check that the harness of the surface has not dropped below Shore hardness number (Hs) 75.
- Replace the crankshaft if defects are evident.

Mitsubishi 4M50 Crankshaft undersize dimensions (Unit: mm {in.})

		Undersizes			
		0.25 {0.0098}	0.50 {0.020}	0.75 {0.030}	1.00 {0.039}
Finished journal diameter	No. 1, 2, 4, 5	85.68 to 85.70 {3.37 to 3.37}	85.43 to 85.45 {3.36 to 3.36}	85.18 to 85.20 {3.35 to 3.35}	84.93 to 84.95 {3.34 to 3.34}
	No. 3	85.66 to 85.68 {3.37 to 3.37}	85.41 to 85.43 {3.36 to 3.36}	85.16 to 85.18 {3.35 to 3.35}	84.91 to 84.93 {3.34 to 3.34}
Finished pin diameter		64.69 to 64.71 {2.55 to 2.55}	64.44 to 64.46 {2.54 to 2.54}	64.19 to 64.21 {2.53 to 2.53}	63.94 to 63.96 {2.52 to 2.52}
Out-of-roundness		0.01 {0.00039} or less			
Taper		0.006 {0.00024} or less			



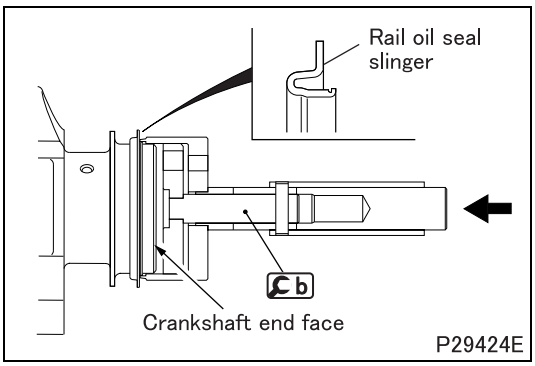
- When grinding, turn both the crankshaft and the grinder counterclockwise as viewed from the crankshaft front end.
- When finishing the crankshaft with whetstone or sandpaper, rotate the crankshaft clockwise.



■ Inspection: Distortion of upper crankcase top surface

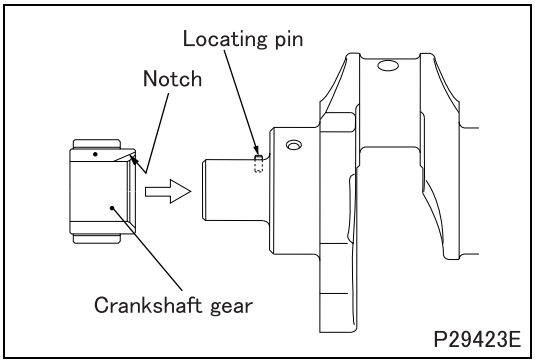
- If the measurement exceeds the specified limit, grind the crankcase top surface with a surface grinder.
- Limit the amount of removed metal to make sure that the amount of piston projection above the crankcase top surface stays within the standard value range.

◆Installation procedure◆



■ **Installation: Mitsubishi 4M50 Rear oil seal slinger**

- Press in the rear oil seal slinger until Cb sits snugly on the crankshaft end surface.



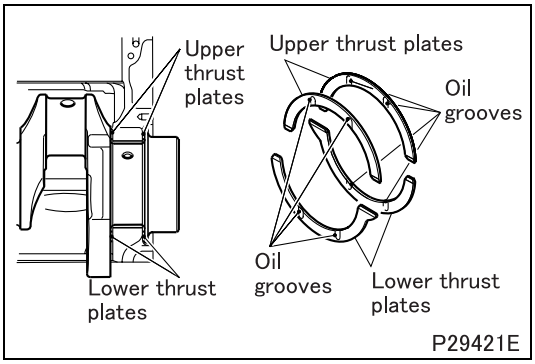
■ **Installation: Mitsubishi 4M50 Crankshaft gear**

- Heat the crankshaft gear to approximately 150°C {300°F} with a gas burner or the like.

CAUTION ⚠

- **Be careful not to get burned.**

- Align the locating pin in the crankshaft with the slot in the crankshaft gear. Drive the gear into position by lightly striking its end face with a plastic hammer.



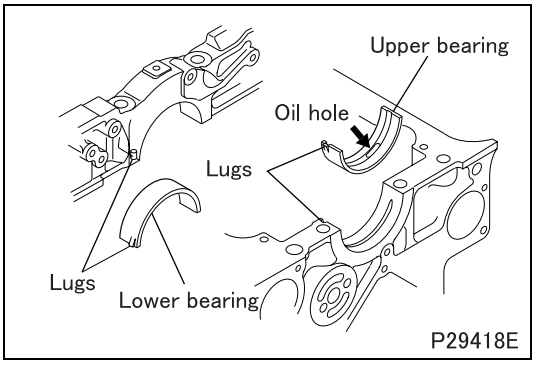
■ **Installation: Thrust plate**

- Install the thrust plates on both sides of the rearmost main bearing with the oil grooves on the inner plates facing inward and those on the outer plates outward as shown in the illustration.

CAUTION ⚠

- **Be sure to orient the oil grooves as indicated above, otherwise seizures may occur in the engine.**

- Use oversize thrust plates when adjusting the crankshaft end play. The upper and lower thrust plates on the same side must be of the same size. The thrust plates on one side may differ in size from those on the other side.

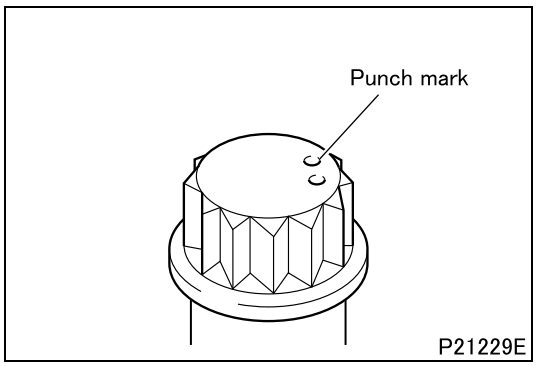


■ **Installation: Main bearings**

- Install the main bearings with their lugs aligned as shown in the illustration. When the crankshaft journals have been ground to an undersize, use undersize main bearings.
  Available main bearing undersizes:
  0.25 mm {0.0098 in.}, 0.50 mm {0.020 in.}, 0.75 mm {0.030 in.}, 1.00 mm {0.039 in.}

CAUTION ⚠

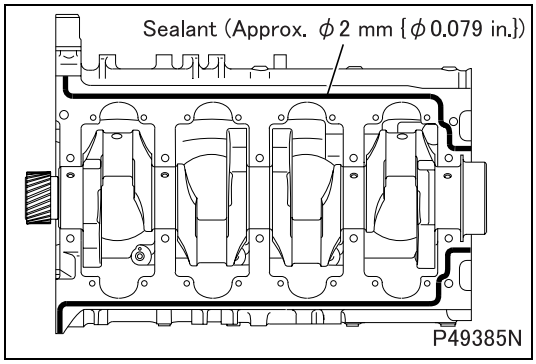
- **The upper main bearing has an oil hole. The lower main bearing has no oil hole. Do not confuse the upper and lower bearings, as this can cause seizure in the engine.**



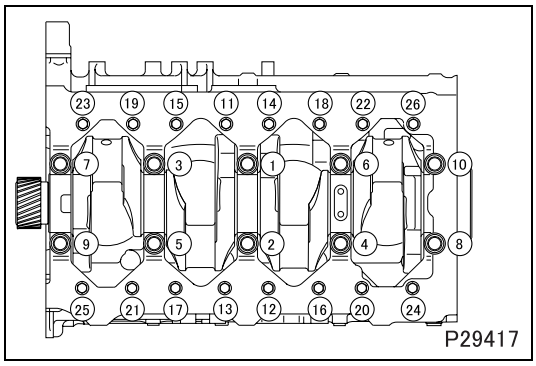
■ **Installation: Mitsubishi 4M50 Lower crankcase**

CAUTION ⚠

- **Before installing the main bearing cap bolts, check the number of punch marks on the head of each bolt. (A bolt with two or less marks is reusable.)**
- **The number of punch marks corresponds with the number of times the main cap bolt has been tightened using the torque-turn tightening method. Any bolt that has three marks (i.e. that has been used three times) must be replaced.**



- Clean all sealant application surfaces.
- Apply evenly thick beads of sealant to the upper crankcase without any breaks as shown in the illustration.
- Install the lower crankcase within three minutes of applying the sealant, being careful not to dislodge the sealant.



- Apply engine oil to the Mitsubishi 4M50 main cap bolt threads and seating surfaces of the bolt heads, then tighten them to a torque of 49 N·m {36 lbf·ft, 5.0 kgf·m} in the order indicated in the illustration (1 to 10).
- Tighten each main cap bolt further by 90° in the same order.
- Finally, tighten each bolt to the specified torque in the order indicated in the illustration (11 to 26).

CAUTION ⚠

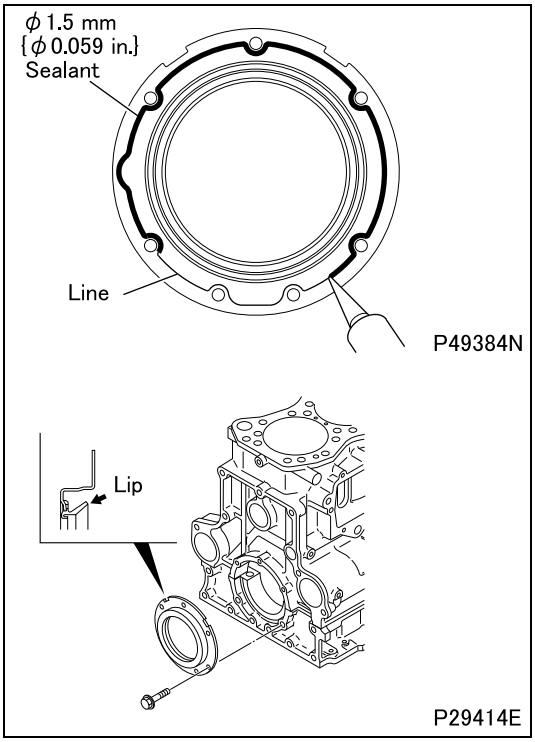
- **After installing the bolts, wait at least an hour before starting the engine.**
- **Apply new beads of sealant whenever the main cap bolts have been loosened or removed.**

- After tightening the bolts using the above torque-turn tightening method, make a punch mark on the head of each bolt to indicate the number of times that it has been used.

CAUTION ⚠

- **The bolts that have been tightened using the torque-turn method must never be additionally tightened after the final angular tightening.**

- After installing the main bearing caps, rotate the crankshaft by hand. If it cannot be rotated smoothly, inspect the main bearing caps for correct installation.



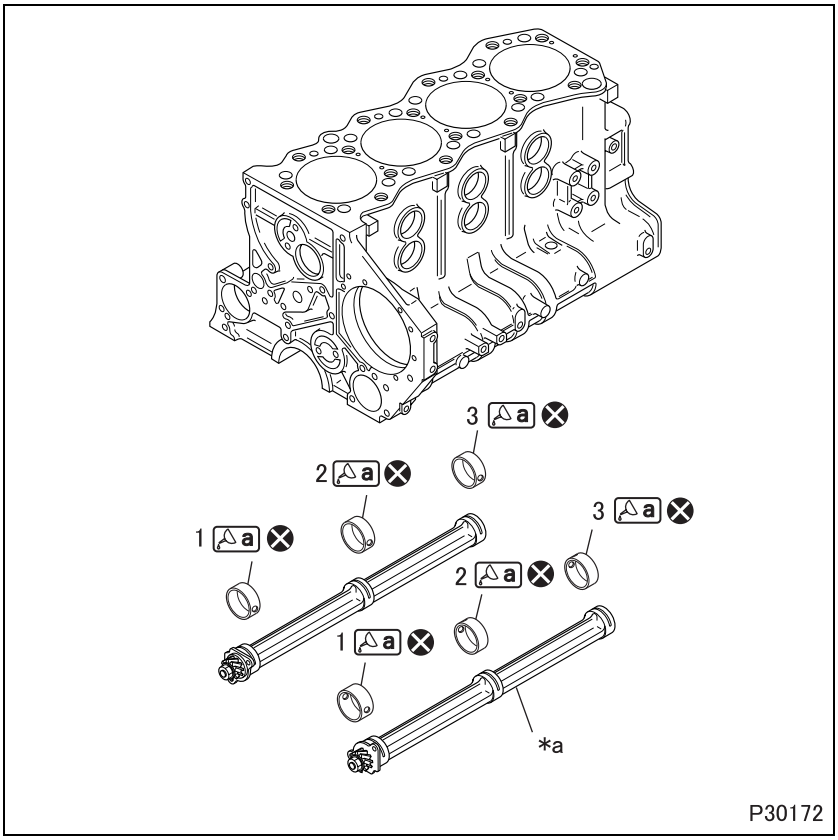
■ **Installation: Mitsubishi 4M50 Rear oil seal**

- Apply engine oil to the lip of the rear oil seal.
- Clean the seal surface of the crankshaft.
- Apply a bead of sealant along the line on the rear oil seal evenly without any breaks.
- Install the rear oil seal within three minutes after applying the sealant. Be careful not to let the applied sealant slip out of place during installation.

CAUTION ⚠

- **After fitting the rear oil seal, wait at least an hour before starting the engine.**
- **Apply a new bead of sealant whenever the mounting bolts of the rear oil seal have been loosened.**

MITSUBISHI 4M50 BALANCE SHAFT BUSHINGS



● **Disassembly sequence**

1 No. 1 balance shaft bushing
2 No. 2 balance shaft bushing
3 No. 3 balance shaft bushing

***a**: Balance shaft
⊗: Non-reusable parts

NOTE

- **Do not remove the balance shaft bushings unless defects are evident.**

● **Assembly sequence**

Follow the disassembly sequence in reverse.

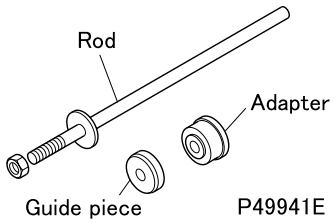
Service standards (Unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
1 to 3, *a	Balance shaft journal-to-balance shaft bushing clearance	No. 1	0.055 to 0.099 {0.0022 to 0.0039}	0.15 {0.0059}	Replace
		No. 2	0.075 to 0.119 {0.030 to 0.0047}		
		No. 3	0.055 to 0.099 {0.0022 to 0.0039}		

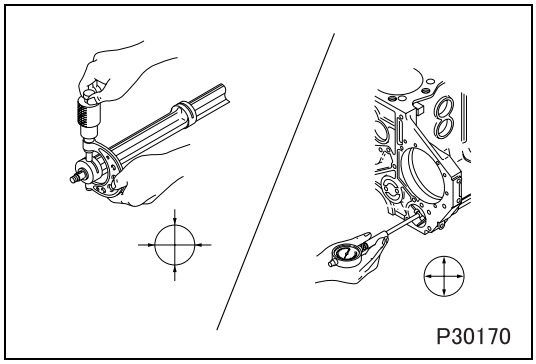
Lubricant and/or sealant

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

Special tools

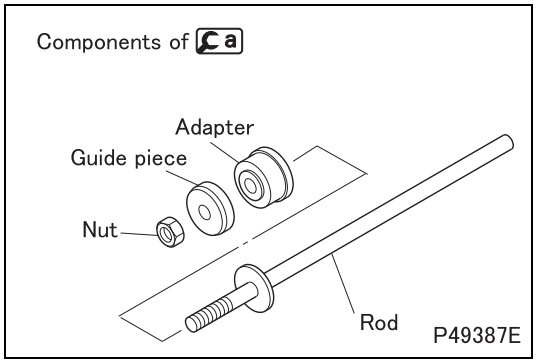
Mark	Tool name and shape	Part No.	Application
a	Balance shaft bushing installer and extractor 	MH062782	Removal and installation of balance shaft bushing

◆Inspection procedure◆



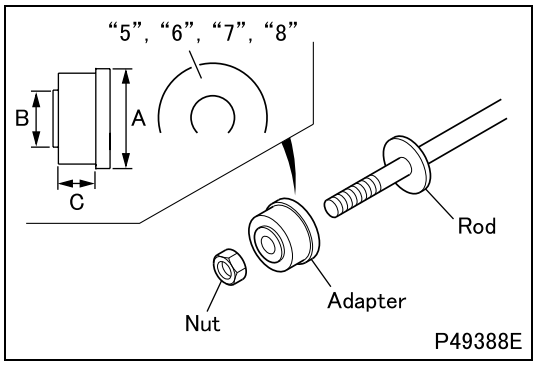
■ **Inspection: Balance shaft-to-balance shaft bushing clearance**

- Replace the bushing if the measurement exceeds the specified limit.



Replacement of balance shaft bushing

- Replace the bushing using a.

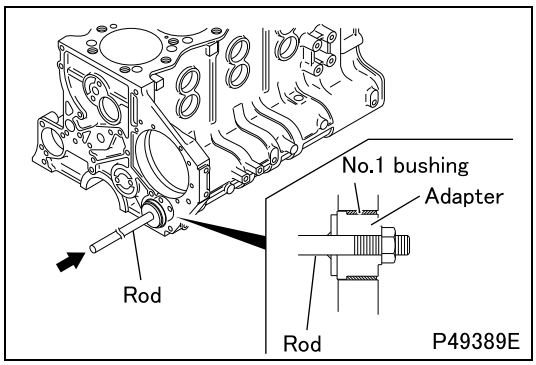


[Removal]

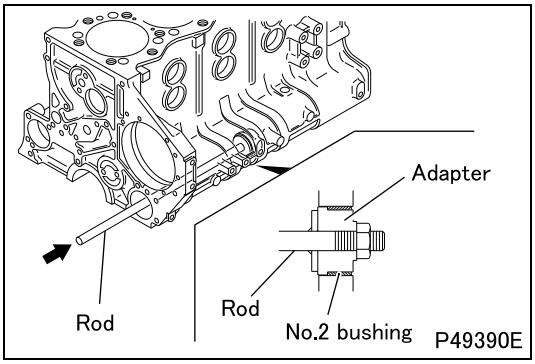
- To remove the bushings, use the rod fitted with an adapter corresponding to the size of each bushing.

Unit: mm {in.}

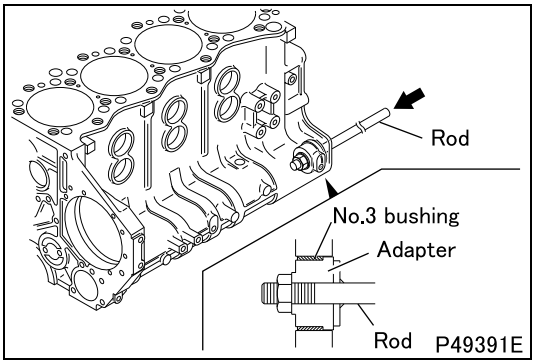
Bushing		Adapter			
		Identification mark	A	B	C
No. 1	Left	**"5"**	ϕ55.25 {ϕ2.18}	ϕ 51.5 {ϕ2.03}	26.5 {1.04}
	Right	**"6"**			21.5 {0.85}
No. 2		**"7"**	ϕ 55 {ϕ2.17}	ϕ 51 {ϕ2.01}	
No. 3		**"8"**	ϕ 54.75 {ϕ2.16}	ϕ 50.5 {ϕ1.99}	



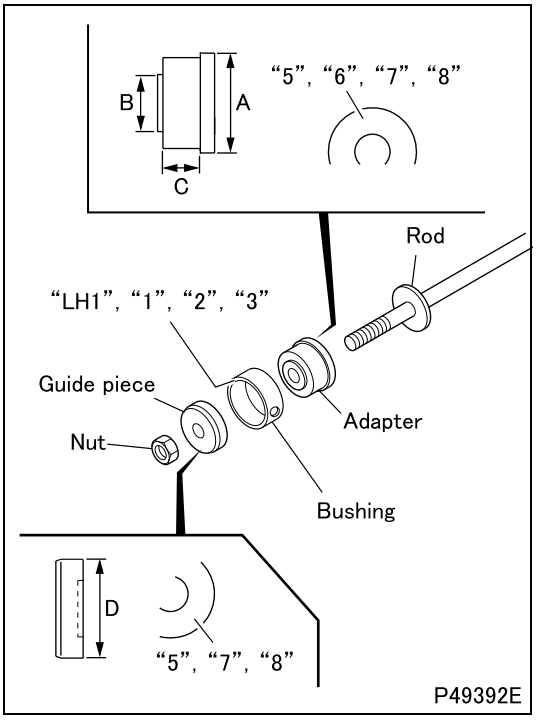
- Remove the No. 1 bushing by tapping on the rod from the front of the engine.



- Remove the No. 2 bushing by tapping on the rod from the front of the engine.



- Remove the No. 3 bushing by tapping on the rod from the back of the engine.

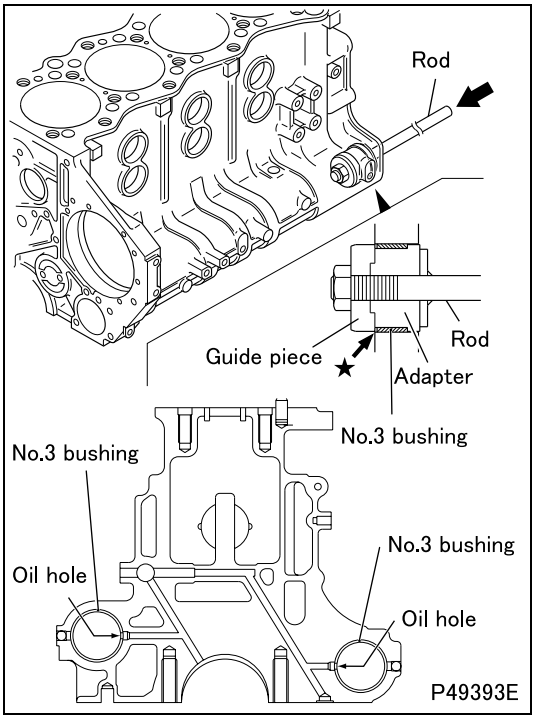


[Installation]

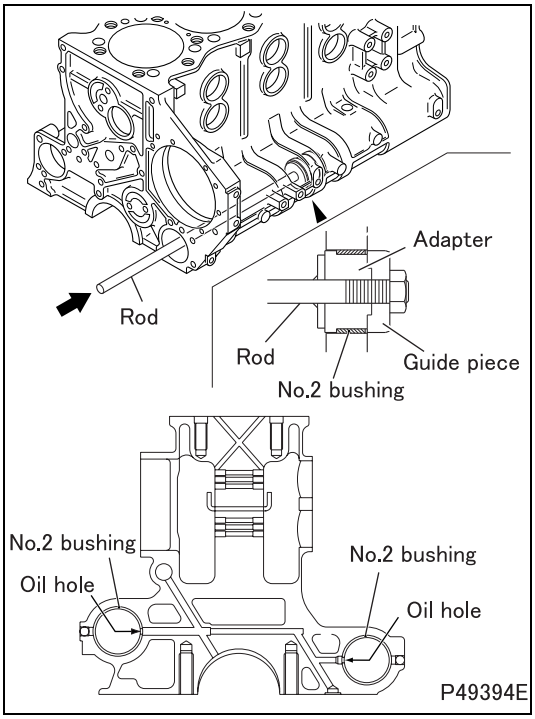
- To install the bushings, use the rod fitted with an adapter corresponding to the size of each bushing. Each bushing has an identification mark. These identification marks are used to distinguish between the No. 1, No. 2 and No. 3 bushings. If the identification mark is not clear, measure the outside diameter of the bushing and use the measurement as a means of identification.

Unit: mm {in.}

Bushing				Adapter				Guide piece	
		Identification mark	Outside diameter	Identification mark	**A**	**B**	**C**	Identification mark	**D**
No. 1	Left	**"LH1"**	ϕ 55.25 {ϕ2.18}	**"5"**	ϕ 55.25 {ϕ2.18}	ϕ 51.5 {ϕ2.03}	26.5 {1.04}	**"5"**	ϕ 55.25 {ϕ2.18}
	Right	**"1"**	ϕ 55.25 {ϕ2.18}	**"6"**			21.5 {0.85}	**"6"**	
No. 2		**"2"**	ϕ55 {ϕ2.17}	**"7"**	ϕ55 {ϕ2.17}	ϕ51 {ϕ2.01}		**"7"**	ϕ55 {ϕ2.17}
No. 3		**"3"**	ϕ 54.75 {ϕ2.16}	**"8"**	ϕ 54.75 {ϕ2.16}	ϕ 50.5 {ϕ1.99}		**"8"**	ϕ 54.75 {ϕ2.16}

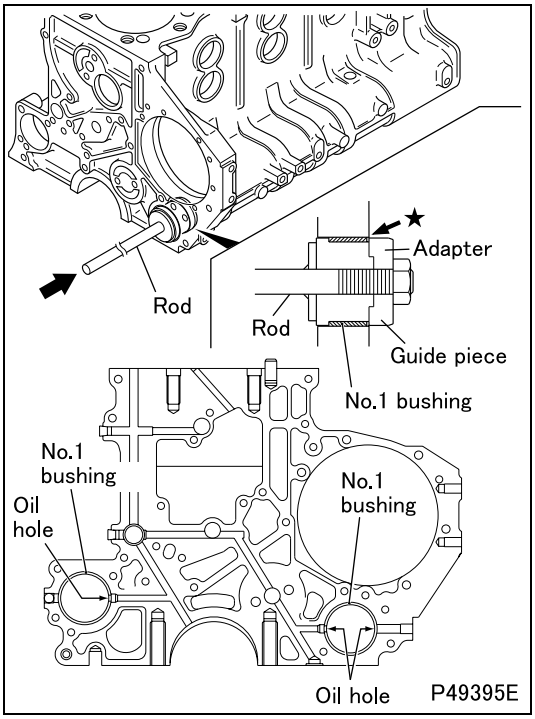


- Align the oil hole in the No. 3 bushing with the oil hole in the upper crankcase.
- Force the No. 3 bushing into the upper crankcase as deep as the ★ mark in the illustration by tapping on the rod from the rear of the engine.



- Align the oil hole in the No. 2 bushing with the oil hole in the upper crankcase.
- Force the No. 2 bushing into the upper crankcase to the illustrated position by tapping on the rod from the front of the engine.

BALANCE SHAFT BUSHINGS



- Align the oil hole(s) in the No. 1 bushing with the oil hole(s) in the upper crankcase.
- Force the No. 1 bushing into the upper crankcase as deep as the ★ mark in the illustration by tapping on the rod from the front of the engine.

CAUTION ⚠

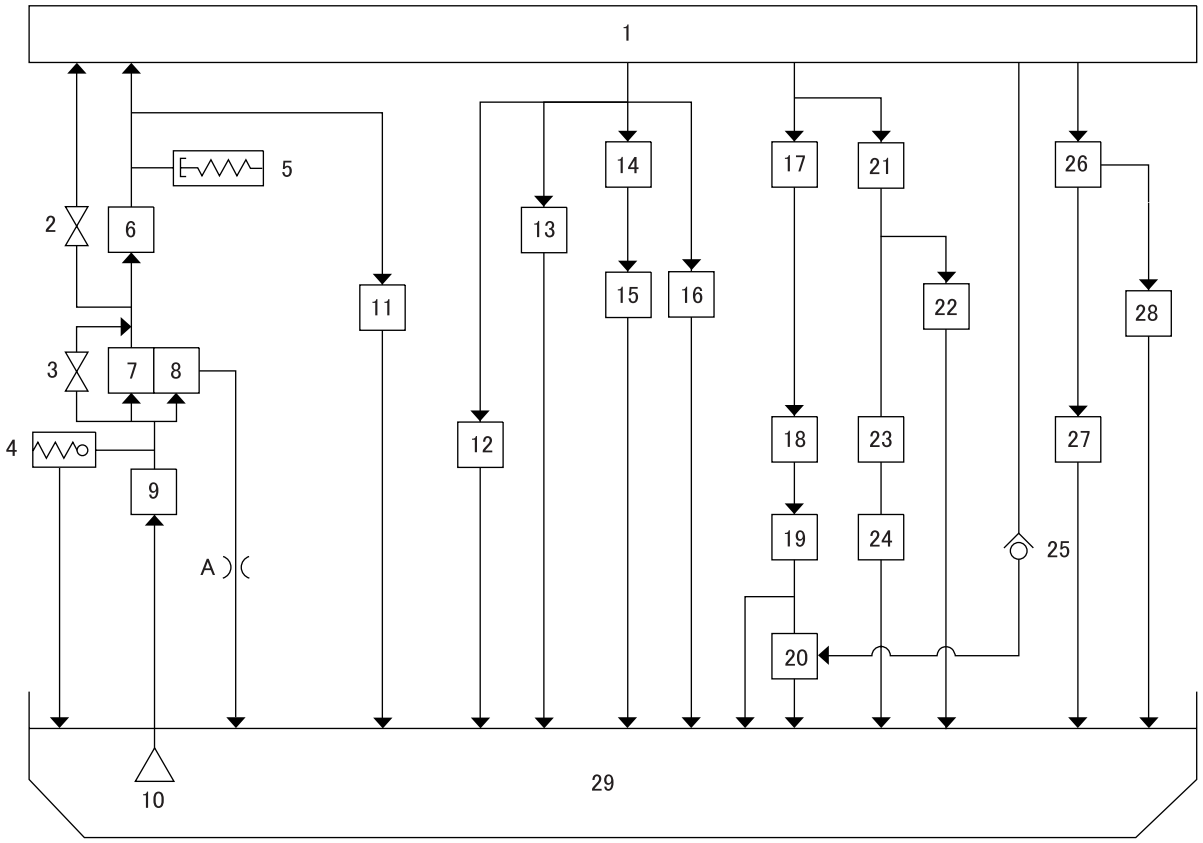
- **The left and right No. 1 bushings are different from each other, and should not be installed in reverse positions.**
- **The left No. 1 bushing has two oil holes, whereas the right No. 1 bushing has only one oil hole.**

GROUP 12 INDEX

SPECIFICATIONS

Item			Specifications
Method of lubrication			Forced lubrication by oil pump
Oil filter			Spin-on filter paper 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
	Quantity L (qts)	Oil pan	Approx. 9
		Oil filter	Approx. 1
Regulator valve opening pressure		kPa {psi, kgf/cm^2}	$600\ ^{+100}_{0}$ {$87\ ^{+15}_{0}$, $6\ ^{+1}_{0}$ }
Bypass valve opening pressure		kPa {psi, kgf/cm^2}	390 ± 29 {57 ± 4.2, 4.0 ± 0.3}

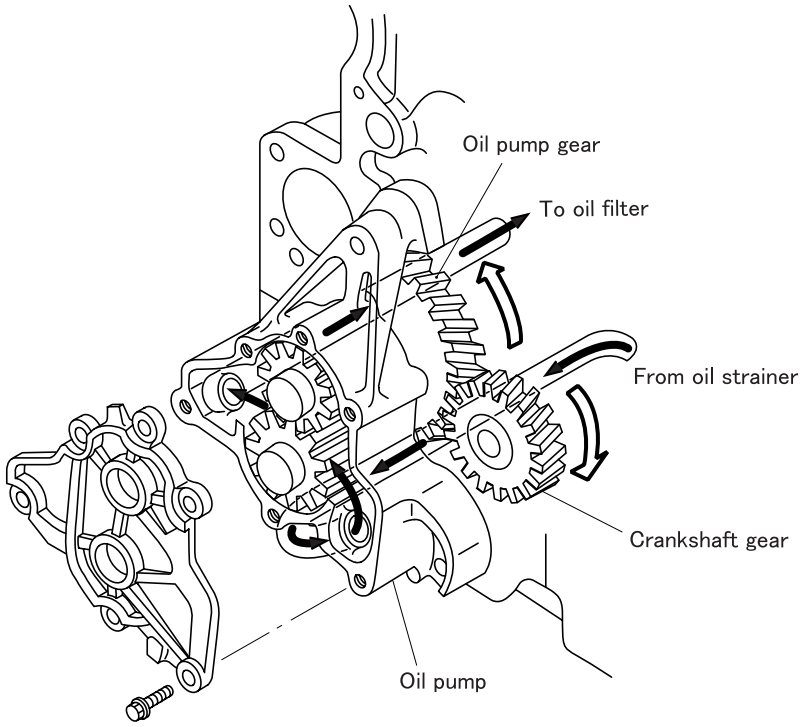
1. Mitsubishi 4M50 Lubrication System



1 Main oil gallery
2 Bypass valve
3 Bypass valve
4 Regulator valve
5 Engine oil pressure switch
6 Oil cooler
7 Full-flow filter element
8 Bypass filter element
9 Oil pump
10 Oil strainer
11 Turbo charger
12 Oil jet for gear
13 Vacuum pump
14 Idler bushing
15 Timing gear
16 Balance shaft bushing LH
17 Crankshaft main bearing
18 Connecting rod bearing
19 Connecting rod bushing
20 Piston
21 Balance shaft bushing RH
22 Supply pump gear bushing
23 Supply pump idler gear bushing
24 Supply pump idler gear shaft
25 Check valve for oil jet
26 Rocker bushing
27 Camshaft bushing
28 Rocker roller
29 Oil pan

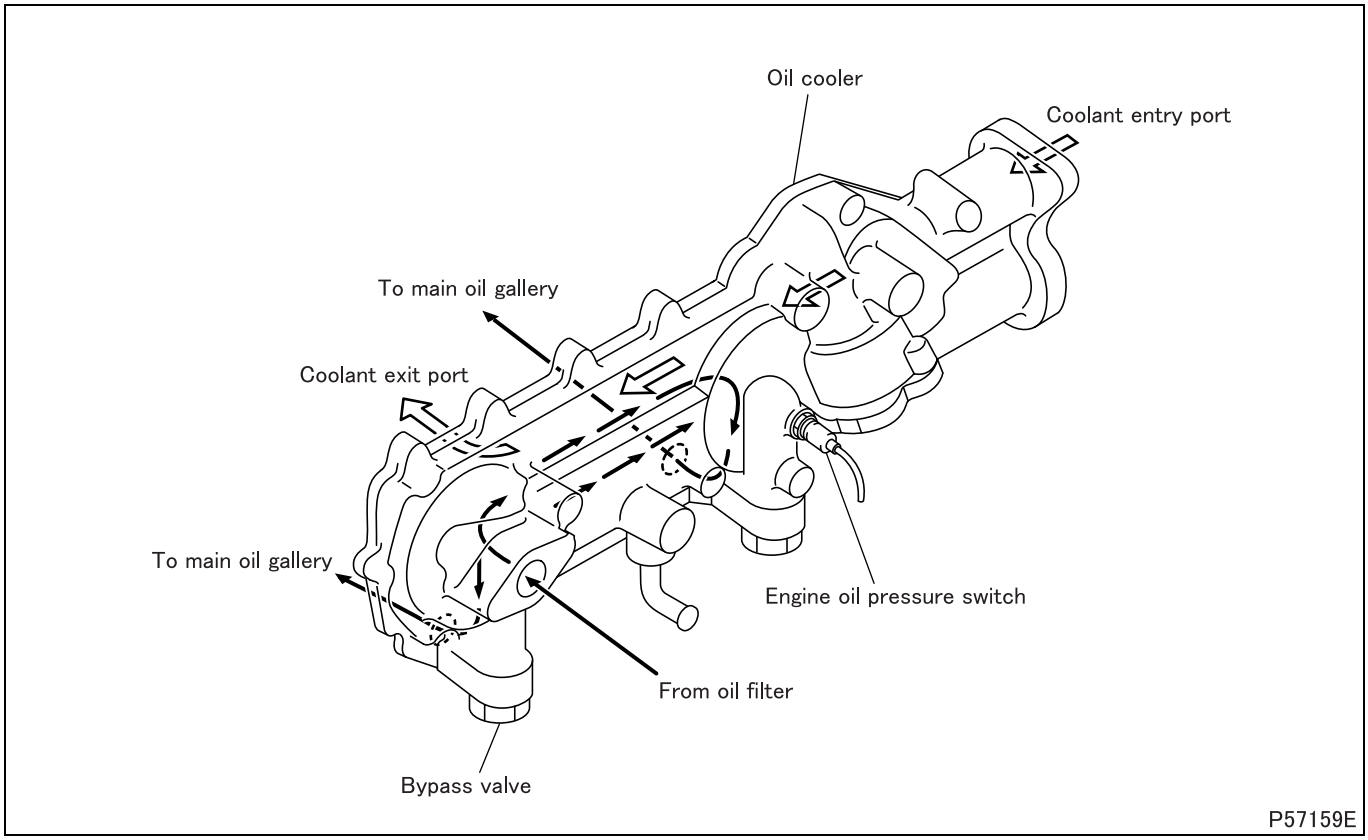
A: Orifice

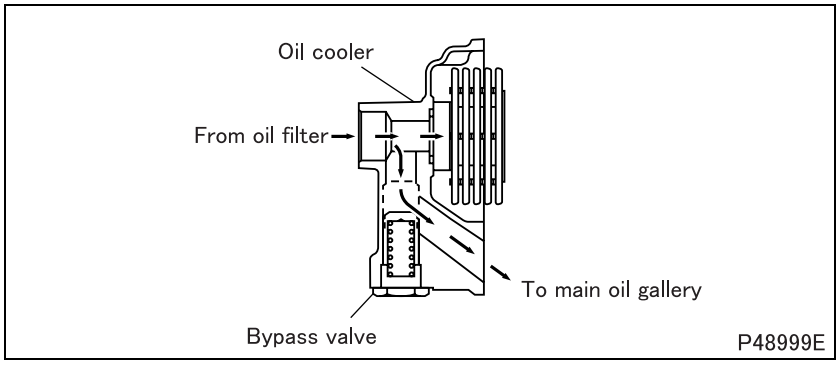
2. Mitsubishi 4M50 Oil Pump

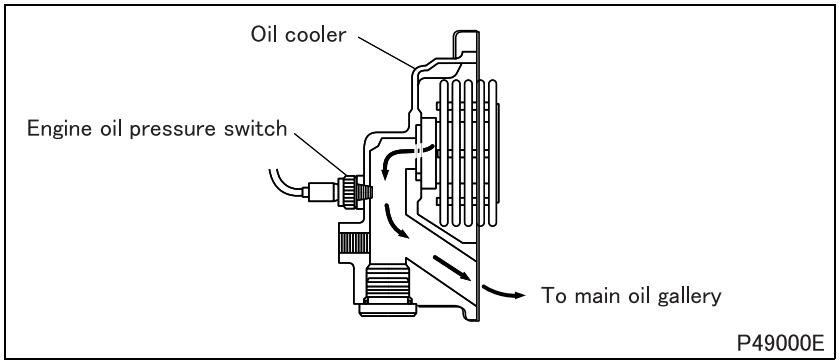


- This engine uses a gear-type oil pump driven by the rotation of the crankshaft transmitted through the engagement of the crankshaft gear and the oil pump gear.

3. Mitsubishi 4M50 Oil Cooler







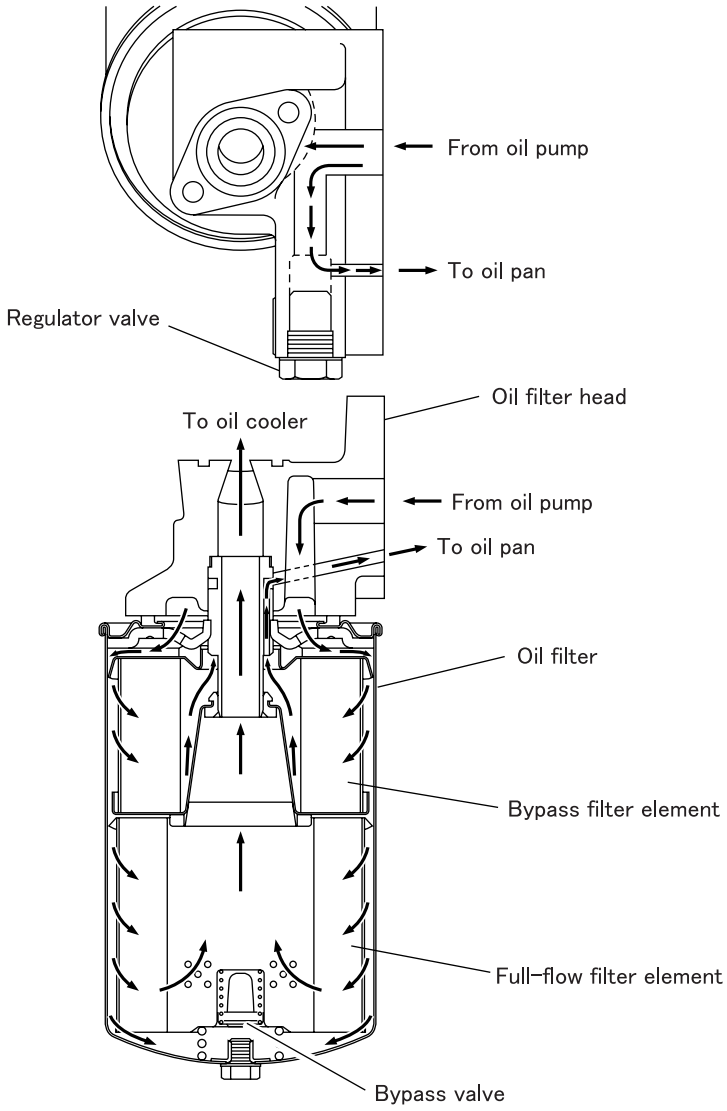
3.1 Mitsubishi 4M50 Bypass valve

- 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.

3.2 Mitsubishi 4M50 Engine oil pressure switch

- When the pressure of the engine oil to the main oil gallery drops below the specified level, an electrical contact inside the engine oil pressure switch closes.
- This causes a warning lamp on the meter cluster to illuminate and notify the operator of the excessive pressure drop.

4. Oil Filter

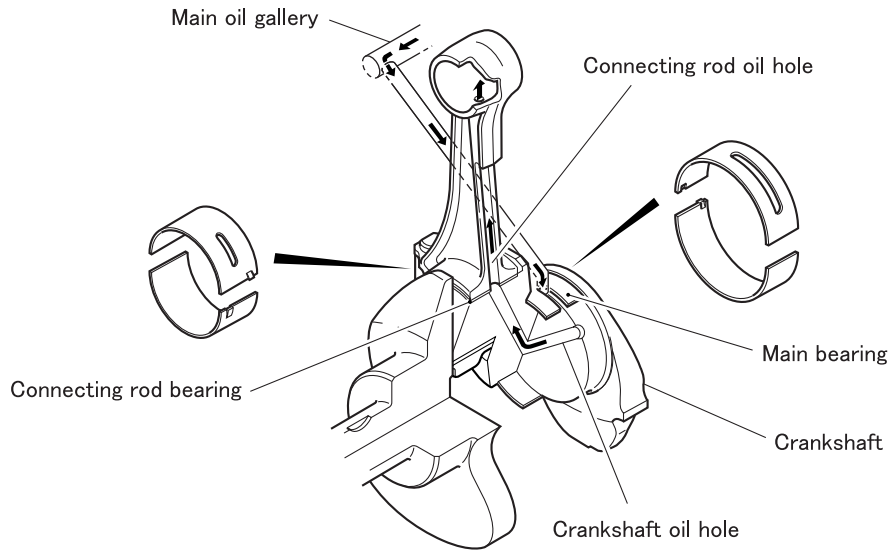


- The oil filter used in this engine is a spin-on, paper-filter type that incorporates both a bypass filter and a full-flow filter.
- A bypass valve is installed in the lower part of the oil filter. When the filter elements are clogged, this valve opens to let the engine oil bypass the filter elements and flow directly to the oil cooler, thereby preventing seizures in the engine.
- A regulator valve is installed on the oil filter head. When the oil pressure in the main oil gallery exceeds the specified level, the regulator valve opens to adjust the oil pressure by returning part of the engine oil to the oil pan.

5. Lubrication of Engine Components

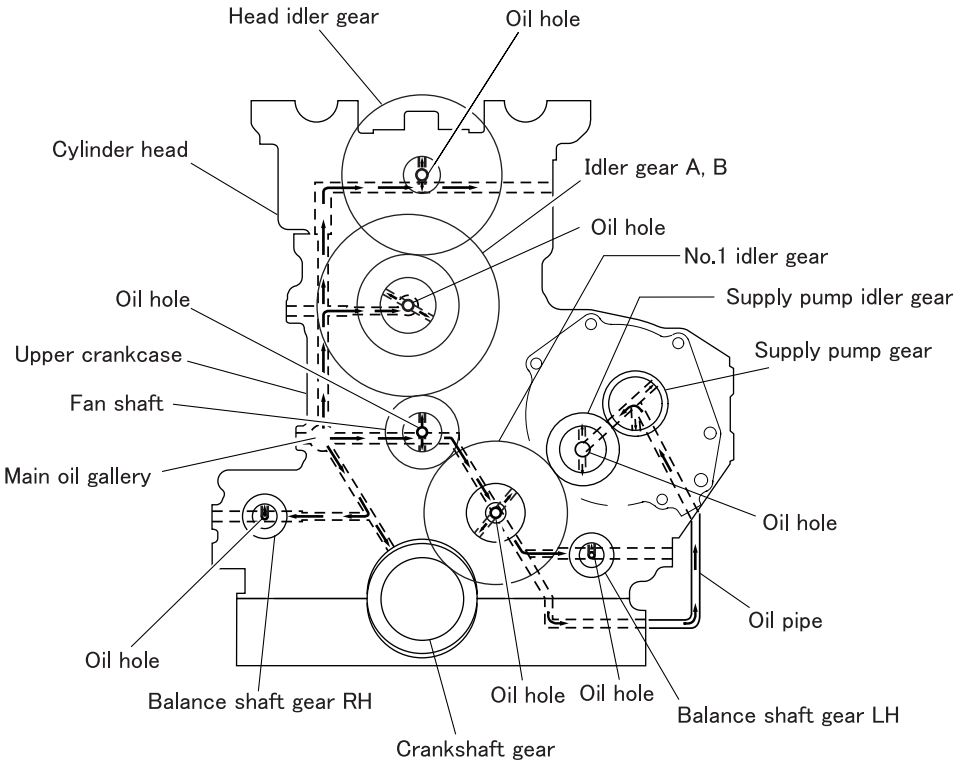
- The engine oil in the main oil gallery lubricates the engine components in the following ways.

5.1 Mitsubishi 4M50 Main bearing and connecting rod bearing

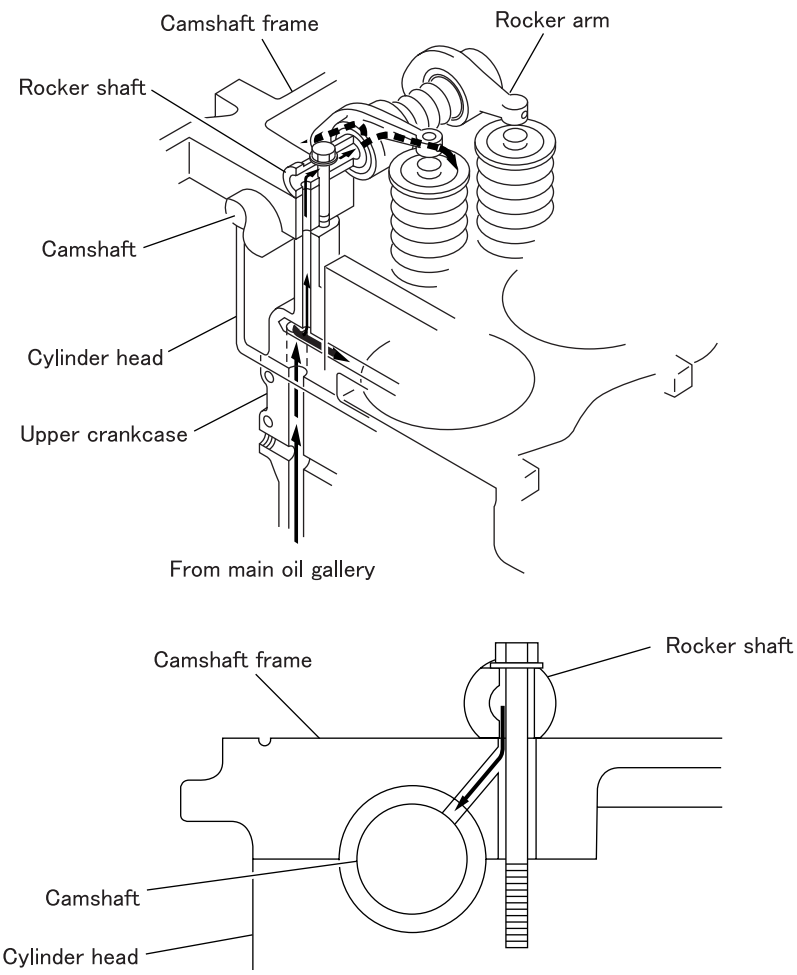


- Engine oil supplied through an oil passage in the crankshaft lubricates the big end (connecting rod bearing) of each connecting rod. Simultaneously, engine oil supplied through an oil passage in the connecting rod lubricates the connecting rod's small end.

5.2 Mitsubishi 4M50 Timing gears

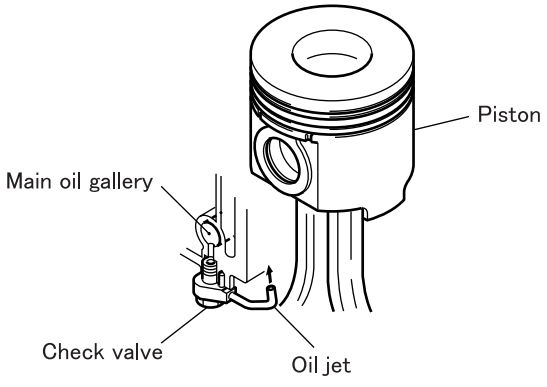


5.3 Mitsubishi 4M50 Valve mechanism



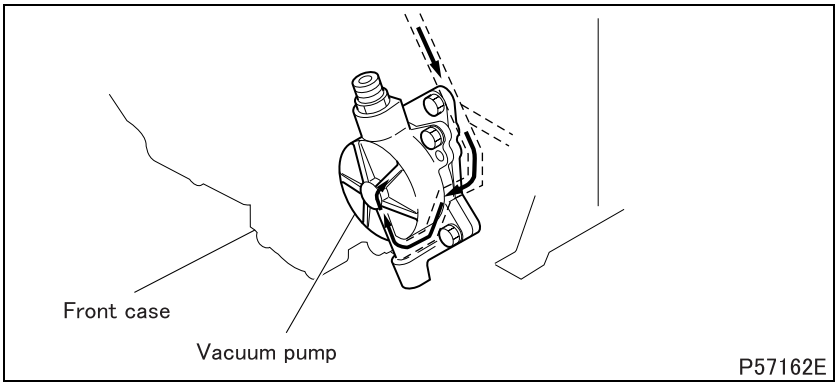
- The engine oil flows from the main oil gallery to the rocker shaft through the oil passages in the upper crankcase, cylinder head, and camshaft frame.
- The engine oil in the rocker shaft lubricates the rocker arms and camshaft, then returns to the oil pan.

5.4 Mitsubishi 4M50 Check valves and oil jets



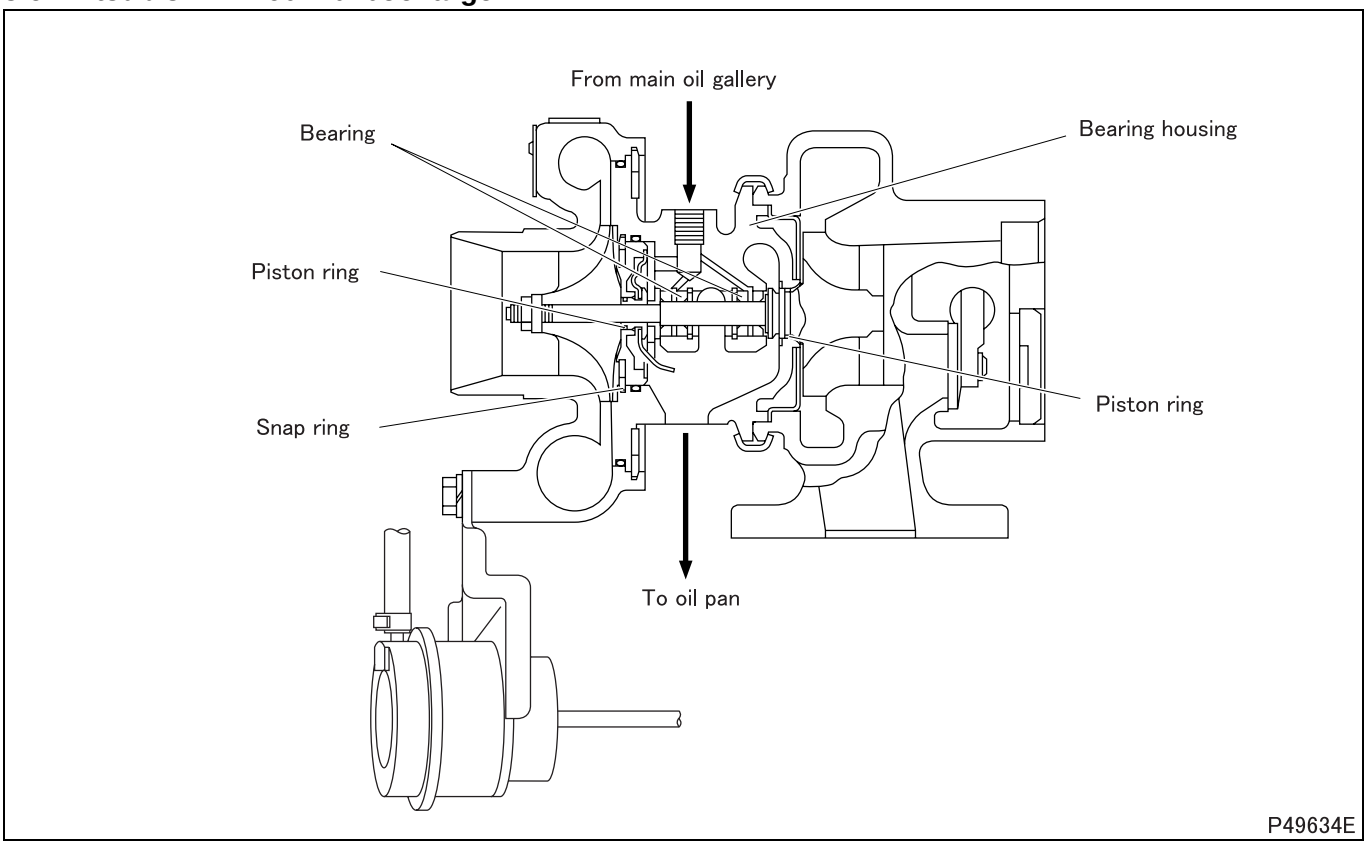
- An oil jet is fitted in the lower part of the main oil gallery for each cylinder.
- Engine oil is sprayed out of the oil jet into the piston to cool the piston.
- Each oil jet is fitted with a check valve that opens and closes at predetermined oil pressure levels. At low engine speeds, the check valve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

5.5 Vacuum pump



- Engine oil flows through the oil passages in the front case to the vacuum pump.
- The oil in the pump lubricates the vanes, and then is discharged into the front case from the air discharge port of the vacuum pump along with air, and returns to the oil pan.

5.6 Mitsubishi 4M50 Turbocharger



- Engine oil flows from the main oil gallery through the oil pipes to the turbocharger bearing housing and lubricates the inner surfaces of the bearing housing.
- The piston rings mounted on both sides of the turbine wheel shaft act as oil seals.

Possible causes \ Symptoms		Engine is difficult to start	Overheating	Low oil pressure	Excessive oil consumption (oil leakage)	Reference Gr
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		
Oil filter	Incorrect installation				O	
	Clogged element		O	O		
	Defective gasket			O		
Weakened regulator valve spring				O		
Incorrectly mounted and/or clogged oil strainer			O	O		
Defective fan shaft front oil seal					O	Gr11
Defective crankshaft rear oil seal					O	
Incorrectly mounted front case					O	
Defective piston cooling oil jet(s)			O	O		
Incorrectly mounted gear lubrication oil jet				O		
Oil working its way up into combustion chamber(s) through piston rings					O	
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			
Fuel mixed with oil			O			

3. Oil Pressure Measurement

Service standards

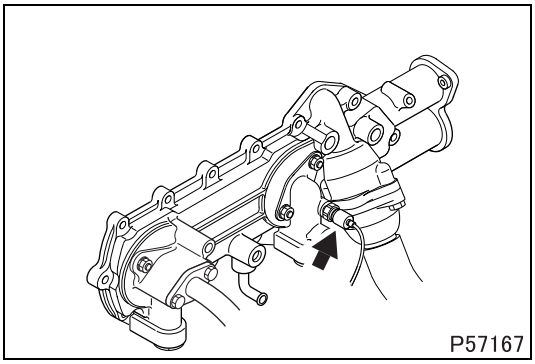
Location	Maintenance item		Standard value	Limit	Remedy
–	Oil pressure (oil temperature at 70 to 90°C {158 to 195°F})	No-load minimum speed	195 kPa {28 psi, 2.0 kgf/cm^2}	98 kPa {14 psi, 1.0 kgf/cm^2}	Inspect
		No-load maximum speed	295 to 490 kPa {43 to 71 psi, 3 to 5 kgf/cm^2}	195 kPa {28 psi, 2.0 kgf/cm^2}	

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

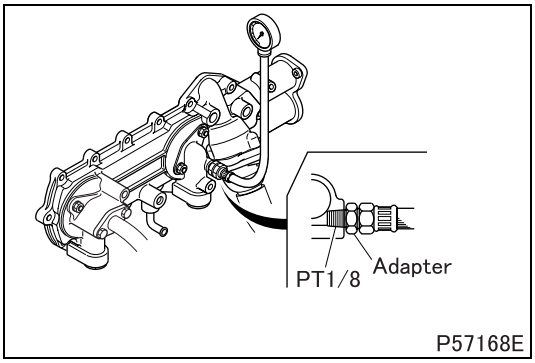
Mark	Parts to be tightened	Tightening torque	Remarks
–	Mitsubishi 4M50 Engine oil pressure switch	7.8 to 14.7 {5.8 to 11, 0.8 to 1.5}	Sealant With cold engine

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
–	Engine oil pressure switch threads	ThreeBond 1215	As required


P57167

- Remove the engine oil pressure switch.



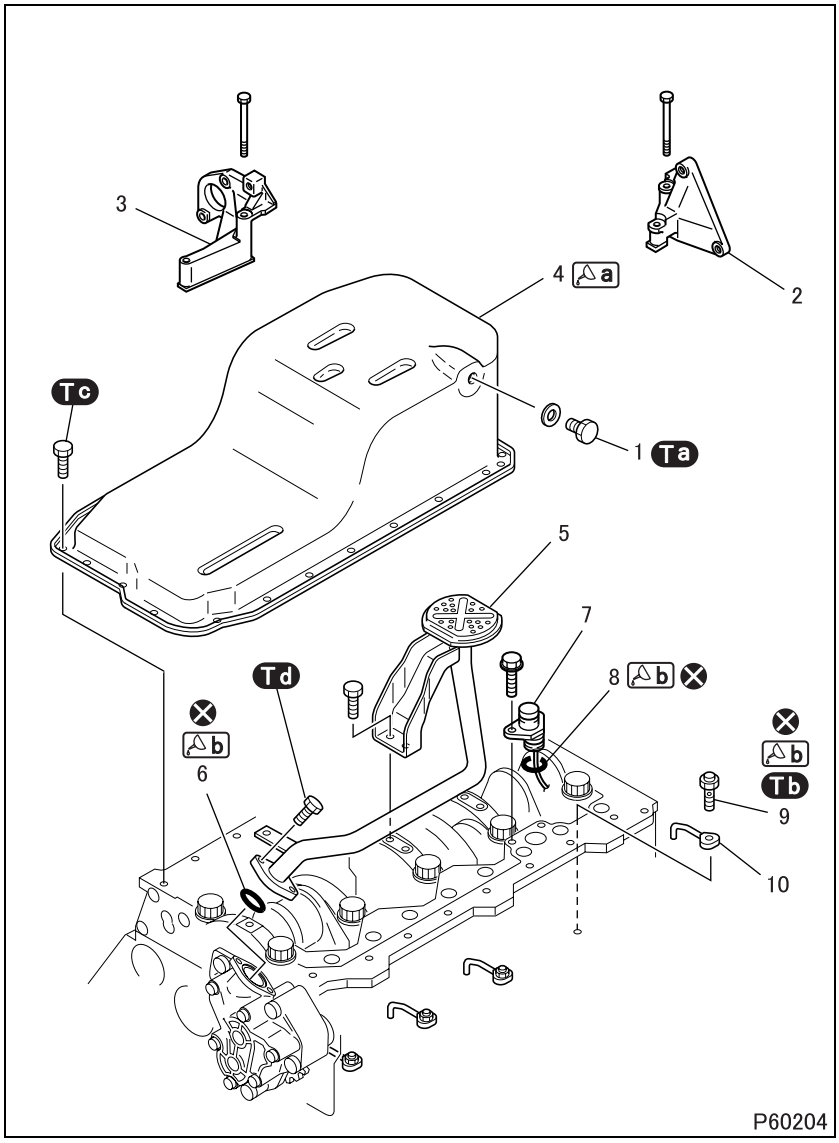
P57168E

- 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 {158 to 195°F}.
- 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.
- After taking the measurements, apply sealant to the threads of the oil pressure switch and tighten the switch to the specified torque.

CAUTION ⚠

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

MITSUBISHI 4M50 OIL JETS, OIL PAN, OIL STRAINER



● Disassembly sequence

1. Drain plug
2. Stiffner RH
3. Stiffner LH
4. Oil pan
5. Oil strainer
6. O-ring
7. Engine oil level sensor
8. O-ring
9. Check valve
10. Oil jet

⊗: Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

CAUTION ⚠

- **Make sure to tighten the check valve only to the specified torque. Overtightening it can cause defective operation, resulting in engine seizure.**

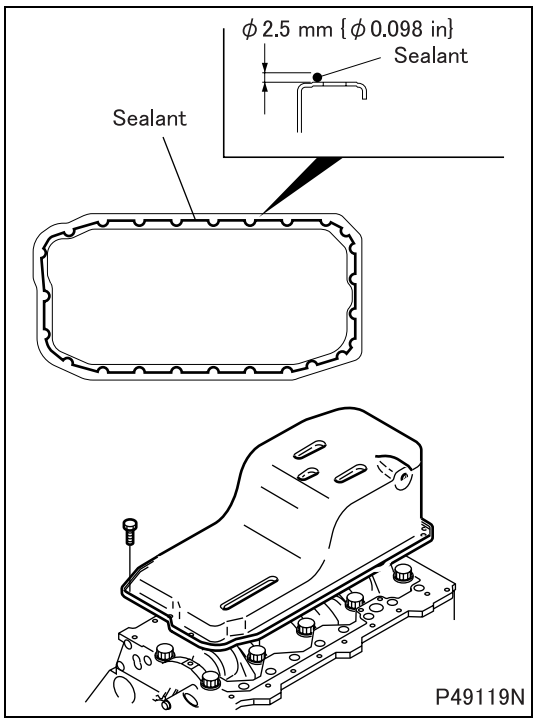
Tightening torque (Unit: N·m {lbf·ft, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Drain plug	34.3 to 43.1 {25 to 32, 3.5 to 4.4}	–
Tb	Mitsubishi 4M50 Oil Jet Check valve	29.4 {22, 3.0}	Wet
Tc	Bolt (oil pan mounting)	23.5 {17, 2.4}	–
Td	Bolt (oil strainer mounting)	23.2 {17, 2.4}	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Crankcase mounting surface of oil pan	ThreeBond 1207C	As required
b	O-ring	Engine oil	As required
	Check valve threads		

◆Installation procedure◆



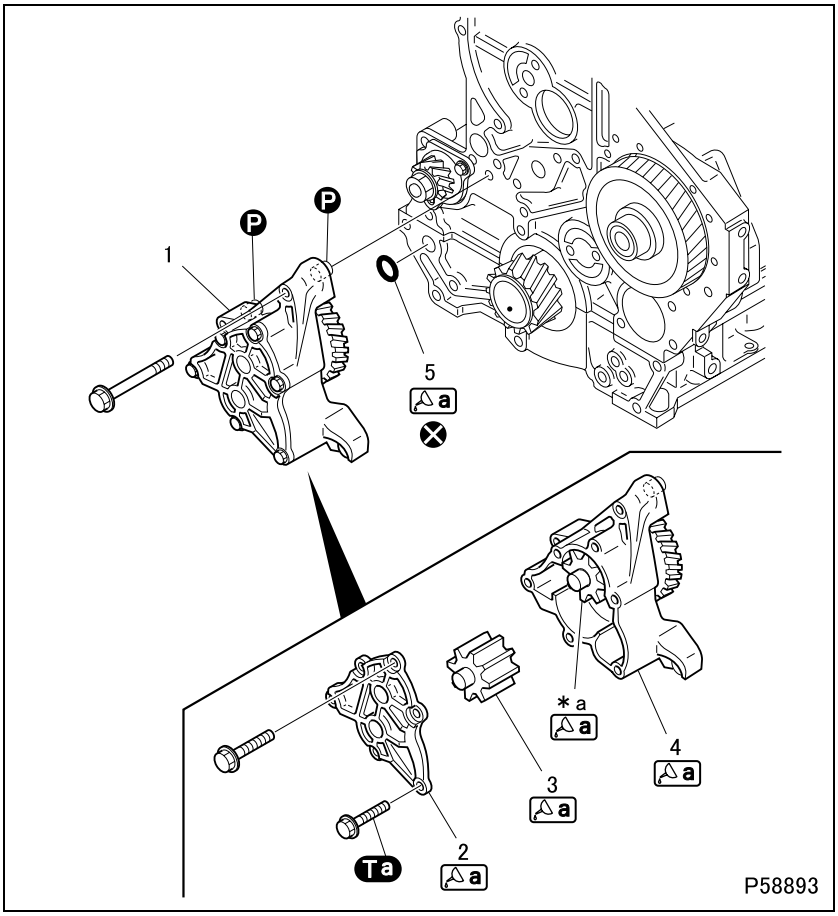
■ **Installation: Oil pan**

- 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 as 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 4M50 OIL PUMP



● **Disassembly sequence**

1 Oil pump
2 Oil pump cover
3 Driven gear
4 Gear and case assembly
5 O-ring

***a**: Drive gear
Ⓟ: Locating pin
⊗: Non-reusable parts

● **Assembly sequence**

Follow the disassembly procedure in reverse.

Mitsubishi 4M50 Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
2, 3	Oil pump cover-to-driven gear shaft clearance	0.04 to 0.075 {0.0016 to 0.0030}	0.15 {0.0059}	Replace
2, *a	Oil pump cover-to-drive gear shaft clearance	0.04 to 0.075 {0.0016 to 0.0030}	0.15 {0.0059}	Replace
3, 4	Gear and case assembly-to-driven gear shaft clearance	0.04 to 0.075 {0.0016 to 0.0030}	0.15 {0.0059}	Replace
3, 4, *a	Sinkage of each gear from gear and case assembly end surface	0.05 to 0.11 {0.0020 to 0.0043}	0.15 {0.0059}	Replace
	Gear and case assembly-to-tooth tip clearance for each gear	0.13 to 0.22 {0.0051 to 0.0087}	0.23 {0.0091}	Replace

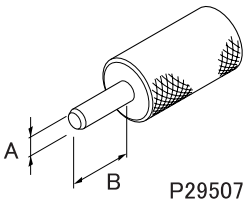
Tightening torque (Unit: N·m {lbf·ft, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (oil pump cover mounting)	27.4 {20, 2.8}	–

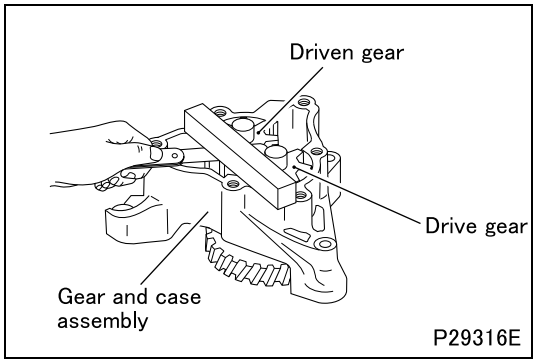
Lubricant and/or sealant

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

Special tools (Unit: mm {in.})

Mark	Tool name and shape	Part No.	Application
Ca	Pump cover pin A: $\phi 7\ ^{0}_{-0.14}$ {$\phi 0.28\ ^{0}_{-0.0055}$} B: 20 {0.79}  P29507	MH063431	Installation of oil pump cover

◆Inspection procedure◆

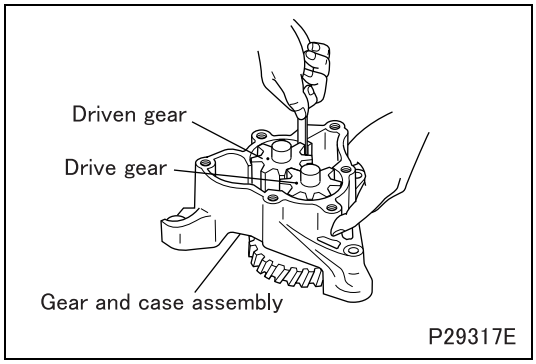


P29316E

■ Inspection: Driven gear, drive gear and gear and case assembly

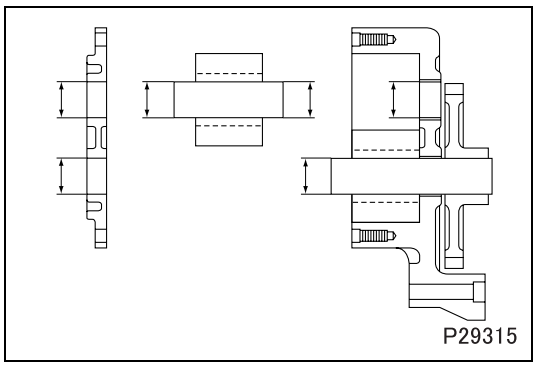
- Carry out the following inspection. Replace the oil pump if any defects are found.

(1) Sinkage of each gear from gear and case assembly end surface



P29317E

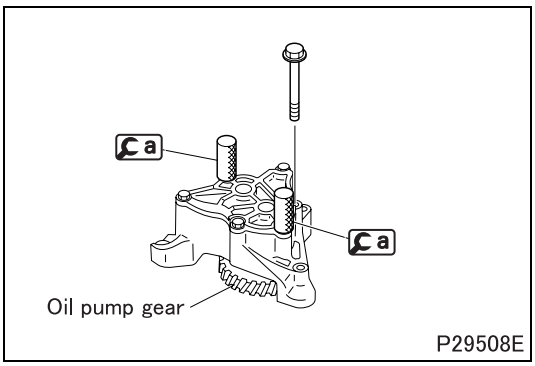
(2) Gear and case assembly-to-tooth tip clearance for each gear


P29315

■ Inspection: Oil pump cover, driven gear, and gear and case assembly

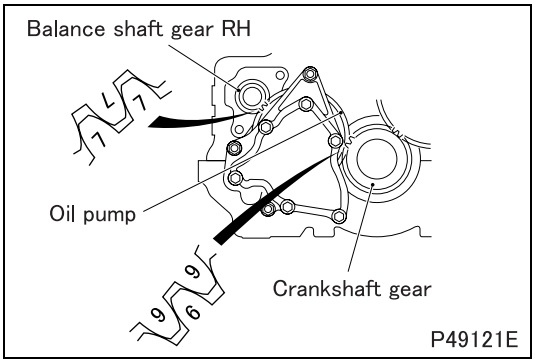
- Measure the clearance between each gear's shaft and the oil pump cover, as well as between each gear's shaft and the gear and case assembly.
- If the measurements are not within the standard value range, replace the oil pump.

◆Installation procedure◆



■ Installation: Oil pump cover and gear and case assembly

- Apply engine oil to each component.
- Hold the oil pump cover in place on the gear and case assembly by fitting two a s in the illustrated locations.
- Install a bolt into an empty bolt hole and tighten it to the specified torque.
- Remove the two a s. Install the rest of the bolts and tighten them to the specified torque.
- After installing all the bolts, turn the oil pump gear by hand and check that it rotates smoothly.
- Disassemble and reassemble the oil pump cover and gear and case assembly if the oil pump gear does not rotate smoothly.

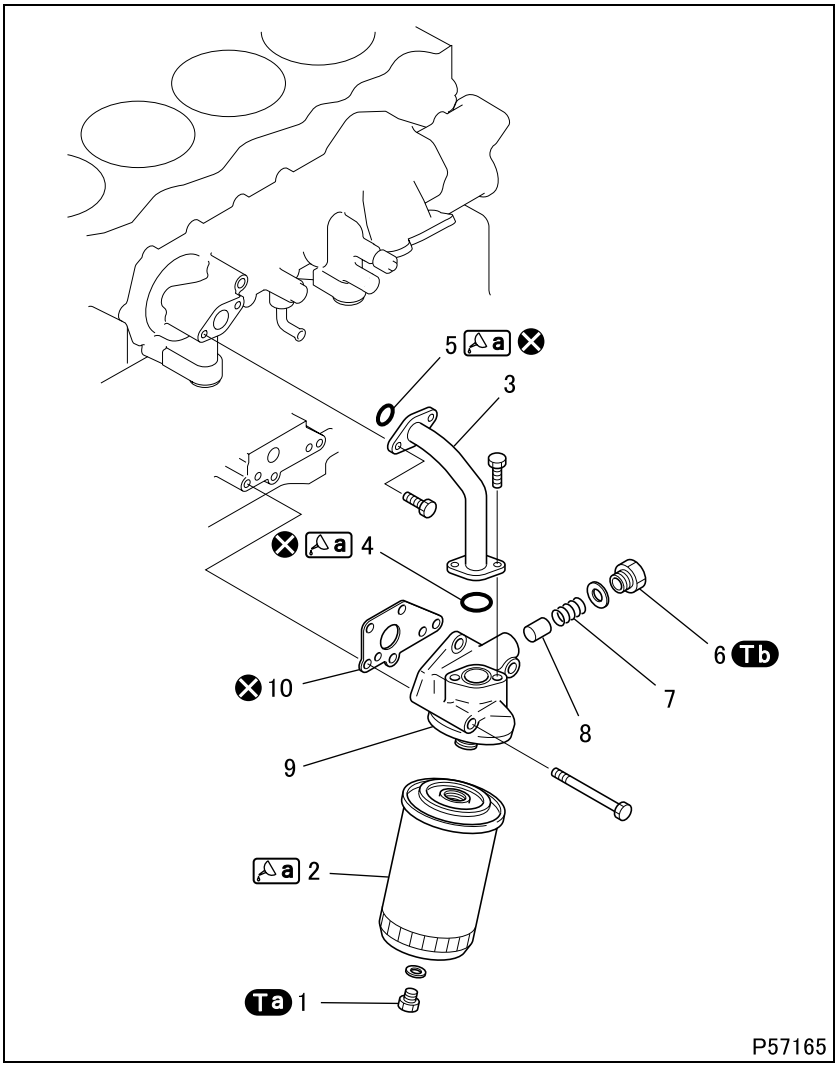


■ Installation: Oil pump

- Place the No.1 cylinder piston at top dead center to bring the crankshaft gear to an appropriate position.
- Inject approximately 5 cm^3 {0.3 cu. in.} of engine oil.
- Align the mating mark "**6**" on the crankshaft gear and the mating mark "**7**" on the balance shaft gear RH with the corresponding mating marks on the oil pump gear, and then install the oil pump gear.

M E M O

OIL FILTER



● Disassembly sequence

1 Drain plug
2 Oil filter
3 Oil pipe
4 O-ring
5 O-ring
6 Plug
7 Regulator valve spring
8 Regulator valve
9 Oil filter head
10 Gasket

⊗: Non-reusable parts

● Assembly sequence

Follow the disassembly sequence in reverse.

WARNING ⚠

- **Wipe up any spilled engine oil, as it can cause fires.**

CAUTION ⚠

- **Make sure not to put any engine oil on the V-belt when working on the oil cooler and oil filter. V-belts soiled with oil or grease may easily slip, resulting in deteriorated performance of the cooling system.**
- **Make sure to install the gasket in the correct position so that it does not cover up the oil hole.**

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
7	Load of installed regulator valve spring (installed length: $39^{+0.3}_{0}$ {$1.54^{+0.012}_{0}$})	93.5 ± 0.5 N {21 ± 0.1 lbs, 9.5 ± 0.05 kgf}	–	Replace

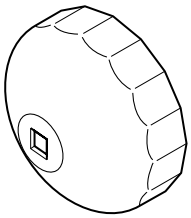
Tightening torque (Unit: N·m {lbf·ft, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Drain plug	9.8 ± 1.96 {7.2 ± 1.4, 1.0 ± 0.2}	–
Tb	Plug (regulator valve mounting)	60 {44, 6.0}	–

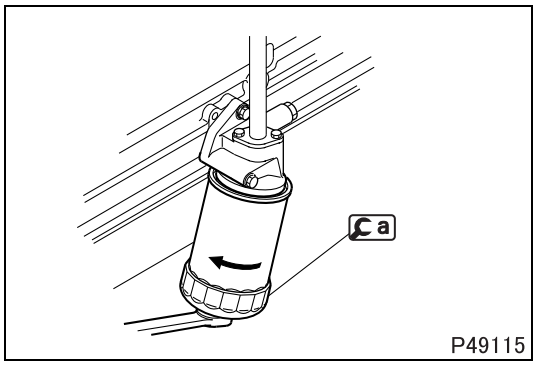
Lubricant and/or sealant

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

Special tools

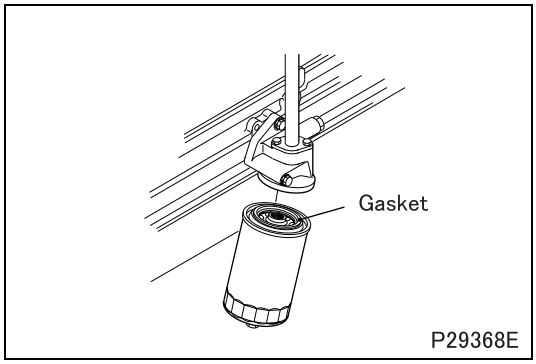
Mark	Tool name and shape	Part No.	Application
a	Oil filter element socket  P08550	MH061566	Removal of oil filter

◆Removal procedure◆



■ **Removal: Oil filter**

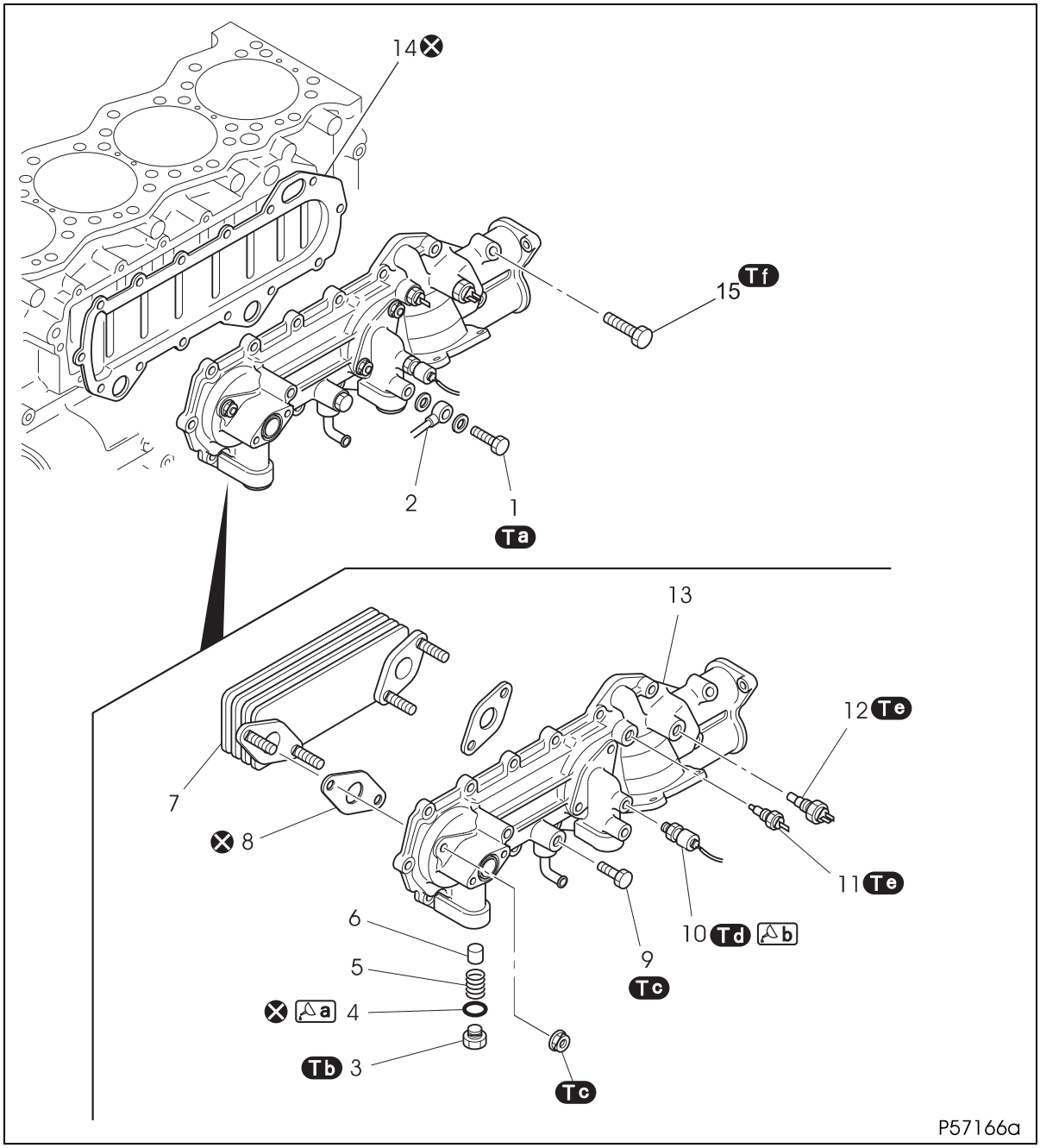
◆Installation procedure◆



■ **Installation: Oil filter**

- Clean the oil filter mounting surface of the oil filter head.
- Apply a thin coat of engine oil on the oil filter gasket.
- Screw in the oil filter by hand until the gasket touches the oil filter head. Then, tighten the filter by turning further by three quarters (3/4) of a turn.
- After installing the oil filter, start the engine and check that there are no oil leaks from the gasket.
- Remove and reinstall the oil filter if it is leaky.
- Stop the engine and check the engine oil level.
- Add engine oil if necessary.

MITSUBISHI 4M50 OIL COOLER



● **Disassembly sequence**

1 Eyebolt
2 Oil pipe
3 Plug
4 O-ring
5 Bypass valve spring
6 Bypass valve
7 Oil cooler element
8 Gasket
9 Water drain valve
10 Engine oil pressure switch
11 Mitsubishi 4M50 Coolant temperature sensor (for water temperature gage)
12 Mitsubishi 4M50 Coolant temperature sensor (for engine control)
13 Oil cooler body
14 Gasket
15 Oil cooler manifold bolt

⊗: Non-reusable parts

● **Assembly sequence**

Follow the disassembly sequence in reverse.

Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
5	Load of bypass valve spring (installed length: $48^{0}_{-0.5}$ {$1.89^{0}_{-0.02}$})	95.3 ± 4.9 N {21 ± 1.1 lbs, 9.7 ± 0.5 kgf}	–	Replace
7	Air leakage from oil cooler element (air pressure: 980 kPa {140 psi, 10 kgf/cm^2} for 15 seconds)	0 cm^3 {0 cu. in.}	–	Replace

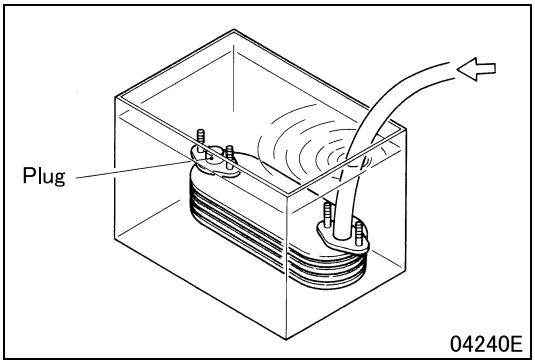
Tightening torque (Unit: N·m {lbf·ft, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Eyebolt (oil pipe mounting)	21.6 {16, 2.2}	–
Tb	Plug	34.3 ± 4.9 {25 ± 3.6, 3.5 ± 0.5}	–
Tc	Nut (oil cooler element mounting)	24.5 ± 4.9 {18 ± 3.6, 2.5 ± 0.5}	–
	Water drain valve		
Td	Engine oil pressure switch	7.8 to 14.7 {5.8 to 11, 0.8 to 1.5}	Sealant With cold engine
Te	Coolant temperature sensor (for water temperature gage)	34.3 {25, 3.5}	–
	Coolant temperature sensor (for engine control)		
Tf	Oil cooler manifold bolt	23.2 {17, 2.4}	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	O-ring	Engine oil	As required
b	Engine oil pressure switch threads	ThreeBond 1215	As required

◆Inspection procedure◆



■ Inspection: Oil cooler element

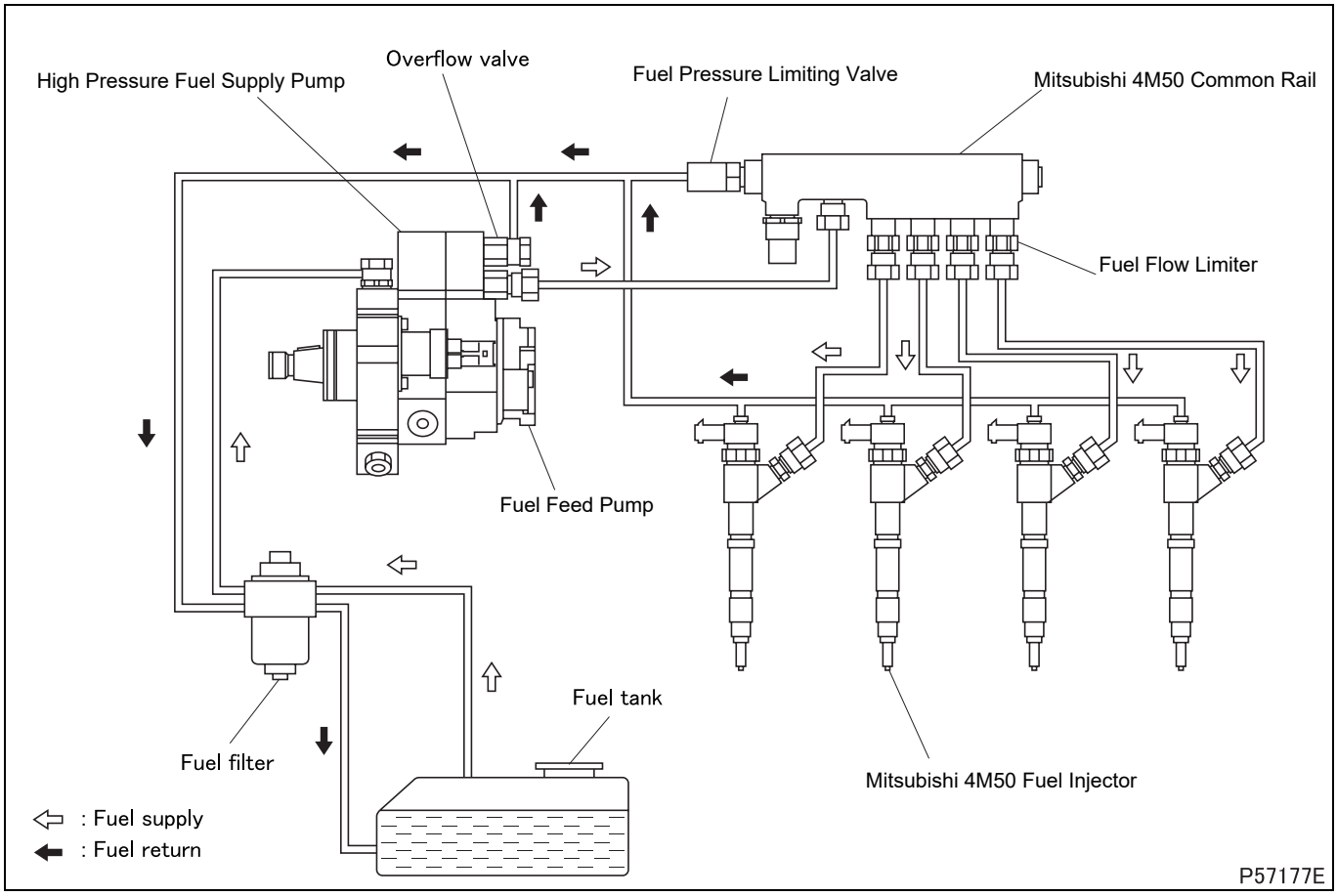
- Plug the outlet of the oil cooler element and connect a hose to the engine oil inlet port. Then, immerse the oil cooler element in a tank of water.
- Apply an air pressure of 980 kPa {140 psi, 10 kgf/cm^2} for 15 seconds through the hose, and check for any air leaks.
- Replace the element if it leaks air.

GROUP 13A INDEX

MITSUBISHI 4M50 FUEL SYSTEM SPECIFICATIONS

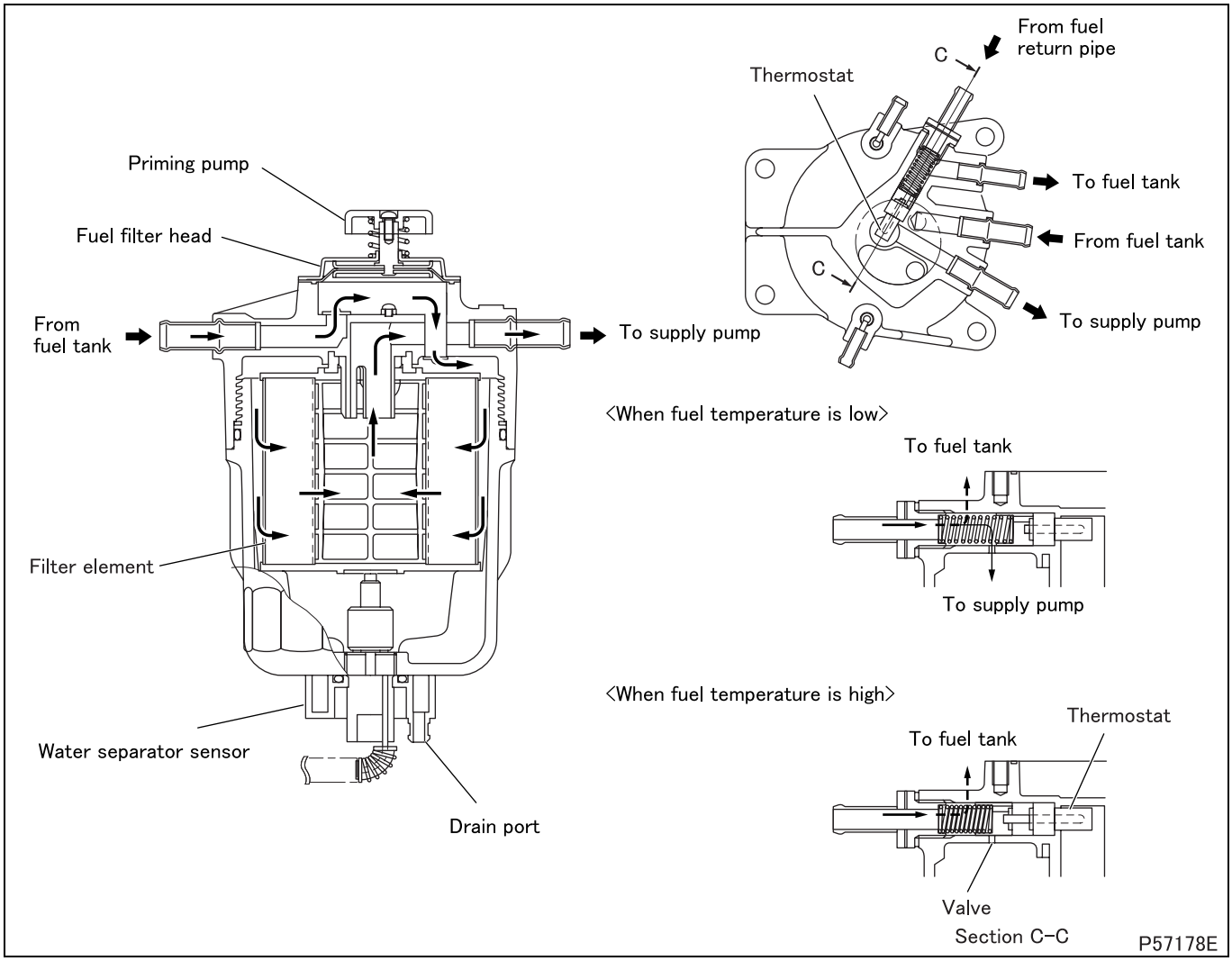
Item			Specifications
Supply pump	Manufacturer		Bosch
	Model		CP3.3
	Control method		Electronic
	Type		Radial, 3-cylinder
	Type		External gear type
	Injection quantity adjustment valve	Model	MPROP
		Rated voltage V	12
	Max. common rail pressure MPa {psi, kgf/cm^2}		160 {23200, 1631}
Common rail	Manufacturer		Bosch
	Common rail volume cm^3 {cu.in., ml}		16.5 {1.01, 16.5}
	Pressure limiting valve opening pressure MPa {psi, kgf/cm^2}		185 to 195 {26830 to 28280, 1886 to 1988}
	Common rail pressure sensor supply voltage V		5
Injectors	Manufacturer		Bosch
	Control method		Electrical
	Max. operating pressure MPa {psi, kgf/cm^2}		160 {23200, 1631}
	Min. operating pressure MPa {psi, kgf/cm^2}		25 {3630, 255}
Common rail electronic control unit	Manufacturer		Bosch
	Rated voltage V		12

1. Mitsubishi 4M50 Fuel System (Flow of Fuel)



- The 4M50 feed pump, which is driven by the camshaft inside the 4M50 supply pump, draws up the fuel from inside the fuel tank and sends it through the fuel filter, where dust and other impurities in the fuel are filtered out.
- The filtered fuel is then sent to the 4M50 supply pump, where it is compressed. The compressed fuel is accumulated in the 4M50 common rail for a time, then sprayed out through the 4M50 injection nozzles into the combustion chamber.
- If fuel leaks from an 4M50 injection pipe at the pipe joint, the flow limiter is activated to close the fuel passage, preventing the fuel from flowing elsewhere.
- The excess fuel from the 4M50 injectors returns to the fuel tank through the 4M50 fuel return hose.
- When the internal fuel pressure of the 4M50 Common Rail exceeds the limit, the pressure limiting valve opens to allow part of the fuel to return to the fuel tank.
- When the internal fuel pressure of the supply pump exceeds the limit, the 4M50 overflow valve opens to allow part of the fuel to return to the fuel tank.

3. Fuel Filter



- The fuel filter removes impurities in the fuel through the filter element and also separates water from fuel.
- The water that has been separated from the fuel collects at the bottom of the fuel filter. A water separator sensor is installed in the fuel filter, which activates the warning lamp on the meter cluster when the water reaches a certain level.
- The water can be drained through the drain port by loosening the water separator sensor.
- A priming pump is provided at the fuel filter head. The priming pump is used for air-bleeding the fuel system.
- When the fuel temperature rises, the thermostat swells and the valve of the fuel filter head is closed. The high-temperature fuel entirely returns to the fuel tank through the fuel return pipe.
- When the fuel temperature lowers, the thermostat does not swell and the valve to the fuel filter remains open. The high-temperature fuel returning through the fuel return pipe is let through the valve to mix into the fuel around the element. The fuel around the element is warmed as a result and wax in it (precipitated when the fuel temperature is low) is dissolved to prevent clogging of the element.

Possible causes \ Symptoms		Engine refuses to start	Engine is difficult to start	Engine knocks	Engine output is unstable	Engine output is insufficient	Engine maximum speed is too high	Engine is idling unstably	Engine stops soon after starting	Engine does not reach maximum speed	Engine does not stop	Accelerator pedal is too stiff	Fuel supply is insufficient	warning lamp illuminates	Reference Gr
Faulty electronic fuel control system														O	Gr13E
Supply pump	Malfunctioning feed pump check valve		O			O			O		O				*
	Defective feed pump		O			O			O		O				*
	Poorly airtight supply pump overflow valve		O			O			O		O				*
	Open or short circuit failure, poor contact of supply pump M/V		O			O			O		O			O	*
	Defective supply pump M/V, defective supply pump		O			O			O		O				*
Injectors	Open or short circuit failure, poor contact of injector M/V		O	O		O					O			O	*
	Defective injector, defective injector M/V, defective nozzle		O	O		O					O				*
Clogged fuel filter		O			O			O	O						
No fuel in fuel tank		O													
Clogged fuel pipe and/or leaky pipe joints		O													
Air or water in fuel system		O			O			O	O						
Use of low quality fuel			O	O		O		O							
Open or short circuit failure, poor contact of common rail pressure sensor, defective sensor		O	O		O	O			O					O	*
Flow limiter activated				O		O								O	*
Fuel leakage from high pressure pipe joint			O	O	O	O					O				*
Engine control	Poorly adjusted accelerator pedal stopper bolt					O				O					
	Defective accelerator pedal position sensor													O	
Cracked fuel pipe and/or hose													O		

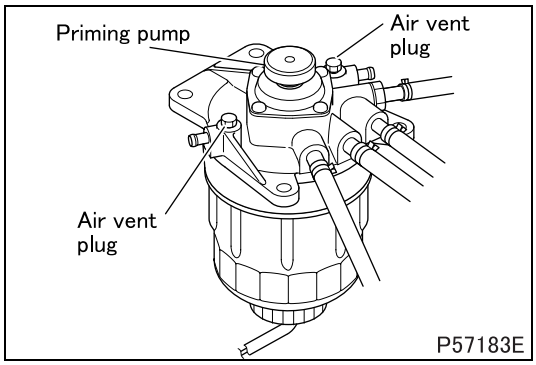
*****: Contact a Bosch service station for repair.

Symptoms / Possible causes	Engine refuses to start	Engine is difficult to start	Engine knocks	Engine output is unstable	Engine output is insufficient	Engine maximum speed is too high	Engine is idling unstably	Engine stops soon after starting	Engine does not reach maximum speed	Engine does not stop	Accelerator pedal is too stiff	Fuel supply is insufficient	warning lamp illuminates	Reference Gr
Inappropriate oil viscosity		O					O							Gr12
Poorly adjusted valve clearance		O					O							Gr11
Defective cylinder head gasket		O					O							
Wear of and/or carbon deposits on valve and valve seat		O					O							
Distorted valve springs		O					O							
Worn or damaged piston rings		O					O							
Worn or damaged piston ring groove		O												
Worn piston and/or cylinder liner		O					O							
Poorly functioning cooling system		O					O							Gr14
Defective starter switch	O	O												Gr54
Defective glow plug		O												
Open-circuited, short-circuited or poorly connected engine speed sensor and/or cylinder sensor	O	O											O	Gr13E
Open-circuited, short-circuited or poorly connected boost pressure sensor			O	O	O				O				O	
Open-circuited, short-circuited or poorly connected coolant temperature sensor	O	O											O	
Poorly connected injection rate adjusting resistor			O		O								O	
Poorly connected idling adjustment control			O				O						O	
Blown fuse	O	O						O					O	Gr54

2. Air-bleeding of Fuel System

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

Mark	Parts to be tightened	Tightening torque	Remarks
–	Air vent plug	10 ± 2 {7.4 ± 1.5, 1 ± 0.2}	–



- Loosen one of the air vent plugs on the fuel filter.
- Move the priming pump up and down to pump out the fuel.
- Continue operating the priming pump until the fuel flowing out of the air vent plug is free of air bubbles.
- When no more air bubbles are evident, tighten the air vent plug to the specified torque.
- Feed the fuel some more by operating the priming pump further until a strong resistance is felt.

NOTE

- **When the fuel temperature is low, you may not feel the resistance. Be sure to operate the priming pump several times even in such a case.**

- Wipe up any spilled fuel and start the engine.
- Check that there is no fuel leakage.

WARNING ⚠

- **Fuel is highly flammable. Keep it away from flames and sources of heat.**
- **To avoid risk of fire, wipe up any spilled fuel.**

3. Fuel Filter Replacement

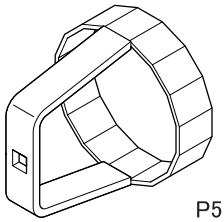
Tightening torque (Unit: N·m {lbf·ft, kgf·m})

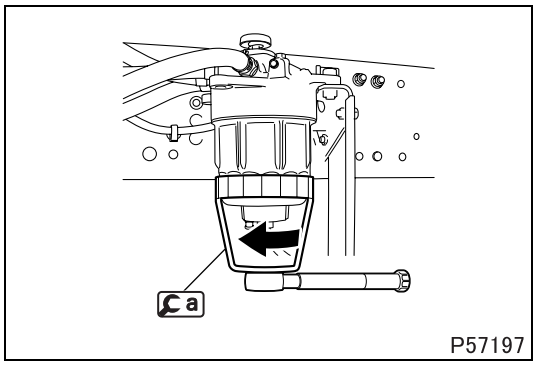
Mark	Parts to be tightened	Tightening torque	Remarks
–	Water separator sensor	5 ± 1 {3.7 ± 0.7, 0.5 ± 0.1}	–
–	Case	30 ± 2 {22 ± 1.5, 3.1 ± 0.2}	–

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
–	Fuel filter gasket	Engine oil	As required

Special tools

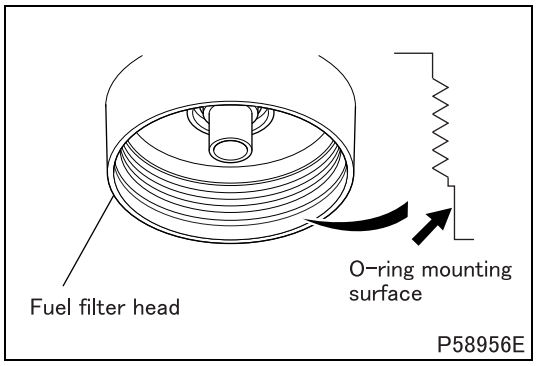
Mark	Tool name and shape	Part No.	Application
ⓐ	Filter wrench  P57179	MH063203	Removal and installation of case



P57197

[Removal]

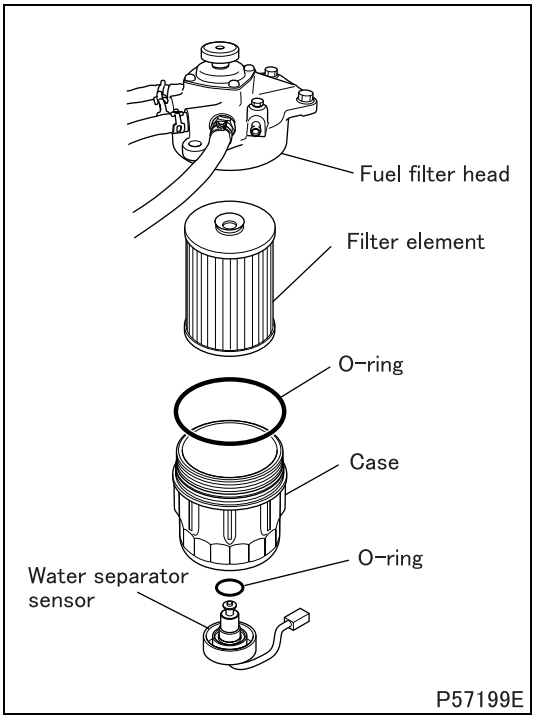
- Loosen the water separator sensor and drain fuel from the case.
- Remove the case using ⓐ.



P58956E

[Installation]

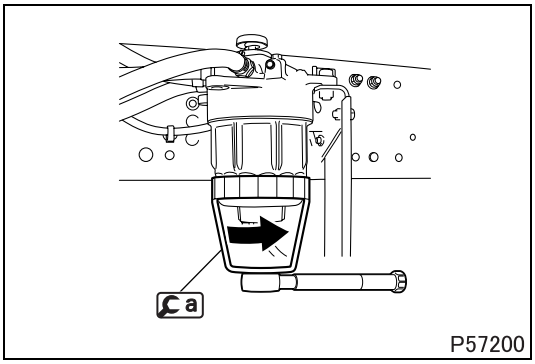
- Clean the O-ring mounting surface of the fuel filter head.



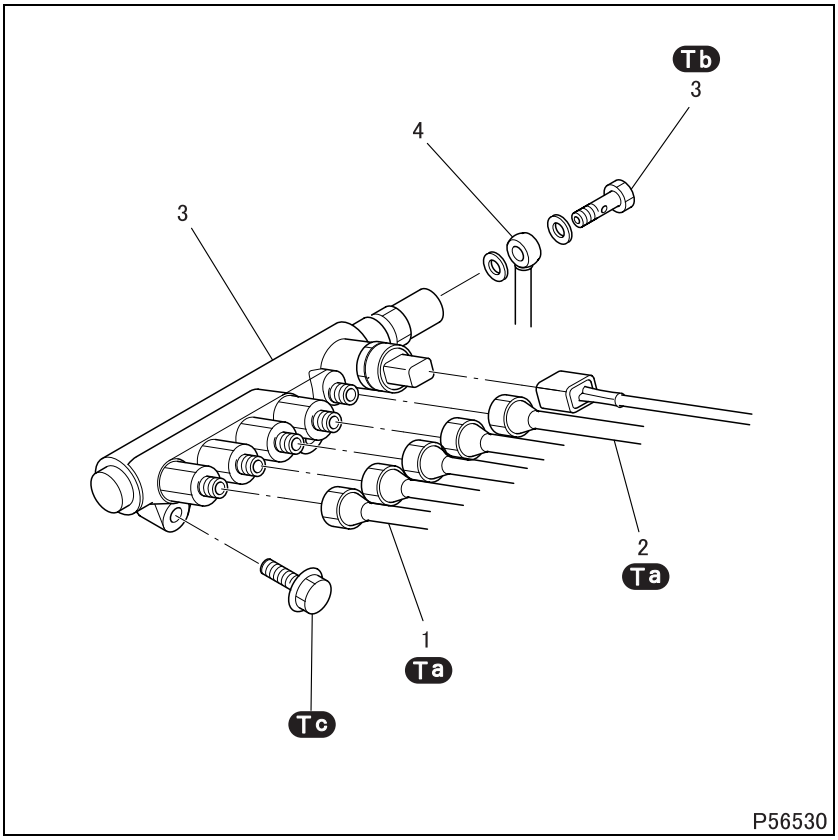
- Replace the filter element and O-ring with new one.
- Apply a thin coat of engine oil to the O-ring, and install it on the case and water separator sensor.

CAUTION ⚠

- **Be sure to use only genuine Sterling filter elements. The use of non-genuine fuel filters can cause engine failure.**
- **Prevent fine dust particles from entering the fuel filter and fuel pipe, as they can cause problems such as faulty fuel injection.**



- Use a to tighten the case to the specified torque.
- Install the water separator sensor, and then air-bleed the fuel system.
- Start the engine, and check that there is no fuel leakage.
- Reinstall the fuel filter if there is any leakage.



● **Disassembly sequence**

1 Mitsubishi 4M50 Injection pipe
2 Mitsubishi 4M50 Fuel pipe
3 Mitsubishi 4M50 Fuel Eyebolt
4 Mitsubishi 4M50 Fuel return pipe
5 Mitsubishi 4M50 Common rail

● **Assembly sequence**

Follow the disassembly sequence in reverse.

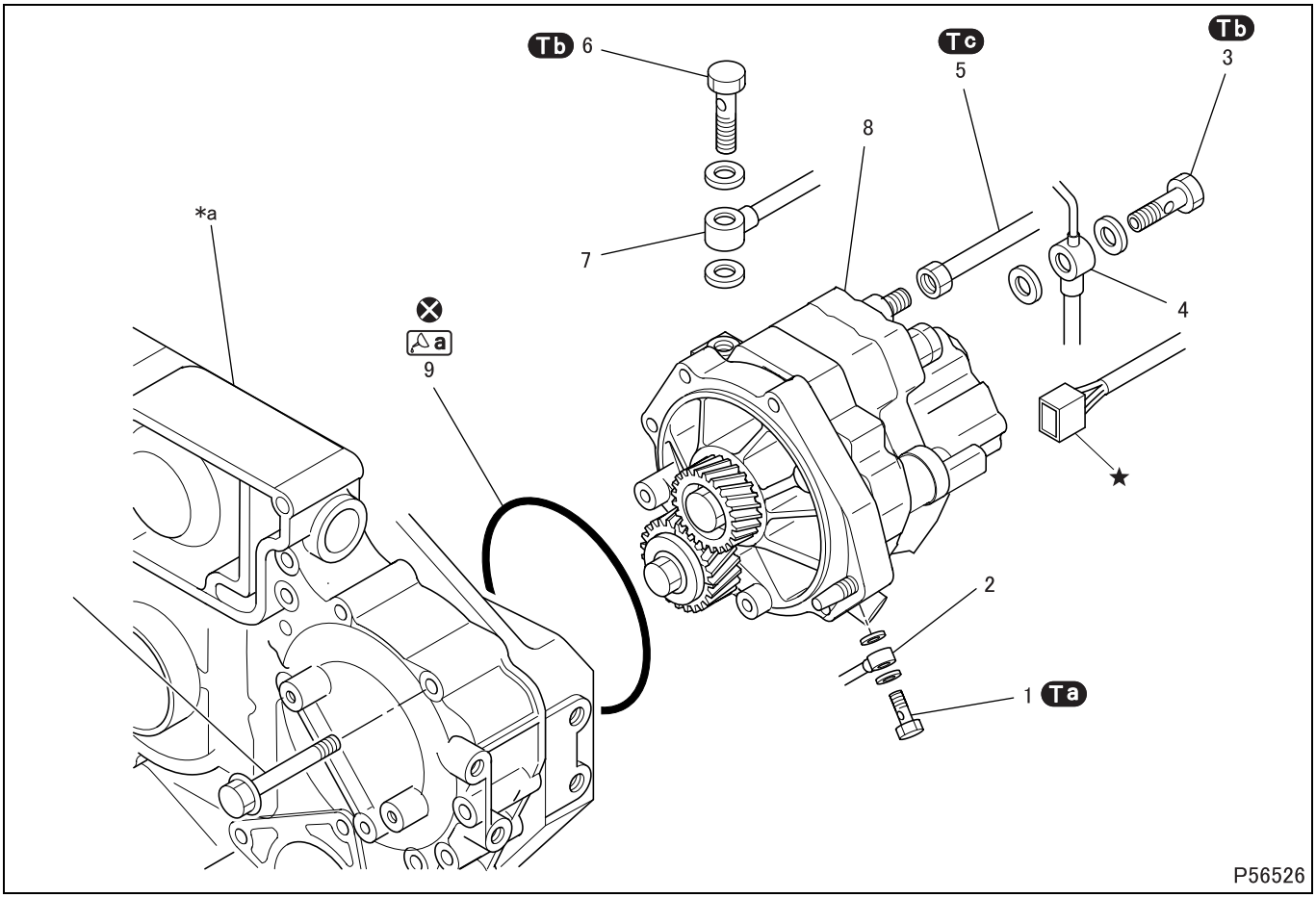
CAUTION ⚠

- **Contact each seating surface fully and evenly, tighten the bolt or nut temporarily, and finally tighten it to the specified torque.**
- **For servicing the common rail, contact a BOSCH service station.**
- **If dust enters the common rail, the engine performance will be greatly affected. To prevent it, be sure to cover up openings left after pipes and other parts are removed. Also, wash eyebolts, gaskets, etc. in light oil to clear of dirt.**
- **Before installing, make sure that the seat surfaces of fuel pipes and injection pipes are free of scratches and irregularities.**

Mitsubishi 4M50 Tightening torque (Unit: N·m {lbf·ft, kgf·m})

Location	Parts to be tightened	Tightening torque	Remarks
Ta	Mitsubishi 4M50 Injection pipe (union nut tightening)	30.4 to 35 {22 to 26, 3.1 to 3.6}	–
	Mitsubishi 4M50 Fuel pipe (union nut tightening)		
Tb	Mitsubishi 4M50 Eyebolt (fuel return pipe mounting)	25 to 29 {18 to 21, 2.6 to 3.0}	–
Tc	Mitsubishi 4M50 Bolt (common rail mounting)	23.2 {17, 2.4}	–

MITSUBISHI 4M50 HIGH PRESSURE FUEL SUPPLY PUMP



● **Removal sequence**

1 Eyebolt
2 Oil pipe
3 Eyebolt
4 Fuel return pipe
5 Fuel pipe
6 Eyebolt (with gauze filter)
7 Fuel suction pipe
8 Supply pump
9 O-ring

***a**: Front case
⊗: Non-reusable parts

CAUTION ⚠

- **Contact each seating surface fully and evenly, tighten the bolt or nut temporarily, and finally tighten it to the specified torque.**
- **Have the injection pump assembly serviced by a BOSCH service station.**
- **Dirt and dust in the injection pump assembly can seriously detract from engine performance. To prevent this from happening, fully cover all open joints after removing any pipes or hoses.**

● **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.**

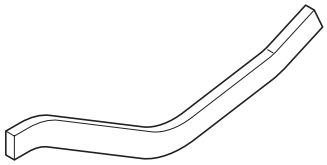
Mitsubishi 4M50 Tightening torque (Unit: N·m {lbf·ft, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Eyebolt (oil pipe mounting)	23.5 {17, 2.4}	–
Tb	Eyebolt (fuel return pipe mounting)	38.2 {28, 3.9}	–
	Eyebolt (fuel pipe mounting)		
Tc	Fuel pipe (union nut mounting)	20.5 {15, 2.1}	–

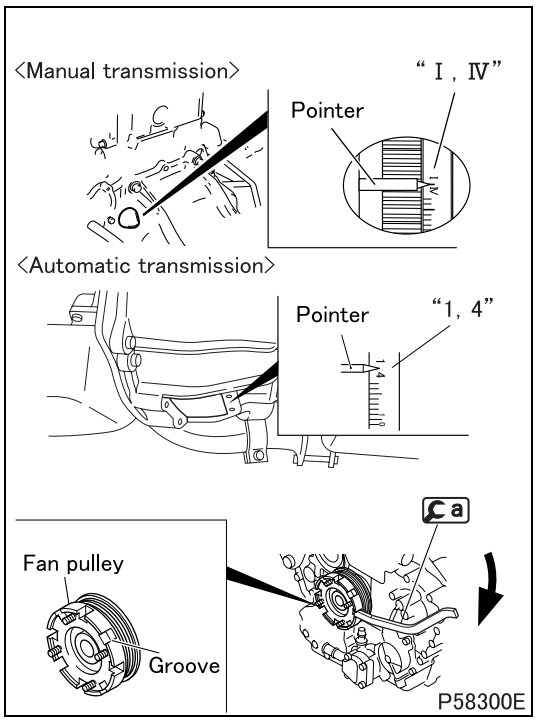
Lubricant and/or sealant

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

Special tools

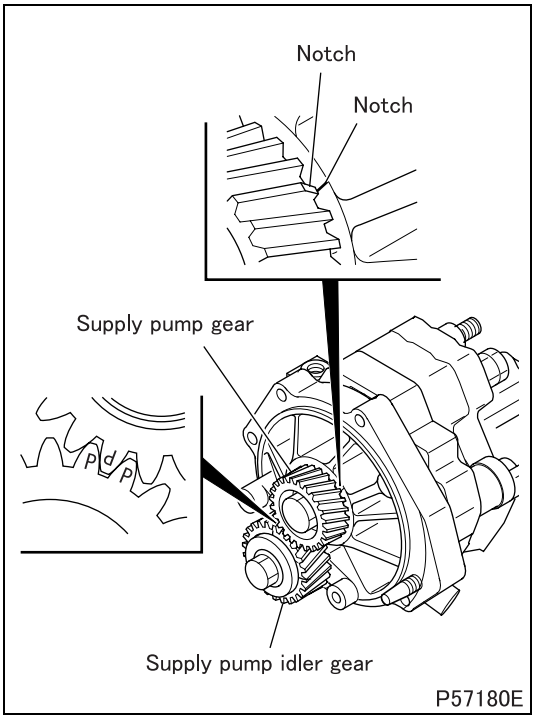
Mark	Tool name and shape	Part No.	Application
a	Cranking handle  P58299	MH063704	Rotating the fan pulley

◆Installation procedure◆



■ Installation: Mitsubishi 4M50 Fuel Supply pump

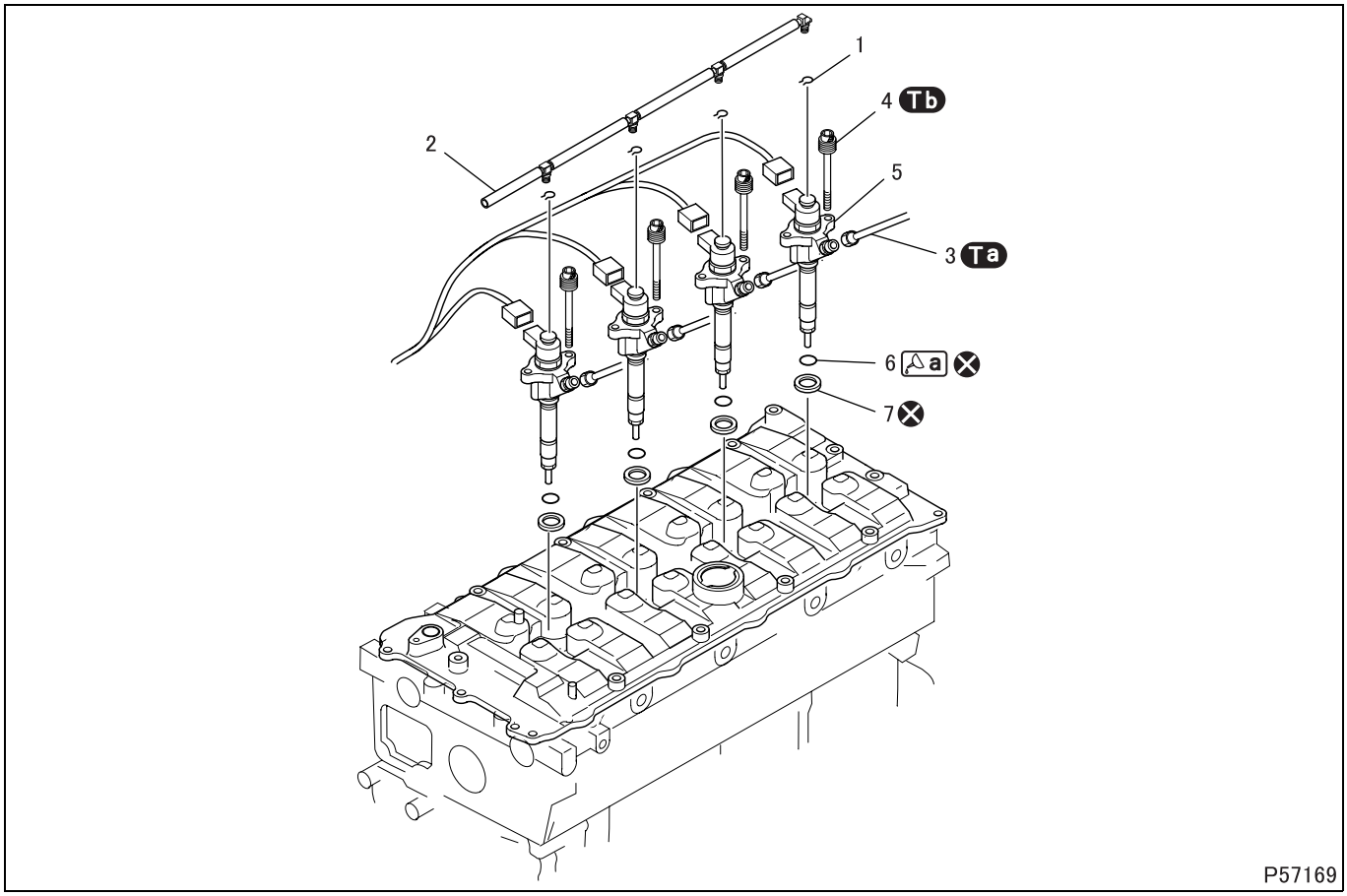
- Remove the rocker cover.
- Bring the No. 1 cylinder piston to the top dead center (TDC) on the compression stroke by the following procedure:
- Hook a on a groove in the fan pulley.
- Turn the fan pulley in the illustrated direction so that the pointer is aligned with the "I – IV" or "1 – 4" mark on the inscribed scale on the flywheel.
- This will place either the No. 1 or No. 4 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. 4 cylinder pistons.



- Align the match mark “P” on the supply pump idler gear with that of the supply pump gear.
- Align the notch on the flange plate with the notch on the supply pump gear.
- Check that the notch on the flange plate and the notch on the supply pump gear are correctly aligned, and then push the supply pump.

M E M O

MITSUBISHI 4M50 FUEL INJECTORS



● **Disassembly sequence**

1 Snap ring
2 Fuel return hose
3 Injection pipe
4 Bolt (with hexagonal hole)
5 Injector
6 O-ring
7 Nozzle gasket

⊗: Non-reusable parts

● **Assembly sequence**

Follow the disassembly sequence in reverse.

WARNING ⚠

- **Before removing the injectors, always turn the starter switch to the LOCK position.**
- **Fuel is highly flammable. Wipe up spilled fuel to avoid the risk of fire.**

CAUTION ⚠

- **Contact each seating surface fully and evenly, tighten the bolt or nut temporarily, and finally tighten it to the specified torque.**
- **When removing the injectors, take care not to strike them with the tool, etc.**
- **To prevent an injection failure or any other trouble, make sure that no dust enters the injectors and injection pipes.**

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

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Mitsubishi 4M50 Injection pipe (union nut mounting)	30.4 to 35 {22 to 26, 3.1 to 3.6}	–
Tb	Mitsubishi 4M50 Bolt (injector mounting)	5.2 to 7.2 {3.8 to 5.3, 0.53 to 0.73}	–

Lubricant and/or sealant

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

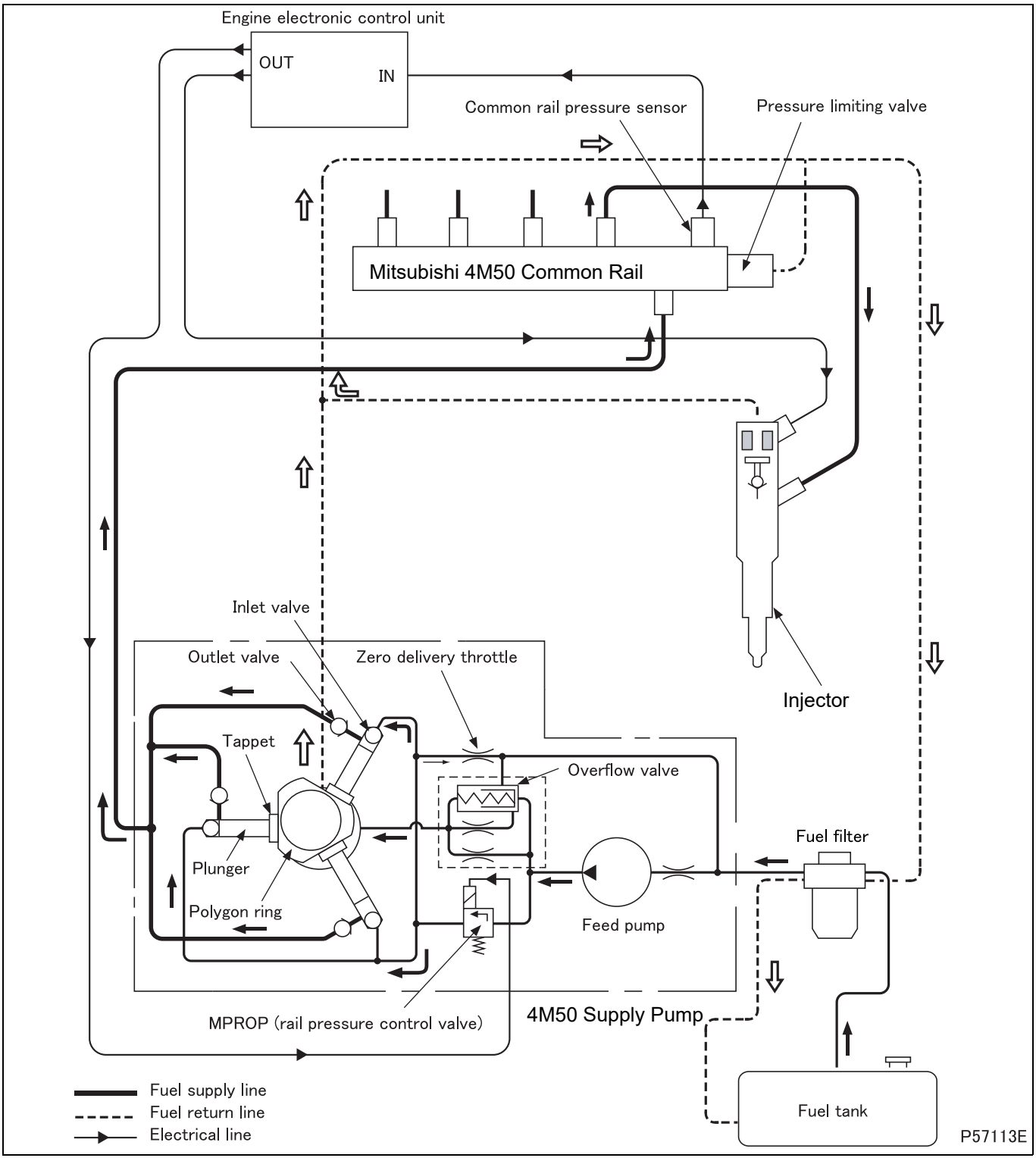
GROUP 13E INDEX

MITSUBISHI 4M50 SPECIFICATIONS

Item			Specifications
Mitsubishi 4M50 Supply pump	Manufacturer		Bosch
	Model		CP3.3
	Control method		Electronic
	Type		Radial, 3-cylinder
	Type		External gear type
	Rail pressure control valve	Model	MPROP
		Rated voltage V	12
	Max. common rail pressure MPa {psi, kgf/cm^2}		160 {23200, 1631}
Mitsubishi 4M50 Common rail	Manufacturer		Bosch
	Common rail volume cm^3 {cu. in., ml}		16.5 {1.01, 16.5}
	Pressure limiting valve opening pressure MPa {psi, kgf/cm^2}		185 to 195 {26830 to 28280, 1886 to 1988}
	Common rail pressure sensor supply voltage V		5
Mitsubishi 4M50 Injectors	Manufacturer		Bosch
	Control method		Electrical
	Max. operating pressure MPa {psi, kgf/cm^2}		160 {23200, 1631}
	Min. operating pressure MPa {psi, kgf/cm^2}		25 {3630, 255}
Mitsubishi 4M50 Common rail electronic control unit	Manufacturer		Bosch
	Rated voltage V		12

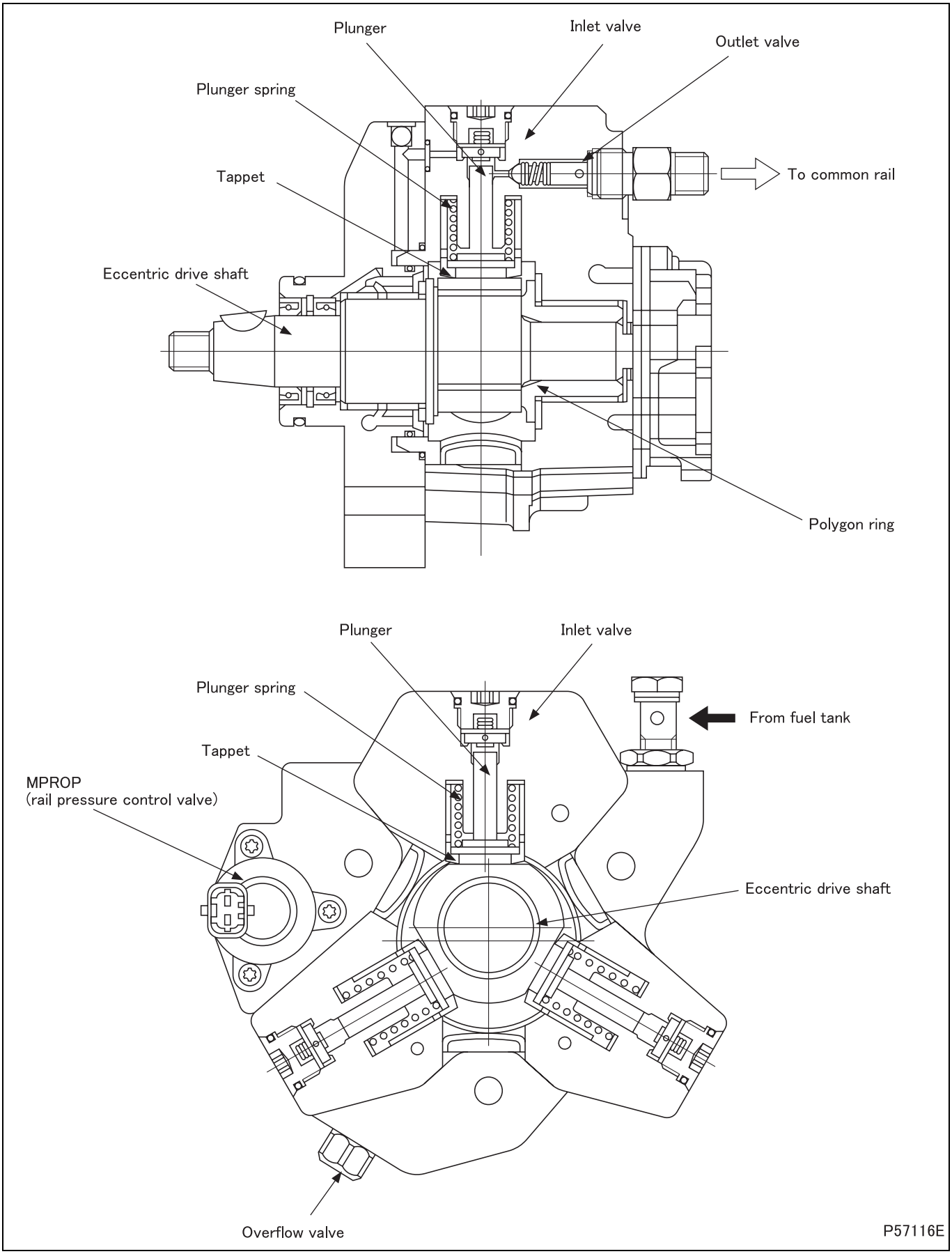
1. Overview

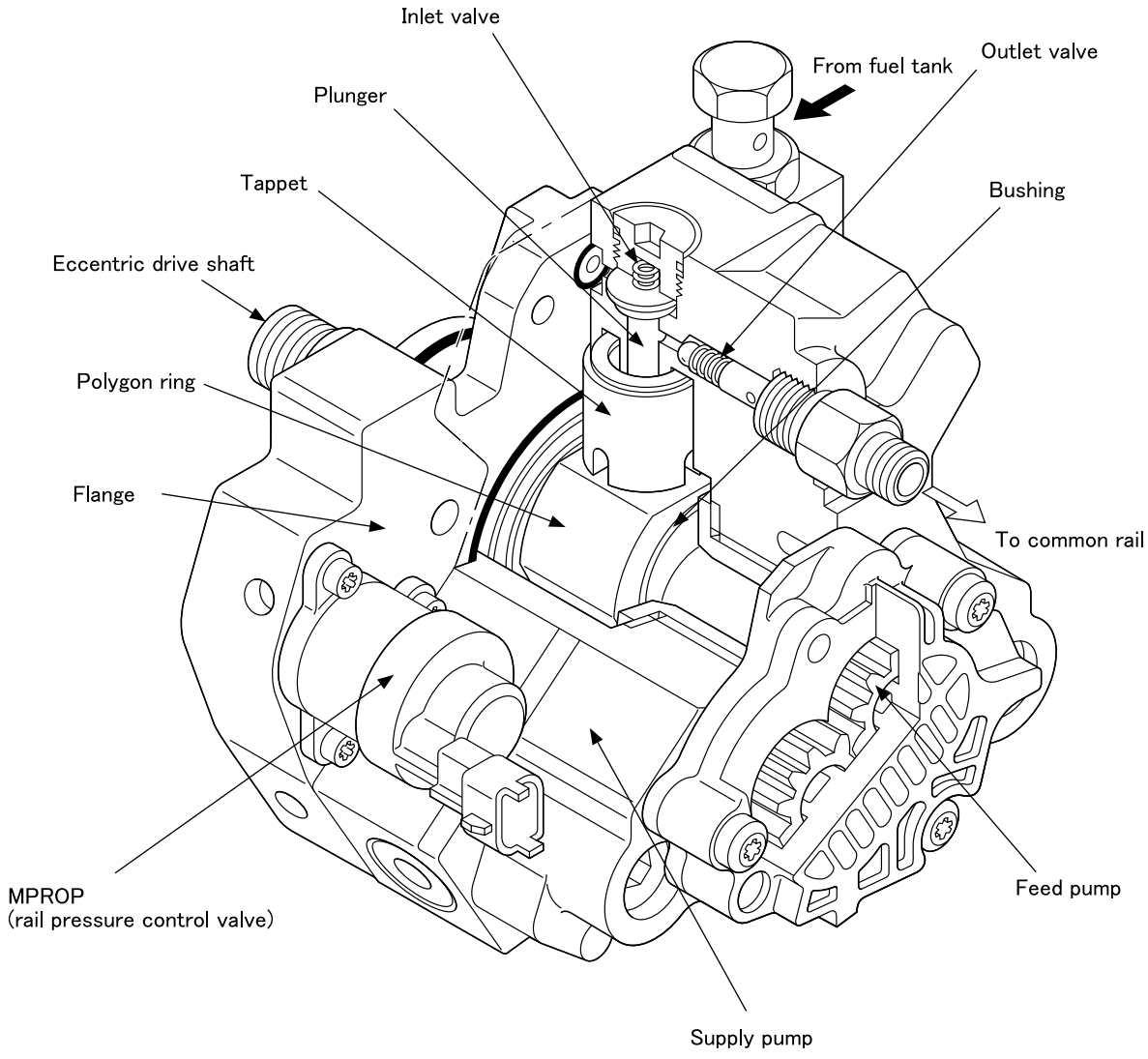
- In the Mitsubishi 4M50 common rail system, an electronic control unit monitors various aspects of the engine (engine speed, throt-tle opening, coolant temperature, etc.) using information from sensors. In accordance with these data, the elec-tronic control unit effects control over the fuel injection 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.



- 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 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.

1.1 Mitsubishi 4M50 Fuel Supply pump

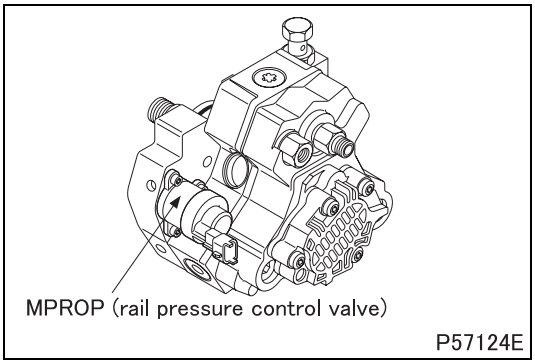




CAUTION ⚠

- **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.**

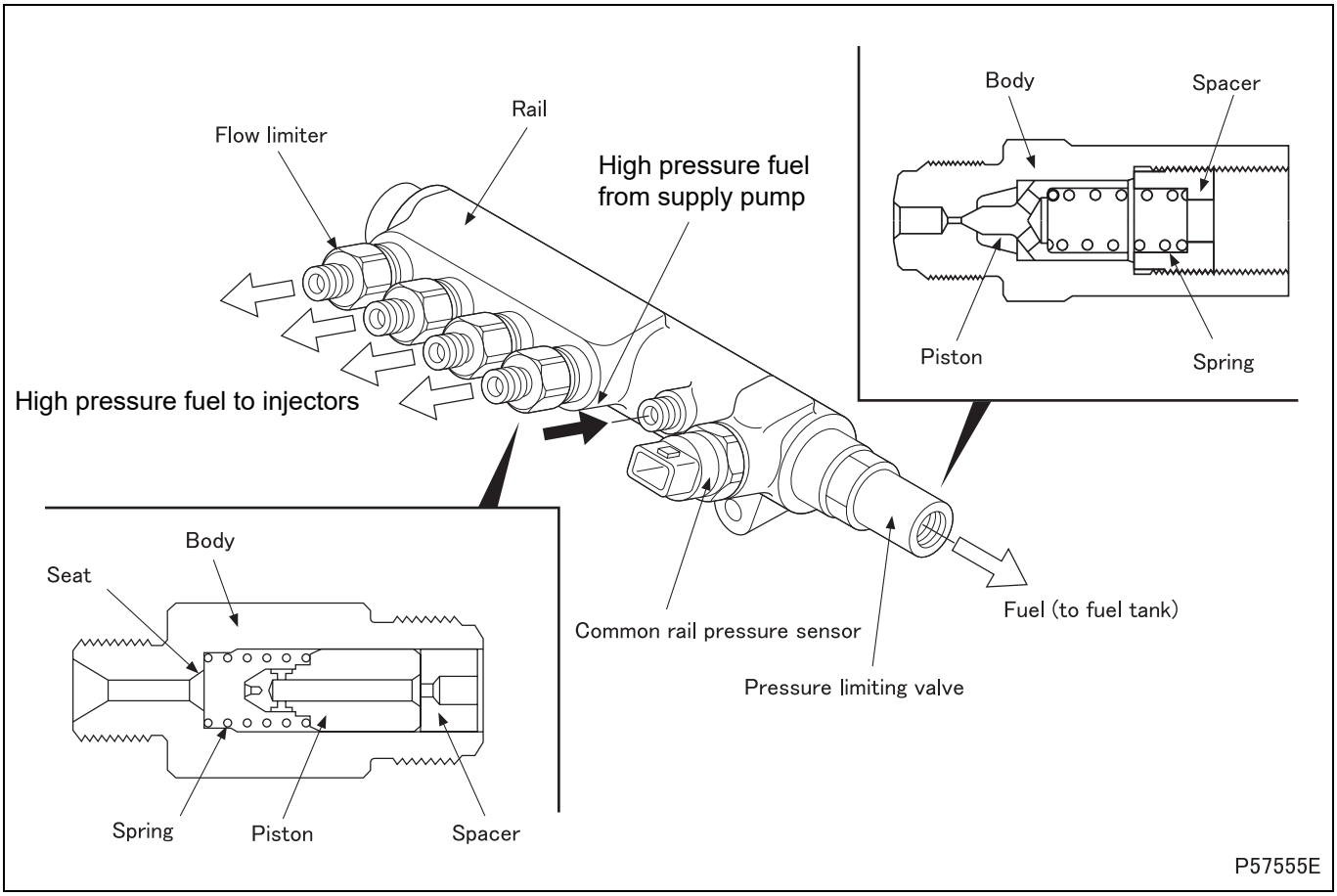
- The Mitsubishi 4M50 supply pump pressurizes fuel and supplies it in a highly pressurized state.
- Fuel drawn from the fuel tank by the feed pump is not supplied directly to the plungers. It is supplied first to the MPROP (rail pressure control valve), which controls the amount of fuel reaching the plungers.
- If the fuel pressure exceeds a certain level, the overflow valve returns fuel to the inlet side of the feed pump. This operation keeps the fuel pressure constant.
- Rotation of the eccentric drive shaft causes (via the tappets) up-down movement of the plungers. Fuel in the plunger chambers is thus highly pressurized.



(1) MITSUBISHI 4M50 MPROP (rail pressure control valve)

- 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 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.

1.2 Mitsubishi 4M50 Common rail

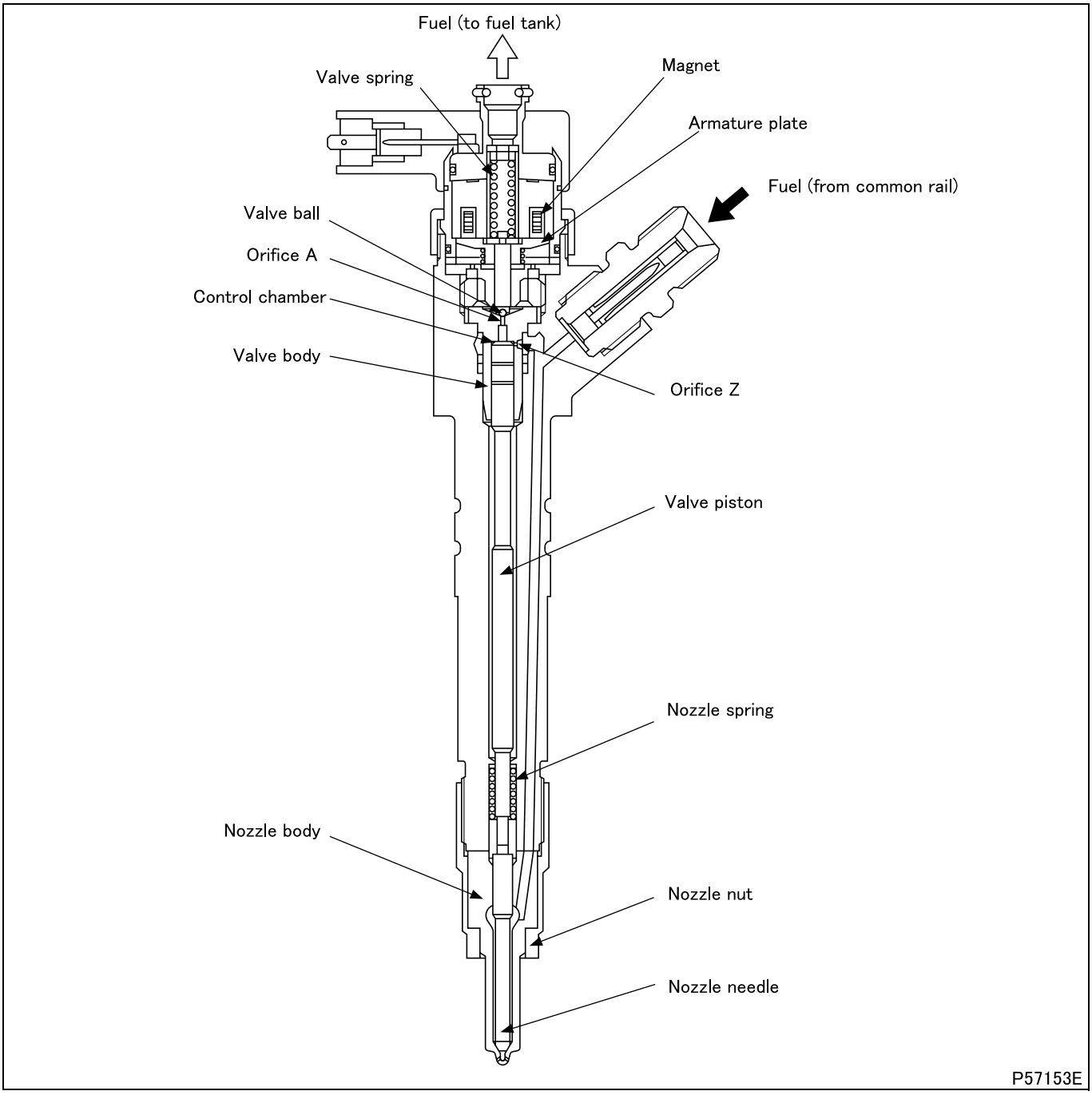


- The Mitsubishi 4M50 common rail distributes to the injectors high-pressure fuel that has been fed from the supply pump.
- Each flow limiter prevents an abnormal outflow of fuel. It does so by blocking the fuel passage in the event of fuel leakage from the injection pipe or excessive injection of fuel from the injector.
- The common rail pressure sensor is used in feedback control. It senses the fuel pressure 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.

Mitsubishi 4M50 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.

1.3 Mitsubishi 4M50 Injector



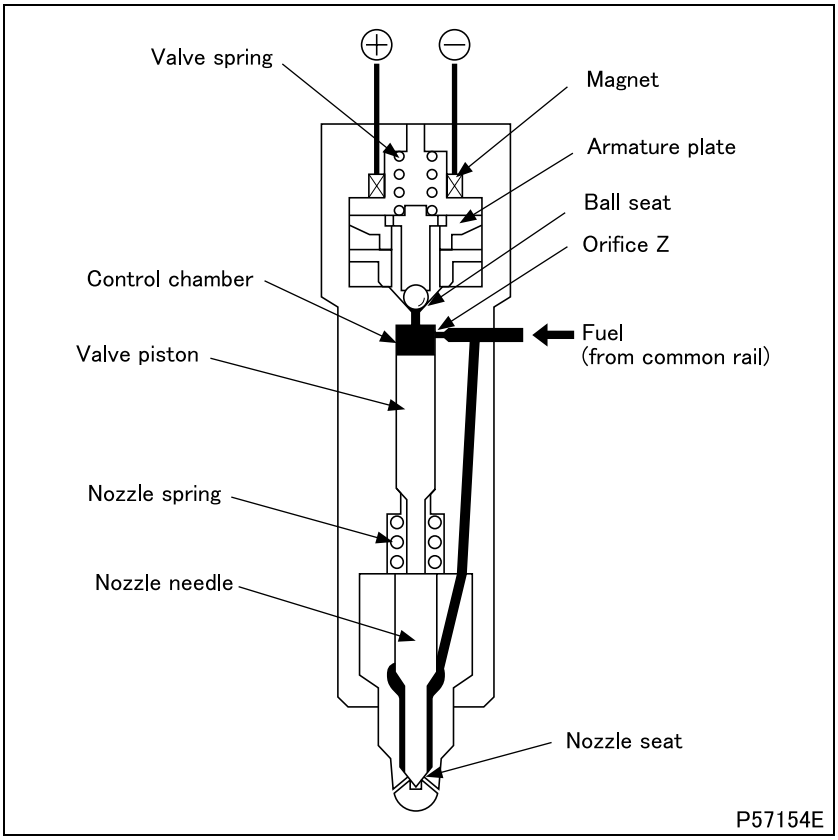
- In accordance with electrical signals from the engine electronic control unit, each Mitsubishi 4M50 injector supplies high-pressure fuel from the common rail to the relevant combustion chamber of the engine at the optimal timing and in the opti-mal quantity.
- The valve body and valve piston together form the control chamber.
- The functional units of each injector can be broadly defined as follows:

(1) Control 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.

(2) Injection section

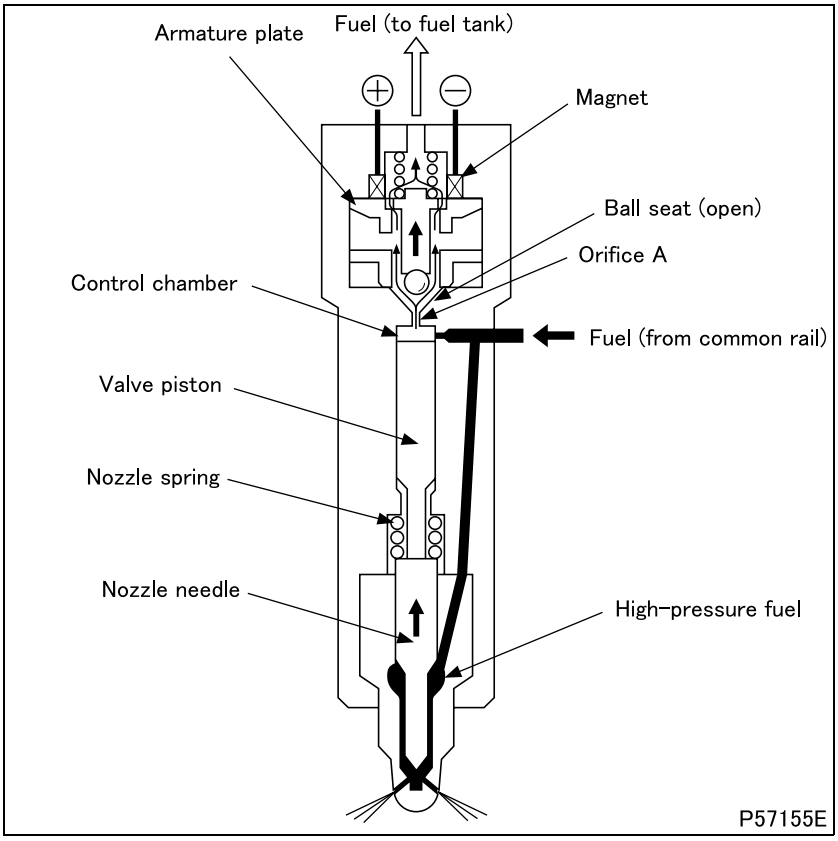
- The injection section consists of the nozzle body, nozzle needle, nozzle spring, and nozzle nut.



(3) Operation

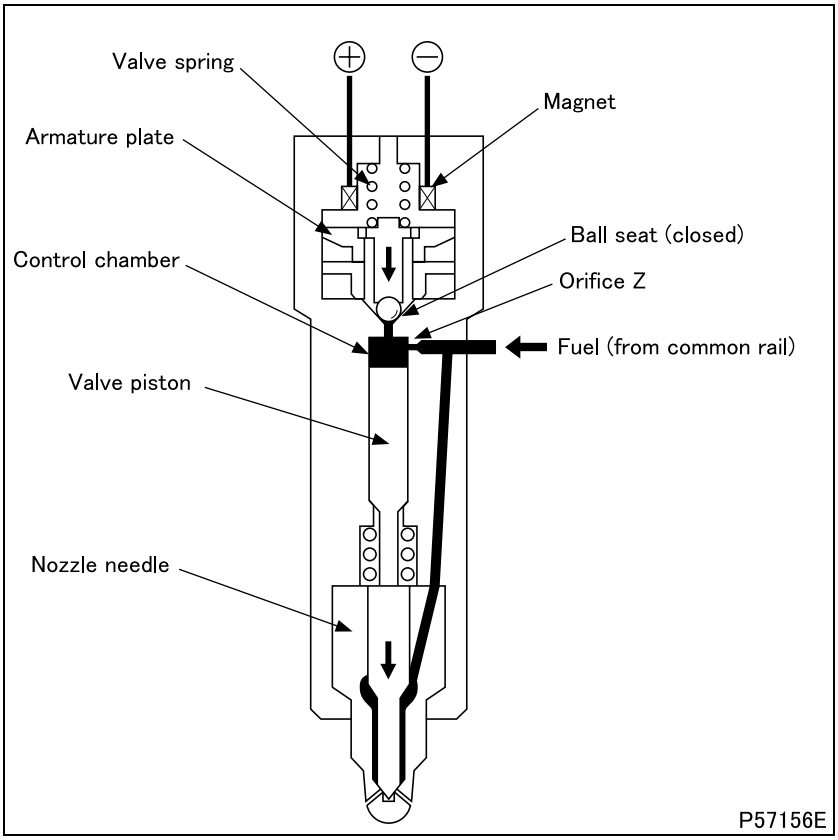
(3.1) Injection not taking place

- With the magnet not energized, the armature plate is pushed up 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.



(3.2) 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 ball seat and orifice A 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 rate reaches its maximum level.

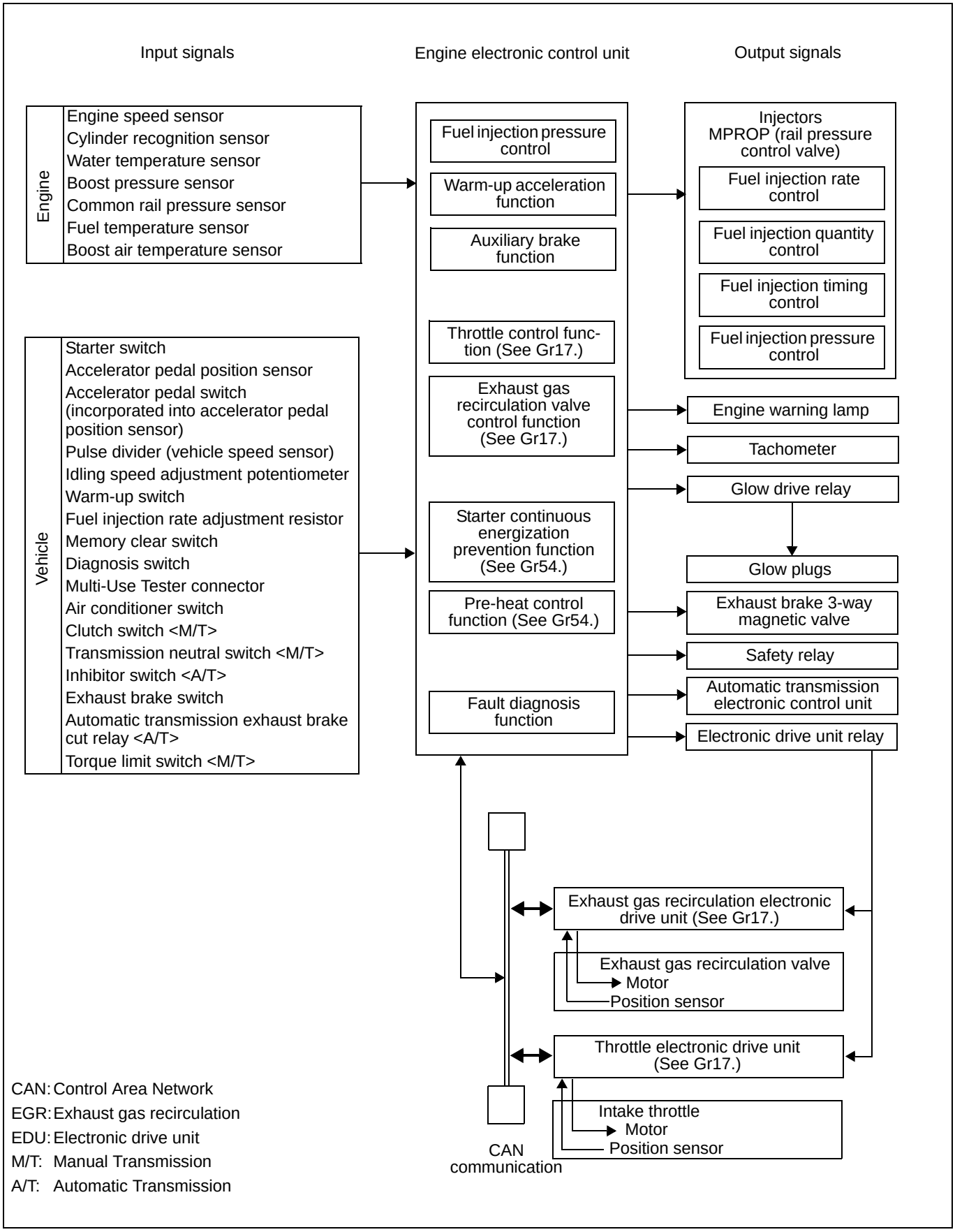


(3.3) End of injection

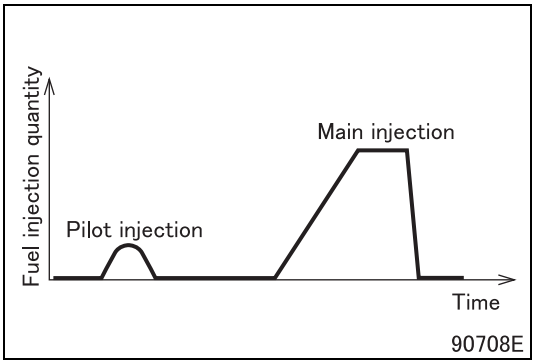
- When energization of the magnet is stopped, the armature plate is pushed downward by the valve spring such that the ball seat closes. At this time, fuel flows into the control chamber via orifice Z, pushing down the valve piston and nozzle needle such that injection finishes.

2. Electronic Control System

2.1 System block diagram



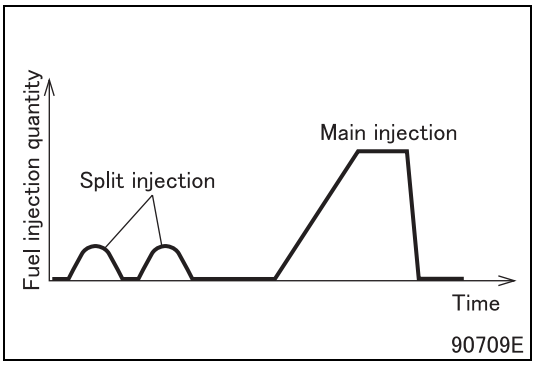
Part	Main function/operation
Engine speed sensor	Sensing of engine speed
Cylinder recognition sensor	Cylinder recognition
Water temperature sensor	Sensing of coolant temperature
Boost pressure sensor	Sensing of boost pressure
Common rail pressure sensor	Sensing of common rail pressure
Fuel temperature sensor	Sensing of fuel temperature
Boost air temperature sensor	Sensing of boost 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 (incorporated into accelerator pedal position sensor)	Sensing of released/pressed condition of accelerator pedal (ON with pedal released)
Pulse divider (vehicle speed sensor)	Sensing of vehicle speed
Idling speed adjustment potentiometer	Acceleration of warm-up
Warm-up switch	
Fuel injection rate adjustment resistor	Correction of fuel injection rate
Diagnosis switch	Output of diagnosis codes
Memory clear switch	Deletion of diagnosis codes; output of past diagnosis codes
Multi-Use Tester connector	Communication between Multi-Use Tester and common rail system
Air conditioner switch	ON when air conditioner is operating
Clutch switch <Manual transmission>	Sensing of released/pressed condition of clutch pedal (OFF with pedal released)
Transmission neutral switch <Manual transmission>	Detection of transmission neutral condition (OFF with transmission in neutral)
Inhibitor switch <Automatic transmission>	Detection of transmission neutral condition (high idle inhibited with transmission in any range except ‘N’)
Exhaust brake switch <Manual transmission>	Exhaust brake ON/OFF control
Automatic transmission exhaust brake cut relay <Automatic transmission>	
Torque limit switch <Manual transmission>	Detection of 1st and reverse positions
Injectors	Control of fuel injection rate, fuel injection quantity, and fuel injection timing
MPROP (rail pressure control valve)	Control of fuel injection pressure
Engine warning lamp	Indication of system abnormalities
Tachometer	Indication of engine speed (in meter cluster)
Glow drive relay	ON/OFF control of glow plugs
Exhaust brake 3-way magnetic valve	ON/OFF control of exhaust brake valve
Safety relay	Control of starter continuous energization prevention function
Automatic transmission electronic control unit	Output of signals corresponding to engine speed and extent of accelerator pedal depression
Electronic drive unit relay	Supply of power to exhaust gas recirculation electronic drive unit and throttle electronic drive unit
CAN communication (exhaust gas recirculation electronic drive unit and throttle electronic drive unit)	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. Each electronic drive unit issues signals to the engine electronic control unit via the CAN bus to enable it to effect engine control appropriate for each type of system control.



2.2 Fuel injection rate control

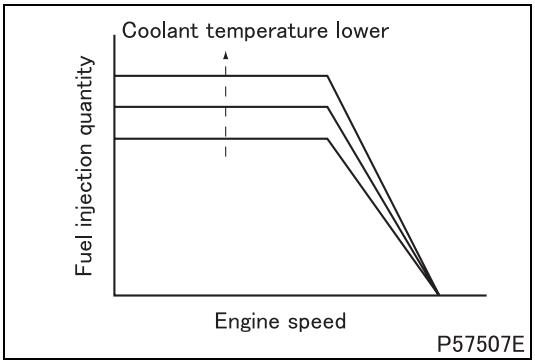
(1) Pilot injection

- Pilot injection entails the injection of an extremely small amount of fuel ahead of the main injection.
- Pilot injection suppresses heat generation early in the injection cycle and thus suppresses NOx generation and noise at the start of combustion.



(2) Split injection control

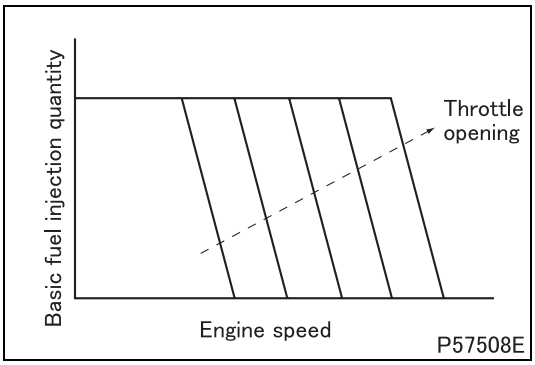
- Split injection entails the injection of an extremely small amount of fuel two or more times ahead of the main injection.
- Split injection increases the fuel's combustibility and thus enhances the engine's cold startability.



2.3 Fuel injection quantity control

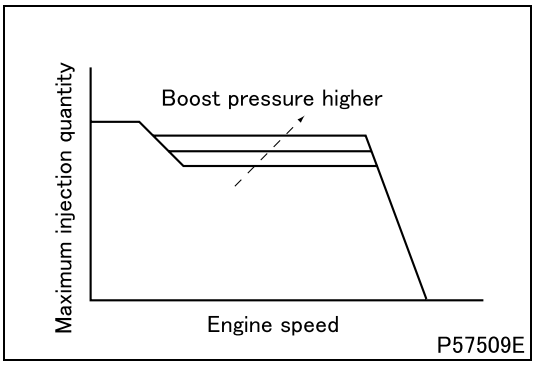
(1) Fuel injection quantity during engine startup

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



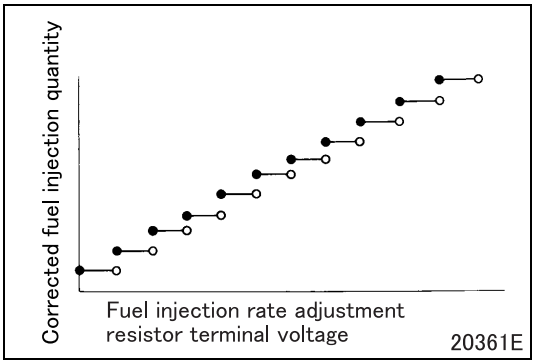
(2) Basic fuel injection quantity

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



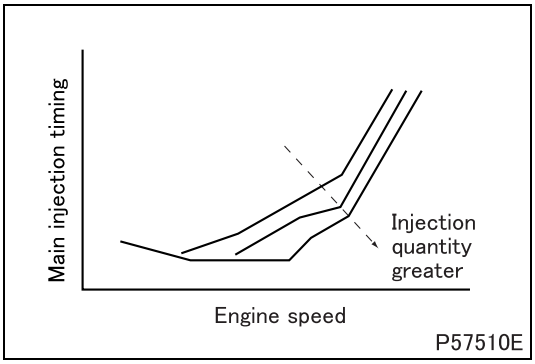
(3) Maximum injection quantity

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



(4) Fuel injection rate adjustment resistor correction amount

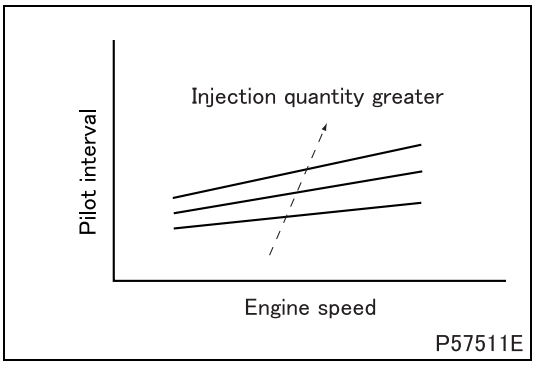
- To limit inconsistency in the injection quantity, the injection quantity is corrected by the fuel injection rate adjustment resistor.



2.4 Fuel injection timing control

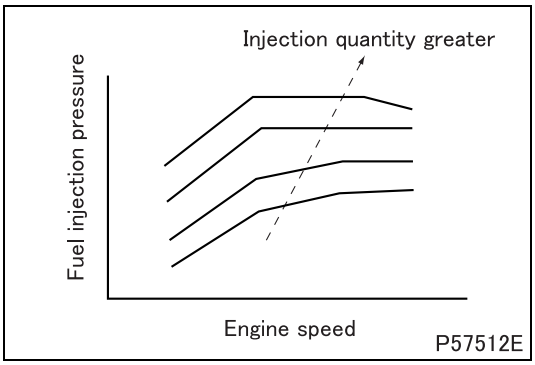
(1) Main injection timing

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



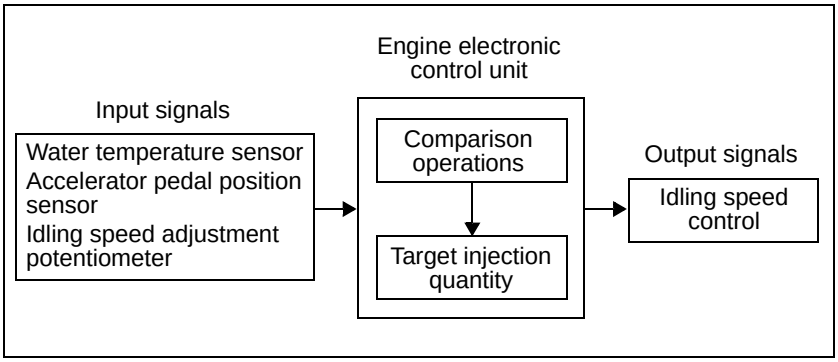
(2) Pilot injection timing (pilot interval)

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



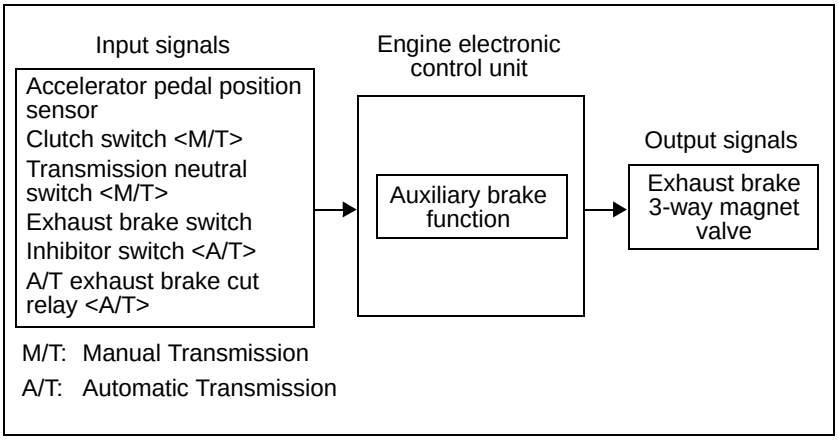
2.5 Fuel injection pressure control

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



2.6 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.



2.7 Auxiliary brake function

- The auxiliary brake function activates or deactivates the exhaust brake 3-way magnet valve according to the vehicle condition to control the exhaust brake.

2.8 Fault diagnosis function

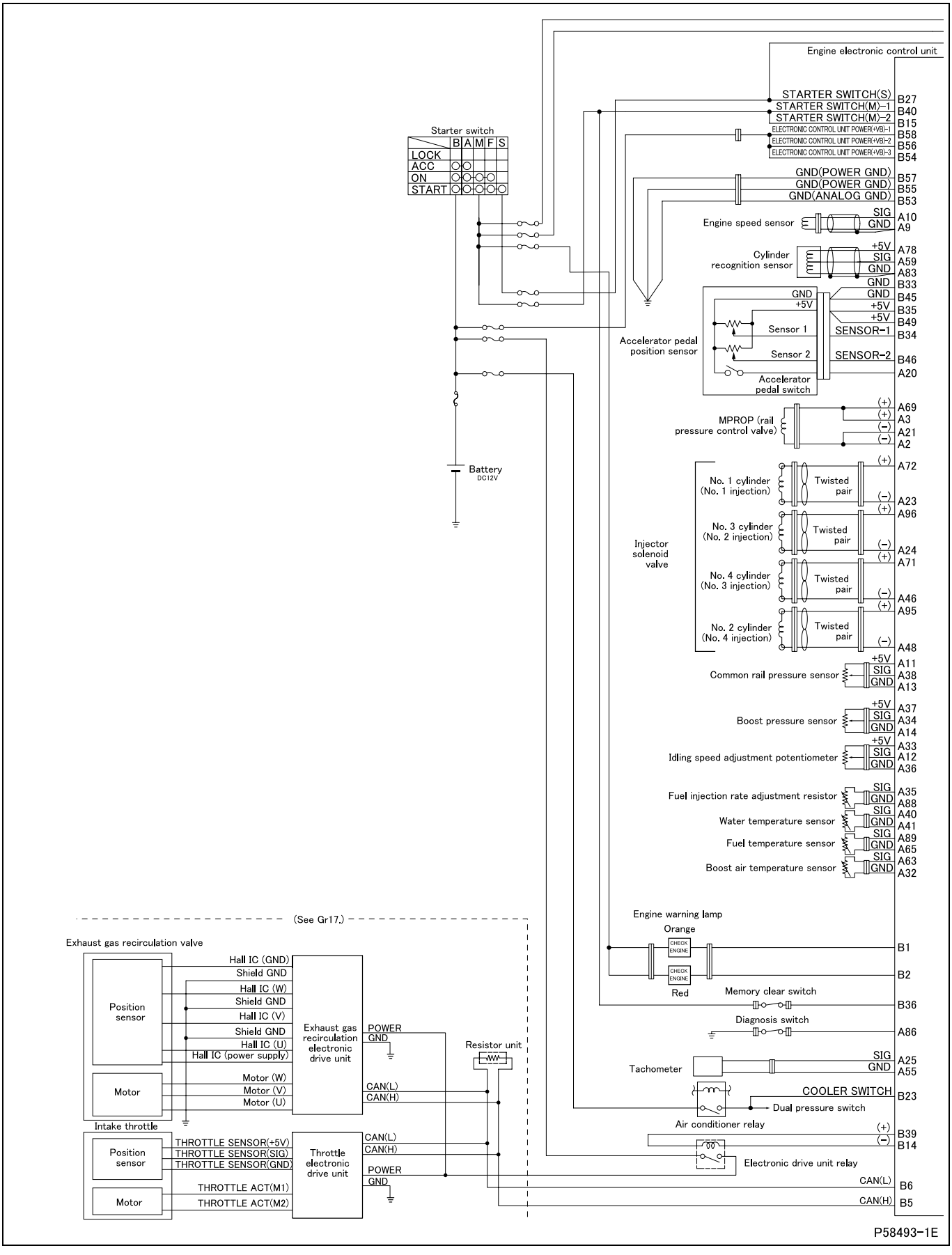
- While the starter switch is in the ON position, the sensors and other components are continuously monitored for faults. In the event that a component is found faulty, an indication is made in the meter cluster to alert the driver, the fault location is memorized in the form of a diagnosis code, and the control during fault is initiated.
- 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.

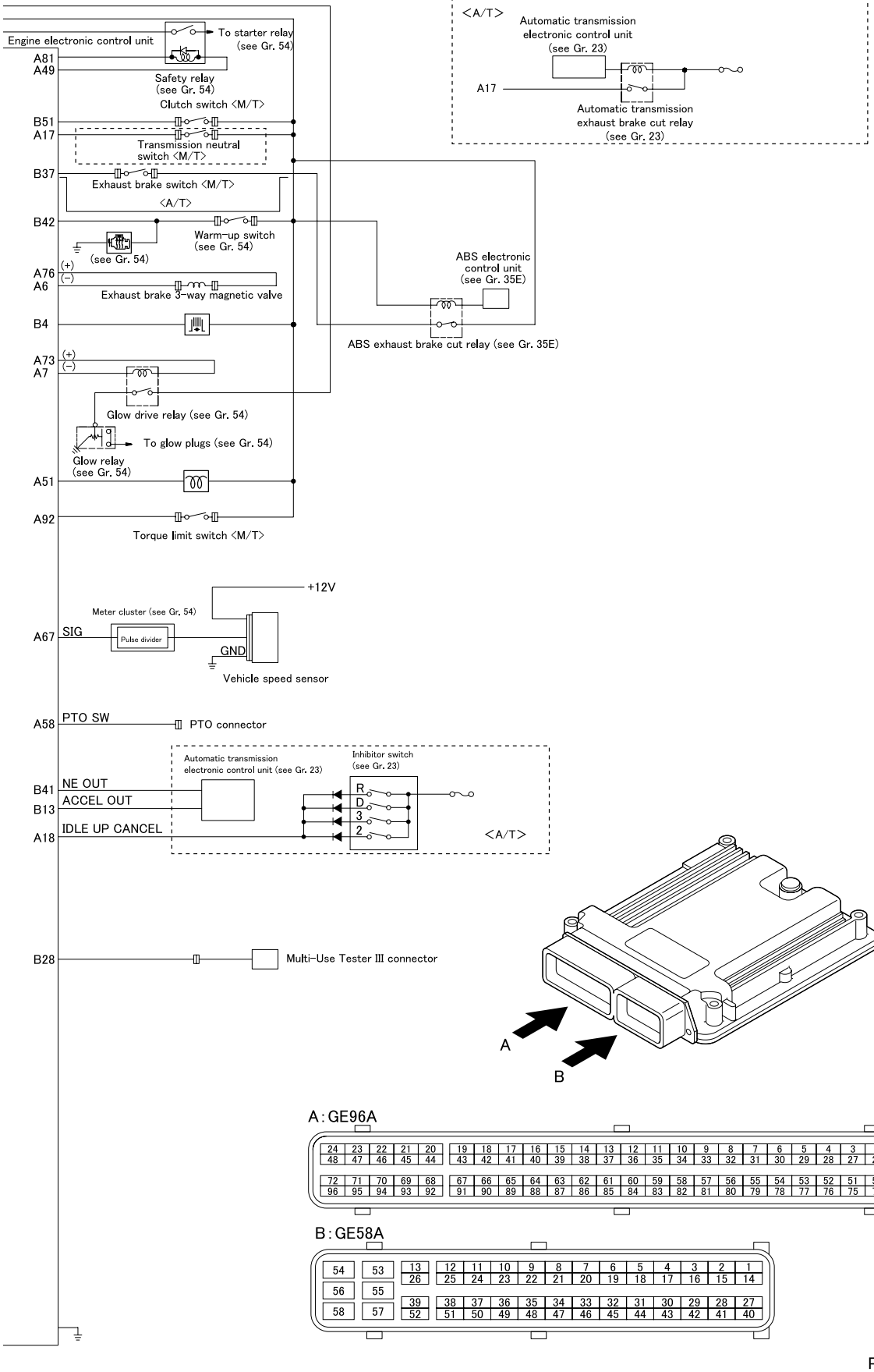
NOTE

- **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.**

M E M O

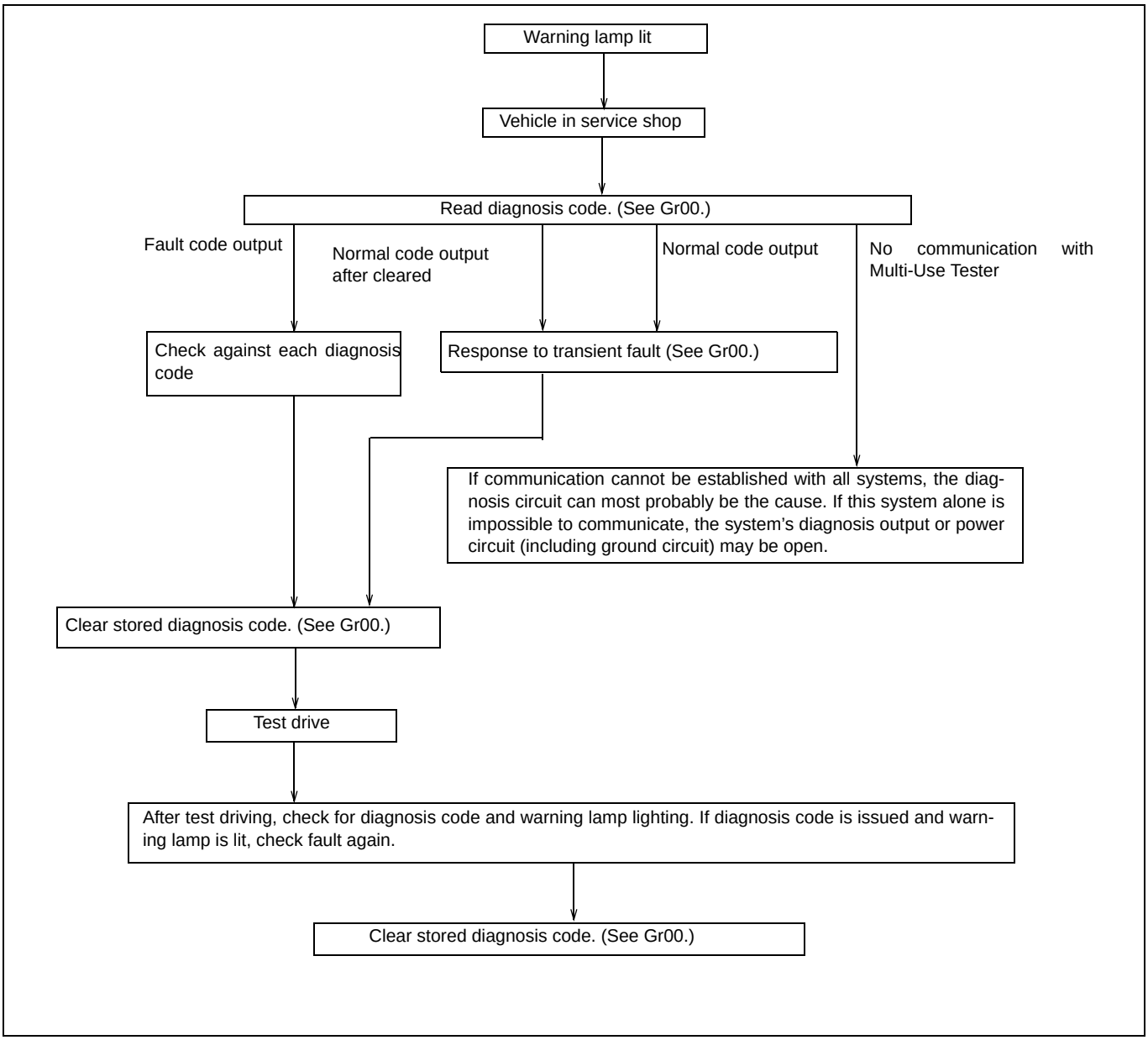
3. Electronic Control Unit Connection Diagram




<A/T>
Automatic transmission electronic control unit (see Gr. 23)
A17
Automatic transmission exhaust brake cut relay (see Gr. 23)
Engine electronic control unit
To starter relay (see Gr. 54)
A81
A49
Safety relay (see Gr. 54)
Clutch switch <M/T>
B51
A17
Transmission neutral switch <M/T>
B37
Exhaust brake switch <M/T>
<A/T>
B42
Warm-up switch (see Gr. 54)
(see Gr. 54)
ABS electronic control unit (see Gr. 35E)
A76
A6
Exhaust brake 3-way magnetic valve
B4
ABS exhaust brake cut relay (see Gr. 35E)
A73
A7
Glow drive relay (see Gr. 54)
To glow plugs (see Gr. 54)
Glow relay (see Gr. 54)
A51
A92
Torque limit switch <M/T>
+12V
Meter cluster (see Gr. 54)
A67
SIG
Pulse divider
GND
Vehicle speed sensor
A58
PTO SW
PTO connector
Automatic transmission electronic control unit (see Gr. 23)
Inhibitor switch (see Gr. 23)
B41
NE OUT
B13
ACCEL OUT
A18
IDLE UP CANCEL
R
D
3
2
<A/T>
B28
Multi-Use Tester III connector
A
B
A : GE96A
B : GE58A
P58493-2E

1. Diagnosis Procedure

- The system can be efficiently inspected for faults using a Multi-Use Tester-III.
  System inspection can be accomplished basically in two ways according to trouble symptom and diagnosis code as shown below.
  - Check against each diagnosis code stored in memory by the electronic control unit
  - Response to transient fault



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.
- To avoid having electrical parts damaged, set the starter switch and lighting switch to LOCK or OFF before disconnecting and reconnecting battery cables.
- Before disconnecting connectors, set the starter switch to LOCK or OFF, then allow at least 20 seconds. Voltage may remain in electric parts or connected circuit.
- 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 {50 to 95°F}) as the measuring condition.

3. Inspections Based on Diagnosis Codes

3.1 Diagnosis code list

NOTE

- **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	Flashes	Remarks
P0107	Atmospheric Pressure Sensor	19	
P0108	Atmospheric Pressure Sensor	19	
P0112	INT Air Temp. SNSR (Upstream)	44	
P0113	INT Air Temp. SNSR (Upstream)	44	
P0117	Water Temperature Sensor	21	
P0118	Water Temperature Sensor	21	
P0121	Accel Pedal Check (Plausibility)	58	
P0122	Accel Pedal Sensor 1	24	
P0123	Accel Pedal Sensor 1	24	
P0182	Fuel Temp. Sensor (inlet)	41	
P0183	Fuel Temp. Sensor (inlet)	41	
P0192	Common Rail Pressure Sensor	11	
P0193	Common Rail Pressure Sensor	11	
P0200	Injector Circuit 1	82	
P0201	Injector M/V-Cylinder 1	37	
P0202	Injector M/V-Cylinder 2	38	
P0203	Injector M/V-Cylinder 3	39	
P0204	Injector M/V-Cylinder 4	08	
P0219	Engine Overrunning	07	
P0222	Accel Pedal Sensor 2	16	
P0223	Accel Pedal Sensor 2	16	
P0234	Over Boost Error	54	
P0237	Boost Pressure Sensor	32	
P0238	Boost Pressure Sensor	32	
P0251	Common Rail Pressure Defect	36	
P0253	Common Rail Pressure Defect	22	
P0254	Common Rail Pressure Defect	23	
P0335	Engine Revolution Sensor	15	
P0340	Camshaft Position Sensor	12	
P0380	Relay for Glow Relay	26	Gr54
P0381	Glow Lamp	89	Gr54
P0403	EGR 1	67	Gr17
P0500	Vehicle Speed Sensor	25	

Code	Message	Flashes	Remarks
P0506	Idle Volume	31	
P0507	Idle Volume	31	
P0510	Accel SW	65	
P0560	M/V Supply Voltage	79	
P0605	ECU System (Hardware)	33	
P0615	Starter Safety Relay	48	Gr54
P0616	Starter Safety Relay	48	Gr54
P0617	Starter Safety Relay	48	Gr54
P1121	Intake Throttle 1	28	Gr17
P1171	Q Adjustment Resister	34	
P1172	Q Adjustment Resister	34	
P1200	Injector Circuit 2	82	
P1251	Common Rail Pressure M/V 1	63	
P1255	Common Rail Pressure M/V 1	63	
P1256	Common Rail Pressure M/V 1	63	
P1335	Revolution & Position Sensor	14	
P1460	Exhaust Brake M/V 1	93	
P1462	Exhaust Brake M/V 1	93	
P1463	Exhaust Brake M/V 1	93	
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	
P1573	Sensor Supply Voltage 3	81	
P1577	Segment Sensor Supply Voltage	81	
P1578	Segment Sensor Supply Voltage	81	
P1605	ECU System (EEPROM)	33	
P1606	ECU System (Software)	33	
P1625	EDU Relay	84	Gr17
P1630	CAN (EGR)	95	Gr17
P1635	CAN (Intake Throttle)	96	Gr17
P1700	Torque Cut SW	86	

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 is below standard value (2 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		• Control is effected using backup value of 101.3 kPa {15 psi, 1.03 kgf/cm^2}. (Exhaust emissions worsen.) • Exhaust gas recirculation control and throttle control are stopped.
Inspection	Service data	38: Atmospheric Pressure
	Electrical equipment	Engine electronic control unit

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

Generation condition		Atmospheric pressure sensor (incorporated into engine electronic control unit) voltage is below standard value (4.7 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		• Control is effected using backup value of 101.3 kPa {15 psi, 1.03 kgf/cm^2}. (Exhaust emissions worsen.) • Exhaust gas recirculation control and throttle control are stopped.
Inspection	Service data	38: Atmospheric Pressure
	Electrical equipment	Engine electronic control unit

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

Generation condition		Boost air temperature sensor voltage is below standard value (0.15 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Control is effected using backup value (25°C {77°F}).
Inspection	Service data	27: Intake Air Temperature
	Electronic control unit connector	01 : Boost air temperature sensor
	Electrical equipment	#305: Boost air temperature sensor
	Electric circuit diagram	Boost air temperature sensor system

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

Generation condition		Boost air temperature sensor voltage is below standard value (4.85 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Control is effected using backup value (25°C {77°F}).
Inspection	Service data	27: Intake Air Temperature
	Electronic control unit connector	01 : Boost air temperature sensor
	Electrical equipment	#305: Boost air temperature sensor
	Electric circuit diagram	Boost air temperature sensor system

P0117: Water Temperature Sensor (warning lamp flashes: 21)

Generation condition		Water temperature sensor voltage is below standard value (0.2 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		• Water temperature is assumed as constant –20°C {–4°F} during engine start-up and as constant 80°C {175°C} while vehicle is being driven. (Exhaust emissions worsen.) • Exhaust gas recirculation control and throttle control are stopped. • Glow control is stopped.
Inspection	Service data	35: 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 Temperature Sensor (warning lamp flashes: 21)

Generation condition		Water temperature sensor voltage is above standard value (4.85 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		• Water temperature is assumed as constant –20°C {–4°F} during engine start-up and as constant 80°C {175°C} while vehicle is being driven. (Exhaust emissions worsen.) • Exhaust gas recirculation control and throttle control are stopped. • Glow control is stopped.
Inspection	Service data	35: 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		Accelerator pedal position sensor output voltages 1 and 2 are outside standard range; or compared value is out of specification.
Recoverability		– (Low output)
Control effected by electronic control unit		Control is effected using value of 30 % with accelerator pedal pressed and using value of 0 % with accelerator pedal not pressed. (Output is reduced.)
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 is below standard value (0.5 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Control is effected using accelerator pedal position sensor 2.
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

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

Generation condition		Accelerator pedal position sensor 1 voltage is below standard value (4.7 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Control is effected using accelerator pedal position sensor 2.
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) (warning lamp flashes: 41)

Generation condition		Fuel temperature sensor voltage is below standard value (0.15 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Control is effected using backup value.
Inspection	Service data	36: 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) (warning lamp flashes: 41)

Generation condition		Fuel temperature sensor voltage is below standard value (4.8 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Control is effected using backup value.
Inspection	Service data	36: 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: Common Rail Pressure Sensor (warning lamp flashes: 11)

Generation condition		Common rail pressure sensor voltage is below standard value (0.2 V).
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		• Common rail pressure open loop control is effected. (Output is reduced, and exhaust emissions worsen.) • Exhaust gas recirculation control and throttle control 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: Common Rail Pressure Sensor (warning lamp flashes: 11)

Generation condition		Common rail pressure sensor voltage is below standard value (4.8 V).
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		• Common rail pressure open loop control is effected. (Output is reduced, and exhaust emissions worsen.) • Exhaust gas recirculation control and throttle control 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 magnetic valve circuit (No. 1 and No. 4 cylinder) is short-circuited, open-circuited, or overloaded.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		• Faulty circuit is stopped, resulting in two-cylinder operation. (Output is reduced, and exhaust emissions worsen.) • Exhaust gas recirculation control and throttle control are stopped.
Inspection	Actuator tests	BB: Injector Test 1, 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. 1 cylinder) or (No. 4 cylinder) system

P0201: Injector M/V-Cylinder1 (warning lamp flashes: 37)

Generation condition		Injector magnetic valve (No. 1 cylinder) is short-circuited or open-circuited.
Recoverability		Short circuit: System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON. Open circuit: System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		• Exhaust gas recirculation control is stopped. • Throttle control is stopped. • Open circuit: Energization is stopped. • Short circuit: Injector magnetic valves 1 and 4 are stopped. (Output is reduced, fuel economy worsens, and exhaust emissions worsen.)
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

P0202: Injector M/V-Cylinder2 (warning lamp flashes: 38)

Generation condition		Injector magnetic valve (No. 3 cylinder) is short-circuited or open-circuited.
Recoverability		Short circuit: System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON. Open circuit: System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		• Exhaust gas recirculation control is stopped. • Throttle control is stopped. • Open circuit: Energization is stopped. • Short circuit: Injector magnetic valves 2 and 3 are stopped. (Output is reduced, fuel economy worsens, and exhaust emissions worsen.)
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

P0203: Injector M/V-Cylinder3 (warning lamp flashes: 39)

Generation condition		Injector magnetic valve (No. 4 cylinder) is short-circuited or open-circuited.
Recoverability		Short circuit: System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON. Open circuit: System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		• Exhaust gas recirculation control is stopped. • Throttle control is stopped. • Open circuit: Energization is stopped. • Short circuit: Injector magnetic valves 1 and 4 are stopped. (Output is reduced, fuel economy worsens, and exhaust emissions worsen.)
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

P0204: Injector M/V-Cylinder4 (warning lamp flashes: 08)

Generation condition		Injector magnetic valve (No. 2 cylinder) is short-circuited or open-circuited.
Recoverability		Short circuit: System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON. Open circuit: System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		• Exhaust gas recirculation control is stopped. • Throttle control is stopped. • Open circuit: Energization is stopped. • Short circuit: Injector magnetic valves 2 and 3 are stopped. (Output is reduced, fuel economy worsens, and exhaust emissions worsen.)
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

P0219: Engine Overrunning (warning lamp flashes: 07)

Generation condition		Engine speed is higher than specified level.
Recoverability		System recovers if engine speed becomes normal while starter switch in ON position.
Control effected by electronic control unit		• Injectors are turned OFF. • MPROP (rail pressure control valve) stops feeding fuel.
Inspection	Electronic control unit connector	Engine electronic control unit

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

Generation condition		Accelerator pedal position sensor 2 voltage is below standard value (0.5 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Control is effected using accelerator pedal position sensor 1.
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 is above standard value (4.7 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Control is effected using accelerator pedal position sensor 1.
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

P0234: Over Boost Error (warning lamp flashes: 54)

Generation condition		Boost pressure exceeds the limit.
Recoverability		System recovers if signal becomes normal when starter switchis turned OFF → ON (power is re-supplied to electronic control unit).
Control effected by electronic control unit		Injection volume is limited.
Inspection	Other	Turbocharger (See Gr15.)

P0237: Boost Pressure Sensor (warning lamp flashes: 32)

Generation condition		Boost pressure sensor voltage is below standard value (0.3 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Control is effected using backup value of 101.3 kPa {1.03 kgf/cm^2}. (Output is reduced, and fuel economy worsens.)
Inspection	Service data	26: Boost Pressure
	Electrical equipment	#318: Boost pressure sensor
	Electric circuit diagram	Boost pressure sensor system

P0238: Boost Pressure Sensor (warning lamp flashes: 32)

Generation condition		Boost pressure sensor voltage is above standard value (4.7 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Control is effected using backup value of 101.3 kPa {1.03 kgf/cm^2}. (Output is reduced, and fuel economy worsens.)
Inspection	Service data	26: Boost Pressure
	Electrical equipment	#318: Boost pressure sensor
	Electric circuit diagram	Boost pressure sensor system

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

Generation condition		Difference between target rail pressure and actual rail pressure is above standard value.
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		Injectors are turned OFF. (Engine is stopped.)
Inspection	Actuator test	B9: Fuel Leak Check
	Other	• Air-bleeding of fuel system (See Gr13A.) • Inspection of fuel piping (See Gr13A.) • Fuel filter (See Gr13A.) • Supply pump (Have work performed by Bosch Automotive Systems.) • Pressure limiting valve (Have work performed by Bosch Automotive Systems.) • Injectors (Have work performed by Bosch Automotive Systems.)

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

Generation condition		Actual rail pressure is below standard value.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Injectors are turned OFF. (Engine is stopped.)
Inspection	Actuator test	B9: Fuel Leak Check
	Other	• Air-bleeding of fuel system (See Gr13A.) • Inspection of fuel piping (See Gr13A.) • Fuel filter (See Gr13A.) • Supply pump (Have work performed by Bosch Automotive Systems.) • Pressure limiting valve (Have work performed by Bosch Automotive Systems.) • Injectors (Have work performed by Bosch Automotive Systems.)

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

Generation condition		Actual rail pressure is high even with delivery rate of zero; or actual rail pressure is above standard value.
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		• Injection quantity is limited. (Output is reduced.) • Exhaust gas recirculation control and throttle control are stopped.
Inspection	Other	Supply pump (Have work performed by Bosch Automotive Systems.)

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

Generation condition		Engine speed sensor emits no pulses or too many pulses.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Control is effected using cylinder recognition sensor. (Output decreases owing to reduced control accuracy.)
Inspection	Service data	01: Engine Revolution
	Electronic control unit connector	06 : Engine speed sensor
	Electrical equipment	#263: Engine speed sensor
	Electric circuit diagram	Engine speed sensor system

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

Generation condition		Cylinder recognition sensor emits no pulses or too many pulses.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Control is effected using engine speed sensor.
Inspection	Service data	01: Engine Revolution
	Electronic control unit connector	07 : 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 sensor signal is missing or indicates an abnormally high speed.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Engine is controlled normally.
Inspection	Service data	3C: Vehicle Speed
	Electronic control unit connector	08 : Vehicle speed sensor
	Electrical equipment	#265: Vehicle speed sensor
	Electric circuit diagram	Vehicle speed sensor system

P0506: Idle Volume (warning lamp flashes: 21)

Generation condition		Idling speed adjustment potentiometer voltage is below standard value (0.7 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Control is effected with auto idle permanently selected.
Inspection	Service data	3B: Idle Volume Voltage
	Electronic control unit connector	09 : 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 is above standard value (4.6 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Control is effected with auto idle permanently selected.
Inspection	Service data	3B: Idle Volume Voltage
	Electronic control unit connector	09 : 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 signal is abnormal when compared with accelerator pedal position sensor outputs 1 and 2.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Normal control is effected.
Inspection	Service data	73: Accel SW
	Electronic control unit connector	10 : Accelerator pedal switch
	Electrical equipment	#324: Accelerator pedal switch (incorporated into accelerator pedal position sensor)
	Electric circuit diagram	Accelerator pedal switch system

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

Generation condition		Circuit (magnetic valve power supply) in electronic control unit is abnormal.
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 owing to circuit abnormality.
Inspection	Other	Engine electronic control unit

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

Generation condition		Circuit (hardware power supply) in electronic control unit is abnormal.
Recoverability		System recovers if signal becomes normal with starter switch in ON position. System does not recover unless diagnosis code is deleted.
Control effected by electronic control unit		No specific control is effected. Failure occurs owing to circuit abnormality.
Inspection	Other	Engine electronic control unit

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

Generation condition		Fuel injection rate adjustment resistor voltage is below standard value (0.2 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Control is effected using backup value (No. 1). (Output is slightly reduced.)
Inspection	Service data	3E: Q Adjustment Resistor No.
	Electronic control unit connector	11 : Fuel injection rate adjustment resistor
	Electrical equipment	#828: Fuel injection rate adjustment resistor
	Electric circuit diagram	Fuel injection rate adjustment resistor

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

Generation condition		Fuel injection rate adjustment resistor voltage is above standard value (4.8 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Control is effected using backup value (No. 1). (Output is slightly reduced.)
Inspection	Service data	3E: Q Adjustment Resistor No.
	Electronic control unit connector	11 : Fuel injection rate adjustment resistor
	Electrical equipment	#828: Fuel injection rate adjustment resistor
	Electric circuit diagram	Fuel injection rate adjustment resistor

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

Generation condition		Injector magnetic valve circuit (No. 2 and No. 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 → ON.
Control effected by electronic control unit		• Faulty circuit is stopped, resulting in two-cylinder operation. (Output is reduced, and exhaust emissions worsen.) • Exhaust gas recirculation control and throttle control are stopped.
Inspection	Actuator tests	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. 2 cylinder) or (No. 3 cylinder) system

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

Generation condition		Current flowing to MPROP (rail pressure control valve) is above standard value.
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		• Injection quantity is limited. (Output is reduced, fuel economy worsens, and exhaust emissions worsen.) • Exhaust gas recirculation control and throttle control are stopped.
Inspection	Actuator test	B9: Fuel Leak Check
	Electronic control unit connector	12 : MPROP (rail pressure control valve)
	Electrical equipment	#574: MPROP (rail pressure control valve)
	Electric circuit diagram	MPROP (rail pressure control valve) system

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

Generation condition		MPROP (rail pressure control valve) voltage is below standard value.
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		• Injection quantity is limited. (Output is reduced, fuel economy worsens, and exhaust emissions worsen.) • Exhaust gas recirculation control and throttle control are stopped.
Inspection	Actuator test	B9: Fuel Leak Check
	Electronic control unit connector	12 : MPROP (rail pressure control valve)
	Electrical equipment	#574: MPROP (rail pressure control valve)
	Electric circuit diagram	MPROP (rail pressure control valve) system

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

Generation condition		MPROP (rail pressure control valve) voltage is above standard value.
Recoverability		High voltage: System recovers if signal becomes normal with starter switch in ON position. Short circuit: 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		• Injection quantity is limited. (Output is reduced, fuel economy worsens, and exhaust emissions worsen.) • Exhaust gas recirculation control and throttle control are stopped.
Inspection	Actuator test	B9: Fuel Leak Check
	Electronic control unit connector	12 : MPROP (rail pressure control valve)
	Electrical equipment	#574: MPROP (rail pressure control valve)
	Electric circuit diagram	MPROP (rail pressure control valve) system

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

Generation condition		Engine speed sensor and cylinder recognition sensor emit no pulses or too many pulses.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Injectors are turned OFF. (Engine is stopped.)
Inspection	Service data	01: Engine Revolution
	Electronic control unit connector	06 : Engine speed sensor, 07 : 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: Exhaust Brake M/V 1 (warning lamp flashes: 93)

Generation condition		Current flowing to exhaust brake 3-way magnetic valve is above standard value.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Operation of exhaust brake is stopped.
Inspection	Service data	87: Exhaust Brake M/V 1
	Actuator test	AC: Auxiliary Brake M/V 1
	Electronic control unit connector	13 : Exhaust brake 3-way magnetic valve
	Electrical equipment	#565: Exhaust brake 3-way magnetic valve
	Electric circuit diagram	Exhaust brake 3-way magnetic valve system

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

Generation condition		Exhaust brake 3-way magnetic valve voltage is below standard value.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Operation of exhaust brake is stopped.
Inspection	Service data	87: Exhaust Brake M/V 1
	Actuator test	AC: Auxiliary Brake M/V 1
	Electronic control unit connector	13 : Exhaust brake 3-way magnetic valve
	Electrical equipment	#565: Exhaust brake 3-way magnetic valve
	Electric circuit diagram	Exhaust brake 3-way magnetic valve system

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

Generation condition		Exhaust brake 3-way magnetic valve voltage is above standard value.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Operation of exhaust brake is stopped.
Inspection	Service data	87: Exhaust Brake M/V 1
	Actuator test	AC: Auxiliary Brake M/V 1
	Electronic control unit connector	13 : Exhaust brake 3-way magnetic valve
	Electrical equipment	#565: Exhaust brake 3-way magnetic valve
	Electric circuit diagram	Exhaust brake 3-way magnetic valve system

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

Generation condition		Circuit voltage (sensor supply voltage 1) in electronic control unit is below standard value.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
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, 3B: Idle Volume Voltage
	Electronic control unit connector	03 : Accelerator pedal position sensor 1, 09 : Idling speed adjustment potentiometer
	Electrical equipment	#157: Idling speed adjustment potentiometer, #324: Accelerator pedal position sensor 1
	Electric circuit diagram	Boost air temperature sensor, 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 is above standard value.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
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, 3B: Idle Volume Voltage
	Electronic control unit connector	03 : Accelerator pedal position sensor 1, 09 : Idling speed adjustment potentiometer
	Electrical equipment	#157: Idling speed adjustment potentiometer, #324: Accelerator pedal position sensor 1
	Electric circuit diagram	Boost air temperature sensor, 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 is below standard value.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
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, accelerator pedal position sensor 2, and fuel temperature sensor systems

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

Generation condition		Circuit voltage (sensor supply voltage 2) in electronic control unit is above standard value.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
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, accelerator pedal position sensor 2, and fuel temperature sensor systems

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

Generation condition		Circuit voltage (sensor supply voltage 3) in electronic control unit is below standard value.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
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
	Electrical equipment	#319: Common rail pressure sensor
	Electric circuit diagram	Common rail pressure sensor system

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

Generation condition		Circuit voltage (sensor supply voltage 3) in electronic control unit is above standard value.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
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
	Electrical equipment	#319: Common rail pressure sensor
	Electric circuit diagram	Common rail pressure sensor system

P1577: Segment Sensor Supply Voltage (warning lamp flashes: 81)

Generation condition		Cylinder recognition sensor supply voltage is below standard value (0 V).
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		No specific control is effected. Failure occurs only to circuit abnormality.
Inspection	Service data	01: Engine Revolution
	Electronic control unit connector	07 : Cylinder recognition sensor
	Electrical equipment	#320: Cylinder recognition sensor
	Electric circuit diagram	Cylinder recognition sensor system

P1578: Segment Sensor Supply Voltage (warning lamp flashes: 81)

Generation condition		Cylinder recognition sensor supply voltage is above standard value (5 V).
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	Service data	01: Engine Revolution
	Electronic control unit connector	07 : Cylinder recognition sensor
	Electrical equipment	#320: Cylinder recognition sensor
	Electric circuit diagram	Cylinder recognition sensor system

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	Engine electronic control unit

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

Generation condition		• System overload occurs. • Task execution time exceeds limit duration.
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	Engine electronic control unit

P1700: Torque Cut SW (warning lamp flashes: 86)

Generation condition		Error occurs in comparison with VN ratio.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Normal control is effected.
Inspection	Service data	7F: Torque Cut Switch
	Electronic control unit connector	14 : Torque limit SW
	Electrical equipment	#163: Torque limit switch
	Electric circuit diagram	Torque limit switch system

4. Multi-Use Tester Service Data

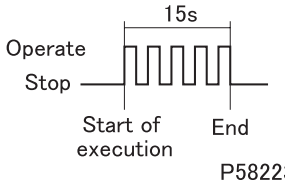
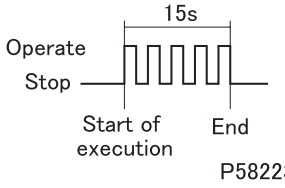
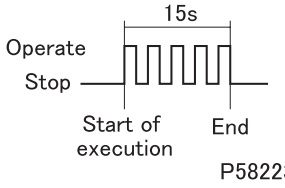
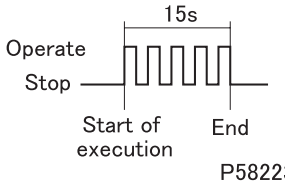
NOTE

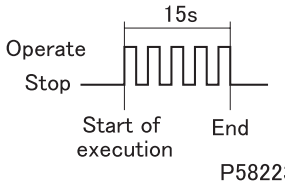
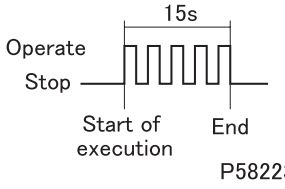
- **It is possible to see service data and actuator tests simultaneously.**

No.	Item	Data	Inspection condition	Requirement
01	Engine Revolution	■■■■.rpm	Racing (engine running)	Value corresponds to tachometer indication.
02	Reference Injection Quantity	■■■.■ %	Starter switch ON	0 %
0C	Difference Common Rail Pressure	■■■.■ %	Engine idling	0 % or lower
1F	EGR Position	■■■.■ %	See Gr17.	–
20	Intake Throttle Position	■■■.■ %	See Gr17.	–
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	■■■.■ inHg	Engine speed: 3100 rpm	49.9 in.Hg
27	Intake Air Temperature	■■■.■ °F	Engine cold	Value corresponds to ambient temperature.
35	Water Temperature	■■■.■ °F	Engine cold	Value corresponds to ambient temperature.
			Engine in process of warming up	Value gradually increases.
			Engine stopped after warming up	Value gradually decreases.
36	Fuel Temperature (inlet)	■■■.■ °F	Engine cold	Value corresponds to ambient temperature.
			Engine in process of warming up	Value gradually increases.
			Engine stopped after warming up	Value gradually decreases.
38	Atmospheric Pressure	■■■.■ inHg	Altitude: 0 m {0 ft.}	29.8 in.Hg
			Altitude: 600 m {1,970 ft.}	28.1 in.Hg
3B	Idle Volume Voltage	■.■■■ V	SLOW to FAST	2.6 to 1.2 V
3C	Vehicle Speed	■■■■.MPH	Vehicle in motion	Value corresponds to speedometer indication.
3E	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.
42	Power Supply Voltage	■■.■■ V	Starter switch ON	Value matches battery voltage.
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

No.	Item	Data	Inspection condition	Requirement
76	Auxiliary Brake SW 1	ON/OFF	Combination switch ON	ON
			Combination switch OFF	OFF
78	Clutch SW	ON/OFF	Clutch pedal pressed	ON
			Clutch pedal not pressed	OFF
7A	Neutral SW	ON/OFF	• Transmission in neutral <Manual transmission> • Shift lever in N position <Automatic transmission>	ON
			• Transmission not in neutral <Manual transmission> • Shift lever in D position <Automatic transmission>	OFF
7B	Idle Up Cancel SW	ON/OFF	• Shift lever in D position <Automatic transmission>	ON
			• Continuously <Manual transmission> • Shift lever in N position <Automatic transmission>	OFF
			[Actuator test] B8: Idle Up Cancel SW	
7C	Air Conditioner SW 1	ON/OFF	Air conditioner compressor running	ON
			Air conditioner compressor not running	OFF
			[Actuator test] B6: Air Conditioner SW 1	
7E	Cold Start SW	ON/OFF	See Gr54.	–
7F	Troque Cut SW	ON/OFF	Transmission in 1st or reverse	ON
			Transmission not in 1st or reverse	OFF
82	PTO SW	ON/OFF	Switch ON	ON
			Switch OFF	OFF
83	Diagnosis SW	ON/OFF	Diagnosis switch OFF (fuse fitted)	ON
			Diagnosis switch ON (fuse removed)	OFF
84	Memory Clear SW	ON/OFF	Memory clear switch OFF (fuse fitted)	ON
		ON/OFF	Memory clear switch ON (fuse removed)	OFF
87	Exhaust Brake M/V 1	ON/OFF	Exhaust brake operating	ON
			Exhaust brake not operating	OFF
			[Actuator test] AC: Auxiliary Brake M/V 1	
8C	Auxiliary Brake Indicator Lamp	ON/OFF	Exhaust brake operating	ON
			Exhaust brake not operating	OFF
			[Actuator test] AE: Auxiliary Brake Indicator Lamp	
8D	Glow Relay	ON/OFF	See Gr54.	–
8E	Glow Relay Indicator Lamp	ON/OFF	See Gr54.	–
8F	Starter Safety Relay	ON/OFF	See Gr54.	–
90	EDU Power Relay	ON/OFF	See Gr54.	–
91	MIL Lamp	ON/OFF	Starter switch ON (engine not started)	ON
			No error after engine startup	OFF
			[Actuator test] B3: MIL Lamp	
92	Diagnosis Lamp	ON/OFF	Starter switch ON (engine not started)	ON
			No error after engine startup	OFF
			[Actuator test] B4: Diagnosis Lamp	

5. Actuator Tests Performed Using Multi-Use Tester

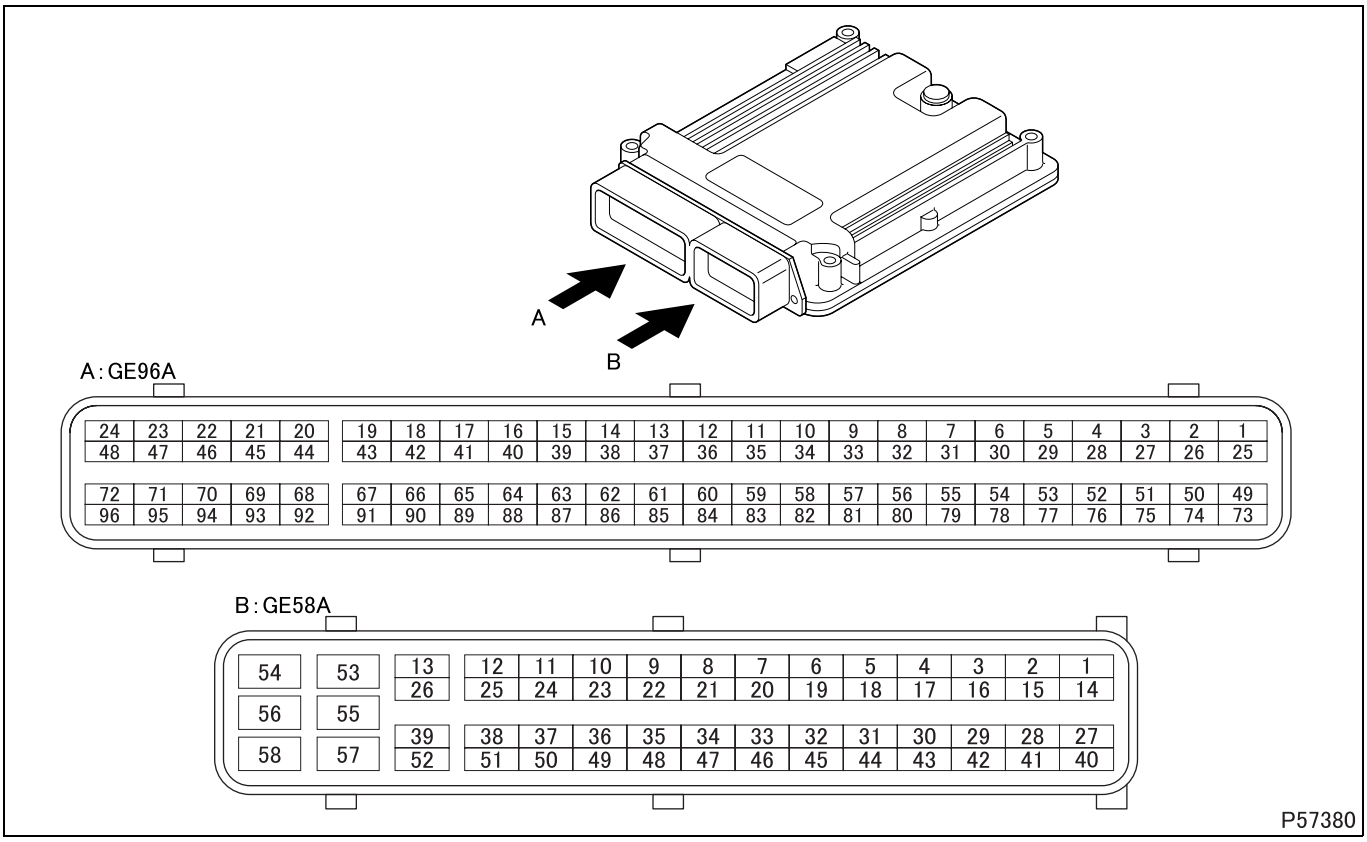
No.	Item	Explanation	Confirmation method
A1	EGR 1	See Gr17.	–
A7	Intake Throttle 1	See Gr17.	–
AC	Auxiliary Brake M/V 1	Exhaust brake 3-way magnetic valve drive signal (Can be executed with engine not running.) 	Operating sound of magnetic valve [Service data] 87: Exhaust brake M/V 1
AE	Auxiliary Brake Indicator Lamp	Exhaust brake indicator lamp drive signal (Can be executed with engine not running.) 	ON/OFF condition of indicator lamp [Service data] 8C: Auxiliary Brake Indicator Lamp
AF	Relay for Glow Relay	See Gr54.	–
B0	Glow Indicator Lamp	See Gr54.	–
B1	Starter Safety Relay	See Gr54.	–
B2	EDU Relay	See Gr17.	–
B3	MIL Lamp	Warning lamp (orange) drive signal 	ON/OFF condition of warning lamp (orange) [Service data] 91: MIL Lamp
B4	Diagnosis Lamp	Warning lamp (orange) drive signal 	ON/OFF condition of warning lamp (red) [Service data] 92: Diagnosis Lamp

No.	Item	Explanation	Confirmation method
B6	Air Conditioner SW 1	Idle up control reproduced by means of dummy signal (air conditioner operation). (Can be executed with vehicle speed of zero and with transmission in neutral.)  P58223E	Increase in idling speed [Service data] 7C: Air conditioner SW 1
B8	Idle Up Cancel SW	Idle up cancel condition reproduced by means of dummy signal (idle up cancel). (Can be executed with vehicle speed of zero and with transmission in neutral.)  P58223E	Idling speed low idle [Service data] 7B: Idle Up Cancel SW
B9	Fuel Leak Check	Rail pressure increased on constant slope (Can be executed with vehicle speed of zero and transmission in neutral and diagnosis switch open.)	Check that no fuel leaks from fuel system.
BB	Injector Test 1	Injector magnetic valve (No. 1 cylinder) not activated (Can be executed with engine speed not exceeding 1,500 rpm and no errors and transmission in neutral and vehicle speed of zero.)	Engine RPM should decrease
BC	Injector Test 2	Injector magnetic valve (No. 2 cylinder) not activated (Can be executed with engine speed not exceeding 1,500 rpm and no errors and transmission in neutral and vehicle speed of zero.)	Engine RPM should decrease
BD	Injector Test 3	Injector magnetic valve (No. 3 cylinder) not activated (Can be executed with engine speed not exceeding 1,500 rpm and no errors and transmission in neutral and vehicle speed of zero.)	Engine RPM should decrease
BE	Injector Test 4	Injector magnetic valve (No. 4 cylinder) not activated (Can be executed with engine speed not exceeding 1,500 rpm and no errors and transmission in neutral and vehicle speed of zero.)	Engine RPM should decrease

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

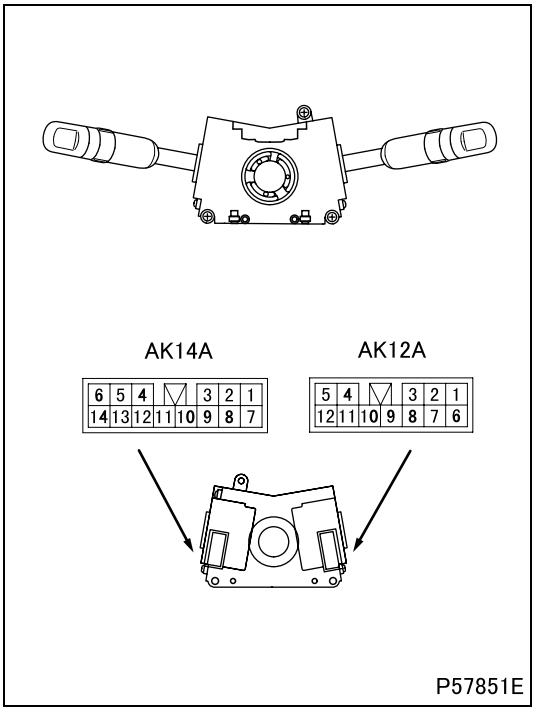
CAUTION ⚠

- **Some inspections are performed with the connectors removed. Others are performed with the connectors fitted. Observe the following 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 boost air temperature sensor	[Conditions] • Starter switch OFF • Disconnect connector. Perform inspection on vehicle-side connector. [Requirements] Terminals: A63-A32 • 0°C {32°F}: $15^{+3.78}_{-2.94}$ kΩ • 20°C {68°F}: $6.514^{+1.473}_{-1.147}$ kΩ • 80°C {176°F}: $0.874^{+0.136}_{-0.115}$ 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 {68°F}: 2.3 to 2.6 kΩ • 80°C {176°F}: 0.30 to 0.34 kΩ
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 and B45 (accelerator pedal position sensor 1) B46-B33 and B45 (accelerator pedal position sensor 2) • With accelerator pedal not pressed: 0.85 ± 0.1 V • With accelerator pedal pressed: 4.15 ± 0.1 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 {68°F}: 2.45 $^{+0.14}_{-0.13}$ kΩ • 80°C {176°F}: 0.318 ± 0.01 kΩ • 110°C {230°F}: 0.1417 ± 0.01 kΩ
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) A95-A48 (injector magnetic valve: No. 2 cylinder) A96-A24 (injector magnetic valve: No. 3 cylinder) A71-A46 (injector magnetic valve: No. 4 cylinder) • 0.255 ± 0.04 Ω
06 Resistance of engine speed sensor	[Conditions] • Starter switch OFF • Disconnect connector. Perform inspection on vehicle-side connector. [Requirements] Terminals: A10-A9 • 860 ± 86 kΩ (20°C {68°F})
07 Resistance of cylinder recognition sensor	[Conditions] • Starter switch OFF • Disconnect connector. Perform inspection on vehicle-side connector. [Requirements] Terminals: A78-A83 (+5 V to GND) • 200 to 1800 kΩ
08 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 earth • High pulse voltage: Approx. 8 ± 1 V • Low pulse voltage: 0.5 V or lower
09 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

Check item	Measurement method
10 Operating voltage of accelerator pedal switch	[Conditions] • Starter switch ON • Vehicle-side harness connected (Perform inspection on back of connector.) [Requirements] Terminals (+)-(–): A20-B33 and B45 • With accelerator pedal pressed: 0 V • With accelerator pedal not pressed: 5 V
11 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: 1,300 ± 65 Ω • No. 5 resistor: 2,000 ± 100 Ω • No. 6 resistor: 3,300 ± 165 Ω • No. 7 resistor: 5,600 ± 280 Ω • No. 8 resistor: 15,000 ± 750 Ω • No. 9 resistor: 390 ± 19.5 Ω • No. 10 resistor: 4,300 ± 215 Ω • No. 11 resistor: 9,100 ± 455 Ω
12 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 2.6 to 3.15 Ω
13 Voltage of exhaust brake 3-way magnetic valve	[Conditions] • Starter switch ON • Vehicle-side harness connected (Perform inspection on back of connector.) [Requirements] Terminals (+)-(–): A76-A6 • With exhaust brake operating: Corresponding to battery voltage • With exhaust brake not operating: 0 V
14 Voltage of torque limit switch	[Conditions] • Starter switch ON • Vehicle-side harness connected (Perform inspection on back of connector.) [Requirements] Terminals (+)-(–): A92-chassis earth • Transmission in 1st or reverse: Corresponding to battery voltage • Transmission not in 1st or reverse: 0 V

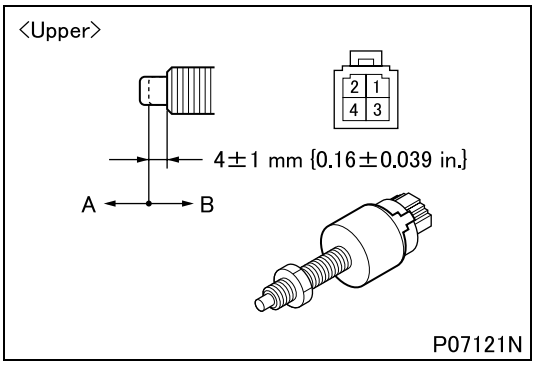


#001 Inspection of combination switch

AK14A connector connection table

Switch position		Terminals with continuity
Exhaust brake switch	OFF	–
	ON	8 - 9

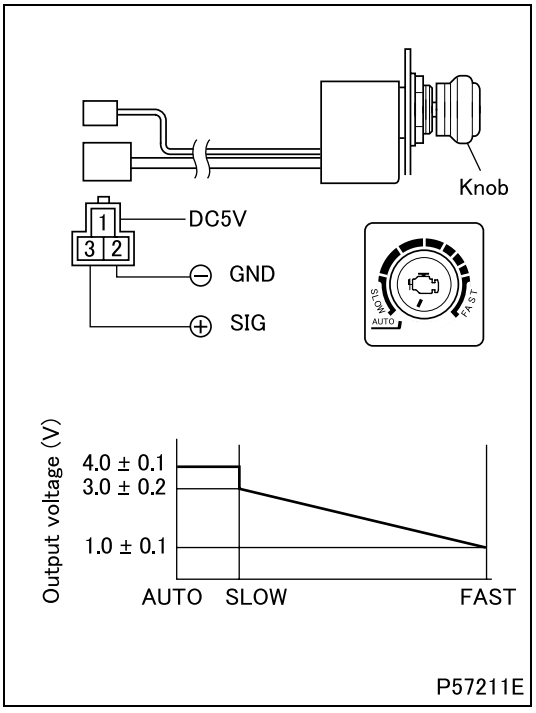
- If there is any abnormality, replace the switch.



#031 Inspection of clutch switch

Switch position	Terminals with continuity
A	1 - 4
B	2 - 3

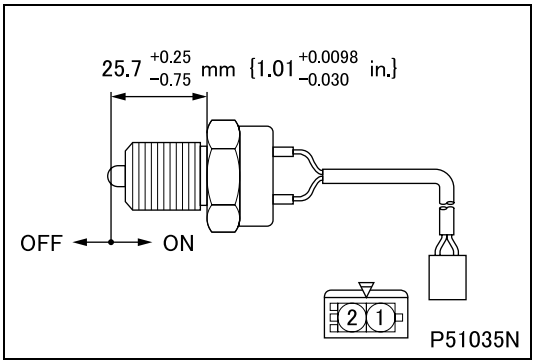
- If there is any abnormality, replace the switch.



#157 Inspection of idling speed adjustment potentiometer

- Apply 5 V 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.
- If any measurement is out of specification, replace the idling speed adjustment potentiometer.

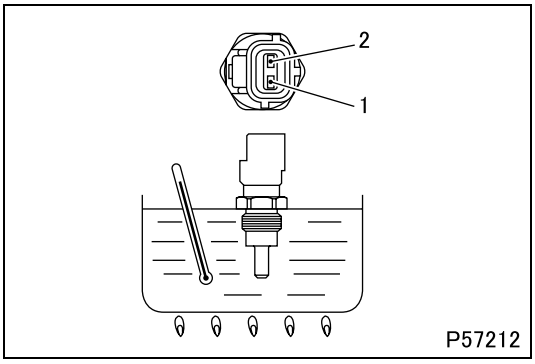
	Knob position	Output voltage
Standard value	AUTO (0°)	4.0 ± 0.1 V
	SLOW (30°)	3.0 ± 0.2 V
	FAST (300°)	1.0 ± 0.1 V



#163 Inspection of torque limit switch

Switch position	Terminals with continuity
OFF	–
ON	1 - 2

- If there is any abnormality, replace the switch.

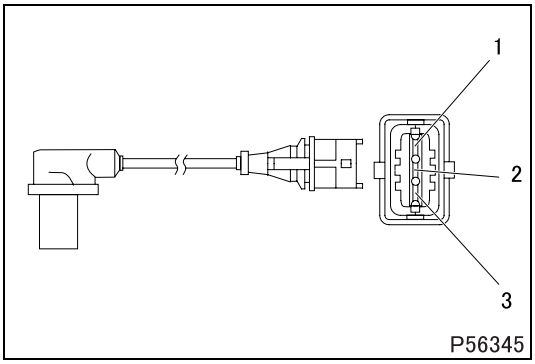


#262 Inspection of water temperature sensor

- 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 {68°F}	2.3 to 2.6 kΩ
	80°C {176°F}	0.30 to 0.34 kΩ

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

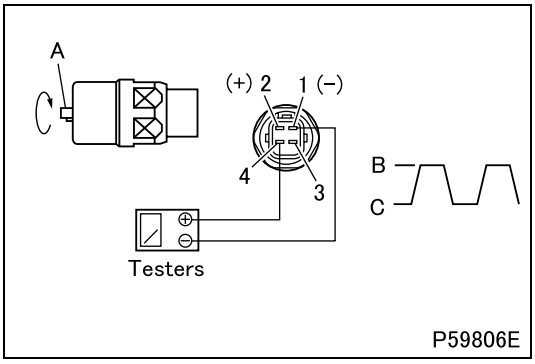


#263 Inspection of engine speed sensor

- Measure the resistance between terminals 1 and 2.

Standard value (at 20°C {68°F})	860 ± 86 Ω

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

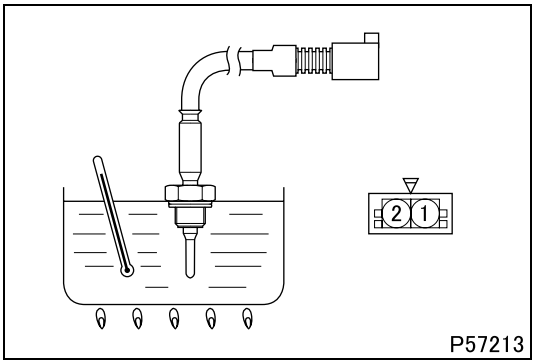


#265 Inspection of vehicle speed sensor

- With the battery voltage applied to terminals 1 and 2, slowly turn part A of the sensor.
- Measure the maximum voltage (high pulse voltage B) and minimum voltage (low pulse voltage C) occurring at each specified pair of terminals.

Terminals	Inspection condition	Standard value
25-pulse output: terminals 1 and 4	Low pulse voltage	0.5 V or lower
	High pulse voltage	8 ± 1 V

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

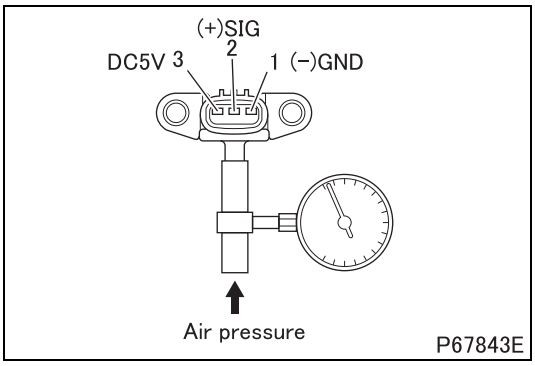


#305 Inspection of boost air temperature sensor

- Place the boost air 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	0°C {32°F}	$15\ ^{+3.78}_{-2.94}$ kΩ
	20°C {68°F}	$6.514\ ^{+1.437}_{-1.147}$ kΩ
	80°C {176°F}	$0.874\ ^{+0.136}_{-0.115}$ kΩ

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



##318 Inspection of boost pressure sensor

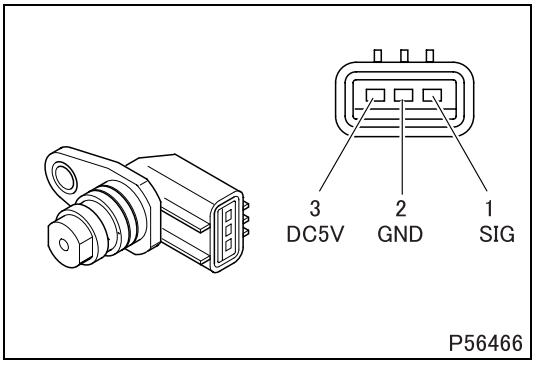
- Apply 5 V DC to terminals 3 and 1.
- Apply air pressure. Gradually increase it and, while doing so, measure the output voltage occurring at terminals 2 and 1.

	Air pressure	Voltage
Standard value	99 kPa {14 psi, 1.0 kg/cm^2}	Approx. 2.5 V
	232.3 kPa {34 psi, 2.3 kg/cm^2}	Approx. 4.5 V

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

#319 Inspection of 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.

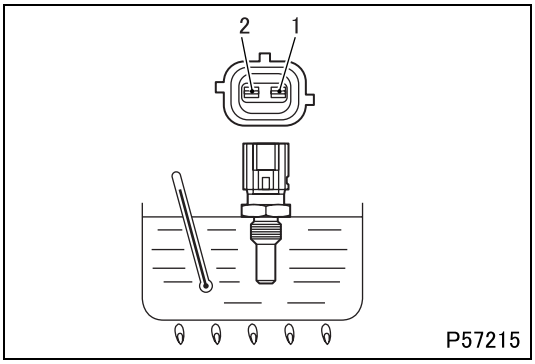


#320 Inspection of cylinder recognition sensor

- Measure the resistance between terminals 2 and 3.

Standard value	200 to 1800 Ω

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

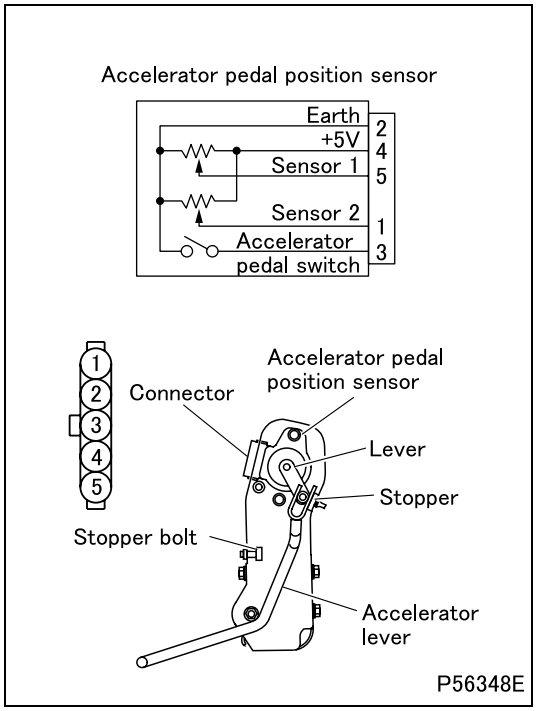


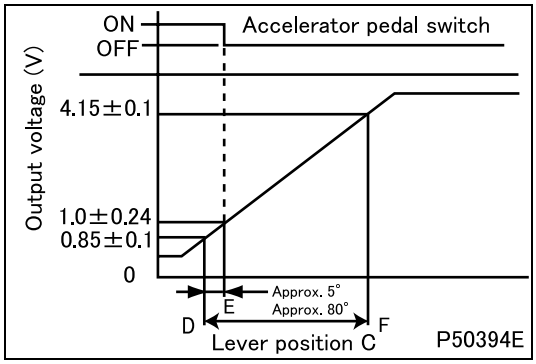
#323 Inspection of fuel temperature sensor

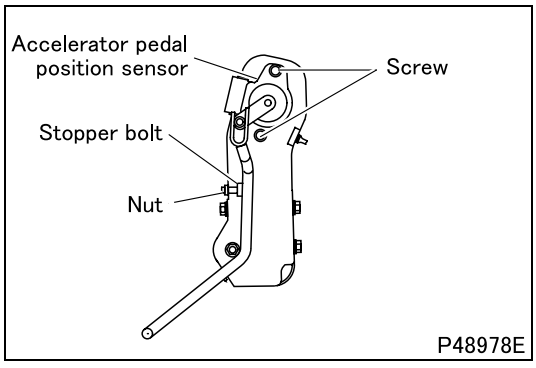
- Measure the resistance between terminals 1 and 2.

Standard value	20°C {68°F}	$2.45\ ^{+0.14}_{-0.13}$ kΩ
	80°C {176°F}	0.318 ± 0.01 kΩ
	110°C {230°F}	0.1417 ± 0.01 kΩ

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







#324 Inspection of accelerator pedal position sensor

[Inspection]

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

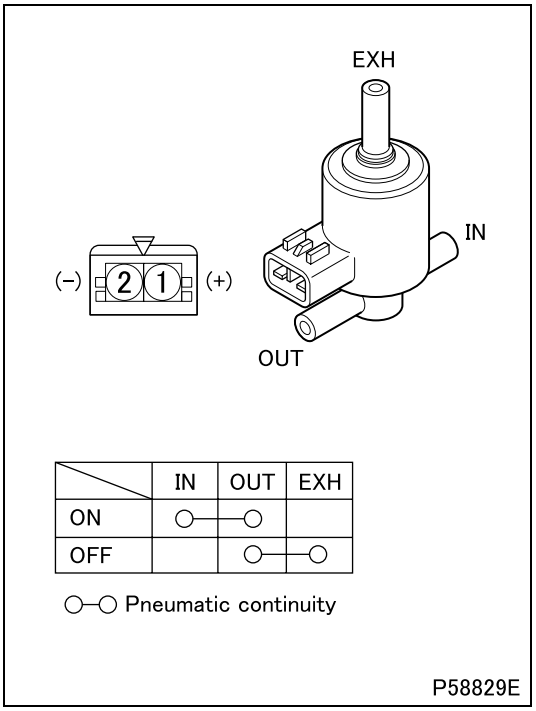
	Accelerator lever position	Output voltage
Standard value	Idling position A	0.85 ± 0.1 V
	Accelerator pedal switch operating position B	1.0 ± 0.24 V
	Full load position C	4.15 ± 0.1 V

A: Position in which accelerator lever is touching stopper
B: Position at which continuity between terminals 2 and 3 disappears as accelerator pedal is pushed downward
C: Position in which accelerator 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.

[Adjustment]

- To adjust the output voltage for the idling position A, loosen the screws and move the accelerator pedal position sensor. Tighten the screws after making the adjustment.
- To adjust the output voltage for the full load position C, loosen the nut and make the adjustment using the stopper bolt. After making the adjustment, lock the stopper bolt in position with the nut.



#565 Inspection of exhaust brake 3-way magnetic valve

- Perform the following checks. If there is any abnormality, replace the exhaust brake 3-way magnetic valve.

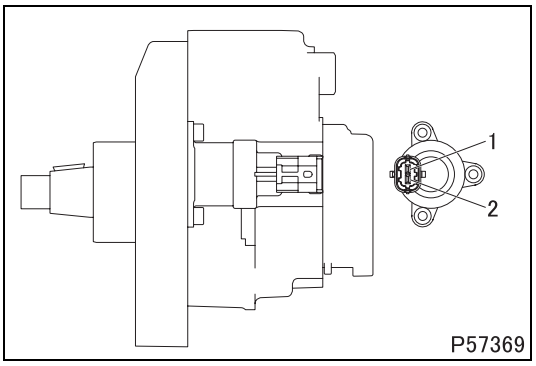
(1) Check of operation

- Gradually increase from zero the voltage applied to terminals 1 and 2.
- Observe the voltage when the exhaust brake 3-way magenetic valve operates.
  (Determine the magnet valve's OFF-ON operation from the operating sound.)

Standard value (min. operating voltage)	11 V or lower

(2) Check of continuity and airtightness

- Vacuum pressure applied during check:
  –100 kPa {–29.5 in.Hg, –750 mmHg}

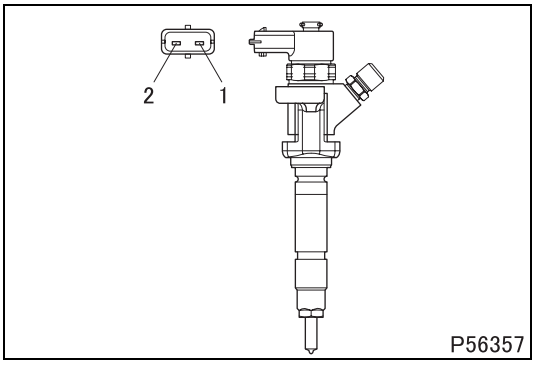


#574 Inspection of MPROP
(injection quantity adjustment valve)

- Measure the resistance between terminals 1 and 2.

Standard value	2.6 to 3.15 Ω

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

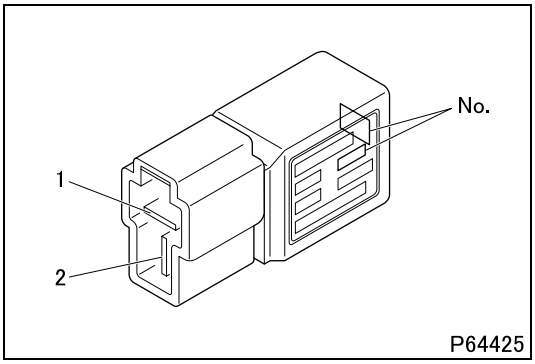


#582 Inspection of injector magnetic valve

- Measure the resistance between terminals 1 and 2.

Standard value (at 20°C {68°F})	0.255 ± 0.04 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 {68°F})	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

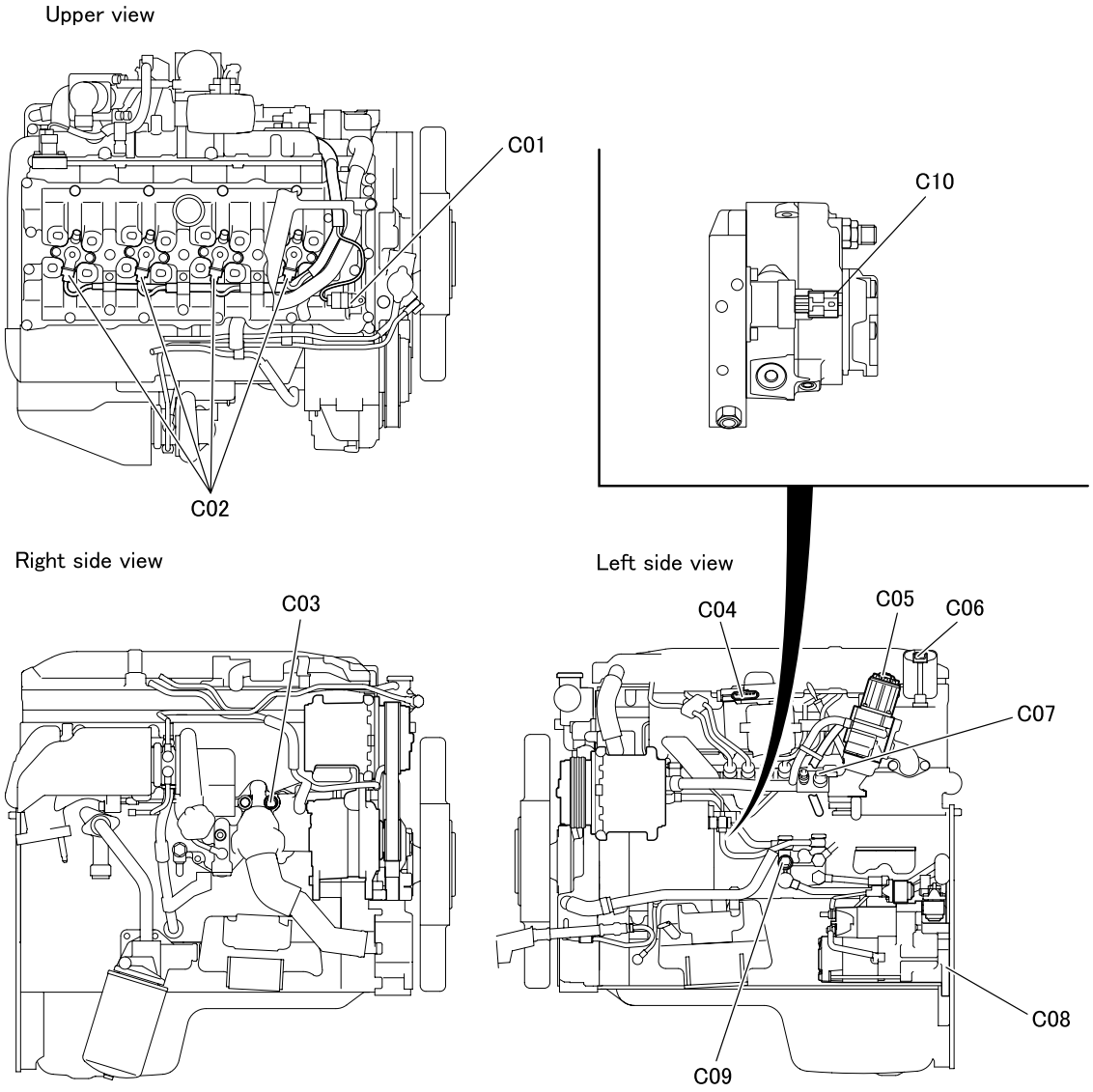
- If the measurement is out of specification, replace the fuel injection rate adjustment resistor with one that has the same resistor number and same specified resistance.

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.**

C01 to 10

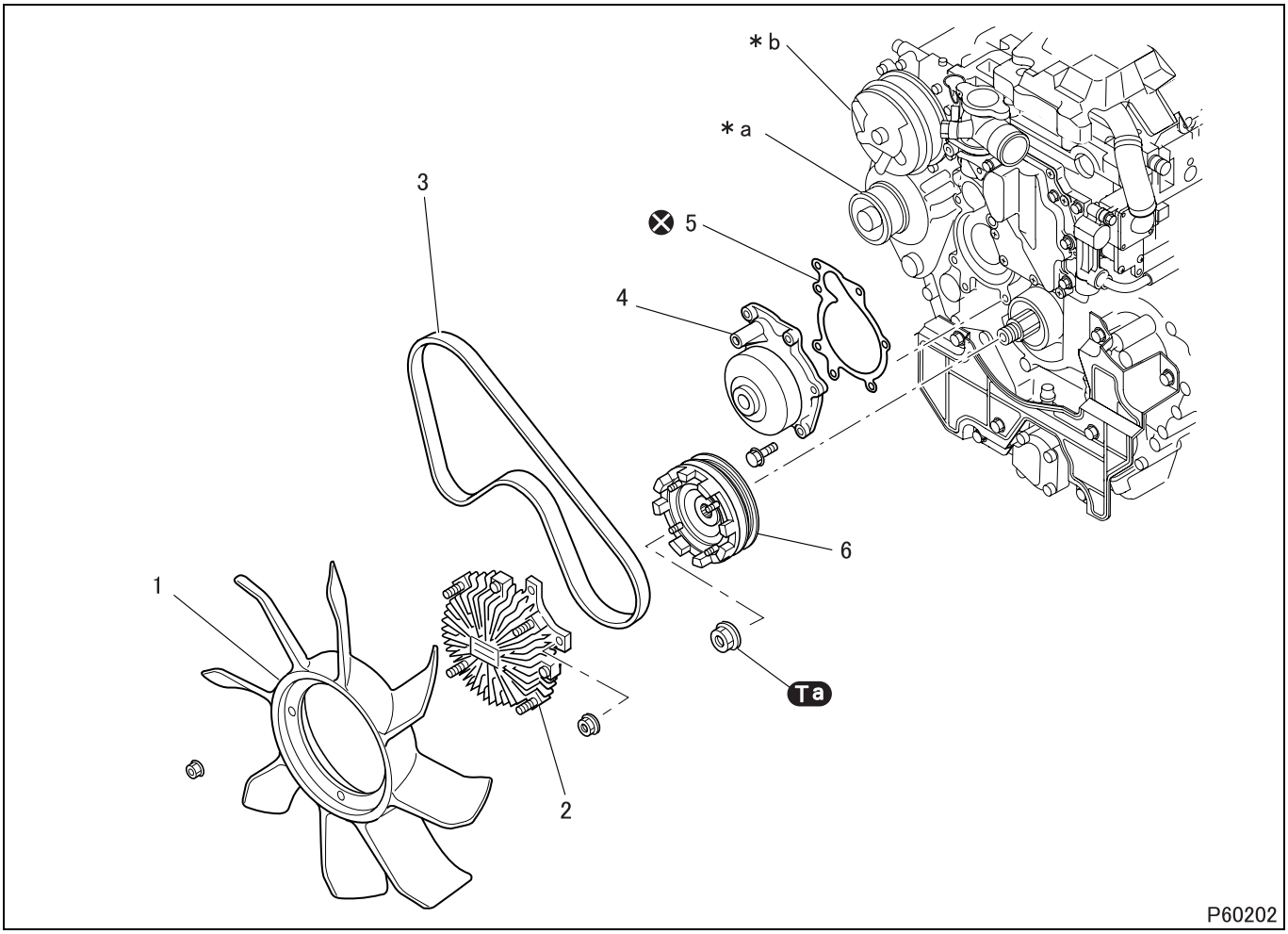
Mitsubishi 4M50 Location of Electrical Parts, Sensors, Valves,



C01 Cylinder recognition sensor
C02 Injector magnetic valve
C03 Water temperature sensor
(Connects to engine ECU)
C04 Intake throttle
(Building into motor, position sensor)
C05 EGR valve
(Building into motor, position sensor)
C06 Boost pressure sensor
C07 Common rail pressure sensor
C08 Starter
C09 Fuel temperature sensor
C10 MPROP (rail pressure control valve)

ECU : Electronic control unit

L00185



● **Removal sequence**

1 Cooling fan
2 Automatic cooling fan coupling (OPTIONAL)
3 V-belt
4 Water pump
5 Gasket
6 Fan pulley

***a**: Alternator
***b**: Compressor <With air conditioner> Tension pulley <Without air conditioner>
⊗: Non-reusable parts

● **Installation sequence**

Follow the removal sequence in reverse.

CAUTION ⚠

- **The automatic cooling fan coupling and the water pump cannot be disassembled. It must be replaced if defective.**
- **Make sure that there is no oil or grease on the V-belts. V-belts soiled with oil or grease may easily slip, resulting in deteriorated performance of the cooling system.**

Service standards (Unit: mm {in.})

Location	Maintenance item			Standard value	Limit	Remedy
3	V-belt tension	with air conditioner	New	7.5 to 8.5 {0.30 to 0.33}	–	Adjust
			Reused	9.5 to 10.5 {0.37 to 0.41}		
		without air conditioner	New	8 to 10 {0.31 to 0.39}		
			Reused	10 to 12 {0.39 to 0.47}		

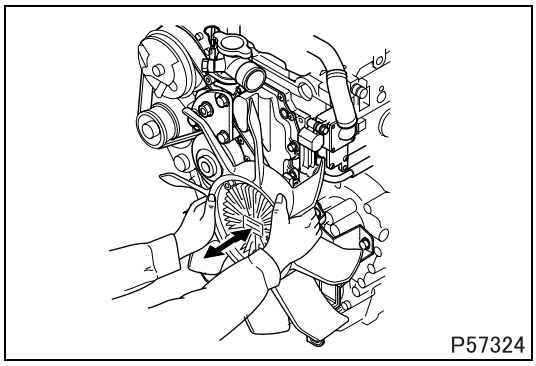
Tightening torque (Unit: N·m {lbf·ft, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Nut (fan pulley mounting)	196.1 {145, 20}	–

Special tools

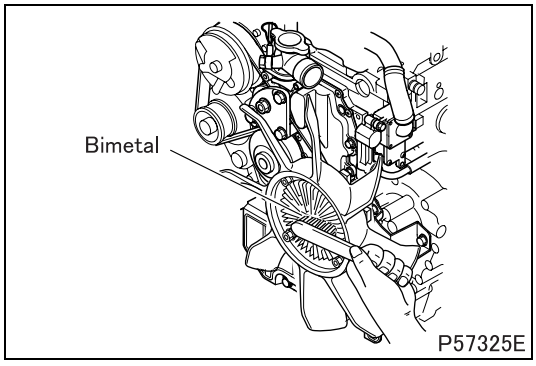
Mark	Tool name and shape	Part No.	Application
Ca	Belt tension gauge  P03612	MH062345	Measurement of tension of V-belt

◆Inspection and cleaning procedure◆


P57324

■ Inspection: Automatic cooling fan coupling

- Make an inspection of the following points. Replace the automatic cooling fan coupling if defective.
  Check that:
  - the hydraulic oil sealed inside the coupling is not leaking;
  - the coupling does not make any abnormal noise or rotate unevenly due to defects in the inside bearing when rotated manually; and
  - the automatic cooling fan coupling does not move too much when pushed and pulled in the axial directions when the engine is cold.

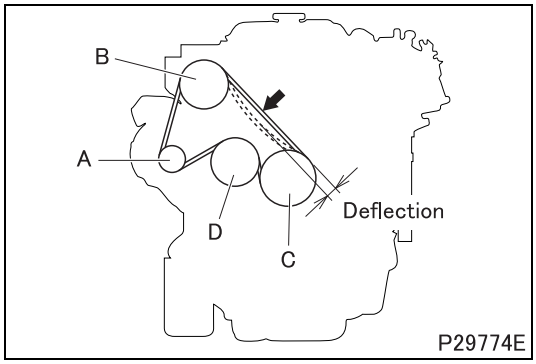


P57325E

■ Cleaning: Automatic cooling fan coupling

- When removing foreign matter from the bimetal, be careful not to press too hard against the bimetal.

◆Inspection after installation◆

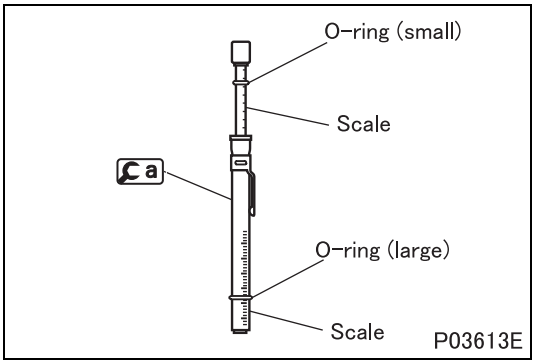


P29774E

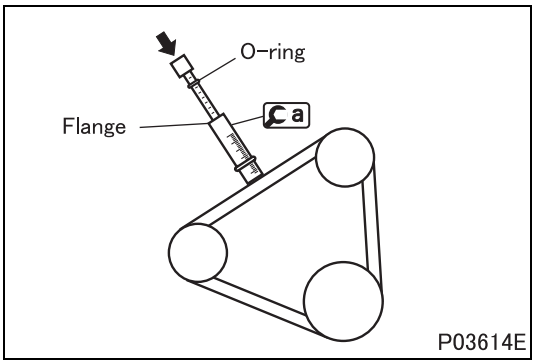
■ Inspection: Tension of V-belts

- Press each V-belt at a central portion between pulleys with a force of approximately 98 N {22 lbs, 10 kgf} as shown in the illustration and measure the amount of deflection of the belt.
  - **A:** Alternator pulley
  - **B:** Air conditioner compressor pulley or tension pulley
  - **C:** Fan pulley
  - **D:** Water pump pulley

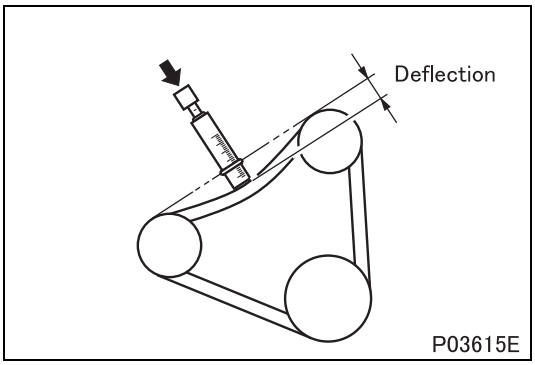
TENSION PULLEY



- Place the small O-ring on a at the scale mark corresponding to 98 N {22 lbs, 10 kgf} (press force).
- Place the large O-ring on a at the scale mark corresponding to the maximum permissible deflection value specified for the belt.

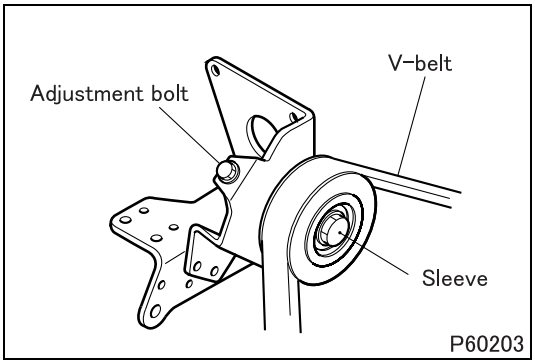


- Place a at a central portion between pulleys of the V-belt and push the handle (indicated by the arrow in the illustration) until the O-ring touches the flange.



- Measure the amount of deflection of the V-belt.
- If the measured value deviates from the standard value range, adjust the tension of the belt as follows.

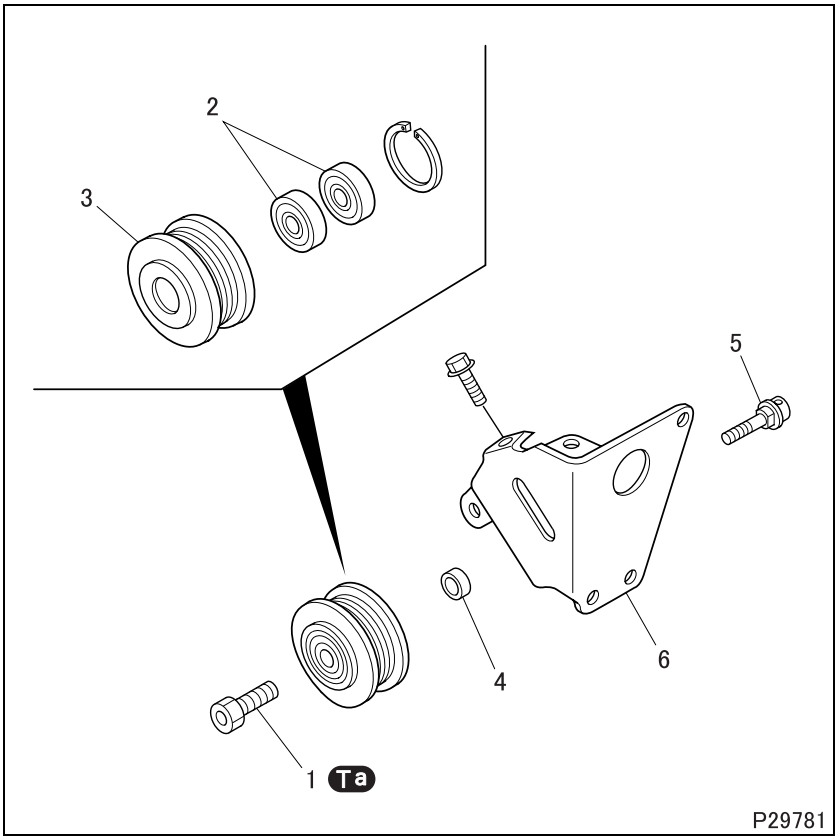
△



- Loosen the Mitsubishi 4M50 tension pulley mounting sleeve and turn in or out the adjustment bolt to adjust the tension of the V-belt.
- After the adjustment is completed, retighten the mounting sleeve firmly.

CAUTION ⚠

- **Excessive tension in the V-belt may damage not only the belt itself but also the bearings of the related components.**



● **Mitsubishi 4M50 Disassembly sequence**

1 Sleeve
2 Bearing
3 Tension pulley
4 Spacer
5 Shaft
6 Tension pulley bracket

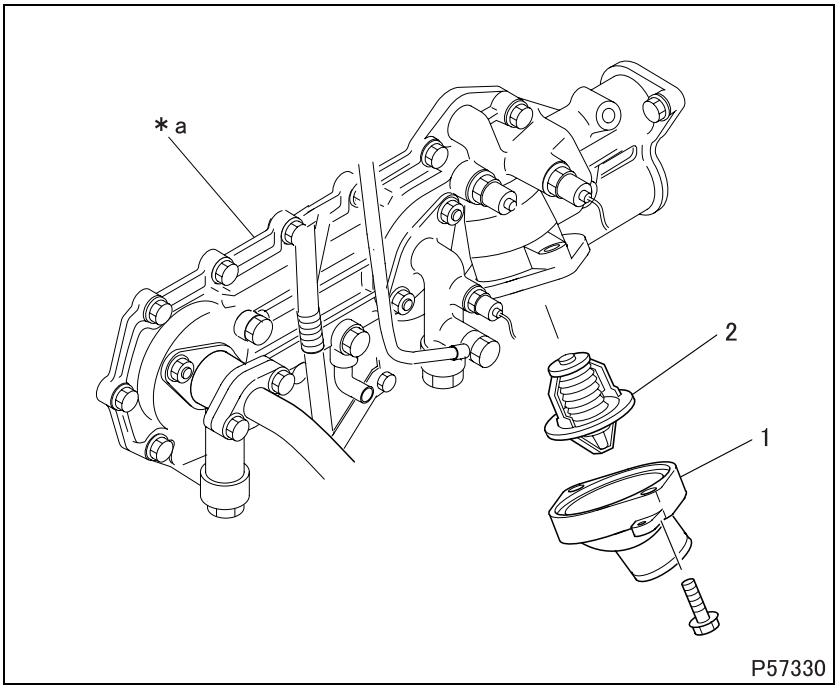
● Assembly sequence

Follow the disassembly sequence in reverse.

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

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Sleeve	49 {36, 5.0}	–

THERMOSTAT



● Disassembly sequence

1 Mitsubishi 4M50 Thermostat cover
2 Thermostat

***a**: Oil cooler

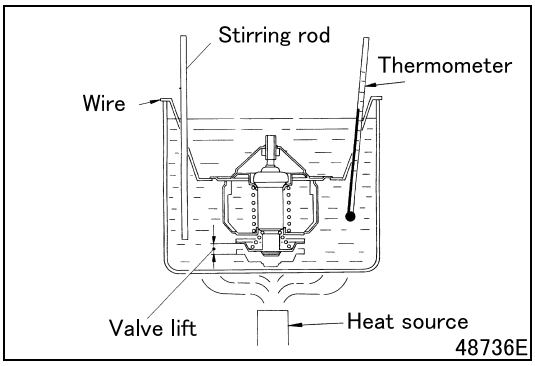
● Assembly sequence

Follow the disassembly sequence in reverse.

Service standards (Unit: mm {in.})

Location	Maintenance item		Standard value	Limit	Remedy
2	Thermostat	Valve opening temperature	82 ± 2°C {180 ± 3.6°F}	–	Replace
		Valve lift / temperature	10 {0.39} or more / 95°C {205°F}		

◆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 measured values deviate from the standard value ranges, replace the thermostat.

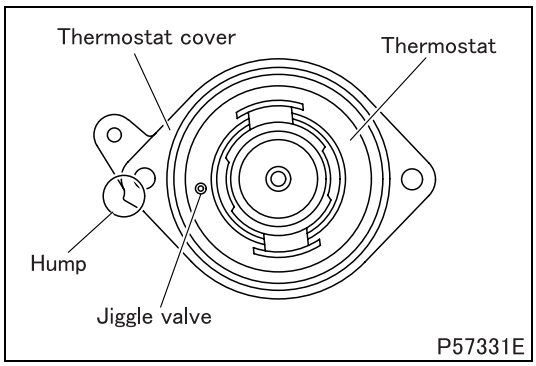
(1) Valve opening temperature

- 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 {150°F}.

(2) Valve lift

- Heat the water to a temperature slightly higher than the valve opening temperature. Maintain this temperature for five minutes and measure the valve lift.

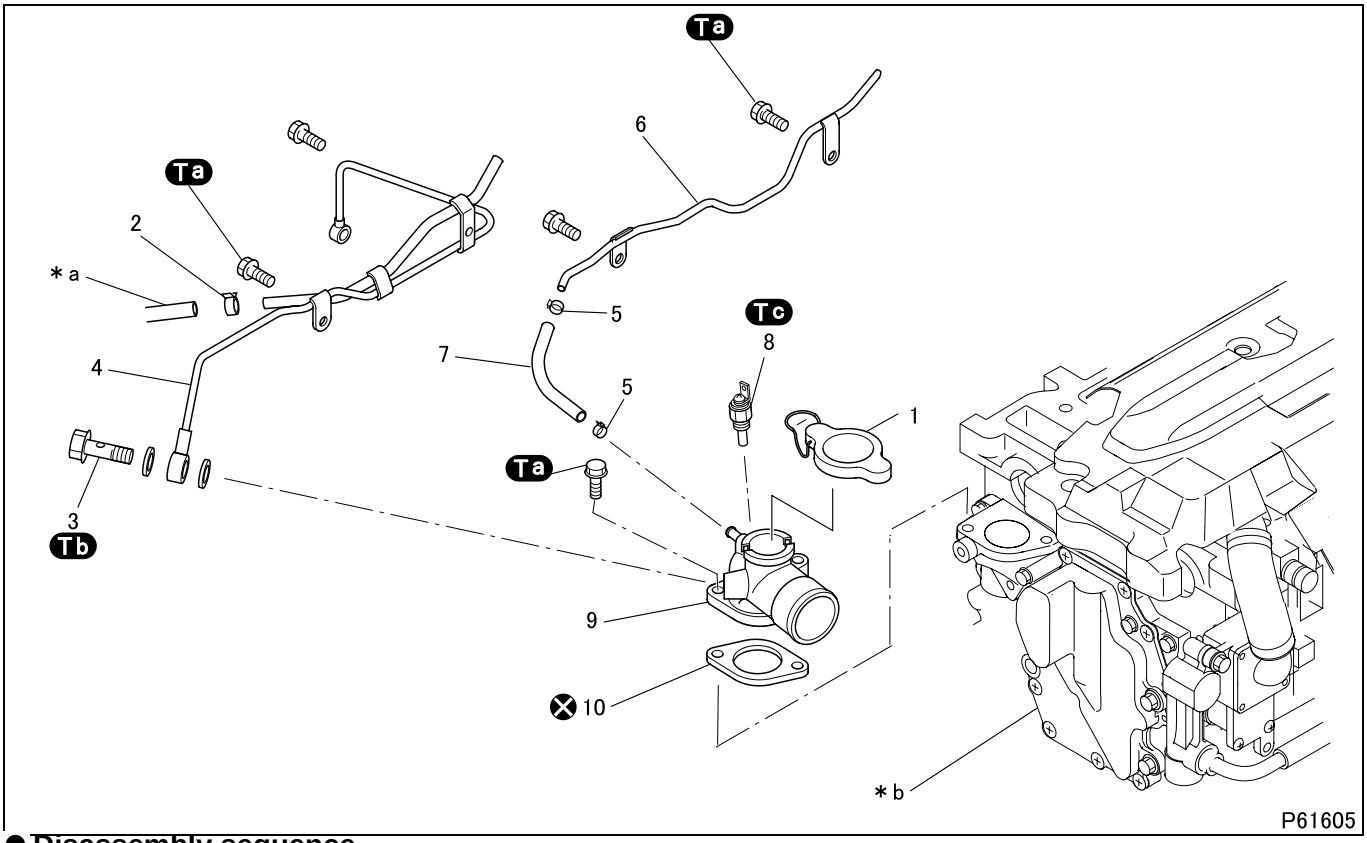
◆Installation procedure◆



■ **Installation: Thermostat**

- Mount the thermostat on the thermostat cover in the illustrated direction.

MITSUBISHI 4M50 THERMOSTAT CASE



● **Disassembly sequence**

1 Pressure cap
2 Clip
3 Eyebolt
4 Water and vacuum pipe
5 Clip
6 Water pipe
7 Water hose
8 Overheating switch
9 Water outlet case
10 Gasket
***a**: Vacuum hose
***b**: Breather cover
⊗: Non-reusable parts

● **Assembly sequence**

Follow the disassembly sequence in reverse.

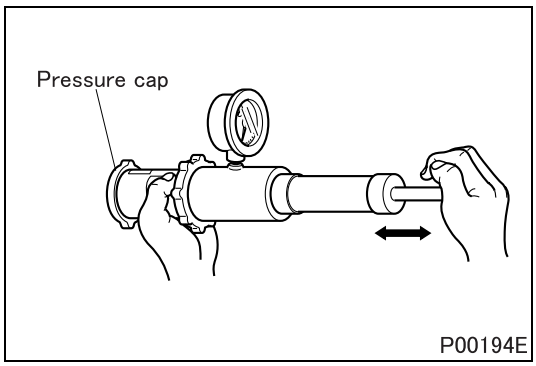
Service standards

Location	Maintenance item	Standard value	Limit	Remedy
1	Pressure cap valve opening pressure	110 ± 15 kPa {16 ± 2.2 psi, 1.1 ± 0.15 kgf/cm^3}	–	Replace

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

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (water and vacuum pipe mounting)	23.2 {17, 2.4}	–
	Bolt (water pipe mounting)		
	Bolt (water outlet pipe mounting)		
Tb	Eyebolt (water and vacuum pipe mounting)	25.5 {19, 2.6}	–
Tc	Overheating switch	34 ± 6.9 {25 ± 5.1, 3.5 ± 0.7}	–

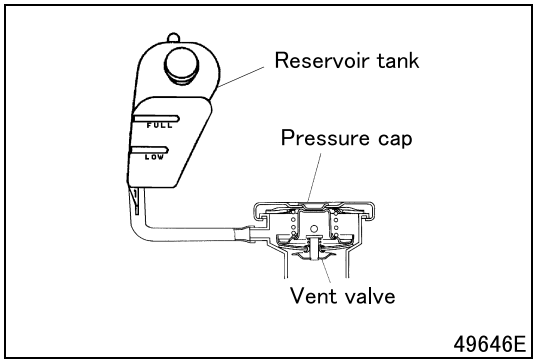
◆Inspection procedure◆



■ **Inspection: Pressure cap**

(1) Pressure valve opening pressure

- Replace the pressure cap if the measured value deviates from the standard value range.



(2) Inspection of vent valve

- Before starting the inspection, check the level of coolant in the reservoir tank.
- Run the engine at full speed. Stop the engine when the level of coolant in the reservoir tank noticeably rises.
- Wait until the coolant temperature drops to the ambient temperature. Then, check if the coolant in the reservoir tank has returned to the same level as that confirmed before the engine was started.
- If the coolant has failed to return to its original level, the vent valve is defective. In this case, replace the pressure cap.

CAUTION ⚠

- **Be aware that removing the pressure cap before the coolant cools down to the ambient temperature will result in loss of vacuum in the radiator, which disables the coolant from being returned to the reservoir tank.**

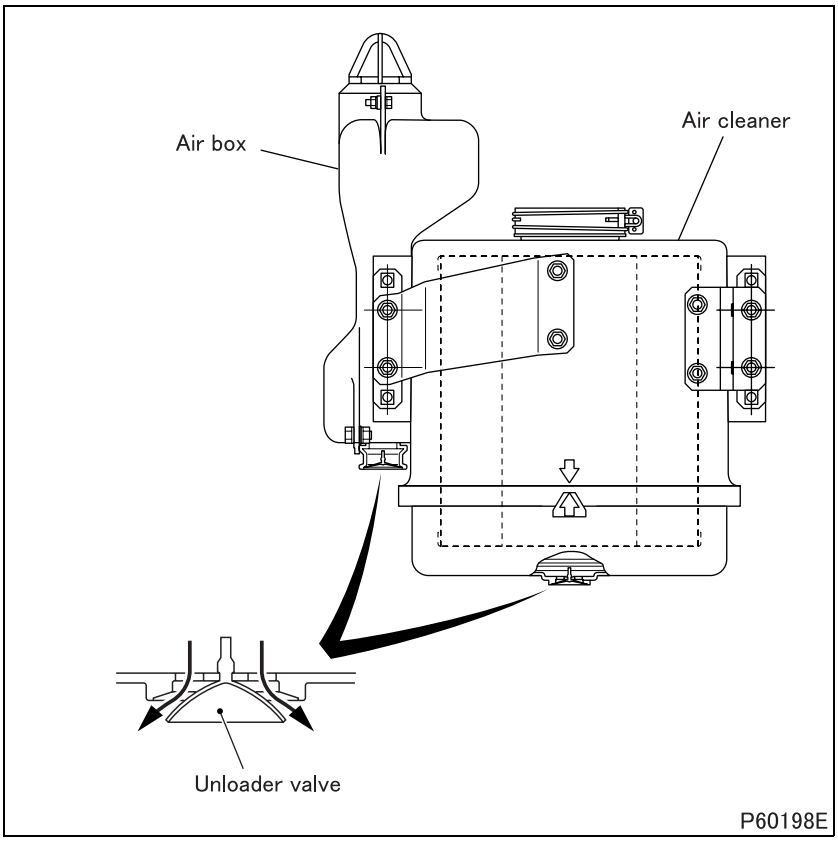
GROUP 15 INDEX

SPECIFICATIONS

Item		Specifications
Air cleaner element		Filter paper type
Turbocharger	Model	TD04
	Manufacturer	Mitsubishi Heavy Industries, Ltd.
Intercooler		Tube and corrugated fin type air-to-air heat exchanger

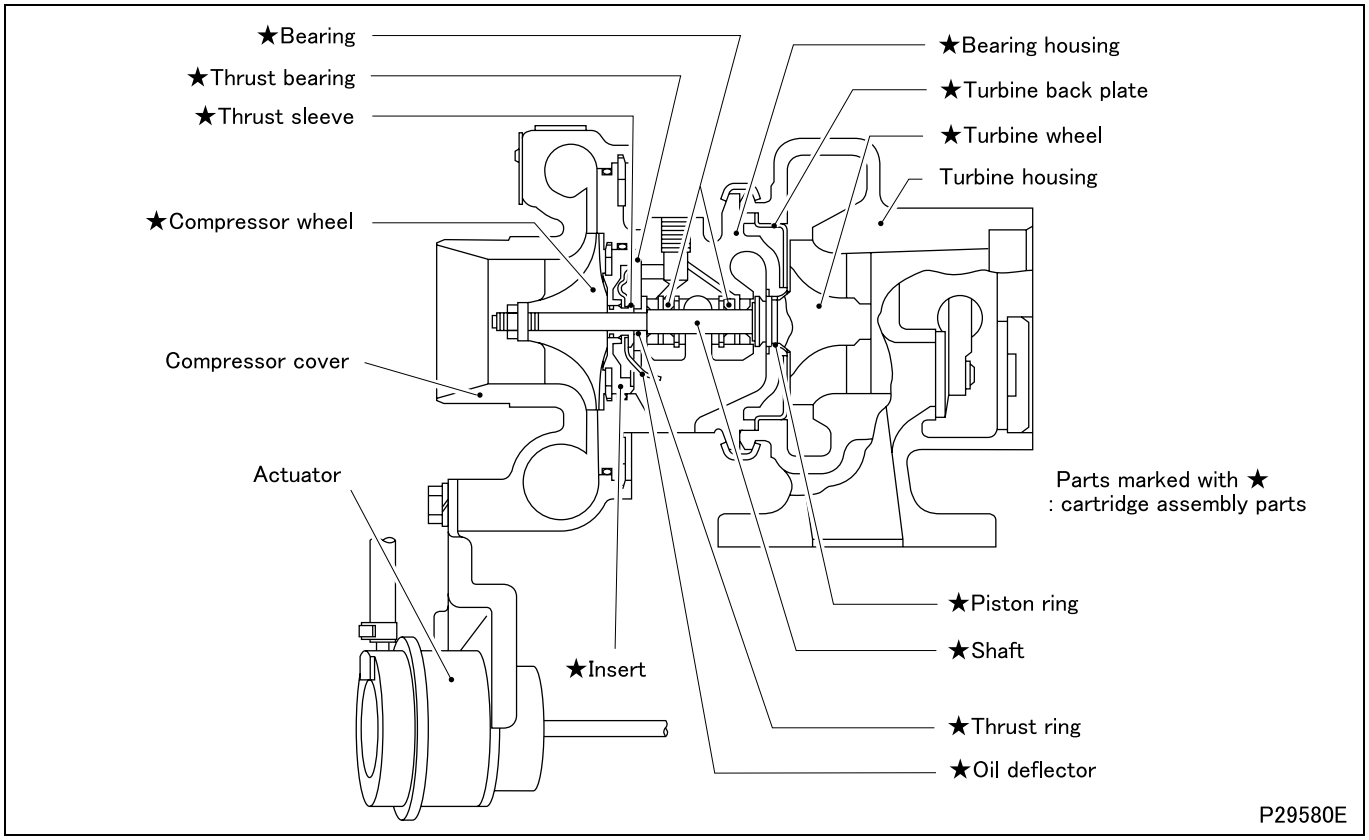
STRUCTURE AND OPERATION

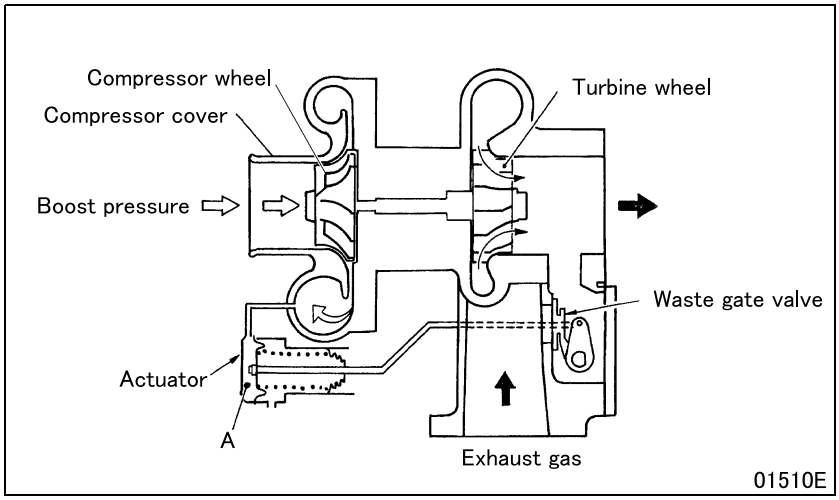
1. Air Cleaner



- The air cleaner is a single element type.
- When the engine slows down below the predetermined speed, the level of vacuum changes and causes the unloader valve to vibrate. Vibration of the unloader valve allows the air cleaner to automatically discharge any water and dust that has accumulated in its inside.

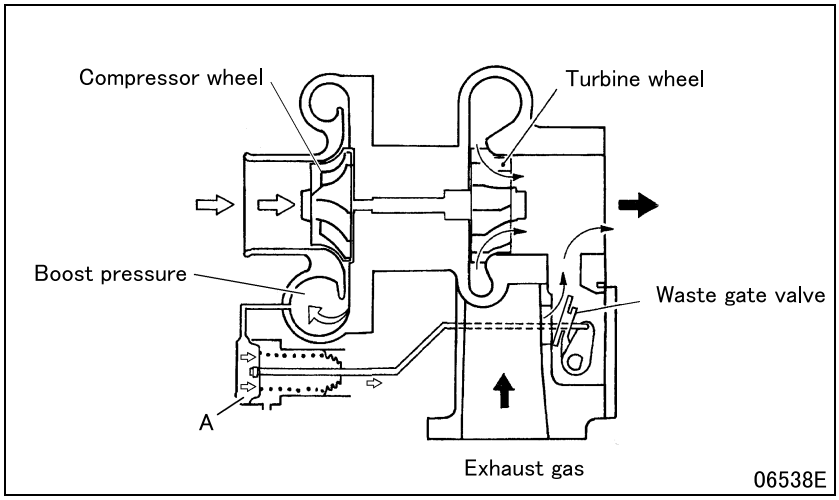
2. Mitsubishi 4M50 Turbocharger Parts





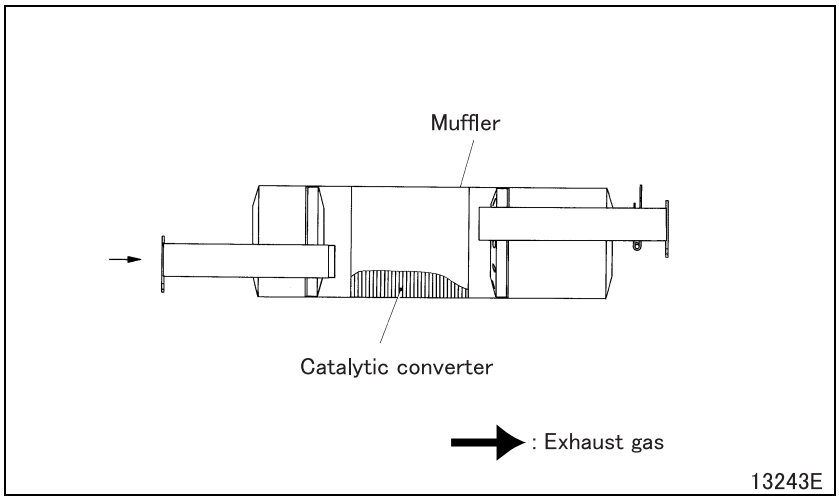
2.1 Waste gate mechanism

- The waste gate mechanism allows excess exhaust gas to escape from the turbocharger by means of an actuator in order to maintain the boost pressure at an appropriate level. This prevents overrunning of the turbocharger and excessive pressure buildups in the intake manifold.
- The boost pressure is led via a rubber hose from the compressor cover to chamber **A** in the actuator. When the boost pressure in chamber **A** is less than the predetermined value, the actuator does not function and the waste gate valve remains closed. All exhaust gas then flows toward the turbine wheel.



- When the boost pressure in chamber **A** exceeds the predetermined value, the waste gate valve opens, reducing the amount of exhaust gas flowing toward the turbine wheel. As a result, the speed of the compressor wheel and thus the boost pressure are reduced.

3. Muffler



- Converter is built into muffler to decrease the amount of particulate matter (PM) in the exhaust gas.

Possible causes \ Symptoms			Engine is difficult to start	Exhaust gas is black	Exhaust gas is white	Engine output is insufficient	Fuel consumption is too high	Intake and exhaust system vibrates and/or makes abnormal noises	Reference Gr
Air cleaner		Clogged air cleaner element	O	O		O			
Turbocharger	Cartridge assembly	Defective bearing		O		O		O	
		Carbon deposits on turbine wheel		O		O			
		Interference between turbine wheel and turbine back plate		O		O		O	
		Interference between turbine wheel and turbine housing		O		O		O	
		Bent shaft		O		O		O	
		Damaged turbine wheel		O		O		O	
		Interference between compressor wheel and compressor cover		O		O		O	
		Seizure of 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		
		Poorly installed piston ring					O		
		Unsmooth sliding of inner parts due to clogged lubricating oil pipe and/or eyebolt		O		O			
		Damaged oil seals due to clogged oil return pipe			O		O		
	Poorly mounted compressor cover			O		O	O	O	
	Poorly mounted turbine housing					O		O	
Intercooler						O			
Throttle actuator		Butterfly valve stuck in closed position		O	O	O			Gr13E
		Poorly adjusted butterfly valve		O	O	O			
Deformed front pipe, muffler, and/or tail pipe								O	
Poorly installed front pipe, muffler, and/or tail pipe								O	
Inappropriate valve clearance				O					Gr11
Defective cylinder head gasket				O					
Worn valve and valve seat and/or carbon deposits				O					
Weakened valve springs				O					
Worn and/or damaged piston rings					O		O		
Worn and/or damaged piston ring grooves					O		O		
Malfunctioning cooling system				O					Gr14
Excessive engine oil level					O				Gr12
Seizure of main moving parts				O					Gr11
Uneven or excessive fuel injection				O					Gr13E

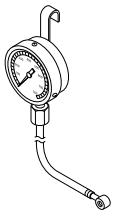
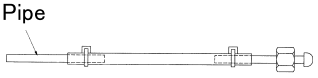
ON-VEHICLE INSPECTION AND ADJUSTMENT

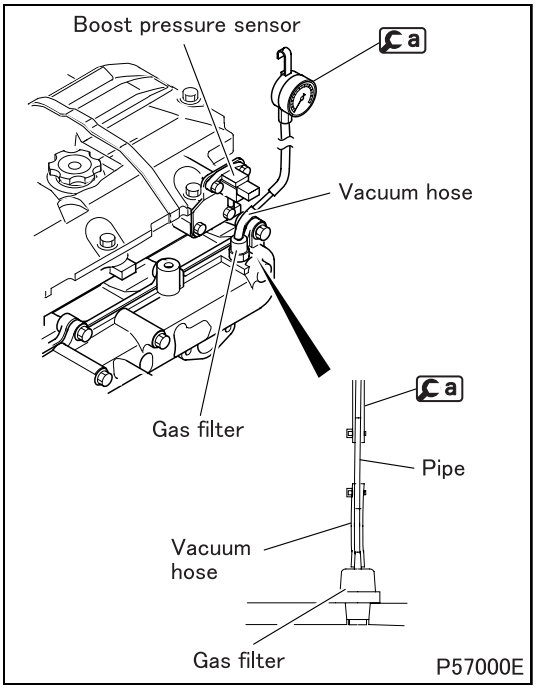
1. Measurement of Turbocharger Boost Pressure

Service standards (Unit: mm {in.})

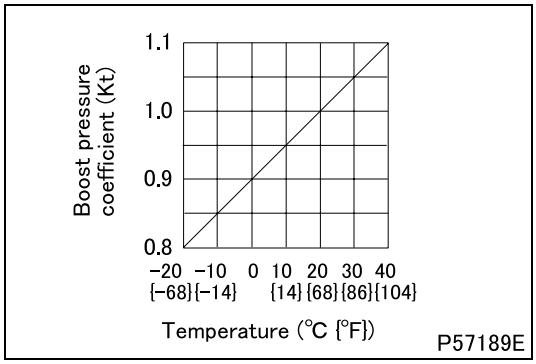
Location	Maintenance item		Standard value	Limit	Remedy
–	Boost pressure (temperature: 20°C {68°F}; air pressure: 100 kPa {29.9 in. Hg, 760 mmHg})	Boost pressure gauge reading	–	67.8 kPa {20 in. Hg, 509 mmHg} /3100 rpm	Inspect or adjust
		Multi-Use Tester reading (See Gr13E.)	–	168.8 kPa {49.9 in. Hg, 1270 mmHg} /3100 rpm	

Special tools

Mark	Tool name and shape	Part No.	Application
ⓐ	Boost pressure gauge  P01524	MH061366	Measurement of turbocharger boost pressure
ⓑ	Boost pressure gauge adapter  51603E	MH062047 (Only the pipe section will be used.)	



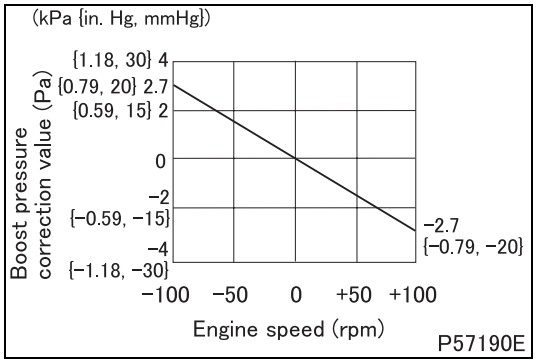
- Before measuring the turbocharger boost pressure, clean or replace the air cleaner element.
- Disconnect the vacuum hose from the boost pressure sensor.
- Connect the pipe ⓑ between the vacuum hose connected to the gas filter and ⓐ.
- Warm up the engine well, then measure the boost pressure at no-load maximum speed. Also measure the engine speed and atmospheric temperature.



- Adjust the boost pressure to the standard value (boost pressure changes according to the atmospheric temperature and the engine speed).

[Atmospheric temperature correction of boost pressure]

- Based on the current atmospheric temperature, determine the appropriate boost pressure correction coefficient in the graph.

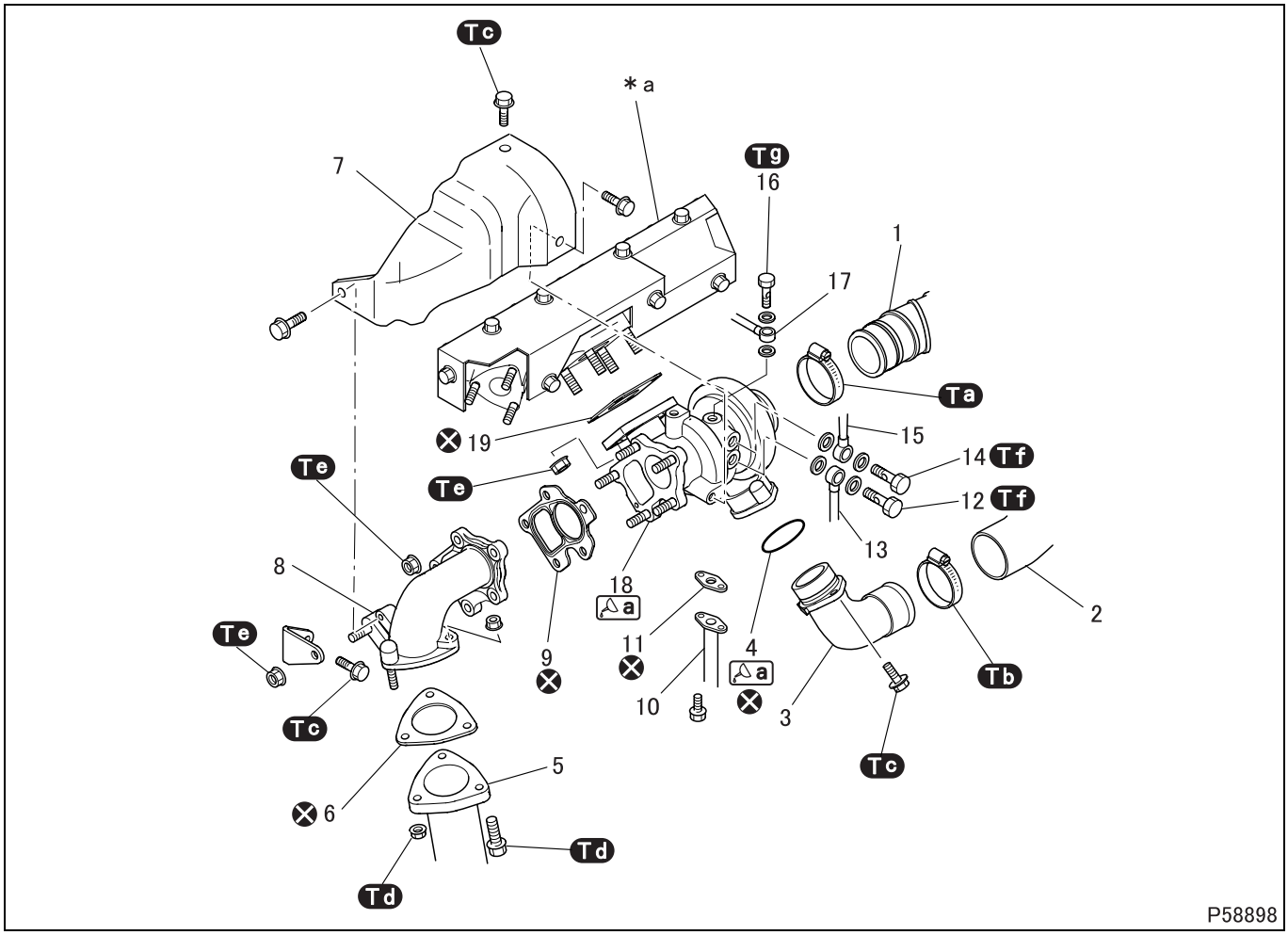


[Engine speed correction of boost pressure]

- Subtract the median of the no-load maximum speed values from the engine speed at the time of boost pressure measurement. Use the difference to determine the necessary boost pressure correction value (Pa) in the graph.
  Median: 3200 rpm

[Calculation of corrected boost pressure]

- With **P** as the measured boost pressure, determine the correctedboost pressure **Pb** using the following equation:
  Pb = **KtP** + **Pa**
  Pb: Corrected boost pressure
  P: Measured boost pressure
  Kt: Ambient temperature correction coefficient for boost pressure
  Pa: Boost pressure correction value
- The turbocharger must be inspected and/or adjusted if **Pb** is below the specified limit.



● **Removal sequence**

1 Air hose
2 Air inlet hose
3 Turbocharger coupler
4 O-ring
5 Front pipe
6 Gasket
7 Insulator
8 Exhaust coupler
9 Gasket
10 Oil return pipe
11 Gasket
12 Eyebolt
13 Water pipe
14 Eyebolt
15 Water and vacuum pipe
16 Eyebolt
17 Oil pipe
18 Turbocharger (See later section.)
19 Gasket

***a**: Exhaust manifold
⊗: Non-reusable parts

● **Installation sequence**

Follow the removal sequence in reverse.

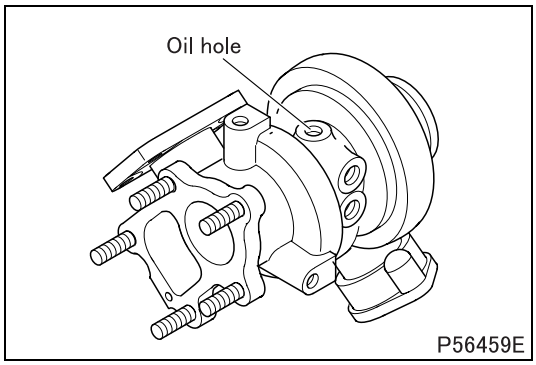
Mitsubishi 4M50 Tightening torque (Unit: N·m {lbf·ft, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Clamp	3 to 3.4 {2.2 to 2.5, 0.3 to 0.35}	–
Tb	Clamp	3.9 to 4.9 {2.9 to 3.6, 0.4 to 0.5}	–
Tc	Bolt (turbocharger coupler mounting)	23.2 {17, 2.4}	–
	Bolt (insulator mounting)		
	Bolt (exhaust pipe stay mounting)		
Td	Bolt (front pipe mounting)	25 to 30 {18 to 22, 2.5 to 3.1}	–
	Nut (front pipe mounting)		
Te	Nut (exhaust coupler stay mounting)	53 {39, 5.4}	–
	Nut (exhaust coupler mounting)		
	Nut (turbocharger mounting)		
Tf	Eyebolt (water pipe mounting)	25.5 {19, 2.6}	–
	Eyebolt (water and vacuum pipe mounting)		
Tg	Eyebolt (oil pipe mounting)	23.5 {17, 2.4}	–

Lubricant and/or sealant

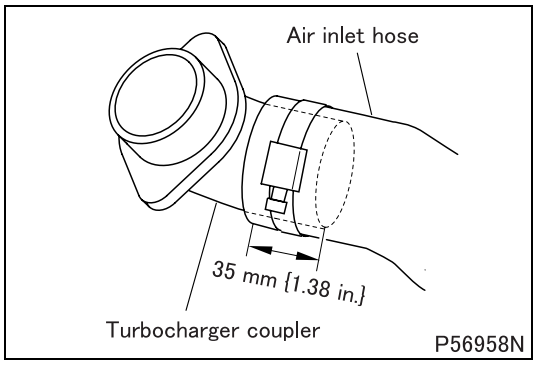
Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	O-ring	Engine oil	As required
	Turbocharger		

◆Installation procedure◆



■ Installation: Turbocharger

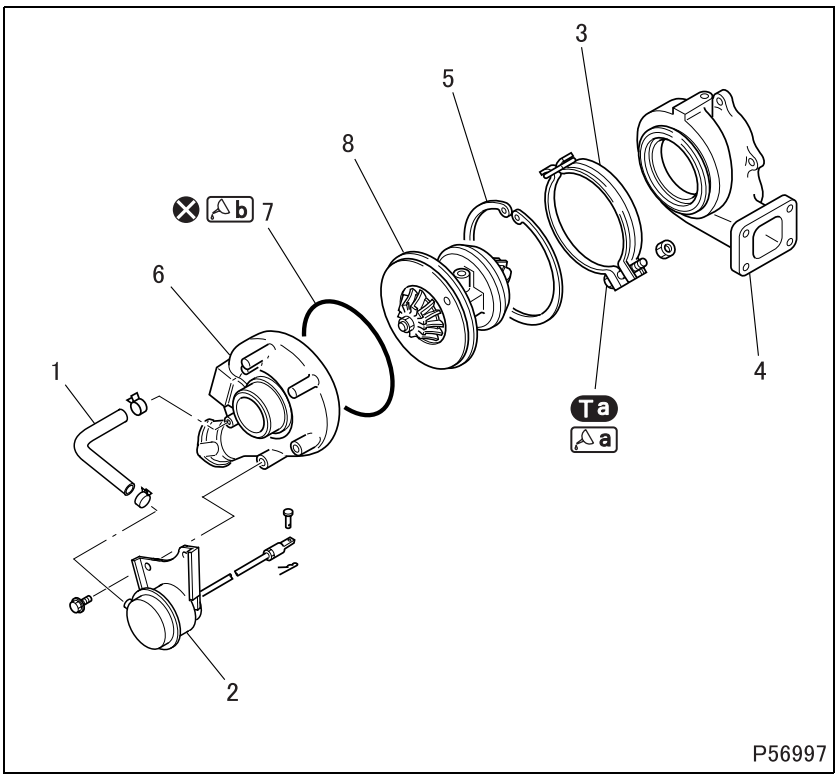
- When installing the turbocharger, fill adequate amount of engine oil through the oil hole for smooth operation.



■ Installation: Air inlet hose

- Install the air inlet hose on the turbocharger coupler to the indicated dimension.

Mitsubishi 4M50 Turbocharger Parts



●Disassembly sequence

1 Hose
2 Actuator
3 Coupling
4 Turbine housing
5 Snap ring
6 Compressor cover
7 O-ring
8 Cartridge assembly

⊗: Non-reusable parts

●Assembly sequence

Follow the disassembly sequence in reverse.

CAUTION ⚠

- **The cartridge assembly cannot be disassembled. If the turbine wheel or the compressor cover is damaged or does not rotate smoothly, replace the entire cartridge assembly.**

Service standards (Unit: mm {in.})

Location	Maintenance item			Standard value	Limit	Remedy
8	Cartridge assembly	Play in axial directions		0.03 to 0.10 {0.0012 to 0.0039}	0.11 {0.0043}	Replace
		Play in radial directions	Turbine wheel end	0.40 to 0.53 {0.016 to 0.021}	0.58 {0.023}	Replace
			Compressor wheel end	0.55 to 0.66 {0.022 to 0.026}	0.72 {0.028}	Replace

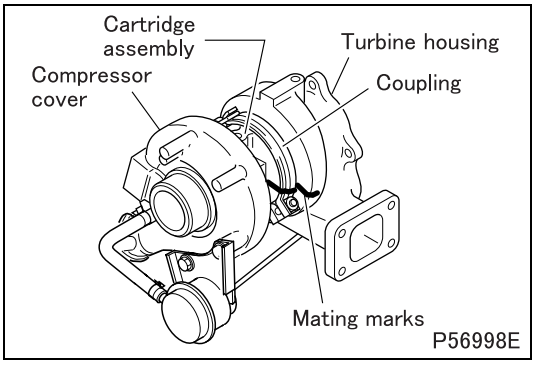
Tightening torque (Unit: N·m {lbf·ft, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (coupling fastening)	7.8 to 8.8 {5.8 to 6.5, 0.8 to 0.9}	Wet

Lubricant and/or sealant

Mark	Points of application	Specified lubricant and/or sealant	Quantity
a	Bolt threads	MoriCoat BR-2 Plus	As required
b	O-ring	Engine oil	As required

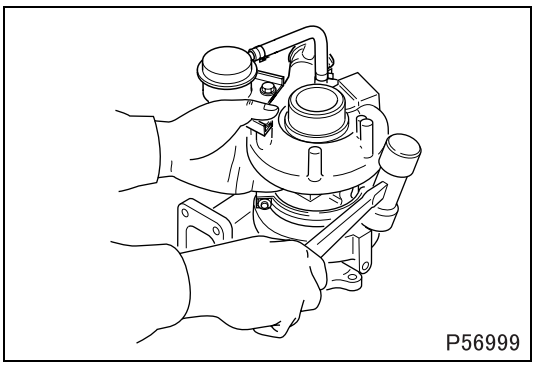
◆Work before removal◆



■ Mating marks

- Draw a line across the coupling, turbine housing, compressor cover, and cartridge assembly. This line will serve as mating marks in the installation procedure.

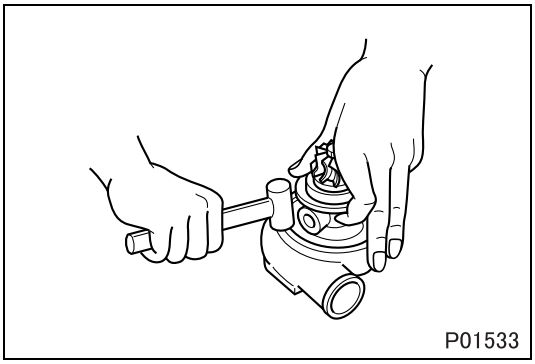
◆Removal procedure◆



■ **Removal: Turbine housing**

CAUTION ⚠

- **Tap all around the end of the turbine housing with a rubber hammer or a similar tool, being careful not damage the turbine housing.**
- **Do not let the blades of the cartridge assembly hit the turbine housing, as they are easily bent.**

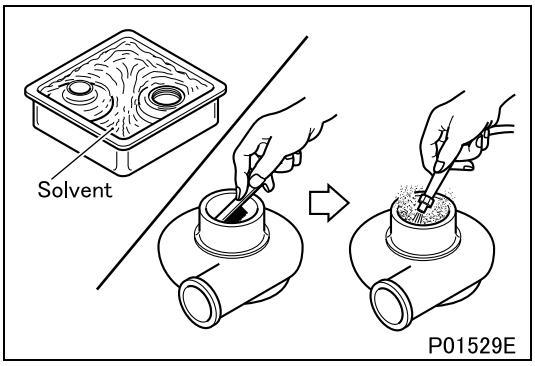


■ **Removal: Compressor cover**

CAUTION ⚠

- **Tap all around the end of the turbine housing with a rubber hammer or a similar tool, being careful not damage the turbine housing.**
- **Do not let the blades of the cartridge assembly hit the turbine housing, as they are easily bent.**

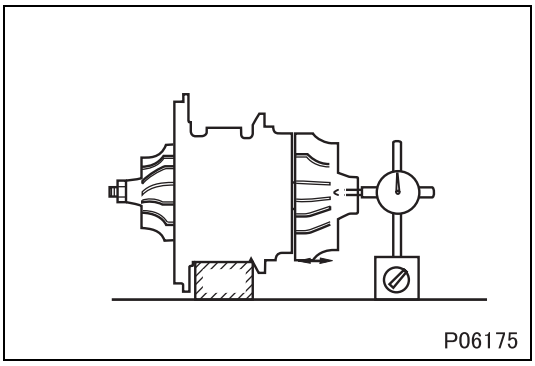
◆Work after disassembly◆



■ **Cleaning**

- Before cleaning the parts, carry out a visual inspection for any marks of burns or wear that may become difficult to find after the cleaning. If any defects are evident, replace the part(s).
- Immerse the disassembled parts in an inflammable solvent (Daicleaner-T-30 by Daido Chemical Industry Co., Ltd.). Remove the parts from the solvent, and dry them with compressed air.
  If there is any solid matter remaining on the parts, remove them with a plastic scraper or a bristle brush.
- Reimmerse the parts in the solvent.
- Dry each part with compressed air.

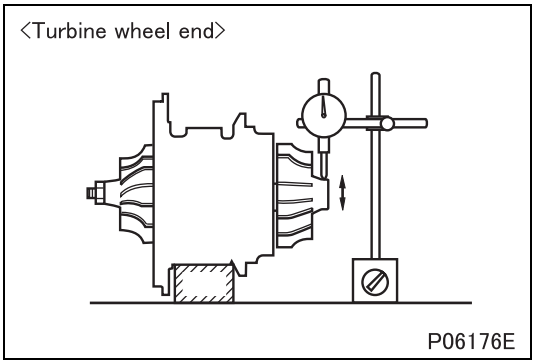
◆Inspection procedure◆

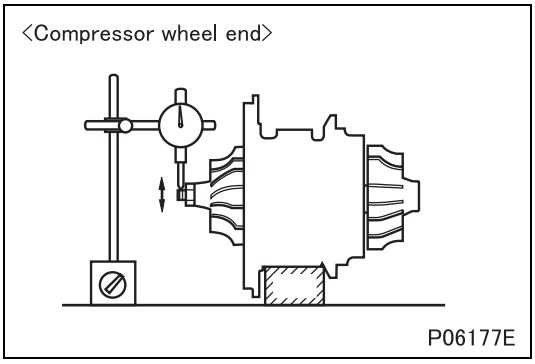


■**Inspection: Cartridge assembly**

(1) Play in axial directions

- If the measurement exceeds the specified limit, replace the cartridge assembly.

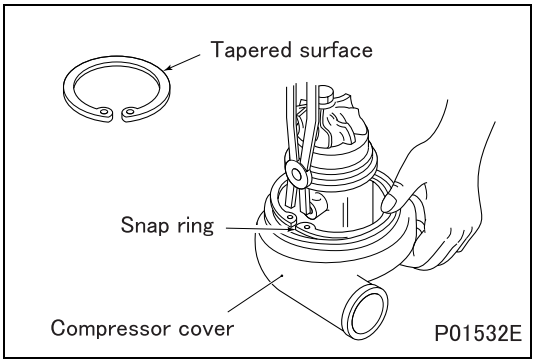




(2) Play in radial directions

- If the measurement exceeds the specified limit, replace the cartridge assembly.

◆Installation procedure◆



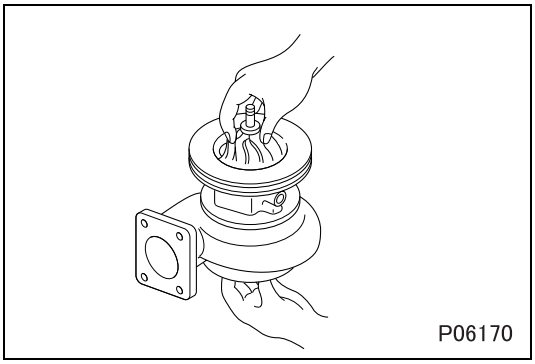
■ Installation: Snap ring

- Fit the snap ring into the compressor cover with the tapered surface on top.

CAUTION ⚠

- **Always keep one hand on the snap ring to prevent it from flying off.**

◆Work after installation◆

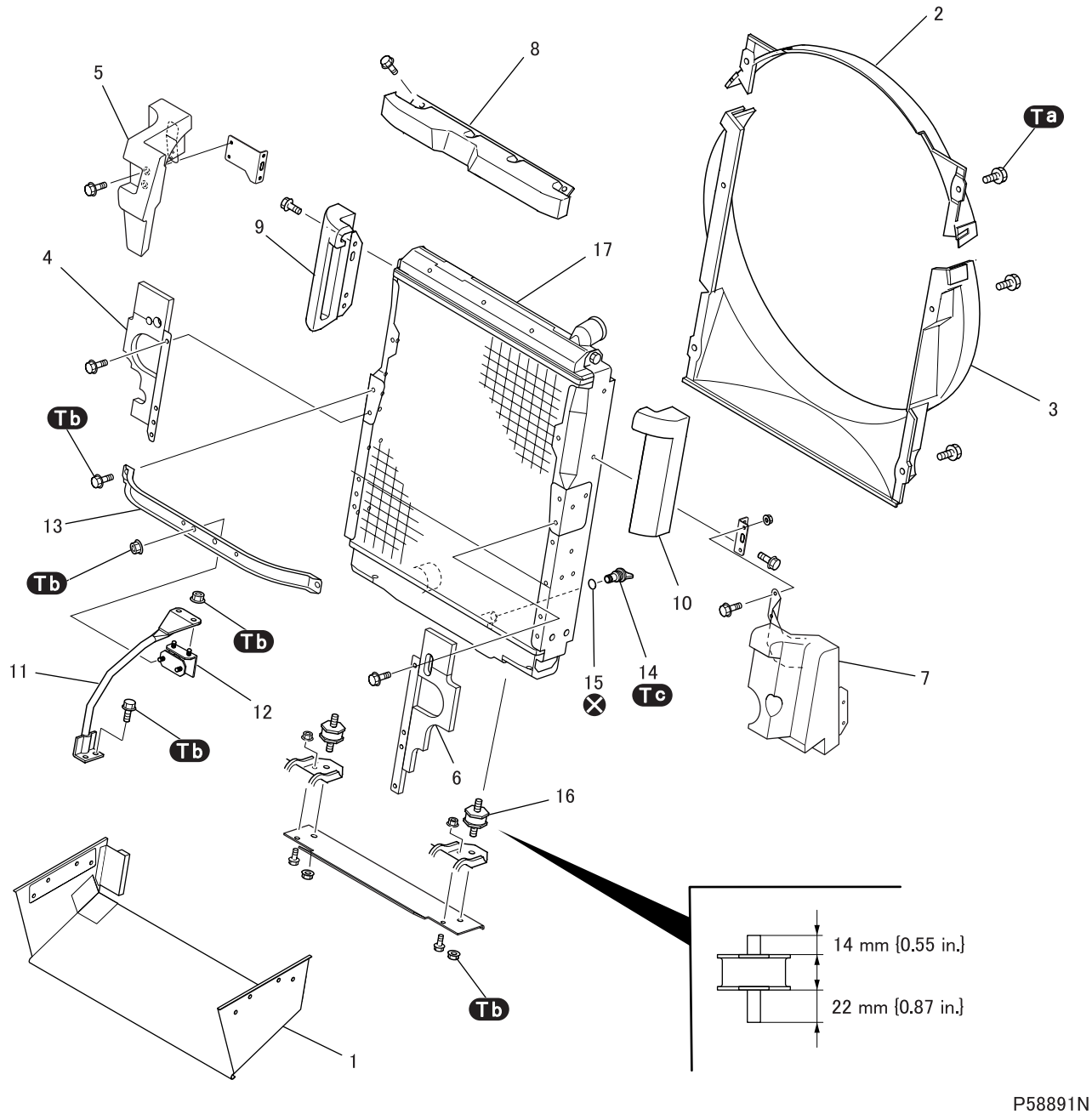


■ Inspection: Rotation of cartridge assembly

- Turn both wheels of the cartridge assembly to check that they rotate smoothly.
- If anything abnormal is found, disassemble the cartridge assembly and perform necessary service.

M E M O

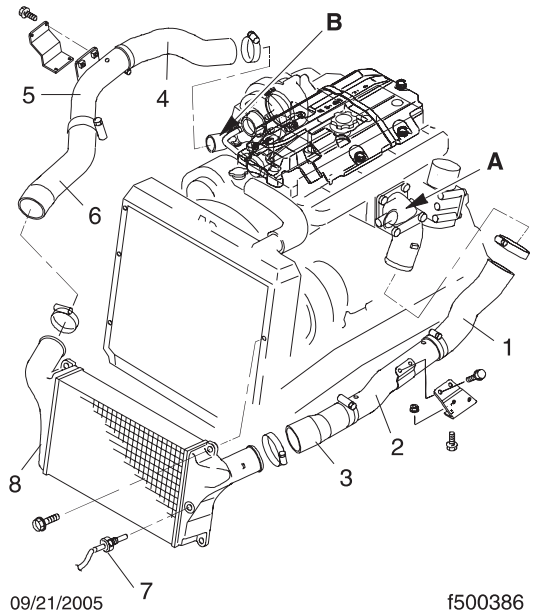
MITSUBISHI 4M50 INTERCOOLER



P58891N

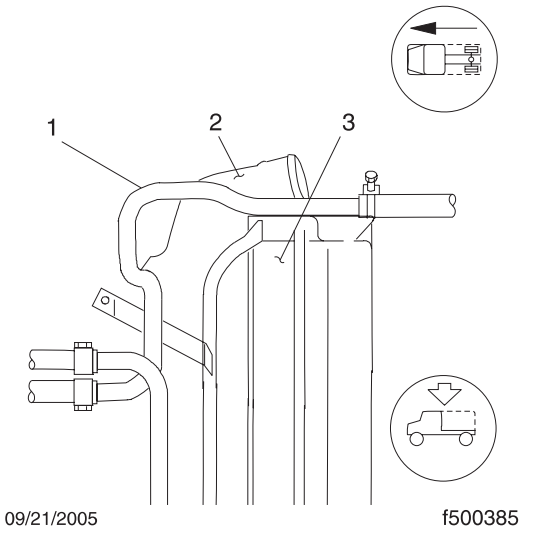
1. Air scoop
2. Upper shroud
3. Lower shroud
4. Baffle plate RH
5. Baffle plate RH
6. Baffle plate LH
7. Baffle plate LH
8. Baffle plate upper
9. Baffle plate RH
10. Baffle plate LH
11. Support rod
12. Support cushion
13. Upper support
14. Radiator drain cock
15. O-ring
16. Support cushion
17. Radiator (See later section.)

⊗: Non-reusable parts



1. Air inlet hose
2. Air inlet pipe LH
3. Air inlet hose
4. Air inlet hose
5. Air inlet pipe RH
6. Air inlet hose
7. Intake temperature sensor
8. Intercooler

A Air inlet duct
B Turbocharger coupler



1. Heater line
2. Intercooler
3. Radiator

● Removal sequence

NOTE: The radiator and intercooler must be removed as an assembly then separated as needed.

1. Park the vehicle on a level surface, set the parking brake, chock the tires, and shut down the engine.
2. Tilt the cab.

WARNING ⚠

Drain the coolant only when the coolant and engine are cool. Draining it when these are hot could cause severe personal injury due to scalding.

3. Remove the radiator cap and drain the coolant.
4. Remove the air hose (#4) from turbo inlet.
5. Detach the metal air inlet pipe (#5) from the support bracket.
6. Remove the air inlet air hose (#6) from intercooler.
7. Remove the air inlet hose (#1) from the intake manifold.
8. Remove the metal air inlet pipe (#2) from the support bracket.
9. Remove the air inlet hose (#3) from the intercooler.
10. Disconnect the connector for the intercooler temp sensor. Remove the temperature sensor from intercooler.
11. Remove the air scoop.
12. From under the truck, remove the following pieces from the radiator:
    - Baffle plate RH (#5)
    - Baffle plate RH (#9)
    - Baffle plate LH (#10)
    - Baffle plate LH (#7)
    - Support rod (#11)
    - Upper support (#13)
    - A/C line support bracket (lower right side).
13. Disconnect the heater line that goes around the lower right side of radiator.
14. Disconnect the upper radiator hose.
15. Disconnect the lower radiator hose.
16. Disconnect any heater hose or A/C line support brackets in front of radiator.
17. Remove the upper fan shroud.
18. Remove the lower fan shroud.
19. Remove the two nuts securing the radiator to the frame crossmember.
20. Remove the radiator and intercooler.
21. Remove the intercooler from radiator. Keep track of the brackets sandwiched between the intercooler and radiator.

● Installation sequence

1. Install the intercooler onto the radiator. Make sure the correct brackets are installed between intercooler and radiator.
2. Install the radiator and intercooler into the truck. Align the radiator mounting studs with holes in the frame crossmember. Install, but do not tighten, the nuts at this time.
3. Install the lower fan shroud.

4. Install the upper fan shroud.
5. Attach the heater tube to the lower right side of the radiator. Attach the heater hoses to the tube.
6. Install the A/C line support bracket on the lower right side of the radiator.
   NOTE: From this point on, install fasteners but do not tighten until all support brackets are installed.
7. Install the hoses from the turbo to the intercooler.
8. Attach the metal air inlet pipe #5 to the support bracket.
9. Install the RH baffle plates.
10. Install the hoses from the intercooler to the intake manifold.
11. Fasten the metal air inlet pipe #2 to the support bracket.
12. Install the heater hose bracket to the radiator.
13. Install the LH baffle plates.
14. Install the upper support on the front of the radiator.
15. Install the support rod.
16. Install all heater hose and A/C line support brackets in front of the radiator.
17. Tighten all fasteners.
18. Install the lower radiator hose.
19. Install the upper radiator hose.
20. Install the intercooler temperature sensor. Attach the connector.
21. Tighten the two nuts that secure the radiator to the frame crossmember.
22. Install the air scoop.
23. Close the radiator drain cock.
24. Fill the system with coolant. Install the radiator cap.
25. Start the engine and check for air and water leaks.

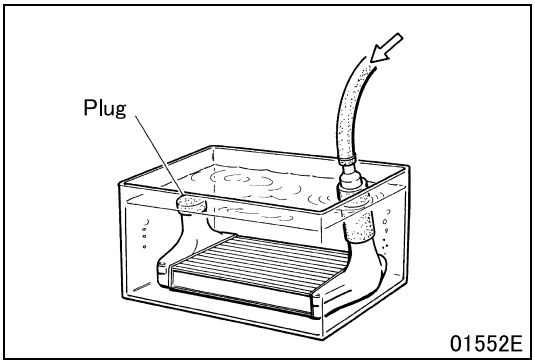
Service standards (Unit: mm {in.})

Location	Maintenance item	Standard value	Limit	Remedy
8	Intercooler air leakage (air pressure: 200 kPa {29 psi, 2.0 kgf/cm^2} maintained for 30 seconds)	0 cm^3 {0 cu.in.}	–	Replace

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

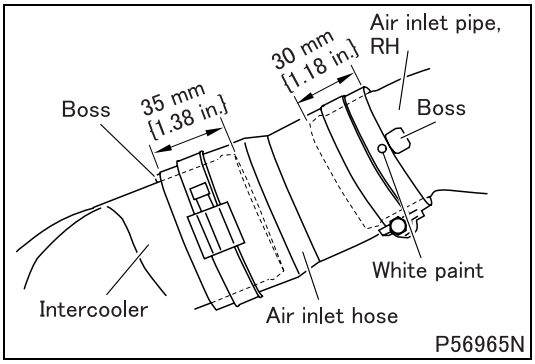
Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Clamp	3.9 to 4.9 {2.9 to 3.6, 0.4 to 0.5}	–
Tb	Mitsubishi 4M50 Intake temperature sensor	24.5 {18, 2.5}	–

◆Inspection procedure◆



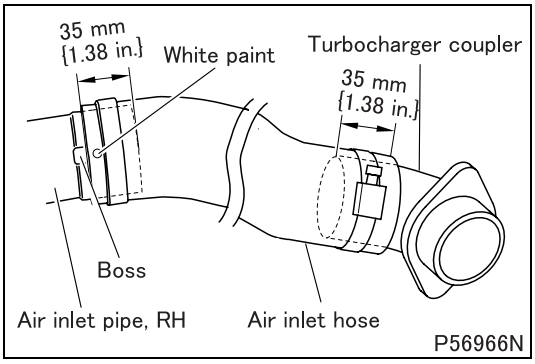
■ Inspection: Intercooler

- Plug one of the air ports on the intercooler and connect an air source to the other port. Place the intercooler in a tank of water and apply air pressure of the specified level (200 kPa {29 psi, 2.0 kgf/cm^2}) to the intercooler and retain the pressure for 30 seconds.
- Replace the intercooler if any air leakage is evident.

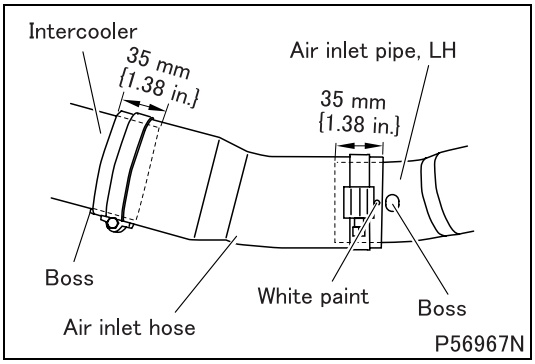


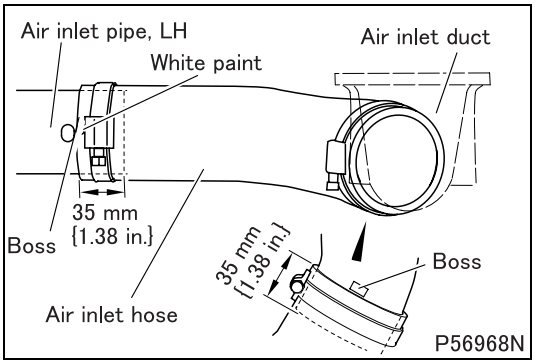
■ Installation: Air inlet hose

- Connect the air inlet hose to the RH air inlet pipe with the white paint on the hose aligned with the boss on the pipe.
- Connect the air inlet hoses to the intercooler, RH air inlet pipe and turbocharger coupler to the dimensions indicated in the illustrations.

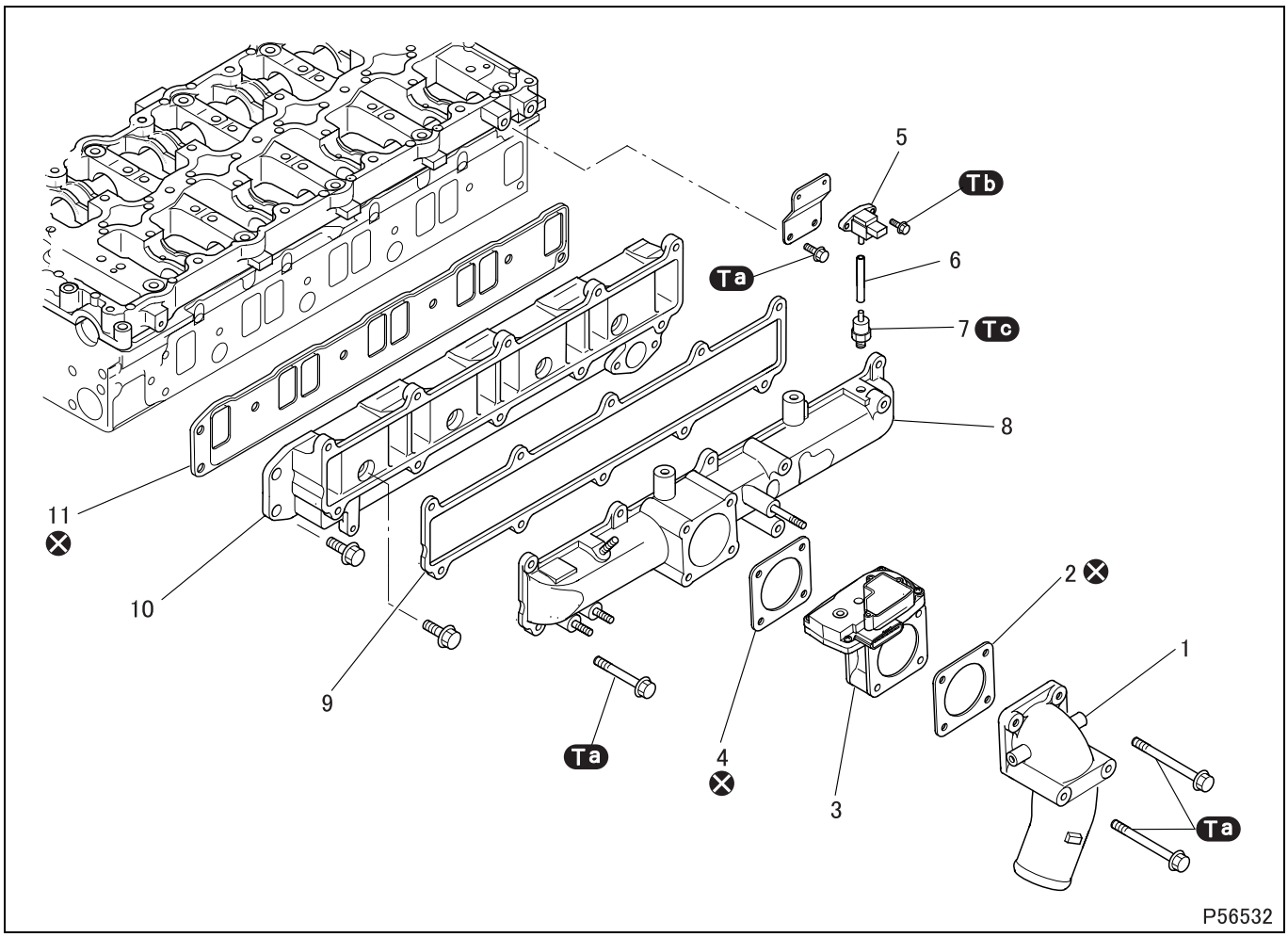


- Connect the air inlet hose to the LH air inlet pipe with the white paint on the hose aligned with the boss on the pipe.
- Connect the air inlet hoses to the intercooler, LH air inlet pipe and air inlet duct to the dimensions indicated in the illustrations.





MITSUBISHI 4M50 INTAKE MANIFOLD



● **Disassembly sequence**

1 Air inlet duct
2 Gasket
3 Intake throttle
4 Gasket
5 Boost pressure sensor
6 Vacuum hose
7 Gas filter
8 Intake manifold B
9 Mitsubishi 4M50 Intake Gasket B
10 Intake manifold A
11 Mitsubishi 4M50 Intake Manifold Gasket A

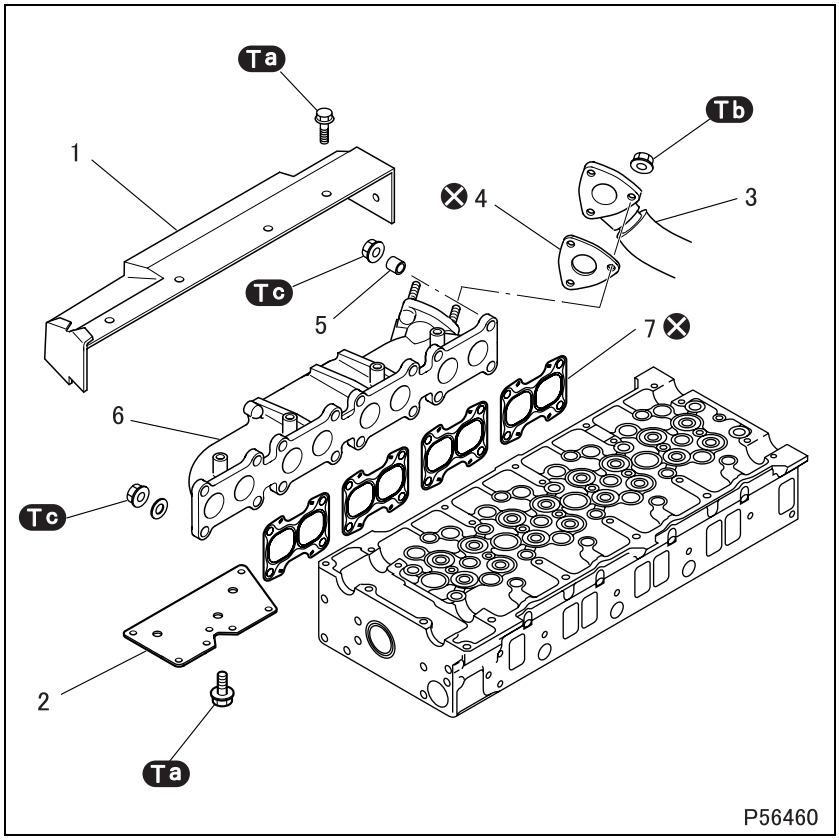
⊗: Non-reusable parts

● **Assembly sequence**

Follow the disassembly sequence in reverse.

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

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (air inlet duct and throttle actuator mounting)	23.2 {17, 2.4}	–
	Bolt (boost pressure sensor bracket mounting)		
	Bolt (intake manifold B mounting)		
Tb	Bolt (boost pressure sensor mounting)	12.7 {9.4, 1.3}	–
Tc	Gas filter	14.7 to 19.6 {11 to 14, 1.5 to 2.0}	–



● **Disassembly sequence**

1 Insulator
2 Under insulator
3 Exhaust gas recirculation pipe
4 Gasket
5 Distance piece
6 Exhaust manifold
7 Mitsubishi 4M50 Exhaust Manifold Gaskets
⊗: Non-reusable parts

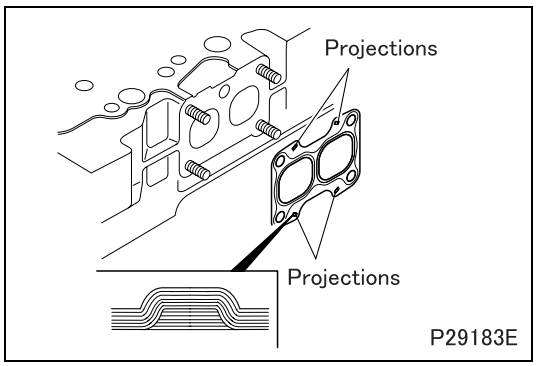
● **Assembly sequence**

Follow the disassembly sequence in reverse.

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

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (insulator mounting)	11.8 {8.7, 1.2}	–
Tb	Nut (exhaust gas recirculation pipe mounting)	20.6 {15, 2.1}	–
Tc	Mitsubishi 4M50 exhaust manifold mounting nut	41.2 {30, 4.2}	–

◆**Installation procedure**◆



■ **Installation: Gasket**

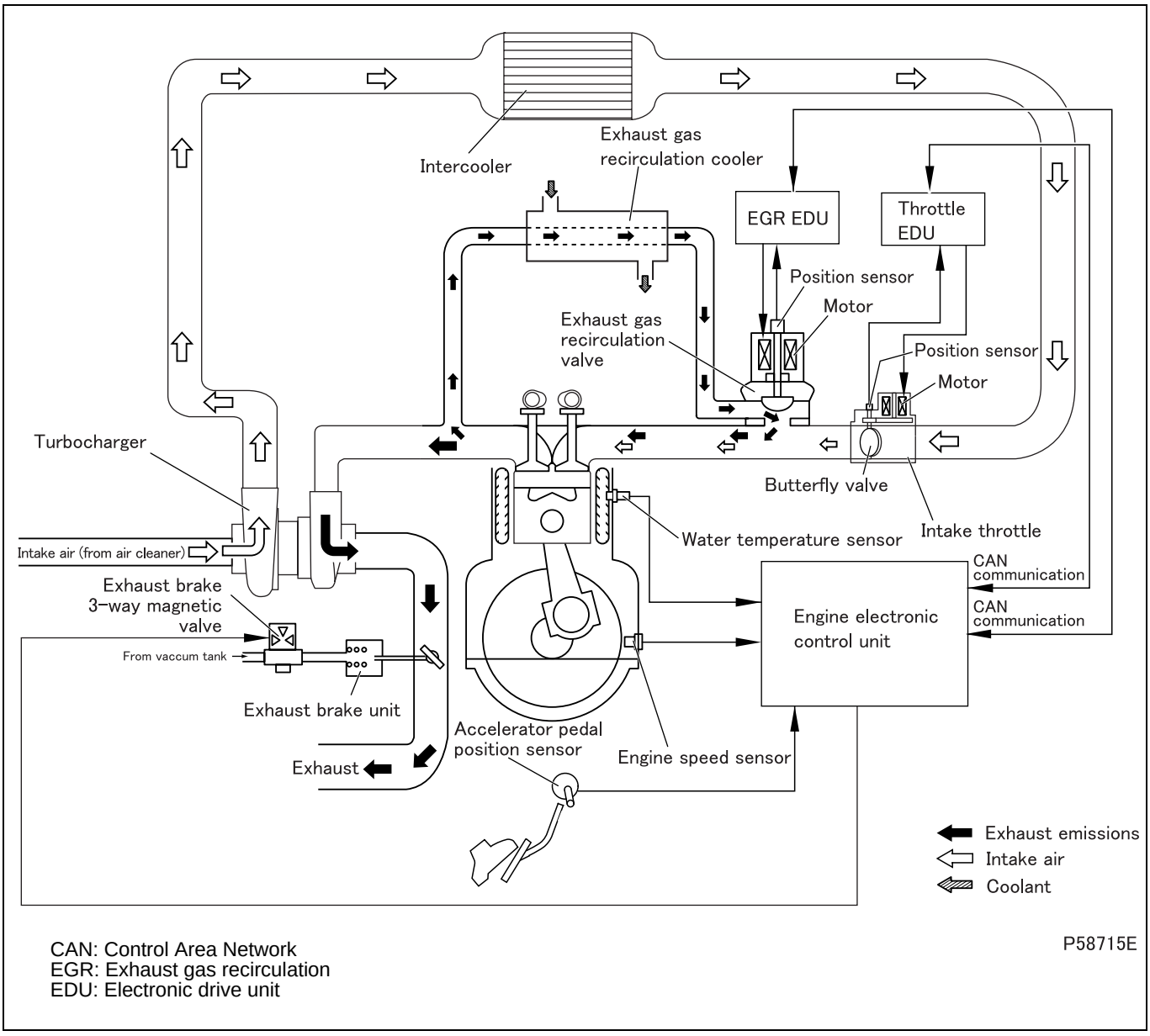
- Install the gasket on the cylinder head with their surfaces facing in the illustrated directions.

GROUP 17 INDEX

1. Mitsubishi 4M50 Exhaust Gas Recirculation System

1.1 Overview

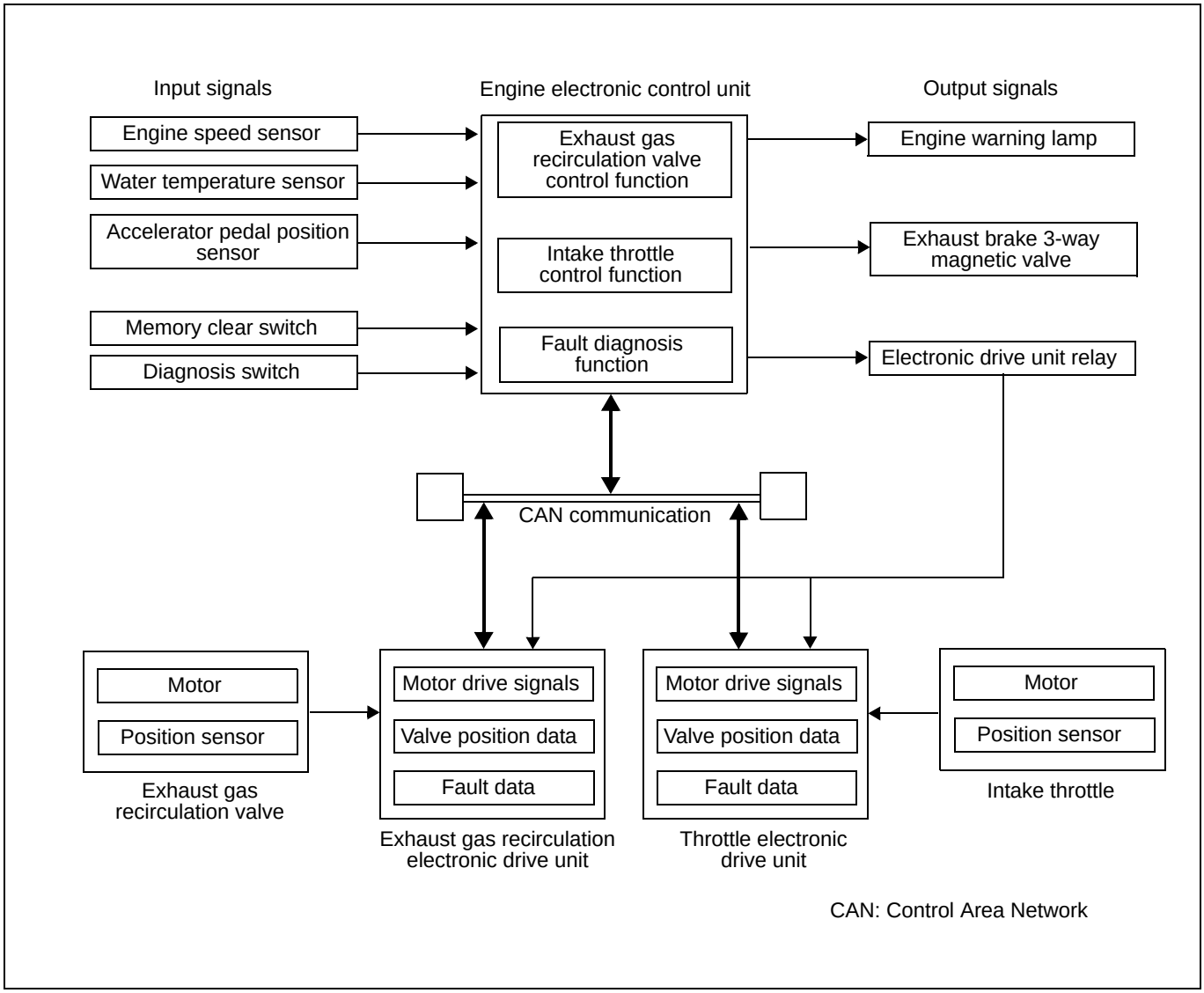
- In the exhaust gas recirculation system, the engine electronic control unit and multiple electronic drive units control the exhaust gas recirculation valve and intake throttle in accordance with information from sensors on various aspects of the engine (engine speed, coolant temperature, throttle opening, etc.).
- Exhaust gas recirculation involves the introduction of inert gases in the post-combustion exhaust emissions into the intake manifold. By reducing the combustion temperature, it reduces the amount of nitrogen oxides (NOx), which are harmful, in the exhaust emissions. Further, an exhaust gas recirculation cooler cools the recirculated exhaust emissions, thereby reducing the peak combustion temperature.
- The intake air quantity is adjusted by means of intake throttle control such that the effectiveness of exhaust gas recirculation is maximized.



CAN: Control Area Network
EGR: Exhaust gas recirculation
EDU: Electronic drive unit

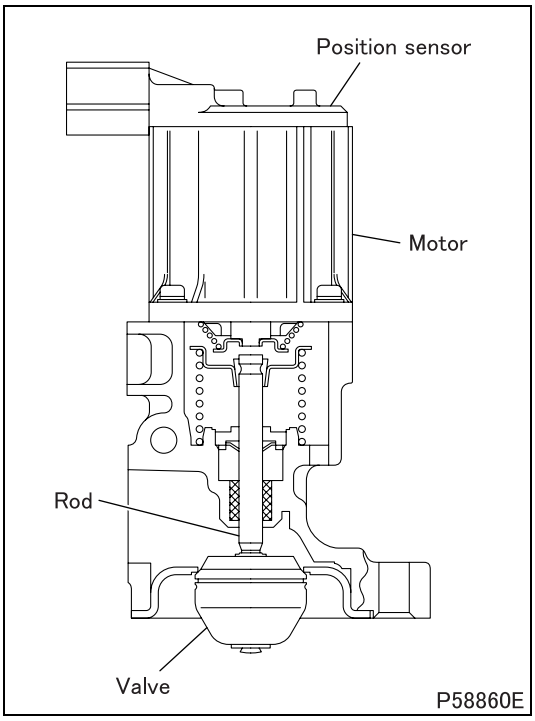
1.2 Electronic control system

(1) System block diagram



(2) Exhaust gas recirculation valve control function

- In accordance with data from sensors, the engine electronic control unit determines the exhaust gas recirculation valve opening that suits the operating condition and sends a control signal (this indicates the target exhaust gas recirculation valve opening) to the exhaust gas recirculation electronic drive unit.
  When necessary to prevent black smoke emissions and engine speed instability (for example, when the engine is heavily loaded, when the engine is lightly loaded, and when the exhaust brake is operating), the engine electronic control unit stops exhaust gas recirculation valve control.
- The exhaust gas recirculation electronic drive unit activates the exhaust gas recirculation valve motor. At the same time, it monitors the extent of valve lift using a position sensor and sends this information (this indicates the actual exhaust gas recirculation valve opening) to the engine electronic control unit.
  This operation makes it possible for the target exhaust gas recirculation valve opening indicated by the engine electronic control unit to be precisely maintained.

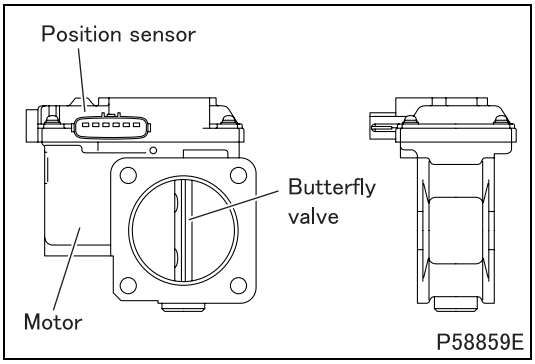


(2.1) Mitsubishi 4M50 Exhaust gas recirculation valve

- A motor in the exhaust gas recirculation valve is driven by control signals from the exhaust gas recirculation electronic drive unit. Via a rod, the motor's operation opens and closes the valve.

(3) Intake throttle control function

- When the engine electronic control unit determines from sensor data on the engine speed and engine loading that the vacuum pressure in the intake manifold is low, it increases the amount of exhaust emissions introduced into the intake manifold by determining an appropriate butterfly valve opening and by sending corresponding control signals (these indicate the target throttle opening) to the throttle electronic drive unit.
- The throttle electronic drive unit activates the valve motor. At the same time, it monitors the valve opening using a position sensor and sends this information (this indicates the actual throttle opening) to the engine electronic control unit.
  This operation makes it possible for the target throttle opening indicated by the engine electronic control unit to be precisely maintained.



(3.1) Intake throttle

- In accordance with signals from the throttle electronic drive unit, the motor opens and closes the butterfly valve, thereby adjusting the intake air amount such that the effectiveness of exhaust gas recirculation is maximized.

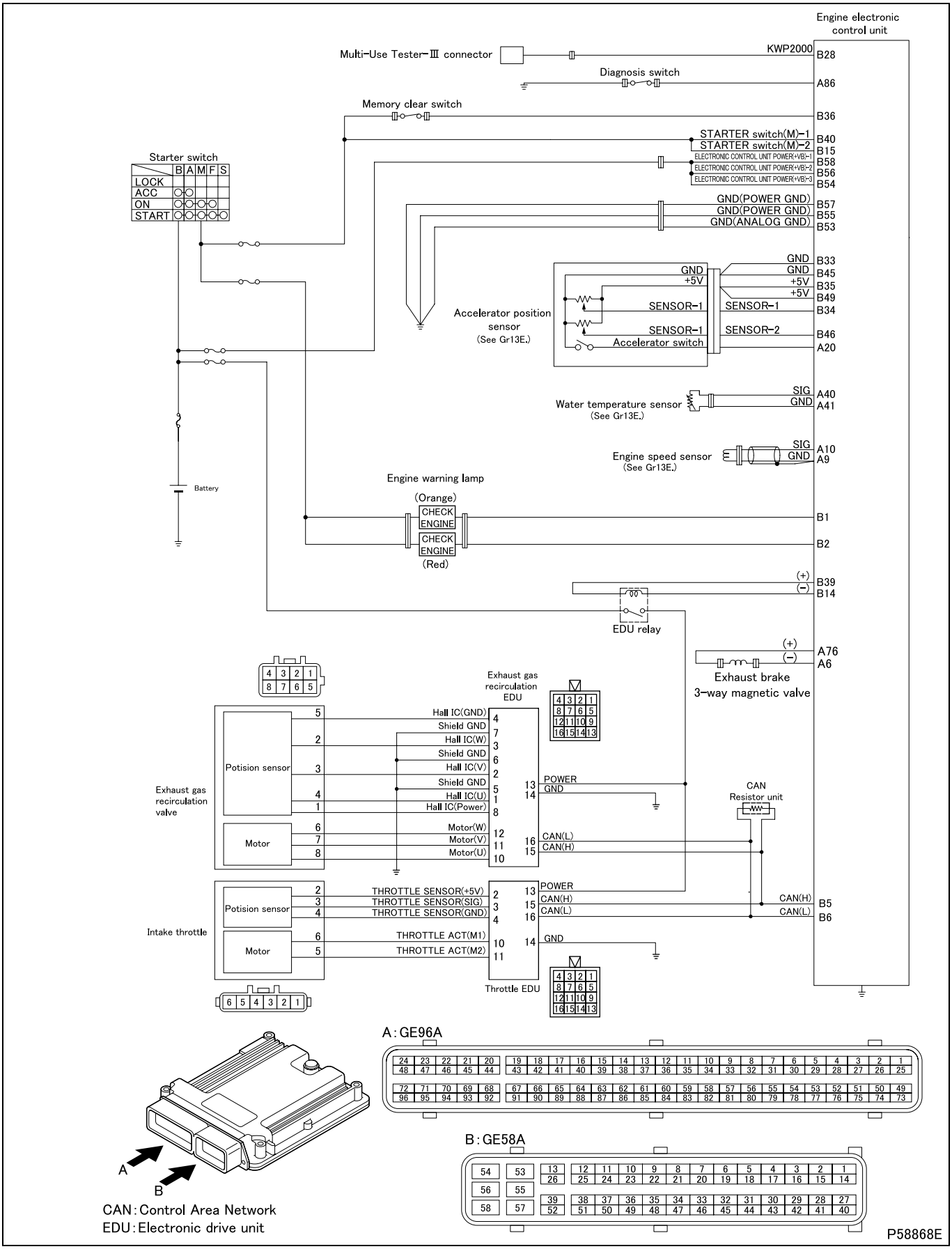
(4) Fault diagnosis function

- While the starter switch is in the ON position, the engine electronic control unit continuously monitors the electronic drive units and sensors 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 and starts a control during fault.
- While the engine is running, the exhaust gas recirculation electronic drive unit and throttle electronic drive unit continuously monitor communication with the position sensor and motor of the exhaust gas recirculation valve, communication with the position sensor and motor of the intake throttle, and communication with the engine electronic control unit. In the event that they identify a fault, they send fault data to the engine electronic control unit.
- While control necessitated by a 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.

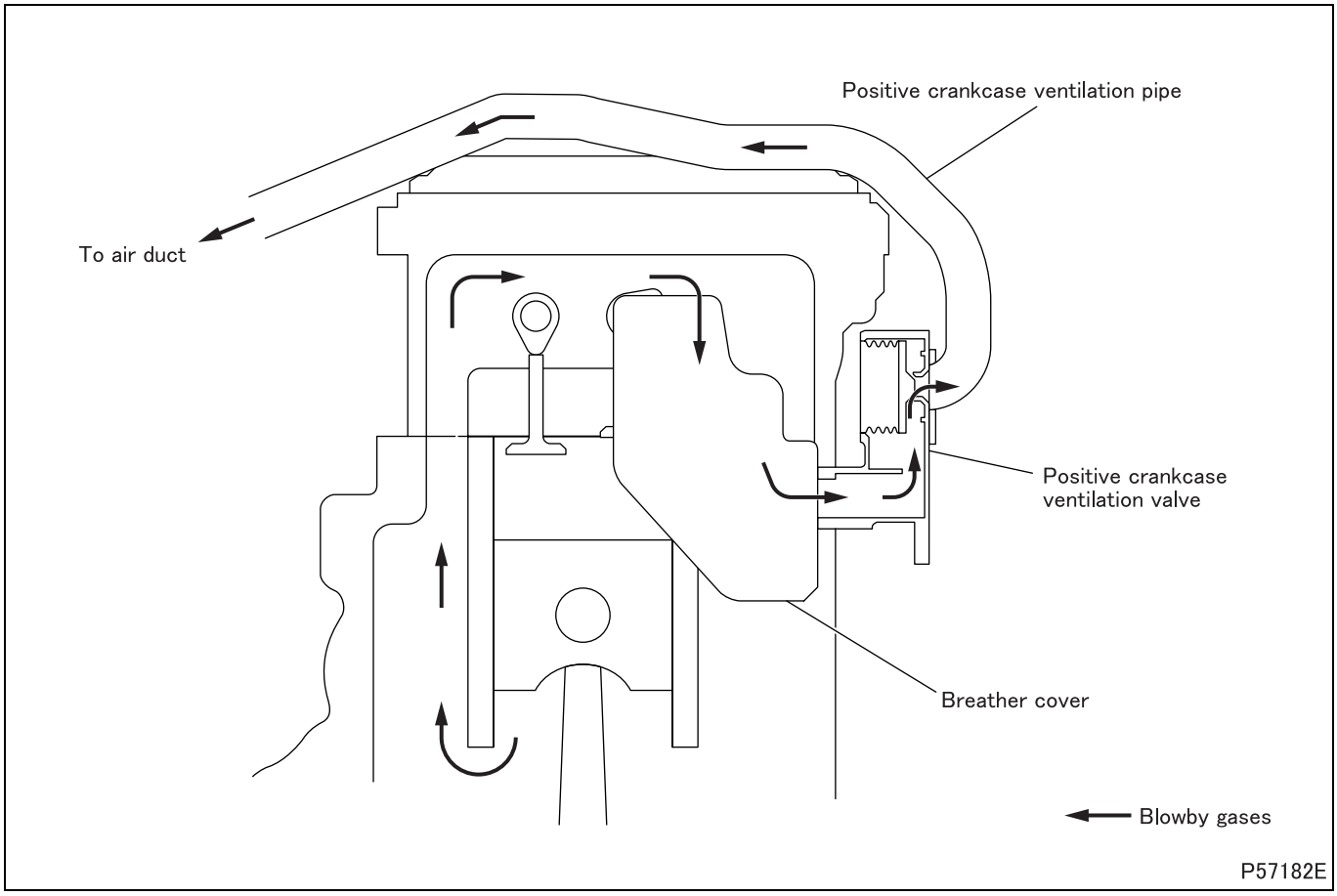
NOTE

- **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.**

1.3 Electronic control unit connection diagram



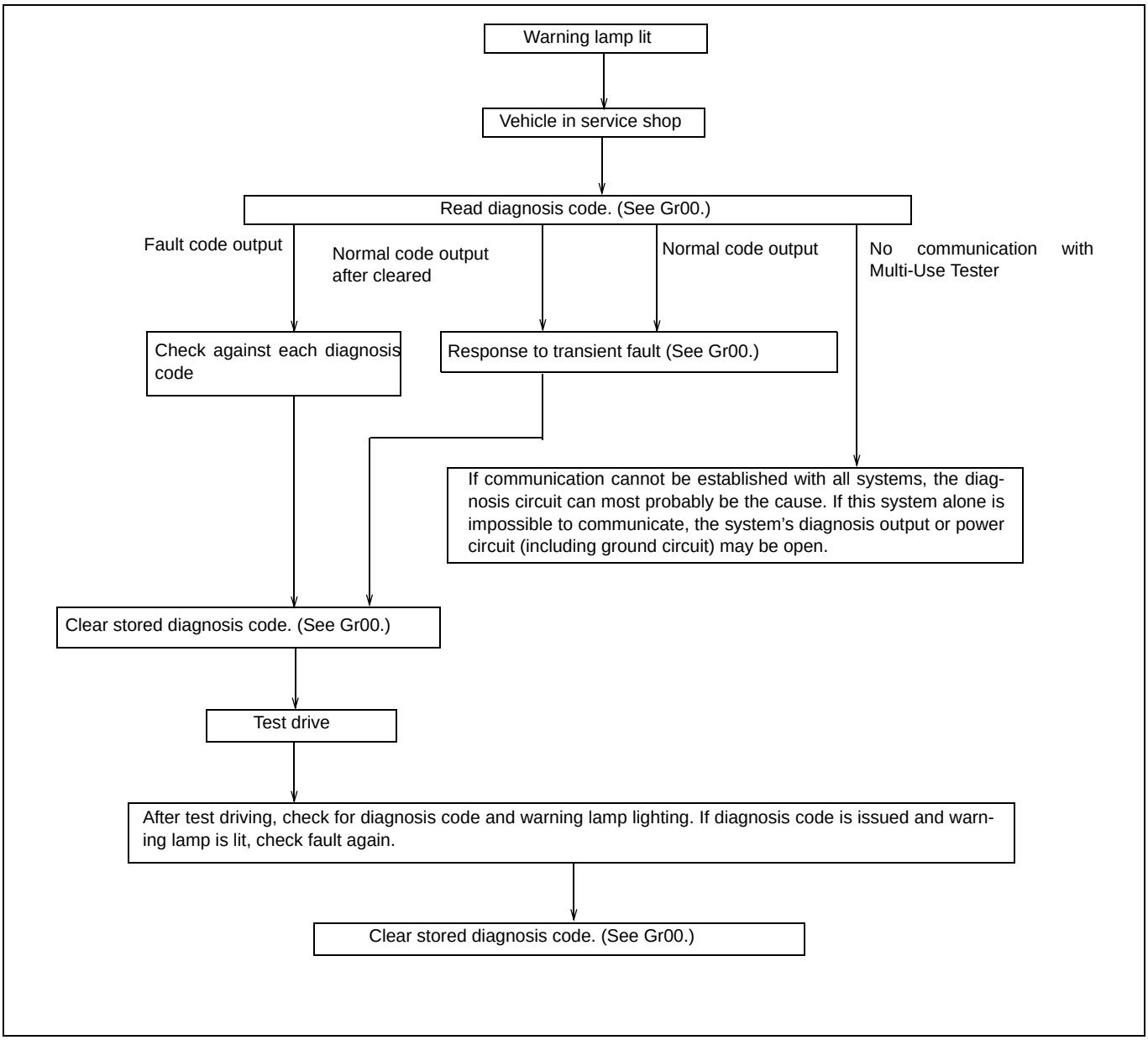
2. Crankcase Emission Control System



- The crankcase emission control system returns blowby gases to an air duct to prevent them from being released to the outside air.
- The positive crankcase ventilation valve keeps constant the pressure inside the crankcase.

1. Diagnosis Procedure

- The system can be efficiently inspected for faults using a Multi-Use Tester-III.
  System inspection can be accomplished basically in two ways according to trouble symptom and diagnosis code as shown below.
  - Check against each diagnosis code stored in memory by the electronic control unit
  - Response to transient fault



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.
- To avoid having electrical parts damaged, set the starter switch and lighting switch to LOCK or OFF before disconnecting and reconnecting battery cables.
- Before disconnecting connectors, set the starter switch to LOCK or OFF, then allow at least 20 seconds. Voltage may remain in electric parts or connected circuit.
- 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 {50 to 95°F}) as the measuring condition.

3. Inspections Based on Diagnosis Codes

3.1 Diagnosis code list

NOTE

- **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	Flashes
P0403	EGR 1	67
P0404	EGR System	02
P1121	Intake Throttle 1	28
P1625	EDU Relay	84
P1630	CAN (EGR)	95
P1635	CAN (intake throttle)	96

3.2 Diagnosis code generation conditions and inspection items

P0403: EGR 1 (warning lamp flashes: 67)

Generation condition		• Any of the following items: • Exhaust gas recirculation motor is short-circuited to earth, short-circuited to power supply line, or open-circuited. • Exhaust gas recirculation position sensor is open-circuited. • Abnormality (target position data outside range, data not received, etc.) occurs in communication between electronic drive unit and exhaust gas recirculation valve. • Power supply voltage is abnormal (excessively high or excessively low).
Recoverability		• Motor or sensor abnormality: System recovers (power is re-supplied to electronic control unit) if signal becomes normal when starter switch is turned OFF → ON. • Communication or power supply voltage abnormality: System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		• Exhaust gas recirculation control and throttle control are stopped. • Exhaust gas recirculation system error evaluation is stopped. • Engine output lowered.
Inspection	Service data	1F: EGR Position
	Actuator test	A1: EGR 1
	Electrical equipment	• #530: Exhaust gas recirculation valve • Exhaust gas recirculation electronic drive unit • Engine electronic control unit
	Electric circuit diagram	Engine electronic control unit, exhaust gas recirculation electronic drive unit, and exhaust gas recirculation valve systems

P0404: EGR System (warning lamp flashes: 02)

Generation condition		Motor abnormality (permanent)
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		Engine output lowered.
Inspection	Service data	1F: EGR Position
	Actuator test	A1: EGR 1
	Electrical equipment	• #530: Exhaust gas recirculation valve • Exhaust gas recirculation electronic drive unit • Engine electronic control unit
	Electric circuit diagram	Exhaust gas recirculation electronic drive unit and exhaust gas recirculation valve systems

P1121: Intake Throttle 1 (warning lamp flashes: 28)

Generation condition		Intake throttle abnormality (motor abnormality, position sensor abnormality, or motor seizure)
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		Engine output lowered.
Inspection	Actuator test	A7: Intake Throttle 1
	Electrical equipment	• #529: Intake throttle • Throttle electronic drive unit • Engine electronic control unit
	Electric circuit diagram	Engine electronic control unit, throttle electronic drive unit, and intake throttle systems

P1625: EDU Relay (warning lamp flashes: 84)

Generation condition		Electronic drive unit relay is short-circuited, open-circuited, or overloaded.
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		• Exhaust gas recirculation control and throttle control are stopped. (Exhaust emissions worsen.) • Engine output lowered.
Inspection	Service data	90: EDU Power Relay
	Actuator test	B2: EDU Relay
	Electronic control unit connector	01 : Electronic drive unit relay
	Electrical equipment	#201: Electronic drive unit relay
	Electric circuit diagram	Electronic drive unit relay system

P1630: CAN (EGR) (warning lamp flashes: 95)

Generation condition		Communication with exhaust gas recirculation electronic drive unit is impossible. (CAN messages are not received for certain period, or CAN bus is off.)
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		• Exhaust gas recirculation control and throttle control are stopped. (Exhaust emissions worsen.) • Engine output lowered.
Inspection	Actuator test	A1: EGR 1
	Electronic control unit connector	02 : CAN resistor
	Electrical equipment	• Exhaust gas recirculation electronic drive unit • Engine electronic control unit
	Electric circuit diagram	CAN communication circuitry to engine electronic control unit and exhaust gas recirculation electronic drive unit

P1635: CAN (intake throttle) (warning lamp flashes: 96)

Generation condition		Communication with throttle electronic drive unit is impossible. (CAN messages are not received for certain period, or CAN bus is off.)
Recoverability		System recovers if signal becomes normal with starter switch in ON position.
Control effected by electronic control unit		• Exhaust gas recirculation control and throttle control are stopped. (Exhaust emissions worsen.) • Engine output lowered.
Inspection	Actuator test	A7: Intake Throttle 1
	Electronic control unit connector	02 : CAN resistor
	Electrical equipment	• Throttle electronic drive unit • Engine electronic control unit
	Electric circuit diagram	CAN communication circuitry to engine electronic control unit and throttle electronic drive unit

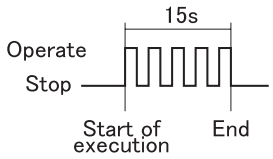
4. Multi-Use Tester Service Data

NOTE

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

No.	Item	Data	Inspection condition	Requirement
1F	EGR Position	■■■.■ %	Idling	0 %
20	Intake Throttle Position	■■■.■ %	Idling	50 %
90	EDU Power Relay	ON/OFF	Starter switch ON	ON
			Starter switch OFF	OFF
			[Actuator test] B2: EDU relay	

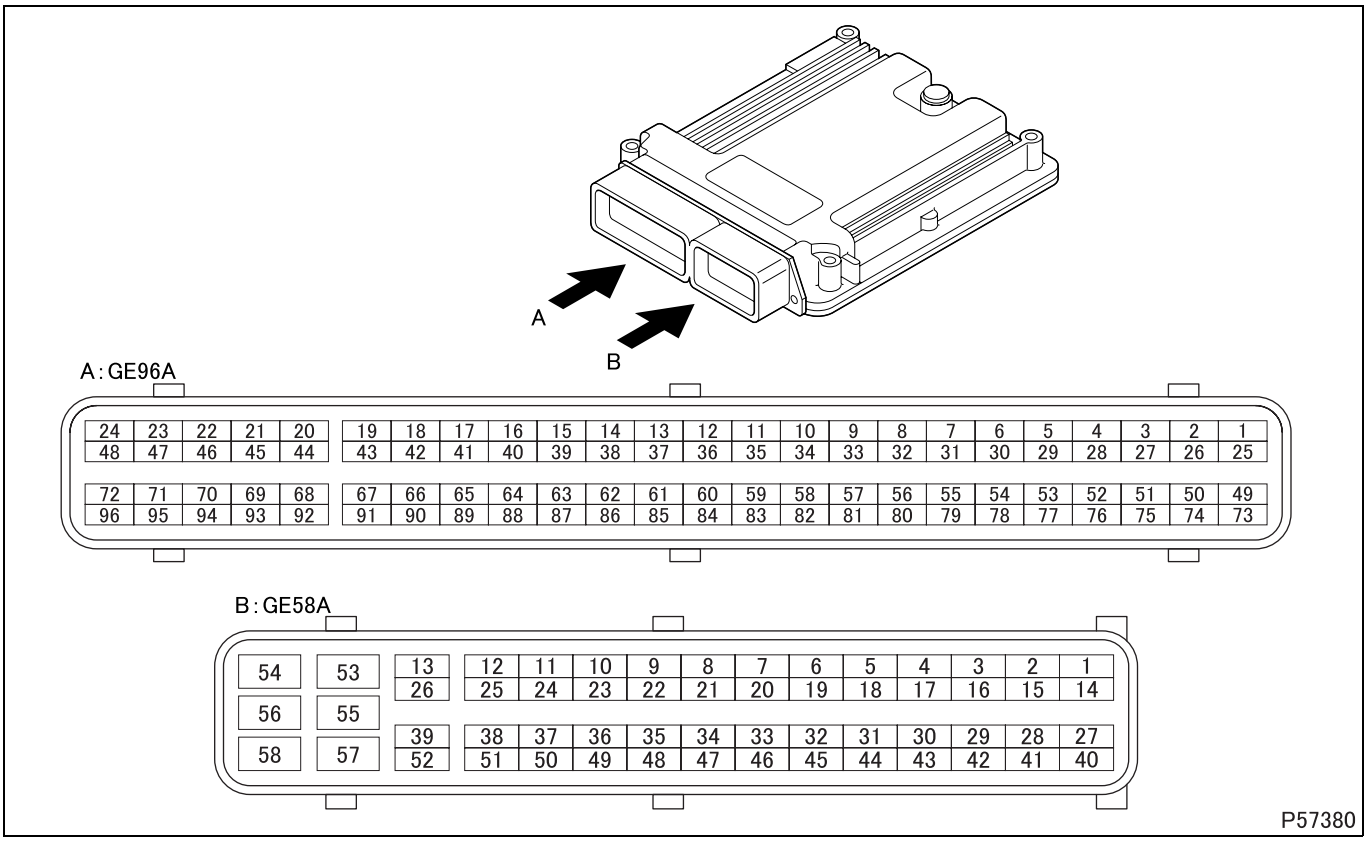
5. Actuator Tests Performed Using Multi-Use Tester

No.	Item	Explanation	Confirmation method
A1	EGR 1	Maintain exhaust gas recirculation valve opening indicated by Multi-Use Tester.	[Service data] 1F: EGR Position
A7	Intake Throttle 1	Maintain intake throttle opening indicated by Multi-Use Tester.	[Service data] 20: Intake Throttle position
B2	EDU Relay	Electronic drive unit relay drive signal (Errors related to exhaust gas recirculation and to the intake throttle can be detected when this actuator test is executed.)  P58223E	Relay operating sound [Service data] 90: 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 number **01** corresponds to the similarly printed reference number in section "**3. Inspections based on diagnosis codes**".

6.1 Electronic control unit connector terminal layout



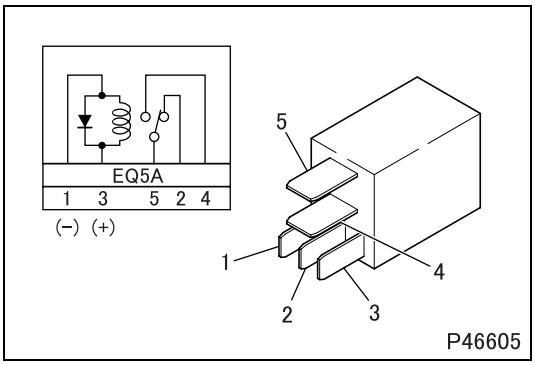
6.2 Inspection instructions

CAUTION ⚠

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

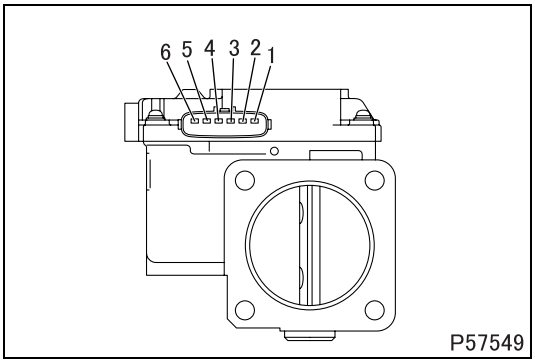
Check item	Measurement method
01 Voltage of electronic drive unit relay	[Conditions] • Starter switch ON • Vehicle-side harness connected (Perform inspection on back of connector.) [Requirements] Terminals (+)-(–): B39-B14 • With relay operating: Corresponding to battery voltage • With relay not operating: 0V
02 Resistance of CAN resistor	[Conditions] • Starter switch OFF • Disconnect connecter. Perform inspection on vehicle-side connector. [Requirements] Terminals : B5-B6 • 120 ± 6Ω

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.



#529 Inspection of intake throttle

- Perform the following checks. If there is any abnormality, replace the throttle.

(1) Coil resistance of motor

- Measure the resistance between terminals 5 and 6.

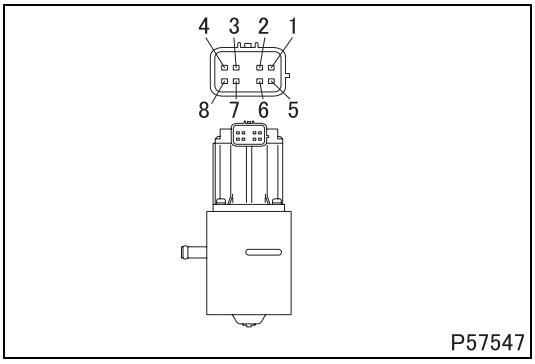
Standard value	0.3 to 80 Ω

NOTE

- **If the measurement deviates from the standard value, measure the resistance again after manually opening and closing the butterfly valve 5 times.**

(2) Position 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 intake throttle.



#530 Inspection of exhaust gas recirculation valve

- Perform the following checks. If there is any abnormality, replace the exhaust gas recirculation valve.

(1) Coil resistance of motor

- Measure the resistance between terminals 8 and 7, the resistance between terminals 8 and 6, and the resistance between terminals 7 and 6.

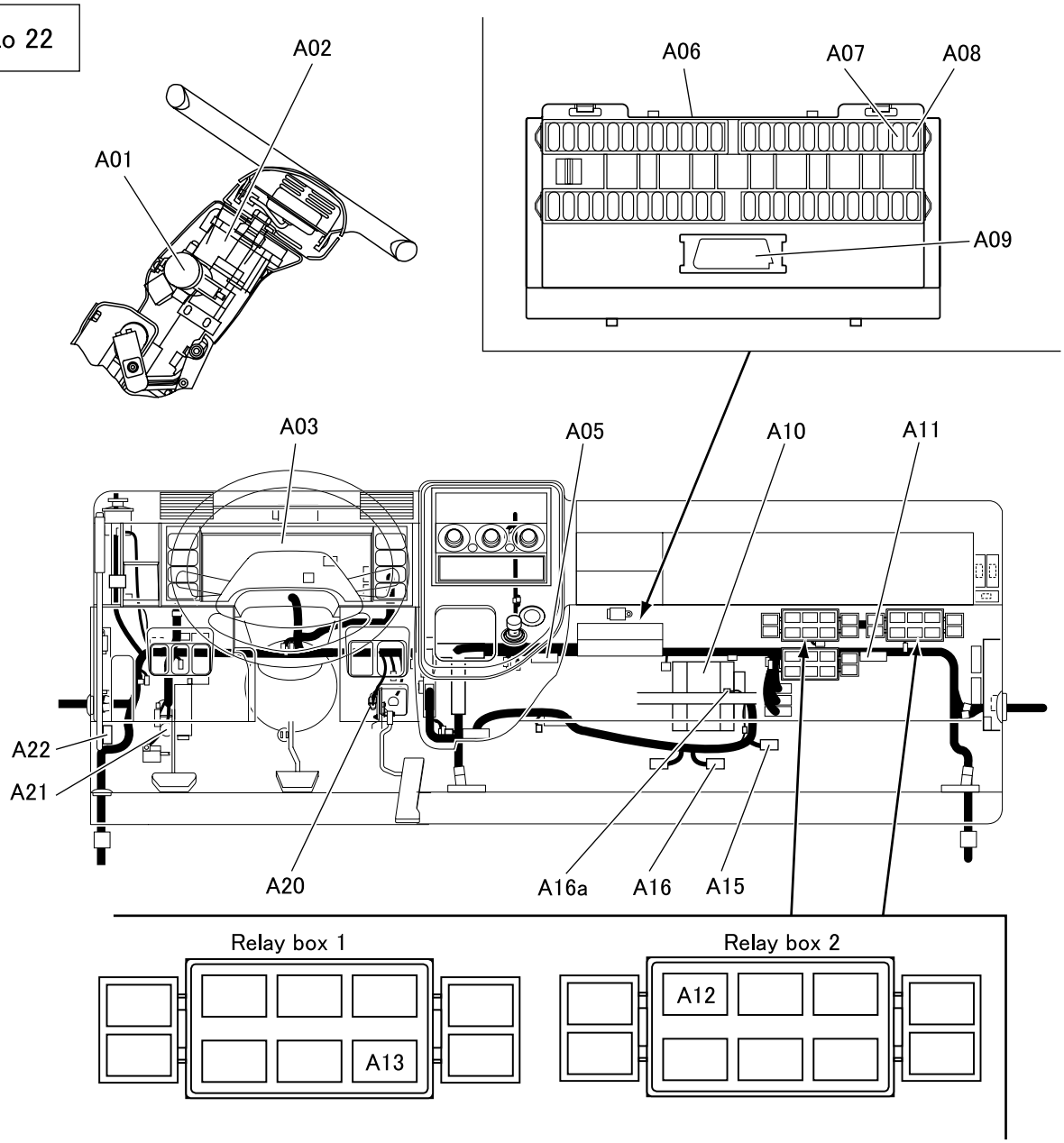
Standard value	2.1 ± 0.3 Ω

(2) Position 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 exhaust gas recirculation valve.

8. Installed Locations of Parts

A01 to 22



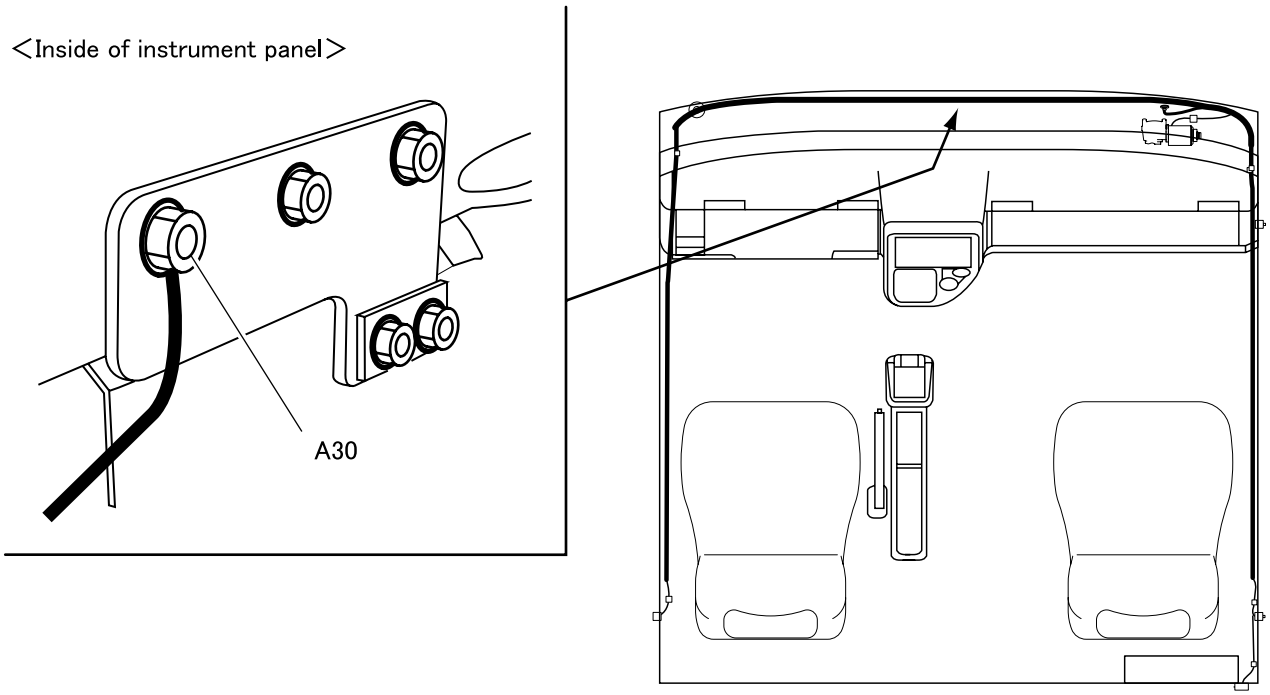
No relevant parts in a missing number

A01 Starter switch
A02 Combination switch
A03 Meter cluster
A05 Joint connector (J/C-1)
A06 Fuse box
A07 Diagnosis switch
A08 Memory clear switch
A09 Multi-Use Tester-Ⅲ connector (for recorder)
A10 Engine ECU
A11 Joint connector (J/C-2, 3)
A12 ABS exhaust brake cut relay
A13 Exhaust brake cut relay <A/T>
A15 Joint connector (J/C-4)
A16 Resister unit
A16a Ground
A20 Accelerator pedal position sensor
A21 Clutch switch
A22 Multi-Use Tester-Ⅲ connector (for inspection)

ABS : Anti-lock brake system
A/T : Automatic transmission
ECU : Electronic control unit

L00190

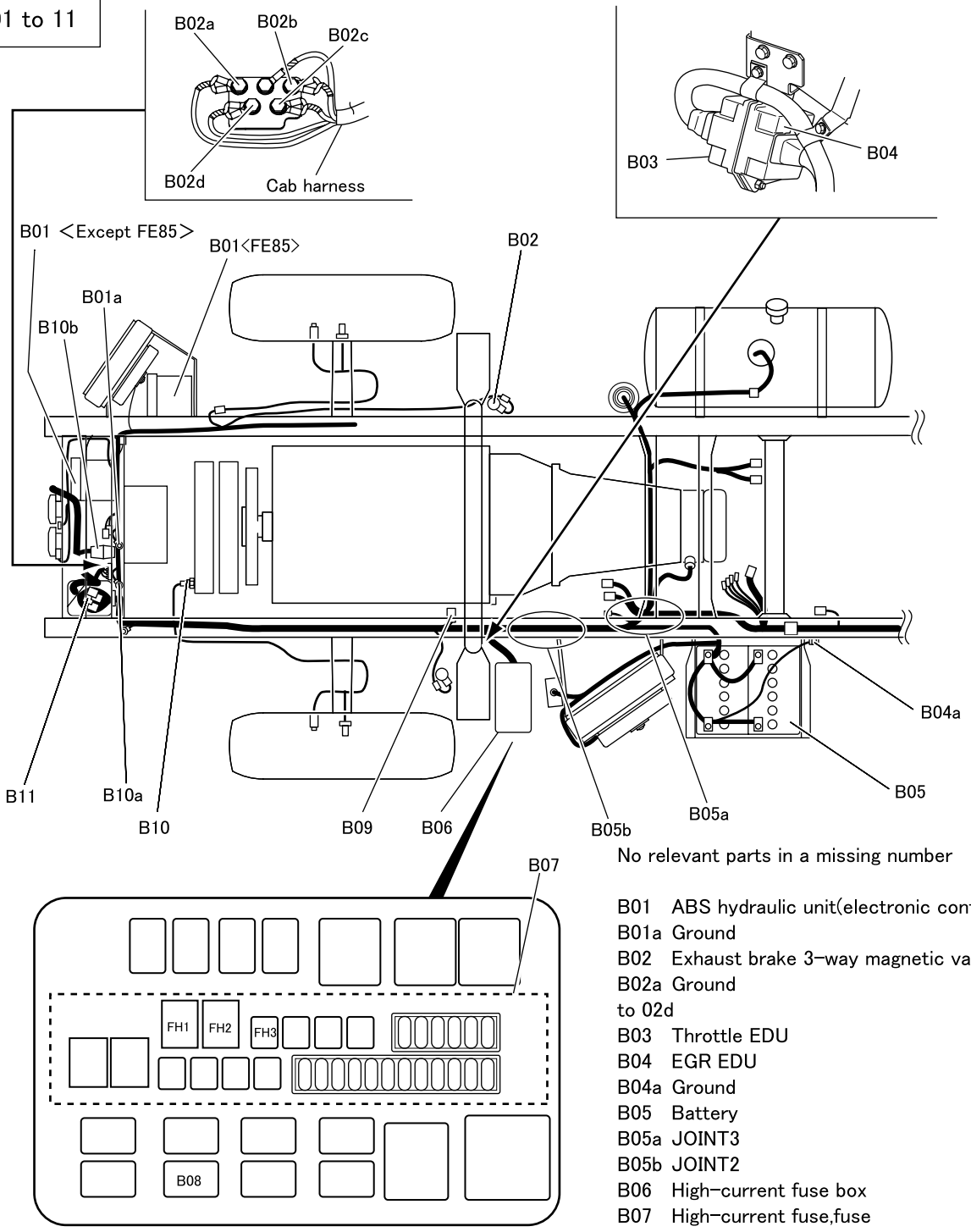
A30



A30 Ground

L00183

B01 to 11



No relevant parts in a missing number

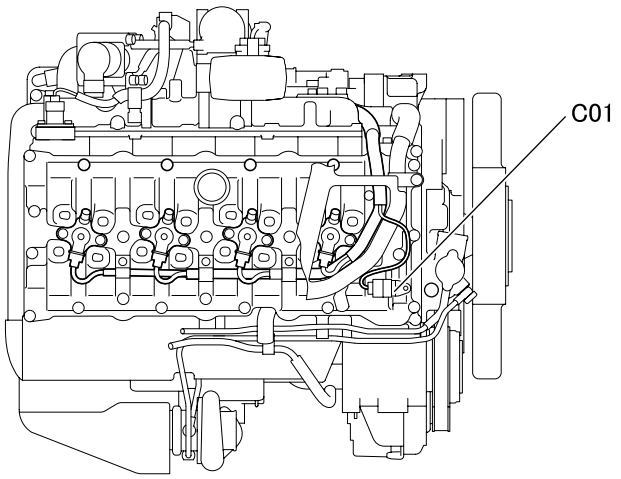
B01 ABS hydraulic unit(electronic control unit)
B01a Ground
B02 Exhaust brake 3-way magnetic valve
B02a Ground
to 02d
B03 Throttle EDU
B04 EGR EDU
B04a Ground
B05 Battery
B05a JOINT3
B05b JOINT2
B06 High-current fuse box
B07 High-current fuse,fuse
B08 EDU relay
B09 Joint connector
B10 Boost air temperature sensor
B10a Ground
B10b Connection of cab harness and engine harness
B11 Connection of chassis harness and cab harness or engine herness

ABS : Anti-lock brake system
EGR : Exhaust-gas recirculation
EDU : Electronic drive unit

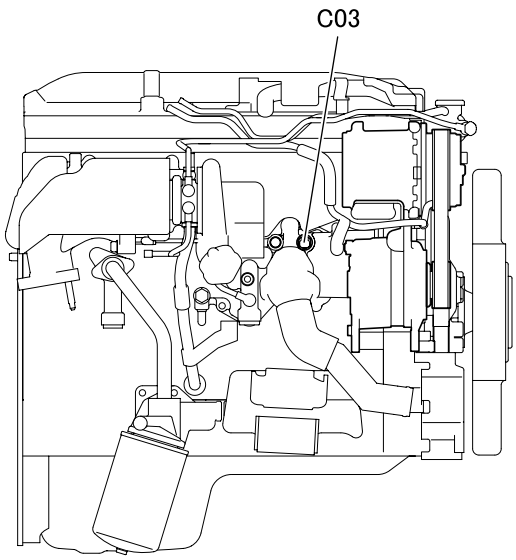
L01273

C01 to 06

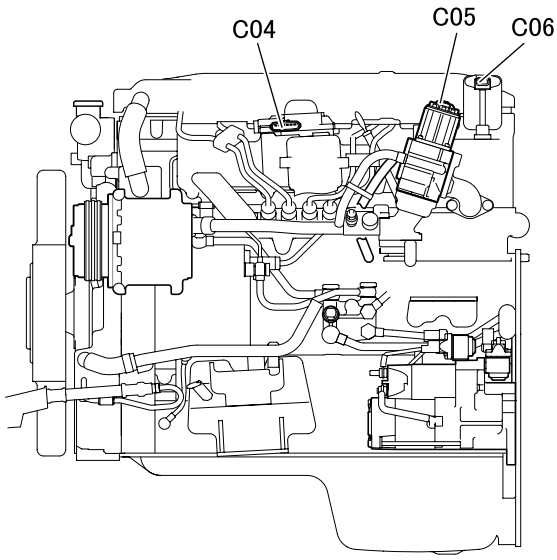
Upper view



Right side view



Left side view



No relevant parts in a missing number

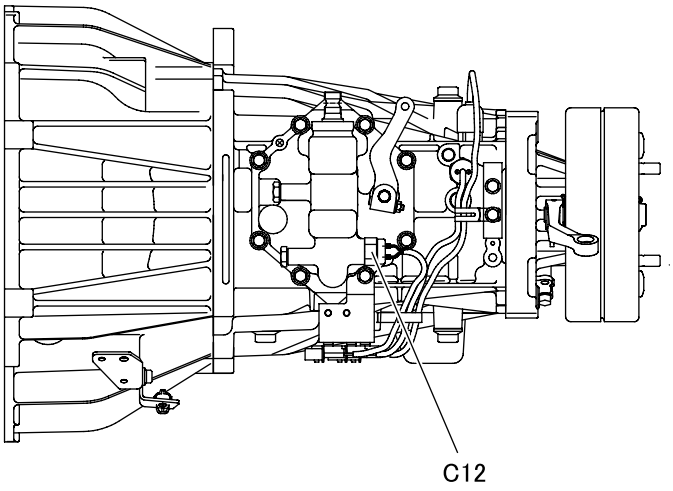
C01 Cylinder recognition sensor
C03 Water temperature sensor
(Connects to engine ECU)
C04 Intake throttle
(Building into motor, position sensor)
C05 EGR valve
(Building into motor, position sensor)
C06 Boost pressure sensor

ECU : Electronic control unit
EGR : Exhaust-gas recirculation

L00191

C12 to 14 Manual transmission

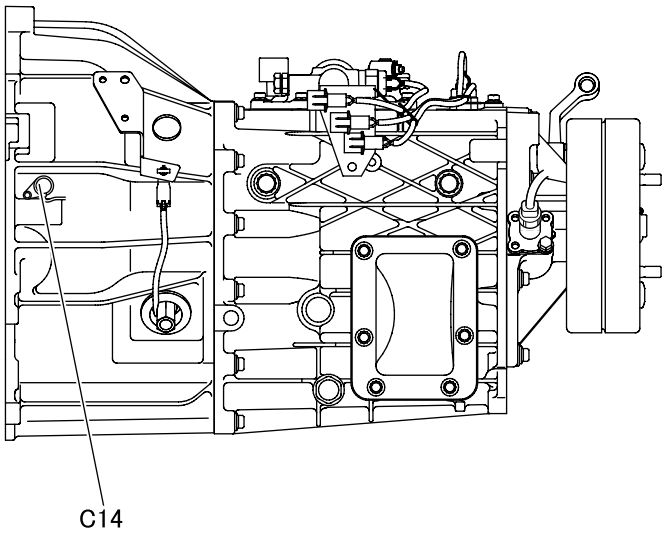
Upper view



No relevant parts in a missing number

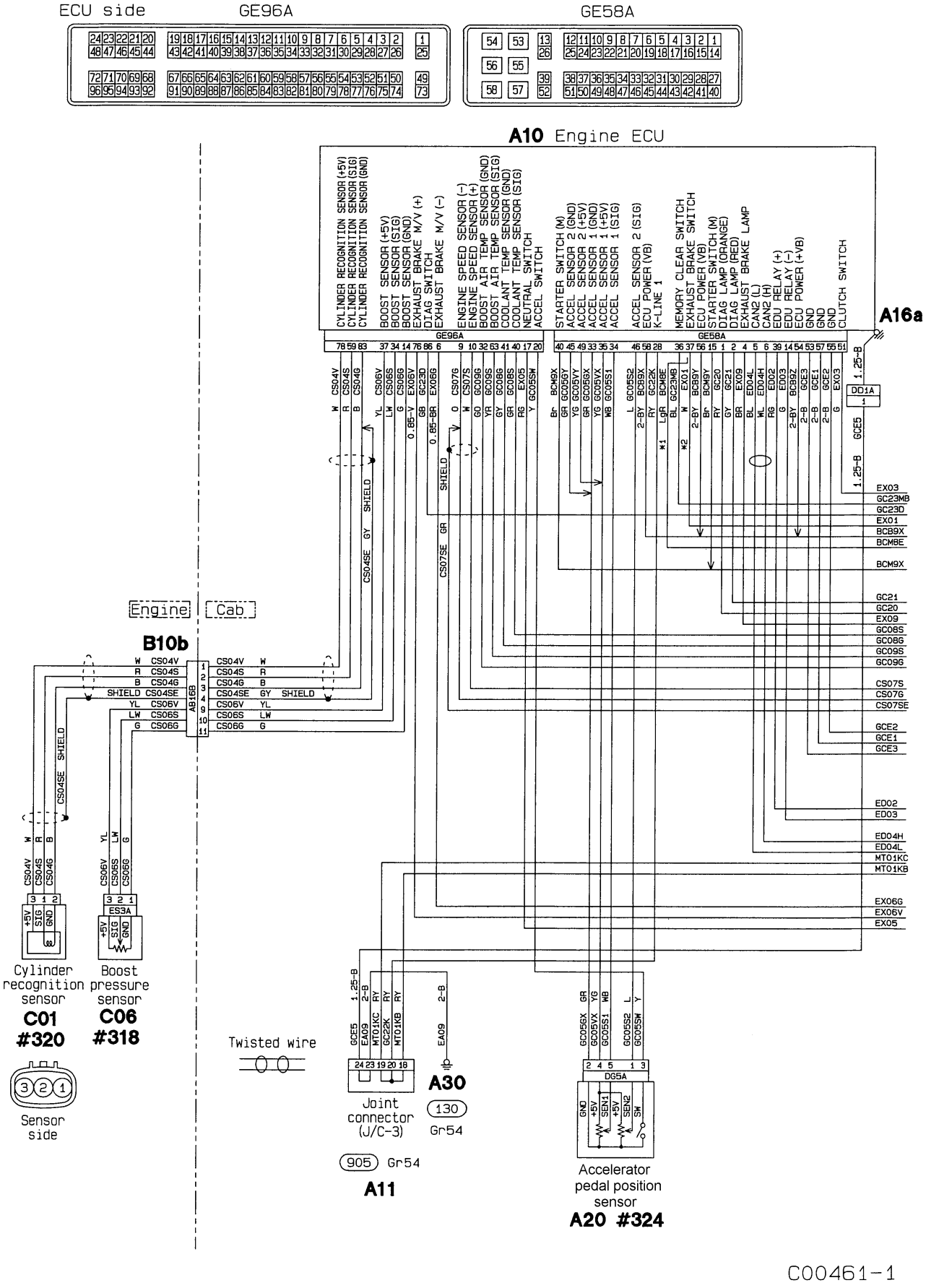
C12 Transmission neutral switch
C14 Engine speed sensor

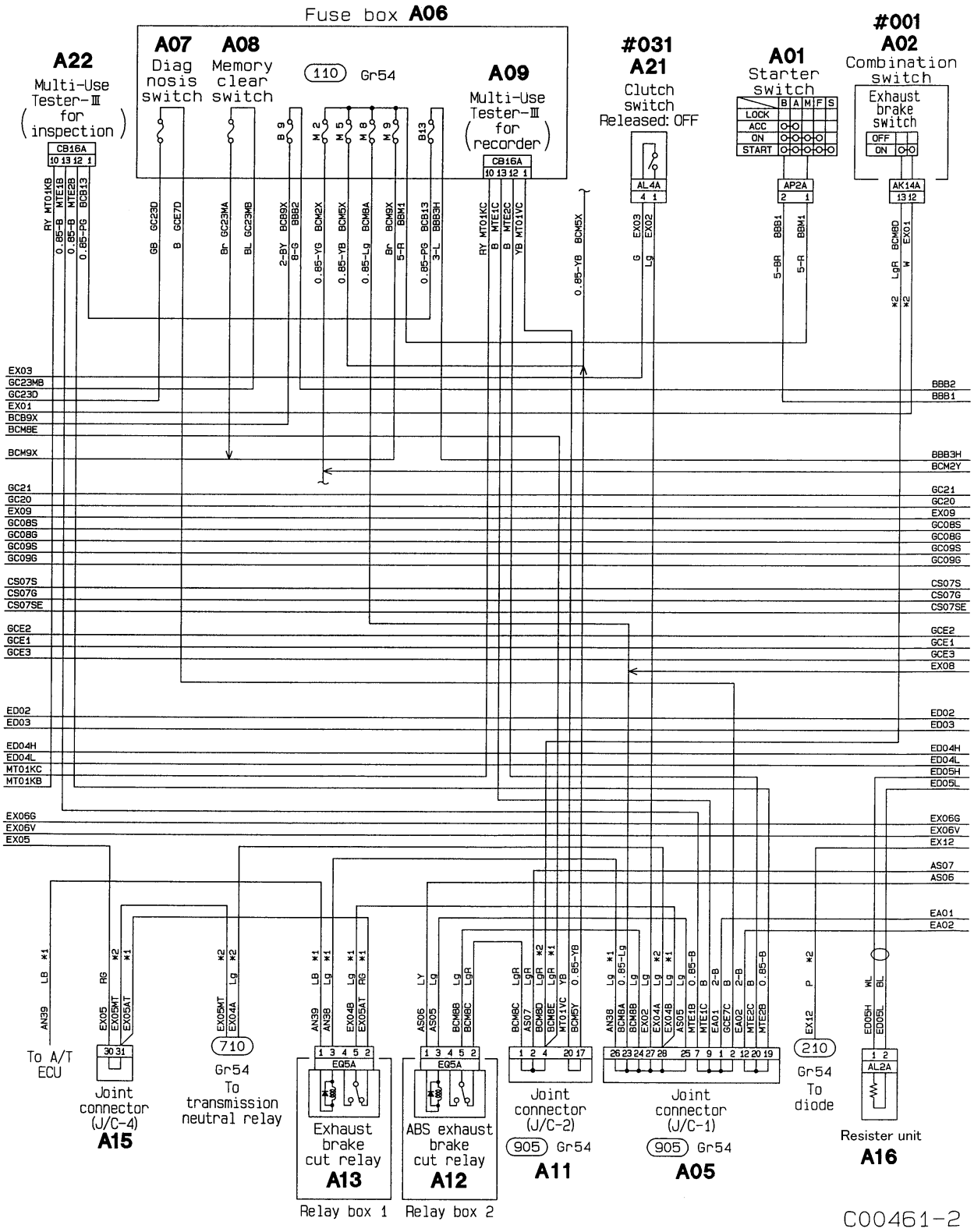
Left side view

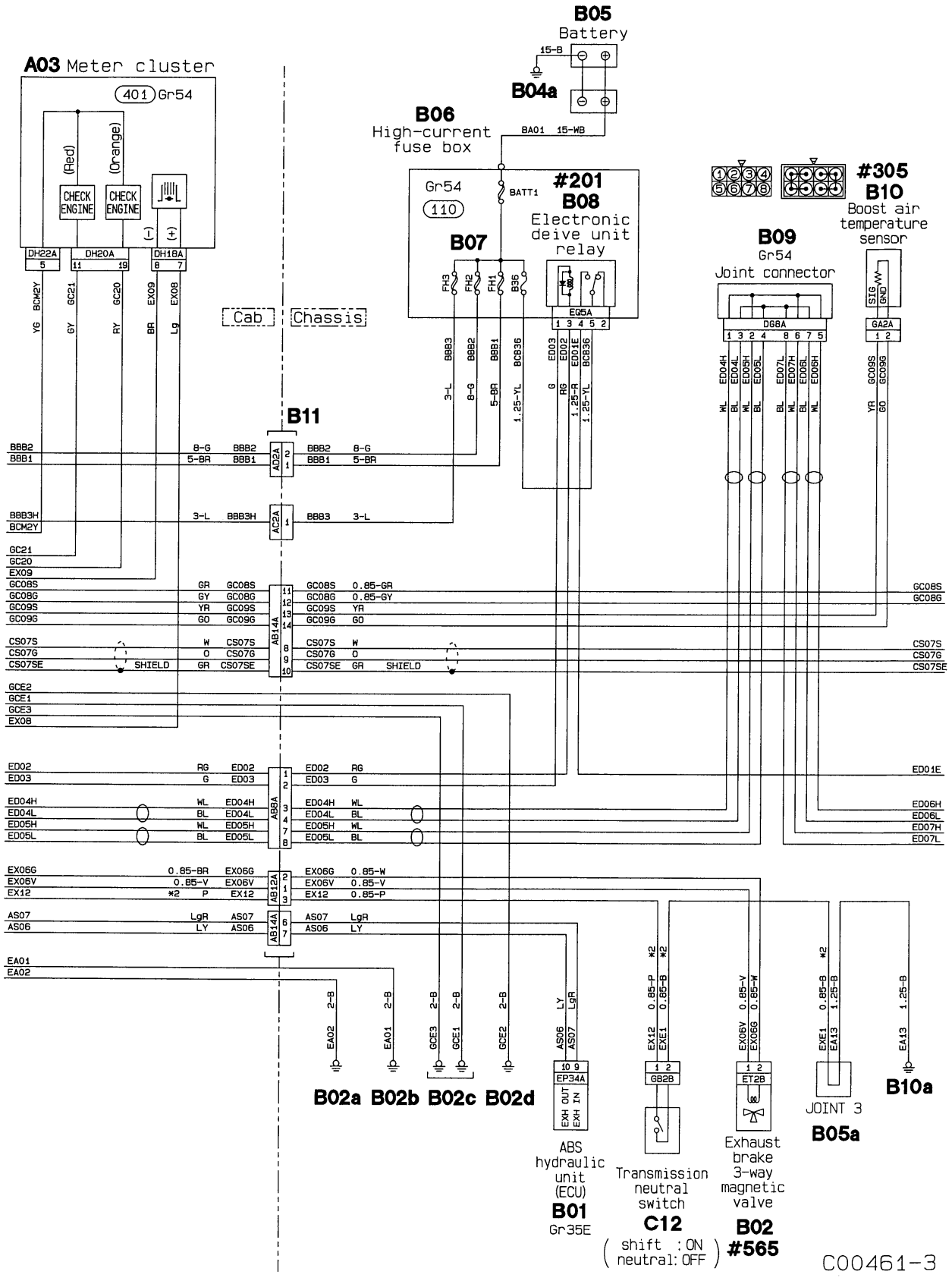


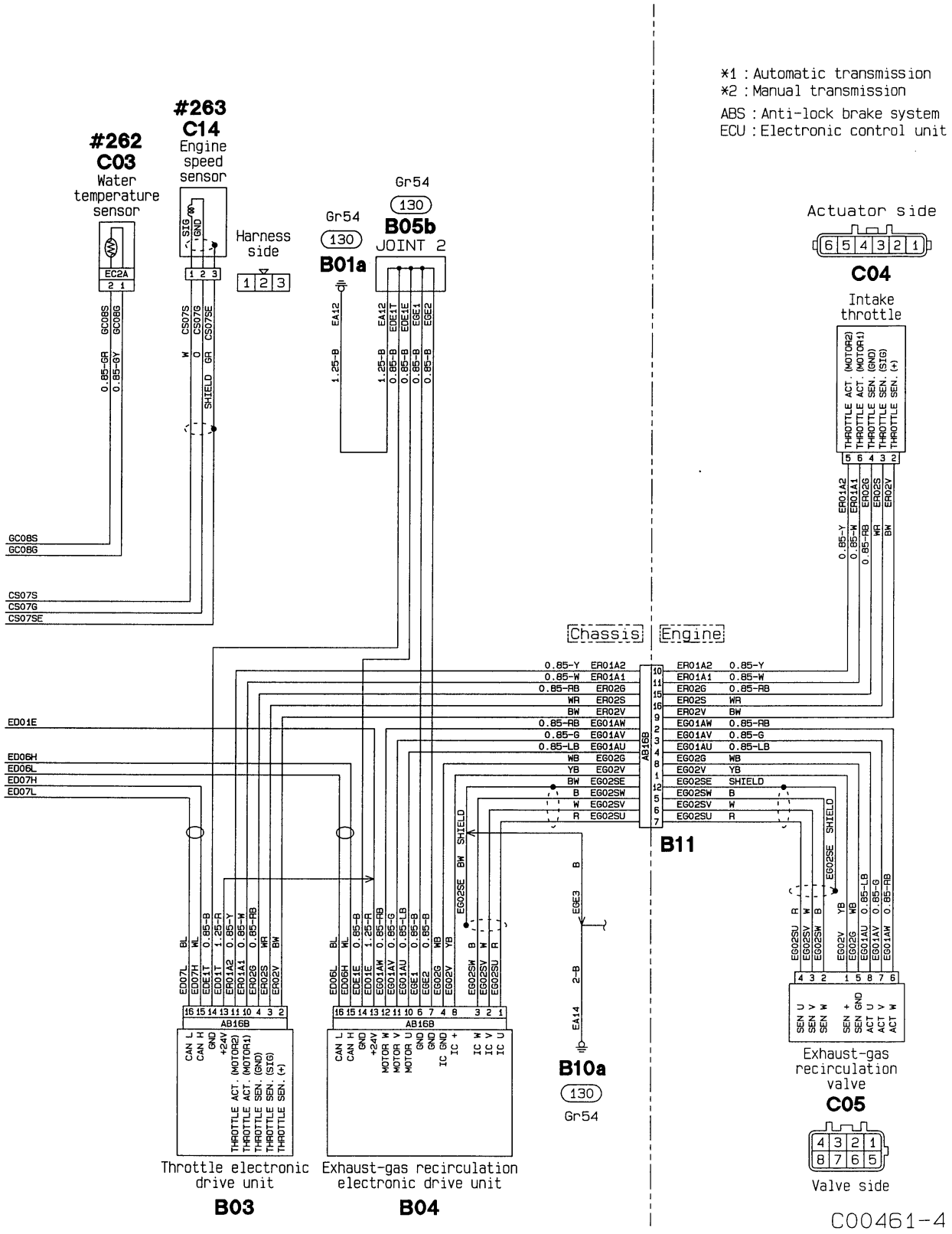
L00192

9. Electric Circuit Diagram

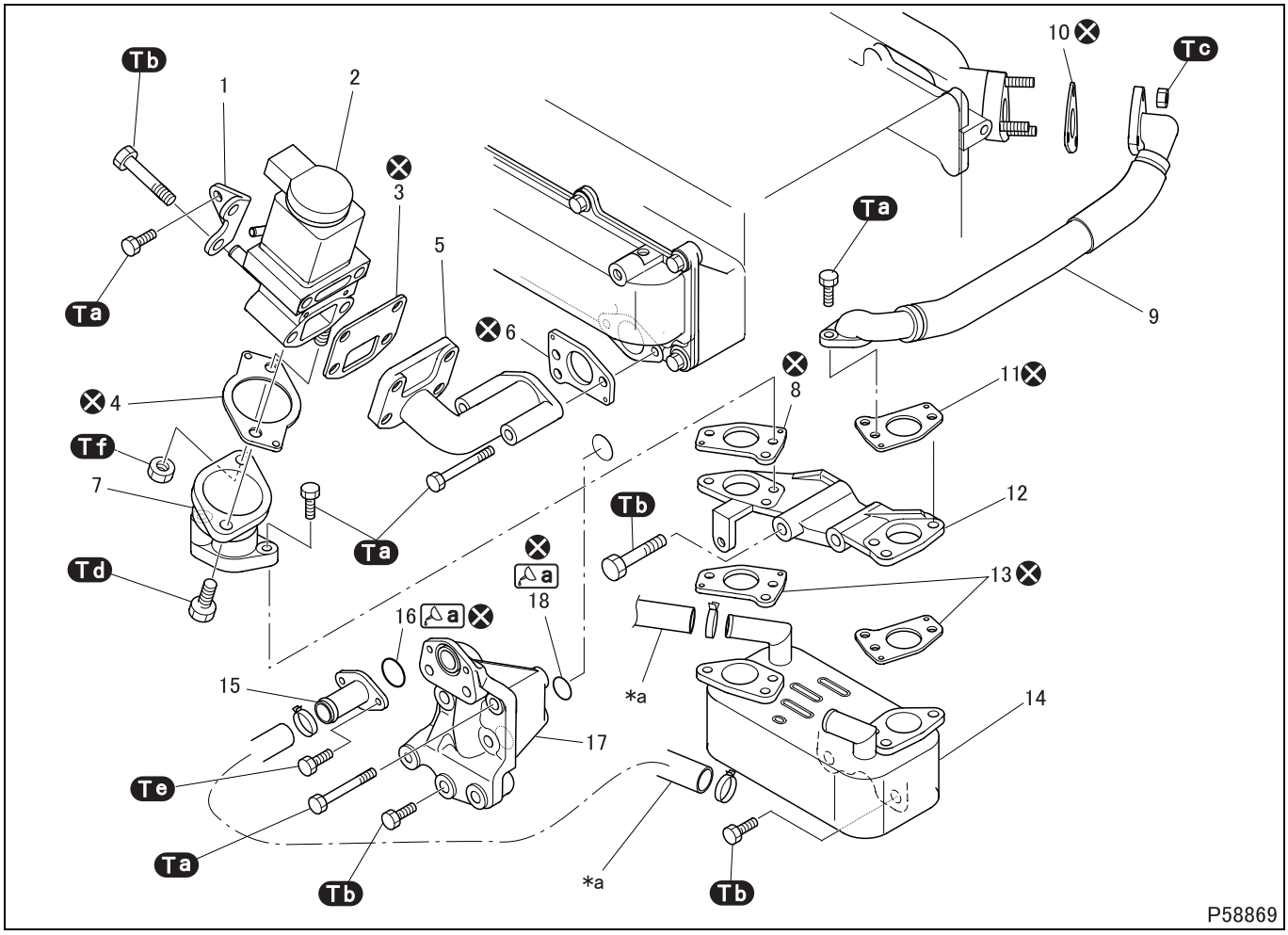



Fuse box A06
A22
Multi-Use Tester-III for inspection
A07
Diag nosis switch
A08
Memory clear switch
110 Gr54
A09
Multi-Use Tester-III for recorder
#031
A21
Clutch switch Released: OFF
A01
Starter switch
#001
A02
Combination switch
Exhaust brake switch
To A/T ECU
Joint connector (J/C-4)
A15
710 Gr54
To transmission neutral relay
Exhaust brake cut relay
A13
ABS exhaust brake cut relay
A12
Relay box 1
Relay box 2
Joint connector (J/C-2)
905 Gr54
A11
Joint connector (J/C-1)
905 Gr54
A05
210 Gr54
To diode
Resister unit
A16
C00461-2


A03 Meter cluster
401 Gr54
(Red)
(Orange)
CHECK ENGINE
CHECK ENGINE
(-)
(+)
DH22A
DH20A
DH18A
BCM2Y
GC21
GC20
EX09
EX08
YG
GY
RY
BR
Lg
Cab
Chassis
B05
Battery
15-B
B04a
B06
High-current fuse box
BA01 15-WB
Gr54
110
BATT1
#201
B08
Electronic deive unit relay
B07
FH3
FH2
FH1
B36
EQ5A
#305
B10
Boost air temperature sensor
B09
Gr54
Joint connector
D68A
GA2A
STG
GND
B11
AD2A
AC2A
AB14A
AB8A
AB12A
BBB2 8-G
BBB1 5-BR
BBB3H 3-L
BBB3 3-L
GC08S GR
GC08G GY
GC09S YR
GC09G GO
CS07S W
CS07G O
CS07SE GR SHIELD
GCE2
GCE1
GCE3
EX08
ED02 RG
ED03 G
ED04H WL
ED04L BL
ED05H WL
ED05L BL
EX06G 0.85-BR
EX06V 0.85-V
EX12 *2 P
AS07 LgR
AS06 LY
EA01
EA02
ED01E
ED06H
ED06L
ED07H
ED07L
CS07S
CS07G
CS07SE
B02a B02b B02c B02d
EP34A
EXH OUT
EXH IN
ABS hydraulic unit (ECU)
B01
Gr35E
GB28
Transmission neutral switch
C12
shift : ON
neutral: OFF
ET28
Exhaust brake 3-way magnetic valve
B02
#565
JOINT 3
B05a
B10a
C00461-3


*1 : Automatic transmission
*2 : Manual transmission
ABS : Anti-lock brake system
ECU : Electronic control unit
#262
C03
Water temperature sensor
#263
C14
Engine speed sensor
Harness side
Gr54
130
B01a
Gr54
130
B05b
JOINT 2
Actuator side
C04
Intake throttle
Chassis
Engine
B11
B10a
Gr54
130
Throttle electronic drive unit
B03
Exhaust-gas recirculation electronic drive unit
B04
Exhaust-gas recirculation valve
C05
Valve side
C00461-4

MITSUBISHI 4M50 EXHAUST GAS RECIRCULATION VALVE, PIPE AND COOLER



● Removal sequence

1 Exhaust gas recirculation bracket
2 Exhaust gas recirculation valve
3 Exhaust gas recirculation valve gasket B
4 Exhaust gas recirculation valve gasket A
5 Exhaust gas recirculation cooler adapter B
6 Exhaust gas recirculation gasket
7 Exhaust gas recirculation cooler adapter A
8 Exhaust gas recirculation gasket
9 Exhaust gas recirculation pipe
10 Exhaust gas recirculation pipe gasket
11 Exhaust gas recirculation gasket
12 Exhaust gas recirculation cooler bracket B
13 Exhaust gas recirculation gasket
14 Exhaust gas recirculation cooler
15 Connector
16 O-ring
17 Exhaust gas recirculation cooler bracket A
18 O-ring

***a**: Water hose
⊗: Non-reusable parts

NOTE

- **Even when all coolant in the crankcase has been drained out, approximately 1L {1.1qt.} of coolant remains in the exhaust gas recirculation cooler. Before removing the exhaust gas recirculation cooler, make ready a container to catch the coolant.**

● Installation sequence

Perform installation by following the removal sequence in reverse.

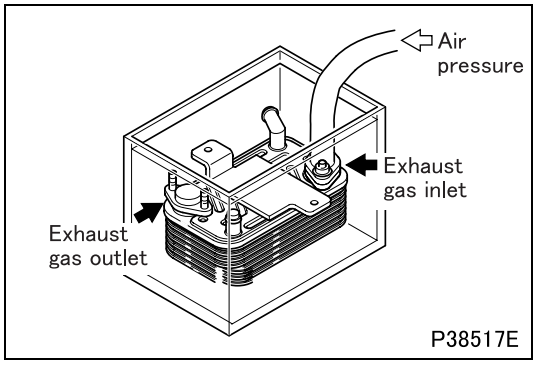
Tightening torque (Unit: N·m {lbf·ft, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (mounting of exhaust gas recirculation bracket)	23.2 {17, 2.4}	–
	Bolt (mounting of exhaust gas recirculation cooler adapter A)		
	Bolt (mounting of exhaust gas recirculation cooler adapter B)		
	Nut (mounting of exhaust gas recirculation pipe)		
	M8 bolt (mounting of exhaust gas recirculation cooler bracket A)		
Tb	Bolt (mounting of exhaust gas recirculation valve)	44.5 {33, 4.5}	–
	Bolt (mounting of exhaust gas recirculation cooler)		
	M10 bolt (mounting of exhaust gas recirculation cooler bracket A)		
	Bolt (mounting of exhaust gas recirculation cooler bracket B)		
Tc	Nut (mounting of exhaust gas recirculation pipe)	20.6 {15, 2.1}	–
Td	Bolt (mounting of exhaust gas recirculation valve)	57.5 {42, 5.9}	–
Te	Bolt (mounting of connector)	8 {5.9, 0.82}	–
Tf	Nut (mounting of exhaust gas recirculation valve)	57.5 {42, 5.9}	–

Lubricant and/or sealant

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

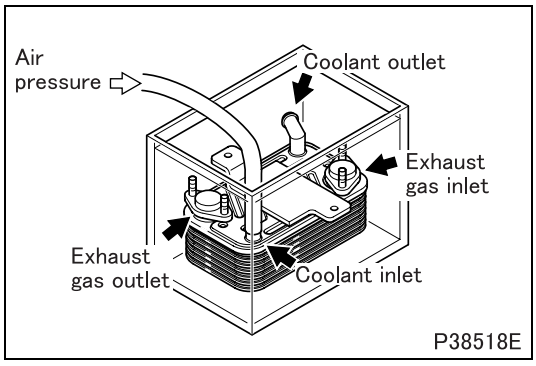
◆Inspection procedures◆



■ Inspection: Exhaust gas recirculation cooler

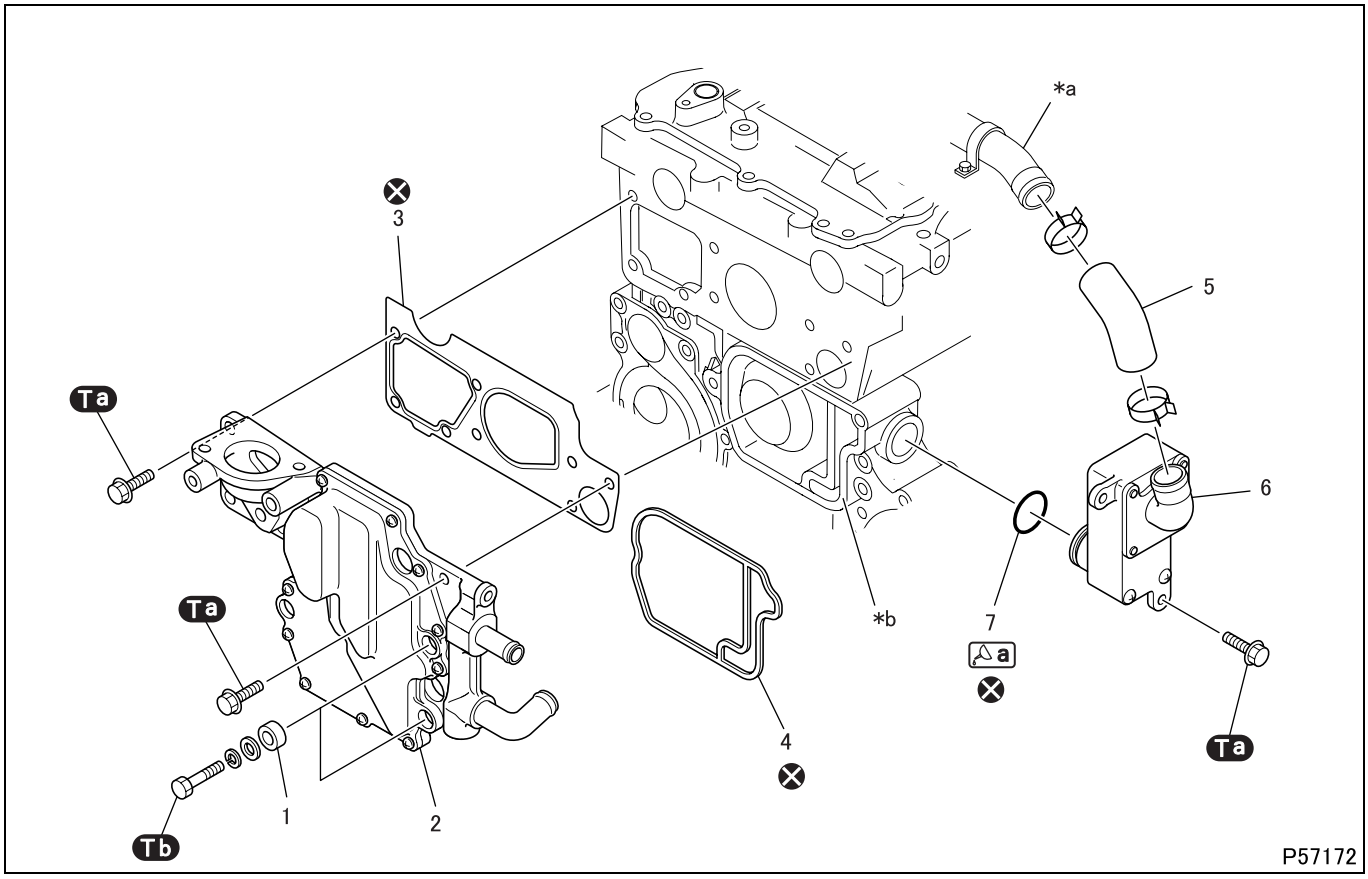
(1) Exhaust gas passage side

- Fit a cover over the exhaust gas outlet of the exhaust gas recirculation cooler, and connect a hose to the exhaust gas inlet. Then, submerge the exhaust gas recirculation cooler in a container of water. Make sure the coolant passage is full of water.
- Apply air pressure of 294 kPa {43 psi, 3 kgf/cm^2} through the hose. Check that air does not leak from any part of the exhaust gas recirculation cooler.
- If there is any abnormality, replace the exhaust gas recirculation cooler.



(2) Coolant passage side

- Fit covers over the exhaust gas recirculation cooler's exhaust gas inlet, exhaust gas outlet, and coolant outlet, and connect a hose to the coolant inlet. Then, submerge the exhaust gas recirculation cooler in a container of water.
- Apply air pressure of 196 kPa {28 psi, 2 kgf/cm^2} through the hose. Check that air does not leak from any part of the exhaust gas recirculation cooler.
- If there is any abnormality, replace the exhaust gas recirculation cooler.



● **Removal sequence**

1 Spacer
2 Breather cover (See later section.)
3 Gasket
4 Breather gasket
5 PCV hose
6 PCV valve
7 O-ring
***a**: PCV pipe
***b**: Front case
⊗: Non-reusable parts
PCV: Positive crankcase ventilation

● **Installation sequence**

Perform installation by following the removal sequence in reverse.

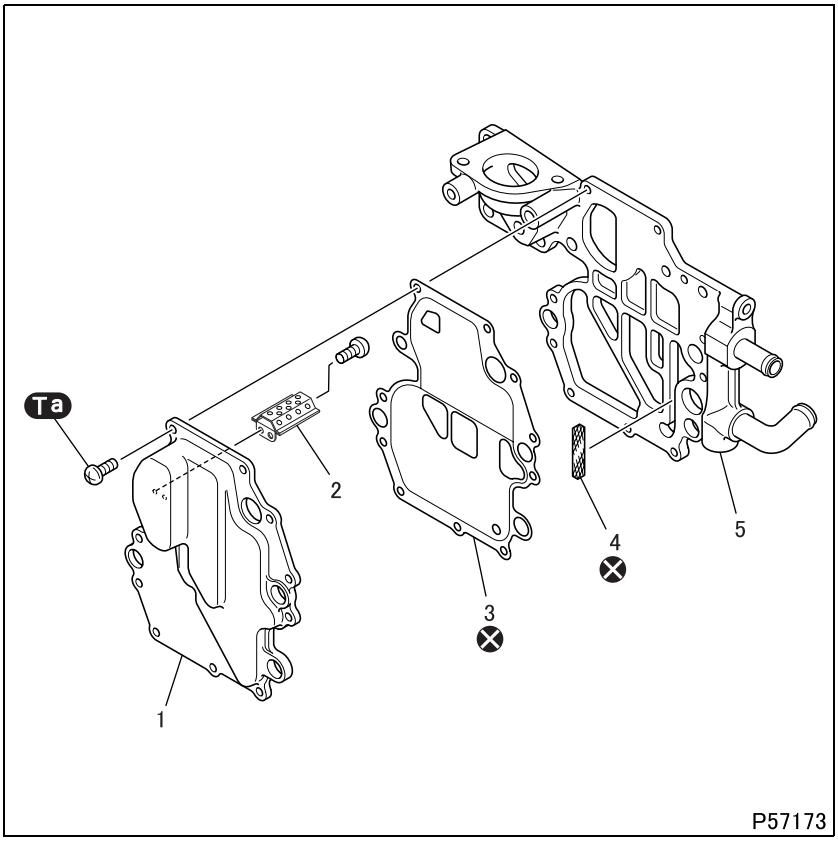
Tightening torque (Unit: N·m {lbf·ft, kgf·m})

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Bolt (mounting of breather cover)	23.2 {17, 2.4}	–
	Bolt (mounting of PCV valve)		
Tb	Bolt (mounting of breather cover)	9.8 {7.2, 1.0}	–

Lubricant and/or sealant

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

Breather cover



● **Removal sequence**

1 Breather cover A
2 Separator plate
3 Gasket
4 Element
5 Breather cover B

⊗:Non-reusable parts

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

Mark	Parts to be tightened	Tightening torque	Remarks
Ta	Screw (mounting of breather cover)	7.8 to 11.8 {5.8 to 8.7, 0.8 to 1.2}	–