

# ENGINE

## 4M41

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# 1. SPECIFICATIONS

## SERVICE SPECIFICATIONS

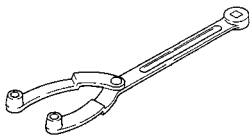
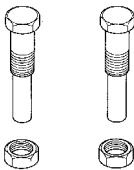
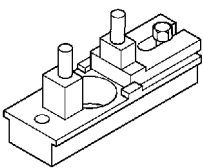
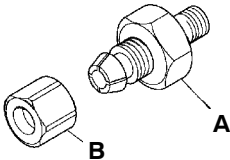
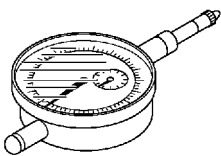
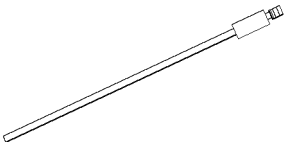
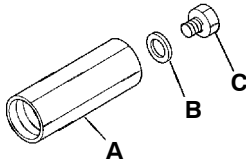
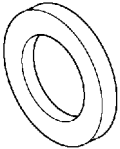
Unit: mm

Descriptions			Standard	Limit	
<b>Glow plug</b>					
Glow plug	Resistance $\Omega$		1.1	-	
<b>Turbocharger assembly</b>					
Turbocharger	Actuator operating pressure (when operating 1 mm) kPa		161	-	
<b>Rocker cover, camshaft holder assembly, camshaft assembly</b>					
Camshaft	End play		0.10 - 0.18	0.3	
	Cam lobe lift	Intake	Front	6.16	6.11
			Rear	6.10	6.05
		Exhaust	Front	5.91	5.86
			Rear	6.16	6.11
	Bend		Less than 0.015	0.03	
Journal oil clearance		0.05 - 0.09	0.15		
Rocker	Rocker roller radial play		0.03 - 0.07	-	
<b>Injection nozzle</b>					
Injection nozzle	Injection pressure (valve opening pressure)	No. 1 valve opening pressure MPa	17.60 - 18.58	-	
		No. 2 valve opening pressure MPa	22.6 - 23.6	-	
	Pre-lift		0.05 - 0.07	-	
	Needle valve lift		0.23 - 0.28	-	
<b>Cylinder head and valve mechanism</b>					
Valve spring	Free height		51.3	-	
	Load (installed height: 39.5) N		255	-	
	Out-of-squareness		2°	4°	
Valve	Intake	Stem diameter	6.560 - 6.575	6.45	
		Sinkage from cylinder head bottom	0.05 - 0.55	0.8	
		Margin	1.0	0.8	
		Valve seat angle	45° ± 15'	-	
	Exhaust	Stem diameter	6.53 - 6.55	6.45	
		Sinkage from cylinder head bottom	0.05 - 0.55	0.8	
		Margin	1.0	0.8	
		Valve seat angle	45° ± 15'	-	
Valve guide	Stem-to-guide clearance		Intake	0.02 - 0.06	0.10
			Exhaust	0.05 - 0.09	0.15

**TORQUE SPECIFICATIONS**

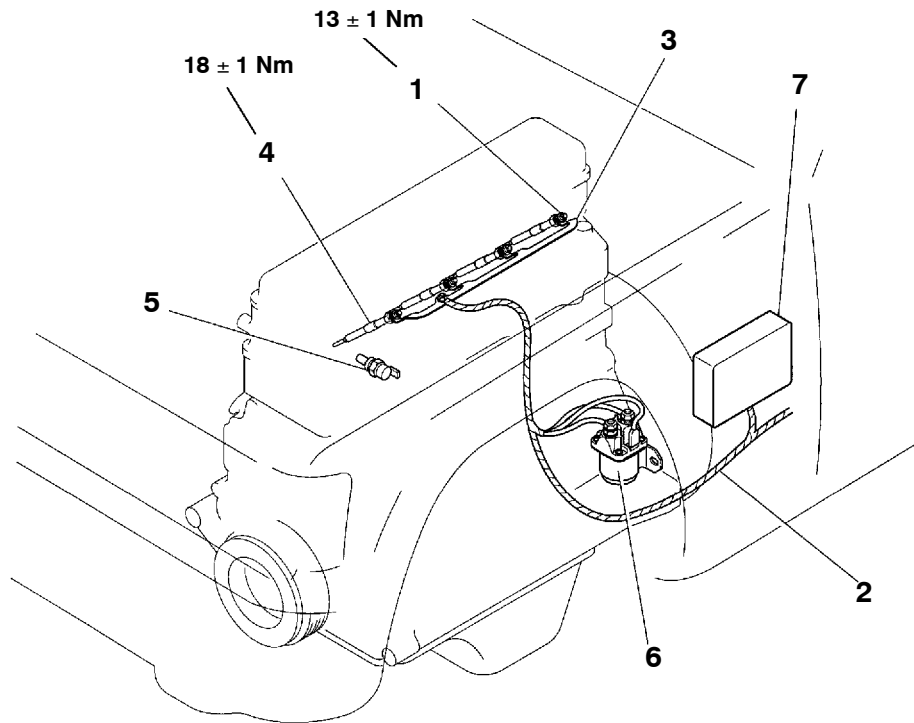
Items	Torque Nm	
<b>Glow plug</b>		
Connection plate	1.3 ± 1	
Glow plug	18 ± 1	
<b>Cooling fan V-belt and water pump</b>		
Cooling fan bolt	10 ± 1	
Auto-cooling fan coupling nut	24 ± 2	
Water pump bolt	24 ± 2	
<b>Water hoses and pipes</b>		
Eyebolt	25 ± 2	
Coolant temperature sensor	9 ± 1	
<b>Intake manifold</b>		
Boost air temperature sensor	15 ± 1	
Gas filter assembly	17 ± 1	
<b>Turbocharger assembly</b>		
Eye bolt (for oil pipe)	20 ± 2	
Eye bolt (for water pipe)	25 ± 2	
Coupler nut	49 ± 4	
Turbocharger nut	49 ± 4	
Turbocharger bolt	54 ± 5	
<b>Exhaust manifold</b>		
Exhaust manifold nut	30 ± 3	
<b>Injection pump assembly</b>		
Injection pipe	25 ± 2	
Pump stay mounting bolt	18 ± 2	
<b>Injection pump</b>		
Injection pump gear mounting nut	180 ± 10	
Sensor plate mounting bolt	5 ± 1	
Flange plate mounting nut	38 ± 2	
Engine speed sensor mounting bolt	5 ± 1	
<b>Rocker cover, camshaft holder assembly, camshaft assembly</b>		
Rocker cover mounting bolt	3.0 ± 0.3	
Fuel leak-off pipe eyebolt	Injection nozzle side	13 ± 2
	Cylinder head side	11 ± 1
Cam sprocket mounting bolt	88 ± 10	
Camshaft cap mounting bolt	20 ± 1	
Adjust screw locknut	9.5 ± 0.5	
Pivot bolt	38 ± 8	

## 2. SPECIAL TOOLS

Tool	Number	Name	Use
	MB990767	Front hub and flange yoke holder	<ul style="list-style-type: none"> <li>Removal of crankshaft pulley</li> <li>Installation of injection pump assembly</li> </ul>
	MD998754	Crankshaft pulley holder pin	
	157944-9520 (Zexel)	Plate	Removal and installation of retaining nut
	105789-0010 (Zexel)	Nozzle cleaning tool	Cleaning of nozzle and needle valve
	157892-4420	Adjusting device	<ul style="list-style-type: none"> <li>Adjustment of valve opening pressure</li> <li>Checking needle valve maximum lift</li> <li>Checking injection nozzle assembly</li> </ul>
	157892-4400: A	Holder	
	157892-1000: B	Nut	
	157954-3801	Dial gauge	
	157892-7200	Pin	
	157892-5120	Retaining nut	
	157892-5100: A	Retaining nut	
	026508-1140: B	Gasket	
	157892-1600: C	Plug	
	157892-3200	Gasket	

## 4. GLOW PLUG

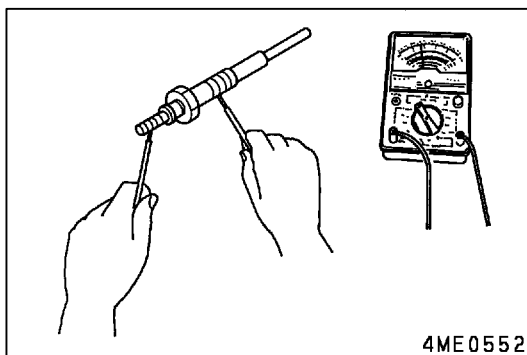
### REMOVAL AND INSTALLATION



4ME0551

#### Removal steps

1. Nut
2. Glow plug wiring harness
3. Connection plate
4. Glow plug
5. Coolant temperature sensor (For engine control)
6. Glow relay
7. Engine ECU



4ME0552

#### INSPECTION

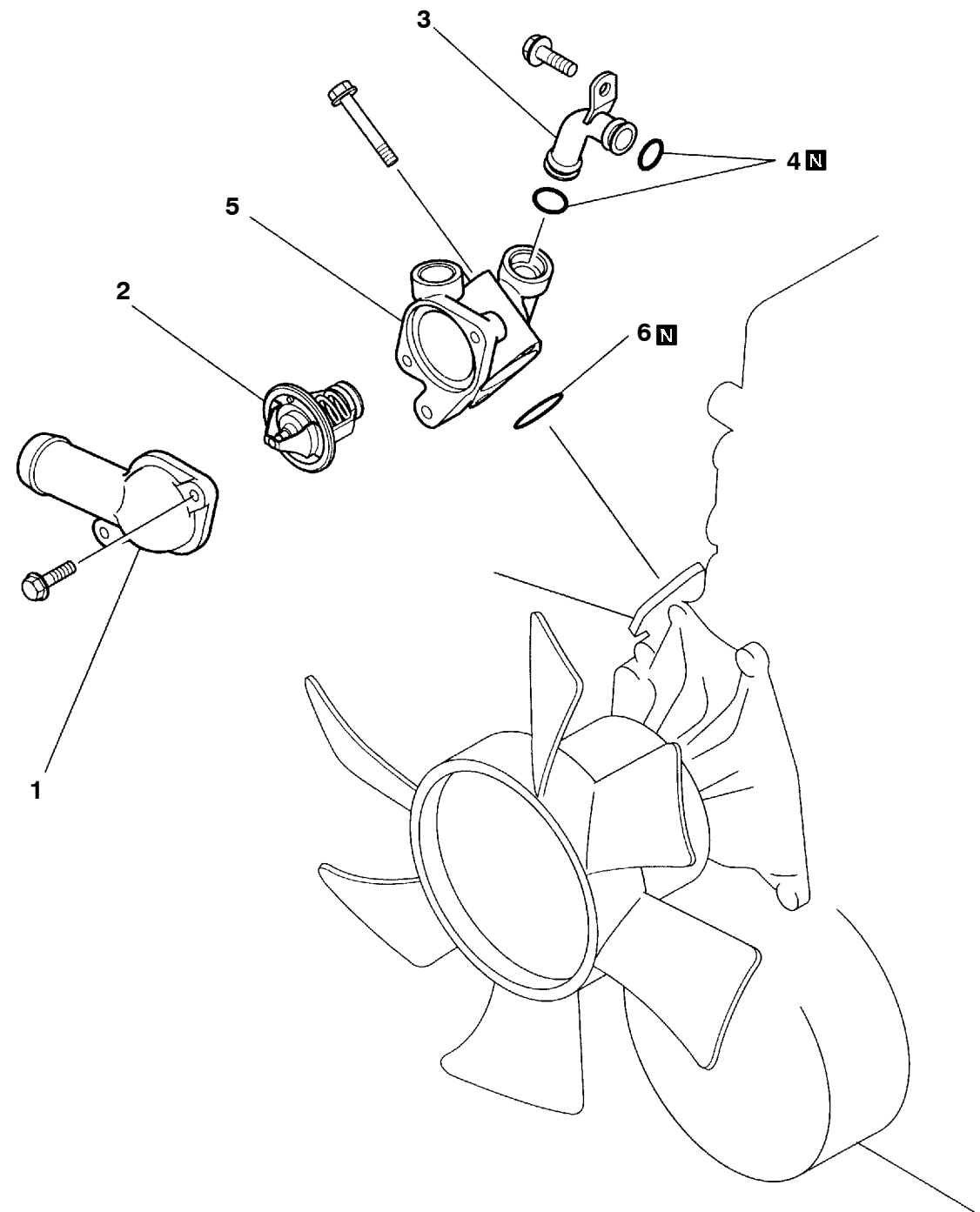
##### GLOW PLUG

Measure resistance of the glow plug 4. Replace the glow plug if the reading deviates from the specified standard value.

**Standard value:  $1.1 \Omega$**

## 7. THERMOSTAT

### REMOVAL AND INSTALLATION



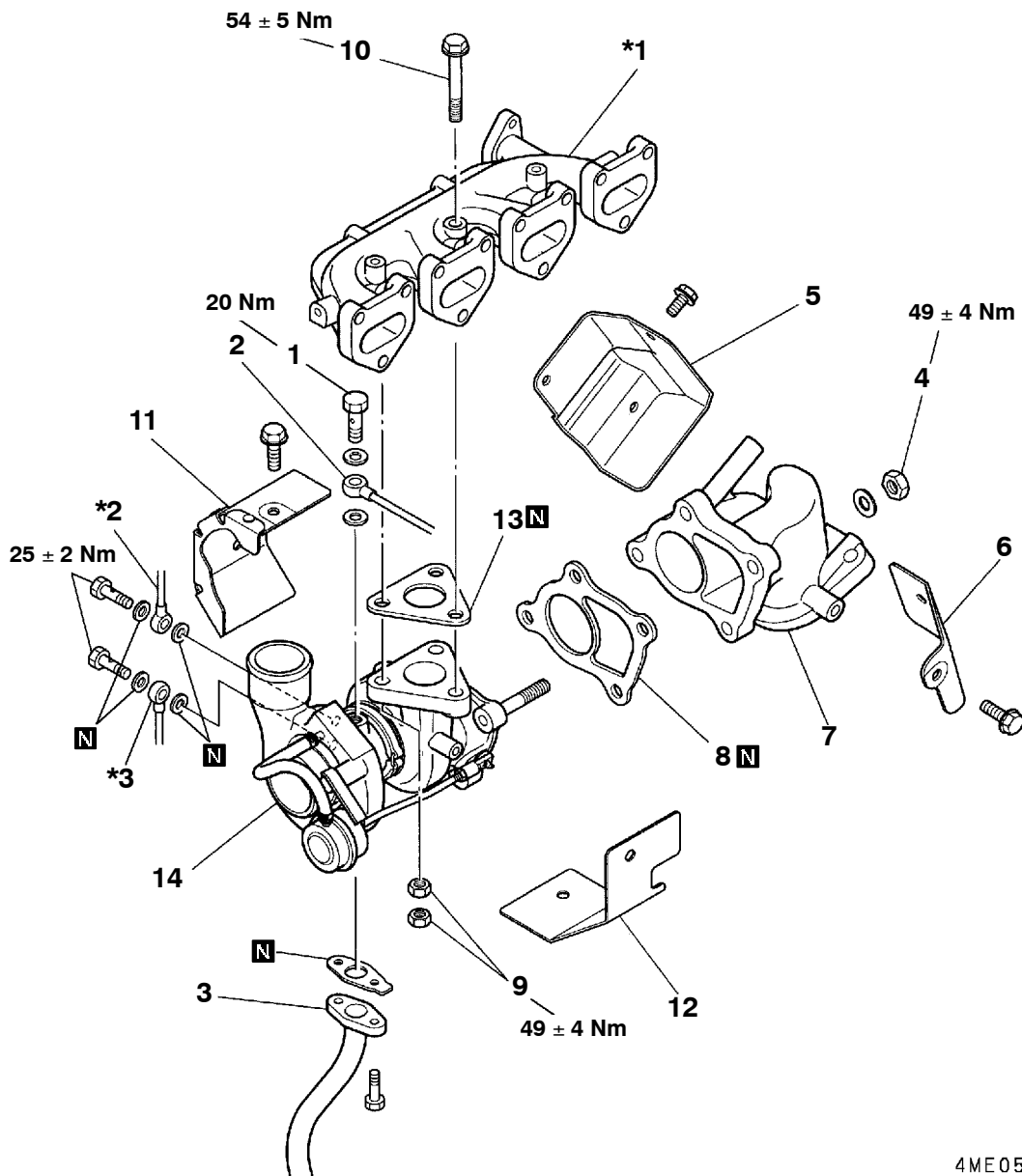
4ME0560

#### Removal steps

- ▶B◀ 1. Thermostat cover
- ▶B◀ 2. Thermostat
- ▶A◀ 3. Bypass pipe
- ▶A◀ 4. O-ring
- ▶A◀ 5. Thermostat case
- ▶A◀ 6. O-ring

# 10. TURBOCHARGER ASSEMBLY

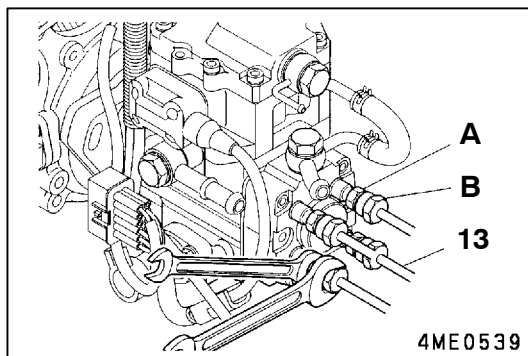
## REMOVAL AND INSTALLATION



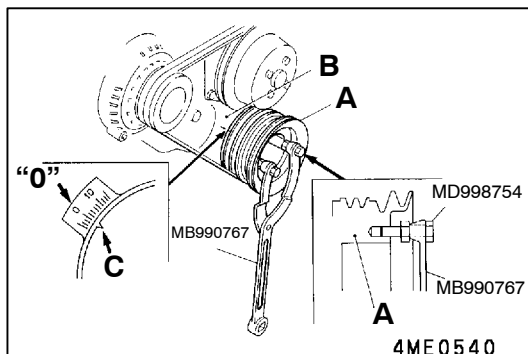
4ME0565

### Removal steps

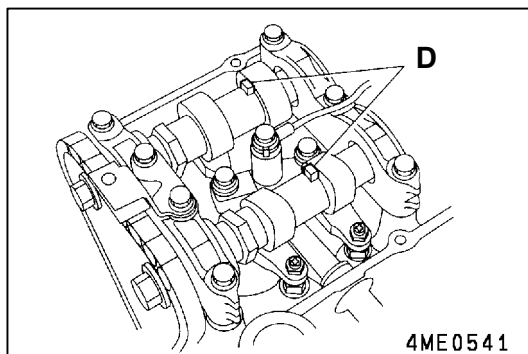
1. Eyebolt
  2. Oil feed pipe
  3. Oil return pipe
  4. Nut
  5. Coupler insulator
  6. Insulator
  7. Coupler
  8. Gasket
  9. Nut
  10. Bolt
  11. Insulator B
  12. Insulator A
  13. Gasket
  - ▶A◀ 14. Turbocharger assembly
- \*1: Exhaust manifold  
 \*2: Turbocharger water outlet pipe  
 (Refer to page 11B-6-1.)  
 \*3: Turbocharger water inlet pipe  
 (Refer to page 11B-6-1.)

**REMOVAL SERVICE POINT****◀A▶ INJECTION PIPE REMOVAL**

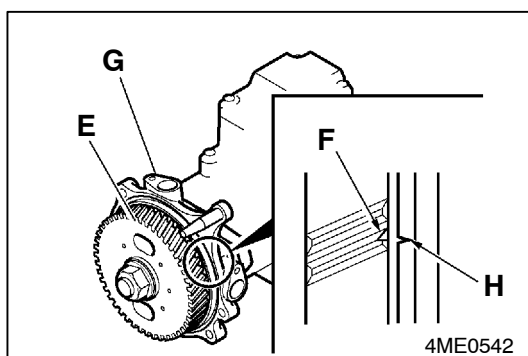
Loosen the union nut **B** of the fuel injection pipe **13** while locking the delivery valve holder **A** to prevent it from rotating together.

**INSTALLATION SERVICE POINTS****▶A◀ INJECTION PUMP ASSEMBLY INSTALLATION**

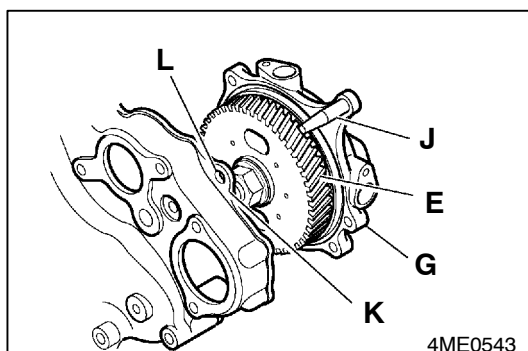
- (1) Turn the crankshaft pulley **A** clockwise with the specified special tool to place the No.1 piston at the TDC on the compression stroke. Align the notch **C** in the crankshaft pulley with the timing mark "**0**" on the timing gear case **B**.

**Caution**

1. If the dent **D** on the camshaft faces upward, the No.1 piston is at the TDC on the compression stroke. If not, rotate the crankshaft pulley **A** one more turn in normal direction.
2. Never rotate the crankshaft pulley **A** in reverse direction (counterclockwise). It may cause damage to the timing chain tensioner. If the crankshaft is accidentally rotated in reverse direction, remove and reinstall the tensioner according to the correct installation procedure.



- (2) Align the notch **F** on the injection pump gear **E** with the mating mark "**H**" on the flange plate **G**.




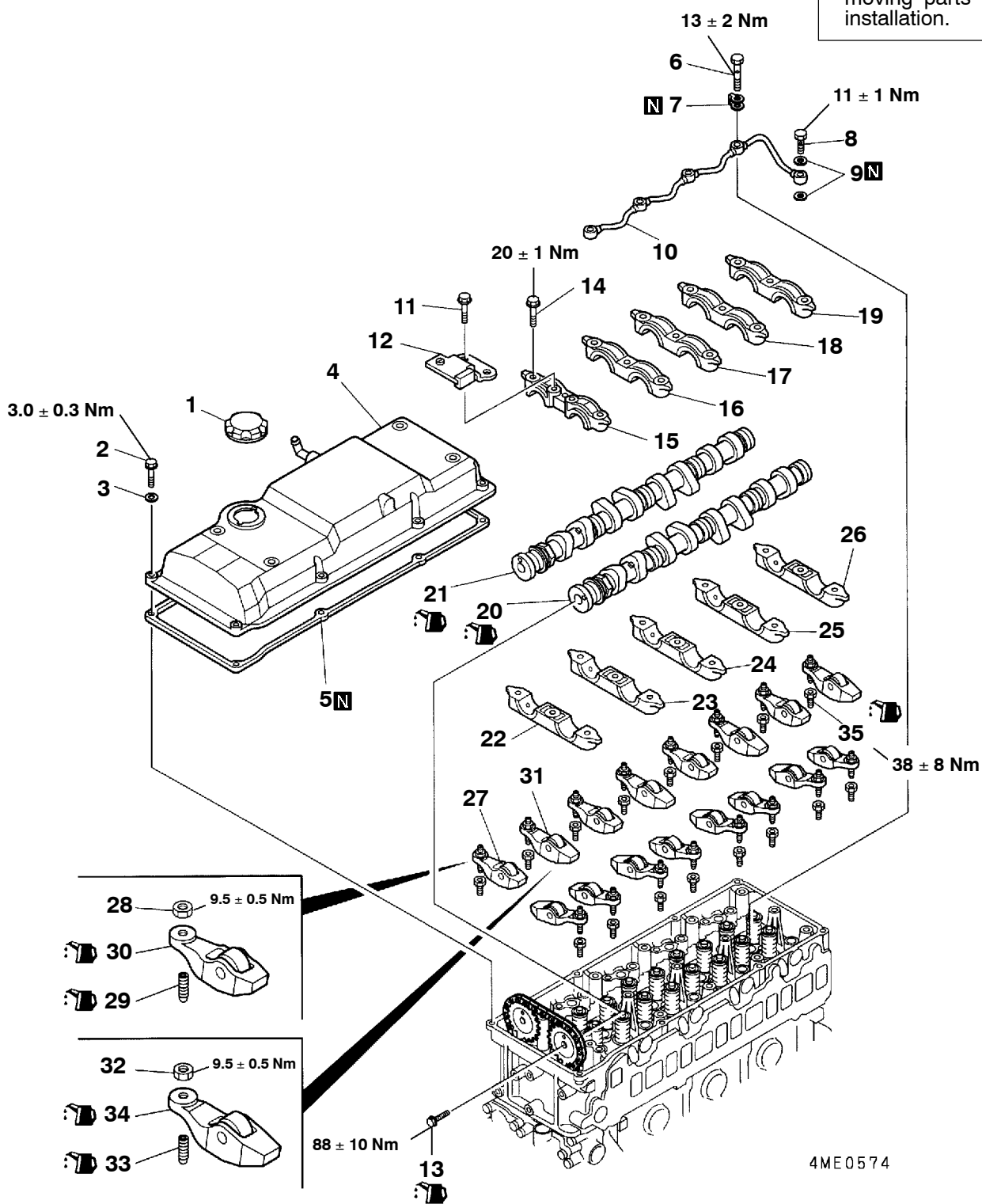
- (3) Align the guide bar **J** of the flange plate **G** with the guide hole **L** of the front plate **K** and insert the injection pump assembly into the front plate just before the injection pump gear **E** meshes with the idler gear.

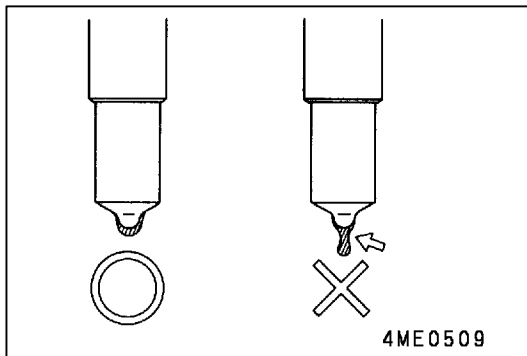


# 14. ROCKER COVER, CAMSHAFT HOLDER ASSEMBLY AND CAMSHAFT

## REMOVAL AND INSTALLATION

 Apply engine oil to all moving parts before installation.





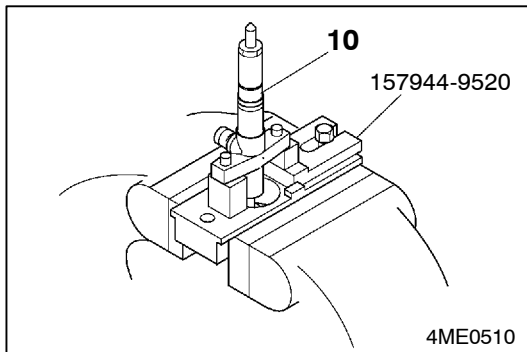
### 3. OIL TIGHTNESS CHECK

- (1) Slowly increase the nozzle internal pressure and maintain it at a pressure 1960 kPa lower than the specified 1st valve opening pressure. In this condition, check that the fuel injection nozzle does not start dribbling within 10 seconds.
- (2) If the dribbling begins in less than 10 seconds, disassemble, clean and recheck the fuel injection nozzle assembly **10**. If the problem still remains after another check, replace the fuel injection nozzle assembly.

### REMOVAL SERVICE POINTS

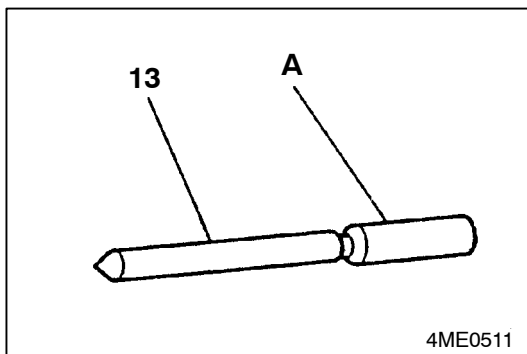
#### ◀A▶ RETAINING NUT REMOVAL

Using the special tool, remove the retaining nut.



#### Caution

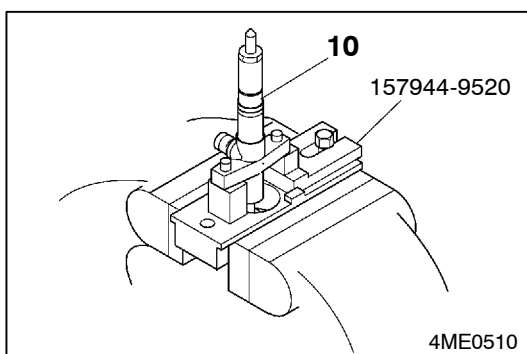
1. Be sure not to touch the sliding surface **A** of the needle valve **13** with dirty hands.
2. Be sure not to change the original combination of the needle valve **13** and nozzle tip **12** removed.



### INSTALLATION SERVICE POINT

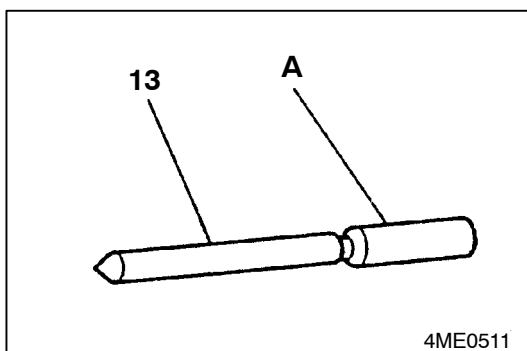
#### ▶A◀ RETAINING NUT INSTALLATION

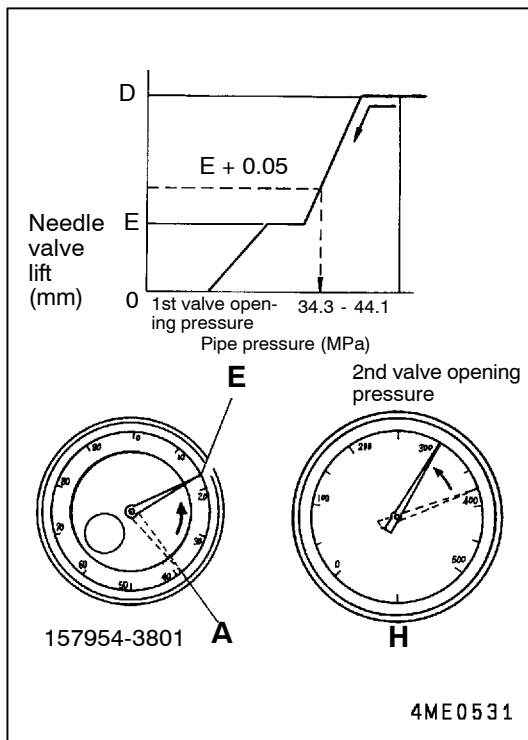
Using the special tool, install the retaining nut.



#### Caution

1. Be sure not to touch the sliding surface **A** of the needle valve **13** with dirty hands.
2. Be sure not to change the original combination of the needle valve **13** and nozzle tip **12** removed.





- (3) Note the value indicated by the pressure gauge **H** the moment the dial gauge indicates the specified amount of needle valve lift (normally prelift **E** + 0.05 mm).

**D:** Needle valve full lift

**Standard value: 22.6 - 23.6 MPa**

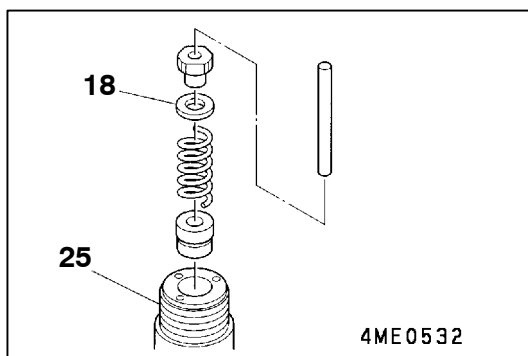
- (4) If the dial gauge reading deviates from the specified limits of standard value, disassemble the nozzle holder **25** and make pressure adjustment by changing the existing shim **18** for a shim with appropriate thickness.

**Thicknesses of available 2nd valve opening pressure adjusting shims (outside diameter:  $\phi 7.2$  mm):**

**0.10, 0.20, 0.30, 0.40, 0.50, 0.51, 0.52, 0.53, 0.54, 0.55, 0.56, 0.57, 0.58, 0.59 mm**

**Caution**

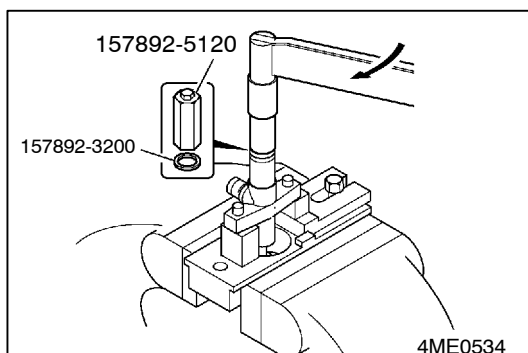
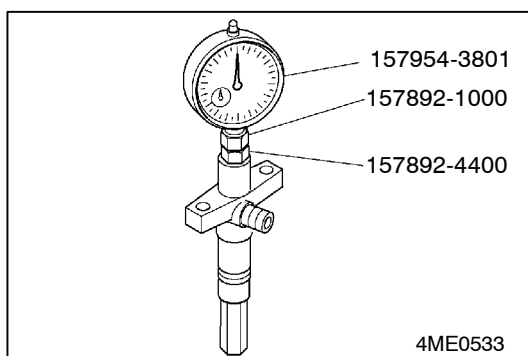
**Adjusting the 1st valve opening pressure changes the 2nd valve opening pressure. After the 1st valve opening pressure is altered, therefore, be sure to check and readjust the 2nd valve opening pressure.**

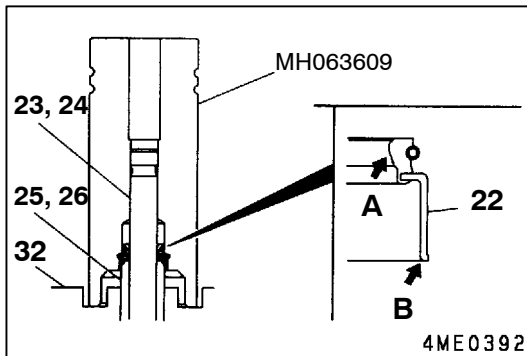


**CHECKING INJECTION NOZZLE ASSEMBLY**

Upon completion of all necessary adjustments, perform a final check on the injection nozzle assembly by the following procedure.

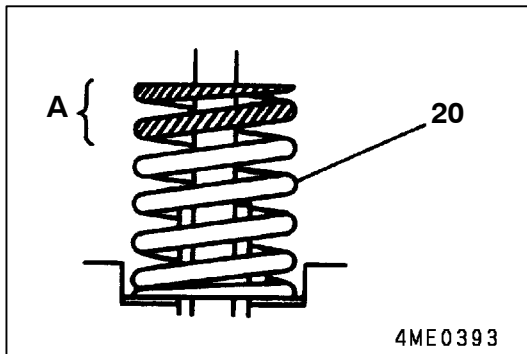
- (1) Remove the special tools Dial Gauge, Nut and Holder.
- (2) Remove the special tools Retaining Nut (for adjustment) and Gasket.
- (3) Check that the pin **14** is secured in position. Install the regular retaining nut **11** handtight. then tighten it to the specified torque.
- (4) Attach the nozzle holder **25** to the nozzle tester **B**. Using the nozzle tester **B**, check the 1st valve opening pressure, spray form and seat oiltightness. Check that all parts are leak-free at the same time.





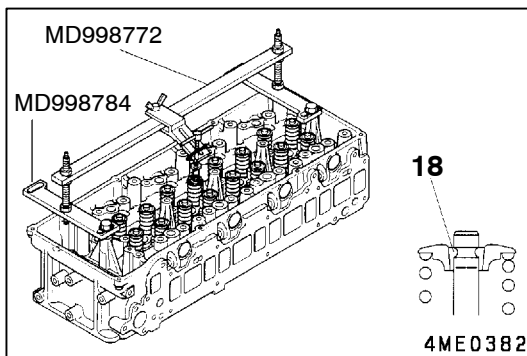
►C◄ VALVE STEM SEAL INSTALLATION

- (1) Apply a thin coat of engine oil to the lip **A** of the valve stem seal **22**, then press in the valve stem seal **22** by hand until its lower end **B** contacts the top of the valve guide **25, 26**.
- (2) Install the valve stem seal **22** in position by carefully striking the special tool vertically until it comes into full to fully contact with the valve spring seat surface in the cylinder head **32**.



►D◄ VALVE SPRING INSTALLATION

Install the valve spring **20** with the blue painted end **A** upward.



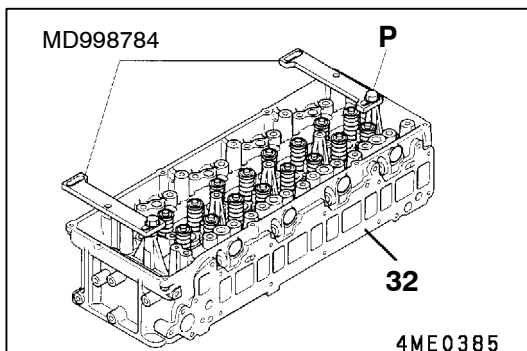
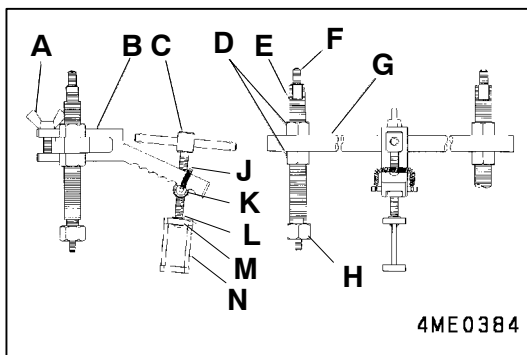
►E◄ VALVE COTTER INSTALLATION

<Method 1>

Using the special tools, install the valve cotten **18** as follows.

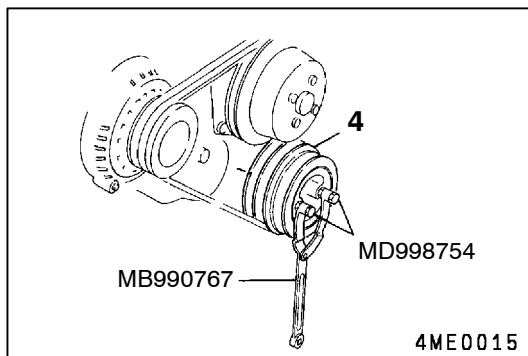
Component parts of special tool MD998772 Valve Spring Compressor

- A: Wing bolt
- B: Retainer
- C: Handle
- D: Nut
- E: Bolt
- F: Slotted screw
- G: Stay
- H: Lock nut
- J: Tension spring
- K: Mobile nut
- L: Washer
- M: Snap ring
- N: Retainer holder

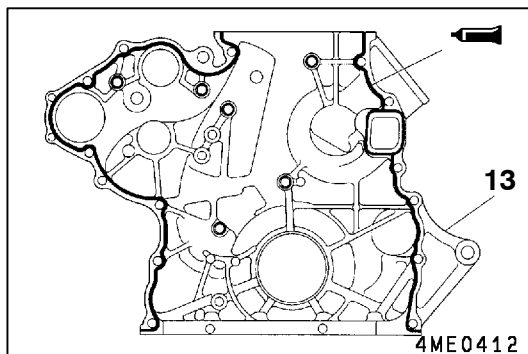


- (1) Install the special tools on the cylinder head **32** as shown in the illustration.

P: Bolt (M8 x 12.5 mm)

**REMOVAL SERVICE POINT****◀A▶ CRANKSHAFT PULLY REMOVAL**

Holding the crankshaft pulley 4 with the special tool, remove the bolt 2.

**INSTALLATION SERVICE POINTS****▶A◀ TIMING GEAR CASE INSTALLATION**

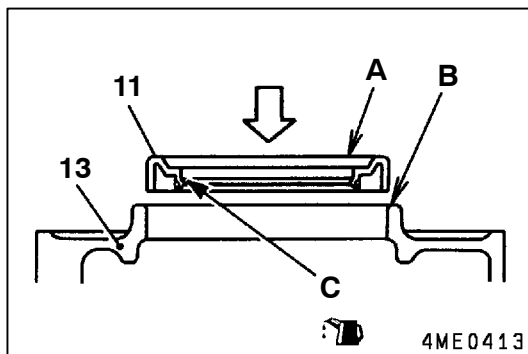
Apply an even bead of sealant to the entire joint surface of the timing gear case 13 as shown. Bead diameter: 3.5 mm.

**Specified sealant:**

**Mitsubishi Genuine Part No. MD970389 or equivalent**

**Caution**

**Squeeze out the sealant uniformly without excess and discontinuity.**

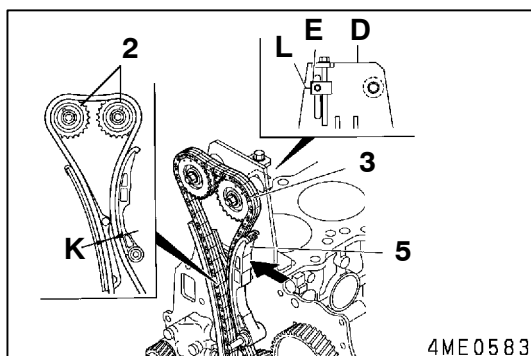
**▶B◀ FRONT OIL SEAL INSTALLATION**

Apply a thin coat of engine oil to the lip C, and install the front oil seal 11 in the timing gear case 13 with the lip directed as shown until its end surface A becomes flush with the end surface B of the case.

**A:** End surface (front oil seal)

**B:** End surface (timing gear case)

**C:** Lip



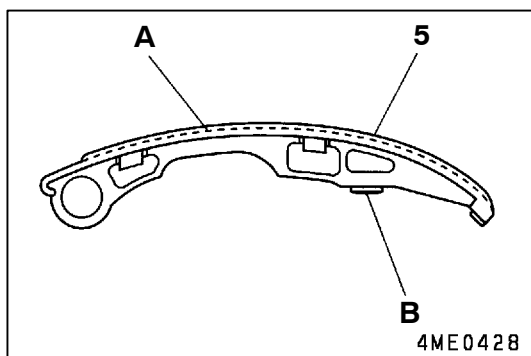
## INSPECTION

### 1. TIMING CHAIN

- (1) Aligning the stamped lines **L** on the adjusting plate **D** and nut **E**, set the camshaft sprocket **2** in position.
- (2) Push the tension lever **5** by hand to take up the slack of the timing chain **3**. Measure the minimum clearance **K** between the chain spans facing each other. If the reading deviates from the specified limit, replace the timing chain.

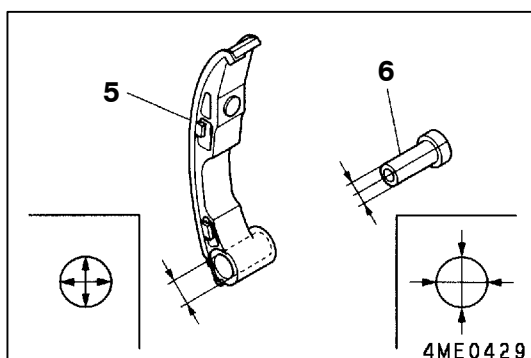
**Standard value: 16.5 mm**

**Limit: 9 mm**



### 2. TENSION LEVER AND TENSION LEVER SHAFT

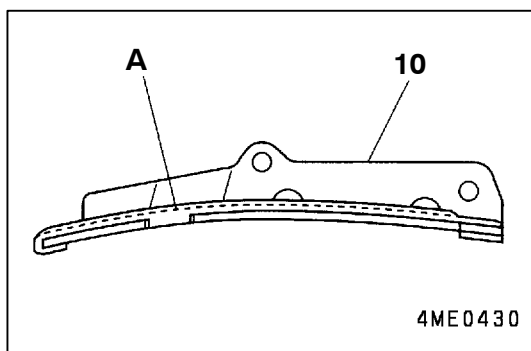
- (1) Replace the tensioner lever **5** if it shows any cracks or flakes on the surface **A** that makes sliding contact with the timing chain and the tensioner contact surface **B**.



- (2) If the tensioner lever **5** to tension lever shaft **6** clearance exceeds the specified limit, replace the defective part.

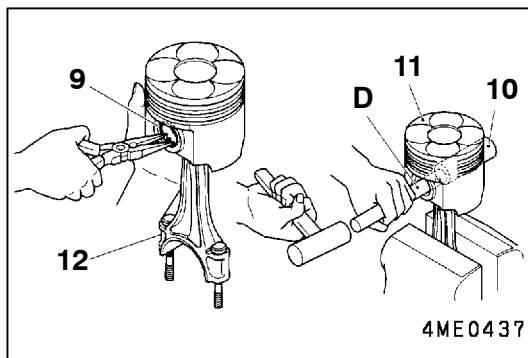
**Standard value: 0.06 - 0.18 mm**

**Limit: 0.3 mm**



### 3. GUIDE PLATE

Replace the guide plate **10** if it shows any cracks or flakes on the surface **A** that makes sliding contact with the timing chain.

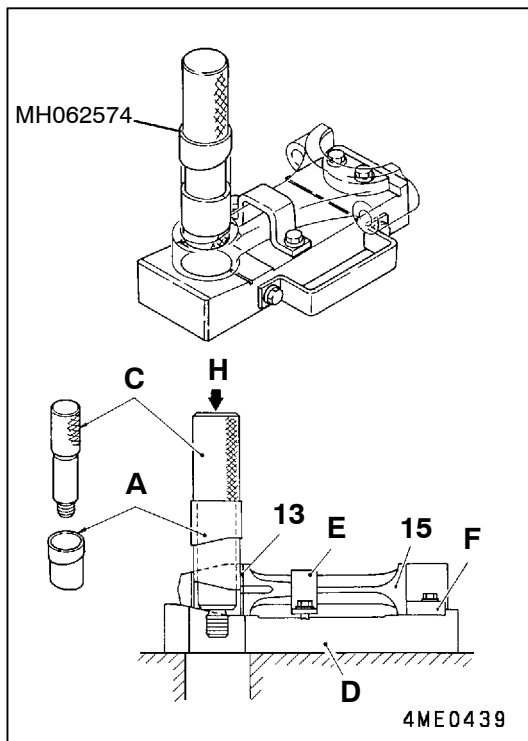


### ◀C▶ PISTON PIN / PISTON / CONNECTING ROD ASSEMBLY REMOVAL

Remove the piston pin **10** using an appropriate push-out bar **D** as shown.

#### NOTE

To make the piston pin **10** easy to remove, warm the piston **11** over an appropriate heater or in hot water if necessary.



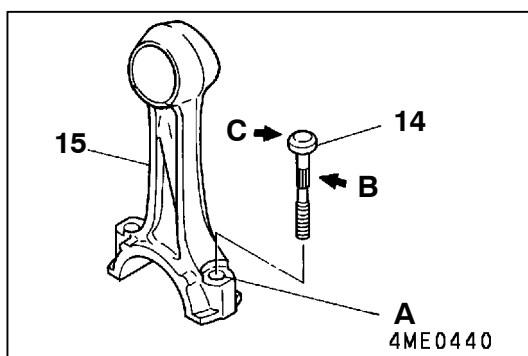
### ◀D▶ CONNECTING ROD BUSH REMOVAL

Use the special tool to remove the connecting rod bush **13**.

Component Parts of Special Tool MH062574 - Connecting Rod Bush Puller Kit

- A: Collar
- B: Collar
- C: Puller
- D: Base
- E: Bracket
- F: Plate
- G: Nut

1. Secure the connecting rod **15** to the base **D** with the bracket **E** and plate **F**.
2. Attach the collar **A** onto the puller **C** as shown, and remove the connecting rod bush **13** slowly under a press ram load **H** of approximately 49,035 N.



## INSTALLATION SERVICE POINTS

### ▶A▶ CONNECTING ROD BOLT INSTALLATION

- (1) Check that the bolt hole **A** in the connecting rod **15** is free of damage, burrs, etc.
- (2) Apply a thin coat of engine oil to the knurled portion **B** of the connecting bolt **14**. Then, fit it in the connecting rod with the notch **C** in the head inward under a press ram load of less than 4,903 N.

C: Notch in bolt head