

## HOW TO READ THIS MANUAL

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c-visk250-visk250nlc-vi-hydraulic-excavator-engine-service-repair-workshop-manual/

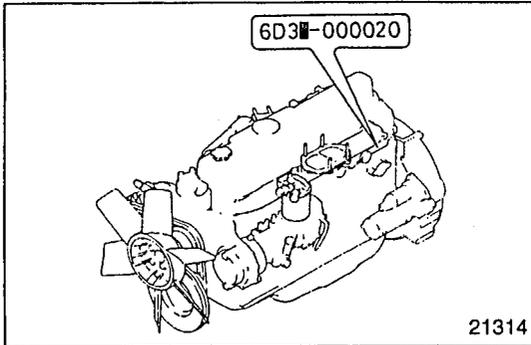
Unit	Sign of SI unit	Sign of foot-pound unit	Conversion rate
Mass quantity of matter	kg	lb	1 kg = 2.2046 lb
	g	oz	1 g = 0.035274 oz
Dimension	m	ft.	1 m = 3.2808 ft.
	mm	in.	1 mm = 0.03937 in.
Capacity	L	gal.	1 L = 0.2642 gal. (U.S.) 1 L = 0.220 gal. (Imp.)
	cm <sup>3</sup>	oz	1 cm <sup>3</sup> = 0.033814 oz (U.S.)
	cm <sup>3</sup>	cu.in.	1 cm <sup>3</sup> = 0.035195 oz (Imp.) 1 cm <sup>3</sup> = 0.061023 cu.in.
Force	N (Newton)	lbf	1 N = 0.2248 lbf
Pressure	kPa (kilopascal)	lbf/in. <sup>2</sup>	1 kPa = 0.145 lbf/in. <sup>2</sup>
			1 kPa = 0.2953 in. Hg
Stress	N/cm <sup>2</sup>	lbf/in. <sup>2</sup>	1 N/cm <sup>2</sup> = 1.45 lbf/in. <sup>2</sup>
Moment of force	N · m	lbf.ft	1 N · m = 0.7375 lbf.ft
Output	kW (kilowatt)	HP	1 kW = 1.34 HP
Temperature	°C	°F	t°C = (1.8t°C + 32)°F

ENGINE NUMBER, NAME PLATE AND CAUTION PLATE 00

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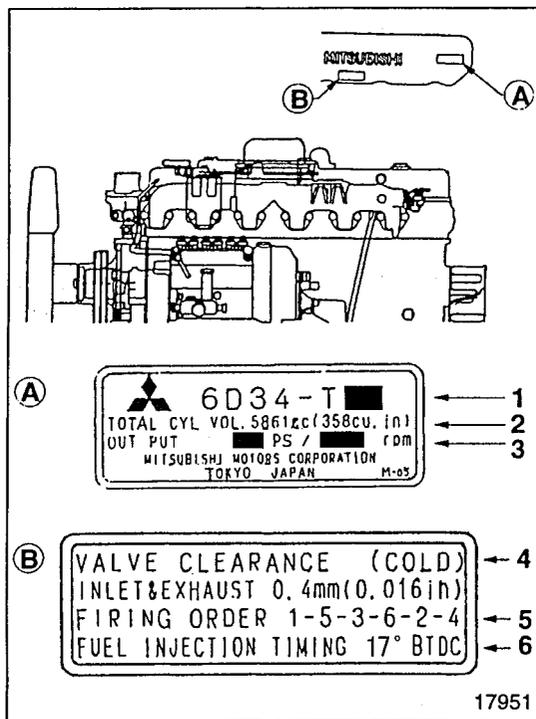
The serial number for engine is assigned to the respective engine in manufacturing sequence: every engine has its own number. This number is required for incidental inspection of the engine. Please do not fail to mention this number to the dealers when ordering spare parts.

### Engine Number



The engine number is punch-marked on the shown location.

### Name Plate and Caution Plate

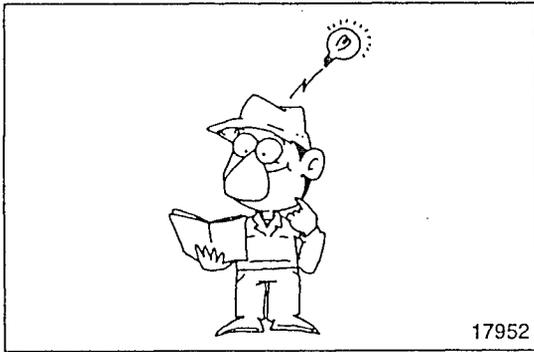


A: Name plate  
B: Caution plate

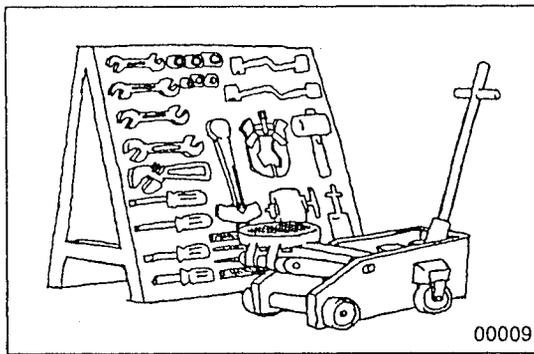
- 1 Engine model
- 2 Total displacement
- 3 Maximum output
- 4 Valve clearance
- 5 Firing order
- 6 Fuel injection timing

# PRECAUTIONS FOR MAINTENANCE OPERATION

In order to determine the condition of the vehicle adequately, attend the vehicle beforehand to find and keep record of the accumulated mileage, operating condition, what the customer's demand is, and other information that may be necessary. Prepare the steps to be taken and perform efficient and wasteless maintenance procedure.



- Determine where the fault exists and check for the cause to see whether removal or disassembly of the part is necessary. Then follow the procedure specified by this manual.
- Perform maintenance work at a level area.



- Prepare general and special tools necessary for the maintenance work.

## WARNING

Do not attempt to use tools other than special tools where use of special tools is specified in this manual. This will avoid injury or damage.

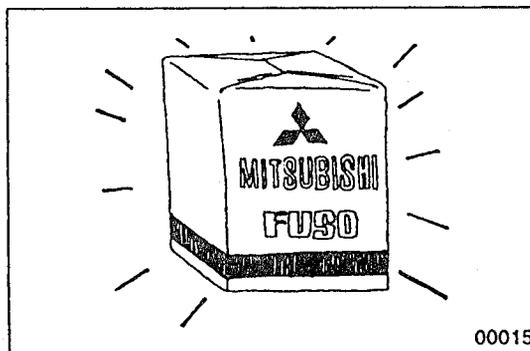
- When removing or installing the engine, attach the lifting wire rope hooks to the engine's lifting eyes and hoist the engine slowly such that it does not touch other components.

## WARNING

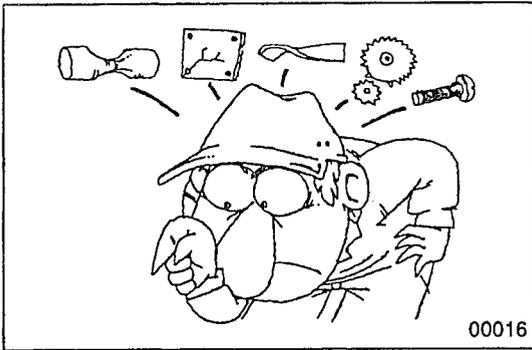
Check that the wire rope and crane are sufficiently strong.



- Be particularly careful not to work in shoes that have oily soles and are slippery. When working as a team of two or more, arrange signals in advance and keep confirming safety. Be careful not to accidentally bump switches or levers.
- Check for oil leakage before cleaning the area having the fault otherwise you might miss detecting the leakage.
- Prepare replacement part(s) beforehand.

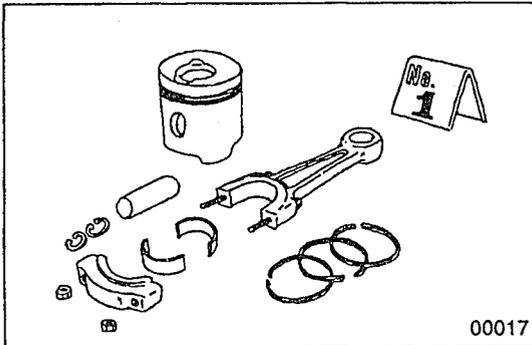


- Replace oil seals, packing, O-rings and other rubber parts; gaskets and split pins with new parts whenever any of them has been removed. Use only genuine MITSUBISHI replacement parts.



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On disassembly, visually inspect all parts for wear and tear, cracks, damage, deformation, degradation, rust, corrosion, smoothness in rotation, fatigue, clogging and any other possible defect.



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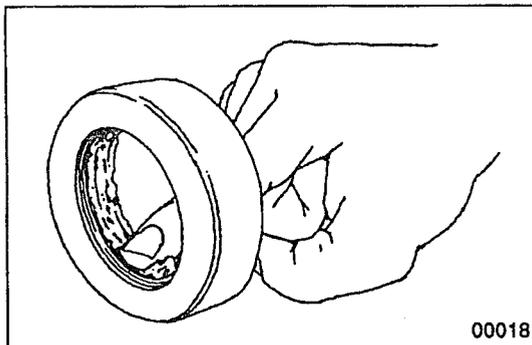
Put alignment marks on part combinations before disassembly and arrange the disassembled parts neatly. This will help avoid mismatching of the parts later.

Put the alignment marks, punch marks, etc. where performance and appearance will not be affected.

Cover the area left open after removal of parts to keep it free from dust.

**CAUTION** ⚠

- Take care to avoid mixing up numerous parts, similar parts, left and right, etc.
- Keep new parts for replacement and original (removed) parts separate.

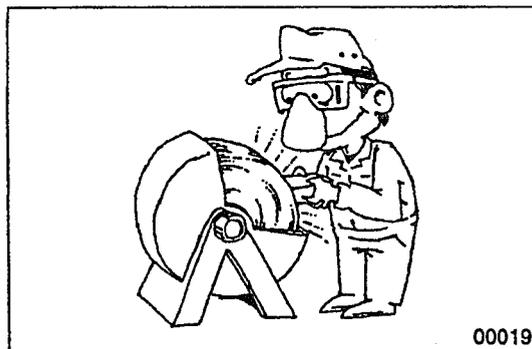


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Apply the specified oil or grease to U-packings, oil seals, dust seals and bearings during assembly.

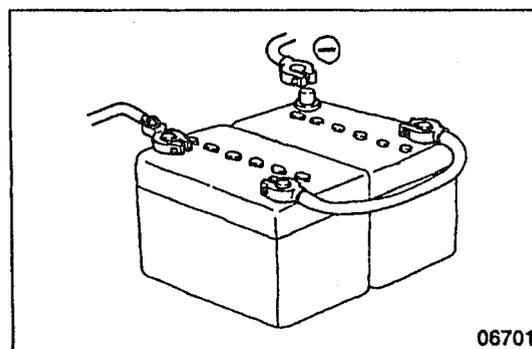
**CAUTION** ⚠

Use only the specified oil, grease, etc. for lubricant. Remove the excess immediately after application with a piece of rag.



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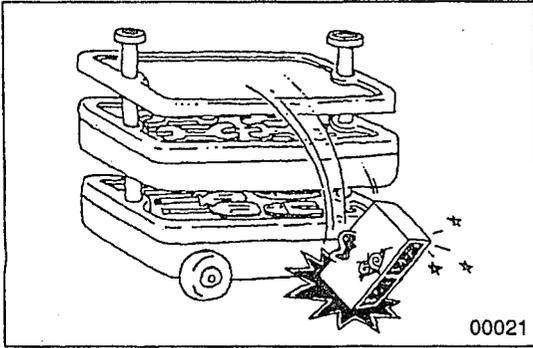
Wear goggles when using a grinder or welder. Pay full attention to safety by wearing gloves when necessary. Watch out for sharp edges, etc. that might injure your hands or fingers.



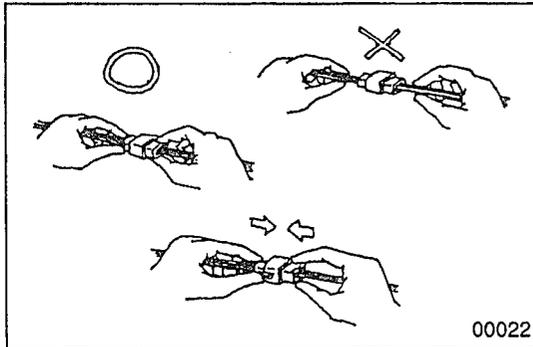
06701

Before carrying out maintenance work on the electric system, disconnect the negative terminals of the batteries.

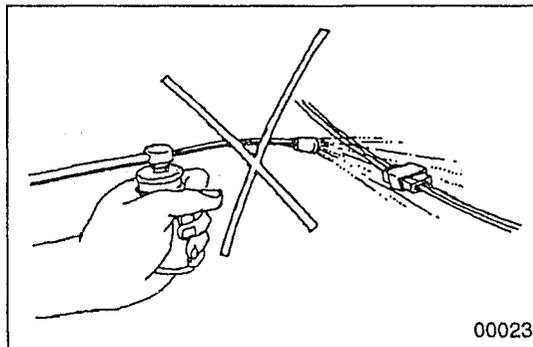
# PRECAUTIONS FOR MAINTENANCE OPERATION



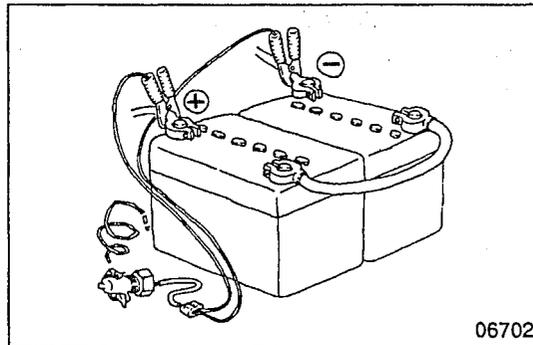
- Take care when handling sensors, relays, etc. which are vulnerable to shock and heat.



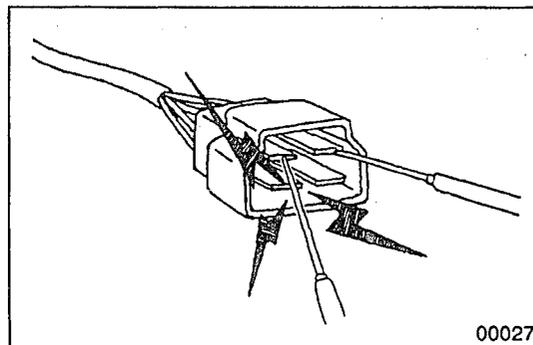
- Pull the connector, and not the harness lead, to separate connectors. To separate a lock-type connector, first push toward arrow mark. To re-connect a lock-type connector, press the separated parts until they click together.



- When washing the vehicle, cover the electric system parts and instruments with waterproof material beforehand (Cover with vinyl sheet or the like). Keep water away from harness wire connectors and sensors. If any of them should get wet, wipe them off immediately.



- To apply voltage for testing, check that the positive and negative cables are connected properly, then increase voltage gradually from 0 volt. Do not apply voltage higher than the specified value. In particular, pay close attention to the electronic control unit and sensors, since they are not always supplied with 24V.



- When using testers or the like for continuity tests, be careful not to allow test probes to touch the wrong terminals.

# TABLE OF STANDARD TIGHTENING TORQUES

00

- Use specified bolts and nuts and tighten them at specified torques according to the following table, unless otherwise specified.
- Threads and contact seats shall be dry.
- Where there is a difference in strength classification between the nut and bolt (or stud bolt), the torque specified for the bolt shall apply.

## Hex-head Bolt and Stud Bolt

Unit: N · m {kgf · m}

Strength classification	4T		7T		8T	
Representation Diameter symbol	  (Stud)		  (Stud)		  (Stud)	 02154
M5	2 to 3 {0.2 to 0.3}	-	4 to 6 {0.4 to 0.6}	-	5 to 7 {0.5 to 0.7}	-
M6	4 to 6 {0.4 to 0.6}	-	7 to 11 {0.7 to 1.1}	-	8 to 12 {0.8 to 1.2}	-
M8	9 to 14 {0.9 to 1.4}	-	17 to 26 {1.7 to 2.6}	-	20 to 29 {2.0 to 3.0}	-
M10	19 to 28 {1.9 to 2.8}	18 to 26 {1.8 to 2.7}	36 to 52 {3.5 to 5.5}	33 to 49 {3.3 to 5.0}	45 to 60 {4.5 to 6.0}	41 to 59 {4.3 to 6.9}
M12	35 to 50 {3.4 to 5.0}	31 to 46 {3.1 to 4.7}	70 to 95 {7.0 to 9.5}	65 to 85 {6.5 to 8.5}	85 to 110 {8.5 to 11}	75 to 100 {7.5 to 10}
M14	60 to 85 {6.0 to 8.5}	55 to 75 {5.5 to 7.5}	120 to 160 {12 to 16}	110 to 140 {11 to 14}	130 to 180 {13 to 18}	120 to 160 {12 to 17}
M16	90 to 130 {9.5 to 13}	90 to 120 {9.0 to 12}	180 to 240 {18 to 24}	160 to 220 {16 to 22}	200 to 270 {20 to 27}	190 to 260 {19 to 26}
M18	140 to 190 {14 to 19}	120 to 160 {12 to 16}	260 to 340 {26 to 35}	220 to 290 {22 to 30}	290 to 390 {30 to 40}	260 to 340 {26 to 35}
M20	190 to 260 {19 to 26}	170 to 230 {17 to 23}	350 to 470 {36 to 48}	320 to 420 {32 to 43}	410 to 550 {41 to 56}	370 to 490 {37 to 50}
M22	260 to 340 {26 to 35}	230 to 300 {23 to 31}	470 to 640 {48 to 65}	430 to 570 {43 to 58}	550 to 740 {56 to 75}	490 to 670 {50 to 68}
M24	340 to 450 {34 to 46}	290 to 390 {29 to 40}	630 to 840 {63 to 86}	540 to 730 {55 to 74}	730 to 980 {74 to 100}	630 to 840 {64 to 86}

## Hex-head Flange Bolt

Unit: N · m {kgf · m}

Strength classification	4T		7T		8T	
Representation Diameter symbol						 02154
M6	4 to 6 {0.4 to 0.6}	-	8 to 12 {0.8 to 1.2}	-	9 to 14 {0.9 to 1.4}	-
M8	10 to 15 {1.0 to 1.5}	-	19 to 28 {1.9 to 2.8}	-	22 to 32 {2.2 to 3.3}	-
M10	21 to 30 {2.1 to 3.1}	20 to 28 {1.9 to 2.9}	39 to 58 {3.9 to 6.0}	37 to 53 {3.6 to 5.4}	50 to 65 {5.0 to 6.5}	45 to 65 {4.5 to 6.5}
M12	38 to 54 {3.8 to 5.5}	35 to 51 {3.4 to 5.2}	80 to 110 {8.0 to 11}	70 to 95 {7.0 to 9.5}	90 to 120 {9.0 to 12}	85 to 110 {8.5 to 11}

# TABLE OF STANDARD TIGHTENING TORQUES

## Hex-head Nut

Unit: N·m {kgf·m}

Strength classification	4T		6T			
Representation						
Diameter symbol	Standard screw	Coarse screw	Standard screw	Coarse screw	02155	
M5	2 to 3 {0.2 to 0.3}	—	4 to 6 {0.4 to 0.6}	—		
M6	4 to 6 {0.4 to 0.6}	—	7 to 11 {0.7 to 1.1}	—		
M8	9 to 14 {0.9 to 1.4}	—	17 to 26 {1.7 to 2.6}	—		
M10	19 to 28 {1.9 to 2.8}	18 to 26 {1.8 to 2.7}	36 to 52 {3.5 to 5.5}	33 to 49 {3.3 to 5.0}		
M12	35 to 50 {3.4 to 5.0}	31 to 46 {3.1 to 4.7}	70 to 95 {7.0 to 9.5}	65 to 85 {6.5 to 8.5}		
M14	60 to 85 {6.0 to 8.5}	55 to 75 {5.5 to 7.5}	120 to 160 {12 to 16}	110 to 140 {11 to 14}		
M16	90 to 130 {9.5 to 13}	90 to 120 {9.0 to 12}	180 to 240 {18 to 24}	160 to 220 {16 to 22}		
M18	140 to 190 {14 to 19}	120 to 160 {12 to 16}	260 to 340 {26 to 35}	220 to 290 {22 to 30}		
M20	190 to 260 {19 to 26}	170 to 230 {17 to 23}	350 to 470 {36 to 48}	320 to 420 {32 to 43}		
M22	260 to 340 {26 to 35}	230 to 300 {23 to 31}	470 to 640 {48 to 65}	430 to 570 {43 to 58}		
M24	340 to 450 {34 to 46}	290 to 390 {29 to 40}	630 to 840 {63 to 86}	540 to 730 {55 to 74}		

## Hex-head Flange Nut Unit: N·m {kgf·m}

Strength classification	4T	
Representation		
Diameter symbol	Standard screw	Coarse screw
M6	4 to 6 {0.4 to 0.6}	—
M8	10 to 15 {1.0 to 1.5}	—
M10	21 to 30 {2.1 to 3.1}	20 to 28 {1.9 to 2.9}
M12	38 to 54 {3.8 to 5.5}	35 to 51 {3.4 to 5.2}

### Tightening torque for flare nut for general purpose

Unit: N · m {kgf · m}

Pipe diameter	φ4.76 mm	φ6.35 mm	φ8 mm	φ10 mm	φ12 mm	φ15 mm
Tightening torque	17 {1.7}	25 {2.6}	39 {4.0}	59 {6.0}	88 {9.0}	98 {10.0}

### Tightening torque for air piping nylon tube for general purpose {DIN type}

Unit: N · m {kgf · m}

Standard diameter	6 × 1 mm	10 × 1.25 mm	12 × 1.5 mm	15 × 1.5 mm
Tightening torque	$20^{+5.9}_{-0} \left\{ \begin{array}{l} 2.0^{+0.6} \\ -0 \end{array} \right\}$	$29^{+9.8}_{-0} \left\{ \begin{array}{l} 3.5^{+1.0} \\ -0 \end{array} \right\}$	$49^{+9.8}_{-0} \left\{ \begin{array}{l} 5.0^{+1.0} \\ -0 \end{array} \right\}$	$54^{+4.9}_{-0} \left\{ \begin{array}{l} 5.5^{+1.0} \\ -0 \end{array} \right\}$

### Tightening torque for air piping nylon tube for general purpose {SAE type}

Unit: N · m {kgf · m}

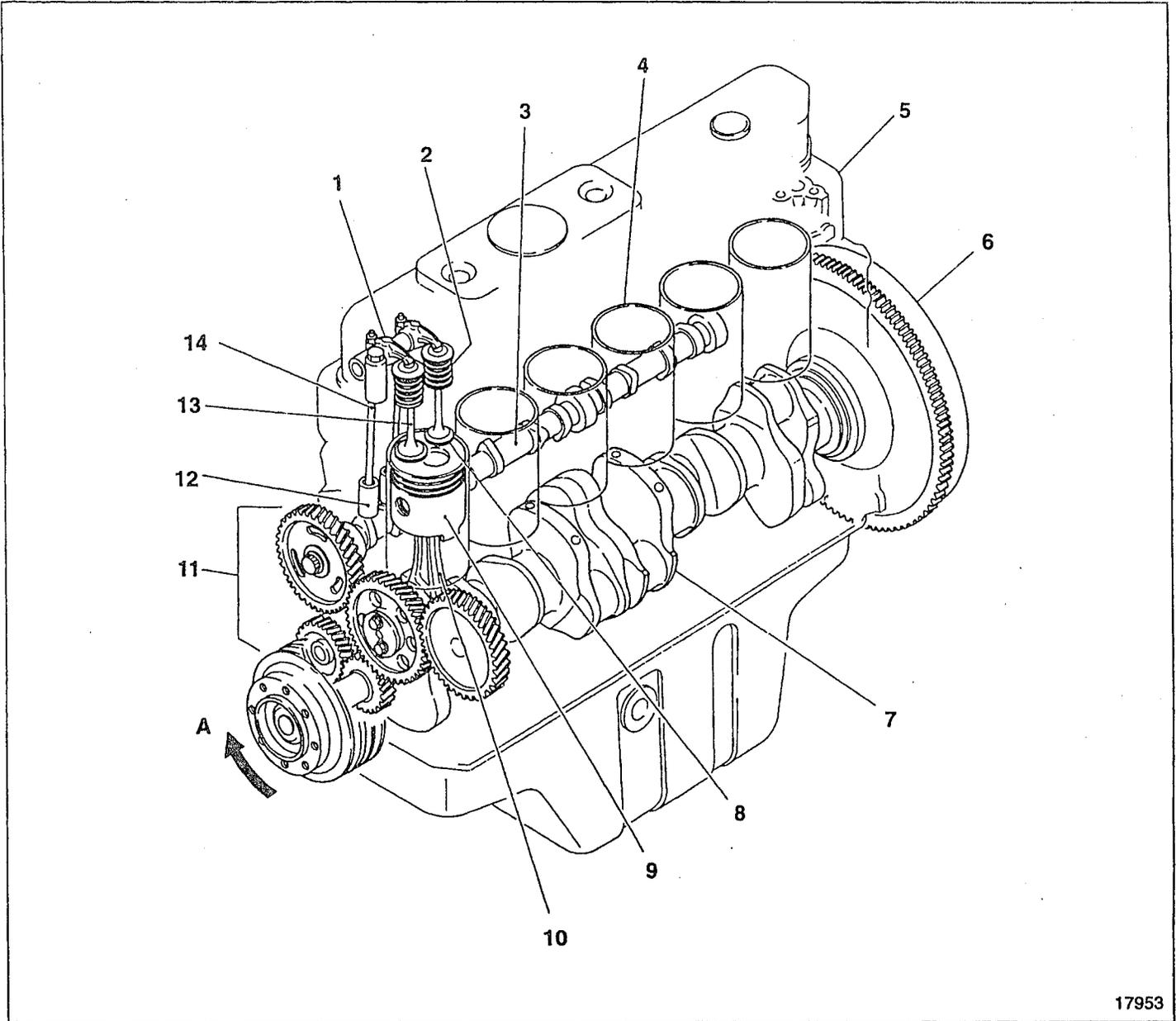
Standard diameter	1/4 in.	3/8 in.	1/2 in.	5/8 in.
Tightening torque	$13^{+3.9}_{-0} \left\{ \begin{array}{l} 1.3^{+0.4} \\ -0 \end{array} \right\}$	$29^{+4.9}_{-0} \left\{ \begin{array}{l} 3.0^{+0.5} \\ -0 \end{array} \right\}$	$49^{+4.9}_{-0} \left\{ \begin{array}{l} 5.0^{+0.5} \\ -0 \end{array} \right\}$	$64^{+4.9}_{-0} \left\{ \begin{array}{l} 6.5^{+0.5} \\ -0 \end{array} \right\}$



# GROUP 11 ENGINE

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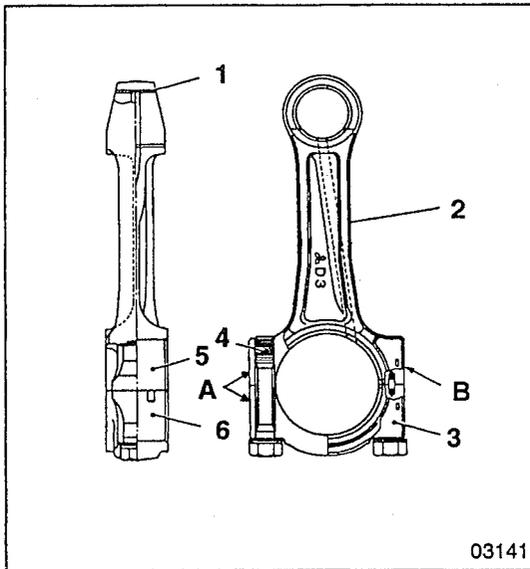
# STRUCTURE AND OPERATION



17953

- |                   |                          |
|-------------------|--------------------------|
| 1 Rocker arm      | 9 Piston                 |
| 2 Valve spring    | 10 Connecting rod        |
| 3 Camshaft        | 11 Timing gear           |
| 4 Cylinder sleeve | 12 Tappet                |
| 5 Cylinder head   | 13 Inlet valve           |
| 6 Flywheel        | 14 Push rod              |
| 7 Crankshaft      |                          |
| 8 Exhaust valve   | A: Direction of rotation |

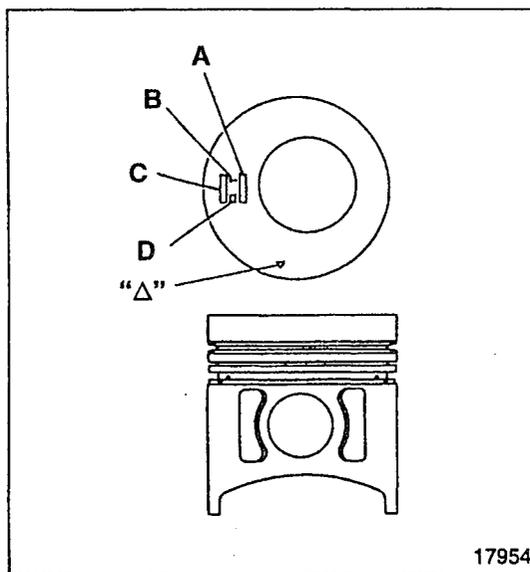
## Connecting Rods



- 1 Connecting rod bushing
- 2 Connecting rod
- 3 Connecting rod cap
- 4 Connecting rod bolt
- 5 Upper connecting rod bearing
- 6 Lower connecting rod bearing

A: Alignment mark  
 B: Weight mark stamp  
 (A, B, C, D, E, F, G)

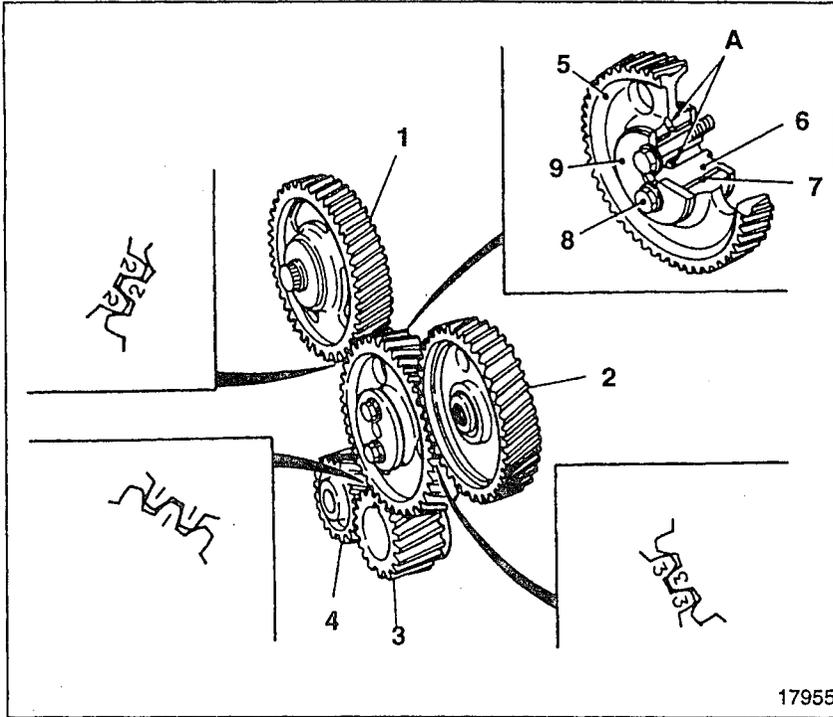
## Pistons



A: Part number  
 B: "T" mark  
 C: Weight mark  
 D: Oversize mark (0.50, 1.00)  
 Δ: Front mark

# STRUCTURE AND OPERATION

## Timing Gears



- 1 Camshaft gear
- 2 Injection pump gear
- 3 Crankshaft gear
- 4 Oil pump gear
- 5 Idler gear
- 6 Idler gear shaft
- 7 Idler bushing
- 8 Bolt
- 9 Thrust plate

A: Oil hole

Each gear is stamped with a timing gear alignment mark ("1", "2" or "3") for correct gear engagement during reassembly.

17955

Symptoms			
Possible causes	Low power output	Abnormal engine noise	Remarks
Incorrect oil viscosity	<input type="radio"/>	<input type="radio"/>	Gr 12
Incorrect/defective fuel	<input type="radio"/>	<input type="radio"/>	
Incorrect valve clearance	<input type="radio"/>	<input type="radio"/>	
Defective cylinder head gasket	<input type="radio"/>	<input type="radio"/>	
Worn valve/valve seat, and carbon deposits	<input type="radio"/>	<input type="radio"/>	
Weakened valve spring	<input type="radio"/>	<input type="radio"/>	
Worn/damaged piston ring(s)	<input type="radio"/>	<input type="radio"/>	
Worn/damaged piston ring groove(s)	<input type="radio"/>	<input type="radio"/>	
Incorrect injection timing	<input type="radio"/>	<input type="radio"/>	Gr 13
Defective injection pump	<input type="radio"/>	<input type="radio"/>	Gr 13
Defective cooling system	<input type="radio"/>	<input type="radio"/>	Gr 14
Defective injection nozzle(s)	<input type="radio"/>	<input type="radio"/>	Gr 13
Air trapped in fuel system	<input type="radio"/>	<input type="radio"/>	Gr 13
Clogged air cleaner	<input type="radio"/>	<input type="radio"/>	Gr 15
Defective turbocharger	<input type="radio"/>	<input type="radio"/>	Gr 15
Incorrectly fitted pipe(s)/hose(s)	<input type="radio"/>	<input type="radio"/>	
Injection pump, alternator, or other auxiliary device(s) defective/incorrectly fitted	<input type="radio"/>	<input type="radio"/>	Gr 13, 54
Loose/damaged V-belt	<input type="radio"/>	<input type="radio"/>	Gr 14
Incorrectly fitted crankshaft pulley	<input type="radio"/>	<input type="radio"/>	
Defective air cleaner or muffler	<input type="radio"/>	<input type="radio"/>	Gr 15
Defective valve spring(s)	<input type="radio"/>	<input type="radio"/>	
Defective rocker shaft and bracket	<input type="radio"/>	<input type="radio"/>	
Incorrect lubrication of rocker shaft bracket	<input type="radio"/>	<input type="radio"/>	
Incorrect backlash in timing gears	<input type="radio"/>	<input type="radio"/>	
Incorrect lubrication of timing gear peripheries and idler shafts	<input type="radio"/>	<input type="radio"/>	
Defective injection nozzle spray condition	<input type="radio"/>	<input type="radio"/>	Gr 13
Worn connecting rod small end bushing and piston pin	<input type="radio"/>	<input type="radio"/>	
Worn/damaged crankshaft pin and connecting rod big end bearing	<input type="radio"/>	<input type="radio"/>	
Worn/damaged crankshaft journal and main bearing	<input type="radio"/>	<input type="radio"/>	
Excessive end play in crankshaft and camshaft	<input type="radio"/>	<input type="radio"/>	
Worn tappet(s) and camshaft	<input type="radio"/>	<input type="radio"/>	

# ON-VEHICLE INSPECTION AND ADJUSTMENT

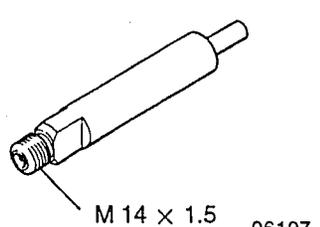
## Measuring Compression Pressure

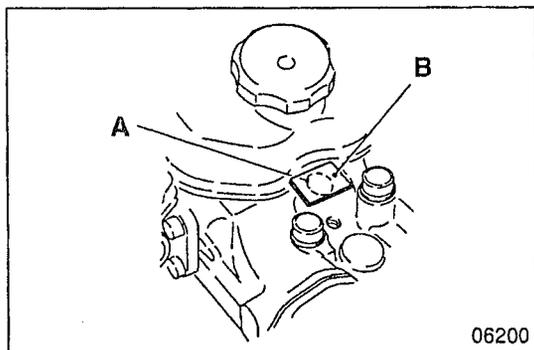
### Service standards

Location	Maintenance item	Standard value	Limit	Remedy	
—	Compression pressure	Each cylinder (at 200 rpm)	2550 kPa {26 kgf/cm <sup>2</sup> }	1690 kPa {20 kgf/cm <sup>2</sup> }	Inspect
		Cylinder-to-cylinder pressure difference	—	390 kPa {4 kgf/cm <sup>2</sup> }	Inspect

### Special tools

Unit: mm

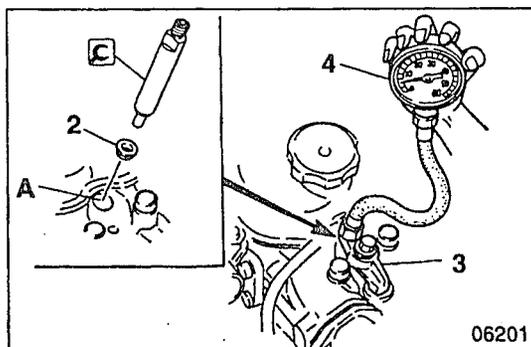
Location	Tool name and shape	Part No.	Application
—	 <p>Compression Gauge Adapter</p> <p>M 14 x 1.5 06197</p>	MH061460	Measuring compression pressure



- Remove the injection nozzle.
- Cover the injection nozzle mounting hole **A** with a cloth **B**. Then, turn the engine over with the starter and check that no foreign matter adheres to the cloth.

### WARNING

If any cylinder is cracked, coolant, engine oil, and fuel will enter the cylinder through the crack. When the engine is turned over, these substances will spray out of the nozzle mounting hole **A** at a high temperature. For safety, move away from the nozzle mounting hole before turning over the engine.



- Fit the  Compression Gauge Adapter onto the injection nozzle mounting hole **A** together with a gasket **2**. Lock these items in position with the nozzle bridge **3**, then connect the compression gauge **4**.
- Turn the engine over and measure the compression pressure.
- Measure the compression pressure in every cylinder and determine the pressure differences between cylinders.

Limit: 4 kg/cm<sup>2</sup> maximum

- If any compression pressure or cylinder-to-cylinder pressure difference exceeds the specified limit, pour a little engine oil into the cylinder via the injection nozzle mounting hole then take the measurement again.
  - If the compression pressure increases, there may be wear or damage on piston rings and inner surfaces of cylinders.
  - If the compression pressure does not increase, valves may be seized or incorrectly seated, or the cylinder head gasket may be defective.

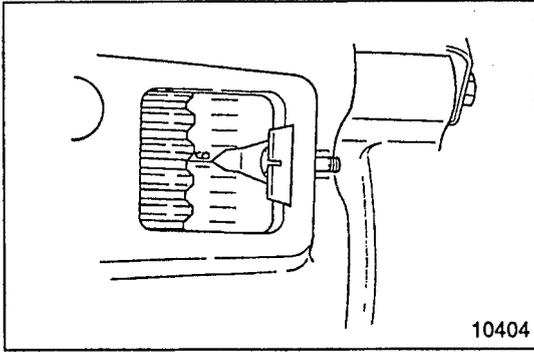
## Inspecting and Adjusting Valve Clearances

### Service standards

Unit: mm

Location	Maintenance item	Standard value	Limit	Remedy
—	Valve clearance (when cold)	0.4	—	Adjust

Valve clearances should be checked and adjusted when the engine is cold.



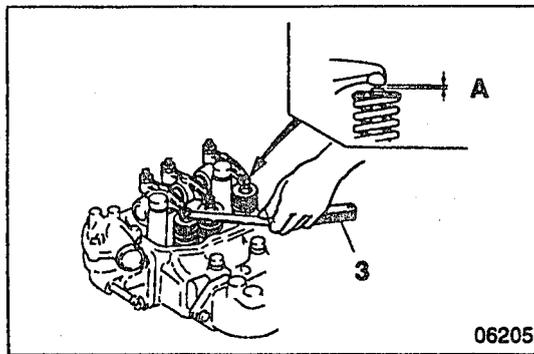
- Crank the engine until the "16" mark on the flywheel is aligned with the pointer in the flywheel housing inspection window.

#### NOTE

Pistons whose push rods are not pushing up their rockers are at the top-dead-center (TDC) positions of their compression strokes.

- When piston No. 1 is at the TDC position of its compression stroke, check and adjust the clearance of each valve marked "○" in the following table. When piston No. 6 is at the TDC position of its compression stroke, check and adjust the clearance of each valve marked "×" in the table. Be sure to check and adjust every valve.

Piston No.	1		2		3		4		5		6		
	In.	Ex.											
No. 1 piston at TDC of compression stroke	○	○	○			○	○				○		
No. 6 piston at TDC of compression stroke				×	×			×	×			×	×

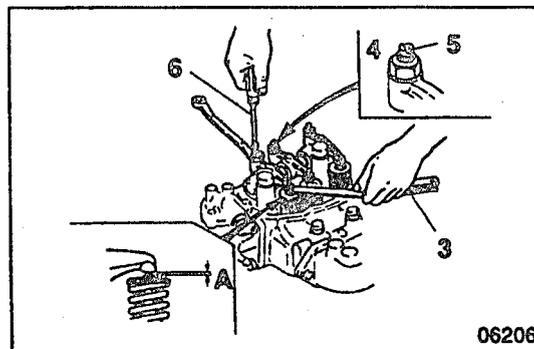


#### NOTE

To measure the clearance, insert a feeler gauge 3. The gauge should be able to move in the gap, albeit not loosely. Accurate measurements cannot be taken if the gauge moves loosely in the gap.

- If any measurement is out of specification, make adjustments as follows:

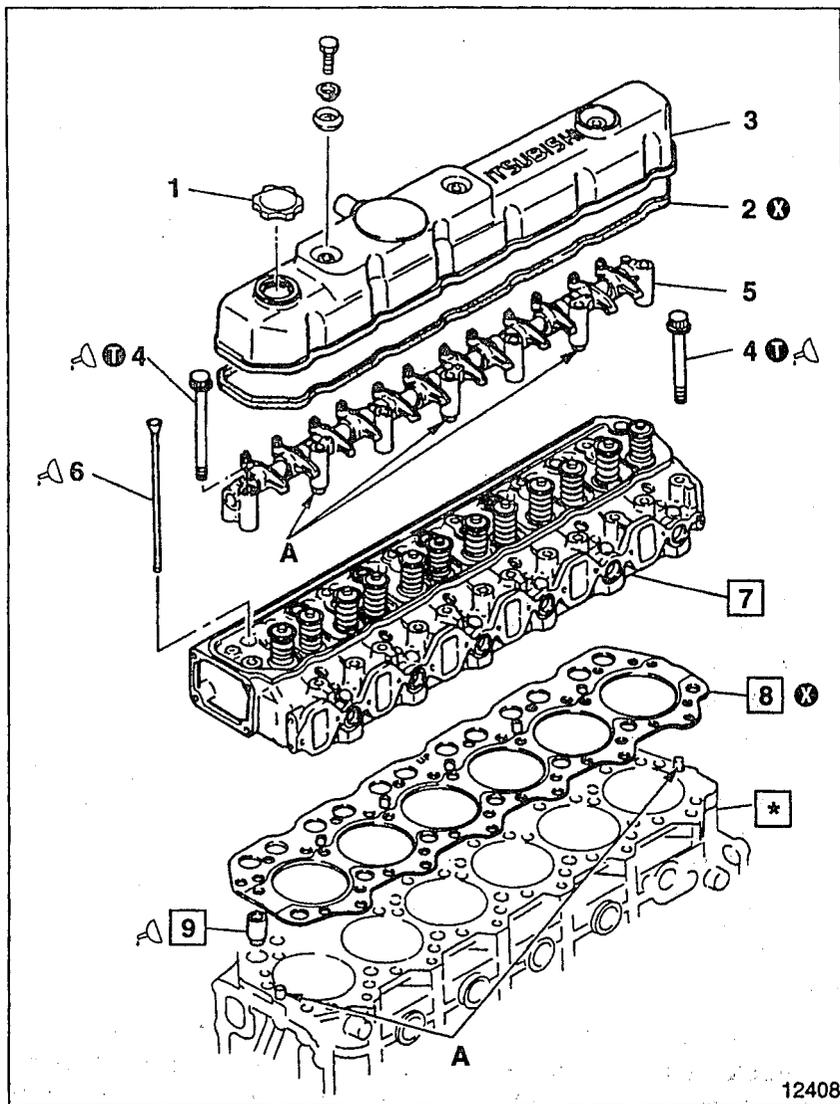
Standard value: 0.4 mm



#### [Adjustment]

- To adjust the valve clearance A, loosen the lock nut 4 and turn the adjusting screw 5 until the feeler gauge 3 moves more stiffly in the gap.
- After adjusting the clearance, tighten the lock nut 4. At this time, use a screwdriver 6 to stop the adjusting screw 5 from turning. Next, insert the feeler gauge 3 once more to confirm that the clearance A is correct.

# CYLINDER HEAD AND VALVE MECHANISM



## ● Disassembly sequence

- 1 Oil filler cap
- 2 Rocker cover gasket
- 3 Outer rocker cover
- 4 Cylinder head bolt
- 5 Rocker and bracket assembly P.11-12
- 6 Push rod
- 7 Cylinder head assembly P.11-14
- 8 Cylinder head gasket
- 9 Tappet

\*: Crankcase P.11-54

A: Locating pin

⊗: Non-reusable part

## ● Assembly sequence

Reverse the order of disassembly.

## Service standards

Unit: mm

Location	Maintenance item	Standard value (Basic diameter in [ ])	Limit	Remedy
6	Push rod runout	—	0.4	Replace
9, *	Tappet-to-crankcase clearance	[28] 0.05 to 0.09	0.2	Replace tappet

## ① Tightening torques

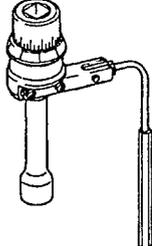
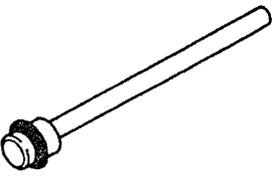
Unit: N · m {kgf · m}

Location	Parts to be tightened	Tightening torque	Remarks
4	Cylinder head bolt	145 {15} + 90° ± 5°	<ul style="list-style-type: none"> <li>● Wet</li> <li>● Can be reused up to 3 times</li> </ul>

## Lubricants

Location	Points of application	Type	Quantity
4	Threads of cylinder head bolts	Engine oil	As required
6	Both ends of push rods	Engine oil	As required
9	Outer surfaces of tappets	Engine oil	As required

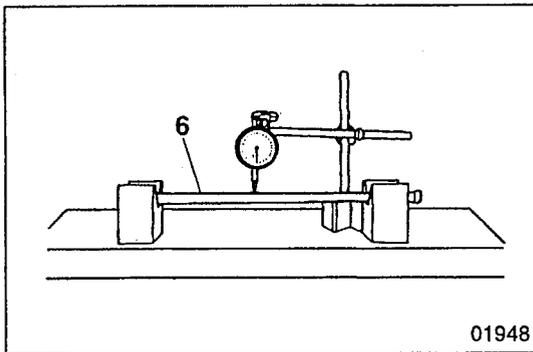
**C Special tools**

Location	Tool name and shape	Part No.	Application
7	 <p>Socket Wrench</p> <p>01984</p>	MH061560	Tightening cylinder head bolts
16	 <p>Tappet Extractor</p> <p>03320</p>	MH063329	Removing tappets

**◆ Service procedure**

**6 Push rod runout**

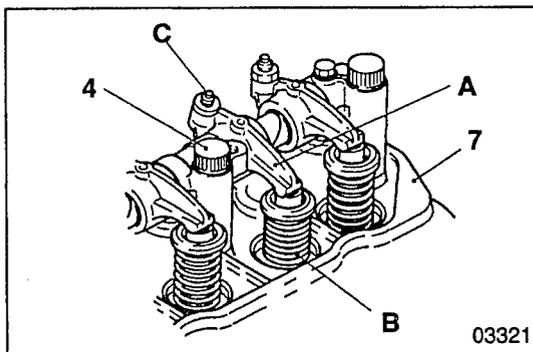
If the measurement exceeds the specified limit, replace the push rod 6.



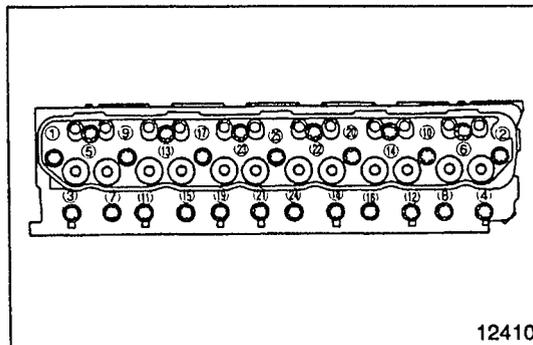
**7 Cylinder head assembly**

[Removal]

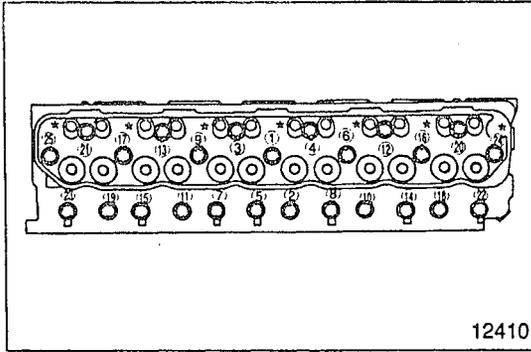
- Before loosening the cylinder head bolts 4, loosen the adjusting screw C on every rocker A that is compressing its valve spring B.



- Loosen and remove the cylinder head bolts 4 in the sequence shown. Each cylinder head bolt should be loosened a little at a time.



# CYLINDER HEAD AND VALVE MECHANISM



[Fitting]

- The cylinder head bolts 4 can be reused only three times. Before refitting the cylinder head bolts, make a punch mark on the head of each one to indicate how many times it has been reused.

**CAUTION** ⚠

If any bolt already has three punch marks, it cannot be used again; replace it with a new one.

- Tighten the cylinder head bolts 4 to the specified torque [145 N·m (15 kgf·m)] in the sequence shown. Then, turn the bolts further in accordance with the following procedure.

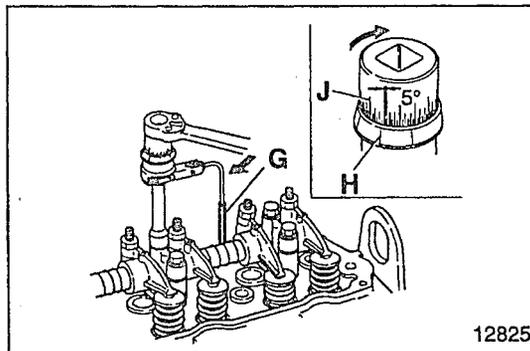
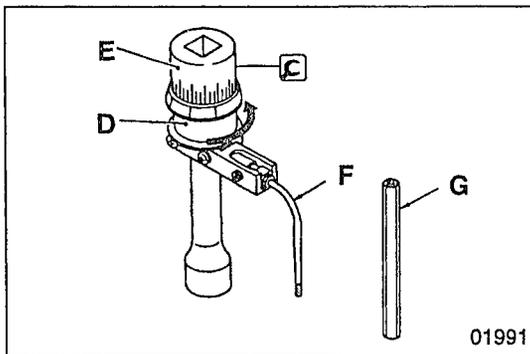
\*: Tighten together with rocker and bracket assembly

- Before fitting the  Socket Wrench over a cylinder head bolt, turn the holder **D** counter-clockwise to tension the built-in spring.

**E**: Socket

**F**: Rod

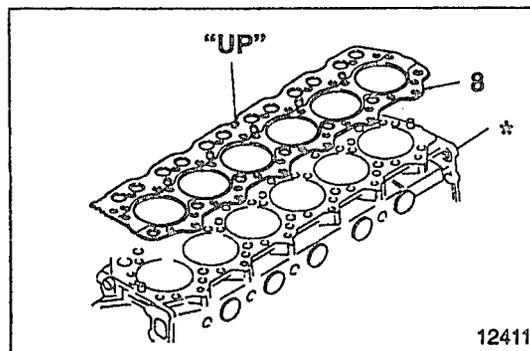
**G**: Rod (extension)



- Set the socket such that the built-in spring force forces the rod **G** against the rocker shaft bracket, an injection pipe, or another nearby part.
- On the holder **D**, select the inscribed line **H** that is easiest to see.
- Using the selected line as a reference, turn the socket **E** 90° clockwise. (One gradation on the scale **J** represents 5°.)

**CAUTION** ⚠

Since the cylinder head bolts 4 utilize the plastic region tightening method, they must not be tightened further after this procedure.



## **8** Cylinder head gasket

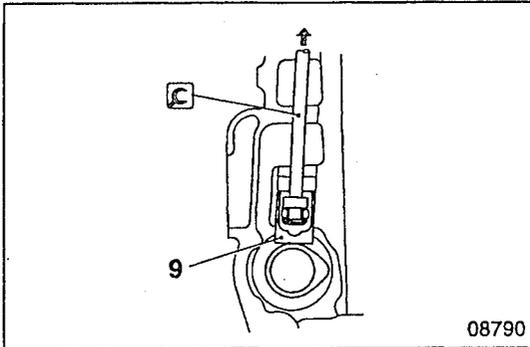
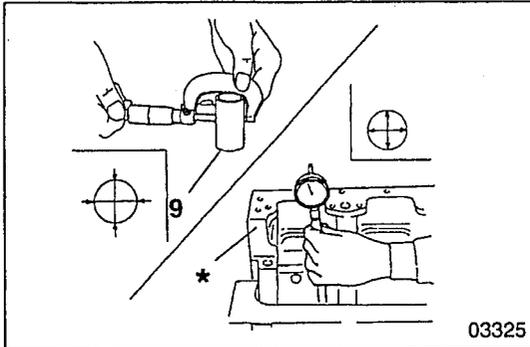
[Removal]

**CAUTION** ⚠

When removing the cylinder head gasket **8**, be careful not to scratch the cylinder head and valve assembly **7** and the crank-case \*.

[Fitting]

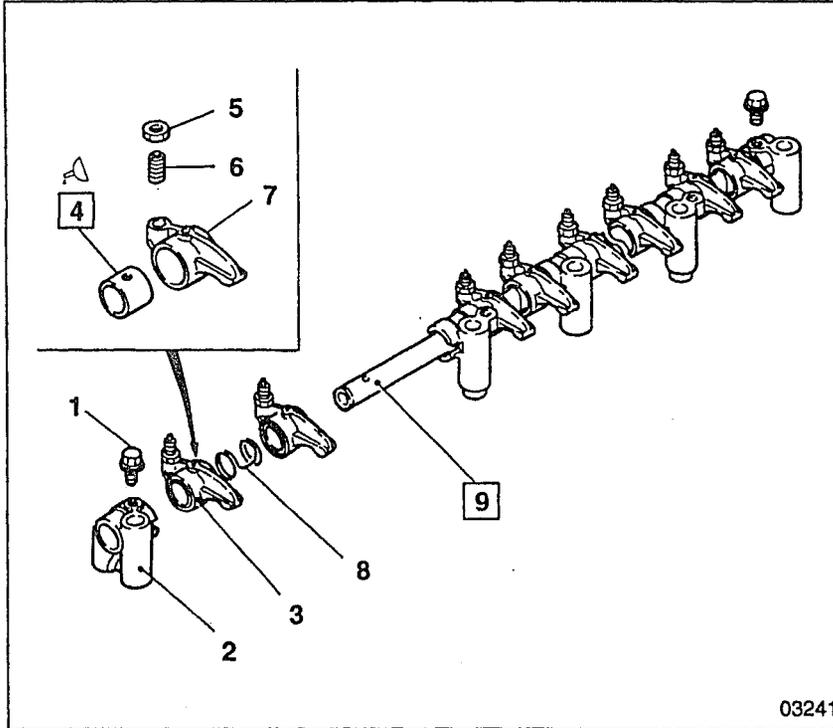
- Fit the cylinder head gasket **8** with the "UP" mark positioned as shown.

**9** Tappet removal**9** \* Tappet-to-crankcase clearance

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

# CYLINDER HEAD AND VALVE MECHANISM

## Rocker and Bracket Assembly



### ● Disassembly sequence

- 1 Set bolt
- 2 Rocker shaft bracket
- 3 Rocker assembly
- 4 Rocker bushing
- 5 Lock nut
- 6 Adjusting screw
- 7 Rocker
- 8 Rocker shaft spring
- 9 Rocker shaft

### ● Assembly sequence

Reverse the order of disassembly.

03241

### Service standards

Unit: mm

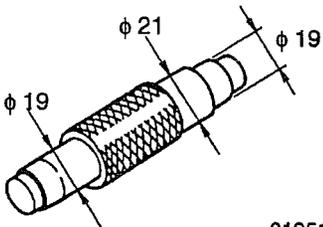
Location	Maintenance item	Standard value (Basic diameter in [ ])	Limit	Remedy
4, 9	Rocker bushing-to-rocker shaft clearance	[19] 0.06 to 0.11	0.2	Replace

### Lubricants

Location	Points of application	Type	Quantity
4	Rocker bushing inner surface	Engine oil	As required

### Special tools

Unit: mm

Location	Tool name and shape	Part No.	Application
4	Rocker Bushing Puller 	MH061378	Removing and installing rocker bushings

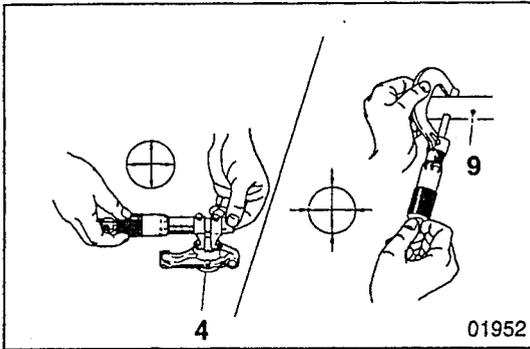
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## ◆ Service procedure

### 4 9 Rocker bushing and rocker shaft

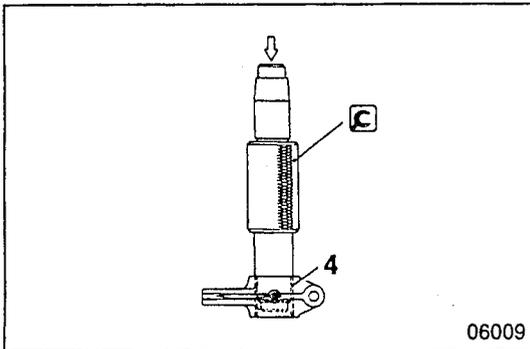
[Inspection]

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



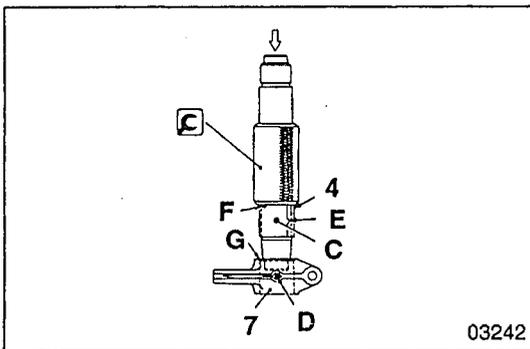
### Rocker bushing

[Removal]



[Installation]

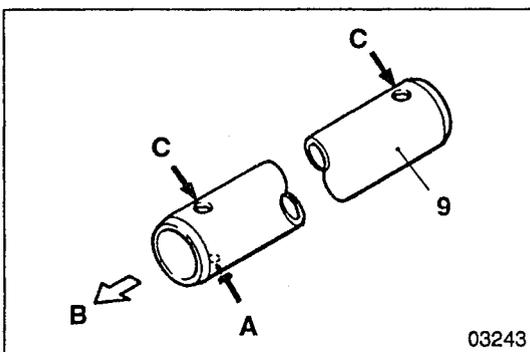
- Align the oil hole **A** in the rocker bushing **4** with the oil hole **D** in the rocker **7**.
- Position the notch **E** and seam **F** on the rocker bushing **4** as shown.
- Install the rocker bushing **4** into the rocker **7** from the chamfered side **G**.



### 9 Installing rocker shaft

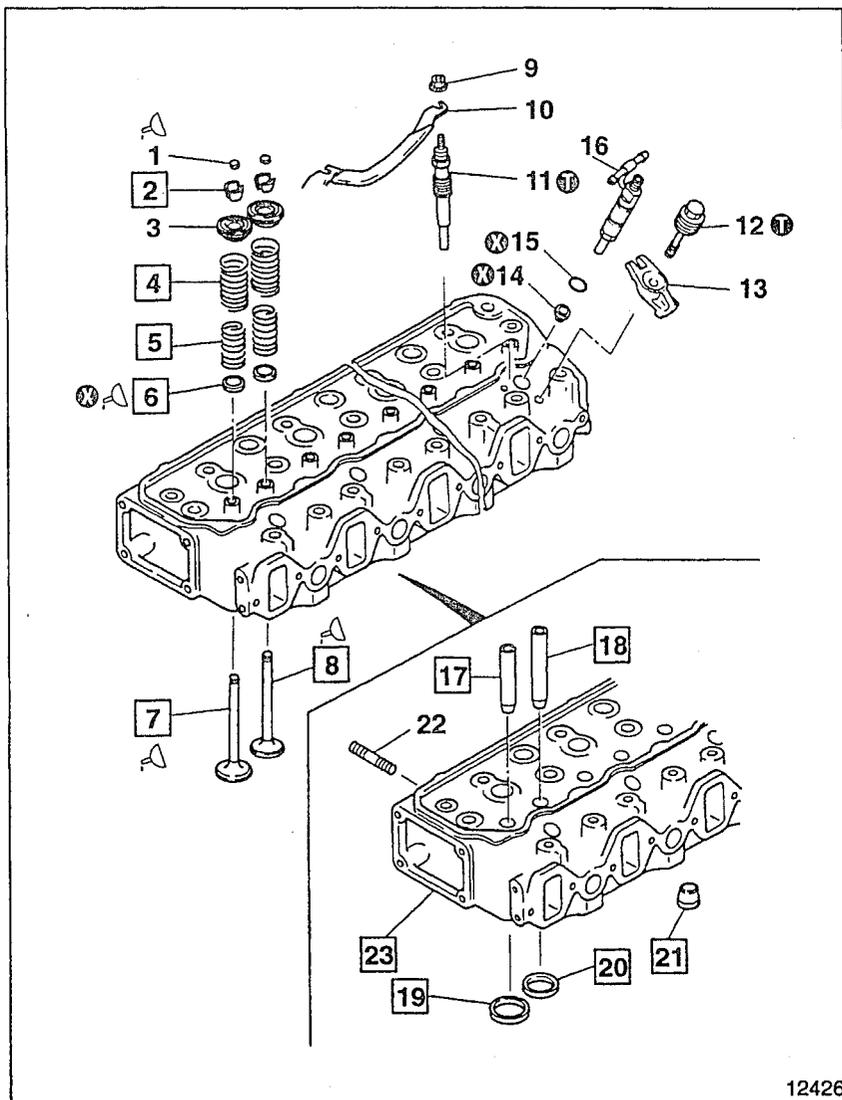
Install the rocker shaft **9** with the engine oil supply hole **A** (this is provided for lubrication) toward the front of the engine **B**.

**C**: Hole for set bolt **1**



# CYLINDER HEAD AND VALVE MECHANISM

## Cylinder Head and Valve Assembly



### ● Disassembly sequence

- 1 Valve cap
- 2 Valve cotter
- 3 Upper retainer
- 4 Outer valve spring
- 5 Inner valve spring
- 6 Valve stem seal
- 7 Inlet valve
- 8 Exhaust valve
- 9 Nut
- 10 Connecting plate
- 11 Glow plug Gr 54
- 12 Bolt
- 13 Nozzle bridge
- 14 Nozzle tip gasket
- 15 O-ring
- 16 Injection nozzle Gr 13
- 17 Inlet valve guide
- 18 Exhaust valve guide
- 19 Inlet valve seat
- 20 Exhaust valve seat
- 21 Water director
- 22 Stud
- 23 Cylinder head

⊗ : Non-reusable part

### CAUTION

The injection nozzles 16 and glow plugs 11 project from the bottom surface of cylinder head 23. Take care not to damage them.

### ● Assembly sequence

Reverse the order of disassembly.

### NOTE

Any valve stem seal 6 removed from an exhaust valve 8 or inlet valve 7 must be replaced.

## Service standards

Unit: mm

Location	Maintenance item		Standard value (Basic diameter in [ ])	Limit	Remedy
4	Outer valve spring	Free length	60.84	57.8	Replace
		Installed load (at 47.25 installed length)	240 ± 12 N {24.5 ± 1.2 kgf}	205 N {20.8 kgf}	
		Squareness	—	2.5	
5	Inner valve spring	Free length	55.07	52.1	Replace
		Installed load (at 40.3 installed length)	93 ± 4.4 N {9.5 ± 0.45 kgf}	79 N {8.1 kgf}	
		Squareness	—	2	
7	Inlet valve	Stem outside diameter	φ 8.96 to 8.97	φ 8.85	Replace
		Sinkage from cylinder head bottom surface	0.75 to 1.25	1.5	Inspect every location
		Valve margin	1.5	1.2	Reface or replace
		Seat angle	45° ± 1.5'	—	Correct
7, 17	Inlet valve stem-to-valve guide clearance		[9] 0.04 to 0.06	0.15	Replace
8	Exhaust valve	Stem outside diameter	φ 8.93 to 8.94	φ 8.85	Replace
		Sinkage from cylinder head bottom surface	0.75 to 1.25	1.7	Inspect every location
		Valve margin	1.5	1.2	Reface or replace
		Seat angle	45° ± 15'	—	Correct
8, 18	Exhaust valve stem-to-valve guide clearance		[9] 0.07 to 0.1	0.2	Replace
19	Inlet valve seat width		2 ± 0.2	2.8	Correct or replace
20	Exhaust valve seat width		2 ± 0.2	2.8	Correct or replace
23	Cylinder head	Bottom surface distortion	0.05 or less	0.2	Correct or replace
		Height from top to bottom surface	95 ± 0.1	94.6	Replace

## ⓘ Tightening torques

Unit: N·m {kgf·m}

Location	Parts to be tightened	Tightening torque	Remarks
11	Glow plug	15 to 20 {1.5 to 2.0}	—
13	Bolt (nozzle bridge installation)	25 {2.5}	—

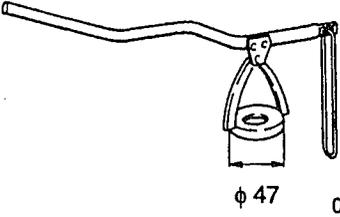
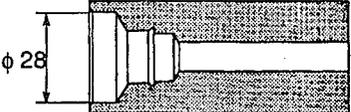
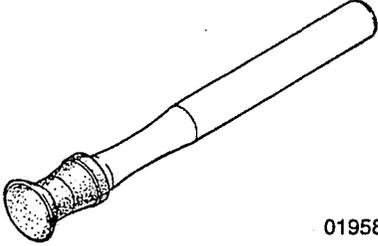
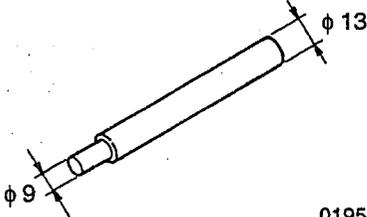
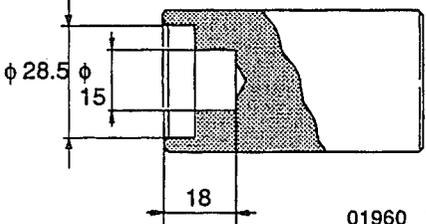
# CYLINDER HEAD AND VALVE MECHANISM

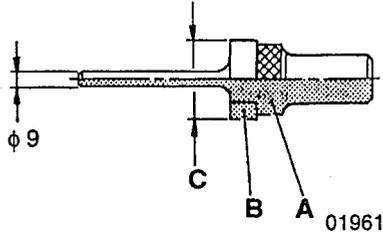
## Lubricants

Location	Points of application	Type	Quantity
1	Rocker contact surface on valve cap top	Engine oil	As required
6	Lip of valve stem seal	Engine oil	As required
7, 8	Valve stem	Engine oil	As required

## Special tools

Unit: mm

Location	Tool name and shape	Part No.	Application
2	Valve Lifter 	30091-08500	Removing and installing valve cotters
6	Valve Stem Seal Installer 	MH061293	Installing valve stem seals
7, 8	Valve Lapper 	30091-07500	Lapping valves and valve seats
17, 18	Valve Guide Remover 	MH061066	Removing valve guides
	Valve Guide Installer 	MH061998	Installing inlet and exhaust valve guides

Location	Tool name and shape	Part No.	Application								
19, 20	<p>A: Caulking Tool Body B: Caulking Ring</p> <p>&lt;Inlet&gt;</p> <table border="1"> <tr> <td></td> <td>C dimension</td> </tr> <tr> <td>MH061275</td> <td>φ 47.6</td> </tr> </table> <p>&lt;Exhaust&gt;</p> <table border="1"> <tr> <td></td> <td>C dimension</td> </tr> <tr> <td>MH061069</td> <td>φ 40.6</td> </tr> </table> 		C dimension	MH061275	φ 47.6		C dimension	MH061069	φ 40.6	<p>A: MH061067 B: MH061275 (Inlet) MH061069 (Exhaust)</p>	Installing valve seats
	C dimension										
MH061275	φ 47.6										
	C dimension										
MH061069	φ 40.6										

◆ Service procedures

2 Valve cotters

[Removal]

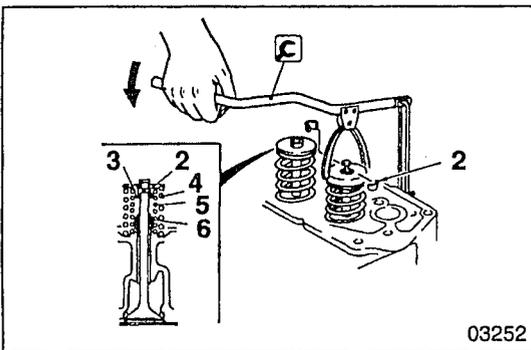
To remove the valve cotter 2, use the  Valve Lifter to evenly compress the valve springs 4, 5.

[Installation]

To install valve cotters, follow the removal instructions in reverse.

**CAUTION** 

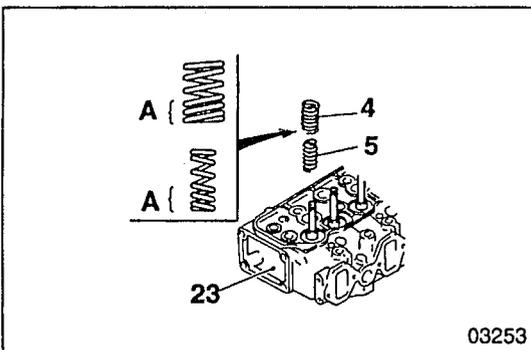
Do not compress the valve springs 4, 5 more than is necessary. If the valve springs are compressed excessively, the upper retainers 3 can touch the valve stem seal 6 and be damaged.



4 5 Installing outer and inner valve springs

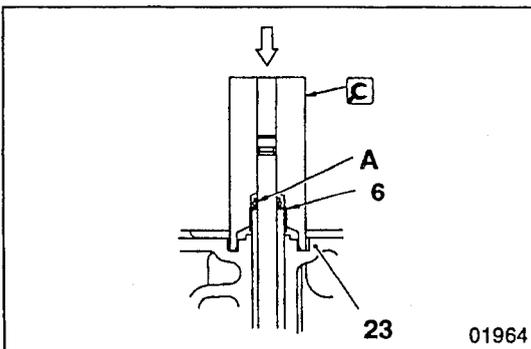
Fit the outer and inner valve springs 4, 5 onto the cylinder head 23 as shown.

A: Tightly wound portion

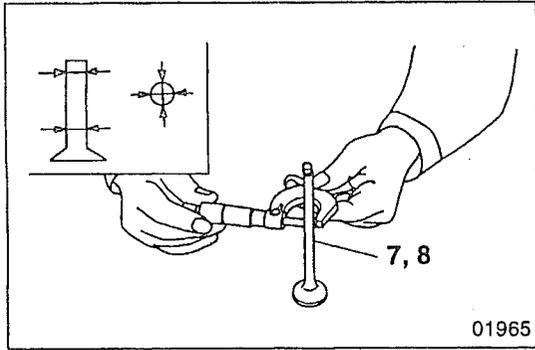


6 Installing valve stem seals

- Apply engine oil to the lip A of the valve stem seal 6.
- Install the valve stem seal 6 using the  Valve Stem Seal Installer. Strike the Valve Stem Installer until it sits snugly on the cylinder head 23.



# CYLINDER HEAD AND VALVE MECHANISM



## 7 8 Inlet and exhaust valves

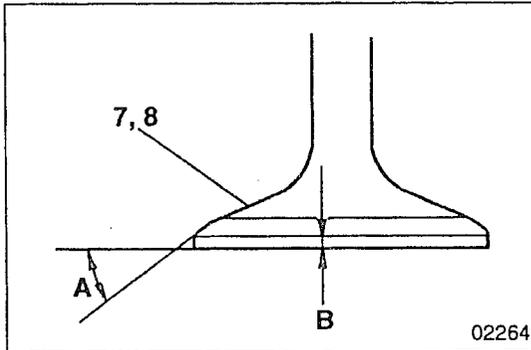
[Inspection]

### (1) Valve stem outside diameter

Replace the valve 7, 8 if its stem's outside diameter is below specification or severely worn.

### CAUTION

Whenever a valve 7, 8 is replaced, be sure to lap the valve and valve seat 19, 20.  P.11-20

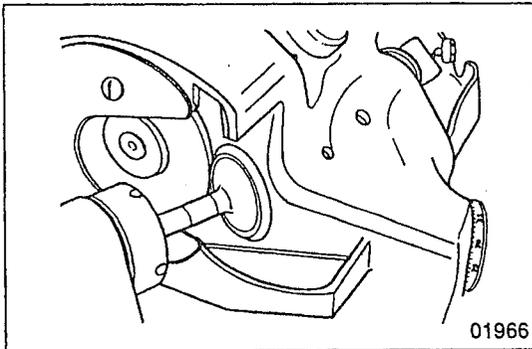


### (2) Valve seat angle and valve margin

Reface or replace the valve 7, 8 if the valve seat angle or valve margin exceeds the specified limits.

A: Valve seat angle

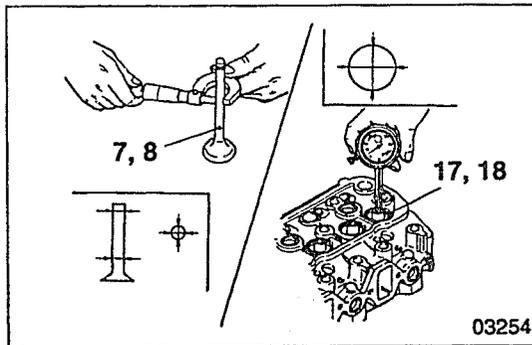
B: Valve margin



[Rectification]

### NOTE

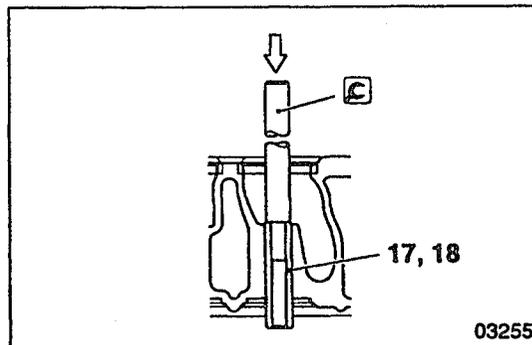
- Keep grinding to a minimum.
- If the valve margin is below specification after grinding, replace the valve 7, 8.
- After grinding, be sure to lap the valve and 7,8 valve seat 19, 20.  P.11-20



## 7 8 17 18 Valves and valve guides

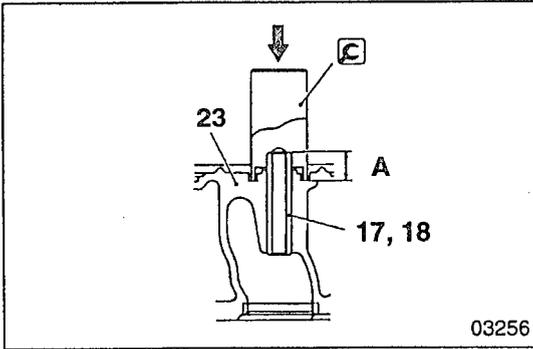
[Inspection]

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



### Valve guides

[Removal]

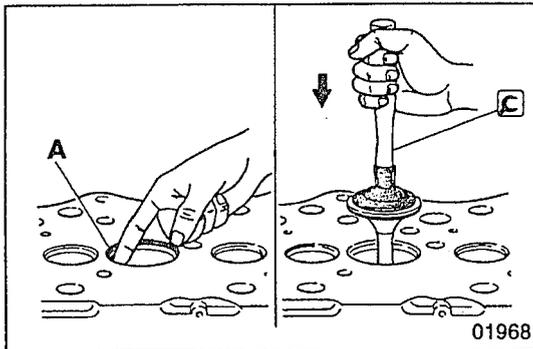


[Installation]

Install the valve guide 17, 18 using the Valve Guide Installer. Strike the Valve Guide Installer until it sits snugly on the cylinder head 23.

**CAUTION**

- The valve guides 17, 18 must be pressed in to the specified depth A. Be sure to use the Valve Guide Installer for this operation.  
A: 10 mm
- Exhaust valve guides 18 are longer than inlet valve guides 17. Be sure to install the correct type of guide in each location.



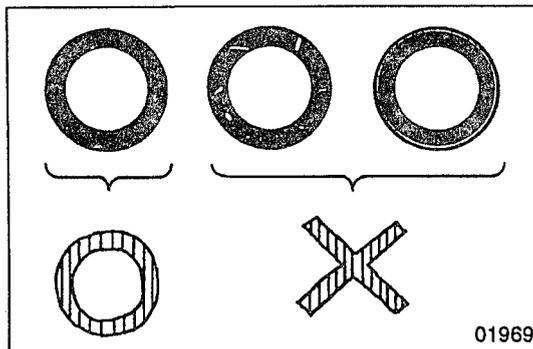
**7 8 19 20** Valves and valve seats

[Inspection]

- Apply an even coat of minium to the valve seat 19, 20 surface A that makes contact with the valve 7, 8.
- Using the Valve Lapper, strike the valve 7, 8 against the valve seat 19, 20 once. Do not rotate the valve during this operation.

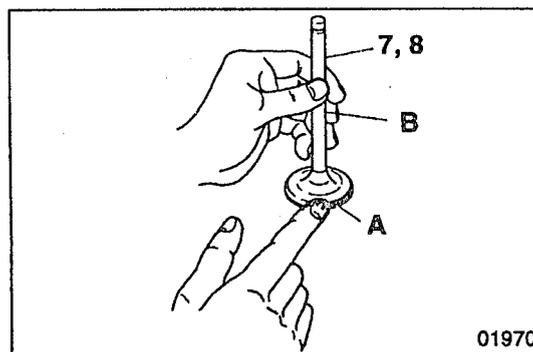
**NOTE**

Carry out these inspections after inspecting the valves 7, 8 and valve guides 17, 18.



- If the minium deposited on the valve 7, 8 indicates a poor contact pattern, rectify the contact pattern as follows:

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



[Refacing]

Lap the valve in accordance with the following procedure:

- Apply a thin, even coat of lapping compound to the surface A of the valve 7, 8 that makes contact with the valve seat 19, 20.

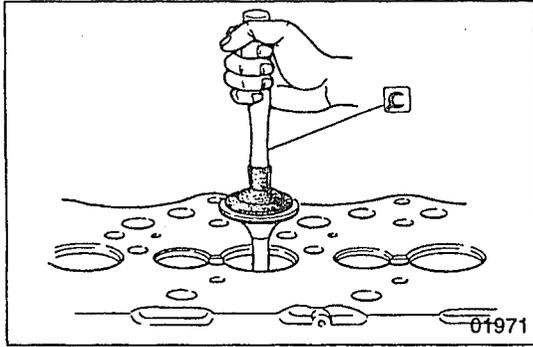
**CAUTION**

Ensure that no compound adheres to the stem B of the valve 7, 8.

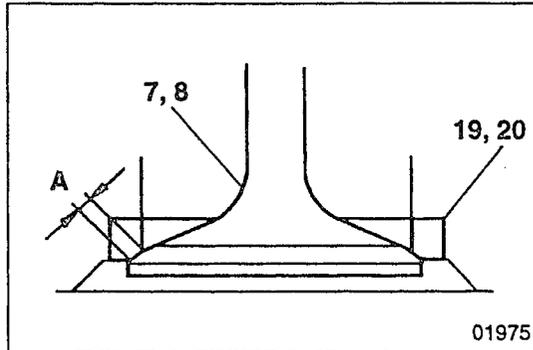
**NOTE**

- Start with intermediate-mesh compound (120 to 150 mesh) and finish with fine-mesh compound (200 mesh or more).
- The addition of a small amount of engine oil makes lapping compound easier to apply.

# CYLINDER HEAD AND VALVE MECHANISM



- Using the **C** Valve Lapper, lightly strike the valve **7, 8** against the valve seat **19, 20** while turning it little by little.
- Wash away the compound with gas oil or a similar fluid.
- Apply engine oil to the contact surfaces **A** of the valve seat **19, 20** and rub it in so that the contact surfaces are lubricated and mate together snugly.
- Inspect the contact pattern of the valve **7, 8** and valve seat **19, 20** once more.
- If the contact pattern is still defective, replace the valve seat **19, 20**.



## **19 20** Valve seats

[Inspection]

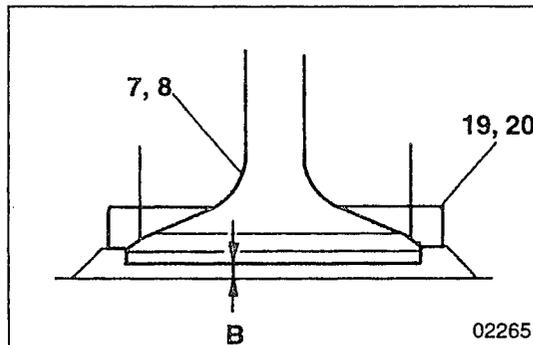
### (1) Valve seat width

If the measurement exceeds the specified limit, rectify or replace the valve seat.

**A:** Valve seat width

## NOTE

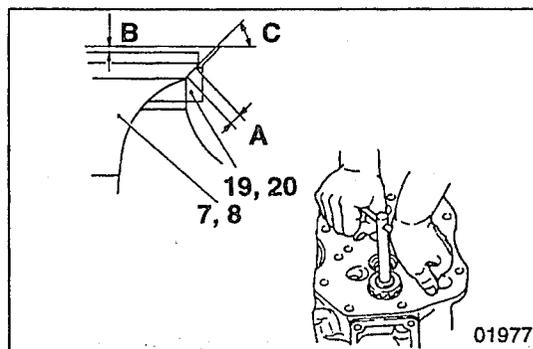
Whenever a valve seat **19, 20** is rectified or replaced, be sure to lap the valve seat **19, 20** and valve **7, 8**.



### (2) Valve sinkage from cylinder head bottom surface

If any measurement exceeds the specified limit, rectify or replace the defective part(s).

**B:** Valve sinkage



[Rectification]

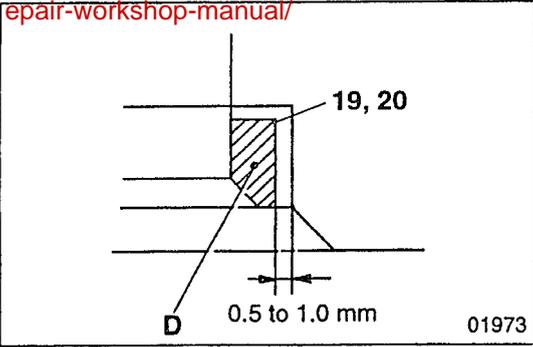
- Grind the valve seat **19, 20** using a valve seat cutter or valve seat grinder.
- After grinding, put some sandpaper of around #400 grade between the cutter and valve seat and grind the valve seat lightly.
- Use a 15° or 75° cutter to achieve the specified valve seat width **A**.

**C:** Valve seat angle

## CAUTION

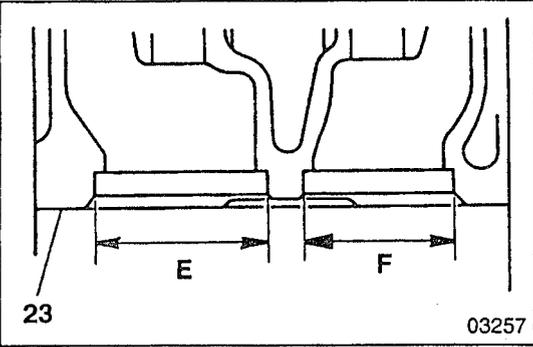
Ensure that grinding does not cause the valve sinkage **B** to exceed the specified limit.

- After rectification, lap the valve **7, 8** and valve seat **19, 20**.



**[Removal]**  
 Valve seats 19, 20 are installed by expansion fitting. To remove a valve seat, grind the inside surface to reduce its thickness, then remove the valve seat at room temperature.

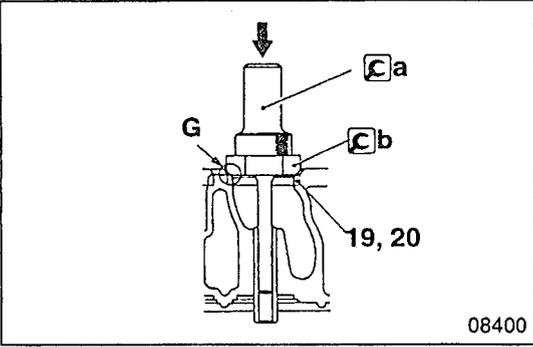
D: Material to remove



**[Installation]**  
 • Check that the valve seat hole diameters in the cylinder head 23 conform with the values shown below.

Unit: mm

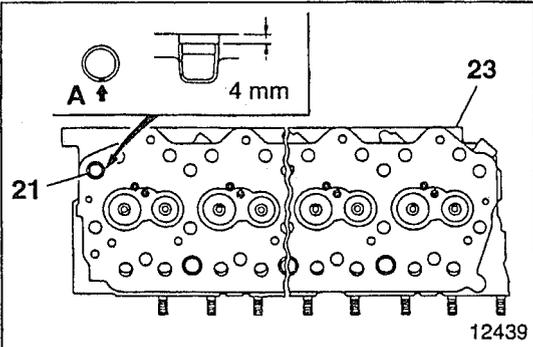
Inlet valve seat hole (E)	$\phi 46^{+0.025}_0$
Exhaust valve seat hole (F)	$\phi 39^{+0.025}_0$



• Cool the valve seat 19, 20 by immersing it in liquid nitrogen. Install the valve seat in the cylinder head using the C a Caulking Tool Body and C b Caulking Ring.

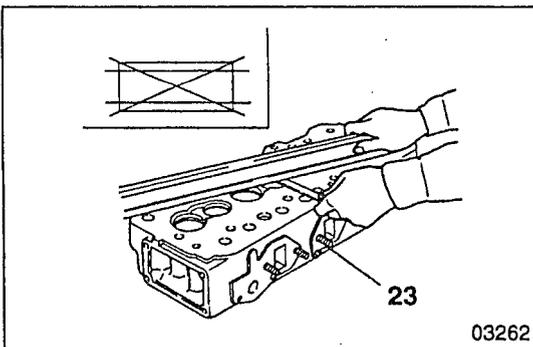
**CAUTION** ⚠  
 Place the Caulking Ring's chamfered side G on the inlet and exhaust valve seats 19, 20 when installing them.

• After installing the valve seat 19, 20, lap the valve seat and valve 7, 8.



**21 Installing water directors**

• With the notch A aligned as shown, strike the water directors 21 into the cylinder head 23 to the specified depth.



**23 Inspecting cylinder head**

• Measure the extent of distortion in the cylinder head's 23 bottom surface.  
 • If the degree of distortion exceeds the specified limit, rectify the distortion with a surface grinder.

**CAUTION** ⚠  
 Ensure that grinding does not cause the cylinder head's top surface-to-bottom surface distance to fall below the specified limit.