YANMAR
SERVICE MANUAL

MARINE DIESEL ENGINE

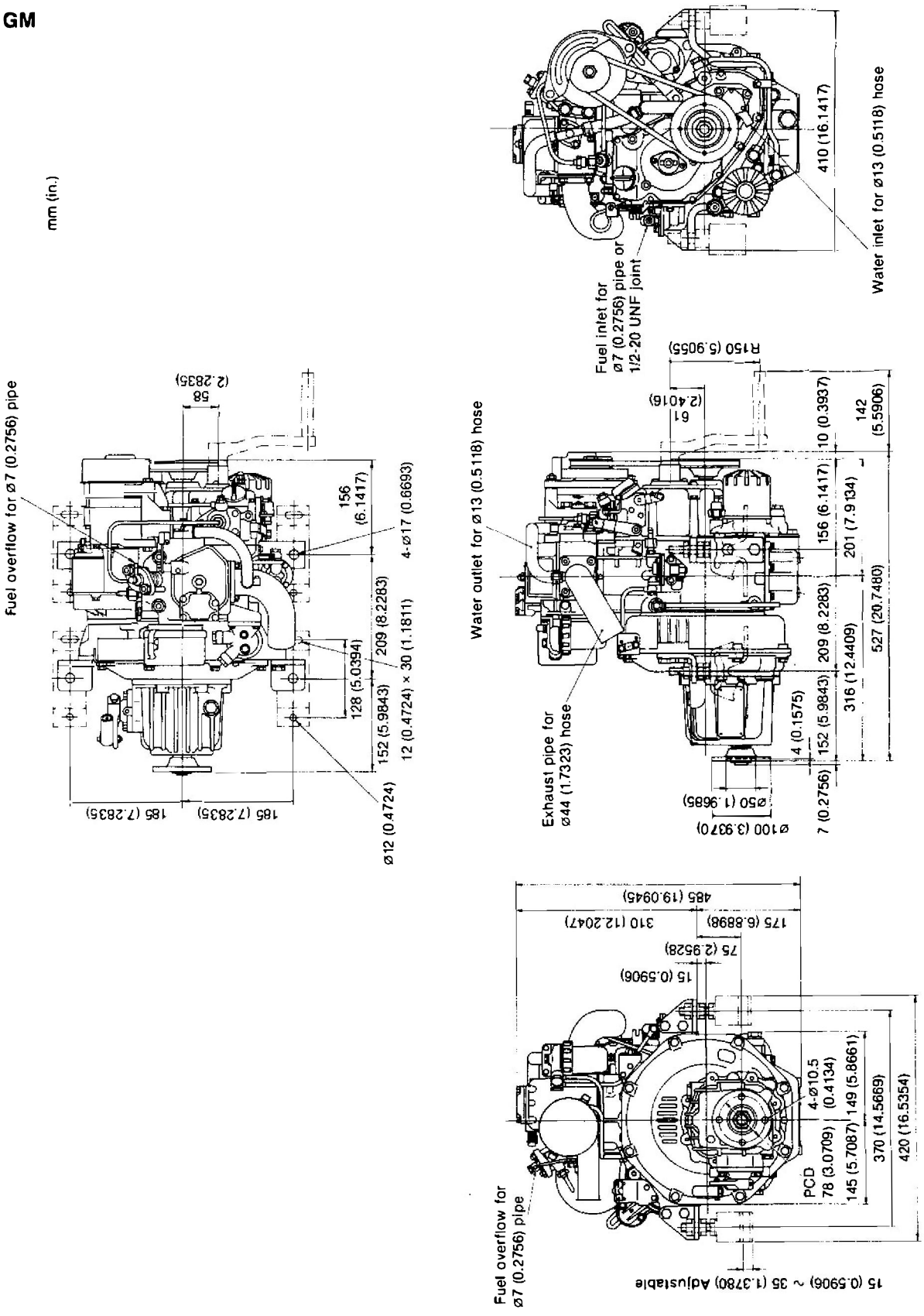
MODELS

1GM (10L)
2GM (F)(L)
3GM (D)(F)(L)
3HM (F)(L)

7. Dimensions

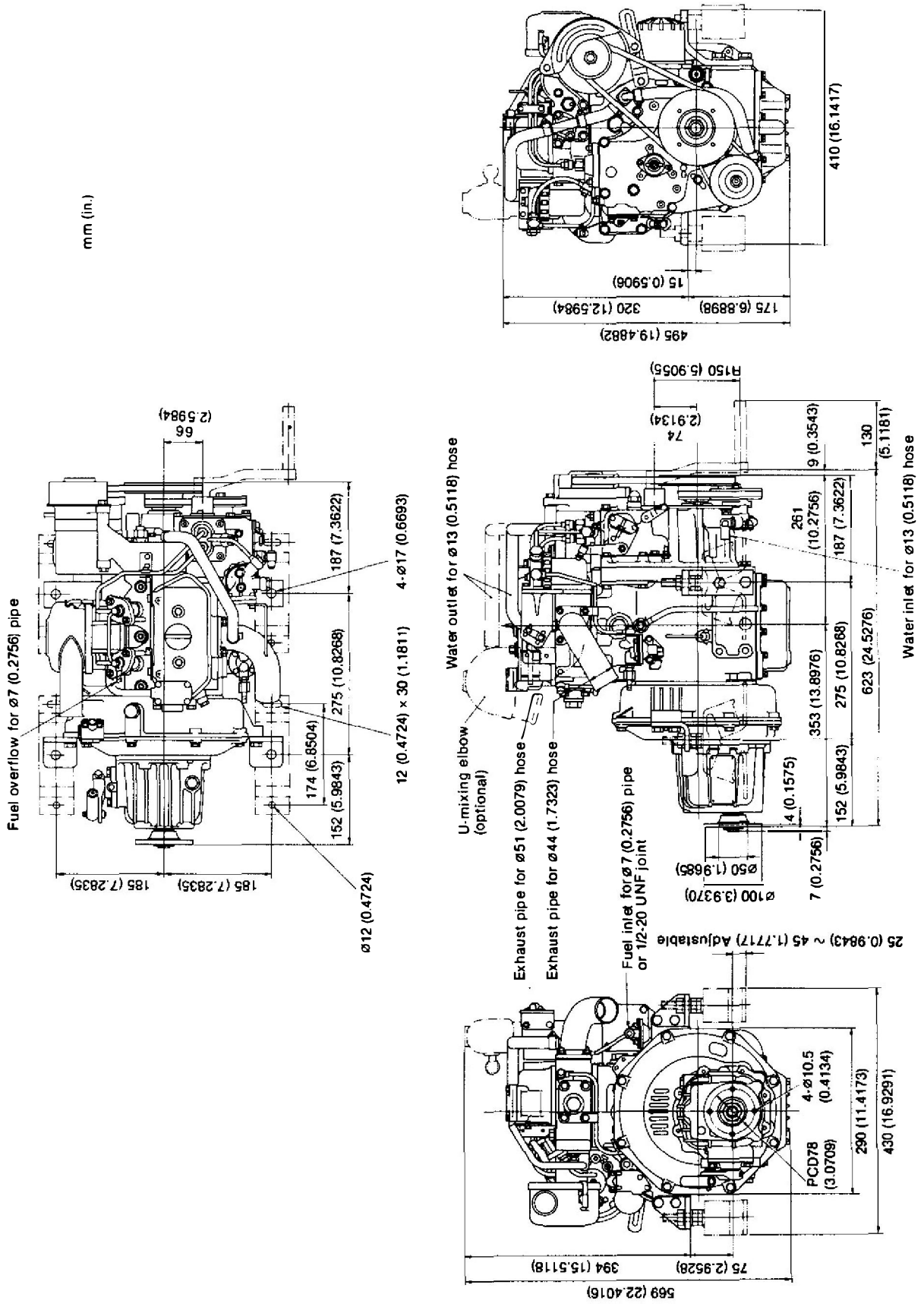
7-1 1GM

mm (in.)

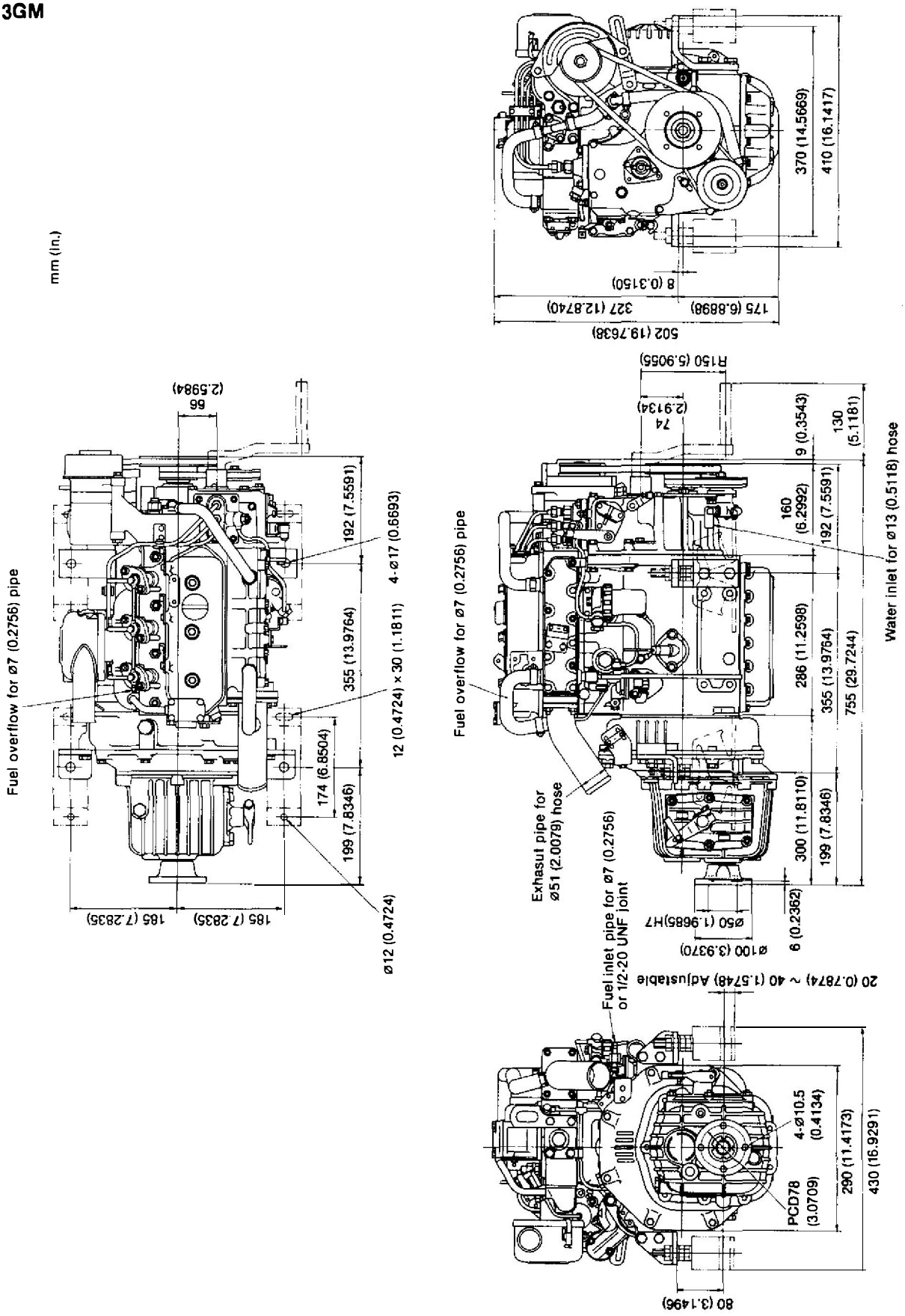


7-2 2GM

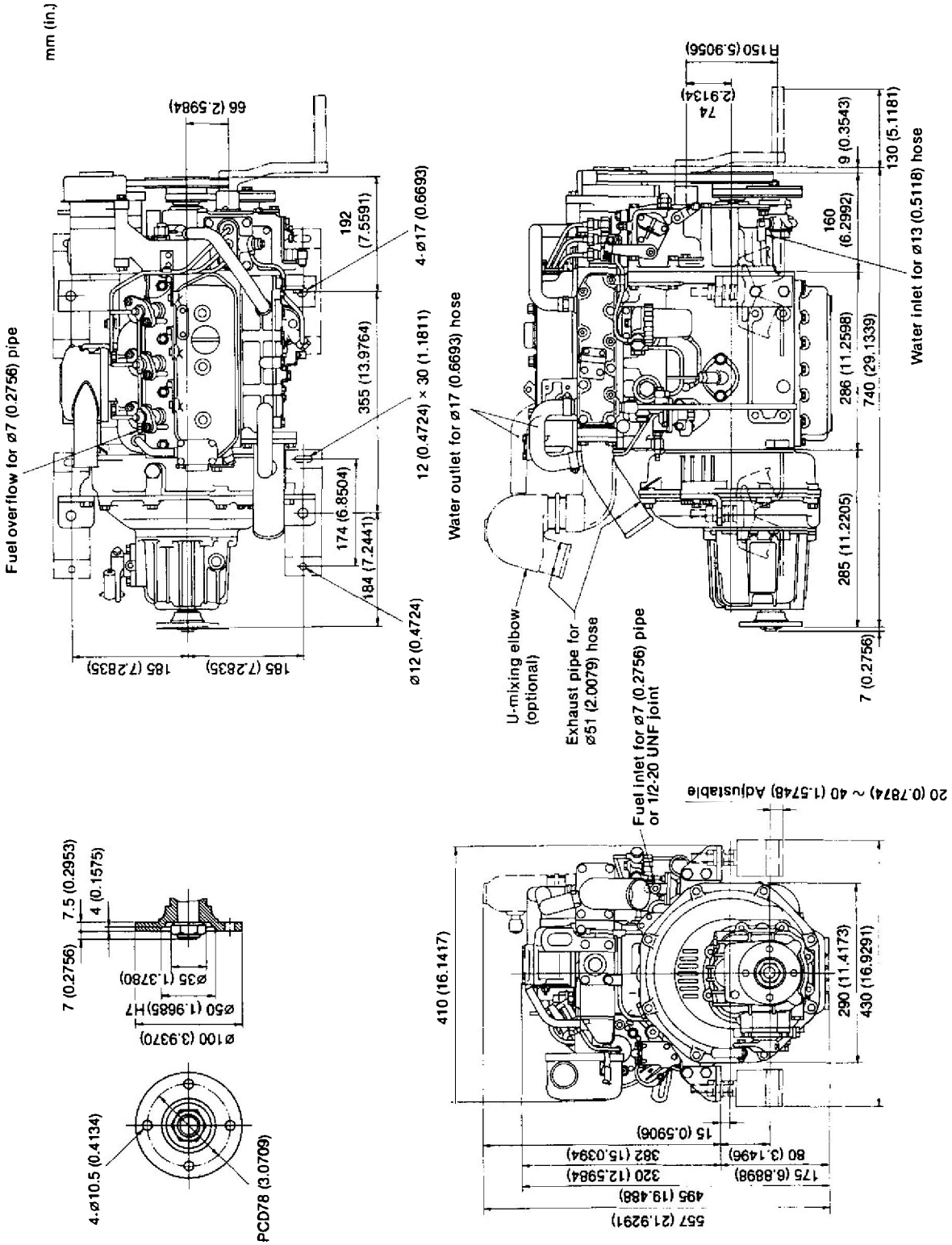
mm (in.)


410 (16.1417)
15 (0.5906)
175 (6.8898)
320 (12.5984)
495 (19.4882)
R150 (5.9055)
74 (2.9134)
9 (0.3543)
130 (5.1181)
261 (10.2756)
187 (7.3622)
623 (24.5276)
275 (10.8268)
353 (13.8976)
152 (5.9843)
4 (0.1575)
7 (0.2756)
ø100 (3.9370)
ø50 (1.9685)
Water outlet for ø13 (0.5118) hose
Water inlet for ø13 (0.5118) hose
U-mixing elbow (optional)
Exhaust pipe for ø51 (2.0079) hose
Exhaust pipe for ø44 (1.7323) hose
Fuel inlet for ø7 (0.2756) pipe or 1/2-20 UNF joint
25 (0.9843) ~ 45 (1.7717) Adjustable
4-ø10.5 (0.4134)
PCD78 (3.0709)
290 (11.4173)
430 (16.9291)
75 (2.9528)
394 (15.5118)
569 (22.4016)
66 (2.5984)
187 (7.3622)
4-ø17 (0.6693)
275 (10.8268)
12 (0.4724) x 30 (1.1811)
174 (6.8504)
152 (5.9843)
Fuel overflow for ø7 (0.2756) pipe
185 (7.2835)
185 (7.2835)
ø12 (0.4724)

7-3 3GM

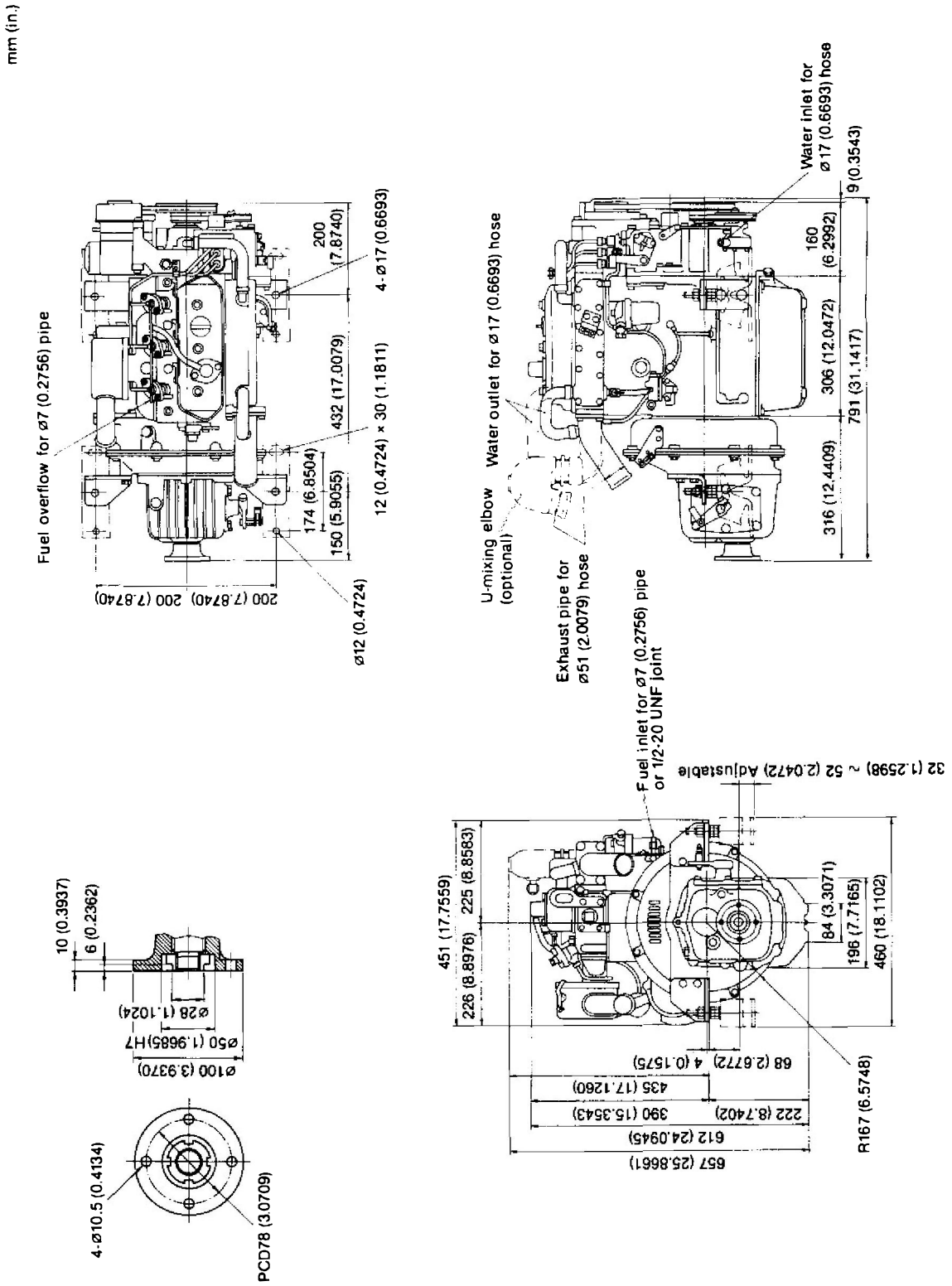

mm (in.)
502 (19.7638)
175 (6.8898)
327 (12.8740)
8 (0.3150)
370 (14.5669)
410 (16.1417)
R150 (5.9055)
74 (2.9134)
9 (0.3543)
130 (5.1181)
160 (6.2992)
192 (7.5591)
286 (11.2598)
355 (13.9764)
755 (29.7244)
300 (11.8110)
199 (7.8346)
6 (0.2362)
Ø50 (1.9685)H7
Ø100 (3.9370)
Fuel overflow for ø7 (0.2756) pipe
Water inlet for ø13 (0.5118) hose
Exhasut pipe for ø51 (2.0079) hose
Fuel inlet pipe for ø7 (0.2756) or 1/2·20 UNF joint
20 (0.7874) ~ 40 (1.5748) Adjustable
4-ø10.5 (0.4134)
PCD78 (3.0709)
290 (11.4173)
430 (16.9291)
80 (3.1496)
66 (2.5984)
192 (7.5591)
4-ø17 (0.6693)
355 (13.9764)
12 (0.4724) × 30 (1.1811)
174 (6.8504)
199 (7.8346)
185 (7.2835)
185 (7.2835)
Ø12 (0.4724)
Fuel overflow for ø7 (0.2756) pipe

7-4 3GMD


mm (in.)
66 (2.5984)
192 (7.5591)
355 (13.9764)
174 (6.8504)
184 (7.2441)
185 (7.2835)
185 (7.2835)
4-ø17 (0.6693)
12 (0.4724) × 30 (1.1811)
ø12 (0.4724)
Fuel overflow for ø7 (0.2756) pipe
R150 (5.9056)
74 (2.9134)
9 (0.3543)
130 (5.1181)
160 (6.2992)
Water inlet for ø13 (0.5118) hose
Water outlet for ø17 (0.6693) hose
286 (11.2598)
740 (29.1339)
285 (11.2205)
7 (0.2756)
U-mixing elbow (optional)
Exhaust pipe for ø51 (2.0079) hose
Fuel inlet for ø7 (0.2756) pipe or 1/2-20 UNF joint
20 (0.7874) ~ 40 (1.5748) Adjustable
7.5 (0.2953)
4 (0.1575)
7 (0.2756)
ø35 (1.3780)
ø50 (1.9685) H7
ø100 (3.9370)
4-ø10.5 (0.4134)
PCD78 (3.0709)
410 (16.1417)
290 (11.4173)
430 (16.9291)
15 (0.5906)
382 (15.0394)
80 (3.1496)
175 (6.8898)
320 (12.5984)
495 (19.488)
557 (21.9291)

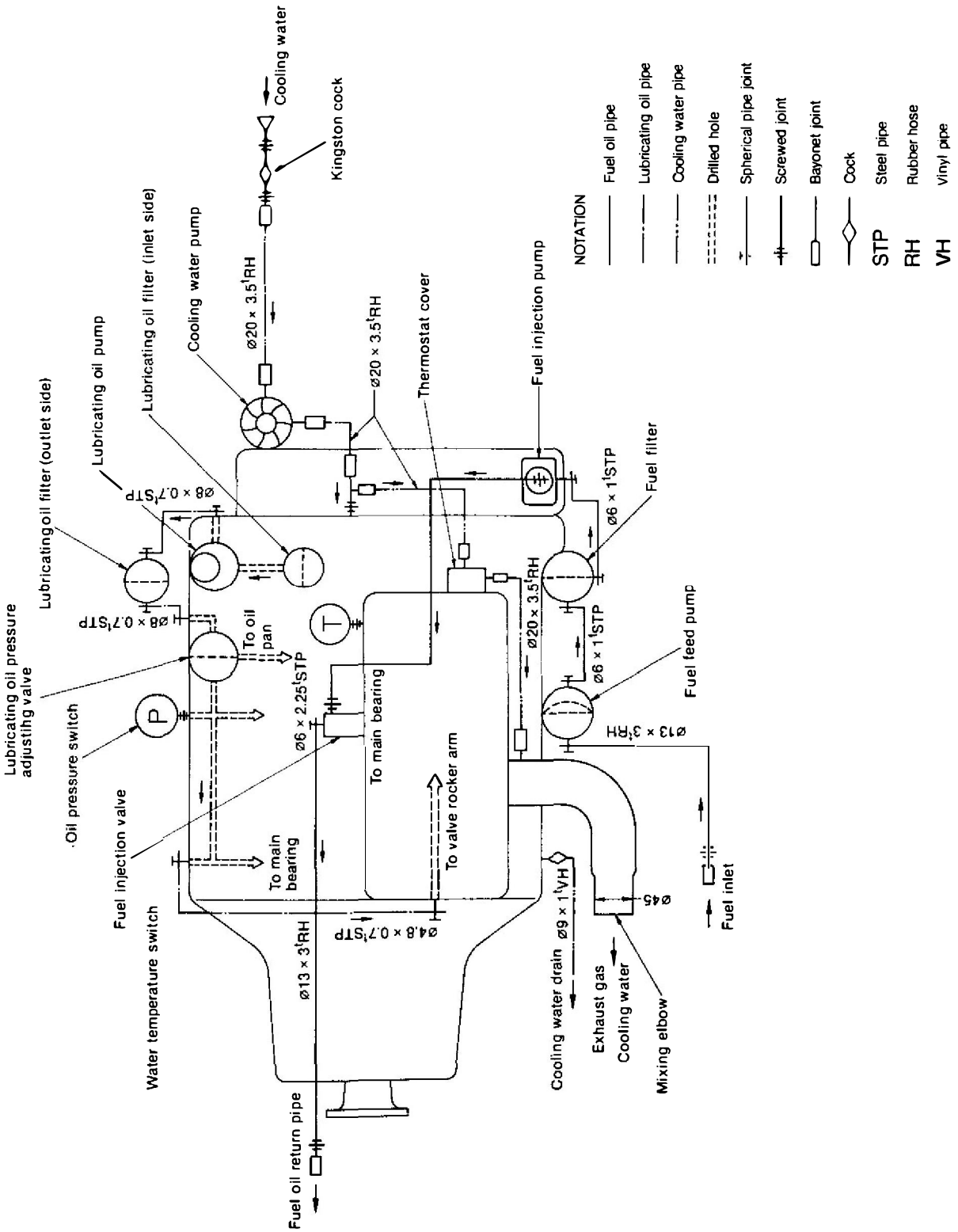
7-5 3HM

mm (in.)

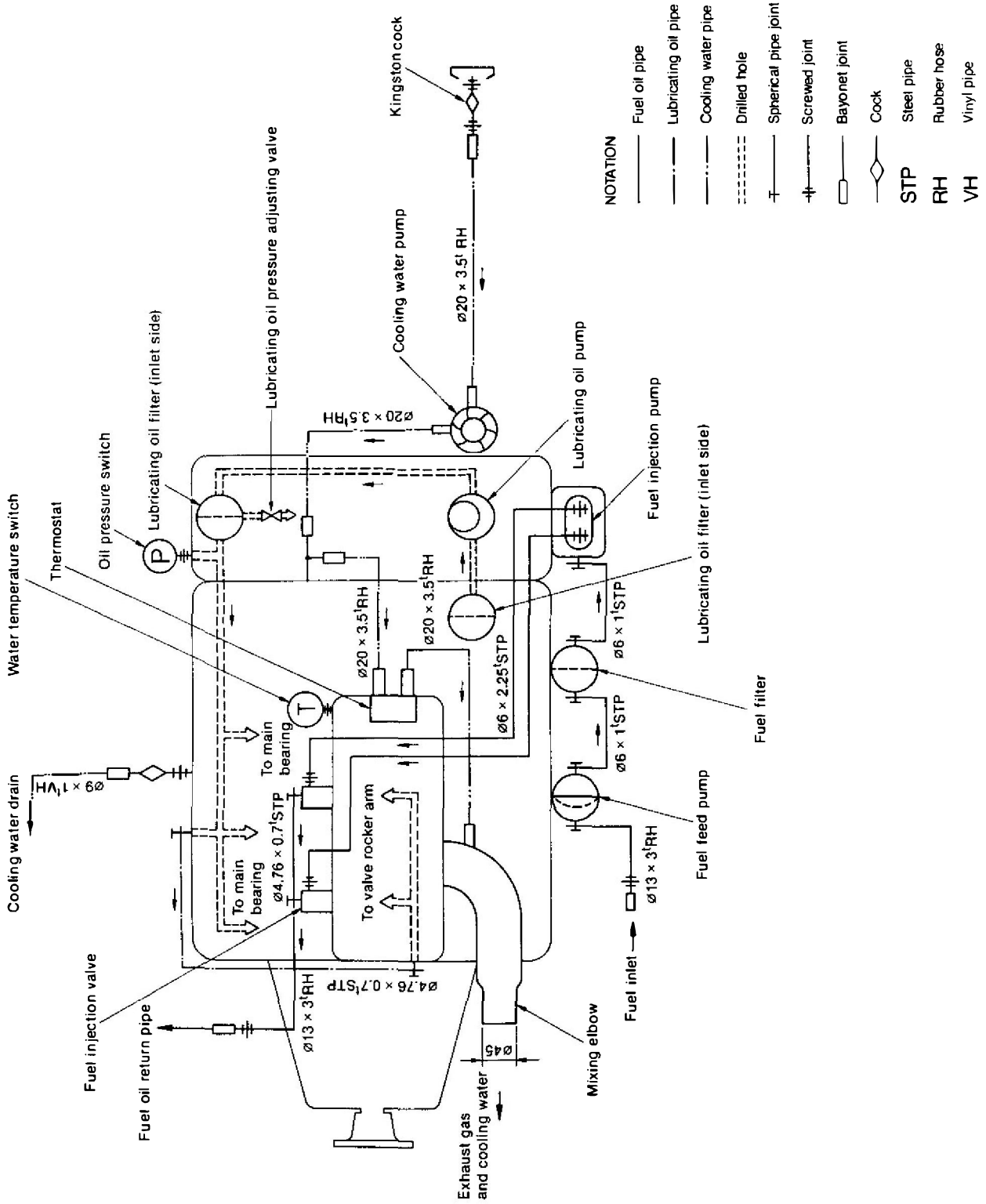

Fuel overflow for ø7 (0.2756) pipe
200 (7.8740)
4-ø17 (0.6693)
432 (17.0079)
12 (0.4724) × 30 (1.1811)
174 (6.8504)
150 (5.9055)
200 (7.8740) 200 (7.8740)
ø12 (0.4724)
Water inlet for ø17 (0.6693) hose
9 (0.3543)
160 (6.2992)
306 (12.0472)
791 (31.1417)
316 (12.4409)
Water outlet for ø17 (0.6693) hose
U-mixing elbow (optional)
Exhaust pipe for ø51 (2.0079) hose
Fuel inlet for ø7 (0.2756) pipe or 1/2-20 UNF joint
32 (1.2598) ~ 52 (2.0472) Adjustable
451 (17.7559)
226 (8.8976)
225 (8.8583)
84 (3.3071)
196 (7.7165)
460 (18.1102)
68 (2.6772) 4 (0.1575)
435 (17.1260)
222 (8.7402)
390 (15.3543)
612 (24.0945)
657 (25.8661)
R167 (6.5748)
10 (0.3937)
6 (0.2362)
ø28 (1.1024)
ø50 (1.9685)H7
ø100 (3.9370)
4-ø10.5 (0.4134)
PCD78 (3.0709)

8. Piping Diagrams

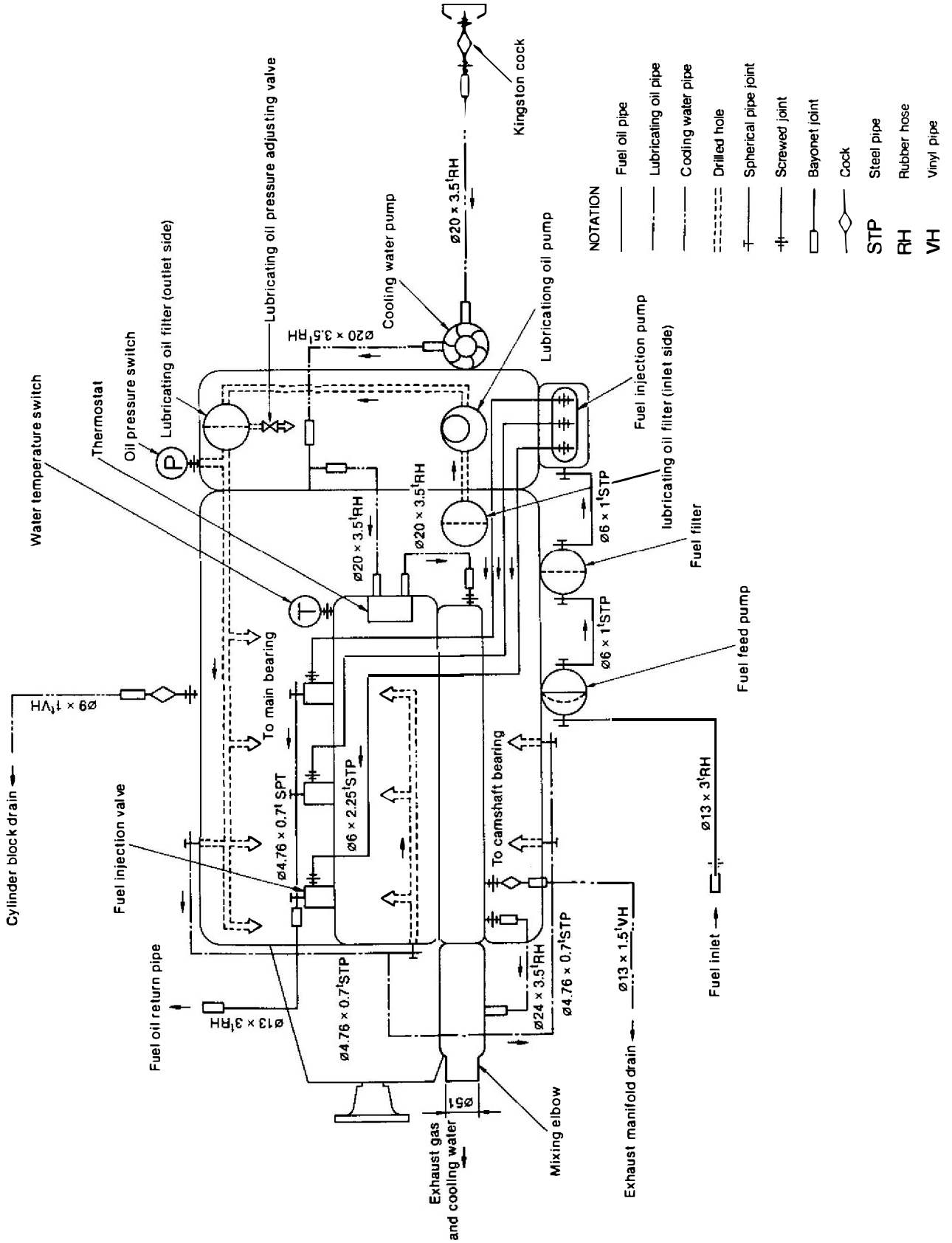
8-1 1GM



8-2 2GM


Kingston cock
Cooling water pump
ø20 × 3.5 RH
Lubricating oil pressure adjusting valve
Lubricating oil filter (inlet side)
Oil pressure switch
Thermostat
Water temperature switch
Lubricating oil pump
Fuel injection pump
Lubricating oil filter (inlet side)
Fuel filter
Fuel feed pump
Fuel inlet
Mixing elbow
Exhaust gas and cooling water
Fuel injection valve
Fuel oil return pipe
Cooling water drain
To main bearing
To valve rocker arm
ø20 × 3.5 RH
ø6 × 2.25 STP
ø6 × 1 STP
ø13 × 3 RH
ø4.76 × 0.7 STP
ø45
NOTATION
Fuel oil pipe
Lubricating oil pipe
Cooling water pipe
Drilled hole
Spherical pipe joint
Screwed joint
Bayonet joint
Cock
STP Steel pipe
RH Rubber hose
VH Vinyl pipe

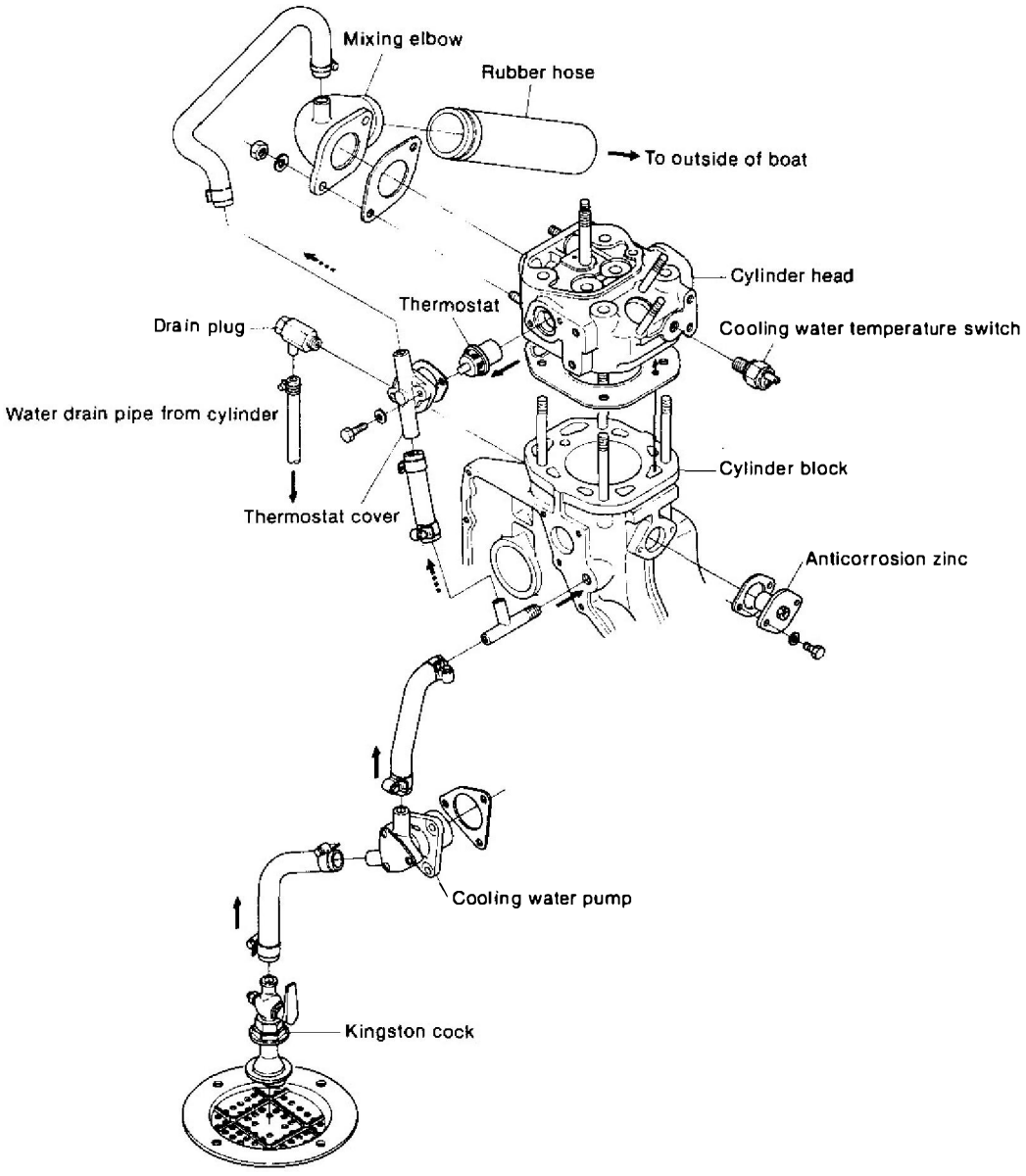
8-3 3GM(D) and 3HM



9. System Diagrams

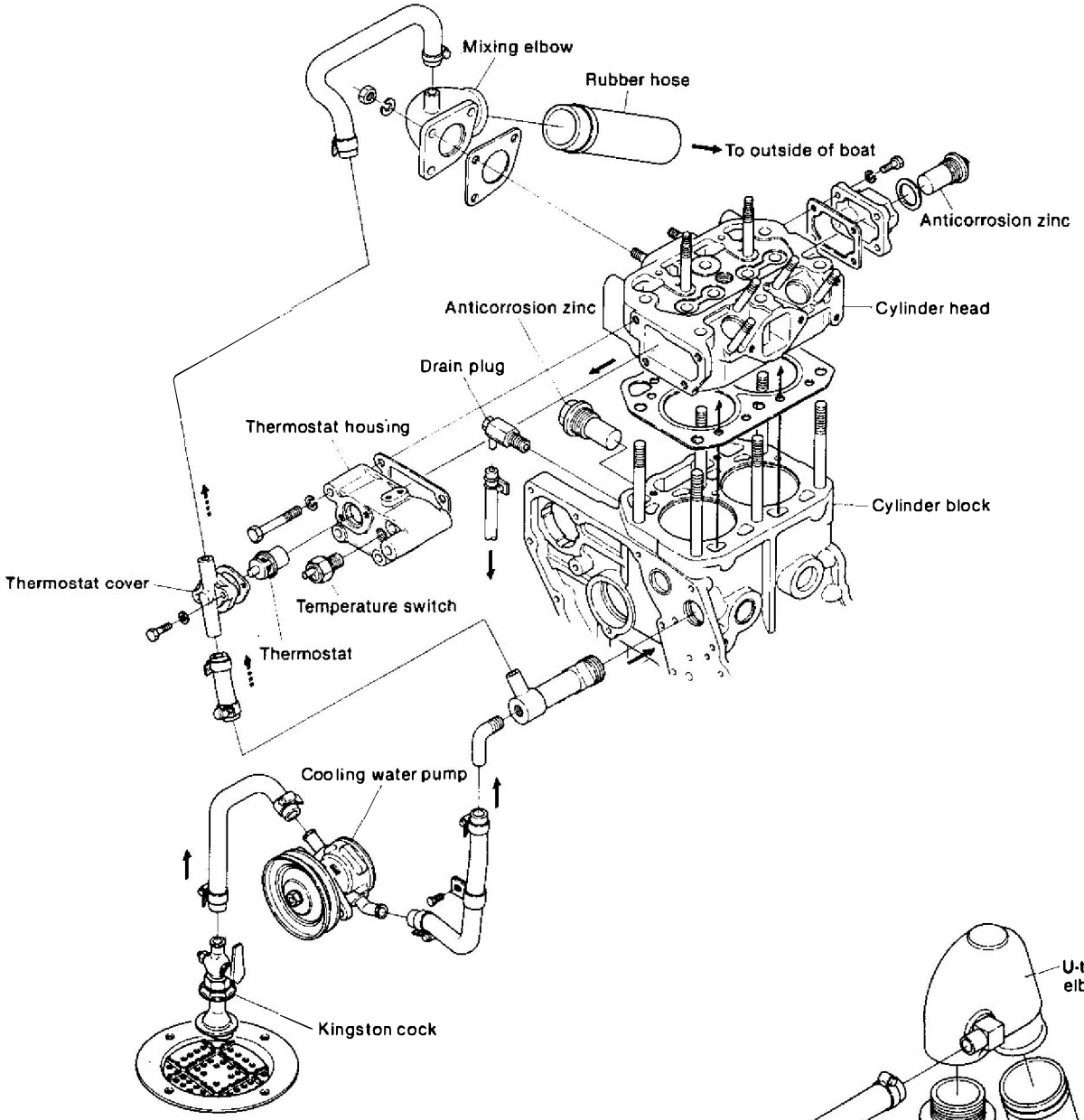
9-1 Cooling system

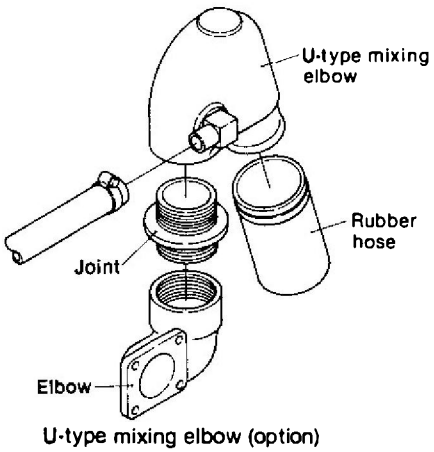
9-1.1 1GM



← When the cooling water is at the correct temperature
←··· When the cooling water temperature is lower than the correct temperature

9-1.2 2GM

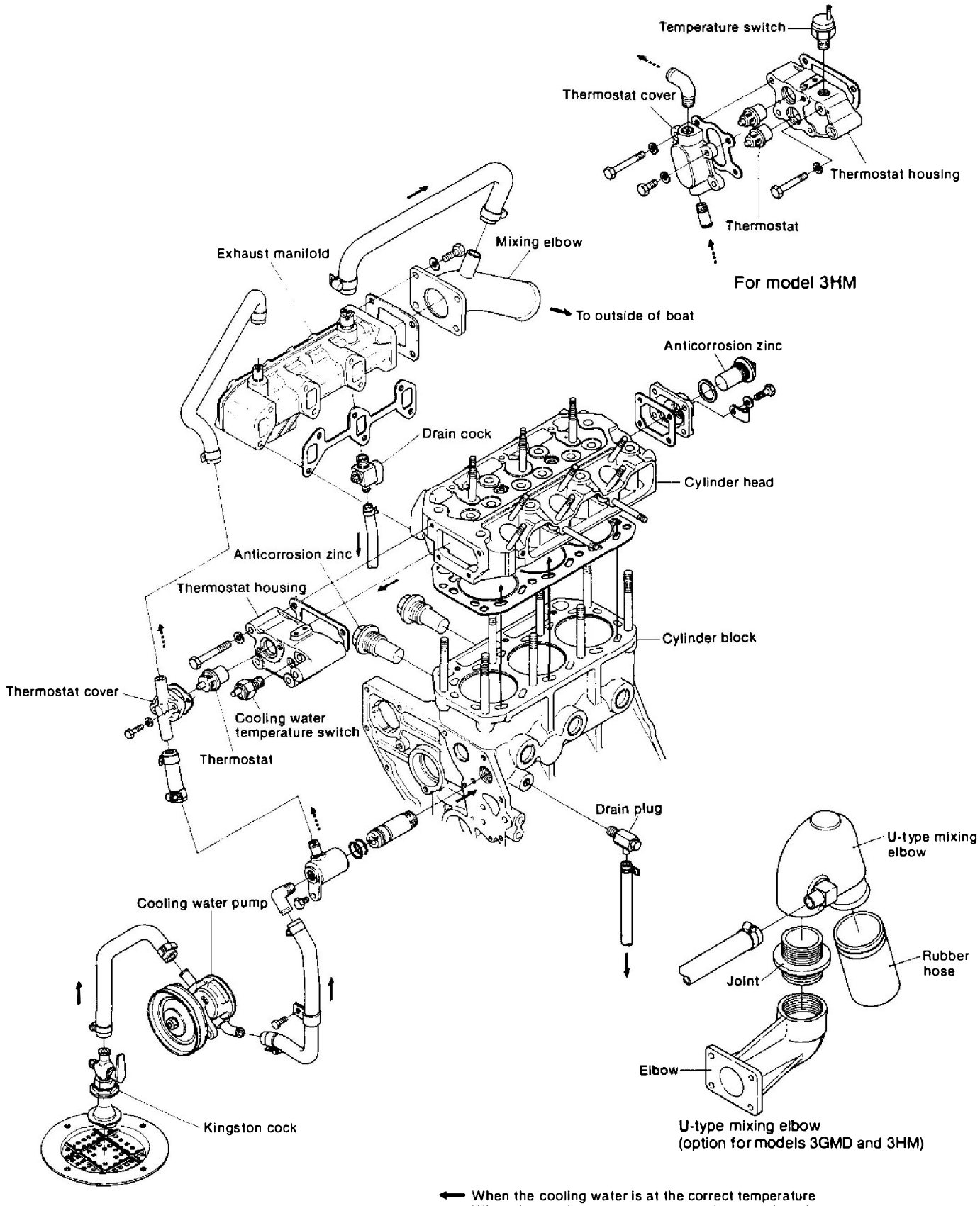




U-type mixing elbow (option)

⟵ When the cooling water is at the correct temperature
⟵ When the cooling water temperature is lower than the correct temperature

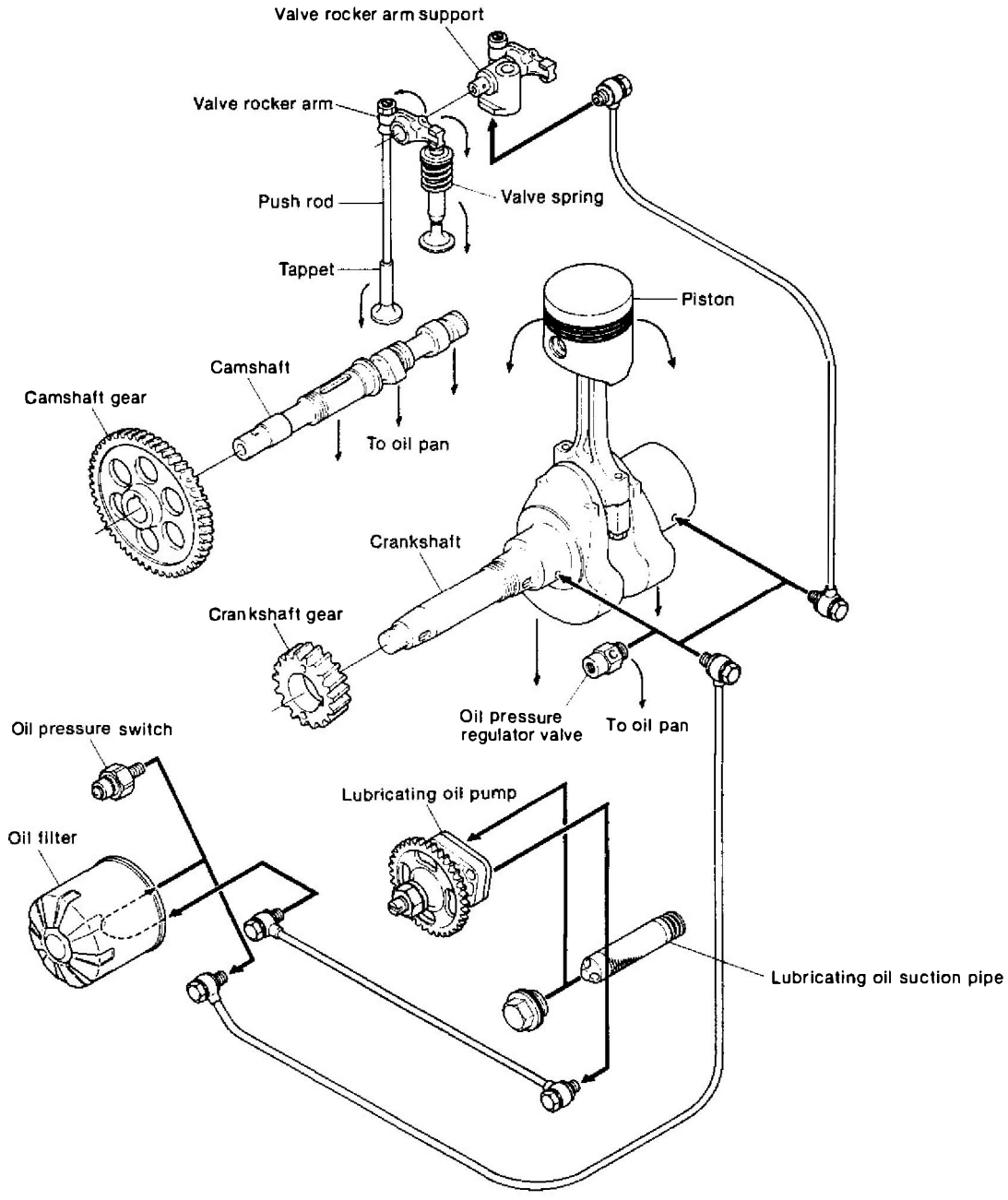
9-1.3 3GM(D) and 3HM



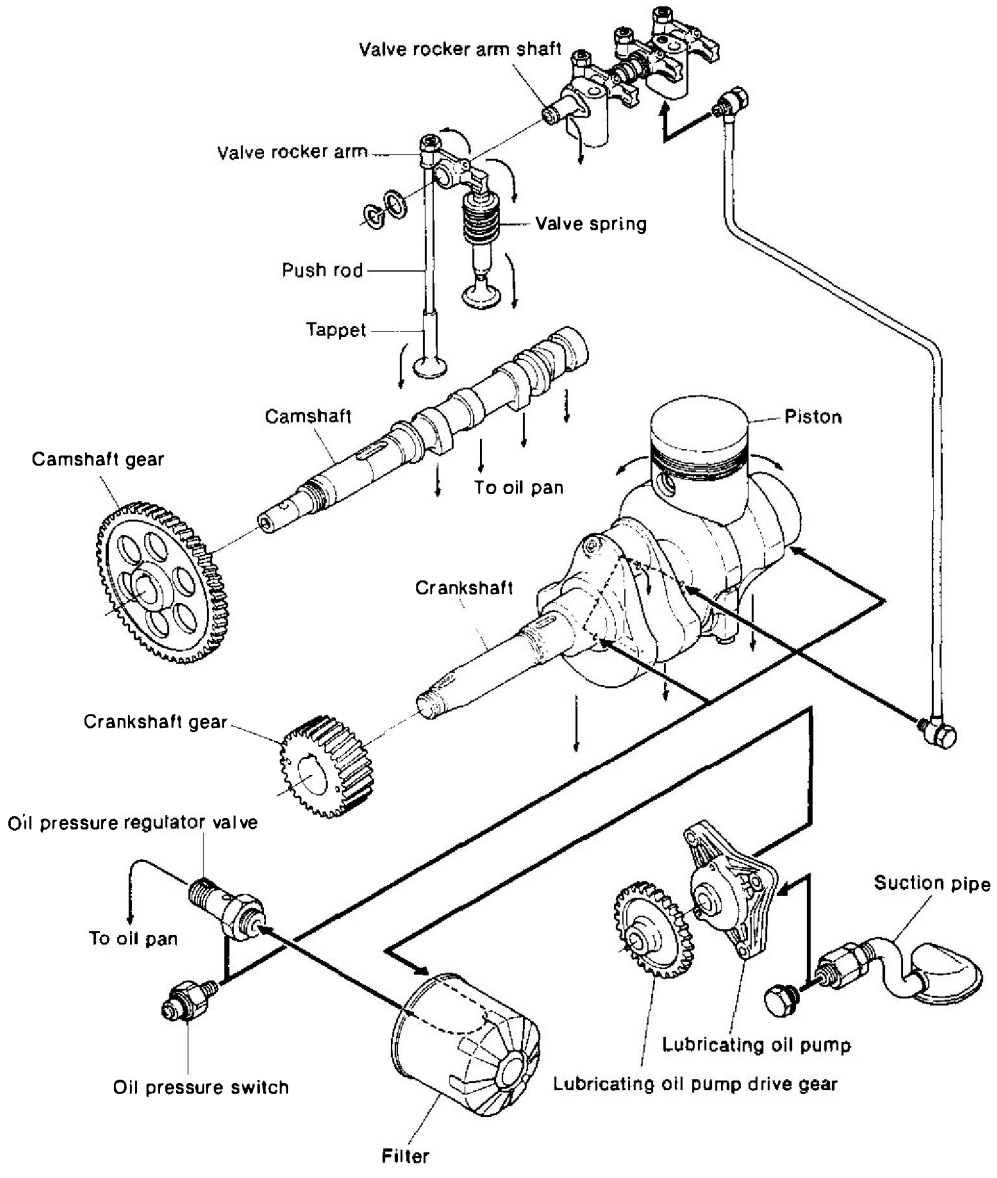
← When the cooling water is at the correct temperature
←··· When the cooling water temperature is lower than the correct temperature

9-2 Lubrication system

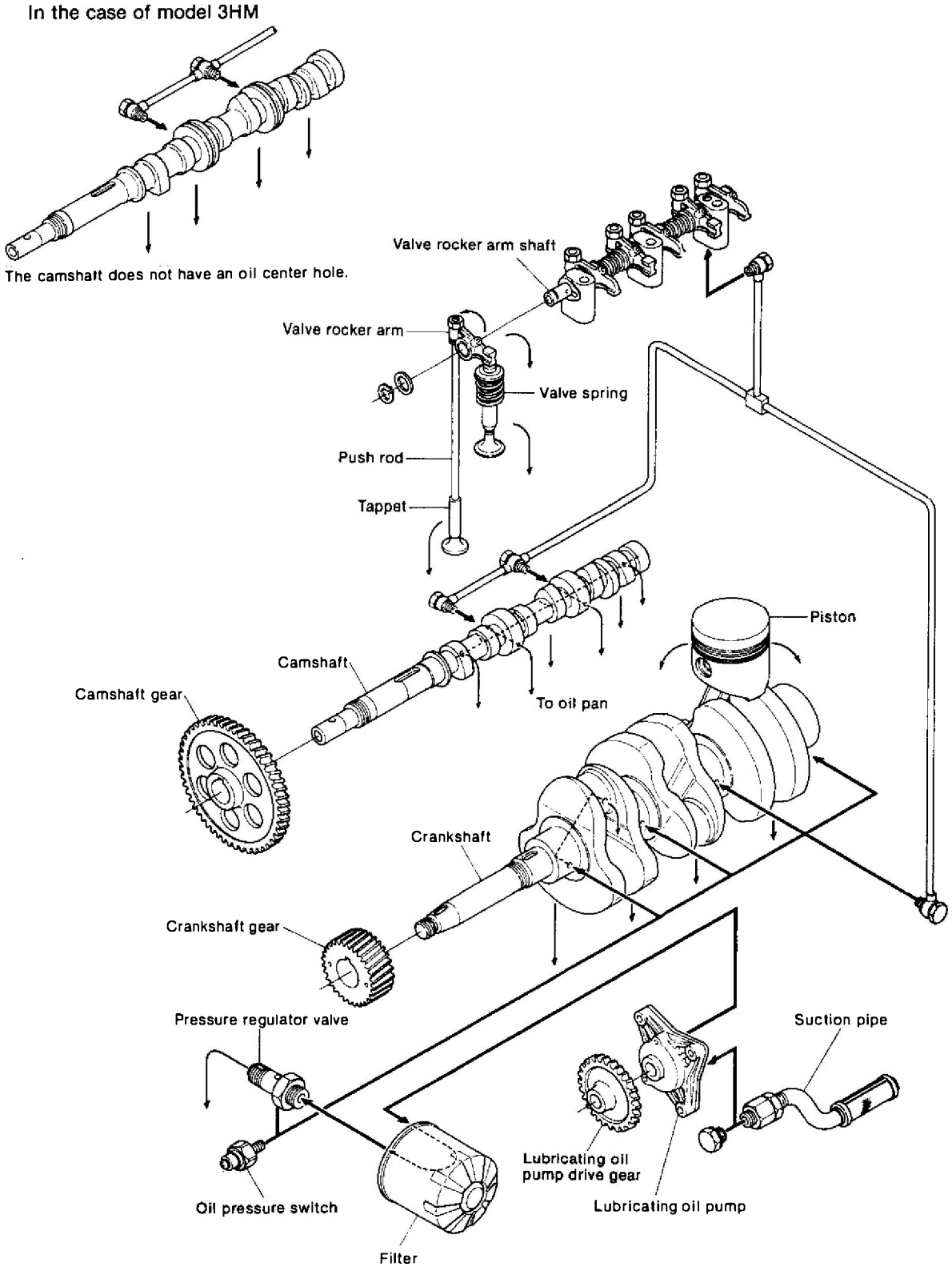
9-2.1 1GM



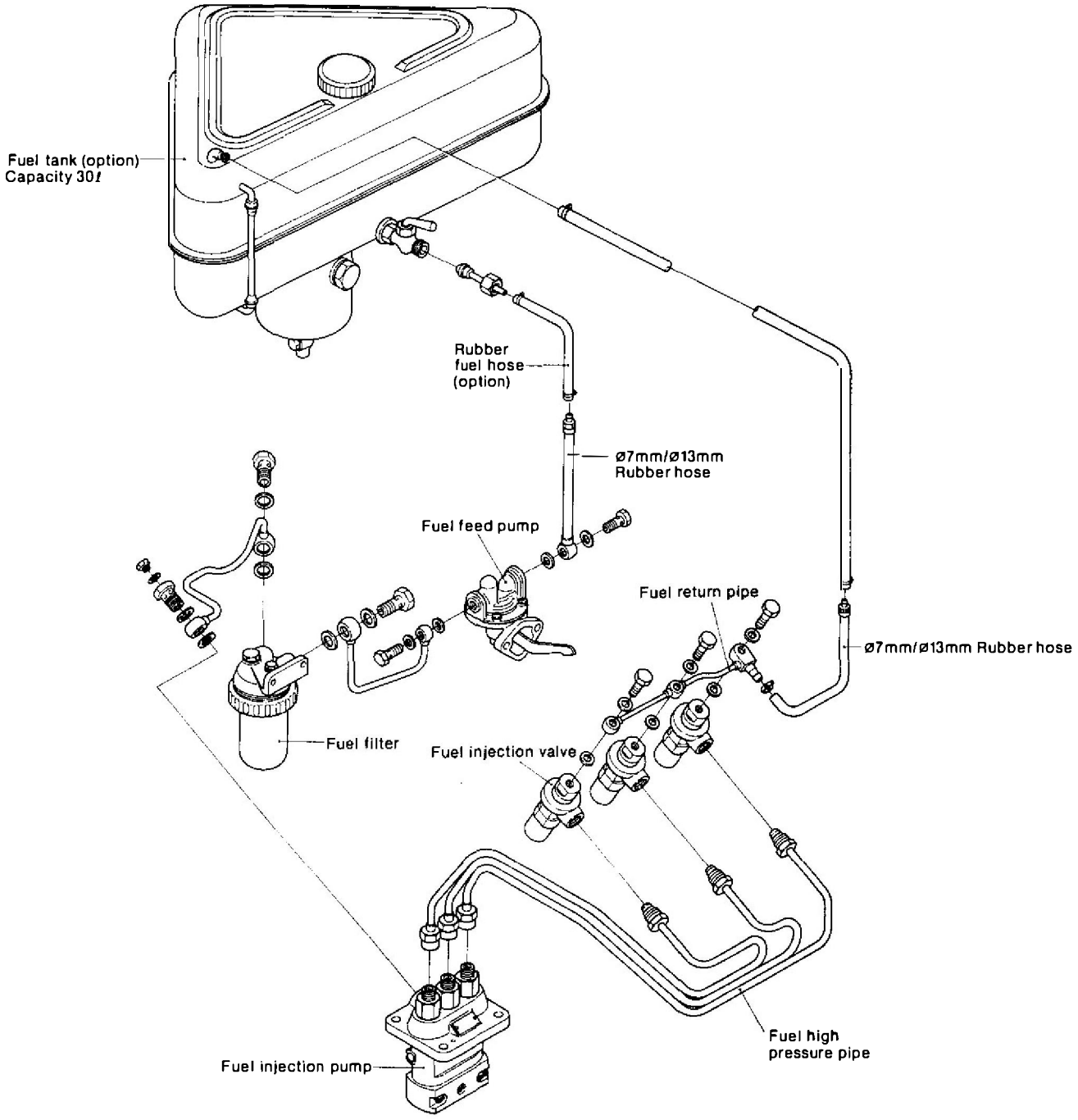
9-2.2 2GM


Valve rocker arm shaft
Valve rocker arm
Valve spring
Push rod
Tappet
Camshaft
Camshaft gear
To oil pan
Piston
Crankshaft
Crankshaft gear
Oil pressure regulator valve
To oil pan
Suction pipe
Lubricating oil pump
Lubricating oil pump drive gear
Oil pressure switch
Filter

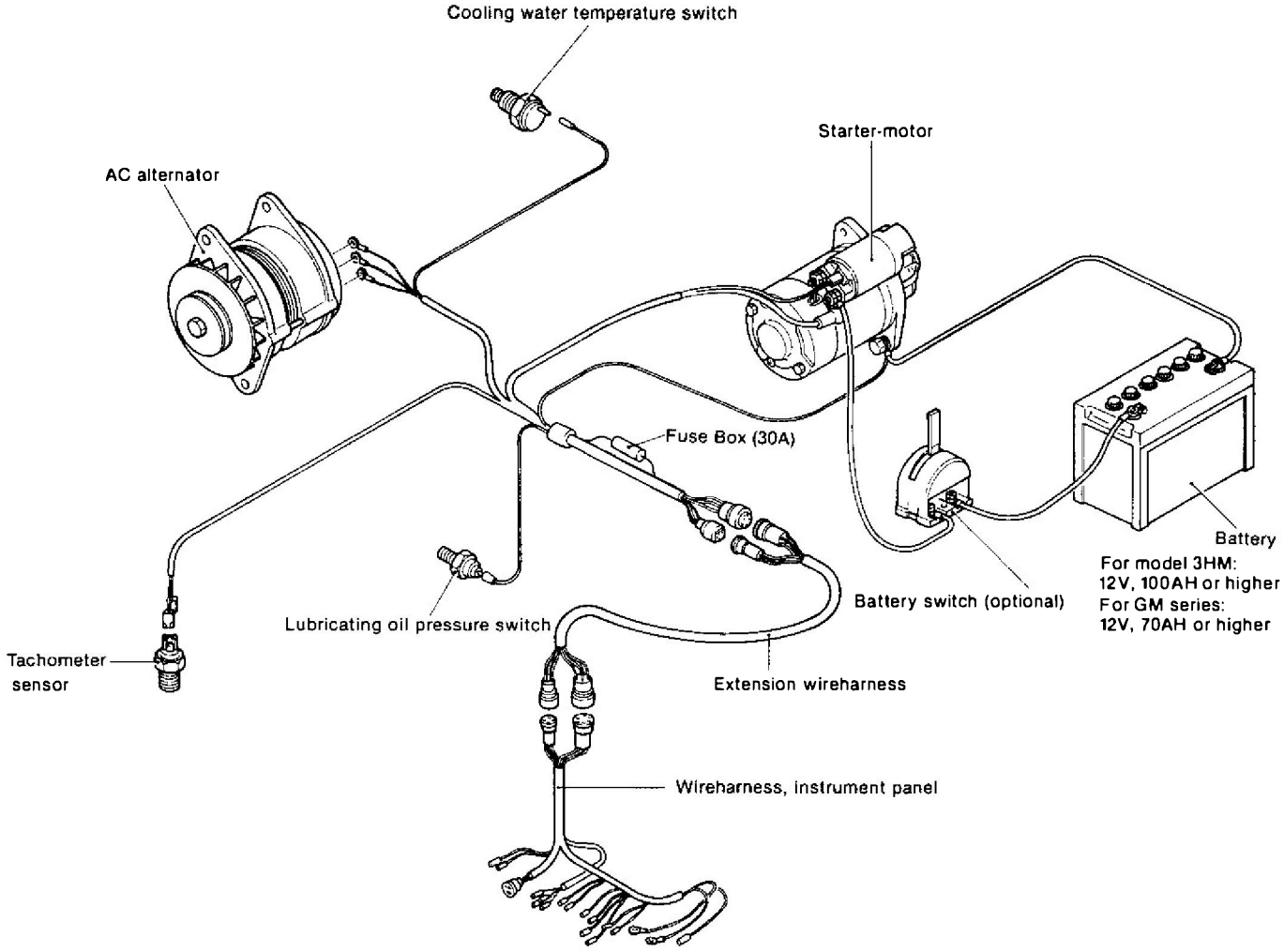
9-2.3 3GM (3HM)

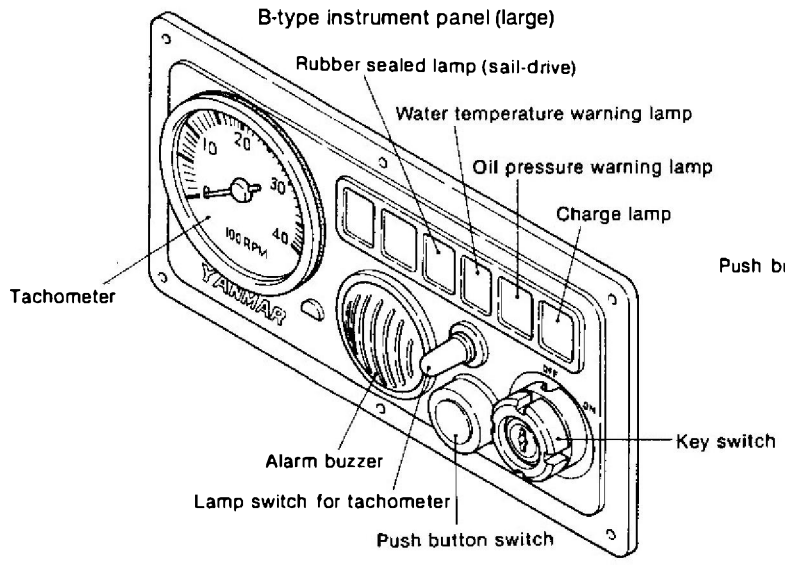

In the case of model 3HM
The camshaft does not have an oil center hole.
Valve rocker arm shaft
Valve rocker arm
Valve spring
Push rod
Tappet
Piston
Camshaft
Camshaft gear
To oil pan
Crankshaft
Crankshaft gear
Pressure regulator valve
Suction pipe
Lubricating oil pump drive gear
Lubricating oil pump
Oil pressure switch
Filter

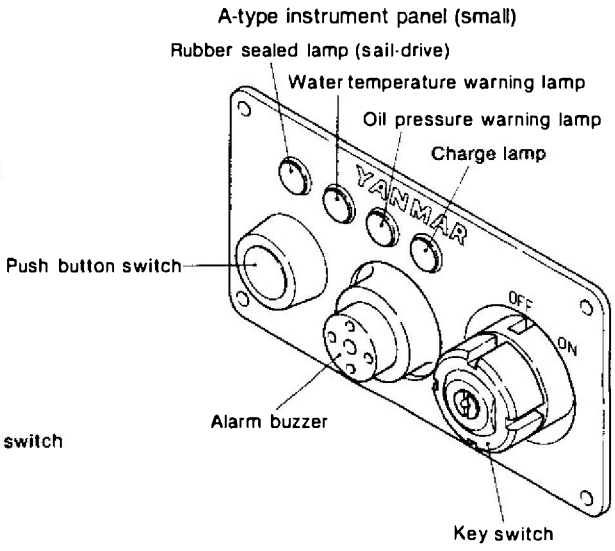
9-3 Fuel system



9-4 Electrical system







10. Standard Accessories

10-1 Parts packed with engine

The parts packed with the engine are listed below.

Part name	Remarks
Instrument panel with wiring harness, 3m	
Starting handle	except model 3HM
Tool box	
Operating manual	
Flexible mount.	

10-2 Parts mounted on engine

The parts mounted on the engine are listed below.

Part name	Remarks
Intake silencer	
Mixing elbow	
Cooling water pump	
Fuel feed pump	
Fuel oil filter	
Lubricating oil filter	
Oil pressure switch	
Cooling water temperature switch	
Thermostat	
Starter motor	
Alternator (with ICR)	
Electric wiring harness	
Speed remote control bracket	with cable clamp
Engine stop remote control bracket	
Engine stop device	
Clutch remote control bracket	with cable clamp
Clevis or spring joint	Fitted to clutch lever

11. Optional Accessories

11-1 Parts mounted on engine

The parts mounted on the engine are listed below.

Part name	Remarks
Tachometer sender	Hex plug M18 unnecessary

11-2 Parts packed with engine

The parts packed with the engine are listed below.

Part name	Remarks
Stop remote control cable ass'y	3m × 1
Morse one handle control	Model M12 top mounted type
Morse one handle control	Model MV side mounted type
Push-pull cable	33-C, 4m × 2
Battery switch	
Oil evacuation pump ass'y	
Kingston cock and cooling water pipe	Cooling water pipe; 2m × 1
Propeller shaft coupling	Taper type
Propeller shaft coupling	Slit type
Fuel oil tank and fuel oil pipe	Fuel oil tank; 30ℓ, pipe; 2m
Spare parts kit	
Packing kit	
Special disassembly tools	
Instrument panel (large, with tachometer)	
Instrument panel (small)	
Extension wiring harness, 3m	To be selected according to order specifications. One harness is fitted as a standard accessory. However, longer parts are optionally available should the standard accessory prove too short.
U-type mixing elbow	except model 1GM

CHAPTER 2

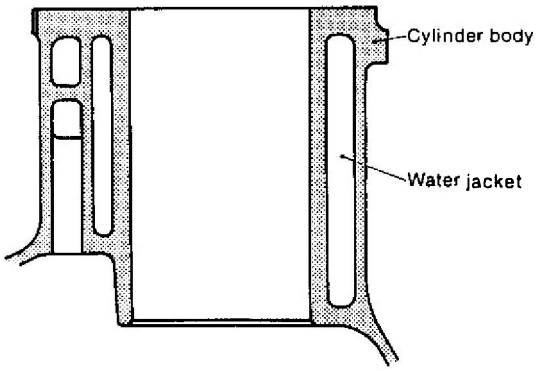
BASIC ENGINE

1. Cylinder Block

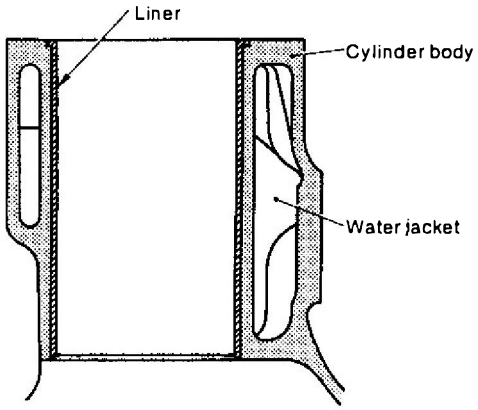
1-1 Construction

The cylinder block of model 1GM engine comprises a single unit casting as the cylinder body without the use of cylinder liners.
For models 2GM, 3GM(D) and 3HM, the dry liner construction is adopted in which the cooling water does not come into direct contact with the external surface of the liner.

Cylinder of Model 1GM engine
Unit cast cylinder type

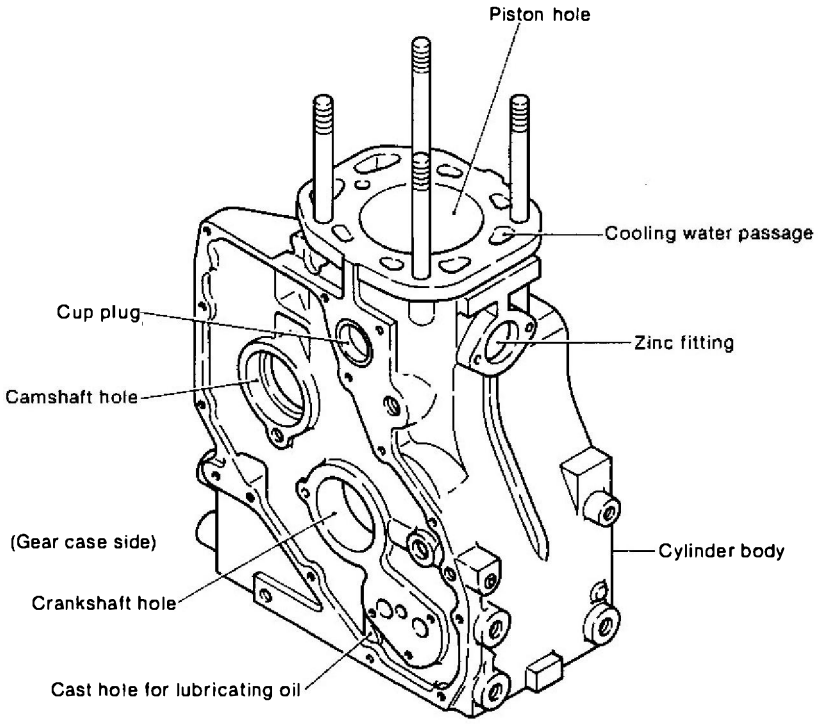


Cylinder of Models 2GM, 3GM(D), 3HM, engines Dry liner type

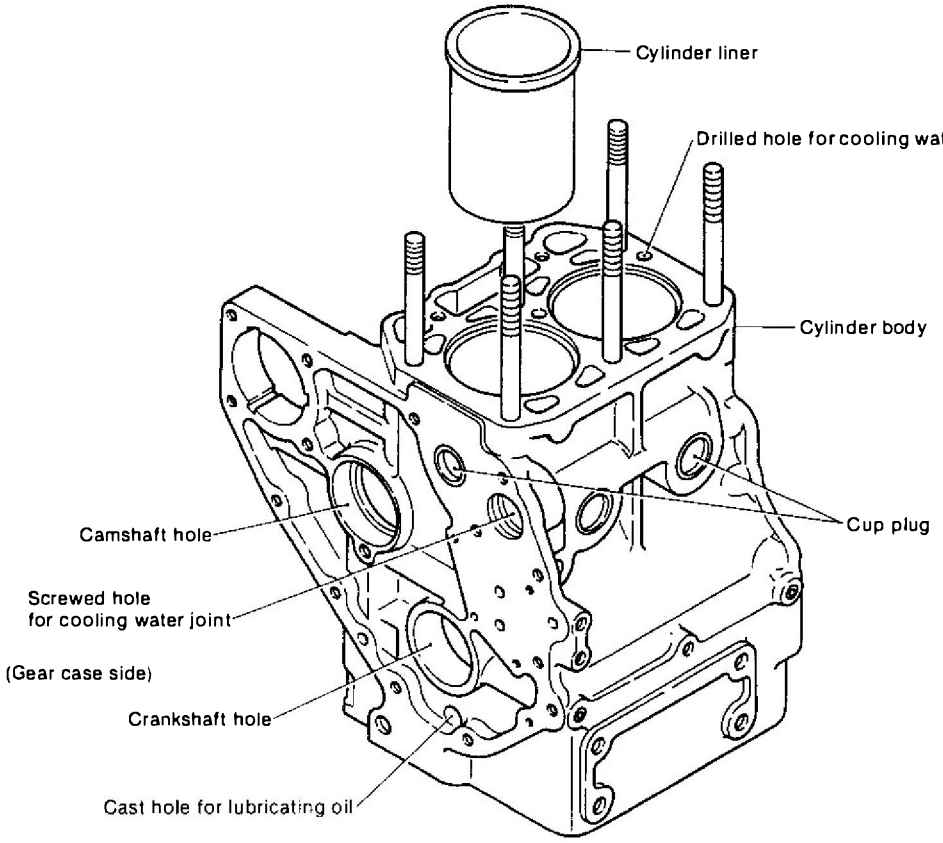


The cylinder block is a high-quality cast iron casting, with integral cylinders and deep skirt crankcase construction. As a result of stress analyses, the shape and thickness of each part has been optimized, and special ribs employed which not only increase the strength and rigidity of the block, but also reduce noise.

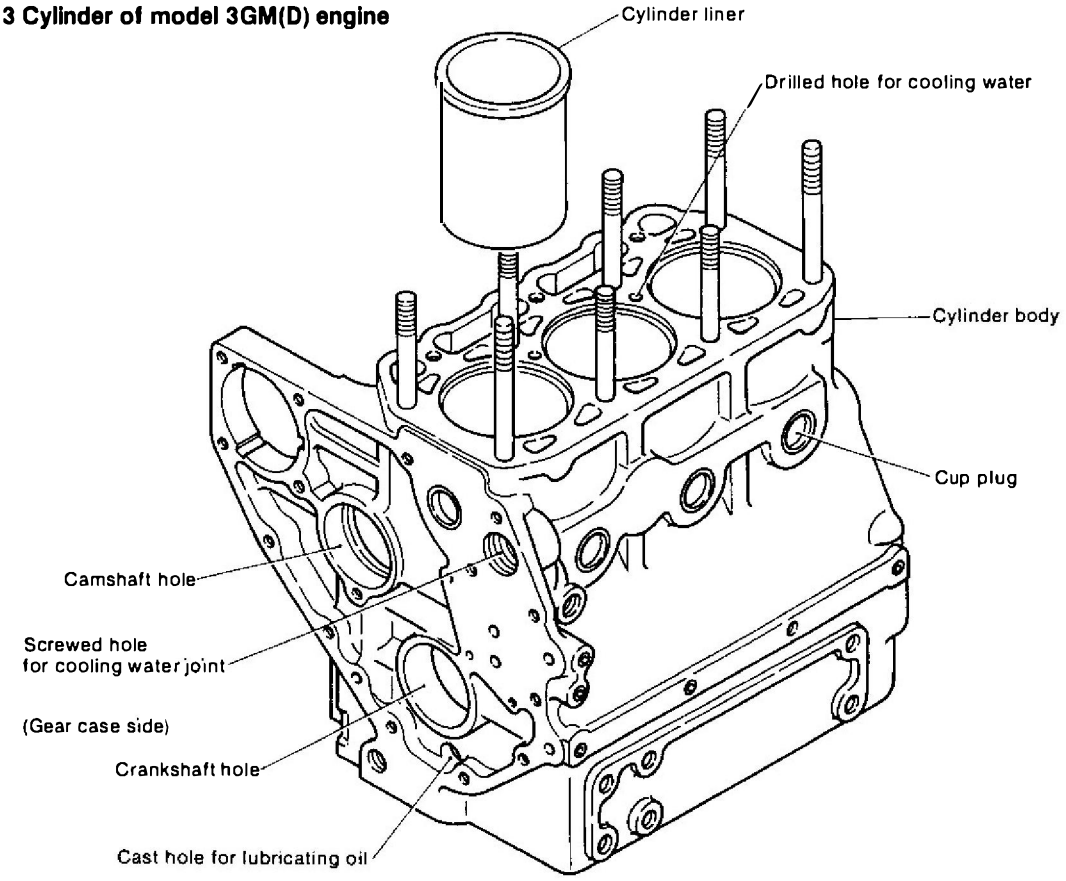
1-1.1 Cylinder of model 1GM engine



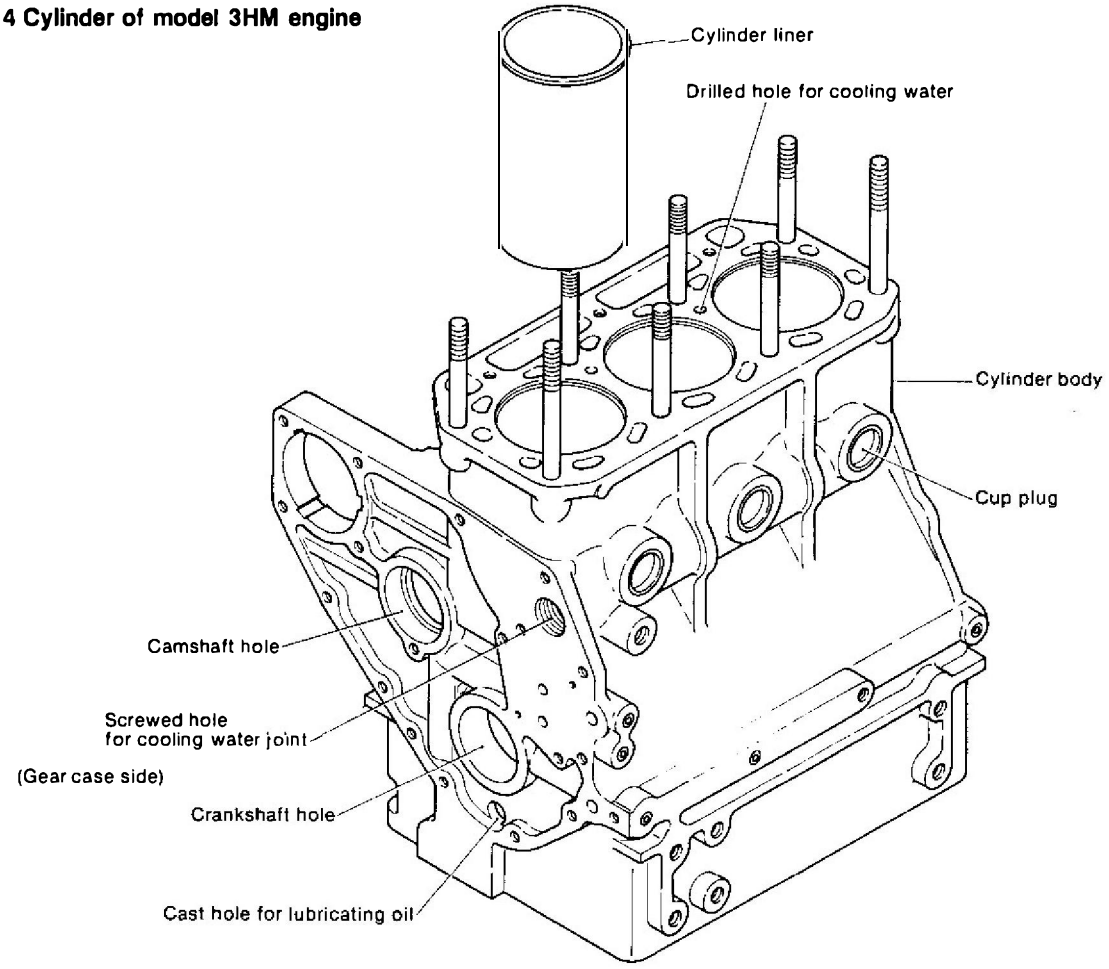
1-1.2 Cylinder of model 2GM engine



1-1. 3 Cylinder of model 3GM(D) engine



1-1. 4 Cylinder of model 3HM engine



1-2 Cylinder block inspection

1-2.1 Inspecting each part for cracks

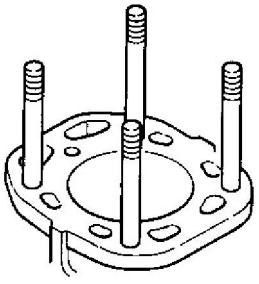
If the engine has been frozen or dropped, visually inspect it for cracks and other abnormalities before disassembling. If there are any abnormalities or the danger of any abnormalities occurring, make a color check.

1-2.2 Inspecting the water jacket of the cylinder for corrosion

Inspect the cooling water passages for sea water corrosion, scale, and rust. Replace the cylinder body if corrosion, scale or rust is severe.

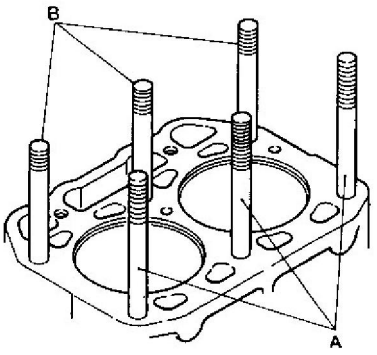
1-2.3 Cylinder head stud bolts

Check for loose cylinder head bolts and for cracking caused by abnormal tightening, either by visual inspection or by a color check.
Replace the cylinder block if cracked.



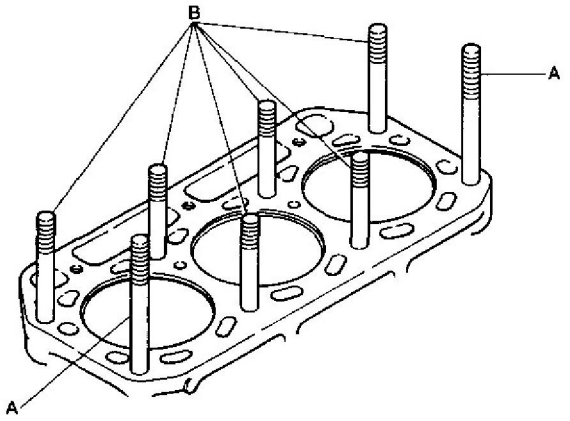
1GM

Bolt diameter	M10 (0.3937in.)
Length	79mm (3.1102in.)
Tightening torque	2.5 ~ 3.0 kg-m (18.1 ~ 21.7 ft-lb)



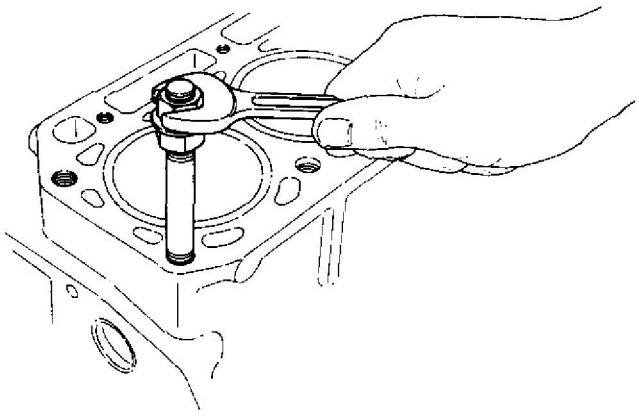
2GM

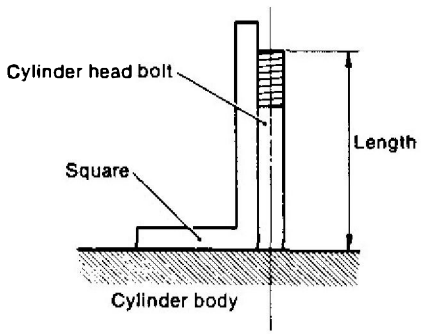
Bolt diameter		M12 (0.4724in.)
Length	A	96mm (3.7795in.)
	B	82mm (3.2283in.)
Tightening torque		4.0 ~ 4.5 kg-m (28.9 ~ 32.5 ft-lb)



3GM(D), 3HM

Bolt diameter		M12 (0.4724in.)
Length	A	96mm (3.7795in.)
	B	82mm (3.2283in.)
Tightening to que		4.0 ~ 4.5 kg-m (28.9 ~ 32.5 ft-lb)



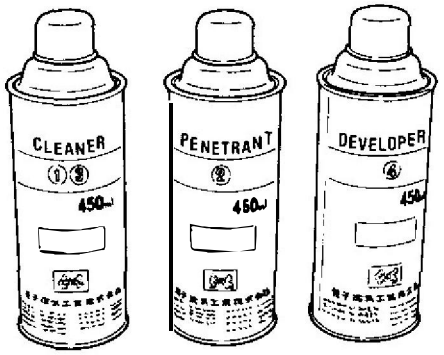


1-2.4 Oil and water passages

Check the oil and water passages for clogging and build-up of foreign matter.

1-2.5 Color check flaw detection procedure

(1) Clean the inspection point thoroughly.
(2) Procure the dye penetration flaw detection agent. This agent comes in spray cans, and consists of a cleaner, penetrant, and developer in one set.



(3) Pretreat the inspection surface with the cleaner. Spray the cleaner directly onto the inspection surface, or wipe the inspection surface with a cloth moistened with the cleaner.
(4) Spray the red penetration liquid onto the inspection surface. After cleaning the inspection surface, spray the red penetrant (dye penetration flaw detection agent) onto it and allow the liquid to penetrate for5-10 minutes. If the penetrant fails to penetrate the inspection surface because of the ambient temperature or other conditions, allow it to dry and respray the inspection surface.
(5) Spray the developer onto the inspection surface. After penetration processing, remove the residual penetrant from the inspection surface with the cleaner, and then spray the developer onto the inspection surface. If the inspection surface is flawed, red dots or lines will appear on the surface within several minutes. When spraying the developer onto the inspection surface, hold the can about 30—40cm from the surface and sweep the can slowly back and forth to obtain a uniform film.
(6) Reclean the inspection surface with the cleaner.

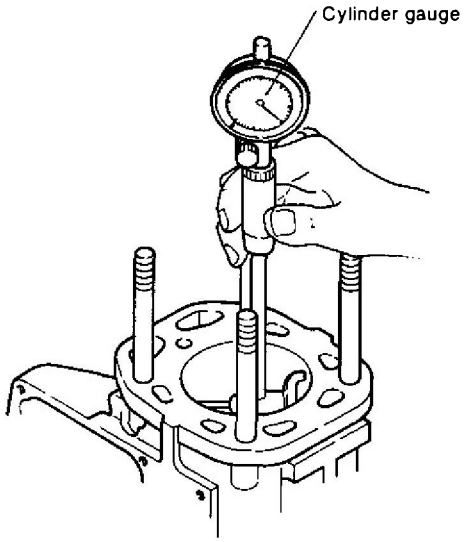
NOTE: Before using the dye penetration flaw detection agent, read its usage instructions thoroughly.

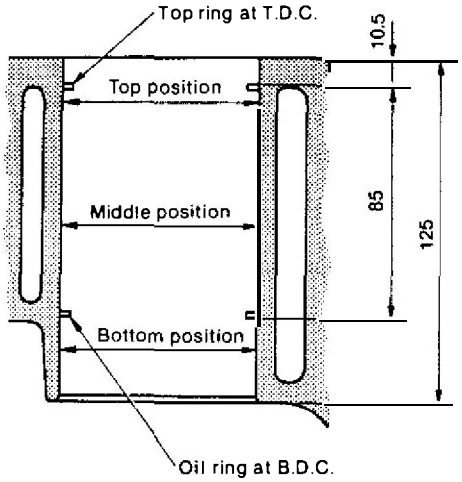
1-3 Cylinder bore measurement

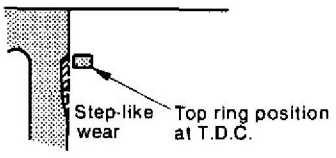
1-3. 1 Cylinder model 1GM

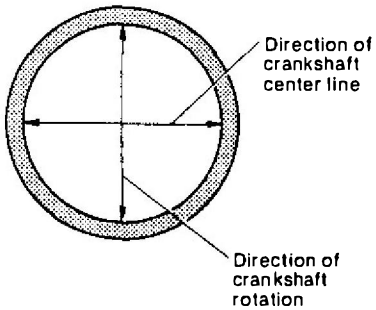
Cylinder wear is measured with a cylinder gauge. The amount of cylinder wear becomes greater as the piston nears the top, and it becomes greatest at the position of the top ring when the piston is at top dead centre. The reason for this is that when the piston is at the top position, lateral pressure is high due to the high explosive pressure, and lubrication is very difficult due to the high temperature. Therefore, the amount of wear must be measured in at least 3 positions, namely the top, middle and bottom positions of the cylinder.

Although the greatest wear is at the top of the cylinder, the piston ring does not slide with the cylinder at the topmost position. Therefore, a step-like pattern is formed between the worn part and the non-worn part.
Furthermore, wear is liable to occur along the rotating direction of the crankshaft due to the lateral pressure of the piston. On the other hand, wear occurs in the direction of the crankshaft center line due to the thrust of the crankshaft and the angle of the connecting rod.
Therefore, the amount of wear must be measured in both directions of crankshaft rotation and crankshaft center line. When the difference of these two values (i.e. circularity wear) is large, the cylinder must be repaired.









mm (in.)

	Maintenance standard	Maximum allowable clearance	Wear limit
Cylinder diameter	$\varnothing 72^{+0.03}_{0}$ (2.8346 ~ 2.8358)	0.3 (0.0118)	
Piston outside diameter	ø72 (2.8346)		ø71.8 (2.8268)
Cylinder roundness	0 ~ 0.01 (0 ~ 0.0004)	—	0.1 (0.0039)

When the result indicates that eccentric and circularity wear exceed the specified limit, the cylinder must be rebored.

1-3.2 Boring the cylinder

When wear on the Inside of the cylinder is excessive, rectify by machining. This is what is known as boring.
When boring is carried out, note the following points.

(1) Dimension to be bored
The cylinder must be bored to the same dimension as an over-size piston.

mm (in.)

O.D. of standard piston	O.D. of over-size piston
ø72 (2.8346)	ø72.25 (2.8445)

(2) Limit of cylinder's expanded I.D.
Never bore the cylinder beyond the limit of the expanded inner diameter, because no over-size piston is available for that dimension, besides which there is danger in having too thin a wall thickness.

mm (in.)

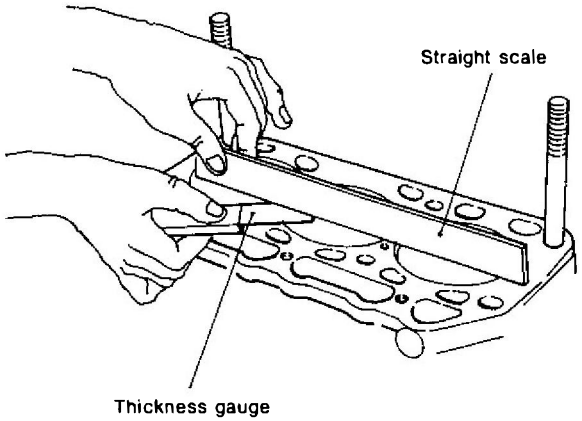
I.D. of standard cylinder	Limit of I.D. expansion
ø72 (2.8346)	$72.25^{+0.03}_{0}$ (2.8445 ~ 2.8457)

(3) Honing
The inside surface of the cylinder must be honed after being bored in order to remove machine tool marks.

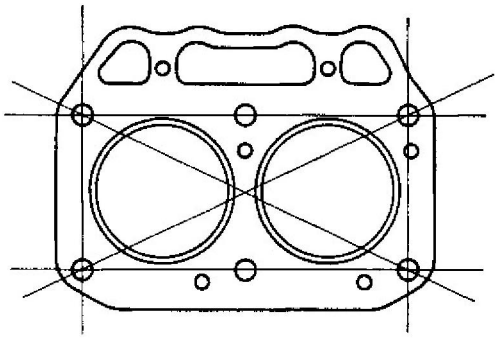
1-4 Measurement of distortion on the upper surface of the cylinder

As the cylinder is subjected to thermal expansion and high pressure repeatedly, it will not recover its original shape after the engine has stopped and cooled down and will be distorted. The distortion is mainly caused by construction and material differences of the cylinder, but may arise from the cylinder head bolts being tightened in the wrong order or an uneven tightening torque of the bolts when assembling. If there is any distortion at the upper surface of the cylinder, it will cause a compression pressure leakage, gas leakage or water leakage as a clearance is formed around the cylinder head even though the cylinder head is thoroughly secured.

(1) How to measure distortion on the upper surface of the cylinder
The amount of distortion is measured by placing a straight scale on the upper surface of the cylinder and inserting a thickness gauge between the upper surface of the cylinder and the straight scale.



Measurement is to be carried out on the 4 sides and 2 diagonal lines as shown In the figure, and the largest value of clearance for each measurement Is to be taken as the amount of distortion.



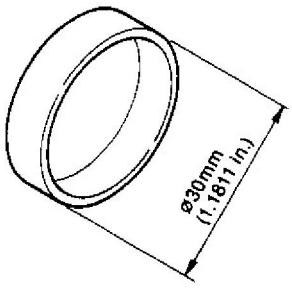
mm (in.)

	Allowable limit of distortion
1GM	0.07 (0.0028)
2GM	0.07 (0.0028)
3GM(D) 3HM	0.07 (0.0028)

1-5 Cup plug

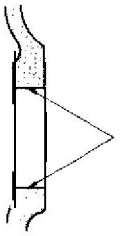
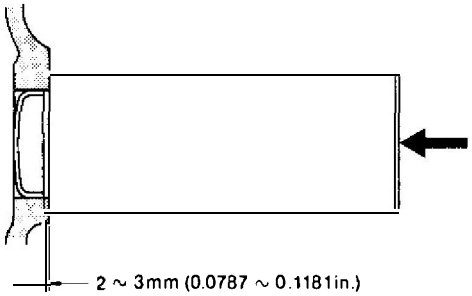
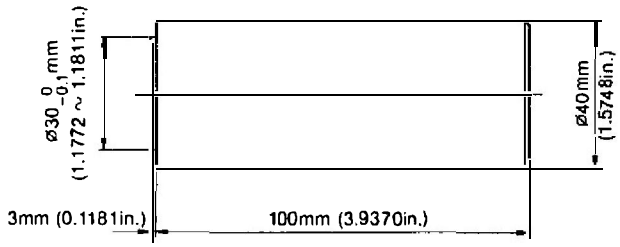
1-5.1 Purpose of cup plug

In order to minimize the danger of cylinder block breakage caused by the cooling water freezing, a cup plug is provided at the side of the cylinder block to prevent damage by frost.
In the event that freezing cooling water has caused the cup plug to come out repair in the following way.
In cold weather it is necessary to drain the cooling water completely from the inside of the cylinder block through the cooling water drain pipe.



	1GM	2GM	3GM(D)	3HM
No. of plugs used	2	4	5	4
Part No.	105311-01090			

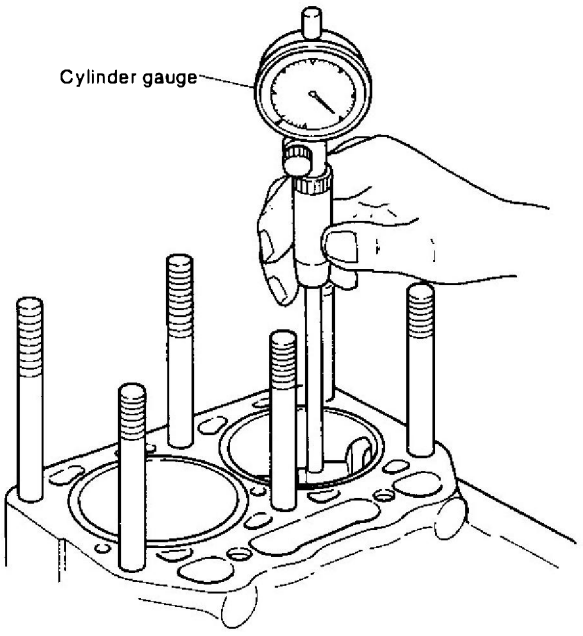
1-5.2 How to drive in the cup plug

Step No.	Description	Procedure	Tool or material used
1.	Clean and remove grease from the hole into which the cup plug is to be driven. (Remove scale and sealing material previously applied.)	 Remove foreign materials with screw driver or saw blade.	•Screw driver or saw blade •Thinner
2.	Remove grease from the cup plug.	Visually check the nick around the plug.	•Thinner
3.	Apply Threebond No. 4 to the seat surface where the plug is to be driven in.	Apply over the whole outside of the plug.	•Threebond No. 4
4.	Insert the plug into the hole.	Insert the plug so that it seats correctly.	
5.	Place a driving tool on the cup plug and drive it in using a hammer.  2 ~ 3mm (0.0787 ~ 0.1181in.) *Using the special tool drive the cup plug to a depth where the edge of the plug is 2mm (0.0787in.) below the cylinder surface.	Drive in the plug parallel to the seating surface.  ø30 $^{0}_{-0.1}$ mm (1.1772 ~ 1.1811in.) ø40mm (1.5748in.) 3mm (0.1181in.) 100mm (3.9370in.)	•Driving tool •Hammer

2. Cylinder Liner [For models 2GM, 3GM(D) and 3HM]

2-1 Construction

In engine models 2GM, 3GM(D) and 3HM, the dry type liner construction is used.
The cylinder liner is the thin wall type of liner (thickness 2mm [0.0787in.]) made of special cast-iron which is highly wear resistant, and its inside surface is finished by honing.
The part of the liner fitting against the cylinder is ground to a precise finished, and clearance between the liner and cylinder is greater towards the top of the cylinder in order to prevent any abnormal deformation which will occur with thermal expansion.
Clearance is always kept to within 10μ to 30μ when assembling by selecting the appropriate liner, from the 3 kinds with different dimensions, by measurng the inside diameter of the cylinder and the outside diameter of the liner.

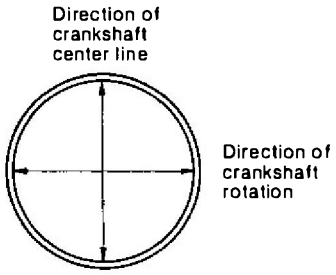


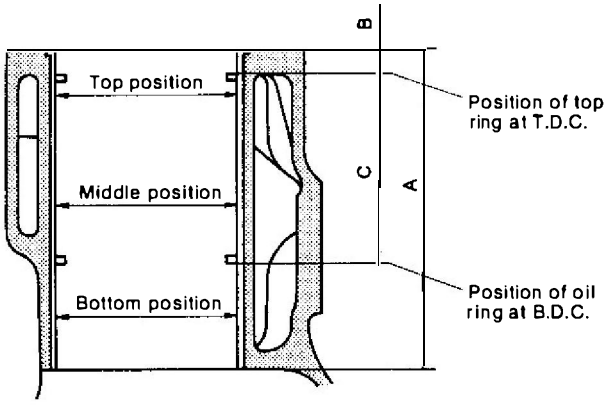
2-2 Inspection

Since the piston and piston rings constantly slide against the cylinder liner while the engine is in operation, and side pressure is applied to the cylinder liner by the movement of the crankshaft, eccentric wear occurs easily.
Moreover, if lubrication and cooling are insufficient, the inner surface will be damaged or rusted. Inspect the inner surface and replace the cylinder liner if the surface is noticeably damaged or rusted.

2-3 Cylinder liner bore diameter measurement

Measure the bore diameter of the cylinder liner with a cylinder gauge at the positions shown in the figure. Replace the cylinder liner when the measured value exceeds the wear limit.
Measurements are to be taken in at least 3 positions as shown in the figure, namely, top, middle and bottom positions in both directions of crankshaft rotation and crankshaft center line.





mm (in.)

	A	B	C
2GM, 3GM(D)	125 (4.9213)	10.5 (0.4134)	85 (3.3485)
3HM	143 (5.6300)	10.5 (0.4134)	98.5 (3.8800)

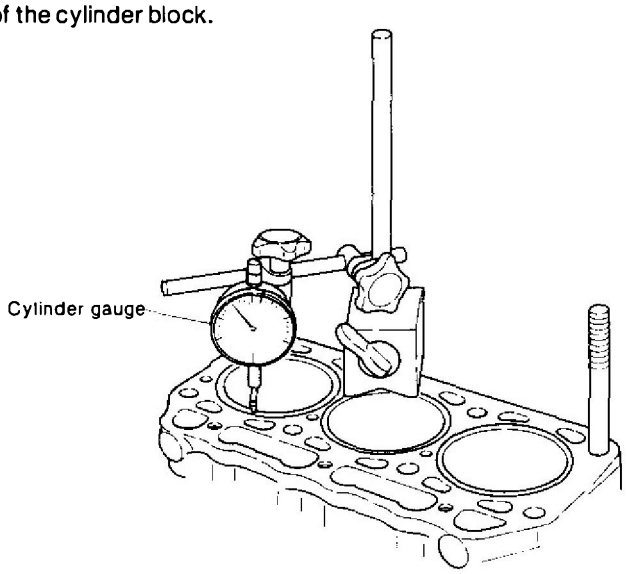
mm (in.)

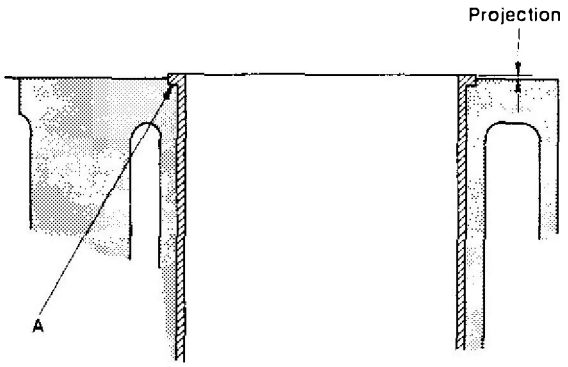
		Maintenance standard	Clearance at assembly	Wear limit
2GM, 3GM(D)	Cylinder liner diameter	ø72 (2.8348)	0.057 ~ 0.117 (0.0022 ~ 0.0046)	ø72.10 (2.8386)
	Piston outside diameter	ø72 (2.8346)		ø71.85 (2.8287)
	Cylinder liner roundness	0.02 (0.0008)	—	0.04 (0.0016)
3HM	Cylinder liner diameter	ø75 (2.9528)	0.038 ~ 0.148 (0.0015 ~ 0.0058)	ø75.10 (2.9567)
	Piston outside diameter	ø75 (2.9528)		ø74.85 (2.9469)
	Cylinder liner roundness	0.02 (0.0008)	—	0.04 (0.0016)

2-4 Measuring cylinder liner projection

The flange of the cylinder liner projects slightly from the end surface of the cylinder. This projection will bed into the gasket packing so as to prevent compression pressure leakage or gas leakage. However, if the projection is excessive, compression pressure or gas leakage may occur because the gasket packing is damaged. On the otherhand, if the projection is insufficient, the cylinder liner can not be securely fixed.

Excessive cylinder liner projection is frequently caused by Incomplete removal of the rust at the ledge (part A of figure) of the cylinder block.





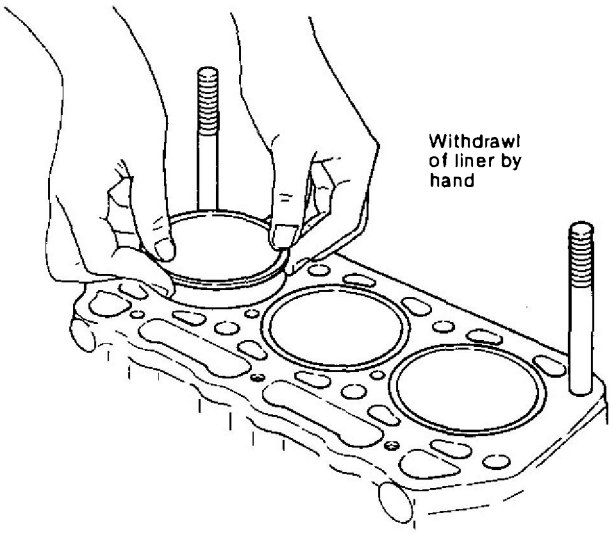
mm (in.)

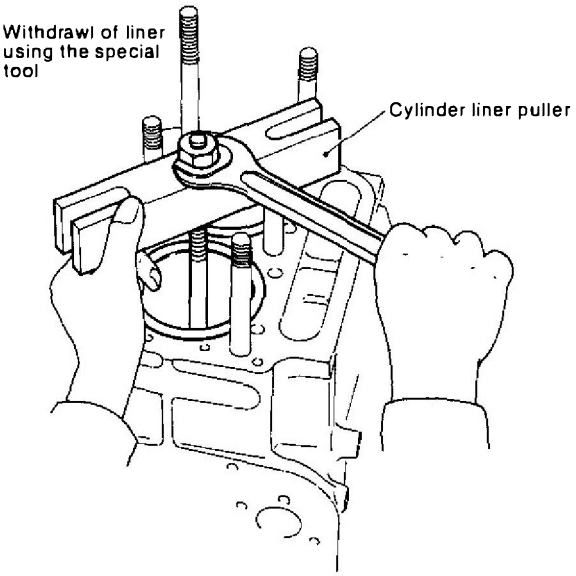
	2GM, 3GM(D)	3HM
Cylinder liner projection	0.005 ~ 0.075 (0.0002 ~ 0.0030)	0.005 ~ 0.075 (0.0002 ~ 0.0030)

2-5 Cylinder liner replacement

2-5.1 Withdrawl of cylinder liner

As the liner used in these engines is especially fitted to the cylinder to ensure constant clearance when assembled, it fits closely to the cylinder while running to enable good heat conduction, and can be easily withdrawn when the engine is cool. However, it may prove difficult to withdraw the liner when there is reduced clearance due to cylinder distortion. In such an event, a special tool must be used to withdraw the liner.





2-5.2 Inserting the cylinder liner

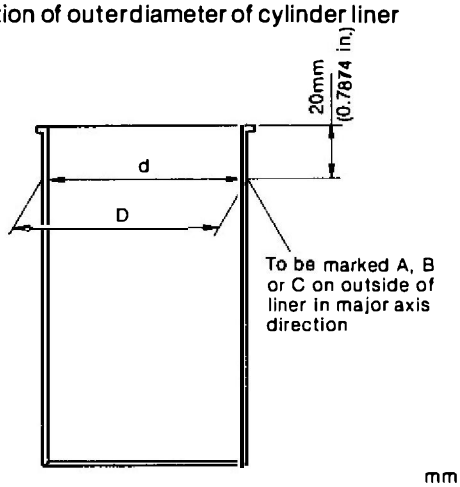
Insert the liner by hand after applying oil to the whole of the outside of the liner.

(Tapping with a wooden hammer or something may distort it.)

2-5.3 Notes on replacing cylinder liner

During assembly at the manufacturing plant, the inner diameter of the cylinder and the outer diameter of the liner are measured and classified into three categories so that they can be matched and fitted. For replacement parts (service part), the liner with dimensions listed in Notation B in the following table is to be used.

(1) Classification of outerdiameter of cylinder liner



mm (in.)

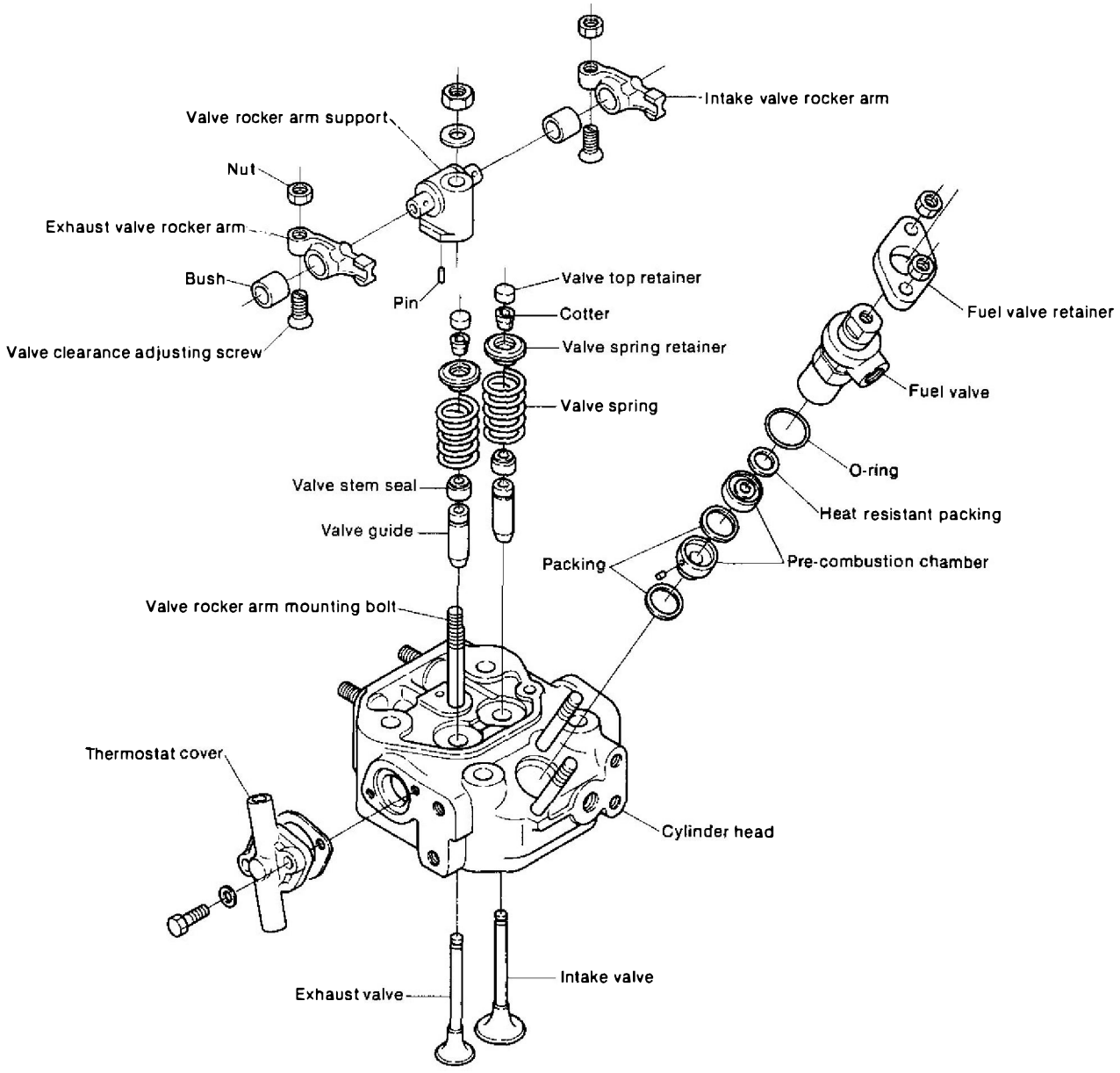
Notation	Dimension D	
	2GM; 3GM(D)	3HM
A	$76^{+0.010}_{0}$ (2.9921 ~ 2.9925)	$79^{+0.010}_{0}$ (3.1102 ~ 3.1106)
B	$76^{0}_{-0.010}$ (2.9917 ~ 2.9921)	$79^{0}_{-0.010}$ (3.1098 ~ 3.1102)
C	$76^{-0.010}_{-0.020}$ (2.9913 ~ 2.9917)	$79^{-0.010}_{-0.020}$ (3.1094 ~ 3.1098)

3. Cylinder Head

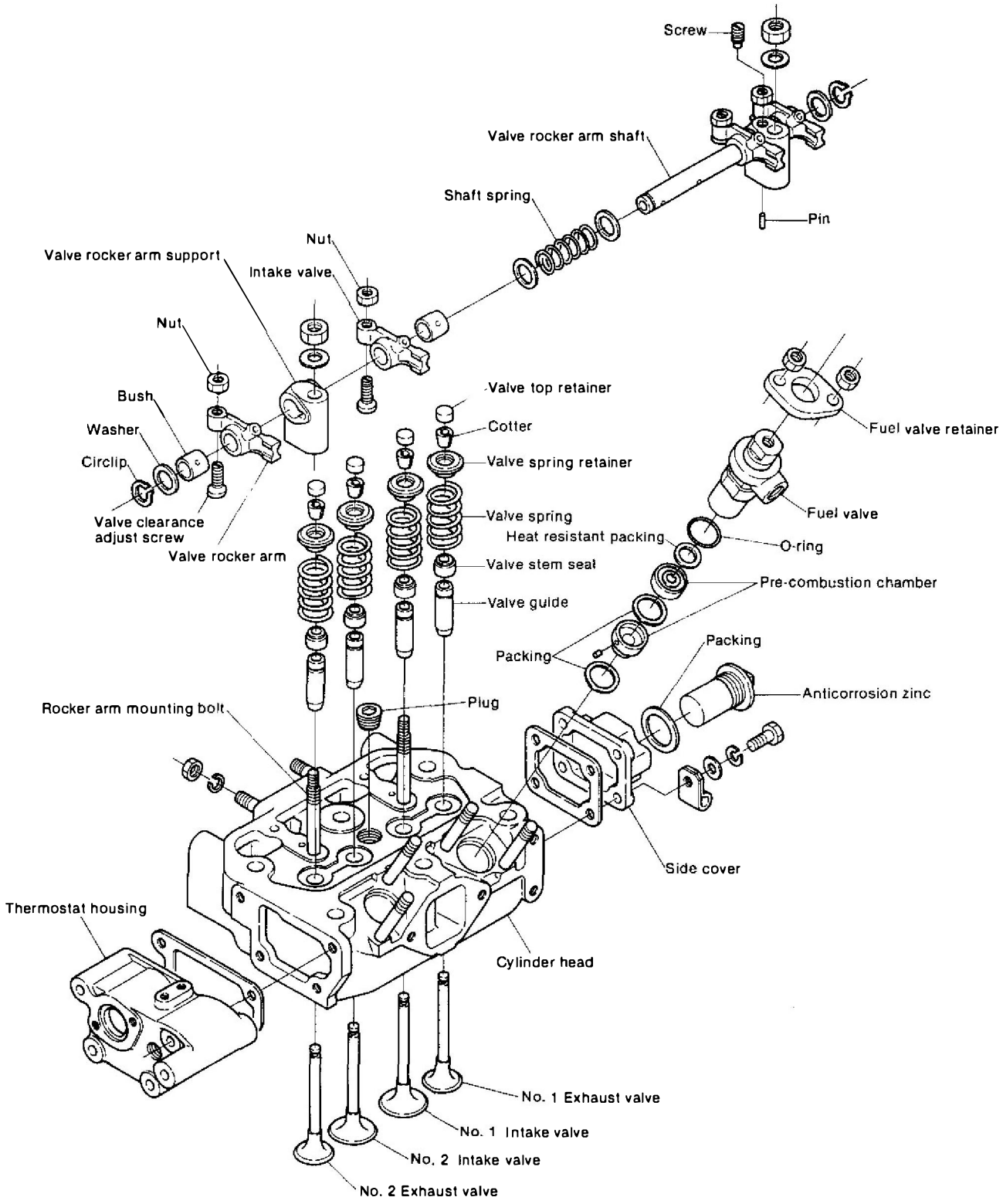
3-1 Construction

The cylinder head is an integral two/three cylinder type which is bolted to the block.
The unique Yanmarswirl type precombustion chambers are at an angle in the cylinder head, and form the combustion chambers, together with the intake and exhaust valves. Large diameter intake valves and smoothly shaped intake and exhaust ports provide high intake efficiency and superior combustion performance.
Special consideration has also been given to the shape of the cooling water passages so that the combustion surface and precombustion chamber are uniformly cooled by an ample water flow.
The thermostat is installed on the side surface of the cylinder at the timing gear case side. (On models 2GM, 3GM(D) and 3HM, it is integrated with the alternator bracket).
In addition, on models 2GM, 3GM(D) and 3HM, the anticorrosion zinc is set on the side surface at the flywheel end, and prevents electrolytic corrosion.

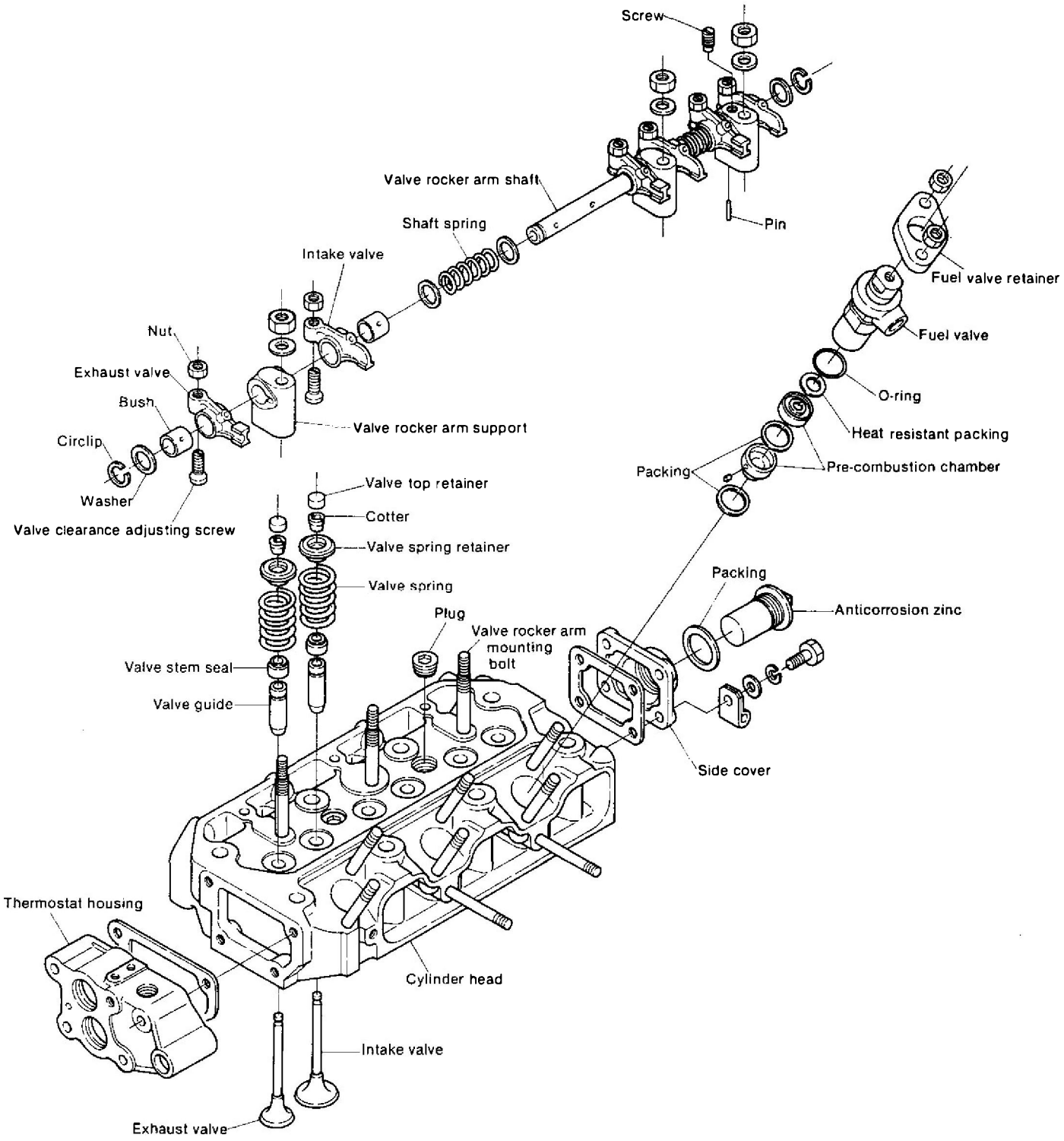
3-1.1 Cylinder head of model 1GM engine



3-1.2 Cylinder head of model 2GM engine



3-1.3 Cylinder head of models 3GM(D) and 3HM



3-2 Cylinder head inspection and measurement

3-2.1 Measurement of carbon build-up at combustion surface and intake and exhaust ports

Visually check for carbon build-up around the combustion surface and the port near the intake and exhaust valve seats, and remove any build-up.
When a large amount of carbon has built up, check the top of the chamber combustion for oil flow at the intake and exhaust valve guides, and take suitable corrective action.

3-2.2 Deposit build-up in water passages

Check for build-up deposit in the water passages, and remove any deposit with a deposit remover. When a large amount of deposit has built up, check each part of the cooling system.

3-2.3 Inspection of corrosion in water passages and anti-corrosion zinc

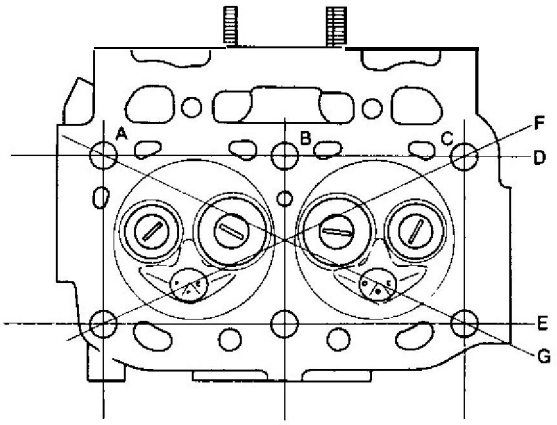
Inspect the state of corrosion of the water passages, and replace the cylinder head when corrosion is severe.
Corrosion pitting limit: 2mm (0.0787in.)
Inspect the anticorrosion zinc on the cylinder head cover, and replace the zinc when it has worn over the wear limit.
Anticorrosion zinc wear limit: Volumetric ratio with new zinc = 1/2

3-2.4 Cracking of combustion surface

The combustion surface is exposed to high temperature, high pressure gas and low temperature air, and is repeatedly flexed during operation. Moreover, it is used under extremely severe conditions, such as the high temperature difference between the combustion surface and cooling water passages.
Inspect the combustion surface for cracking by the color check, and replace the cylinder head if any cracking is detected. At the same time, check for signs of overloading and check the cooling water flow.

3-2.5 Cylinder head distortion

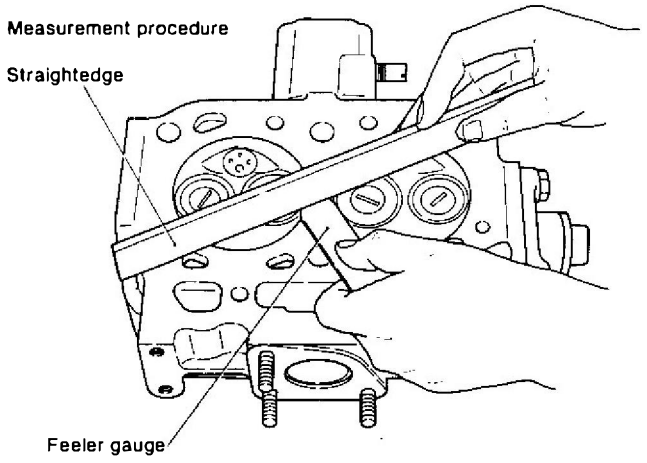
Distortion of the cylinder head causes gasket packing damage, compression leakage, change in compression, etc.
Measure the distortion as described below, and replace the cylinder head when the wear limit is exceeded. Since distortion of the cylinder head is caused by irregular tightening forces, faulty repair of the mounting face, and gasket packing damage, these must also be checked.



Cylinder head distortion mm (in.)

	Wear limit
1GM	0.07 (0.0028)
2GM	0.07 (0.0028)
3GM(D), 3HM	0.07 (0.0028)

(1) Clean the cylinder head tightening surface.
(2) Place a straightedge across two symmetrical points at the four sides of the cylinder head, as shown in the figure.
(3) Insert feeler gauges between the straightedge and the cylinder head combustion face.

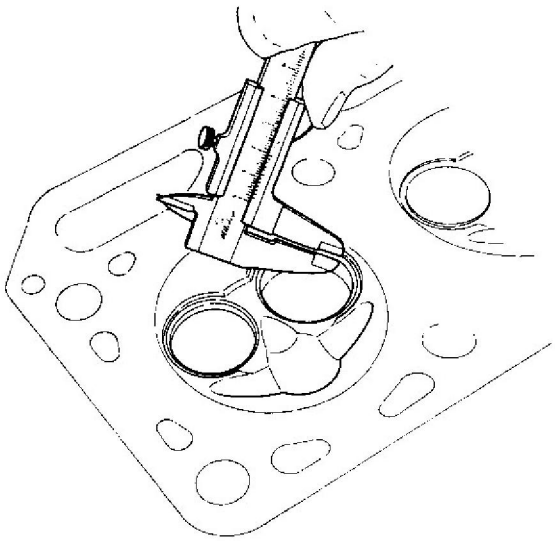


(4) The thickness of the largest feeler gauge that can be inserted is the amount of distortion.

3-2.6 Cylinder head valve seat

The valve seats become wider with use. If the seats become wider than the maintenance standard, carbon built-up at the seats will cause compression leakage. On the other hand, if the seats are too narrow, they will wear quickly and heat transmission efficiency will deteriorate. Clean the carbon and other foreign matter from the valve seats, and check that the seats are not scored or dented.

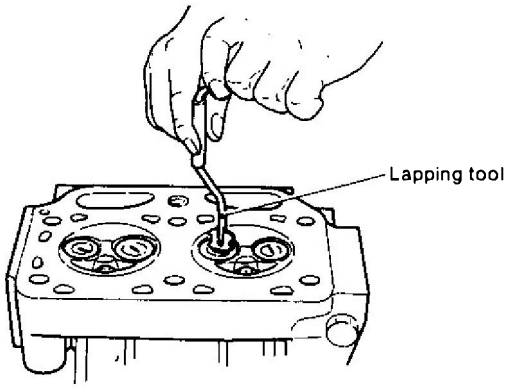
Measure the seat width with vernier calipers, and repair or replace the seat when the wear limit is exceeded.
When the valves have been lapped and/or ground, measure the amount of valve recess, and replace the valve when the wear limit is exceeded.



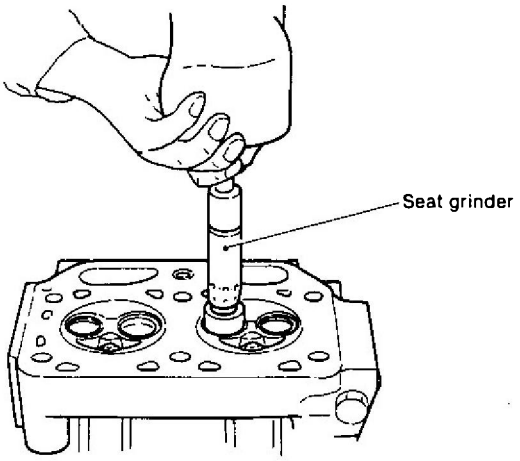
(Common to 4 models) mm (in.)

	Maintenance standard	Wear limit
Seat width	1.77 (0.06969)	—
Seat angle	90°	—

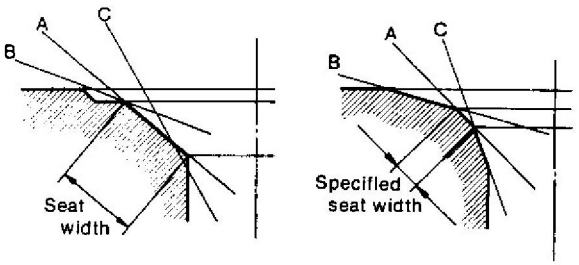
(1) Lapping the valve seat.
When scoring and pitting of the valve seat is slight, coat the seat with valve compound mixed oil, and lap the seat with a lapping tool.
At this time, be sure that the compound does not flow into the valve stem and valve guide.



(2) Correcting valve seat width.
When the valve seat is heavily pitted and when the seat width must be corrected, repair with a seat grinder.
1) Repair pitting of the seat face with a 45° grinder.
2) Since the valve seat is larger than the initial value, correct the seat width to the maintenance standard by grinding the inside face of the seat with a 70° grinder.
3) Grind the outside face of the valve seat with a 15° grinder, and finish the seat width to the standard value.



4) Mix the compound with oil, and lap the valve.
5) Finally, lap with oil.



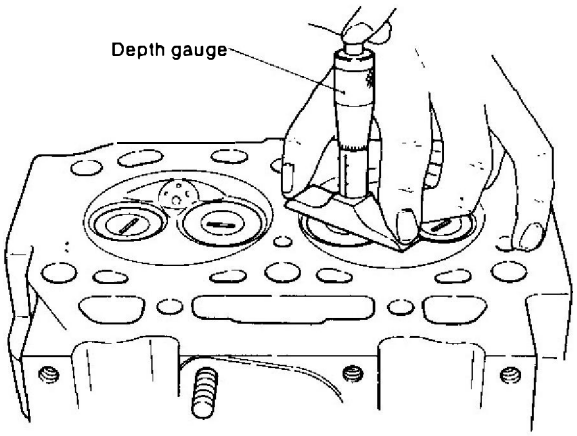
Before correction After correction

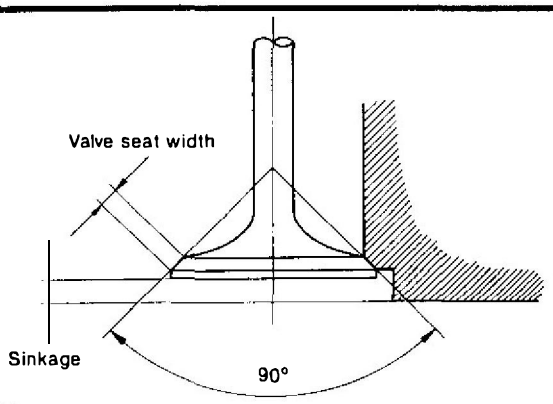
(A) Grind with a 45° grinder
(B) Grind with a 15° grinder
(C) Grind with a 65°~75° grinder

NOTE: When the valve seat has been corrected with a seat grinder, insert an adjusting shim between the valve spring and cylinder head.

3-2.7 Measuring valve sinkage

When the valve has been lapped many times, the valve will be recessed and will adversely affect combustion performance. Therefore, measure the valve sinkage, and replace the valve and cylinder head when the wear limit is exceeded.





mm (in.)

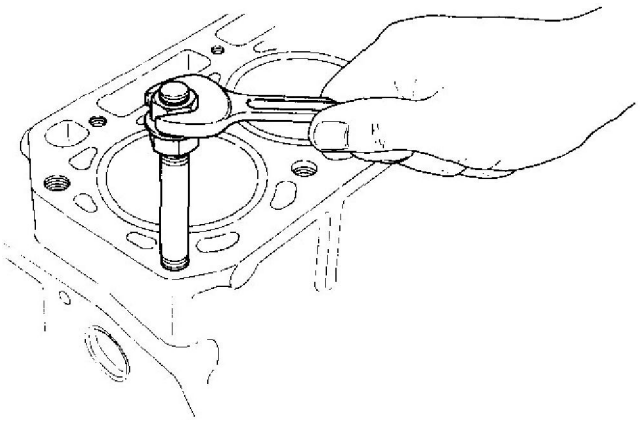
	1GM, 2GM, 3GM(D)		3HM	
	Maintenance standard	Wear limit	Maintenance standard	Wear limit
Valve sinkage	0.95 (0.0374)	1.25 (0.0492)	1.25 (0.0492)	1.55 (0.0610)

3-2.8 Rocker arm support positioning pin (for model 1GM)

Check if the guide pin is damaged or if the hole is clogged, and replace the pin if faulty.

3-3 Dismounting and remounting the cylinder head

When dismounting and remounting the cylinder head, the mounting bolts must be removed and installed gradually and in the prescribed sequence to prevent damaging the gasket packing and to prevent distortion of the cylinder head. Since the tightening torque and tightening sequence of the mounting bolts when remounting the cylinder head are especially important from the standpoint of engine performance, the following items must be strictly observed.



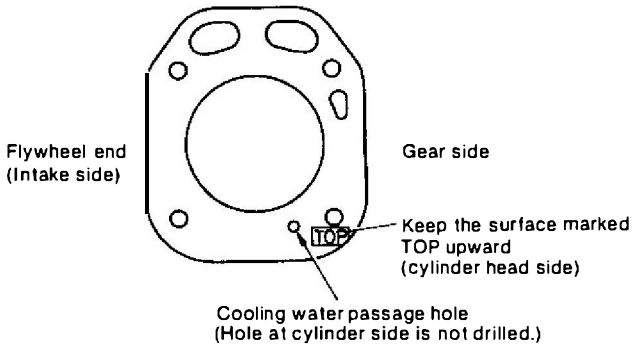
3-3.1 Cylinder head assembly sequence

(1) Check for loose cylinder head stud bolts, and lock any loose bolts with two nuts and then tighten to the prescribed torque.
The cylinder head is fitted to the engine with 4 stud bolts in model 1GM, but in other engine models both stud bolts and auxiliary tap bolts are used.

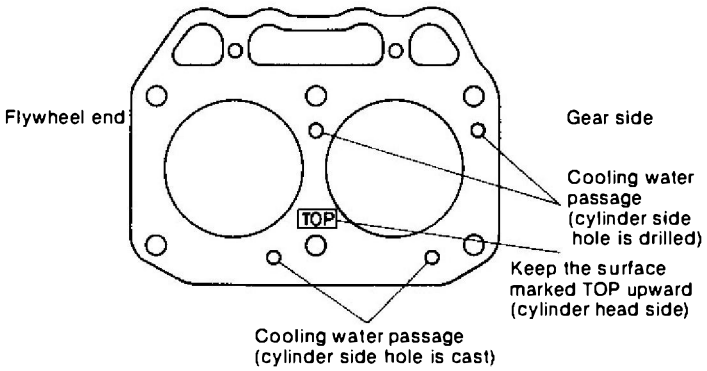
	1GM	2GM, 3GM(D)	3HM
Stud bolt diameter of cylinder head	M10 (0.3937in.)	M12 (0.4724in.)	M12 (0.4724in.)
Cylinder head stud bolt tightening torque	2.5 ~ 3.0 kg-m (18.1 ~ 21.7 ft-lb)	4.0 ~ 4.5 kg-m (28.9 ~ 32.5 ft-lb)	4.0 ~ 4.5 kg-m (28.9 ~ 32.5 ft-lb)

(2) Checking the gasket packing mounting face.
Confirm correct alignment of the front and rear of the gasket packing, and install the packing by coating both sides with Three Bond 50.
Assemble the gasket packing keeping the flat surface upward (cylinder head side). Make sure that the gasket hole aligns with the drilled hole in the cooling water passage in the cylinder block.

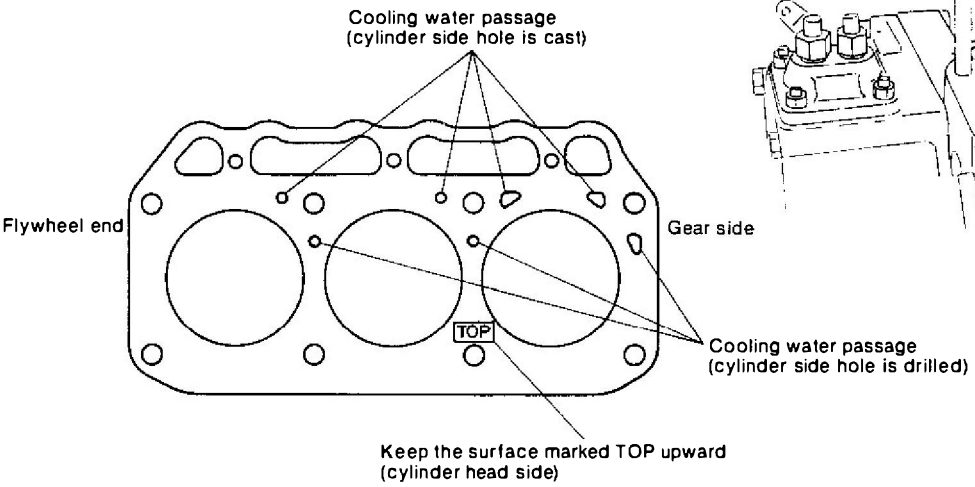
1) For Model 1GM



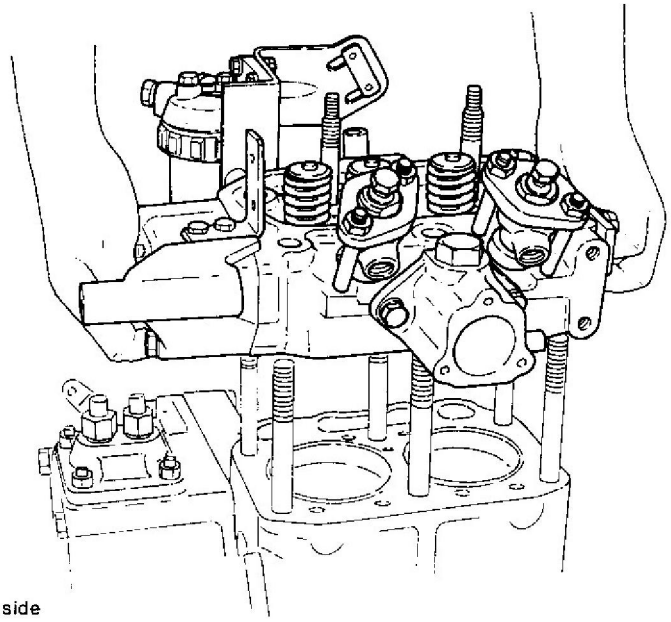
2) For model 2GM



3) For models 3HM and 3GM(D)



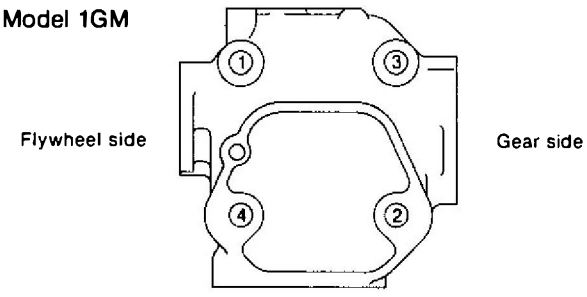
(3) Installing the cylinder head ass'y.
Position the cylinder head ass'y parallel to the top of the cylinder block, and install the ass'y on the block, being careful that the cylinder head ass'y does not touch the threads of the cylinder head bolts.



3-3.2 Tightening the cylinder head bolts and nuts

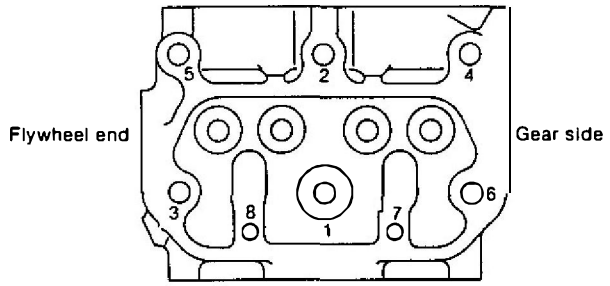
(1) Kinds of cylinder head fixing nuts and bolts, tightening torque, tightening sequence

1) Model 1GM



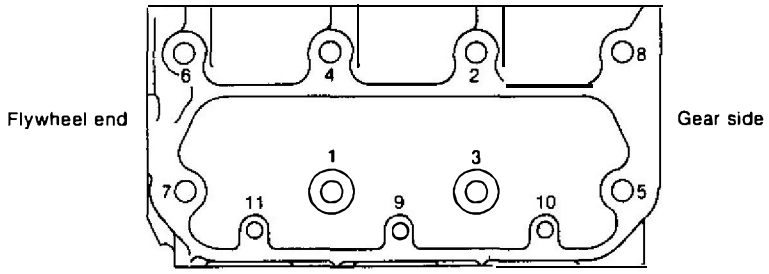
Tightening sequence	Kinds of fixing	Dia.	Torque
1	Stud bolt fixing nut	M10 (0.3937in.)	7.5 kg-m (54.2 ft-lb)
2			
3			
4			

2) Model 2GM



Tightening sequence	Kinds of fixing	Dia.	Tightening Torque
1, 2, 3, 4, 5, 6	Stud bolt fixing nut	M12 (0.4724In.)	10 kg-m (72.3 ft-lb)
7, 8	Auxiliary tap bolt	M8 (0.3150in.)	2.5 kg-m (18.1 ft-lb)

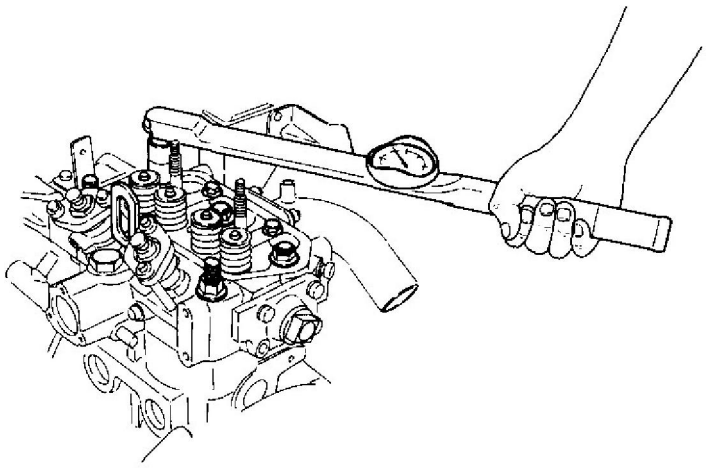
3) Models 3GM(D) and 3HM



Tightening sequence	Kinds of fixing	Dia.	Tightening torque	
			3GM(D)	3HM
1, 2, 3, 4, 5, 6, 7, 8	Stud bolt fixing nut	M12 (0.4724in.)	10 kg-m (72.3 ft-lb)	13 kg-m (94.0 ft-lb)
9, 10, 11	Auxiliary tap bolt	M8 (0.3150in.)	2.5 kg-m (18.1 ft-lb)	3 kg-m (21.7 ft-lb)

(2) Cylinder head nut tightening sequence

1) Coat the threads of the cylinder head bolts with lubricating oil, and screw the cylinder head nuts onto the bolts.



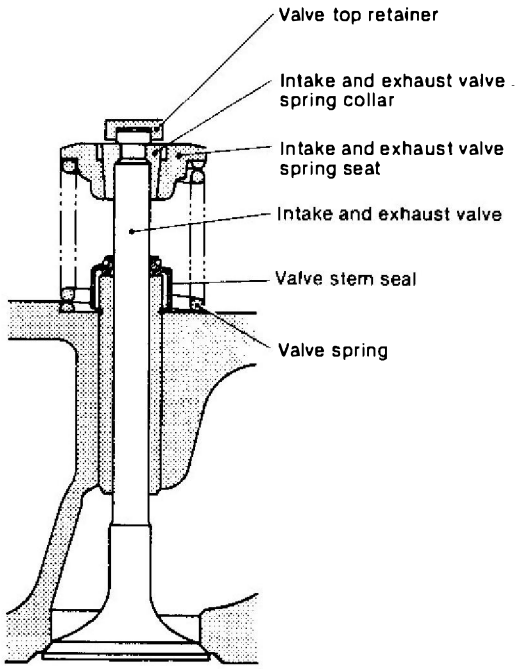
2) First, tighten the nuts sequentially to 1/3 of the prescribed torque.
3) Second, tighten the nuts sequentially to 2/3 of the prescribed torque.
4) Third, tighten the nuts to the prescribed torque.
5) Recheck that all the nuts have been properly tightened.

NOTE: After tightening, valve clearance must be adjusted.

3-3.3 Cylinder head nut loosening sequence

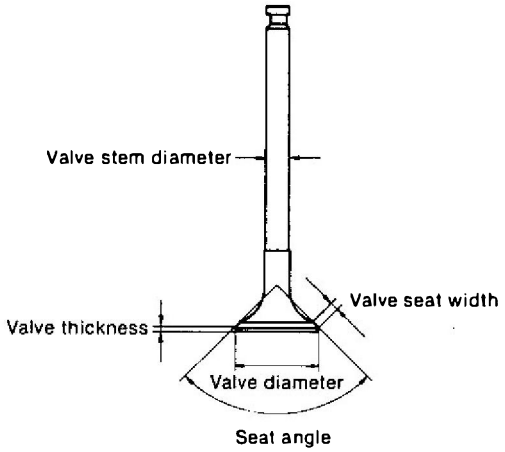
When loosening the cylinder head nuts, reverse the tightening sequence. The cylinder head nut loosening sequence is shown in the figure.

3-4 Intake and exhaust valves, valve guide and valve spring



3-4.1 Inspecting and measuring the intake and exhaust valves

(1) Valve seat wear and contact width.
Inspect valve seats for carbon build-up and heavy wear. Also check if each valve seat contact width is suitable. If the valve seat contact width is narrower than the valve seat width, the seat angle must be checked and corrected.



mm (in.)

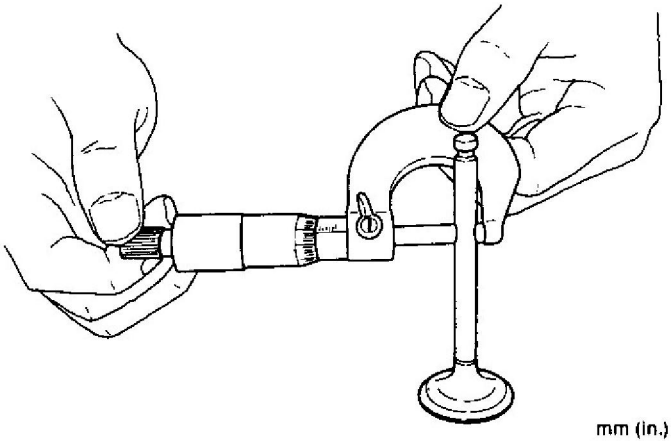
	1GM, 2GM, 3GM(D)	3HM
Intake valve diameter	ø32 (1.2598)	ø32 (1.2598)
Exhaust valve diameter	ø26 (1.0236)	ø27 (1.0630)
Valve seat width	3.15 (0.1240)	3.04 (0.1197)
Valve seat angle	90°	90°

NOTE: Note that the intake valve and exhaust valve have a different diameter.

mm (in.)

	1GM, 2GM, 3GM(D)		3HM	
	Maintenance standard	Wear limit	Maintenance standard	Wear limit
Valve thickness	0.75 ~ 1.15 (0.0295 ~ 0.0453)	—	0.85 ~ 1.15 (0.0335 ~ 0.0453)	—

(2) Valve stem bending and wear.
Check for valve stem wear and strain, and repair when such damage is light. Measure the outside diameter and bend, and replace the valve when the wear limit is exceeded.



mm (in.)

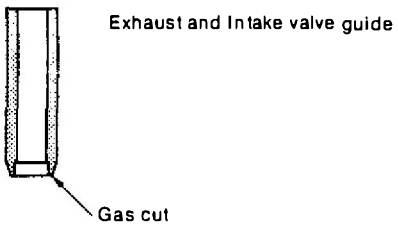
	1GM, 2GM, 3GM(D)		3HM	
	Maintenance standard	Wear limit	Maintenance standard	Wear limit
Valve stem outside diameter	ø7 (0.2756)	ø6.9 (0.2717)	ø7 (0.2756)	ø8.9 (0.2717)
Valve stem bend	—	0.03 (0.0012)	—	0.03 (0.0012)

(3) Valve seat hairline cracks.
Inspect the valve seat by the color check, and replace the seat if cracked.

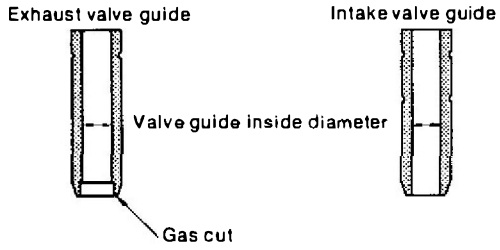
3-4.2 Inspecting and measuring valve guides

The same valve guide is used both for intake and exhaust valves in the modei 1GM engine. It has a gas blow opening cut in the inner face at the bottom.
As for models 2GM, 3GM(D)and 3HM, the valve guide is different for the intake valve and exhaust valve in that the inner face of the exhaust valve guide has a gas blow opening cut.
Be sure that the correct one is used when replacing the guides.

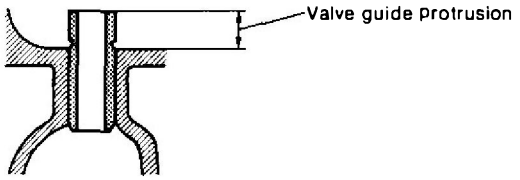
For modei 1GM



For models 2GM, 3GM(D) and 3HM



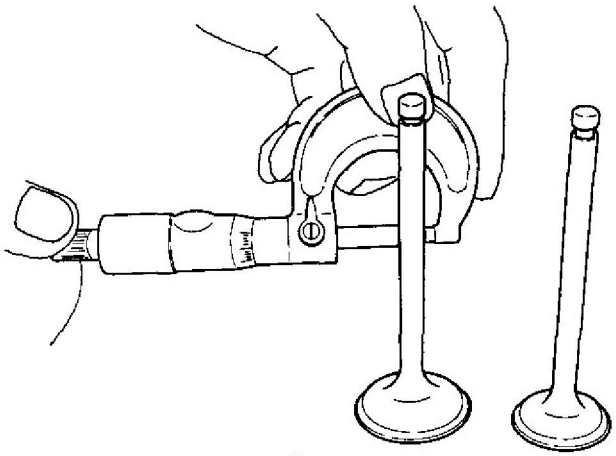
(1) Floating of the intake and exhaust valve guides.
Check for intake and exhaust valve guide looseness and floating with a test hammer, and replace loose or floating guides with guides having an oversize outside diameter.

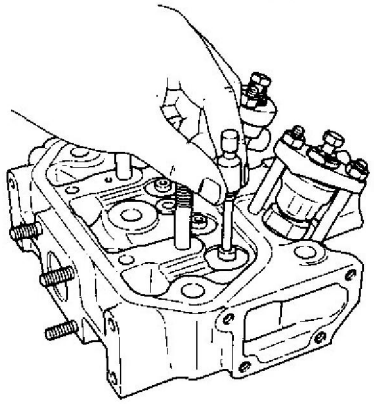


mm (in.)

	1GM, 2GM, 3GM(D), 3HM
Valve guide protrusion	7 (0.2756)

(2) Measuring the valve guide inside diameter.
Measure the valve guide inside diameter and clearance, and replace the guide when wear exceeds the wear limit.



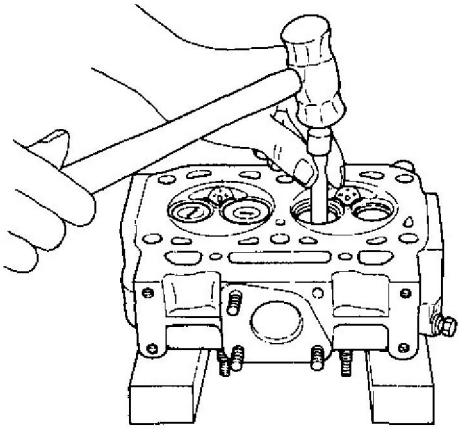


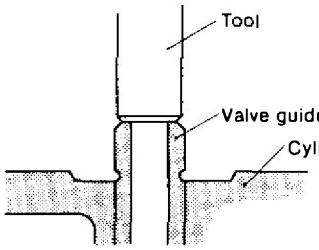
mm (in.)

			Maintenance standard	Clearance at assembly	Maximum allowable clearance	Wear limit
1GM	Intake	Valve guide Inside diameter (after assembly)	ø7 (0.2756)	0.045 ~ 0.070 (0.0018 ~ 0.0028)	0.15 (0.0059)	ø7.08 (0.2787)
		Stem outside diameter	ø7 (0.2756)			ø6.9 (0.2717)
	Exhaust	Valve guide inside diameter (after assembly)	ø7 (0.2756)	0.045 ~ 0.070 (0.0018 ~ 0.0028)	0.15 (0.0059)	ø7.08 (0.2787)
		Stem outside diameter	ø7 (0.2756)			ø6.9 (0.2717)
2GM 3GM(D) 3HM	Intake	Valve guide Inside diameter (after assembly)	ø7 (0.2756)	0.040 ~ 0.065 (0.0016 ~ 0.0026)	0.15 (0.0059)	ø7.08 (0.2787)
		Stem outside diameter	ø7 (0.2756)			ø6.9 (0.2717)
	Exhaust	Valve guide inside diameter (after assembly)	ø7 (0.2756)	0.045 ~ 0.070 (0.0018 ~ 0.0028)	0.15 (0.0059)	ø7.08 (0.2787)
		Stem outside diameter	ø7 (0.2756)			ø6.9 (0.2717)

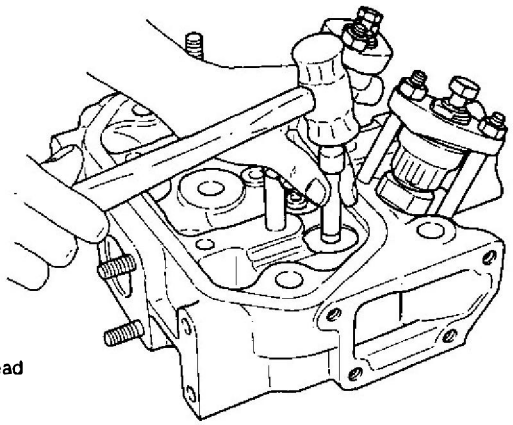
(3) Replacing the intake/exhaust valve guide

1) Using a special tool for extracting and inserting the valve guide, extract the valve guide.





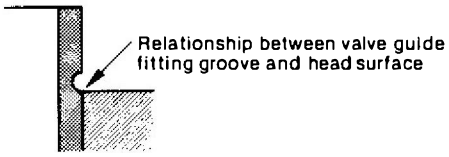
2) Using the above tool, drive the valve guide into position by starting from the valve spring side and finish the inside diameter with a reamer.



mm (in.)

	1GM	2GM, 3GM(D)	3HM
Amount of interference of valve guide	0.005 ~ 0.034 (0.0002 ~ 0.0013)	0.018 ~ 0.047 (0.0007 ~ 0.0019)	0.018 ~ 0.047 (0.0007 ~ 0.0019)

Fit the intake and exhaust valve guides until the bottom of the groove around the outside of the valve guide is flush with the end of the cylinder head.
As the valve guide for model 1GM does not have a groove, fit it after checking its dimension and marking it.



3-4.3 Valve spring

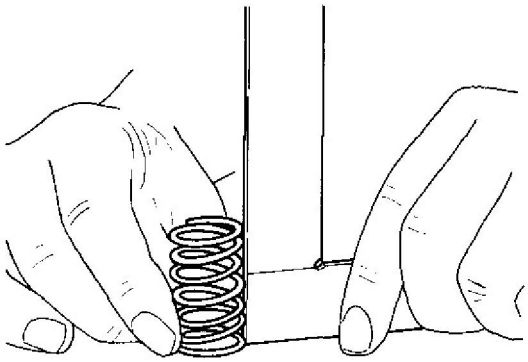
(1) Valve spring inclination.

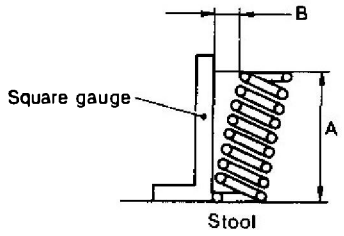
Since inclination of the valve spring is a direct cause of eccentric contact of the valve stem, always check it at disassembly.

Stand the valve upright on a stool, and check if the entire spring contacts the gauge when a square gauge is placed against the outside diameter of the valve spring.

If there is a gap between the gauge and spring, measure the gap with a feeler gauge.

When the valve spring inclination exceeds the wear limit, replace the spring.





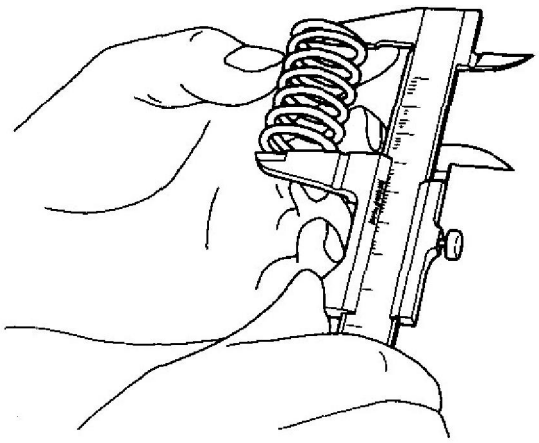
mm (in.)

	Maintenance standard
Valve spring free length (A)	38.5 (1.5157)

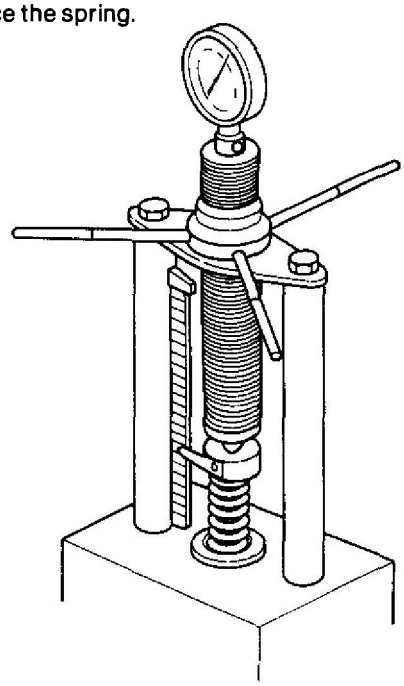
Allowable tilt value (B/A) is less than 0.035

(2) Valve spring free length.

Measure the free length of the valve spring, and replace the spring when the wear limit Is exceeded.

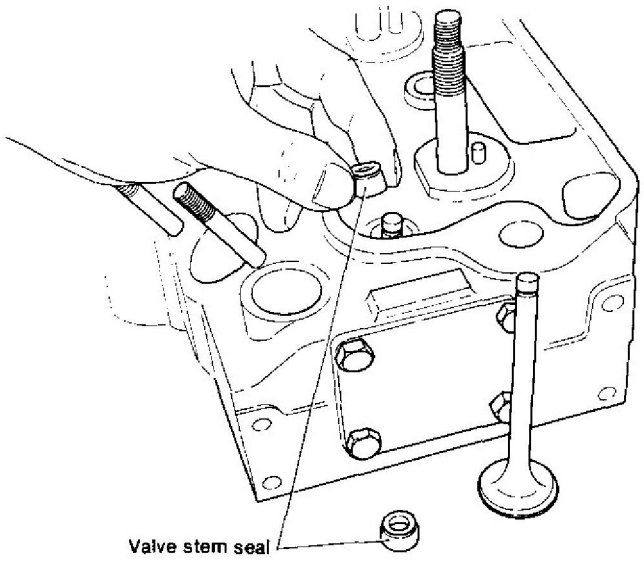


Also, measure the tension of the spring with a spring tester. If the tension is below the prescribed limit, replace the spring.

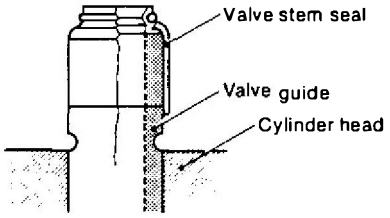


	1GM, 2GM, 3GM(D)		3HM	
	Maintenance standard	Wear limit	Maintenance standard	Wear limit
Valve spring free length	38.5mm (1.5157in.)	37mm (1.4567in.)	38.5mm (1.5157in.)	37mm (1.4567in.)
Length when attached	29.2mm (1.1496in.)	—	30.2mm (1.1890in.)	—
Load applied attached	16.16kg (35.63lb)	13.7kg (30.20lb)	14.43kg (31.81lb)	12.2kg (26.90lb)

3-4.4 Valve stem seal

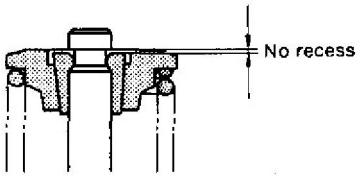


A valve stem seal is assembled at the top of the valve guide and the valve stem chamber oil is sucked into the combustion chamber through the valve guide (oil down) to prevent an increase in oil consumption.
The valve stem seal must always be replaced whenever it has been removed.
When assembling, coat the valve stem with engine oil before inserting.



3-4.5 Spring retainer and spring cotter pin

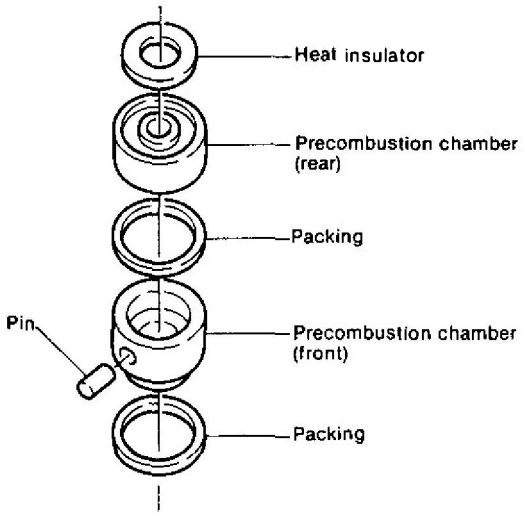
Inspect the inside face of the spring retainer and the outside surface of the spring cotter pin, and the contact area of the spring cotter pin inside surface and the notch in the head of the valve stem. Replace the spring retainer and spring cotter pin when the contact area is less than 70% or when the spring cotter pin has been recessed because of wear.



3-5 Precombustion chamber and top clearance

3-5.1 Precombustion chamber

Remove the packing and insulation packing at the precombustion chamber's front and rear chambers, and inspect.
Check for burning at the front end of the precombustion chamber front chamber, acid corrosion at the precombustion chamber rear chamber, and for burned packing.
Replace if faulty.

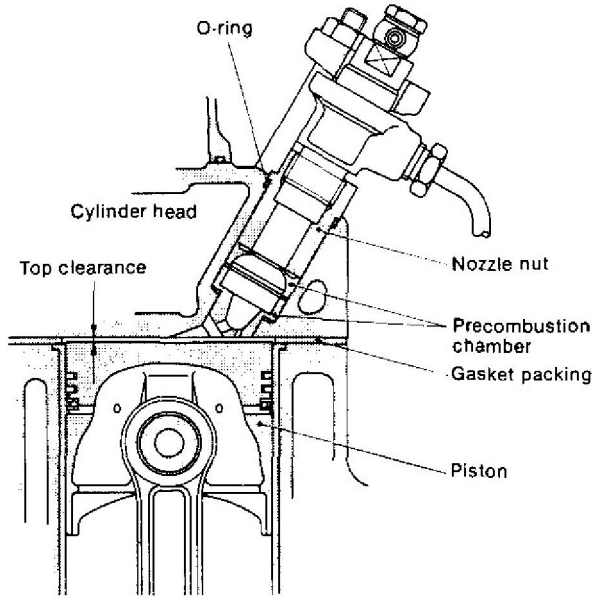


3-5.2 Insulation packing

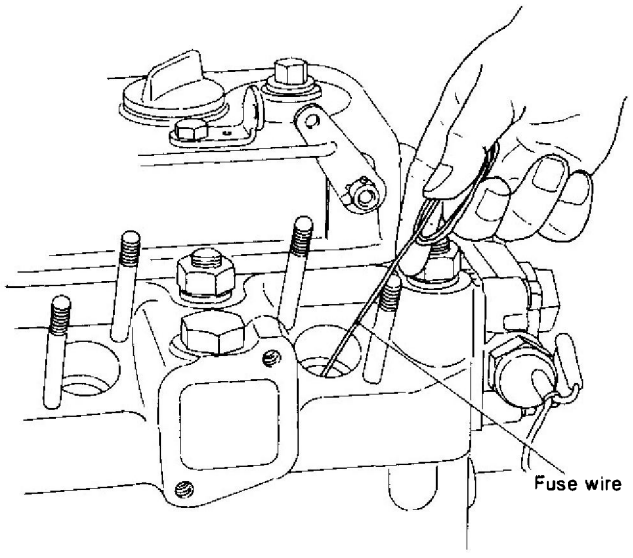
The insulation packing prevents transmission of heat from the precombustion chamber to the nozzle valve and serves to improve the nozzle's durability.
Always put in new insulation packing when it has been disassembled.

3-5.3 Top clearance

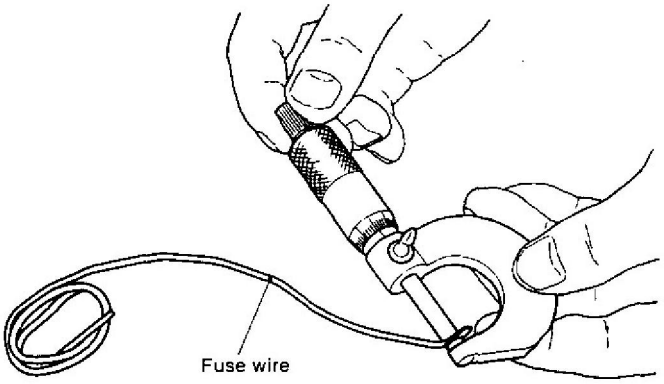
Top clearance is the size of the gap between the cylinder head combustion surface and the top of the piston at top dead center.
Since top clearance has considerable effect on the combustion performance and the starting characteristic of the engine, it must be checked periodically.



(1) Top clearance measurement
1) Check the cylinder head mounting bolts and tightening torque.
2) Remove the fuel injection valve and precombustion chamber.



3) Lower the piston at the side to be measured.
4) Insert quality fuse wire (ø1.2mm, 0.472in.) through the nozzle holder hole. (Be careful that the wire does not enter the intake and exhaust valve and the groove in the combustion surface.)
5) Crush the fuse wire by moving the piston to top dead center by slowly cranking the engine by hand.
6) Lower the piston by hand cranking the engine and remove the crushed fuse wire, being careful not to drop it.
7) Measure the thickness of the crushed part of the fuse wire with vernier calipers or a micrometer.



(2) Top clearance value.

mm (in.)

	1GM, 2GM, 3GM(D)	3HM
Top clearance	0.7 (0.0276)	0.8 (0.0315)

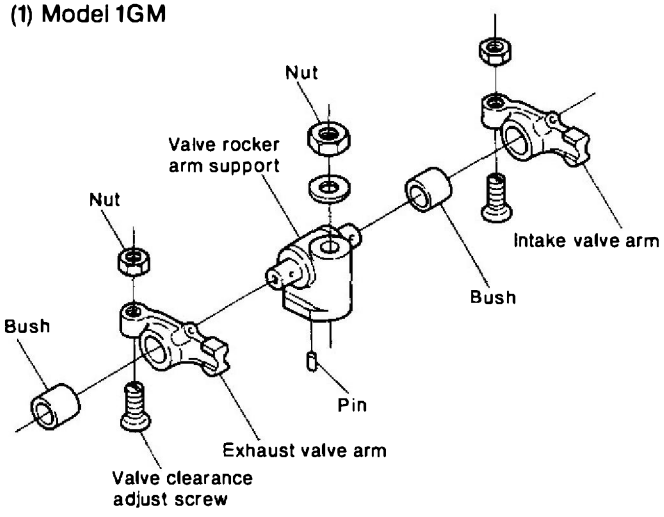
When the top clearance value is not within the above range, check for damaged gasket packing, distortion of the cylinder head combustion surface, or other abnormal conditions.

3-6 Intake and exhaust valve rocker arm

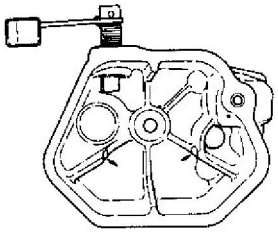
Since the intake and exhaust valve rocker arm shaft and bushing clearance and valve head and push rod contact wear are directly related to the valve timing, and have an effect on engine performance, they must be carefully serviced.

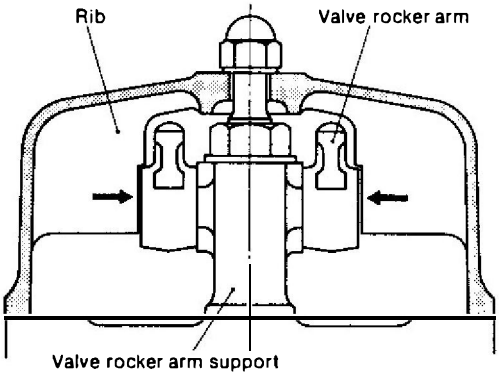
3-6.1 Components of valve rocker arm

(1) Model 1GM



The same part is used for both intake valve rocker arm and exhaust valve rocker arm. The bush is not fitted to the valve rocker arm.
In has a simple construction as the valve rocker arms are fitted to the valve rocker arm support from both sides without using the retainer. In the place of a retainer, the rib of the bonnet cover prevents the rocker arms from coming out.

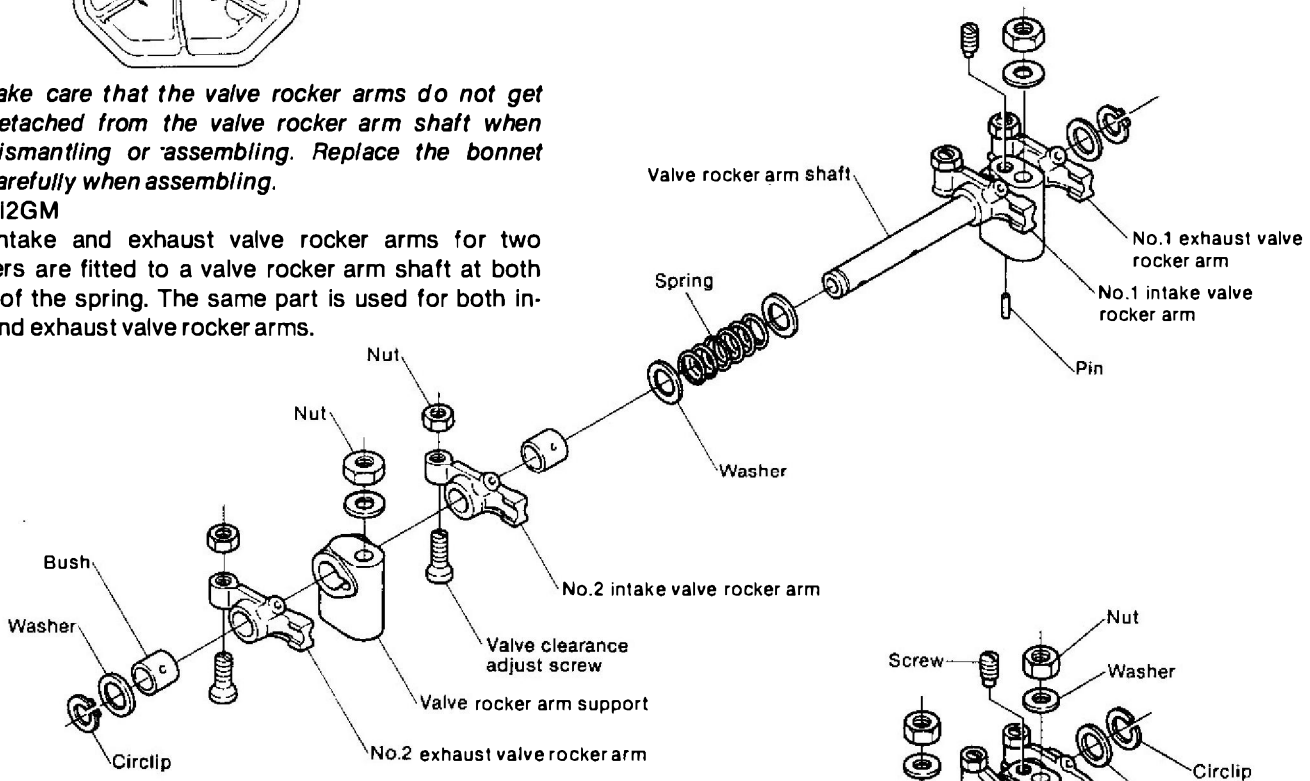




NOTE: Take care that the valve rocker arms do not get detached from the valve rocker arm shaft when dismantling or assembling. Replace the bonnet carefully when assembling.

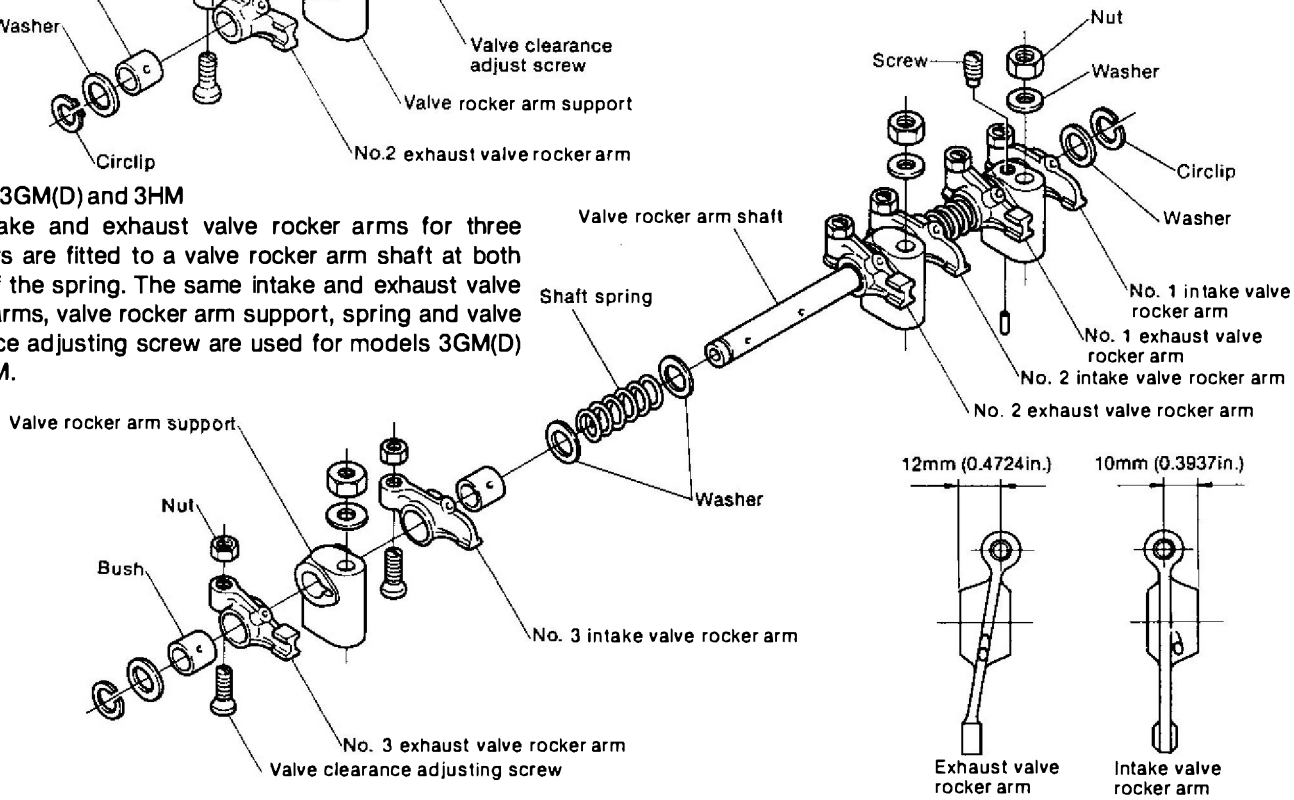
(2) Model2GM

The intake and exhaust valve rocker arms for two cyinders are fitted to a valve rocker arm shaft at both sides of the spring. The same part is used for both intake and exhaust valve rocker arms.



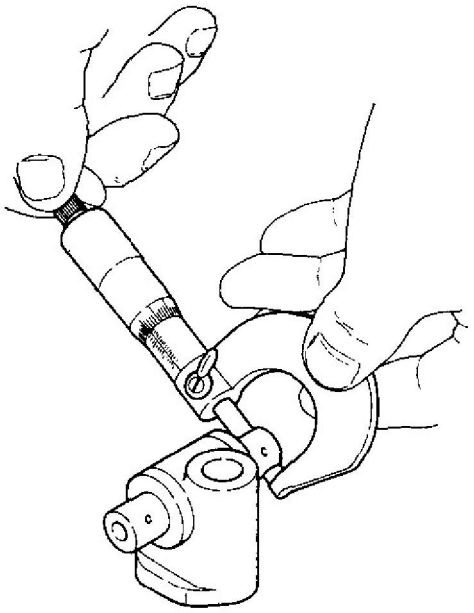
(3) Models 3GM(D) and 3HM

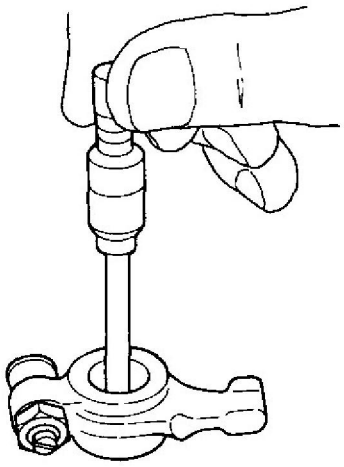
The intake and exhaust valve rocker arms for three cylinders are fitted to a valve rocker arm shaft at both sides of the spring. The same intake and exhaust valve rocker arms, valve rocker arm support, spring and valve clearance adjusting screw are used for models 3GM(D) and3HM.

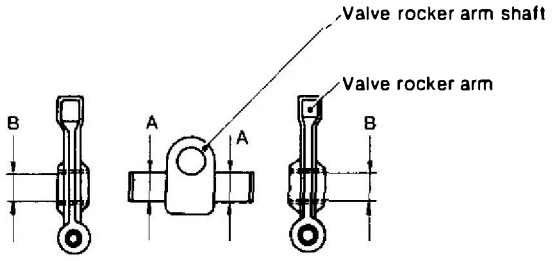


3-6.2 Measuring the valve rocker arm shaft and bushing clearance

Measure the outside diameter of the valve rocker arm shaft and the inside diameter of the bushing, and replace the rocker arm or bushing if the measured value exceeds the wear limit.
Replace a loose valve rocker arm shaft bushing with a new bushing. However, when there is no tightening allowance, replace the valve rocker arm.







mm (in.)

			Maintenance standard	Clearance at assembly	Maximum allowable clearance	Wear limit
1GM	Intake and exhaust valve rocker arm shaft outside diameter	A	ø12 (0.4724)	0.016 ~ 0.052 (0.0006 ~ 0.0020)	0.15 (0.0059)	ø11.9 (0.4685)
	Intake and exhaust valve rocker arm bushing inside diameter (assembled)	B	ø12 (0.4724)			ø12.1 (0.4764)
2GM	Intake and exhaust valve rocker arm shaft outside diameter	A	ø14 (0.5512)	0.016 ~ 0.052 (0.0006 ~ 0.0020)	0.15 (0.0059)	ø13.9 (0.5472)
	Intake and exhaust valve rocker arm bushing inside diameter (assembled)	B	ø14 (0.5512)			ø14.1 (0.5551)
3GM(D) 3HM	Intake and exhaust valve rocker arm shaft outside diameter	A	ø14 (0.5512)	0.016 ~ 0.052 (0.0006 ~ 0.0020)	0.15 (0.0059)	ø13.9 (0.5472)
	Intake and exhaust valve rocker arm bushing inside diameter (assembled)	B	ø14 (0.5512)			ø14.1 (0.5551)

3-6.3 Valve rocker arm and valve top retainer contact and wear

Check the valve rocker arm and valve top retainer contact, and replace when there is any abnormal wear or peeling.

3-6.4 Valve clearance adjusting screw

Inspect the valve clearance adjusting screw and push rod contact, and replace when there is any abnormal wear or peeling.

3-6.5 Classification of the intake and exhaust valve rocker arms

Since the intake and exhaust valve rocker arms have different shapes, care must be exercised in service and assembly.

3-7 Adjusting intake and exhaust valve head clearance

Adjustment of the intake and exhaust valve head clearance governs the performance of the engine, and must be performed accurately. The intake and exhaust valve head clearance must always be checked and readjusted, as required, when the engine is disassembled and reassembled, and after every 300 hours of operation. Adjust the valve head clearance as described below.

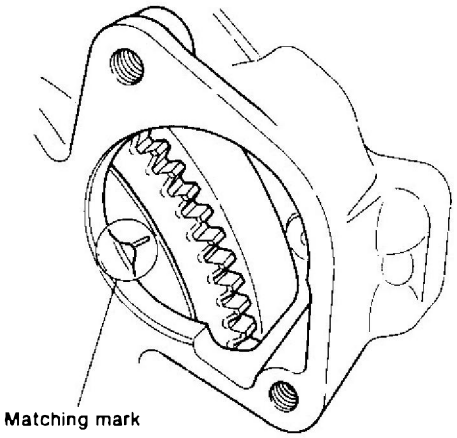
3-7.1 Adjustment

Make this adjustment when the engine is cold.

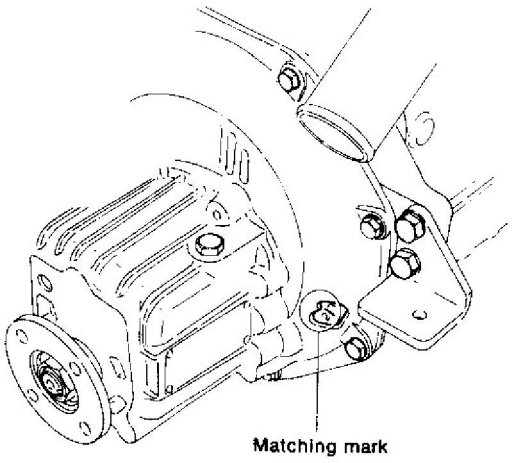
(1) Remove the valve rocker arm cover.

(2) Crank the engine and set the piston to top dead center (TDC) on the compression stroke.

The matching mark is made at the setting hole of the starter motor on all models.

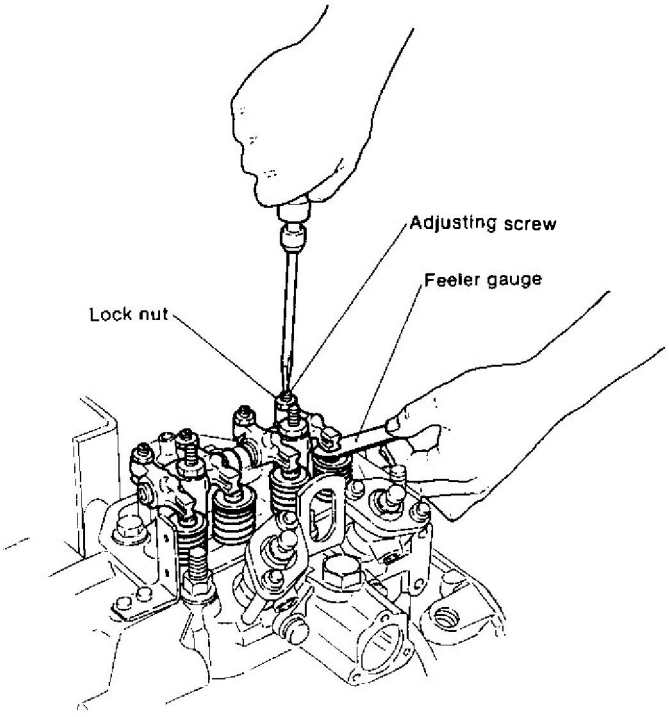


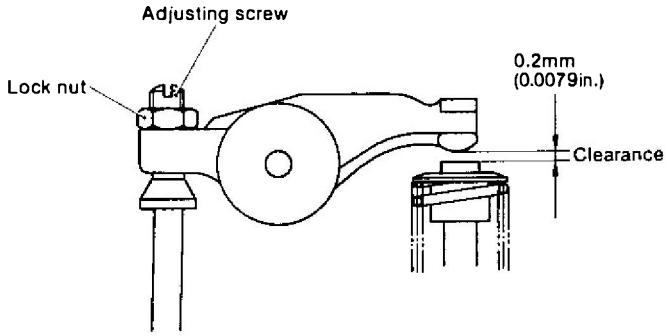
With respect to models 1GM, 2GM and 3GMD only, a projection which serves as the matching mark is provided in the cast hole of the clutch housing.



NOTE: Set to the position at which the valve rocker arm shaft does not move even when the crankshaft is turned to the left and right, centered around the matching mark.

(3) Check and adjust the intake and exhaust valve head clearances of the No. 1 piston.
Loosen the valve clearance adjusting screw lock nut, adjust the clearance to the maintenance standard with a feeler gauge, and retighten the lock nut.





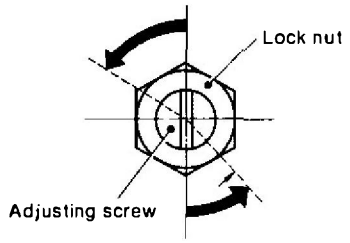
	1GM, 2GM, 3GM(D), 3HM
Intake and exhaust valve head clearance:	0.2mm (0.0079in.)

In the case of 2GM, adjust the valve head clearance of the No. 2 cylinder in the same manner after turning the crankshaft 180°.
In the case of 3GM(D), 3HM, adjust the valve head clearance on the No. 3 cylinder in the same manner after turning the crankshaft 240° and then adjust the No. 2 cylinder after turning the crankshaft another 240°.

NOTE: If you adjust the valve head clearance of the No. 2 cylinder first, turn the crankshaft 540°. Adjust the clearance of the No. 1 cylinder in the same manner on a 2 cylinder engine.

3-7.2 Adjusting without a feeler gauge

Set the head clearance to zero by tightening the adjusting screw, being careful not to tighten the screw too tight.
Then adjust the valve clearance to the maintenance standard by backing off the adjusting screw by the angle given below.



mm (in.)

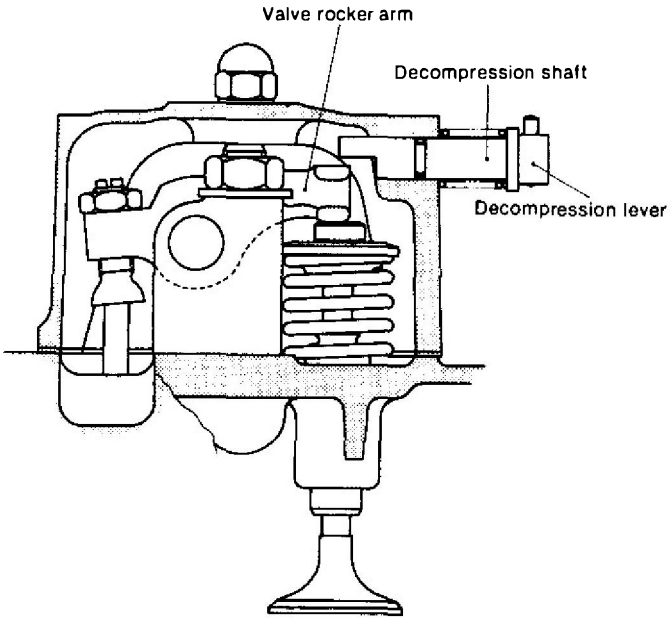
Valve clearance adjusting screw	M8 × 1.25 (0.3149 × 0.0492)
Adjusting screw backoff angle	Approx 58°

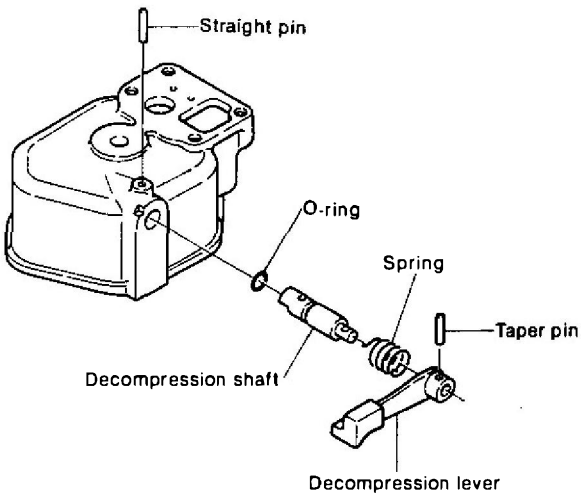
NOTE: Calculating the backoff angle.
calculate the 0.2mm advance angle from 1.25mm advance at one turn = 360°
0.2/1.25×360° = 58°
One side (60°) of the hexagonal nut should be used to measure.

3-8 Decompression mechanism

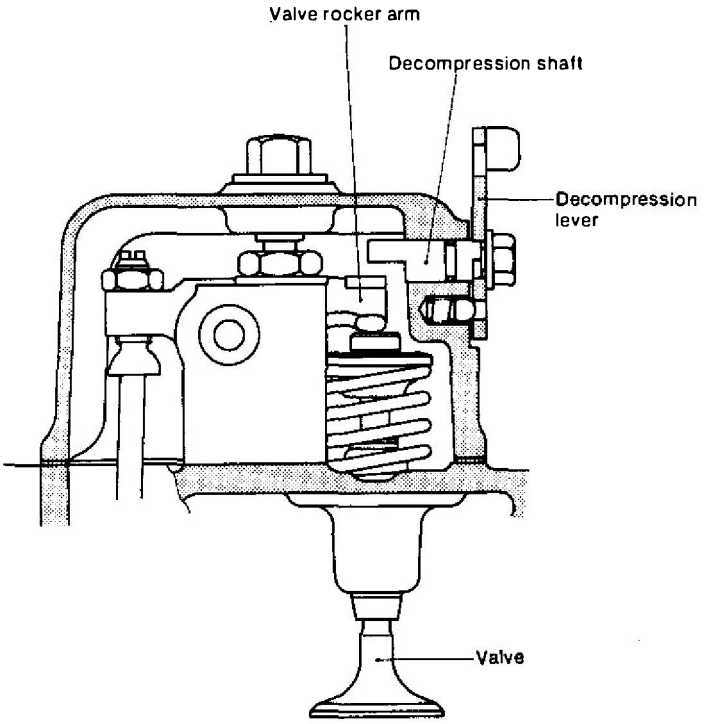
The decompression mechanism is used when the starter motor fails to rotate sufficiently because the battery is weak, and to facilitate starting in cold weather.
When the decompression lever is operated, the valve is pushed down, the engine is decompressed, the engine turns over easily and the flywheel inertia increases, thus making starting easy.

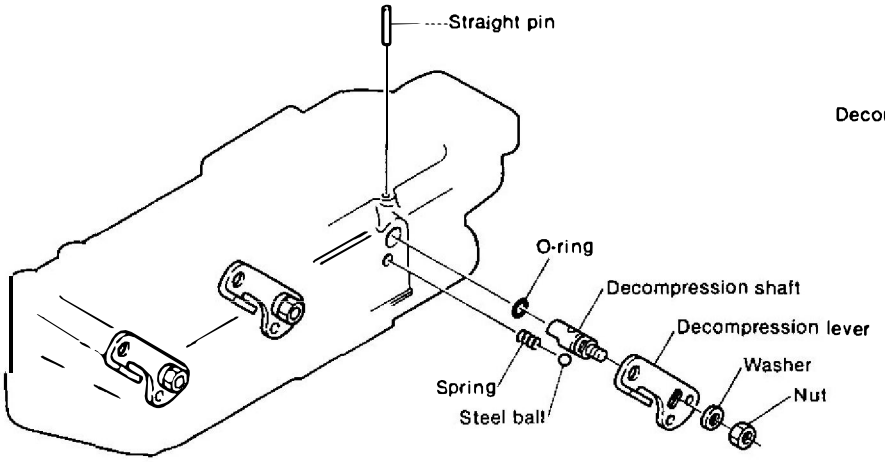
3-8.1 Model 1GM

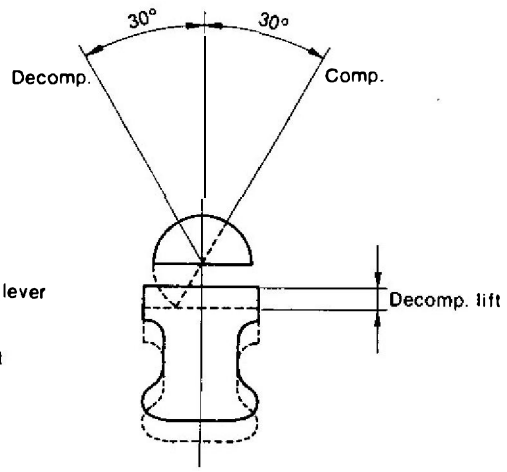




3-8.2 Models 2GM, 3GM(D) and 3HM







With this engine, there is no need to adjust the decompression lift.

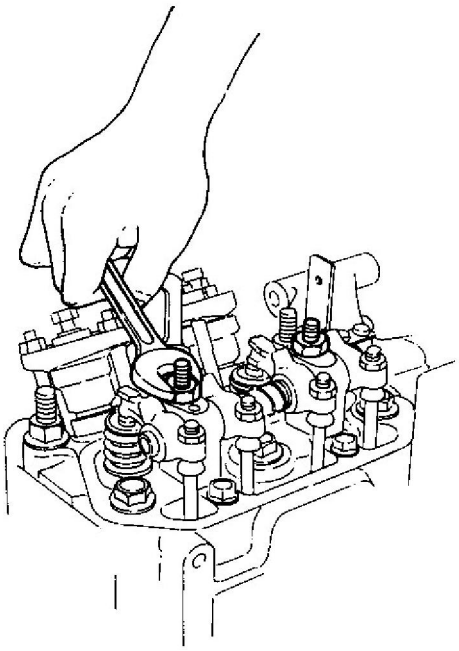
3-9 Disassembling and reassembling the cylinder head

3-9.1 Disassembling the cylinder head

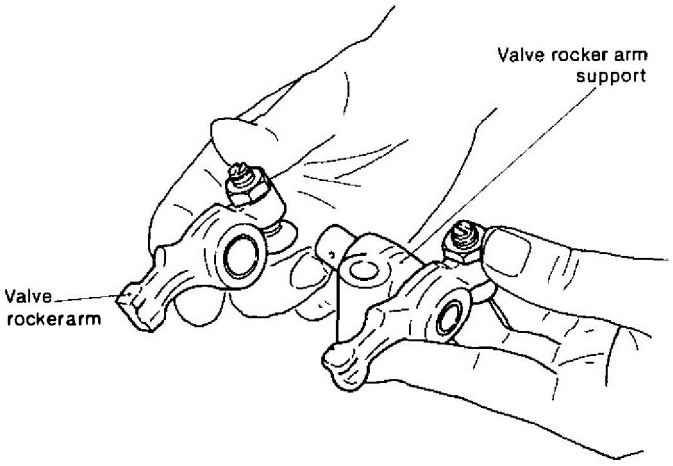
When disassembling the cylinder head, group the parts separately according to cylinder, intake or exhaust to avoid confusion.

(1) Disassembling the rocker arm ass'y

1) Remove the rocker arm ass'y mounting nuts.
2) Remove the rocker arm ass'y.

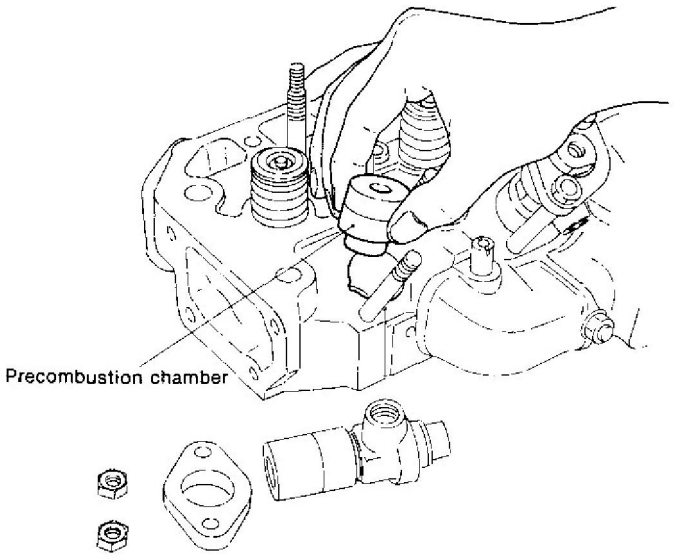


3) Remove the rocker arm retainer, and pull the rocker arm from the rocker arm support.

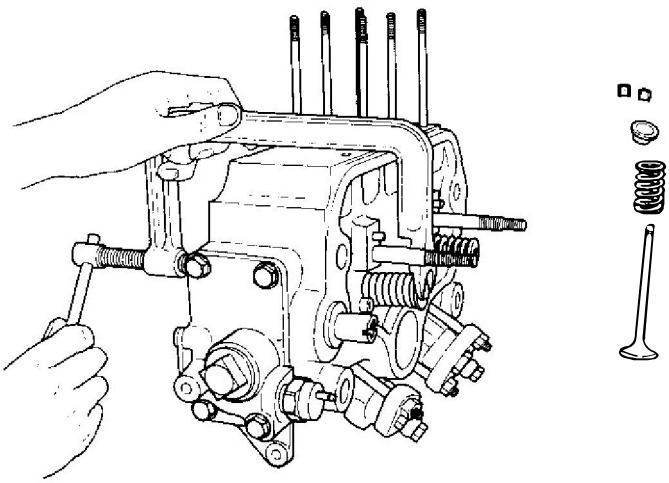


NOTE: A retainer is not used for the valve rocker arm on model 1GM and is kept free, therefore the rocker arm can be removed directly.

(2) Removing the precombustion chamber
1) Remove the rear precombustion chamber and packing.
2) Remove the front precombustion chamber and packing.



(3) Removing the intake and exhaust valve ass'y



1) Set the special tool at the intake and exhaust valve ass'y and depress the valve spring by turning the lever.
2) When the special tool is not available, depress the valve spring with a wrench.
3) Remove the spring cotter pin.
4) Turn the lever of the special tool in the loosening direction, release the valve spring retainer, and remove the valve spring retainer and valve spring.
5) Pull the valve from the cylinder head.
6) Remove the valve stem seal.
7) Remove the valve guide.

3-9.2 Reassembling the cylinder head

Before reassembling the cylinder head, wash all the parts, inspect and measure the dimensions of each part, and repair or replace any parts that are abnormal. Be careful not to confuse the parts grouped by cylinder number and intake or exhaust.

(1) Assembling the Intake and exhaust valves
1) Press the valve guide into the cylinder head.
2) Install the valve stem seal. (Always replace the valve stem seal with a new seal.)
3) Install the valve in the cylinder head.
4) Install the valve spring and valve spring seat.
5) Install the split collar.
- Using the special tool
- Using a wrench

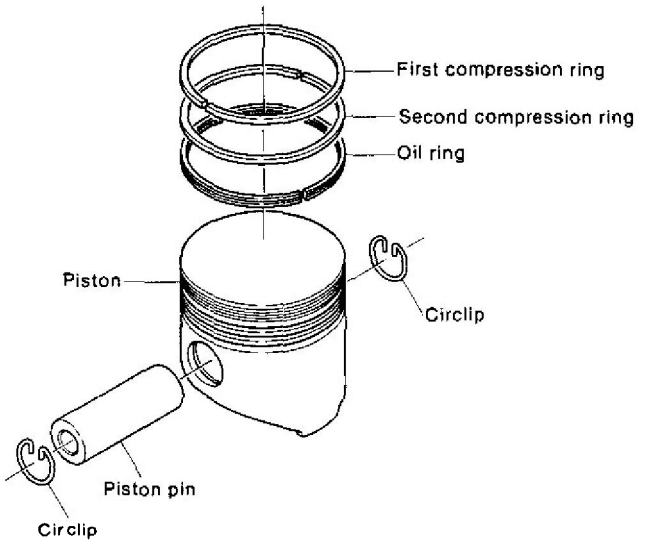
(2) Installing the valve arm ass'y
1) Install the intake and exhaust rocker arms on the rocker arm support.
2) Install both the rocker arm supports and rocker arm retainers on the cylinder head, then tighten them with nuts.

(3) Installing the precombustion chamber
1) Install the front precombustion chamber and packing.
2) Install the rear precombustion chamber and packing. (Always replace the insulation packing.)

4. Piston

4-1 Piston assembly construction

The pistons are made of LO-EX (AC8A-T6) for lightness and are designed for reduced vibration. The outside of the piston is machined to a special oval shape. During operation, thermal expansion is small, the optimum clearance between the piston and cylinder liner is maintained, and a stable supply of lubricating oil is assured.

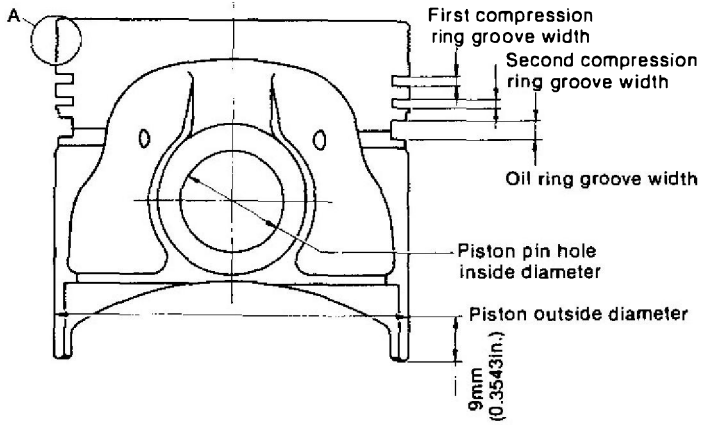


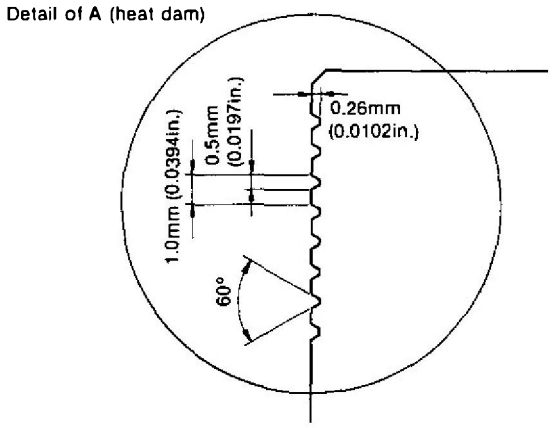
A complete set of piston rings consists of two compression rings and one oil ring.
To improve the rigidity of the piston skirt no ring is installed on the skirt itself so that the piston seldom becomes deformed and retains stable contact.
The piston pin is of the floating type. Both its ends are fastened with circlips.
Grooves called a heat dam are cut round the top section of the piston. These grooves help to dissipate heat and prevent scuffing.

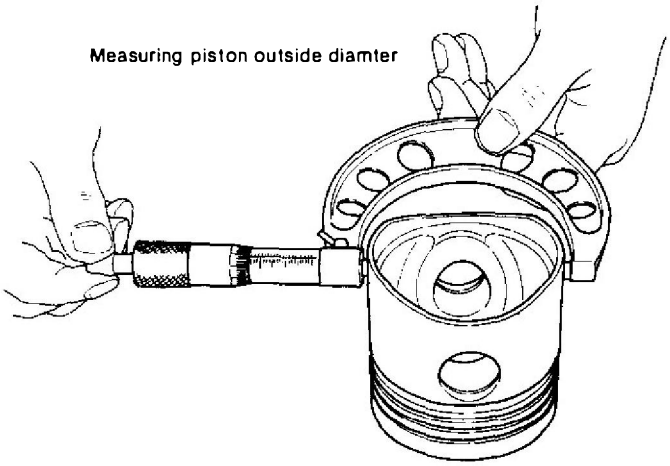
4-2 Piston

4-2.1 Inspection

(1) Measuring important dimensions
Measure each important dimension, and replace the piston when the wear limit is exceeded.







(2) Measure the clearance between the piston ring or oil ring and the ring groove with a thickness gauge.