

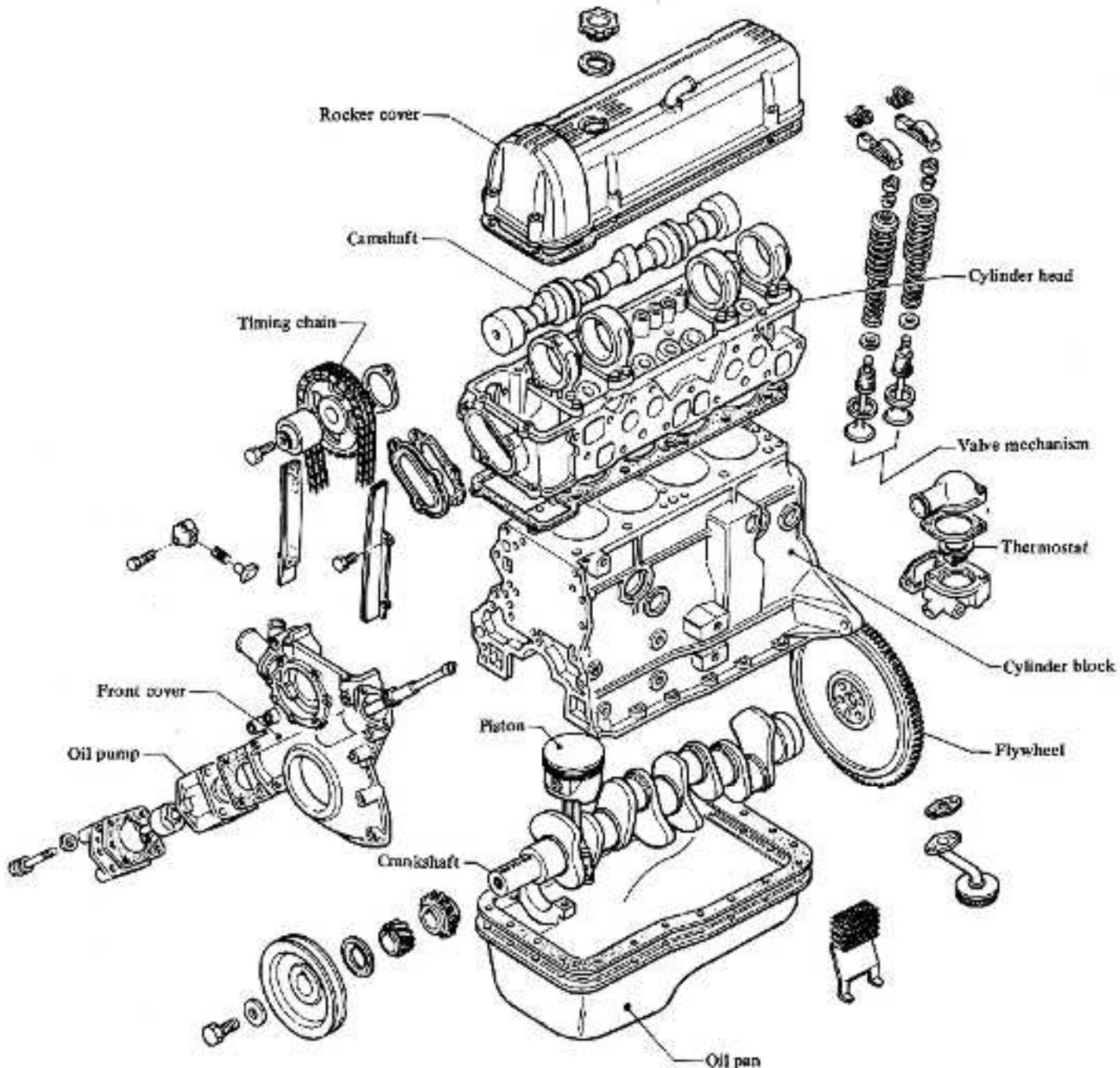
**DATSON****Model S110 Series****SECTION EM****ENGINE MECHANICAL**

EM

**CONTENTS**

<b>ENGINE COMPONENTS</b>	EM- 2
<b>ENGINE DISASSEMBLY</b>	EM- 3
PRELIMINARY CLEANING AND	
INSPECTION	EM- 3
DISASSEMBLY	EM- 3
PISTON AND CONNECTING ROD	EM- 5
CYLINDER HEAD	EM- 5
<b>INSPECTION AND REPAIR</b>	EM- 6
PREPARATION FOR INSPECTION	EM- 6
CYLINDER HEAD AND VALVE	EM- 6
CAMSHAFT AND CAMSHAFT BEARING	EM- 8
CYLINDER BLOCK	EM- 8
PISTON, PISTON PIN AND	
PISTON RINGS	EM- 9
CONNECTING ROD	EM-10
CRANKSHAFT	EM-10
BEARING	EM-11
MISCELLANEOUS COMPONENTS	EM-11
<b>ENGINE ASSEMBLY</b>	ME-13
PRECAUTIONS	EM-13
CYLINDER HEAD	EM-13
PISTON AND CONNECTING ROD	EM-14
ENGINE ASSEMBLY	EM-14
<b>SERVICE DATA AND</b>	
<b>SPECIFICATIONS</b>	EM-18
INSPECTION AND ADJUSTMENT	EM-18
TIGHTENING TORQUE	EM-23
<b>TROUBLE DIAGNOSES AND</b>	
<b>CORRECTIONS</b>	EM-24
<b>SPECIAL SERVICE TOOLS</b>	EM-25

## ENGINE COMPONENTS



SEM209

Z·ONE·DATSUN

## ENGINE DISASSEMBLY

### **PRELIMINARY CLEANING AND INSPECTION**

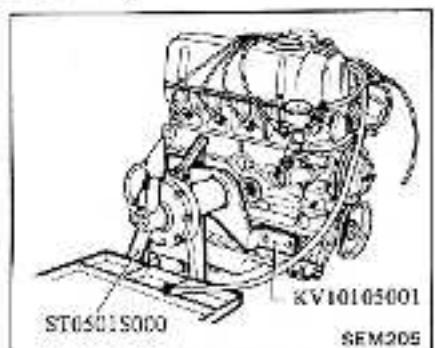
Before disassembling engine, observe the following items:

1. Prior to disassembling, check outer parts for sign of leak past their gasketed surfaces.
2. Check fuel hoses for deterioration, cracks or otherwise leakage of fuel past their jointed or connected surface.
3. Wipe dust and mud off engine.
4. Inspect outer parts for visual faults and broken or missing parts such as bolts and nuts.
5. Check piping and electrical circuits for deterioration, breakage, fittings, discontinuity or insulation.

### **DISASSEMBLY**

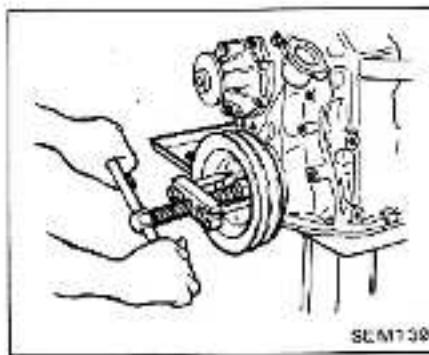
To remove engine from car, refer to Section ER.

1. Remove transmission from engine.
2. Remove clutch assembly, using Tool KV30100100 to support weight of clutch disc.
3. Remove alternator, alternator bracket and starting motor.
4. Place engine assembly on the engine stand.
- (1) Remove engine mounting bracket R.H.
- (2) Remove oil filter using Tool ST19320000.
- (3) Remove oil pressure sending unit.
- (4) Install engine attachment to cylinder block using bolt holes securing alternator bracket and water drain plug.
- (5) Set engine on the stand.



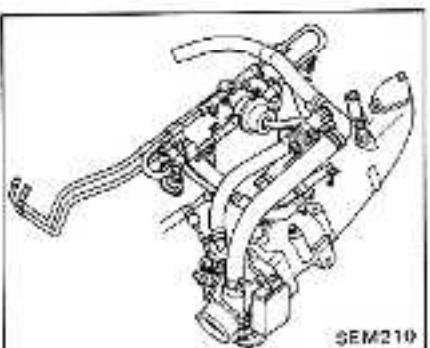
5. Thoroughly drain engine oil and coolant by removing drain plugs.
6. Remove the following outer parts and electrical parts.

- Distributor cap and high tension cable.
- Distributor
- Hose and pipe connected to engine
- Fuel line
- Intake manifold

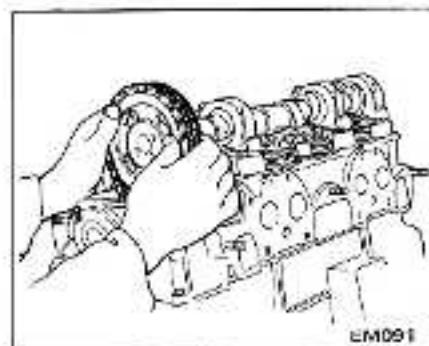


Remove intake manifold as an assembly of fuel pipe, injector, air regulator, etc. as follows:

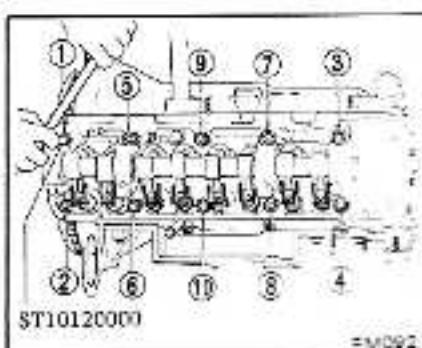
- a. Disconnect hose connecting rocker cover to throttle chamber at rocker cover.
- b. Disconnect water pipe connecting heater housing to water inlet at water inlet.
- c. Remove bolt which secures water pipe and fuel pipe to cylinder head.
- d. Remove tube connecting heater housing to thermostat housing.
- e. Remove bolt which secures intake manifold to cylinder head and remove intake manifold as an assembly.
- f. Remove P.C.V. valve hose.



- Water pump
  - Oil pump and oil pump drive spindle.
  - Oil level gauge
  - Spark plugs, etc.
  - 7. Remove cylinder head assembly.
- (1) Remove camshaft sprocket and slowly lower timing chain.



- (2) Loosen cylinder head bolts in the sequence as shown below using Tool.

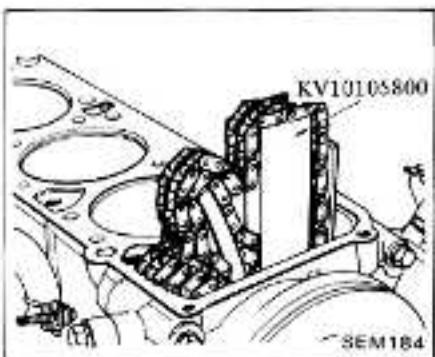


- Exhaust manifold
- Thermostat housing
- Crank pulley: use suitable puller on air conditioner equipped models

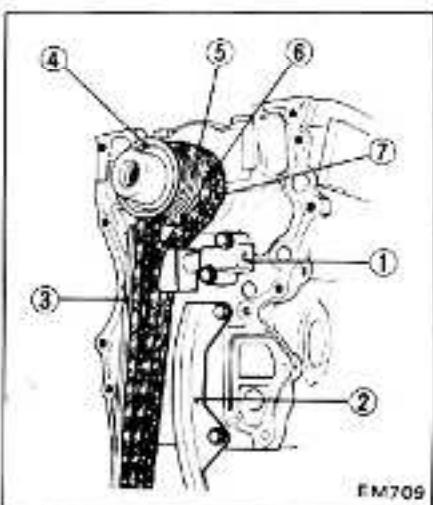
- (3) Remove bolts securing cylinder head to front cover.

When removing cylinder head from engine installed on car, follow the instructions below.

- Turn crankshaft until No. 1 piston is at T.D.C. on its compression stroke.
- To facilitate assembling operation, scribe a mark on timing chain and camshaft sprocket with paint before removal.
- Support timing chain by utilizing Tool between timing chains.

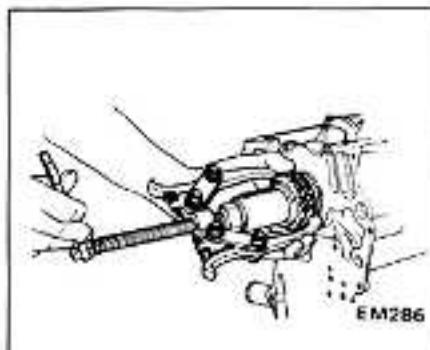


- Remove oil pan and oil strainer.
- Remove front cover.
- Remove chain tensioner and chain guide.
- Remove timing chain.
- Remove oil thrower, oil pump drive gear and crankshaft sprocket from crankshaft.

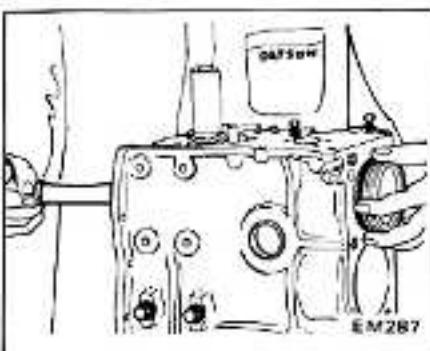


- Chain tensioner
- Slack side chain guide
- Tension side chain guide
- Oil thrower
- Oil pump drive gear
- Crankshaft sprocket
- Timing chain

If it is hard to extract crankshaft sprocket, use a suitable puller.



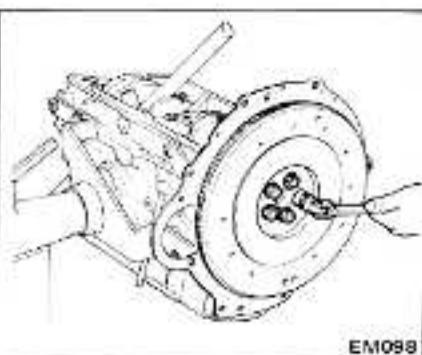
- Remove piston and connecting rod assembly.



- Piston can be easily removed by scraping carbon off top face of cylinder liner with a scraper.
- Numbers are stamped on connecting rod and cap corresponding to each cylinder. Care should be taken to avoid wrong combination including bearing.

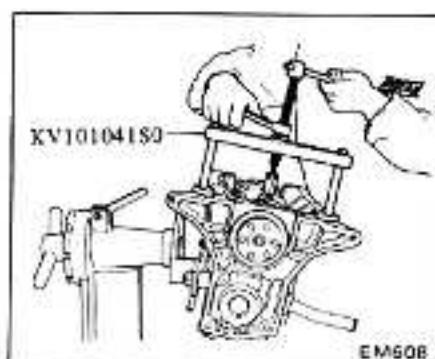
- Remove crankshaft.
- Remove flywheel and end plate.

**WARNING:**  
When removing flywheel, be careful not to drop it.

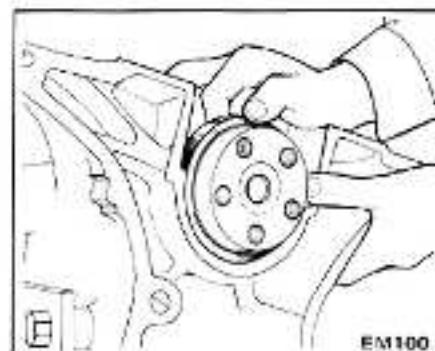


- Remove main bearing cap.

- When loosening main bearing cap bolt, loosen from outside in sequence.
- Use Tool to remove center and rear main bearing caps. Keep them in order.

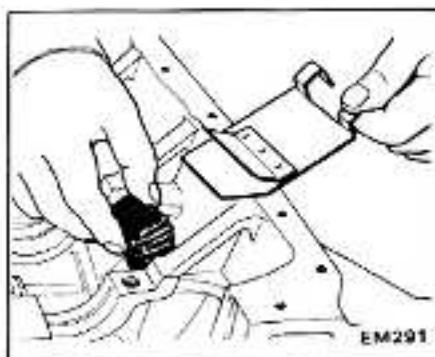


- Remove rear oil seal.



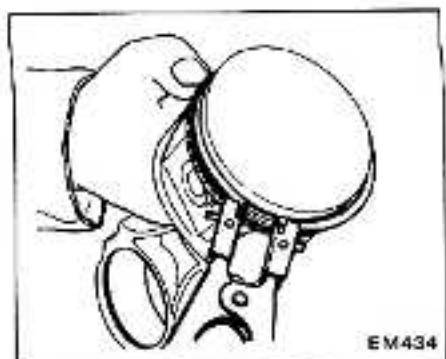
- Remove crankshaft.

- Remove baffle plate and steel net.

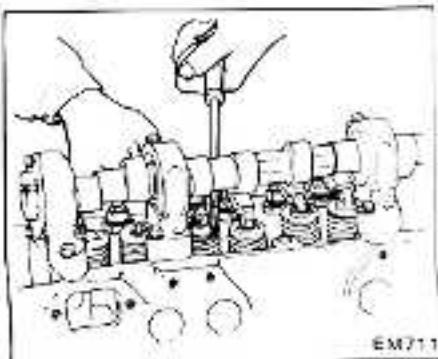
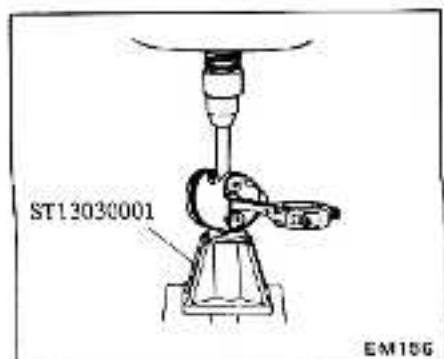


## PISTON AND CONNECTING ROD

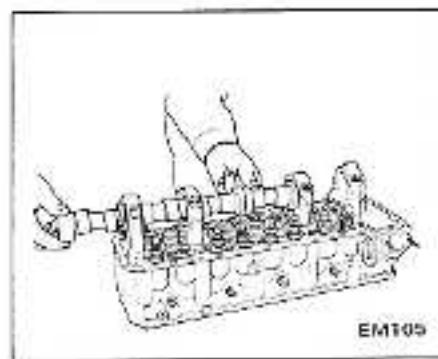
- Remove piston rings with a ring remover.



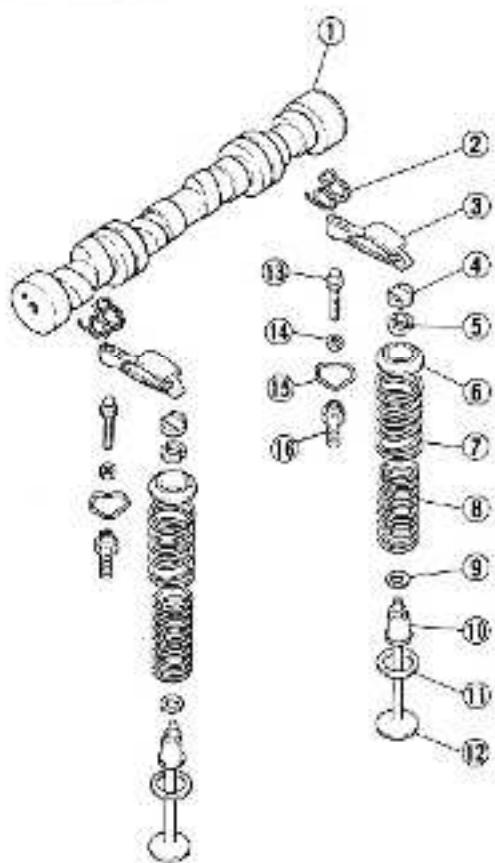
- Press piston pin out. Using press and Tool.



- Remove camshaft.



## CYLINDER HEAD



- Camshaft
- Valve rocker spring
- Valve rocker arm
- Valve rocker guide
- Valve spring collet
- Valve spring retainer
- Valve outer spring
- Valve inner spring
- Valve inner spring seat
- Valve oil seal
- Valve outer spring seat
- Valve
- Valve rocker pivot
- Rocker pivot lock nut
- Rocker spring retainer
- Rocker pivot bushing

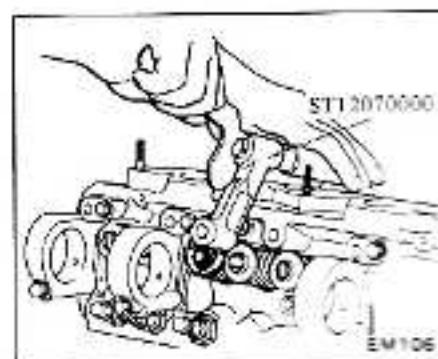
EM756

At this time, take care not to damage camshaft bearings and cam lobes.

- Remove valve rocker pivot, rocker pivot lock nut and rocker spring retainer.

**Do not remove rocker pivot bushing.**

- Remove valves using Tool.



- Remove valve rocker spring.
- Loosen valve rocker pivot lock

nut and remove rocker arm by pressing down valve spring.

- Be sure to leave camshaft bearing intact. Because bearing center is liable to be out of alignment.
- Take care not to lose valve spring seat, oil seal, valve collet, and valve rocker guide.

# INSPECTION AND REPAIR

## PREPARATION FOR INSPECTION

1. Before cleaning, check for sign of water and oil leaks.
2. Clean oil and carbon deposits from all parts. They should be clean from gasket or sealant.
3. Clean all oil holes with solvent and dry with compressed air. Make sure that they are not restricted.

### Surface grinding limit:

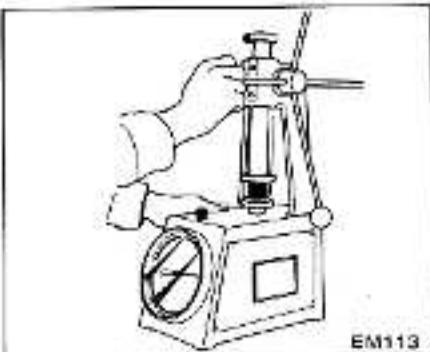
The grinding limit of cylinder head is determined by the cylinder block grinding in an engine.

Depth of cylinder head grinding is "A"

Depth of cylinder block grinding is "B"

The limit is as follows:

$$A + B = 0.2 \text{ mm (0.008 in)}$$



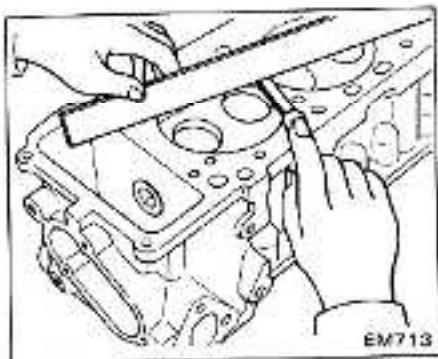
EM113

## CYLINDER HEAD AND VALVE

### CHECKING CYLINDER HEAD MATING FACE

#### CAUTION:

**Never remove camshaft bearings unless you have a suitable machine for boring camshaft bearing in line. If you once remove camshaft bearings, bearing centers will be out of alignment and reconditioning is very difficult without center borings.**



1. Make a visual check for cracks and flaws.
2. Measure the surface of cylinder head (on cylinder block side) for warpage.

If beyond the specified limit, correct with a surface grinder.

#### Warpage of surface:

Less than

0.1 mm (0.004 in)

## VALVE

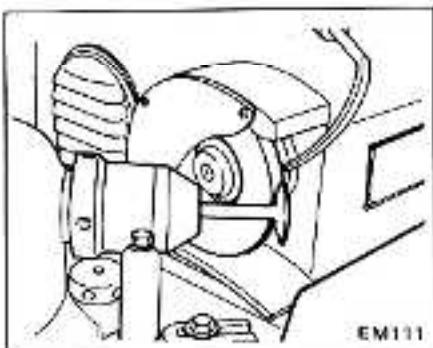
1. Check each of the intake and exhaust valve for worn, damaged or deformed valve caps or stems. Correct or replace the valve that is faulty.

For standard size of valve, refer to S.D.S.

2. Valve face or valve stem end surface should be refaced by using a valve grinder.

When valve head has been worn down to 0.5 mm (0.020 in) in thickness, replace the valve.

Grinding allowance for valve stem end surface is 0.5 mm (0.020 in) or less.



## VALVE SPRING

1. Check valve spring for squareness using a steel square and surface plate. If spring is out of square "S" more than specified limit, replace with new ones.

### Out of square ("S")

#### Outer:

Less than

2.2 mm (0.087 in)

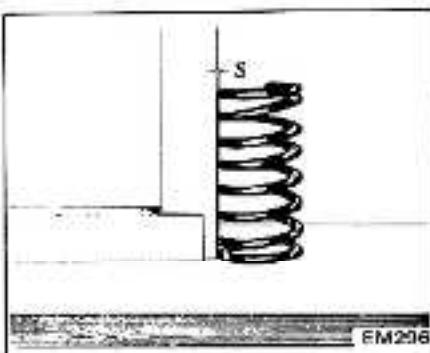
#### Inner:

Less than

1.2 mm (0.047 in)

2. Measure the free length and the tension of each spring. If the measured value exceeds the specified limit, replace spring.

Refer to S.D.S.



EM206

## ROCKER ARM AND VALVE ROCKER PIVOT

Check pivot head and cam contact and pivot contact surfaces of rocker arm for damage or wear. If faults are found, replace them. A faulty pivot necessitates its replacement together with the corresponding rocker arm.

## VALVE GUIDE

Measure the clearance between valve guide and valve stem. If the clearance exceeds the specified limit, replace the worn parts or both valve

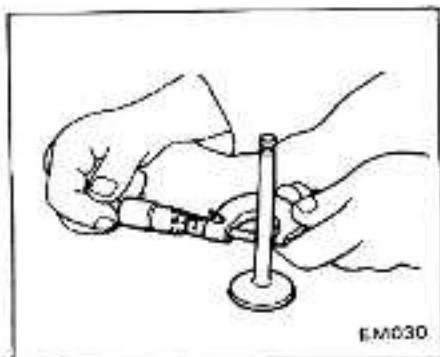
and valve guide. In this case, it is essential to determine if such a clearance has been caused by a worn or bent valve stem or by a worn valve guide.

#### Determining clearance

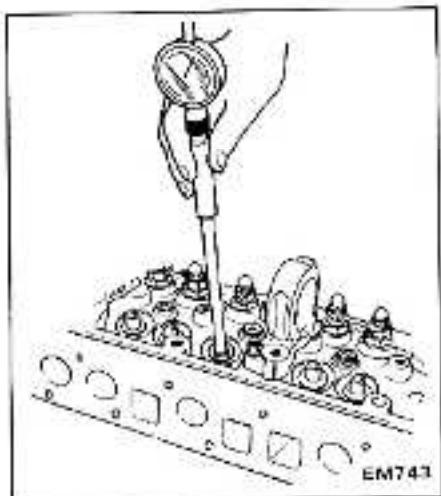
Precise measurement of clearance between valve stem and valve guide needs the aid of a micrometer and a telescope hole gauge.

- Measure the diameter of valve stem in three places; top, center and bottom.

Refer to S.D.S.



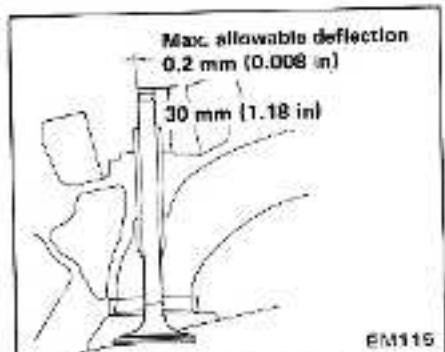
- Insert telescope hole gauge in valve guide bore, measuring at center.



Subtract the highest reading of valve stem diameter from valve guide bore to obtain the stem to guide clearance.

- As an expedient, a valve is pushed in valve guide and moved to the right and left. If its tip deflects beyond the specified limit there, it will be known

that the clearance between stem and guide exceeds the maximum limit.



**Max. allowable deflection:**

0.2 mm (0.008 in)

**Max. tolerance:**

Stem to guide clearance

0.1 mm (0.004 in)

Valve should be moved in parallel with rocker arm. (Generally, a large amount of wear occurs in this direction.)

Valve guide of 0.2 mm (0.008 in) oversize diameter is available for service. Refer to S.D.S.

- Ream the bore with valve guide pressed in, using Tool ST11032000 [8.0 mm (0.315 in) dia.]

**Reaming bore:**

8.000 - 8.018 mm  
(0.3150 - 0.3157 in)

- Correct valve seat surface with new valve guide as the axis.

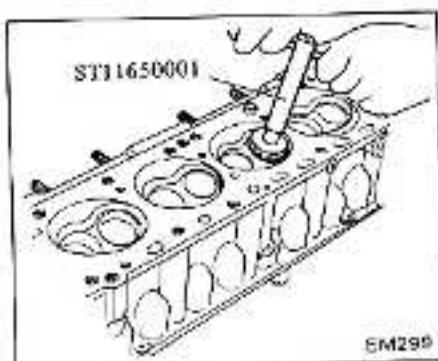
#### VALVE SEAT INSERTS

Check valve seat inserts for any evidence of pitting at valve contact surface, and reseat or replace if worn out excessively.

Correct valve seat surface with Tool and grind with a grinding compound.

Valve seat insert of 0.5 mm (0.020 in) oversize is available for service.

Refer to S.D.S.

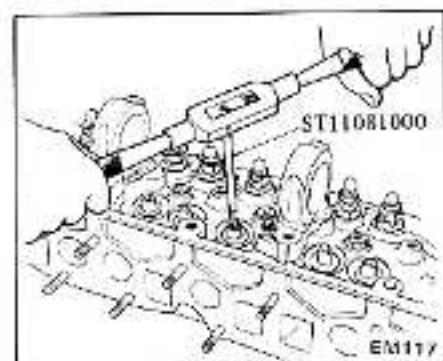


#### Replacement of valve guide

- To remove old guides, use Tool ST11320000 and a press (under a 2-ton pressure) or a hammer.

Drive them out from combustion chamber side toward rocker cover. Heated cylinder head will facilitate the operation.

- Ream cylinder head valve guide hole using Tool [12.2 mm (0.480 in) dia.] at room temperature.



- Press new valve guide into head carefully so that it will fit smoothly after heating cylinder head to 150 to 200°C (302 to 392°F).

#### Replacement of valve seat insert

- Old insert can be removed by boring out until it collapses. The machine depth stop should be set so that boring cannot continue beyond the bottom face of the insert recess in cylinder head.

2. Select a suitable valve seat insert and check its outside diameter.

3. Machine cylinder head recess to the concentric circles to valve guide center so that insert will have the correct fit.

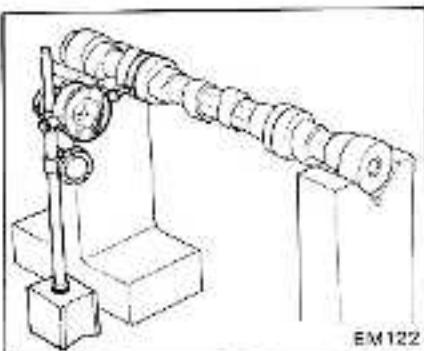
4. Ream the cylinder head recess at room temperature.

5. Heat cylinder head to a temperature of 150 to 200°C (302 to 392°F).

6. Fit insert ensuring that it beds on the bottom face of its recess, and caulk more than 4 points.

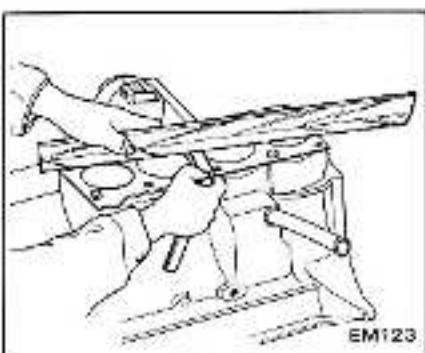
7. Valve seats newly fitted should be cut or ground using Tool ST11650001 at the specified dimensions as shown in S.D.S.

8. Apply small amount of fine grinding compound to valve contacting face and put valve into guide. Lap valve against its seat until proper valve seating is obtained. Remove valve and then clean valve and valve seat.



**Camshaft bend:**  
Less than 0.05 mm  
(0.0020 in)

2. Measure the top of cylinder block (cylinder head mating face) for warpage. If warpage exceeds the specified limit, correct with a grinder.

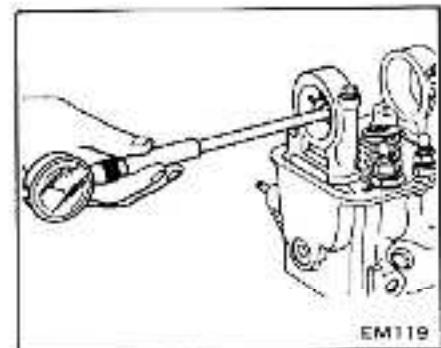


**Warpage of cylinder block surface:**  
Less than 0.10 mm (0.0039 in)

## CAMSHAFT AND CAMSHAFT BEARING

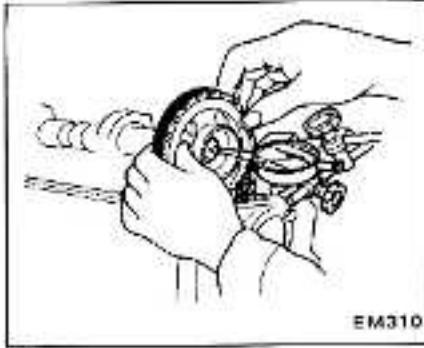
### CAMSHAFT BEARING CLEARANCE

Measure the inside diameter of camshaft bearing with an inside dial gauge and the outside diameter of camshaft journal with a micrometer. If any malfunction is found, replace camshaft or cylinder head assembly.



**Max. tolerance of camshaft bearing clearance:**  
0.1 mm (0.004 in)

3. Measure camshaft end play. If beyond the specified limit, replace locating plate.



**Camshaft end play:**  
0.08 - 0.38 mm  
(0.0031 - 0.0150 in)

4. Measure camshaft cam height. If beyond the specified limit, replace camshaft.

Refer to S.D.S.

### VALVE TIMING

If any valve is found out of specifications (refer to S.D.S.), one possibility is that cam lobe is worn or damaged, calling for replacement of camshaft.

### CAMSHAFT ALIGNMENT

1. Check camshaft, camshaft journal and cam surface for bend, wear or damage. If problems are beyond the limits, replace the parts.

2. A bend value is one-half of the total indicator reading obtained when camshaft is turned one full revolution with a dial gauge to 2nd and 3rd journals.

### CYLINDER BLOCK

1. Visually check cylinder block for cracks or flaws.

**Surface grinding limit:**  
The grinding limit of cylinder block is determined by the cylinder head grinding in an engine.

Depth of cylinder head grinding is "A"

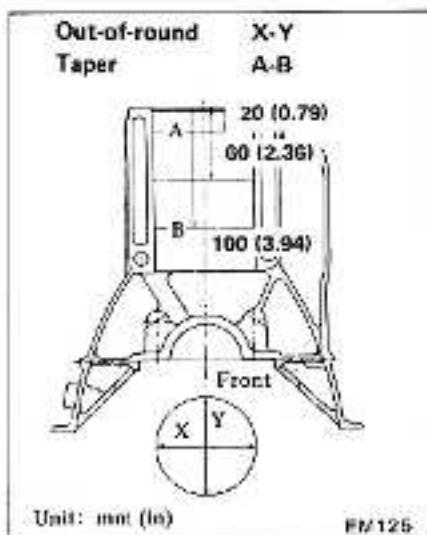
Depth of cylinder block grinding is "B"

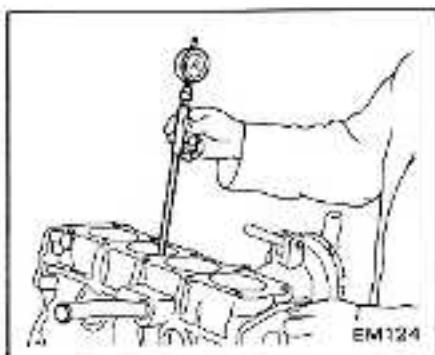
The limit is as follows:

$$A + B = 0.2 \text{ mm (0.008 in)}$$

3. Using a bore gauge, measure cylinder bore for out-of-round or taper. If, out-of-round or taper is excessive, re bore the cylinder walls by means of a boring machine. Measurement should be taken along bores for taper and around bores for out-of-round.

Refer to S.D.S.





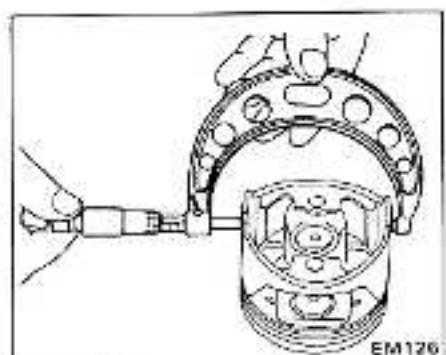
4. When wear, taper or out-of-round is minor and within the limit, remove the step at the topmost portion of cylinder using a ridge reamer or other similar tool.

## CYLINDER BORING

- When any cylinder needs boring, all other cylinders must also be bored at the same time.
- Determine piston oversize according to amount of wear of cylinder.

Refer to S.D.S.

- The size to which cylinders must be honed is determined by adding piston-to-cylinder clearance to the piston skirt diameter "A".



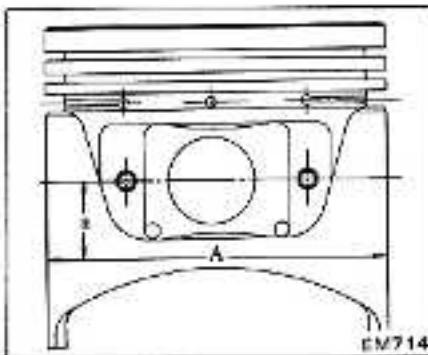
Measure dimension "a" at position shown below.

Dimension "a"

(distance from center of pin):

Approximately

20 mm (0.79 in)



Honed size calculation:

$$D = A + B - C = A + [0.005 \text{ to } 0.025 \text{ mm (0.0002 to 0.0010 in)}]$$

where,

D : Honed diameter

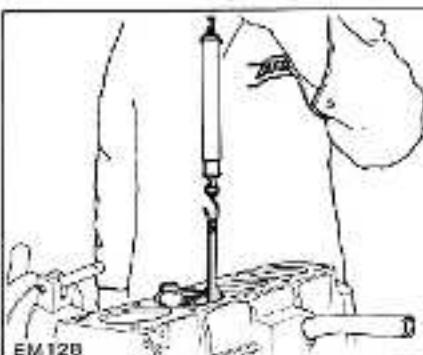
A : Skirt diameter as measured

B : Piston-to-wall clearance

C : Machining allowance

0.02 mm (0.0008 in)

- When measuring clearance, slowly pull feeler gauge straight upward.
- It is recommended that piston and cylinder be heated to 20°C (68°F).



If cylinder bore has worn beyond the wear limit, use cylinder liner.

Undersize cylinder liners are available for service.

Interference fit of cylinder liner in cylinder block should be 0.08 to 0.09 mm (0.0031 to 0.0035 in).

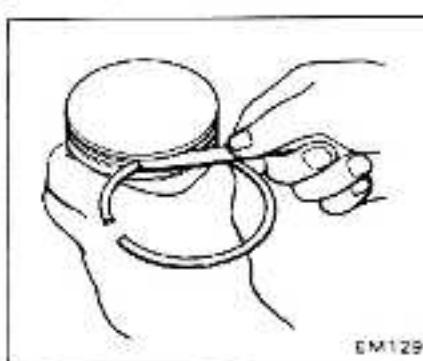
## PISTON, PISTON PIN AND PISTON RINGS

1. Scrape carbon off piston and ring grooves with a carbon scraper and a curved steel wire. The wire will be useful in cleaning bottom land of ring groove. Clean out oil slots in bottom land of oil ring groove.

2. Check for damage, scratches and wear. Replace if such a fault is detected.

3. Measure the side clearance of rings in ring grooves as each ring is installed.

If side clearance exceeds the specified limit, replace piston together with piston ring.



Max. tolerance of side clearance:

0.1 mm (0.004 in)

Feeler gauge used:

0.04 mm (0.0016 in)

Extracting force:

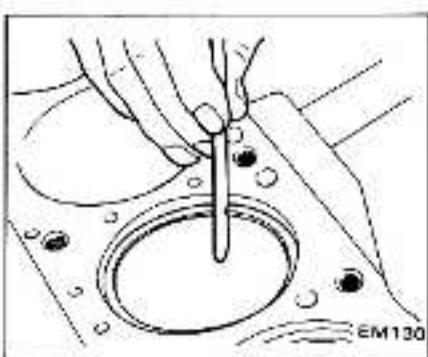
2.0 - 14.7 N

(0.2 - 1.5 kg, 0.4 - 3.3 lb)

4. Measure ring gap with a feeler gauge, placing ring squarely in cylinder.

Ring should be placed to diameter at upper or lower limit of ring travel.

If ring gap exceeds the specified limit, replace ring.



Max. tolerance of ring gap:

1.0 mm (0.039 in)

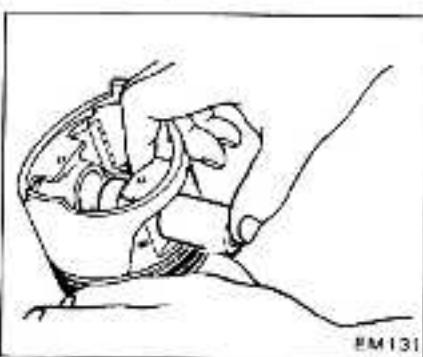
- When piston ring only is to be replaced, without cylinder bore being corrected, measure the gap at the bottom of cylinder where the wear is minor.
- Oversize piston rings are available for service. [0.5 mm (0.020 in), 1.0 mm (0.039 in) oversize].
- 5. Measure piston pin hole in relation to the outer diameter of pin. If wear exceeds the limit, replace such piston pin together with piston on which it is installed.

#### Piston pin to piston clearance:

0.006 - 0.013 mm

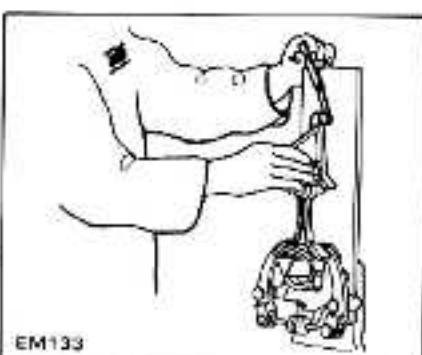
(0.0002 - 0.0005 in)

Determine the fitting of piston pin into piston pin hole to such an extent that it can be pressed smoothly by finger at room temperature. This piston pin must be a tight press fit into connecting rod.



## CONNECTING ROD

1. If a connecting rod has any flaw on both sides of the thrust face and the large end, correct or replace it.
2. Check connecting rod for bend or torsion using a connecting rod aligner. If bend or torsion exceeds the limit, correct or replace.



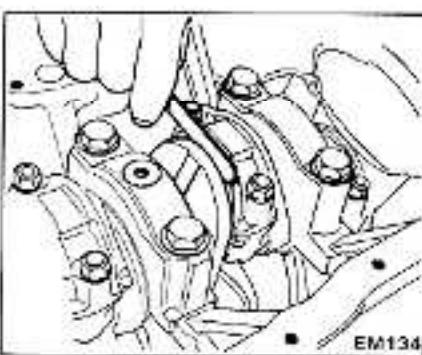
#### Bend and torsion

[per 100 mm (3.94 in) length]:

Less than

0.05 mm (0.0020 in)

3. When replacing connecting rod, select rod so that weight difference between new and old ones is within 7 g (0.25 oz).
4. Install connecting rods with bearings on to corresponding crank pins and measure the thrust clearance. If the measured value exceeds the limit, replace such connecting rod.



Max. tolerance of big end play:

0.6 mm (0.024 in)

## CRANKSHAFT

1. Repair or replace as required. If faults are minor, correct with fine crocus cloth.

2. Check with a micrometer journals and crank pins for taper and out-of-round. Measurement should be taken along journals for taper and around journals for out-of-round.

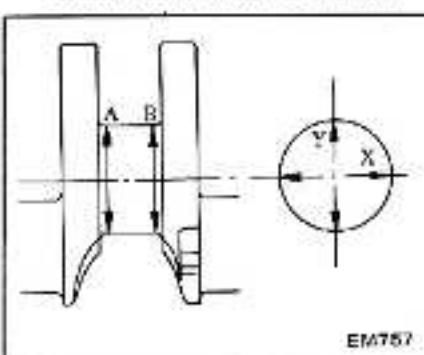
If out-of-round or taper exceeds the specified limit, replace or repair.

#### Out-of-round (X-Y):

Less than 0.03 mm (0.0012 in)

#### Taper (A-B):

Less than 0.03 mm (0.0012 in)

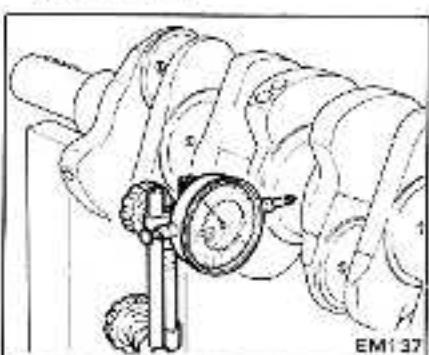


3. After regrounding crankshaft, finish it to the necessary size indicated in the chart under Service Data and Specifications by using an adequate undersize bearing according to the extent of required repair.

4. Crankshaft can be checked for bend by placing it on V-blocks and using a dial gauge with its indicating finger resting on center journal.

A bend value is one-half of the total indicator reading obtained when crankshaft is turned one full revolution.

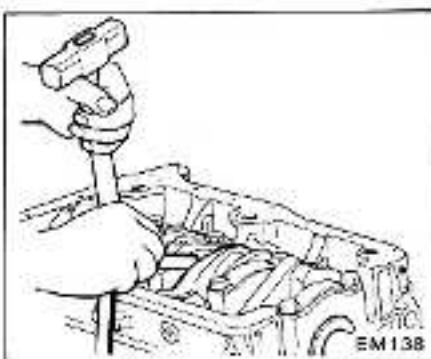
If bend exceeds the specified limit, replace or repair.



#### Bend:

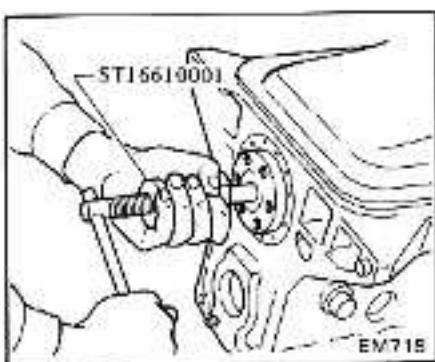
Less than 0.05 mm (0.0020 in)

5. Install crankshaft in cylinder block and measure crankshaft free end play.

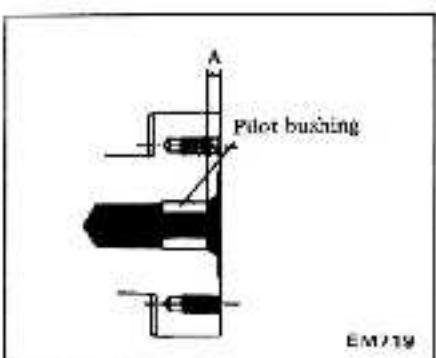


**Max. tolerance of end play:**  
0.3 mm (0.012 in)

6. To replace crankshaft rear pilot bushing, proceed as follows:  
(1) Pull out bushing using Tool.



- (2) Before installing a new bushing, thoroughly clean bushing hole.  
(3) Insert pilot bushing until distance between flange end and pilot bushing is the specified distance "A".



**Distance "A":**  
Approximately  
4.0 mm (0.157 in)

**Do not oil bushing.**

**When installing pilot bushing, be careful not to damage edge of pilot bushing and not to insert excessively.**

## BEARING

### MEASUREMENT OF MAIN BEARING CLEARANCE

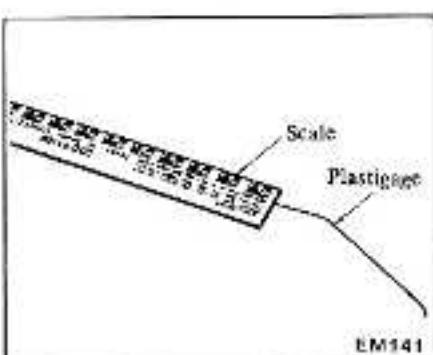
- Thoroughly clean all bearings and check for scratches, melt, score or wear.

Replace bearings, if any fault is detected.

- Crankshaft journals and bearings should be clean and free from dust and dirt before oil clearance is measured.

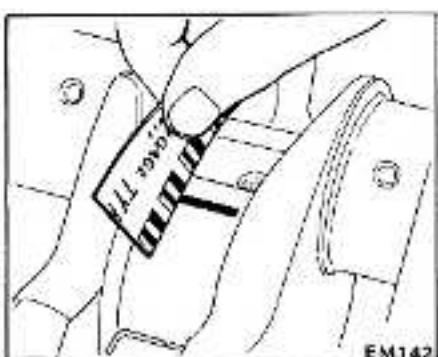
- Set main bearing on cap block.
- Cut a plastigage to the width of bearing and place it in parallel with crank journal, getting clear of the oil hole. Install cap on the assembly and tighten them together to the specified torque.

① : Main bearing cap  
44 - 54 N·m  
(4.5 - 5.5 kg·m,  
33 - 40 ft-lb)



**Do not turn crankshaft while the plastigage is being inserted.**

- Remove cap, and compare width of the plastigage at its widest part with the scale printed in the plastigage envelope.



- If clearance exceeds the specified value, replace bearing with an undersize bearing and grind crankshaft journal adequately.

**Max. tolerance of main bearing clearance:**  
0.12 mm (0.0047 in)

### MEASUREMENT OF CONNECTING ROD BEARING

- Measure connecting rod bearing clearance in the same manner as above.

② : Connecting rod bearing cap  
44 - 54 N·m  
(4.5 - 5.5 kg·m,  
33 - 40 ft-lb)

- If clearance exceeds the specified value, replace bearing with an undersize bearing and grind the crankshaft journal adequately.

**Max. tolerance of connecting rod bearing clearance:**  
0.12 mm (0.0047 in)

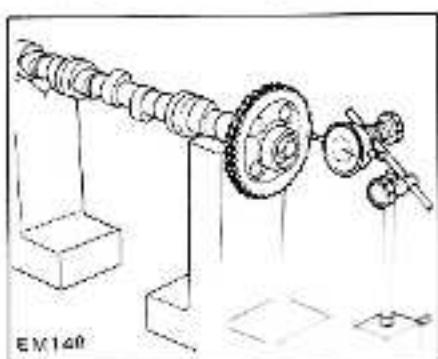
## MISCELLANEOUS COMPONENTS

### CAMSHAFT SPROCKET

- Check tooth surface for flaws or wear. Replace sprocket if any fault is found.

- Install camshaft sprocket in position and check for runout.

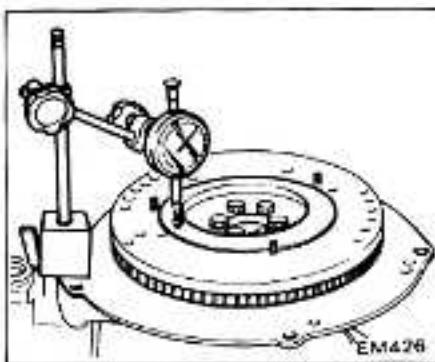
If runout exceeds the specified limit, replace camshaft sprocket.



**Runout:**  
(Total indicator reading)  
Less than 0.1 mm (0.004 in)

**CHAIN**

Check chain for damage, excessive wear or stretch at roller links. Replace if faulty.

**CHAIN TENSIONER AND CHAIN GUIDE**

Check for wear and breakage. Replace if necessary.

**Runout:**  
(Total indicator reading)  
Less than 0.15 mm (0.0059 in)

3. Check tooth surfaces of ring gear for flaws or wear.  
Replace if necessary.

Replace ring gear at about 180 to 220°C (356 to 428°F).

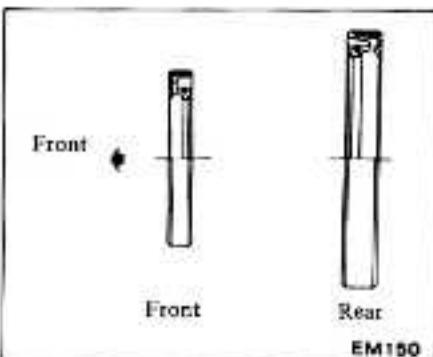
**FLYWHEEL**

1. Check the clutch disc contact surface with flywheel for damage or wear. Repair or replace if necessary.
2. Measure runout of the clutch disc contact surface with a dial gauge. If it exceeds the specified limit, replace it.

**FRONT AND REAR OIL SEAL**

First check front and rear oil seals for worn or folded over sealing lip or oil leakage. If necessary, replace with a new seal. When installing a new seal, pay attention to its mounting direction.

It is good practice to renew oil seal whenever engine is overhauled.



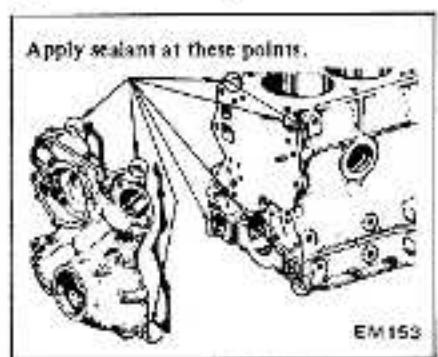
## ENGINE ASSEMBLY

### PRECAUTIONS

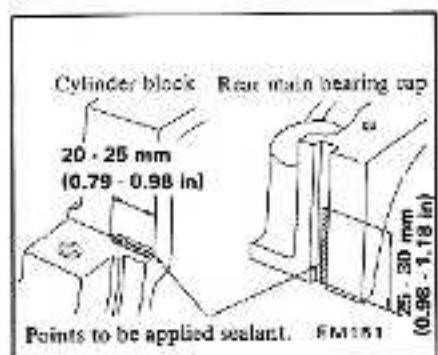
1. Use thoroughly cleaned parts. Particularly, make sure that oil holes are clear of foreign matter.
2. When installing sliding parts such as bearings, be sure to apply engine oil to them.
3. Use new packings and oil seals.
4. Do not reuse lock washers that have been removed.
5. Keep tools and work benches clean.
6. Keep the necessary parts and tools ready near at hand.
7. Be sure to follow specified tightening torque and order.
8. Applying sealant

Use sealant to eliminate water and oil leaks. Parts requiring sealant are:

- (1) Front cover gasket: Front side of cylinder block and cover gasket.
- (2) Front cover: Top of front cover.

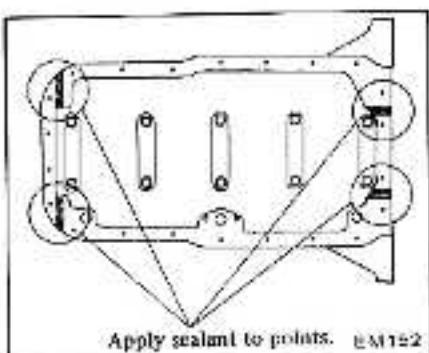


- (3) Main bearing cap and cylinder block: Each side of rear main bearing cap and each corner of cylinder block.

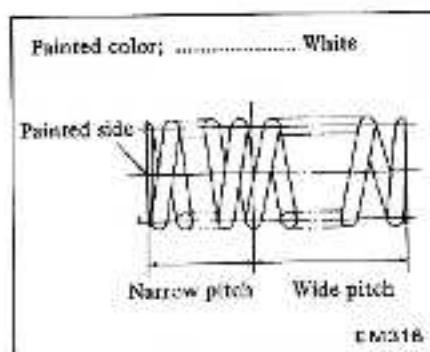


- (4) Cylinder block: Step portions at four mating surfaces (cylinder block to front chain cover and cylinder block to rear main bearing cap).

**Do not apply sealant too much.**



- Outer valve spring is of an uneven pitch type. Install valve spring with its narrow pitch side (painted) at cylinder head side.



2. Install valve rocker pivot bushing.
3. Install valve rocker pivots joined with lock nuts into pivot bushing.

**Fully screw in valve rocker pivot.**

4. Install rocker spring retainer on pilot bushing.
5. Install camshaft in cylinder head carefully.

**Do not damage the bearing inside.**

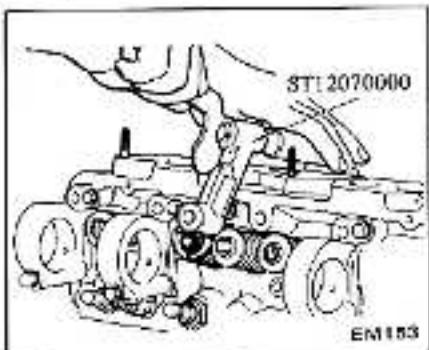
① : Camshaft locating plate

5.9 - 15.7 N·m  
(0.6 - 1.0 kg·m,  
4.3 - 7.2 ft-lb)

### CYLINDER HEAD

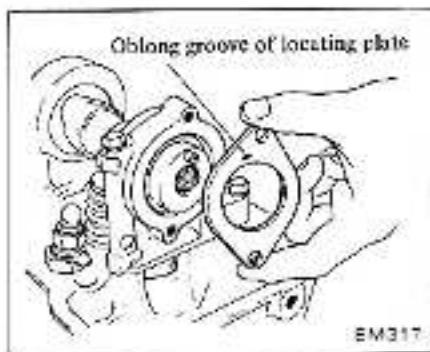
1. To install valve, proceed as follows:

- (1) Set valve spring inner and outer seat and valve oil seal.
- (2) Install valve spring inner and outer, valve spring retainer, valve spring collet and valve rocker guide by using Tool.

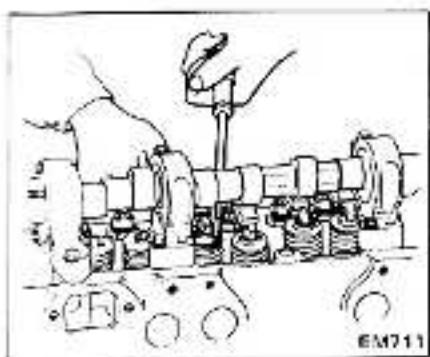


- Check whether the valve face is free from foreign matter.

The oblong groove of locating plate must be directed toward the front side of engine.



- 6. Install rocker arms by pressing down valve springs with a screwdriver, etc.



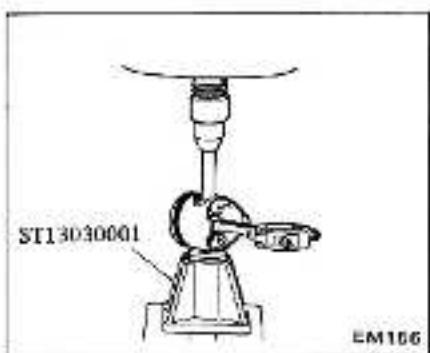
7. Install valve rocker springs.
8. After assembling cylinder head, turn camshaft until No. 1 piston is at T.D.C. on its compression stroke.

## PISTON AND CONNECTING ROD

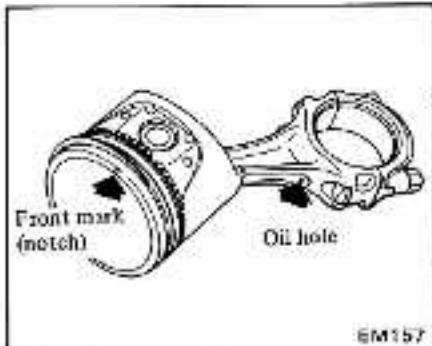
1. Assemble pistons, piston pins and connecting rods on the designated cylinder.

- Piston is pressed into connecting rod, and fitting force is from 0.6 to 1.5 tons and the aid of Tool is necessary.

When pressing piston pin in connecting rod, apply engine oil to pin and small end of connecting rod.

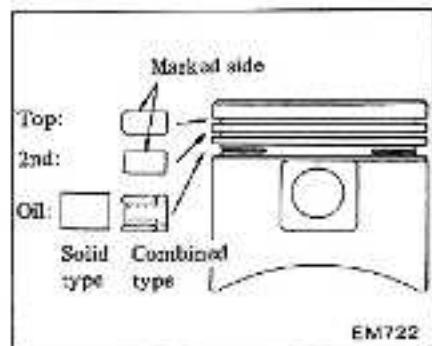


- Arrange so that oil jet of connecting rod big end is directed toward the right side of cylinder block.
- Be sure to install piston in cylinders with notch mark of piston head toward the front of engine.



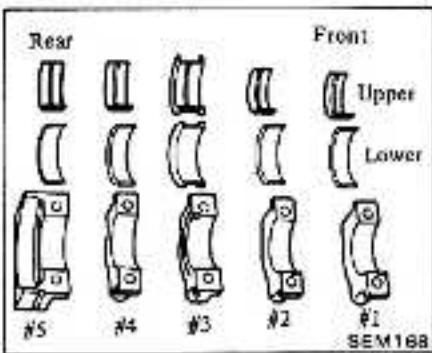
2. Install piston ring. Install so that stamped mark on ring faces upward.

- Top ring is chromium-plated on liner contacting face.
  - Second ring has larger taper surface than top ring.
  - Oil ring comes in two types: one is a solid type and the other a combined type.
- In the combined oil ring, upper rail is the same as lower one.



## ENGINE ASSEMBLY

1. Install baffle plate including steel net.
2. Set main bearings at the proper portion of cylinder block.



- Only center bearing (No. 3) is a flanged type.
- All inter-bearings (No. 2 and No. 4) are the same type.
- Front bearing (No. 1) is also the same type as rear bearing (No. 5). The difference is that an oil hole is provided in the front bearing.
- Upper and lower bearings are not interchangeable. Upper ones have oil groove.

### CAUTION:

Use care when installing main bearings. Side with oil groove should be at cylinder block side and side without oil groove should be at main cap side.

3. Apply engine oil to main bearing surfaces on both sides of cylinder block and cap.

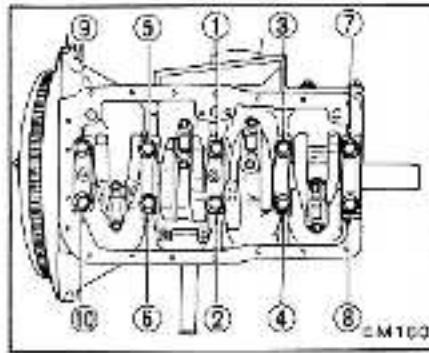
Install crankshaft.

4. Install main bearing cap and tighten bolts to specified torque.

#### (1) Main bearing cap

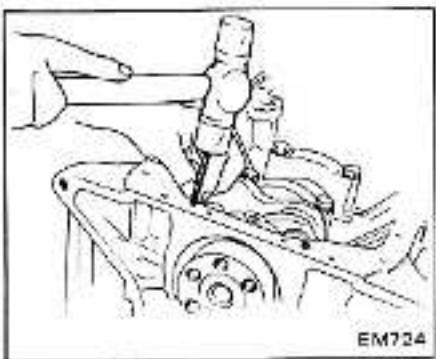
44 - 54 N·m  
(4.5 - 5.5 kg-m,  
33 - 40 ft-lb)

- Apply sealant to each side of rear main bearing cap and each corner of cylinder block.
- Arrange the parts so that the arrow mark on bearing cap faces toward the front of engine.
- Prior to tightening bearing cap bolts, place bearing cap in proper position by shifting crankshaft in the axial direction.
- Tighten bearing cap bolts gradually in separating two to three stages and outwardly from center bearing in sequence.



- After securing bearing cap bolts, ascertain that crankshaft turns smoothly.

- Install side oil seals into rear main bearing cap. Prior to installing, apply sealant to these seals.

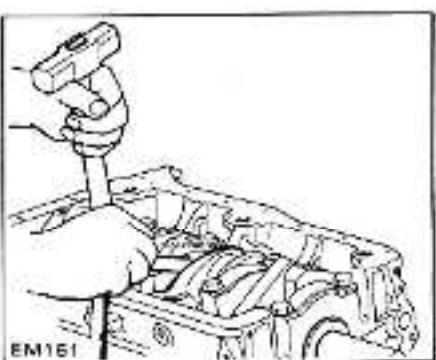


Install oil seal with its core at bearing cap side.

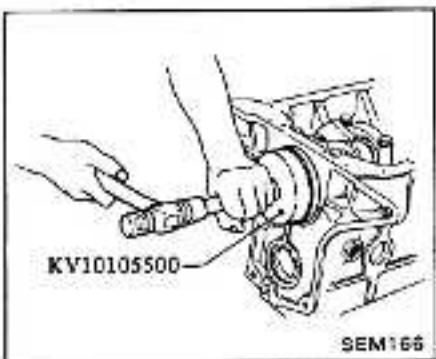
- Make sure that there exists proper end play at crankshaft.

**Crankshaft end play:**

Max. 0.3 mm (0.012 in)

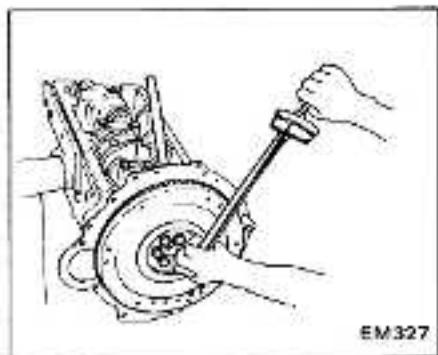


- Install rear oil seal using Tool. Apply a lithium grease to sealing lip of oil seal.



When installing oil seal, give coating of engine oil to mating shaft to prevent scratches and folded lip. Also apply coating of oil to periphery of oil seal.

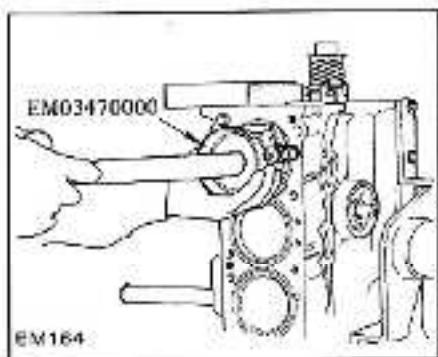
- Install rear end plate.
- Install flywheel securely, and tighten bolts to specified torque.



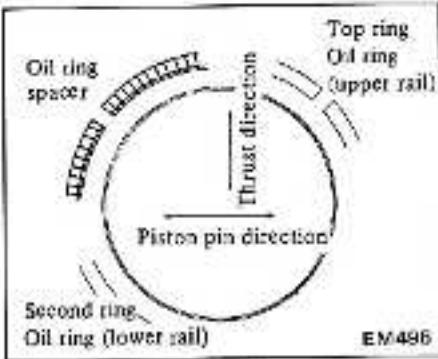
**① : Flywheel fixing bolts**

137 - 157 N·m  
(14 - 16 kg·m,  
101 - 116 ft·lb)

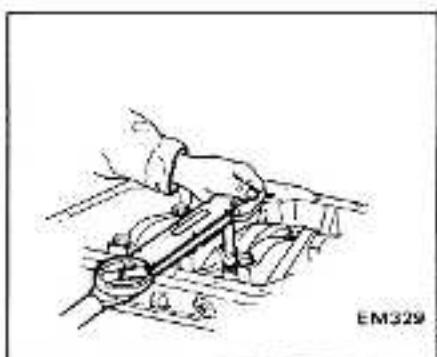
- Insert pistons in corresponding cylinder using Tool.



- Apply engine oil to sliding parts.
- Arrange so that the front mark on piston head faces to the front of engine.
- Install piston ring as shown below.



- Install connecting rod caps.



**② : Connecting rod cap nut**

44 - 54 N·m  
(4.5 - 5.5 kg·m,  
33 - 40 ft·lb)

Arrange connecting rods and connecting rod caps so that the cylinder numbers face in the same direction.

- Make sure that there exists proper end play at connecting rod big end. Refer to connecting rod for inspection and repair.

- Install crankshaft sprocket and oil pump drive gear and fit oil thrower.

- Make sure that the mating marks of crankshaft sprocket faces to the front.
- Install oil pump drive gear so that large chamfered inner side faces rearward.

- Install chain guide to cylinder block.

- Install cylinder head assembly through gasket by accommodating knock pin of cylinder block.

- Thoroughly clean cylinder block and head surface.

Do not apply sealant to any other part of cylinder block and head surface.

- Turn crankshaft until No. 1 piston is at T.D.C. on its compression stroke.

- When installing cylinder head, make sure that all valves are apart from head of pistons.

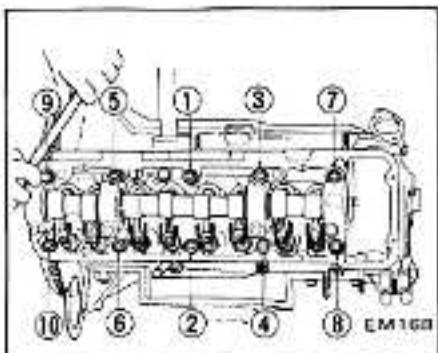
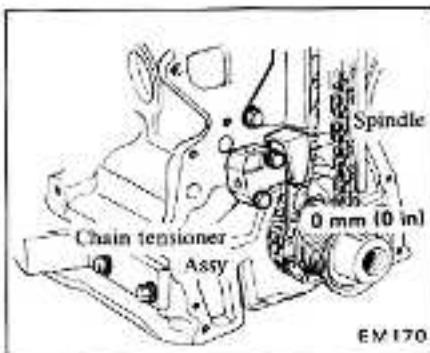
- Do not rotate crankshaft and cam-shaft separately, because valves will hit head of pistons.

- Temporarily tighten two center bolts.

**T** : Temporary tightening torque  
Cylinder head bolt  
20 N·m (2 kg·m, 14 ft·lb)

16. Set chain by aligning mating mark on camshaft sprocket with that of crankshaft sprocket and install camshaft sprocket to camshaft.

**T** : Camshaft sprocket  
118 - 157 N·m  
(12 - 16 kg·m,  
87 - 116 ft·lb)

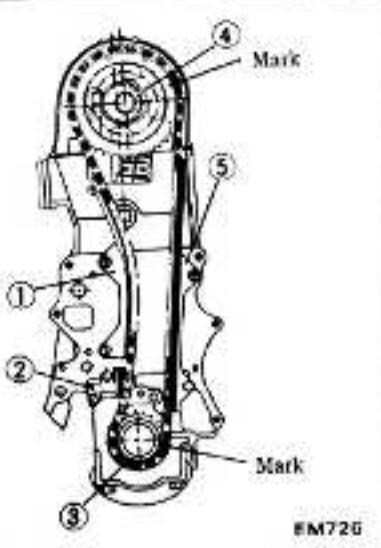


18. Press new oil seal in front cover.

Front cover oil seal should be replaced when front cover is disassembled.

19. Install front cover with gasket in place.

- Apply sealant to front side of cylinder block and front cover gasket.
- Apply sealant only to the top of front cover.
- Install front cover with head gasket in place.
- Check the height difference between cylinder block upper face and front cover upper face. Its difference must be less than 0.15 mm (0.0059 in).
- Note that different lengths of bolts are used.
- Apply a lithium grease to sealing lip of oil seal.



- 1 Chain guide (Slack side)  
2 Chain tensioner  
3 Crank sprocket  
4 Cam sprocket  
5 Chain guide (Tension side)

- Set timing chain by making its mating marks align with those of crankshaft sprocket and camshaft sprocket the right hand side.
- No. 2 hole is factory adjusted. When chain stretches excessively, adjust camshaft sprocket at No. 3. For adjustment, refer to Inspection and Repair of Chain.

17. Install chain guide and chain tensioner.

**T** : 5.9 - 9.8 N·m  
(0.6 - 1.0 kg·m,  
4.3 - 7.2 ft·lb)

Adjust the protrusion of chain tensioner spindle to 0 mm (0 in) with slack side chain guide.

**T** : Front cover bolts

Size M8  
10 - 16 N·m  
(1.0 - 1.6 kg·m,  
7 - 12 ft·lb)

Size M6  
3.9 - 9.8 N·m  
10.4 - 1.0 kg·m,  
2.8 - 7.2 ft·lb)

20. Install crankshaft pulley and water pump.

**T** : Crankshaft pulley nut  
118 - 157 N·m  
(12 - 16 kg·m,  
87 - 116 ft·lb)

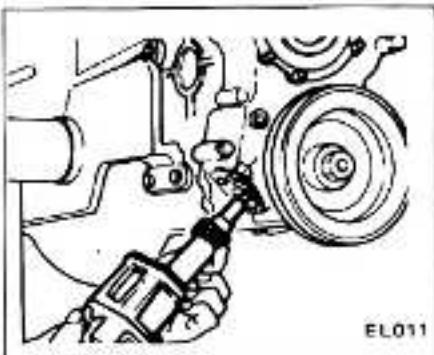
21. Finally tighten head bolts to the specified torque in several steps by using Tool ST10120000.

**T** : Cylinder head bolt

69 - 83 N·m  
(7.0 - 8.5 kg·m,  
51 - 61 ft·lb)

- Be sure to tighten bolt securing cylinder head to front cover.
- After engine has been operated for several minutes; if necessary, retighten.

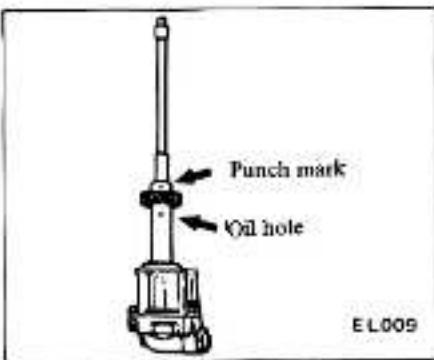
22. Install oil pump and distributor driving spindle in front cover.



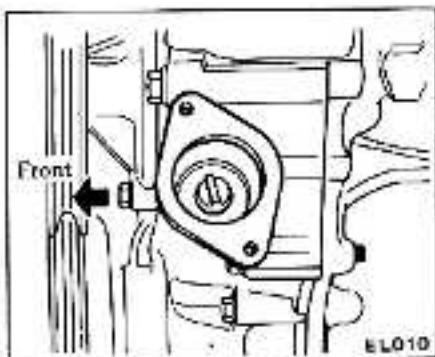
**T** : Oil pump bolts

11 - 15 N·m  
(1.1 - 1.5 kg·m,  
8 - 11 ft·lb)

- Assemble oil pump and drive spindle, aligning driving spindle face with oil pump hole.



- Install oil pump together with drive spindle so that the projection on its top is located at the 11:25 a.m. position. At this point, the smaller bow-shape will be facing toward the front.



Be sure to install gasket.

- Install oil strainer and oil pan with gasket in place.

**T : Oil strainer bolts**

10 - 16 N·m  
(1.0 - 1.6 kg-m,  
7 - 12 ft-lb)

**Oil pan bolts**

6.9 - 9.8 N·m  
(0.6 - 1.0 kg-m,  
4.3 - 7.2 ft-lb)

- Apply sealant to the step portions at four mating surfaces.
- Oil pan should be tightened in criss-cross pattern.

- Adjust valve clearance to the specified dimensions using Tool.

**T : 49 - 59 N·m**  
(5.0 - 6.0 kg-m,  
36 - 43 ft-lb)

**Valve clearance:**

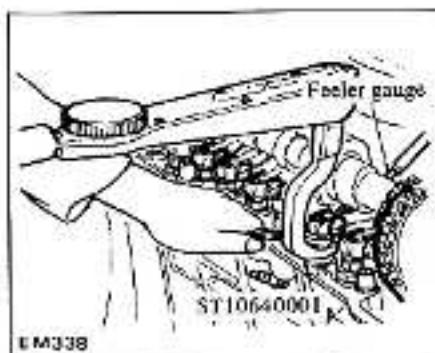
Cold - Intake  
0.20 mm (0.008 in)

Cold - Exhaust  
0.25 mm (0.010 in)

Hot - Intake  
0.25 mm (0.010 in)

Hot - Exhaust  
0.30 mm (0.012 in)

- First set clearance to the cold specifications.

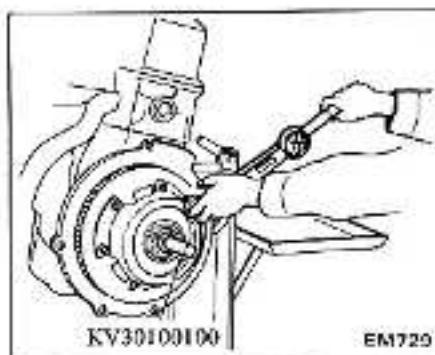


- After engine has been assembled, run it for at least several minutes, finally adjust the clearance to the hot specifications.

- Install the following outer parts and electrical parts.

For tightening torque specifications, refer to S.D.S.

- Rocke: cover
- Exhaust manifold and intake manifold with gasket
- Fuel line
- Water inlet and thermostat housing
- Water piping
- Engine slinger
- Idler pulley and air conditioning compressor mounting bracket (if so equipped)
- Distributor
- High tension cable
- Engine mounting bracket L.H.
- Clutch assembly, using Tool



- Using an overhead hoist and lifting cable, hoist engine away from engine stand and remove engine attachment.

- Install alternator bracket adjusting bar, alternator, cooling fan and belt.

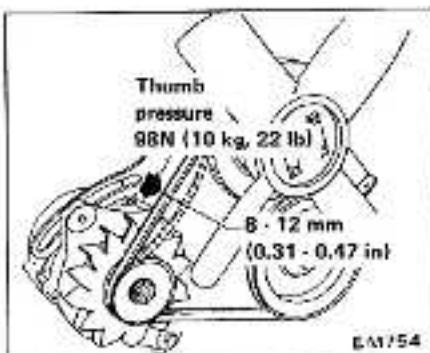
Be sure that belt deflection is held within specified range when moderate force is applied midway between pulleys.

**Belt deflection:**

8 - 12 mm  
(0.31 - 0.47 in)

**Thumb pressure:**

98 N (10 kg, 22 lb)



- Install engine mounting bracket R.H., oil filter, oil pressure switch or gauge unit and oil level gauge. When installing oil filter, fasten it to cylinder block by hand.

Do not overtighten filter, otherwise oil leakage may occur.

- Fill engine oil up to specified level.

# SERVICE DATA AND SPECIFICATIONS

## INSPECTION AND ADJUSTMENT

### CYLINDER HEAD AND VALVE

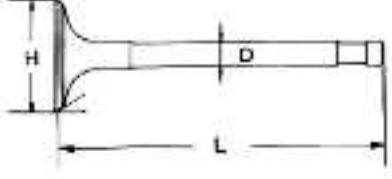
#### Cylinder head

Unit: mm (in)

	Standard	Limit
Head surface flatness	Less than 0.05 (0.0020)	0.1 (0.004)

#### Valve

Unit: mm (in)



SEM232

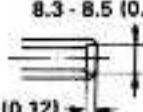
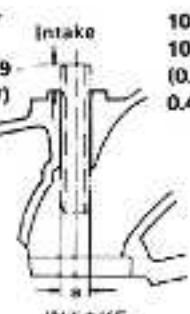
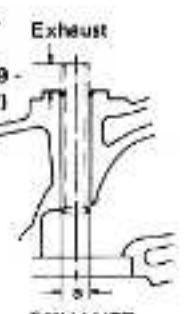
Valve head diameter "H"	In.	42.0 - 42.2 (1.654 - 1.661)
	Ex.	35.0 - 35.2 (1.378 - 1.386)
Valve length "L"	In.	114.9 - 115.2 (4.52 - 4.54)
	Ex.	115.7 - 116.0 (4.56 - 4.57)
Valve stem diameter "D"	In.	7.965 - 7.980 (0.3136 - 0.3142)
	Ex.	7.945 - 7.960 (0.3128 - 0.3134)
Valve face angle "α"	In.	45°30'
	Ex.	

#### Valve spring

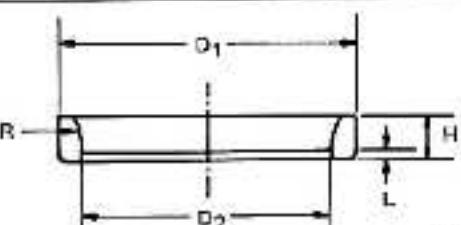
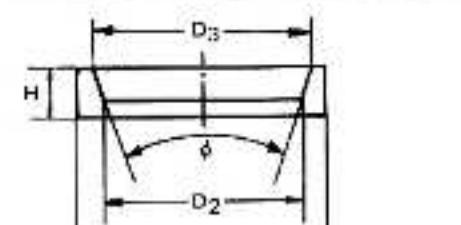
Free height	Intake	Outer mm (in)	49.98 (1.9677)
		Inner mm (in)	44.85 (1.7657)
Exhaust	Outer mm (in)	49.98 (1.9677)	
	Inner mm (in)	44.85 (1.7657)	
Loaded length	Intake	Outer mm/N (mm/kg, in/lb)	29.5/480.5 (29.5/49.0, 1.161/108.0)
		Inner mm/N (mm/kg, in/lb)	24.5/250.1 (24.5/25.5, 0.965/56.2)
Assembled height	Exhaust	Outer mm/N (mm/kg, in/lb)	29.5/480.5 (29.5/49.0, 1.161/108.0)
		Inner mm/N (mm/kg, in/lb)	24.5/250.1 (24.5/25.5, 0.965/56.2)
	Intake	Outer mm/N (mm/kg, in/lb)	40.0/208.9 (40.0/21.3, 1.575/47.0)
		Inner mm/N (mm/kg, in/lb)	35.0/120.6 (35.0/12.3, 1.378/27.1)
	Exhaust	Outer mm/N (mm/kg, in/lb)	40.0/208.9 (40.0/21.3, 1.575/47.0)
		Inner mm/N (mm/kg, in/lb)	35.0/120.6 (35.0/12.3, 1.378/27.1)

#### Valve guide

Unit: mm (in)

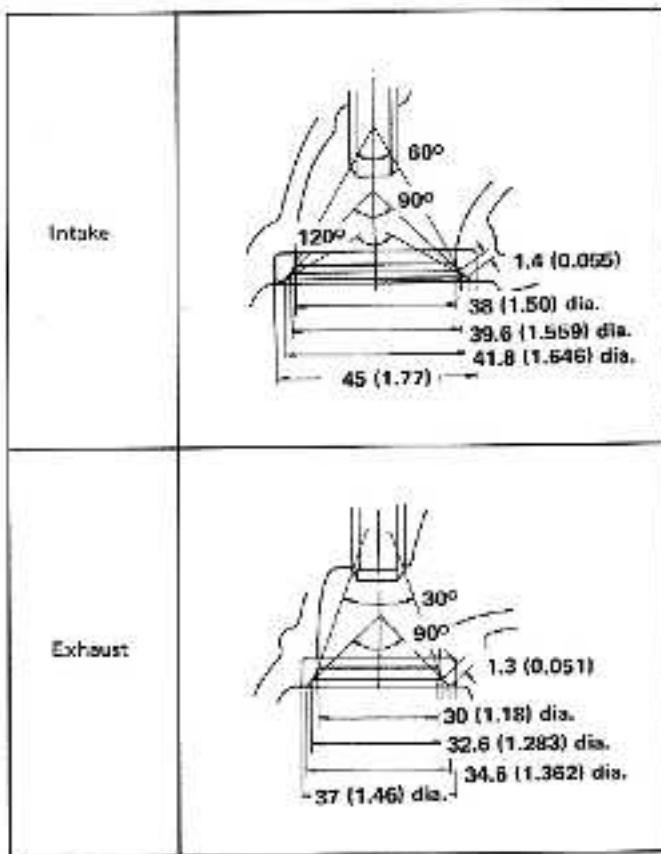
EXHAUST	8.3 - 8.5 (0.327 - 0.335) dia. 	
INTAKE	 d D 10.7 - 11.0 (0.421 - 0.433) 59.0 (2.323)	
EM730		
Intake	 10.4 - 10.6 (0.409 - 0.417)	
Exhaust	 10.4 - 10.6 (0.409 - 0.417)	
EM116		
	Standard Service	
Valve guide Outer diameter "D"	12.023 - 12.034 (0.4733 - 0.4738)	12.223 - 12.234 (0.4812 - 0.4817)
Valve guide Inner diameter "d" [Finished size]	8.000 - 8.018 (0.3150 - 0.3157)	
Cylinder head valve guide hole diameter "a"	11.985 - 11.996 (0.4718 - 0.4723)	12.185 - 12.196 (0.4797 - 0.4802)
Interference fit of valve guide	0.027 - 0.049 (0.0011 - 0.0019)	
	Standard Max. tolerance	
Stem to guide clearance	In. 0.020 - 0.053 (0.0008 - 0.0021)	0.1 (0.004)
	Ex. 0.040 - 0.073 (0.0016 - 0.0029)	

**Valve seat****Service valve insert dimensions**

		Unit: mm (in)
"Intake"		
Profile		
		FM731
D <sub>1</sub>	45.697 - 45.613 (1.7962 - 1.7856)	
D <sub>2</sub>	37.9 - 38.1 (1.492 - 1.500)	
H	6.7 - 6.8 (0.264 - 0.268)	
L	1.0 - 2.0 (0.039 - 0.079)	
R	9 (0.35)	
"Exhaust"		
Profile		
		FM733
D <sub>1</sub>	37.680 - 37.596 (1.4795 - 1.4802)	
D <sub>2</sub>	29.9 - 30.1 (1.177 - 1.185)	
D <sub>3</sub>	32.5 - 32.7 (1.280 - 1.287)	
H	7.4 - 7.5 (0.291 - 0.295)	
φ	30°	

**Finished size of service valve insert cutter**

Unit: mm (in)

**Cylinder head recess diameter**

Unit: mm (in)

In.	For standard insert	45.000 - 45.016 (1.7717 - 1.7723)
	For service insert	45.600 - 45.616 (1.7913 - 1.7920)
Ex.	For standard insert	37.000 - 37.016 (1.4567 - 1.4573)
	For service insert	37.500 - 37.516 (1.4764 - 1.4770)

**Interference fit**

Unit: mm (in)

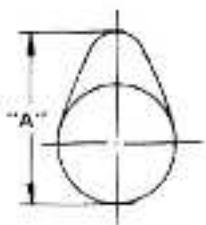
In.	0.081 - 0.113 (0.0032 - 0.0044)
Ex.	0.064 - 0.096 (0.0025 - 0.0038)

## Service Data and Specifications – ENGINE MECHANICAL

### CAMSHAFT AND CAMSHAFT BEARING

Unit: mm (in)

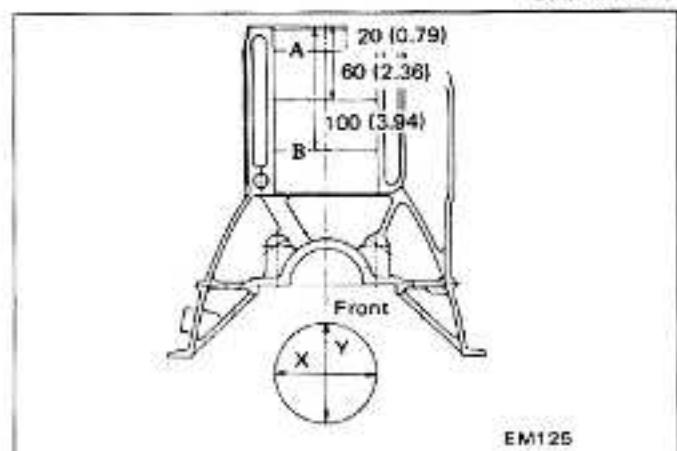
	Standard	Max. tolerance
Camshaft journal to bearing clearance (Oil clearance)	0.038 - 0.067 (0.0015 - 0.0026)	0.1 (0.004)
Inner diameter of camshaft bearing	48.000 - 48.016 (1.8898 - 1.8904)	—
Outer diameter of camshaft journal	47.949 - 47.962 (1.8878 - 1.8883)	—
Camshaft bend	Less than 0.02 (0.0008)	0.05 (0.0020)
Camshaft end play	0.08 - 0.38 (0.0031 - 0.0150)	



EM671

### CYLINDER BLOCK

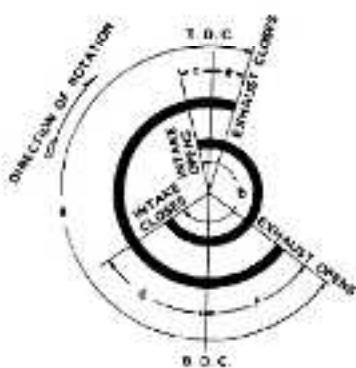
Unit: mm (in)



EM125

	Standard	Wear limit
Surface flatness	Less than 0.05 (0.0020)	0.10 (0.0038)
Cylinder bore	Inner diameter	85.000 - 86.050 (3.3465 - 3.3494)
	Out-of-round (X-Y)	Less than 0.015 (0.0006)
	Taper (A-B)	Less than 0.015 (0.0006)
Difference in inner diameter between cylinders	Less than 0.05 (0.0020)	0.2 (0.008)
Piston to cylinder clearance	0.025 - 0.045 (0.0010 - 0.0018)	—
Extracting force N (kg, lb)	2.0 - 14.7 (0.2 - 1.5, 0.4 - 3.3)	

### Valve timing



Unit: degree

a	b	c	d	e	f
248	248	16	52	14	54

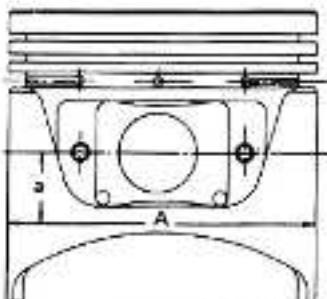
### Cylinder liner for service

Unit: mm (in)

	Outside diameter	Inner diameter
4.0 (0.1575) Undersize	89.00 - 89.05 (3.5039 - 3.5059)	84.50 - 84.60 (3.3268 - 3.3307)
4.5 (0.1772) Undersize	89.50 - 89.55 (3.5236 - 3.5256)	
5.0 (0.1969) Undersize	90.00 - 90.05 (3.5433 - 3.5453)	

**PISTON, PISTON RING AND PISTON PIN****Piston**

Unit: mm (in)



a: About 20 (0.791)

EM714

Piston diameter "A"	Standard	84.985 - 85.035 (3.3459 - 3.3478)
	0.50 (0.0197) Oversize	85.465 - 85.515 (3.3648 - 3.3667)
	1.00 (0.0394) Oversize	85.985 - 86.015 (3.3844 - 3.3864)

**Side clearance**

	Standard	Wear limit
Top ring	0.045 - 0.08 (0.0018 - 0.0031)	0.1 (0.004)
Second ring	0.030 - 0.070 (0.0012 - 0.0028)	
Oil ring	—	—

**Ring gap**

	Standard	Wear limit
Top ring	0.35 - 0.55 (0.0138 - 0.0217)	
Second ring	0.30 - 0.50 (0.0118 - 0.0197)	1.0 (0.039)
Oil ring	0.30 - 0.90 (0.0118 - 0.0364)	

**Piston pin**

	Standard
Piston pin outside diameter	20.993 - 20.998 (0.8265 - 0.8267)
Piston pin hole diameter	21.001 - 21.006 (0.8268 - 0.8271)
Piston pin to piston clearance	0.006 - 0.013 (0.0002 - 0.0005)
Interference fit of piston pin to connecting rod	0.015 - 0.033 (0.0006 - 0.0013)

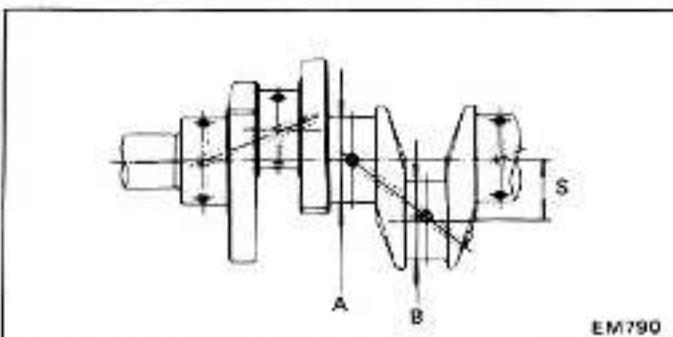
**CONNECTING ROD**

Unit: mm (in)

	Standard	Limit
Connecting rod bend or torsion [per 100 mm (39.37 in) length]	Less than 0.03 (0.0012)	0.05 (0.0020)
Big end play	0.2 - 0.3 (0.008 - 0.012)	0.6 (0.024)

**CRANKSHAFT**

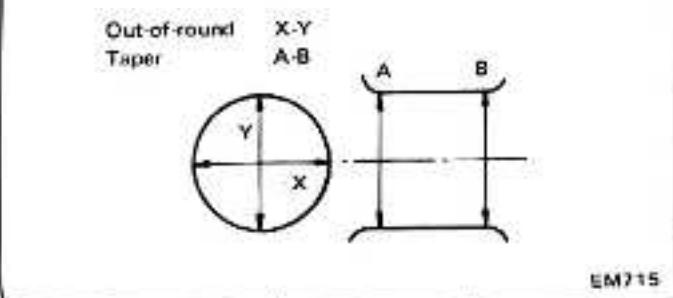
Unit: mm (in)



Journal diameter "A" 54.942 - 54.955 (2.1631 - 2.1636)

Pin diameter "B" 49.961 - 49.974 (1.9670 - 1.9675)

"S" 38.87 - 39.03 (1.5303 - 1.5366)



EM715

	Standard	Limit
Taper of journal and pin "A-B"	Less than 0.01 (0.0004)	0.03 (0.0012)
Out-of-round of journal and pin "X-Y"	Less than 0.01 (0.0004)	0.03 (0.0012)
Crankshaft bend	Less than 0.025 (0.0010)	0.05 (0.0020)
Crankshaft free end play	0.05 - 0.18 (0.0020 - 0.0071)	0.30 (0.0118)
Pilot bushing inserting distance	.....	4.0 (0.157)

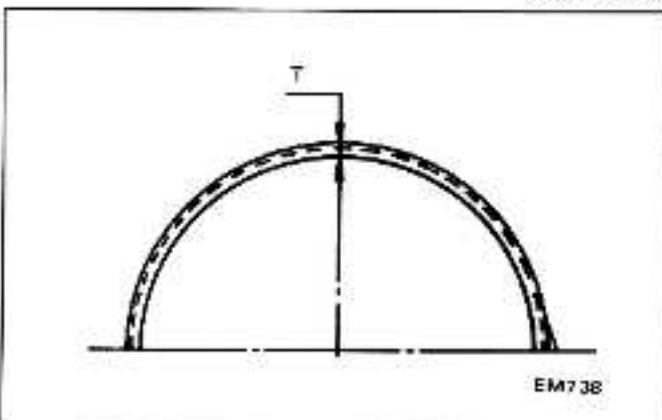
**BEARING****Bearing clearance**

Unit: mm (in)

	Standard	Limit
Main bearing clearance	0.020 - 0.062 (0.0008 - 0.0024)	0.12 (0.0047)
Connecting rod bearing clearance	0.025 - 0.058 (0.0010 - 0.0022)	0.12 (0.0047)

**Main bearing undersize**

Unit: mm (in)



	Bearing top thickness "T"	Crank journal diameter
STD	1.822 - 1.836 (0.0717 - 0.0722)	54.942 - 54.955 (2.1631 - 2.1636)
0.25 (0.0098) Undersize	1.947 - 1.960 (0.0767 - 0.0772)	54.892 - 54.705 (2.1532 - 2.1537)
0.50 (0.0197) Undersize	2.072 - 2.085 (0.0815 - 0.0821)	54.442 - 54.455 (2.1434 - 2.1439)
0.75 (0.0295) Undersize	2.197 - 2.210 (0.0865 - 0.0870)	54.192 - 54.205 (2.1336 - 2.1341)
1.00 (0.0394) Undersize	2.322 - 2.336 (0.0914 - 0.0919)	53.942 - 53.955 (2.1237 - 2.1242)

**Connecting rod bearing undersize**

Unit: mm (in)

	Bearing top thickness "T"	Crank journal diameter
STD	1.493 - 1.506 (0.0588 - 0.0593)	49.981 - 49.974 (1.9670 - 1.9675)
0.08 (0.0032) Undersize	1.523 - 1.536 (0.0600 - 0.0606)	49.901 - 49.914 (1.9646 - 1.9651)
0.12 (0.0047) Undersize	1.553 - 1.566 (0.0611 - 0.0617)	49.841 - 49.854 (1.9622 - 1.9628)
0.25 (0.0098) Undersize	1.618 - 1.631 (0.0637 - 0.0642)	49.711 - 49.724 (1.9671 - 1.9676)
0.50 (0.0197) Undersize	1.743 - 1.756 (0.0686 - 0.0691)	49.461 - 49.474 (1.9473 - 1.9478)
0.75 (0.0295) Undersize	1.868 - 1.881 (0.0735 - 0.0741)	49.211 - 49.224 (1.9374 - 1.9379)
1.00 (0.0394) Undersize	1.993 - 2.006 (0.0785 - 0.0790)	48.961 - 48.974 (1.9276 - 1.9281)

**MISCELLANEOUS COMPONENTS****Camshaft sprocket**

Unit: mm (in)

Runout (Total indicator reading) ..... Less than 0.1 (0.004)

**Flywheel**

Runout (Total indicator reading) ..... Less than 0.15 (0.0059)

**TIGHTENING TORQUE**

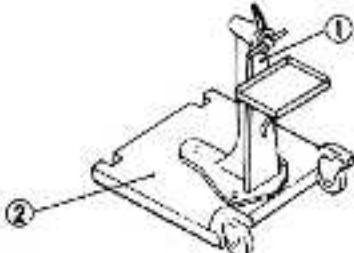
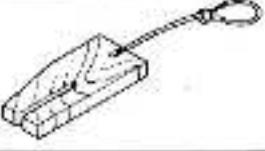
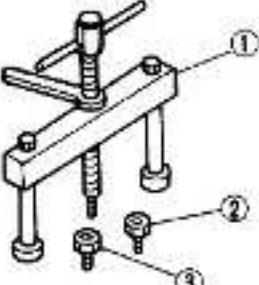
Unit	N·m	kg·m	ft·lb
Main bearing cap bolt	44 - 54	4.5 - 5.5	33 - 40
Connecting rod big end nut	44 - 54	4.5 - 5.5	33 - 40
Flywheel bolt (M/T)	137 - 157	14.0 - 16.0	101 - 116
Drive plate bolt (A/T)	137 - 157	14.0 - 16.0	101 - 116
Front cover bolt	M8	1.0 - 1.6	7 - 12
	M6	0.4 - 0.8	2.9 - 5.8
Cylinder head	69 - 93	7.0 - 8.5	51 - 61
Cylinder head to front cover bolt	3.9 - 7.8	0.4 - 0.8	2.9 - 5.8
Camshaft locating plate bolt	5.9 - 9.8	0.6 - 1.0	4.3 - 7.2
Pivot bushing bolt	78 - 118	8.0 - 12.0	58 - 87
Pivot lock nut	49 - 59	5.0 - 6.0	36 - 43
Camshaft sprocket bolt	118 - 157	12 - 16	87 - 116
Chain guide bolt	5.9 - 9.8	0.6 - 1.0	4.3 - 7.2
Chain tensioner bolt	5.9 - 9.8	0.6 - 1.0	4.3 - 7.2
Oil pump bolt	M8	1.1 - 1.6	8 - 11
Water pump bolt	M8	0.4 - 1.0	2.9 - 7.2
	M8	1.0 - 1.6	7 - 12
Water pump pulley stud	5.9 - 9.8	0.6 - 1.0	4.3 - 7.2
Water inlet bolt	10 - 15	1.0 - 1.6	7 - 12
Crank pulley bolt	118 - 157	12 - 16	87 - 116
Oil strainer bolt	10 - 15	1.0 - 1.6	7 - 12
Oil pan bolt	5.9 - 9.8	0.6 - 1.0	4.3 - 7.2
Oil pan drain plug	20 - 29	2.0 - 3.0	14 - 22
Clutch cover bolt	16 - 21	1.6 - 2.1	12 - 15
Rocker cover bolt	10 - 15	1.0 - 1.6	7 - 12
Spark plug	15 - 20	1.5 - 2.0	11 - 14
Manifold bolt and nut	12 - 16	1.2 - 1.6	9 - 12
Water outlet bolt	12 - 20	1.2 - 2.0	9 - 14
Thermostat housing	12 - 20	1.2 - 2.0	9 - 14
Distributor support bolt	3.9 - 7.8	0.4 - 0.8	2.9 - 5.8
Oil pressure sending unit	10 - 15	1.0 - 1.6	7 - 12
Alternator bracket	39 - 59	4.0 - 6.0	29 - 43
Alternator to adjusting bar bolt	20 - 29	2.0 - 3.0	14 - 22
Engine mounting bracket	29 - 39	3.0 - 4.0	22 - 29

**TROUBLE DIAGNOSES AND CORRECTIONS**

Condition	Probable cause	Corrective action
I. Noisy engine		
Knocking of crankshaft and bearing.	Loose main bearing. Seized bearing. Bent crankshaft. Uneven wear of journal. Excessive crankshaft end play.	Replace. Replace. Repair or replace. Correct. Replace center bearing.
Piston and connecting rod knocking.	Loose bearing. Seized bearing. Loose piston pin. Loose piston in cylinder. Broken piston ring. Improper connecting rod alignment.	Replace. Replace. Replace pin or connecting rod bushing. Recondition cylinder. Replace. Realign rod or replace rod.
Camshaft knocking.	Loose bearing. Excessive axial play. Rough gear teeth. Broken cam gear.	Replace. Replace bearing thrust plate. Repair. Replace.
Timing chain noise.	Improper chain tension. Worn and/or damaged chain. Worn sprocket. Worn and/or broken tension adjusting mechanism. Excessive camshaft and bearing clearance.	Adjust. Replace. Replace. Replace. Replace.
Camshaft and valve mechanism knocking.	Improper valve clearance. Worn adjusting screw. Worn rocker face. Loose valve stem in guide. Weakened valve spring. Seized valve.	Adjust. Replace. Replace. Replace guide. Replace. Repair or replace.
Water pump knocking.	Improper shaft end play. Broken impeller.	Replace. Replace.
II. Other mechanical troubles		
Stuck valve.	Improper valve clearance. Insufficient clearance between valve stem and guide. Weakened or broken valve spring. Seized or damage of valve stem. Poor quality fuel.	Adjust. Clean stem or ream guide. Replace. Replace or clean. Use good fuel.

Condition	Probable cause	Corrective action
Seized valve seat.	Improper valve clearance. Weakened valve spring. Thin valve head edge. Narrow valve seat. Overheating. Over speeding. Stuck valve guide.	Adjust. Replace. Replace valve. Reface. Repair or replace. Drive at proper speed. Repair.
Excessively worn cylinder and piston.	Shortage of engine oil. Dirty engine oil.  Poor quality of oil. Overheating. Wrong assembly of piston with connecting rod.  Improper piston ring clearance. Broken piston ring. Dirty air cleaner. Mixture too rich. Engine over run.	Add or replace oil. Clean crankcase, replace oil and oil filter element.  Use proper oil. Repair or replace. Repair or replace.  Adjust. Replace. Clean. Adjust. Drive at proper speeds.
Faulty connecting rod.	Shortage of engine oil. Low oil pressure. Poor quality engine oil. Rough surface of crankshaft. Clogged oil passage. Bearing worn or eccentric. Bearing improperly assembled. Loose bearing. Incorrect connecting rod alignment.	Add oil. Correct. Use proper oil. Grind and replace bearing. Clean. Replace. Correct. Replace. Repair or replace.
Faulty crankshaft bearing.	Shortage of engine oil. Low oil pressure. Poor quality engine oil. Crankshaft journal worn or out-of-round. Clogged oil passage in crankshaft. Bearing worn or eccentric. Bearing improperly assembled. Eccentric crankshaft or bearing.	Add or replace. Correct. Use specified oil. Repair. Clean. Replace. Correct. Replace.

**SPECIAL SERVICE TOOLS**

Tool number	Tool name
ST19320000	Oil filter wrench  SLC038
KV10105001 (KV10105000)	Engine attachment 
ST0501S000 ① ST05011000 ② ST05012000	Engine stand assembly Engine stand Base 
ST16540000	Puller crank pulley 
KV10105800 (ST17420001)	Chain stopper 
ST10120000	Cylinder head bolt wrench 
KV10104180 ① KV10104110 ② ST16512001 ③ ST16701001	Crankshaft main bearing cap puller Crankshaft main bearing puller Adapter Adapter 
ST13030001	Piston pin press stand 

Tool number	Tool name
ST12070000	Valve lifter
KV101039S0 ① ST11081000 ② ST11032000 ③ ST11320000	Valve guide reamer set Reamer [12.2 mm (0.480 in) dia.] Reamer [8.0 mm (0.315 in) dia.] Drift
ST11650001	Valve seat cutter set
ST16610001	Pilot bushing puller
KV10105500 (ST15310000)	Crankshaft rear oil seal drift
EM03470000	Piston ring compressor
ST10640001	Pivot adjuster
KV30100100	Clutch aligning bar

