SERVICE MANUAL

MODEL
L20A, L24 SERIES
ENGINE

NISSAN

NISSAN MOTOR CO., LTD.
TOKYO, JAPAN

SECTION EM

ENGINE MECHANICAL

EM

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GENERAL DESCRIPTION

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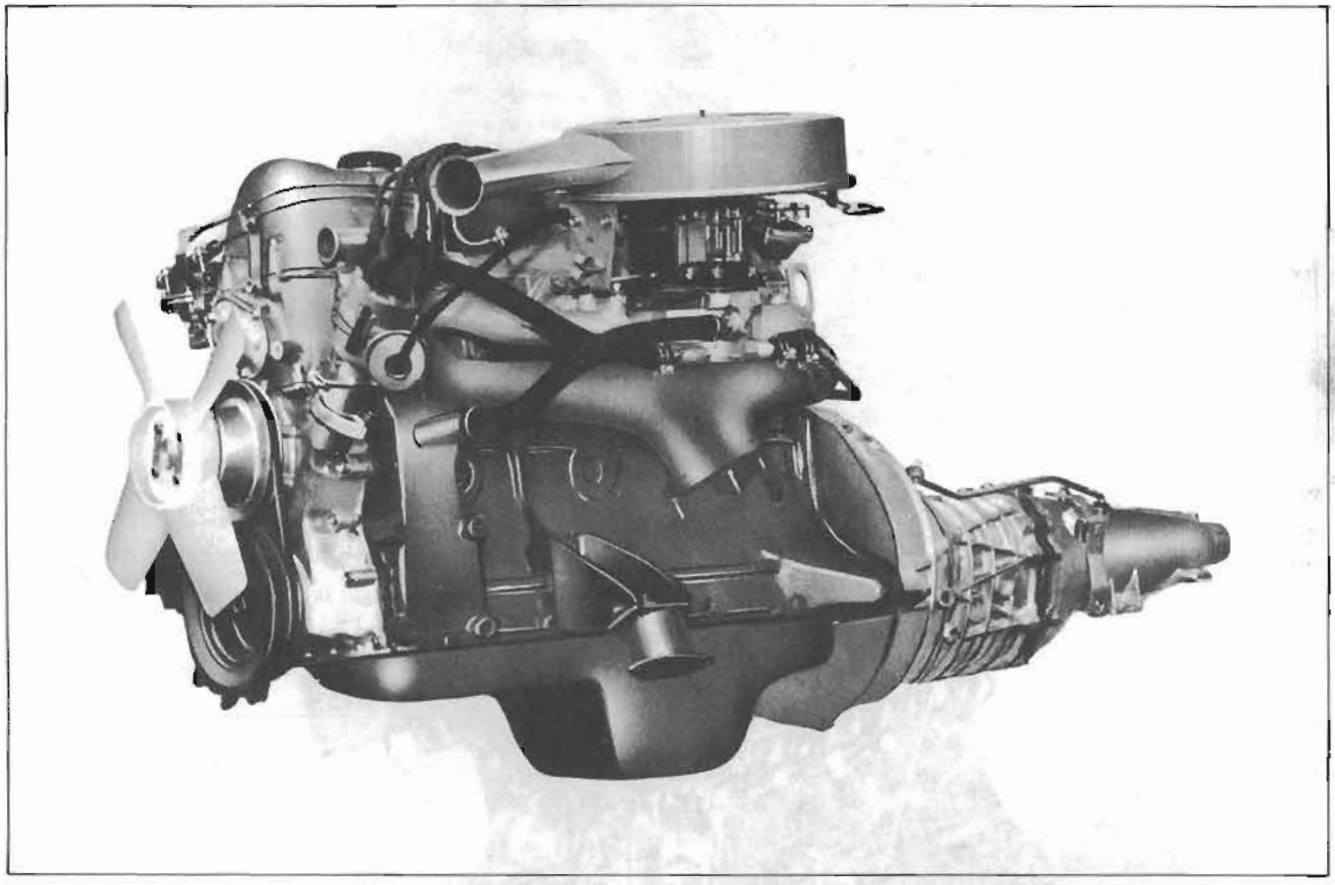


Fig. EM-1 General view of L20A engine

L20A ENGINE

L20A engine is a 1,998 cc (121.9 cu in) in line overhead camshaft six-cylinder engine and has 78 mm (3.071 in) bore and 69.7 mm (2.744 in) stroke with a compression ratio of 8.6 : 1.

This engine is of a light-weight design using many aluminum diecast parts.

Using a two barrel type single carburetor, L20A engine develops a maximum output of 115 HP/5,600 rpm (SAE).

L24 ENGINE

L24 engine is a 2,393 cc (146.0 cu in) in line overhead camshaft six-cylinder engine and has 83 mm (3.2677 in) bore and 73.7 mm (2.9026 in) stroke.

This engine is of the same design and external appearance as L20A engine, differing principally bore, stroke, power and dimensions of parts to bear higher output.

L24 engine is available in two types. In one type, which uses two SU type carburetors, it develops a maximum output of 151 HP/5,600 rpm (SAE) at a compression ratio of 9.0 : 1.

The other type, which uses a single carburetor of a two barrel type, is capable of a maximum output of 130 HP/5,600 rpm (SAE) at a compression ratio of 8.55 : 1.

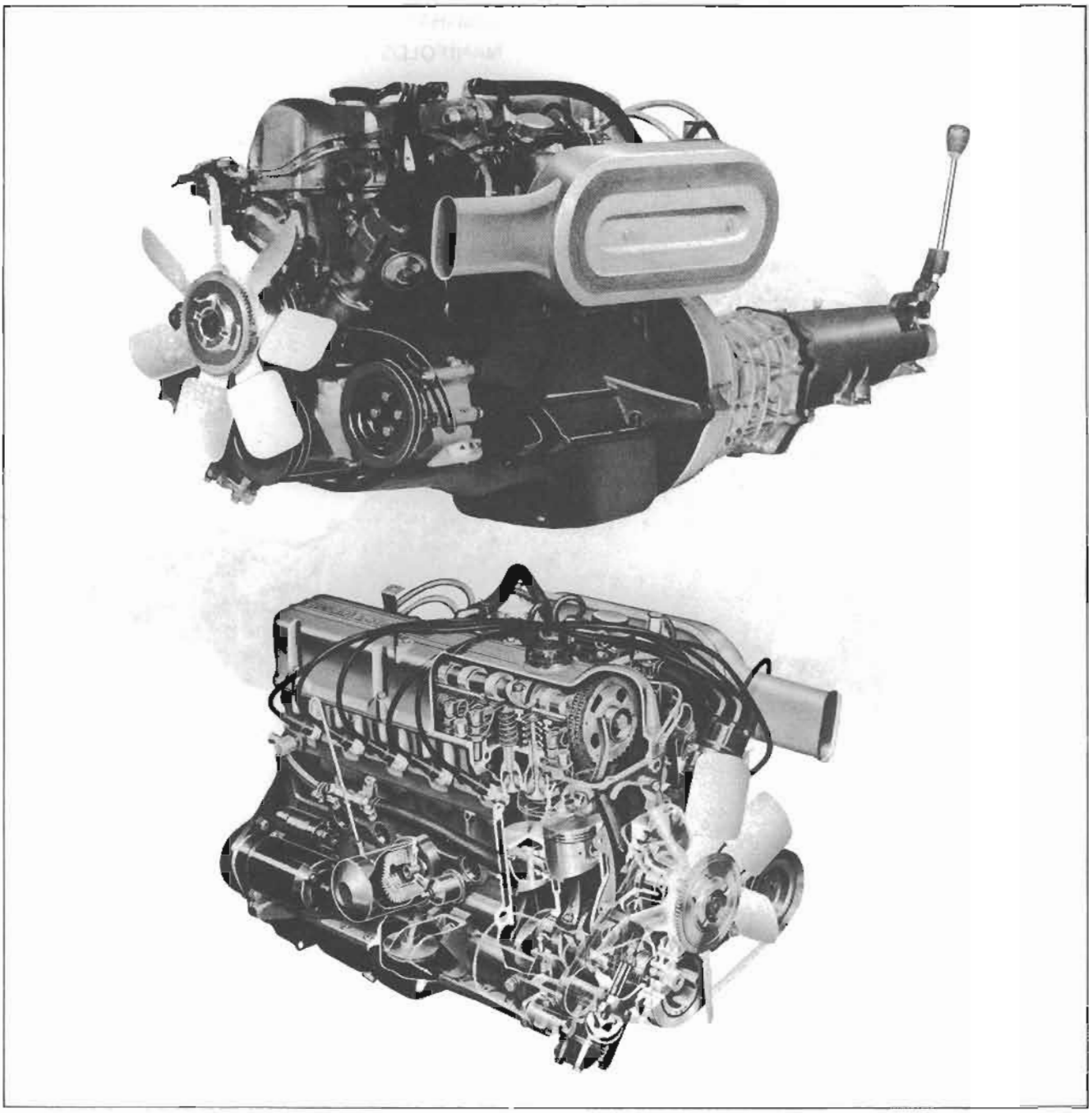


Fig. EM-2 General view of L24 engine

CYLINDER BLOCK

The cylinder block, which is of a monoblock special casting structure, adopts the seven bearing-support system, for quietness and higher durability. Of a highly rigid deep-skirt design, it requires no complicated tappet chamber because of the OHC engine system and thus is light-weight.

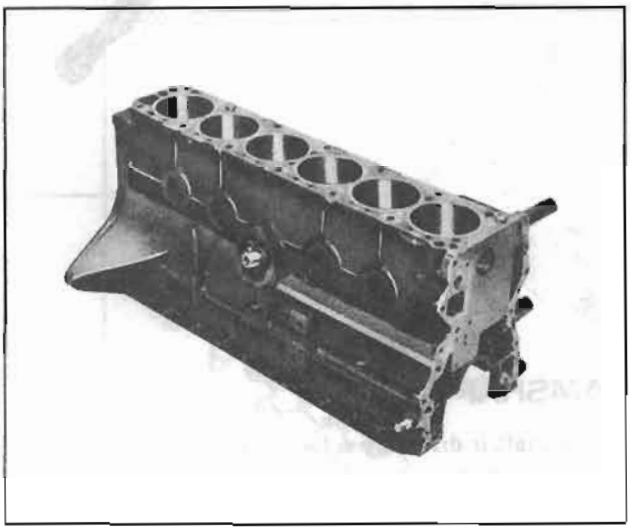


Fig. EM-3 Cylinder block

CRANKSHAFT

The crankshaft is fabricated of special forged steel. Provided with a high capacity balance weight, it shows quietness and high durability at high speed operation. Main bearings are lubricated from oil holes which intersect the main oil gallery which runs parallel to the cylinder bores.

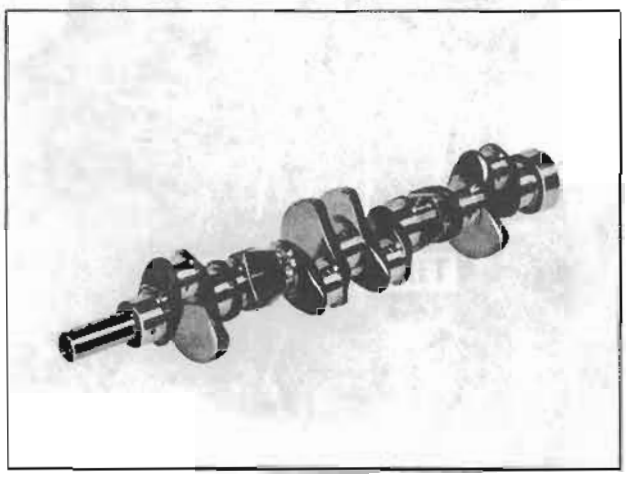


Fig. EM-4 Crankshaft

PISTONS AND CONNECTING RODS

New-design light-weight pistons are of cast aluminum slipper-skirt type with invar-strut. The piston pin is of a special steel hollow type and is connected to the piston in a full floating fit, and is press-fitted onto the connecting rod.

Connecting rods are made of forged steel. Full pressure lubrication is directed to the connecting rods by drilled oil passages from the adjacent main bearing journal. Oil holes at the connecting rod journals are located so that oil is supplied to give maximum lubrication just proper to full bearing load.

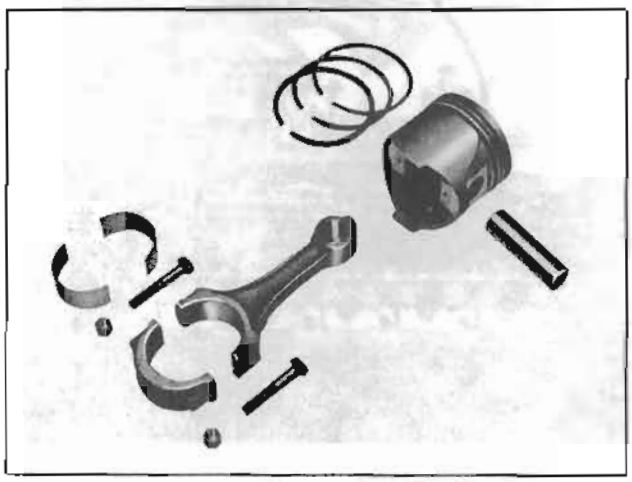


Fig. EM-5 Piston and connecting rod

CYLINDER HEAD

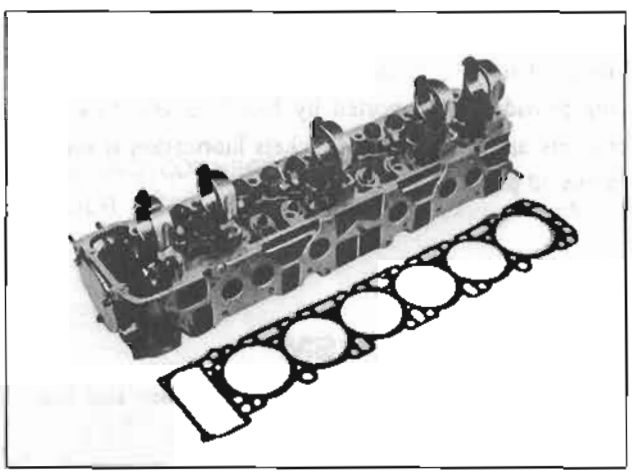


Fig. EM-6 Cylinder head

The cylinder head is made of light and strong aluminum alloy with good cooling efficiency. A special aluminum cast valve seat is used on the intake valve, while a special cast valve seat is installed on the exhaust valve.

These parts are all hot press-fitted.

CAMSHAFT

Camshaft is made of special cast iron and located inside the rocker cover. In this engine five aluminum alloy brackets support the camshaft.

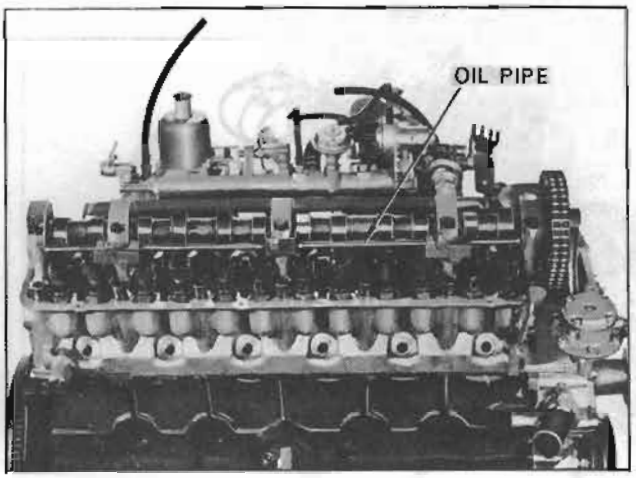


Fig. EM-7 Camshaft

Camshaft bearings are lubricated from oil holes which intersect the main oil gallery of the cylinder head.

There is no oil gallery in the camshaft and to lubricate the cam pad surface of the rocker arm an oil pipe with many oil holes is provided along the camshaft. This oil pipe provided is supported by No. 1, 3 and 5 camshaft brackets and from No. 3 brackets lubrication is supplied to this oil pipe.

VALVE MECHANISM

The valve system has a pivot type rocker arm that is activated directly by the cam mechanism, and this has made its moving parts considerably lighter and provides an ideal high-speed performance.

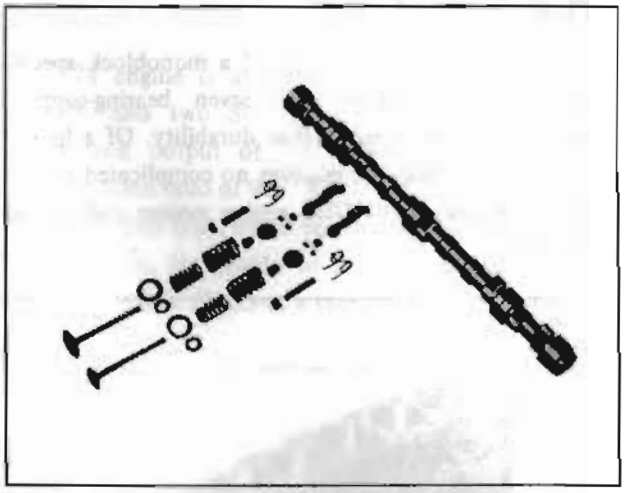


Fig. EM-8 Valve mechanism

CAMSHAFT DRIVE

Camshaft is driven by a double row roller chains driven by crankshaft. The tension of the chain is controlled by a chain tensioner which are operated by spring and oil pressure.

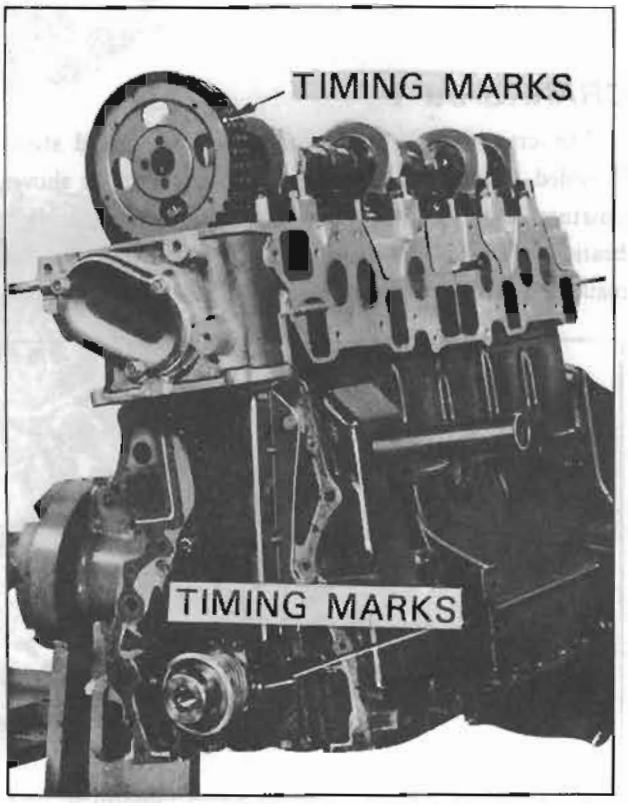
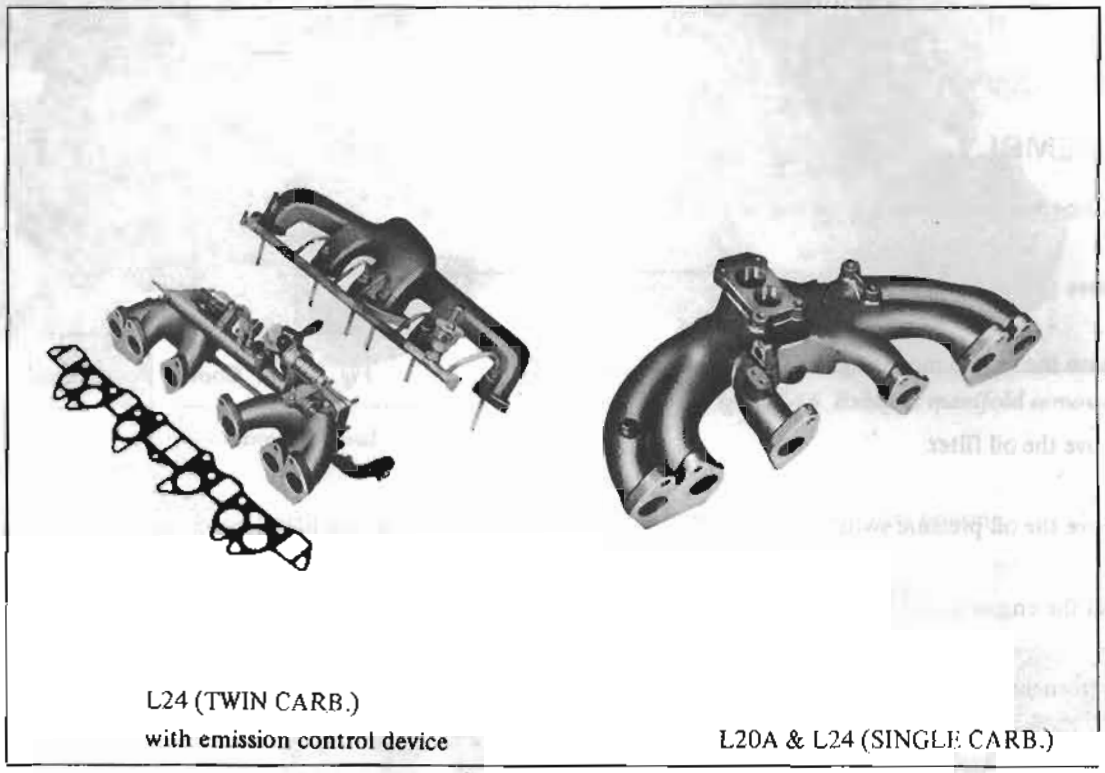


Fig. EM-9 Camshaft driving chain

MANIFOLDS

The intake manifold is aluminum cast.

The exhaust manifold types, is a dual exhaust system intended to prevent decline in output due to exhaust interference and to increase output through the inertia scavenging action. It is connected to exhaust pipes by flanges, which insure complete absence of exhaust leaks.



L24 (TWIN CARB.)
with emission control device

L20A & L24 (SINGLE CARB.)

Fig. EM-10 Exhaust and intake manifold

ENGINE DISASSEMBLY

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CLEANING AND INSPECTING

Wash the engine thoroughly before disassembly. Before washing, remove the alternator and starter, and plug up the carburetor air cleaner to avoid any infiltration of foreign matter.

1. The exterior of the engine: check the covers and bolts for breakage, rust, damage and loss.

2. Cylinder block: check thoroughly the water jacket

for cracks and breakage.

3. Clutch housing: check for cracks.

4. Oil pan: check for excessive rust.

DISASSEMBLY

1. Place the engine assembly on the engine stand.

(1) Remove the oil level gauge.

(2) Remove the engine mounting R.H.

(3) Remove the oil filter.

(4) Remove the oil pressure switch.

(5) Install the engine attachment.

(6) Set the engine on the stand.

Engine stand: ST05010000
Engine attachment: ST05340000

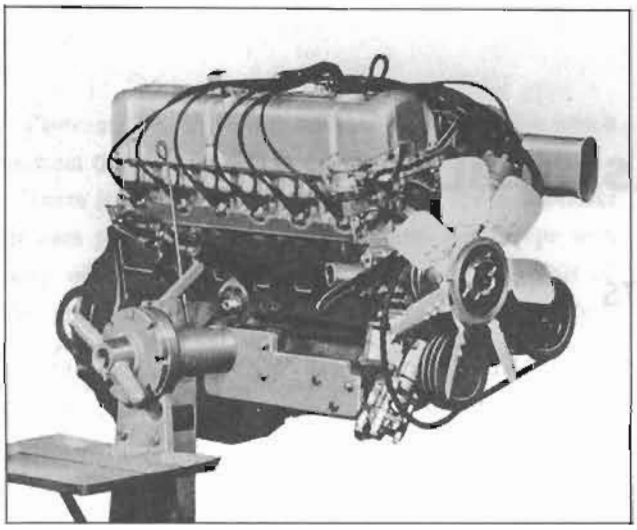


Fig. EM-11 The engine on the engine stand

2. Remove the fan, the fan belt (for all engines) and the air pump belt (only for L24 engine with emission control system).

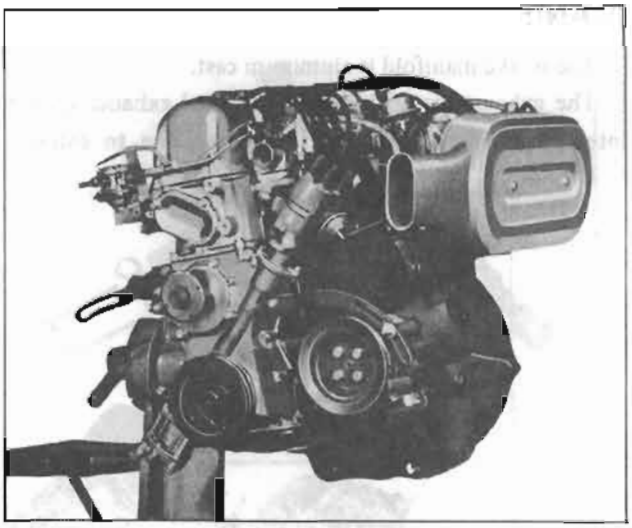


Fig. EM-12 Cooling fan removal

3. Remove the high tension cable (with the distributor cap on).

4. Remove the fuel pump.

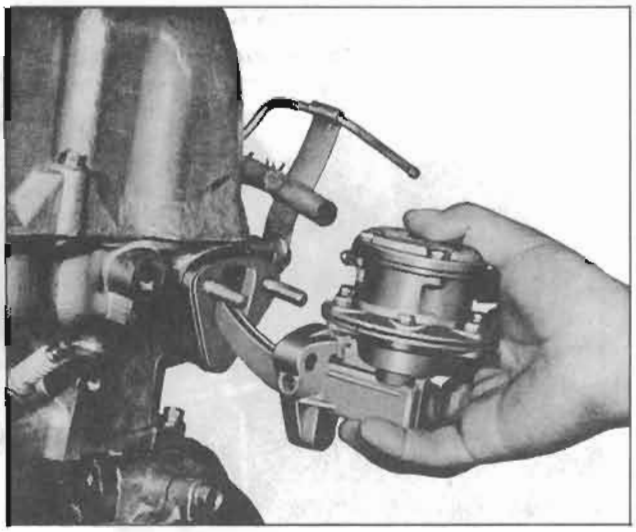


Fig. EM-13 Fuel pump removal

5. Remove the spark plugs.

6. Remove the distributor assembly.

7. Remove the air cleaner.

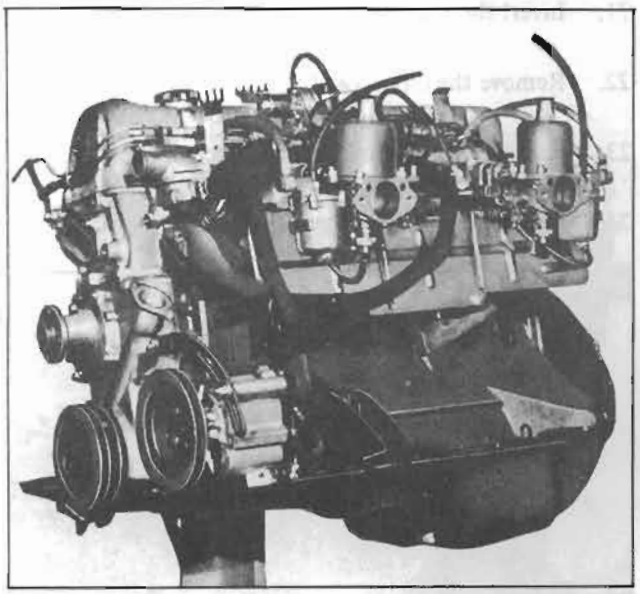


Fig. EM-14 Air cleaner removal

8. Remove the engine mounting bracket (L.H. side).

9. Remove air pump (for L24 engine with emission control system).

10. Remove the fuel line and heater hoses.

11. Remove the heat shield plate.

12. Remove the intake manifold with carburfetor and exhaust manifold.

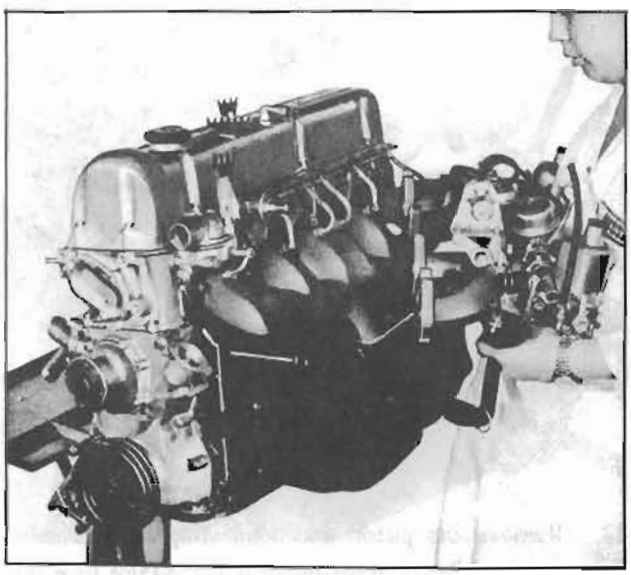


Fig. EM-15 Intake manifold removal



Fig. EM-16 Exhaust manifold removal

13. Remove the thermostat housing.

14. Remove the crank pulley.

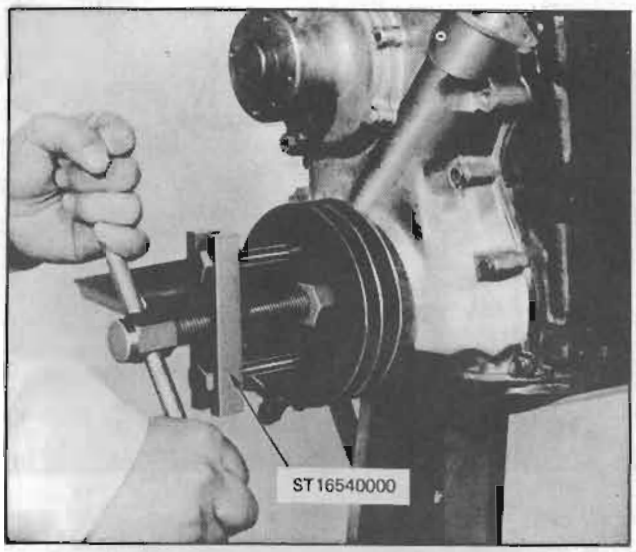


Fig. EM-17 Crank pulley removal

Note: The crank pulley is a vibration damper type. So on removal use a special tool.

Special tool: ST16540000

15. Remove the water pump.

16. Remove the rocker cover.

17. Remove the fuel pump drive cam and the camshaft sprocket.

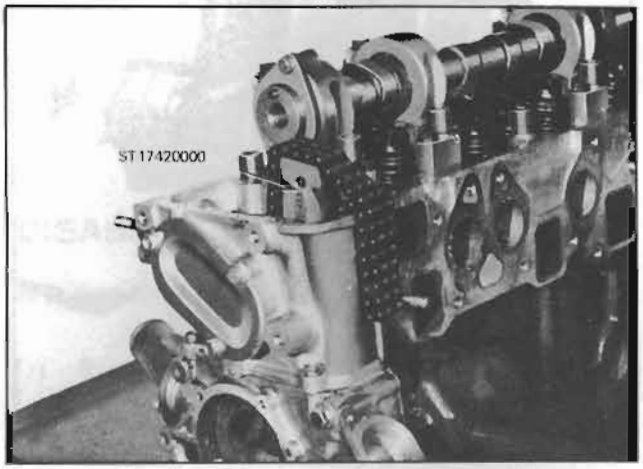


Fig. EM-18 Camshaft drive sprocket removal

18. Remove the oil pipe.

19. Remove the cylinder head assembly. Use a special tool for removing the cylinder head bolts.

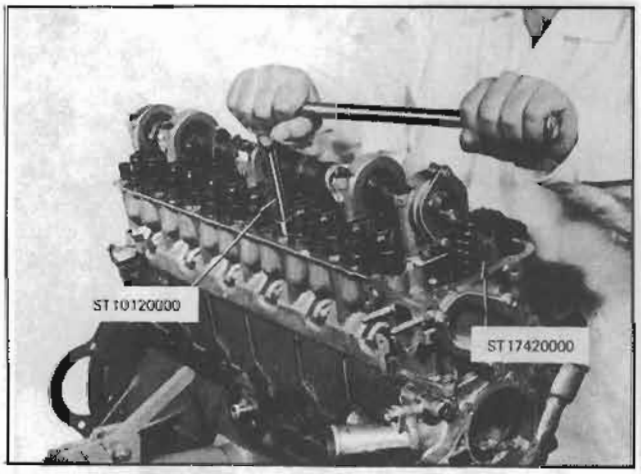


Fig. EM-19 Cylinder head removal

Special tool: ST10120000 and ST17420000

Note: **For the convenience of the cylinder head replacement, a special service tool ST17420000 is prepared to support the timing chain during the service operation. By using this tool, the timing marks on the crankshaft sprocket and the timing chain will be unchanged. So the work for aligning the timing marks will be saved so much.**

20. Remove the flywheel and end plate.

21. Invert the engine.

22. Remove the oil pan and the oil strainer.

23. Remove the oil pump and its drive gear.

24. Remove the front cover.

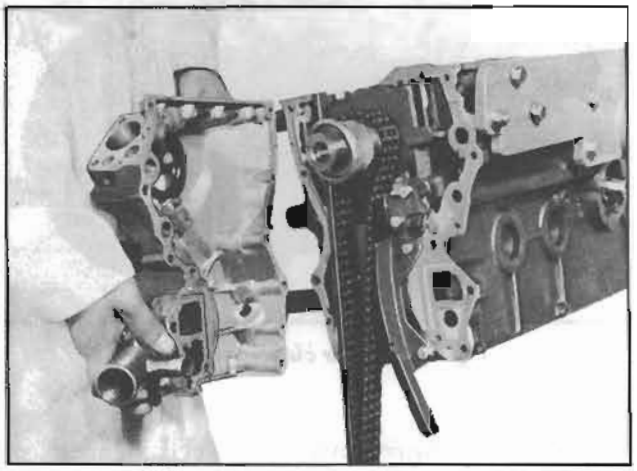


Fig. EM-20 Engine front cover removal

25. Remove the timing chain, chain tensioner and chain guide.

26. Remove the oil thrower, the crankshaft worm gear and the chain drive sprocket.

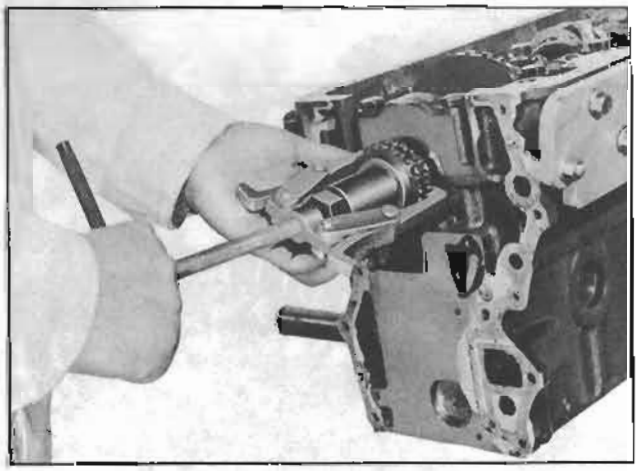


Fig. EM-21 Chain drive sprocket removal

27. Remove the piston and connecting rod assembly. Take off the connecting rod bearings at the same time and keep them in order.

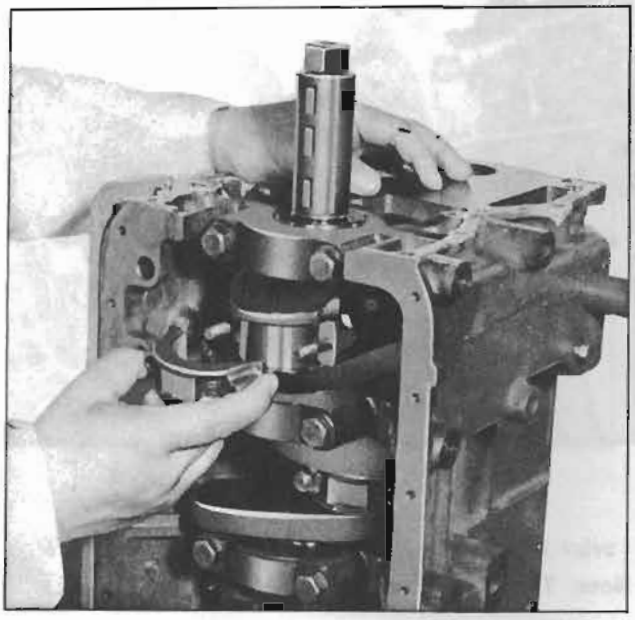


Fig. EM-22 Piston and connecting rod assembly removal

28. Remove the main bearing cap.

Use a special tool for removing the rear main bearing cap.

Special tool: ST16510000

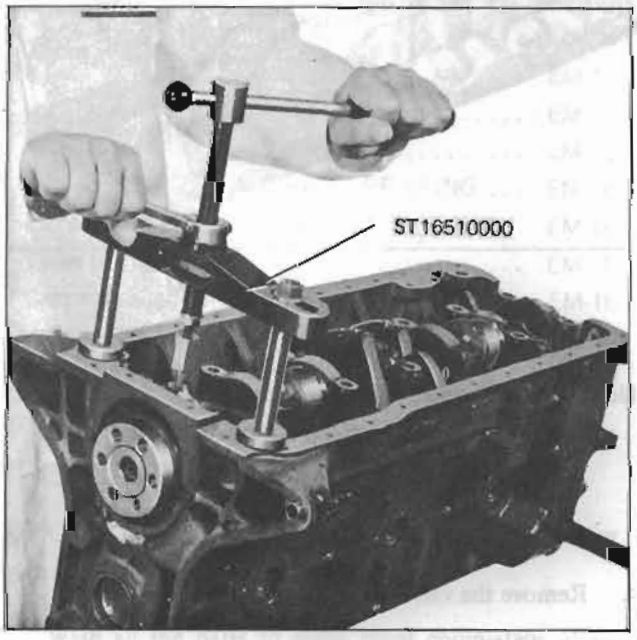


Fig. EM-23 Rear main bearing cap removal

29. Remove the crankshaft rear oil seal.

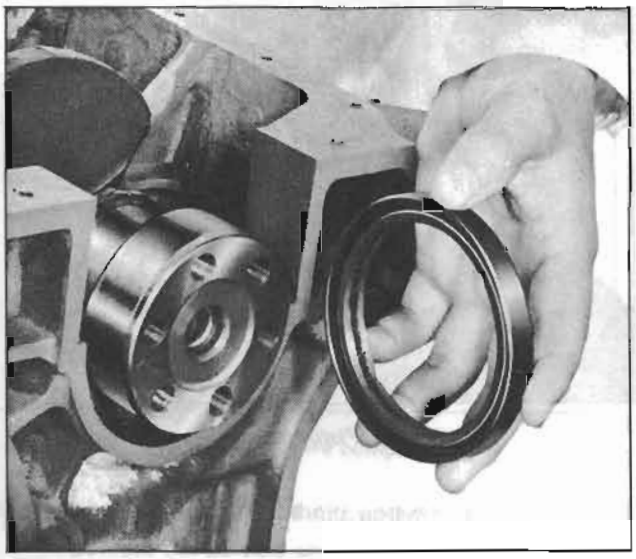


Fig. EM-24 Rear oil seal removal

30. Remove the crankshaft.

31. Remove the buffle plate and the cylinder block net.

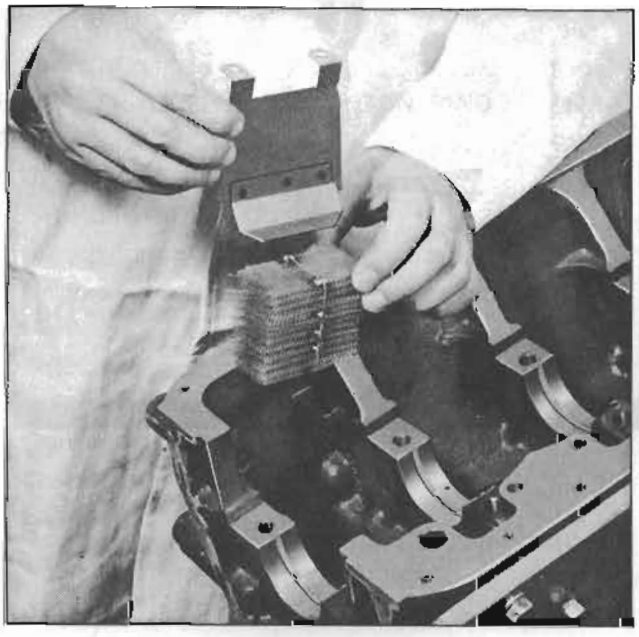


Fig. EM-25 Cylinder block net removal

PISTON AND CONNECTING ROD

1. Remove the piston rings with a ring remover.

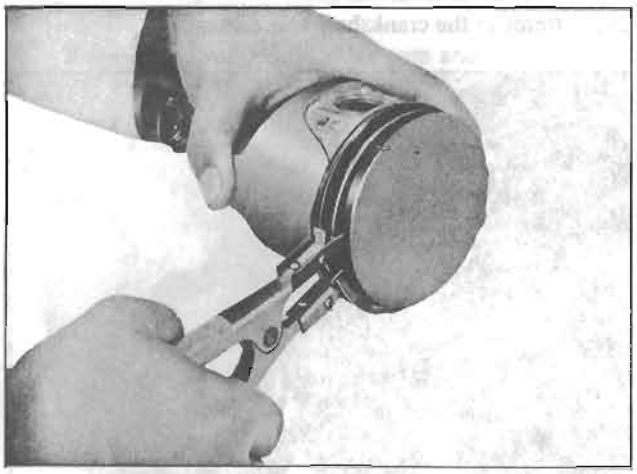


Fig. EM-26 Piston ring removal

2. Press out the piston pin with a piston pin remover and an arbor press.

3. Keep the disassembled parts in order not to mix all parts.

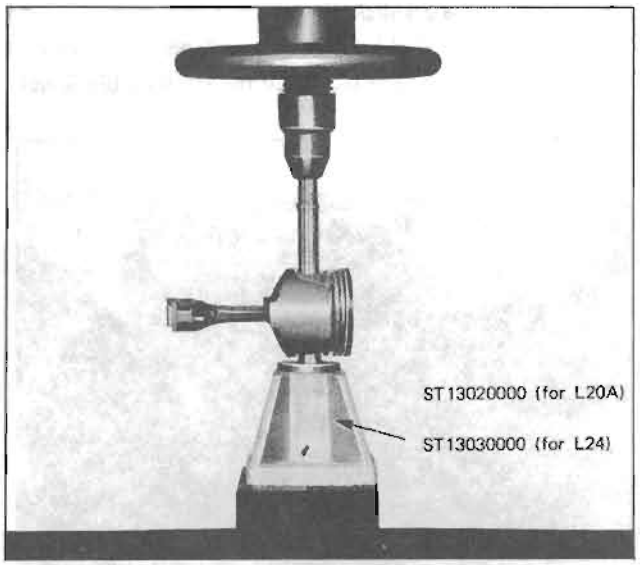


Fig. EM-27 Piston pin removal

Special tool: ST13020000 (for L20A)
ST13030000 (for L24)

CYLINDER HEAD

1. Remove the valve rocker spring.

2. Loosen the valve rocker pivot lock nut and remove the rocker arm by pressing down the valve spring.

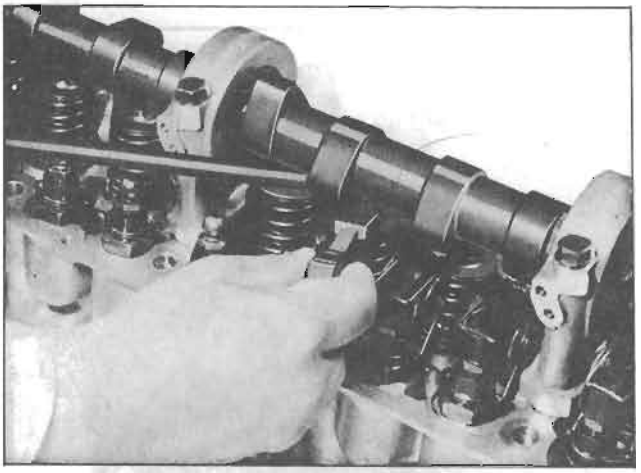


Fig. EM-28 Rocker arm removal

Note: Take care not to lose the valve rocker guide.

3. Remove the camshaft.

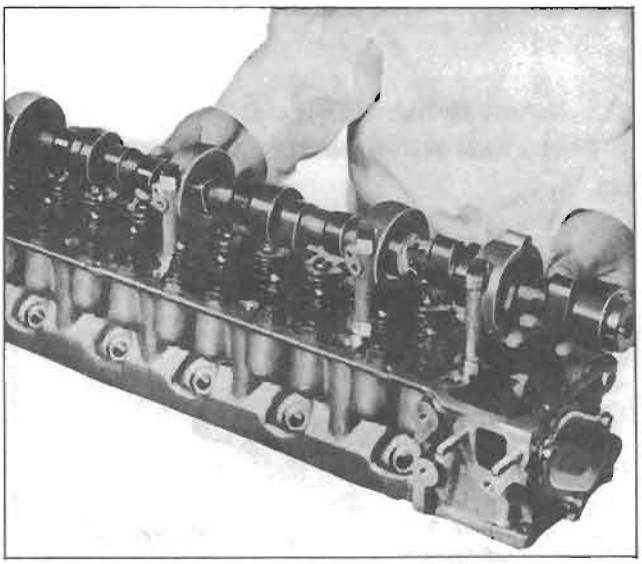


Fig. EM-29 Camshaft removal

Note: At this time, take care not to let the camshaft scratch the cam bushing during removal.

4. Remove the valves using a valve lifter.

Special tool: ST12070000

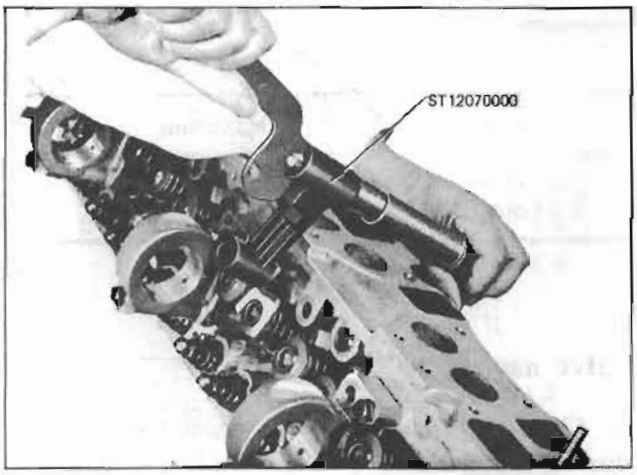


Fig. EM-30 Valve removal

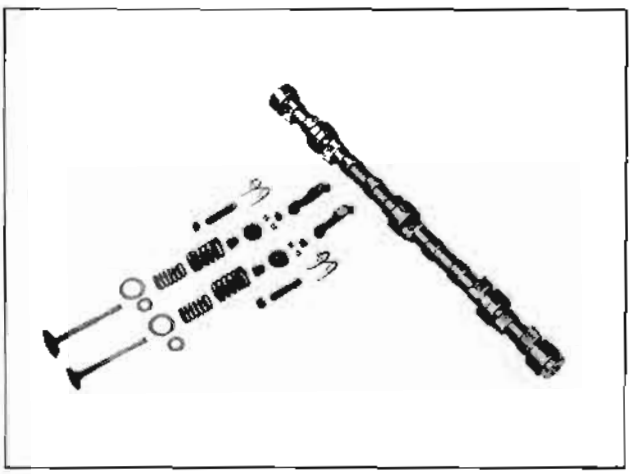


Fig. EM-31 Valve components

5. Take care not to lose valve spring seat, oil seal, valve collet, and valve rocker guide.

Note: Be sure to leave the camshaft bearing intact. Because the bearing centers are liable to be out of alignment.

INSPECTION AND REPAIR

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PREPARATION FOR INSPECTION

1. Check the cylinder head and the cylinder block for traces of water leaks before cleaning.

2. Wash all the parts to clean them completely of oil stains, carbon deposits, fur, and sealing material.

3. Ascertain if all the oil holes are clear by blowing air into them.

4. Use every caution to secure proper assembly.

CYLINDER HEAD AND VALVES

Checking head mating face

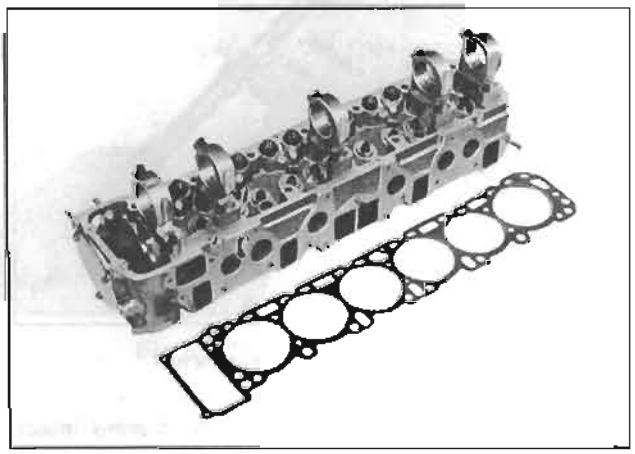


Fig. EM-32 Cylinder head

Note: Never remove camshaft bearings. If you once remove camshaft bearings, the bearing centers will be out of alignment and the recondition is very difficult without center borings.

1. Make a visual check for cracks and flaws.

2. Measure the surface of the cylinder head (on the cylinder block side) for warping. If it is found to be beyond the limit designated below, regrind the affected surface with a surface grinder.

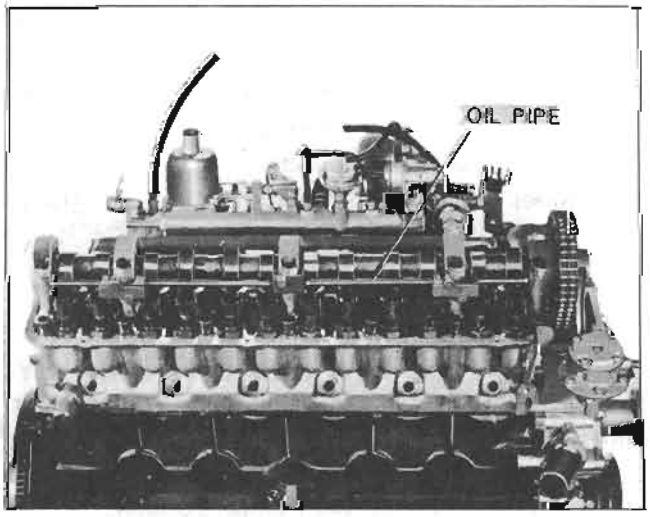


Fig. EM-33 Checking the cylinder head surface

Head surface flatness

Standard	Maximum
Less than 0.05 mm (0.0020 in)	0.1 mm (0.0039 in)

Valve assembly

1. Check each of the intake and exhaust valve assemblies for worn, damaged or deformed valve caps and stems. Correct or replace the valve, if any excessive defects are detected.

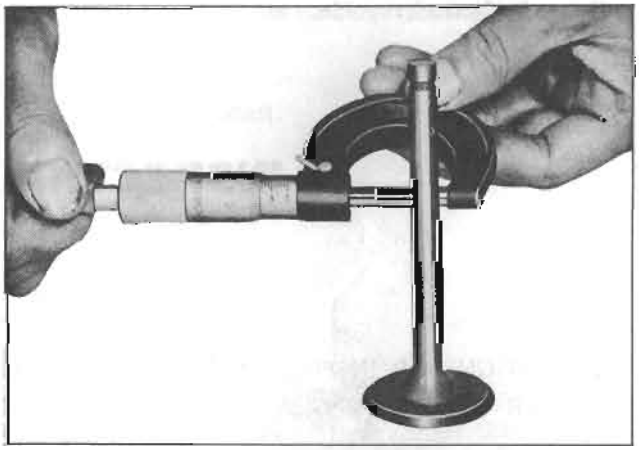


Fig. EM-34 Valve stem diameter check

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

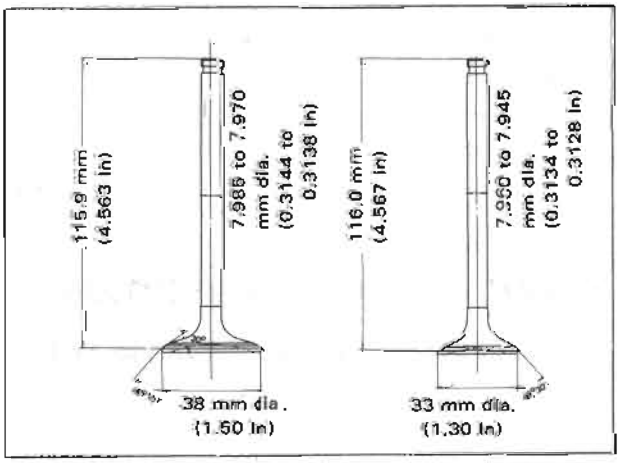


Fig. EM-35 Valves for L20A and L24 (Single carb.)

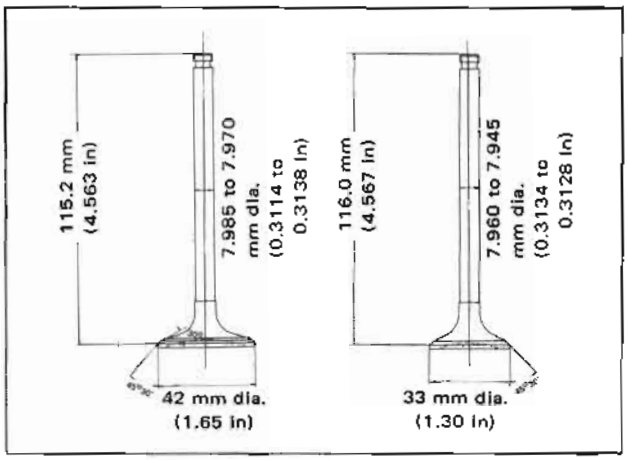


Fig. EM-36 Valves for L24 (Twin carb.)

Note: When the valve head has been reduced to 0.5 mm (0.0197 in) or less in thickness, replace the valve. Grinding allowance for the valve stem end surface is 0.5 mm (0.0197 in) or less.

Valve spring

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

2. Check the deformation of each spring with a square. Any springs with the deflection of 1.6 mm (0.0630 in) or more must be replaced.

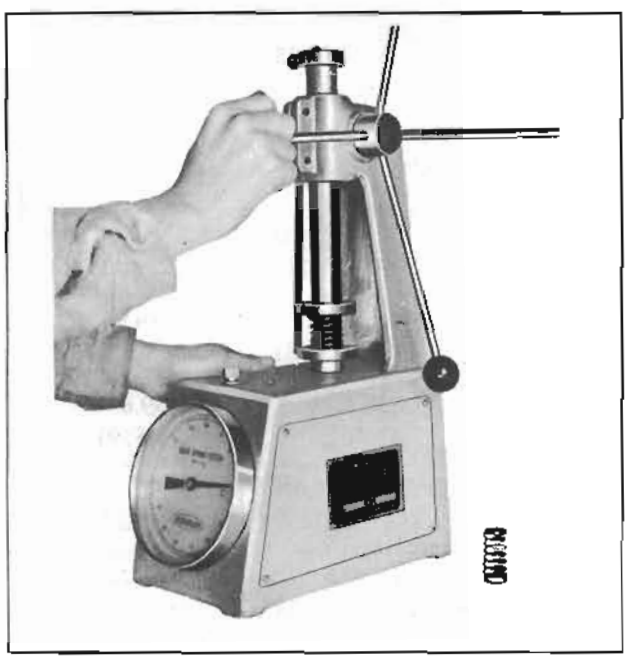


Fig. EM-37 Valve spring test

Spring specification

		L20 & L24 (Single carb.)	L24 (Twin carb.)
Free length mm (in)	Outer	47.75 (1.88 in)	**49.98 (1.97 in)**
	Inner	44.68 (1.76 in)	**44.85 (1.76 in)**
Valve closed mm at kg (in at lb)	Outer	40.0/16.6 ± 0.8 (1.57/36.60 ± 1.76)	40.0/21.3 ± 1.6 (1.57/**46.96** ± 3.53)
	Inner	35.0/9.6 ± 0.6 (1.38/21.16 ± 1.32)	35.0/**12.3 ± 0.7** (1.38/**20.12** ± 1.54)
Valve open mm at kg (in at lb)	Outer	30.0/43.0 ± 2.2 (1.18/94.80 ± 4.85)	29.5/**49.0 ± 3.7** (1.16/**108.03** ± 8.16)
	Inner	25.0/19.6 ± 1.0 (0.98/43.21 ± 2.20)	24.5/**25.5 ± 1.3** (0.96/**56.22** ± 2.78)

Rocker arm and valve rocker pivot

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

Valve guide

Measure the clearance between the valve guide and the valve stem. If the clearance exceed the designated limit, replace the worn parts or both valves 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 guides.

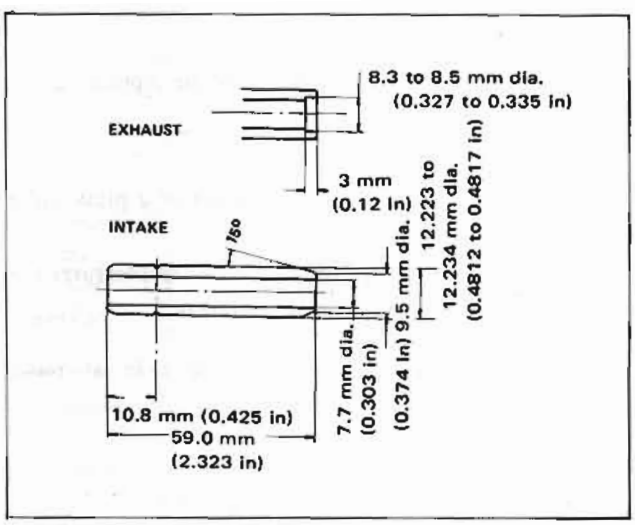


Fig. EM-38 Service valve guide

	Intake valve	Exhaust valve
Stem to guide clearance mm (in)	0.020 to 0.053 (0.0008 to 0.0021)	0.040 to 0.073 (0.0016 to 0.0029)
Max. tolerance of above clearance mm (in)	0.1 (0.0039)	

Determining clearance

Precise measurement of clearance between the valve stem and the valve guide needs the aid of a micrometer and a telescope hole gauge. By using these gauge, check the diameter of the valve stem in three places; top, center and bottom. Insert telescope hole gauge in valve guide bore, measuring at center. Subtract highest reading of valve stem diameter from valve guide bore measured to obtain its clearance from the two center diameter to obtain valve to valve guide clearance. As an emergency expendient, a valve is pushed in the valve guide and moved to the left and the right at which point if its tip deflects about 0.2 mm (0.0079 in) or more, it will be known that the clearance between the stem and the guide exceeds the maximum limit of 0.1 mm (0.0039 in).

Note: The valve should be moved in parallel with the rocker arm. (Generally, a large amount of wear occurs in this direction.)

Replacement of valve guide

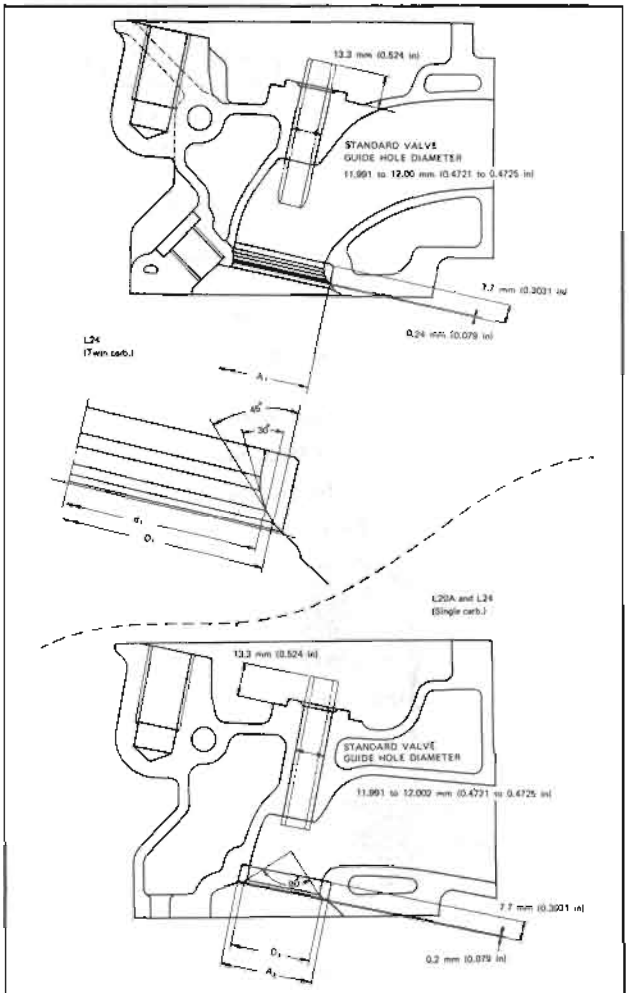
A valve guide found defective must be replaced in the following manner:

1. Take out the old guide by means of a press and a drift pin (under a 2-ton pressure).
This job may be carried out at room temperatures but with better effect at higher temperature.

2. Ream cylinder head side guide hole at room temperature.

Guide hole inner diameter mm (in)	12.185 to 12.196 (0.4797 to 0.4802)

As the valve guides of 0.2 mm (0.0079 in) oversize diameter are available for service, the guide hole should be reamed to the following dimensions.



	L20A and L24 (Single carb.)	L24 (Twin carb.)
A1 mm (in) dia.	41.000 to 41.016 (1.6140 to 1.6148)	44.000 to 44.016 (1.7323 to 1.7329)
D1 mm (in) dia.	37.6 to 37.8 (1.480 to 1.488)	41.6 to 41.8 (1.638 to 1.646)
d1 mm (in) dia.	35.6 (1.402)	39.6 (1.559)
A2 mm (in) dia.	37.000 to 37.016 (1.4567 to 1.4573)	37.000 to 37.016 (1.4567 to 1.4573)
D2 mm (in) dia.	32.4 to 32.6 (1.276 to 1.283)	32.4 to 32.6 (1.276 to 1.283)

Fig. EM-39 Valve guide and valve seat insert

3. Press the new valve guide into the valve with care so that it will fit smoothly after heat the cylinder head to a temperature of 150° to 200°C (302° to 392°F).

Interference fit of valve guide to guide hole mm (in)	0.027 to 0.049 (0.0011 to 0.0019)

4. Ream the bore of the valve guide pressed in using a valve guide reamer.

Valve guide reamer set: ST11030000
Reaming bore: 8.000 to 8.018 mm
(0.3150 to 0.3157 in)

5. Correct the valve seat surface, with the new valve guide as the axis.

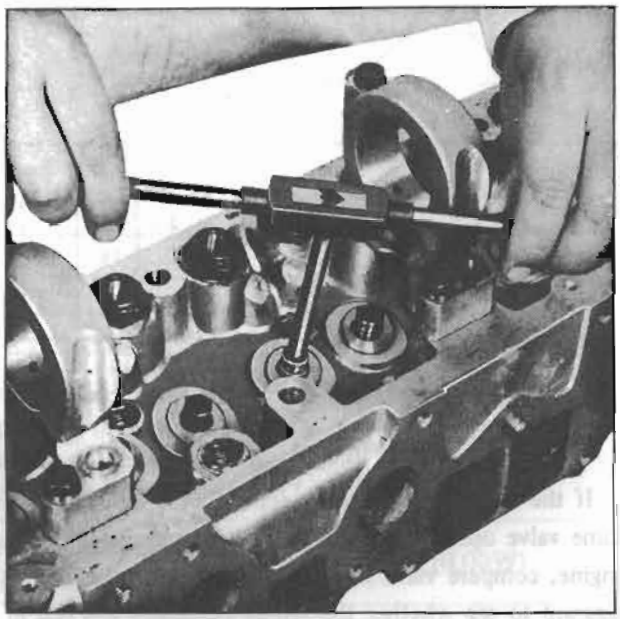


Fig. EM-40 Valve guide reaming

Valve seat inserts

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

The valve seat insert of 0.5 mm (0.0197 in) over size is available for service in this L series engine.

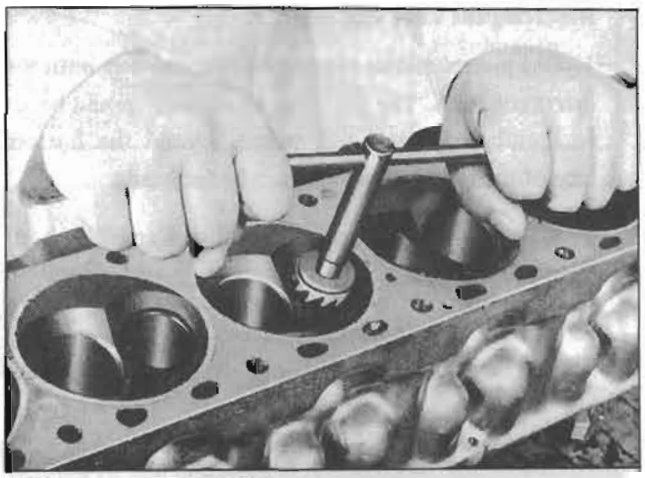


Fig. EM-41 Valve seat correction

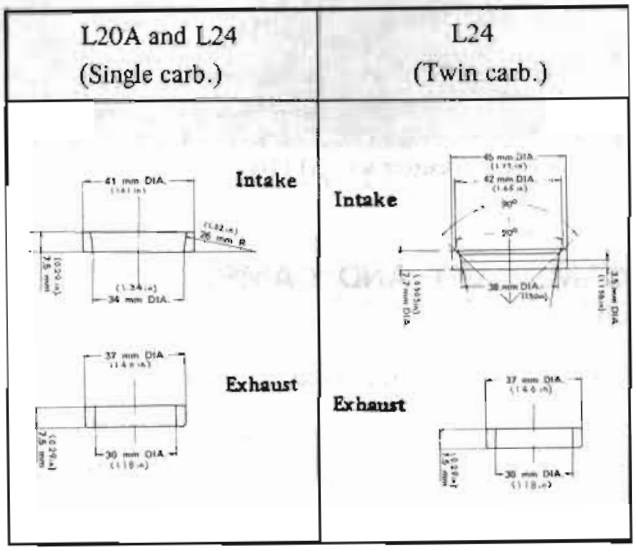


Fig. EM-42 Standard valve seat insert

		L20A and L24	L24
Cylinder head recess diameter mm (in)	Intake	$41.5\ ^{+0.02}_{0}$ ($1.634\ ^{+0.0008}_{0}$)	$45.5\ ^{+0.02}_{0}$ ($1.791\ ^{+0.0008}_{0}$)
	Exhaust	$37.5\ ^{+0.02}_{0}$ ($1.476\ ^{+0.0008}_{0}$)	$37.5\ ^{+0.02}_{0}$ ($1.476\ ^{+0.0008}_{0}$)

Interference fit mm (in)	Intake	0.11 to 0.08 (0.0043 to 0.0031)
	Exhaust	0.10 to 0.06 (0.0039 to 0.0024)

Replacing the valve seat insert

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

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

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

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

5. Fit the insert ensuring that it beds on the bottom face of its recess.

6. The valve seats newly fitted should be cut or ground at the specified dimensions as shown in Figure EM-39.

Valve seat cutter set: ST11650000

CAMSHAFT AND CAMSHAFT BEARINGS

Camshaft bearing clearance check

1. Measure the inner diameter of the camshaft bearing and the outer diameter of the camshaft journal. If wear is found inside the bracket replace the cylinder head assembly.

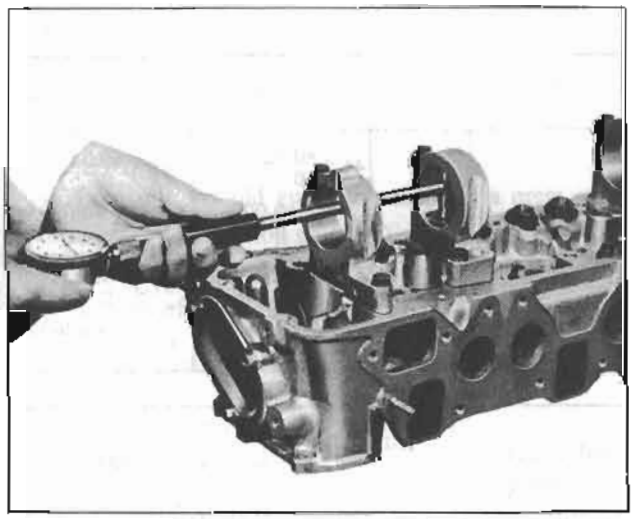
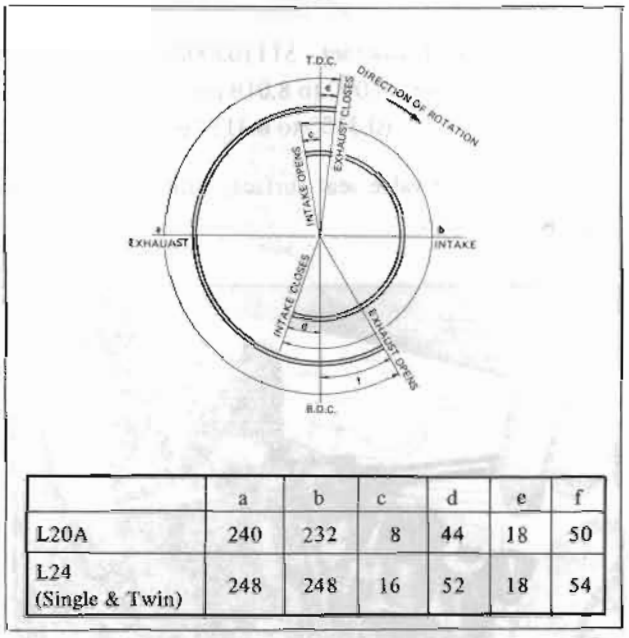


Fig. EM-43 Camshaft bearing check

	Standard	Wear limit
Oil clearance mm (in)	0.038 to 0.076 (0.0015 to 0.0026)	0.1 (0.0039)
Inner diameter of camshaft bearing mm (in)	48.00 to 48.016 (1.8898 to 1.8904)	

Valve timing check



	a	b	c	d	e	f
L20A	240	232	8	44	18	50
L24 (Single & Twin)	248	248	16	52	18	54

Fig. EM-44 Valve timing diagram

If the camshaft shown no apparent damage although some valve operation troubles have been detected in the engine, compare valve timing data with the valve timing diagram to see whether the stroke beginning and end in various cylinders are complying with specified advance and retard figures.

Camshaft alignment check

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

2. Bend values are expressed in terms of half values of the readings, obtained when the camshaft is given a turn with a dial gauge applied to the center journal.

	Standard	Bend limit
Camshaft bend mm (in)	0.015 (0.0006)	0.05 (0.0020)

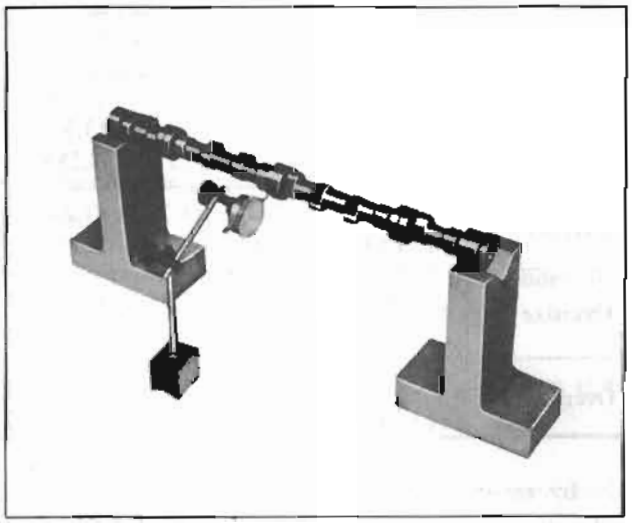


Fig. EM-45 Camshaft bend check

	Standard	Maximum tolerance
Surface flatness mm (in)	less than 0.05 (0.0020)	0.10 (0.0039)

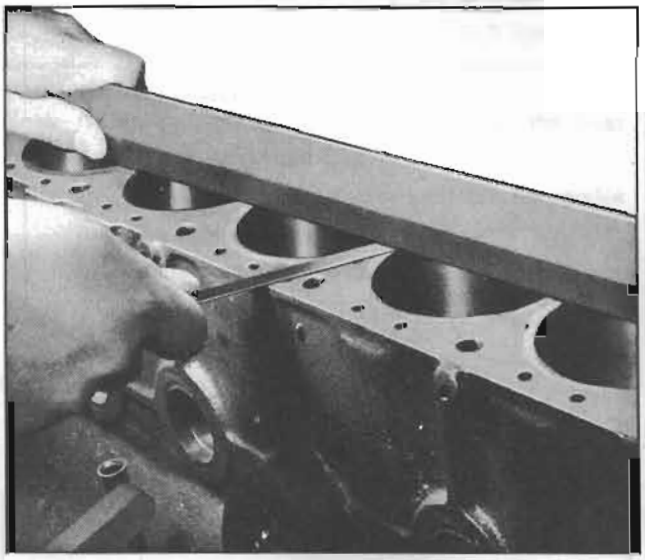


Fig. EM-46 Cylinder block surface check

Engine model / Unit mm (in)	L20A	L24 (Single and Twin)
Standard height of cam	40.30 to 40.35 (1.587 to 1.589)	39.95 to 40.00 (1.573 to 1.575)
Wear limit of cam height	0.25 (0.0098)	
Allowable difference in diameter between maximum worn and minimum worn parts of camshaft journal	0.05 (0.0020)	
Maximum tolerance in journal diameter	0.1 (0.0039)	
Camshaft end play	0.04 to 0.3 (0.0016 to 0.0118)	

CYLINDER BLOCK

1. Check visually for defects, such as cracks and flaws.

2. Measure the top face of the block (cylinder head mating face) for warping. If the warp exceeds the limit value, correct it.

3. Measure the cylinder bore for out-of-round or excessive taper with a bore gauge. If excessive wear, taper or out-of-round are detected on the cylinder wall, rebore the cylinder walls by a boring machine.

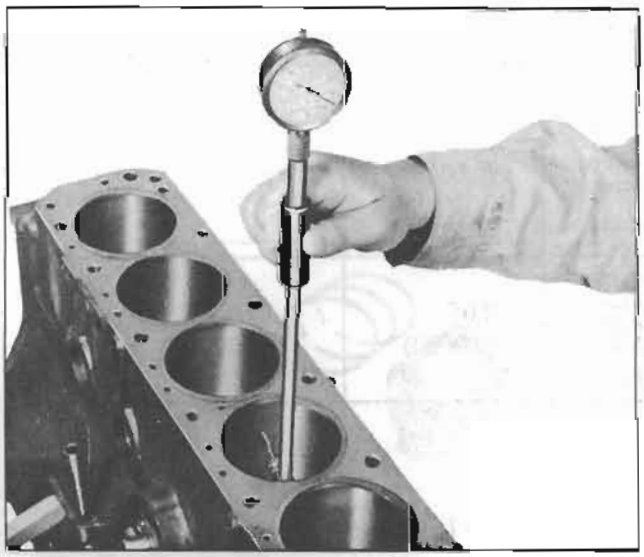


Fig. EM-47 Measuring the cylinder bore.

4. When the wear, taper and out-of-round are not excessive to the limit, remove the step at the topmost portion of the cylinder by using a ridge reamer or the like.

How to measure cylinder bore

A bore gauge is used. Measure the cylinder bore at top, middle and bottom points in each direction A and B as illustrated and record the measured values.

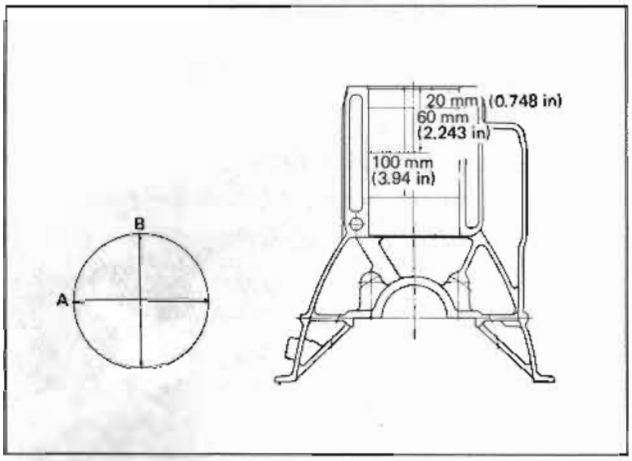


Fig. EM-48 Measuring points of cylinder bore

	Standard		Wear limit
	L20A	L24	
Cylinder bore mm (in)	$78.000\ ^{+0.050}_{0}$ ($3.0709\ ^{+0.0020}_{0}$)	$83.000\ ^{+0.050}_{0}$ ($3.2677\ ^{+0.0020}_{0}$)	0.2 (0.0097)
Error in cylinder bore elliptic tapered mm (in)	0.02 (0.0008)	0.015 (0.0006)	
Difference cylinder bore mm (in)	0.05 (0.0020)	0.05 (0.0020)	0.2 (0.0079)

Boring of cylinder

1. When any of the cylinders needs boring, all other cylinders must be bored at the same time.

2. Determine piston oversize according to the amount of wear of the cylinder.

Piston for service Unit: mm (in)

Piston size	Outside diameter (H)	
	L20A	L24
STD	77.92 to 77.97 (3.068 to 3.070)	82.99 to 83.04 (3.267 to 3.269)
Oversize 1	77.94 to 77.99 (3.068 to 3.070)	83.22 to 83.27 (3.276 to 3.278)
Oversize 2	78.17 to 78.22 (3.077 to 3.079)	83.47 to 83.52 (3.286 to 3.288)
Oversize 3	78.42 to 78.47 (3.087 to 3.089)	83.72 to 83.77 (3.296 to 3.298)
Oversize 4	78.67 to 78.72 (3.097 to 3.099)	83.97 to 84.02 (3.305 to 3.308)
Oversize 5	78.92 to 78.97 (3.107 to 3.109)	84.47 to 84.52 (3.326 to 3.328)

3. By measuring piston to be installed at piston skirt (side thrust face) and adding the mean of clearance specification, the finish hone cylinder measurement can be determined.

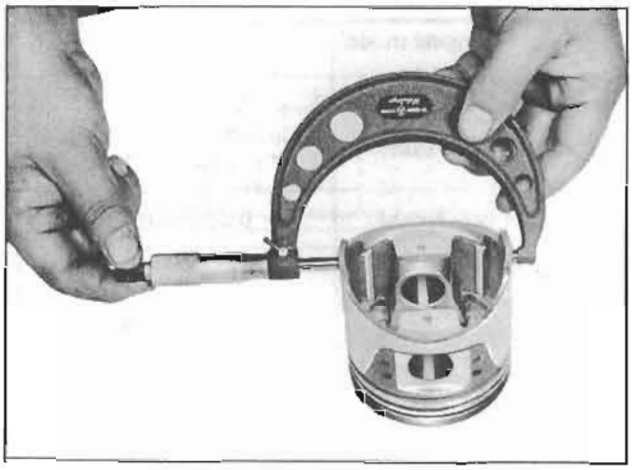


Fig. EM-49 Measuring the piston diameter

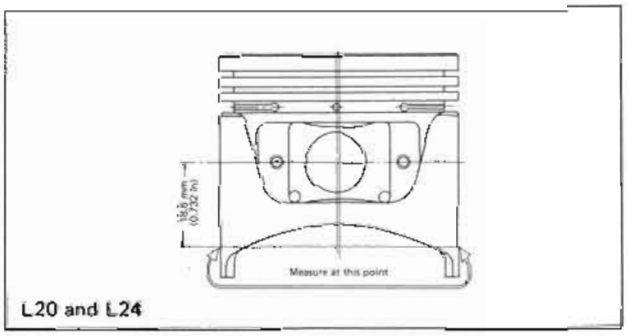


Fig. EM-50 Measuring point

Outer diameter of piston skirt (measured value):

A, Piston-cylinder clearance:
B = 0.025 to 0.045 mm (0.0010 to 0.0018 in)

Boring allowance C = 0.02 mm (0.0008 in)

Cylinder bore to be treated:

A + B – C = A + (0.005 to 0.025 mm) [0.0002 to 0.0010 in]

4. Machine the cylinder bore to the determined inner diameter.

Note: To prevent strain due to cutting heat, bore the cylinders in the order of 1-5-3-6-2-4.

5. Do not cut too much out of the cylinder bore at a time, but cut 0.05 mm (0.0020 in) or so at a time.

6. Measurement of the cylinder bore just machined requires the utmost care since it is expanded by cutting heat.

7. Finish the treated cylinder bore to a final finish bore by honing.

8. Measure the finished cylinder bore for elliptic or tapered part.

9. Measure the piston to cylinder clearance. This clearance can be checked easily by using a feeler gauge and a spring scale.

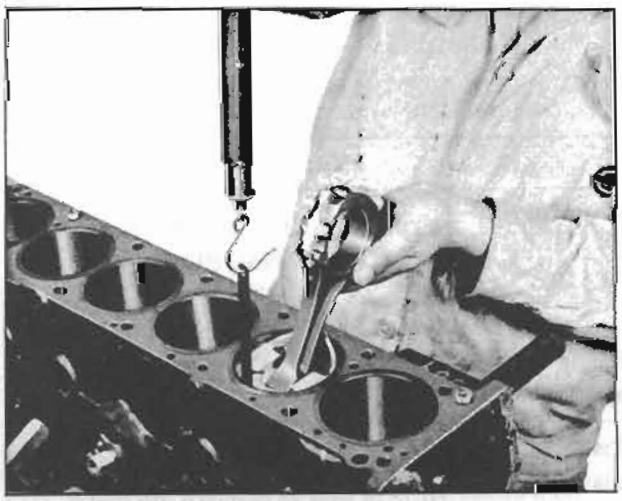


Fig. EM-51 Piston to cylinder clearance check

Standard clearance mm (in)	0.025 to 0.045 (0.0010 to 0.0018)
Feeler gauge mm (in)	0.04 (0.0016)
Extracting force kg (lb)	0.2 to 1.5 (0.4409 to 3.3069)

Note: If the cylinder bore has worn beyond the wear limit, use the cylinder liner.
Undersize cylinder liners are available for service (only for L24 engine).
Interference fit of cylinder liner Cylinder Block 0.08 to 0.09 mm (0.0031 to 0.0035 in).

Cylinder liner for service (for L24 engine)

Unit: mm (in)

	Outside diameter	Inner diameter
400 undersize	87.00 to 87.05 (3.4252 to 3.4272)	82.45 to 82.55 (3.2461 to 3.2500)
450 undersize	87.50 to 87.55 (3.4449 to 3.4468)	82.45 to 82.55 (3.2461 to 3.2500)
500 undersize	88.00 to 88.05 (3.4646 to 3.4665)	82.45 to 82.55 (3.2461 to 3.2500)

PISTON, PISTON PIN AND PISTON RING

1. Check for seizing, scratches and wear. Effect a replacement when such a defect is detected.

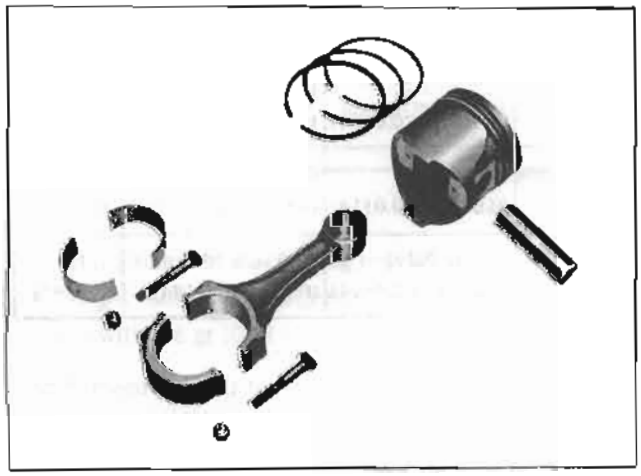


Fig. EM-52 Piston and connecting rod assembly

2. Measure the side clearance of rings in ring groove as each ring is installed. Clearance with new pistons and rings should be as follows.



Fig. EM-53 Side clearance measurement

Side clearance

	Standard		Wear limit
	L20A	L24	
Top ring mm (in)	0.045 to 0.078 (0.0018 to 0.0031)		0.1 (0.0039)
Second ring mm (in)	0.030 to 0.063 (0.0012 to 0.0025)		0.1 (0.0039)
Oil ring mm (in)	0.025 to 0.063 (0.0010 to 0.0025)	0	0.1 (0.0039)

Ring gap

	Standard		Wear limit
	L20A	L24	
Top ring mm (in)	0.20 to 0.35 (0.0079 to 0.0138)	0.23 to 0.38 (0.0091 to 0.0150)	1.0 (0.0394)
Second ring mm (in)	0.14 to 0.29 (0.0055 to 0.0114)	0.15 to 0.30 (0.0059 to 0.0118)	1.0 (0.0394)
Oil ring mm (in)	0.14 to 0.29 (0.0055 to 0.0114)	0.15 to 0.30 (0.0059 to 0.0118)	1.5 (0.0591)

3. Place the ring at the bottom of the ring traveled part of cylinder bore in which it will be used.

Square ring in bore by pushing it into position with the head piston.

Measure the gap between ends of ring with feeler gauge. Gap should be as listed above.

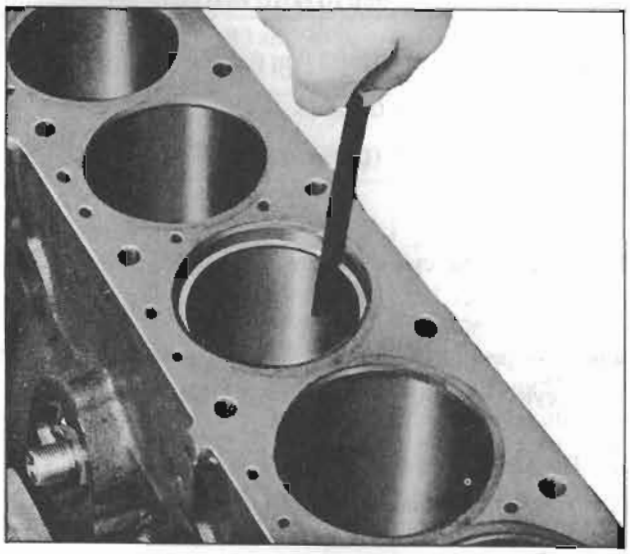


Fig. EM-54 Ring gap measurement

Note: a. When the piston ring only is to be replaced, without the cylinder bore being corrected, measure the gap at the bottom of the cylinder where the wear is minor.

b. Oversize piston rings are available for service. (25, 50, 75, 100, 150 oversize)

4. Measure the piston pin hole in relation to the outer diameter of the pin. If wear exceeding the limit is indicated, replace such piston pin together with the piston on which it is installed.

	L20A	L24
Piston pin outside diameter mm (in)	19.995 to 20.005 (0.7872 to 0.7876)	20.993 to 20.998 (0.8265 to 0.8267)
Piston pin length mm (in)	66.40 to 66.65 (2.6142 to 2.6240)	72.00 to 72.25 (2.835 to 2.844)
Piston pin hole diameter mm (in)	19.999 to 20.010 (0.7874 to 0.7878)	21.001 to 21.008 (0.8268 to 0.8271)

5. Fitting of piston pin

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



Fig. EM-55 Piston pin fitting

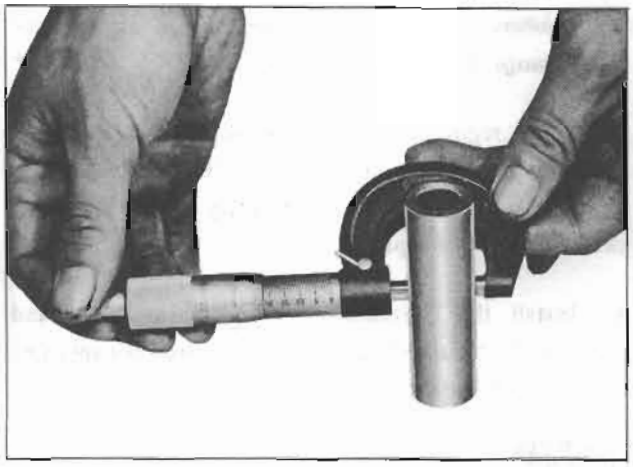


Fig. EM-56 Measuring piston pin diameter

	L20A	L24
Piston pin to piston clearance mm (in)	0.004 to 0.011 (0.0002 to 0.0004)	0.008 to 0.010 (0.0003 to 0.0004)
Interference fit of piston pin to connecting rod mm (in)	0.017 to 0.035 (0.0007 to 0.0014)	0.015 to 0.033 (0.0006 to 0.0013)

CONNECTING ROD

1. If a connecting rod has any flaw within the both sides of the thrust face and the large end, correct or replace it.

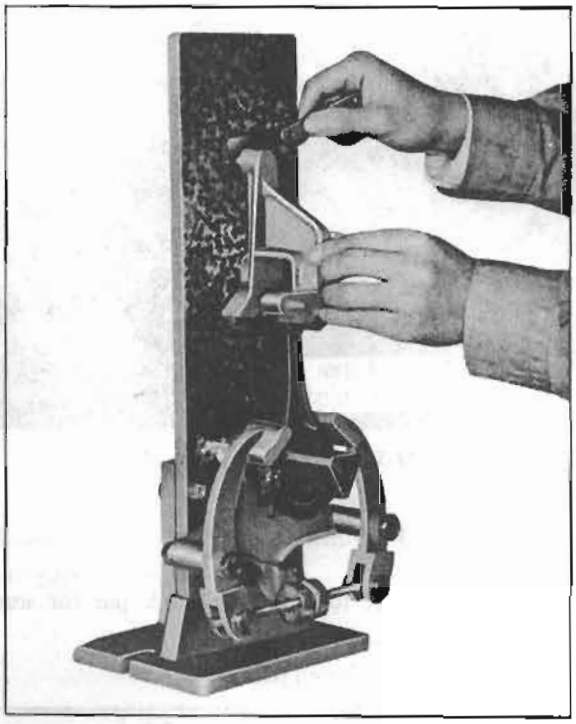


Fig. EM-57 Connecting rod aligner

2. Check for bend or torsion using a connecting rod aligner. If bends or torsion exceeds the limit, correct or replace the connecting rod.

	Standard	Maximum
Connecting rod bend or torsion (per 100 mm or 3.94 in: length) mm (in)	0.025 (0.0010)	0.05 (0.0020)

3. In replacing the connecting rod, select the rod so that the weight difference between new rods and old one become within 6 gr (0.212 oz) in unit weight.

4. Install connecting rods with bearings on to the corresponding crank pins and measure the thrust clearance. If the measured values exceed the limit, replace such connecting rod.

	Standard	Wear limit
Big end end play mm (in)	0.2 to 0.3 (0.0079 to 0.0118)	0.30 (0.0118)

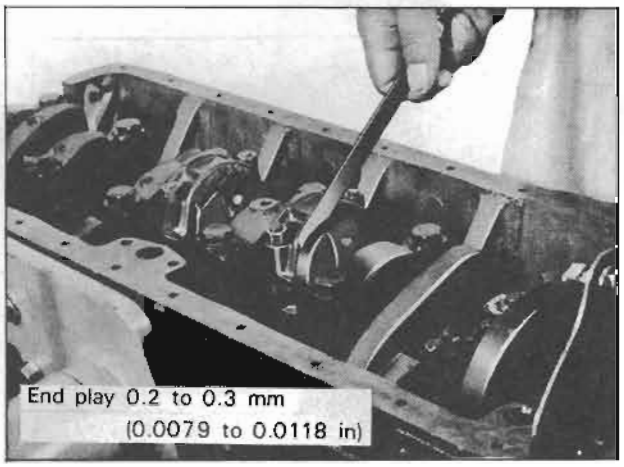


Fig. EM-58 Big end end play check

CRANKSHAFT

1. Check the shaft journal and crank pin for scars, biased wear and cracks.

Repair or replace affected parts.

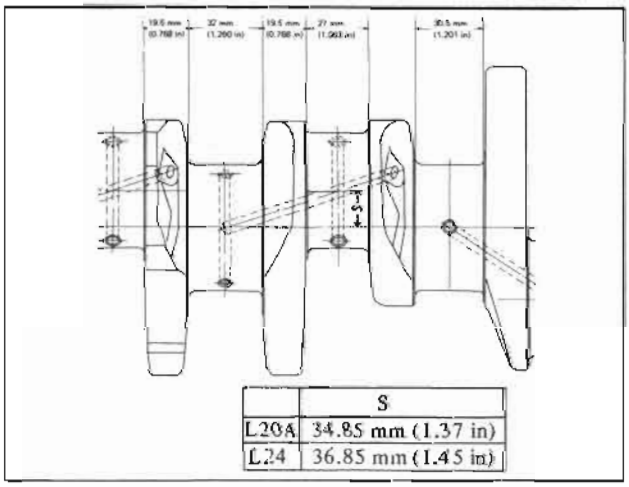


Fig. EM-59 Crankshaft

	Standard	Maximum
Taper and out-of-round of crank journal and crank pin mm(in)	less than 0.01 (0.0004)	0.03 (0.0012)

2. Check the crankshaft for bend. If the bend exceeds the specified value repair or replace the crankshaft.

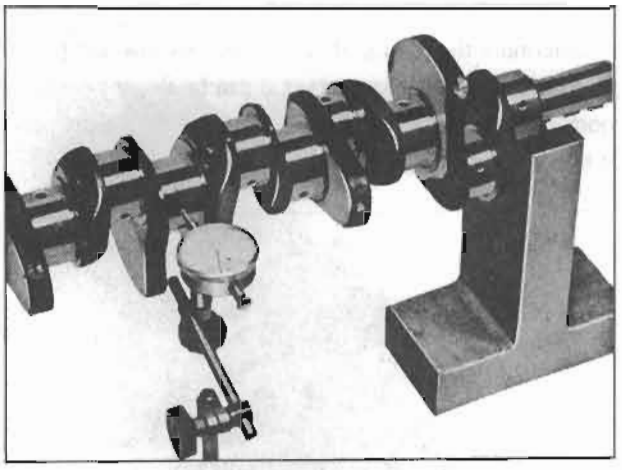


Fig. EM-60 Crankshaft bend check

	Standard	Maximum
Crank shaft bend mm (in)	less than 0.025 (0.0010)	0.05 (0.0020)

Note: For measuring the bend, use a dial gauge. Bend values are half as much as the readings obtained when the crankshaft is given a turn with the dial gauge applied to its center journal.

3. After regrinding the crankshaft, finish it to the necessary size indicated in the lists on page EM-24 by using an adequate undersize bearing according to the extent of required repair.

4. Install the crankshaft in the cylinder block and measure the thrust clearance. If it exceeds the specified value, replace the center shims.

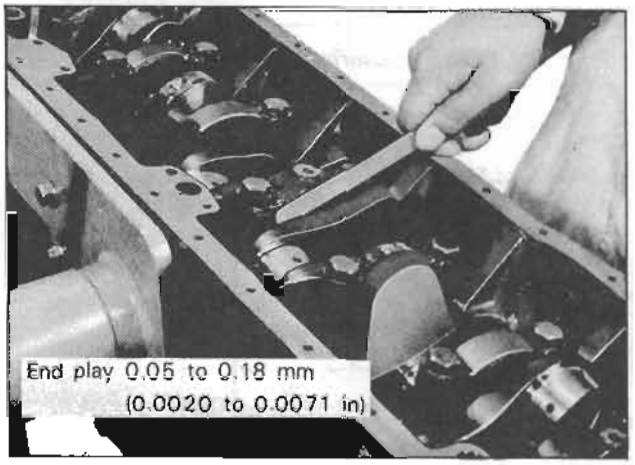


Fig. EM-61 Crankshaft end play check

	Standard	Wear limit
Crankshaft free end play mm (in)	0.05 to 0.18 (0.0020 to 0.0071)	0.3 (0.0118)

5. Check the main drive shaft pilot bearing at the rear of the crankshaft for wear and damage. Replace it if any defects are detected.

BUSHINGS AND BEARINGS

Measurement of main bearing clearance

1. Check all bearings and bushings for seizures, melts, scars and burns.
   Replace bushings, if any defects are detected.

2. Wipe off oil and dust (especially the rear of the bushing).

3. Set the main bearing on the cap block.

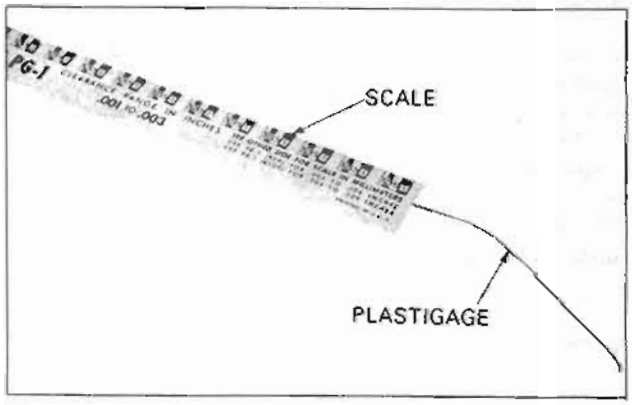


Fig. EM-62 Plastigage

4. Cut a plastigage to the width of the bearing and place it in parallel with the crank pin, getting clear of the oil hole. Install the cap on the assembly and tighten them together under the specified torque.

Tightening torque: 4.5 to 5.5 kg-m (32.5 to 39.8 ft-lb)

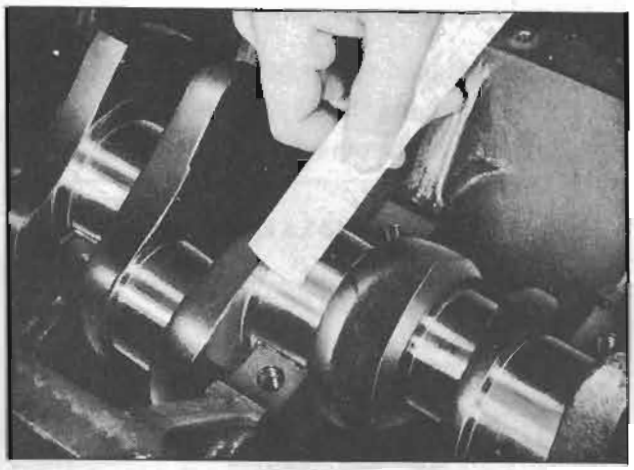


Fig. EM-63 Bearing clearance check

Note: Be sure not to turn the crankshaft when the plastigage is inserted.

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

Measurement of connecting rod bearing clearance

1. Measure the connecting rod bearing clearance in the same manner.

Tightening torque: 2.7 to 3.3 kg-m (19.5 to 23.9 ft-lb)

Bearing oil clearance

	Standard	Wear limit
Main bearing clearance mm (in)	0.020 to 0.072 (0.0008 to 0.0028)	0.12 (0.0047)
Connecting rod bearing clearance mm (in)	0.014 to 0.066 (0.0006 to 0.0026)	0.10 (0.0039)

2. If clearance proves to be in excess of the specified value, replace bearing by undersize and, consequently, grind out the crankshaft journal.

Fitting bearings

1. Set the bushings on the main bearing cap and the cylinder block bearing recess and after installing the bearing cap, tighten the cap bolts to the specified torque.

Tightening torque: 4.5 to 5.5 kg-m (32.5 to 39.8 ft-lb)

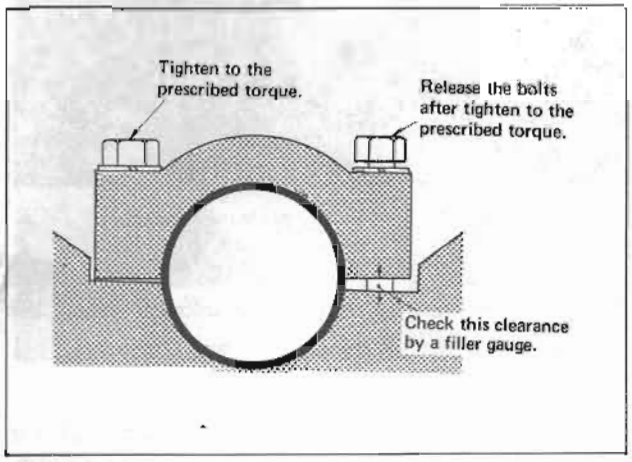


Fig. EM-64 Bearing crush check

2. Loosen the cap bolt on one side and measure the clearance between the cap and block side.

3. Ascertain that the clearance is within double the figures listed below. If it is not, replace the bearing.

4. Handle the connecting rod bearing in the same manner.

Connecting rod cap tightening torque:
2.7 to 3.3 kg-m (19.5 to 23.9 ft-lb)

Bearing crush

All main bearing mm (in)	0 to 0.03 (0 to 0.0012)
All connecting rod bearing mm (in)	0.015 to 0.040 (0.0006 to 0.0016)

Main bearing undersize

Bearing size 1/1,000 mm	Bearing top thickness mm (in)	Crank journal diameter mm (in)
STD	1.822 to 1.835 (0.0717 to 0.0722)	54.942 to 54.955 (2.1631 to 2.1636)
25 undersize	1.947 to 1.960 (0.0767 to 0.0772)	54.692 to 54.705 (2.1532 to 2.1537)
50 undersize	2.072 to 2.085 (0.0816 to 0.0821)	54.442 to 54.455 (2.1434 to 2.1439)
75 undersize	2.197 to 2.210 (0.0865 to 0.0870)	54.172 to 54.205 (2.1328 to 2.1341)
100 undersize	2.322 to 2.335 (0.0914 to 0.0919)	53.942 to 53.955 (2.1237 to 2.1242)

Connecting rod bearing undersize

Bearing size 1/1,000mm	Bearing top thickness mm (in)	Crank pin diameter mm (in)
STD	1.493 to 1.506 (0.0588 to 0.0593)	49.961 to 49.974 (1.9670 to 1.9675)
6 undersize	1.523 to 1.536 (0.0600 to 0.0605)	49.901 to 49.914 (1.9646 to 1.9651)
12 undersize	1.553 to 1.566 (0.0611 to 0.0617)	49.841 to 49.854 (1.9622 to 1.9628)
25 undersize	1.618 to 1.631 (0.0637 to 0.0642)	49.711 to 49.724 (1.9571 to 1.9576)
50 undersize	1.743 to 1.756 (0.0686 to 0.0691)	49.461 to 49.474 (1.9473 to 1.9478)
75 undersize	1.868 to 1.881 (0.0735 to 0.0741)	49.211 to 49.224 (1.9374 to 1.9379)
100 undersize	1.993 to 2.006 (0.0785 to 0.0790)	48.961 to 48.974 (1.9726 to 1.9281)

MISCELLANEOUS COMPONENTS

Crankshaft sprocket, camshaft sprocket

1. Check tooth surfaces for flaws and wears. Replace defective sprocket if any defects are found.

2. Install the camshaft sprocket in position and check for run-out. If it is found to exceed 0.1 mm (0.04331 in), replace the camshaft sprocket. Check for thrust deviation at the same time. Three kinds of locating plate differing in thickness are available, so make the necessary adjustment using those locating plates.

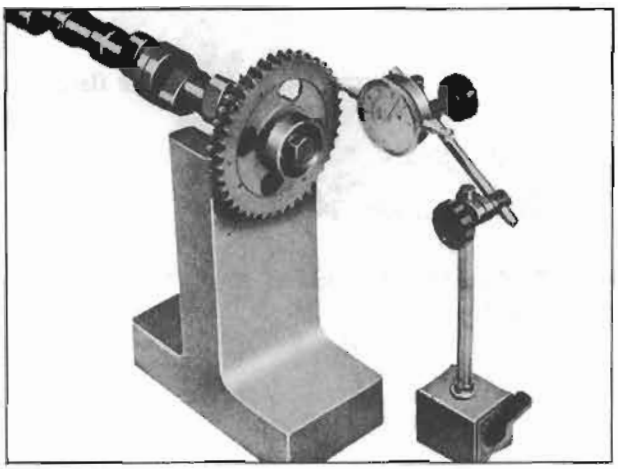


Fig. EM-65 Camshaft sprocket run-out check

Thrust deviation mm (in)	0.04 to 0.30 (0.0016 to 0.0118)
Locating plate thickness mm (in)	4.8 ± 0.05 (0.1890 ± 0.0020) 4.9 + 0.05 (0.1929 ± 0.0020) 5.0 ± 0.05 (0.1969 ± 0.0020)

3. Check the chain for damage, severe wear and stretch at its roller links. Replace a defective chain.

4. When the chain stretches extremely, the valve timing goes out of order. In L20A and L24 engine, two locate (Camshaft set) holes are provided in the camshaft sprocket to correct the valve timing.

Adjustment of camshaft sprocket location

If the stretch of the chain roller links is extreme, adjust the camshaft sprocket location by transfering the camshaft set position of the camshaft sprocket to No. 2 or No. 3 holes.

1. Turn engine until No. 1 piston is at T.D.C. on its compression stroke. Examine whether the camshaft location hole on the camshaft sprocket comes off the left end of the oblong groove on the camshaft locate plate.
(If the camshaft location hole is off the left end of the oblong groove, the stretch of the chain is beyond the limit.)

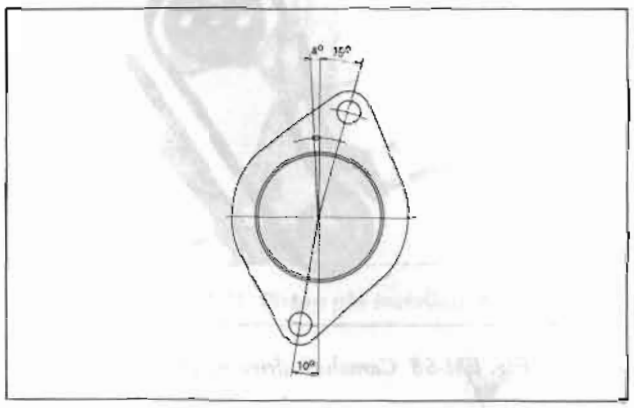


Fig. EM-66 Camshaft locate plate

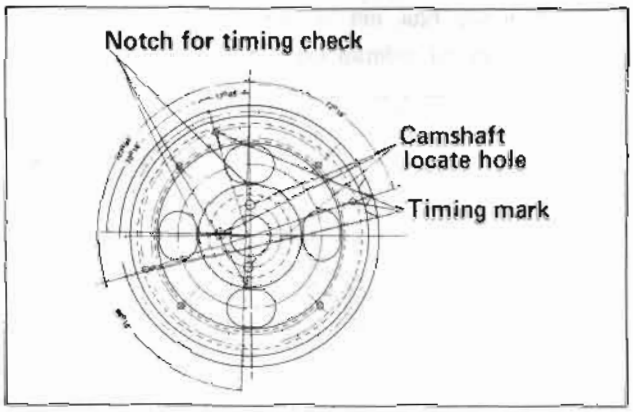


Fig. EM-67 Camshaft sprocket

2. Turn the engine until No. 1 piston is at T.D.C. on its compression stroke set the camshaft on No. 2 location hole of the camshaft sprocket. Then this No. 2 hole should be on the right end of the oblong groove. When the No. 2 hole is used, the amount of the modification is 4° by the rotation of the crankshaft.

3. If the valve timing can not be corrected by using No. 2 hole, use No. 3 hole as the same procedure as mentioned above. The amount the modification by using No. 3 hole is 8° by the rotation of the crankshaft.

4. When the modification becomes impossible even by transfering the camshaft location hole, replace the chain assembly.

Chain tensioner and chain guide

Check for wear and breakage. Replace if necessary.

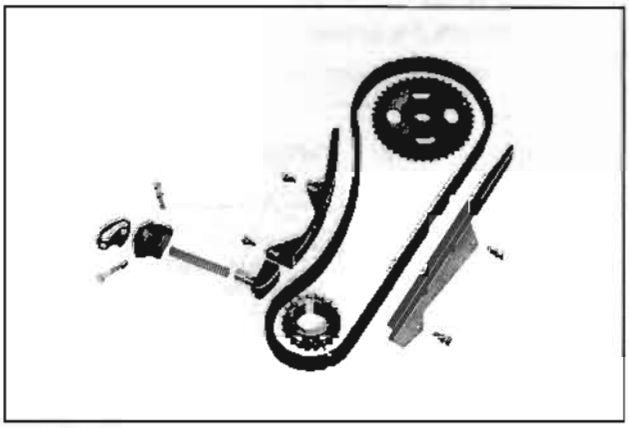


Fig. EM-68 Camshaft drive mechanism

Flywheel

1. Check the clutch disc contact surface of the flywheel for damage and wear. Repair or replace if necessary.

2. Measure deviation of the clutch disc contact surface with a dial gauge. If it exceeds 0.1 mm (0.04331 in), replace it.

3. Check tooth surfaces of the ring gear for flaws and wear.

Replace if necessary.

Note: Replace the ring gear at about 180° to 200°C (356° to 392°F).

ENGINE ASSEMBLY

CONTENTS

PRECAUTIONS EM-26
CYLINDER HEAD EM-26
PISTON AND CONNECTING ROD EM-27
ASSEMBLING OF ENGINE EM-28

PRECAUTIONS

1. Use thoroughly cleaned parts. Particularly, check whether oil holes are clear of foreign matter or not.

2. In installing sliding parts, such as bearings proceed after applying engine oil to them as required.

3. Use new packings and oil seals, in principle.

4. Keep tools and work benches clean and clear of dust and oil stains.

5. Keep the necessary parts and tools ready near at hand.

6. Be sure to follow specified tightening torque and orders where necessary.

CYLINDER HEAD

1. Assembly of valve and valve spring

Set the valve spring seat in position, and fit the valve guide with the oil seal.

Assemble the valve in order of the following, valve, inner and outer valve springs, spring retainer, valve collet and valve rocker guide.

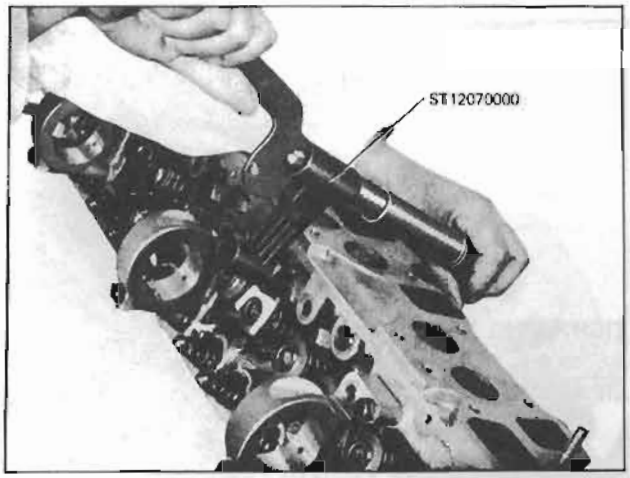


Fig. EM-69 Valve installation

Note: Check whether the valve face is clear from foreign matters.

2. Assembly of valve rocker pivot.

Screw valve rocker pivots joined with rocker spring washer and lock nuts in the pivot bush.

3. Assembly of camshaft

Install the camshaft in cylinder head carefully and set the locating plate. Do not damage the bearing inside.

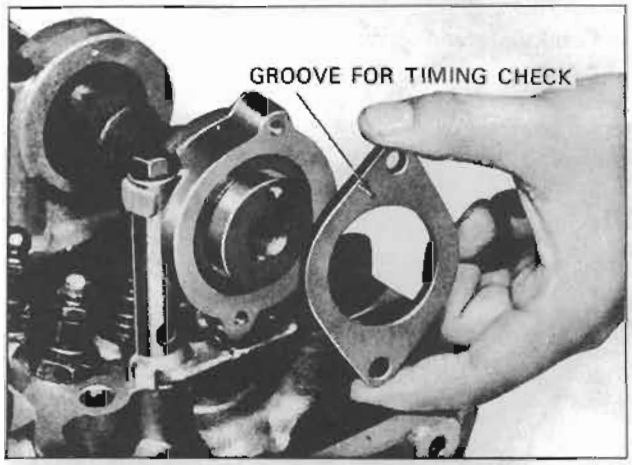


Fig. EM-70 Camshaft locate plate installation

4. Install the rocker arms, pressing down the valve springs by screwdriver.

5. Install the valve rocker springs.

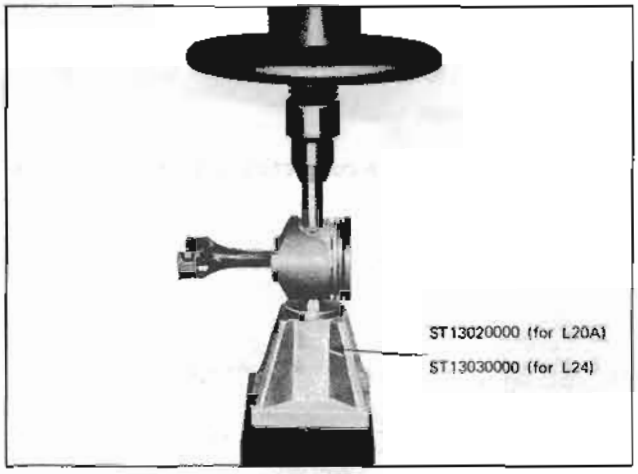


Fig. EM-71 Piston pin installation

PISTON AND CONNECTING ROD

1. Assemble piston, piston pin and connecting rod assorted according to cylinder number for every cylinder.

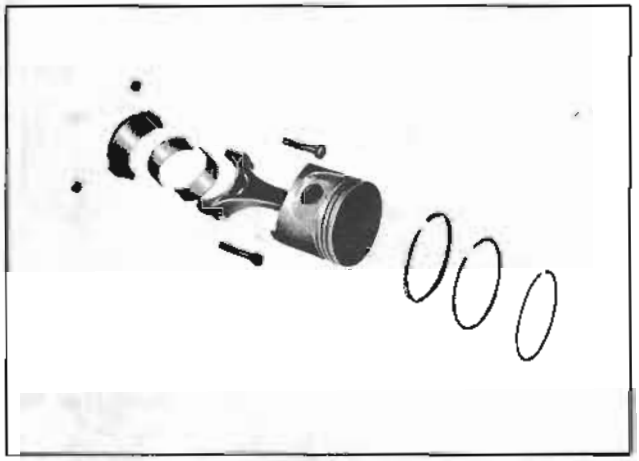


Fig. EM-72 Piston and connecting rod assembly

Note: a. Piston pin is a tight press fit to the connecting rod, and fitting force is from 1 to 3 tons and the aid of the special tool is necessary.
In pressing the piston pin in the connecting rod, apply engine oil to the pin and the small end of the connecting rod.
b. Arrange so as the oil jet of the connecting rod large end is directed toward the right side of the cylinder block.
c. As the center of the piston pin is off-set in relation to the center of the piston, be sure to make proper assembly.

2. Install the piston rings.

Install top and second rings in right position, as the rings with marks up.

3. Fix bearings on the connecting rod and the connecting rod cap.

Note: Clean the back side of the bearing carefully.

ASSEMBLING OF ENGINE

1. Set the cylinder block on the working stand.

2. Set the main bearings on the proper portion of the cylinder block.

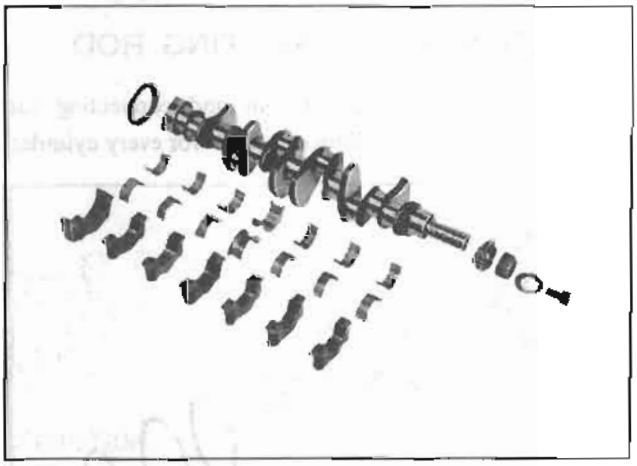


Fig. EM-73 Main bearings and caps

Note: a. Only the center bearing is a flanged type for thrust force.

b. All inter bearings are the same type ones.

c. The front bearing (No.1) is also the same type with the rear bearing. Only difference between both bearings is that the front bearing has an oil hole and the rear one has no hole.

d. All bearings except No.1 bearing have a interchangeability between upper and lower bearings.

3. Apply the engine oil to the main bearing surfaces on the both side of the cylinder block and cap. Then, install the crankshaft.

4. Install the main bearing cap and tighten the bolts with specified torque.

Tightening torque: 4.5 to 5.5 kg-m (32.5 to 39.8 ft-lb)

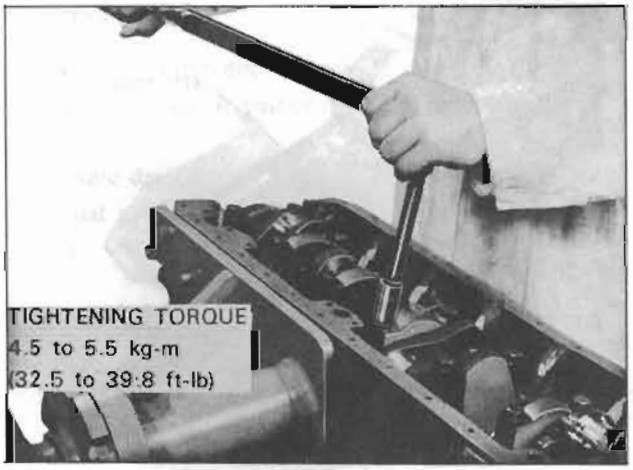


Fig. EM-74 Main bearing cap installation

Note: a. Arrange so as the arrow mark on the bearing cap is faced toward the front of the engine.

b. Prior to the tightening of the bearing cap bolts, place the bearing cap at a proper position by shifting the crankshaft in the axial direction.

c. The tightening operation should be made gradually in separating three of four stages and outwardly from center bearing.

d. After securing the bearing cap bolts ascertain whether the crankshaft is easily rotatable.

5. Make sure of the crankshaft end play.

Crankshaft end play: 0.05 to 0.18 mm (0.002 to 0.007 in)

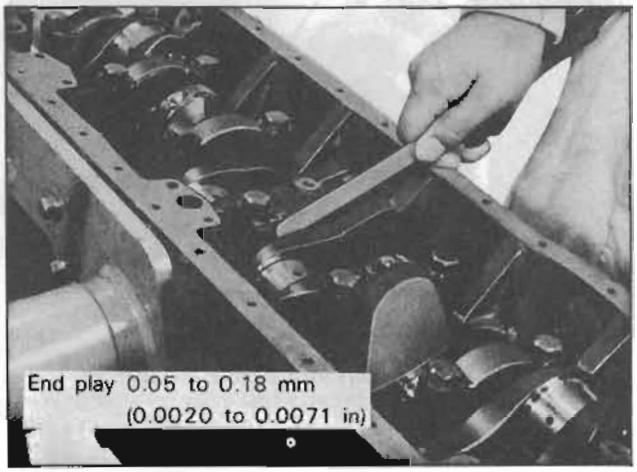


Fig. EM-75 Camshaft end play check

6. Install the side oil seals into the rear main bearing cap as same way in the cylinder block.

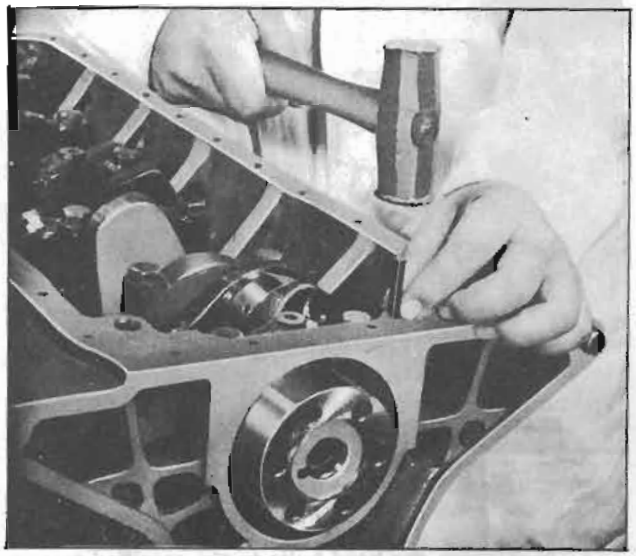


Fig. EM-77 Side oil seal installation

7. Install the crankshaft rear oil seal.

Special tool: ST15310000

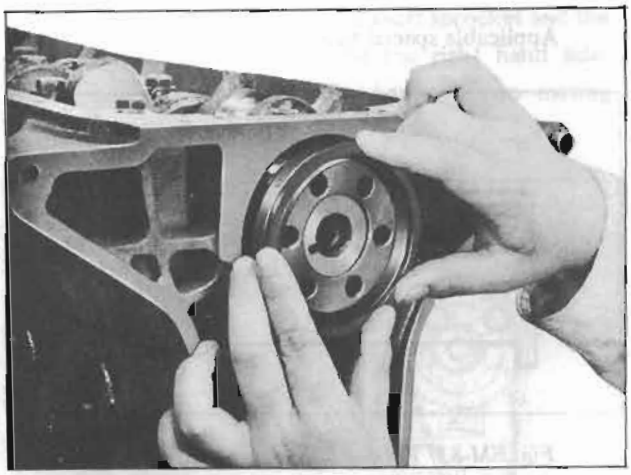


Fig. EM-76 Rear oil seal installation

8. Install the cylinder block net.

9. Install the rear end plate.

10. Install the flywheel securely and tighten the bolts with specified torque.

Tightening torque: 14.0 kg-m (101.2 ft-lb)

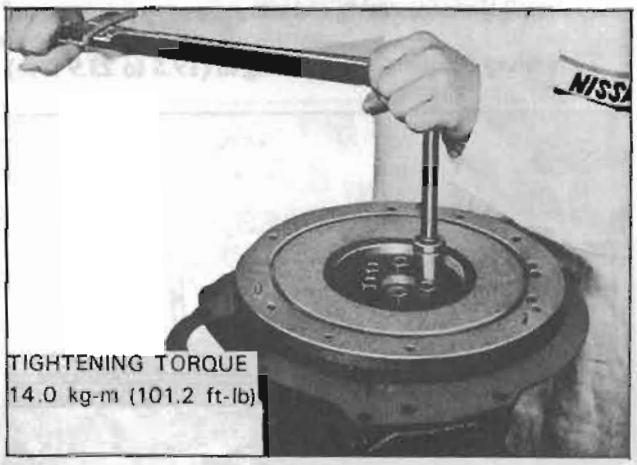


Fig. EM-78 Flywheel installation

11. Install the piston-rod assembly.

Note: a. Insert the pistons in the corresponding cylinders.

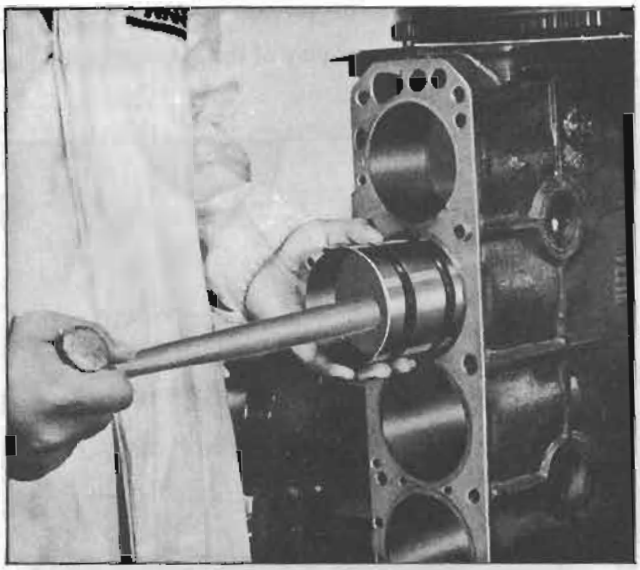


Fig. EM-79 Piston-rod assembly installation

Special tool: EM03470000

b. Apply the engine oil on concerning parts.

c. Arrange so as the "F" marking on the piston is facing front of engine.

d. Install piston rings at 180° to each other, avoiding their fit in the thrust and piston pin axial directions.

12. Install the connecting rod cap.

Tightening torque: 2.7 to 3.3 kg-m (19.5 to 23.9 ft-lb)

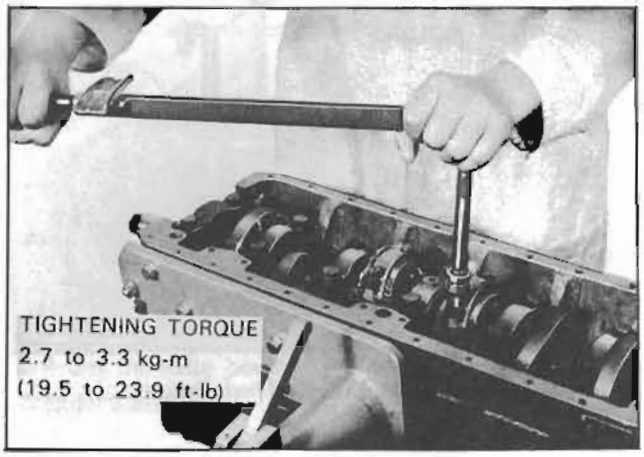


Fig. EM-80 Connecting rod cap installation

Note: Arrange connecting rods and connecting rod caps so that the cylinder number on them faces the same side.

13. Make sure of the end play of the connecting rod big end.

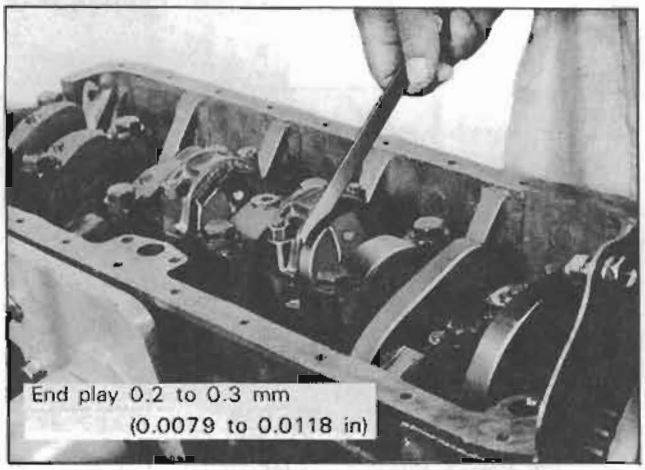


Fig. EM-81 Big end end play check

Big end end play: 0.20 to 0.30 mm
(0.0079 to 0.0118 in)

14. Install the cylinder head assembly.

Note: a. Spread sealing agent over the cylinder block surface. Place the gasket on it, and apply sealing agent to the gasket top.

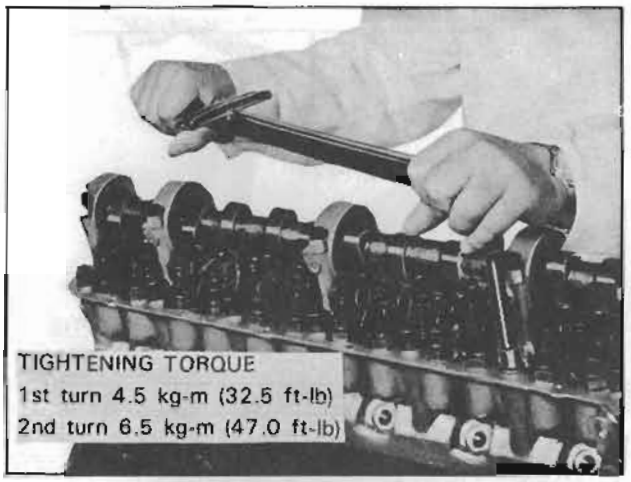


Fig. EM-82 Cylinder head installation

b. Tighten the head bolts to the specified torque. Three different types of bolts are used. (So be careful when installing.)

Tightening torque:

1st turn	4.5 kg-m (32.5 ft-lb)
2nd turn	6.5 kg-m (47.0 ft-lb)

Applicable special tool: ST10120000

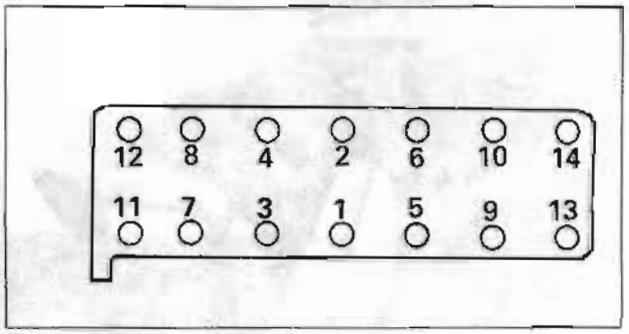


Fig. EM-83 Torque tightening sequence chart

Note: a. When installing the cylinder head, make sure that all the valves are apart from the head of the pistons.

b. Do not rotate the crankshaft and camshaft separately, because the valves will hit the head of the pistons.

15. Install the crankshaft sprocket and distributor drive gear and fit the oil throwers.

Note: Face the mating marks of the crankshaft sprocket forwards.

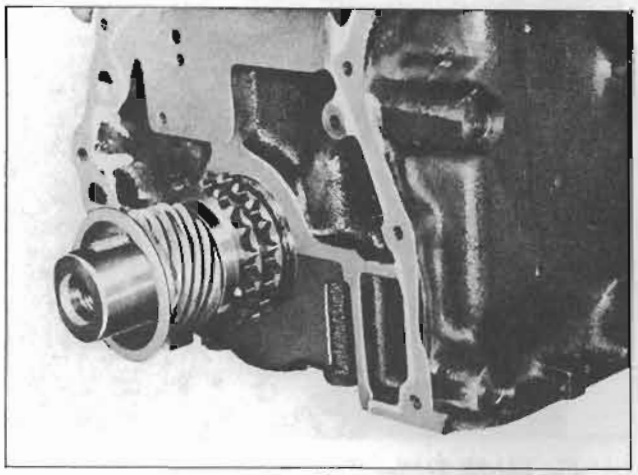


Fig. EM-84 Crankshaft sprocket and distributor drive gear

16. Install the chain guide to the cylinder block.

17. Install the timing chain and camshaft sprocket.

Note: **a. Make sure that the crankshaft and camshaft keys point upwards.**

b. Set the timing chain making its mating marks meet with those of the crankshaft sprocket and the camshaft drive sprocket at the right hand side. There are 42 chain links between two mating marks of the timing chain.

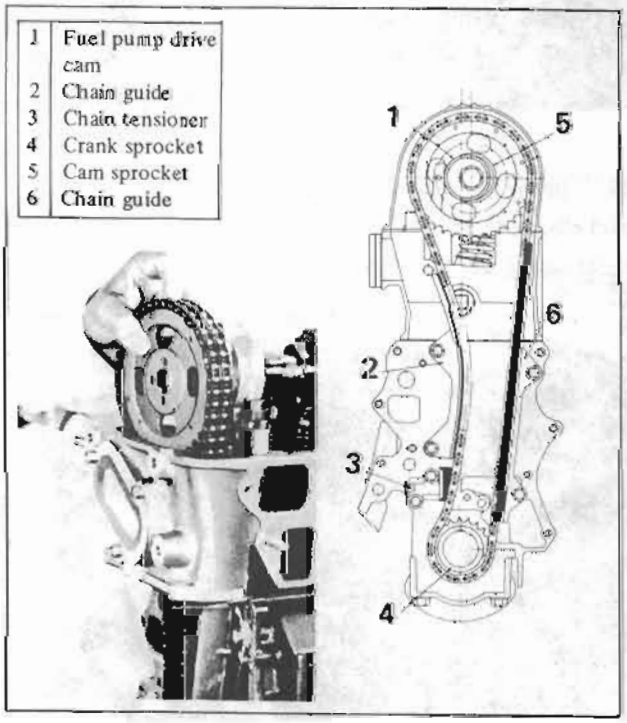


Fig. EM-85 Timing chain installation

18. Tighten the camshaft sprocket together with fuel pump cam to the specified torque.

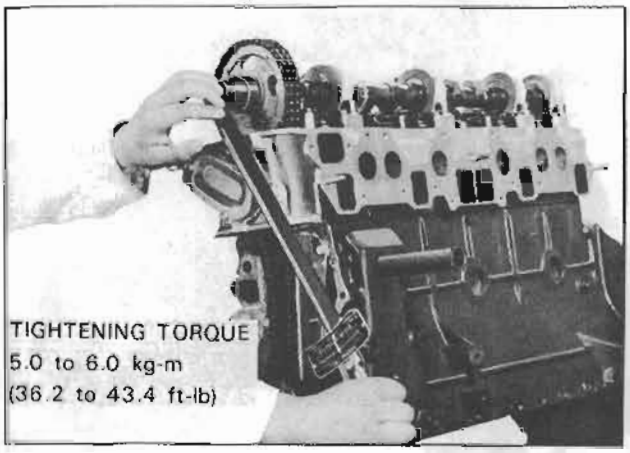


Fig. EM-86 Fuel pump cam installation

19. Install the timing chain tensioner.

20. Press in the new oil seal to the front cover. (the front cover oil seal should be replaced when the front cover is disassembled.)

21. Install the front cover with the gasket in between.

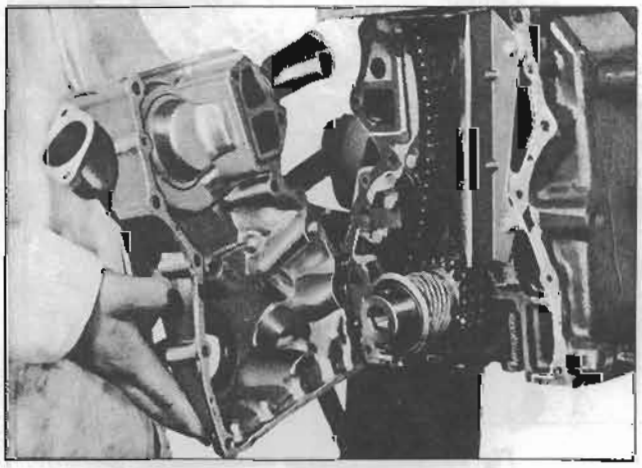


Fig. EM-87 Front cover installation

Note: **Apply the sealing agent to the both surface of the gasket.**

22. Install the crankshaft pulley and water pump, then set the No. 1 - piston to its T.D.C. of the compression stroke.

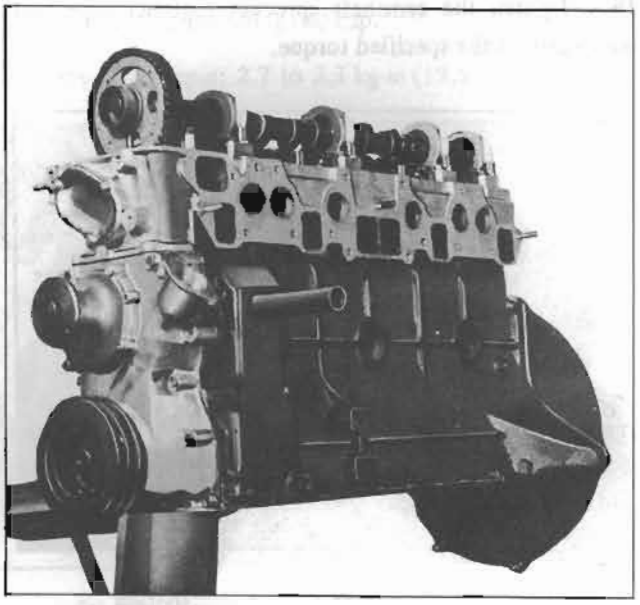


Fig. EM-88 Crankshaft pulley and water pump installation

23. Invert the engine and insert the oil pump and distributor driving spindle into the front cover.

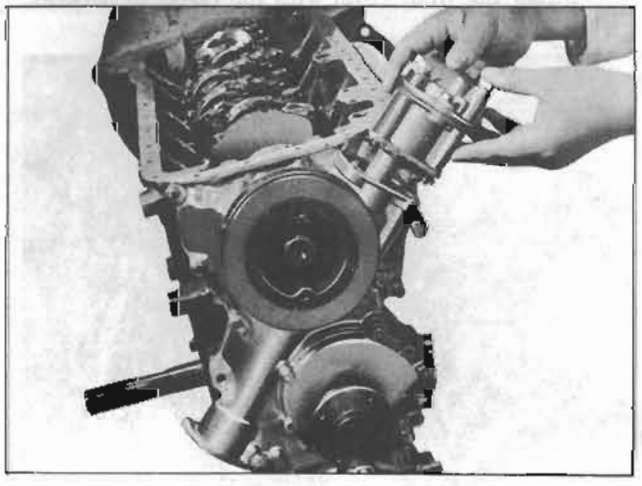


Fig. EM-89 Oil pump installation

Note: Install the driving spindle so as the projection on its top is located just in 11:25 a.m. position, at this time, the smaller bow-shape will be placed toward the front.

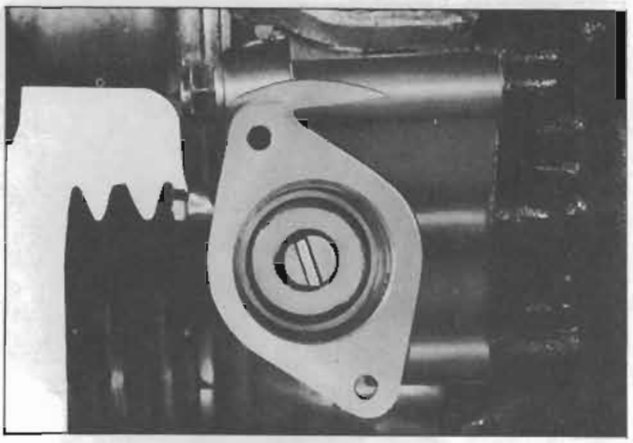


Fig. EM-90 Setting the distributor driving spindle

24. Install the oil strainer and the oil pan using the gasket.

Apply the sealing agent on the both surface of the gasket especially on the front and rear positions of oil pan.

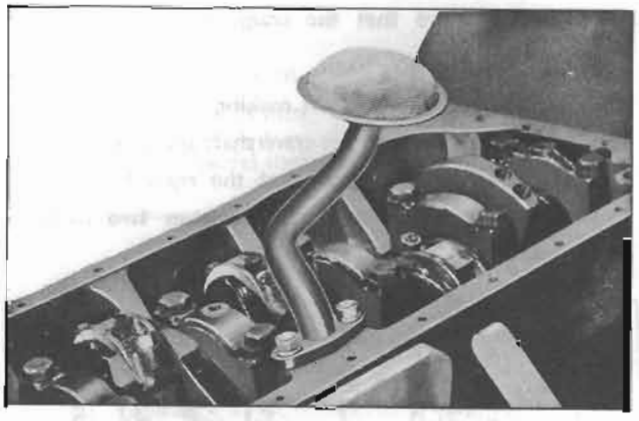


Fig. EM-91 Oil strainer installation

25. Invert the engine and install the fuel pump, water inlet elbow, thermostat housing front, thermostat, and the water outlet elbow in their position.

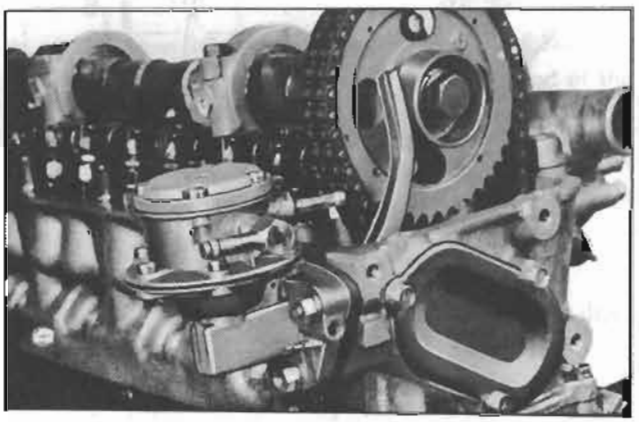


Fig. EM-92 Fuel pump installation

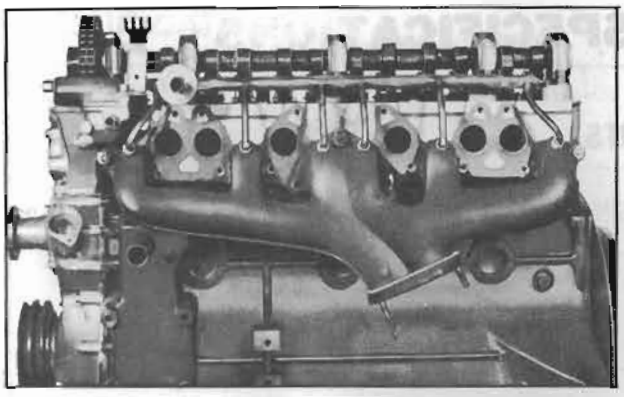


Fig. EM-93 Exhaust manifold installation

26. Install the engine slingers, exhaust manifold.

27. Install the intake manifold with carburetor and heat shield plate.

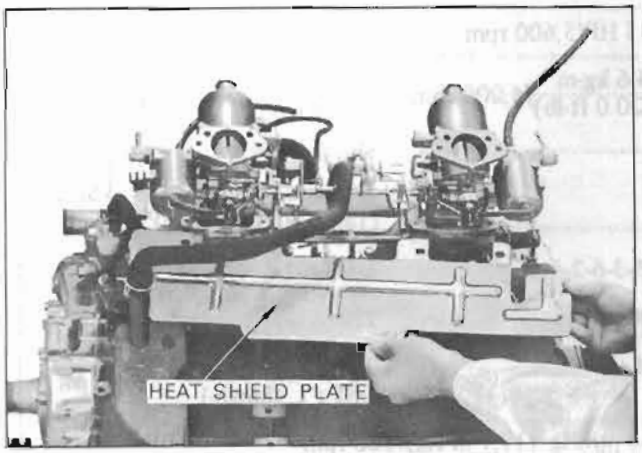


Fig. EM-94 Heat shield plate installation

28. Adjust the valve clearance with the specified dimensions.

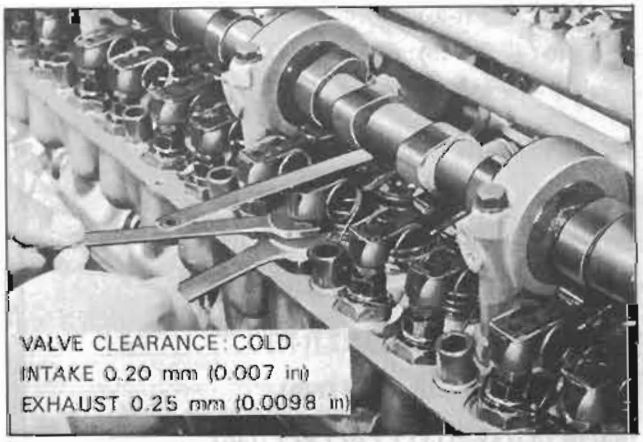


Fig. EM-95 Valve clearance adjustment

29. Install the oil pipe.

30. Install the rocker cover.

Note: Bond the gasket to the rocker cover using the before-mentioned sealing agent.
Then, install the rocker cover to the head.

31. Install the fuel line and heater hoses.

32. Install the air pump (for L24 engine with emission control system).

33. Install all spark plugs.

34. Install the distributor assembly.

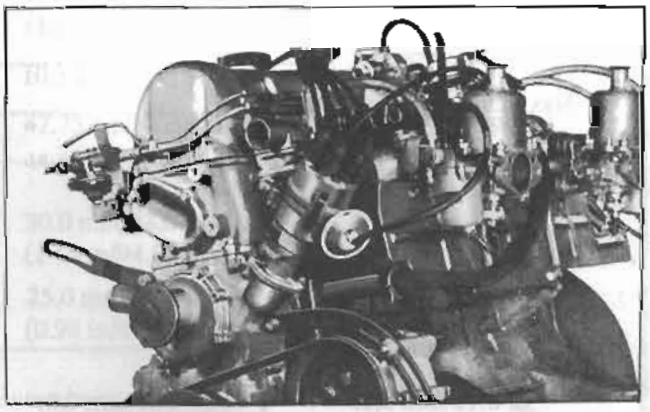


Fig. EM-96 Distributor installation

35. Install the cooling fan and the air cleaner.

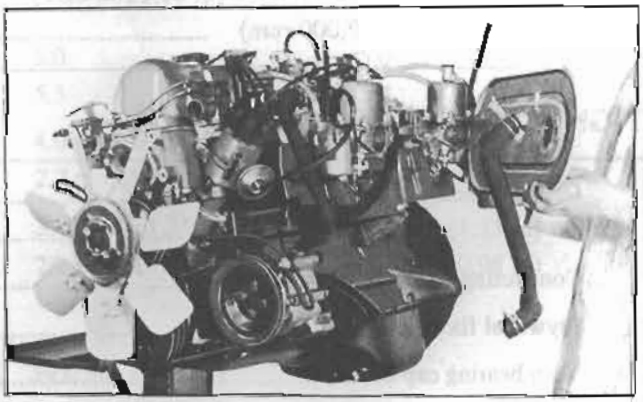


Fig. EM-97 Air cleaner installation

36. Install the clutch assembly.

37. Dismount the engine assembly from the working stand. Install the alternator bracket, alternator, engine mountings, oil filter, oil pressure switch, and oil level gauge, etc.

SERVICE DATA AND SPECIFICATIONS

CONTENTS

GENERAL SPECIFICATION EM-34
TIGHTENING TORQUE EM-34
SPECIFICATIONS EM-35

GENERAL SPECIFICATION

Model	L20A	L24	
Cylinder arrangement	6 in line	6 in line	
Displacement	1,998 cc (121.9 cu in)	2,393 cc (146.0 cu in)	
Bore and stroke	78 x 69.7 mm (3.071 x 2.744 in)	83 x 73.7 mm (3.268 x 2.902 in)	
Valve arrangement	OHC	OHC	
Maximum brake horsepower	115 HP/5,600 rpm	151 HP/5600 rpm	SU twin
Maximum gross torque	16.6 kg-m (120.0 ft-lb)/4,000 rpm	20.1 kg-m (145.7 ft-lb)/4,400 rpm	SU twin
		130 HP/5,600 rpm	Single
		20.0 kg-m (144.9 ft-lb)/3,600 rpm	Single
Firing order	1-5-3-6-2-4	1-5-3-6-2-4	
Engine idle rpm	700	750	
Compression ratio	9.4 : 1	9.0 : 1 (SU twin) 8.55 : 1 (Single)	
Engine idle manifold vacuum	450 mmHg (17.7 in Hg)/550 rpm		
Oil pressure (Hot at 2,000 rpm)	3.5 to 4.0 kg/cm^2 (49.7 to 56.8 lb/sq in)		

TIGHTENING TORQUE

Cylinder head bolts	1st turn	4.5 kg-m (32.5 ft-lb)
	2nd turn	6.5 kg-m (47.0 ft-lb)
Connecting rod big end nuts		2.7 to 3.3 kg-m (19.5 to 23.9 ft-lb)
Flywheel fix bolts		14.0 kg-m (101.2 ft-lb)
Main bearing cap bolts		4.5 to 5.5 kg-m (32.5 to 39.8 ft-lb)
Camshaft gear bolt		5.0 to 6.0 kg-m (86.7 to 115.8 ft-lb)
Oil pan		0.4 to 0.8 kg-m (2.9 to 5.8 ft-lb)
Oil pump		1.5 to 2.1 kg-m (10.8 to 15.2 ft-lb)
Oil strainer		0.8 to 1.2 kg-m (5.78 to 8.7 ft-lb)
Crank pulley bolt		16.0 to 18.0 kg-m (115.7 to 130.1 ft-lb)

SPECIFICATIONS

a) **Valve mechanism**

			L20A and L24
Valve clearance (Hot)			In. 0.25 mm (0.0098 in) Ex. 0.30 mm (0.0118 in)
Valve clearance (Cold)			In. 0.20 mm (0.0079 in) Ex. 0.25 mm (0.0098 in)
		L20A and L24 (Single carb.)	L24 (Twin carb.)
Valve head dia.	- Intake	38 mm (1.50 in)	42 mm (1.65 in)
	- Exhaust	33 mm (1.30 in)	33 mm (1.30 in)
Valve stem dia.	- Intake	8 mm (0.31 in)	8 mm (0.31 in)
	- Exhaust	8 mm (0.31 in)	8 mm (0.31 in)
Valve length	- Intake	110.7 mm (4.36 in)	110.7 mm (4.36 in)
	- Exhaust	110.7 mm (4.36 in)	110.7 mm (4.36 in)
Valve lift		10.5 mm (0.413 in)	10.5 mm (0.413 in)
Valve spring free length	- Outer	47.75 mm (1.88 in)	49.98 mm (1.97 in)
	- Inner	44.68 mm (1.76 in)	44.85 mm (1.76 in)
Valve spring loaded length	- Outer	30.0 mm/43.0 kg (1.18 in/94.80 lb)	29.5 mm/49.0 kg (1.16 in/108.03 lb)
	- Inner	25.0 mm/19.6 kg (0.98 in/43.21 lb)	24.5 mm/25.5 kg (0.96 in/56.22 lb)
Valve spring assembled height	- Outer	40.0 mm/16.6 kg (1.57 in/36.60 lb)	40.0 mm/21.3 kg (1.57 in/46.96 lb)
	- Inner	35.0 mm/9.6 kg (1.38 in/21.16 lb)	35.0 mm/12.3 kg (1.38 in/27.12 lb)
Valve spring effective turns	- Outer	5.0	5.0
	- Inner	5.5	5.5
Valve spring wire dia.	- Outer	4.0 mm (0.16 in)	4.0 mm (0.16 in)
	- Inner	2.7 mm (0.10 in)	2.9 mm (0.11 in)
Valve spring coil dia.	- Outer	33.2 mm (1.31 in)	33.2 mm (1.31 in)
	- Inner	24.2 mm (0.95 in)	24.9 mm (0.98 in)

		L20A and L24
Valve guide length	- Intake	59.0 mm (2.32 in)
	- Exhaust	59.0 mm (2.32 in)
Valve guide height from head surface		10.4 to 10.6 mm (0.41 to 0.42 in)
Valve guide inner dia.	- Intake	8.000 to 8.018 mm (0.3150 to 0.3154 in)
	- Exhaust	8.000 to 8.018 mm (0.3150 to 0.3154 in)
Valve guide outer dia. (standard)	- Intake	11.985 to 11.996 mm (0.4718 to 0.4723 in)
	- Exhaust	11.985 to 11.996 mm (0.4718 to 0.4723 in)

Valve guide to stem clearance	- Intake	.....	0.020 to 0.053 mm (0.0008 to 0.0021 in)
	- Exhaust	.....	0.040 to 0.073 mm (0.0016 to 0.0029 in)
Valve seat width	- Intake	.....	1.4 to 1.6 mm (0.055 to 0.0063 in)
	- Exhaust	.....	1.8 to 2.2 mm (0.071 to 0.087 in)
Valve seat angle	- Intake	.....	45°
	- Exhaust	.....	45°
Valve seat interference fit	- Intake	.....	0.08 to 0.11 mm (0.0031 to 0.0043 in)
	- Exahust	.....	0.06 to 0.10 mm (0.0024 to 0.0039 in)
Valve guide interference fit		.....	0.027 to 0.049 mm (0.0011 to 0.0019 in)

b) **Camshaft and timing chain**

Camshaft end play		.....	0.08 to 0.38 mm (0.0031 to 0.0150 in)
Camshaft robe lift		.....	7.00 mm (0.275 in)
Camshaft journal dia.	- 1st	.....	47.949 to 47.962 mm (1.8877 to 1.8883 in)
	- 2nd	.....	47.949 to 47.962 mm (1.8877 to 1.8883 in)
	- 3rd	.....	47.949 to 47.962 mm (1.8877 to 1.8883 in)
	- 4th	.....	47.949 to 47.962 mm (1.8877 to 1.8883 in)
	- 5th	.....	47.949 to 47.962 mm (1.8877 to 1.8883 in)
Camshaft bend		.....	0.05 mm (0.0020 in)
Camshaft journal to bearing clearance		.....	0.038 to 0.067 mm (0.0015 to 0.0026 in)
Camshaft bearing inner dia.	- 1st	.....	48.000 to 48.016 mm (1.8898 to 1.8904 in)
	- 2nd	.....	48.000 to 48.016 mm (1.8898 to 1.8904 in)
	- 3rd	.....	48.000 to 48.016 mm (1.8898 to 1.8904 in)
	- 4th	.....	48.000 to 48.016 mm (1.8898 to 1.8904 in)
	- 5th	.....	48.000 to 48.016 mm (1.8898 to 1.8904 in)

c) **Rocker arm lever ratio** 1.50

d) **Connecting rod**

Center distance	.....	132.97 to 133.08 mm (5.235 to 5.237 in)
Bearing thickness (S.T.D.)	.....	1.493 to 1.506 mm (0.0588 to 0.0593 in)
Big end end play	.....	0.20 to 0.30 mm (0.0079 to 0.0118 in)
Connecting rod bearing clearance	.....	0.014 to 0.066 mm (0.0006 to 0.0022 in)
Connecting rod bend (per 100 mm or 3.937 in)	.....	0.03 mm (0.0012 in)

e) **Crankshaft and main bearing**

Journal dia.	.....	54.942 to 54.955 mm (2.1631 to 2.1636 in)
Journal taper & out of round	.....	less than 0.03 mm (0.0012 in)
Crankshaft free end play	.....	0.05 to 0.18 mm (0.002 to 0.007 in)
Wear limit of dittoed play	.....	0.3 mm (0.012 in)

Crank pin dia.	49.961 to 49.974 mm (1.9670 to 1.9675 in)
Crank pin taper & out of round	less than 0.03 mm (0.0012 in)
Main bearing thickness	1.822 to 1.835 mm (0.0717 to 0.0722 in)
Main bearing clearance	0.020 to 0.072 mm (0.0008 to 0.0028 in)
Wear limit of dittoed clearance	0.12 mm (0.0047 in)
Crankshaft bend	0.05 mm (0.0019 in)

f) **Piston**

	L20A	L24
Piston dia. -STD	77.915 to 77.965 mm (3.0675 to 3.0695 in)	82.99 to 83.04 mm (3.267 to 3.269 in)
Oversize 1	77.935 to 77.985 mm (3.0683 to 3.0702 in)	83.22 to 83.27 mm (3.276 to 3.278 in)
Oversize 2	78.165 to 78.215 mm (3.0774 to 3.0793 in)	83.47 to 83.52 mm (3.286 to 3.288 in)
Oversize 3	78.415 to 78.465 mm (3.0872 to 3.0892 in)	83.72 to 83.77 mm (3.296 to 3.298 in)
Oversize 4	78.665 to 78.715 mm (3.0970 to 3.0990 in)	83.97 to 84.02 mm (3.305 to 3.308 in)
Oversize 5	78.915 to 78.965 mm (3.1069 to 3.1089 in)	84.47 to 84.52 mm (3.326 to 3.328 in)
Ellipse difference	0.29 to 0.33 mm (0.011 to 0.0130 in)	0.32 to 0.35 mm (0.013 to 0.014 in)

L20A and L24

Ring groove width	- Top	2.0 mm (0.08 in)
	- Second	2.0 mm (0.08 in)
	- Oil	4.0 mm (0.16 in)
Piston to bore clearance		0.025 to 0.045 mm (0.0010 to 0.0018 in)
Piston pin hole off-set		1 ± 0.05 mm (0.0394 ± 0.0020 in)

g) **Piston pin**

Pin dia.		20.995 to 21.000 mm (0.8266 to 0.8268 in)
Pin length		66.40 to 66.65 mm (2.6142 to 2.6240 in) ... L20A 72.00 to 72.25 mm (2.8346 to 2.8445 in) ... L24
Piston pin to piston clearance		0.008 to 0.010 mm (0.0003 to 0.0004 in)
Interference fit of piston pin to connecting rod bushing		0.015 to 0.033 mm (0.0006 to 0.0013 in)

h) **Piston ring**

Ring height	- Top	2.0 mm (0.0787 in)
	- Second	2.0 mm (0.0787 in)
	- Oil	4.0 mm (0.1575 in)

		L20A	L24
Side clearance	- Top	0.040 to 0.078 mm (0.0016 to 0.0031 in)	0.045 to 0.078 mm (0.0018 to 0.0031 in)
	- Second	0.030 to 0.068 mm (0.0012 to 0.0027 in)	0.030 to 0.063 mm (0.0012 to 0.0025 in)
	- Oil	0.025 to 0.068 mm (0.0010 to 0.0027 in)	0.025 to 0.063 mm (0.0010 to 0.0025 in)
Ring gap	- Top	0.20 to 0.35 mm (0.008 to 0.014 in)	0.23 to 0.38 mm (0.0091 to 0.0150 in)
	- Second	0.14 to 0.29 mm (0.006 to 0.011 in)	0.15 to 0.30 mm (0.0059 to 0.0118 in)
	- Oil	0.14 to 0.29 mm (0.006 to 0.011 in)	0.15 to 0.30 mm (0.0059 to 0.0118 in)

TROUBLE DIAGNOSES AND CORRECTIONS

Troubles	Possible causes	Corrective action
1. Noisy engine		
Knocking of crankshaft and bearing	Loose main bearing	Replace.
	Seized bearing	Replace.
	Bent crankshaft	Repair or replace.
	Uneven wear of journal	Correct.
	Excessive crankshaft end play	Replace center bearing.
Piston and connecting rod knocking	Loose bearing	Replace.
	Seized bearing	Replace.
	Loose piston pin	Replace pin or bushing.
	Loose piston in cylinder	Recondition cylinder.
	Broken piston ring	Replace.
	Improper connecting rod alignment	Realign.
Camshaft knocking	Loose bearing	Replace.
	Excessive axial play	Replace bearing thrust plate.
	Rough gear teeth	Repair.
	Broken cam gear	Replace.

Timing chain noise	Improper chain tension	Adjust.
	Worn and/or damaged chain	Replace.
	Worn sprocket	Replace.
	Worn and/or broken tension adjusting mechanism	Replace.
	Excessive camshaft and bearing clearance	Replace.
Camshaft and valve mechanism knocking	Improper valve clearance	Adjust.
	Worn adjusting screw	Replace.
	Worn rocker face.	Replace.
	Loose valve stem in guide	Replace guide.
	Weakened valve spring	Replace.
	Seized valve	Repair or replace.
Water pump knocking	Improper shaft end play	Replace.
	Broken impeller	Replace.
II. Other mechanical trouble		
Sticked valve	Improper valve clearance	Adjust.
	Insufficient clearance between valve stem and guide	Clean stem or ream the guide.
	Weakened or broken valve spring	Replace.
	Biting or damage of valve stem	Replace or clean.
	Poor fuel quality	Use good fuel.
Seized valve seat	Improper valve clearance	Adjust.
	Weakened valve spring	Replace.
	Thin valve head edge	Replace valve.
	Narrow valve seat	Refacing.
	Overheat	Repair or replace.
	Over speeding	Drive under proper speed.
	Sticked valve guide	Repair.
Excessively worn cylinder and piston	Shortage of engine oil	Add or replace oil.
	Dirty engine oil	Clean crankcase, replace oil and oil filter element.
	Poor oil quality	Use right oil.
	Overheat	Repair or replace.
	Wrong assembly of piston with connecting rod	Repair or replace.

	Improper correct piston ring clearance	Adjust.
	Broken piston ring	Replace.
	Dirty air cleaner	Clean periodically.
	Too rich mixture	Adjust.
	Engine over run	Drive under proper speed.
	Sticked choke valve	Clean and adjust.
	Overchoking	Start correct way.
Defective connecting rod	Shortage of engine oil	Add oil or replace.
	Low oil pressure	Correct.
	Poor engine oil quality	Use right oil.
	Rough surface of crankshaft	Grind and replace bearing.
	Clogged oil passage	Clean.
	Wear or eccentricity of bearing	Replace.
	Wrong assembly of bearing	Repair.
	Loose bearing	Replace.
	Incorrect connecting rod alignment	Repair or replace.
Defective crankshaft bearing	Shortage of engine oil	Add or replace.
	Low oil pressure	Adjust.
	Poor engine oil quality	Use right oil.
	Wear or out of round of crankshaft journal	Repair.
	Clogged oil passage in crankshaft	Clean.
	Wear or eccentricity of bearing	Replace.
	Wrong assembly of bearing	Repair.
	Not concentric crankshaft or bearing	Replace.

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