

ENGINE MECHANICAL

SECTION EM-1

CONTENTS

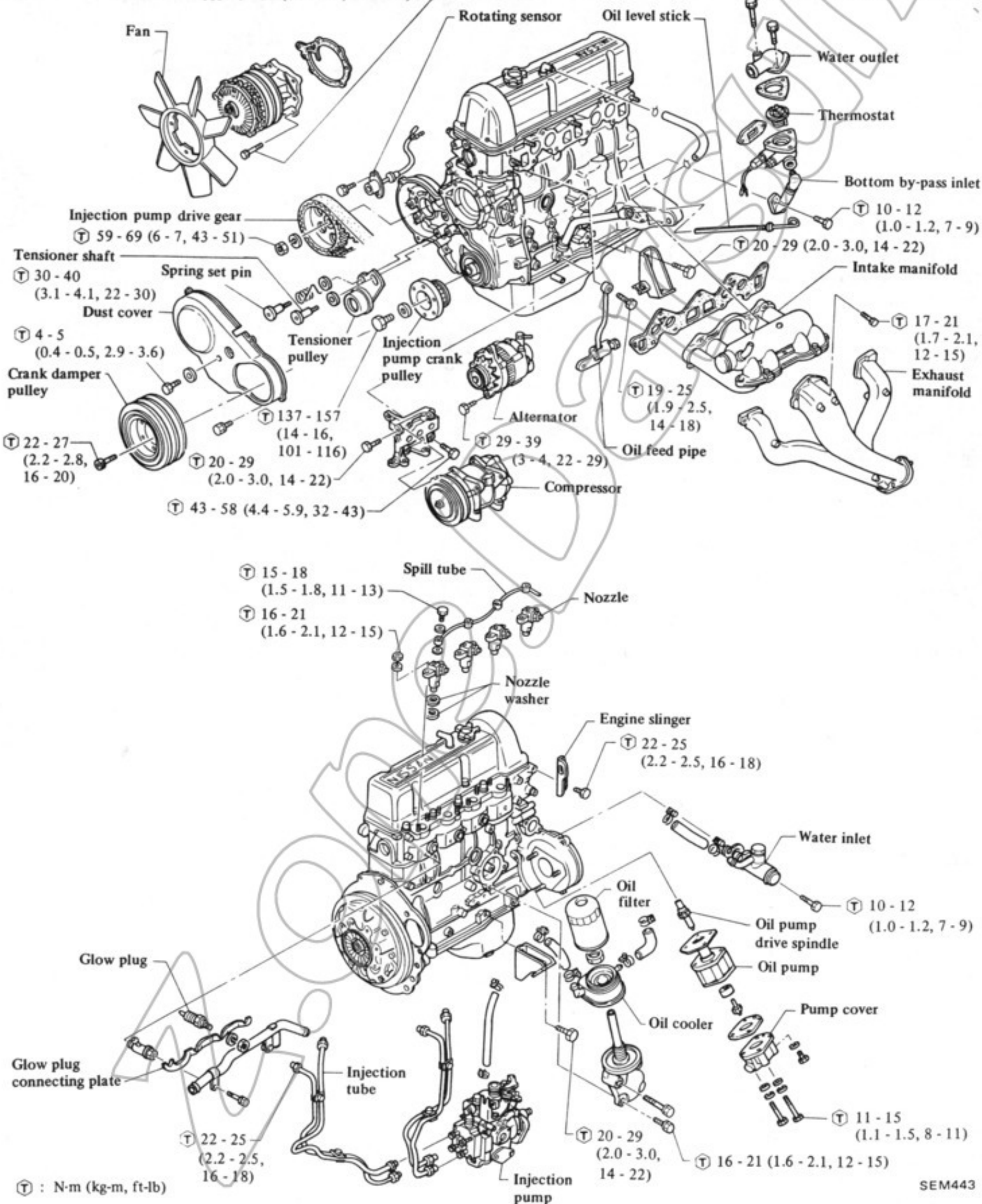
EM

ENGINE COMPONENT (Outer parts) ..	EM-2
ENGINE COMPONENT (Body parts) ..	EM-4
ENGINE DISASSEMBLY ..	EM-6
PRECAUTIONS ..	EM-6
DISASSEMBLY ..	EM-6
DISASSEMBLING PISTON AND CONNECTING ROD ..	EM-9
DISASSEMBLING CYLINDER HEAD ..	EM-9
COMBUSTION CHAMBER REPLACEMENT ..	EM-9
INSPECTION AND REPAIR ..	EM-10
CYLINDER HEAD ..	EM-10
CAMSHAFT AND CAMSHAFT BEARING ..	EM-12
CYLINDER BLOCK ..	EM-12
PISTON, PISTON PIN AND PISTON RING ..	EM-13
CONNECTING ROD ..	EM-14
CRANKSHAFT ..	EM-14
MAIN BEARING AND CONNECTING ROD BEARING ..	EM-15
MISCELLANEOUS COMPONENTS ..	EM-15
ENGINE ASSEMBLY ..	EM-16
PRECAUTIONS ..	EM-16
ASSEMBLING CYLINDER HEAD ..	EM-16
ASSEMBLING PISTON AND CONNECTING ROD ..	EM-17
ASSEMBLING ENGINE OVERALL ..	EM-17
SERVICE DATA AND SPECIFICATIONS ..	EM-22
GENERAL SPECIFICATIONS ..	EM-22
INSPECTION AND ADJUSTMENT ..	EM-22
TIGHTENING TORQUE ..	EM-27
SPECIAL SERVICE TOOLS ..	EM-28

ENGINE COMPONENT (Outer parts)

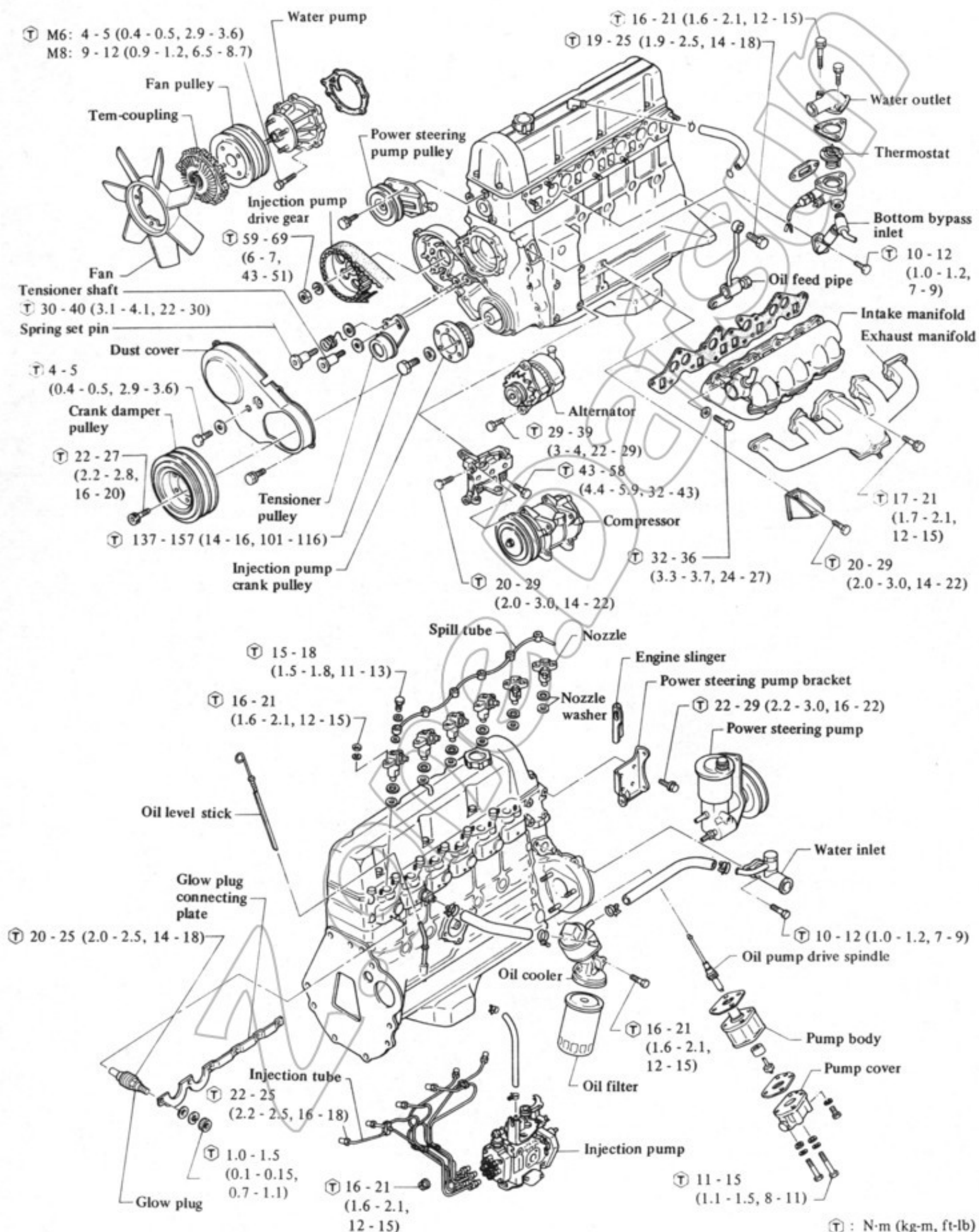
LD20 engine

Ⓓ M6: 4 - 5 (0.4 - 0.5, 2.9 - 3.6)
M8: 9 - 12 (0.9 - 1.2, 6.5 - 8.7)



SEM443

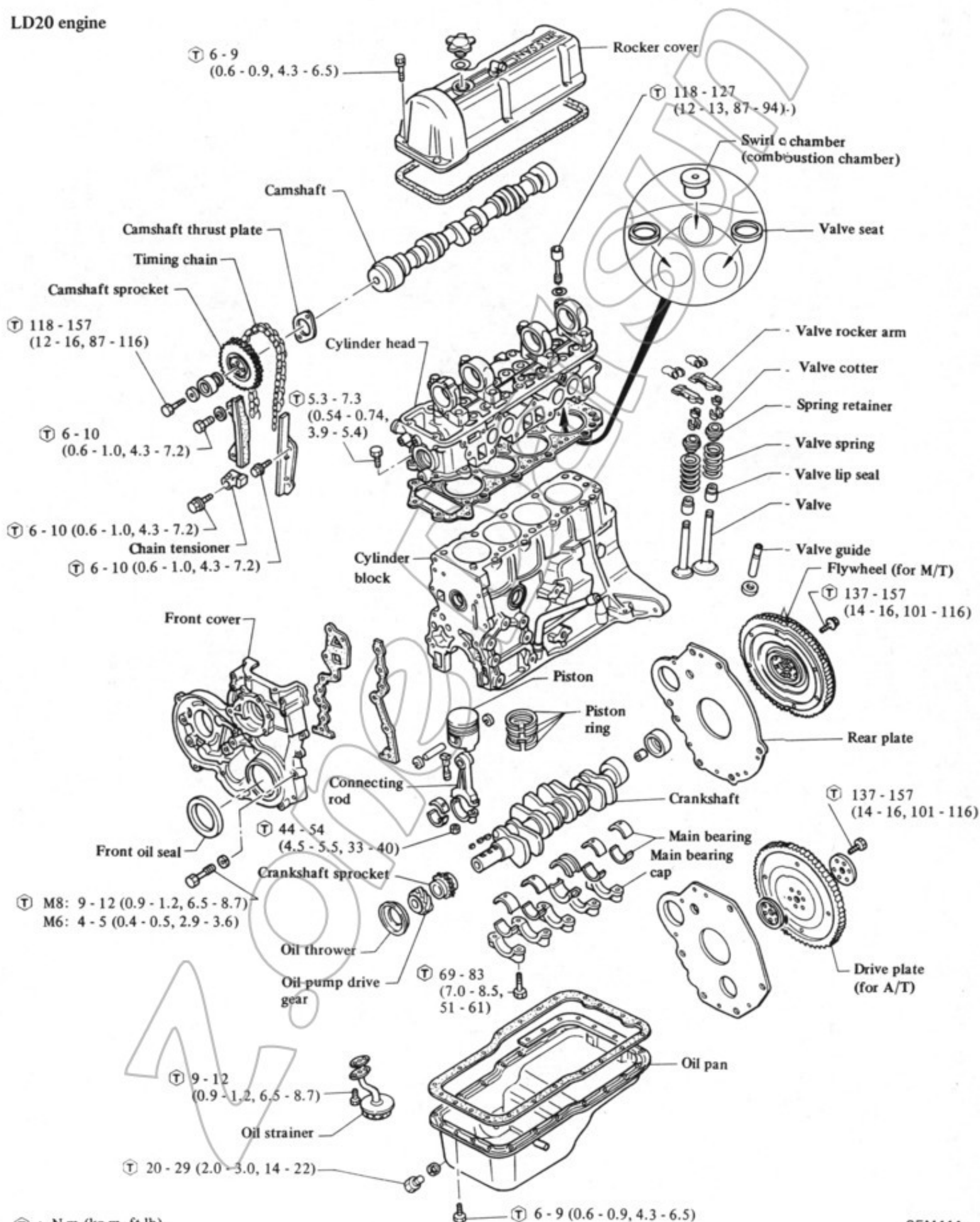
LD28 engine



T : N·m (kg-m, ft-lb)
 SEM267

ENGINE COMPONENT (Body parts)

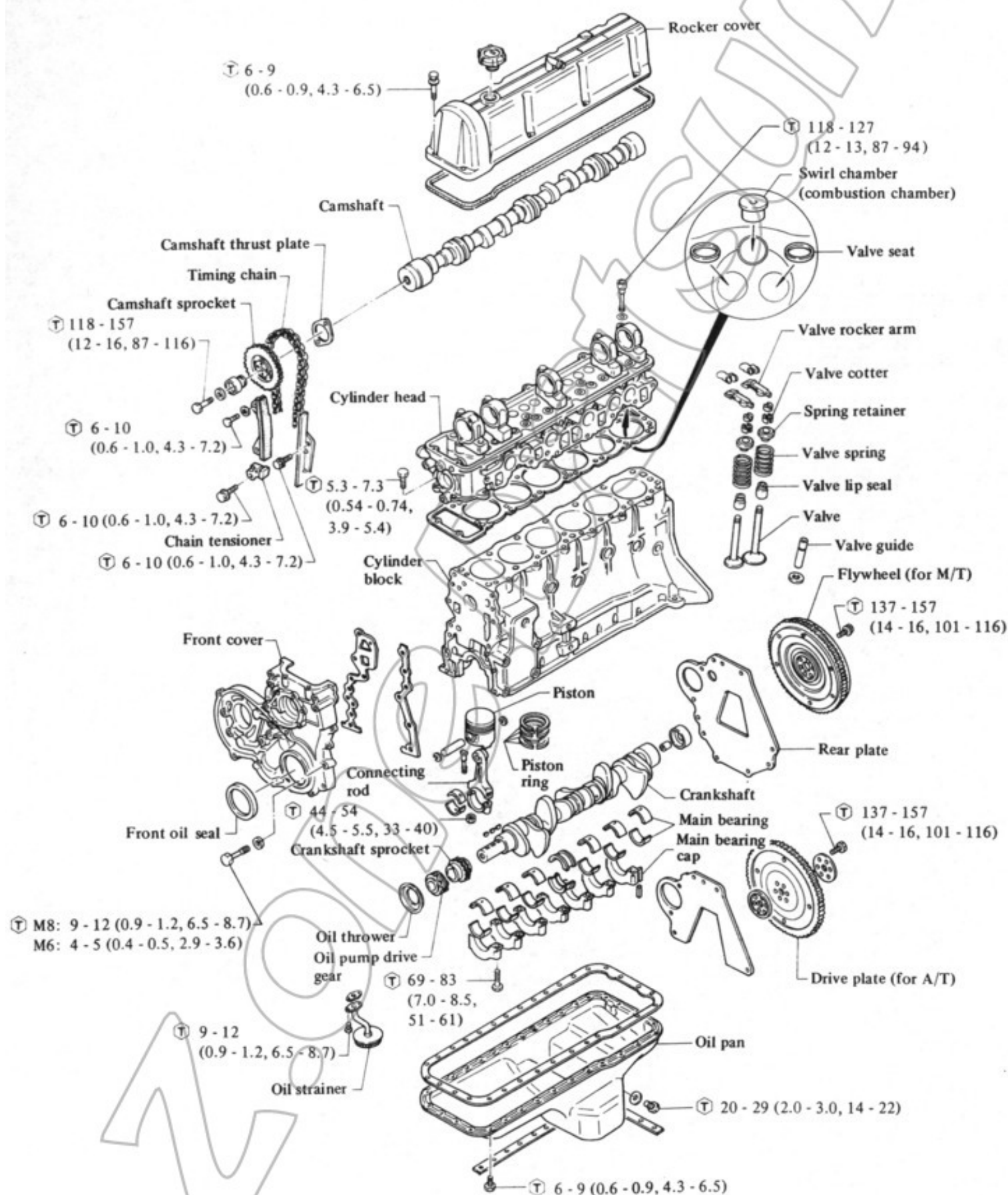
LD20 engine



T : N-m (kg-m, ft-lb)

SEM444

LD28 engine



T : N·m (kg·m, ft·lb)

SEM268

ENGINE DISASSEMBLY

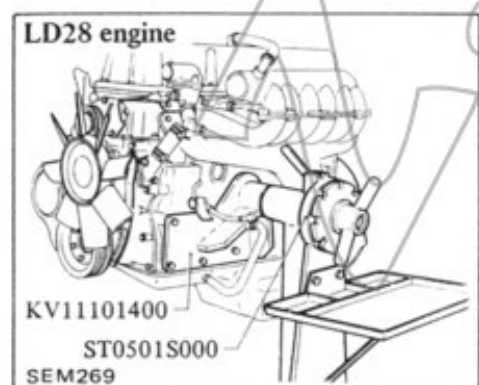
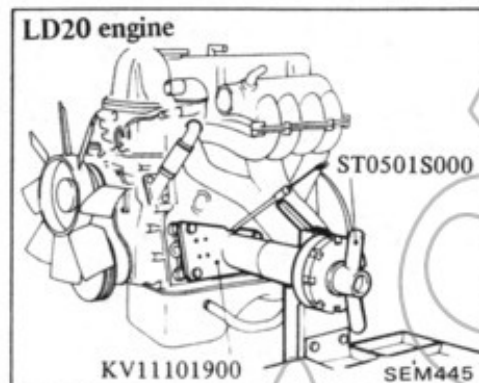
PRECAUTIONS

Arrange the disassembled parts on the parts stand in accordance with their assembled locations, sequence, etc., so that the parts will be re-assembled in their original locations. Place mating marks on the parts if necessary.

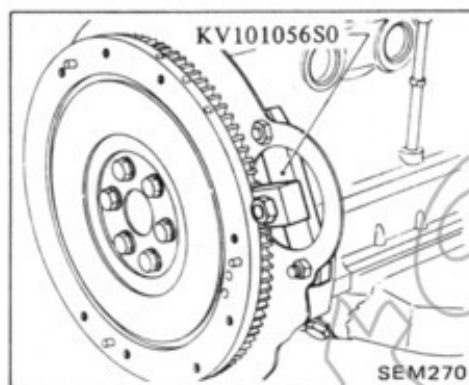
DISASSEMBLY

MOUNTING ENGINE ON WORK STAND

1. Remove rear and left side parts.
 - Starter motor (on right side of engine)
 - Transmission assembly
 - Clutch cover assembly (M/T)
 - Engine mounting bracket
 - Alternator assembly and fan belt
 - Alternator bracket (on air conditioner equipped models, one bracket holds both alternator and compressor)
2. Install engine attachment to cylinder block. Then, mount the engine on the work stand.



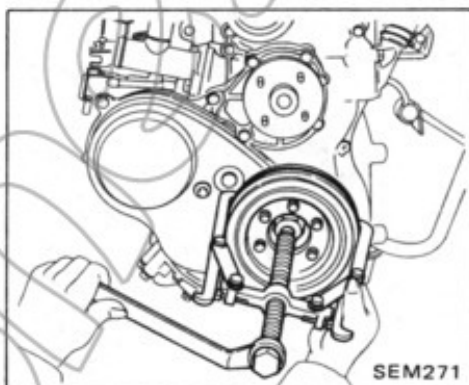
3. Install Tool, to prevent crankshaft rotation.



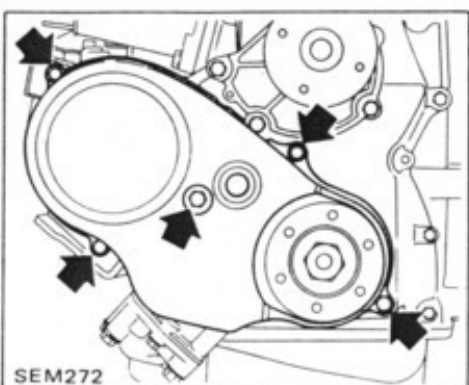
4. Drain engine oil and coolant.

REMOVING OUTER PARTS

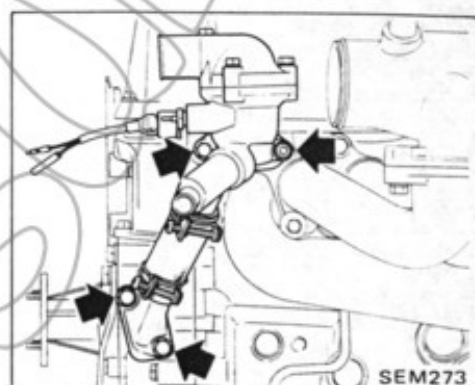
1. Remove front side engine parts:
 - Fan, tem-coupling and fan pulley
 - Alternator adjusting bar
 - Remove crank damper pulley by lightly tapping around it. If it is difficult to remove, use a puller.



- Pulley bracket with idler pulley (If so equipped)
- Front dust cover

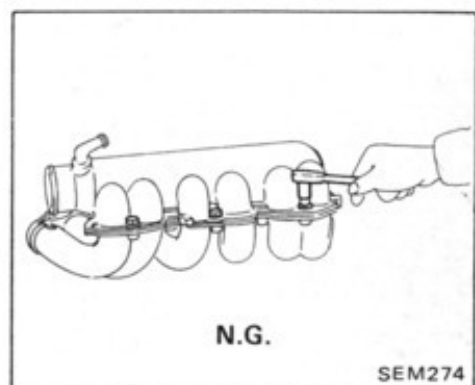


2. Remove left side engine parts.
 - Thermostat housing and bottom bypass inlet with hose.

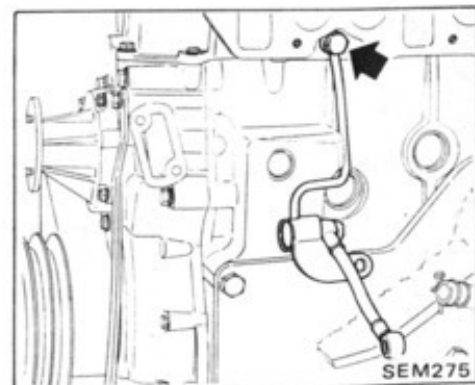


- Intake, exhaust manifold and engine slinger

Do not separate the intake manifold.



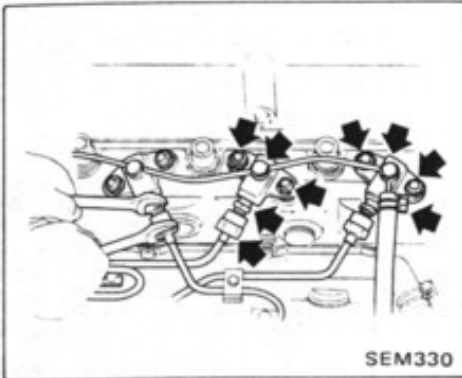
- Oil feed pipe



- Oil return hose from oil pan

3. Remove right side engine parts.

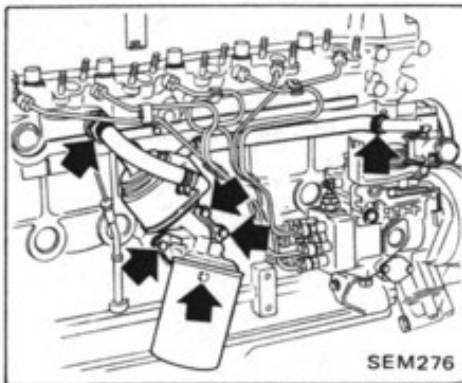
- Spill tube
- Fuel return hose
- Injection tubes at nozzle side
- Injection nozzles
- Nozzle washers



Plug nozzle holes to prevent entry of dust and dirt.

- Oil cooler and coolant hoses with oil filter

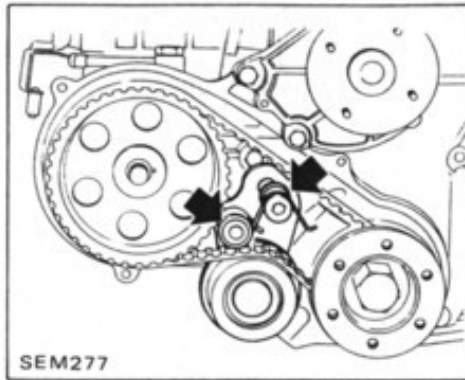
Above parts can be removed only after injection pump has been detached (LD20 engine).



- Water inlet
- Oil level stick
- Engine mounting bracket
- Engine slinger (If power steering is equipped, remove power steering oil pump bracket.)
- Oil pump

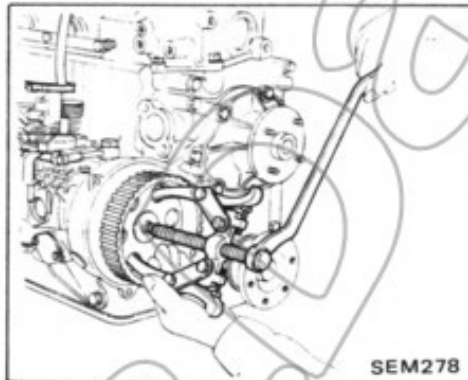
REMOVING BODY PARTS

1. Remove oil pan and oil strainer.
2. Injection pump
 - (1) Remove tensioner shaft and spring set pin, then remove tensioner pulley. (Tensioner pulley is fastened with a tensioner shaft and spring pin.)

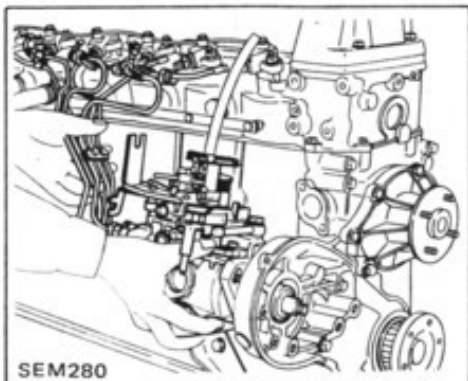
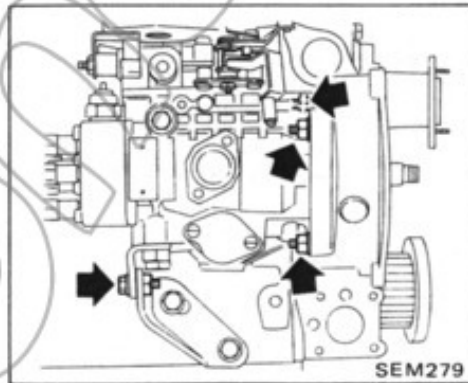


- (2) Remove injection pump drive belt.
- (3) Remove injection pump drive gear.

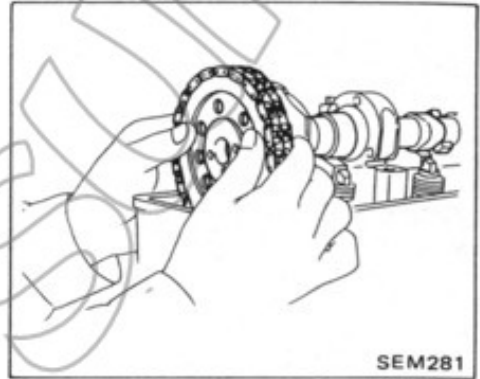
Do not remove drive shaft nut as this will cause drive gear to pop out.



- (4) Remove injection pump assembly with injection tubes.

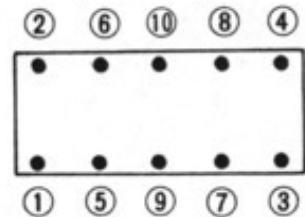


3. Remove valve rocker cover.
4. Cylinder head assembly
 - (1) Remove camshaft bolt.
 - (2) Remove camshaft sprocket and slowly lower timing chain.

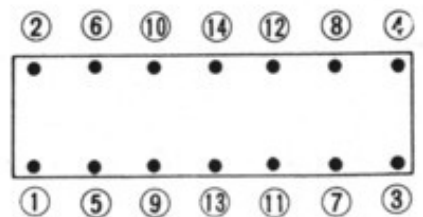


- (3) Remove bolts securing cylinder head to front cover.
- (4) Loosen cylinder head bolts in the sequence as shown.

LD20 engine



LD28 engine

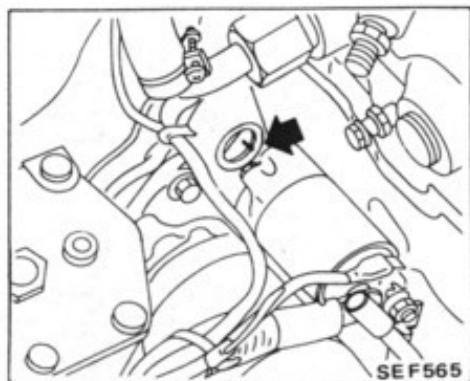


Gradually loosen cylinder head bolts in two or three stages.

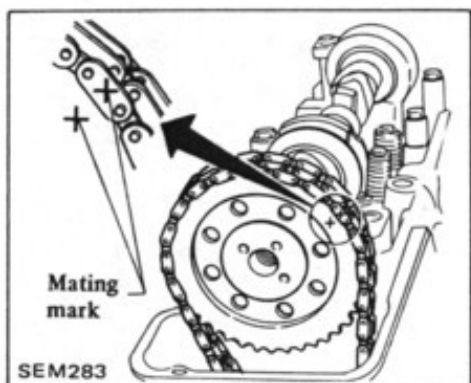
- (5) Remove cylinder head.

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

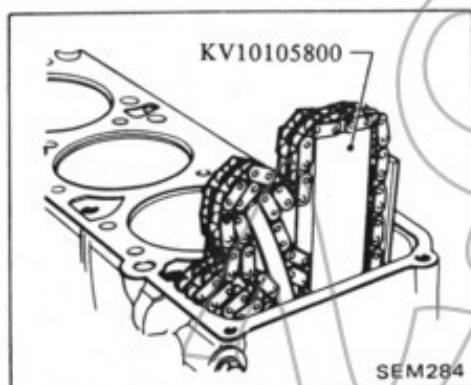
- a. Remove blind plug from rear plate. Rotate crankshaft until timing marks on flywheel and rear plate are properly aligned. Make sure that No.1 piston is at T.D.C. on its compression stroke.



- b. To facilitate assembly operation, scribe a mark on timing chain and camshaft sprocket prior to removal.

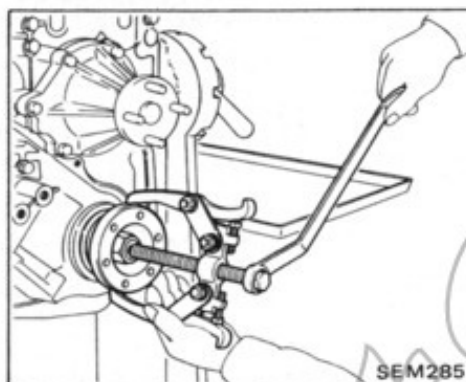


- c. Support timing chain by placing Tool between timing chains.



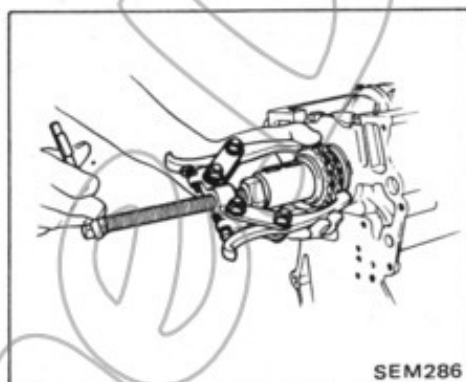
- d. Install cylinder head, and then install camshaft sprocket by aligning marks on it and timing chain.

5. Remove front side parts.
Loosen bolt and pull out injection pump drive crank pulley.

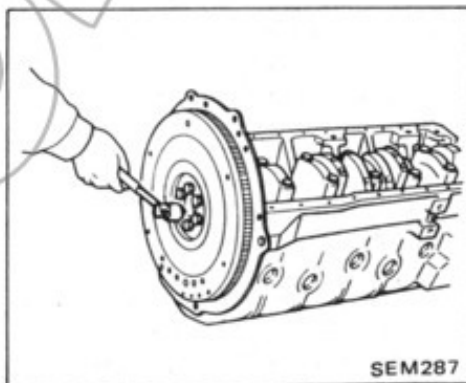


- Water pump
- Front cover
- Timing chain
- Chain tensioner and chain guides
- Oil thrower, oil pump drive gear from crankshaft

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



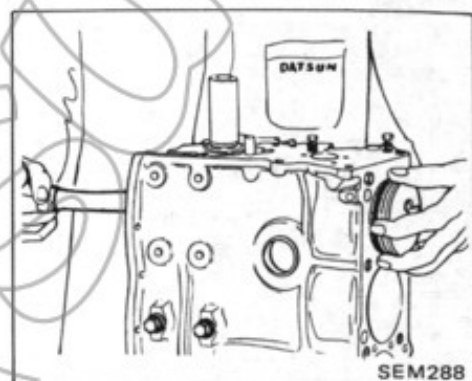
6. Remove flywheel (M/T) or drive plate (A/T).



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

7. Piston and connecting rod assembly

- (1) Remove connecting rod bearing cap with bearing.
- (2) Push out piston with connecting rod toward cylinder head side.



- Piston can be easily removed by scraping carbon off top face of cylinder 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.

8. Crankshaft

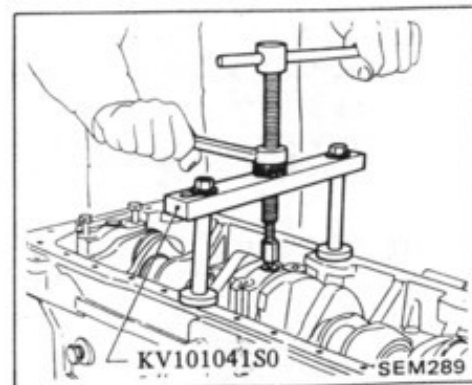
- (1) Remove main bearing cap with bearing.

- When loosening main bearing cap bolts, loosen from outside in sequence.

Do not completely loosen bolts in one step.

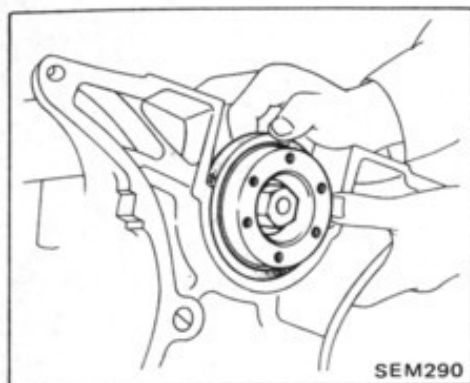
Instead use two or three steps for this procedure.

- Remove center and rear main bearing caps using Tool.



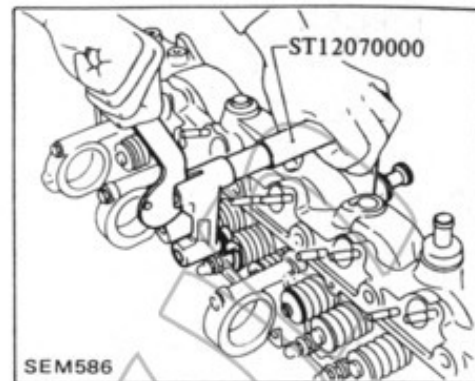
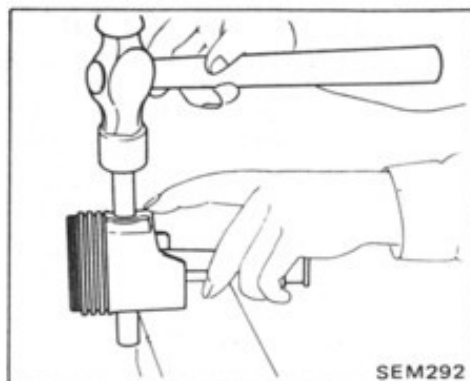
- Keep them in order.

- (2) Remove rear oil seal.



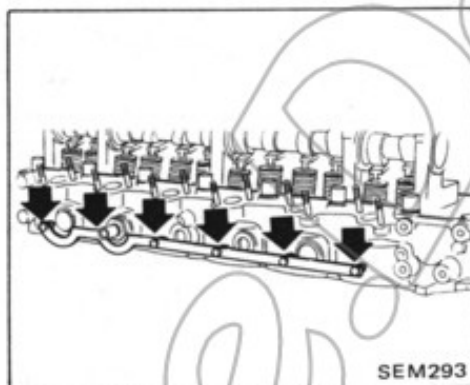
When removing rear oil seal without removing main bearing cap, pry it off with a screwdriver so as not to damage crankshaft.

- (3) Remove crankshaft.
(4) Remove main bearing from the side of the block.



DISASSEMBLING CYLINDER HEAD

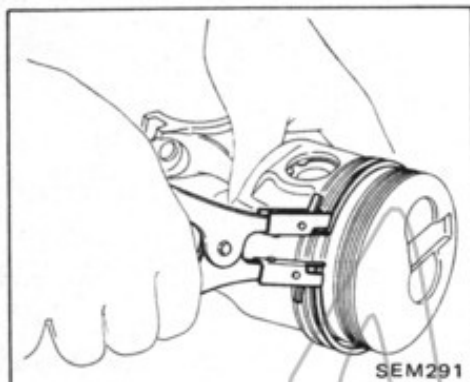
1. Remove glow plug connecting plate and glow plugs.



DISASSEMBLING PISTON AND CONNECTING ROD

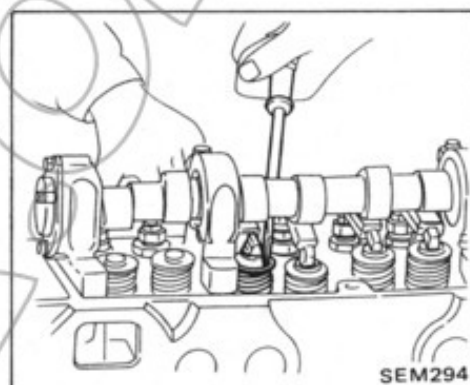
1. Remove top, second piston rings and rails with a ring remover and remove oil ring expander by hand.

When removing piston rings, be careful not to scratch piston.



2. Heat piston to approximately 60 to 70°C (140 to 158°F), using heater or hot water, and take out piston pin with a suitable drift.

2. Remove valve rocker spring.
3. Loosen valve rocker pivot lock nut and set cam nose to upper position, then remove rocker arm by pressing down on valve spring.



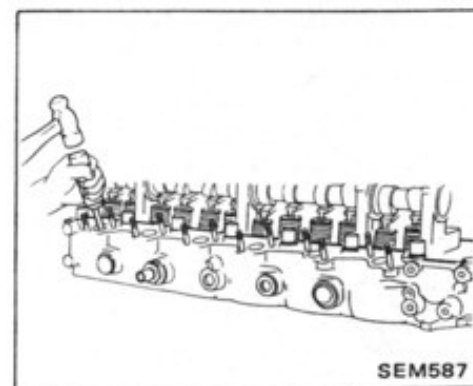
4. Remove camshaft.
5. Remove valves, valve springs and relating parts using Tool.

- Keep the disassembled parts in order.
- Do not remove rocker pivot bushing from cylinder head.
- Do not remove camshaft bearing from cylinder head.

COMBUSTION CHAMBER REPLACEMENT

Usually combustion chamber should not be removed.

1. Remove glow plug connecting plate and glow plugs.
2. Remove combustion chamber so that cylinder head will not be damaged.



Be careful not to scratch inside of nozzle hole.

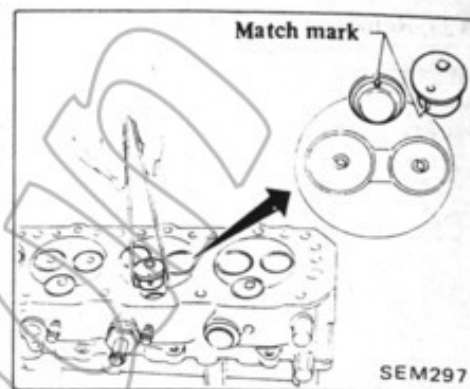
Install combustion chamber.

1. Cool combustion chamber with dry ice for approximately 5 to 10 minutes.

WARNING:

Do not touch cooled combustion chamber with bare hand.

2. Align combustion chamber knock pin with cylinder head notch, and install it into cylinder head using a plastic-tip hammer.



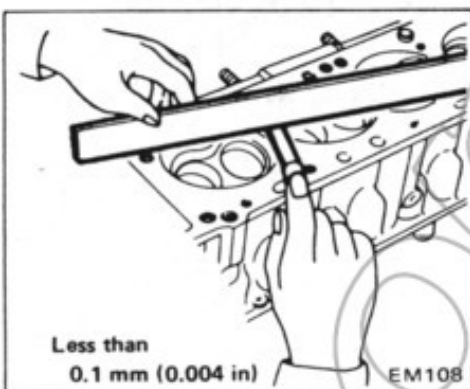
INSPECTION AND REPAIR

CYLINDER HEAD

CHECKING CYLINDER HEAD MATING FACE

1. Make a visual check for cracks or flaws. If cracks or melted areas are found in combustion chamber, replace.
2. Measure the surface of cylinder head (on cylinder block side) for warpage.

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



Less than
0.1 mm (0.004 in)

Nominal height:
 89.5 ± 0.1 mm (3.524 ± 0.004 in)

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"

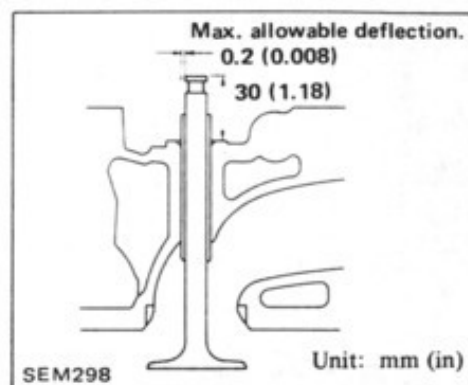
Depth of cylinder block grinding is "B"

The limit is as follows:

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

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.



Max. allowable deflection.
0.2 (0.008)

30 (1.18)

Unit: mm (in)

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

Determining clearance

1. Precise method:
 - (1) Measure the diameter of valve stem with a micrometer in three places; top, center and bottom.
 - (2) Measure valve guide bore at center using telescope hole gauge.
 - (3) Subtract the highest reading of valve stem diameter from valve guide bore to obtain the stem to guide clearance.

Stem to guide clearance:

Maximum Limit

0.10 mm (0.0039 in)

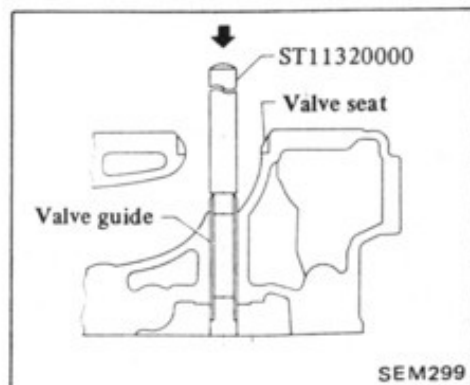
2. Expedient method

Pry the valve in a lateral direction, and measure the deflection at stem tip with dial gauge.

Replacement of valve guide

To remove old guides, use a press [under a 20 kN (2 t, 2.2 US ton, 2.0 Imp ton) pressure] or a hammer, and Tool.

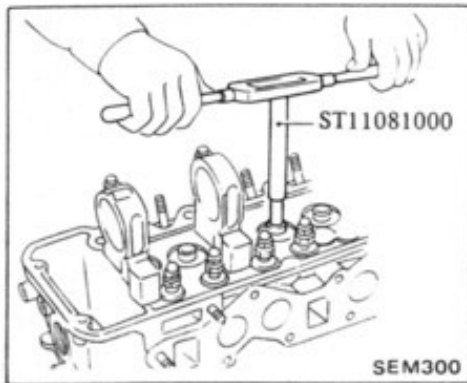
1. Drive them out toward rocker cover side using Tool.



2. Ream cylinder head valve guide hole using Tool at room temperature.

Reaming bore:

12.223 - 12.234 mm
(0.4812 - 0.4817 in)



3. Fit snap ring on new valve guide. Press the guide onto cylinder head until the snap ring comes in contact with cylinder head surface.

Valve guide with 0.2 mm (0.008 in) oversize diameter is available for service.

Refer to S.D.S.

4. Ream the bore using Tool ST11032000.

Reaming bore:

8.000 - 8.018 mm
(0.3150 - 0.3157 in)

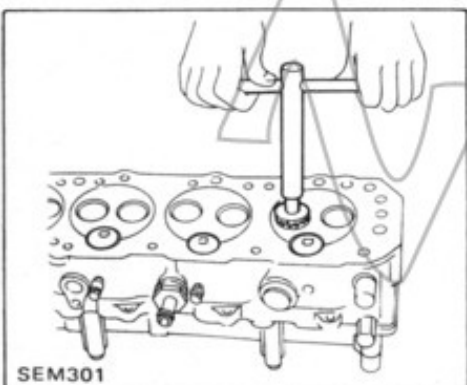
5. Correct valve seat surface with new valve guide as the axis.

VALVE SEAT INSERTS

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

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

Oversize valve seat insert of 0.5 mm (0.020 in) is available for service. Refer to S.D.S.



- a. When repairing valve seat, check valve and valve guide for wear beforehand. If worn, replace them. Then correct valve seat.
- b. The cutting should be done with both hands for uniform cutting.

Replacement

1. Old insert can be removed by boring it 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 the cylinder head.
2. Select a suitable valve seat insert and check its outside diameter.
3. Machine the cylinder head recess in concentric circles which center on the valve guide.
4. Ream the cylinder head recess at room temperature. Refer to S.D.S.
5. Cool valve seat with dry ice for approximately 5 to 10 minutes.
6. Fit insert, ensuring that it bends on the bottom face of its recess, and caulk more than 4 points.
7. Newly-fitted valve seats 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.

VALVE

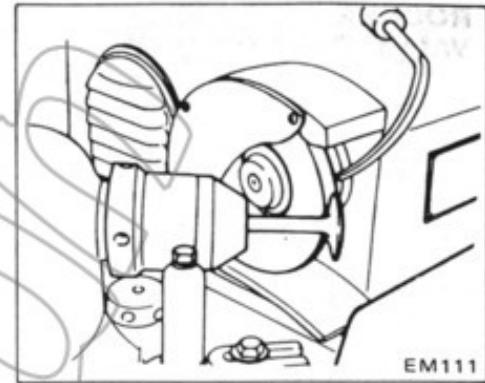
1. Check each of the intake and exhaust valves for worn, damaged or deformed valve head or stem.

Correct or replace any valve that is faulty.

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-margin-thickness, replace the valve.

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

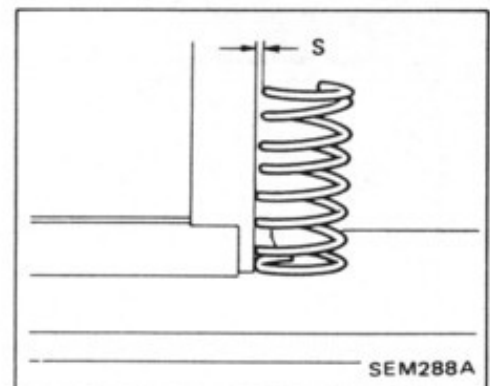
**VALVE SPRING**

1. Check valve spring for squareness using a steel square and surface plate.

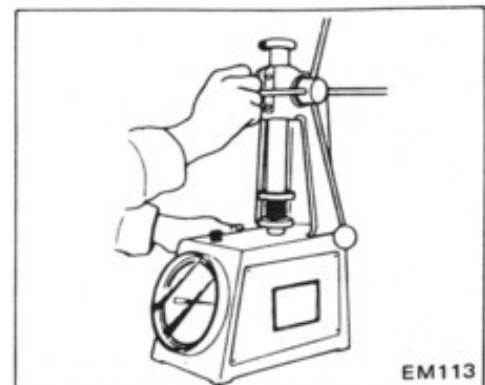
If spring is out of square "S" more than specified limit, replace with new one.

Out of square:

2.2 mm (0.087 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.



ROCKER ARM AND VALVE ROCKER PIVOT

Check pivot head, and cam contact and pivot contact surfaces of rocker arm for damage or wear.

If faulty, replace them.

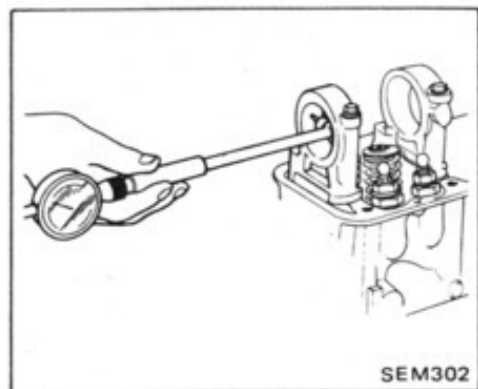
A faulty pivot must be replaced together with the corresponding rocker arm.

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.

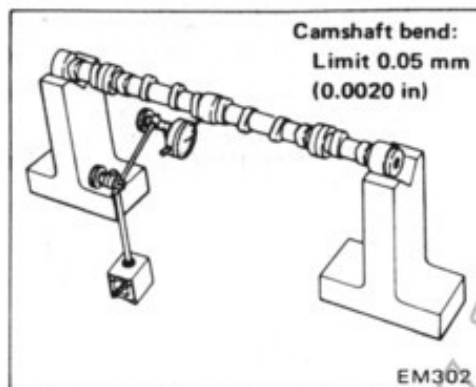
Max. tolerance of camshaft bearing clearance:
0.1 mm (0.004 in)



Do not remove camshaft brackets. If camshaft bracket were removed, install them by checking for a smooth rotation with the camshaft.

CAMSHAFT ALIGNMENT

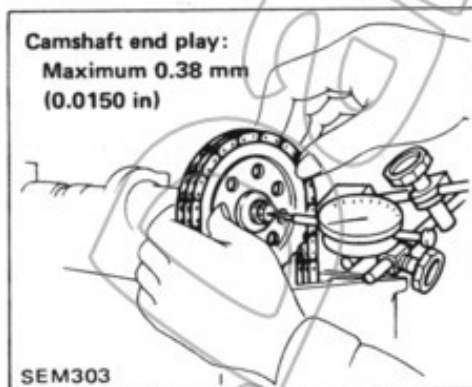
1. Check camshaft, camshaft journal and cam surface for bend, wear or damage. If beyond specified limits, replace them.
2. Camshaft can be checked for bend by placing it on V-blocks and using a dial gauge with its indicating finger resting on center journal.



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

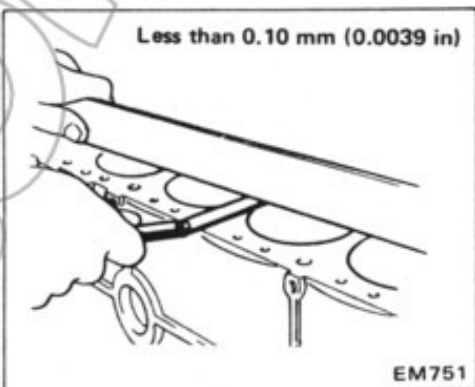
Wear limit of cam height:
0.15 mm (0.0059 in)

4. Measure camshaft end play. If beyond the specified limit, replace thrust plate.



CYLINDER BLOCK

1. Visually check cylinder block for cracks or flaws.
2. Measure the top of cylinder block (cylinder head mating face) for warp. If warp exceeds the specified limit, correct with a grinder.



Nominal height
(From crankshaft center):
227.45±0.05 mm
(8.9547±0.0020 in)

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"

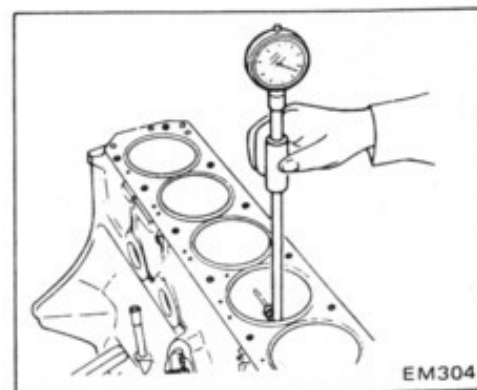
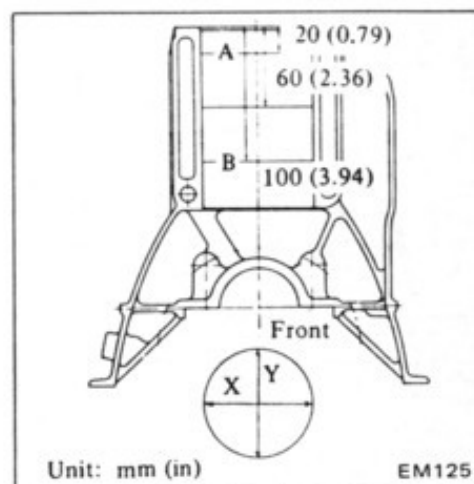
The limit is as follows:

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

3. Using a bore gauge, measure cylinder bore for wear, out-of-round or taper. If they are excessive, rebore the cylinder walls with a boring machine. Measurement should be taken along bores for taper and around bores for out-of-round.

Refer to S.D.S.

Out-of-round X-Y
Taper A-B



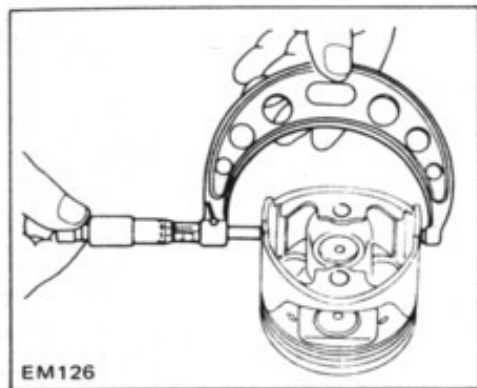
4. When wear, taper or out-of-round is minor and within the limit, remove the step at the topmost portion of cylinder using a ridge reamer or other similar tool.

CYLINDER BORING

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

Determining bore size

1. Determine piston oversize according to amount of cylinder wear. Refer to S.D.S.
2. The size to which cylinders must be honed is determined by adding piston-to-cylinder clearance to the piston skirt diameter.



Rebored 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)

Boring

1. Install main bearing caps in place, and tighten to the specified torque to prevent distortion of the cylinder bores in final assembly.
2. Cut cylinder bores.
 - Do not cut too much out of the cylinder bore at a time. Cut only 0.05 mm (0.0020 in) or so in diameter at a time.
 - Bore the cylinders in the order of 1-3-4-2 (LD20) or 1-5-3-6-2-4 (LD28) to prevent heat strain due to cutting.

3. Hone the cylinders to the required size referring to S.D.S.

- Use clean sharp stones of proper grade.
- Cross-hatch pattern should be approximately 45° .

4. Measure the finished cylinder bore for out-of-round and taper.

Measuring piston-to-cylinder clearance

Measure the extracting force, and pull feeler gauge straight upward.

It is recommended that piston and cylinder be heated to 20°C (68°F).

Feeler gauge thickness:

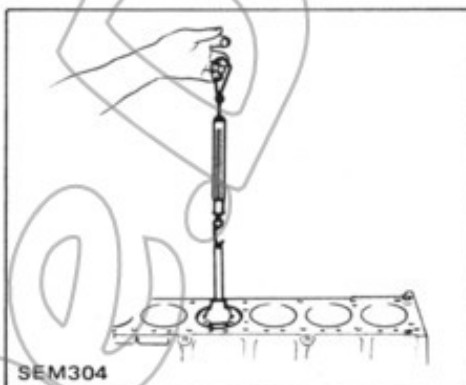
0.06 mm (0.0024 in)

Extracting force:

5.9 - 11.8 N

(0.6 - 1.2 kg,

1.3 - 2.6 lb)



PISTON, PISTON PIN AND PISTON RING

PISTON

1. Scrape carbon off piston and ring grooves with a carbon scraper and a curved steel wire.

Clean out oil slots in bottom land of oil ring groove.

2. Check for damage, scratches and wear.

Replace if such a faulty is detected.

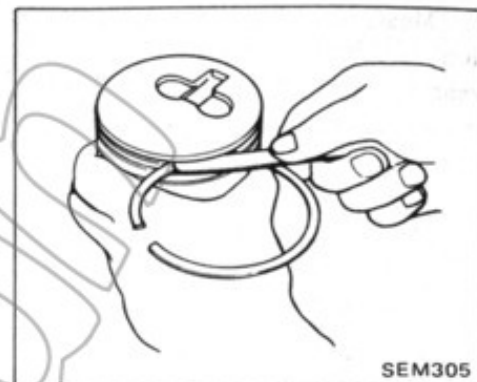
3. Measure the side clearance of rings in ring grooves as each ring is installed.

Max. tolerance of side clearance:

Top ring: 0.20 mm (0.0079 in)

2nd ring: 0.15 mm (0.0059 in)

Oil ring: 0.10 mm (0.0039 in)



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

PISTON RING

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

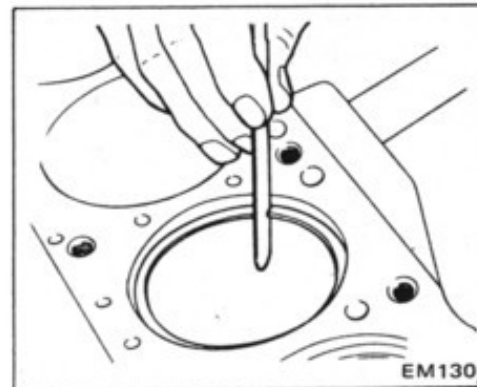
Ring should be placed to diameter at upper or lower limit of ring travel.

Max. tolerance of ring gap:

Top ring: 0.6 mm (0.024 in)

2nd ring: 0.8 mm (0.031 in)

Oil ring: 1.0 mm (0.039 in)



a. 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.

b. Oversize piston rings are available for service.

0.5 mm (0.020 in),

1.0 mm (0.039 in) oversize

PISTON PIN

1. Check piston pin and piston pin hole for signs of sticking and other abnormalities.

2. 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 - 0.004 mm
(0 - 0.0002 in)

When replacing connecting rod, select so that weight difference between each cylinder is within the specified limit in the condition of piston and connecting rod assembly.

Weight difference limit:

4 gr (0.14 oz)

CRANKSHAFT

CRANK JOURNAL AND PIN

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

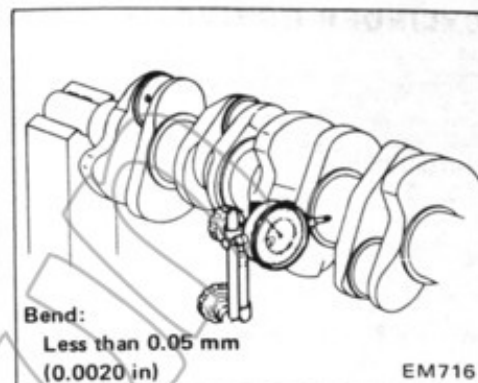
2. Check journals and crank pins with a micrometer for taper and out-of-round. Measurement should be taken along journals for taper and around journals for out-of-round.

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

Out-of-round (X-Y) and

Taper (A-B):

Less than 0.03 mm (0.0012 in)



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.

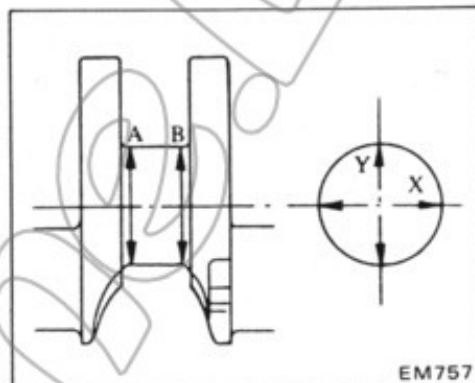
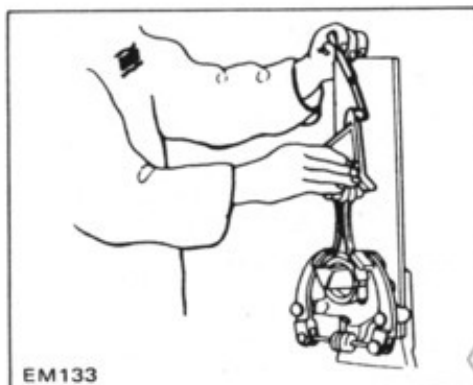
2. Check connecting rod for bend or torsion using a connecting rod aligner. If bend or torsion exceeds the limit, correct or replace.

Bend and torsion

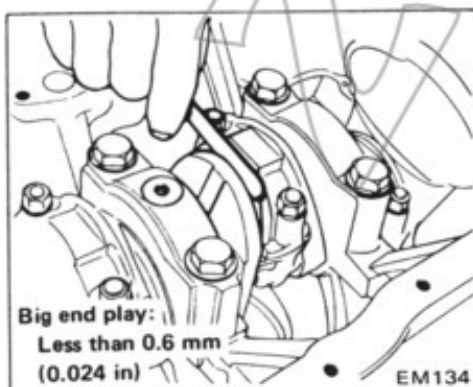
[per 100 mm (3.94 in) length]:

Less than

0.05 mm (0.0020 in)



3. 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.



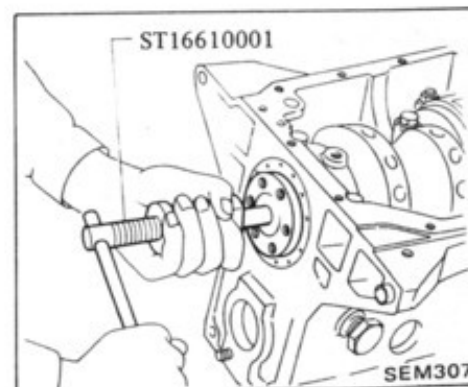
2. Install crankshaft in cylinder block and measure crankshaft free end play at the center bearing.



REPLACING PILOT BUSHING

To replace crankshaft rear pilot bushing, proceed as follows:

1. Pull out bushing using Tool.



BEND AND END PLAY

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

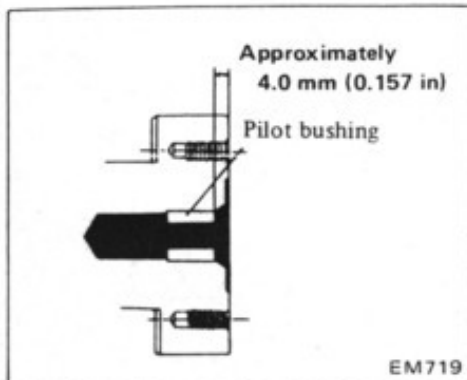
Bend value is half of the gauge reading obtained when crankshaft is turned one full revolution.

If bend exceeds the specified limit, replace or repair.

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.

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



MAIN BEARING AND CONNECTING ROD BEARING

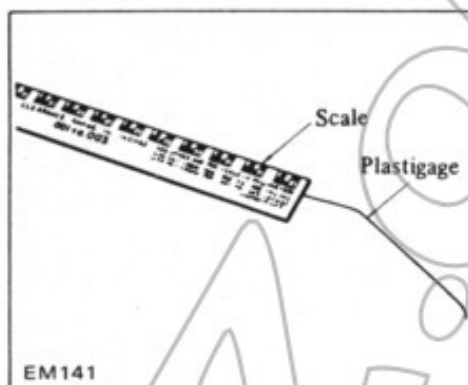
MAIN BEARING

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

Replace bearings, if faulty.

2. Measure bearing clearance as follows:

(1) Cut a plastigage to the width of bearing and place it in parallel with crank journal, getting clear of the oil hole.



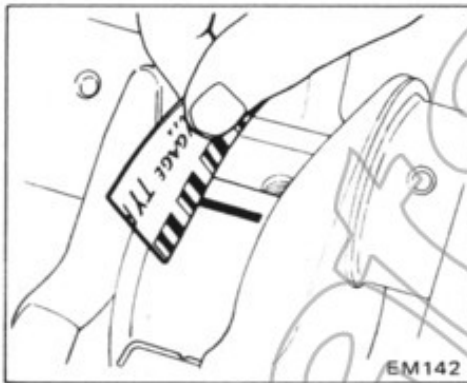
(2) Install crankshaft, bearings and bearing cap, with the bolts tightened to the specified torque.

Ⓙ : Main bearing cap
69 - 83 N·m
(7.0 - 8.5 kg-m,
51 - 61 ft-lb)

Do not rotate crankshaft while the plastigage is being inserted.

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

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



3. If clearance exceeds the specified value, replace bearing with an under-size bearing and grind crankshaft journal adequately. Refer to S.D.S.

CONNECTING ROD BEARING

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

Ⓙ : Connecting rod big end nuts
44 - 54 N·m
(4.5 - 5.5 kg-m,
33 - 40 ft-lb)

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

2. If clearance exceeds the specified value, replace bearing with an under-size bearing and grind the crankshaft journal adequately. Refer to S.D.S.

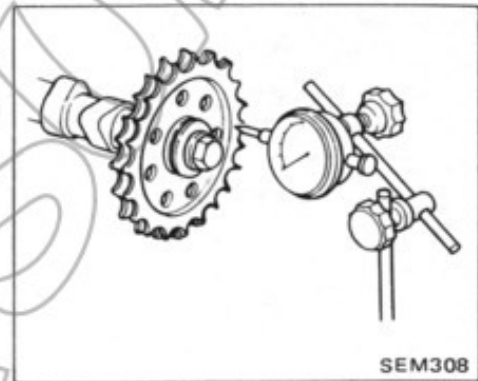
MISCELLANEOUS COMPONENTS

CAMSHAFT SPROCKET

1. Check tooth surface for flaws or wear. Replace sprocket if faulty.

2. 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 and excessive wear at roller links. Replace if faulty.

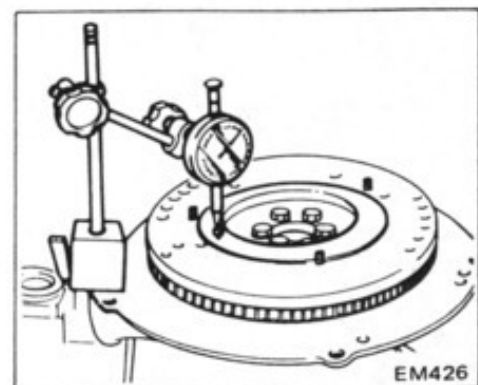
CHAIN TENSIONER AND CHAIN GUIDE

Check for wear and breakage. Replace if necessary.

FLYWHEEL

1. Check the clutch disc contact surface on 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.

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



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

Install ring gear on flywheel, heating ring gear to about 180 to 220°C (356 to 428°F).

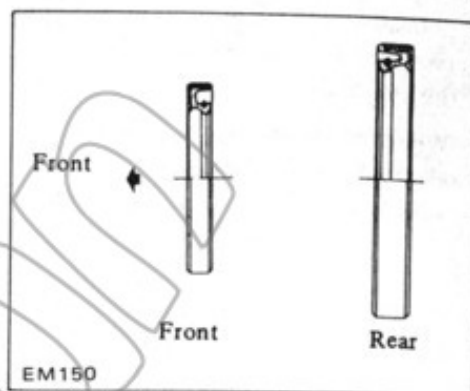
DRIVE PLATE (A/T models)

1. Check drive plate for cracks or distortion.
2. Check tooth surface of ring gear for flaws or wear. Replace drive plate assembly if necessary.

FRONT AND REAR OIL SEAL

Check front and rear oil seal for worn or folded over sealing lip and oil leakage. If necessary, replace with a new seal. When installing a new front or rear seal, be sure that it is mounted in the right direction.

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



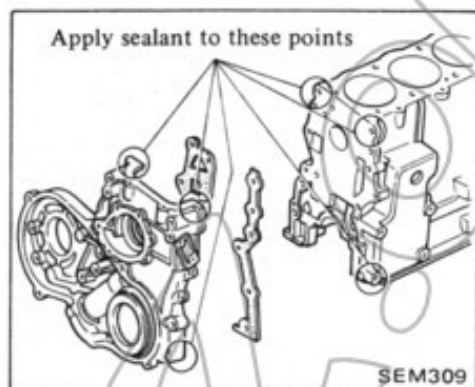
PRECAUTIONS

1. When installing sliding parts such as bearings, be sure to apply engine oil on the sliding surfaces.
2. Use new packings and oil seals.
3. Be sure to follow the specified order and tightening torque.
4. Applying sealant
Use sealant to eliminate water and oil leaks.

Do not apply too much sealant.

Parts requiring sealant are:

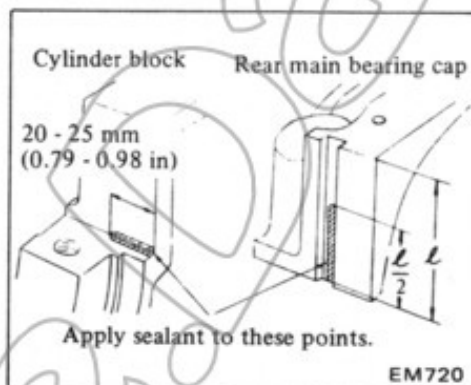
- (1) Front cover



- (2) Main bearing cap and cylinder block:

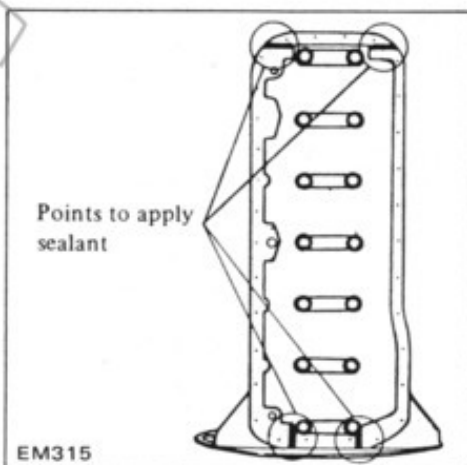
Each side of rear main bearing cap and each corner of cylinder block.

ENGINE ASSEMBLY



- (3) Cylinder block:

Step portions on the bottom and at the four mating surfaces (cylinder block to front cover and cylinder block to rear main bearing cap).



After inserting rear bearing cap side seals, apply sealant to rear main bearing cap.

ASSEMBLING CYLINDER HEAD

1. Install glow plug and glow plug connecting plate.

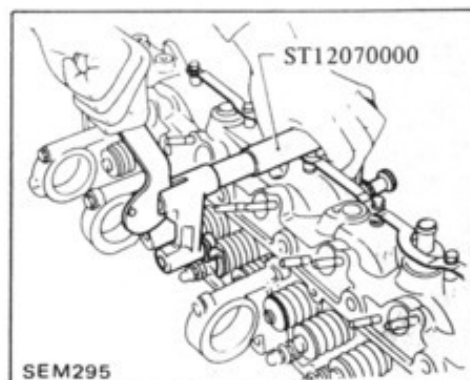
Ⓘ : Glow plug

20 - 25 N·m
(2.0 - 2.5 kg-m,
14 - 18 ft-lb)

Glow plug connecting plate

1.0 - 1.5 N·m
(0.10 - 0.15 kg-m,
0.7 - 1.1 ft-lb)

2. Install valve and valve spring.
(1) Set valve spring seat and install valve oil seal to valve guide.
(2) Install valve, valve spring, valve spring retainer and valve spring collet by using Tool.



- a. When installing valve, apply engine oil on the valve stem and lip of valve oil seal.
- b. Check whether the valve face is free from foreign matter.

3. Install valve rocker pivot assembly.

Screw valve rocker pivots joined with lock nuts into pivot bushing.

Install valve rocker spring retainer.

Fully screw in valve rocker pivot.

4. Install camshaft assembly in cylinder head carefully.

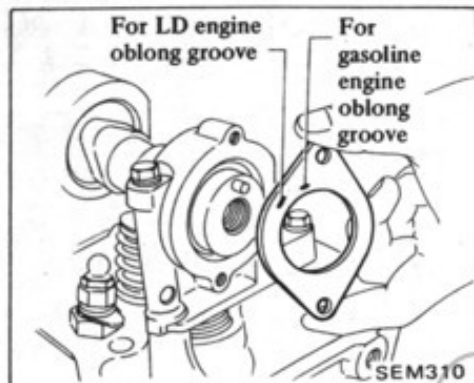
Do not damage the bearing inside.

5. Set thrust plate.

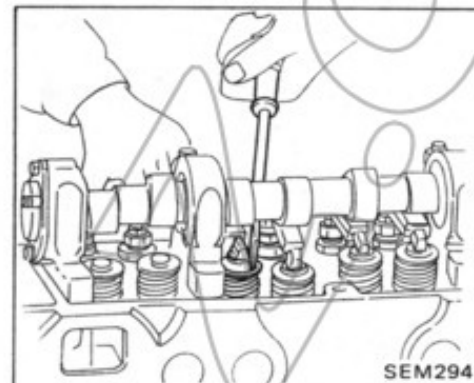
Ⓙ : Camshaft thrust plate

6 - 10 N·m
(0.6 - 1.0 kg-m,
4.3 - 7.2 ft-lb)

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



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



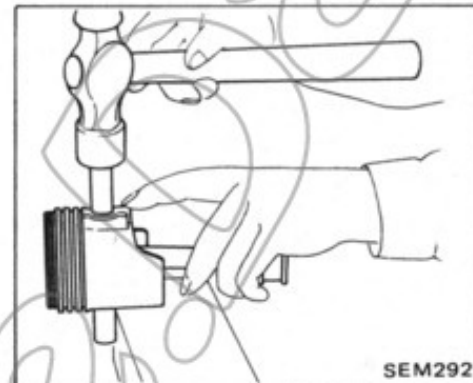
8. Install valve rocker springs.

9. After assembling cylinder head, turn camshaft until No. 1 piston is at T.D.C. on its compression stroke.

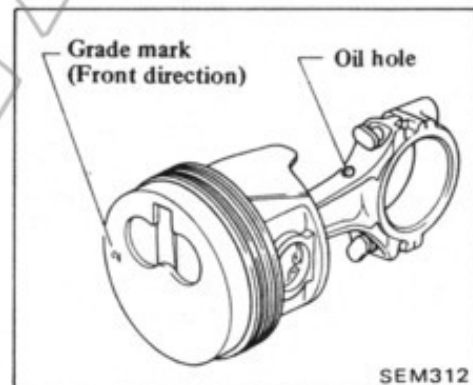
ASSEMBLING PISTON AND CONNECTING ROD

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

- a. Heat piston with a heater or hot water [approximately 60 to 70°C (140 to 158°F)], insert piston pin into piston hole with your hand while aligning piston and connecting rod.



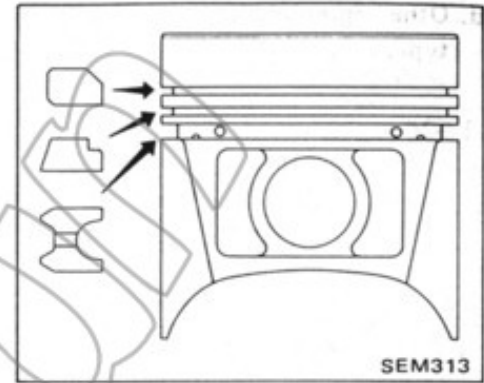
- b. Arrange so that oil jet of connecting rod big end is directed toward the right side of cylinder block.



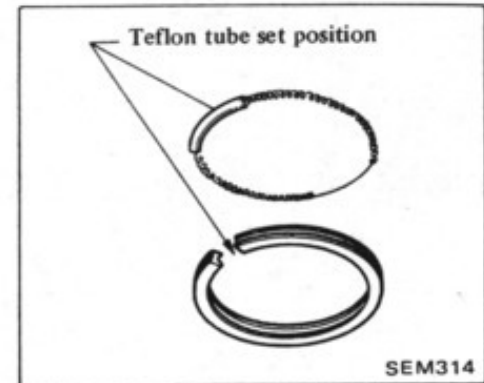
- c. Connecting rods are marked at side of big end for identifying the designated cylinder.

2. Install piston rings.

Install so that stamped mark on ring faces upward.



- a. Use top and second rings which have no marks when bore grade stamped near cylinder block bore is (1) or (2); use rings with "S" mark when bore grade is (3), (4) or (5).
- b. Align teflon tube with ring gap.



ASSEMBLING ENGINE OVERALL

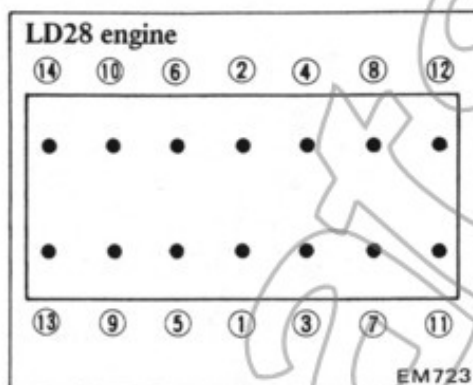
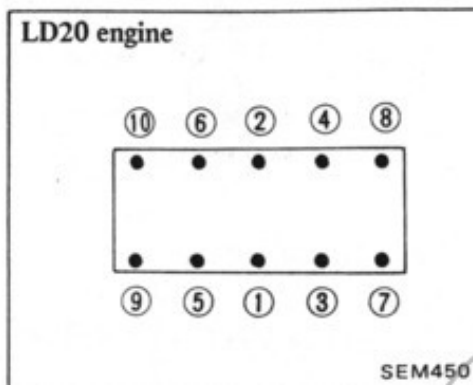
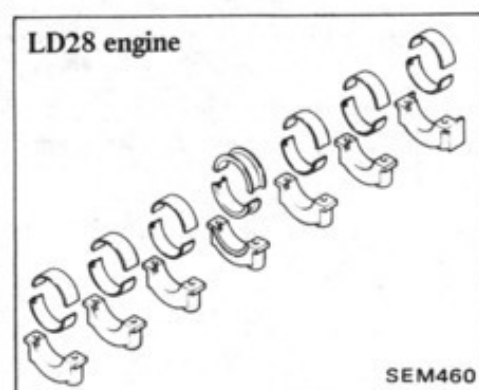
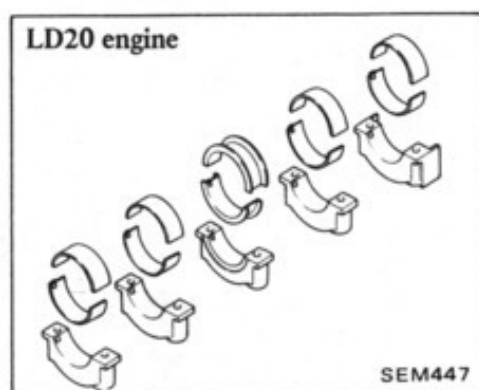
INSTALLING BODY PARTS

First, mount cylinder block on work stand (refer to Engine Disassembly).

Then install following parts:

1. Crankshaft.
 - (1) Set upper main bearings at the proper portion of cylinder block.
 - a. Upper bearings have oil hole and oil groove, however lower bearings do not.
 - b. Only center bearing is a flange type.
 - c. Front bearing is also the same type as rear bearing.

- d. Other inter-bearings are the same type.



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

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

- (2) Apply engine oil to main bearing surfaces on both sides of cylinder block and cap.

- (3) Install crankshaft.

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

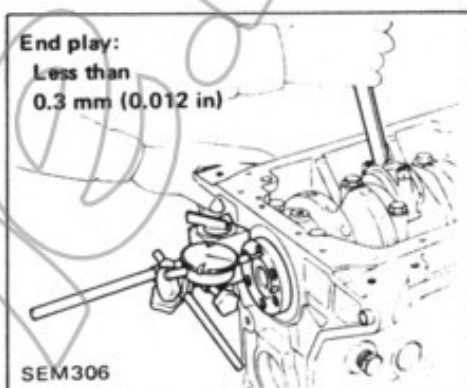
- Ⓙ : Main bearing cap bolts
69 - 83 N·m
(7.0 - 8.5 kg-m,
51 - 61 ft-lb)

- a. Apply sealant to each side of rear main bearing cap and each corner of cylinder block. Refer to Precautions.

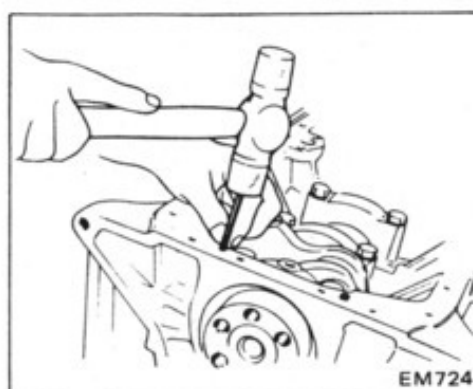
- b. Arrange the parts so that the arrow mark on bearing cap faces toward the front of engine.

- c. Prior to tightening bearing cap bolts, place bearing cap in proper position by shifting crankshaft in the axial direction.

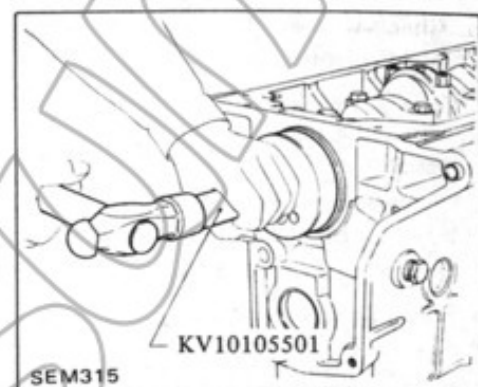
- d. Tighten bearing cap bolts gradually in separating two to three stages and in sequence outwardly from center bearing.



2. Side oil seals. Apply sealant to these seals. Then install them into main bearing cap.



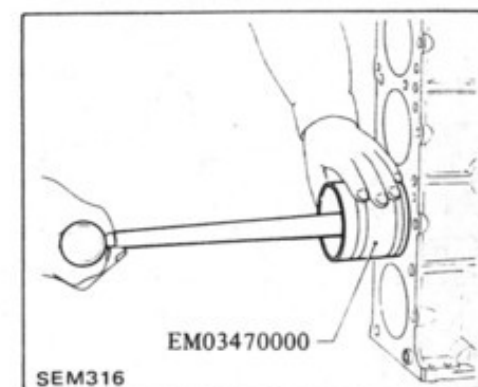
3. Rear oil seal. Install rear oil seal by using Tool.



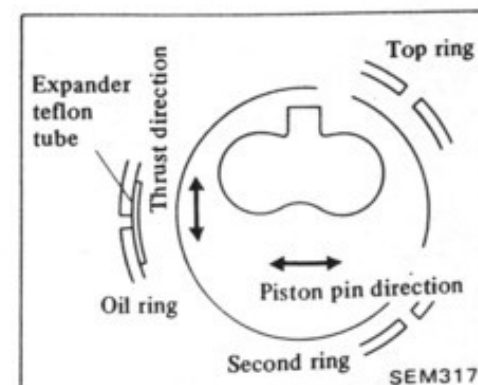
- a. When installing oil seal, give coating of engine oil to mating shaft to prevent scratches and folded lip. Also apply coating of oil to periphery of oil seal.

- b. Install oil seal in the direction that dust seal lip faces to the outside of crankcase.

4. Piston with connecting rod
(1) Install them into corresponding cylinders using Tool.

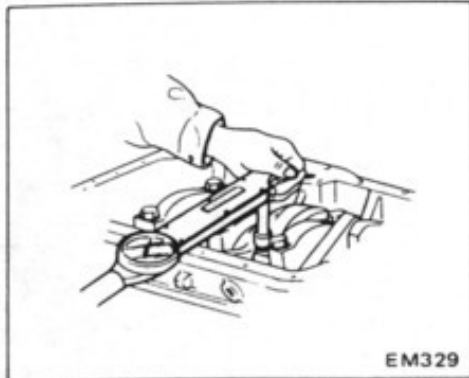


- a. Apply engine oil to sliding parts.
b. Arrange so that the grade mark on piston head faces the front of engine.
c. Set piston rings as shown below.



(2) Install connecting rod caps.

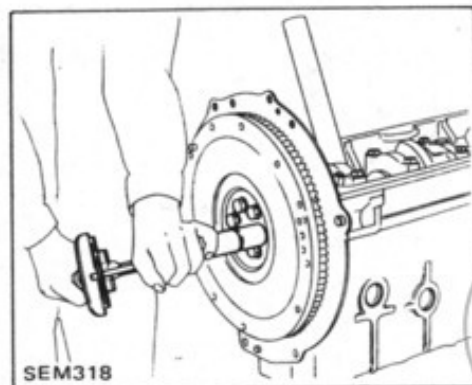
- Ⓙ : Connecting rod big end nuts
 44 - 54 N·m
 (4.5 - 5.5 kg-m,
 33 - 40 ft-lb)



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

(3) Make sure that there is sufficient play at the large end of the connecting rod. Refer to Inspection and Repair.
 5. Install rear plate and flywheel or drive plate.

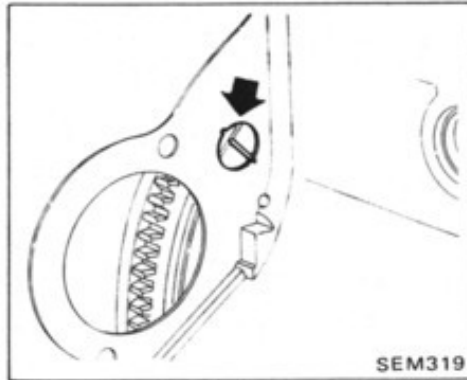
- Ⓙ : Flywheel or drive plate fixing bolts
 137 - 157 N·m
 (14 - 16 kg-m,
 101 - 116 ft-lb)



6. Cylinder head assembly. Install it through gasket by accommodating knock pin of cylinder block as follows:

- (1) Thoroughly clean cylinder block and head surface. Do not apply sealant to any other part of cylinder block or head surface.
- (2) Rotate crankshaft until timing marks on flywheel and rear plate are properly aligned. Make sure that No.1

piston is at T.D.C. on its compression stroke.



(3) When installing cylinder head, set intake and exhaust valve for No. 1 piston its compression stroke by turning camshaft.

(4) Temporarily tighten two center bolts.

- a. Final tightening should be carried out after installing chain and front cover.
- b. Do not rotate crankshaft and camshaft separately, because valves will hit piston heads.
- c. Always use new cylinder head gasket.
- d. There are two kinds of cylinder head bolts with different length.

INSTALLING TIMING CHAIN

1. Install crankshaft sprocket, oil pump drive gear and oil thrower.

(1) Make sure that the mating marks of crankshaft sprocket face front.

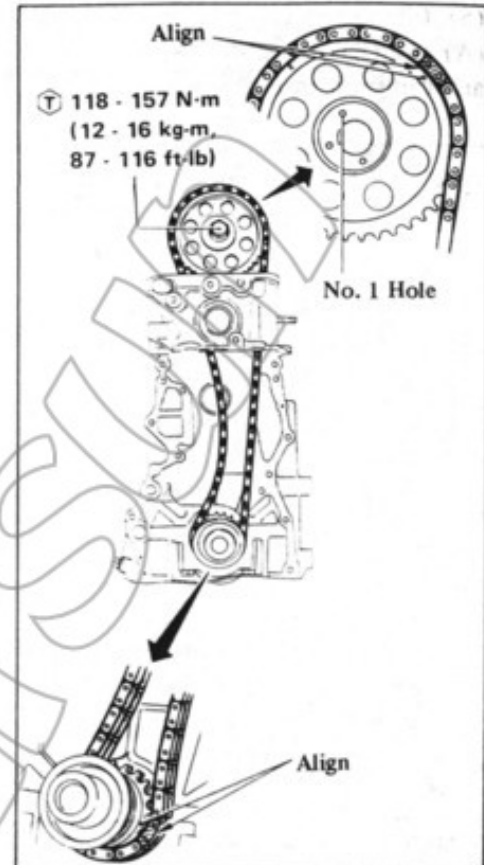
(2) Install oil pump drive gear so that large chamfered inner side faces rearward.

2. Install timing chain.

(1) Align timing marks on chain and crankshaft sprocket properly.

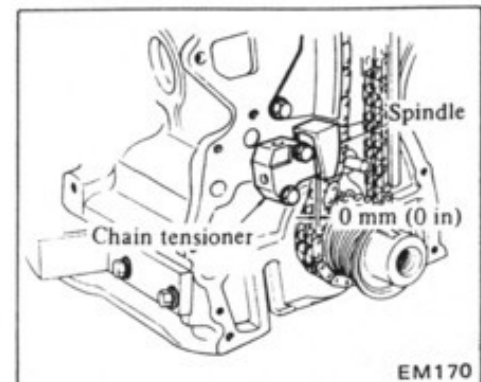
(2) Align No. 1 mark on camshaft sprocket with timing mark on chain.

(3) Insert camshaft dowel pin into No. 1 hole in camshaft sprocket, and install camshaft sprocket bolt.

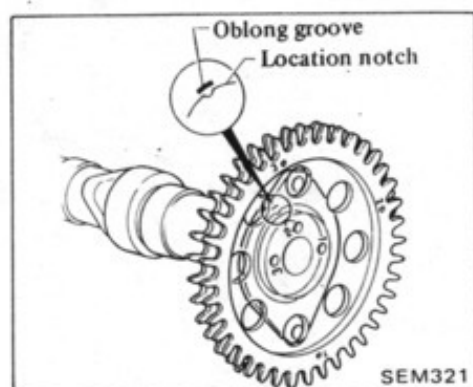


(4) Install chain guide and chain tensioner. Then tighten slack side chain guide mounting bolt so that protrusion of chain tensioner spindle is 0 mm (0 in).

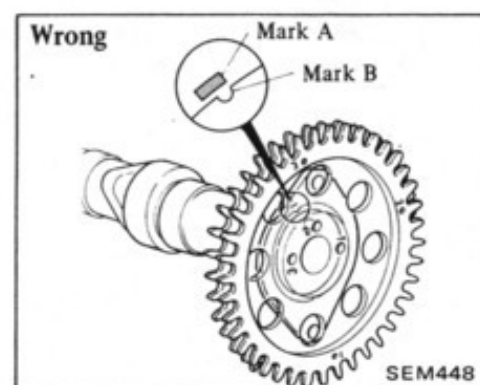
- Ⓙ : Chain guide and chain tensioner mounting bolt
 6 - 10 N·m
 (0.6 - 1.0 kg-m,
 4.3 - 7.2 ft-lb)



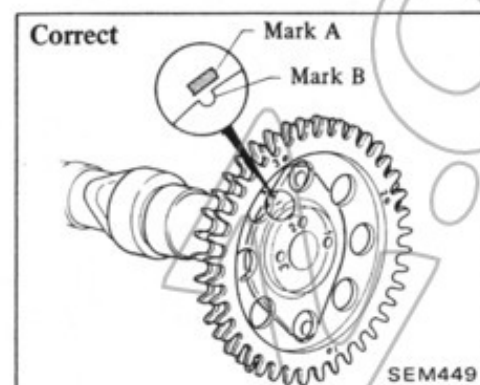
- (5) Check relative positions of marks (A) and (B) on camshaft locating plate and camshaft sprocket.



If relative positions of these two marks are as shown in figure below, change the position of dowel hole in camshaft sprocket and reinstall sprocket.



After reinstalling camshaft sprocket, check marks (A) and (B) to ensure that they are in correct position, as shown in figure below.

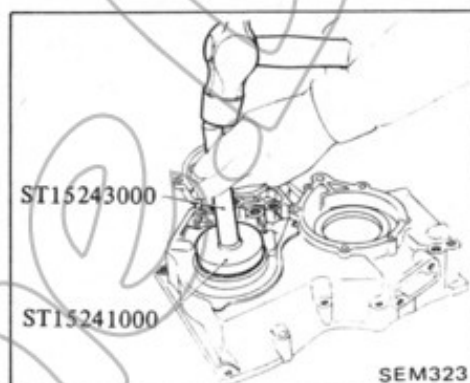


- a. Align No. 2 mark on camshaft sprocket with mark on chain.

- b. Camshaft sprocket should be installed by accommodating its No. 2 hole to camshaft knock pin.
- c. Make sure both marks on locating plate and camshaft sprocket are on right side.
- d. If mark is displaced to left side, utilize No. 3 hole in camshaft sprocket and adjust.
- e. If mark is still on left side although adjustment is made at No. 3 hole in camshaft sprocket, replace chain.

INSTALLING FRONT SIDE PARTS

1. Install front cover with gasket in place observing the following:
 - a. Before installing front cover, using Tool new oil seal in front cover in the direction that dust seal lip faces to the outside of front cover.



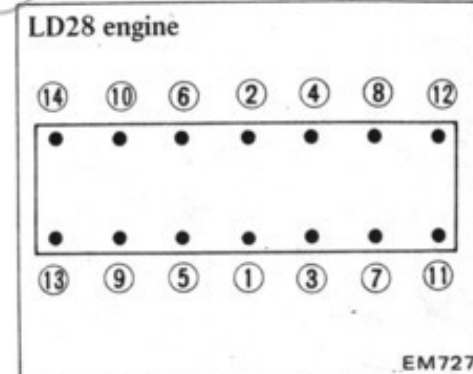
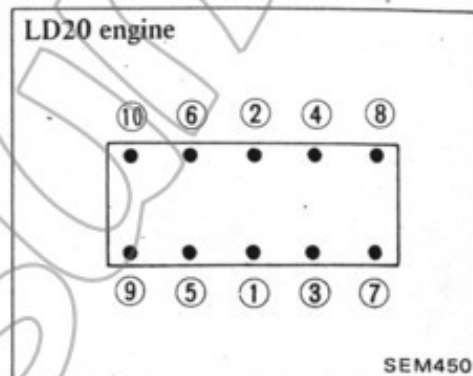
- b. Apply sealant to gaskets and sealing portions designated. Refer to Precautions.
- c. Apply coating of engine oil to periphery of oil seal.

2. Tighten temporarily front cover to cylinder block bolts and cylinder head to front cover bolts.

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).

3. Tighten cylinder head bolts to the specified torque in several steps in the sequence as follows.

- Ⓙ : Cylinder head bolt
118 - 127 N·m
(12 - 13 kg·m,
87 - 94 ft·lb)



4. Finally tighten front cover to cylinder block bolts and cylinder head to front cover bolts.

- Ⓙ : Front cover bolts

	N·m	kg·m	ft·lb
M8 (4T)	9 - 12	0.9 - 1.2	6.5 - 8.7
M6 (4T)	4 - 5	0.4 - 0.5	2.9 - 3.6

- Ⓙ : Cylinder head to front cover bolts

5.3 - 7.3 N·m
(0.54 - 0.74 kg·m,
3.9 - 5.4 ft·lb)

5. Injection pump
For details concerning injection pump, refer to Section EF.

- (1) Install injection pump.

- Ⓙ : Nut

16 - 21 N·m
(1.6 - 2.1 kg·m,
12 - 15 ft·lb)

- Bracket bolt

30 - 35 N·m
(3.1 - 3.6 kg·m,
22 - 26 ft·lb)

(2) Install injection pump drive gear.

- ⊕ : Drive gear nut
59 - 69 N·m
(6.0 - 7.0 kg-m,
43 - 51 ft-lb)

(3) Install injection pump drive crank pulley.

- ⊕ : Crank pulley bolt
137 - 157 N·m
(14.0 - 16.0 kg-m,
101 - 116 ft-lb)

(4) Install tensioner pulley.

- ⊕ : Tensioner shaft
30 - 40 N·m
(3.1 - 4.1 kg-m,
22 - 30 ft-lb)

- Spring set pin
30 - 40 N·m
(3.1 - 4.1 kg-m,
22 - 30 ft-lb)

(5) Install drive belt.

6. Install dust cover.

- ⊕ : Dust cover bolt
4 - 5 N·m
(0.4 - 0.5 kg-m,
2.9 - 3.6 ft-lb)

7. Install crank pulley.

- ⊕ : Crank damper pulley bolt
22 - 27 N·m
(2.2 - 2.8 kg-m,
16 - 20 ft-lb)

8. Install water pump assembly.

- ⊕ : Water pump bolt

	N·m	kg-m	ft-lb
M8	9 - 12	0.9 - 1.2	6.5 - 8.7
M6	4 - 5	0.4 - 0.5	2.9 - 3.6

9. Install fan pulley, fan coupling and fan.

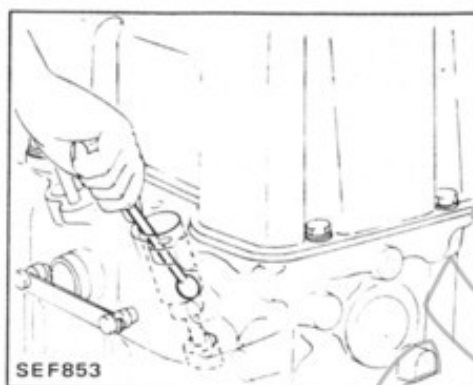
10. Install idler pulley for power steering (If so equipped).

INSTALLING SIDE PARTS AND OIL PAN

1. Install engine right side parts.

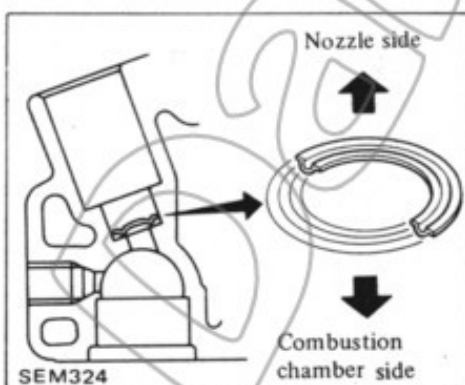
- Nozzle washers and nozzle assembly.

a. Always clean nozzle holes.



b. Do not reuse nozzle washers after removal, but rather install new ones.

c. Install nozzle washers as follows:



- ⊕ : Nozzle to cylinder head
16 - 21 N·m
(1.6 - 2.1 kg-m,
12 - 15 ft-lb)

- Injection tubes

- ⊕ : Flare nut
22 - 25 N·m
(2.2 - 2.5 kg-m,
16 - 18 ft-lb)

- Spill tube

- 15 - 18 N·m
(1.5 - 1.8 kg-m,
11 - 13 ft-lb)

Replace spill tube washers with new ones.

- Fuel return hose
- Oil cooler and coolant hoses with oil filter

- ⊕ : Oil cooler bracket bolt
16 - 21 N·m
(1.6 - 2.1 kg-m,
12 - 15 ft-lb)

- Engine mounting brackets

- ⊕ : Bracket bolt
20 - 29 N·m
(2.0 - 3.0 kg-m,
14 - 22 ft-lb)

- Oil level dipstick

2. Install left side engine parts.

- Oil feed pipe

- ⊕ : Feed pipe bolt
19 - 25 N·m
(1.9 - 2.5 kg-m,
14 - 18 ft-lb)

Always install a new manifold gasket.

- Intake, exhaust manifold and engine slinger

Always install a new manifold gasket.

- ⊕ : Manifold upper (M10)
32 - 36 N·m
(3.3 - 3.7 kg-m,
24 - 27 ft-lb)

- Lower nut & bolt (M8)
17 - 21 N·m
(1.7 - 2.1 kg-m,
12 - 15 ft-lb)

- Thermostat housing and bottom bypass inlet with hose

Always install a new gasket.

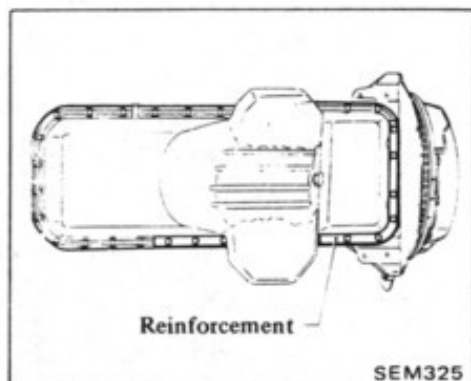
- ⊕ : Thermostat housing bolt
16 - 21 N·m
(1.6 - 2.1 kg-m,
12 - 15 ft-lb)
- Bottom bypass inlet
10 - 12 N·m
(1.0 - 1.2 kg-m,
7 - 9 ft-lb)

3. Install oil strainer and oil pan with new gasket.

- ⊕ : Oil strainer bolts
9 - 12 N·m
(0.9 - 1.2 kg-m,
6.5 - 8.7 ft-lb)

- Oil pan bolts
6 - 9 N·m
(0.6 - 0.9 kg-m,
4.3 - 6.5 ft-lb)

- Apply sealant to the designated portions. Refer to Precautions.
- Oil pan should be tightened in a criss-cross pattern. Do not over-tighten.
- Always use new oil pan gasket.
- Always install reinforcement on rear side of oil pan.



- Dismount engine from work stand and remove engine attachment.
- Install following parts.
 - Alternator bracket with oil feed pipe.

Ⓣ : Alternator bracket bolt
 44 - 54 N·m
 (4.5 - 5.5 kg-m,
 33 - 40 ft-lb)

- Alternator assembly

Ⓣ : Alternator to bracket
 29 - 39 N·m
 (3 - 4 kg-m,
 22 - 29 ft-lb)

- Fan belt

For details concerning clutch assembly (torque converter) and transmission, refer to Section MT of consolidated Service Manual for applied model.

- After installing engine to vehicle, tune up engine. Refer to Section ET.
 - Fill engine oil and coolant to the specified level.
 - Adjust fan belt deflection.
 - Adjust idle speed.
 - Adjust valve clearance.
 - Retighten cylinder head bolt.
 - Bleeding fuel system. Refer to Section EF.

SERVICE DATA AND SPECIFICATIONS

GENERAL SPECIFICATIONS

Engine model		LD20	LD28
Cylinder arrangement		4, in-line	6, in-line
Displacement	cm ³ (cu in)	1,952 (119.11)	2,793 (170.43)
Bore and Stroke	mm (in)	85.0 x 86.0 (3.346 x 3.386)	84.5 x 83.0 (3.327 - 3.268)
Valve arrangement		O.H.C.	
Firing order		1-3-4-2	1-5-3-6-2-4
Number of piston rings	Compression	2	
	Oil	1	
Number of main bearings		5	7
Compression ratio		22.2	22

INSPECTION AND ADJUSTMENT

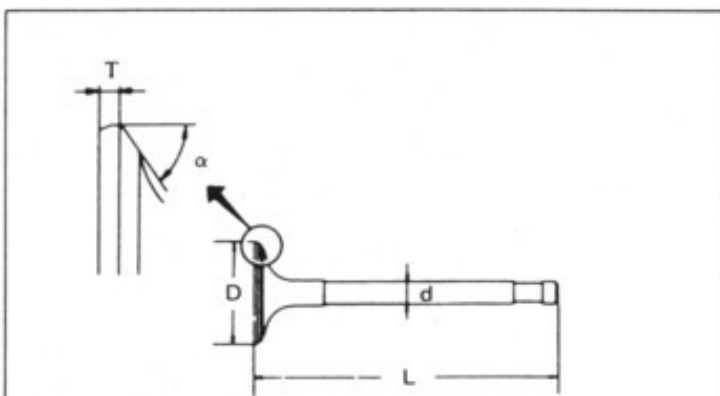
CYLINDER HEAD

Unit: mm (in)

	Standard	Limit
Head surface flatness	Less than 0.05 (0.0020)	0.1 (0.004)
Nominal height	89.5±0.1 (3.524±0.004)	

VALVE

Unit: mm (in)



SEM188

		LD28
Valve head diameter "D"	Intake	39.0 (1.535)
	Exhaust	32.0 (1.260)
Valve length "L"	Intake	116.83 - 117.27 (4.5996 - 4.6169)
	Exhaust	117.03 - 117.47 (4.6075 - 4.6248)
Valve stem diameter "d"	Intake	7.965 - 7.980 (0.3136 - 0.3142)
	Exhaust	7.945 - 7.960 (0.3128 - 0.3134)
Valve seat angle "α"		45°30'
Valve margin "T" Limit		0.5 (0.020)
Valve stem end surface grinding limit		0.5 (0.020)
Valve clearance Hot	Intake	0.25 (0.010)
	Exhaust	0.30 (0.012)
Valve clearance Cold	Intake	0.18 (0.007)
	Exhaust	0.25 (0.010)

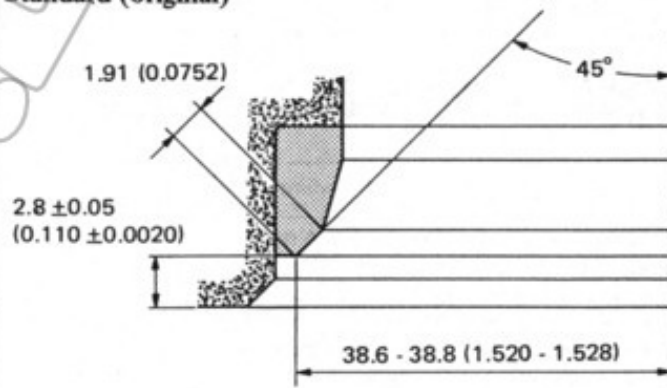
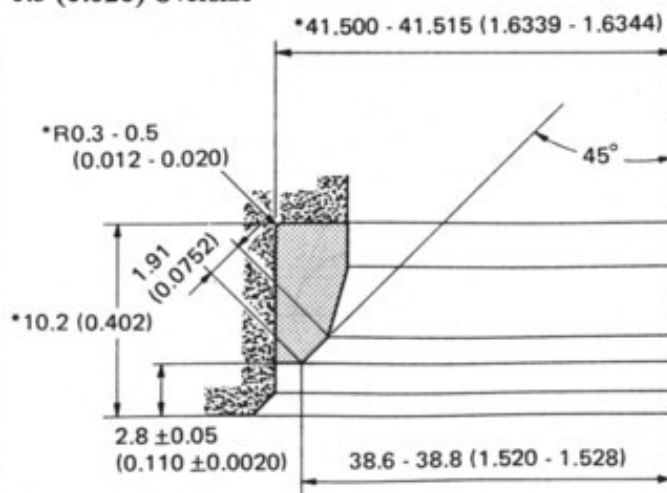
Valve spring

Free height	mm (in)	49.77 (1.9594)
Pressure height	mm/N (mm/kg, in/lb)	30.0/512.9 (30.0/52.3, 1.181/115.3)
Assembled height	mm/N (mm/kg, in/lb)	40.0/226 (40.0/23, 1.575/51)
Out of square ("S")	mm (in)	2.2 (0.087)

Valve guide

Unit: mm (in)

		Standard	Service
Valve guide Outer diameter		12.023 - 12.034 (0.4733 - 0.4738)	12.223 - 12.234 (0.4812 - 0.4817)
Valve guide Inner diameter [Finished size]		8.000 - 8.018 (0.3150 - 0.3157)	
Cylinder head valve guide hole diameter		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	Intake	0.020 - 0.053 (0.0008 - 0.0021)	0.1 (0.004)
	Exhaust	0.040 - 0.073 (0.0016 - 0.0029)	
Valve deflection limit		0.2 (0.008)	

Intake valve seat**Standard (original)****0.5 (0.020) Oversize**

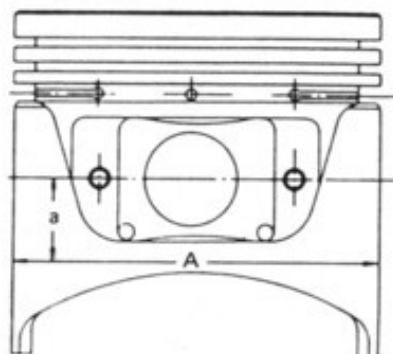
*Cylinder head machining data

Unit: mm (in)

SEM334

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

Unit: mm (in)



EM714

Piston skirt diameter "A"	Standard		LD20	84.94 - 84.99 (3.3441 - 3.3461)
			LD28	84.44 - 84.49 (3.3244 - 3.3264)
	Oversize	0.5 (0.020)	LD20	85.44 - 85.49 (3.3638 - 3.3657)
			LD28	84.94 - 84.99 (3.3441 - 3.3461)
		1.0 (0.039)	LD20	85.94 - 85.99 (3.3835 - 3.3854)
			LD28	85.44 - 85.49 (3.3638 - 3.3657)
"a" dimension			About 20 (0.79)	
Piston pin hole diameter			24.991 - 24.999 (0.9839 - 0.9842)	
Piston clearance to cylinder block			0.05 - 0.07 (0.0020 - 0.0028)	

Piston pin

Unit: mm (in)

Piston pin outer diameter	24.994 - 25.000 (0.9840 - 0.9843)
Piston pin to piston clearance	0 - 0.004 (0 - 0.0002)
Interference fit of piston pin to connecting rod	0.025 - 0.044 (0.0010 - 0.0017)

CONNECTING ROD

Unit: mm (in)

Center distance	LD20	138.5 (5.4527)
	LD28	140 (5.5118)
Bend, Torsion [per 100 mm (3.94 in)]	Std.	Less than 0.025 (0.0010)
	Limit	0.05 (0.0020)
Piston pin bore dia.		25.025 - 25.038 (0.9852 - 0.9857)
Big end play	Std.	0.2 - 0.3 (0.008 - 0.012)
	Limit	0.6 (0.024)

Piston ring

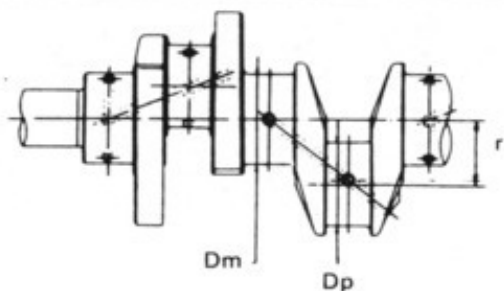
Unit: mm (in)

		Standard	Limit
Side clearance	Top	0.060 - 0.100 (0.0024 - 0.0039)	0.2 (0.008)
	2nd	0.040 - 0.080 (0.0016 - 0.0031)	0.15 (0.0059)
	Oil	0.030 - 0.070 (0.0012 - 0.0028)	0.1 (0.004)
Ring gap	Top	Without mark 0.20 - 0.29 (0.0079 - 0.0114)	0.6 (0.024)
		With mark 0.14 - 0.22 (0.0055 - 0.0087)	
	2nd	0.20 - 0.35 (0.0079 - 0.0138)	0.8 (0.031)
	Oil (rail ring)	0.30 - 0.45 (0.0118 - 0.0177)	1.0 (0.039)

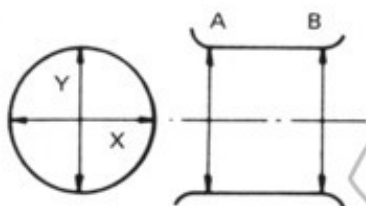
CRANKSHAFT

Unit: mm (in)

Main journal dia. "Dm"	LD20	59.942 - 59.955 (2.3599 - 2.3604)
	LD28	54.942 - 54.955 (2.1631 - 2.1636)
Pin journal dia. "Dp"	49.961 - 49.974 (1.9670 - 1.9675)	
Center distance "r"	LD20	43.00 (1.6929)
	LD28	41.5 (1.6339)
Out-of-round (X-Y) and taper (A-B)	Std.	Less than 0.01 (0.0004)
	Limit	0.03 (0.0012)
Bend [T.I.R.]	Std.	Less than 0.05 (0.0020)
	Limit	0.10 (0.0039)
Free end play	Std.	0.05 - 0.18 (0.0020 - 0.0071)
	Limit	0.30 (0.0118)
Pilot bushing insert distance	Approximately 4.0 (0.157)	



EM737

Out-of-round
TaperX-Y
A-B

EM715

Main bearing undersize

Unit: mm (in)

	Crank journal diameter	
	LD20	LD28
STD	59.942 - 59.955 (2.3599 - 2.3604)	54.942 - 54.955 (2.1631 - 2.1636)
0.25 (0.0098) Undersize	59.692 - 59.705 (2.3501 - 2.3506)	54.692 - 54.705 (2.1532 - 2.1537)
0.50 (0.0197) Undersize	59.442 - 59.455 (2.3402 - 2.3407)	54.442 - 54.455 (2.1434 - 2.1439)
0.75 (0.0295) Undersize	59.192 - 59.205 (2.3304 - 2.3309)	54.192 - 54.205 (2.1335 - 2.1341)
1.00 (0.0394) Undersize	58.942 - 58.955 (2.3205 - 2.3211)	53.942 - 53.955 (2.1237 - 2.1242)

Connecting rod bearing undersize

Unit: mm (in)

	Crank pin diameter
STD	49.961 - 49.974 (1.9670 - 1.9675)
0.06 (0.0024) Undersize	49.901 - 49.914 (1.9646 - 1.9651)
0.12 (0.0047) Undersize	49.841 - 49.854 (1.9622 - 1.9628)
0.25 (0.0098) Undersize	49.711 - 49.724 (1.9571 - 1.9576)
0.50 (0.0197) Undersize	49.461 - 49.474 (1.9473 - 1.9478)
0.75 (0.0295) Undersize	49.211 - 49.224 (1.9374 - 1.9379)
1.00 (0.0394) Undersize	48.961 - 48.974 (1.9276 - 1.9281)

MISCELLANEOUS COMPONENTS

Unit: mm (in)

Camshaft sprocket Runout [T.I.R.]	Less than 0.1 (0.004)
Flywheel Runout [T.I.R.]	Less than 0.15 (0.0059)

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	0.020 - 0.062 (0.0008 - 0.0024)	0.12 (0.0047)

TIGHTENING TORQUE




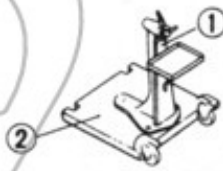


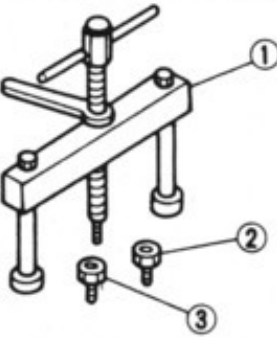

Engine outer parts

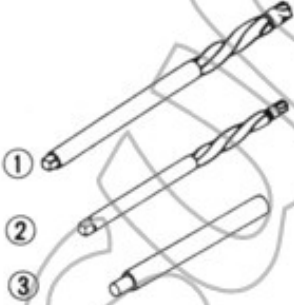






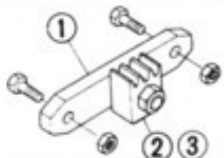
Unit		N-m	kg-m	ft-lb
Alternator bracket		44 - 54	4.5 - 5.5	33 - 40
Alternator to adjusting bar bolt		16 - 21	1.6 - 2.1	12 - 15
Alternator to bracket		29 - 39	3 - 4	22 - 29
Bottom bypass inlet		10 - 12	1.0 - 1.2	7 - 9
Crank damper pulley bolt		22 - 27	2.2 - 2.8	16 - 20
Crank pulley bolt		137 - 157	14.0 - 16.0	101 - 116
Dust cover bolt		4 - 5	0.4 - 0.5	2.9 - 3.6
Engine mounting bracket		20 - 29	2.0 - 3.0	14 - 22
Glow plug		20 - 25	2.0 - 2.5	14 - 18
Glow plug connecting plate		1.0 - 1.5	0.1 - 0.15	0.7 - 1.1
Injection pump bracket		30 - 35	3.1 - 3.6	22 - 26
Injection pump drive gear nut		59 - 69	6.0 - 7.0	43 - 51
Injection pump nut		16 - 21	1.6 - 2.1	12 - 15
Injection tube flare nut		22 - 25	2.2 - 2.5	16 - 18
Manifold Bolt and Nut	Upper bolt (M10)	32 - 36	3.3 - 3.7	24 - 27
	Lower nut & bolt (M8)	17 - 21	1.7 - 2.1	12 - 15
Nozzle holder to cylinder head nut		16 - 21	1.6 - 2.1	12 - 15
Oil cooler bracket bolt		16 - 21	1.6 - 2.1	12 - 15
Oil feed pipe bolt		19 - 25	1.9 - 2.5	14 - 18
Oil pump bolt		11 - 15	1.1 - 1.5	8 - 11
Power steering pump bracket bolt		22 - 29	2.2 - 3.0	16 - 22
Spill tube bolt		15 - 18	1.5 - 1.8	11 - 13
Spring set pin		30 - 40	3.1 - 4.1	22 - 30
Tensioner shaft		30 - 40	3.1 - 4.1	22 - 30
Thermostat housing		16 - 21	1.6 - 2.1	12 - 15
Vacuum pump pipe bolt		26 - 32	2.7 - 3.3	20 - 24
Water inlet bolt		10 - 12	1.0 - 1.2	7 - 9
Water outlet bolt		16 - 21	1.6 - 2.1	12 - 15
Water pump bolt	M6	4 - 5	0.4 - 0.5	2.9 - 3.6
	M8	9 - 12	0.9 - 1.2	6.5 - 8.7

Engine body parts

Unit		N-m	kg-m	ft-lb
Camshaft sprocket bolt		118 - 157	12 - 16	87 - 116
Camshaft thrust plate bolt		6 - 10	0.6 - 1.0	4.3 - 7.2
Chain guide bolt		6 - 10	0.6 - 1.0	4.3 - 7.2
Chain tensioner bolt		6 - 10	0.6 - 1.0	4.3 - 7.2
Connecting rod big end nut		44 - 54	4.5 - 5.5	33 - 40
Cylinder head bolt		118 - 127	12 - 13	87 - 94
Cylinder head to front cover bolt		5.3 - 7.3	0.54 - 0.74	3.9 - 5.4
Drive plate bolt (A/T)		137 - 157	14 - 16	101 - 116
Flywheel bolt (M/T)		137 - 157	14 - 16	101 - 116
Front cover bolt	M6	4 - 5	0.4 - 0.5	2.9 - 3.6
	M8	9 - 12	0.9 - 1.2	6.5 - 8.7
Main bearing cap bolt		69 - 83	7.0 - 8.5	51 - 61
Oil pan bolt		6 - 9	0.6 - 0.9	4.3 - 6.5
Oil pan drain plug		20 - 29	2.0 - 3.0	14 - 22
Oil strainer bolt		9 - 12	0.9 - 1.2	6.5 - 8.7
Pivot bushing bolt		78 - 118	8.0 - 12.0	58 - 87
Pivot lock nut		49 - 59	5.0 - 6.0	36 - 43
Rocker cover bolt		6 - 9	0.6 - 0.9	4.3 - 6.5

SPECIAL SERVICE TOOLS

Tool number	Tool name	
ST19320000	Oil filter wrench	
KV11101900 (LD20 engine)	Engine attachment	
KV11101400 (LD28 engine)	Engine attachment	
ST0501S000 ① ST05011000 ② ST05012000	Engine stand assembly Engine stand Base	
KV10105800	Chain stopper	
ST10120000	Cylinder head bolt wrench	
KV101041S0 ① ST16511000 ② ST16512001 ③ ST16701001	Crankshaft main bearing cap puller Crankshaft main bearing puller Adapter Adapter	
ST12070000	Valve lifter	

Tool number	Tool name	
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	
KV10105501	Crankshaft rear oil seal drift	
EM03470000	Piston ring compressor	
ST10640001	Pivot adjuster	
KV30100100	Clutch aligning bar	
KV101056S0 ① KV10105610 ② KV10105630 ③ KV10105620	Engine stopper Plate and bolt Stopper B Stopper A (Useless)	
① ST15241000 ② ST15243000	Front oil seal drift Seal drift Bar	