

ENGINE

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GENERAL

GENERAL

SPECIFICATIONS

Description	Specification	Limit
General		
Type	V-type, OHC	
Number of cylinders	6	
Bore	91.1 mm (3.587 in.)	
Stroke	76.0 mm (2.992 in.)	
Total displacement	2,972 cc (181.4 cu.in.)	
Compression ratio	8.9	
Firing order	1 - 2 - 3 4 - 5 - 6	
Idle R.P.M	700 ± 100	
Ignition timing at curb idle	BTDC 5° ± 2°	
Valve timing		
Intake valve		
Opens (BTDC)	19°	
Closes (ABDC)	59°	
Exhaust valve		
Opens (BBDC)	59°	
Closes (ATDC)	19°	
Valve overlap	38°	
Intake valve duration	258°	
Exhaust valve duration	258°	
Rocker arm		
I.D.	18.910-18.928 mm (0.744-0.745 in.)	
Oil clearance	0.01-0.04 mm (0.0004-0.0016 in.)	0.1 mm (0.0039 in.)
Rocker arm shaft		
O.D.	18.885-18.898 mm (0.7435-0.7440 in.)	
Overall height	333.5 mm (13.130 in.)	
Rocker arm shaft spring		
Free length	55.2 mm (2.173 in.)	
Camshaft		
Drive mechanism	Cogged type belt	
Cam height	41.1541.35 mm (1.620-1.628 in.)	40.65 mm (1.600 in.)
Journal diameter	33.935-33.950 mm (1.336-1.337 in.)	
Bearing oil clearance	0.05-0.09 mm (0.0020-0.0035 in.)	
End play	0.1-0.2 mm (0.004-0.008 in.)	

GENERAL

Description	Specification	Limit
Cylinder head		
Flatness of gasket surface	Max. 0.05 mm (0.002 in.)	0.2 mm (0.008 in.)
Flatness of manifold mounting surface		
Intake	Max. 0.10 mm (0.004 in.)	0.2 mm (0.008 in.)
Exhaust	Max. 0.15 mm (0.006 in.)	0.3 mm (0.012 in.)
Valve guide hole diameter		
0.05 (0.002) O.S.	13.050-13.068 mm (0.5140-0.5145 in.)	
0.25 (0.010) O.S.	13.250-13.268 mm (0.5217-0.5224 in.)	
0.50 (0.020) O.S.	13.500-13.518 mm (0.5315-0.5322 in.)	
Intake valve seat ring hole diameter		
0.3 (0.012) O.S.	44.300-44.325 mm (1.7441-1.7451 in.)	
0.6 (0.024) O.S.	44.600-44.625 mm (1.7559-1.7569 in.)	
Exhaust valve seat ring hole diameter		
0.3 (0.012) O.S.	38.300-38.325 mm (1.5079-1.5089 in.)	
0.6 (0.024) O.S.	38.600-38.625 mm (1.5197-1.5207 in.)	
Valve		
Overall length		
Intake	102.97 mm (4.047 in.)	
Exhaust	102.67 mm (4.042 in.)	
Stem diameter		
Intake	7.995-7.982 mm (0.3148-0.3143 in.)	
Exhaust	7.960-7.940 mm (0.3134-0.3126 in.)	
Face angle	45°/45°/50°	
Margin		
Intake	1.2 mm (0.047 in.)	0.7 mm (0.028 in.)
Exhaust	2.0 mm (0.079 in.)	1.5 mm (0.059 in.)
Clearance (stem-to-guide)		
intake	0.03-0.06 mm (0.0012-0.0024 in.)	0.10 mm (0.0039 in.)
Exhaust	0.05-0.09 mm (0.0020-0.0035 in.)	0.15 mm (0.0059 in.)
Valve spring		
Free height	50.5 mm (1.988 in.)	49.5 mm (1.949 in.)
Load	32.9 kg/40.4 mm (74 lb/1.591 in.)	32.9 kg/41.4 mm (74 lb/1.630 in.)
Out of squareness	Max 2°	Max 4°
Piston		
Diameter (Standard)	91.07-91.10 mm (3.5854-3.5866 in.)	
Clearance (Piston-to-cylinder)	0.02-0.04 mm (0.0008-0.0016 in.)	
Ring groove width		
No.1	1.51-1.53 mm (0.0594-0.0602 in.)	
No.2	1.51-1.53 mm (0.0594-0.0602 in.)	
Oil	4.010-4.035 mm (0.1579-0.1589 in.)	
Piston for service	0.25 mm (0.010 in.), 0.50 mm (0.020 in.) 0.75 mm (0.030 in.), 1.00 mm (0.040 in.)	
	Oversize	

GENERAL

Description	Specification	Limit
Piston ring		
Number of rings per piston	3	
Compression rings	2	
Oil ring	1	
Compression ring type		
No.1	Barrel type, steel	
No.2	Taper type, special cast iron	
Oil ring type		
	3-piece type	
Ring end gap		
No.1	0.30-0.45 mm (0.0118-0.0177 in.)	0.8 mm (0.031 in.)
No.2	0.25-0.40 mm (0.0098-0.0157 in.)	0.8 mm (0.031 in.)
Oil ring side rail	-0.30-0.90 mm (0.0118-0.0354 in.)	1.0 mm (0.039 in.)
Ring side clearance		
No.1	0.03-0.09 mm (0.0012-0.0035 in.)	0.1 mm (0.004 in.)
No.2	0.02-0.06 mm (0.0008-0.0024 in.)	0.1 mm (0.004 in.)
Rings for service	0.25 mm (0.010 in.), 0.50 mm (0.020 in.) 0.75 mm (0.030 in.), 1.00 mm (0.039 in.), Oversize	
Connecting rod		
Piston pin press-in load	7,500-17,500 N (765-1,785 kg, 1,686-3,934 lb)	
Side clearance (Big end)	0.10-0.25 mm (0.0039-0.0098 in.)	0.4 mm (0.016 in.)
Bend	0.05 mm or less/100 mm (0.0020 in. or less/3.937 in.)	
Twist	0.1 mm or less/100 mm (0.0039 in. or less/3.937 in.)	
Bearing		
Oil clearance	0.016-0.046 mm (0.0006-0.0018 in.)	0.1 mm (0.004 in.)
Bearings for service	0.25 mm (0.010 in.), 0.50 mm (0.020 in.) 0.75 mm (0.030 in.), Undersize	
Crankshaft		
Journal O.D.	59.980-60.000 mm (2.3614-2.3622 in.)	
Pin O.D.	49.980-50.000 mm (1.9677-1.9685 in.)	
Out-of-roundness of journal and pin	Max. 0.03 mm (0.0012 in.)	
Taper of journal and pin	Max. 0.005 mm (0.0002 in.)	
End play	0.05-0.25 mm (0.0020-0.0098 in.)	0.3 mm (0.012 in.)
Main bearing		
Oil clearance	0.02-0.048 mm (0.0008-0.0019 in.)	0.1 mm (0.004 in.)
Bearings for service	0.25 mm (0.010 in.), 0.50 mm (0.20 in.) 0.75 mm (0.030 in.), Undersize	
Cylinder block		
Cylinder bore	91.10-91.14 mm (3.5866-3.5882)	
Flatness of gasket surface	Max. 0.05 mm (0.0020 in.)	0.10 mm (0.0039 in.)
Out-of-roundness and taper	Max. 0.02 mm (0.0008 in.)	
Oil pump		
Side clearance		
Body clearance	0.100-0.181 mm (0.0039-0.0071 in.)	
Side clearance	0.040-0.095 mm (0.0016-0.0037 in.)	

GENERAL

Description	Specification	Limit
Relief spring		
Free length	43.8 mm (1.724 in.)	
Load	3.7 kg/40.1 mm (8.2 lb/1.579 in.)	
Oil filter		
Type	Cartridge, full flow	
Engine oil		
Capacity (including oil filter, but not including oil cooler)	4.3 fit (4.5 U.S.qts., 3.8 Imp.qts.)	
Recommended oil (API classification)	SF, SF/CC or SG (For U.S.A. & Canada) SE or above (For Australia & EC) SD or above (For M/EAST & General)	
V-belts		
Deflection		
Alternator and power steering oil pump		
When inspected	6.0-9.0 mm (0.236-0.354 in.)	
When a new belt is installed	4.0-5.0 mm (0.157-0.197 in.)	
When a used belt is installed	7.0 mm (0.276 in.)	
Air conditioner compressor	4.5-5.5 mm (0.177-0.216 in.)	
Tension		
Alternator and power steering oil pump		
When inspected	35-60 kg (77-132 lb)	
When a new belt is installed	70-90 kg (154-198 lb)	
When a used belt is installed	50 kg (110 lb)	
Engine oil pressure	80 kPa (11.4 psi) or more [Conditions: Oil temperature is 75 to 90°C (167 to 194°F)]	

GENERAL

TIGHTENING TORQUE

	Nm	kg.cm	lb.ft
Engine support bracket bolt [10x53 mm (0.39x2.09 in.)]	64-74	650-750	47-54
[12x56 mm (0.47x2.20 in.)]	103-113	1,050-1,150	76-83
Roll stopper bracket bolt [10x25 mm (0.39x0.98 in.)]	3 2 4 9	330-500	24-36
(Front) [12x30 mm (0.47x1.18 in.)]	64-83	650-850	47-61
Roll stopper bracket bolt [10x25 mm (0.39x0.98 in.)]	3 2 4 9	330-500	24-36
(Rear)			
Crankshaft bolt	147-157	1,500-1,600	109-115
Timing belt tensioner	22-29	220-300	16-21
Camshaft sprocket bolt	78-98	800-1,000	58-72
Rocker cover bolts	8-10	80-100	5.7-7.2
Main bearing cap bolts	74-83	750-850	55-61
Connecting rod cap nuts	49-52	500-530	36-38
Cylinder head bolts			
Cold engine	88-98	900-1,000	65-72
Hot engine	98-108	1,000-1,100	72-80
Oil pan drain plug	34-44	350-450	26-32
Oil pan bolt	5-7	50-70	3.7-5.0
Oil screen bolt	15-22	150-220	11-15
Oil filter bracket bolt	12-15	120-150	9-10
Oil pump case bolts	12-15	120-150	9-10
Oil relief valve plug	39-49	400-500	29-36
Oil pressure switch	8-12	80-120	5.8-8.6
Oil pump cover screw	8-12	80-120	5.8-8.6
Oil filter	17-25	170-250	12-18
Drive plate and adaptor plate bolt	72-75	730-770	53-55
Distributor adaptor assembly to engine	12-15	120-150	9-10
Rocker arm and shaft assembly bolt	19-21	190-210	14-15
Air cleaner body installation bolt	8-10	80-100	6-7
Surge tank stay	12-15	120-150	9-11
Air intake surge tank to intake manifold (bolt)	15-20	150-200	11-14
Air intake surge tank to intake manifold (nut)	15-20	150-200	11-14
Intake manifold to engine	15-20	150-200	11-14
Heat protector to exhaust manifold	12-15	120-150	9-11
Exhaust manifold to engine	15-22	150-220	11-16
Oil level gauge guide to engine	12-15	120-150	9-11
Water outlet fitting bolt	17-20	170-200	12.3-14.5
Power steering oil pump bracket	17-25	170-260	12-19
to front cylinder head assembly			
Power steering oil pump to bracket	17-25	170-260	12-19

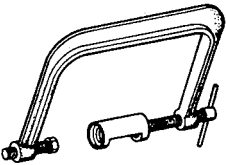
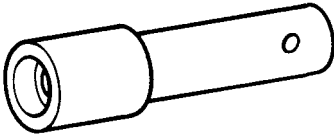
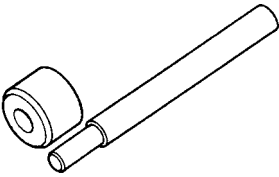
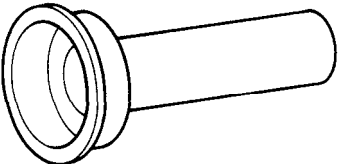
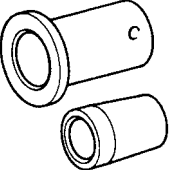
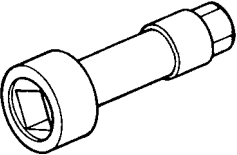
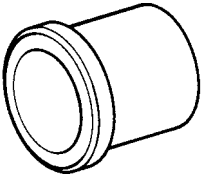
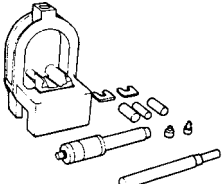
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TIGHTENING TORQUE

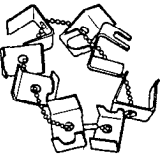
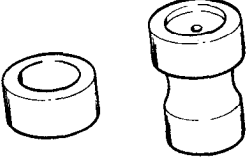
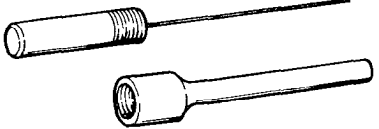
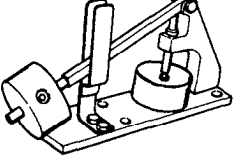
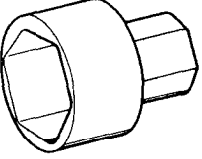
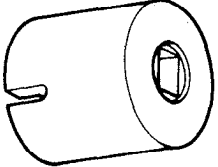
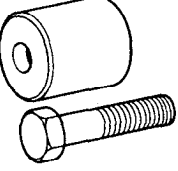

	Nm	kg.cm	lb.ft
Front exhaust pipe to exhaust manifold	29-39	300-400	22-29
Engine mount insulator nut (large)	59-78	600-800	43-58
Engine mount insulator nut (small)	29-39	300-400	22-29
Engine mount bracket nut	59-78	600-800	43-58
Front roll stopper insulator nut	49-64	500-650	36-47
Front roll stopper bracket to crossmember (Bolt)	39-49	400-500	29-36
Engine damper to engine (Bolt)	29-39	300-400	22-29
Engine damper to crossmember (Nut)	39-49	400-500	29-36
Rear roll stopper insulator nut	29-39	300-400	22-29
Rear roll stopper bracket to crossmember (Bolt)	39-49	400-500	29-36
Transaxle mount insulator nut	58-78	600-800	43-58
Transaxle mount bracket to body (Bolt)	39-49	400-500	29-36
Transaxle mount bracket to transaxle	59-78	600-800	43-58
Transaxle stay to engine bolt	64-83	650-850	47-61
Starter to engine	26-33	270-340	20-25
Bell housing cover to engine	8-10	80-100	6-7
Water inlet pipe to front cylinder head assembly	12-15	120-150	9-11
Fuel hose clamp to rear cylinder head assembly	12-15	120-150	9-11
Transaxle mounting plate	10-12	100-120	7.3-8.6
Rear plate	8-10	80-100	5.8-7.2
Oil seal case	10-12	100-120	7.3-8.6
Alternator tension pulley bracket to engine	32-49	330-500	24-36
Alternator tension pulley nut	38-59	390-600	28-43
Crankshaft pulley	147-157	1,500-1,600	108-116
Timing belt cover	10-12	100-120	7-9
Engine hanger bracket to engine	20-26	200-270	14-20

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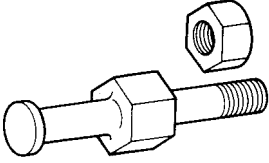
SPECIAL TOOLS

Tool (Number and name)	Illustration	Use
09222-21001 Valve spring compressor		1. Removal and installation of the intake or exhaust valve
09222-32100 Valve stem oil seal installer		Installation of the valve stem oil seal
09222-32200 Valve guide installer		Removal and installation of the valve guide
09231-33000 Crankshaft rear oil seal installer		Installation of the crankshaft rear oil seal
09214-33000 Crankshaft front oil seal installer		Installation of the crankshaft front oil seal
09221-32001 Cylinder head bolt wrench		Removal and tightening of the cylinder head bolt
09221-21000 Camshaft oil seal installer		Installation of circular packing
09234-33001 Piston pin remover and installer		Removal and installation of the piston pin

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Tool (Number and name)	Illustration	Use
09246—32000 Auto lash adjuster holder	 <p style="text-align: right; font-size: small;">20Y272</p>	Retaining of auto lash adjuster
09246—32100 Auto lash adjuster retainer	 <p style="text-align: right; font-size: small;">20Y273</p>	Air bleeding of auto lash adjuster (use with 09246—32200)
09246—32200 Air bleed wire	 <p style="text-align: right; font-size: small;">20Y274</p>	Air bleeding of auto lash adjuster (use with 09246—32100)
09246—32300 Leak down tester	 <p style="text-align: right; font-size: small;">20Y275</p>	Test for leak down of auto lash adjuster
09260—32000 Oil pressure switch wrench	 <p style="text-align: right; font-size: small;">20Y276</p>	Removal and installation of the oil pressure switch
09231—33100 Crankshaft wrench	 <p style="text-align: right; font-size: small;">20Y277</p>	Used if the crankshaft needs to be rotated to attach the timing belt, etc.
09221—33000 Camshaft oil seal installer	 <p style="text-align: right; font-size: small;">20Y278</p>	Press fitting for the camshaft oil seal
09231—33200 Crankshaft pulley wrench	 <p style="text-align: right; font-size: small;">20Y279</p>	Removal and installation of crankshaft pulley. (use with 09231—33300)

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Tool (Number and name)	illustration	Use
09231-33300 Crankshaft pulley holder		Supporting the crankshaft pulley when crankshaft bolt and pulley are removed and reinstalled. (use with 09231-33200)

GENERAL

TROUBLESHOOTING

Symptom	Probable cause	Remedy
Knocking of crankshaft and bearing	Worn main bearing Seized bearing Bent crankshaft Excessive crankshaft end play	Replace Replace Replace Replace thrust bearing
Piston and connecting rod knocking	Worn bearing Seized bearing Worn piston pin Worn piston in cylinder Broken piston ring Improper connecting rod alignment	Replace Replace Replace piston and pin or connecting rod Recondition cylinder Repair or replace Re-align
Noisy valves	Faulty auto-lash adjuster Thin or diluted engine oil (low oil pressure) Worn or damaged valve stem or valve guide	Replace Change Replace
Excessively worn cylinder and piston	Shortage of engine oil Dirty engine oil Poor oil quality Improperly assembled piston and connecting rod Improper piston ring end clearance Dirty air cleaner	Add or replace Check oil level on daily basis Replace Use proper oil Repair or replace Replace Clean air cleaner assembly and replace the air filter
Connecting rod and/main bearing noise	Insufficient oil supply Thin or diluted engine oil Excessive bearing clearance	Check engine oil level Change and determine cause Replace
Damaged crankshaft bearing	Shortage of engine oil Low oil pressure Poor quality engine oil Worn or out-of round crankshaft journal Restricted oil passage in crankshaft Worn bearing Bearing improperly installed Non-concentric crankshaft or bearing	Add or replace Check oil level on daily basis Adjust or repair Use proper engine oil Repair or replace Clean Replace bearing and check engine oil lubrication system Repair or replace Replace
Timing belt noise	Incorrect belt tension	Adjust belt tension

GENERAL

TROUBLESHOOTING

Symptom	Probable cause	Remedy
Low compression	Blown cylinder head gasket Worn or damaged piston rings Worn piston or cylinder Worn or damaged valve seat	Replace gasket Replace rings Repair or replace piston and/or cylinder block Repair or replace valve and/or seat ring
Oil pressure drop	Low Engine oil level Faulty oil pressure switch Clogged oil filter Worn oil pump gears or cover Thin or diluted engine oil Oil relief valve stuck (open) Excessive bearing clearance	Check engine oil level Replace Replace Replace Change and determine cause Repair Replace
High oil pressure	Oil relief valve stuck (closed)	Repair
Excessive engine rolling and vibration	Loose engine roll stopper (front, rear) Loose transaxle mount bracket Loose engine mount bracket Loose center member Broken transaxle mount insulator Broken engine mount insulator Broken engine roll stopper insulator	Re-tighten Re-tighten Re-tighten Re-tighten Replace Replace Replace

VALVE CLEARANCE ADJUSTMENT

As the intake and exhaust valves are equipped with auto-lash adjustment mechanisms, there is no need for valve clearance adjustment. The proper functioning of the auto-lash mechanism may be determined by checking for tappet noise. When there is tappet noise or any unusual noise, check the auto-lash by removing and bleeding or replacing it.

TIGHTENING CYLINDER HEAD BOLTS

1. Using special tool (09221-32001), first loosen slightly and then tighten to the specified torque.

Tightening torque

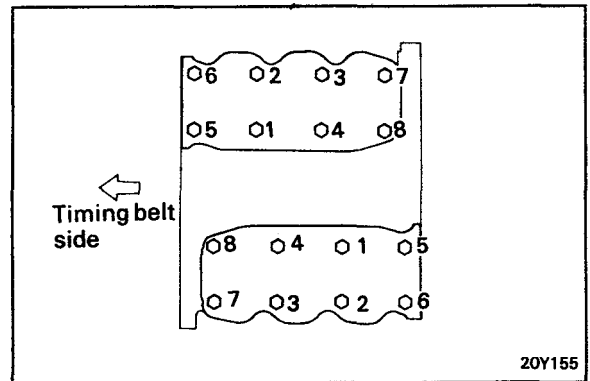
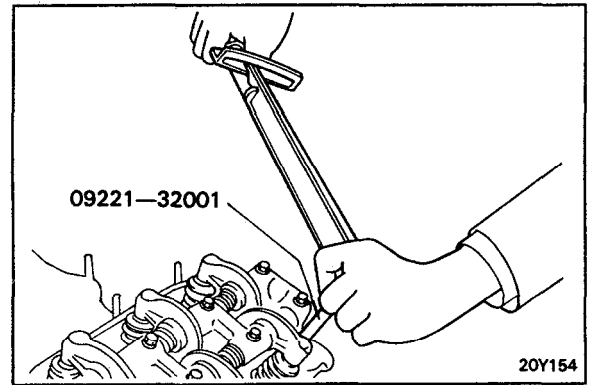
Cylinder head bolts

Cold [Engine temperature approximately 20°C (68°F)]	88-98 Nm (900-1,000 kg.cm, 65-72 lb.ft)
Hot [Engine temperature approximately 80°C (176°F)]	98-108 Nm (1,000-1,100 kg.cm, 72-80 lb.ft)

2. Be sure to follow the specific torque sequence as shown in the illustration.

NOTE

Run the engine until normal operating temperature is reached, allow it to cool down, and then re-torque the bolts to specifications.



CHECKING COMPRESSION PRESSURE

1. Before checking compression, check the engine oil level and that the starter motor and battery are all in normal operating condition.
2. Start the engine and wait until engine coolant temperature has risen to 80-95°C (176-205°F).
3. Stop the engine and disconnect the spark plug cables.
4. Remove the spark plugs.
5. Crank the engine to remove any foreign objects in the cylinders.

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6. Attach the compression gauge to the spark plug hole.
7. Depress the accelerator pedal to fully open the throttle.
8. Crank the engine and read the gauge.

Standard value : 12.2 kg/cm² (1200 kPa, 170 psi)

Limit : 10.7 kg/cm² (1050 kPa, 149 psi)

9. Repeat steps 6 through 8 on all cylinders, making sure ensuring that the pressure differential for each of the cylinders is within the specified limit.

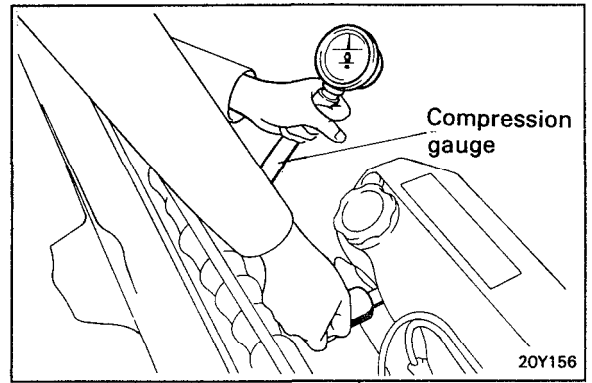
Limit : Max. 1.0 kg/cm² (100 kPa, 14 psi) between cylinders

10. If a cylinder's compression or pressure differential is below the specification, add a small amount of oil through the spark plug hole and repeat steps 6 through 9.

- 1) If the addition of oil brings the compression up, it is possible that there is wear between the piston ring and cylinder wall.
- 2) If compression remains the same, valve seizure, poor valve seating or a compression leak from the cylinder head gasket are all possible causes.

Tightening torque

Spark plug
20-30 Nm (200-300 kg.cm, 14-22 lb.ft)



CHECKING ENGINE OIL

1. Position vehicle on a level surface.
2. Stop engine.

NOTE

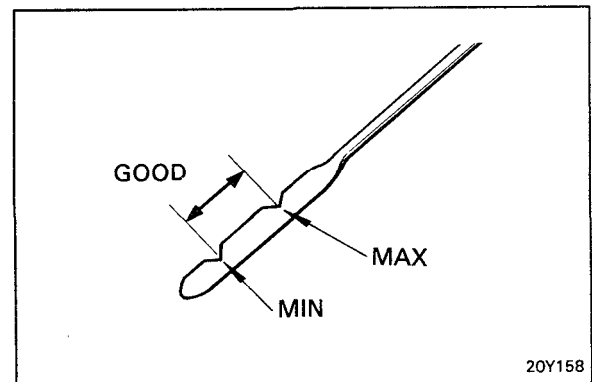
In the case of a vehicle that has been out of service for a prolonged period, run the engine for several minutes. Stop the engine, wait one minute, then check the oil level.

3. Check that the engine oil level is within the level range indicated on the oil dipstick. If the oil level is found to have fallen to the lower limit (the MIN mark), refill to the "MAX" mark.

NOTE

When refilling, use the same type of engine oil as the one currently being used.

4. Check that the oil is not dirty or mixed with coolant or gasoline, and that it has the proper viscosity.

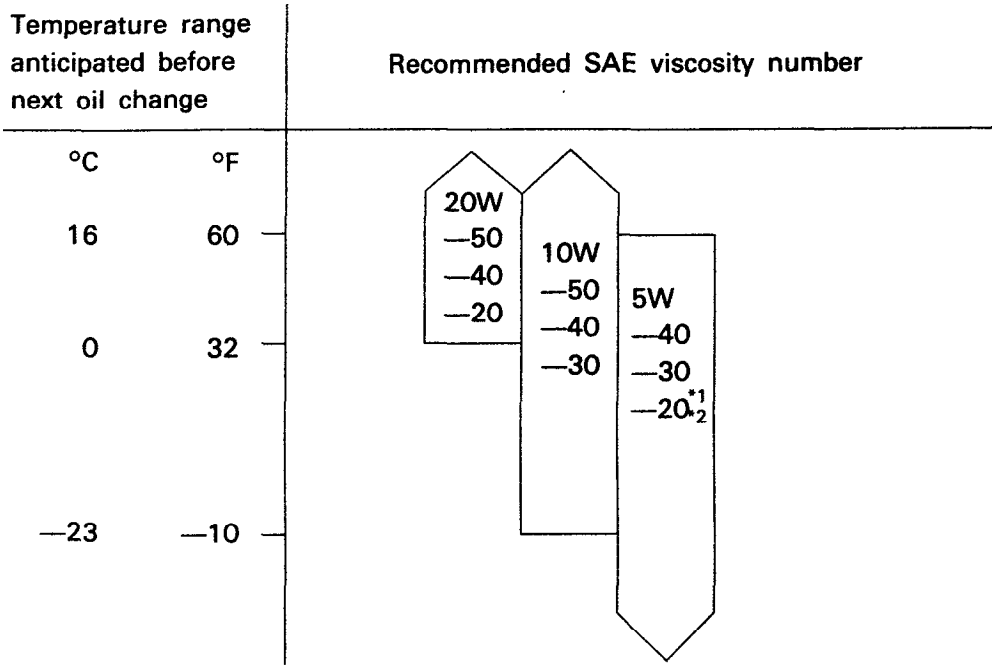


GENERAL

SELECTION OF ENGINE OIL [For USA & Canada]

Recommended API classification: SF, SF/CC OR SG

Recommended SAE viscosity grades:



*1. Restricted by driving and climate condition.

*2. Not recommended for sustained high speed vehicle operation.

NOTE
 For best performance and for maximum protection for all types of operation, select only those lubricants which:

1. Conform to the requirements of the API classification.
2. Have the proper SAE grade number for expected ambient temperature range.

Lubricants which do not have both a SAE grade number and an API service classification on the container should not be used.

GENERAL

SELECTION OF ENGINE OIL [For Aust., EC. GEN., M/EAST]

Recommended API classification: SE OR ABOVE [For Aust., EC,]
SD OR ABOVE [For M/EAST, GEN.]

Recommended SAE viscosity grades:

Temperature range anticipated before next oil change		Recommended SAE viscosity number			
°C	°F				
40	104	20W —50 —40	15W —50 —40	10W —50 —30	5W —40*1
20	68				5W —30*1
10	50				5W —20*1*2
—10	14				
—15	5				
—25	—13				

*1. Restricted by driving and climate condition.

*2. Not recommended for sustained high speed vehicle operation.

NOTE

For best performance and for maximum protection for all types of operation, select only those lubricants which:

1. Conform to the requirements of the API classification.
2. Have proper SAE grade number for expected ambient temperature range.

Lubricants which do not have both a SAE grade number and an API service classification on the container should not be used.

CHANGING ENGINE OIL

1. Run the engine until it reaches normal operating temperature.
2. Stop the engine.
3. Remove the oil filler cap (on rocker cover) and the drain plug (on the oil pan). Drain the engine oil.
4. Re-install and tighten the drain plug to the specified torque.

Tightening torque

Drain plug 34-44 Nm (350-450 kg.cm, 25-33 lb.ft)

5. Fill the crankcase with fresh engine oil through the oil filler cap opening.

Dry fill. 4.3 lit (4.5 U.S.qts., 3.8 Imp.qts.)

Drain and Refill

Without oil filter; 3.7 lit (3.9 U.S.qts., 3.25 Imp.qts.)

With oil filter; 4.0 lit (4.23 U.S.qts., 3.51 Imp.qts.)

CAUTION

Do not overfill the crankcase. This will cause oil aeration and loss of oil pressure.

6. Install the oil filler cap.
7. Start and run the engine.
8. Stop the engine and then check the oil level. Add oil if necessary.

REPLACING OIL FILTER

Filter Selection

All Hyundai Motor Company engines are equipped with a high quality, throw-away oil filter. This filter is recommended as a replacement filter on all vehicles. The quality of replacement filters varies considerably. Only high quality filters should be used to assure the most efficient service. Make sure that the rubber gasket from the old oil filter is completely removed from the mating surface on the engine block, before installing the new filter.

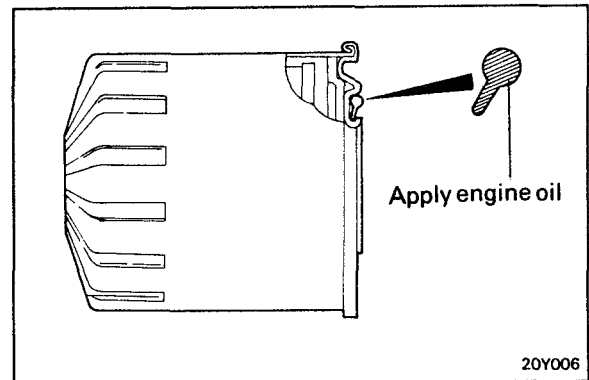
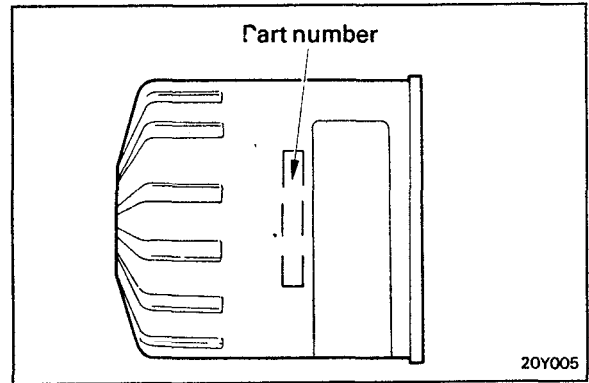
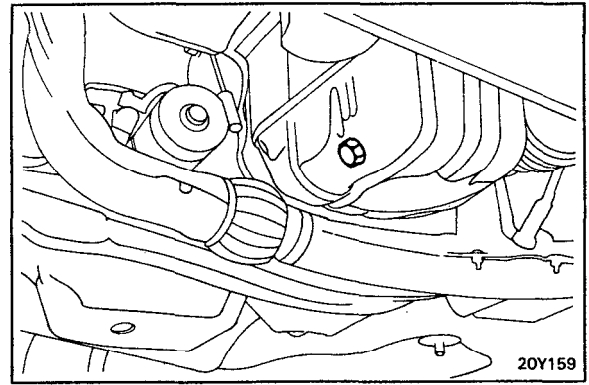
Replacing Oil Filter

1. Use a filter wrench to remove the oil filter.
2. Before installing the new oil filter on the engine, apply clean engine oil to the surface of the rubber gasket.
3. Tighten the oil filter to the specified torque.

Tightening torque

Oil filter 17-25 Nm (170-250 kg.cm, 12-18 lb.ft)

4. Start and run the engine and check for engine oil leaks.
5. After stopping the engine, check the oil level and add oil as necessary.



TIMING BELT TENSION ADJUSTMENT

NOTE

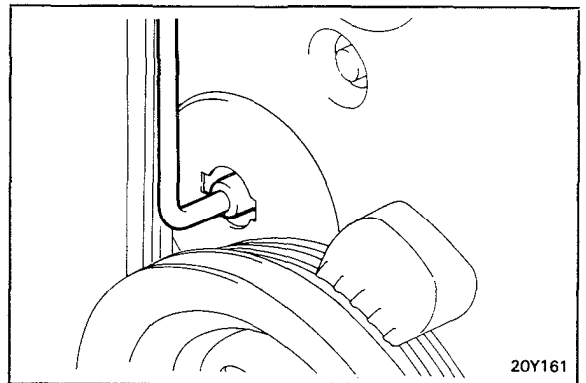
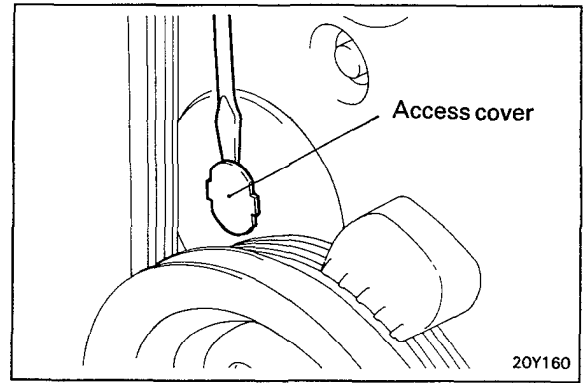
The timing belt tension does not normally require adjustment. However, if noise results from the timing belt hitting the cover, timing belt tension should be adjusted using the following procedure.

1. Remove the access cover.

NOTE

This job is easier, if the air conditioner compressor belt is removed.

2. Loosen the timing belt tensioner mounting bolt 1 to 2 turns.
3. Turn the crankshaft 2 revolutions in a clockwise direction.
4. Tighten the timing belt tensioner mounting bolt.
5. Install the access cover.

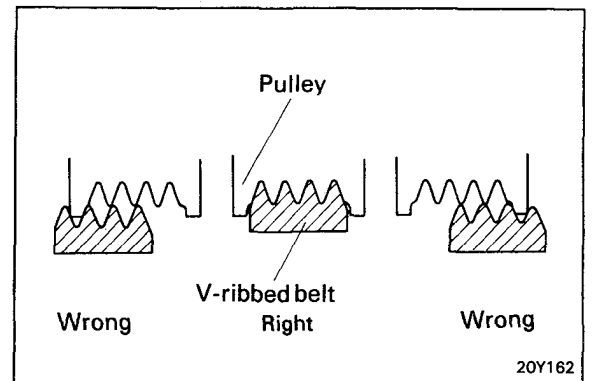


DRIVE BELTS TENSION ADJUSTMENT

1. Check that the belts are not damaged and are properly fit into the pulley grooves.

CAUTION

1. When installing the V-ribbed belt, check that the V-ribs are properly in alignment.
2. If noise or slippage is detected, check the belt for wear, damage, or breakage on the pulley contact surface, and check the pulley for scoring. Also check for the proper belt deflection measurement.



GENERAL

2. Apply 100 N (22 lbs.) force to the belt back midway between the pulleys as shown in the illustration, measure the amount of deflection with a tension gauge.

Standard value:

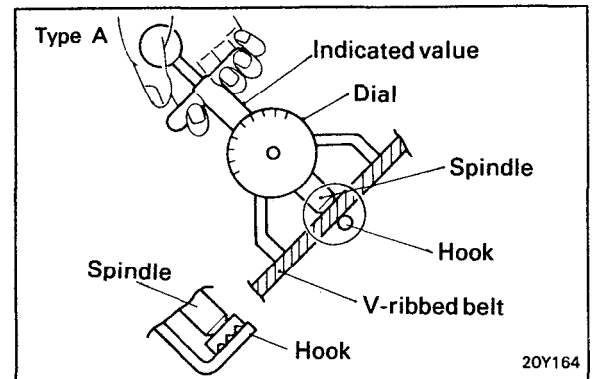
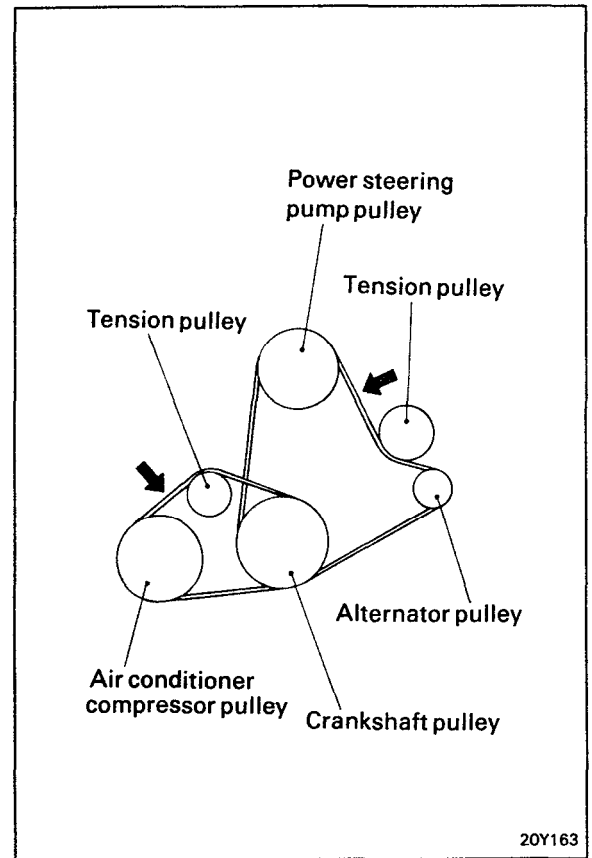
Items		New	Used	Inspection
Alternator and P/S pump	Deflection mm (in.)	4.0—5.0 (0.157—0.197)	7.0 (0.276)	6.0—9.0 (0.236—0.354)
	Tension Kg (lb)	70—90 (154—198)	50 (110)	35—60 (77—132)
A/C compressor	Deflection mm (in.)	—	—	4.5—5.5 (0.177—0.216)

NOTE

1. The belt tension must be measured between the specified pulleys.
2. When a new belt is installed, adjust the tension to the center of the standard range indicated under “New”. And then let the engine idle for 5 minutes or more, and check the standard value indicated under “Inspection”.
3. When adjusting a belt which has been used or a belt newly installed after 5 minutes or more of operation, refer to the standard value indicated under “Used”.
4. Refer to the standard value indicated under “Inspection” for periodic inspections.

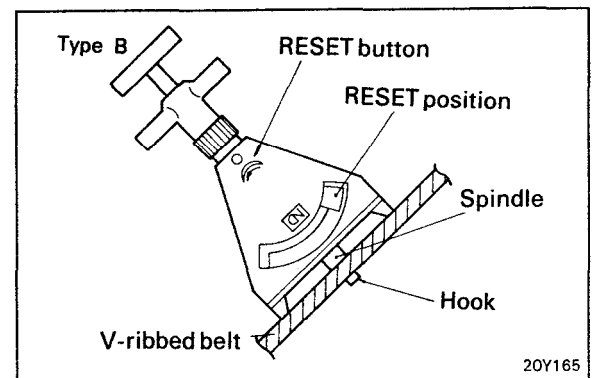
Type A tension gauge

Do not let the dial section of the tension gauge contact other objects during measurement.



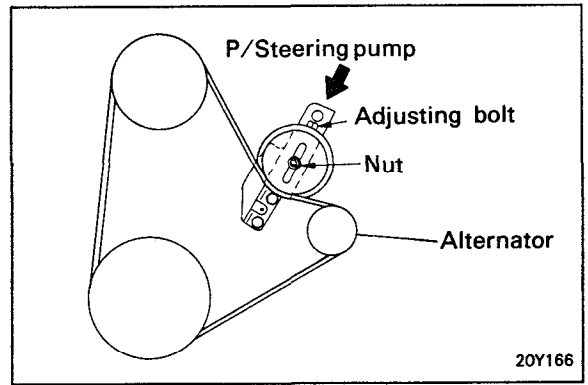
Type B tension gauge

1. When measuring, be sure to turn the reset button in the arrow direction to set the gauge needle to the RESET position.
2. If the tension gauge is removed from the belt, the needle will still indicate the tension. Read the tension after removing the gauge.



Alternator and Power Steering Pump Belt Adjustment

1. To increase belt tension, loosen the tension pulley locking nut slightly. Turn the left-hand threaded adjusting bolt clockwise, and move the tension pulley slightly.



2. Tighten the locking nut.

Tightening torque

Alternator tension pulley nut.....	
	38-59 Nm (390-600 kg.cm, 28-43 lb.ft)

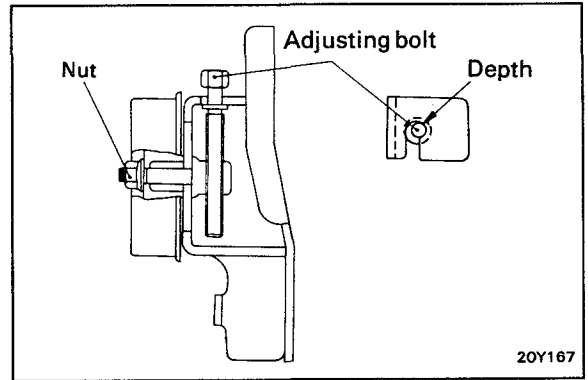
NOTE

Put the adjusting bolt into the recess at the far depth of the elongated hole on the tension bracket.

Check for the proper amount of belt deflection. Readjust if necessary.

NOTE

Before re-checking, crank the engine one or more revolutions.

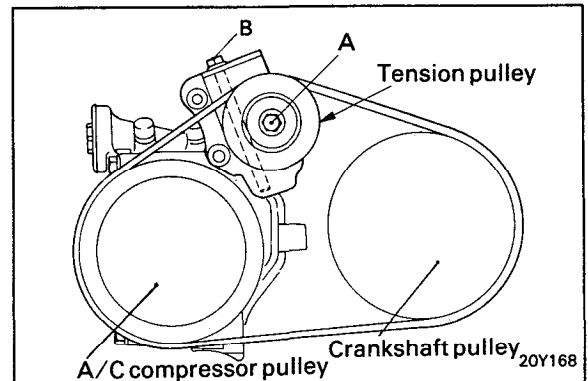


Air Conditioner Compressor Belt Adjustment

1. Loosen tension pulley fixing bolt A.
2. Adjust the belt deflection with adjusting bolt B.
3. Tighten locking bolt A.
4. Re-check the belt deflection and readjust, if necessary.

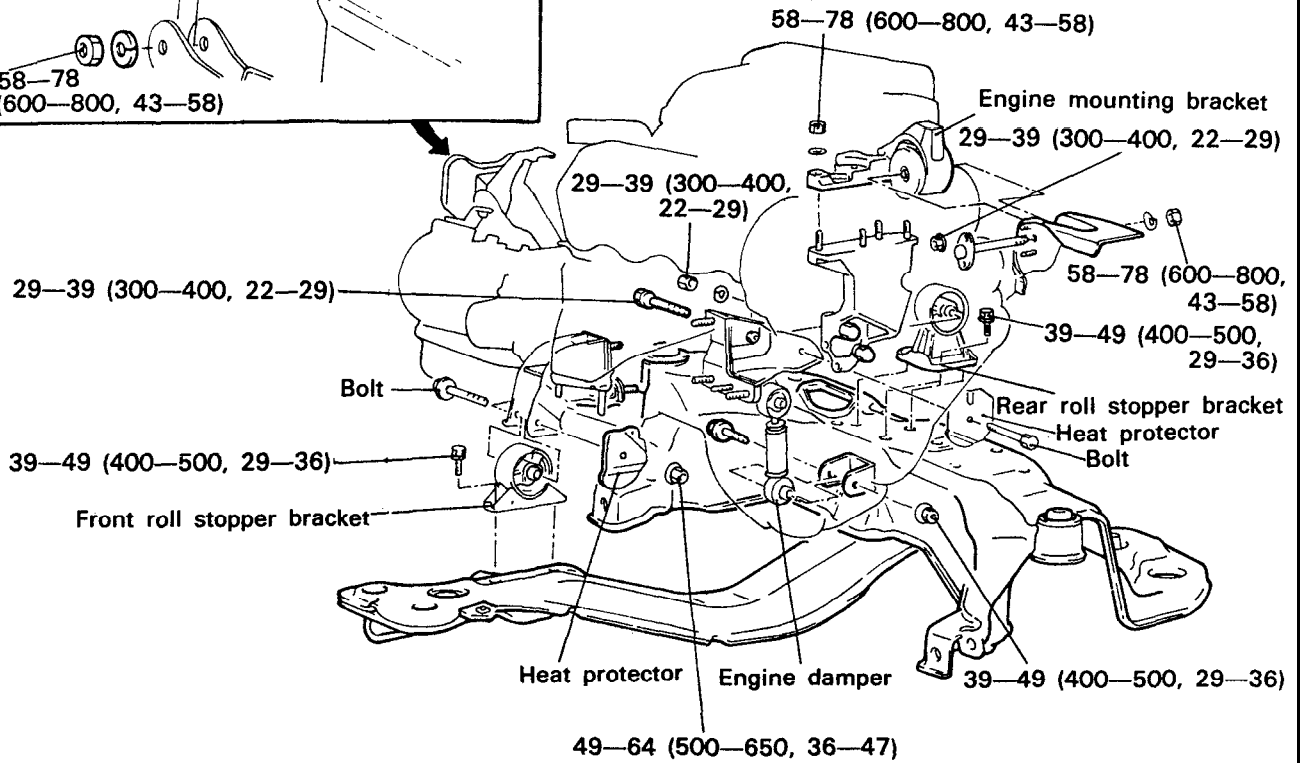
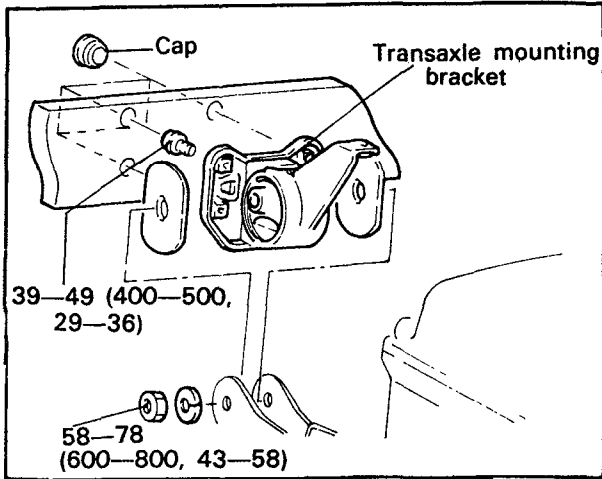
NOTE

Before re-checking, crank the engine one or more revolutions.



ENGINE MOUNTING

COMPONENTS



TORQUE : Nm (kg.cm, lb.ft)

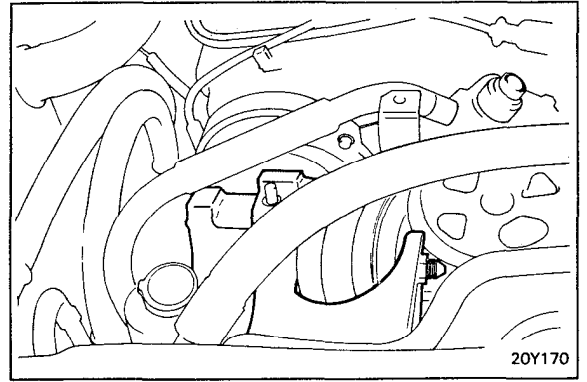
ENGINE MOUNTING

REMOVAL

Attach a cable or chain to the engine hooks, and then lift enough so that there is no pressure on the insulators.

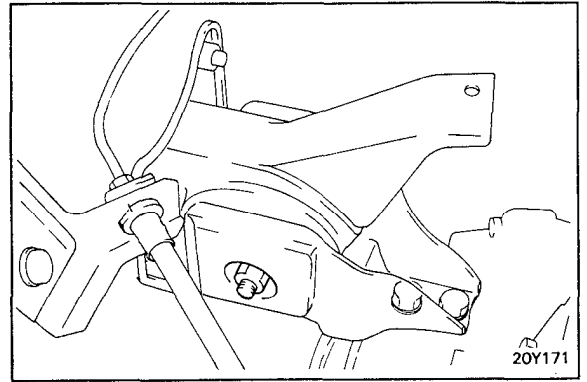
Engine Mounting

1. Remove the engine mount insulator bolts.
2. Remove the engine mount bracket from the engine.

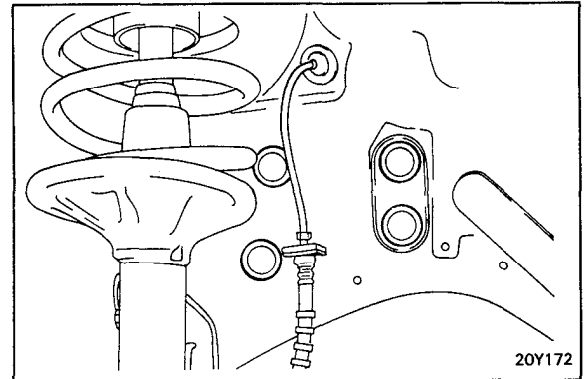


Transaxle Mounting

1. Remove the transaxle mounting bolt.

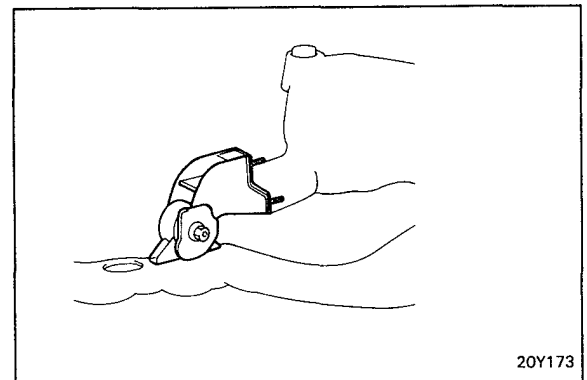


2. Remove the plugs from the inside of the right fender shield and then remove the remaining transaxle mounting bolts.
3. Remove the transaxle bracket.



Front Roll Stopper

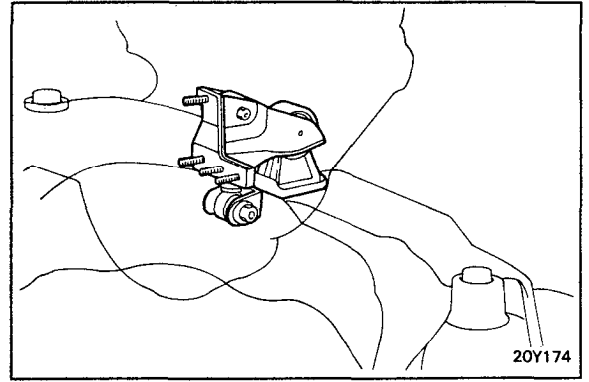
1. Remove the front roll stopper upper and lower bolts.
2. Remove the front roll rod assembly.



ENGINE MOUNTING

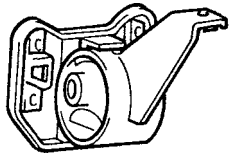
Rear Roll Stopper and Engine Damper

1. Remove the bolt from the rear roll stopper.
2. Remove the bolt from the engine damper.
3. Remove the rear roll stopper from the crossmember.

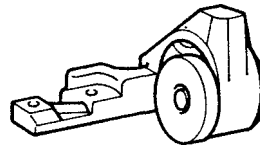


INSPECTION ITEMS

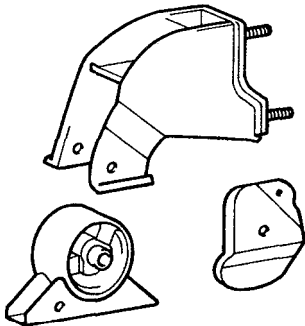
Transaxle mount



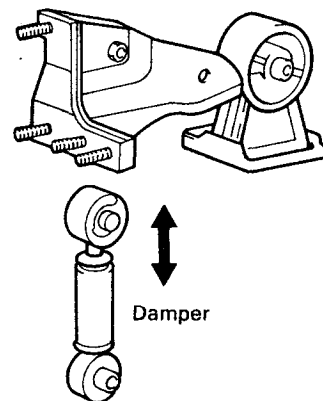
Engine mount



Front roll stopper assembly



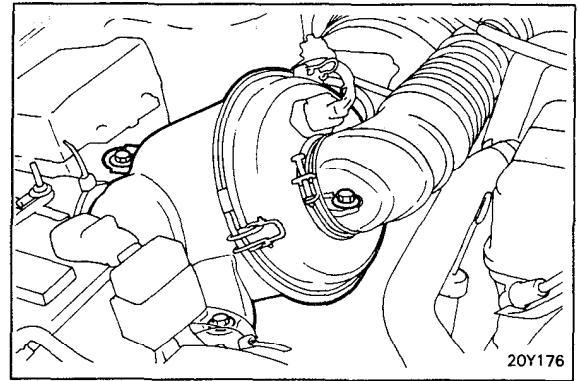
Rear roll stopper assembly and Engine damper



ENGINE AND TRANSAXLE ASSEMBLY

REMOVAL

1. Remove the battery.
2. Detach the air cleaner.
3. Disconnect the connectors for the backup light and engine harness.



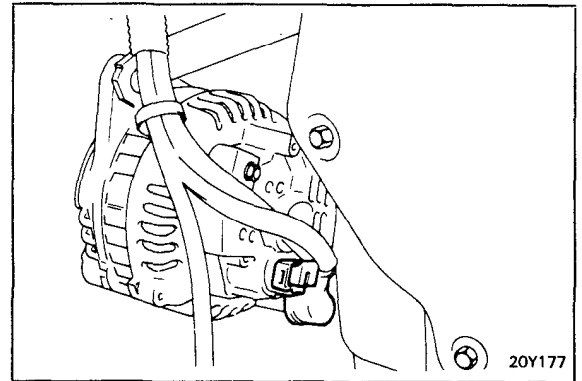
4. Disconnect the connectors for the alternator harness, the oil pressure switch and the oil pressure sender.
5. Drain the engine coolant.
6. Disconnect the transaxle oil cooler hoses.

NOTE

When disconnecting the hoses, make identification marks to avoid making any mistakes when re-installing them.

CAUTION

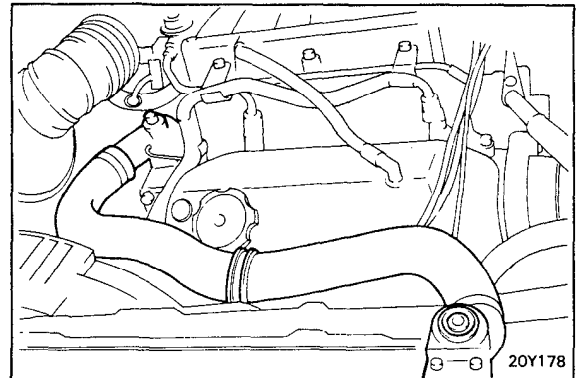
Be careful not to spill any of the oil or fluid out of the hoses. Plug the openings to prevent the entry of foreign material.



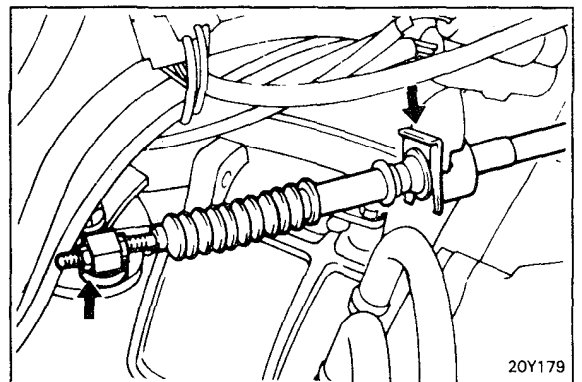
7. Disconnect the radiator upper and lower hoses on the engine side, and then remove the radiator assembly.
8. Disconnect the high tension cable and all wires to the distributor from the ignition coil.
9. Disconnect the engine ground.
10. Disconnect the brake booster vacuum hose.
11. Remove the main fuel line, and the return and vapor hoses from the engine side.

CAUTION

To reduce the residual pressure in the hoses, refer to Group Fuel System "Fuel filter replacement".

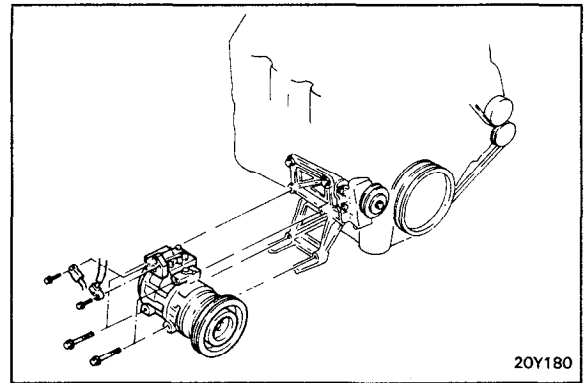


12. Disconnect the heater hoses (inlet and outlet) on the engine side.
13. Disconnect the accelerator cable and cruise control cable at the engine side.
14. Remove the control cable from the transaxle.



ENGINE AND TRANSAXLE ASSEMBLY

15. Disconnect the speedometer cable from the transaxle.
16. Detach the air conditioner compressor from the mounting bracket.
17. Remove the power steering oil pump from the cylinder block.

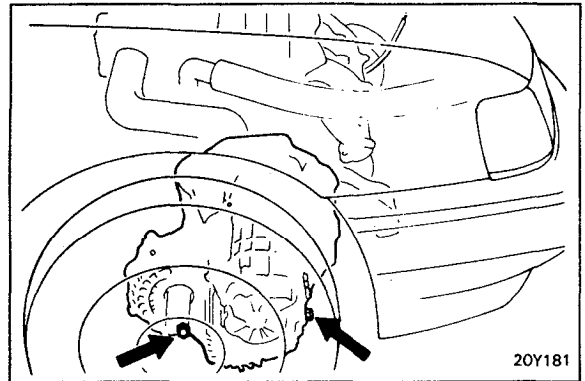


18. Raise the vehicle.
19. Remove the oil pan shield.
20. Drain the transaxle oil.
21. Disconnect the front exhaust pipe from the manifold.

NOTE

Use a wire to suspend the exhaust pipe from the bottom of the vehicle.

22. Remove the lower arm ball joint bolts and the stabilizer bar at the point where it is mounted to the lower arm.

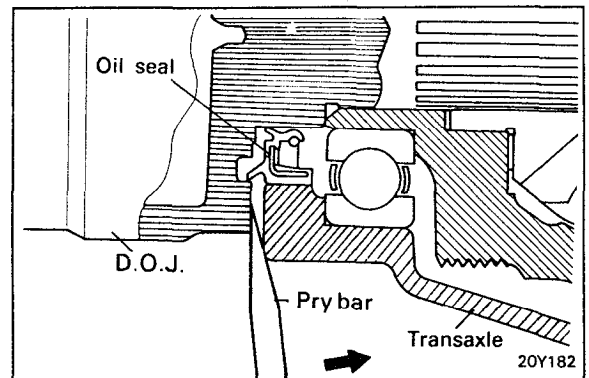


23. Remove the drive shafts from the transaxle housing.

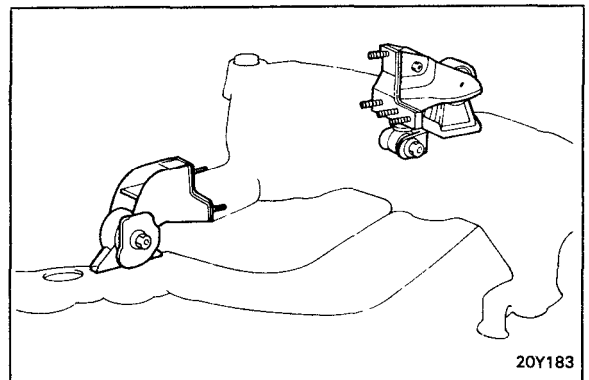
CAUTION

1. Plug up the holes of the transaxle case to prevent entry of foreign material.
2. The circlips on the drive shafts should be replaced upon re-installation.

24. Hang the lower arm and drive shaft from the body with a wire.
25. Attach a cable to the engine, and use a chain hoist to lift the engine only enough to pull the cable tight.

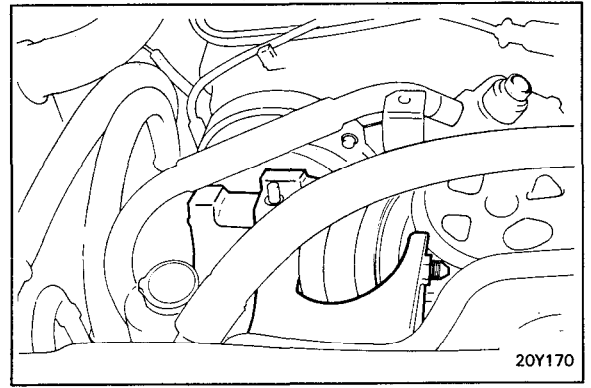


26. Remove the front roll stopper.
27. Remove the engine damper and the rear roll stopper.



ENGINE AND TRANSAXLE ASSEMBLY

28. Remove the engine mount bolts.
29. Remove the bolts and nuts that fasten the engine mount bracket to the body.

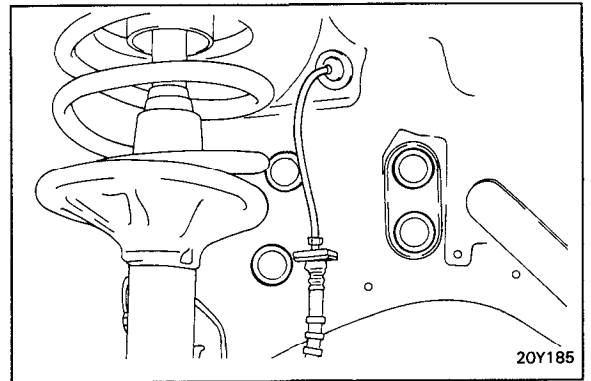


30. Slowly raise the engine and transaxle and temporarily hold it in the raised condition.

CAUTION

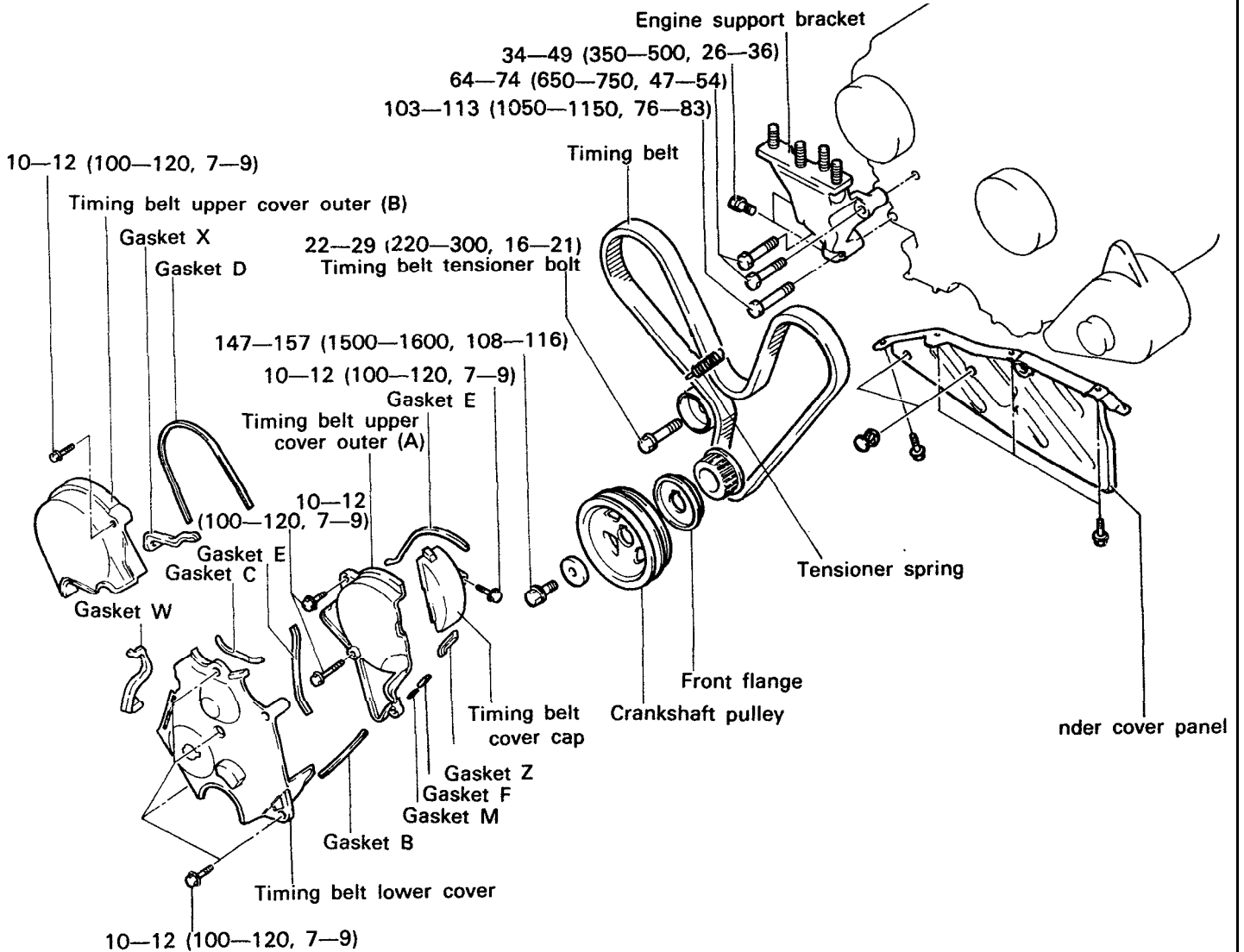
Confirm that all of the cables, hoses, harnesses, connectors etc., are disconnected from the engine.

31. Remove the blind plugs from the inside of the right fender shield and remove the transaxle mounting bracket bolts.
32. Remove the left mount insulator bolt.
33. While directing the transaxle side downward, lift the engine and transaxle assembly up and out of the vehicle.



TIMING BELT

COMPONENTS



TORQUE : Nm (kg.cm, lb.ft)

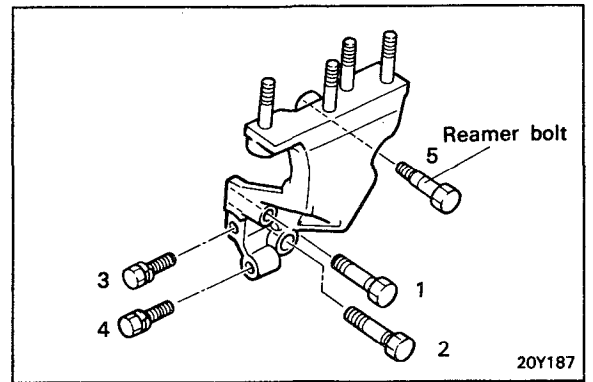
TIMING BELT

REMOVAL

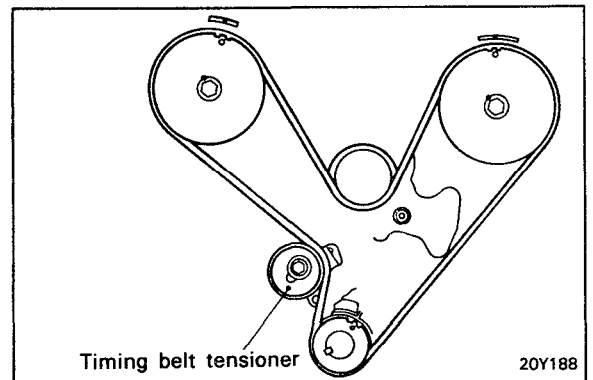
1. To remove the engine mounting bracket, support the oil pan with a block of wood and jack until removal is completed.
2. Remove the power steering oil pump with the return hoses connected.
3. Remove the engine support bracket in the numbered sequence shown in the illustration. Slowly remove the reamer bolt indicated by the arrow.

NOTE

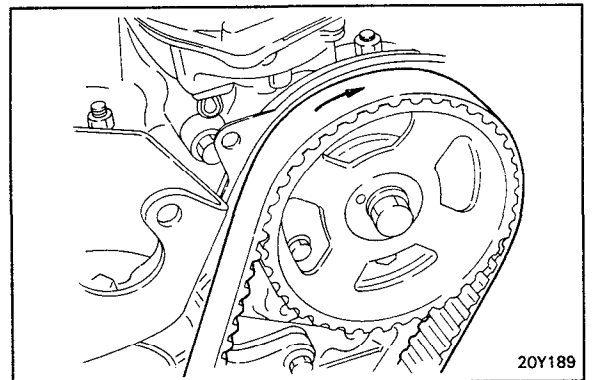
- o Keep in mind that the reamer bolt is sometimes heat seized on the engine support bracket.
 - o To make the installation easier, raise the engine as necessary.
4. Remove the crankshaft pulley from the crankshaft and the upper and lower timing belt covers.



5. Loosen the timing belt tensioner bolt and turn the timing belt tensioner counterclockwise along the elongated hole.



6. When the timing belt is to be reused, mark the direction of travel with an arrow before removing it.

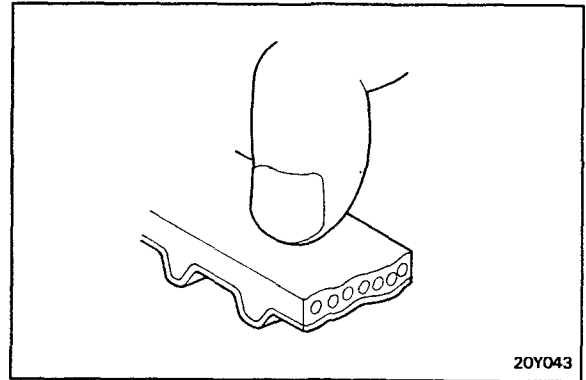


INSPECTION

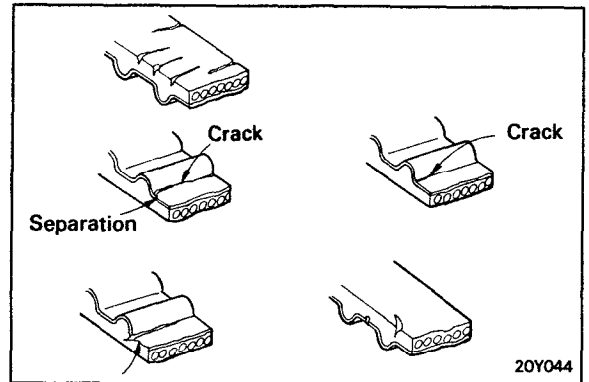
1. Closely inspect the belt. If the following problems are evident, replace the belt with a new one.

1) **Hardened back surface rubber**

Back surface glossy. Non-elastic and so hard that even if a finger nail is forced into it, no mark is produced.



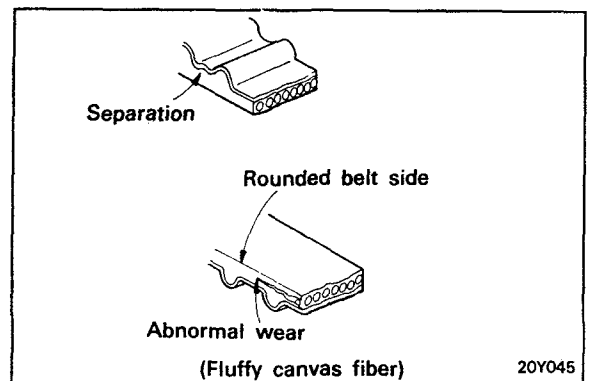
2) **Cracked surface rubber**



3) **Side of belt badly worn**

NOTE

A belt in good condition should have clear-cut sides as if cut with a sharp knife.



4) **Badly worn teeth**

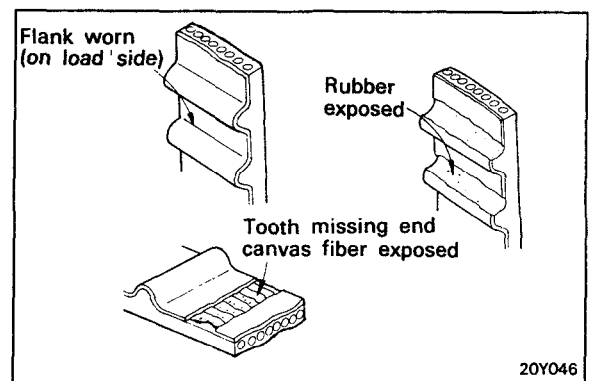
Initial stage:

Canvas on the load side of the tooth flank worn (fluffy canvas fibers, rubber gone and color changed to white, unclear canvas texture)

Last stage:

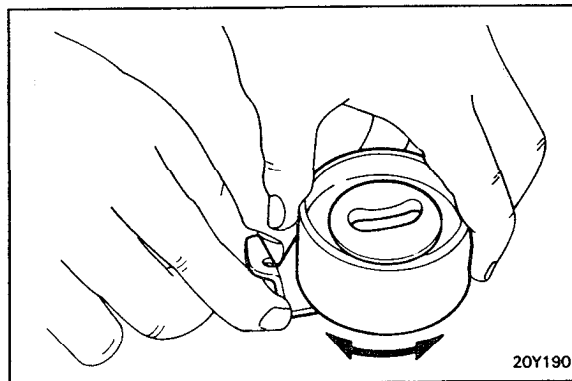
Canvas on the load side of the tooth flank worn down and rubber exposed (tooth width reduced)

5) **Missing tooth**



TIMING BELT

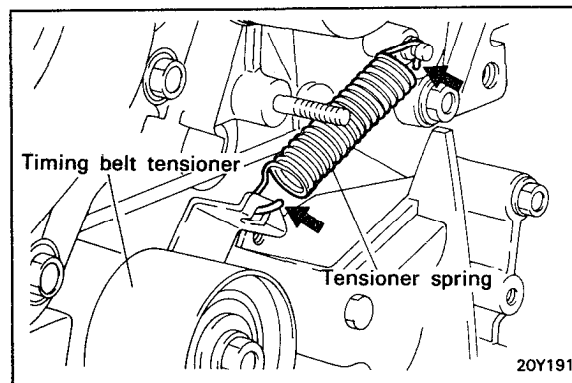
2. If backlash or an irregular noise is observed when rotating the pulley, replace the timing belt tensioner



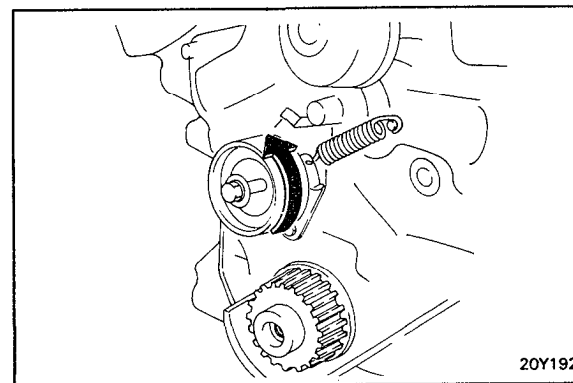
INSTALLATION

Timing belt tensioner and tensioner spring

1. Install the timing belt tensioner.
2. Attach the top of the tensioner spring on the water pump pin. Install the hook in the direction shown in the illustration.

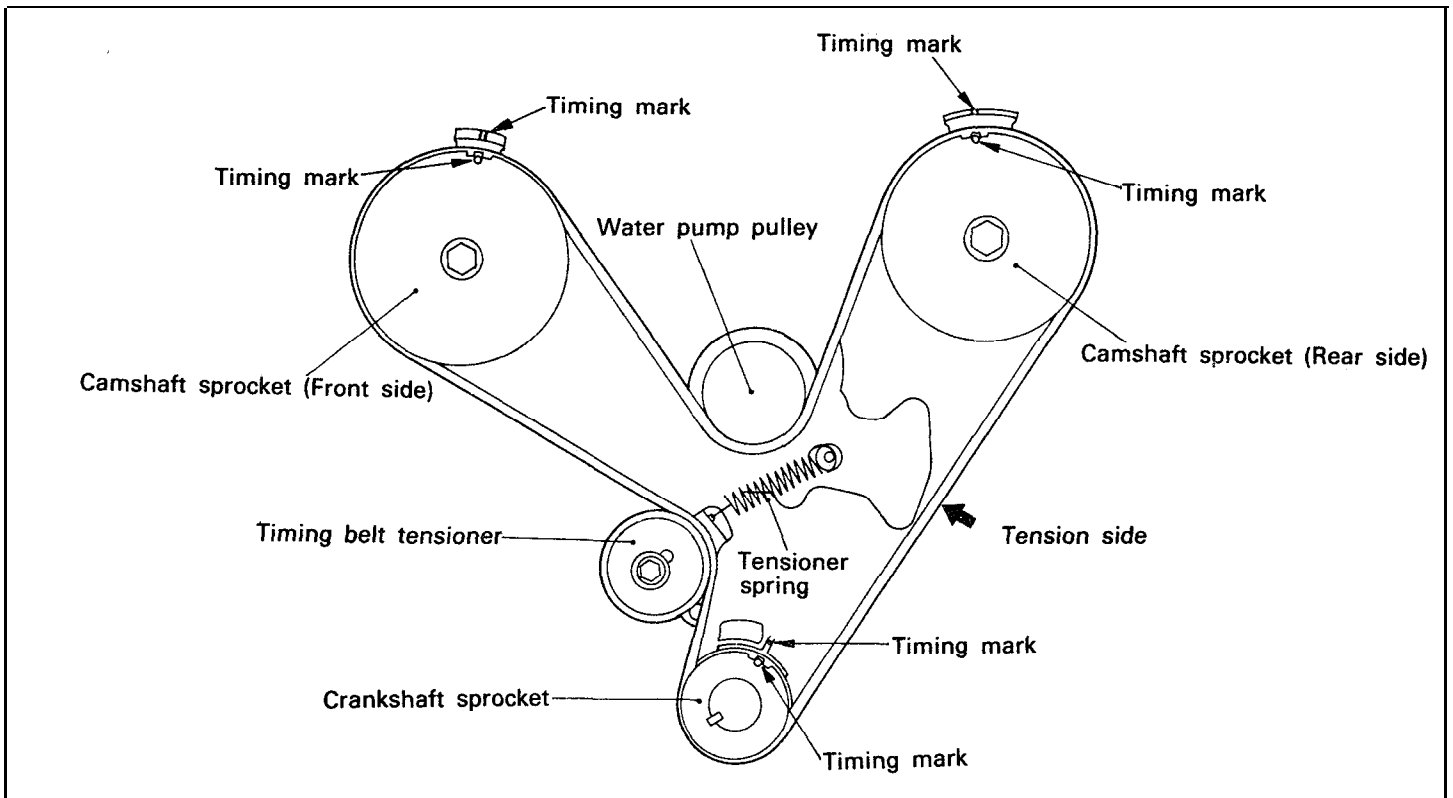


3. Rotate the timing belt tensioner to the extreme counter-clockwise along the elongated hole. Temporarily lock the timing belt tensioner in place.



TIMING BELT

TIMING BELT

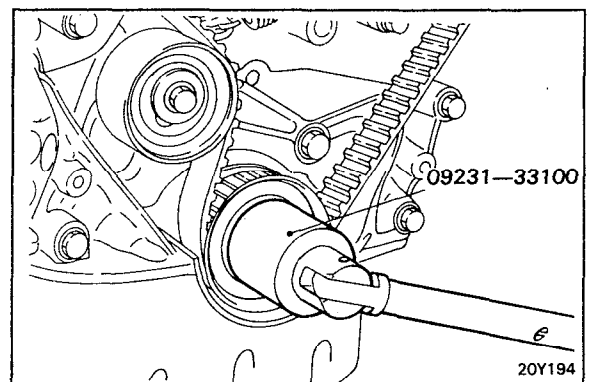


Timing Belt

1. Align the timing marks of the camshaft sprockets (on the front and rear sides) and the crankshaft sprocket (At the top dead center position of the No.1 cylinder compression stroke.)
2. Route the timing belt on the crankshaft sprocket, then onto the rear camshaft sprocket.
3. Run the timing belt onto the water pump pulley, the front camshaft sprocket and the timing belt tensioner.
4. Apply force counterclockwise to the rear camshaft sprocket with tension on the tight side of the belt, check that the timing marks are all aligned.
5. Install the flange.
6. Back off the fixing bolts of the temporarily tightened tensioner one or two turns and tighten the timing belt with the tensioner spring force specified.
7. Using the special tool (09231-33100), turn the crankshaft two turns in the normal rotating direction (clockwise).

NOTE

Turn smoothly, only in a clockwise direction.



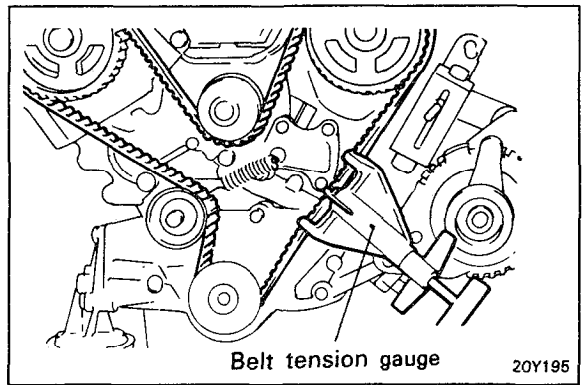
TIMING BELT

8. Readjust the sprocket timing marks and re-tighten the tensioner locking bolts.
9. Measure the belt tension with a belt tension gauge as shown in the illustration.

Tension force 260-380 N (57-84 lbs.)
(New)

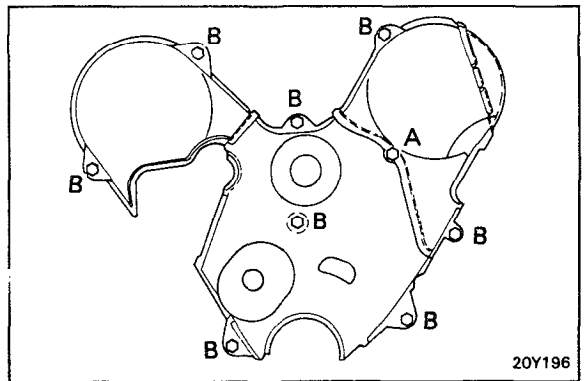
CAUTION

Position the hooks in the tooth bottoms and apply the spindle to the back of the belt.



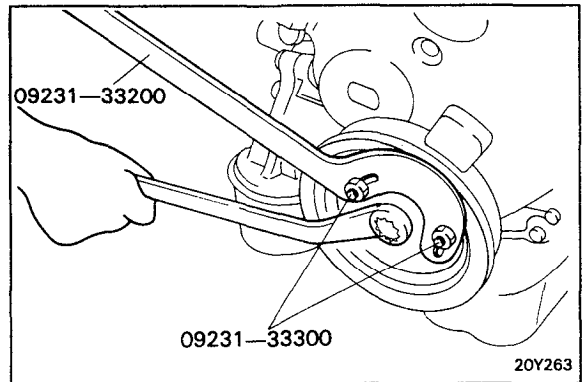
10. As the mounting bolts of the timing cover are different in size according to location, be sure to locate them according to the illustration.

Thread diameter x height
 A 6 x 60 mm (0.24 x 2.36 in.)
 B 6 x 20 mm (0.24 x 0.79 in.)



11. Using the special tool (09231-33200, 09231-33300), install the crankshaft pulley on the crankshaft.

Tightening torque
 Crankshaft pulley bolt
 147-157 Nm (1,500-1,600 kg.cm, 108-116 lb.ft)



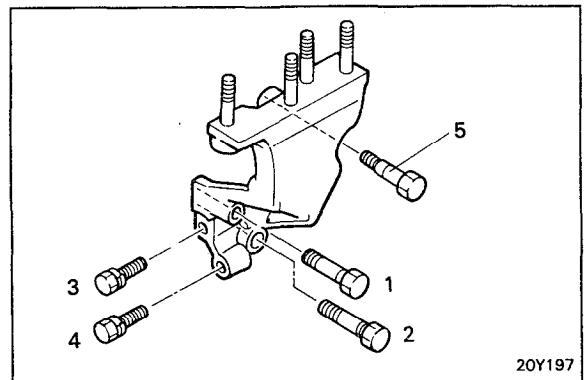
12. As the mounting bolts of the engine support bracket are different in size according to location, install them in the recommended sequence.

NOTE

When installing the reamer bolt, tighten it, slowly spraying lubricant on the reamer area.

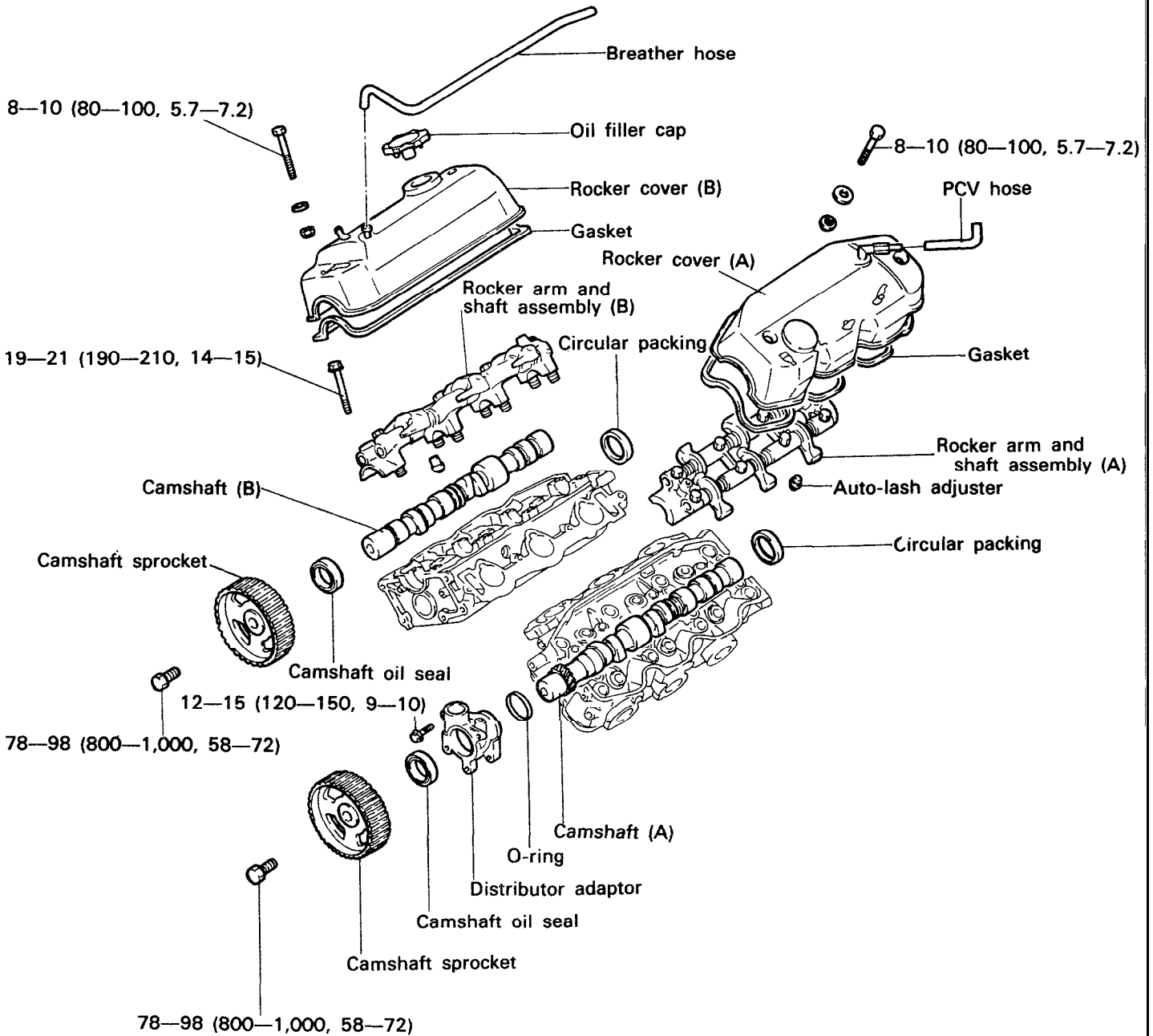
To make the installation easier, raise the engine as necessary.

Thread diameter x height
 1,5 10 x 53 mm (0.39 x 2.09 in.)
 2 12 x 56 mm (0.47 x 2.20 in.)
 3,4 10 x 40 mm (0.39 x 1.57 in.)



ROCKER ARMS, ROCKER ARM SHAFTS AND CAMSHAFTS

COMPONENTS



TORQUE : Nm (kg.cm, lb.ft)

SERVICE ADJUSTMENT PROCEDURE

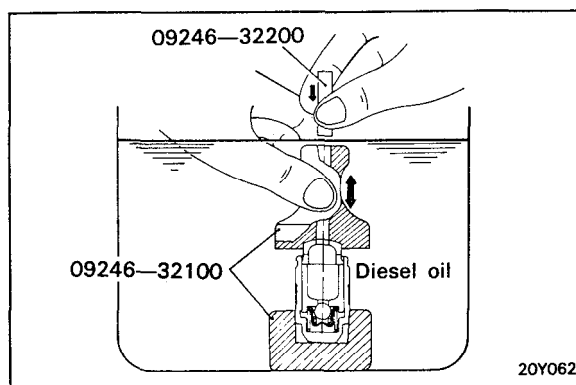
Bleeding Auto Lash Adjuster

NOTE

Since the auto-lash adjuster is a precision part, use care to prevent entry of foreign substances such as dirt. Do not attempt disassembly of the auto-lash adjuster. Use clean Diesel fuel for cleaning the auto-lash adjuster.

1. Individual unit

- 1) Combine the auto-lash adjuster and the special tool (09246-32100), as shown in illustration, and immerse in Diesel fuel.
- 2) Using the special tool (09246-32200), lightly hold down the steel ball and move the plunger up and down 4 or 5 times.
- 3) Remove the air bleed wire and push down firmly on the plunger.
If it moves at all even slightly, repeat steps 1) and 2).
If the plunger continues to move even after the steps have been repeated several times, replace the auto-lash adjuster.

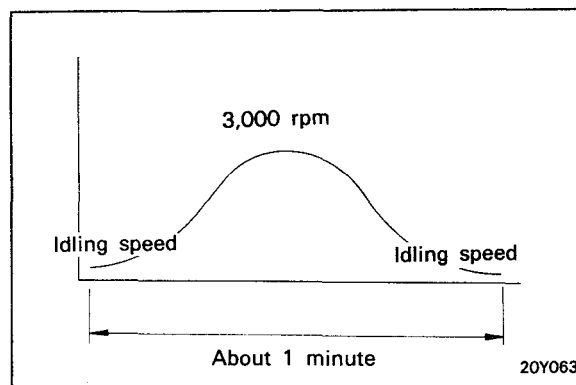


NOTE

The fully bled auto-lash adjuster should be held in an up-right position to make sure that the Diesel fuel in the adjuster does not drain out. Use care to make sure that dust and other foreign substances do not contaminate the adjuster.

2. Engine assembly

After installing in the engine, if there is air in the auto-lash adjuster, abnormal noises may occur. If this happens, the air can be bled and the noise eliminated by slowly increasing the engine speed to 3,000 rpm and then returning to idle.



NOTE

If a leak-down tester is not available, check the auto-lash adjuster as follows.

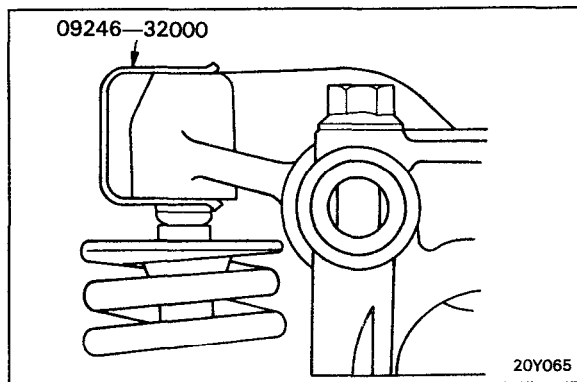
1. Check whether or not there is any abnormal noise with the engine idling (at normal operating temperature).
2. If there is abnormal noise, there may be a malfunction of the auto-lash adjuster's air bleeding. Bleed the air from the auto-lash adjuster, and then recheck for abnormal noise while the engine is idling.
3. If there is still abnormal noise, replace the auto-lash adjuster.

REMOVAL

1. Before removing the rocker arm and shaft assemblies, use the special tool (09246-32000) to ensure that the auto-lash adjuster doesn't fall out.

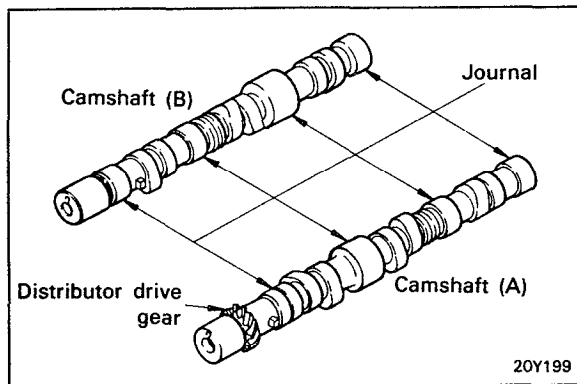
NOTE

Store the rocker arms and auto-lash adjusters in order clearly identifying between the intake and exhaust to prevent mixing them during reassembly.



INSPECTION

1. If the following areas of the camshaft are badly worn or damaged, replace the camshaft.
 - 1) Journals
 - 2) Cam lobes
 - 3) Distributor drive gear teeth
 - 4) Oil seal contacting surface
2. If the camshaft bearings are badly worn, replace the cylinder head.
3. If the oil seal lip is worn, replace.

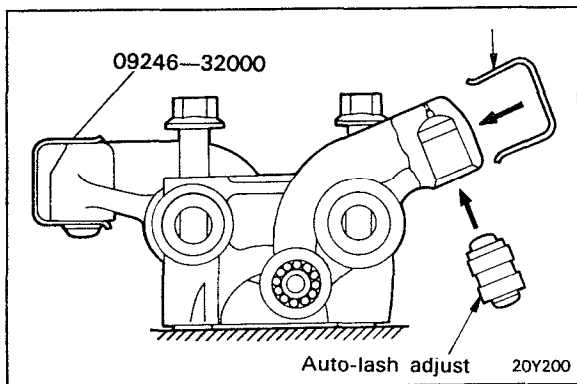


Cam height

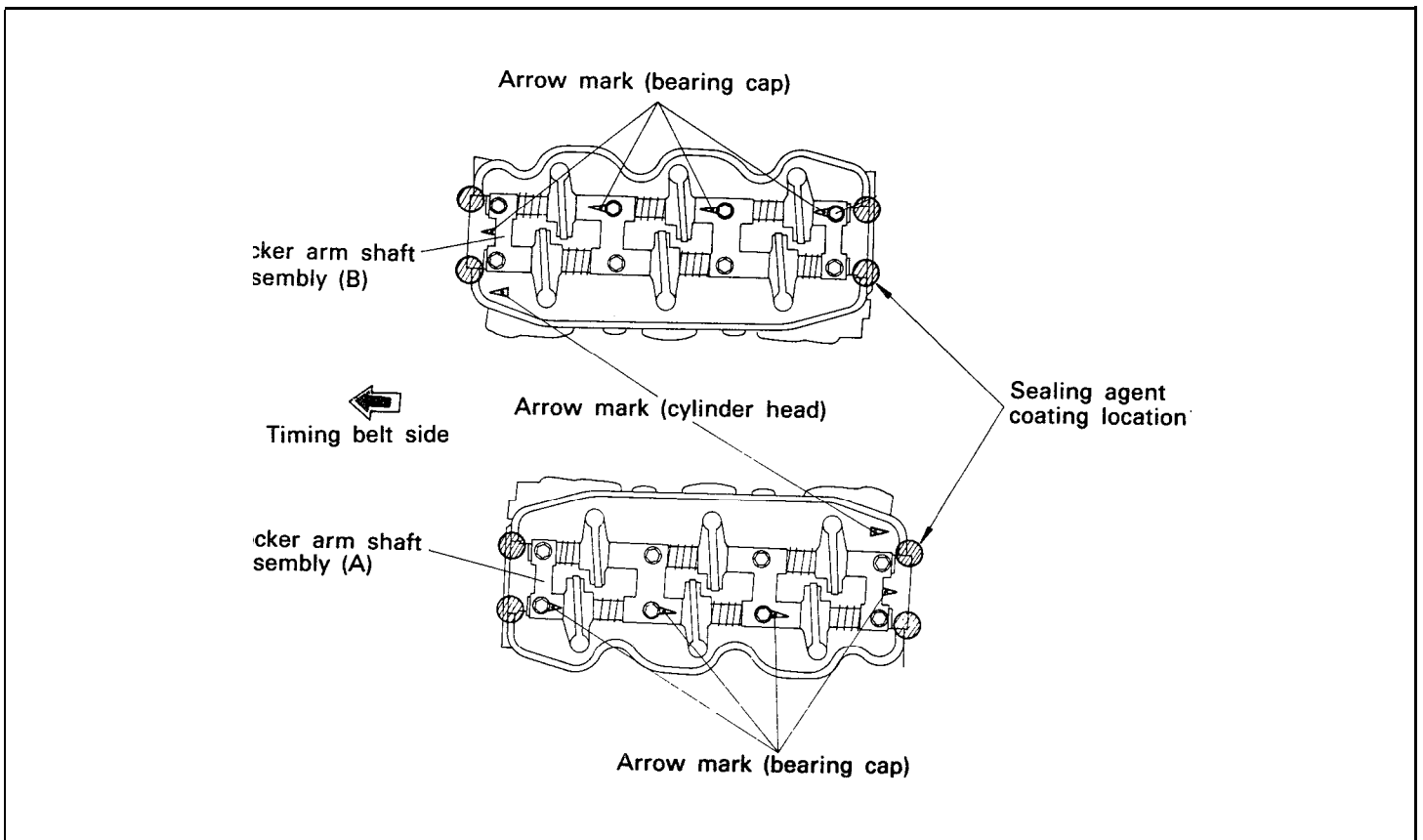
Standard	41.15-41.35	mm	(1.6201-1.6279	in.)
Limit	40.65	mm	(1.6004	in.)

INSTALLATION

1. Install camshaft in the cylinder head after applying a coat of engine oil to the camshaft journal and cams.
2. Insert the auto-lash adjusters, being careful not to spill the diesel oil inside them. Then use the special tool to prevent the adjusters from falling out while installing.



ROCKER ARMS, ROCKER ARM SHAFTS AND CAMSHAFTS



3. Apply a minimum amount of sealing agent on the four places (shown in the illustration).

NOTE

Ensure that the sealing agent does not leak out onto the cam journal surface of the cylinder head. If it does wipe it off before it dries.

Sealant Threebond No.1324 or equivalent

4. Install the rocker arm shaft assemblies (A) and (B) such that the arrow mark on the bearing cap faces in the same direction as the arrow mark on the cylinder head.

NOTE

The arrow marks face each other on rocker arm shaft assemblies (A) and (B).

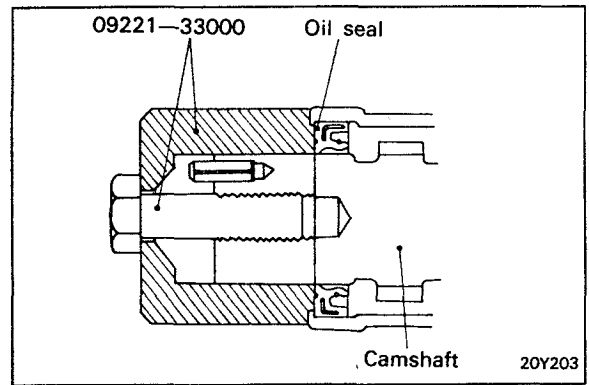
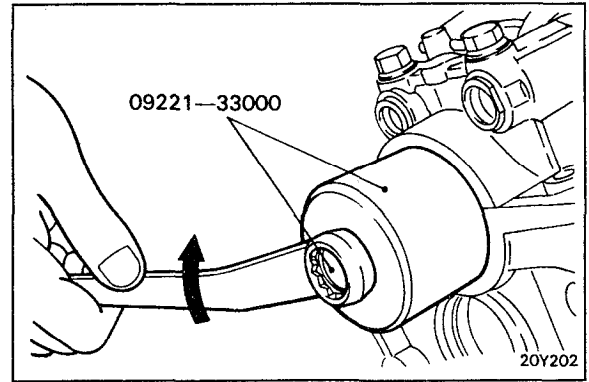
5. Tighten the bearing cap bolt to the specified torque. Remove the special tool attached in auto-lash adjuster.

Tightening torque

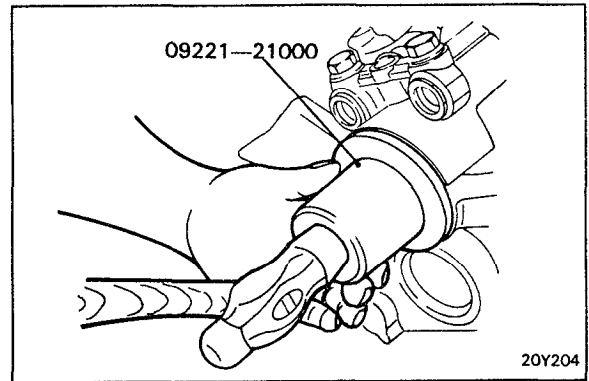
Rocker arm and shaft assembly bolt
19-21 Nm (190-210 kg.cm, 14-15 lb.ft)

ROCKER ARMS, ROCKER ARM SHAFTS AND CAMSHAFTS

6. Apply a slight amount of engine oil over the circumference of the camshaft oil seal lip section.
Using the special tool (09221-33000), insert the oil seal.



7. Using the special tool (09221-21000), insert the circular packing.



8. When the rocker cover is installed, apply sealant to circular packing and cylinder head top surfaces.

Sealant

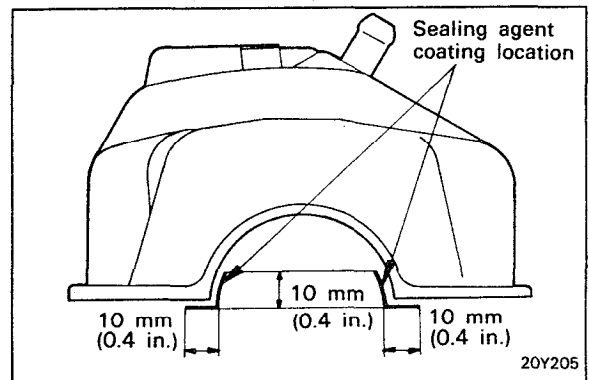
Rocker cover Three-bond No.1212D or equivalent

NOTE

Make sure that rocker cover bolts are tightened to the specified torque. If they are overtightened, the rocker cover will be distorted and oil leakage could result.

Tightening torque

Rocker cover bolts.
8-10 Nm (80-100 kg.cm, 5.7-7.2 lb.ft)

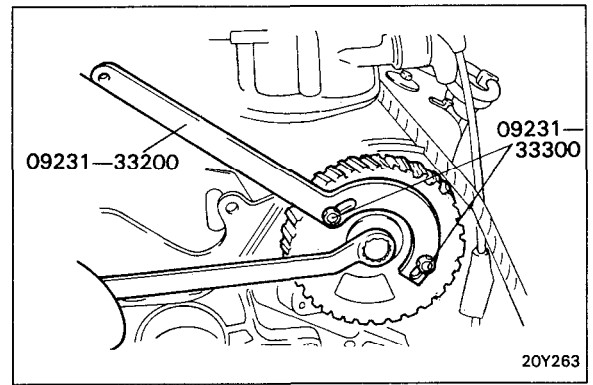


ROCKER ARMS, ROCKER ARM SHAFTS AND CAMSHAFTS

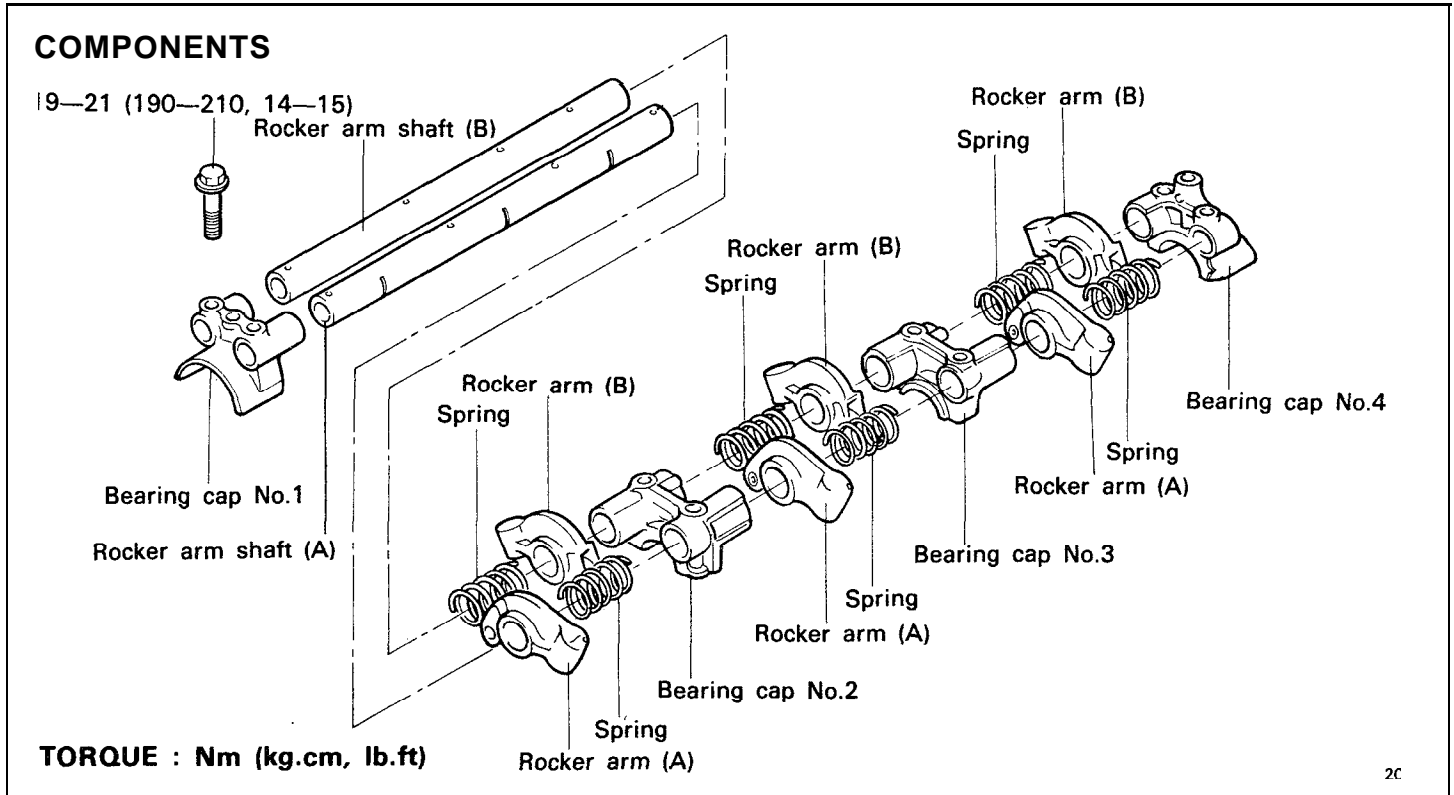
9. Using the special tools (09231-33200, 09231-33300), tighten the camshaft sprocket bolt to the specified torque.

Tightening torque

Camshaft sprocket bolt
78-98 Nm (800-1.000 kg.cm, 58-72 lb.ft)



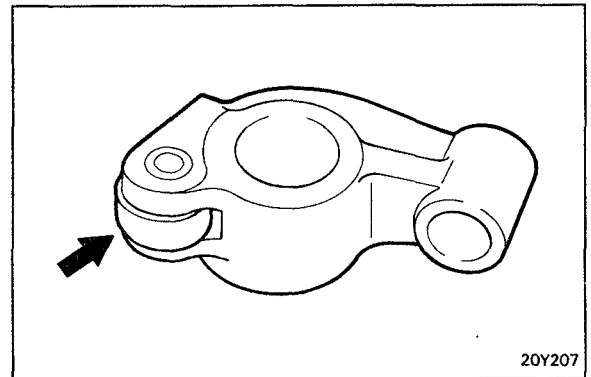
ROCKER ARMS AND SHAFTS



INSPECTION

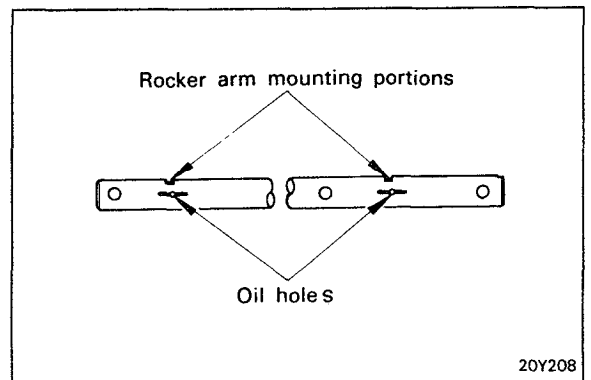
Rocker Arms

1. Check the rocker arm roller surfaces.
Replace if recesses, damage or heat seizure are observed.
2. Check the rocker arms for the roller rotation.
Replace if uneven rotation or roller backlash is observed.
3. Check the inside diameter. Replace if damage or seizure is observed.



Rocker Arm Shafts

1. Check the rocker arm mounting portions of the rocker arm shafts for wear or damage. Replace as necessary.
2. Check that the oil holes are clear.



ROCKER ARMS AND SHAFTS

INSTALLATION

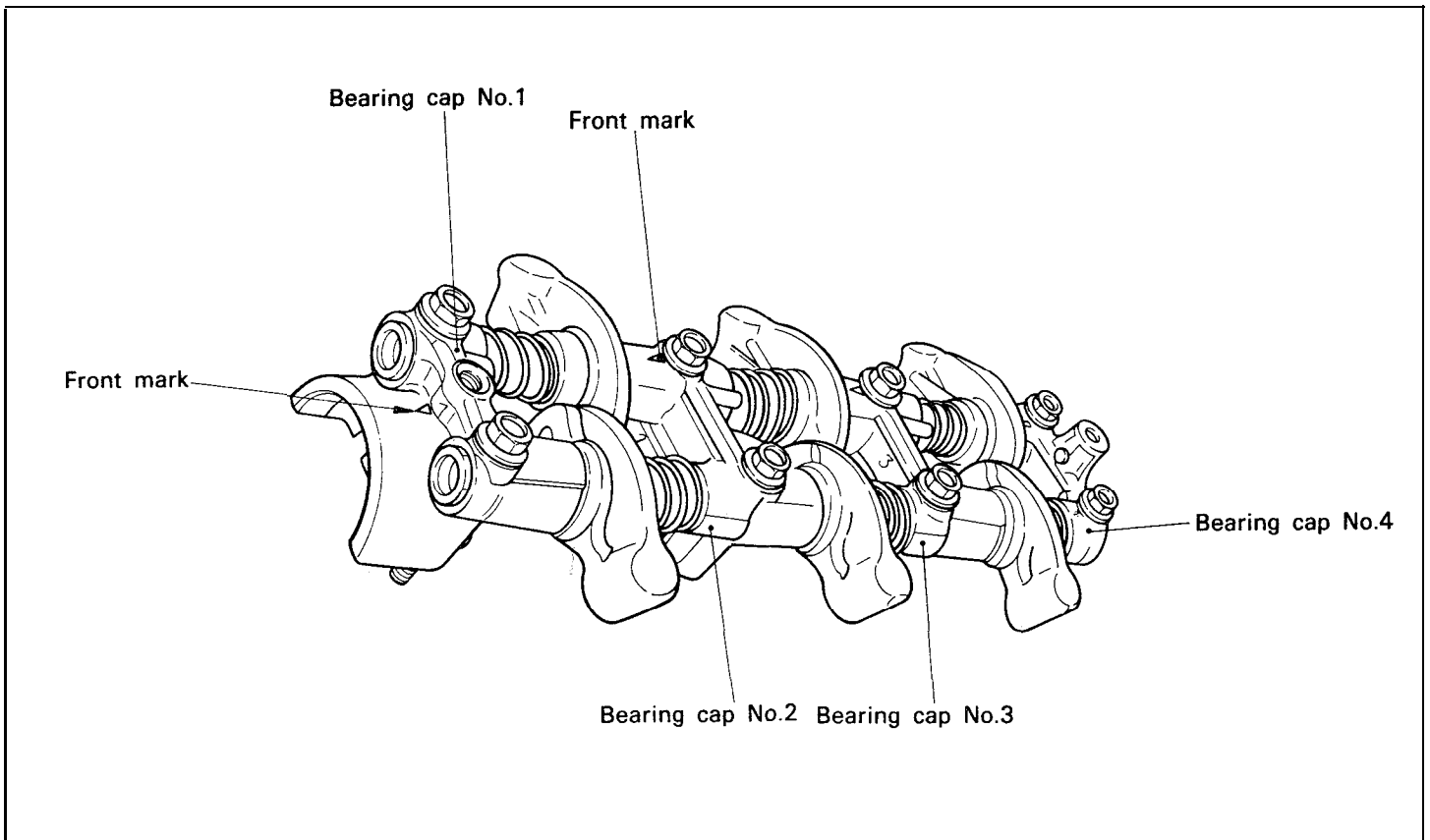
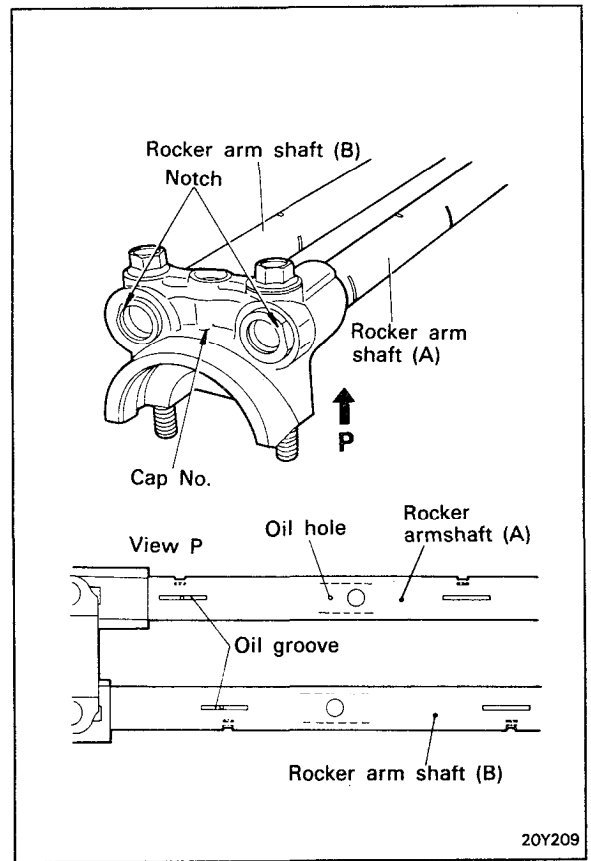
Insert bearing cap No.1 so that the notch on the end of the shaft faces in the direction shown in the illustration and insert the mounting bolt.

NOTE

1. Since bearing caps No.1 and No.4 look alike, check for the proper stamped cap No.
2. Check that the oil groove faces downward as shown in the illustration and the oil port is located on the rocker shaft (A) side.
3. Since bearing caps No.2 and No.3 look alike, check for the proper stamped cap No. Then attach the caps.
4. Apply engine oil on the inside diameter area of the rocker arm and attach the rocker shaft.

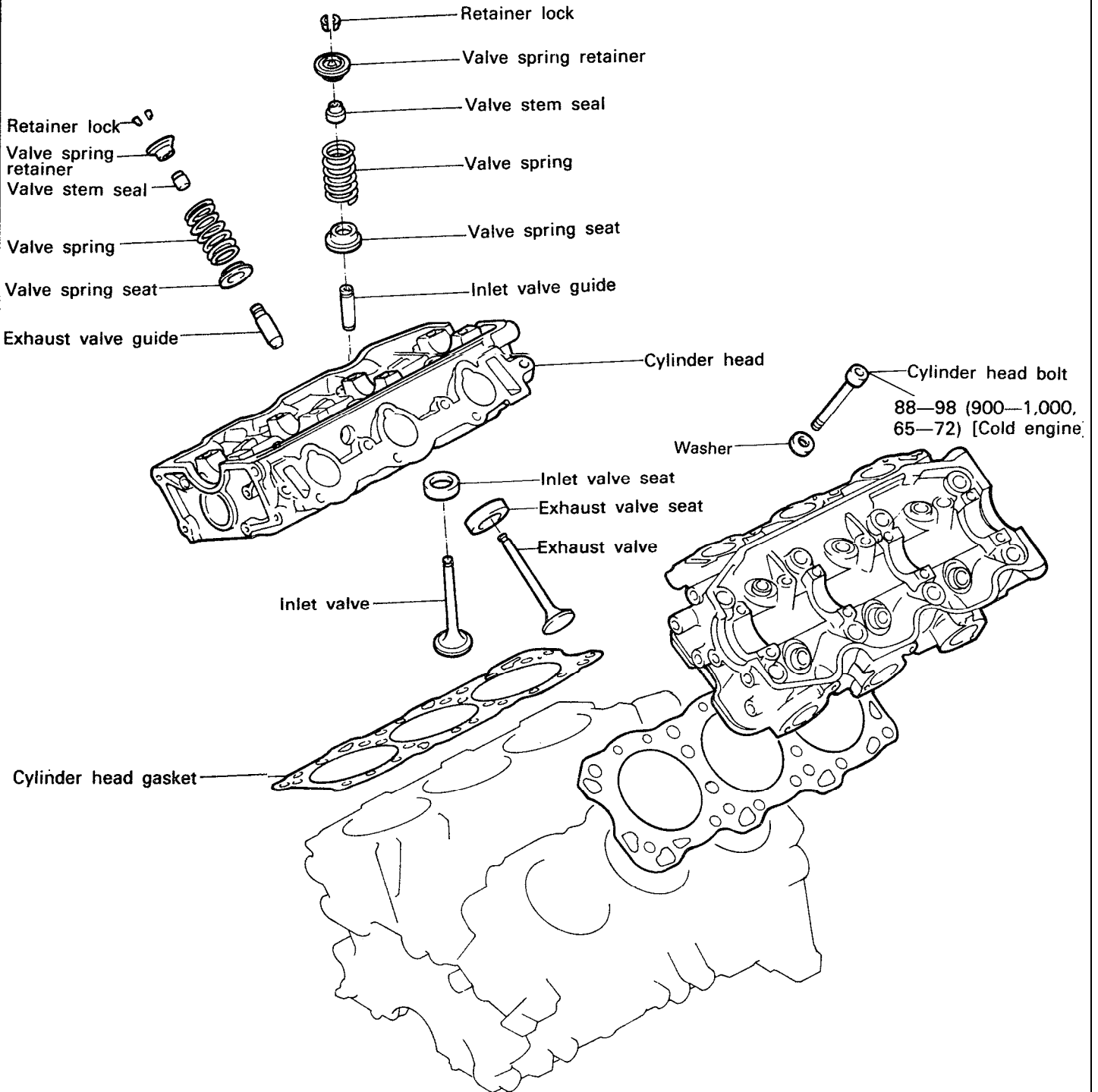
Tightening torque

Rocker arm and shaft assembly bolt.....
19-21 Mm (190-210 kg.cm, 14-15 lb.ft)



CYLINDER HEADS, VALVES AND VALVE SPRINGS

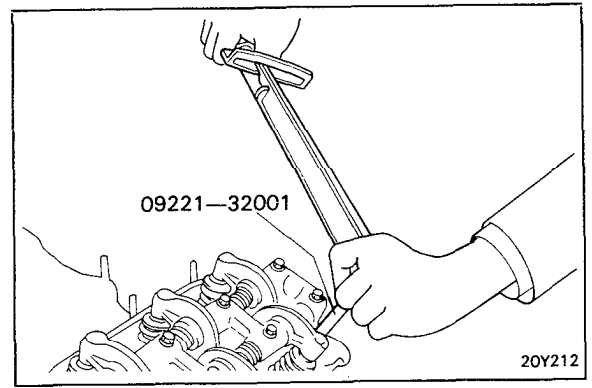
COMPONENTS



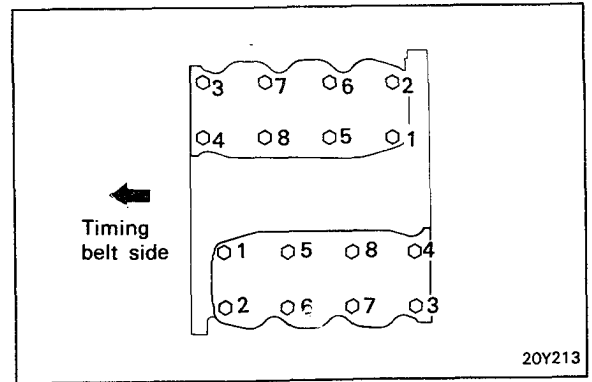
TORQUE : Nm (kg.cm, lb.ft)

REMOVAL

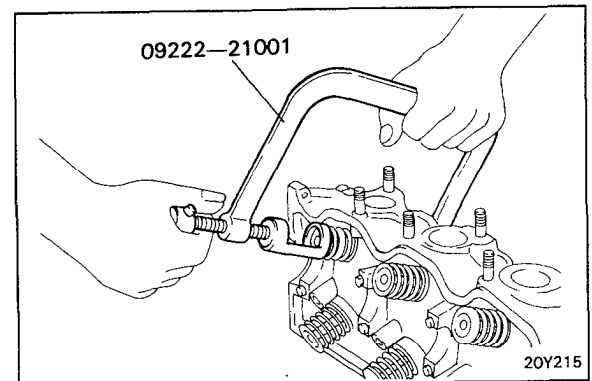
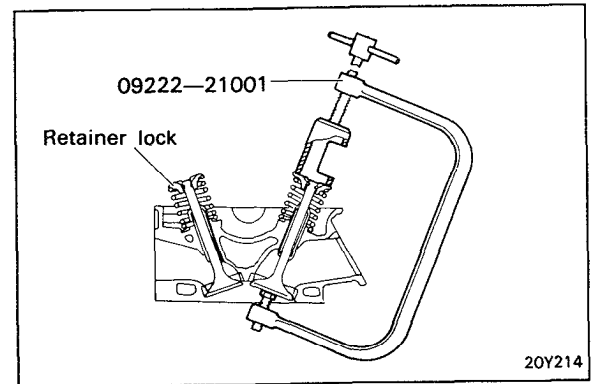
1. Using the special tool (09221-32001), loosen the cylinder head bolts.



2. Slowly loosen the cylinder head bolts in the sequence shown in the illustration.



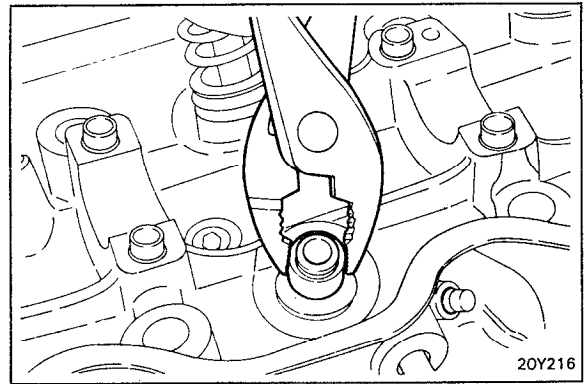
3. Using the special tool (09222-21001) valve spring compressor, remove the retainer locks.
4. Put these parts in order so that they can be reinstated in their original positions.



5. Remove the valve stem seals with pliers and discard them.

NOTE

Do not reuse valve stem seals.

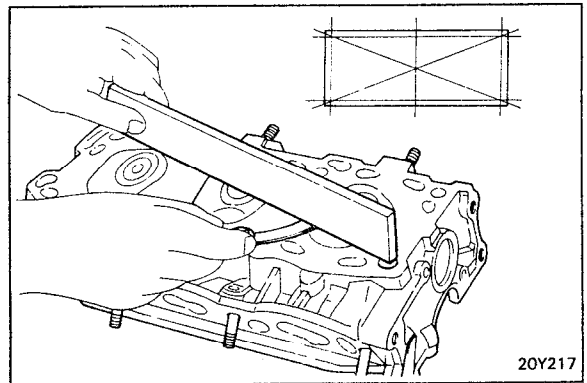


20Y216

INSPECTION

Cylinder Head

1. Remove scale, sealing compound and carbon deposits completely. After cleaning oil passages, apply compressed air to make certain that the passages are not clogged.
2. Visually check the cylinder head for cracks, damage or water leakage.
3. Check the cylinder head gasket surface for flatness with a straight edge and feeler as shown in illustration.



20Y217

Cylinder head flatness:

Standard dimension	Max. 0.05 mm (0.002 in.)
Service limit0.20 mm (0.008 in.)

Valve Guides

Check the valve stem-to-guide clearance. If the clearance exceeds the service limit, replace the valve guide with a new oversize guide.

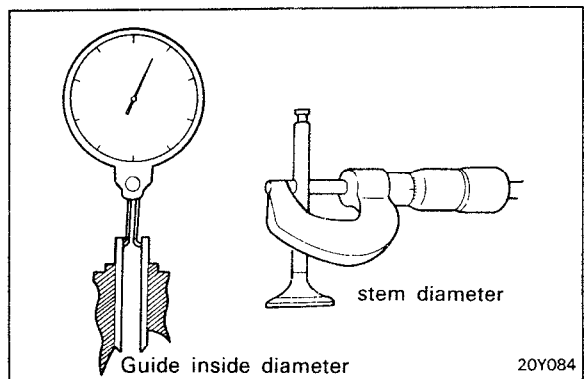
Valve stem-to-guide clearance

Standard value

Intake	0.03-0.06 mm (0.0012-0.0024 in.)
Exhaust0.05-0.09 mm (0.0020-0.0035 in.)

Service limit

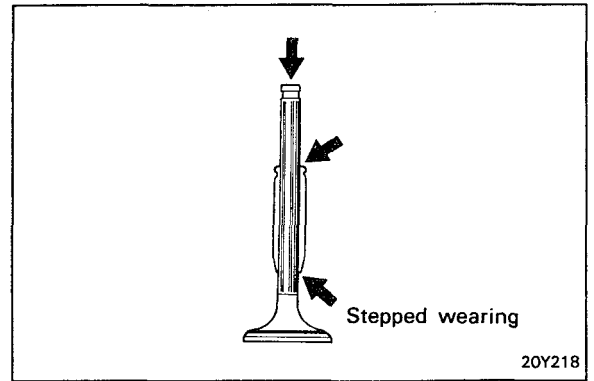
Intake	0.10 mm (0.0039 in.)
Exhaust	0.15 mm (0.0059 in.)



20Y084

Valve

1. Replace the valve stem if it is worn (stepped, worn or damaged). Also replace it if the stem end (the surface contacting the auto-lash adjuster) is recessed.
2. Check the valve face contact area, and recondition or replace as necessary.



3. Replace the valve if the width of the margin (thickness of the valve head) is less than the minimum specified.

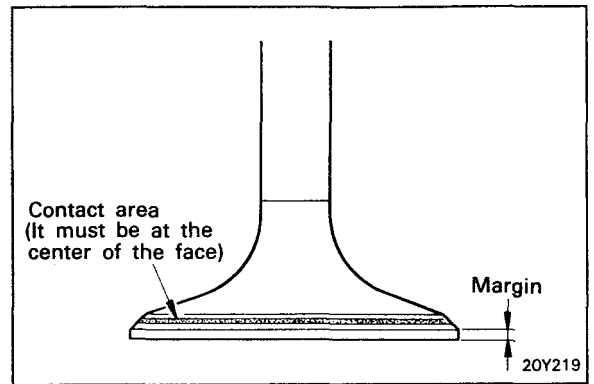
Valve margin

Standard value

- Intake side..... 1.2 mm (0.047 in.)
- Exhaust side..... 2.0 mm (0.079 in.)

Service limit

- Intake side..... 0.7 mm (0.028 in.)
- Exhaust side..... 1.5 mm (0.059 in.)



Valve Springs

1. Check free height of each valve spring and replace if necessary.
2. Using a square, test squareness of each valve spring. If spring is excessively out of square, replace it.

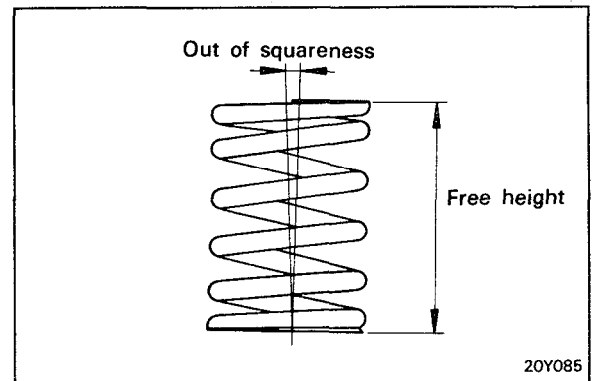
Valve spring

Standard value

- Free height..... 50.5 mm (1.988 in.)
- Load..... 32.9 kg/40.4 mm (74 lb/1.591 in.)
- Out of squareness..... Max. 2°

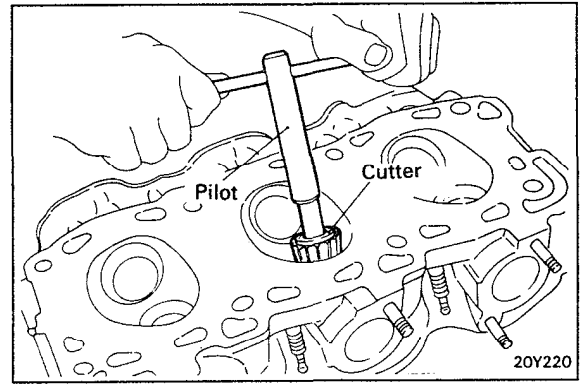
Service limit

- Free height..... 49.5 mm (1.949 in.)
- Load..... 32.9 kg/41.4 mm (74 lb/1.630 in.)
- Out of squareness..... Max. 4°

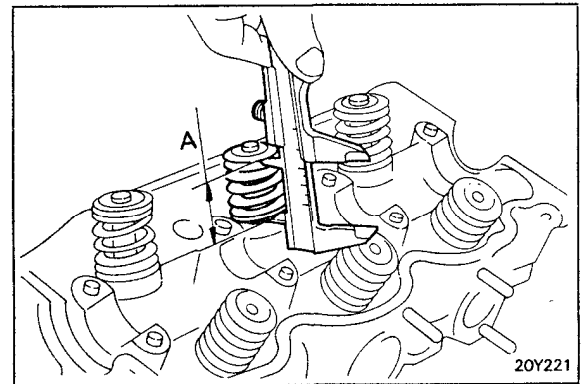


Valve Seat Reconditioning

1. Before reconditioning, check the valve guide for wear. Replace if necessary, worn guide, and then recondition the the valve seat.
2. To recondition the valve seat, use the Valve Seat Cutter and Pilot.
3. After reconditioning, the valve and valve seat should be lapped lightly with a lapping compound.



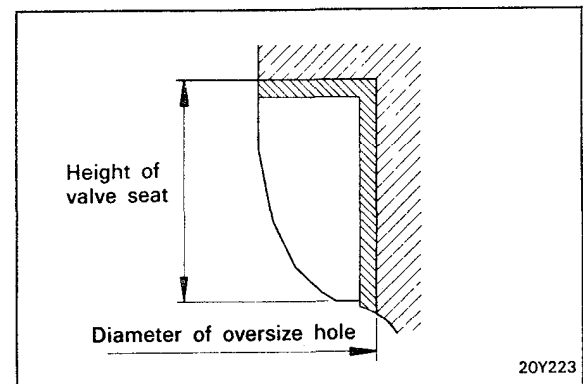
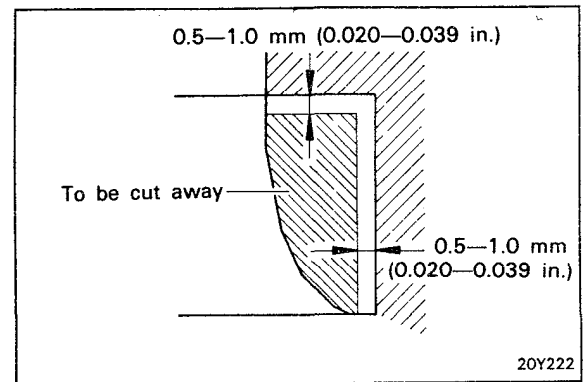
4. Check valve seat insert sinkage. If the sinkage exceeds the service limit, replace the insert with an oversize insert.
5. Measure the installed height of the spring between the spring seat and the retainer with the valve spring seat, spring retainer and retainer lock installed. The amount of sinkage can be judged from the measured value.



Installed height of spring A (For intake, exhaust)	
Standard value.....	40.4 mm (1.591 in.)
Service limit	41.4 mm (1.630 in.)

Valve Seat Insert Replacement

1. Cut away the inner face of the valve seat to reduce the wall thickness, and remove.
2. Adjust the press fit diameter of the valve seat on the cylinder head side so that it matches the diameter of the oversize valve seat.



CYLINDER HEADS, VALVES AND VALVE SPRINGS

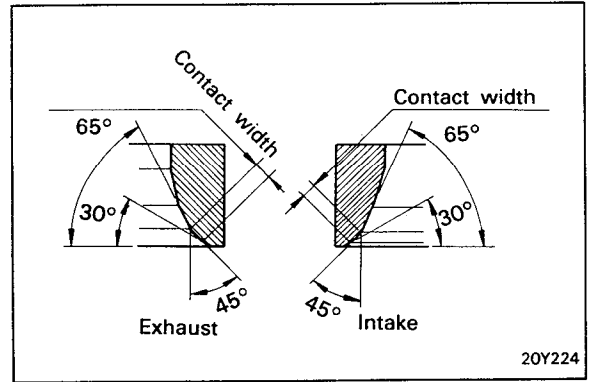
Valve Seat Insert Oversizes

Description	Size mm (in.)	Size mark	Seat insert height H mm (in.)	Cylinder head I.D. mm (in.)
Intake valve seat insert	0.3 (0.012) O.S.	30	7.9-8.1 (0.311-0.319)	44.300-44.325 (1.7440-1.7451)
	0.6 (0.024) O.S.	60	8.2-8.4 (0.323-0.331)	44.600-44.625 (1.7559-1.7569)
Exhaust valve seat insert	0.3 (0.012) O.S.	30	7.9-8.1 (0.311-0.319)	38.300-38.325 (1.5079-1.5089)
	0.6 (0.024) O.S.	60	8.2-8.4 (0.323-0.331)	38.600-38.625 (1.5197-1.5207)

- Heat the cylinder head to about 250°C (480°F) and press in an oversize seat insert fit to the insert bore in the cylinder head at normal temperature.
- Treat the valve seat in the way shown in the illustration.
- Use the lapping compound, and lap the valve.

Valve seat contact width

Intake..... 0.9-1.3 mm (0.035-0.051 in.)
 Exhaust..... 0.9-1.3 mm (0.035-0.051 in.)

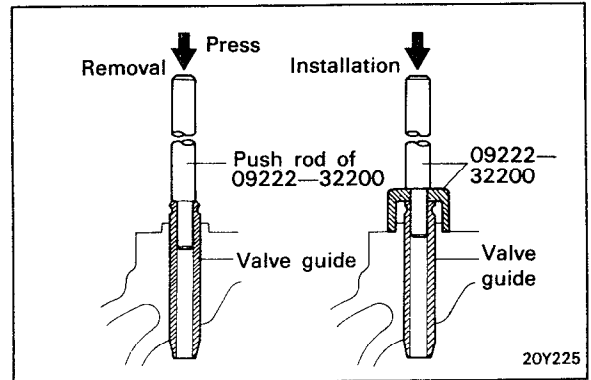


Valve Guide Replacement

- Using the Special tool (09222-32200), press out the old valve guide toward the bottom of cylinder head.
- Recondition the valve guide hole so that it matches the newly press-fit oversize valve guide.

Valve Guide Insert Oversizes

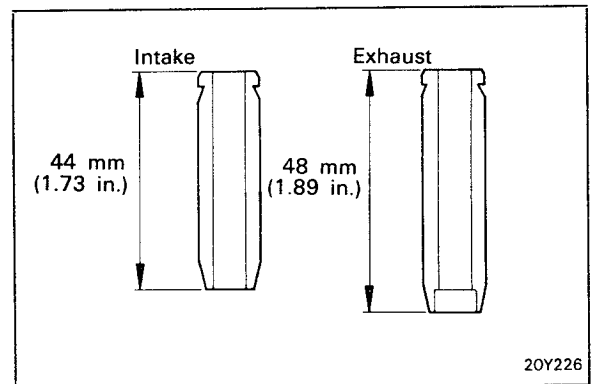
Size mm (in.)	Size mark	Cylinder head hole size mm (in.)
0.05 (0.002) O.S.	5	13.050—13.068 (0.5138—0.5145)
0.25 (0.010) O.S.	25	13.250—13.268 (0.5217—0.5224)
0.50 (0.020) O.S.	50	13.500—13.518 (0.5315—0.5322)



- Using the special tool (09222-32200), press-fit the valve guide. The valve guide must be press-fit from the upper side of the cylinder head. Keep in mind that the valve guides are different in length.
- After the valve guide is press-fit, insert a new valve and check for proper clearance.
- After the valve guide has been replaced, check for proper valve face to valve seat contact.

NOTE

Do not re-install a valve guide of the same size.

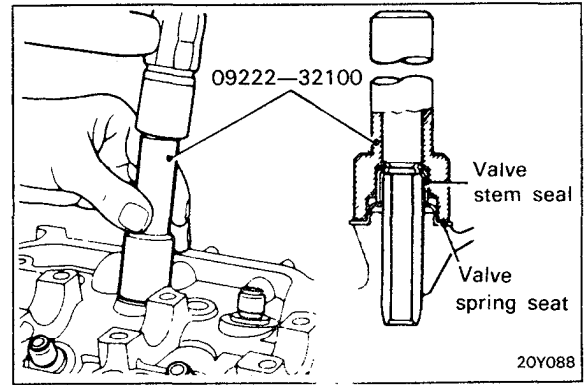


INSTALLATION

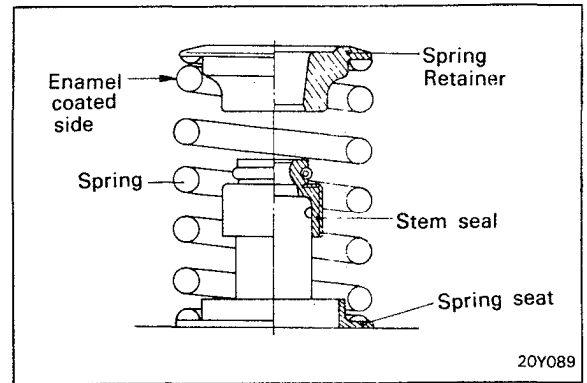
1. Install the spring seats.
2. Using the special tool (09222-32100), lightly tap the seal into place. The seal is installed in the specified position, using the special tool.

NOTE

- o Do not reuse old valve stem seals.
- o Incorrect installation of the seal could result in oil leakage down the valve guides.



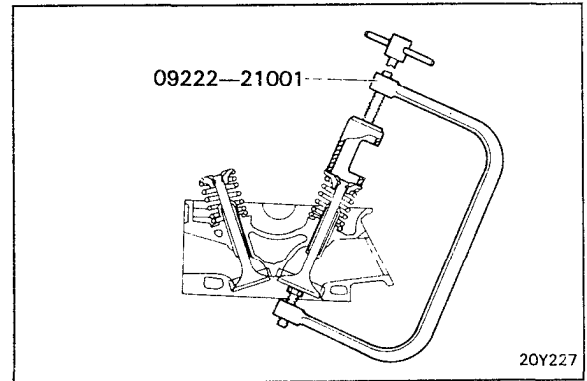
3. Apply engine oil to each valve. Insert valves into guides. Avoid forcing the valve into the seal. After installing the valve, check that it moves smoothly.
4. Valve springs should be installed with the enamel coated side toward the valve spring retainer.



5. Using the special tool (09222-21001), compress the spring and install the retainer locks. After installation of the valves, make certain that the retainer locks are correctly in place before releasing the valve spring compressor.

NOTE

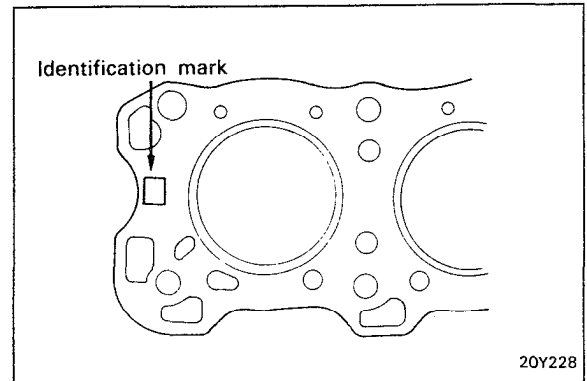
When the spring is compressed, check that the valve stem seal is not pressed against the bottom of retainer.



6. Clean both gasket surfaces of the cylinder head and cylinder block.
7. Verify the identification marks on the cylinder head gasket.
8. Position the gasket surface with the identification mark towards the cylinder head.

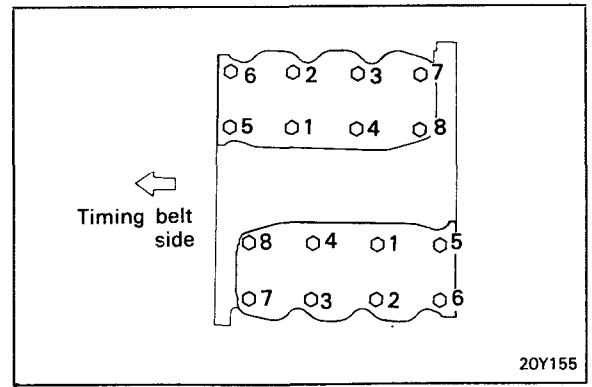
NOTE

Do not apply sealant to these surfaces.



CYLINDER HEADS, VALVES AND VALVE SPRINGS

9. Torque the cylinder head bolts in the sequence shown in the illustration with the special tool (09221-32001) and a torque wrench.

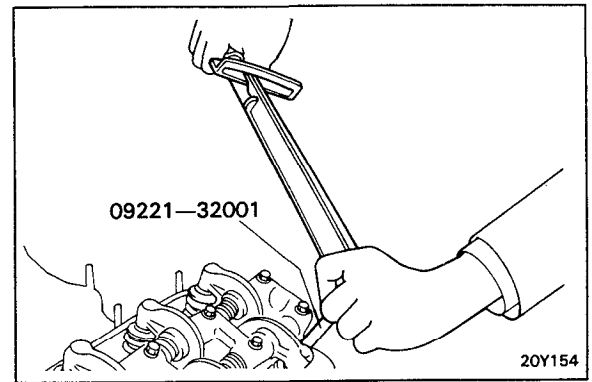


10. When torquing the cylinder head bolts, repeat the sequence 2 or 3 times, each time increasing the torque until the specified torque is reached.

Tightening torque

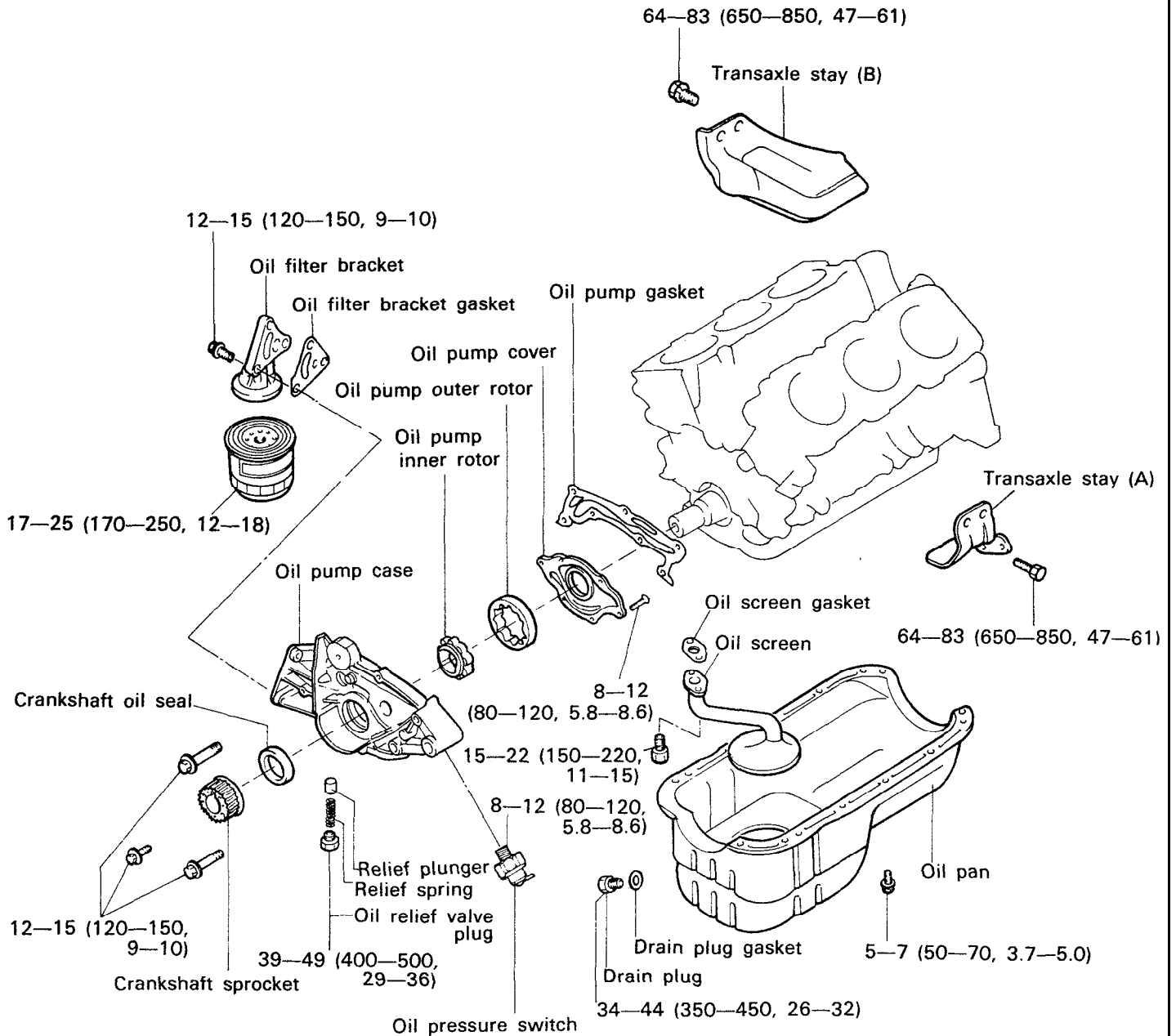
Cylinder head bolts

Cold [Engine coolant temperature approximately 20°C (68°F)]	88-98 Nm (900-1,000 kg.cm, 65-72 lb.ft)
Hot [Engine coolant temperature approximately 80°C (176°F)]	98-108 Nm (1,000-1,100 kg.cm, 72-80 lb.ft)



OIL PUMP AND OIL PAN

COMPONENTS



TORQUE : Nm (kg.cm, lb.ft)

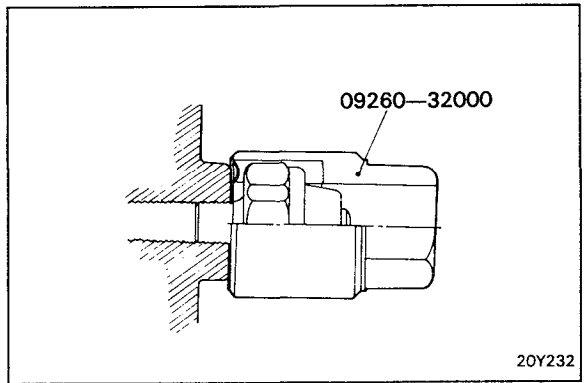
REMOVAL

1. Remove the oil pressure switch, using the special tool (09260-32000).

NOTE

Since a sealant is used on the threaded area, be careful not to damage the oil pressure switch.

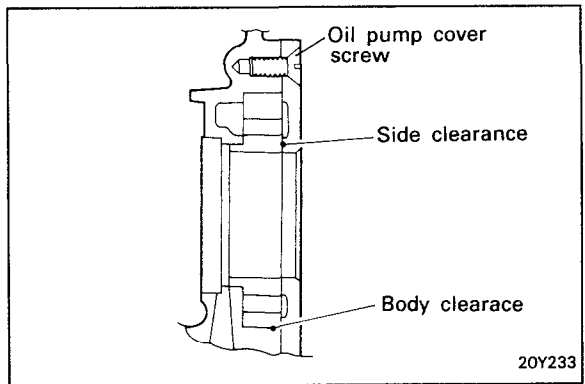
2. Remove the oil filter and the oil pan.
3. Remove the oil screen and gasket.
4. Remove the three bracket securing bolts and remove the oil filter bracket and gasket.
5. Remove the oil relief valve plug from the oil pump case.
6. Remove the oil pump case.



INSPECTION

Oil Pump

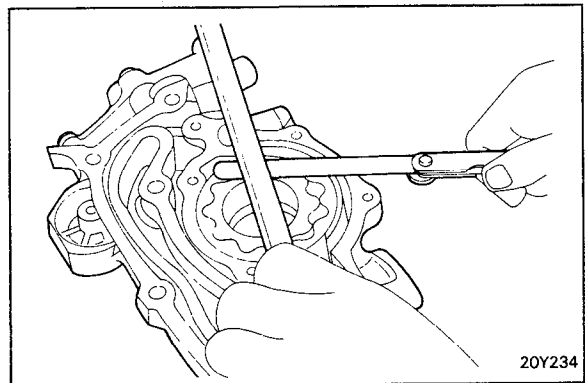
1. Visually check the parts of the oil pump case for cracks and damage.
2. Assemble the rotor on the oil pump and then check the clearance with a thickness gauge.



Oil pump side clearance

Standard value

Body clearance.....	0.100-0.181 mm (0.0039-0.0071 in.)
Side clearance	0.040-0.095 mm (0.0016-0.0037 in.)



Relief Plunger and Spring

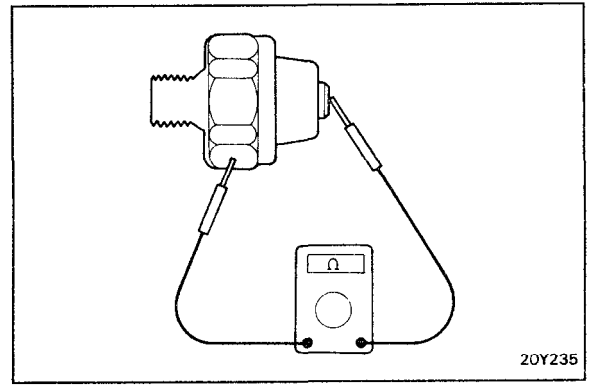
1. Check the relief plunger for smooth operation.
2. Check the relief spring for a deformed or broken condition.

Oil Filter Bracket

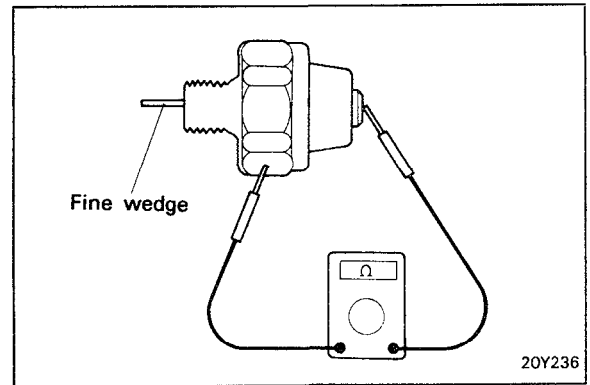
1. Make sure that there is no damage on the oil filter installation surface.
2. Check the oil filter bracket for oil leaks or cracks.

Oil Pressure Switch

1. Check the continuity between the terminal and the body with an ohmmeter.
If there is continuity, replace the oil pressure switch.



2. Check the continuity between the terminal and the body when the fine wedge is pushed. If there is continuity even when the fine wedge is pushed, replace it.
3. Or, if there is no continuity when a 50 kPa (70 psi) vacuum is applied through the oil hole, the switch is operating properly. Check that air doesn't leak. If air leaks, the diaphragm is broken, and replace it.

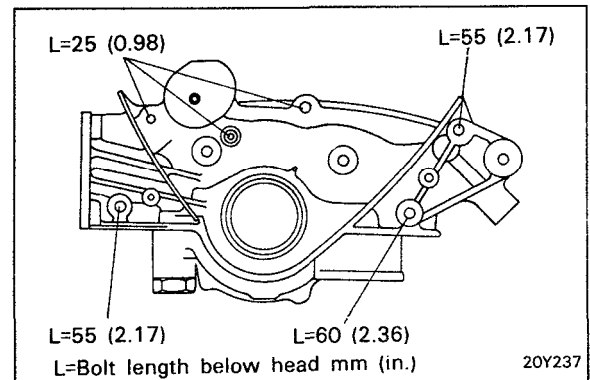


INSTALLATION

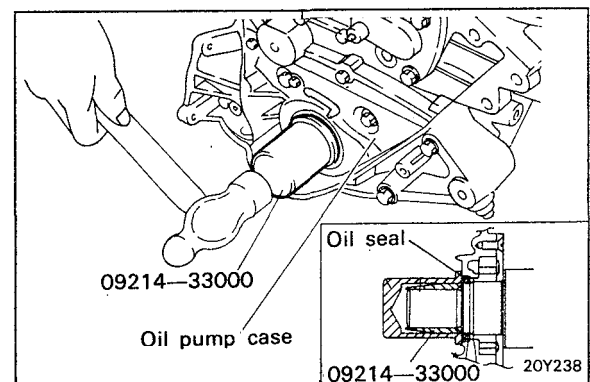
1. Install the oil pump case with the gasket.

Tightening torque

Oil pump case bolt.....	12-15 Nm (120-150 kg.cm, 9-10 lb.ft)
Oil pump cover screw.....	8-12 Nm (80-120 kg.cm, 5.8-8.6 lb.ft)



2. Install the oil seal into the oil pump case as far as possible, using special tool (09214-33000).



OIL PUMP AND OIL PAN

3. Install the relief plunger and spring, and tighten the oil relief valve plug to the specified torque.

Tightening torque

Oil relief valve plug
 39-49 Nm (400-500 kg.cm, 29-36 lb.ft)

4. Install the oil screen and a new gasket.

Tightening torque

Oil screen bolt
 15-22 Nm (150-220 kg.cm, 11-15 lb.ft)

5. Clean the gasket surfaces of the cylinder block and the oil pan.

6. Apply sealant into the groove of the oil pan flange.

NOTE

1. Make the first cut from the end of the nozzle furnished with the sealant approx. 4 mm. After application of the sealant, do not exceed 15 minutes before installing the oil pan.
2. Do not allow the sealant into the range A shown in the illustration on the oil pan flange.

7. Install the oil pan and tighten the bolts to the specified torque.

Tightening torque

Oil pan bolt.....
 5-7 Nm (50-70 kg.cm, 3.7-5.0 lb.ft)

8. Install oil filter bracket with a new gasket.

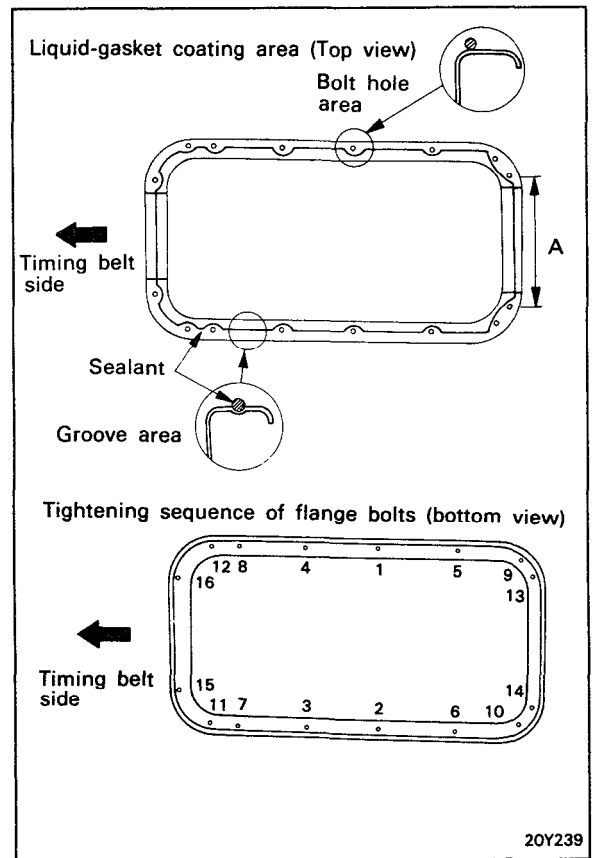
Tightening torque

Oil filter bracket bolt
 12-15 Nm (120-150 kg.cm, 9-10 lb.ft)

9. Clean the mounting surface on the oil filter bracket side. Apply a thin coat of engine oil to the oil filter O-ring. Tighten the oil filter.

Tightening torque

Oil filter
 17-25 Nm (170-250 kg.cm, 12-18 lb.ft)



OIL PUMP AND OIL PAN

10. Using the special tool (09260-32000), install the oil pressure switch after applying sealant to the threaded area.

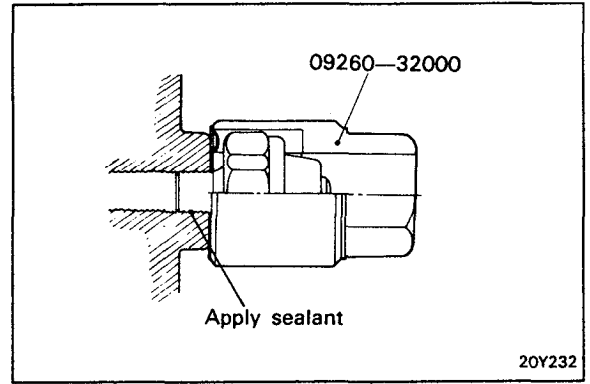
Sealant Threebond 1104 or equivalent

NOTE

Do not over torque the oil pressure switch.

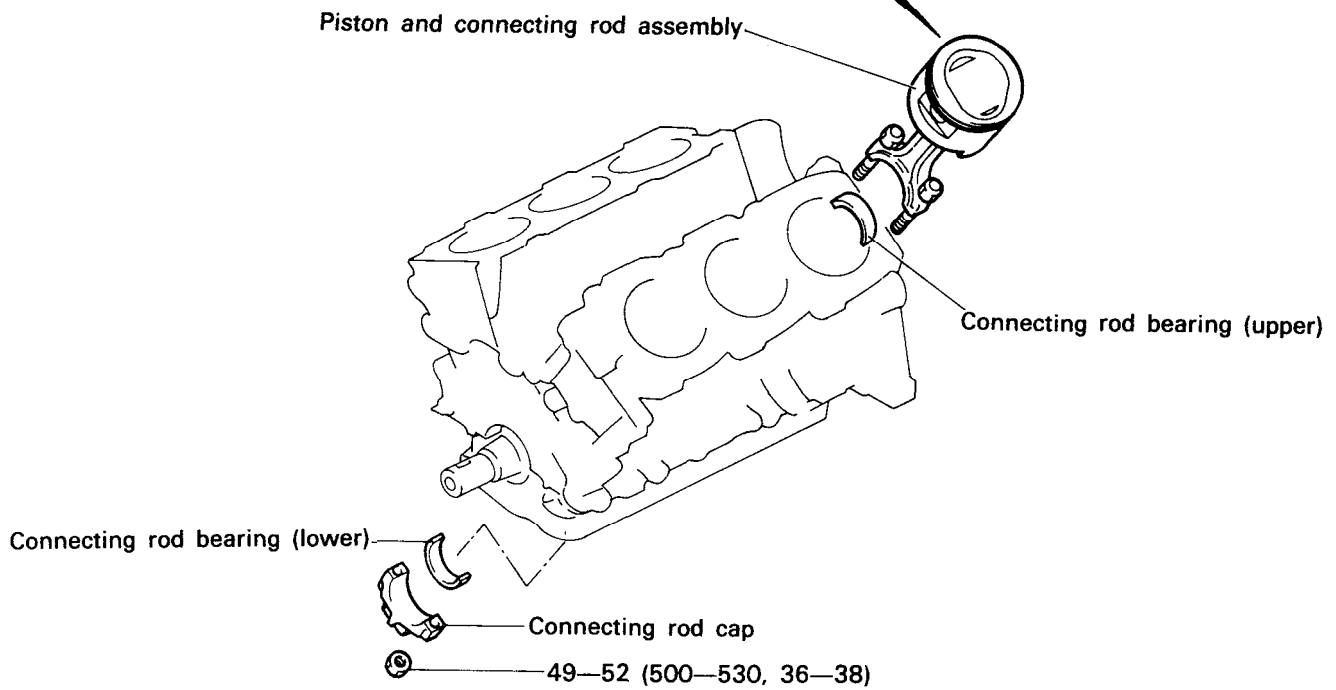
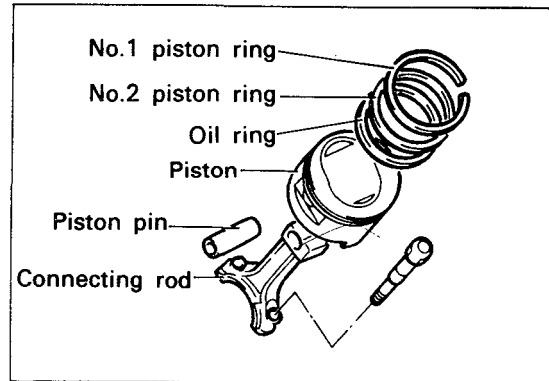
Tightening torque

Oil pressure switch
8-12 Nm (80-120 kg.cm, 5.8-8.6 lb.ft)



PISTONS AND CONNECTING RODS

COMPONENTS



TORQUE : Nm (kg.cm, lb.ft)

PISTONS AND CONNECTING RODS

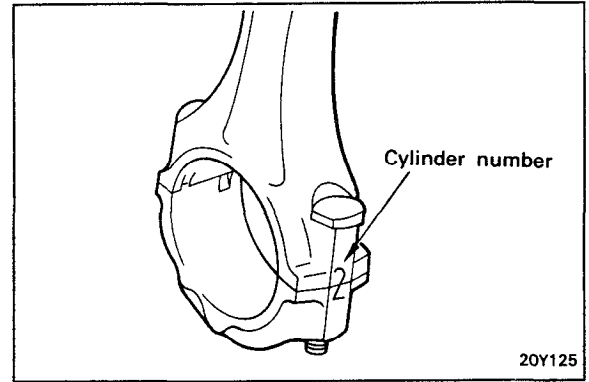
REMOVAL

Connecting Rod Cap

CAUTION

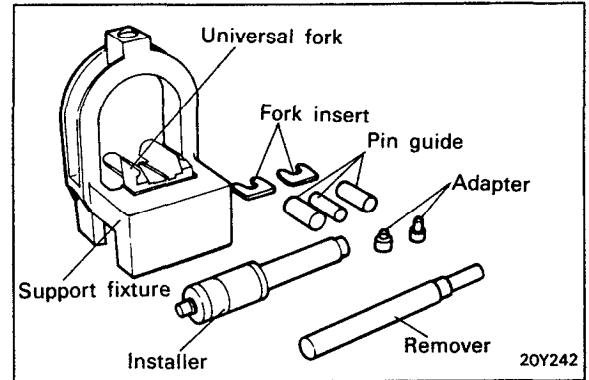
Keep the bearings in order with their corresponding connecting rods (according to cylinder numbers) for proper reassembly.

1. Remove the connecting rod cap nuts and then remove the caps and the big end lower bearing.
2. Push each piston-connecting rod assembly toward the top of the cylinder.



Piston Pin Removal and installation Procedures

1. Use the special tools (09234-33001), to disassemble and re-assemble the piston and connecting rod.
2. Place the proper insert in the fork of the tool. Position the insert between the connecting rod and the piston.

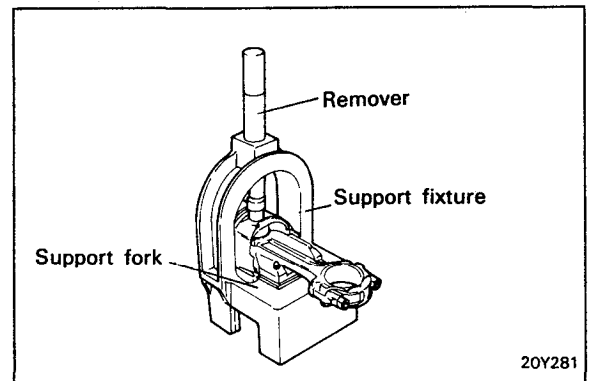


3. Insert the proper removal tool through the hole in the arch of the tool.

CAUTION

Center the piston, rod and pin assembly with the removal arbor.

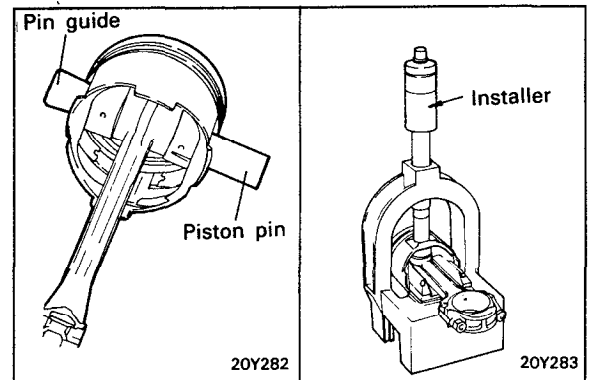
4. Press the piston pin out of the connecting rod.



5. Install proper pin guide (refer to application chart) through piston and into connecting rod. Hand tap pin guide into piston for proper retention. Drop piston pin into the other side of the piston.

CAUTION

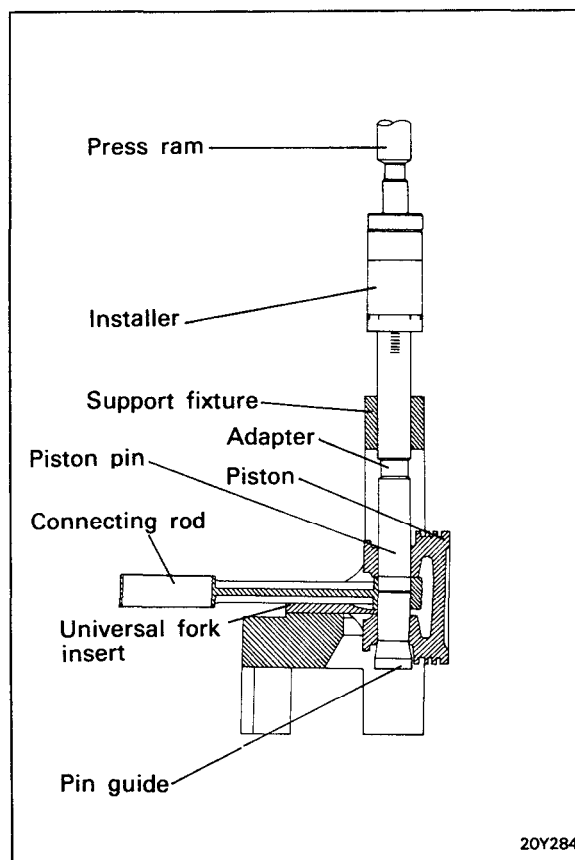
The pin guide centers the connecting rod in the piston. When the piston, connecting rod, piston pin and pin guide assembly are positioned on the fork of the tool, the pin guide will also center this assembly in the tool. If a pin guide that is too small is used, the piston assembly will not be located centrally in the tool, and damage may occur to the fork and/or the insert of the tool.



6. Install piston assembly onto fork assembly of tool. Tool will support connecting rod at the piston pin. Be sure piston assembly is slid onto the fork until the pin guide contacts the fork insert.
7. Adjust the installing arbor to the proper length by turning the numbered sleeve on the lettered shaft until the specified alphanumeric setting from the application chart is obtained. Turn knurled nut to lock numbered sleeve on shaft.
8. Insert the installing arbor through the hole in the arch of the tool. Press piston pin into the connecting rod until the sleeve on the installing arbor contacts the top of the tool arch. The pin guide will fall out of the connecting rod as the piston pin is pressed in.

CAUTION

Do not exceed 5000 pounds of force when stopping the installing arbor sleeve against the arch.



INSPECTION

Piston and Piston Pins

1. Check each piston for scuffing, scoring, wear and other defects. Replace any piston that is defective.
2. Check each piston ring for breakage, damage and abnormal wear. Replace the defective rings. When the piston requires replacement, its rings should also be replaced.
3. Check the piston pin fit in the piston pin hole. Replace any piston and pin assembly that is defective.
The piston pin must be smoothly pressed by hand into the pin hole at room temperature.

Piston Rings

1. Measure the piston ring side clearance. If the measured value exceeds the service limit, insert a new ring in a ring groove to measure the side clearance. If the clearance still exceeds the service limit, replace the piston and rings together. If it is less than the service limit, replace the piston rings only.

Piston ring side clearance

No.1 0.03-0.09 mm (0.0012-0.0035 in.)

No.2 0.02-0.06 mm (0.0008-0.0024 in.)

[Limit]

No.1 0.1 mm (0.004 in.)

No.2 0.1 mm (0.004 in.)

PISTONS AND CONNECTING RODS

- To measure the piston ring end gap, insert a piston ring into the cylinder bore. Position the ring at right angles to the cylinder wall by gently pressing it down with a piston. Measure the gap with a feeler gauge. If the gap exceeds the service limit, replace the piston ring.

Piston ring end gap

[Standard dimension]

No.1 0.30-0.45 mm (0.0118-0.0177 in.)

No.2 0.25-0.40 mm (0.0098-0.0157 in.)

Oil ring side rail 0.30-0.90 mm (0.0118-0.0354 in.)

[Limit]

No.1, No.2 0.8 mm (0.031 in.)

Oil ring side rail 1.0 mm (0.039 in.)

When replacing the ring without correcting the cylinder bore, check the gap with the ring positioned at the lower part of cylinder that is less worn.

When replacing a ring, be sure to use a ring of the same size.

Piston ring service size and mark

STD	None
0.25 mm (0.010 in.) O.S.	25
0.50 mm (0.020 in.) O.S.	50
0.75 mm (0.030 in.) O.S.	75
1.00 mm (0.039 in.) O.S.	100

NOTE

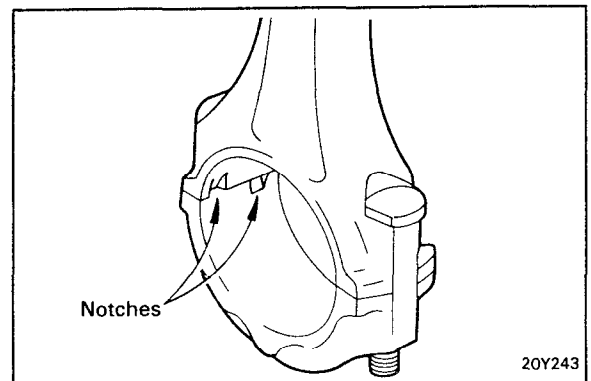
The mark can be found on the upper side of the ring next to the end.

Connecting Rods

- When the connecting rod cap is installed, make sure that cylinder numbers put on the rod end cap at disassembly match.

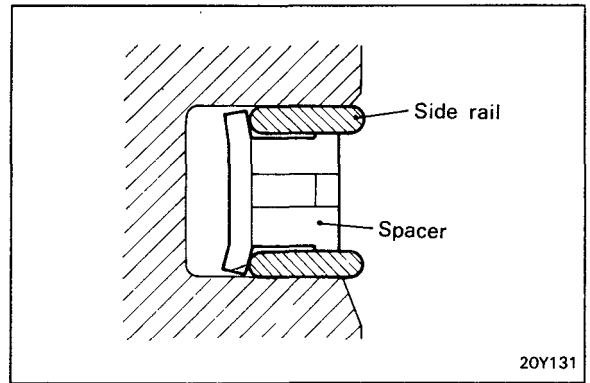
When a new connecting rod is installed, make sure that the notches for holding the bearing in place are on the same side.

- Replace the connecting rod if it is damaged on the thrust faces at either end, and also if it has a step wear in, or severely rough surface of, the inside diameter of the small end.



INSTALLATION

1. Install the spacer.

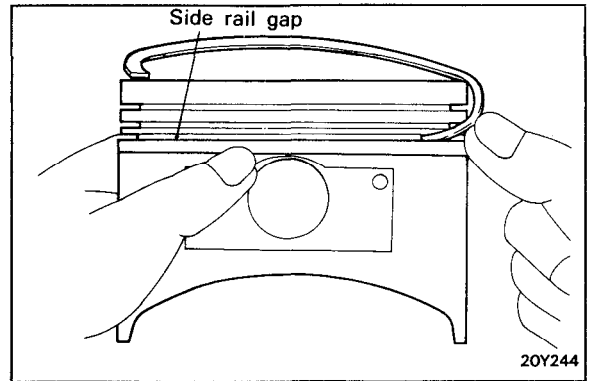


2. Install the upper side rail. To install the side rail, first put one end of the side rail between the piston ring groove and spacer, hold it down firmly, and then press down on the portion which is to be inserted into the groove with a finger as illustrated.

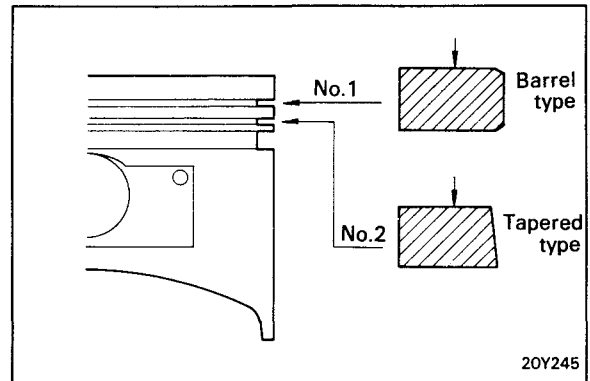
CAUTION

Do not use a piston ring expander when installing side rail.

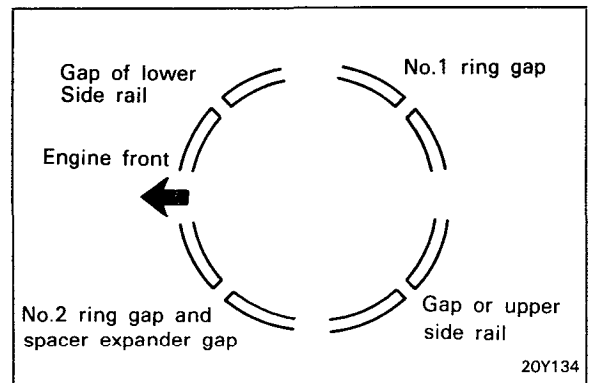
3. Install the lower side rail by same procedure as Step 2.



4. Apply engine oil around the piston and piston rings.
 5. Using a piston ring expander, install the No.2 piston ring.
 6. Install the No.1 piston ring.



7. Position each piston ring end gap as far apart from neighboring gaps as possible. Make sure that the gaps are not positioned in the thrust and pin directions.
 8. Hold piston rings firmly in a piston ring compressor as they are inserted into cylinder.

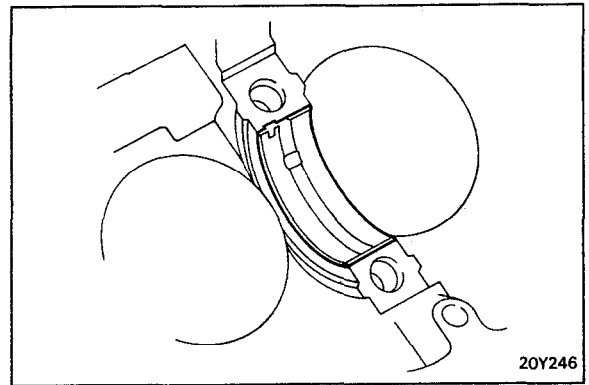


PISTONS AND CONNECTING RODS

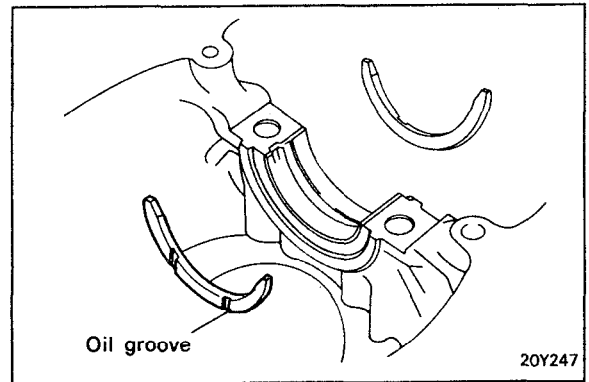
9. Install the upper main bearings in the cylinder block.
10. Install the lower main bearings in the main bearing caps.

CAUTION

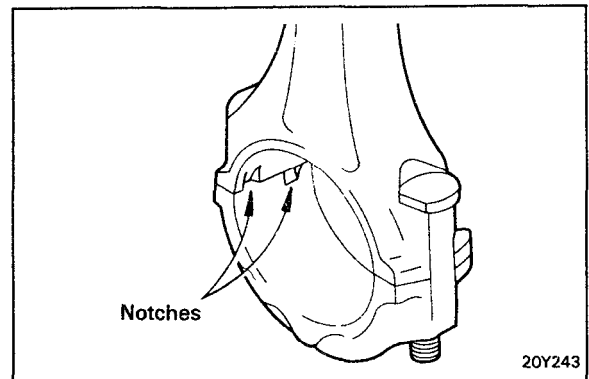
Install the bearing with the oil hole in the block.



11. Install the thrust washers in the No.3 main bearing cap with the oil grooves facing outward.



12. Make sure that the front mark of the piston and the front mark (identification mark) of the connecting rod are directed toward the front of the engine.
13. When the connecting rod cap is installed, make sure that the cylinder numbers put on the rod and cap at disassembly match.
14. When a new connecting rod is installed, make sure that the notches for holding the bearing in place are on the same side.



15. Tighten the connecting rod cap nuts.

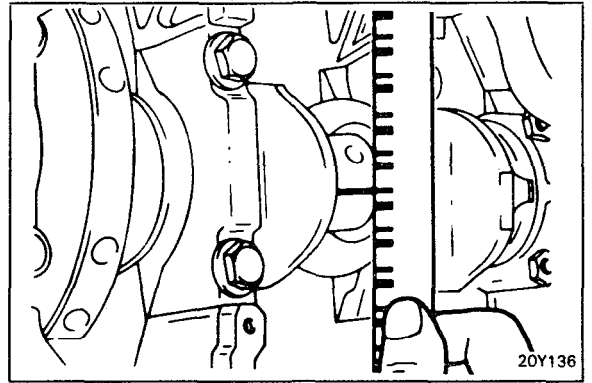
Tightening torque

Connecting rod cap nuts.....
49-52 Nm (500-530 kg.cm, 36-38 lb.ft)

PISTONS AND CONNECTING RODS

16. Check the bearing clearance as follows:

- 1) Remove oil and dirt from the bearings and journals.
- 2) Cut plastigauge to the same length as the width of the bearing and place it in parallel with the journal, avoiding the oil holes.
- 3) Install the bearing and cap. Tighten to the specified torque. During this operation, do NOT turn the crankshaft.
- 4) Remove the cap, measure the width of the plastigauge at the widest part by using the scale printed on the plastigauge package.



Connecting rod cap

Bearing clearance

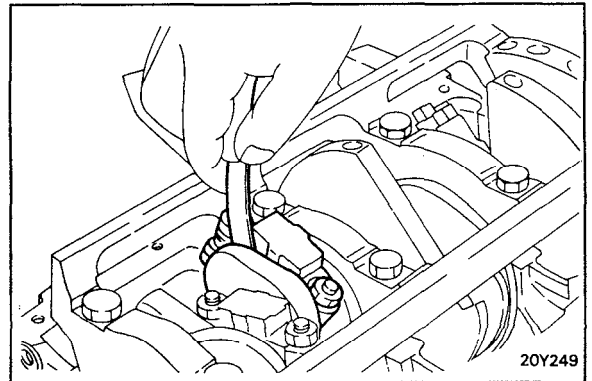
Standard 0.016-0.046 mm (0.0006-0.0018 in.)

Limit 0.1 mm (0.0039 in.)

17. Check the connecting rod side clearance.

Side clearance 0.10-0.25 mm (0.0039-0.0098 in.)

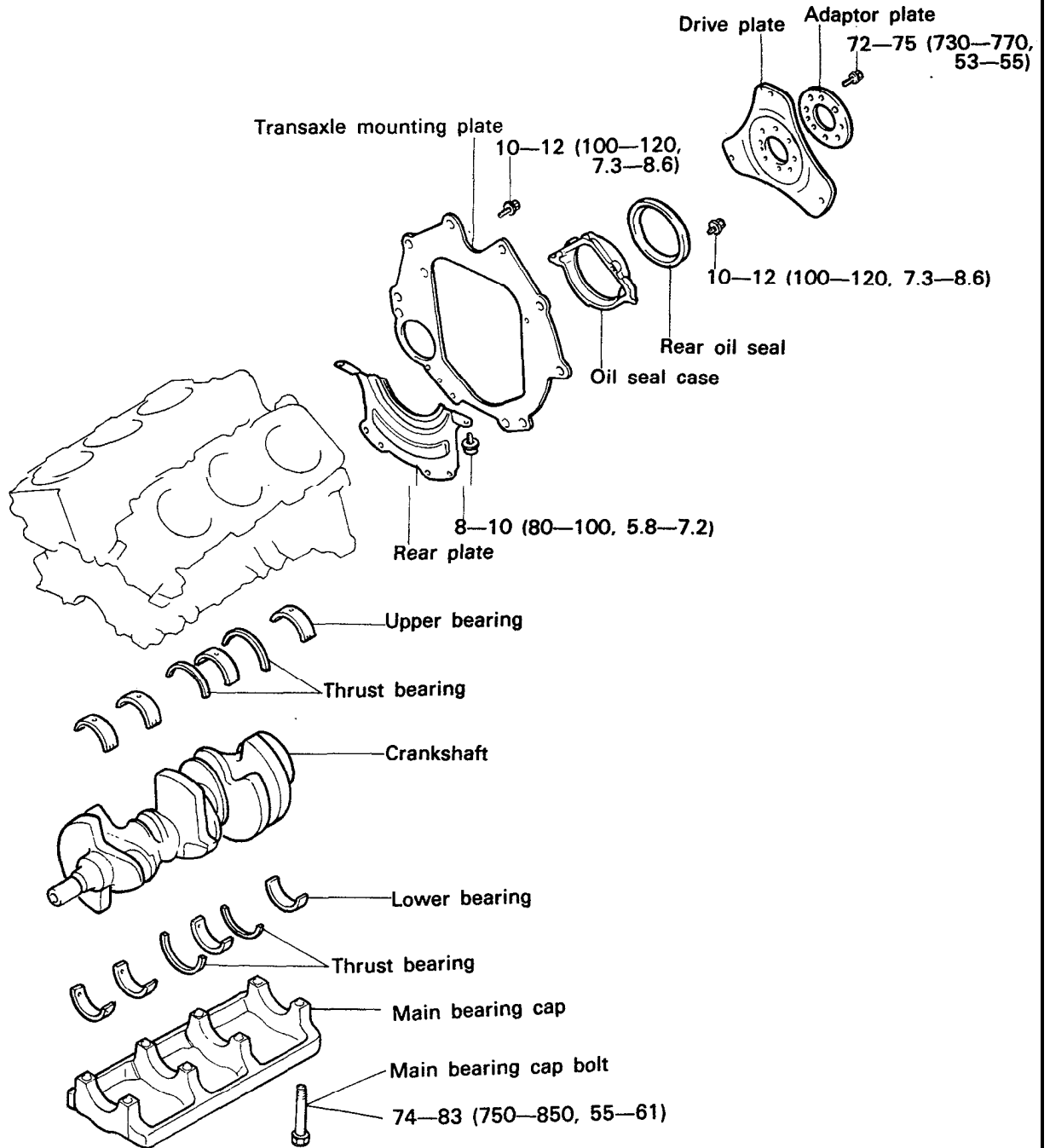
Limit 0.4 mm (0.016 in.)



CRANKSHAFT

CRANKSHAFT

COMPONENTS



TORQUE : Nm (kg.cm, lb.ft)

REMOVAL

1. Remove the timing belt, cylinder head assembly, drive plate, transaxle mounting plate oil pan. For details, refer to their respective chapters.
2. Remove the oil seal case and the rear oil seal.
3. Remove the connecting rod caps.

NOTE

Mark the main bearing caps to permit reassembly in the original position and direction.

4. Remove the main bearing caps and remove the crankshaft. Keep the bearings in order by cap number.

INSPECTION

Crankshaft

1. Check the crankshaft journals and pins for damage, uneven wear and cracks. Also check the oil holes for restrictions. Repair or replace any defective part.
2. Inspect for out-of-roundness and taper of the crankshaft journal and pin.

Standard value

Crankshaft journal O.D.	59.980-60.000 mm (2.3614-2.3622 in.)
Crankshaft pin O.D.	49.980-50.000 mm (1.9677-1.9685 in.)

Main Bearings and Connecting Rod Bearings

Visually inspect each bearing for peeling, melt, seizure and improper contact. Replace any defective bearings.

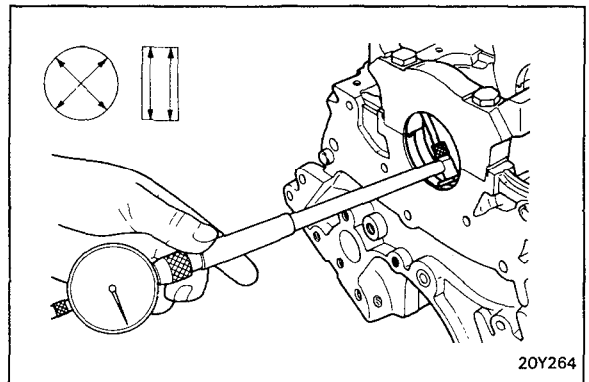
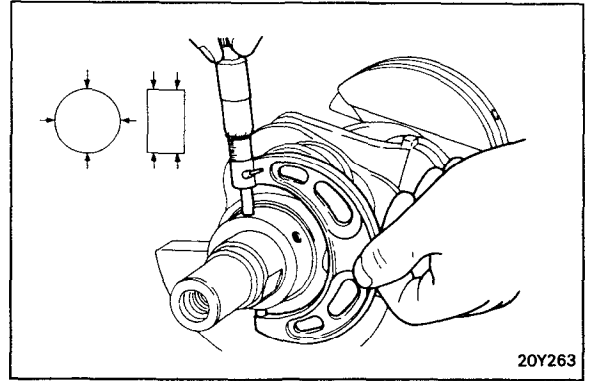
Oil Clearance Measurement

To check for oil clearance by measuring the outside diameter of the crankshaft journal and the inside diameter of the bearing. The clearance can be obtained by calculating the difference between the measured outside and inside diameters.

Standard value

Oil clearance

Crankshaft main bearing	0.02-0.048 mm (0.0008-0.0019 in.)
Connecting rod bearing.....	0.016-0.046 mm (0.0006-0.0018 in.)



CRANKSHAFT

Plastigauge Method

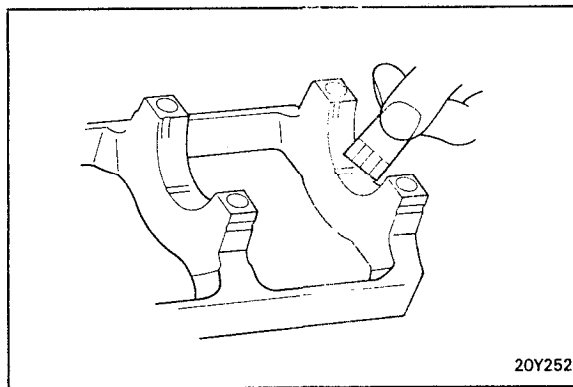
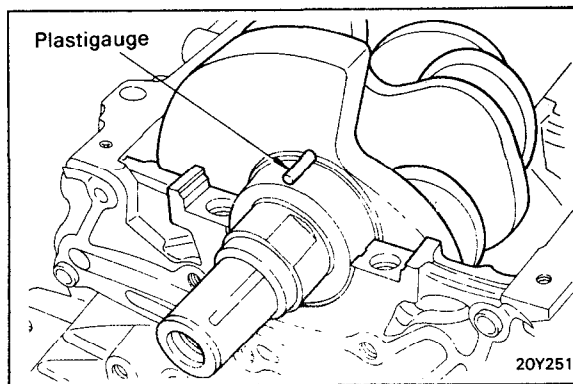
Plastigauge may be used to measure the clearance.

1. Remove oil and grease and any other dirt from the bearings and journals.
2. Cut the plastigauge to the same length as the width of the bearing and place it in parallel with the journal, avoiding the oil holes.
3. Install the crankshaft, bearings and caps and tighten them to the specified torques. During this operation, do not turn the crankshaft. Remove the caps. Measure the width of the plastigauge at the widest part by using the scale printed on the gauge package.

If the clearance exceeds the repair limit, the bearing should be replaced or an undersize bearing should be used.

When installing a new crankshaft, be sure to use standard size bearings.

Should the standard clearance not be obtained even after bearing replacement, the journal and pin should be ground to undersize and a bearing of the corresponding undersize should be installed.



Oil Seal

Check the front and rear oil seals for damage or worn surfaces. Replace any seal that is defective.

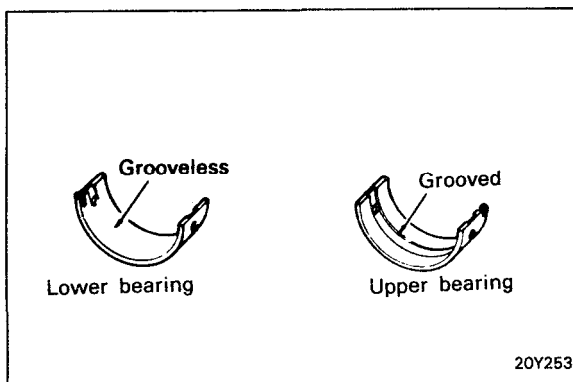
Drive Plate

Replace distorted, damaged, or cracked drive plates.

INSTALLATION

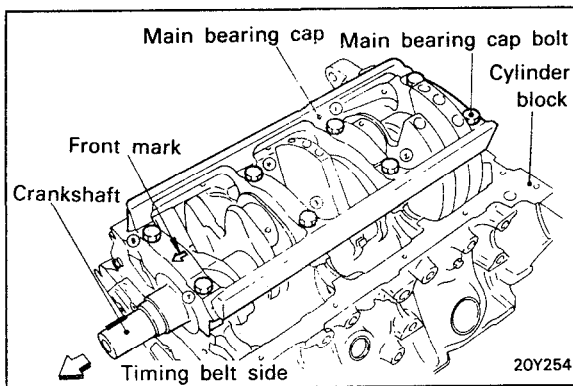
Main Bearing

1. Install the grooved main bearing (upper bearing) on the cylinder block side.
2. Install the grooveless main bearing (lower bearing) on the main bearing cap side.
3. Install the crankshaft. Apply engine oil to the journal and pin.
4. Caps should be installed with the arrow mark directed toward the front of the engine. The cap number sequence must be correct.
5. Tighten cap bolts to the specified torque.



Tightening torque

Main bearing cap bolts
74-83 Nm (750-850 kg.cm, 55-61 lb.ft)

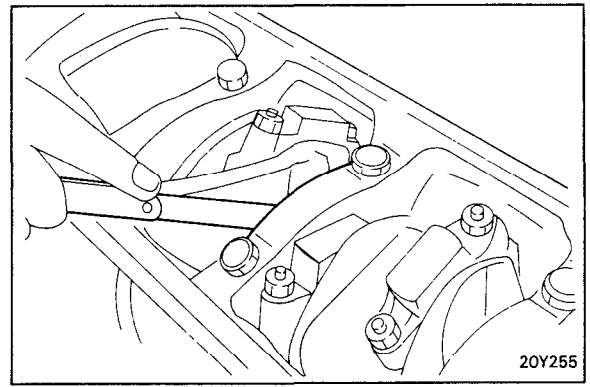


CRANKSHAFT

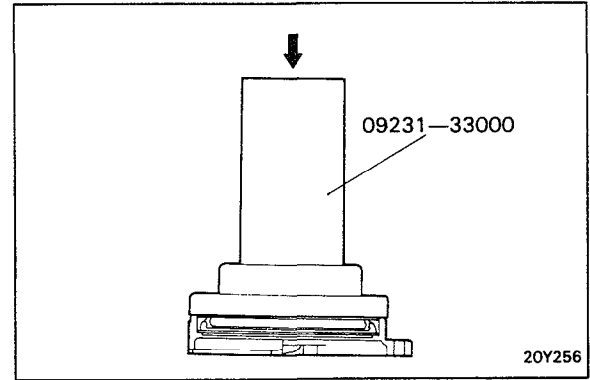
7. Cap bolts should be tightened evenly in 4 to 5 stages before they are tightened to the specified torque.
8. Make certain that the crankshaft turns freely and has the proper end play.

Crankshaft end play

Standard 0.05-0.25 mm (0.0020-0.0098 in.)
 Limit..... 0.3 mm (0.012 in.)



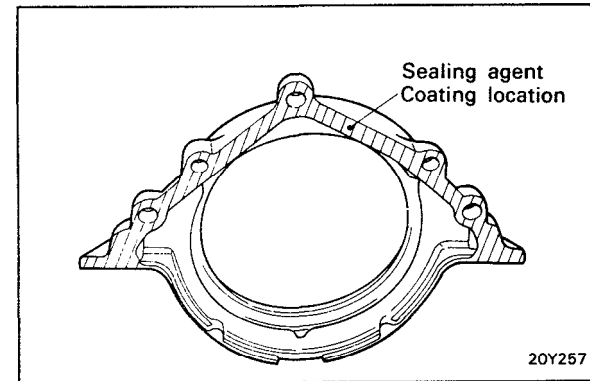
9. Using the special tool (09231-33000), install the rear oil seal in the oil seal case.



10. Apply sealant to the area shown in the illustration. Install the oil seal case on the cylinder block.

Tightening torque

Oil seal case bolt
 101-12 Nm (100-120 kg.cm, 7.3-8.6 lb.ft)



11. Tighten the transaxle mounting plate to the specified torque.

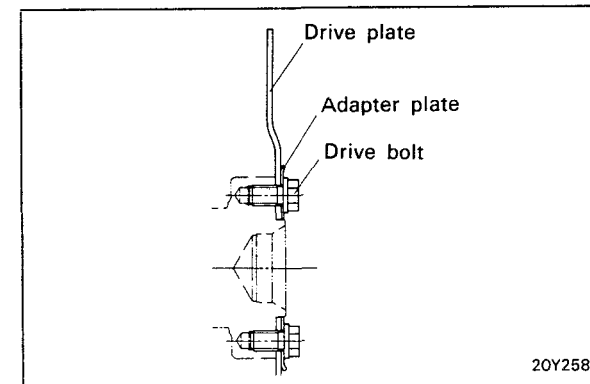
Tightening torque

Transaxle mounting plate bolt.....
 10-12 Nm (100-120 kg.cm, 7.3-8.6 lb.ft)

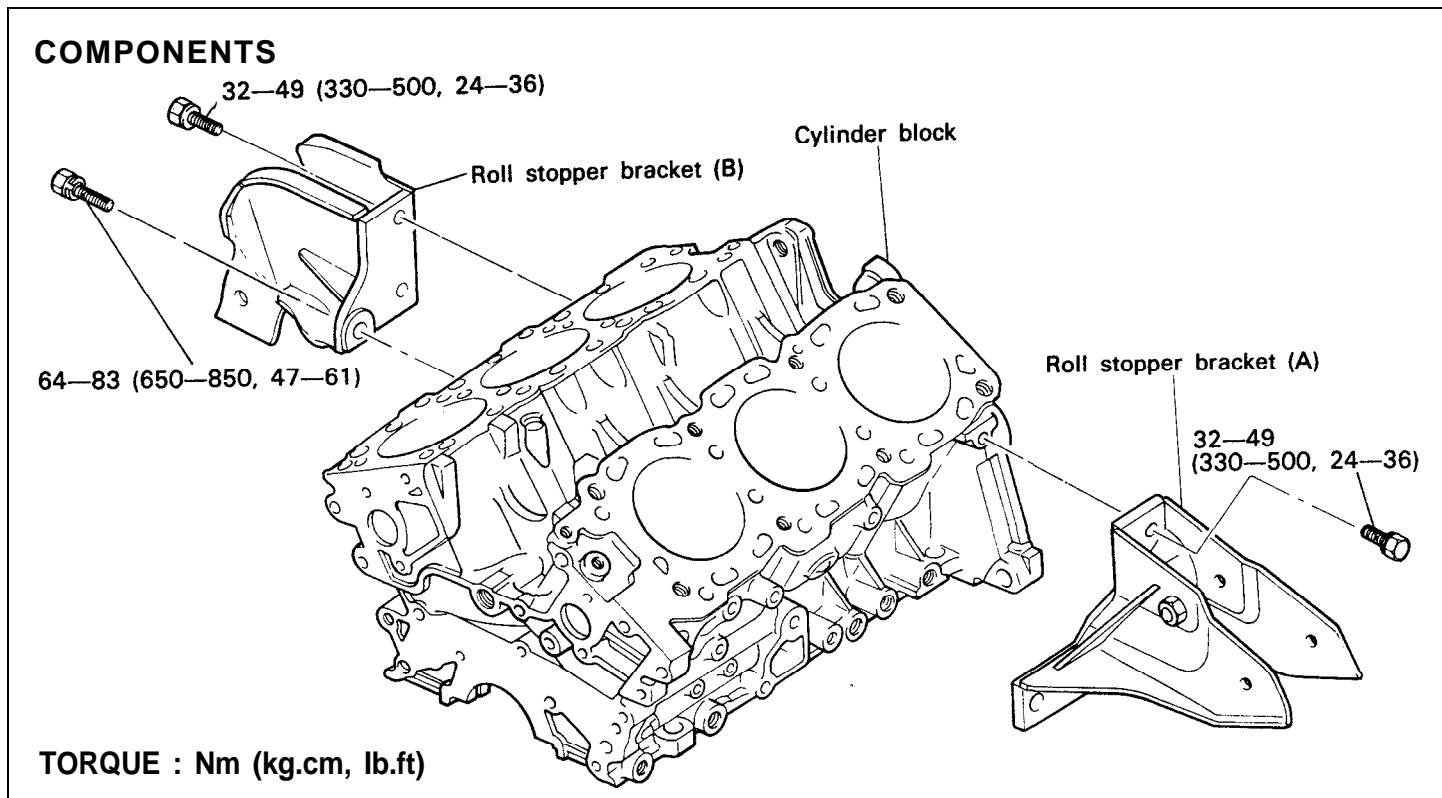
12. Tighten the drive plate and the adapter-plate.

Tightening torque

Drive plate and adaptor plate bolt.....
 72-75 Nm (730-770 kg.cm, 53-55 lb.ft)



CYLINDER BLOCK



REMOVAL

Remove the timing belt, cylinder head assembly, drive plate, transaxle mounting plate, oil pan, and the oil pump case.

For further details, refer to their respective chapters.

INSPECTION

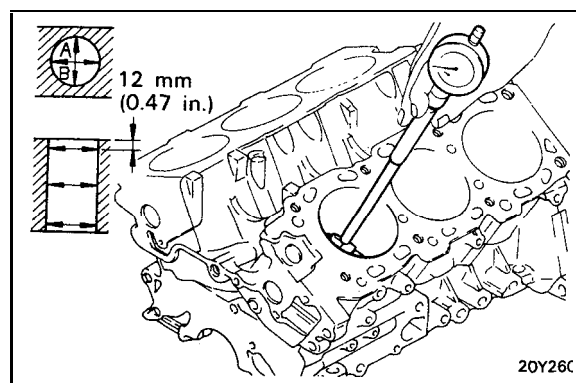
Cylinder Block

1. Visually check the cylinder block for scores, rust and corrosion. Also check for cracks or any other defects. Repair or replace the block if defective.
2. Measure the cylinder bore with a cylinder gauge at the three levels indicated in the directions of A and B.

Level 1 : No.1 piston ring position with piston at TDC

Level 2 : Center of cylinder

Level 3 : Bottom of cylinder



CYLINDER BLOCK

3. If the cylinder bores show more than the specified out-of-round or taper, or if the cylinder walls are badly scuffed or scored, the cylinder block should be rebored and honed. New oversize pistons and rings should be installed.

Standard value	
Cylinder bore.....	91.10-91.14 mm (3.5866-3.5882 in.)
Out-of-roundness and taper of cylinder bore.....	Max. 0.02 mm (0.0008 in.)

4. If a ridge exists at the top of the cylinder, cut it away with a ridge reamer.
5. Oversize pistons are available in four sizes.

Piston service size and mark mm (in.)	
0.25 (0.010) O.S..	0.25
0.50 (0.020) O.S.....	0.50
0.75 (0.030) O.S.	0.75
1.00 (0.039) O.S..	1.00

6. To rebores the cylinder to oversize, keep the specified clearance between the oversize piston and the bore, and make sure that all pistons used are of the same oversize. The standard measurement of the piston outside diameter is taken at a level 12 mm (0.47 in.) above the bottom of the piston skirt and across the thrust faces.

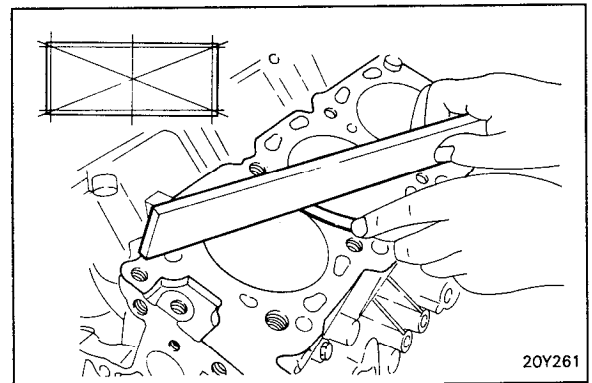
Piston-to-cylinder wall clearance	0.02-0.04 mm (0.0008-0.0016 in.)
---	----------------------------------

7. Check for damage or cracks in the cylinders.

8. Check the top surface of the cylinder block for flatness. If the top surface exceeds limits, grind to the minimum limit or replace.

Standard value	
Flatness of gasket surface	Max. 0.05 mm (0.0020 in.)
Service limit	
Flatness of gasket surface	0.10 mm (0.0039 in.)

CAUTION
When the cylinder head is assembled, grinding less than 0.2 mm (0.008 in.) is permissible.

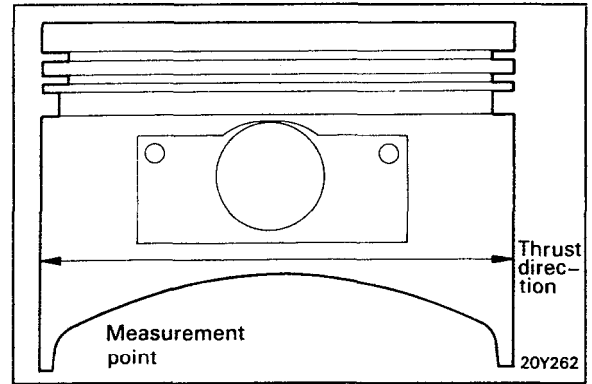


CYLINDER BLOCK

Boring Cylinder

1. Oversize pistons used should be determined on the basis of the largest bore cylinder.

Size	Identification mark
0.25 mm (0.010 in.) O.S.	0.25
0.50 mm (0.020 in.) O.S.	0.50
0.75 mm (0.030 in.) O.S.	0.75
1.00 mm (0.039 in.) O.S.	1.00



NOTE

Size mark is stamped on top of the piston.

2. Measure the outside diameter of the piston to be used.
3. Based on the measured O.D., calculate the boring finish dimension.

Boring finish dimension = Piston O.D + 0.02 to 0.04 mm (0.0008 to 0.0016 in.) (clearance between piston and cylinder) - 0.02 mm (0.008 in.) (honing margin.)

- 4.hone each of the cylinders to the calculated size.

CAUTION

To prevent distortion that may result from temperature rise during honing, bore the cylinder holes in the firing order sequence.

- 5.hone the cylinders, finishing them to the proper dimension (piston outside diameter + gap with cylinder).
6. Check the clearance between the piston and cylinder.

Standard 0.02-0.04 mm (0.0008-0.0016 in.)

NOTE

When boring the cylinders, finish all of the cylinders to the same oversize. Do not bore only one cylinder to an oversize.

INSTALLATION

1. Install the following parts by referring to their respective sections.
 - 1) Crankshaft
 - 2) Drive plate
 - 3) Piston
 - 4) Cylinder head
 - 5) Timing belt
 - 6) Oil pump case

OIL PRESSURE SWITCH AND SENDER ASSY

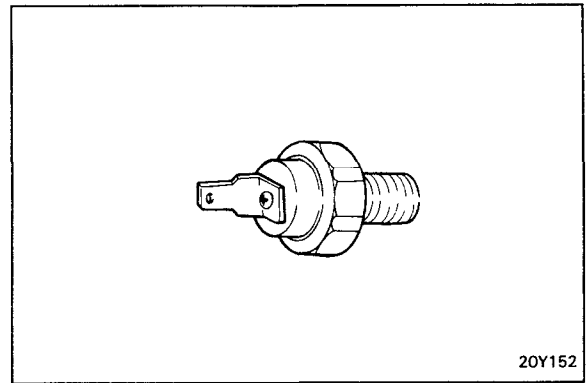
INSPECTION

Oil Pressure Switch

1. If the "OIL PRESSURE" indicating lamp lights when the ignition switch is set to "ON" and goes out when the engine is started and runs at idle, then everything is in order. If the "OIL PRESSURE" lamp does not light when ignition switch is set to "ON", check the switch, lamp and wiring.
2. If there is current flow when the ignition switch is "ON" and if there is no current flow when the engine is running at idle, the switch is good.

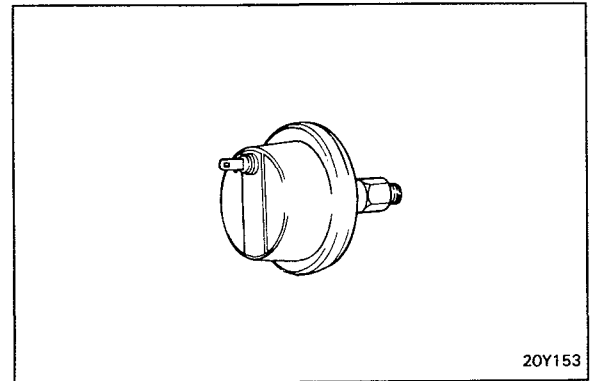
If the switch is good, check the lamp and wiring.

Oil pressure switch operation pressure..
20-39 kPa (0.2-0.4 kg/cm², 2.9-5.7 psi)



Oil Pressure Sender Assembly

1. Since bimetal type has constructional characteristics which vary its resistance as it repeats ON-OFF states, it cannot be changes in current.
2. It can be checked by use of an AC type ammeter measuring changes in current.
Refer to page 90-19.



INSTALLATION

1. Apply sealant to the threaded portion.
2. Using the special tool (09260-32000), tighten the switch to the specified torque.

Tightening torque

Oil pressure switch and sender assy
8-12 Nm (80-120 kg.cm, 5.8-8.7 lb.ft)
