ENGINE MECHANICAL

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GENERAL

SPECIFICATIONS

Description	Standard	Limit
General		
Type	In-line OHC	
Number of cylinders	4	
Bore	75.5 mm (2.97 in.)	
Stroke	82 mm (3.23 in.)	
Total displacement	1,468 cc (89.6 cu.in.)	
Compression ratio	9.4	
Firing order	1-3-4-2	
Basic ignition timing	Refer to emission control information label on car	
Valve timing		
Intake valve		
Opens (BTDC)	18.5°	
Closes (ABDC)	51.5°	
Exhaust valve	[MPI] [FBC]	
Opens (BBDC)	51.5° 47.5°	
Closes (ATDC)	18.5° 14.5°	
Compression pressure	1.32 MPa (13.5 kg/cm^2, 192 psi)/ 250-400 rpm	
Valve clearance-Hot engine		
Intake valve	0.15 mm (0.006 in.)	
Exhaust valve	0.25 mm (0.010 in.)	
*Jet valve	0.25 mm (0.010 in.)	
Cylinder head		
Warpage of lower face of head	Within 0.05 mm (0.002 in.)	0.1 mm (0.004 in.)
Clearance with camshaft	0.05-0.09 mm (0.002-0.0035 in.)	
Oversize rework dimension of valve seat hole		
Intake 0.3 mm (0.102 in.)	36.30-36.33 mm (1.4291-1.430 in.)	
0.6 mm (0.024 in.)	36.60-36.63 mm (1.441-1.442 in.)	
Exhaust 0.3 mm (0.012 in.)	32.30-32.325 mm (1.272-1.273 in.)	
0.6 mm (0.024 in.)	32.60-32.63 mm (1.283-1.285 in.)	
Oversize rework of valve guide hole		
(both intake and exhaust)	12.05-12.068 mm (0.4744-0.4751 in.)	
0.05 mm (0.002 in.)	12.25-12.268 mm (0.4822-0.4829 in.)	
0.25 mm (0.010 in.)	12.50-12.518 mm (0.4921-0.4928 in.)	
0.50 mm (0.020 in.)		
Camshaft		
Height of cam lobe		
Intake	38.909 mm (1.5318 in.)	-0.5 mm (-0.020 in.)
Exhaust	38.974 mm (1.5344 in.) [MPI]	-0.5 mm (-0.020 in.)
	38.648 mm (1.5216 in.) [FBC]	-0.5 mm (-0.020 in.)
End play	0.05-0.20 mm (0.002-0.008 in.)	0.4 mm (0.016 in.)

* : FBC only

Description		Standard	Limit
Valve			
Stem O.D.			
Intake		6.6 mm (0.26 in.)	
Exhaust		6.6 mm (0.26 in.)	
Thickness of valve head (Margin)			
Intake		1.0 mm (0.039 in.)	0.7 mm (0.028 in.)
Exhaust		1.5 mm (0.059 in.)	1.0 mm (0.039 in.)
Clearance with valve guide			
Intake		0.03-0.06 mm (0.0012-0.0024 in.)	0.10 mm (0.004 in.)
Exhaust		0.05-0.09 mm (0.0020-0.0035 in.)	0.15 mm (0.006 in.)
Valve guide			
Installed dimension		13.7-14.3 mm (0.5394-0.5630 in.)	
Oversize		0.05 mm, 0.25 mm, 0.50 mm (0.002 in., 0.010 in., 0.020 in.)	
Valve seat insert			
Width of seat contact		0.9-1.3 mm (0.035-0.051 in.)	
Seat angle		45º	
Oversize		0.3 mm, 0.6 mm (0.012 in., 0.024 in.)	
Valve spring			
Free length		44.6 mm (1.756 in.)	-1.0 mm (-0.039 in.)
Load		24 kg/27.3 mm (53 lb./1.075 in.)	
Installed height		**36** mm (1.417 in.)	+1 mm (+0.039 in.)
Squareness		1.5º or less	**3º**
*Jet valve			
Stem O.D.		**4.3** mm (0.1693 in.)	
Seat angle		**45º**	
*Jet valve spring			
Free length		29.60 mm (1.1654 in.)	
Load		**3.5** kg/21.5 mm (5.5 lb/0.846 in.)	
Cylinder block			
Cylinder bore		**75.50-75.53** mm (2.9724-2.9736 in.)	
Out-of-roundness and taper of cylinder bore		Within 0.02 mm (0.0008 in.)	
Clearance with piston		**0.02-0.04** mm (0.0008-0.0016 in.)	
Piston			
O.D.		**75.47-75.5** mm (2.9713-2.9724 in.)	
Oversize		**0.25** mm, 0.50 mm, 0.75 mm, 1.00 mm (0.010 in., 0.020 in., 0.030 in., 0.039 in.)	
Piston ring			
Side clearance			
No.1		0.03-0.07 mm (0.0012-0.0028 in.)	0.15 mm (0.006 in.)
No.2		0.02-0.06 mm (0.0008-0.0024 in.)	0.12 mm (0.005 in.)
End gap	No. 1 and No.2	0.20-0.35 mm (0.008-0.0138 in.)	0.8 mm (0.031 in.)
	Oil ring	0.20-0.70 mm (0.008-0.028 in.)	**0.8** mm (0.031 in.)
Oversize		**0.25** mm, 0.50 mm, 0.75 mm, 1.00 mm (0.010 in., 0.020 in., 0.030 in., 0.039 in.)	

* : FBC only

Description	Standard	Limit
Connecting rod		
Bend	0.05 mm (0.0020 in.) or less	
Twist	0.10 mm (0.0039 in.) or less	
Side clearance	0.10-0.25 mm (0.004-0.010 in.)	0.4 mm (0.016 in.)
Connecting rod bearing		
Oil clearance	0.014-0.044 mm (0.0006-0.0017 in.)	
Undersize	0.25 mm, 0.50 mm, 0.75 mm (0.01 in., 0.02 in., 0.03 in.)	
Crankshaft		
Pin O.D.	42 mm (1.6535 in.)	
Journal O.D.	48 mm (1.8898 in.)	
Bend	Within 0.03 mm (0.0012 in.)	
Out-of-roundness, taper of journal and pin	Within 0.01 mm (0.0004 in.)	
End play	0.05-0.18 mm (0.002-0.007 in.)	0.25 mm (0.0098 in.)
Undersize rework dimension of pin		
0.25 mm (0.010 in.)	41.735-41.750 mm (1.6431-1.6437 in.)	
0.50 mm (0.020 in.)	41.485-41.500 mm (1.6333-1.6339 in.)	
0.75 mm (0.030 in.)	41.235-41.250 mm (1.6234-1.6240 in.)	
Undersize rework dimension of journal		
0.25 mm (0.010 in.)	47.735-47.750 mm (1.8793-1.8799 in.)	
0.50 mm (0.020 in.)	47.485-47.500 mm (1.8695-1.8701 in.)	
0.75 mm (0.030 in.)	47.235-47.250 mm (1.8596-1.8602 in.)	
Flywheel		
Out-of-roundness		Within 0.13 mm (0.005 in.)
Engine oil pressure		
At engine idle speed	78 KPa (0.8 $kgcm^2$, 11 psi) or more [Engine oil temperature 75-95°C (164-190ºF)]	
Oil pump		
Outer gear		
Clearance between outer circumference and front case	0.1-0.2 mm (0.0039-0.0079 in.)	
Clearance between addendum and crescent	0.22-0.34 mm (0.0087-0.0134 in.)	
End play	0.04-0.10 mm (0.0016-0.0039 in.)	
Inner gear		
Clearance between addendum and crescent	0.21-0.32 mm (0.0083-0.0126 in.)	
End play	0.04-0.10 mm (0.0016-0.0039 in.)	
Relief spring		
Free height	46.6 mm (1.835 in.)	
Load	6.1 kg/40.1 mm (13.4 lb/1.579 in.)	

TIGHTENING TORQUE

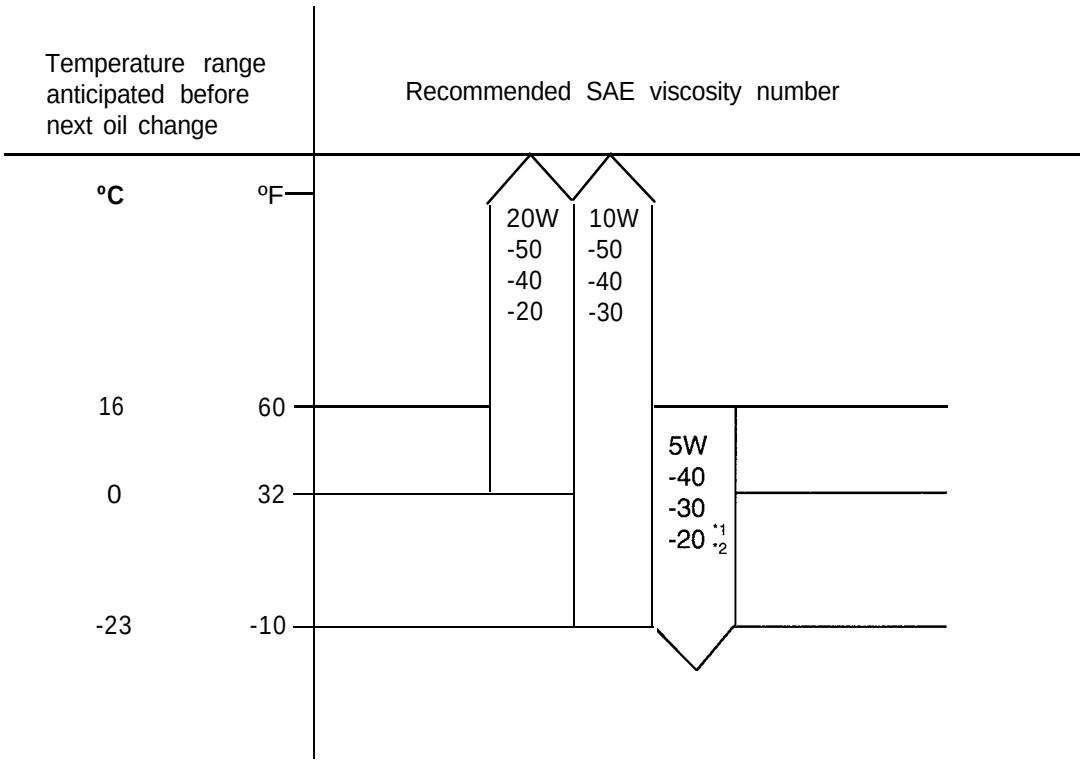
	Nm	kg.cm	lb.ft
Cylinder Block			
Front engine support bracket bolt	50-70	500-700	37-50
Front roll stopper bracket bolt	55-75	550-750	40-54
Rear roll stopper bracket bolt	110-130	1100-1300	80-94
Left engine support bracket bolt	30-42	300-420	22-30
Oil pressure switch	15-22	150-220	11-15
Cylinder head			
Cylinder head bolt-cold engine	70-75	700-750	51-54
-hot engine	80-85	800-850	58-61
Intake/exhaust manifold bolts or nuts	15-20	150-200	11-14
Rocker cover bolt	1.5-2.0	15-20	1.1-1.4
Rocker arm shaft bolt	20-27	200-270	14-20
Camshaft bolt	20-27	200-270	14-20
Rear plate bolt	8-10	80-100	5.8-7.2
*Jet valve	18-22	180-220	13-16
Main Moving			
Connecting rod cap nut	32-35	320-350	23-25
Crankshaft bearing cap	50-54	500-540	36-39
Flywheel (manual transaxle) bolt	130-140	1300-1400	94-101
Drive plate (automatic transaxle) bolt	130-140	1300-1400	94-101
Timing Belt			
Crankshaft pulley bolt	12-15	120-150	8.7-11
Crankshaft sprocket bolt	70-100	700-1000	51-72
Camshaft sprocket bolt	65-75	650-750	47-54
Timing belt tensioner bolt	20-27	200-270	14-20
Timing belt cover bolt	10-12	100-120	7.2-8.7
Front case bolt	12-15	120-150	8.7-11
Engine Mounting			
Left mounting insulator (large) nut	90-110	900-1106	65-80
Left mounting insulator (small) nut	45-60	450-600	36-43
Left mounting bracket to engine nuts and bolts	50-65	500-650	36-47
Transaxle mount insulator nut	90-110	900-1100	65-80
Transaxle insulator bracket to side member bolts	30-40	300-400	22-29
Transaxle mount bracket to automatic transaxle nut	90-110	900-1100	65-80
Rear roll stopper insulator nut	45-60	450-600	33-43
Rear roll stopper bracket to center member bolts	45-60	450-600	33-43
Front roll stopper insulator nut	45-60	450-600	33-43
Front roll stopper bracket to center member bolts	30-40	300-400	22-29
Center member to body bolts	60-80	600-800	43-58
Roll rod to engine bolt	55-65	550-650	40-47
Roll rod to roll rod bracket nut	45-60	450-600	33-43
Roll rod bracket to body bolts	70-95	700-950	51-65
Oil filter	11-13	110-130	8-9.4
Oil pan bolts	6-8	60-80	4-6
Oil pan drain plug	35-45	350-450	25-33
Oil screen bolts	15-22	150-220	11-16
Timing belt upper cover bolts	10-12	100-120	7-9
Timing belt lower cover bolts	10-12	100-120	7-9
Surge tank to inlet manifold nuts and bolts	15-20	150-200	11-14

* : FBC only

SELECTION OF LUBRICANTS

Engine Oil

Recommended API classification : SF, SF/CC OR SG
Recommended SAE viscosity grades :



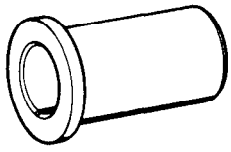
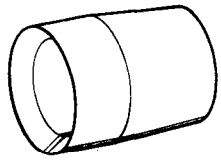
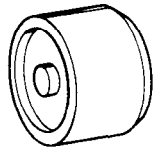
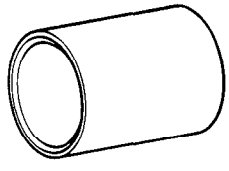
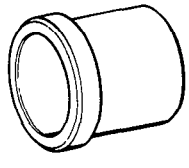
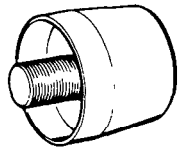
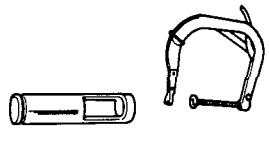
***1. Restricted by driving conditions and climate conditions.**
***2. Not recommended for sustained high speed vehicle operation.**

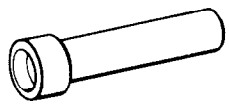
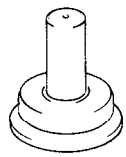
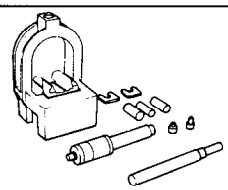
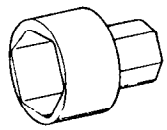
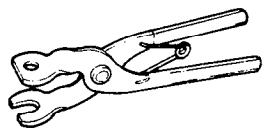
For best performance and for maximum protection of all engines for all types of operation, select only those lubricants which:

1. Conform to the requirements of 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.

SPECIAL TOOLS

Tool (Number and name)	Illustration	Use
09214-21000 Crankshaft front oil seal installer		Installation of the crankshaft front oil seal (use with 09214-21100)
09214-21100 Crankshaft front oil seal guide		Installation of the crank shaft front oil seal (use with 09214-21000)
09216-21000 Mount bushing remover and installer arbor		Removal and installation of the front roll rod upper bushing (use with 09216-21100 and 09216-21000)
09216-21100 Mount bushing remover and installer base		Removal and installation of the roll rod upper bushing (use with 09216-21000)
09221-11001 Cylinder head bolt wrench		Removal and tightening of the cylinder head bolt
09221-21000 Camshaft oil seal installer		Installation of the camshaft oil seal (use with 09221-21100)
09221-21100 Camshaft oil seal guide		Used as a guide when pressing in the camshaft oil seal (use with 09221-21000)
09222-28000 Valve spring compressor 09222-28100 Valve spring compressor holder		Removal and installation of the inlet or exhaust valve

Tool (Number and name)	Illustration	Use
09222-21100 Valve stem oil seal installer		Installation of the valve stem oil seal
09222-21200 Valve guide installer		Removal and installation of the valve guide
09231-21000 Crankshaft rear oil seal installer		1. Installation of the engine rear oil seal 2. Installation of the crankshaft rear oil seal
09234-33001 Piston pin setting tool		Removal and installation of the piston pin
09260-11000 Oil pressure switch wrench		Removal and installation of the oil pressure switch
09222-21300 *Jet valve socket wrench		Removal and installation of jet valve
09222-21400 *Jet valve spring plier		For assembling and reassembling jet valve
09222-21500 *Jet valve stem seal installer		Installation of the jet valve stem oil seal

* : FBC only

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
Noisy valves	Thin or diluted engine oil (low oil pressure) Worn or damaged valve stem or valve guide	Change Replace
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
Timing belt noise	Incorrect belt tension	Adjust belt tension

CHECKING ENGINE OIL

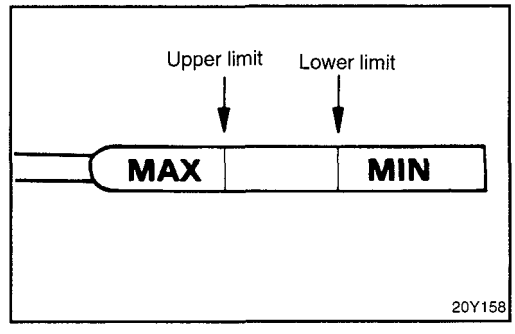
1. Position the vehicle on a level surface.
2. Warm up the engine.

NOTE
If a vehicle that has been out of service for a prolonged period of time, warm up the engine for approximately 20 minutes.

3. Stop the engine, and wait 2 or 3 minutes, then check the oil level after engine oil drains to the oil pan.
4. 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.

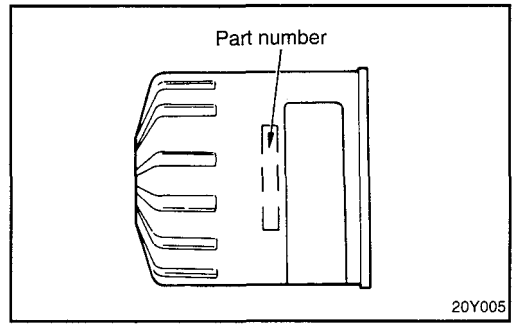
5. Check that the oil is not dirty or contaminated with coolant or gasoline, and that it has the proper viscosity.



REPLACING OIL FILTER

Filter Selection

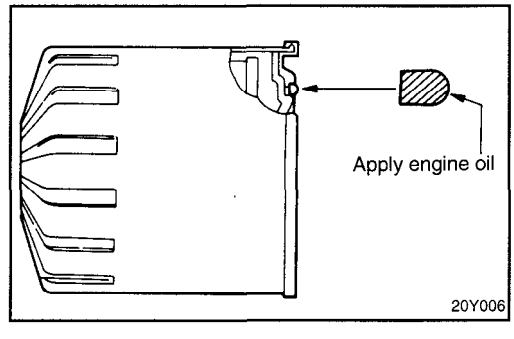
All Hyundai engines are equipped with a high quality, throwaway oil filter. This filter is recommended as a replacement filter on all vehicles. The quality of replacement filters varies considerably. Only high quality filters should be used to assure the most efficient service. Make sure that the
rubber 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

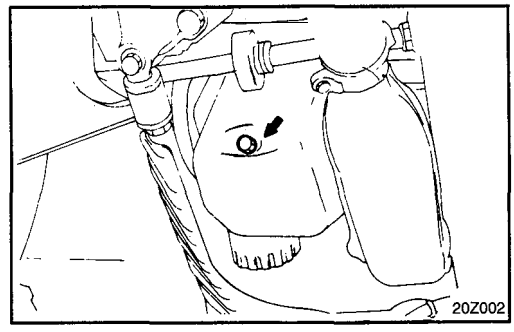
1. Use a filter wrench to remove the oil filter.
2. Before installing the new oil filter on the engine, apply clean engine oil to the surface of the rubber gasket.
3. Tighten the oil filter to the specified torque.

Tightening torque	
Oil filter	11-13 Nm (110-130 kg.cm, 8-9.4 lb.ft)



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

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. Reinstall and tighten the drain plug to the specified torque.

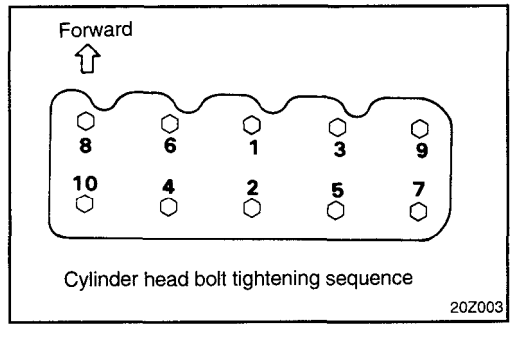
Tightening torque
Drain plug . . . . . 35-45 Nm (350-450 kg.cm, 25-33 lb.ft)

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

Dry fill 3 . . . . . 3.4 lit (3.59 U.S.qts., 2.99 Imp.qts.)
Drain and Refill
Without oil filter; 2.6 lit (2.74 U.S.qts., 2.28 Imp.qts.)
With oil filter; 3.0 lit (3.17 U.S.qts., 2.64 Imp.qts.)

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.

TIGHTENING CYLINDER HEAD BOLTS



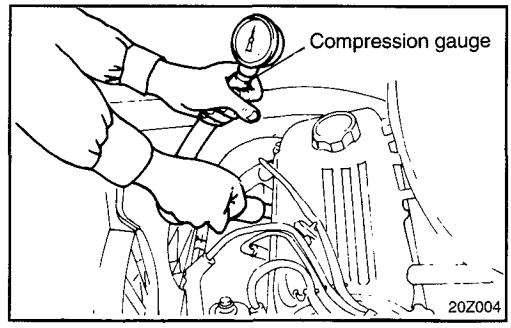
1. When retorquing cylinder head bolts, slightly loosen and then tighten to the specified torque.
2. Be sure to follow the specified torquing sequence.
3. After the cylinder head bolts have been tightened to the specified torque, run the engine until normal operating temperature is reached. Allow it to cool down, then retorque the bolts to specification for best results.

Tightening torque
Cold engine . . . . . 70-75 Nm (700-750 kg.cm, 51-54 lb.ft)
Hot engine . . . . . 80-85 Nm (800-850 kg.cm, 58-61 lb.ft)

CHECKING COMPRESSION PRESSURE

1. Before checking compression, check the engine oil level. Make sure the starter motor and battery are in normal operating condition.
2. Start the engine and wait until engine coolant temperature reaches 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.
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 : 13.5 kg/cm^2 (1.32 MPa, 192 psi) [250-400 rpm]
Limit: 12.0 kg/cm^2 (1.18 MPa, 171 psi) [250-400 rpm]



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

Limit : Max. 1.0 kg/cm^2 (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.

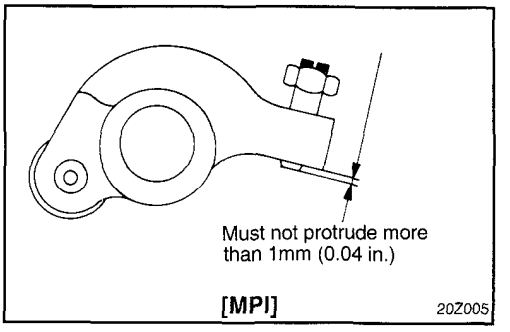
Tightening torque
Spark plug . . . . . 20.4-30.6 Nm (204-306 kg.cm, 15-21 lb.ft)

VALVE CLEARANCE ADJUSTMENT

Refer to GROUP 10 Lubrication and Maintenance.

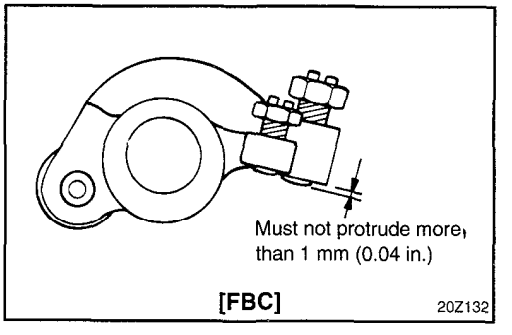
TIMING BELT AND TIMING BELT TENSIONER INSTALLATION PROCEDURE

1. Assemble rocker arm adjusting screw in tentative state. Then screw must not protrude more than 1 mm (0.04 in.)

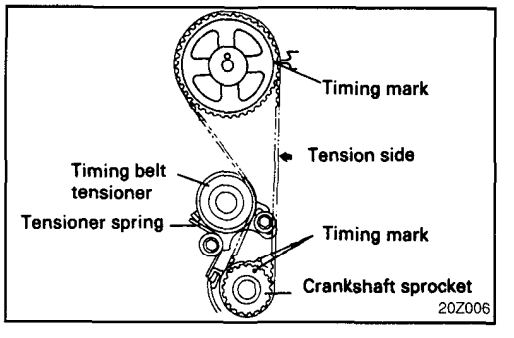


NOTE
1) **Take special care not screw to be below arm end, otherwise valve stem would rust thread part.**
2) **In case of protruding too much, tension of belt would be excessive.**

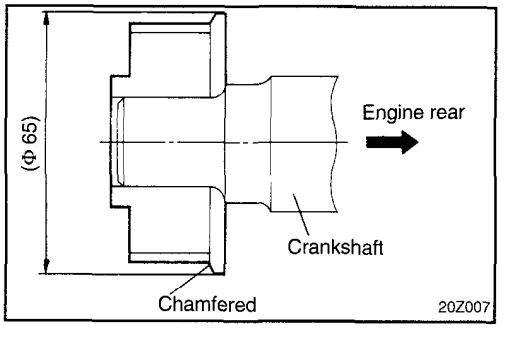
2. Tentatively fasten timing belt tensioner at such position as to place it's pulley nearest to water pump (pulley may touch water pump body).



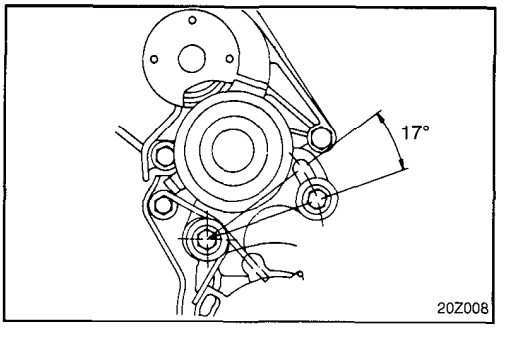
3. After installing the tensioner, the crankshaft sprocket and the camshaft sprocket, match timing mark of each sprocket as shown in illustration.
Rotate the crankshaft until the piston in No.1 cylinder is at top dead center on the compression stroke.



CAUTION
1) **Be sure to install the flange in the correct direction. (Chamfered part shows front of engine).**
2) **When installing the camshaft sprocket, make sure that the pin on the camshaft fits small hole in pulley.**



NOTE
Allow tensioner to remain in assemble state must be installed temporarily as follows.
1) **Tentatively tighten tensioner at position as shown in illustration, in state that one extended end of spring tensioner is assembled to bend of tensioner bracket as imaginary line (wheel spring tensioner is inoperative and not loaded).**
2) **Then set extended end of tensioner spring at front case with drive etc.**



4. Install the timing belt so as not to allow slack to the tension side. Make sure that all timing marks are at their correct position with the tension side in a strained state by applying force to the camshaft sprocket in a reversing (counterclockwise) direction.

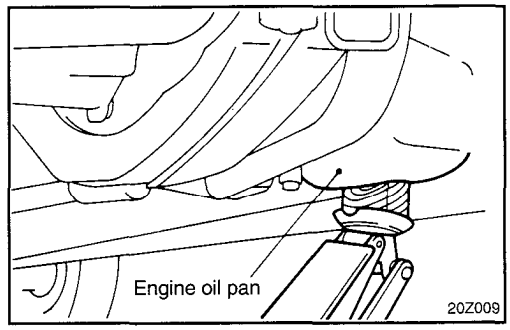
TIMING BELT TENSION ADJUSTMENT PROCEDURE

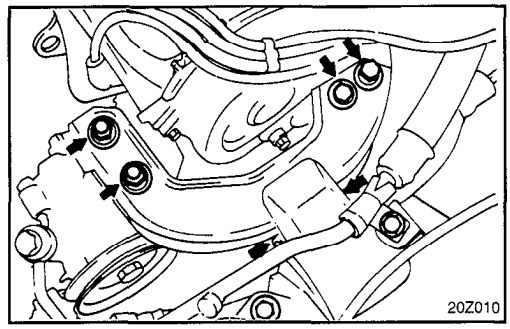
The timing belt has an automatic tension adjusting mechanism. Adjustment can be made by the following procedure:

1. Turn the steering wheel fully counterclockwise.
2. Apply a wood block under the engine oil pan and carefully raise the engine.

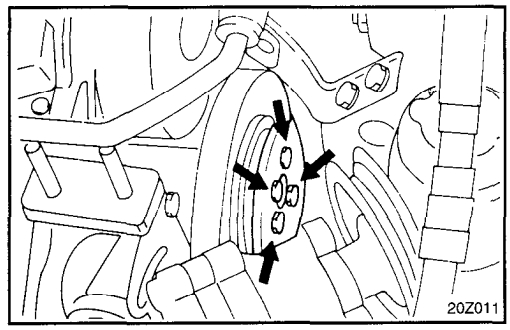
CAUTION
Jack up only slightly to prevent undue stress on parts.

3. Remove the engine left mount bracket.

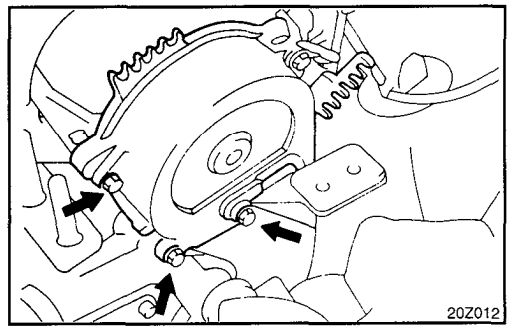




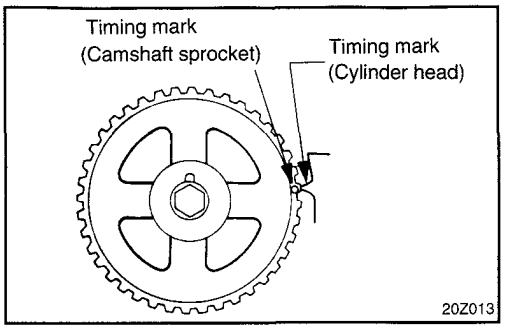
4. Remove the water pump pulley.



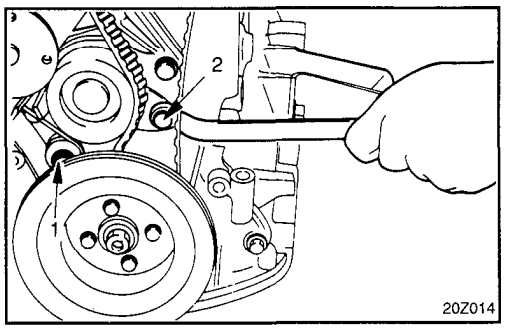
5. Remove the timing belt upper cover.



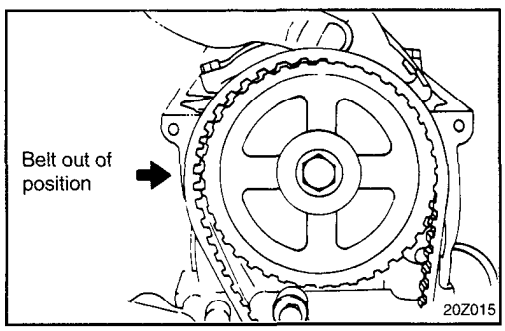
6. Check the belt for cracking, peeling or other damage. Be sure to carefully check the entire length of the belt.
7. Rotate the crankshaft so that the No. 1 piston is at top dead center of the compression stroke. In other words, align the timing mark on the camshaft sprocket with that on the cylinder head.
   Note that the crankshaft should be turned clockwise, not counterclockwise. Turning the crankshaft counterclockwise will cause the tension to become improperly adjusted.



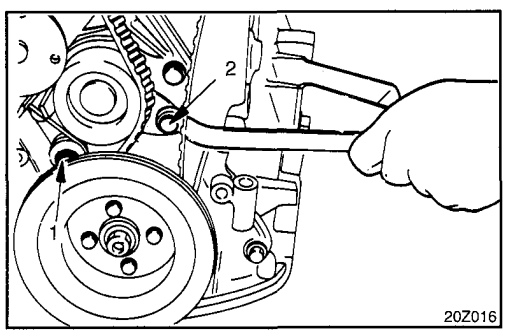
8. Remove the timing belt lower cover.
9. Loosen the tensioner mounting bolts 1 and 2 in that order as shown to give the timing belt spring tension.



10. Check the belt to ensure that it is not out of position



11. Tighten the tensioner attaching bolts 2 and 1 in that order as shown. If the bolt 1 is tightened first, the tensioner will move with the bolt and cause the belt to become overtightened.



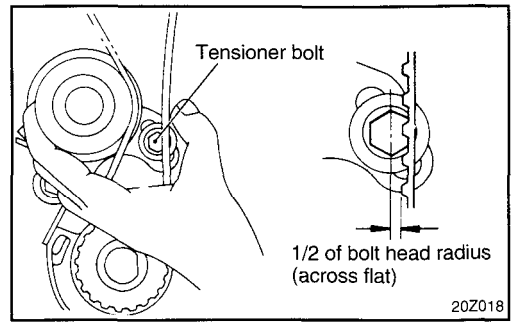
12. Give the crankshaft one turn in operating direction (clockwise) and realign crankshaft sprocket timing mark with the top dead center position.

CAUTION:
Do not turn the crankshaft in a counterclockwise direction.

13. Loosen the tensioner attaching bolts 1 and 2 in that order as shown.
14. Retighten the tensioner attaching bolts 2 and 1 in that order as shown to the specified torque.

Tightening torque . . . . . 20-27 Nm (200-270 kg.cm, 14-20 lb.ft)

15. Recheck the belt tension. When the tensioner and the tension side of the timing belt are pushed in horizontally with a moderate force [approx. 49 N (11 lb)], the timing belt cog end is approx. 1/2 of the tensioner mounting bolt head radius (across flats) away from the bolt head center.

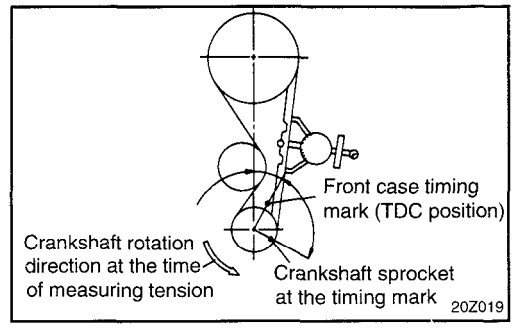


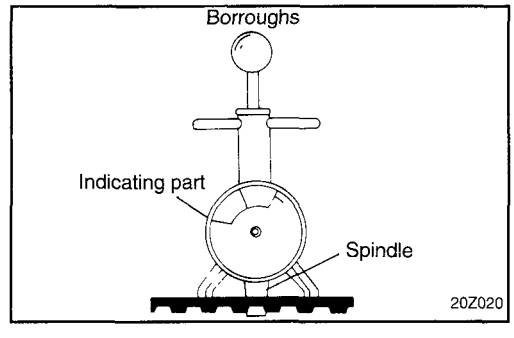
TENSION MEASURING PROCEDURE (When using a tension gauge)

1. Rotate the crankshaft counterclockwise to position 90 degrees before top dead center as shown in the illustration.
2. Measure the belt tension in the middle of the tension side span using the tension gauge. (BORROUGHS BT-33-73F TYPE)

Timing belt tension (In cool condition) . . . . . 14.5-21.5 kg (32-47 lb)

CAUTION
Place the arms on the bottom of the belt teeth. Place the spindle against the middle of the back surface of the belt.

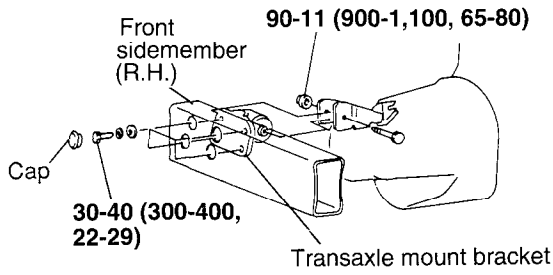




ENGINE MOUNTING

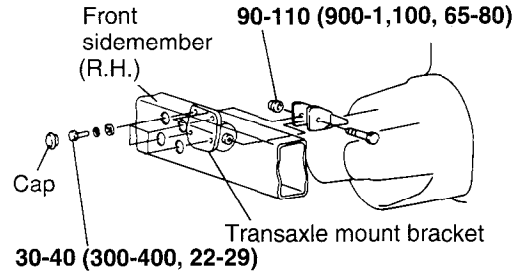
COMPONENTS

Vehicle with a manual transaxle

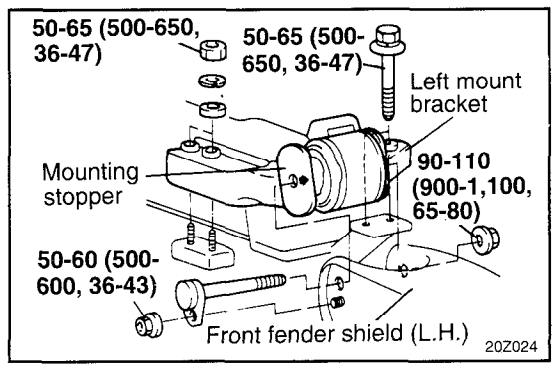


20Z022

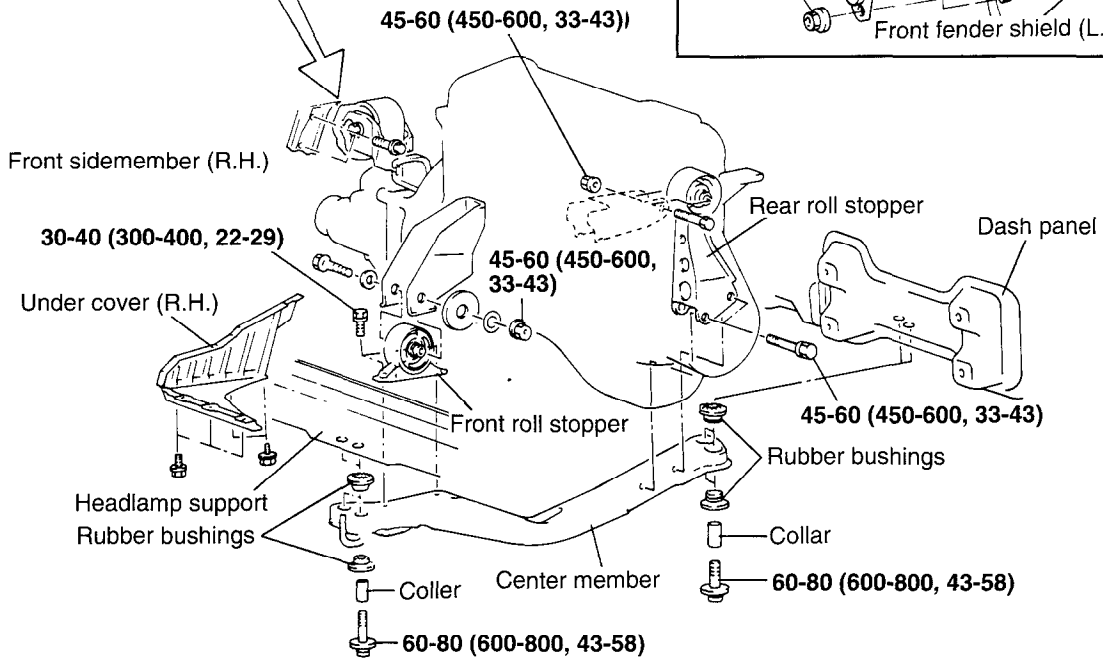
Vehicle with an automatic transaxle



20Z023



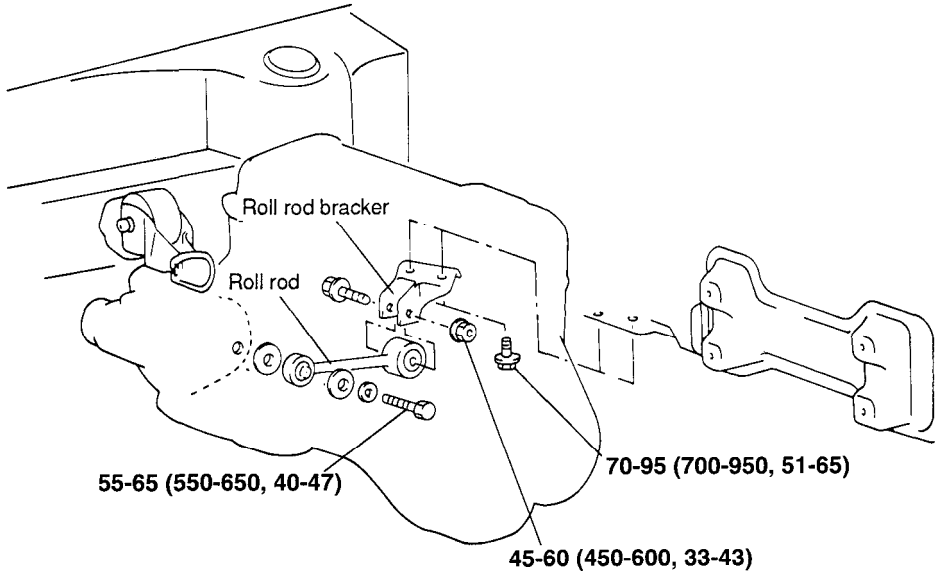
20Z024



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

20Z021

Roll rod (Vehicle with a manual transaxle)



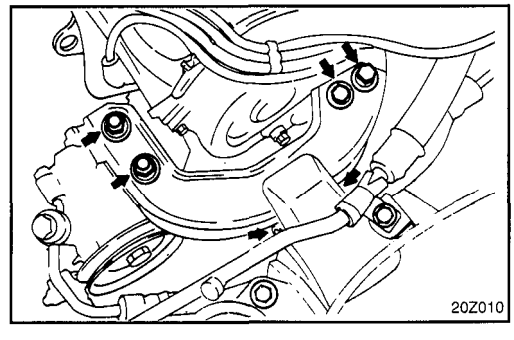
TORQUE : Nm (kg.cm, lb.ft)

REMOVAL

Attach an engine hoist to the engine hooks, and raise just enough so that there is no pressure on the insulators.

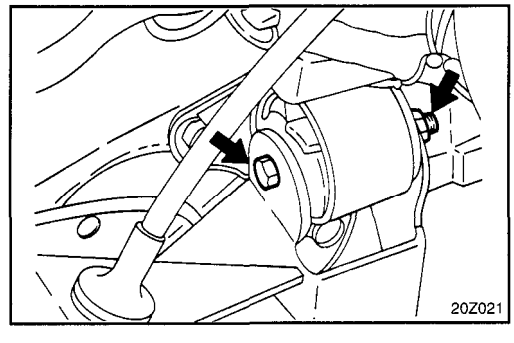
Engine Mounting

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

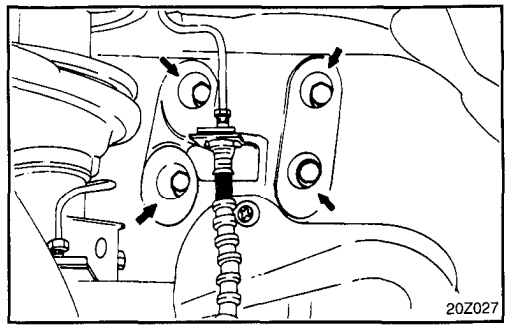


Transaxle

1. For vehicles with a Speed manual transaxle, remove the select control valve.
2. Remove the transaxle mount bolt.

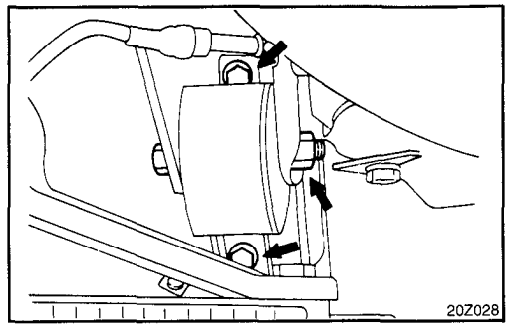


3. Detach the cap from the inside of the right fender shield, remove the transaxle mounting bolts.
4. Remove the transaxle bracket.



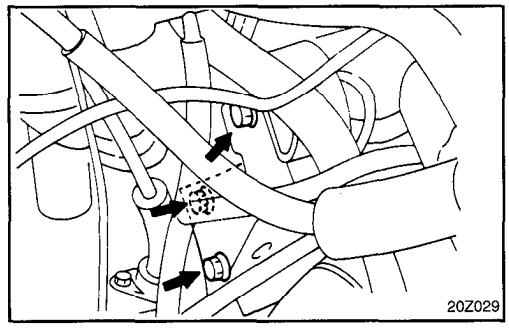
Front Roll Stopper

Remove the front roll stopper bracket from the center member.



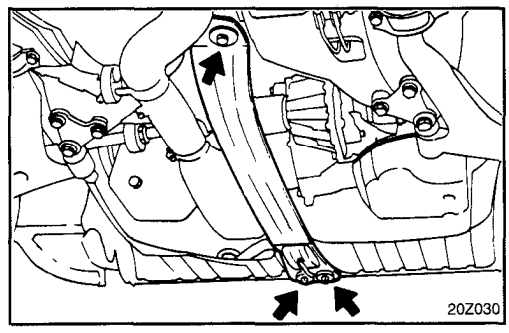
Rear Roll Stopper

Remove the rear roll stopper from the center member.



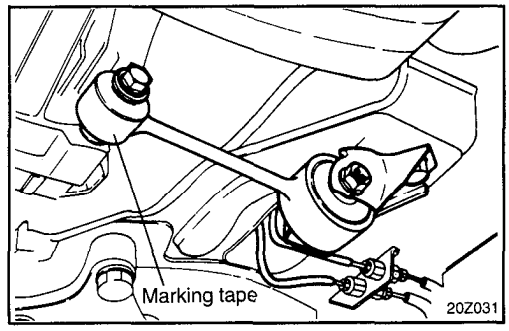
Center member

1. Remove the under cover (R.H.).
2. Remove the front roll stopper mounting bolts.
3. Remove the rear roll stopper mounting bolts.
4. Remove the center member from the body.



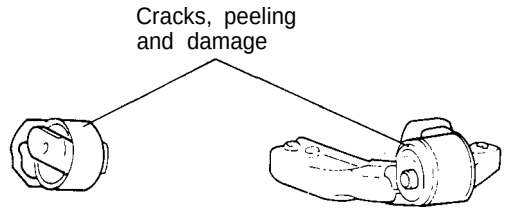
Roll Rod (Manual Transaxle only)

Before removal, place a piece of tape as illustrated to the bottom side of the roll rod for identification.

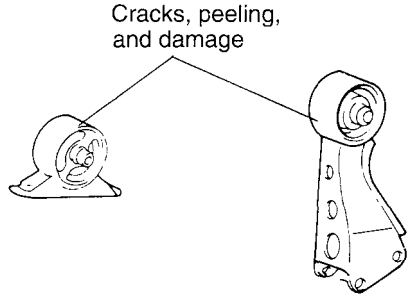


INSPECTION ITEMS

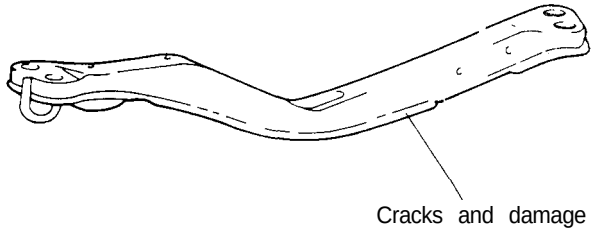
Transaxle mounting **Engine mounting**



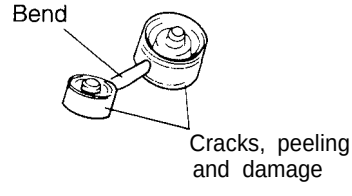
Front roll stopper **Rear roll stopper**



Center member



Roll rod (Manual Transaxle only)



ENGINE AND TRANSAXLE ASSEMBLY

REMOVAL

1. Remove the battery.
2. Detach the air cleaner.
3. Disconnect the connectors for the backup lamp and engine harness.
4. For a vehicle with a 5speed manual transaxle, disconnect the select control valve connector.

5. Disconnect the connectors for the alternator harness and the oil pressure gauge wiring.
6. Drain the engine coolant.
7. For vehicles with an automatic transaxle, disconnect the transaxle oil cooler hoses.

NOTE
When disconnecting the hoses, identify their location to avoid making any errors during reassembly.

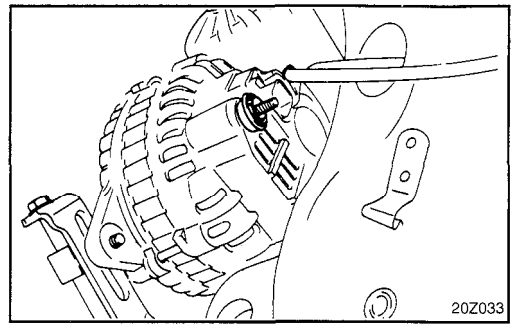
CAUTION
Be careful not to spill any oil or fluid from any of the openings. Also take care in preventing the entrance of foreign material.

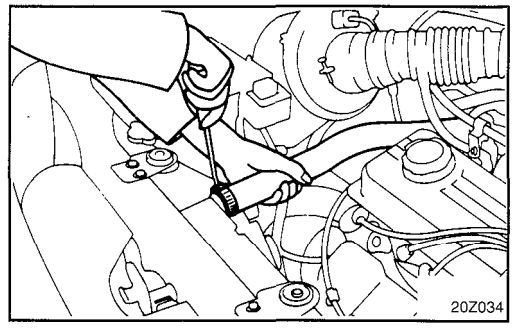
8. Disconnect the radiator upper and lower hoses on the engine side, and then remove the radiator assembly.
9. Disconnect the high tension cable and all wires to the distributor from the ignition coil section.
10. Disconnect the engine ground.
11. Disconnect the brake booster vacuum hose.
12. Remove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

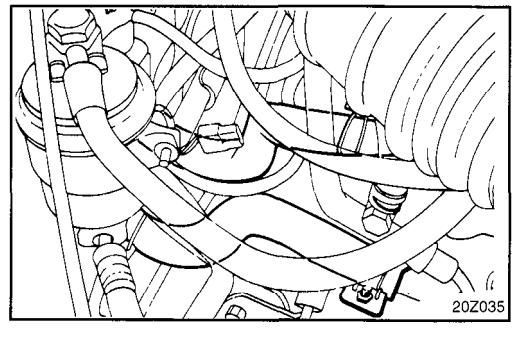
CAUTION
To reduce the residual pressure in the hoses, refer to Group Fuel System "Fuel filter replacement" [For MPI System].

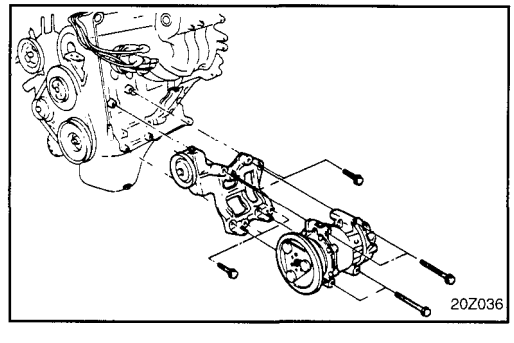
13. Disconnect the heater hoses (inlet and outlet) on the engine side.
14. Disconnect the accelerator cable at the engine side.
15. For vehicles with a manual transaxle, remove the clutch cable from the transaxle.
16. For vehicles with an automatic transaxle, remove the control cable from the transaxle.

17. Disconnect the speedometer cable from the transaxle.
18. Disconnect the air conditioner from the mounting bracket.









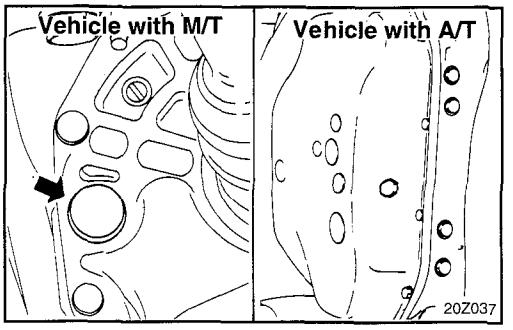
19. Jack up the vehicle.
20. Drain the transaxle-oil (or fluid).
21. Disconnect the front exhaust pipe from the manifold.

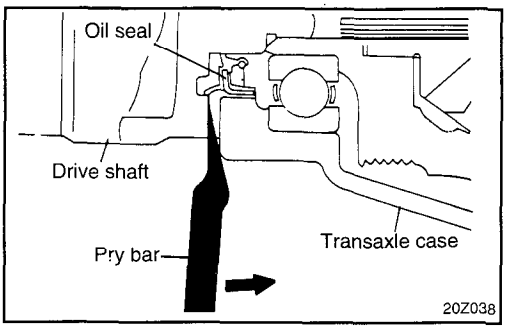
NOTE:
Use wire to suspend the exhaust pipe from the bottom of the vehicle.

22. For vehicles with a manual transaxle, remove the shift control rod and extension rod.
23. Remove the lower arm ball joint bolts and the strut bar at the point where it is mounted to the lower arm.
24. Remove the drive shafts from the transaxle case.

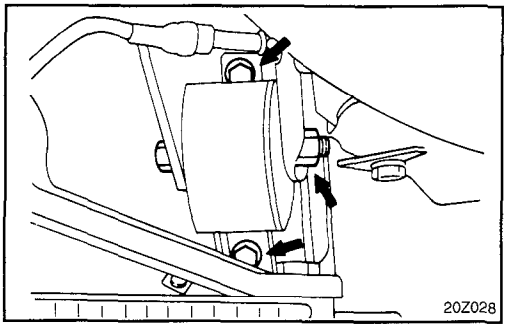
CAUTION
1) Plug the holes of the transaxle case to prevent entry of foreign material.
2) Install new circlips on the drive shafts when reassembling.

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

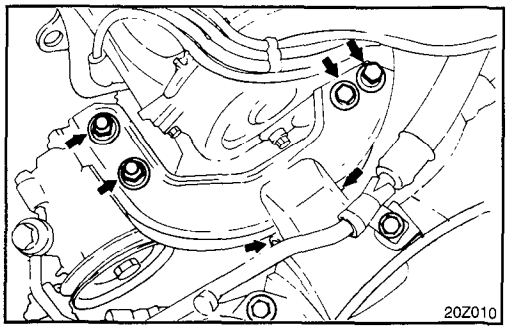




27. Remove the front roll stopper.
28. Separate the rear roll stopper.
29. For vehicles with a manual transaxle, remove the roll rod.



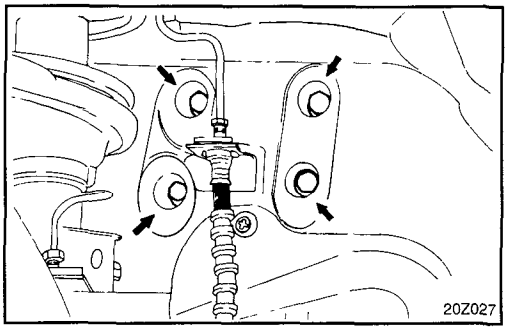
30. Remove the engine mounting insulator bolts.
31. Remove the engine mounting bracket from the engine.



32. Slowly raise the engine (to the extent that the engine and transaxle weights are not applied to the mounting portions) and temporarily hold it in the raised condition.

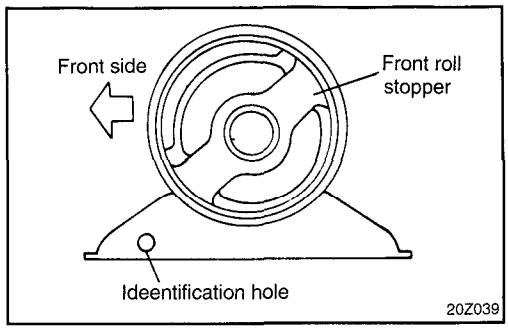
CAUTION
Check that all of the cables, hoses, harnesses, connectors etc. are disconnected from the engine.

33. Remove the caps from inside the right fender shield and remove the transaxle mount bracket bolts.
34. Remove the left mount insulator bolt.
While directing the transaxle side downward, lift the engine and transaxle assembly up and out of the vehicles.

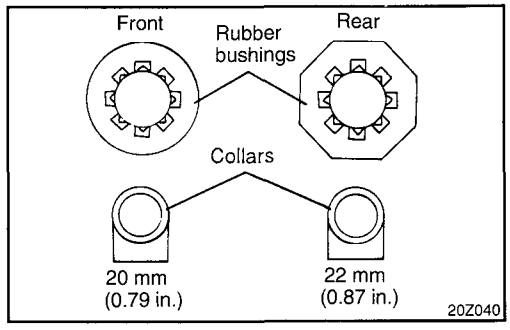


INSTALLATION

1. While checking the connections of the harnesses, pipes, hoses, etc., and making sure that none of them are being caught, damaged, etc., install the engine and transaxle assembly.
2. When the engine and transaxle assembly is installed temporarily tighten the front roll stopper.



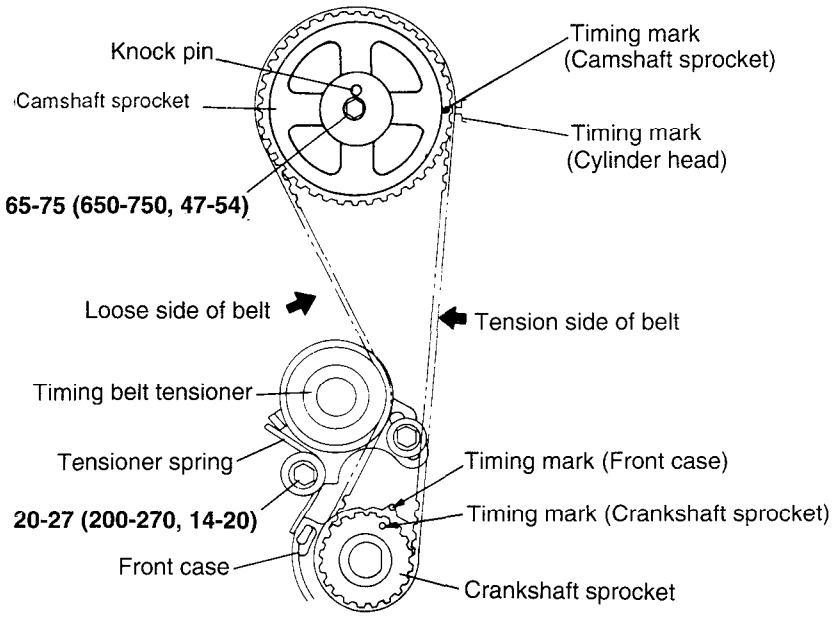
3. The front and rear center member rubber bushings and collars are different.



4. After the weight of the engine and transaxle assembly has been put on each insulator, tighten to specified torque.
5. Reassemble all of the components removed during disassembly. Be especially careful to properly secure all components, including fuel, electrical and fluid pipe connections.
6. Refill the coolant and check for leaks.
7. Refill the transaxle fluid, test its operation, and check for leaks.
8. Check the operation of the transaxle control cable and accelerator cable. Adjust as necessary.
9. Check for proper operation of each of the various gauges.

TIMING BELT

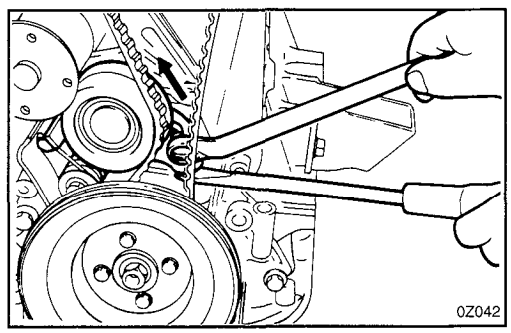
COMPONENT



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

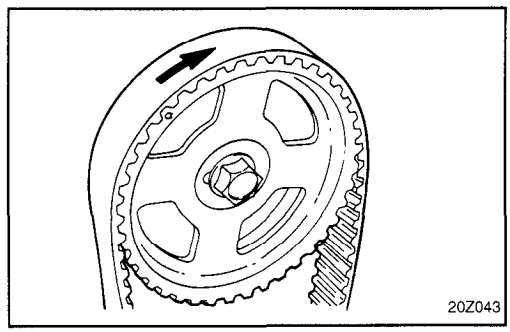
REMOVAL

1. Remove the water pump pulley, and belt.
2. Remove the timing belt cover.
3. Move the timing belt tensioner pulley toward the water pump, and temporarily secure it.
4. Remove the timing belt from the camshaft sprocket.
5. Remove the camshaft sprocket.
6. Remove the crankshaft pulley.
7. Remove the timing belt.

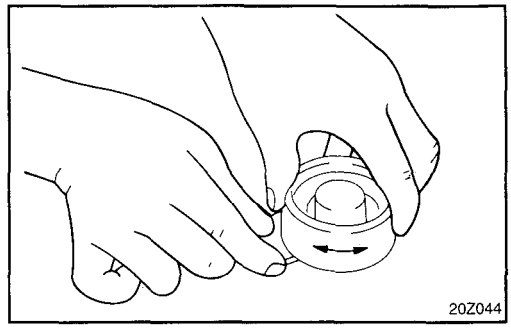


NOTE
If the timing belt is reused, make an arrow mark indicating the turning direction (or the front of the engine) to make sure that the belt is reinstalled in the same direction as before.

8. Remove the crankshaft sprocket bolts. Remove the crankshaft sprocket and flange.
9. Remove the timing belt tensioner.



INSPECTION

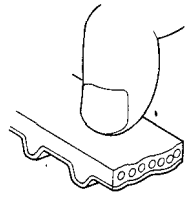
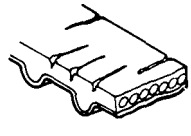
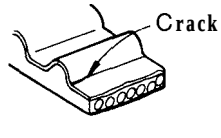
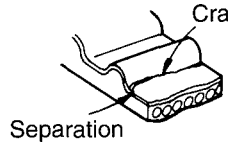
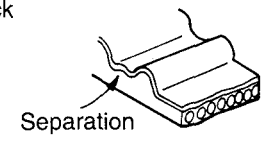


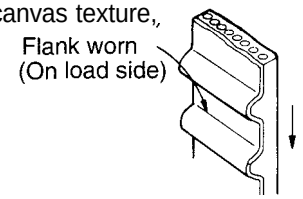
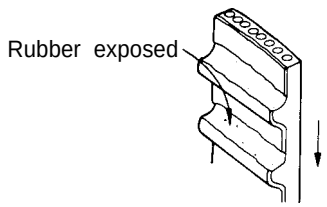
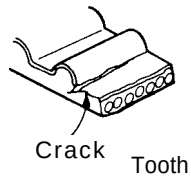
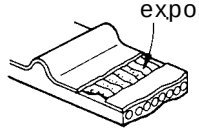
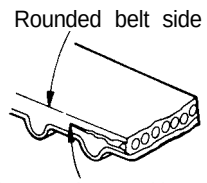
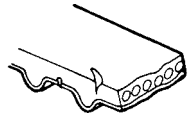
Sprockets and Tensioner

1. Check the camshaft sprocket, crankshaft sprocket and tensioner for abnormal wear, cracks, or damage. Replace as necessary.
2. Inspect the tensioner for easy and smooth pulley rotation and check for play or noise. Replace as necessary.

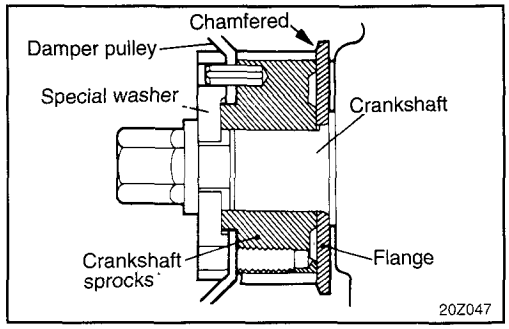
Timing Belt

1. Check the belt for oil or dust deposits Replace if necessary.
   Small deposits should be wiped away with a dry cloth or paper. Do not clean with solvent.
2. When the engine is overhauled or belt tension adjusted, check the belt in detail. If the following flaws are evident, replace the belt with a new one.

Description	Flaw conditions
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 back surface rubber	
3. Cracked or separating **canvas**	  

Description	Flaw conditions
4. Badly worn teeth (initial stage)	Canvas on load side tooth flank worn (Fluffy canvas fibers, rubber gone and color changed to white, and unclear canvas texture,, 
5. Badly worn teeth (last stage)	Canvas on load side tooth flank worn down and rubber exposed (tooth width reduced) 
6. Cracked tooth bottom	
7. Missing tooth	
8. Side of belt badly worn	 **NOTE** **Normal belt should have precisely cut sides as if produced by a sharp knife.**
9. Side of belt cracked	

INSTALLATION



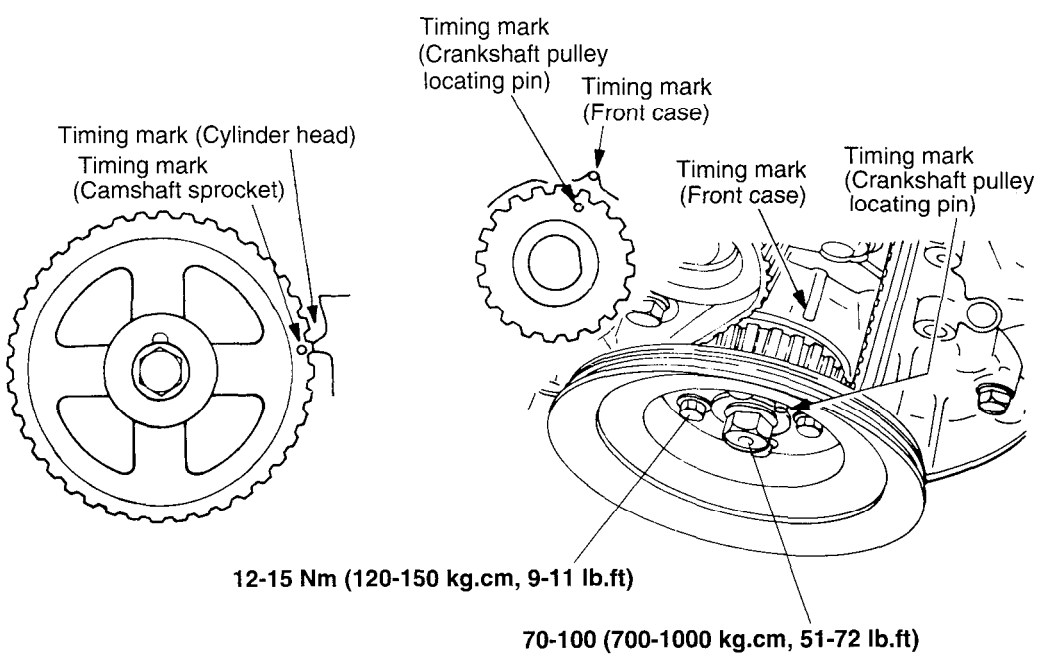
1. Install the flange and crankshaft sprocket as shown. Pay close attention to their mounting directions.

Tightening torque
Crankshaft sprocket bolt . . . . . .
70-100 Nm (700-1,000 kg.cm, 51-72 lb.ft)

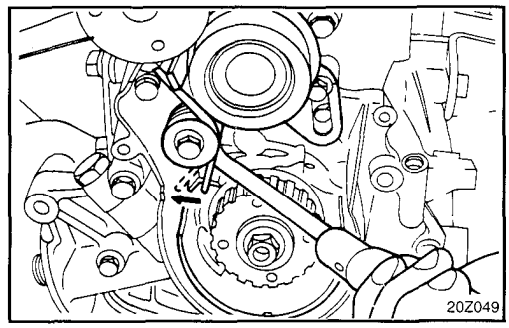
2. Install the camshaft sprocket and tighten the bolt to the specified torque.

Tightening torque
Crankshaft sprocket bolt . . . . . .
65-75 Nm (650-750 kg.cm, 47-54 lb.ft)

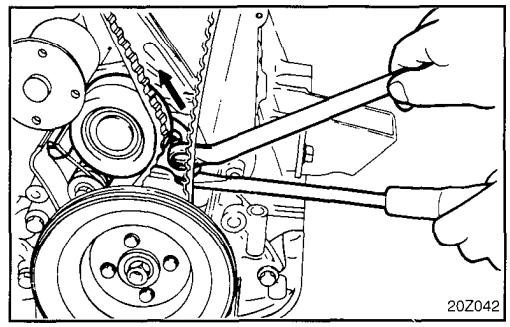
3. Align the timing marks of the camshaft sprocket and crank shaft sprocket, with the No.1 piston placed at top dead center on its compression stroke.



4. To install the timing belt tensioner, first mount the tensioner, spring, and spacer. Temporarily tighten the bolts. Next, temporarily tighten the tensioner long hole side washer and bolts. Install the bottom end of the spring against the front case as shown in the illustration.

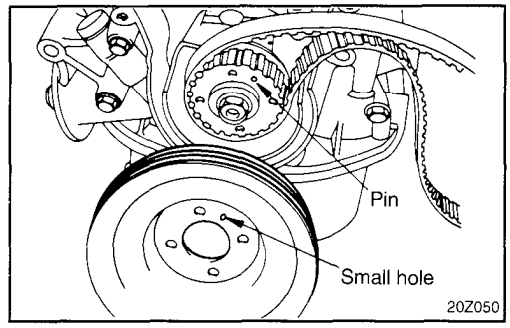


5. Secure the tensioner, positioned towards the water pump.
6. Install the timing belt on the crankshaft sprocket.
7. Install the timing belt on the camshaft sprocket.
   When the timing belt is installed on the camshaft sprocket, make sure that the tension side is tight. Then, check to ensure that when the tension side is tightened by turning the camshaft sprocket in a reverse direction, all timing marks are in line.

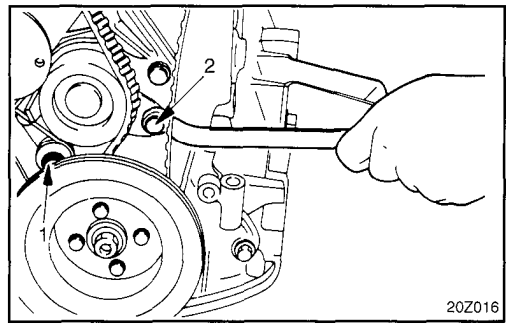


8. Install the crankshaft pulley. In this case, make sure that the crankshaft sprocket pin fits the small hole in the pulley.

Tightening torque
Crankshaft pulley bolt. . . . . 10-12 Nm (100-120 kg.cm, 7.2-8.7 lb.ft)



9. Loosen the tensioner mounting bolts 1 and 2 in that order as shown. This will apply spring tension to the timing belt only. Check the belt to ensure that it is not out of position.
10. Tighten the tensioner tightening bolts 2 and 1 in that order. If the bolt 1 is tightened first, the tensioner will move with the belt in the direction that the belt is tightened.
11. Rotate the crankshaft one revolution in a clockwise direction. Realign the crankshaft sprocket timing mark with the top dead center position.

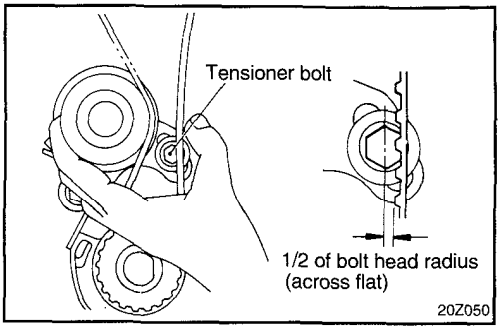


CAUTION
Do not turn the crankshaft in a counterclockwise direction; The crankshaft should turn smoothly.

12. Loosen the tensioner attaching bolts 1 and 2 in that order.
13. Tighten the tensioner attaching bolts 2 and 1 in that order to the specified torque.

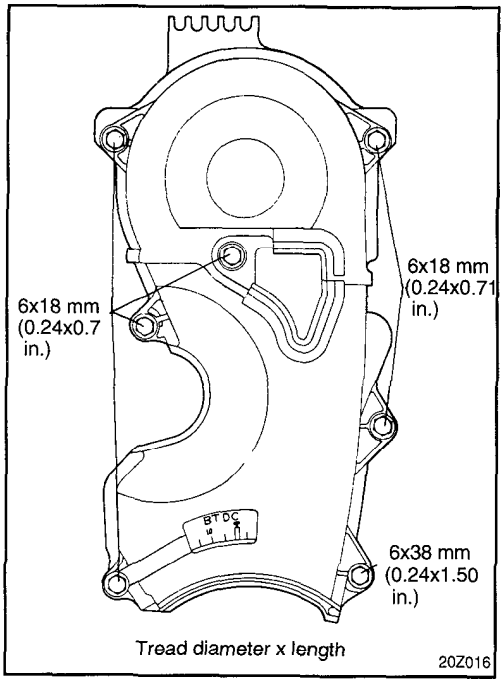
Tightening torque
Tensioner attaching bolt . . . . . 20-27 Nm (200-270 kg.cm, 14-20 lb.ft)

14. Recheck the belt tension. Verify that when the tensioner and the tension side of the timing belt are pushed in horizontally with a moderate force [approx. 49 N (11 lb)], the timing belt cog end is approx. 1/2 of the tensioner mounting bolt head radius (across flats) away from the bolt head center.



15. Install the timing belt cover.

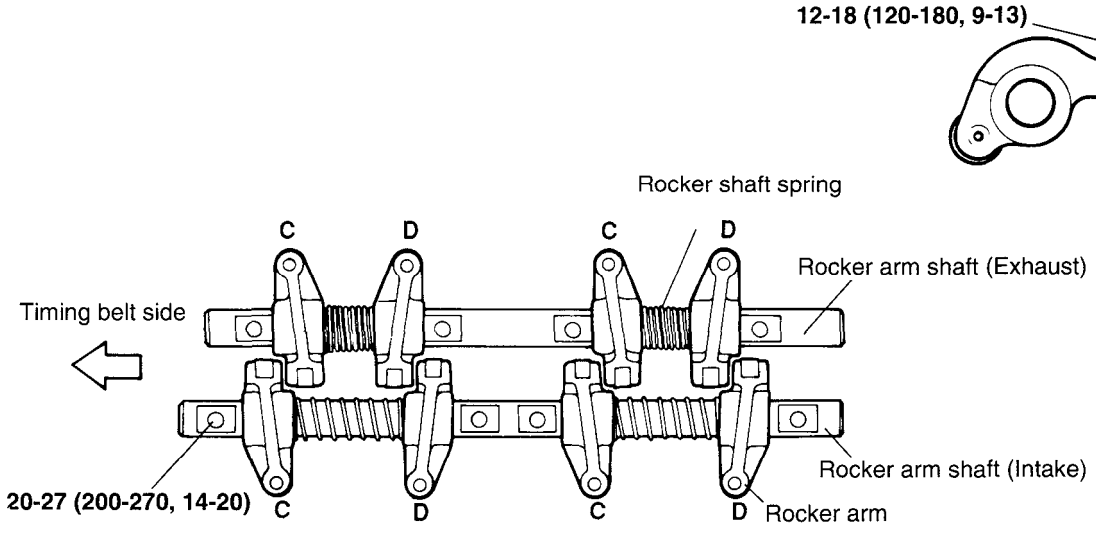
Tightening torque
Timing belt cover bolt. . . . . .
10-12 Nm (100-120 kg.cm, 7.2-8.7 lb.ft)



16. Install the V-ribbed belt and adjust the belt tension.

ROCKER ARMS AND ROCKER ARM SHAFTS

COMPONENTS [MPI]

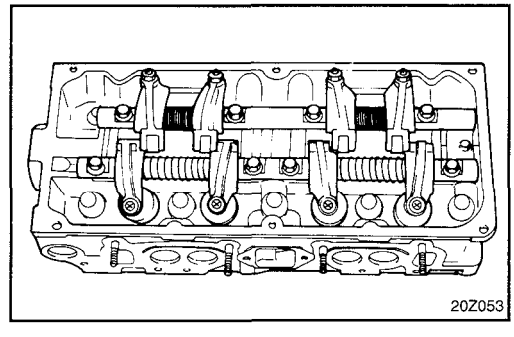


C : Marked 1-3
D : Marked 2-4

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

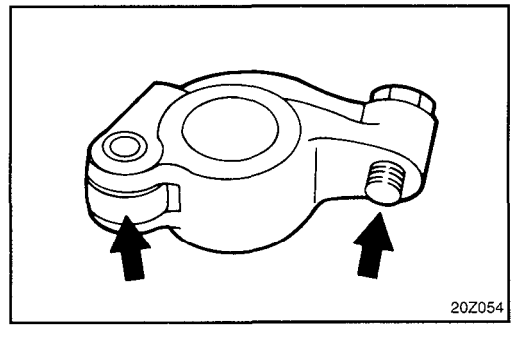
REMOVAL

1. Remove the breather hose between the air cleaner and the rocker cover.
2. Remove the timing belt cover.
3. Remove the rocker cover.
4. Loosen the rocker arm shaft mounting bolts and remove the rocker arm shaft, rocker arms and rocker arm shaft springs as an assembly.
6. Remove the bolts, the rocker arms and rocker arm shaft springs from the rocker arm shaft.



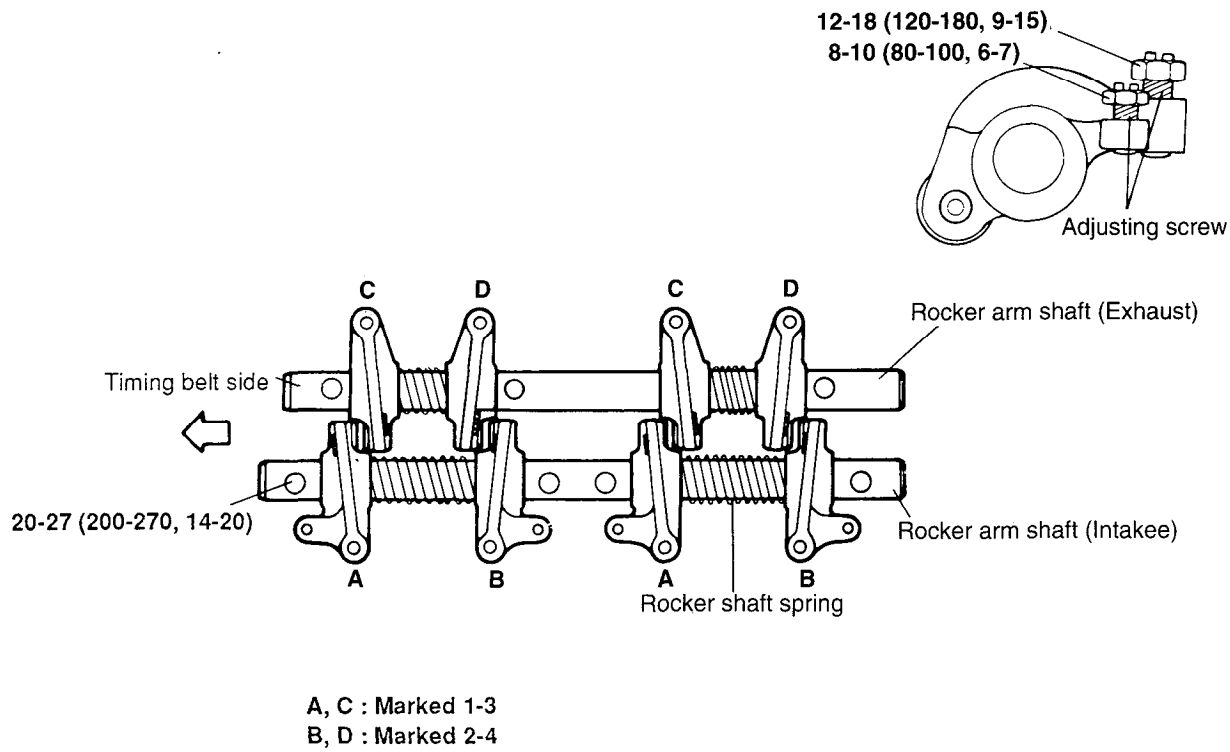
INSPECTION

1. Check the roller surface. Replace there are any dents, damage or evidence of seizure.
2. Check rotation of the roller. If it does not rotate smoothly or if looseness is evident, replace it.
3. Check the inside diameter. If damage or seizure is evident replace the roller.
4. Check the areas marked with arrows for wear and damage. If considerable wear or damage is evident, replace the roller.



ROCKER ARMS AND ROCKER ARM SHAFTS

COMPONENTS [FBC]

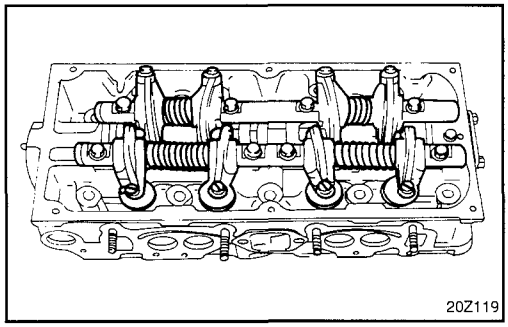


A, C : Marked 1-3
B, D : Marked 2-4

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

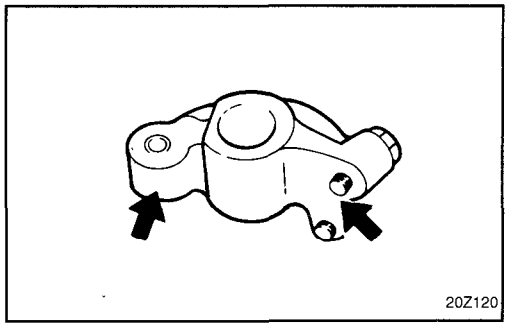
REMOVAL

1. Remove the breather hose between the air cleaner and the rocker cover.
2. Remove the air cleaner.
3. Remove the timing belt cover.
4. Remove the rocker cover.
5. Loosen the rocker arm shaft mounting bolts and remove the rocker arm shaft, rocker arms and rocker arm shaft springs as an assembly.
6. Remove the bolts, the rocker arms and rocker arm shaft springs from the rocker arm shaft.



INSPECTION

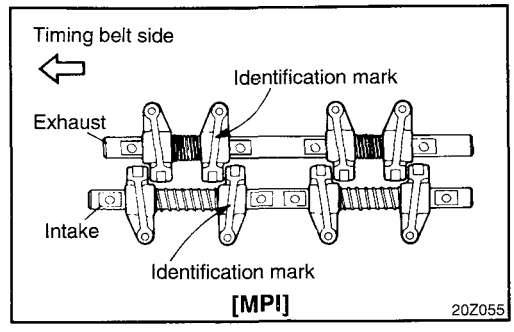
1. Check the rocker arm face that contacts the cam lobe and the adjusting screw end that contacts the valve stem. If badly worn or damaged, replace rocker arm and/or adjusting screws.
2. Check the rocker arm shaft for damage. Replace as necessary.



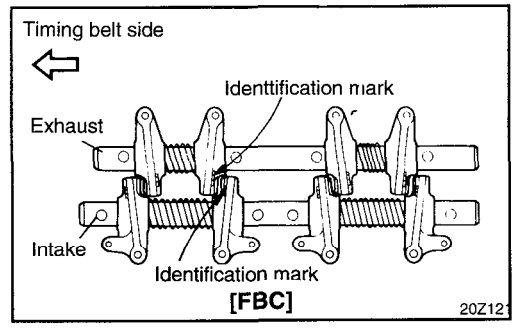
INSTALLATION

1. Install the rocker arms and rocker arm shaft springs to the rocker arm shafts. Install the rocker arm shafts to the cylinder head.
   Tighten the rocker arm shaft mounting bolts to the specified torque.

Tightening torque
Rocker arm shaft mounting bolt . . . . . .
20-27 Nm (200-270 kg.cm, 14-20 lb.ft)

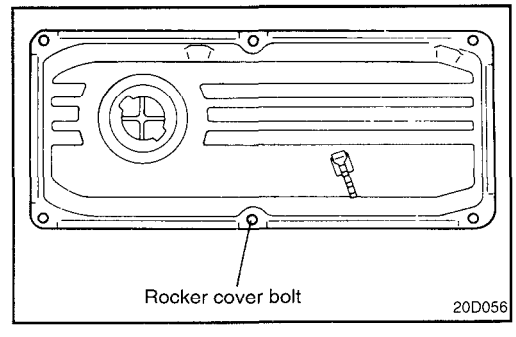


2. When installing the rocker arms, shafts and springs, note the difference between the RH and LH parts. The RH springs (exhaust) are approx. 44.2 mm (1.74 in.) free length, while the LH springs (intake) are approx. 77 mm (3.03 in.) free length.



3. Install the rocker cover and tighten the bolts to the specified torque.

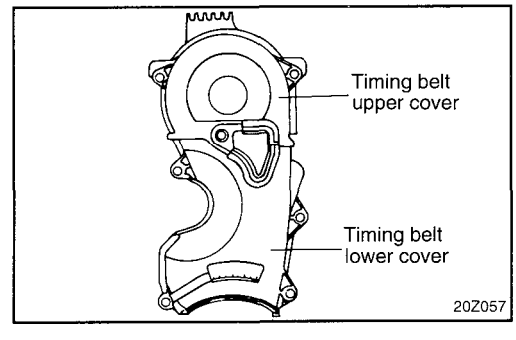
Tightening torque
Rocker cover bolt . . . . . .
1.5-2.0 Nm (15-20 kg.cm, 1.1-1.4 lb.ft)



4. Install the timing belt cover.

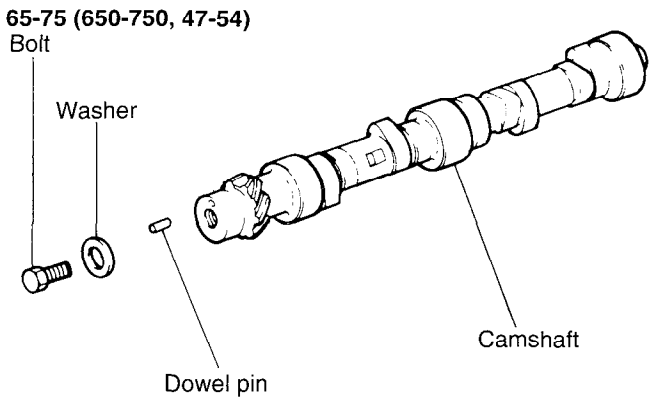
Tightening torque
Timing belt cover bolt . . . . . .
10-12 Nm (100-120 kg.cm, 7.2-8.7 lb.ft)

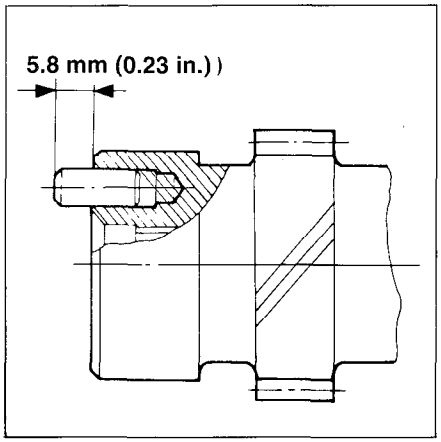
5. Install the air cleaner.
6. Install the breather hose.



CAMSHAFT

COMPONENTS

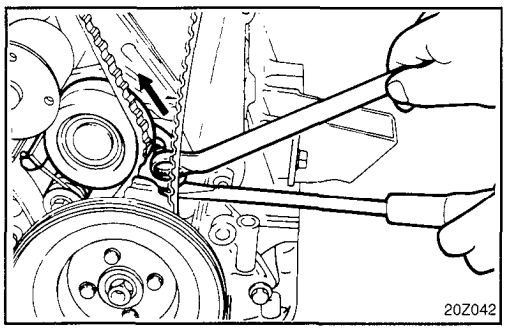


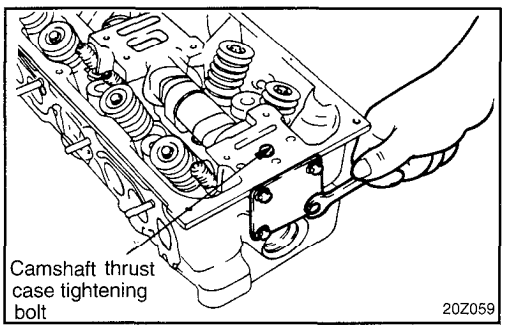


TORQUE : Nm (kg.cm, lb.ft)

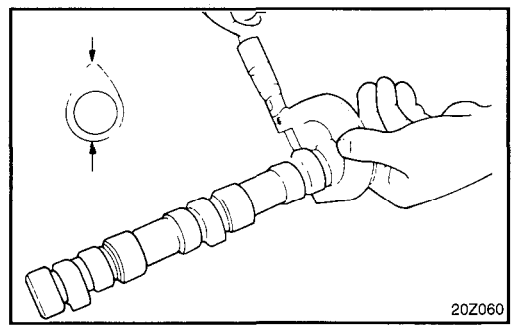
REMOVAL

1. Disconnect the breather hose and the secondary air hose.
2. Remove the air cleaner.
3. Remove the timing belt cover.
4. Move the timing belt tensioner pulley toward the water pump and temporarily secure it.
5. Remove the timing belt from the camshaft sprocket. Since the crankshaft pulley need not be removed, the timing belt should be left installed on the crankshaft sprocket.
6. Remove the camshaft sprocket.
7. Remove the rocker cover.
8. Remove the rocker arm shaft assembly. Refer to “Rocker Arms and Rocker Arm Shafts”.
9. Remove the cylinder head rear cover.
10. Remove the camshaft thrust case tightening bolt.
11. Remove the camshaft thrust case and camshaft toward the transaxle side of the cylinder head.





INSPECTION

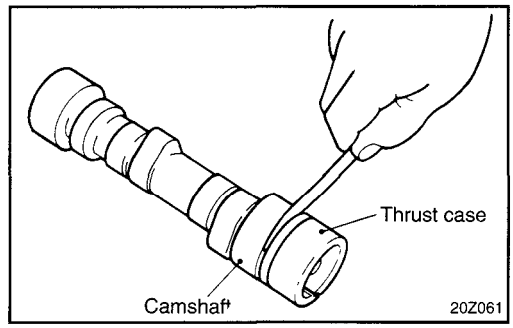


1. Check the camshaft journals for wear. If the journals are badly worn, replace the camshaft.
2. Check the cam lobes for damage. If the lobe is damaged or worn excessively, replace the camshaft.

Cam height	
[Standard] [MPI]	
Intake	38.909 mm (1.5318 in.)
Exhaust	38.947 mm (1.5344 in.)
[Standard] [FBC]	
Intake	38.909 mm (1.5318 in.)
Exhaust	38.648 mm (1.5216 in.)
[Limit]	
Intake	-0.5 mm (-0.020 in.)
Exhaust	-0.5 mm (-0.020 in.)

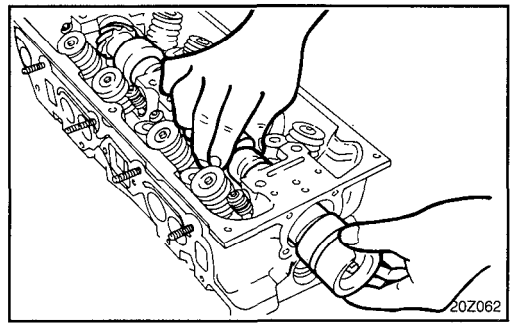
3. Check the cam surface for abnormal wear or damage, and replace if necessary.
4. Check the distributor drive gear tooth surfaces. If abnormal wear is evident, replace the camshaft.
5. Check each bearing for damage. If the bearing surface is excessively damaged, replace the cylinder head assembly.
6. Oil Seal (camshaft front)
   1) Check the lips for wear. If lip threads are worn, replace.
   2) Check the oil seal lip contacting surface of camshaft. If it is worn in stages, replace the camshaft.
7. Check the camshaft end play.
   If the end play is too large, replace the thrust case and recheck the end play. If the end play is still too large, check the rear end of camshaft rear journal for wear. If it is badly worn, replace the camshaft.

End play of camshaft [Standard value]	0.05-0.20 mm (0.002-0.008 in.)

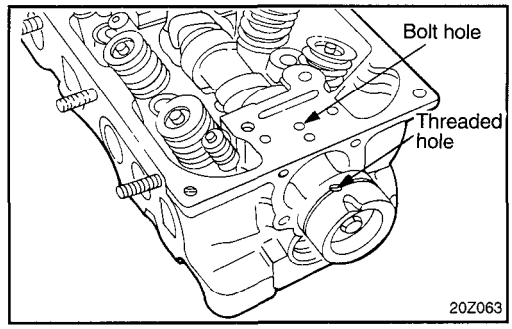


INSTALLATION

1. Install the crankshaft thrust case and thrust plate to the camshaft end and firmly tighten the bolt.

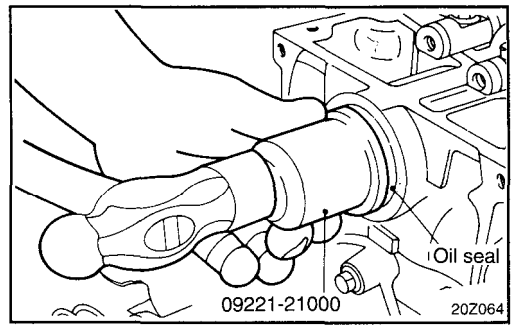


2. After lubricating the journal and thrust portions of the camshaft with engine oil, insert the camshaft from the transaxle side of the cylinder head. Insert the camshaft thrust case with the threaded hole at the top. Align the threaded hole with the bolt hole in the cylinder head. Install and tighten the bolt.
3. Install the rear cover and gasket and tighten the bolts.



4. Using special tools, Camshaft Oil Seal Installer (09221-21000), press fit the camshaft oil seal. Be sure to apply engine oil to the external surface of the oil seal.

   Insert the oil seal along the camshaft front end and install by driving the installer with a hammer until the oil seal is fully seated.



5. Install the camshaft sprocket and tighten the bolts to the specified torque.
6. Install the rocker arm and shafts.
   Refer to “Rocker Arms and Rocker Arm Shafts”.
7. Align the camshaft sprocket and crankshaft sprocket timing marks. The piston in the No. 1 cylinder will then be at the top dead center on the compression stroke.

Tightening torque
Camshaft sprocket bolt . . . . . 65-75 Nm (650-750 kg.cm, 47-54 lb.ft)

8. Temporarily set the valve clearance to specification with the engine cold. See “Valve Clearance Adjustment Procedure”.

Valve clearance (cold engine) [Standard value]
Intake valve . . . . . 0.07 mm (0.003 in.)
Exhaust valve . . . . . 0.17 mm (0.007 in.)
Jet valve [FBC only] . . . . . 0.17 mm (0.007 in.)

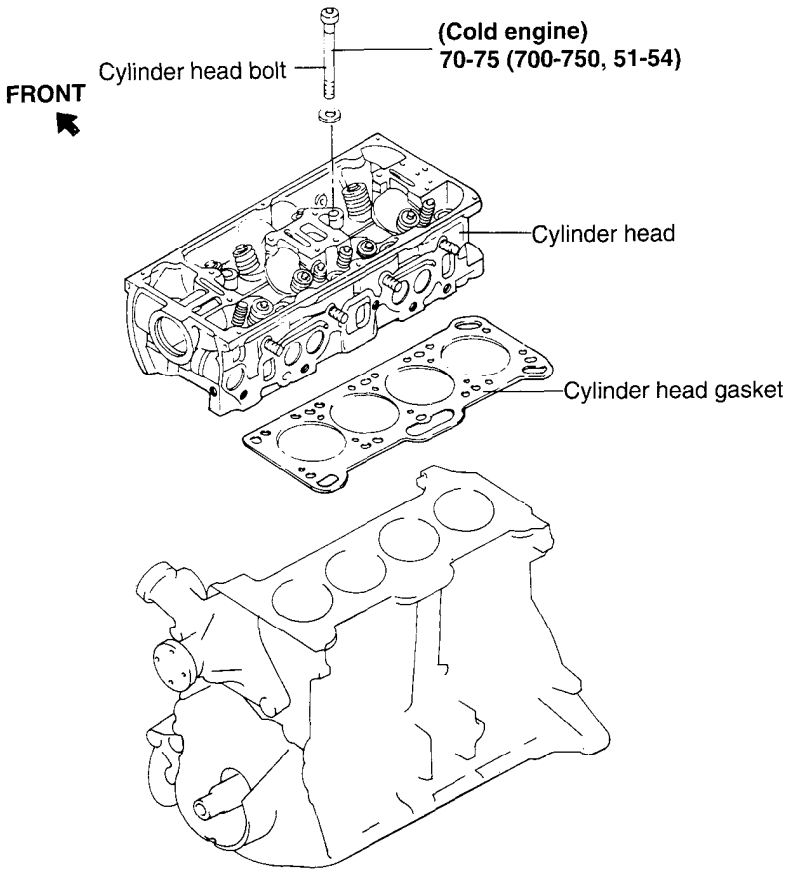
9. Install a gasket in the rocker cover groove.
10. Temporarily install the rocker cover.
11. Start the engine and run at idle.
12. After warming the engine to normal operating temperature [80 to 95°C (176 to 205°F) coolant temperature], adjust the valve clearance to specification. See “Valve Clearance Adjustment Procedure”.
13. Install the rocker cover and tighten the bolts to the specified torque.

Tightening torque
Rocker cover bolt . . . . . 1.5-2.0 Nm (15-20 kg.cm, 1.1-1.4 lb.ft)

14. Install the timing belt cover.

CYLINDER HEAD

COMPONENTS

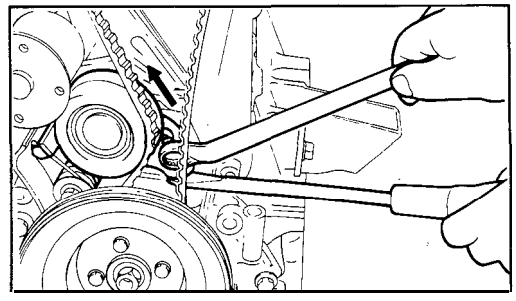


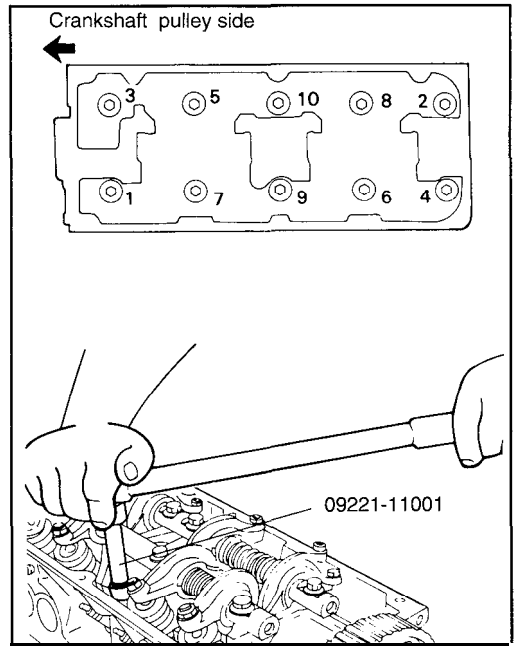
TORQUE : Nm (Kg.cm, lb.ft)

REMOVAL

1. Drain the coolant and disconnect the upper radiator hose.
2. Remove the breather hose (between the air cleaner and the rocker cover).
3. Remove the air cleaner.
4. Remove the vacuum hose, fuel hose and water hose.
5. Remove the cables from the spark plugs. The cables should be removed by holding their boot portions.

6. Remove the distributor.
7. Remove the surge tank.
8. Remove the intake manifold.
9. Remove the heat cowl and exhaust manifold assembly.
10. Remove the timing belt cover.
11. Move the timing belt tensioner pulley toward the water pump and temporarily secure it.
12. Remove the timing belt from the camshaft sprocket. Since the crankshaft pulley need not be removed, the timing belt should be left on the crankshaft sprocket.
13. Remove the rocker cover.
14. Remove the cylinder head assembly. The cylinder head bolts should be removed by using Special Tool, Cylinder Head Bolt Wrench (09221-11001), in the sequence as shown in the illustration.
15. Remove the gasket pieces from the cylinder block top surface and cylinder head bottom surface.

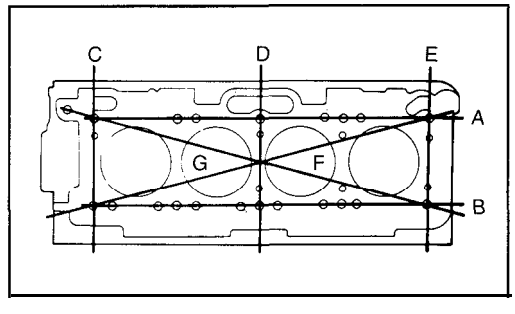




NOTE
Make sure that the gasket pieces do not fall in the engine.

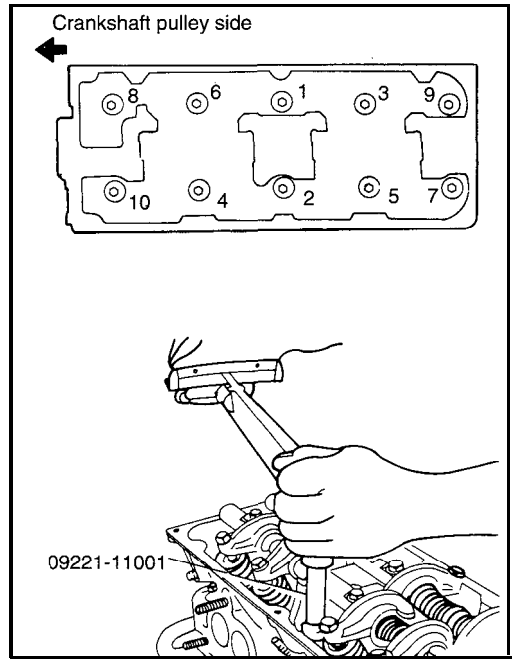
INSPECTION

1. Check the cylinder head for cracks, damage and coolant leakage.
2. Remove scale, sealing compound and carbon deposits completely. After cleaning oil passages, apply compressed air to make certain that the passages are not clogged.
3. Check the EGR gas passage for clogging.
   And for FBC system, also check the jet air passage for clogging.
4. Check the cylinder head gasket surface for flatness by using a straight edge in the direction of A, B, . . . as shown.
   If flatness exceeds service limit in any direction, either replace the cylinder head, or lightly machine the cylinder head gasket surface.



Flatness of cylinder head gasket surface	
[Standard dimension]	Less than 0.05 mm (0.002 in.)
[Limit]	0.1 mm (0.004 in.)

INSTALLATION



1. Clean all gasket surfaces of the cylinder block and the cylinder head.
2. Install a new cylinder head gasket onto the cylinder head assembly. Do not apply sealant to the gasket and do not reuse the old cylinder head gasket.
3. Install the cylinder head bolts. Starting at top center, tighten all cylinder head bolts in sequence as shown in illustration, using the Cylinder Head Bolt Wrench (09221-11001). Repeat the procedure, retightening all cylinder head bolts to the specified torque.

Tightening torque
Cylinder head bolt
Cold . . . . . 70-75 Nm (700-750 kg.cm, 51-54 lb.ft)
Hot . . . . . 80-85 Nm (800-850 kg.cm, 58-61 lb.ft)

4. Move the timing belt tensioner pulley toward the water pump and temporarily secure it.
5. Install the timing belt on the camshaft sprocket, making sure that the tension side is tight. Check to ensure that when the tension side is tightened by turning the camshaft sprocket in reverse, all timing marks are in alignment.
6. Adjust the timing according to 'Timing Belt".
7. Install the rocker cover and tighten the bolts to the specified torque.

Rocker cover bolt Tightening torque . . . . . 1.5-2.0 Nm (15-20 kg.cm, 1.1-1.4 lb.ft)

8. Install the timing belt cover.
9. Install the new intake manifold gasket and the intake manifold. Tighten the nuts and bolts to the specified torque.

Tightening torque
Manifold nuts and bolts . . . . . (both intake and exhaust)
15-20 Nm (150-200 kg.cm, 11-14 lb.ft)

10. Install the new exhaust manifold gasket and the exhaust manifold. Tighten the exhaust manifold attaching nuts to the specified torque.

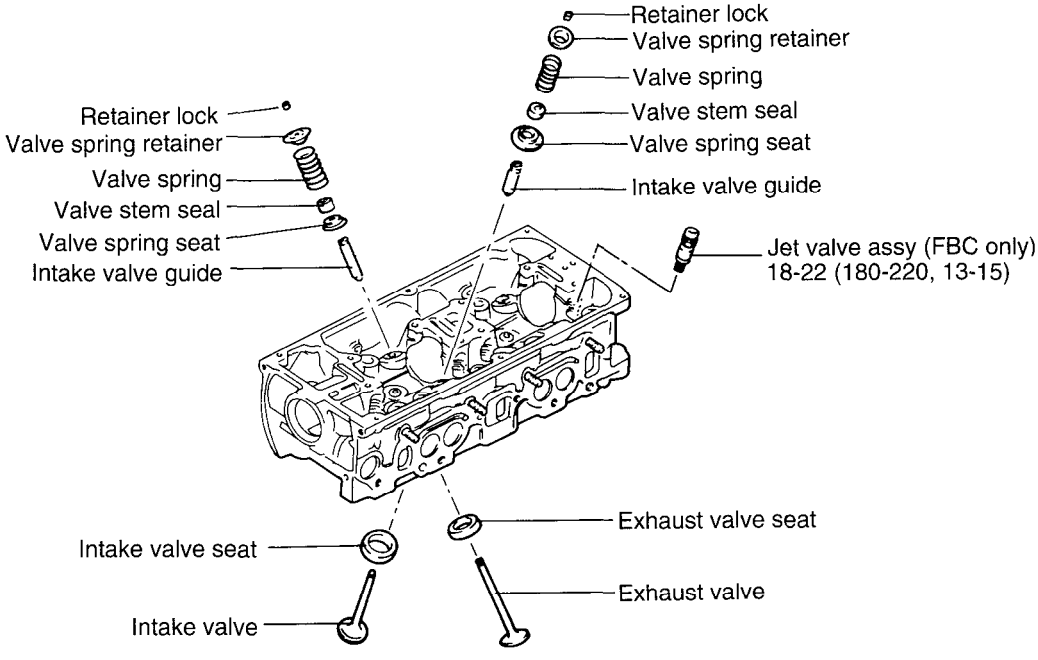
11. Install the surge tank and tighten the nuts and bolts to the specified torque.
    For carburetor type, install the carburetor and tighten the bolts to the specified torque.

Tightening torque
- Surge tank to inlet manifold nuts and bolts . . . . . 15-20 Nm (150-200 kg.cm, 11-14 lb.ft)
- Carburetor to intake manifold bolts . . . . . 15-20 Nm (150-200 kg.cm, 11-14 lb.ft)

12. Install the distributor.
13. Connect the vacuum hose, fuel hose and water hose.
14. Install the air cleaner and breather hose.

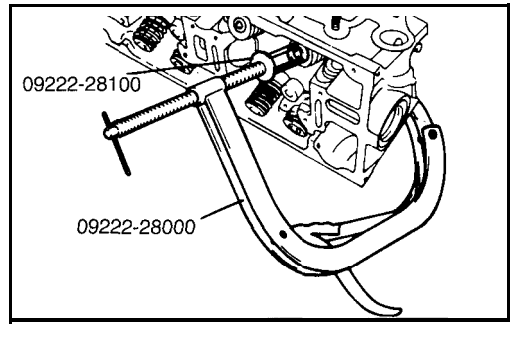
VALVES AND VALVE SPRINGS

COMPONENTS



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

REMOVAL



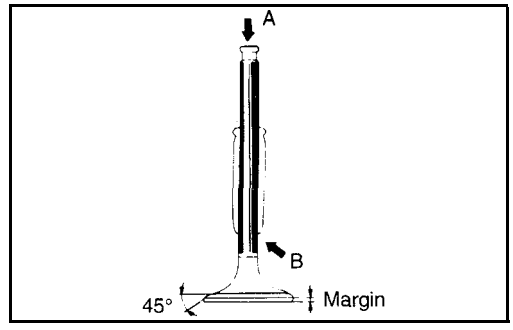
1. Using Special Tool, Valve Spring Compressor (09222-28000, 09222-28100), remove the retainer lock.
   Next remove the spring retainer, valve spring, spring seat and valve.

   NOTE
   Keep these parts in order so that they can be reinstalled in their original positions.

2. Remove the valve stem seals with pliers, and discard.

   NOTE
   Do not reuse the valve stem seals.

INSPECTION



Valves

Check each valve for wear, damage and distortion of head and stem at B. Repair or correct if necessary.
If stem end A is pitted or worn, resurface as necessary This correction must be limited to a minimum. Also resurface the valve face.
Replace the valve if the margin has decreased to less than the service limit.

Margin
- [Standard dimension]
  - Intake . . . . . 1.0 mm (0.039 in.)
  - Exhaust . . . . . 1.5 mm (0.059 in.)
- [Limit]
  - Intake . . . . . 0.7 mm (0.028 in.)
  - Exhaust. . . . . 1.0 mm (0.039 in.)

Valve Springs

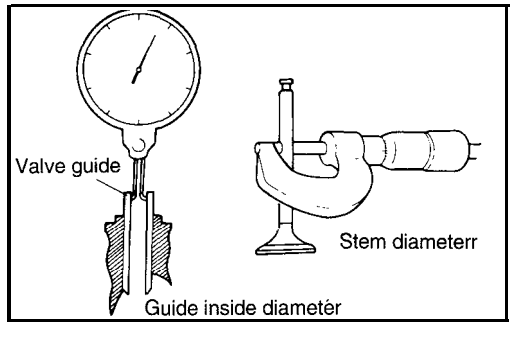
1. Check the valve spring free length and tension. If they exceed the service limit, replace the spring.
2. Using a square, test the squareness of each spring. If the spring is excessively out of square, replace it.

Valve spring
- [Standard Value]
  - Free height . . . . . 44.6 mm (1.756 in.)
  - Load. . . . . 24 kg at 27.3 mm (53 lb at 1.075 in.)
  - Out of square . . . . . 1.5º or less
- [Limit]
  - Free height . . . . . -1.0 mm (-0.039 in.)
  - Out of square 3º

Valve Guides

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

Valve stem-to-guide clearance
- [Standard dimension]
  - Intake . . . . . 0.03-0.06 mm (0.0012-0.0024 in.)
  - Exhaust. . . . . 0.05-0.09 mm (0.0020-0.0035 in.)
- [Limit]
  - Intake . . . . . 0.1 mm (0.004 in.)
  - Exhaust . . . . . 0.15 mm (0.006 in.)



Valve Guide Oversizes

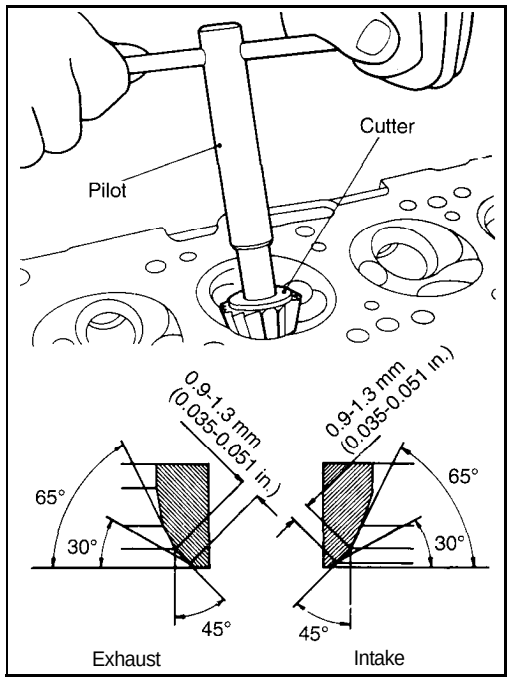
Size mm (in.)	Size mark	Cylinder head hole size mm (in.)
0.05 (0.002) O.S	5	12.05-12.068 (0.4744-0.4751)
0.25 (0.010) O.S	25	12.25-12.268 (0.4822-0.4829)
0.50 (0.020) O.S	50	12.50-12.518 (0.4921-0.4928)

Valve Seat Insert

Check the valve seat for evidence of overheating and improper contact with the valve face. Recondition or replace the seat if necessary.

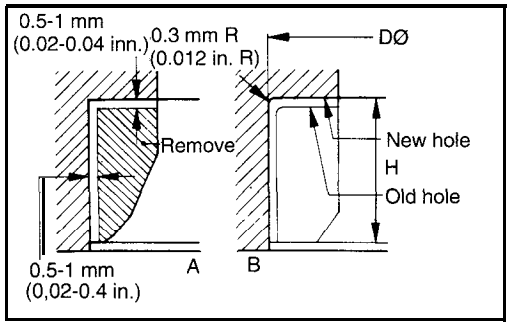
Before reconditioning the seat, check the valve guide for wear. If the valve guide is worn, replace it, then recondition the seat.

Recondition the valve seat with a valve seat grinder or cutter. The valve seat contact width should be within specifications and centered on the valve face.



Valve Seat Insert Replacement Procedure

1. Any valve seat insert that has been worn over the service limit should be removed at normal temperature after cutting away most of the insert wall, using valve seat cutters, as shown in Fig. “A”.



Valve Seat Insert Oversizes

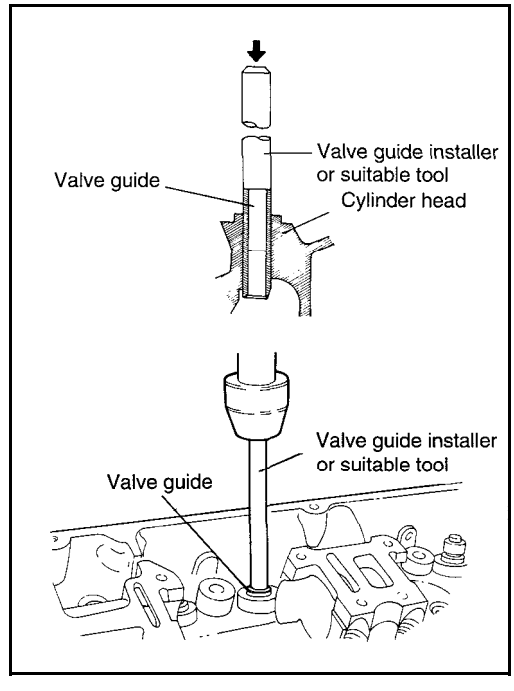
Description	Size mm (in.)	Size mark	Seat insert height H mm (in.)	Cylinder head I.D. mm (in.)
Intake valve seat insert	0.3 (0.012) O.S	30	7.0-7.2 (0.276-0.283)	36.30-36.33 (1.429-1.430)
	0.6 (0.024) O.S	60	7.3-7.5 (0.287-0.295)	36.60-36.63 (1.441-1.442)
Exhaust valve seat insert	0.3 (0.012) O.S	30	7.4-7.6 (0.291-0.299)	32.30-32.33 (1.272-1.273)
	0.6 (0.024) O.S	60	7.7-7.9 (0.303-0.311)	32.60-32.63 (1.283-1.285)

2. After removing the seat insert, machine the seat insert bore using a reamer or a cutter. Cut to the size shown in the table.
3. Heat the cylinder head to about 250°C (480°F) and press in the oversize seat insert. The oversize seat insert should be at normal room temperature for installation. After installation of a new valve seat insert, resurface the valve seat using the same procedure as in paragraph 1. in Valve Seat Insert.

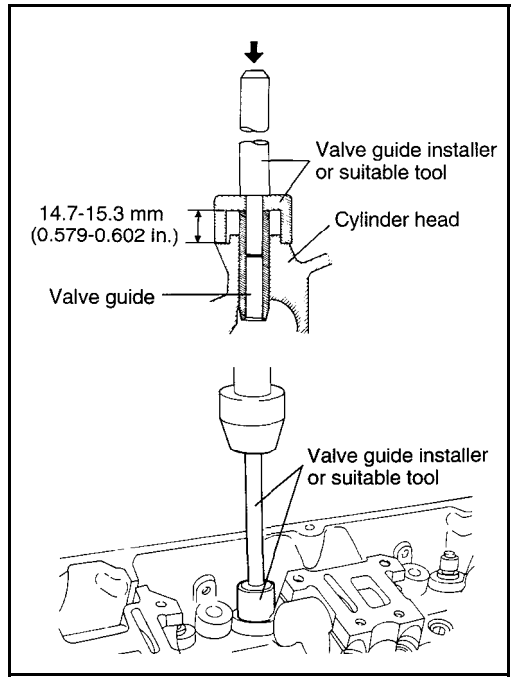
Valve Guide Replacement Procedures

The valve guide is installed using a press fit. Using a Valve Guide Installer (09222-21200) or suitable tool, replace the valve guide by the following procedure.

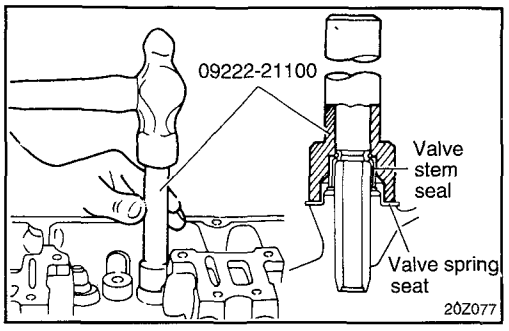
1. Using the push rod of the Valve Guide Installer, push the valve guide out toward the cylinder block with a press.
2. Machine the valve guide insert hole in the cylinder head to the specified oversize of the new valve guide.



3. Using the Valve Guide Installer or suitable tool, press fit the valve guide. The use of the valve guide installer makes it possible to press fit the valve guide to a predetermined height. The valve guide should be installed from the top of the cylinder head. Note that the intake and exhaust valve guides are different in length [44 mm (1.73 in.) for intake and 49.5 mm (1.95 in.) for exhaust].
4. After the valve guides have been installed, insert new valves and check the clearance.
5. Whenever valve guides are replaced, check for valve to seat contact and recondition the valve seats as necessary.

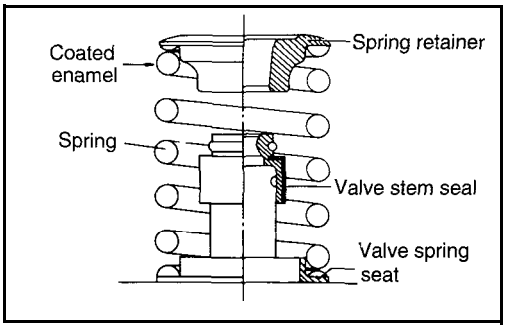


INSTALLATION

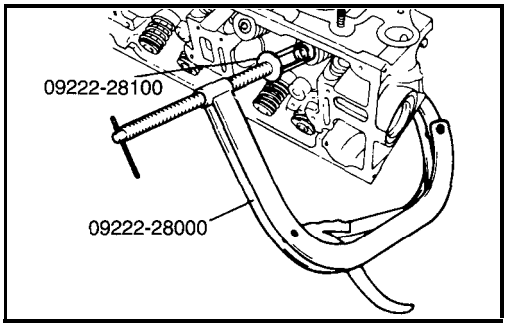


CAUTION
1) Clean each part before assembly.
2) Apply engine oil to sliding and rotating parts.

1. After installing the spring seat, fit the stem seal onto the valve guide.
   To install, fit the seal in by lightly tapping the Special Tool, Valve Stem Oil Seal Installer (09222-21100).
   The seal is installed in the specified position by means of the special tool. Incorrect installation of the seal will adversely affect the lip I.D. and eccentricity, resulting in oil leakage down the valve guides. When installing, therefore, be careful not to twist the seal. Do not reuse old stem seals.
2. Apply engine oil to each valve. Insert the valves into the valve guides. Avoid inserting the valve into the seal with force.
   After insertion, check to see if the valve moves smoothly.



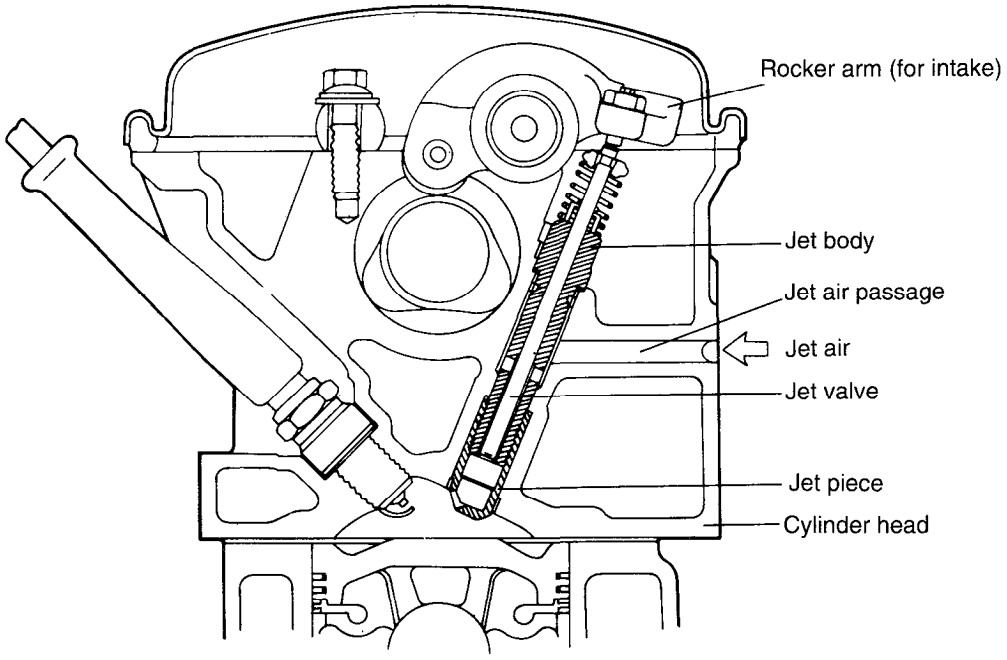
3. Install springs and spring retainers.
   Valve springs should be installed with the enamel coated side toward the valve spring retainer.



4. Using Special Tool, Valve Spring Compressor (09222-28000, 09222-28100), compress the spring. Be careful that the valve stem seal is not distorted by the bottom of the retainer. Then install the retainer locks. After installation of the valves, make certain that the retainer locks are properly installed.
5. Install the cylinder head. Refer to “Cylinder Head’.

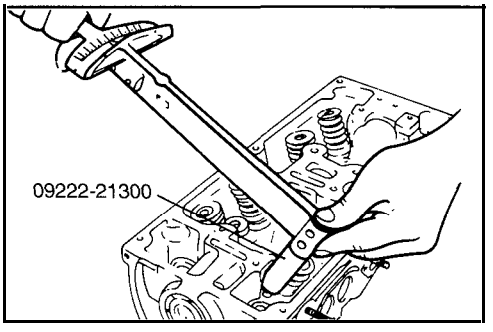
JET VALVE

COMPONENTS



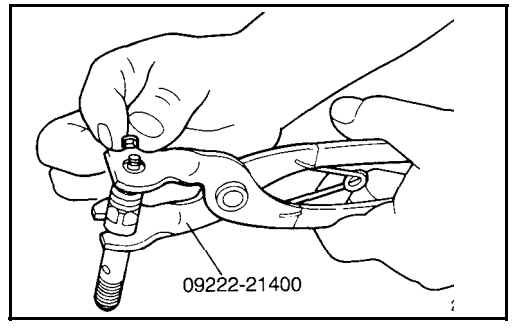
REMOVAL

1. Remove the rocker arms and shafts. Refer to Rocker Arm and Rocker Arm Shaft.
2. Remove the valves, using Special Tool, Jet Valve Socket Wrench (09222-21300).



CAUTION
When the jet valve socket wrench is used, make certain that the wrench is not tilted with respect to the center of the jet valve. If the tool is tilted, the valve stem might be bent by the force exerted on the valve spring retainer, resulting in defective jet valve operation or a damaged tool.

3. When disassembling the jet valve, compress the spring with the Special Tool, Jet Valve Spring Pliers (09222-21400), remove the valve spring retainer lock, and then remove the valve spring retainer and valve spring.



CAUTION
Do not mix up the combination of the jet valve body after the disassembly of the jet valve assembly, other wise gas leakage and malfunctioning may result.

4. Pull off valve stem seals with pliers and discard.

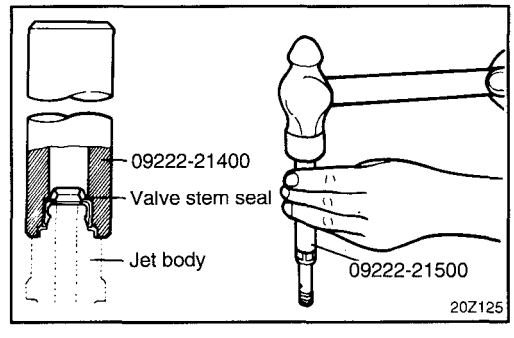
INSPECTION

1. Make sure that the jet valve slides smoothly in the body and has no play.
   Combination of the jet valve and jet body should not be disturbed and the jet valve and jet body should be replaced as an assembly.
2. Check the valve head and valve seat for damage of seizure.
3. Check the spring for sag, cracks or breakage.

[Standard value]
- Diameter of jet valve stem . . . . . 4.30 mm (0.1693 in.)
- Angle of valve face and seat 45º
- Jet valve spring
  - Free length . . . . . 29.60 mm (1.165 in.)
  - Load . . . . . 3.5 kg/21.5 mm (5.5 lb/0.846 in.)

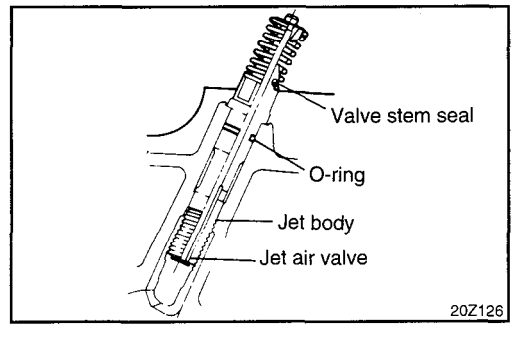
INSTALLATION

1. Using the Special Tool, Jet Valve Stem Seal Installer (09222-21500), drive the valve stem seal into the jet body.



CAUTION
1) The valve stem seal is not reusable.
2) Use Special Tool, otherwise valve stem seal will be improperly installed and oil will work down.

2. Apply engine oil to the jet valve stem when installing it to the jet body. Take care not to damage the valve stem seal lip. Make sure that the jet valve stem slides smoothly in the body.
3. Compress the spring with the Special Tool, Jet Valve Spring Pliers (09222-21400) and install it together with valve spring retainer, and install the retainer lock.
   Be careful not to damage the valve stem seal with bottom of the retainer while installing.
4. Install new O-ring in the jet valve body groove and apply a thin coat of engine oil to it.
5. Install the jet valve assembly, assembled as described in 1 thru 4 above, using Special Tool, Jet Valve Socket Wrench (09222-21300).
   Tighten to the specified torque below. While installing, apply engine oil to the threaded portion and seating surface of the jet body.



CAUTION
1) Install the jet valve assembly, finger-tighten and finally tighten to the specified torque with torque wrench.
2) Keep the socket of wrench aligned with the jet valve stem to prevent it from forcing the stem sidewise or to keep it from dropping.

Tightening torque
Jet valve assembly. . . . . 18-22 Nm (180-220 kg.cm, 13-16 lb.ft)

6. Install the rocker arm shaft assembly and rocker cover. Refer to “Rocker Arm Shaft Assembly”.

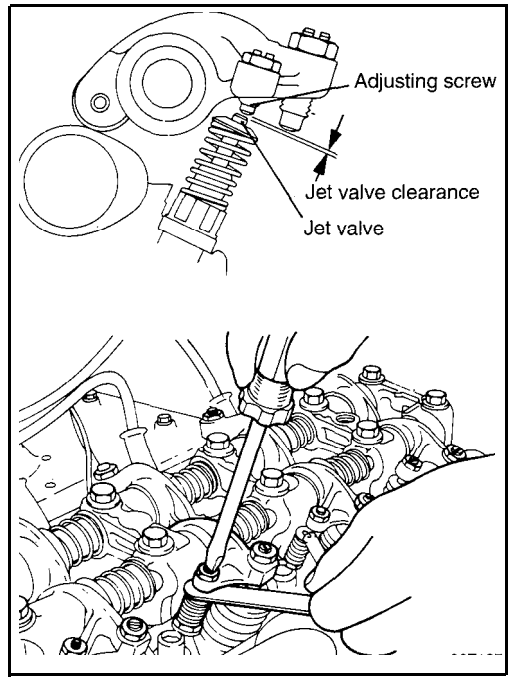
JET VALVE CLEARANCE ADJUSTMENT

CAUTIONS
1) The misadjustment of the jet valve clearance not only affects the exhaust gas level but also may cause some engine trouble. So, be sure to make adjustment as follows:
2) Adjust the jet valve clearance before the adjustment of the intake valve clearance. Readjust it after additional tightening of cylinder head bolts.
3) Loosen fully the adjusting screws while making jet valve clearance adjustment.

1. Warm up the engine until the temperature of the coolant rises to 80 to 95°C (176 to 205°F).
2. With the piston in the cylinder positioned at TDC on the compression stroke, adjust in the following sequence.
3. Back off the adjusting screw for the intake valve 2 or more turns.
4. Loosen the lock nut on the adjusting screw for the jet valve.
5. Turn the adjusting screw for the jet valve counterclockwise and insert a 0.25 mm (0.010 in.) feeler gauge between the jet valve stem and adjusting screw.

Jet valve clearance (hot engine)
[Standard value] . . . . . 0.25 mm (0.010 in.)

6. Tighten the adjusting screw until it touches the feeler gauge. Since the jet valve spring is weak in tensile strength, use special care not to force the jet valve in. Be careful particularly when the adjusting screw is hard to turn.
7. Tighten the lock nut securely while holding the rocker arm adjusting screw with a screwdriver to prevent it from turning.
8. Make sure that a 0.25 mm (0.010 in.) feeler gauge can be easily inserted.
9. Adjust the intake valve clearance.
10. Check for idle CO and R.P.M. and adjust if necessary.



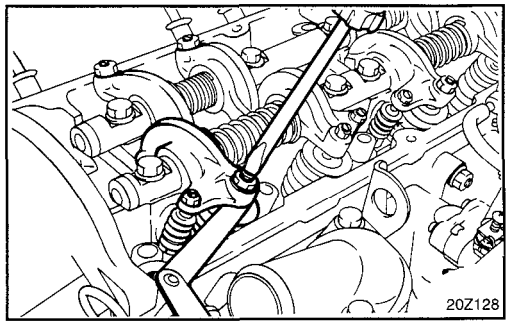
INTAKE AND EXHAUST VALVE CLEARANCE ADJUSTMENT PROCEDURE

CAUTIONS

1) **Adjust the jet valve clearance before adjusting intake valve clearance.**
2) **The valve clearance should be adjusted after additional tightening of the cylinder head bolts.**

1. Warm up the engine until the temperature of the coolant rises to 80 to 95°C (176 to 205°F).
2. With the piston positioned at TDC on the compression stroke, adjust as follows:
3. Loosen the lock nut.
4. Adjust the valve clearance by turning the adjusting screw while measuring the clearance with a feeler gauge.

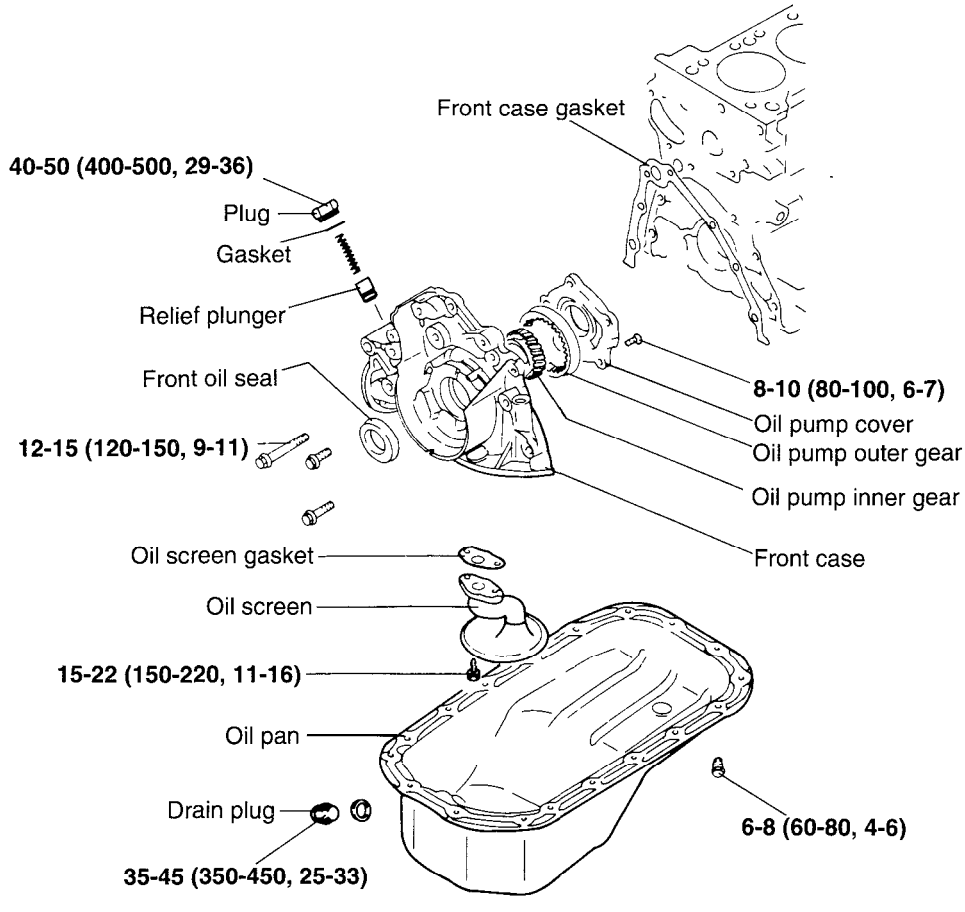
Valve clearance (hot engine) [Standard value]
Intake . . . . . 0.15 mm (0.006 in.)
Exhaust . . . . . 0.25 mm (0.010 in.)



5. Tighten the lock nut securely while holding the rocker arm adjusting screw with a screwdriver to prevent it from turning.
6. Check for idle CO, HC and R.P.M. and adjust if necessary.

FRONT CASE, OIL PUMP

COMPONENTS

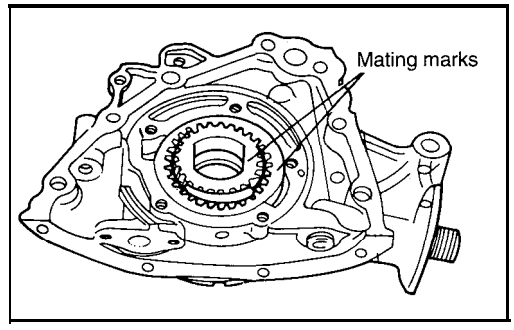


TORQUE : Nm (kg.cm, lb.ft)

REMOVAL

1. Remove the timing belt. Refer to “Timing Belt”.
2. Remove all the oil pan bolts.
3. Remove the oil pan.
4. Remove the oil screen.
5. Remove the front case assembly.

6. Remove the oil pump cover.
7. Remove the inner and outer gears from the front case. The mating marks on the inner and outer gears indicate the direction of installation. Make sure that the inner and outer gears are installed as shown.
8. Remove the plug and remove the relief spring and relief valve.



INSPECTION

Front Case

1. Check the front case for cracks or damage. Replace as necessary.
2. Check the front oil seal for worn or damaged lips. Replace if defective.

Oil Pan and Oil Screen

1. Check the oil pan for failure, damage or cracks. Replace if defective.
2. Check the oil screen for failure, damage and cracks and replace if defective.

Front Case and Oil Pump Cover

Worn (especially stepped) or damaged surfaces contacting gears.

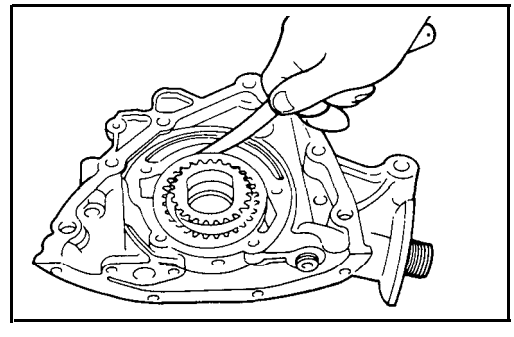
Oil Pump Gears

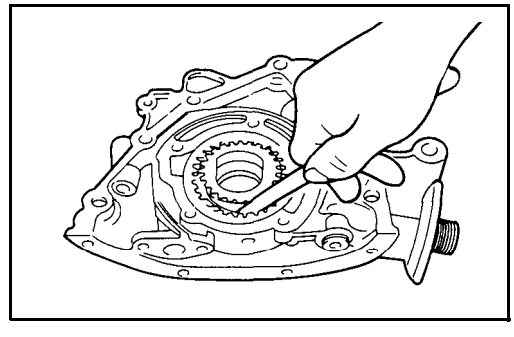
1. Worn or damaged gear tooth surfaces.
2. Clearance between outer gear and front case.

Outer gear
- Clearance between outer circumference and front case.... 0.1-0.2 mm (0.0039-0.0079 in.)
- Clearance between addendum and crescent . . . . . 0.22-0.34 mm (0.0087-0.0134 in.)
- End play . . . . . 0.04-0.10 mm (0.0016-0.0039 in.)

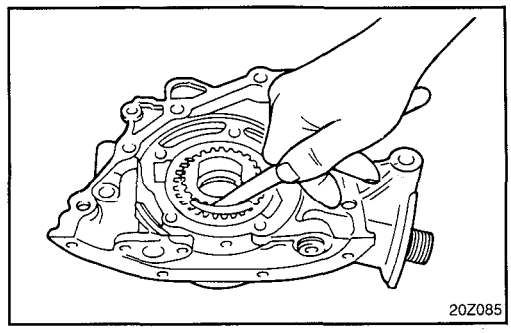
Inner gear
- Clearance between addendum and crescent . . . . . 0.21-0.32 mm (0.0083-0.0126 in.)
- End play . . . . . 0.04-0.10 mm (0.0016-0.0039 in.)

3. Check the clearance between the outer gear addendum and crescent.





4. Check the clearance between the inner gear addendum and crescent.



Relief Valve and Spring

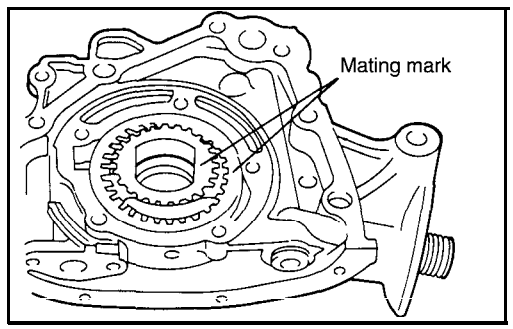
1. Check sliding condition of the relief valve inserted in the front case.
2. Inspect for distorted or broken relief valve spring.

[Standard value]
Free height . . . . . 46.6 mm (1.835 in.)
Load. . . . . 6.1 kg/40.1 mm (13.4 lb/1.579 in.)

INSTALLATION

Oil Pump

1. Install the outer and inner gears into the front case. Make sure that the inner and outer gears are installed in the same direction as shown.
2. Install the oil pump cover and tighten the bolts to the specified torque. After the bolts have been tightened, check to ensure that the gear turns smoothly.



Tightening torque
Oil pump cover bolt . . . . . 8-10 Nm (80-100 kg.cm, 6-7 lb.ft)

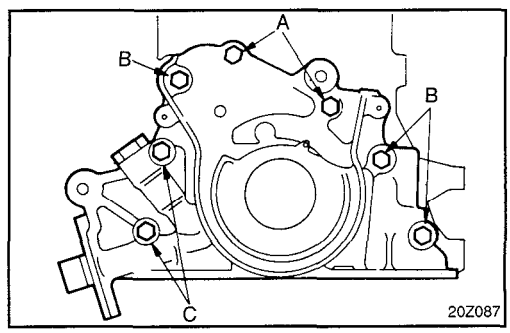
3. Install the relief valve and spring. Tighten the plug to the specified torque. Apply engine oil to the relief valve.

Tightening torque
Relief valve plug . . . . . 40-50 Nm (400-500 kg.cm, 29-36 lb.ft)

Front Case

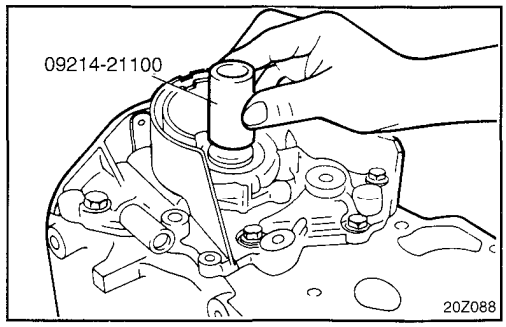
Install the front case assembly with a new gasket, and tighten the bolts to the specified torque.

Body length (A) . . . . . 30 mm (1.18 in.)
(B) . . . . . 20 mm (0.79 in.)
(C) . . . . . 60 mm (2.36 in.)
Tightening torque . . . . . 12-15 Nm (120-150 kg.cm, 8.7-11 lb.ft)

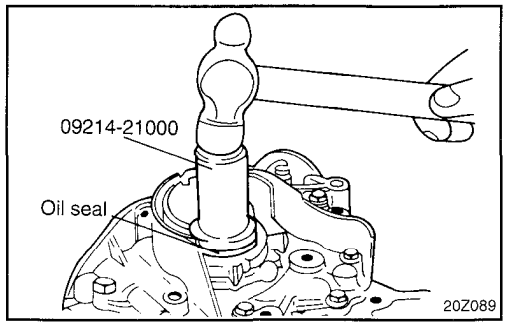


Oil Seal

1. Inspect for worn, distorted or damaged lips.
2. Check for elongated spring ring.
3. Install Special Tool, Crankshaft Front Oil Seal Guide (09214-21100), to the front end of the crankshaft. Apply engine oil to the outer surface of the oil seal guide, and install the new oil seal along the guide by hand, until it touches front case. Always use a new oil seal when reassembling.

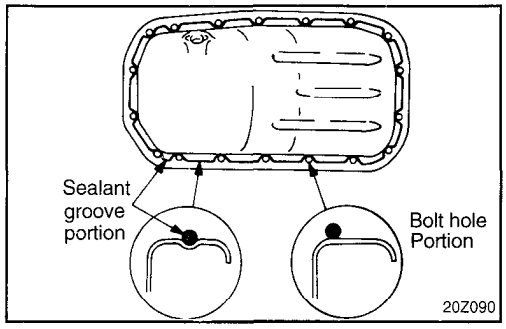


4. Use Special Tool, Crankshaft Front Oil Seal Installer (09214-21000), to install the oil seal.
5. Install the crankshaft sprocket, timing belt and crank shaft pulley. Refer to “Timing Belt”.
6. Install the oil screen.
7. Clean both gasket surfaces of the oil pan and the cylinder block.



8. Apply sealant into the groove of the oil pan flange as shown.

CAUTION
1) Apply sealant approx. 4 mm (0.16 in.) in thickness.
2) After application of sealant, do not exceed 15 minutes before installing the oil pan.

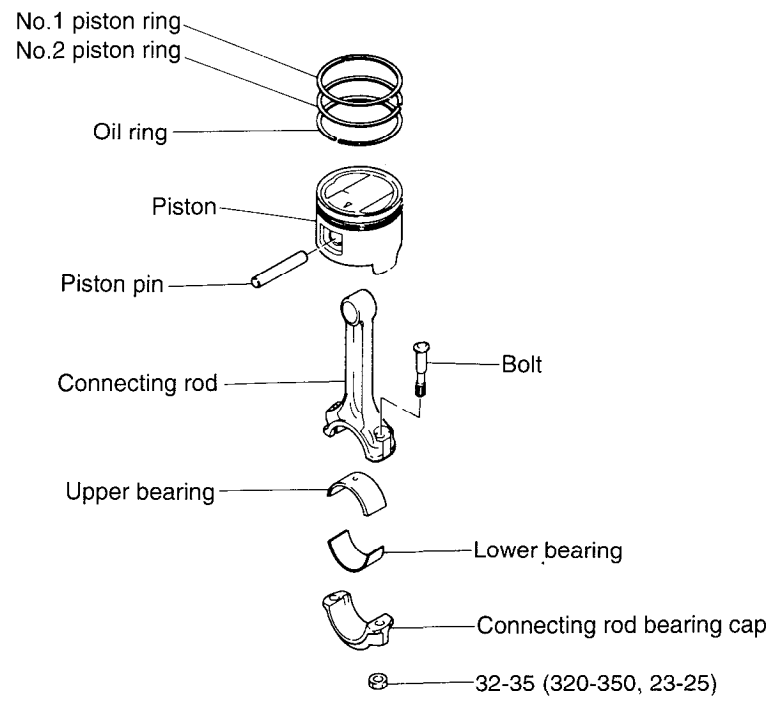


9. Install the oil pan and tighten the bolts to the specified torque.

Tightening torque
Oil pan bolt. . . . . 6-8 Nm (60-80 kg.cm, 4-6 lb.ft)

PISTON AND CONNECTING ROD

COMPONENTS



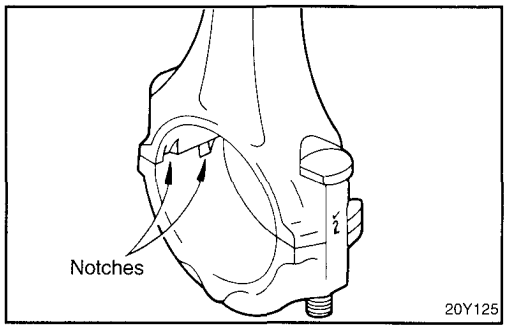
TORQUE : Nm (kg.cm, lb.ft)

REMOVAL

Connecting Rod Cap

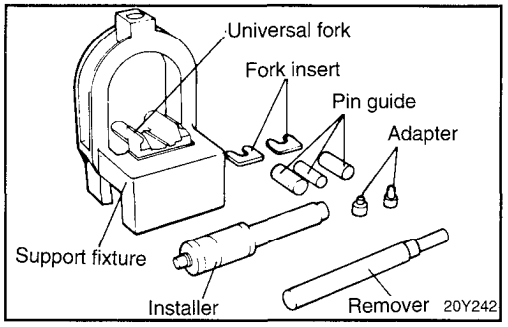
NOTE
Keep the bearings sin order with their corresponding connecting rods (according to cylinder numbers) for proper reassembly.

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

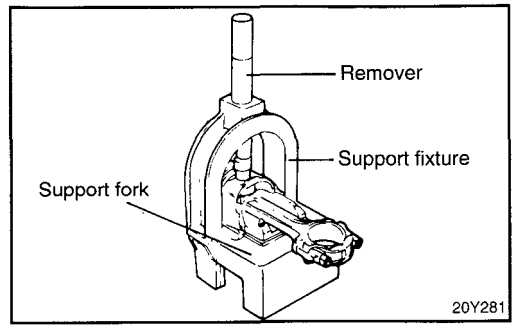
1. Use the special tools (09234-33001) to disassemble and reassemble the piston and connecting rod.
2. Place the proper insert in the fork of the tool. Position the insert between the connecting rod and the piston.



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

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

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

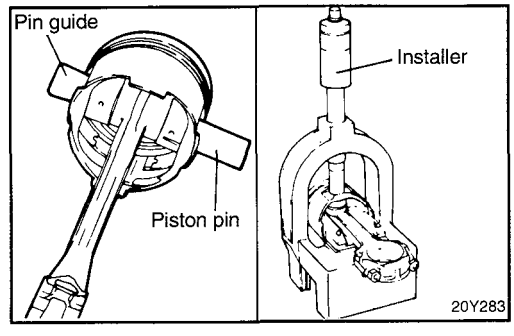


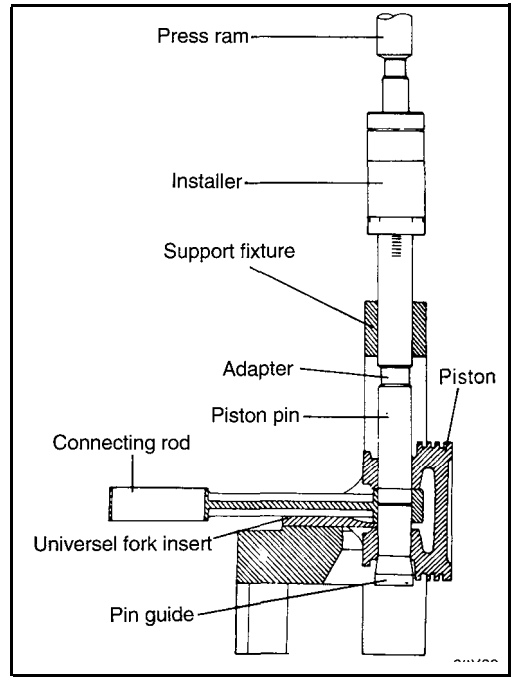
5. Install proper pin guide (refer to application chart) through piston and into connecting rod. Hand tap pin guide into piston for proper retention. Drop piston pin into the other side of the piston.

NOTE
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 thee 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 Pin

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 also should 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 push into the pin hole by hand 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	0.03-0.07 mm (0.0012-0.0028 in.)
No.2	0.02-0.06 mm (0.0008-0.0024 in.)
[Limit]	
No.1	0.15 mm (0.006 in.)
No.2	0.12 mm (0.005 in.)

2. To measure the piston ring end gap, insert a piston ring into the cylinder bore. Correctly position the ring into the cylinder by gently pushing it down with a piston. Remove the piston and measure the end gap with a feeler gauge. If the gap is not within the service limit, replace the piston ring.

Piston ring end gap No.1 and No.2	
[Standard dimension]	0.2-0.35 mm (0.008-0.014 in.)
[Limit]	0.8 mm (0.031 in.)
Oil ring side rail end gap	
[Standard dimension]	0.2-0.7 mm (0.008-0.030 in.)
[Limit]	1 mm (0.039 in.)

When replacing the ring only, without correcting the cylinder bore, check the end gap with the ring positioned at the bottom of the ring travel.

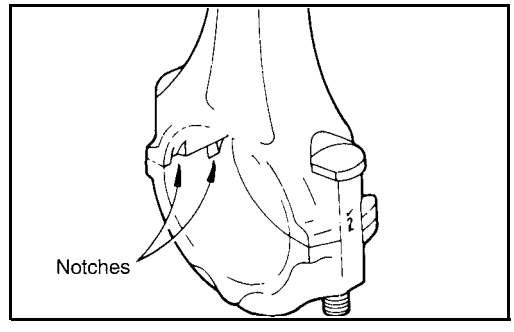
When replacing a ring, be sure to use a ring of the same size.

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

1. When reinstalling, make sure that cylinder numbers put on the connecting rod and 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.

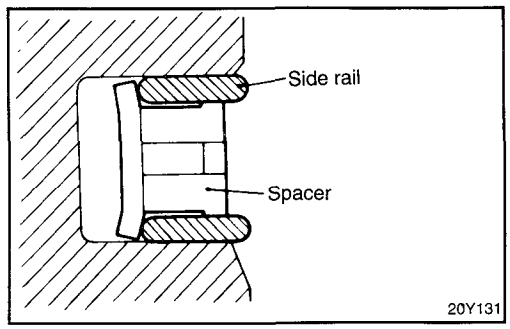


2. Replace the connecting rod if it is damaged on the thrust faces at either end. Also if step wear or a severely rough surface of the inside diameter of the small end is apparent, the rod must be replaced as well.
3. Using a connecting rod aligning tool, check the rod for bend and twist. If the measured value is close to the repair limit, correct the rod by a press. Any connecting rod that has been severely bent or distorted should be replaced.

Allowable bend of connecting rod	0.05 mm/100 mm (0.0020 in./3.94 in.) or less
Allowable twist of connecting rod	0.1 mm/100 mm (0.0039 in./3.94 in.) or less

INSTALLATION

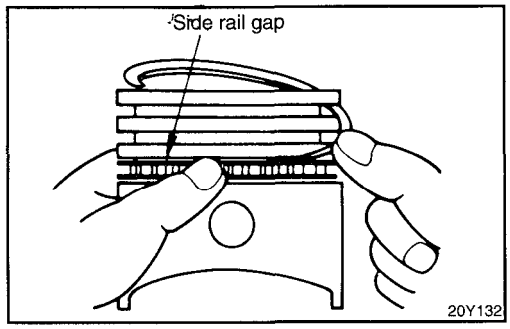
1. Install the spacer.



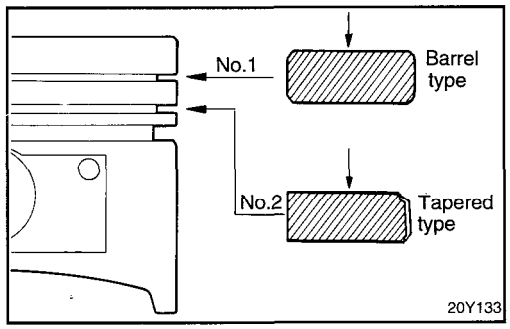
2. Install upper side rail. To install side rail, first put one end of side rail between piston ring groove and spacer, hole it down firmly, and then press down the portion which is to be inserted into groove with a finger as illustrated.

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

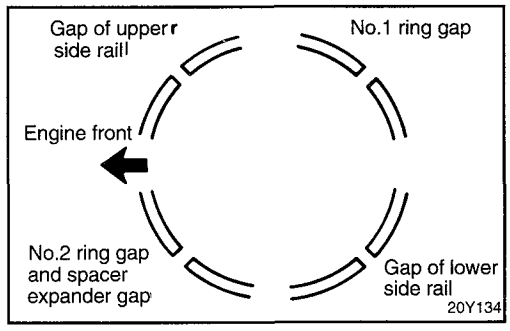
3. Install lower side rail by same procedure as Step 2.



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

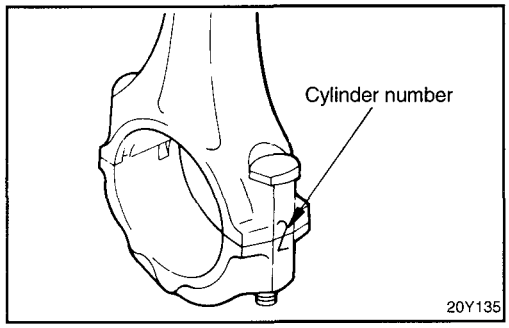


7. Position each piston ring end gap as for apart from neighboring gaps as possible. Make sure that gaps are not positioned in thrust and pin directions.
8. Hold piston rings firmly in a piston ring compressor as they are inserted into cylinder.



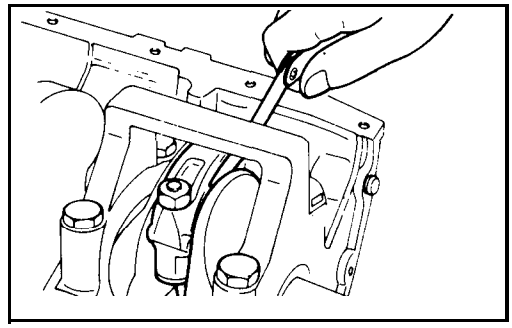
9. Make sure that front mark of piston and front mark (identification mark) of connecting rod are directed toward front of engine.
10. When connecting rod cap is installed, make sure that cylinder numbers put on rod and cap at disassembly match.
11. When new connecting rod is installed, make sure that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

Tightening torque
Connecting rod cap nuts . . . . . 32-35 Nm (320-350 kg.cm, 23-25 lb.ft)



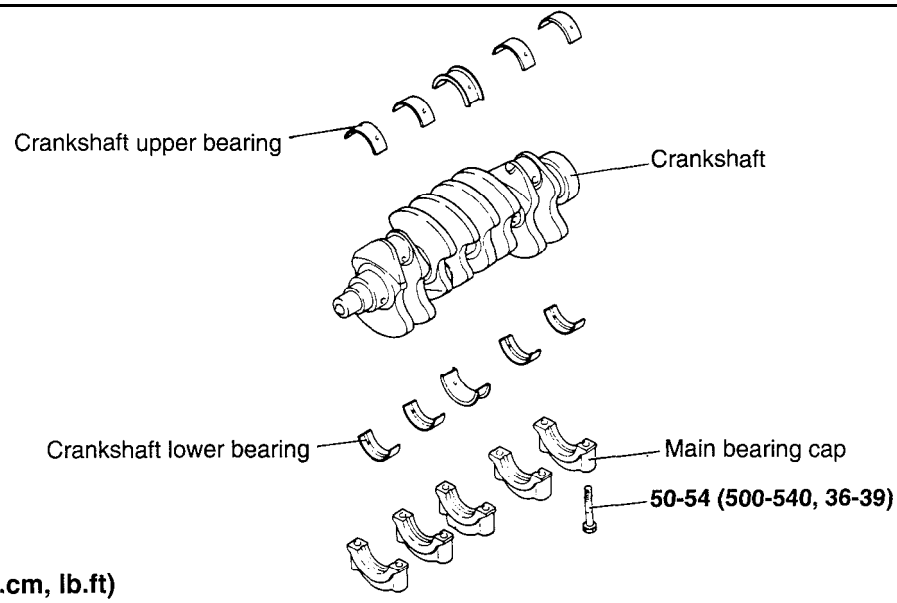
13. Check connecting rod side clearance.

Side clearance	0.10-0.25 mm (0.004-0.010 in.)
Limit	0.4 mm (0.016 in.)



CRANKSHAFT

COMPONENTS



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

REMOVAL

1. Remove the timing belt, front case, flywheel, cylinder head assembly and oil pan. For details refer to respective chapters.
2. Remove the rear plate 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 oil holes for clogging. Correct or replace any defective part.
2. Inspect out-of-roundness and taper of the crankshaft journals and pins.

[Standard dimension]
Crankshaft journal O.D . . . . . 48 mm (1.8898 in.)
Crank pin O.D . . . . . 42 mm (1.6535 in.)
Crankshaft journal pin out-of-roundness and taper.....
0.01 mm (0.004 in.) or less

Main Bearings and Connecting Rod Bearings.

Visually inspect each bearing for peeling, overheating, seizure and improper contact. Replace the defective bearings.

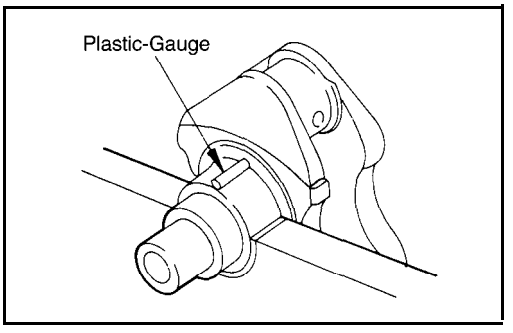
Oil Clearance Measurement

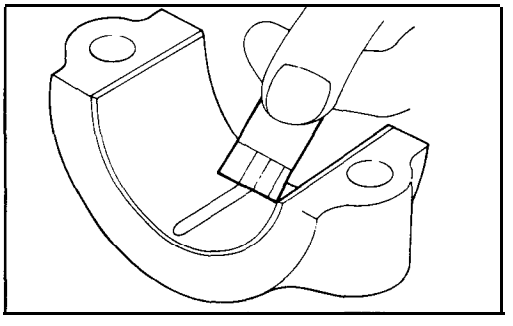
To check the oil clearance, measure the outside diameter of the crankshaft journal and the crank pin and the inside diameter of the bearing. The clearance can be obtained by calculating the difference between the measured outside and inside diameters.

Journal oil clearance	0.02-0.07 mm (0.0008-0.0028 in.)
Pin oil clearance	0.01-0.06 mm (0.0004-0.0024 in.)

Tightening torque	
Main bearing cap bolt	50-54 Nm (500-540 kg.cm, 36-39 lb.ft)
Connecting rod cap nut	32-35 Nm (320-350 kg.cm, 23-25 lb.ft)

Oil Clearance Measurement (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 crankshaft journal and place it in parallel with the journal, away from oil holes.
3. Install the bearings and caps and tighten them to the specified torque. During this operation, do not turn the crankshaft. Remove the caps. Measure the width of the plastigauge at the widest part by using a scale printed on the plastigauge package.
   If the clearance exceeds the repair limit, the bearing should be replaced or an undersize bearing 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 should be ground to a recommended undersize, and a bearing of the same size should be installed.

Oil Seal

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

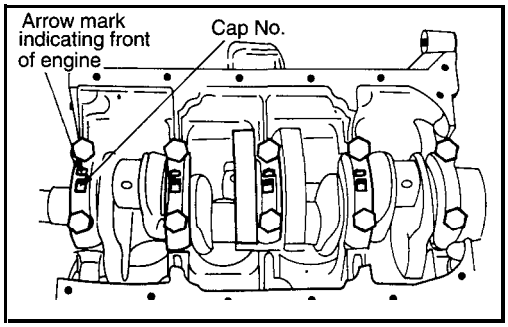
INSTALLATION

1. Install the upper main bearing inserts in the cylinder block.

   When reusing the main bearings, remember to install them by referring to the location marks made at the time of disassembly.

   Oil holes in the bearings must match up with the oil holes in the block.
2. Install the crankshaft. Apply engine oil to the journals.

3. Install the bearing caps and tighten the bolts to the specified torque in the following sequence: No.3, No.2, No.4, No.1 and No.5.
   Cap bolts should be tightened evenly in 2 to 3 stages before they are tightened to the specified torque.
   The caps should be installed with the arrow mark directed toward the crank pulley side of engine. Cap numbers must be in order.

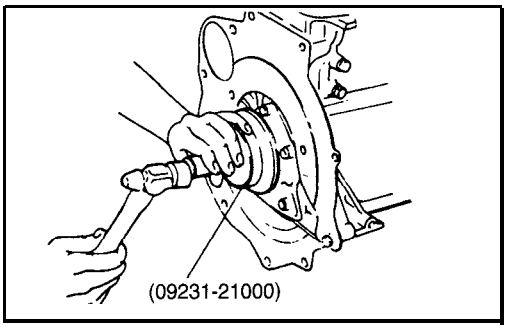


Tightening torque	
Main bearing cap bolt	50-54 Nm (500-540 kg.cm, 36-39 lb.ft)

4. Make certain that the crankshaft turns freely and has the proper clearance between the center main bearing thrust flange and the connecting rod big end bearing.

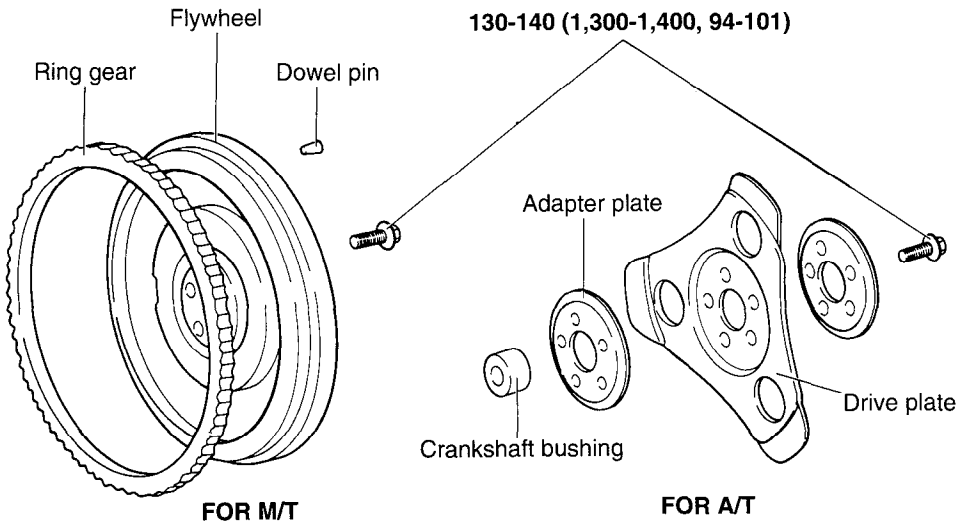
Crankshaft end play	0.05-0.18 mm (0.002-0.007 in.)

5. Install the oil seal in the crankshaft rear oil seal case. Use Special Tool, Crankshaft Rear Oil Seal Installer (09231-21000) as shown. Press fit the oil seal all the way in, being careful not to misalign it.
6. Install the rear oil seal case and gasket. Tighten the five bolts. Apply engine oil to the oil seal lips and crankshaft at the time of installation.
7. Install the rear plate and tighten the bolts.
8. Install the connecting rod caps. Refer to “Piston and Connecting Rods”.
9. Install the flywheel, front case, oil pan and timing belt. For further details, refer to the respective chapters.



FLYWHEEL

COMPONENTS



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

M/T : Manual Transaxle Vehicles
A/T : Automatic Transaxle Vehicles

REMOVAL

1. Remove the transaxle and clutch.
2. Remove the flywheel.

INSPECTION

1. Check the clutch disc contacting surface of the flywheel for damage and wear. Replace the flywheel if excessively damaged or worn.
2. Check the clutch disc contacting surface of the flywheel for run-out.

Standard value
Flywheel run-out . . . . . 0.1 mm (0.004 in.)

3. Check the ring gear for damage, cracks and wear, and replace if necessary.

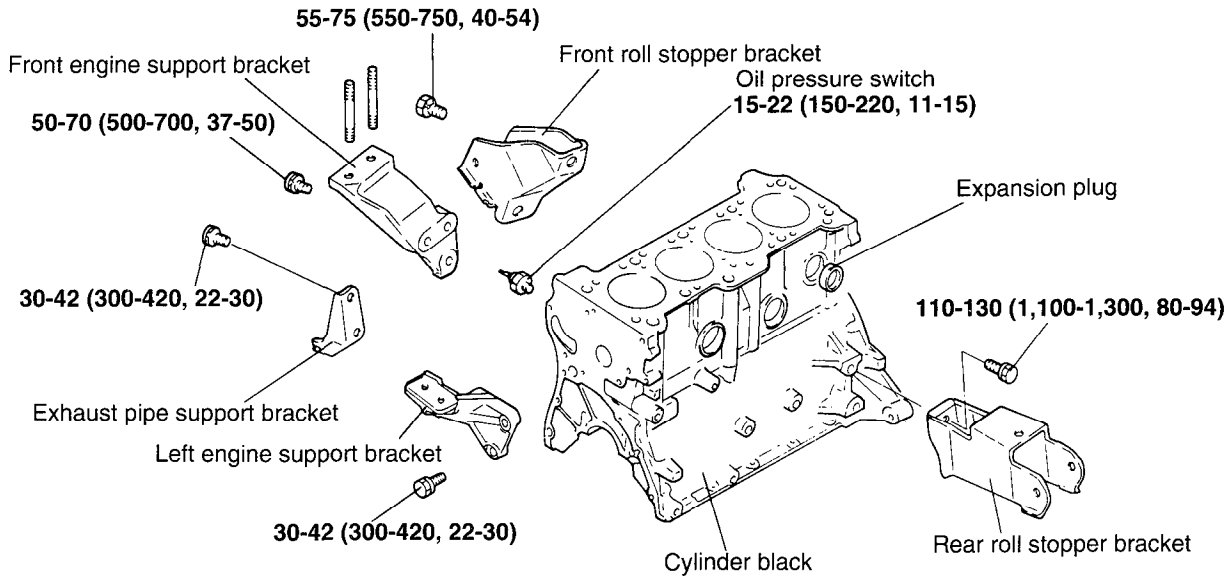
INSTALLATION

Install the flywheel assembly and tighten the bolts to the specified torque.

Tightening torque
Flywheel bolt . . . . . 130-140 Nm (1,300-1,400 kg.cm, 94-101 lb.ft)

CYLINDER BLOCK

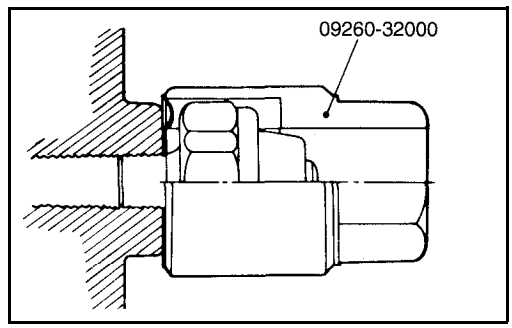
COMPONENTS



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

REMOVAL

1. Remove the cylinder head, timing belt, front case, flywheel, piston and crankshaft.
2. Using the special tool (09260-11000), remove the oil pressure switch.
   For further details, refer to the respective chapters.

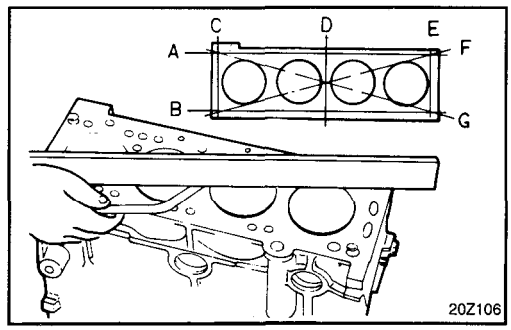


INSPECTION

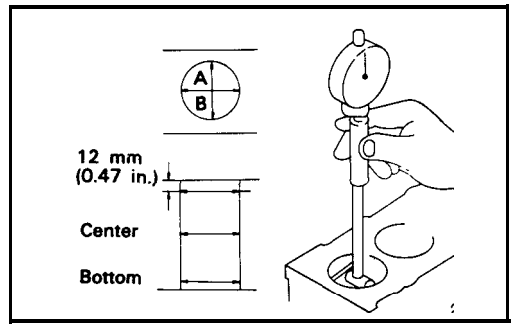
Cylinder Block

1. Visually check the cylinder block for scratches, rust and corrosion. Also check for cracks or any other defects, using a flaw detecting agent (magnafluxing). Correct or replace the block if defective.
2. Using a straightedge and feeler gauge, check the block top surface for warpage. Make sure that the surface is free from gasket chips and other foreign matter.

Standard	0.05 mm (0.0020 in.) or less
Limit	0.1 mm (0.0039 in.)



3. Measure the cylinder bore with a cylinder gauge at three levels in the directions A and B. 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 must be fitted.
   Measuring points are as shown.



Cylinder I.D.	75.5-75.53 mm (2.972-2.974 in.)
Cylinder I.D. taper	0.02 mm (0.0008 in. or less)

4. If a cylinder ridge exists, cut 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. When boring the cylinder bore 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.)

INSTALLATION

Install the following parts by referring to the respective chapters.
(a) Crankshaft
(b) Flywheel
(c) Piston
(d) Cylinder head
(e) Timing belt
(f) Front case

OIL PRESSURE SWITCH

The oil pressure switch is located at the center of the right-hand side of the engine. If the oil pressure in the lubricating system has dropped below 28 kPa (4 psi) during normal operation, the oil pressure warning light will come on. The hexagonal portion of this switch is 26 mm (1.024 in.) wide across the flats.

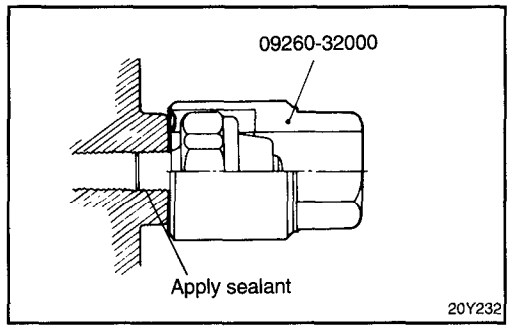
REMOVAL AND INSTALLATION

Using the special tool (09260-11000), install the oil pressure switch after applying sealant to the threaded area.

Sealant . . . . . Threebond 1104. or equivalent

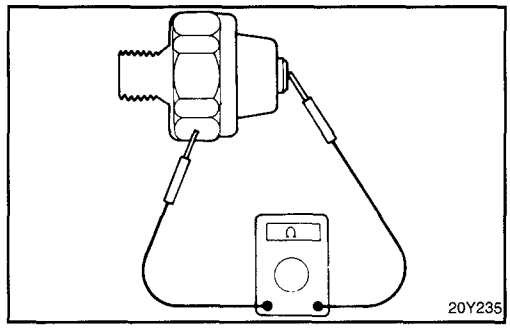
NOTE
Do not over torque the oil pressure switch.

Tightening torque
Oil pressure switch . . . . . 15-21 Nm (150-220 kg.cm, 11-15 lb.ft)



INSPECTION

1. Check the continuity between the terminal and the body with an ohmmeter.
   If there is no 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 to see that air doesn't leak. If air leaks, the diaphragm is broken. Replace the switch.