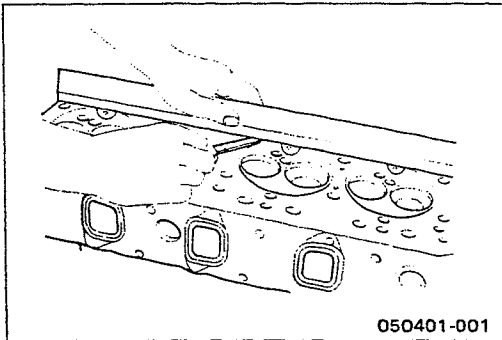




INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.

050401, 05040101A



050401-001



CYLINDER HEAD

Cylinder Head Lower Face Warpage

1. Use a straight edge and a feeler gauge to measure the four sides and the two diagonals of the cylinder head lower face.
2. Regrind the cylinder head lower face if the measured values are greater than the specified limit but less than the maximum grinding allowance.

If the measured values exceed the maximum grinding allowance, the cylinder head must be replaced.

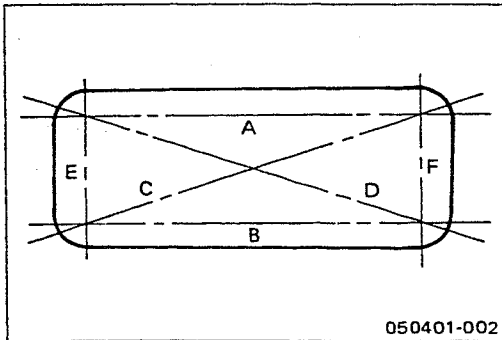
Cylinder Head Lower Face Warpage mm(in)

Standard	Limit	Maximum Grinding Allowance
0.05 (0.002) or less	0.20 (0.008)	0.30 (0.012)

Note:

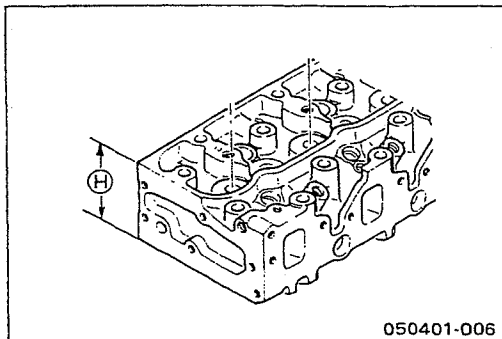
The 4JB1T and 4JB1TC cylinder head cannot be reground.

05040101B



050401-002

05040101C



050401-006



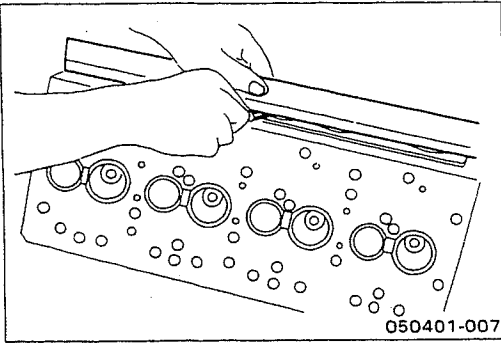
Cylinder Head Height (H) (Reference) mm(in)

Standard	Limit
91.95 - 92.05 (3.620 - 3.624)	91.55 (3.60)

Note:

If the cylinder head lower face is reground, valve depression must be checked.

05040102



050401-007



Manifold Fitting Face Warpage

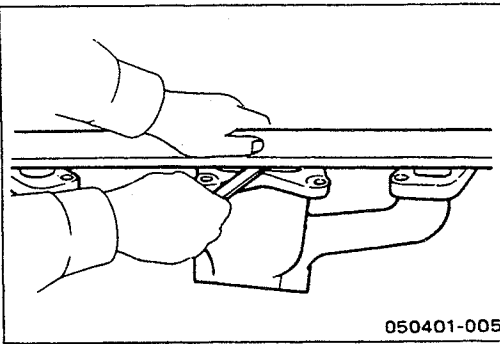
Use a straight edge and a feeler gauge to measure the manifold cylinder head fitting face warpage.

Regrind the manifold cylinder head fitting surfaces if the measured values are greater than the specified limit but less than the maximum grinding allowance.

If the measured values exceed the maximum grinding allowance, the cylinder head must be replaced.

Manifold Fitting Face Warpage		mm(in)
Standard	Limit	Maximum Grinding Allowance
0.05 (0.002) or less	0.20 (0.008)	0.40 (0.016)

05040103



050401-005



Exhaust Manifold Warpage

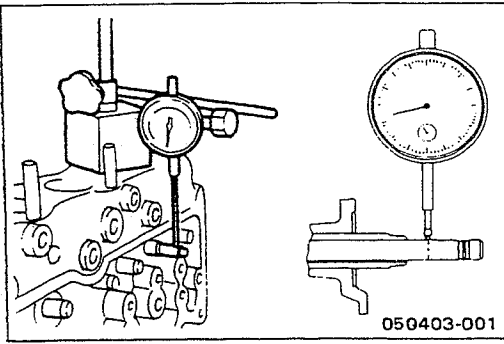
Use a straight edge and a feeler gauge to measure the manifold cylinder head fitting face warpage.

Regrind the exhaust manifold cylinder head fitting surfaces if the measured values are between the specified limit and the standard.

If the measured values exceed the specified limit, the manifold must be replaced.

Exhaust Manifold Warpage		mm(in)
Standard	Limit	
0.05 (0.002) or less	0.20 (0.008)	

050403, 05040301A



VALVE GUIDE

Valve Stem and Valve Guide Clearance

Measuring Method-I

1. With the valve stem inserted in the valve guide, set the dial indicator needle to "0".
2. Move the valve head from side to side.

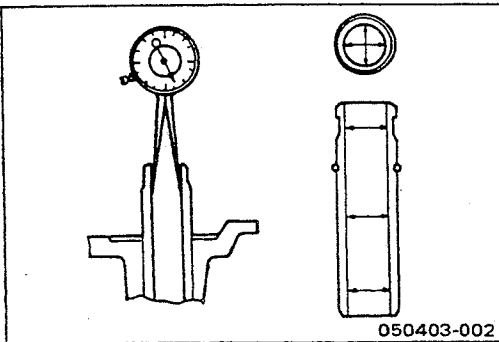
Read the dial indicator.

Note the highest dial indication.

If the measured values exceed the specified limit, the valve and the valve guide must be replaced as a set.

Valve Stem Clearance	mm(in)	
	Standard	Limit
Intake Valve	0.039 - 0.069 (0.0015 - 0.0027)	0.200 (0.008)
Exhaust Valve	0.064 - 0.093 (0.0025 - 0.0037)	0.250 (0.0098)

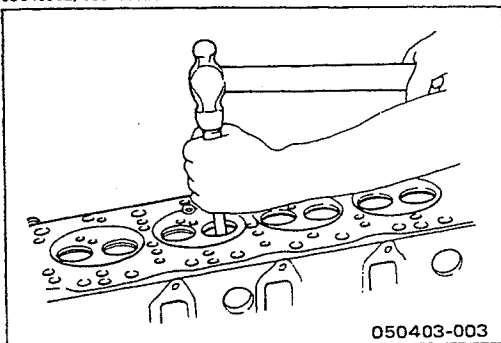
05040301B



Measuring Method-II

1. Measure the valve stem outside diameter.
Refer to the Item "Valve Stem Outside Diameter".
2. Use a caliper calibrator or a telescoping gauge to measure the valve guide inside diameter.
- 3.

05040302, 050403020101



Valve Guide Replacement

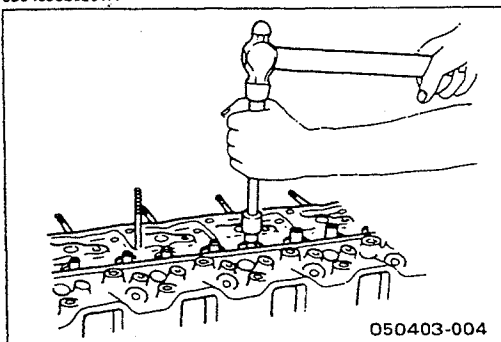
Valve Guide Removal

Use a hammer and the valve guide replacer to drive out the valve guide from the cylinder head lower face.

Valve Guide Replacer: 9-8523-1212-0



050403020201A



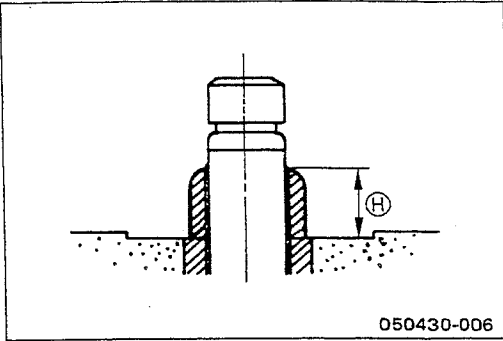
Valve Guide Installation

1. Apply engine oil to the valve guide outer circumference.
2. Attach the valve guide installer to the valve guide.
3. Use a hammer to drive the valve guide into position from the cylinder head upper face.



Valve Guide Installer: 9-8523-1212-0

0504030202B



050430-006



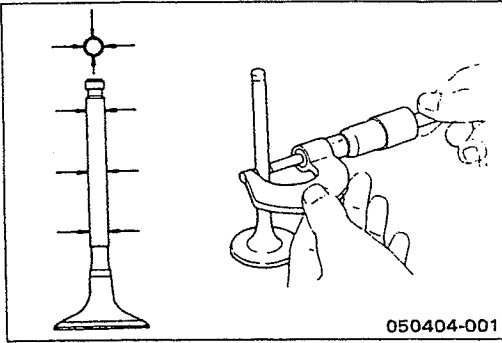
4. Measure the height of the valve guide upper end from the upper face of the cylinder head.

Valve Guide Upper End Height (H) (Reference)	mm(in)
	13 (0.51)

Note:

If the valve guide has been removed, both the valve and the valve guide must be replaced as a set.

050404, 05040401



050404-001



VALVE AND VALVE SEAT INSERT

Valve Stem Outside Diameter

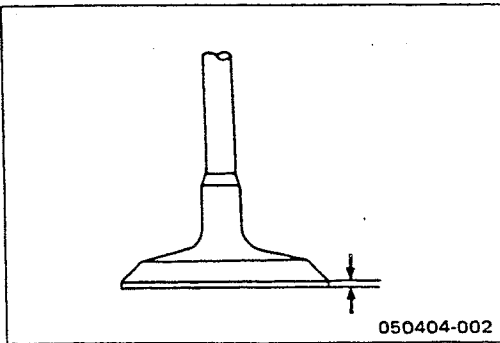
Measure the valve stem diameter at three points.

If the measured value is less than the specified limit, the valve and the valve guide must be replaced as a set.

Valve Stem Outside Diameter mm(in)

	Standard	Limit
Intake Valve	7.946 – 7.961 (0.3128 – 0.3134)	7.880 (0.3102)
Exhaust Valve	7.921 – 7.936 (0.3119 – 0.3124)	7.850 (0.3090)

05040402



050404-002



Valve Thickness

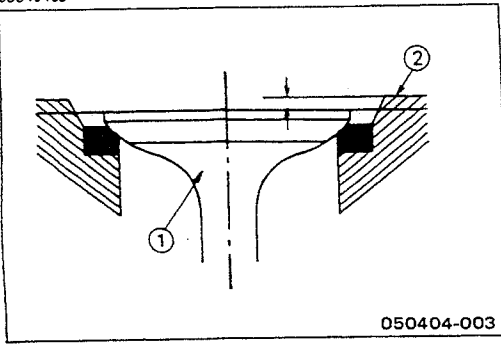
Measure the valve thickness.

If the measured value is less than the specified limit, the valve and the valve guide must be replaced as a set.

Intake and Exhaust Valve Thickness mm(in)

Standard	Limit
1.8 (0.07)	1.5 (0.06)

05040403



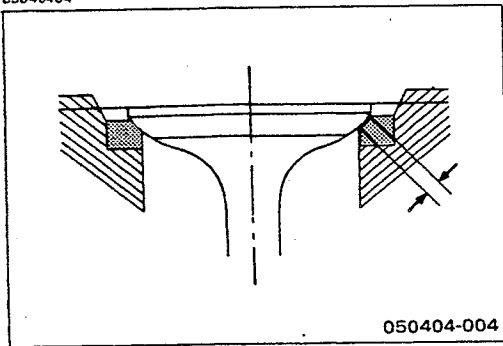
Valve Depression

1. Install the valve ① to the cylinder head ②.
2. Use a depth gauge or a straight edge with steel rule to measure the valve depression from the cylinder head lower surface.

If the measured value exceeds the specified limit, the valve seat insert must be replaced.

Valve Depression		mm(in)
	Standard	Limit
Intake	0.73 (0.029)	1.28 (0.050)
Exhaust	0.70 (0.028)	1.20 (0.047)

05040404



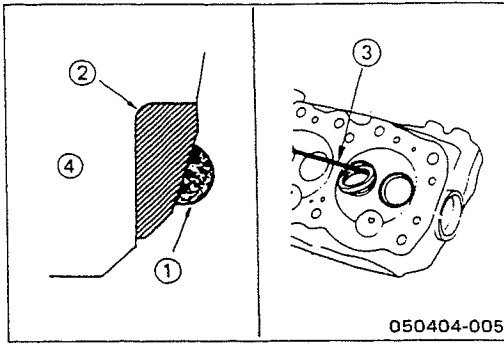
Valve Contact Width

1. Check the valve contact faces for roughness and unevenness. Make smooth the valve contact surfaces.
2. Measure the valve contact width.

If the measured value exceeds the specified limit, the valve seat insert must be replaced.

Valve Contact Width		mm(in)
	Standard	Limit
Intake	1.7 (0.067)	2.2 (0.087)
Exhaust	2.0 (0.079)	2.5 (0.078)

05040405, 0504040501



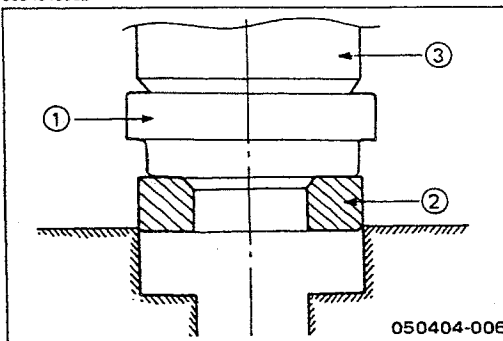
Valve Seat Insert Replacement

Valve Seat Insert Removal



1. Arc weld the entire inside circumference ① of the valve seat insert ②.
2. Allow the valve seat insert to cool for a few minutes.
This will invite contraction and make removal of the valve seat insert easier.
3. Use a screwdriver ③ to pry the valve seat insert free.
Take care not to damage the cylinder head ④.
4. Carefully remove carbon and other foreign material from the cylinder head insert bore.

0504040502



Valve Seat Insert Installation



1. Carefully place the attachment ① (having a smaller outside diameter than the valve seat insert) on the valve seat insert ②.

Note:

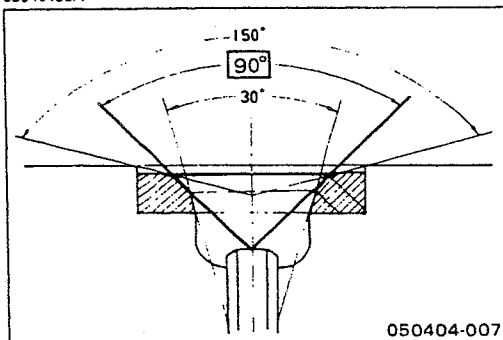
The smooth side of the attachment must contact the valve seat insert.

2. Use a bench press ③ to gradually apply pressure to the attachment and press the valve seat insert into place.

Note:

Do not apply an excessive amount of pressure with the bench press. Damage to the valve seat insert will result.

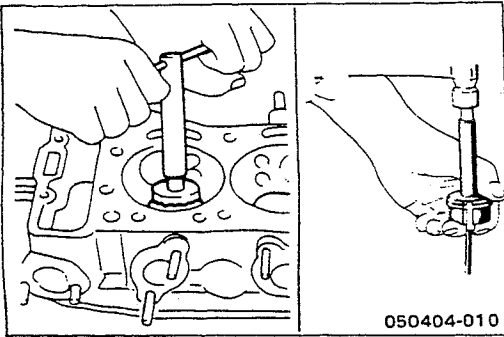
05040406A



Valve Seat Insert Correction

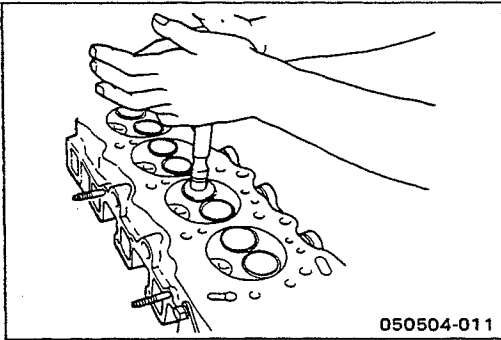
1. Remove the carbon from the valve seat insert surface.
2. Use a valve cutter (15°, 45°, and 75° blades) to minimize scratches and other rough areas. This will bring the contact width back to the standard value.
Remove only the scratches and rough areas. Do not cut away too much. Take care not to cut away unblemished areas of the valve seat surface.

05040406B



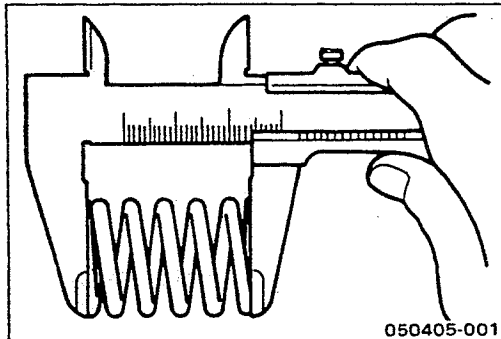
050404-010

05040406C



050504-011

050405, 05040501



050405-001



Valve Seat Angle	degree
	45

Note:

Use an adjustable valve cutter pilot.

Do not allow the valve cutter pilot to wobble inside the valve guide.

3. Apply abrasive compound to the valve seat insert surface.
4. Insert the valve into the valve guide.
5. Turn the valve while tapping it to fit the valve seat insert.
6. Check that the valve contact width is correct.
7. Check that the valve seat insert surface is in contact with the entire circumference of the valve.



VALVE SPRING

Valve Spring Free Height

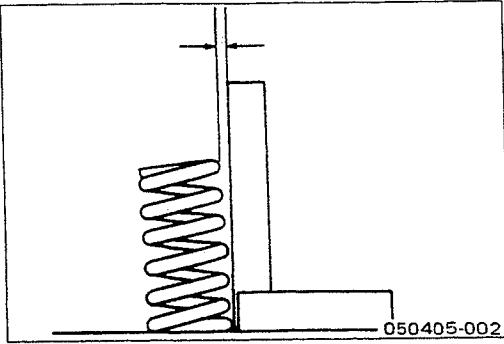
Use a vernier caliper to measure the valve spring free height.

If the measured value is less than the specified limit, the valve spring must be replaced.

Inner and Outer Spring Free Height mm(in)

		Standard	Limit
4JA1	Inner spring	45.3 (1.78)	44.4 (1.75)
	Outer spring	49.7 (1.96)	48.2 (1.90)
4JB1	Single spring	48.0 (1.89)	47.1 (1.85)

05040502



Valve Spring Squareness

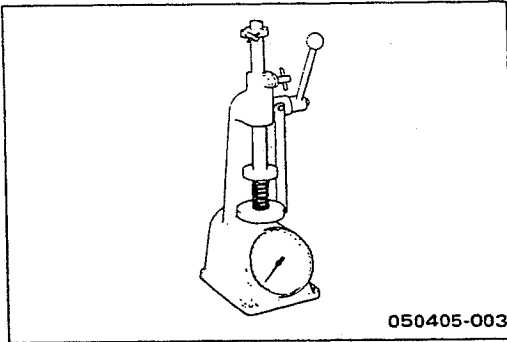
Use a surface plate and a square to measure the valve spring squareness.

If the measured value exceeds the specified limit, the valve spring must be replaced.

Inner and Outer Spring Squareness mm(in)

		Limit
4JA1	Inner Spring	3.0 (0.120)
	Outer Spring	3.2 (0.126)
4JB1	Single Spring	1.7 (0.07)

05040503



Valve Spring Tension

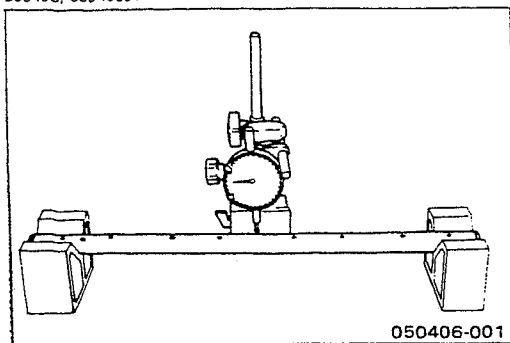
Use a spring tester to measure the valve spring tension.

If the measured value is less than the specified limit, the valve spring must be replaced.

Valve Spring Tension kg(lb/N)

		Compressed Height	Standard	Limit
4JA1	Inner Spring	37.0 mm (1.46 in)	5.9 (13.0/57.9)	5.0 (11.0/49.0)
	Outer Spring	39.0 mm (1.54 in)	20.9 (46.0/205.0)	18.1 (39.8/177.4)
4JB1	Single Spring	38.9 mm (1.53 in)	30.2 (66.4/296.0)	26.3 (57.9/257.7)

050406, 05040601



ROCKER ARM SHAFT AND ROCKER ARM

Rocker Arm Shaft Run-Out

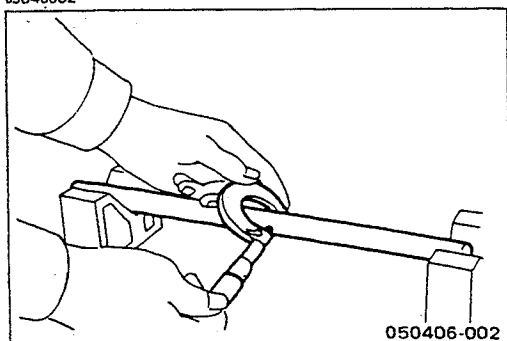
1. Place the rocker arm shaft on a V-block.
2. Use a dial indicator to measure the rocker arm shaft central portion run-out.

If the run-out is very slight, correct the rocker arm shaft run-out with a bench press. The rocker arm must be at cold condition.

If the measured rocker arm shaft run-out exceeds the specified limit, the rocker arm shaft must be replaced.

Rocker Arm Shaft Run-Out	mm(in)
Limit	
	0.3 (0.0012)

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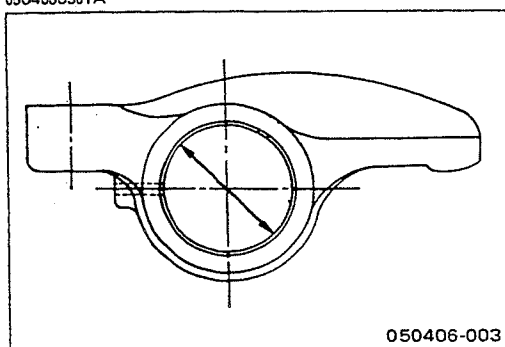
Rocker Arm Shaft Outside Diameter

Use a micrometer to measure the rocker arm fitting portion outside diameter.

If the measured value is less than the specified limit, the rocker arm shaft must be replaced.

Rocker Arm Shaft Outside Diameter		mm(in)
Standard	Limit	
18.98-19.00 (0.747-0.748)	18.90 (0.744)	

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Rocker Arm Shaft and Rocker Arm Clearance

1. Use either a vernier caliper or a dial indicator to measure the rocker arm inside diameter.

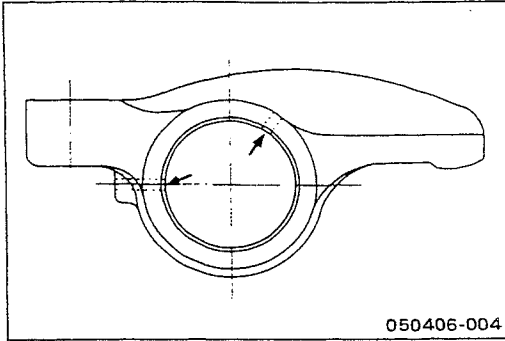
Rocker Arm Inside Diameter		mm(in)
Standard	Limit	
19.036 - 19.060 (0.749 - 0.750)	19.100 (0.752)	

2. Measure the rocker arm shaft outside diameter.

If the measured value exceeds the specified limit, replace either the rocker arm or the rocker arm shaft.

Rocker Arm Shaft and Rocker Arm Clearance		mm(in)
Standard	Limit	
0.01 - 0.05 (0.0004 - 0.0020)	0.20 (0.008)	

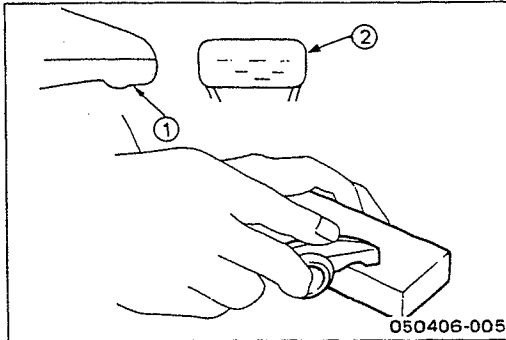
05040603B



3. Check that the rocker arm oil port is free of obstructions.

If necessary, use compressed air to clean the rocker arm oil port.

05040604



Rocker Arm Correction

Inspect the rocker arm valve stem contact surfaces for step wear ① and scoring ②.

If the contact surfaces have light step wear or scoring, they may be honed with an oil stone.

If the step wear or scoring is severe, the rocker arm must be replaced.

050407, 0504070101A

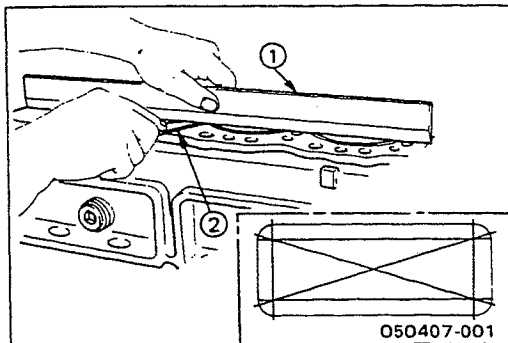
CYLINDER BODY

Cylinder Body Upper Face Warpage

1. Remove the cylinder body dowel.
2. Remove the cylinder liner.

Refer to "Cylinder Liner Replacement".

0504070101B

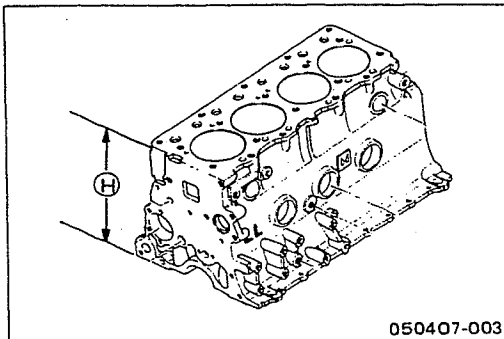


3. Use a straight edge ① and a feeler gauge ② to measure the four sides and the two diagonals of the cylinder body upper face.

If the measured values exceeds the limit, the cylinder body must be replaced.

Cylinder Body Upper Face Warpage		mm(in)
Standard	Limit	
0.05 (0.002) or less	0.20 (0.008)	

0504070101D

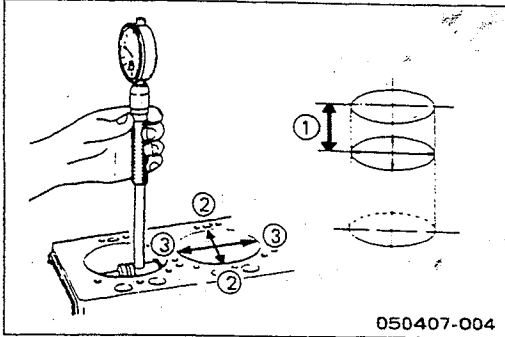


Cylinder Body Height (H) (Reference) mm(in)

	Standard	
	mm	in
4JA1	244.945 - 245.055	(9.6430 - 9.6478)
4JB1	269.945 - 270.055	(10.6277 - 10.6320)

5. Reinstall the cylinder liner.
Refer to "Cylinder Liner Replacement".
6. Reinstall the cylinder body dowel.

05040705A



050407-004

05040705B



Cylinder Liner Bore Measurement

Use a cylinder indicator to measure the cylinder bore at measuring point ① in the thrust ②-② and axial ③-③ directions of the crankshaft.

Measuring Point ① 20 mm (0.79 in)

If the measured value exceeds the specified limit, the cylinder liner must be replaced.

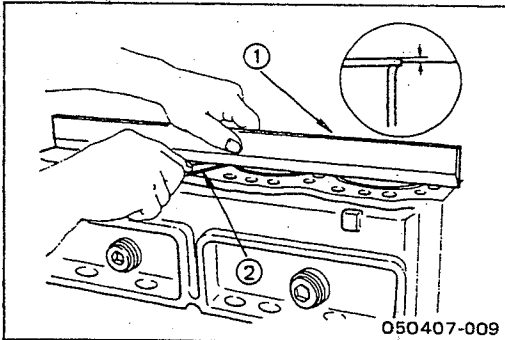
Cylinder Liner Bore		mm(in)
Standard	Limit	
93.021 (3.662)	93.100 (3.665)	

Note:

The inside of the dry type cylinder liner is chrome plated. It cannot be rebored or honed.

If the inside of the cylinder liner is scored or scorched, the cylinder liner must be replaced.

05040706



050407-009



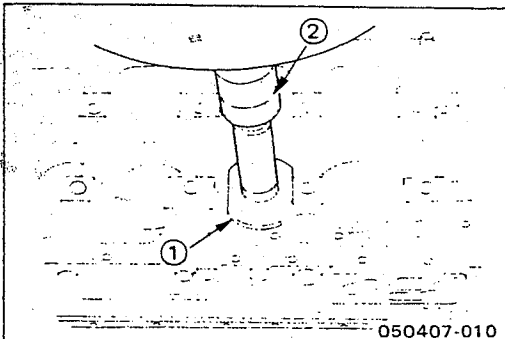
Cylinder Liner Projection Inspection

1. Hold a straight edge ① along the top edge of the cylinder liner to be measured.
2. Use a feeler gauge ② to measure each cylinder liner projection.

Cylinder Liner Projection	mm(in)
Standard	
0 - 0.1 (0 - 0.004)	

The difference in the cylinder liner projection height between any two adjacent cylinders must not exceed 0.03 mm (0.0012 in).

05040707, 0504070701



050407-010



Cylinder Liner Replacement

Cylinder Liner Removal

1. Insert the cylinder liner remover ① into the cylinder body (from the lower side of the cylinder body) until it makes firm contact with the cylinder liner.

Cylinder Liner Remover: 5-8840-2039-0

2. Use a bench press ② to slowly force the cylinder liner from the cylinder body.

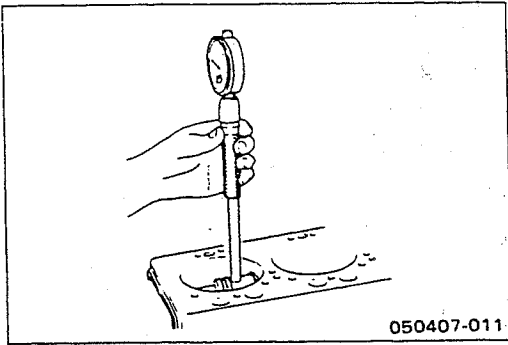


Note:

Take care not to damage the cylinder body upper face during the cylinder liner removal procedure.

3. Measure the cylinder body upper face warpage.
Refer to "Cylinder Body Upper Face Warpage".

0504070702

**Cylinder Liner Grade Selection**

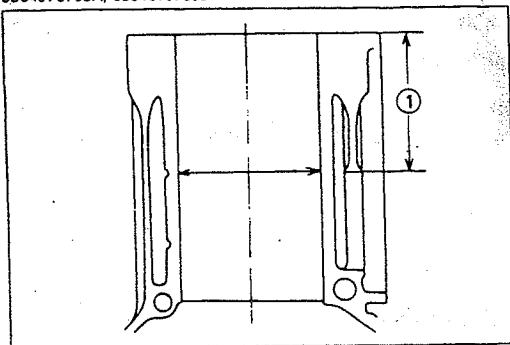
Measure the cylinder body inside diameter and select the appropriate cylinder liner grade.

Standard Fitting Interference	mm(in)
	0.001 - 0.019 (0.0004 - 0.0007)

If the cylinder liner fitting interference is too small, engine cooling efficiency will be adversely affected.

If the cylinder liner fitting interference is too large, it will be difficult to insert the cylinder liner into the cylinder body.

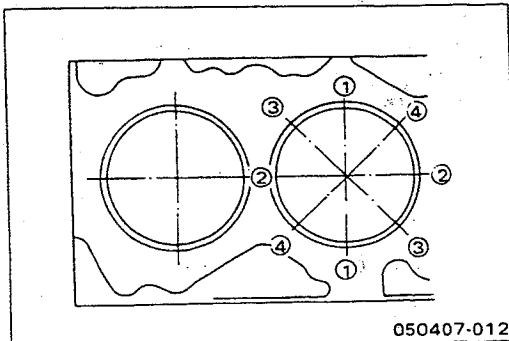
0504070703A, 0504070703B

**Cylinder Body Bore Measurement**

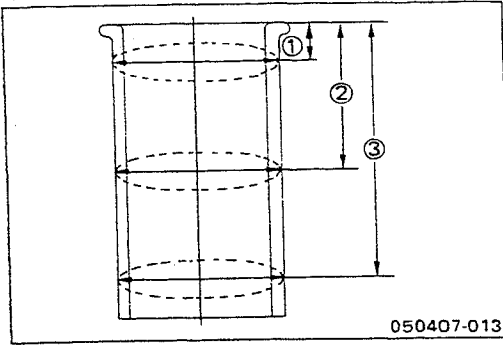
1. Take measurements at measuring point ① across positions ①-①, ②-②, ③-③, and ④-④.

Measuring Point ① 98 mm (3.86 in)

2. Calculate the average value of the four measurements to determine the correct cylinder grade.



050407070401C



Cylinder Liner Outside Diameter Measurement

1. Take two measurements at measuring points ①, ②, and ③.

Measuring Points ① 20 mm (0.79 in) all 4J models

Measuring Points ② 80 mm (3.15 in) 4JA1
90 mm (3.54 in) 4JB1

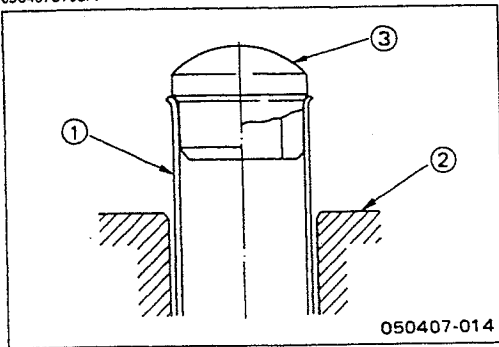
Measuring Points ③ 140 mm (5.50 in) 4JA1
160 mm (6.30 in) 4JB1

2. Calculate the average value of the six measurements to determine the correct cylinder liner grade.

Cylinder Bore and Cylinder Liner Outside Diameter Combination

(Reference)	Cylinder Bore	Cylinder Liner Outside Diameter
1.	95.001 – 95.010 (3.74019 – 3.74055)	95.011 – 95.020 (3.74059 – 3.74094)
2.	95.011 – 95.020 (3.74059 – 3.74094)	95.021 – 95.030 (3.74098 – 3.74133)
3.	95.021 – 95.030 (3.74098 – 3.74133)	95.031 – 95.040 (3.74137 – 3.74173)

0504070705A



Cylinder Liner Installation

1. Cylinder Liner Installation Using The Special Tool

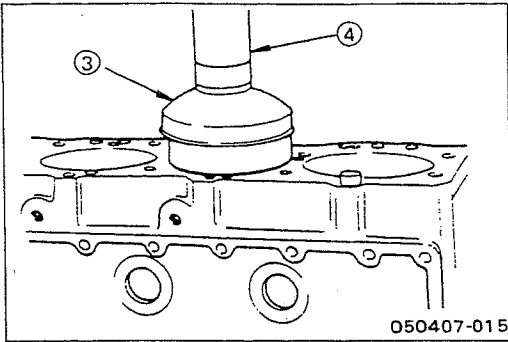
- 1) Use new kerosene or diesel oil to thoroughly clean the cylinder liners and bores.
- 2) Use compressed air to blow-dry the cylinder liner and bore surfaces.

Note:

All foreign material must be carefully removed from the cylinder liner and the cylinder bore before installation.

- 3) Insert the cylinder liner ① into the cylinder body ② from the top of the cylinder body.

0504070705B



- 4) Set the cylinder liner installer ③ to the top of the cylinder liner.

Cylinder Liner Installer: 5-8840-2040-0

- 5) Position the cylinder body so that the installer center ③ is directly beneath the bench press shaft center ④.

Note:

Check that the cylinder liner is set perpendicular to the bench press and that there is no wobble.

- 6) Use the bench press to apply a seating force of 500 kg (1,102.5 lb/4,900 N) to the cylinder liner.
- 7) Apply a force of 2,500 kg (5,512.5 lb/24,500 N) to fully seat the cylinder liner.
- 8) After installing the cylinder liner, measure the cylinder liner projection.
Refer to "Cylinder Liner Projection Inspection".

0504070705C

2. Cylinder Liner Installation Using Dry Ice

If the cylinder liner is a chrome plated dry type, it is advisable to use dry ice during the installation procedure.

Cooling the cylinder liner with dry ice will cause the cylinder liner to contract, thus making installation easier.

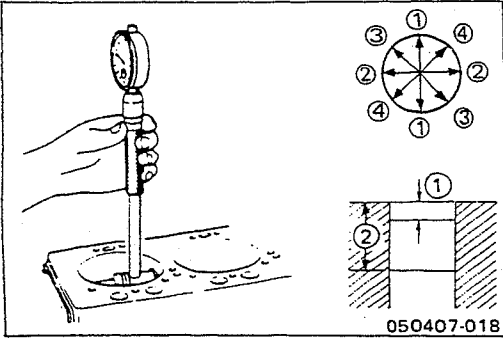
Note:

It is important that the cylinder liner be inserted to the cylinder body immediately after it has been cooled.

WARNING:

DRY ICE MUST BE USED WITH GREAT CARE. CARELESS HANDLING OF DRY ICE CAN RESULT IN SEVERE FROSTBITE.

05040706A, 05040706B



050407-018



Piston Grade Selection

Measure the cylinder liner bore after installing the cylinder liner. Then select the appropriate piston grade for the installed cylinder liner.

1. Measure the cylinder liner bore.

Refer to "Cylinder Liner Bore Measurement".

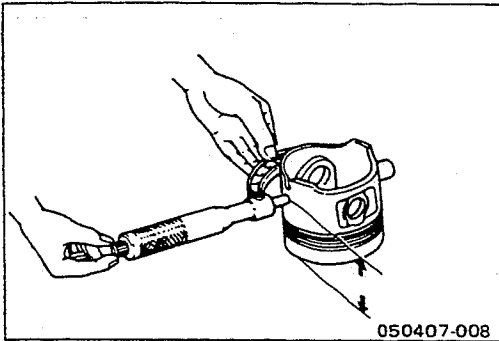
Measuring Points ① 20 mm (0.79 in) for 4JA1 and 4JB1
 ② 140 mm (5.51 in) for 4JA1
 160 mm (6.30 in) for 4JB1

Cylinder Liner Bore		mm(in)
Standard	Limit	
93.021 – 93.060 (3.662 – 3.663)	93.100 (3.665)	

Note:

It is most important that the correct piston grade be used. Failure to select the correct piston grade will result in engine failure. Always measure the cylinder bore and select the correct piston grade.

05040706C



050407-008



2. Measure the piston outside diameter.

Piston Measuring Point : 70 mm (3.13 in) for 4JA1
 74 mm (2.91 in) for 4JB1

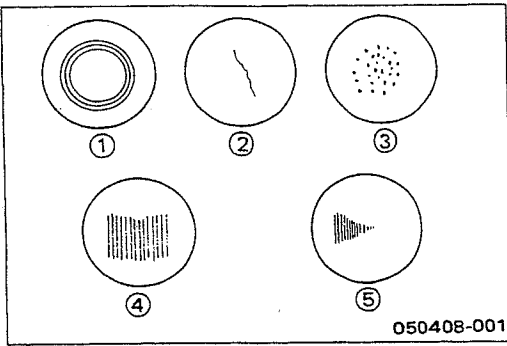
Piston Grade	mm(in)
Grade	Size
Ⓐ	92.985 – 93.004 (3.660 – 3.662)
Ⓒ	93.005 – 93.024 (3.6616 – 3.6623)

Cylinder Liner and Piston Clearance	mm(in)
0.025 – 0.045 (0.0010 – 0.0018)	

Note:

Cylinder liner kit clearances are preset. However, the cylinder liner installation procedure may result in slight decreases in cylinder liner clearances. Always measure the cylinder liner clearance after installation to be sure that it is correct.

050408



TAPPET AND PUSH ROD

Visually inspect the tappet contact surfaces for pitting, cracking, and other abnormal conditions. The tappet must be replaced if any of these conditions are present.

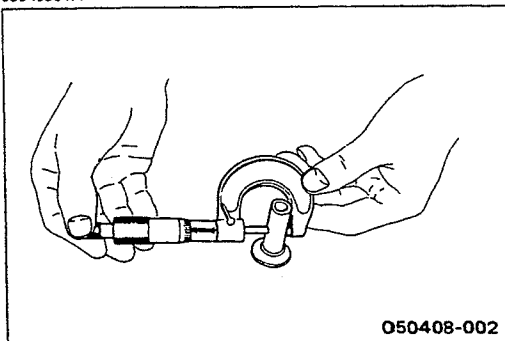
Refer to the illustration at the left.

- ① Normal contact
- ② Cracking
- ③ Pitting
- ④ Irregular contact
- ⑤ Irregular contact

Note:

The tappet surfaces are spherical. Do not attempt to grind them with an oil stone or similar tool in an effort to repair the tappet. If the tappet is damaged, it must be replaced.

05040801A

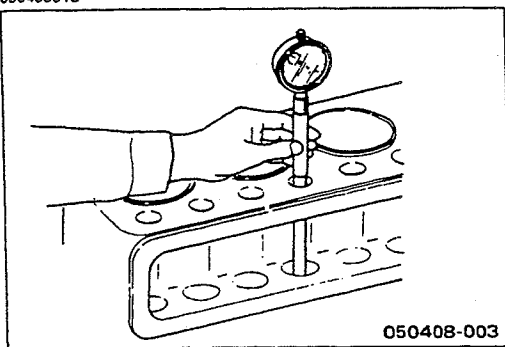


Tappet Outside Diameter

Measure the tappet outside diameter with a micrometer. If the measured value is less than the specified limit, the tappet must be replaced.

Tappet Outside Diameter		mm(in)
Standard	Limit	
12.97 – 12.99 (0.510 – 0.511)	12.95 (0.509)	

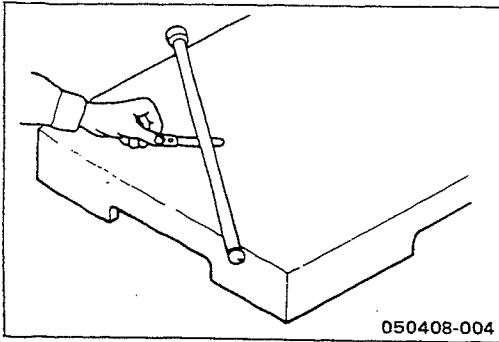
05040801B



Tappet and Cylinder Body Clearance

Tappet and Cylinder Body Clearance		mm(in)
Standard	Limit	
0.03 (0.001)	0.10 (0.004)	

05040802



Push Rod Curvature

1. Lay the push rod on a surface plate.
2. Roll the push rod along the surface plate and measure the push rod curvature with a thickness gauge.
If the measured value exceeds the specified limit, the push rod must be replaced.

Push Rod Curvature	mm(in)
Limit	
	0.3 (0.012)



3. Visually inspect both ends of the push rod for excessive wear and damage. The push rod must be replaced if these conditions are discovered during inspection.

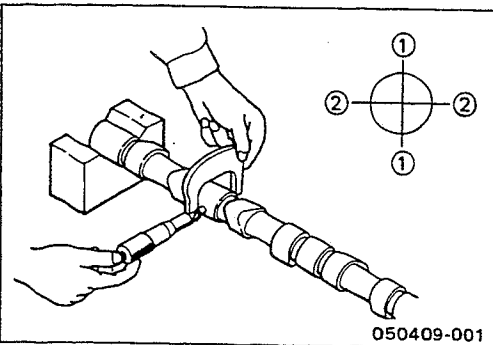
050409



CAMSHAFT

Visually inspect the journals, the cams, the oil pump drive gear, and the camshaft bearings for excessive wear and damage. The camshaft and the camshaft bearings must be replaced if these conditions are discovered during inspection.

05040901

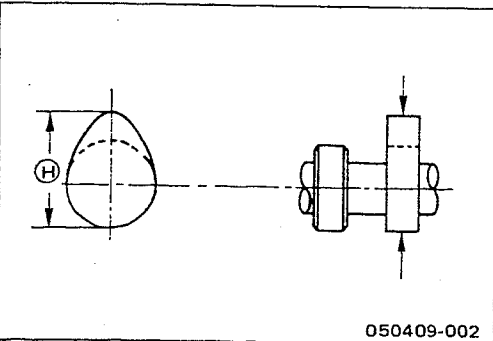


Camshaft Journal Diameter

Use a micrometer to measure each camshaft journal diameter in two directions (① and ②). If the measured value is less than the specified limit, the camshaft must be replaced.

Camshaft Journal Diameter	mm(in)
Standard	Limit
49.945 — 49.975 (1.966 — 1.965)	49.60 (1.953)

05040902

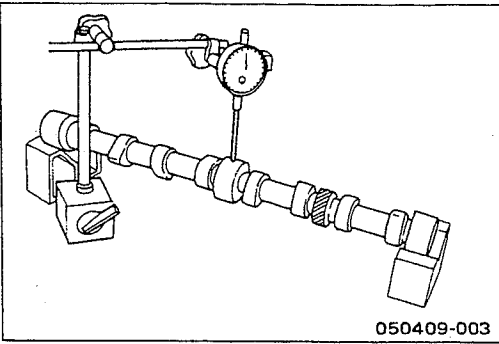


Cam Height

Measure the cam height (H) with a micrometer. If the measured value is less than the specified limit, the camshaft must be replaced.

Cam Height (H)	mm(in)
Standard	Limit
42.08 (1.65)	41.65 (1.64)

05040903



050409-003



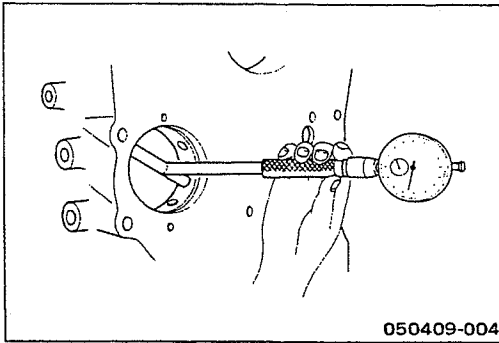
Camshaft Run-Out

1. Mount the camshaft on V-blocks.
2. Measure the run-out with a dial indicator.

If the measured value exceeds the specified limit, the camshaft must be replaced.

Camshaft Run-Out		mm(in)
Standard	Limit	
0.02 (0.0008)	0.10 (0.004)	

05040904



050409-004



Camshaft and Camshaft Bearing Clearance

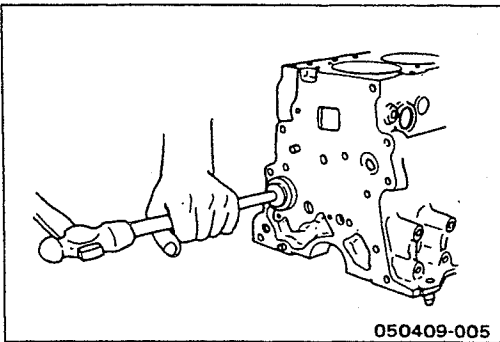
Use an inside dial indicator to measure the camshaft bearing inside diameter.

Crankshaft Bearing Inside Diameter		mm(in)
Standard	Limit	
50.00 – 50.03 (1.9685 – 1.9696)	50.08 (1.9716)	

If the clearance between the camshaft bearing inside diameter and the journal exceeds the specified limit, the camshaft bearing must be replaced.

Camshaft Bearing Clearance		mm(in)
Standard	Limit	
0.05 (0.002)	0.12 (0.005)	

05040905, 0504090501



050409-005



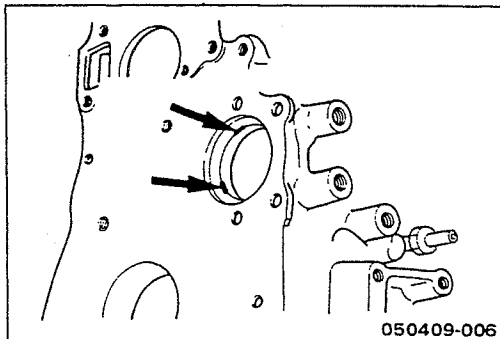
Camshaft Bearing Replacement

Camshaft Bearing Removal

1. Remove the cylinder body plug plate.
2. Use the bearing replacer to remove the camshaft bearing.

Bearing Replacer: 5-8840-2038-0

0504090502



050409-006



Camshaft Bearing Installation

1. Align the bearing oil holes with the cylinder body oil holes.
2. Use the replacer to install the camshaft bearing.

Bearing Replacer: 5-8840-2038-0



CRANKSHAFT AND BEARING

Inspect the surface of the crankshaft journals and crankpins for excessive wear and damage.

Inspect the oil seal fitting surfaces for excessive wear and damage.

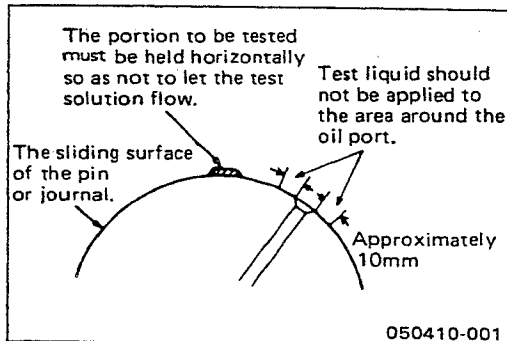
Inspect the oil ports for obstructions.

Note:

To increase crankshaft strength, tufftriding (Nitriding treatment) has been applied. Because of this, it is not possible to regrind the crankshaft surfaces.

Therefore, under size bearing are not available.

05041001A



Crankshaft Tufftriding Inspection

1. Use an organic cleaner to thoroughly clean the crankshaft. There must be no traces of oil on the surfaces to be inspected.
2. Prepare a 5 — 10% solution of ammonium cuprous chloride (dissolved in distilled water).
3. Use a syringe to apply the solution to the surface to be inspected.

Hold the surface to be inspected perfectly horizontal to prevent the solution from running.

Note:

Do not allow the solution to come in contact with the oil ports and their surrounding area.

05041001B



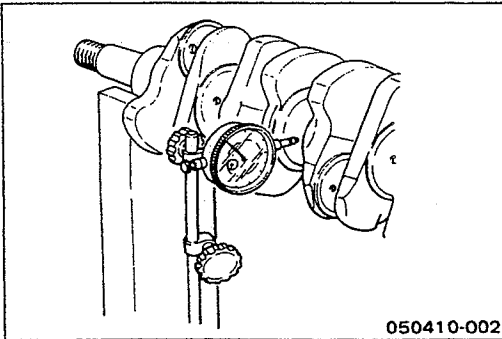
Judgment

1. Wait for thirty to forty seconds.
If there is no discoloration after thirty or forty seconds, the crankshaft is usable.
If discoloration appears (the surface being tested will become the color of copper), the crankshaft must be replaced.
2. Steam clean the crankshaft surface immediately after completing the test.

Note:

The ammonium cuprous chloride solution is highly corrosive. Because of this, it is imperative that the surfaces being tested be cleaned immediately after completing the test.

05041002

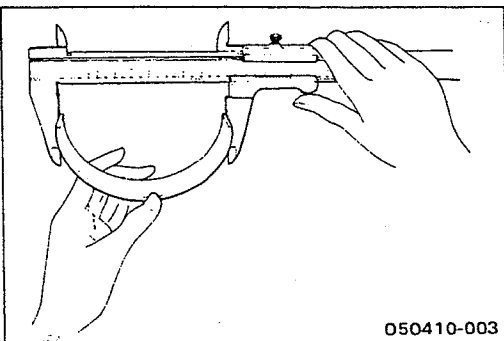


Crankshaft Run-Out

1. Set a dial indicator to the center of the crankshaft journal.
2. Gently turn the crankshaft in the normal direction of rotation.
Read the dial indicator as you turn the crankshaft.
If the measured value exceeds the specified limit, the crankshaft must be replaced.

Crankshaft Run-Out		mm(in)
Standard	Limit	
0.05 (0.02) or less	0.08 (0.003)	

0504100301

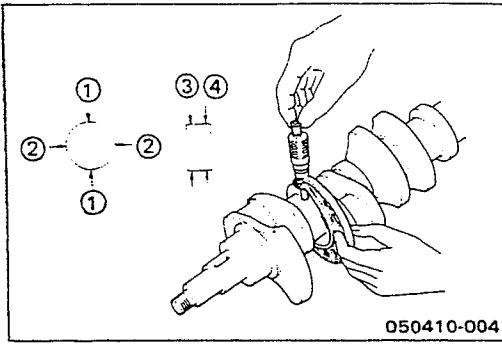


Bearing Spread

Use a vernier caliper to measure the bearing spread. If the measured value is less than the specified limit, the bearing must be replaced.

Bearing Spread		mm(in)
		Limit
Crankshaft Bearing	4JA1	64.5 (2.54)
	4JB1	74.5 (2.93)
Connecting Rod Bearing	56.5 (2.22)	

05041004A



050410-004

05041004B



Crankshaft Journal and Crankpin Diameter

1. Use a micrometer to measure the crankshaft journal diameter across points ① - ① and ② - ②.
2. Use the micrometer to measure the crankshaft journal diameter at the two points (③ and ④).
3. Repeat Steps ① and ② to measure the crankpin diameter.

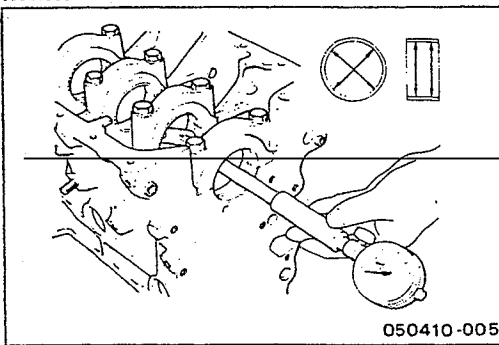
If the measured values are less than the specified limit, the crankshaft must be replaced.

Crankshaft Journal Diameter		mm(in)
	Standard	Limit
4JA1	59.92 - 59.93 (2.3591 - 2.3544)	59.91 (2.3587)
4JB1	69.92 - 69.93 (2.7526 - 2.7531)	69.91 (2.7524)

Crankpin Diameter		mm(in)
	Standard	Limit
	52.92 - 52.93 (2.0833 - 2.0839)	52.90 (2.083)

Crankshaft Journal and Crankpin Uneven Wear		mm(in)
	Standard	Limit
	0.05 (0.002) or less	0.08 (0.003)

05041005



050410-005

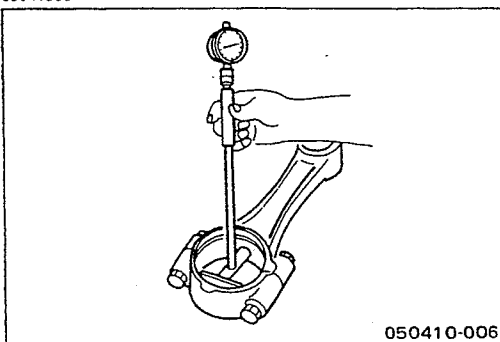


Crankshaft Journal and Bearing Clearance

If the clearance between the measured bearing inside diameter and the crankshaft journal diameter exceeds the specified limit, the bearing and/or the crankshaft must be replaced.

Crankshaft Journal and Bearing Clearance		mm(in)
	Standard	Limit
	0.035 - 0.080 (0.0014 - 0.0036)	0.110 (0.0043)

05041006



050410-006



Connecting Rod Bearing Inside Diameter

1. Install the bearing to the connecting rod big end.
2. Tighten the bearing cap to the specified torque.



Connecting Rod Bearing Cap Bolt Torque

	kg·m(lb.ft/N·m)
	8.5 ± 0.5 (61.5 ± 3.6/83.40 ± 4.90)

3. Use an inside dial indicator to measure the connecting rod bearing inside diameter.

05041007

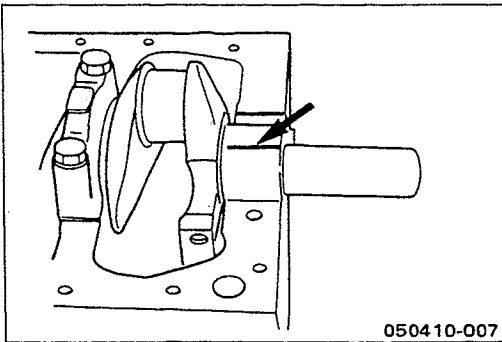


Crankpin and Bearing Clearance

If the clearance between the measured bearing inside diameter and the crankpin exceeds the specified limit, the bearing and/or the crankshaft must be replaced.

Crankpin and Bearing Clearance		mm(in)
Standard	Limit	
0.029 – 0.066 (0.0011 – 0.0026)	0.100 (0.0039)	

05041008, 0504100801A



050410-007

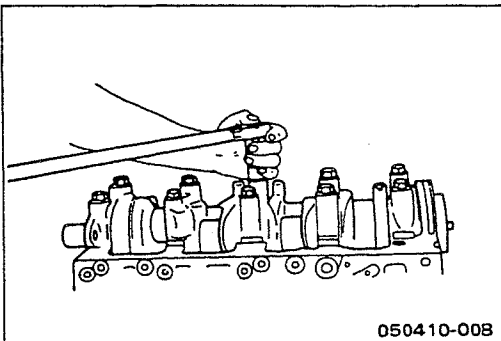


Clearance Measurements (With Plastigage)

Crankshaft Journal and Bearing Clearance

1. Clean the cylinder body, the journal bearing fitting surface, the bearing caps, and the bearings.
2. Install the bearings to the cylinder body.
3. Carefully place the crankshaft on the bearings.
4. Rotate the crankshaft approximately 30° to seat the bearing.
5. Place the Plastigage (arrow) over the crankshaft journal across the full width of the bearing.
6. Install the bearing caps with the bearing.

0504100801B



050410-008



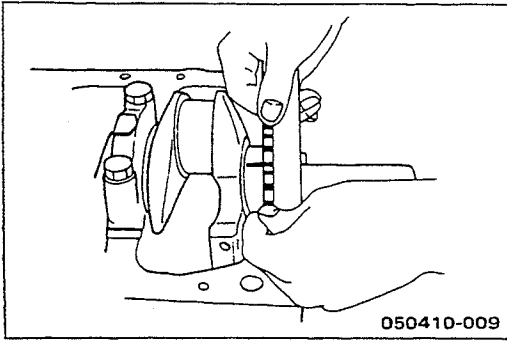
7. Tighten the bearing caps to the specified torque.

Crankshaft Bearing Cap Bolt Torque	kg-m(lb.ft/N-m)
	17 ± 1 ($122.9 \pm 7.2/166.60 \pm 9.80$)

Do not allow the crankshaft to turn during bearing cap installation and tightening.

8. Remove the bearing cap.

0504100801C, 0504100801D



9. Compare the width of the Plastigage attached to either the crankshaft or the bearing against the scale printed on the Plastigage container.

If the measured value exceeds the limit, perform the following additional steps.

- 1) Use a micrometer to measure the crankshaft outside diameter.
- 2) Use an inside dial indicator to measure the bearing inside diameter.

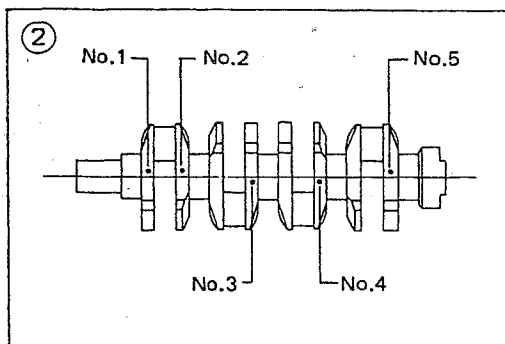
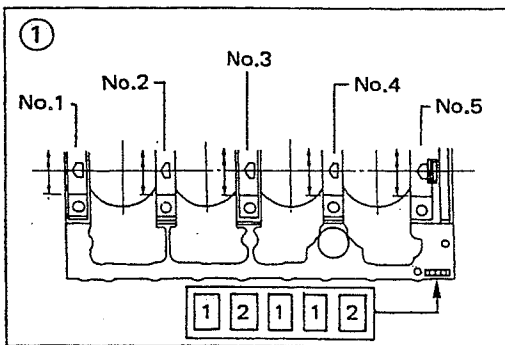
If the crankshaft journal and bearing clearance exceeds the limit, the crankshaft and/or the bearing must be replaced.

Crankshaft Journal and Bearing Clearance		mm(in)
Standard	Limit	
0.035 - 0.080 (0.0014 - 0.0036)	0.110 (0.0043)	

CRANKSHAFT BEARING SELECTION (REFERENCE)

Crankshaft bearing selection is based on the measured diameters of the crankshaft journals and the bearing inserts.

Match the crankshaft bearing housing grade marks and the crankshaft journal grade marks in the table below to determine the correct crankshaft bearing size.



Crankshaft Bearing Insert Grade Mark Position

Crankshaft bearing housing grade marks 1 or 2 are stamped on the rear right hand side of the cylinder body.

Example:

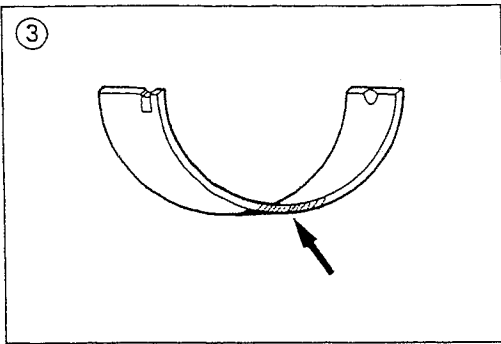


Crankshaft Journal Grade Mark Position

The crankshaft journal grade marks (1 or —) are stamped on each crankshaft journal wave.

The crankshaft journal and bearing clearance must be the same for each position after installation of the crankshaft and the crankshaft bearings.

Crankshaft Journal and Crankshaft Bearing Clearance	mm(in)
	0.031 - 0.063 (0.0012 - 0.0025)



Crankshaft Bearing Housing, Crankshaft Journal, and Crankshaft Bearing Combinations (Reference) mm(in)

Crankshaft Bearing ①		Crankshaft Journal ②		Crankshaft Bearing Size Color Code ③
Grade Mark	Diameter	Grade Mark	Diameter	
1	73.987—74.000 (2.9129—2.9134)	1 or —	69.927—69.932 (2.7530—2.7532)	Black
		2 or — —	69.922—69.927 (2.7528—2.7530)	Blue
		3 or — — —	69.917—69.922 (2.7556—2.7528)	
2	73.975—73.987 (2.9124—2.9129)	1 or —	69.927—69.932 (2.7530—2.7532)	Green
		2 or — —	69.922—69.927 (2.7528—2.7530)	
		3 or — — —	69.917—69.922 (2.7556—2.7528)	Black

0504100802A, 0504100802B, 0504100802C



Crankpin and Bearing Clearance

1. Clean the crankshaft, the connecting rod, the bearing cap, and the bearings.
2. Install the bearing to the connecting rod and the bearing cap.

Do not allow the crankshaft to move when installing the bearing cap.

3. Prevent the connecting rod from moving.
4. Attach the Plastigage to the crankpin.

Apply engine oil to the Plastigage to keep it from falling.

5. Install the bearing cap and tighten it to the specified torque.

Do not allow the connecting rod to move when installing and tightening the bearing cap.



Connecting Rod Bearing Cap Bolt

Torque	kg·m(lb.ft/N·m)
8.5 ± 0.5 (61.5 ± 3.6/83.30 ± 4.90)	

6. Remove the bearing cap.
7. Compare the width of the Plastigage attached to either the crankshaft or the bearing against the scale printed on the Plastigage container.

If the measured value exceeds the specified limit, perform the following additional steps.

- 1) Use a micrometer to measure the crankpin outside diameter.

- 2) Use an inside dial indicator to measure the bearing inside diameter.

If the crank pin and bearing clearance exceeds the specified limit, the crankshaft and/or the bearing must be replaced.

Crankpin and Bearing Clearance		mm(in)
Standard	Limit	
0.029 – 0.066 (0.0011 – 0.0026)	0.100 (0.0039)	

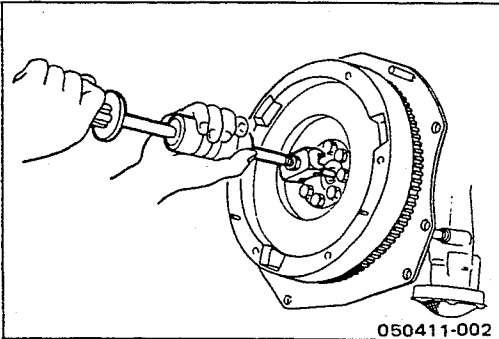
050411



CRANKSHAFT PILOT BEARING

Check the crankshaft pilot bearing for excessive wear and damage and replace it if necessary.

05041101, 0504110101



050411-002



Crankshaft Pilot Bearing Replacement

Crankshaft Pilot Bearing Removal

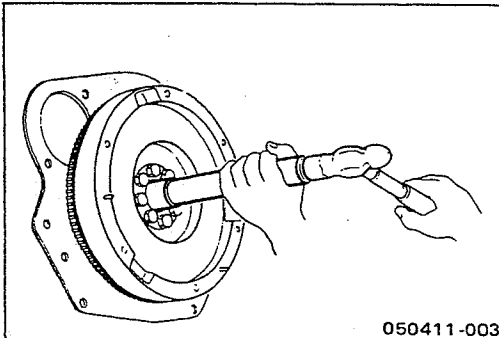


Use the pilot bearing remover to remove the crankshaft pilot bearing.

Pilot Bearing Remover: 5-8840-2000-0

Sliding Hammer: 5-8840-0019-0 (J-23907)

050411 0102



050411-003



Crankshaft Pilot Bearing Installation



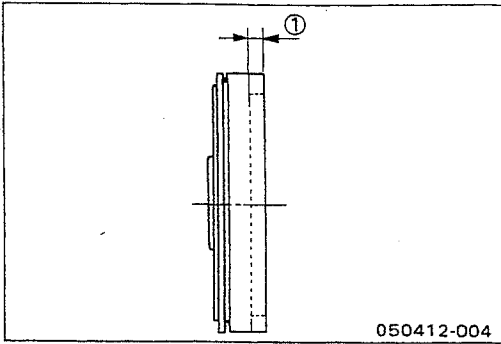
1. Place the crankshaft pilot bearing horizontally across the crankshaft bearing installation hole.
2. Tap around the edges of the crankshaft pilot bearing outer races with a brass hammer to drive the bearing into the crankshaft bearing installation hole.

Pilot Bearing Installer: 5-8522-0024-0

Note:

Strike only the crankshaft pilot bearing outer races with the hammer. Do not strike the bearing inner races. Bearing damage and reduced bearing service life will result.

050412, 05041201



050412-004



FLYWHEEL AND RING GEAR

Flywheel

1. Inspect the flywheel friction surface for excessive wear and heat cracks.
2. Measure the flywheel friction surface depth.
If the measured value is between the standard and the specified limit, the flywheel may be reground.
If the measured value exceeds the specified limit, the flywheel must be replaced.

Flywheel Friction Surface Depth ① mm(in)

	Standard	Limit
4JA1, 4JB1	20 (0.787)	21 (0.827)
4JB1T, 4JB1TC	14 (0.551)	15 (0.591)

Flywheel Friction Surface Roughness mm(in)

Less than 0.006 (0.00024)

05041202

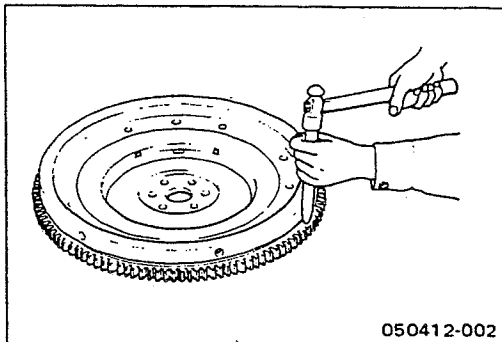


Ring Gear

Inspect the ring gear.

If the ring gear teeth are broken or excessively worn, the ring gear must be replaced.

05041203, 0504120301



050412-002

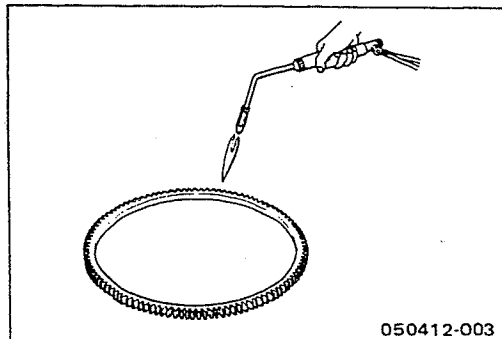


Ring Gear Replacement

Ring Gear Removal

Strike around the edges of the ring gear with a hammer and chisel to remove it.

0504120302



050412-003



Ring Gear Installation

1. Heat the ring gear evenly with a gas burner to invite thermal expansion.
Do not allow the temperature of the gas burner to exceed 200°C (390°F).
2. Install the ring gear when it is sufficiently heated.
The ring gear must be installed with the chamfer facing the clutch.

050413

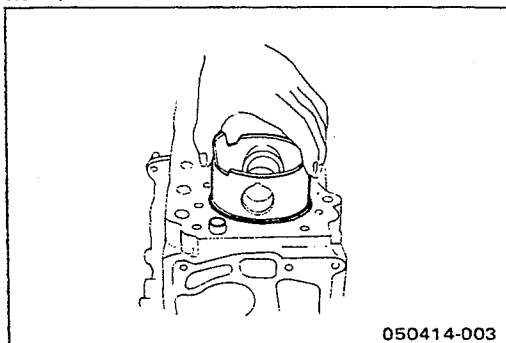


PISTON

Piston Grade Selection and Cylinder Bore Measurement

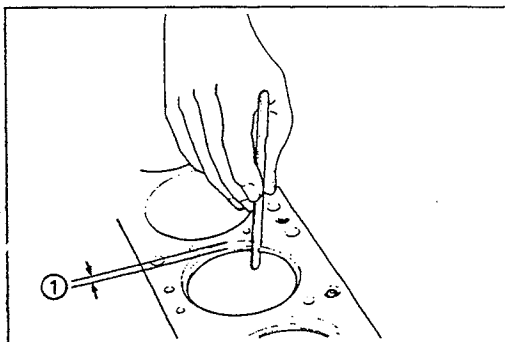
Refer to the Section "CYLINDER BODY", Item "Cylinder Liner Bore Measurement" for details on piston grade selection and cylinder liner bore measurement.

050414, 0504140101A

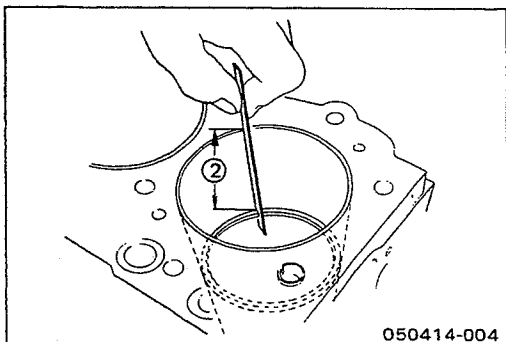


050414-003

0504140101B



05041401C



050414-004

PISTON RING

Piston Ring Gap

1. Insert the piston ring horizontally (in the position it would assume if it were installed to the piston) into the cylinder liner.

2. Push the piston ring into the cylinder bore until it reaches the measuring point ① where the cylinder liner bore is the smallest.

Do not allow the piston ring to slant to one side or the other. It must be perfectly horizontal.

Measuring Point ① 10 mm (0.39 in)

or

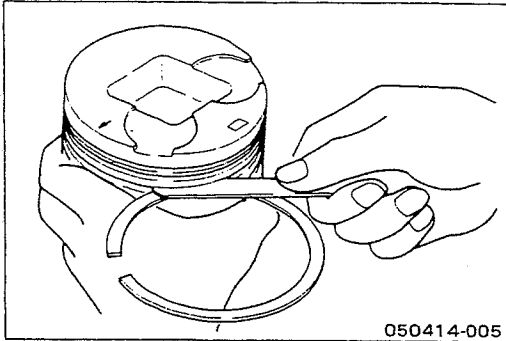
Measuring Point ② 120 mm (4.72 in)

3. Use a feeler gauge to measure the piston ring gap. If the measured value exceeds the specified limit, the piston ring must be replaced.



Piston Ring Gap	mm(in)	
	Standard	Limit
1st Compression Ring	0.2 - 0.4	1.5 (0.059)
2nd Compression Ring	(0.008 - 0.016)	
Oil Ring	0.1 - 0.3 (0.004 - 0.012)	

0504140201



050414-005



Piston Ring and Piston Ring Groove Clearance

Use a feeler gauge to measure the clearance between the piston ring and the piston ring groove at several points around the piston.



If the clearance between the piston ring and the piston ring groove exceeds the specified limit, the piston ring must be replaced.

Piston Ring and Piston Ring Groove

Clearance

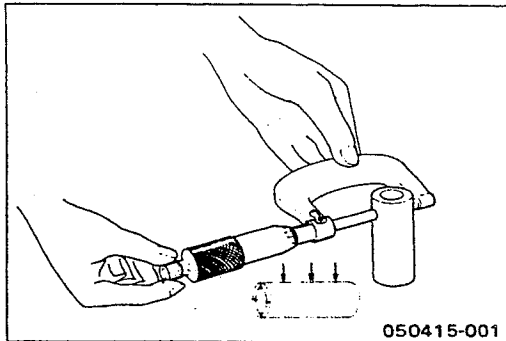
mm(in)

	Standard	Limit
1st Compression Ring	0.09–0.125 (0.0035–0.0049)	0.150 (0.006)
2nd Compression Ring	0.05–0.075 (0.002–0.003)	
Oil Ring	0.03–0.070 (0.0012–0.0028)	

4. Visually inspect the piston rings.

If a piston ring groove is damaged or distorted, the piston must be replaced.

050415, 05041501



050415-001



PISTON PIN

Piston Pin Diameter

Use a micrometer to measure the piston pin diameter at several points.

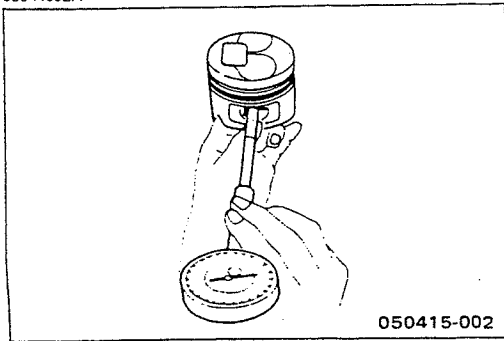
If the measured value is less than the specified limit, the piston pin must be replaced.

Piston Pin Diameter

mm(in)

	Standard	Limit
All 4JA1, 4JB1, and -'88 4JB1T	30.995 – 31.000 (1.2202 – 1.2204)	30.97 (1.219)
'89– 4JB1T and 4JB1TC	33.994 – 34.000 (1.3383 – 1.3386)	33.97 (1.337)

05041502A



050415-002



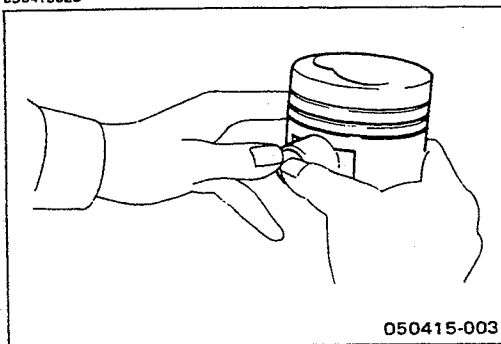
Piston Pin and Piston Clearance

Use an inside dial indicator to measure the piston pin hole (in the piston).

Piston Pin Hole		mm(in)
		Standard
All 4JA1, 4JB1, and -'88 4JB1T	31.002 – 31.010	(1.2206 – 1.2208)
'89– 4JB1T and 4JB1TC	34.002 – 34.010	(1.3387 – 1.3390) (1.3383 – 1.3386)

Piston Pin Clearance		mm(in)
		Standard
All Engine	0.002 – 0.015	(0.00008 – 0.0006)

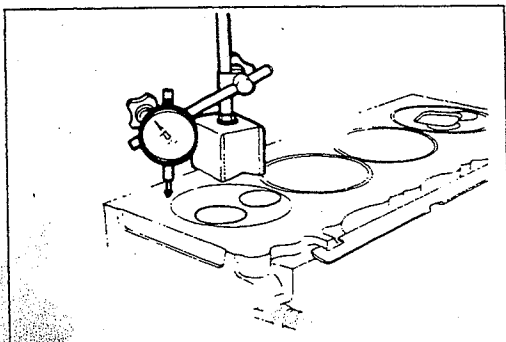
05041502B



050415-003

If an inside dial indicator is not available, use the following procedure.

1. Insert the piston pin into the piston.
Both the piston and the piston pin must be at room temperature.
2. Use your hand to forcefully push the piston pin in all directions.
You should feel a firm resistance to any movement.
If the piston pin moves loosely, both the piston and or the piston pin must be replaced.

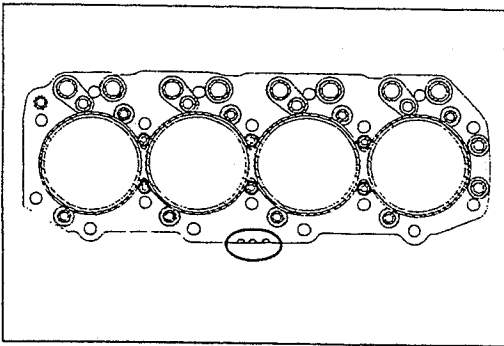
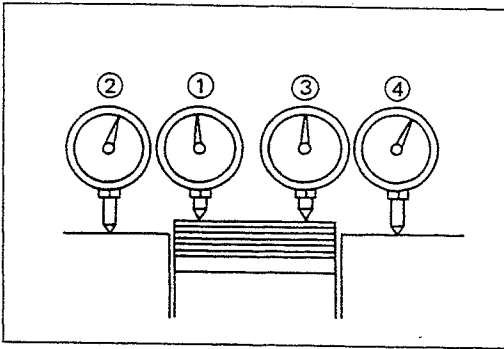
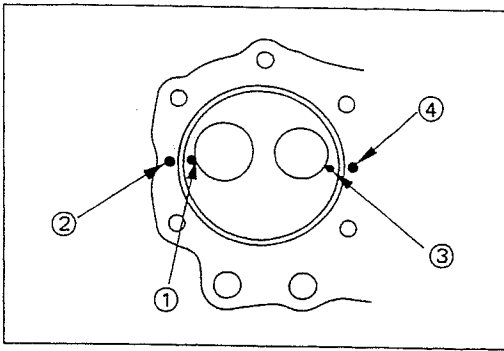


CYLINDER HEAD GASKET SELECTION (ALL 4JB1)

Cylinder head gasket is determined by the piston head projection from the cylinder body upper surface, in order to improve engine performance.

Three types of gasket are provided by the difference of thickness. Select the adequate one out of three grades of gasket, according to the following procedure.

Before measurement, clear off carbon from the piston head and cylinder body surface and also clean the place where a gasket was installed.



Piston Head Projection Measurement Point




1. Use a dial indicator to measure the piston projection amount.
2. Refer to the illustration for the piston head projection measuring positions.

All measuring positions should be as close as possible to the cylinder liner.



3. Measure the points ① ② ③ ④ and obtain two differences ①-② and ③-④ on each cylinder. Calculate the average value of the piston head projection on each cylinder.
4. Obtain the maximum value in the four cylinders.
5. Determine the gasket grade required to the maximum value described above in accordance with the following table.

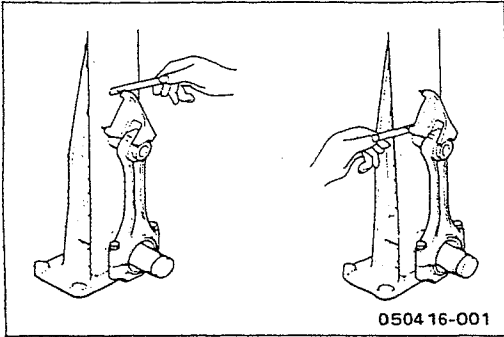
Cylinder Head Gasket Thickness mm(in)

Gasket Grade Mark	Piston Projection	Gasket Thickness (Reference)
(A) 	0.758-0.813 (0.030-0.032)	1.50 (0.0591)
(B) 	0.813-0.859 (0.032-0.034)	1.55 (0.0610)
(C) 	0.859-0.914 (0.034-0.036)	1.60 (0.0630)

Note:

Difference of each piston projection and must be equal or within 0.1 mm (0.0039 in).

050416, 05041601



CONNECTING ROD

Connecting Rod Alignment

Use a connecting rod aligner to measure the distortion and the parallelism between the connecting rod big end hole and the connecting rod small end hole.

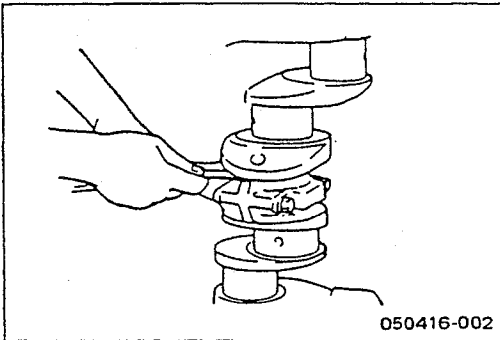
If either the measured distortion or parallelism exceed the specified limit, the connecting rod must be replaced.

Connecting Rod Alignment

Per Length of 100 mm (3.94 in) mm(in)

	Standard	Limit
Distortion	0.08 or Less (0.003)	0.20 (0.008)
Parallelism	0.05 or Less (0.002)	0.15 (0.006)

05041602



Connecting Rod Side Face Clearance

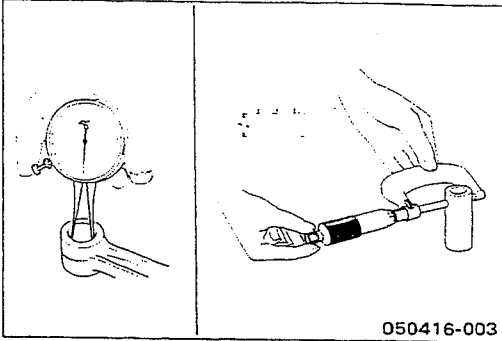
1. Install the connecting rod to the crankpin.
2. Use a feeler gauge to measure the clearance between the connecting rod big end side face and the crankpin side face.

If the measured value exceeds the specified limit, the connecting rod must be replaced.

Connecting Rod Big End and Crankpin Side Face Clearance

Standard	Limit
0.23 (0.009)	0.35 (0.014)

05041603



050416-003



Piston Pin and Connecting Rod Small End Bushing Clearance

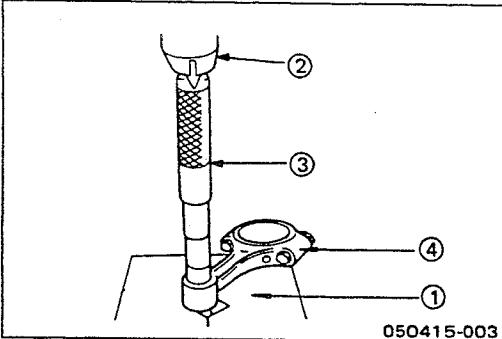
Use a caliper calibrator and a dial indicator to measure the piston pin and connecting rod small end bushing clearance.

If the clearance between the piston pin and the connecting rod small end bushing exceeds the specified limit, replace the piston pin and/or the connecting rod bushing.

Piston Pin and Connecting Rod Small End Bushing Clearance

		mm(in)
		Limit
Standard		
0.008 — 0.020 (0.0003 — 0.0008)		0.050 (0.002)

05041604, 050416040101A



050415-003



Connecting Rod Bushing Replacement

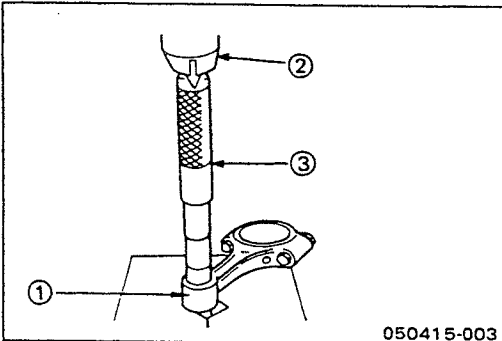
Connecting Rod Bushing Removal

1. Set the connecting rod small end to the bench press V-block ①.
2. Use the bench press ② and the bar ③ to slowly force the bushing from the connecting rod ④.

Note:

Take care not to damage the connecting rod with the bar when removing the bushing.

0101B



050415-003

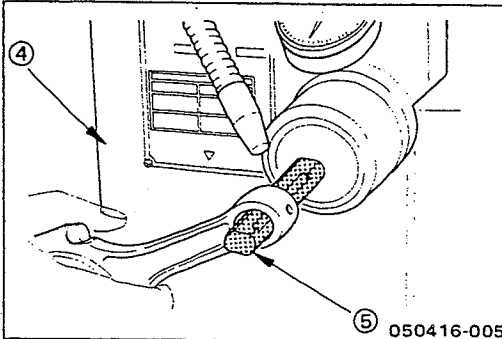


Connecting Rod Bushing Installation

1. Set the connecting rod small end ① to the bench press V-block.
2. Use the bench press ② and the bar ③ to slowly force the bushing with oil hole into position.



0101B

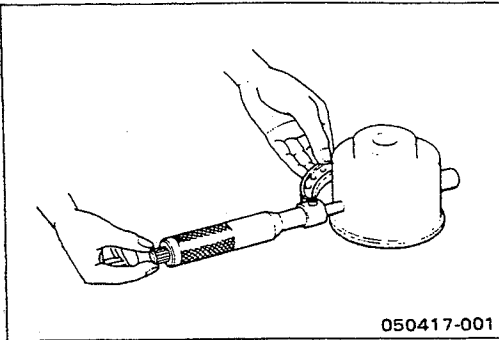


050416-005



3. Use a pin hole grinder ④ fitted with a reamer ⑤ to ream the piston pin hole.

050417, 05041701



IDLER GEAR SHAFT AND IDLER GEAR (TIMING GEAR DRIVE)

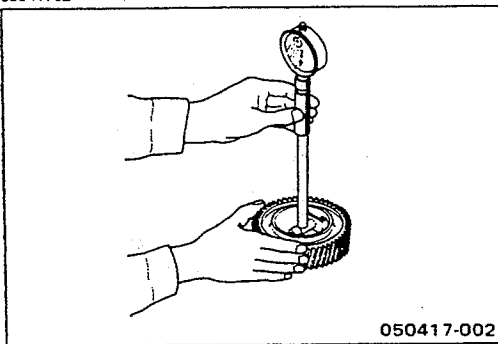
Idler Gear Shaft Outside Diameter

Use a micrometer to measure the idler gear shaft outside diameter.

If the measured value is less than the specified limit, the idler gear must be replaced.

Idler Gear Shaft Outside Diameter		mm(in)
Standard	Limit	
44.945 – 44.975 (1.769 – 1.770)	44.845 (1.766)	

05041702



Idler Gear "A" Inside Diameter

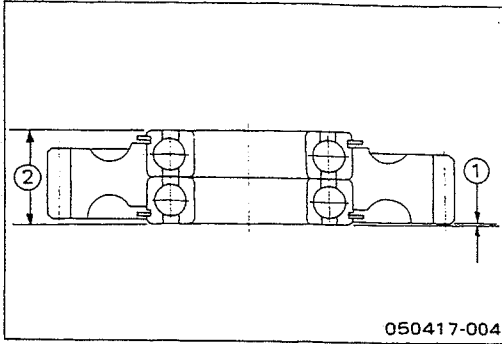
1. Use an inside dial indicator or an inside micrometer to measure the idler gear inside diameter.

Idler Gear Inside Diameter		mm(in)
Standard	Limit	
45.0 – 45.03 (1.7717 – 1.7718)	45.10 (1.7756)	

If the clearance between the idler gear shaft outside diameter and the idler gear inside diameter exceeds the limit, the idler gear must be replaced.

Idler Gear Shaft and Idler Gear Clearance		mm(in)
Standard	Limit	
0.025 – 0.085 (0.0010 – 0.0033)	0.200 (0.008)	

05041703



050417-004



Idler Gear "B"
Bearing Replacement



Bearing Removal

Use a bench press or a hammer and a bar to remove the bearing from the idler gear.

Bearing Installation

Use a bench press and bar to install the bearing into the idler gear.

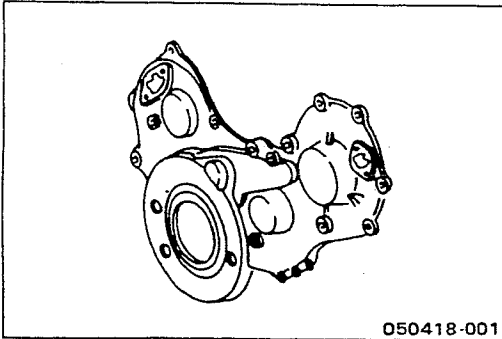
Bearing Projection and Height mm(in)

Projection①	0.4 – 0.6 (0.016 – 0.024)
Height ②	23.7 – 24.0 (0.933 – 0.945)

Note:

The bench press and bar should make contact only with the bearing outer races. Do not allow them to make contact with the bearing inner races. Bearing damage and reduced bearing service life will result.

050418



050418-001

TIMING GEAR CASE COVER
(TIMING GEAR DRIVE)

Replace the crankshaft front oil seal if it is excessively worn or damaged.

05041801, 050418010101



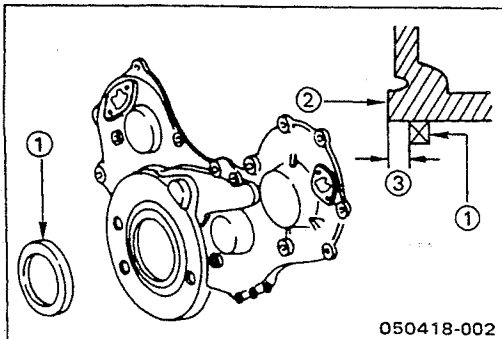
Crankshaft Front Oil Seal Replacement

Oil Seal Removal

Use a plastic hammer and a screwdriver to tap around the oil seal to free it from the gear case cover.

Take care not to damage the oil seal fitting surfaces.

050418010201



050418-002



Oil Seal Installation

Use the installer to install the front oil seal ① to the gear case cover ②.



Oil Seal Installer: 5-8840-2061-0

Note the oil seal installation depth ③ shown in the illustration.

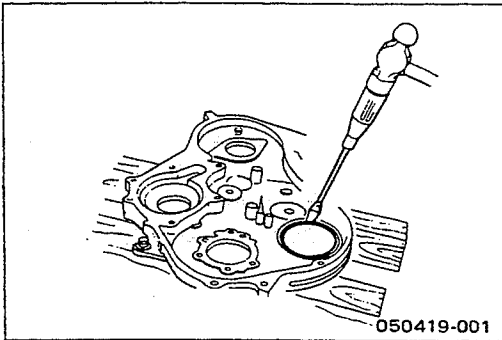
Depth ③ = 1 mm (0.039 in.)

TIMING PULLEY HOUSING (TIMING BELT DRIVE)

Replace the crankshaft front oil seal if it is worn or damaged.

Take care not to damage the oil seal fitting surfaces.

05041901, 050419010101



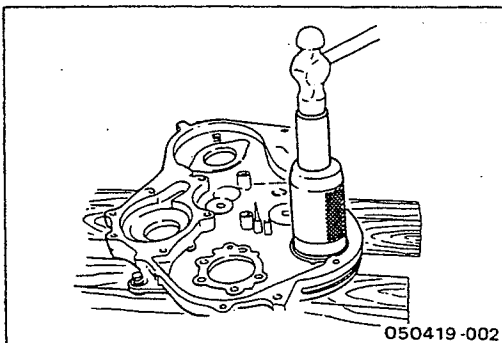
Crankshaft Front Oil Seal Replacement

Oil Seal Removal

1. Place two flat pieces of wood beneath the timing pulley housing.
Leave an open space beneath the oil seal.
2. Use a plastic hammer and a screwdriver to drive the oil seal out from the front side (lower side in the illustration) of the timing pulley housing.



050419010201



Oil Seal Installation

1. Use an oil seal installer to install the oil seal to the timing pulley housing.
The oil seal must be flush with the pulley housing.
Oil Seal Installer: 5-8840-2036-0
Grip: 9-8522-1608-0
2. Apply engine oil to the oil seal lip.



050500A



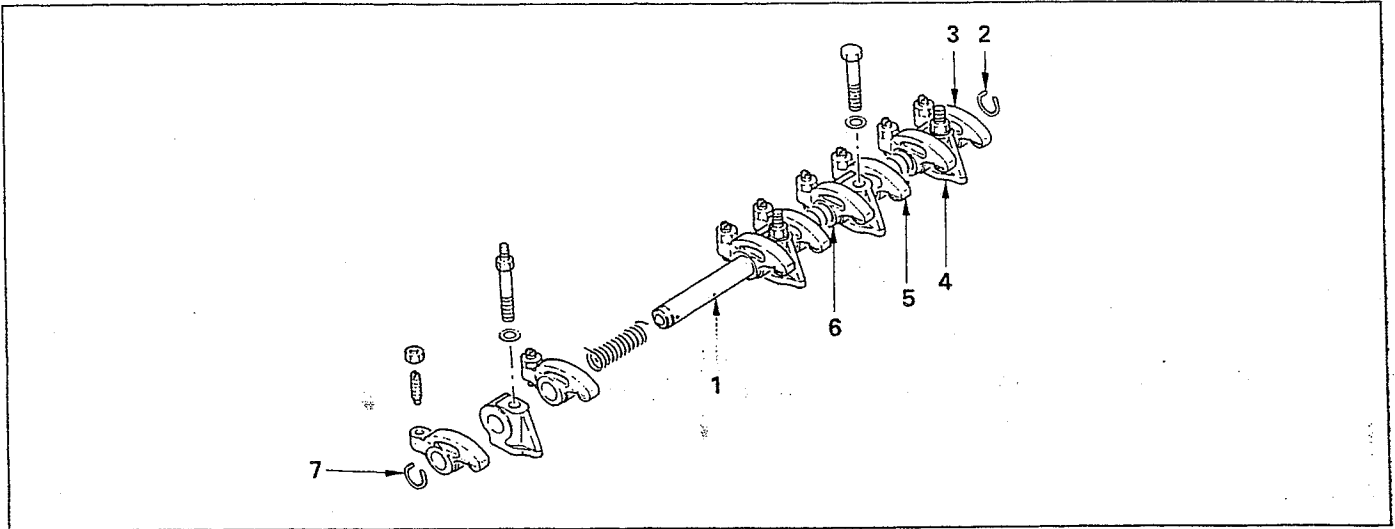
REASSEMBLY

INTERNAL PARTS

MINOR COMPONENTS



ROCKER ARM SHAFT AND ROCKER ARM



05050001B

Reassembly Steps

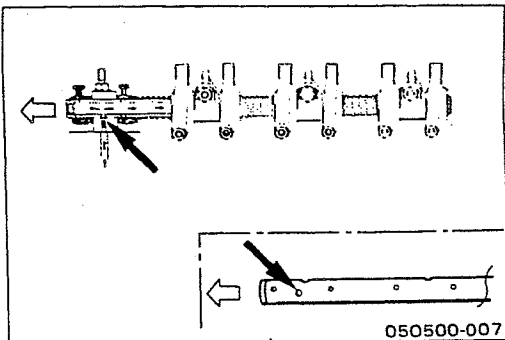
- | | |
|-------------------------------|-------------------------------|
| ▲ 1. Rocker arm shaft | 5. Rocker arm |
| 2. Rocker arm shaft snap ring | 6. Rocker arm shaft spring |
| 3. Rocker arm | 7. Rocker arm shaft snap ring |
| 4. Rocker arm shaft bracket | |

05050001



Important Operations

0505000101



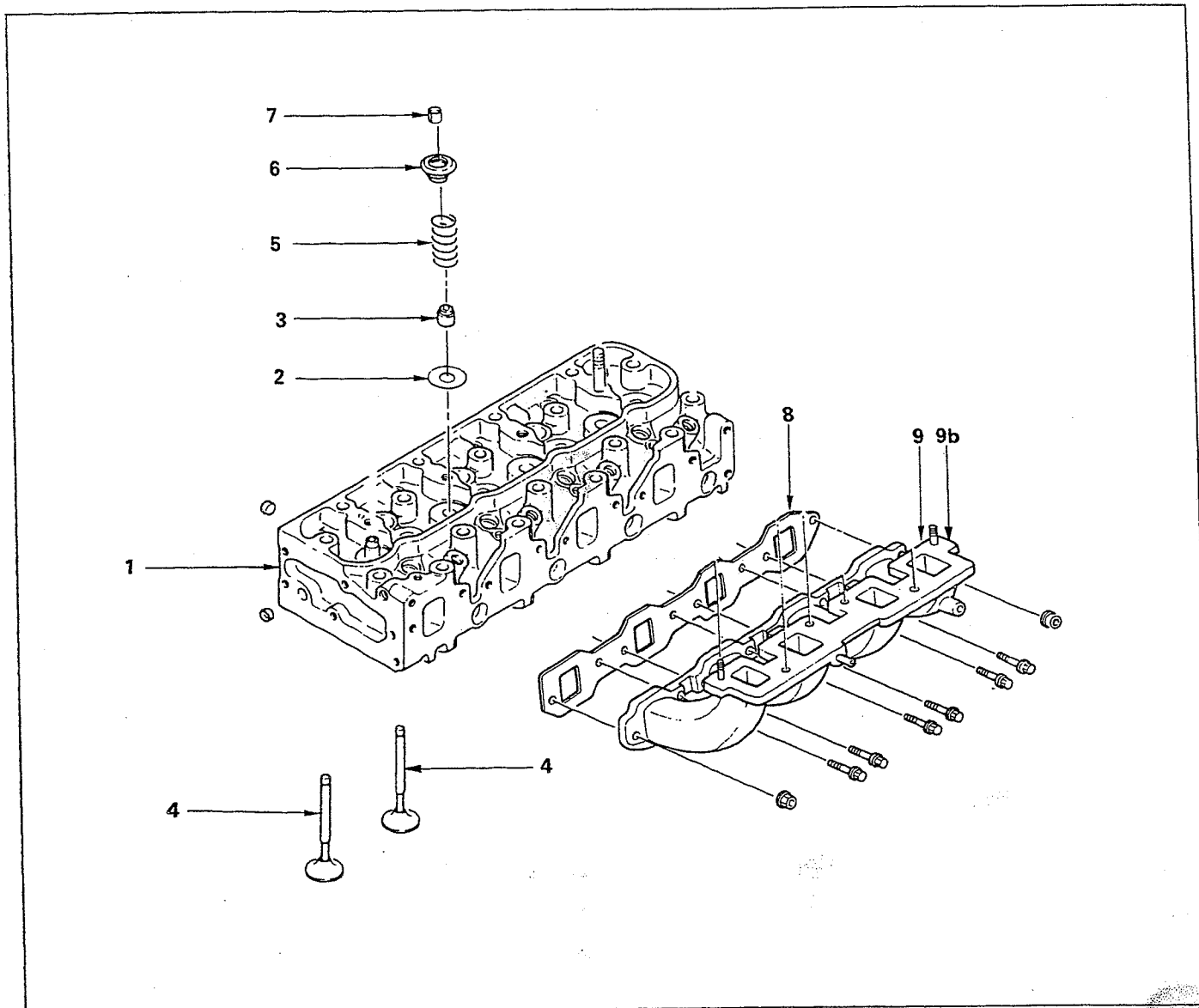
▲ Rocker Arm Shaft

- 1) Position the rocker arm shaft with the large oil hole (4φ) facing the front of the engine.
- 2) Install the rocker arm shaft together with the rocker arm, the rocker arm shaft bracket, and the spring.



CYLINDER HEAD

This illustration is based on the 4JB1T engine.



050501B

Reassembly Steps

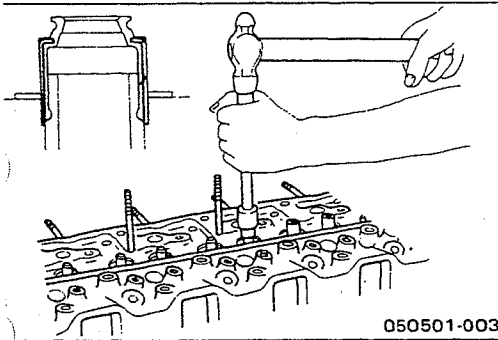
- | | |
|-------------------------------|-------------------------------------|
| 1. Cylinder head | 6. Valve spring upper seat |
| 2. Valve spring lower seat | ▲ 7. Split collar |
| ▲ 3. Valve stem oil seal | ▲ 8. Intake manifold gasket |
| ▲ 4. Intake and exhaust valve | ▲ 9. Lower intake manifold (4JB1T) |
| ▲ 5. Valve spring | ▲ 9a Intake manifold (Except 4JB1T) |

5050101



Important Operations

505010101



050501-003

505010102



▲ Valve Stem Oil Seal

- 1) Apply a coat of engine oil to the oil seal inner face.
- 2) Use an oil seal installer to install the oil seal to the valve guide.

Oil Seal Installer: 5-8840-2033-0

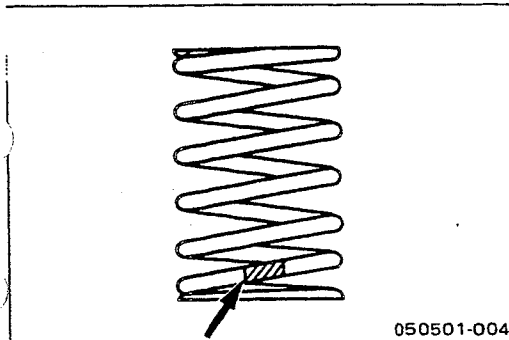


▲ Intake and Exhaust Valve

- 1) Apply a coat of engine oil to each valve stem before installation.
- 2) Install the intake and exhaust valves.
- 3) Turn the cylinder head up to install the valve springs.

Take care not to allow the installed valves to fall free.

0505010103



050501-004

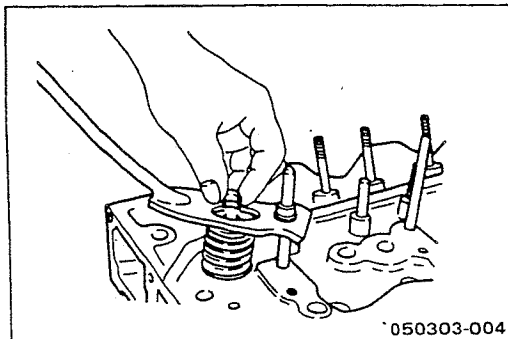


▲ Valve Spring

Install the inner and outer valve springs with their fine pitched end (painted) facing down. (For 4JA1)

Install the valve springs with their fine pitched end (Painted) facing down. (For 4JB1)

0505010104

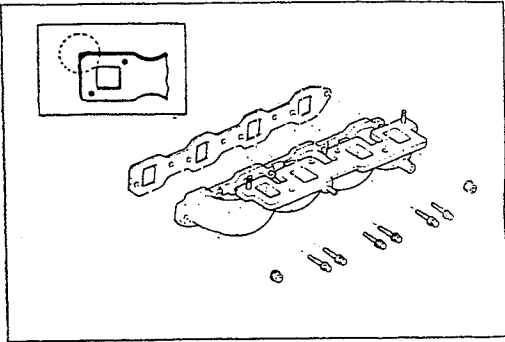


050303-004



▲ Split Collar

- 1) Use the spring compressor to compress the valve spring into position.
Spring Compressor: 9-8523-1423-0 (J-29760)
- 2) Install the split collars to the valve stem.
- 3) Set the split collars by tapping around the head of the collar with a rubber hammer.



▲ Intake Manifold Gasket

▲ Lower Intake Manifold (4JB1T)



▲ Intake Manifold (Except 4JB1T)

- 1) Install the manifold gasket with the end having the sharp corners facing the front of the engine.
- 2) Install the lower intake manifold to the cylinder head.
- 3) Tighten the manifold bolts to the specified torque.

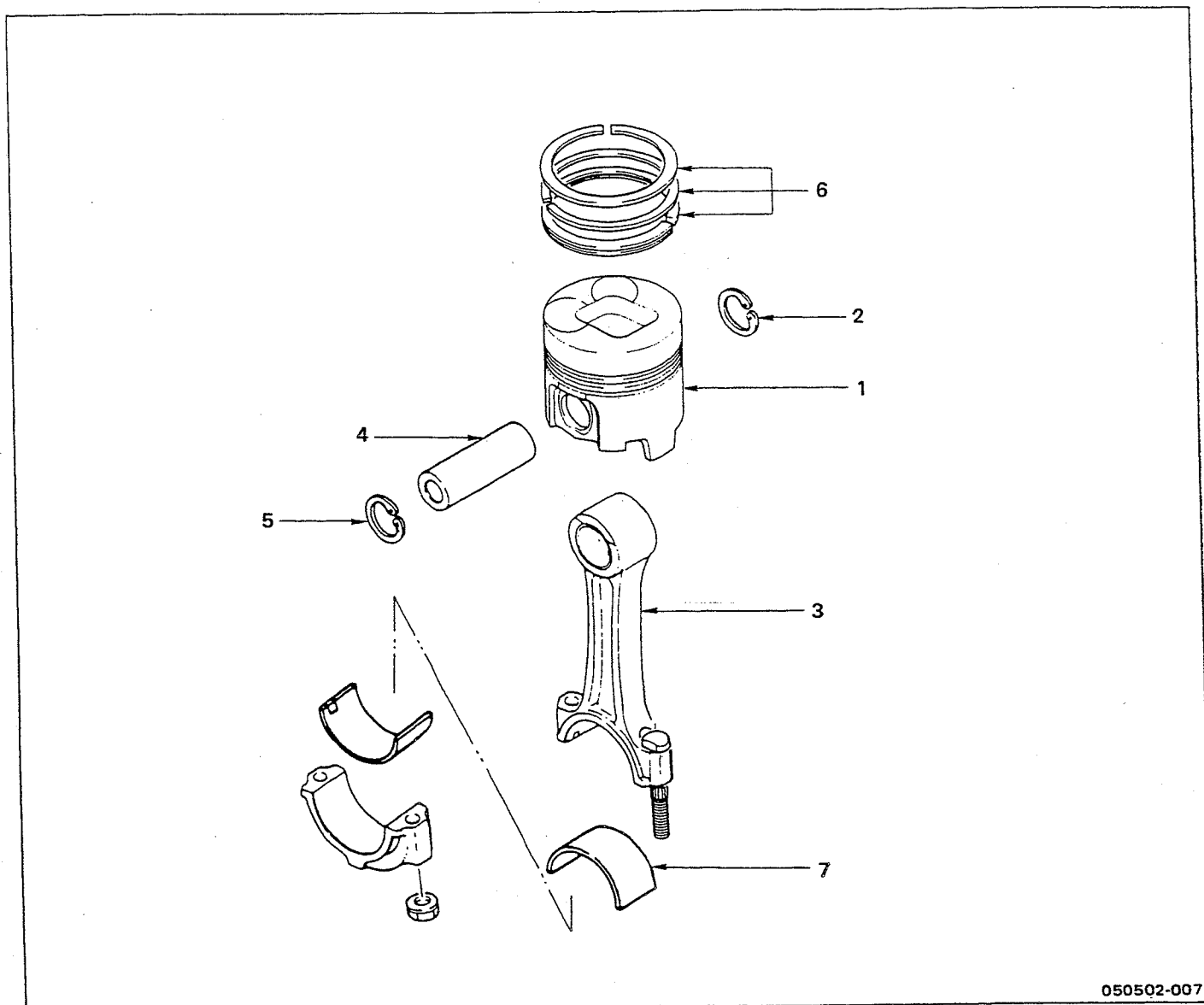
Manifold Bolt Torque kg·m(lb.ft/N·m)

1.9 ± 0.5 ($13.7 \pm 3.6/18.62 \pm 4.90$)

050502A



PISTON AND CONNECTING ROD



050502-007

050502B

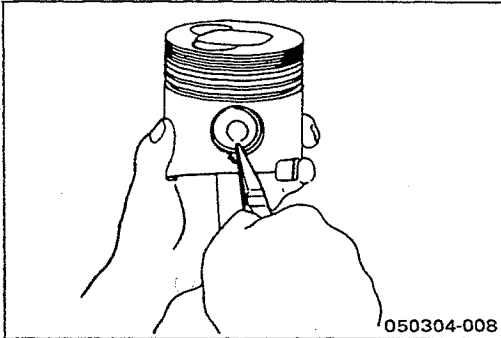
Reassembly Steps

- ▲ 1. Piston
- ▲ 2. Piston pin snap ring
- ▲ 3. Connecting rod
- ▲ 4. Piston pin
- ▲ 5. Piston pin snap ring
- ▲ 6. Piston ring
- ▲ 7. Connecting rod bearing



Important Operations

0505020101A



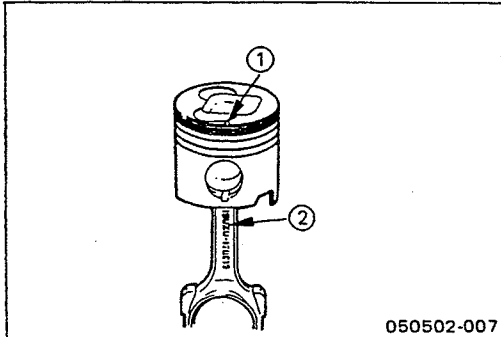
050304-008



- ▲ Piston
- ▲ Piston Pin Snap Ring
- ▲ Connecting Rod

- 1) Clamp the connecting rod in a vise.
Take care not to damage the connecting rod.
- 2) Use a pair of pliers to install the piston pin snap ring to the piston.

0505020101B

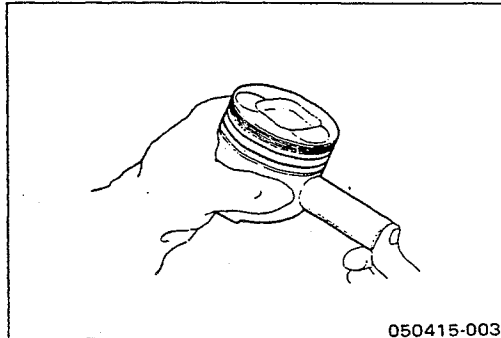


050502-007



Install the piston to the connecting rod so that the piston head front mark ① and the connecting rod "ISUZU" casting mark ② are facing in the same direction.

050502010201A

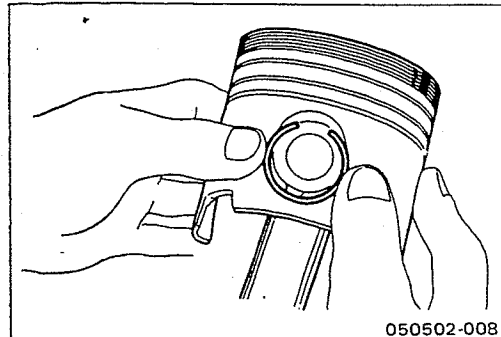


050415-003



- ▲ Piston Pin
- 1) Apply a coat of engine oil to the piston pin and the piston pin hole.
 - 2) Use your fingers to force the piston pin into the piston until it makes contact with the snap ring.

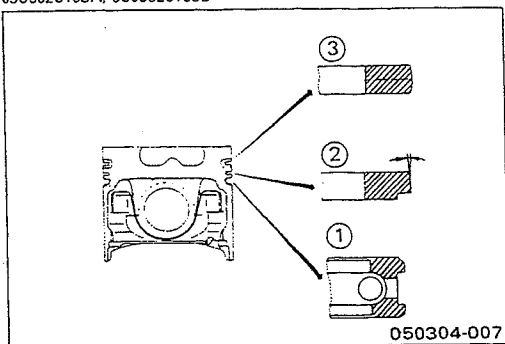
050502010201B



050502-008

- ▲ Piston Pin Snap Ring
- 1) Use your fingers to force the piston pin snap ring into the piston snap ring groove.
 - 2) Check that the connecting rod moves smoothly on the piston pin.

0505020103A, 0505020103B



▲ Piston Ring

- 1) Use a piston ring replacer to install the three piston rings.

Piston Ring Replacer

Install the piston rings in the order shown in the illustration.

- ① Oil ring
- ② 2nd compression ring
- ③ 1st compression ring



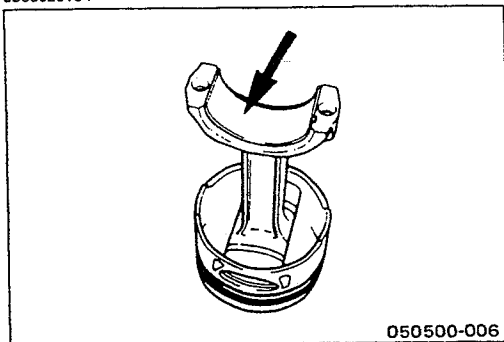
Note:

Install the compression rings with the stamped side facing up.

Insert the expander coil into the oil ring groove so that there is no gap on either side of the expander coil before installing the oil ring.

- 2) Apply engine oil to the piston ring surfaces.
- 3) Check that the piston rings rotate smoothly in the piston ring grooves.

0505020104



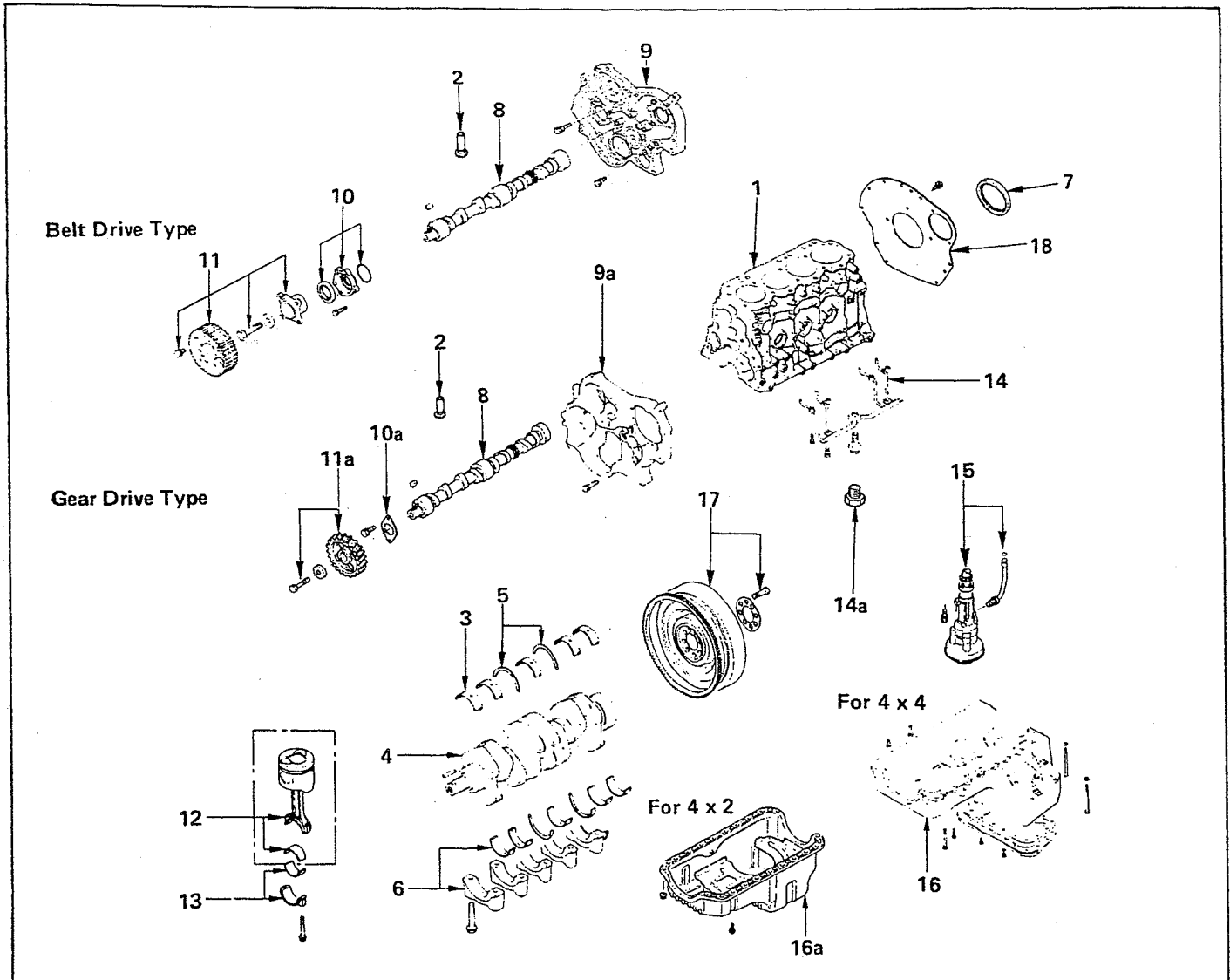
▲ Connecting Rod Bearing

Carefully wipe any oil or other foreign material from the connecting rod bearing back face and the connecting rod bearing fitting surface.



INTERNAL PARTS

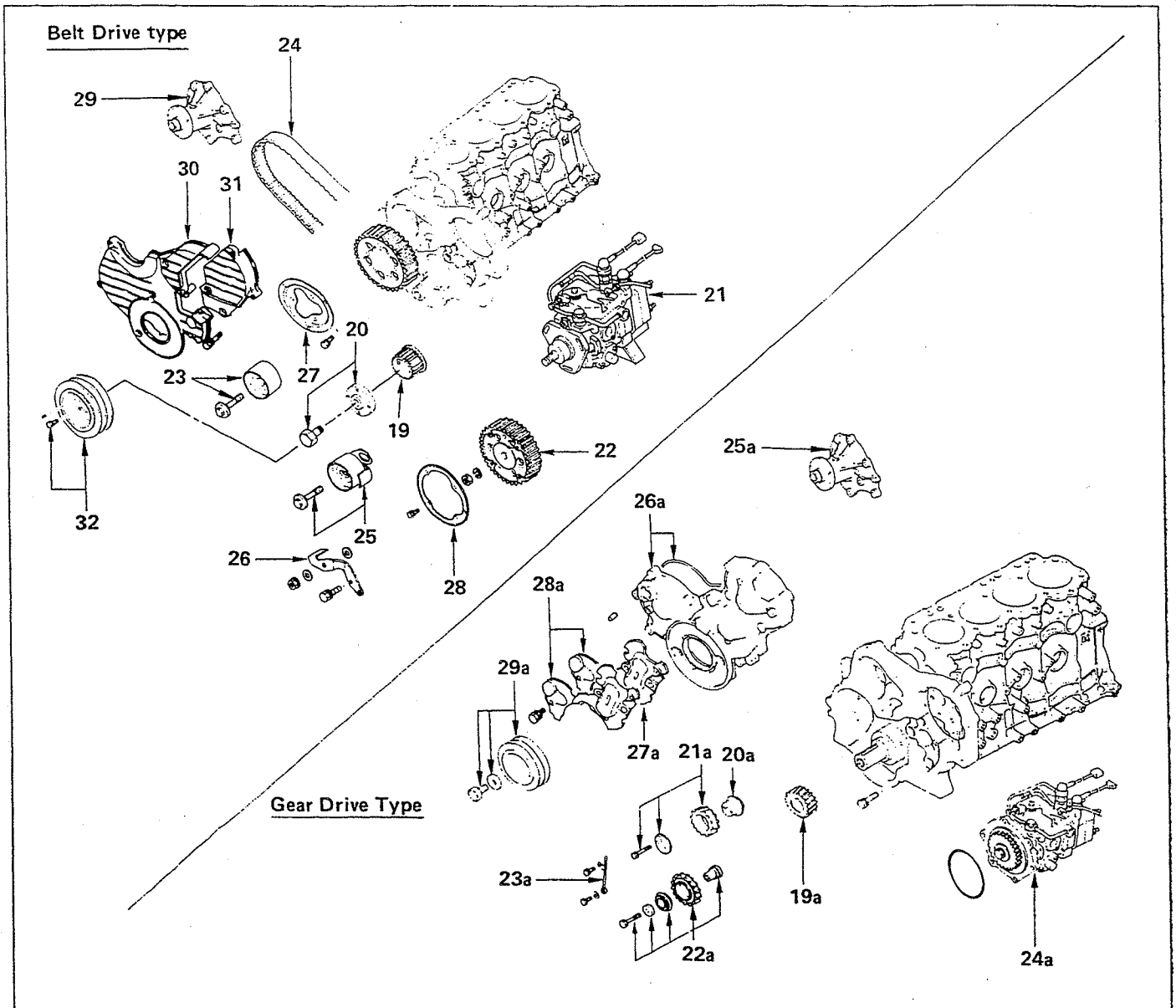
MAJOR COMPONENTS



Reassembly Steps-1

- ▲ 1. Cylinder body
- ▲ 2. Tappet
- ▲ 3. Crankshaft upper bearing
- ▲ 4. Crankshaft
- ▲ 5. Crankshaft thrust bearing
- ▲ 6. Crankshaft bearing cap with lower bearing
- ▲ 7. Crankshaft rear oil seal
- ▲ 8. Camshaft
- ▲ 9. Timing pulley housing (For belt drive)
- ▲ 9a Timing gear case (For gear drive)
- ▲ 10. Oil seal retainer (For belt drive)
- ▲ 10a Camshaft thrust plate (For gear drive)
- ▲ 11. Camshaft timing pulley (For belt drive)
- ▲ 11a Camshaft timing gear (For gear drive)
- ▲ 12. Piston and connecting rod with upper bearing
- ▲ 13. Connecting rod bearing cap with lower bearing
- ▲ 14. Piston cooling oil pipe
- ▲ 14a Oil jet plug (For 4JB1)
- ▲ 15. Oil pump with oil pipe
- ▲ 16. Oil pan (For 4JB1)
- ▲ 16a Oil pan (For 4JA1)
- ▲ 17. Flywheel
- ▲ 18. Cylinder body rear plate

Inverted Engine



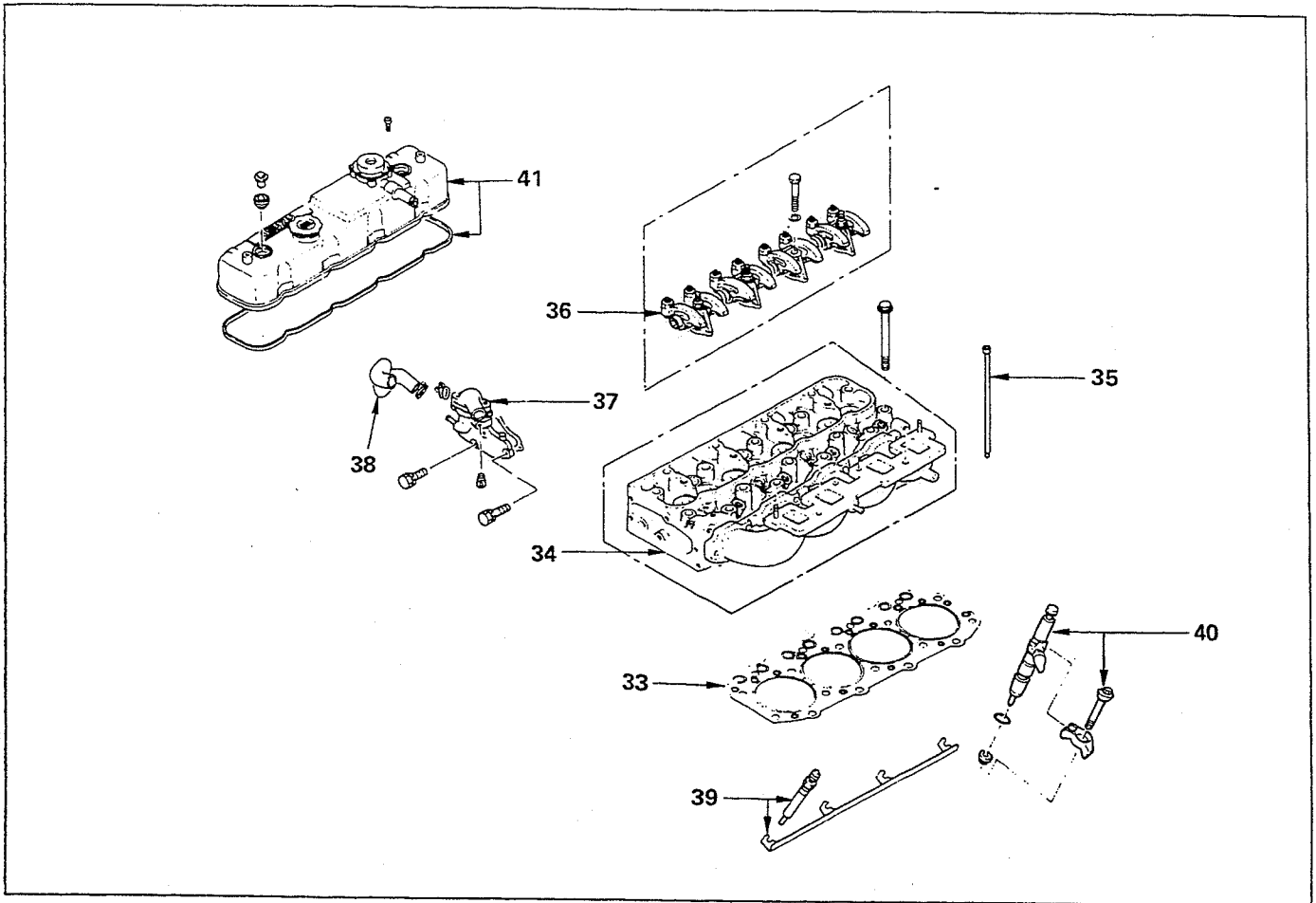
Reassembly Steps-2

Belt Drive Type

- ▲ 19. Crankshaft timing pulley
- ▲ 20. Crankshaft timing pulley center
- ▲ 21. Injection pump
- ▲ 22. Injection pump timing pulley
- ▲ 23. Tension idler
- ▲ 24. Timing belt
- ▲ 25. Timing belt tensioner
- ▲ 26. Timing belt tension adjusting lever
- ▲ 27. Camshaft timing pulley flange
- ▲ 28. Injection pump timing pulley flange
- ▲ 29. Water pump
- ▲ 30. Timing pulley housing lower cover
- ▲ 31. Timing pulley housing upper cover
- ▲ 32. Crankshaft damper pulley

Gear Drive Type

- ▲ 19a Crankshaft timing gear
- ▲ 20a Idler gear shaft
- ▲ 21a Idler gear "A"
- ▲ 22a Idler gear "B" and shaft
- ▲ 23a Timing gear oil pump
- ▲ 24a Injection pump
- ▲ 25a Water pump
- ▲ 26a Timing gear case cover
- 27a Space rubber
- 28a Gear case cover upper cover and lower cover
- ▲ 29a Crankshaft damper pulley
- 30. —
- 31. —
- 32. —



Reassembly Steps-3

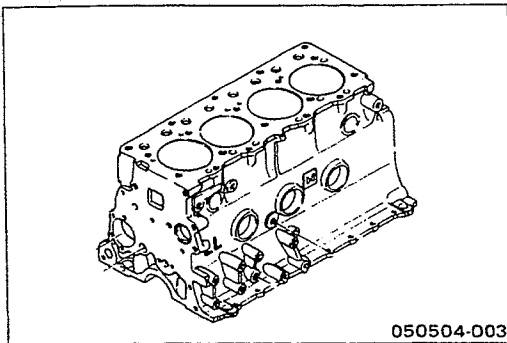
- ▲ 33. Cylinder head gasket
- ▲ 34. Cylinder head
- 35. Push rod
- ▲ 36. Rocker arm shaft and rocker arm
- ▲ 37. Thermostat housing with thermo switch
- 38. Water by-pass hose
- ▲ 39. Glow plug and glow plug connector
- ▲ 40. Injection nozzle holder
- ▲ 41. Cylinder head cover

05050601



Important Operations

0505040101



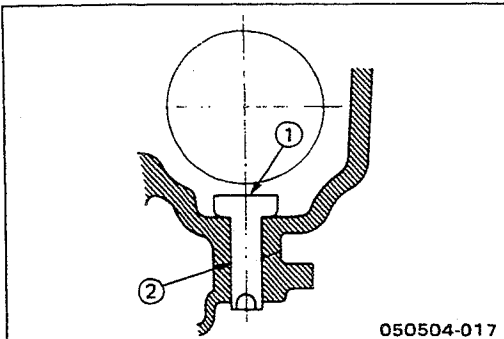
050504-003



▲ Cylinder Body

Use compressed air to thoroughly clean the inside and outside surfaces of the cylinder body, the oil holes, and the water jackets.

0505040110



050504-017



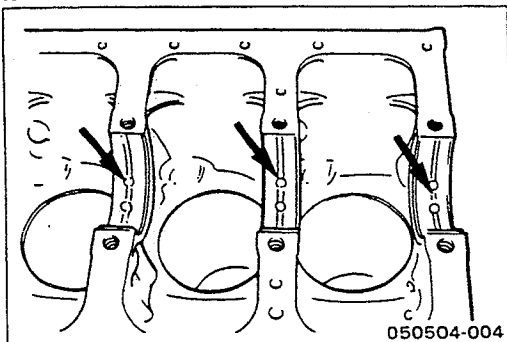
▲ Tappet

- 1) Apply a coat of engine oil to the tappet ① and the cylinder body tappet insert holes ②.
- 2) Locate the position mark applied at disassembly (if the tappet is to be reused).

Note:

The tappet must be installed before the camshaft.

0505040102



050504-004

▲ Crankshaft Upper Bearing

The crankshaft upper bearings have an oil hole and an oil groove. The lower bearings do not.

- 1) Carefully wipe any foreign material from the upper bearing.

Note:

Do not apply engine oil to the bearing back faces and the cylinder body bearing fitting surfaces.

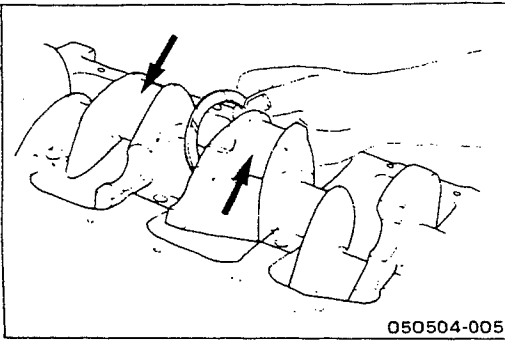
- 2) Locate the position mark applied at disassembly if the removed upper bearings are to be reused.

Note:

All 4JB1 engine (for UBS vehicles) bearings are selected according to cylinder body and crankshaft grade.

Refer to "INSPECTION AND REPAIR", "Crankshaft Bearing Selection".

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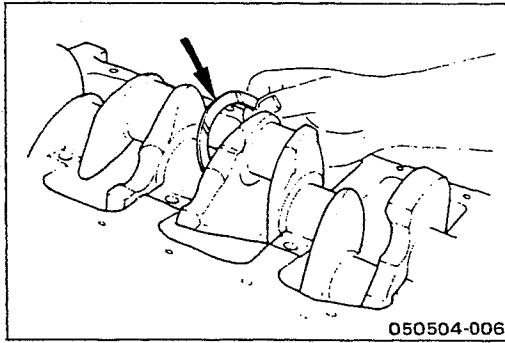
050504-005



▲ Crankshaft

Apply an ample coat of engine oil to the crankshaft journals and the crankshaft bearing surfaces before installing the crankshaft.

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050504-006



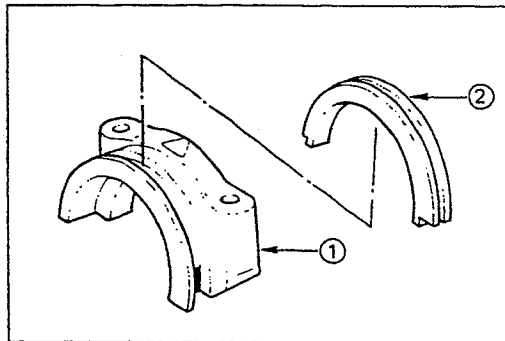
▲ Crankshaft Thrust Bearing

Apply an ample coat of engine oil to the thrust bearings before installation.



Install the thrust bearings to the crankshaft center journal.

The thrust bearing oil grooves must be facing the sliding faces.



▲ Crankshaft Bearing Cap with Lower Bearing

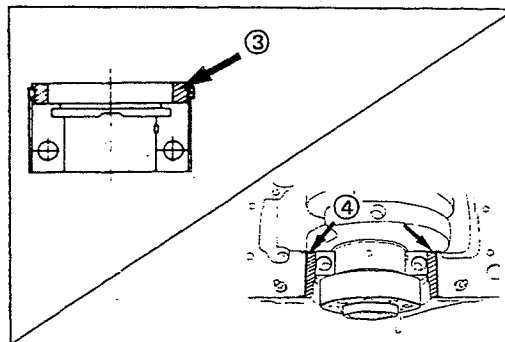
Install the selected bearing for all 4JB1 engines.

1) Apply the recommended liquid gasket or its equivalent to the No. 5 crankshaft bearing cap ① as shown in the illustration.

2) Install the arch gasket ② to the No. 5 bearing cap.

Use your fingers to push the arch gasket into the bearing cap groove.

Take care not to scratch the arch gasket outer surface.

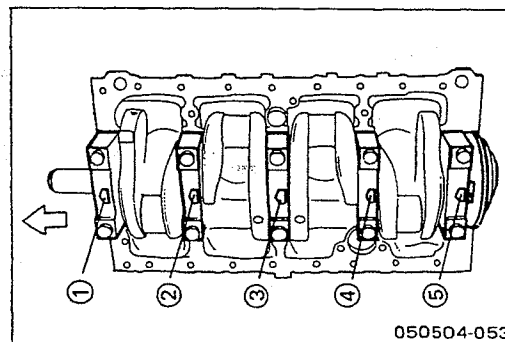


3) Apply the recommended liquid gasket or its equivalent to the No. 5 crankshaft bearing cap cylinder body fitting surfaces at the points (③ and ④) shown in the illustration.

Note:

Be sure that the bearing cap fitting surface is completely free of oil before applying the liquid gasket.

Do not allow the liquid gasket to obstruct the cylinder thread holes and bearings.



050504-053



4) Install the bearing caps with the bearing cap head arrow mark facing the front of the engine.

The bearing cap numbers must be facing up.

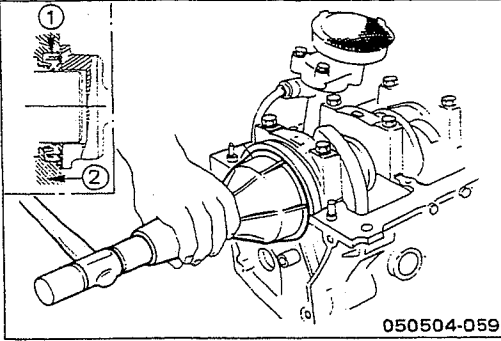


5) Apply engine oil to the crankshaft bearing cap bolts.

6) Temporarily tighten the bearing cap bolts.

The bolts will be tightened to the specified torque after the crankshaft rear oil seal is installed.

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050504-059



▲ Crankshaft Rear Oil Seal

- 1) Apply engine oil to the oil seal ① lip circumference and the oil seal inner circumference.
- 2) Use the oil seal installer to install the oil seal to the cylinder body ②.

There must be no step between the cylinder body and the oil seal.

Oil Seal Installer: 5-8840-0141-0

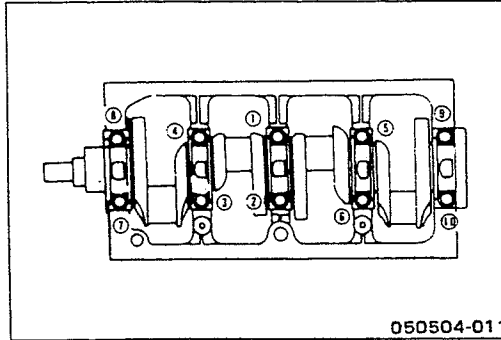


- 3) Tighten the crankshaft bearing cap bolts to the specified torque a little at a time in the sequence shown in the illustration.

Crankshaft Bearing Cap Torque	kg-m(lb.ft/N-m)
	17 ± 1 ($123.0 \pm 7.23/166.77 \pm 9.80$)

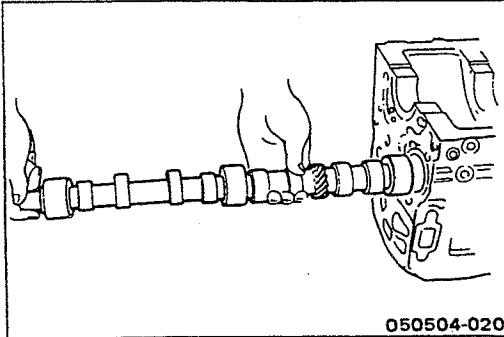


- 4) Check to see that the crankshaft turns smoothly by rotating it manually.



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050504-020



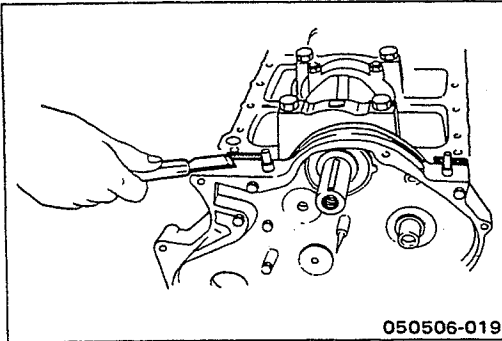
▲ Camshaft

- 1) Apply a coat of engine oil to the camshaft and the camshaft bearings.

Install the camshaft to the cylinder body.

Take care not to damage the camshaft bearings.

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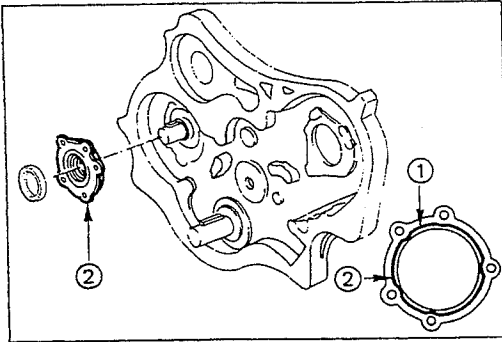


▲ Timing Pulley Housing (For Belt Drive)

- 1) Install the timing pulley housing to the cylinder body. Take care not to twist the front oil seal.
- 2) Tighten the timing pulley housing together with the timing pulley housing gasket to the specified torque.

Timing Pulley Housing Bolt Torque	kg-m(lb.ft/N-m)
	1.9 ± 0.5 ($13.7 \pm 3.6/18.62 \pm 4.90$)

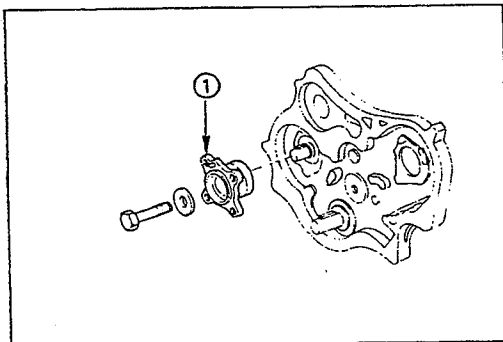
- 3) Cut away the flash from the gasket.



▲ Oil Seal Retainer (For Belt Drive)

- 1) Apply engine oil to the oil seal lip of the oil seal retainer.
- 2) Apply the recommended liquid gasket or its equivalent ① to the retainer ② at the position shown in the illustration.
Do not apply an excessive amount of liquid gasket.
- 3) Install the oil seal retainer ②.
- 4) Tighten the retainer bolts to the specified torque.

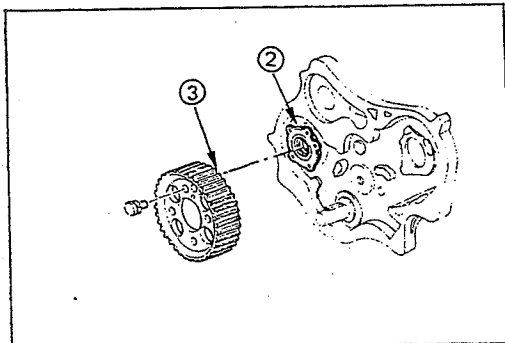
Oil Seal Retainer Bolt Torque	kg-m(lb.ft/N-m)
	1.9 ± 0.5 ($13.7 \pm 3.6/18.62 \pm 4.90$)



▲ Camshaft Timing Pulley (For Belt Drive)

- 1) Align the timing pulley center ① with the camshaft key.
- 2) Tighten the timing pulley center bolts to the specified torque.
Prevent the camshaft from turning when tightening the timing center.

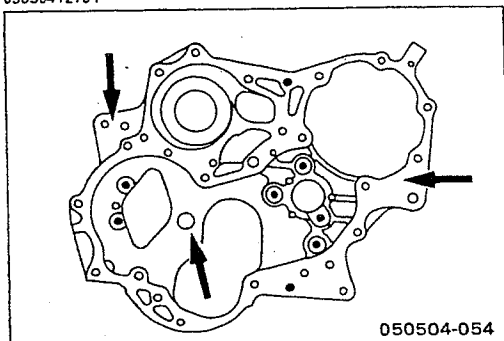
Timing Center Bolt Torque	kg-m(lb.ft/N-m)
	6.5 ± 0.5 ($47.0 \pm 3.6/63.70 \pm 4.90$)



- 3) Align the timing pulley with the timing center knock pin ② and then install the timing pulley ③ to the center.
Install the stopper bolt to the camshaft timing pulley to prevent it from turning.
- 4) Tighten the timing pulley bolts to the specified torque.

Timing Pulley Bolt Torque	kg-m(lb.ft/N-m)
	0.8 ± 0.2 ($5.8 \pm 1.4/7.84 \pm 1.96$)

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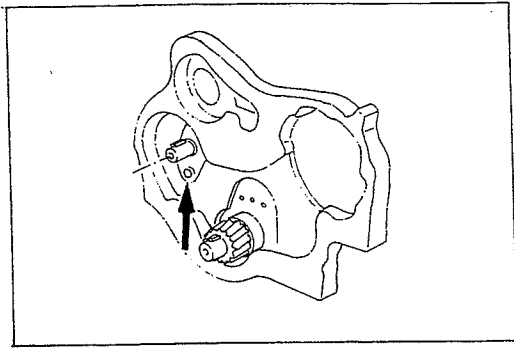
▲ Timing Gear Case (For Gear Drive)

- 1) Tighten the timing gear case with timing gear case gasket to the specified torque.

Timing Gear Case Bolt Torque	kg-m(lb.ft/N-m)
	1.9 ± 0.5 ($13.7 \pm 3.6/18.6 \pm 4.9$)

- 2) Cut away the flash from the gasket.

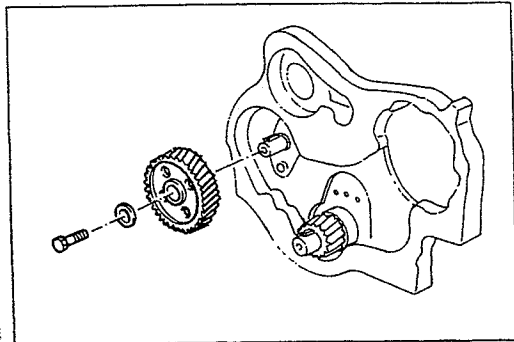
050504-054



▲ **Camshaft Thrust Plate (For Gear Drive)**

Install the thrust plate to the cylinder body and tighten the thrust plate bolts to specified torque.

Thrust Plate Bolt Torque	kg·m(lb.ft/N·m)
	1.8 ± 0.5 ($13.0 \pm 3.6/17.64 \pm 4.90$)



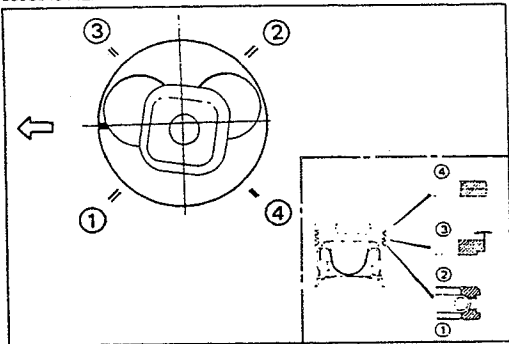
▲ **Camshaft Timing Gear (For Gear Drive)**

- 1) Install the camshaft timing gear to the camshaft.
The timing gear mark ("Y - Y") must be facing outward.
- 2) Tighten the timing gear to the specified torque.



Timing Gear Bolt Torque	kg·m(lb.ft/N·m)
	6.5 ± 0.5 ($47.0 \pm 3.6/63.70 \pm 4.90$)

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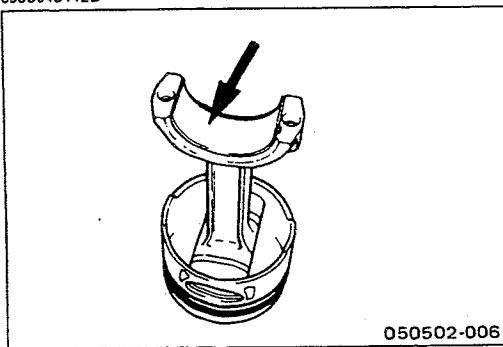


▲ **Piston and Connecting Rod with Upper Bearing**

▲ **Connecting Rod Bearing Cap with Lower Bearing**

- 1) Apply a coat of engine oil to the circumference of each piston ring and piston.
- 2) Position the piston ring gaps as shown in the illustration.
 - ① Oil ring (Lower side)
 - ② Oil ring (Upper side)
 - ③ 2nd Compression ring
 - ④ 1st Compression ring

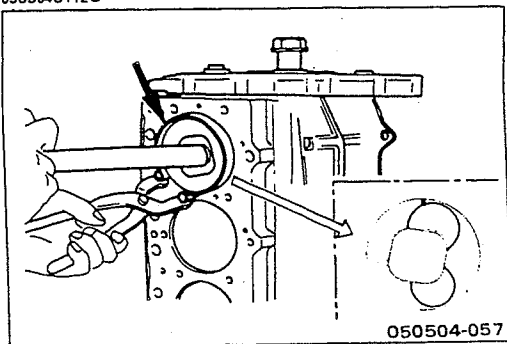
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- 3) Apply a coat of molybdenum disulfide grease to the two piston skirts.
This will facilitate smooth break-in when the engine is first started after reassembly.
- 4) Apply a coat of engine oil to the upper bearing surfaces.
- 5) Apply a coat of engine oil to the cylinder wall.



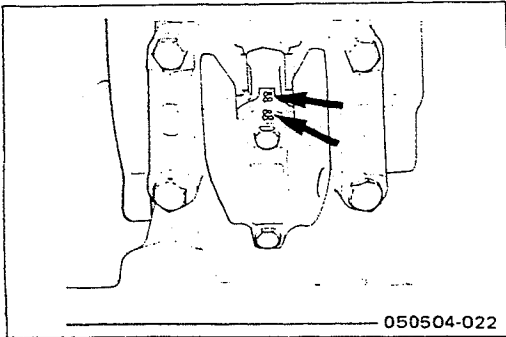
0505040112C



- 6) Position the piston head front mark so that it is facing the front of the engine.
- 7) Use the piston ring compressor to compress the piston rings.
Piston Ring Compressor: 5-8840-9018-0 (J-8037)
- 8) Use a hammer grip to push the piston in until the connecting rod makes contact with the crankpin.
At the same time, rotate the crankshaft until the crankpin is at BDC.



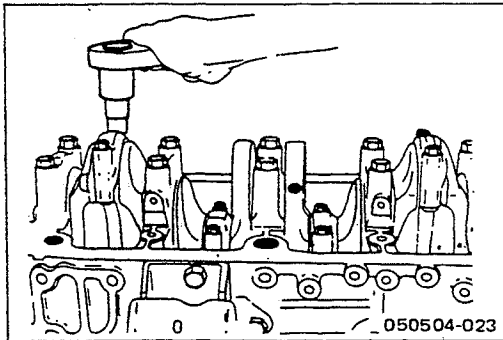
050504-057



9) Align the bearing cap cylinder number marks and the connecting rod cylinder number marks.



The cylinder number marks must be turned toward the exhaust manifold.



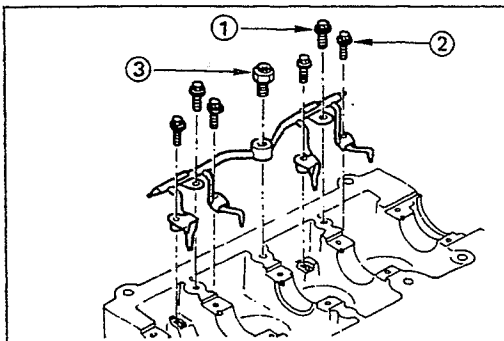
10) Apply a coat of engine oil to the threads and setting faces of each connecting rod cap bolt.



11) Tighten the connecting rod caps to the specified torque.

Connecting Rod Bearing Cap Bolt

Torque	kg·m(lb.ft/N·m)
	8.5 ± 0.5 ($61.5 \pm 3.6/83.30 \pm 4.90$)



▲ Piston Cooling Oil Pipe (Except 4JB1)

- 1) Install the piston cooling oil pipe to the cylinder body.
- 2) Tighten the oil pipe bolts and relief valve to the specified torque.

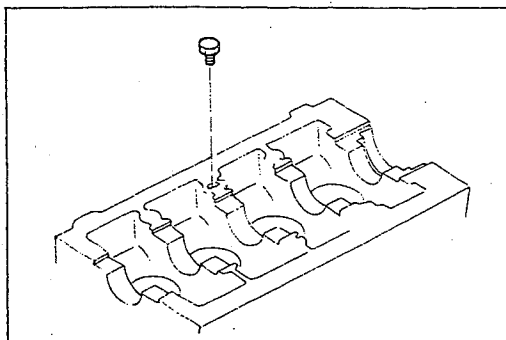
Oil Pipe Bolt Torque	kg ·m(lb.ft/N ·m)
① M8 × 1.25	1.9 ± 0.5 ($13.7 \pm 3.6/14.70 \pm 4.90$)
② M6 × 1.00	0.8 ± 0.2 ($5.1 \pm 1.4/7.84 \pm 1.96$)

Oil Pressure Regulating Valve Torque

	kg·m(lb.ft/N·m)
③ M6 × 1.5	3.0 ± 0.5 ($21.7 \pm 3.6/29.40 \pm 4.90$)

Note:

Check that there is no interference between the piston and the oiling jet pipe by slowly rotating the crankshaft.



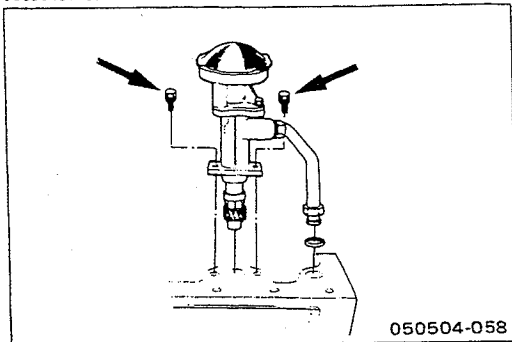
▲ Oil Jet Plug (For 4JB1)

- 1) Apply the recommended liquid gasket or its equivalent to the plug thread.
- 2) Tighten the oil jet plug to the specified torque.



Plug Torque	kg·m(lb.ft/N·m)
	5 ± 1 ($36.2 \pm 7.2/49.0 \pm 9.8$)

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▲ Oil Pump with Oil Pipe

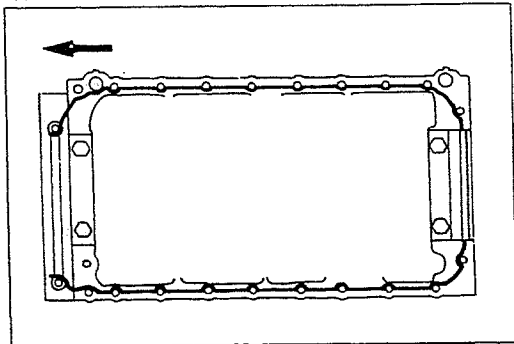
Install the oil pump with the oil pipe and tighten the bolts to the specified torque.

Oil Pump Bolt Torque	kg·m(lb.ft/N·m)
	$1.9 \pm 0.5 (13.7 \pm 3.6/18.62 \pm 4.90)$

Note:

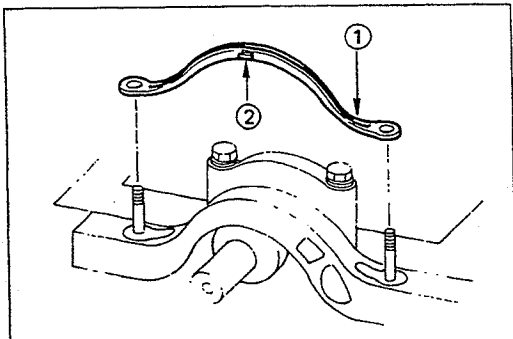
Take care not to damage the O-rings when tightening the oil pipe bolts.

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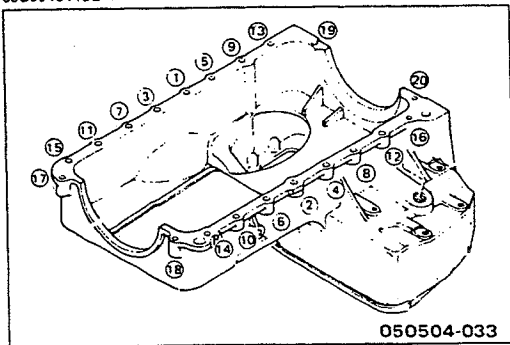
▲ Oil Pan

- 1) Apply the recommended liquid gasket or its equivalent to the cylinder body fitting faces and the No. 1 and No. 5 bearing cap arch gaskets at the positions shown in the illustration.
- 2) Apply the recommended liquid gasket or its equivalent to the cylinder body lower surface circumference shown in the illustration.



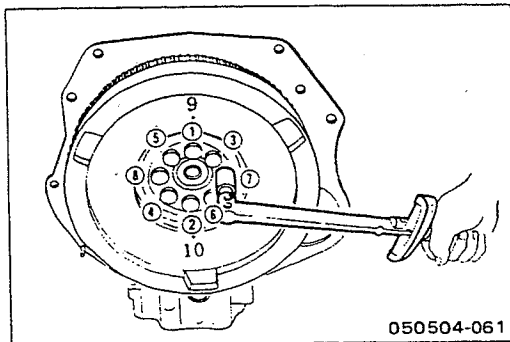
- 3) Install the oil pan front gasket ① to the timing pulley housing arches.
The gasket projection ② must be facing forward.

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- 4) Install the oil pan to the cylinder body.
- 5) Tighten the oil pan bolts to the specified torque a little at a time in the sequence shown in the illustration.

Oil Pan Bolt Torque	kg·m(lb.ft/N·m)
	$1.9 \pm 0.5 (13.7 \pm 3.6/18.62 \pm 4.90)$



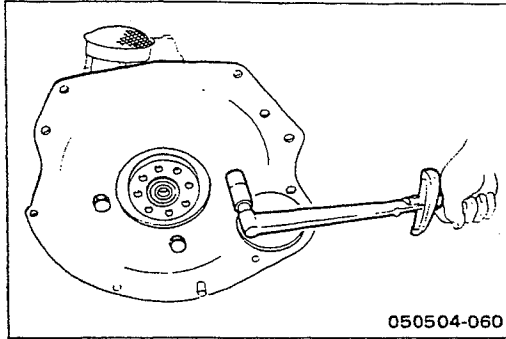
▲ Flywheel



- 1) Block the crankshaft with a piece of hard wood to prevent the flywheel from turning.
- 2) Apply a coat of engine oil to the threads of the flywheel bolts.
- 3) Align the flywheel with the crankshaft dowel pin.
- 4) Tighten the flywheel bolts to the specified torque in the numerical order shown in the illustration.

Flywheel Bolt Torque	kg·m(lb.ft/N·m)
	$12.0 \pm 0.5 (86.8 \pm 3.6/117.60 \pm 4.90)$

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050504-060



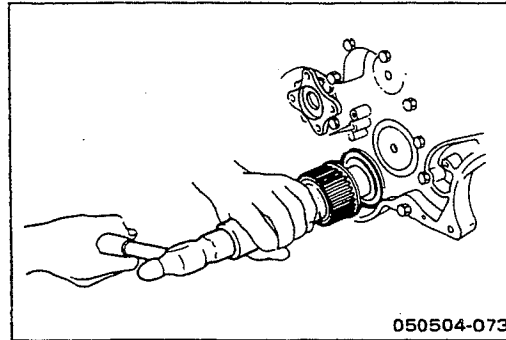
▲ **Cylinder Body Rear Plate**

- 1) Align the rear plate with the cylinder body knock pins.
- 2) Tighten the rear plate to the specified torque.



Rear Plate Torque	kg-m(lb.ft/N-m)
	8.4 ± 0.8 ($60.7 \pm 5.8/82.32 \pm 7.84$)

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050504-073



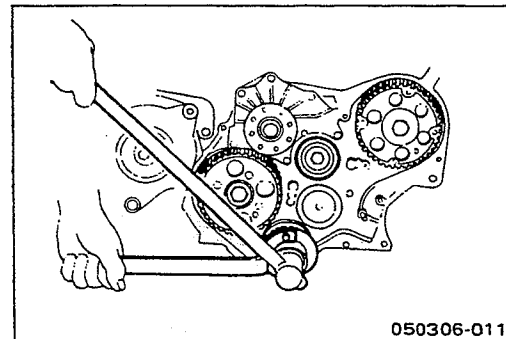
▲ **Crankshaft Timing Pulley (For Belt Drive)**

- 1) Install the timing pulley to the crankshaft.
- 2) Use the crankshaft timing pulley installer to install the timing pulley.



Crankshaft Timing Pulley Installer: 9-8522-0021-0

The timing pulley flange must be facing the cylinder body.



050306-011



▲ **Crankshaft Timing Pulley Center (For Belt Drive)**

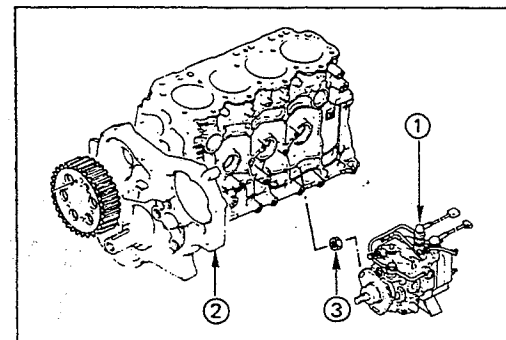
- 1) Install the crankshaft timing pulley center.
- 2) Use the fixing wrench to prevent the crankshaft from turning.
- 3) Tighten the crankshaft pulley center bolt to the specified torque.



Fixing Wrench: 5-8840-0161-0

Crankshaft Pulley Center Bolt Torque	kg-m(lb.ft/N-m)
	19 ± 2 ($137.4 \pm 14.5/186.20 \pm 19.60$)

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▲ **Injection Pump (For Belt Drive)**

- 1) Install the injection pump ① to the timing pulley housing ②.
- 2) Temporarily tighten the three injection pump nuts ③.

The injection pump nuts will be finally tightened after the injection pump rear bracket bolts.