INDUSTRIAL DIESEL ENGINE

2KA1, 2KB1, 2KC1 3KA1, 3KB1, 3KC1 MODELS

WORKSHOP MANUAL

ISUZU MOTORS LIMITED

ISUZU

WORKSHOP MANUAL INDUSTRIAL DIESEL ENGINE 2KA1, 2KB1, 2KC1 3KA1, 3KB1, 3KC1

FOREWORD

This manual includes special notes, important points, service data, precautions, etc. that are needed for the maintenance, adjustments, service, removal and installation of components of the models titled.

All information, illustrations and specifications contained in this manual are based on the latest product information available at the time of publication.

The right is reserved to make changes at any time without notice.

Arrangement of the material is shown by the table of contents on the right-hand side of this page. Black spot on the first page of each section can be seen on the edge of the book below section title. A more detailed table of contents precedes each section.

This manual applies to the 1983 year and later models.

SECTION INDEX

NOTICE

Before using this Workshop Manual to assist you in performing engine service and maintenance operations, it is recommended that you carefully read and throughly understand the information contained in Section-1 under the headings "GENERAL REPAIR INSTRUCTION" and "NOTES ON THE FORMAT OF THIS MANUAL"

SECTION 1

GENERAL INFORMATION

INDEX

CONTENTS PAGE

GENERAL REPAIR INSTRUCTIONS

1. Before performing service operations, disconnect ground cable from the battery to reduce the chance of cable damage and burning due to short-circuiting.
2. The use of proper tools and special tools where specified, is important for efficient and reliable service operations.
3. Use genuine Isuzu parts.
4. Used cotter pins, gaskets, O-rings, oil seals, lock washers and self lock nuts should be discarded and new ones used as normal function of the parts can not be maintained if these parts are reused.
5. To facilitate proper and smooth reassembly, keep disassembled parts neatly in groups.
   Keeping bolts and nuts separate is very important as they vary in hardness and design depending on position of installation.
6. Clean the parts before inspection or reassembly. Also clean oil ports, etc. using compressed air to make certain they are free from restrictions.
7. Lubricate rotating and sliding faces of the parts with oil or grease before installation.
8. When necessary, use a sealer on gaskets to prevent leakage.
9. Carefully observe all specifications for bolt and nut torques.

10. When service operation is completed, make a final check to be sure service has been done properly.

11. For assurance of safety, always release air pressure solely from the air tanks before disconnecting pipes, hoses or other parts from any unit under air pressure.

HOW TO USE THIS MANUAL

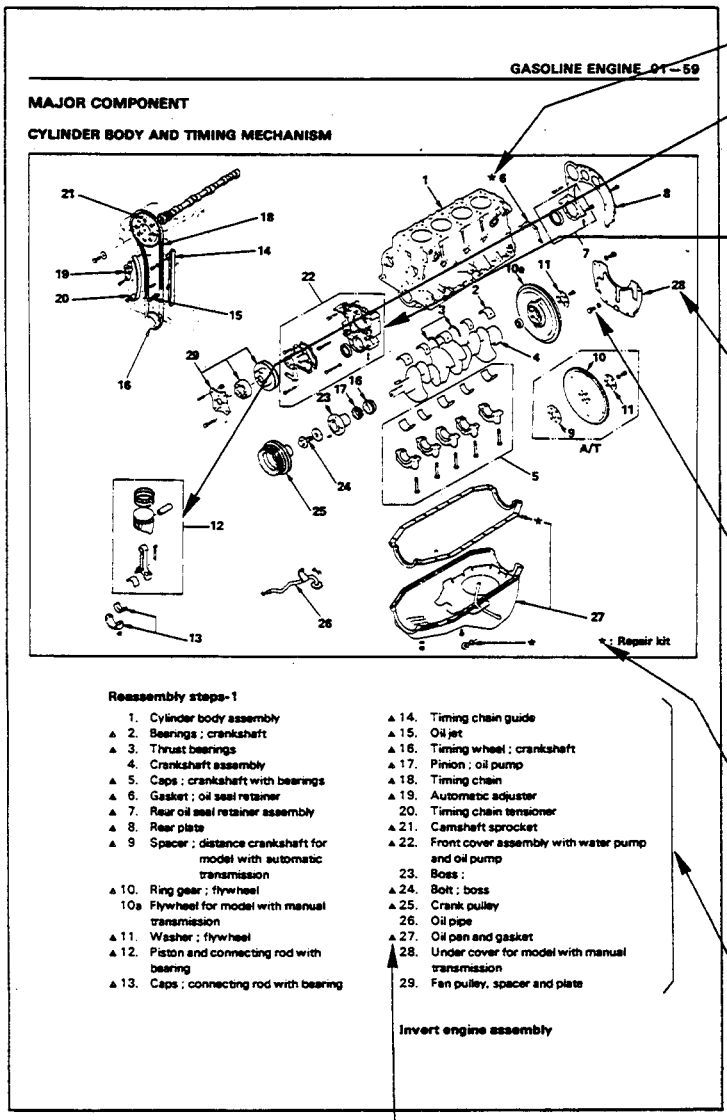
1. Find the applicable section by referring to the index.

2. This manual includes a "General information" section in which service data, maintenance items and specifications with torques are included.

3. Each section includes, disassembly, inspection and repair and reassembly. When the same service operation applies to more than one unit or equipment, notice is inserted stating, "Refer to manual for other units or equipment".

4. In the removal and installation section, description of self-explanatory items such as removal of individual parts from the unit to be removed, is omitted and important operation such as adjustments, torque specifications, etc. are dealt with mainly.

5. Each service operation section begins with disassembled view of unit or equipment which is useful to find components, service procedure, availability and content of repair kits, etc.



★ parts contained in repair kit.

Parts to be removed or installed as a unit.

All units or parts within frame are to be considered as a "major component".
Each unit or part within frame is to be considered as a "minor component".

The number represents sequence of service operation.

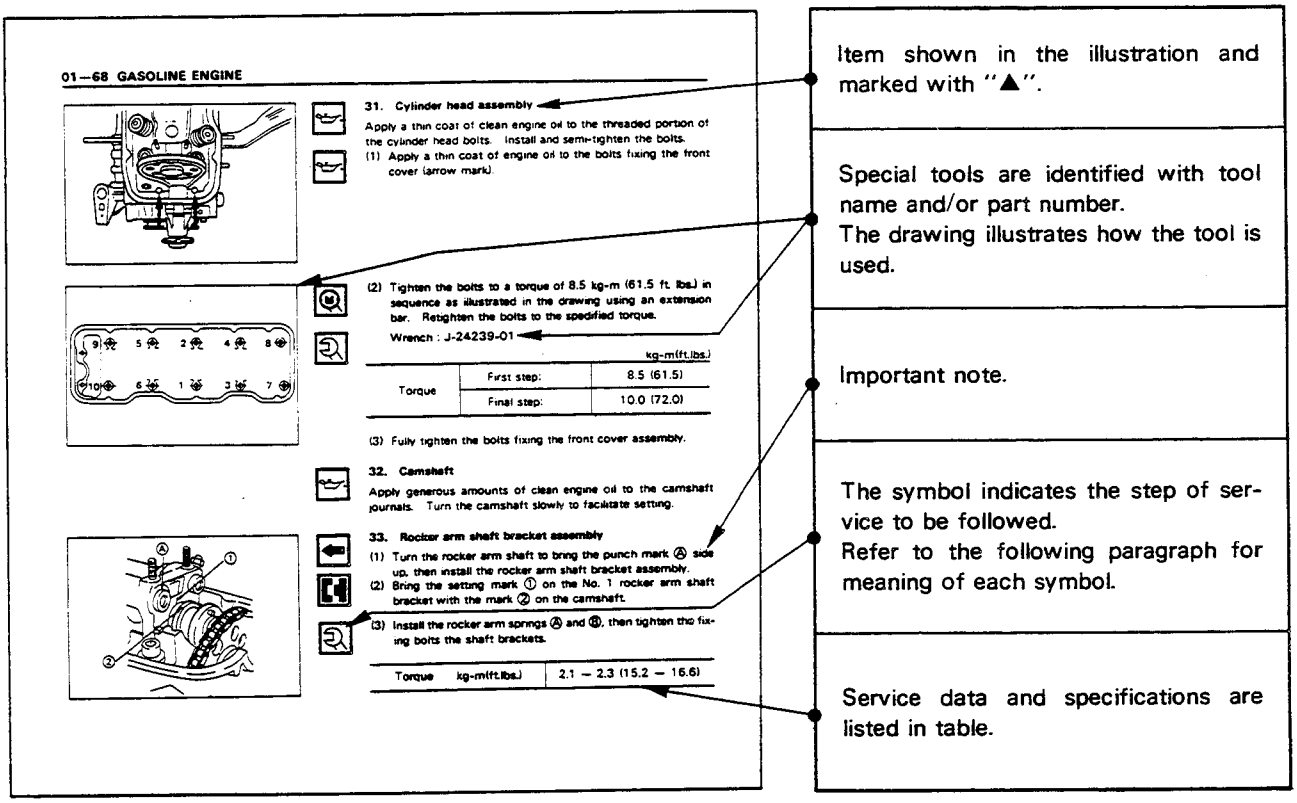
Removal of the parts without number (excluding bolts, nuts, washers, gaskets, cotter pins, etc.) is unnecessary unless replacement is needed.
Where parts replacement requires a specific note, instructions are given in "Inspection and repair".

★ indicates repair kit availability.

Name of parts listed in sequence of service operation.

▲ indicates important operation.
Details of service operation are described in the paragraph "Important operations".

6. The section following illustration(s) deals with important service steps marked with "▲".
   This section also includes "notes", "use of special tools", "service data", etc.



7. In this manual, the following symbols are used to indicate the type of service operations to be performed.

.... Remove		.... Adjustment	
.... Install		.... Clean	
.... Disassemble		.... Pay close attention — important	
.... Reassemble		.... Tighten to specified torque	
.... Align the marks		.... Use special tool(s) (Isuzu's tool(s))	
.... Correct direction		.... Use special tool(s) (parts manufacturer's tool(s))	
.... Inspect		.... Lubricate with oil	
.... Take measurement		.... Lubricate with grease	

8. The service standard is indicated in terms of "Standard" and "Limit".
   The "standard" means the assembly standard and standard range within which the parts are considered serviceable.
   "Limit" indicates the limit value (Correction or replacement is necessary when measurement is beyond this limit.)

9. In this manual, the components and parts are printed in singular form.

MAIN DATA AND SPECIFICATIONS

Items \ Engine model		2KA1	2KB1	2KC1
Engine type		4 cycle water-cooled, O.H.C., vertical		
Combustion chamber type		In line swirl chamber type		
Timing gear system		Gear and chain drive		
No. of piston rings		Compression ring 2, oil ring 1		
No. of cylinders - Bore x Stroke	(mm)	2 - 70 x 70	2 - 70 x 76	2 - 74 x 76
Total piston displacement	(cc)	538	584	653
Compression ratio		23 : 1	23 : 1	23 : 1
Engine dimensions L x W x H	(mm)	449.5 x 466.5 x 599.5		
Engine weight dry	(kg)	85	88	88
Fuel injection timing B.T.D.C.		See below*		
Fuel injection order		1-2	1-2	1-2
Type of fuel used		High-speed diesel fuel (SAE No. 2)		
Idle speed	(rpm)	800		
Compression pressure	(kg/cm^2/rpm)	31/250		
Intake and exhaust valve clearance	(mm)	IN & EXH 0.25 (cold)		
Intake valve open at		8°(B.T.D.C.)		
Intake valve close at		34°(A.B.D.C.)		
Exhaust valve open at		51°(B.B.D.C.)		
Exhaust valve close at		9°(A.T.D.C.)		
Injection pump type		PFR-2KD55 BOSCH-diesel kiki		
Governor type		Mechanical type		
Injection nozzle type		Throttle type		
Injection starting pressure	(kg/cm^2)	120		
Lubrication method		Pressurized circulation		
Oil pressure at idle speed	(kg/cm^2)	1.5		
Oil pressure at medium speed		3		
Oil pump type		Trochoid type		
Oil filter type	Main filter	Cartridge-paper element full-flow type		
Lubricating oil capacity	(liters)	Max. 3.05 — 2.05 min.		
Water pump type		Centrifugal, belt drive		
Thermostat type		Wax pellet type		
Battery type voltage – no of unit		N70 – 12V – 1		
Air cleaner type		Paper element dry type		
Generator voltage-capacity		12V - 20A		
Starter voltage-output		12V - 0.8 kW		

*Fuel injection timing B.T.D.C.

Model \ Rated speed	3000 rpm	3600 rpm
2KC1	12°	14°
2KC1 for U.S.A.	16°	18°

Items \ Engine model		3KA1	3KB1	3KC1
Engine type		4 cycle water-cooled, O.H.C., vertical		
Combustion chamber type		In line swirl chamber type		
Timing gear system		Gear and chain drive		
No. of piston rings		Compression ring 2, oil ring 1		
No. of cylinders - Bore x Stroke	(mm)	3 - 70 x 70	3 - 70 x 76	3 - 74 x 76
Total piston displacement	(cc)	808	877	980
Compression ratio		23 : 1	23 : 1	23 : 1
Engine dimensions L x W x H	(mm)	534.5 x 453.5 x 595		
Engine weight dry	(kg)	107	110	110
Fuel injection timing B.T.D.C.		See below*		
Fuel injection order		1-3-2	1-3-2	1-3-2
Type of fuel used		High-speed diesel fuel (SAE No. 2)		
Idle speed	(rpm)	800		
Compression pressure	(kg/cm²/rpm)	31/250		
Intake and exhaust valve clearance	(mm)	IN & EXH 0.25 (cold)		
Intake valve open at		8°(B.T.D.C.)		
close at		34°(A.B.D.C.)		
Exhaust valve open at		51°(B.B.D.C.)		
close at		9°(A.T.D.C.)		
Injection pump type		PFR-3KD55 BOSCH-diesel kiki		
Governor type		Mechanical type		
Injection nozzle type		Throttle type		
Injection starting pressure	(kg/cm²)	120		
Lubrication method		Pressurized circulation		
Oil pressure at idle speed	(kg/cm²)	1.5		
at medium speed		3		
Oil pump type		Trochoid type		
Oil filter type	Main filter	Cartridge-paper element full-flow type		
Lubricating oil capacity	(liters)	Max. 3.3 — 2.3 min.		
Water pump type		Centrifugal, belt drive		
Thermostat type		Wax pellet type		
Battery type voltage — no of unit		N70 — 12V — 1		
Air cleaner type		Paper element cyclone type		
Generator voltage-capacity		12V - 20A		
Starter voltage-output		12V - 1.0 kW		

*Fuel injection timing B.T.D.C.

Model \ Rated speed	3000 rpm	3600 rpm
3KC1	12°	14°
3KC1 for U.S.A.	16°	18°

TORQUE SPECIFICATIONS

STANDARD BOLTS

The torque values given in the following table should be applied where a particular torque is not specified.

(kg-m)

Bolt identification / Bolt diameter x pitch (mm)			
	4 T (Low carbon steel)	7 T (High carbon steel)	9 T (Alloy steel)
6 x 1.0	0.4 — 0.8	0.5 — 1.0	—
8 x 1.25	0.8 — 1.8	1.2 — 2.3	1.7 — 3.1
10 x 1.25	2.1 — 3.5	2.8 — 4.7	3.8 — 6.4
*10 x 1.5	2.0 — 3.4	2.8 — 4.6	3.7 — 6.1
12 x 1.25	5.0 — 7.5	6.2 — 9.3	7.7 — 11.6
*12 x 1.75	4.6 — 7.0	5.8 — 8.6	7.3 — 10.9
14 x 1.5	7.8 — 11.7	9.5 — 14.2	11.6 — 17.4
*14 x 2.0	7.3 — 10.9	9.0 — 13.4	10.9 — 16.3
16 x 1.5	10.6 — 16.0	13.8 — 20.8	16.3 — 24.5
*16 x 2.0	10.2 — 15.2	13.2 — 19.8	15.6 — 23.4
18 x 1.5	15.4 — 23.0	19.9 — 29.9	23.4 — 35.2
20 x 1.5	21.0 — 31.6	27.5 — 41.3	32.3 — 48.5
22 x 1.5	25.6 — 42.2	37.0 — 55.5	43.3 — 64.9
24 x 2.0	36.6 — 55.0	43.9 — 72.5	56.5 — 84.7

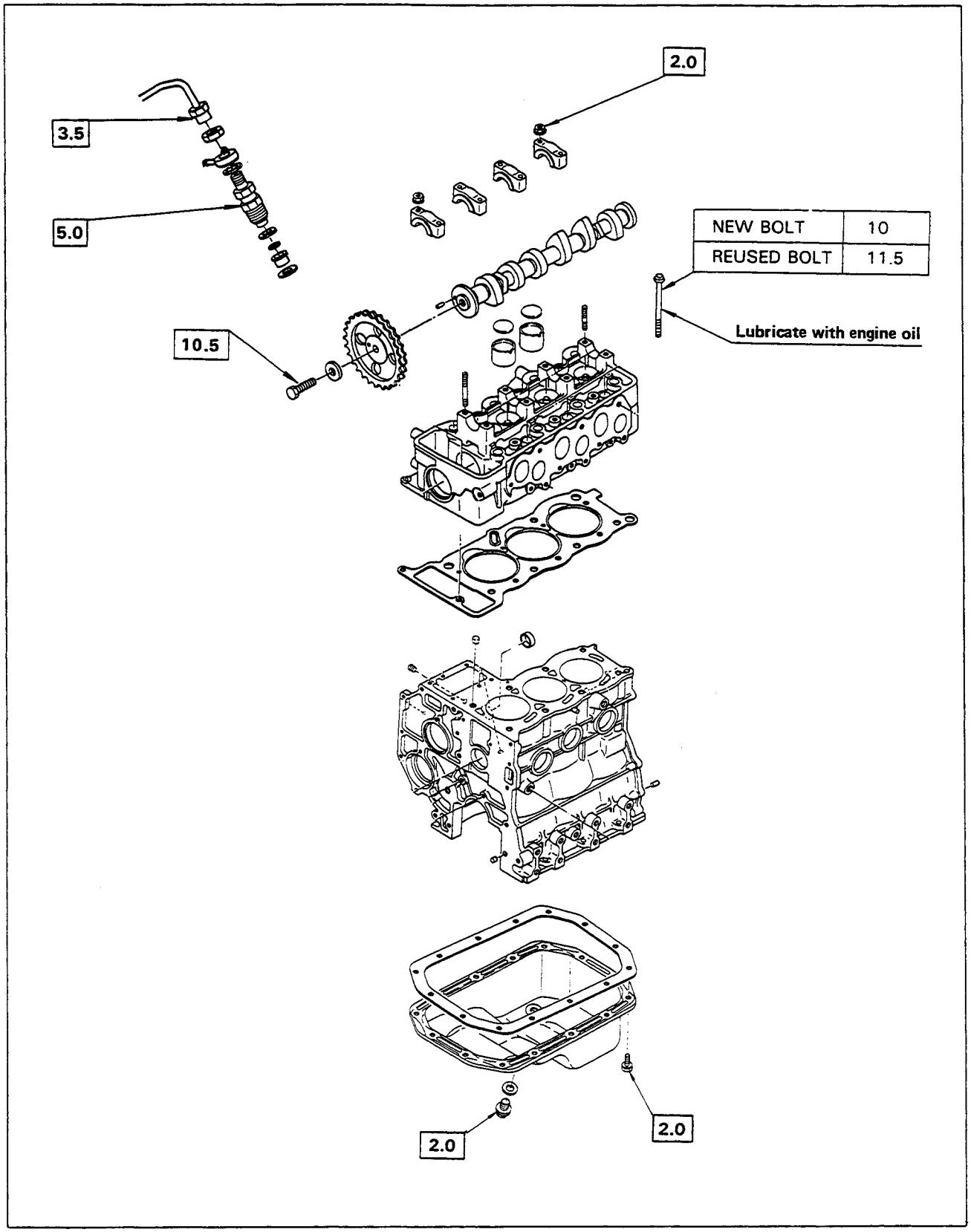
The asterisk * indicates that the bolts are used for female-threaded parts that are made of soft materials such as casting, etc.

MAJOR PARTS FIXING BOLT AND NUT - TORQUE SPECIFICATIONS.

These illustrations are based on the 3KC1 model.

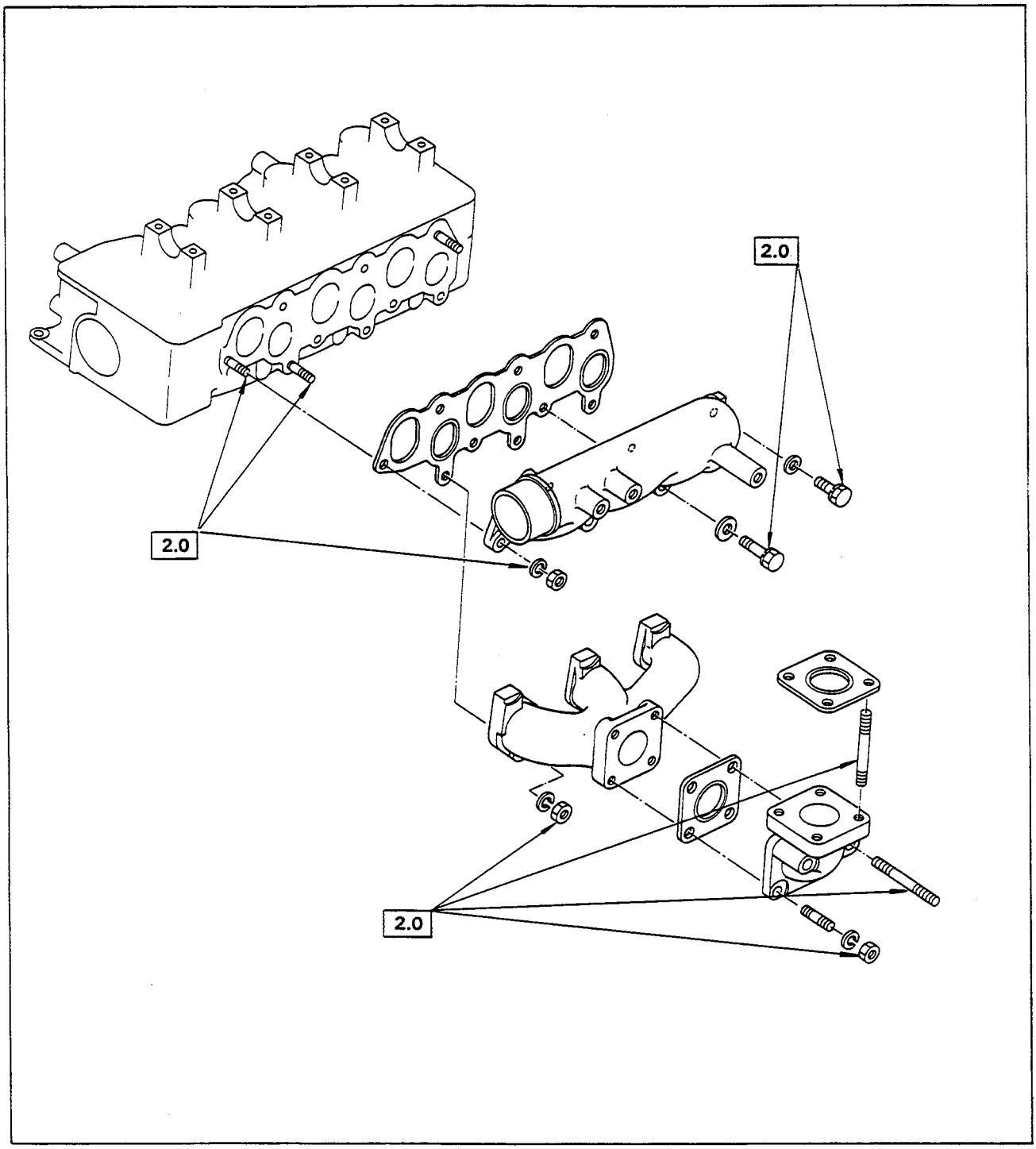
CYLINDER HEAD AND BODY

(kg-m)



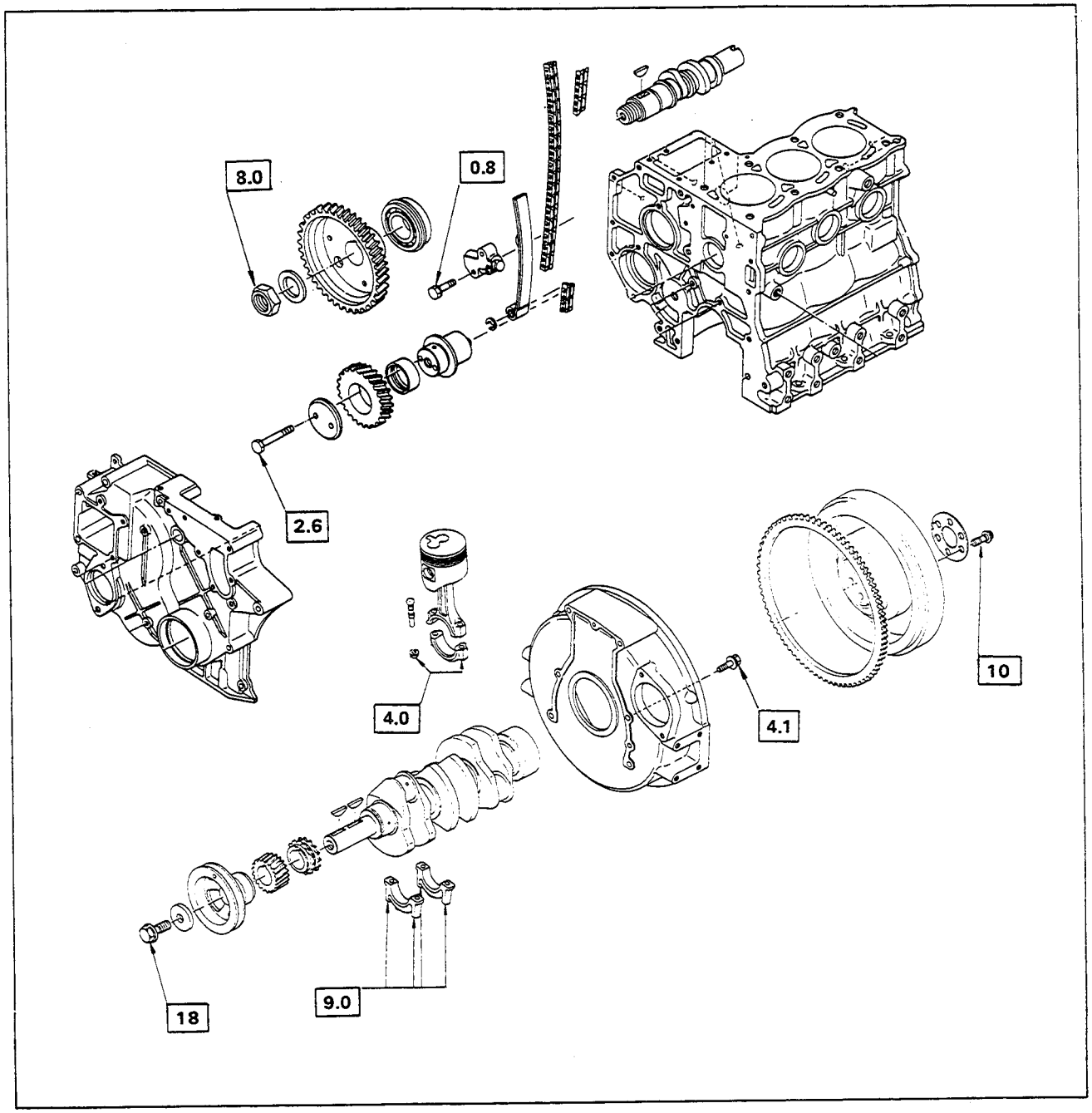
INTAKE AND EXHAUST MANIFOLD

(kg-m)



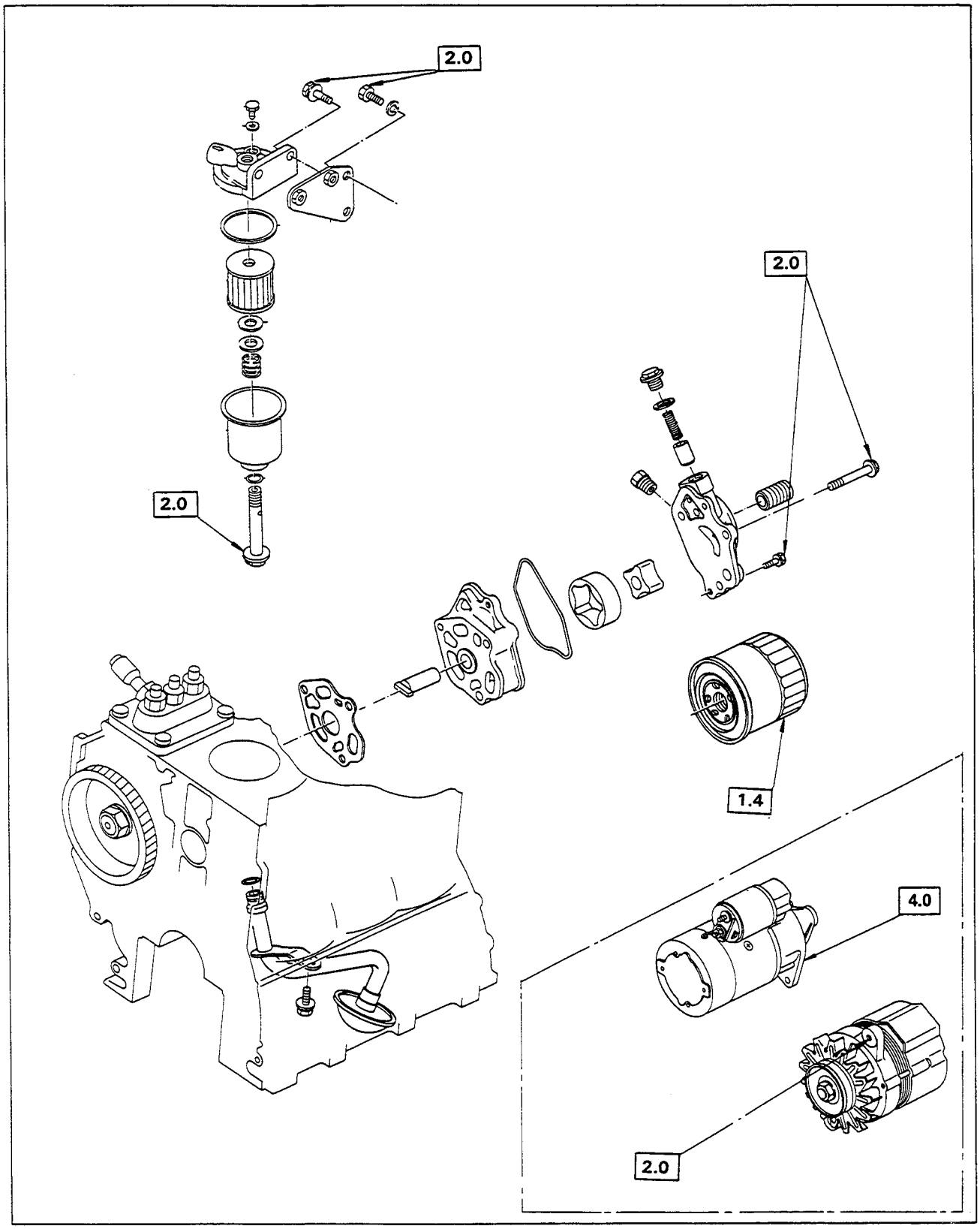
TIMING GEAR AND FLYWHEEL HOUSING, CRANKSHAFT AND PISTON

(kg-m)



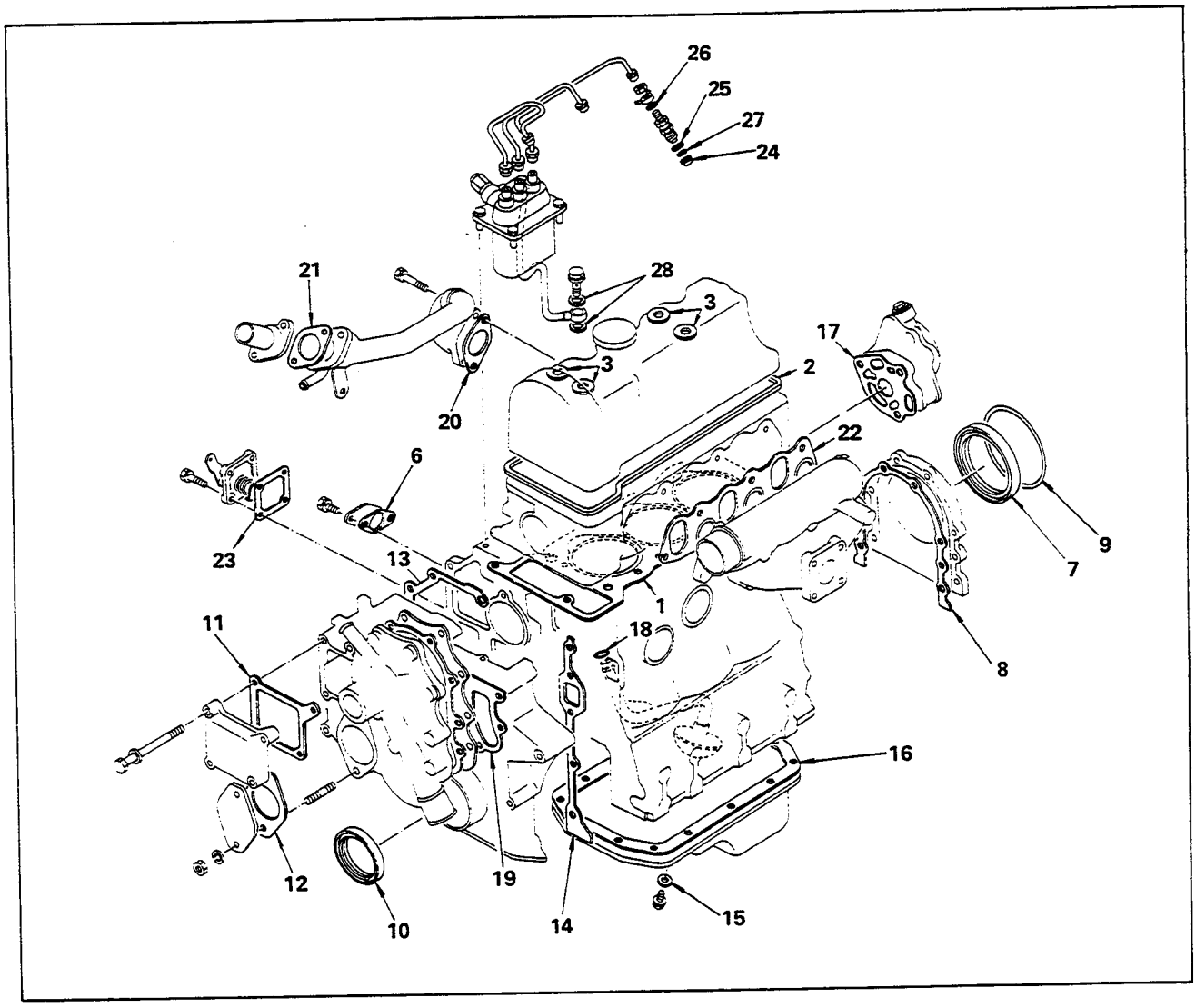
OIL PUMP OTHERS, ENGINE ELECTRICALS

(kg-m)



ENGINE REPAIR KIT

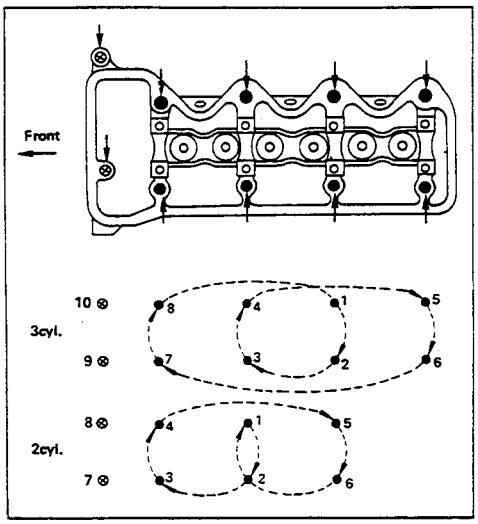
3KC1 model



1. Gasket ; cylinder head
2. Gasket ; head cover
3. Gasket ; head cover to bolt
6. Packing ; cover cylinder block
7. Seal ; oil retainer
8. Packing ; oil seal
9. Packing ; retainer
10. Seal ; oil crank front
11. Packing ; cover
12. Packing ; cover
13. Packing ; timing case
14. Packing ; timing case
15. Packing ; drain plug
16. Packing ; oilpan-block
17. Packing ; O-ring-block
18. Seal ; O-ring, strainer
19. Packing ; water pump
20. Packing ; water pipe-head
21. Packing ; outlet pipe
22. Gasket ; manifold
23. Packing ; cover
24. Heat ; shield
25. Gasket ; nozzle holder
26. Gasket ; heat shield
27. Corrugated ; washer
28. Packing ; joint bolt

SERVICING

CYLINDER HEAD BOLT



The cylinder head bolt should be retightened in sequence as shown in the figure.

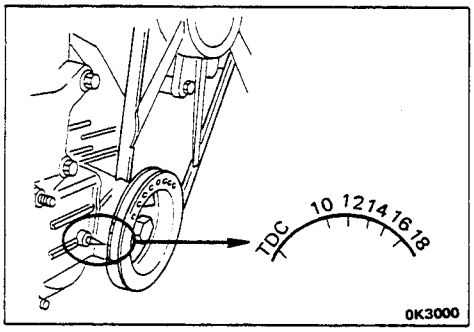
● marked bolts

Torque	(kg-m)	10

⊗ marked bolts

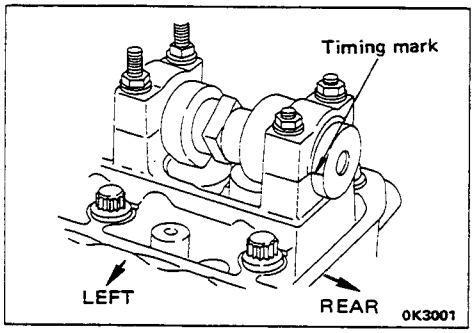
Torque	(kg-m)	2

VALVE CLEARANCE

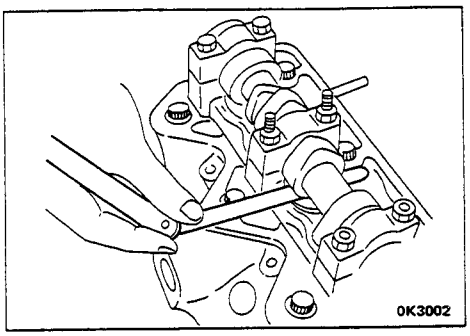


Measurement of valve clearances

Remove the cylinder head cover and bring the TDC mark on the crankshaft pulley into alignment with the pointer on the timing gear cover.



Check direction of timing mark at rear end of camshaft.
If the mark is in line with the No. 4 camshaft bracket joining face at left hand side (viewed from rear end), it indicates that the piston in the No. 1 cylinder is at top dead center (TDC) on *compression* stroke.
If the mark is at right hand side, it indicates that the piston in the No. 1 cylinder is at top dead center on *exhaust* stroke.



Check the clearance between the cam and tappet using a feeler gauge.

(mm)

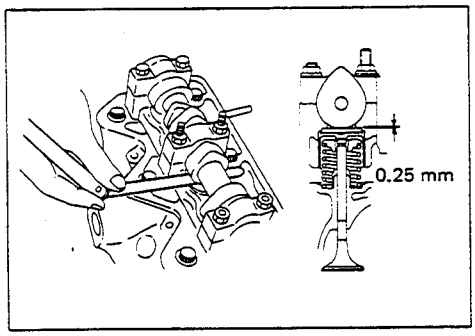
Standard (in cold)	Limit
0.25	0.10 or less 0.40 or more

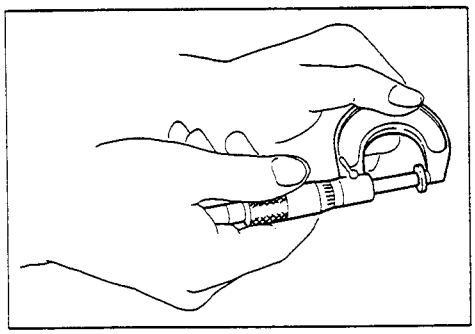
2KA1·2KB1·2KC1

Timing mark	Cylinder No.	Front 1		Rear 2	
	Valve arrangement	I	E	I	E
Left	Piston in No. 1 cylinder is at TDC on *compression* stroke	○	○	○	
Right	Piston in No. 1 cylinder is at TDC on *exhaust* stroke				○

3KA1·3KB1·3KC1

Timing mark	Cylinder No.	Front 1		2		Rear 3	
	Valve arrangement	I	E	I	E	I	E
Left	Piston in No. 1 cylinder is at TDC on *compression* stroke	○	○	○			○
Right	Piston in No. 1 cylinder is at TDC on *exhaust* stroke				○	○	





Upper shim type

Adjustment of valve clearance

2 cyl. ... ENG. No. 500980 and after
3 cyl. ... ENG. No. 108014 and after

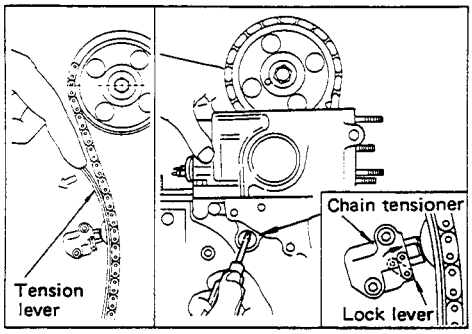
If the measurement deviates from the standard value, adjustment of valve clearance necessitates the replacement of a valve adjuster located on the tappet head.

Valve clearance adjuster : 5-8840-9020-0

The thickness of adjuster to be installed can be calculated by the followings.

Thickness of adjuster in use + (measured clearance — 0.25mm)

The adjusters are available in 57 different thickness (with the minimum thickness of 2.35mm) with graduations of 0.025mm.



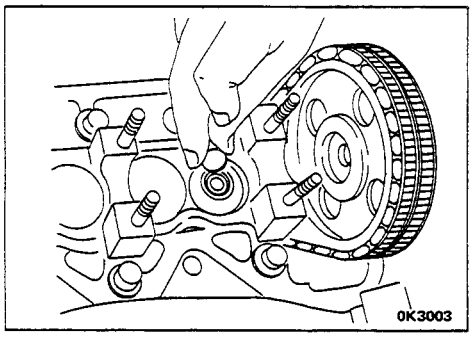
Lower shim type

Adjustment of valve clearances

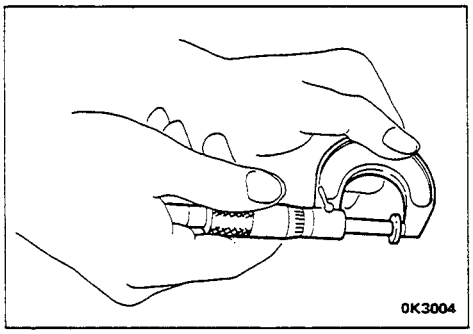
If the measurement deviates from the standard value, adjustment of valve clearance necessitates the replacement of a valve adjusting shim between tappet and valve stem end.

Remove the chain tensioner plug from the timing gear cover. Insert screw driver into plug fitting hole, push the lock lever to the right and tilt the tension lever to the left, so that the tensioner becomes locked, giving a slackness in the timing chain.

- Remove the camshaft timing wheel and leave it on the chain guide without removing it from the chain.



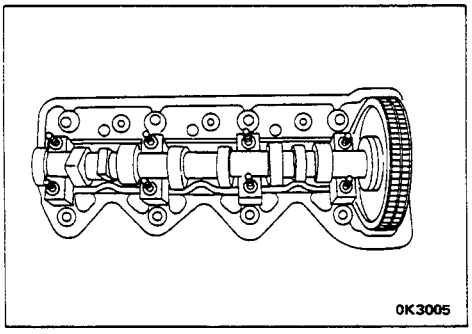
Remove the camshaft brackets, camshaft and tappets, then take out the adjusting shims.



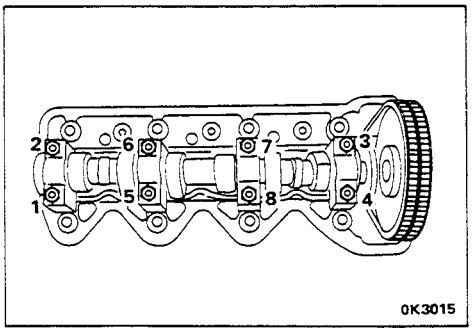
The thickness of adjusting shims to be installed can be calculated by the following:

Thickness of shims in use + (measured clearance – 0.25)

The adjusting shims are available in 49 different thicknesses (with the minimum thickness of 1.000 mm) with graduations of 0.025 mm.

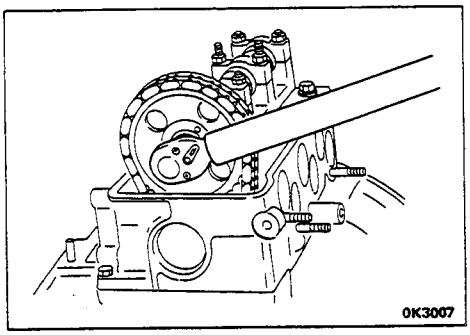


Install and partially-tighten camshaft front bolt after aligning locating pin on the camshaft with the pin hole in the camshaft timing wheel.



Tighten the camshaft bolts a little at a time in numerical sequence as specified.

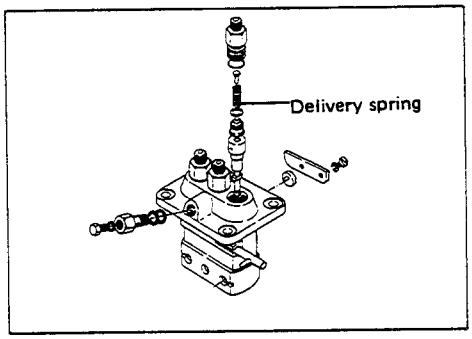
Torque	(kg-m)	2



Torque (kg-m)	10.5

Release the tensioner

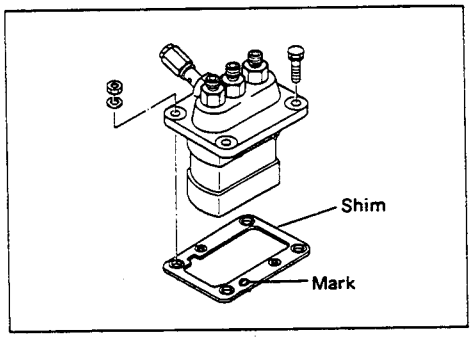
INJECTION TIMING



Fuel injection timing check

Remove the fuel delivery valve holder from the fuel injection pump.
Remove the delivery valve spring and replace the delivery valve holder.
Carefully rotate the crankshaft operating the fuel feed pump and check to see that the timing mark on the crankshaft pulley is in alignment with the pointer on the timing gear cover when the fuel stops overflowing.
If the timing mark deviates from the pointer, the fuel injection timing should be adjusted.

Fuel injection timing	Refer to maindata and specification



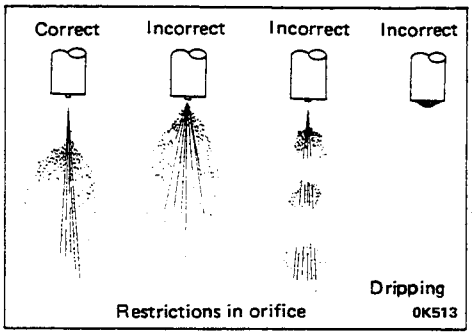
Adjustment

Check the mark on the injection timing adjusting shim used in position between the fuel injection pump and cylinder body, and select the shim of appropriate thickness according to the following table.
The injection timing varies at a rate of 1 degree (crankshaft angle) for each 0.1 mm change in thickness of the adjusting shim.

(mm)

MARK	T(mm)	MARK	T(mm)	MARK	T(mm)	MARK	T(mm)
2	0.2	5	0.5	8	0.8	11	1.1
3	0.3	6	0.6	9	0.9	12	1.2
4	0.4	7	0.7	10	1.0		

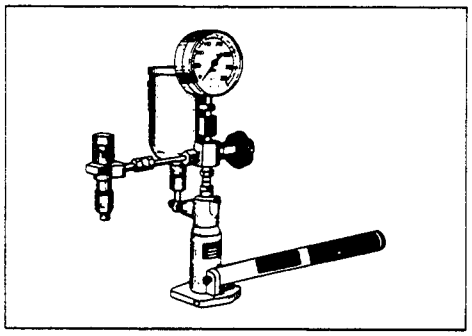
FUEL SYSTEM



Injection nozzle

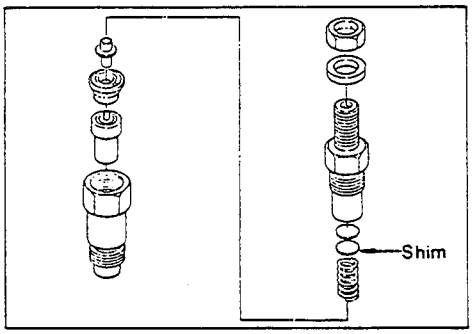
Check the spraying condition and injection starting pressure.

Injection pressure (kg/cm²)	120



Adjustment

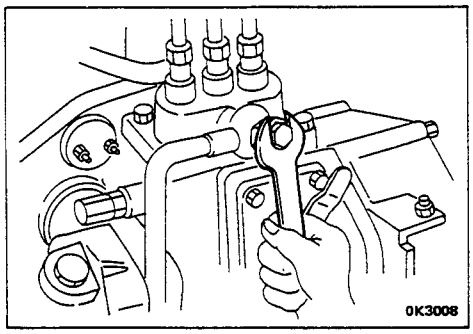
Adjust the injection starting pressure with the adjusting shim using a nozzle tester.



Adjusting shims are available in 38 different thicknesses from 0.5 mm to 1.24 mm. They are graduated in thickness by 0.02 mm. The injection starting pressure varies approximately 4.8 kg/cm² with every 0.02 mm change in thickness.

Tighten the retaining nut.

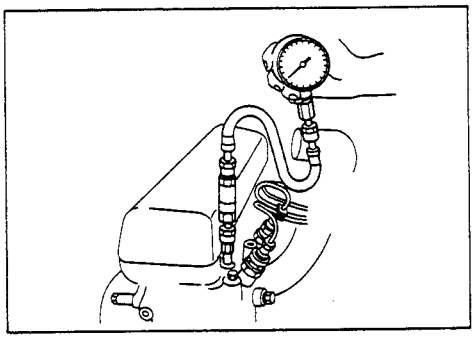
Torque	(kg-m)	3 — 5



Bleeding

Perform bleeding by loosening the screw plug on the injection pump. Fully tighten the screw plug when air bubbles disappear completely from the fuel flowing out through the plug hole.

COMPRESSION PRESSURE



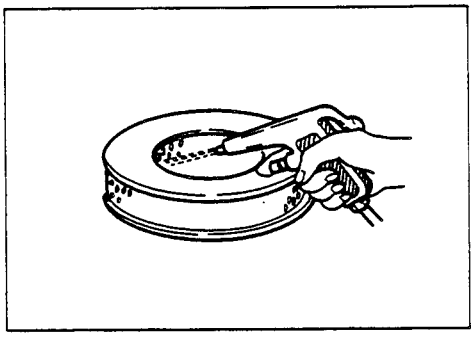
After warming up the engine, remove the glow plugs from all cylinders, then check the compression pressure in each cylinder with a compression gauge by engaging starter.

(kg/cm² at 200 rpm)

Standard	Limit
31	20

Adaptor : 5-8840-2009-0

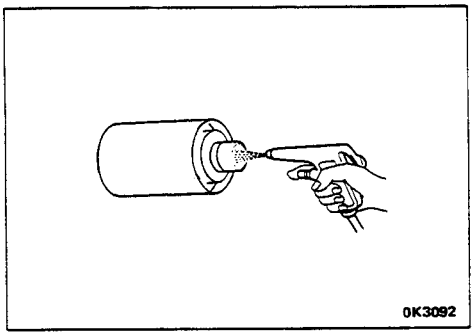
AIR CLEANER



2KA1, 2KB1, 2KC1

Every 100 hours, clean the element by applying compressed air (7 kg/cm² or lower) from inside.
Replace the element every 600 hours.
The element service and replacement intervals must be shortened accordingly if the engine has been operated under vary dusty conditions.
Do not bring the element into contact with oil, grease, etc.

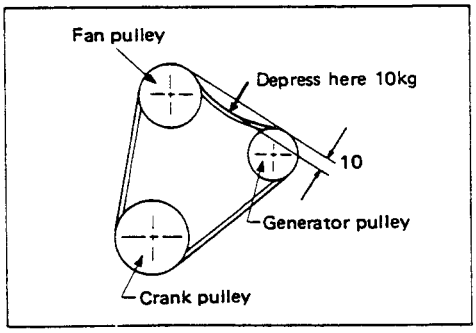
AIR CLEANER



3KA1, 3KB1, 3KC1

This air cleaner has the body case integrated with the filter element and can not be disassembled.
Every 600 hours, clean the air cleaner by applying compressed air (pressure: 7kg/cm² or lower) into the body from inside of the element.
The air cleaner assembly must be replaced every 1800 hours.

FAN BELT

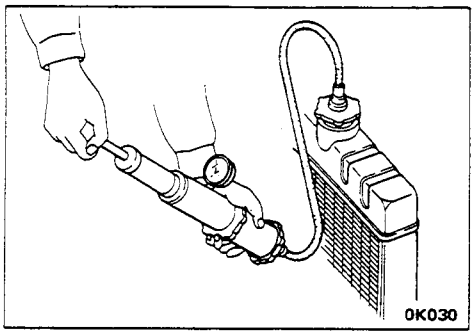


Adjustment

Adjust belt tension by moving generator pulley.

Specified belt deflection (mm)	10 — 12

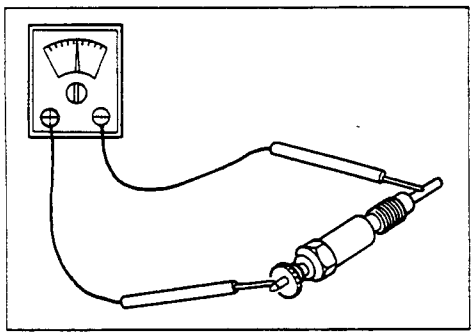
RADIATOR



Install radiator filler cap tester on the radiator and check the cooling system for leakage by applying testing pressure.
Testing pressure should not exceed the specified pressure.

Testing pressure (kg/cm²)	2.0

GLOW PLUG



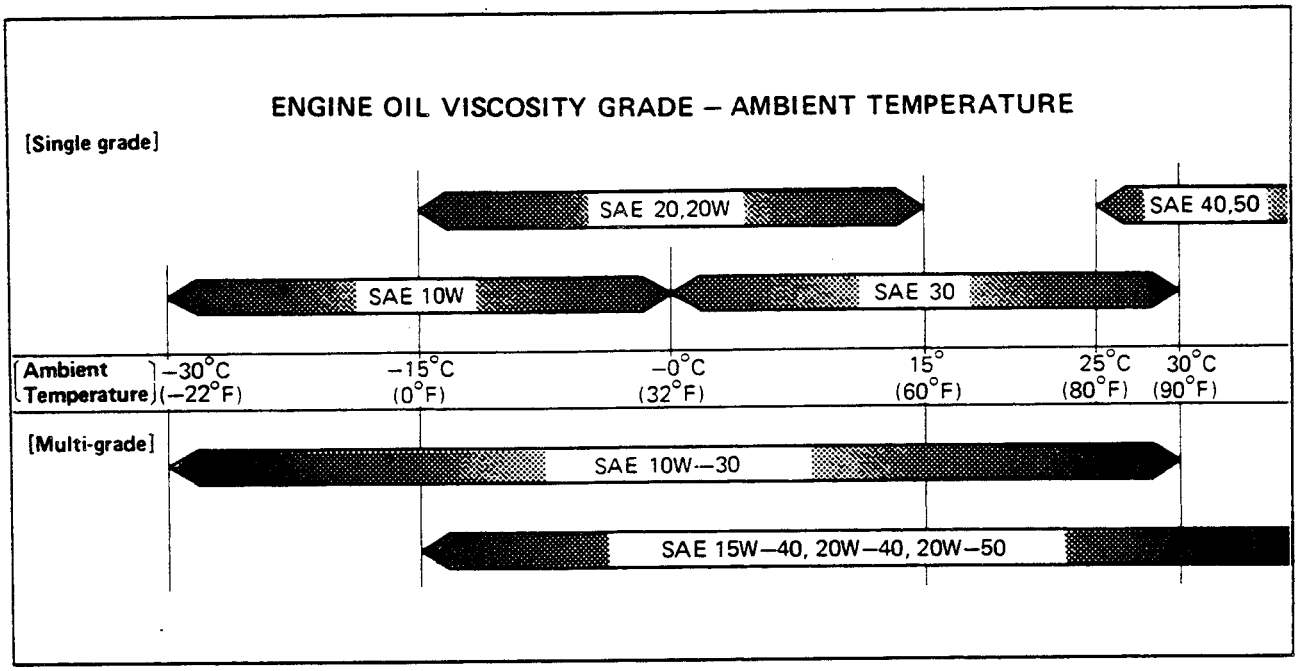
Glow plugs

Check for continuity across the plug terminals and body.

RECOMMENDED LUBRICANTS

ENGINE TYPE	TYPES OF LUBRICATION
Without turbocharger	Diesel engine oil CC or CD grade
With turbocharger	Diesel engine oil CD grade

ENGINE OIL VISCOSITY CHART



ADHESIVE FOR REPAIRS

Liquid gasket, adhesives and other chemicals are used in various parts of the engine to prevent leakage of oil, water and to prevent the bolts and nuts from loosening and these chemicals are available at Isuzu Motors as Isuzu genuine parts. When servicing the engine, it is recommended to use Isuzu genuine parts or equivalent.

ITEMS	PARTS NAMES
Liquid gasket	BELCOBOND NO. 4 BELCOBOND NO. 5 BELCOBOND No. 201 SEAL END NO. 242
Adhesives and sealant	THREE CEMENT SUPER THREE CEMENT LOCKTITE 242 (Locktite Nutlock) LOCKTITE 262 (Locktite Studlock) LOCKTITE PRIMER "N"

SECTION 2

ENGINE ASSEMBLY

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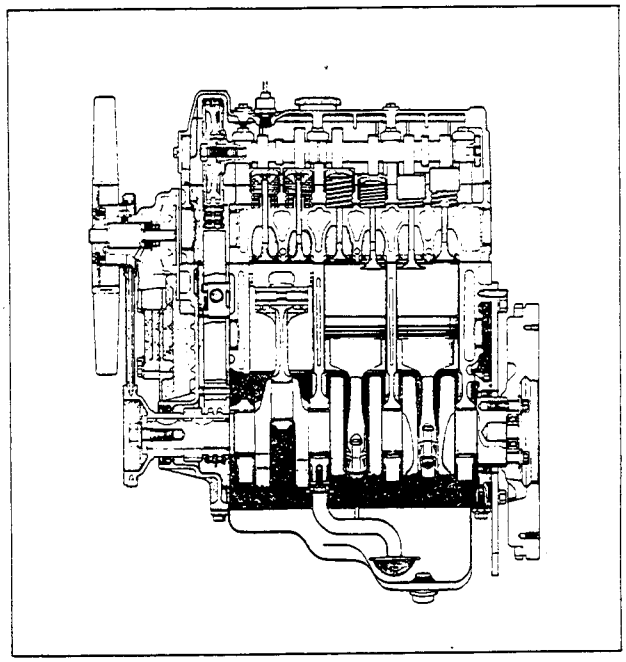
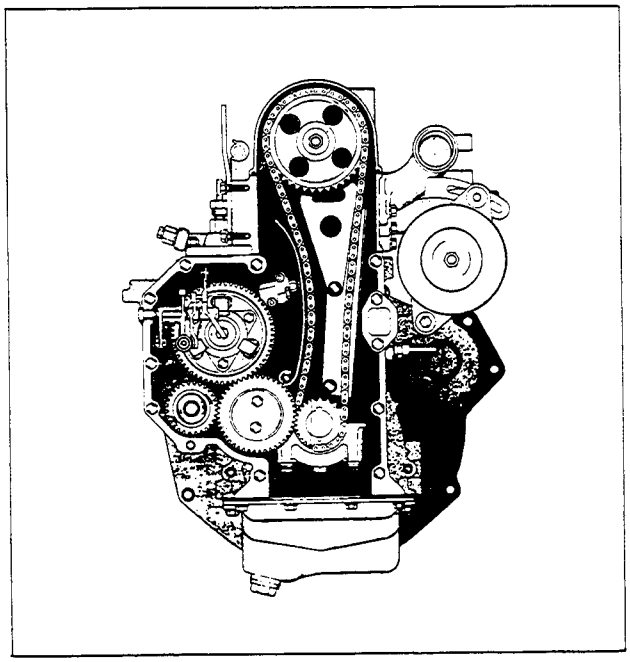
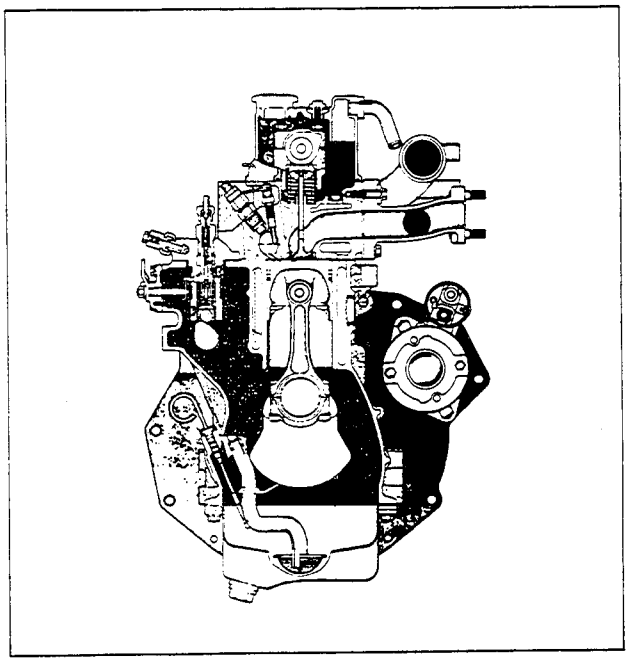
GENERAL DESCRIPTION



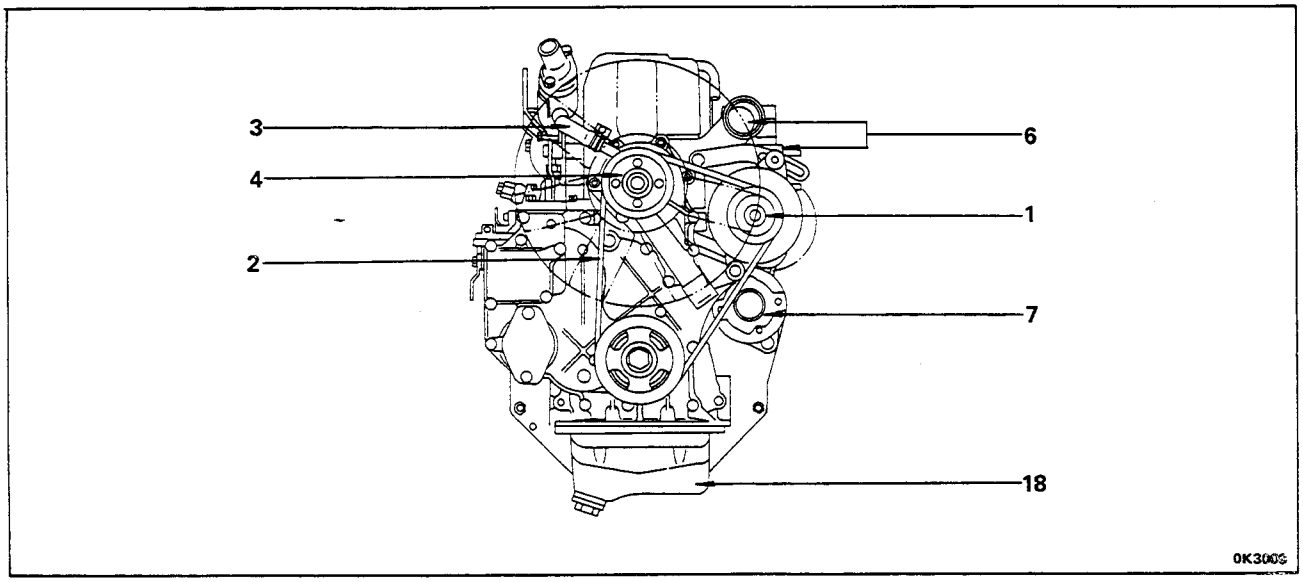


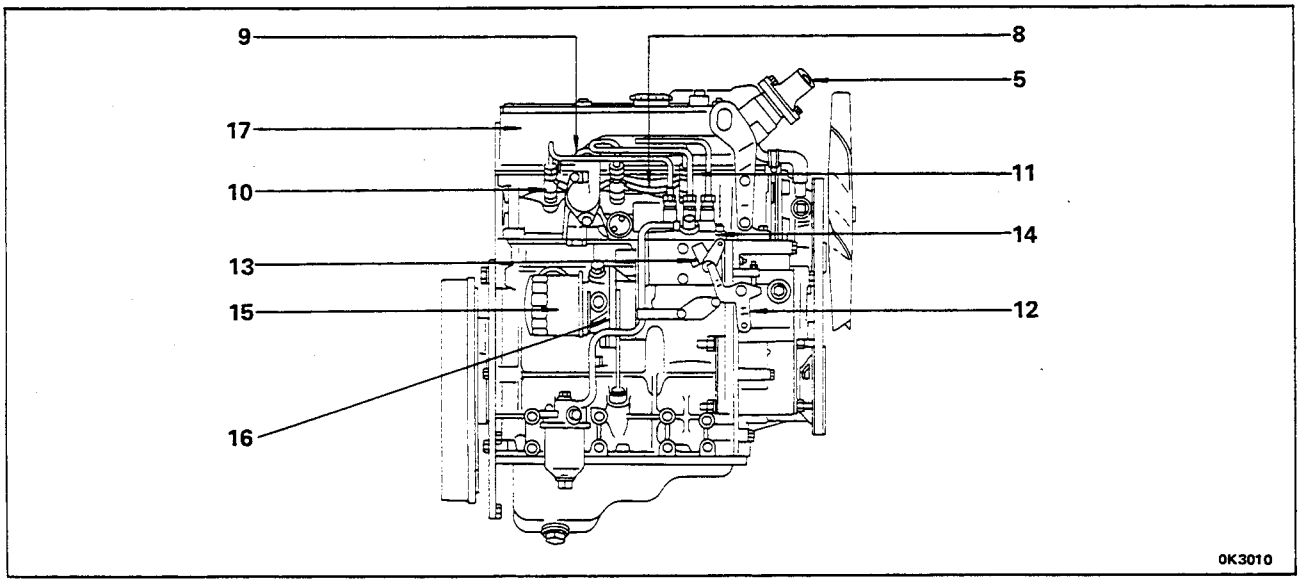


DISASSEMBLY

EXTERNAL PARTS

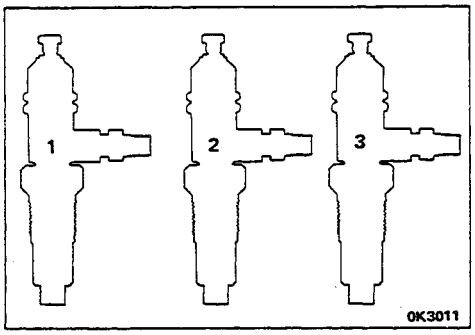
These illustrations are based on the 3KC1 model.

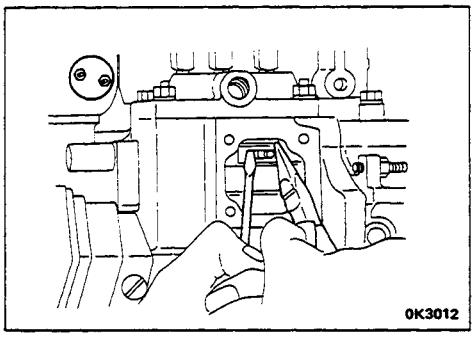


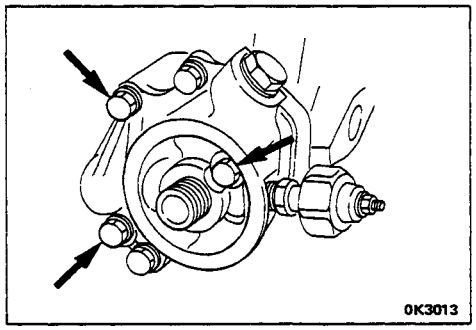


Disassembly steps

1. Generator
2. Fan belt
3. Rubber hose
4. Fan pulley and water pump
5. Water outlet pipe
6. Intake and exhaust manifold
7. Starter motor
8. Leak off pipe
9. Injection pipe
- ▲ 10. Injection nozzle
- 11. Glow plug
- 12. Engine speed control lever
- 13. Fuel cut lever
- ▲ 14. Injection pump assembly
- 15. Oil filter
- ▲ 16. Oil pump
- 17. Cylinder head cover
- 18. Oil pan







Important operations

10. Injection nozzle

Keep the parts removed from each cylinder separate and handle them carefully so as not to cause damage to the nozzle end.

14. Injection pump assembly

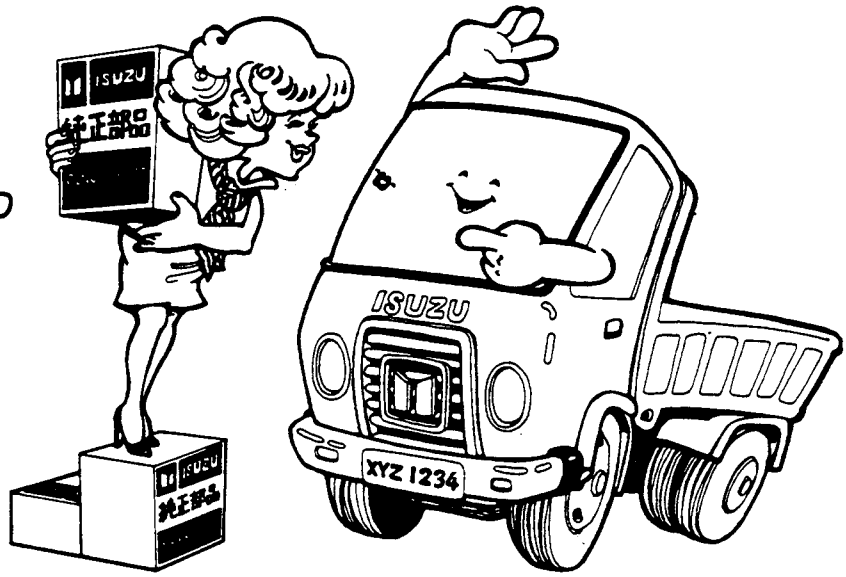
Remove the link plate and set spring, then pull out injection pump assembly.
When the injection pump is removed, cap or tape the openings to prevent entry of dust or other foreign matter into the delivery valve holder.

16. Oil pump

Loosen and remove the three bolts.

MEMO

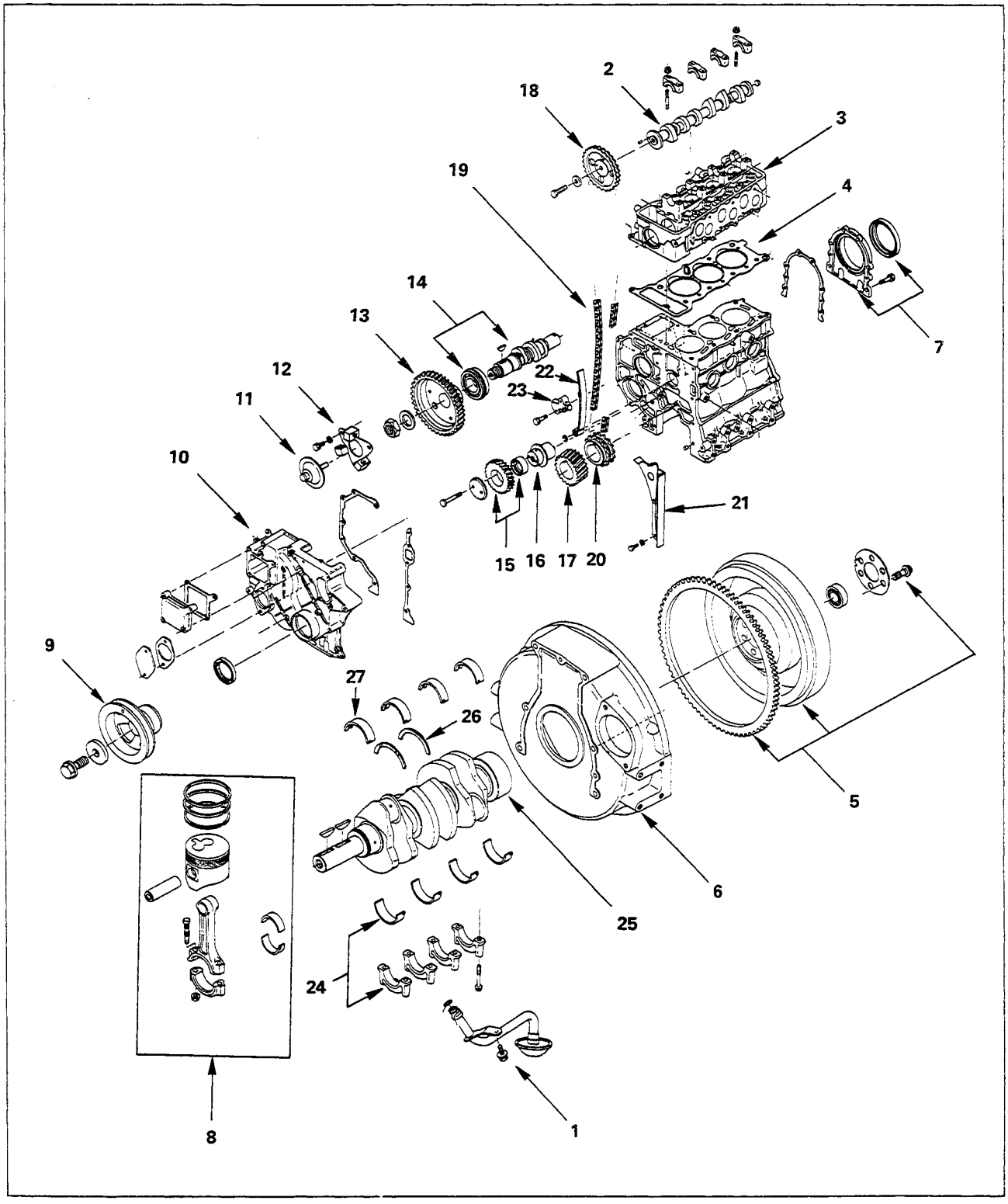
PARTES DE CALIDAD
EN LAS CUALES
PUEDE CONFIAR



INTERNAL PARTS

MAJOR COMPONENTS

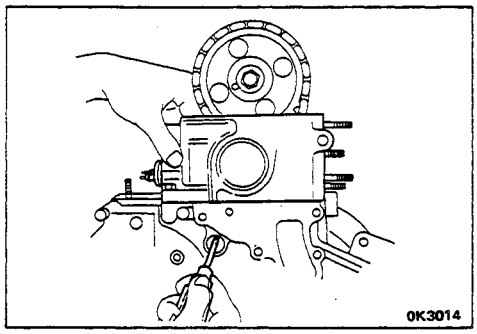
This illustration is based on the 3KC1 model.



Disassembly steps

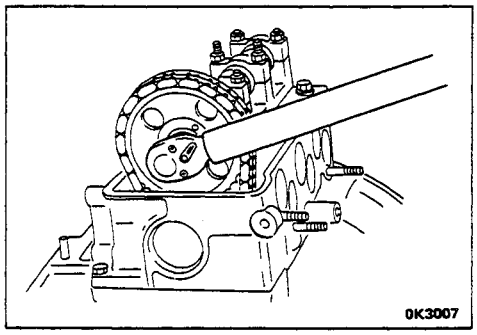
1. Oil strainer
▲ 2. Camshaft
▲ 3. Cylinder head assembly
4. Cylinder head gasket
▲ 5. Flywheel assembly
6. Flywheel housing
7. Rear oil seal assembly
▲ 8. Piston and connecting rod assembly
▲ 9. Crankshaft pulley
▲ 10. Timing gear cover
11. Sleeve
12. Fly weight assembly
13. Injection pump timing gear
14. Injection pump camshaft
▲ 15. Idler gear
16. Idler gear shaft
17. Crankshaft timing gear
18. Camshaft timing wheel
19. Timing chain
20. Crankshaft timing wheel
21. Timing chain guide
22. Tension lever
23. Chain tensioner
▲ 24. Crankshaft bearings (lower) and crankshaft bearing caps
25. Crankshaft
26. Thrust bearings
27. Crankshaft bearings (Upper)

Important operations

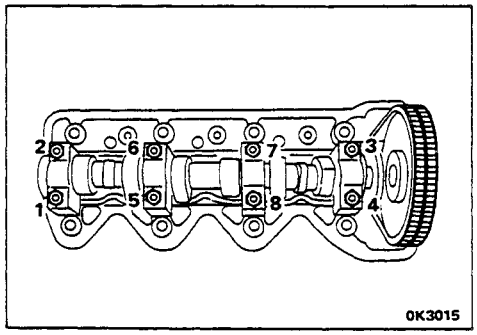


2. Camshaft assembly

Lock the chain tensioner. (Refer to "SERVICING")

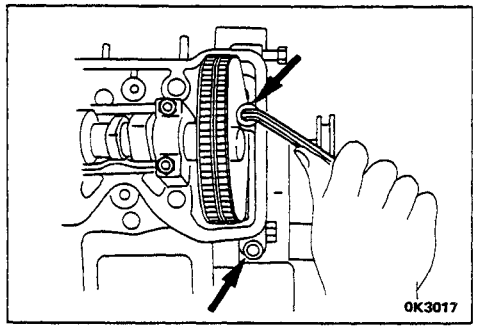


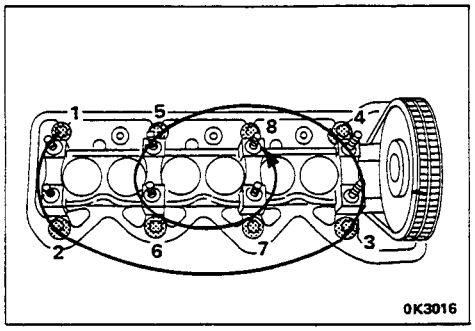
Remove camshaft front bolt, then remove camshaft timing wheel.
Keep camshaft timing wheel on chain guide and on tensioner.



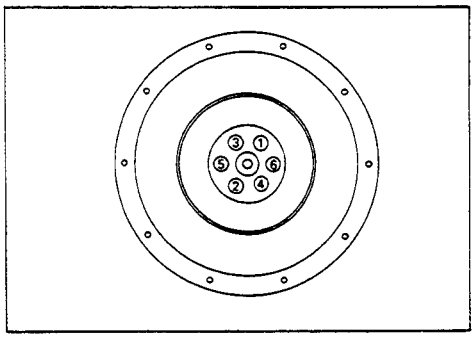
Loosen the camshaft assembly bolts a little at a time in numerical sequence as specified.

3. Cylinder head assembly



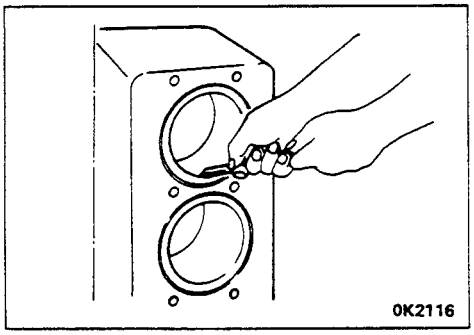


Loosen the cylinder head bolts a little at a time in numerical sequence as specified.



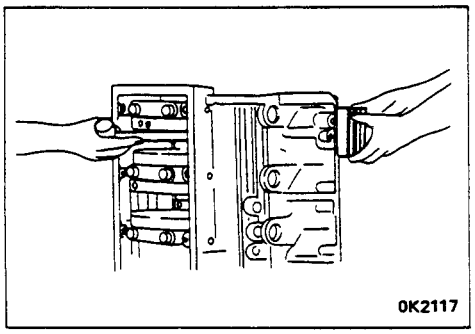
5. Flywheel

Loosen the flywheel bolts a little at a time in numerical sequence as specified.

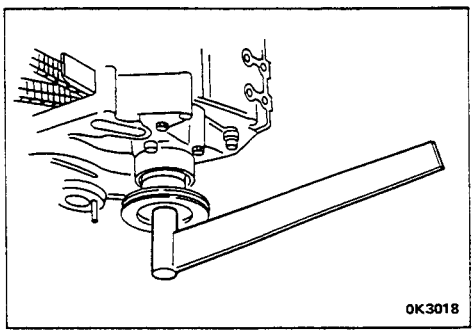


8. Piston assembly

With a scraper remove deposit of carbon from each cylinder wall before removing the piston assembly.

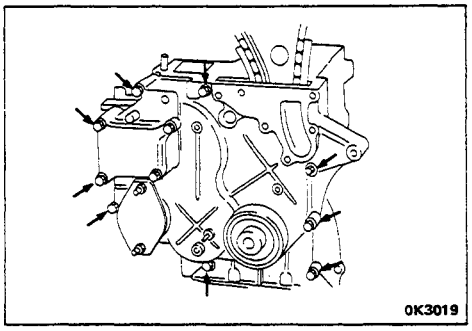


Bring the piston to top dead center by turning the crankshaft, then push out the piston and connecting rod assembly from the cylinder bore using the handle of a hammer or wood bar.



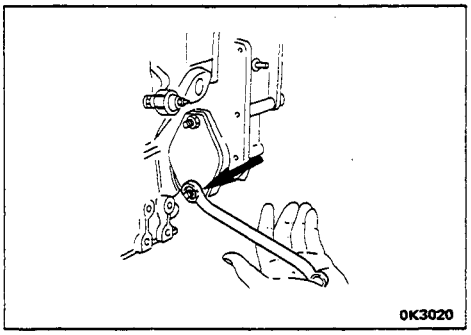
9. Crankshaft pulley

Wrench : 24 mm

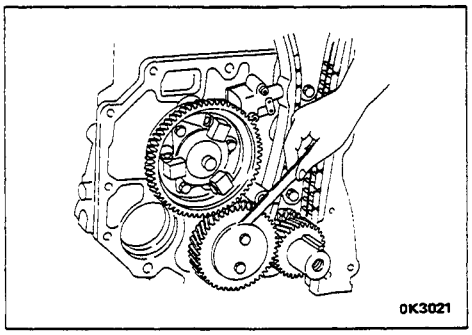


10. Timing gear cover

Loosen the nine bolts on timing gear cover.



Loosen the nut opposite side to timing gear cover.



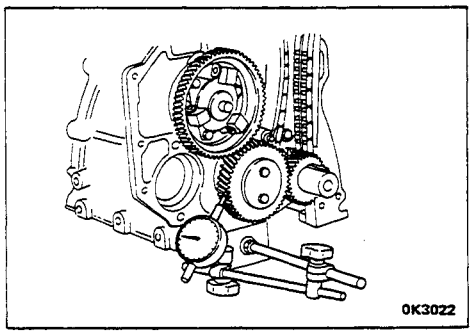
15. Idler gear

Check the following points before disassembly.

Idler gear end play

(mm)

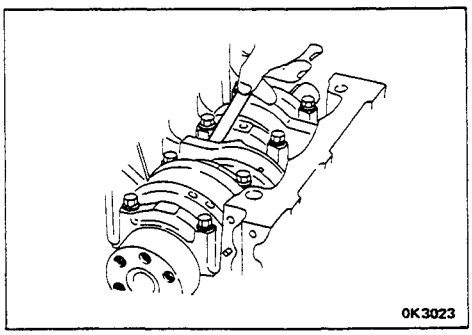
Standard	Limit
0.058 — 0.115	0.2



Backlash in gears (Crankshaft gear, idler gear, injection pump gear)

(mm)

Standard	Limit
0.06	0.3

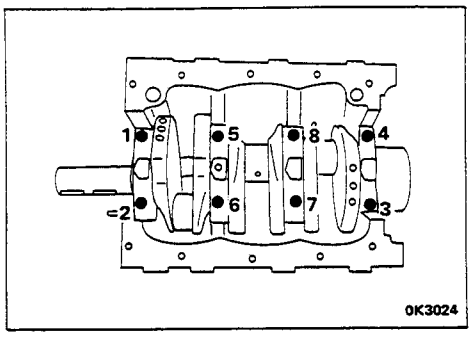


24. Crankshaft bearing caps and crankshaft bearings

Check the crankshaft end play before disassembly.

(mm)

Standard	Limit
0.06 — 0.26	0.3

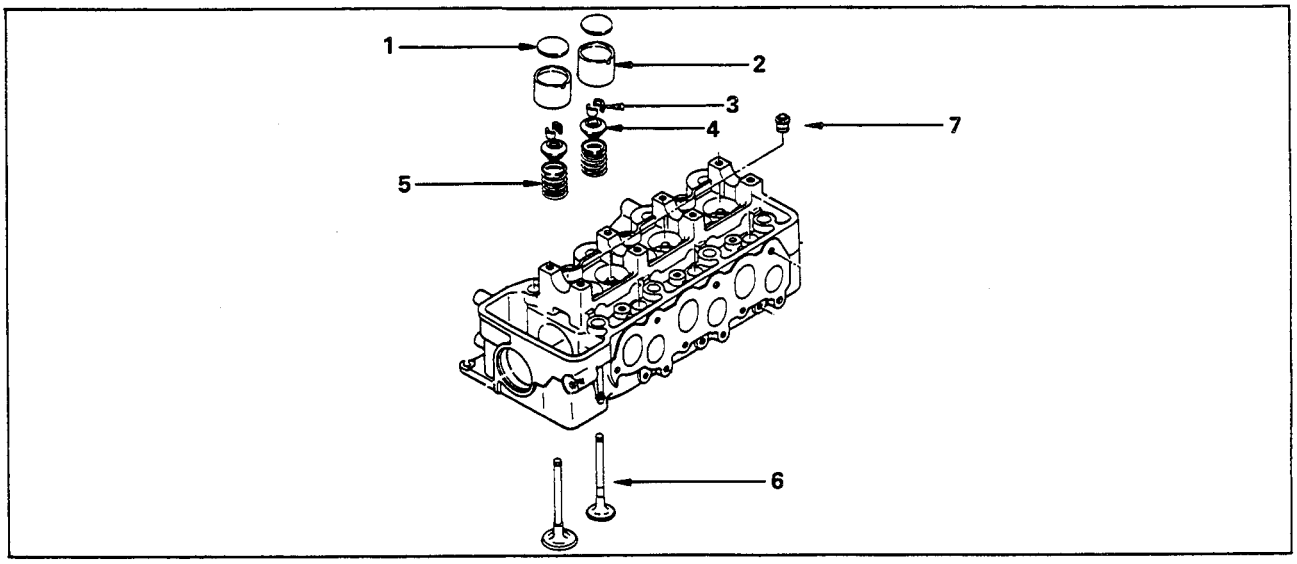


Loosen the crankshaft bearing cap bolts in numerical order.

MINOR COMPONENT

CYLINDER HEAD ASSEMBLY

This illustration is based on the 3KC1 model.



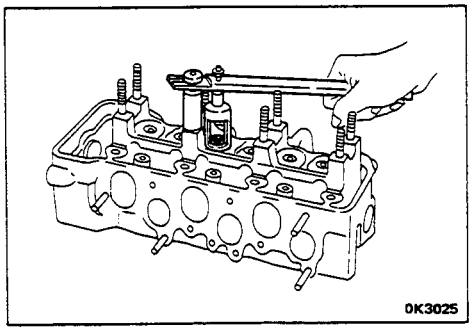
Disassembly steps

1. Adjuster
2. Tappet
▲ 3. Valve collets
4. Spring cap
5. Valve spring
6. Valve
7. Valve stem oil seal

Important operations

Mark cylinder number on each part after removal.

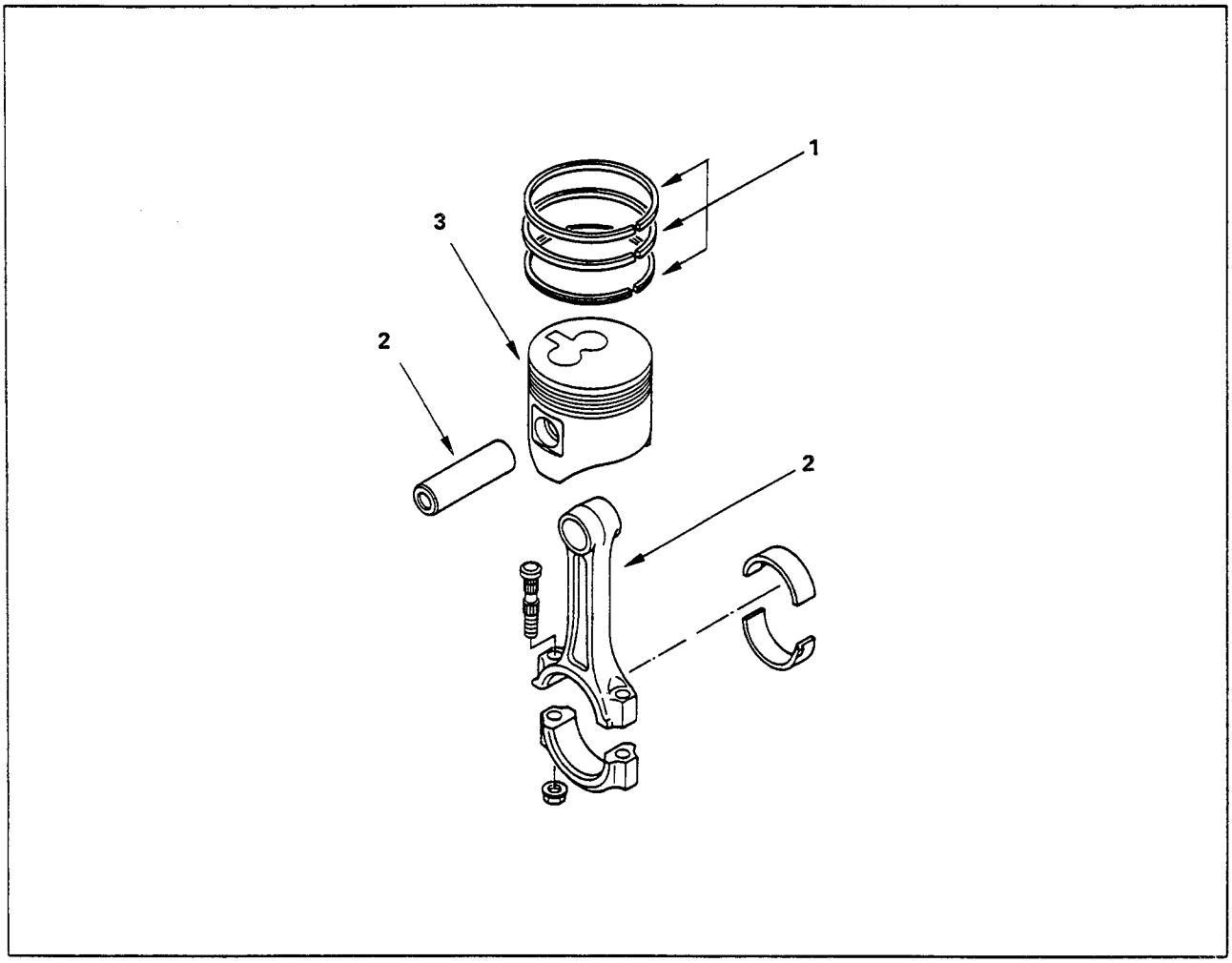
- VALVE SPRING
- VALVE
- VALVE SEAT
- TAPPET
- ADJUSTER



3. Valve collets

Spring compressor : 5-8840-9001-0

PISTON AND CONNECTING ROD ASSEMBLY



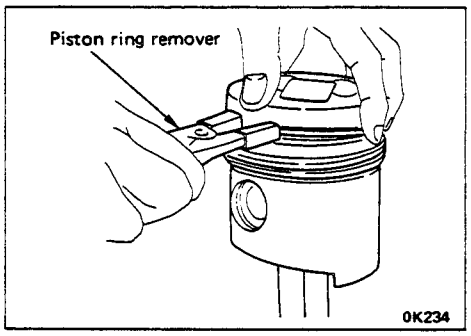
Disassembly steps

▲ 1. Piston ring
▲ 2. Piston pin and connecting rod
3. Piston

- PISTON RING
- PISTON
- PISTON PIN
- CONNECTING ROD

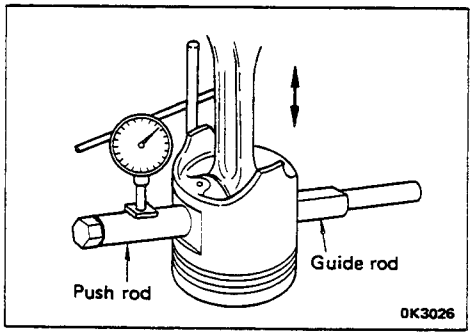
Important operations

Mark cylinder number on each part after removal.



1. Piston rings

Remove piston rings using a piston ring remover



2. Piston pin and connecting rod

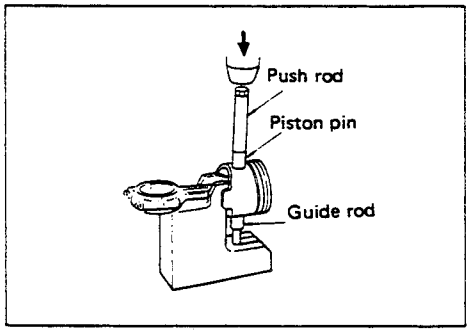
It is not advisable to remove piston from the connecting rod unless parts replacement are necessary.

Move the connecting rod up and down fixing the piston.

(mm)

Standard	Limit
0.016 — 0.020	0.075

Piston pin replacer : 5-8840-9013-0 (Piston dia. ϕ 70)
5-8840-9002-0 (Piston dia. ϕ 74)

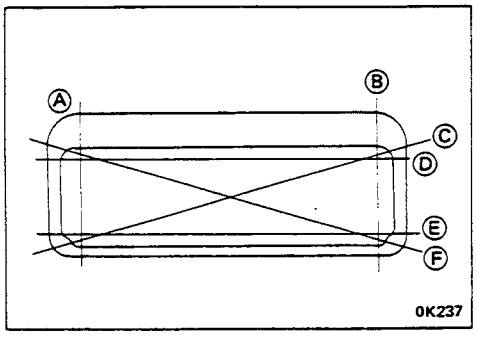


Use a set of piston pin remover and installer tools.
Force out the pin with the press.
Separate the piston from the connecting rod.

INSPECTION AND REPAIR

Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found through inspection.

CYLINDER HEAD



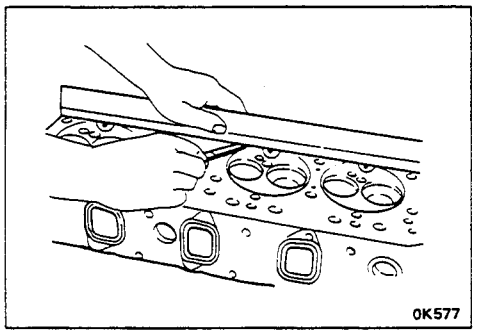
Distortion at lower face.

Check in six (6) different directions (A — F) using a straight edge.

(mm)

Standard	Limit
0.075 or less	0.15

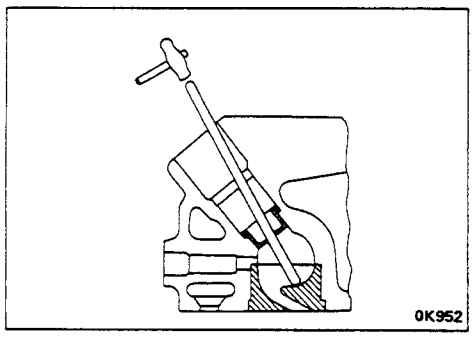
The amount of the thickness shaved off of the upper face of the cylinder body and the lower face of the cylinder head must not be more than 0.3mm.
Oversize gasket should be used when the lower face of the cylinder head is shaved off.



Depression of hot plugs

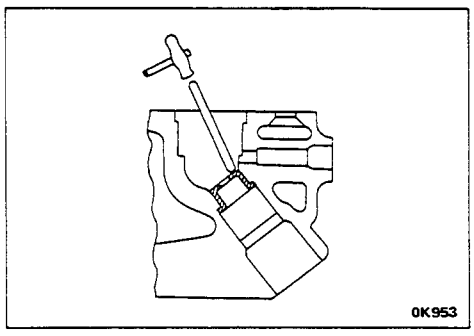
Check the amount of depression of hot plugs on No. 1 through No. 3 cylinders using a feeler gauge, with a straight edge held against the hot plug face.

Limit (mm)	0.05



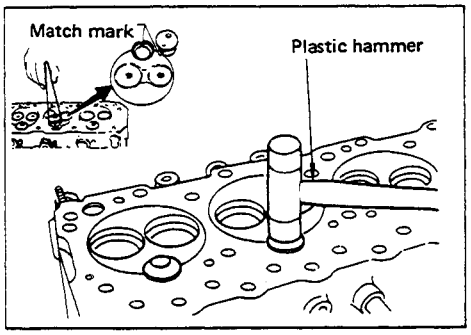
Hot plug replacement

Remove the hot plug in the following manner: Insert a suitable round bar measuring 3 to 5 mm in diameter into nozzle holder fitting hole so as to touch the hot plug, then drive out the hot plugs using a hammer.



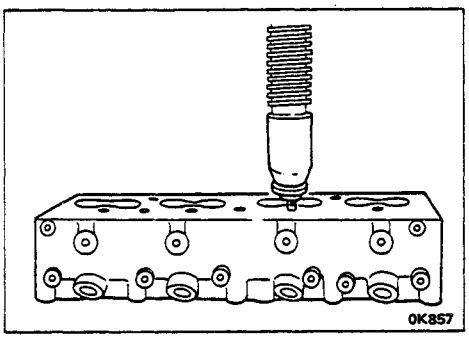
Heat shield replacement

Drive out the heat shield using a brass bar and hammer.

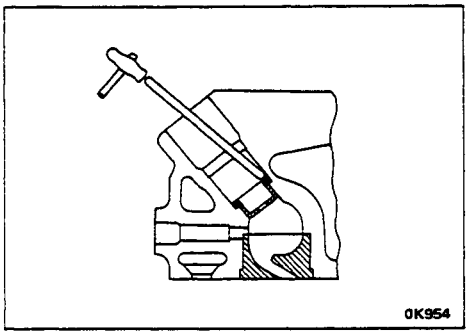


Installation of new hot plug

Drive the hot plug into cylinder head by aligning lock ball in hot plug with groove in the cylinder head.



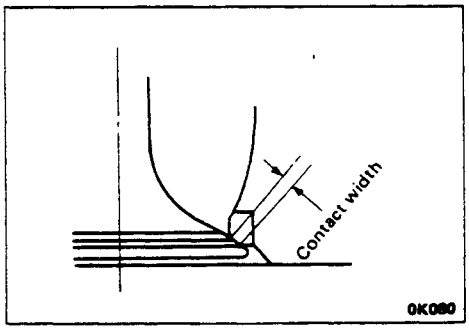
Press the hot plug into position by applying 4000 kg pressure using a bench press with a piece of metal fitted against the hot plug face for protection.
After installation, grind the face of hot plug flush with the face of the cylinder head.



Installation of new heat shield

Install the heat shield with the flanged side up on the cylinder head by tapping on the flange lightly with a brass bar.

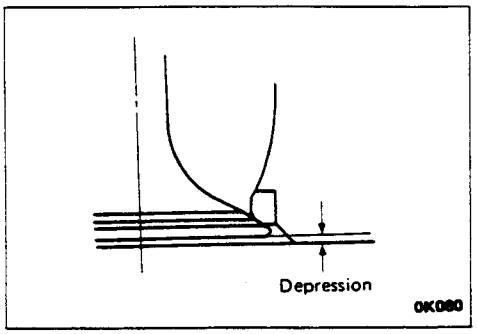
VALVE, VALVE GUIDE AND VALVE SEAT INSERT



Contact width

(mm)

Standard	Limit
1.75	2.5

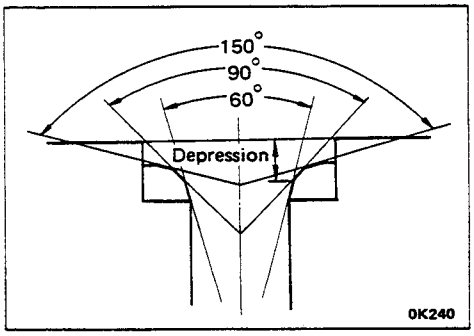


Depression of the valve

(mm)

Standard	Limit
0.7*	1.4

* The value of the depression must take more than 0.7mm also when you shave the cylinder head off.

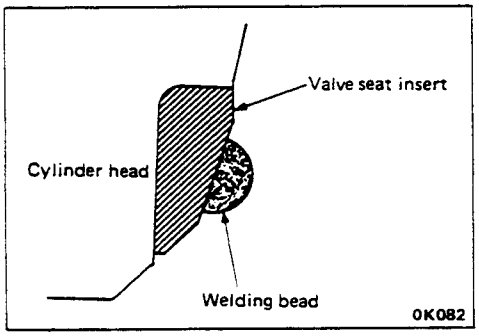


Valve seat angle

Depression of the valve seat

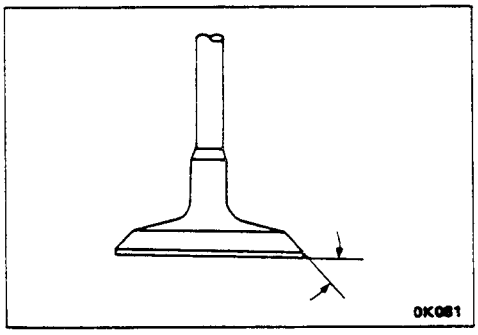
(mm)

Standard	Limit
3.2	3.7



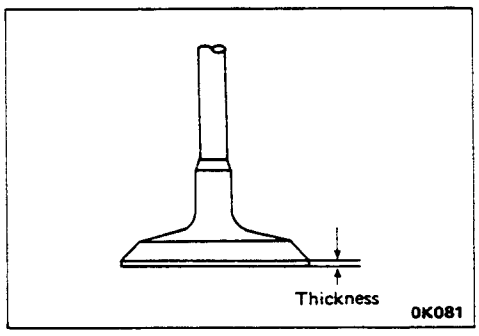
Valve seat insert replacement

Removal :
Arc-weld a bead of metal around the inner face of insert and allow to cool off a few minutes, then pry out seat with a screw driver.
Installation : Press the insert into position by applying 4000 kg force.



Valve seating angle

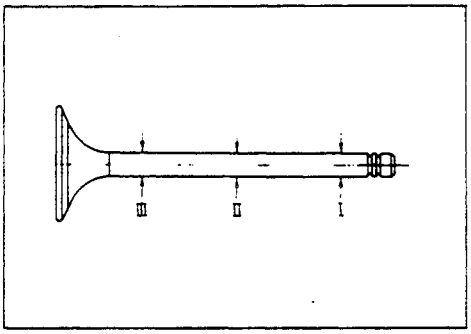
Intake valves	45°
Exhaust valves	45°



Valve head thickness

(mm)

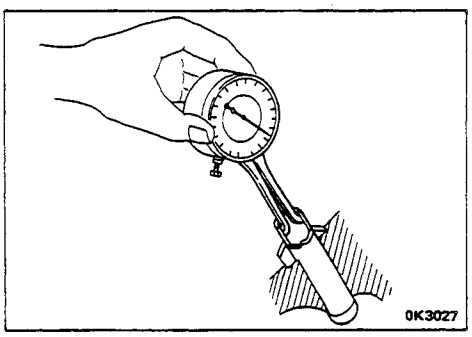
Standard	Limit
1.0	0.7



Valve stem diameter

(mm)

	Nominal	Limit
Intake valves	7	6.85
Exhaust valves	7	6.80

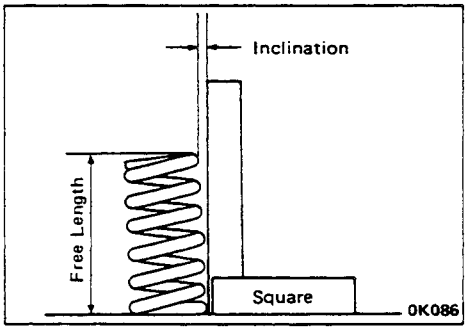


Clearance between valve and valve guide.

(mm)

	Standard	Limit
Intake	0.023 — 0.056	0.15
Exhaust	0.030 — 0.063	0.2

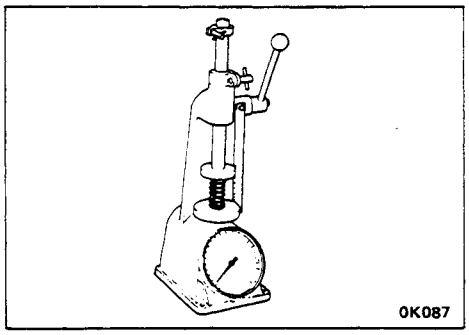
VALVE SPRINGS



Free length and inclination

(mm)

	Standard	Limit
Free length	45.45	44.0
Inclination	2.0 or less	2.4

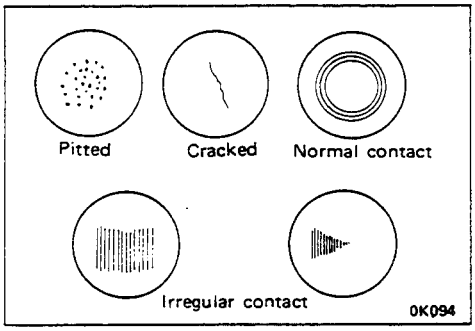


Tension

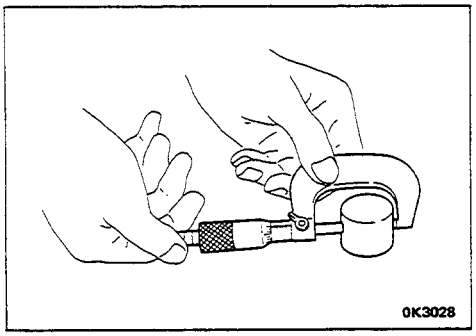
(kg)

Set length	Standard	Limit
34.7 mm	21.3	18.0

TAPPET



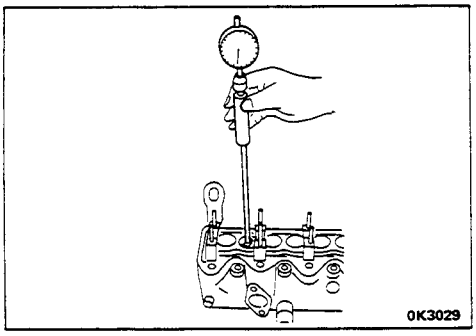
Inspect tappets for wear, damage or other abnormal conditions.



Diameter

(mm)

Nominal	Limit
35	34.93



Tappet bore inside diameter

Nominal	35

Clearance between tappet and cylinder head

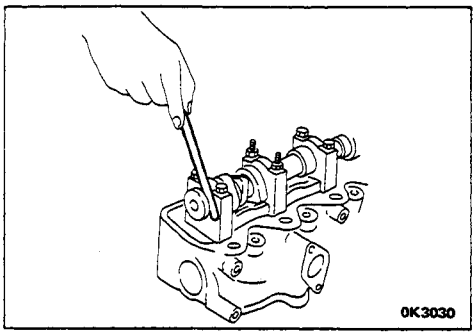
(mm)

Standard	Limit
0.020 — 0.058	0.08

CAMSHAFT ASSEMBLY

- CAMSHAFT
- CAM GEAR

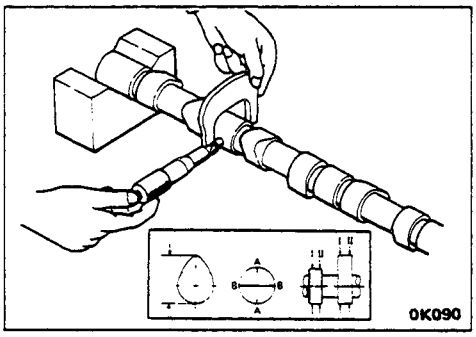
Inspect all disassembled parts for wear, damage or other abnormal conditions.



End play

(mm)

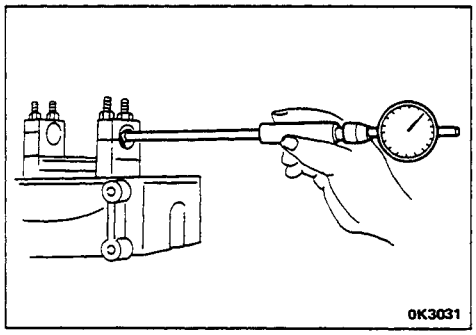
Standard	Limit
0.05 — 0.15	0.2



Camshaft journal diameter

(mm)

Nominal	Limit (A—B)
ϕ 26	±0.05



Measure the clearance between camshaft journal and cylinder head

Install camshaft brackets

Torque (kg-m)	2.0

Camshaft bracket inside diameter

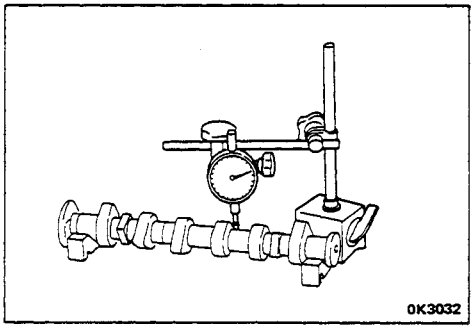
(mm)

Nominal	Limit
26	26.06

Clearance between camshaft journal and cylinder head

(mm)

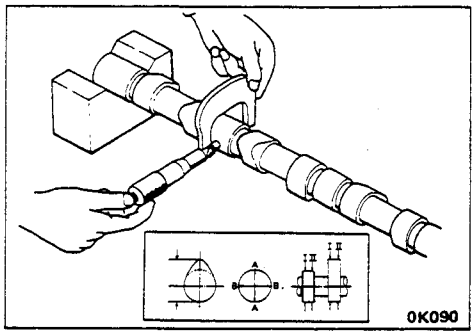
Standard	Limit
0.040 — 0.082	0.12



Run-out

TIR (mm)

Standard	Limit
0.02 or less	0.1

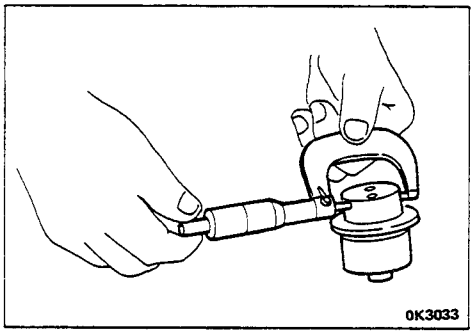


Cam lobe height

(mm)

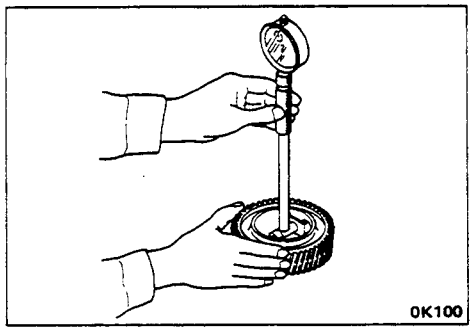
	Nominal	Limit
Inlet	45.75	45.25
Exhaust	46.68	46.18

IDLER GEAR AND IDLER GEAR SHAFT



Shaft outside diameter

Nominal (mm)	45

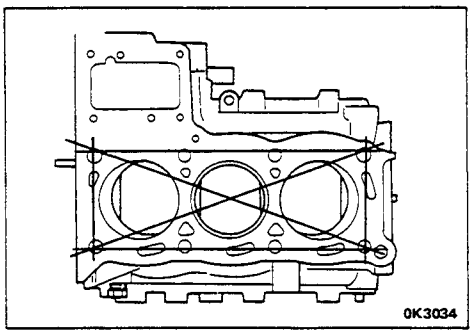


Clearance between shaft and gear

(mm)

Standard	Limit
0.025 — 0.085	0.2

CYLINDER BODY

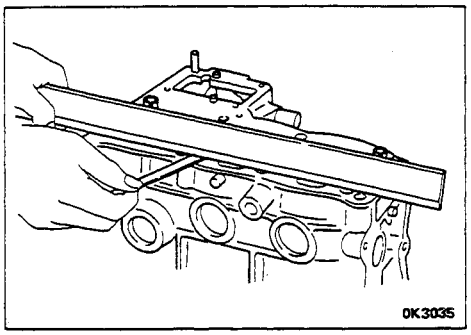


Distortion at upper face

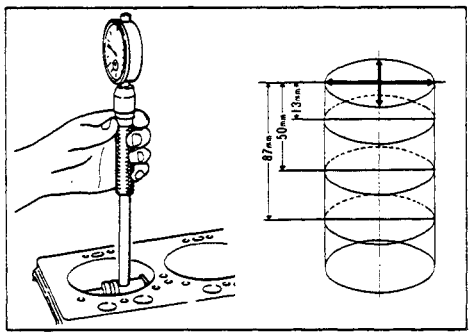
Check in six (6) different directions (A-F) using a straight edge.

(mm)

Standard	Limit
0.075 or less	0.15



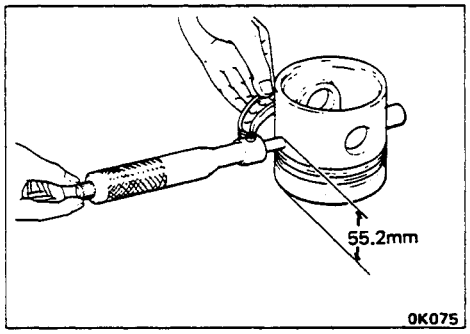
The amount of the thickness shaved off of the upper face of the cylinder body and the lower face of the cylinder head must not be more than 0.3 mm.
Oversize gasket should be used when the upper face of the cylinder body is shaved off.



Cylinder bore

(mm)

Model	Piston	Nominal	Limit
2KC1, 3KC1	Standard	74	Nominal + 0.4
	Oversize	74.25 74.5	
2KA1, 3KA1 2KB1, 3KB1	Standard	70	Nominal + 0.4
	Oversize	70.25 70.5	

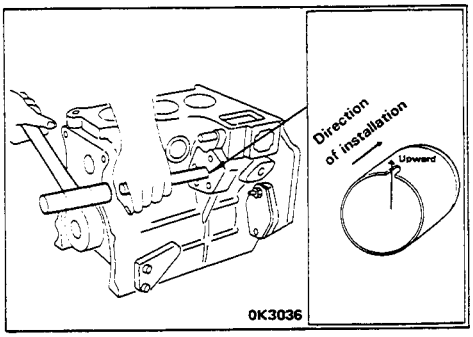


Reboring Cylinder block

1. Determine the size of the oversize pistons.

Oversize pistons	(mm)	+ 0.25 and 0.5

2. Caluculate the cylinder bore to be obtained after reboring.
   Cylinder bore diameter (after reboring) = P + C − H ± E
   P: Piston outside diameter
   C: Piston clearance of 0.102 to 0.122 mm
   H: Allowance for honing of 0.02 mm or less
   E: Error in boring finish
3. Cylinder bores should be honed after reboring; allowance for honing = 0.02 mm or less. Honing is to remove traces of reboring, giving a smoother wall surface. It is advisable to hold allowance for honing to a minimum since excessive allowance will adversely affect accuracy of cylinder bore finishing.
4. Measure bore diameter after honing; variance in bore diameters should be 0.02 mm or less.
5. Oversize piston rings should be used when you use oversize pistons.

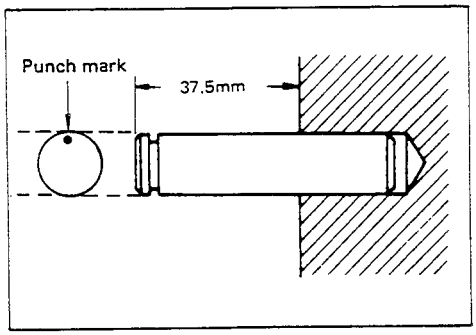


Injection pump camshaft bushing

Remover : 5-8840-9006-0

Installer : 5-8840-9005-0

Install the bushing with slit side up.

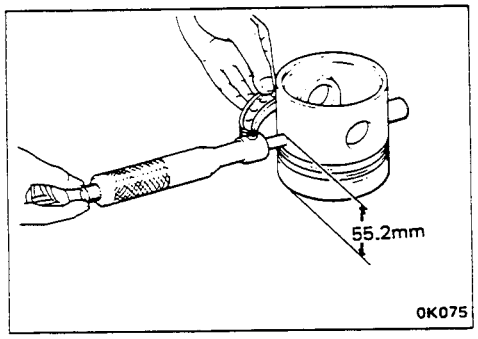


Tension lever pin

Install the tension lever pin with punch marked side up.

Installer : 5-8840-9009-0

PISTON, PISTON PIN AND PISTON RING



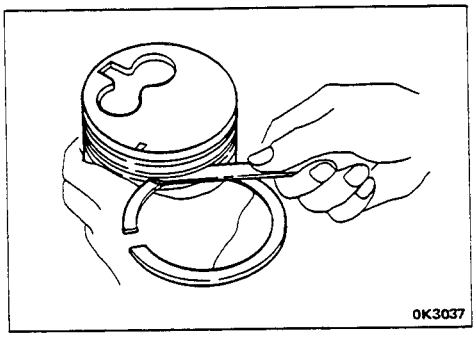
Piston diameter

(mm)

Piston grade	2KC1, 3KC1	2KA1, 3KA1 2KB1, 3KB1
A	73.898 — 73.917	69.898 — 69.917
C	73.918 — 73.937	69.918 — 69.937

Piston clearance

Standard	(mm)	0.102 — 0.132

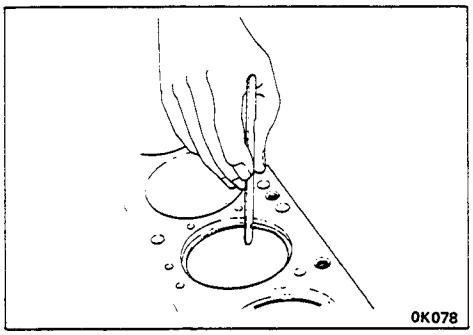


Piston ring

Clearance between piston ring and ring groove.

(mm)

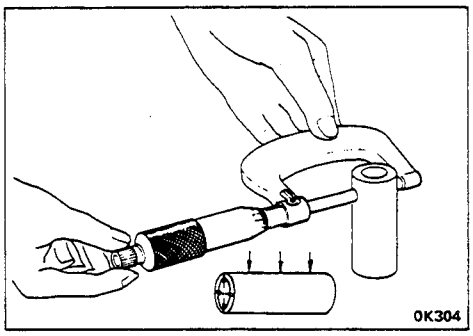
	Standard	Limit
1st compression	0.045 — 0.085	0.3
2nd compression	0.030 — 0.070	0.3
Oil	0.020 — 0.060	0.15



Piston ring gap

(mm)

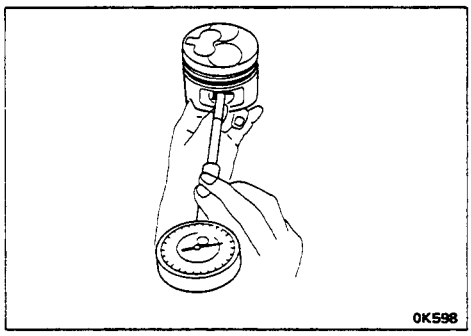
	Standard	Limit
1st compression	0.2 — 0.4	2.0
2nd compression	0.2 — 0.4	2.0
Oil	0.2 — 0.4	1.0



Piston pin diameter

New ones should be used.

Nominal	(mm)	21



Piston pin hole inside diameter

(mm)

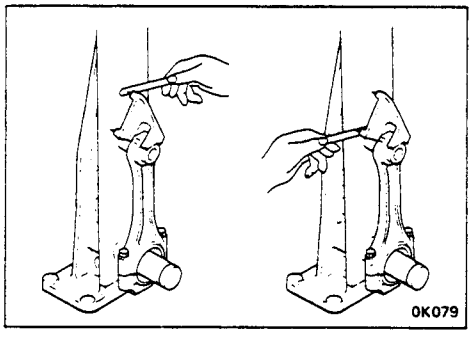
Nominal	Limit
21	21.075

Clearance between piston pin and piston pin hole

(mm)

Standard	Limit
0.016 — 0.020	0.075

CONNECTING RODS AND BEARINGS

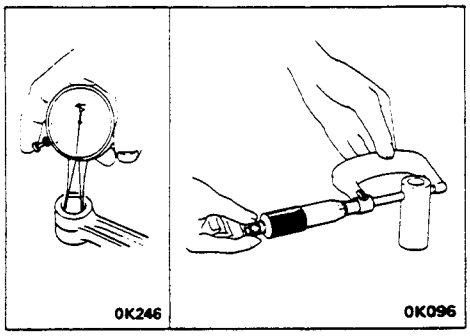


Distortion or misalignment

Connecting rod aligner.

(per 100 mm)(mm)

	Standard	Limit
Distortion	0.05 or less	0.2
Bending	0.05 or less	0.15

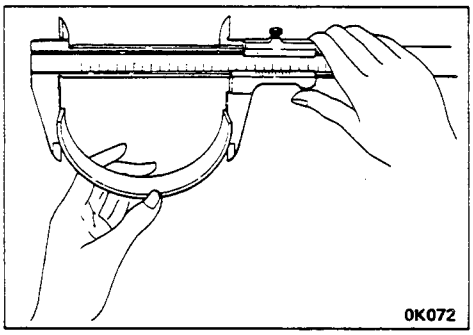


Small end inside diameter

Standard	(mm)	20.964 — 20.977

Fitting interference between piston pin and connecting-rod small-end

Standard	(mm)	0.020 — 0.041

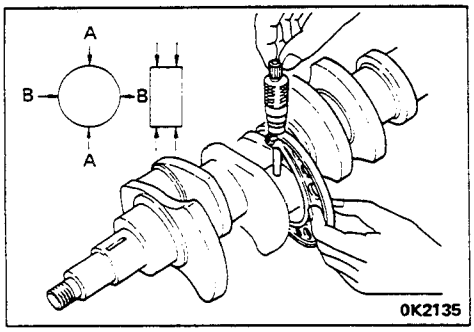


Bearing tension

(mm)

Standard	Limit
46.9 — 47.7	46.3

CRANKSHAFT AND BEARINGS



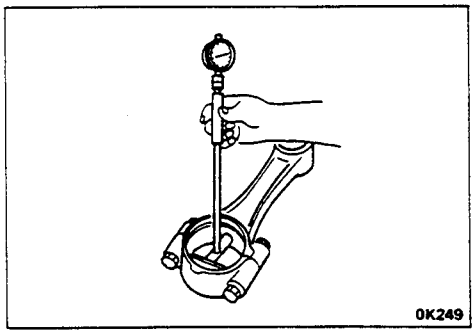
Crank pin outside diameter

(mm)

Standard	Limit
42.925 — 42.940	42.87

Limit (A—B)	(mm)	±0.05

Measure the clearance between crank pin and connecting rod.



Install bearings and caps

Torque	(kg-m)	4.0

Inside diameter

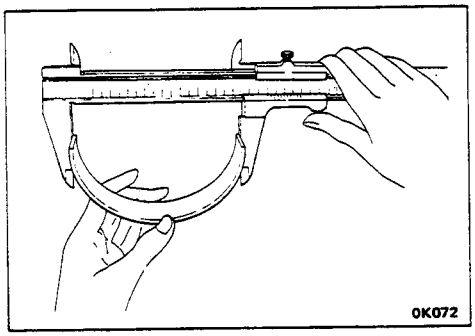
Apply engine oil to bearing, then measure the connecting rod big end bore diameter.

Nominal diameter	(mm)	43

Clearance between crank pin and connecting rod.

(mm)

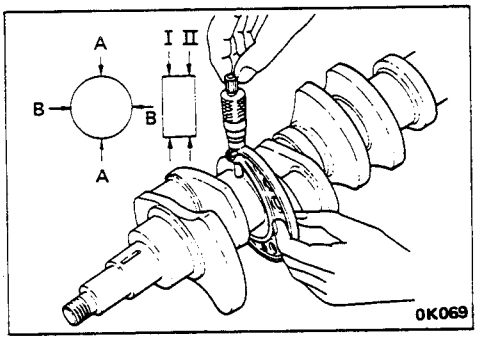
Standard	Limit
0.035 — 0.073	0.12



Bearing tension

(mm)

Standard	Limit
56.7 — 57.5	56.3



Crankshaft outside diameter

(mm)

Standard	Limit
51.920 — 51.935	51.86

Limit (A—B)	(mm)	±0.05

Refer to "REASSEMBLY OF MAJOR COMPONENTS" for installation of crankshaft and bearing caps.

Measure the clearance between crankshaft journal and crankshaft bearing cap.

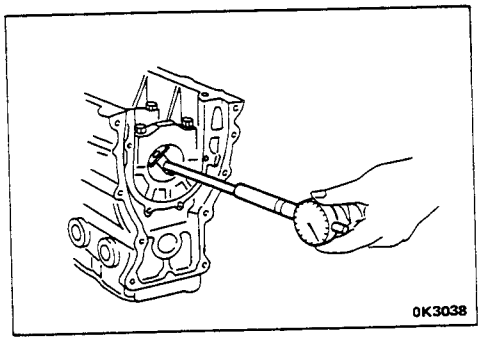
Install bearings and caps

Torque	(kg-m)	9.0

Inside diameter

Apply engine oil to bearing, then measure the main bearing cap inside diameter.

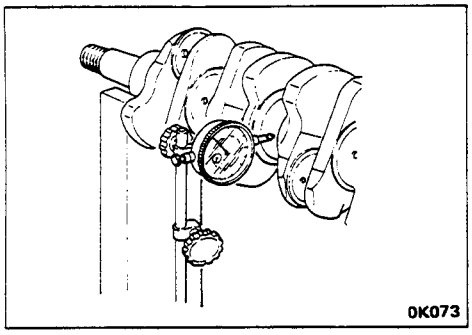
Norminal diameter	(mm)	52



Clearance between crankshaft journal and bearing.

(mm)

Standard	Limit
0.029 — 0.072	0.12

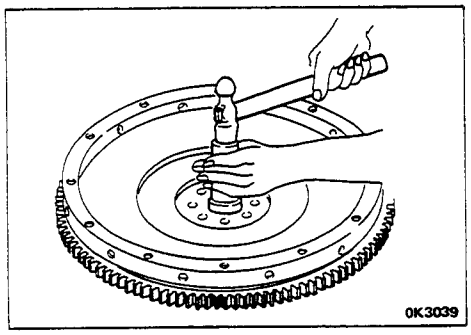


Run-out

TIR (mm)

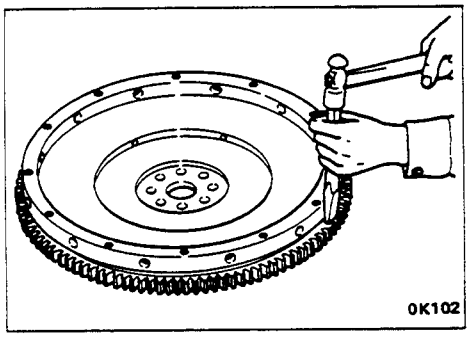
Standard	Limit
0.025	0.05

FLYWHEEL



Pilot bearing

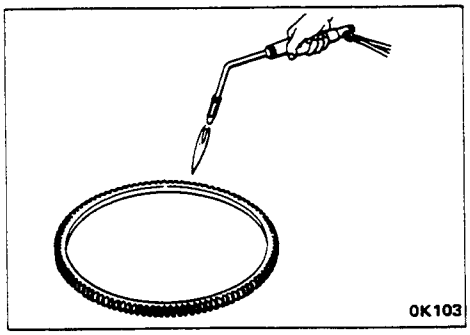
Remover and installer : 5-8522-0024-0



Ring gear replacement

Removal :

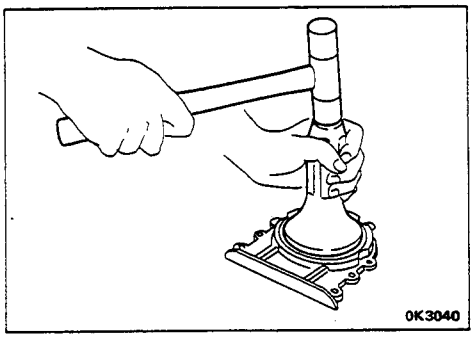
Use a suitable brass bar and a hammer.



Installation :

With a gas burner, heat the ring gear until heat expansion takes place, then install it using a hammer.

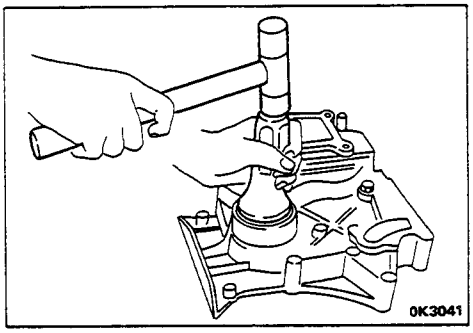
OIL SEAL



Oil seal replacement (Rear)

If the crankshaft face in contact with the oil seal has been worn, the contact portion of the crankshaft can be changed by taking out the spacer.
Discard used oil seal and install a new one.

Installer : 5-8840-9004-0
(Used with drive handle : 5-8840-0007-0)



Oil seal replacement (Front)

Removal : pry off or pull out.

Installation

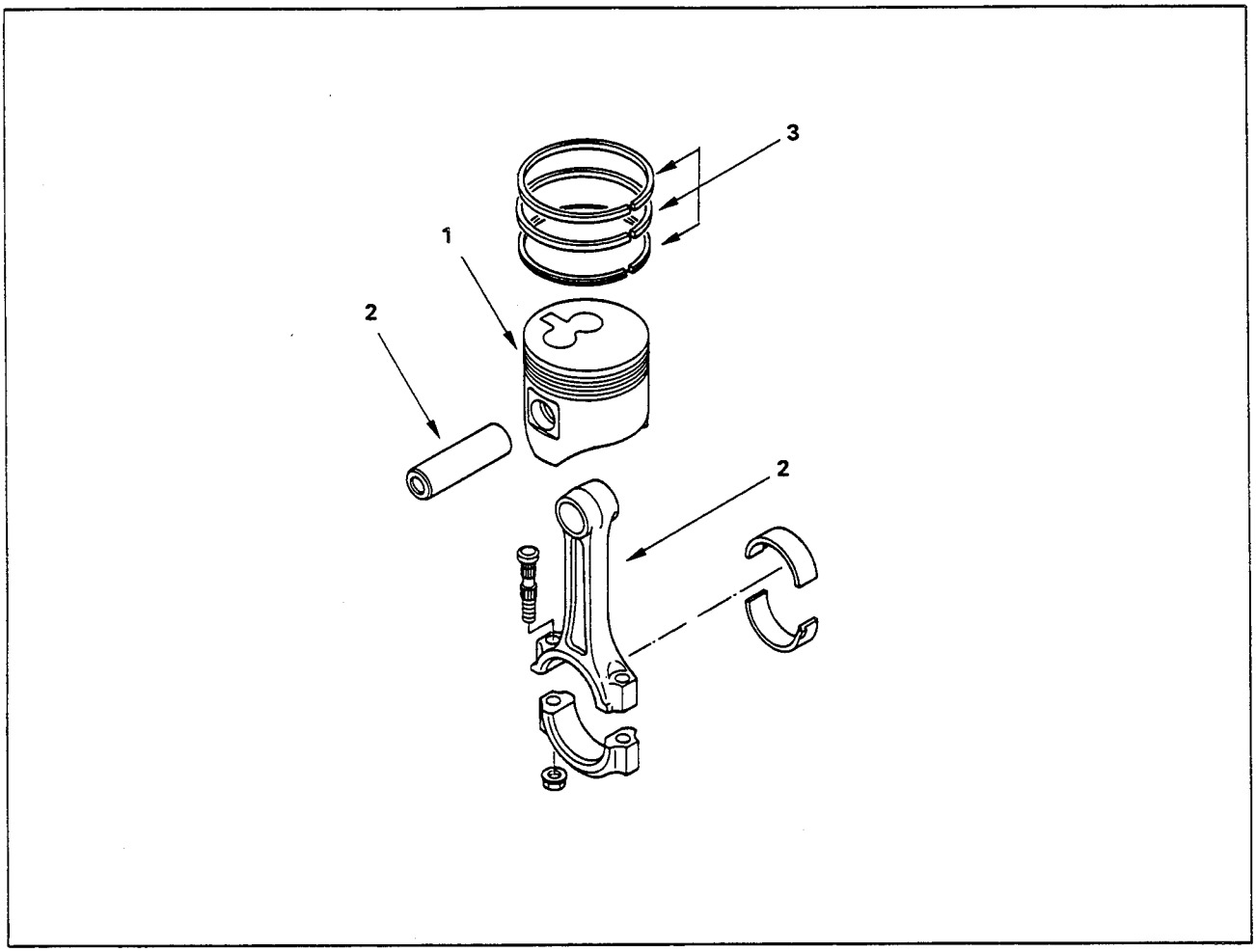
Installer : 5-8840-9003-0
(Used with drive handle : 5-8840-0007-0)

REASSEMBLY

INTERNAL PARTS

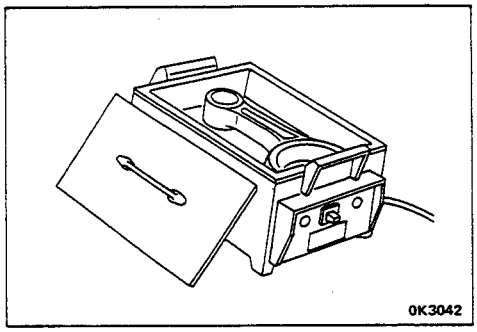
MINOR COMPONENTS

PISTON AND CONNECTING-ROD ASSEMBLY



Removal steps

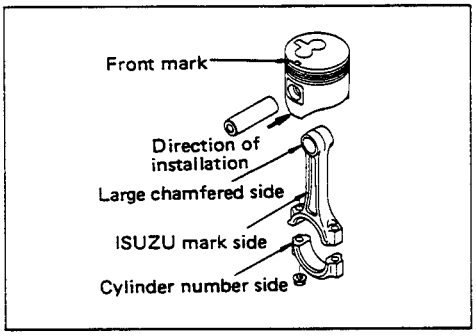
1. Piston
▲ 2. Piston pin and connecting-rod
▲ 3. Piston ring



Important operations

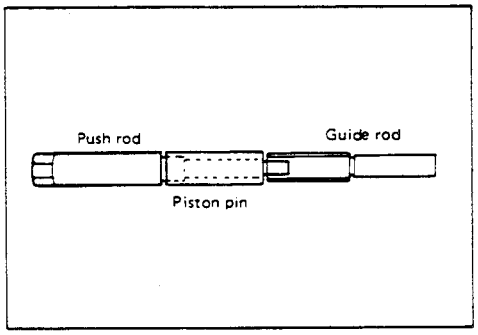
2. Connecting rod

Heat the connecting rod to about 180 ~ 220°C using a piston heater or equivalent.



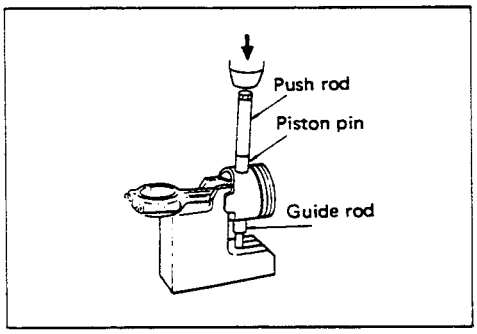
2. Piston pin and connecting rod

Refer to the alignment instructions given for the piston and the connecting rod.
Piston pin should be pressed in from the large chamfered side. (ISUZU mark side)



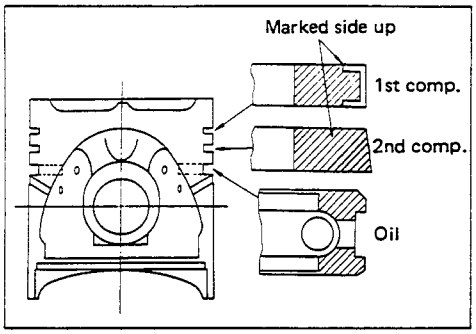
Insert the piston pin into push bar, then screw these parts into guide rod.

Piston pin replacer : 5-8840-9013-0 (Piston dia. ϕ 70)
: 5-8840-9002-0 (Piston dia. ϕ 74)



Insert the guide bar into the hole in the piston and connecting-rod, so that machined face of the guide bar is at a right angle to the groove in the body.
With a bench press, install the piston pin into the connecting-rod, so that stepped portion of guide bar is brought into contact with the edge of the body.

- Avoid applying a shock load to the piston, or distortion may result.

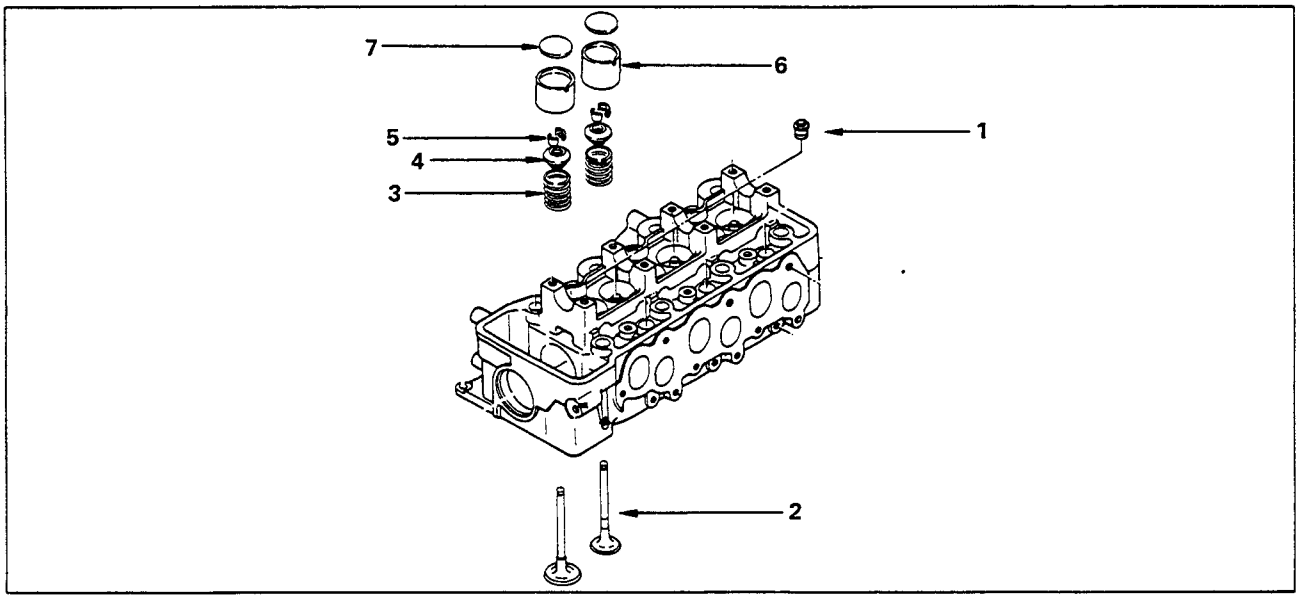


3. Piston ring

Install the piston ring using a piston ring installer.
For 1st and 2nd rings the face with the mark "N" or "IN" should be up.

CYLINDER HEAD ASSEMBLY

This illustration is based on the 3KC1 model.

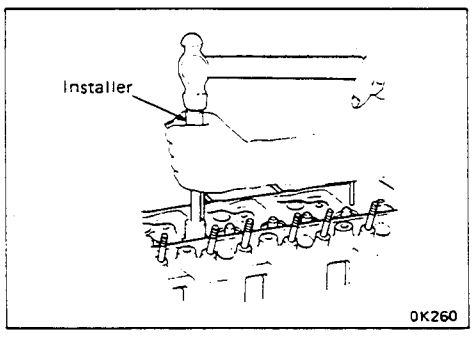


Reassembly steps

- ▲ 1. Valve stem oil seal
- ▲ 2. Valve
- ▲ 3. Valve spring
- 4. Spring cap
- ▲ 5. Valve collets
- ▲ 6. Tappet
- ▲ 7. Adjuster

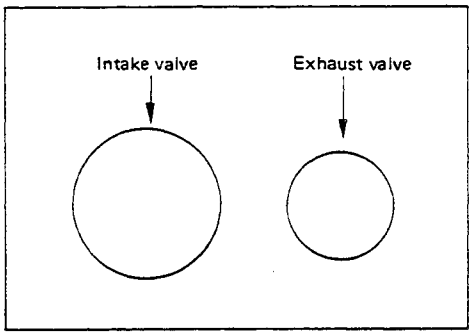
Important operations

1. Valve stem oil seal



Installer : 5-8840-9007-0

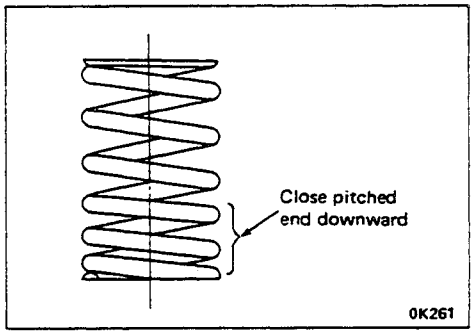
Install valve stem oil seals after lubricating them with clean engine oil.



2. Valve

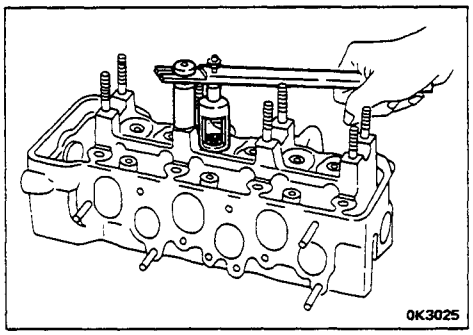
Install the intake and exhaust valves in the proper position without interchanging.

Lubricate valve stem with the mixture of molybdemum disulfide and oil. (Mixing ratio : 1 to 1).



3. Valve spring

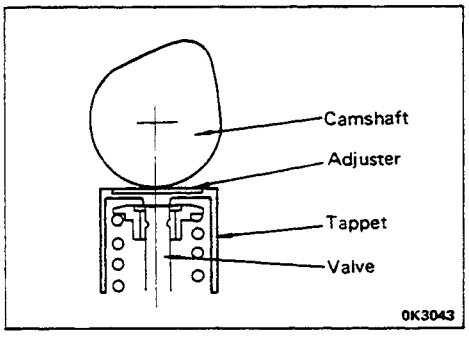
Install the valve springs with their close pitched (painted side) ends down.



5. Valve collets

Installer : 5-8840-9001-0

When valve collets are installed, tap on valve stem end lightly with a plastic hammer.



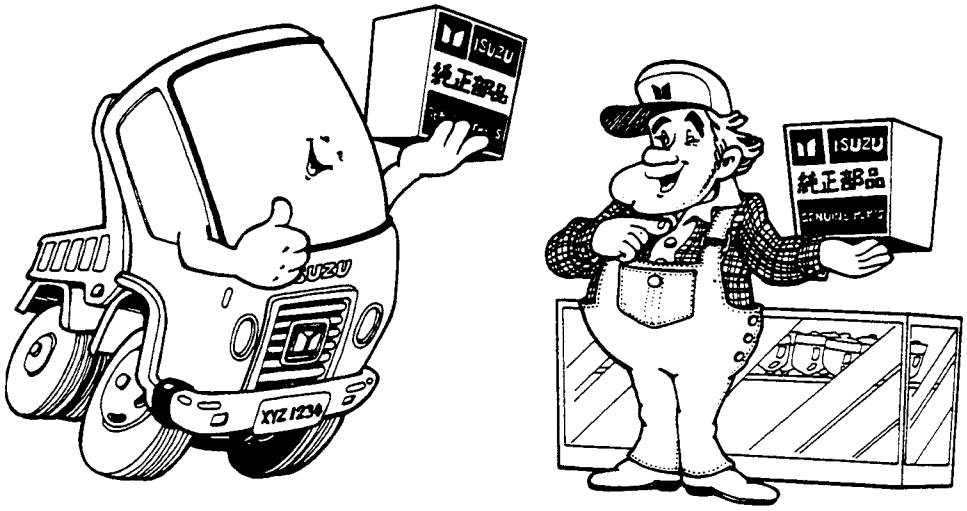
6. Adjuster

7. Tappet

Apply engine oil to the upper and lower faces of the adjuster, valve stem end and outside of tappets.

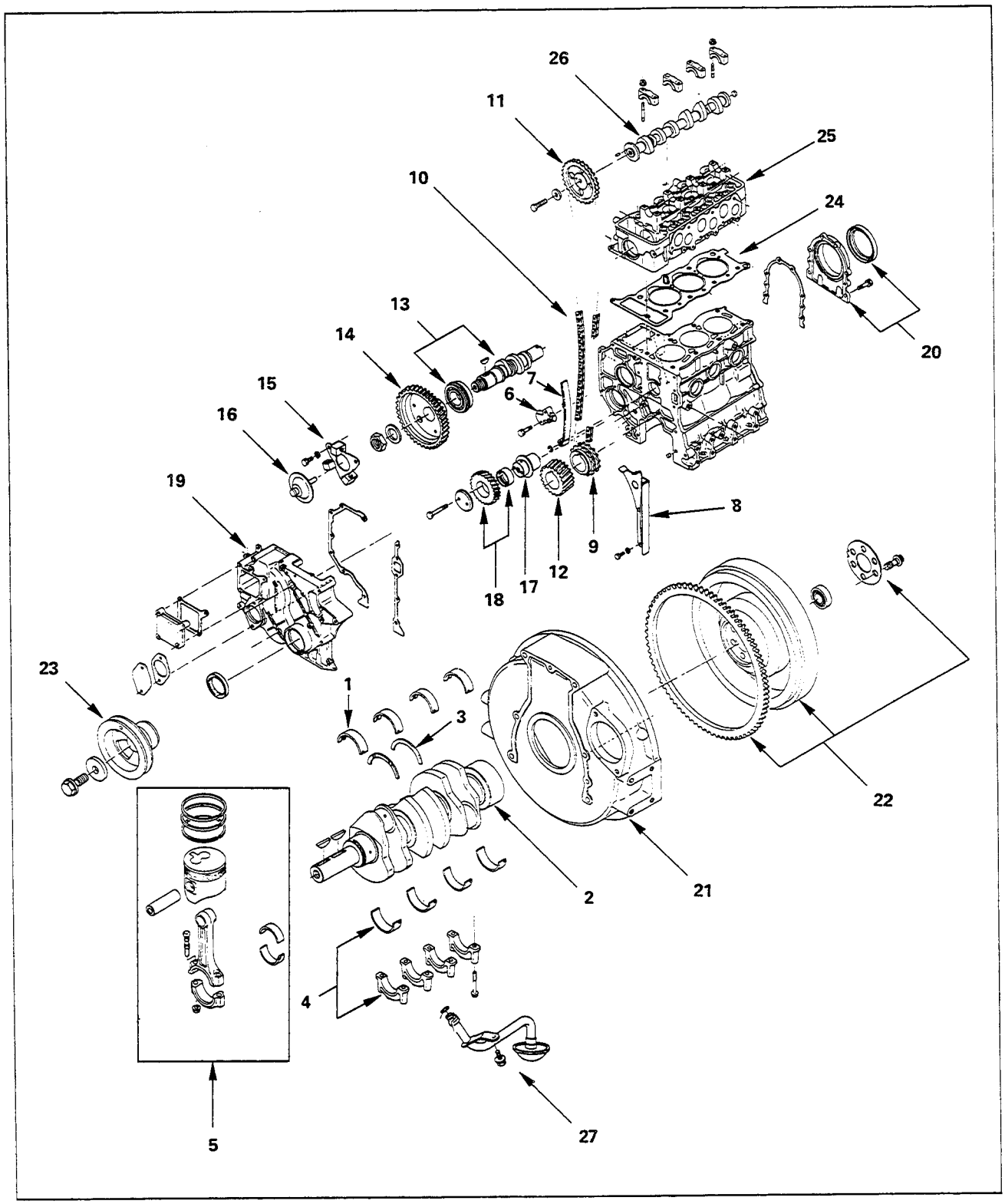
MEMO

"QUALITY PARTS YOU CAN TRUST"



MAJOR COMPONENTS

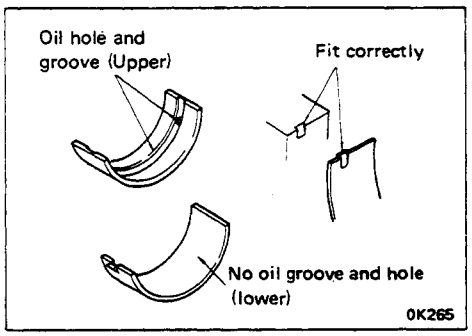
This illustration is based on the 3KC1 model.



Reassembly steps

▲ 1. Crankshaft bearings (Upper)
▲ 2. Crankshaft
▲ 3. Thrust bearings
▲ 4. Crankshaft bearings (Lower) and crankshaft bearing caps
▲ 5. Piston and connecting rod assembly
▲ 6. Chain tensioner
▲ 7. Tension lever
▲ 8. Timing chain guide
▲ 9. Crankshaft timing wheel
▲ 10. Timing chain
▲ 11. Camshaft timing wheel
▲ 12. Crankshaft timing gear
▲ 13. Injection pump camshaft
▲ 14. Injection pump timing gear
▲ 15. Fly weight assembly
▲ 16. Sleeve
▲ 17. Idler gear shaft
▲ 18. Idler gear
▲ 19. Timing gear cover
▲ 20. Rear oil seal assembly
▲ 21. Flywheel housing
▲ 22. Flywheel assembly
▲ 23. Crankshaft pulley
▲ 24. Cylinder head gasket
▲ 25. Cylinder head assembly
▲ 26. Camshaft
▲ 27. Oil strainer

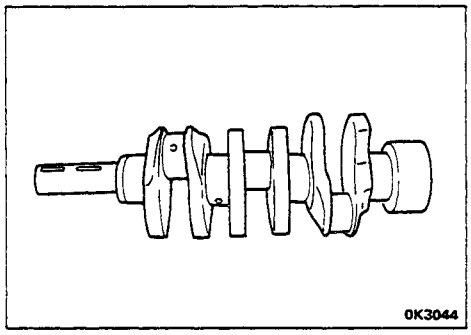
Important operations



1. Crankshaft bearings (Upper side)

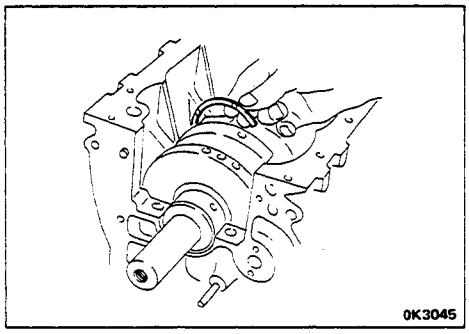
4. Crankshaft bearings (Lower side)

The lower bearings are not provided with either oil groove or oil hole, while upper bearings have the oil groove and oil hole.



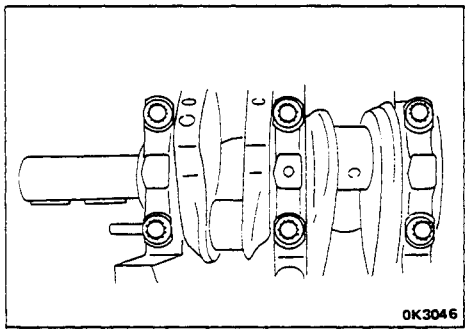
2. Crankshaft

The crankshaft should be installed as shown.



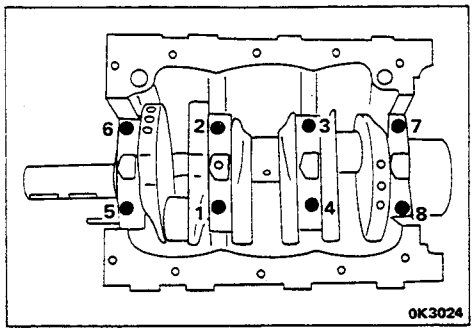
3. Thrust bearings

Thrust bearings should be installed in position between the second crankshaft web and block so that their oil grooves are turned to the sliding face of the crankshaft.



4. Crankshaft bearing caps and crankshaft bearings (Lower side)

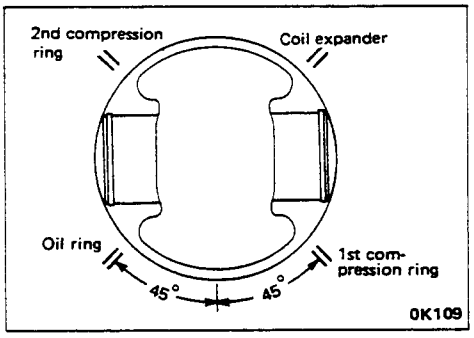
Each bearing cap (with the exception of No. 2 bearing cap) has a punched mark which corresponds to the cylinder number.
The arrow mark should be pointed to the front of engine.



Lubricate the crankshaft journals, inner face of bearings and bearing cap bolts with clean engine oil.
Tighten the crankshaft bearing cap bolts in sequence as specified.

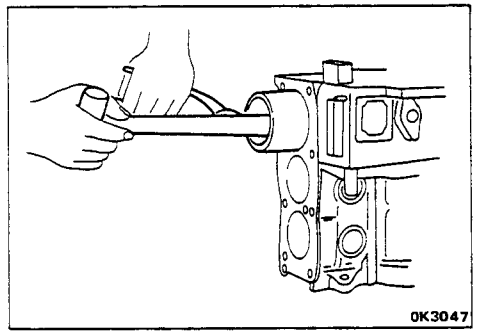
Torque	(kg-m)	9.0

After reinstallation, check to make certain that crankshaft rotates smoothly.



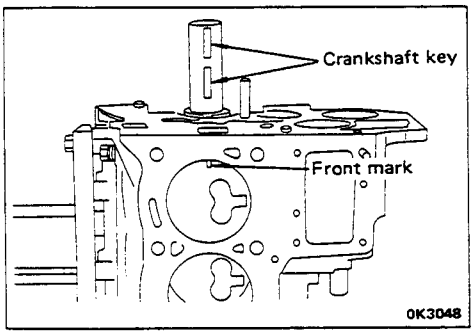
5. Piston and connecting rod assembly

Set the piston rings to position as recommended.

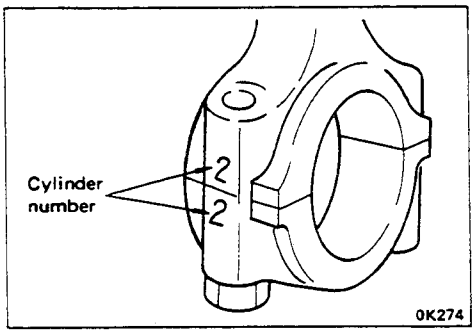


Lubricate the pistons and cylinders with clean engine oil
Check to make certain the piston grade marking is in alignment with the cylinder grade marking.
The front mark should be turned to the front side.

Piston ring compressor : 5-8840-9018-0



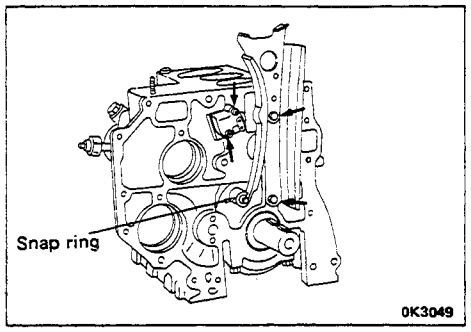
Check to make certain the front mark on piston is shown as figure.



Lubricate connecting rod bearings and crank pins with engine oil.
Align the cylinder numbers marked on the bearing caps and connecting rod.

Torque	(kg-m)	4.0

After reinstallaion, check to make certain that crankshaft rotates smoothly.



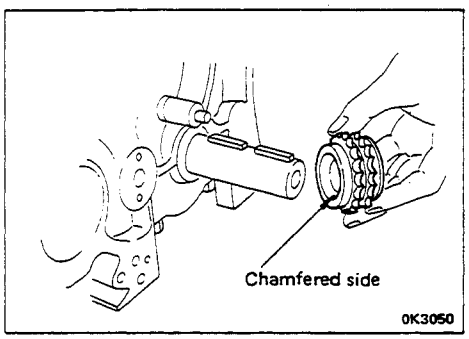
6. Chain tensioner

7. Tension lever

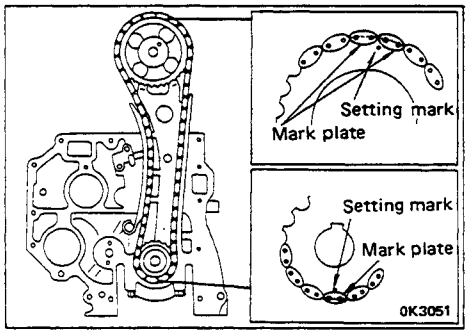
8. Timing chain guide

Install the tension lever, then set the snap ring.

Torque (kg-m)	Tensioner	0.8
	Chain guide	2.0



9. Crankshaft timing wheel



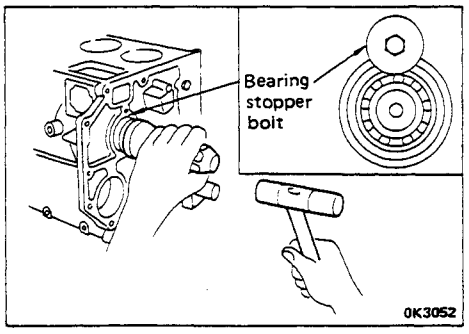
10. Timing chain

11. Camshaft timing wheel

12. Crankshaft timing gear

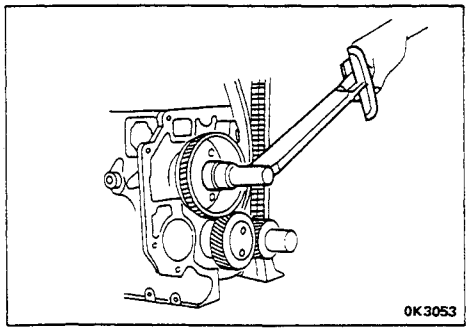
Lock the chain tensioner prior to parts installation.

Place the crankshaft key in the upper position (No. 1 piston is at TDC).
Align the timing marks on the crankshaft timing wheel, timing chain, camshaft timing wheel and chain.



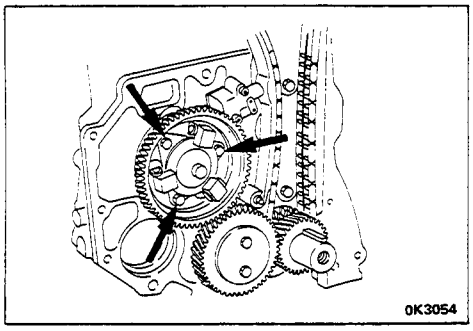
13. Injection pump camshaft

lubricate the inner face of injection pump camshaft bushing with clean engine oil.
After reinstallation, check to make certain that camshaft rotates smoothly.



14. Injection pump timing gear

Torque	(kg-m)	7.0 — 9.0

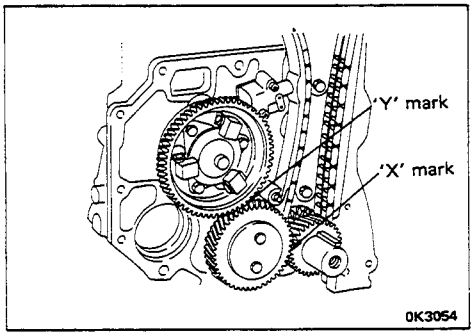


15. Fly weight assembly

16. Sleeve

Lubricate sleeve shaft with oil, then check that the shaft moves smoothly.
Apply generous amount of oil to the sliding faces of the flyweights.

Torque	(kg-m)	0.8



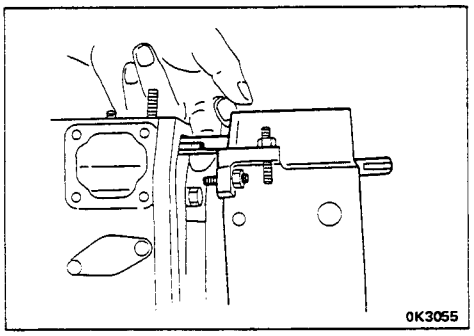
17. Idler gear shaft

Install the idle gear shaft with it's oil hole turning to the left as viewed from front side.

18. Idler gear

Lubricate the inner bushing with engine oil when the idler gear is installed.
Align the timing marks ("X" to "XX" and "Y" to "YY") on the gears.

Torque	(kg-m)	2.6

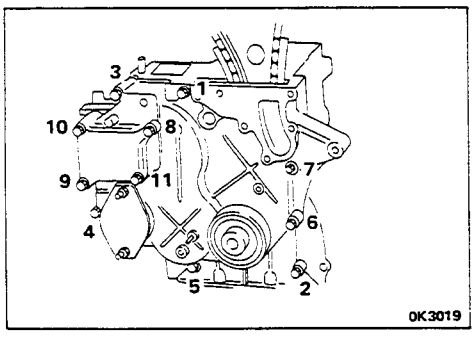


19. Timing gear cover

Place link plate and set spring into pump connecting hole.

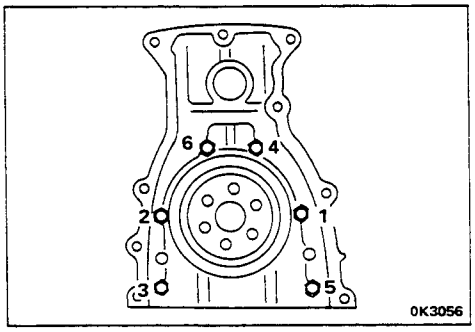
Torque	(kg-m)	2.0

Cut off excess portion of the gasket after installation and apply adhesive (three bond 1207B) to cut portion.



Tighten the bolts in numerical sequence as specified.

Torque	(kg-m)	2.0

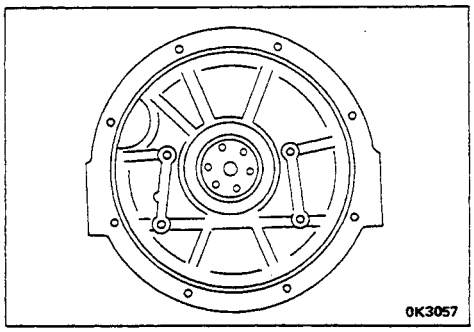


20. Rear oil seal assembly

Lubricate the lip of the oil seal with engine oil.

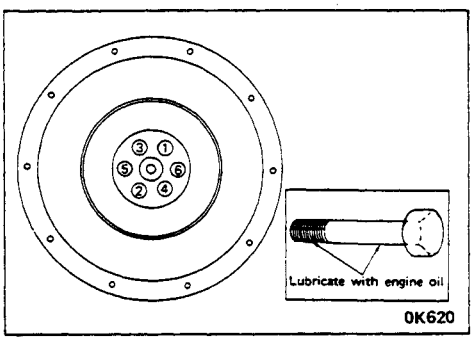
Torque	(kg-m)	2.0

Cut off excess portion of the gasket after installation and apply adhesive (three bond 1207B) to cut portion.



21. Flywheel housing (Rear plate)

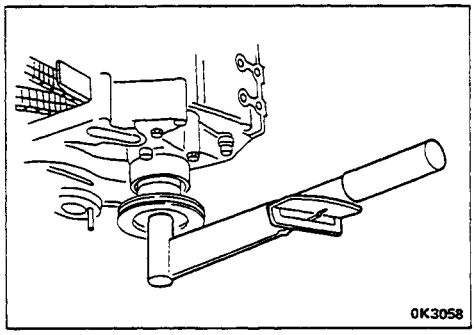
Torque	(kg-m)	4.1



22. Flywheel

Install the flywheel by aligning bolt holes.

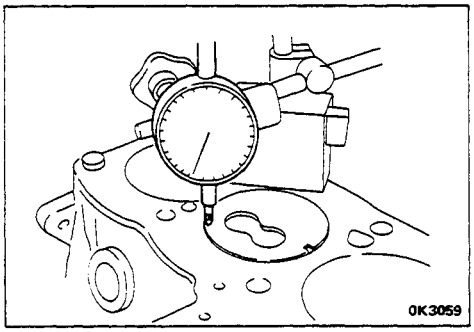
Torque	(kg-m)	10.0



23. Crankshaft pulley

Lubricate the lip of the oil seal with engine oil.

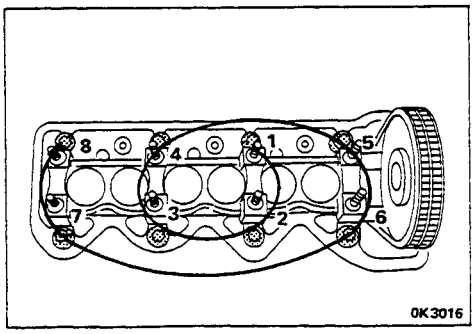
Torque	(kg-m)	18.0



24. Cylinder head gasket

Take the highest reading of the dial indicator while turning the crankshaft one full turn to bring each piston to the top dead center.

Limit	(mm)	0.94



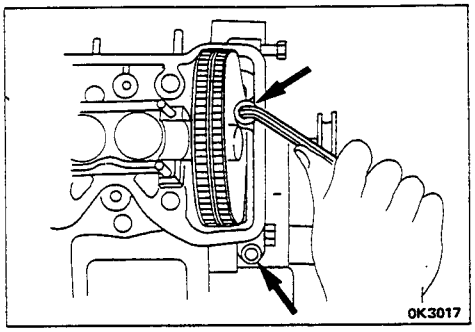
25. Cylinder head assembly

Lubricate the cylinder head bolts with engine oil and tighten them in the following sequence in two steps.

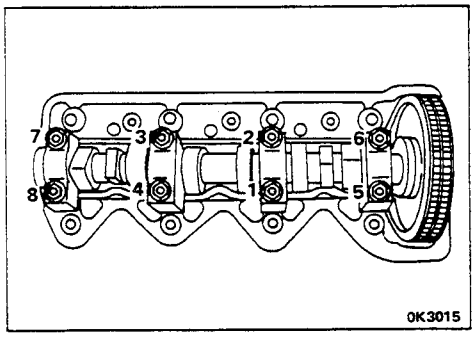
(kg-m)

1st step	2nd step
5.0	10.0 (11.5*)

* When the head bolts are used again.



Torque	(kg-m)	2.0



26. Camshaft

Lubricate the upper face of valve tappets (lifters) and inner face of camshaft brackets with engine oil.

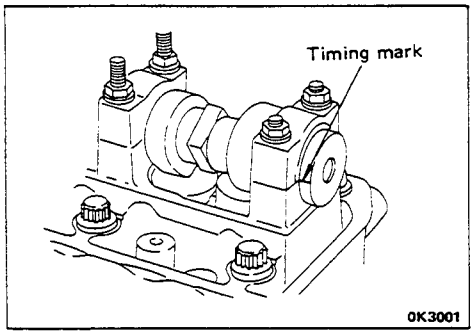
Tighten the camshaft bolts a little at a time in numerical sequence as specified.

Torque	(kg-m)	2.0

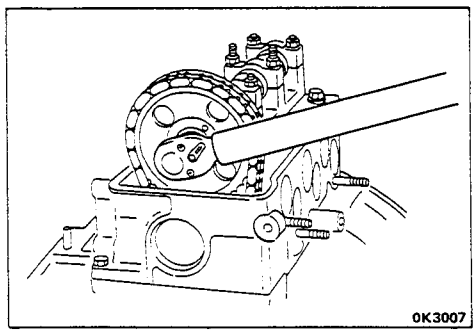
Valve clearance
Refer to "SERVICING"

Adjust the valve clearance

Avoid the top dead center position in every cylinder by turning crankshaft.
Adjust the valve clearance turning camshaft by itself.



The timing mark on the camshaft must be on the left hand side as viewed from rear side. (Also check to make certain the TDC mark on crankshaft pulley is at pointor.)

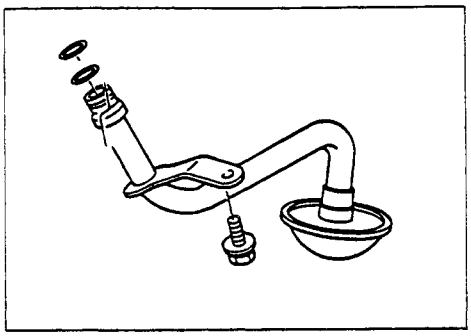


26. Camshaft front bolt

Install and tighten camshaft front bolt after aligning locating pin on the camshaft with the pin hole in the camshaft timing wheel.

Torque	(kg-m)	10.5

Release the tensioner.



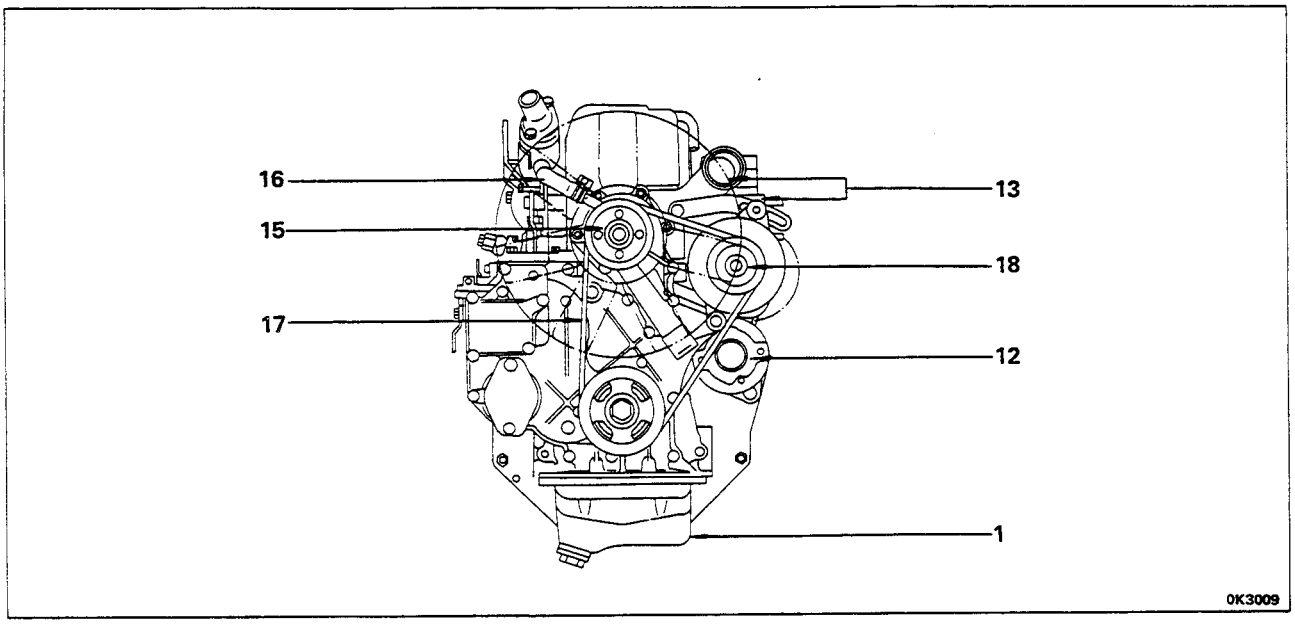
27. Oil strainer

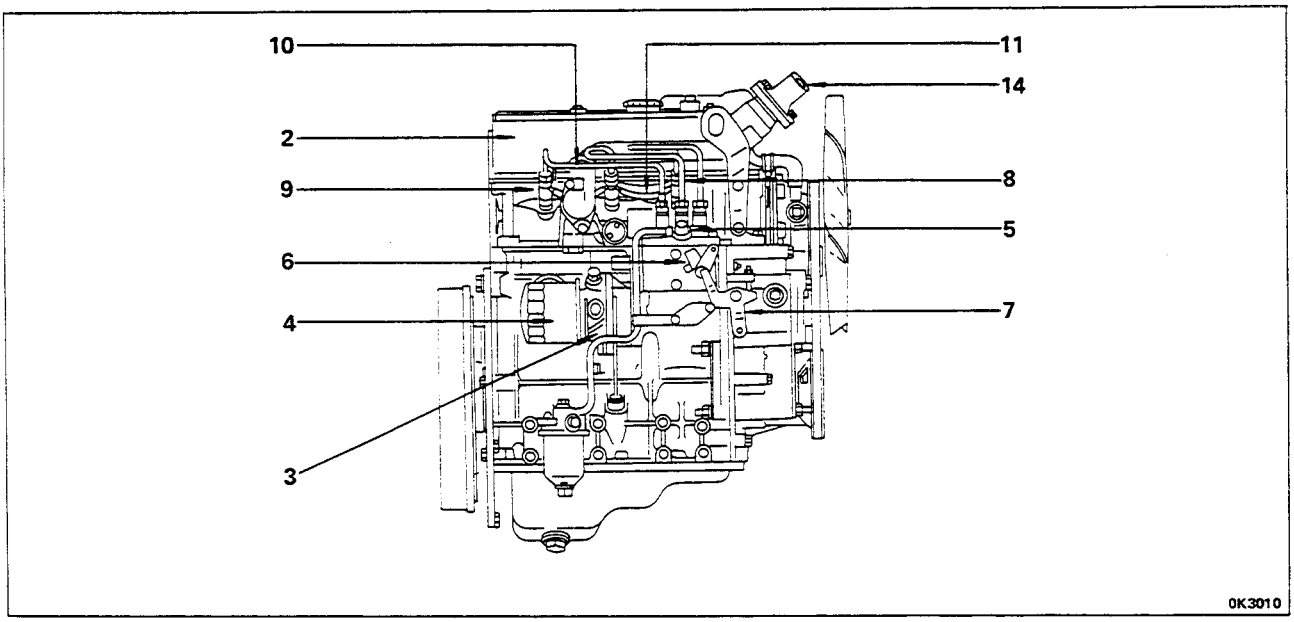
Install the oil strainer after lubricating that fits into cylinder block portion with engine oil.

After oil strainer installation, check for interference by turning the crankshaft.

EXTERNAL PARTS

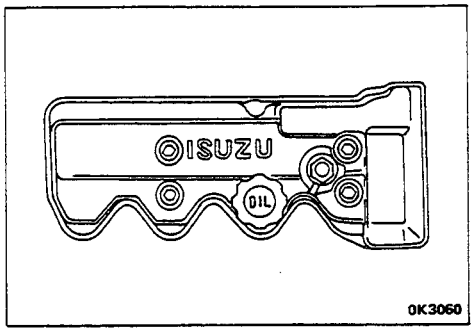
These illustrations are based on 3KC1 model.





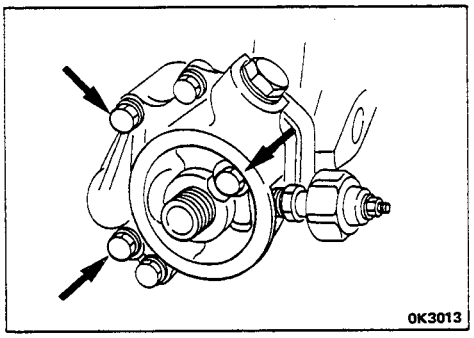
Reassembly steps

1. Oil pan
▲ 2. Cylinder head cover
▲ 3. Oil pump
4. Oil filter
▲ 5. Injection pump assembly
▲ 6. Fuel cut lever
7. Engine speed control lever
▲ 8. Glow plug
▲ 9. Injection nozzle
▲ 10. Injection pipe
11. Leak off pipe
▲ 12. Starter motor
▲ 13. Intake and exhaust manifold
14. Water outlet pipe
15. Water pump and fan pulley
16. Rubber hose
17. Fan belt
18. Generator



2. Cylinder head cover

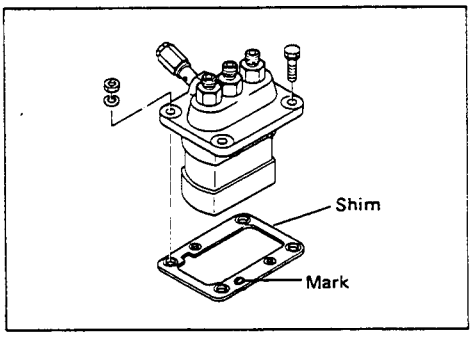
Torque	(kg-m)	0.8 — 1.5



3. Oil pump

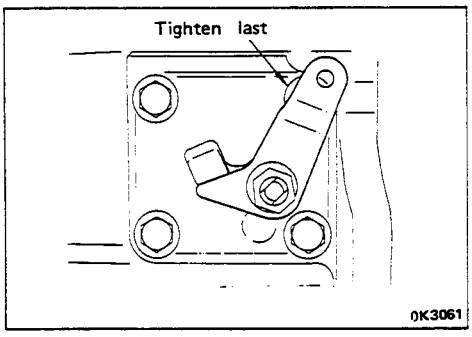
Lubricate the rotor with engine oil and install the oil pump assembly by aligning the end of the shaft with the slot at rear end of the injection pump camshaft.

Torque	(kg-m)	2.0



5. Injection pump assembly

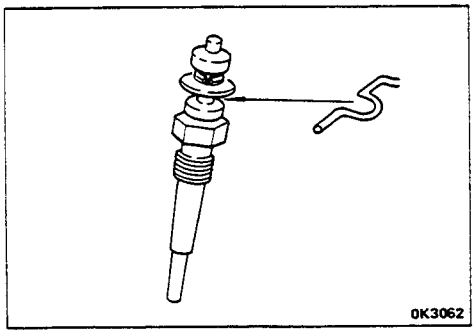
Install injection timing adjusting shim. Shim may be reused only three times. When a new one is used, it must have the same thickness marking.
(Refer to "SERVICING" for the injection timing).



6. Fuel cut lever

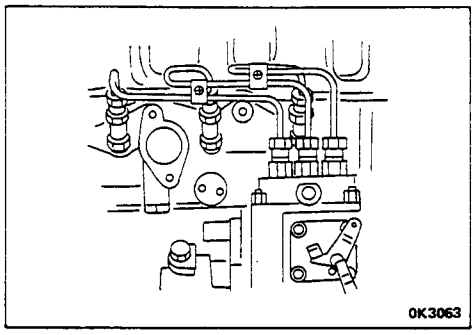
The fuel cut lever should be installed as shown.
The pointed bolt should be tightened last after tightening the other three bolts.

Torque	(kg-m)	0.8



8. Glow plugs

Torque	(kg-m)	1.5

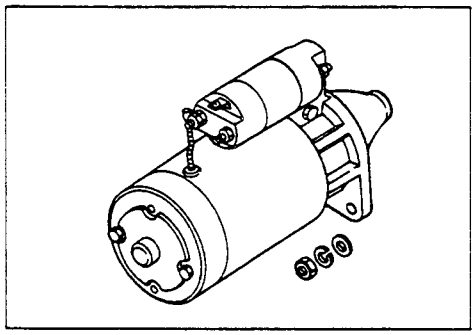


9. Injection nozzle

Torque	(kg-m)	5.0

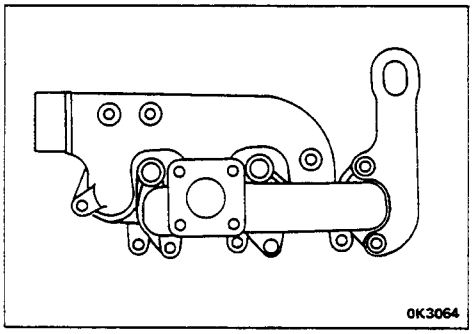
10. Injection pipe sleeve nuts

Torque	(kg-m)	3 — 3.5



12. Starter motor

Torque	(kg-m)	4.0



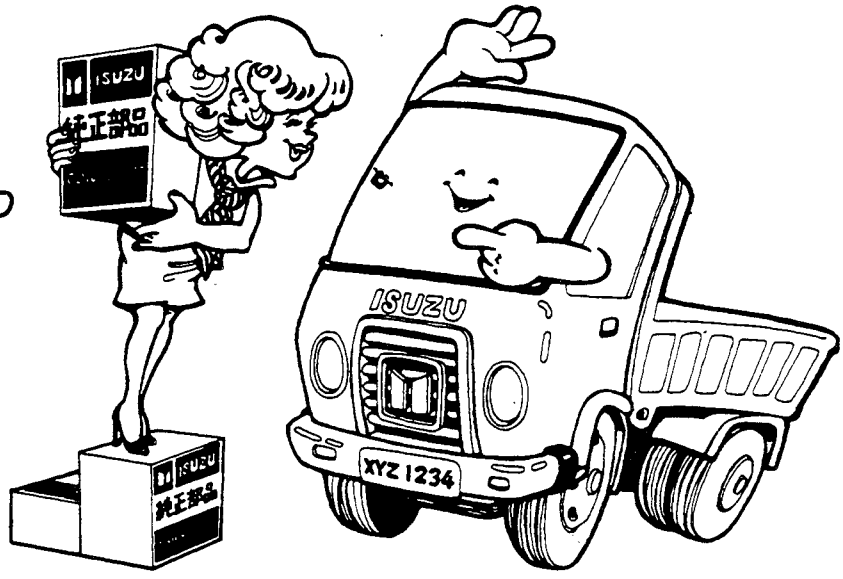
13. Intake and exhaust manifolds

Clamp the engine rear hanger together with the manifolds.

Torque	(kg-m)	2.0

MEMO

PARTES DE CALIDAD
EN LAS CUALES
PUEDE CONFIAR



SECTION 3

LUBRICATING SYSTEM

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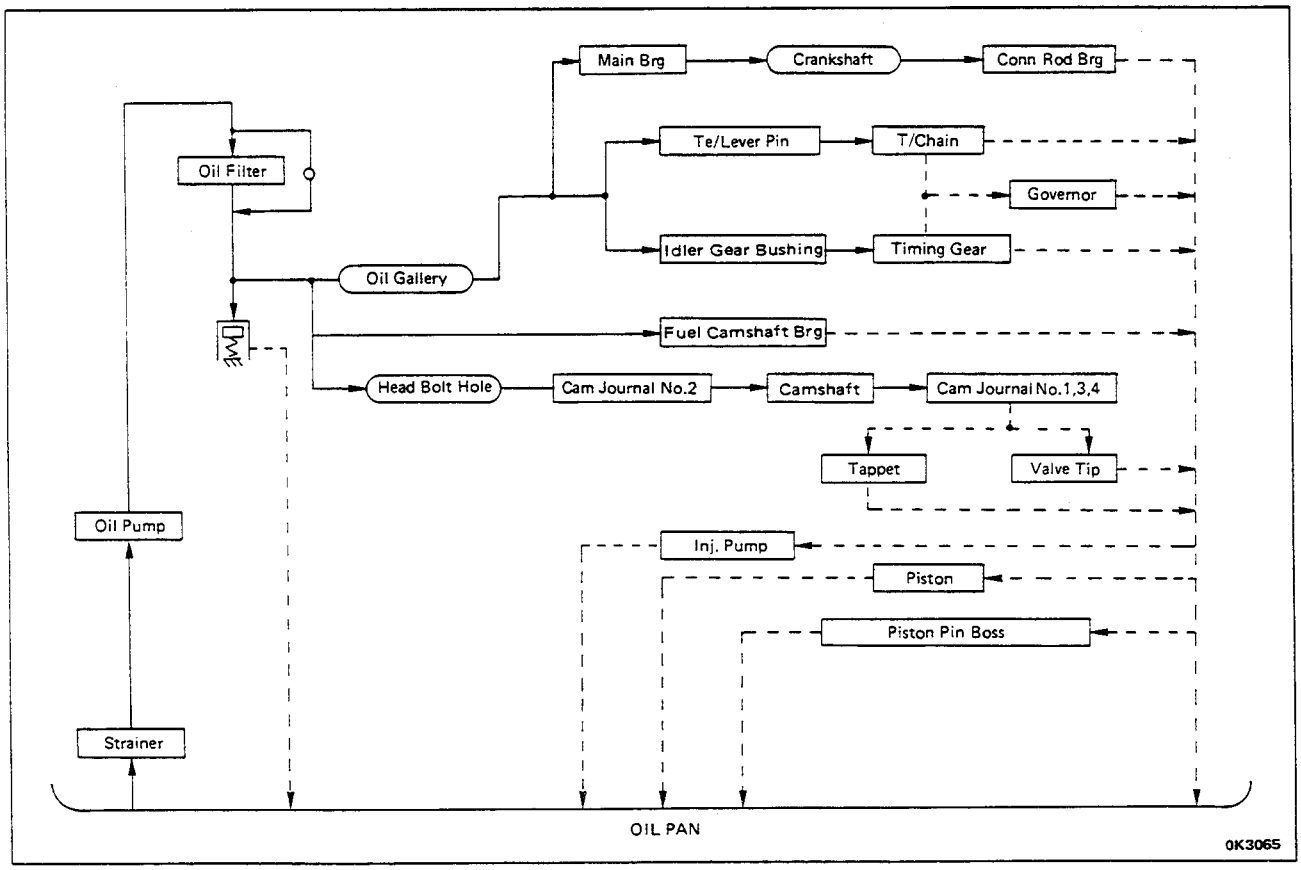
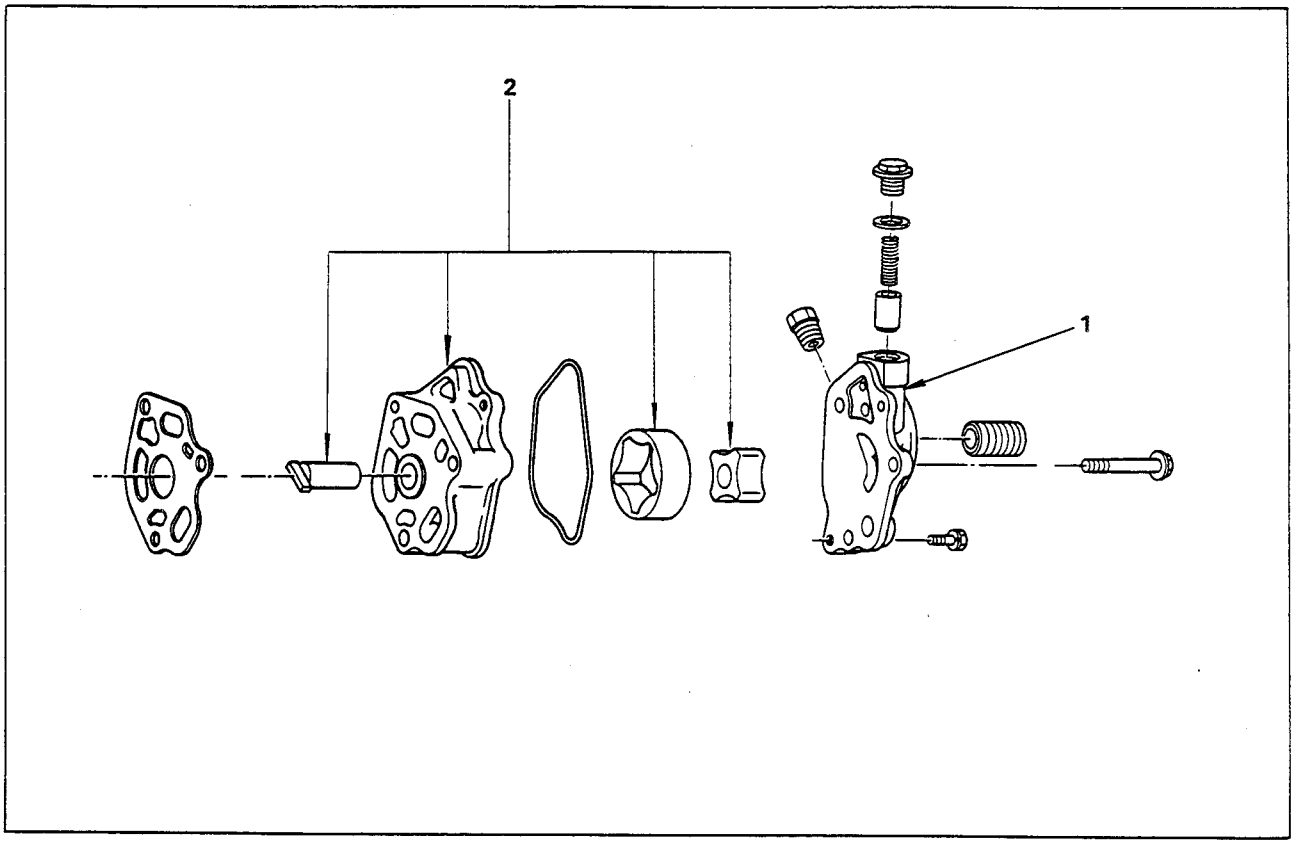
GENERAL DESCRIPTION



OIL PUMP

DISASSEMBLY

This illustration is based on the 3KC1 model.

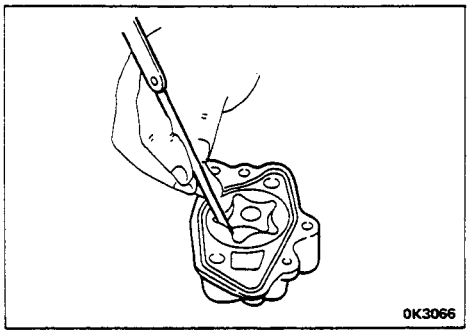


Disassembly steps

1. Oil pump cover
2. Oil pump body assembly

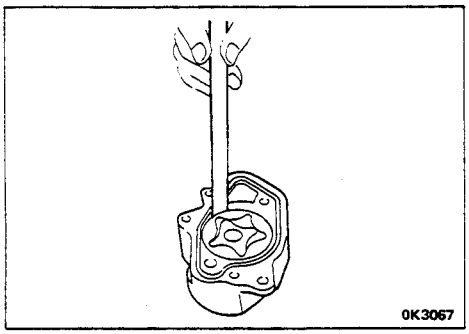
INSPECTION AND REPAIR

Make necessary correction or parts replacement if wear, damage or any other abnormal condition are found through inspection.



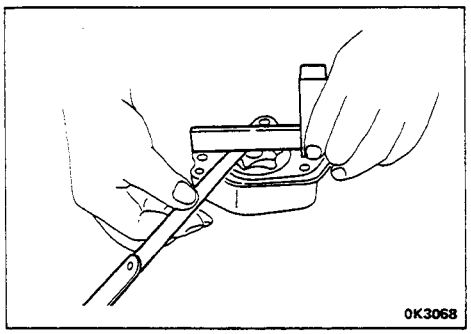
Clearance between inner rotor and outer rotor wall.

Limit	(mm)	0.2



Clearance between outer rotor and body.

Limit	(mm)	0.4



Clearance between cover and inner rotor.

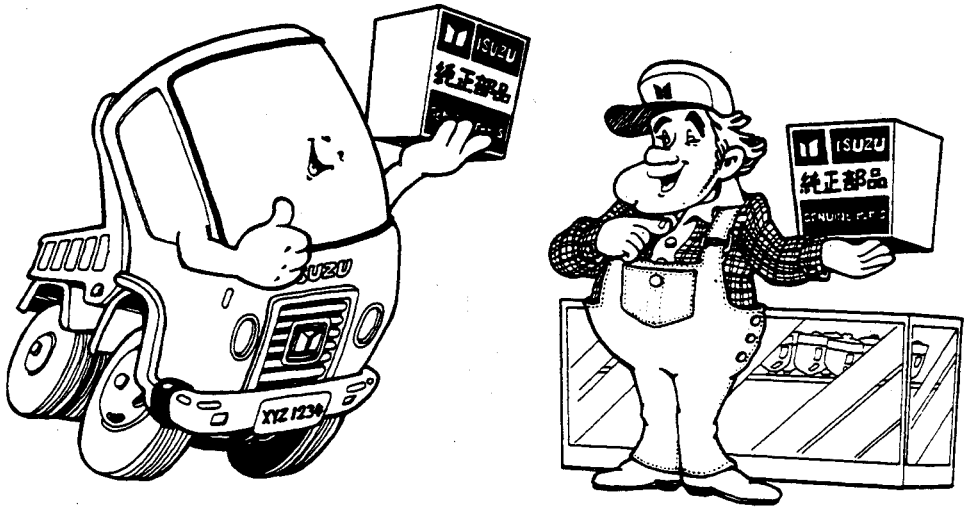
Limit	(mm)	0.15

REASSEMBLY

To assemble, follow the disassembly procedure in reverse order.

MEMO

"QUALITY PARTS YOU CAN TRUST"



SECTION 4

COOLING SYSTEM

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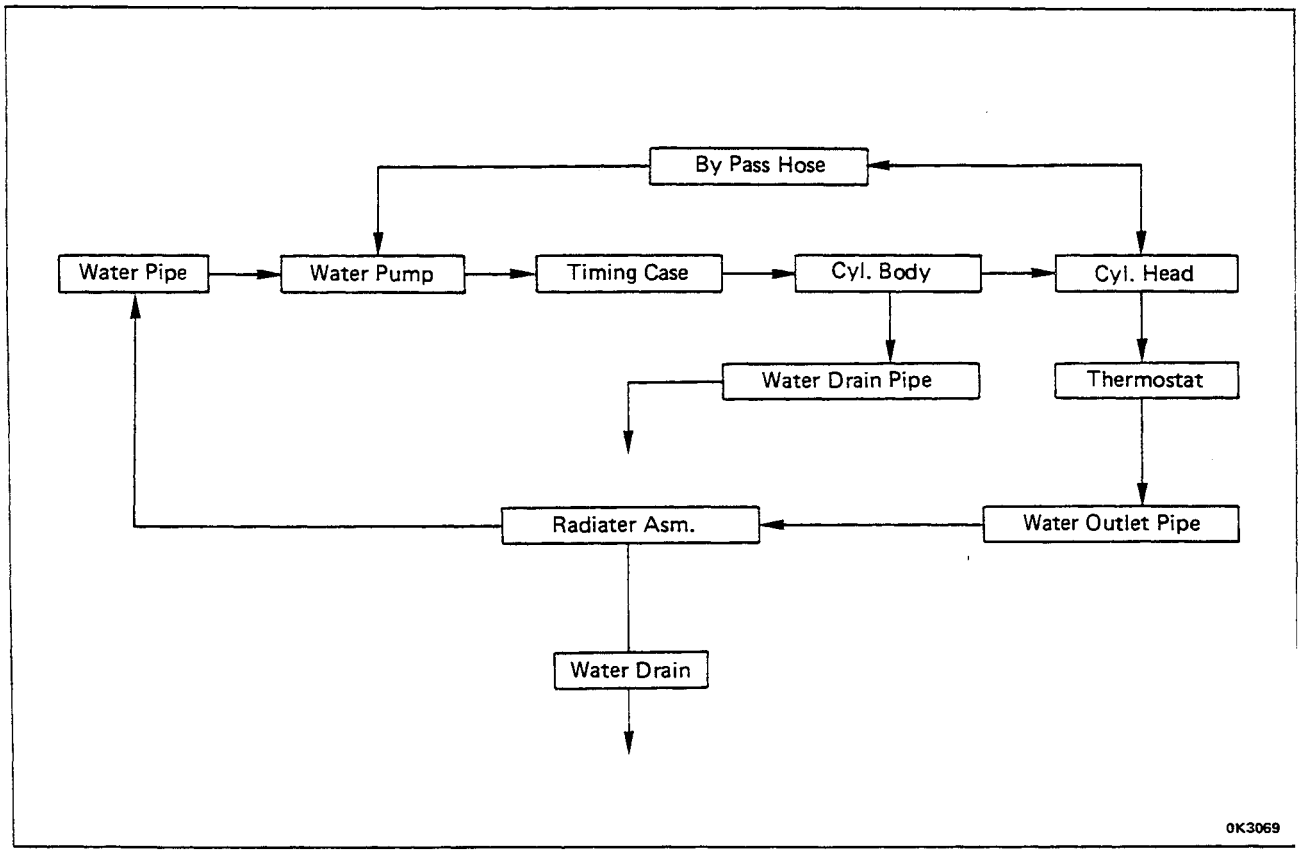
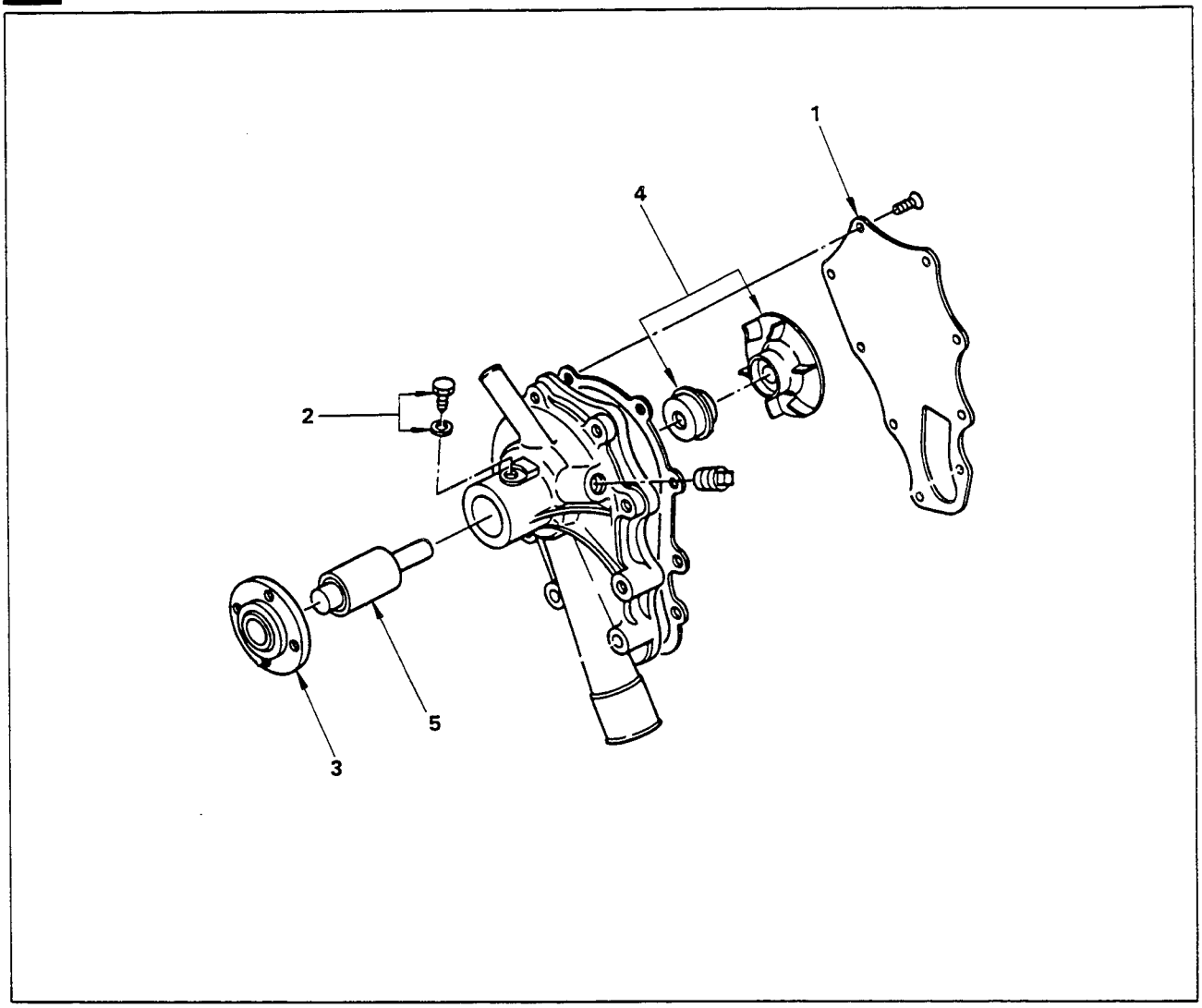
GENERAL DESCRIPTION



WATER PUMP

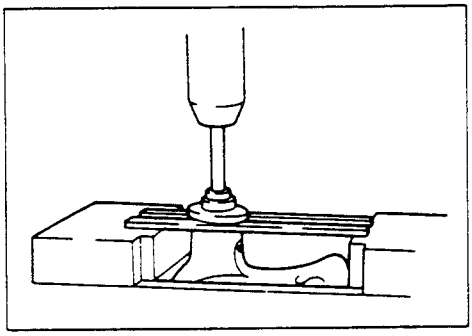
DISASSEBMLY



Disassembly steps

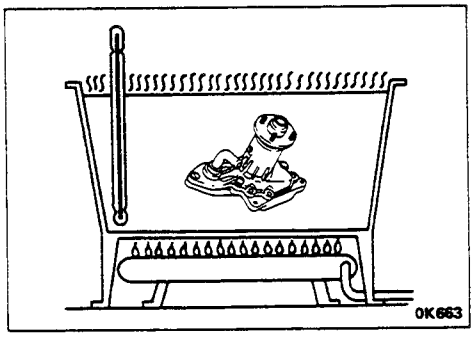
1. Cover
2. Set screw
▲ 3. Fan center
▲ 4. Impeller and seal unit
5. Bearing unit

Important operations



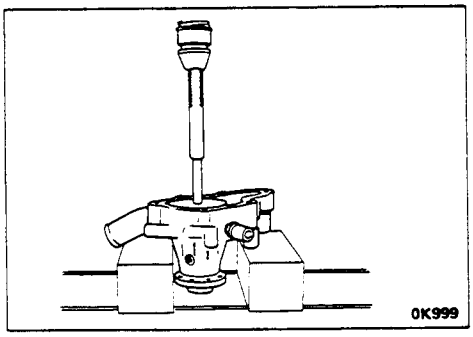
3. Fan center

Remove the fan center.



4. Impeller and seal unit

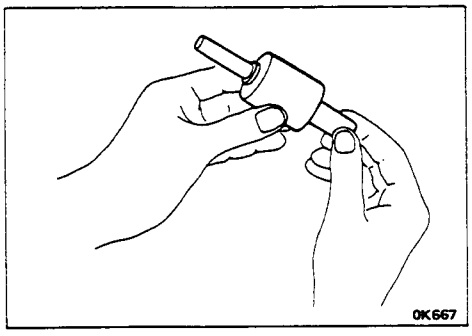
For aluminum body only.
Heat the pump body in hot water (80° ~ 90°C).



Remove impeller using a bench press and a suitable bar.

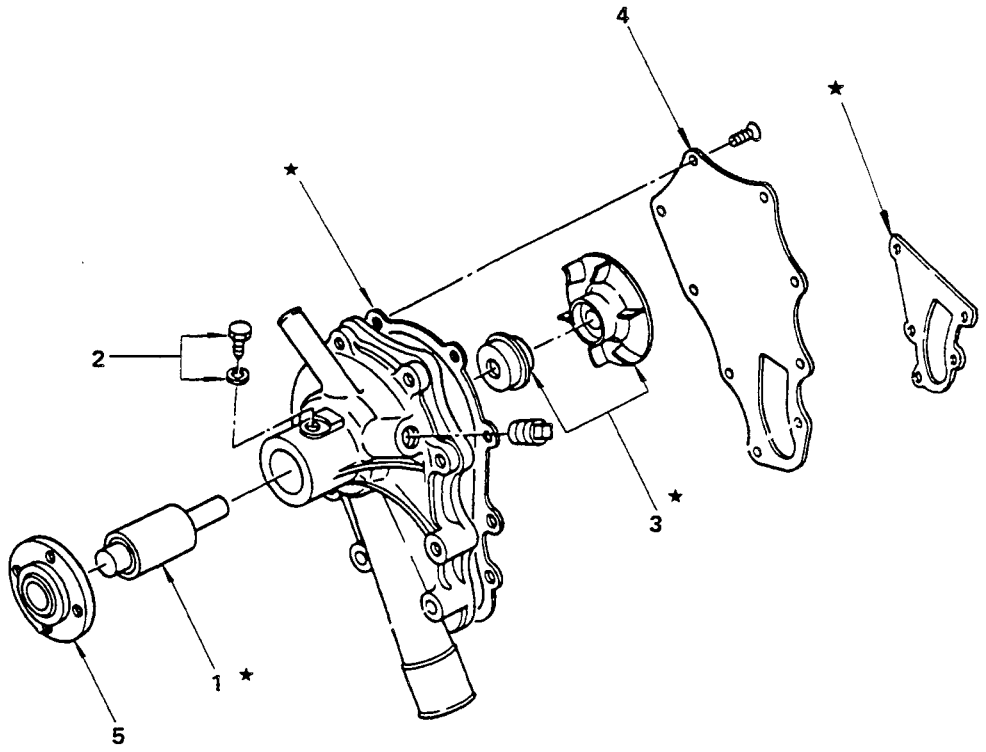
INSPECTION AND REPAIR

Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found through inspection.



Check the bearing for abnormal noise, binding and other abnormal conditons.

REASSEMBLY

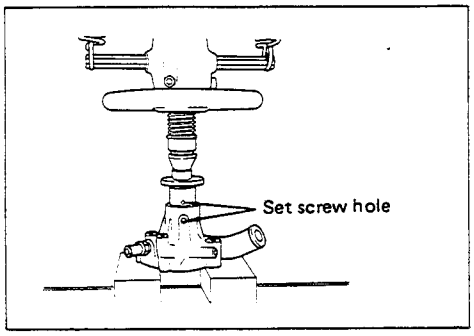


★ Repair kit

Reassembly steps

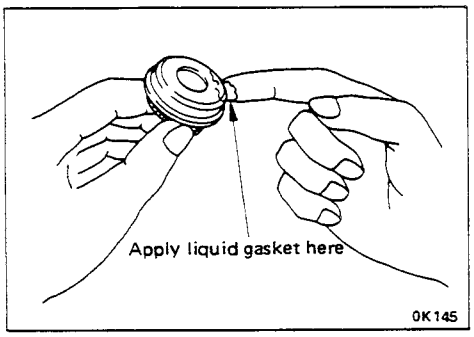
▲ 1. Bearing unit
2. Set screw
▲ 3. Impeller and seal unit
4. Cover
▲ 5. Fan center

Important operation



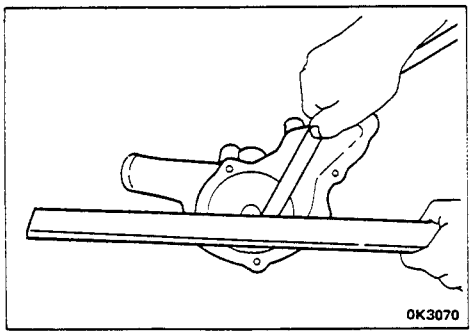
1. Bearing unit

Press the bearing unit into place by aligning set screw hole in bearing with that in the pump body, then secure the bearing unit in position with the screws.



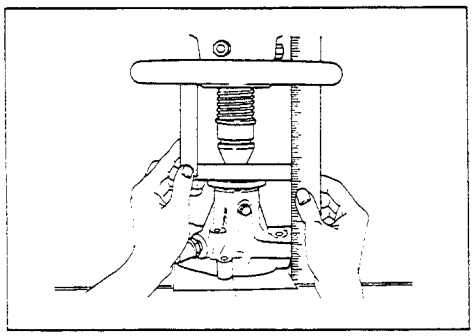
3. Impeller and seal unit

Apply a thin coat of liquid gasket; BELCO BOND No. 4 to the outer periphery of seal unit before installing the seal unit.



Install the impeller in position using bench press, so that the rear face of the impeller is indented from the face of the pump body.

Depth	(mm)	0.4 — 0.6



5. Fan center

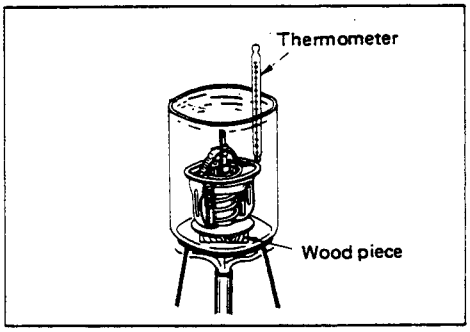
Distance between fan fitting face and rear face of the rear cover.

Distance	(mm)	91.7 — 92.3

THERMOSTAT

INSPECTION AND REPAIR

Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found through inspection.



Valve opening temperature	(°C)	75 — 78

SECTION 5

FUEL SYSTEM

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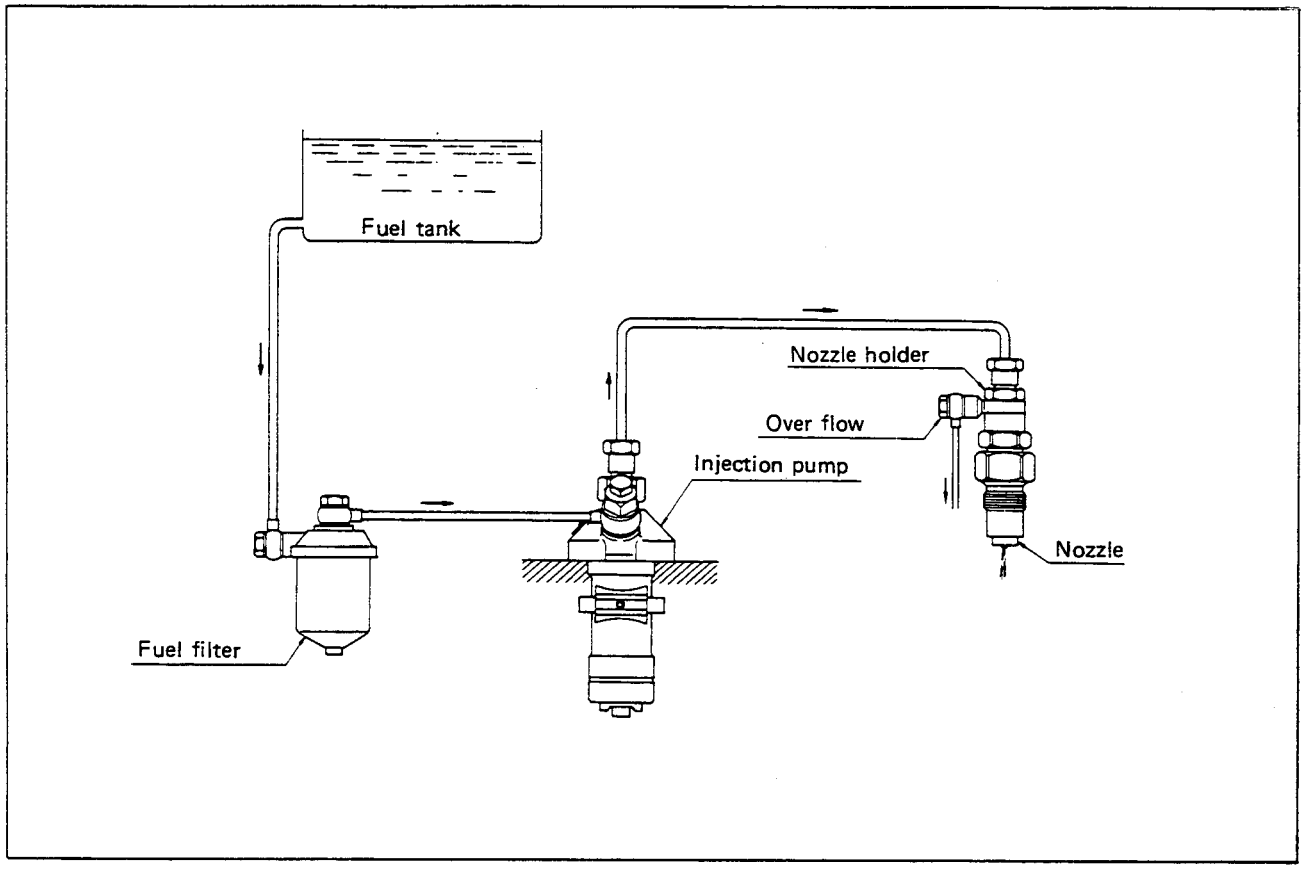
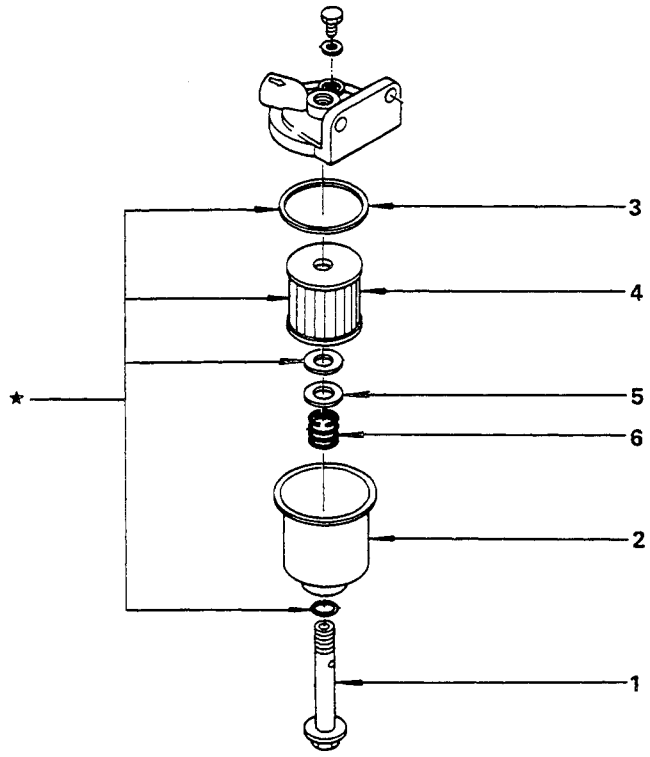
GENERAL DESCRIPTION



FUEL FILTER
(Center bolt type)

DISASSEMBLY



★ Element kit

Disassembly steps

1. Center bolt
2. Fuel filter cover
3. Body cover packing
4. Fuel filter element
5. Spring seat
6. Spring

INSPECTION AND REPAIR

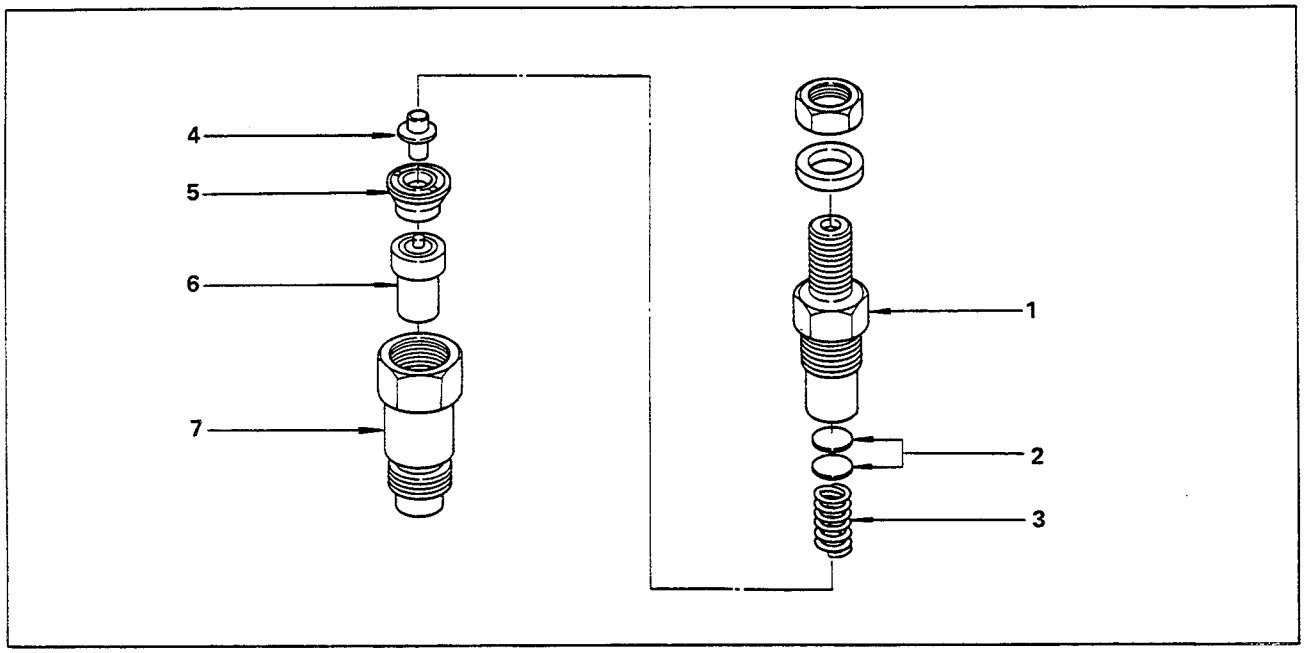
Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found through inspection.

REASSEMBLY

To reassemble, follow the disassembly procedure in reverse order.

INJECTION NOZZLE

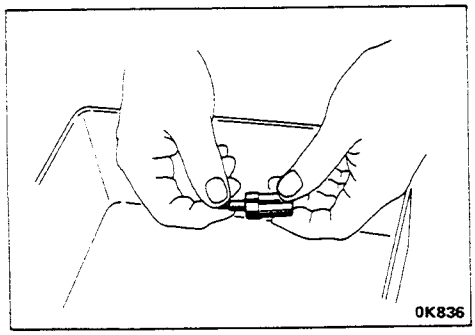
DISASSEMBLY



Disassembly steps

1. Body
2. Adjusting shim
3. Spring
4. Spring seat
5. Spacer
▲ 6. Nozzle
7. Retaining nut

Important operation



6. Nozzle

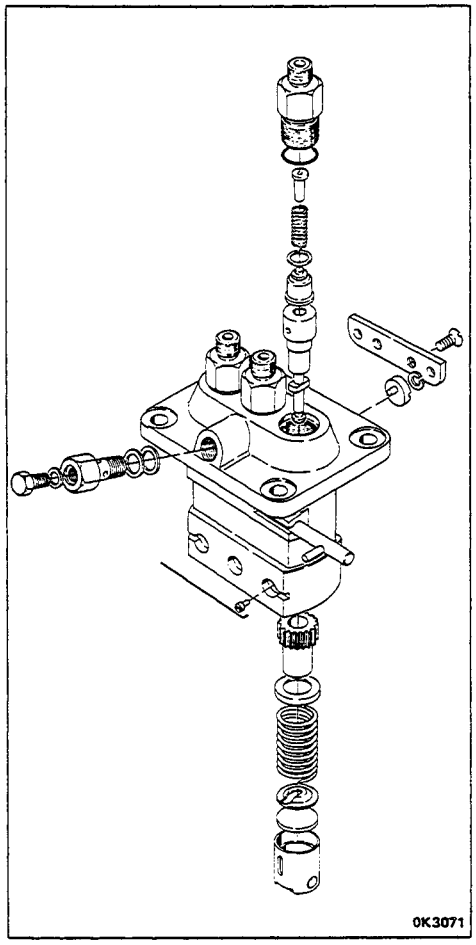
After removal of nozzle assembly from the nozzle body, keep them separate to maintain proper needle valve to body combinations.

REASSEMBLY

To reassemble, follow the disassembly procedure in reverse order.
Refer to section 1 "General information" on page 1 — 16 for injection of spraying condition and injection starting pressure adjustment.

PFR-KD INJECTION PUMP

The K-Series engine uses a Diesel Kiki PFR injection pump. The PFR pump does not include a camshaft or governor, these are parts of the engine.



INJECTION PUMP BOSCH NUMBER

NP—P F R 3 KD 55 /2 NP

- NP: Manufactured by Diesel Kiki
- P: Injection pump
- F: The camshaft is not included in the injection pump
- R: The tappet is included in the injection pump
- 3: Number of cylinder
- KD: Size
- 55: Plunger dia. x 10
- /2: lead (/1: Left lead plunger, /2: Right lead plunger)
- NP: Diesel Kiki design No.

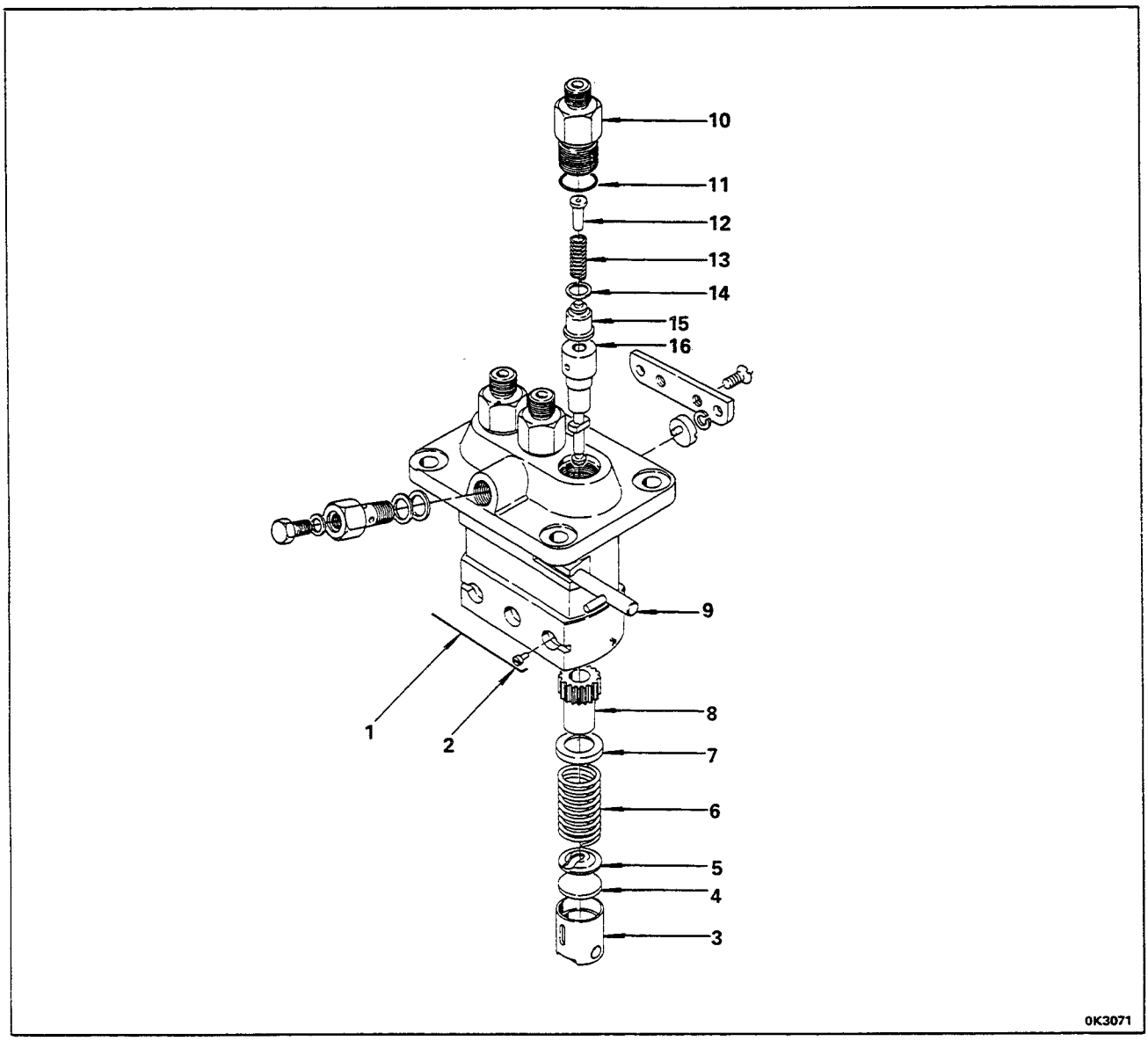
INJECTION PUMP CODE NUMBER

10429 4 — 3 05 2

- 10429: Type of pump
- 4: Type of plunger
- 3: Number of cylinder
- 05: Design No.
- 2: Suffix number

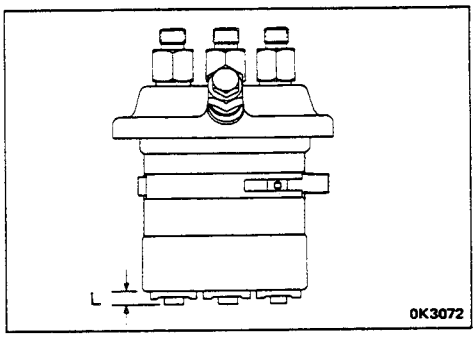
DISASSEMBLY

This illustration is based on the 3KC1 model.



Disassembly steps

- ▲ 1. Wire
- ▲ 2. Tappet guide pin
- ▲ 3. Tappet
- ▲ 4. Tappet plate
- ▲ 5. Spring seat (Lower)
- ▲ 6. Plunger spring
- ▲ 7. Spring seat (Upper)
- ▲ 8. Control sleeve
- ▲ 9. Control rack
- 10. Delivery valve holder
- 11. O-ring
- 12. Stopper
- 13. Delivery spring
- 14. Gasket
- ▲ 15. Delivery valve assembly
- ▲ 16. Plunger assembly



Important operations

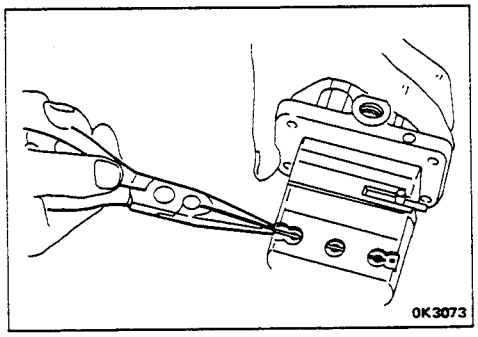
CHECKS BEFORE DISASSEMBLY:

1. Check the distance from the tappet roller to the pump body (Dimension L). This dimension should be 6.5mm or more.
2. Push the tappet roller with the thumb to check if the roller moves to the bottom of the pump housing.
3. Check to determine if control rack moves smoothly. Hold pump with the control rack vertical. The weight of the rack should cause it to move smoothly. Try 5 or 6 times to insure condition.
4. Delivery holder torque. Check before disassembly.

Torque (kg-m)	4 — 4.5

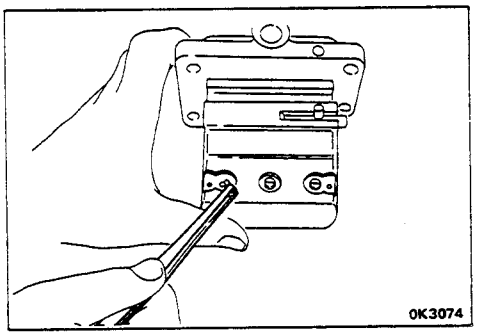
If all of these checks are favorable, there is no need to disassemble the pump.

Caution: The plunger, barrel and delivery valve seat are a set. Do NOT intermix parts between sets.



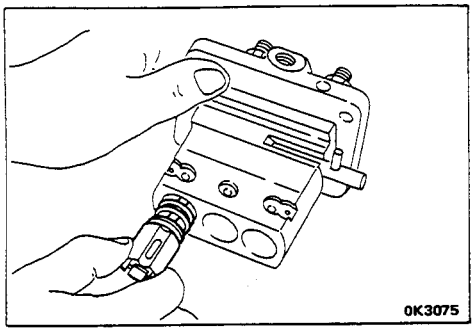
1. Wire

Remove wire which is holding tappet guide pins in place.



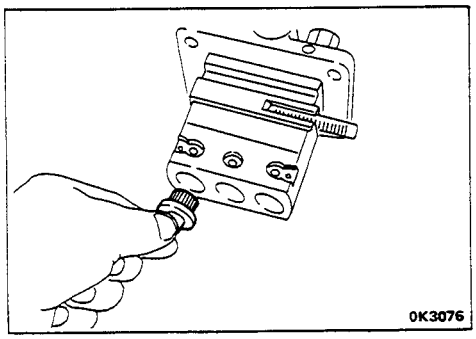
2. Tappet guide pin

While pushing tappet with thumb, remove tappet guide pin with tweezers.



3. Tappet

Remove tappet assembly.



4. Tappet plate

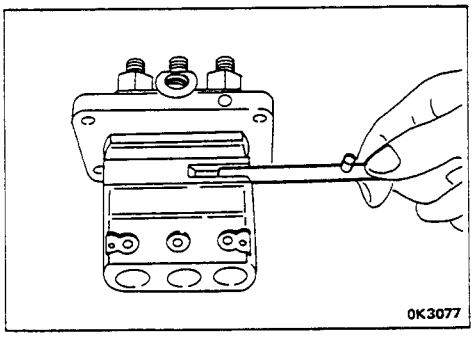
5. Spring seat (lower)

6. Plunger spring

7. Spring seat (upper)

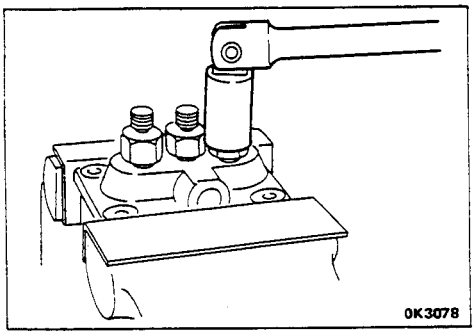
8. Control sleeve

Tappet plate, plunger, lower spring seat and plunger spring are removed together.



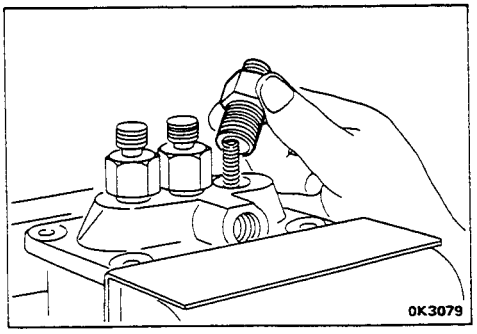
9. Control rack

Remove control rack.



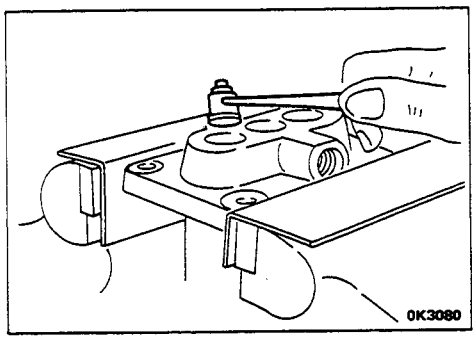
10. Delivery valve holder

Using copper jaws, clamp injector pump body flange in vise. Loosen delivery valve holders.



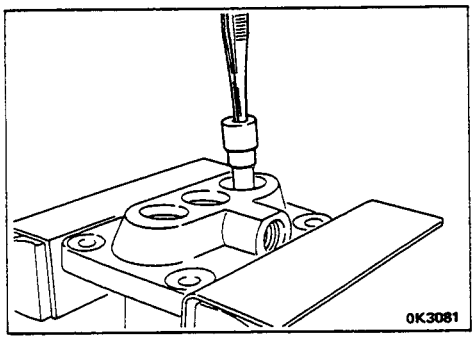
Remove delivery valve holders and springs.

Caution: do not drop springs.



15. Delivery valve assembly

Remove delivery valves using tweezers.



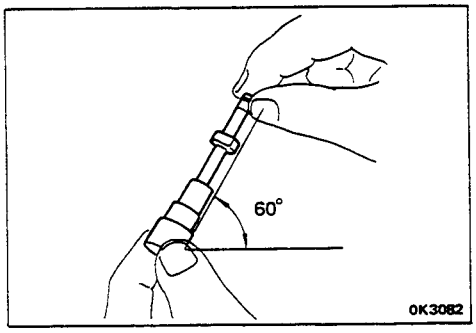
16. Plunger assembly

Remove plunger barrels.

Caution: When removing plunger barrel do not turn eccentric pin. If turned, injection flow will be affected upon reassembly.

INSPECTION AND REPAIR

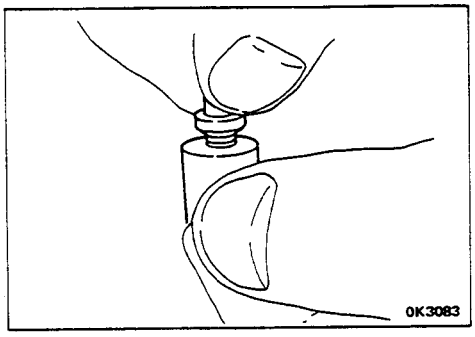
Make necessary correction or parts replacement of wear, damage or any other abnormal conditions are found through inspection.



CHECKING PARTS:

Plunger Assembly. Wash each plunger, barrel and related parts in clean fuel as a set.

After cleaning, check to insure that the plunger moves smoothly in its barrel. To check, incline assembly 60° and plunger should move smoothly by the action of gravity. If plunger does not move smoothly, replace plunger and barrel as a set.



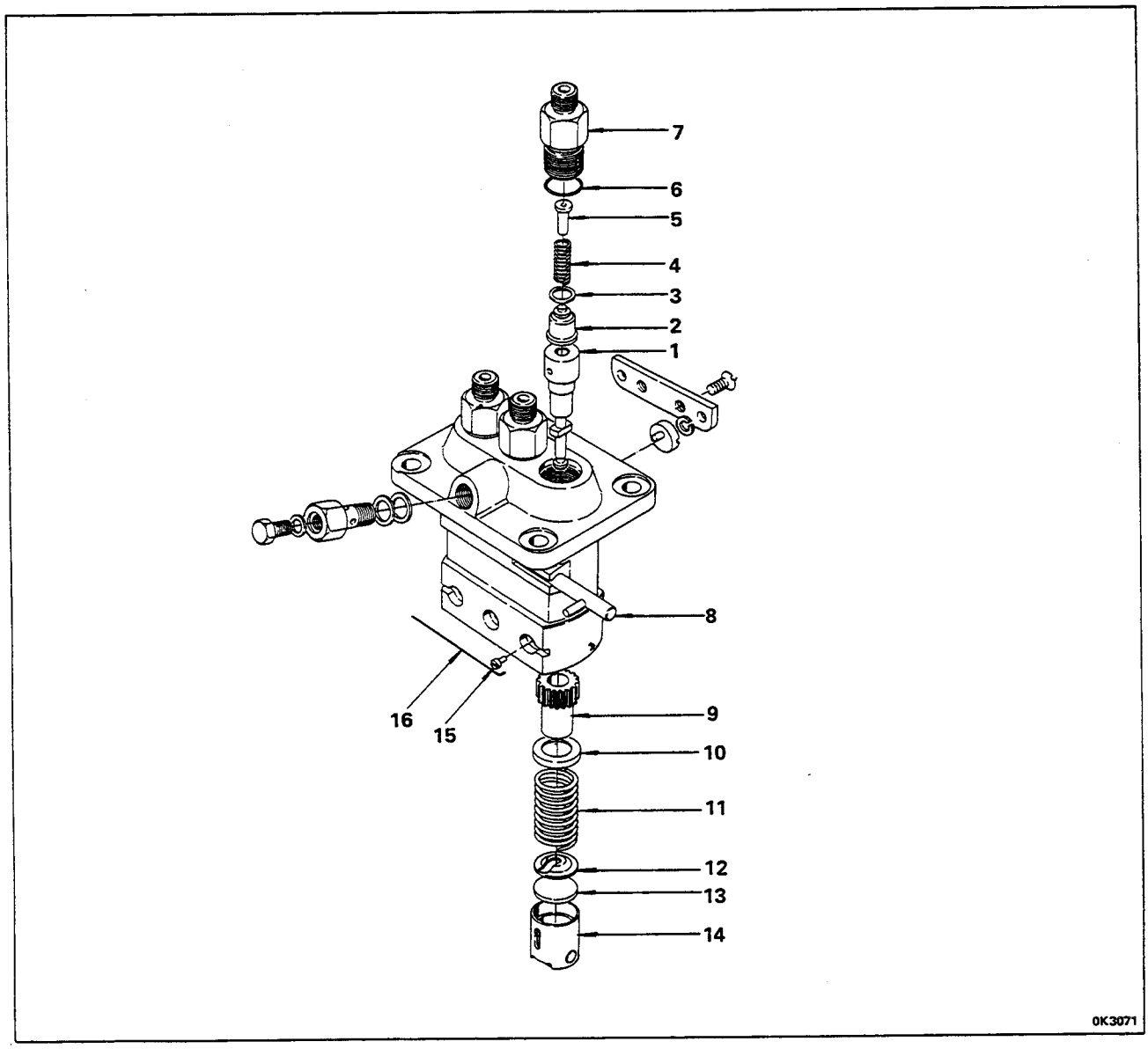
Delivery Valve Assembly. Using finger tip, close hole in delivery valve seat. Pull on delivery valve. If vacuum exists, valve is good. If no vacuum, replace delivery valve.

Tappet Roller. Replace if worn or showing signs of distress. Measure diameter to determine if it is at least 14.8mm. If not, replace.

Other Parts. If any crank, damage, or abnormal wear is found, replace the part.

REASSEMBLY

This illustration is based on the 3KC1 model.

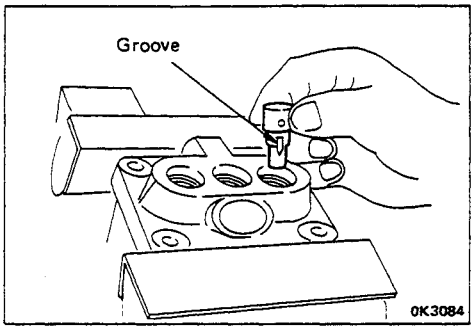


Reassembly steps

- ▲ 1. Plunger assembly
- 2. Delivery valve assembly
- 3. Gasket
- 4. Delivery spring
- 5. Stopper
- 6. O-ring
- ▲ 7. Delivery valve holder
- 8. Control rack
- ▲ 9. Control sleeve
- 10. Spring seat (Upper)
- 11. Plunger spring
- 12. Spring seat (Lower)
- 13. Tappet plate
- 14. Tappet
- 15. Tappet guide pin
- 16. Wire

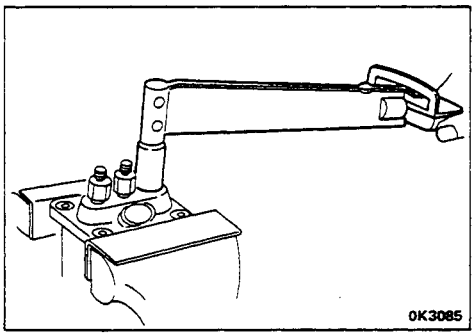
Reassembly is in the reverse order of disassembly.

Caution: Parts must be reinstalled in the same cylinder as they were originally.



1. Plunger assembly

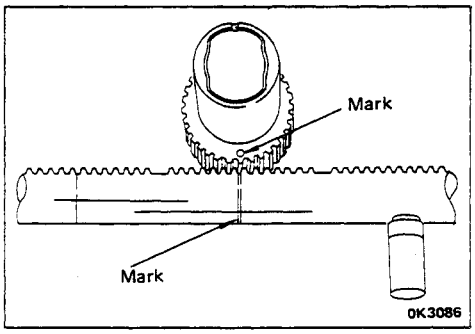
Insert plunger and barrel into pump body. Groove in barrel must be a aligned with eccentric pin in pump body.



7. Delivery valve holder

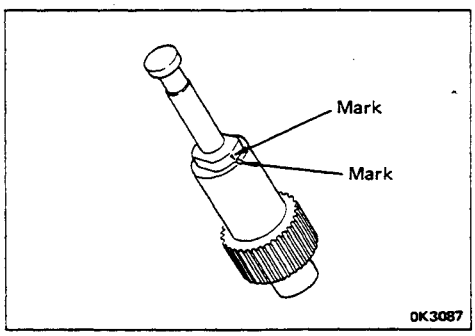
Use new O-ring and delivery valve gasket. Tighten delivery valve holder to specified torque.

Torque	(kg-m)	4.5



9. Control sleeve

The mark on the control sleeve must be aligned with the mark on the control rack.



Plunger and Barrel. Align marks on plunger and barrel as shown.

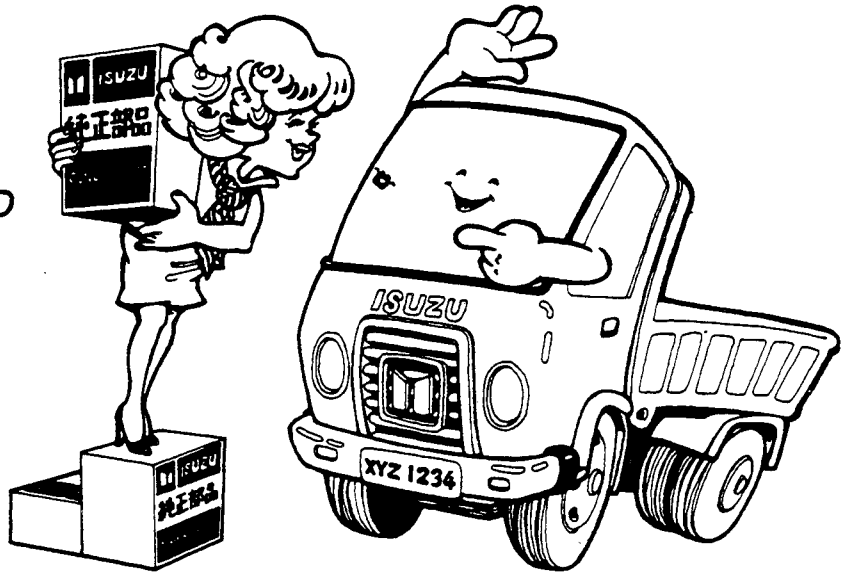
CHECKING AFTER REASSEMBLY:

1. Check control rack for smooth operation.
2. Push tappet roller with thumb to insure that roller tappet travels to bottom of pump housing.
3. Check dimension "L" which must be at least 6.5mm. (Refer to "CHECKS BEFOR DISASSEMBLY")

If any of the checks does not meet requirements, disassemble pump and repeat.

MEMO

PARTES DE CALIDAD
EN LAS CUALES
PUEDE CONFIAR



SECTION 6

ELECTRICALS

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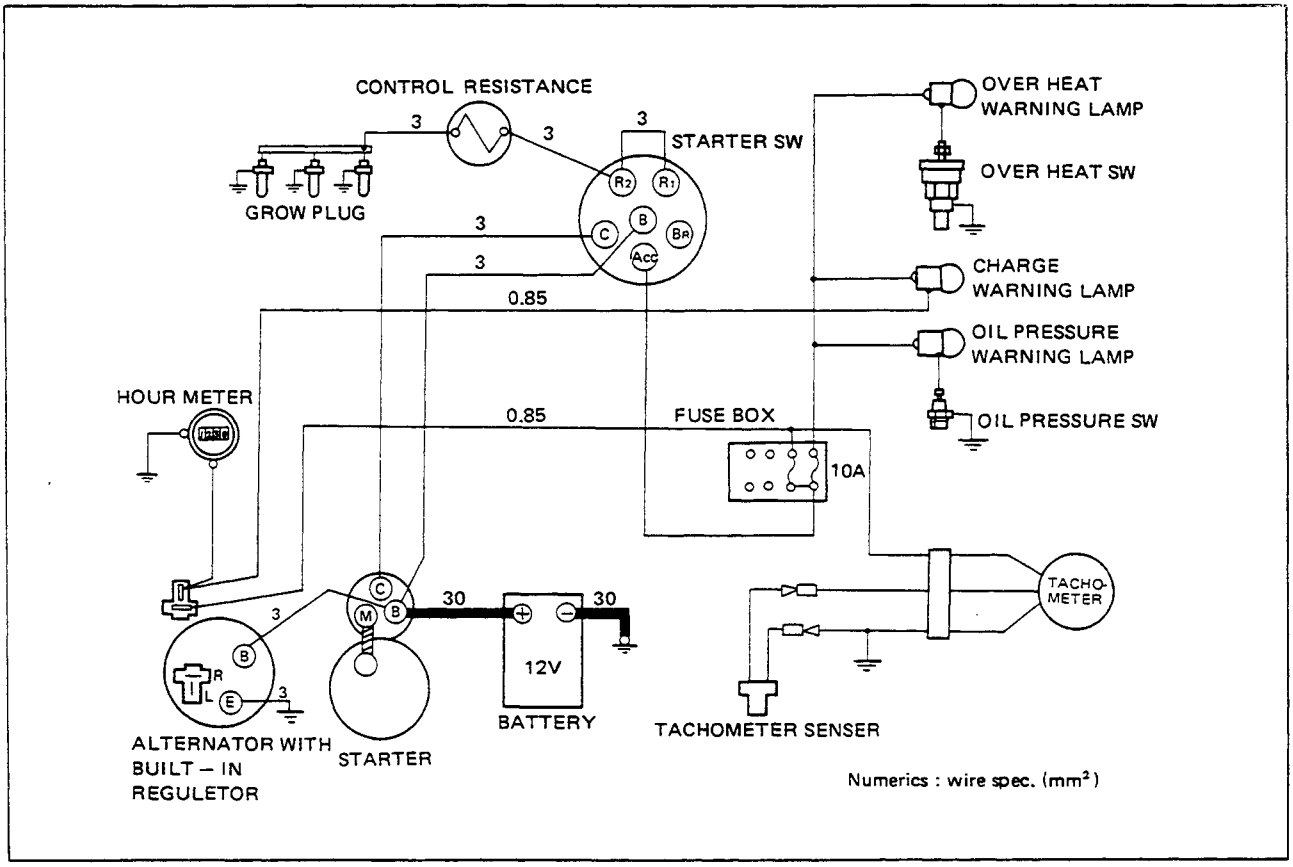
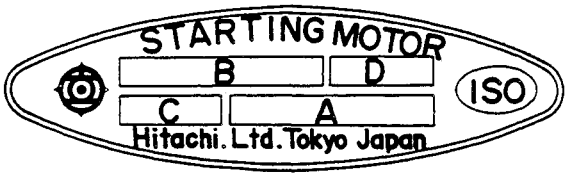
GENERAL DESCRIPTION



STARTER MOTOR

IDENTIFICATION OF UNIT OR EQUIPMENT

Hitachi starter motors are identified with a name plate attached to the yoke as illustrated in figure.



A: Isuzu part number
B: Manufacturer's code number
C: Rated output
D: Manufacturer's production mark

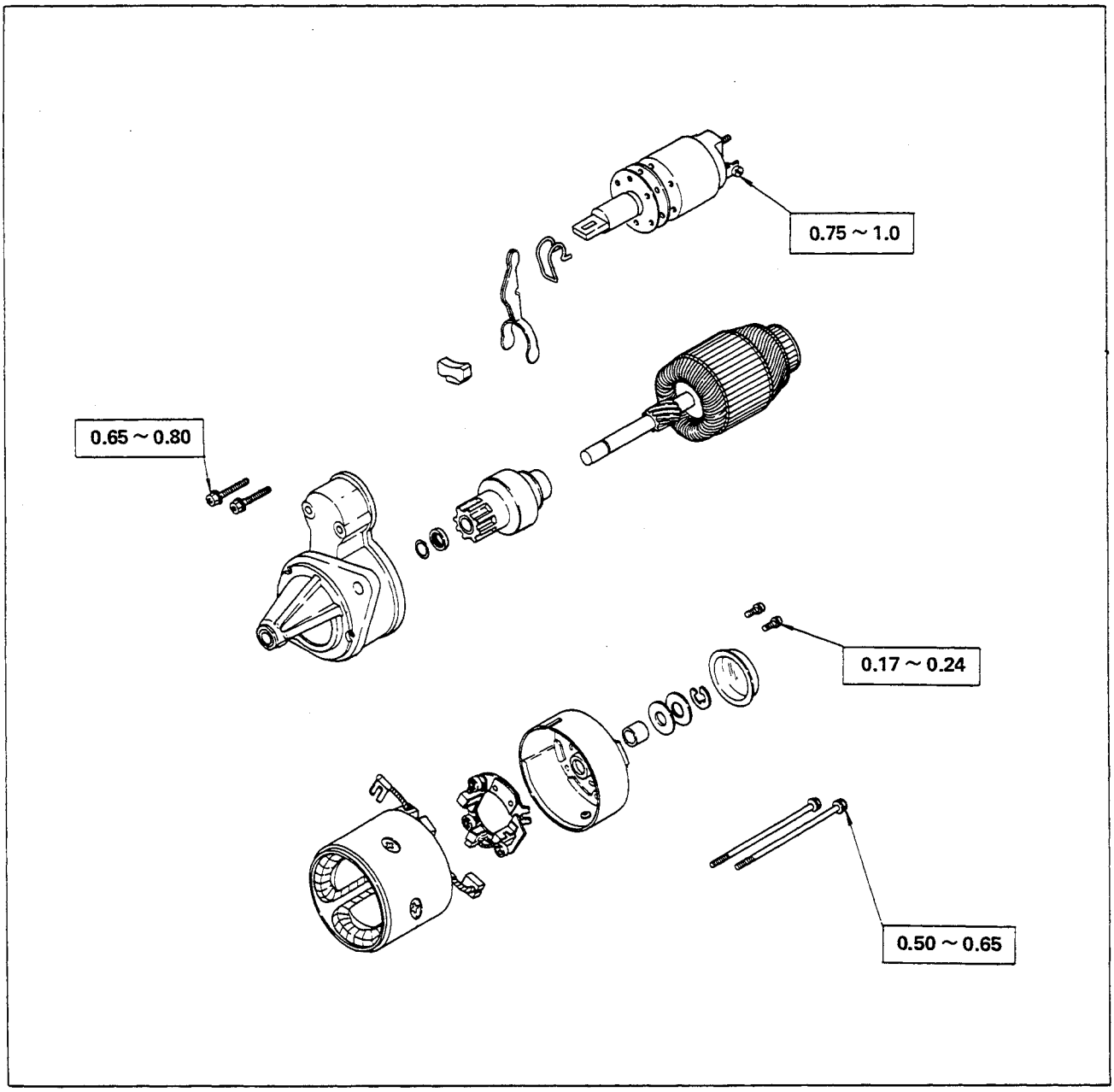
Isuzu part no.	Manufacturer's code no.
5-81100-192-0	S114-385
5-81100-215-0	S114-387

MAIN DATA AND SPECIFICATIONS

Isuzu part no.		5-81100-192-0	5-81100-215-0
Manufacturer's code No.		S114-385	S114-387
Rated voltage	(V)	12	12
Rated output	(KW)	1.2	0.8
Rating	(Sec.)	30	30
Direction of rotation : As viewed from pinion side		Clockwise	Clockwise
Type of clutch		Roller	Roller
Terminal voltage : (No load)	(V)	11.5	11.5
No-load current: Max.	(A)	60	60
Number of revolutions : Min. : (No load)	(rpm)	6000	7000
Pinion gear			
Module		–	–
Diametral pitch		10/12	10/12
Pressure angle	(°)	20	20
Number of teeth		9	9
Outside diameter	(mm)	29.6	29.6
Distance of travel	(mm)	1.27	1.27
Yoke			
Outside diameter	(mm)	100	90
Armature			
Outside diameter	(mm)	60	60
Number of poles		4	4
Magnetic switch: At 20°C			
Series coil resistance	(Ω)	0.32	0.32
Shunt coil resistance	(Ω)	0.69	0.69
Brush length			
Standard	(mm)	16	16
Limit	(mm)	12	12
Brush springs			
Standard fitting load	(kg)	1.6	1.6
Commutator: Outside diameter			
Standard	(mm)	33	33
Limit	(mm)	32	32
Commutator: Depth of undercut mica			
Standard	(mm)	0.5 — 0.8	0.5 — 0.8
Limit	(mm)	0.2	0.2
Shaft run-out			
Standard	(mm)	0.05	0.05
Limit	(mm)	0.1	0.1
Pinion gap	(mm)	0.3 — 2.5	0.3 — 2.5

TORQUE SPECIFICATIONS

Manufacturer's code No. S114-385/387 **(kg-m)**

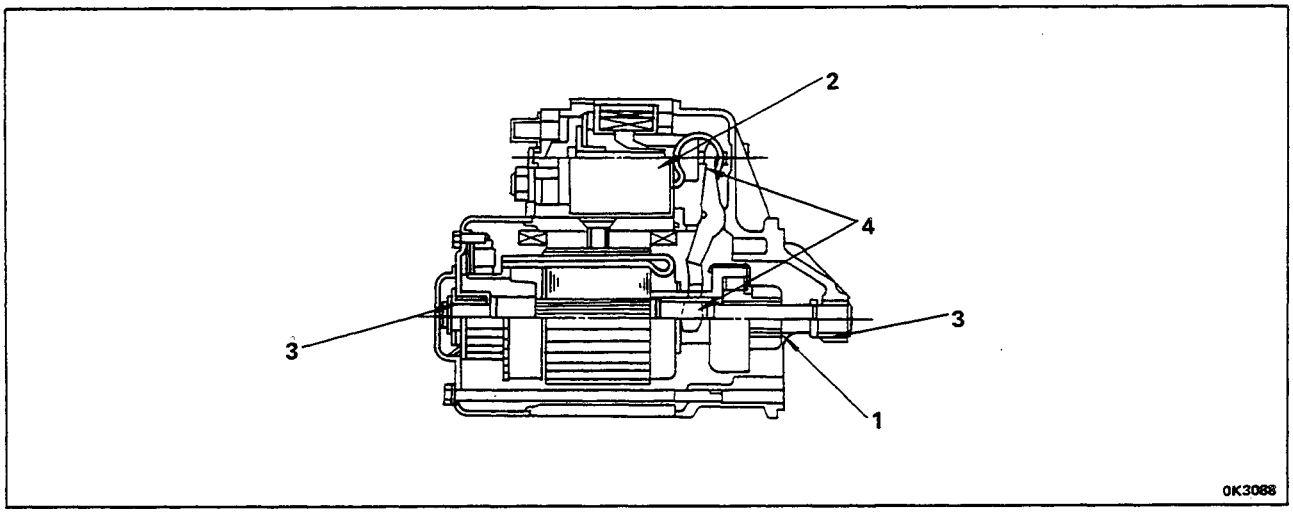


RECOMMENDED LUBRICANTS

Grease of different types should never be blended, or characteristics will be deteriorated.

Apply a thin coat of grease where amount of lubricant is not specified.

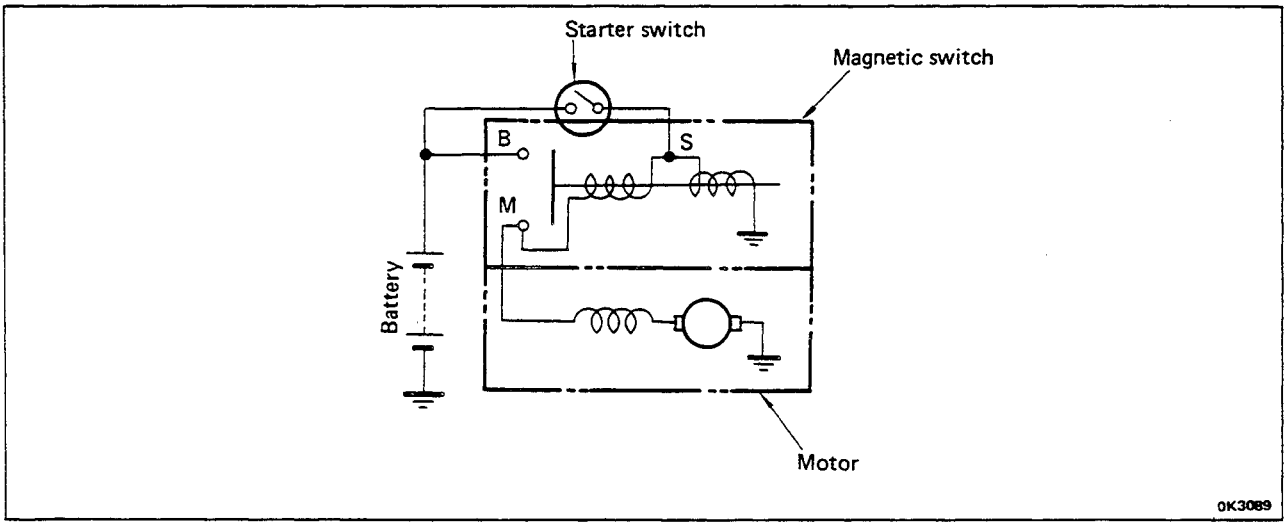
Manufacturer's code No. S114-385/-387



No.	Lubricating points	Amount of grease	Recommended lubricants
1	Pinion sliding face	0.1 (g)	AEROSHELL NO. 7 (SHELL) MALTEMP SRL (KYODO)
2	Magnetic switch plunger sliding face	0.3	
3	Armature bearing		
4	Shift lever working points		MALTEMP SRL (KYODO)

CIRCUIT ARRANGEMENT

Manufacturer's code No. S114-385/387

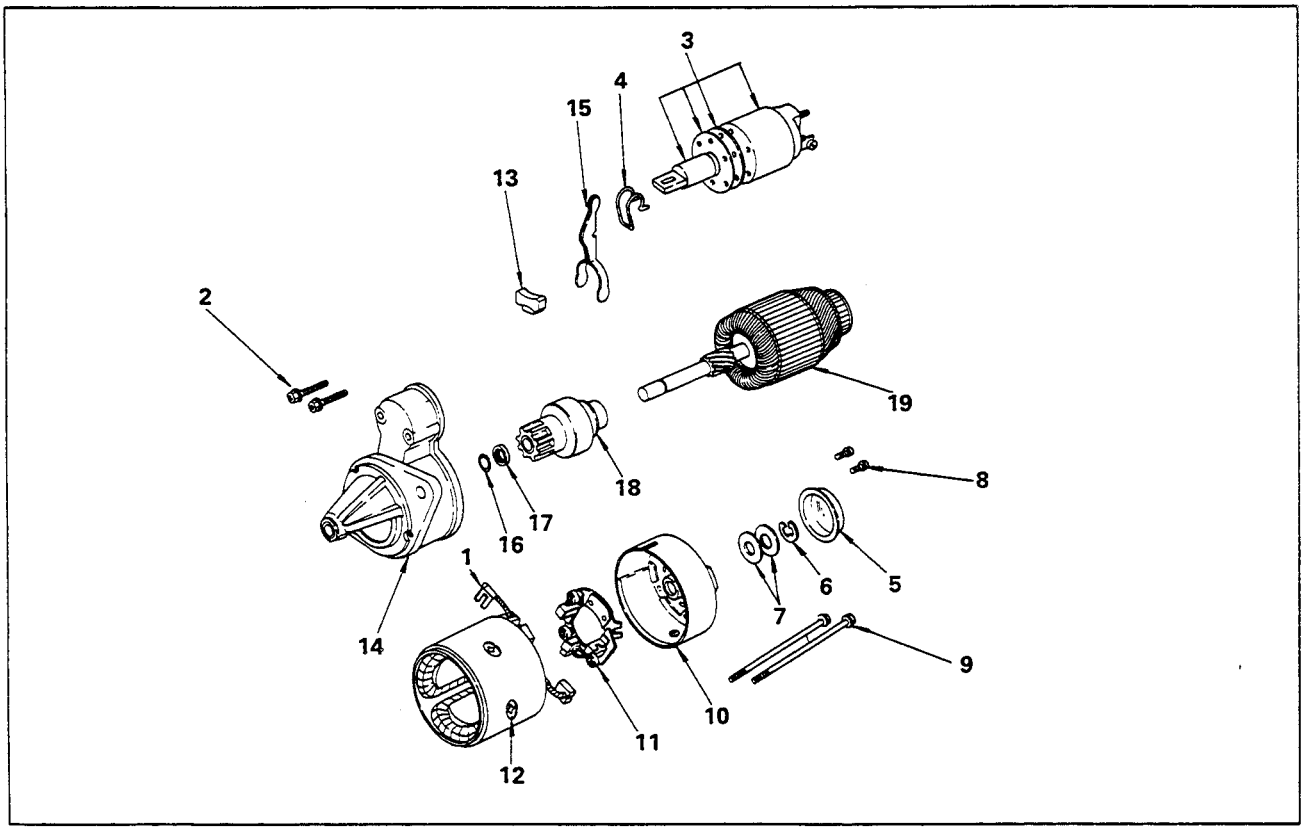


DISASSEMBLY

Note the following points when disassembling the starter motor:

1. To facilitate installation of the parts in original position, apply a setting mark across the yoke and gear case or across the yoke and housing.
2. When removing shift levers, carefully note their position of installation to avoid installing them in wrong position as various types of shift levers are in use.
3. When removing brush (+) on field coil side, raise brush spring, then remove the brush from holder.
4. Raise brush spring on brush holder side and pull the brush (—) part way off the commutator and hold it in that position by setting brush spring against the brush.
5. If the gear case, housing, bearing retainer or yoke is fitted tightly and does not come off easily, tap on the circumference of the parts lightly with a plastic hammer or soft-faced hammer.

Manufacturer's code No. S114-385/387



Disassembly steps

1. Connecting wire
2. Bolt
3. Magnetic switch
4. Torsion spring
5. Dust cover
6. "E" ring
7. Thrust washer
8. Screw
9. Through bolt
10. Rear cover
11. Brush holder
12. Yoke
13. Dust cover
14. Gear case
15. Shift lever
16. Pinion stopper clip
17. Pinion stopper
18. Pinion
19. Armature

INSPECTION AND REPAIR

Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found through inspection.

REASSEMBLY

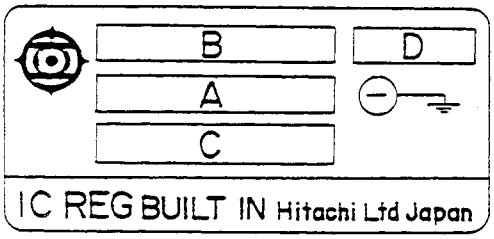
Note the following points when reassembling the starter motor.

1. When installing rotating or sliding parts, check to make sure they operate smoothly before proceeding to the following step.
2. When installing brush holder, exercise care so as not to cause damage to the brush.
3. Note the direction of installation when installing shift levers.
4. On model with torsion spring, check to make certain torsion spring is fitted into cutaway portion of the shift lever properly.
5. Properly align the setting marks applied to the yoke and gear case (or housing) at disassembly before tightening.
6. Tighten fixing bolts, screws and nuts to the specified torques.

GENERATOR

IDENTIFICATION OF UNIT OR EQUIPMENT

Hitachi generators are identified with the mark attached to the rear cover as illustrated in figure.



5-81200-358-0	LR120-23

A: Isuzu parts number
B: Manufacturer's code number
C: Rated output
D: Manufacturer's production mark

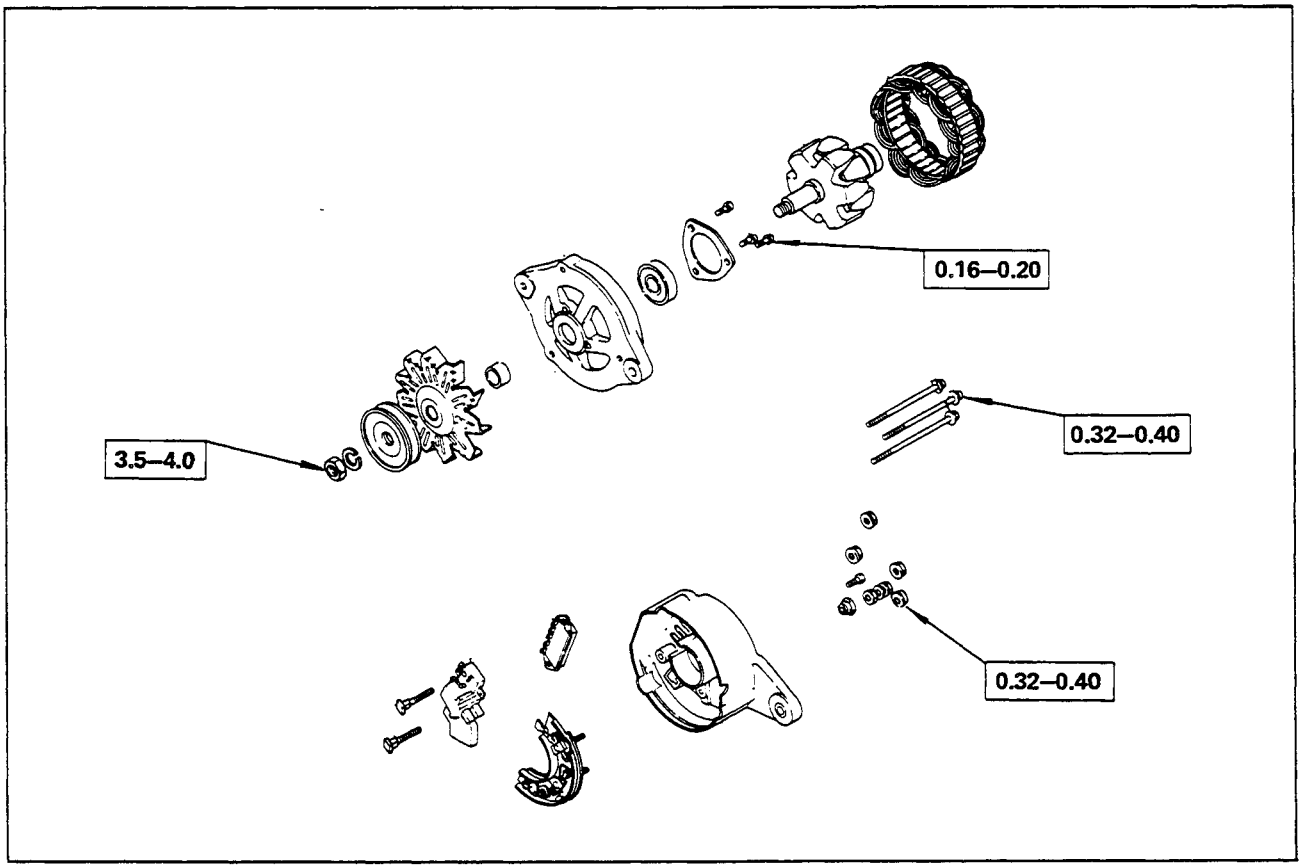
MAIN DATA AND SPECIFICATIONS

GENERATOR

Isuzu part no.		5-81200-358-0
Manufacturer's code no.		LR120-23
Rated voltage	(V)	12
Rated output	(A)	20
Operating speed	(rpm)	1000 — 13500
Rated speed	(rpm)	5000
Direction of rotation as viewed from pulley side		Clockwise
Polarity grounded		Negative
Pulley diameter	(mm)	74
Coil resistance at 20°C		
Rotor coil	(Ω)	5.2
Stator coil	(Ω)	0.21
Brush length		
Standard	(mm)	16
Limit	(mm)	9
Brush springs		
Standard fitting load	(g)	255 — 345
Slip diameter		
Standard	(mm)	31.6
Limit	(mm)	30.6
Shaft diameter		
Front	(mm)	15
Rear	(mm)	12

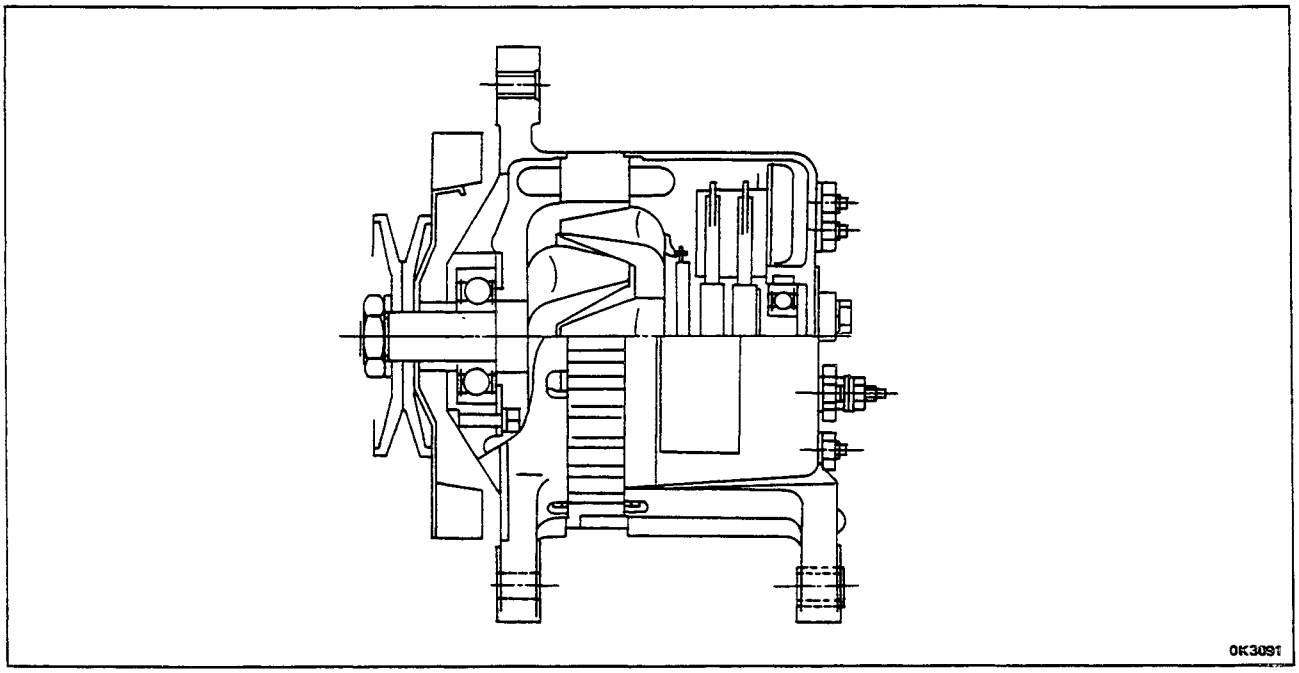
TORQUE SPECIFICATION

Manufacturer's code No. LR120-23 **(kg-m)**



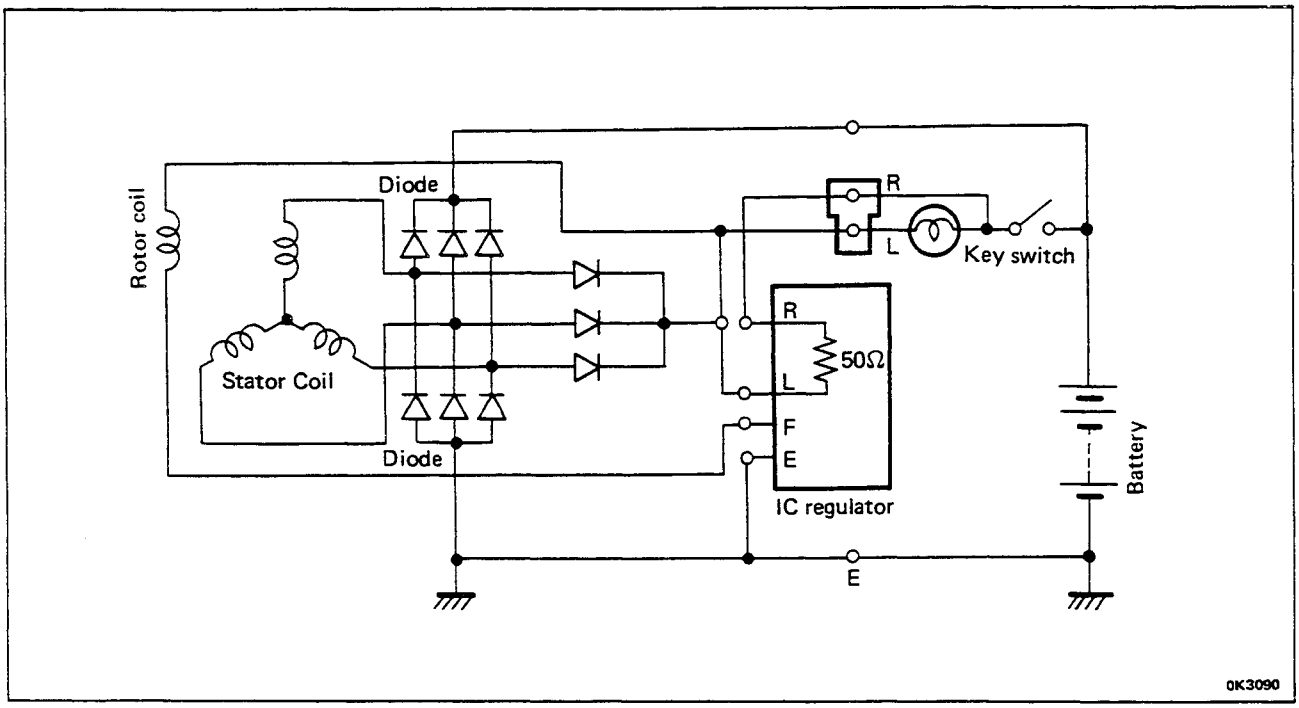
SECTIONAL VIEW

Manufacturer's code No. LR120-23



CIRCUIT ARRANGEMENT

Manufacturer's code No. LR120-23

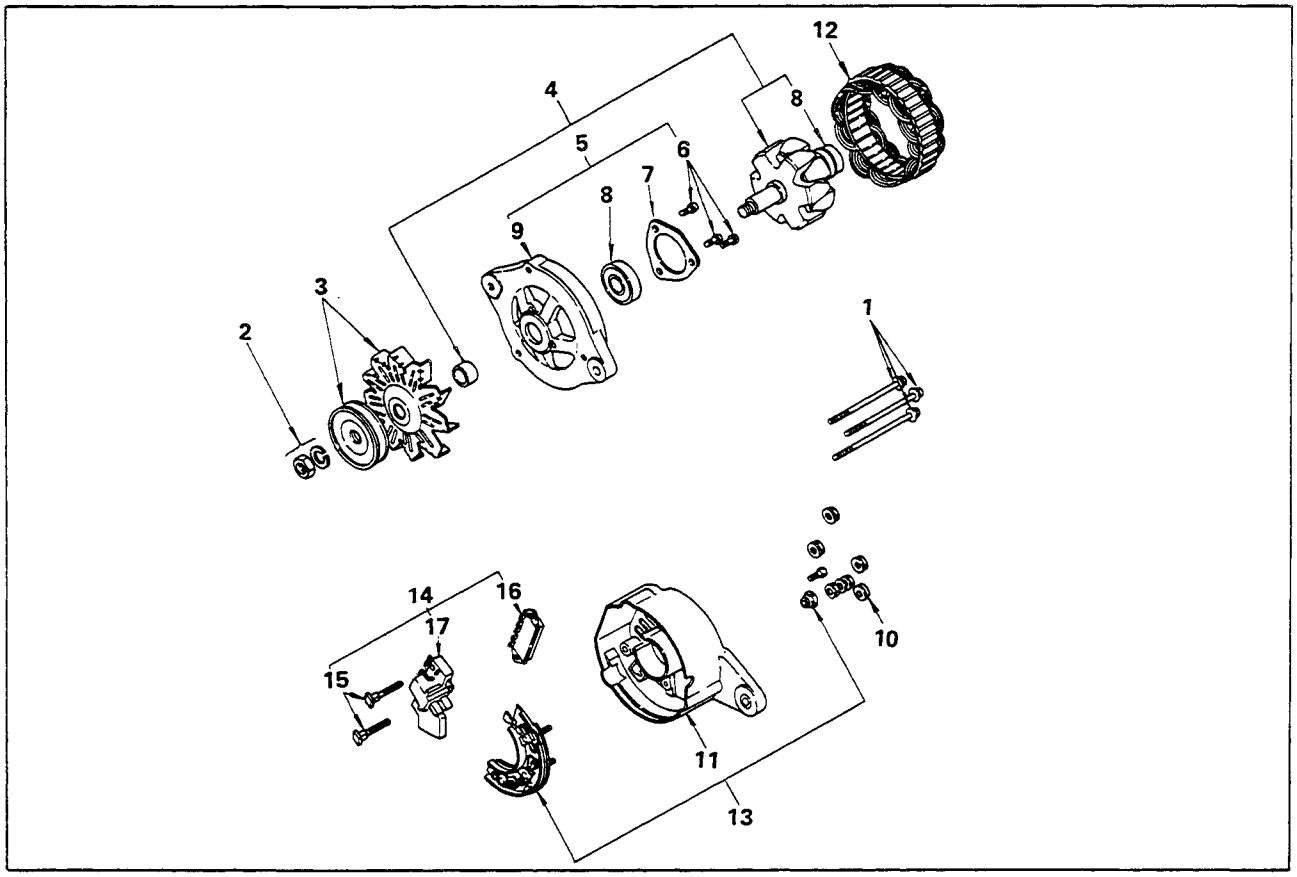


DISASSEMBLY

Note the following points when disassembly the generator:

1. To facilitate installation of the parts in original position, apply a setting mark across the front cover and rear cover.
2. When through bolts are installed, separate the stator with the rotor installed in the front cover. When separating stator, exercise care so as not to allow stator to come off the rear cover.
3. Clamp the rotor in a vise when removing pulley nut. Use a soft-jawed vise to prevent damaging rotor assembly.
4. Keep insulation washers neatly in sequence of removal to avoid installing them in wrong position.
5. When disconnecting stator coil leads from diodes using a soldering iron, melt solder quickly and use long-nose pliers or equivalent to allow for heat dissipation.
6. Vacuum pump can be disassembled into individual parts when fixing bolts are removed. Remove the parts carefully so as not to damage vanes, etc.

Manufacturer's code No. LR120-23



Disassembly steps

1. Bolt
2. Nut ; pulley
3. Pulley
4. Rotor asm
5. Cover asm ; front
6. Screw M4
7. Bearing retainer
8. Bearing ; ball
9. Front ; cover
10. Nut
11. Cover ; rear
12. Stator asm
13. Diode asm
14. Brush regulator asm
15. Bolt
16. IC regulator asm
17. Brush asm

INSPECTION AND REPAIR

Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found through inspection.

REASSEMBLY

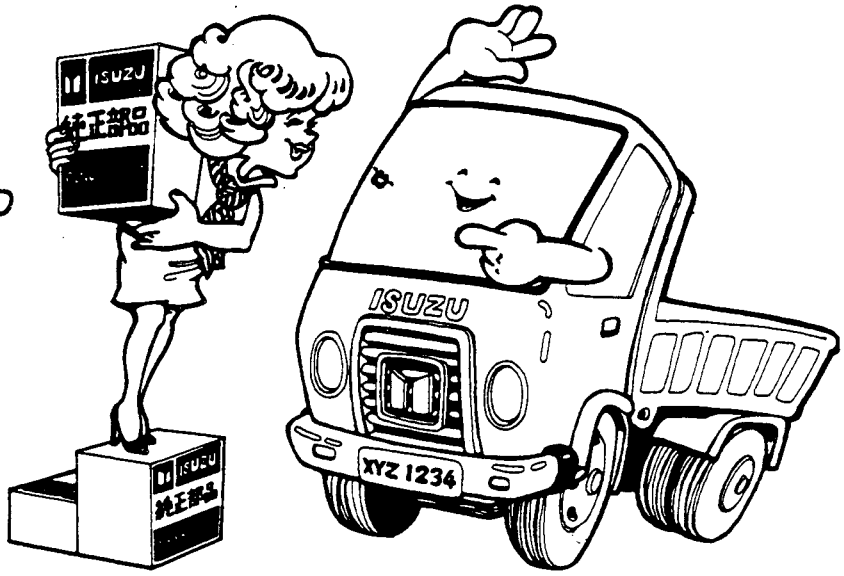
GENERATOR

Note the following points when reassembling the generator:

1. When connecting stator coil leads to diodes using a soldering iron, solder quickly and use long-nose pliers or equivalent to allow for heat dissipation.
2. When installing terminal bolts and rectifier holder fixing screws, be sure insulation washers are in place.
3. Install a guide bar through holes in rear cover and front cover for alignment of setting marks, then install through bolts.
4. Tighten fixing bolts, screws and nuts to the specified torques.
5. When installing vacuum pump, check that vane is not resting on the center plate vane guide.

MEMO

PARTES DE CALIDAD
EN LAS CUALES
PUEDE CONFIAR



SECTION 7

SPECIAL TOOL LIST

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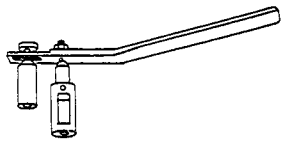
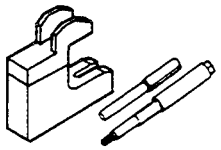
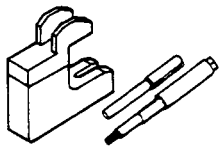
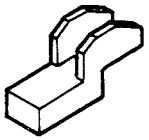
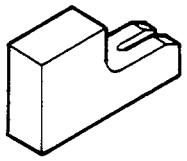
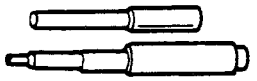
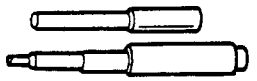
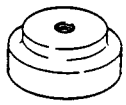
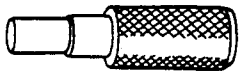
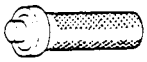
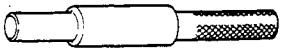
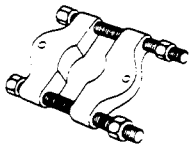
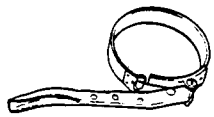
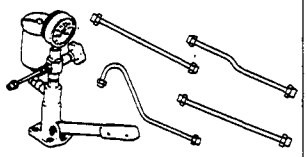
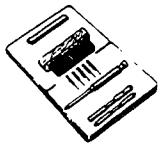
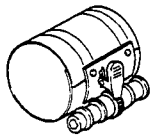
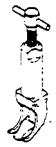
NO.	ILLUSTRATION	PARTS NO.	PARTS NAME	K.M. NO.
1.		5-8840-9001-0	Valve spring compressor	JKM-1003
2.		5-8840-9013-0	Piston pin replacer Asm. (2KA1, 2KB1, 3KA1, 3KB1)	JKM-1078
3.		5-8840-9002-0	Piston pin replacer Asm. (2KC1, 3KC1)	JKM-1004
(2) (3)		5-8840-9010-0	Head; piston pin replacer (common)	JKM-1004-1
(2) (3)		5-8840-9011-0	Body; piston pin replacer (common)	JKM-1004-2
(2)		5-8840-9014-0	Push rod and guide rod (2KA1, 2KB1, 3KA1, 3KB1)	JKM-1078-1
(3)		5-8840-9012-0	Push rod and guide rod (2KC1, 3KC1)	JKM-1004-3
4.		5-8840-9003-0	Oil seal installer; crankshaft Ft.	JKM-1005
5.		5-8840-9004-0	Oil seal installer; crankshaft Rr.	JKM-1006

K.M. NO. : Kent Moore number

NO.	ILLUSTRATION	PARTS NO.	PARTS NAME	K.M. NO.
6.		5-8840-0007-0	Drive handle	J-8092
7.		5-8840-9005-0	Bush installer; Inj. pump camshaft	JKM-1007
8.		5-8840-9006-0	Bush remover; Inj. pump camshaft	JKM-1008
9.		5-8840-9007-0	Valve guide seal installer	JKM-1009
10.		5-8840-9008-0	Gauge plate; Inj. pump (T=10.0m)	JKM-1010
11.		5-8840-9009-0	Pin installer; tension lever	JKM-1011
12.		5-8522-0024-0	Pilot bearing remover/installer	JKM-3035
13.		5-8525-3001-0	Clutch driven plate aligner	J-24547
14.		5-8840-0015-0	Bearing remover	J-22912-01
15.		5-8840-2008-0	Compression gauge set	J-29762

NO.	ILLUSTRATION	PARTS NO.	PARTS NAME	K.M. NO.
16.		5-8840-2009-0	Glow plug port adaptor; Compression gauge	J-26999-20
17.		5-8840-9015-0	Oil filter wrench	JKM-9004
18.		5-8840-9016-0	Inj. nozzle tester	J-28829
19.		5-8840-9017-0	Nozzle cleaning kit	J-28826
20.		5-8840-9018-0	Piston ring compressor	J-8037
21.		5-8840-9020-0	Valve clearance adjuster	

GENERAL INFORMATION

- Ordering procedures for special service tools:

CASE 1. When ordering special service tools from Isuzu Motors directly, please follow the same procedures used for service parts ordering. Please note that you must use Isuzu special tool numbers (PARTS NO.) in this case.

CASE 2. When ordering special service tools from Kent-Moore Groups, please order them from one of the following Kent-Moore Groups. Please note that you must use Kent-Moore tool numbers (K.M NO.) in this case.

Kent-Moore Group

- **Kent-Moore Canada Inc.,**
  5466 Timberiea Blvd., unit No. 2, Mississauga,
  Ontario, Canada L4W2T7
  Telephone: 416-624-6295 Telex: 216961338

- **Kent-Moore (Europe) AG,**
  Overneuhofstrass 1, Postfach 64,
  CH-6340 Baar/Switzerland
  Telephone: 042-314343 Telex: 45868762

- **Kent-Moore U.K. Limited,**
  19-21 Stockfield Road, Acocks Green,
  Birmingham B27 6AJ, England
  Telephone: 021-707-6955 Telex: 51339338

- **Kent-Moore Australia Pty. Ltd.,**
  Unit 3, 9 Pioneer Avenue,
  Thornleigh, New Sourth Sales, Australia 2120
  Telephone: (sydney-02) 848-9777 Telex: 7122355

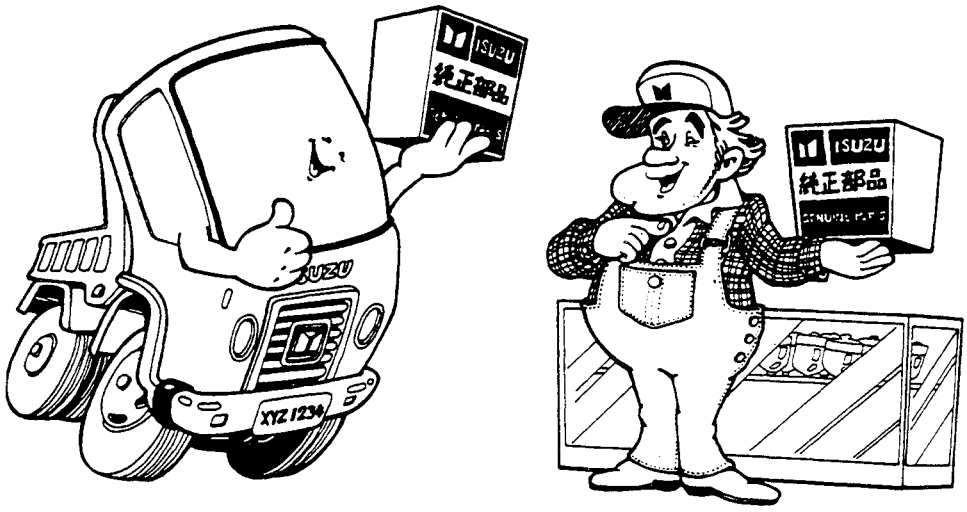
- **Jurubatuba S/A,**
  Rua Joao Araujo, 105-Pedreira,
  Santo Amaro, Sao Paulo 04452, Brazil Telex: 381125817

- **Kent-Moore Japan, Ltd.,**
  Dai-Ni-Maruzen Building, 9-2, Nihonbashi 3-chome,
  Chuo-ku, Tokyo, Japan
  Telephone: 03-271-1941 Telex: 2222729 EOMOTJ

Kent-Moore Tool Division
29784, Little Mack, Roseville,
Michigan 48066, U.S.A. Telex: 230235377

MEMO

"QUALITY PARTS YOU CAN TRUST"



SECTION 8

CONVERSION TABLE

INDEX

CONTENTS PAGE

LENGTH

MILLIMETERS TO INCHES

mm	in.	mm	in.	mm	in.	mm	in.
1	0.0394	26	1.0236	51	2.0079	76	2.9921
2	0.0787	27	1.0630	52	2.0472	77	3.0315
3	0.1181	28	1.1024	53	2.0866	78	3.0709
4	0.1575	29	1.1417	54	2.1260	79	3.1102
5	0.1969	30	1.1811	55	2.1654	80	3.1496
6	0.2362	31	1.2205	56	2.2047	81	3.1890
7	0.2756	32	1.2598	57	2.2441	82	3.2283
8	0.3150	33	1.2992	58	2.2835	83	3.2677
9	0.3543	34	1.3386	59	2.3228	84	3.3071
10	0.3937	35	1.3780	60	2.3622	85	3.3465
11	0.4331	36	1.4173	61	2.4016	86	3.3858
12	0.4724	37	1.4567	62	2.4409	87	3.4252
13	0.5118	38	1.4961	63	2.4803	88	3.4646
14	0.5512	39	1.5354	64	2.5197	89	3.5039
15	0.5906	40	1.5748	65	2.5591	90	3.5433
16	0.6299	41	1.6142	66	2.5984	91	3.5827
17	0.6693	42	1.6535	67	2.6378	92	3.6220
18	0.7087	43	1.6929	68	2.6772	93	3.6614
19	0.7480	44	1.7323	69	2.7165	94	3.7008
20	0.7874	45	1.7717	70	2.7559	95	3.7402
21	0.8268	46	1.8110	71	2.7953	96	3.7795
22	0.8661	47	1.8504	72	2.8346	97	3.8189
23	0.9055	48	1.8898	73	2.8740	98	3.8583
24	0.9449	49	1.9291	74	2.9134	99	3.8976
25	0.9843	50	1.9685	75	2.9528	100	3.9370

INCHES TO MILLIMETERS

in.	mm	in.	mm
1/64	0.3969	33/64	13.0969
1/32	0.7938	17/32	13.4938
3/64	1.1906	35/64	13.8906
1/16	1.5875	9/16	14.2875
5/64	1.9844	37/64	14.6844
3/32	2.3813	19/32	15.0813
7/64	2.7781	39/64	15.4781
1/8	3.1750	5/8	15.8750
9/64	3.5719	41/64	16.2719
5/32	3.9688	21/32	16.6688
11/64	4.3656	43/64	17.0656
3/16	4.7625	11/16	17.4625
13/64	5.1594	45/64	17.8594
7/32	5.5563	23/32	18.2563
15/64	5.9531	47/64	18.6531
1/4	6.3500	3/4	19.0500
17/64	6.7469	49/64	19.4469
9/32	7.1438	25/32	19.8438
19/64	7.5406	51/64	20.2406
5/16	7.9375	13/16	20.6375
21/64	8.3344	53/64	21.0344
11/32	8.7313	27/32	21.4313
23/64	9.1281	55/64	21.8281
3/8	9.5250	7/8	22.2250
25/64	9.9219	57/64	22.6219
13/32	10.3188	29/32	23.0188
27/64	10.7156	59/64	23.4156
7/16	11.1125	15/16	23.8125
29/64	11.5094	61/64	24.2094
15/32	11.9063	31/32	24.6063
31/64	12.3031	63/64	25.0031
1/2	12.7000	1	25.4000

8—2 CONVERSION TABLE

LENGTH

FEET TO METERS

ft.	0	1	2	3	4	5	6	7	8	9	ft.
	m	m	m	m	m	m	m	m	m	m	
—		0.305	0.610	0.914	1.219	1.524	1.829	2.134	2.438	2.743	—
10	3.048	3.353	3.658	3.962	4.267	4.572	4.877	5.182	5.486	5.791	10
20	6.096	6.401	6.706	7.010	7.315	7.620	7.925	8.230	8.534	8.839	20
30	9.144	9.449	9.754	10.058	10.363	10.668	10.973	11.278	11.582	11.887	30
40	12.192	12.497	12.802	13.106	13.411	13.716	14.021	14.326	14.630	14.935	40
50	15.240	15.545	15.850	16.154	16.459	16.764	17.069	17.374	17.678	17.983	50
60	18.288	18.593	18.898	19.202	19.507	19.812	20.117	20.422	20.726	21.031	60
70	21.336	21.641	21.946	22.250	22.555	22.860	23.165	23.470	23.774	24.079	70
80	24.384	24.689	24.994	25.298	25.603	25.908	26.213	26.518	26.822	27.127	80
90	27.432	27.737	28.042	28.346	28.651	28.956	29.261	29.566	29.870	30.175	90
100	30.480	30.785	31.090	31.394	31.699	32.004	32.309	32.614	32.918	33.223	100

METERS TO FEET

m	0	1	2	3	4	5	6	7	8	9	m
	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.	
—		3.2808	6.5617	9.8425	13.1234	16.4042	19.6850	22.9659	26.2467	29.5276	—
10	32.8084	36.0892	39.3701	42.6509	45.9318	49.2126	52.4934	55.7743	59.0551	62.3360	10
20	65.6168	68.8976	72.1785	75.4593	78.7402	82.0210	85.3018	88.5827	91.8635	95.1444	20
30	98.4252	101.7060	104.9869	108.2677	111.5486	114.8294	118.1102	121.3911	124.6719	127.9528	30
40	131.2336	134.5144	137.7953	141.0761	144.3570	147.6378	150.9186	154.1995	175.4803	160.7612	40
50	164.0420	167.3228	170.6037	173.8845	177.1654	180.4462	183.7270	187.0079	190.2887	193.5696	50
60	196.8504	200.1312	203.4121	206.6929	209.9738	213.2546	216.5354	219.8163	223.0971	226.3780	60
70	229.6588	232.9396	236.2205	239.5013	242.7822	246.0630	249.3438	252.6247	255.9055	259.1864	70
80	262.4672	265.7480	269.0289	272.3097	275.5906	278.8714	282.1522	285.4331	288.7139	291.9948	80
90	295.2756	298.5564	301.8373	305.1181	308.3990	311.6798	314.9606	318.2415	321.5223	324.8032	90
100	328.0840	331.3648	334.6457	337.9265	341.2074	344.4882	347.7690	351.0499	354.3307	357.6116	100

MILES TO KILOMETERS

miles	0	1	2	3	4	5	6	7	8	9	miles
	km	km	km	km	km	km	km	km	km	km	
—		1.609	3.219	4.828	6.437	8.047	9.656	11.265	12.875	14.484	—
10	16.093	17.703	19.312	20.921	22.531	24.140	25.750	27.359	28.968	30.578	10
20	32.187	33.796	35.406	37.015	38.624	40.234	41.843	43.452	45.062	46.671	20
30	48.280	49.890	51.499	53.108	54.718	56.327	57.936	59.546	61.155	62.764	30
40	64.374	65.983	67.592	69.202	70.811	72.420	74.030	75.639	77.249	78.858	40
50	80.467	82.077	83.686	85.295	86.905	88.514	90.123	91.733	93.342	94.951	50
60	96.561	98.170	99.779	101.389	103.000	104.607	106.217	107.826	109.435	111.045	60
70	112.654	114.263	115.873	117.482	119.091	120.700	122.310	123.919	125.529	127.138	70
80	128.748	130.357	131.966	133.576	135.185	136.794	138.404	140.013	141.622	143.232	80
90	144.841	146.450	148.060	149.669	151.278	152.888	154.497	156.106	157.716	159.325	90
100	160.934	162.544	164.153	165.762	167.372	168.981	170.590	172.200	173.809	175.418	100

KILOMETERS TO MILES

km	0	1	2	3	4	5	6	7	8	9	km
	miles	miles	miles	miles	miles	miles	miles	miles	miles	miles	
—		0.621	1.243	1.864	2.485	3.107	3.728	4.350	4.971	5.592	—
10	6.214	6.835	7.456	8.078	8.699	9.321	9.942	10.563	11.185	11.806	10
20	12.427	13.049	13.670	14.292	14.913	15.534	16.156	16.777	17.398	18.020	20
30	18.641	19.262	19.884	20.505	21.127	21.748	22.370	22.990	23.612	24.233	30
40	24.855	25.476	26.098	26.719	27.340	27.962	28.583	29.204	29.826	30.447	40
50	31.065	31.690	32.311	32.933	33.554	34.175	34.797	35.418	36.039	36.661	50
60	37.282	37.904	38.525	39.146	39.768	40.389	41.010	41.632	42.253	42.875	60
70	43.496	44.117	44.739	45.360	45.981	46.603	47.224	47.845	48.467	49.088	70
80	49.711	50.331	50.952	51.574	52.195	52.816	53.438	54.059	54.681	55.302	80
90	55.923	56.545	57.166	57.187	58.409	59.030	59.652	60.273	60.894	61.516	90
100	62.137	62.758	63.380	64.001	64.622	65.244	65.865	66.487	67.108	67.729	100

AREA

SQUARE INCHES TO SQUARE CENTIMETERS

in^2	0	1	2	3	4	5	6	7	8	9	in^2
	cm^2	cm^2	cm^2	cm^2	cm^2	cm^2	cm^2	cm^2	cm^2	cm^2	
—		6.452	12.903	19.355	25.806	32.258	38.710	45.161	51.613	58.064	—
10	64.516	70.968	77.419	83.871	90.322	96.774	103.226	109.677	116.129	122.580	10
20	129.032	135.484	141.935	148.387	154.838	161.290	167.742	174.193	180.645	187.096	20
30	193.548	200.000	206.451	212.903	219.354	225.806	232.258	238.709	245.161	251.612	30
40	258.064	264.516	270.967	277.419	283.870	290.322	296.774	303.225	309.677	316.128	40
50	322.580	329.032	335.483	341.935	348.386	354.838	361.290	367.741	374.193	380.644	50
60	387.096	393.548	399.999	406.451	412.902	419.354	425.806	432.257	438.709	445.160	60
70	451.612	458.064	464.515	470.967	477.418	483.870	490.322	496.773	503.225	509.676	70
80	516.128	522.580	529.031	535.483	541.934	548.386	554.838	561.289	567.741	574.192	80
90	580.644	587.096	593.547	599.999	606.450	612.902	619.354	625.805	632.257	638.708	90
100	645.160	651.612	658.063	664.515	670.966	677.418	683.870	690.312	696.773	703.224	100

SQUARE CENTIMETERS TO SQUARE INCHES

cm^2	0	1	2	3	4	5	6	7	8	9	cm^2
	in^2	in^2	in^2	in^2	in^2	in^2	in^2	in^2	in^2	in^2	
—		0.155	0.310	0.465	0.620	0.775	0.930	1.085	1.240	1.395	—
10	1.550	1.705	1.860	2.015	2.170	2.325	2.480	2.635	2.790	2.945	10
20	3.100	3.255	3.410	3.565	3.720	3.875	4.030	4.185	4.340	4.495	20
30	4.650	4.805	4.960	5.115	5.270	5.425	5.580	5.735	5.890	6.045	30
40	6.200	6.355	6.510	6.665	6.820	6.975	7.130	7.285	7.440	7.595	40
50	7.750	7.905	8.060	8.215	8.370	8.525	8.680	8.835	8.990	9.145	50
60	9.300	9.455	9.610	9.765	9.920	10.075	10.230	10.385	10.540	10.695	60
70	10.850	11.005	11.160	11.315	11.470	11.625	11.780	11.935	12.090	12.245	70
80	12.400	12.555	12.710	12.865	13.020	13.175	13.330	13.485	13.640	13.795	80
90	13.950	14.105	14.260	14.415	14.570	14.725	14.880	15.035	15.190	15.345	90
100	15.500	15.655	15.810	15.965	16.120	16.275	16.430	16.583	16.740	16.895	100

VOLUME

CUBIC INCHES TO CUBIC CENTIMETERS

in^3	0	1	2	3	4	5	6	7	8	9	in^3
	cm^3(cc)	cm^3(cc)	cm^3(cc)	cm^3(cc)	cm^3(cc)	cm^3(cc)	cm^3(cc)	cm^3(cc)	cm^3(cc)	cm^3(cc)	
		16.387	32.774	49.161	65.548	81.935	98.322	114.709	131.097	147.484	—
10	163.871	180.258	196.645	213.032	229.419	245.806	262.193	278.580	294.967	311.354	10
20	327.741	344.128	360.515	376.902	393.290	209.677	426.064	442.451	458.838	475.225	20
30	491.612	507.999	524.386	540.773	557.160	573.547	589.934	606.321	622.708	639.095	30
40	655.483	671.870	688.257	704.644	721.031	737.418	753.805	770.192	786.579	802.966	40
50	819.353	835.740	852.127	868.514	884.901	901.289	917.676	934.063	950.450	966.837	50
60	983.224	999.611	1015.998	1032.385	1048.772	1065.159	1081.546	1097.933	1114.320	1130.707	60
70	1147.094	1163.482	1179.869	1196.256	1212.643	1229.030	1245.417	1261.804	1278.191	1294.578	70
80	1310.965	1327.352	1343.739	1360.126	1376.513	1392.900	1409.288	1425.675	1442.062	1458.449	80
90	1474.836	1491.223	1507.610	1523.997	1540.384	1556.771	1573.158	1589.545	1605.932	1622.319	90
100	1638.706	1655.093	1671.481	1687.868	1704.255	1720.642	1737.029	1753.416	1769.803	1786.190	100

CUBIC CENTIMETERS TO CUBIC INCHES

cm^3(cc)	0	1	2	3	4	5	6	7	8	9	cm^3(cc)
	in^3	in^3	in^3	in^3	in^3	in^3	in^3	in^3	in^3	in^3	
—		0.0610	0.1220	0.1831	0.2441	0.3051	0.3661	0.4272	0.4882	0.5492	—
10	0.6102	0.6713	0.7323	0.7933	0.8543	0.9153	0.9764	1.0374	1.0984	1.1594	10
20	1.2205	1.2815	1.3425	1.4035	1.4646	1.5256	1.5866	1.6476	1.7086	1.7697	20
30	1.8307	1.8917	1.9527	2.0138	2.0748	2.1358	2.1968	2.2579	2.1389	2.3799	30
40	2.4409	2.5020	2.5630	2.6240	2.6850	2.7460	2.8071	2.8681	2.9291	2.9901	40
50	3.0512	3.1122	3.1732	3.2342	3.2952	3.3563	3.4173	3.4783	3.5393	3.6004	50
60	3.6614	3.7224	3.7834	3.8444	3.9055	3.9665	4.0275	4.0885	4.1496	4.2106	60
70	4.2716	4.3326	4.3937	4.4547	4.5157	4.5767	4.6377	4.6988	4.7598	4.8208	70
80	4.8818	4.9429	5.0039	5.0649	5.1259	5.1870	5.2480	5.3090	5.3700	5.4310	80
90	5.4921	5.5531	5.6141	5.6751	5.7362	5.7972	5.8582	5.9192	5.9803	6.0413	90
100	6.1023	6.1633	6.2243	6.2854	6.3464	6.4074	6.4684	6.5295	6.5905	6.6515	100

VOLUME

GALLONS (U. S.) TO LITERS

U.S. gal.	0	1	2	3	4	5	6	7	8	9	U.S. gal.
	liters	liters	liters	liters	liters	liters	liters	liters	liters	liters	
—		3.7854	7.5709	11.3563	15.1417	18.9271	22.7126	26.4980	30.2834	34.0633	—
10	37.8543	41.6397	45.4251	49.2105	52.9960	56.7814	60.5668	64.3523	68.1377	71.9231	10
20	75.7085	79.4940	83.2794	87.0648	90.8502	94.6357	98.4211	102.2065	105.9920	109.7774	20
30	113.5629	117.3482	121.1337	124.9191	128.7045	132.4901	136.2754	140.0608	143.8462	147.6316	30
40	151.4171	155.2025	158.9879	162.7734	166.5588	170.3442	174.1296	177.9151	181.7005	185.4859	40
50	189.2713	193.0568	196.8422	200.6276	204.4131	208.1985	211.9839	215.7693	219.5548	223.3402	50
60	227.1256	230.9110	234.6965	238.4819	242.2673	246.0527	249.8382	253.6236	257.4090	261.1945	60
70	264.9799	268.7653	272.5507	276.3362	280.1216	283.9070	287.6924	291.4779	295.2633	299.0487	70
80	302.8342	306.6196	310.4050	314.1904	317.9759	321.7613	325.5467	329.3321	333.1176	336.9030	80
90	340.6884	344.4738	348.2593	352.0447	355.8301	359.6156	363.4010	367.1864	370.9718	374.7573	90
100	378.5427	382.3281	386.1135	389.8990	393.6844	397.4698	401.2553	405.0407	408.8261	412.6115	100

LITERS TO GALLONS (U.S.)

liters	0	1	2	3	4	5	6	7	8	9	liters
	gal.	gal.	gal.	gal.	gal.	gal.	gal.	gal.	gal.	gal.	
—		0.2642	0.5283	0.7925	1.0567	1.3209	1.5850	1.8492	2.1134	2.3775	—
10	2.6417	2.9059	3.1701	3.4342	3.6984	3.9626	4.2268	4.4909	4.7551	5.0193	10
20	5.2834	5.5476	5.8118	6.0760	6.3401	6.6043	6.8685	7.1326	7.3968	7.6610	20
30	7.9252	8.1893	8.4535	8.7177	8.9818	9.2460	9.5102	9.7743	10.0385	10.3027	30
40	10.5669	10.8311	11.0952	11.3594	11.6236	11.8877	12.1519	12.4161	12.6803	12.9444	40
50	13.2086	13.4728	13.7369	14.0011	14.2653	14.5295	14.7936	15.0578	15.3220	15.5861	50
60	15.8503	16.1145	16.3787	16.6428	16.9070	17.1711	17.4354	17.6995	17.9637	18.2279	60
70	18.4920	18.7562	19.0204	19.2846	19.5487	19.8129	20.0771	20.3412	20.6054	20.8696	70
80	21.1338	21.3979	21.6621	21.9263	22.1904	22.4546	22.7188	22.9830	23.2471	23.5113	80
90	23.7755	24.0397	24.3038	24.5680	24.8322	25.0963	25.3605	25.6247	25.8889	26.1530	90
100	26.4172	26.6814	26.9455	27.2097	27.4739	27.7381	28.0022	28.2664	28.5306	28.7947	100

GALLONS (IMP.) TO LITERS

Imp gal.	0	1	2	3	4	5	6	7	8	9	Imp gal.
	liters	liters	liters	liters	liters	liters	liters	liters	liters	liters	
—		4.5459	9.0918	13.6377	18.1836	22.7295	27.2754	31.8213	36.3672	40.9131	—
10	45.4590	50.0049	54.5508	59.0967	63.6426	68.1885	72.7344	77.2803	81.8262	86.3721	10
20	90.9180	95.4639	100.0098	104.5557	109.1016	113.6475	118.1954	122.7393	127.2852	131.8311	20
30	136.3770	140.9229	145.4688	150.0147	154.5606	159.1065	163.6524	168.1983	172.7442	177.2901	30
40	181.8360	186.3819	190.9278	195.4737	200.0196	204.5655	209.1114	213.6573	218.2032	222.7491	40
50	227.2950	231.8409	236.3868	240.9327	245.4786	250.0245	254.5704	259.1163	263.6622	268.2081	50
60	272.7540	277.2999	281.8458	286.3917	290.9376	295.4835	300.0294	304.5753	309.1212	313.6671	60
70	318.2130	322.7589	327.3048	331.8507	336.8966	340.9425	345.4884	350.0343	354.5802	359.1261	70
80	363.6720	368.2179	372.7638	377.3097	381.8556	386.4015	390.9474	395.4933	400.0392	404.5851	80
90	409.1310	413.6769	418.2228	422.7687	427.3146	431.8605	436.4064	440.9523	445.4982	450.0441	90
100	454.5900	459.1359	463.6818	468.2277	472.7736	477.3195	481.8654	486.4113	490.9572	495.5031	100

LITERS TO GALLONS (IMP.)

liters	0	1	2	3	4	5	6	7	8	9	liter
	gal.	gal.	gal.	gal.	gal.	gal.	gal.	gal.	gal.	gal.	
—		0.2200	0.4400	0.6599	0.8799	1.0999	1.3199	1.5399	1.7598	1.9798	—
10	2.1998	2.4198	2.6398	2.8597	3.0797	3.2997	3.5197	3.7397	3.9596	4.1796	10
20	4.3996	4.6196	4.8396	5.0595	5.2795	5.4995	5.7195	5.9395	6.1594	6.3794	20
30	6.5994	6.8194	7.0394	7.2593	7.4793	7.6993	7.9193	8.1393	8.3592	8.5792	30
40	8.7992	9.0192	9.2392	9.4591	9.6791	9.8991	10.1191	10.3391	10.5590	10.7790	40
50	10.9990	11.2190	11.4390	11.6590	11.8789	12.0989	12.3189	12.5389	12.7588	12.9788	50
60	13.1988	13.4188	13.6388	13.8587	14.0787	14.2987	14.5187	14.7387	14.9586	15.1786	60
70	15.3986	15.6186	15.8386	16.0585	16.2785	16.4985	16.7185	16.9385	17.1584	17.3784	70
80	17.5984	17.8184	18.0384	18.2583	18.4783	18.6983	18.9183	19.1383	19.3582	19.5782	80
90	19.7982	20.0182	20.2382	20.4581	20.6781	20.8981	21.1181	21.3381	21.5580	21.7780	90
100	21.9980	22.2180	22.4380	22.6579	22.8779	23.0979	23.3179	23.5379	23.7578	23.9778	100

MASS

POUNDS TO KILOGRAMS

lbs.	0	1	2	3	4	5	6	7	8	9	lbs.
	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	
–		0.454	0.907	1.361	1.814	2.268	2.722	3.175	3.629	4.082	–
10	4.536	4.990	5.443	5.897	6.350	6.804	7.257	7.711	8.165	8.618	10
20	9.072	9.525	9.979	10.433	10.886	11.340	11.793	12.247	12.701	13.154	20
30	13.608	14.061	14.515	14.969	15.422	15.876	16.329	16.783	17.237	17.690	30
40	18.144	18.597	19.051	19.504	19.958	20.412	20.865	21.319	21.772	22.226	40
50	22.680	23.133	23.587	24.040	24.494	24.948	25.401	25.855	26.308	26.762	50
60	27.216	27.669	28.123	28.576	29.030	29.484	29.937	30.391	30.844	31.298	60
70	31.751	32.205	32.659	33.112	33.566	34.019	34.473	34.927	35.380	35.834	70
80	36.287	36.741	37.195	37.648	38.102	38.555	39.009	39.463	39.916	40.370	80
90	40.823	41.277	41.731	42.184	42.638	43.091	43.545	43.998	44.452	44.906	90
100	45.359	45.813	46.266	46.720	47.174	47.627	47.081	48.534	48.988	49.442	100

KILOGRAMS TO POUNDS

kg	0	1	2	3	4	5	6	7	8	9	kg
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	
–		2.205	4.409	6.614	8.818	11.023	13.228	15.432	17.637	19.842	–
10	22.046	24.251	26.455	28.660	30.865	33.069	35.274	37.479	39.683	41.888	10
20	44.092	46.297	48.502	50.706	52.911	55.116	57.320	59.525	61.729	63.934	20
30	66.139	68.343	70.548	72.753	74.957	77.162	79.366	81.571	83.776	85.980	30
40	88.185	90.390	92.594	94.799	97.003	99.208	101.413	103.617	105.822	108.026	40
50	110.231	112.436	114.640	116.845	119.050	121.254	123.459	125.633	127.868	130.073	50
60	132.277	134.482	136.687	138.891	141.096	143.300	145.505	147.710	149.914	152.119	60
70	154.324	156.528	158.732	160.937	163.142	165.347	167.551	169.756	171.961	174.165	70
80	176.370	178.574	180.780	182.984	185.188	187.393	189.597	191.802	194.007	196.211	80
90	198.416	200.621	202.825	205.030	207.234	209.439	211.644	213.848	216.053	218.258	90
100	220.462	222.667	224.871	227.076	229.281	231.485	233.690	235.895	238.099	240.304	100

KILOGRAMS TO NEWTON

kg	0	1	2	3	4	5	6	7	8	9	kg
	N	N	N	N	N	N	N	N	N	N	
–	–	9.81	19.61	29.42	39.23	49.03	58.84	68.65	78.45	88.26	–
10	98.07	107.87	117.68	127.49	137.29	147.10	156.91	166.71	176.52	186.33	10
20	196.13	205.94	215.75	225.55	235.36	245.17	254.97	264.78	274.59	284.39	20
30	294.20	304.01	313.81	323.62	333.43	343.23	353.04	362.85	372.65	382.46	30
40	392.27	402.07	411.88	421.69	431.49	441.30	451.11	460.91	470.72	480.53	40
50	490.33	500.14	509.95	519.75	529.56	539.37	549.17	558.98	568.79	578.59	50
60	558.40	598.21	608.01	617.82	627.63	637.43	647.24	657.05	666.85	676.66	60
70	686.47	696.27	706.08	715.89	725.69	735.50	745.31	755.11	764.92	774.73	70
80	784.53	794.34	804.15	813.95	823.76	833.57	843.37	853.18	862.99	872.79	80
90	882.60	892.41	902.21	912.02	921.83	931.63	941.44	951.25	961.05	970.86	90
100	980.67	990.47	1000.28	1010.08	1019.89	1029.70	1039.50	1049.31	1059.12	1068.92	100

NEWTON TO KILOGRAMS

N	0	10	20	30	40	50	60	70	80	90	N
	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	
–	–	1.020	2.039	3.059	4.079	5.099	6.118	7.138	8.158	9.177	–
100	10.197	11.217	12.237	13.256	14.276	15.296	16.316	17.335	18.355	19.375	100
200	20.394	21.414	22.434	23.453	24.473	25.493	26.513	27.532	28.552	29.572	200
300	30.592	31.611	32.631	33.651	34.670	35.690	36.710	37.730	38.749	39.769	300
400	40.789	41.809	42.828	43.848	44.868	45.887	46.907	47.927	48.947	49.966	400
500	50.986	52.006	53.025	54.045	55.065	56.085	57.104	58.124	59.144	60.163	500
600	61.183	62.203	63.223	64.242	65.262	66.282	67.302	68.321	69.341	70.361	600
700	71.380	72.400	73.420	74.440	75.459	76.479	77.499	78.518	79.538	80.558	700
800	81.578	82.597	83.617	84.637	85.656	86.676	87.696	88.716	89.735	90.755	800
900	91.775	92.795	93.814	94.834	95.854	96.873	97.893	98.913	99.933	100.952	900
1000	101.972	102.992	104.011	105.031	106.051	107.071	108.090	109.110	110.130	111.149	1000

PRESSURE

POUNDS PER SQUARE INCHES TO KILOGRAMS PER SQUARE CENTIMETERS

lb/in²	0	1	2	3	4	5	6	7	8	9	lb/in²
(psi)	kg/cm²	kg/cm²	kg/cm²	kg/cm²	kg/cm²	kg/cm²	kg/cm²	kg/cm²	kg/cm²	kg/cm²	(psi)
—		0.0703	0.1406	0.2109	0.2812	0.3515	0.4218	0.4921	0.5625	0.6328	—
10	0.7031	0.7734	0.8437	0.9140	0.9843	1.0546	1.1249	1.1952	1.2655	1.3358	10
20	1.4061	1.4764	1.5468	1.6171	1.6874	1.7577	1.8280	1.8983	1.9686	2.0389	20
30	2.1092	2.1795	2.2498	2.3201	2.3904	2.4607	2.5311	2.6014	2.6717	2.7420	30
40	2.8123	2.8826	2.9529	3.0232	3.0935	3.1638	3.2341	3.3044	3.3747	3.4450	40
50	3.5154	3.5857	3.6560	3.7263	3.7966	3.8669	3.9372	4.0075	4.0778	4.1481	50
60	4.2184	4.2887	4.3590	4.4293	4.4996	4.5700	4.6403	4.7106	4.7809	4.8512	60
70	4.9215	4.9918	5.0621	5.1324	5.2027	5.2730	5.3433	5.4136	5.4839	5.5543	70
80	5.6246	5.6947	5.7652	5.8355	5.9058	5.9761	6.0464	6.1167	6.1870	6.2573	80
90	6.3276	6.3979	6.4682	6.5386	6.6089	6.6792	6.7495	6.8198	6.8901	6.9604	90
100	7.0307	7.1010	7.1713	7.2416	7.3119	7.3822	7.4525	7.5228	7.5932	7.6635	100

KILOGRAMS PER SQUARE CENTIMETERS TO POUNDS PER SQUARE INCHES

kg/cm²	0	1	2	3	4	5	6	7	8	9	kg/cm²
	lb/in²(psi)	lb/in²(psi)	lb/in²(psi)	lb/in²(psi)	lb/in²(psi)	lb/in²(psi)	lb/in²(psi)	lb/in²(psi)	lb/in²(psi)	lb/in²(psi)	
—		14.22	28.45	42.67	56.89	71.12	85.34	99.56	113.78	128.01	—
10	142.23	156.45	170.68	184.90	199.12	213.35	227.57	241.79	256.01	270.24	10
20	284.46	298.68	312.91	327.13	341.35	355.58	369.80	384.02	398.24	412.47	20
30	426.69	440.91	455.14	469.36	483.58	497.81	512.03	526.25	540.47	554.70	30
40	568.92	583.14	597.37	611.59	625.81	640.04	654.26	668.48	682.70	696.93	40
50	711.16	725.37	739.60	753.82	768.04	782.27	795.49	810.71	824.93	839.16	50
60	853.38	867.60	881.83	896.05	910.27	924.50	938.72	952.94	967.16	981.39	60
70	995.61	1009.83	1024.06	1038.28	1052.50	1066.73	1080.95	1095.17	1109.39	1123.62	70
80	1137.84	1152.06	1166.27	1180.51	1194.73	1208.96	1223.18	1237.40	1251.62	1265.85	80
90	1280.07	1294.20	1308.52	1322.74	1336.96	1351.19	1365.41	1379.63	1393.85	1408.08	90
100	1422.30	1436.52	1450.75	1464.97	1479.19	1493.42	1507.64	1521.86	1536.08	1550.31	100

KILOGRAMS PER SQUARE CENTIMETERS TO KILO PASCAL

kg/cm²	0	1	2	3	4	5	6	7	8	9	kg/cm²
	KPa	KPa	KPa	KPa	KPa	KPa	KPa	KPa	KPa	KPa	
—	—	98.1	196.1	294.2	392.3	490.3	588.4	686.5	784.5	882.6	—
10	980.7	1078.7	1176.8	1274.9	1372.9	1471.0	1569.1	1667.1	1765.2	1863.3	10
20	1961.3	2059.4	2157.5	2255.5	2353.6	2451.7	2549.7	2647.8	2745.9	2843.9	20
30	2942.0	3040.1	3138.1	3236.2	3334.3	3432.3	3530.4	3628.5	3726.5	3824.6	30
40	3922.7	4020.7	4118.8	4216.9	4314.9	4413.0	4511.1	4609.1	4707.2	4805.3	40
50	4903.3	5001.4	5099.5	5197.5	5295.6	5393.7	5491.7	5589.8	5687.9	5785.9	50
60	5584.0	5982.1	6080.1	6178.2	6276.3	6374.3	6472.4	6570.5	6668.5	6766.6	60
70	6864.7	6962.7	7060.8	7158.9	7256.9	7355.0	7453.1	7551.1	7649.2	7747.3	70
80	7845.3	7943.4	8041.5	8139.5	8237.6	8335.7	8433.7	8531.8	8629.9	8727.9	80
90	8826.0	8924.1	9022.1	9120.2	9218.3	9316.3	9414.4	9512.5	9610.5	9708.6	90
100	9806.7	9904.7	10002.8	10100.8	10198.9	10297.0	10395.0	10493.1	10591.2	10689.2	100

KILO PASCAL TO KILOGRAMS PER SQUARE CENTIMETERS

KPa	0	100	200	300	400	500	600	700	800	900	KPa
	kg/cm²	kg/cm²	kg/cm²	kg/cm²	kg/cm²	kg/cm²	kg/cm²	kg/cm²	kg/cm²	kg/cm²	
—	—	1.020	2.039	3.059	4.079	5.099	6.118	7.138	8.158	9.177	—
1000	10.197	11.217	12.237	13.256	14.276	15.296	16.316	17.335	18.355	19.375	1000
2000	20.394	21.414	22.434	23.453	24.473	25.493	26.513	27.532	28.552	29.572	2000
3000	30.592	31.611	32.631	33.651	34.670	35.690	36.710	37.730	38.749	39.769	3000
4000	40.789	41.809	42.828	43.848	44.868	45.887	46.907	47.927	48.947	49.966	4000
5000	50.986	52.006	53.025	54.045	55.065	56.085	57.104	58.124	59.144	60.163	5000
6000	61.183	62.203	63.223	64.242	65.262	66.282	67.302	68.321	69.341	70.361	6000
7000	71.380	72.400	73.420	74.440	75.459	76.479	77.499	78.518	79.538	80.558	7000
8000	81.578	82.597	83.617	84.637	85.656	86.676	87.696	88.716	89.735	90.755	8000
9000	91.775	92.794	93.814	94.834	95.854	96.873	97.893	98.913	99.933	100.952	9000
10000	101.972	102.992	104.011	105.031	106.051	107.071	108.090	109.110	110.130	111.149	10000

TORQUE

FOOT POUNDS TO KILOGRAMMETERS

ft. lbs.	0	1	2	3	4	5	6	7	8	9	ft. lbs.
	kg-m	kg-m	kg-m	kg-m	kg-m	kg-m	kg-m	kg-m	kg-m	kg-m	
—		0.138	0.277	0.415	0.553	0.691	0.830	0.968	1.106	1.244	—
10	1.383	1.521	1.659	1.797	1.936	2.074	2.212	2.350	2.489	2.627	10
20	2.765	2.903	3.042	3.180	3.318	3.456	3.595	3.733	3.871	4.009	20
30	4.148	4.286	4.424	4.562	4.700	4.839	4.977	5.115	5.253	5.392	30
40	5.530	5.668	5.807	5.945	6.083	6.221	6.360	6.498	6.636	6.774	40
50	6.913	7.051	7.189	7.328	7.466	7.604	7.742	7.881	8.019	8.157	50
60	8.295	8.434	8.572	8.710	8.848	8.987	9.125	9.263	9.401	9.540	60
70	9.678	9.816	9.954	10.093	10.231	10.369	10.507	10.646	10.784	10.922	70
80	11.060	11.199	11.337	11.475	11.613	11.752	11.890	12.028	12.166	12.305	80
90	12.442	12.581	12.719	12.858	12.996	13.134	13.272	13.410	13.549	13.687	90
100	13.826	13.964	14.102	14.240	14.379	14.517	14.655	14.793	14.932	15.070	100

KILOGRAMMETERS TO FOOT POUNDS

kg-m	0	1	2	3	4	5	6	7	8	9	kg-m
	ft. lbs.	ft. lbs.	ft. lbs.	ft. lbs.	ft. lbs.	ft. lbs.	ft. lbs.	ft. lbs.	ft. lbs.	ft. lbs.	
—		7.23	14.47	21.70	28.93	36.17	43.40	50.63	57.86	65.10	—
10	72.33	79.56	86.80	94.03	101.26	108.50	115.73	122.96	130.19	137.43	10
20	144.66	151.89	159.13	166.36	173.59	180.83	188.06	195.29	202.52	209.76	20
30	217.00	224.22	231.46	238.69	245.92	253.16	260.39	267.62	274.85	282.09	30
40	289.32	296.55	303.79	311.02	318.25	325.49	332.72	339.95	347.18	354.42	40
50	361.65	368.88	376.12	383.35	390.58	397.82	405.05	412.28	419.51	426.75	50
60	433.98	441.21	448.45	455.68	462.91	470.15	477.38	484.61	491.84	499.08	60
70	506.31	513.54	520.78	528.01	535.24	542.48	549.71	556.94	564.17	571.41	70
80	578.64	585.87	593.11	600.34	607.57	614.81	622.04	629.27	636.50	643.74	80
90	650.97	658.20	665.44	672.67	679.90	687.14	694.37	701.60	708.83	716.07	90
100	723.30	730.53	737.77	745.00	752.23	759.47	766.70	773.93	781.16	788.40	100

KILOGRAMMETERS TO NEWTONMETERS

kg-m	0	1	2	3	4	5	6	7	8	9	kg-m
	N-m	N-m	N-m	N-m	N-m	N-m	N-m	N-m	N-m	N-m	
—	—	9.81	19.61	29.42	39.23	49.03	58.84	68.65	78.45	88.26	—
10	98.07	107.87	117.68	127.49	137.29	147.10	156.91	166.71	176.52	186.33	10
20	196.13	205.94	215.75	225.55	235.36	245.17	254.97	264.78	274.59	284.39	20
30	294.20	304.01	313.81	323.62	333.43	343.23	353.04	362.85	372.65	382.46	30
40	392.27	402.07	411.88	421.69	431.49	441.30	451.11	460.91	470.72	480.53	40
50	490.33	500.14	509.95	519.75	529.56	539.37	549.17	558.98	568.79	578.59	50
60	588.40	598.21	608.01	617.82	627.63	637.43	647.24	657.05	666.85	676.66	60
70	686.47	696.27	706.08	715.89	725.69	735.50	745.31	755.11	764.92	774.73	70
80	784.53	794.34	804.15	813.95	823.76	833.57	843.37	853.18	862.99	872.79	80
90	882.60	892.41	902.21	912.02	921.83	931.63	941.44	951.25	961.05	970.86	90
100	980.67	990.47	1000.28	1010.08	1019.89	1029.70	1039.50	1049.31	1059.12	1068.92	100

NEWTONMETERS TO KILOGRAMMETERS

N-m	0	10	20	30	40	50	60	70	80	90	N-m
	kg-m	kg-m	kg-m	kg-m	kg-m	kg-m	kg-m	kg-m	kg-m	kg-m	
—	—	1.020	2.039	3.059	4.079	5.099	6.118	7.138	8.158	9.177	—
100	10.197	11.217	12.236	13.256	14.276	15.296	16.315	17.335	18.355	19.374	100
200	20.394	21.414	22.433	23.453	24.473	25.493	26.512	27.532	28.552	29.571	200
300	30.591	31.611	32.630	33.650	34.670	35.690	36.710	37.729	38.749	39.768	300
400	40.789	41.808	42.827	43.847	44.867	45.887	46.906	47.926	48.946	49.965	400
500	50.986	52.005	53.024	54.044	55.064	56.084	57.103	58.123	59.143	60.162	500
600	61.183	62.202	63.221	64.241	65.261	66.281	67.300	68.320	69.340	70.359	600
700	71.380	72.399	73.418	74.438	75.458	76.478	77.497	78.517	79.537	80.556	700
800	81.577	82.596	83.615	84.635	85.655	86.675	87.694	88.714	89.734	90.753	800
900	91.774	92.793	93.812	94.832	95.852	96.872	97.891	98.911	99.931	100.950	900
1000	101.972	102.990	104.009	105.029	106.049	107.069	108.088	109.108	110.128	111.147	1000

TEMPERATURE

FAHRENHEIT TO CENTIGRADE

°F	°C	°F	°C
-20	-28.9	90	32.2
-15	-26.1	95	35.0
-10	-23.3	100	37.8
-5	-20.6	105	40.6
0	-17.8	110	43.3
1	-17.2	115	46.1
2	-16.7	120	48.9
3	-16.1	125	51.7
4	-15.6	130	54.4
5	-15.0	135	57.2
10	-12.2	140	60.0
15	-9.4	145	62.8
20	-6.7	150	65.6
25	-3.9	155	68.3
30	-1.1	160	71.1
35	1.7	165	73.9
40	4.4	170	76.7
45	7.2	175	79.4
50	10.0	180	82.2
55	12.8	185	85.0
60	15.6	190	87.8
65	18.3	195	90.6
70	21.1	200	93.3
75	23.9	205	96.1
80	26.7	210	98.9
85	29.4	212	100.0

CENTIGRADE TO FAHRENHEIT

°C	°F	°C	°F
-30	-22.0	28	82.4
-28	-18.4	30	86.0
-26	-14.8	32	89.6
-24	-11.2	34	93.2
-22	-7.6	36	96.8
-20	-4.0	38	100.4
-18	-0.4	40	104.0
-16	3.2	42	107.6
-14	6.8	44	111.2
-12	10.4	46	114.8
-10	14.0	48	118.4
-8	17.6	50	122.0
-6	21.2	52	125.6
-4	24.8	54	129.2
-2	28.4	56	132.8
0	32.0	58	136.4
2	35.6	60	140.0
4	39.2	62	143.6
6	42.8	64	147.2
8	46.4	66	150.8
10	50.0	68	154.4
12	53.6	70	158.0
14	57.2	75	167.0
16	60.8	80	176.0
18	64.4	85	185.0
20	68.0	90	194.0
22	71.6	95	203.0
24	75.2	100	212.0
26	78.8		

WORKSHOP MANUAL (INDUSTRIAL)

2KA1, 2KB1, 2KC1
3KA1, 3KB1, 3KC1

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