

WORKSHOP MANUAL

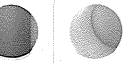
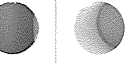
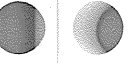
KB, UBS

SECTION 06C

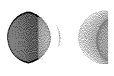
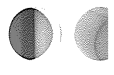
C223/C223T DIESEL ENGINE



ISUZU MOTORS LIMITED



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SPECIFICATIONS

Items	Engine model	C223		C223T
		4 x 2	4 x 4	4 x 4
Engine type		Water-cooled, 4-cycle in-line, overhead valve		
Combustion chamber type		Swirl chamber type		
Cylinder liner type		Dry type, cromard liner	None	
Timing gear system		Gear/Belt drive (for Europe)		
Number of piston rings		Compression ring: 2, oil ring: 1		
Number of cylinders - bore x stroke	mm(in.)	4 - 88 x 92 (3.46 x 3.62)		
Piston displacement	cc(cu in.)	2238(136.6)		
Compression ratio		21.0		
Engine dimensions: length x width x height	mm(in.)	740 x 547 x 668 (29.1 x 21.5 x 26.3)		
Engine weight (dry)	kg(lbs.)	213 (249)		
Fuel injection order		1-3-4-2		
Fuel injection timing (B.T.D.C.Static)		10°(for general export) 15°(for Europe)	6°(for general export) 10°(for Europe)	
Type of fuel used		Number 2-D diesel fuel		
Fuel filter type		Cartridge type		
Injection pump type		Bosch distributor VE type		
Governor type		Mechanical, variable speed, (half all speed) with aneroid compensator.		
Injection nozzle type		Throttle type		
Fuel injection starting pressure	kg/cm ² (psi)	105(1493)	135(1920)	
Compression pressure	kg/cm ² (psi)	31 at 200 rpm (441 at 200 rpm)		
Idle speed	rpm	675—725	725—775	
Valve clearances (Intake and exhaust)	mm(in.)	0.45 (0.0177) at cold	0.40 (0.0158) at cold	
Intake valves	open at	11° (B.T.D.C)		
	close at	49° (A.B.D.C)		
Exhaust valves	open at	51° (B.B.D.C)		
	close at	9° (A.T.D.C)		
Lubrication method		Pressurized circulation		
Oil pump type		Trochoid type	Gear type	Gear type
Oil filter type		Cartridge type, combination main and partial flow filter		
lubrication oil capacity.	liters(gal)	6.5 (1.72) with oil filter and oil cooler		
Oil cooler type		Water cooled type		
Piston cooling method		with oiling jets		
Cooling method		Pressurized circulation		
Cooling water capacity.	liters(gal)	10.3 (2.7)	11.9 (3.1)	

06C—2 DIESEL ENGINE

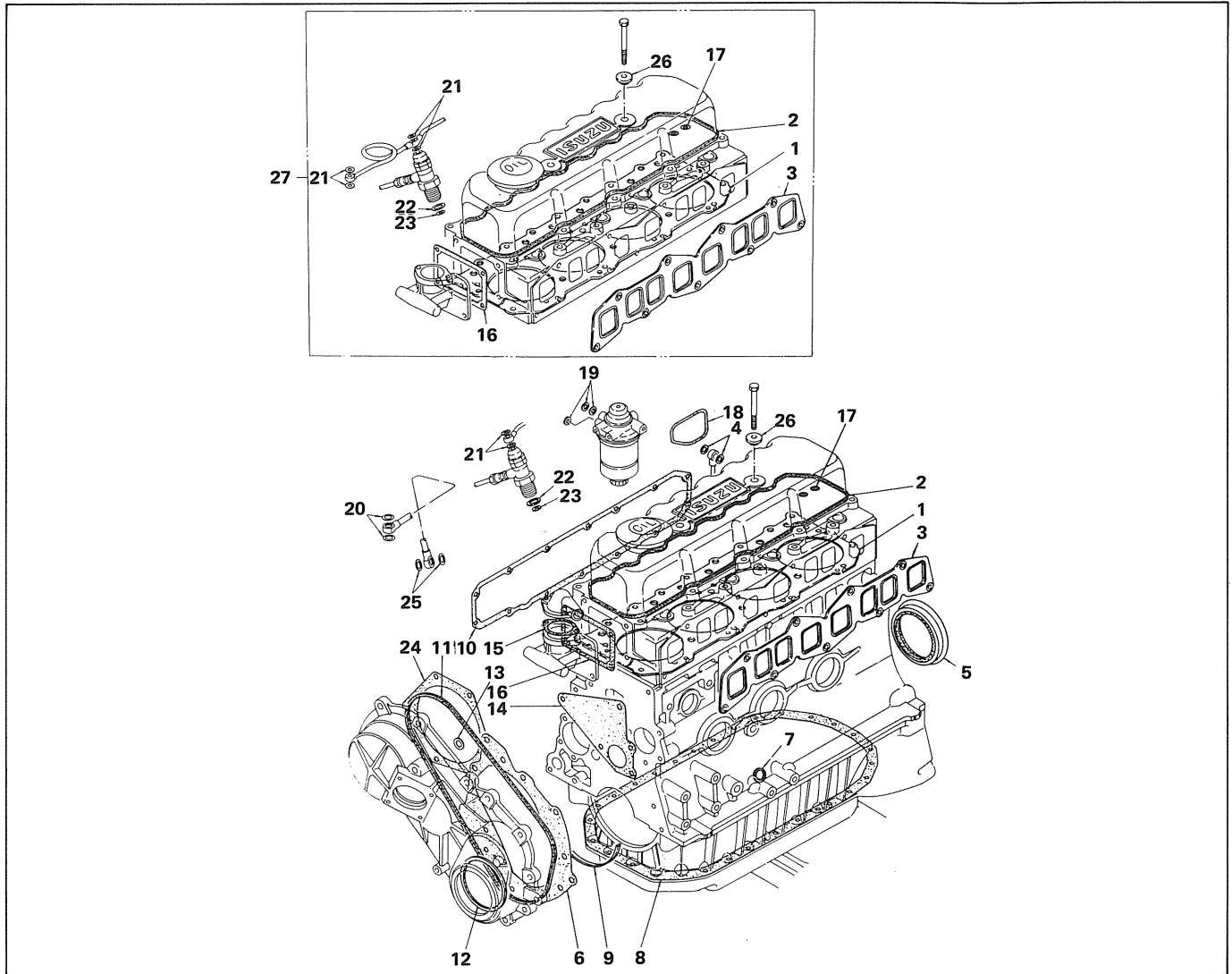
Items	Engine model	C223		C223T
		4 x 2	4 x 4	4 x 4
Water pump type		Impeller type		
Thermostat type		Waxpellet type(with jiggle valve)		
Air cleaner type		Viscous type paper element/Dry paper element		
Battery type — Voltage	V	65D23RMF-12, NX120-7MF-12, N70ZMF-12		
Alternator Voltage-capacity	V-A	12 — 40 / 12 — 50		
Starter Voltage-output	V-KW	12 — 2.0		
Turbocharger type			TBO 209	
Turbine type			Radial, inward-flow	
Compressor type			140,000	
Maximum speed	(rpm)		6.60	
Maximum pressure ratio			690 ± 20	
Boost pressure	(mmHg)		280 or more at 4,000 engine rpm	

ENGINE REPAIR KIT

TIMING GEAR TRAIN

Item No. 1 — No. 27 : Engine overhaul kit

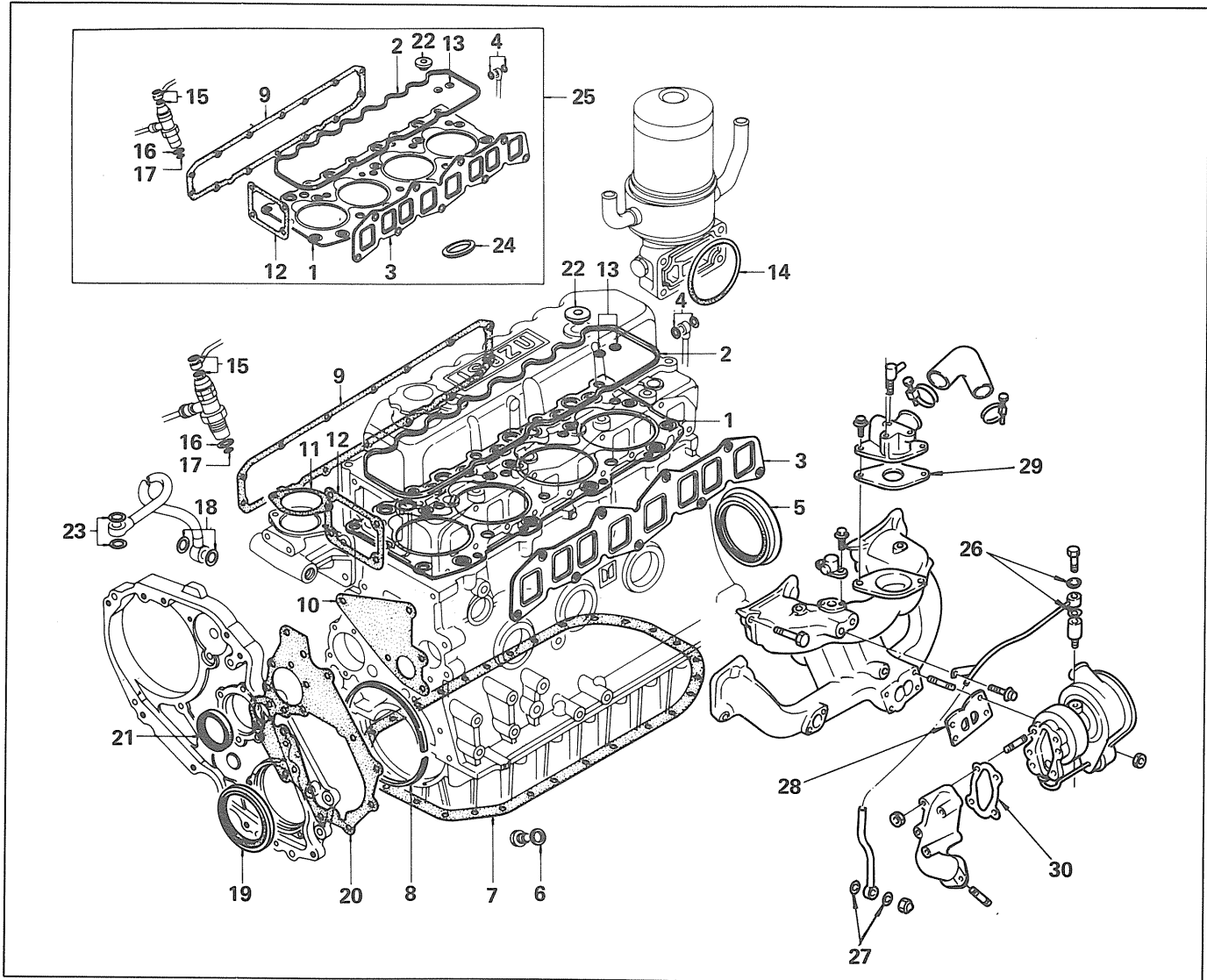
Item No. 1, 2, 3, 16, 17, 21, 22, 23 and 26 : Engine top overhaul kit



- | | |
|---|---------------------------------------|
| 1. Gasket ; cylinder head | 15. Gasket ; outlet pipe |
| 2. Gasket ; cylinder head cover | 16. Gasket ; cylinder head to housing |
| 3. Gasket ; intake and exhaust manifold | 17. Sealing ring |
| 4. Gasket ; joint bolt | 18. Gasket ; oil filter |
| 5. Seal ; crankshaft rear | 19. Gasket ; fuel filter |
| 6. Gasket ; body to housing | 20. Gasket ; vacuum pipe |
| 7. Gasket ; drain plug | 21. Gasket ; throttle valve |
| 8. Gasket ; oil pan to case | 22. Gasket ; nozzle holder |
| 9. Gasket ; oil pan to bearing cap | 23. Washer ; corrugated, holder |
| 10. Gasket ; tappet cover | 24. Gasket ; body to housing |
| 11. Gasket ; timing gear case | 25. Gasket ; vacuum pipe |
| 12. Oil seal ; crankshaft, front | 26. Gasket ; head cover |
| 13. Washer ; corrugated, holder | 27. Repair kit ; top over haul |
| 14. Gasket ; water pump to cylinder block | |

TIMING BELT TRAIN

Item No. (1) — No. (24) : Engine overhaul kit
 Item No. (25) : Engine top overhaul kit.



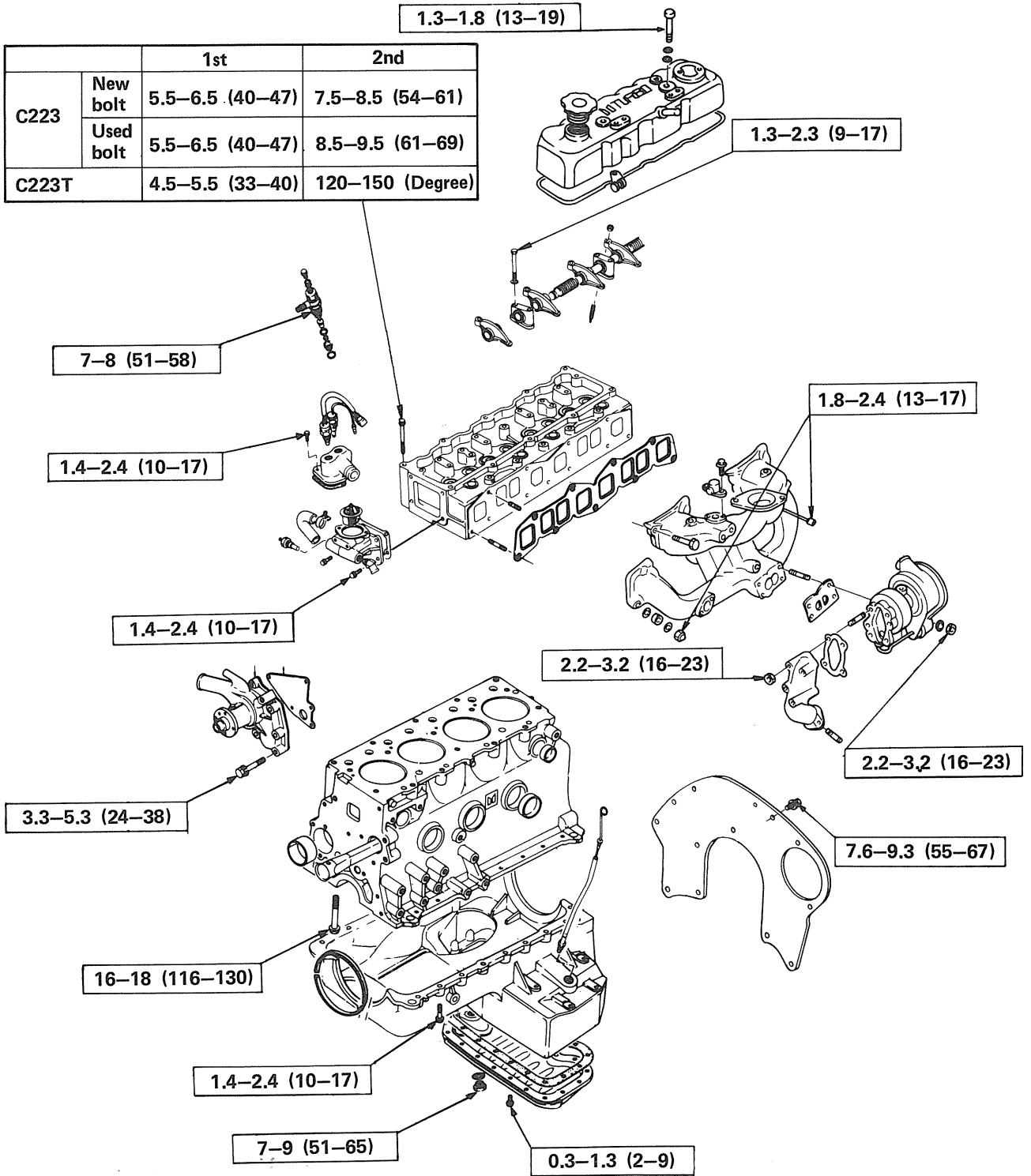
- | | |
|---|--|
| 1. Gasket ; cylinder head | 17. Washer ; corrugated holder |
| 2. Gasket ; cylinder head cover | 18. Gasket ; vacuum pipe |
| 3. Gasket ; intake and exhaust manifold | 19. Oil seal ; crank front |
| 4. Gasket ; joint bolt | 20. Gasket ; body to housing |
| 5. Oil seal ; crankshaft rear | 21. Gasket ; pulley to pump |
| 6. Gasket ; drain plug | 22. Gasket ; head cover |
| 7. Gasket ; oil pan to case | 23. Gasket ; oil gallery |
| 8. Gasket ; oil pan to bearing cap | 24. Gasket ; exhaust pipe to manifold |
| 9. Gasket ; tappet cover | 25. Engine top overhaul kit |
| 10. Gasket ; water pump to cylinder black | 26. Gasket ; oil head feed turbocharger (C223T only) |
| 11. Gasket ; outlet pipe | 27. Gasket ; oil feed pipe (C223T only) |
| 12. Gasket ; cylinder head to housing | 28. Gasket ; turbocharger, exhaust manifold (C223T only) |
| 13. Ring ; sealing | 29. Gasket ; inlet pipe (C223T only) |
| 14. Gasket ; oil filter to block | 30. Gasket ; exhaust pipe (C223T only) |
| 15. Gasket ; nozzle holder | |
| 16. Gasket ; nozzle holder | |

FIXING TORQUE

CYLINDER HEAD AND BODY

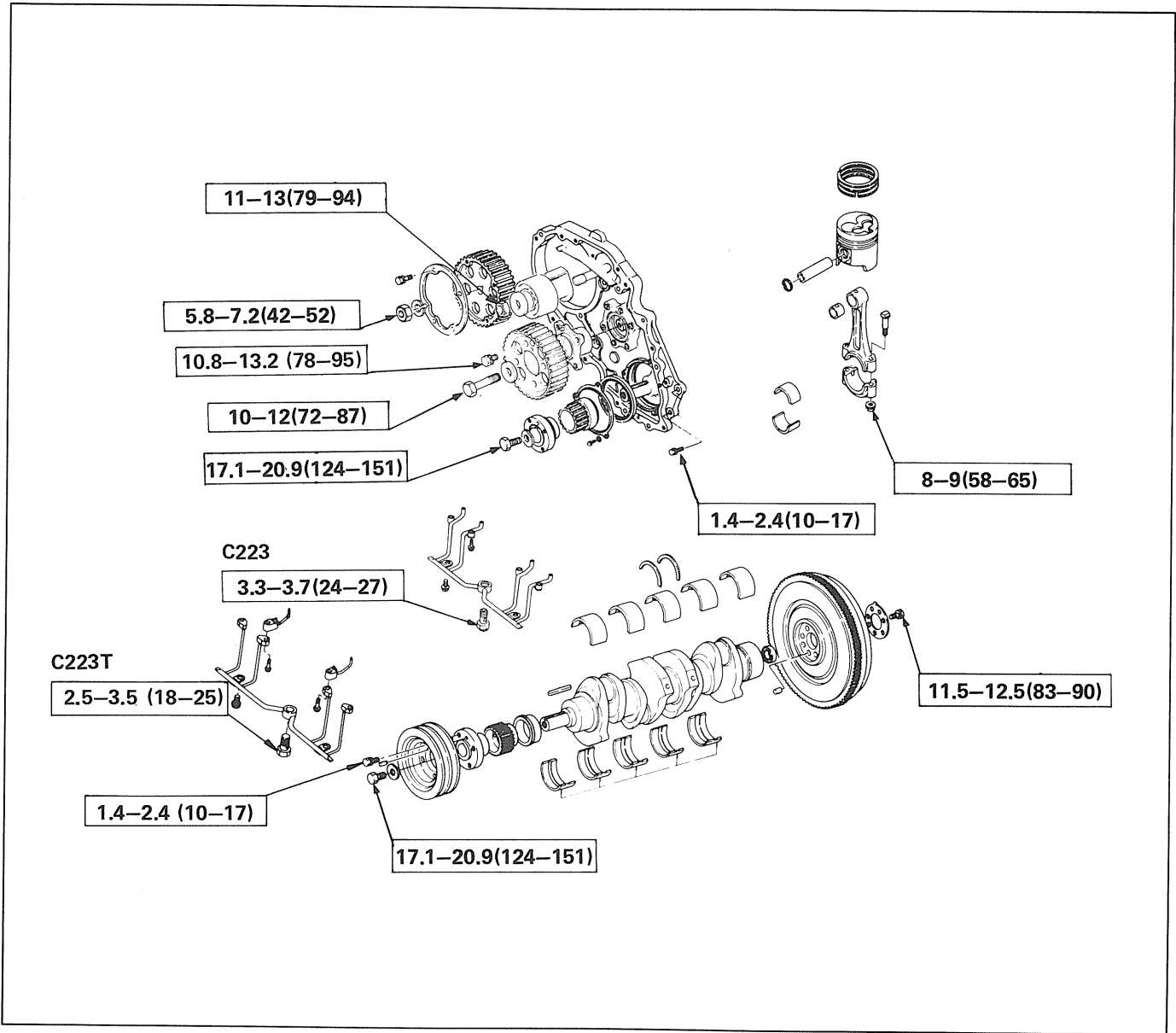
kg·m(ft.lbs.)

		1st	2nd
C223	New bolt	5.5-6.5 (40-47)	7.5-8.5 (54-61)
	Used bolt	5.5-6.5 (40-47)	8.5-9.5 (61-69)
C223T		4.5-5.5 (33-40)	120-150 (Degree)



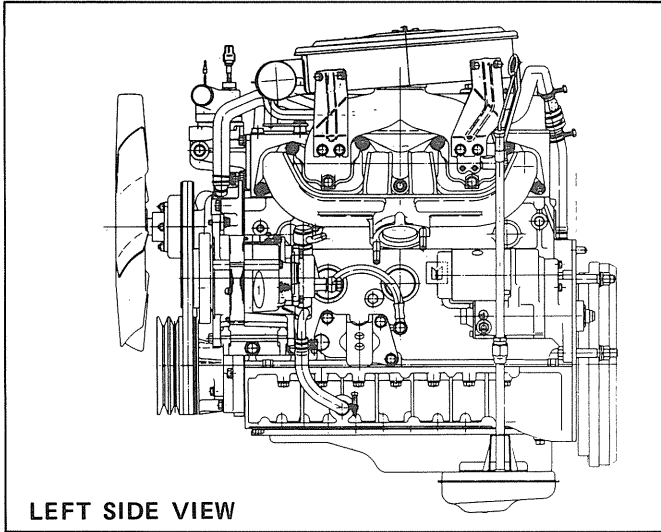
CRANKSHAFT

kg·m(ft.lbs.)

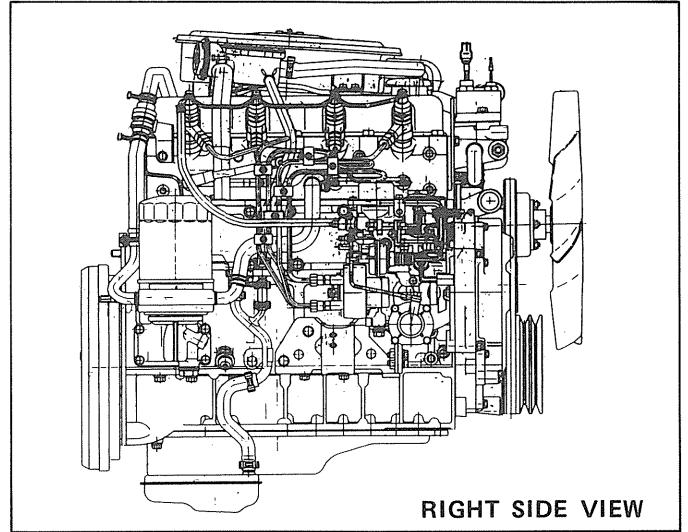


ENGINE ASSEMBLY GENERAL DESCRIPTION

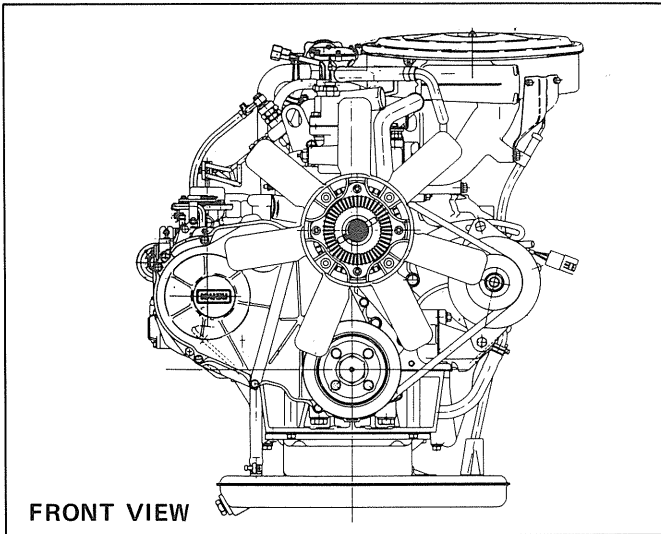
C223 KB (4 x 2)



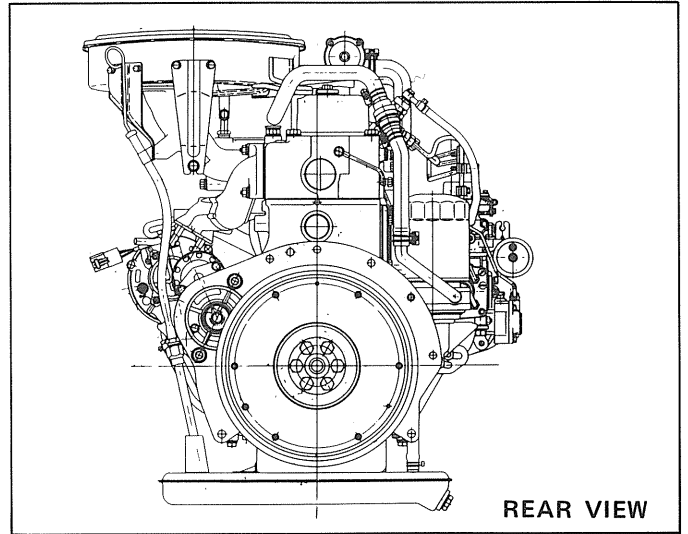
LEFT SIDE VIEW



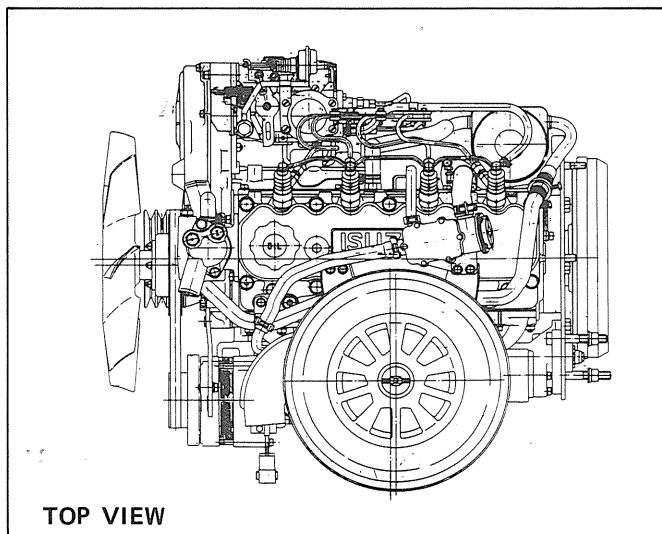
RIGHT SIDE VIEW



FRONT VIEW

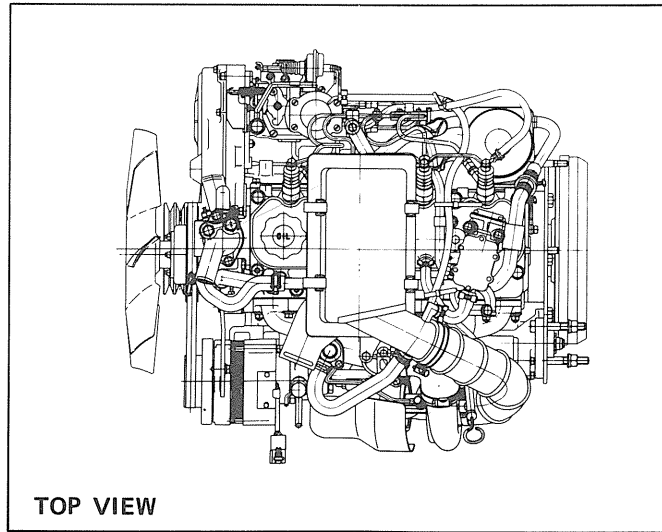
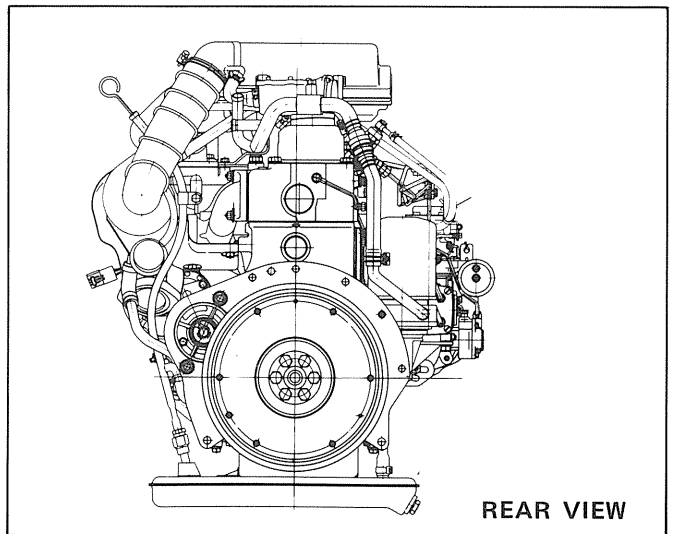
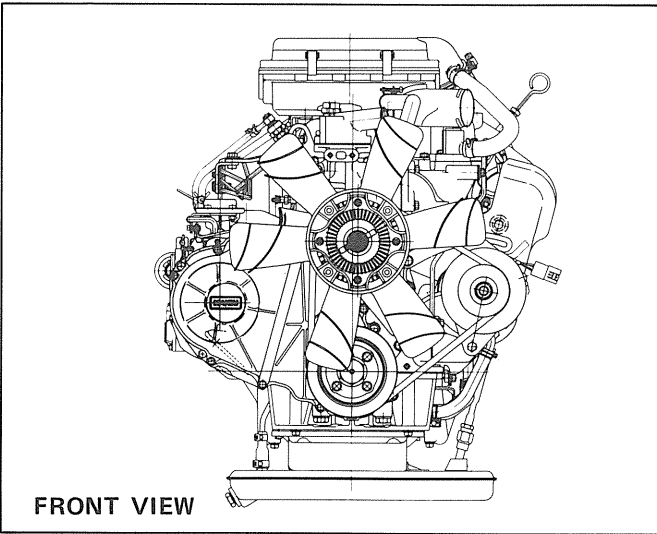
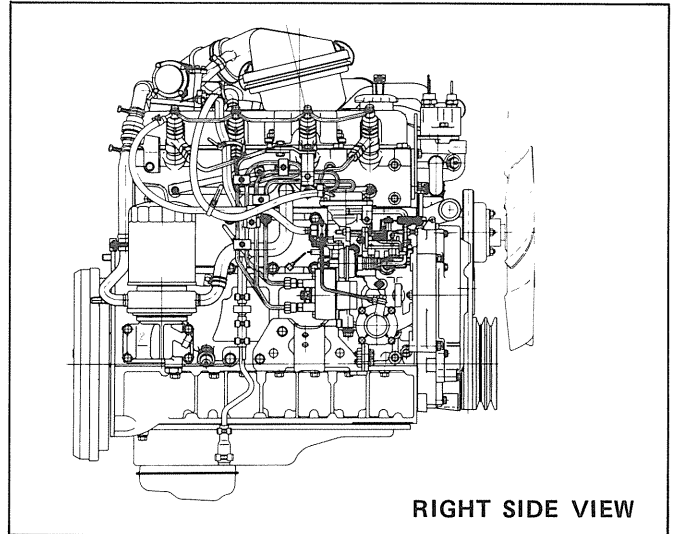
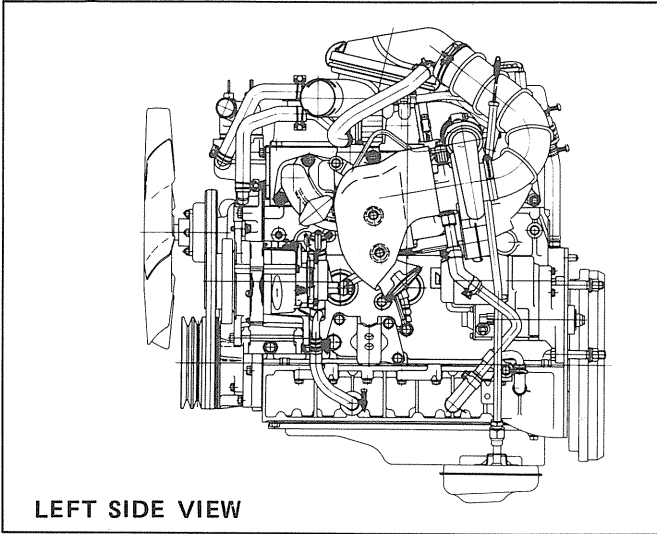


REAR VIEW

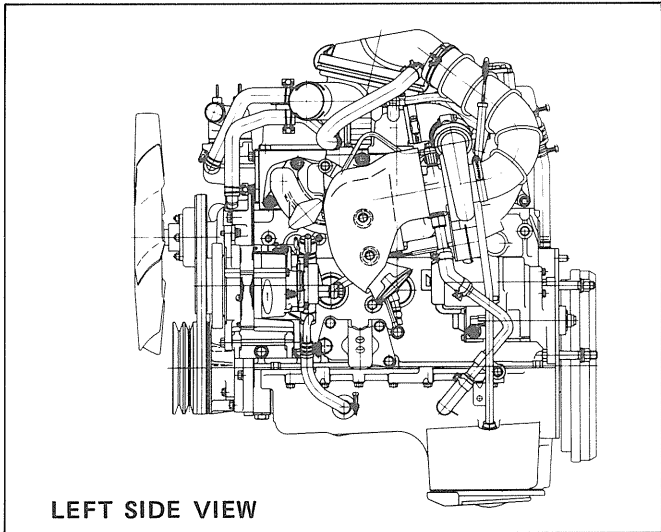


TOP VIEW

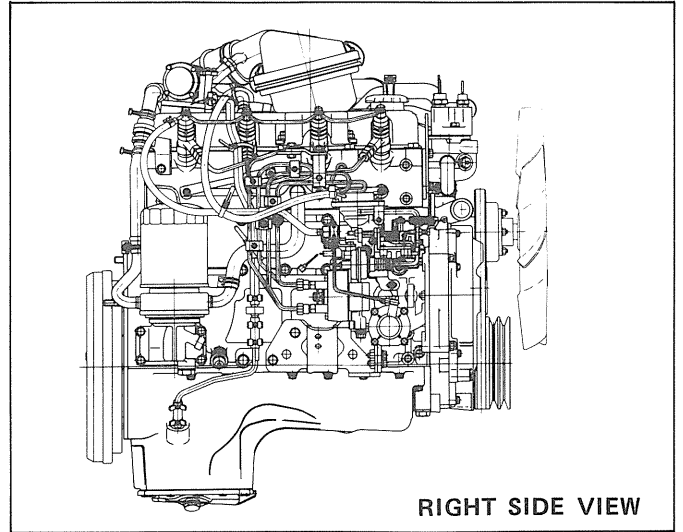
C223T KB (4 x 2)



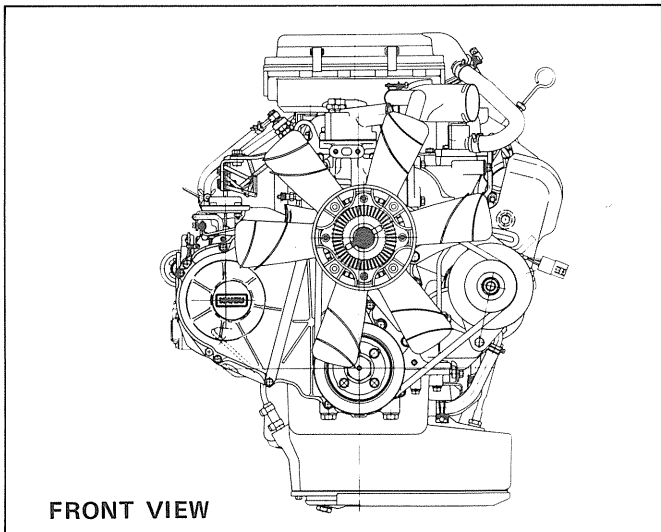
C223T KB (4 x 4)



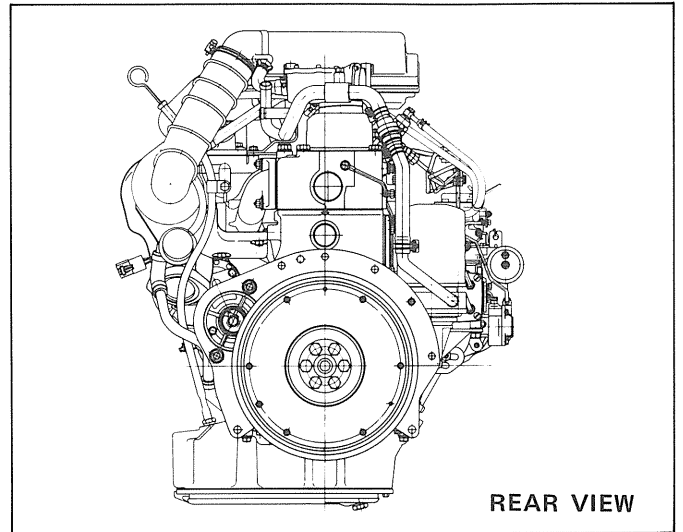
LEFT SIDE VIEW



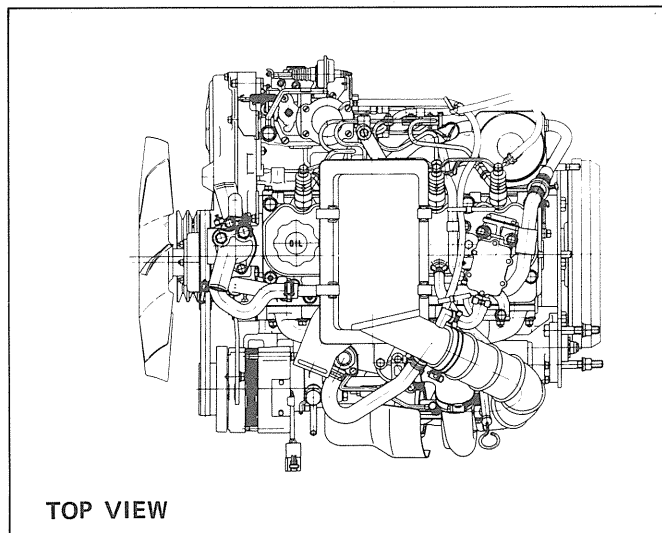
RIGHT SIDE VIEW



FRONT VIEW

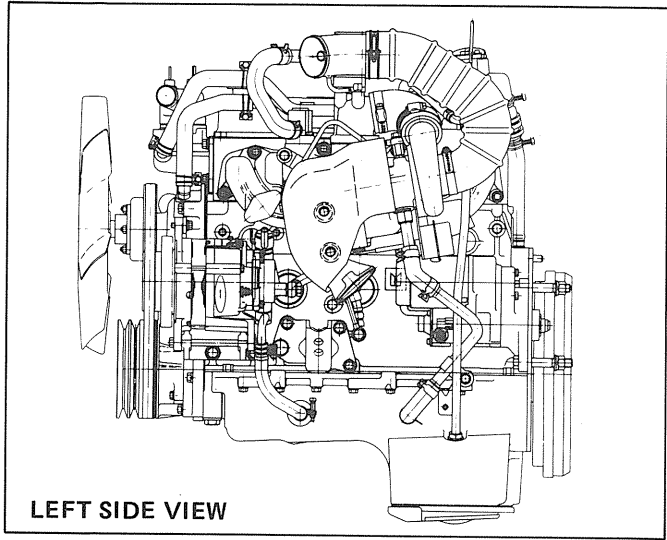


REAR VIEW

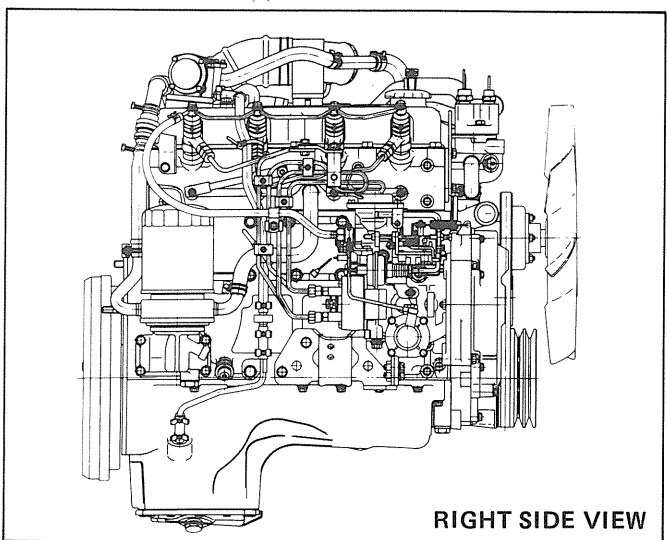


TOP VIEW

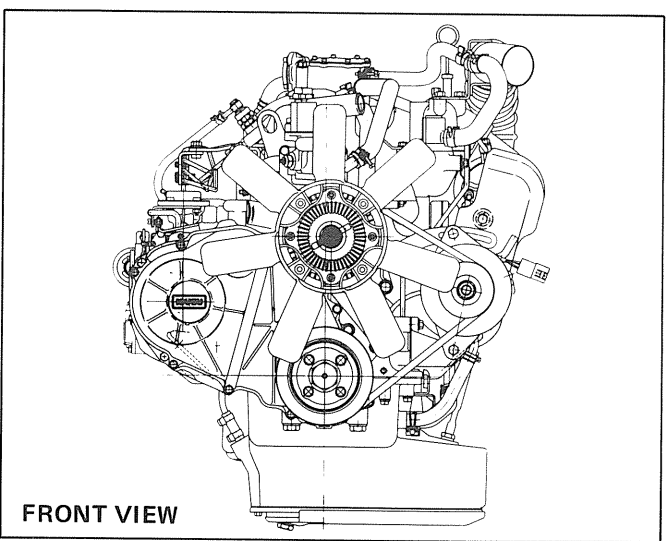
C223T UBS



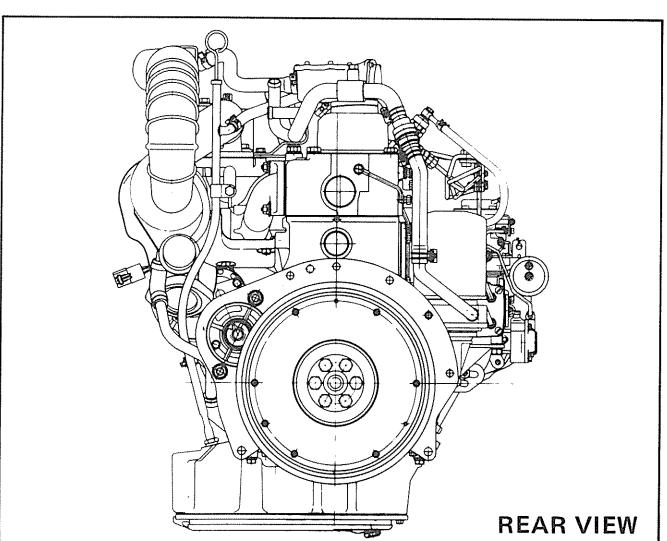
LEFT SIDE VIEW



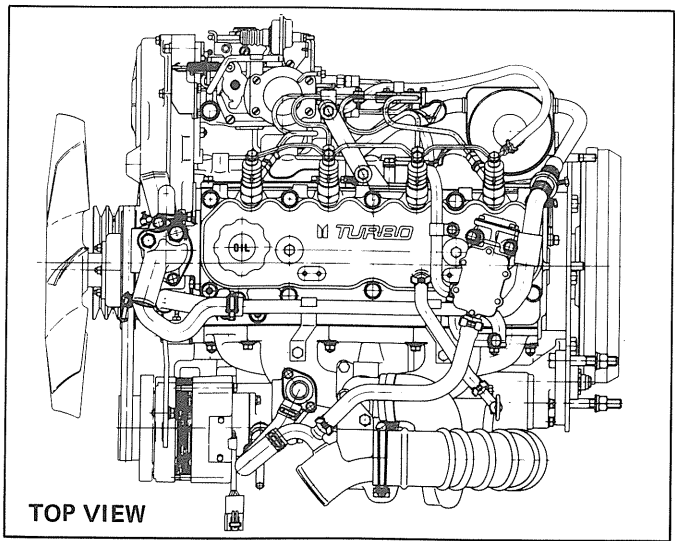
RIGHT SIDE VIEW



FRONT VIEW



REAR VIEW

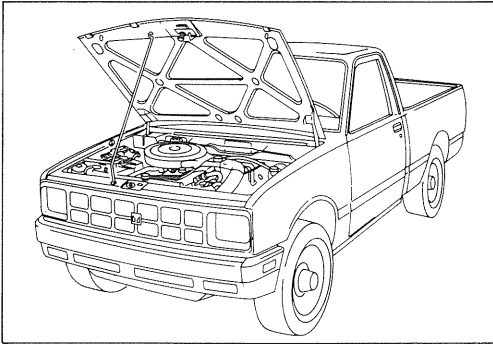


TOP VIEW



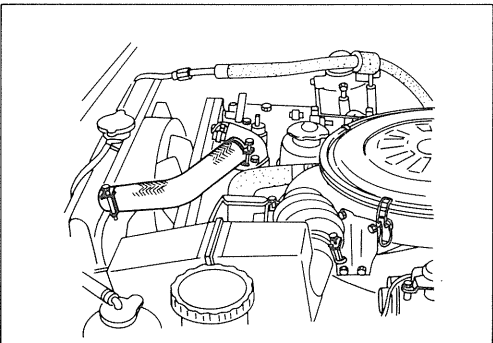
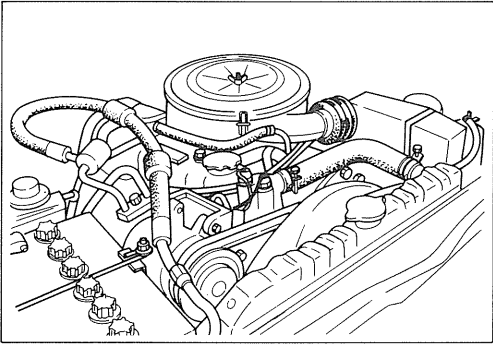
REMOVAL AND INSTALLATION

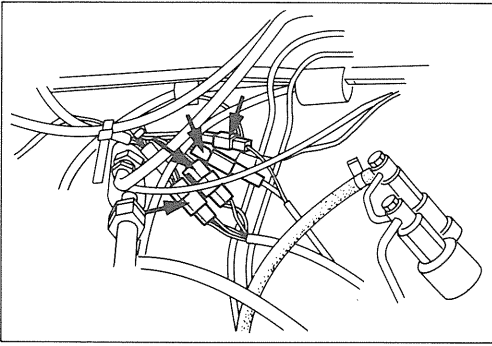
KB (4 x 2 MODELS)



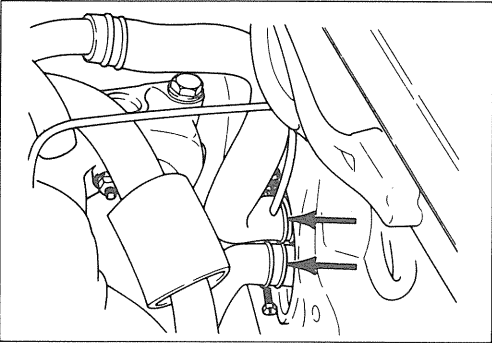
Removal steps

1. Raise engine hood.
2. Disconnect the battery ground cable.
3. Remove the engine hood.
4. Remove the battery assembly.
5. Remove splash cover and drain the cooling system by opening the drain plugs on the radiator and on the cylinder block.
6. Remove the air cleaner assembly as follows:
 - (1) Remove the intake silencer.
 - (2) Remove the bolts holding the air cleaner and loosen the clamp bolt, then remove the air cleaner assembly.
7. Disconnect the upper radiator hose at the engine side.
8. Loosen the compressor drive belts by moving the power steering oil pump or idler. (If so equipped)
9. Remove the cooling fan and fan shroud.
10. Disconnect the lower radiator hose at the engine side.
11. Remove the radiator grille.
12. Remove the radiator attaching bolts and remove the radiator.
13. Disconnect the accelerator control cable from the injection pump side.
14. Disconnect the air conditioner compressor control cable. (If so equipped)
15. Disconnect the fuel hoses from the injection pump.
16. Disconnect the battery cable from the cylinder body.
17. Disconnect the transmission wiring.
18. Disconnect the vacuum hose from the fast idle actuator.
19. Disconnect the connector at fuel cut solenoid.

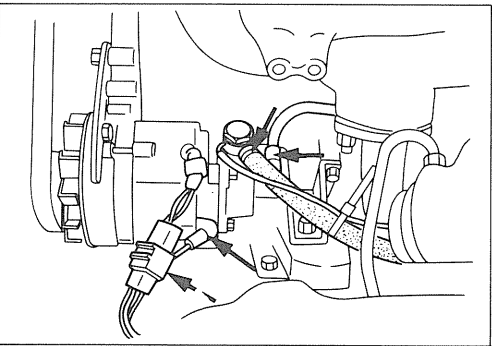




20. Disconnect the connectors shown (● Sensing resistor, ● Thermostatic switch, ● Air conditioner compressor switch.)



21. Disconnect the heater hoses extending from the heater unit from the dash panel side.



22. Disconnect the hose for the power brake unit from the vacuum pump.

23. Disconnect vacuum hose from the vacuum pump.

24. Disconnect the alternator wiring at the connector.

25. Disconnect the exhaust pipe from the exhaust manifold at the flange.

26. Remove the exhaust pipe mounting bracket from the engine back plate.

27. Disconnect the starter motor wiring.

28. Disconnect the battery cable from starter motor.

29. Slide the gearshift lever boot upwards on the lever. Remove 2 gearshift lever attaching bolts and remove lever.

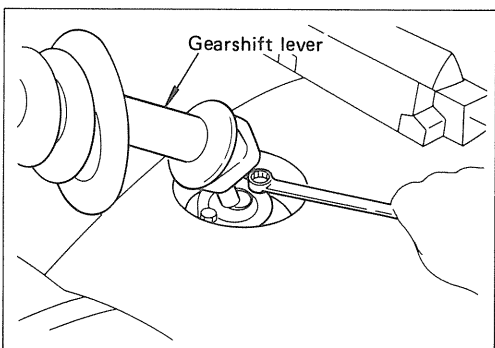
30. Place a pan under transmission to catch oil, disconnect speedometer cable at the transmission then disconnect the ground cable.

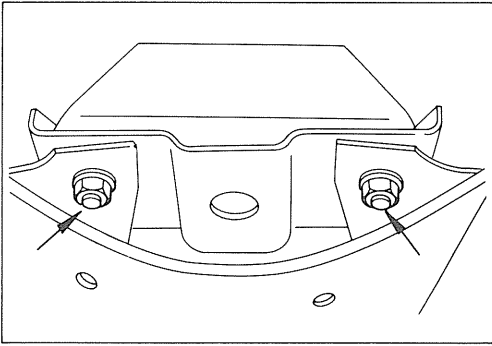
31. Disconnect the propeller shaft at the differential side.

32. Remove the propeller shaft.

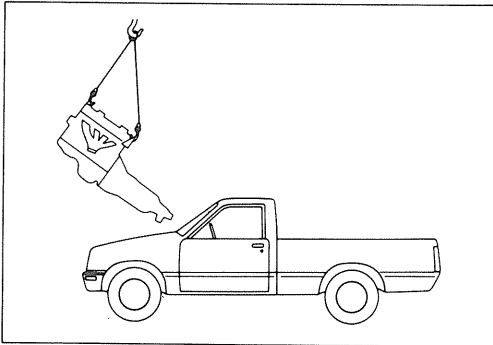
33. Remove return spring from clutch fork.

34. Disconnect clutch cable from hooked portion of clutch fork and pull it out forward through stiffener bracket.

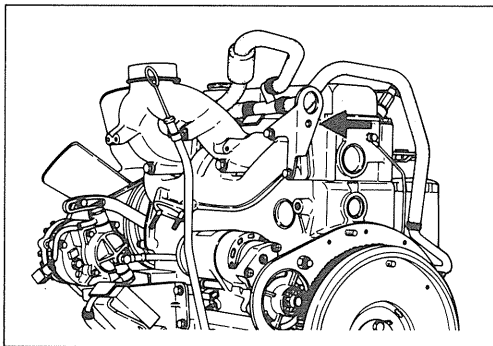




35. Remove bracket to transmission rear mounting bolts and nuts. (2)
36. Raise engine and transmission as required and remove (4) crossmember to frame bracket bolts.



37. Remove the rear mounting nuts from the transmission rear extension.
38. Disconnect electrical connectors at CRS switch and back-up lamp switch.



39. Install the engine lift hanger (Rear)
 Engine hunger : 5-8840-2083-0
 (J-35624)

40. Remove the engine mounting bolt and nuts.
 Check that the engine is slightly raised before removing the engine mounting bolt and nuts.
41. Engine removal
 - Check to make certain all the parts have been removed or disconnected from the engine that are fastened to the frame side.
 - Remove the engine toward front of the vehicle by maneuvering the hoist, so that front part of the engine is raised slightly above the level.



Installation steps

To install the engine on the vehicle, follow the removal procedure in the reverse order.



1. Preparation for engine installation.

Check harnesses for damage and correct or replace with new ones as necessary.

Check engine mounting rubbers for looseness or damage and tighten or replace with new ones as necessary.

2. Steps to be followed after engine installation.



- (1) Fill the engine cooling system.

		liters (gal)
Cooling water capacity	C223	10.3 (2.7)
	C223T	11.9 (3.1)

- (2) Fill the engine lubricating system.

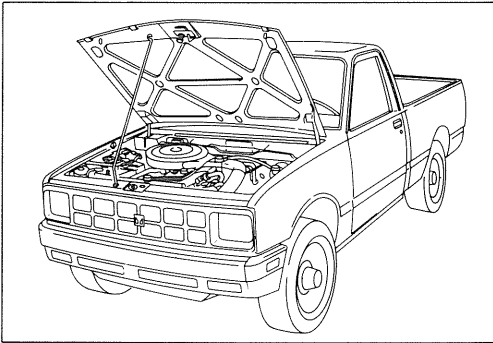
Engine oil capacity	6.5 liters (1.72 gal)
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- (3) Check and adjust clutch pedal free play to 20mm (0.79 in.).

- (4) Adjust the following points by referring to "Servicing".

- a) Check and adjust fan belt tension as necessary.
- b) Adjust engine idle speed.

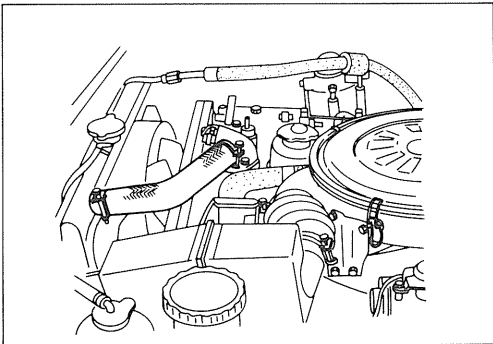
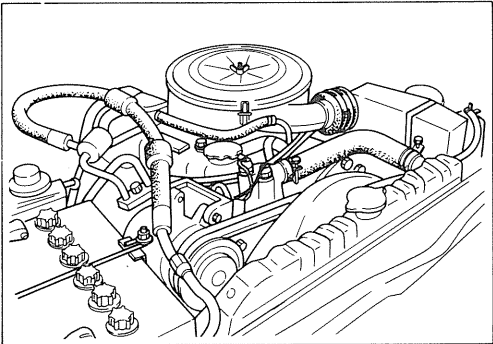


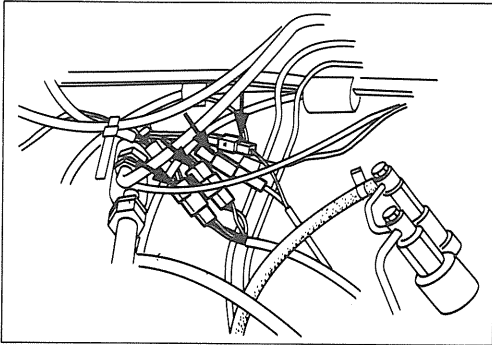
KB (4 x 4 MODELS)



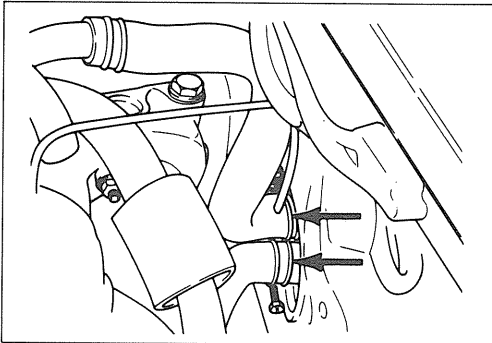
Removal steps

1. Raise engine hood.
2. Disconnect the battery ground cable.
3. Remove the engine hood.
4. Remove the battery assembly.
5. Remove splash cover and drain the cooling system by opening the drain plugs on the radiator and on the cylinder block.
6. Remove the air cleaner as follows:
 - (1) Remove the intake silencer.
 - (2) Remove the bolts fixing the air cleaner and loosen the clamp bolt, then remove the air cleaner assembly.
7. Disconnect the upper radiator hose at the engine side.
8. Loosen the compressor drive belts by moving the power steering oil pump or idler. (If so equipped)
9. Remove the cooling fan and fan shroud.
10. Disconnect the lower radiator hose at the engine side.
11. Remove the radiator grille.
12. Remove the radiator attaching bolts and remove the radiator.
13. Disconnect the accelerator control cable from the injection pump side.
14. Disconnect the air conditioner compressor control cable. (If so equipped)
15. Disconnect the fuel hoses from the injection pump.
16. Disconnect the battery cable from the cylinder body.
17. Disconnect the transmission wiring.
18. Disconnect the vacuum hose from the fast idle actuator.
19. Disconnect the connector at fuel cut solenoid.

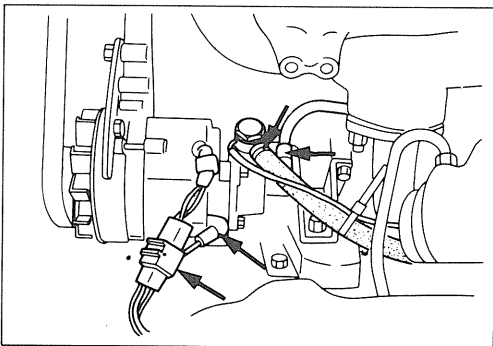




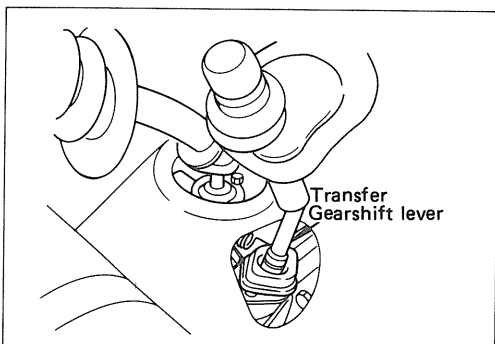
20. Disconnect the connectors shown.
(● Sensing resistor, ● Thermoswitch, ● Air conditioner compressor switch).



21. Disconnect the heater hoses extending from the heater unit from the dash panel side.

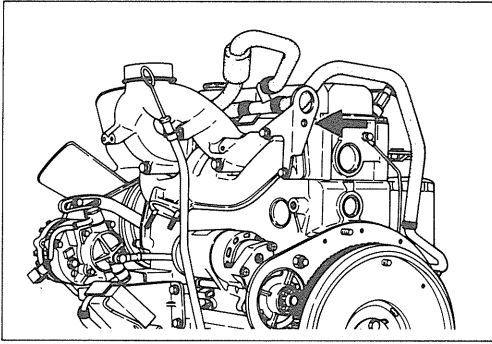


22. Disconnect the hose for the power brake unit from the vacuum pump.
23. Disconnect the vacuum hose from the vacuum pump.
24. Disconnect the alternator wiring at the connector.
25. Disconnect the exhaust pipe from the exhaust manifold at the flange.
26. Remove the exhaust pipe mounting brake from the engine back plate.
27. Disconnect the starter motor wiring.
28. Disconnect the battery cable from starter motor.

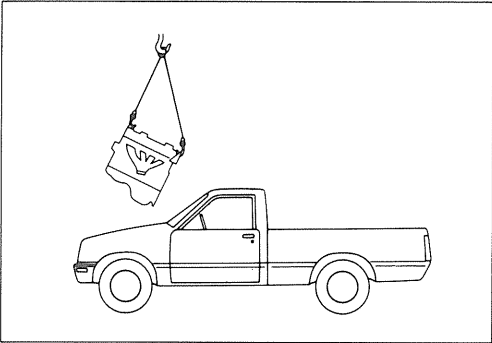


29. Slide the transmission and transfer gearshift lever boot upwards on each lever, remove gearshift lever attaching bolts.
30. Remove return spring from transfer gear shift lever then remove levers.
31. Remove the transmission.

Refer to WORK SHOP MANUAL KB Section "MANUAL TRANSMISSION/TRANSFER CASE" for removal of transmission assembly.



32. Install the engine lift hanger (Rear)
 Engine hanger : 5-8840-2083-0
 (J-35624)



33. Remove the engine mounting bolts and nuts.
 Check that the engine is slightly raised before removing the engine mounting bolts and nuts.
34. Engine removal
- Check to make certain all the parts have been removed or disconnected from the engine that are fastened to the frame side.
 - Remove the engine toward front of the vehicle by maneuvering the hoist, so that front part of the engine is raised slightly above the level.



Installation steps

To install the engine on the vehicle, follow the removal procedure in the reverse order.



1. Preparation for engine installation.

Check harnesses for damage and correct or replace with new ones as necessary.

Check engine mounting bushings for looseness or damage and tighten or replace with new ones as necessary.

2. Steps to be followed after engine installation.

(1) Fill the engine cooling system.

		liters (gal)
Cooling water capacity	C223	10.3 (2.7)
	C223T	11.9 (3.1)



(2) Fill the engine lubricating system.

Engine oil capacity	6.5 liters (1.72 gal)
---------------------	-----------------------



(3) Check and adjust clutch pedal free play to 20mm (0.79 in.).

(4) Adjust the following points by referring to Section 00. "General Information".

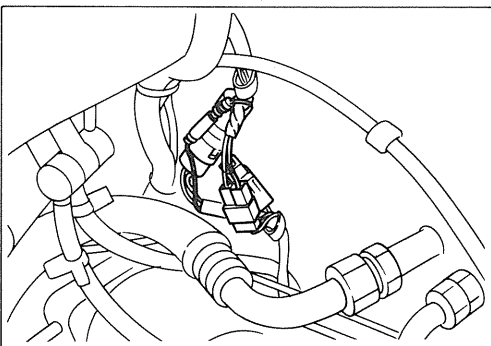
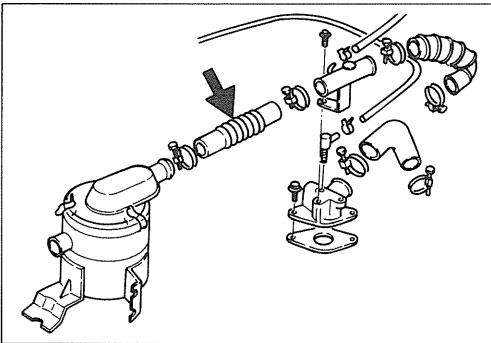
- a) Check and adjust fan belt tension as necessary.
- b) Adjust engine idling.

USB

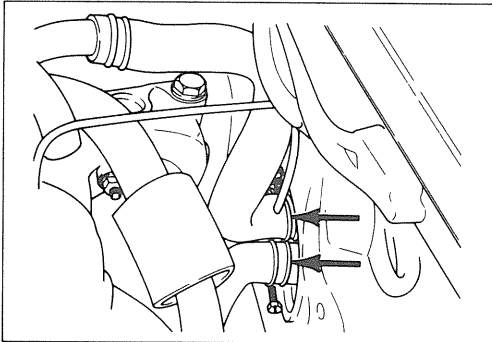


Removal steps

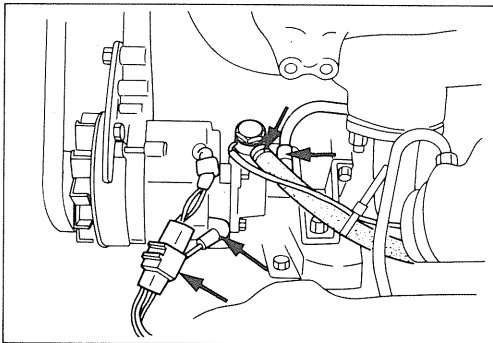
1. Raise engine hood.
2. Disconnect the battery ground cable.
3. Remove the engine hood.
4. Remove the battery assembly.
5. Remove splash cover and drain the cooling system by opening the drain plugs on the radiator and on the cylinder block.
6. Disconnect the air cleaner connecting hose.
7. Disconnect the upper water hose at the engine side.
8. Loosen the compressor drive belts by moving the power steering oil pump or idler. (If so equipped)
9. Remove the cooling fan and fan shroud.
10. Disconnect the lower water hose at the engine side.
11. Remove the radiator grill.
12. Remove the radiator attaching bolts and remove the radiator.
13. Disconnect the accelerator control cable from the injection pump side.
14. Disconnect the air conditioner compressor control cable. (If so equipped)
15. Disconnect the fuel hoses from the injection pump.
16. Disconnect the battery cable from the cylinder body.
17. Disconnect the transmission wiring.
18. Disconnect the vacuum hose from the fast idle actuator.



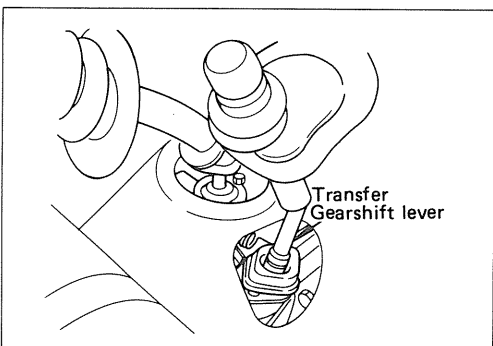
19. Disconnect the connector at fuel cut solenoid.
20. Disconnect the connectors shown (● Sensing resistor, ● Thermoswitch, ● Air conditioner compressor switch.)



21. Disconnect the heater hoses extending from the heater unit from the dash panel side.



22. Disconnect the hose for master-vac from the vacuum pump.
23. Disconnect the vacuum hose from the vacuum pump.
24. Disconnect the generator wiring at the connector.
25. Disconnect the exhaust pipe from the exhaust manifold at the flange.



26. Remove the exhaust pipe mounting brake from the engine back plate.
27. Disconnect the starter motor wiring.
28. Disconnect the battery cable from starter motor.
29. Slide the transmission and transfer gearshift lever boot upwards on each lever, remove gearshift lever attaching bolts.
30. Remove return spring from transfer gear shift lever then remove levers.

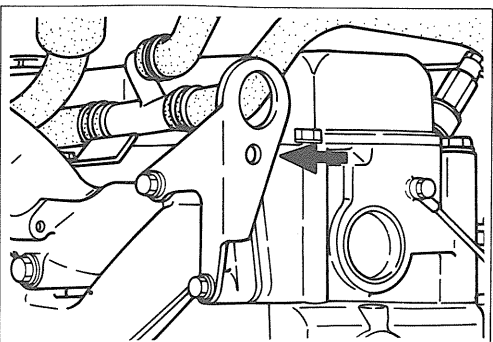
31. Remove the transmission.

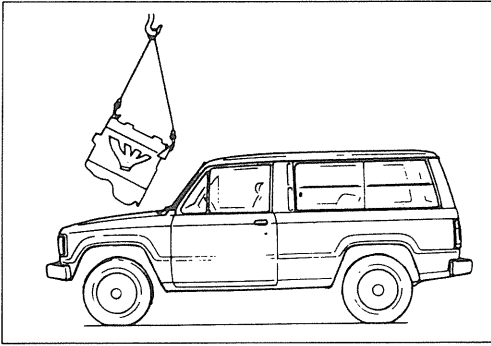
Refer to WORK SHOP MANUAL UBS Section "MANUAL TRANSMISSION/TRANSFER CASE" for removal of transmission assembly.

32. Remove the engine mounting bolts and nuts.

Check that the engine is slightly raised before removing the engine mounting bolts and nuts.

33. Install the engine lift hanger (Rear)
Engine hanger (Rear) : 5-8840-2083-0
(J-35624)





34. Engine removal

- Check to make certain all the parts have been removed or disconnected from the engine that are fastened to the frame side.
- Remove the engine toward front of the vehicle by maneuvering the hoist, so that front part of the engine is raised slightly above horizontal.



Installation steps

To install the engine on the vehicle, follow the removal procedure in the reverse order.



1. Preparation for engine installation.

Check harnesses for damage and correct or replace with new ones as necessary.

Check engine mounting bushings for looseness or damage and tighten or replace with new ones as necessary.

2. Steps to be followed after engine installation.

(1) Fill the engine cooling system.

Cooling water capacity	10.3 liters (2.7 gal)
------------------------	-----------------------



(2) Fill the engine lubricating system.

Engine oil capacity	6.5 liters (1.72 gal)
---------------------	-----------------------



(3) Check and adjust clutch pedal free play to 20mm (0.79 in.).

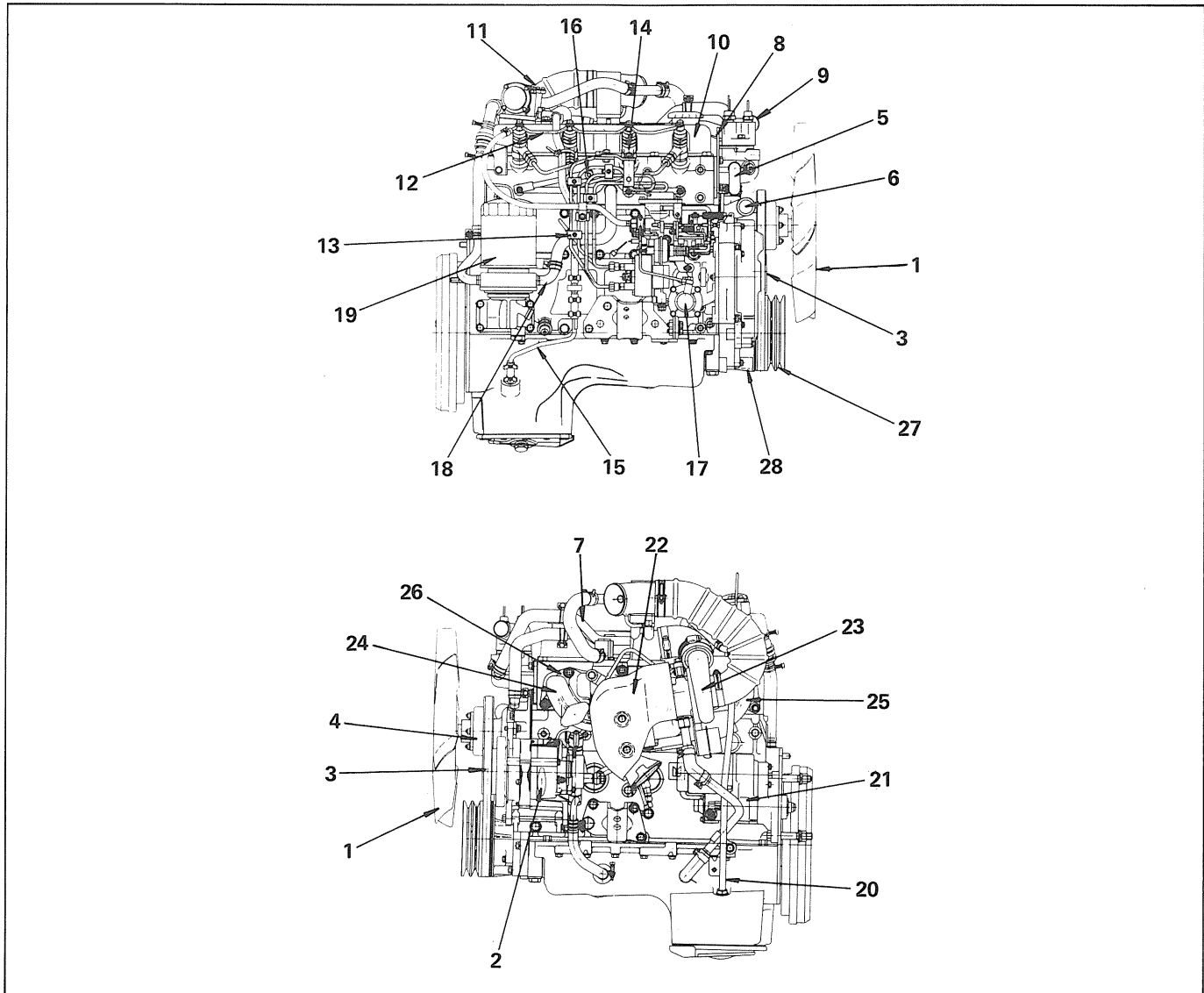
(4) Adjust the following points by referring to Section 00 "General Information".

- a) Check and adjust fan belt tension as necessary.
- b) Adjust engine idling.



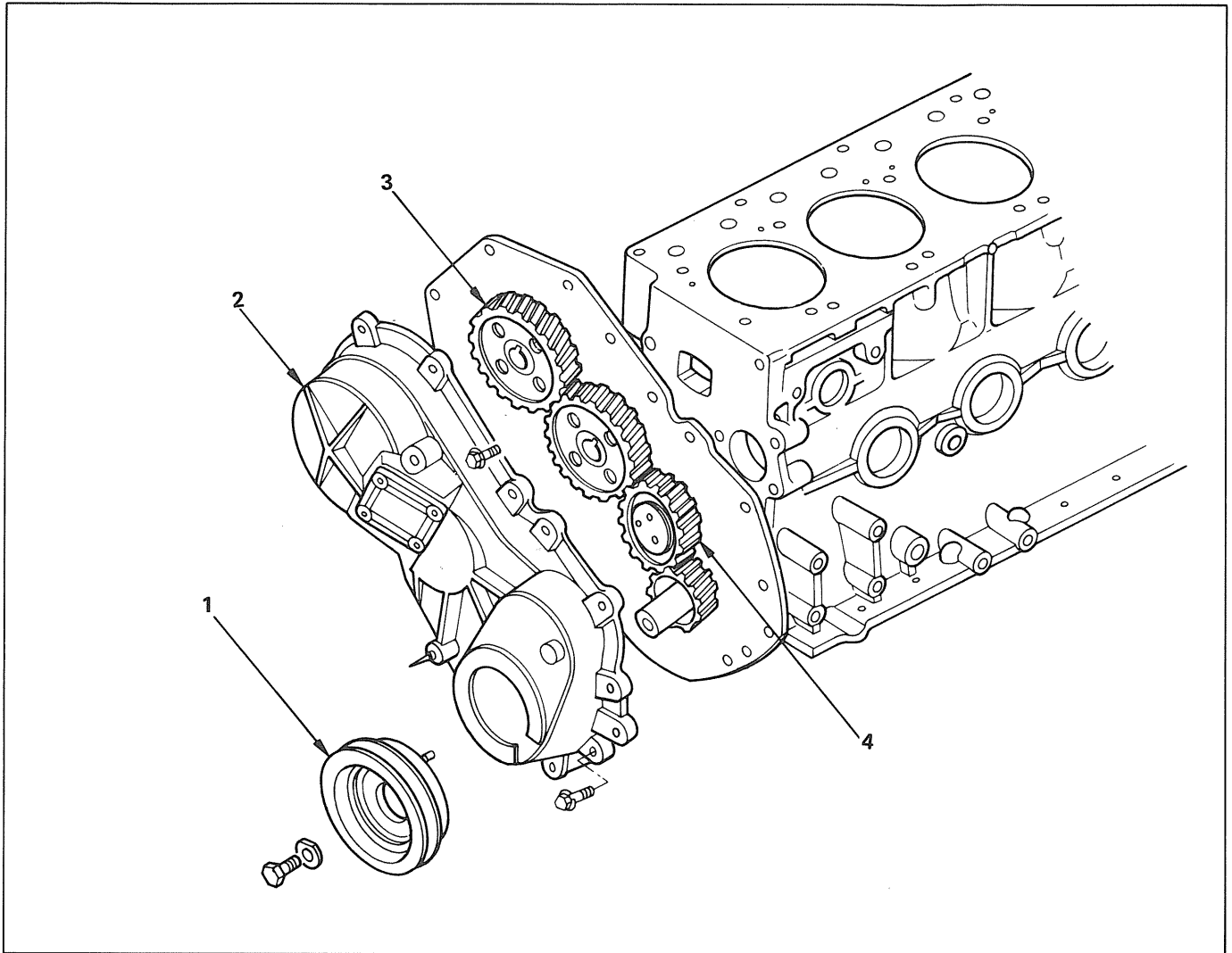
DISASSEMBLY

EXTERNAL PARTS

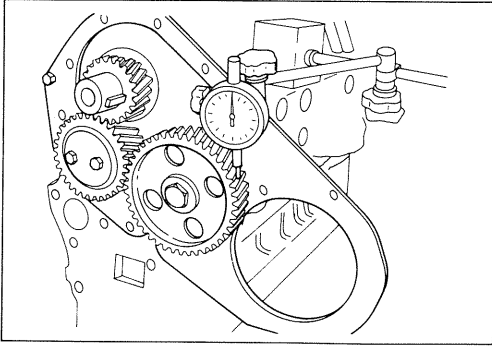


Disassembly steps

- | | |
|-----------------------------------|---|
| 1. Cooling fan | 15. Breather hose |
| 2. Generator assembly and bracket | 16. Glow plug and sensing resistor |
| 3. Fan belt | 17. Oil pressure switch and oil pressure unit |
| 4. Fan pulley | 18. Oil cooler hose |
| 5. Water by-pass hose | 19. Oil filter |
| 6. Water pump | 20. Oil guide tube assembly |
| 7. Heater hose | 21. Starter motor assembly |
| 8. Engine hanger (Front) | 22. Turbocharger cover (C223T only) |
| 9. Thermostat housing | 23. Turbocharger (C223T only) |
| 10. Head cover | 24. Exhaust manifold |
| 11. PCV valve | 25. Intake manifold |
| 12. Leak-off pipe | 26. Intake and exhaust manifold gaskets |
| 13. Injection pipe and clip | 27. Crankshaft pulley |
| 14. Nozzle holder assembly | 28. Timing pulley housing cover |

INTERNAL PARTS**TIMING GEAR TRAIN****MAJOR COMPONENTS****Disassembly steps**

1. Pulley
2. Timing gear case cover
- ▲ 3. Injection pump assembly
- ▲ 4. Idler gear



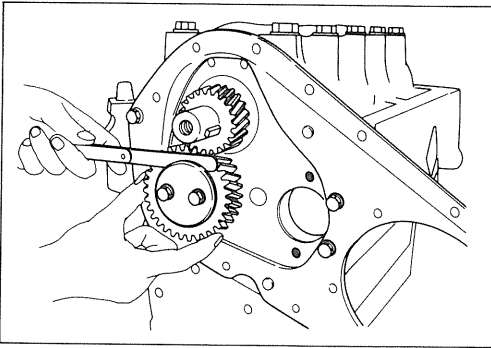
Important operations

3. Injection pump assembly

Inspect the following items before timing gear removal.

Backlash (crankshaft gear, idler gear, camshaft gear, injection pump gear).

mm(in.)	
Standard	Limit
0.10—0.17 (0.0039—0.0067)	0.3 (0.0118)



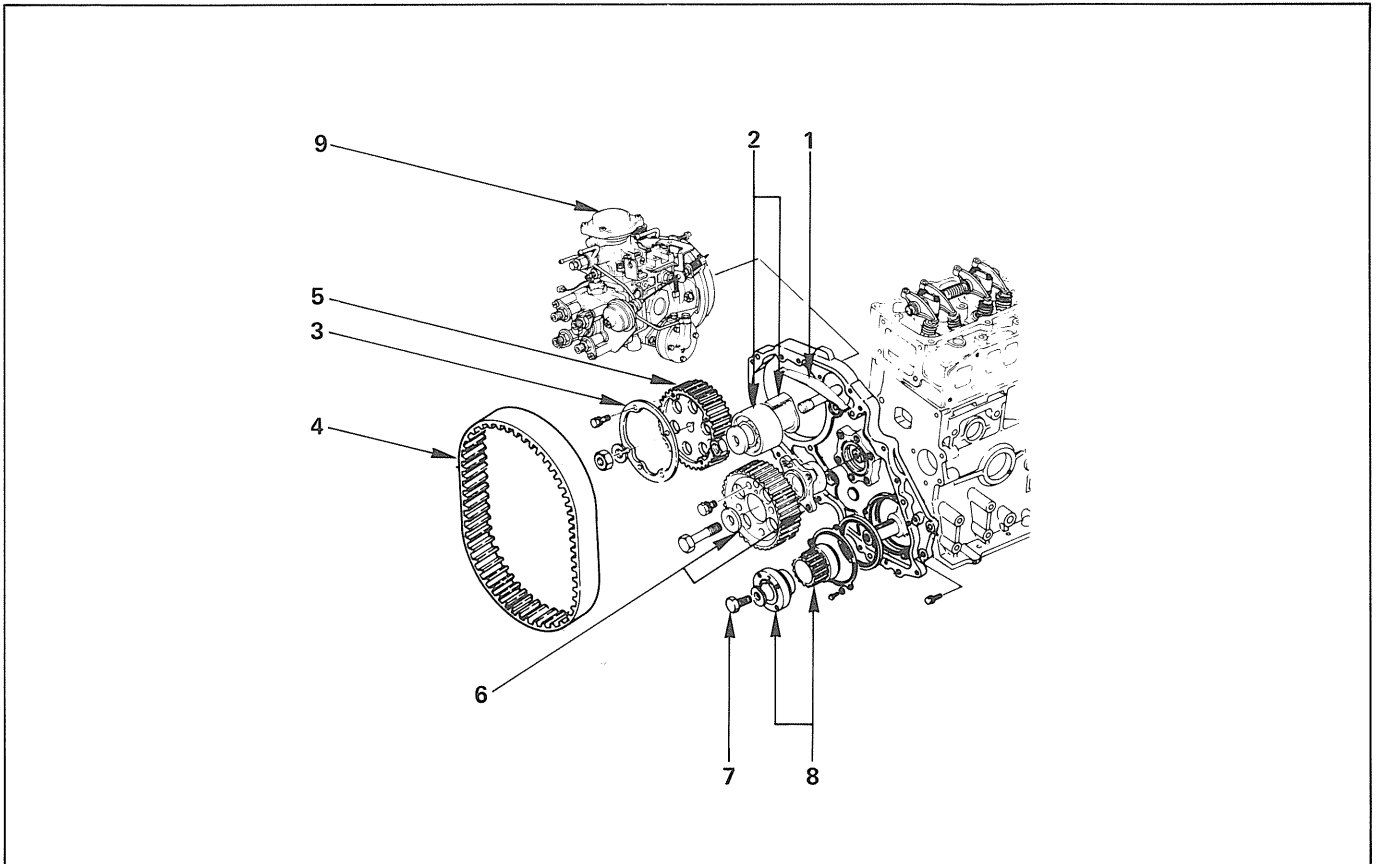
4. Idler gear end play

mm(in.)	
Standard	Limit
0.07 (0.0027)	0.2 (0.079)

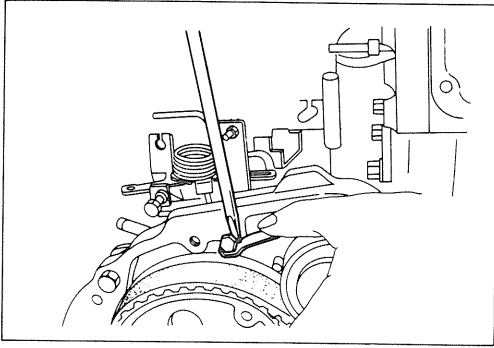
TIMING BELT TRAIN

MAJOR COMPONENTS

INJECTION PUMP AND TIMING MECHANISM

**Disassembly steps**

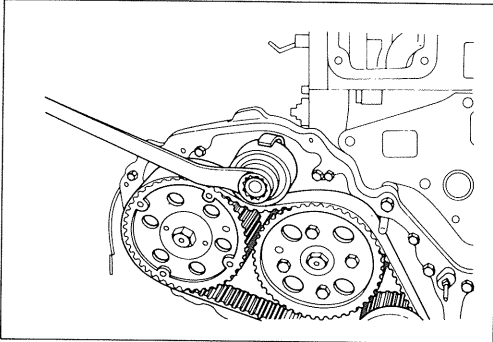
- | | |
|---|---|
| ▲ 1. Tension spring | ▲ 6. Camshaft timing pulley and center |
| ▲ 2. Tension pulley and tension center | ▲ 7. Crankshaft pulley bolt |
| ▲ 3. Injection pump timing pulley, flange | ▲ 8. Crankshaft center and timing pulley. |
| ▲ 4. Timing belt | ▲ 9. Injection pump |
| ▲ 5. Injection pump timing pulley | |



Important operations

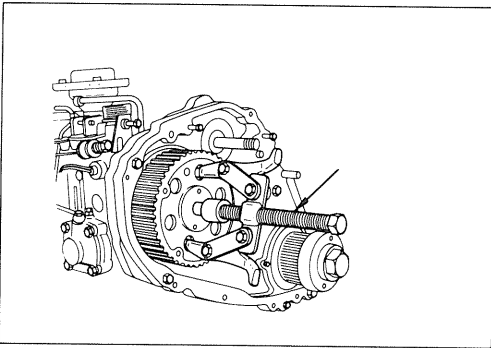
1. Tension spring

When removing tension spring avoid using excess force, or distortion of spring will result.



2. Tension pulley and tension center

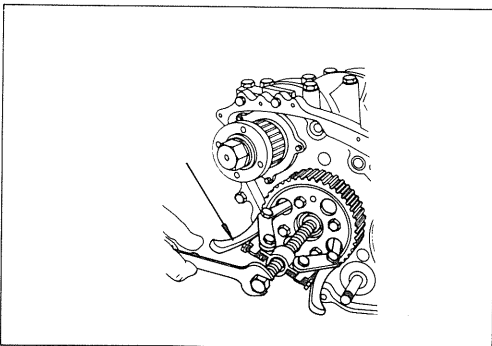
Remove the fixing bolt, then tensioner assembly.



5. Injection pump timing pulley

Install a 6 mm bolt (with pitch of 1.25) into threaded hole in the timing pulley housing through the hole in pulley to prevent turning of the pulley. Remove the bolts fixing the injection pump timing pulley, then remove the pulley using puller.

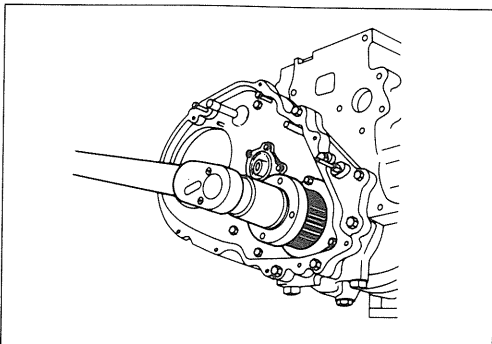
Pulley puller : 5-8840-0142-0
(J-29801)



6. Camshaft timing pulley and center

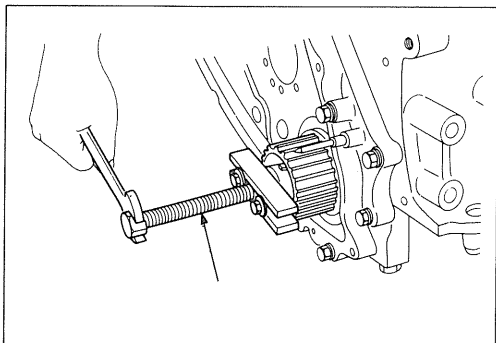
Install a 6 mm bolt (with pitch of 1.25) into threaded hole in the timing pulley housing through the hole in the pulley to prevent turning of the pulley. Remove the bolts fixing the camshaft timing pulley, then remove the pulley using puller.

Pulley puller : 5-8840-0013-0
(J-22888)



7. Crankshaft pulley bolt

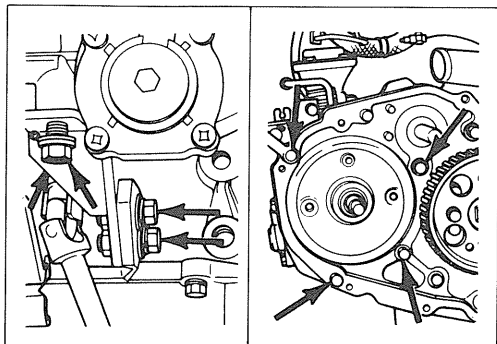
Remove the crankshaft pulley bolt using a bar to prevent turning of the crankshaft.



8. Crankshaft center and timing pulley

Remove the crankshaft center and timing pulley using puller.

Pulley puller : 5-8521-0016-0
(J-29752)

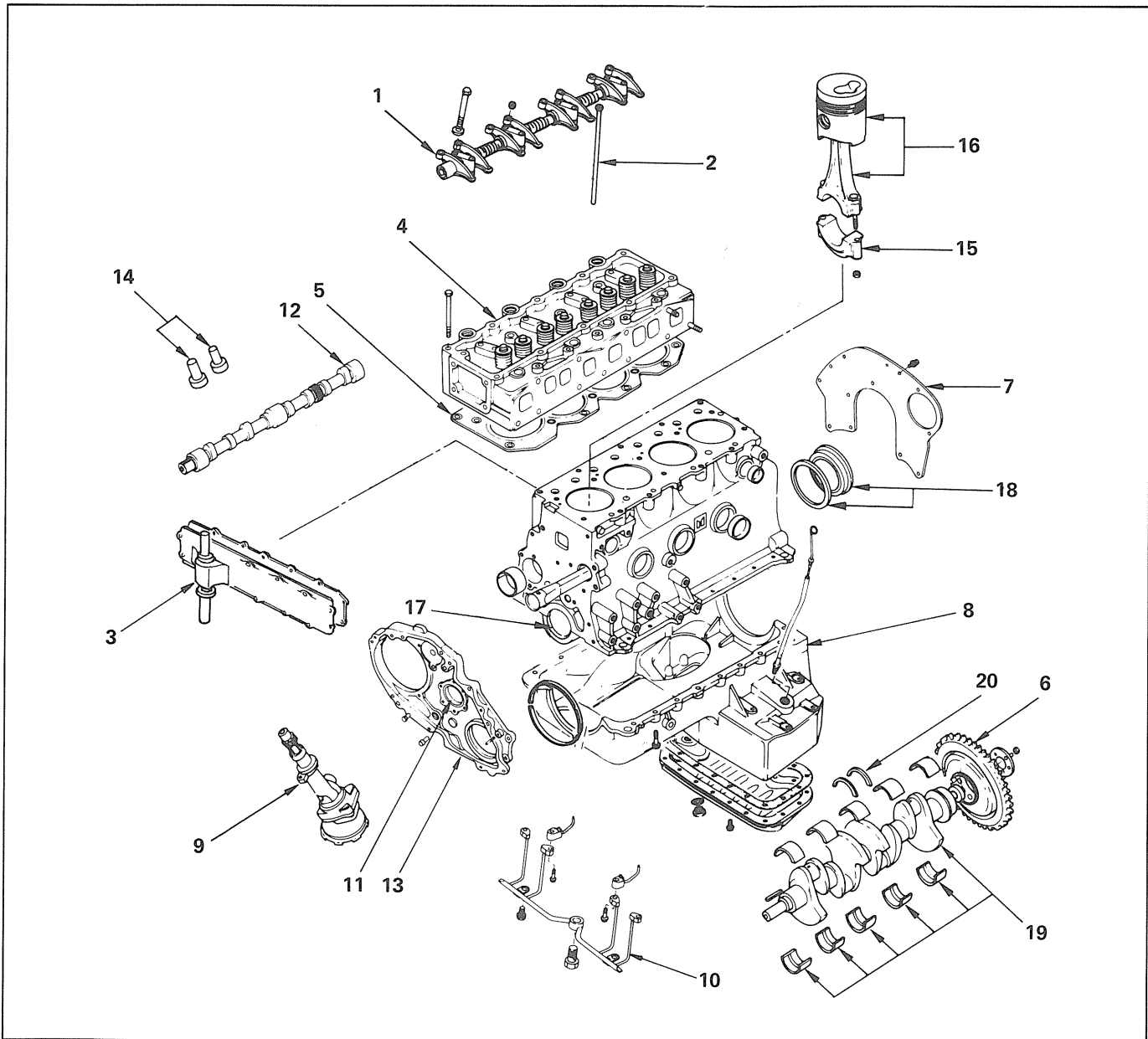


9. Injection pump

Remove the bolts fixing the injection pump bracket to the timing pulley housing.

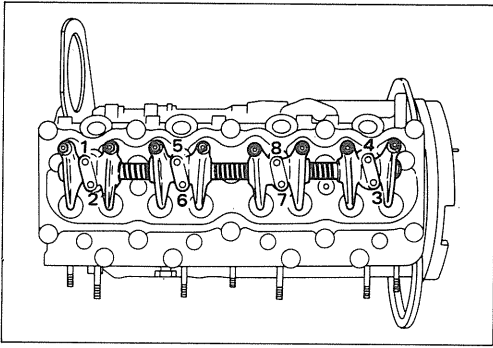
Remove the bolts fixing the injection pump bracket at the rear of the injection pump, then remove the injection pump assembly.

CYLINDER HEAD, CYLINDER,
CRANKSHAFT, PISTON, CAMSHAFT



Disassembly steps

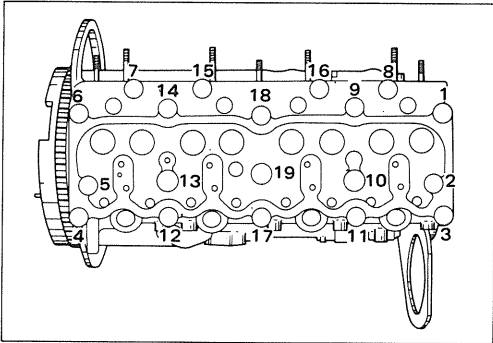
- ▲ 1. Rocker arm assembly
- 2. Push-rods
- 3. Tappet chamber cover and rocker oil feed pipe
- ▲ 4. Cylinder head
- 5. Cylinder head gasket
- ▲ 6. Flywheel
- 7. Rear plate
- 8. Crankcase with oil pan
- ▲ 9. Oil pump
- 10. Oil jet
- 11. Camshaft oil seal retainer
- ▲ 12. Camshaft and cam gear
- 13. Timing pulley housing
- 14. Tappets
- ▲ 15. Connecting-rod bearing cap
- ▲ 16. Piston and connecting-rod
- ▲ 17. Crankshaft bearing cap
- ▲ 18. Crankshaft rear oil seal and spacer
- 19. Crankshaft and bearing
- 20. Thrust bearing



Important operations

1. Rocker arm assembly

Remove the 8 bolts fixing the rocker arm brackets in sequence starting with the outer bolts. Remove the rocker arm assembly.

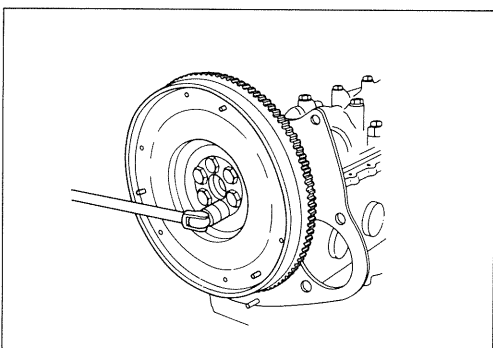


4. Cylinder head

Remove the 19 bolts clamping the cylinder head and remove the cylinder head assembly. Remove the cylinder head gasket.

Loosen the cylinder head bolts in 2 or 3 steps in sequence circular starting with the outer bolts. Remove the cylinder head upward as it is fitted to the cylinder body with dowels.

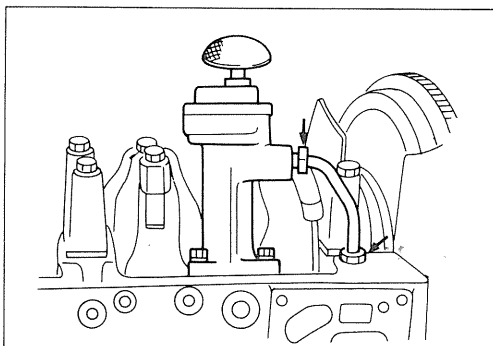
Wrench : 9-8511-3127-0



6. Flywheel

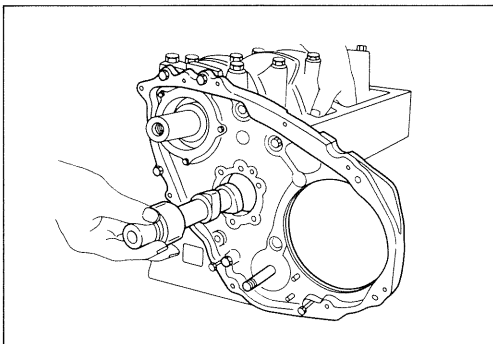
Remove the 6 bolts mounting the flywheel and remove the flywheel assembly.

When loosening the flywheel bolts, hold the crankshaft pulley bolt with a wrench to prevent turning of the crankshaft.



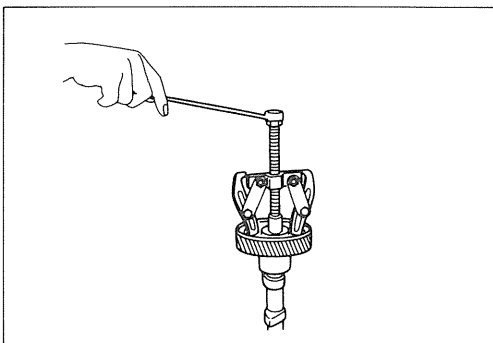
9. Oil pump

Remove the oil pipe sleeve nut. Remove the 2 bolts fixing the oil pump and remove the oil pump with oil line.



12. Camshaft

Remove the camshaft carefully so as not to cause damage to the camshaft bearings.

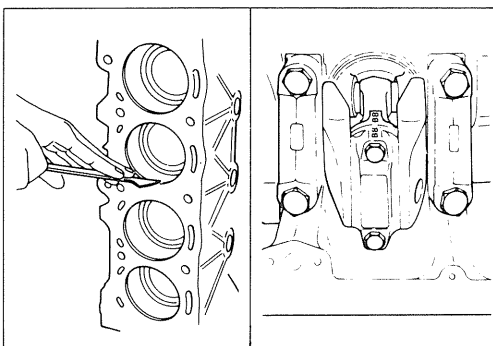


Camshaft gear replacement (Timing gear train)

Removal



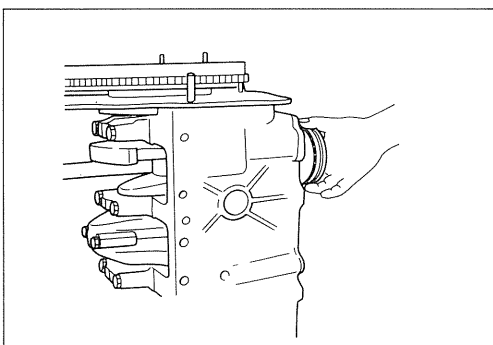
Remover : 5-85210-002-0



15. Connecting-rod bearing cap

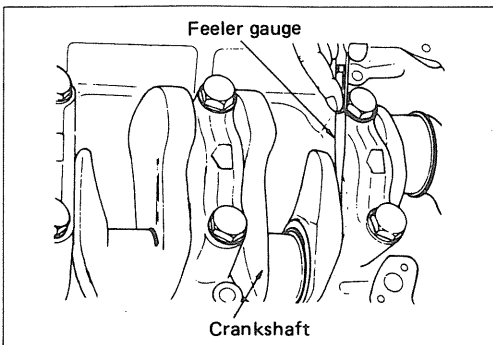
Remove carbon from upper part of the cylinder wall with a scraper to facilitate smooth removal of the piston.

Remove the connecting-rod bearing cap nuts, then remove the bearing cap.



16. Piston and connecting-rod

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

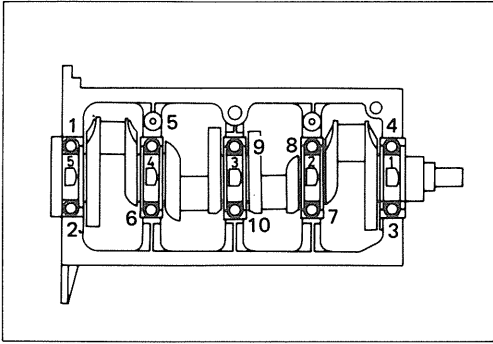


17. Crankshaft bearing and cap

Check the crankshaft end play before disassembly.

mm(in.)

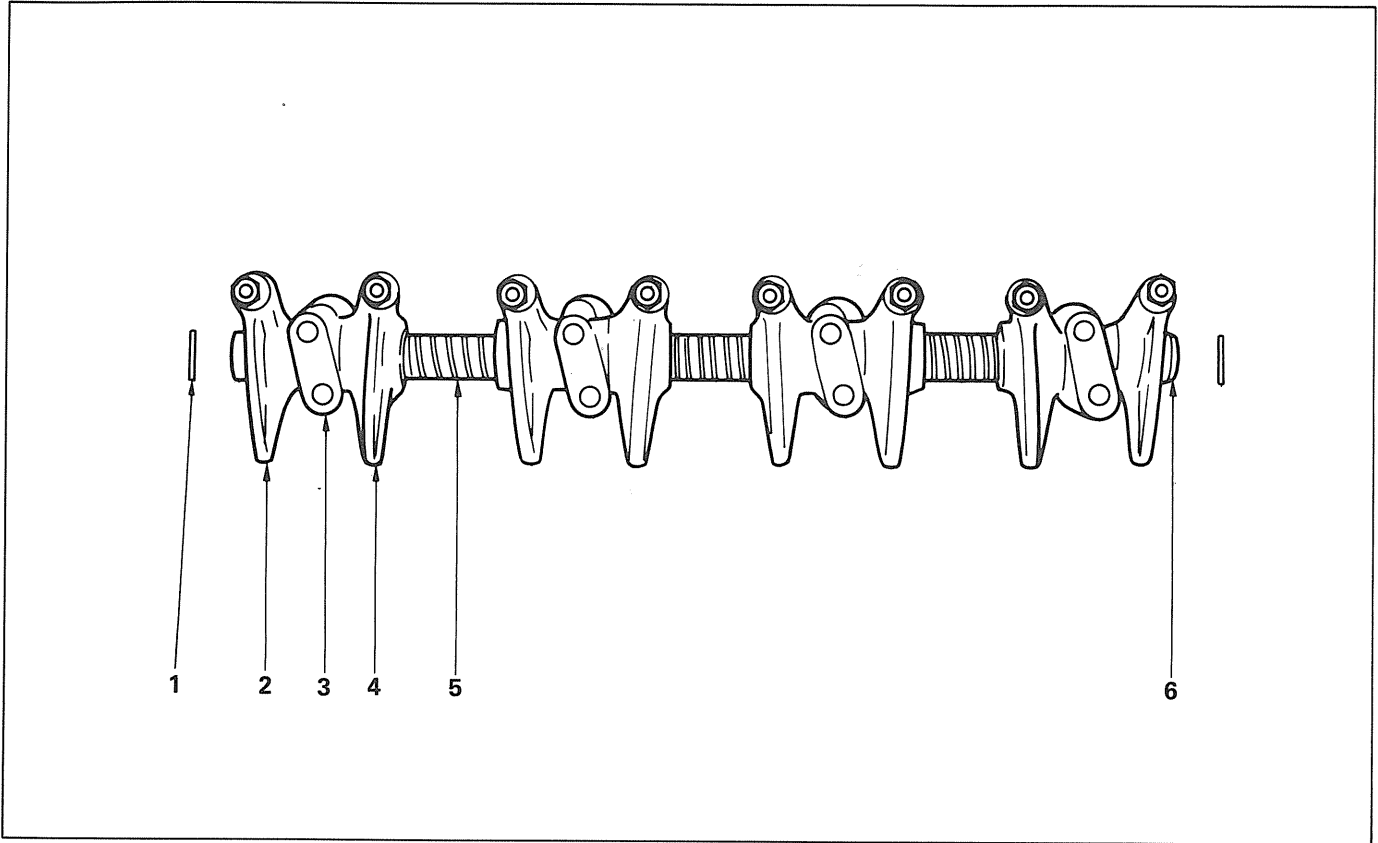
Standard	Limit
0.1 (0.0039)	0.3 (0.0018)



Loosen the crankshaft bearing cap bolts in sequence starting with the outer ones.
Remove the bolts, bearing caps and bearings.

MINOR COMPONENTS

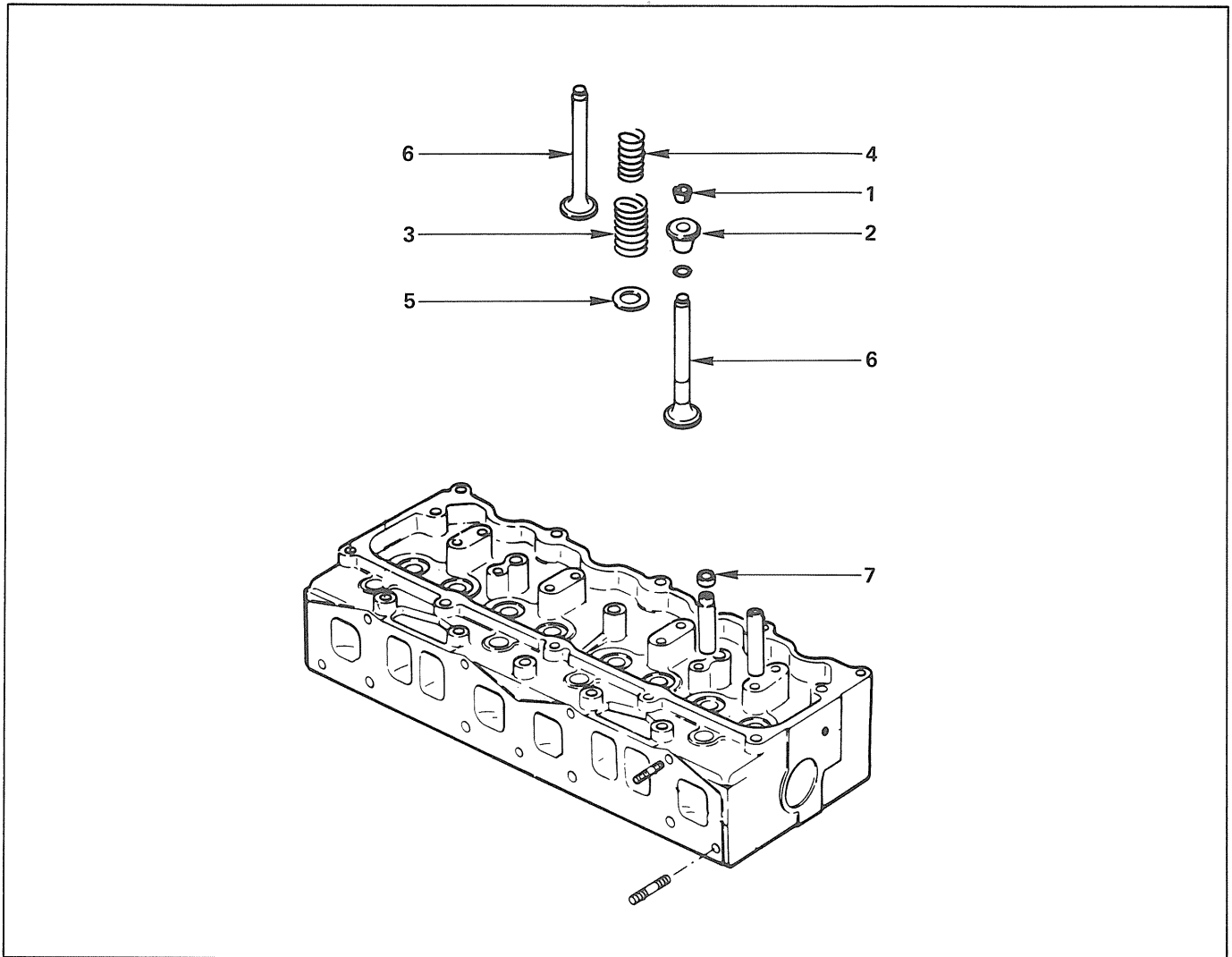
ROCKER ARM ASSEMBLY



Disassembly steps

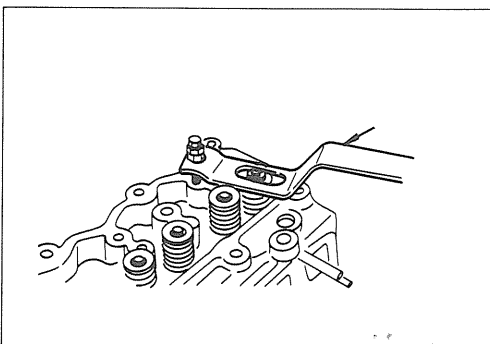
- | | |
|-----------------------------|---------------------|
| 1. Snap ring | 4. Rocker arm |
| 2. Rocker arm | 5. Spring |
| 3. Rocker arm shaft bracket | 6. Rocker arm shaft |

CYLINDER HEAD



Disassembly steps

- | | |
|------------------------|------------------------------|
| ▲ 1. Split collar | 5. Valve spring lower washer |
| 2. Valve spring seats | 6. Valve |
| 3. Valve spring; outer | 7. Valve stem oil seal |
| 4. Valve spring; inner | |



Important operations

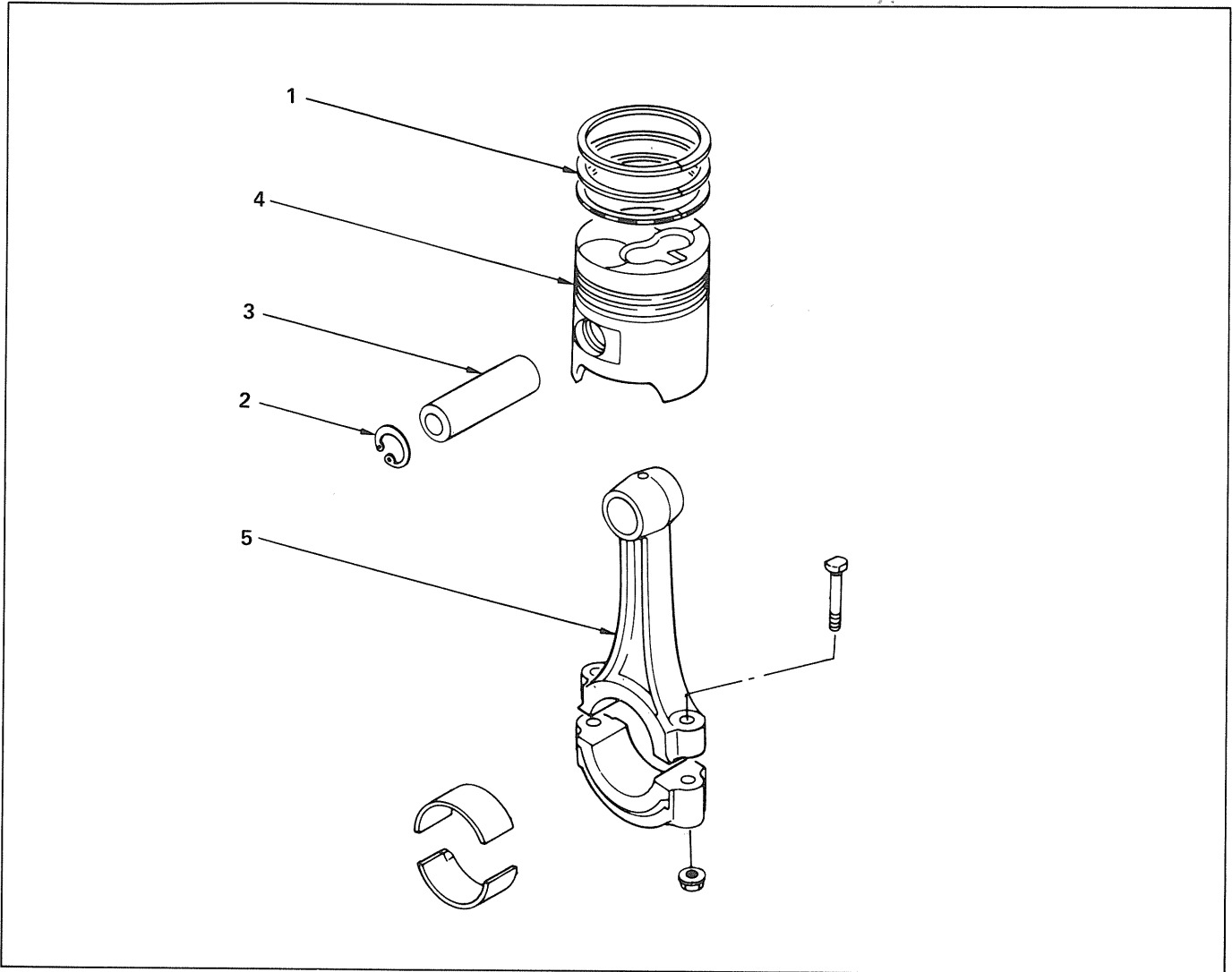
1. Split collars

Compress the valve springs with valve spring compressor and remove the split collars.



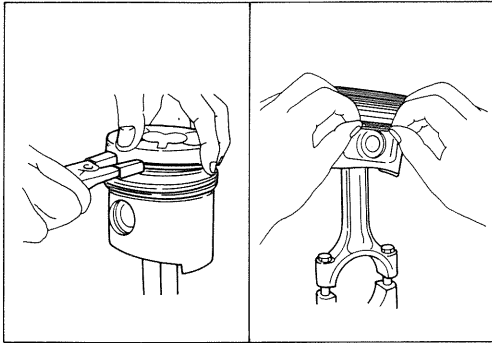
Valve spring compressor : 9-8523-1423-0
(J-29760)

PISTON AND CONNECTING ROD ASSEMBLY



Disassembly steps

- ▲ 1. Piston ring
- ▲ 2. Snap ring
- ▲ 3. Piston pin
- ▲ 4. Piston
- ▲ 5. Connecting-rod

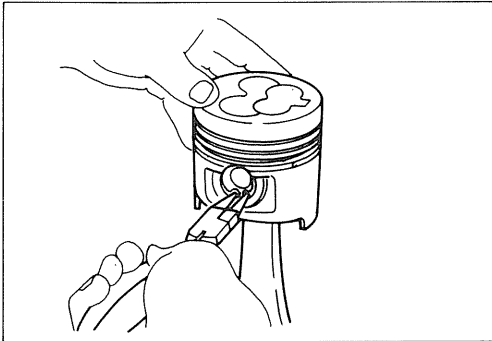


Important operations

1. Piston ring

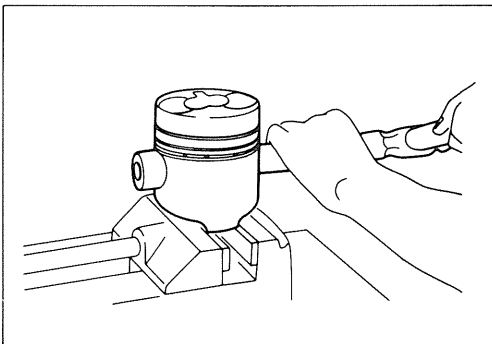
Remove the piston rings using piston ring remover or equivalent tool.

Remover : 1-85221-025-0
(J-25220)



2. Snap ring

Remove the piston pin snap rings using snap ring pliers.



3. Piston pin

Drive out using a brass rod at normal temperature.



INSPECTION AND REPAIR

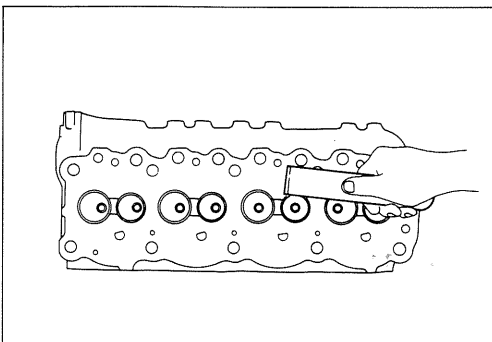
Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found through inspection.

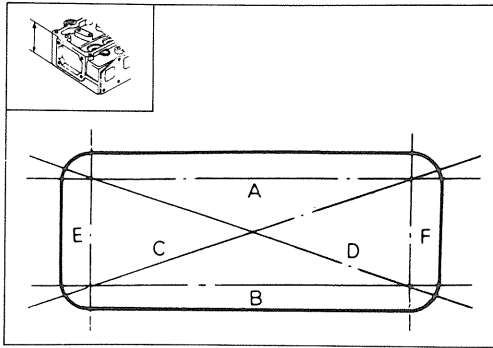
CYLINDER HEAD



Visual check

Remove carbon deposits from lower surface of the cylinder head using care so that valve seats and other machined surfaces are not damaged.

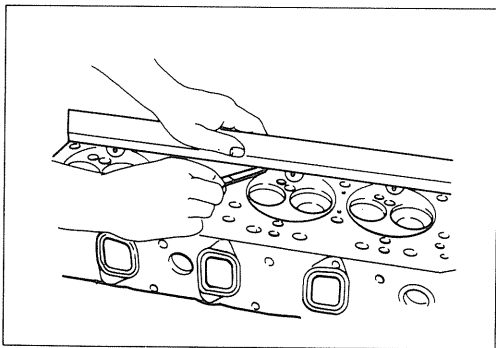




Distortion of lower face

Check the lower face for distortion in directions diagonally and across the face as shown using a straight edge and a feeler gauge. Correction is necessary if the amount of distortion is beyond the specified value.

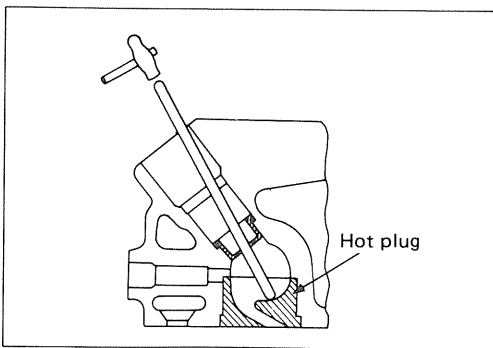
	mm(in.)	
	Standard	Limit
Overall length	0.05 or less (0.0020)	0.4 (0.0158)
Thickness	91.95-92.05 (3.6201-3.6240)	91.75 (3.6122)



Depression of hot plugs

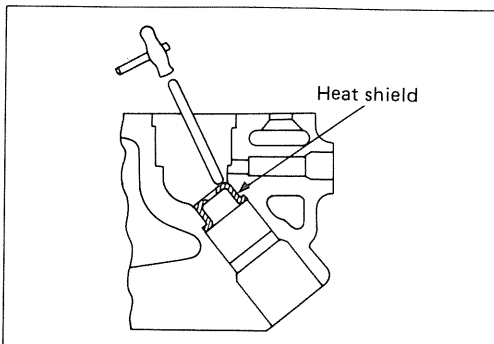
Check the amount of depression of hot plugs on No. 1 through No. 4 cylinders using a feeler gauge, with a straight edge held against the hot plug face.

Limit	mm(in.)
	0.02 (0.0008)



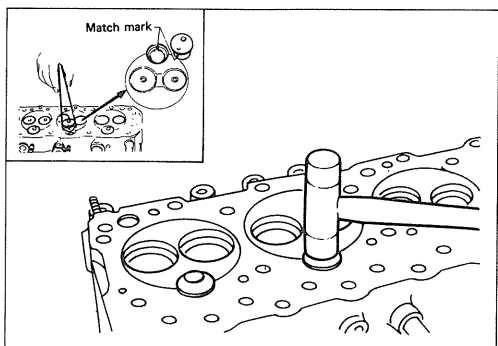
Hot plug replacement

Remove the hot plug in the following manner: Insert a suitable round rod 3 to 5 mm (0.12 to 0.2 in.) in diameter into nozzle holder fitting hole to touch the hot plug, then drive out the hot plugs using a hammer.

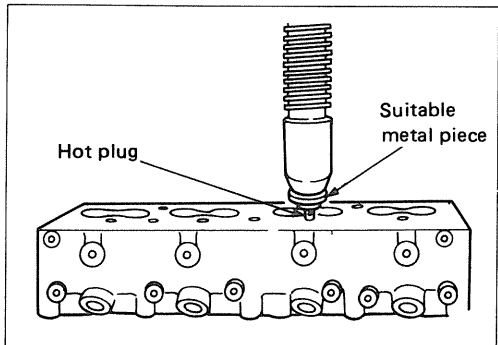


Heat shield replacement

Drive out the heat shield.

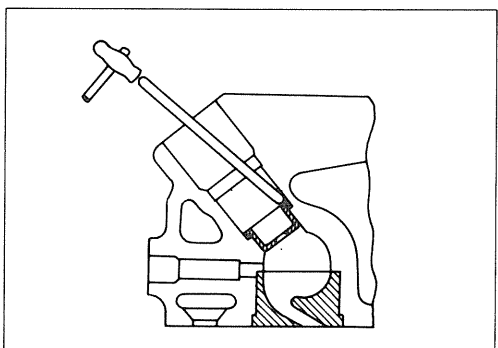


Install lock ball into groove in hot plug. Drive the hot plug into cylinder head by aligning lock ball in hot plug with groove in cylinder head.



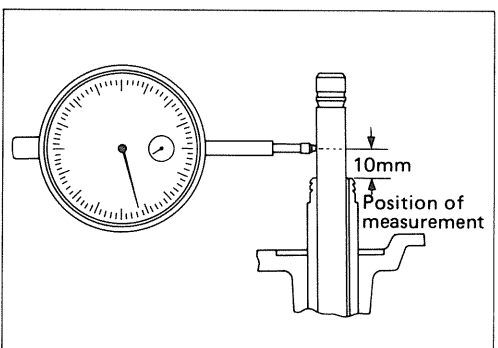
Installation of hot plug

Press the hot plug into position by applying 4500 to 5000 kg (9,923 to 11,025 lb.) 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 heat shield

Install the heat shield with the flanged side up on the cylinder head by tapping on the flange lightly with a brass rod. Discard used heat shield and install a new one at reassembly.

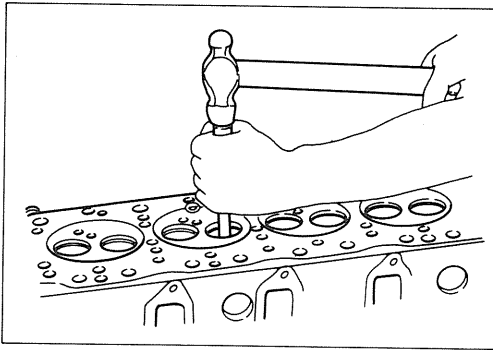


Valve guide

Check the amount of wear in valve guide to determine the clearance between valve stem and guide.

Clearance between valve stem and valve guide

		mm(in.)
	Standard	Limit
Intake:	0.039—0.068 (0.0015—0.0027)	0.20 (0.0079)
Exhaust:	0.064—0.093 (0.0025-0.0037)	0.20 (0.0079)

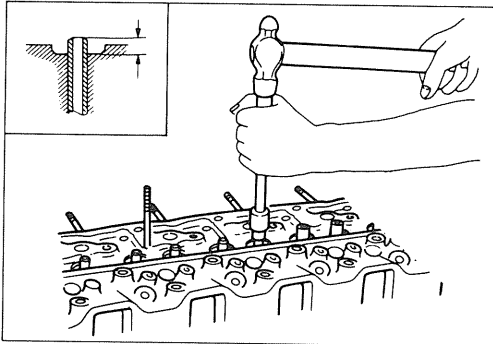


Valve guide replacement

Drive out the valve guide with the remover fixed against the valve guide from lower face of the cylinder head.



Valve guide remover : 5-85230-002-0
5-85232-0003-0
(J-26512)



Apply engine oil to the outer circumference of the valve guide.



Set the installer on the valve guide, then drive the guide into position from the upper face of the cylinder head using a hammer.



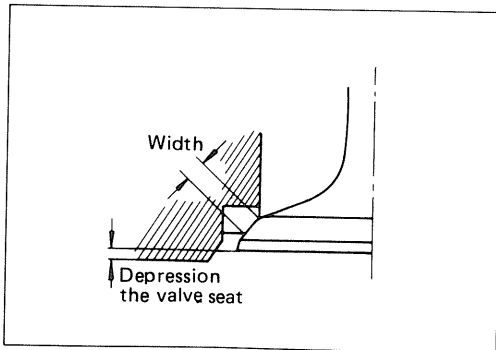
mm(in.)

Height of valve guide upper end from cylinder head upper face	12 (0.4724)
---	-------------



Valve guide installer : 5-85230-002-0
5-85232-003-0
(J-26512)

The valve guide should always be replaced together with the valve as a set.



Valve seat insert

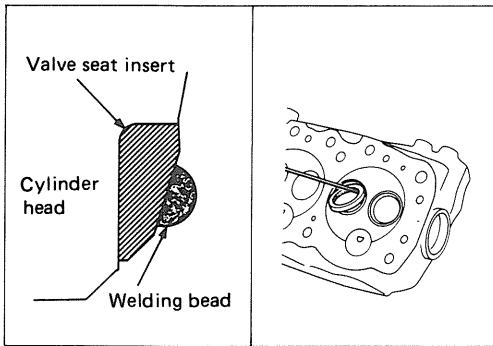
Check valve seat contact width, condition of seat contact, scores, dents, etc.

Check the amount of valve seat depression (from lower face of cylinder head to valve face) using a depth gauge with a valve placed into the cylinder head.

Contacting width and depression:

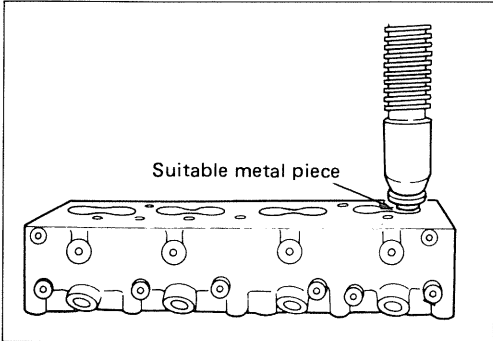
mm(in.)

	Standard	Limit
Width	1.2—1.5 (0.0473—0.0591)	3.6 (0.1418)
Depression	0.7 (0.0276)	2.0 (0.0788)

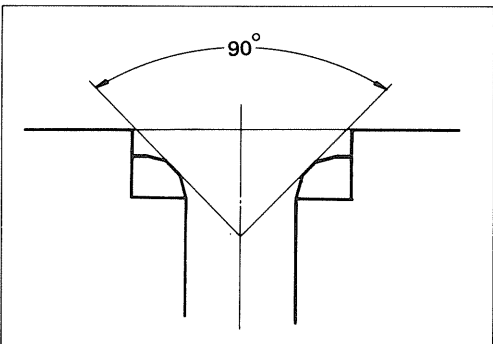


Valve seat insert replacement

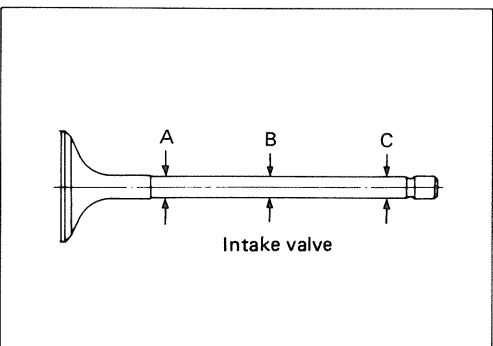
Arc-weld excess metal around inner face of the valve seat insert and allow to cool off a few minutes, then pry off the valve seat insert with screwdrivers.



Press a new valve seat insert into the bore using a bench press. After installation of the valve seat insert, grind finish the seating face with a seat grinder carefully noting the seating angle, contact width and depression. Lap the valve and seat as the final step.



Valve seat angle



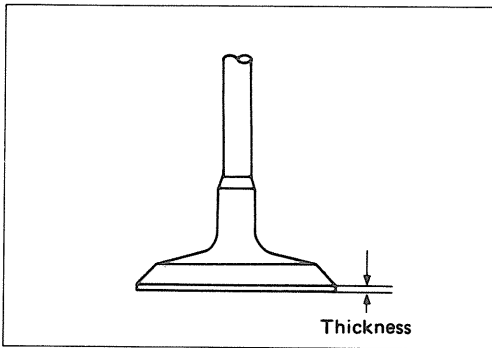
Valve stem

Check working face of rocker arm and valve stem end for step wear and scores and replace the valve together with the valve guide.



Valve stem diameter

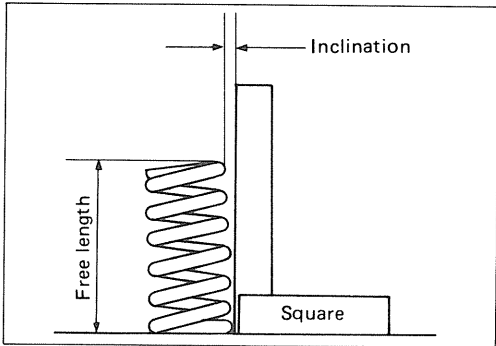
		mm(in.)
	Standard	Limit
Intake valve	7.949—7.961 (0.3132—0.3137)	7.88 (0.3103)
Exhaust valve	7.921—7.936 (0.3121—0.3127)	7.85 (0.3091)



Valve seat thickness

Intake and exhaust valve head edge thickness: mm(in.)

Standard	Limit
1.3 (0.0512)	1.0 (0.0394)



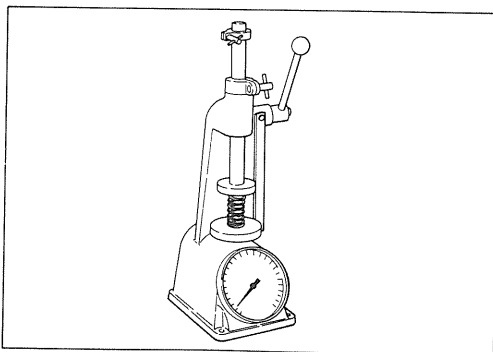
Valve spring

Free length mm(in.)

	Standard	Limit
Inner	47.9 (1.8873)	46.5 (1.832)
Outer	47.3 (1.8636)	45.8 (1.8045)

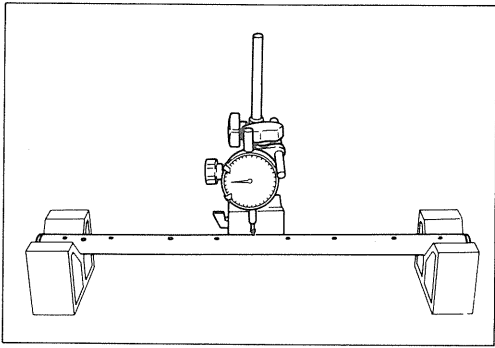
Inclination from vertical

Limit	mm(in.)	1.0(0.0394)
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Spring Tension

	When compressed to	Standard	limit
Inner	37 mm (1.4567 in.)	5.55-6.25 (12.24-13.78)	5.02 (11.07)
Outer	39 mm (1.5354 in.)	19.65-22.15 (43.33-48.84)	18.1 (39.91)



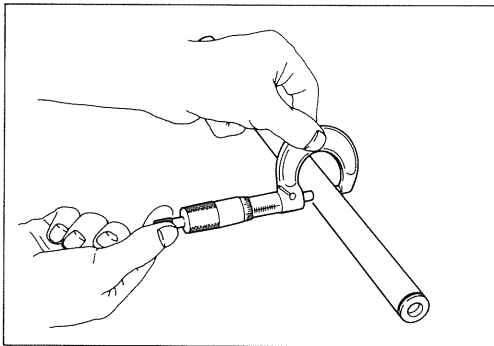
ROCKER ARM SHAFT AND ROCKER ARM ASSEMBLY

Rocker arm shaft

Inspection of rocker arm shaft for run-out and wear. The rocker arm shaft with a slight amount of run-out may be corrected with a bench press without using heat.

Run-out:

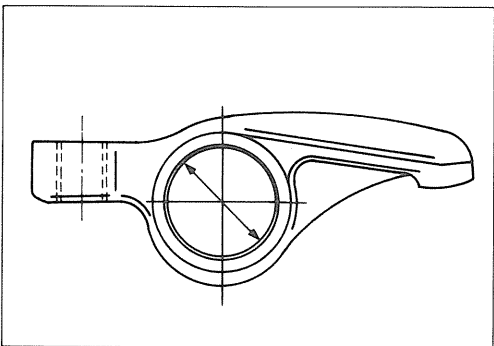
mm(in.)	
Standard	Limit
0.2 (0.0079) or less	0.6 (0.0236)



Measure the diameter of the rocker arm shaft at the 8 points corresponding to the rocker arms.

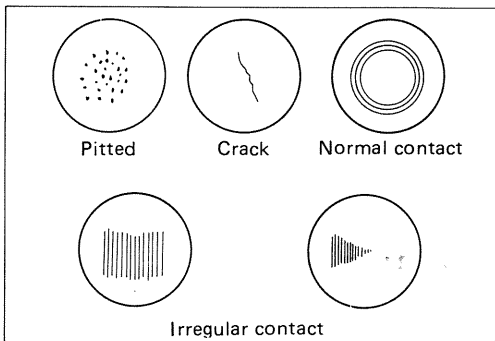
Outside diameter

mm(in.)	
Standard	Limit
18.98 – 19.00 (0.7472 – 0.7480)	18.85 (0.7421)



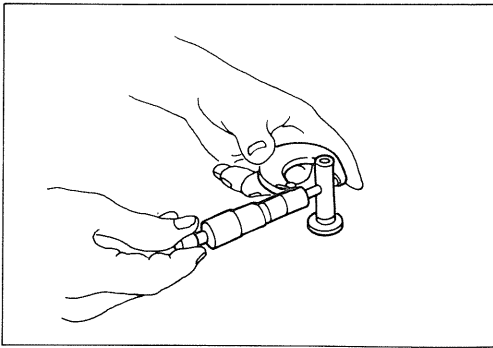
Measure the inside diameter of the rocker arm bushings with a dial indicator.

mm(in.)		
Clearance between rocker arm shaft and bushings	Standard	Limit
	0 – 0.05 (0 – 0.0020)	0.2 (0.0079)



Tappet

Visually inspect the tappets for damage, camshaft contacting face for pitting, cracks scores or other abnormal conditions.

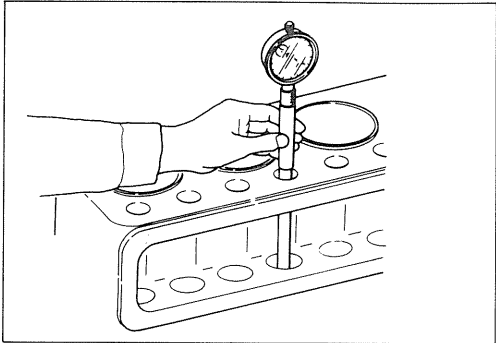


Measure the tappet outside diameter

Outside diameter

mm(in.)

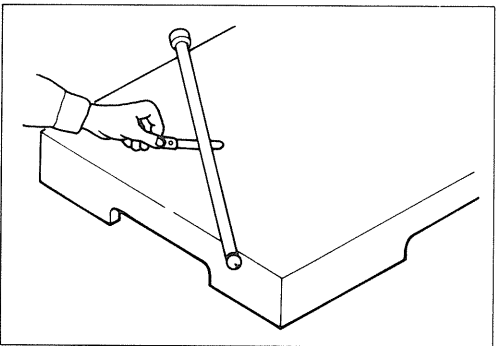
Standard	Limit
12.97-12.99 (0.5106-0.514)	12.95 (0.5098)



Clearance between tappet and cylinder block

mm(in.)

Standard	limit
0.03 (0.0012)	0.1 (0.0394)



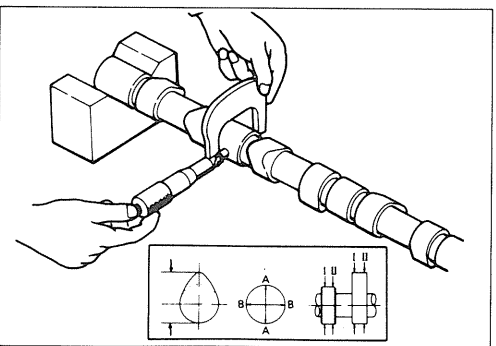
Push rod

Visually inspect for damage, wear or other abnormal conditions.



Bending

Limit	mm(in.)	0.3 (0.0118)
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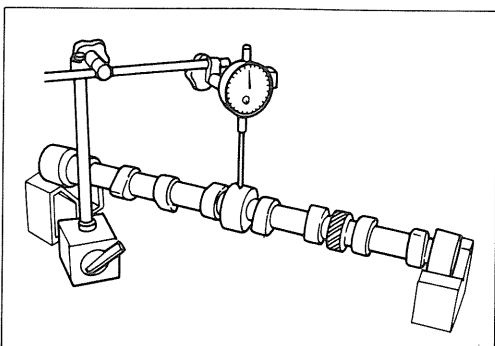


CAMSHAFT ASSEMBLY

Measure the journal diameter and height of cam lobe.

mm(in.)

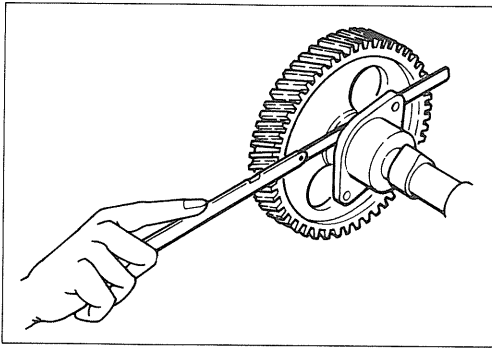
	Standard	Limit
Journal diameter	48.0 (1.8898)	47.6 (1.8741)
Hight of cam lobe	40.57 (1.5973)	40.2 (1.5827)



Run-out

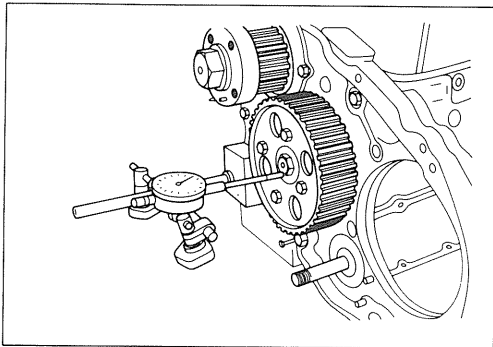
mm(in.)

Standard	Limit
0.05 (0.0020) or less	0.1 (0.0039)



End play (Timing gear train)

		mm(in.)
	Standard	Limit
	0.05—0.11 (0.0020—0.0043)	0.2 (0.0079)

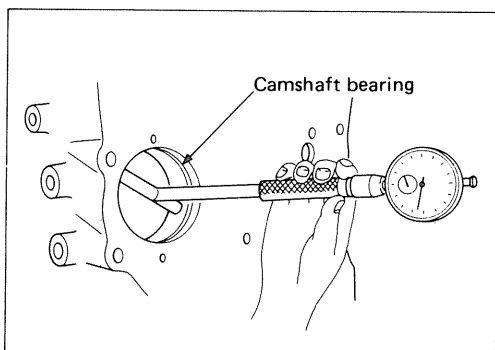


Inspection of camshaft end play (Timing belt train)

Set a dial indicator and take a reading of the indicator by moving the camshaft in the axial direction using a screwdriver.

	mm(in.)	
	Standard	Limit
Camshaft end play	0.08(0.0032)	0.2(0.0079)

If the camshaft end play is in excess of the value indicating need for servicing, then the camshaft oil pump drive gear or oil pump gear has been worn and should be replaced.

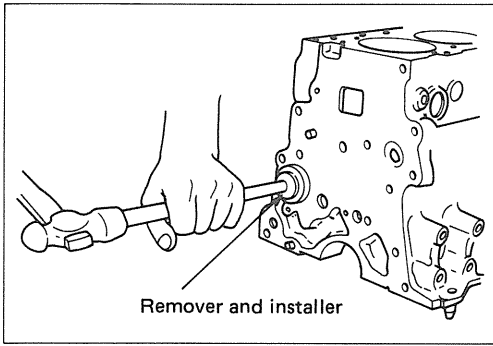


Camshaft bearing

Check the inner face of the camshaft bearings for damage.

Measure the inside diameter of the camshaft bearings with a cylinder bore indicator.

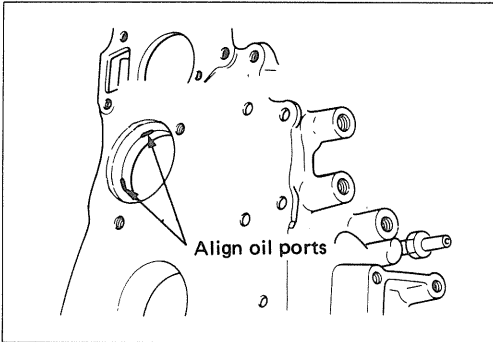
	mm(in.)	
	Standard	Limit
Clearance between journals and bearings	0.05 (0.0020) or less	0.12 (0.0047)



Camshaft bearing replacement

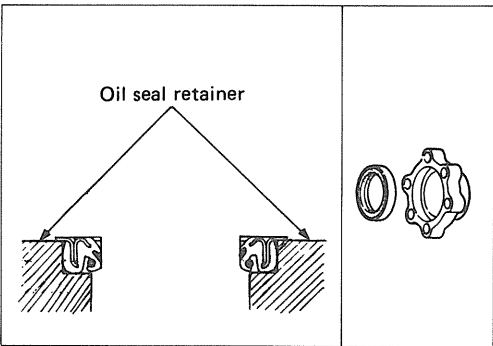
Remove the camshaft bearing using camshaft bearing remover.

Camshaft bearing remover : 9-8523-1737 or
9-9523-1360
(J-29764)



Install the camshaft bearings with the use of camshaft bearing installer by aligning oil ports in the bearings with those in the cylinder body.

Camshaft bearing installer : 9-8523-1737 or
9-8523-1360
(J-29764)



Oil seal replacement

Removal

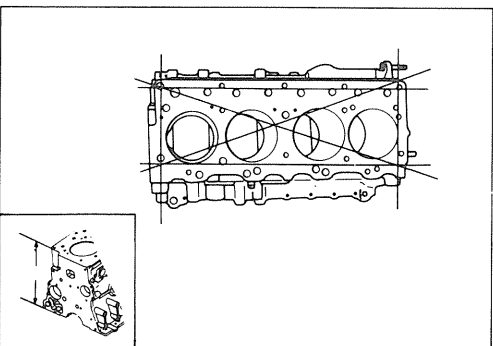
Drive out the oil seal using a brass bar against the side with boss.



Install the oil seal flush with the retainer face.



Installer : 5-85220-020-0



CYLINDER BODY

Visual check

Clean and inspect for damage or other abnormal conditions.



Distortion of upper face

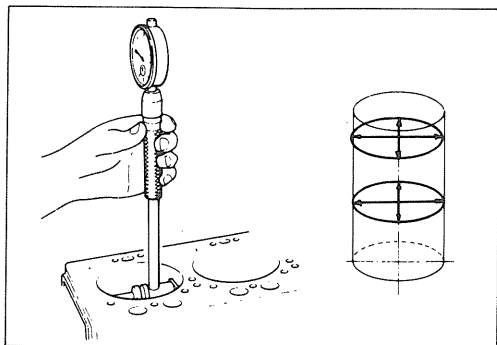
With the dowels removed, check the cylinder body upper face for distortion in directions diagonally and across the face as shown using a straight edge and feeler gauge.

If the amount of distortion is beyond the specified value, correct with a surface grinder.



mm(in.)

	Standard	Limit
Thickness	0.05 (0.0020)	0.2 (0.0079)
Overall height	247.92-248.08 (9.7606-9.7670)	247.72 (9.7530)



Cylinder bore

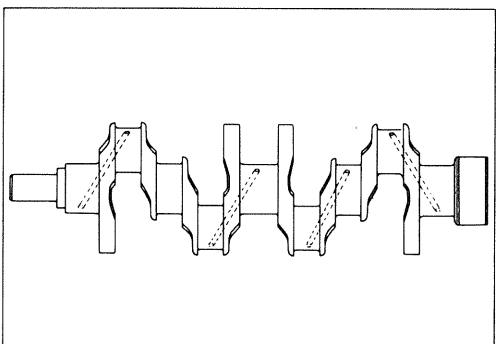
Measure the cylinder bore diameter at points 16 mm and 114 mm (0.630 in. and 4.488 in.) from the upper end in directions in line with and at a right angle to the crankshaft

If the amount of wear is beyond the value indicating need for servicing, or if the wall shows evidence of seizure or scuffs, the cylinders should be reconditioned by reboring.

Standard	Limit
88.0 (3.4646)	89.2 (3.5118)



1. All cylinders must be rebored to the same diameter even if only one of the cylinders is in need of reconditioning.
2. When disassembling, ridges on the upper part of the cylinder bores should be removed using an edge reamer.



CRANKSHAFT

Crankshaft and bearings

Check the surfaces of the crankshaft journals, crankpins and oil seal fitting surfaces for wear and damage, and oil ports for obstruction.

No attempt should be made to polish the surfaces of the crankshaft journals and crankpins as they are tufftrided.



Confirmation of layer of tufftriding

Apply 5—10 percent solution of ammonium cuprous chloride (dissolve in distilled water) to the surfaces of the crankshaft journals and crankpins (excluding area with oil ports) and carefully check for discoloration. If discoloration (rust formation) is not found, the crankshaft may be regarded as adequate for further service.

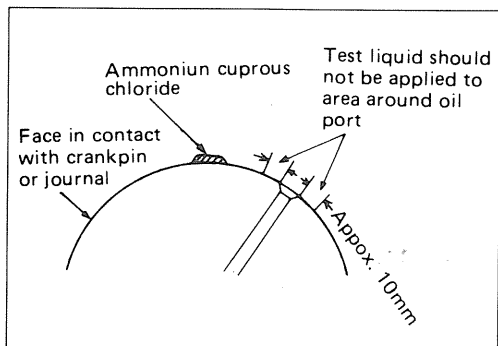
If discoloration is evident, the layer of tufftriding has been worn out and crankshaft should be replaced with a new one.



Inspection method

1. Thoroughly clean the crankshaft (use organic cleaner to remove oil completely from the surfaces to be inspected).
2. Apply a drop of test solution onto the testing face using a spot glass rod.

Hold the face to be tested horizontally to prevent testing solution from running down. Testing solution should not be applied to area within about 10 mm from oil ports.



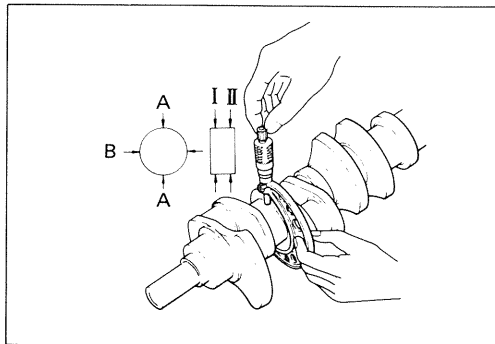


Judgement

- (1) Adequate for further service
Discoloration does not appear even after 30-40 seconds.
- (2) Inadequate for further service.
After 30-40 seconds, testing solution changes in color from pale blue to transparent causing the affected area to become copper like color.



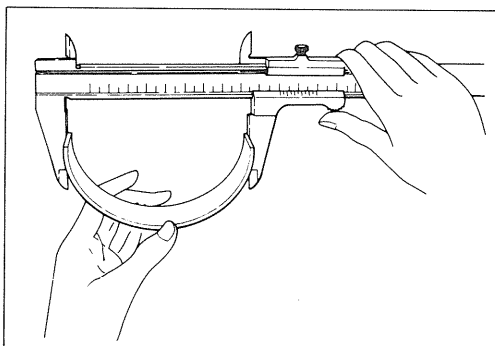
Since Ammonium cuprous chloride is highly corrosive, test faces must be cleaned immediately and washed thoroughly with water or steam.



Measure the diameters of the crankshaft journals and crankpins at the front and rear (I and II) in directions of A and B, to determine the amount of wear and taper wear.

Crankshaft journal and pin diameter

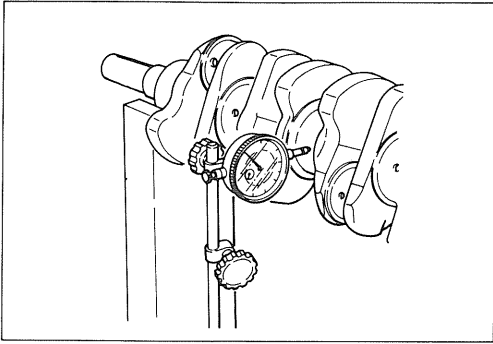
	mm(in.)	
	Journal	Pin
Standard	59.92 - 59.93 (2.3591 - 2.3594)	52.92 - 52.93 (2.0835 - 2.0839)
Limit	59.90 (2.3583)	52.90 (2.0827)



CRANKSHAFT BEARING

Bearing tension

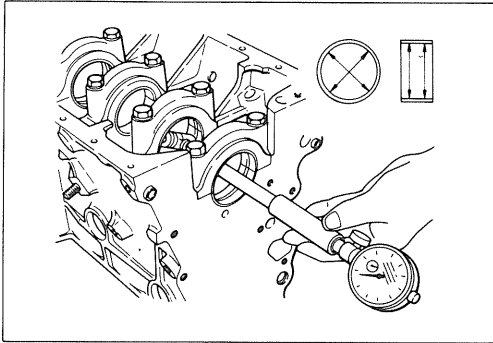
	mm(in.)
	Limit
Crankshaft bearing	64.5 (2.5293)
Connecting-rod bearing	56.5 (2.2244)



Check for run-out by turning the crankshaft slowly with the probe of a dial indicator set against the No. 3 journal.

Run-out

mm(in.)	
Standard	Limit
0.03 or less (0.0012)	0.06 (0.0024)



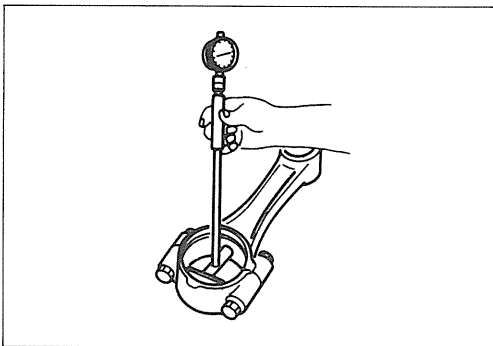
Install the bearing halves on the body and bearing cap, respectively, then install the bearing cap on the cylinder body.

Torque	kg-m(ft.lbs.)	16-18 (116-130)
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Clearance between journals and bearings

mm(in.)	
Standard	Limit
0.029-0.085 (0.0011-0.0033)	0.12 (0.0047)



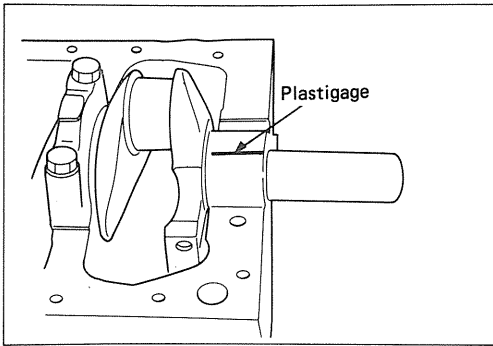
Install the bearing on the connecting-rod big-end, then install the connecting-rod cap.

Torque	kg-m(ft.lbs.)	8-9 (58-65)
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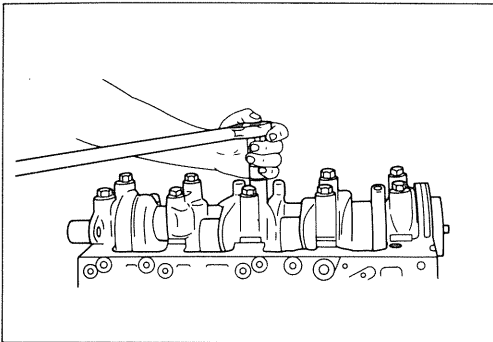
Clearance between pins and bearings

mm(in.)	
Standard	Limit
0.04 (0.0016)	0.12 (0.0047)



Clean the journal, cap and bearing.

Position a piece of plastigage over the crankshaft journal in full width of the bearing.

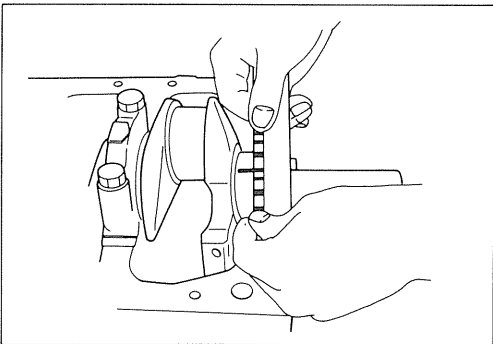


Install bearing on the bearing cap, then install the bearing cap.

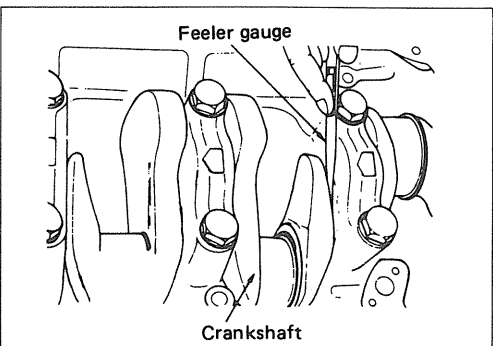
Torque	kg·m(ft.lbs.)	16-18 (116-130)
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Do not turn the crankshaft.

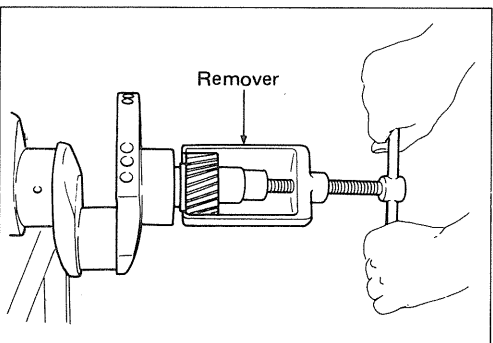


Check the width of plastigage stuck to either crankshaft or bearing against the scale printed on the container of the plastigage.



Measure endplay at thrust bearing installed on bearing cap No. 3 using a feeler gauge.

mm(in.)	
Standard	Limit
0.1 (0.0039)	0.3 (0.0018)

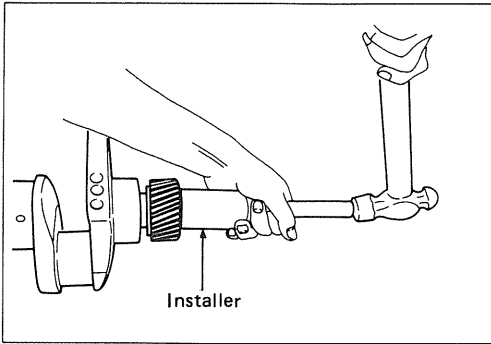


Crankshaft gear replacement (Timing gear train)

Removal

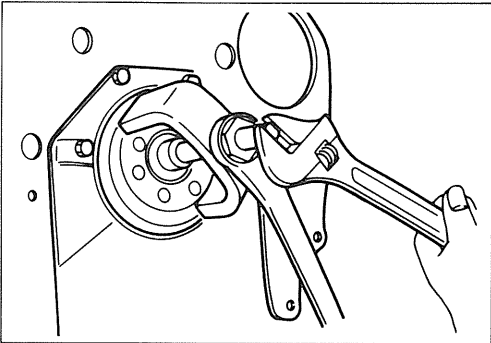


Remover : 9-8521-0074-0



Installation

Installer : 9-8522-0021-0
(J-26587)



FLYWHEEL AND RING GEAR

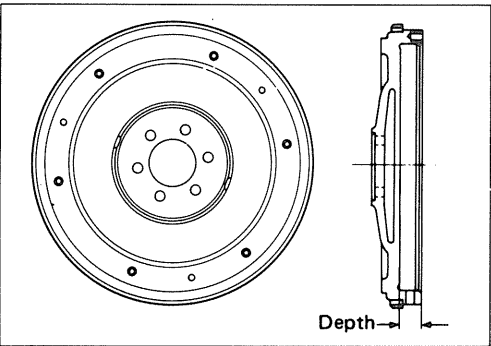
Crankshaft pilot bearing replacement

Remove the pilot bearing from the crankshaft using bearing remover.

Bearing remover : 9-8523-1812-0
(J-23907)
(J-5822)

Install the pilot bearing using bearing installer.

Bearing installer :



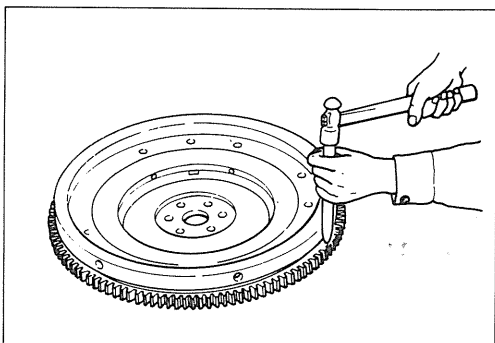
Flywheel

Check the friction faces of the flywheel and clutch driven plate for cracks and damage and correct as necessary.

Depth of friction face from the edge

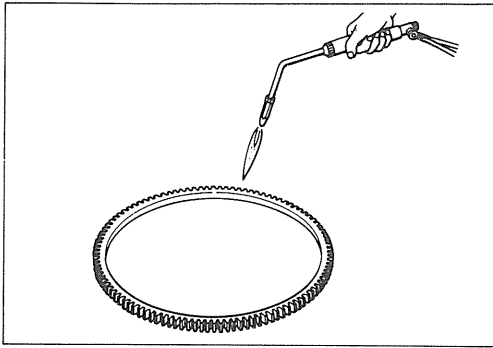
		mm(in.)
Standard	Limit	
13.0 (0.5118)	14.0 (0.5512)	

Replace the flywheel ring gear if the teeth are found to be damaged or worn excessively.

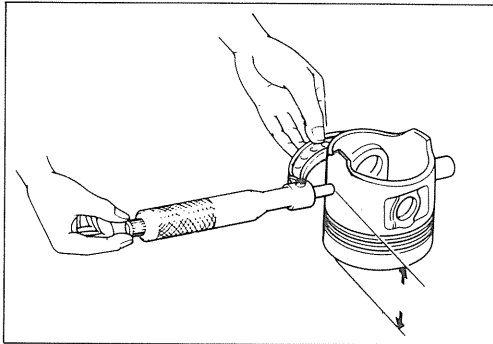


Ring gear replacement

Remove the ring gear from the flywheel by tapping around the side face of the gear with a brass rod.



Heat the ring gear evenly with a gas burner (Max. temperature 200°C) to initiate volumetric expansion. Install the ring gear on the flywheel when it is sufficiently heated.



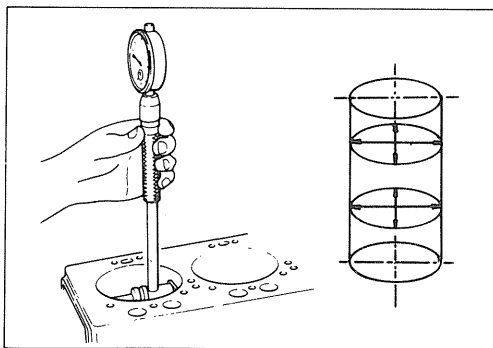
PISTON, PISTON PIN AND PISTON RING

Piston (Thermal flow type to '81)

Visually inspect for damage, wear or other abnormal conditions.

Piston grading position (From piston head)	mm(in.)	47.6 (1.875)
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Take measurement in direction at a right angle to the piston pin hole.

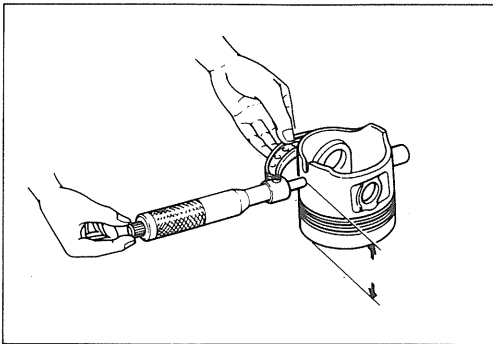


Take measurement in line with and at a right angle to the crankshaft. Compare the measured values to determine the clearance.

Cylinder bore measuring position (L)	mm(in.)	15 and 98 (0.59 and 3.86)
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Clearance between piston and cylinder bore (at Grading position and measuring position).

Standard	mm(in.)	0.114—0.134 (0.0045—0.0053)
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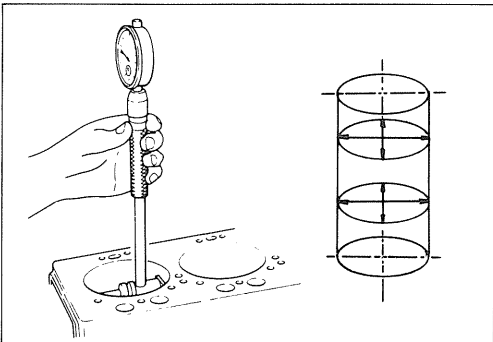
Pistons (Auto thermatic type from '82)

Visually inspect for damage, wear or other abnormal conditions.

Diameter;

Grading position	mm(in.)	64.65 (2.5472)
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Take measurement in direction at a right angle to the piston pin hole.



Measure the cylinder bore diameter in directions in line with and at a right angle to the crankshaft. Compare the measured values to determine the clearance.

Specified point of cylinder bore.

Measuring point	mm(in.)
	16 and 114 (0.6299 and 4.4882)

Clearance between piston and cylinder bore

Standard

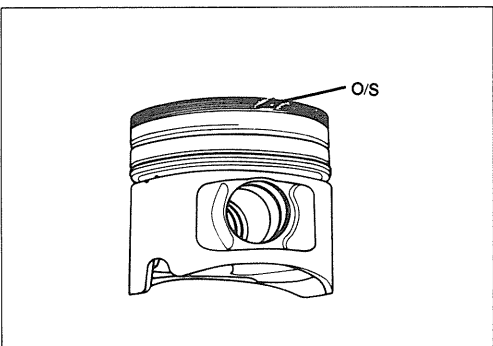
Clearance	mm(in.)
	0.036-0.055 (0.0014-0.0022)

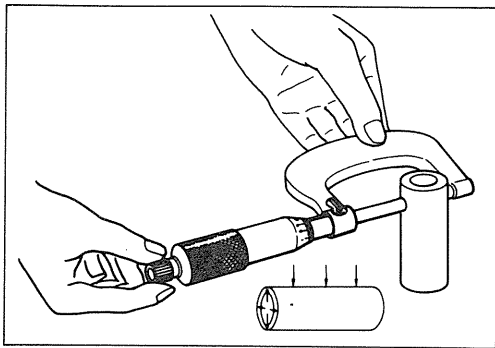
Pistons grading

	mm(in.)
A	87.955-87.975 (3.4628-3.4636)
C	87.976-87.995 (3.4636-3.4644)

Use oversize pistons when the cylinders are rebored.

Oversize pistons available	mm(in.)
	88.455-88.495 (3.4851-3.4867)
	88.955-88.995 (3.5048-3.5064)





Piston pin

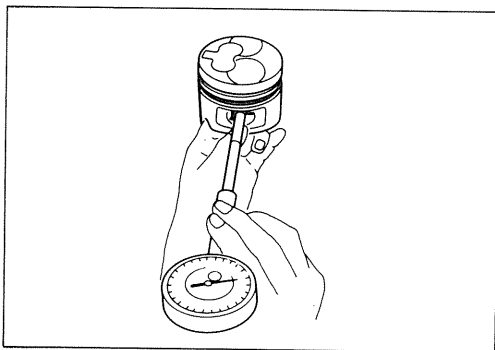
Visually inspect for damage, wear or other abnormal conditions.

Outside diameter

mm(in.)

	Standard	Limit
C223	27.0 (1.0630)	26.97 (1.618)
C223T	29.0 (1.1417)	28.97 (1.1406)

Measure the diameter at several points around the circumference.

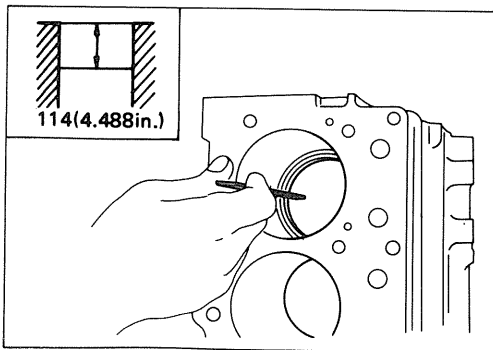


Fitting interference between piston pin and piston pin hole.

Standard

mm(in.)

C223	0.002-0.012 (0.00008-0.00047)
C223T	0.002-0.012 (0.00008-0.00047)



Piston ring

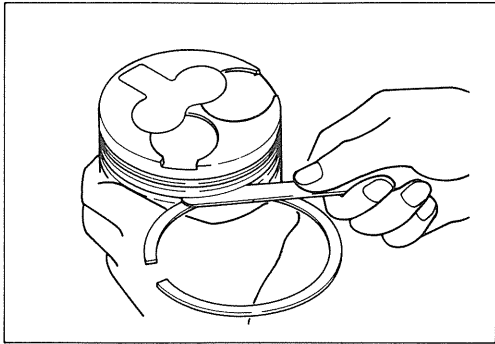
Remove carbon deposit from piston rings and check for wear and damage.

Insert the piston ring into bore and push it in, at a right angle to the wall, deep enough to reach the point where the cylinder bore diameter is smallest (114 mm 4.4882 in.) then measure the ring gap.

Piston ring gap:

mm(in.)

		Standard	Limit
1st, 2nd compression		0.2-0.4 (0.0079-0.0158)	2.0 (0.0787)
Oil	C223	0.2-0.4 (0.0079-0.0158)	2.0 (0.0787)
	C223T	0.2-0.4 (0.0079-0.0158)	2.0 (0.0787)

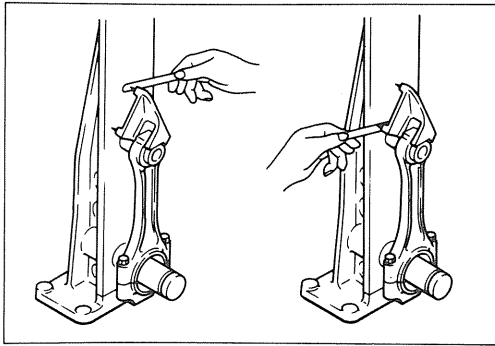


Take measurements at several points around the circumference after removal of carbon.

Clearance between piston ring and ring groove mm(in.)

C223	Standard	Limit
1st compression ring	0.045—0.070 (0.0018—0.0028)	0.3 (0.0118)
2nd compression ring	0.030—0.055 (0.0012—0.0021)	0.3 (0.0118)
Oil ring	0.020—0.054 (0.0008—0.0021)	0.3 (0.0118)

C223T	Standard	Limit
1st compression ring	0.120—0.155 (0.0047—0.0061)	0.185 (0.0073)
2nd compression ring	0.050—0.085 (0.0020—0.0033)	0.115 (0.0045)
Oil ring	0.030—0.070 (0.0012—0.0028)	0.100 (0.0039)



CONNECTING-ROD AND BUSHING

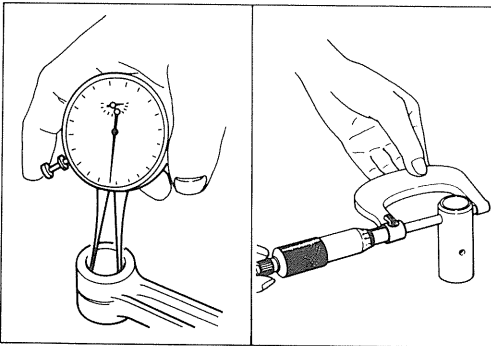


Connecting-rod

Check between centers of small-end and big-end for distortion and parallelism.

Connecting-rod aligner

Per length of 100 mm (3.9370 in.)		mm(in.)
	Standard	Limit
Distortion	0.08 (0.0032) or less	0.2 (0.0079)
Parallelism	0.05 (0.0020) or less	0.15 (0.0059)

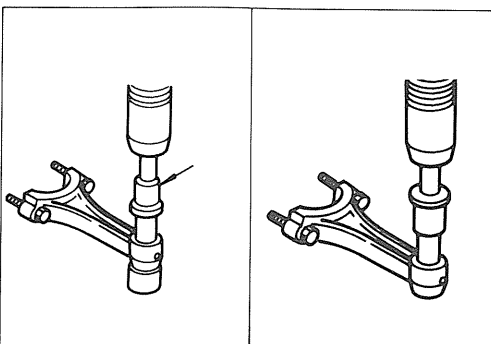


Bushing

Measure the inside diameter of the connecting-rod small-end bushing and outside diameter of the piston pin.

If the clearance is beyond the limit, replace either the connecting-rod small-end bushing or piston pin.

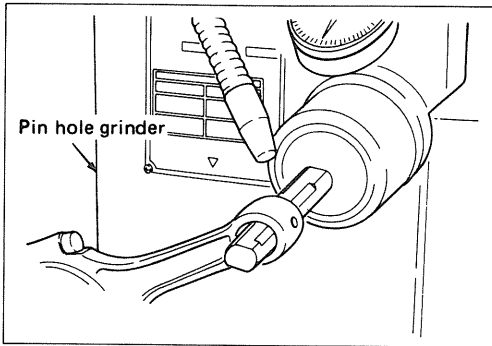
		mm(in.)
Standard	Limit	
0.008—0.020 (0.0003—0.0008)	0.05 (0.0020)	



Bushing replacement

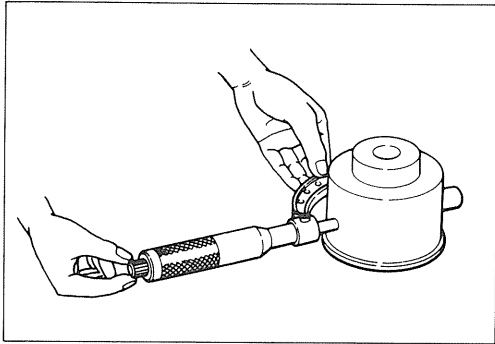
Replace bushing using piston pin bushing remover & installer and finish the bore using a remover.

Piston pin bushing remover & installer : 9-8523-1369-0
(J-29765)



The inner face of the bushing must be finished with a remmer after installation of the bushing.

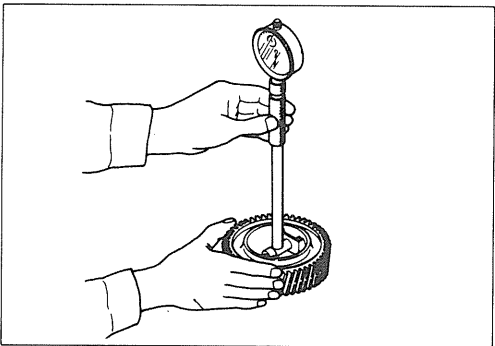
Inside diameter mm(in.)	27.008—27.015 (10.6412—10.6439)
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IDLER GEAR AND SPINDLE (TIMING GEAR TRAIN)

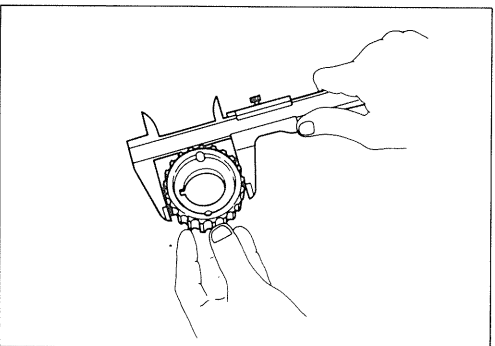
Spindle diameter

mm(in.)	
Standard	Limit
44.945—44.975 (1.7708—1.7720)	44.845 (1.7669)



Clearance between spindle and idler gear

mm(in.)	
Standard	Limit
0.025—0.085 (0.00098—0.00335)	0.2 (0.00788)

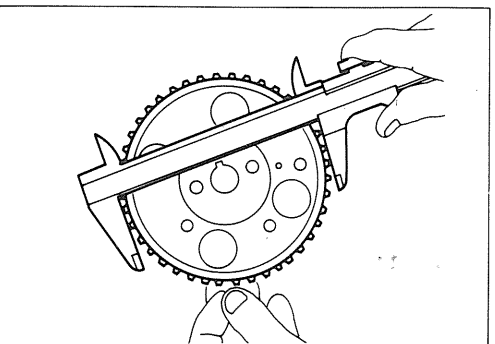


TIMING PULLEY (TIMING BELT TRAIN)

Crankshaft pulley

Outside diameter:

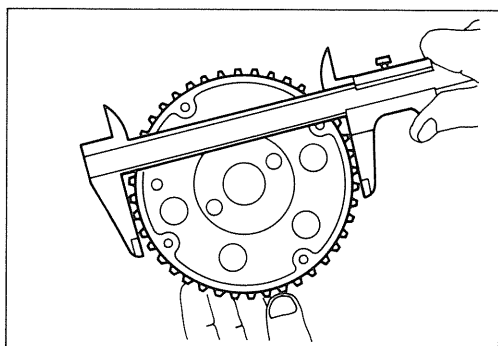
mm(in.)	
Standard	Limit
65.33—65.43 (2.5720—2.5760)	65.230(2.5681)



Camshaft pulley

Outside diameter:

mm(in.)	
Standard	Limit
132.032—132.152 (5.1981—5.2028)	131.932(5.1942)

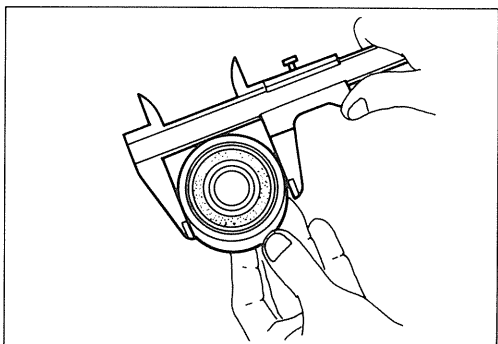


Injection pump pulley

Outside diameter

mm(in.)

Standard	Limit
132.032 – 132.152 (5.1981 – 5.2020)	131.932 (5.1942)



Tension pulley

mm(in.)

Standard	Limit
61.8 – 62.0 (2.4331 – 2.4409)	61.6 (2.4252)

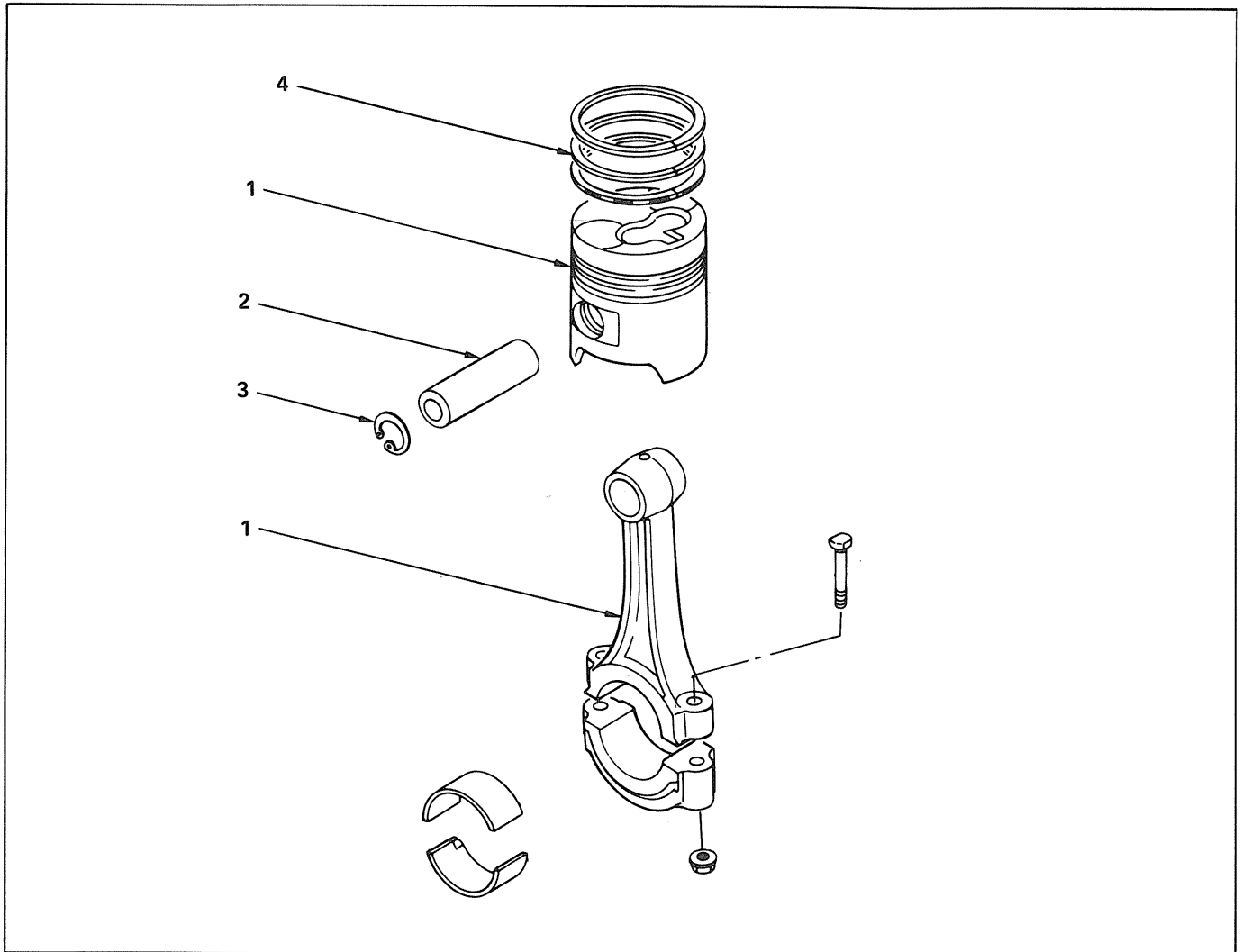


REASSEMBLY

INTERNAL PARTS

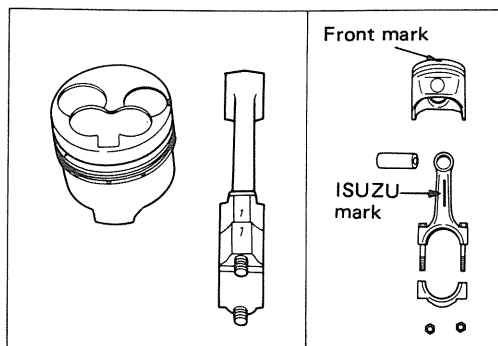
MINOR COMPONENTS

PISTON AND CONNECTING ROD ASSEMBLY



Reassembly steps

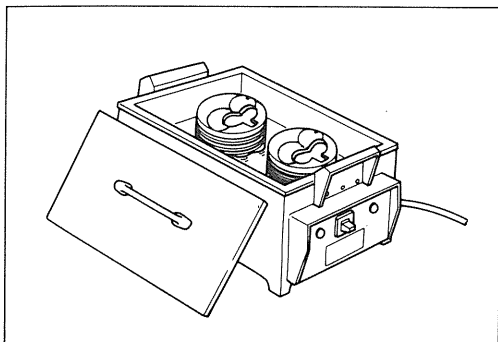
- ▲ 1. Piston and connecting-rod
- ▲ 2. Piston pin
- ▲ 3. Snap ring
- ▲ 4. Piston ring



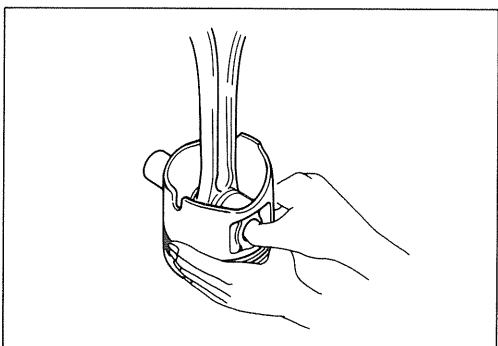
Important operations

1. Piston and connecting-rod

The connecting-rod should be installed so that the side with cylinder number marking is turned toward the combustion chamber in the piston head. Front mark on the piston head should be in the same direction as the ISUZU mark on the connecting-rod.

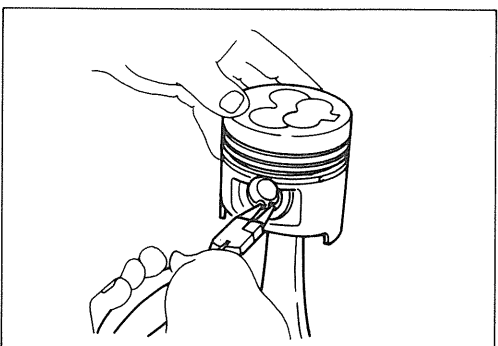


Piston heater or equivalent:
Heat the piston to about 80°C (176°F)



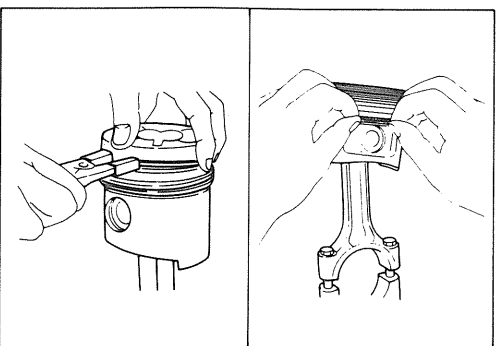
2. Piston pin

The piston pin should be fitted into piston pin hole smoothly after lubricating it with engine oil.



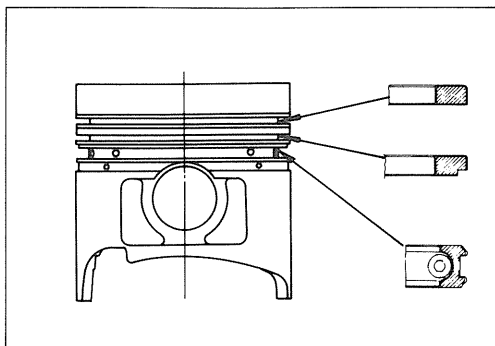
3. Snap ring

Install the snap ring into slots in piston pin hole properly using snap ring pliers.



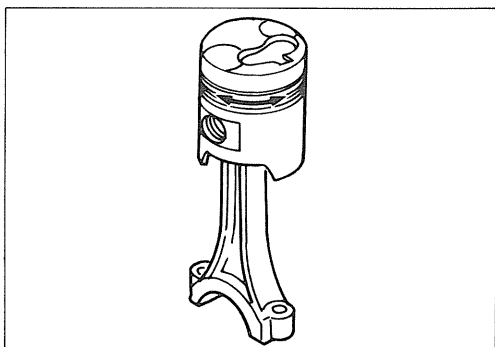
4. Piston ring

Install the piston rings in the following sequence of coil expander, oil ring, 2nd compression ring and 1st compression ring.



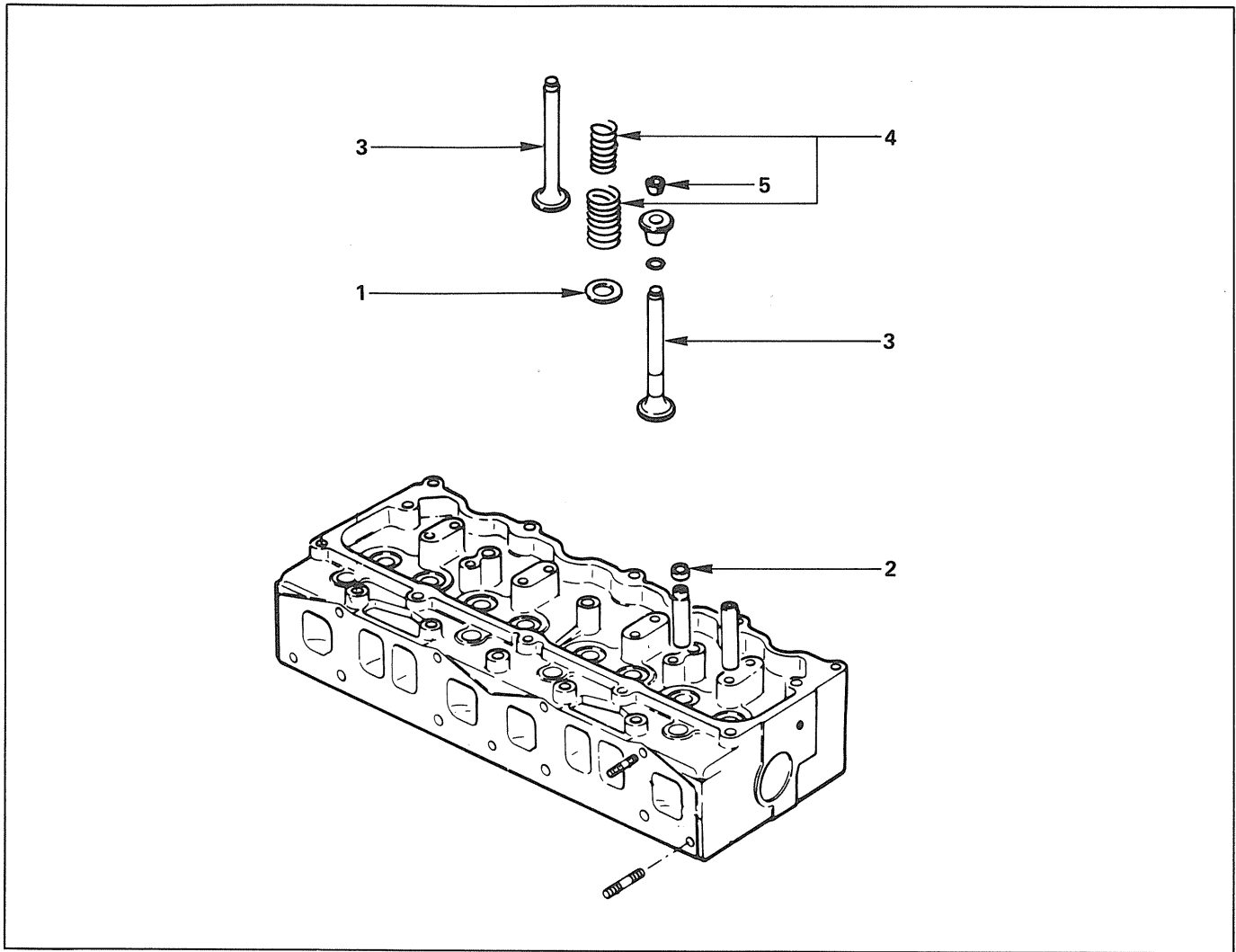
Piston ring expander

Install the 1st and 2nd compression rings and oil ring with the 'N' mark facing upward. The ends of coil expander should be opposed to the oil ring gap.



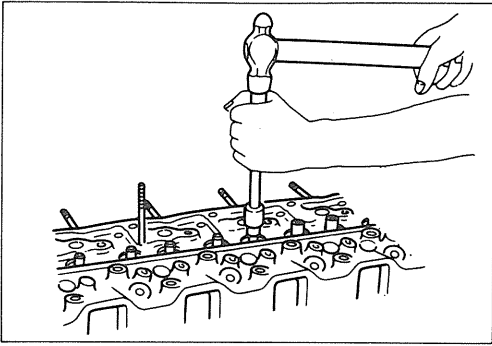
After installation of piston rings, apply engine oil to the circumference of the rings and check that each ring rotates smoothly.

CYLINDER HEAD ASSEMBLY



Reassembly steps

- 1. Valve spring lower washer.
- ▲ 2. Valve stem oil seal
- 3. Valve
- ▲ 4. Valve spring; inner, outer.
- 5. Valve spring seat.
- ▲ 6. Split collars

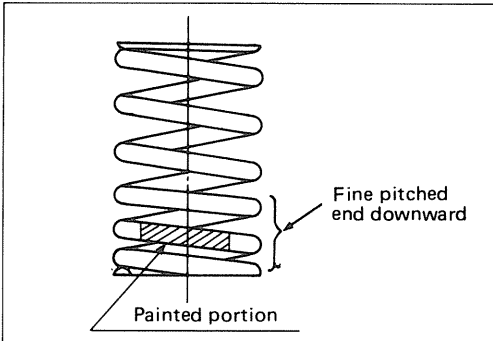


Important operations



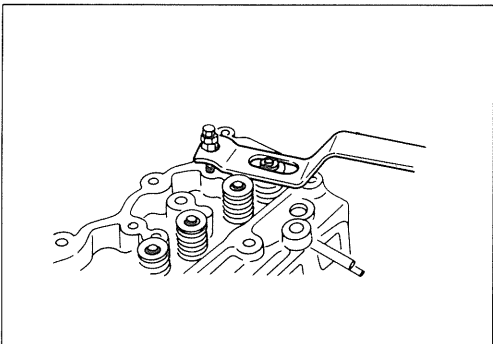
2. Valve stem oil seal

Install the oil seal on the valve guide after applying engine oil to the inner face of the oil seal.



4. Valve spring; inner, outer

Install the inner and outer valve springs with green color painted side (fine pitched end) turned to cylinder head.

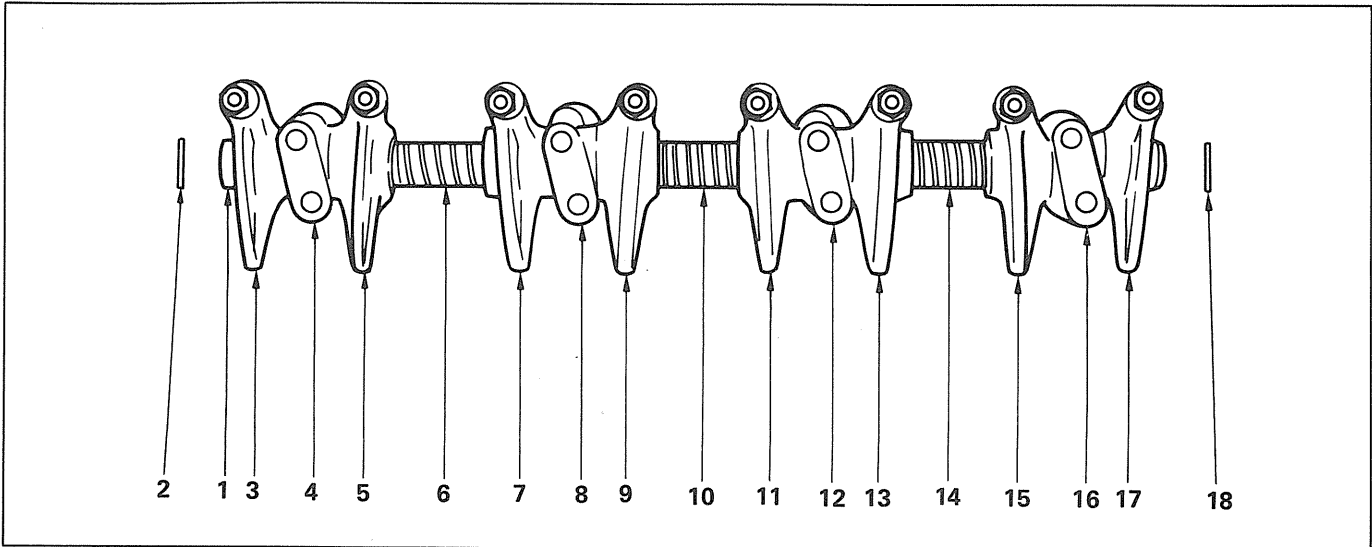


6. Split collars

Compress the valve springs with valve spring compressor and install the split collars.

Valve spring compressor : 9-8523-1423-0
(J-29760)

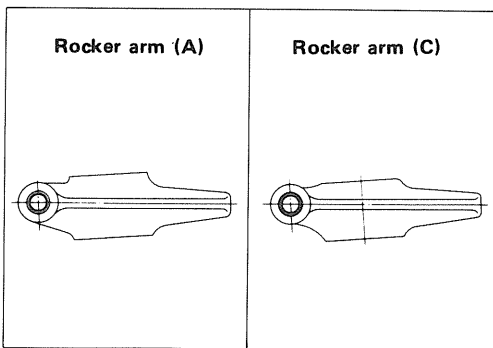
ROCKER ARM ASSEMBLY



Reassembly steps

- | | |
|-------------------------------|------------------------------|
| 1. Rocker arm shaft | 10. Spring |
| 2. Snap ring | ▲ 11. Rocker arm (C) |
| ▲ 3. Rocker arm (A) | 12. Rocker arm shaft bracket |
| ▲ 4. Rocker arm shaft bracket | ▲ 13. Rocker arm (D) |
| 5. Rocker arm (D) | 14. Spring |
| 6. Spring | ▲ 15. Rocker arm (C) |
| ▲ 7. Rocker arm (C) | 16. Rocker arm shaft bracket |
| 8. Rocker arm shaft bracket | ▲ 17. Rocker arm (B) |
| ▲ 9. Rocker arm (D) | 18. Snap ring |

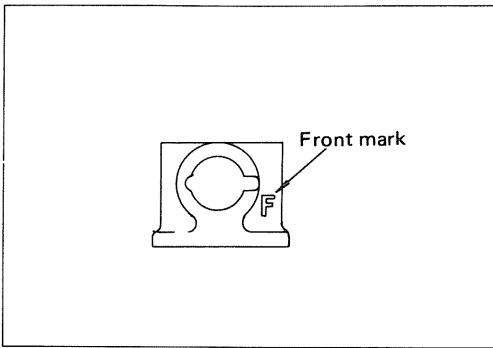
▲ See reassembly procedures for details



Important operations

3.7.11.15. Rocker arm

Difference between rocker arm A and C.



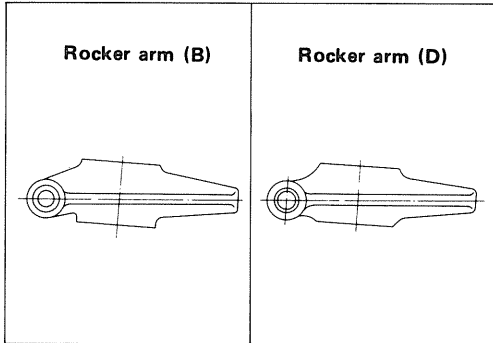
4. Rocker arm shaft bracket

Install the brackets with the F-mark side turned to front of engine.



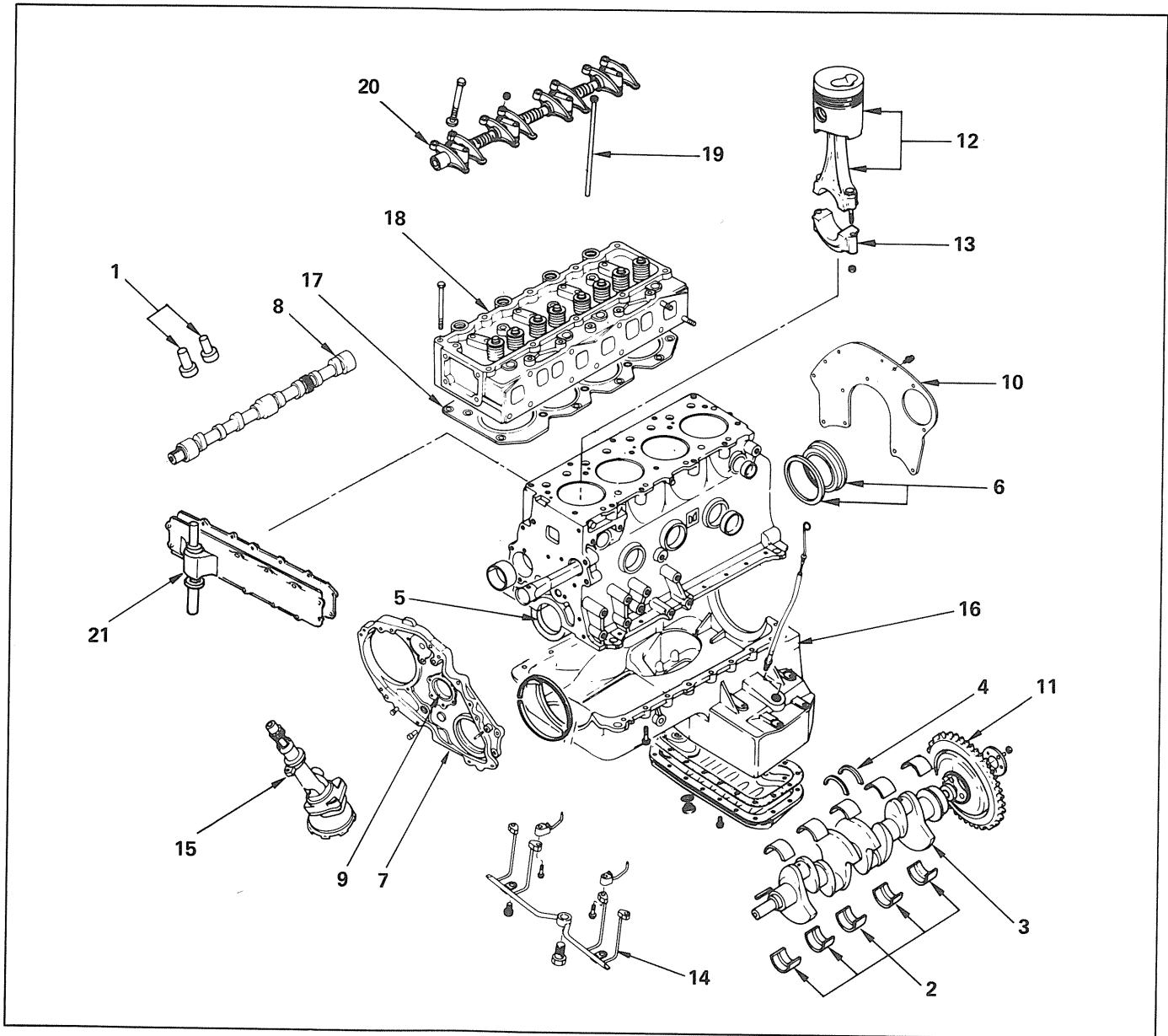
5., 9., 13., 17. Rocker arm

Difference between rocker arm B and C.



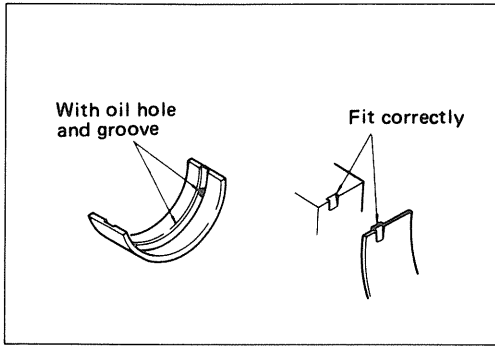
MAJOR COMPONENTS

CYLINDER HEAD, CYLINDER, CRANKSHAFT, PISTON, CAMSHAFT



Reassembly steps

- | | |
|--|---|
| 1. Tappet | ▲ 13. Connecting-rod bearing cap and bearing. |
| ▲ 2. Crankshaft bearing | ▲ 14. Oil jet pipe |
| 3. Crankshaft | ▲ 15. Oil pump |
| ▲ 4. Thrust bearing | ▲ 16. Crankcase with oil pan |
| ▲ 5. Crankshaft bearing cap | ▲ 17. Cylinder head gasket |
| ▲ 6. Crankshaft rear oil seal and spacer | ▲ 18. Cylinder head |
| 7. Timing pulley housing | 19. Push-rod |
| ▲ 8. Camshaft | ▲ 20. Rocker arm assembly |
| 9. Camshaft oil seal retainer | 21. Tappet chamber cover and rocker arm shaft oil feed pipe |
| ▲ 10. Rear plate | |
| ▲ 11. Flywheel | |
| ▲ 12. Piston and connecting-rod | |



Important operations

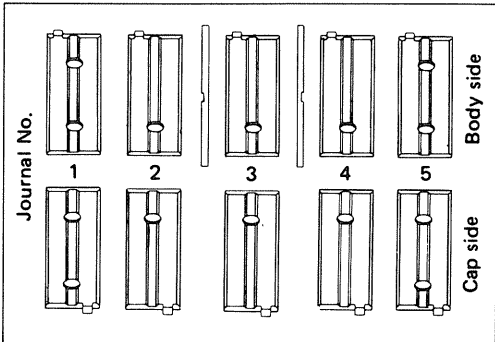


2. Crankshaft bearing

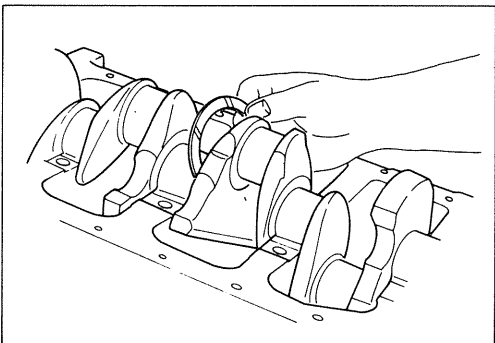
Insert projected portion of the bearings into position properly.



Apply a thick coat of engine oil to the inner face of the bearings.

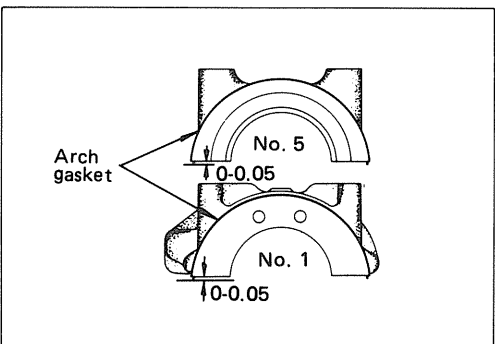


The bearings should be installed correctly in their respective position. Install the thrust bearing with the oil grooved side turned outward.



4. Thrust bearing

Install front and rear side thrust bearings with the oil groove turned to the timing gear and flywheel, respectively.



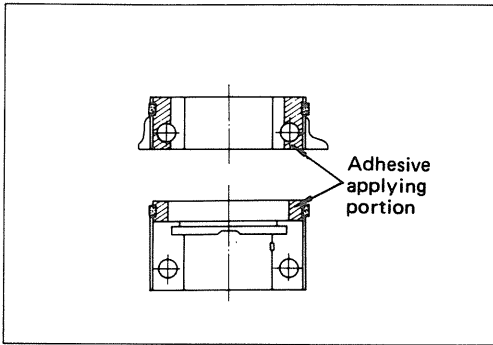
5. Crankshaft bearing caps

Install arch gasket on the No. 1 and No. 5 bearing caps in the following manner:

To prevent the gasket sealer from coming out of position, apply permatex silicone gasket to the inner face of the gasket. Push the gasket into groove evenly and keep it depressed for about 5 seconds to insure proper seating.

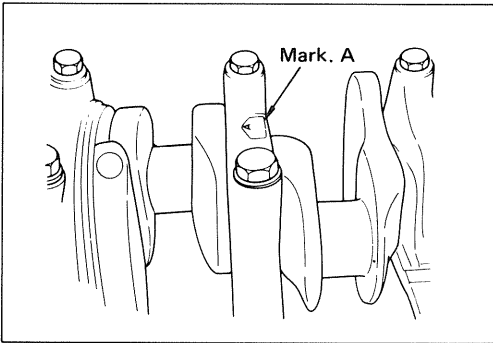
mm(in.)

Amount of projecting of gasket	0—0.05 (0—0.0020)
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Apply a thin coat of permatex silicone gasket sealer evenly to the body fitting face of No. 1 and No. 5 bearing caps.

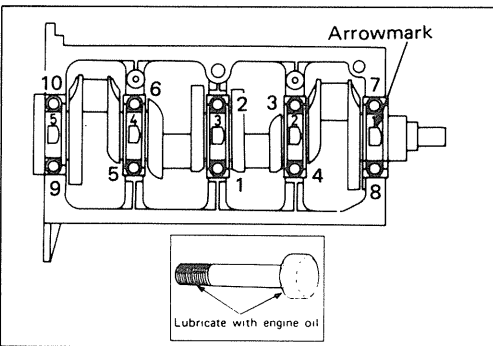
The bearing caps should be installed soon after application of liquid gasket sealer as it loses adhesive strength in a short period of time.



Install the bearing caps.

Make sure to push arch gaskets into the body side when installing No. 1 and No. 5 bearing caps.

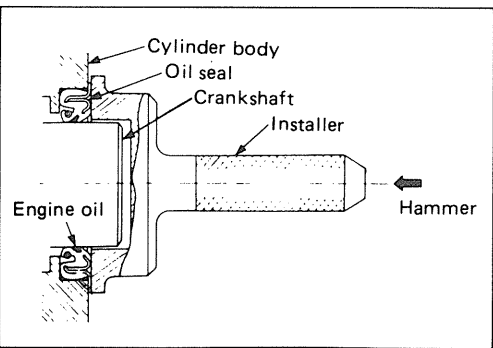
Install the bearing cap with the mark "A" on rear face in the front side (No. 2) as the No. 2 and No. 4 bearing caps are identical in appearance and dimensions.



Install and semi-tighten the bearing cap bolts in sequence of No. 3, No. 4, No. 2, No. 5, and No. 1 by turning the crankshaft and tighten the bolts to the specified torque in that sequence.

When bearing cap bolts are tightened, turn the crankshaft with hand to see that it rotates smoothly.

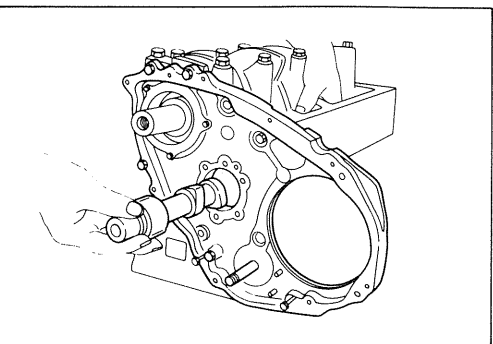
Torque	kg·m(ft.lbs.)	16—18 (116—130)
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6. Crankshaft rear oil seal and spacer

Apply engine oil to the lipped portion of the rear oil seal, then install it in position using oil seal installer.

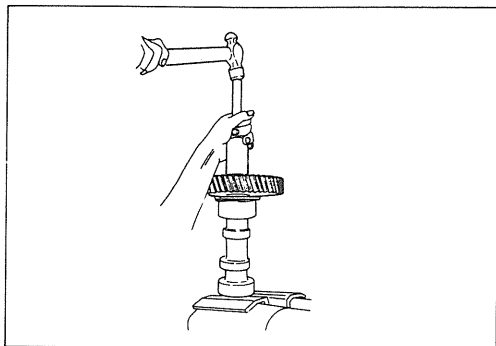
Oil seal installer : 9-8522-1279-0
(J-22928)



8. Camshaft

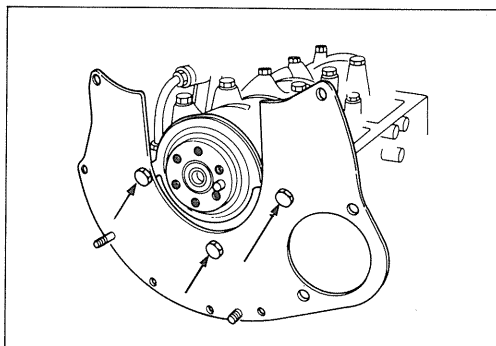
Apply engine oil to the journals and cams on the camshaft, then insert the into the cylinder body.

When inserting the camshaft, care should be exercised so as not to scratch camshaft bearings.



Installation

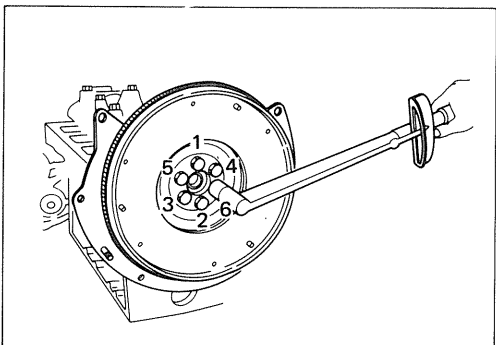
Drive the key into the key groove in the gear by aligning it with the key groove.



10. Rear plate

Install the rear plate with the holes fitted to the dowels. Then install and tighten three bolts.

Torque	kg·m(ft.lbs.)	7.6-9.3 (55-67)
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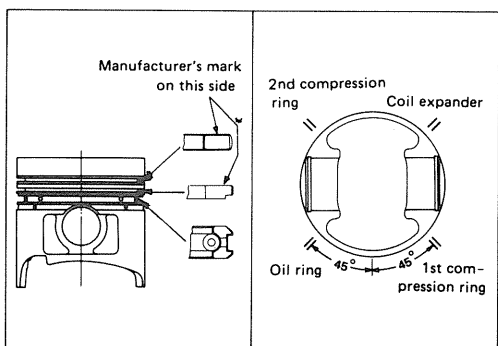


11. Flywheel

Align the flywheel with the locating dowels on the crankshaft. Install bolts and washers. Use a bar between the crankshaft and cylinder block to prevent the crankshaft from turning. Install and tighten the bolts in diagonal sequence.

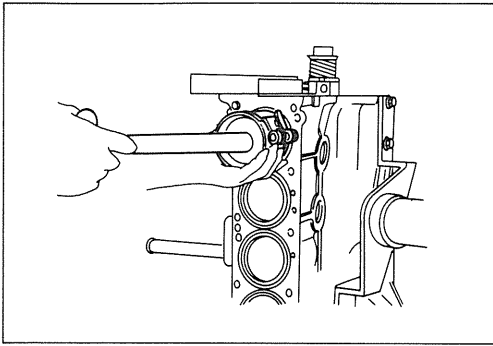


Torque	kg·m(ft.lbs.)	11.5-12.5 (83-90)
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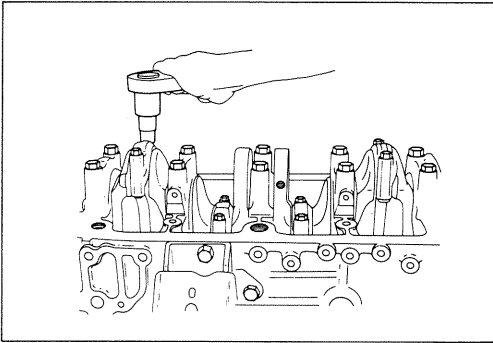
12. Piston and connecting-rod

Lightly oil the piston rings fitted to the piston, then position the piston ring gaps as illustrated in the drawing.



Install the piston into the piston compressor, then insert the piston and connecting-rod assembly into cylinder bore with the front mark on piston turned to front of engine. With a hammer handle, push in on the piston head until the connecting-rod big end bearing is fitted against the crankpin.

Piston installer : 5-8840-9018-0
(J-8037)



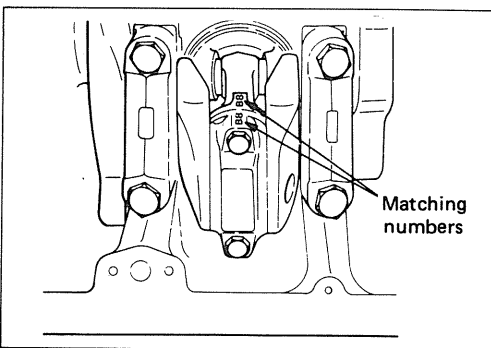
13. Connecting-rod bearing cap and bearing

Install the connecting-rod bearing cap by aligning it with the cylinder number mark on the connecting-rod. Apply engine oil to the threads and seating surface of the nuts, then install and tighten the nuts to specification.

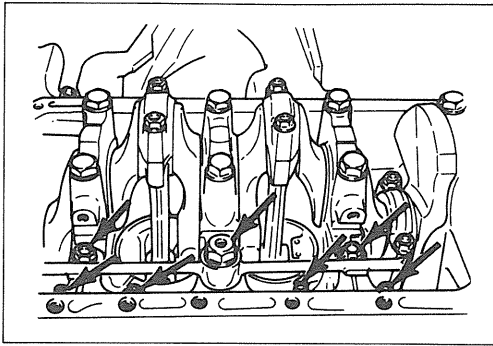
Bearing cap nut



Torque	kg·m(ft.lbs.)	8-9 (58-65)
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After tightening nuts, check to make certain the crankshaft rotates smoothly.



14. Oil jet pipe

C223

Semi-tighten oil jet line fixing bolt (6 mm) and make an adjustment, so that end of line is pointed toward rear face (rear side of combustion chamber on piston head) of the piston.

C223T

Semi-tighten oil jet line joint bolt (5mm hexagon socket head bolts) and make an adjustment, so that end of line is pointed toward cooling journal port of the piston.

C223

Fully tighten the bolt with the oil jet line set in correct position.

Regulating valve:

Torque	kg·m(ft.lbs.)	3 (22)
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Turn the crankshaft and check to make certain oil jet line is apart from the piston.

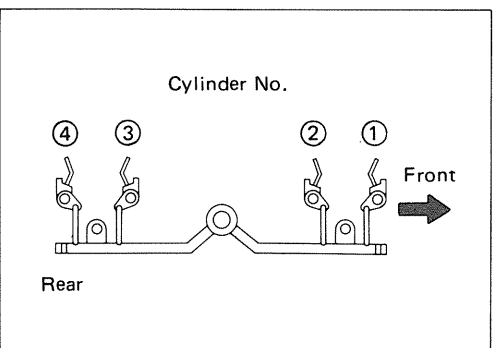
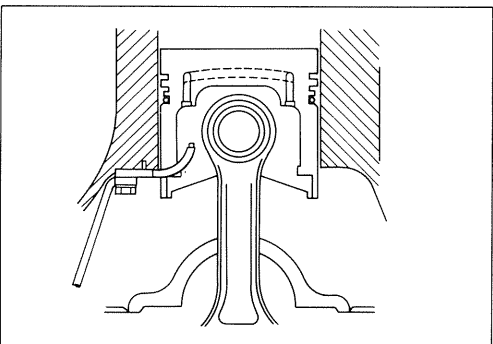
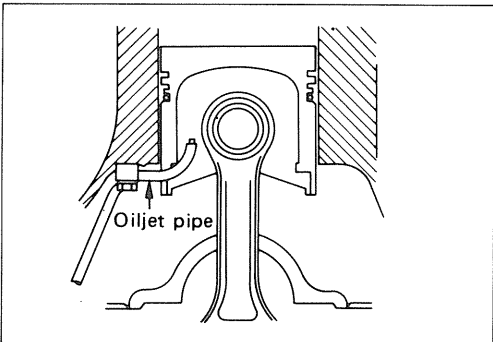
C223T

Fully tighten the bolt with the oil jet line set in correct position.

Regulating valve:

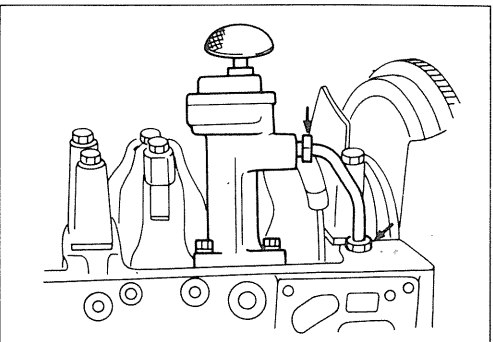
Torque	kg·m(ft.lbs.)	2.5-3.5 (18-25)
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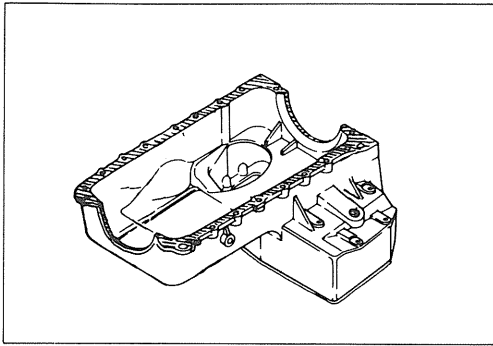
Turn the crankshaft and check to make certain oil jet pipe is apart from the piston.



15. Oil pump

Torque	kg·m(ft.lbs.)	2.6 (19)
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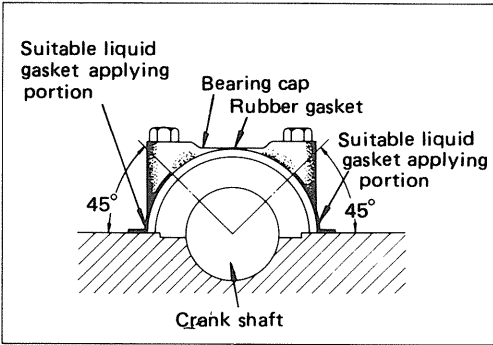


16. Crankcase with oil pan

Install the crankcase by aligning it with the locating dowels, install and tighten 20 bolts evenly in progression.



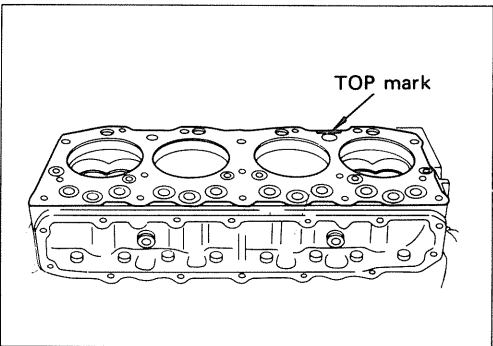
Apply a thin coat of permatex silicone gasket sealer evenly to the circumference of the crankcase.



Apply permatex silicone gasket sealer to the arch gasket fitting face of the cylinder block as shown in the figure.

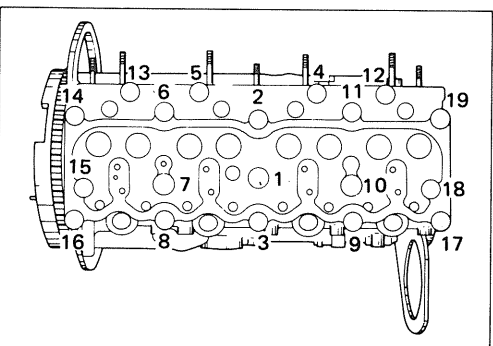
Crankcase fixing bolt.

Torque	kg·m(ft.lbs.)	1.4-2.4 (10-17)
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17. Cylinder head gasket

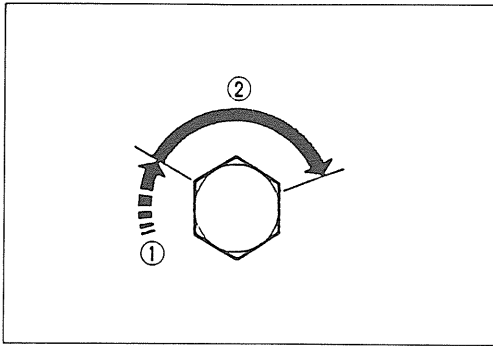
Install the cylinder head gasket with the "TOP" mark side up, by aligning it with the dowels.



18. Cylinder head

Install the cylinder head over the gasket. Install the cylinder head bolts after lubricating threads with engine oil.

Tighten cylinder head bolts in 2 steps in sequence as shown in the figure.



C223T

Torque

kg·m(ft.lbs.)

① 1st step (snug torque)	4.5—5.5 (33—40)
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Tighten the cylinder head bolts to the specified angle in sequence above.

Angle

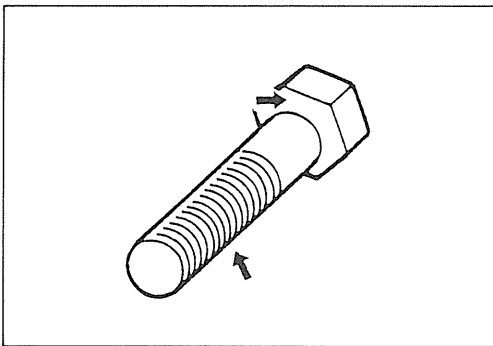
degree

② 2nd step	120 — 150
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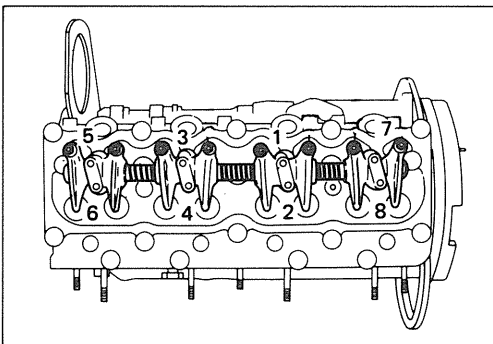


C223

	Torque	kg·m(ft.lbs.)
1st		5.5—6.5 (40—47)
2nd	(new bolt)	7.5—8.5 (54—61)
	(used bolt)	8.5—9.5 (61—69)



Apply bisulfide molybdenum grease to thread and contact surface when using used bolt. (See the illustration)



20. Rocker arm assembly

Install the rocker arm assembly on the cylinder head. Tighten the rocker arm shaft bracket bolts evenly in sequence starting with the inner ones.



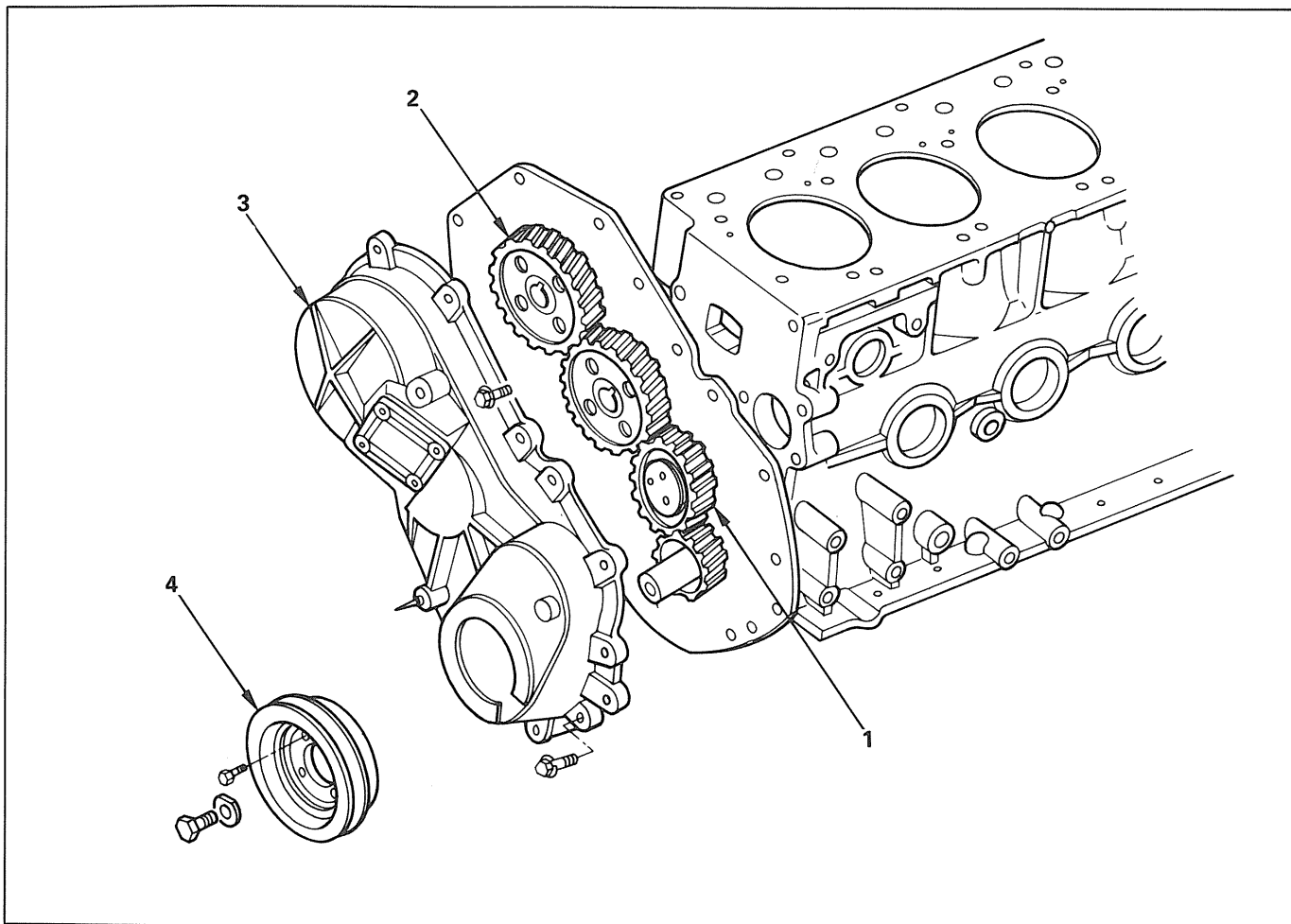
Torque	kg·m(ft.lbs.)	1.3—2.3 (9—17)
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Wrench : 9-8511-3127-0

INTERNAL PARTS

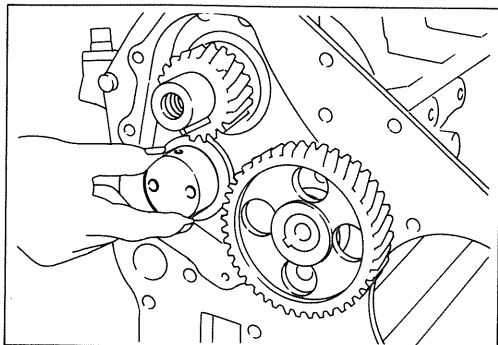
TAIMING GEAR TRAIN

MAJOR COMPONENTS



Reassembly steps

- ▲ 1. Idler gear assembly
- ▲ 2. Injection pump
- ▲ 3. Timing case cover
- ▲ 4. Pulley

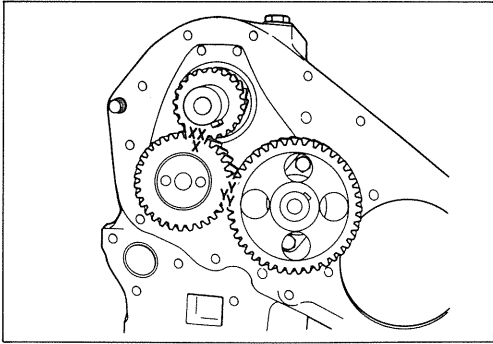


Important operations

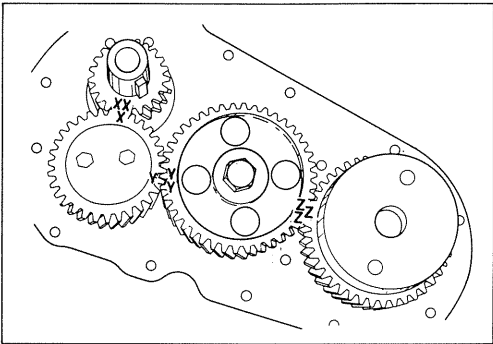
1. Idler gear assembly

Install the idler gear, so that the oil port in the idler gear shaft is turned to the crankshaft gear side and bolt holes are aligned.

Torque	kg·m(ft.lbs.)	1.9 (14)
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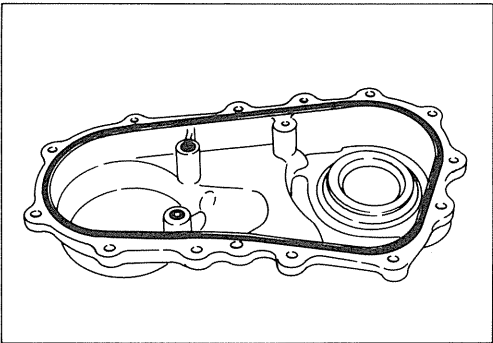


Align the marks on the camshaft gear, idler gear and crankshaft gear.



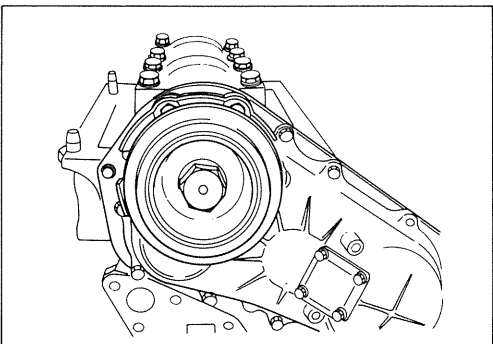
2. Injection pump

Install the injection pump by aligning the mark with that on the camshaft.



3. Timing case cover

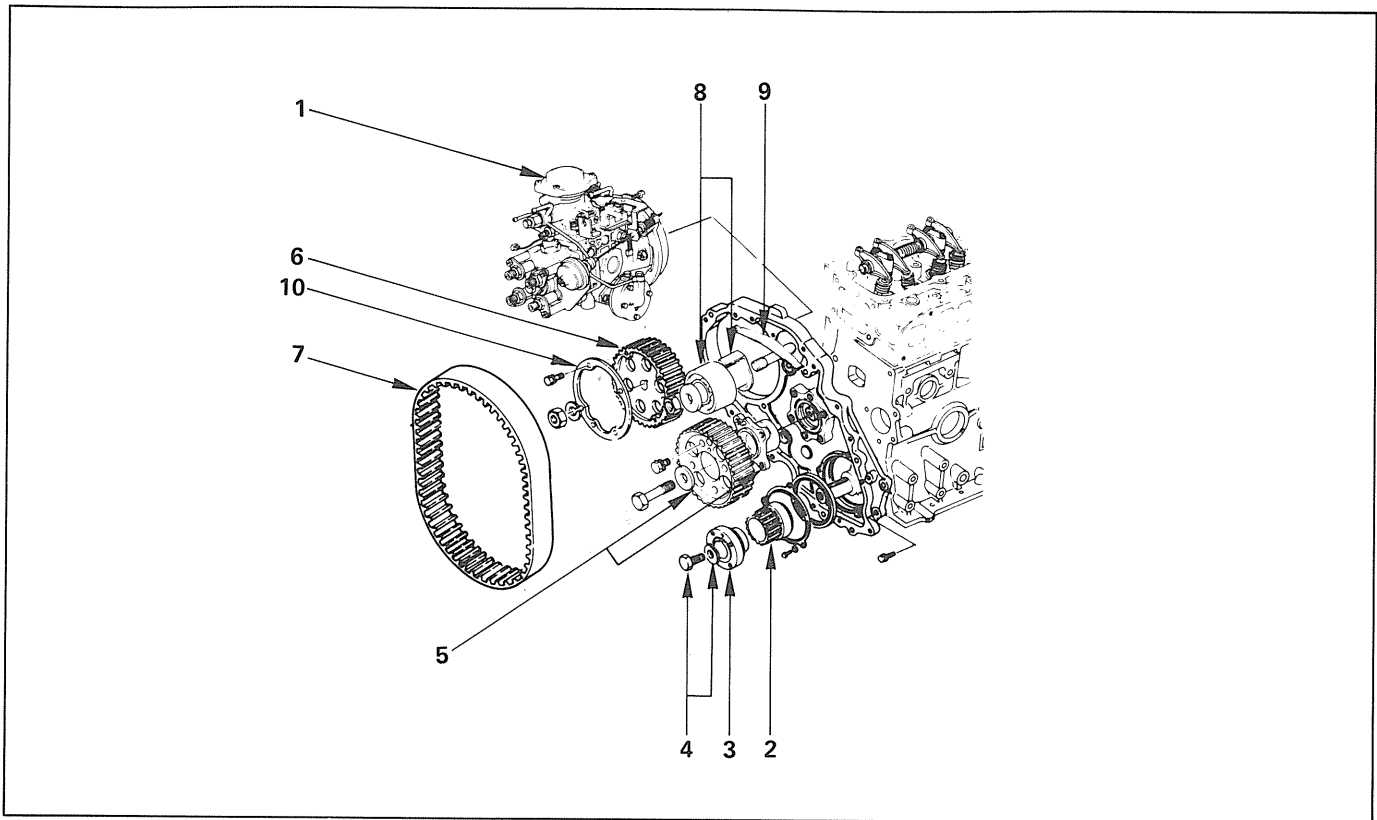
Check to make certain the O-ring is fitted properly into ring groove in the timing gear case cover.



4. Pulley

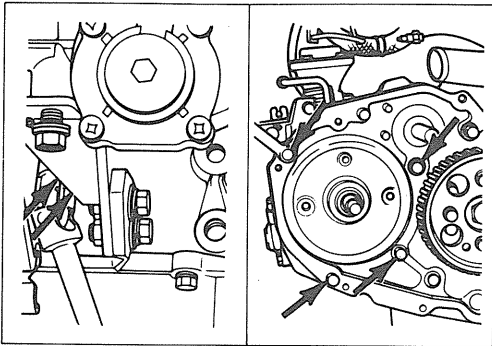
Torque	kg·m(ft.lbs.)	19.0 (14)
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INJECTION PUMP AND TIMING MECHANISM (TIMING BELT TRAIN)



Reassembly steps

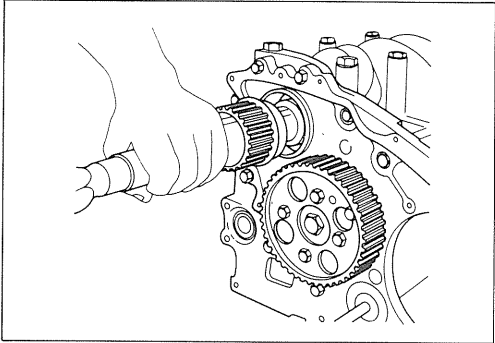
- ▲ 1. Injection pump
- ▲ 2. Crankshaft timing pulley
- ▲ 3. Crankshaft center pulley
- ▲ 4. Crankshaft pulley bolt and washer
- ▲ 5. Cam center and cam shaft timing pulley
- ▲ 6. Injection pump timing pulley
- ▲ 7. Timing belt
- ▲ 8. Tension center and tension pulley
- ▲ 9. Tension spring
- ▲ 10. Injection pump timing pulley flange



Important operations

1. Injection pump

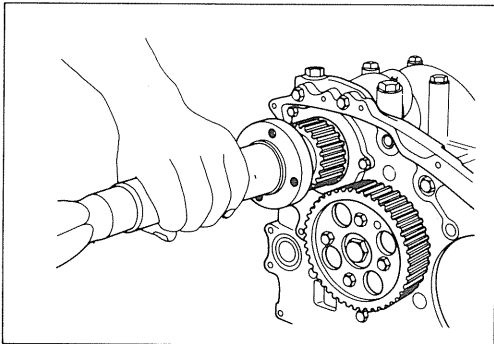
Install the injection pump with brackets to the timing pulley housing using four fixing bolts. Leave the fixing bolts on the injection pump rear bracket semi-tight.



2. Crankshaft timing pulley

Install the crankshaft timing pulley using pulley installer.

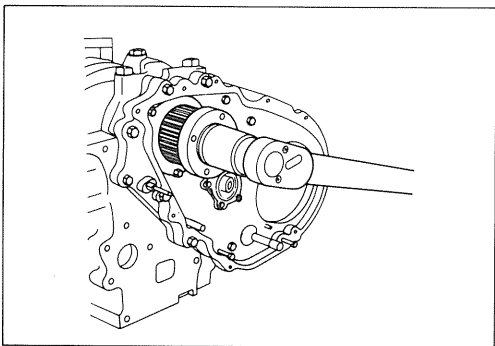
Pulley installer : 5-8522-0020-0



3. Crankshaft center pulley

Install the crankshaft center pulley using special tools.

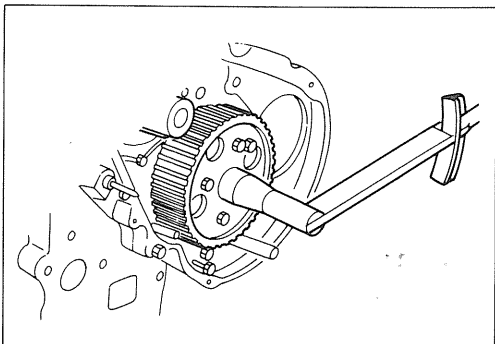
Pulley installer : 5-8522-0020-0



4. Crankshaft pulley bolt and washer

Tighten bolt using a bar to prevent turning of the crankshaft.

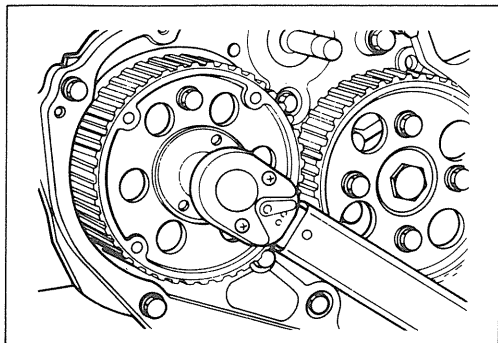
Torque	kg·m(ft.lbs.)	17.1—20.9 (124—151)
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5. Cam center with camshaft timing pulley

Install cam center with the camshaft timing pulley.

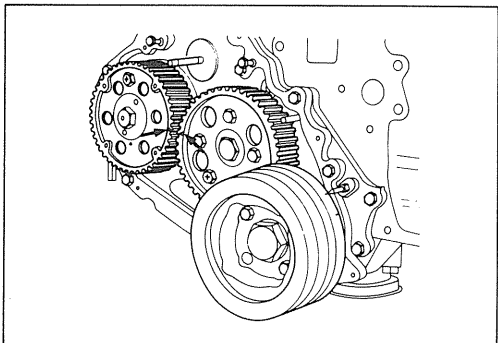
Torque	kg·m(ft.lbs.)	10—12 (72—87)
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6. Injection pump timing pulley

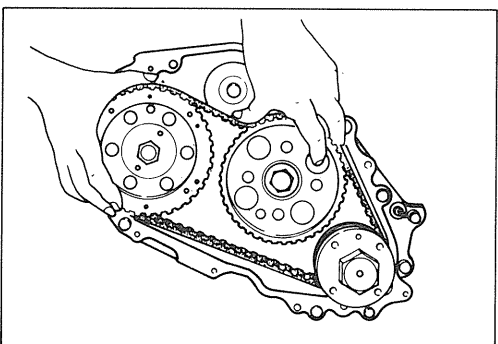
Install the injection pump timing pulley by aligning it with the key groove.

Torque	kg·m(ft.lbs.)	5.8—7.2 (42—52)
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7. Timing belt

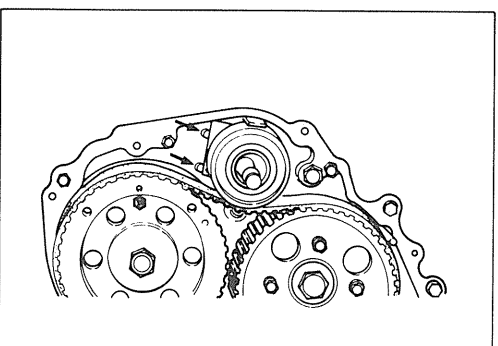
Bring the piston in No. 1 cylinder to top dead center on compression stroke and align marks on the timing pulleys.



Make an adjustment, so that slackness of the belt is taken up by the tension pulley.

When installing, care should be used so as not to damage the belt.

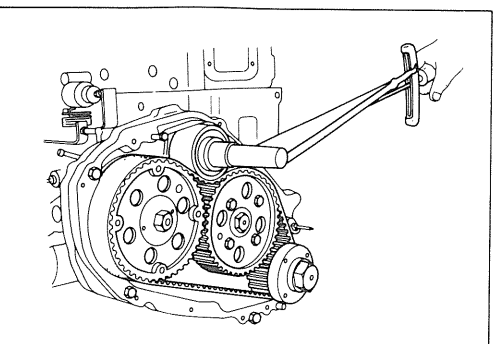
Install the timing belt in sequence of crankshaft timing pulley, camshaft timing pulley and injection pump timing pulley.



8. Tension center and tension pulley

Install the tension center and tension pulley, so that end of the tension center is fitted against two pins on the timing pulley housing properly.

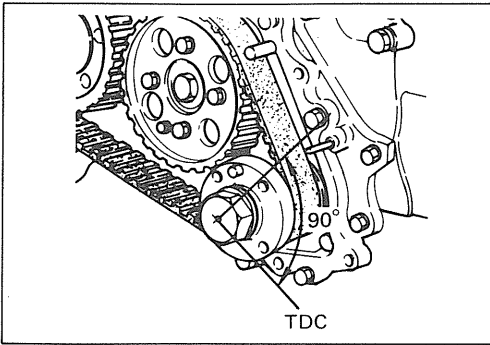
Hand tighten the nut, so that the tension pulley can be rotated freely.



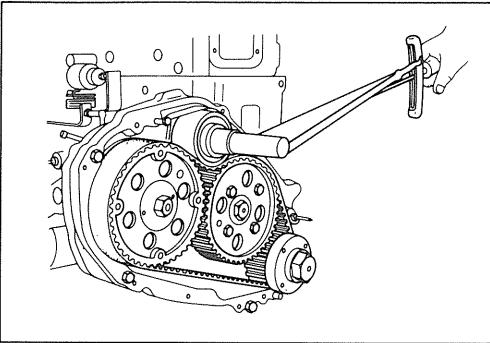
9. Tension spring

Install the tension spring correctly and semitighten the tension pulley nuts.

Torque	kg·m(ft.lbs.)	3—5 (22—36)
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Turn the crankshaft 2 turns in normal direction of rotation to permit seating of the belt. Further turn the crankshaft 90 degrees beyond top dead center to settle the injection pump.



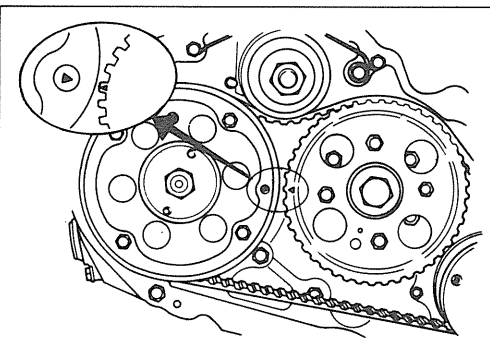
Loosen the tension pulley nut allowing slackness of the belt to be taken up, then tighten the tension pulley nuts.



Never attempt to turn the crankshaft in the reverse direction.

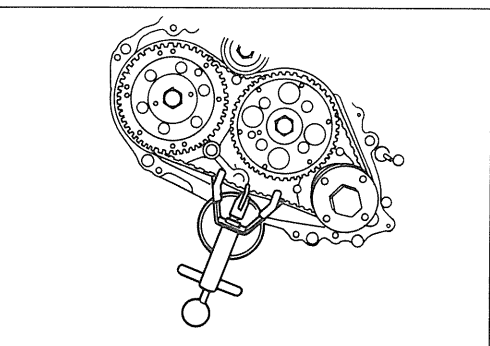


Torque	kg·m(ft.lbs.)	11.0-13.0 (79-94)
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10. Injection pump timing pulley flange

Install the flange on the injection pump pulley. The hole in the outer circumference of the flange should be aligned with the timing mark "△" on the injection pump pulley.



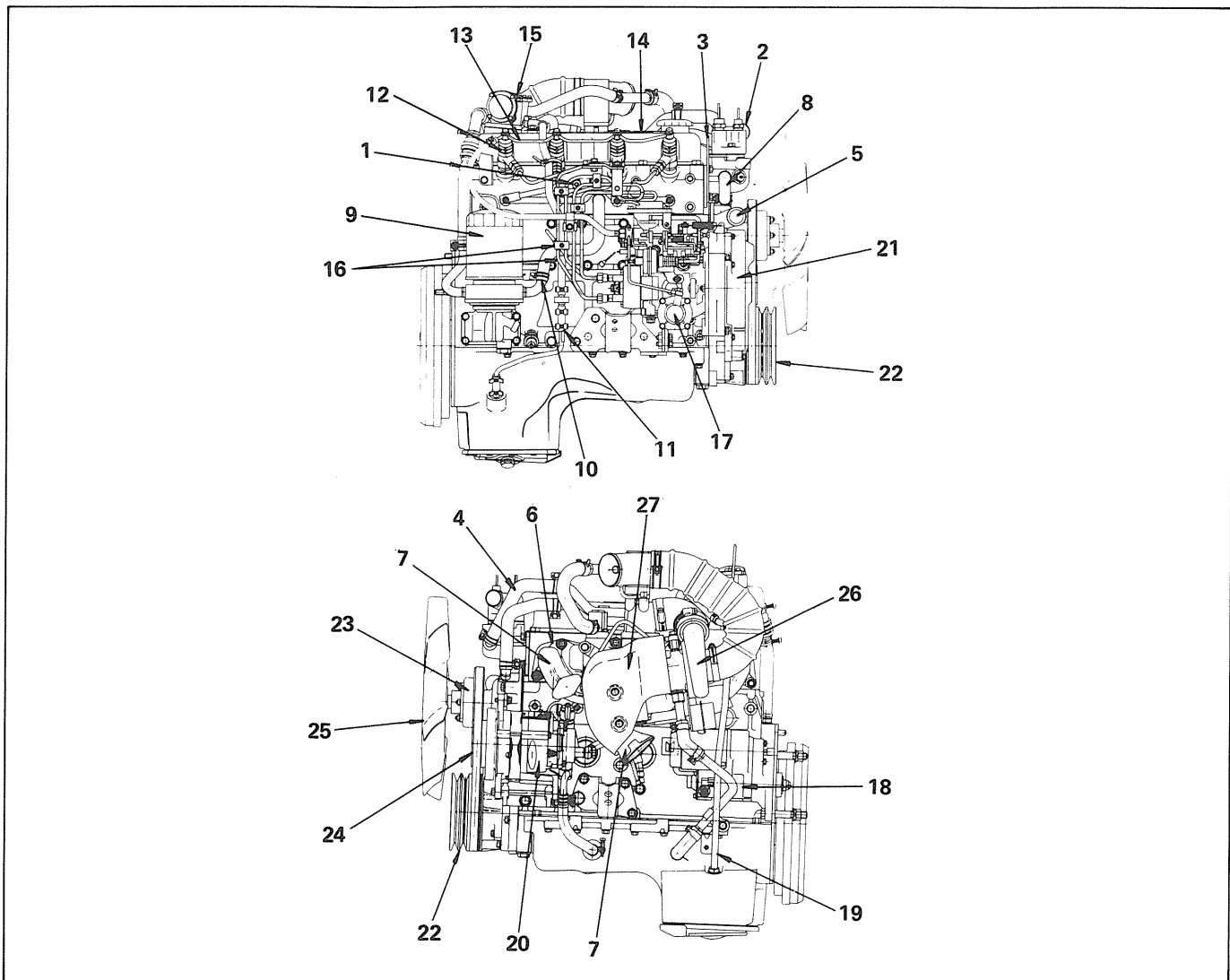
Turn the crankshaft 2 turns in normal direction of rotation to bring the piston in No. 1 cylinder to top dead center on compression stroke and check that the mark "△" on the timing pulley is in alignment with the hole in the flange, then measure the tension of the timing belt with a special tool.

Tension gauge : 5-8840-2084-0
(J-29771)



Standard	kg(lbs.)	15-25 (33-55)
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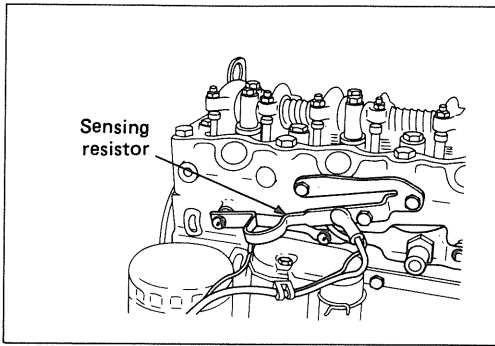
EXTERNAL PARTS



Reassembly steps

- | | |
|-------------------------------------|---|
| ▲ 1. Glow plug and sensing resistor | 15. PCV valve |
| ▲ 2. Thermostat housing | ▲ 16. Injection line and clip |
| 3. Engine hanger (Front) | 17. Oil pressure switch and oil pressure unit |
| 4. Heater hose | 18. Starter motor assembly |
| 5. Water pump | 19. Oil guide tube assembly |
| ▲ 6. Intake and exhaust gasket | 20. Alternator assembly and bracket |
| ▲ 7. Intake and exhaust manifolds | ▲ 21. Timing pulley housing cover |
| 8. Water by-pass hose | 22. Crank pulley |
| 9. Oil filter | 23. Fan pulley |
| 10. Oil cooler hose | ▲ 24. Fan belt |
| 11. Breather hose | 25. Cooling fan |
| ▲ 12. Nozzle holder assembly | 26. Turbocharger (C223T only) |
| 13. Leak-off pipe | 27. Turbocharger cover (C223T only) |
| ▲ 14. Cylinder head cover | |

▲ See reassembly procedures for details



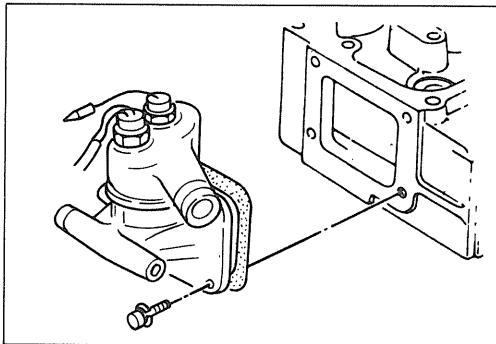
Important operations

1. Glow plugs and sensing resistor

Install glow plugs. Make connections at the connector.

Connect the sensing resistor to No. 4 glow plug.

All glow plugs must be replaced even if only one of them is found to be defective.

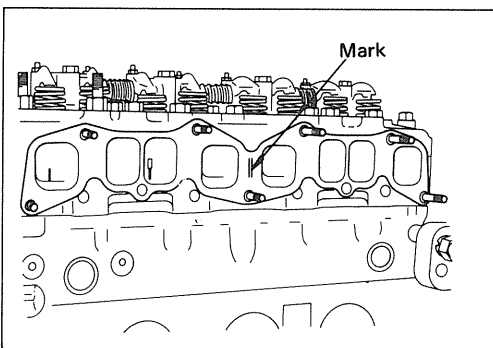


2. Thermostat housing

Install the thermostat housing using a gasket.

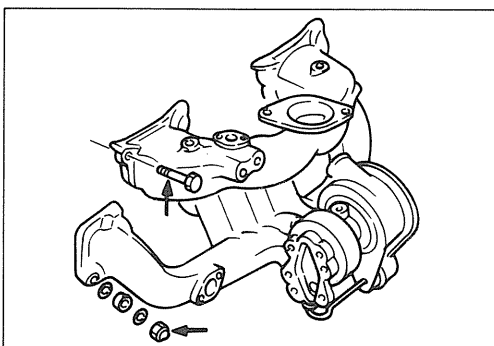
The bolts fixing the thermostat housing are also used to secure the engine front hanger.

Apply a thin coat of permatex silicone sealant gasket evenly to both faces of the gasket.



6. Intake and exhaust manifold gasket

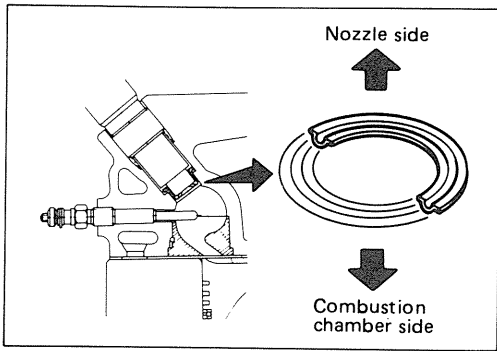
Install the intake and exhaust manifold gaskets on the cylinder head with the mark turned up and pointing outward.



7. Intake and exhaust manifolds

Install the intake and exhaust manifolds, and tighten the bolts and nuts to specification.

Torque	kg·m(ft.lbs.)
C223	1.8-2.4 (13-17)
C223T	1.8-2.4 (13-17)



12. Nozzle holder assembly

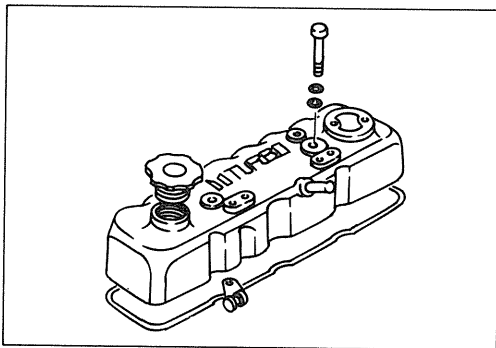
Install the parts in the sequence following corrugated washer, nozzle gasket and nozzle holder.

Do not reuse the corrugated washer. Use the new one.

The corrugated washer should be installed with blue color paint side towards to the nozzle.

Tighten the nozzle holder assembly.

Torque	kg·m(ft.lbs.)	7—8 (51—58)
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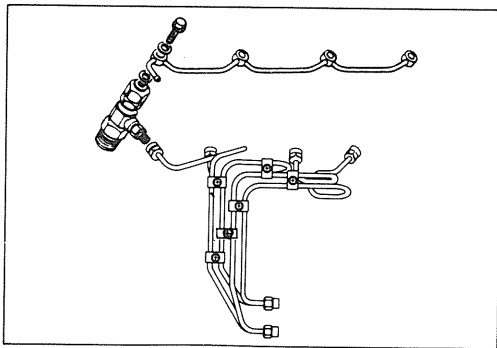


14. Cylinder head cover

Lubricate the rocker arms and valve springs with engine oil and install the cylinder head cover, fitting the O ring into the groove in the lower face of the cover properly. Install and tighten nuts to specification.

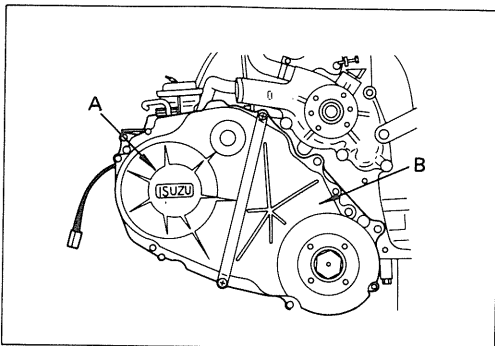


Torque	kg·m(ft.lbs.)	0.8—1.8 (6—13)
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16. Injection line and clip

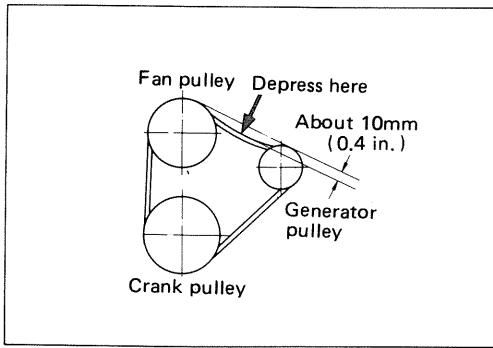
Install the injection lines and clips correctly as shown in the figure.



21. Timing pulley housing cover

Install the pulley housing (A) and pulley housing (B) in that order.

Torque	kg·m(ft.lbs.)	0.6—1.0 (4—7)
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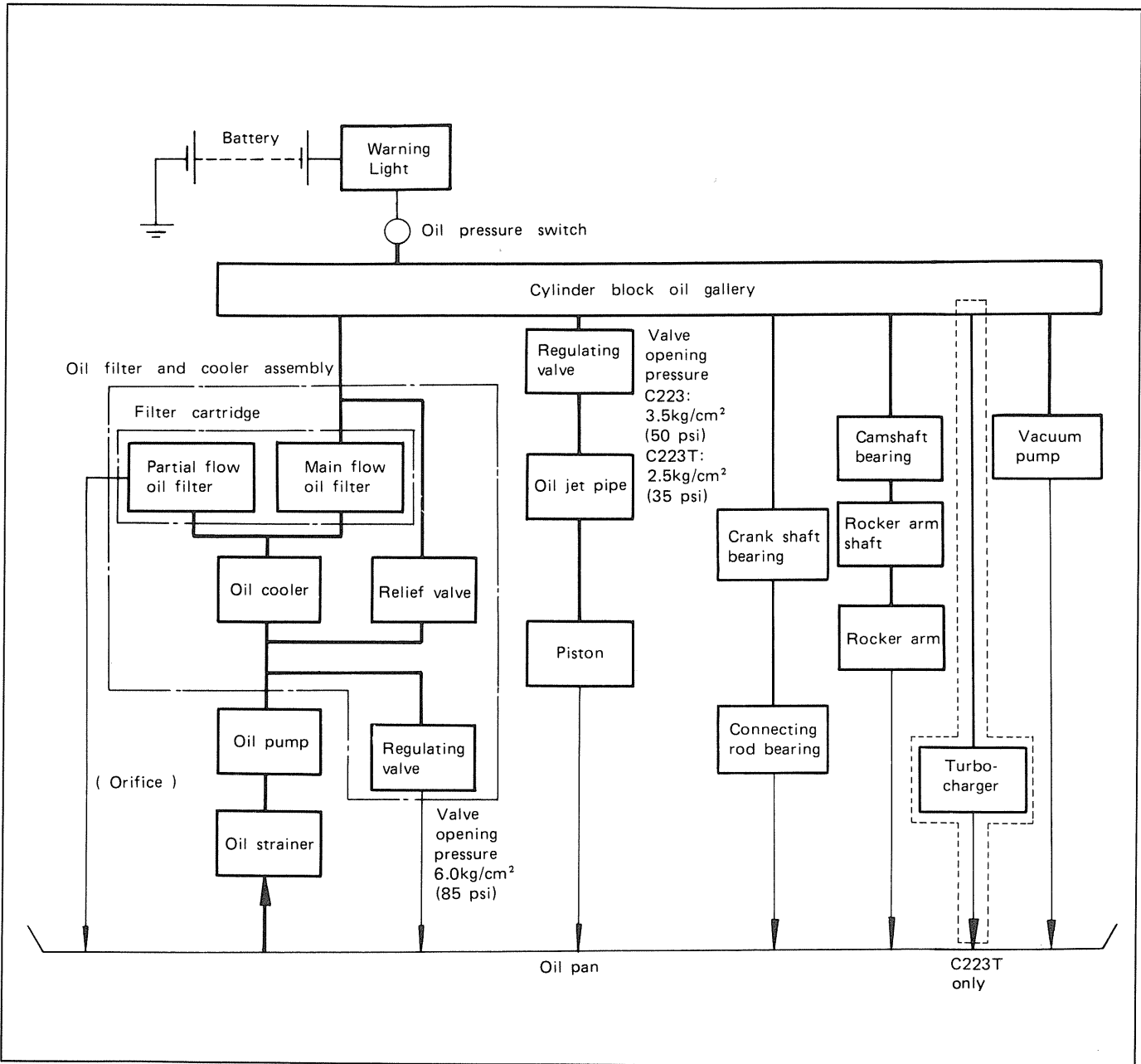


24. Fan belt

Adjust by pivoting the generator assembly, so that the fan belt gives a deflection of 10 mm when checked by applying a test load of 10 kg to the belt between the fan pulley and generator.

LUBRICATING SYSTEM

GENERAL DESCRIPTION

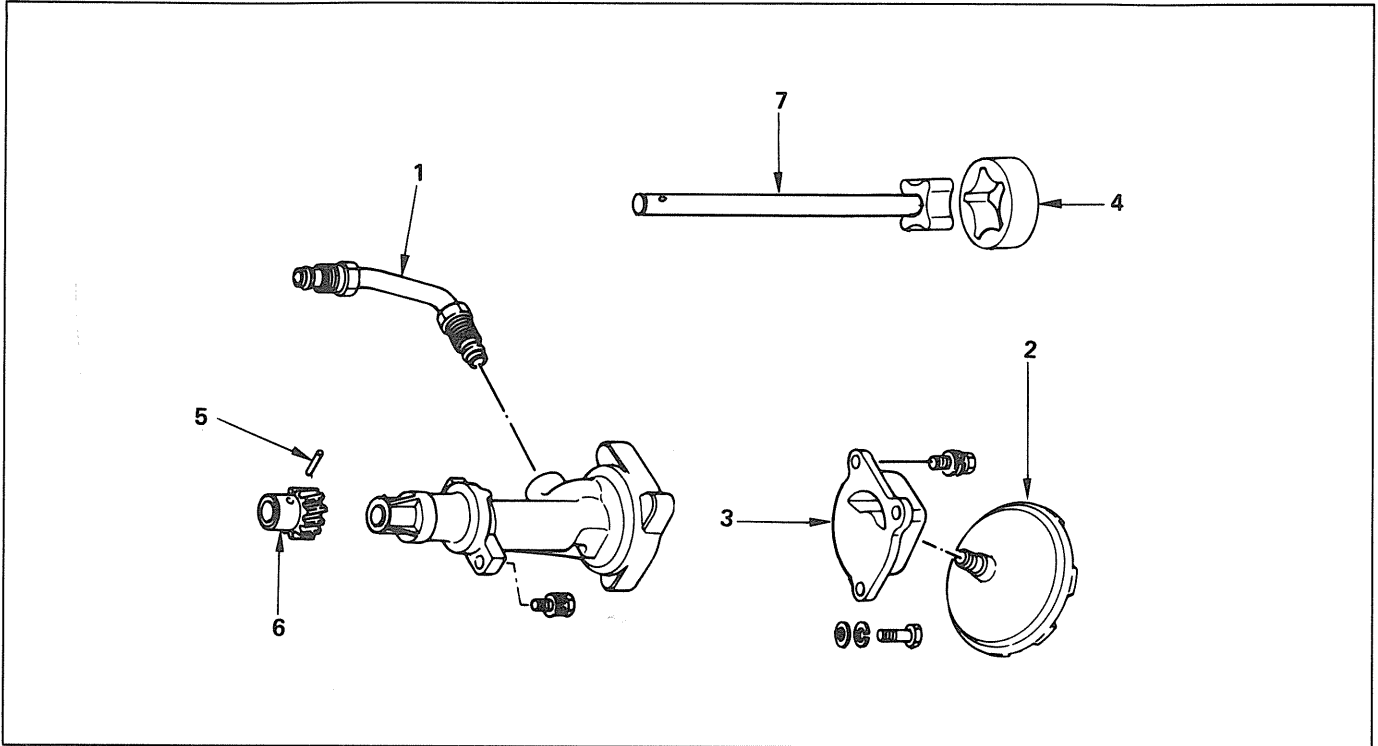


OIL PUMP

4 x 2 MODELS (Except C223T)



DISASSEMBLY

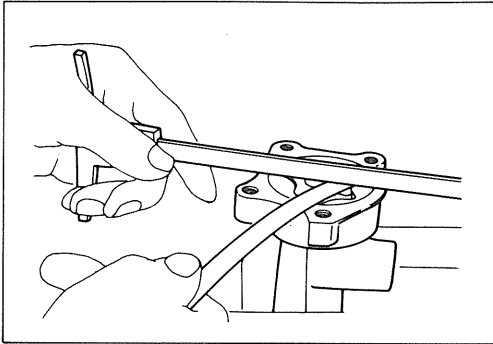
**Disassembly steps**

1. Oil line
2. Strainer
3. Cover
4. Vane
5. Pin; Pinion to shaft
6. Pinion
7. Rotor with shaft



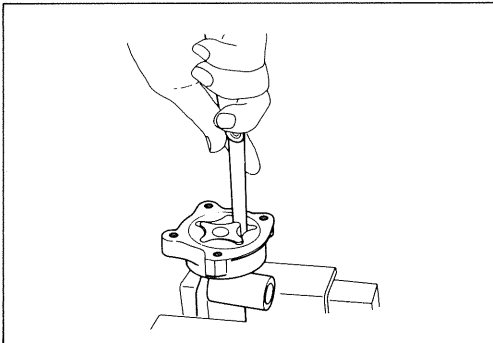
INSPECTION AND REPAIR

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



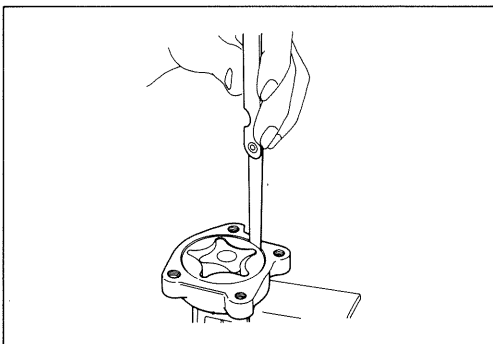
Check the clearance between the vane, rotor and cover. If the measured value is beyond the specified value, replace the rotor set (pin, shaft, rotor, vane.)

Standard	Limit
0.02—0.07 (0.0008—0.0028)	0.15 (0.0059)



Check the clearance between the rotor and vane. If the measured value is beyond the standard value, replace the rotor set.

Standard	Limit
	0.14 or less (0.0055)



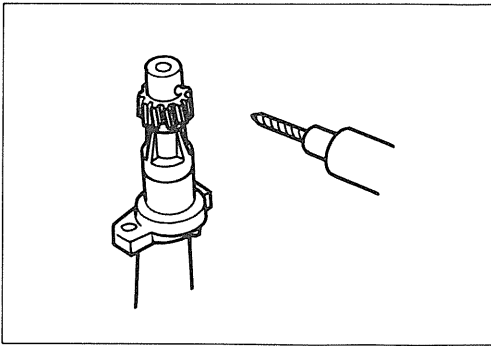
Check the clearance between the vane and pump body. If the clearance is excessive, replace the entire pump assembly.

Standard	mm(in.)	Limit
		0.2—0.27 (0.0079—0.0106)



Check the clearance between the rotor shaft and pump body. If the measured value is beyond the specified value, replace the entire pump assembly.

Standard	Limit
0.04 (0.0016)	0.2 (0.0079)



When necessary to replace the pinion and shaft, install the shaft in the pump body and set the pinion on the shaft.

Drill a hole through the pinion and shaft using a 5 mm drill then install and caulk the pin.



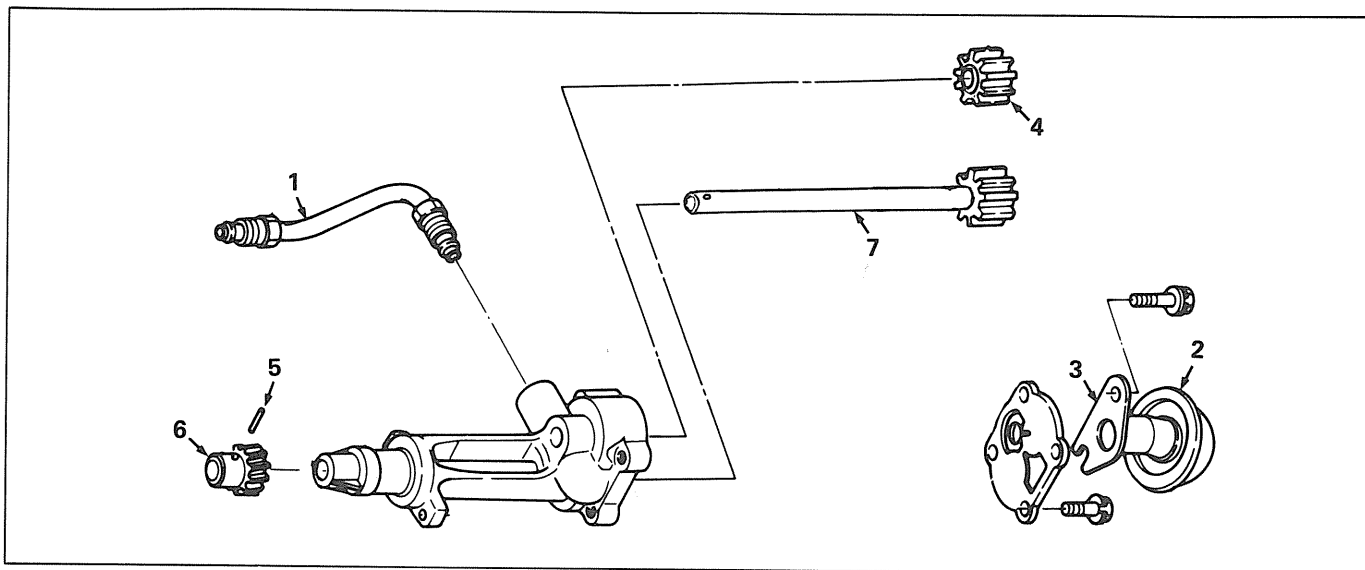
REASSEMBLY

Reassemble the parts in the reverse order of disassembly. After reassembly check that the rotor shaft turns smoothly.

4 x 4 MODELS and C223T



DISASSEMBLY



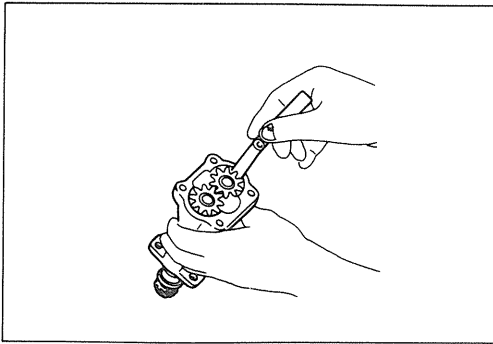
Disassembly steps

1. Oil line
2. Strainer
3. Cover
4. Driven gear
5. Pin; Pinion to shaft
6. Pinion
7. Drive gear with shaft



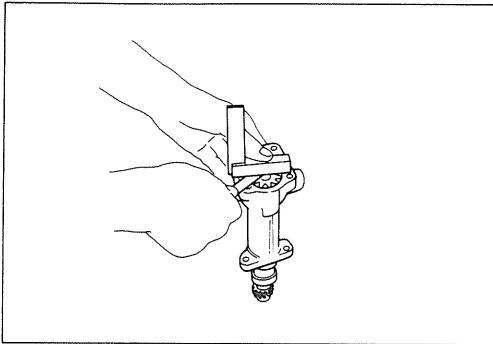
INSPECTION AND REPAIR

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



Check the clearance between pump body inner wall and gear tip.
If the clearance is beyond the standard value, replace the gear set (drive gear, shaft, pin).

Standard	mm(in.)	0.125—0.139 (0.0049—0.0055)
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Check the clearance between pump body and gear sideface.
If the clearance is beyond the standard value, replace the pump assembly.

Standard	mm(in.)	0.04—0.094 (0.0016—0.0037)
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REASSEMBLY

Reassemble the parts in the reverse order of disassembly and check that the shaft turns smoothly.

OIL JET PIPE AND REGULATING VALVE



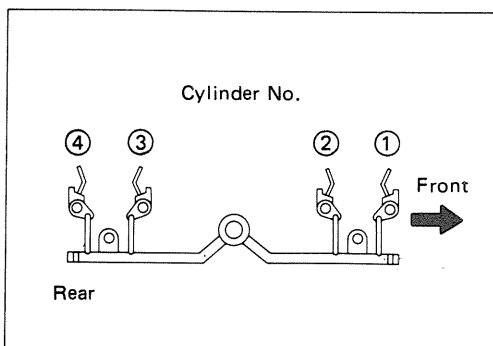
INSPECTION AND REPAIR

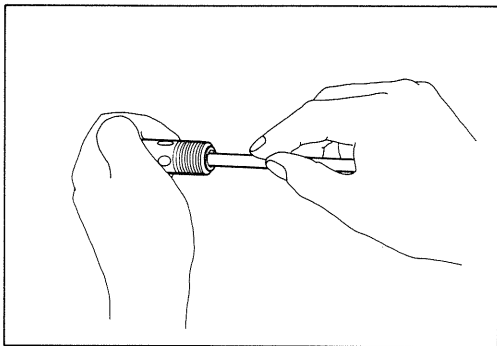
Make necessary correction or parts replacement if in wear, damage or any other abnormal conditions, are found through inspection.



Visual check

Inspect for damage or other abnormal conditions.



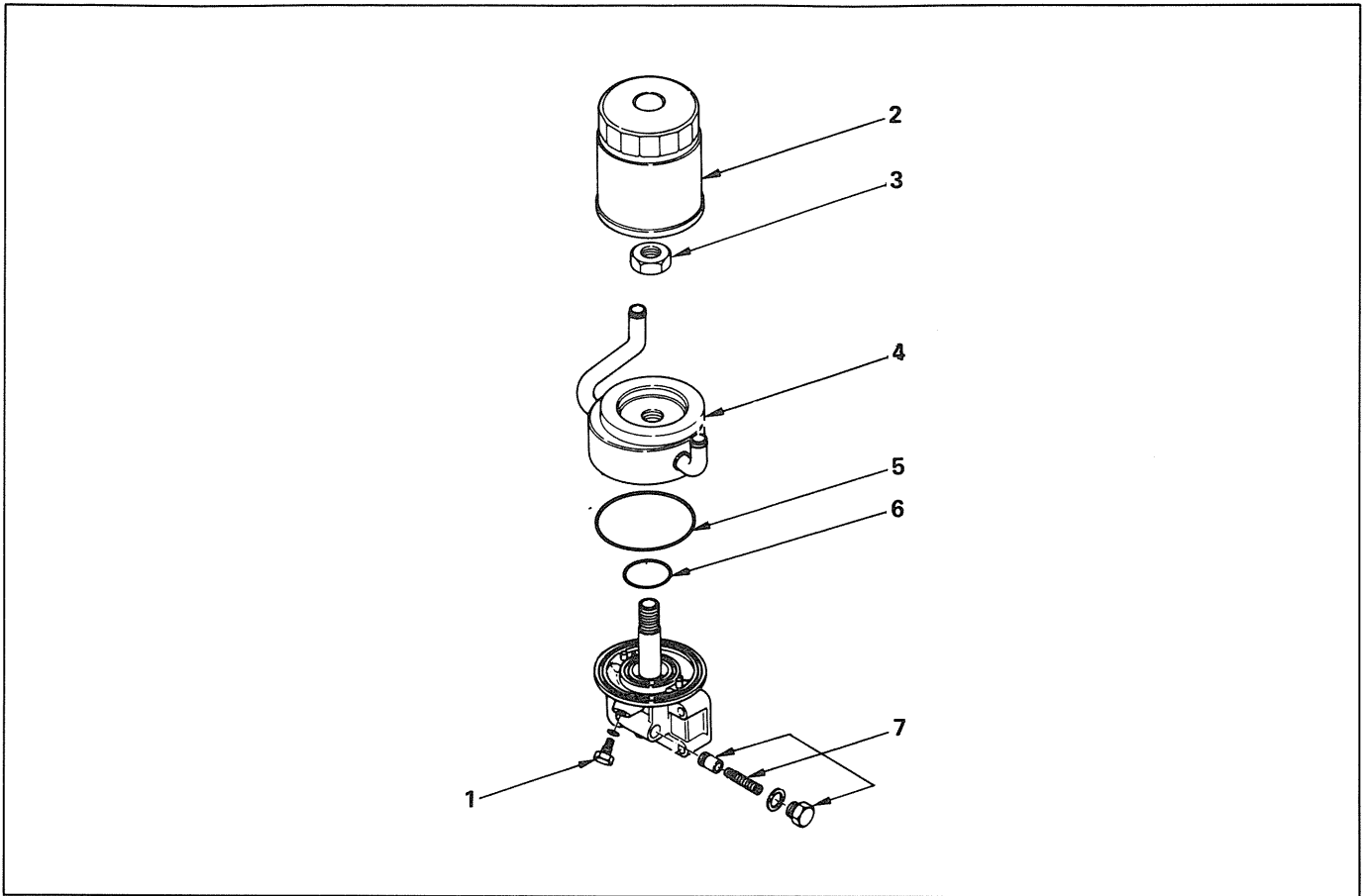


Check valve action by applying a light force to the valve with a screwdriver.

MAIN OIL FILTER WITH OIL COOLER



DISASSEMBLY

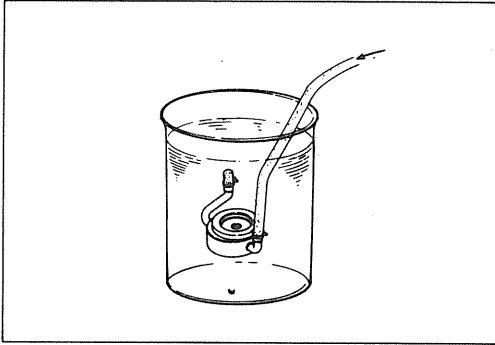
**Disassembly**

- | | |
|-------------------------|-------------------------------------|
| 1. Drain plug | 5. O-ring |
| 2. Cartridge oil filter | 6. O-ring |
| 3. Nut | 7. Oil cooler relief valve assembly |
| 4. Oil cooler | |



INSPECTION AND REPAIR

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

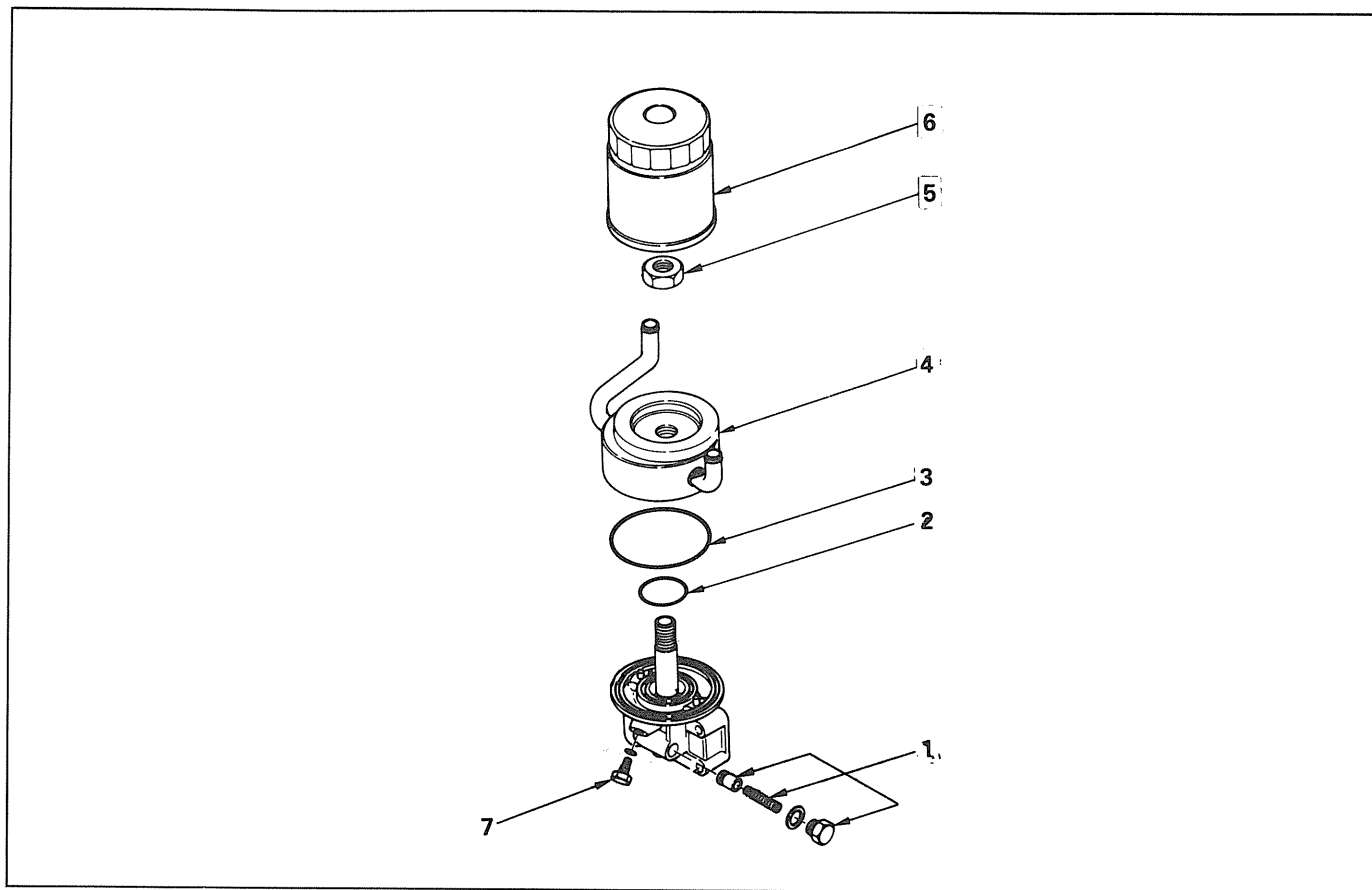


Inspection for water leakage

Submerge the oil cooler in water with compressed air of 2 kg/cm^2 applied into the oil cooler with the water passage in one side plugged and check to see if air bubbles arise, indicating leakage.



REASSEMBLY



Reassembly steps

- ▲ 1. Oil cooler relief valve assembly
- 2. O-ring
- 3. O-ring
- 4. Oil cooler
- ▲ 5. Nut
- 6. Cartridge oil filter
- ▲ 7. Drain plug



Important operations



1. Oil cooler relief valve assembly.

Torque	kg·m(ft.lbs.)	1.5—2.5 (11—18)
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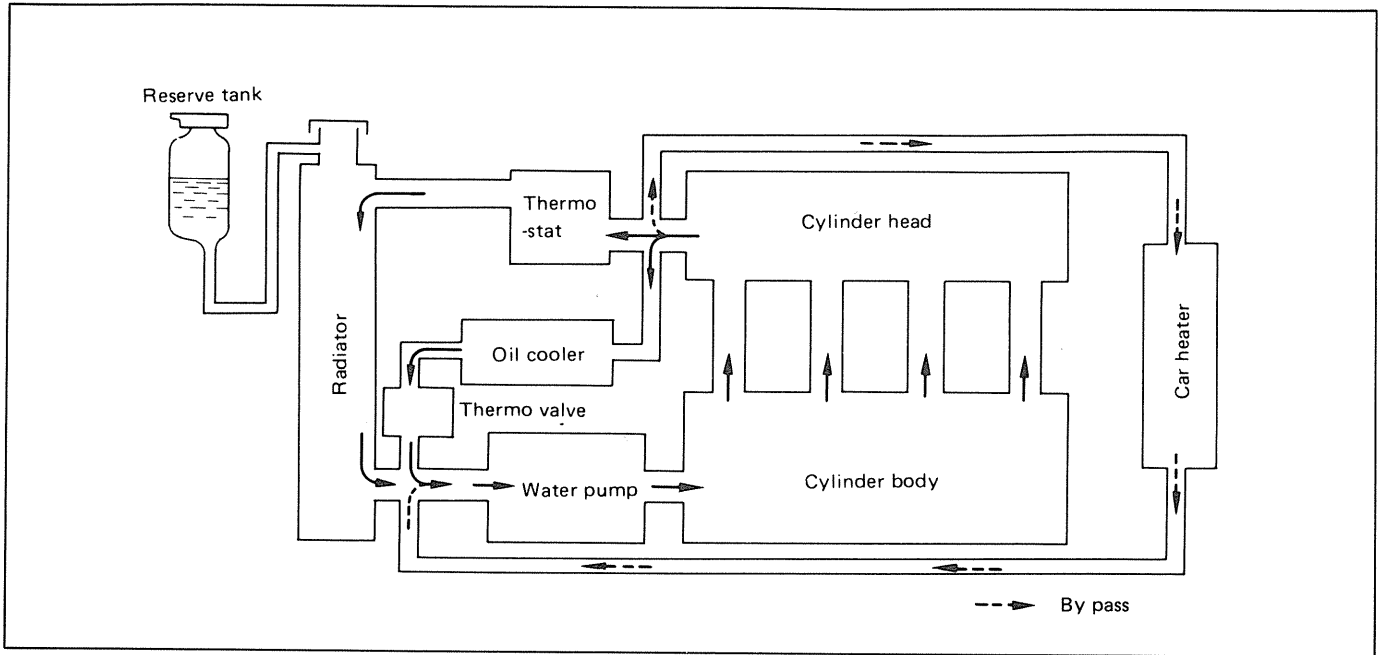


5. Nut

Torque	kg·m(ft.lbs.)	2.5—3.5 (18—25)
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COOLING SYSTEM

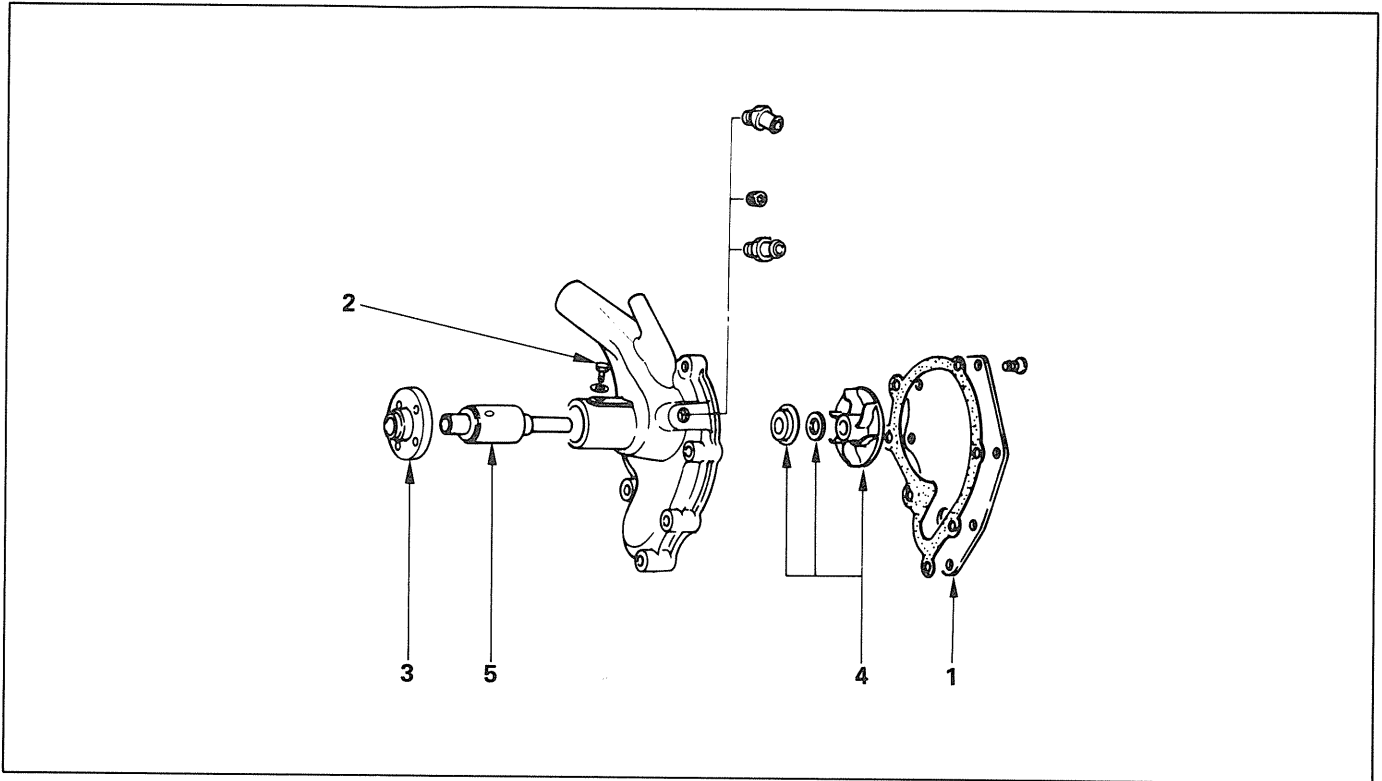
GENERAL DESCRIPTION



WATER PUMP

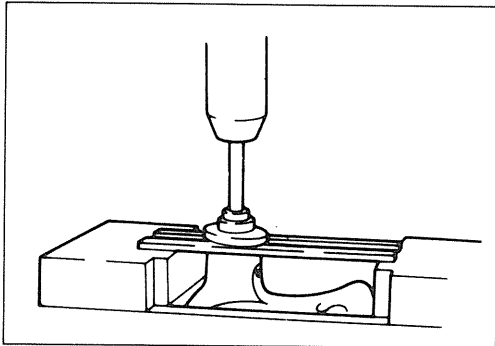


DISASSEMBLY



Disassembly steps

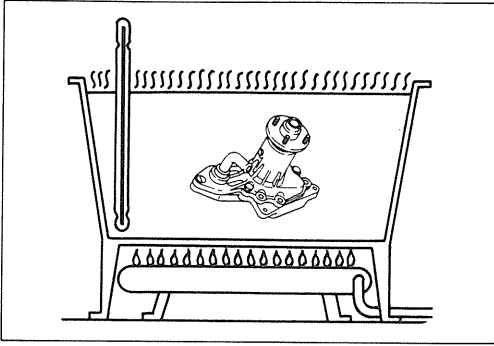
- 1. Cover
- 2. Set screw
- ▲ 3. Fan center
- ▲ 4. Impeller and seal unit
- 5. Bearing unit



Important operations



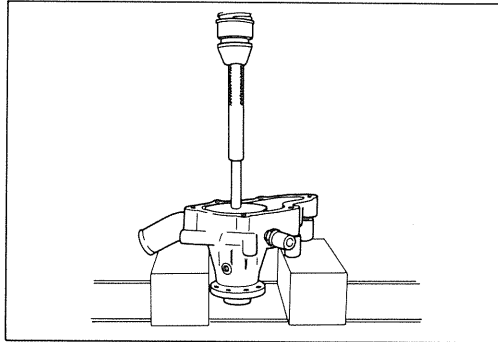
- 3. Fan center
Remove.



4. Impeller and seal unit

For aluminum body only.

Heat the pump body in hot water (80 — 90°C).

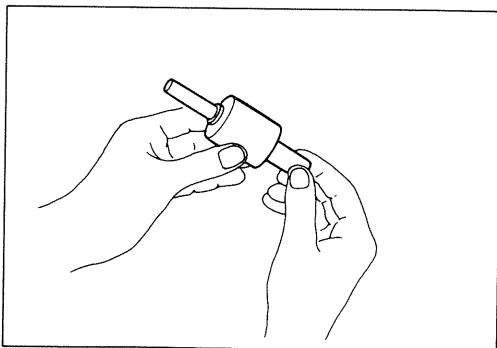


Remove impeller using a bench press and a suitable bar.



INSPECTION AND REPAIR

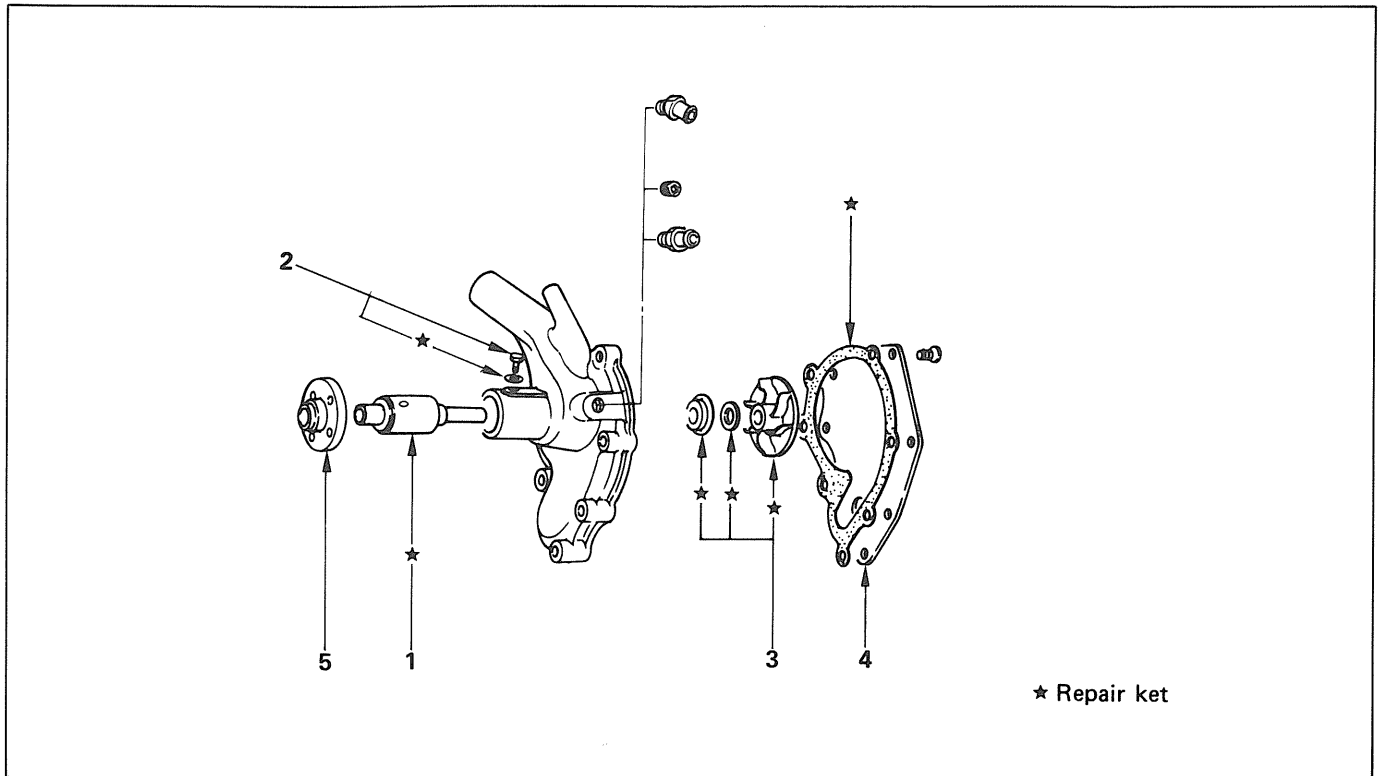
Make necessary correction or parts replacement if wear, damage or any other abnormal condition are found through inspection.



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



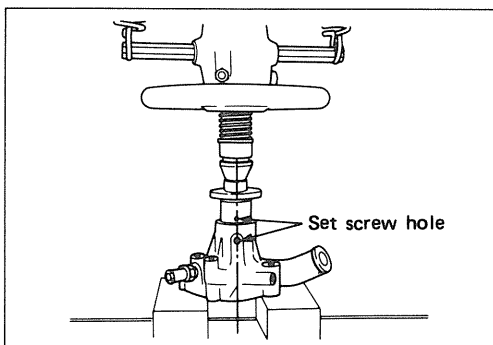
REASSEMBLY



★ Repair kit

Reassembly steps

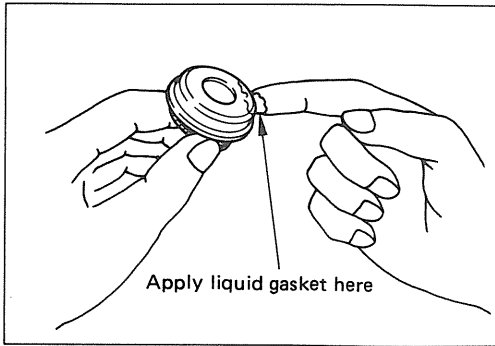
- ▲ 1. Bearing unit
- 2. Set screw
- ▲ 3. Impeller and seal unit
- 4. Cover
- ▲ 5. Fan center



Important operations

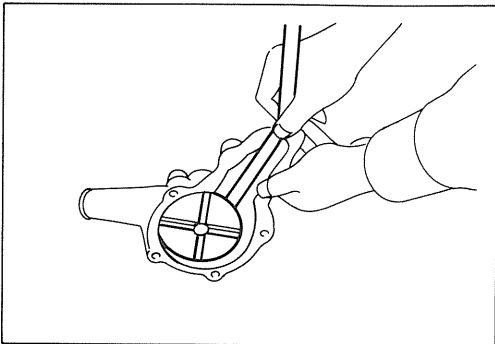
1. Bearing unit

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.



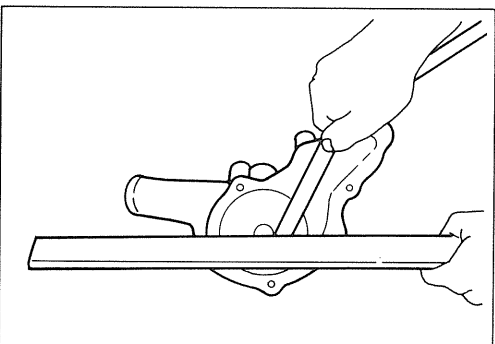
3. Impeller and seal unit

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



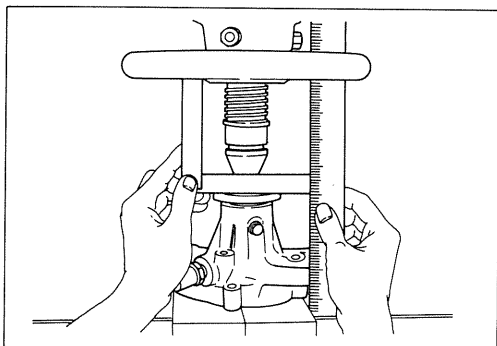
Install the impeller in position using bench press, so that the specified clearance is provided between the impeller and pump body.

Clearance	mm(in.)	0.3-0.6 (0.0118-0.0236)
-----------	---------	----------------------------



After installation, check that rear face of the impeller is indented from the face of the pump body.

Depth	mm(in.)	1 (0.0394)
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5. Fan center

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

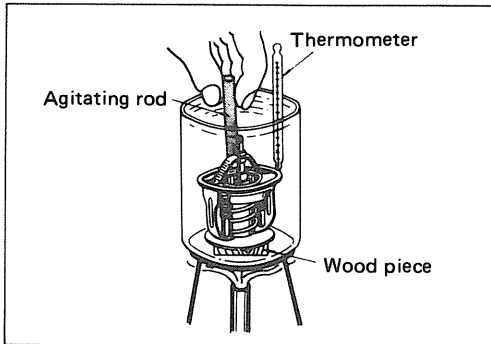
Distance	mm(in.)	110.7-111.3 (4.3616-4.3852)
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THERMOSTAT



INSPECTION AND REPAIR

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



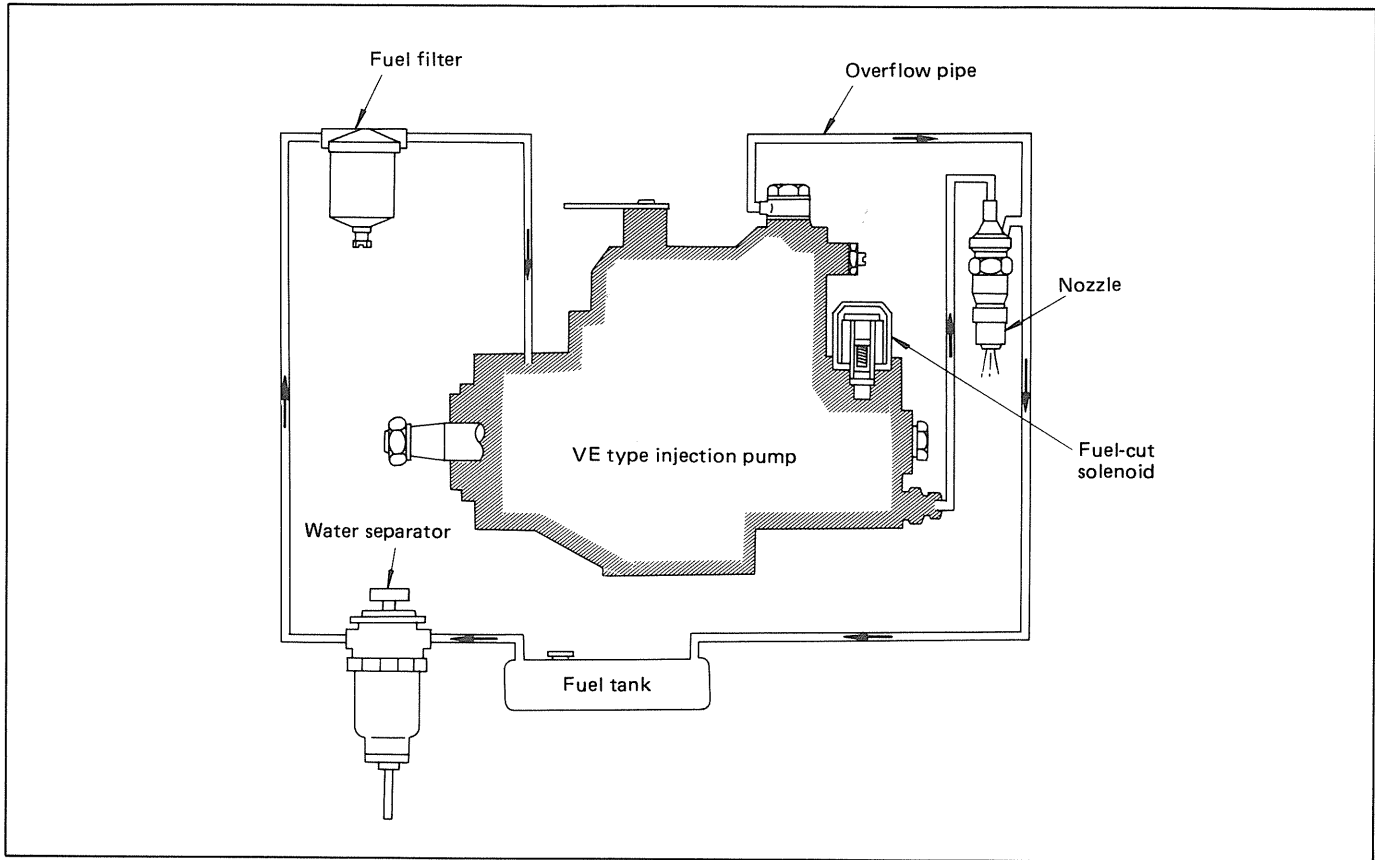
Submerge the thermostat assembly in water completely and check the temperature at which valve begins to open and becomes wide open by increasing the temperature gradually.

Valve opening temperature	82°C (180°F)
Valve lift	8 mm (0.3150 in.) or more at 95°C (203°F)

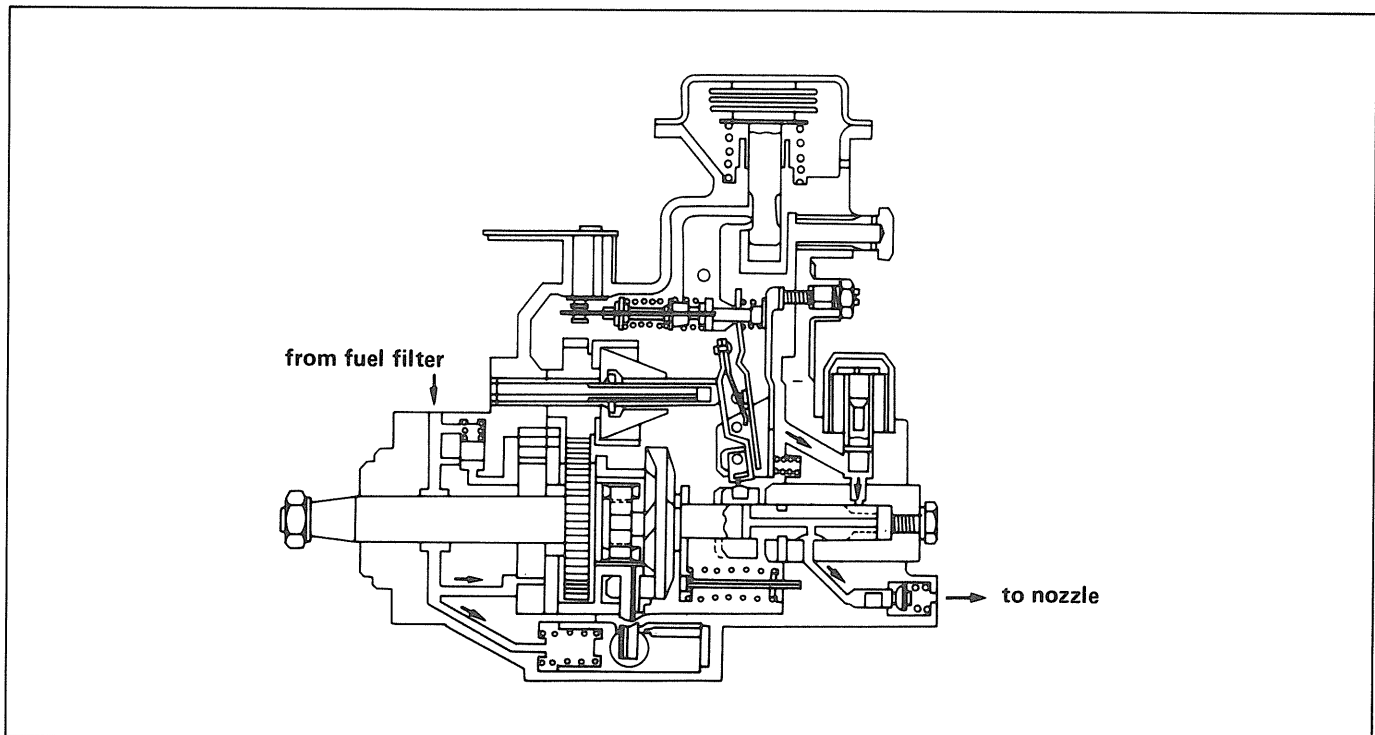
Stir water constantly and avoid heating the thermostat directly.

FUEL SYSTEM

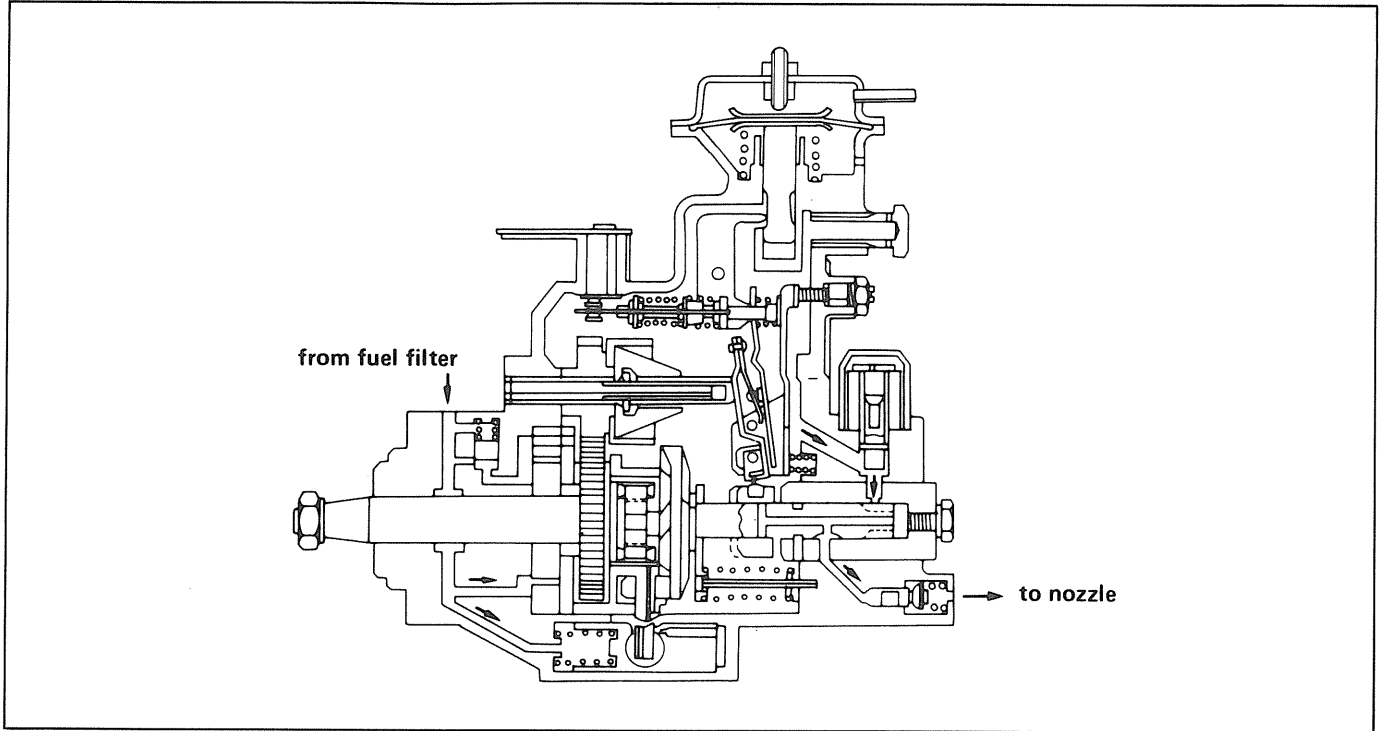
GENERAL DESCRIPTION



C223



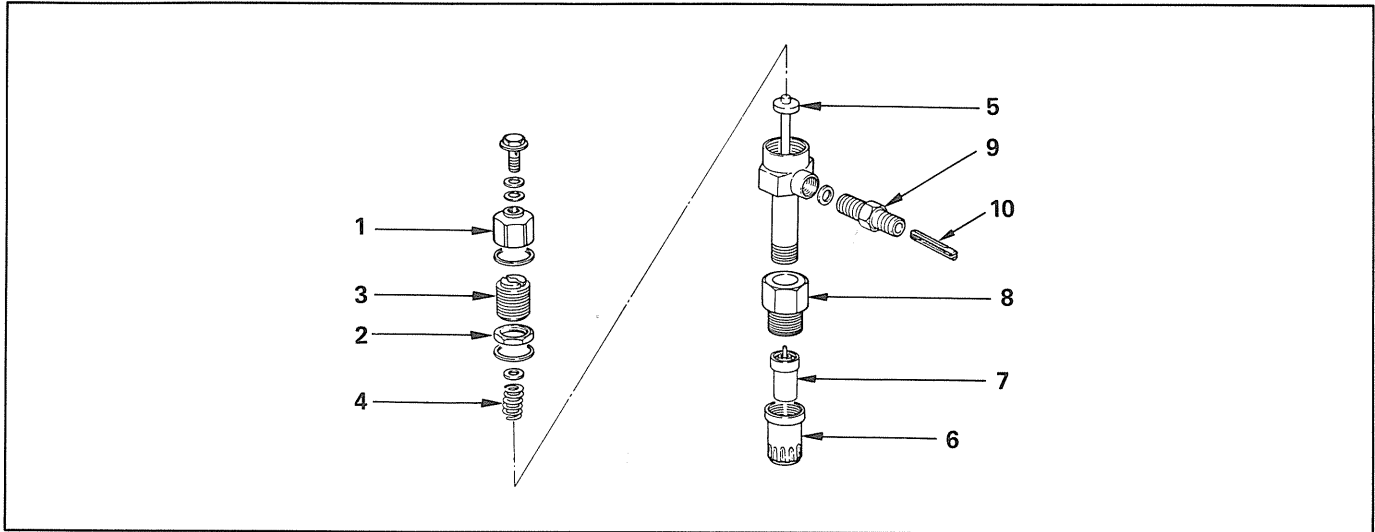
C223T



INJECTION NOZZLE

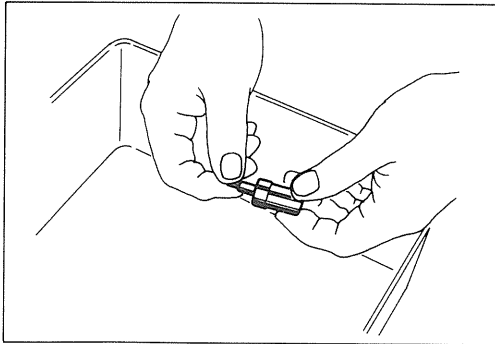


DISASSEMBLY



Disassembly steps

- | | |
|--------------------------|------------------------|
| 1. Nozzle holder cap nut | 6. Retaining nut |
| 2. Nozzle holder nut | ▲ 7. Nozzle |
| 3. Adjusting screw | 8. Nozzle holder screw |
| 4. Nozzle spring | 9. Connector |
| 5. Push rod | |



Important operation

7. Nozzle

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

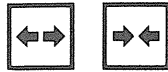


REASSEMBLY

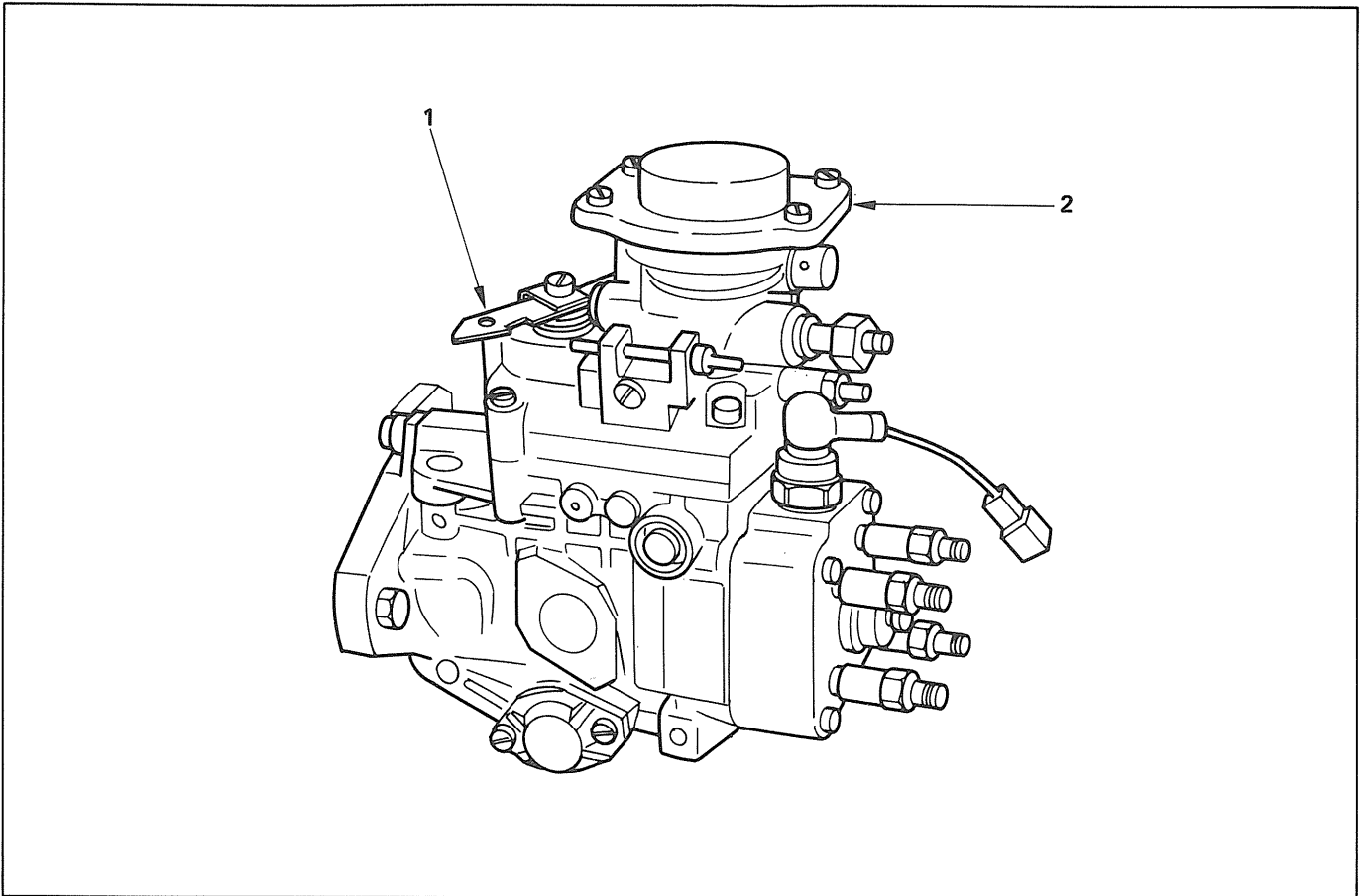
To reassemble, follow the disassembly procedure in reverse order.

Refer to "FUEL SYSTEM" in section 1 "General information" on page 1 — 14 for injection of spraying condition and injection starting pressure adjustment.

ANEROID COMPENSATOR



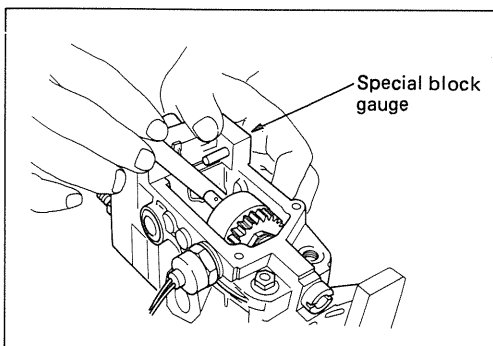
REMOVAL AND INSTALLATION

**Removal steps**

1. Fuel control lever
2. Aneroid compensator

Installation steps

- ▲ 2. Aneroid compensator assembly
1. Fuel control lever

**Important operation — Installation****2. Aneroid compensator assembly**

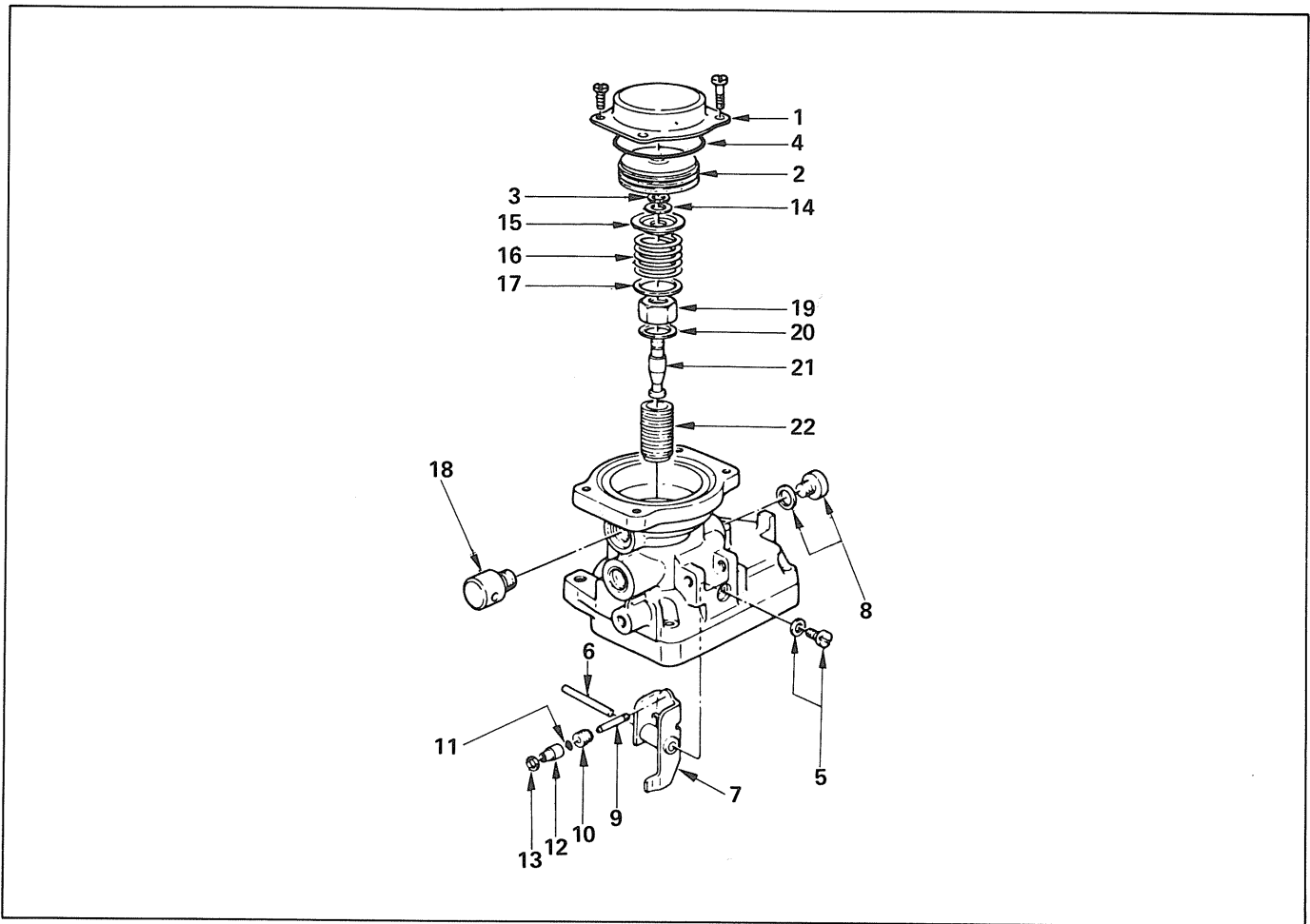
Measure of dimension MS before installing aneroïd compensator assembly.



A pump with aneroïd compensator is not provided with a stopper pin on the pump housing side. Therefore, measure and adjust dimension MS with a special block gauge mounted.



DISASSEMBLY

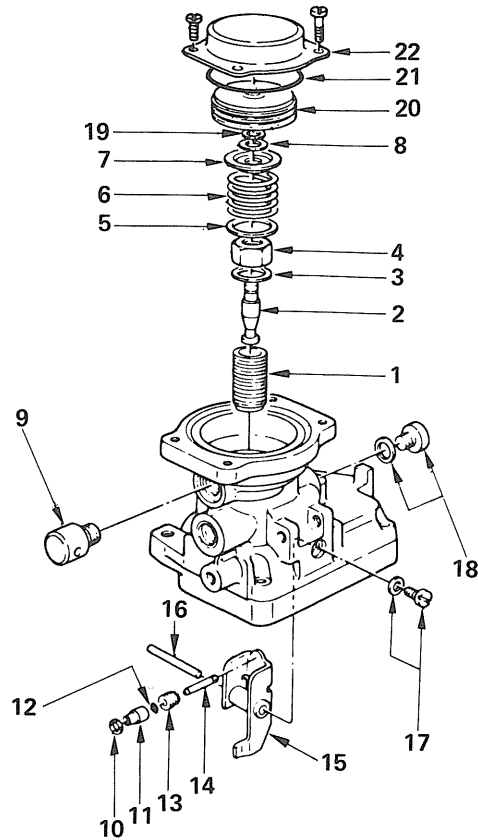


Disassembly steps

- | | |
|--------------------|------------------|
| 1. Cover | 12. Bush |
| 2. Bellows | 13. Gasket |
| 3. Shim | 14. Snap ring |
| 4. O-ring | 15. Spring seat |
| 5. Plug and gasket | 16. Spring |
| 6. Lever shift pin | 17. Washer |
| 7. Lever | 18. Air breather |
| 8. Plug and gasket | 19. Nut |
| 9. Pin | 20. Washer |
| 10. Nut | 21. Adjust pin |
| 11. O-ring | 22. Screw bush |

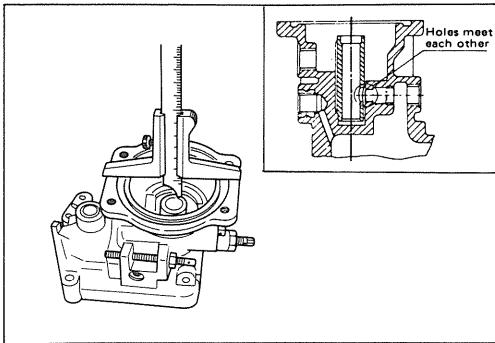


REASSEMBLY



Reassembly steps

- | | |
|-------------------|-----------------------|
| ▲ 1. Screw bush | 12. O-ring |
| 2. Adjust pin | ▲ 13. Nut |
| ▲ 3. Washer | 14. Pin |
| ▲ 4. Nut | ▲ 15. Lever |
| 5. Washer | ▲ 16. Mount pin |
| 6. Spring | ▲ 17. Plug and gasket |
| 7. Spring seat | ▲ 18. Plug and gasket |
| ▲ 8. Snap ring | 19. Shim |
| ▲ 9. Air breather | 20. Bellows |
| 10. Gasket | 21. O-ring |
| 11. Bush | 22. Mount cover |

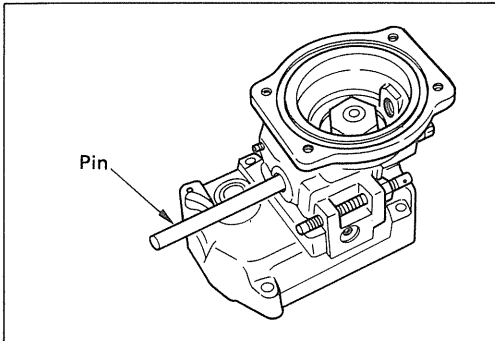


Important operations

1. Screw bush

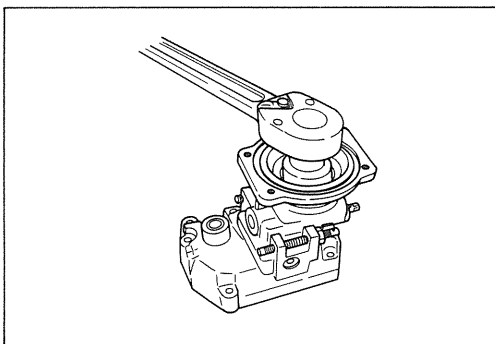
Screw bush in until the dimension to its top end face from the governor cover top end face becomes $20.5 \pm 0.5\text{mm}$.

Locate the bush so that its hole for pin is aligned with the hole in the governor cover.



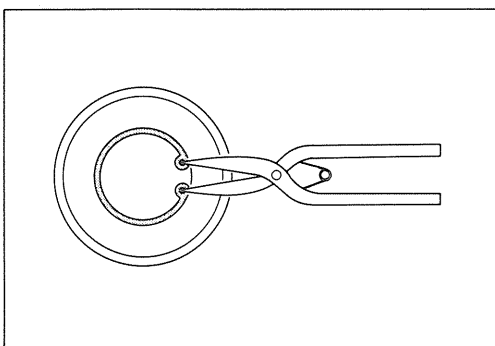
3. Washer

Mount a bush locking tool end then fit washer.



4. Nut

Torque	(kg·m(ft.lbs.))	2.5—3.5 (18—25)
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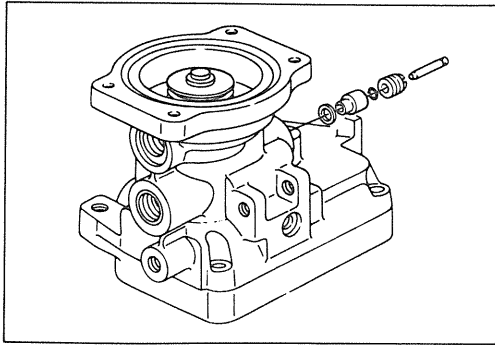
8. Snap ring

Install the snap ring using a snap ring pliers.



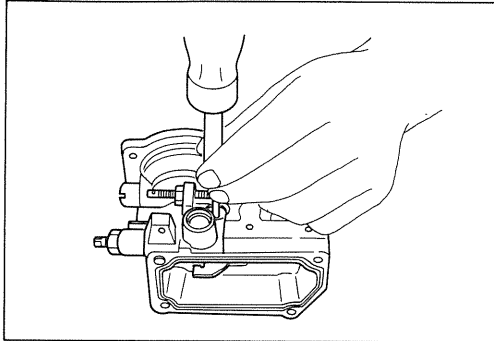
9. Air breather

Torque	kg·m(ft.lbs.)	1.0—1.5 (7.2—10.8)
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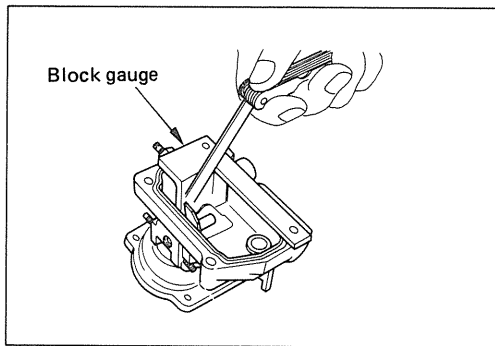
13. Nut

Torque	kg·m(ft.lbs.)	0.9—1.2 (6.5—8.6)
--------	---------------	-------------------



15. Lever

For mounting the pin, lightly drive it from the left-hand side as viewed from the drive shaft side. Assure that the lever moves smoothly.



Attach a block gauge to the bottom side of the governor cover.

Check by using a feeler gauge if the clearance between the bottom end face of the lever and the block gauge is in the range of $-0.1 \sim +0.1$ mm (0.0039 in.).

Part No.	Length (mm)	Shape
146712-0200	24.6	
146712-0300	24.8	
146712-0400	25.0	
146712-0500	25.2	
146712-0600	25.4	



16. Mount pin

Make adjustment, if necessary, by replacing pin.



17. Plug and gasket

Plug torque	kg·m(ft.lbs.)	0.6—0.7 (4.3—5.0)
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18. Plug and gasket

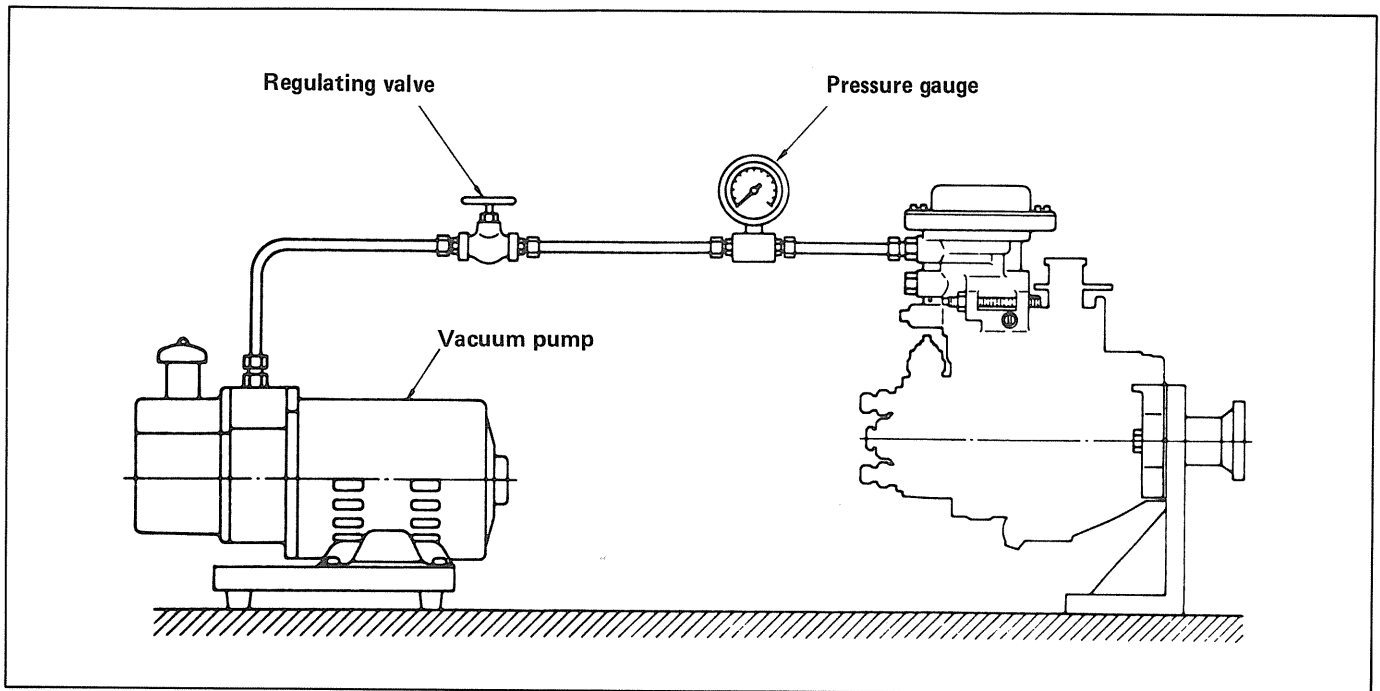
Plug torque kg·m(ft.lbs.)	1.0-1.3 (7.2-9.4)
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ADJUSTMENT

The procedure for adjustment of the fuel injection pump with aneroid compensator is same as that for pumps of standard specification except for the aneroid compensator.

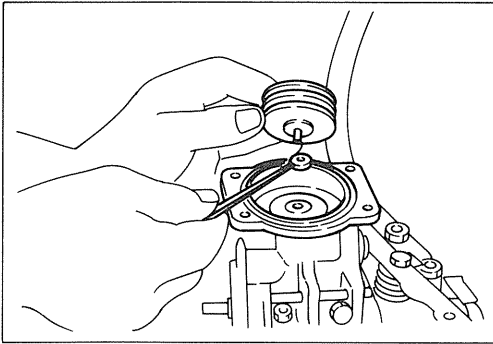
The method of adjustment of the aneroid compensator is described below.



Piping

For adjustment of the aneroid compensator, remove the air breather to use the hole as the negative pressure intake.

- 1) Adjustment of Full Load standard injection quantity
 - a) Fix the control lever in the Full position, and make adjustment by the Full Load adjusting screw in the state where the negative pressure is "Zero".
Make adjustment of paragraph 1) above in the conventional procedure.
- 2) Adjustment of Full Load injection quantity
Apply the specified negative pressure based on the calibration data, fix the control lever in the Full position, and make adjustment by using shims so that the injection quantity is within the specification.



- NOTES:**
1. Except for adjustment of the aneroid compensator at the pressure specified in the calibration data, all adjustments are made in the state where the negative pressure is "Zero".
 2. The calibration data is applicable to lowlands.
For making adjustment at highlands, observe the following instructions.
 - 1) Except for adjustment of Full Load standard injection quantity and other adjustments of the aneroid compensator, make adjustments with the cover on top of the bellows removed.
 - 2) Make adjustment to meet the individual inspection specification for the applicable altitude.

INJECTION PUMP DATA

C223

INJECTION VOLUME ADJUSTMENT

TEST CONDITIONS

Injection nozzle	D.K.K.C. P.No.105780-0000 Bosch type No.DN12SD12T
Injection nozzle holder	D.K.K.C. P.No.105780-2080 Bosch type No.EF8511/9A
Injection starting pressure	150kg/cm ²
Injection line	Inner dia. 2mm x Outer dia. 6mm — Length 840mm
Transfer pump pressure	0.2kg/cm ²
Test diesel fuel	Bosch oil OL61V11 SAE standard test oil (SAE 967.D)
Testing oil temperature	45 — 50°C
Identification number	104749-1130, 104749-1131, 104749-1140, 104749-1141, 104749-1150, 104749-1151, 104749-1160, 104749-1161, 104749-1170, 104749-1180, 104749-1500, 104749-1510, 104749-1520, 104749-1530, 104749-1580, 104749-1590

IDENTIFICATIONS PLATE AND NUMBER

When adjusting injection volume, use the correct data following the injection pump identification number.

MAKER/ASSY NO.	894225 2471
INJ.PUMP ASSY NO.	104748-1010

INJECTION VOLUME AND GOVERNOR PERFORMANCE DIAGRAM

Identification number : 104749-1130, 104749-1140

Test diesel fuel : Bosch diesel fuel OL61V11

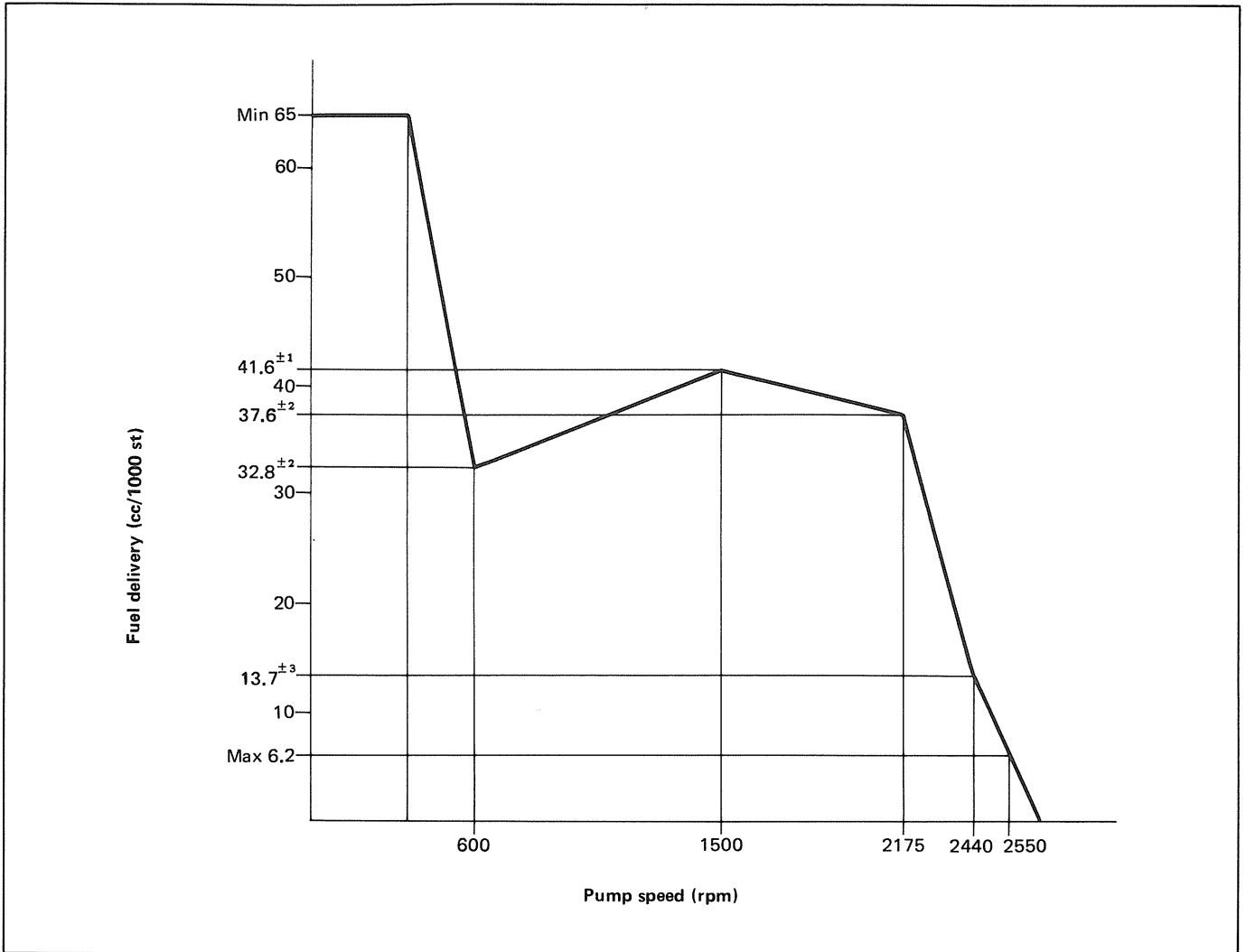
1. Settings	Pump Speed (rpm)	Settings	Difference in delivery(cc)
1.1 Timing device travel	1500	3.9—4.3 mm	
1.2 Supply pump pressure	1500	5.3—5.7 kg/cm ²	
1.3 Full load delivery without charge-air pressure	1500	41.1—42.1 cc/1000st	3.0
1.4 Idle speed regulation	350	5.7—9.7 cc/1000st	2.0
1.5 Start	100	Min. 65 cc/1000st	
1.6 Full-load speed regulation	2175	10.7—16.7 cc/1000st	
1.7 Load Timer Adjustment			

2. Test Specifications				
2.1 Timing device	N = rpm mm	1000 1.5—2.7	1500 3.8—4.4	2175 6.2—7.0
2.2 Supply pump	N = rpm kg/cm ²	1000 3.9—4.5	1500 5.3—5.7	2175 6.7—7.3
Overflow delivery	N = rpm cc/10s	1000 48—91		

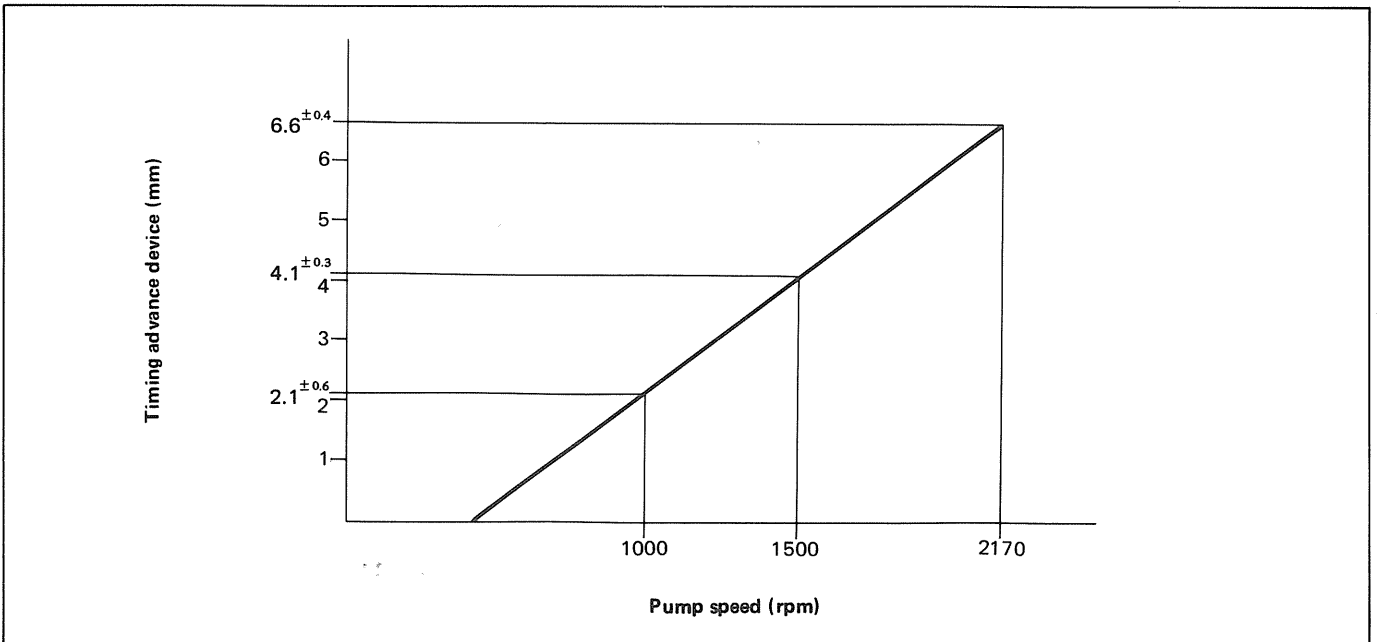
2.3 Fuel deliveries		
Speed control lever	Pump speed (rpm)	Fuel delivery (cc/1000st.)
End stop	2550	Max. 6.2
	2440	10.7—16.7
	2175	35.6—39.6
	1500	40.6—42.6
	600	30.8—34.8
Switch-off	350	0
Idle stop	350	5.7—9.7
	450	Max. 3.1
Partial load		
2.4 Solenoid	Max. cut-in voltage test voltage	8V 12V—14V

3. Dimensions	
Designation	For assembly and adjustment (mm)
K	3.2—3.4
KF	5.7—5.9
MS	1.7—1.9
α	21—29 deg.
A	2.5—8.0 mm
β	36.5—46.5 deg.
B	10.5—14.6 mm
τ	deg.
C	mm
Observations	

GOVERNOR PERFORMANCE DIAGRAM



TIMING DEVICE DIAGRAM



INJECTION VOLUME AND GOVERNOR PERFORMANCE DIAGRAM

Identification number : 104749-1130, 104749-1140

Test diesel fuel : SAE standard test diesel fuel SAE J967C

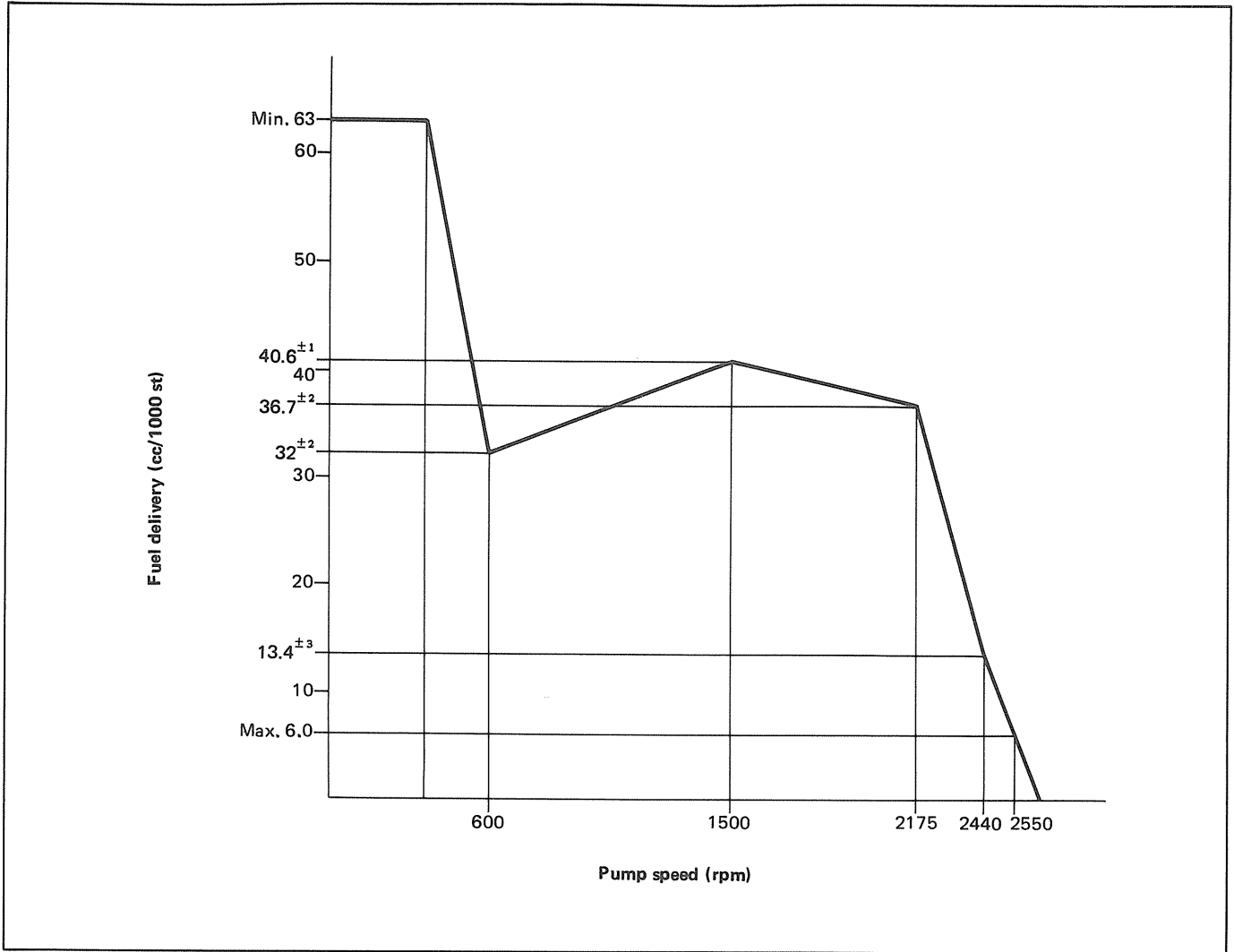
1. Settings	Pump Speed (rpm)	Settings	Difference in delivery(cc)
1.1 Timing device travel	1500	3.8-4.2 mm	
1.2 Supply pump pressure	1500	5.2-5.6 kg/cm ²	
1.3 Full load delivery without charge-air pressure	1500	40.1-41.1 cc/1000st	3.0
1.4 Idle speed regulation	350	5.5-9.5 cc/1000st	2.0
1.5 Start	100	Min. 63 cc/1000st	
1.6 Full-load speed regulation	2175	10.4-16.4 cc/1000st	
1.7 Load Timer Adjustment			

2. Test Specifications				
2.1 Timing device	N = rpm mm	1000 1.4-2.6	1500 3.7-4.3	2175 6.1-7.0
2.2 Supply pump	N = rpm kg/cm ²	1000 3.8-4.4	1500 5.2-5.6	2175 6.6-7.2
Overflow delivery	N = rpm cc/10s	1000 52-95		

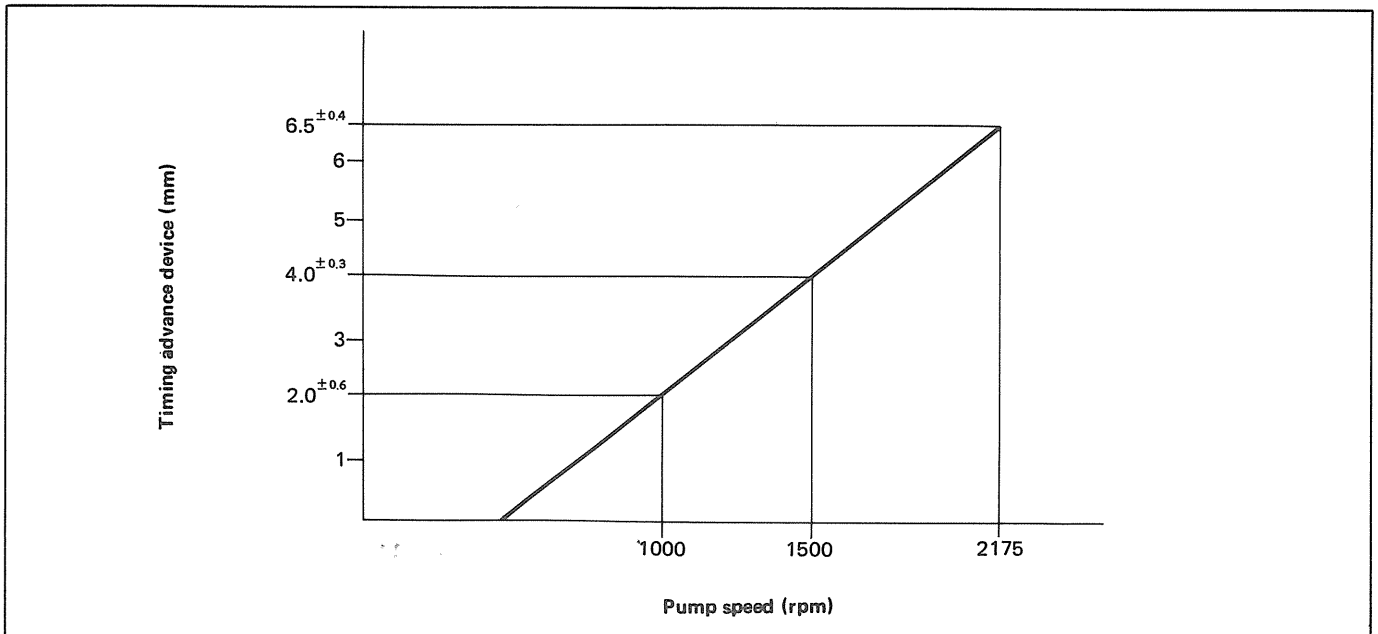
2.3 Fuel deliveries		
Speed control lever	Pump speed (rpm)	Fuel delivery (cc/1000st.)
End stop	2550	Max. 6.0
	2440	10.4-16.4
	2175	34.7-38.7
	1500	39.6-41.6
	600	30.0-34.0
Switch-off	350	0
Idle stop	350	5.5-9.5
	450	Max. 3.0
Partial load		
2.4 Solenoid	Max. cut-in voltage test voltage	8V 12V-14V

3. Dimensions	
Designation	For assembly and adjustment (mm)
K	3.2-3.4
KF	5.7-5.9
MS	1.7-1.9
α	21-29 deg.
A	2.8-8.0 mm
β	36.5-46.5 deg.
B	10.5-14.6 mm
τ	deg.
C	mm
Observations	

GOVERNOR PERFORMANCE DIAGRAM



TIMING DEVICE DIAGRAM



INJECTION VOLUME AND GOVERNOR PERFORMANCE DIAGRAM

Identification number : 104749-1131, 104749-1141

Test diesel fuel : Bosch diesel fuel OL61V11

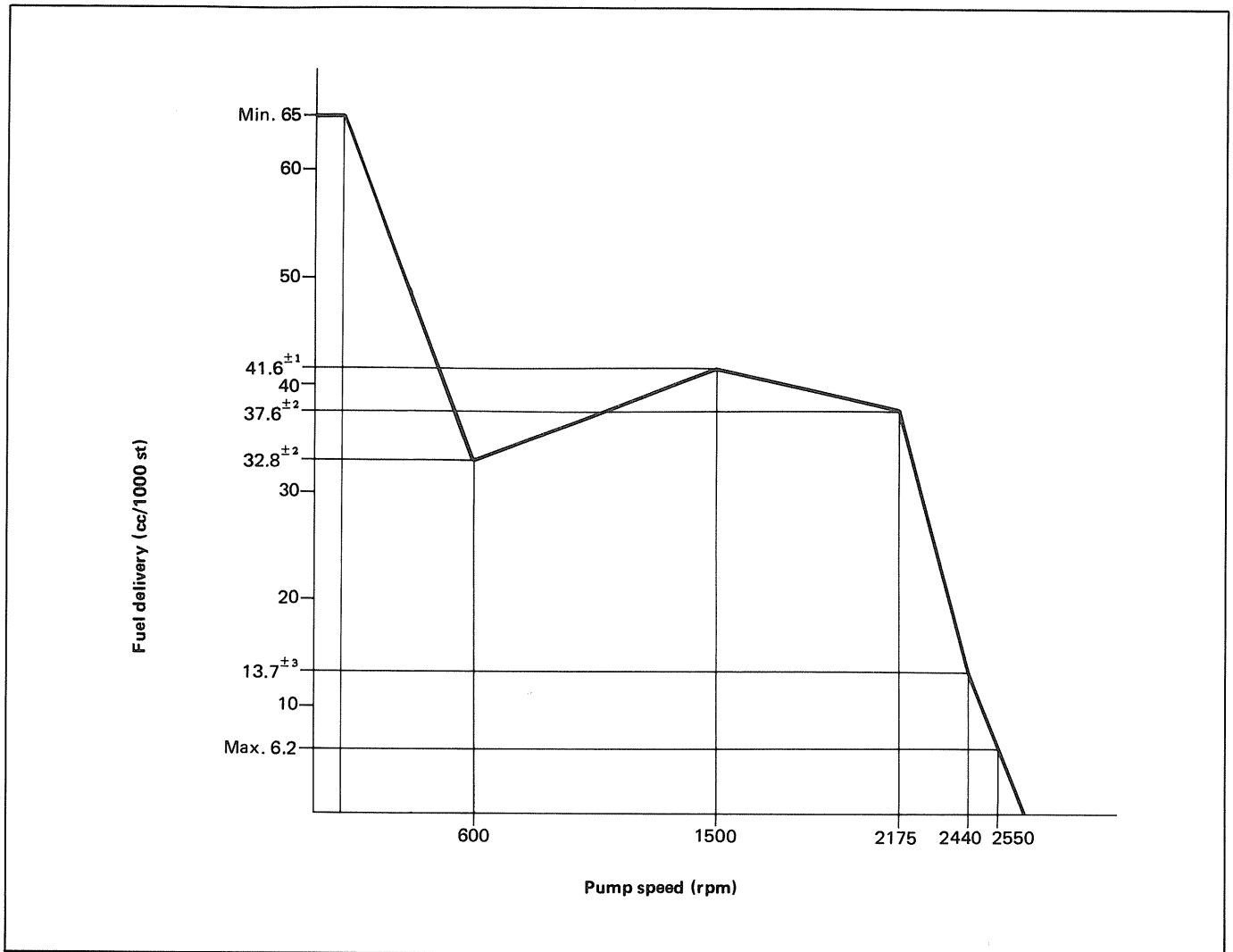
1. Settings	Pump Speed (rpm)	Settings	Difference in delivery (cc)
1.1 Timing device travel	1500	3.9—4.3 mm	
1.2 Supply pump pressure	1500	5.3—5.7 kg/cm ²	
1.3 Full load delivery without charge-air pressure	1500	41.1—42.1 cc/1000st	3.0
1.4 Idle speed regulation	350	5.7—9.7 cc/1000st	2.0
1.5 Start	100	Min. 65 cc/1000st	
1.6 Full-load speed regulation	2175	10.7—16.7 cc/1000st	
1.7 Load Timer Adjustment			

2. Test Specifications				
2.1 Timing device	N = rpm mm	1000 1.5—2.7	1500 3.8—4.4	2175 6.2—7.0
2.2 Supply pump	N = rpm kg/cm ²	1000 3.9—4.5	1500 5.3—5.7	2175 6.7—7.3
Overflow delivery	N = rpm cc/10s	1000 48—91		

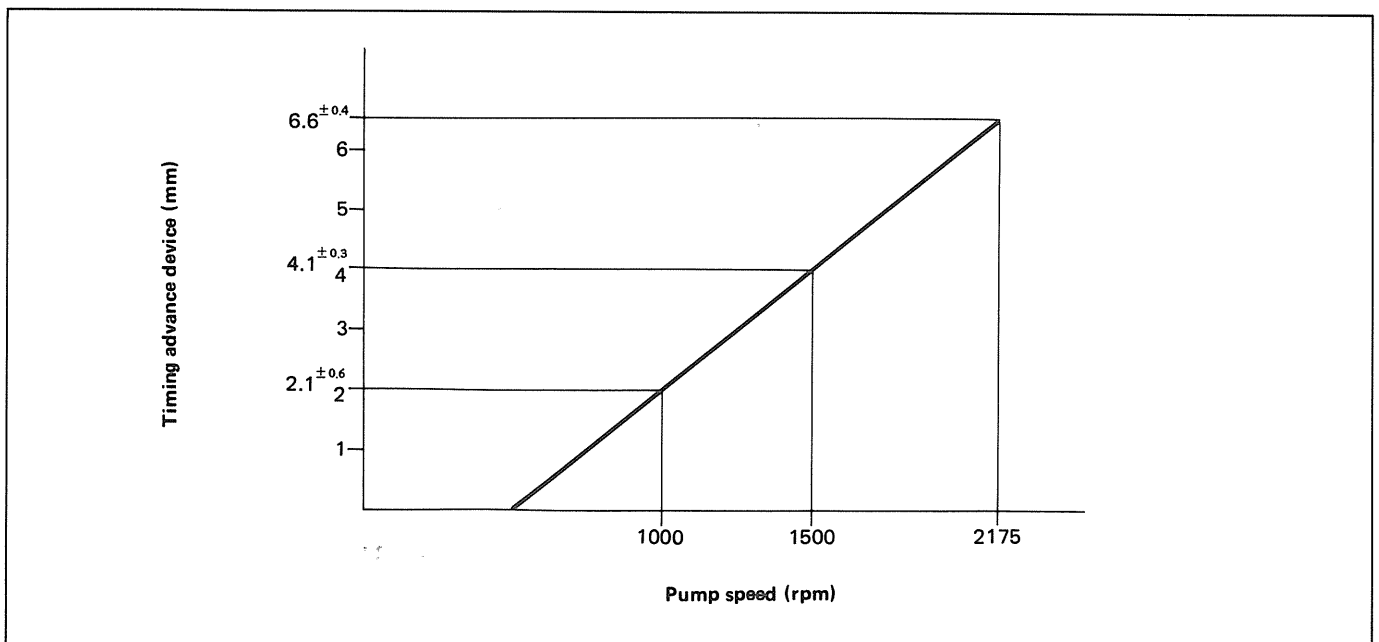
2.3 Fuel deliveries		
Speed control lever	Pump speed (rpm)	Fuel delivery (cc/1000st.)
End stop	2550	Max. 6.2
	2440	10.7—16.7
	2175	35.6—39.6
	1500	40.6—42.6
	600	30.8—34.8
Switch-off	350	0
Idle stop	350	5.7—9.7
	450	Max. 3.1
Partial load		
2.4 Solenoid	Max. cut-in voltage test voltage	8V 12V—14V

3. Dimensions		
Designation	For assembly and adjustment (mm)	
K	3.2—3.4	
KF	5.7—5.9	
MS	1.7—1.9	
α	21—29	deg.
A	2.5—8.0	mm
β	36.5—46.5	deg.
B	10.5—14.5	mm
τ		deg.
C		mm
Observations		

GOVERNOR PERFORMANCE DIAGRAM



TIMING DEVICE DIAGRAM



INJECTION VOLUME AND GOVERNOR PERFORMANCE DIAGRAM

Identification number : 104749-1131, 104749-1141

Test diesel fuel : SAE standard test diesel fuel SAE J967C

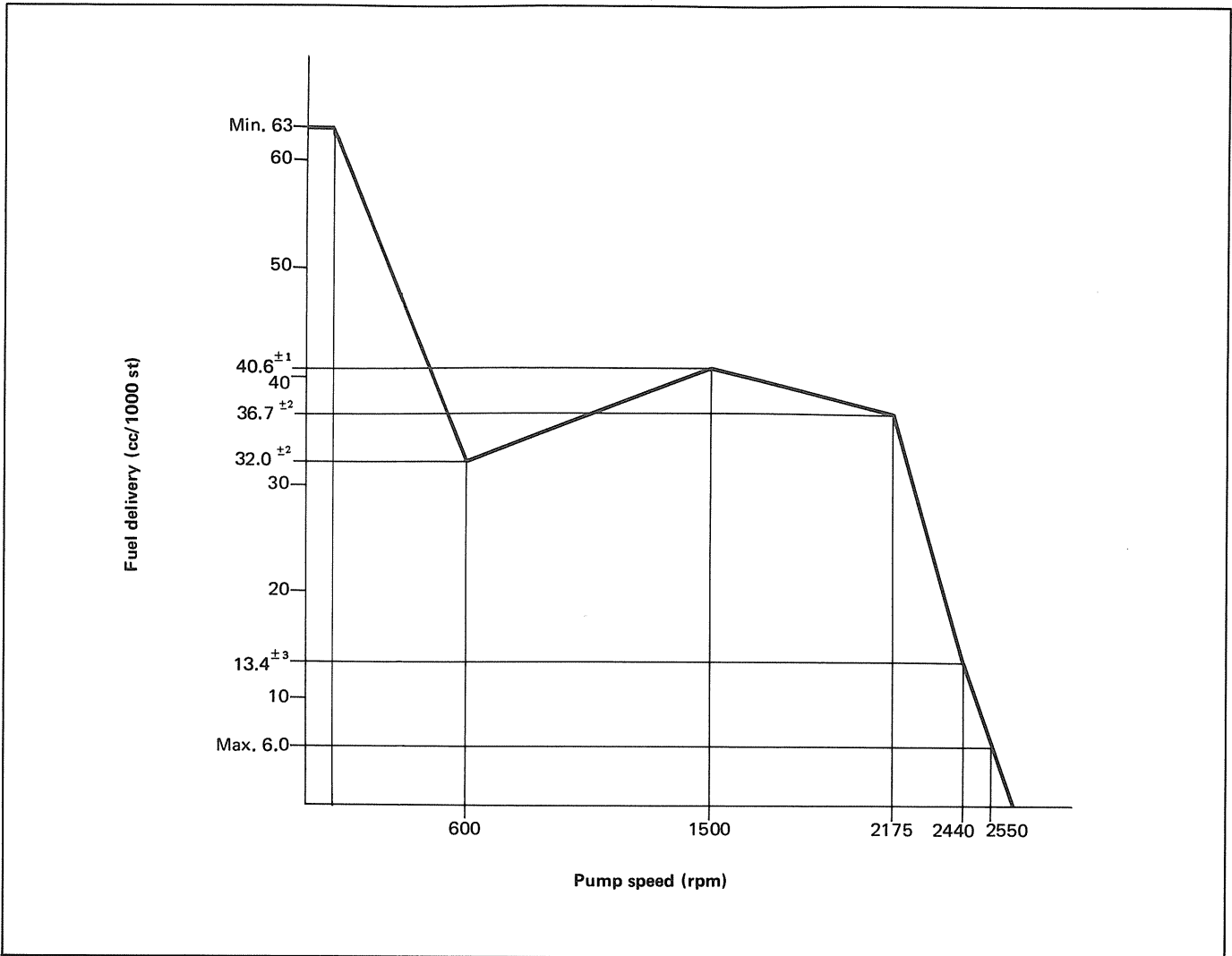
1. Settings	Pump Speed (rpm)	Settings	Difference in delivery(cc)
1.1 Timing device travel	1500	3.8—4.2 mm	
1.2 Supply pump pressure	1500	5.2—5.6 kg/cm ²	
1.3 Full load delivery without charge-air pressure	1500	40.1—41.1 cc/1000st	3.0
1.4 Idle speed regulation	350	5.5—9.5 cc/1000st	2.0
1.5 Start	100	Min. 63 cc/1000st	
1.6 Full-load speed regulation	2175	10.4—16.4 cc/1000st	
1.7 Load Timer Adjustment			

2. Test Specifications				
2.1 Timing device	N = rpm mm	1000 1.4—2.6	1500 3.7—4.3	2175 6.1—7.0
2.2 Supply pump	N = rpm kg/cm ²	1000 3.8—4.4	1500 5.2—5.6	2175 6.6—7.2
Overflow delivery	N = rpm cc/10s	1000 52—95		

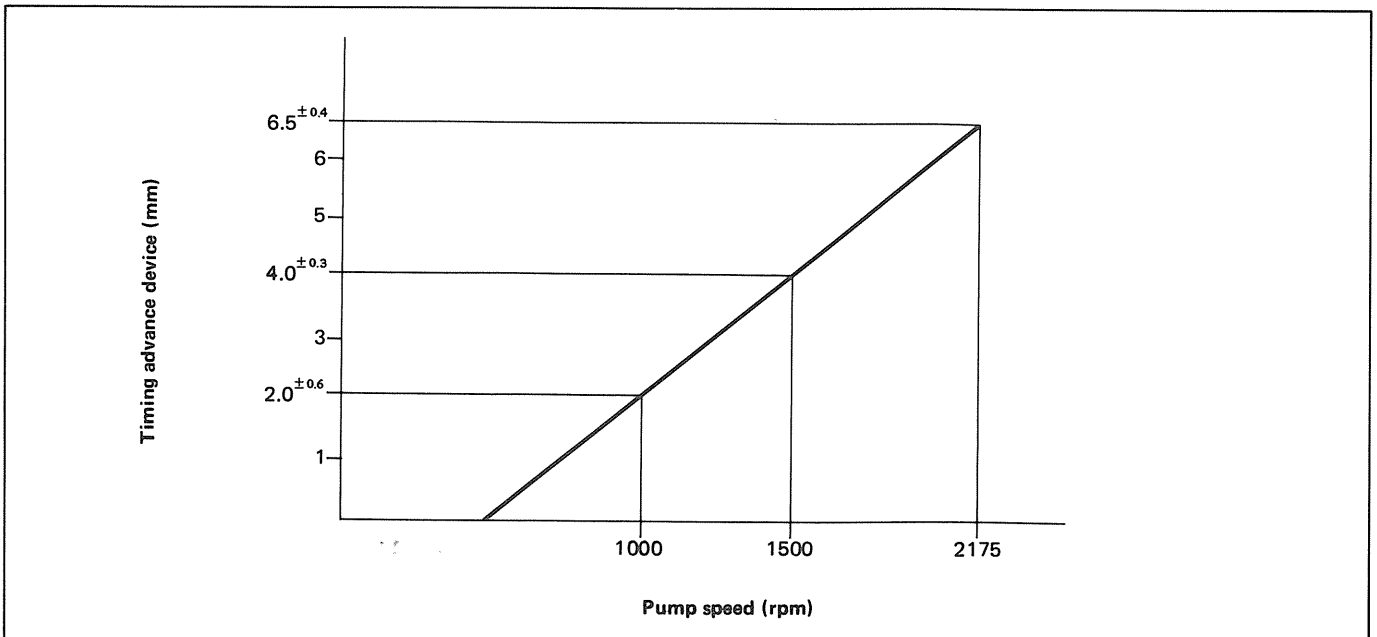
2.3 Fuel deliveries		
Speed control lever	Pump speed (rpm)	Fuel delivery (cc/1000st.)
End stop	2550	Max. 6.0
	2440	10.4—16.4
	2175	34.7—38.7
	1500	39.6—41.6
	600	30.0—34.0
Switch-off	350	0
Idle stop	350	5.5—9.5
	450	Max. 3.0
Partial load		
2.4 Solenoid	Max. cut-in voltage	8V
	test voltage	12V—14V

3. Dimensions	
Designation	For assembly and adjustment (mm)
K	3.2—3.4
KF	5.7—5.9
MS	1.7—1.9
α	21—29 deg.
A	2.8—8.0 mm
β	36.5—46.5 deg.
B	10.5—14.5 mm
τ	deg.
C	mm
Observations	

GOVERNOR PERFORMANCE DIAGRAM



TIMING DEVICE DIAGRAM



INJECTION VOLUME AND GOVERNOR PERFORMANCE DIAGRAM

Identification number : 104749-1150, 104749-1160

Test diesel fuel : Bosch diesel fuel OL61V11

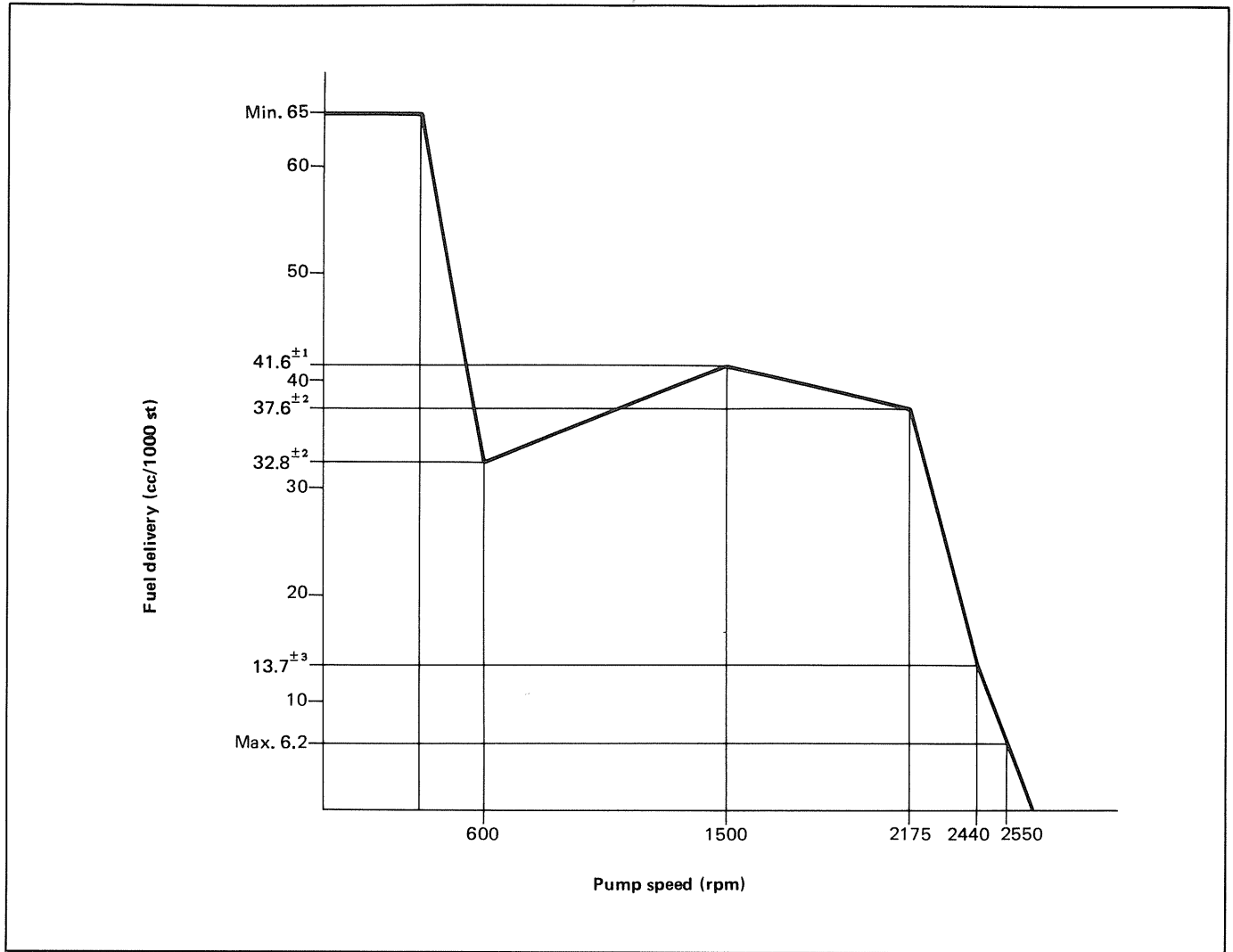
1. Settings	Pump Speed (rpm)	Settings	Difference in delivery(cc)
1.1 Timing device travel	1500	3.9—4.3 mm	
1.2 Supply pump pressure	1500	5.3—5.7 kg/cm ²	
1.3 Full load delivery without charge-air pressure	1500	41.1—42.1 cc/1000st	3.0
1.4 Idle speed regulation	350	5.7—9.7 cc/1000st	2.0
1.5 Start	100	Min. 65 cc/1000st	
1.6 Full-load speed regulation	2175	10.7—17.6 cc/1000st	
1.7 Load Timer Adjustment			

2. Test Specifications				
2.1 Timing device	N = rpm mm	1000 1.5—2.7	1500 3.8—4.4	2175 6.2—7.0
2.2 Supply pump	N = rpm kg/cm ²	1000 3.9—4.5	1500 5.3—5.7	2175 6.7—7.3
Overflow delivery	N = rpm cc/10s	1000 48—91		

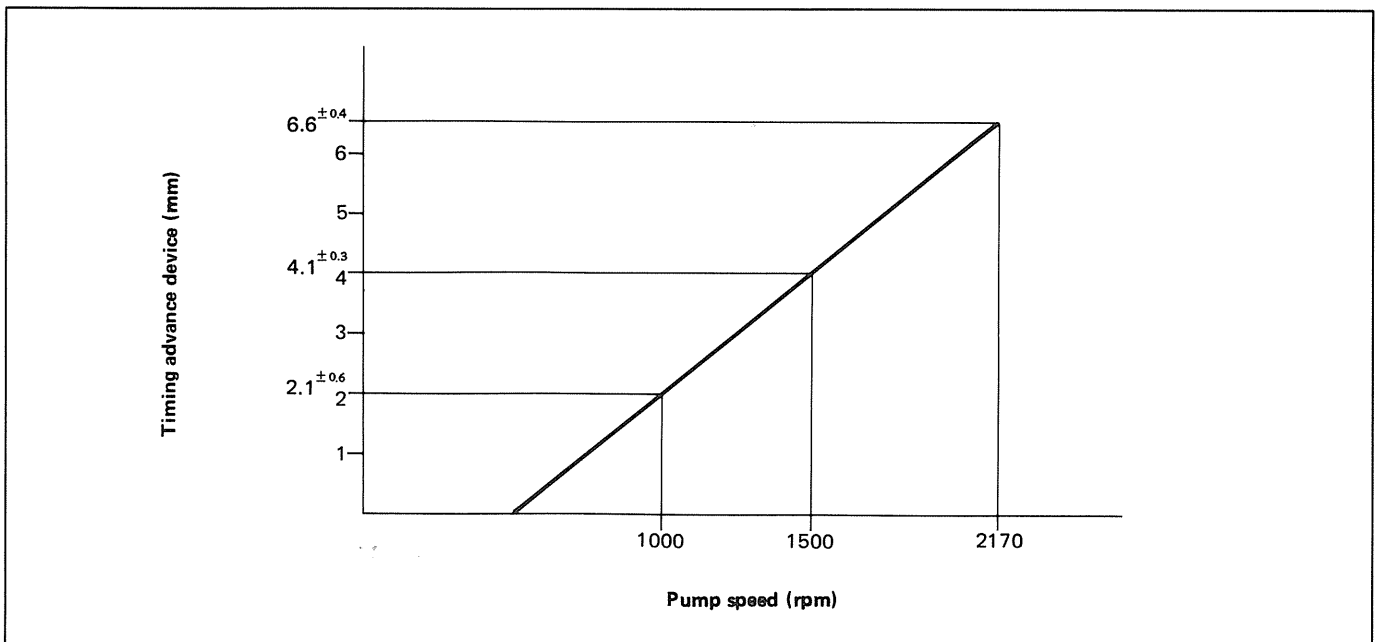
2.3 Fuel deliveries		
Speed control lever	Pump speed (rpm)	Fuel delivery (cc/1000st.)
End stop	2550	Max. 6.2
	2440	10.7—16.7
	2175	35.6—39.6
	1500	40.6—42.6
	600	30.8—34.8
Switch-off	350	0
Idle stop	350	5.7—9.7
	450	Max. 3.1
Partial load		
2.4 Solenoid	Max. cut-in voltage test voltage	8V 12V—14V

3. Dimensions	
Designation	For assembly and adjustment (mm)
K	3.2—3.4
KF	5.7—5.9
MS	1.7—1.9
α	21—29 deg.
A	7.5—11.0 mm
β	36.5—46.5 deg.
B	10.5—15.0 mm
τ	deg.
C	mm
Observations	

GOVERNOR PERFORMANCE DIAGRAM



TIMING DEVICE DIAGRAM



INJECTION VOLUME AND GOVERNOR PERFORMANCE DIAGRAM

Identification number : 104749-1150, 104749-1160

Test diesel fuel : SAE standard test diesel fuel SAE J967C

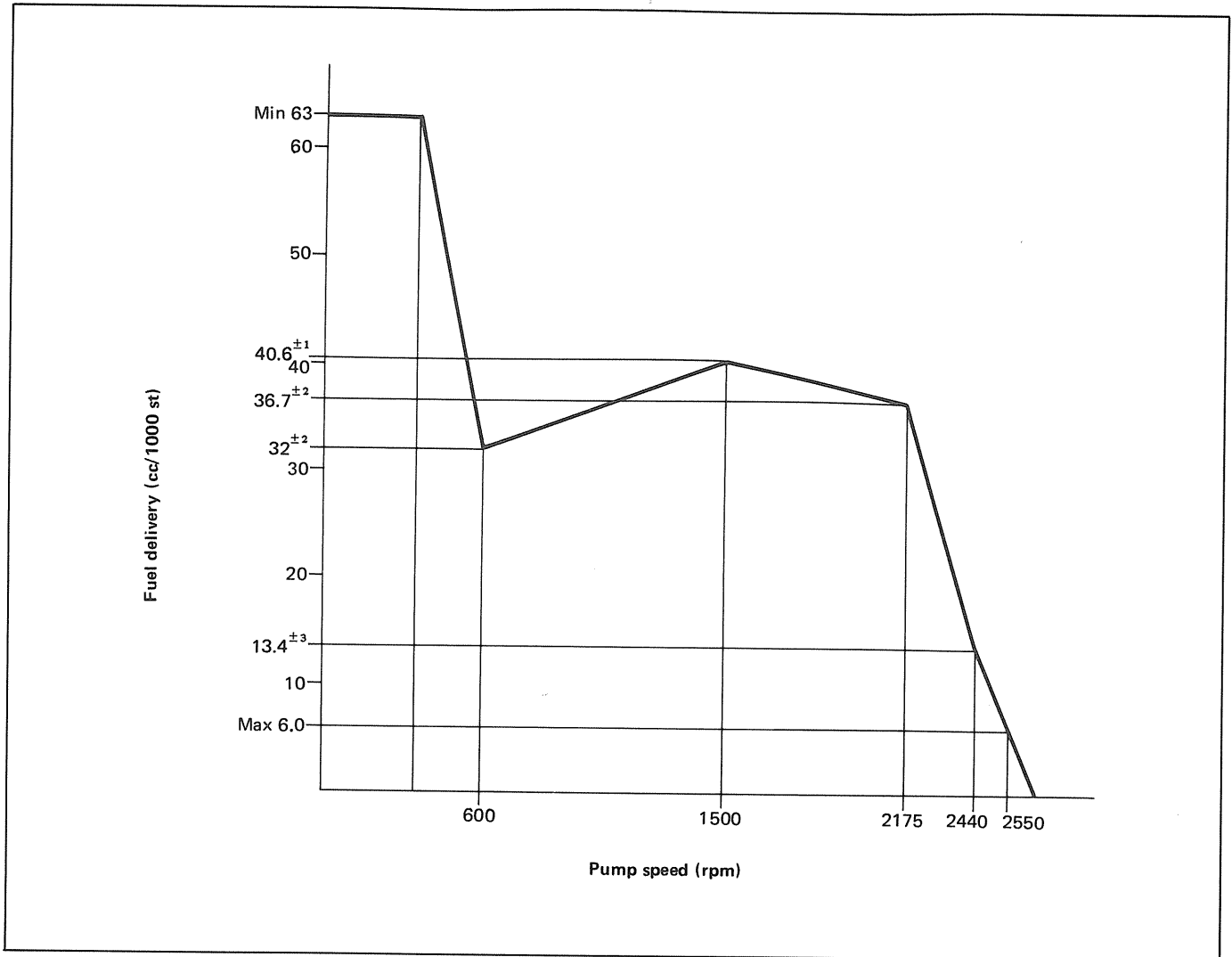
1. Settings	Pump Speed (rpm)	Settings	Difference in delivery(cc)
1.1 Timing device travel	1500	3.8—4.2 mm	
1.2 Supply pump pressure	1500	5.2—5.6 kg/cm ²	
1.3 Full load delivery without charge-air pressure	1500	40.1—41.1 cc/1000st	3.0
1.4 Idle speed regulation	350	5.5—9.5 cc/1000st	2.0
1.5 Start	100	Min. 63 cc/1000st	
1.6 Full-load speed regulation	2175	10.4—16.4 cc/1000st	
1.7 Load Timer Adjustment			

2. Test Specifications				
2.1 Timing device	N = rpm mm	1000 1.4—2.6	1500 3.7—4.3	2175 6.1—7.0
2.2 Supply pump	N = rpm kg/cm ²	1000 3.8—4.4	1500 5.2—5.6	2175 6.6—7.2
Overflow delivery	N = rpm cc/10s	1000 52—95		

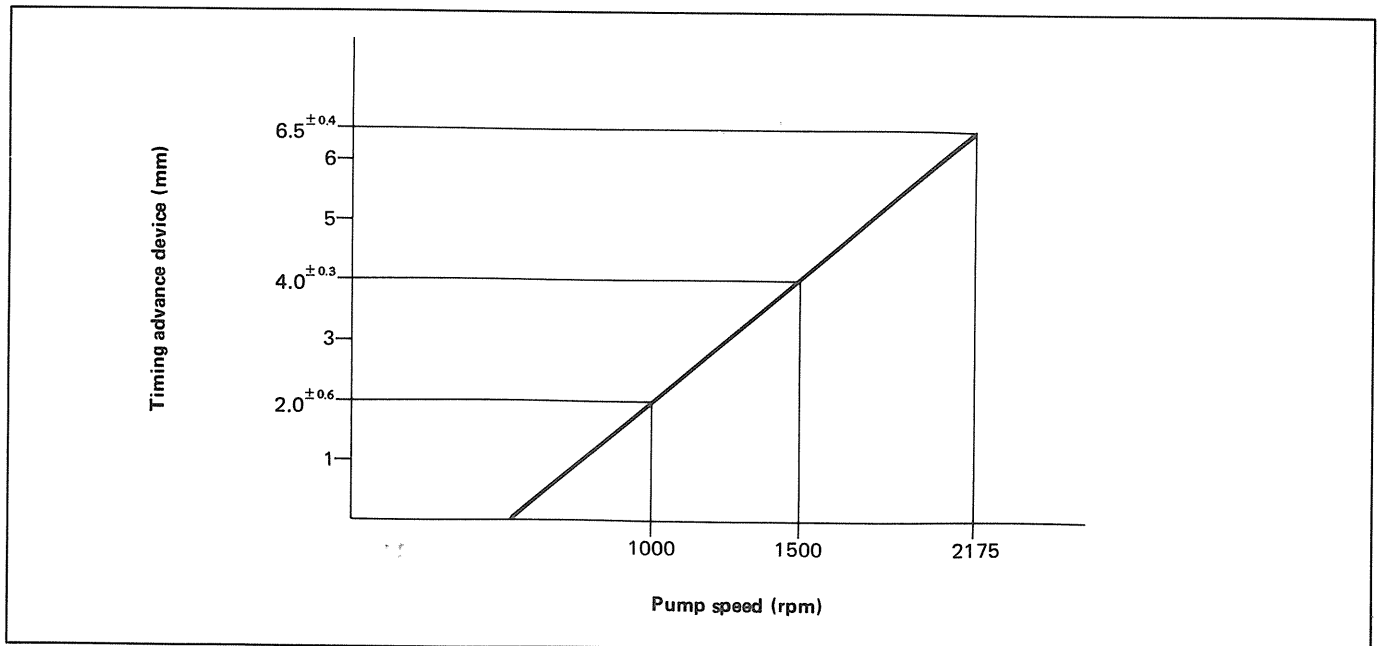
2.3 Fuel deliveries	Pump speed (rpm)	Fuel delivery (cc/1000st.)
Speed control lever		
End stop	2550 2440 2175 1500 600	Max. 6.0 10.4—16.4 34.7—38.7 39.6—41.6 30.0—34.0
Switch-off	350	0
Idle stop	350 450	5.5—9.5 Max. 3.0
Partial load		
2.4 Solenoid	Max. cut-in voltage test voltage	8V 12V—14V

3. Dimensions	
Designation	For assembly and adjustment (mm)
K	3.2—3.4
KF	5.7—5.9
MS	1.7—1.9
α	21—29 deg.
A	7.5—11.0 mm
β	36.5—46.5 deg.
B	10.5—15.0 mm
τ	deg.
C	mm
Observations	

GOVERNOR PERFORMANCE DIAGRAM



TIMING DEVICE DIAGRAM



INJECTION VOLUME AND GOVERNOR PERFORMANCE DIAGRAM

Identification number : 104749-1151, 104749-1161

Test diesel fuel : Bosch diesel fuel OL61V11

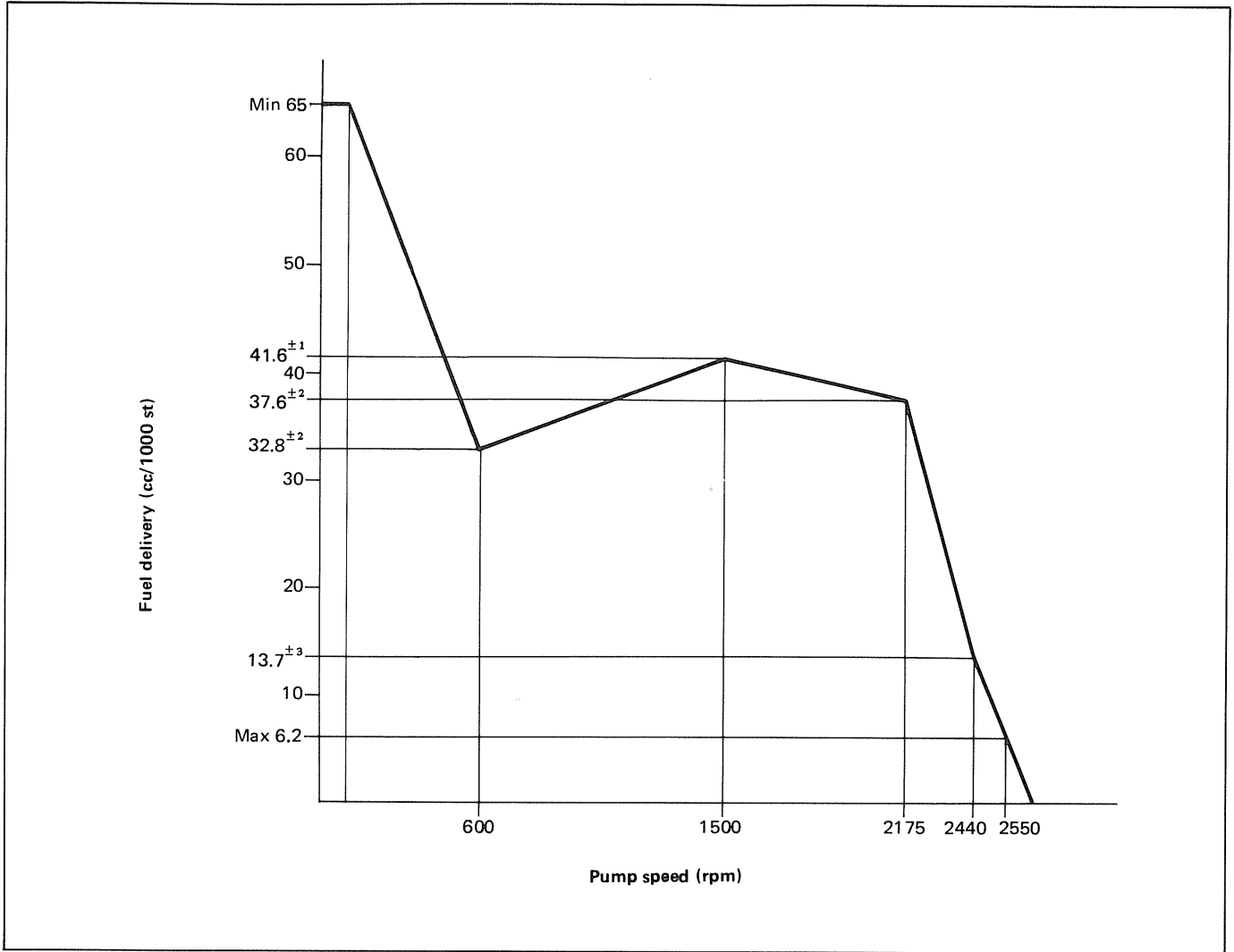
1. Settings	Pump Speed (rpm)	Settings	Difference in delivery(cc)
1.1 Timing device travel	1500	3.9—4.3 mm	
1.2 Supply pump pressure	1500	5.3—5.7 kg/cm ²	
1.3 Full load delivery without charge-air pressure	1500	41.1—42.1 cc/1000st	3.0
1.4 Idle speed regulation	350	5.7—9.7 cc/1000st	2.0
1.5 Start	100	Min. 65 cc/1000st	
1.6 Full-load speed regulation	2175	10.7—16.7 cc/1000st	
1.7 Load Timer Adjustment			

2. Test Specifications				
2.1 Timing device	N = rpm mm	1000 1.5—2.7	1500 3.8—4.4	2175 6.2—7.0
2.2 Supply pump	N = rpm kg/cm ²	1000 3.9—4.5	1500 5.3—5.7	2175 6.7—7.3
Overflow delivery	N = rpm cc/10s	1000 48—91		

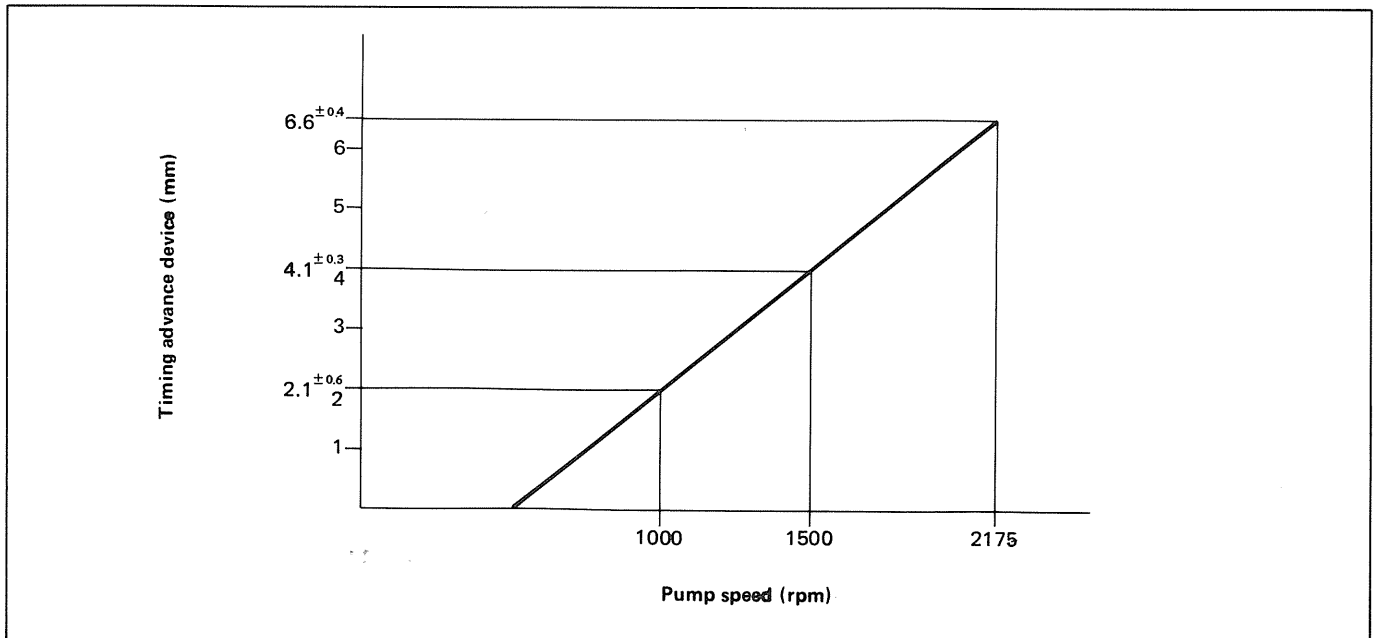
2.3 Fuel deliveries		
Speed control lever	Pump speed (rpm)	Fuel delivery (cc/1000st.)
End stop	2550	Max. 6.2
	2440	10.7—16.7
	2175	35.6—39.6
	1500	40.6—42.6
	600	30.8—34.8
Switch-off	350	0
Idle stop	350	5.7—9.7
	450	Max. 3.1
Partial load		
2.4 Solenoid	Max. cut-in voltage test voltage	8V 12V—14V

3. Dimensions	
Designation	For assembly and adjustment (mm)
K	3.2—3.4
KF	5.7—5.9
MS	1.7—1.9
α	21—29 deg.
A	7.5—11.0 mm
β	36.5—46.5 deg.
B	10.5—15.0 mm
τ	deg.
C	mm
Observations	

GOVERNOR PERFORMANCE DIAGRAM



TIMING DEVICE DIAGRAM



INJECTION VOLUME AND GOVERNOR PERFORMANCE DIAGRAM

Identification number : 104749-1151, 104749-1161

Test diesel fuel : Bosch diesel fuel OL61V11

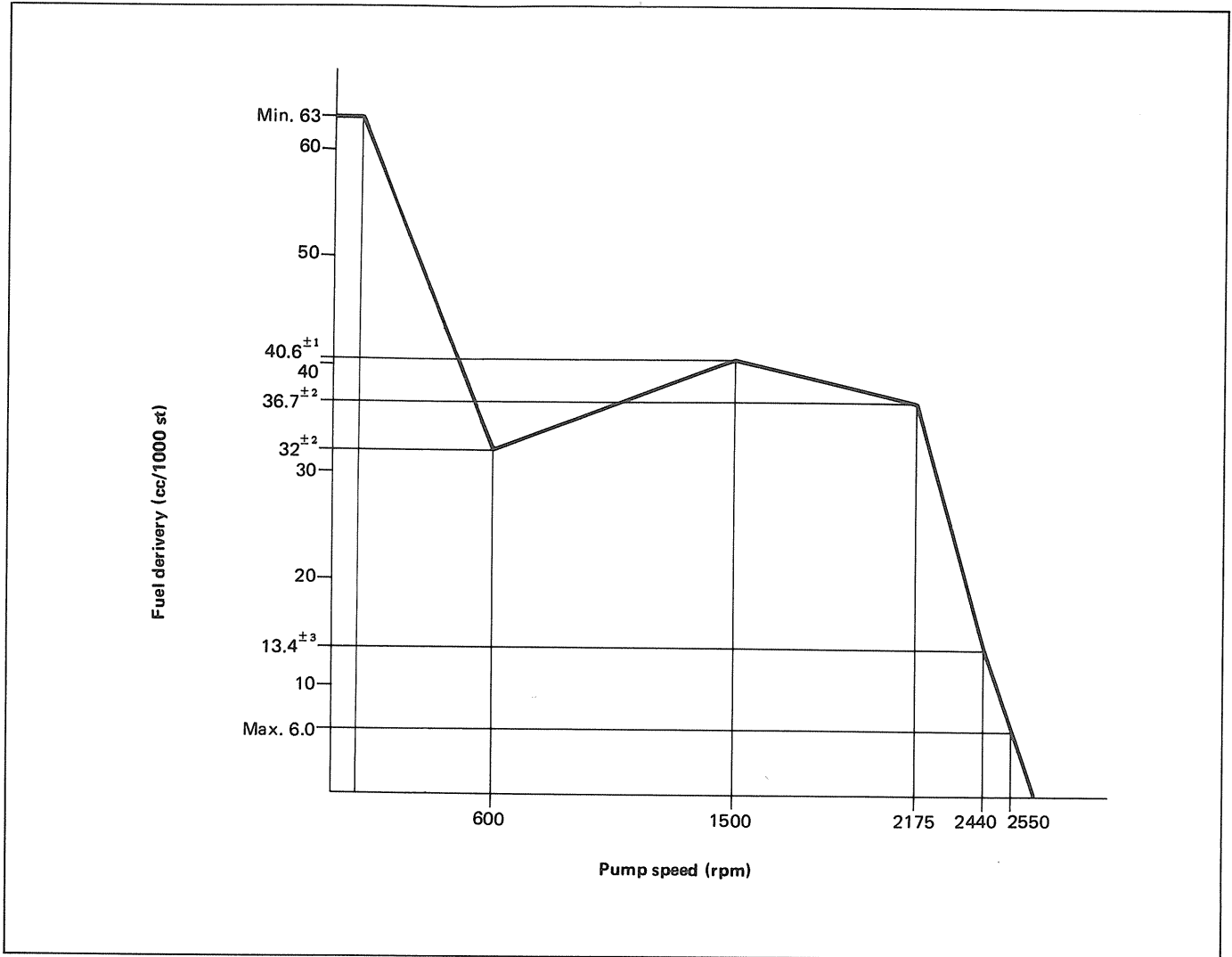
1. Settings	Pump Speed (rpm)	Settings	Difference in delivery(cc)
1.1 Timing device travel	1500	3.8—4.2 mm	
1.2 Supply pump pressure	1500	5.2—5.6 kg/cm ²	
1.3 Full load delivery without charge-air pressure	1500	40.1—41.1 cc/1000st	3.0
1.4 Idle speed regulation	350	5.5—9.5 cc/1000st	2.0
1.5 Start	100	Min. 63 cc/1000st	
1.6 Full-load speed regulation	2175	10.4—16.4 cc/1000st	
1.7 Load Timer Adjustment			

2. Test Specifications				
2.1 Timing device	N = rpm mm	1000 1.4—2.6	1500 3.7—4.3	2175 6.1—7.0
2.2 Supply pump	N = rpm kg/cm ²	1000 3.8—4.4	1500 5.2—5.6	2175 6.6—7.2
Overflow delivery	N = rpm cc/10s	1000 52—95		

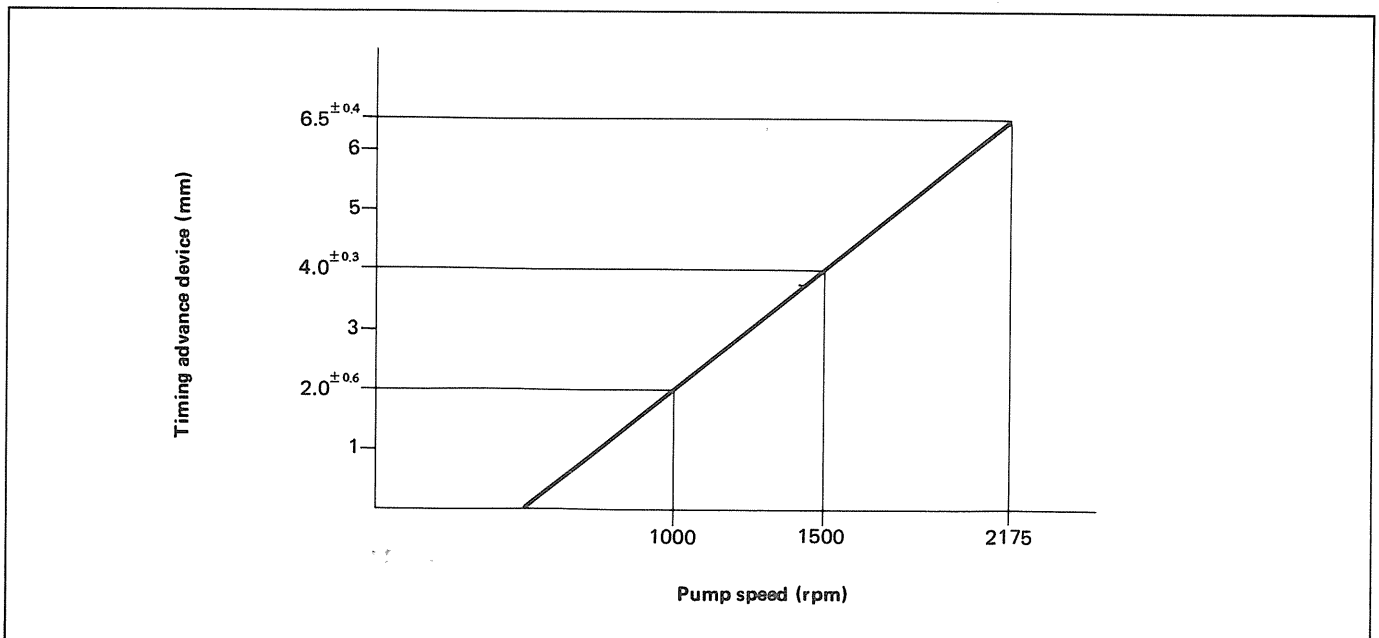
2.3 Fuel deliveries		
Speed control lever	Pump speed (rpm)	Fuel delivery (cc/1000st.)
End stop	2550	Max. 6.0
	2440	10.4—16.4
	2175	34.7—38.7
	1500	39.6—41.6
	600	30.0—34.0
Switch-off	350	0
Idle stop	350	5.5—9.5
	450	Max. 3.0
Partial load		
2.4 Solenoid	Max. cut-in voltage test voltage	8V 12V—14V

3. Dimensions	
Designation	For assembly and adjustment (mm)
K	3.2—3.4
KF	5.7—5.9
MS	1.7—1.9
α	21—29 deg.
A	7.5—11.0 mm
β	36.5—46.5 deg.
B	10.5—15.0 mm
τ	deg.
C	mm
Observations Upon canceling of C.S.D. check the revolution and make sure no fuel leakage from the overflow of C.S.D.	

GOVERNOR PERFORMANCE DIAGRAM



TIMING DEVICE DIAGRAM



INJECTION VOLUME AND GOVERNOR PERFORMANCE DIAGRAM

Identification number : 104749-1170, 104749-1180

Test diesel fuel : Bosch diesel fuel OL61V11

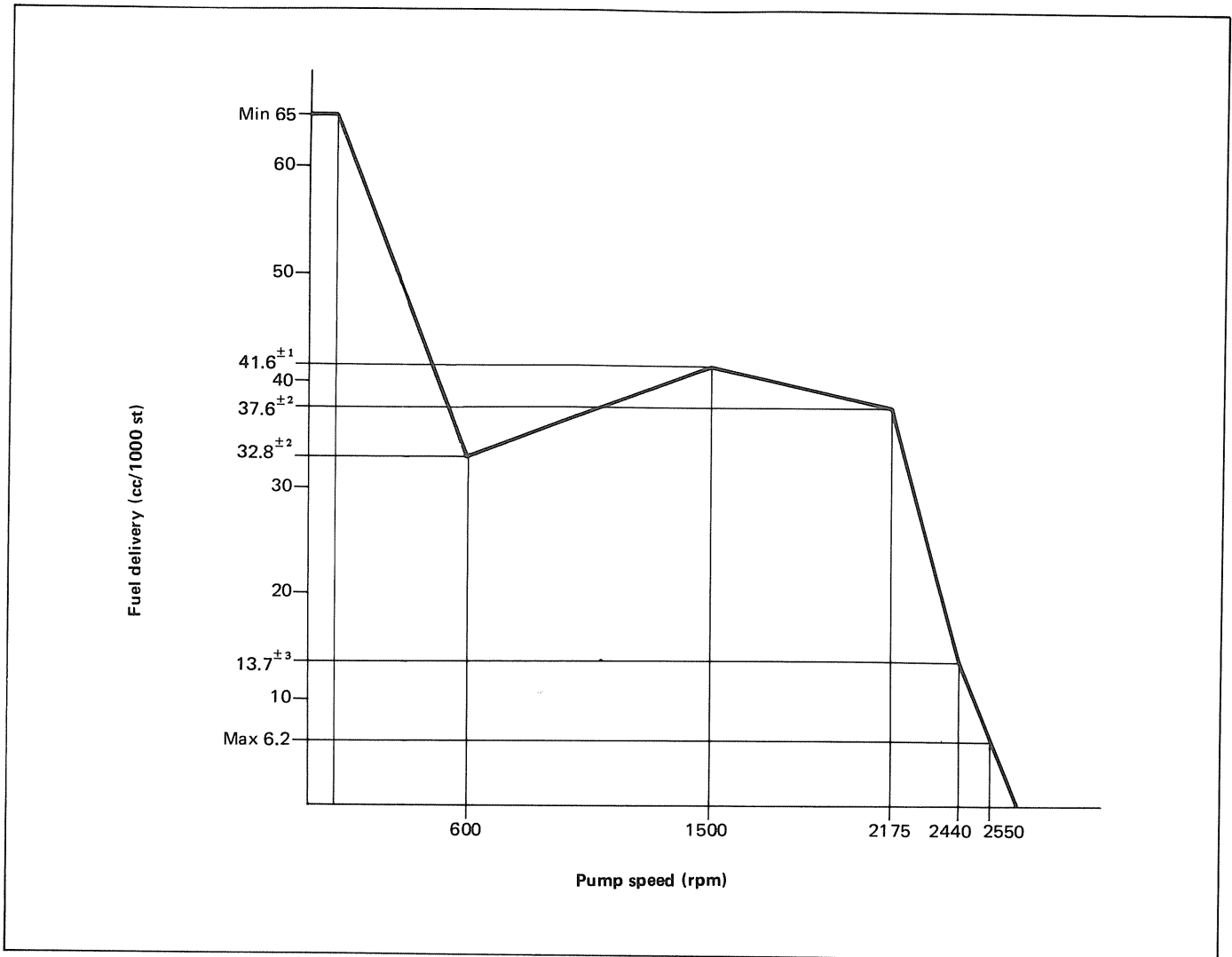
1. Settings	Pump Speed (rpm)	Settings	Difference in delivery(cc)
1.1 Timing device travel	1500	4.3-4.7 mm	
1.2 Supply pump pressure	1500	5.3-5.7 kg/cm ²	
1.3 Full load delivery without charge-air pressure	1500	41.1-42.1 cc/1000st	3.0
1.4 Idle speed regulation	350	5.7-9.7 cc/1000st	2.0
1.5 Start	100	Min. 65 cc/1000st	
1.6 Full-load speed regulation	2175	10.7-16.7 cc/1000st	
1.7 Load Timer Adjustment	460-660	Cancel	

2. Test Specifications				
2.1 Timing device	N = rpm mm	1000 1.7-2.9	1500 4.2-4.8	2175 7.0-7.8
2.2 Supply pump	N = rpm kg/cm ²	1000 3.9-4.5	1500 5.3-5.7	2175 6.8-7.4
Overflow delivery	N = rpm cc/10s	1000 48-91		

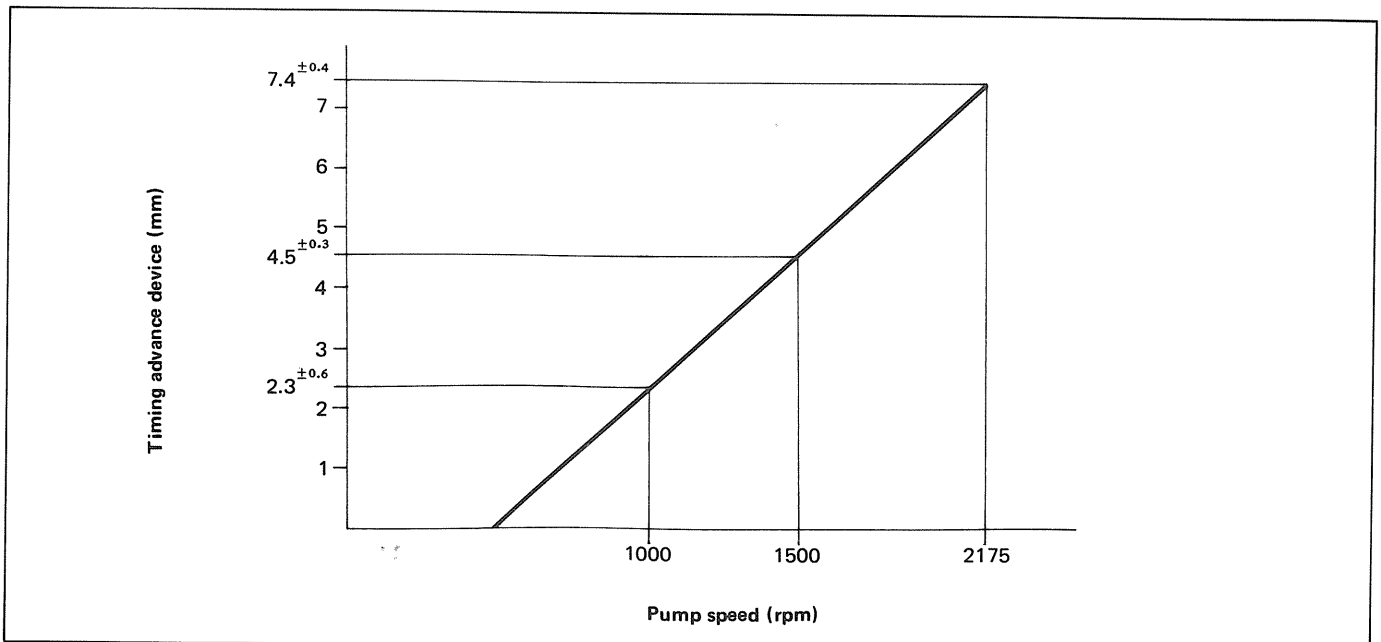
2.3 Fuel deliveries	Pump speed (rpm)	Fuel delivery (cc/1000st.)
Speed control lever	2550	Max. 6.2
	2440	10.7-16.7
	2175	35.6-39.6
	1500	40.6-42.6
	600	30.8-34.8
Switch-off	350	0
Idle stop	350	5.7-9.7
	450	Max. 3.1
Cold start device	0	2.7-3.1 mm
	460-660	Cancel
Partial load		
2.4 Solenoid	Max. cut-in voltage test voltage	8V 12V-14V

3. Dimensions	
Designation	For assembly and adjustment (mm)
K	3.2-3.4
KF	5.7-5.9
MS	1.7-1.9
α	21-29 deg.
A	7.5-11.0 mm
β	36.5-46.5 deg.
B	10.5-15.0 mm
τ	deg.
C	mm
Observations Upon canceling of C.S.D. check the revolution and make sure no fuel leakage from the overflow of C.S.D.	

GOVERNOR PERFORMANCE DIAGRAM



TIMING DEVICE DIAGRAM



INJECTION VOLUME AND GOVERNOR PERFORMANCE DIAGRAM

Identification number : 104749-1170, 104749-1180

Test diesel fuel : SAE standard test diesel fuel SAE J967C

1. Settings	Pump Speed (rpm)	Settings	Difference in delivery(cc)
1.1 Timing device travel	1500	4.2—4.6 mm	
1.2 Supply pump pressure	1500	5.2—5.6 kg/cm ²	
1.3 Full load delivery without charge-air pressure	1500	40.1—41.1 cc/1000st	3.0
1.4 Idle speed regulation	350	5.5—9.5 cc/1000st	2.0
1.5 Start	100	Min. 63 cc/1000st	
1.6 Full-load speed regulation	2175	10.4—16.4 cc/1000st	
1.7 Load Timer Adjustment	500—700	Cancel	

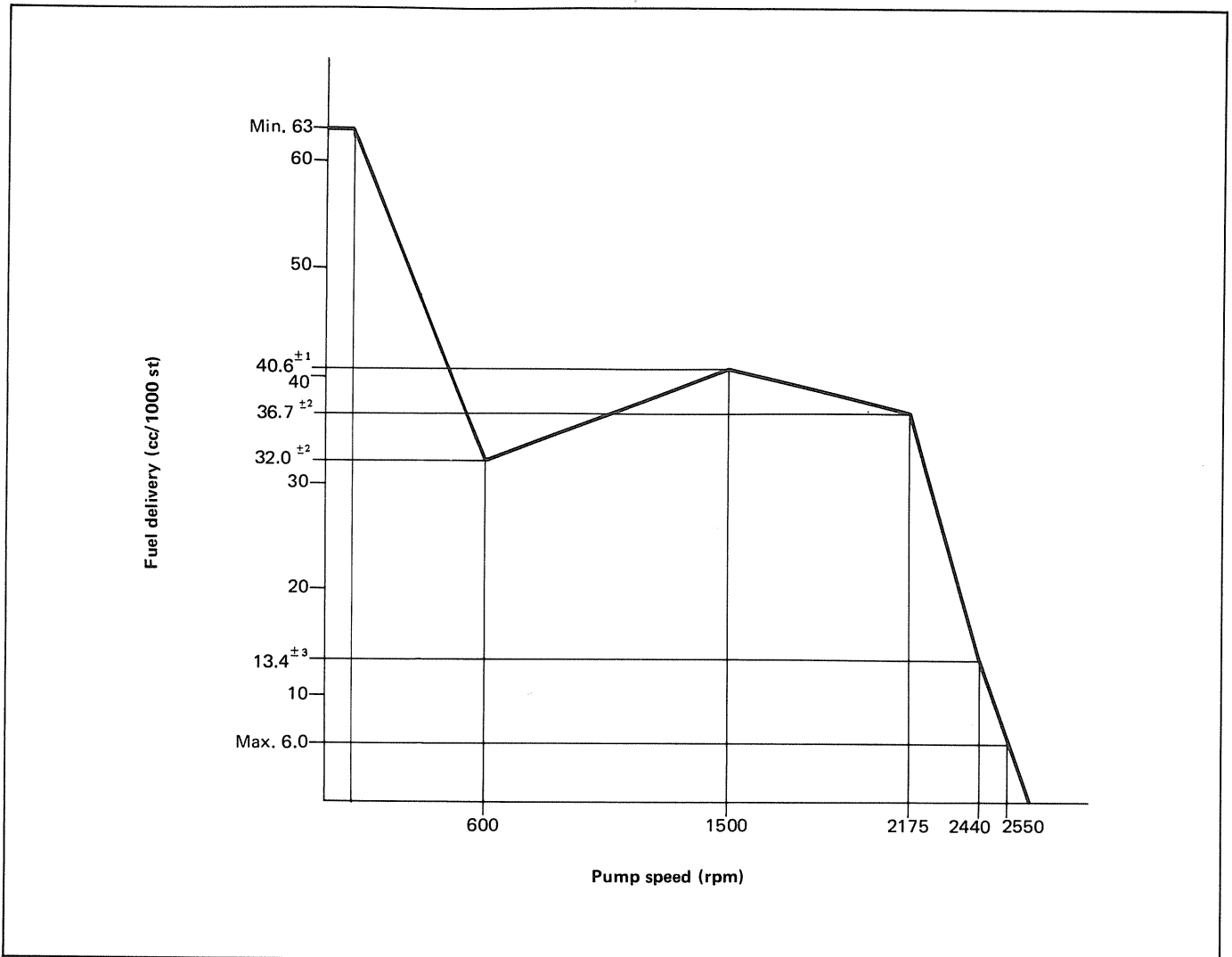
2. Test Specifications				
2.1 Timing device	N = rpm mm	1000 1.6—2.8	1500 4.1—4.7	2175 6.9—7.8
2.2 Supply pump	N = rpm kg/cm ²	1000 3.8—4.4	1500 5.2—5.6	2175 6.6—7.2
Overflow delivery	N = rpm cc/10s	1000 52—95		

2.3 Fuel deliveries		
Speed control lever	Pump speed (rpm)	Fuel delivery (cc/1000st.)
End stop	2550	Max. 6.0
	2440	10.4—16.4
	2175	34.7—38.7
	1500	39.6—41.6
	600	30.0—34.0
Switch-off	350	0
Idle stop	350	5.5—9.5
	450	Max. 3.0
Cold start device	0	2.7—3.1 mm
	500—700	Cancel
Partial load		
2.4 Solenoid	Max. cut-in voltage test voltage	8V 12V—14V

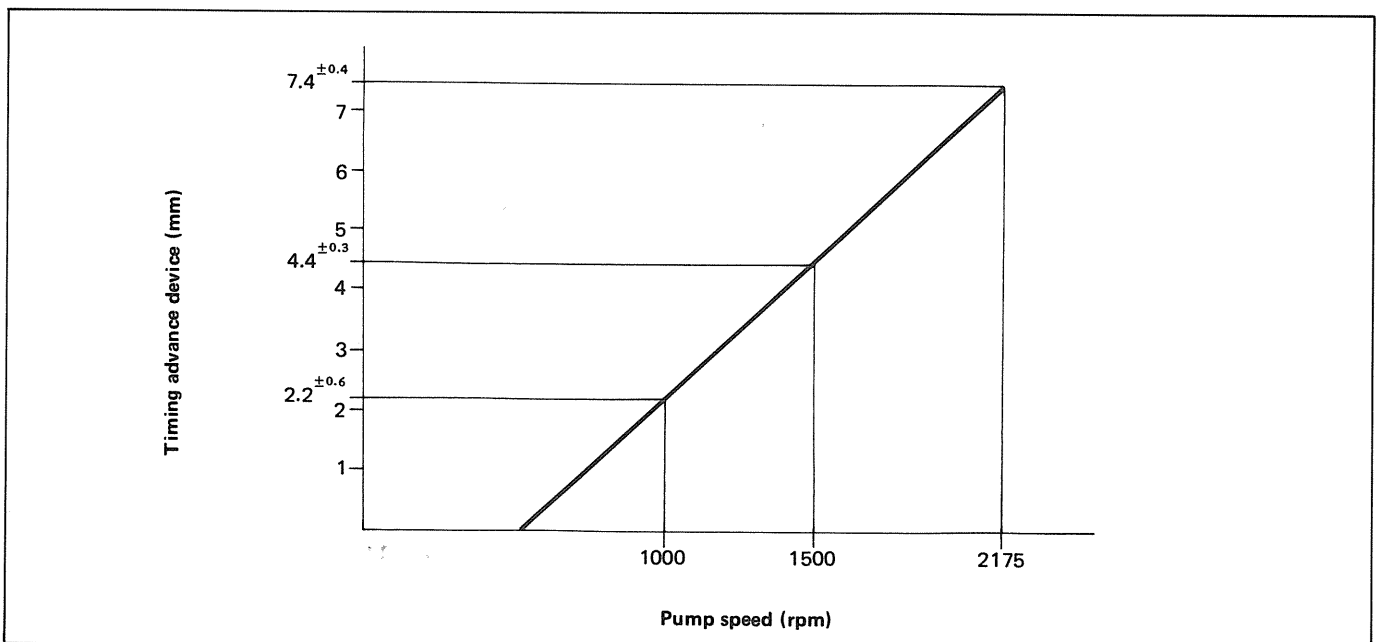
3. Dimensions	
Designation	For assembly and adjustment (mm)
K	3.2—3.4
KF	5.7—5.9
MS	1.7—1.9
α	21—29 deg.
A	7.5—11.0 mm
β	36.5—46.5 deg.
B	10.5—15.0 mm
τ	deg.
C	mm

Observations
Upon canceling of C.S.D. check the revolution and make sure no fuel leakage from the overflow of C.S.D.

GOVERNOR PERFORMANCE DIAGRAM



TIMING DEVICE DIAGRAM



INJECTION VOLUME AND GOVERNOR PERFORMANCE DIAGRAM

Identification number : 104749-1500, 104749-1510, 104749-1520, 104749-1530,
104749-1580, 104749-1590

Test diesel fuel : SAE standard test diesel fuel SAE J967D

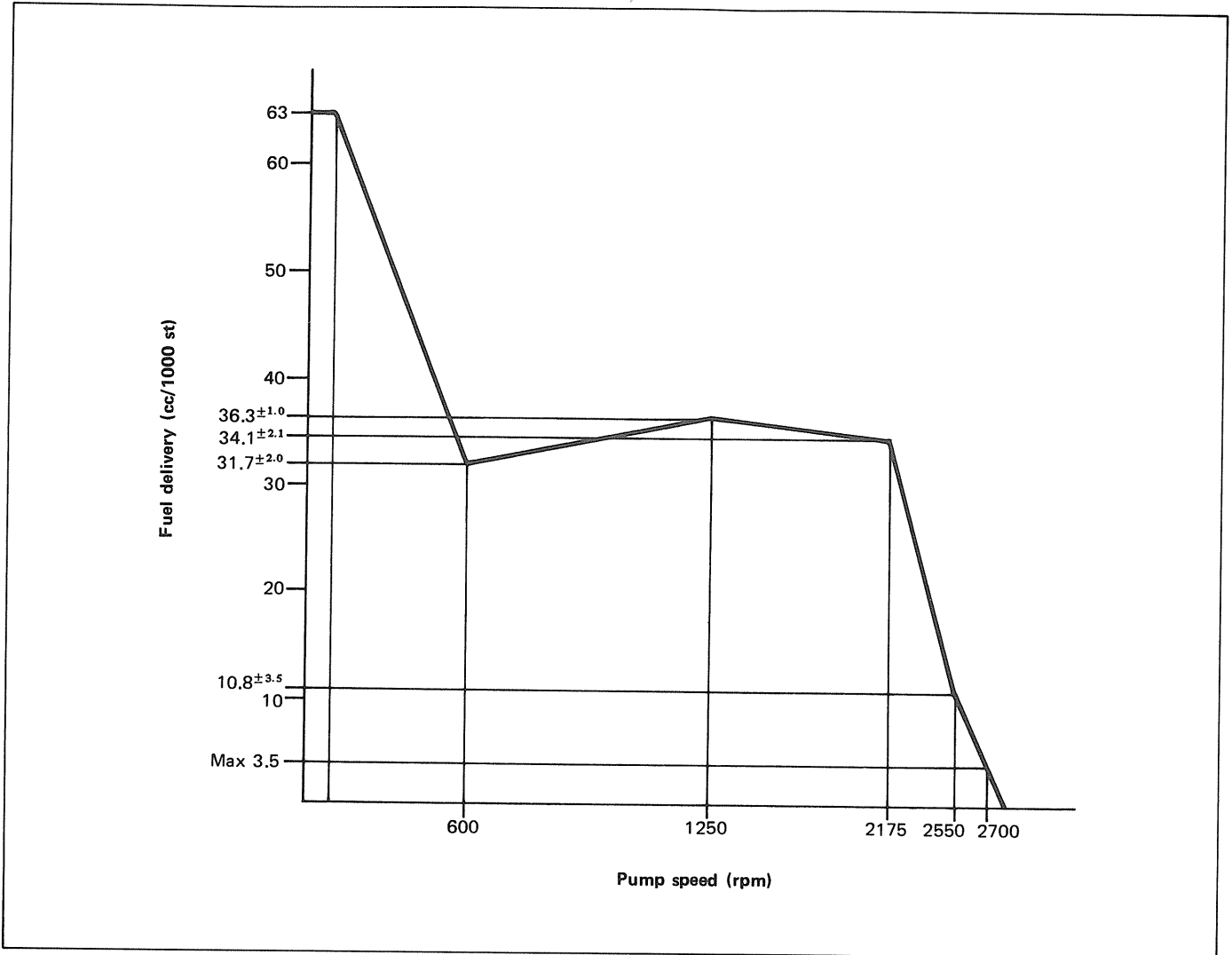
1. Settings	Pump Speed (rpm)	Settings	Difference in delivery(cc)
1.1 Timing device travel	1500	4.2—4.6 mm	
1.2 Supply pump pressure	1500	5.2—5.6 kg/cm ²	
1.3 Full load delivery without charge-air pressure	1250	35.8—36.8 cc/1000st	3.0
1.4 Idle speed regulation	375	5.6—9.6 cc/1000st	2.0
1.5 Start	100	Min. 63 cc/1000st	
1.6 Full-load speed regulation	2550	7.8—13.8 cc/1000st	3.0
1.7 Cold Start Device	500—700	Cancel speed cc/1000st	

2. Test Specifications				
2.1 Timing device	N = rpm mm	1000 1.6—2.8	1500 4.1—4.7	2175 7.0—7.8
2.2 Supply pump	N = rpm kg/cm ²	1000 3.8—4.4	1500 5.2—5.6	2175 6.6—7.2
Overflow delivery	N = rpm cc/10s	1000 48—92		

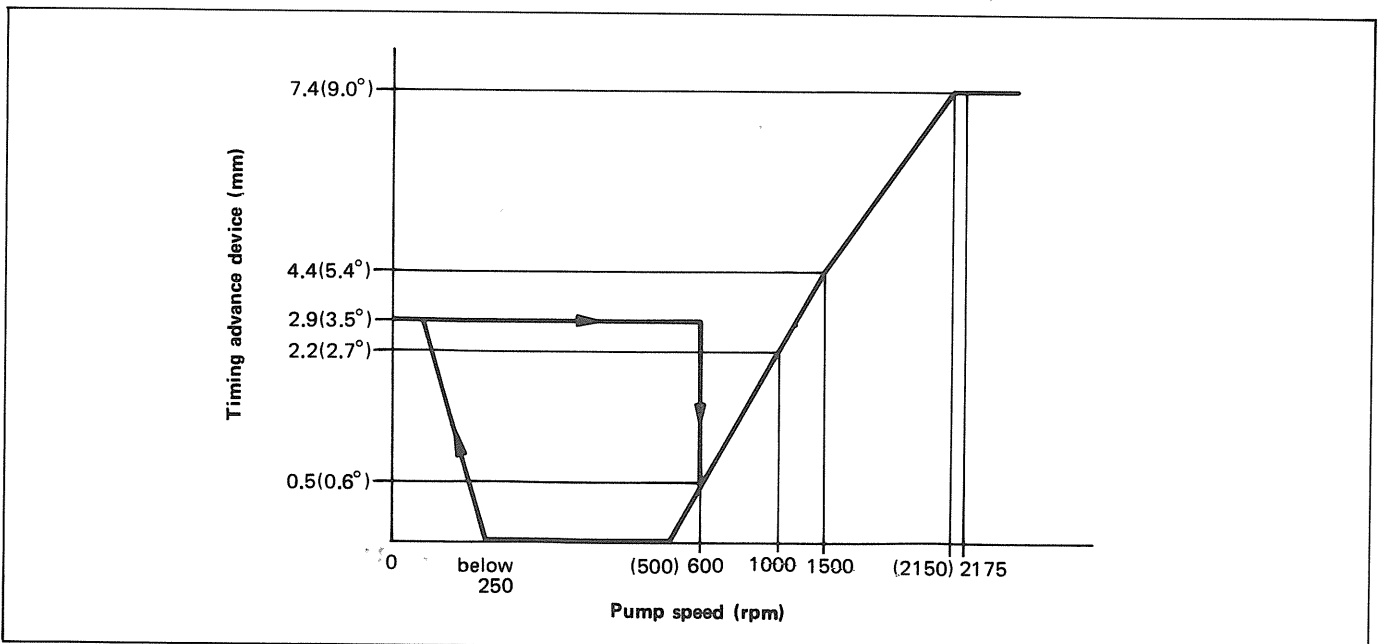
2.3 Fuel deliveries		
Speed control lever	Pump speed (rpm)	Fuel delivery (cc/1000st.)
End stop	2700	Max. 3.5
	2550	7.3—14.3
	2175	32.0—36.2
	1250	35.3—37.3
	600	29.7—33.7
Switch-off	375	0
Idle stop	375	5.6—9.6
	500	Max. 3.0
Cold start device	0	2.7—3.1 mm
	500—700	Cancel
Partial load		
2.4 Solenoid	Max. cut-in voltage test voltage	8V 12V—14V

3. Dimensions		
Designation	For assembly and adjustment (mm)	
K	3.2—3.4	
KF	5.7—5.9	
MS	1.7—1.9	
α	21—29	deg.
A	9.6—12.2	mm
β	37—47	deg.
B	11.9—15.1	mm
τ		deg.
C		mm
Observations Upon canceling of C.S.D. check the revolution and make sure no fuel leakage from the overflow of C.S.D.		

GOVERNOR PERFORMANCE DIAGRAM



TIMING DEVICE DIAGRAM



C223T
INJECTION VOLUME ADJUSTMENT
TEST CONDITIONS

Injection nozzle	D.K.K.C. P.No.105780-0000 Bosch type No.DN12SD12T
Injection nozzle holder	D.K.K.C. P.No.105780-2080 Bosch type No.EF8511/9A
Injection starting pressure	150kg/cm ²
Injection line	Inner dia. 2mm x Outer dia. 6mm — Length 840mm
Transfer pump pressure	0.2kg/cm ²
Test diesel fuel	ISO standard test oil (ISO 4113) SAE standard test oil (SAE 967.d)
Testing oil temperature	45 — 50°C
Identification number	104740-1030, 104740-1050, (894171-8510, 894171-8520) 104740-1020, 104740-1120, 104740-1130, 104740-1140

IDENTIFICATIONS PLATE AND NUMBER

When adjusting injection volume, use the correct data following the injection pump identification number.

MAKER/ ASS'Y NO.	894132-3380
INJ.PUMP ASS'Y NO.	104740-1030

INJECTION VOLUME AND GOVERNOR PERFORMANCE DIAGRAM

Identification number : 104740-1030, 104740-1510, (894171-8510, 894171-8520)

Test diesel fuel : SAE standard test diesel fuel SAE J967d (or ISO 4113)

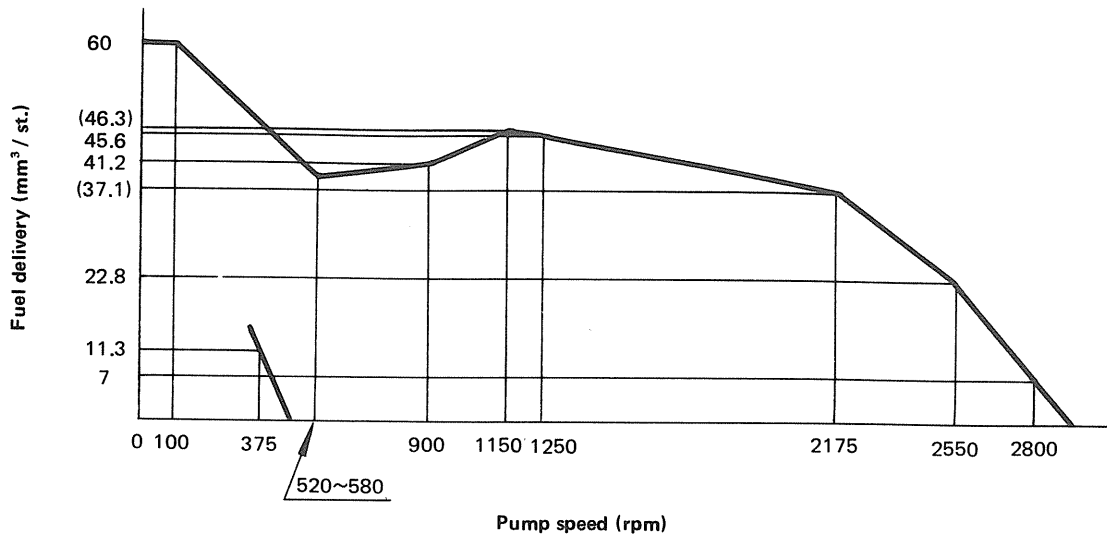
1. Settings	Pump Speed (rpm)	Settings	Charge-air press (mmHg)	Difference in delivery (cc)
1.1 Timing device travel	1250	2.7—3.1 mm	0	
1.2 Supply pump pressure	1250	4.6—5.0 kg/cm ²	0	
1.3 Full load delivery without charge-air pressure		cc/1000st		
Full-load deliver with charge-air pressure	1250	45.4—46.5 cc/1000st	590—610	4.0
1.4 Idle speed regulation	375	9.3—13.3 cc/1000st	0	2.0
1.5 Start	100	Min. 60 cc/1000st	0	
1.6 Full-load speed regulation	2550	19.9—25.9 cc/1000st	590—610	7.0
1.7 Load Timer Adjustment		cc/1000st		
1.8		cc/1000st		

2. Test Specifications					
2.1 Timing device	N = rpm mm	1250 2.6—3.2	1700 5.0—6.0	2150 7.9—8.6	
2.2 Supply pump	N = rpm kg/cm ²	250 1.6—2.2	1250 4.6—5.0	2000 6.1—6.7	2150 6.4—7.0
Overflow delivery	N = rpm cc/10s	1000 40.8—84.2			

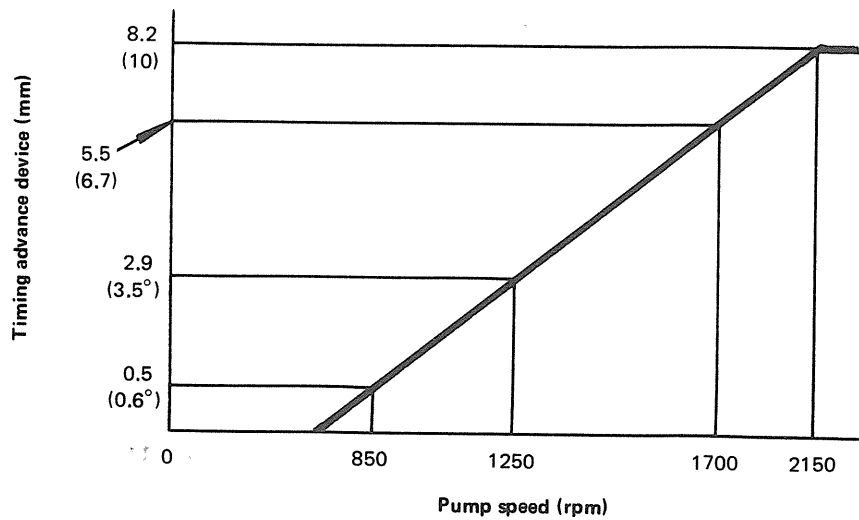
2.3 Fuel deliveries			
Speed control lever	Pump Speed (rpm)	Fuel delivery cc/1000sts	Charge-air press. (mmHg)
End stop	2800	Max. 7.0	
	2550	19.4—26.4	
	2175	34.8—40.4	
	2000	37.1—42.1	
	1250	44.9—46.9	
	1250	32.3—37.3	
	1150	44.8—49.8	
	900	40.4—42.4	
	600	31.4—36.4	
Switch-off	375	0	
Idle stop	375	9.3—13.3	0
	450	Max. 3.0	0
Partial load			
2.4 Solenoid	max. cut-in voltage : 8V test voltage : 12V—14V		

3. Dimensions		
Designation	for assembly and adjustment (mm)	
K	3.2—3.4	
KF	5.7—5.9	
MS	1.5—1.7	
BSC stroke	3.4—3.6	
α	21—27	deg.
A	9.2—11.0	mm
β	37—47	deg.
B	12—15	mm
τ		deg.
C		mm
Observations:		

GOVERNOR PERFORMANCE DIAGRAM



TIMING DEVICE DIAGRAM



INJECTION VOLUME AND GOVERNOR PERFORMANCE DIAGRAM

Identification number : 104740-1021, 104740-1120, 104740-1130, 104740-1140

Test diesel fuel : SAE standard test diesel fuel SAE J967d (or ISO 4113)

1. Settings	Pump Speed (rpm)	Settings	Charge-air press (mmHg)	Difference in delivery (cc)
1.1 Timing device travel	1250	3.5—3.9 mm	0	
1.2 Supply pump pressure	1250	4.6—5.0 kg/cm ²	0	
1.3	Full load delivery without charge-air pressure	cc/1000st		
	Full-load deliver with charge-air pressure	1250	47.8—48.8 cc/1000st	590—610
1.4 Idle speed regulation	375	9.3—13.3 cc/1000st	0	2.0
1.5 Start	100	Min. 60 cc/1000st	0	
1.6 Full-load speed regulation	2550	19.9—25.9 cc/1000st	590—610	7.0
1.7 CSD Adjustment	500—700	Cancel speed cc/1000st		
1.8		cc/1000st		

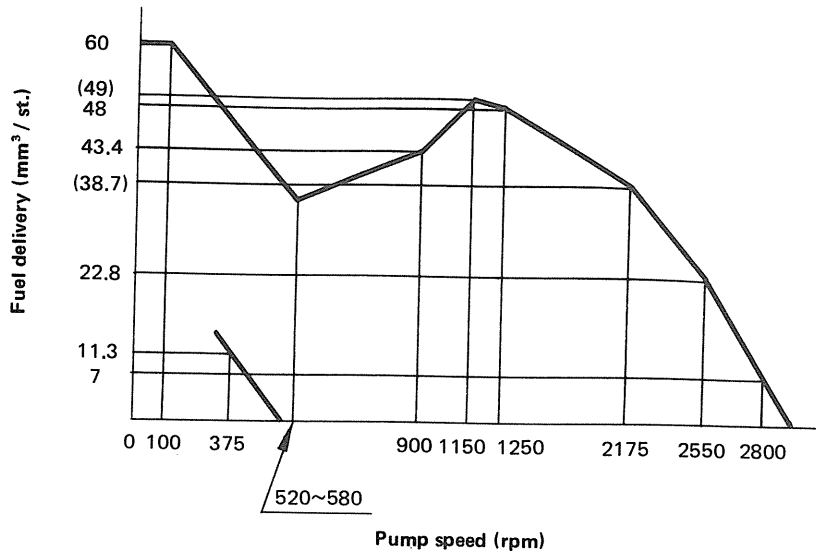
2. Test Specifications				
2.1 Timing device	N = rpm mm	1250 3.4—4.0	1700 5.8—6.8	2150 8.7—9.4
2.2 Supply pump	N = rpm kg/cm ²	250 1.6—2.2	1250 4.6—5.0	2000 6.1—6.7
Overflow delivery	N = rpm cc/10s	1000 40.8—84.2		

2.3 Fuel deliveries			
Speed control lever	Pump Speed (rpm)	Fuel delivery cc/1000sts	Charge-air press. (mmHg)
End stop	2800	Max. 7.0	
	2550	19.4—26.4	
	2175	36.7—41.7	
	2000	38.4—43.4	
	1250	47.3—49.3	
	1250	34.1—39.1	
	1150	46.5—51.5	
	900	42.7—44.7	
	600	34.1—39.1	
	Switch-off	375	0
Idle stop	375	9.3—13.3	0
	450	Max. 3.0	0
CSD Adjustment	0	2.3—2.7mm	
	500—700	Cancel speed	
Partial load			
2.4 Solenoid	max. cut-in voltage : 8V test voltage : 12V—14V		

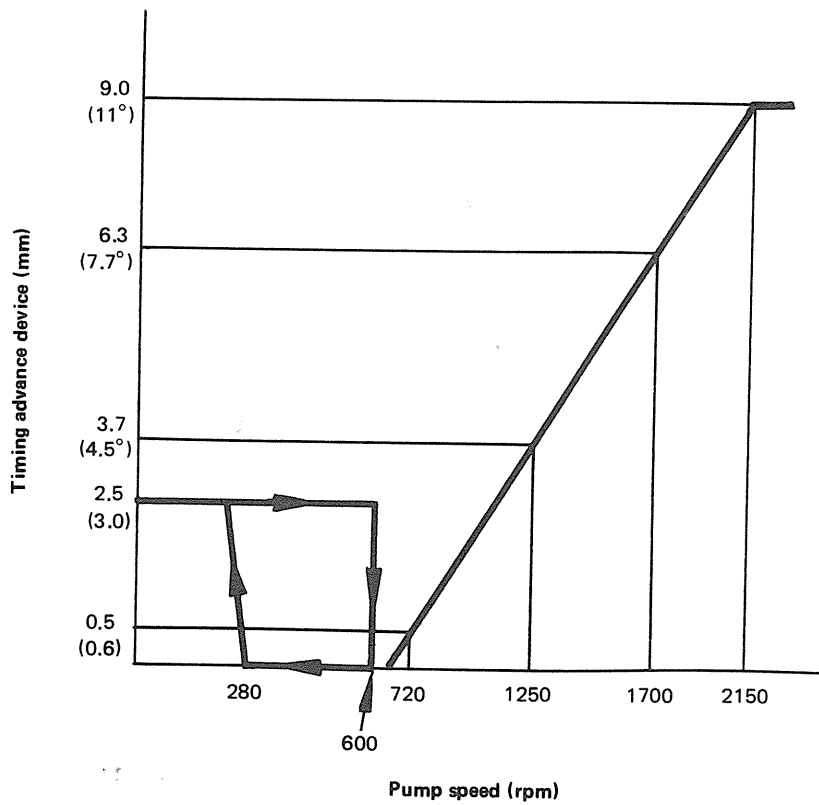
3. Dimensions		
Designation	for assembly and adjustment (mm)	
K	3.2—3.4	
KF	5.7—5.9	
MS	1.5—1.7	
BSC stroke	3.4—3.6	
α	21—27	deg.
A	9.2—11.0	mm
β	37—47	deg.
B	12—15	mm
τ		deg.
C		mm

Observations:
Upon canceling of C.S.D. check the revolution and make sure no fuel leakage from the overflow of C.S.D.

GOVERNOR PERFORMANCE DIAGRAM



TIMING DEVICE DIAGRAM



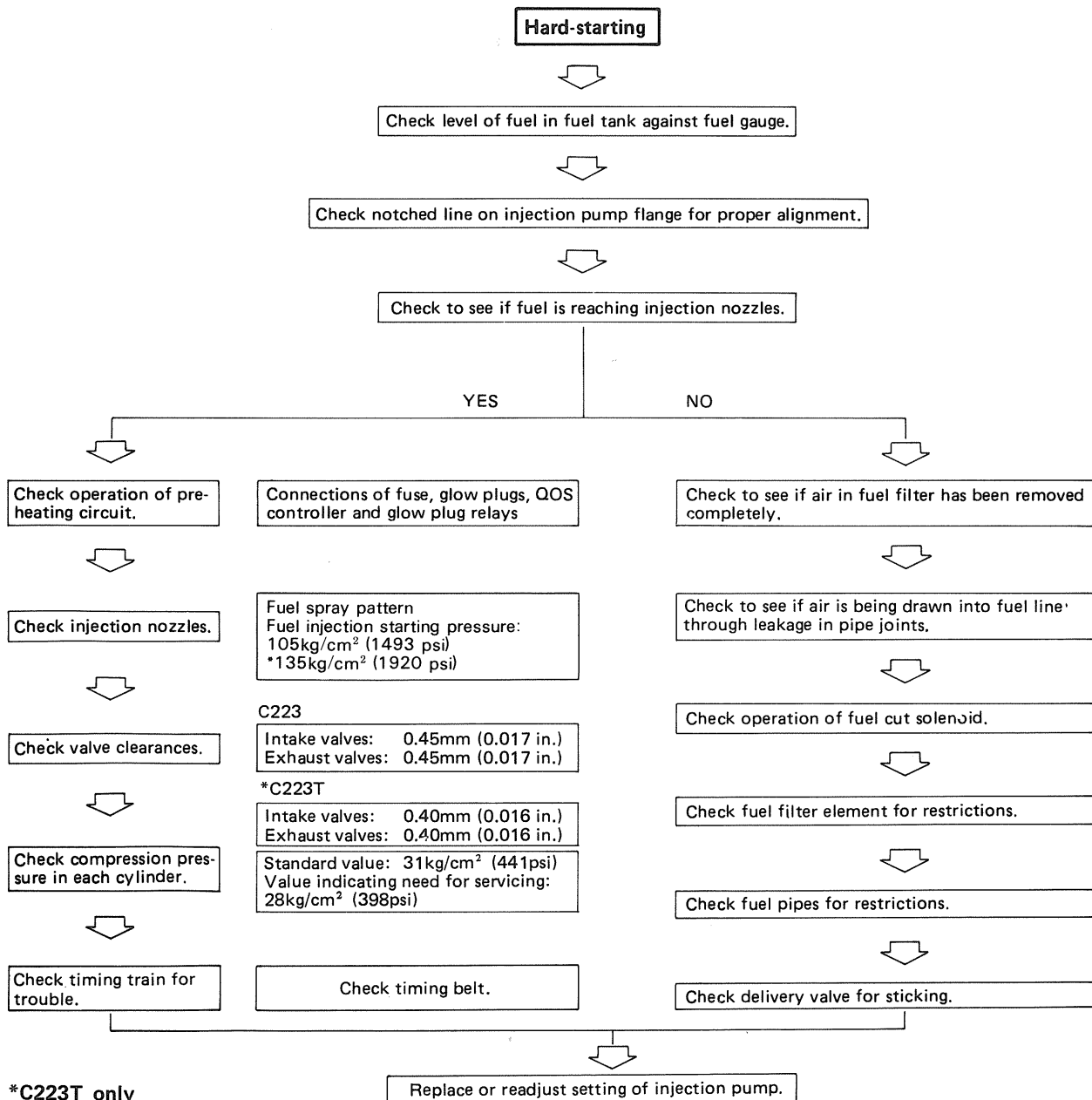
TROUBLE SHOOTING

ENGINE ASSEMBLY

HARD-STARTING

Difficulty will not be experienced in starting a diesel engine provided a sufficient power is supplied for cranking, compression pressure is sufficiently high, preheating system is operating normally and an appropriate volume of fuel is supplied. As an initial step for checking the cause of hard-starting, loosen pipe joint at nozzle side and see if the fuel is being supplied. In some instances, it may be necessary to check nozzle spray conditions and fuel injection timing. If these checks do not disclose any problems, measure the compression pressure to determine the condition of valves and piston rings.

If the engine starts but stalls suddenly and can not be restarted, presence of air in the fuel system is probable. Engine startability is more or less affected by the environmental temperature conditons.

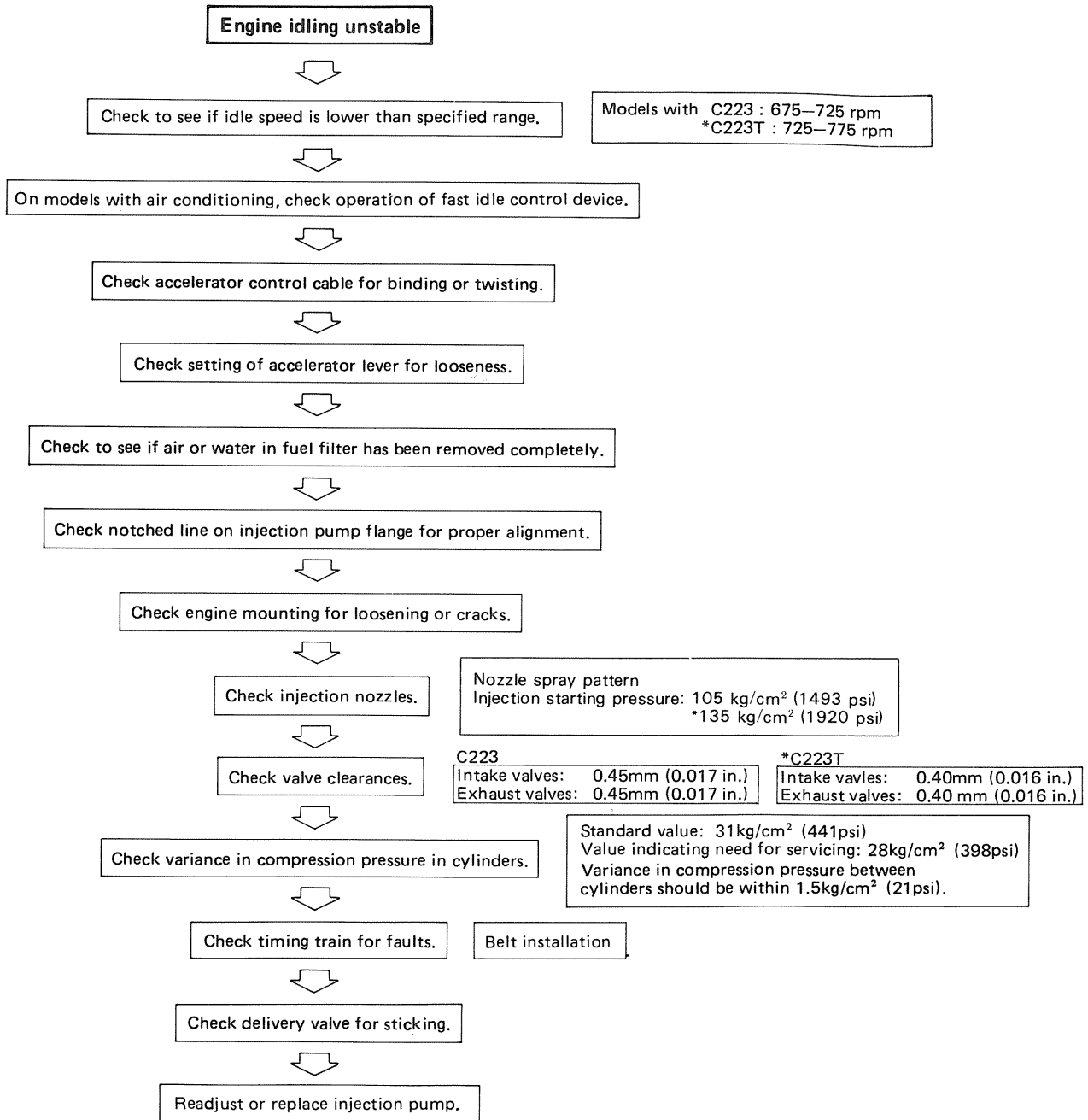


ENGINE IDLING ROUGH

Rough engine idling can cause engine surging and sudden engine stalling at quick deceleration. If the engine operates normally at medium and high speeds, perform diagnostic checks on the injection pump and related components, then check engine idling speed.

Engine hunting may be caused by too low an idling speed, rough plunger operation, over-tightened delivery valve holder, etc.

If the engine stalls at quick deceleration, idling speed might have been set too low.



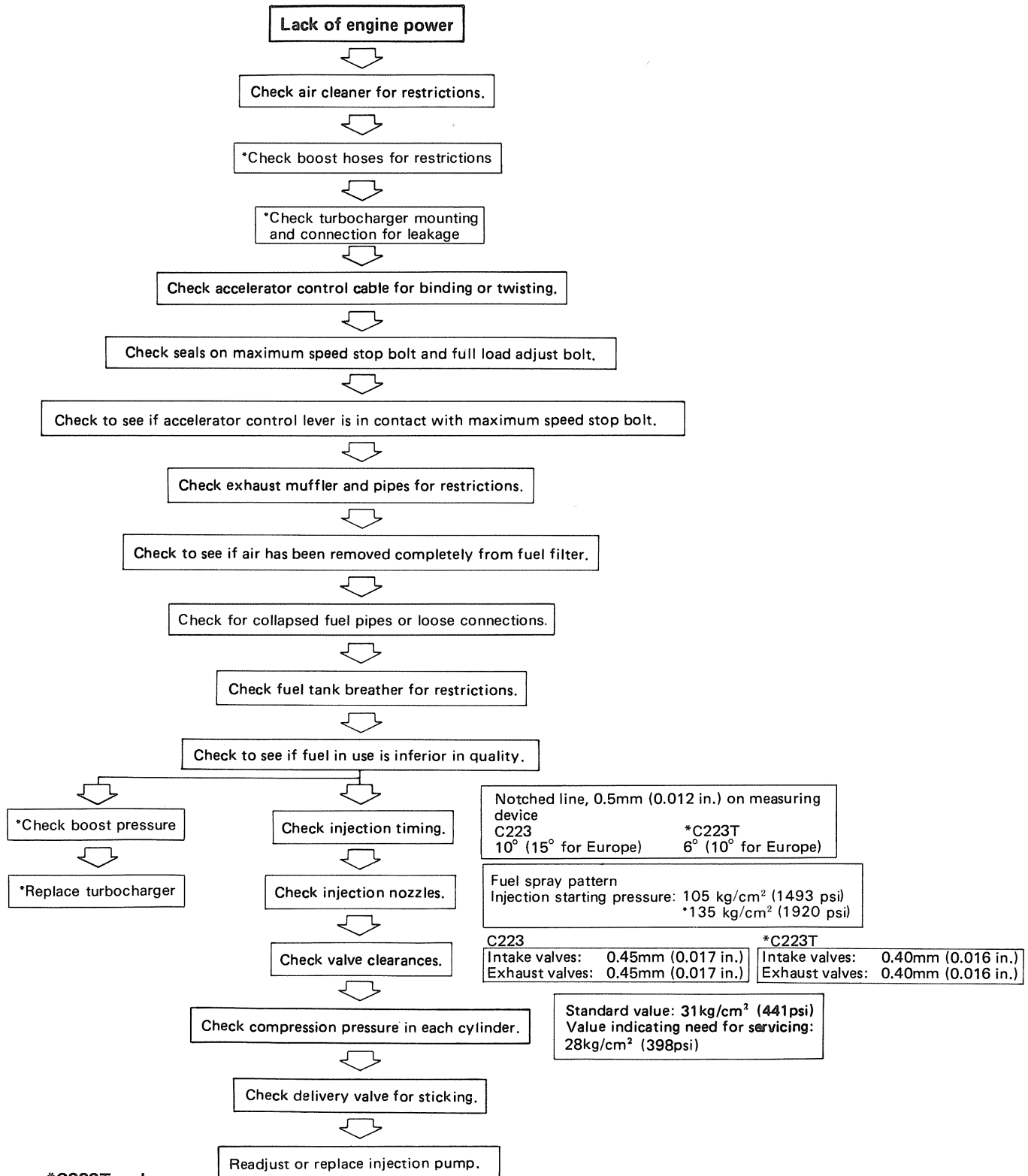
*C223T only

ENGINE LACKS POWER

Lack of engine power may be caused by insufficient injection volume, insufficient volume of intake air, lowered compression pressure, etc. If the trouble is due to lack of volume of fuel injection, check fuel filter element for restrictions and fuel system for presence of air.

If the above checks do not disclose any troubles, make a test on the fuel injection pump and governor, using a pump tester.

If the volume of intake air is insufficient, check air cleaner element for restrictions and exhaust pipe(s) for clogging.



Notched line, 0.5mm (0.012 in.) on measuring device
 C223 10° (15° for Europe) *C223T 6° (10° for Europe)

Fuel spray pattern
 Injection starting pressure: 105 kg/cm² (1493 psi)
 *135 kg/cm² (1920 psi)

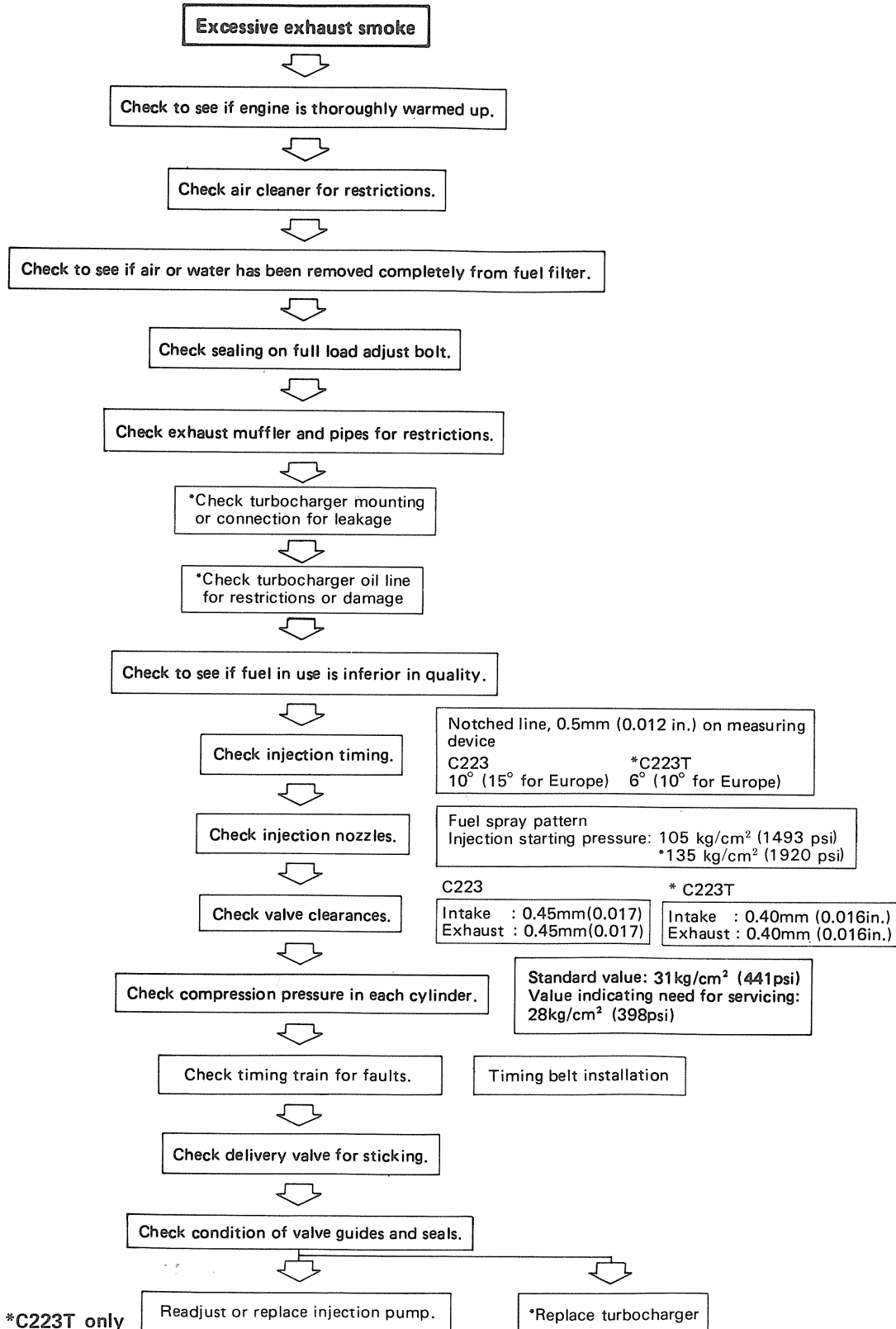
C223	Intake valves: 0.45mm (0.017 in.)	*C223T	Intake valves: 0.40mm (0.016 in.)
	Exhaust valves: 0.45mm (0.017 in.)		Exhaust valves: 0.40mm (0.016 in.)

Standard value: 31 kg/cm² (441psi)
 Value indicating need for servicing: 28kg/cm² (398psi)

*C223T only

DARK OR WHITE EXHAUST SMOKE

A considerable amount of dark smoke in the exhaust gases is due to incomplete fuel combustion caused by excessive volume of fuel injection, insufficient volume of intake air, malfunctioning of aneroid compensator or boost compensator, poor spray condition, excessively advanced injection timing, etc. To determine the cause, check seals on the injection pump, check compression pressure, condition of air cleaner and injection nozzle spray conditons, then check fuel injection timing.



ENGINE OVERHEATING

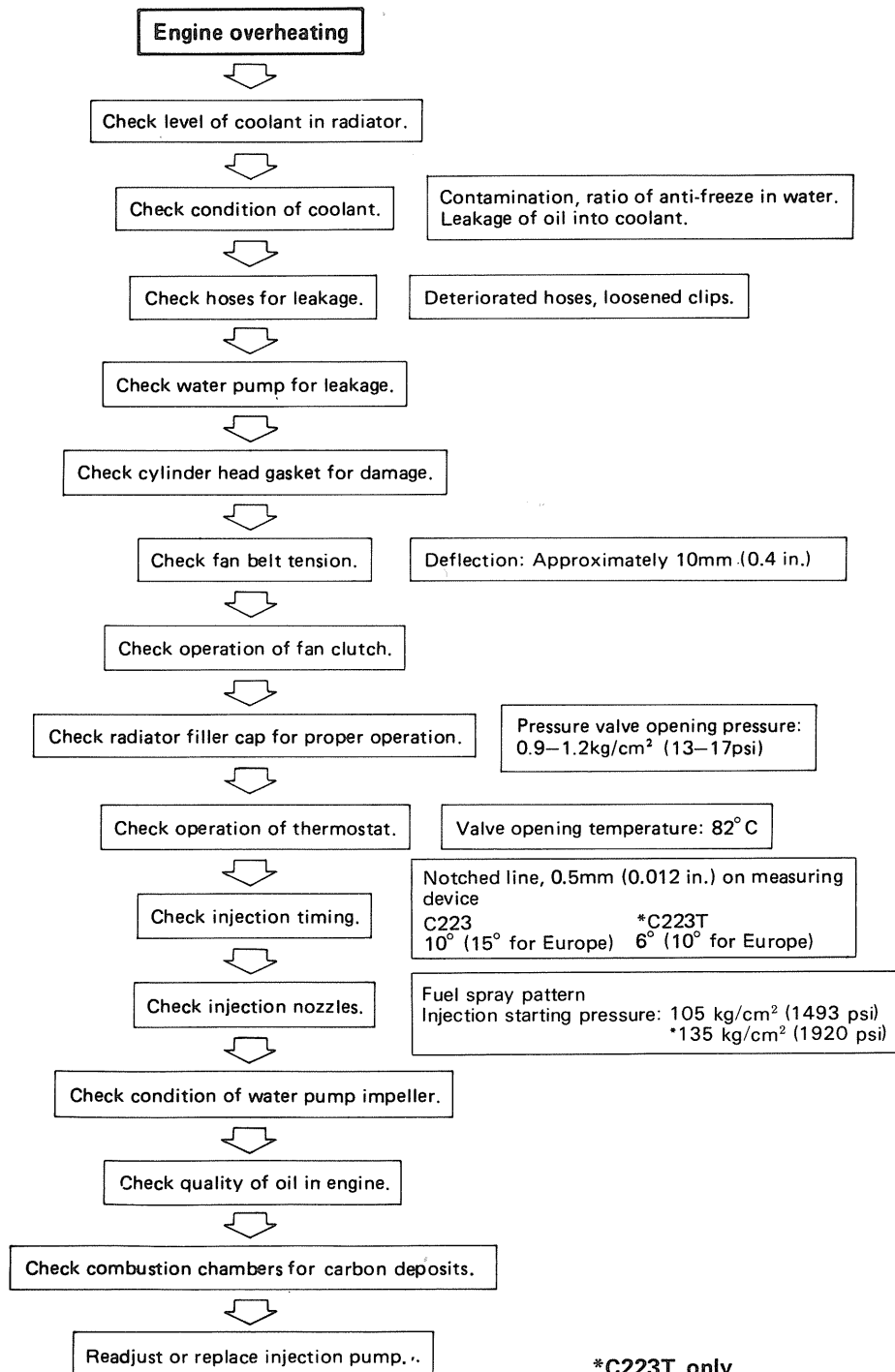
When locating the cause of engine overheating, it is necessary to find whether the engine is actually overheating or the temperature gauge is giving a false indication.

To determine the true cause, measure the temperature of engine coolant at the upper part of the radiator with the engine running and compare the measured value with the reading of the temperature gauge on the instrument panel to check the accuracy of gauge indication.

Then check the following causes, starting with the item which can be checked easily.

Common causes of engine overheating will be as follows when listed in sequence of frequency: Leakage of coolant from water pump, radiator and hoses which causes a reduction in coolant level, defective thermostat, formation of scales in water passages. etc.

Leakage of gases into cooling water circuit due to defective gasket, excessive volume of fuel injection, incorrect injection timing, deposit of carbon within the combustion chambers are but some of the causes of engine overheating which are often overlooked.



*C223T only

ENGINE NOISY

Abnormal noise of engine includes knocking sound, piston slap, etc.

Engine knocking is a result of rapid fuel combustion caused by a delay in the ignition timing and is due mainly to excessively advanced fuel injection timing or deteriorated fuel spray conditions.

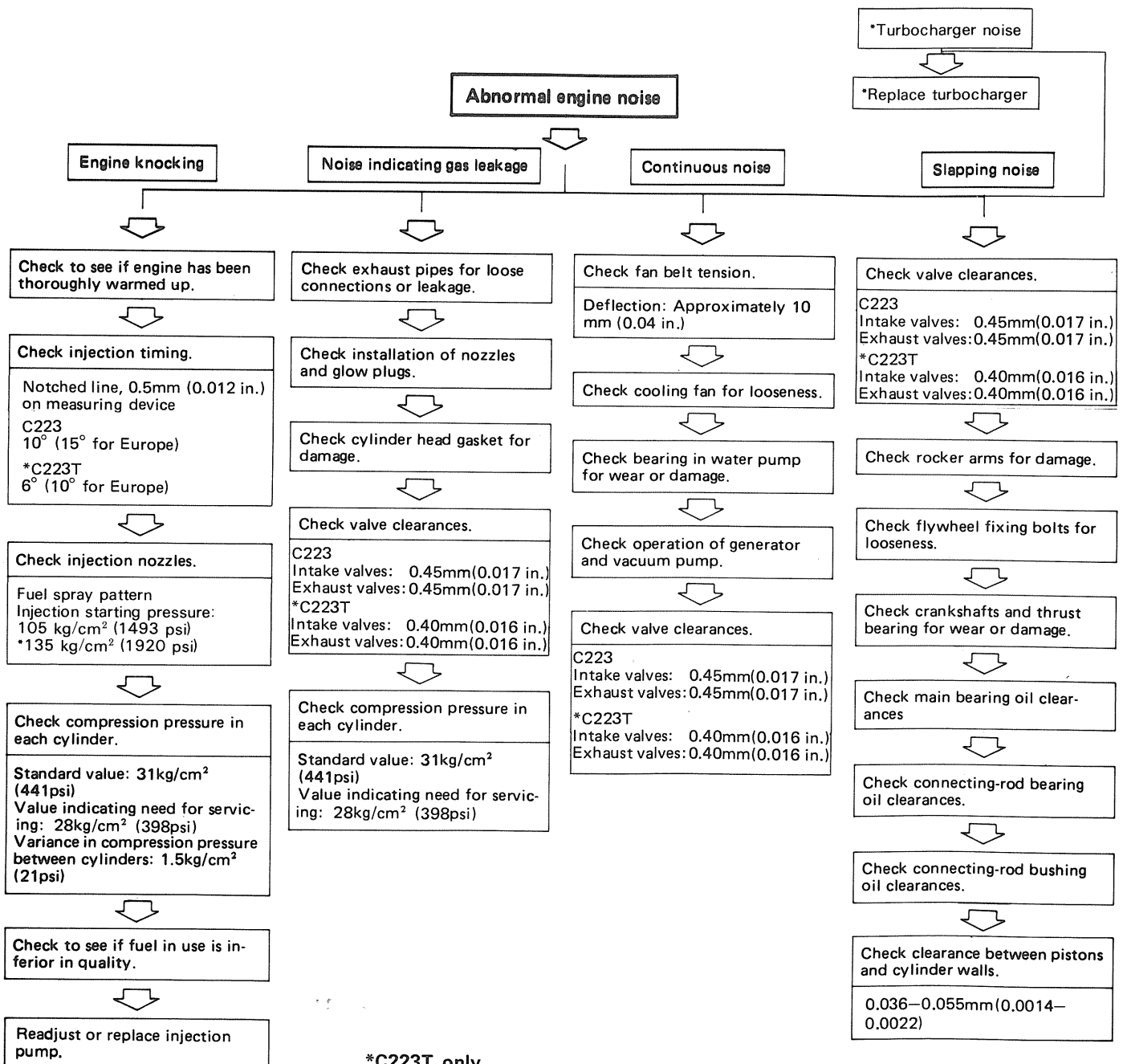
Engine may produce slight knocking immediately after starting which normally diminishes as the engine temperature increases.

If engine produces a continuous noise, systematic checks are usually performed to determine the source of the noise, and noise from the auxiliaries such as generator, water pump, etc. can be shut-off by removing the belt to make checks on the engine easier.

If the engine produces slapping noise such as piston slap, piston pins and connecting-rod bearing noise, from which cylinder the noise comes can be checked by interrupting flow of fuel with the injection pipe joints loosened in sequence.

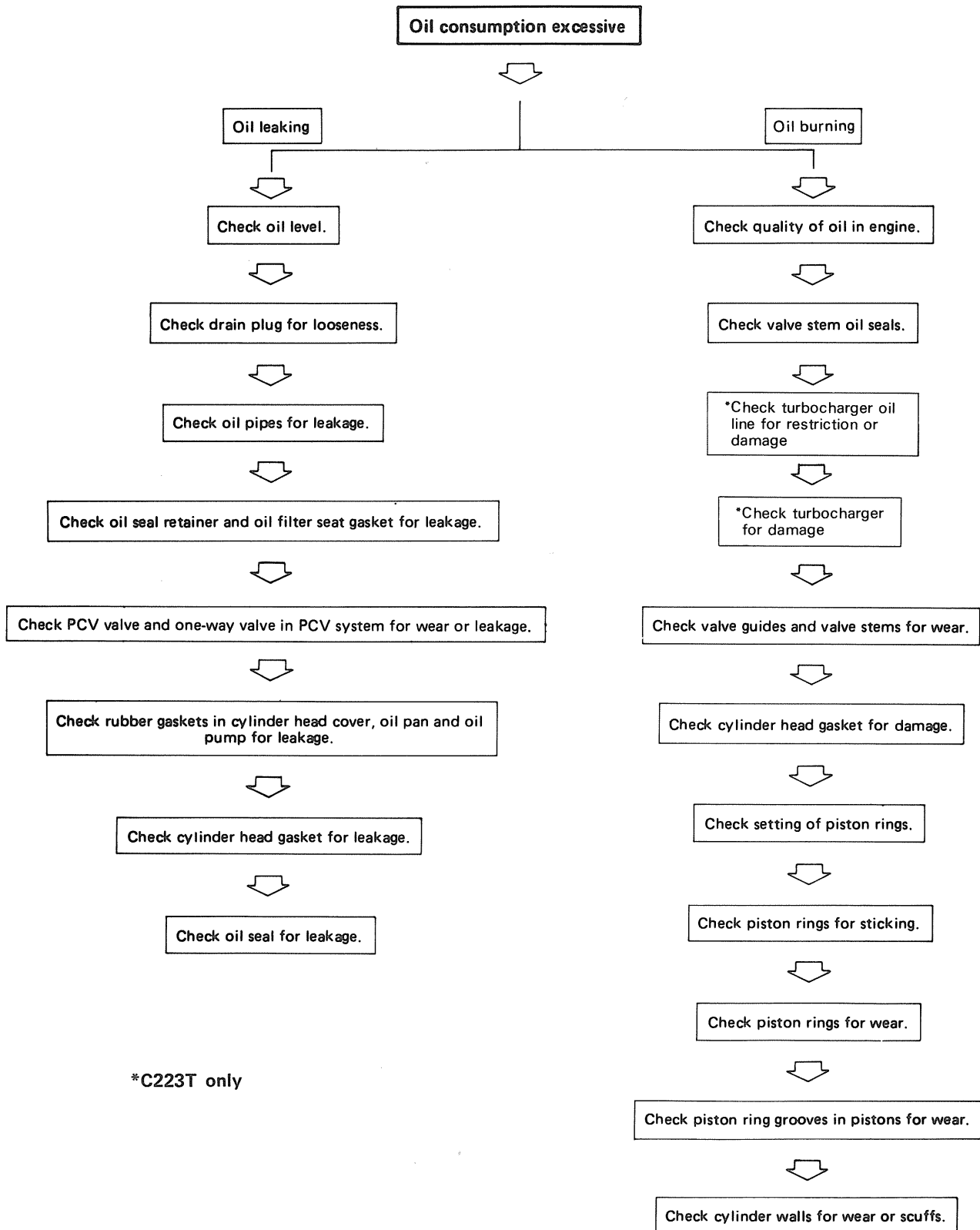
Engine crankshaft noise can be diagnosed by moving the clutch pedal in and out.

If noise is caused by crankshaft movement, noise will change as the clutch is operated.



EXCESSIVE ENGINE OIL CONSUMPTION

Major causes of excessive oil consumption include oil leakage, oil burning and internal leakage of oil past the piston clearances, and external oil leakage can be detected with relative ease through visual checks. To find whether oil is burning or leaking past the piston clearances, start and let the engine idle for a few minutes, then check with the cylinder head removed. Oil burning is indicated by the traces of oil around the circumference of pistons. A trace of oil is normally found around the valve head and deposit of carbon is localized to that area when internal oil leakage is present.

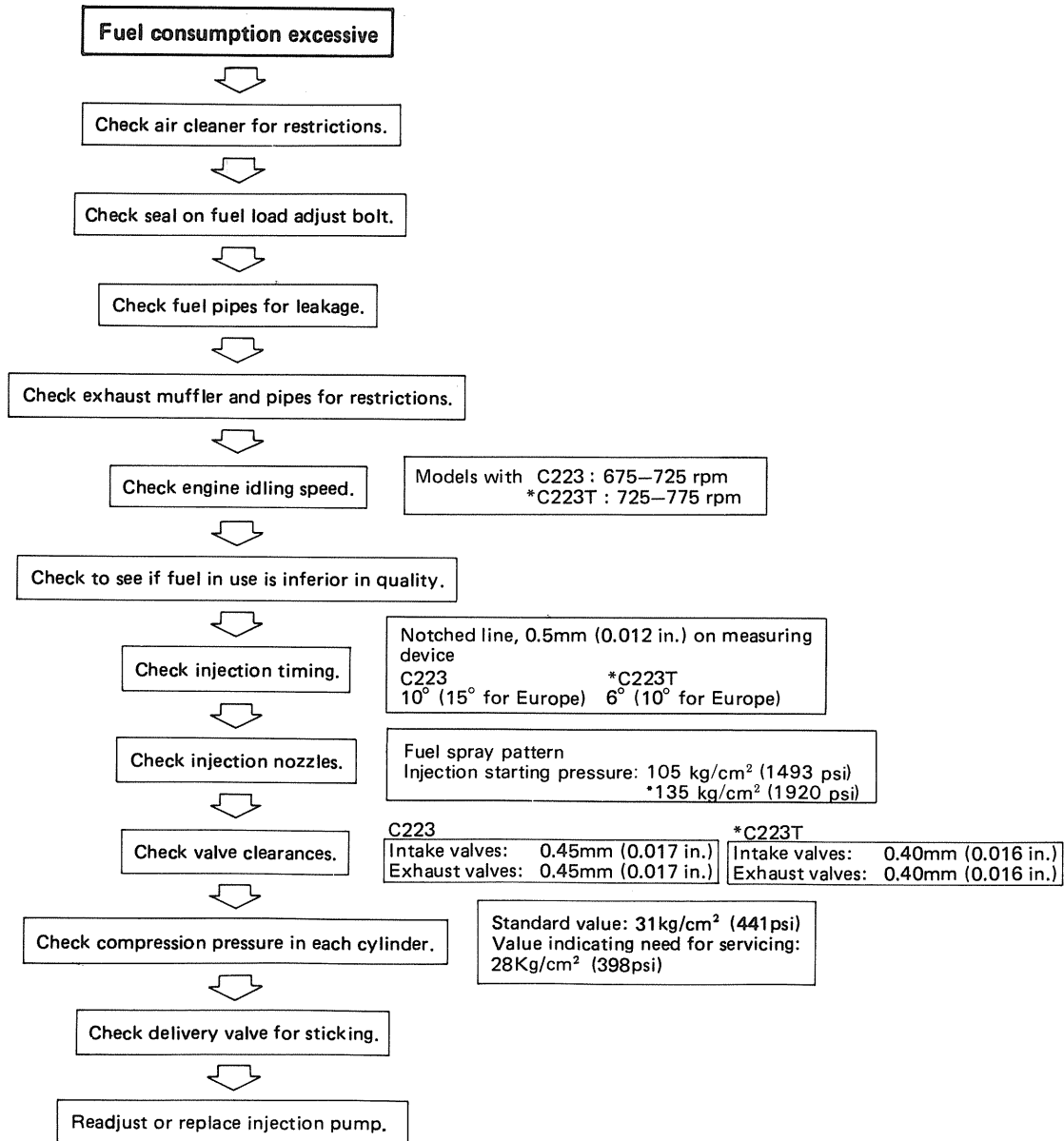


EXCESSIVE FUEL CONSUMPTION

It is necessary to find what rate of fuel consumption is registered under which driving conditions before following the diagnosis procedure since the fuel consumption varies greatly with the driving habits, load the vehicle carries and general condition of the roads and streets.

As a first step check the air cleaner and exhaust muffler for restrictions, then check the compression pressure in the cylinders. Road test the vehicle to see if the engine operates normally, giving reasonable acceleration. If the results of road test are satisfactory, trouble in the fuel system is suspected.

To determine the condition of the fuel system, check fuel spray condition and injection starting pressure using a nozzle tester.



*C223T only

LUBRICATING SYSTEM

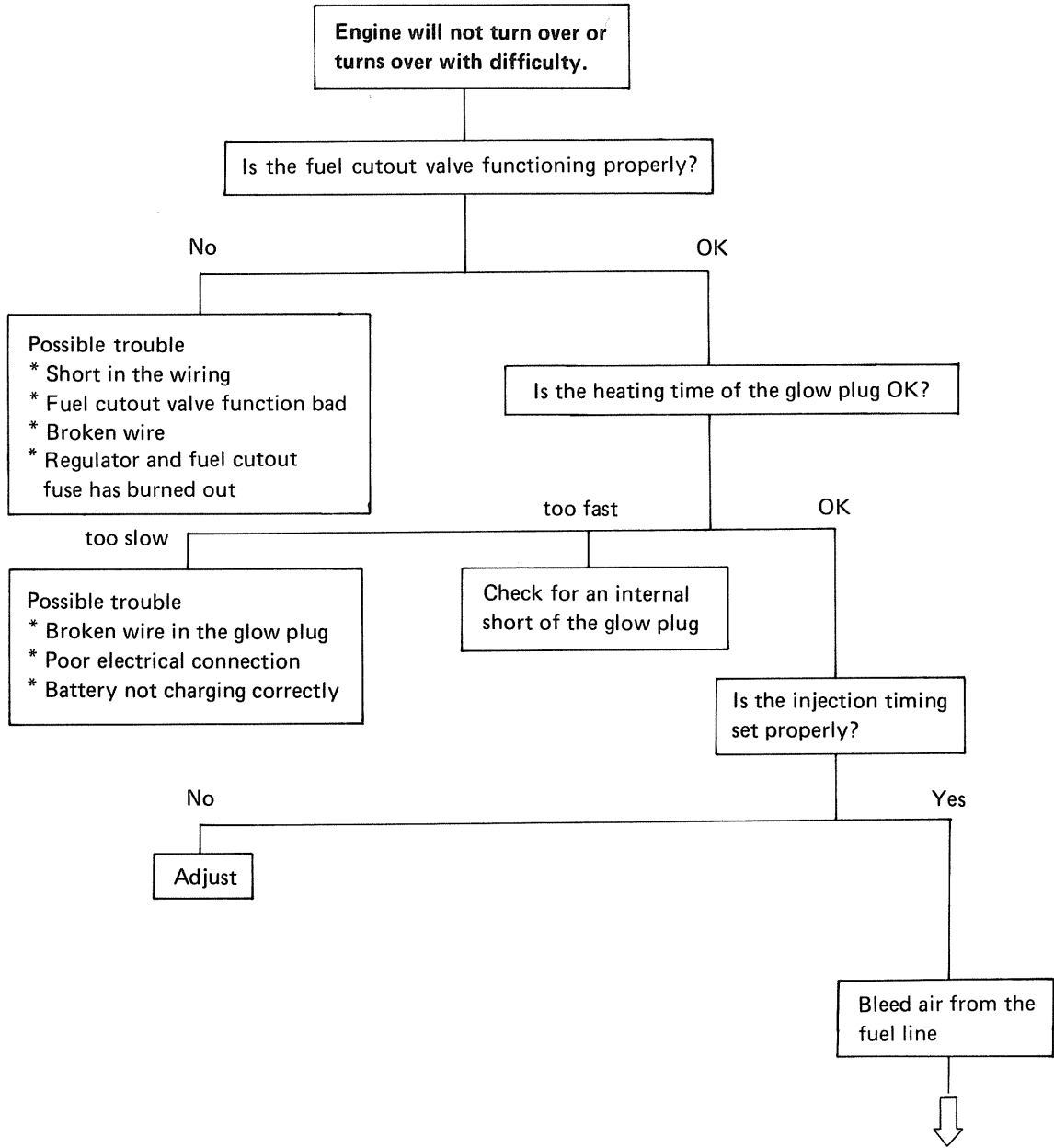
Complaint	Cause	Correction
Oil consumption too high	Use of wrong oil One-way valve leakage in PCV system Oil seals for gaskets defective Piston rings or ring grooves worn Piston rings sticking Valve stem oil seals, valve guides or valve stems worn Cylinder bores worn	Drain and refill with specified oil Clean or replace one-way valve Correct Replace piston rings or pistons Replace piston rings or pistons Replace oil seals, valves or valve guides Rebore cylinders
Oil pressure too low	Use of wrong oil Relief valve sticking Obstruction in oil pump gauze filter Oil pump rotor or vane worn (4 x 2 only) Oil pump driven and drive gear worn (4 x 4 only) Oil pipe cracked, broken or loosely connected Oil pump defective Crankshaft bearings or connecting-rod Bearings worn excessively Oil pressure gauge defective	Drain and refill with specified oil Replace relief valve Clean or replace gauze filter Replace oil pump assembly Replace oil pump assembly Correct or replace Replace oil pump assembly Replace Correct or replace
Oil deteriorates quickly	Obstruction in oil filter Gases leaking Use of wrong oil	Replace filter cartridge Replace piston rings or rebore cylinders Drain and refill with specified oil
Oil does not reach valve system	Oil ports in cylinder block and cylinder head clogged Oil ports in rocker arm shaft clogged Oil ports in rocker arm shaft brackets clogged Oil ports in rocker arms clogged	Clean or correct Clean or correct Clean or correct Clean or correct

COOLING SYSTEM

Complaint	Cause	Correction
Engine overheating	Cooling water level too low Radiator cap pressure valve spring weakened Fan belt loosened or broken Fan belt slipping Thermostat defective (valve not opening) Water pump defective Obstructions in water passages due to accumulation of scales Injection timing incorrect Obstructions in radiator core Gases leaking into water jacket due to broken cylinder head gasket	Replenish, check for leakage and correct as necessary Replace filler cap assembly Adjust or replace fan belt Replace fan belt Replace thermostat assembly Replace water pump assembly Clean radiator and water passages Adjust injection timing correctly Clean exterior of radiator Check cylinder head and replace gasket
Engine over-cooling	Thermostat defective (valve not closing completely) Thermo valve defective (valve not closing completely)	Replace thermostat Replace
Frequent replenishment is needed	Radiator leaking Radiator hoses loosely connected or damaged Radiator cap valve spring weakened Water pump leaking Heater hoses loosely connected or broken Cylinder head gasket leaking Cylinder head or cylinder block cracked	Correct or replace Retighten clips or replace hoses Correct or replace filler cap assembly Replace water pump assembly Retighten or replace hoses Check cylinder head and replace gasket Replace cylinder head or cylinder block
Cooling system noisy	Water pump bearing defective Fan loosely fitted or bent Fan out of balanced Fan belt defective	Replace water pump assembly Retighten or replace fan assembly Replace fan assembly Replace fan belt

FUEL SYSTEM

General conditions
 * Fuel in the vehicle.
 * Starter operation is normal.
 * Battery condition is normal.



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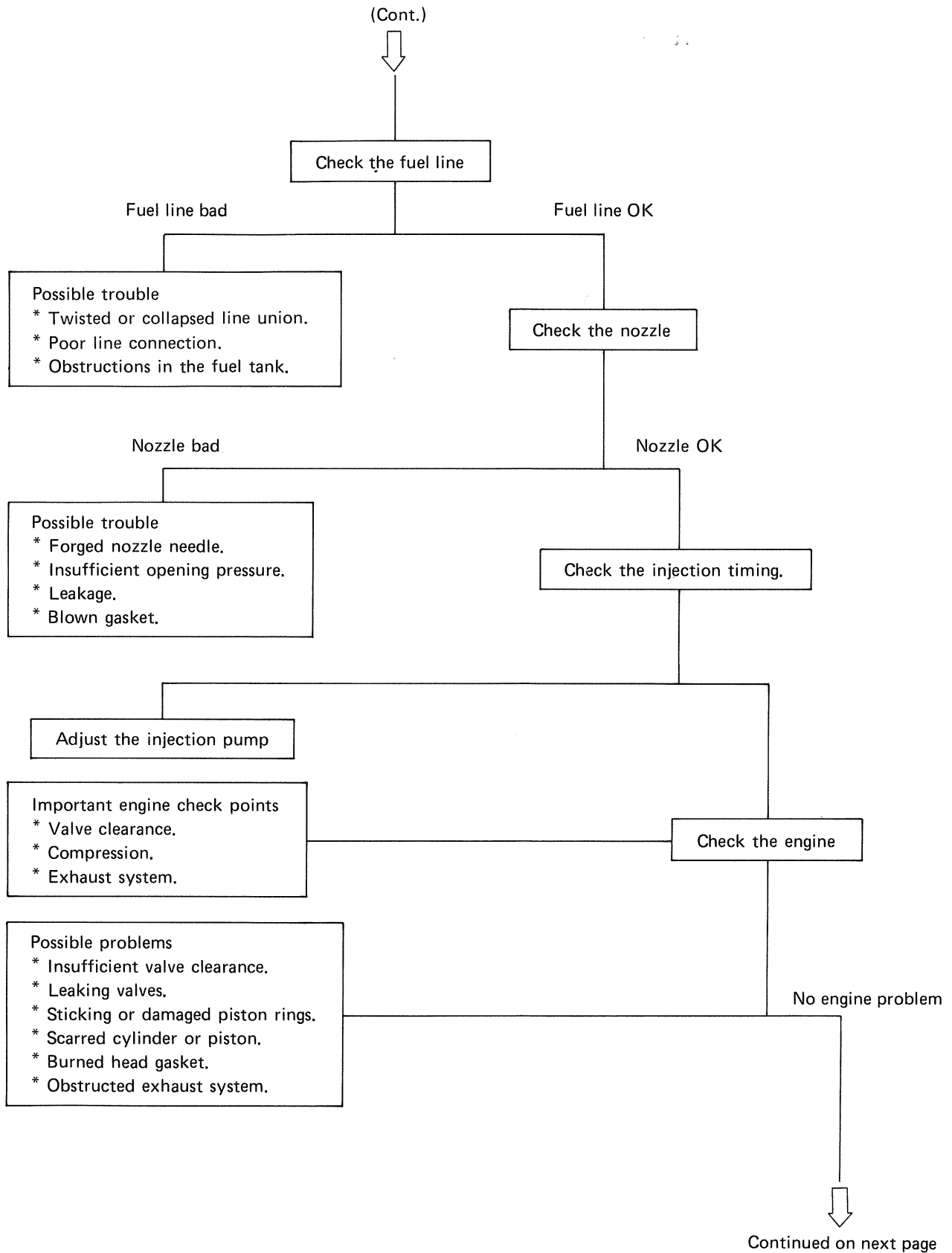
Try replacing the injection pump

Problem persists

Problem disappears

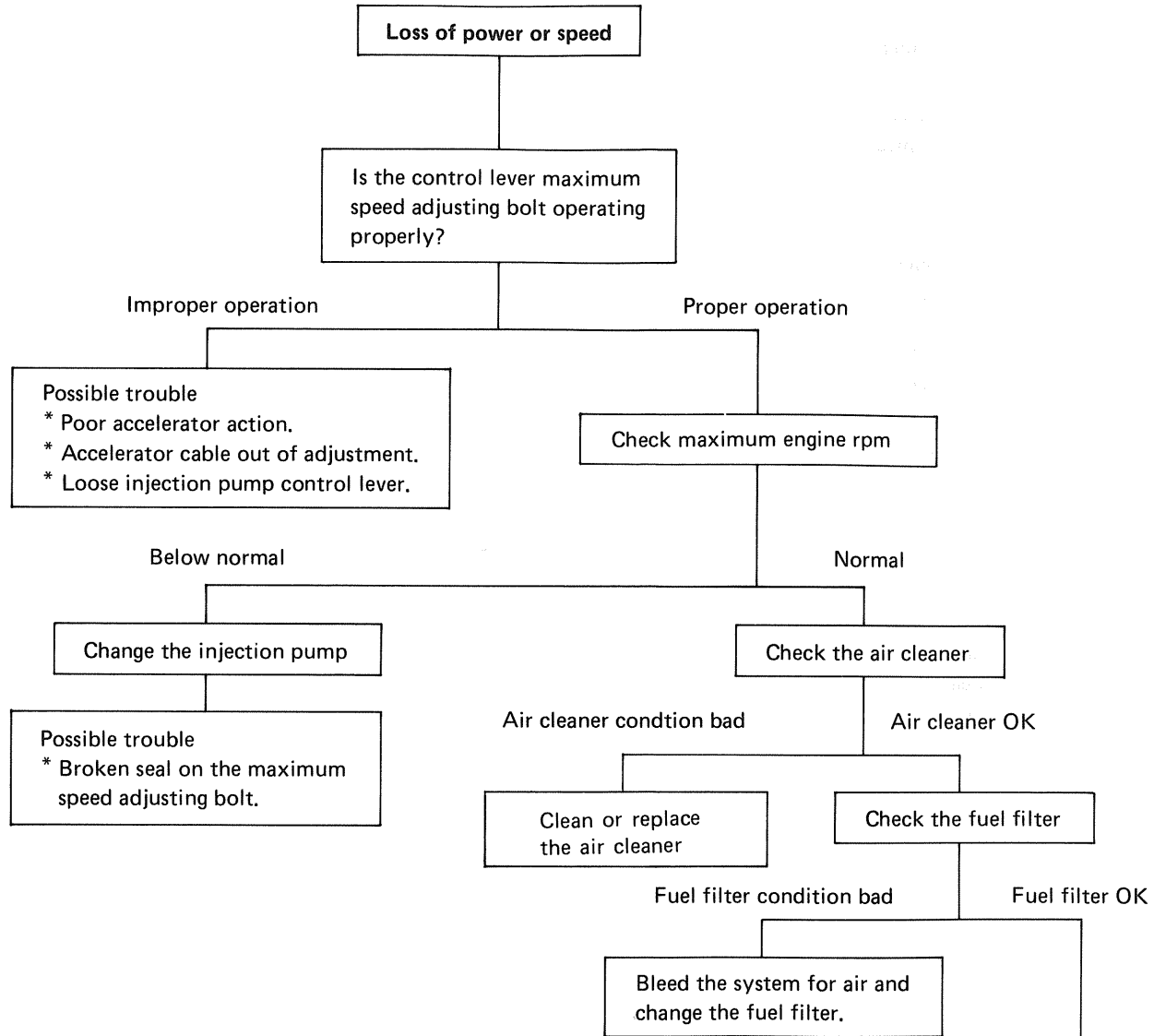
- Possible trouble
- Feed pump
 - * Rusted
 - * Clogged
 - Regulating valve
 - * Spring broken or weakened
 - * Rusted valve
 - * Valve pressure below standard
 - Delivery valve
 - * Spring broken or weakened
 - * Poor valve seating
 - Plunger
 - * Spring broken or weakened
 - * Scoring
 - * Clogged or rusted
 - Governor lever
 - * Poor operation
 - Timer
 - * Spring broken or weakened
 - * Clogged piston
 - * Rust
 - Governor spring broken or weakened
 - Injection volume improperly adjusted
 - Badly worn or scored cam disk

End of service procedure

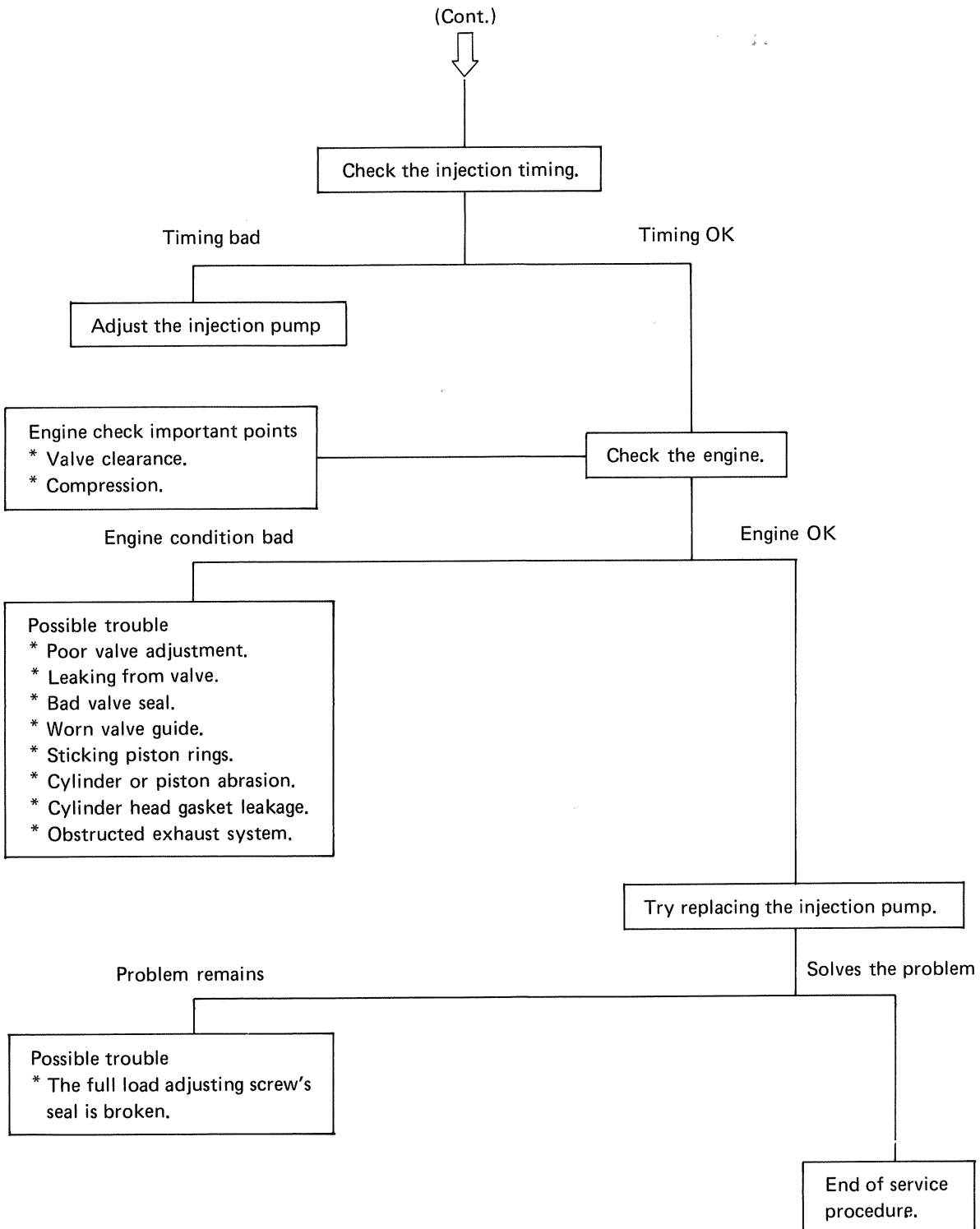


General conditions

- * Maximum speed is normal.
- * Tires are normal.
- * Clutch function is normal.
- * The turbocharger is normal.

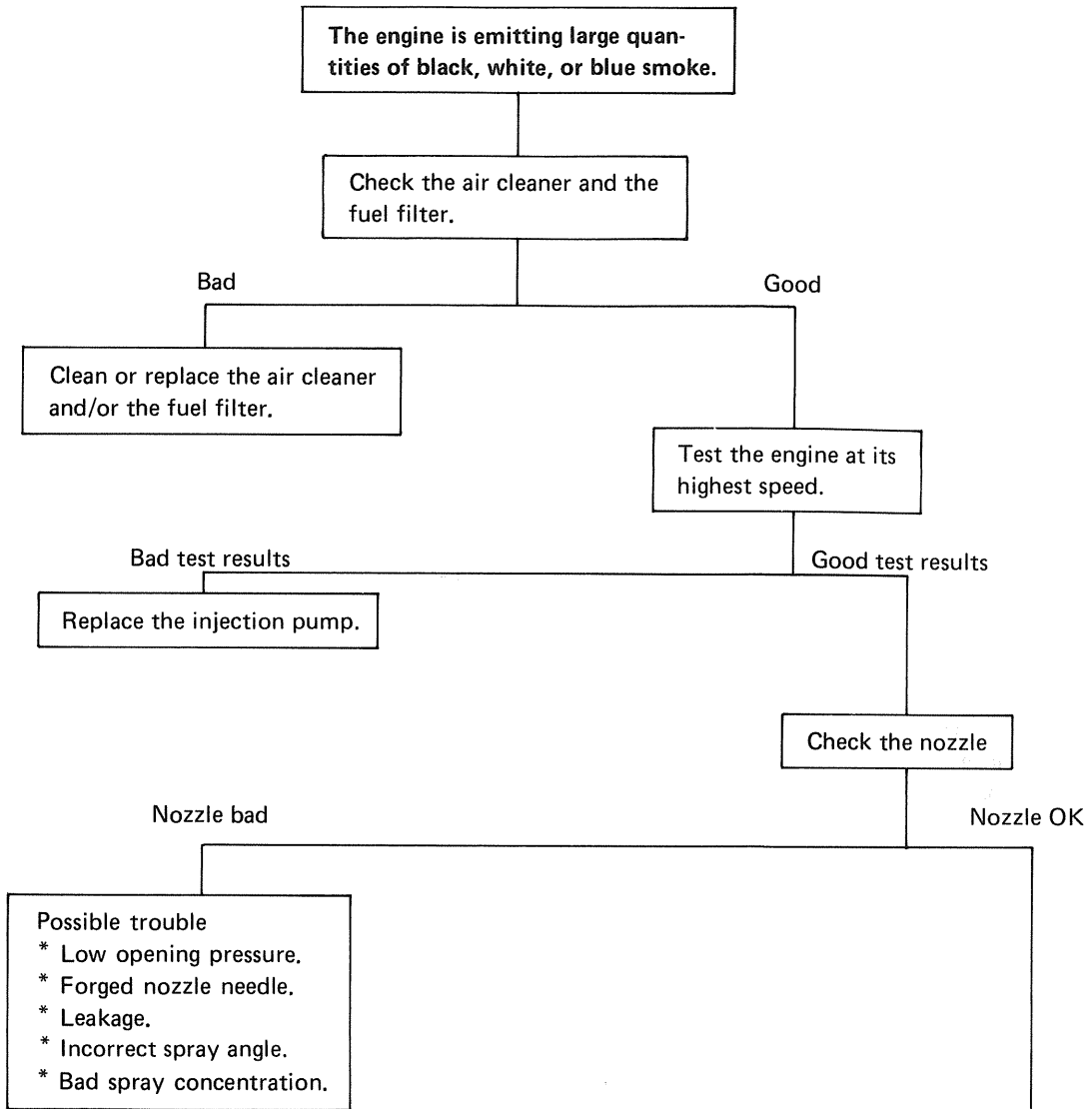


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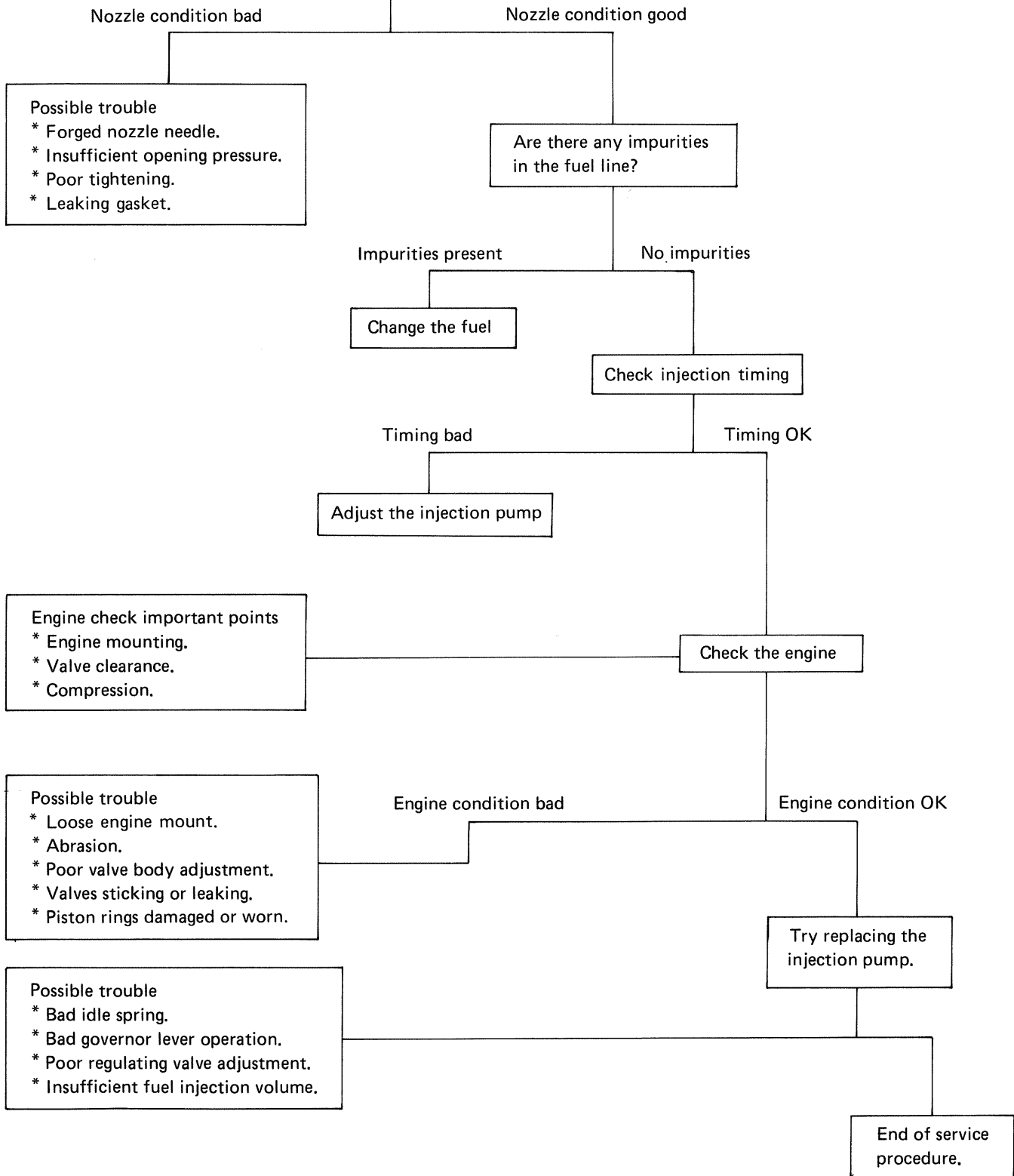
General conditions

- * The engine is warm.
- * The transmission is operating properly.
- * The vehicle is burning the correct fuel.
- * The turbocharger is normal.

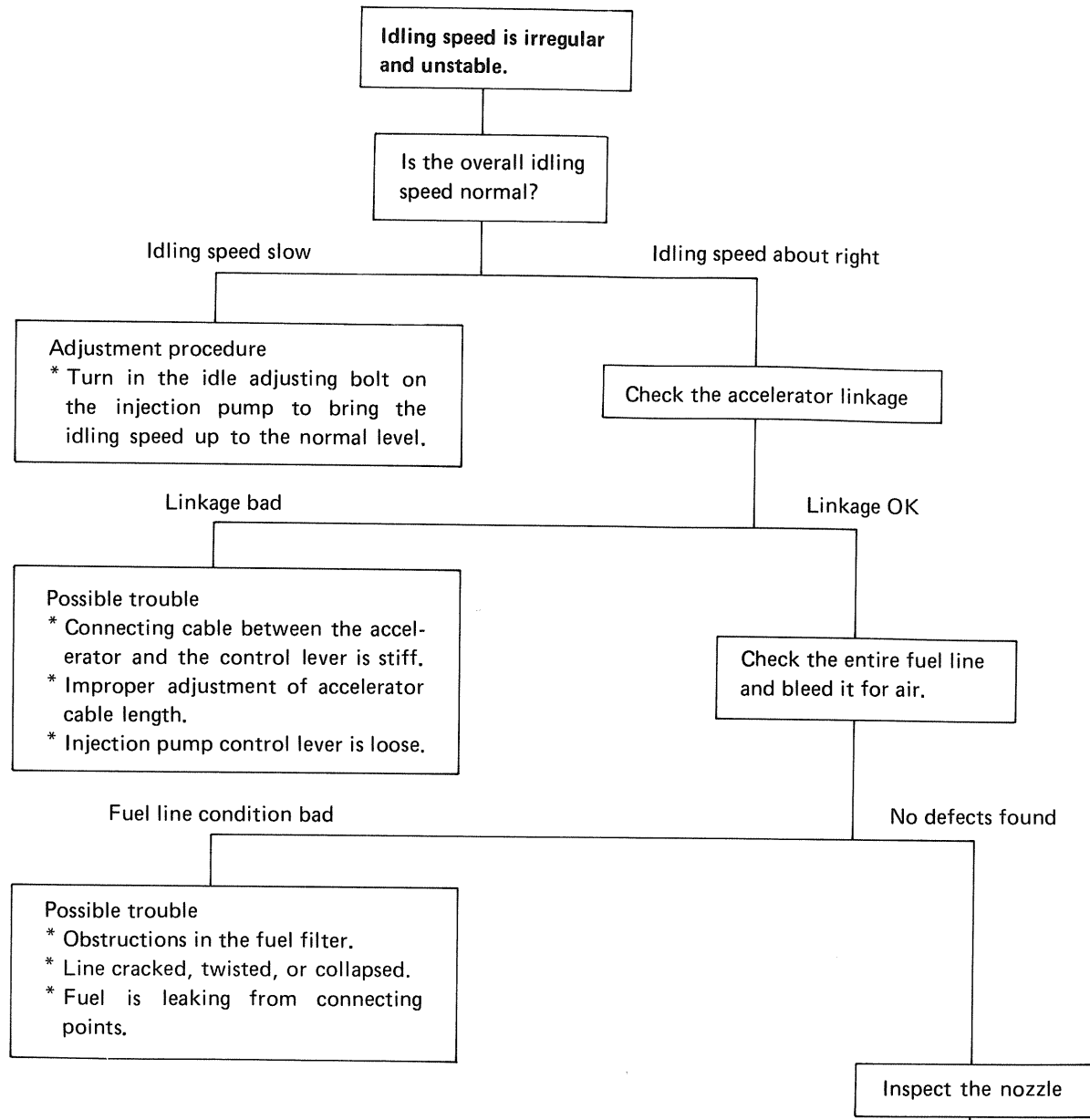


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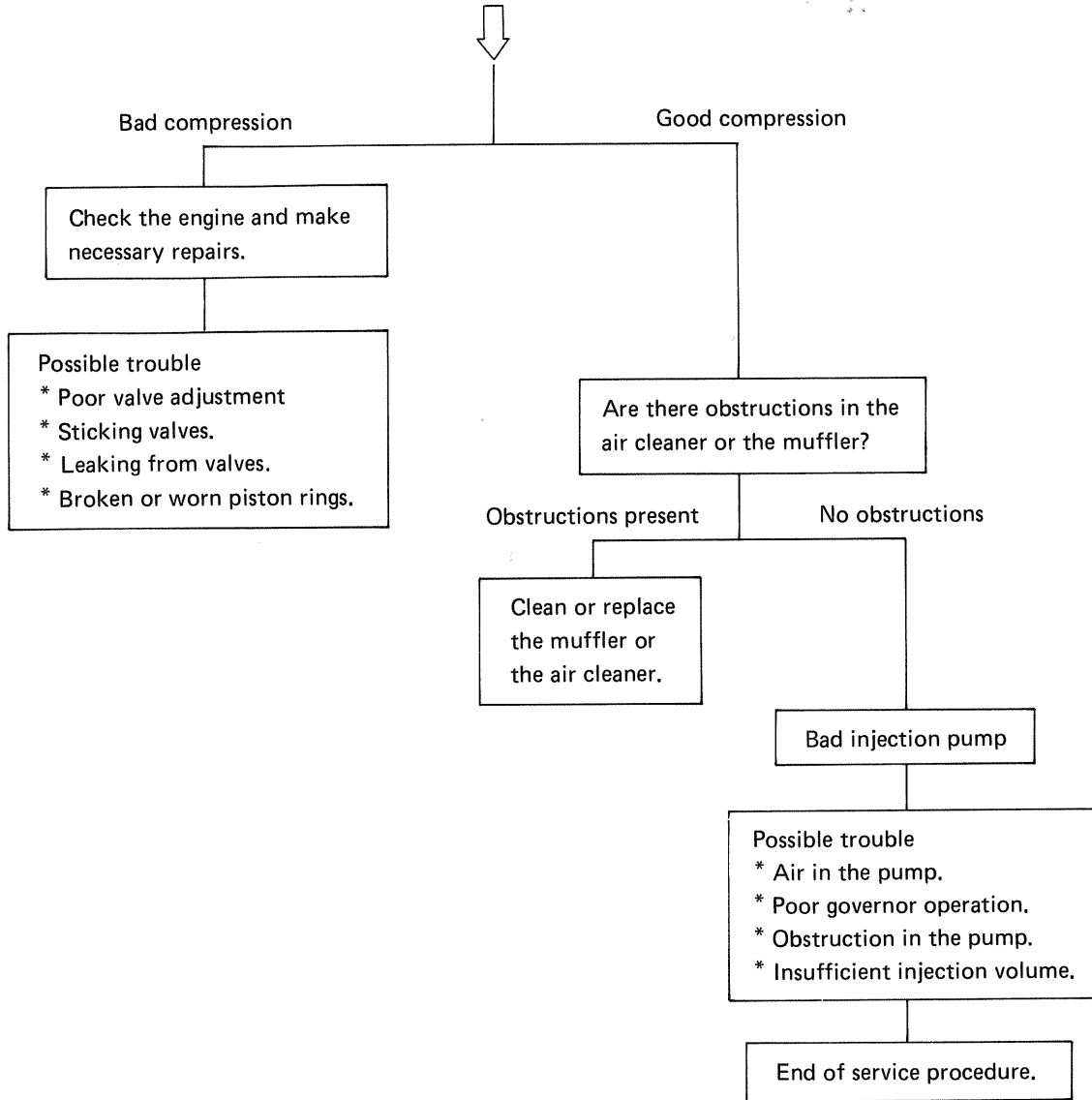


General conditions
* Engine is warm

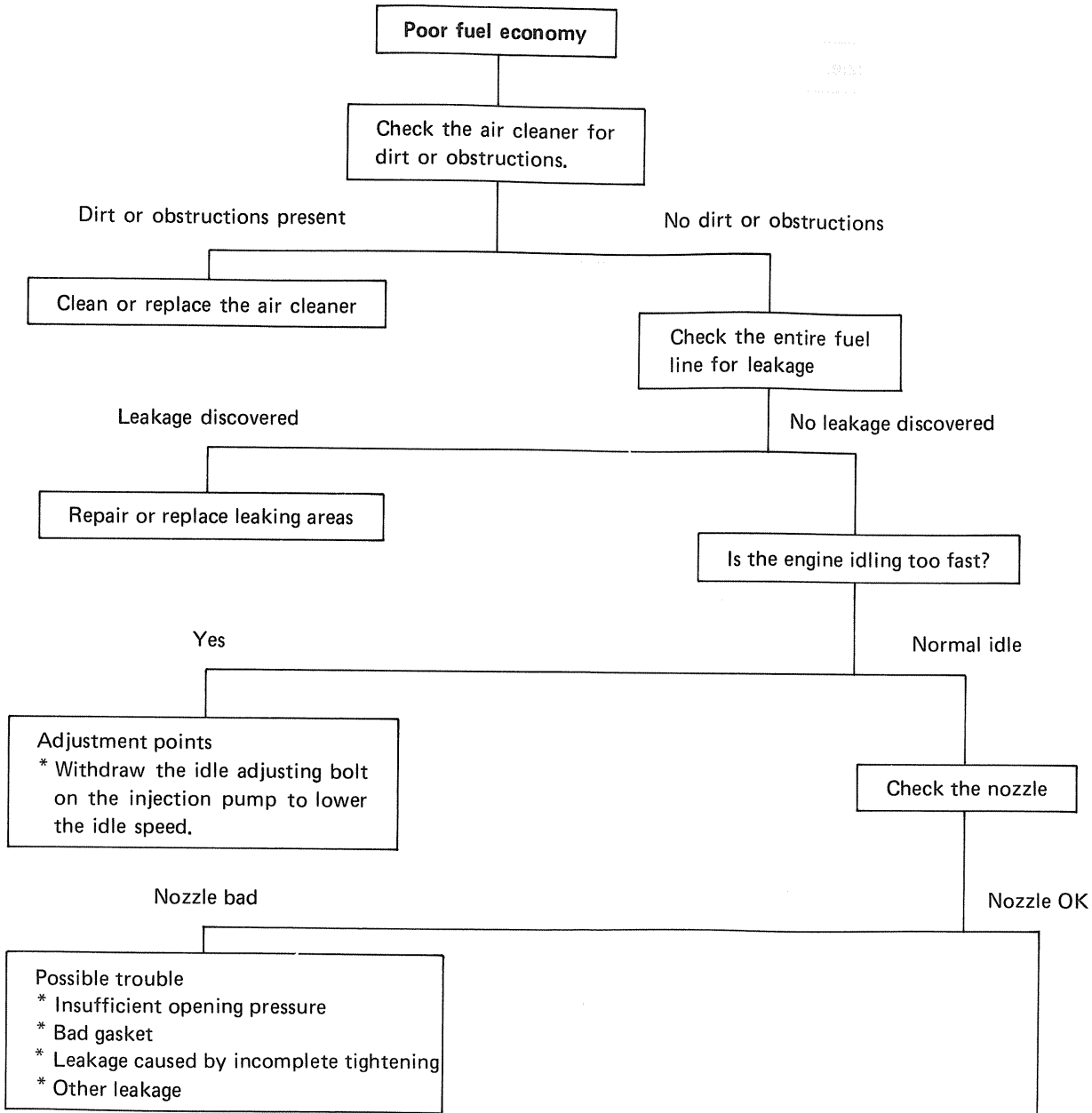


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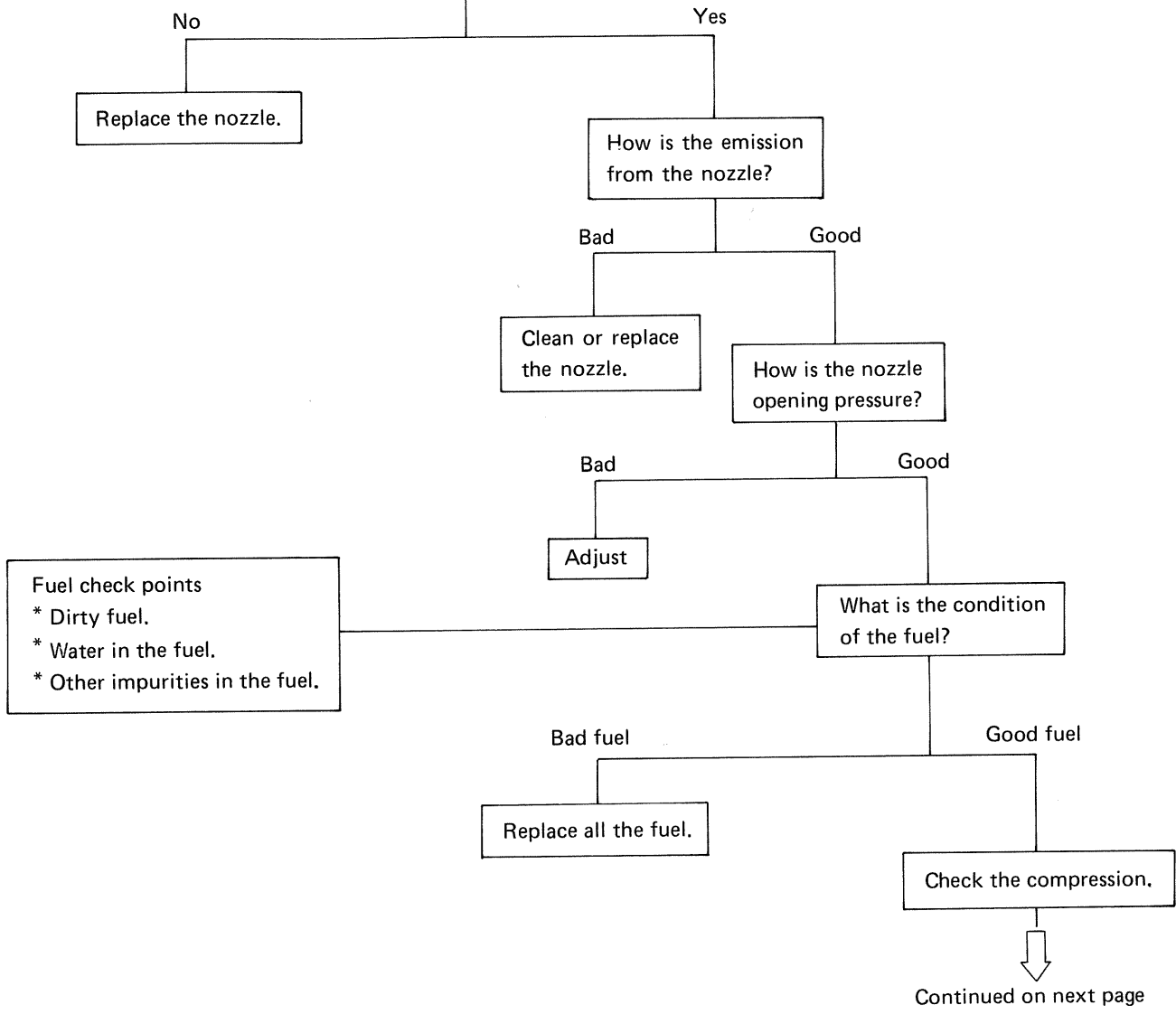


General conditions
 * Tires are normal.
 * Brakes are not pulling to one side or the other.
 * Clutch is not slipping.



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Does the engine start?

Yes

No

Service procedure completed.

Is fuel being delivered to the injection pump?

No

Yes

Possible trouble

- * Dirty fuel line.
- * Obstruction in the line.
- * Leak in the line.
- * Obstruction in the filter.
- * Obstruction in the tank.

Is the injection pump emitting fuel?

No

Yes

Injection pump not functioning.

Possible trouble

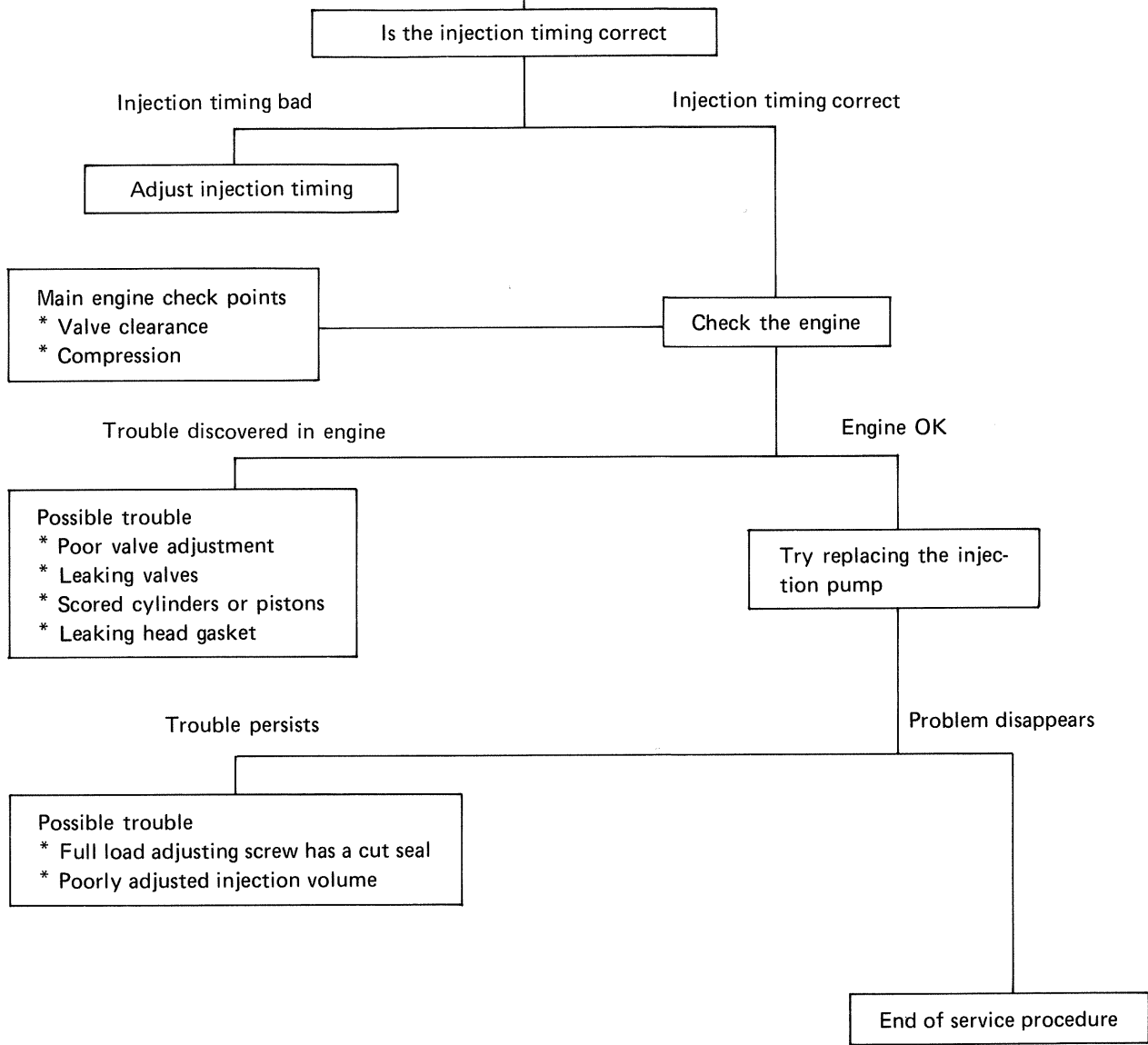
- * Fused drive shaft.
- * Broken drive shaft.
- * Clogged or fused feed pump.
- * Broken or fused plunger.
- * Fused governor sleeve.

Is fuel being emitted from the nozzle?



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KUC22-WE-65G

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