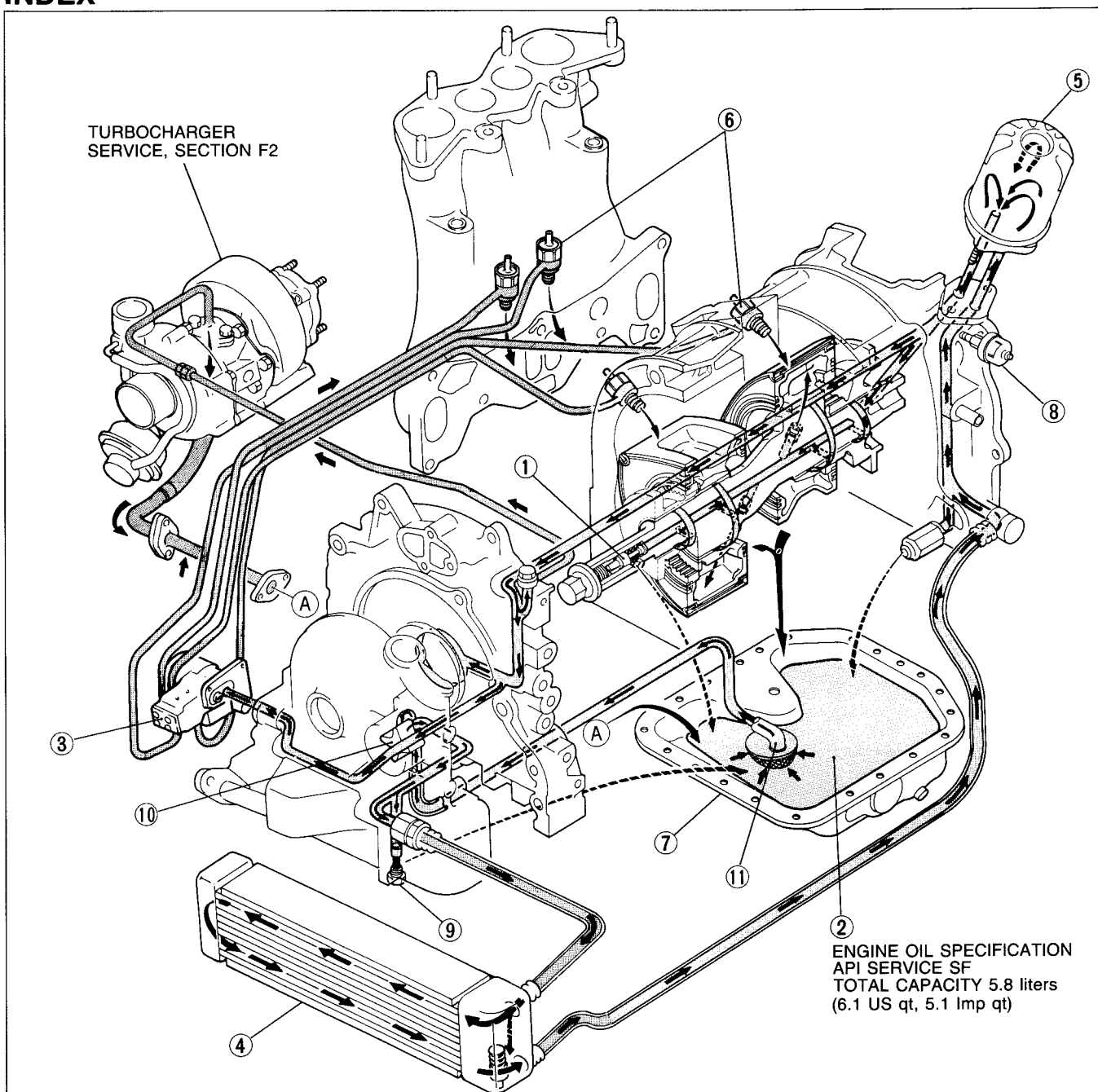


LUBRICATION SYSTEM

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SPECIFICATIONS

Items		Engine models	Turbo	Non-Turbo
Lubrication system			Forced-fed	
Oil pump	Type		Trochoid	
	Number of rotors		2	
	Diameter x width of rotor mm (in)		50 x 17.5 (1.97 x 0.69)	50 x 12.5 (1.97 x 0.49)
Control valve relief pressure		kPa (kg/cm ² , psi)	1,079 (11.0, 156)	
Oil cooler	Type		Air-cooled, with bypass valve	
	Relief temperature °C (°F)		60—65 (140—149) or below	
	Relief pressure differential kPa (kg/cm ² , psi)		349 (3.56, 50) at 60°C (140°F)	
Regulator valve relief pressure		kPa (kg/cm ² , psi)	490 (5.0, 71)	
Oil filter	Type		Full-flow, paper element	
	Relief pressure differential kPa (kg/cm ² , psi)		98 (1.0, 14)	
Eccentric shaft bypass valve relief temperature		°C (°F)	60 (140) or below	
Oil capacity	Total (dry engine) liters (US qt, Imp qt)		5.8 (6.1, 5.1)	
	Oil pan liters (US qt, Imp qt)		4.4 (4.7, 3.9)	
	Oil cooler liters (US qt, Imp qt)		0.85 (0.90, 0.75)	
	Oil filters		Factory-installed	
	liter (US qt, Imp qt)		Service parts	
Engine oil (API service)			“Fuel efficient” SF (Mineral oil only)	

97U0DX-003

Recommended SAE Viscosity

Temperature	(°C)	(°F)	—30	—20	—10	0	10	20	30	40	50
			—20	0	20	40	60	80	100	120	
Engine oil	5W-30										
	10W-30										
	10W-40										
	10W-50										
	20W-40										
	20W-50										

Anticipated ambient temperature range before the succeeding oil change, °C (°F)

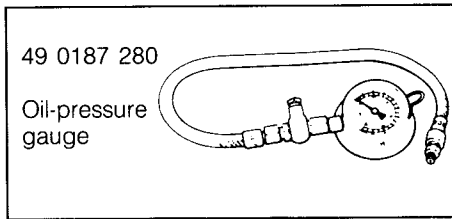
97U0DX-004

TROUBLESHOOTING GUIDE

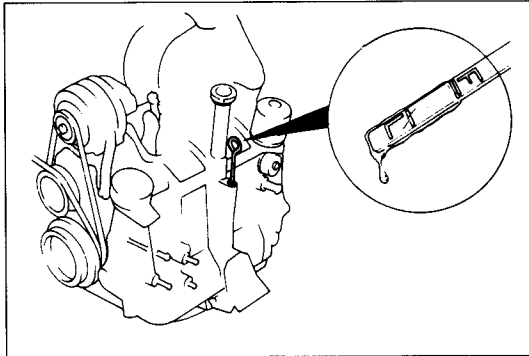
Problem	Possible Cause	Action	Page
Engine hard starting	Improper engine oil Insufficient engine oil	Replace Add oil	D- 5 D- 6
Excessive oil consumption	Malfunction of metering oil pump mechanical component Faulty oil nozzle Oil leakage	Inspect Inspect	D-16 D-19 As described below
Oil leakage	Loose drain plug or damaged washer Faulty seal at oil pan Damaged front cover Loose front cover bolt or oil pan bolt Damaged sealing rubber, O-ring, or front cover gasket Malfunction of oil seal Loose oil filter Loose or damaged oil level sensor or oil pressure gauge Damaged oil cooler or oil cooler hose Damaged oil tube	Tighten or replace Repair Replace Tighten Replace Replace Tighten Tighten or replace Replace Replace	D- 7 D- 7 — — — — D- 6 — D-14 —
Oil pressure drop*	Oil leak Insufficient oil Worn or damaged oil pump gear Clogged oil strainer Malfunction of oil pressure control valve Malfunction of oil cooler bypass valve Malfunction of oil pressure regulator valve Clogged oil filter Malfunction of eccentric shaft bypass valve Excessive oil clearance between eccentric shaft and main bearing	Add oil Replace Clean Replace Replace Replace Replace Replace	As described above D- 5 D-10 — D-15 D-14 — D- 6 D-15 Section C
Oil pressure gauge does not work	Oil pressure drop Malfunction of oil pressure gauge unit Malfunction of electrical system		As described above Section T Section T
Oil level warning indicator illuminates when engine is running	Insufficient oil Malfunction of oil level sensor Malfunction of electrical system	Add oil	D- 5 Section T Section T
Poor acceleration	Malfunction of metering oil pump electrical component	Inspect	D-16
Low engine stability	Malfunction of metering oil pump electrical component	Inspect	D-16

97U0DX-005

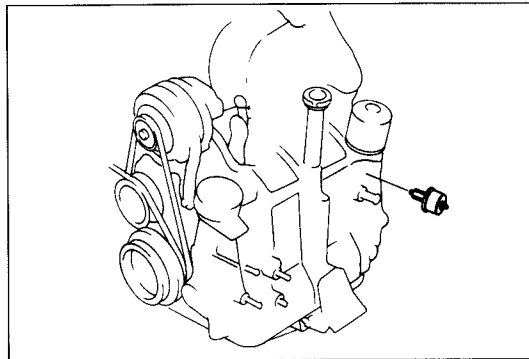
* Oil pressure becomes low when the engine is cold because the eccentric shaft bypass valve operates.

ON-VEHICLE INSPECTION**PREPARATION
SST**

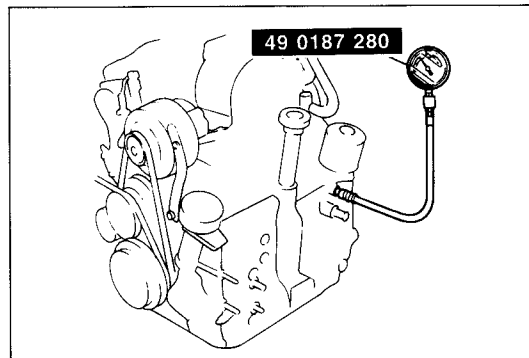
9MU0DX-008



9MU0DX-009



97U0DX-006



97U0DX-007

ENGINE OIL

1. Be sure the vehicle is on level ground.
2. Warm up the engine to normal operating temperature and stop it.
3. Wait for five minutes.
4. Remove the oil-level gauge and check the oil level and condition.
5. Add or replace oil if necessary.

Note

The distance between the L and F marks on the level gauge represents 1.0 liter (1.06 US qt, 0.88 Imp qt).

OIL PRESSURE

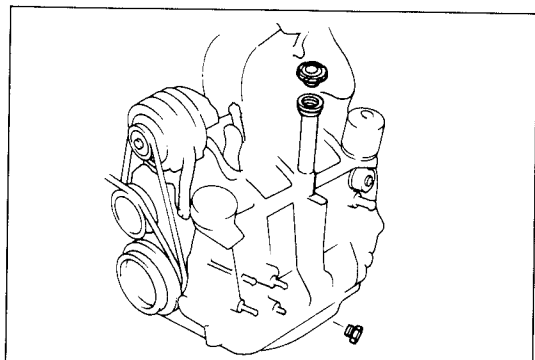
1. Remove the oil pressure gauge unit.
2. Install the **SST**.

3. Start the engine and let it warm up to operating temperature.
4. Run the engine at **3,000 rpm** and note the gauge reading.

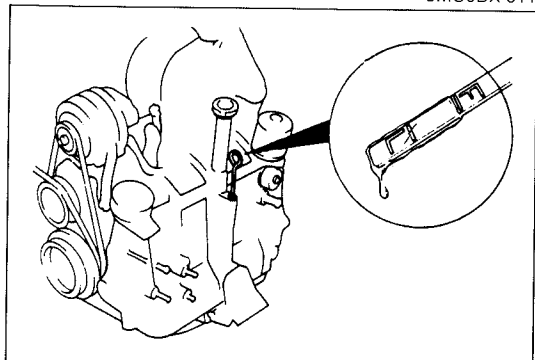
Oil pressurekPa (kg/cm², psi)

	Specification
3,000 rpm	441—540 (4.5—5.5, 64—78)

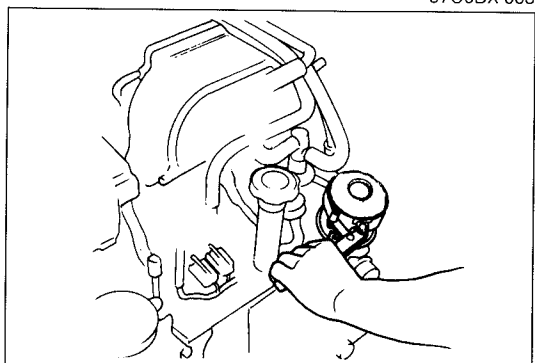
5. If the pressure is not as specified check for the cause, and repair. (Refer to Troubleshooting Guide.)



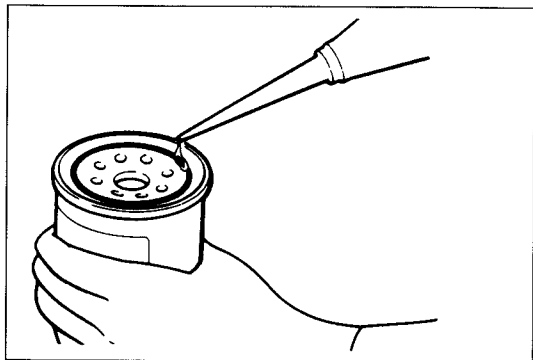
9MU0DX-011



97U0DX-008



9MU0DX-013



97U0DX-009

ON-VEHICLE MAINTENANCE

ENGINE OIL Replacement

1. Warm up the engine to the normal operating temperature and stop it.
2. Remove the oil filler cap and the oil pan drain plug.
3. Drain the oil into a suitable container.

Warning

Be careful when draining; the oil is hot.

4. Install the drain plug and a new gasket.

Tightening torque:

29—41 N·m (3.0—4.2 m·kg, 22—30 ft·lb)

5. Refill the engine with the specified type and amount of engine oil.
6. Refit the oil filler cap.

Oil pan capacity:

4.4 liters (4.7 US qt, 3.9 Imp qt)

7. Recheck the oil level after the engine has been run.

OIL FILTER Replacement

1. Remove the oil filter with a suitable wrench.
2. Use a clean rag to wipe off the mounting surface on the engine.
3. Apply a small amount of engine oil to the rubber seal of the new filter.
4. Install the oil filter until the rubber seal contacts the base, and then tighten the filter an additional 1—1/6 turn with a wrench.
5. Start the engine and inspect for leaks around the filter seal.
6. Check the oil level and add oil if necessary.

Note

The factory-installed oil filter and service parts is different.

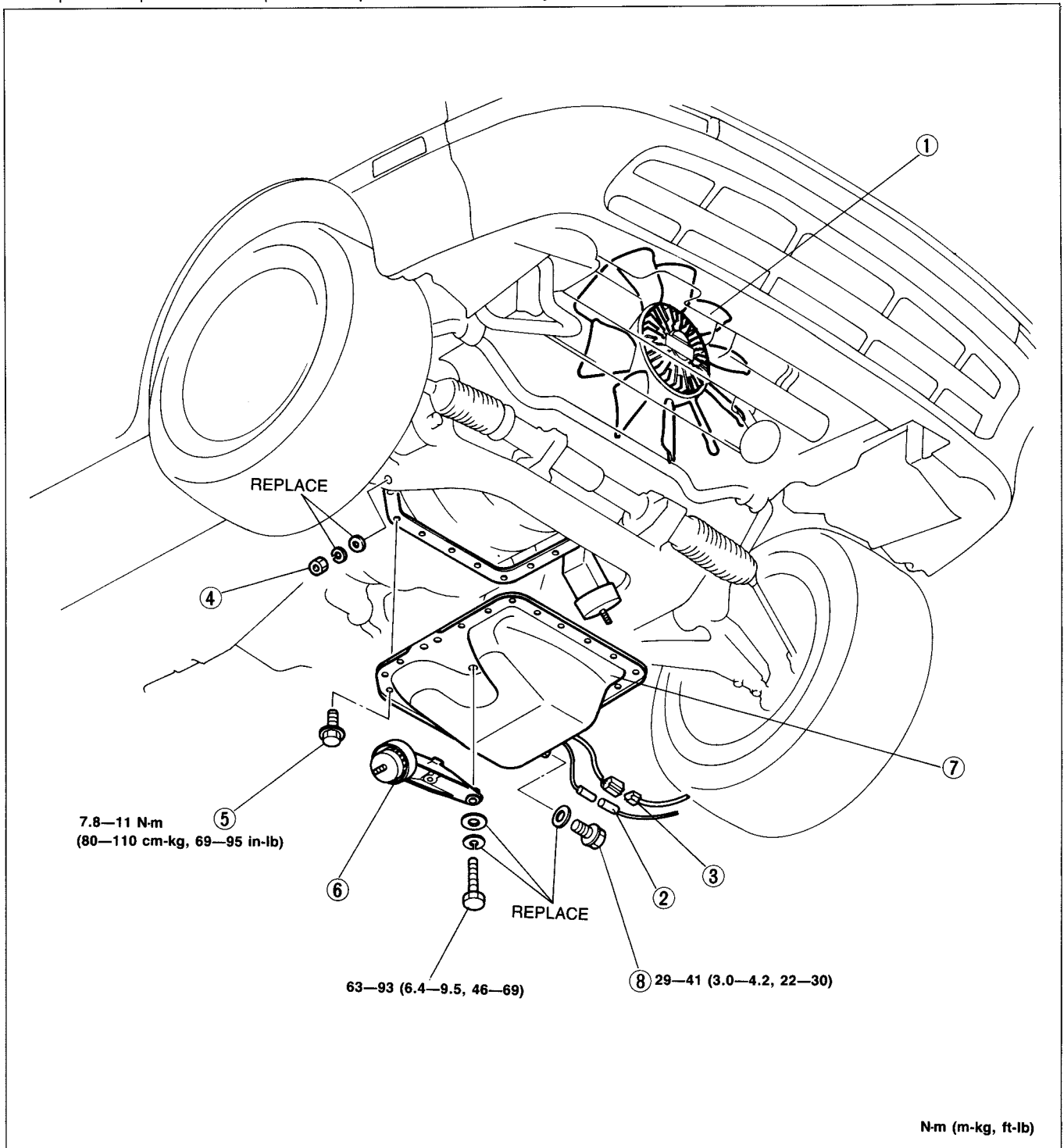
Oil filter capacity

liter (US qt, Imp qt)

Factory-installed	0.19 (0.20, 0.17)
Service parts	0.17 (0.18, 0.15)

OIL PAN**Removal**

1. Disconnect the negative battery cable.
2. Remove the undercover.
3. Drain the engine oil.
4. Remove in the sequence shown in the figure, referring to **Removal Note**.
5. Inspect all parts and repair or replace as necessary.

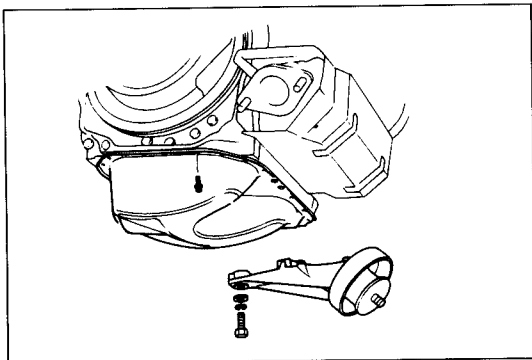


97U0DX-010

1. Cooling fan
2. Oil level sensor connector
3. Sub-zero sensor connector
4. Engine mount nut
5. Oil pan mounting bolt

6. Right engine mount
7. Oil pan
8. Drain plug
Inspect for cracks, deformation, or damage

D ON-VEHICLE MAINTENANCE (OIL PAN)



97U0DX-011

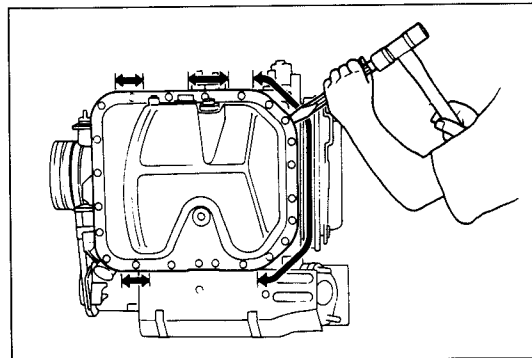
Removal note

Oil pan attaching bolt

1. Remove the engine mounting nuts and lift the engine 40—60mm (1.6—2.4 in).
2. Remove the oil pan attaching bolts.

Warning

Be sure the vehicle is securely supported and the engine is securely hung.



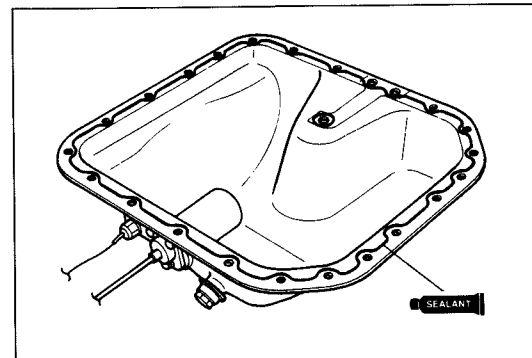
97U0DX-012

Oil pan

To separate the oil pan, insert a screw driver or a suitable tool into only the areas shown in the figure.

Installation

Install in the reverse order of removal referring to the **Installation Note**.



97U0DX-013

Installation note

Oil pan

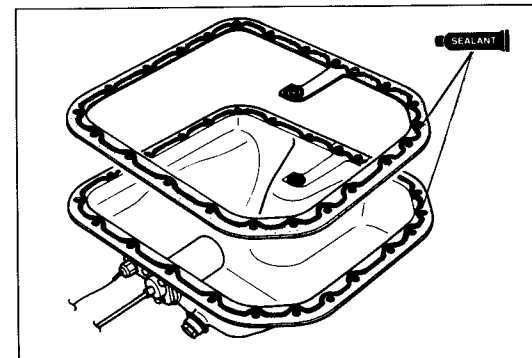
1. Clean the mating surface of the housings and oil pan.
2. **(Without gasket)**
Apply a 4—6mm (0.16—0.24 in) diameter bead of the sealant around the inside rim of the oil pan as shown in the figure. It should be continuously applied inboard of the bolt holes, and the ends should overlap.

(With gasket)

Apply a 4—6mm (0.16—0.24 in) diameter bead of sealant around the rim of the oil pan and the housing side of the new gasket. It should be continuously applied inboard of the bolt holes, and the ends should overlap.

Caution

Install the oil pan within 30 minutes after the sealant is applied.



97U0DX-014

3. Install the oil pan and the right engine mount. Tighten the bolts gradually.

Tightening torque:

Oil pan bolt:

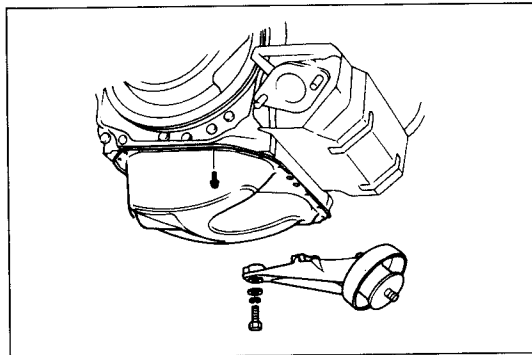
7.8—11 N·m (80—110 cm·kg, 69—95 in·lb)

Engine mount bolt:

63—93 N·m (6.4—9.5 m·kg, 46—69 ft·lb)

Step After Installation

1. Add engine oil to the specified levels.
2. Connect the negative battery cable.
3. Start the engine and do the following:
 - (1) Check for leakage of engine oil.
 - (2) Perform engine adjustments if necessary.
 - (3) Recheck the oil levels.



97U0DX-015

49 S120 710

Holder, coupling
flange

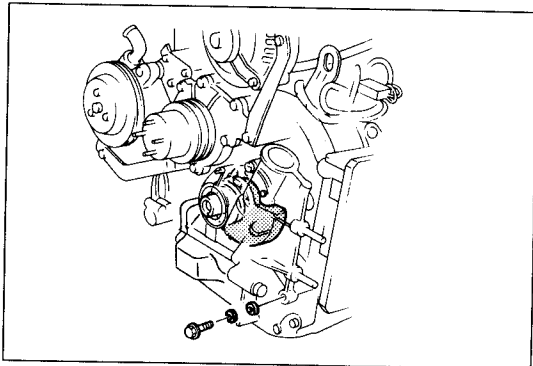
9MU0DX-021

1. Disconnect the negative battery cable.
2. Drain the engine oil.
3. Remove in the sequence shown in the figure, referring to **Removal Note**.



- D-9

D ON-VEHICLE MAINTENANCE (OIL PUMP)

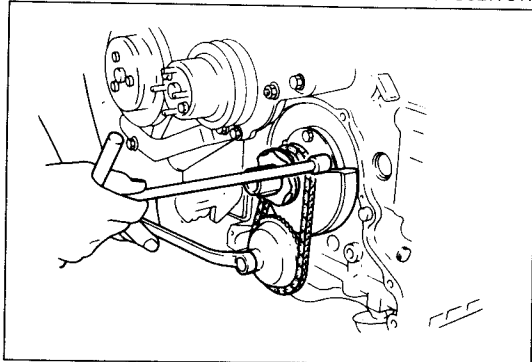


97U0DX-017

Removal note

Front cover

1. Turn the eccentric shaft so that the balance weight is in the lower position to provide clearance between the balance weight and water pump.
2. Remove the front cover.



97U0DX-018

Oil pump locknut

To loosen the oil pump locknut, lock the balance weight.

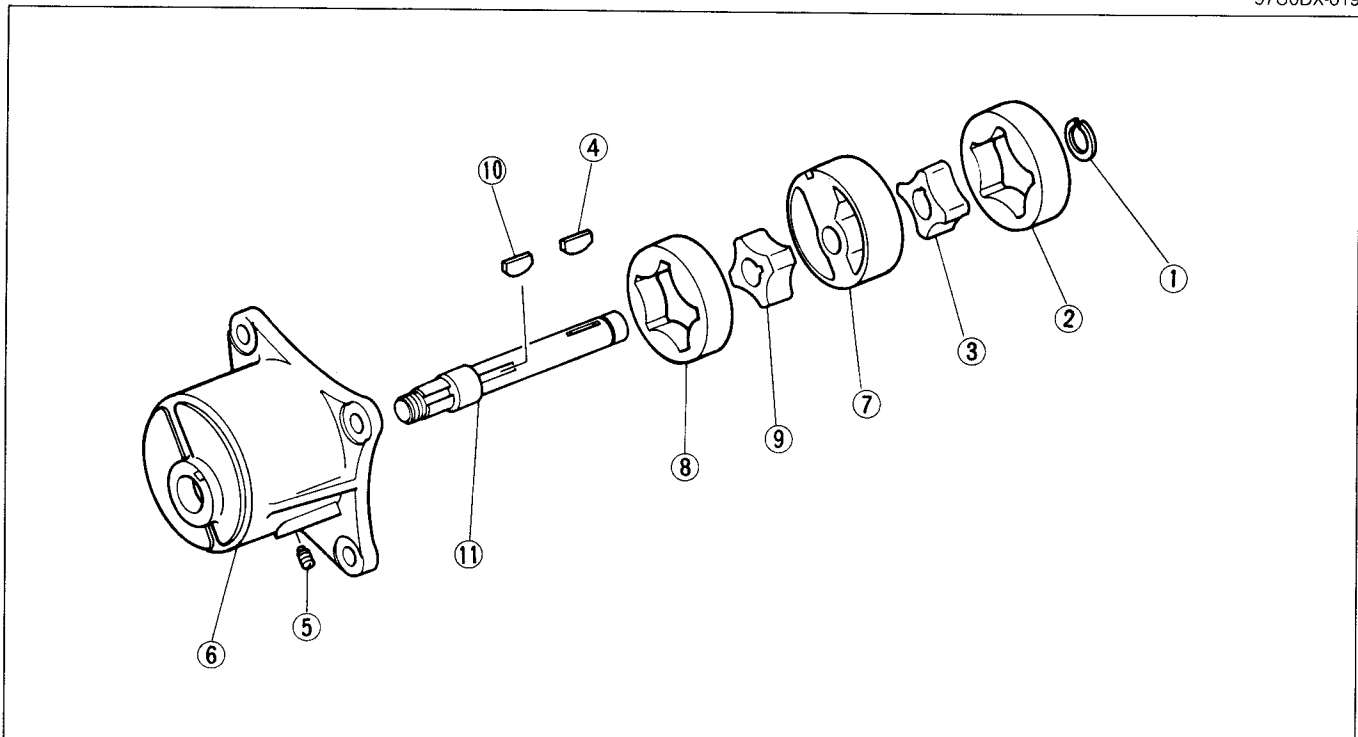
DISASSEMBLY AND ASSEMBLY

Disassemble in the sequence shown in the figure.

Caution

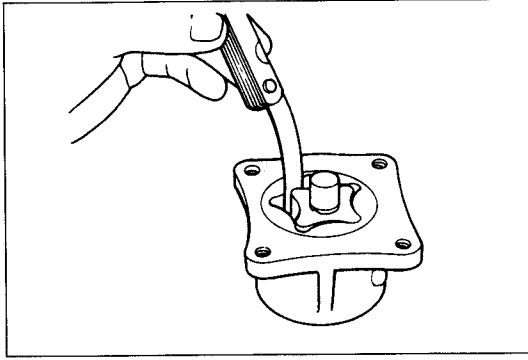
Do not interchange front and rear rotors when assembling.

97U0DX-019

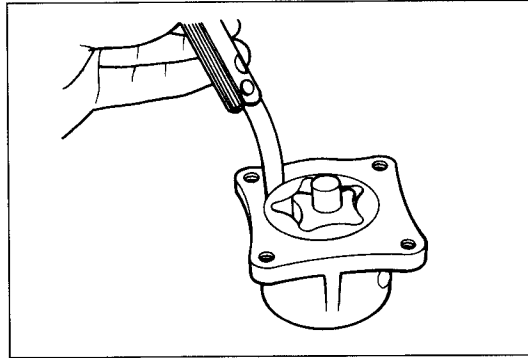


97U0DX-020

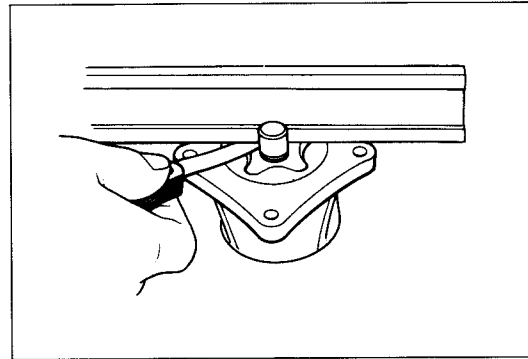
- | | | |
|---------------------|----------------------|----------------------|
| 1. Snap ring | 5. Screw | 9. Front inner rotor |
| 2. Rear outer rotor | 6. Body | 10. Key |
| 3. Rear inner rotor | 7. Middle plate | 11. Shaft |
| 4. Key | 8. Front outer rotor | |



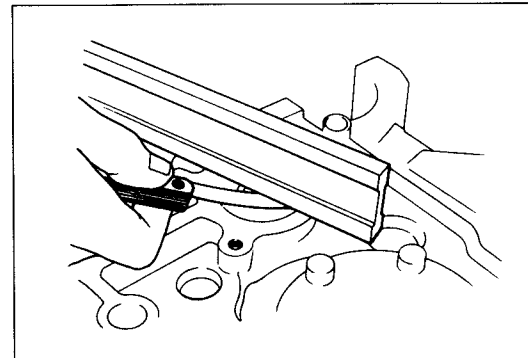
97U0DX-021



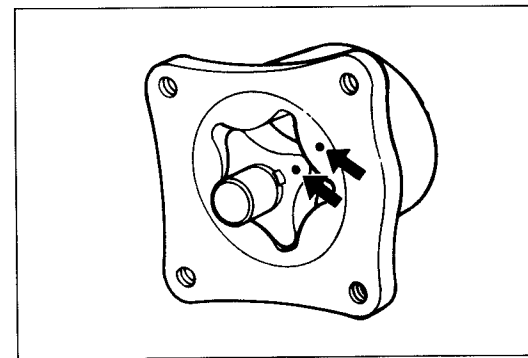
67U02X-040



67U02X-041



97U0DX-022



97U0DX-023

Inspection

1. Inspect the oil pump parts for wear or damage, and replace if necessary.
2. Measure the clearance between the lobes of rotors with a feeler gauge.

Standard clearance:

0.03—0.12mm (0.0012—0.0047 in)

Limit: 0.15mm (0.0059 in)

3. Measure the clearance between the outer rotor and the pump body.

Standard clearance:

0.20—0.25mm (0.0079—0.0098 in)

Clearance limit: 0.30mm (0.0118 in)

4. Inspect the end float of the rotors.

(1) Measure the sinking of the rotor from the pump body.

(2) Measure the sinking of the rotor sliding surface from the pump mounting surface.

(3) Add the two sinking amounts. If necessary, grind the pump body, or replace it.

Standard end float:

0.03—0.13mm (0.0012—0.0051 in)

End float limit: 0.15mm (0.0059 in)

Assembly

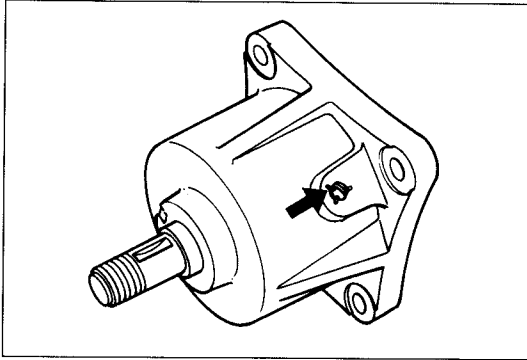
Assemble in the reverse order of disassembly, referring to **Assembly Note**.

Assembly note

Outer rotor and inner rotor

Install the outer and inner rotors at front and rear so that the tally marks on the rotors go toward the front housing.

D ON-VEHICLE MAINTENANCE (OIL PUMP)



97U0DX-024

Screw

Stake the screw after installing it.

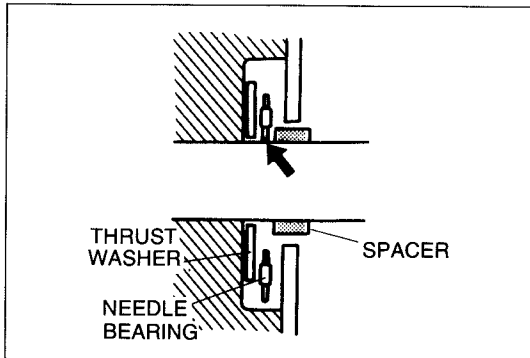
Installation

Install in the reverse order of removal, referring to **Installation Note**.

Installation note

Caution

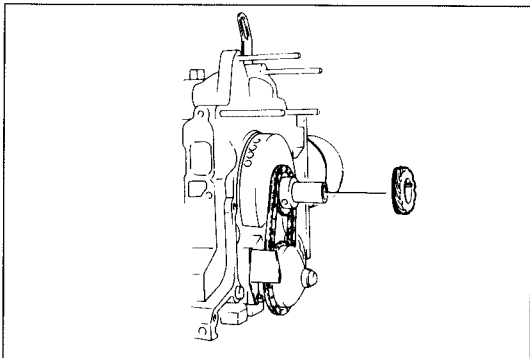
Before tightening the eccentric shaft lock bolt, do not move the eccentric shaft and the balance weight to prevent the needle bearing from being caught by the spacer.



97U0DX-025

Distributor drive gear

Install the distributor drive gear so that the chamfer surface faces the front housing.



67U02X-030

Front cover

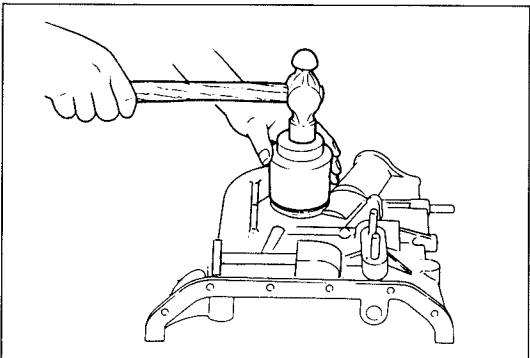
1. Replace the front oil seal.

(1) Press out the oil seal.

(2) Apply engine oil to the front cover and new oil seal.

(3) Tap the oil seal into the front cover.

(4) Apply engine oil to the oil seal lip.



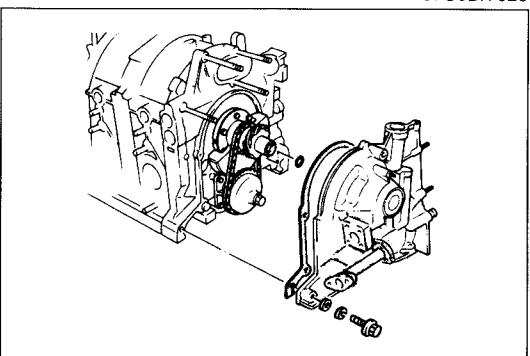
97U0DX-026

2. Apply petroleum jelly to the new O-ring and backup ring and install it in the oil passage hole.
3. Install the front cover and a new gasket.

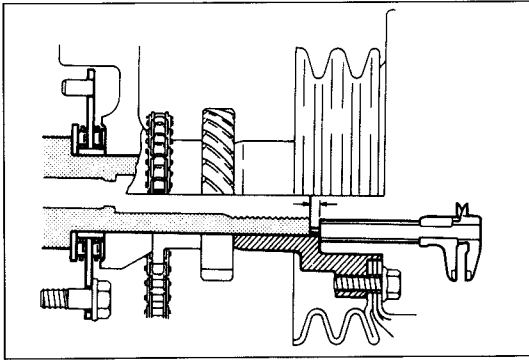
Tightening torque:

16—23 N·m (1.6—2.3 m·kg, 12—17 ft·lb)

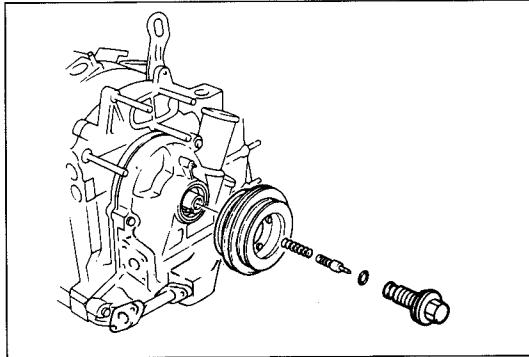
4. Cut away the part of the gasket which projects from between the cover and housing.



97U0DX-027



97U0DX-028



97U0DX-029

Eccentric shaft pulley lock bolt

1. Check the pulley boss protrusion from the eccentric shaft end.
 - (1) Temporarily install the lock bolt, and tighten it by hand only.
 - (2) Remove the lock bolt, and measure the pulley boss protrusion. If it is over the limit, the needle bearing may be caught by the spacer.
Remove and reinstall the needle bearing.

Protrusion limit: 2.44mm (0.0961 in)

2. Apply sealant to the flange of the new pulley lockbolt.
3. Apply thread-lock to the threads of the bolt.
4. Apply engine oil to the new O-ring and install it on the bolt.
5. Tighten the lockbolt.

Tightening torque:

108—132 N·m (11.0—13.5 m·kg, 80—98 ft·lb)

Steps After Installation

1. Add engine oil to the specified levels.
2. Connect the negative battery cable.
3. Start the engine and do the following:
 - (1) Check for leakage of engine oil.
 - (2) Perform engine adjustment if necessary.
 - (3) Recheck the oil level.

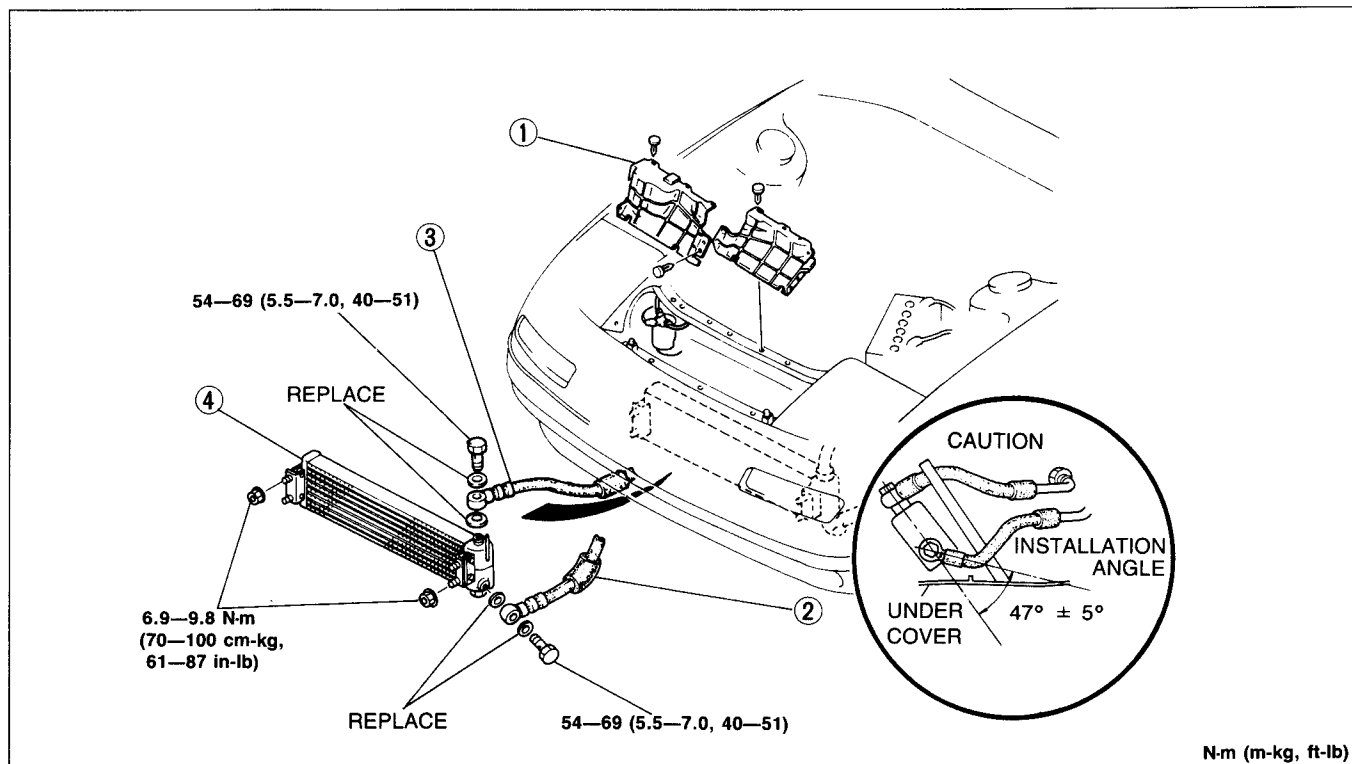
97U0DX-030

OIL COOLER

Removal and Installation

1. Remove the undercover.
2. Remove in the sequence shown in the figure.
3. Install in the reverse order of removal.
4. Check the engine oil level and for leakage.

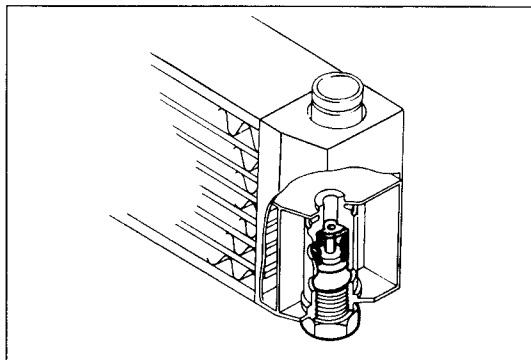
97U0DX-031



97U0DX-032

1. Radiator grille upper cover
2. Oil inlet hose

3. Oil outlet hose
4. Oil cooler



97U0DX-033

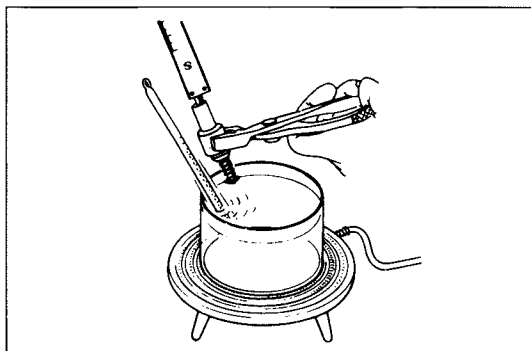
Inspection

Oil cooler

Visually check the oil cooler for damage, cracks or leakage. Repair or replace if necessary.

Oil cooler bypass valve

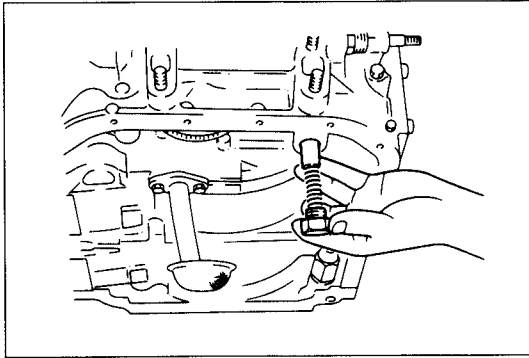
1. Remove the bypass valve from the bottom of the oil cooler.



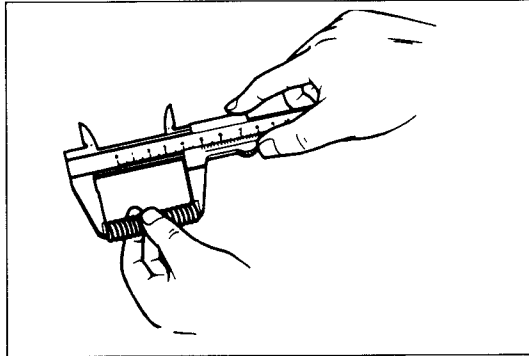
67U02X-046

2. Place the bypass valve in oil and heat the oil gradually.
3. Check the protrusion of the valve at **65°C (149°F)**.

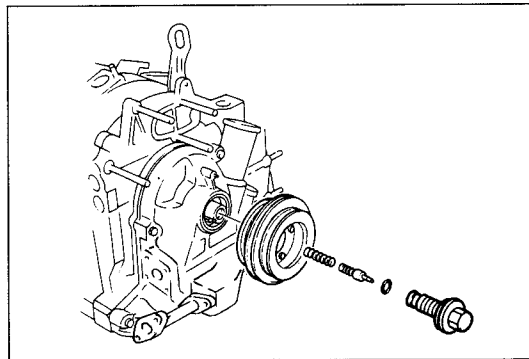
Protrusion: 5mm (0.2 in) min.



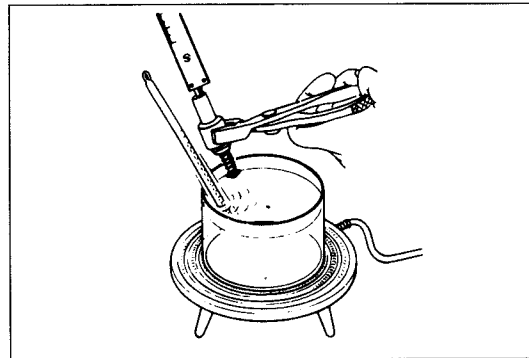
97U0DX-034



97U0DX-035



97U0DX-036



97U0DX-037

OIL PRESSURE CONTROL VALVE

Removal and Installation

1. Remove the parts in the following order:
 - (1) Oil pan (Refer to page D-7.)
 - (2) Cap bolt and spring
 - (3) Control plunger
2. Install in the reverse order.
3. Check the engine oil for leakage and level.

Inspection

1. Check each part for damage or scoring. Replace if necessary.
2. Measure the free length of the spring, and if necessary, replace it.

Standard free length: 73.0mm (2.87 in)

ECCENTRIC SHAFT BYPASS VALVE

Removal and Installation

1. Remove the parts in the following order:
 - (1) Cooling fan
 - (2) Drive belts
 - (3) Eccentric shaft lockbolt
 - (4) Bypass valve and spring
2. Install in the reverse order. (Refer to page D-13 when installing eccentric shaft pulley.)
3. Check the engine oil level and for leakage.

Inspection

1. Place the eccentric shaft bypass valve in oil and heat up the oil gradually.
2. Check the protrusion of the valve at **60°C (140°F)**.

Protrusion: 6mm (0.24 in) min.

D ON-VEHICLE MAINTENANCE (METERING OIL PUMP)

METERING OIL PUMP

Malfunctions related to the metering oil pump are separated into the electrical component problems and the mechanical component problems.

Electrical Component Related Problem

1. Check the malfunction code with the **SST (49 H018 9A1)**..... Refer to Section F1, F2.
2. Check if the malfunction code No.20, 27, or 37 appears.
3. If code No.20, 27 or 37 appears, check metering oil pump with diagnosis chart below.

97U0DX-038

Diagnosis Chart

Malfunction code	Possible cause	Action
20 (Metering oil pump position sensor)	• Open or short circuit in position sensor wiring • Open or short circuit in wiring between engine control unit and position sensor • Loose connection of position sensor or engine control unit	Perform inspection 2
27 (Metering oil pump control system)	• Open or short circuit in wiring between engine control unit and stepping motor • Loose connection of metering oil pump connector or engine control unit • Open or short circuit in stepping motor wiring • Stepping motor sticking • Position sensor's accuracy loss • Engine control unit voltage lack	Perform inspection 1
37 (Battery voltage drop)	• Malfunction of ignition system	Refer to Section G

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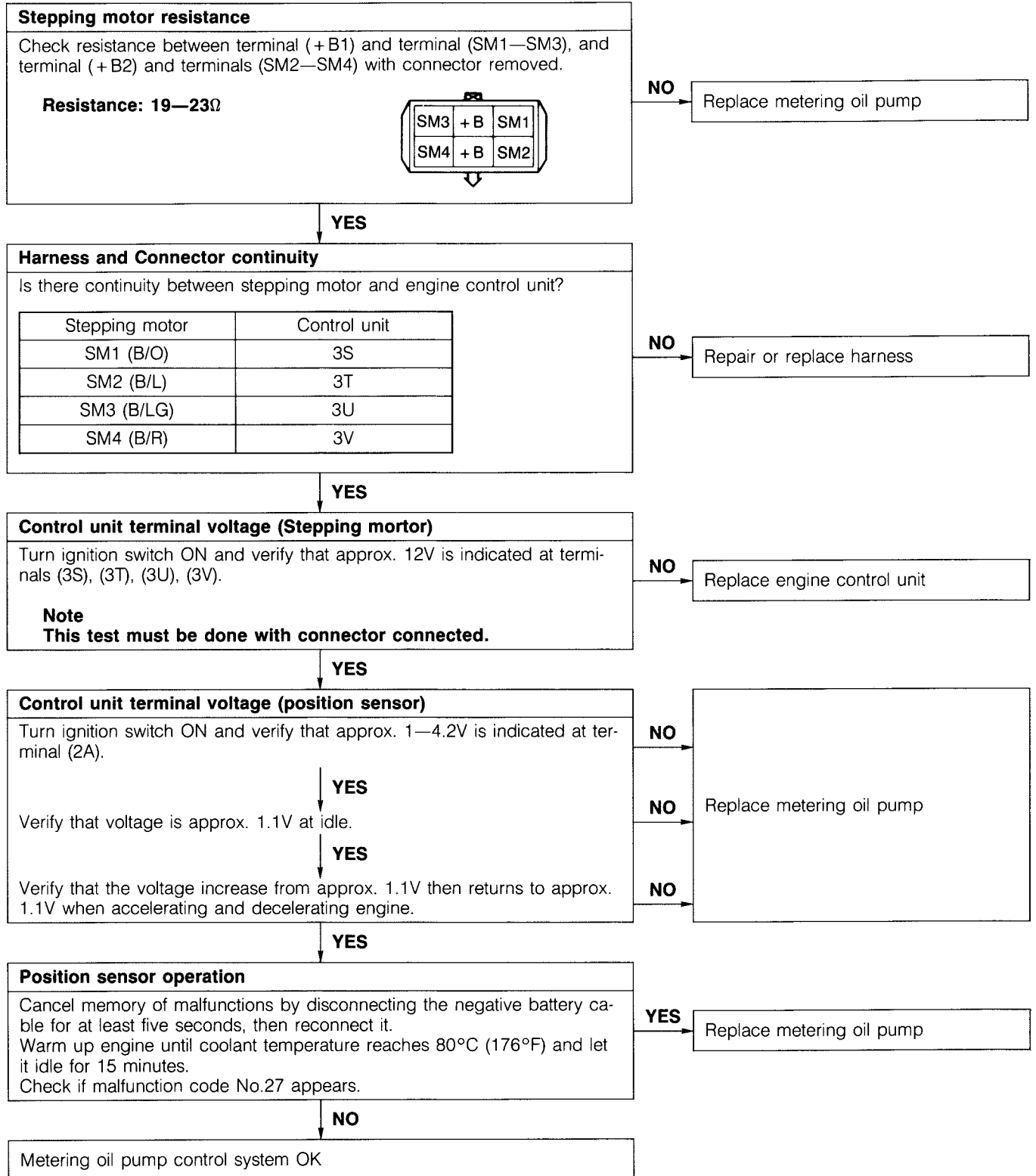
Control Unit Terminal

3Y	3W	3U	3S	3Q	3O	3M	3K	3I	3G	3E	3C	3A	20	2M	2K	2I	2G	2E	2C	2A	1U	1S	1Q	1O	1M	1K	1I	1G	1E	1C	1A
3Z	3X	3V	3T	3R	3P	3N	3L	3J	3H	3F	3D	3B	2P	2N	2L	2J	2H	2F	2D	2B	1V	1T	1R	1P	1N	1L	1J	1H	1F	1D	1B

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Inspection

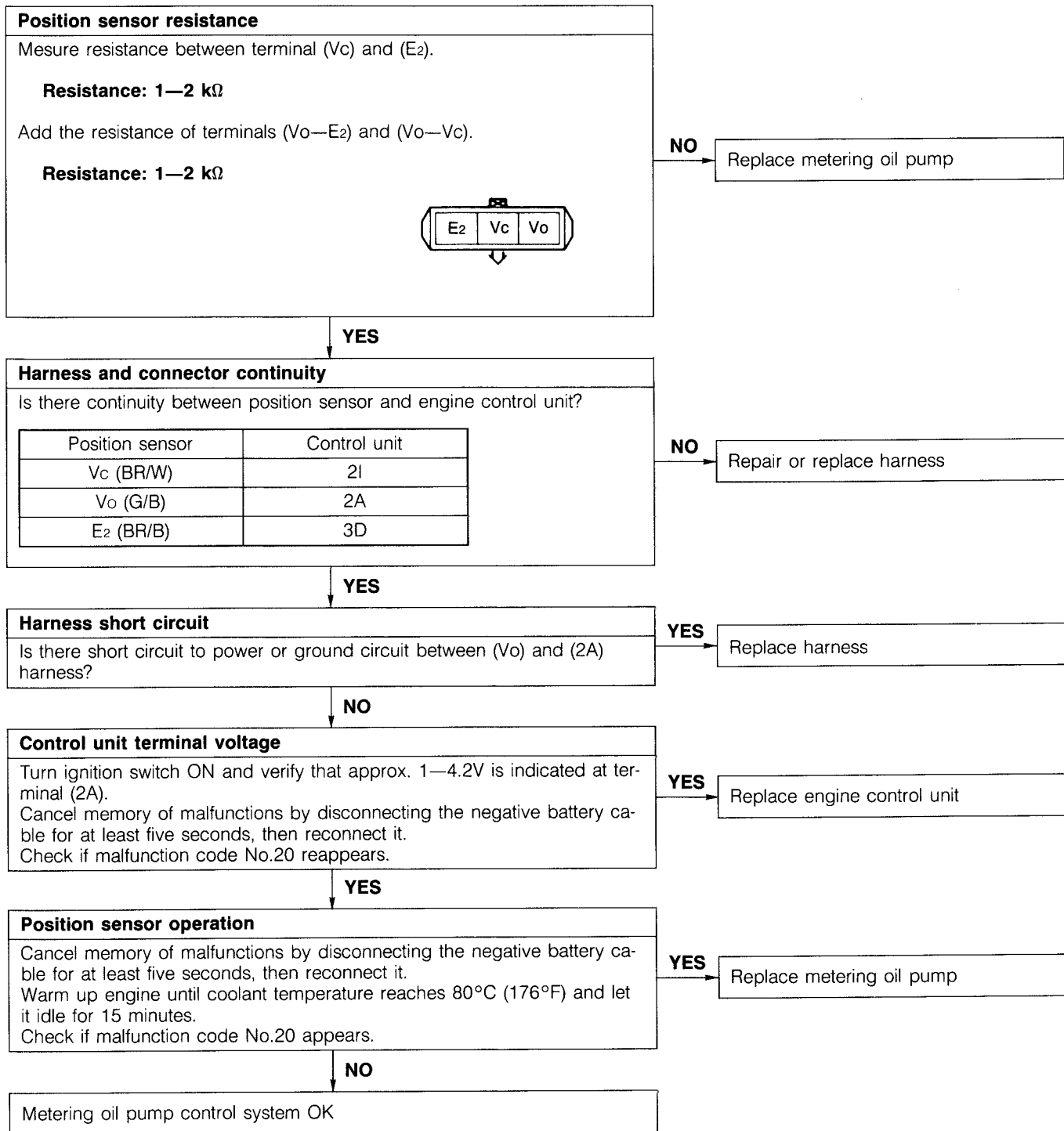
1. Metering oil pump control system



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D ON-VEHICLE MAINTENANCE (METERING OIL PUMP)

2. Metering oil pump position sensor



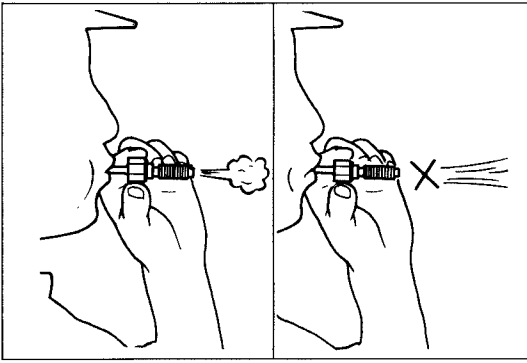
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Mecanical Component Related Problem

Excessive oil consumption is caused by metering oil pump malfunction.

Before replacing the metering oil pump, first perform the oil leakage inspection in Troubleshooting guide (page D-4) and electrical component inspection.

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Oil nozzle

1. Remove the housing oil nozzles from the rotor housing and remove the manifold oil nozzle from the intake manifold.
2. Check that air passes in only one direction.
If not so, replace the oil nozzle.