

ENGINE

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1 OUTLINE

OUTLINE

OUTLINE OF CONSTRUCTION

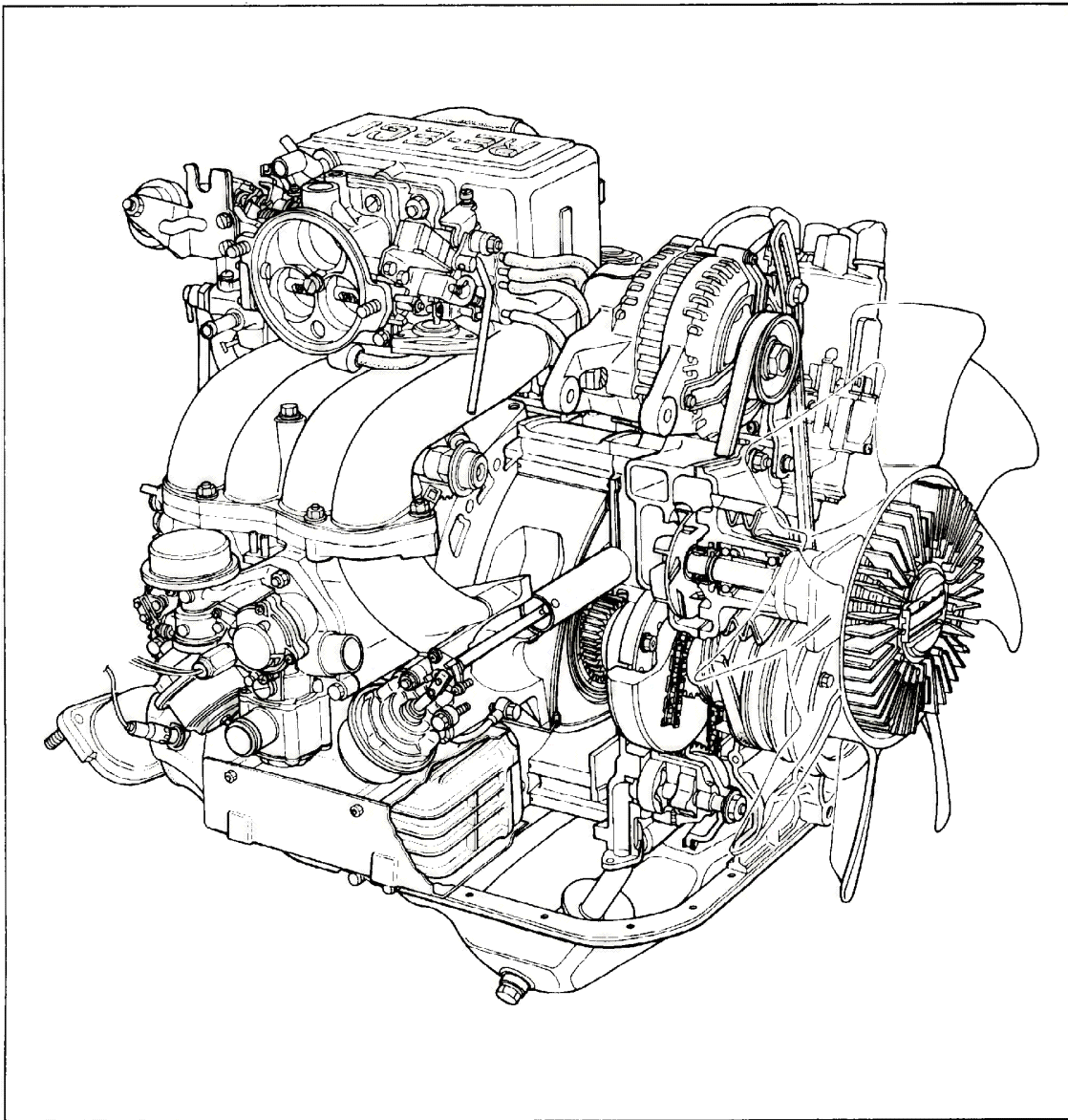
The engines equipped on the Mazda RX-7 are the type 12A rotary engine and the new 13B type rotary engine.

The new 13B type rotary engine employs the new EGI (Electronic Gasoline Injection) system, and the fuel supply is regulated by a computer.

Moreover, in order to obtain greater air-intake efficiency and power, a 3-stage, 6-port, variable-intake-port system has been used.

As a result, the 13B type rotary engine has, compared to the 12A type rotary engine, 35% greater horsepower and 25% higher torque.

STRUCTURAL VIEW



47U01X-501

SPECIFICATIONS

Engine model		13B		12A	
Type		Rotary engine			
Displacement cc (cu. in)		654 x 2 (40.0 x 2)		573 x 2 (35.0 x 2)	
Number of cylinders and arrangement		2 rotors, longitudinal			
Combustion chamber type		Bath tub			
Compression ratio		9.4 : 1		9.4 : 1	
Maximum power (HP/rpm)		135/6,000		101/6,000	
Maximum torque (lb-ft/rpm)		133/2,750		107/4,000	
Port timing	Intake	Open ATDC	Primary	32°	32°
			Secondary	32°	
			Auxiliary	45°	
		Close ABDC	Primary	40°	40°
			Secondary	30°	
			Auxiliary	70°	
	Exhaust	Open BBDC	71°		75°
		Close ATDC	48°		38°
Fuel supply system		EGI (Electronic gasoline injection)		Carburetor	
Ignition timing	Trailing	20° ATDC (RED)		20° ATDC (RED)	
	Leading	5° ATDC (YELLOW)		0° TDC (YELLOW)	
Idling rpm		800		750	

47U01X-503

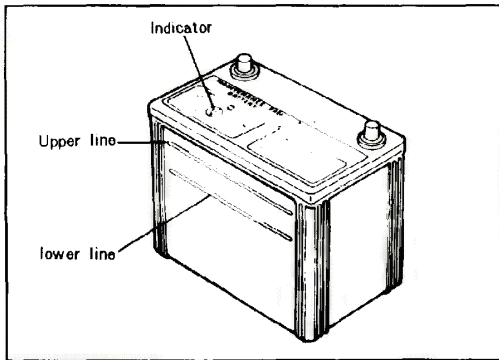
1 TROUBLESHOOTING GUIDE

TROUBLESHOOTING GUIDE

Problem	Possible cause	Remedy	Page
Insufficient power	Insufficient compression		
	Deformation or abnormal wear of side housing	Replace	1-31
	Deformation or abnormal wear of rotor housing	Replace	1-34
	Wear of rotor grooves	Replace	1-35
	Deformation or poor fastening of each gas seal	Replace	1-37
	Wear (especially wear (heat mark) of apex seal) and weak spring tension.		
	Malfunction of fuel system	See section 4	
	Malfunction of ignition system	See section 5	
Excessive oil consumption	Leakage into combustion chamber		
	Deformation or abnormal wear of side housing	Replace	1-31
	Malfunction of rotor (blowholes)	Replace	1-35
	Scratched or burred rotor land	Replace	
	Malfunction of oil seal (incorrect angle)	Replace	1-36
	Malfunction of check valve	Replace	2-7
	Leakage into coolant passages		
	Deformed rotor housing	Replace	1-34
	Malfunction of O ring	Replace	
	Leakage to outside of engine		
	Malfunction of lubricating system	Replace	
	Malfunction of lubricating system	See section 2	
Starting malfunction	Insufficient compression		
	Deformation or abnormal wear of side housing	Replace	1-39
	Deformation or abnormal wear of rotor housing	Replace	1-34
	Wear of rotor grooves	Replace	1-35
	Deformation or poor fastening of each gas seal	Replace	1-37
	Wear and weak spring tension	Replace	
	Engine cranking malfunction		
	Entrance of foreign matter	Remove and clean	
	Malfunction of fuel system	See section 4	
Malfunction of electrical system	See section 5		
Abnormal combustion	Malfunction of combustion chamber		
	Carbon accumulation	Remove and clean	1-30
	Malfunction of fuel system	See section 4	
	Malfunction of ignition system	See section 5	
Poor idling	Insufficient compression		
	Deformation or abnormal wear of side housing	Replace	1-31
	Deformation or abnormal wear of rotor housing	Replace	1-34
	Wear of rotor grooves	Replace	1-35
	Deformation or poor fastening of each gas seal	Replace	1-37
	Wear and weak spring tension	Replace	
	Malfunction of fuel system	See section 4	
	Malfunction of ignition system	See section 5	

Problem	Possible cause	Remedy	Page
Engine noise	Gas seal noise		
	Malfunction of gas seal	Replace	1-35, 38
	Malfunction of housing	Replace	1-31
	Malfunction of seal spring	Replace	1-39
	Malfunction of metering oil pump	Rod adjustment	
		See section 7	
	Knocking noise		
	Accumulation of carbon	Remove and clean	1-30
	Hitting noise		
	Malfunction of main bearing or rotor bearing	Replace	1-32, 35
	Excessive end play	Adjust	1-50
	Foreign matter in internal gear or stationary gear, or malfunction	Replace	1-32, 35
	Other		
Malfunction of water pump bearing	See section 3		
V belt tension	Adjust	1-8	
Malfunction of alternator bearing	See section 5		
Exhaust gas leakage	See section 4		
Malfunction of fuel system	See section 4		

1 TUNE-UP PROCEDURE



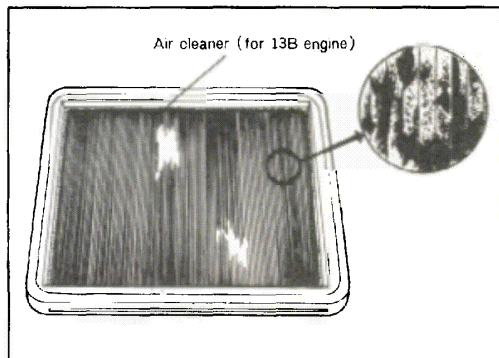
57U01X-002

TUNE - UP PROCEDURE

Tune the engine according to the procedures described below.

1. Checking battery

- (1) Check the indicator sign on the top of the battery. If the indicator sign is blue, the battery is normal.
- (2) If the blue indicator sign is not visible, then the electrolyte level of the battery is low and/or the capacity is insufficient.
- (3) Check whether or not the electrolyte level lies between the upper and lower lines. If low, add distilled water. Do not overfill. If the electrolyte level is acceptable and yet the blue indicator sign is not visible, the battery must be recharged.
- (4) Check the tightness of the terminals to ensure good electrical connections. Clean the terminals and coat the terminals with grease.
- (5) Inspect for corroded or frayed battery cables.
- (6) Check the rubber protector on the positive terminal for proper coverage.

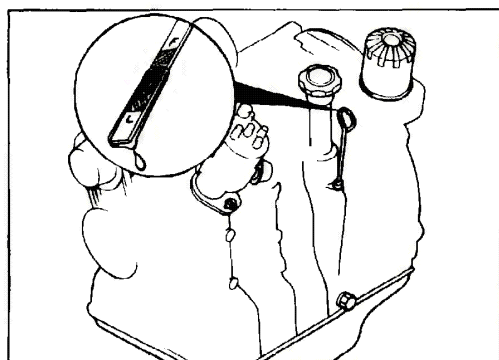


47U01X-003

2. Checking air cleaner

Visually check that the air cleaner is not excessively dirty.

Replace the air cleaner if necessary.



47U01X-004

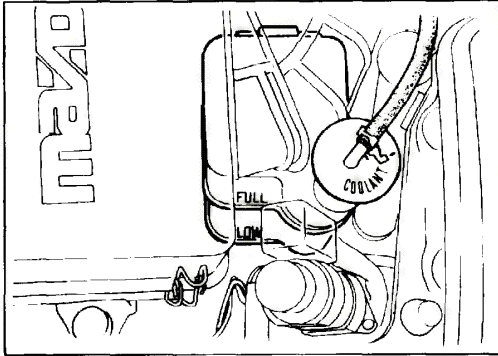
3. Checking engine oil

- (1) Check to be sure that the engine oil level is between the F and L marks. If the oil level is near or below the L mark, add oil until the F mark is reached.

Notes

- a) Distance between the L and F marks on the dipstick represents 1 liter (0.9 Imp. quart 1 U.S. quart)
- b) Be sure the vehicle is on level ground.

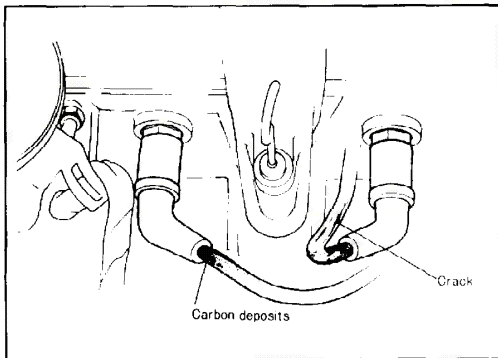
- (2) Check for dirty engine oil. If it is extremely dirty, replace it.



47U01X-005

4. Checking coolant level

Check whether the coolant level is near the radiator inlet port, and whether the level in the reserve tank is between the FULL and LOW marks. Add coolant to the FULL if the level is low.

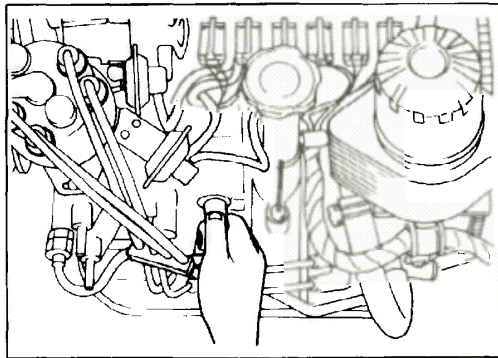


47U01X-006

5. Checking high-tension cords

Check the following points

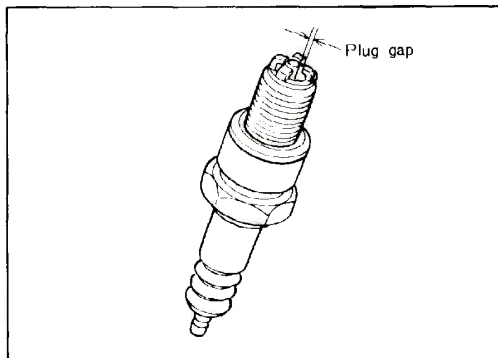
- (1) Damaged cord
If a problem is found, replace the high tension cords.
- (2) Carbon deposits
Clean the high-tension cords using a clean rag, if necessary.



47U01X-007

6. Checking spark plugs

- (1) Disconnect the high-tension cords and remove the spark plugs.
Do not pull on the cords because the wire connection inside the cap may become separated.
- (2) Check the spark plugs for burned and eroded electrode, black deposits, fouling, and cracked porcelain.
- (3) Clean the spark plugs with a spark plug cleaner or a wire brush if they are fouled.
Replace any badly burned or eroded spark plugs.



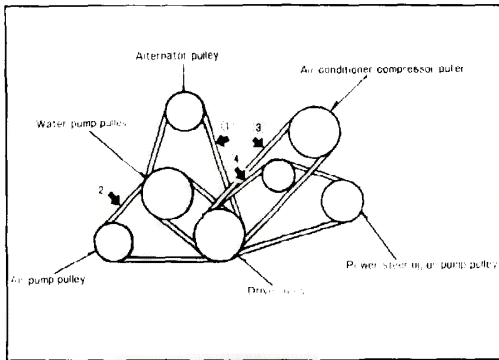
47U01X-008

- (4) Measure the electrode gap of each spark plug with a wire gauge. If it is improper, replace the spark plug.

Standard spark plug gap:

1.35 ~ 1.45 mm (0.053 ~ 0.057 in)

1 TUNE-UP PROCEDURE



47U01X-009

7. Checking drive belt tension

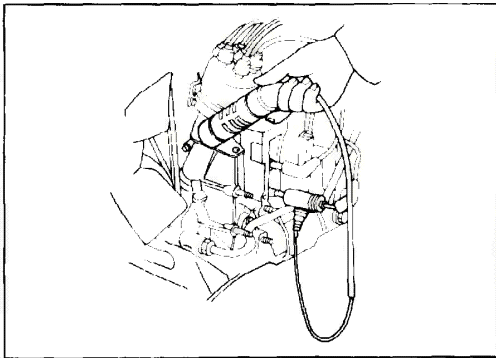
To check belt tension, apply moderate thumb pressure (approximately 10 kg, 22 lb) midway between pulleys, and check the deflection.

Note

If the drive belt becomes worn, cracked or frayed, it should be replaced.

Standard drive belt deflection:

	Drive belt	Deflection
1	Alternator drive belt	13 ~ 17 mm (0.51 ~ 0.67 in)
2	Air conditioner drive belt	10 ~ 12 mm (0.39 ~ 0.47 in)
3	Air pump drive belt	11 ~ 13 mm (0.43 ~ 0.51 in)
4	Power steering pump drive belt	10 ~ 12 mm (0.39 ~ 0.47 in)



57U01X-010

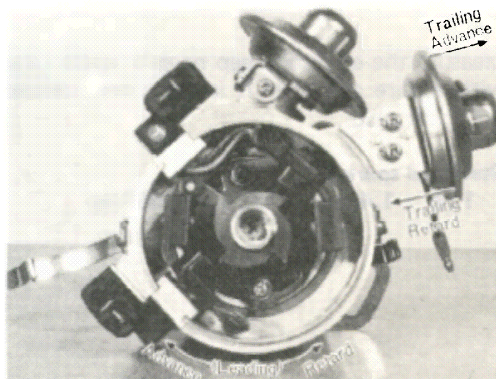
8. Warm up the engine thoroughly

9. Checking ignition timing

- (1) Connect a tachometer to the engine.
- (2) Connect a timing light to hightension cord of the leading spark plug on the front.
- (3) Start the engine and run it at specified idle speed.
- (4) Aim the timing light at the timing indicator pin on the front cover.

Ignition timing: (ATDC)

	Trailing	Leading
13B engine	20°	5°
12A engine	20°	0°

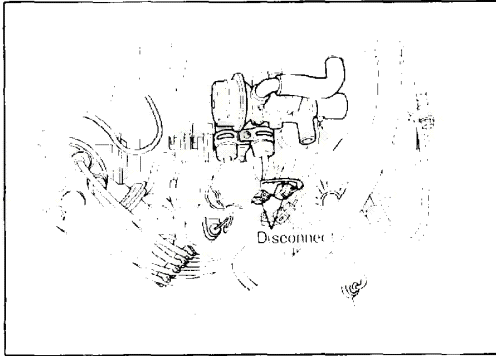


47U01X-011

- (5) If the leading timing is not correct, loosen the distributor lock nut and rotate the distributor housing until the correct leading timing is obtained.

Tighten the distributor lock nut, and recheck the leading timing.

- (6) Connect a timing light to hightension cord of the trailing spark plug on the front.
- (7) Check the trailing timing.
- (8) If the trailing timing is not correct, loosen the vacuum unit attaching screws of trailing and move the vacuum unit until the correct trailing timing is obtained.
- (9) Tighten the vacuum unit attaching screws and recheck the trailing timing.

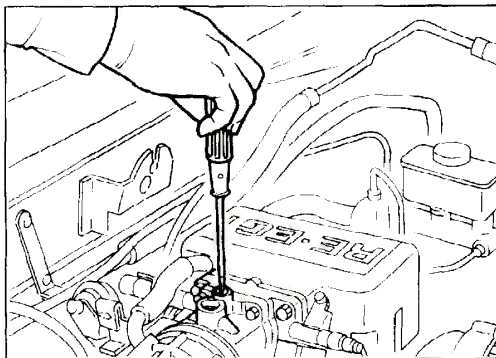


47U01X-012

10. Adjusting idle speed

13B engine

1. Switch off all accessories.
2. Remove the fuel filler cap.
3. Connect a tachometer to the engine.
4. Warm up the engine again until it reaches normal operating temperature.
5. Check and adjust the throttle sensor as instructed on page 4B-39.
6. Disconnect the vent and vacuum solenoid valve coupler.

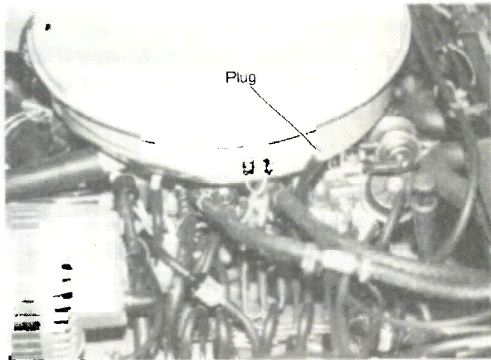


47U01X-509

7. Remove the blind cap and adjust the idling speed to 800 rpm by turning AAS (air adjust screw).

Idling speed: 800 rpm

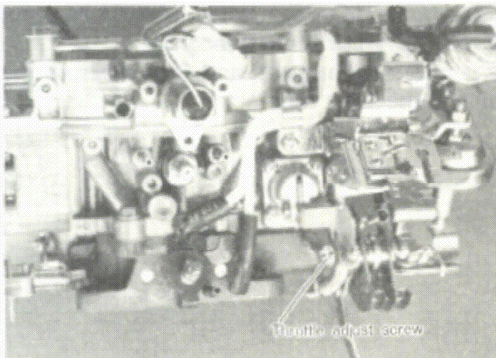
8. After adjusting the idling speed, install the blind cap onto AAS.



57U01X-609

12A engine

1. Set the parking brake and block the wheels.
2. Switch off all accessories.
3. Remove the fuel filler cap.
4. Connect a tachometer to the engine.
5. Disconnect the tube at the idle compensator in the air cleaner and plug the end of the tube.
6. Check that the dash pot rod and throttle opener (for air conditioner) does not keep the throttle lever from returning to the idle stop.



47U01X-709

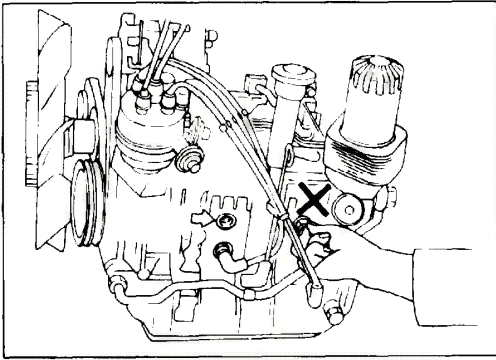
7. On the vehicle equipped with automatic transmission, shift the selector lever to "D" position.
8. Check the idling speed. If the idling speed is not specified, adjust the idle speed to 750 rpm by turning the throttle adjust screw.

Idling speed:

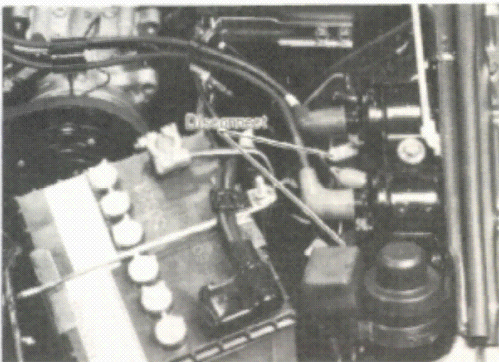
Manual transmission: 750 rpm

Automatic transmission:

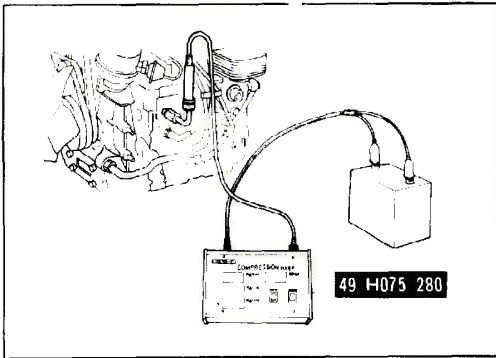
750 rpm in "D" position



47U01X-013



57U01X-014



47U01X-015

INSPECTION

CHECKING COMPRESSION

Checking by using the compression tester (49 H075 280)

1. Check to be sure that the battery is fully charged.
2. Warm up the engine thoroughly.
3. After the engine is warm, stop it and allow it to sit for about ten minutes (in order to reduce the catalytic converter temperature).
4. Remove the trailing-side plug(s).

Warning

For the 13B engine, remove from both front and rear, for the 12A engine, remove from only the side to be measured. The reason for this is because, for the 13B engine, the fuel supply can be cut by taking out the primary wire of the trailing-side coil, but this cannot be done for the 12B engine.

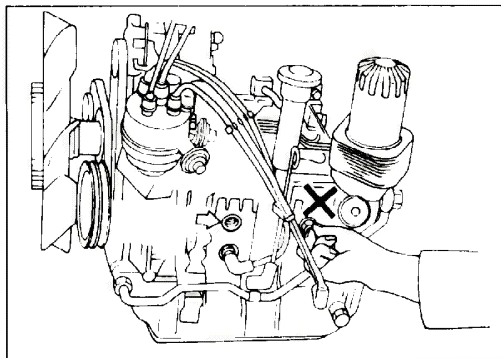
If both the front and rear are removed for the 12B engine, uncombusted gases would be discharged through the plug holes, which is very dangerous.

5. Disconnect both the trailing-side and leading-side primary wires.
6. Connect the adapter of the **compression tester** (49 H075 280) to the front rotor housing.
7. Connect the tester hose of the **compression tester** (49 H075 280) to the adaptor, and connect the wires to the (+) and (-) terminals of the battery.

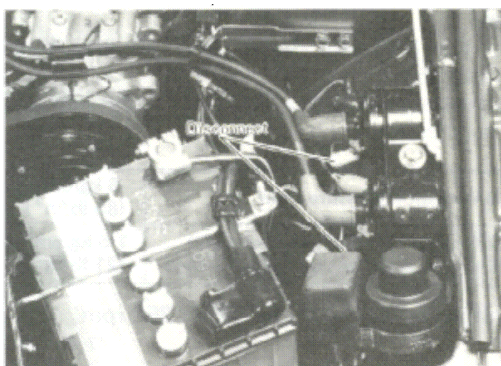
Note

The **compression tester** for conventional piston engines reads only the highest pressure of the three combustion chambers in the rotor housing. Make sure to use the **compression tester** (49 H075 280 or 49 0820 280K).

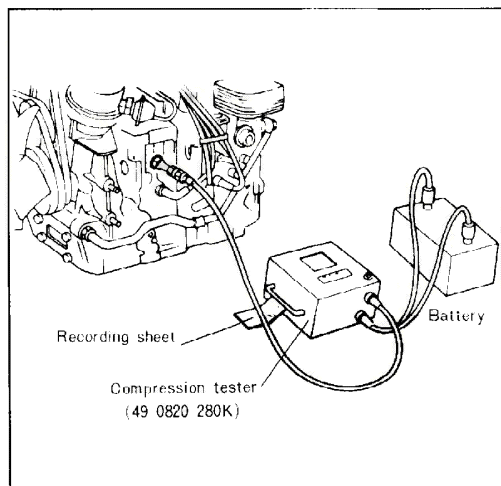
8. Depress the accelerator pedal completely, and crank the engine for 5 to 10 seconds.
9. Make a note of the result, and then measure the rear side in the same way.



47U01X-016



47U01X-017



47U01X-018

Checking by using the compression tester (49 0820 280K)

1. Check to be sure that the battery is fully charged.
2. Warm up the engine thoroughly.
3. After the engine is warm, stop it and allow it to sit for about ten minutes (in order to reduce the catalytic converter temperature).
4. Remove the trailing side plug(s).

Warning

For the 13B engine, remove from both front and rear; for the 12A engine, remove from only the side to be measured.

The reason for this is because, for the 13B engine, the fuel supply can be cut by taking out the primary wire of the trailing-side coil, but this cannot be done for the 12B engine.

If both the front and rear are removed for the 12B engine, uncombusted gases would be discharged through the plug holes, which is very dangerous.

5. Disconnect both the trailing-side and leading side primary wires.

6. Connect the compression tester hose to the spark plug hole and the wires to the battery.

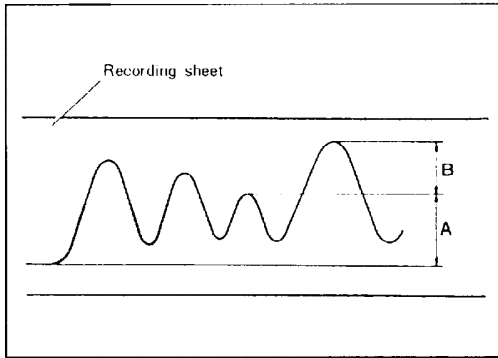
Note

The compression tester for conventional piston engines reads only the highest pressure of the three combustion chambers in the rotor housing.

Make sure to use the compression tester (49 H075 280 or 49 0820 280K).

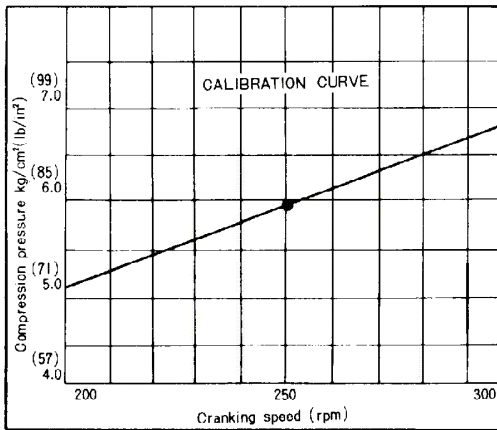
7. When the indicator is warmed up, switch on to allow the recording sheet to be fed in. On the recording sheet, the line of 20 ~ 30 mm (0.8 ~ 1.2 in) long is automatically drawn to indicate the zero position.
8. With the throttle valve fully opened, crank the engine for 5 ~ 10 seconds to allow the pressure to be plotted graphically.
9. Stop cranking the engine and switch off to stop feeding of the recording sheet.
10. To take the measurement on the rear rotor, follow the same procedure as on the front rotor.

1 INSPECTION



57U01X-019

Peaks	17	28	29	20	21	22	23	24	25
rpm	204	216	228	240	252	264	276	288	300



JUDGEMENT CRITERIA OF COMPRESSION PRESSURE

Measurement items

Prepare the following data from the measured results.

A. Minimum compression pressure

B. Difference between maximum and minimum compression pressures

Note

Items A and B appear as shown in the figure at the left if the compression tester (49 0820 280K) is used.

Judgment

1. Make the judgment based upon A and B as described above.
(The standard values are the same for the 13B and 12A engines.)

A	Compression pressure limit	6 kg/cm ² (85 lb/in ²)
B	Difference between maximum and minimum compression pressure limit	1.5 kg/cm ² (21 lb/in ²)

The cranking speed should be 240 ~ 250 rpm.

47U01X-020

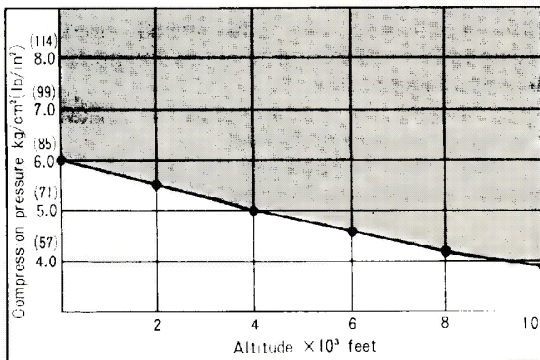
Cranking speed vs. compression pressure

Both the cranking speed and compression pressure vary depending upon the battery condition, starter and engine accessories. The Figure shows the relationship between the cranking speed and the compression pressure.

Note

To obtain the cranking speed, crank the engine for 5 seconds and read the number of peaks of the curve plotted on the recording sheet.

47U01X-512



47U01X-021

Altitude vs. compression pressure

Values for compression pressure differ depending upon the altitude at a place where measurement is taken. This relation needs to be taken into the judgement criteria. The Figure shows the relationship between the altitude and the compression pressure. **Make sure always to check the readings against the graph for selecting the appropriate judgement criteria.** The pressures within the meshed area are normal.

REMOVAL AND INSTALLATION OF 13B ENGINE

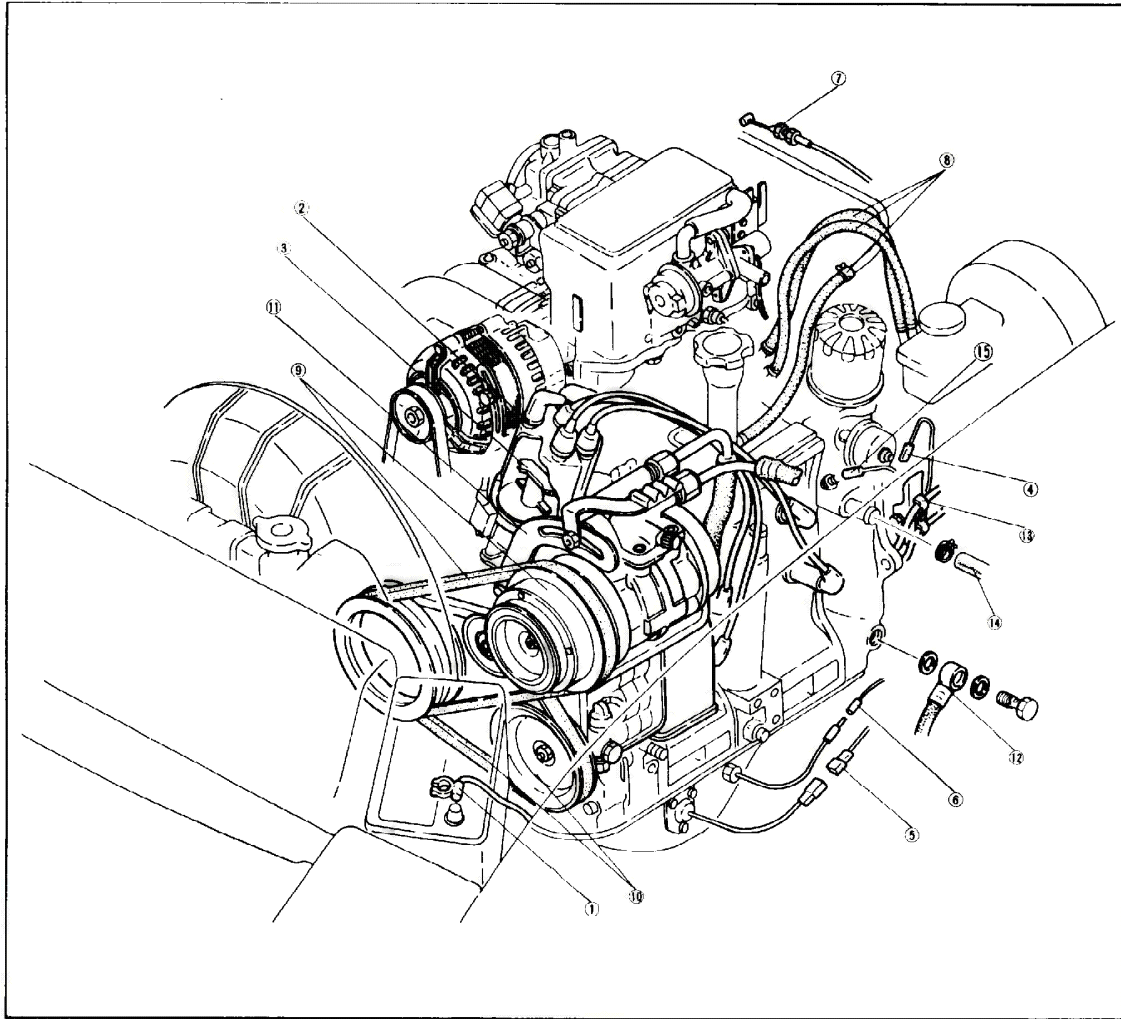
After draining the engine oil and coolant, remove the engine in the following order. Installation is the reverse order of removal.

After installing the engine, perform the following operations.

1. Refill the engine with coolant, and lubricant.
2. Tune up the engine.

Removal of parts: Left side of compartment

47U01X-513

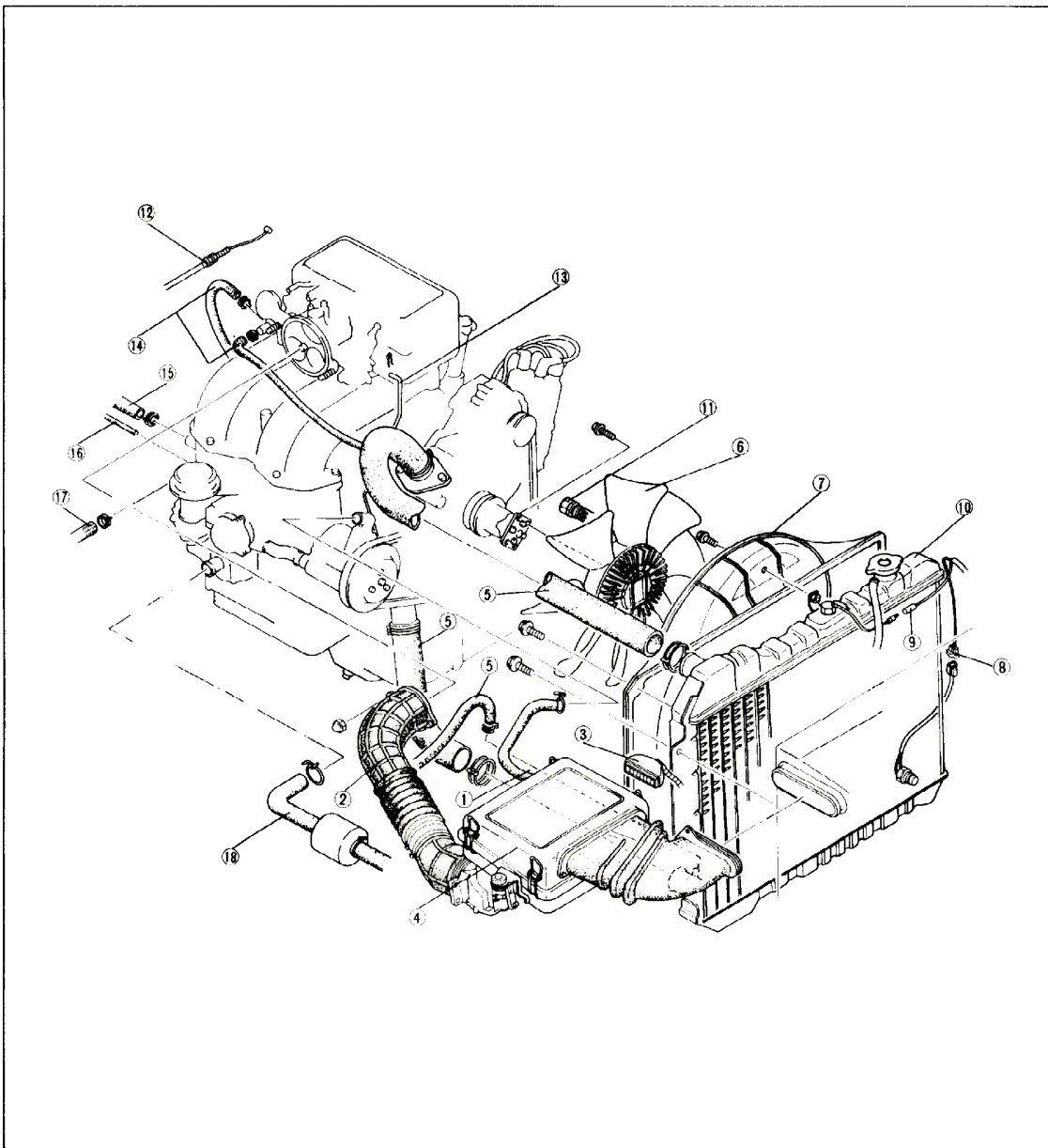


- | | |
|---|--|
| <ol style="list-style-type: none"> 1. Battery negative cable 2. High-tension cords & discap 3. Rotor 4. Oil pressure gauge connector 5. Oil level gauge connector 6. Oil temperature sensor connector 7. Accelerator cable 8. Fuel hoses & evapolator hosc
(After disconnecting the fuel hoses, plug it surely) | <ol style="list-style-type: none"> 9. Air conditioner compressor & drive belt 10. Power steering pump & belt 11. Bracket 12. Rear oil hose
(Drain the engine oil to the suitable container.) 13. Startor harness bracket 14. Heater hose 15. Water temperature gauge unit connector |
|---|--|

57U01X-022

1 REMOVAL AND INSTALLATION OF 13B ENGINE

Removal of engine: Front and right side of engine compartment.

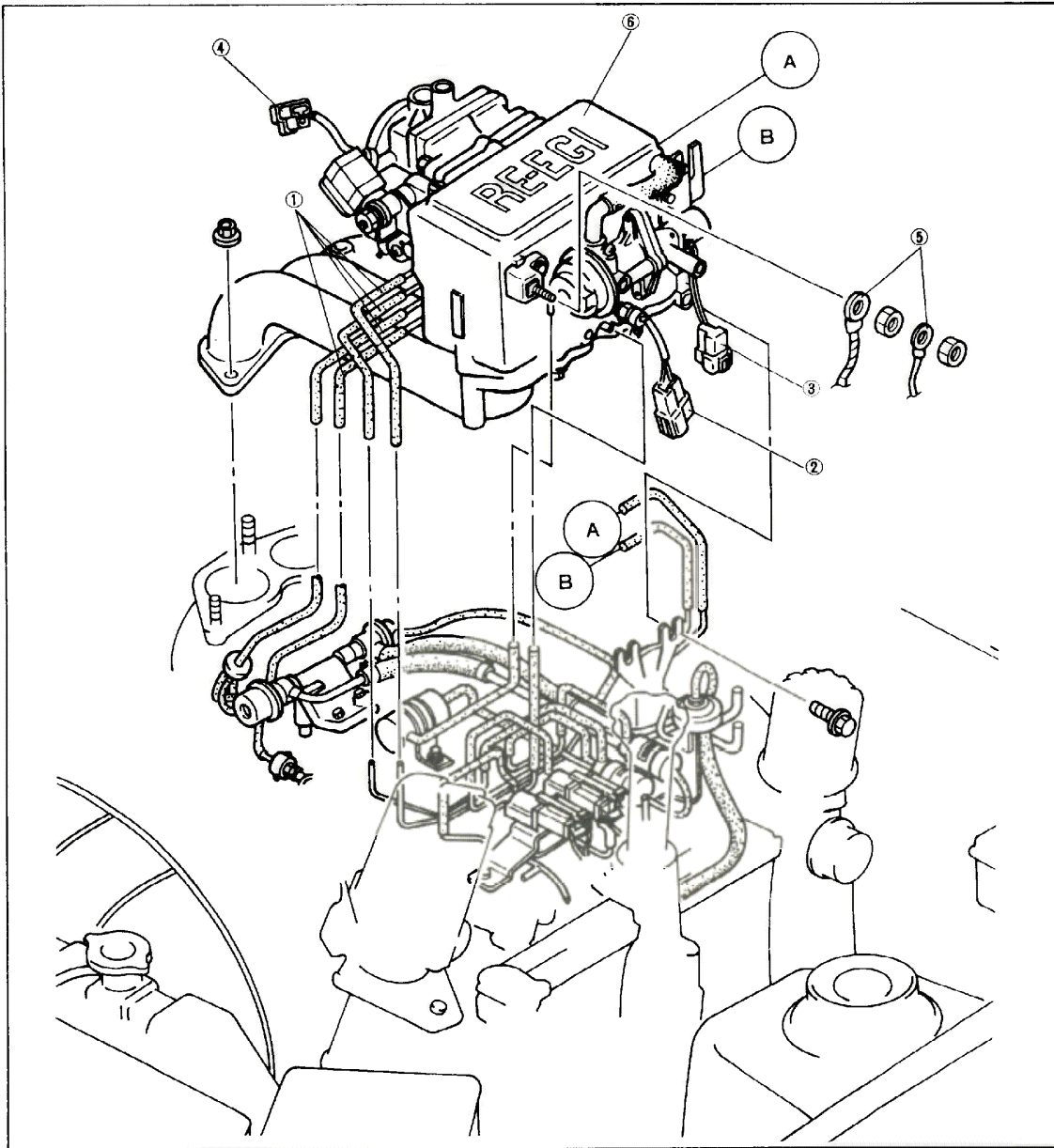


- | | |
|--|--------------------------------------|
| 1. Air pump hose | 11. Oil cooler hose, front |
| 2. Air funnel | 12. Cruise control cable |
| 3. Air flow meter connector | 13. Metering oil pump connecting rod |
| 4. Air cleaner assembly | 14. Water hoses |
| 5. Radiator hose upper, lower and heater | 15. Brake master back hose |
| 6. Cooling fan | 16. Air tube |
| 7. Cooling fan cover | 17. Split air hose |
| 8. Radiator water temperature switch connector | 18. Relief air hose |
| 9. Coolant level sensor connector | |
| 10. Radiator | |

47U01X-514

57U01X-023

Removal of engine: Around dynamic chamber of engine compartment.



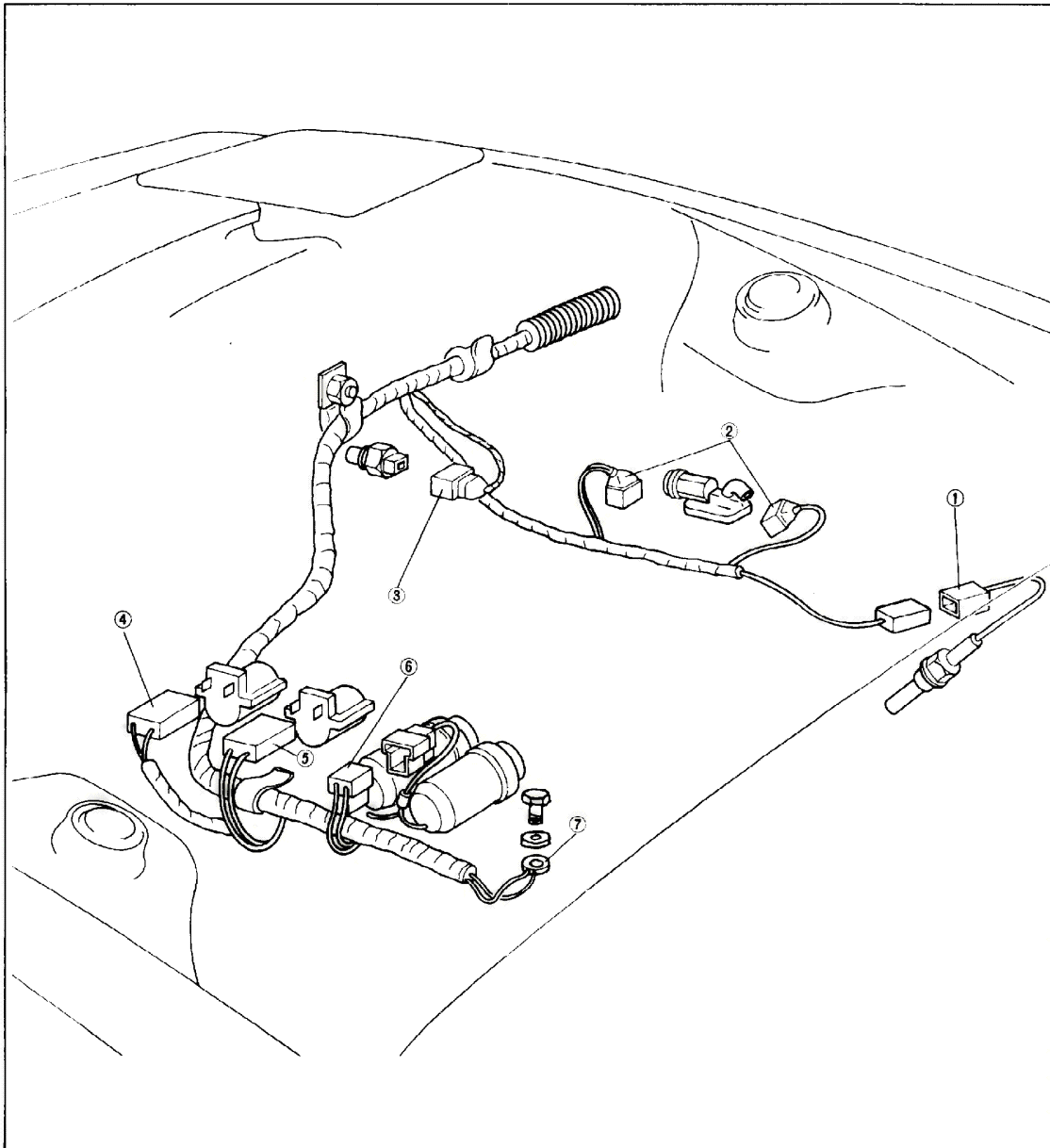
47U01X-515

1. Vacuum sensing tubes (8)
2. Intake air temperature sensor connector
3. Air supply valve connector
4. Throttle sensor connector
5. Terminal cover wire
6. Dynamic chamber assembly

47U01X-024

1 REMOVAL AND INSTALLATION OF 13B ENGINE

Removal of engine: parts related to electric connector

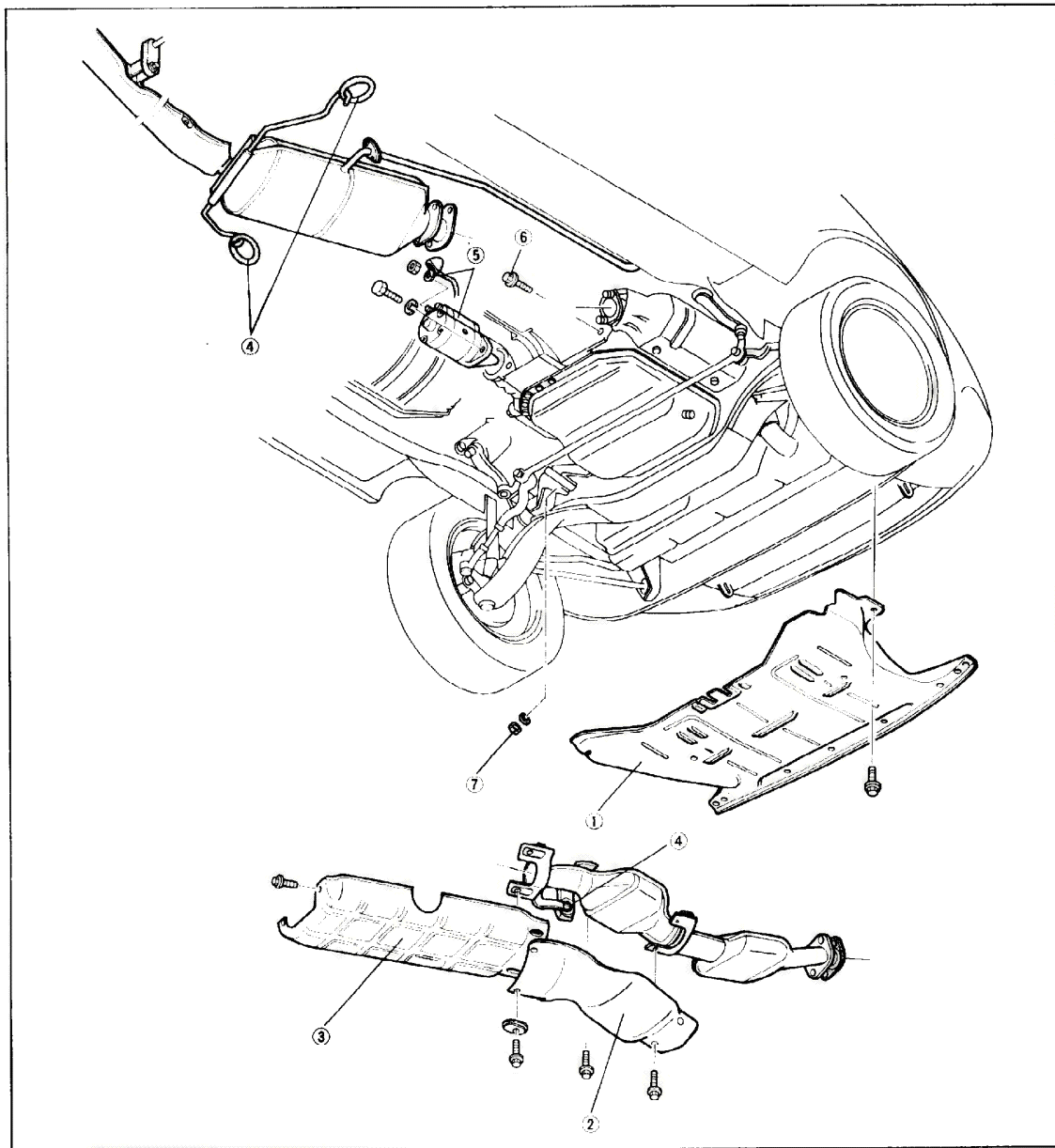


47U01X-516

1. Oxegon sensor connector
2. Injector connectors
3. Water temperature sensor connector
4. Vacuum control solenoid valve connector
5. Pressure regulate control solenoid valve connector
6. Vent solenoid & vacuum solenoid valve connector
7. Engine earth
8. Alternator harness & connector

47U01X-025

Removal of engine: Lower part of engine compartment



- 1. Engine under cover
- 2. Exhaust pipe front cover
- 3. Catalytic converter insulator
- 4. Exhaust pipe brackets
- 5. Starter motor harness and starter motor

- 6. Transmission attaching bolts
- 7. Engine mount nuts

57U01X-517

After jack down

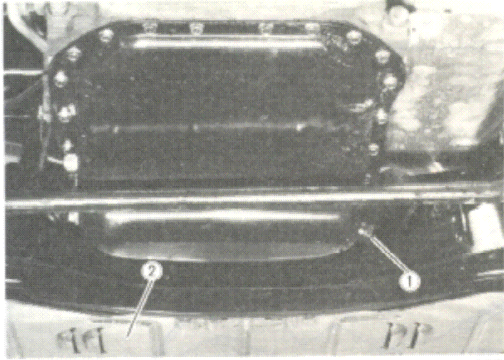
Using a suitable hoist and lifting sling, remove the engine from the vehicle.

Caution

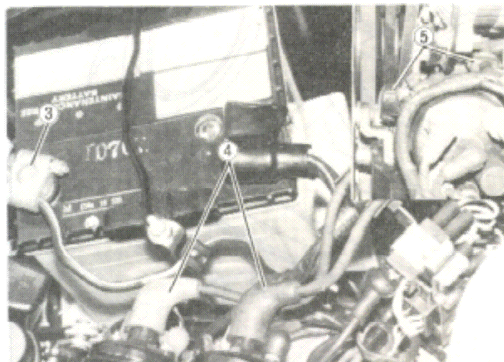
Don't damage the air conditioner condenser.

47U01X-026

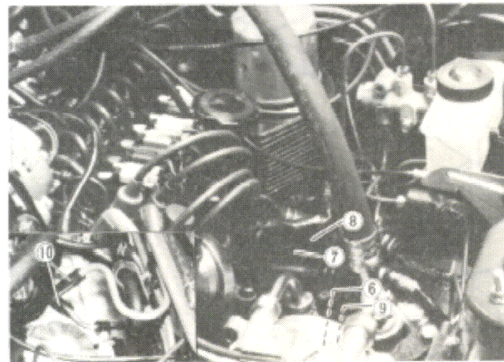
1 REMOVAL AND INSTALLATION OF 12A ENGINE



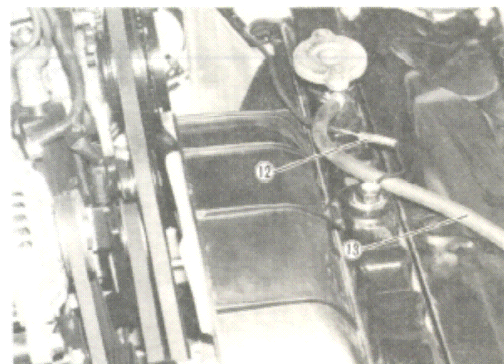
57U01X-027



57U01X-028



57U01X-029



47U01X-030

REMOVAL AND INSTALLATION OF 12A ENGINE

The procedures for removing the engine from the vehicle are as follows:

Engine installation procedures are the reverse of those for removal.

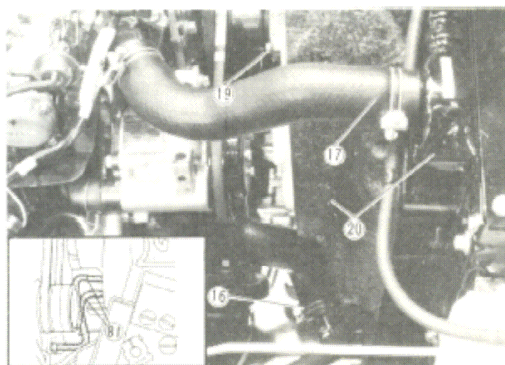
Follow the steps below after installing the engine.

1. Refill the engine with coolant and lubricant.
2. Tune up the engine.
3. Check and adjust hood for proper closing.

Apply the parking brake and block the wheels.

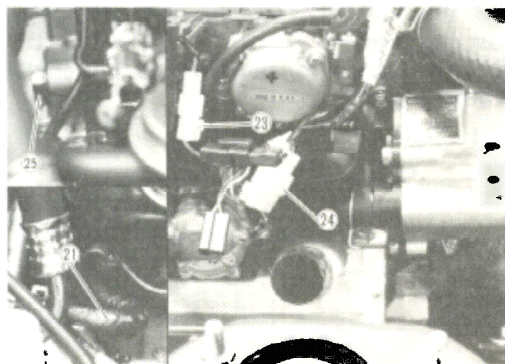
1. Drain the lubricant from the engine.
After draining, clean and reinstall the drain plug.
2. Remove the engine under cover.
3. Open the hood and disconnect the battery negative cable.
Remove the hood.
4. Disconnect the hightension cords at the ignition coils.
5. Disconnect the connectors of pick-up coil wiring and condenser lead.
6. Disconnect the connector of the oil level sensor lead.
7. Disconnect the connector from the water temperature gauge unit.
8. Disconnect the connector from the oil pressure gauge unit.
9. Disconnect the connector from the oil thermo sensor (except for California).
10. Disconnect the vacuum sensing tube for vacuum diaphragm (automatic transmission) and evaporative hose.
12. Disconnect the connector from coolant level sensor lead.
13. Disconnect the coolant reservoir hose.
14. Remove the air cleaner assembly.
15. Remove the connector from the No. 2 water temperature switch.

REMOVAL AND INSTALLATION OF 12A ENGINE 1



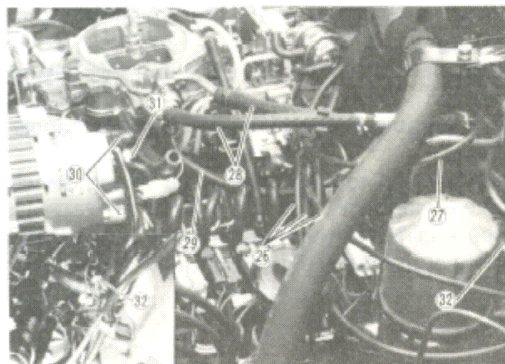
47U01X-031

16. Drain the cooling system by disconnecting the radiator lower hose from the radiator.
17. Disconnect the radiator upper hose from the radiator.
18. Disconnect the oil pipes from the radiator (automatic transmission only).
19. Remove the cooling fan and fan drive assembly.
20. Remove the radiator and radiator shroud assembly.



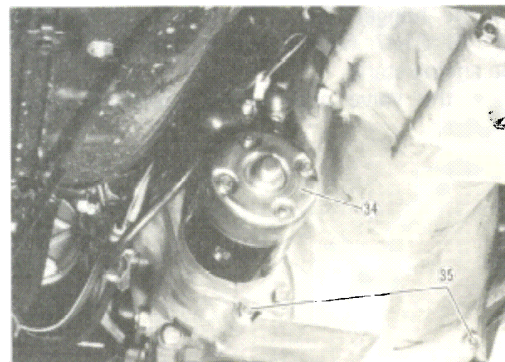
47U01X-032

21. Disconnect the vacuum hose for power brake assist.
22. Disconnect the air pipe from the rear end of the intake manifold.
23. Disconnect the connectors from the choke heater lead.
24. Disconnect the following connectors.
 - (1) Throttle sensor
 - (2) MAB solenoid valve
 - (3) Idle richer solenoid
 - (4) Port air solenoid valve
25. Remove the bolts attaching the transmission to rear end of the engine.



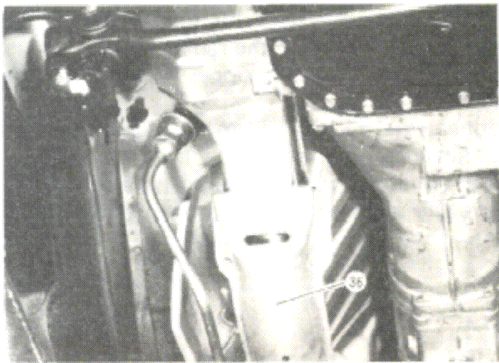
47U01X-033

26. Disconnect the accelerator cable, choke cable and hot start assist cable.
27. Disconnect the cruise control cable (if equipped).
28. Disconnect the fuel main and return hoses.
29. Disconnect the sub-zero start assist fluid hose (Except for Calif.).
30. Disconnect the connector and "B" terminal from the rear end of the alternator.
31. Disconnect the following connectors.
 - (1) No. 1 water temperature switch
 - (2) Air vent solenoid valve
 - (3) Vacuum switch
 - (4) Three way valve and engine earth.
32. Disconnect the water hoses.
33. Demount the air conditioning compressor (If equipped).
34. Disconnect the wirings and remove the starting motor.
35. Remove the bolts attaching the transmission to rear end of the engine.



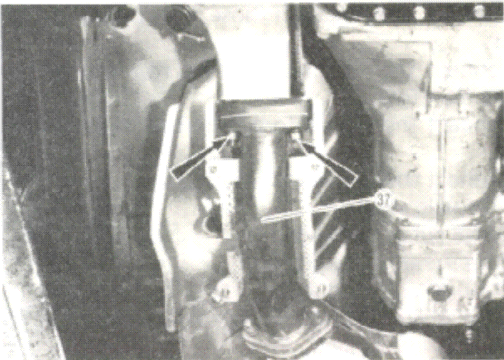
47U01X-034

1 REMOVAL AND INSTALLATION OF 12A ENGINE



47U01X-035

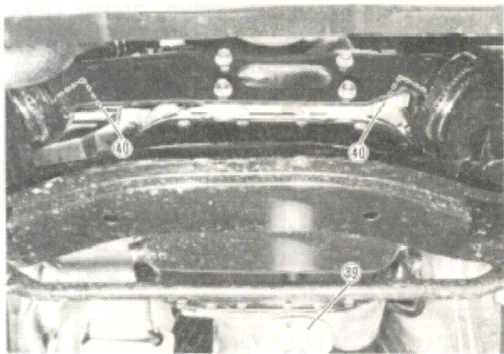
36. Remove the exhaust pipe front cover.



47U01X-036

37. Loosen the nuts attaching the exhaust pipe to exhaust manifold.

38. Support the monolith converter to prevent it from dropping.



47U01X-037

39. Support the front end of the transmission with a suitable jack.

40. Remove the nuts from the right and left engine mountings.

41. Install a suitable lifting sling on the engine hanger brackets.

Attach the sling to a hoist or other lifting device and take up all slack.

42. Pull the engine forward until it clears the clutch shaft. Then, lift the engine from the vehicle.



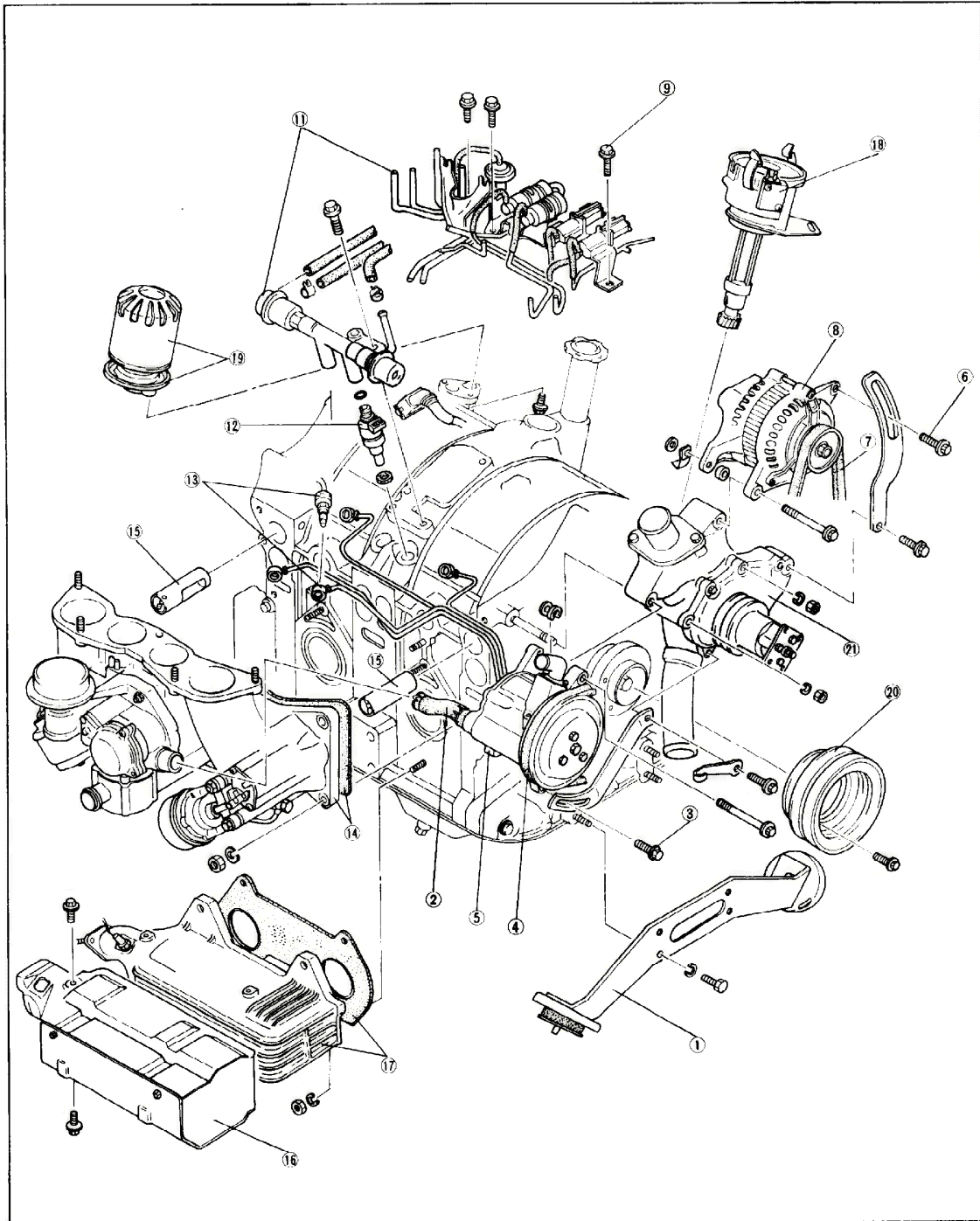
47U01X-038

43. Install the **hanger** (49 1114 005) to the **engine stand** (49 0107 680A) and mount the engine on the engine stand.

44. Remove the valve and piping assemblies from the engine.

DISASSEMBLY OF ENGINE**Disassembly of the 13B engine auxiliary parts**

To disassemble, proceed in the numbered order below after first installing the engine on the **engine stand hanger** (49 1114 005) and the **engine stand** (49 0107 680A), as described on page 1-22.

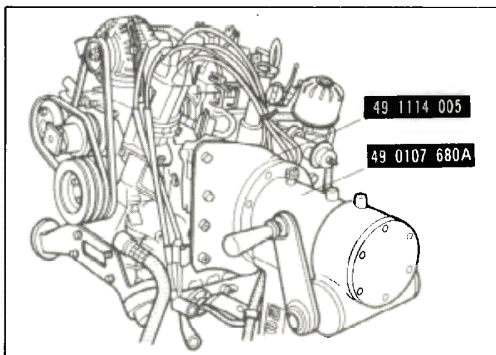


57U01X-521

1 DISASSEMBLY OF ENGINE

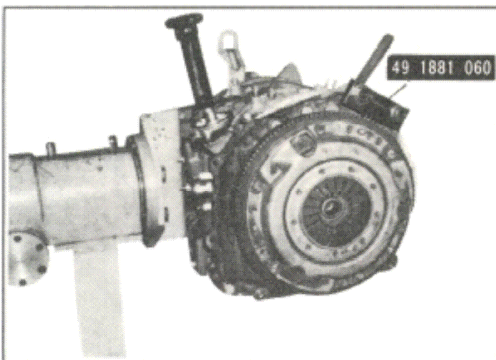
1. Engine mount
2. Air outlet hose
3. Air pump strap bolt
4. Air pump drive belt
5. Air pump
6. Alternator strap bolt
7. Alternator drive belt
8. Alternator
9. Emission devices attaching bolts
10. Delivery pipe attaching bolts
11. Remove the emission devices & delivery pipe assembly as one unit.
12. Fuel injection nozzles
13. Metering oil pump hoses
14. Intake manifold & gasket
15. Auxiliary port valves
16. Exhaust manifold covers
17. Exhaust manifold & gasket
18. Distributor
19. Oil filter & body
20. Remove the eccentric shaft pulley
21. Water pump

57U01X-039



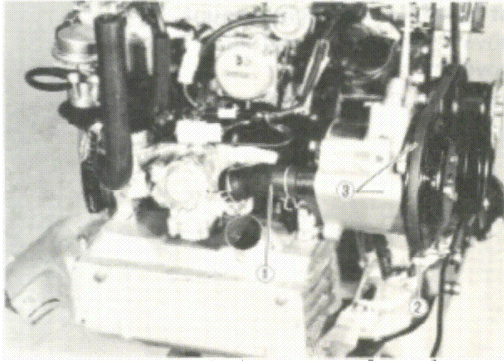
57U01X-040

Place the engine on the **engine hanger** (49 1114) and **engine stand** (49 0107 680A) as shown in the figure.



57U01X-041

Before loosening the eccentric shaft pulley bolt, attach the **ring gear brake** (49 1881 060).



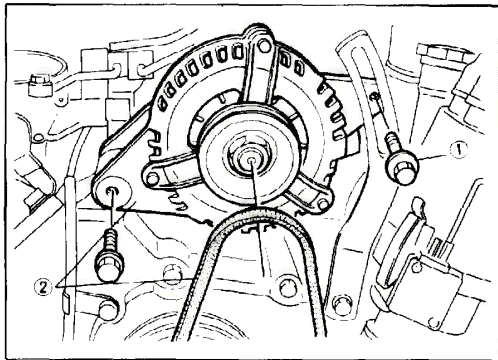
57U01X-042

Disassembly of 12A Engine Auxiliary Parts

Remove the following component parts in sequence.

Air pump and drive belt

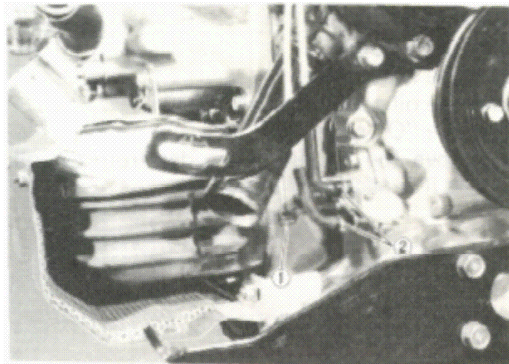
1. Disconnect the air outlet hose.
2. Remove the air pump strap bolt.
3. Disengage the air pump drive belt and remove the air pump.



47U01X-043

Alternator

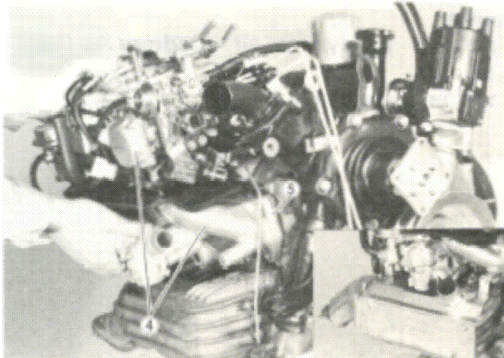
1. Remove the alternator strap bolt.
2. Disengage the alternator drive belt and remove the alternator.



47U01X-044

Intake manifold and carburetor assembly

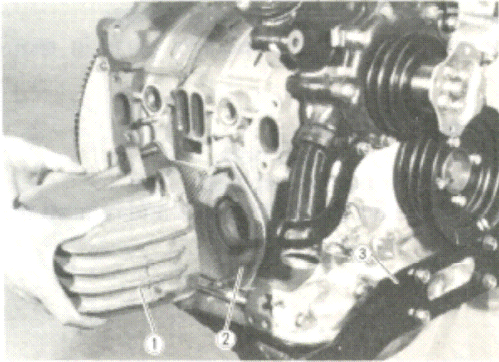
1. Disconnect the connecting rod at the metering oil pump.
2. Disconnect the oil hoses at the metering oil pump outlets.



47U01X-045

3. Remove the exhaust manifold cover.
4. Remove the intake manifold and carburetor assembly.
5. Remove the gasket and "O" rings.

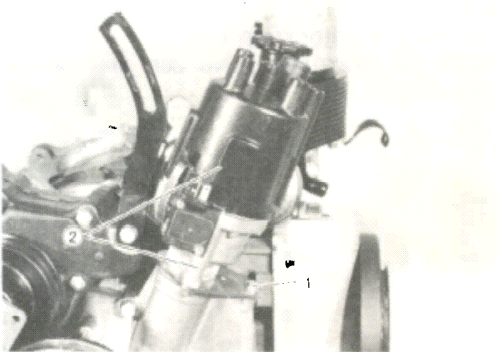
1 DISASSEMBLY OF ENGINE



47U01X-046

Exhaust manifold and engine mount

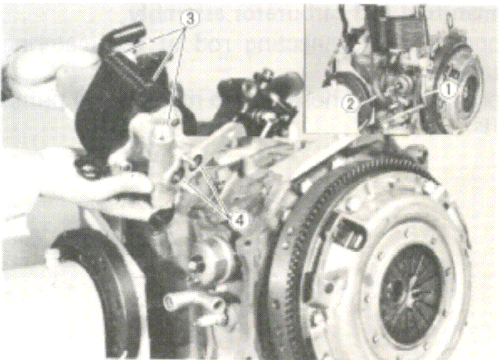
1. Remove the exhaust manifold.
2. Remove the gasket.
3. Remove the engine mount.



47U01X-047

Distributor

1. Remove the distributor lock nut.
2. Remove the distributor.

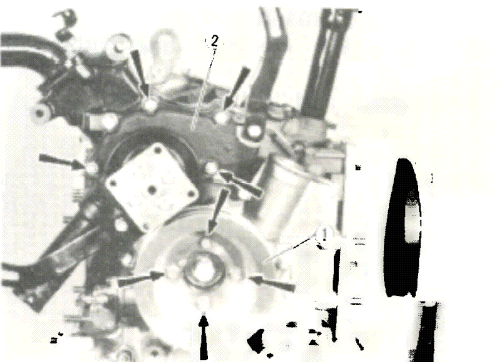


47U01X-048

Oil cooler and oil filter

1. Remove the oil pipe.
2. Remove the water hose.
3. Remove the oil cooler and oil filter.
4. Remove the "O" rings.

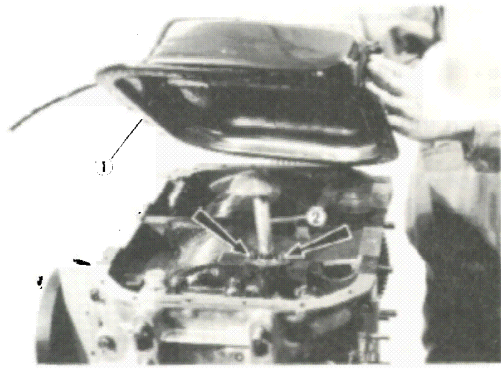
Do not remove the oil filter cartridge from the oil cooler unless it is necessary to replace.



47U01X-049

Water pump

1. Remove the pulley for air conditioning compressor.
2. Remove the water pump.



57U01X-050

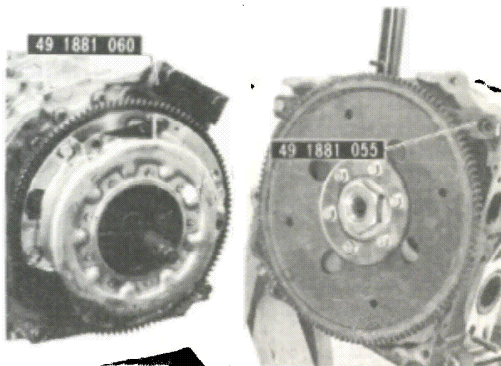
Disassembly of 13B and 12A Engine Internal Parts

Oil pan and oil strainer

1. Remove the oil pan.
2. Remove the oil strainer and gasket.

To remove the oil pan, slowly drive the scraper of 30 mm (1.2 in) width and 1.5 ~ 2.0 mm (0.06 ~ 0.08 in) thickness with hammer, between the oil pan and rear housing.

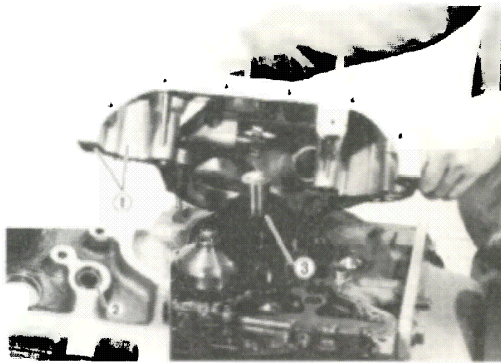
Be careful not to damage the oil pan and housings.



57U01X-051

Eccentric shaft pulley

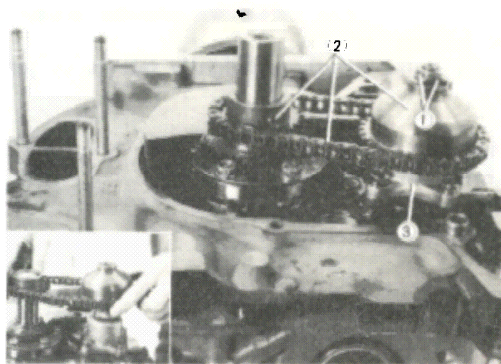
1. On the engine equipped with manual transmission, attach the **ring gear brake** (49 1881 060) to the flywheel. On the engine equipped with automatic transmission, attach the **counter weight stopper** (49 1881 055) to the counter weight.
2. Remove the eccentric shaft pulley bolt and remove the pulley.



47U01X-052

Front cover

1. Remove the front cover and gasket.
2. Remove the "O" ring on the oil passage.
3. Slide the distributor drive gear off the shaft.

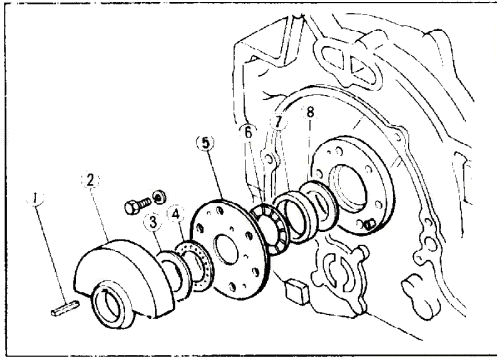


47U01X-053

Oil pump drive and oil pump

1. Straighten the lock washer tab and remove the nut and lock washer.
2. Slide the oil pump sprocket and eccentric shaft sprocket together with the drive chain off the eccentric shaft and oil pump shaft simultaneously.
3. Remove the oil pump.

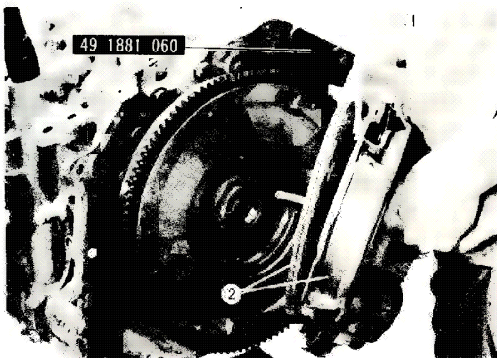
1 DISASSEMBLY OF ENGINE



57U01X-054

Balance weight and bearing housing

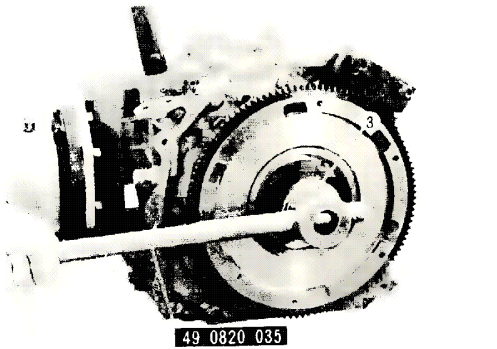
1. Remove the key, balance weight, thrust washer and needle bearing.
2. Remove the bearing housing, needle bearing, spacer and thrust plate.
 - 1) Key
 - 2) Balance weight
 - 3) Thrust washer
 - 4) Needle bearing
 - 5) Bearing housing
 - 6) Needle bearing
 - 7) Spacer
 - 8) Thrust plate



47U01X-055

Clutch cover and flywheel (manual transmission)

1. Attach the **brake** (49 1881 060) to the flywheel.
2. Remove the clutch cover assembly and clutch disc.



47U01X-056

3. Remove the flywheel nut with the **box wrench** (49 0820 035).



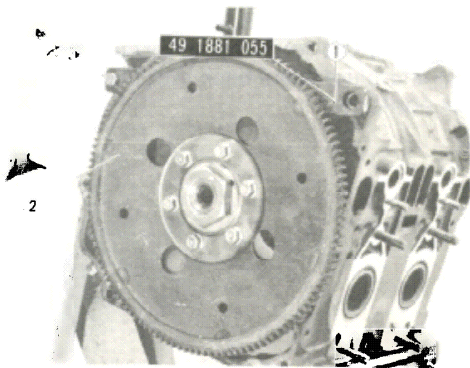
57U01X-057

4. Remove the flywheel with the **counter weight puller** (49 0823 305A).
Turn the puller handle and lightly tap the puller head.

Warning

Be careful not to drop the flywheel.

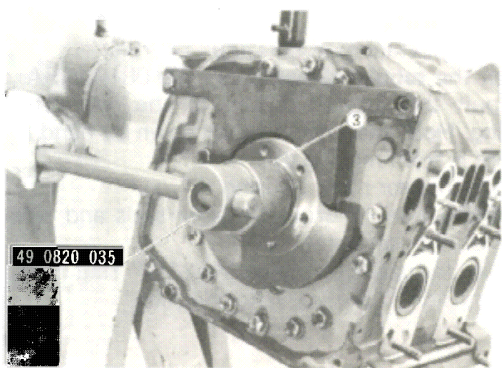
5. Remove the key.



57U01X-058

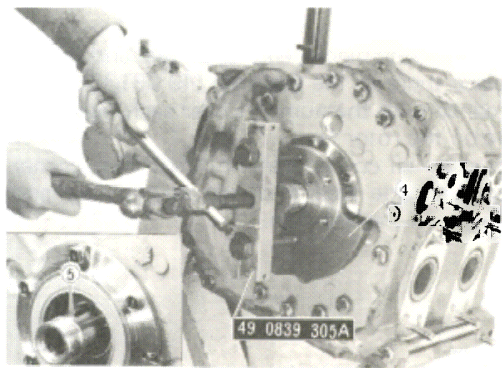
Drive plate and counter weight (automatic transmission)

1. Attach the **counter weight stopper** (49 1881 055) to the rear housing.
2. Remove the drive plate.



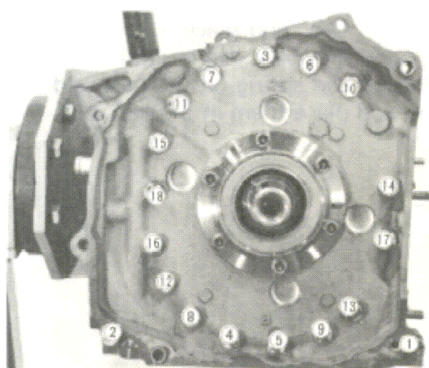
57U01X-059

3. Remove the counter weight nut with the **flywheel box wrench** (49 0820 035).



57U01X-060

4. Remove the counter weight by using the **counter weight puller** (49 0839 305A). Turn the puller handle and lightly tap the puller head. **Be careful** not to drop the counter weight.
5. Remove the key.



47U01X-061

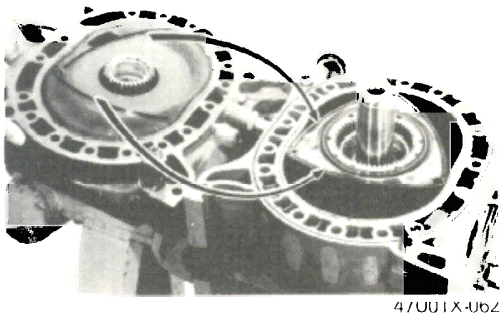
Rear housing

1. Remove the tension bolts.

Note

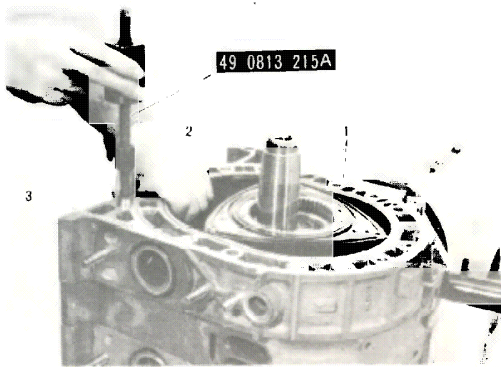
- a) Loosen the tension bolts in the sequence shown in figure.
- b) Do not loosen the tension bolts at one time. Perform the removal in two or three procedures.
- c) Because the 12A engine does not have tension bolt No. 6, skip that one when loosening the bolts.

1 DISASSEMBLY OF ENGINE



47U01X-062

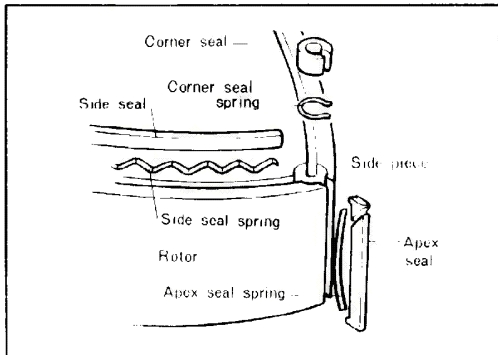
2. Lift the rear housing off the shaft. Remove the seals stuck on the rotor sliding surface of the rear housing and place them back into their respective original positions.



57U01X-063

Rear rotor housing

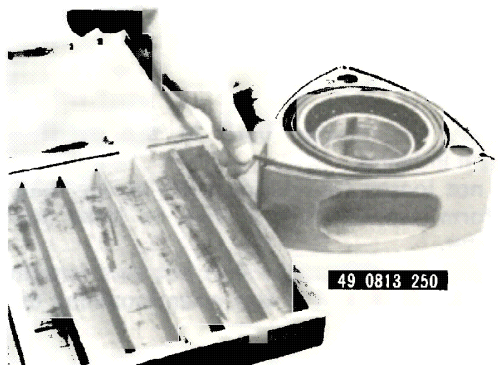
1. Remove the sealing rubbers and "O" ring.
2. Attach the **tubular dowel puller** (49 0813 215A), and pull the tubular dowels of the rear rotor housing. **Hold the rotor housing down** by hand to prevent it from moving up.
3. Remove the rear rotor housing. **Be careful** not to drop the apex seals and side pieces on the rear rotor. Remove the sealing rubbers and "O" ring from the front side of the rear rotor housing.



47U01X-064

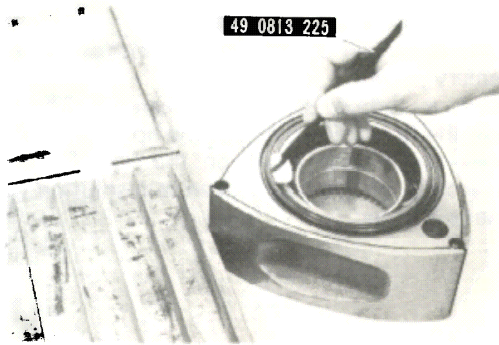
Rear rotor

1. Remove the side pieces, each apex seal and spring, and place them in the **seal case** (49 0813 250), in accordance with the numbers near each respective groove on the rotor face.
2. Remove the all corner seals with soft seal, corner seal springs, side seals and side seal springs, and place them in the seal case.

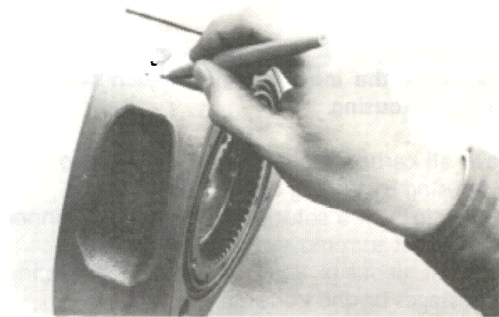


47U01X-065

3. Remove the rear rotor and place it internal gear side down on a clean rubber pad or cloth.
4. Remove each seal and spring on the other side of the rear rotor, and place them in the seal case.



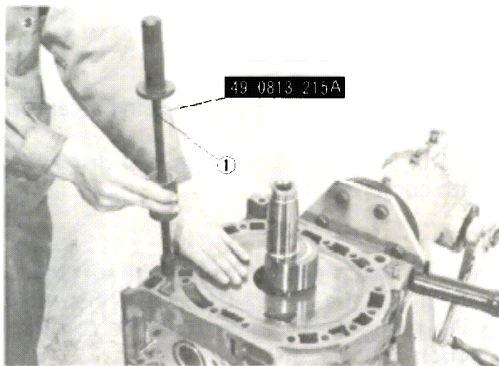
57U01X-066



47U01X-067

5. Place a suitable protector onto the inner oil seal lip to protect the inner oil seal lip and remove the outer oil seal with **oil seal remover** (49 0813 225). **Do not** exert strong pressure at only one place to prevent deformation of the oil seal.
6. Remove the inner oil seal with oil seal remover.
7. Remove the oil seal springs from the each respective groove.
8. Remove the oil seals and springs on the other side of the rear rotor.

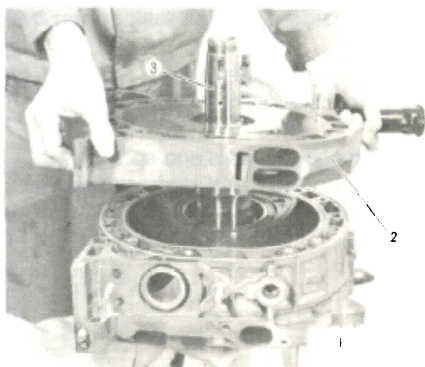
9. Apply the identification mark onto the rear rotor so as to enable reinstalling to original location.



57U01X-068

Intermediate housing and eccentric shaft

1. Attach the **tubular dowel puller** (49 0813 215A), and pull the tubular dowels off the intermediate housing. **Hold the** intermediate housing down by hand to prevent it from moving up.



57U01X-069

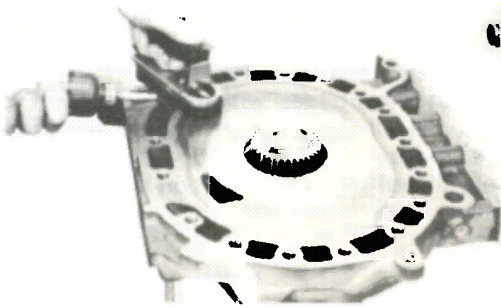
2. Remove the intermediate housing. The intermediate housing should be removed by sliding it beyond the rear rotor journal on the eccentric shaft while holding the intermediate housing up and at the same time pushing up the eccentric shaft.
3. Remove the eccentric shaft. **Be careful** not to damage the rotor bearing and the main bearing.

Front rotor housing and front rotor

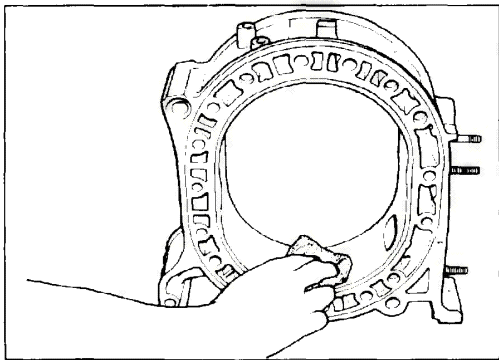
Remove the front rotor housing and the front rotor assembly referring to page 1–28.

47U01X 529

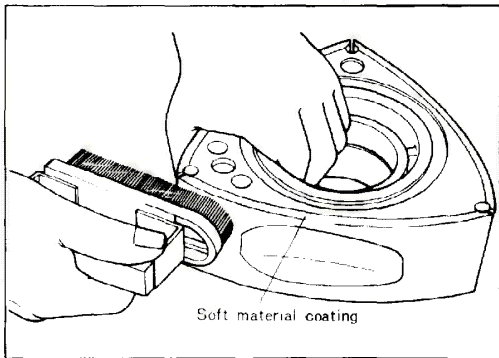
1 DISASSEMBLY OF ENGINE



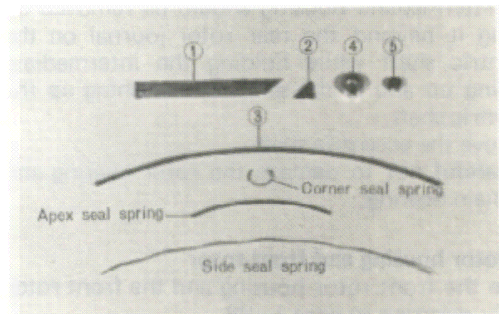
47U01X-070



47U01X-071



47U01X-072



47U01X-073

CLEANING

Front, intermediate and rear housings

1. Remove all carbon on the housings with an extra fine emery paper.
If using a carbon scraper, be careful not to damage the finished surfaces of the housings.
2. Remove the sealing agent on the housings by using a cloth or a brush soaked in a solution of ketone or thinner.

Rotor housing

Note

Before cleaning, check for traces of gas or water leakage along the inner margin of each side face of the rotor housing.

1. Remove all carbon from the inner surface of the rotor housing by wiping with cloth. Soak the cloth in a solution of ketone or thinner if it is difficult to remove the carbon.
2. Remove all deposits and rust from the cooling water passages on the housing.
3. Remove the sealing agent by wiping with a cloth or brush soaked in a solution of ketone or thinner.

Rotor

Remove the carbon on the rotor by using a carbon remover or emery paper. Wash the rotor in cleaning solution and dry it by blowing with compressed air.

Note

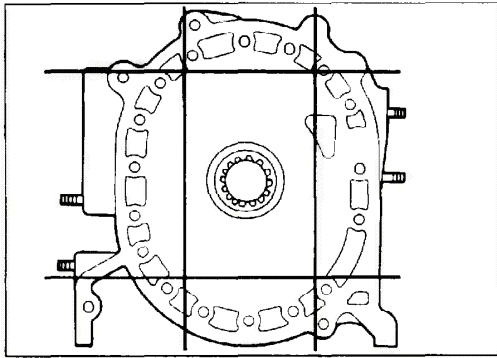
Care must be taken not to damage the soft material coating on the side surfaces of the rotor during the removal of carbon from the rotor by using carbon remover, etc.

Apex seal, side piece, side seal, soft seal, corner seal and springs

Remove all carbon from the apex seal 1, side piece 2, side seal 3, corner seal 4, soft seal 5 and each spring.

Be careful not to damage the seals and springs.

Never use emery paper as it will damage the seals. Wash them with cleaning solution.



57U01X-074

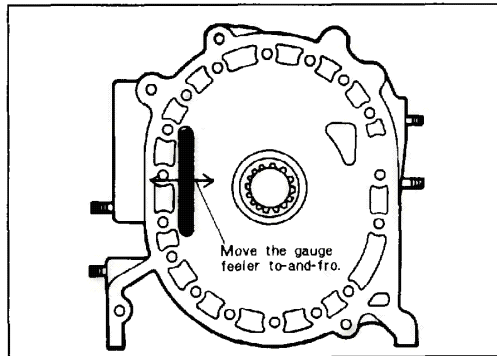
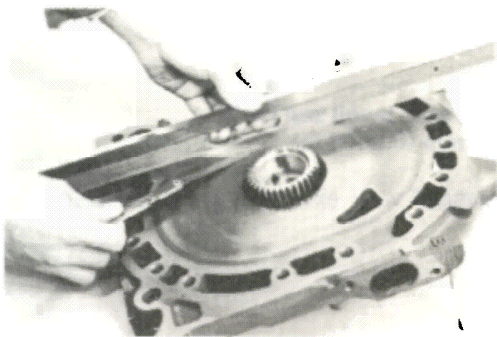
INSPECTION AND ADJUSTMENT

Inspect the following parts in sequences.

Front, intermediate and rear housings

1. Check for housing warp by placing a straight edge on the housing surface.
If the warp exceeds the limit, replace the housing.

Warp limit: 0.04 mm (0.0016 in)

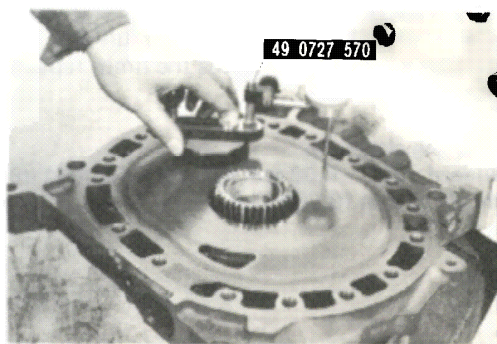


57U01X-076

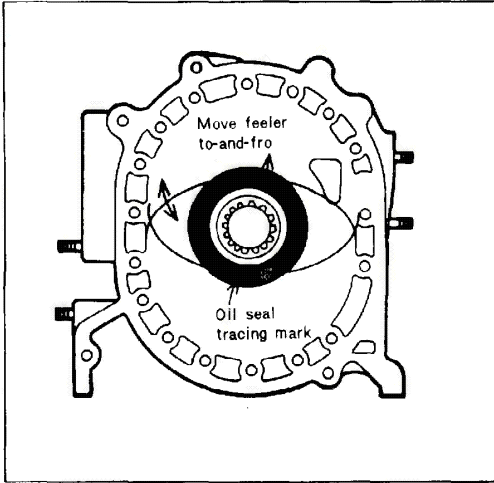
2. Check for stepped wear on the rotor sliding surfaces of the housing.

To check, mount a dial indicator on the **pinion height adjust gauge body** (49 0727 570) and slide the gauge body on the sliding surface of the housing.

**Stepped wear by side seal limit:
0.10 mm (0.0039 in)**

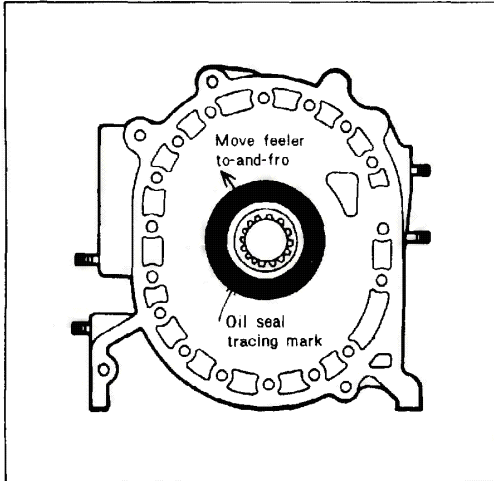


1 INSPECTION AND ADJUSTMENT



47U01X-078

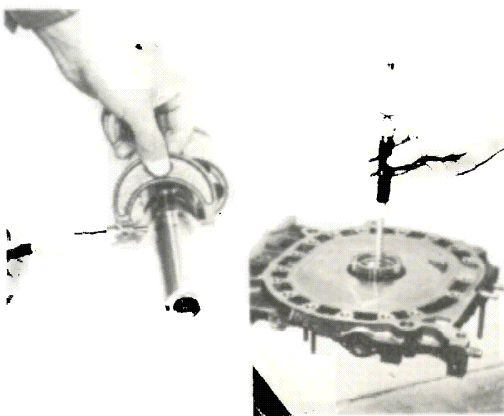
Stepped wear by side seal limit:
Inside of oil seal tracing mark
0.01 mm (0.0004 in)
Outside of oil seal tracing mark
0.10 mm (0.0039 in)



47U01X-079

Stepped wear by oil seal limit:
0.02 mm (0.0008 in)

If the stepped wear exceeds the limit, replace the housing.

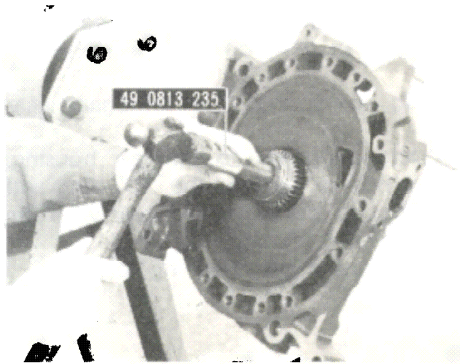


47U01X-080

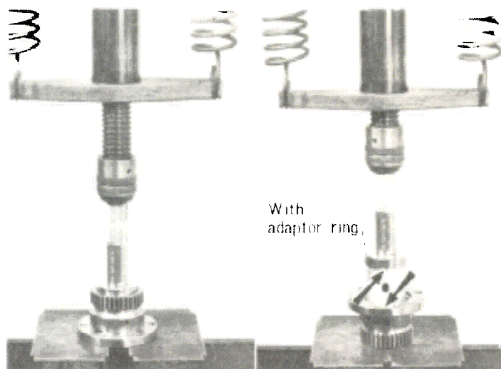
Front stationary gear and main bearing

1. Check the stationary gear for cracked, scored, worn or chipped teeth.
2. Check the main bearing for wear, scratching, flaking or any damage.
3. Check the main bearing clearance by measuring the inner diameter of the main bearing and outer diameter of the eccentric shaft main journal. If the bearing clearance exceeds the limit, replace the main bearing.

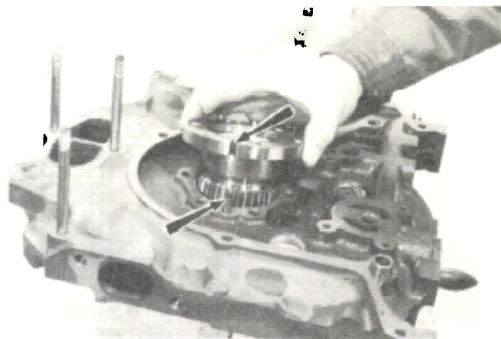
Main bearing clearance:
Standard 0.04 ~ 0.08 mm (0.0016 ~ 0.0031 in)
Limit 0.10 mm (0.0039 in)



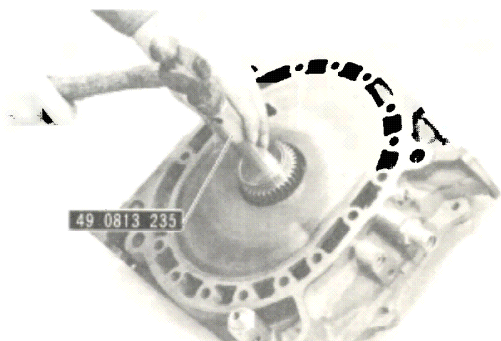
57U01X-081



57U01X-082



47U01X-083



57U01X-084

Replacing front main bearing

1. Remove the stationary gear and main bearing assembly, using the **main bearing puller & installer** (49 0813 235).

2. Using the **main bearing puller & installer without adaptor ring** (49 0813 235) press out the main bearing.

3. Using the **puller & installer with adaptor ring** (49 0813 235) and aligning the lug of the bearing and the slot or the stationary gear, press fit the main bearing into the stationary gear until the adaptor touches the stationary gear flange.

4. Install the stationary gear into the front housing, aligning the slot of the stationary gear flange and the dowel pin on the housing.

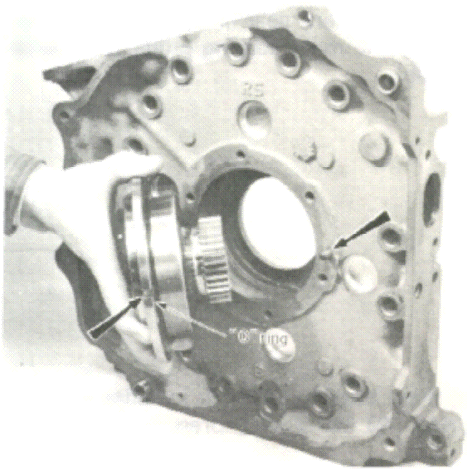
Rear stationary gear and main bearing

Check the rear stationary gear and main bearing as described on page 1–32.

Replacing rear main bearing

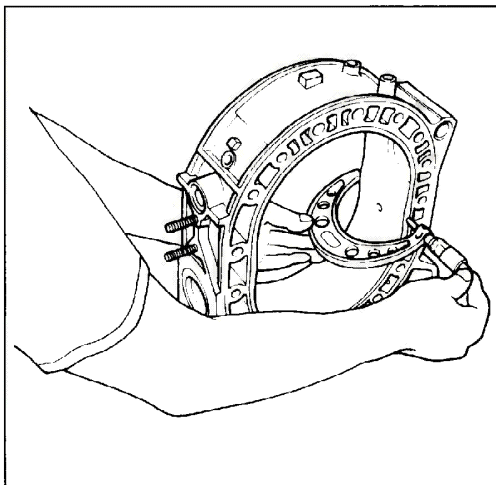
1. Remove the stationary gear attaching bolts.
2. Using the **main bearing puller & installer** (49 0813 235), remove the stationary gear.
3. Replace the rear main bearing, referring to Steps 2 and 3 on page 1–33.

1 INSPECTION AND ADJUSTMENT



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4. Apply a thin coat of vaseline on the **new "O" ring** and place it in the groove of the stationary gear.
5. Apply sealing agent onto the stationary gear flange.
6. Install the stationary gear to the rear housing, being careful not to damage the "O" ring and aligning the slot of the stationary gear with the dowel pin on the rear housing.
7. Tighten the stationary gear attaching bolts.



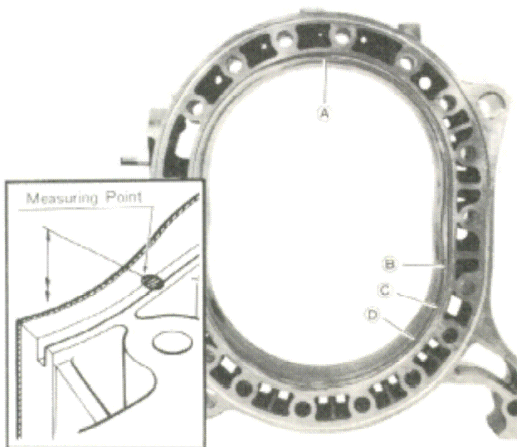
47U01X-086

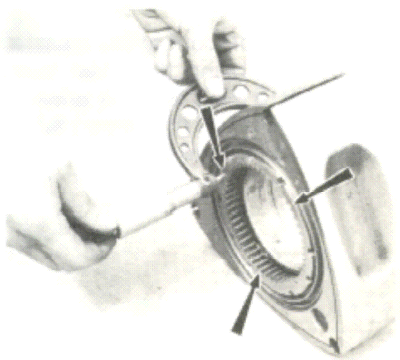
Rotor housing

1. Check the chromium plated surface on the rotor housing for scoring, flaking or any damage. If any of these conditions are excessive, replace the rotor housing.
2. Check the rotor housing width by using a micrometer.

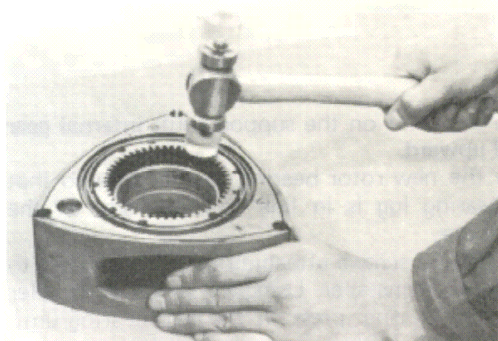
The measurements should be **taken at four points**. If the difference between the value of point A and the minimum value among the points B, C and D exceeds the limit, the rotor housing should be replaced with a new one.

**Difference of rotor housing width limit:
0.06 mm (0.0024 in)**

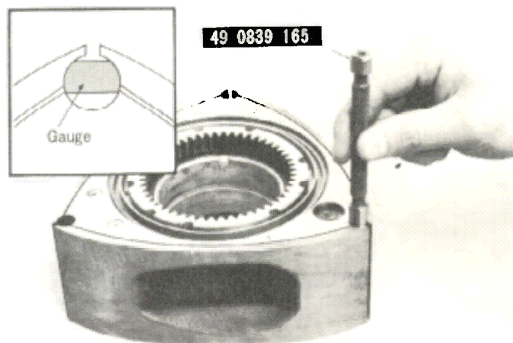




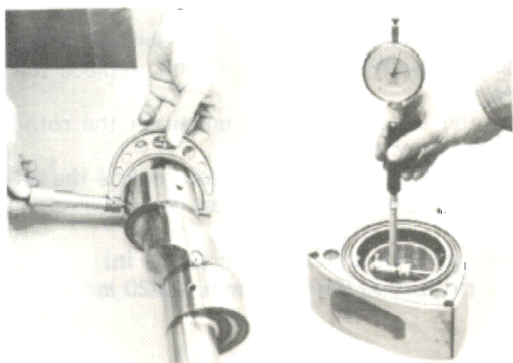
57U01X-088



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Rotor

- Carefully inspect the rotor and replace if it is severely worn or damaged.
- Check the internal gear for cracked, scored, worn or chipped teeth.
- Check the clearance between the side housing and rotor by measuring the rotor housing width A (see page 1-34) and the maximum rotor width. The rotor width should be measured at **three points**.

12A	Standard	0.12 ~ 0.19 mm (0.0047 ~ 0.0074 in)
	Limit	less than 0.10 mm (0.004 in)
13B	Standard	0.12 ~ 0.21 mm (0.0047 ~ 0.0083 in)
	Limit	less than 0.10 mm (0.004 in)

If the clearance is more than the specification, replace the rotor assembly.

If the clearance is less than the specification, it indicates that the internal gear has come out, so strike the internal gear lightly with plastic hammer, being careful not to damage and recheck the clearance between the side housing and the rotor.

- Check the corner seal bores for wear with the **gauge** (49 0939 165).
 - If neither end of the gauge go into the bore, use the original corner seal.
 - If the not-go-end of the gauge does not go into the bore while the go-end does, replace with a new corner seal.
 - If both ends of the gauge go into the bore, replace the rotor.

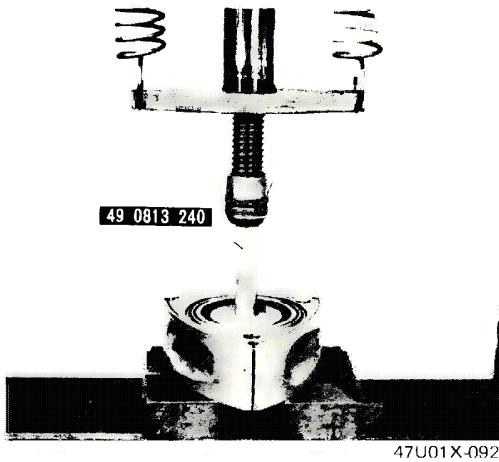
Rotor bearing

- Check the rotor bearing for wear, flaking, scoring or any damage. If any of these conditions is found, replace the bearing.
- Check the rotor bearing clearance by measuring the inner diameter of the rotor bearing and outer diameter of the eccentric shaft rotor journal. If the bearing clearance exceeds the limit, replace the rotor bearing.

Rotor bearing clearance:

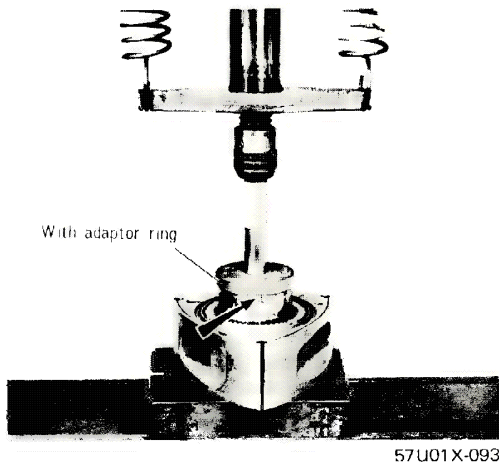
Standard	0.04 ~ 0.08 mm (0.0016 ~ 0.0031 in)
Limit	0.10 mm (0.039 in)

1 INSPECTION AND ADJUSTMENT

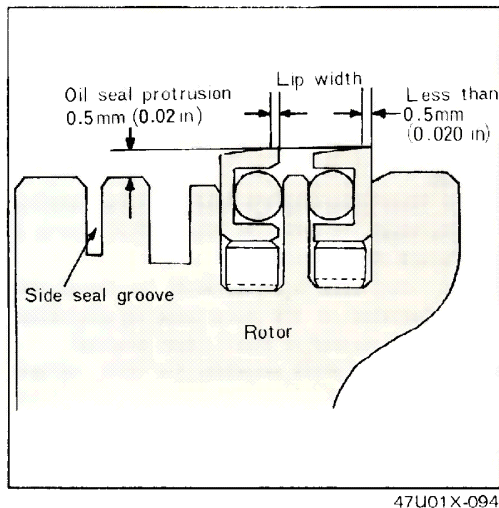


Replacing rotor bearing

1. Place the rotor on the support so that the **internal gear is facing downward**. Using the **rotor bush puller & installer (49 0813 240) without adaptor ring**, press the bearing out of the rotor. **Being careful** not to damage the internal gear.



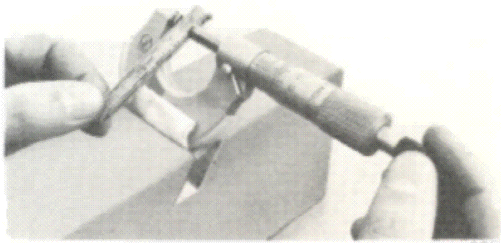
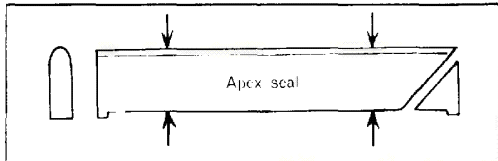
2. Place the rotor on the support with **internal gear faced upward**.
3. Place the new rotor bearing on the rotor so that the bearing lug is in line with the slot of the rotor bore.
4. Remove the screws attaching the adaptor ring to the puller & installer. Using the puller & installer and adaptor ring, press fit the new bearing until the bearing is flush with the rotor boss.



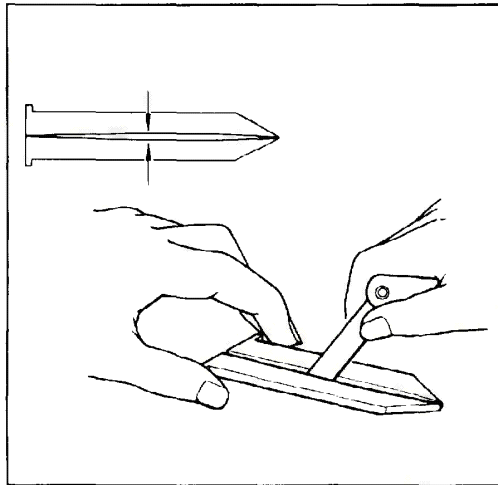
Rotor oil seal and spring

1. Check the oil seal for wear or any damage. If the oil seal lip width exceeds the limit, replace the oil seal.
2. Check the oil seal free movement in the rotor groove by pressing with finger.
3. Check the oil seal protrusion and replace the oil seal spring if the protrusion is less than the limit.

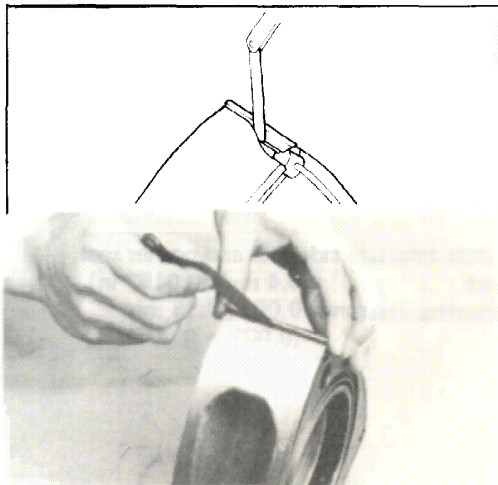
Oil seal lip width limit: 0.5 mm (0.020 in)
Oil seal protrusion limit: 0.5 mm (0.020 in)



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Apex seal, side piece and spring

1. Check the apex seal and side piece for wear, crack or any damage. If any of these conditions is found, replace the seal.
2. Measure the apex seal height with a micrometer at two positions and replace if the height is less than the limit.

Apex seal height:

Standard 8.5 mm (0.3347 in)

Limit 7.0 mm (0.2756 in)

3. Check the apex seal for warp by measuring the clearance between the top surfaces of the apex seals picked out from the three seals of the rotor. If the clearance exceeds the limit, replace all three apex seals on a rotor.

Apex seal warpe limit:

Limit 0.06 mm (0.0024 in)

4. Check the clearance between the apex seal and the groove. To check, place the apex seal in its respective groove on the rotor and measure the clearance between the apex seal and the groove with a feeler gauge.

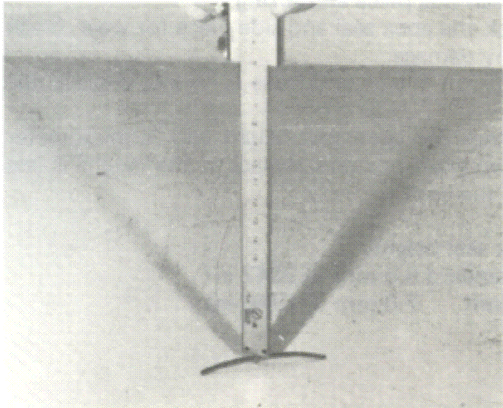
The feeler gauge should be inserted until the tip of the gauge reaches the bottom of the groove. If the clearance exceeds the limit, replace the apex seal.

Clearance between apex seal and rotor groove:

Standard 0.05 ~ 0.09 mm (0.002 ~ 0.0035 in)

Limit 0.15 mm (0.0059 in)

1 INSPECTION AND ADJUSTMENT



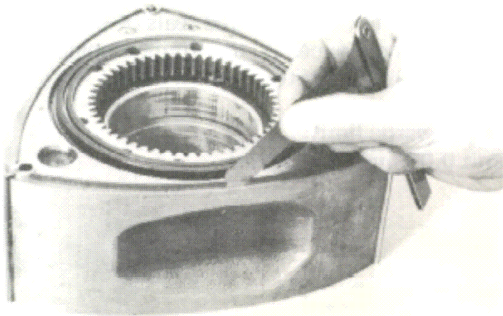
47U01X-098

5. Check the apex seal spring for wear and free height. If the free height is less than the limit, replace the spring.

Free height limit:

13B 3.8 mm (0.1496 in)

12A 5.5 mm (0.2165 in)



47U01X-100

Side seal and spring

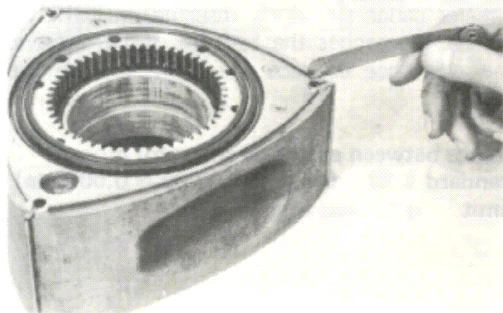
1. Check the side seal free movement in the rotor groove by pressing with finger.
2. Check the side seal protrusion from the rotor surface and replace the side seal spring if the protrusion is less than the limit.
3. Check the clearance between the side seal and the groove with a feeler gauge. If the clearance exceeds the limit, replace the side seal.

Side seal protrusion limit: 0.5 mm (0.02 in)

Clearance between the side seal and rotor groove:

Standard 0.03 ~ 0.08 mm (0.0012 ~ 0.031 in)

Limit 0.10 mm (0.0039 in)



57U01X-101

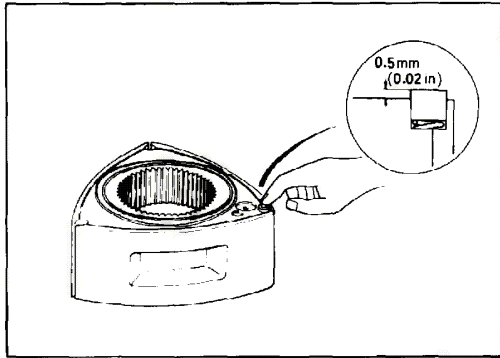
4. Using a feeler gauge, check the clearance between the side seal and the corner seal with these seals installed on the rotor. If the clearance exceeds the limit, replace the side seal.

When the side seal is replaced, adjust the clearance between the side seal and the corner seal by grinding the one end of the side seal along the round shape of the corner seal with a fine file.

Clearance between side seal and corner seal:

Limit 0.4 mm (0.0157 in)

**Adjusting clearance 0.05 ~ 0.15 mm
(0.002 ~ 0.0059 in)**

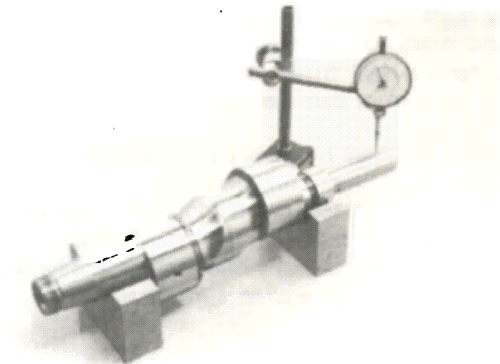


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Corner seal, soft seal and spring

1. Check the corner seal for wear, crack or any damage. If any of these conditions is found, replace the seal.
2. Check the soft seal for excessive heat, wear or any damage. If any of these conditions is found, replace the seal.
3. Check the corner seal free movement in the rotor groove by pressing with finger.
4. Check the corner seal protrusion from the rotor surface. Replace the corner seal spring if the protrusion is less than the limit.
5. Check the corner seal spring for wear.

Corner seal protrusion limit: 0.5 mm (0.02 in)

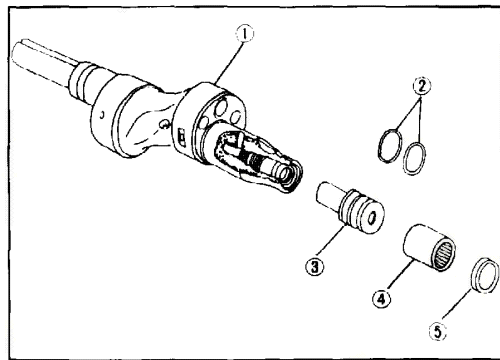


57U01X-103

Eccentric shaft

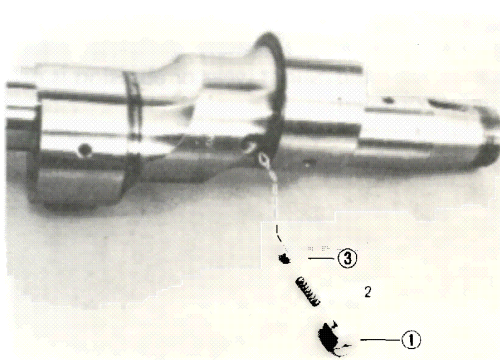
1. Check the shaft for cracks, scratches, wear or any damage. Be sure that the oil passages are open.
2. Check the shaft for run-out.
To check, use a dial indicator and turn the eccentric shaft, and take one-half of the largest difference shown by the dial indicator.
If the run-out is more than the limit, replace the shaft with a new one.

**Eccentric shaft run-out limit:
0.06 mm (0.0024 in)**



47U01X-104

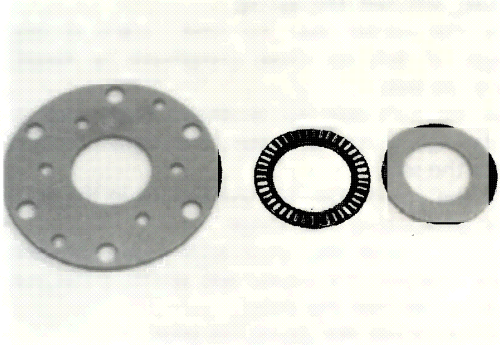
3. Check the blind plug in the shaft end for oil leakage or looseness. If any oil leakage is found, remove the blind plug with a hexagonal allen key and replace the "O" ring.
 - 1) Eccentric shaft
 - 2) "O" ring
 - 3) Blind plug
 - 4) Bearing
 - 5) Oil seal



47U01X-105

4. Check the oil jet for spring weakness, sticking or damage of the steel ball.
 - 1) Plug
 - 2) Spring
 - 3) Steel ball

1 INSPECTION AND ADJUSTMENT



47U01X-540

Needle bearing and thrust plate

Check the needle bearing for wear or damage. Inspect the bearing housing and thrust plate for wear or any damage.



47U01X-640

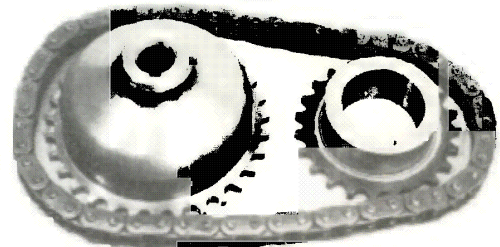
Eccentric shaft front and rear oil seals

Check the front oil seal fitted into the front cover and the rear oil seal fitted into the rear stationary gear. If it is worn or damaged, replace the oil seal as follows:

1. Remove the oil seal by using a suitable tool.
2. Clean the oil seal mounting bore.
3. Position a new oil seal on its mounting bore and place a hardwood on the oil seal. Then, install the oil seal while tapping the hardwood with a hammer until it is firmly seated.

Notes

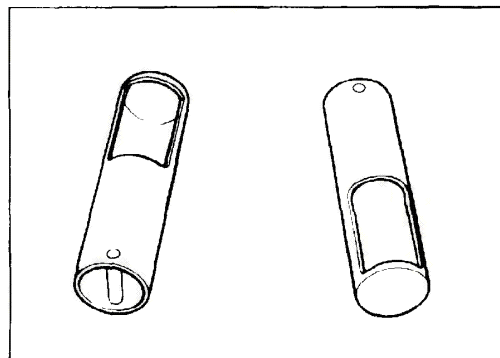
- a) Do not coat the outer surface of the oil seal with any lubricant or sealing agent.
- b) Do not tap the oil seal directly with a hammer.



47U01X-740

Oil pump drive chain and sprockets

Check the oil pump drive chain for broken links. Check the eccentric shaft sprocket and oil pump sprocket for cracks and worn or damaged teeth. If any defects are found, replace with new parts.



47U01X-840

Auxiliary port valve

1. Check the valve for extremely abnormal wear, damage or cracking. Slight wear or abrasion is not a particular problem.
2. Insert the valve into the side housing and turn the valve; check to be sure that it turns smoothly.

ASSEMBLY OF ENGINE

13B, 12A Engine Internal Parts

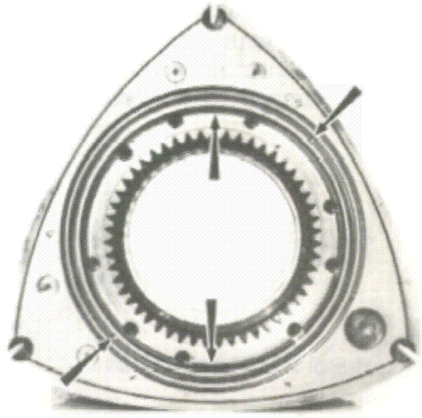
Assemble the following component parts in sequences.

Note

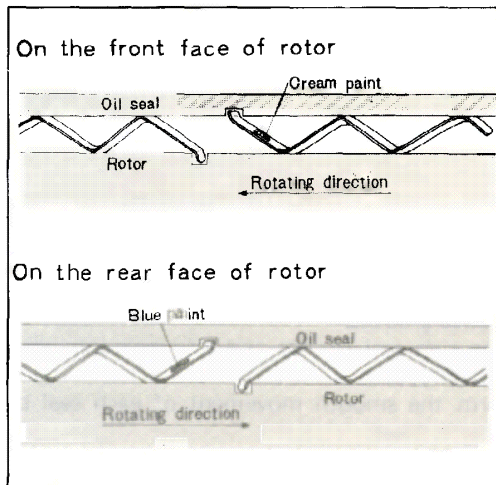
The "O" rings, rubber seals, and gaskets should be replaced with new ones.

Oil seal

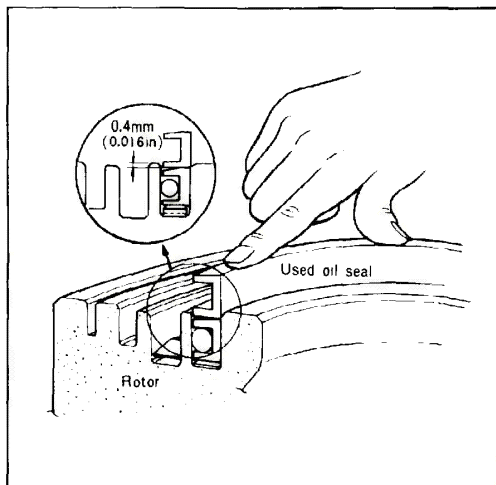
1. Place the rotor on a clean rubber pad or cloth.
2. Install the oil seal springs in their respective grooves on the rotor with each round edge of the spring fitted in the stopper hole in the oil seal grooves.



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47U01X-107



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The oil seal springs have been painted in cream or blue color.

The **cream-painted** springs should be fitted on the front faces of both front and rear rotors.

While the **blue-painted** springs should be fitted on the rear faces.

3. Install a **new "O" ring** in each oil seal.
4. Place the inner oil seal to the oil seal groove so that the square edge of the spring fits in the stopper notch of the oil seal.

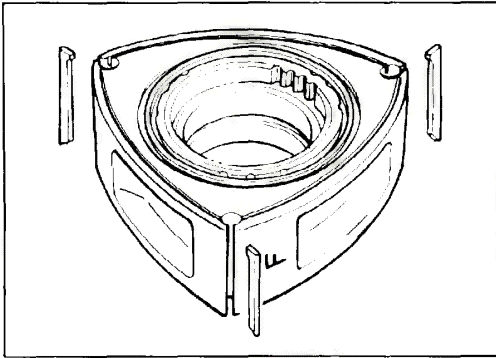
5. Press the inner oil seal by using a used inner oil seal so that the lip surface of the oil seal sinks into a position approximately **0.4 mm (0.016 in)** below the surface of the rotor.
6. Place the outer oil seal to the oil seal groove so that the square edge of the spring fits in the stopper notch of the oil seal.
7. Push the oil seal slowly with fingers. Confirm the smooth movement of each oil seal by pressing the oil seal.
8. Install the oil seal springs and oil seals on the other side of the rotor.

Note

a) When replacing the oil seal, confirm the smooth movement of oil seal by placing the oil seal on the oil seal spring in the groove before inserting the "O" ring.

b) Be careful not to deform the lip of the oil seal.

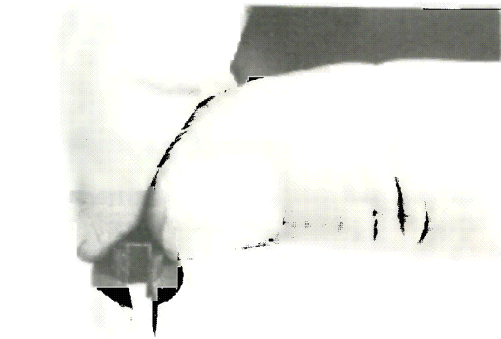
1 ASSEMBLY OF ENGINE



47U01X-109

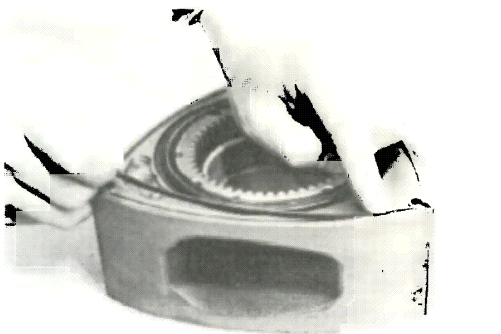
Seals (Front side of rotor)

1. Place the front rotor on a clean rubber pad or cloth with the internal gear upward.
2. Install the apex seals without the spring and side piece into their respective grooves so that the side piece is positioned to the rear side of the rotor.



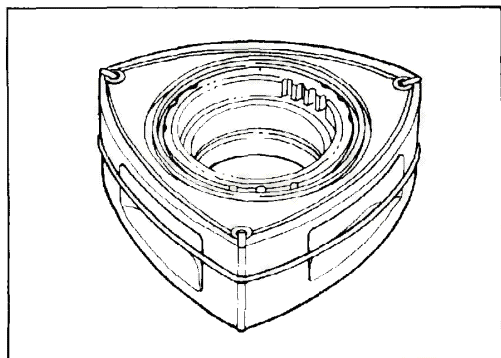
47U01X-110

3. Install the soft seal into the corner seal.



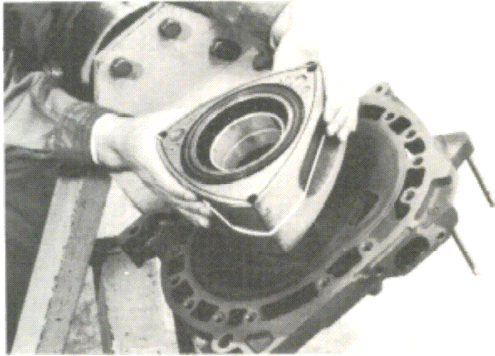
57U01X-111

4. Place the corner seal springs and corner seals into respective grooves.
5. Fit the side seal springs and side seals into their respective grooves.
Confirm the smooth movement of each seal by pressing its head.



47U01X-112

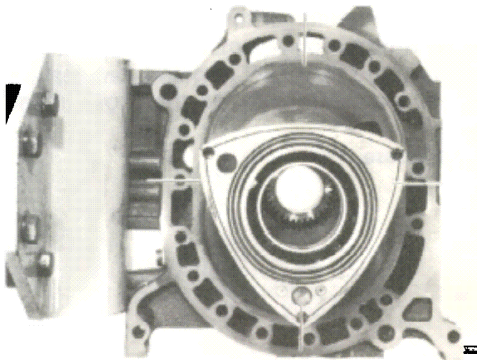
6. Set the rubber ring as shown in figure, not to drop the apex seals from the rotor.



47U01X-113

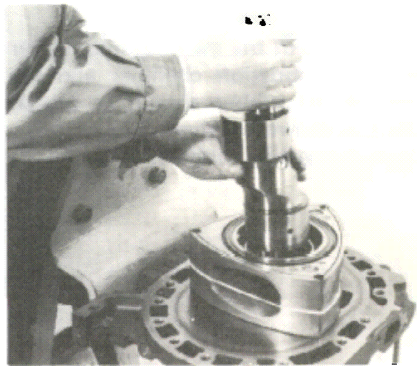
Front rotor

1. Mount the front housing on the engine stand.
2. Place the front rotor assembly on the front housing. Be careful not to drop the seals into the port.



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3. Mesh the internal gear and stationary gear so that one of the rotor apexes is set to any one of the four positions illustrated.

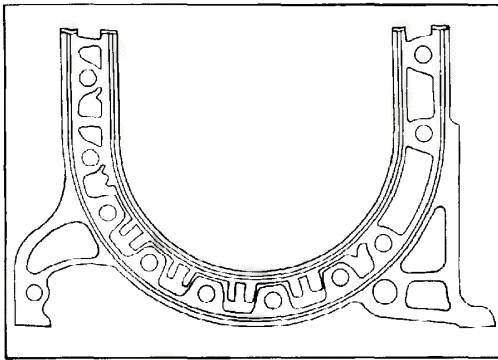


57U01X-115

Eccentric shaft

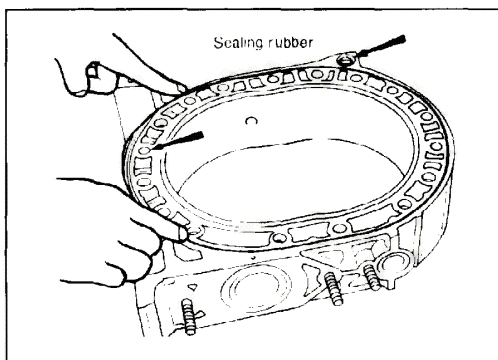
1. Lubricate the front rotor journal and main journal on the shaft with engine oil.
2. Insert the eccentric shaft, being careful not to damage the rotor bearing and main bearing.

1 ASSEMBLY OF ENGINE



47U01X-117

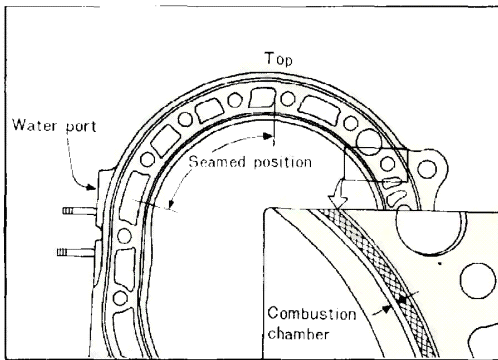
2. Apply sealing agent onto the front side of the front rotor housing.



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3. Slightly apply vaseline onto **new "O" ring** and **new sealing rubbers** to prevent them from coming off, and place the new "O" ring and new sealing rubbers on the front side of the front rotor housing.

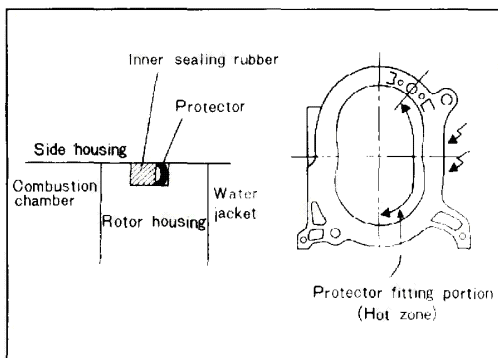
Do not use grease.



47U01X-119

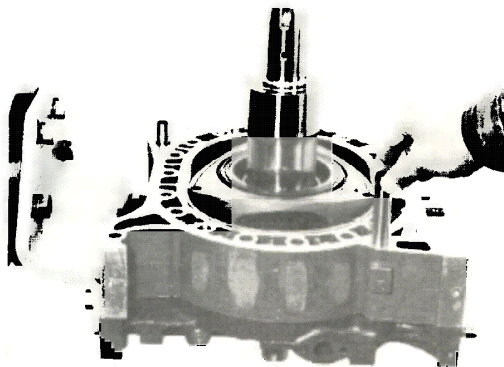
Notes

a) The wider white line of the inner sealing rubber should face to combustion chamber and the seam of the sealing rubber should be placed at the position as shown in figure.
Do not stretch the sealing rubbers.



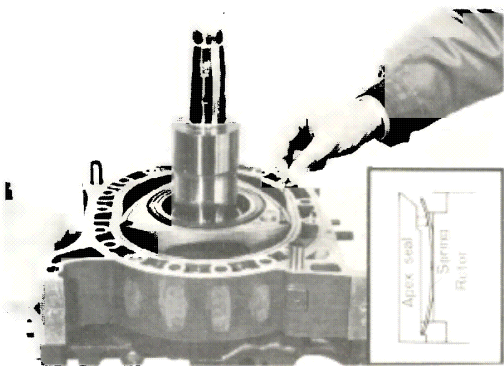
47U01X-120

b) When the engine is overhauled, install the protector behind the inner sealing rubber to improve sealing rubber durability.



47U01X-121

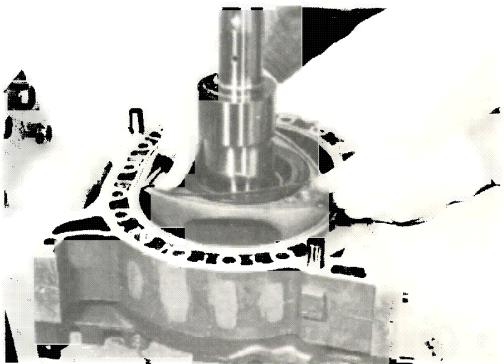
4. Invert the front rotor housing and install it onto the front housing, being careful not to drop the sealing rubbers and "O" ring out of the grooves.
5. Apply engine oil onto the tubular dowels and insert the tubular dowels through the front rotor housing holes into the front housing holes.



47U01X-122

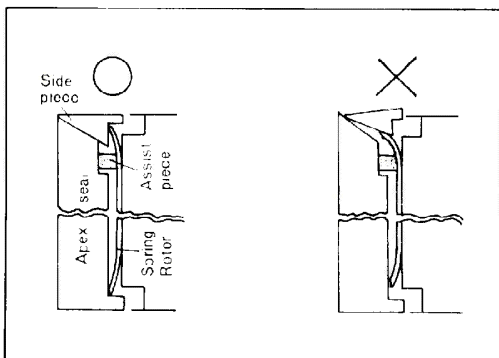
Seals (Rear side of rotor)

1. Insert the each apex seal spring so that both ends of the spring may support the back side of the apex seal.



47U01X-123

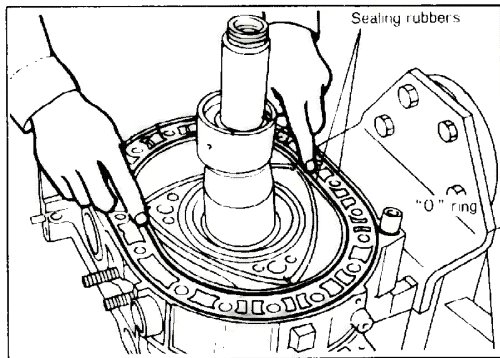
2. Install the soft seal into the corner seal.
3. Install the corner seal springs and corner seals into their respective grooves.
4. Install the side seal springs and side seals into their respective grooves.



47U01X-124

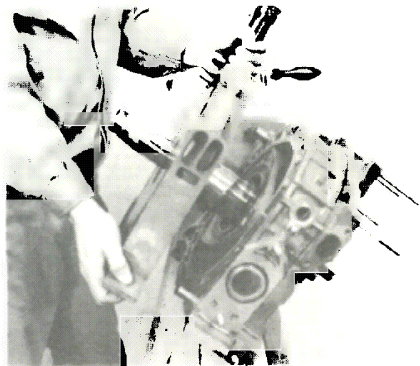
5. Fit the each side piece to its original position. And confirm that the spring is set correctly on the side piece.
6. Confirm the smooth movement of each seal by pressing its head.

1 ASSEMBLY OF ENGINE



47U01X-125

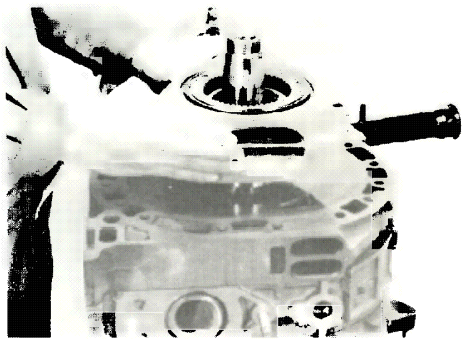
7. Apply the sealing agent on the rear side of the front rotor housing and then, place the **new "O" ring, new sealing rubbers** and protector on the rear side of the front rotor housing, as instructed on page 1-34.
8. Apply engine oil onto the each seal and sliding surface of the front rotor housing. Make sure that the front rotor housing is free from any foreign matter.



47U01X-126

Intermediate housing

1. Pull the eccentric shaft about 25 mm (1.0 in), but do not pull over 35 mm (1.5 in).
2. Install the intermediate housing through the eccentric shaft on the front rotor housing.



47U01X-127

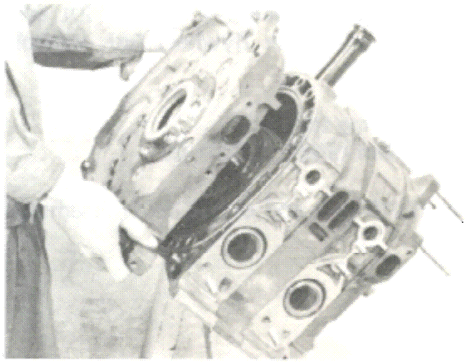
Rear rotor and rear rotor housing

1. Install the rear rotor, referring to Page 1-43.



47U01X-128

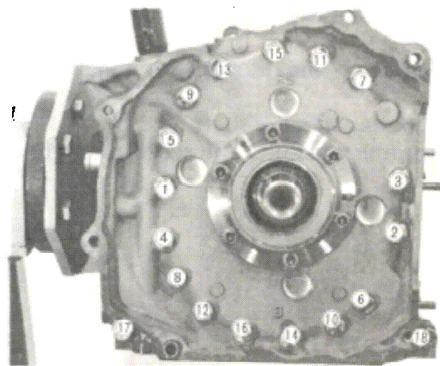
2. Install the rear rotor housing, referring to Page 1-43.



47U01X-129

Rear housing

1. Apply sufficient engine oil onto the stationary gear and main bearing, then install the rear housing on the rear rotor housing.



47U01X-130

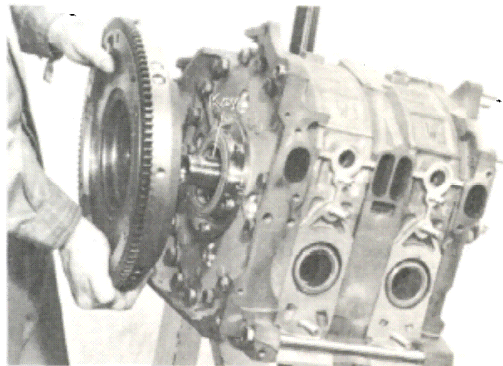
2. Apply engine oil onto the thread of the bolt.
3. Fit the tension bolts and tighten the bolts in the order shown in figure.

Tension bolt tightening torque:

13B	32 ~ 40 N-m (23 ~ 29 ft-lb)
12A	32 ~ 38 N-m (23 ~ 27 ft-lb)

Notes

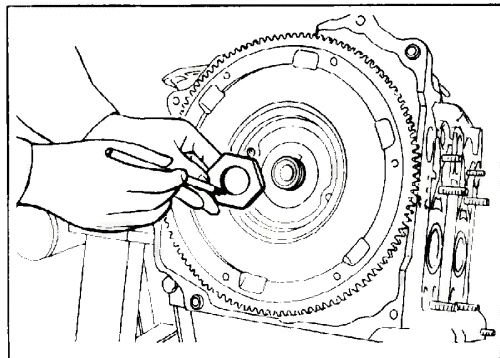
- a) Replace the sealing washer in the tension bolt when the engine is overhauled.
 - b) The bolt should be tightened gradually and in the sequence illustrated.
 - c) Because the 12A engine does not have tension bolt No. 11, skip that one when tightening the bolts.
4. Turn the eccentric shaft and make sure that the rotation is light and smooth.



47U01X-131

Flywheel (Manual transmission)

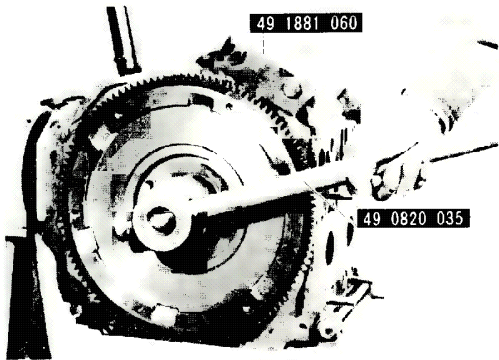
1. Apply engine oil to the oil seal in the rear housing.
2. Fit the key to the eccentric shaft.
3. Install the flywheel to the eccentric shaft.



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4. Apply sealing agent at the surface on the lock nut that contacts the flywheel.

1 ASSEMBLY OF ENGINE

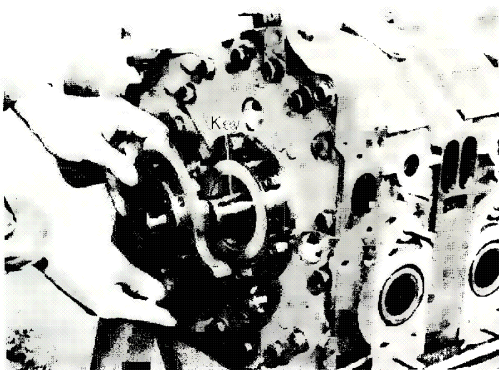


57U01X-133

5. Install the **ring gear brake** (49 1881 060) and tighten the nut with the **flywheel box wrench** (49 0820 035).

Lock nut tightening torque:
400 ~ 500 N-m (289 ~ 362 ft-lb)

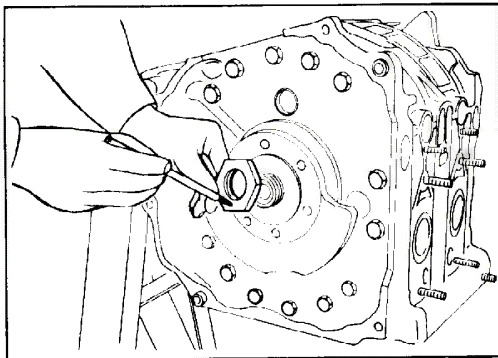
6. Install the clutch disc and clutch cover assembly.



47U01X-134

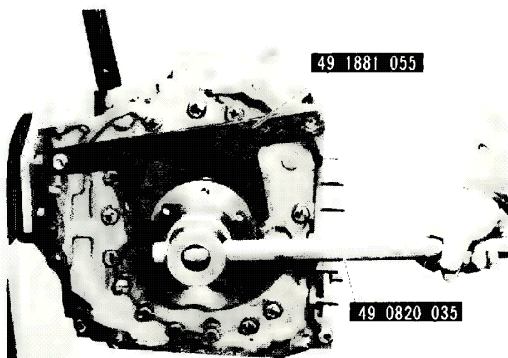
Counter weight and drive plate (automatic transmission)

1. Apply engine oil to the oil seal in the rear housing.
2. Fit the key to the eccentric shaft.
3. Install the counter weight to the eccentric shaft.



47U01X-135

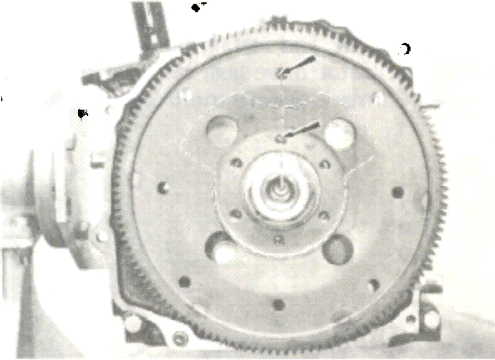
4. Apply sealing agent to the surface of the lock nut that contacts the counter weight.



57U01X-136

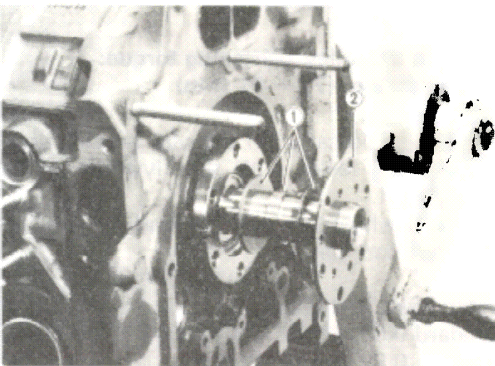
5. Install the **counter weight stopper** (49 1881 055) and tighten the nut with the **flywheel box wrench** (49 0820 035).

Lock nut tightening torque:
400 ~ 500 N-m (289 ~ 362 ft-lb)



47U01X-137

6. Install the drive plate so that the hole of the drive plate and counter weight are positioned as shown in figure.



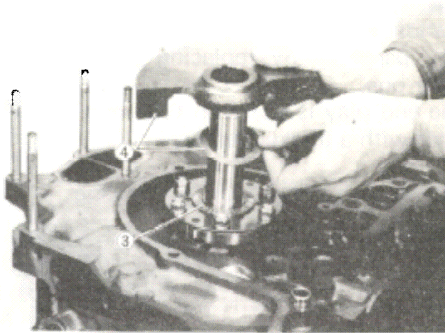
47U01X-138

Bearing housing and balance weight

1. Place the thrust plate with the chamfer downward, and slide the spacer and needle bearing onto the eccentric shaft. Then apply sufficient engine oil to them.
2. Place the bearing housing on the front housing, and tighten the attaching bolts.

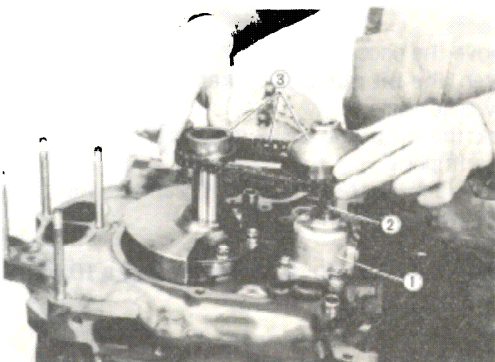
Note

If the bearing housing has not been removed from the front housing, special care should be taken, when installing the spacer, so that the center of the needle bearing in the bearing housing comes to the center of eccentric shaft, the spacer should be seated to the thrust plate.



47U01X-139

3. Slide the needle bearing onto the shaft, and apply engine oil to it.
4. Slide the balance weight together with the thrust washer onto the shaft.



47U01X-140

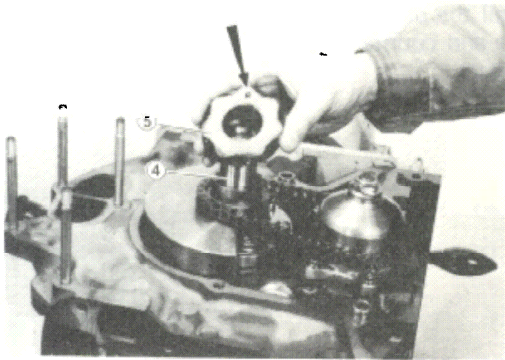
Oil pump and oil pump drive

1. Install the oil pump assembly on the front housing.
2. Fit the key onto the oil pump shaft.
3. Fit the oil pump drive chain onto the oil pump sprocket and eccentric shaft sprocket, and install them to the eccentric shaft and oil pump shaft, aligning the key and keyway.

Oil pump sprocket tightening torque:

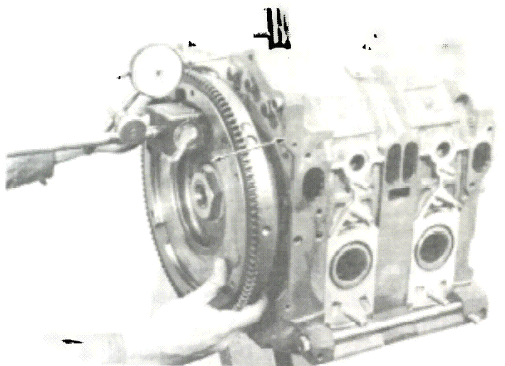
32 ~ 47 N·m (23 ~ 34 ft·lb)

1 ASSEMBLY OF ENGINE



47U01X-141

4. Align the keyways of the eccentric shaft sprocket and balance weight, and install the key.
5. Slide the distributor drive gear onto the eccentric shaft with "F" mark toward the front of engine.



47U01X-142

Adjusting eccentric shaft end play

1. Install the eccentric shaft pulley onto the shaft and tighten the attaching bolt.

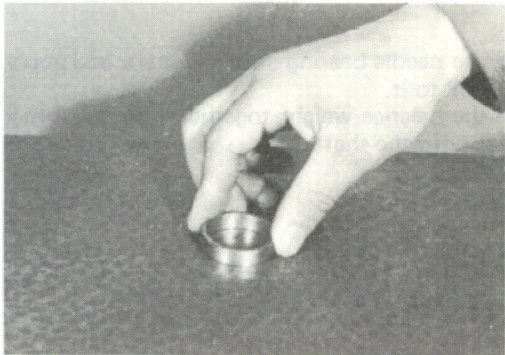
Eccentric shaft pulley tightening torque:
100 ~ 120 N-m (72 ~ 87 ft-lb)

2. Mount a dial indicator on the rear housing so as to contact the feeler with the flywheel or the counter weight.
3. Move the flywheel fore and aft, and read the eccentric shaft end play.

Eccentric shaft end play:
Standard 0.04 ~ 0.07 mm (0.0016 ~ 0.0028 in)
Limit 0.09 mm (0.0035 in)

If the end play is more than the limit, adjust it by sanding the spacer on a surface plate using an emery paper or by replacing the spacer with a thinner one.

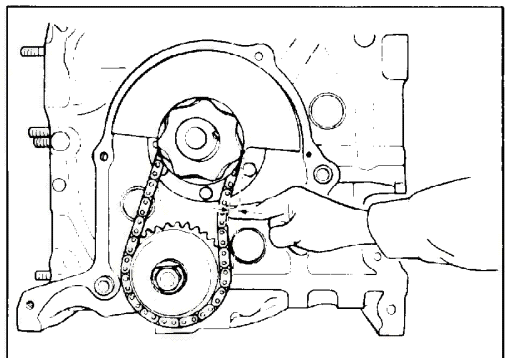
If the end play is less than **0.04 mm (0.0016 in)**, replace with a thicker spacer.



47U01X-143

The spacers are available in the following thicknesses:

Mark	Thickness	Mark	Thickness
X	8.08 mm (0.3181 in)	V	8.02 mm (0.3158 in)
K	8.06 mm (0.3173 in)	Z	8.00 mm (0.3150 in)
Y	8.04 mm (0.3165 in)		

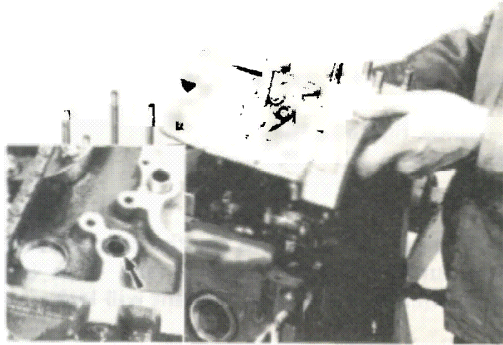


57U01X-144

Front cover

1. Remove the eccentric shaft pulley.
2. Tighten the oil pump sprocket nut and bend the lockwasher tab.
3. Check the oil pump drive chain slack by pressing with a finger.
 If the slack exceeds the limit, replace the drive chain with a new one.

Oil pump drive chain slack limit: 12 mm (0.47 in)



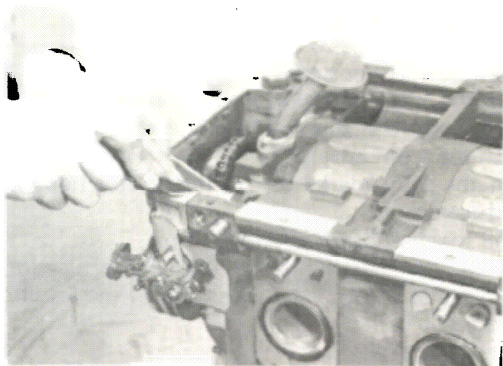
57U01X-145

4. Place a **new "O" ring** on the oil passage of the front housing.
5. Place the gasket and front cover on the front housing, and tighten the attaching bolts.
6. Apply engine oil onto the oil seal in the front cover.
7. Install the eccentric shaft pulley onto the shaft and tighten the pulley bolt.

Eccentric shaft pulley tightening torque:
100 ~ 120 N-m (72 ~ 87 ft-lb)

Note

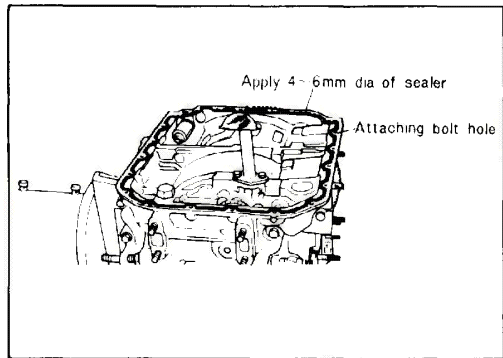
Use a new washer on the eccentric shaft pulley bolt when the pulley is removed.



47U10X-146

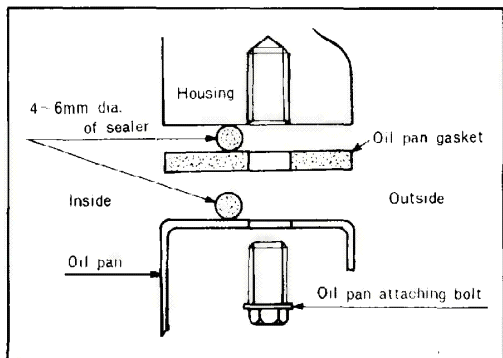
Oil strainer and oil pan

1. Install the oil strainer and gasket on the front housing.
2. Cut off the excess gaskets along the mounting surface of the oil pan.



47U01X-147

3. Clean the mating surfaces of the housings and oil pan.
4. Apply the **4 ~ 6 mm (0.16 ~ 0.24 in)** diameter continuous bead of the sealer (part No. 8527 77 739) to the mounting surface of the oil pan. The sealer bead should be overlapped.

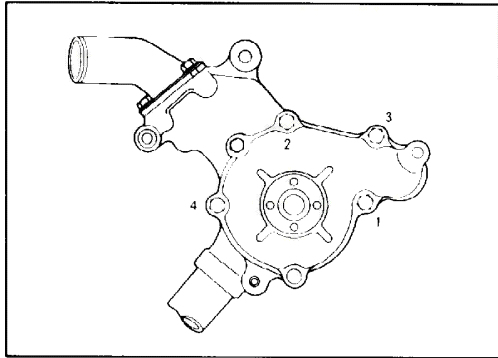


47U01X-148

Without the sealer (8527 77 739), use the suitable silicone base sealer and the oil pan gasket.

1. Apply the **4 ~ 6 mm (0.16 ~ 0.24 in)** diameter continuous bead of the sealer on mounting surface of oil pan and place the gasket on it. The both ends of the sealer bead should be overlapped.
2. Apply the sealer onto the gasket and install the oil pan.
5. Tighten the oil pan attaching bolts little by little in turn until the torque comes to **8 ~ 11 N-m (6 ~ 8 ft-lb)** evenly.

1 ASSEMBLY OF ENGINE



47U01X-149

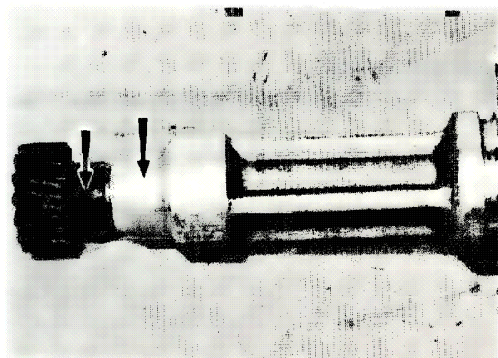
Assembly of the 13B Engine Auxiliary Parts Water pump

1. Install the water pump and tighten the nuts in sequence as shown in figure.

Water pump tightening torque:
18 ~ 27 N·m (13 ~ 20 ft·lb)

Caution

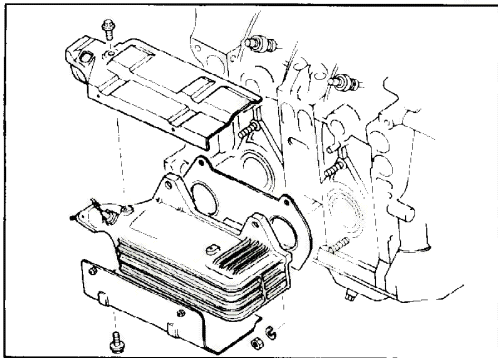
Do not forget to use shims on the side housing contact surfaces indicated by 2 and 4 in the figure. If shims are not used, coolant will leak.



47U01X-150

Oil filter and distributor

1. Attach two O-rings to the oil filter body.
2. Install the oil filter body.
3. Align the leading timing mark (Yellow painted) on the eccentric shaft pulley with the indicator pin on the front cover.
4. Align the tally marks on the distributor housing and driven gear.
5. Install the distributor and lock nut.
6. Turn the distributor housing until the projection of the signal rotor aligns with core of the leading side pick-up coil.
Tighten the lock nut.
7. Install the distributor rotor and cap.



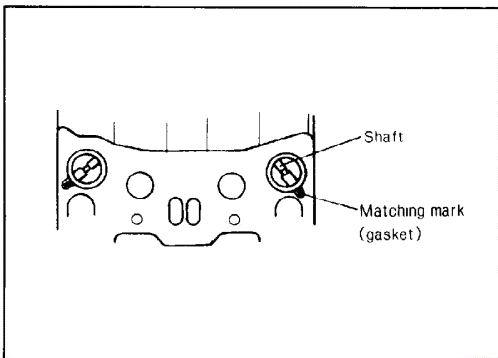
47U01X-151

Exhaust manifold

1. Place the gasket in position and install the exhaust manifold.

Exhaust manifold tightening torque:
32 ~ 47 N·m (23 ~ 34 ft·lb)

2. Install the hot air duct and absorber plate.



57U01X-152

Auxiliary ports

Intake manifold

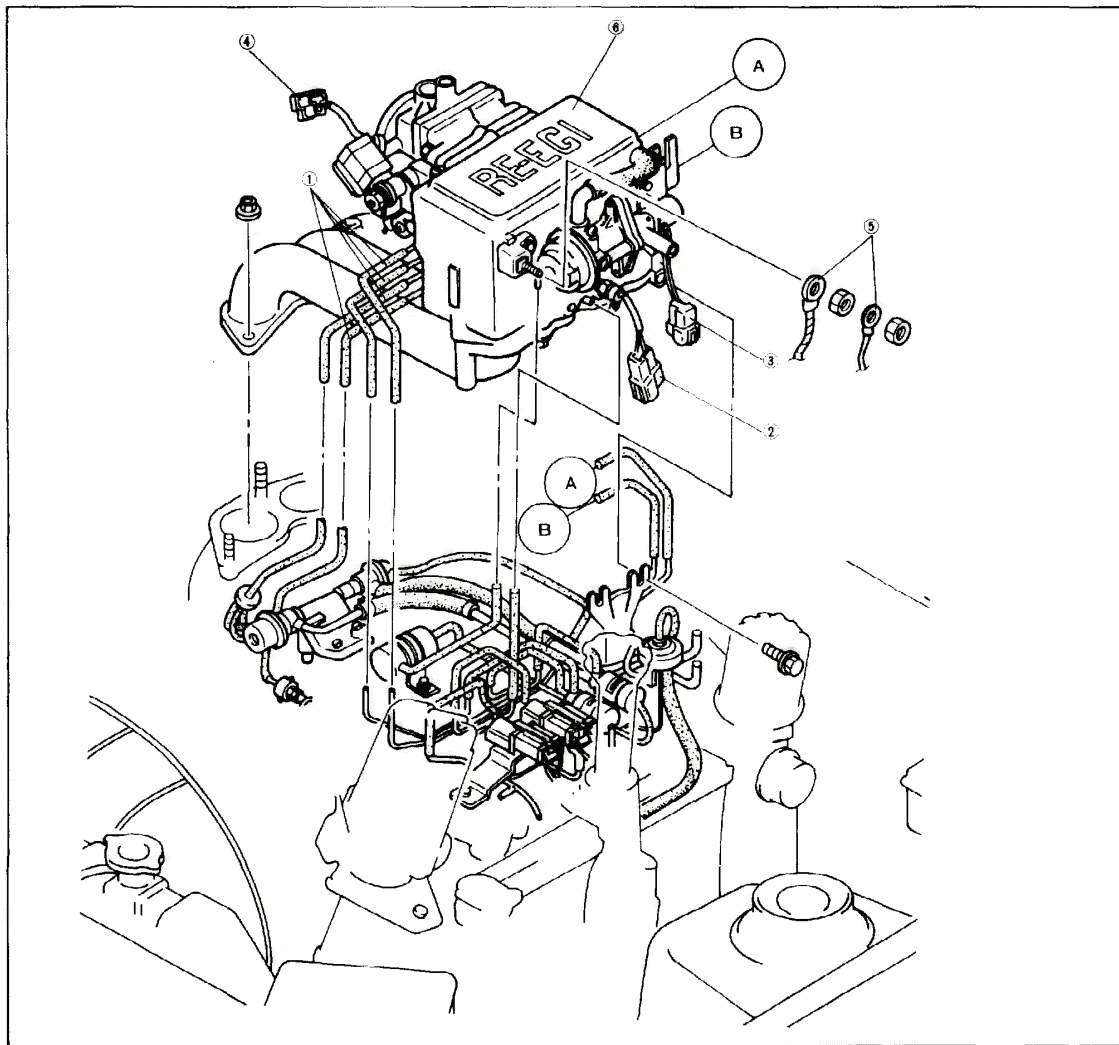
1. Install the auxiliary ports.

Note

Installation should be made so that the bigger sides of the auxiliary port valve shafts align the matching mark on the gasket as shown in the figure.

2. Install the "O" rings.
3. Install the intake manifold with a gasket.

Assembly of 13B engine parts related to lubricating, emission device



7U01X-553

1. Connect the metering oil pump pipes.

Tightening torque: 16 ~ 23 N-m (12 ~ 17 ft-lb)

2. Install the fuel injection nozzles.
3. Referring to the figure above, install the delivery pipe assembly, the chamber, and the emission device assembly as one piece.

Delivery pipe body tightening torque:

19 ~ 26 N-m (14 ~ 19 ft-lb)

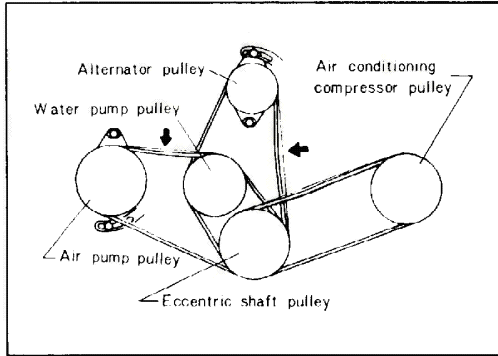
Emission device assembly tightening torque:

19 ~ 26 N-m (14 ~ 19 ft-lb)

4. Referring to the figure above, check to be sure that the vacuum sensing tube is not installed incorrectly.

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1 ASSEMBLY OF ENGINE



47U01X-154

Alternator and drive belt

1. Install the alternator to the bracket.
2. Install the drive belt and adjust the belt tension.

Alternator drive belt tension:
13 ~ 17 mm (0.51 ~ 0.67 in)

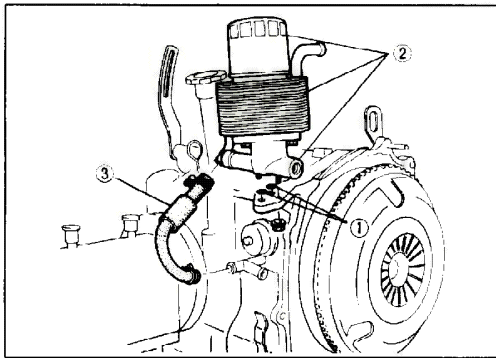
When pressed at **100 N (22 lb)** between the alternator pulley and eccentric shaft pulley.

Air pump and drive belt

Install the air pump and drive belt, and then, adjust the drive belt tension.

Air pump drive belt tension:
11 ~ 13 mm (0.43 ~ 0.51 in)

When pressed at **100 N (22 lb)** between the air pump pulley and water pump pulley.



57U01X-155

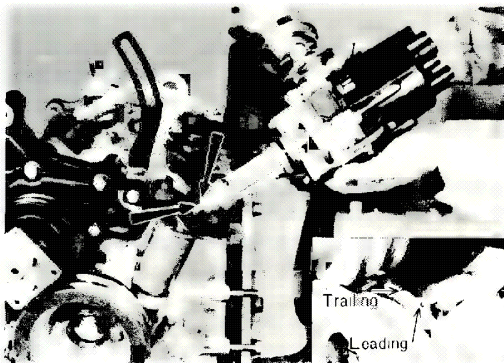
Assembly of 12B Engine Auxiliary Parts

Oil cooler and oil filter

1. Attach two O-rings to the oil filter body.
2. Install the oil filter body and oil cooler.
3. Connect the water hose.

Caution

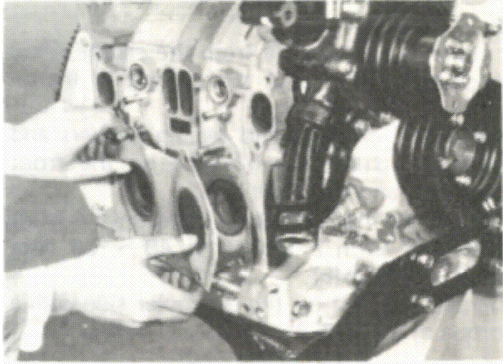
Never disassemble the oil cooler and oil cooler body. If done, engine oil leakage might happen.



47U01X-156

Distributor

1. Align the leading timing mark (Yellow painted) on the eccentric shaft pulley with the indicator pin on the front cover.
2. Align the tally marks on the distributor housing and driven gear.
3. Install the distributor and lock nut.
4. Turn the distributor housing until the projection of the signal rotor aligns with core of the leading side pick-up coil.
Tighten the lock nut.
5. Install the distributor rotor and cap.



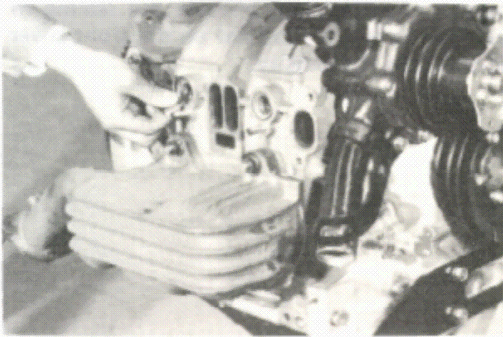
47U01X-157

Exhaust manifold and engine mount

1. Install the engine mount.
2. Place the gasket in position and install the exhaust manifold.

Exhaust manifold tightening torque:

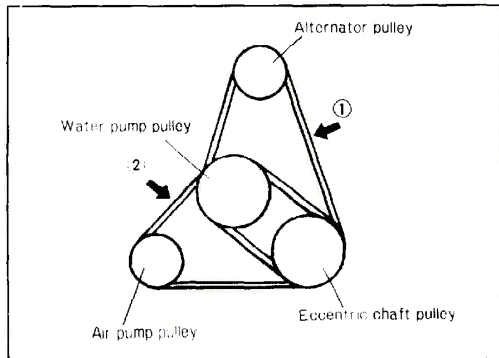
44 ~ 59 N-m (32 ~ 43 ft-lb)



57U01X-158

Intake manifold and carburetor assembly

1. Place the "O" rings and gasket.
2. Install the intake manifold and carburetor assembly in the reverse order of removing.



47U01X-159

Alternator and drive belt

1. Install the alternator to the bracket.
2. Install the drive belt and adjust the belt tension.

Alternator drive belt tension:

13 ~ 17 mm (0.51 ~ 0.67 in)

When pressed at **100 N (22 lb)** between the alternator pulley and eccentric shaft pulley.



47U01X-160

Air pump and drive belt

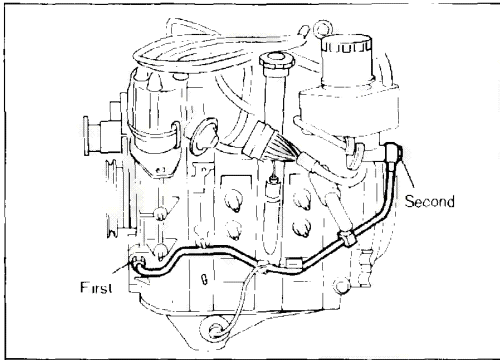
Install the air pump and drive belt, and then, adjust the drive belt tension.

Air pump drive belt tension:

11 ~ 13 mm (0.43 ~ 0.51 in)

When pressed at **100 N (22 lb)** between the air pump pulley and water pump pulley.

1 ASSEMBLY OF ENGINE



57U01X-161

Oil pipe

1. After removing the engine from the engine stand and engine hanger, install the oil pipe of the oil cooler.

- (1) Install the oil pipe and sealing washers and partially tighten the oil pipe on the front cover side and oil cooler side.
- (2) Tighten the nut of the oil pipe on the front cover side with a torque of **40 ~ 50 N·m (28.9 ~ 36.2 ft·lb)**.
- (3) Tighten the bolt on the oil cooler side with a torque of **60 ~ 85 N·m (43 ~ 61 ft·lb)**.

Caution

If the oil cover side bolt is tighten first, engine oil leakage might happen because the sealing of the oil pipe surface of contact on the front cover side is not done thoroughly.