DAIHATSU

F300

[HD - Engine]

ENGINE MECHANICALS

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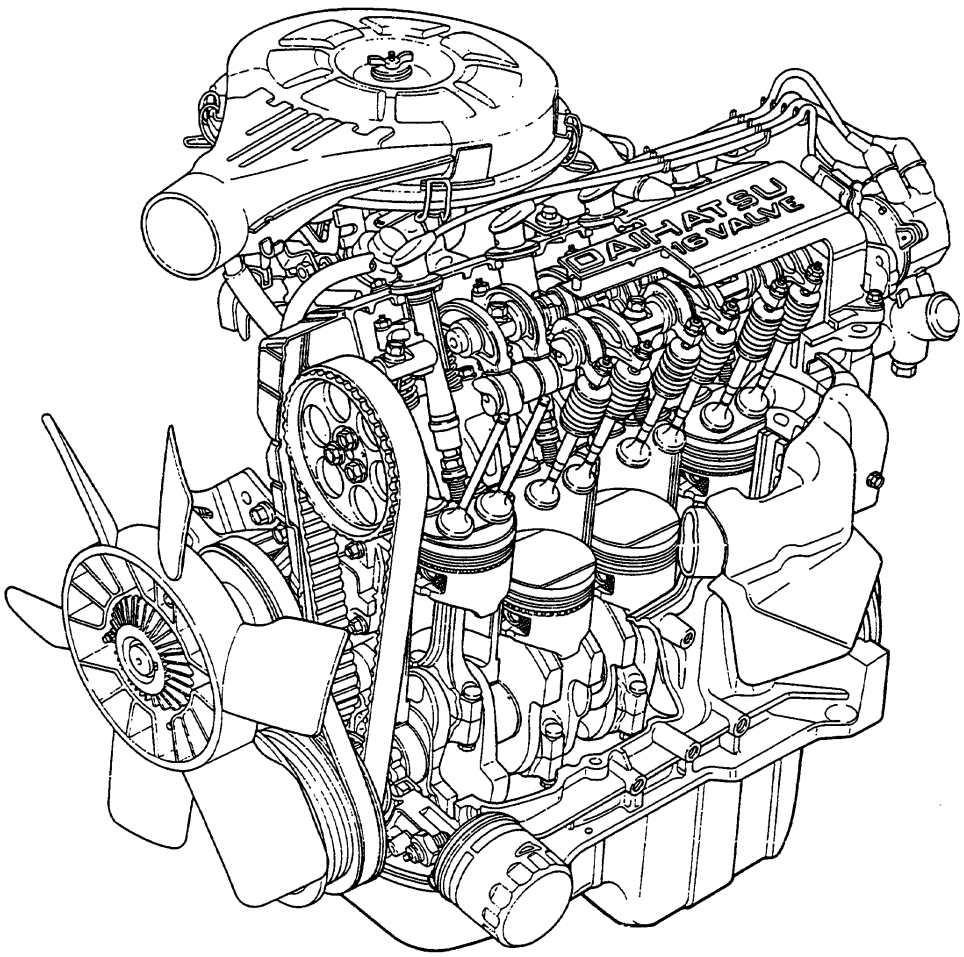
WFE90-EM001

INTRODUCTION

Type HD engine is a water-cooled, 4-cycle, 4-cylinder-in-line, SOHC 16-valve gasoline engine. The cylinders are arranged in a sequence of 1-2-3-4 from the timing belt side.

[HD-C engine]



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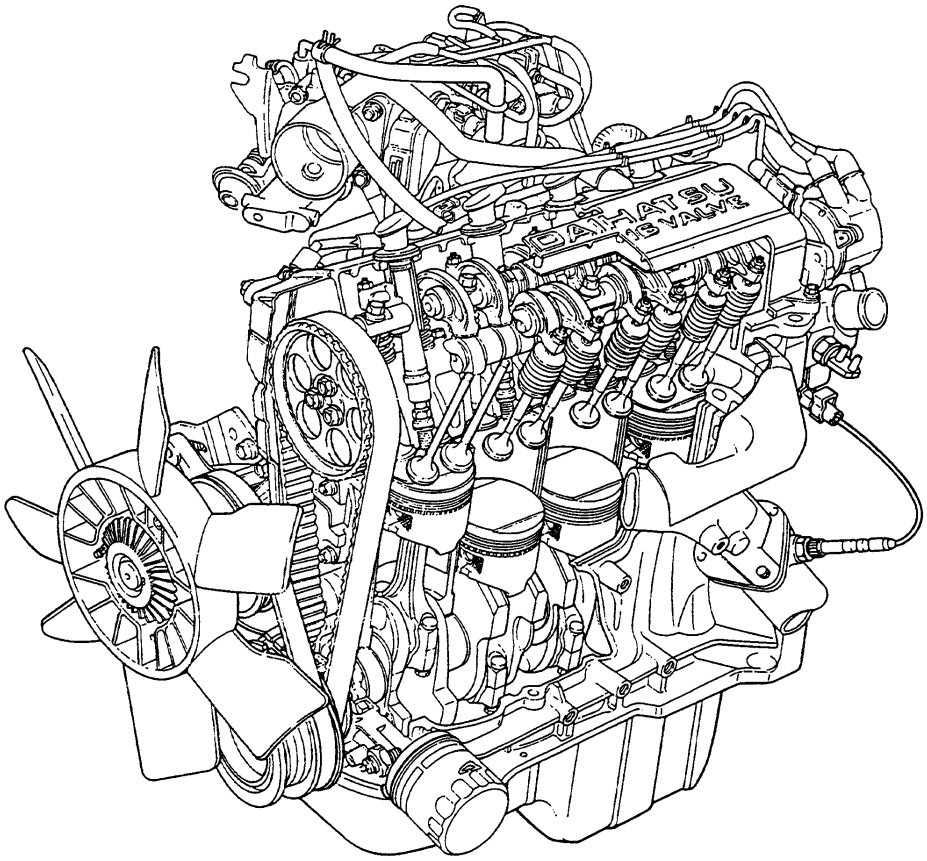
[HD-E engine]



WFE90-EM003

FEATURES

Type HD engine is mounted in the engine compartment longitudinally relative to the vehicle forward direction. The firing order is 1-3-4-2.

CYLINDER HEAD COVER

The cylinder head cover is made of aluminum alloy. A ventilation baffle plate and an oil separator are integrated inside the cylinder head cover so that the oil contained in the blow-by gas may be separated. Moreover, to prevent the leakage of oil and blow-by gas, a grommet is press-fitted at the contact section with each spark plug tube.

CYLINDER HEAD

In this aluminum alloy cylinder head, its combustion chamber adopts a pent roof type. The spark plug is located at the central position in the combustion chamber.
For improved flame propagation characteristics, the squash area is provided at the combustion chamber in order that a turbulence may be generated in the mixture during the compressed stroke.

CYLINDER HEAD GASKET

The cylinder head gasket employs a carbon gasket which features remarkable durability.

CYLINDER BLOCK

The cylinder block is made of aluminum alloy. The cylinder liner made of cast iron is cast at the cylinder block.
For assured rigidity, the crankshaft journal bearing caps are made of cast iron. Moreover, the bores have been machined integral with the cylinder block so as to improve the roundness accuracy.

OIL PAN

In this oil pan made of pressed a steel sheets, ribbed sections are provided in order to increase its strength. Moreover, the oil pan is provided with a baffle plate so as to prevent excessive movements of the oil while the vehicle is cornering, moving off or stopping quickly. Also, the baffle plate prevents the generation of resonating noises.

PISTON

The piston is made of aluminum alloy.
A triangle front mark is stamped on the piston's top.
The piston pin hole is offset 0.5 mm in relation to the center of the piston in order to reduce thrust pressure toward the piston cylinder wall.
In addition, slit type oil holes are provided in the oil ring groove in order that the lubricating performance may be further improved.

PISTON PIN

The piston pin is made of chrome molybdenum steel which features adequate strength and light weight. This piston pin adopts a semi-floating type.

CONNECTING ROD

The connecting rod employs a vanadium steel as the material in order to assure sufficient strength and reduce its weight for decreased stress of inertia. Also, a front mark is provided on each of the connecting rod and connecting rod cap.
Moreover, the adoption of serration type connecting rod bolts has improved the roundness of the connecting rod at its big end.

PISTON RINGS

The piston ring No. 1 is made of steel iron, whereas the piston ring No. 2 is made of cast iron.
The oil ring made of stainless steel employs a three-piece type.

WFE90-EM600

CAMSHAFT
The camshaft made of cast iron employs a hollow type so as to achieve the reduction in weight. This sing camshaft actuates a total of 16 valves; two intake valves and two exhaust valves of each cylinder.

VALVE SPRING
For improved anti-surging characteristics, the valve spring adopts an unequal pitch type.
The valve springs are assembled in such a direction that the side having a painted mark (the side with greater pitch) may come at the valve rocker arm side.

VALVE ROCKER ARM & VALVE ROCKER SHAFT
The valve rocker shaft made of carbon steel has undergone nitriding treatment.
The valve rocker shaft is bolt-attached to the cylinder head together with the camshaft caps of the cylind head.
Furthermore, the valve rocker shaft at the intake side is provided with recessed portions so as to accor modate the spark plug tubes.
When installing the valve rocker shaft, care must be exercised as to its correct installing direction. Tr chamfer dimension at the timing belt side is greater than that at the distributor side.
The valve rocker arm employs aluminum alloy. Moreover, high chrome cast iron is provided at its conta surface with the camshaft so that the durability may be enhanced.
The valve rocker arm comes in four different shapes.

CAMSHAFT TIMING BELT PULLEY & CRANKSHAFT TIMING BELT PULLEY
Both the camshaft timing belt pulley and crankshaft timing belt pulley are made of sintered alloy.
The camshaft timing belt pulley is driven by the crankshaft timing belt pulley through an RU type cogge belt. The tension of this timing belt is maintained by means of a belt tensioner.

CRANKSHAFT
The crankshaft employs spheroidal graphite cast iron as the material.
The crankshaft is supported via crankshaft bearings by the five main journals provided in the cylinder bloc

For reduced weight, the crankshaft is a hollow type.
Furthermore, four balance weights prevents the occurrence of vibrations.

CRANKSHAFT PULLEY
To reduce torsional vibrations, the crankshaft pulley adopts a damper.
The crankshaft pulley is attached to the crankshaft timing belt pulley by means of four bolts.

FLYWHEEL
A flywheel made of cast iron is employed.
The flywheel adopts a thin contour which features excellent heat radiating properties. To provide an adequat inertia weight, the outer diameter of the flywheel has been made larger.
An oil catch is provided so that the engine oil may flow to the cylinder block. This design prevents the c from reaching the clutch disc surface in the event that oil leaks out from the crankshaft side through th flywheel attaching bolts.
The ring gear is shrinkage-fitted onto the outer periphery of the flywheel.

FLYWHEEL/ATTACHING BOLT
The bolt employs a six point type. To prevent these bolts from becoming loose, special care has bee exercised to achieve the torque stability when tightening them.
In addition, the attaching holes at the crankshaft are of pass-through type. Therefore, the bolts are seale by applying sealer to them.

WFE90-EM6(

TIMING BELT COVER

The timing belt cover is divided into two parts; the upper cover and lower cover. The ignition timing indicator is mounted on the lower cover.

INTAKE MANIFOLD

Intake manifold is made of aluminum alloy. Design has been made so that the length from the throttle body attaching section to the intake manifold installation section on the cylinder head may become equal in all cylinders. Consequently, the air charging rate for each cylinder has been made uniformed.
In addition, the intake tube portion from the surge tank to the intake manifold adopts a diffuser type so as to improve the air charging efficiency.

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ABBREVIATION CODES

The abbreviation codes that appear in this workshop manual stand for the following, respectively.

A/C	Air Conditioner
BDC	Bottom Dead Center
BTDC	Before Top Dead Center
BVSV	Bimetal Vacuum Switching Valve
C/B	Choke Breaker
ECU	Electronic Control Unit
EFI	Electronic Fuel Injection
EGR	Exhaust Gas Recirculation
EVAP	Fuel evaporative emission control
EVSV	EGR Vacuum Switching Valve
EX	Exhaust (Manifold · Valve)
FL	Fusible Link
HIC	Hot Idle Compensator
IN	Intake (Manifold · Valve)
ISC	Idle Speed Control
ITC	Intake air Temperature Compensating Valve
LH	Left Hand
LHD	Left Hand Drive
LLC	Long Life Coolant
MP	Multipurpose
MT (M/T)	Manual Transmission
O_2S	Oxygen Sensor
PCV	Positive Crankcase Ventilation
PVSV	Pressure Vacuum Switching Valve
RH	Right Hand
SD	Spark Delay
SST	Special Service Tool
STD	Standard
TDC	Top Dead Center
TP	Throttle Positioner
TVSV	Thermostatic Vacuum Switching Valve
TWC	Three-Way Catalyst
VSV	Vacuum Switching Valve
VTV	Vacuum Transmiting Valve
W/	With
W/O	Without
2WD	Two-wheel Drive Vehicle
4WD	Four-wheel Drive Vehicle

The abbreviation codes that appear in the figure stand for the following, respectively

Ⓑ	Bolt	Ⓢ	Screw
Ⓝ	Nut	Ⓦ	Washer

WFE90-EM004

TROUBLE SHOOTING (HD-C ENGINE)

Problem	Possible causes	Remedies	Page
Engine overheats.	Cooling system faulty	Trouble shoot cooling system.	CO–2
	Incorrect ignition timing	Trouble shoot ignition system.	IG–2
	Fuel system faulty	Trouble shoot fuel system.	FU–2
	Lubrication system faulty	Trouble shoot lubrication system.	LU–2
Engine will not crank or cranks slowly.	Starting system faulty	Trouble shoot starting system.	
	Charging system faulty	Trouble shoot charging system.	
Engine will not start/Hard to start. (Only cases where cranking by starter motor is normal)	Ignition problem • Ignition coil • Distributor • Ignition timing	 Inspect ignition coil. Inspect distributor. Reset ignition timing.	 IG–14 IG–16 EM–23
	Spark plugs faulty	Inspect spark plugs	IG–12
	Resistive cords disconnected or faulty	Inspect resistive cords.	IG–11
	Vacuum leaks • PCV line • ITC line • Intake manifold • Carburetor hoses • Brake booster line	 Check PCV line. Check ITC line. Check intake manifold. Check carburetor hoses. Check brake booster.	 EC–4, 16 EC–3
	Low compression	Check compression.	EM–29
	No fuel supply to carburetor • Fuel line • Fuel filter • Fuel pump	Check fuel line and fuel pump.	FU–4
	Carburetor problems • Carburetor out of adjustment • Choke operation • Flooding (outer vent valve, BVSV) • Needle valve sticking or clogged • Vacuum hose disconnected • Fuel cut solenoid valve not open	Repair, as necessary.	FU–14
Rough idle/Engine stalls or misses.	Spark plug faulty	Inspect spark plugs.	IG–12
	Resistive cords faulty	Inspect resistive cords.	IG–11
	Ignition problems • Ignition coil • Distributor	 Inspect ignition coil. Inspect distributor.	IG–14 IG–16
	Incorrect ignition timing	Reset timing.	EM–23
	Incorrect valve clearance	Adjust valve clearances.	EM–16
	Low compression	Check compression.	EM–29
	Incorrect idle speed	Adjust idle speed.	EM–23
	Vacuum leaks • PCV line • ITC line • Intake manifold • Carburetor hoses • Brake booster line	 Check PCV system. Check ITC system. Check intake manifold. Check carburetor hoses. Check brake booster.	 EC–4, 16 EC–3

WFE90-EM005

Problem	Possible causes	Remedies	Page
Rough idle/Engine stalls or misses.	Engine overheating Carburetor problems • Slow jet clogged • Idle mixture incorrect • Fuel cut solenoid valve not open • Choke system faulty	Repair, as necessary.	FU–14
Engine hesitates/poor acceleration	Spark plug faulty	Inspect spark plugs.	IG–12
	Resistive cords faulty	Inspect resistive cords.	IG–11
	Ignition problems • Distributor • Ignition coil	Inspect distributor. Inspect ignition coil.	IG–16 IG–14
	Incorrect ignition timing	Reset ignition timing.	EM–23
	Incorrect valve clearances	Adjust valve clearances.	EM–16
	Low compression	Check compression.	EM–29
	Engine overheats	Check cooling system.	CO–7
	Air cleaner clogged	Check air cleaner.	EM–13
	Fuel system clogged	Check fuel system.	FU–4
	Carburetor problems • Float level too low • Accelerator pump faulty • Power valve faulty • Choke system faulty • Emission control system malfunctioning	Repair, as necessary.	FU–14
	• ITC system always ON (hot engine)	Check ITC system.	
	Intake manifold thermo-control valve (cold engine)	Check thermo-control valve.	
	Hot water circulating system (cold engine)	Check hot water circulating system.	
	Clutch slipping	Trouble shoot clutch.	
	Brakes dragging	Trouble shoot brakes.	
Engine dieseling (Runs after ignition switch is turuned off)	Incorrect ignition timing	Reset ignition timing.	EM–23
	Engine overheating	Check cooling system.	CO–7
	Carburetor problems • Fuel cut solenoid faulty • Idle speed out of adjustment • Linkage sticking	Repair, as necessary.	FU–14
Muffler explosion (after fire) during deceleration only.	TP system faulty	Check TP system.	EC–11
Muffler explosion (after fire) all the time.	Air cleaner clogged	Check air cleaner.	EM–13
	Choke system faulty	Check choke system.	FU–9
	Incorrect ignition timing	Reset ignition timing.	EM–23
	Incorrect valve clearance	Adjust valve clearances.	EM–16

WFE90-EM006

Problem	Possible causes	Remedies	Page
Engine backfires.	Insufficient fuel flow	Trouble shoot fuel system.	FU–2
	Incorrect ignition timing	Reset ignition timing.	EM–23
	Incorrect valve clearances	Adjust valve clearances.	EM–16
	Carbon deposits in combustion chambers	Inspect cylinder head.	EM–65
	Vacuum leaks • Carburetor hoses • PCV hoses • Intake manifold • Brake booster line	 Repair, as necessary. Check carburetor hoses. Check PCV system. Check intake manifold.	
Excessive oil consumption.	Oil leaks	Repair, as necessary.	
	PCV line clogged	Check PCV hose.	EC–4, 16
	Piston rings worn or damaged	Check piston rings. (Check compression)	EM–124
	Valve stems worn	Check valves and guides.	
	Valve stem oil seals worn or damaged	Replace oil seals.	
Poor fuel economy	Spark plugs faulty	Inspect spark plugs.	IG–12
	Incorrect ignition timing	Reset ignition timing.	EM–23
	Low compression	Check compression.	EM–29
	Air cleaner clogged	Check air cleaner.	EM–13
	Fuel leak	Repair, as necessary.	
	Carburetor problems • Choke system faulty • Idle speed too high • Power valve always on	 Repair, as necessary.	 FU–15
Unpleasant odor	Incorrect idle speed	Adjust idle speed.	EM–23
	Incorrect ignition timing	Reset ignition timing	EM–23
	Vacuum leaks • PCV line • Intake manifold • Carburetor hoses • Brake booster line	Repair, as necessary. Check PCV system. Check intake manifold. Check carburetor hoses. Check brake booster.	
	Charcoal canister faulty	Check charcoal canister.	EC–6, 19
	Fuel filler cap faulty	Check fuel filler cap.	EC–5, 18
	Outer vent valve faulty	Check outer vent valve.	EC–7
	BVSV faulty		

WFE90-EM007

TROUBLE SHOOTING (HD-E ENGINE)

Problem	Possible causes	Remedies	Page
Engine overheats.	Cooling system faulty. Incorrect ignition timing.	Trouble shoot cooling system. Reset timing.	CO–2 EM–23
Engine will not crank or cranks slowly.	Starting system faulty. Charging system faulty	Trouble shoot starting system. Trouble shoot charging system.	
Engine will not start/Hard to start (Only cases where cranking by starter motor is normal)	Ignition problem • Ignition coil • Igniter • Distributor Spark plugs faulty Resistive cords disconnected or faulty. Low compression. No fuel supply to injector • No fuel in tank • Fuel pump not working • Fuel filter clogged • Fuel line clogged or leaking EFI system malfunctioning	Inspect ignition coil. Inspect igniter. Inspect distributor. Inspect ignition plugs. Inspect resistive cords. Check compression. Repair, as necessary. Trouble shoot EFI system.	IG–2 IG–14 IG–16 IG–12 IG–11 EM–29 EF–97, 220 EF–12, 118
Rough idle/Engine stalls or misses.	Spark plugs faulty. Resistive cords faulty. Ignition problem. • Ignition coil • Igniter • Distributor Incorrect ignition timing Incorrect valve clearance Low compression Incorrect idle speed Vacuum leaks. • Throttle body EFI system malfunctioning	Inspect spark plugs. Inspect resistive cords. Inspect ignition coil. Inspect igniter Inspect distributor. Reset timing. Adjust valve clearance Check compression. Adjust idle speed. Check throttle body. Repair, as necessary.	IG–12 IG–11 IG–14 IG–16 EM–23 EM–16 EM–29 EM–23 EF–106, 224 EF–29, 136
Idle speed is too high.	Fuel line clogged Air suction • Intake manifold • Vacuum hose disconnected • Throttle body EFI system malfunctioning Incorrect idle speed.	Check fuel line. Check intake manifold. Check vacuum hose for proper piping. Check throttle body. Trouble shoot EFI system. Adjust idle speed.	FU–4 EC–3, 14 EF–106, 224 EF–12, 118 EM–23

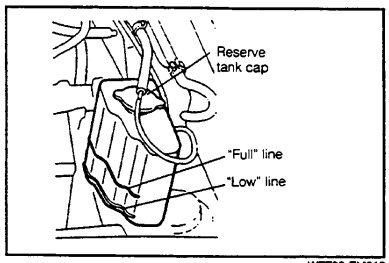
WFE90-EM008

Problem	Possible causes	Remedies	Page
Engine hesitates/Poor acceleration	Spark plugs faulty	Inspect spark plugs.	IG–12
	Resistive cords faulty.	Inspect resistive cords.	IG–11
	Incorrect ignition timing.	Reset ignition timing.	EM–23
	Incorrect valve clearances.	Adjust valve clearances.	EM–16
	Low compression.	Check compression.	EM–29
	Fuel system clogged.	Check fuel system.	FU–4
	Air cleaner clogged.	Check air cleaner.	EM–13
	Engine overheats.	Check cooling system.	CO–7
	Air leakage • Throttle body	Check throttle body.	EF–106, 224
	Emission control system malfunctioning (cold engine)	Repair as necessary.	EF–14, 15
	EFI system malfunctioning	Repair, as necessary.	EF–29, 136
Engine dieseling (Runs after ignition switch is turned off.)	EFI system malfunctioning	Repair, as necessary.	EF–29, 136
	Incorrect ignition timing.	Reset timing.	EM–23
Muffler explosion (after fire) during deceleration only	Incorrect ignition timing.	Reset timing.	EM–23
	Incorrect valve clearance.	Adjust valve clearance.	EM–16
	Air cleaner clogged.	Check air cleaner.	EM–13
	EFI system malfunctioning	Repair, as necessary.	EF–29, 136
Engine backfires.	Incorrect ignition timing.	Reset timing.	EM–23
	Incorrect valve clearances.	Adjust valve clearance.	EM–16
	EFI system malfunctioning	Repair, as necessary.	EF–29, 136
Excessive oil consumption.	Oil leak.	Repair, as necessary.	
	PCV line clogged.	Check PCV hose.	EC–4, 16
	Piston rings worn or damaged.	Check piston rings.	EM–124
	Valve stems worn.	Check valves and guides.	
	Valve stem oil seals worn or damaged.	Replace oil seal.	
Poor fuel economy	Spark plugs faulty.	Inspect spark plugs.	IG–12
	Incorrect ignition timing.	Reset timing.	EM–23
	Low compression.	Check compression.	EM–29
	Air cleaner clogged.	Check air cleaner.	EM–13
	Fuel leak.	Repair, as necessary.	
	Tires improperly inflated	Inflate tires to specified pressure.	
	Clutch slipping	Trouble shoot clutch.	
	Brakes dragging	Trouble shoot brakes.	
	EFI system malfunctioning	Repair, as necessary.	EF–29, 136
Unpleasant odor	Incorrect idle speed	Adjust idle speed.	EM–23
	Incorrect ignition timing	Reset ignition timing.	EM–23
	Vacuum leaks • PCV line • Intake manifold • Throttle body	Check PCV system. Check intake manifold. Check throttle body.	
	EFI system malfunctioning	Repair, as necessary.	EF–29, 136

WFE9C-EM009

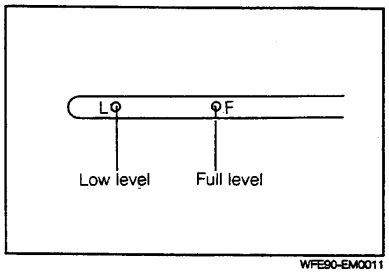
ENGINE TUNE-UP

1. Inspection of engine coolant level
(See page CO–12.)



WFE90-EM010

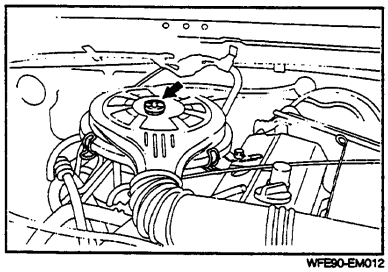
2. Inspection of engine oil level
(See page LU–9.)



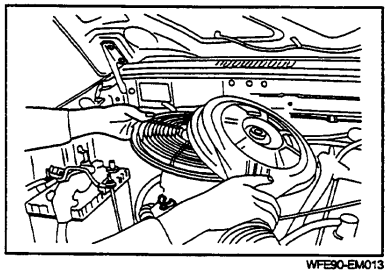
WFE90-EM0011

3. Inspection of air cleaner filter element [HD-C Engine]

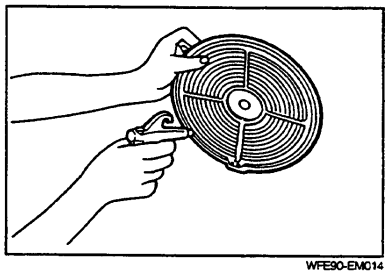
1. Detach the four air cleaner clamps. Remove the air cleaner upper case by loosen the wing nut.


WFE90-EM012

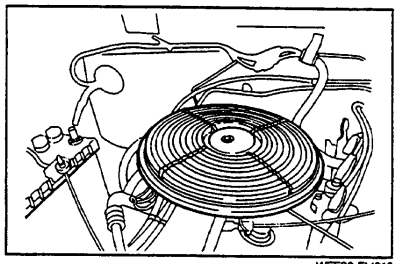
2. Remove the air filter element from the air cleaner case.
3. Visually inspect that the air filter element is not excessively dirty, damaged or oily.
   Replace the air filter element, if necessary.


WFE90-EM013

4. Clean the element with compressed air.
   First, blow compressed air from the back side of the element thoroughly. Then, blow off the upper side of the element.
   CAUTION:
   - The air pressure to be used for this cleaning operation should not exceed 392.3 kPa (4.0 kgf/cm^2).

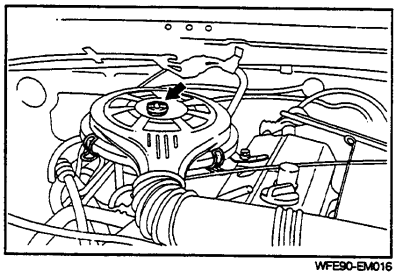

WFE90-EM014

5. Install the air cleaner filter element in the air cleaner case.
   NOTE:
   - The air filter element has the correct installation direction to be observed. Turn the air filter element so that the element may be fitted securely in the air cleaner case.



WFE90-EM015

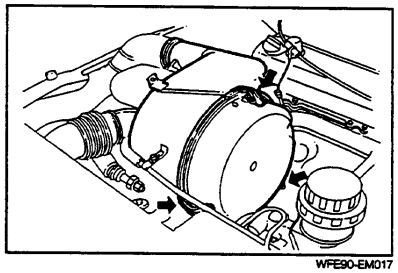
6. Install the air cleaner upper case. Attach the four air cleaner clamps and tighten the wing nut.



WFE90-EM016

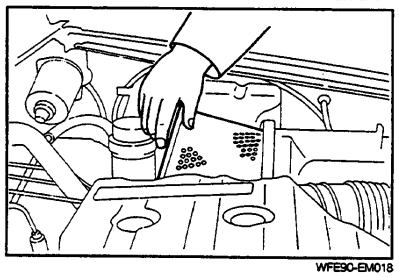
[HD-E Engine]

1. Loosen the three clamps. Remove the air cleaner cap.



WFE90-EM017

2. Loosen the wing nut retaining the element. Take out the element from the air cleaner case.



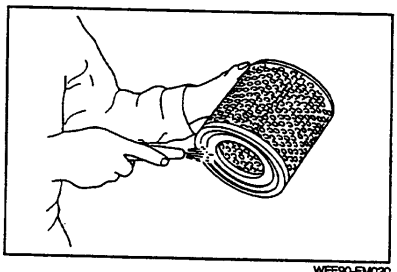
WFE90-EM018

3. Visually inspect that the air filter element is not excessively dirty, damaged or oily.
   Replace the air filter element, if necessary.

WFE90-EM019

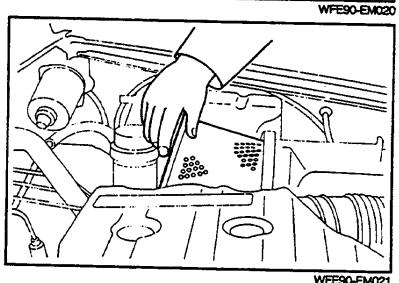
4. Clean the element with compressed air. First, blow compressed air from the inner side of the element thoroughly. Then, blow off the outer side of the element.
   CAUTION:
   - **The air pressure to be used for this cleaning operation should not exceed 392.3 kPa (4.0 kgf/cm²).**

   Replace the air filter element, if necessary.



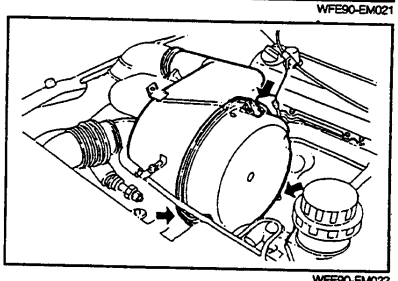
WFE90-EM020

5. Place the element in the air cleaner case. Secure the element with the wing nut.



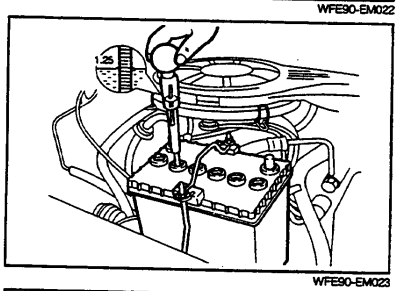
WFE90-EM021

6. Install the air cleaner cap to the air cleaner case. Secure the air cleaner cap by tightening the three clamps.



WFE90-EM022

4. Inspection of battery
(See the Charging System Section.)

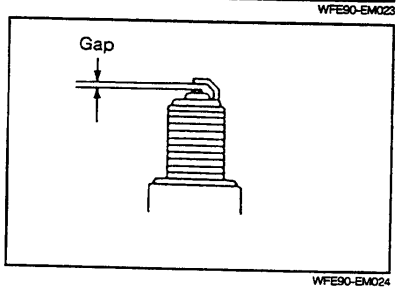


WFE90-EM023

5. Inspection of spark plugs
(See page IG-12.)

Recommended Spark Plugs:

Engine	HD-C · HD-E		
Manufacturer	CHAMPION	NIPPONDENSO	NGK
Type	RC9YC4 RC7YC4	K20PR-U11 K22PR-U11	BKR6E-11 BKR7E-11
Spark plug gap	1.0 - 1.1 mm	←	←



WFE90-EM024

6. Inspection and adjustment of valve clearances

The measurement and adjustment of valve clearances are carried out when each of the pistons of the No. 1 and No. 4 cylinders is set to the top dead center at the end of the compression stroke.

NOTE:

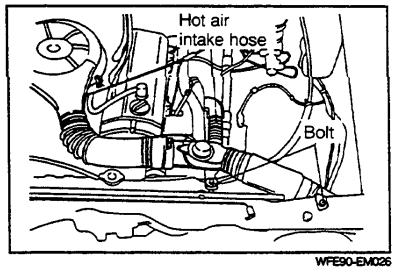
- The valve clearance adjustment is performed normally when the engine is in a hot condition.
- "Hot engine condition" denotes a condition in which the cooling water temperature is 75 - 85°C and the engine oil temperature is above 65°C.
  However, when the engine has been overhauled, it is necessary to adjust the valve clearances while the engine is cold and to readjust the valve clearances in a hot condition after warming up the engine.

WFE90-EM025

1. Removal of cylinder head cover

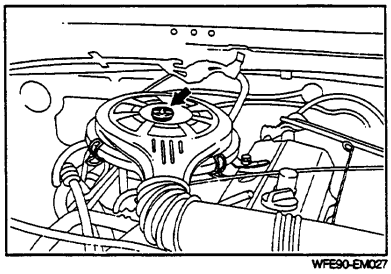
[HD-C Engine]

(1) Remove the three bolts securing the air cleaner and air intake hose.



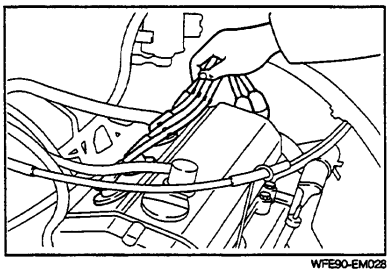
WFE90-EM026

(2) Remove the wing nut located at the center of the air cleaner. Remove the air cleaner and air intake hose subassembly.



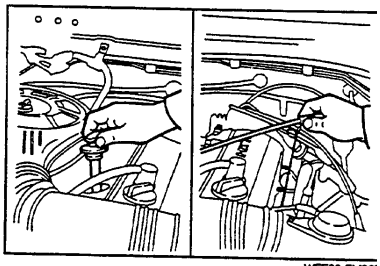
WFE90-EM027

(3) Detach the spark plug wires from the clamp.

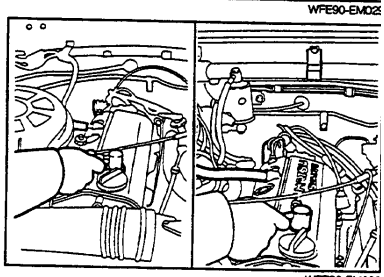


WFE90-EM028

(4) Detach the spark plug wires at the cylinder head side.
NOTE:
- Be sure to hold the rubber boot during the spark plug wire disconnection. Never remove the spark plug wire, holding the cord portion.


WFE90-EM029

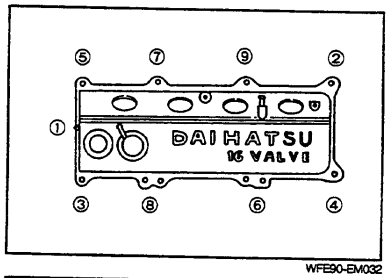
(5) Disconnect the PCV hoses from the cylinder head cover.


WFE90-EM030

(6) Remove the accelerator cable bracket from the cylinder head cover.

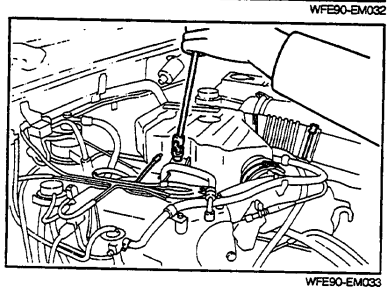
WFE90-EM031

(7) Loosen the nine bolts (10 mm) over two or three stages in the sequence shown in the right figure.
After removing the bolts, proced to remove the cylinder head cover.
NOTE:
1. Be sure to loosen the bolts progressively and unformly over two or three stage.
2. Be very careful not to damage the grommets of the spark plug tubes.
3. The timing belt cover attaching bolt ① should pulled out fully.

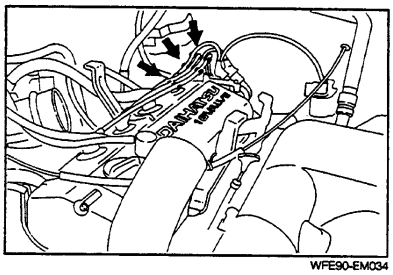


WFE90-EM032

[HD-E Engine]
(1) Removal of the air intake chamber
① Disconnect the vacuum hoses from the air intake chamber.
② Remove the air intake chamber by removing the three attaching screws and two clamps.

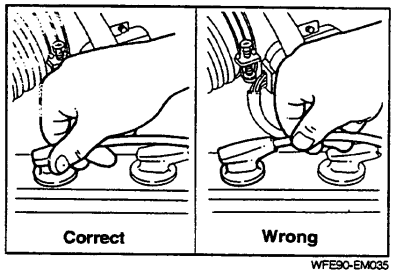

WFE90-EM033

(2) Detach the spark plug wires from the clamps.



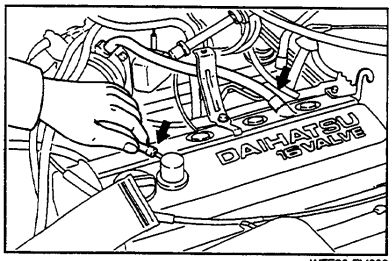
WFE90-EM034

(3) Detach the spark plug wires at the cylinder head side.
NOTE:
- Be sure to hold the rubber boot during the spark plug wire disconnection. Never remove the spark plug wire, holding the cord portion.



WFE90-EM035

(4) Disconnect the PCV hoses from the cylinder head cover.

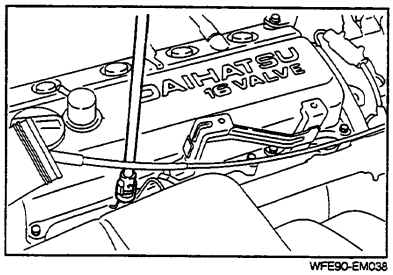


WFE90-EM036

(5) Detach the engine bond cable from the cylinder head cover. (Radio equipped vehicle only)

WFE90-EM037

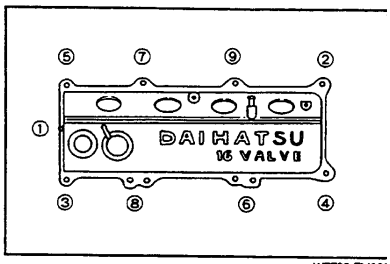
(6) Detach the bolts for intake air chamber bracket and accelerator cable clamp



WFE90-EM038

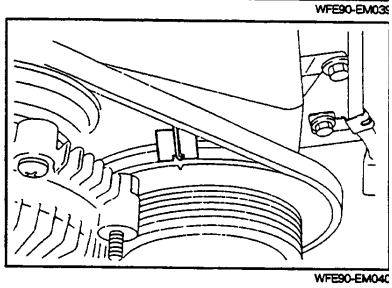
(7) Loosen the nine bolts (10 mm) over two or three stages in the sequence shown in the right figure. After removing the bolts, proceed to remove the cylinder head cover.

NOTE:
- Be sure to loosen the bolts progressively and uniformly over two or three stages.
- The timing belt cover attaching bolt ① should be pulled out fully.
- Be very careful not to damage the grommets of the spark plug tubes.

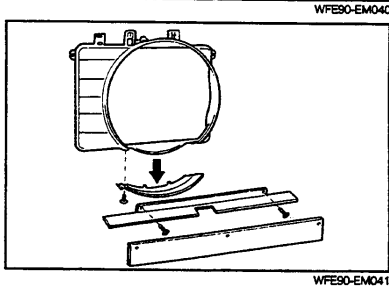


WFE90-EM039

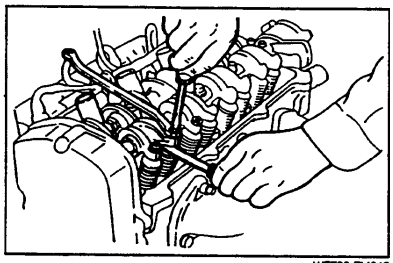
2. Inspection and adjustment of valve clearances
(1) Turn the crankshaft until the recessed mark on the crankshaft pulley is aligned with the indicator mark on the timing belt cover.


WFE90-EM040

NOTE:
- If the vehicles equipped with the power steering and the air-conditioner or only the power steering is equipped, turn the power steering pump pulley while pushing the drive belt.
- If the vehicles equipped with only the air conditioner, remove the engine under cover, rubber plate, the engine under cover No. 3 and lower fan shroud. Then turn the crankshaft pulley from the vehicle lower side.


WFE90-EM041

(2) Check to see if the valve rocker arms of the No. 1 cylinder are free or are being pushed up. According to the following table, check and/or adjust the valve clearances, using a thickness gauge.
Valve Clearances (Hot condition)
Intake: 0.20 - 0.30 mm
Exhaust: 0.28 - 0.38 mm
(Reference: Cold)
Intake: 0.18 mm
Exhaust: 0.25 mm


WFE90-EM042

NOTE:
- Before the adjusting bolts are tightened, apply engine oil to the lock nuts and rocker arm adjusting bolts.

The "O" marks denote those valves that can be adjusted under that setting.

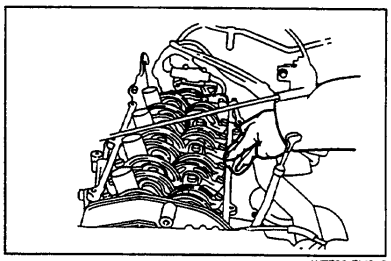
Rocker arm condition \ Cylinder No.		1	2	3	4
When valve rocker arms of No. 1 cylinder are free: (Piston of No. 1 cylinder is at top dead center under compression stroke)	IN	○	○		
	EX	○		○	
When valve rocker arms of No. 4 cylinder are free: (Piston of No. 4 cylinder is at top dead center under compression stroke)	EX			○	○
	IN		○		○

WFE90-EM043

(3) Turn the crankshaft 360-degrees. Proceed to check and/or adjust the remaining valve clearances.

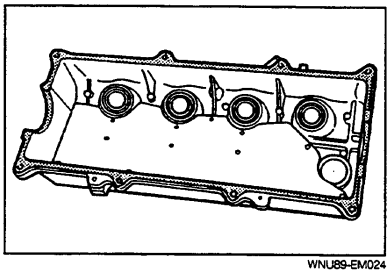
WFE90-EM044

3. Installation of cylinder head cover
   (1) Wipe off the oil or dirt from the gasket surface of the cylinder head cover.
   CAUTION:
   - **Be sure not to drop the dirt or gasket tips into the timing belt cover.**



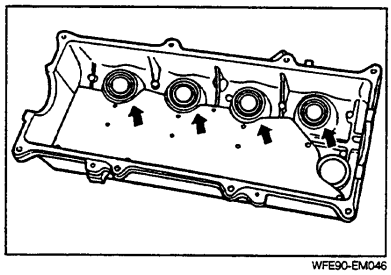
WFE90-EM045

   (2) Check the cylinder head cover gasket for evidence of damage.
   Replace the gasket, as required.
   NOTE:
   - **Install the cylinder head cover gasket in such a direction that the identification mark may come at the intake side.**



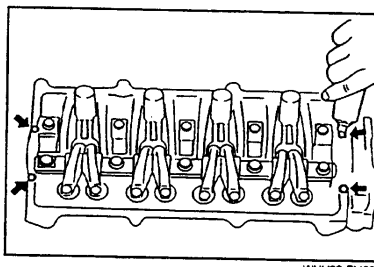
WNU89-EM024

   (3) Check the rubber grommets of the spark plug tubes for evidence of damage.
   Replace the rubber grommets, as required.
   (See page EM-93.)



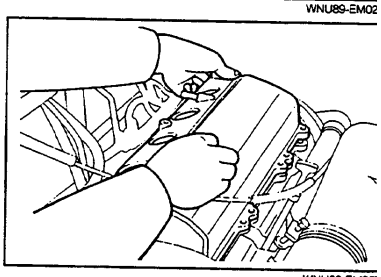
WFE90-EM046

(4) Install the cylinder head cover gasket on the cylinder head. Apply the Three Bond 1104 to the four points on the cylinder head, as indicated in the figure.



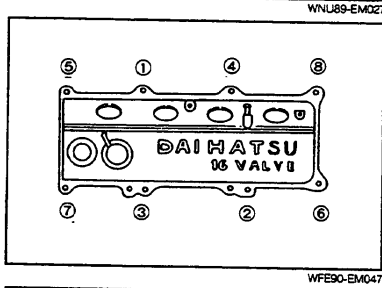
WNU89-EM02

(5) Install the cylinder head cover on the cylinder head.
NOTE:
- Be very careful not to damage the rubber grommets for spark plugs during the cover installation.
- Make sure that the rubber grommet is fitted properly to the spark plug tube.



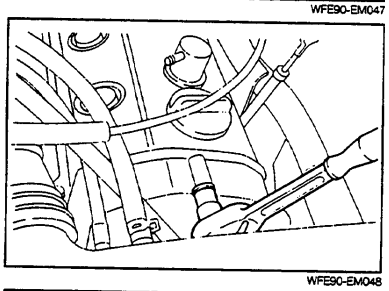
WNU89-EM02

(6) Tighten the cylinder head cover bolts over two or three stages in the sequence shown in the right figure, until they are tightened to the specified torque.
Tightening Torque: 2.9 - 4.9 N·m (0.3 - 0.5 kgf-m)



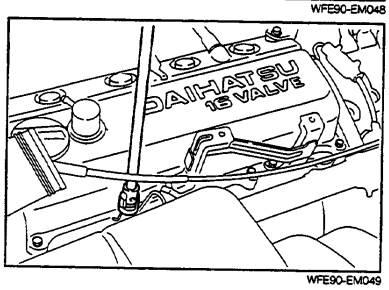
WFE90-EM047

(7) Tighten the timing belt cover attaching bolt.
Tightening Torque: 2.0 - 3.9 N·m (0.2 - 0.4 kgf-m)



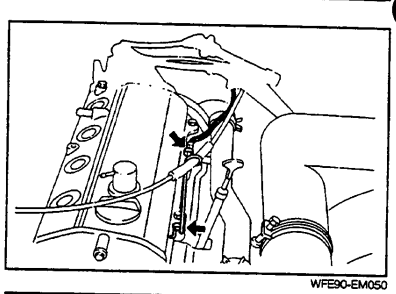
WFE90-EM048

(8) Tighten the air intake chamber bracket tightening bolts and the clamp bolt, and clamp the accelerator cable. (HD-E Engine only)
Tightening Torque: 3.0 - 4.9 N·m (0.3 - 0.5 kgf-m)

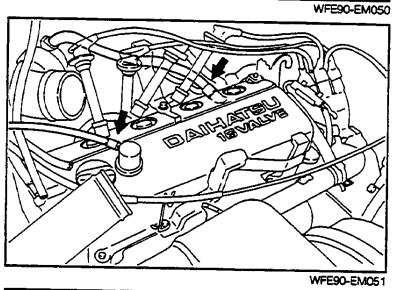


WFE90-EM049

(9) Install the engine ground wiring harness to the cylinder head. (Radio equipped vehicle only)
Tightening Torque: 3.0 - 4.9 N·m (0.3 - 0.5 kgf-m)

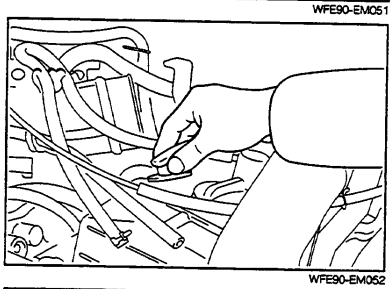

WFE90-EM050

(10) Connect the PCV hoses to the cylinder head cover.

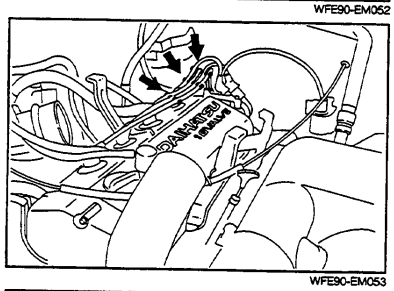


WFE90-EM051

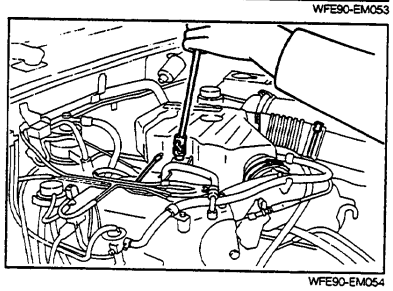
(11) Install the spark plug wires to the spark plugs.
NOTE:
- **Be sure that the spark plug wire is connected securely to each spark plug.**
- **Care should be exercised not to damage the spark plug wire rubber grommet with the spark plug tube.**


WFE90-EM052

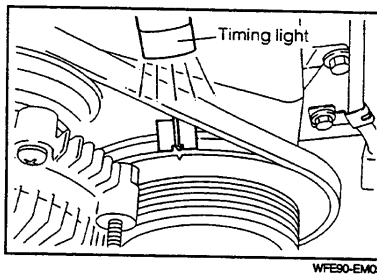
(12) Install the spark plug wires to the clamp.


WFE90-EM053

(13) Install the intake air chamber to the intake air hose. Secure it to the bracket with the three bolts. (HD-E Engine only)
(14) Insert the vacuum hose into the intake air chamber. (HD-E Engine only)
(15) Start the engine. Ensure that the engine exhibits no trouble, such as oil leakage.


WFE90-EM054

7. Inspection of ignition timing
   The ignition timing mark of crankshaft pulley is aligned with the indicator of timing belt cover.

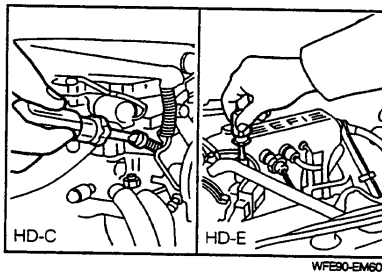


WFE90-EM0

NOTE:
- This does not include the sub ignition timing advance of the distributor.

WFE90-EM0

8. Adjustment of idle speed
   Engine Idle Speed
   HD-C engine: 850 ± 50 rpm
   HD-E engine: 850 ± 50 rpm



WFE90-EM60

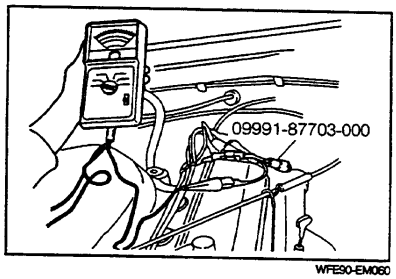
9. Check of fast idle

[HD-C Engine]
Preparation to be made prior to fast idle check
- All accessory switches are turned OFF.
  On those vehicles equipped with a day-lamp system, set the lamp control switch to the first stage.
- The air cleaner element is installed.
- All vacuum hoses are connected.
- Ensure that the intake system exhibits no air leakage.
- Ensure that the exhaust system exhibits no air leakage.
  NOTE:
  - HD-C engine is mounted with automatic choke carburetor.
    Therefore, perform the engine fast idle check while the engine is cold.

WFE90-EM05

(1) Connect the tachometer to the engine with SST.
SST: 09991-87703-000

(2) Check to see if the fast idle speed sets within the specified value.
REFERENCE:
Engine Fast Idle Speed:
1,300 - 2,000 rpm at 22 - 28°C



WFE90-EM060

10. Check of throttle positioner

[HD-C Engine]
Dashpot Touch Revolution Speed:
1,500 ± 50 rpm
Specified Time: 0.5 - 5 seconds.

[HD-E Engine]
Dashpot Touch Revolution Speed:
- General Spc. 1,800 ± 100 rpm
- US Spc. 1,600 ± 100 rpm

Specified Time: 0.5 - 5 seconds

WFE90-EM602

CHECK AND ADJUSTMENT OF CO/HC CONCENTRATIONS
[HD-C Engine]

- Warm up the engine thoroughly.
- All accessory switches are turned OFF.
  On those vehicles equipped with a day-lamp system, set the lamp control switch to the first stage.
- The air cleaner element is installed.
- All vacuum hoses are connected.
- Ensure that the intake system exhibits no air leakage.
- Ensure that the exhaust system exhibits no air leakage.

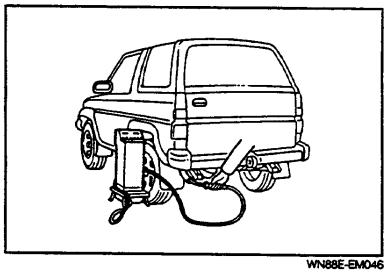
CO adjustment

1. Adjust the idle speed.
   (See page EM–23.)
2. Race the engine until its speed reaches 2000 rpm.

WFE90-EM062

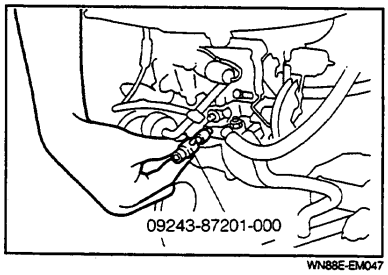
3. Measure the CO concentration at the idle speed. Check to see if the CO concentration conforms to the specification.
   Specified CO Concentration: 1.5 ± 0.5%

   If the measured concentration fails to conform to the specification, perform the adjustments described in the step 4. onward.



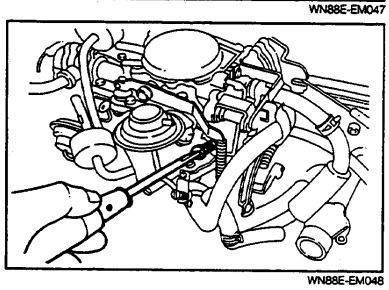
WN88E-EM046

4. Using the following SST, gradually turn the mixture adjusting screw so that the CO concentration may conform to the specification.
   SST: 09243-87201-000



WN88E-EM047

5. Turn the throttle adjusting screw so that the idle speed may become the specified speed.
6. Measure the CO concentration. Check to see if the CO concentration conforms to the specification.
   If the repeated adjustments will not get the conformity to the specification, carry out the trouble shooting in accordance with the table next page.

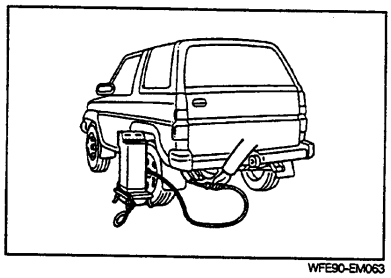


WN88E-EM048

HC adjustment

1. Adjust the idle speed.
2. Measure the HC concentration at the idle speed. Check to see if the HC concentration conforms to the specification.
   Specified CO Concentration: Not to exceed 1000 rpm

   If the measured concentration fails to conform to the specification, carry out the trouble shooting in accordance with the following tables.



WFE90-EM063

Possible causes for improper CO/HC concentrations

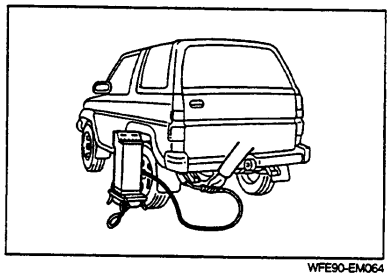
Item / Possible cause	CO concentration	HC concentration	Remarks
Ignition timing		O	
Valve clearances		O	
Improper valve seating		O	Compression pressure
Ignition system problems Spark plugs Resistive cord Distributor Ignition coil	O	O	
Air leakage in intake system	O	O	
ITC valve malfunctioning	O	O	
Great mechanical loss of engine inner parts	O	O	

WFE90-EM603

[HD-E Engine]

NOTE:

- **This check is used only to determine whether or not the idle HC/CO emissions comply with the regulations.**

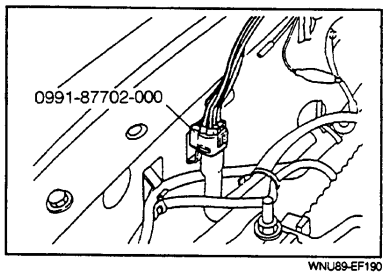


WFE90-EM064

1. Initial Conditions
   (1) Air cleaner filter element installed.
   (2) All accessories switched OFF.
   (3) All vacuum lines connected.
   (4) All pipes and hose of air intake system connected.
   (5) Ignition timing set correctly.
   (6) Transmission in "Neutral" Position.
   (7) Warm up the engine thoroughly.
   (8) Ensure that the exhaust system exhibits no gas leakage.
   (9) Ensure that the intake system exhibits no air leakage.
   (10) Tachometer and HC/CO meter at hand and calibrated.

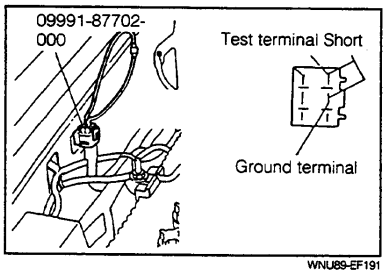
WFE90-EM065

2. System inspection of oxygen sensor
   (1) Remove the cap of the check connector. Connect the following SST to the check connector.
   SST: 09991-87702-000



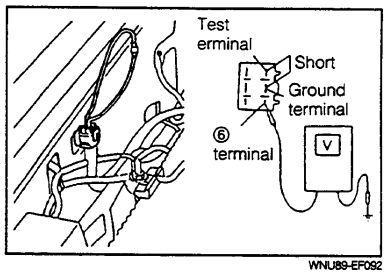
WNU89-EF190

   (2) Start and warm up the engine completely.
   (3) Connect the test terminal (brown) of the SST to the ground terminal (black).



WNU89-EF191

   (4) Connect a voltmeter to the output terminal (green) of the SST.

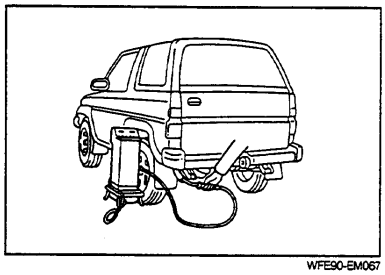


WNU89-EF092

   (5) Hold the engine speed at 3000 rpm
   (6) After a lapse of two minutes, ensure that the reading of the voltmeter connected in the step (4) changes eight times or more for 10 seconds.
   If the change in voltage fails to occur eight times or more, check the diagnosis code. Replace the oxygen sensor if no malfunction code is memorized.

WFE90-EM066

3. Measurement
   (1) Insert the HC/CO meter testing probe into the tail pipe at least 400 mm.



WFE90-EM067

(2) Measurement of HC/CO concentrations at idle.
Wait at least one minute before the measurement so as to allow concentrations to stabilize.
Complete the measurement within three minutes.
If the HC/CO concentrations dose not conform to the regulations, see the following table for possible causes.

WNU89-EM040

Trouble shooting

HC	CO	Problems	Possible causes
High	Normal	Rough idle	1. Faulty ignition • Incorrect timing • Fouled, shorted or improperly gapped spark plugs • Open or crossed high tension cords • Cracked distributor cap
			2. Incorrect valve clearance 3. Leaky EGR valve (US. spc. only) 4. Leaky exhaust valves 5. Leaky cylinder
High	Low	Rough idle (Fluctuating HC reading)	1. Lean mixture causing misfire
High	High	Rough idle (Black smoke from exhaust)	1. Restricted air filter 2. Faulty EFI system • Faulty pressure regulator • Clogged fuel return line • Defective water temp. sensor • Defective air temp. sensor • Faulty throttle position sensor • Faulty pressure sensor • Faulty injector • Faulty ECU 3. Insufficient warmed up three way catalyst

WFE90-EM068

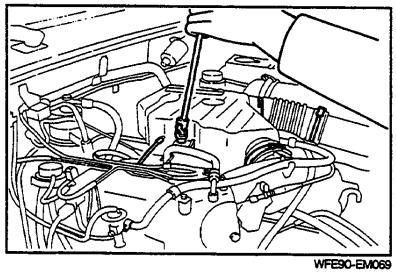
COMPRESSION CHECK

NOTE:
- **After completion of the engine tune-up, if the engine exhibits lack of power, excessive oil consumption or poor fuel economy, measure the cylinder compression pressure.**

1. Warm up the engine thoroughly.
2. Turn OFF the ignition key switch.

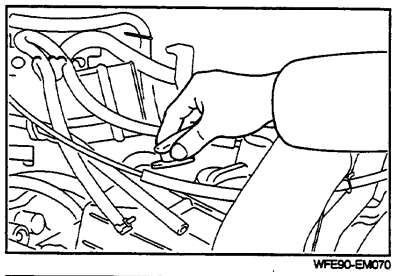
3. Removal of spark plugs
   (1) Disconnect the vacuum hoses from the air intake chamber.
   Remove the air intake chamber by removing the three attaching screws and two clamps.

WFE90-EM042



   (2) Remove the spark plug wires from the clamp.
   (3) Disconnect the spark plug wires at spark plug side.
   NOTE:
   - **Be sure to hold the rubber boot during the spark plug wire disconnection. Never remove the spark plug wire, holding the cord portion.**

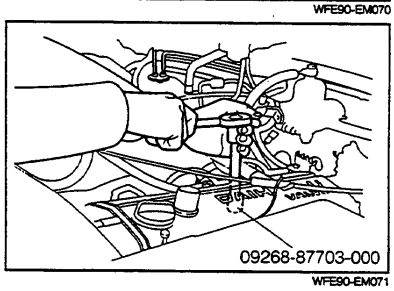
WFE90-EM069



   (4) Remove the all spark plugs, using the following SST {Plug wrench (16 mm)}.
   SST: **09268-87703-000**

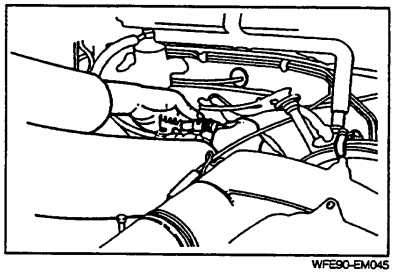
   WARNING:
   - **Be very careful not to burn yourself.**

WFE90-EM070



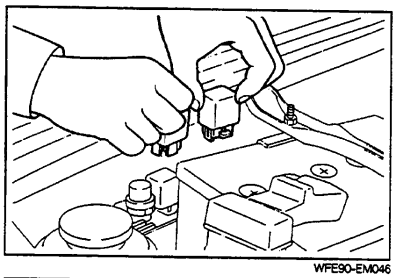
4. Disconnect the distributor connector.

WFE90-EM071



WFE90-EM045

5. Pull out the injector relay and fuel pump relay from the relay block.

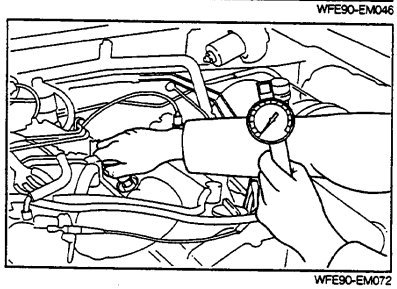


WFE90-EM046

6. Measurement of cylinder compression pressure
   (1) Insert a compression gauge into the spark plug hole.
   (2) Depress the accelerator pedal fully.
   (3) While cranking the engine, measure the compression pressure.
   NOTE:
   - **Always use a fully charged battery so that at least a revolution speed of 300 rpm is attained.**

   (4) Repeat the steps (1) through (3) for each cylinder.

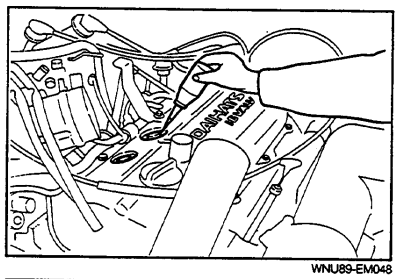
   NOTE:
   - **Perform the measurement in the shortest possible time.**
   - **Crank the engine for the same duration for each cylinder.**
     Compression Pressure:
     1373 kPa (14 kgf/cm²)/at 300 rpm
     Minimum Pressure:
     1030 kPa (10.5 kgf/cm²)/at 300 rpm
     Difference Between Cylinders:
     147 kPa (1.5 kgf/cm²)/at 300 rpm



WFE90-EM072

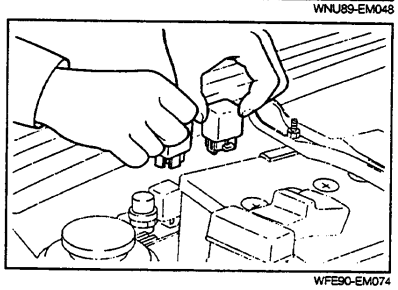
WFE90-EM073

   (5) If the compression of one or more cylinders is low, pour a small amount of engine oil into that cylinder through the spark plug hole and repeat the steps (1) through (4) for the cylinder with low compression.
   - If adding oil helps the compression to improve, chances are that the piston rings and/or cylinder bores are worn or damaged.
   - If the pressure remains low after the operation described in the step (5) has been performed, the valve may be sticking or seated improperly, or there may be leakage past the gasket.



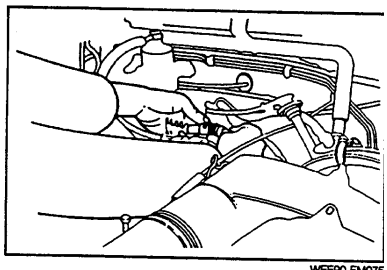
WNU89-EM048

7. Install the injector relay and fuel pump relay to the relay block.



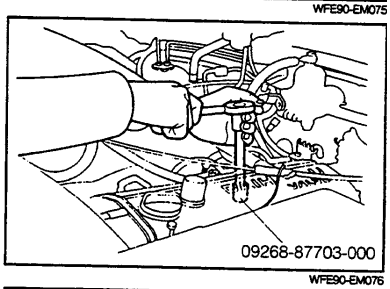
WFE90-EM074

8. Connect the distributor connector. Install it to the clamp.



WFE90-EM075

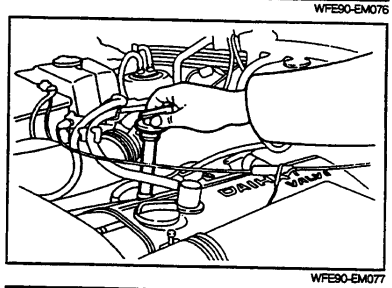
9. Install the spark plugs using the following SST.
   SST: 09268-87703-000
   Tightening Torque: 14.7 - 21.6 N·m (1.5 - 2.2 kgf-m)



WFE90-EM076

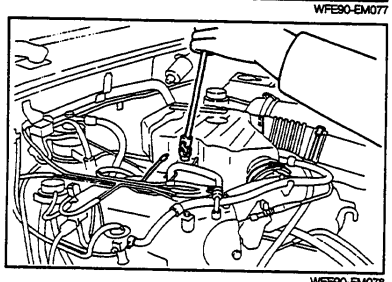
10. Connect the spark plug wires.
    NOTE:
    - Be sure that the spark plug wire is connected securely to each spark plug.
    - Care should be exercised not to damage the spark plug wire with the spark plug tube.

11. Attach the spark plug wires to the clamp.



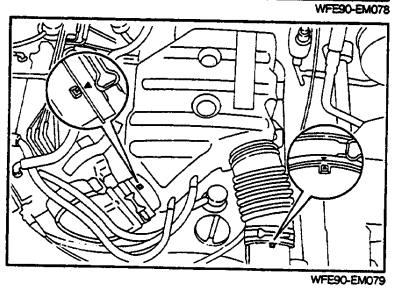
WFE90-EM077

12. Insert the intake air chamber into the intake air hose. Secure it with the three attaching bolts.



WFE90-EM078

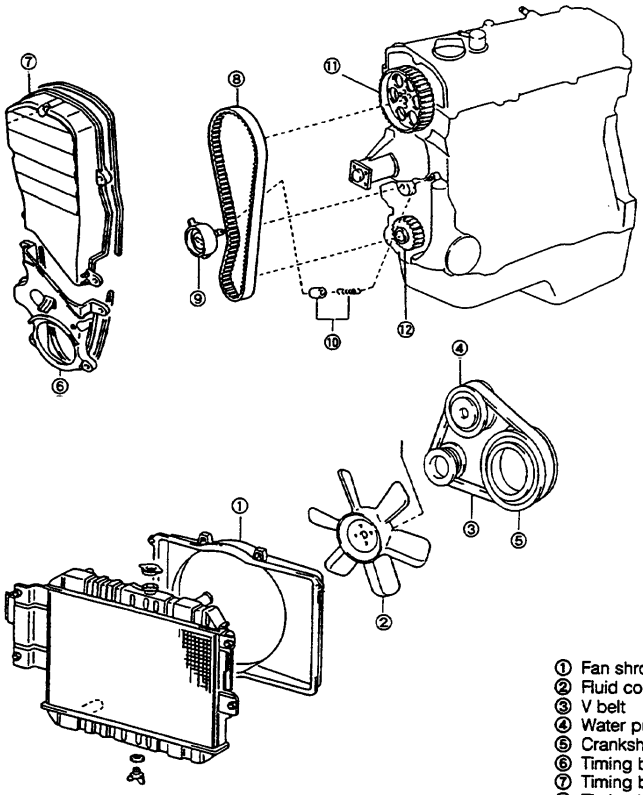
13. Insert the vacuum hoses into the intake air chamber.



WFE90-EM079

TIMING BELT

COMPONENTS



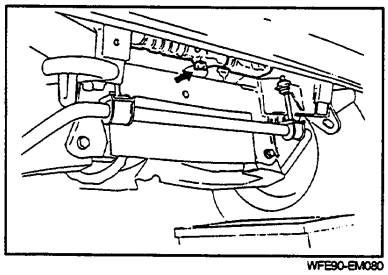
① Fan shroud
② Fluid coupling fan
③ V belt
④ Water pump pulley
⑤ Crankshaft pulley
⑥ Timing belt cover No. 1
⑦ Timing belt cover No.2
⑧ Timing belt
⑨ Timing belt tensioner
⑩ Tension spring assy
⑪ Camshaft timing pulley
⑫ Crankshaft timing pulley

WNU89-EM053

REMOVAL OF TIMING BELT

1. Disconnect the battery ground cable from the negative (–) terminal of the battery.
2. Remove the engine under cover and drain the engine coolant about 1 liter from drain plug of the radiator.

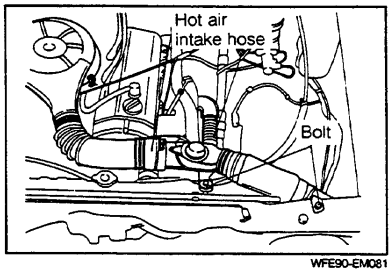
WARNING:
- The engine coolant may be vary hot. Care must be exercised to avoid getting scalded.



WFE90-EM080

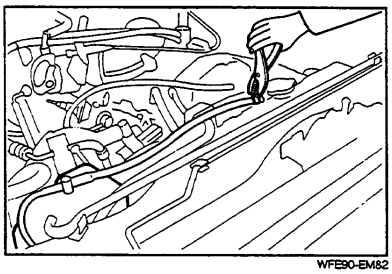
[HD-C Engine]

3. Removal of air cleaner hose
   (1) Remove the air cleaner hose from the air cleaner case by removing the two bolts and one clamp.
   (2) Disconnect the vacuum motor hose and hot air intake hose (except for GCC specification).

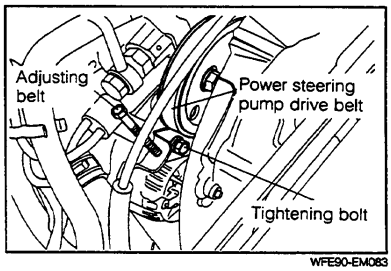


WFE90-EM081

4. Removal of the radiator reserve tank
   (1) Disconnect the radiator reserve tank hose from the radiator
   (2) Pull up the radiator reserve tank together with hose.

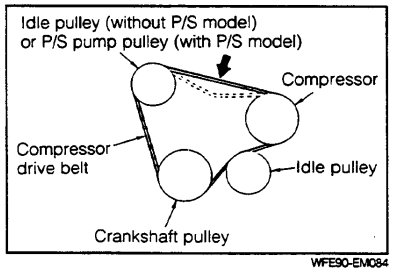

WFE90-EM082

5. Removal of the power steering pump drive belt. (Power steering equipped vehicle only)
   (1) Loosen the adjusting bolt and two tightening bolts. Then push down the pump
   (2) Remove the drive belt



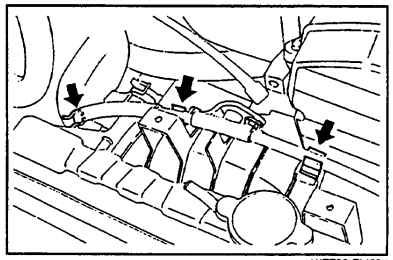
WFE90-EM083

6. Remove the air conditioner drive belt by loosening the adjusting bolt. (Air conditioner equipped vehicle)

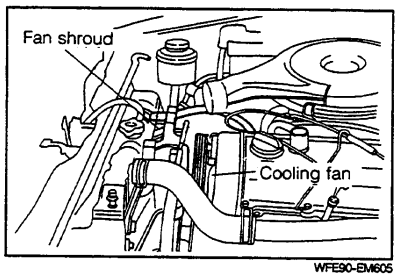


WFE90-EM084

7. Remove the three clamps for clutch cable provide on the fan shroud.

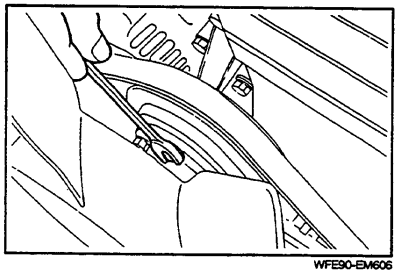

WFE90-EM604

8. Removal of fluid coupling with fan and fan shroud
   (1) Disconnect the water hose from the radiator upper tank.

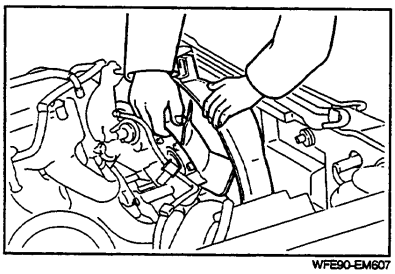


WFE90-EM605

   (2) Remove the four water pump pulley attaching nuts. Then detach the fluid coupling with fan from the water pump pulley tempporarily.
   (3) Remove the drive belt by loosening the alternator pulley adjusting bolt.
   (4) Remove the water pump pulley.

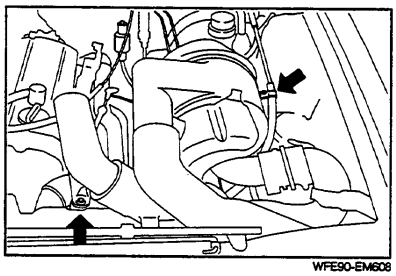

WFE90-EM606

   (5) Remove the two fan shroud attaching bolts from the radiator
   (6) Unlock the lock section of the fan shroud lower part from the radiator by pulling up the fan shroud.
   (7) Remove the fan shroud together with fluid coupling with fan from the engine comportment

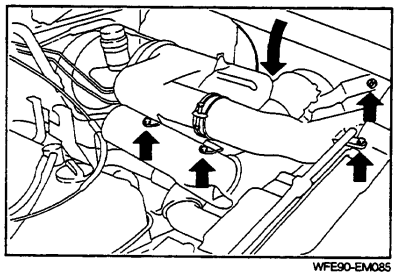

WFE90-EM607

[HD-E Engine]

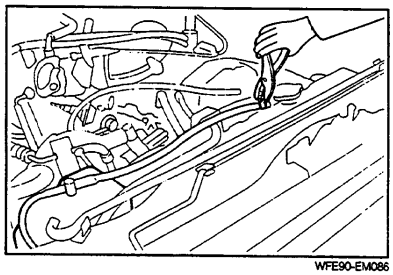
3. Removal of the air cleaner and the air cleaner hose subassembly.
   (1) Remove the tapping screw from the radiator fan shroud upper side.
   (2) Remove the clutch cable clamp provided at the air cleaner.


WFE90-EM608

   (3) Remove the air cleaner hose attaching bolts provided at the left fender panel and radiator center support. Remove the three air cleaner attaching bolts. Then remove the air cleaner and air cleaner hose subassembly.

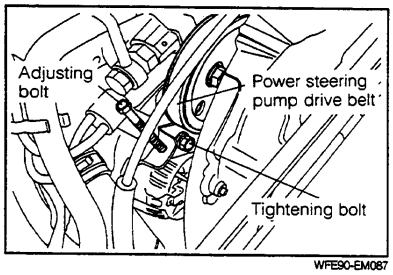

WFE90-EM085

4. Removal of the radiator reserve tank
   (1) Disconnect the radiator reserve tank hose from the radiator
   (2) Pull up the radiator reserve tank together with hose.



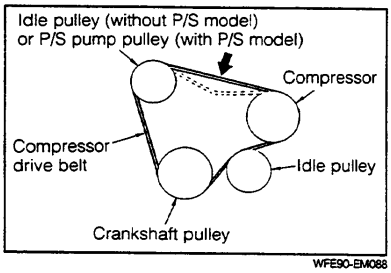
WFE90-EM086

5. Removal of the power steering pump drive belt.
   (Power steering equipped vehicle only)
   (1) Loosen the adjusting bolt and two tightening bolts. Then push down the pump
   (2) Remove the drive belt



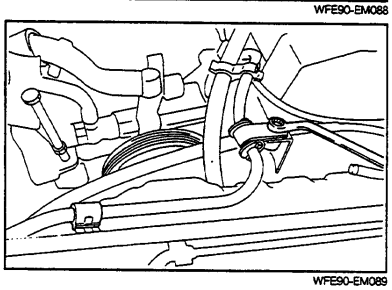
WFE90-EM087

6. Remove the air conditioner drive belt by loosening the adjusting bolt. (Air conditioner equipped vehicle)



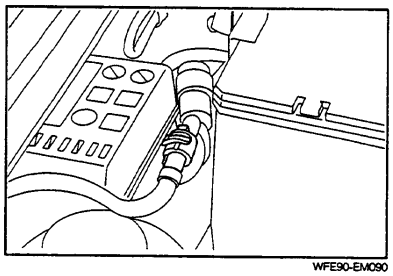
WFE90-EM088

7. Disconnection of the main relay wire
   (1) Remove the clamping bolt and detach the clamp with lock.



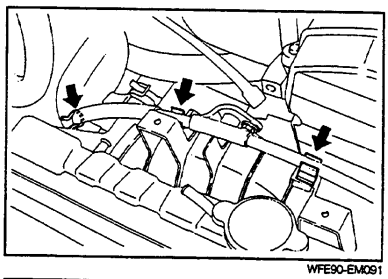
WFE90-EM089

   (2) Disconnect the main relay wire connector at the relay box side.



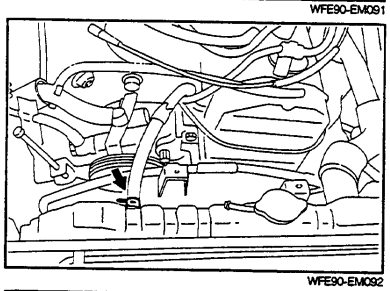
WFE90-EM090

8. Remove the three clamps for clutch cable provide on the fan shroud.



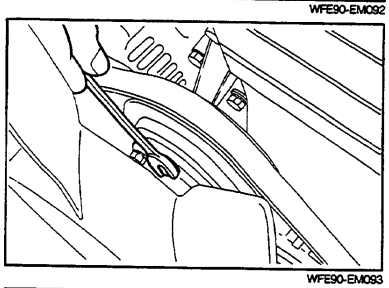
WFE90-EM091

9. Removal of fluid coupling with fan and fan shroud.
   (1) Disconnect the air breather hose from the radiator upper tank.



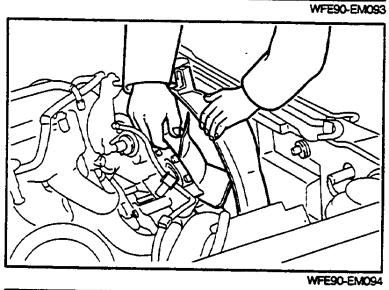
WFE90-EM092

   (2) Remove the four water pump pulley attaching nuts. Then detach the fluid coupling with fan from the water pump pulley tempporarily.
   (3) Remove the drive belt by loosening the alternator pulley adjusting bolt.
   (4) Remove the water pump pulley.



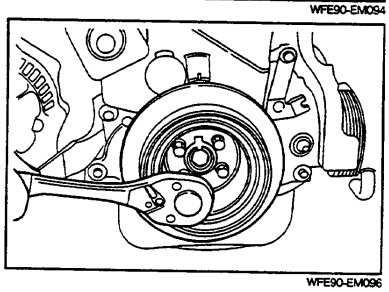
WFE90-EM093

   (5) Remove the two fan shroud attaching bolts from the radiator
   (6) Unlock the lock section of the fan shroud lower part from the radiator by pulling up the fan shroud.
   (7) Remove the fan shroud together with fluid coupling with fan from the engine comportment



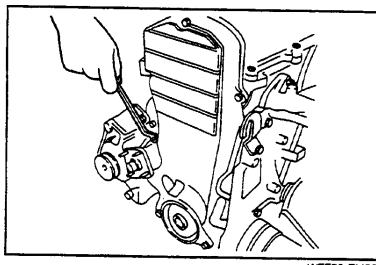
WFE90-EM094

10. Remove the crankshaft pulley by removing the four attaching bolts.
    NOTE:
    - **Place the gear shift lever in the 5-th gear position so as to prevent the rotation of crankshaft.**



WFE90-EM096

11. Remove the timing belt cover No. 1 and No. 2 by removing the eight bolts.



WFE90-EM09

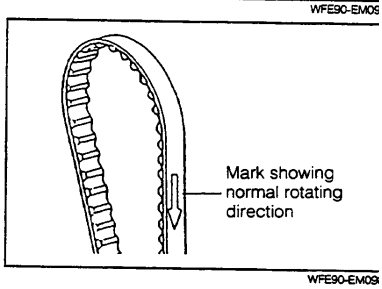
12. Removal of timing belt

NOTE:

- Prior to removal of the timing belt, put an arrow mark indicating the normal rotating direction on the belt, using a chalk or the like.

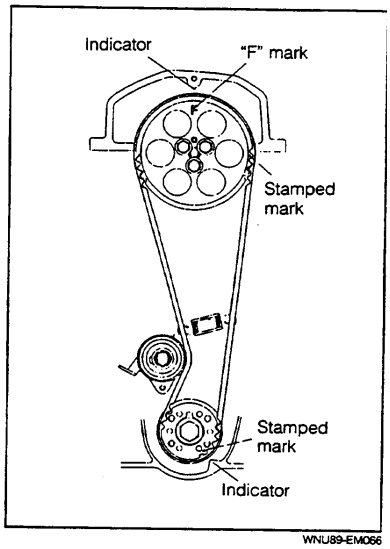
CAUTION:

- Do not try to pry the timing belt with a screwdriver or the like during the removal or installation.
- Do not allow the belt to come into contact with oil, water or dust.
- Do not bend the belt at a sharp angle r turn the belt inside out, for it is very vulnerable to bending.
- Do not utilize the tension of the timing belt pulley when loosening the set bolt of the camshaft timing belt pulley.



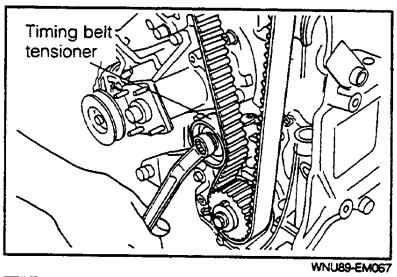
WFE90-EM09

(1) Rotate the crankshaft until the "F" mark of the camshaft timing belt pulley is aligned with the indicator of the cylinder head cover.



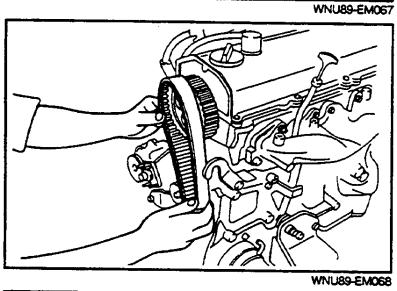
WNU89-EM066

(2) Loosen the attaching bolt of the timing belt tensioner. Move the tensioner to the left as for as it will go and tighten the bolt temporarily.

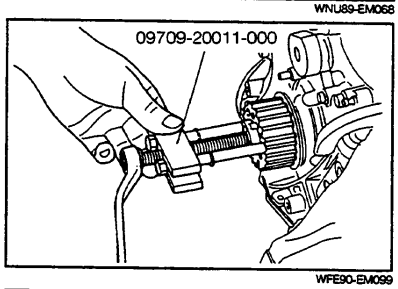


WNU89-EM067

(3) Remove the timing belt.


WNU89-EM068

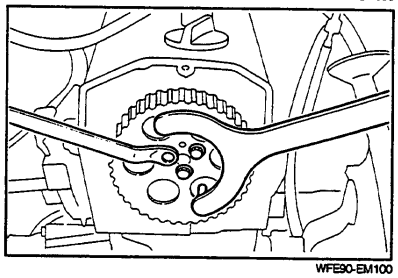
13. Remove the crankshaft timing belt pulley and pulley flange by removing pulley bolt.
    NOTE:
    - Prevent the crankshaft from being rotated by placing the gear shift lever in the 5th gear position.
    - If any difficulty is encountered in removing the crankshaft timing belt pulley, lightly screw in the set bolt of the crankshaft timing belt pulley. Then, remove the pulley, using the following SST.
      SST: 09609-20011-000



WFE90-EM099

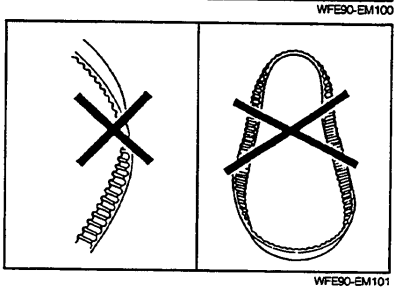
14. Removal of camshaft timing belt pulley
    (1) Loosen the attaching bolts of the camshaft timing belt pulley, by using flowing the SST.
    SST: 09278-87201-000

    (3) Remove the camshaft timing belt pulley.
15. Remove the timing belt tensioner and tension spring.


WFE90-EM100

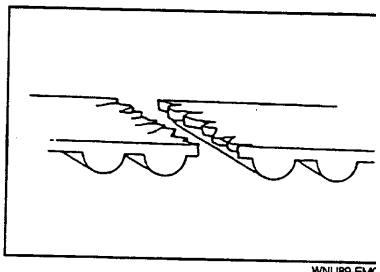
INSPECTION OF COMPONENTS

1. Timing belt inspection
   CAUTION:
   - Do not bend, twist or turn the belt inside out.
   - Do not allow the belt to come into contact with oil, water or steam.
   - Keep the belt clean.


WFE90-EM101

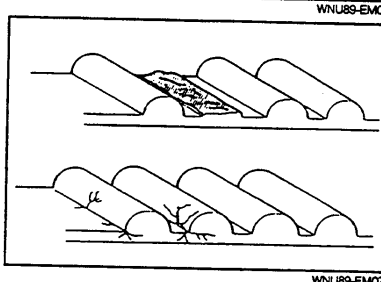
If there are defects, as shown in the figures, check the following points and replace the timing belt, if necessary.

(1) Premature separation
- Check for proper installation.
- Check the timing gear cover gaskets for damage and check for correct installation.



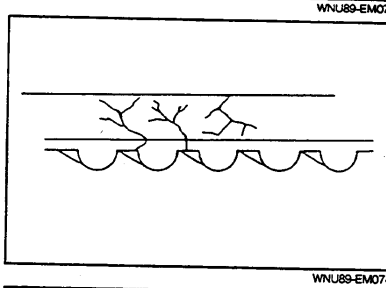
WNU89-EM0

(2) If the belt teeth are cracked or damaged, check to see if the camshaft is seized.



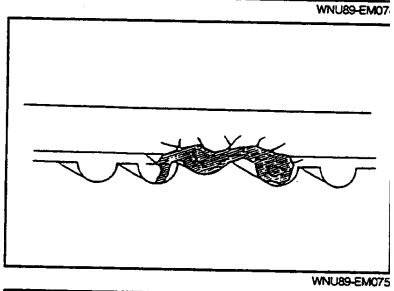
WNU89-EM0

(3) If there is noticeable wear or cracks on the belt face, check to see if there are nicks on one side of the idler pulley lock.



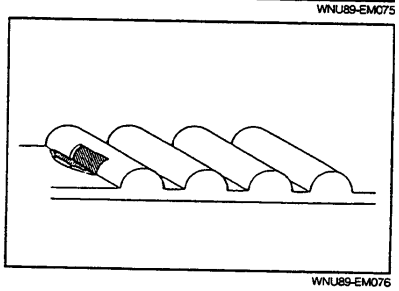
WNU89-EM07

(4) If there is wear or damage on only one side of the belt, check the pulley flange.



WNU89-EM075

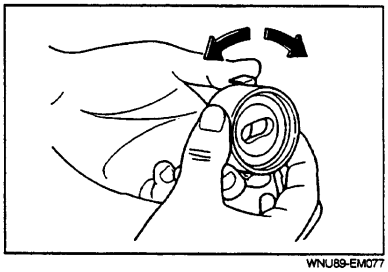
(5) If there is noticeable wear on the belt teeth, check the timing cover gasket for damage and check for correct gasket installation. Check for foreign material on the pulley teeth.



WNU89-EM076

2. Timing belt tensioner inspection
   - Check the timing belt tensioner for smooth turning.
   - Check the belt contact surface for damage.

   If necessary, replace the timing belt tensioner.
   CAUTION:
   - **Never wash the timing belt tensioner.**

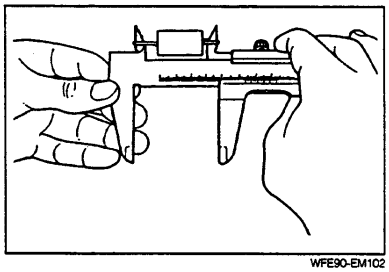


WNU89-EM077

3. Inspect tension spring
   (1) Check the free length of the spring
   Free Length: 46.5 mm

   (2) Check the tension of the spring at the specified installation length.
   Tension as Installed: 29.4 N (3.0 kgf) at 50.9 mm

   If the tension does not conform to the specification, replace the spring.

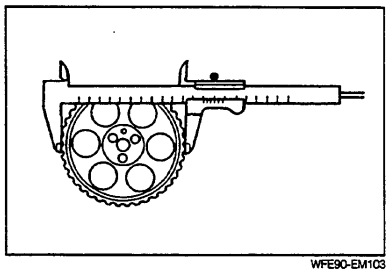


WFE90-EM102

4. Inspection of timing belt pulley
   (1) Measure the maximum diameter of the timing belt pulley, using vernier calipers.

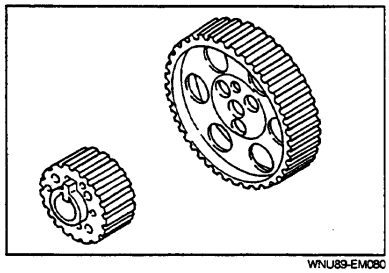
   Reference:

Camshaft timing belt pulley:	119.90 mm
Crankshaft timing belt pulley:	59.37 mm



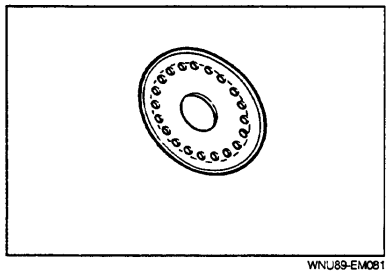
WFE90-EM103

   (2) Visually inspect the timing belt pulley for damage.



WNU89-EM080

5. Inspection of crankshaft timing belt pulley flange
   Check the crankshaft timing belt pulley flange for bend, damage and wear.
   If necessary, replace the crankshaft timing belt pulley flange.



WNU89-EM081

INSTALLATION OF TIMING BELT

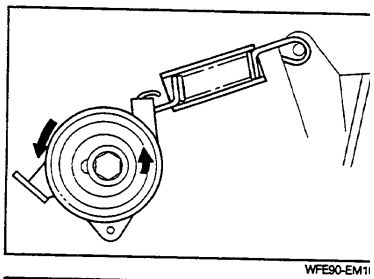
NOTE:

- Check the water pump for water leakage and the oil seal for oil leakage.

Repair any water leakage or oil leakage, if necessary.

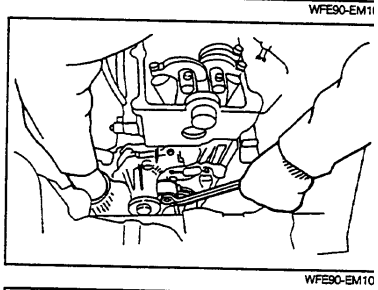
WFE90-EM

1. Attach the tension spring to the timing belt tensioner. Hang the tension spring hook on the pin. Assemble the timing belt tensioner in place and install the bolt.
   CAUTION:
   - Hang the spring hook securely on the pin groove.
   - Ensure that the pin at the oil pump is fitted into the pin hole of the timing belt tensioner.



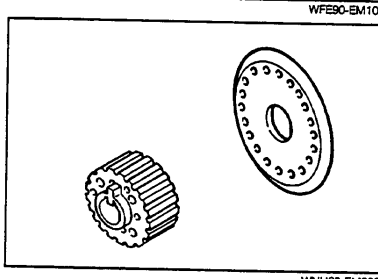
WFE90-EM1

2. While pulling the timing belt tensioner fully toward the water pump side, temporarily tighten the attaching bolt of the timing belt tensioner.



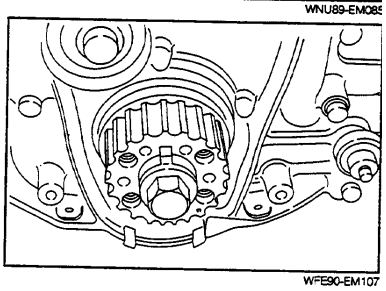
WFE90-EM10

3. Installation of crankshaft timing belt pulley
   (1) Install the crankshaft timing belt pulley flange with its recessed side facing toward the oil pump side.



WNU89-EM085

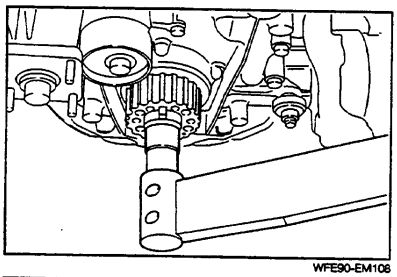
   (2) Install the crankshaft timing belt pulley on the crankshaft by aligning it with the key groove. Install the setting bolt of the crankshaft timing belt pulley. Align the stamped mark of the crankshaft timing belt pulley with the indicator.



WFE90-EM107

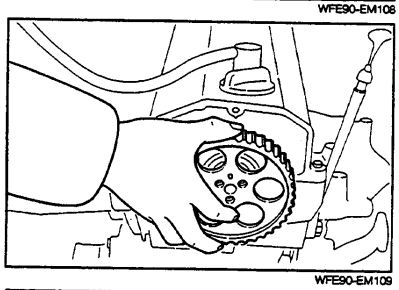
(3) Tighten the crankshaft timing belt pulley bolt.
Tightening Torque: 88.3 - 98.0 N·m (9.0 - 10.0 kgf-m)

NOTE:
- Prevent the crankshaft from being rotated by placing the gear shift lever in the 5-th gear.


WFE90-EM108

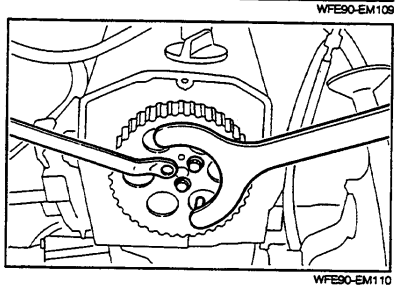
4. Installation of camshaft timing belt pulley
(1) Install the camshaft timing belt pulley on the camshaft in such a way that the "F" mark can be seen and the locating pin hole is aligned.

NOTE:
- Remove any oil or water from the camshaft timing belt pulley. Keep the pulley clean.


WFE90-EM109

(2) Install the three attaching bolts of the camshaft timing belt pulley, while preventing the pulley from turning by using SST.
Tightening Torque: 14.8 - 21.5 N·m (1.5 - 2.2 kgf-m)
SST: 09278-87201-000

CAUTION:
- Never allow the camshaft to turn.


WFE90-EM110

5. Installation of timing belt
CAUTION:
- Do not try to pry the timing belt with a screwdriver or the like.
- Do not allow the belt to come into contact with oil, water or dust.
- Do not bend the belt at a sharp angle or turn the belt inside out.
- Perform the engine turning operation at the crankshaft side.
- Do not utilize the tension of the timing belt when tightening the set bolt of the timing belt pulley.
- When the timing belt is reused, install the timing belt in such a way that the direction of the arrow put during the removal may match with the engine rotation direction.
- The adjustment of belt tension should be made when the cylinder block and its ambient temperatures are in between 5 - 50°C .

WFE90-EM111

(1) Align the "F" mark of the camshaft timing belt pulley with the indicator on the cylinder head cover.

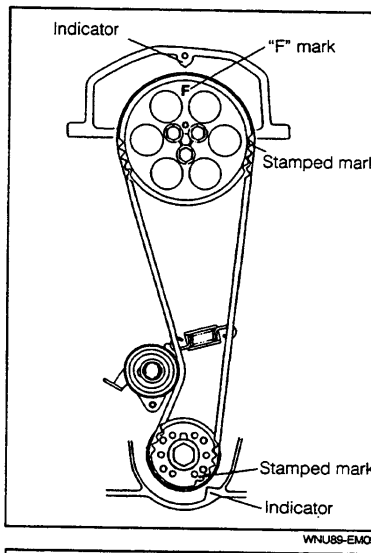
CAUTION:

- It should be noted that the piston may interfere with the valves if the camshaft is turned independently.

(2) Align the stamped mark of the crankshaft timing belt pulley with the indicator.

CAUTION:

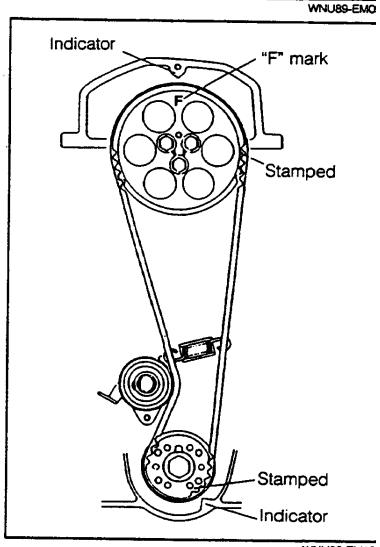
- It should be noted that the piston may interfere with the valves if the crankshaft is turned independently.



(3) Assemble the timing belt in such a way that the two mating marks on the timing belt may be aligned with the corresponding stamped marks on the crankshaft timing belt pulley and camshaft timing belt pulley.

NOTE:

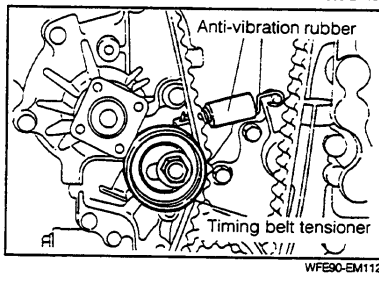
- When the timing belt is reused, install the timing belt in such a way that there exist 35 teeth of the belt between the stamped marks of the crankshaft timing belt pulley and camshaft timing belt pulley.
- When the timing belt is reused, install the timing belt in such a way that the arrowhead which was put during disassembly comes rotational direction of the timing belt.



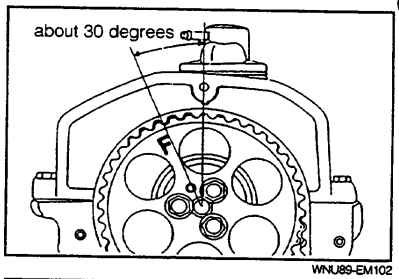
(4) Loosen the attaching bolt of the timing belt tensioner. Apply tension to the timing belt. Temporarily tighten the attaching bolt.

NOTE:

- Ensure that the belt exhibits no slack at the tension side of the belt (the side opposite to the tensioner).



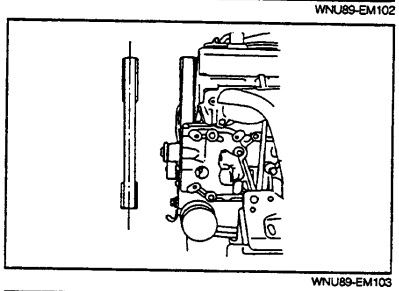
(5) Rotate the crankshaft 1.9 turns in the normal direction (to the right as viewed from the engine cylinder No. 1) so that the "F" mark of the camshaft timing belt pulley comes at a point three teeth in the camshaft timing belt pulley before the indicator of the cylinder head cover.



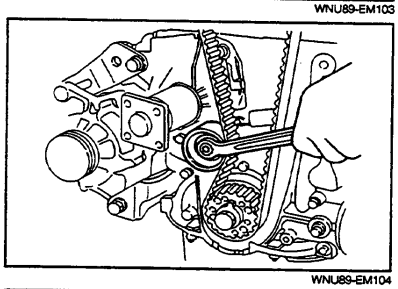
WNU89-EM102

CAUTION:
- **At this time, never turn the crankshaft reversely.**
- **Make sure that the belt is not tilted between the crankshaft timing belt pulley and the camshaft timing belt pulley.**

  If the crankshaft should be reversed or the timing belt should be tilted, turn the crankshaft two more turns.

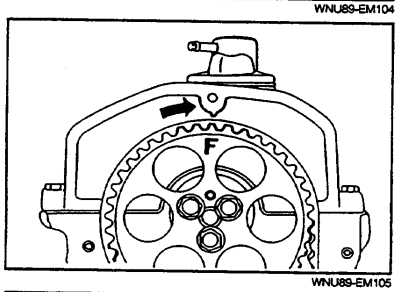

WNU89-EM103

(6) Make the tensioner free by loosening the attaching bolt of the timing belt tensioner.


WNU89-EM104

(7) Turn the crankshaft further in the normal direction until the "F" mark of the camshaft timing belt pulley is aligned with the indicator of the cylinder head cover.

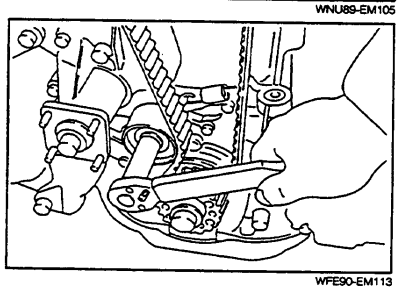
CAUTION:
- **Never turn the crankshaft reversely.**
- **Never turn the crankshaft beyond the point where the "F" mark of the camshaft timing belt pulley is aligned with the indicator.**



WNU89-EM105

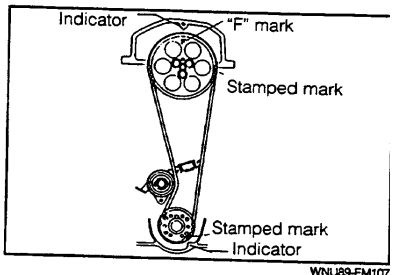
If the crankshaft should be reversed or turned beyond that point, temporarily tighten the tensioner attaching bolt and repeat the operations from the step (5) onward.

(8) Tighten the attaching bolt of the timing belt tensioner to the specified torque.
Tightening Torque: 29.4 - 44.1 N·m (3.0 - 4.5 kgf-m)


WFE90-EM113

(9) Ensure that the stamped marks of the crankshaft timing belt pulley and camshaft timing belt pulley are aligned with the corresponding indicators.

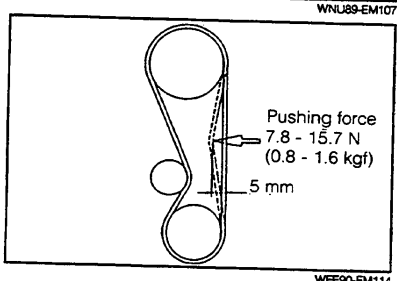
If the stamped mark is not aligned with the indicator, repeat the operations from the step (1) onward.



WNU89-EM107

6. Check of timing belt tension
When the midpoint of the belt at the tension side is pushed 5.0 mm, ensure that the pushing force is
Specified Pushing Force: 7.8 -15.7 N (0.8 - 1.6 kgf)
(When belt is deflected 5.0 mm)

If the belt does not conform to the specification, repeat the operations from the step 15 (4) onward.

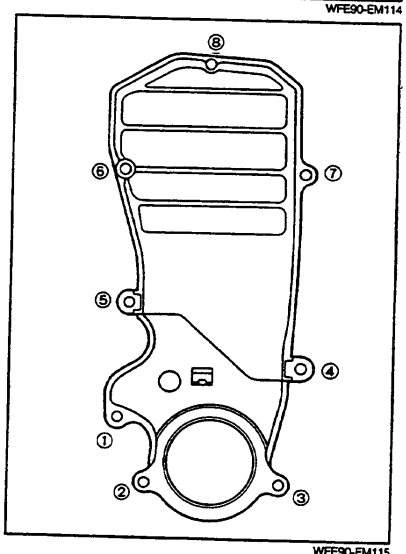


WFE90-EM114

7. Installation of timing belt cover
(1) Install the timing belt cover No. 1 (lower side) with three bolts.
NOTE:
- **Attaching bolts ④ and ⑤ in the figure are tightened both upper and lower side cover.**

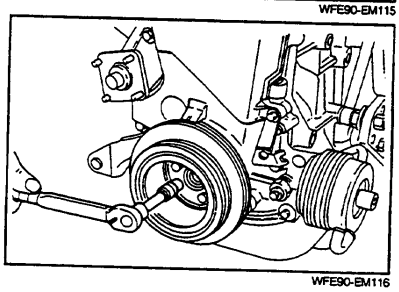
(2) Install the timing belt cover No. 2 (upper side) with five bolts.
Tightening Torque: 2.0 - 3.9 N·m (0.2 - 0.4 kgf-m)
(For both upper and lower cover)

NOTE:
- **First, attaching bolts ① and ④ should be installed.**



WFE90-EM115

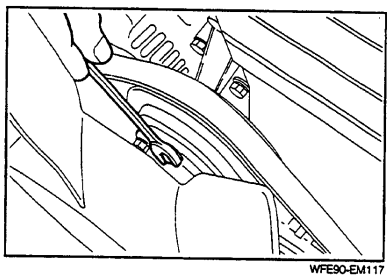
8. Installation of crankshaft pulley
(1) Prevent the crankshaft from turning by placing the gear shift lever in the 5th gear position, and pull the parking break lever.
(2) Install the crankshaft pulley on the crankshaft timing belt pulley with four bolts.
Tightening Torque: 19.6 - 29.4 N·m (2.0 - 3.0 kgf-m)


WFE90-EM116

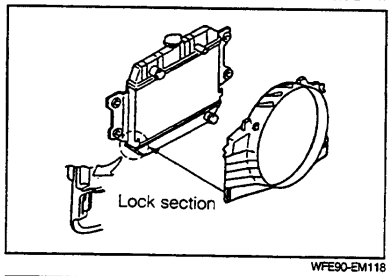
9. Installation of fluid coupling with fan and fan shroud
   (1) Install the water pump pulley to the water pump with temporarily attaching.
   (2) Insert the radiator fan shroud together with the fluid coupling with fan between radiator and the engine.
   NOTE:
   - **Be sure that the water pump pulley is not ride to the spigot section of the water pump pulley seat.**

   (3) Install the fluid coupling to with fan the water pump by means of four bolts through water pump pulley.
   Tightening Torque: 9.8 - 17.7 N·m (1.0 - 1.8 kgf-m)

   (4) Insert the lock section of fan shroud to the radiator. Then, tighten the two attaching bolts of the radiator upper side.
   (5) Connect the water hose to the radiator upper tank. Securely clamp the water hose clamp.



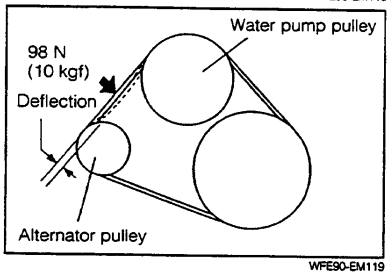
WFE90-EM117



WFE90-EM118

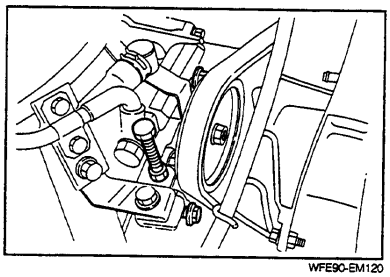
10. Installation of V belt
   (1) Install the V belt.
   (2) Perform the adjustment in such a way that the deflection at the midpoint between the water pump pulley and the alternator may become the specified value when a force of 98 N (10 kgf) is applied to the midpoint.
   Specified Belt Deflection:
   New Belt: 4.0 - 5.0 mm
   With a force of 98 N (10 kgf) applied to point indicated in figure
   Used Belt: 5.0 - 6.0 mm
   With a force of 98 N (10 kgf) applied to point indicated in figure

   NOTE:
   - **The used belt denotes a belt which has been used for more than five minutes after it was put into use.**



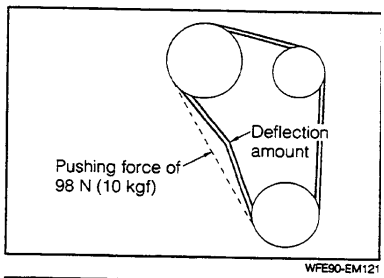
WFE90-EM119

11. Installation of power steering drive belt
   (Power steering equipped vehicle only)
   (1) Install the power steering drive belt.



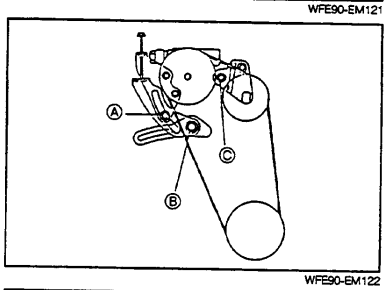
WFE90-EM120

(2) Set the drive belt tension to specified valve by tightening the adjusting bolt.
Specified Deflection: 9 -11 mm
[When a force of 98 N (10 kgf) is applied]



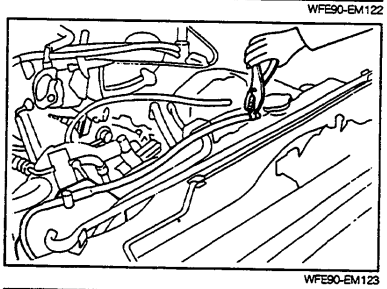
WFE90-EM121

(3) Tighten the bolts and nut to the specified valve.
Tightening Torque:
Ⓐ.... 34.3 - 44.1 N·m (3.5 - 4.5 kgf-m)
Ⓑ.... 14.7 - 21.6 N·m (1.5 - 2.2 kgf-m)
Ⓒ.... 49.0 - 68.6 N·m (5.0 - 7.0 kgf-m)



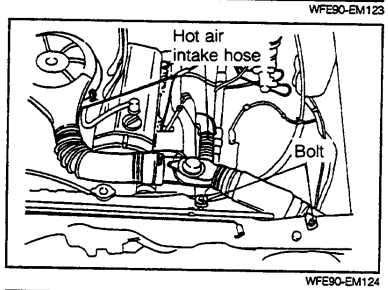
WFE90-EM122

12. Installation of reserve tank.
(1) Install the reserve tank to the radiator assy bracket.
(2) Install the reserve tank hose to the radiator with clip.


WFE90-EM123

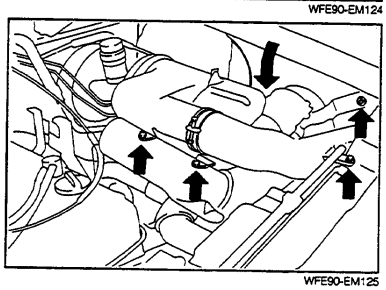
13. Installation of the air cleaner and the air cleaner hose.

[HD-C Engine]
(1) Connect the vacuum motor hose to the air cleaner hose. (Except G.C.C. specification)
(2) Connect the hot air intake hose to the pipe.
(3) Connect the air cleaner hose to the air cleaner case and the pipe with two bolts and one clamp.

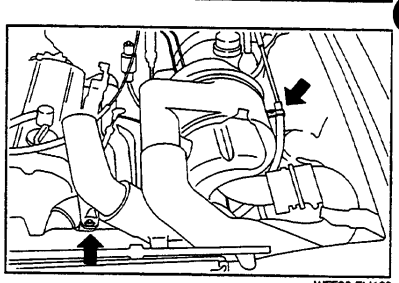


WFE90-EM124

[HD-E Engine]
(1) Put the air cleaner and the air cleaner hose into position.
(2) Tighten the three air cleaner attaching bolts.
(3) Tighten the air cleaner hose attaching bolts provided at the left fender panel and the radiator center support.

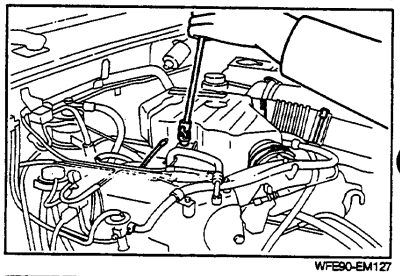

WFE90-EM125

14. Install the clutch cable clamp provided at the air cleaner.
15. Install the tapping screw onto the radiator fan shroud upper side.



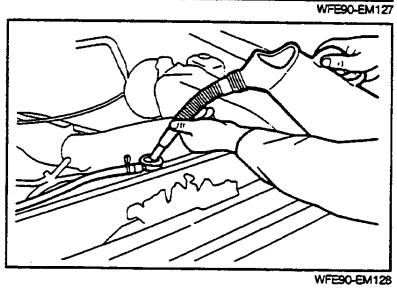
WFE90-EM126

16. Install the air intake chamber.



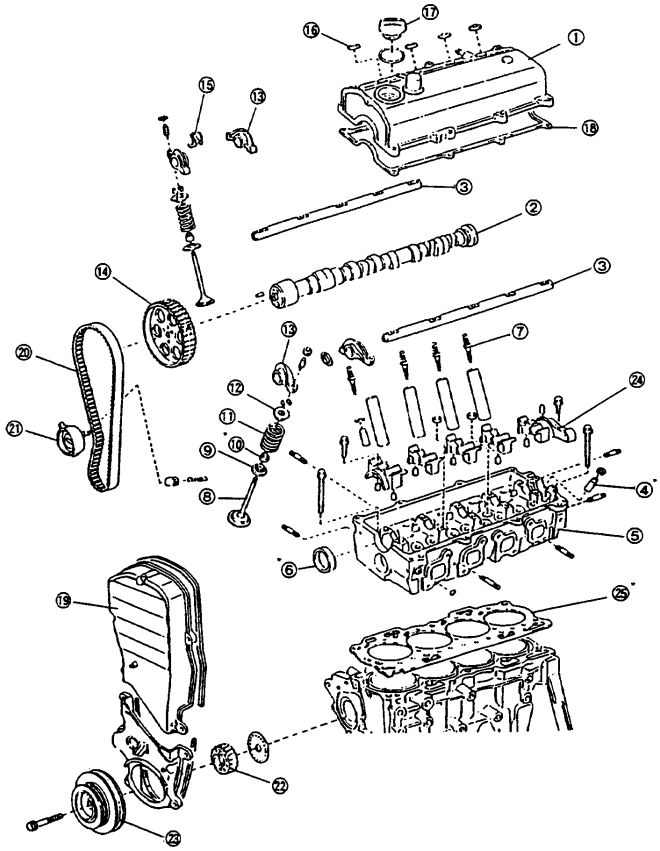
WFE90-EM127

17. Pour the engine coolant about 1 liter into the radiator.
    NOTE:
    - **Use the engine coolant which is drained from radiator in the step 2 of removal of timing belt.**
18. Connect the battery ground cable to the negative (–) terminal of the battery.



WFE90-EM128

CYLINDER HEAD
COMPONENTS



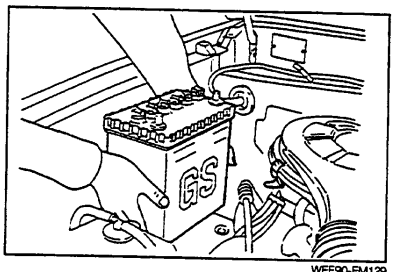
① Cylinder head cover
② Camshaft
③ Valve rocker shaft
④ Valve guide
⑤ Cylinder head
⑥ Oil seal
⑦ Spark plug
⑧ Valve
⑨ Spring seat
⑩ Valve stem oil seal
⑪ Valve spring
⑫ Valve spring retainer
⑬ Valve rocker arm
⑭ Camshaft timing belt pulley
⑮ Spacer
⑯ Grommet
⑰ Oil filler cap
⑱ Gasket
⑲ Timing belt upper cover
⑳ Timing belt
㉑ Timing belt tensioner
㉒ Crankshaft timing belt pulley
㉓ Crankshaft pulley
㉔ Camshaft cap
㉕ Cylinder head gasket

WFE90-EM702

REMOVAL OF CYLINDER HEAD WITH MANIFOLDS

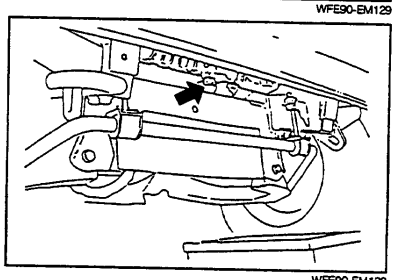
[HD-C Engine]

1. Removal of battery
   (1) Disconnect the battery ground cable from the negtive (–) terminal of battery.
   Then disconnect the positive cable from the positive (+) terminal.
   (2) Remove the battery from the engine compartment by removing the battery holding clamp.



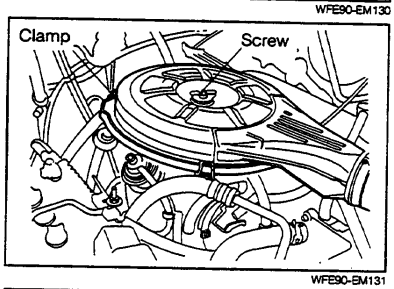
WFE90-EM129

2. Drain the coolant
3. Drain the engine oil
4. Removal of engine hood.
   (1) Disconnect the window shield washer hose
   (2) Remove the engine hood by removing four bolts.


WFE90-EM130

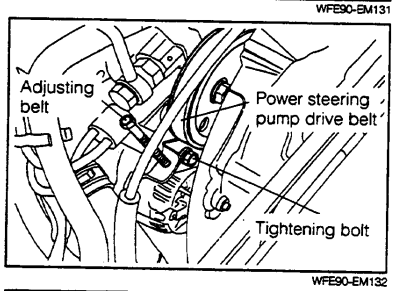
5. Removal of air cleaner assembly.
   (1) Disconnect the flowing hoses at air cleaner side.
   - ITC vacuum hose to carburetor
   - Vacuum hose to TVSV
   - PCV hoses
   - Vacuum hoses for vacuum motor

   (2) Remove the air cleaner by removing the attaching bolt and wing nut.



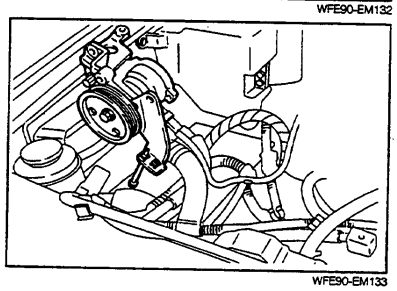
WFE90-EM131

6. Removal of the power steering pump assembly (Power steering equipped vehicle only)
   (1) Loosen the adjusting bolt and two attaching bolts. Then pull down the pump.
   (2) Remove the drive belt.
   (3) Disconnect two tightening bolts.

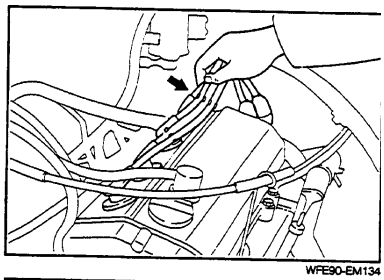


WFE90-EM132

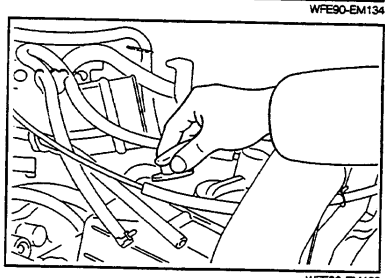
   (4) Remove the power steering pump assembly and put on the battery carrier temprarily.
   (5) Disconnect the vacuum hose for idle up.


WFE90-EM133

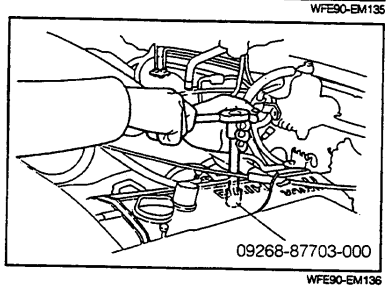
7. Removal of spark plugs.
   (1) Detach the spark plug wires from the clamp.


WFE90-EM134

   (2) Detach the spark plug wires at the cylinder head side.


WFE90-EM135

   (3) Remove the spark plugs, using plug wrench (16 mm) or the fllowing SST.
   SST: **09268-87703-000**

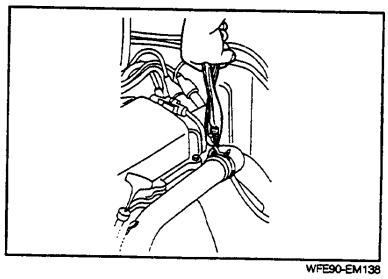


WFE90-EM136

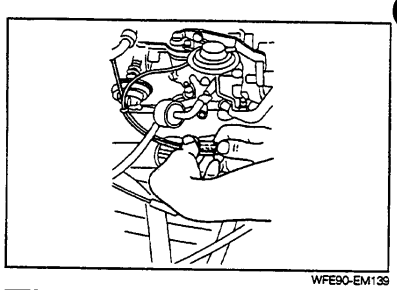
12. Removal of timing velt.
   (See Page EM-32.)

WFE90-EM137

13. Removal of water hose and coupler
   (1) Disconnect the water out let hose at the engine rear side.
   (2) Disconnect the heater hose at the rear right side of engine.
   (3) Disconnect the small water hose at the water inlet side.

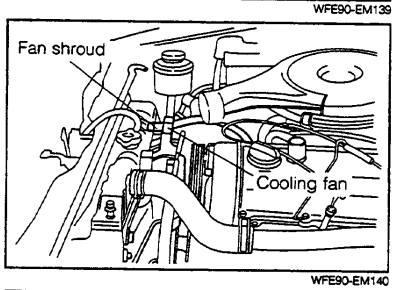

WFE90-EM138

(4) Disconnect the coupler of solenoid valve wiring harness.
(5) Disconnect the coupler of the water temperature sender wiring.



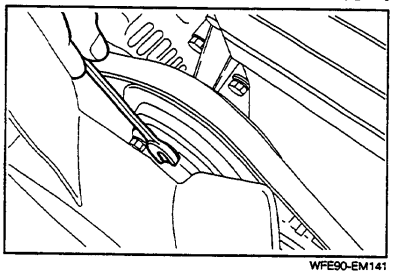
WFE90-EM139

8. Removal of fluid coupling with fan and fan shroud
   (1) Remove the two clamps for clutch cable on the fan shroud.
   (2) Disconnect the water hose from the radiator upper tank.



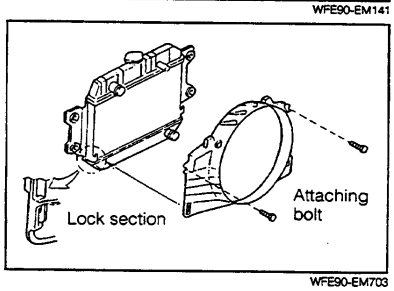
WFE90-EM140

   (3) Remove the fluid coupling with fan from water pump pulley by removing four nuts.
   (4) Loosen the alternator pulley adjusting bolt.



WFE90-EM141

   (5) Remove the two attaching bolts of the fan shroud.
   (6) Un-lock the lock section of fan shroud lower part from the radiator by pulling up the fan shroud.
   Remove the fan shroud together with fluid coupling fan.

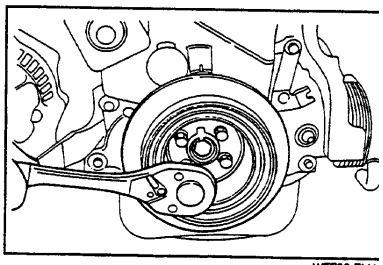


WFE90-EM703

9. Remove the V-ribbed belt and water pump pulley.

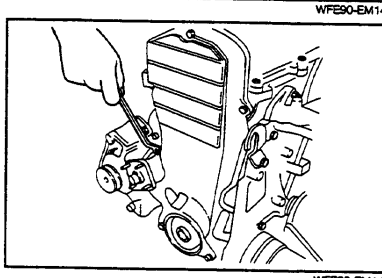
WFE90-EM142

10. Remove the crankshaft pulley by removing the four attaching bolts.
    NOTE:
    - **Place the gear shift lever in the 5th gear position so as to prevent the rotation of the crankshaft.**



WFE90-EM1

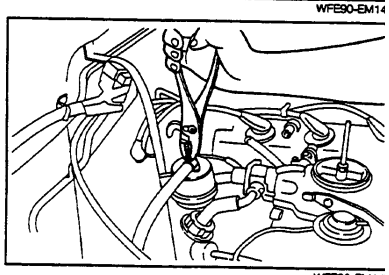
11. Remove the timing belt cover No. 1 and No. 2 by removing the eight bolts.



WFE90-EM14

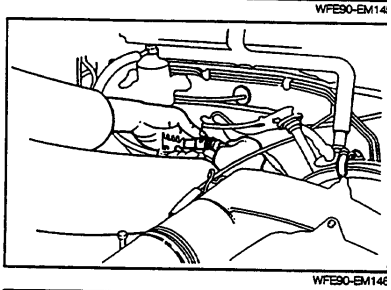
12. Removal of fuel line
    (1) Disconnect the fuel hoses to fuel filter from the fuel pump.
    NOTE:
    - **When disconnecting the fuel hose, take precautionary measures to prevent any dirt from entering into the fuel line.**

    (2) Disconnect the evaporative emission hoses at charcoal canister.



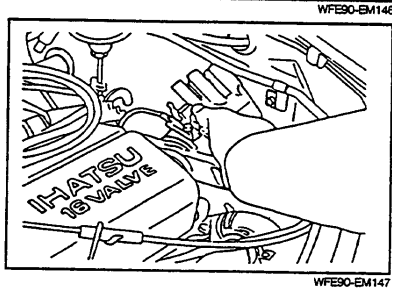
WFE90-EM14

13. Disconnect the brake booster vacuum hoses from the intake manifold.
14. Removal of distributor
    (1) Disconnect the coupler of wiring harness of the distributor.



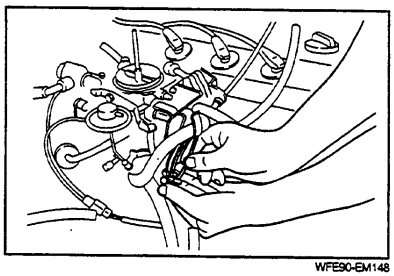
WFE90-EM14

    (2) Remove the distributor from the cylinder head by removing the two attaching bolts.
    NOTE:
    - **Since the remaining engine oil will flow out, be certain to place a cloth or the like.**



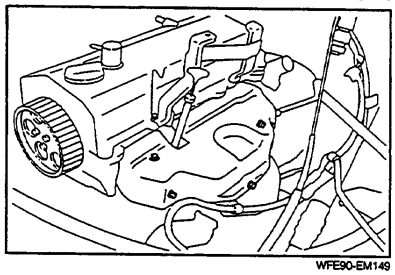
WFE90-EM147

15. Disconnect the accelerator cable from the carburetor.



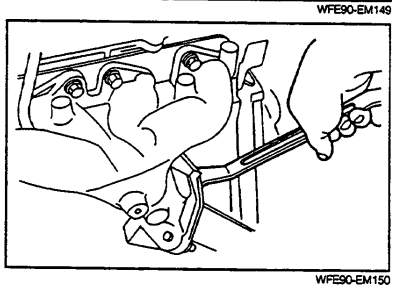
WFE90-EM148

16. Remove the hot air shroud from the exhaust manifold by loosening the five attaching bolts.



WFE90-EM149

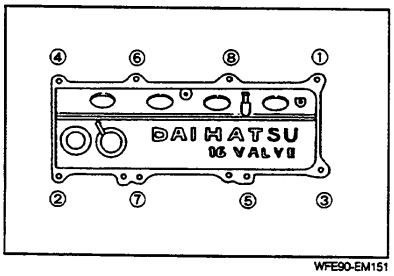
17. Disconnect the exhaust pipe from the exhaust manifold by removing the three attaching nuts.



WFE90-EM150

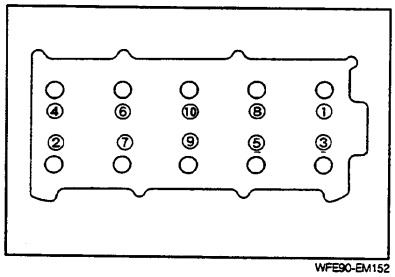
18. Removal of cylinder head cover
    (1) Remove the spark plug wires from the cylinder head.
    (2) Remove the spark plugs, using the SST.
    SST: 09268-877703-000

    (3) Loosen the cylinder head cover attaching bolts evenly over two or three stages in the sequence indicated in the figure. Remove the cylinder head cover attaching bolts.



WFE90-EM151

19. Removal of cylinder head
    (1) Disconnect the bypass hose from the intake manifold.
    (2) Disconnect the water hose from the thermo valve.
    (3) Remove the engine electrical wiring harness clamp from the intake manifold.
    (4) Disconnect the water outlet hose at the cylinder head side.
    (5) Disconnect the heater inlet hose at the cylinder head side.



WFE90-EM152

(6) Loosen the cylinder head bolts, using a hexagon wrench.

NOTE:

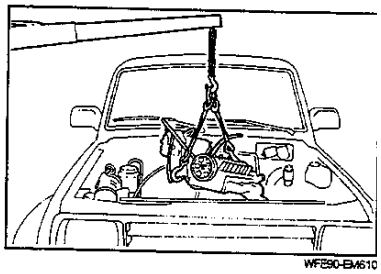
- Loosen the cylinder head bolts evenly over two or three stages in the sequence indicated in the figure.

(7) Remove the cylinder head with intake and exhaust manifold, by using the chain block.

NOTE:

- Be careful not to allow the cylinder head to hit to the vehicle body and/or other parts.
- Place the removed cylinder head on suitable two wooden blocks in order that the cylinder head surface and valve may not be damaged.

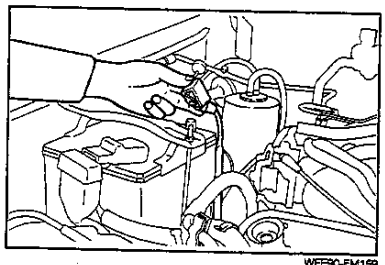
(8) Remove the cylinder head gasket.



WFE90-EM610

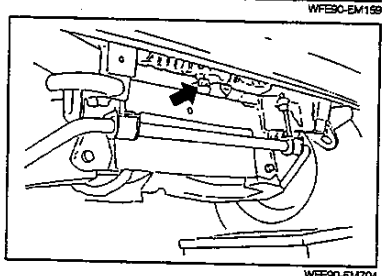
[HD-E Engine]

1. Removal of the battery
   (1) Disconnect the battery ground cable from the negtive (–) terminal of the battery.
   Then disconnect the positive cable from the positive (+) terminal.
   (2) Remove the battery from the engine compartment by removing the battery holding clamp.
2. Drain the coolant.
3. Drain the engine oil



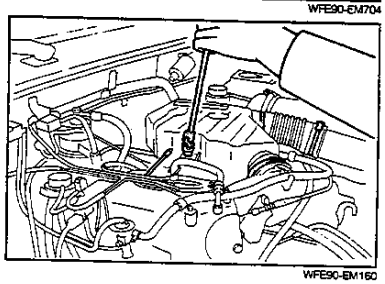
WFE90-EM159

4. Removal of engine hood.
   (1) Disconnect the window shield washer hose.
   (2) Remove the engine hood by removing four bolts.



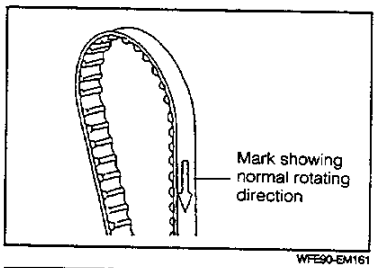
WFE90-EM704

5. Removal of the air intake chamber.
   (See page EM–17.)



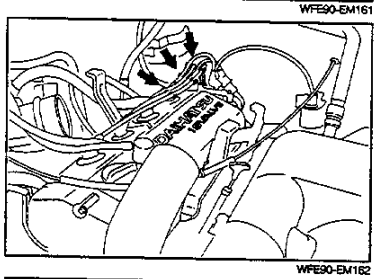
WFE90-EM160

6. Removal of the timing belt
   (See page EM-36.)

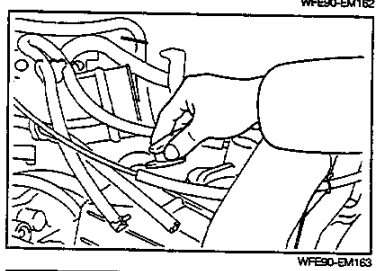


WFE90-EM161

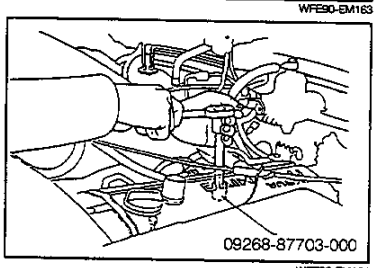
7. Removal of spark plugs.
   (1) Remove the spark plug wire clamps.


WFE90-EM162

   (2) Remove the spark plug wires.

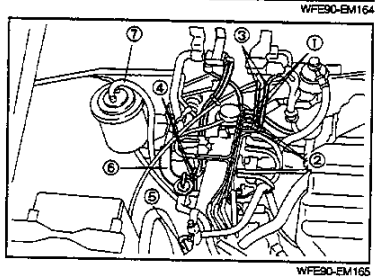

WFE90-EM163

   (3) Remove the spark plugs, using the plug wrench (16 mm) or the flowing SST.
   SST: 09268-87703-000



WFE90-EM164

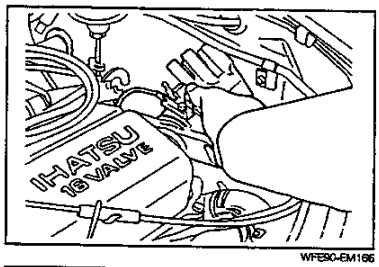
8. Removal of following vacuum hoses at surge tank side.
   (1) Distributor diaphram ①
   (2) BVSV ②
   (3) Pressure VSV ③ (us spc only)
   (4) Air conditioner idle up VSV ④
   (5) Power steering ACV ⑤
   (6) Brake booster ⑥
   (7) Charcoal canister ⑦



WFE90-EM165

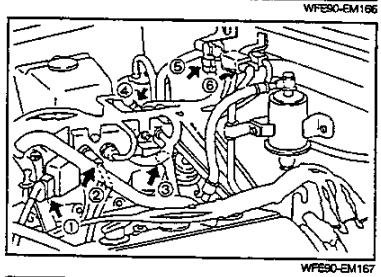
9. Removal of distributor
   (1) Disconnect the distributor wire connector.
   (2) Remove the distributor from the cylinder head by removing the two attaching bolts.

   NOTE:
   - **Since the remaining engine oil will flow out, be certain to place a cloth or the like.**

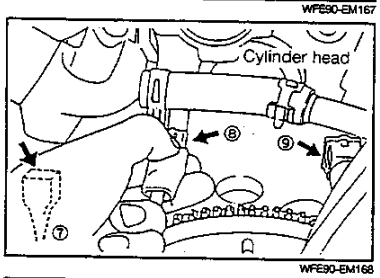


WFE90-EM166

10. Removal of engine wire harness.
    (1) Disconnect the flowing connectors.
        ① Throttle possition sensor ①
        ② Intake air temperature sensor ②
        ③ Idle speed control VSV ③
        ④ EGR VSV and harness clamp ④
        ⑤ Air conditioner idle up VSV ⑤
        ⑥ Idle up VSV connector
        (Pressure sensor, Pressure VSV and clamp. ⑥)

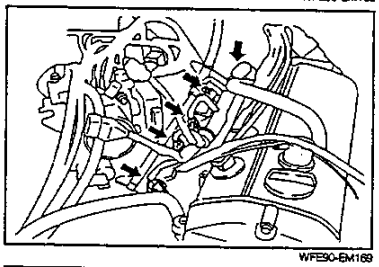

WFE90-EM167

        ⑦ Air conditioner water temperature switch. ⑦
        ⑧ Water temperature sender gauge ⑧
        ⑨ Water temperature sensor ⑨

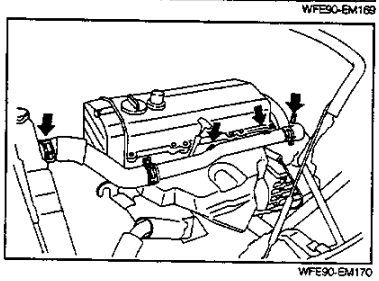


WFE90-EM168

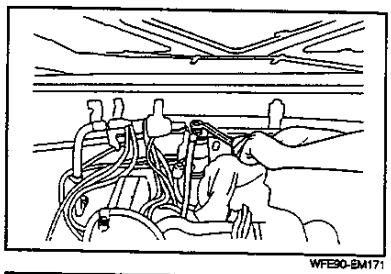
    (2) Disconnect the four injector connectors.
    (3) Remove the engine wire clamps and engine ground cables.


WFE90-EM169

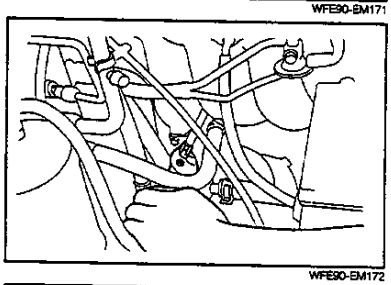
11. Remove the radiator hose No. 1 from the radiator upper tank by loosening the two clamps and attaching bolts.


WFE90-EM170

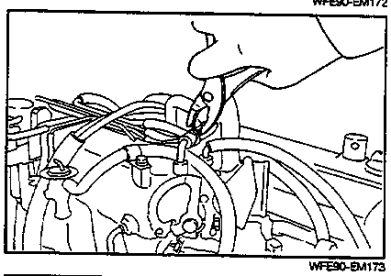
12. Disconnect the hose No. 1 from the fuel filter.
    CAUTION
    - The fuel pressure inside the fuel line is set to a pressure 250 kPa (2.55 kgf/cm²) higher than the atmospheric pressure. Hence, graduall loosen the connection while preventing the fuel from splashing with a cloth or the like.


WFE90-EM171

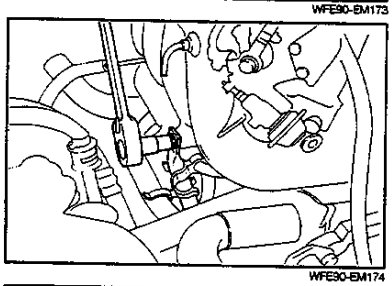
13. Disconnect the fuel return hose from the fuel pipe No.2.
    CAUTION:
    - When disconnecting the fuel hose, take precautionary measures to prevent any dirt from entering the fuel line.
    - Release the inner pressure of fuel tank by removing the fuel filler cap in advance.


WFE90-EM172

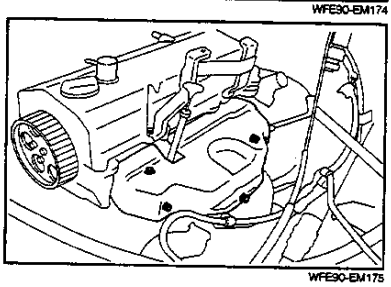
14. Disconnect the water hose from the upper side of the throttle body.


WFE90-EM173

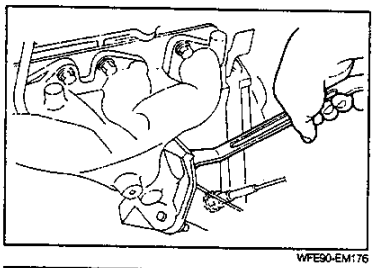
15. Remove the surge tank stay No. 2 from the surge tank.


WFE90-EM174

16. Remove the exhaust manifold cover by removing the five bolts.
17. Remove the oil level gauge support by removing the clamping bolt.

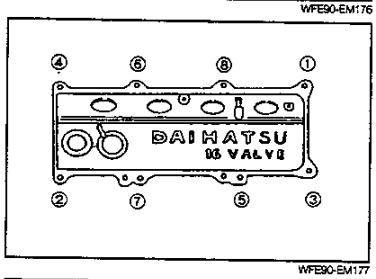

WFE90-EM175

18. Disconnect the exhaust pipe from the exhaust manifold by removing the three attaching nuts.



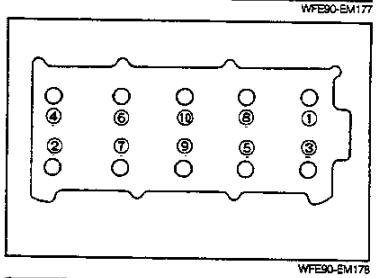
WFE90-EM176

19. Removal of cylinder head cover
    (1) Remove the bond cable from the cylinder head cover.
    (2) Remove the two air intake chamber bracket attaching bolts.
    (3) Loosen the cylinder head cover attaching bolts evenly over two or three stages in the sequence indicated in the figure.
    Remove the cylinder head cover attaching bolts.



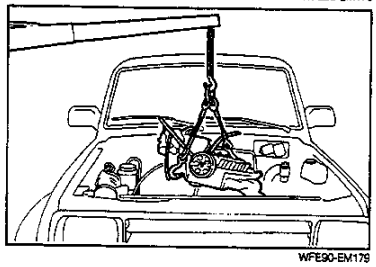
WFE90-EM177

20. Removal of cylinder head
    (1) Loosen the cylinder head bolts, using a hexagon wrench.
    CAUTION:
    - Loosen the cylinder head bolts evenly over two or three stages in the sequence indicated in the figure.



WFE90-EM178

    (2) Remove the cylinder head with intake and exhaust manifold, by using the chain block.
    CAUTION:
    - Be careful not to allow the cylinder head to hit to the vehicle body and/or other parts.
    - Place the removed cylinder head on suitable two wooden blocks in order that the cylinder head surface and valve may not be damaged.

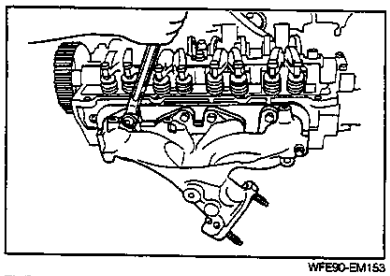


WFE90-EM179

SEPARATION OF INTAKE AND EXHAUST MANIFOLDS

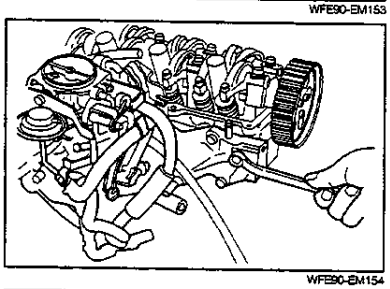
[HD-C Engine]

1. Remove the exhaust manifold by removing the six attaching bolts and two nuts.
2. Remove the exhaust manifold gasket.



WFE90-EM153

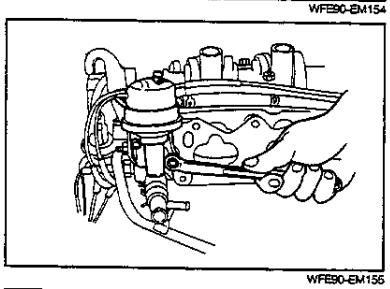
3. Removal of intake manifold
   (1) Disconnect the fuel hose at the carburetor side.
   (2) Disconnect the choke breaker hoses.
   (3) Disconnect the water by-pass hose.
   (4) Remove the intake manifold with carburetor by removing the eight attaching bolts and the four nuts.



WFE90-EM154

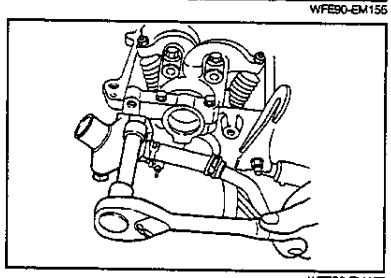
4. Removal of fuel pump
   NOTE:
   - **When disconnecting the fuel pump, take precautionary measures to flow out the engine oil.**

   (1) Remove the fuel pump by removing the two attaching bolts.
   (2) Remove the push rod and insulator.
   (3) Remove the intake manifold gasket.



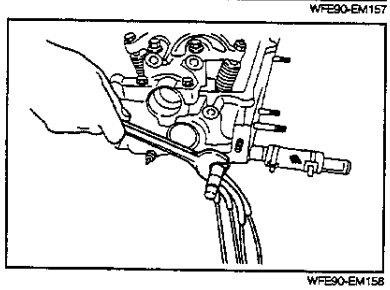
WFE90-EM155

5. Remove the water outlet housing by removing the attaching bolt and nut.
6. Remove the engine hanger by removing the attaching bolt and nut.



WFE90-EM157

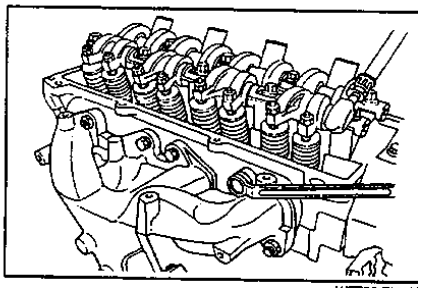
7. Remove the TVSV and water temperature sensor gauge.



WFE90-EM158

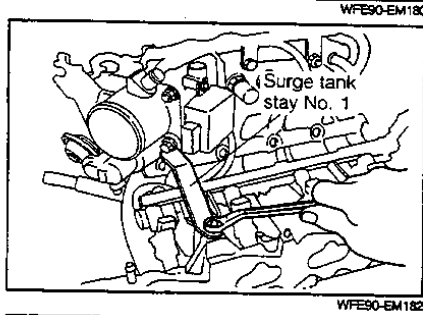
[HD-E Engine]

1. Remove the exhaust manifold by removing the six bolts and two nuts.
2. Remove the exhaust manifold gasket.



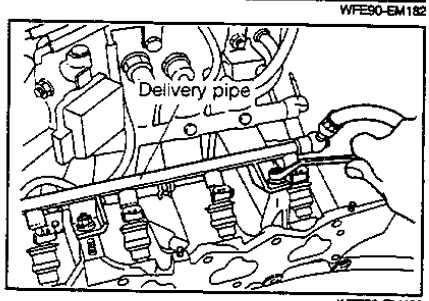
WFE90-EM180

3. Removal of intake manifold assembly.
   (1) Remove the surge tank stay No. 1 by removing the bolt and nut.



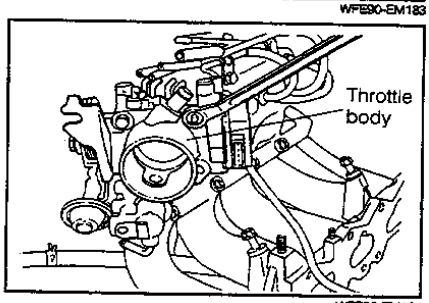
WFE90-EM182

   (2) Remove the delivery pipe by removing the two attaching bolts.



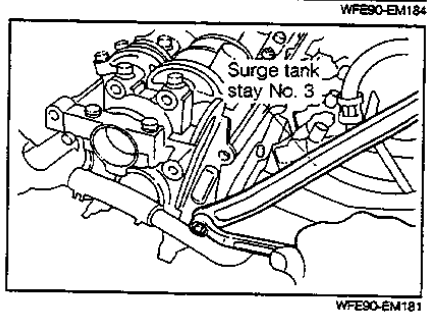
WFE90-EM183

   (3) Remove the throttle body by removing the two bolts and nut.



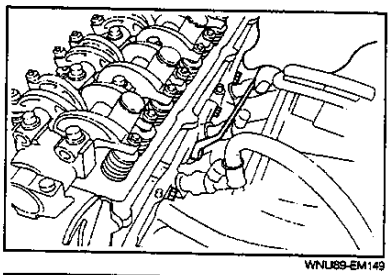
WFE90-EM184

   (4) Remove the surge tank stay No. 3.



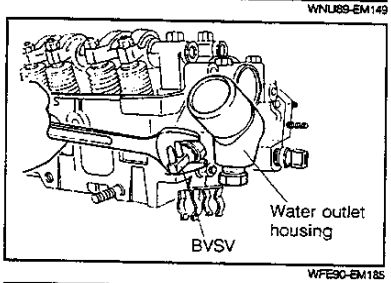
WFE90-EM181

(5) Remove the intake manifold assembly by removing the eight bolts and four nuts.
(6) Remove the intake manifold gasket.



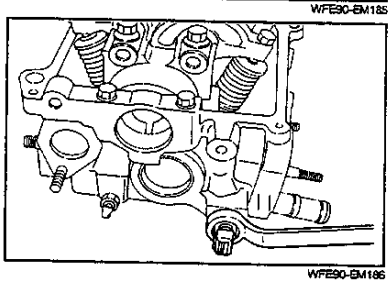
WNU89-EM149

4. Removal of water outlet housing from the cylinder head
   (1) Remove the BVSV.
   (2) Remove the water outlet housing by removing the attaching bolt and nut.



WFE90-EM185

5. Remove the water temperature sensor and water temperature sender gauge.

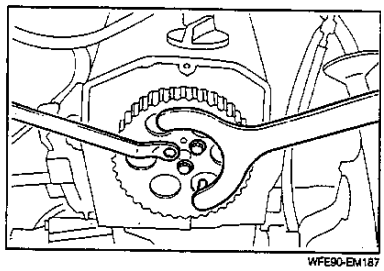


WFE90-EM186

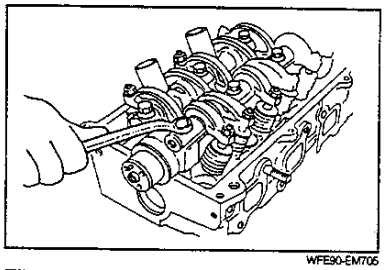
DISASSEMBLY OF CYLINDER HEAD

1. Removal of camshaft timing belt pulley
   (1) Remove the attaching bolts of the camshaft timing belt pulley, while preventing the camshaft timing belt pulley from turning with SST.
   SST: 09278-87201-000

   (2) Remove the camshaft timing belt pulley.

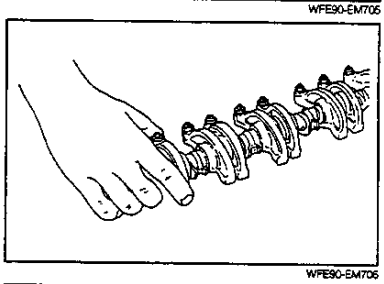

WFE90-EM187

2. Remove the valve rocker shaft sub assembly No. 1 (intake side) and No. 2 (exhaust side) by removing the ten attaching bolts.
   NOTE:
   - **Remove the attaching bolts by loosening them evenly over two or three stages.**

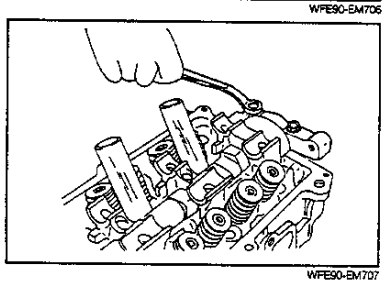

WFE90-EM705

3. Remove the valve rocker shaft together with the rocker arms from the cylinder head.

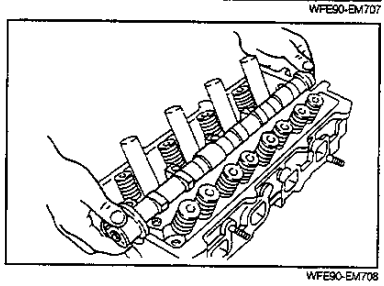
4. Remove the valve rocker arm, spacer and wave washer from valve rocker shaft.


WFE90-EM706

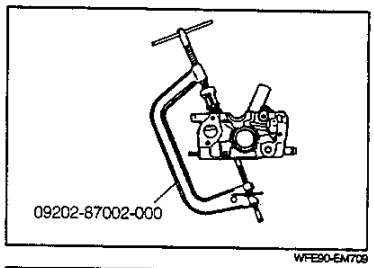
5. Removal of camshaft
   (1) Remove the camshaft bearing cap No. 5 by removing the two attaching bolts.
   (2) Remove the camshaft bearing cap No. 1 to No. 4.


WFE90-EM707

   (3) Remove the camshaft.
   (4) Remove the oil seal from the camshaft.

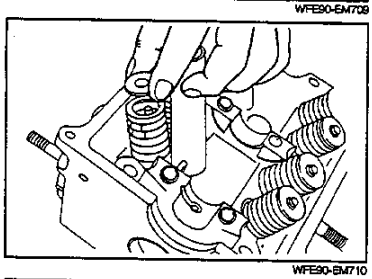

WFE90-EM708

6. Removal of intake and exhaust valve
   (1) Remove the valve spring retainer locks, using the following SST.
   SST: 09202-87002-000

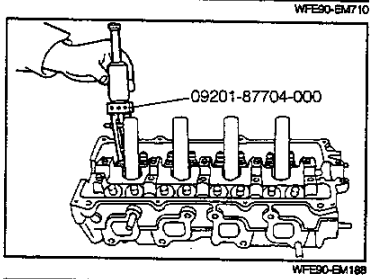


WFE90-EM709

   (2) Remove the valve spring retainers, compression springs, valves, valve stem oil seals and valve spring seats.
   NOTE:
   - Arrange the removal parts in order so that their installing positions may be known easily.

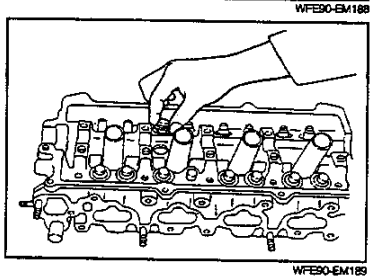

WFE90-EM710

   - If any difficulty is encountered in removing the valve stem oil seal, pull the oil stem, using the following SST.
   SST: 09201-87704-000



WFE90-EM188

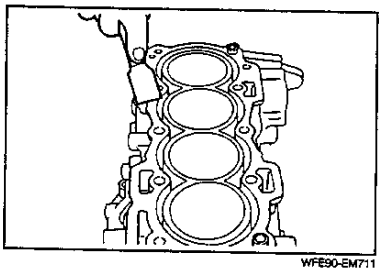
7. Remove the valve spring seats.
   NOTE:
   - Arrange the removed parts in order so that their installing positions may be known easily.


WFE90-EM189

8. Wash the disassembled parts except for electrical parts, plastic parts and grease sealed bearings.
   Dry them by blowing compressed air.

WFE90-EM190

INSPECTION, CLEANING AND REPAIRS OF CYLINDER HEAD COMPONENTS

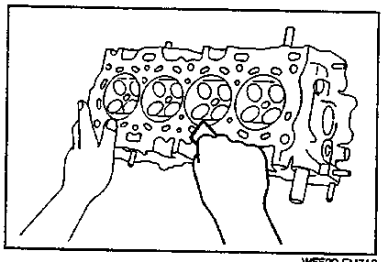

WFE90-EM711

1. Cleaning of top of each piston and cylinder block
   (1) Turn the crankshaft until each piston is brought to the top dead center.
   Using a gasket scraper, remove all carbon deposits from the pistion tops.
   (2) Using a gasket scraper, remove any remaining gasket material from the top of the cylinder block.
   Blow carbon deposits and oil from the bolt holes.

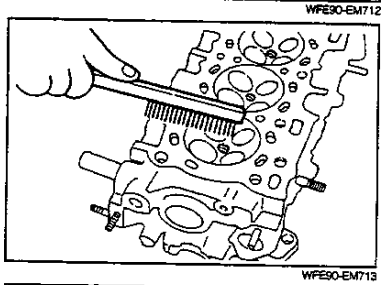
   WARNING:
   - **Protect your eyes during the cleaning operation using compressed air.**

   CAUTION:
   - **Do not scratch the gasket surfaces of the piston and cylinder block.**

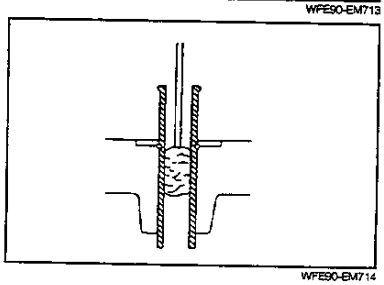
   (3) Set the piston No. 1 to the top dead center.


WFE90-EM712

2. Removal of gasket material
   Using a gasket scraper, remove any remaining gasket material from the cylinder head and manifold surfaces.

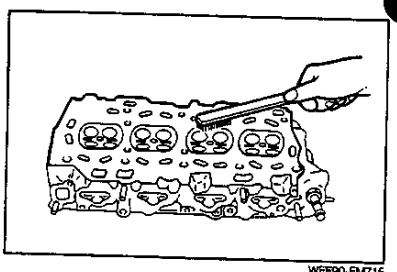

WFE90-EM713

3. Cleaning of combustion chamber
   Using a wire brush, remove all carbon deposits from the combustion chambers.
   CAUTION:
   - **Be careful not to scratch the cylinder head gasket contact surfaces.**


WFE90-EM714

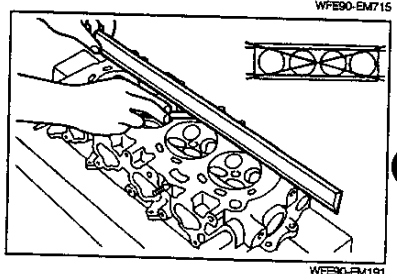
4. Cleaning of valve guide bushings
   Using a valve guide brush and solvent, clean all the valve guide bushings.

5. Cleaning of cylinder head
   Using a soft brush and solvent, thoroughly clean the cylinder head.



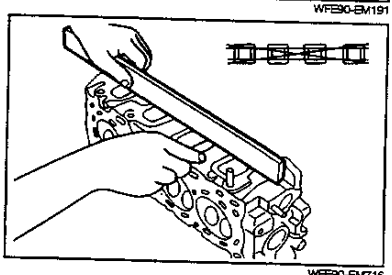
WFE90-EM715

6. Inspection of cylinder head for flatness
   Using a precision straight edge and a thickness gauge, check the gasket surfaces contacting the cylinder block and manifolds for warpage.
   Maximum Surface Warpage:
   Cylinder Block Side: 0.10 mm
   Intake Manifold Side: 0.10 mm
   Exhaust Manifold Side: 0.10 mm



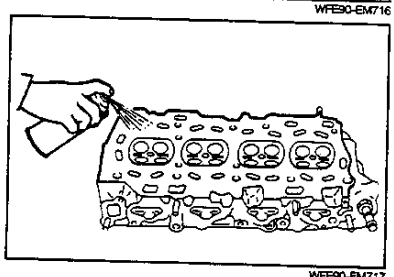
WFE90-EM191

   If surface warpage of the cylinder block side exceeds the maximum limit replace the cylinder head.



WFE90-EM716

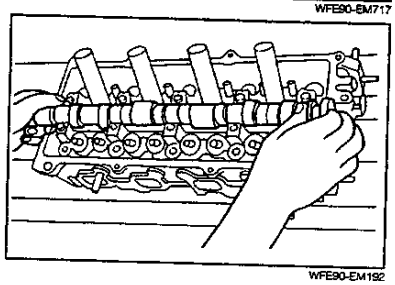
7. Inspection of cylinder head for cracks
   Using a dye penetrant, check the combustion chamber, intake and exhaust ports, head surface and top of the head for cracks.
   If a crack is found, replace the cylinder head.



WFE90-EM717

8. Inspection of camshaft oil clearance
   NOTE:
   - **Prior to this oil clearance check, the camshaft should be checked for bend in advance. (See page EM–76).**

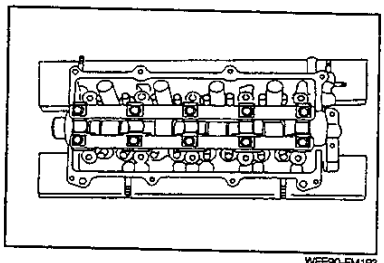
   (1) Clean the bearing and camshaft journals with cloth.
   (2) Install the camshaft to the cylinder head.
   (3) Place a plastigage on each bearing.



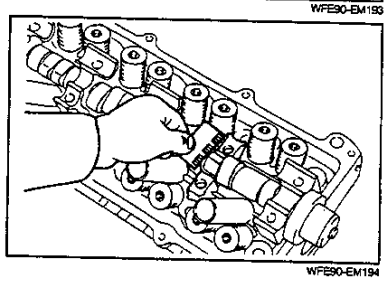
WFE90-EM192

(4) Install the bearing caps and valve rocker shaft. Tighten them to the specified torque.
Tightening Torque:
M10 bolt 28.4 - 36.3 N·m (2.9 - 3.7 kgf-m)
M8 bolt 12.7 - 16.7 N·m (1.3 - 1.7 kgf-m)

NOTE:
- Ensure that the bolt holes and bolts are dry when tightening the bolts.


WFE90-EM193

(5) Remove the bearing caps and measure the oil clearance.
Clearance:
Specified Value: 0.035 - 0.076 mm
Allowable Limit: 0.17 mm


WFE90-EM194

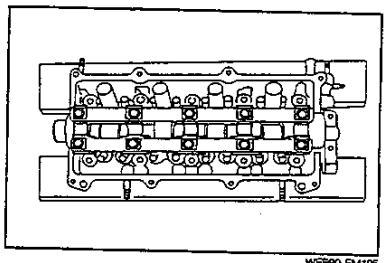
If the oil clearance exceeds the allowable limit, replace the cylinder head and camshaft as a set.

NOTE:
- After completion of the check, remove the plastigages. Wash the camshaft and bearing caps in cleaning solvent.

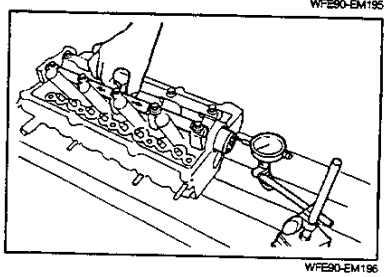
WFE90-EM718

9. Inspection of camshaft thrust clearance
(1) Apply engine oil to the camshaft journals.
(2) Install the camshaft to the cylinder head. Install the bearing caps and rocker shafts and tighten them to the specified torque.
Tightening Torque:
M10 bolt 28.4 - 36.3 N·m (2.9 - 3.7 kgf-m)
M8 bolt 12.7 - 16.7 N·m (1.3 - 1.7 kgf-m)

NOTE:
- Ensure that the bolt holes and bolts are dry when tightening the bolts.


WFE90-EM195

(3) With a dial gauge attached to the camshaft, measure the thrust clearance.
Thrust Clearance:
Specified Value: 0.1 - 0.25 mm
Allowable Limit: 0.45 mm

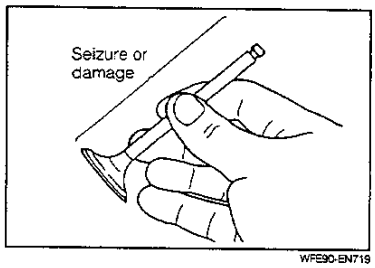

WFE90-EM196

10. Inspection and grinding of valves

(1) Visually inspect the valve stem for seizure or damage.

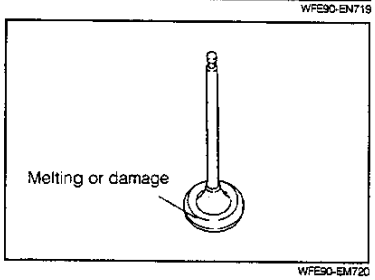
NOTE:

- If seizure or damage is found, replace the valve and valve guide bush as a set.
  However, this replacement should be performed only after the checks for the cylinder head have been finished.
- The valve guide bush hole must be used for refacing the valve seat. Hence, if the valve guide bush hole exhibits any roughness due to seizure, etc., rectify the hole with an adjustable reamer.



WFE90-EM719

(2) Visually inspect the valve head for melting or damage.
If the valve head exhibits any melting or damage, replace the valve.
If the roughness on the contact surface can be corrected, grind the valve seat contact surface with a valve refacer.

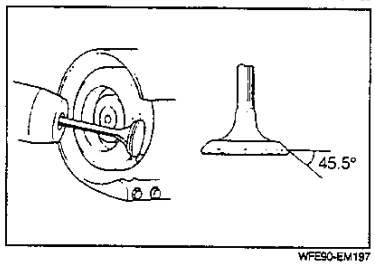


WFE90-EM720

(3) Grind the valves only enough to obtain a smooth contact surface with the valve seat.
Valve Face Angle: 45.5°

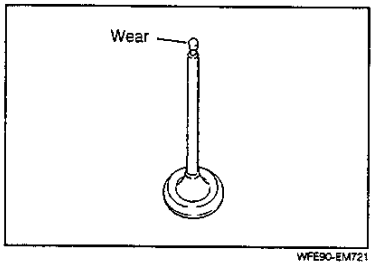
NOTE:

- Make sure the valves are ground to the correct valve face angle.



WFE90-EM197

(4) Visually inspect the valve stem end for abnormal wear.



WFE90-EM721

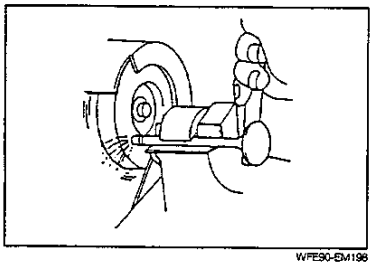
If the valve stem end exhibits abnormal wear, correct the stem end with a valve refacer. However, this correction should be made within a limit of 0.8 mm from that of standard length.

[Reference]

Valve Length (STD):

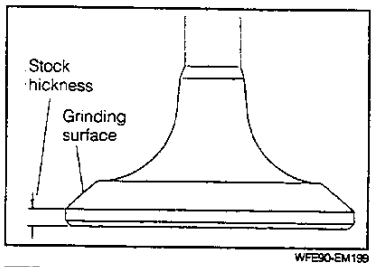
Intake Valve: 112.8 mm

Exhaust Valve: 114.5 mm


WFE90-EM198

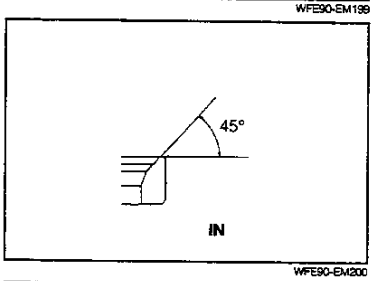
(5) Inspect the valve head for its stock thickness.
Minimum Stock Thickness
Intake Valve: 0.8 mm
Exhaust Valve: 1.0 mm

If the stock thickness of the valve head is less than the minimum stock thickness, replace it with a new one.



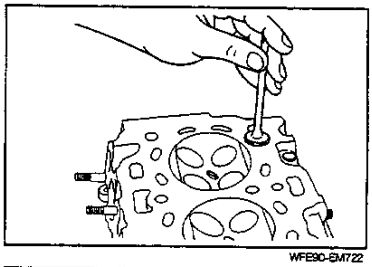
WFE90-EM199

11. Inspection and cleaning of valve seats
(1) Using a 45-degrees valve seat cutter, reface the valve seats. Remove only enough metal stock to clean the seats.
(2) Apply a thin film of red lead (or white lead) to the valve seat.
(3) Let the valve drop by its own weight onto the valve seat two or three times.
(4) Take out the valve.



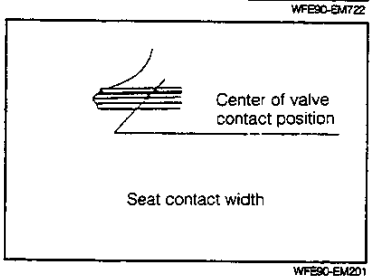
WFE90-EM200

(5) Inspect the valve face and seat for the following items.
① Ensure that the valve seat contact surface of the valve is continuous over the whole circumference. If not, replace the valve.
② Ensure that the valve contact surface of the valve seat is continuous over the whole circumference. If not, reface the valve seat.


WFE90-EM722

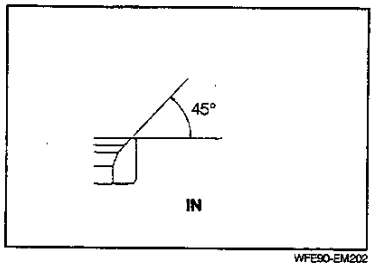
③ Measure the width of the contact surface of valve seat.
Contact Surface of Valve Seat: 1.2 - 1.6 mm

If not, reface the valve seat.



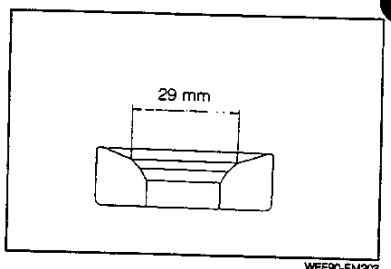
WFE90-EM201

12. Refacing of valve seat
(1) Refacing procedure for intake valve seats
① Using a 45-degrees cutter, recondition the roughness on the valve-to-valve seat contact surface, only enough to obtain a smooth surface.



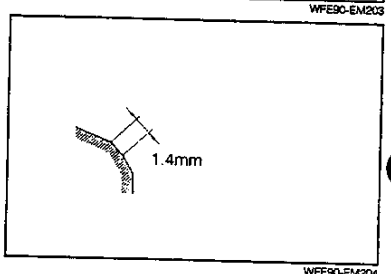
WFE90-EM202

② Using a 30-degrees cutter, cut the valve seat in such way that the circumference of the surface refaced by the 45-degrees cutter may become 29 ± 0.1 mm.



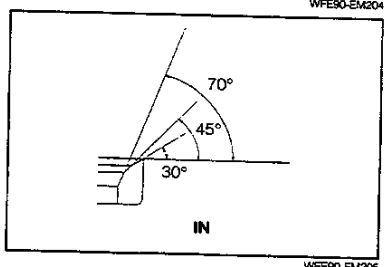
WFE90-EM203

③ Using a 70-degrees cutter, cut the seat in such way that the width, of the surface refaced by the 45-degrees cutter may became 1.4 mm.



WFE90-EM204

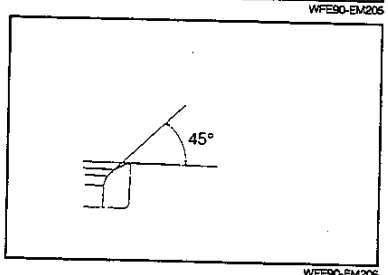
④ Using the 45-degrees cutter, remove burrs produced during the refacing by the 30-degrees and 70-degrees cutters.



WFE90-EM205

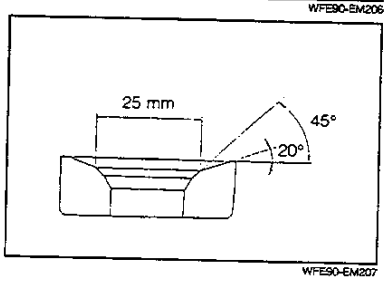
(2) Refacing procedure for exhaust valve seats

① Using a 45-degrees cutter, recondition the roughness on the valve-to-valve seat contact surface, only enough to obtain a smooth surface.



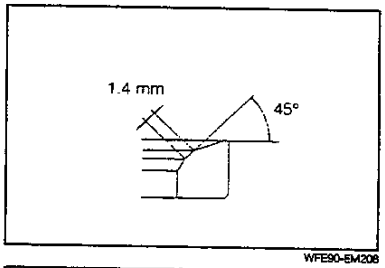
WFE90-EM206

② Using a 20-degrees cutter, cut the valve seat in such a way that the circumference of the surface refaced by the 45-degrees cutter may become 25 mm.



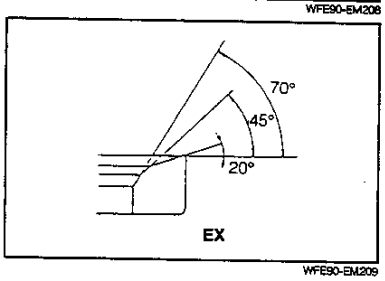
WFE90-EM207

③ Using a 70-degrees cutter, cut the valve seat in such a way that the width of the surface refaced by the 45-degrees cutter may become 1.4 mm.



WFE90-EM208

④ Using the 45-degrees cutter, remove burrs produced during the refacing by the 20-degrees and 70-degrees cutters.



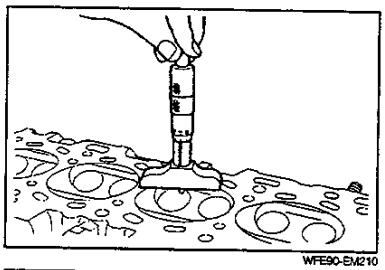
WFE90-EM209

13. Hand lapping of valves
    (1) Perform hand lapping of the valves and valve seats, using an abrasive compound.
    (2) Clean the valves and valve seats after the hand lapping of the valves.

WFE90-EM723

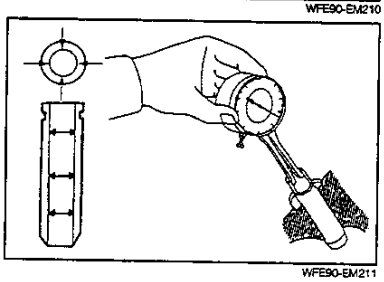
14. Inspection of valve recession
    After the valve seat has been refaced, install the new valve. Measure the distance between the cylinder attaching surface of the cylinder head (attaching surface of the cylinder head gasket) and the upper most section of the valve. Ensure that the distance does not exceed the following maximum limit.
    Maximum Limit
    Intake Valve: 2.775 mm
    Exhaust Valve: 6.026 mm

    If the recession exceeds the maximum limit, replace the cylinder head.



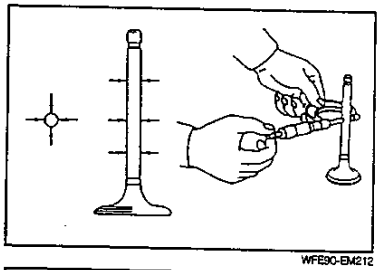
WFE90-EM210

15. Inspection of valve stem-to-guide bushing oil clearance
    (1) Using a caliper gauge, measure the inner diameter of the valve guide at six points.
    Record the measured values.
    Specified Value
    IN: 6,600 - 6;620 mm
    EX: 6,600 - 6,620 mm

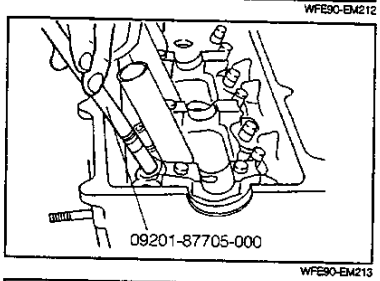


WFE90-EM211

(2) Using a micrometer, measure the diameter of the valve stem at six points.
Record the measured values.
Specified Value
IN: 6,560 - 6,580 mm
EX: 6,555 - 6,575 mm

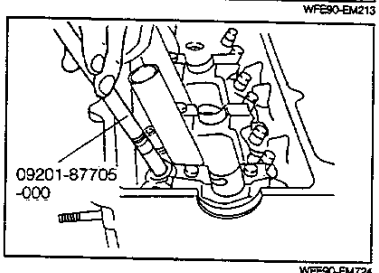

WFE90-EM212

16. Repairs of valve stem-to-guide bushing oil clearance
(1) Intake valve guide bush
① Drive out the valve guide bush from the combustion chamber side, using the following SST.
SST: 09201-87705-000



WFE90-EM213

② Drive a new valve guide bush into position, until the snap ring contacts the cylinder head, using the following SST.
SST: 09201-87705-000

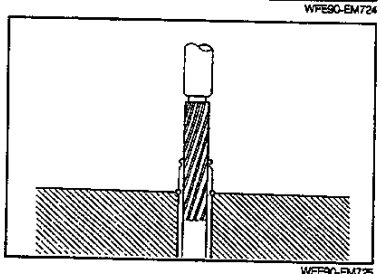


WFE90-EM724

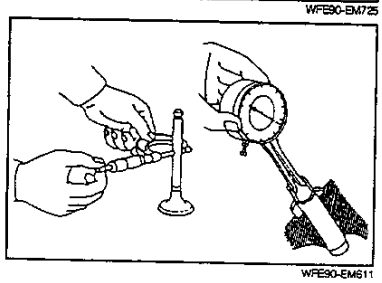
CAUTION:
- Be very careful not to give an excessive impact during the installation. Failure to observe this caution will result in valve guide bush cracks.
- Care should be exercised not to detach the snap ring due to driving the valve guide bush excessively.

③ Using an adjustable reamer, ream the valve guide bush to remove any burr or the like.

NOTE:
- This reaming should be made only enough to remove the burr or the like.


WFE90-EM725

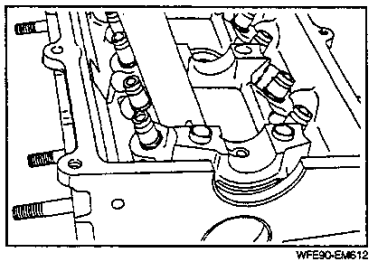
④ Inspection of oil clearance
Ensure that the oil clearance meets the specifications.
Oil Clearance:
Specified Value:
Intake 0.020 - 0.060 mm
Allowable Limit:
Intake 0.08 mm


WFE90-EM611

(2) Exhaust valve guide bush

NOTE:

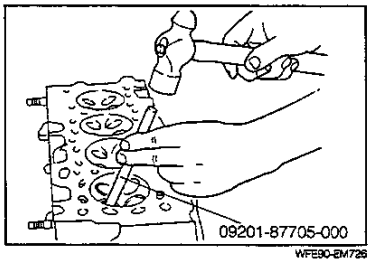
- When the locating ring for the valve guide bush is located 14 mm from the upper end of the valve guide bush, replace the cylinder head.



WFE90-EM612

① Drive out the valve guide bush from the combustion chamber side, using the following SST.

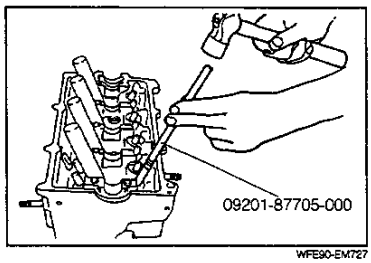
SST: 09201-87705-000



WFE90-EM726

② Drive a new valve guide bush into position, until the snap ring contacts the cylinder head, using the following SST.

SST: 09201-87705-000



WFE90-EM727

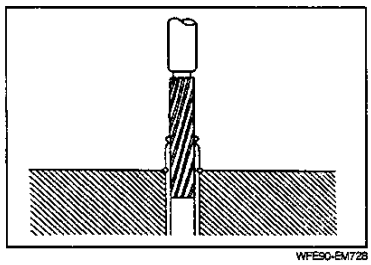
CAUTION:

- Be very careful not to give an excessive impact during the installation. Failure to observe this caution will result in valve guide bush cracks.
- Care should be exercised not to detach the snap ring due to driving the valve guide bush excessively.

③ Using an adjustable reamer, ream the valve guide bush to remove any burr or the like.

NOTE:

- This reaming should be made only enough to remove the burr or the like.



WFE90-EM728

④ Inspection of oil clearance

Ensure that the oil clearance meets the specifications.

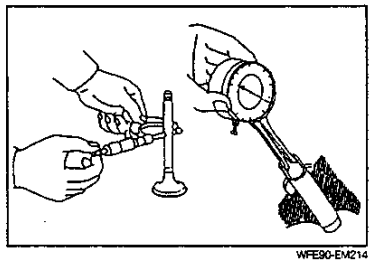
Oil Clearance:

Specified Value:

Exhaust 0.025 - 0.065 mm

Allowable Limit:

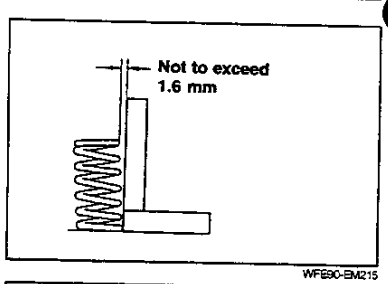
Exhaust 0.09 mm



WFE90-EM214

17. Inspection of valve springs
    (1) Check the valve spring for squareness, using a steel square.
    Maximum Squareness: 1.6 mm

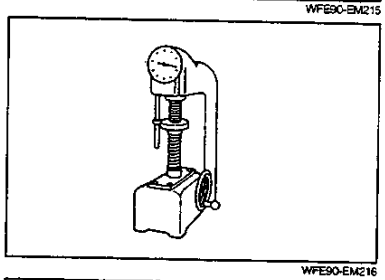
    If the squareness exceeds the maximum limit, replace the valve spring.



WFE90-EM215

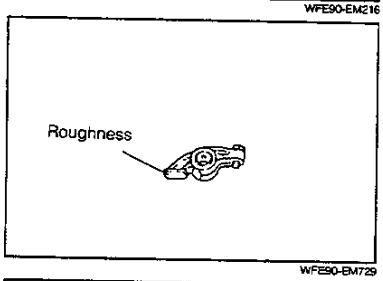
    (2) Measure the valve spring for free length and spring tension, using a spring tester.
    Minimum Free Length: 44.3 mm
    Minimum Tension/Installation Height:
    259 N (26.4 kgf)/38.0 mm

    If the minimum free length and/or minimum tension is less than the minimum limit, replace the valve spring.


WFE90-EM216

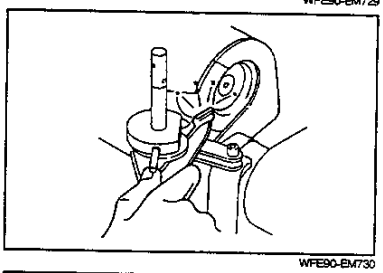
REFERENCE:
Standard Free Length: 45.2 - 46.0 mm

18. Inspection of valve rocker arms and valve rocker shaft
    (1) Visually inspect the valve rocker arm for cracks, seizure or wear.
    Replace the valve rocker arm, if necessary.

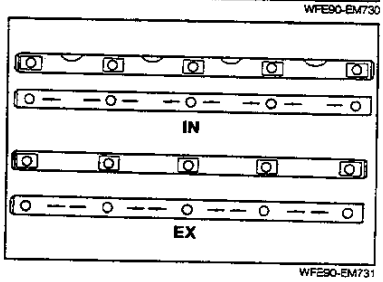


WFE90-EM729

    (2) If the valve rocker arm-to-cam contact surface is worn excessively, grind or replace the rocker arm.


WFE90-EM730

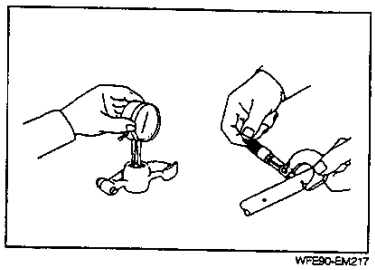
    (3) Visually inspect the valve rocker shaft for cracks, seizure or wear.
    Replace the valve rocker shaft, if necessary.



WFE90-EM731

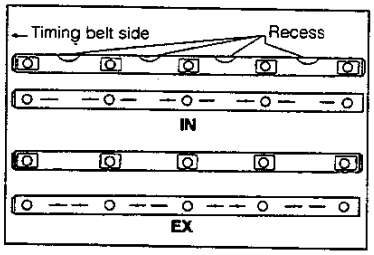
(4) Valve rocker shaft-to-valve rocker arm
- Using a dial gauge, measure the inner diameter of the valve rocker arm in two directions, 90 degrees apart from each other.
- Using a micrometer, measure the outer diameter of the valve rocker arm attaching position of the camshaft in two directions, 90-degrees apart from each other.
- Calculate the oil clearance by substracting the rocker shaft diameter from the rocker arm diameter.

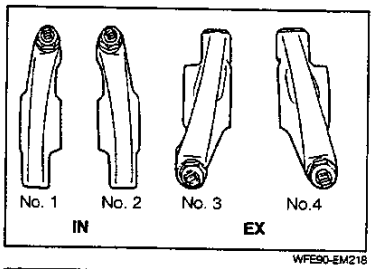
Oil Clearance
Specified Value: 0.012 - 0.053 mm
Allowable Limit: 0.08 mm


WFE90-EM217

NOTE:
- The measurement of the rocker shaft outer diameter must be performed at the assembling position of each rocker shaft.

Reference
- Identification of valve rocker shafts
  On the intake valve rocker shaft, recesses for the spark plug tube are provided.
  Also, the oil grooves are provided very closely to the bolt holes.
  On the exhaust valve rocker shaft, the oil grooves are located near the midpoint of the bolt holes.
- Installing direction of valve rocker shaft
  The valve rocker shaft should be installed in such a way that the side having a wider chamber comes at the timing belt side.
- Identification of valve rocker arm
  The valve rocker arm comes in four kinds; two kinds each for the intake side and exhaust side, as shown in the right figure.
- Specified dimensions of valve rocker shaft and valve rocker arm
  Outer Diameter of Valve Rocker Shaft:
  19.468 - 19.488 mm
  Bore Diameter of Valve Rocker Arm:
  19.500 - 19.521 mm

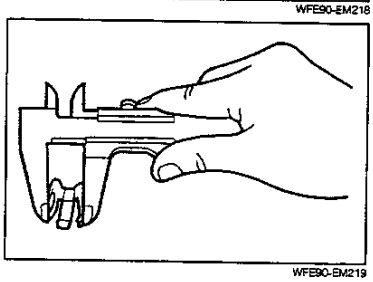




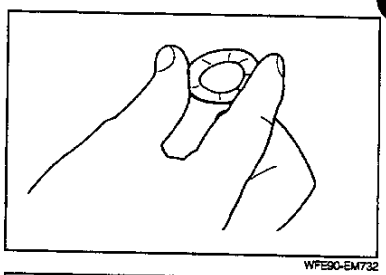
WFE90-EM218

19. Inspection of valve rocker arm, spacer and wave washer
(1) Measure the free width of the spacer, using vernier calipers.
Minimum Free Width: 22.0 mm

Replace the spacer whose free length is less than the minimum free width.


WFE90-EM219

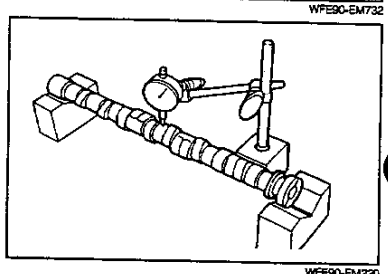
(2) Visually inspect the wave washer for flattened condition or damage.
Replace the wave washer, if necessary.


WFE90-EM732

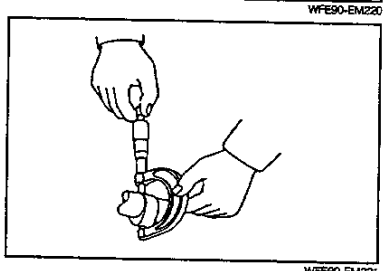
20. Inspection of camshaft

(1) Checking camshaft for runout
Support the camshaft at its both ends with V-shaped blocks. Set a dial gauge to the mid-point of the center journal section of the camshaft. Turn the camshaft one turn, making sure that the camshaft will not move in the axial direction. Take a reading on the dial gauge during the turning. Calculate the maximum runout, i.e. the difference between the maximum and minimum readings.
Maximum Runout: 0.03 mm

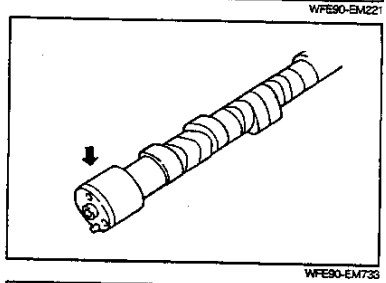
If the runout exceeds the maximum limit, replace the camshaft.


WFE90-EM220

(2) Checking of cam lobe height
Measure the cam lobe height, using a micrometer.
Specified Cam Lobe Height:
Intake: 33.08 - 33.28 mm
Exhaust: 33.00 - 33.20 mm
Minimum Limit:
Intake: 32.9 mm
Exhaust: 32.85 mm

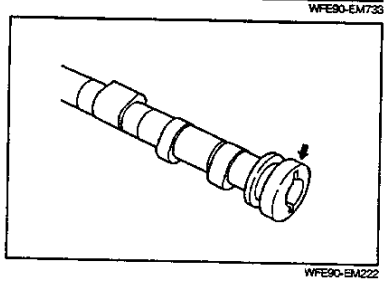

WFE90-EM221

(3) Inspection of oil seal contact surface
Inspect the oil seal contact surface for abnormal wear. Replace the camshaft if the contact surface exhibits any abnormal wear.

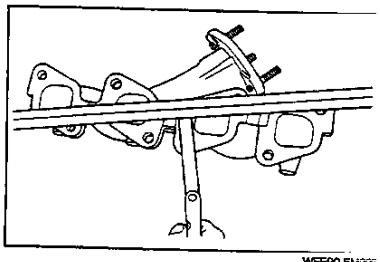

WFE90-EM733

(4) Inspection of groove for driving distributor
Visually inspect to see if any damage is present at the groove for driving the distributor.
Replace the camshaft if the groove exhibits any damage.

NOTE:
- **If any damage is present, check the distributor side, too.**

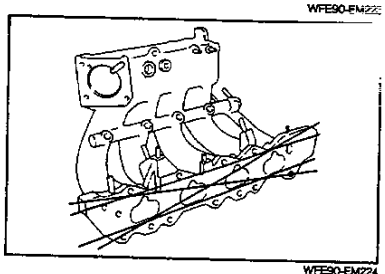

WFE90-EM222

21. Inspection of manifold and surge tank
    (1) Check the cylinder head attaching surface of the exhaust manifold for warpage, using a straight edge and a thickness gauge.
    Maximum Warpage: 0.1 mm



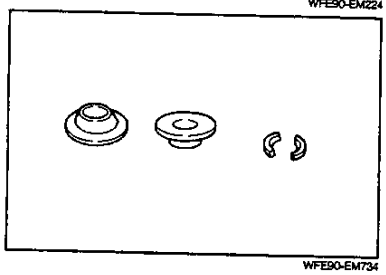
WFE90-EM222

    (2) Check the contact surface of the intake manifold with the cylinder head.
    Maximum Warpage: 0.1 mm



WFE90-EM224

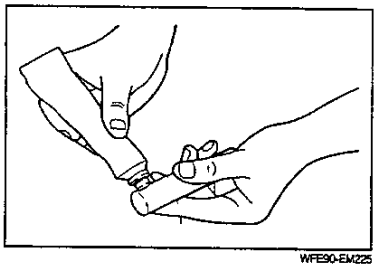
22. Check the valve spring seats, valve spring retainers and valve retainer locks for damage and cracks.
    If any damage is present, replace such faulty parts.



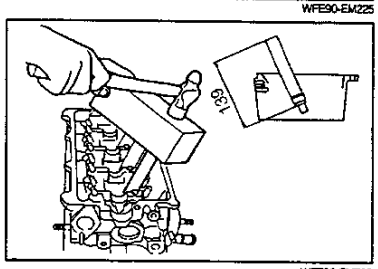
WFE90-EM734

ASSEMBLY OF CYLINDER HEAD

NOTE:
(1) Thoroughly clean all parts to be assembled.
(2) Before installing the parts, apply new engine oil to all sliding and rotating surfaces.
(3) Replace all gaskets and oil seals with new ones.

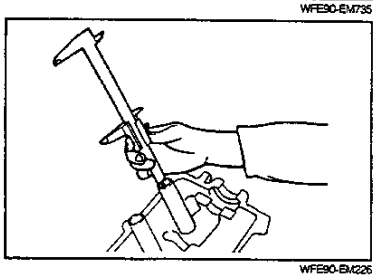

WFE90-EM225

1. Assembly of cylinder head (When new cylinder head is installed:)
When new cylinder head is installed, spark plug tubes and a heater outlet tube have been furnished separately. Assemble these parts, following the procedure given below.
(1) Wash the cylinder head in cleaning solvent and dry it with compressed air.
(2) Apply a thin film of the Three Bond 1377B to the cylinder head attaching surfaces for the spark plug tubes.

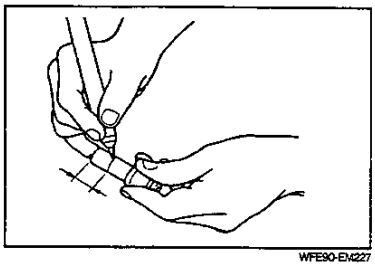


WFE90-EM735

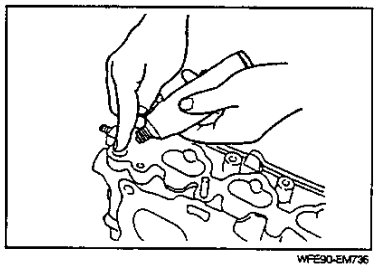
(3) With a wooden piece or the like placed on the upper end of the spark plug tube, drive the spark plug tube to the cylinder head in such an extent that the distance between the spark plug tightening surface and the upper end of the spark plug tube becomes 139 mm.
NOTE:
- Be very careful not to drive the spark plug tube too deeply.
- Be very careful not to damage the upper end of the spark plug tube.
- When driving the spark plug tube into position, make sure that the tube will not tilt in relation to the cylinder head tube hole.


WFE90-EM226

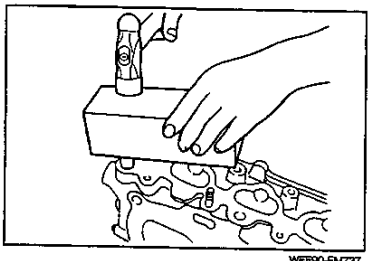
(4) Put mark at a point 45.0 ± 1.0 mm from the forward end of the heater outlet tube.


WFE90-EM227

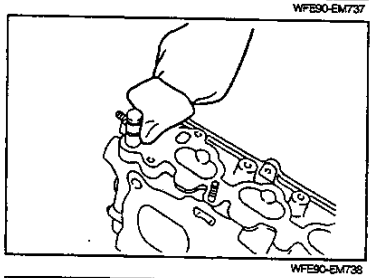
(5) Apply a thin film of the Three Bond 1377B to the attaching section for the heater outlet tube on the cylinder head.


WFE90-EM736

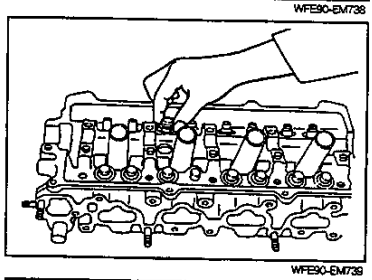
(6) With a wooden piece interposed, drive the heater outlet tube to the point marked in Step (4).


WFE90-EM737

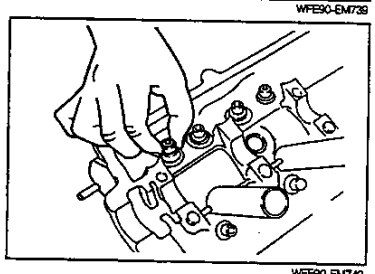
(7) After completion of the operation, remove any oozed bond, wooden chips and so forth.


WFE90-EM738

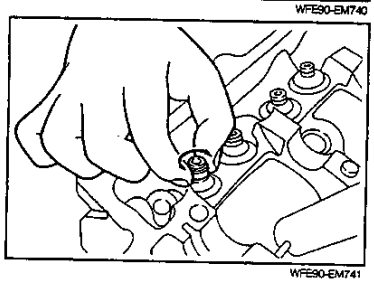
2. Install the valve spring seats to the cylinder head.


WFE90-EM739

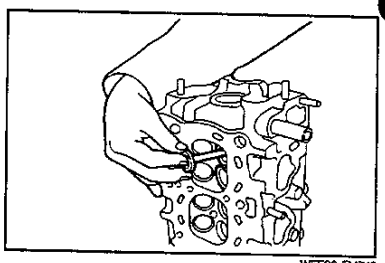
3. Installation of valve stem oil seal
   (1) Apply engine oil to the bore of the valve stem oil seal.
   (2) Drive the valve stem oil seal into the valve stem guide bush by hand.
   NOTE:
   - When driving the oil seal, make sure that the oil seal is not tilted.
   - Do not reuse any oil seal which was tilted or driven diagonally.
   - Hold the frame of the oil seal. Do not touch the rubber lip section of the oil seal.


WFE90-EM740

   (3) Turn the oil seal slightly by hand to see if it can be turned.
   NOTE:
   - Never rotate the oil seal more than one turn, because excessive turning may cause scratches on the oil seal.
   - If the oil seal can not be turned by hand, it means that the oil seal has been tilted, driven diagonally or press-fitted improperly.
   - Do not reuse any oil seal which was tilted or driven diagonally.

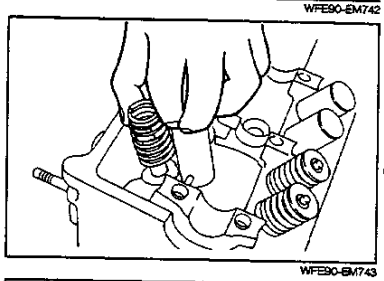

WFE90-EM741

4. Apply oil to the valve stem. Install the valve to the cylinder head.
   NOTE:
   - Care must be exercised as to the installing position. Do not pull out the valve once it has been inserted.
   - If the inserted valve should be pulled out, replace the valve stem oil seal.



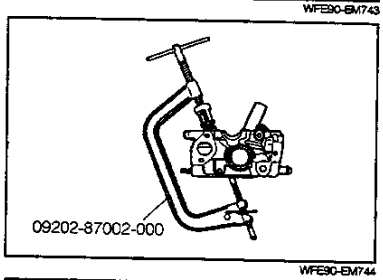
WFE90-EM742

5. Assembly of valve springs, valve spring retainers and valve spring retainer locks
   (1) Assemble the valve spring in such a way that the painted side (the side having a larger pitch) comes at the valve spring retainer.



WFE90-EM743

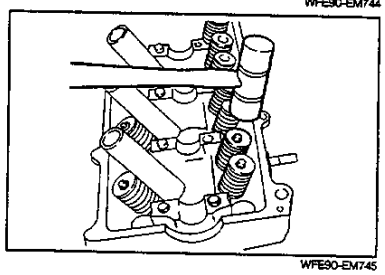
   (2) Install the valve spring retainer to the valve spring. Install the valve spring retainer locks while compressing the valve spring retainer, using the following SST.
   SST: 09202-87002-000



WFE90-EM744

   (3) After installing the valve spring retainer lock, lightly tap the valve spring retainer with a hammer or the like so as to ensure that the valve spring retainer locks are installed securely.

WARNING:
- During this operation, care must be exercised to ensure that the valve spring retainer or retainer locks may not be jumped out.



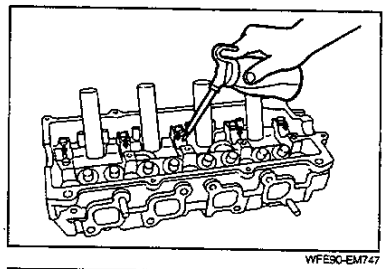
WFE90-EM745

6. Installation of camshaft and rocker shafts
   (1) Wash and dry the holes for the camshaft cap attaching bolts.

WARNING:
- When using compressed air, protect your eyes with safety goggles.

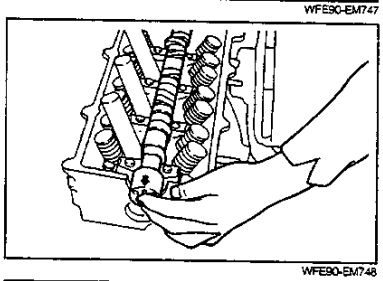
WFE90-EM746

(2) Liberally apply engine oil to the journal sections and thrust bearing sections.



WFE90-EM747

(3) Assemble the camshaft on the cylinder head in such a way that the locating pin for the camshaft timing belt pulley comes exactly at the top position.
Apply engine oil to the camshaft journal section.

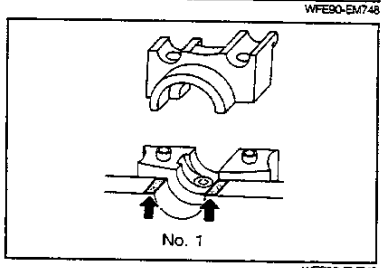


WFE90-EM748

(4) Apply the Three Bond 1104 to the camshaft cap No. 1 attaching section of the cylinder head at those points shown in the right figure.

NOTE:

- **Be careful not to allow any oil to flow into the bearing cap attaching holes.**

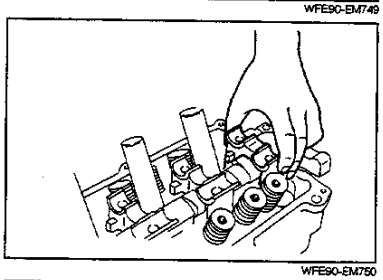


WFE90-EM749

(5) Install the camshaft bearing caps in the sequence of embossed figures on the caps.

NOTE:

- **Before the camshaft bearing caps are installed, wipe off any bond oozed from the camshaft cap No. 1.**

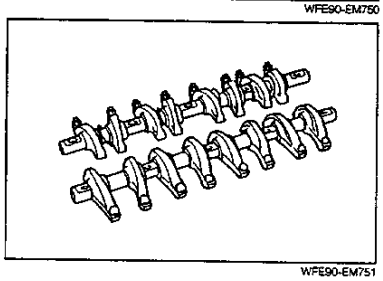


WFE90-EM750

(6) Assemble the valve rocker arms and wave washers onto the valve rocker shaft, while applying engine oil liberally as shown in the right figure.

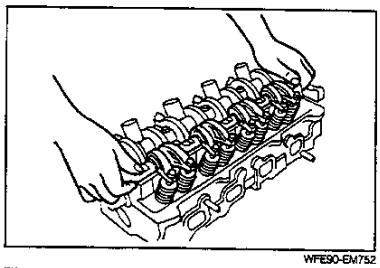
NOTE:

- **The intake valve rocker shaft can be identified by the recessed sections.**

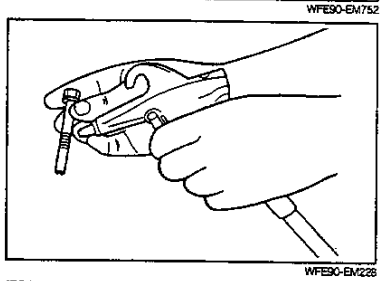


WFE90-EM751

(7) Install the valve rocker shaft on the camshaft caps.
NOTE:
- For easier installation, it is advisable to insert the rocker arm first to the camshaft cap side.

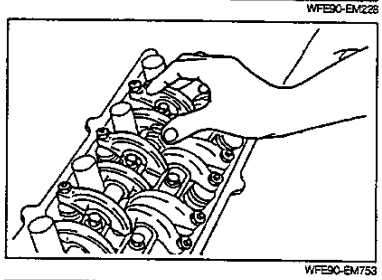

WFE90-EM752

(8) Clean the attaching bolts and dry them with compressed air. Install them to the cylinder head through the rocker shafts and camshaft caps. Tighten the bolts evenly over two or three stages to the specified torque.
Tightening Torque:
M10 bolt 28.4 - 36.3 N·m (2.9 - 3.7 kgf-m)/ Dry
M8 bolt [12.7 - 16.7 N·m (1.3 - 1.7 kgf-m)/ Dry]


WFE90-EM228

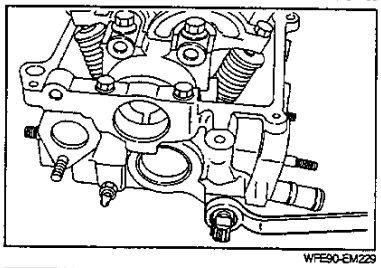
CAUTION:
- Never exceed the specified tightening torque.
- The bolts and bolt holes should be dry when tightening the bolts.
- When using compressed air, protect your eyes with safety goggles.

7. Install the spacers into between the intake valve rocker arms on the rocker shaft.


WFE90-EM753

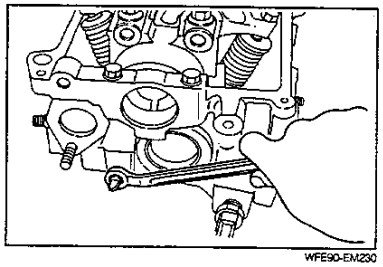
8. Clean the threaded portion of the water temperature sensor. Wind seal tape around the threaded portion and install the sensor to the cylinder head.
Tightening Torque: 24.5 - 34.3 N·m (2.5 - 3.5 kgf-m)

NOTE:
- When using a new water temperature sensor, seal tape is unnecessary since seal material is coated on the water temperature sensor.
- Ensure that the water temperature sensor is installed horizontally.


WFE90-EM229

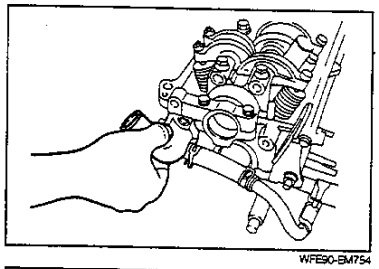
9. Clean the threaded portion of the water temperature sender gauge. Wind seal-tape around the threaded portion. Tighten the gauge to the cylinder head, using the long box wrench.
Tightening Torque: 11.8 - 19.6 N·m (1.2 - 2.0 kgf-m)

NOTE:
- When using a new sender gauge, seal-tape is unnecessary since seal material is coated on the sender gauge.


WFE90-EM230

10. Install the water outlet to the cylinder head with a new gasket interposed.

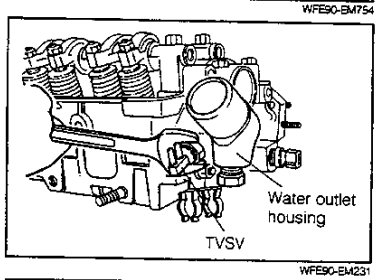
11. Connect the by-pass hoses and by-pass pipe to the water outlet.



WFE90-EM754

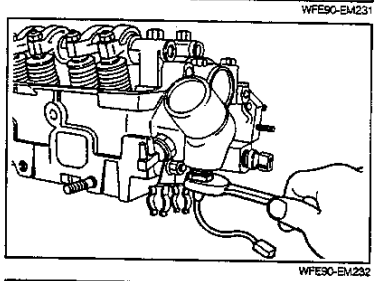
12. Clean the threaded portion of the TVSV. Wind seal tape around the threaded potion and install the TVSV to the cylinder head.
    Tightening Torque: 24.5 - 34.3 N·m (2.5 - 3.5 kgf-m)

    NOTE:
    - When using a new TVSV, seal-tape is unnecessary since seal material is coated on the TVSV.



WFE90-EM231

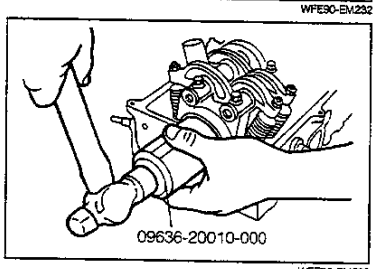
Clean the threaded portion of the A/C water temperature switch. Wind seal tape around the threaded portion and install the A/C water temperature switch to the water outlet (Air conditioner-equipped model only)
Tightening Torque: 24.5 - 34.3 N·m (2.5 - 3.5 kgf-m)



WFE90-EM232

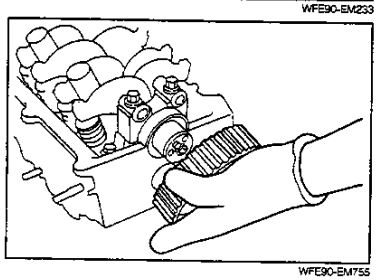
13. Apply engine oil to the bore of the type T oil seal for the camshaft.
    Drive the oil seal into position, using the following SST.
    SST: 09636-20010-000

    NOTE:
    - Be very careful not to slant the oil seal during the installing.



WFE90-EM233

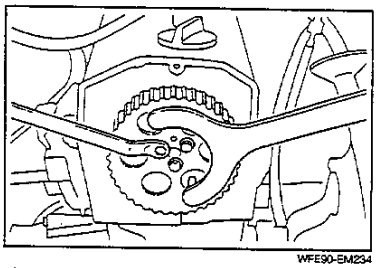
14. Install the camshaft timing belt pulley in such a way that it is aligned with the locating pin of the camshaft and the "F" mark can be seen from the timing belt side.



WFE90-EM755

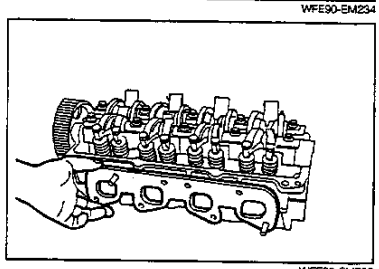
15. Attach the attaching bolts of the camshaft timing belt pulley. Tighten the attaching bolt while preventing the camshaft timing belt pulley from turning, using the flowing SST.
    SST: 09278-87201-000
    Tightening Torque: 14.7 - 21.5 N·m (1.5 - 2.2 kgf-m)

    NOTE:
    - Do not turn the camshaft independently.
    - The bolts and bolt holes should be dry during the tightening.

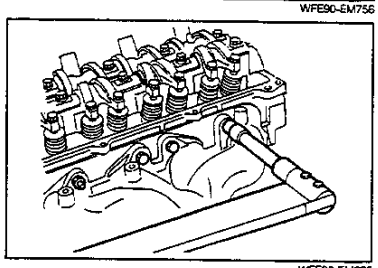

WFE90-EM234

INSTALLATION OF EXHAUST MANIFOLD SIDE PARTS

1. Install the exhaust manifold gasket on the cylinder head.
   NOTE:
   - The exhaust manifold gasket should be installed in such a direction that the side where the grommet turned-out section is bulged may come at the exhaust manifold.


WFE90-EM756

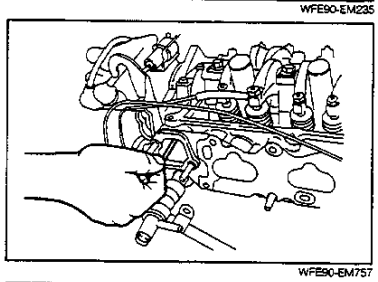
2. Install the exhaust manifold to the cylinder head. Tighten the attaching bolts and nuts evenly over two or three stages.
   Tightening Torque: 29.4 - 44.1 N·m (3.0 - 4.5 kgf-m)


WFE90-EM235

INSTALLATION OF INTAKE MANIFOLD SIDE PARTS

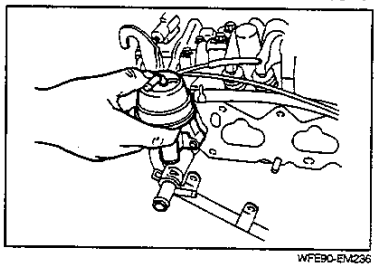
[HD-C Engine]

1. Installation of fuel pump
   (1) Attach a new intake manifold gasket.
   (2) Apply engine oil to the fuel pump rod. Insert it into the cylinder head.


WFE90-EM757

   (3) Install the fuel pump to the cylinder head with a new fuel pump insulator interposed.
   Tightening Torque: 14.7 - 21.6 N·m (1.5 - 2.2 kgf-m)

   NOTE:
   - Be careful to install the insulator in the correct assembly direction. Failure to observe this caution will fail to assemble the insulator because it will interfere with other parts.

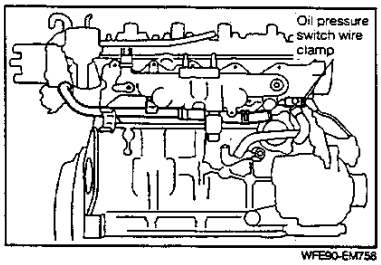

WFE90-EM236

2. Connect the fuel hose to the fuel pump.
   Attach the hose bands.
   NOTE:
   - **The knobbed section of the hose clip for the fuel hose between the fuel pump and the carburetor should be faced down ward.**

3. Installation of intake manifold
   (1) Attach the intake manifold to the cylinder head.

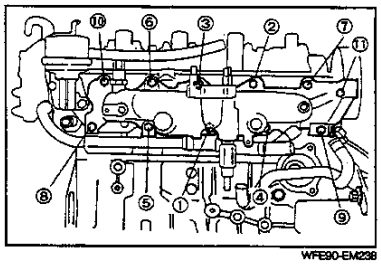
WFE90-EM237

   (2) Install the water by-pass pipe to the stud bolt of the cylinder head, as shown in the figure.
   Connect the by-pass hose to the intake manifold. Attach the hose bands.
   (3) Install the oil pressure switch wire clamp to the stud bolt, as shown in the figure.



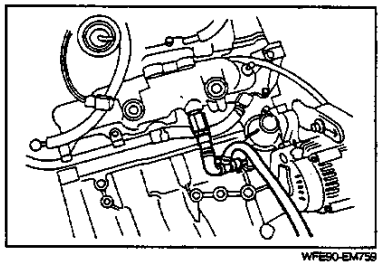
WFE90-EM758

   (4) Tighten the intake manifold attaching bolts and nuts evenly to the specified torque over two or three stages in the sequence as indicated in the figure.
   Tightening Torque: 14.7 - 21.6 N·m (1.5 - 2.2 kgf-m)



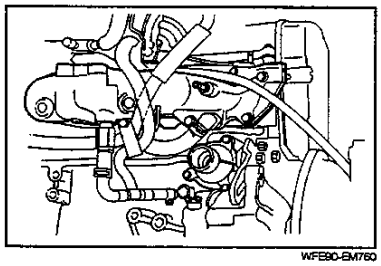
WFE90-EM238

4. Connect the water hose to the thermo valve. Attach the hose bands.



WFE90-EM759

5. Connect the brake booster hose to the intake manifold in such a way that the arrow mark of the booster hose faces the intake manifold side.
6. Install the water hose clamp to the intake manifold.



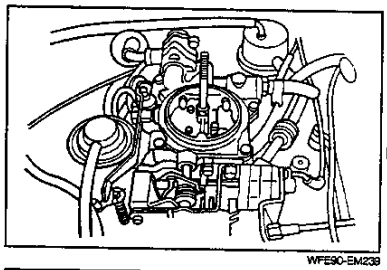
WFE90-EM760

7. Install the carburetor heat insulator to the intake manifold.
   NOTE:
   Be careful not to damage the gasket. Replace the heat insulator with a new part if the gasket exhibits damage.

WN88E-EM246

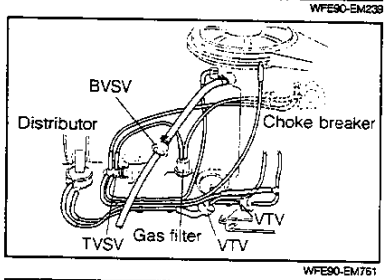
8. Install the carburetor to the intake manifold.
   Tightening Torque: 14.7 - 21.6 N·m (1.5 - 2.2 kgf-m)

9. Connect the connectors of the solenoid valve and outer vent valve.



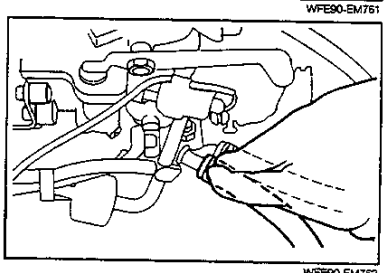
WFE90-EM239

10. Connection of vacuum hoses
    Connect the vacuum hose, as shown in the figure.
    - Outer vent hose to outer vent
    - Choke breaker to TVSV
    - Carburetor to BVSV
    - Throttle positioner to carburetor
    - Vacuum hose to gas filter
    - Vacuum hose to distributor



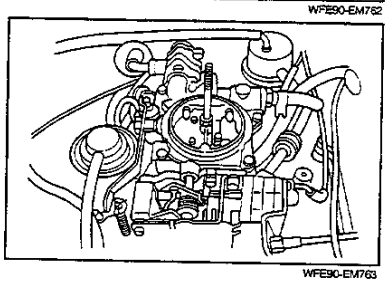
WFE90-EM751

11. Connector the hot water circulating hose to the carburetor.
    Attach the hose bands.



WFE90-EM752

12. Connect the fuel hose to the carburetor.
    Attach the hose bands.
13. Temporarily install the cylinder head cover to the cylinder head.



WFE90-EM763

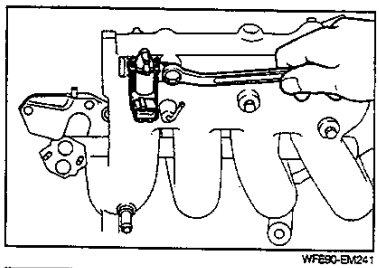
[HD-E engine]

1. Clean the intake manifold.

WARNING:
- When using compressed air, protect your eyes with safety goggles.

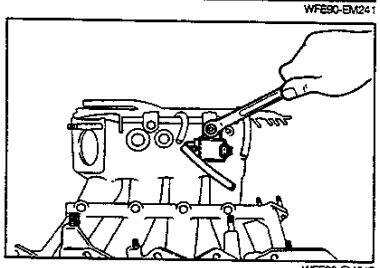
WFE90-EM240

2. Install the EGR VSV to the surge tank. (US spc only)
   NOTE:
   - Apply thin film of the Three Bond 1104 to the threaded portion of the bolt.



WFE90-EM241

3. Install the vacuum hose sub assembly onto the surge tank.
   NOTE:
   - Apply the thin film of the Three Bond 1104 to the threaded portion of the bolt.

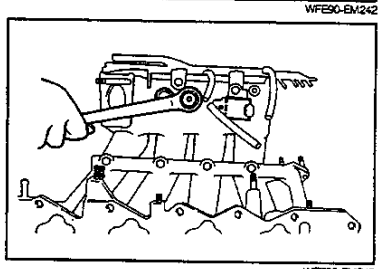


WFE90-EM242

4. Install the ISC VSV to the surge tank. (US spc only)
   NOTE:
   - Apply thin film of the Three Bond 1104 to the threaded portion of the bolt.

5. Clean he threaded portion of the gas filter.
   Wind seal tape around the threaded portion and install it to the surge tank.
   Tightening Torque: 11.8 - 19.6 N·m (1.2 - 2.0 kgf-m)

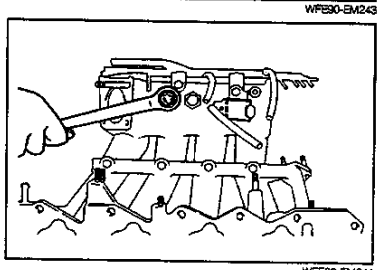
   NOTE:
   - This operation is required only when the gas filter has been removed.
   - Use a hexagonal long box wrench for tightening.



WFE90-EM243

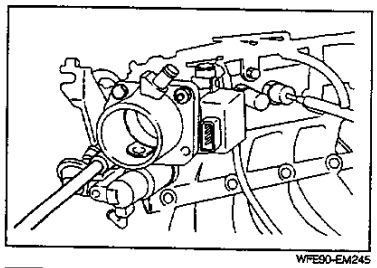
6. Install the intake air temperature sensor to the surge tank with a new washer interposed.
   Tightening Torque: 29.4 - 39.2 N·m (3.0 - 4.0 kgf-m)

   NOTE:
   - This operation is required only when the intake air temperature sensor has been removed.



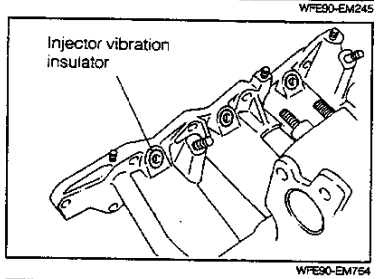
WFE90-EM244

7. Install the throttle body to the surge tank with a new gasket interposed.
   Tightening Torque: 14.7 - 21.5 N·m (1.5 - 2.2 kgf-m)



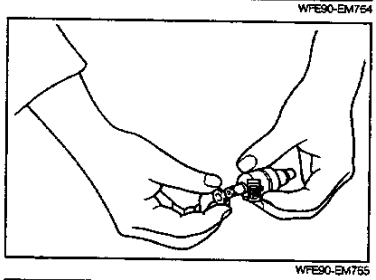
WFE90-EM245

8. Install the injector vibration insulator to the intake manifold section.
   CAUTION:
   - Prior to installation, check the insulator for damage and cracks. Replace any faulty insulator with a new part.



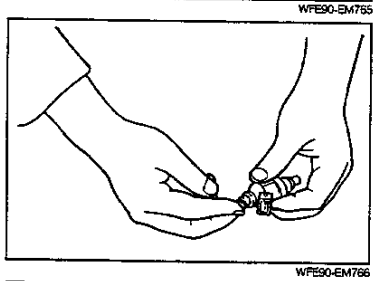
WFE90-EM754

9. Remove the "O" ring of the injector. Remove the grommet and check it for damage or cracks.
   NOTE:
   - If the grommet exhibits any fault, replace it with a new one.



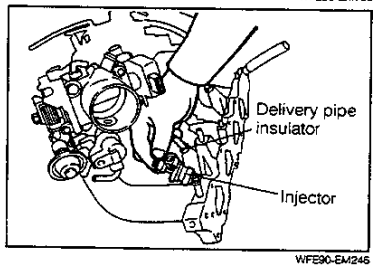
WFE90-EM755

10. Install the grommet and new "O" ring to the injectors.



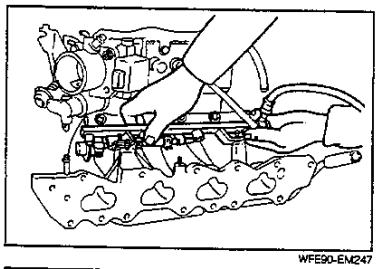
WFE90-EM756

11. Insert the injector to the vibration insulator hole of the intake manifold.
12. Install the delivery pipe insulator to the stud bolt of the intake manifold.



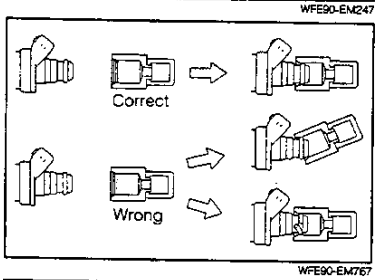
WFE90-EM246

13. Apply silicon oil to the "O" ring of the injector.
Then, install the delivery pipe.



WFE90-EM247

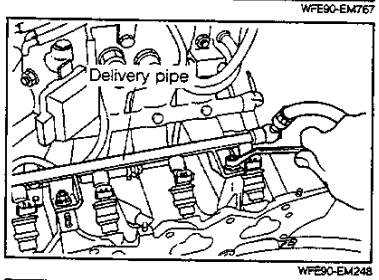
CAUTION:
- Be very careful not to damage the "O" ring of the injector during the delivery pipe installation.
- Do not install the delivery pipe diagonally to the injector.



WFE90-EM767

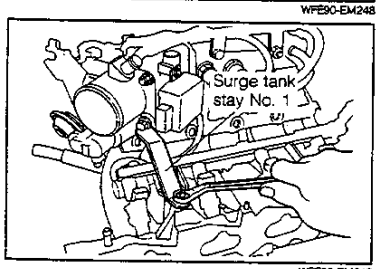
14. Tighten the attaching nuts of the delivery pipe.
Tightening Torque: 14.7 - 21.6 N·m (1.5 - 2.2 kgf-m)

NOTE:
- After tightening the delivery pipe, make sure that the injector can be turned by hand. If the injector can not be turned,it indicates probably a damaged injection "O" ring. Hence, replace the injector "O" ring with a new part.



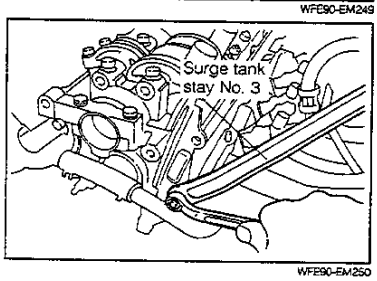
WFE90-EM248

15. Install the surge tank stay No. 1 to the throttle body and intake manifold, using bolt and nut.
Tightening Torque:
Bolt : 14.7 - 21.5 N·m (1.5 - 2.2 kgf-m)
Nut: 14.7 - 21.5 N·m (1.5 - 2.2 kgf-m)



WFE90-EM249

16. Install the engine hanger No. 2 and surge tank stay No. 3 to the stud bolt at the cylinder head. Install the surge tank stay No. 3 to the surge tank side.
Tightening Torque:
Bolt: 18.6 - 30.3 N·m (1.9 - 3.1 kgf-m)
Nut: 18.6 - 30.3 N·m (1.9 - 3.1 kgf-m)

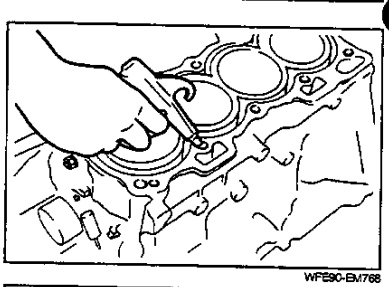


WFE90-EM250

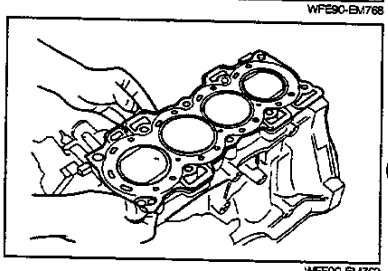
INSTALLATION OF CYLINDER HEAD WITH MANIFOLDS

1. Clean the cylinder block head bolt holes.

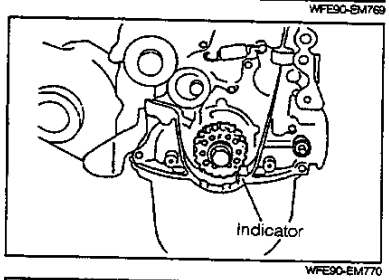
WARNING:
- **Protect your eyes with goggles when using compressed air.**


WFE90-EM768

2. Clean the cylinder block upper gasket surface. Install the cylinder head gasket, while aligning it with the pin ring for locating use.

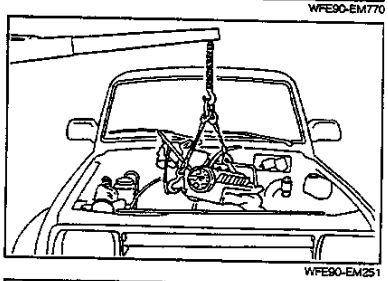

WFE90-EM769

3. Turn the crankshaft so that the crankshaft key groove may come at the top position.



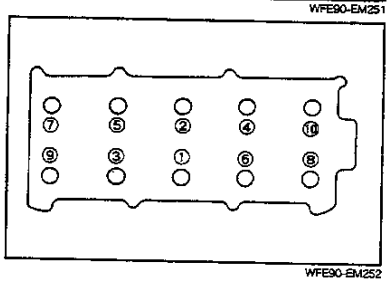
WFE90-EM770

4. Install the cylinder head onto the cylinder block, using chain block.
   CAUTION:
   - **Be careful not to allow the cylinder head to hit to the vehicle body and/or other parts.**


WFE90-EM251

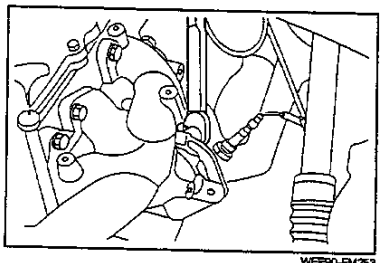
5. Coat each cylinder head bolt with a thin film of engine oil. Using these bolts, install the cylinder head to the cylinder block. Tighten the bolts evenly over two or three stages, following the sequence shown in the right figure.
   Tightening Torque: 58.8 - 66.7 N-m (6.0 - 6.8 kgf-m)

   NOTE:
   - **Make sure that all the bolts are torqued uniformly to a constant level, not only they are torqued within the specified range.**

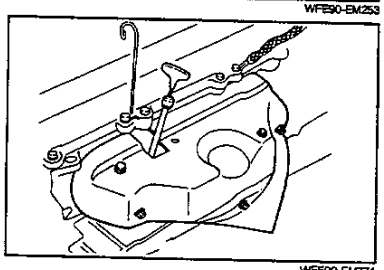


WFE90-EM252

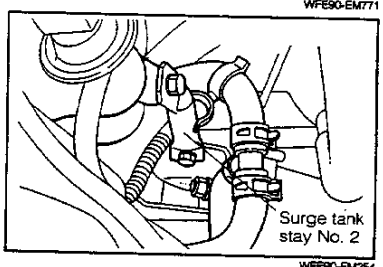
6. Connect the exhaust pipe to the exhaust manifold with a new gasket interposed.
   Then, tighten the attaching nuts.
   Tightening Torque: 34.3 - 49.0 N·m (3.5 - 5.0 kgf-m)


WFE90-EM253

7. Install the oil level gauge support.
   Tighten the clamping bolt.
8. Install the exhaust manifold cover.
   Tighten the five attaching bolts.

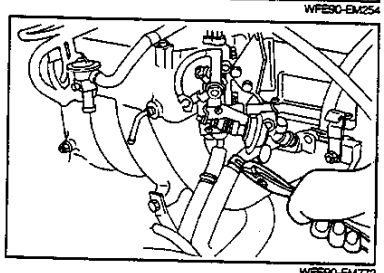

WFE90-EM771

9. Fit the surge tank stay No. 2 to the surge tank.Tighten the attaching bolt and nut.
   Tightening Torque: 29.4 - 44.1 N·m (3.0 - 4.5 kgf-m)

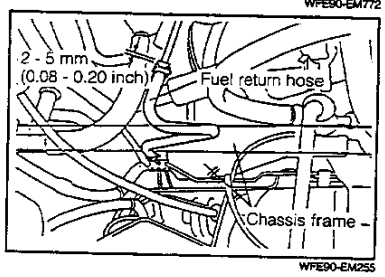


WFE90-EM254

10. Connect the cooling water hoses to the air valve on the throttle body.

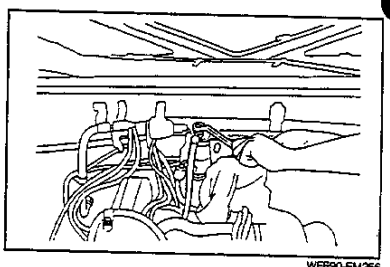

WFE90-EM772

11. Connection of fuel return hose to fuel pipe No. 2.
    (1) Insert the fuel return hose onto the fuel pipe No. 2 until second spool of fuel pipe.
    (2) Securely clamp the fuel hose at 2 - 5 mm from fuel return hose end.
    NOTE:
    Install the fuel return hose in parallel with chassis frame.



WFE90-EM255

12. Install the fuel hose No. 1 to the fuel filter with a new gasket interposed.
    Tightening Torque: 34.3 - 44.1 N·m (3.5 - 4.5 kgf-m)

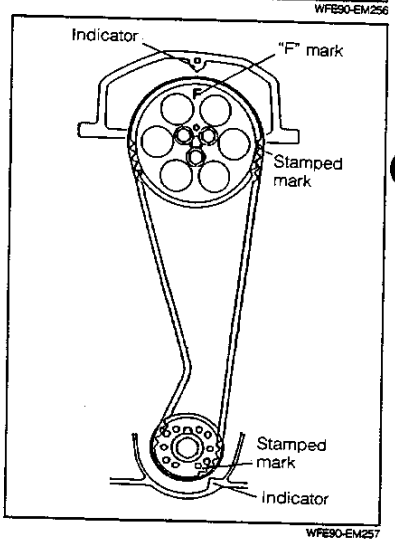


WFE90-EM256

INSTALLATION OF TIMING BELT

(See page EM–31.)

1. Install the cylinder head cover temporarily.
2. Install the timing belt tensioner and tensioner spring. Temporarily tighten them, while they are being pushed toward the alternator side.
3. Align the mating marks of the crankshaft timing belt pulley and camshaft timing belt pulley with the corresponding mating marks.
4. Install the timing belt.
5. Loosen the tensioner attaching bolt so that tension may be given to the belt.
   Then, temporarily tighten the attaching bolt again.
6. Turn the crankshaft two turns in the normal direction.
7. Loosen the tensioner attaching bolt.
8. Turn the crankshaft until the "F" mark of the camshaft is aligned with the indicator on the cylinder head cover.
9. Tighten the tensioner attaching bolt to the specified torque.
10. Remove the cylinder head cover.



WFE90-EM257

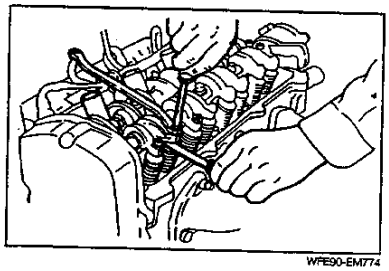
ADJUSTMENT AND INSTALLATION OF OTHER PART

1. Adjustment of Vaive Clearances
   NOTE:
   - **When tightening the adjusting nuts, apply engine oil to the lock nuts, adjusting bolts and rocker arms.**

   (1) Align the stamped mark of the crankshaft timing belt pulley with the indicator mark of the oil pump.

WFE90-EM773

   (2) Check to see if the valve rocker arms of the No. 1 cylinder are in a free state or they are pushed up by the cam.
   Adjust the valve clearances in accordance with the table below.
   The mark represents a valve which can be adjusted at that time.



WFE90-EM774

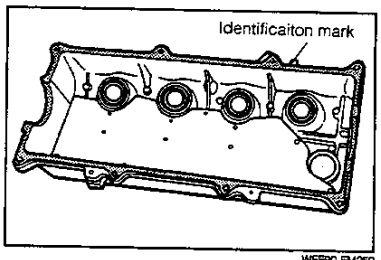
Rocker arm condition \ Cylinder No.		1	2	3	4
(1) When valve rocker arms of No. 1 cylinder is free; "O" marks are available to adjust. (2) Turn the crankshaft 360 degrees. (3) When valve rocker arms of No. 4 cylinder is free; "×" marks are available to adjust.	IN	O	O	×	×
	EX	O	×	O	×

Valve Clearances (Cold):
Intake: 0.18 mm
Exhaust: 0.25 mm

NOTE:
- The valve clearance should be readjusted after the engine has been warmed up thoroughly.

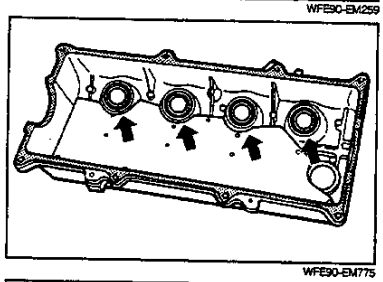
WFE90-EM258

2. Installation of cylinder head cover
   (1) Clean the cylinder head gasket surface of the cylinder head.
   (2) Check the cylinder head gasket for damage. Replace the cylinder head gasket, as required. Assemble the cylinder head gasket with the identification mark facing toward the intake side.



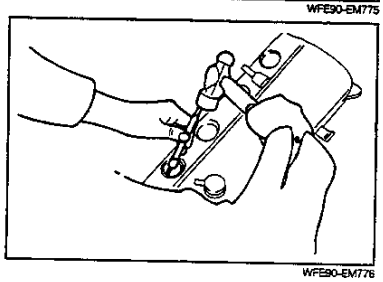
WFE90-EM259

   (3) Check the rubber grommets of the spark plug tubes for damage.
   Replace the rubber grommets, as required.



WFE90-EM775

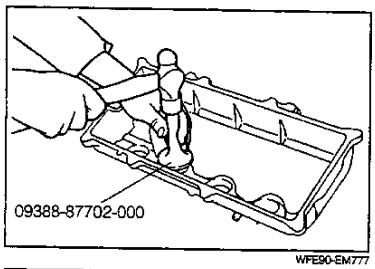
   - Replacement of rubber grommets
     For removal operation, use a slotted pin puller.



WFE90-EM776

- When installing the grommet, drive it into position, using the following SST.

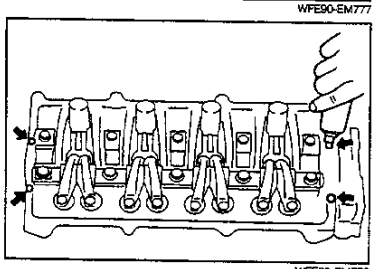
SST: 09388-87702-000



WFE90-EM777

NOTE:
- Make sure that the grommets is not tilted when it is driven into position.
- Be sure to use a suitable wooden piece so as to prevent the cylinder head cover from damage.
- Be careful not to damage the lip section of the grommet.

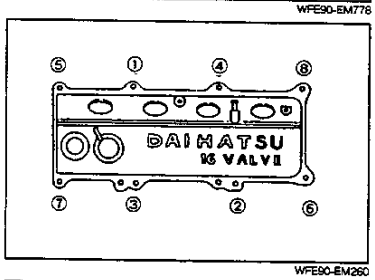
(4) Apply the Three Bond 1104 to the cylinder head at points indicated in the figure.


WFE90-EM778

(5) Install the cylinder head cover to the cylinder head.

NOTE:
- Be careful not to scratch the rubber grommet for the spark plug tube during the installation.
- Care must be exercised to ensure that the rubber grommet will not ride over the spark plug tube.

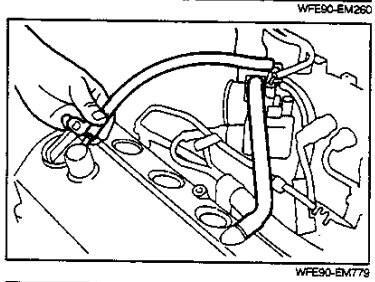
(6) Tighten the cylinder head cover bolts evenly over two or three stages to the specified torque, following the sequence shown at the figure.
Tightening Torque: 2.9 - 4.9 N·m (0.3 - 0.5 kgf-m)



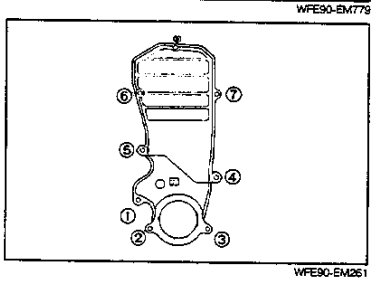
WFE90-EM260

(7) Install the oxygen sensor harness to the clamp.

(8) Connect the blow-by gas hoses to the cylinder head and throttle body.


WFE90-EM779

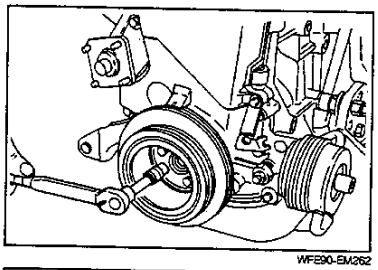
3. Install the timing belt cover.
Tightening Torque: 2.0 - 3.9 N·m (0.2 - 0.4 kgf-m)



WFE90-EM261

NOTE:
- Attaching bolts ① and ④ should be installed first of all.

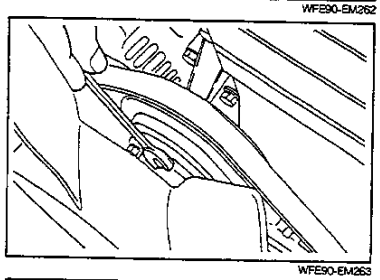
4. Installation of crankshaft pulley
   (1) Prevent the crankshaft from turning by placing the gear shift lever in the 5th gear position, and pull the parking break lever.
   (2) Install the crankshaft pulley on the crankshaft timing belt pulley with four bolts.
   Tightening Torque: 19.6 - 29.4 N·m (2.0 - 3.0 kgf-m)

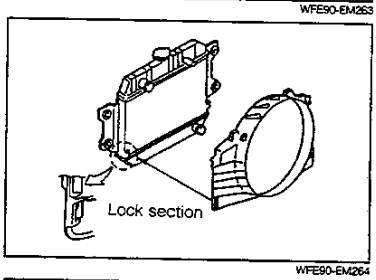

WFE90-EM262

5. Installation of fluid coupling with fan and fan shroud
   (1) Install the water pump pulley to the water pump with temporarily attaching.
   (2) Insert the radiator fan shroud together with the fluid coupling with fan between radiator and the engine.
   NOTE:
   - **Be sure that the water pump pulley is not ride to the spigot section of the water pump pulley seat.**

   (3) Install the fluid coupling with fan to the water pump by means of four bolts through water pump pulley.
   Tightening Torque: 9.8 - 17.7 N·m (1.0 - 1.8 kgf-m)

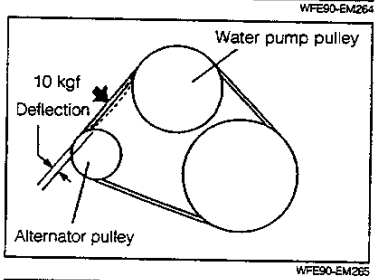
   (4) Insert the lock section of fan shroud to the radiator. Then, tighten the two attaching bolts of the radiator upper side.
   (5) Connect the water hose to the radiator upper tank. Securely clamp the water hose clamp.


WFE90-EM263



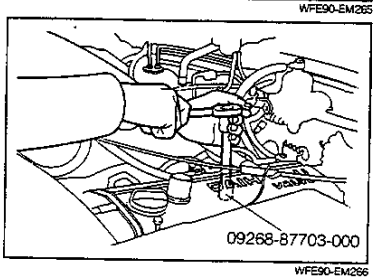
WFE90-EM264

6. Install the V ribbed belt and perform the adjustment in such a way that the deflection at the midpoint between the water pump pulley and the alternator may become the specified value when a force of 98N (10 kgf) is a applied to the midpoint.
   Used Belt: 5.0 - 6.0 mm
   With a force of 98N (10 kgf) applied to point indicated in figure



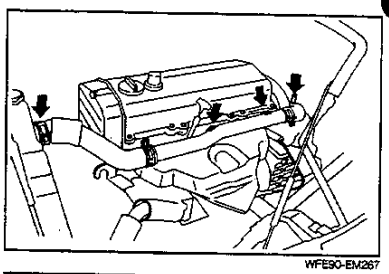
WFE90-EM265

7. Install the reserve tank to the radiator assembly bracket. Insert the over flow hose to the radiator.
8. Install the spark plug, using the following SST.
   SST: 09268-87703-000

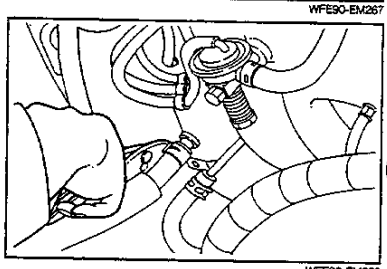


WFE90-EM266

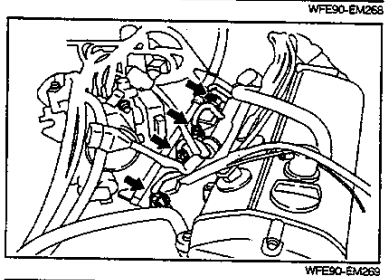
9. Install the radiator hose No. 1 to the radiator upper tank. Tighten the two clamps and two attaching bolts.
   NOTE:
   - **Ensure that the clamp are installed as illustrated in right figure.**


WFE90-EM267

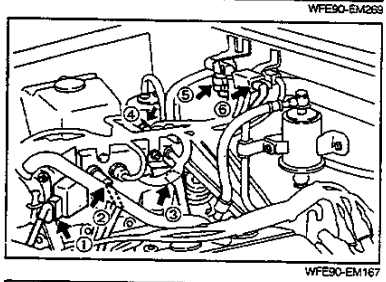
10. Connect the vacuum hose for the brake booster to the intake manifold.


WFE90-EM268

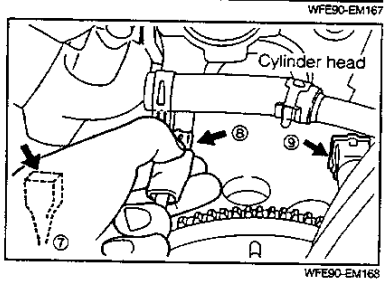
11. Installation of engine wire harness
    (1) Install the engine wire clamps and engine ground cable.
    (2) Connect the injector connector.


WFE90-EM269

    (3) Connect the flowing connectors.
        ① Throttle possition sensor ①
        ② Intake air temperature sensor ②
        ③ Idle speed control VSV ③
        ④ EGR VSV and harness clamp ④
        ⑤ Air conditioner idle up VSV ⑤
        ⑥ Idle up VSV connector
        (Pressure sensor, Pressure VSV and clamp. ⑥)

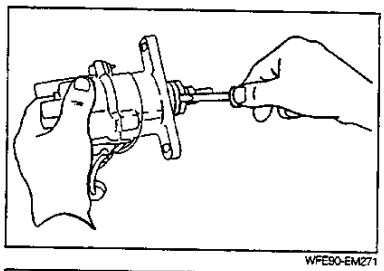

WFE90-EM167

        ⑦ Air conditioner water temperature switch. ⑦
        ⑧ Water temperature sender gauge ⑧
        ⑨ Water temperature sensor ⑨



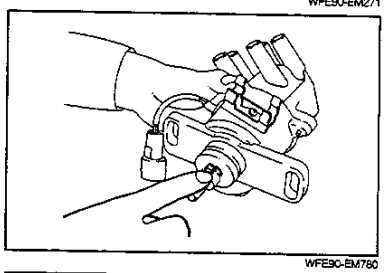
WFE90-EM168

12. Installation of the distributor
    (1) Replace the "O" ring of the distributor body with a new one.
    NOTE:
    - Care must be exercised to avoid scratching the new "O" ring.



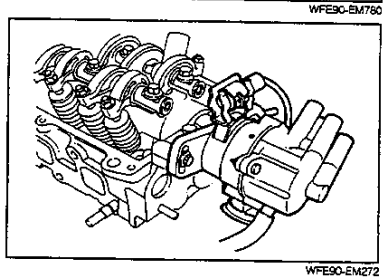
WFE90-EM271

    (2) Align the cutout section of the distributor proper with the cutout groove of the coupling Assemble the distributor on the cylinder head, lining up the protrusion of the distributor with the camshaft groove.
    During this installation, the aligned cutout sections must come at the top side of the engine.



WFE90-EM760

    (3) With the center of each elongated hole on the flange section of the distributor proper aligned with the corresponding threaded hole of the cylinder head, tighten the distributor attaching bolts.
    Tightening Torque: 14.7 - 21.6 N·m (1.5 - 2.2 kgf-m)



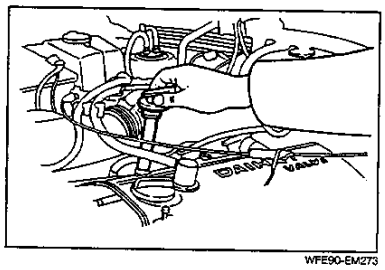
WFE90-EM272

    (4) Connect the distributor connector.

WFE90-EM781

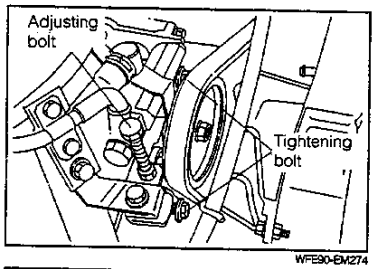
13. Connect the spark plug wire.
    CAUTION:
    - Hold the rubber boot section of the spark plug wire. Securely connect it to the spark plugs, the distributor cap and the ignition coil.
    - Be careful not to damage the spark plug wire with the spark plug tube.

14. Connect the spark plug wire to the cord clamp.



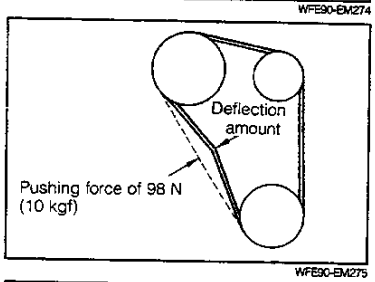
WFE90-EM273

15. Installation of the power steering pump and drive belt (P/S equipped vehicle only) (See page SR-54.)
    (1) Install the power steering pump assembly into the position.
    (2) Install the power steering drive belt.



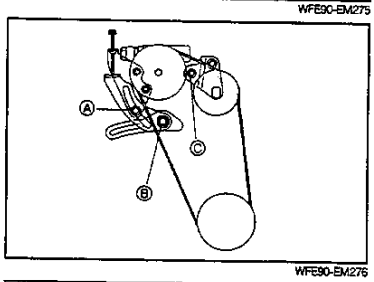
WFE90-EM274

    (3) Set the drive belt tension to the specified value by tightening the adjusting bolt.
    Specified Deflection: 9 - 11 mm
    [When a force of 98N (10 kgf) is applied:]



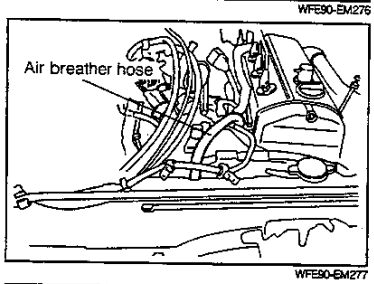
WFE90-EM275

    (4) Tighten the bolts to the specified valve.
    Tightening Torque:
    Ⓐ...34.3 - 44.1 N·m (3.5 - 4.5 kgf-m)
    Ⓑ...14.7 - 21.6 N·m (1.5 - 2.2 kgf-m)
    Ⓒ...49.0 - 68.6 N·m (5.0 - 7.0 kgf-m)



WFE90-EM276

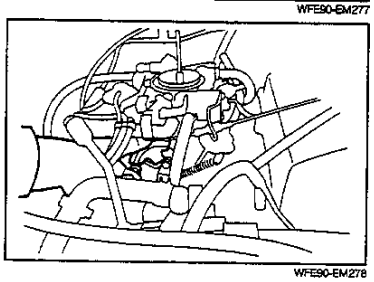
16. Connect the air breather hose to the radiator upper tank.



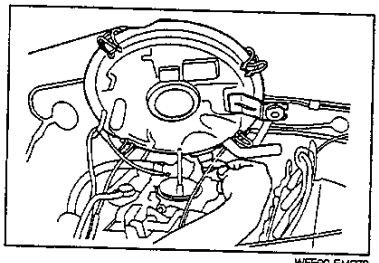
WFE90-EM277

[HD-C engine]

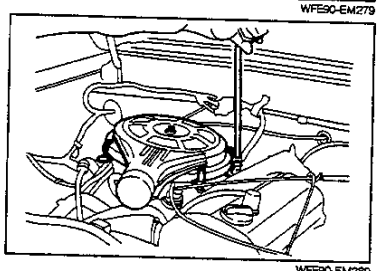
17. Connect the accelerator cable to the carburetor. Adjust the accelerator cable so that the free play in its axial direction may be 3-8 mm.


WFE90-EM278

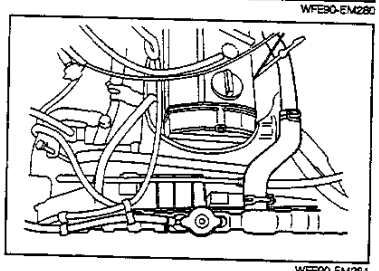
18. Connect the vacuum hoses as follows.
    - Between the air cleaner and the TVSV
    - Between the carburetor and the ITC valve
    - Between the outer vent valve and the BVSV


WFE90-EM279

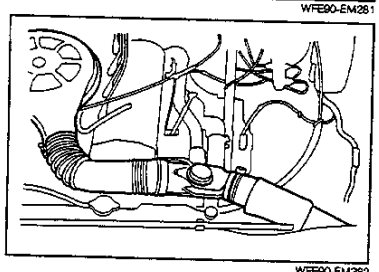
19. Install the air cleaner case onto the carburetor.
    NOTE:
    - In this time, if the gasket is damaged, replace the gasket.


WFE90-EM280

20. Connect the water outlet hose to the radiator upper tank.

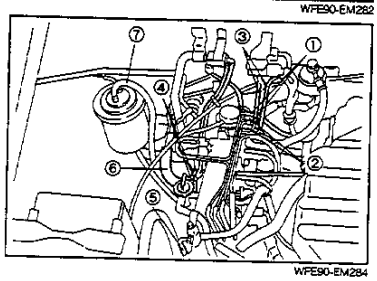

WFE90-EM281

21. Install the cool air intake.
22. Install the hot air intake hose.
23. Install the PCV hoses.


WFE90-EM282

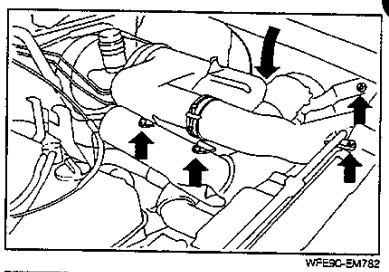
[HD-E Engine]

17. Installation of rubber hoses around the surge tank
    (1) Distributor diaphragm ①
    (2) BVSV ②
    (3) Pressure VSV ③
    (4) Air-conditioner idle up VSV ④
    (5) Power steering ACV ⑤
    (6) Brake booster ⑥
    (7) Charcoal canister ⑦



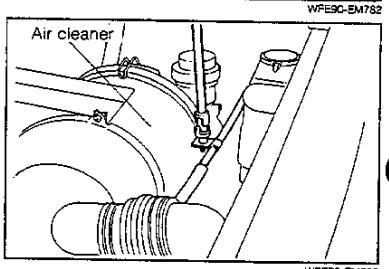
WFE90-EM284

18. Installation of the air cleaner sub assembly
    (1) Install the air cleaner sub assembly into position. Tighten the three attaching bolts.
    (2) Tighten the attaching bolts to the left fender panel and radiator center support.



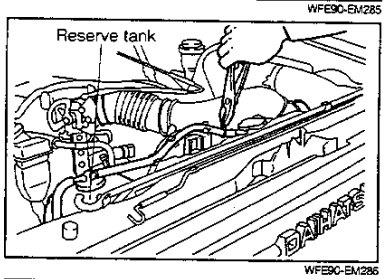
WFE90-EM782

    (3) Tighten the tapping screw at the fan shroud.
    (4) Install the clutch cable clamp to the air cleaner.



WFE90-EM285

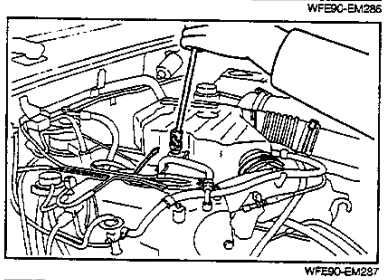
19. Install the radiator reserve tank into position. Clamp the water hose securely.



WFE90-EM286

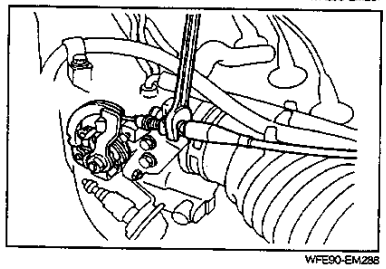
20. Installation of air intake chamber
    (1) Install the air intake chamber by attaching the three screws and two champs.
    NOTE:
    - Align the matching marks provided on the air intake chamber and air intake hose.

    (2) Install the air intake hoses for air conditioner and power steering idle up.



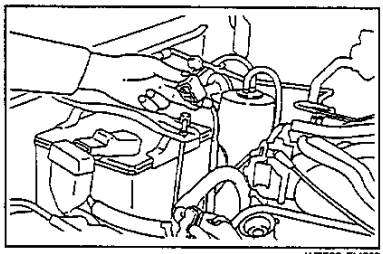
WFE90-EM287

21. Connect the accelerator cable to the throttle body.
22. Adjust the accelerator cable so that the accelerator pedal free play may become 3 - 8 mm.



WFE90-EM288

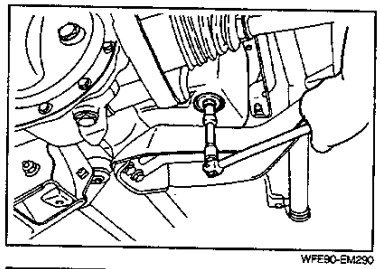
23. Installation of the battery
    (1) Install the battery into position.
    (2) Install the battery holding clamp.
    (3) Connect the positive cable to the positive (+) terminal. Then connect the battery ground cable to the negative (–) terminal of the battery.



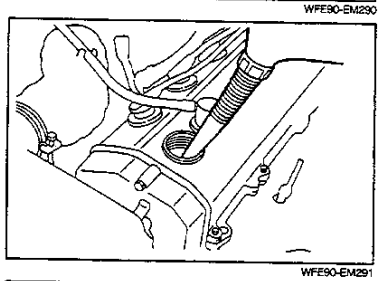
WFE90-EM289

FILLING OF ENGINE OIL AND COOLING WATER

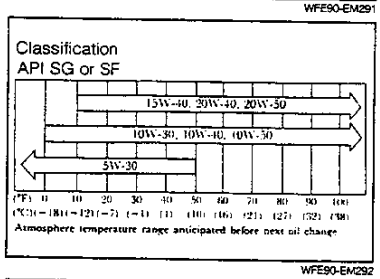
1. Filling engine oil
   (1) Clean the oil drain plug. Install it with a new gasket interposed.
   NOTE:
   - Remove any remaining gasket material from the oil pan, using a gasket scraper.
     Tightening Torque: 19.6 - 29.4 N·m (2.0 - 3.0 kgf-m)


WFE90-EM290

   (2) Fill the engine with engine oil.
   The oil should be API grade SG or SF multigrade viscosity, fuel-efficient oil.
   Oil Capacity
   When only engine oil is changed: 3.3 dm^3
   When engine oil is changed and oil filter is replaced: 3.5 dm^2
   After engine has been overhauled or when engine oil has been drained completely from engine: 3.8 dm^3

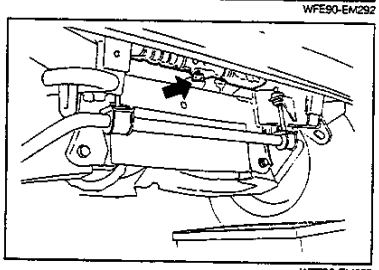

WFE90-EM291

   (3) Check the engine oil level.
   (See page LU–9.)

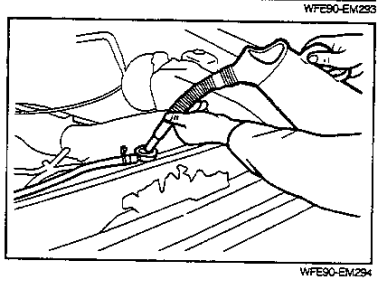


WFE90-EM292

2. Filling cooling water
   (1) Install the cooling water drain plug with new gasket.

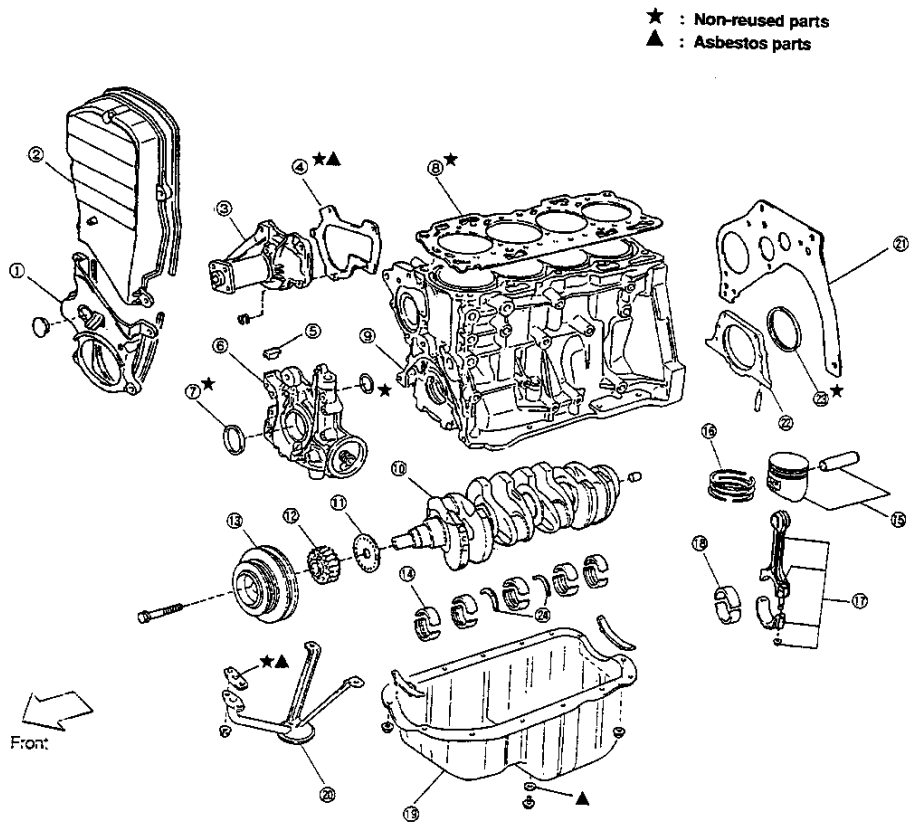

WFE90-EM293

   (2) Fill the radiator and reserve tank with antifreeze solution in accordance with the instructions of the manufacturer of the antifreeze solution.
   CAUTION:
   - Use a Good brand of ethylene-glycol base antifreeze solution.
     Coolant Capacity (Vehicle with Front Heater):
     5.5 dm^3
     [excluding 1.0 dm^3 for reserve tank]


WFE90-EM294

CYLINDER BLOCK

COMPONENTS



①Timing belt cover No. 1
②Timing belt cover No. 2
③Water pump Ay
④Water pump gasket
⑤Dust seal
⑥Oil pump Ay
⑦Oil seal
⑧Cylinder head gasket
⑨Cylinder block
⑩Crankshaft
⑪Crankshaft timing belt pulley flange
⑫Crankshaft timing belt pulley
⑬Crankshaft pulley
⑭Crankshaft bearing
⑮Piston with pin
⑯Piston ring
⑰Connecting rod
⑱Connecting rod bearing
⑲Oil pan
⑳Oil pump strainer
㉑Rear end plate
㉒Oil seal retainer
㉓Oil seal
㉔Crankshaft thrust bearing

WFE90-EM295

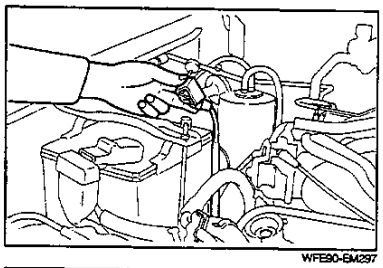
INSTRUCTIONS PRIOR TO OPERATION

Install the fender covers to the fenders so that no scratch may be made to the fenders.

WFE90-EM296

ENGINE REMOVAL

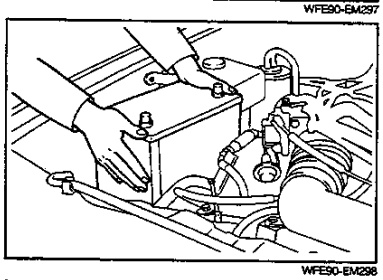
1. Removal of battery
   (1) Disconnect the battery ground cable from the negative (–) terminal of the battery. Then disconnect the wires from the positive (+) terminal of the battery.



WFE90-EM297

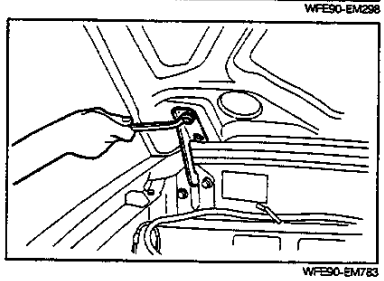
   (2) Remove the battery hold-down clamp and battery clamp bolts.
   (3) Remove the battery from the engine compartment.

WARNING:
- Handle the battery carefully. Never allow any flame to be brought to the battery.



WFE90-EM298

2. Removal of engine hood
   (1) Disconnect the windshield washer hose form the three-way joint. Remove the hose from the clamp of the engine hood.
   (2) Remove the hood, being careful not to scratch the body and hood.



WFE90-EM783

3. Drain the coolant.
   (See page CO–3)
4. Drain the engine oil.
   (See page LU–4)

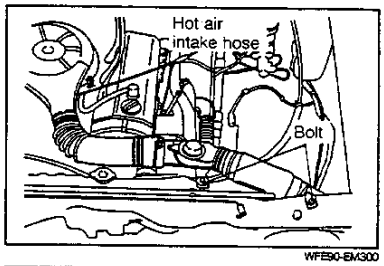
WFE90-EM299

5. Removal of air cleaner assembly with hose

[HD-C Engine]

(1) Remove the air cleaner hose from the air cleaner case by removing the two bolts.

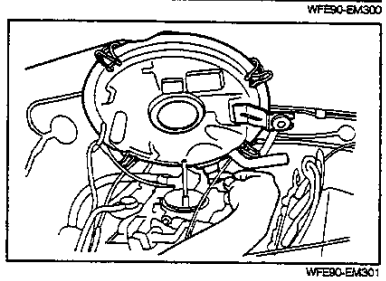
(2) Disconnect the vacuum motor hose and hot air intake hose.
(Except for GCC and tropical specifications)



WFE90-EM300

(3) Disconnect the following hoses at the air cleaner side.
- ITC vacuum hoses
- PCV hoses
- Vacuum hoses to BVSV

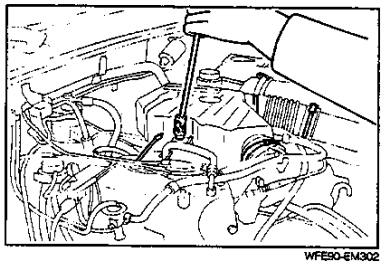
(4) Remove the air cleaner assembly by removing the attaching bolts of the air cleaner bracket and wing nut.


WFE90-EM301

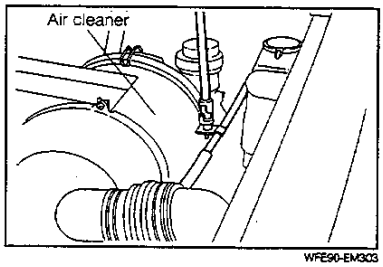
[HD-E Engine]

(1) Remove the air intake chamber by removing the two clamps and three bolts.

(2) Remove the two vacuum hoses for air conditioner idle-up and for power steering.


WFE90-EM302

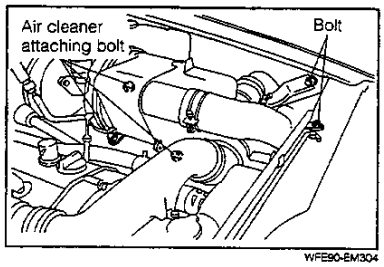
(3) Disconnect the clamp for the clutch cable at the air cleaner.



WFE90-EM303

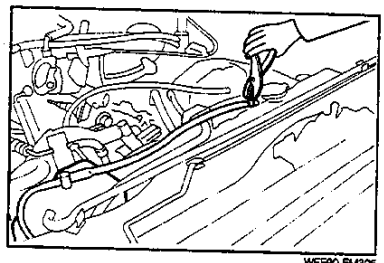
(4) Remove the bolts provided at the left fender panel and radiator center support.

(5) Remove the three air cleaner attaching bolts. Then, remove the air cleaner assembly.



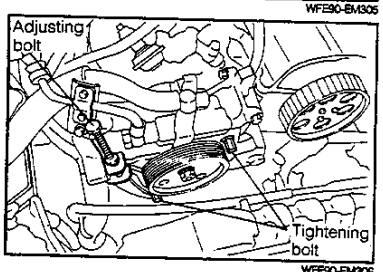
WFE90-EM304

6. Removal of radiator reserve tank
   (1) Disconnect the radiator reserve tank hose from the radiator.
   (2) Pull up the radiator reserve tank together with the hose.



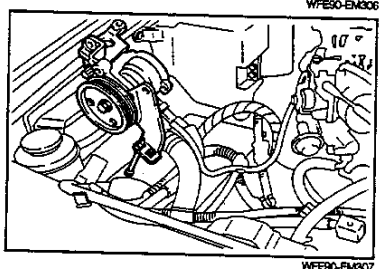
WFE90-EM305

7. Removal of power steering pump and drive belt (power steering equipped vehicle)
   (1) Loosen the adjusting bolt and two tightening bolts. Then push down the pump.
   (2) Remove the power steering drive belt.



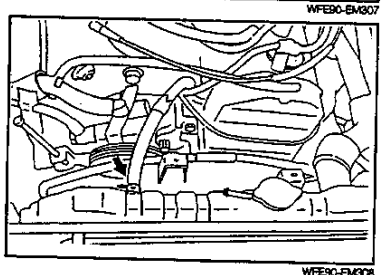
WFE90-EM306

   (3) Remove the power steering pump assembly from the engine by removing the three bolts. Then, temporarily put the pump assembly onto the battery mounting location.



WFE90-EM307

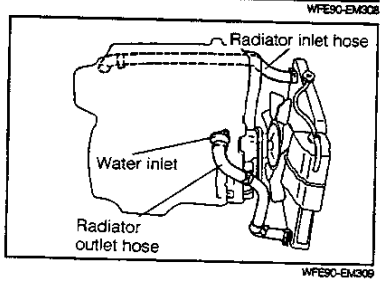
8. Removal of radiator
   (1) Disconnect the air breather hose from the radiator upper tank.



WFE90-EM308

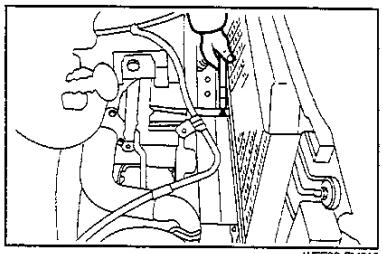
   (2) Remove the radiator inlet hose by disconnecting the radiator and water outlet side clamps.
   (3) Disconnect the radiator outlet hose at the center connection.

   CAUTION:
   - **When disconnecting the radiator outlet hose, take measures to prevent the coolant from entering the alternator.**



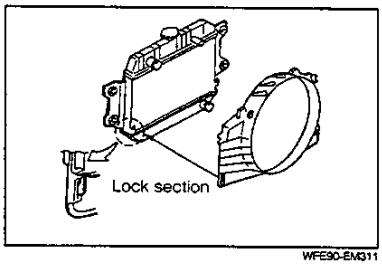
WFE90-EM309

(4) Disconnect the oil cooler hose from the radiator.



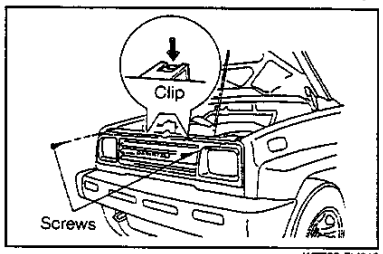
WFE90-EM310

(5) Remove the two attaching bolts of the fan shroud. Then, disconnect the lock section of the fan shroud from the radiator.
(6) Disconnect the fluid coupling with fan by removing the four attaching bolts. Then, remove the fluid coupling with fan together with the fan shroud.



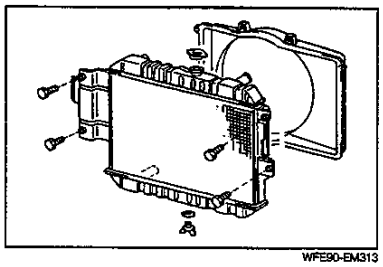
WFE90-EM311

(7) Remove the radiator grille.



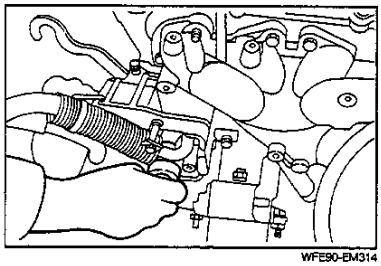
WFE90-EM312

(8) Remove the radiator by removing the four attaching bolts.



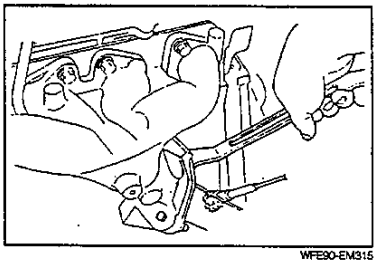
WFE90-EM313

9. Removal of air conditioner compressor
   (1) Remove the compressor cover by removing the attaching bolts.
   (2) Remove the compressor assembly by removing the attaching bolts. Then, temporarily place the compressor assembly onto the engine compartment left side.



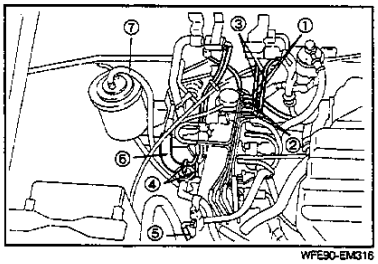
WFE90-EM314

10. Disconnection of exhaust pipe
    (1) Remove the exhaust manifold cover.
    (2) Disconnect the exhaust pipe from the exhaust manifold by removing the three attaching nuts.
    (3) Disconnect the exhaust pipe bracket from the side of the transmission.



WFE90-EM315

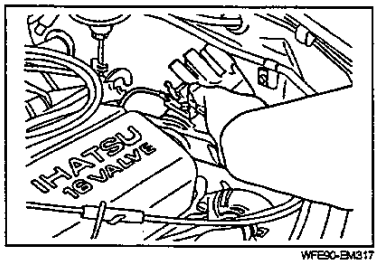
11. Removal of vacuum hoses at surge tank side
    (1) Distributor diaphragm ①
    (2) BVSV ②
    (3) Pressure VSV ③ (U.S. specifications only)
    (4) Air conditioner idle-up VSV ④
    (5) Power steering ACV ⑤
    (6) Brake booster ⑥
    (7) Charcoal canister ⑦



WFE90-EM316

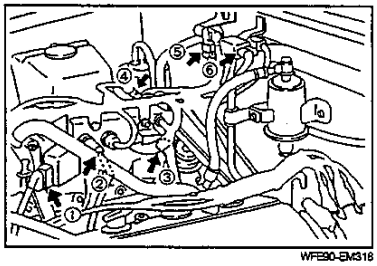
12. Removal of distributor
    (1) Disconnect the distributor wire connector.
    (2) Remove the distributor from the cylinder head by removing the two attaching bolts.

    NOTE:
    - **Since the remaining engine oil will flow out, be certain to place a cloth or the like.**



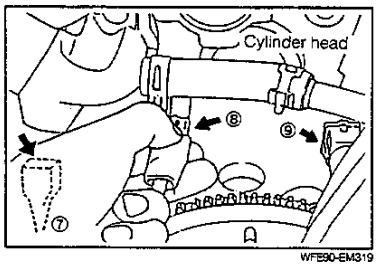
WFE90-EM317

13. Removal of engine wire harness.
    (1) Disconnect the following connectors.
        ① Throttle position sensor ①
        ② Intake air temperature sensor ②
        ③ Idle speed control VSV ③ (U.S. specifications only)
        ④ EGR VSV and harness clamp ④ (U.S. specifications only)
        ⑤ Air conditioner idle-up VSV ⑤
        ⑥ Pressure sensor, pressure VSV and clamp ⑥



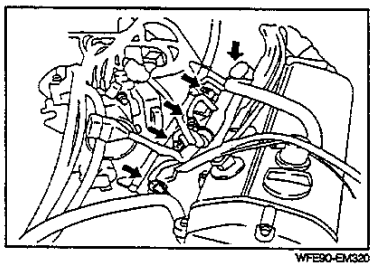
WFE90-EM318

        ⑦ Air conditioner water temperature switch ⑦
        ⑧ Water temperature sender gauge ⑧
        ⑨ Water temperature sensor ⑨
        ⑩ Oxygen sensor ⑩

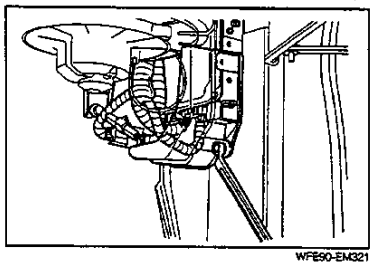


WFE90-EM319

(2) Disconnect the four injector connectors.
(3) Remove the engine wire clamps and engine ground cables.

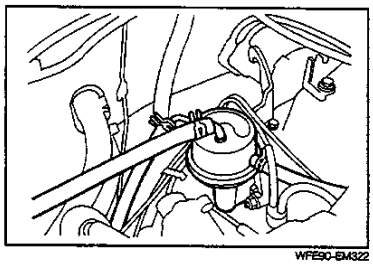

WFE90-EM320

(4) Removal of engine wire from ECU
① Remove the ECU cover at the cowl side panel of the passenger seat.
② Disconnect the engine wire connector from the engine control computer assembly (ECU).
③ Pull out the engine wire toward the engine compartment.
(5) Remove the engine wire from the engine compartment.

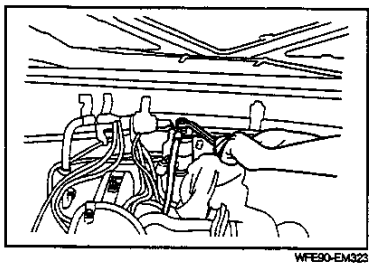

WFE90-EM321

14. Disconnection of fuel line

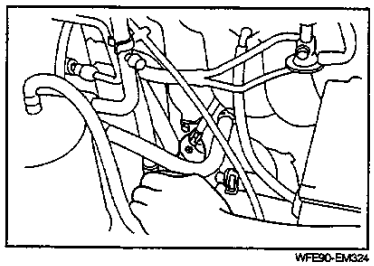
[HD-C Engine]
Disconnect the fuel inlet hose and return hose from fuel pump.
NOTE:
- Make sure to plug the disconnected hose so that no fuel may flow out.


WFE90-EM322

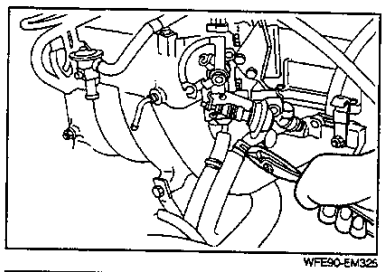
[HD-E Engine]
Disconnect the fuel hose at the upper part of fuel filter.
CAUTION:
- The pressure in the fuel line is kept 250 kPa (2.55 kgf/cm^2) higher than the atmospheric pressure.
- Hence, when the fuel line is loosened, be sure to prevent the fuel from splashing using an adequate cloth or the like.
- Furthermore, place a suitable container under the fuel filter because the fuel flows out.


WFE90-EM323

15. Disconnect the fuel return hose from the pressure regulator.
CAUTION:
- When disconnecting the fuel hose, take precautionary measures to prevent any dirt from entering into the fuel line.

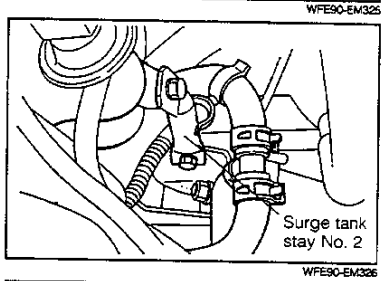

WFE90-EM324

16. Disconnect the two water hoses from the air valve.



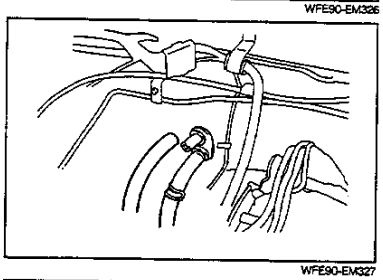
WFE90-EM325

17. Remove the surge tank stay No. 2 from the surge tank.



WFE90-EM326

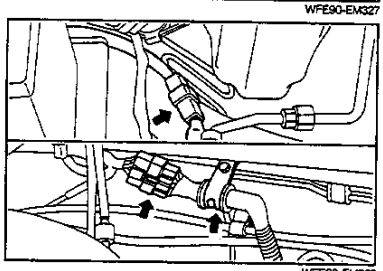
18. Disconnect the inlet and outlet hoses from the heater pipes.
CAUTION:
- Care must be exercised not to damage the heater pipe end.



WFE90-EM327

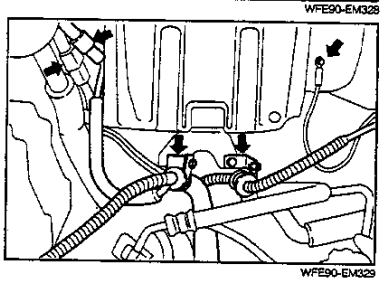
19. Disconnect the following wires and cords.

[HD-C Engine]
(1) Clamp of battery negative ⊖ terminal to engine bracket at battery carrier side.
(2) Clamp of battery positive ⊕ terminal to starter at battery carrier side.
(3) Connector of cable leading to battery at battery carrier side.



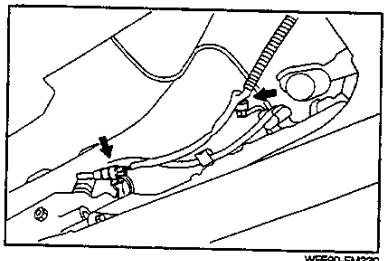
WFE90-EM328

[HD-E Engine]
(1) Clamp of battery negative ⊖ terminal to engine bracket at battery carrier side.
(2) Clamp of battery positive ⊕ terminal to starter at battery carrier side.
(3) Clamp of battery cable ⊕ leading to cowl at battery carrier side.
(4) Three connectors of cable leading to relay box at battery carrier side.



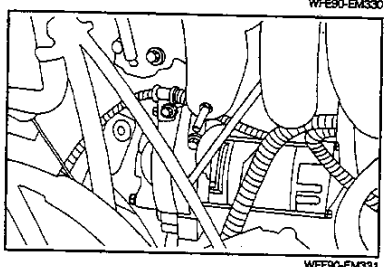
WFE90-EM329

20. Disconnect the connectors from the transmission and transfer by jacking up the vehicle. Disconnect the air breather hose from the transmission.



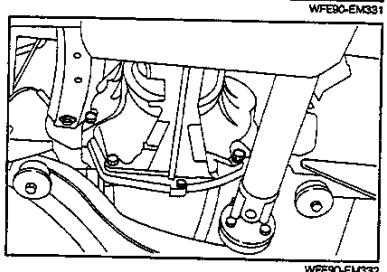
WFE90-EM330

21. Removal of starter
    (1) Disconnect the connector with lock and remove the harness clamping bolt.
    (2) Remove the starter by removing the two attaching bolts.



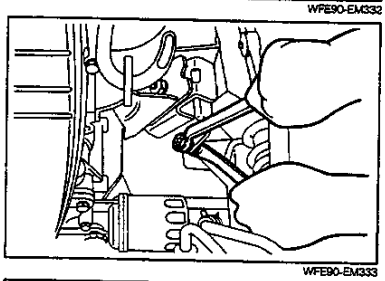
WFE90-EM331

22. Remove the attaching bolts which install the engine to the transmission.



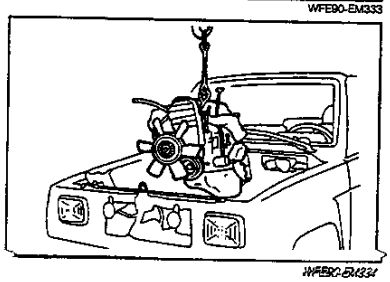
WFE90-EM332

23. Remove the attaching bolts of the engine mountings while suspending the engine, using a chain block.



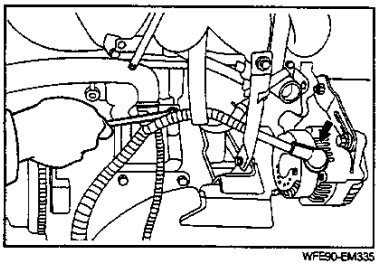
WFE90-EM333

24. Take out the engine from the engine compartment, using a chain block.
    CAUTION:
    - **Be careful not to allow the engine to hit the vehicle body or other parts.**
    - **Make sure that all hoses and wires have been disconnected from the body.**

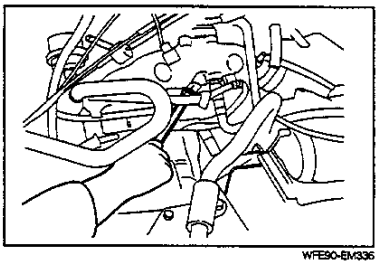


WFE90-EM334

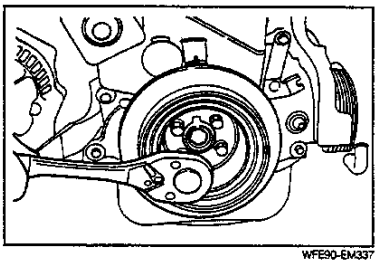
25. Removal of engine harness from engine
    (1) Disconnect the alternator connector.


WFE90-EM335

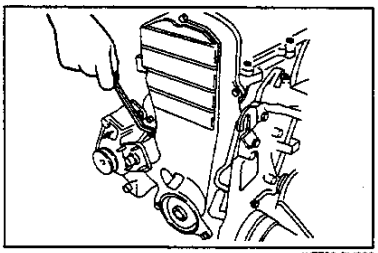
    (2) Remove the engine wire clamp.
    (3) Remove the engine wire from engine.


WFE90-EM336

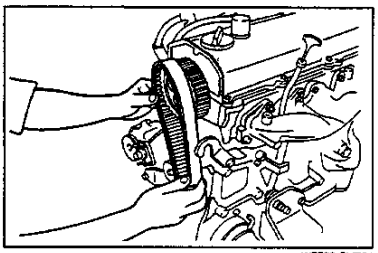
26. Remove the crankshaft pulley by removing the four attaching bolts.
    NOTE:
    - **Prevent the crankshaft from turning, using the following SST.**
      SST: 09210-87701-000


WFE90-EM337

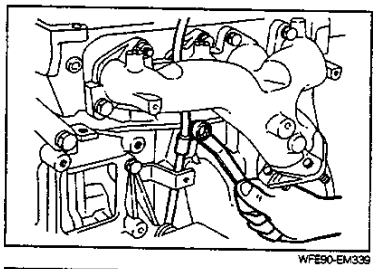
27. Removal of timing belt (See page EM–24.)
    (1) Remove the eight timing belt cover attaching bolts.
    (2) Remove the timing belt covers No. 1 and No. 2.


WFE90-EM338

    (3) Loosen the attaching bolt of the timing belt tensioner. Move the tensioner to the left as for as it will go and tighten the bolt temporarily.
    (4) Remove the timing belt.

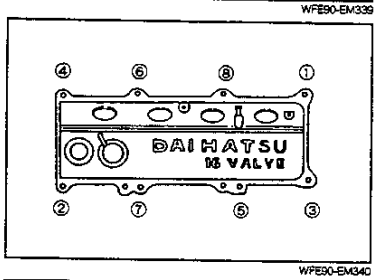

WFE90-EM784

28. Remove the oil level gauge guide attaching bolt.
29. Remove the oil level gauge guide from the cylinder block.


WFE90-EM339

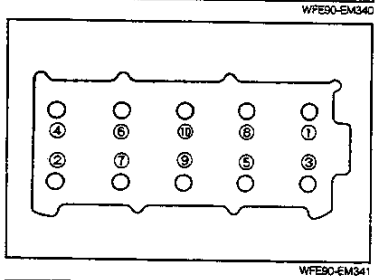
30. Removal of cylinder head cover
    (1) Remove the ground cable from the cylinder head cover.
    (2) Remove the spark plugs, using the SST.
    SST: 09268-87703-000

    (3) Loosen the cylinder head cover attaching bolts evenly over two or three stages in the sequence indicated in the figure.
    Remove the cylinder head cover attaching bolts.



WFE90-EM340

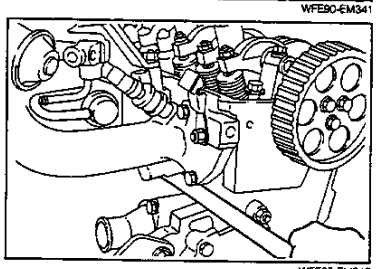
31. Removal of cylinder head
    (1) Loosen the cylinder head bolts, using a hexagon wrench.
    CAUTION:
    - Loosen the cylinder head bolts evenly over two or three stages in the sequence indicated in the figure.



WFE90-EM341

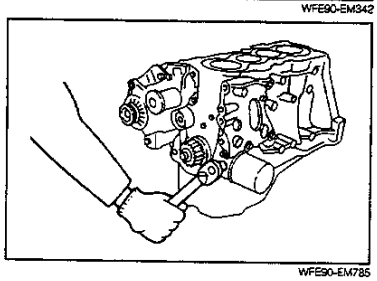
    (2) Remove the cylinder head with the intake and exhaust manifolds.
    NOTE:
    - If it is difficult to remove the cylinder head, pry up the cylinder head, using an iron bar.

    CAUTION:
    - Place the removed cylinder head on suitable two wooden blocks in order that the cylinder head surface and valve may not be damaged.

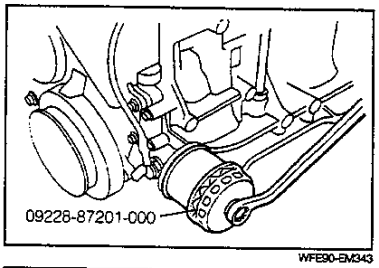

WFE90-EM342

DISASSEMBLY OF CYLINDER BLOCK

1. Remove the oil pressure switch.
   NOTE:
   - Use a hexagon box wrench for the removal operation.

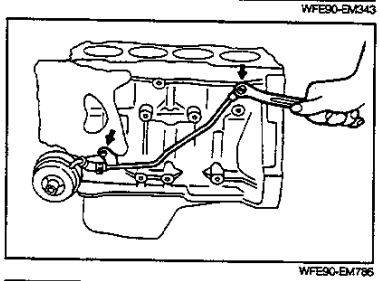

WFE90-EM785

2. Remove the oil filter, using the following SST.
   SST: 09228-87201-000



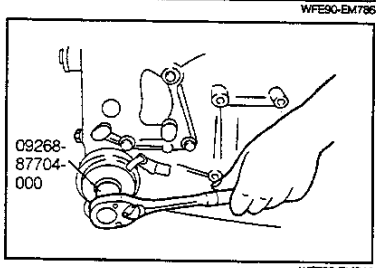
WFE90-EM343

3. Removal of oil cooler
   (1) Remove the oil cooler pipe from the cylinder block.
   (2) Release the hose band and remove the oil cooler pipe.


WFE90-EM786

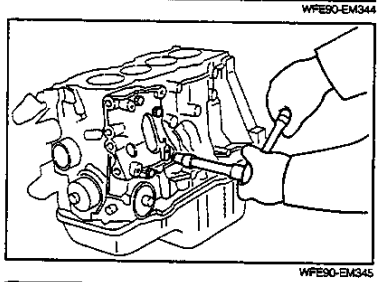
   (3) Remove the oil cooler from the cylinder block, using the following SST.
   SST: 09268-87704-000

   (4) Remove the water hose from the oil cooler.

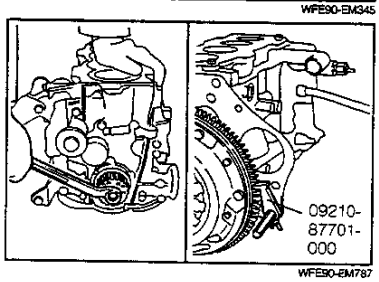


WFE90-EM344

4. Remove the compressor bracket by removing the four attaching bolts.

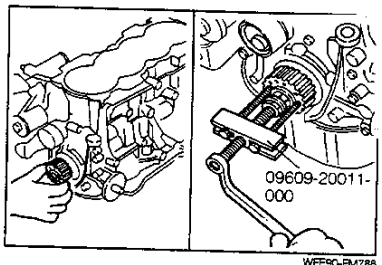

WFE90-EM345

5. Remove the crankshaft pulley bolt.
   NOTE:
   - Prevent the ring gear from turning, using the following SST.
     SST: 09210-87701-000



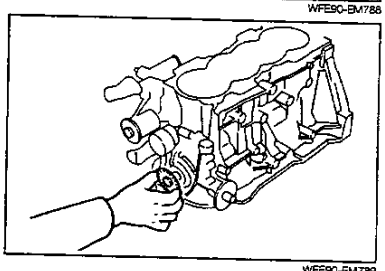
WFE90-EM787

6. Remove the crankshaft pulley.
   NOTE:
   - If the crankshaft pulley can not be removed by hand, install the following SST with the crankshaft pulley bolt interposed.
     SST: 09609-20011-000

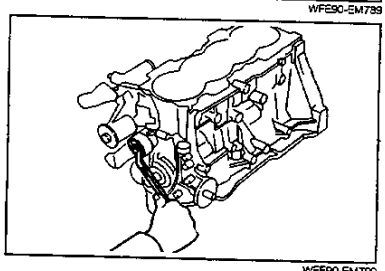


WFE90-EM788

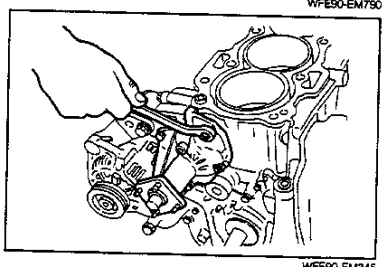
7. Remove the crankshaft pulley flange.


WFE90-EM789

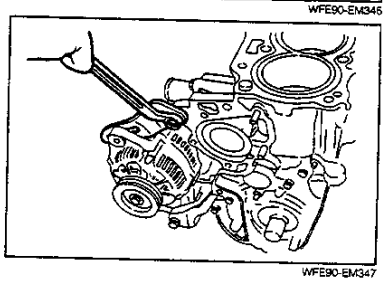
8. Remove the tensioner and tension spring.


WFE90-EM790

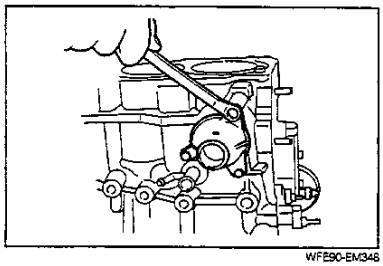
9. Remove the water pump by removing the three attaching bolts and two nuts.
10. Remove the water pump gasket.


WFE90-EM345

11. Remove the alternator assembly with bracket by removing the two attaching bolts and one adjusting bolt.

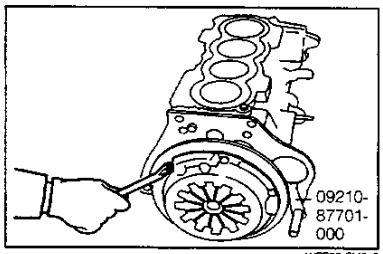

WFE90-EM347

12. Remove the water inlet and thermostat by removing the three attaching bolts.



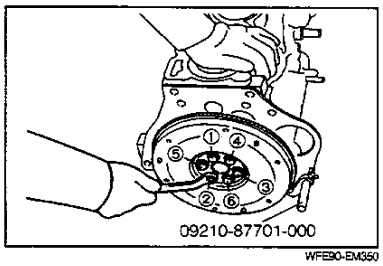
WFE90-EM348

13. Remove the pressure plate and clutch disc by removing the six attaching bolts.
    NOTE:
    - **Prevent the pressure plate from turning, using the following SST.**
      SST: 09210-87701-000



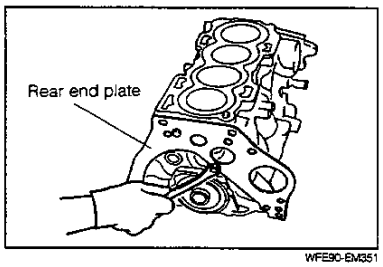
WFE90-EM349

14. Loosen the attaching bolts of the flywheel in the sequence as indicated in the right figure. Remove the flywheel.
    NOTE:
    - **Prevent the flywheel from turning, using the following SST.**
      SST: 09210-87701-000



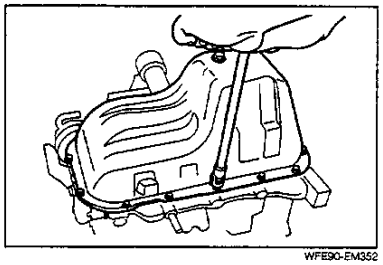
WFE90-EM350

15. Remove the rear end plate by removing the two attaching bolts.



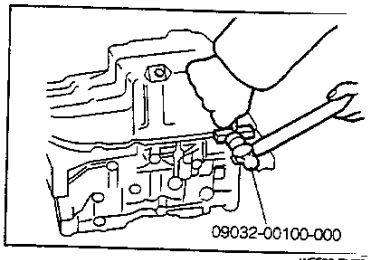
WFE90-EM351

16. Removal of oil pan
    (1) Loosen the ten attaching bolts and four nuts of the oil pan over two or three stages. Pull out the bolts and nuts.



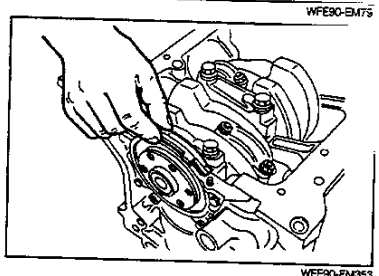
WFE90-EM352

(2) Separate the oil pan from the cylinder block by driving the following SST into between the cylinder block and the oil pan.
SST: 09032-00100-000

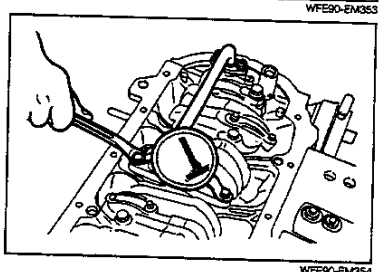


WFE90-EM75

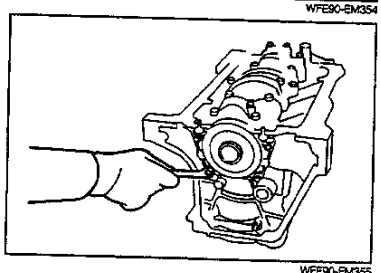
17. Remove the oil pan gasket.


WFE90-EM353

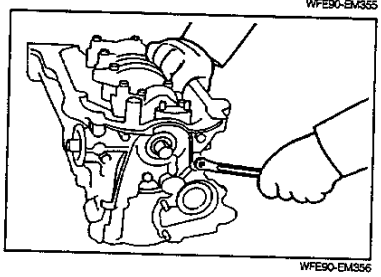
18. Remove the oil pump strainer by removing the two attaching bolts and two nuts.


WFE90-EM354

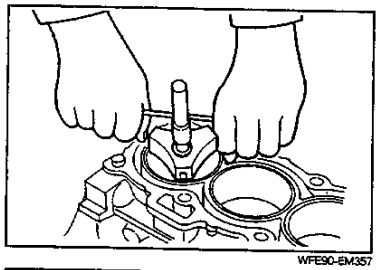
19. Remove the rear oil seal retainer.


WFE90-EM355

20. Remove the oil pump.


WFE90-EM356

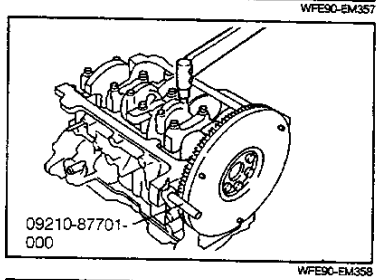
21. Removal of piston
   (1) Remove all carbon deposits from the piston ring ridges.
   (2) Turn the crankshaft, until the connecting rod bearing cap to be removed comes at the oil pan side.



WFE90-EM357

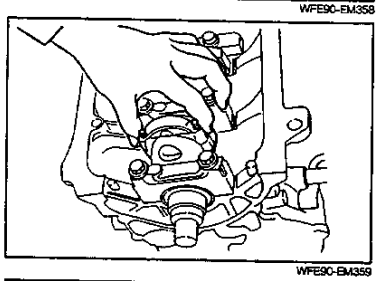
   (3) Lock the flywheel to prevent the crankshaft from turning, using the following SST.
   SST: 09210-87701-000

   (4) Loosen the connecting rod bearing cap nuts evenly over two or three stages. Then, remove the connecting rod bearing cap nuts.



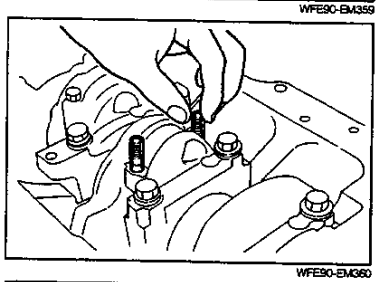
WFE90-EM358

   (5) Remove the bearing cap.
   NOTE:
   - Replace the crankshaft if the crankpin journals exhibit damages, such as seizure.
     (See page EM–121.)



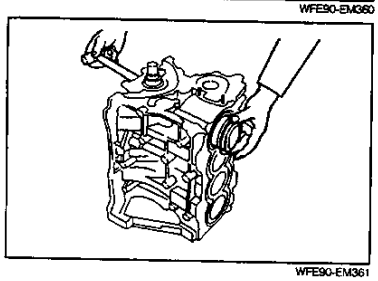
WFE90-EM359

   (6) Cover each connecting rod bolt with a short piece of hose to protect the crankpin journal from damage.



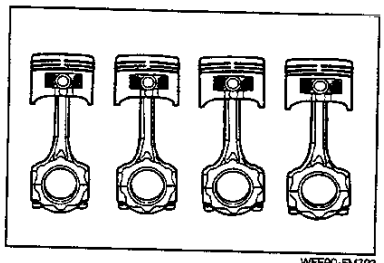
WFE90-EM360

   (7) Push out the piston and connecting rod assembly and the upper bearing through the top of the cylinder block.

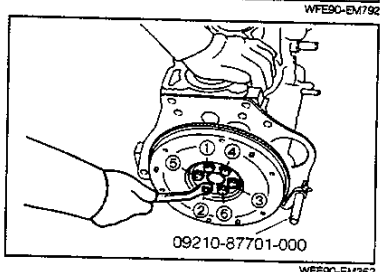


WFE90-EM361

NOTE:
- Arrange the disassembled pistons and connecting rod in order that their installation positions may be known readily.
- Care should be exercised so as not to damage the bearings.

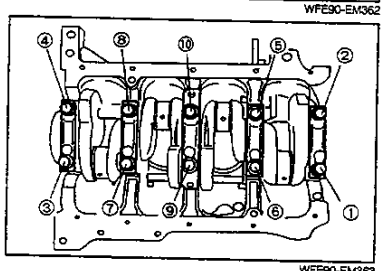

WFE90-EM792

22. Loosen the attaching bolts of the flywheel in the sequence as indicated in the right figure. Remove the flywheel.
NOTE:
- Prevent the flywheel from turning, using the following SST.
  SST: 09210-87701-000

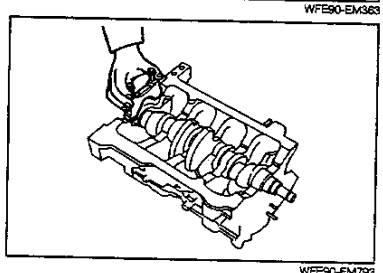


WFE90-EM362

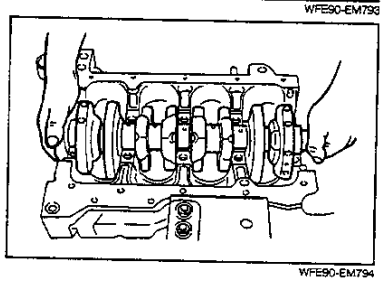
23. Removal of crankshaft
(1) Gradually loosen the main bearing cap bolts over three stages in the numerical sequence shown in the figure. Remove the bearing cap bolts.


WFE90-EM363

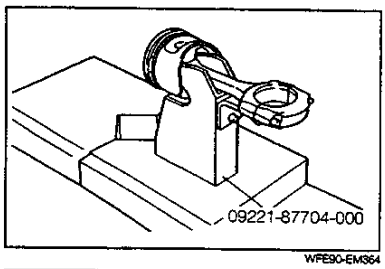
(2) With the main bearing cap bolts inserted into the bolt holes of the main bearing cap, wiggle the bearing cap back and forth. Remove the bearing cap together with the lower bearing.
NOTE:
- Keep the lower bearing fitted to the main bearing cap.
- Arrange the removed main bearing caps in order.


WFE90-EM793

(3) Lift off the crankshaft.
NOTE:
- Be very careful not to allow the main bearings to be mixed with the bearings of the other cylinders.
- Remove the thrust washer.

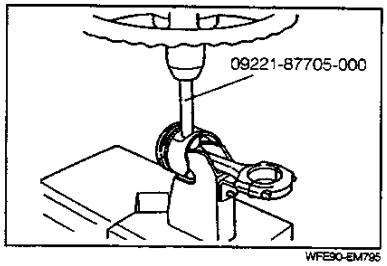

WFE90-EM794

24. Disassembly of piston and connecting rod
    (1) Install the connecting rod in the following SST as shown in the right figure.
    SST: 09221-87704-000



WFE90-EM364

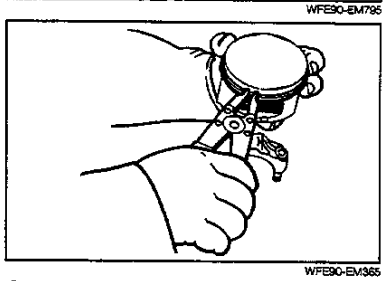
    (2) Insert the longer SST into the piston pin hole. Press off the piston, using a hydraulic press.
    SST: 09221-87705-000



WFE90-EM795

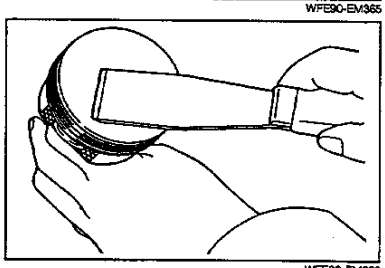
25. Removal of piston rings
    NOTE:
    - **Arrange the removed piston rings in order so that their installation positions may be known readily.**
    - **Do not expand the piston ring unnecessarily beyond the required extent.**

    (1) Remove the piston rings No. 1 and No. 2, using a piston ring expander.
    (2) Remove the oil ring side rails by hand.
    (3) Remove the oil ring expander by hand.


WFE90-EM365

26. Cleaning of pistons
    (1) Remove the carbon deposits from the piston top, using a gasket scraper or the like.
    NOTE:
    - **Be very careful not to scratch the piston.**

    (2) Clean the piston grooves with a broken piston ring or a groove cleaning tool.
    NOTE:
    - **Be very careful not to scratch the piston.**

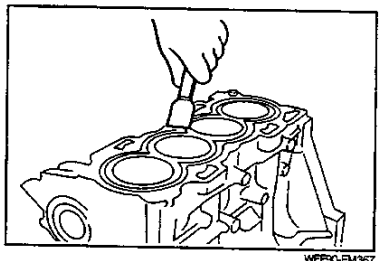

WFE90-EM366

27. Wash the disassembled parts with cleaning agent. Store the parts after drying them by blowing with compressed air.

INSPECTION OF EACH PART

INSPECTION OF CYLINDER BLOCK

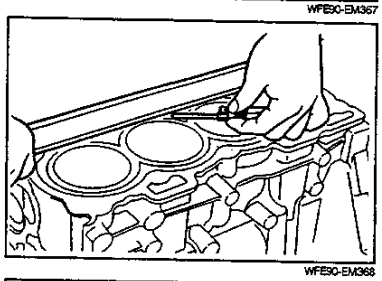
1. Removal of gasket material
   Remove all gasket materials from the cylinder block.
2. Cleaning of cylinder block
   Clean the cylinder block, using a soft brush and cleaning solvent.



WFE90-EM367

3. Inspection of top surface of cylinder block
   Using a precision straight edge and a thickness gauge, check the surface contacting the cylinder head gasket for warpage in the four directions as shown in the figure.
   Allowable Warpage: 0.1 mm

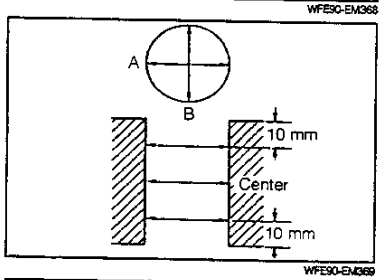
   If the warpage exceeds the allowable limit, replace the cylinder block.



WFE90-EM368

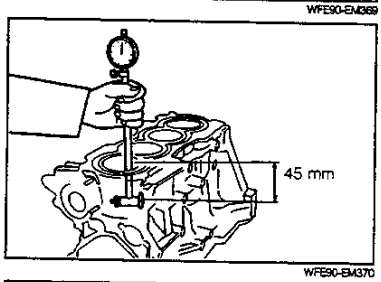
4. Measurement of cylinder bore
   (1) Measure the bore diameter of each cylinder at the six points shown in the right figure. Ensure that the difference between the maximum and minimum bore diameters of each cylinder is within 0.1 mm.

   If the difference between the maximum and minimum values exceeds 0.1 mm, perform boring for the cylinder bore in accordance with the oversized piston.



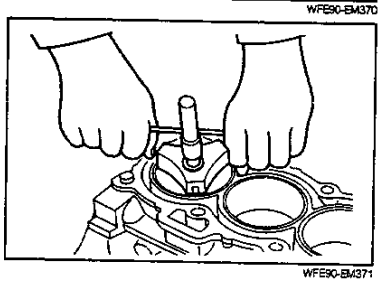
WFE90-EM369

   (2) Measure the bore diameter of each cylinder at a point shown in the right figure. The measured value is regarded as the cylinder bore diameter.
   Specified Bore Diameter: 76.000 - 76.030 mm



WFE90-EM370

5. Removal of cylinder ridges
   If ridges are formed at the upper parts of the cylinder bores, use a ridge reamer to remove the ridges.

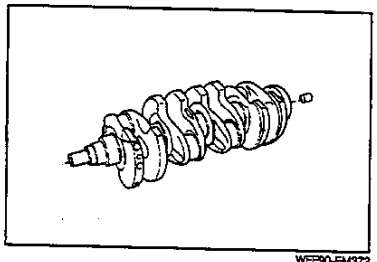


WFE90-EM371

INSPECTION OF CRANKSHAFT

1. Visually inspect the main journals and crankpin journals for pitting or scratches.

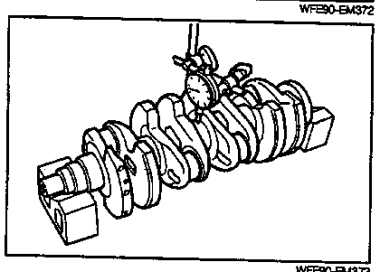
   If the main journals and crankpin journals are damaged, replace the crankshaft.



WFE90-EM372

2. Measurement of crankshaft runout
   (1) Support the both ends of the crankshaft with a V-shaped blocks.
   Measure the crankshaft runout with a dial gauge.
   Allowable Runout Limit: 0.6 mm

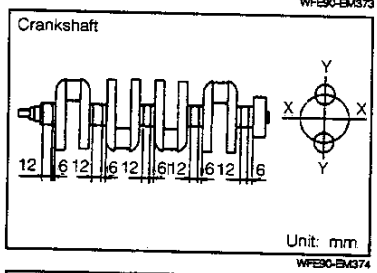
   If the runout exceeds the allowable limit, replace the crankshaft.



WFE90-EM373

3. Measurement of crankshaft journals
   (1) Measure the diameter of each crankshaft main journal at four points, 90 degrees spaced as shown in the right figure.
   The maximum value is regarded as the crankshaft main journal diameter.

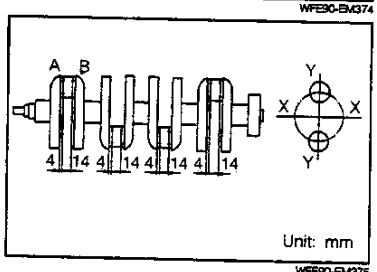
   If the variation in the measured diameters exceeds 0.026 mm, replace the crankshaft.



WFE90-EM374

   (2) Measure the diameter of each crankpin journal at four points, 90 degrees spaced as shown in the right figure.
   The maximum value is regarded as the crankpin journal diameter.

   If the variation in the measured diameters exceeds 0.044 mm, replace the crankshaft.
   Specified Diameter:
   Main Journal: 49.976 - 50.000 mm
   Crankpin Journal: 44.976 - 45.000 mm

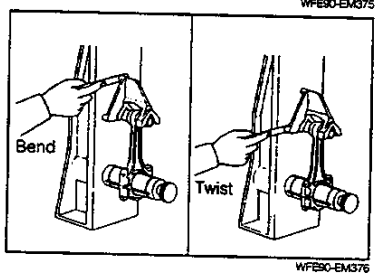


WFE90-EM375

IINSPECTION OF CONNECTING ROD

1. Visually inspect the connecting rods for damage or cracks.
2. Check the connecting rod for bend and twist, using a connecting rod aligner.
   Allowable Bend: 0.05 mm
   Allowable Twist: 0.05 mm

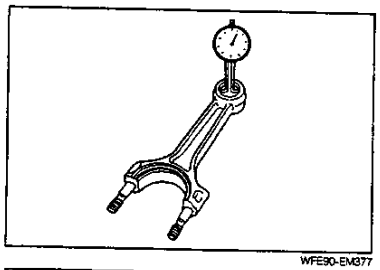
   If the bend or twist is greater than the allowable limit, replace the connecting rod assembly.



WFE90-EM376

3. Measure the inner diameter of the connecting rod small end, using a bore dial gauge.
   Specified Value: 18.953 - 18.979 mm

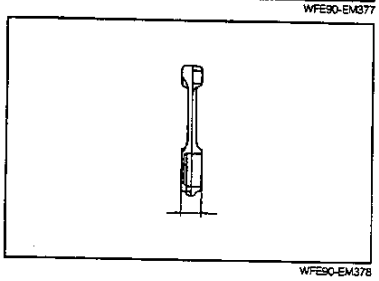
   If the inner diameter of the connecting rod small end exceeds the specified value, replace the connecting rod.



WFE90-EM377

4. Measure the width of the connecting rod big end, using a micrometer.
   Specified Value: 21.80 - 21.85 mm
   Allowable Limit: 21.70 mm

   If the width wear of the connecting rod big end exceeds the allowable limit, replace the connecting rod.
   NOTE:
   - Before measuring the width of the connecting rod big end, tighten the connecting rod bearing cap nuts evenly over two or three stages to the specified torque.
     Specified Torque: 34.3 - 44.1 N·m (3.5 - 4.5 kgf-m)



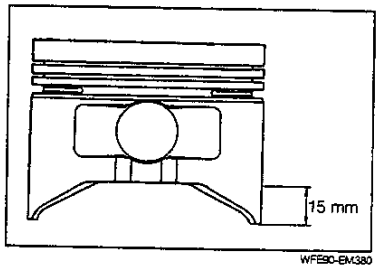
WFE90-EM378

INSPECTION OF PISTONS

1. Visually inspect the piston for cracks, damage or seizure. Replace the piston, as required.

WFE90-EM379

2. Measurement of piston diameter
   (1) Measure the piston outer diameter horizontally at a point 15 mm from the lower end of the piston at right angles to the piston pin.
   Specified Value: 75.965 - 75.995 mm



WFE90-EM380

(2) Calculation of piston-to-cylinder bore clearance
Subtract the measured piston outer diameter from the measured cylinder bore diameter.
Ensure that this piston-to-cylinder bore clearance is less than 0.11 mm.
Piston-to-cylinder bore clearance
Specified Value: 0.025 - 0.045 mm
Allowable Limit: 0.11 mm

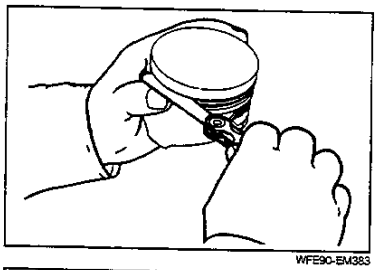
WFE90-EM381

If the piston-to-cylinder bore clearance exceeds the allowable limit, perform boring and honing the cylinder bores so that the cylinder bore diameter may match with the oversized piston.

WFE90-EM382

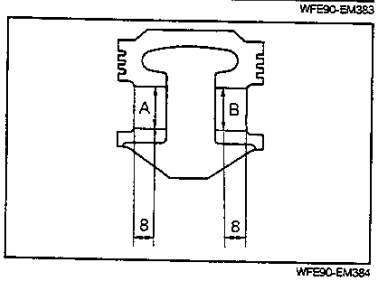
3. Measurement of piston ring groove width
Measure the groove width of the piston rings No. 1, No. 2 and No. 3 with a thickness gauge.
Specified Value:

No. 1 piston ring groove width	1.202 - 1.204 mm
No. 2 piston ring groove width	1.501 - 1.503 mm
No. 3 piston ring groove width	3.01 - 3.03 mm



WFE90-EM383

4. Measurement of piston pin bore diameter of piston
Measure the piston pin bore diameter at the two points as shown in the right figure, using a dial gauge for bore diameter measurement. Record the minimum measured value as the piston pin bore diameter.
Specified Value: 18.999 - 19.005 mm



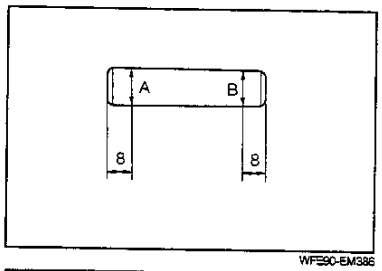
WFE90-EM384

INSPECTION OF PISTON PIN

1. Visually inspect the piston pin for damage or scratches.
Replace the piston pin, as required.

WFE90-EM385

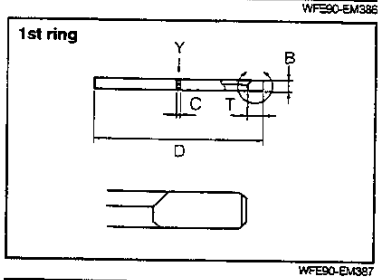
2. Measure the outer diameter of the piston pin at the two points as shown in the right figure, using a micrometer.
   Specified Value: 18.991 - 18.997 mm



WFE90-EM386

INSPECTION OF PISTON RINGS

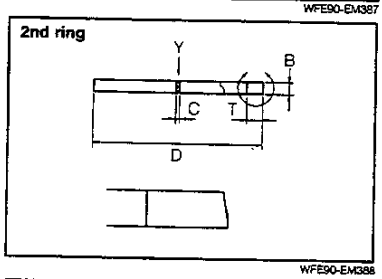
1. Visually inspect the piston ring for excessive uneven wear or scratches. If any abnormality exists, replace the piston ring with a new part.



WFE90-EM387

2. Check of piston ring dimensions
   (1) Measure the width of the piston ring.

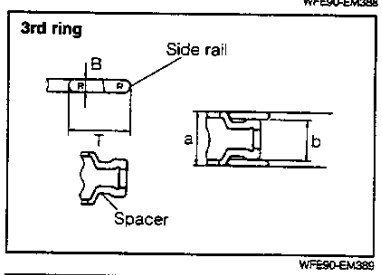
1st		2.80 - 3.00
2nd		3.00 - 3.20
3rd	Side rail	2.25 - 2.45
	Spacer	-



WFE90-EM388

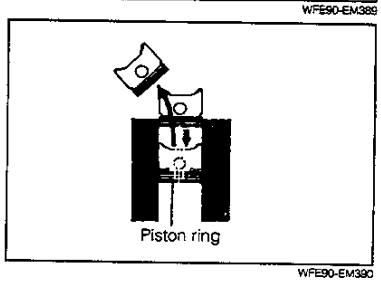
   (2) Measure the length of the piston ring.

1st		1.170 - 1.190
2nd		1.470 - 1.490
3rd	Side rail	0.48 - 0.52
	Spacer	a 2.75 - 2.90
		b 1.87 - 1.92



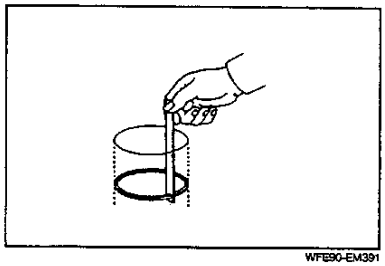
WFE90-EM389

   (3) Inspection of piston ring end gap
   ① Apply engine oil to the cylinder walls.
   ② Insert the piston rings into the cylinder bore.
   ③ Using a piston, push down the piston ring to a point 110 mm measured from the cylinder block upper surface.



WFE90-EM390

④ Measure the piston ring end gap, using a thickness gauge or a feeler gauge.



WFE90-EM391

Piston ring end gap

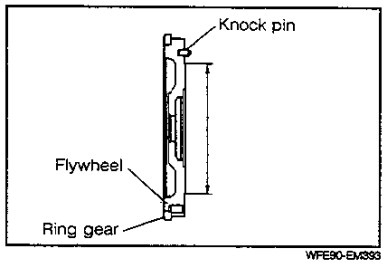
	Specified value mm	Allowable limit mm
Compression ring No. 1	0.27 - 0.42	0.7
Compression ring No. 2	0.35 - 0.50	0.8
Oil ring	0.20 - 0.70	1.0

If the piston ring end gap exceeds the allowable limit, a set of piston rings for one cylinder should be replaced.

WFE90-EM392

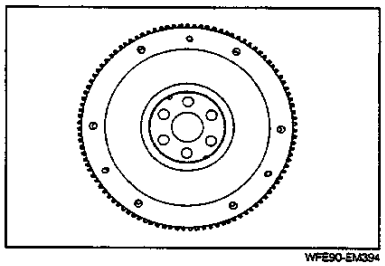
INSPECTION OF FLYWHEEL

1. Visually inspect the flywheel for damage or cracks. Replace the flywheel, as required.



WFE90-EM393

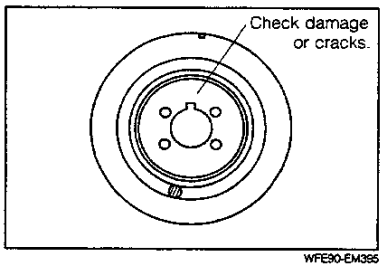
2. While holding the flywheel by your hands, ensure that there is no excessive play or displacement. If any abnormality exists, replace the flywheel.



WFE90-EM394

INSPECTION OF CRANKSHAFT PULLEY

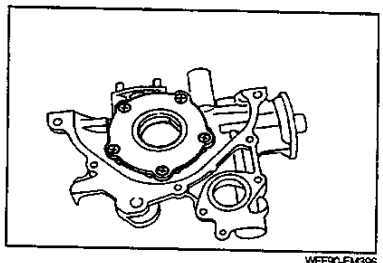
1. Visual inspection of crankshaft pulley
   (1) Check the crankshaft pulley attaching seat for deformation, wear or cracks.
   (2) Check the V-ribbed belt attaching surface for scratches, deformation or wear.
   Replace the crankshaft pulley, as required.



WFE90-EM395

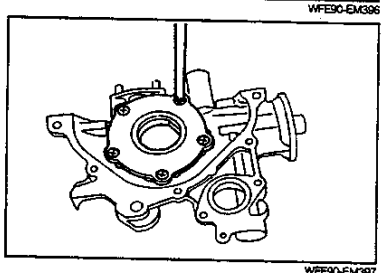
INSPECTION OF OIL PUMP

1. Visually inspect the rotor surface and oil seal section of the oil pump for scratches, wear and so forth.
   If any abnormality exists, replace the oil seal or rotor.



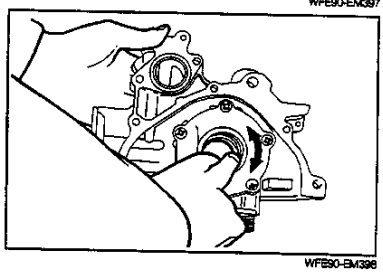
WFE90-EM396

2. Using a screwdriver, ensure that the oil pump cover attaching bolt is not loose.
   If the bolt is loose, retighten the bolt to the specified torque.
   Tightening Torque: 7.8 - 12.7 N·m (0.8 - 1.3 kgf-m)



WFE90-EM397

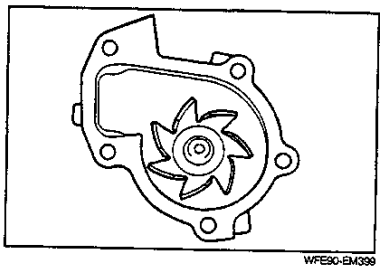
3. Turn the rotor by hand. Ensure that the rotor turns smoothly.
   If the rotor will not turn smoothly, disassemble the oil pump and check each part carefully.
   (See page EM–oo.)
   Replace the parts, as required.
   NOTE:
   - The oil pump performance is described in the LU section.
     (See page LU–6.)
   - The disassembling and assembling procedures for the oil pump is described in the following paragraph.
     (See page EM–144.)



WFE90-EM398

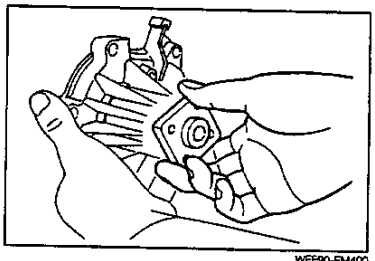
INSPECTION OF WATER PUMP

1. Visually inspect the water pump.
   (1) Mechanical seal section for evidence of water leakage
   (2) Rotary fin of water pump for scratches, deformation or cracks
   (3) Water pump attaching surface for scratches
   (4) Water pump pulley attaching seat for scratches or flattened condition
   Replace the water pump, as required.

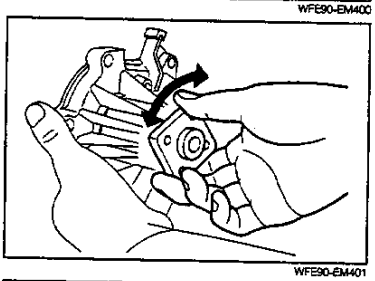


WFE90-EM399

2. Check the water pump bearing and water pump pulley attaching section for excessive play.
   Replace the water pump, as required.

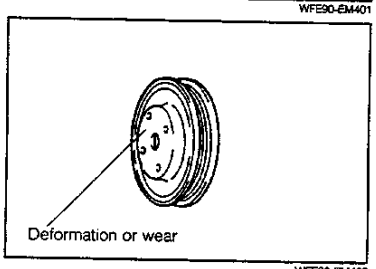

WFE90-EM400

3. Turn the water pump by hand. Ensure that the water pump turns smoothly.
   Replace the water pump, as required.


WFE90-EM401

WATER PUMP PULLEY

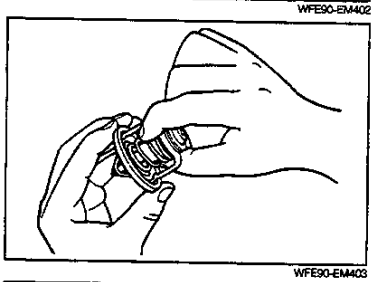
1. Visual inspection of water pump pulley
   (1) Inspect the water pump pulley attaching section for deformation or wear.
   (2) Inspect the V-ribbed belt attaching surface for deformation or wear.
   Replace the water pump pulley, as required.



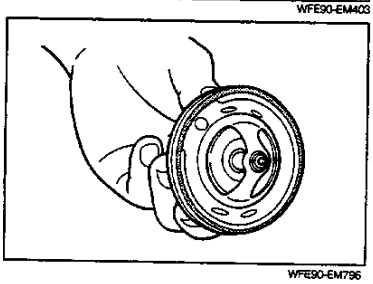
WFE90-EM402

INSPECTION OF THERMOSTAT

1. Ensure that the thermostat valve is closed completely at room temperature 20°C and the spring has no play.
   Replace the thermostat if the valve is open or the spring has a play.


WFE90-EM403

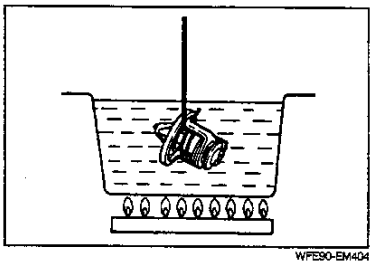
2. Check the rubber grommet of the thermostat for damage or crack.
   Replace the thermostat if the rubber grommet exhibits damage or crack.


WFE90-EM796

3. Immerse the thermostat in water, and check the valve opening temperature by heating the water gradually.

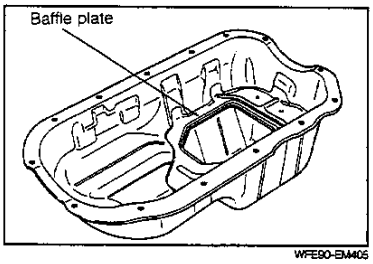
Specifications	Valve opening temperature °C	Valve lift
Standard specifications	76 - 80	8.5 mm or more at 91°C
Cold area specifications	82 - 86	8.5 mm or more at 98°C

Replace the thermostat if the valve operation fails to conform to the specifications.


WFE90-EM404

INSPECTION OF OIL PAN

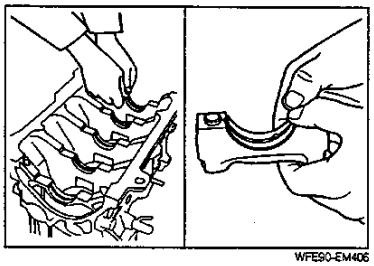
1. Visually inspect the oil pan for damage or cracks. Replace the oil pan, as required.



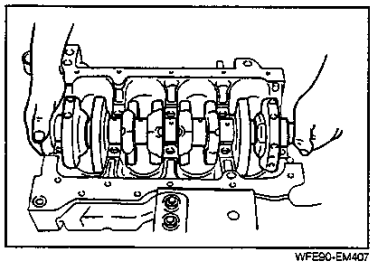
WFE90-EM405

INSPECTION OF OIL CLEARANCE AND SELECTION OF BEARING

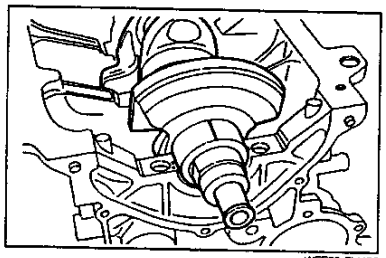
1. Measurement of main journal oil clearance
   (1) Install the main bearings to the cylinder block and crankshaft main bearing cap.
   NOTE:
   - **Do not touch the metal surface of the bearing.**


WFE90-EM406

   (2) Place the crankshaft in the cylinder block.

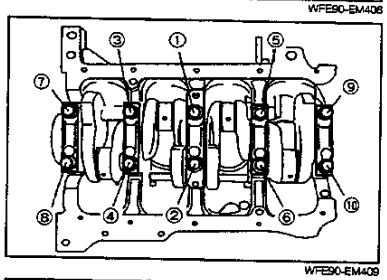

WFE90-EM407

(3) Lay a strip of plastigage across each crankshaft main journal.



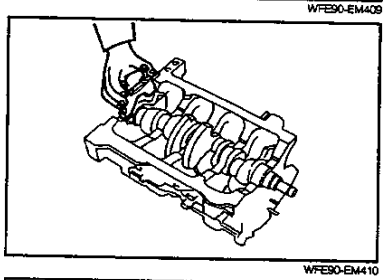
WFE90-EM408

(4) Install the crankshaft bearing caps. Tighten the crankshaft bearing cap bolts evenly in the sequence indicated in the right figure.
Tightening Torque: 44.1 - 53.9 N·m (4.5 - 5.5 kgf-m)



WFE90-EM409

(5) Remove the main bearing caps with the lower bearings fitted on them.

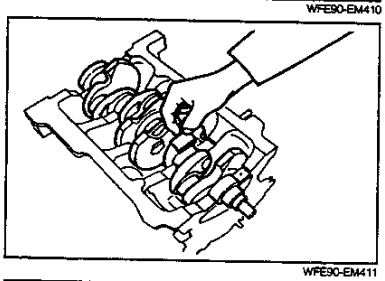


WFE90-EM410

(6) Measure the plastigage width at its widest point.
Oil Clearance: 0.024 - 0.042 mm

If the oil clearance fails to conform to the specified value, measure the crankshaft main journal diameter and select suitable crankshaft main journal bearings or replace the crankshaft.
(See page EM–131.)

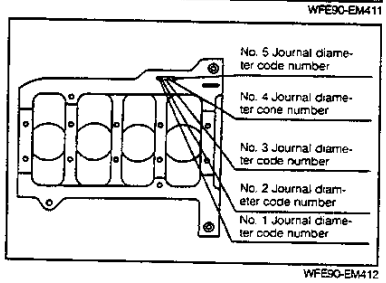
(7) Remove the plastigage from the crankshaft main journals.



WFE90-EM411

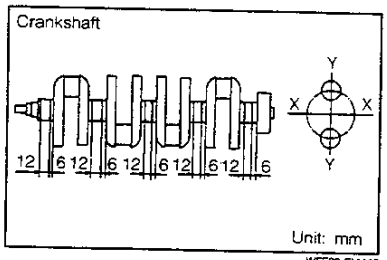
2. Selection of crankshaft bearings
NOTE:
- **The replacement of the crankshaft bearings should be performed after all inspections have been finished.**

(1) Read the cylinder block main journal diameter code number.
NOTE:
- **The main journal diameter code comes in four kinds of 5, 6, 7 and 8.**



WFE90-EM412

(2) Measure the diameter of the crankshaft main journals. The measurement should be performed at four points, 90 degrees spaced, for each crankshaft main journal at the points shown in the right figure. The maximum value is regarded as the crankshaft main journal diameter. However, if the variation in the measured diameters exceeds 0.026 mm, replace the crankshaft.



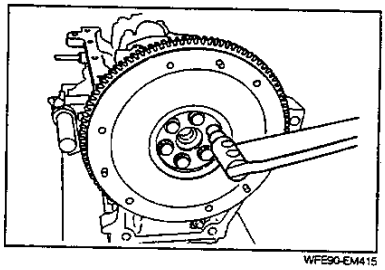
WFE90-EM413

(3) Select the crankshaft bearings or replace the crankshaft, based on the results of (1) and (2).

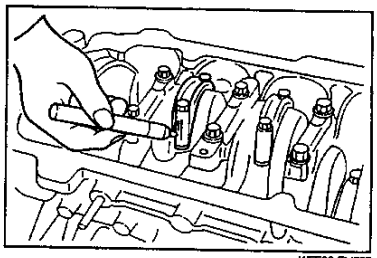
Main journal diameter code	Crankshaft main journal diameter mm	Bearing classification number (color)	Remarks
5	49.995 - 50.000	1 (Yellow)	—
	49.989 - 49.994	2 (Green)	—
	49.983 - 49.988	3 (Brown)	—
	49.976 - 49.982	4 (Black)	—
	49.975 or less	—	Crankshaft replacement
6	49.995 - 50.000	2 (Green)	—
	49.989 - 49.994	3 (Brown)	—
	49.983 - 49.988	4 (Black)	—
	49.976 - 49.982	5 (Blue)	—
	49.975 or less	—	Crankshaft replacement
7	49.995 - 50.000	3 (Brown)	—
	49.989 - 49.994	4 (Black)	—
	49.983 - 49.988	5 (Blue)	—
	49.976 - 49.982	6 (White)	—
	49.975 or less	—	Crankshaft replacement
8	49.995 - 50.000	4 (Black)	—
	49.989 - 49.994	5 (Blue)	—
	49.983 - 49.988	6 (White)	—
	49.976 - 49.982	7 (Pink)	—
	49.975 or less	—	Crankshaft replacement

WFE90-EM414

3. Measurement of crankpin journal oil clearance
(1) Install the flywheel temporarily.

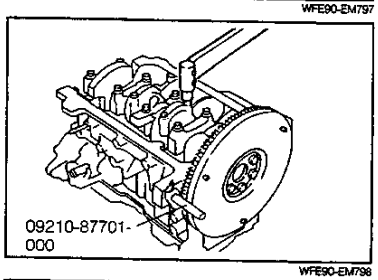

WFE90-EM415

(2) Wipe off any oil from the side of the mate surface between the connecting rod bearing cap and the connecting rod. Daub a mate mark with an oily paint on the side so that the parts can be assembled correctly in the original combination.
(Also ensure that the cylinder number may be identified)
(3) Turn the crankshaft, until the connecting rod bearing cap to be removed comes at the oil pan side.


WFE90-EM797

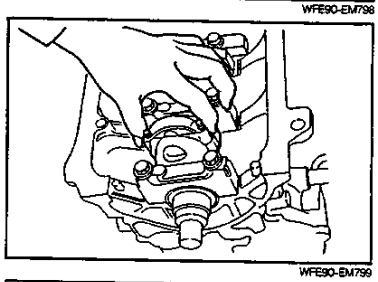
(4) Lock the flywheel to prevent the crankshaft from turning, using the following SST.
SST: 09210-87701-000

(5) Loosen the connecting rod bearing cap nuts evenly over two or three stages. Then, remove the connecting rod bearing cap nuts.

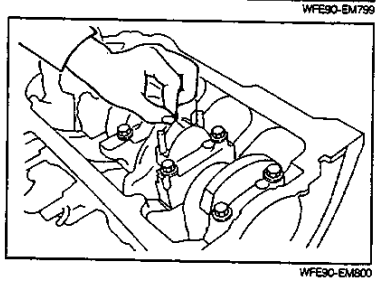


WFE90-EM798

(6) Remove the bearing cap.
NOTE:
- **Replace the crankshaft if the crankpin journals exhibit damages, such as seizure.**
  (See page EM–121.)

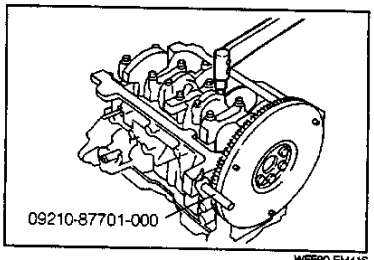

WFE90-EM799

(7) Place a plastigage on the crankpin journal.
NOTE:
- **Wipe off any oil from the crankpin journal.**


WFE90-EM800

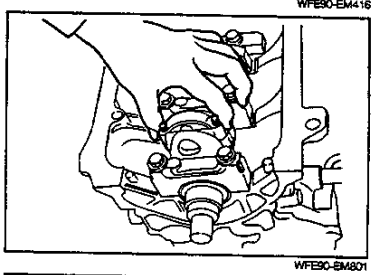
(8) Install the connecting rod cap, making sure that the mate marks are lined up. Tighten the connecting rod bearing cap nuts evenly over two or three stages to the specified torque.
Tightening Torque: 34.3 - 44.1 N·m (3.5 - 4.5 kgf-m)

NOTE:
- When tightening the bearing cap nuts, apply engine oil to the bearing cap nuts.
- Prevent the crankshaft from turning, using the following SST.
  SST: 09210-87701-000



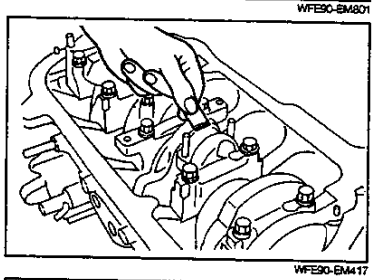
WFE90-EM416

(9) Loosen the connecting rod bearing cap nuts evenly over two or three stages. Then, remove the connecting rod bearing cap.
NOTE:
- Prevent the crankshaft from turning, using the SST.
  SST: 09210-87701-000


WFE90-EM801

(10) Measure the plastigage width at its widest point.
Oil Clearance: 0.020 - 0.044 mm

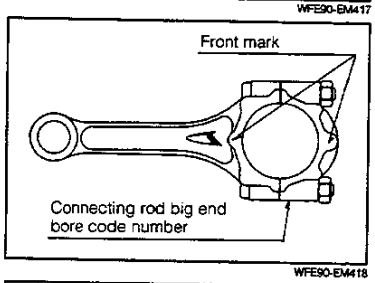
NOTE:
- If the oil clearance fails to conform to the specified value, measure the crankpin journal diameter and select a suitable connecting rod bearing or replace the crankshaft.


WFE90-EM417

(11) Remove the plastigage from the crankpin journal.
(12) Measure the oil clearances of the remaining crankpin journals.

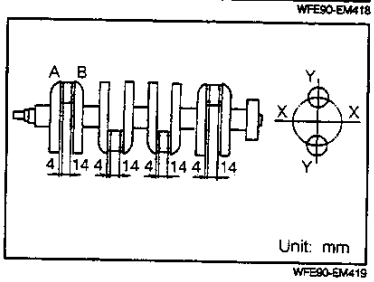
4. Selection of connecting rod bearings
NOTE:
- The replacement of the connecting rod bearings should be performed after all inspections have been finished.

(1) Read the connecting rod big end bore code number.
NOTE:
- The connecting rod big end bore code number comes in three kinds of 4, 5 and 6.



WFE90-EM418

(2) Measure the diameter of the crankpin journal.
The measurement should be performed at four points, 90 degrees spaced, for each crankpin journal at the points shown in the right figure. The maximum value is regarded as the crankpin journal diameter.
However, if the variation in the measured diameters exceeds 0.044 mm, replace the crankshaft.



WFE90-EM419

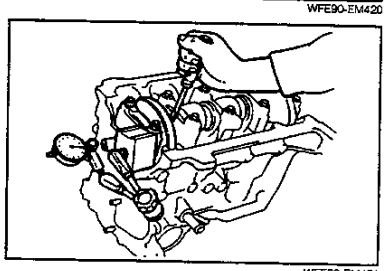
(3) Select the connecting rod bearing or replace the crankshaft, based on the results of (1) and (2).

Connecting rod big end bore code number	Crankpin journal diameter mm	Bearing classification number (color)	Remarks
4	44.993 - 45.000	1 (Yellow)	—
	44.985 - 44.992	2 (Green)	—
	44.976 - 44.984	3 (Brown)	—
	44.975 or less	—	Crankshaft replacement
5	44.993 - 45.000	2 (Green)	—
	44.985 - 44.992	3 (Brown)	—
	44.976 - 44.984	4 (Black)	—
	44.975 or less	—	Crankshaft replacement
6	44.993 - 45.000	3 (Brown)	—
	44.985 - 44.992	4 (Black)	—
	44.976 - 44.984	5 (Blue)	—
	44.975 or less	—	Crankshaft replacement

WFE90-EM420

5. Check of crankshaft thrust clearance
NOTE:
- Measure the thrust clearance, using a dial gauge.
  Thrust Clearance:
  Specified Value: 0.02 - 0.22 mm
  Allowable Limit: 0.30 mm

If the thrust clearance exceeds the allowable limit, measure the width of the crankshaft thrust bearing contact surface. If the measured value is less than 39.92 mm, replace the thrust washer. If the measured value exceeds 39.92 mm, replace the crankshaft and thrust washer.

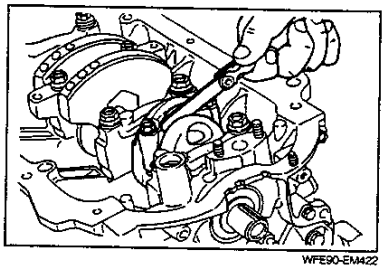


WFE90-EM421

6. Measurement of connecting rod thrust clearance
Measure the thrust clearance between the connecting rod and the crankshaft, using a thickness gauge.
Thrust clearance:
Standard: 0.15 - 0.40 mm
Maximum: 0.45 mm

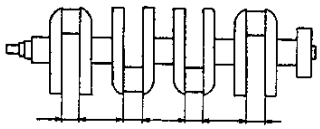
NOTE:
- The thrust clearance should be measured while the connecting rod is being pushed against either side of the crankshaft in the axial direction.
- Measure the thrust clearance at the opposite side.

If the clearance exceeds the specified value, replace the connecting rod or the crankshaft, or both of them, referring to the width of the big end of the connecting rod in the thrust direction and the side width of the crankpin journal.



WFE90-EM422

Reference

Width of big end of connecting rod in thrust direction	Side width of crankpin
21.80 - 21.85 mm	22.0 - 22.2 mm
	Crankshaft 

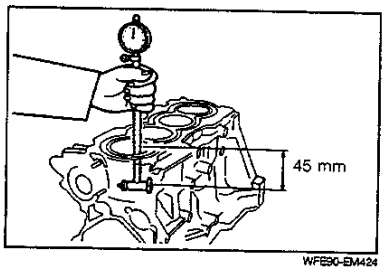
WFE90-EM423

CYLINDER BORING

NOTE:
- When the cylinder is bored, all cylinders should be bored at the same time.
- As for piston rings, use oversized piston rings.

WFE90-EM802

1. Measurement of cylinder bore diameter
   Measure the diameter at a point 45 mm from the cylinder upper surface in the direction shown in the right figure.
   If the measured value exceeds 76.28 mm, replace the cylinder block.



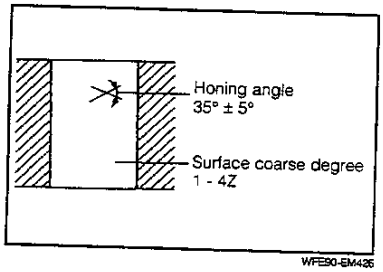
WFE90-EM424

2. Determining cylinder finishing diameter
   (1) Measure the diameter of the oversized piston to be used, using a micrometer.
   NOTE:
   - The measurement should be conducted at the skirt section 13 mm from the piston lower end.
   - Perform the measurement horizontally, not in a tilted state.

   (2) Calculate the finishing dimension, as follows.
   A: Piston diameter
   B: Piston-to-cylinder bore clearance
   0.025 - 0.045 mm
   C: Honing allowance
   0.02 mm
   D: Finishing diameter
   D = A + B – C

WFE90-EM425

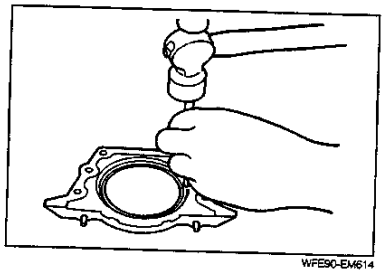
3. Hone the cylinder after the boring.
   (1) Bore the cylinder, leaving a honing allowance of 0.02 mm.
   (2) Hone the cylinder.
   Honing Angle: 35 ± 5°
   Surface Coarse Degree: 1 - 4Z



WFE90-EM426

REPLACEMENT OF REAR OIL SEAL

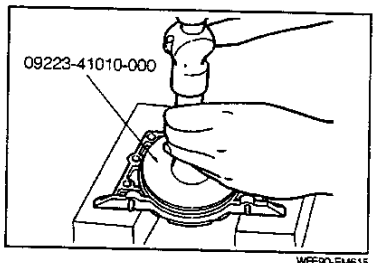
1. Removal of rear oil seal
   Remove the rear oil seal from the rear oil seal retainer, using a pin punch.
   NOTE:
   - Be very careful not to damage the oil seal retainer.



WFE90-EM614

2. Installation of rear oil seal
   Drive a new rear oil seal into position, using the following SST.
   SST: 09223-41010-000

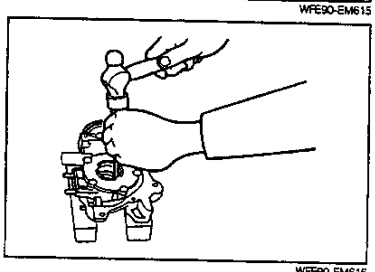
   NOTE:
   - Care must be exercised to ensure that the oil seal is not driven in a tilted state.



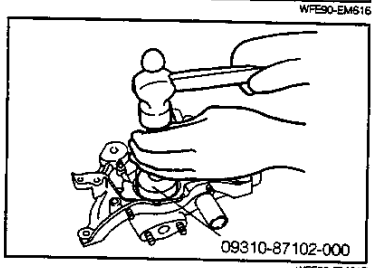
WFE90-EM615

REPLACEMENT OF FRONT OIL SEAL

1. Removal of front oil seal
   Remove the front oil seal from the oil pump, using a pin punch.
   NOTE:
   - Be very careful not to damage the oil pump during the removal.


WFE90-EM616

2. Installation of front oil seal
   Drive a new front oil seal into position, using the following SST.
   SST: 09310-87102-000

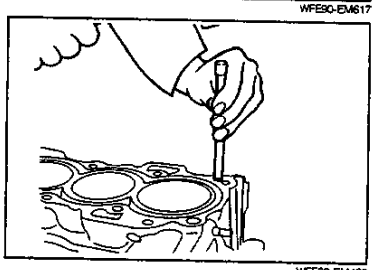


WFE90-EM617

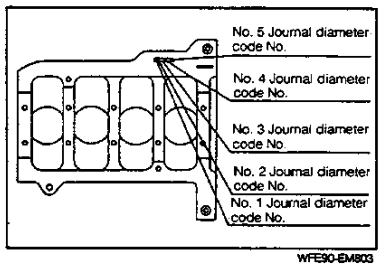
REPLACEMENT OF CYLINDER BLOCK

NOTE:
- The cylinder block is furnished along with the pistons as a set. Hence, make sure that each piston is installed in the mated cylinder bore.

1. Wash the cylinder block using cleaning solvent.
2. Drive the oil orifice until it is recessed 3.0 ± 1.0 mm from the cylinder upper surface.
   NOTE:
   - For driving this oil orifice, use an iron rod having an outer diameter of 10 mm.

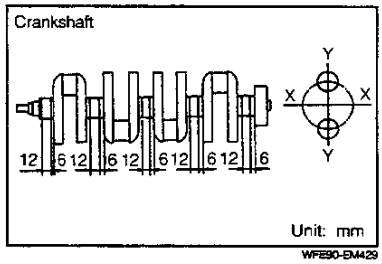

WFE90-EM428

3. Selection of crankshaft bearings
   (1) Read the crankshaft journal diameter code number on the cylinder block.



WFE90-EM803

   (2) Measure the main journal diameter of the crankshaft at those points indicated in the right figure.
      - The measurement should be conducted in four directions for each main journal, 90-degrees spaced, at those points indicated in the right figure.



WFE90-EM429

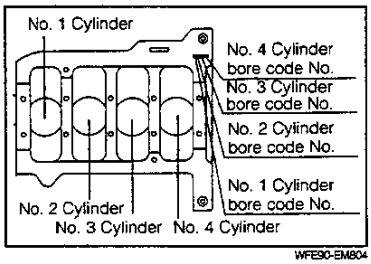
   (3) Select the crankshaft bearings in accordance with the table in the next page.

WFE90-EM430

Main journal hole code	Main journal diameter mm	Crankshaft bearing classification No. (color)	Remarks
5	50.000 - 49.995	1 (Yellow)	—
	49.994 - 49.989	2 (Green)	—
	49.988 - 49.983	3 (Brown)	—
	49.982 - 49.976	4 (Black)	—
	49.975 or less	—	Crankshaft replacement
6	50.000 - 49.995	2 (Green)	—
	49.994 - 49.989	3 (Brown)	—
	49.988 - 49.983	4 (Black)	—
	49.982 - 49.976	5 (Blue)	—
	49.975 or less	—	Crankshaft replacement
7	50.000 - 49.995	3 (Brown)	—
	49.994 - 49.989	4 (Black)	—
	49.988 - 49.983	5 (Blue)	—
	49.982 - 49.976	6 (White)	—
	49.975 or less	—	Crankshaft replacement
8	50.000 - 49.995	4 (Black)	—
	49.994 - 49.989	5 (Blue)	—
	49.988 - 49.983	6 (White)	—
	49.982 - 49.976	7 (Pink)	—
	49.975 or less	—	Crankshaft replacement

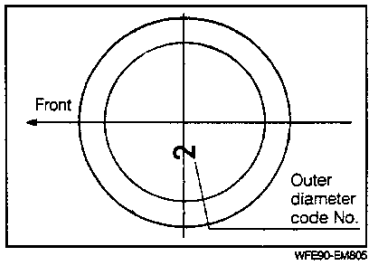
WFE90-EM431

4. Selection of pistons (reference)
   (1) Read the cylinder block bore code number.



WFE90-EM804

   (2) Select a piston having the same classification number as the cylinder block bore code number.
   NOTE:
   - The piston code number is stamped on the top of each piston.



WFE90-EM805

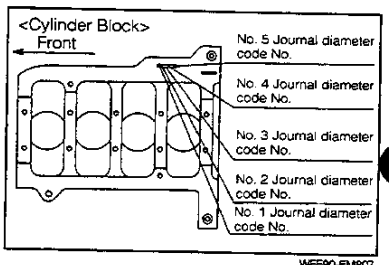
REPLACEMENT OF CRANKSHAFT

(Replacement of the crankshaft only)

1. Wash the crankshaft using cleaning solvent. Dry it with compressed air.
   NOTE:
   - Make sure that the oil gallery exhibits no restriction due to rust-proof oil.

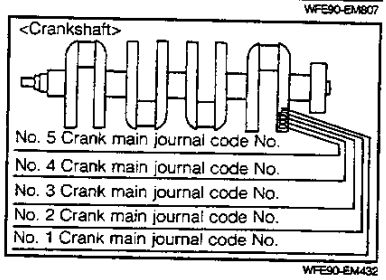
WFE90-EM806

2. Selection of crankshaft bearings
   (1) Read the crankshaft journal diameter code number of the cylinder block.



WFE90-EM807

   (2) Read the crankshaft main journal diameter code number.



WFE90-EM432

   (3) Establish the crankshaft bearing classification number, using the table below.

Cylinder block \ Crankshaft		Crankshaft journal			
		1	2	3	4
Main journal diameter code No.	5	4	3	2	1
	6	5	4	3	2
	7	6	5	4	3
	8	7	6	5	4

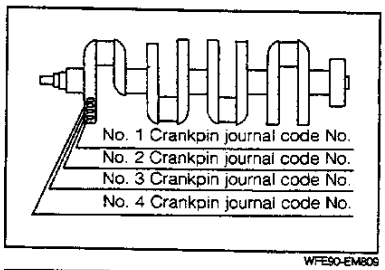
WFE90-EM433

Reference

Bearing classification No.	1	2	3	4	5	6	7
Identification color	Yellow	Green	Brown	Black	Blue	White	Pink

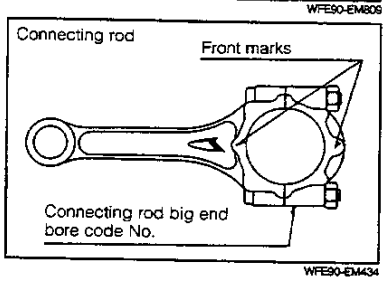
WFE90-EM808

3. Selection of connecting rod bearings
   (1) Read the crankpin journal diameter code number.



WFE90-EM809

   (2) Read the connecting rod big end bore code number.



WFE90-EM434

   (3) Establish the classification number of the connecting rod bearing, using the table below.

Connecting rod \ Crankshaft		Crankpin journal diameter code No.		
		1	2	3
Connecting rod big end borecode No.	4	3	2	1
	5	4	3	2
	6	5	4	3

WFE90-EM810

Reference

Bearing classification No.	1	2	3	4	5
Identification color	Yellow	Green	Brown	Black	Blue

WFE90-EM811

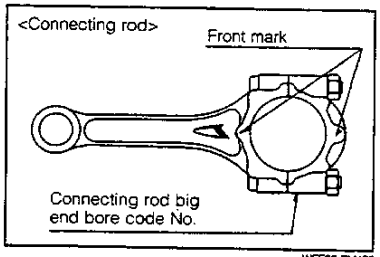
REPLACEMENT OF CONNECTING RODS

1. Wash the connecting rods using cleaning solvent.

WARNING:
- Be sure to protect your eyes, wearing goggles.

WFE90-EM812

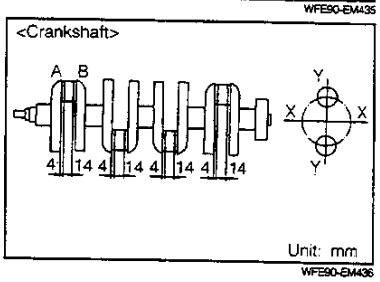
2. Selection of connecting rod bearings
   (1) Read the connecting rod bid end bore code number.



WFE90-EM435

   (2) Measure the crankshaft pin diameter of the crankshaft in four directions for each crankshaft pin, 90-degrees spaced, at those points indicated in the right figure.

NOTE:
- The greatest value among the measured diameters is regarded as the crankpin journal diameter.
- However, if the difference among the measured values exceeds 0.044 mm, replace the crankshaft.



WFE90-EM436

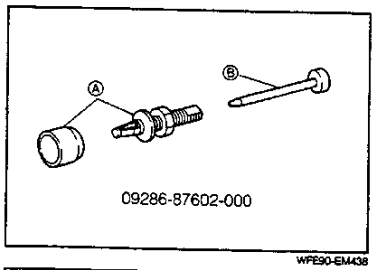
   (3) Select the connecting rod bearing in accordance with the table below.

Connecting rod big end bore code No.	Crankpin journal diameter mm	Connecting rod bearing classification No. (color)	Remarks
4	45.000 - 44.993	1 (Yellow)	—
	44.992 - 44.985	2 (Green)	—
	44.984 - 44.976	3 (Brown)	—
	44.975 or less	—	Crankshaft replacement
5	45.000 - 44.993	2 (Green)	—
	44.992 - 44.985	3 (Brown)	—
	44.984 - 44.976	4 (Black)	—
	44.975 or less	—	Crankshaft replacement
6	45.000 - 44.993	3 (Brown)	—
	44.992 - 44.985	4 (Black)	—
	44.984 - 44.976	5 (Blue)	—
	44.975 or less	—	Crankshaft replacement

WFE90-EM437

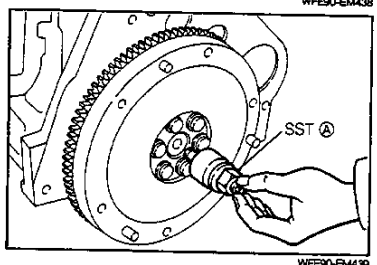
REPLACEMENT OF CRANKSHAFT REAR END BEARING

1. Remove the crankshaft rear end bearing, using the following SST.
   SST: 09286-87602-000



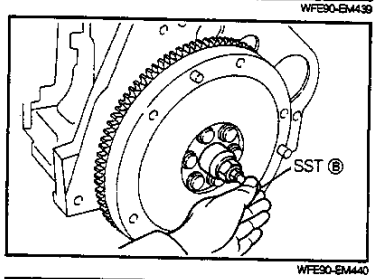
WFE90-EM438

(1) Insert the SST Ⓐ into the crankshaft rear end bearing.



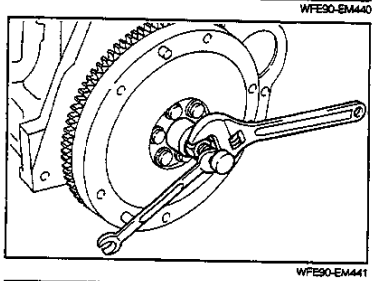
WFE90-EM439

(2) Insert the SST Ⓑ into the SST Ⓐ.

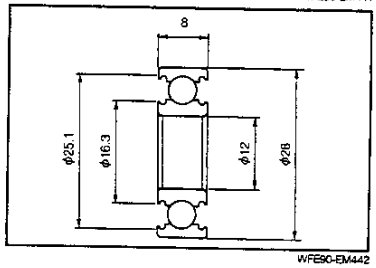


WFE90-EM440

(3) While holding the SST Ⓐ by means of a wrench or the like, tighten the nut. Then, remove the rear end bearing.

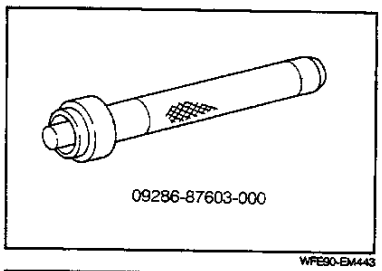

WFE90-EM441

2. Inspect the crankshaft rear end bearing for damage or wear.



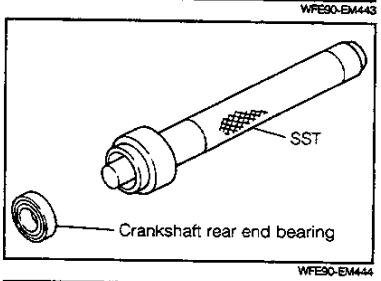
WFE90-EM442

3. Install the crankshaft rear end bearing, using the following SST.
   SST: 09286-87603-000



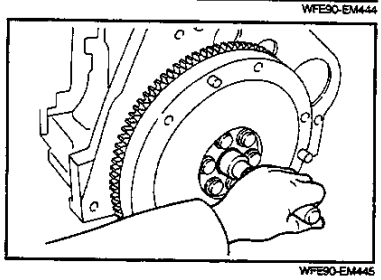
WFE90-EM443

   (1) Install the crankshaft rear end bearing to the SST.



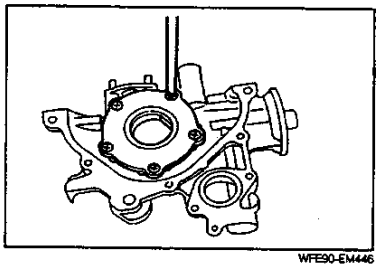
WFE90-EM444

   (2) Press the crankshaft rear end bearing into the crankshaft rear end.
   NOTE:
   - Be sure to press the bearing, until the end surface of the SST contacts with the crankshaft rear end section.
   - When pressing the bearing, be very careful not to allow the bearing to tilt.

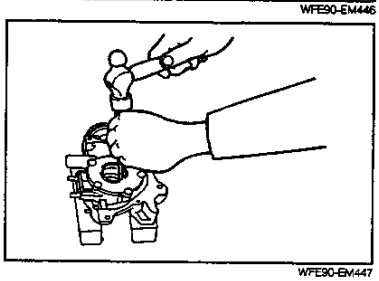

WFE90-EM445

DISASSEMBLY OF OIL PUMP

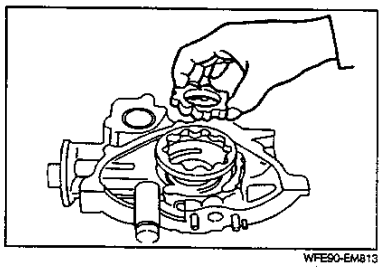
1. Detach the oil pump cover.
   Disconnect the five attaching bolts.


WFE90-EM446

2. Remove the front oil seal.

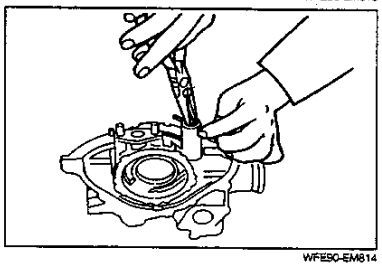

WFE90-EM447

3 Remove the oil pump rotor set.



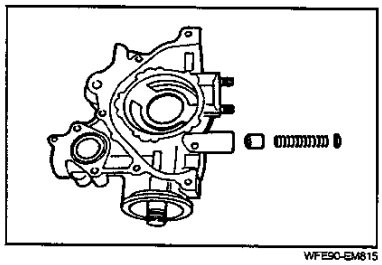
WFE90-EM813

4. Pull out the cotter pin, while pushing the spring retainer with nose pliers or the like.
   NOTE:
   - Put an appropriate cloth, etc. on the retainer spring so that it may not jump out.



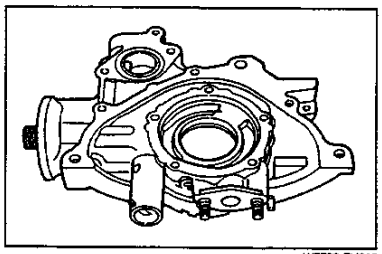
WFE90-EM814

5. Remove the oil pump relief valve spring retainer, compression spring and oil pump relief valve.
   NOTE:
   - Wash the disassembled parts in cleaning solvent.



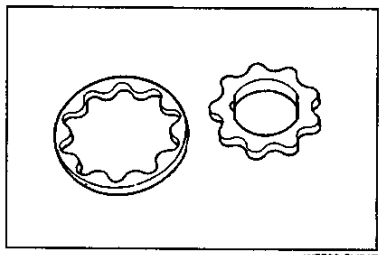
WFE90-EM815

6. Inspection of each part
   (1) Check the pump body for damage.
   Replace the pump body if it exhibits damage.



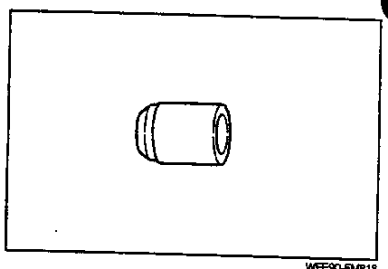
WFE90-EM816

   (2) Check the rotor set for damage.
   Replace the rotor set if it exhibits damage.



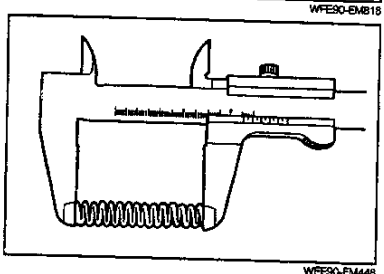
WFE90-EM817

(3) Check the oil pump relief valve for damage.
Replace the relief valve if it exhibits damage. Also, check to see if any damage is present at the relief valve installation hole of the oil pump body.

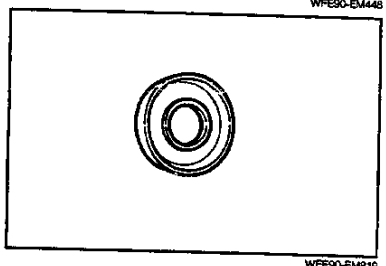

WFE90-EM818

(4) Check the compression spring for damage. Also, measure its free length.
Specified Free Length: 57 mm

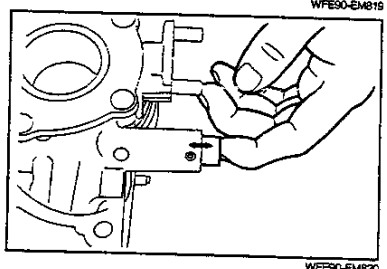
Replace the compression spring if it exhibits damage or the free length is less than the specified value.


WFE90-EM448

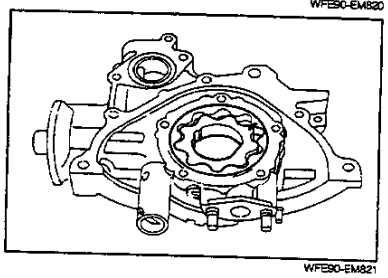
(5) Check the oil pump relief valve spring retainer for damage.
Replace the retainer if it exhibits damage.


WFE90-EM819

(6) Apply engine oil to the oil pump relief valve. Insert the oil pump relief valve into the oil pump body. Check to see if the valve slides smoothly.
Replace the oil pump body if the valve fails to slide smoothly.

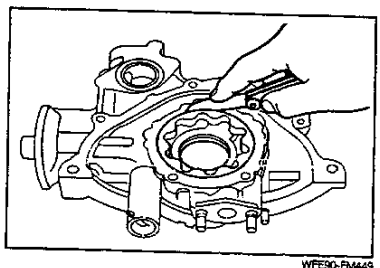

WFE90-EM820

7. Measurement of body clearance, tip clearance and side clearance
   (1) Apply a thin film of engine oil to the rotor mate surface of the oil pump body as well as to the rotor set. Assemble the rotor set in the oil pump body in such a way that the drilled mark may be seen from the outside.


WFE90-EM821

(2) Measure the body clearance between the oil pump body and the outer rotor, using a thickness gauge.
Body Clearance: 0.20 - 0.28 mm

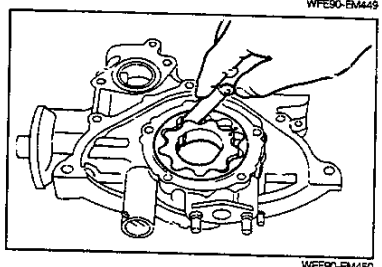
Replace the oil pump if the body clearance exceeds the specified value.



WFE90-EM449

(3) Measure the tip clearance of the rotor set, using a thickness gauge.
Tip Clearance: 0.16 - 0.24 mm

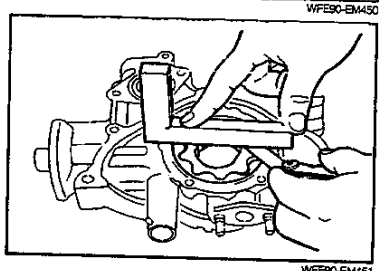
Replace the rotor set if the tip clearance exceeds the specified value.



WFE90-EM450

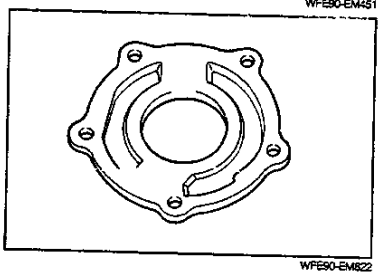
(4) Measure the side clearance between the oil pump body and the rotor set, using a straightedge and a thickness gauge.
Side Clearance: 0.035 - 0.085 mm

Replace the oil pump if the side clearance exceeds the specified value.



WFE90-EM451

8. Check to see if any wear is present at the rotor set mate surface of the pump cover.
Replace the oil pump cover if it exhibits wear.



WFE90-EM822

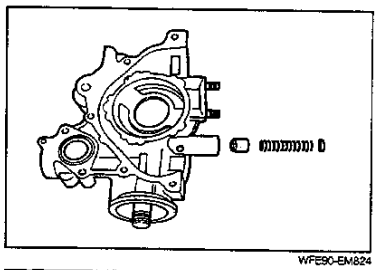
ASSEMBLY OF OIL PUMP

NOTE:
- Wash those parts to be assembled in cleaning solvent. Dry them using compressed air.

WARNING:
- When you use compressed air, be sure to protect your eyes, wearing goggles.

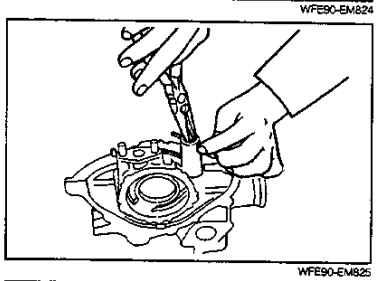
WFE90-EM823

1. Apply engine oil to the relief valve. Then, insert the relief valve into the oil pump body.
2. Insert the compression spring and retainer into the oil pump body.
   NOTE:
   - Install the retainer in such a direction that its projected side may come at the compression spring side.



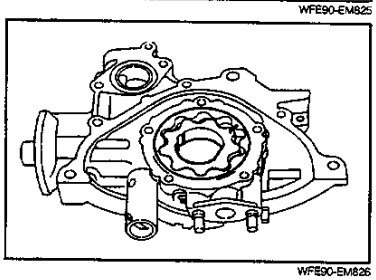
WFE90-EM824

3. Insert a new cotter pin into the retainer while the retainer is being compressed with pliers, etc. Split the end of the cotter pin to form an anchor-like shape.



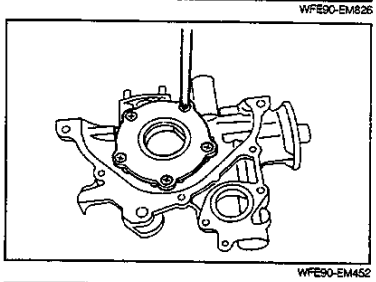
WFE90-EM825

4. Apply engine oil to the rotor set. Assemble the rotor set in the pump body in such a direction that the drilled mark of the rotor may be seen from the outside.



WFE90-EM826

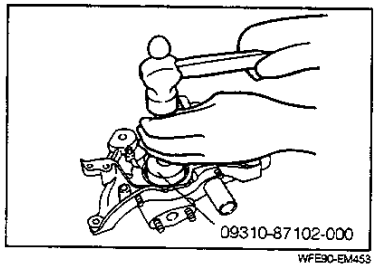
5. Install the oil pump cover. Tighten the cover to the specified torque.
   Tightening Torque: 7.8 - 12.7 N·m (0.8 - 1.3 kgf-m)



WFE90-EM452

6. Drive a new oil seal into position, using the following SST.
   SST: 09310-87102-000

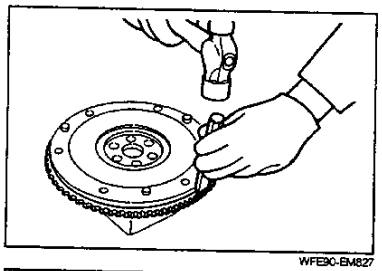
   NOTE:
   - Be very careful not to damage the oil pump during the installation.
   - Make sure that the oil seal is not driven into position in a tilted state.



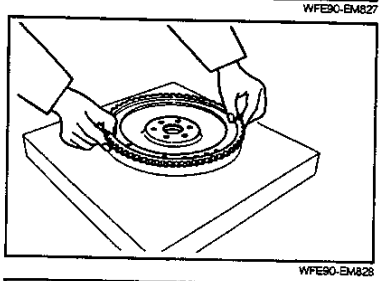
WFE90-EM453

REMOVAL/INSTALLATION OF RING GEAR

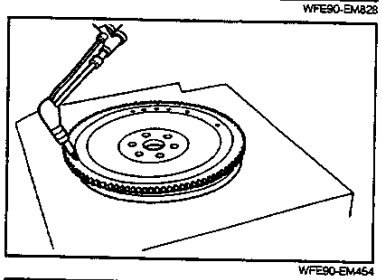
1. Place the ring gear on an adequate wooden block. Drive out the ring gear, using a chisel in combination with a hammer.


WFE90-EM827

2. Place a new ring gear horizontally on the flywheel.


WFE90-EM828

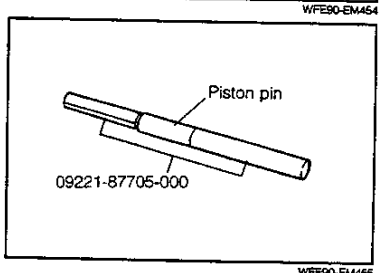
3. Using a gas burner, heat the ring gear evenly, until the ring gear due to its own weight fits onto the flywheel .
   NOTE:
   - Do not tap the ring gear using a hammer or the like.
   - Never cool the ring gear quickly using water or the like.


WFE90-EM454

4. Allow the ring gear to cool naturally.

ASSEMBLY OF PISTON AND CONNECTING ROD

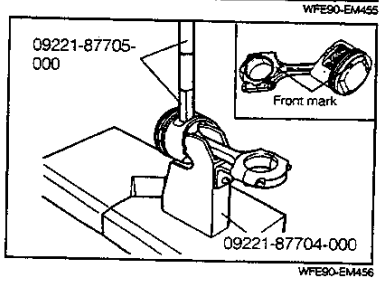
1. Install the piston pin to the following SST in a way shown in the right figure.
   SST: 09221-87705-000



WFE90-EM455

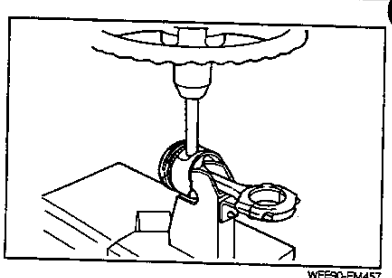
2. Install the piston and connecting rod in the SST in a way shown in the right figure. Insert the SST installed with the piston pin into the piston pin hole.
   SST: 09221-87704-000
   09221-87705-000

   NOTE:
   - The piston and connecting rod should be assembled in such a way that the piston front mark and connecting rod front mark come in the same direction.



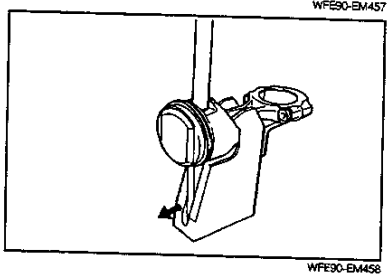
WFE90-EM456

3. Press the piston pin into the piston and connecting rod, using a hydraulic press.



WFE90-EM457

4. Remove the piston and connecting rod assembly from the SST. Remove the SST from the piston pin.



WFE90-EM458

ASSEMBLY OF CYLINDER BLOCK

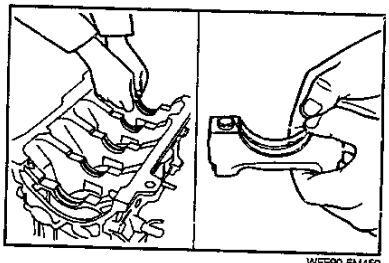
NOTE:

- As for those parts to be reassembled, wash them in cleaning solvent (excluding those parts, such as grease-sealed type bearings, dust seals and electrical parts). Then, dry them using compressed air.
- Remove any remaining sealer, etc. from the threaded portions of the switches and sensors.

WFE90-EM829

1. Installation of crankshaft
   (1) Install the bearings to the cylinder block and crankshaft bearing caps.

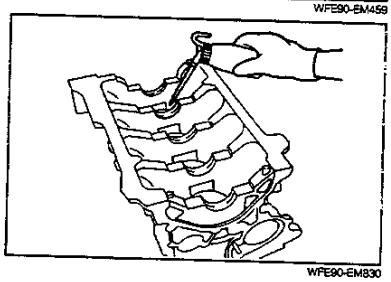
   NOTE:
   - Do not touch with the front and back surfaces of each bearing. Be sure to hold the bearing at its edge surfaces.



WFE90-EM459

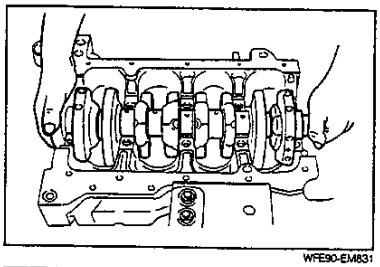
   (2) Lubricate the surface of each bearing with engine oil.

   NOTE:
   - Do not touch with the front and back surfaces of each bearing.
   - Never apply engine oil to the crankshaft bearing caps.



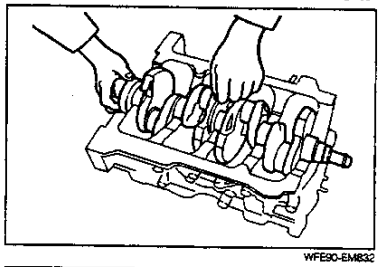
WFE90-EM830

(3) Install the crankshaft in the cylinder block.



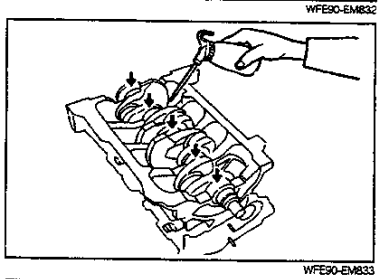
WFE90-EM831

(4) Apply engine oil to the thrust washers. With the side having the oil groove facing toward the crankshaft side, insert each thrust washer between the crankshaft main journal No. 3 and the cylinder block.



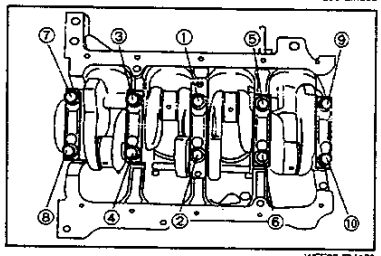
WFE90-EM832

(5) Apply engine oil to the crankshaft main journal sections.
NOTE:
- Care must be exercised to ensure that no oil flows into the bearing cap attaching bolt holes.



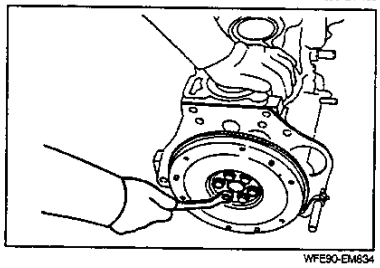
WFE90-EM833

(6) Install the crankshaft bearing caps with the arrow marks facing toward the oil pump side and also in the numerical sequence.
(7) Thinly apply engine oil to the crankshaft bearing cap bolts. Tighten the bolts to the specified torque over two or three stages in the sequence shown in the right figure.
Tightening Torque: 44.1 - 53.9 N·m (4.5 - 5.5 kgf-m)



WFE90-EM460

2. Assembly of piston and connecting rod
Install the flywheel on the crankshaft temporarily.
NOTE:
- Care must be exercised to ensure that no oil, etc. gets to the bolts or bolt holes.

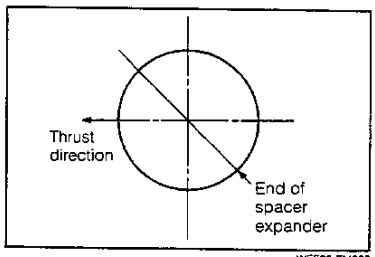


WFE90-EM834

(1) Install the oil ring spacer expander in the oil ring groove. Ensure that the expander end may not line up with the thrust direction nor with the axial direction.

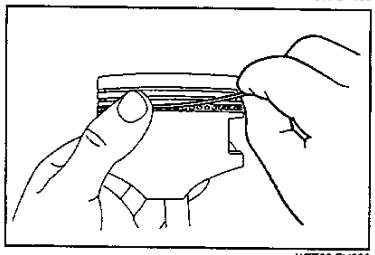
NOTE:

- **Do not expand the spacer expander to an extent more than necessary.**



WFE90-EM835

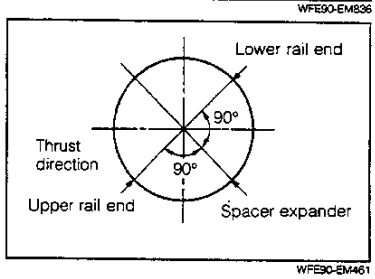
(2) Fit the upper rail into position in such a manner that it is wound up while pushing the edge section of the oil ring spacer expander with your thumb.



WFE90-EM836

NOTE:

- **Ensure that the rail end is deviated 90-degrees to the left from the end of the oil ring spacer expander.**
- **Do not expand the rail to an extent more than necessary.**

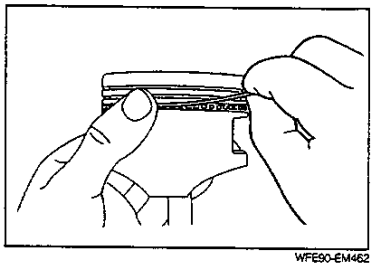


WFE90-EM461

(3) Fit the lower rail into position in such a manner that it is wound up.

NOTE:

- **Ensure that the rail end is deviated 90-degrees to the right from the end of the oil ring spacer expander.**
- **Do not expand the rail to an extent more than necessary.**
- **Make sure that the oil ring can be rotated smoothly.**



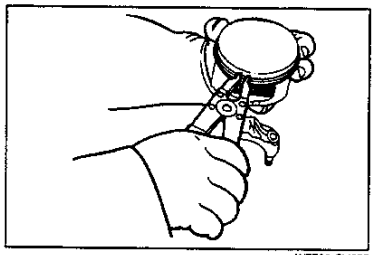
WFE90-EM462

(4) Install the compression ring No. 2 with the stamped mark of T, 2T, N or 2N facing upward, using a piston ring expander.

NOTE:

- **Do not expand the piston ring to an extent more than necessary.**

(5) Install the compression ring No. 1 with the stamped mark of T or N facing upward, using a piston ring expander.

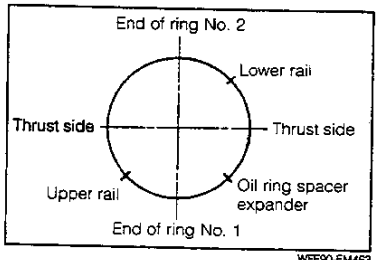


WFE90-EM837

(6) Position the piston rings so that each ring end may come at the respective points as indicated in the right figure.

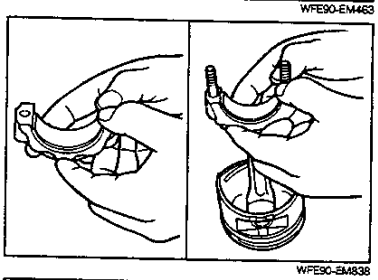
NOTE:

- **It is not necessarily required to follow strictly the right figure. However, be sure that the ring end is not lined up with the thrust direction. Also, each ring should be deviated about 120 to 180 degrees from the adjacent ring.**



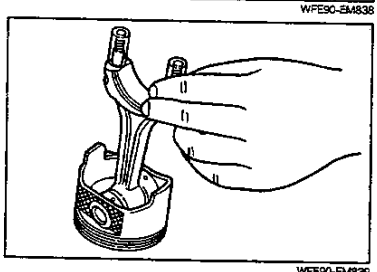
WFE90-EM463

(7) Install the connecting rod bearings on the connecting rod and connecting rod cap, making sure that your fingers will not touch with the front and back surfaces of the bearings.



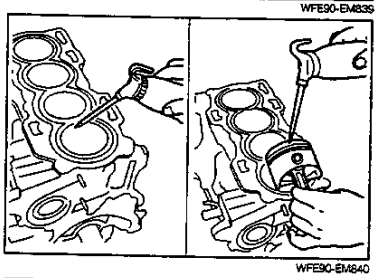
WFE90-EM838

(8) Cut an appropriate vinyl hose to a suitable length. Fit the vinyl hose to each connecting rod bolt sections.



WFE90-EM839

(9) Apply engine oil to the piston rings, piston pins, connecting rod bearings, cylinder walls and crankpin journals.



WFE90-EM840

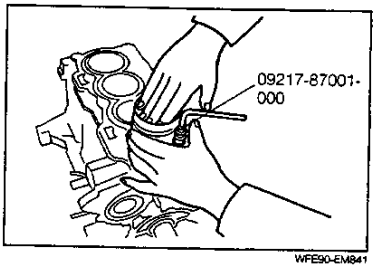
(10) Compress the piston rings by means of the piston ring compressor SST, making sure that the piston ring ends will not move during the installation.
SST: 09217-87001-000

(11) Push the piston by hand into the cylinder bore with the front mark facing toward the oil pump side.

NOTE:

- **Be very careful to avoid damaging the connecting rod bearings during the installation.**
- **Care must be exercised to ensure that the crankpin journal is not scratched by the connecting rod.**

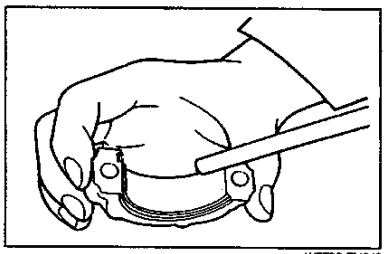
(12) Push the piston by hand until the connecting rod reaches the crankpin journal.



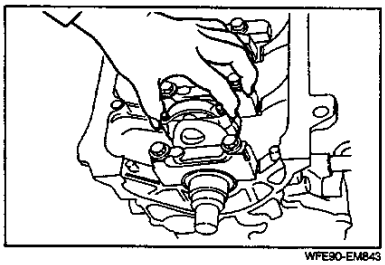
WFE90-EM841

(13) Apply engine oil to the bearing surface of each connecting rod bearing.
NOTE:
- **Do not touch with the bearing front surface.**

(14) Remove the vinyl hoses which were attached to the connecting rod bolt sections.


WFE90-EM842

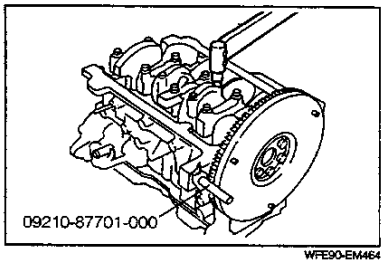
(15) Install the connecting rod cap with the front mark facing toward the oil pump side.


WFE90-EM843

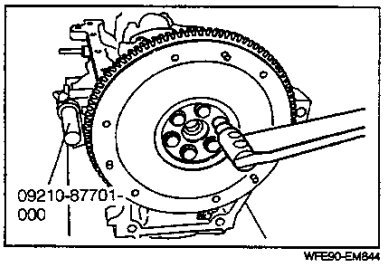
(16) Prevent the crankshaft from turning, using the following SST.
SST: 09210-87701-000

(17) Thinly apply engine oil to the connecting rod cap attaching nuts. Tighten the nuts to the specified torque evenly over two or three stages.
Tightening Torque: 34.3 - 44.1 N·m (3.5 - 4.5 kgf-m)

(18) Perform the operations described in the steps (1) through (18) for each cylinder.
(19) Remove the flywheel.
(20) Remove the following SST.
SST: 09210-87701-000

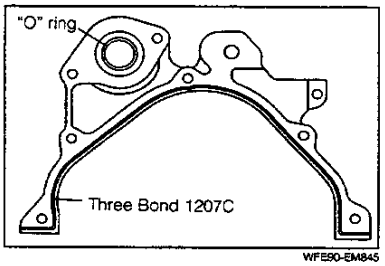


WFE90-EM464



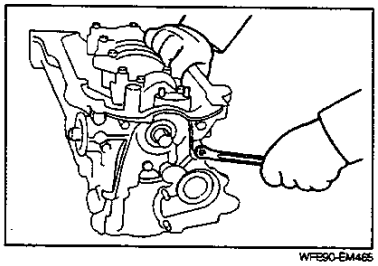
WFE90-EM844

3. Installation of oil pump
   (1) Apply the Three Bond 1207C to the oil pump installation surface of the cylinder block, as indicated in the right figure.
   (2) Replace the "O" ring of the oil pump with a new part.



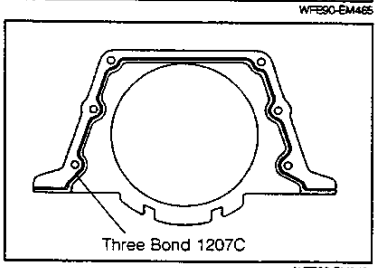
WFE90-EM845

(3) Apply engine oil to the inner surface of the oil seal. Install the oil pump to the cylinder block. Tighten the seven attaching bolts to the specified torque.
Tightening Torque: 5.9 - 8.8 N·m (0.6 - 0.9 kgf-m)



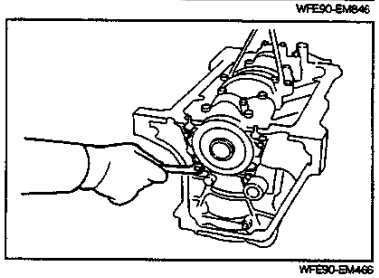
WFE90-EM465

4. Installation of oil seal retainer
   (1) Apply the Three Bond 1207C to the oil seal retainer installation surface of the cylinder block, as indicated in the right figure.



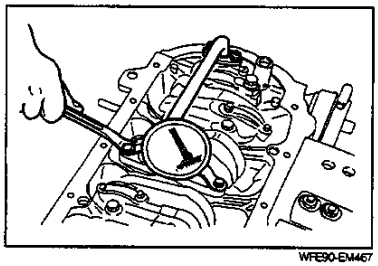
WFE90-EM846

   (2) Apply engine oil to the inner surface of the oil seal. Install the oil seal retainer to the cylinder block. Tighten the four attaching bolts to the specified torque.
   Tightening Torque: 5.9 - 8.8 N·m (0.6 - 0.9 kgf-m)



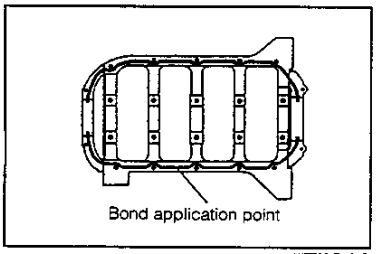
WFE90-EM466

5. Install the oil strainer with a new gasket interposed. Tighten the two oil strainer nuts and two bolts to the specified torque.
   Tightening Torque: 8.8 - 11.8 N·m (0.9 - 1.2 kgf-m)



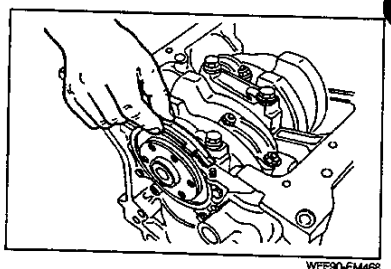
WFE90-EM467

6. Installation of oil pan
   (1) Apply the Three Bond 1207C to the oil pan installation surface of the cylinder block, as indicated in the right figure.

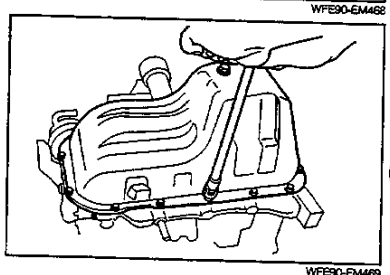


WFE90-EM847

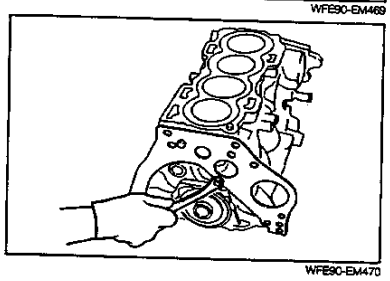
(2) Place the oil pan gasket.
NOTE:
- Ensure that the end section of the oil pan gasket is overlapped at least 10 mm with the Three Bond 1207C.


WFE90-EM468

(3) Install the oil pan. Tighten the four oil pan attaching nuts and ten bolts to the specified torque over two or three stages.
Tightening Torque: 6.9 - 11.8 N·m (0.7 - 1.2 kgf-m)


WFE90-EM469

7. Install the rear end plate.
Tighten the two rear end plate attaching bolts to the specified torque.
Tightening Torque: 9.8 - 14.7 N·m (1.0 - 1.5 kgf-m)

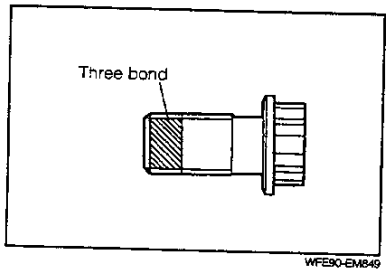

WFE90-EM470

8. Installation of flywheel
(1) Install the flywheel on the crankshaft.

WFE90-EM848

(2) Application of flywheel bolt sealing material
① Wash the flywheel bolts. Then, degrease and dry them.
NOTE:
- When degreasing the bolts, remove any oil completely, using a solvent such as a degreasing spraying agent or alcohol.

CAUTION:
- Make sure that no bond nor other foreign matter, such as dust, gets to the bolts.
- Even when new bolts are used, be sure to perform this operation.



WFE90-EM849

② Check the flywheel bolts for damage. Replace any flywheel bolt which exhibits damage with a new one.
CAUTION:
- Even when a new bolt is used, be sure to perform the operation in the step ①.

③ Clean the flywheel bolt threaded holes at the rear end section of the crankshaft. Degrease and dry them.
CAUTION:
- Make sure that no bond nor other foreign matter, such as dust, gets to the bolt threaded holes.
- As for degreasing, wipe off any oil from the threaded portion with a cloth damped with alcohol.
- Never allow alcohol to get to resin or rubber parts, specifically, the rear oil seal.

④ Clean the bolt seating surface of the flywheel and degrease it.
NOTE:
- As for degreasing, wipe the bolt seating surface with a cloth damped with alcohol.
- Never allow alcohol to get to resin or rubber parts.

⑤ Apply two to three drops of the Three Bond 1324 to the forward end of the threaded portion of each flywheel bolt.
CAUTION:
- If the Three Bond 1324 is applied excessively beyond the specified amount, the bond sealer will penetrate up to the bolt seating surface. This may cause loosening of the bolts.
- Never use bond sealers other than the designated one.
- Never allow the bond sealer to get to resin or rubber parts.

(3) Tighten the flywheel attaching bolts temporarily to the specified torque in the sequence indicated in the right figure.
Tightening Torque: 44.1 - 63.7 N·m (4.5 - 6.5 kgf-m)

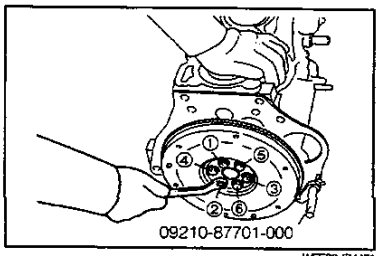
NOTE:
- Prevent the crankshaft from turning at the ring gear section, using the following SST.

SST: 09210-87701-000

WFE90-EM618

CAUTION:
- When tightening the bolt, make sure that no bond is present on the bolt seating surface.
- If the bond oozes out, perform the operations again, starting the step (2).

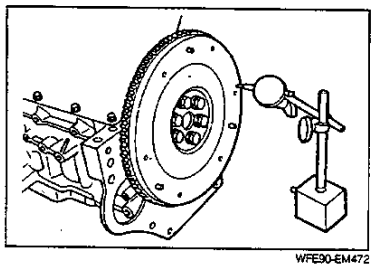
(4) Tighten the flywheel attaching bolts to the specified torque in the sequence indicated in the right figure.
Tightening Torque: 78.5 - 98.0 N·m (8.0 - 10.0 kgf-m)



WFE90-EM471

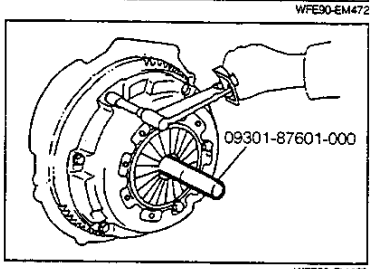
(5) Measure the flywheel runout, using a dial gauge.
Allowable Runout Limit: 0.1 mm

NOTE:
- Replace the flywheel if its runout exceeds the allowable limit.


WFE90-EM472

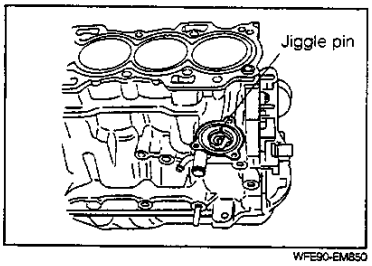
9. Assembly of clutch disc and pressure plate
(1) Insert the following SST into the crankshaft rear end.
SST: 09301-87601-000

(2) Install the clutch disc.
(3) Install the pressure plate, lining up the locating pin of the pressure plate. Tighten the attaching bolts to the specified torque.
Tightening Torque: 14.7 - 21.6 N·m (1.5 - 2.2 kgf-m)



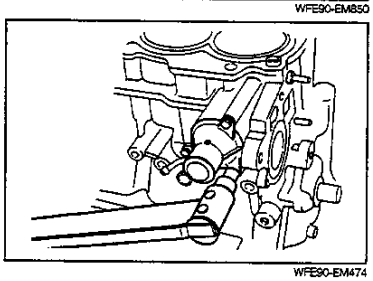
WFE90-EM473

10. Install the thermostat in the cylinder block in such a way that the jiggle pin section may come at the upper side.
CAUTION:
- Make sure to install the jiggle pin of the thermostat in the correct direction. Failure to observe this precaution will be cause of overheating.



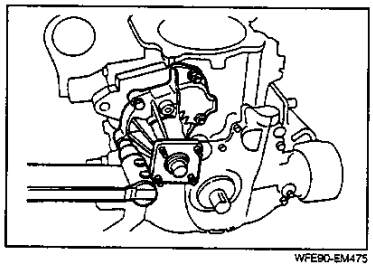
WFE90-EM850

11. Install the water inlet.
Tighten the three water inlet attaching bolts to the specified torque.
Tightening Torque: 5.9 - 8.8 N·m (0.6 - 0.9 kgf-m)

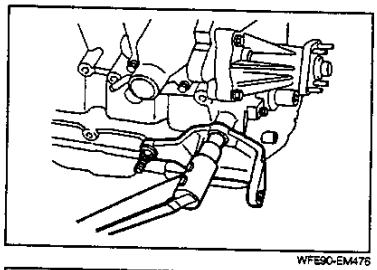

WFE90-EM474

12. Installation of water pump
(1) Install a new water pump gasket on the cylinder block.
(2) Install and tighten the three water pump attaching bolts and two nuts to the specified torque.
Tightening Torque: 14.7 - 21.6 N·m (1.5 - 2.2 kgf-m)

NOTE:
- When the stud bolts have been replaced, apply the Three Bond 1377B to the threaded portion at the cylinder block side.

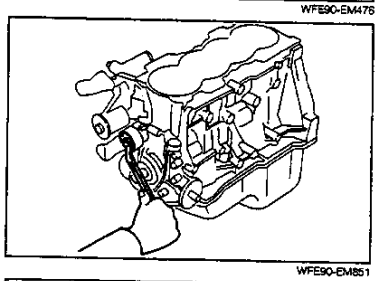

WFE90-EM475

13. Install the alternator bracket.
    Tighten the one alternator bracket attaching bolt and nut to the specified torque.
    Tightening Torque: 34.4 - 49.0 N·m (3.5 - 5.0 kgf-m)



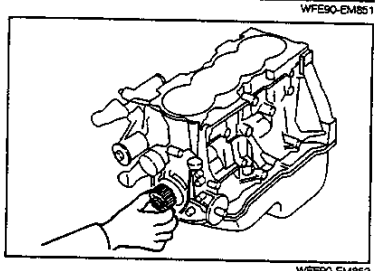
WFE90-EM476

14. Assemble the tensioner tension spring as indicated in the right figure. Push the tensioner to the alternator side as far as it will go. Tighten the tensioner temporarily.



WFE90-EM851

15. Install the crankshaft pulley flange in such a way that its recessed side may come at the cylinder block side.
16. Install the crankshaft timing belt pulley.

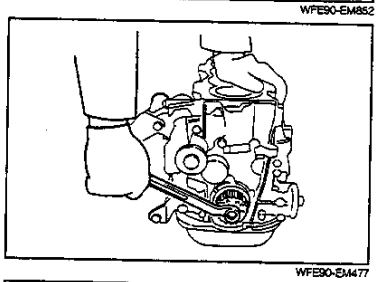


WFE90-EM852

17. Install the crankshaft timing belt attaching bolt. Tighten the bolt to the specified torque.
    Tightening Torque: 88.3 - 98.0 N·m (9.0 - 10.0 kgf-m)

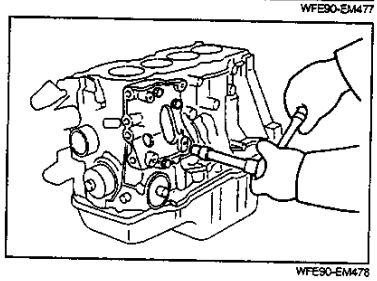
    NOTE:
    - **Prevent the crankshaft from turning, using the following SST.**

    SST: 09210-87701-000



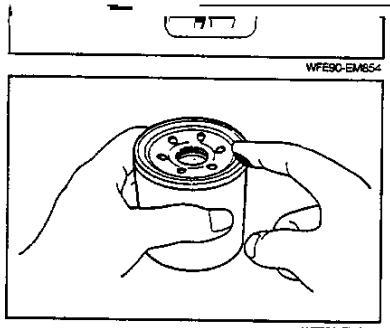
WFE90-EM477

18. Install the compressor mounting bracket.
    (Air conditioner equiped vehicle only)
    Tighten the four compressor mounting bracket attaching bolts to the specified torque.
    Tightening Torque: 29.4 - 44.1 N·m (3.0 - 4.5 kgf-m)

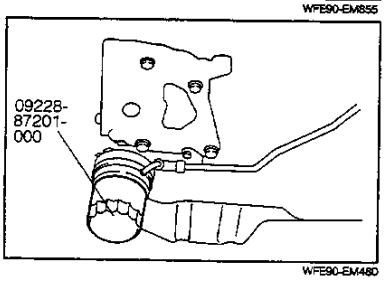


WFE90-EM478

20. Installation of oil filter
    (1) Thinly apply engine oil to the oil seal of the oil filter.

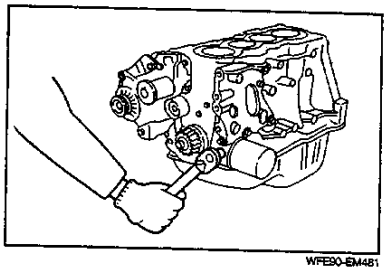

WFE90-EM855

    (2) Screw in the oil filter until the oil seal of the oil filter comes in contact with the oil pump or the contact surface of the oil cooler.
    (3) Then, rotate the oil filter further one complete turn 360-degrees, using the following SST.
    SST: 09228-87201-000



WFE90-EM480

21. Installation of oil pressure switch
    (1) Clean the threaded portion of the oil pressure switch. Wind seal tape around the threaded portion.
    (2) Tighten the oil pressure switch to the specified torque, using a long box wrench having a hexagonal hole.
    Tightening Torque: 11.8 - 19.6 N·m (1.2 - 2.0 kgf-m)



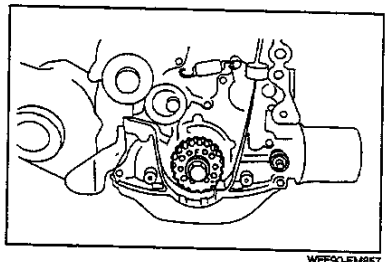
WFE90-EM481

22. Install the alternator.
    At this time, temporarily install the alternator by installing the alternator attaching bolts, adjusting bar, adjusting bar attaching bolt and alternator adjusting bolt.

WFE90-EM856

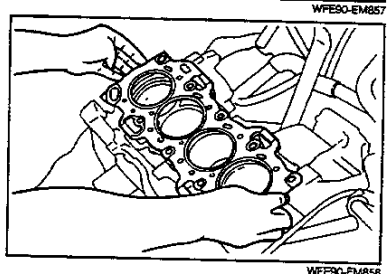
ASSEMBLY OF CYLINDER HEAD

1. Align the stamped mark of the crankshaft timing belt pulley with the indicator of the oil pump.



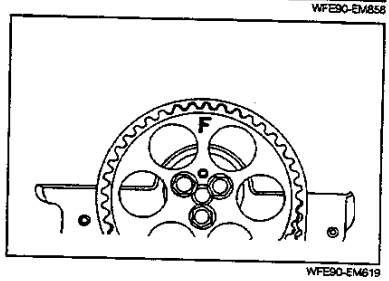
WFE90-EM857

2. Install the cylinder head gasket on the cylinder block.

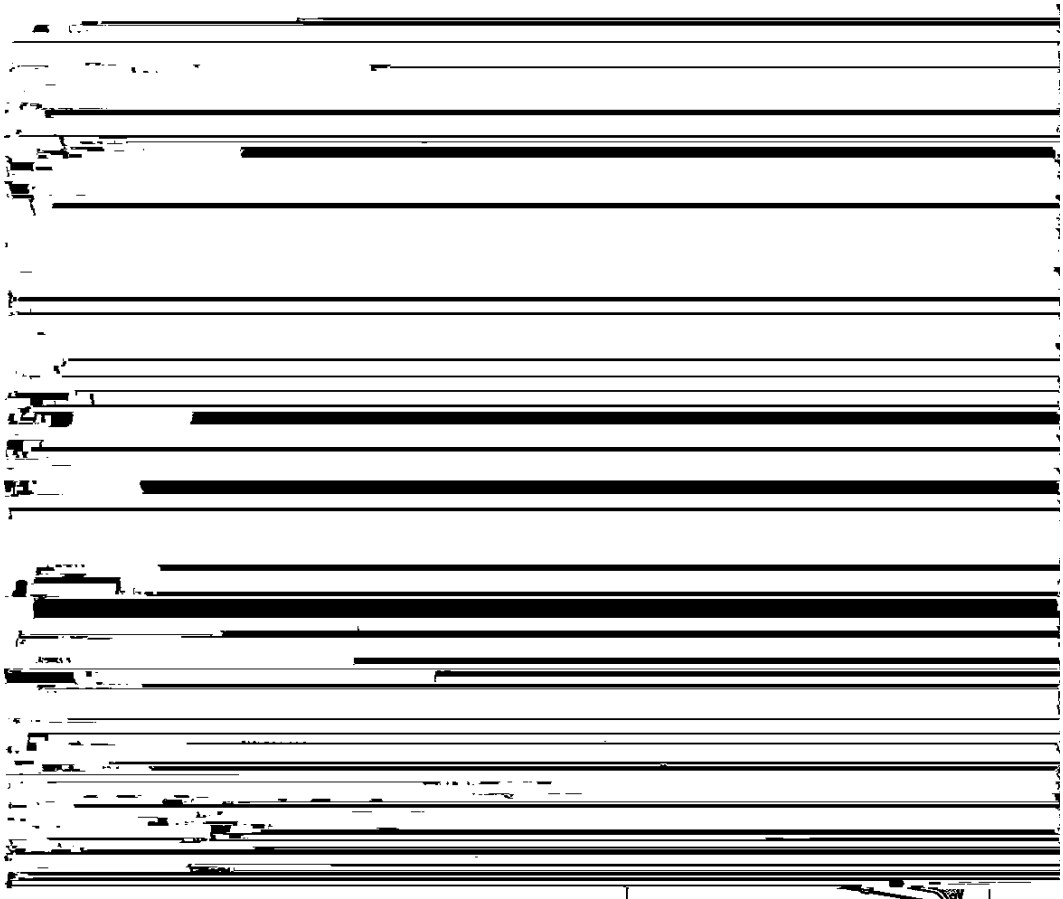


WFE90-EM858

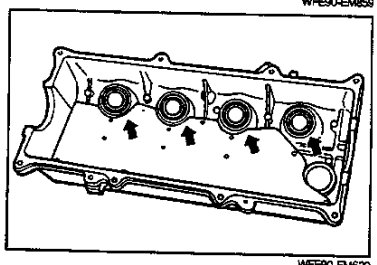
3. Turn the camshaft, until the "F" mark of the camshaft timing belt pulley comes exactly at the top position.
4. Install the cylinder head assembly on the cylinder block.
   NOTE:
   - **Be very careful not to damage the cylinder head gasket and cylinder head gasket surface.**



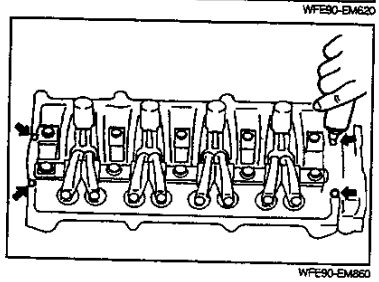
WFE90-EM619



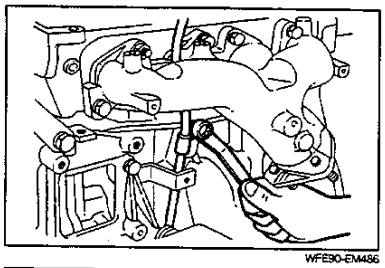
3. Check the spark plug tube grommets for damage. Replace any grommet which exhibits damage.


WFE90-EM620

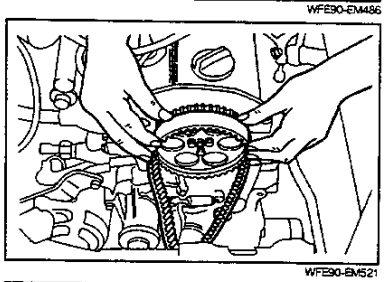
4. Wipe off any oil from the cylinder head cover gasket surface of the cylinder head.
5. Apply the Three Bond 1104 to the mate surface of the cylinder head with the camshaft bearing caps No. 1 and No. 5, but only to those sections which contact the cylinder head gasket.


WFE90-EM860

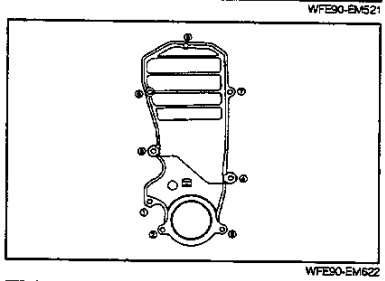
11. Insert the oil level gauge guide into the cylinder block.
12. Install the oil level gauge guide attaching bolts.
    Tightening Torque: 18.6 - 30.4 N·m (1.9 - 3.1 kgf-m)


WFE90-EM486

13. Install the oil level gauge.
14. Installation of timing belt
    (1) Check the timing belt.
    (See page EM–38.)
    (2) Install the timing belt.
    (See page EM–32.)

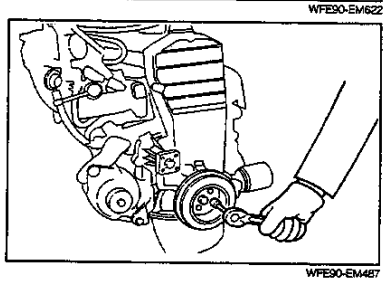

WFE90-EM521

15. Install the timing belt cover.
    (See page EM–45.)

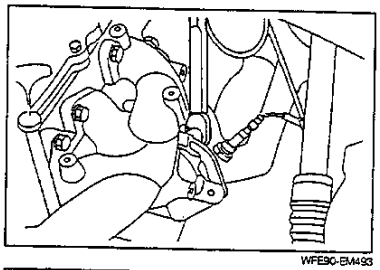

WFE90-EM622

16. Install the crankshaft pulley.
    Tightening Torque: 19.6 - 29.4 N·m (2.0 - 3.0 kgf-m)

    NOTE:
    - Prevent the crankshaft from turning, using the following SST.
      SST: 09210-87701-000

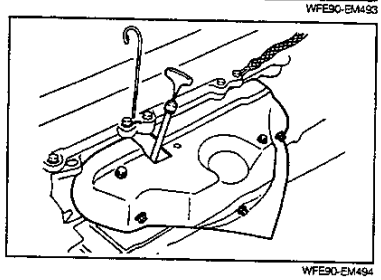

WFE90-EM487

5. Connection of exhaust pipe
   (1) Connect the exhaust pipe to the exhaust manifold with a new gasket interposed.
   Tightening Torque: 34.3 - 49.0 N·m (3.5 - 5.0 kgf-m)



WFE90-EM493

   (2) Install the exhaust manifold cover with the five attaching bolts.
   Tightening Torque: 5.9 - 8.8 N·m (0.6 - 0.9 kgf-m)



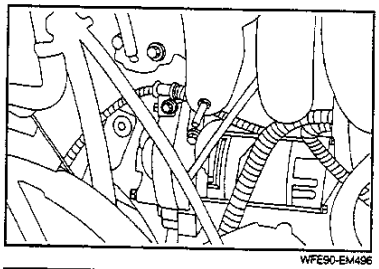
WFE90-EM494

   (3) Connect the exhaust pipe bracket to the side of the transmission.
   Tightening Torque: 15.7 - 21.6 N·m (1.6 - 2.2 kgf-m)

WFE90-EM495

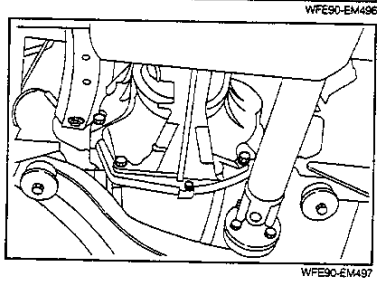
6. Installation of starter
   (1) Install the starter to the engine block with the two attaching bolts.
   Tightening Torque: 49.0 - 68.6 N·m (5.0 - 7.0 kgf-m)

   (2) Connect the connector with lock and the harness clamping bolt.



WFE90-EM496

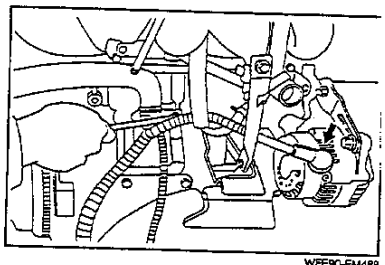
7. Tighten the five attaching bolts between the engine side and the transmission side.
   Tightening Torque: 49.0 - 68.6 N·m (5.0 - 7.0 kgf-m)



WFE90-EM497

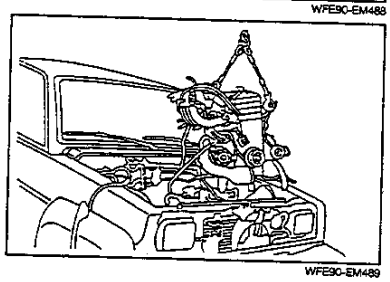
ENGINE INSTALLATION

1. Installation of engine harness onto engine
   (1) Install the engine wire to the engine.
   (2) Connect the engine wire clamp.
   (3) Connect the alternator connector and terminal.



WFE90-EM488

2. Sling the engine, using a chain block. Place the engine in the engine compartment.
   CAUTION:
   - Be very careful not to allow the engine to hit to the vehicle body or other parts.



WFE90-EM489

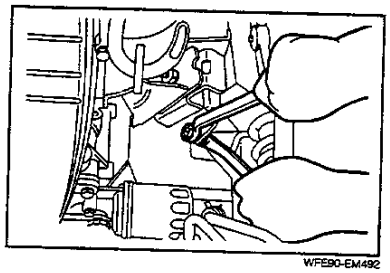
3. Connection of engine and transmission
   (1) Lower the engine down to a height where the engine can be connected to the transmission with ease, using a chain block.
   (2) Carefully bring the engine toward the transmission side. Insert the transmission input shaft into the clutch disc.
   (3) While correcting the angle of the engine, align the attaching bolt holes of the transmission with those of the engine.
   (4) Temporarily connect the engine with the transmission by inserting the attaching bolts so that the transmission may not be detached from the engine.

WFE90-EM490

4. Installation of engine mounting
   (1) Install the engine mounting provided at the left side of the engine to the engine bracket.

WFE90-EM491

   (2) Adjust the engine position. Secure the engine mounting to the engine mounting attaching section at the vehicle body with the four bolts.
   Tightening Torque: 29.4 - 44.1 N·m (3.0 - 4.5 kgf-m)

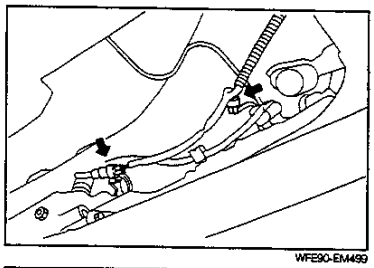


WFE90-EM492

8. Remove the chain block from the engine.

WFE90-EM498

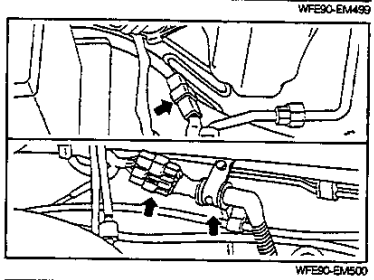
9. Connect the connectors onto the transmission and transfer by jacking up the vehicle. Connect the air breather hose onto the transmission.



WFE90-EM499

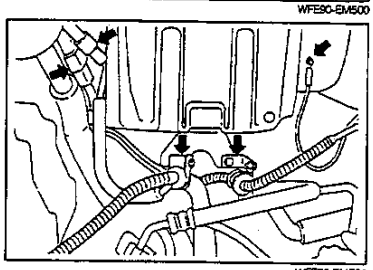
10. Connect the harness and wire.

[HD-C Engine]
(1) Clamp of battery negative ⊖ terminal to engine bracket at battery carrier side
(2) Clamp of battery positive ⊕ terminal to starter at battery carrier side
(3) Connector of cable leading to battery at battery carrier side



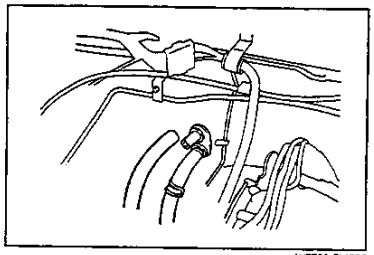
WFE90-EM500

[HD-E Engine]
(1) Clamp of battery negative ⊖ terminal to engine bracket at battery carrier side
(2) Clamp of battery positive ⊕ terminal to starter at battery carrier side
(3) Clamp of battery cable ⊕ leading to cowl at battery carrier side
(4) Three connectors of cable leading to relay box at battery carrier side



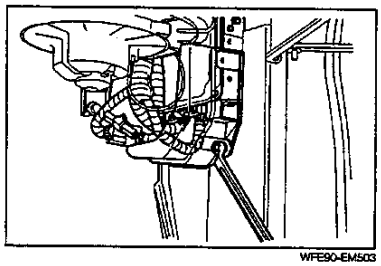
WFE90-EM501

11. Install the inlet and outlet hoses to the heater pipes at the dash panel.

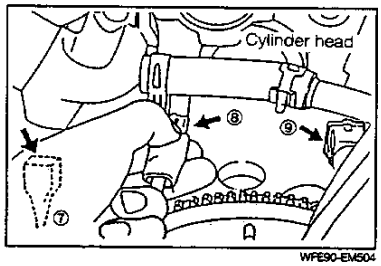


WFE90-EM502

12. Installation of engine wire harness
    (1) Installation of engine wire harness for ECU
        ① Install the engine wire connector for ECU to the cowl side panel at the passenger seat side through the dash panel.
        ② Connect the engine wire connector to the engine control computer assembly.
        ③ Install the ECU cover at the cowl panel of passenger seat side.

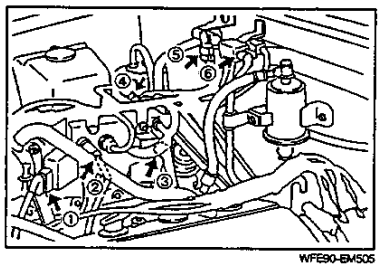

WFE90-EM503

    (2) Connect the following connectors.
        ① Oxygen sensor ⑩
        ② Water temperature sensor ⑨
        ③ Water temperature sender gauge ⑧
        ④ Air conditioner water temperature switch ⑦



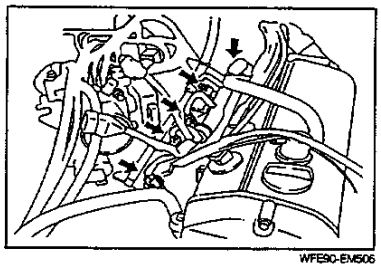
WFE90-EM504

        ⑤ Pressure sensor, pressure VSV and clamp ⑥
        ⑥ Air conditioner idle-up VSV ⑤
        ⑦ EGR VSV ④ (U.S. specifications only)
        ⑧ Idle speed control VSV ③ (U.S. specifications only)
        ⑨ Intake air temperature sensor ②
        ⑩ Throttle position sensor ①

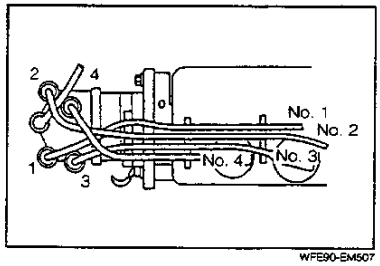


WFE90-EM505

    (3) Connect the four injector connectors.
    (4) Connect the engine wire clamps and engine ground cables.

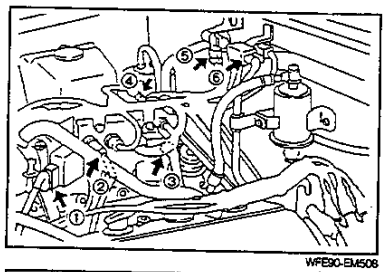

WFE90-EM506

13. Connection of distributor
    (1) Install the distributor into the cylinder head.
    (2) Tighten the two attaching bolts.
    (3) Connect the distributor wire connector.
        Tightening Torque: 14.7 - 21.6 N·m (1.5 - 2.2 kgf-m)

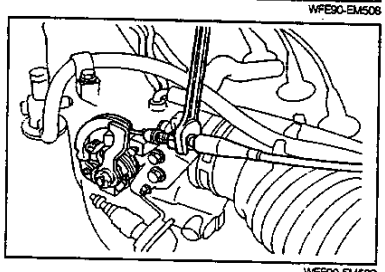


WFE90-EM507

14. Connect the following vacuum hoses at surge tank side.
    (1) Distributor diaphragm ①
    (2) BVSV ②
    (3) Pressure VSV ③
    (4) Air conditioner idle-up VSV ④
    (5) Power steering ACV ⑤
    (6) Brake booster ⑥
    (7) Charcoal canister ⑦

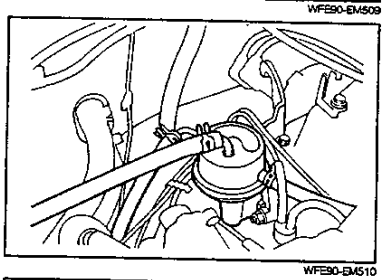

WFE90-EM508

15. Connect the accelerator cable.

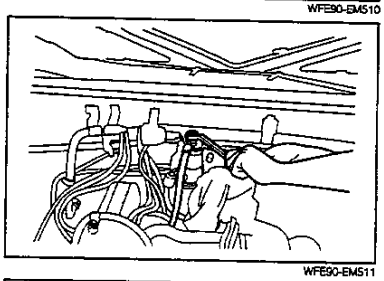

WFE90-EM509

16. Connection of fuel hose

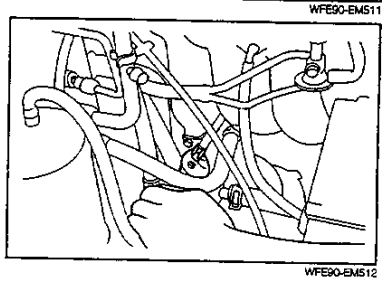
[HD-E Engine]
(1) Connect the fuel hose to the fuel pump. Then, connect the clamp for fuel hose.
(2) Connect the fuel return hose to the fuel pump. Then, connect the clamp for fuel return hose.


WFE90-EM510

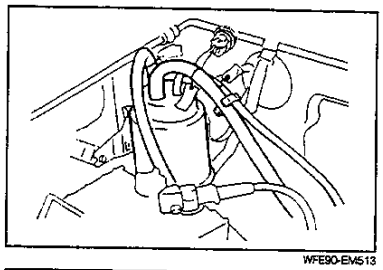
[HD-E Engine]
(1) Connect the fuel hose at the upper part of the fuel filter.
Tightening Torque: 34.3 - 44.1 N·m (3.5 - 4.5 kgf-m)


WFE90-EM511

(2) Install the fuel return hose to the fuel pipe No.2.

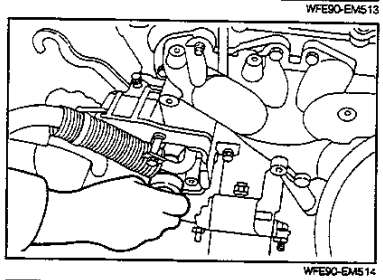

WFE90-EM512

17. Connect the outer vent hose to the charcoal canister.
    (HD-C Engine: GCC specifications only)



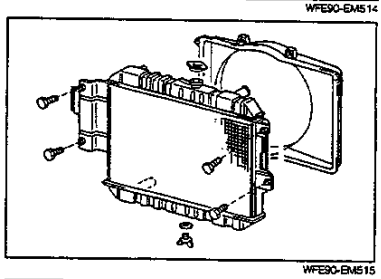
WFE90-EM513

18. Installation of air conditioner compressor
    (1) Install the compressor assembly with the attaching bolts.
    (2) Install the compressor cover with the attaching bolts.



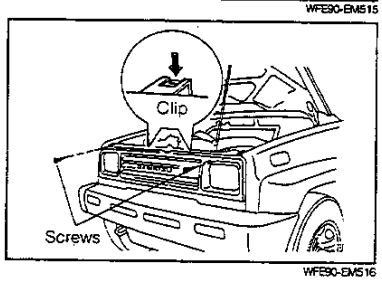
WFE90-EM514

19. Installation of radiator
    (1) Install the radiator with the four attaching bolts.



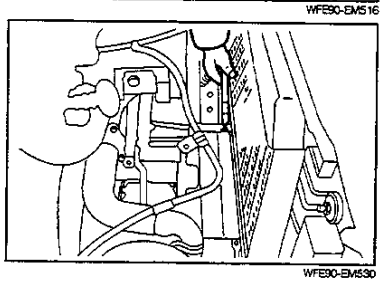
WFE90-EM515

    (2) Install the radiator grille.



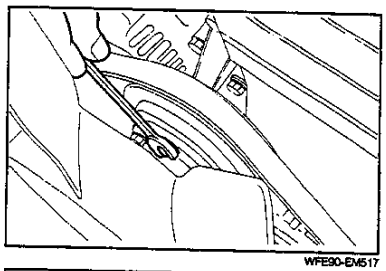
WFE90-EM516

    (3) Install the oil cooler hose to the radiator.

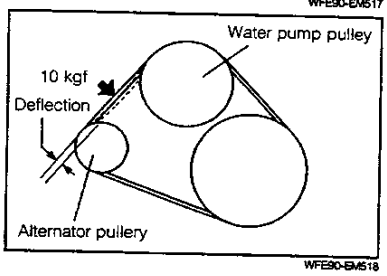


WFE90-EM530

(4) Connect the fluid coupling with the fan by means of the four attaching bolts. Then, connect the fluid coupling with fan together with the fan shroud.
Tightening Torque: 9.8 - 17.7 N·m (1.0 - 1.8 kgf-m)


WFE90-EM517

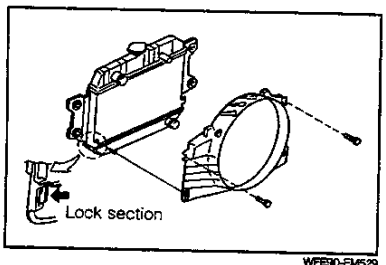
(5) Install the V ribbed belt.
(6) Perform the adjustment in such a way that the deflection at the midpoint between the water pump pulley and the alternator may become the specified value when a force of 10 kg (22 lb) is applied to the midpoint.
Specified Belt Deflection
New Belt: 4.0 - 5.0 mm
Used Belt: 5.0 - 6.0 mm



WFE90-EM518

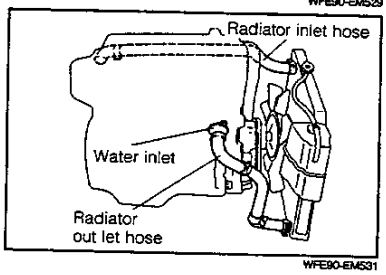
NOTE:
- **"New belt" refers to a belt which has been used less than 5 minutes on a running engine.**
- **"Used 5 belt" refers to a belt which has been used on a running engine 5 minutes or more.**

(7) Insert the lock section of the fan shroud to the radiator. Then, tighten the two attaching bolts at the radiator upper side.



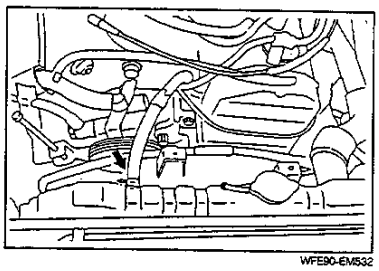
WFE90-EM529

(8) Connect the radiator hose No.1 to the radiator upper tank.
Tighten the two clamps and two attaching bolts.
(9) Connect the radiator outlet hose to the center connection.



WFE90-EM531

(10) Connect the air breather hose from the radiator upper tank.



WFE90-EM532

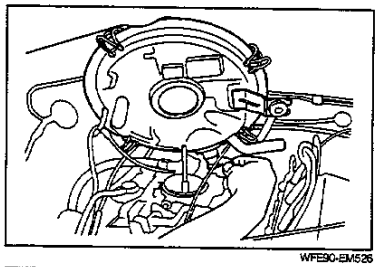
20. Installation of air cleaner and air cleaner hose assembly

[HD-C Engine]

(1) Install the air cleaner assembly with the attaching bolt of the air cleaner bracket and wing nut.

WFE90-EM525

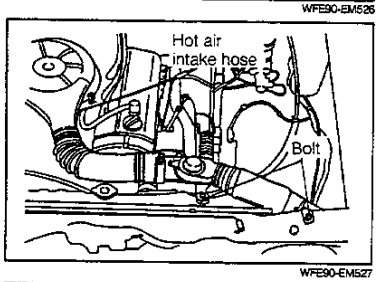
(2) Connect the following hoses to the air cleaner.
① ITC vacuum hoses
② PCV hose
③ Vacuum hose to BVSV



WFE90-EM526

(3) Connect the vacuum motor hose and hot air intake hose.

(4) Connect the air cleaner hose to the air cleaner case with the two bolts.

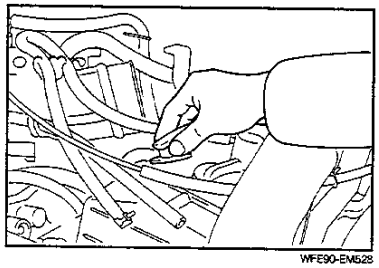


WFE90-EM527

(5) Connect the plug wires to the spark plugs.

NOTE:

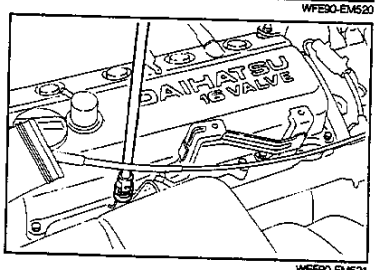
- Make sure that the spark plug wire is connected securely to each spark plug.
- Care should be exercised not to damage the spark plug wire rubber grommet with the spark plug tube.



WFE90-EM528

WFE90-EM520

(5) Tighten the air chamber bracket tightening bolts and clamp bolt. Clamp the accelerator cable.
Tightening Torque: 3.0 - 4.9 N·m (0.3 - 0.5 kgf-m)

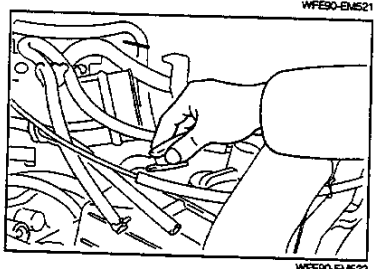


WFE90-EM521

(6) Connect the bond cable to the air chamber bracket. Tighten the attaching bolts.
(Only for the radio-equipped vehicle)
(7) Install the plug wires to the spark plugs.

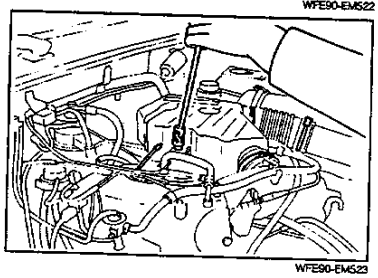
NOTE:

- **Make sure that the spark plug wire is connected securely to each spark plug.**
- **Care should be exercised not to damage the spark plug wire rubber grommet with the spark plug tube.**



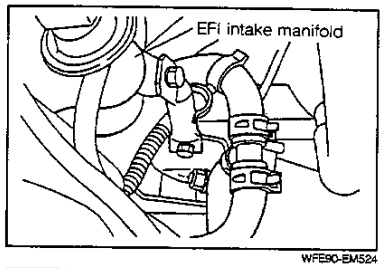
WFE90-EM522

(8) Connect the two vacuum hoses for air conditioner idle-up and for power steering.
(9) Install the air intake chamber by tightening the two clamps and three attaching bolts.



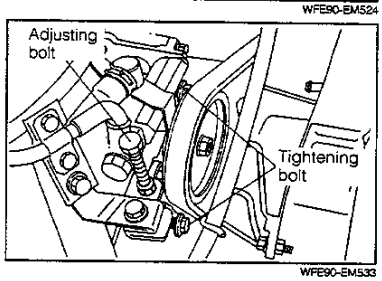
WFE90-EM523

21. Install the surge tank stay No.2 between the engine mounting bracket and the intake manifold.
    Tightening Torque: 14.7 - 21.6 N·m (1.5 - 2.2 kgf-m)



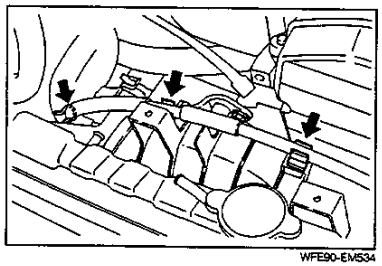
WFE90-EM524

22. Install the power steering pump assembly.
23. Install the drive belt of the power steering pump.



WFE90-EM533

24. Connect the clutch cable onto the fan shroud with the three clamps.
25. Install the reserve tank to the radiator.



WFE90-EM534

26. Fill the engine coolant.
    (See page CO-12.)
27. Fill the engine oil.
    (See page LU-12.)
28. Place the battery on the battery carrier.
    Then, install the battery hold-down clamp.
    NOTE:
    - **Care must be exercised so as not to damage the battery due to excessive tightening of it.**

29. Connect the wire of the positive terminal to the battery positive ⊕ terminal.
30. Connect the battery ground cable to the negative ⊖ terminal of the battery.
31. Start the engine. Ensure that the engine exhibits no leakage of cooling water or oil. Then, stop the engine.
32. Install the engine hood.
33. Connect the window screen washer hose.
34. Install the radiator grille.

WFE90-EM535

SST (Special Service Tools)

Shape	Part No. and Name	Purpose	Remarks
	09090-04010-000 Engine sling device	Removal and installation of engine	
	09219-87202-000 Engine overhaul stand	Stand for engine overhaul	This stand is to be used in combination with engine overhaul attachment.
	09219-87701-000 Engine overhaul attachment	Attaching engine to overhaul stand (However, it is necessary to modify attachment.)	This attachment is to be used in combination with engine overhaul stand.
	09210-87701-000 Flywheel holder	Preventing crankshaft from turning	
	09609-20011-000 Steering wheel puller	Removal of crankshaft timing belt pulley	
	09636-20010-000 Upper ball joint dust cover replacer	Installation of camshaft oil seal	
	09202-87002-000 Valve cotter remover & replacer	Installation and removal of valves	
	09217-87001-000 Piston replacing guide	Guiding piston during insertion	
	09223-41010-000 Crankshaft rear oil seal replacer	Installation of crankshaft rear oil seal	
	09201-87704-000 Valve stem oil seal cover	Removal of valve stem oil seals	
	09310-87102-000 Counter shaft front bearing replacer	Installation of crankshaft front oil seal	
	09221-87704-000 Piston pin remover & replacer body	Removal and installation of piston pins	This remover & replacer body is to be used in combination with piston pin remover & replacer guide.
	09221-87705-000 Piston pin remover & replacer guide	Removal and installation of piston pins	This remover & replacer guide is to be used in combination with piston pin remover & replacer body.

WFE90-EM536

Shape	Part No. and Name	Purpose	Remarks
	09201-87705-000 Valve guide bush remover & replacer	Removal and installation of valve guide bushes	
	09991-87702-000 Engine control system inspection sub harness	Shorting terminal T Actuating fuel pump, etc.	Only for HD-E engine
	09842-87204-000 EFC-II computer check sub harness	Inspection of computer input/output voltage	General specification
	09842-87704-000 EFC computer check sub harness	Inspection of computer input/output voltage	US specification
	09842-30070-000 EFI inspection wire F	Inspection of fuel injectors	Only for HD-E engine
	09268-87701-000 EFI fuel pressure gauge	Inspection of fuel pressure	Only for HD-E engine
	09283-87703-000 Pressure regulator adopter	* Inspection of injectors * Inspection of pressure regulator * Inspection of fuel pressure	Only for HD-E engine
	09268-87702-000 Injection measuring tool set	* Inspection of injectors * Inspection of pressure * regulator * Inspection of fuel pressure	Only for HD-E engine
	09301-87601-000 Clutch guide tool	Assembling clutch	
	09258-00030-000 Plug set	Plugging rubber hoses	
	09860-11011-000 Carburetor screwdriver set	Overhaul of carburetor	Only for HD-C engine
	09388-87702-000 Transfer replacer	Press-fitting of rubber grommets	

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Shape	Parts No. and Name	Purpose	Remarks
	09268-87704-000 Oil cooler set bolt box wrench	Removal and installation of oil cooler (only for oil cooler-equipped vehicle)	Only for oil cooler-equipped vehicle
	09032-00100-000 Oil pan seal cutter	Removal of oil pan	
	09228-87201-000 Oil filter wrench	Removal and installation of oil filter	
	09243-00020-000 Idle adjust wrench	Adjustment of idle mixture adjusting screw	Only for HD-C engine
	09240-00020-000 Wire gauge set	Adjustment of carburetor	Only for HD-C engine
	09240-00014-000 Carburetor adjusting gauge set	Adjustment of carburetor	Only for HD-C engine
	09268-87703-000 Plug wrench	Removal and installation of spark plugs	
	09991-87703-000 Tacho pulse pick-up wire	Connecting engine tachometer	
	09990-87702-000 Engine oil pressure gauge	Measurement of engine oil pressure	
	09286-87602-000 Crankshaft rear end bearing remover	Removal of crankshaft rear end bearing	
	09286-87603-000 Crankshaft rear end bearing replacer	Installation of crankshaft rear end bearing	
	09278-87201-000 Tool timing belt pulley holding	Preventing the crankshaft timing pulley from turning	

WFE90-EM538

TIGTENING TORQUE FOR MAIN COMPONENTS

1. When you want to find out a suitable tightening torque for a bolt, first determine the strength division of the said bolt, using the table below. Then, locate suitable tightening torque in the tightening torque table described later.
2. As for the tightening torque for a nut, find out suitable tightening torque in the same way as with the paragraph 1 above, based on the mating bolt.
3. Tightening torque posted in the workshop manual is a standard value for steel fasteners. It is, therefore, necessary to modify these tightening torque when you tighten fasteners made of materials other then steel.
   This rule also applies to such instances where bolts are undergoing heat or other stress, such as vibratory loads and so forth.

WFE90-539

METHOD TO IDENTIFY STRENGTH DIVISION OF BOLTS

1. Identification Method by Checking Bolts Themselves

	Configuration and how to determine strength division		Strength division		Configuration and how to determine strength division		Strength division
Hexagon bolt		Bolt having an embossed or stamped figure at its head section	4 = 4T 5 = 5T 5 = 5T 7 = 7T	Welded bolt			4T
		No mark	4T	Stud bolt		No mark	4T
		Bolt having two embossed lines at its head section	5T 6T			Bolt having about 2 mm deep recess at one end or both ends	6T
		Bolt having three embossed lines at its head section	7T				

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2. Identification Method by Part Numbers

Hexagon Bolt

Part number example 9 1 1 1 1 - 4 0 6 2 0

- Nominal length (mm)
- Nominal diameter (mm)
- Strength division

Nominal diameter

Nominal length

Stud Bolt

Part number example 9 1 1 1 1 - 4 0 6 2 0

- Nominal length (mm)
- Nominal diameter (mm)
- Strength division

Nominal diameter

Length

WFE90-EM541

TIGHTENING TORQUE TABLE FOR GENERAL STANDARD BOLTS & NUTS

NOTE:
The table below indicates the tightening torques for those standard bolts and nuts which are not posted in the tightening torque table.

Category	Nominal diameter mm	Pitch mm	Standard tightening torque					
			Target value			Tightening range		
			N·m	kgf-m	ft-lb	N·m	kgf-m	ft-lb
4T (Bolt having a mark of "4" at its head section) Example of part number (91○○○ - 4○○○)	6	1.0	5.39 [5.88]	0.55 [0.60]	3.98 [4.34]	4.31 - 6.47 [4.71 - 7.06]	0.44 - 0.66 [0.48 - 0.72]	3.18 - 4.77 [3.47 - 5.21]
	8	1.25	12.75 [14.22]	1.30 [1.45]	9.40 [10.49]	10.2 - 15.3 [11.38- 17.06]	1.04 - 1.56 [1.16 - 1.74]	7.52 - 11.28 [8.39 - 12.59]
	10	1.25	25.50 [28.44]	2.6 [2.90]	18.81 [20.98]	20.4 - 30.6 [22.75 - 34.13]	2.08 - 3.12 [2.32 - 3.48]	15.04 - 22.57 [16.78 - 25.17]
	12	1.25	47.07 [52.96]	4.8 [5.4]	34.72 [39.06]	37.66 - 56.49 [42.36 - 63.55]	3.84 - 5.76 [4.32 - 6.48]	27.77 - 41.66 [31.25 - 46.87]
5T (Bolt having a mark of "5" at its head section) Example of part number (91○○○ - 5○○○)	6	1.0	6.37 [7.35]	0.65 [0.75]	4.70 [5.42]	5.1 - 7.65 [5.88 - 8.83]	0.52 - 0.78 [0.6 - 0.9]	3.76 - 5.64 [4.34 - 6.51]
	8	1.25	15.69 [17.16]	1.60 [1.75]	11.57 [12.66]	12. 55 - 18.83 [13.73 - 184.66]	1.28 - 1.92 [1.40 - 2.10]	9.26 - 13.89 [10.13 - 15.19]
	10	1.25	32.36 [35.30]	3.3 [3.6]	23.87 [26.04]	25.89 - 38.83 [28.24 - 42.36]	2.64 - 3.96 [2.88 - 4.32]	19.1 - 28.64 [20.83 - 31.25]
	12	1.25	58.84 [65.70]	6.0 [6.7]	43.4 [48.46]	47.07 - 70.61 [52.56 - 78.85]	4.80 - 7.20 [5.36 - 8.04]	34.72 - 52.08 [38.77 - 58.15]
6T (Bolt having a mark of "6" at its head section) Example of part number (91○○○ - 6○○○)	6	1.0	7.85 [8.83]	0.8 [0.9]	5.79 [6.51]	6.28 - 9.41 [7.06 - 10.59]	0.64 - 0.96 [0.72 - 1.08]	4.63 - 6.94 [5.21 - 7.81]
	8	1.25	19.12 [20.59]	1.95 [2.10]	14.10 [15.19]	15.3 - 22.95 [16.48 - 24.71]	1.56 - 2.34 [1.68 - 2.52]	11.28 - 16.93 [12.15 - 18.23]
	10	1.25	39.23 [43.15]	4.00 [4.40]	28.93 [31.83]	31.38 - 47.07 [34.52 - 51.78]	3.20 - 4.80 [3.52 - 5.28]	23.15 - 34.72 [25.46 - 38.19]
	12	1.25	71.59 [79.43]	7.30 [8.10]	52.80 [58.59]	57.27 - 85.91 [63.55 - 95.32]	5.84 - 8.76 [6.48 - 9.72]	42.24 - 63.36 [46.87 - 70.30]
7T (Bolt having a mark of "7" at its head section) Example of part number (91○○○ - 7○○○)	6	1.0	10.79 [11.76]	1.10 [1.20]	7.96 [8.68]	8.63 - 12.94 [9.41 - 14.12]	0.88 - 1.32 [0.96 - 1.44]	6.37 - 9.55 [6.94 - 10.42]
	8	1.25	25.5 [28.44]	2.60 [2.90]	18.81 [20.98]	20.4 - 30.6 [22.75 - 34.13]	2.08 - 3.12 [2.32 - 3.48]	15.04- 22.57 [16.78 - 25.17]
	10	1.25	51.98 [57.86]	5.30 [5.90]	38.33 [42.67]	41.58 - 62.37 [46.29 - 69.43]	4.24 - 6.36 [4.72 - 7.08]	30.67 - 47.95 [34.14 - 51.21]
	12	12.5	95.12 [109.97]	9.70 [10.50]	70.16 [75.94]	76.1 - 114.15 [82.38 - 123.56]	7.76 - 11.64 [8.40 - 12.60]	56.13 - 84.19 [60.76 - 91.14]
Pipe tapered thread	PT8/1 PT1/4 PT3/8 PT1/2	*0.9071 *1.3368 *1.3368 *1.8143	16.67 24.52 29.42 29.42	1.7 2.5 3.0 3.0	12.3 18.08 21.7 21.7	11.76 - 21.57 19.61 - 29.42 24.52 - 34.32 24.52 - 34.42	1.2 - 2.2 2.0 - 3.0 2.5 - 3.5 2.5 - 3.5	8.67 - 15.91 14.46 - 21.67 18.08 - 25.32 18.08 - 25.32

Numerals in [ ] denote those for flange bolts.
The asterisked mark (*) represents pitch conversion value.

WFE90-EM864

TIGHTENING TORQUE

Tightening component	Tightening torque			Remark
	N·m	kgf-m	ft-lb	
Cylinder head × Spark plug	14.7 - 21.6	1.5 - 2.2	10.8 - 15.9	Dry
Cylinder head × Cylinder head cover	2.9 - 4.9	0.3 - 0.5	2.2 - 3.6	Dry
Cylinder head × Rocker shaft M10 Bolt	28.4 - 36.3	2.9 - 3.7	21.0 - 26.8	Dry
M8 Bolt	12.7 - 16.7	1.3 - 1.7	9.4 - 12.3	Dry
Cylinder head × Cylinder block	58.8 - 66.6	6.0 - 6.8	43.4 - 49.2	Wet
Cylinder head × Water tempurature sensor (HD-E engine only)	24.5 - 34.3	2.5 - 3.5	18.1 - 25.3	Dry
Cylinder head × BVSV (HD-C engine only)	24.5 - 34.3	2.5 - 3.5	18.1 - 25.3	Dry
Cylinder head × Water temperature sender gauge	11.8 - 19.6	1.2 - 2.0	8.7 - 14.5	Dry
Cylinder head × Distributor	14.7 - 21.6	1.5 - 2.2	10.8 - 15.9	Dry
Cylinder head × Exhaust manifold	29.4 - 44.1	3.0 - 4.5	21.7 - 32.5	Dry
Cylinder head × Intake manifold	14.7 - 21.6	1.5 - 2.2	10.8 - 15.9	Dry
Cylinder head × Fuel pump (HD-C engine only)	14.7 - 21.6	1.5 - 2.2	10.8 - 15.9	Dry
Cylinder block × Water inlet	5.9 - 8.8	0.6 - 0.9	4.3 - 6.5	Dry
Cylinder block × Crankshaft main bearing cap	29.4 - 53.9	4.5 - 5.5	32.5 - 39.8	Wet
Cylinder block × Oil pump	5.9 - 8.8	0.6 - 0.9	4.3 - 6.5	Dry
Cylinder block × Rear oil seal retainer	5.9 - 8.8	0.6 - 0.9	4.3 - 6.5	Dry
Cylinder block × Water pump	14.7 - 21.6	1.5 - 2.2	10.8 - 15.9	Dry
Cylinder block × Engine mounting bracket	39.2 - 53.9	4.0 - 5.5	28.9 - 39.8	Dry
Cylinder block × Transmission	49.0 - 68.6	5.0 - 7.0	36.2 - 50.6	Dry
Cylinder block × Oil cooler pipe	24.5 - 34.3	2.5 - 3.5	18.1 - 25.3	Dry
Surge tank × Intake air temperature sensor	29.4 - 39.2	3.0 - 4.0	21.7 - 28.9	Dry
Surge tank × Gas filter	11.8 - 19.6	1.2 - 2.0	8.7 - 14.5	Dry
Surge tank × Throttle body	14.7 - 21.6	1.5 - 2.2	10.8 - 15.9	Dry
Crankshaft × Flywheel	78.4 - 98.0	8.0 - 10.0	57.9 - 72.0	Dry non-reusable.
Crankshaft × Crankshaft timing belt pulley	88.2 - 98.0	9.0 - 10.0	65.1 - 72.0	Dry
Intake manifold × Delivery pipe (HD-E engine only)	14.7 - 21.6	1.5 - 2.2	10.8 - 15.9	Dry
Intake manifold × Carburetor (HD-C engine only)	14.7 - 21.6	1.5 - 2.2	10.8 - 15.9	Dry
Exhaust manifold × Exhaust pipe	34.3 - 49.0	3.5 - 5.0	25.3 - 36.2	Dry
Exhaust pipe clamp	29.4 - 44.1	3.0 - 4.5	21.7 - 32.5	Dry
Engine mounting bracket × Engine mounting (bolt)	29.4 - 44.1	3.0 - 4.5	21.7 - 32.5	Dry
Engine mounting bracket × Engine mounting (nut)	29.4 - 44.1	3.5 - 5.5	25.3 - 39.8	Dry

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Tightening component	Tightening torque			Remark
	N·m	kgf·m	ft·lb	
Oil pump body × Oil cooler	24.5 - 34.3	2.5 - 3.5	18.1 - 25.3	Dry
Oil pump × Oil pressure switch	11.8 - 19.6	1.2 - 2.0	8.7 - 14.5	Dry
Oil pan	6.9 - 11.8	0.7 - 1.2	5.1 - 8.7	Dry
Oil pan × Drain plug	19.6 - 29.4	2.0 - 3.0	14.5 - 21.7	Dry
Oil pump body × Oil pump cover	7.8 - 12.7	0.8 - 1.3	5.8 - 9.4	Dry
Oil level gauge guide	18.6 - 30.4	1.9 -3.1	13.7 - 22.4	Dry
Surge tank stay No. 1	14.7 - 21.6	1.5 - 2.2	10.8 - 15.9	Dry
Surge tank stay No. 2	29.4 - 44.1	3.0 - 4.5	21.7 - 32.5	Dry
Surge tank stay No. 3	14.7 - 21.6	1.5 - 2.2	10.8 - 15.9	Dry
Camshaft × Camshaft timing belt pulley	14.7 - 21.6	1.5 - 2.2	10.8 - 15.9	Dry
Timing belt cover	2.0 - 3.9	0.2 - 0.4	1.4 - 2.9	Dry
Timing belt tensioner	29.4 - 44.1	3.0 - 4.5	21.7 - 32.5	Dry
Crankshaft timing belt pulley × Crankshaft pulley	19.6 - 29.4	2.0 - 3.0	14.5 - 21.5	Dry
Fluid coupling × Water pump pulley × Water pump	9.8 - 19.6	1.0 - 1.8	7.2 - 13.0	Dry
Cooling fan × Fluid coupling	4.9 - 5.9	0.5 - 0.6	3.6 - 4.3	Dry
Fuel filter × Fuel hose No. 1	34.3 - 44.1	3.5 - 4.5	25.3 - 32.5	Dry
Fuel filter × Fuel pipe	34.3 - 44.1	3.5 - 4.5	25.3 - 32.5	Dry
Fuel hose No. 1 × Delivery pipe	34.3 - 44.1	3.5 - 4.5	25.3 - 32.5	Dry
Connecting rod × Connecting rod cap	34.3 - 44.1	3.5 - 4.5	25.3 - 32.5	Wet
Clutch cover × Fly wheel	14.7 - 21.6	1.5 - 2.2	10.8 - 15.9	Dry
Transmission × Starter motor	49.0 - 68.6	5.0 - 7.0	36.2 - 50.6	Dry
Front pipe × Rear pipe	36.3 - 51.0	3.7 - 5.2	26.8 - 37.6	Dry
Fuel pump × Fuel pipe	34.3 - 43.1	3.5 - 4.4	25.3 - 31.8	Dry

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ENGINE SPECIFICATIONS

Item					Engine type	HD-C	HD-E
Engine proper	Type					Petrol, 4-cycle	Petrol, 4-cycle
	Mounting location					Front	Front
	Number of cylinders and arrangement					4-cylinder-in-line, mounted longitudinally	4-cylinder-in-line, mounted longitudinally
	Combustion chamber type					Pent roof type	Pent roof type
	Valve mechanism					Belt-driven, SOHC	Belt-driven, SOHC
	Bore × stroke				mm	76 × 87.6	76 × 87.6
	Compression ratio					9.5 ± 0.3	9.5 ± 0.3
	Compression pressure				kPa (kgf/cm^2) - rpm)	1373 (14.0) - 300	1373 (14.0) - 300
	Maximum output	SAE net	kW/rpm	General specifications		63/6000	—
		EEC	kW/rpm	Australian specifications		—	70/5700
		EEC DIN	kW/rpm	ECE & EEC specifications		63/6000	70/5700
	Maximum torque	SAE net	kW/rpm	General specifications		126/3500	—
		EEC	kW/rpm	Australian specifications		—	128/4800
		EEC DIN	kW/rpm	ECE & EEC specifications		126/3500	128/4800
	Engine dimensions [Length × width × height]				mm	*693 × 596 × 685	693 × 537 × 673
	Service engine weight				kg	96	95
	Number of piston rings	Compression ring				2	2
		Oil ring				1	1
	Valve timing	Intake	Open			2° BTDC	2° BTDC
			Close			48° ABDC	48° ABDC
		Exhaust	Open			43° BBDC	43° BBDC
			Close			1° ATDC	1° ATDC
	Valve clearance [HOT]		Intake		mm	0.25	0.25
			Exhaust			0.33	0.33
	Idling speed				rpm	850 ± 50	850 ± 50
	Blow-by gas recirculating system					Closed type	Closed type
Lubricating System	Lubricating method					Fully-forced feed method	Fully-forced feed method
	Oil Pump type					Trochoid type	Trochoid type
	Oil filter type					Full-flow filter type, filter paper type	Full-flow filter type, filter paper type
	Lubrication oil capacity dm^3	Whole				3.8	3.8
		When only oil is changed				3.3	3.3
		When oil and oil filter are changed				3.5	3.5
Cooling System	Cooling method					V-belt driven type	V-belt driven type
	Radiator type					Corrugation type forced circulation	Corrugation type forced circulation
	Coolant capacity (Vehicle with front heater)				dm^3	5.5 (excluding 1.0 dm^3 in reserve tank)	5.5 (excluding 1.0 dm^3 in reserve tank)
	Water pump type					Centrifugal type, "V" belt-driven tank	Centrifugal type, "V" belt-driven tank
	Thermostat type					Wax pellet type	Wax pellet type
Air cleaner	Type					Filter unwoven fabric type	Filter paper type
	Number					1	1

* For GCC specifications: 693 × 602 × 685

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Item					Engine type	HD-C		HD-E
Fuel System	Fuel tank	Capacity			liter	60		60
		Location				Underneath rear seat floor		Underneath rear seat floor
	Fuel pipe material					Rubber and steel tube		Rubber and steel tube
	Fuel pump type					Diaphragm type		Electromotor type
	Fuel filter type					Filter paper type		Filter paper type
	Carburetor	Manufacturer				Aisan industry		—
		Type				Down draft, 2-barrel type		—
		Venturi diameter			mm	21, 28		—
		Choke valve type				Wax type automatic choke		—
	Fuel injection device					—		Electronic type
	Injection nozzle or Injector	Type of nozzle retainer				—		With cushion rubber type
		Nozzle type				—		Electronically-controlled throttle type
		Injection pressure			kPa (kgf/cm^2)	—		250 (2.55)
Engine electrical system	Ignition system	Voltage			V	12 [Negative ground]		12 [Negative ground]
		Type				Battery ignition type		Battery ignition type
		Ignition timing			°/rpm	B.T.D.C. 3 ± 2/850 ± 50		B.T.D.C. 3 ± 2/850 ± 50
		Firing order				1-3-4-2		1-3-4-2
		Distributor	Distributor type			Full-transistorized type		Full-transistorized type
			Breaker type			—		—
			Performance of timing advancing mechanism	Centrifugal type		0°/600 rpm 15°/3000 rpm		0°/600 rpm 12°/3000 rpm
				Vacuum type		0°/-13.3 kPa (-100 mmHg) 15°/-53.3 kPa (-400 mmHg)		0°/-20.0 kPa (-150 mmHg) 10°/-56.0 kPa (-420 mmHg)
		Spark plug	Manufacturer			CHAMPION	NIPPONDENSO	NGK
			Type			RC9YC4	K20PR-U11	BKR6E-11
			Thread			M14 × 1.25	M14 × 1.25	M14 × 1.25
			Spark plug gap		mm	1.0 - 1.1	1.0 - 1.1	1.0 - 1.1
	Battery	Type	General specifications			36B20R (*1 55B24R)		36B20R (*1 55B24R)
			ECE & EEC specifications			36B20R (*1 55B24R)		36B20R (*1 55B24R)
			Australian specifications			36B20R		36B20R
		Capacity AH (5 Hr)	General specifications			28 (*1 36)		28 (*1 36)
			ECE & EEC specifications			28 (*1 36)		28 (*1 36)
			Australian specifications			28		28

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SERVICE SPECIFICATIONS
TUNE-UP

Drive belt deflection when pressed with a force of 98N (10 kgf) Alternator	New belt	4 - 5 mm
	Used belt	5 - 6 mm
Coolant capacity w/heater [Excluding 1.0 dm^3 for reserve tank]		5.5 dm^3 [5.8 dm^3 for tropical specifications]
Engine oil capacity Whole amount		3.8 dm^3
When only oil is changed	Full level	3.3 dm^3
	Low level	2.3 dm^3
When oil and filter are changed		3.5 dm^3
		NOTE: For the oil cooler-equipped engine, add 79 cm^3 for whole amount.
Valve clearances (hot)	Intake	0.25 ± 0.05 mm
	Exhaust	0.33 ± 0.05 mm
[Reference (cold)]	Intake	0.18 mm
	Exhaust	0.25 mm

Spark plugs

Manufacturer	NIPPONDENSO	NGK	CHAMPION
Type	K20PR - U11 K22PR - U11	BKR6E - 11 BKR7E - 11	RC9YC4 RC7YC4
Thread	M14 × 1.25		
Spark plug gap mm	1.0 - 1.1		

Ignition timing	B.T.D.C. 3 ± 2°/100 rpm or less (However, engine revolution must be stable.)

Idle speed

Engine type	HD-C	HD-E
Idle speed rpm	850 ± 50	850 ± 50

Fast idle speed adjustment (HD-C)	Full position	1300 - 2000 rpm

Throttle positioner touch revolution (rpm)

HD-C	HD-E (General)	HD-E (US)
1500 ± 50 rpm	1800 ± 50 rpm	1600 ± 100 rpm

Throttle positioner operating time	HD-C	0.5 - 5.0 seconds
	HD-E	0.5 - 5.0 seconds
Compression pressure at 3000 rpm	Standard	1373 kPa (14.0 kgf/cm^2)
	Minimum	1030 kPa (10.5 kgf/cm^2)
	Difference between cylinders	147 kPa (1.5 kgf/cm^2)

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ENGINE MECHANICALS

Timing belt pulley	Wear limit	Camshaft	119.80 mm
		Crankshaft	59.37 mm
Timing belt tension spring		Free length	46.5 mm
		Installation load	
Camshaft	Oil clearance (cylinder head-to-camshaft)		0.035 - 0.076 mm
	Maximum limit		0.17 mm
	Thrust clearance		0.1 - 0.25 mm
	Maximum limit		0.45 mm
	Journal diameter		
	Fuel pump cam diameter	Minimum	42.65 mm
	Fuel pump cam stroke		
		Standard	5.0 mm
		Minimum	4.8 mm
	Valve cam lobe height		
	Intake	Standard	33.08 - 33.28 mm
		Minimum	32.9 mm
	Exhaust	Standard	33.00 - 33.20 mm
		Minimum	32.85 mm
	Maximum circle runout		0.03 mm
Cylinder head	Warpage	Cylinder block side	0.10 mm
		Intake manifold side	0.10 mm
		Exhaust manifold side	0.10 mm
	Valve seat angle	Intake	30 - 45 - 70°
		Exhaust	20 - 45 - 70°
	Valve contacting angle		45°
	Valve seat contacting width		
		Standard	1.4 mm
		Allowance	1.2 - 1.6 mm
	Maximum valve seat recession		0.5 mm
Valves	Valve stem diameter	Intake valve	6.560 - 6.580 mm
		Exhaust valve	6.555 - 6.575 mm
	Valve length	Intake valve	112.8 mm
		Exhaust valve	114.5 mm
	Valve face angle		45.5°
	Valve stock thickness (Minimum)		
		Intake	0.8 mm
		Exhaust	1.0 mm
	Valve stem oil clearance		
	Intake	Standard	0.020 - 0.060 mm
		Maximum	0.080 mm
	Exhaust	Standard	0.025 - 0.065 mm
		Maximum	0.090 mm

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Valve springs	Free length	Standard	45.2 - 46.0 mm
		Minimum	44.3 mm
	Installed tension at 38.0 mm		258.9 N (26.4 kgf)
	Maximum out-of-squareness		1.6 mm
Valve rocker arm and valve rocker shaft	Oil clearance	Standard	0.012 - 0.053 mm
		Maximum	0.08 mm
	Valve rocker arm bore diameter		19.500 - 19.521
	Valve rocker shaft outer diameter		19.468 - 19.488 mm
Valve rocker arm spacer	Free width		22.00 mm
Exhaust manifold	Warpage		0.1 mm
Intake manifold	Warpage	Cylinder head side	0.1 mm
Cylinder block	Maximum cylinder head surface warpage		0.1 mm
	Cylinder bore diameter		
		Standard	76.000 - 76.030 mm
		O/S 0.25	76.250 - 76.280 mm
	Bore honing angle		35 ± 5°
	Coarse degree		1 - 4 Z
Piston, piston pin and piston rings	Piston-to-cylinder bore clearance		
		Standard	0.025 - 0.045 mm
		Maximum limit	0.11 mm
	Piston ring groove-to-piston ring side clearance		
	Standard.	No. 1	0.03 - 0.07 mm
		No. 2	0.02 - 0.06 mm
	Maximum		0.12 mm
	Piston ring thickness		
	Standard	No. 1	1.17 - 1.19 mm
		No. 2	1.47 - 1.49 mm
Piston, piston pin and piston rings	Piston ring end gap		
	Standard	No. 1	0.27 - 0.42 mm
		No. 2	0.35 - 0.50 mm
		0.1	0.20 - 0.70 mm
	Maximum	No. 1	0.7 mm
		No. 2	0.8 mm
		0.1	1.0 mm
	Piston pin-to-connecting rod interference fit		0.012 - 0.044 mm
	Piston-to-piston pin clearance		0.005 - 0.011 mm
Flywheel	Runout	Maximum	0.1 mm
Connecting rod	Big end thrust clearance		
		Standard	0.15 - 0.4 mm
		Maximum	0.45 mm
	Maximum bend		0.05 mm
	Maximum twist		0.05 mm

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Crankshaft	Crankpin journal oil clearance	0.020 - 0.044 mm
	Main journal oil clearance	0.024 - 0.042 mm
	Crankpin journal diameter	44.976 - 45.000 mm
	Main journal diameter	49.976 - 50.000 mm
	Thrust clearance Standard	0.02 - 0.22 mm
	Maximum limit	0.30 mm
	Runout Maximum	0.06 mm
Thermostat valve (HD-C)	Operating temperature ON	63°C or more
	OFF	55°C or less

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FUEL SYSTEM

Carburetor	Float level	Dimension assumed by its own weight	8 mm
		Lip dimension	1.6 mm
	Throttle valve closed angle	Primary	9°
		Secondary	20°
	Throttle valve fully opened angle	Primary	90°
		Secondary	80°
	Kick-up angle		23°
	Secondary touch angle		50°
	• Opening degree of throttle valve at a time when it is set to idling state by means of throttle adjust screw		11.4°
	• Opening degree of throttle valve at a time when throttle positioner is operating		16.0°
	Number of backing-off of idle mixture adjusting screw		$4^1/_2$ rev
	Solenoid valve resistance		80 - 100 Ω
	Outer vent resistance		30 - 45 Ω
Fuel pump (HD-C)	Suction force at 300 rpm		13.3 kPa (100 mm Hg) or more
	Push rod length	Standard	87.95 - 88.25 mm
		Minimum	87.000 mm
	Push rod stroke	Standard	5.0 mm
		Minimum	4.8 mm

WFE90-EM551

LUBRICATION SYSTEM

Oil pump	Compression spring free length		57 mm
	Body clearance		0.20 - 0.28 mm
	Tip clearance		0.16 - 0.24 mm
	Side clearance		0.035 - 0.085 mm
	Oil pressure	idling	19.6 kPa (0.2 kgf/cm^2) or more
		3000 rpm	24.5 - 490.4 kPa (0.25 - 5.0 kgf/cm^2)

WFE90-EM552

COOLING SYSTEM

Radiator cap	Relief valve opening pressure	Standard	73.6 - 103.0 kPa (0.75 - 1.05 kgf/cm²)
		Minimum	58.8 kPa (0.6 kgf/cm²)
Thermostat	Valve opening temperature	General specifications	82 - 86°C
		ECE & EEC specifications	76 - 80°C
	Valve lift	General specifications	8.5 mm or more at 98°C
		ECE & EEC specifications	8.5 mm or more at 91°C

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IGNITION SYSTEM

Ignition timing	No sub vacuum timing advance takes place. Engine revolution must be stable at 1000 rpm or less		BTDC 3 ± 2°
High-tension cord	Resistance	Maximum	15 kΩ per cord
Distributor	Air gap between signal rotor and signal generator		0.2 - 0.4 mm
Ignition coil	Primary coil		1.35 - 1.65 Ω at 20°C
	Secondary coil		22 - 30 k Ω at 20°C

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EFI SYSTEM (General specifications)

Fuel pressure regulator	Fuel pressure at No. vacuum	225 - 275 kPa (2.3 - 2.8 kgf/cm²)
Injector	Resistance at 20°C (approx.)	11.0 - 15.0 Ω
	Injection amount (approx.)	152 - 168 cm³/60 seconds at 20°C
	Difference between each injector	5 cm³ or less
	Fuel leakage	Less than one drop of fuel per minute
EFI main relay injector relay	Between terminals ① - ② ③ - ④	60 - 85 Ω Infinity
Fuel pump relay	Between terminals ① - ② ③ - ④	70 - 90 Ω Infinity
Idle-up VSV	Resistance	30 - 50 Ω at 20°C
Throttle position sensor	Resistance Between terminals ⑩ - ㉑ Throttle valve closed fully	0.2 Ω or less at 20°C
	Throttle valve opened fully	10 kΩ or more at 20°C
	Between terminals bH - bA Throttle valve closed fully	10 kΩ or more at 20°C
	Throttle valve opened fully	5 Ω or less at 20°C
Fuel pump	Fuel flow amount	235 cm³ or more/15 seconds
Water temperature sensor Intake air temperature sensor	Cooling water temperature	Resistance
	80°C	0.322 ± 0.1 kΩ
	60°C	0.584 ± 0.2 kΩ
	40°C	1.14 ± 0.3 kΩ
	20°C	2.45 ± 0.5 kΩ
	0°C	5.88 ± 1.5 kΩ
	-20°C	16.2 ± 3.2 kΩ

Pressure sensor
Output between SST terminals ⑬ - ㉒ (ground) (When engine is stopped.)

Measuring point Altitude (height above sea level) m	Atmospheric pressure kPa (mm Hg)	Voltage V
0	101.3 (760)	3.2 - 4.0
500	95.5 (716)	3.1 - 3.8
1000	89.9 (674)	3.0 - 3.6

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ECU CONNECTORS (General specifications)

No.	Contents of connection	No.	Contents of connection
1	Power ground	15	Cooling water temperature sensor
2	Injector	16	Power ground
3	Battery +B (Main relay)	17	Injector
4	Battery +B (Back-up)	18	Battery +B (Main relay)
5	Idle-up VSV	19	Check engine lamp
6	Feedback check terminal	20	Fuel pump relay
7	Ignition coil (negative)	21	Engine ground
8	Starter switch	22	Pressure sensor ground
9	Test terminal	23	Air conditioner magnet clutch
10	Idle switch	26	Vehicle speed sensor
11	Electric load signal	28	Power switch
12	Sensor power supply (approx. 5V)	29	Oxygen sensor
13	Pressure sensor	30	Sensor ground
14	Intake air temperature sensor		

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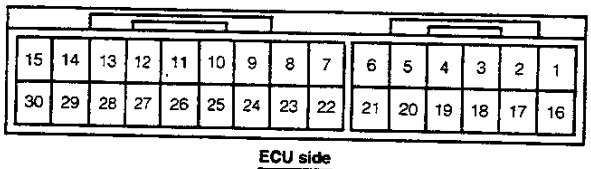
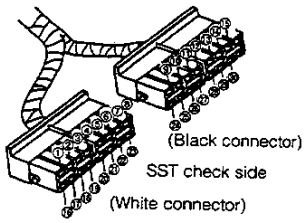


ECU side



VOLTAGES AT ECU WIRING CONNECTORS (General specifications)

Terminals	STD voltage or resistance	Conditions	Remedies
(1) - (21)	Less than 1 Ω	Ignition switch OFF.	Proceed to flow chart (2).
(2) - (21)	Less than 1V	Ignition switch OFF (after more than one minute).	Check power supply.
	About battery voltage	Ignition switch ON.	
(3) - (21)	Less than 0.1V	Ignition switch OFF (after more than ten seconds).	Check power supply.
	About battery voltage	Ignition switch ON.	
(4) - (21)	About battery voltage	At all times (Measured voltage is lower than specified voltage only during starting period.)	Check power supply.
(5) - (21)	About battery voltage	Engine fully warmed up. All accessary switches turned OFF.	Check power supply.
	Less than 3V	Idle-up VSV ON.	Check idle-up VSV control.
(6) - (21)	4.5 - 5.5V	Ignition switch ON. T-terminal shorted with ground terminal. Throttle valve fully closed.	Proceed to flow chart (2).
	Less than 1V		Check diagnosis code.
	0 - 4.5 to 5.5V (Measured voltage varies)	Ignition switch ON. T-terminal shorted with ground terminal. Engine revolution speed builds at 3000 rpm after it has fully warmed up.	Oxygen sensor system.
(7) - (21)	Less than 0.1V	Ignition switch OFF.	Check power supply.
	About battery voltage	Ignition switch ON.	
(8) - (21)	Less than 0.1V	Ignition switch OFF.	Check power supply.
	More than 6V	When ignition switch is set to ST position.	
(9) - (21)	Less than 0.1V	Ignition switch OFF.	Check T-terminal wiring.
	About battery voltage	Ignition switch ON.	
(10) - (21)	Less than 0.5V	Ignition switch ON. Throttle valve fully closed.	Throttle position sensor system.
	About battery voltage	Ignition switch ON. Throttle valve fully opened.	
(11) - (21)	Less than 0.1V	Ignition switch ON. Headlamp switch and/or defogger switch OFF.	Check idle-up VSV control.
	More than 9V	Ignition switch ON. Headlamp switch and/or defogger switch ON.	
(12) - (22)	Less than 0.1V	Ignition switch OFF.	Check VCC wiring.
	4.5 - 5.5V	Ignition switch ON.	
(13) - (22)	3.2 - 4.0V	Ignition switch ON. Atmospheric pressure is 101.3 kPa (760 mmHg).	Check pressure sensor.
(14) - (30)	1.5 - 3.0V	Ignition switch ON. Air temperature inside surge tank: 20°C	Check intake air temperature sensor.
(15) - (30)	0.40 - 0.65V	Ignition switch ON. After engine has been warmed up fully. (Cooling water temperature: 80 - 90°C.	Check cooling water temperature sensor.
(16) - (1)	Less than 1Ω	Ignition switch OFF.	Proceed to flow chart (2).
(17) - (21)	Less than 1V	Ignition switch OFF (after more than one minute).	Check/repair injector power supply.
	About battery voltage	Ignition switch ON.	

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Terminals	STD voltage or resistance	Conditions	Remedies
(18) - (21)	Less than 0.1V	Ignition switch OFF.	Check/repair ECU power supply.
	About battery voltage	Ignition switch ON.	
(19) - (21)	Less than 3V	Ignition switch ON. (Check engine lamp illuminated.)	Check power supply for check engine lamp.
	About battery voltage	Engine is rotating. (Check engine lamp not illuminated).	
(20) - (21)	Less than 1V	Ignition switch ON. Fuel pump is operating.	Check/repair fuel pump power supply.
	About battery voltage	Ignition switch ON. Fuel pump is stopped.	
(21) - Engine ground	Less than 0.2Ω	Ignition switch OFF.	Check ground wiring.
(22) - (21)	Less than 0.5Ω	Ignition switch OFF.	Replace ECU.
(23) - (21)	About battery voltage	Engine is rotating. Air conditioner compressor is rotating. (Genuine air conditioner-equipped vehicle.)	Check air conditioner wiring.
(26) - (21)	0 to Approx battery voltage	Ignition switch ON. When vehicle is moved. (Measured voltage changes 4 times for movement of 1.5 m.)	Check speed sensor
(28) - (21)	About battery voltage	Ignition switch ON. Throttle valve fully closed.	Check throttle position sensor.
	Less than 0.5V	Ignition switch ON. Throttle valve fully opened.	
(29) - (21)	Less than 0.1V	Ignition switch ON (after more than 60 seconds).	Check oxygen sensor.
	Voltage varies within 0 - 1.0V.	After engine has warmed up fully. When engine revolution is held at 3000 rpm for more than two minutes:	Check fuel system.
(30) - (21)	Less than 1Ω	Ignition switch ON.	Proceed to flow chart (2).

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EFI SYSTEM (U.S. specifications)

Fuel pressure regulator	Fuel pressure at No. vacuum	225 - 275 kPa (2.3 - 2.8 kgf/cm²)
Injector	Resistance at 20°C (approx.)	11.0 - 15.0 Ω
	Injection amount (approx.)	152 - 168 cm³/60 seconds at 20°C
	Difference between each injector	5 cm³ or less
	Fuel leakage	Less than one drop of fuel per minute
EFI main relay Injector relay	Between terminals ① - ② ③ - ④	60 - 85 Ω Infinity
Fuel pump relay	Between terminals ① - ② ③ - ④	70 - 90 Ω Infinity
Idle-up VSV	Resistance	30 - 50 Ω at 20°C
Throttle position sensor	Resistance Between terminals ⑫ - ㉓ Throttle valve closed fully	0.2 Ω or less at 20°C
	Throttle valve opened fully	10 kΩ or more at 20°C
	Between terminals ㉒ - ㉓ Throttle valve closed fully	10 kΩ or more at 20°C
	Throttle valve opened fully	5 Ω or less at 20°C
Fuel pump	Fuel flow amount	235 cm³ or more/15 seconds
Water temperature sensor Intake air temperature sensor	Cooling water temperature	Resistance
	80°C	0.322 ± 0.1 kΩ
	60°C	0.584 ± 0.2 kΩ
	40°C	1.14 ± 0.3 kΩ
	20°C	2.45 ± 0.5 kΩ
	0°C	5.88 ± 1.5 kΩ
	-20°C	16.2 ± 3.2 kΩ

Pressure sensor
Output between SST terminals ⑬ - ㉒ (ground) (When engine is stopped.)

Measuring point Altitude (height above sea level) m	Atmospheric pressure kPa (mmHg)	Voltage V
0	101.3 (760)	3.2 - 4.0
500	95.5 (716)	3.1 - 3.8
1000	89.9 (674)	3.0 - 3.6

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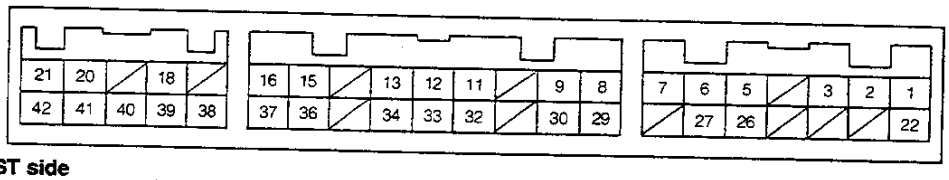
ECU CONNECTORS (U.S. specifications)

The figure below shows the arrangement of the ECU connector terminals.

ECU side



SST side

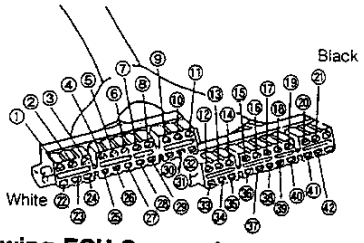


Table Showing ECU Connections (US Specification)

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Terminal code	Contents of connection	Terminal code	Contents of connection
1	Main relay (Power supply)	22	Main relay (Power supply)
2	Battery (Backup power supply)	23	
3	Ignition coil primary voltage	24	
4		25	
5	Pressure sensor power supply	26	Oxygen sensor
6	Pressure sensor	27	Intake air temperature sensor
7	Cooling water temperature sensor	28	
8	Vehicle speed sensor	29	Operation system ground (Engine)
9	Electrical load (Headlamp and defogger)	30	Electrical load (Blower fan)
10		31	
11	Check connector (Test terminal)	32	Throttle position switch (Power switch)
12	Throttle position switch (Idle switch)	33	Stop lamp
13	Starter	34	Air conditioner magnet switch
14		35	
15	Oxygen sensor feedback check terminal	36	Operation system ground
16	Check engine lamp	37	Fuel pump relay
17		38	Pressure VSV
18	EGR VSV	39	System ground
19		40	Idle speed control VSV
20	Injector	41	Injector
21	Actuator drive ground (Engine)	42	Actuator drive ground (Engine)

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Voltages at ECU connectors

Terminals	STD voltage or resistance	Condition		Remedies
① — ㉙	About battery voltage	Ignition switch ON		Check power supply.
② — ㉙	About battery voltage	At all time		Check power supply.
③ — ㉙	About battery voltage	Ignition switch ON	When engine is stopped:	Check power supply.
⑤ — ㉙	4.5 - 5.5 V	Ignition switch ON		Check power supply.
⑥ — ㉙	3.2 - 4.0 V	Ignition switch ON	When atmospheric pressure of 101.3 kPa (760 mmHg) exists.	Check pressure sensor.
⑦ — ㉙	0.4 - 0.65 V	Ignition switch ON	When cooling water temperature is 80°C:	Check water temperature sensor.
⑦ — ㉘	0.322 ± 0.1 W	When cooling water temperature is 80°C		
⑧ — ㉙	0 - About battery voltage	Ignition switch ON	Measured voltage changes when vehicle is moved 1.5 m.	Check speed sensor.
⑨ — ㉙	Less than 5.0 V	Ignition switch ON	When defogger and headlamp switches are turned OFF:	Check TSC VSV.
	About battery voltage	Ignition switch ON	When defogger and/or headlamp switches are turned ON:	
⑪ — ㉙	About battery voltage	Ignition switch ON	When test terminal of check connector is not connected with ground terminal:	Check T-terminal wiring.
	Less than 1.0 V	Ignition switch ON	When test terminal of check connector is connected with ground terminal:	
⑫ — ㉙	Less than 5.0 V	Ignition switch ON	Throttle valve fully closed	Check throttle position system.
	About battery voltage	Ignition switch ON	Throttle valve fully opened	
⑫ — ㉙	Less than 29 Ω	Throttle valve fully closed		
	More than 1000 Ω	Throttle valve fully opened		
⑬ — ㉙	0 V	Ignition switch ON		Check power supply.
	More than 6 V	When ignition switch is set to ST position:		
⑮ — ㉙	Measured voltage changes at a point between 0 - 5.0 V.	After warming up engine completely, connect test terminal of check connector with ground terminal. Hold engine revolution speed at 3000 rpm for two minutes.		Check fuel system.
⑯ — ㉙	Less than 3.0 V	Ignition switch ON	• Engine is stopped. • When check engine lamp is illuminated:	Check power supply for engine lamp.
	About battery voltage	Ignition switch ON	• After engine starts: • When check engine lamp is extinguished:	

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Terminals	STD voltage or resistance	Condition		Remedies
⑯ — ㉙	About battery voltage	Ignition switch ON	• After engine starts: • Cooling water temperature is below 40°C.	Check power supply.
	Less than 3.0 V	Ignition switch ON	• After engine starts: • Cooling water temperature is above 41°C.	Check ESV wiring.
⑳ — ㉙	Less than 1.0 V	At least 30 seconds have elapsed after turning OFF ignition switch.		Check power supply.
	About battery voltage	Ignition switch ON	• Engine is stopped.	
㉑ — ㉙	Less than 0.01 V	Ignition switch ON		Proceed to flow chart (2).
㉒ — ㉙	About battery voltage	Ignition switch ON		Check power supply.
㉔ — ㉙	Change in output voltage	Ignition switch ON	After warming up engine completely, hold engine revolution speed at 3000 rpm for two minutes.	Check fuel system.
㉗ — ㉙	1.5 - 3.0 V	Ignition switch ON	Air temperature inside intake manifold is 20°C:	Check intake air temperature sensor.
㉗ — ㉘	2.45 ± 0.5 Ω	When air temperature inside intake manifold is 20°C:		
㉘ — ㉙	Less than 0.1 V	Ignition switch ON		Check ground wiring.
㉚ — ㉙	About battery voltage	Ignition switch ON	• Blower fan switch turned OFF	Check ISC.
	Less than 2.0 V	Ignition switch ON	When blower fan switch turned ON:	
㉜ — ㉙	About battery voltage	Ignition switch ON	Throttle valve fully closed	Check throttle system.
	Less than 5.0 V	Ignition switch ON	Throttle valve fully opened	
㉜ — ㉘	More than 1000 Ω	Throttle valve fully closed		
	Less than 29 Ω	Throttle valve fully opened		
㉝ — ㉙	Less than 1 V	Ignition switch ON	When brake pedal is not depressed:	Check brake wiring.
	About battery voltage	At all time	When brake pedal is depressed:	

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Terminals	STD Voltage or resistance	Condition		Remedies
㉞ — ㊴	Less than 1 V	Ignition switch ON	When compressor magnet switch of air conditioner is turned OFF:	Check air conditioner idle-up VSV.
	About battery voltage	Ignition switch ON	When compressor magnet switch of air conditioner is turned ON:	
㊱ — ㊴	Less than 0.1 V	Ignition switch ON		Check ground wiring.
㊲ — ㊴	About battery voltage	Ignition switch ON	When fuel pump is stopped:	Check or repair pump power supply.
	Less than 2.0 V	Ignition switch ON	When fuel pump is operating:	
㊳ — ㊴	About battery voltage	Ignition switch ON	When pressure VSV is turned OFF:	Check pressure VSV.
	Less than 3.0 V	Ignition switch ON	For 0.5 second immediately after engine starts	
㊴ — Engine ground	Less than 0.1 V	Ignition switch ON		Check ground wiring.
㊵ — ㊴	Less than 3.0 V	Ignition switch ON	Engine is stopped.	Check ISC VSV.
	About battery voltage	Ignition switch ON	When test terminal of check connector is connected with ground terminal:	
㊶ — ㊴	Less than 1.0 V	At least 30 seconds have elapsed after turning OFF ignition switch.		Check power supply.
	About battery voltage	Ignition switch ON	Engine is stopped.	
㊷ — ㊴	Less than 0.1 V	Ignition switch ON		Check ground wiring.

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