DAIHATSU

F300

[HD - Engine]

ENGINE MECHANICALS

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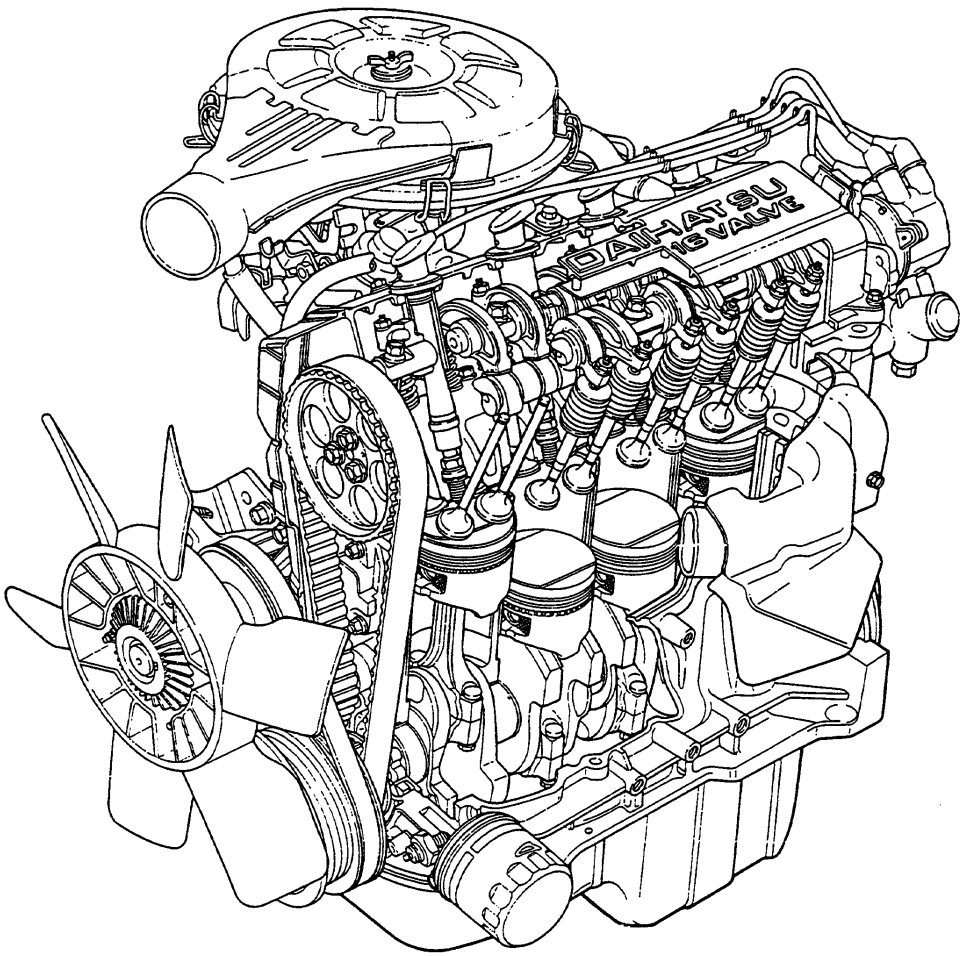
WFE90-EM001

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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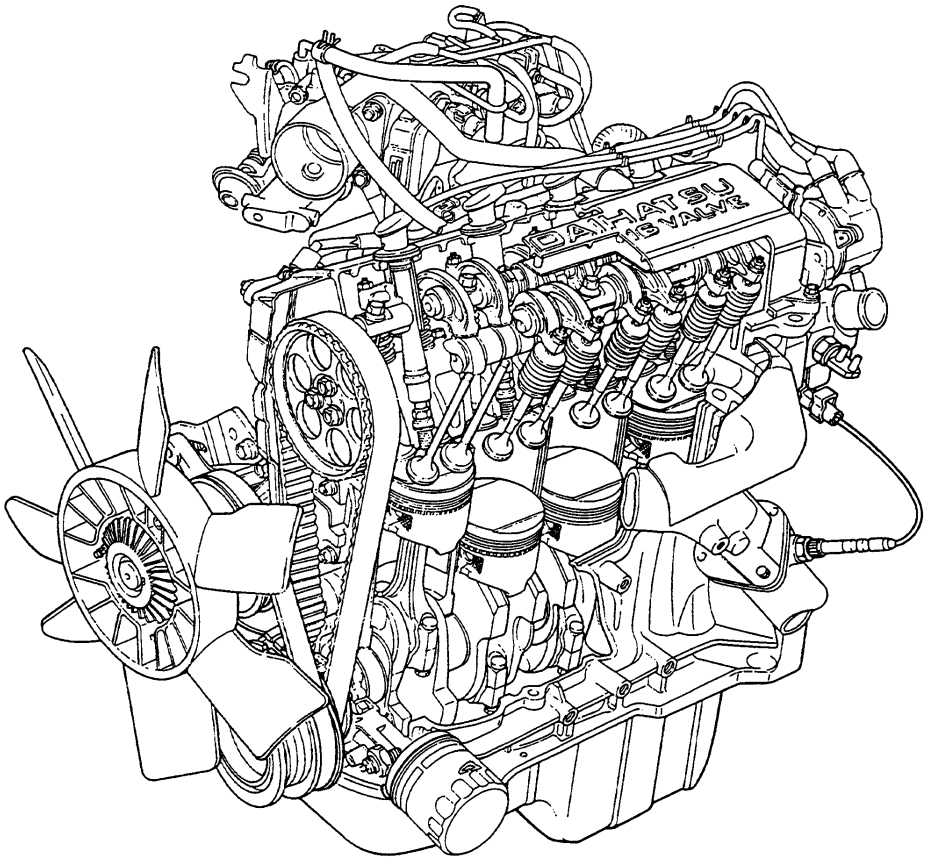
[HD-E engine]



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.

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. Th 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.

WFE90-EM700

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

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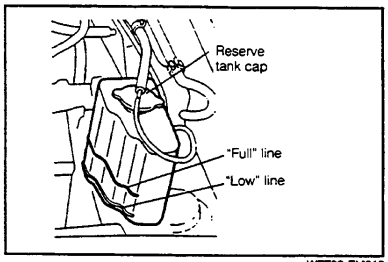
Problem	Possible causes	Remedies	Page
Engine hesitates/Poor acceleration	Spark plugs faulty	Inspect spark plugs.	IG–12
	Resistive cords faulty.	Inspect resistive cords.	IG–11
	Incorrect ignition timing.	Reset ignition timing.	EM–23
	Incorrect valve clearances.	Adjust valve clearances.	EM–16
	Low compression.	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

WFE90-EM009

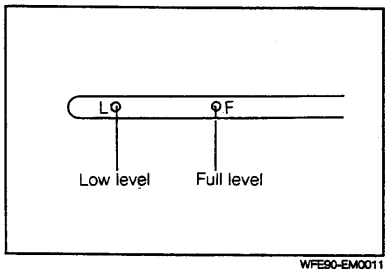
ENGINE TUNE-UP

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



WFE90-EM010

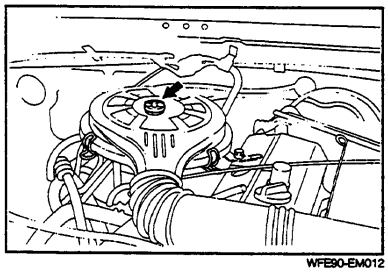
2. **Inspection of engine oil level**
   (See page LU–9.)



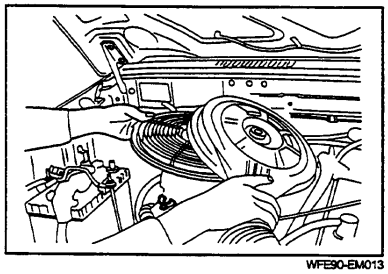
WFE90-EM011

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

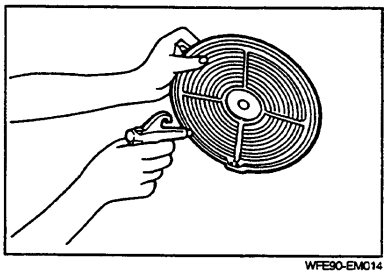
1. Detach the four air cleaner clamps. Remove the air cleaner upper case by loosen the wing nut.


WFE90-EM012

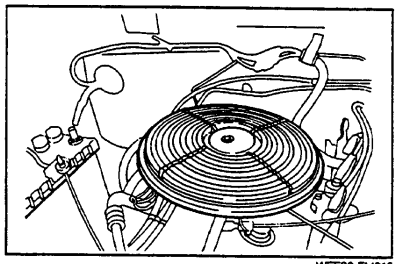
2. Remove the air filter element from the air cleaner case.
3. Visually inspect that the air filter element is not excessively dirty, damaged or oily.
   Replace the air filter element, if necessary.


WFE90-EM013

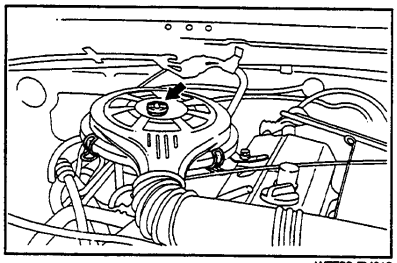
4. Clean the element with compressed air.
   First, blow compressed air from the back side of the element thoroughly. Then, blow off the upper side of the element.
   CAUTION:
   - **The air pressure to be used for this cleaning operation should not exceed 392.3 kPa (4.0 kgf/cm²).**


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.

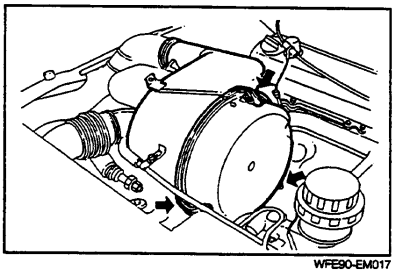

WFE90-EM015

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

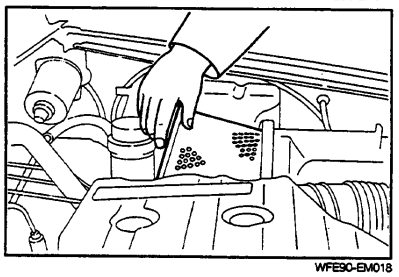

WFE90-EM016

[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.

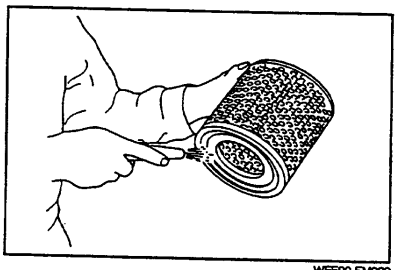

WFE90-EM018

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

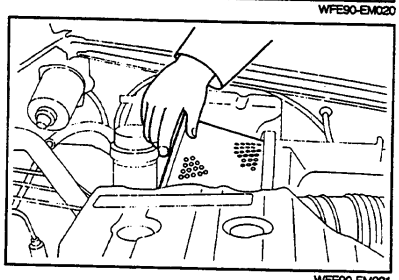
WFE90-EM019

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/cm^2).**

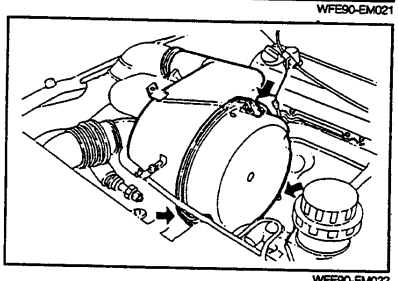
Replace the air filter element, if necessary.


WFE90-EM020

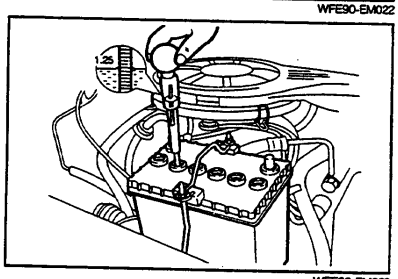
5. Place the element in the air cleaner case. Secure the element with the wing nut.


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

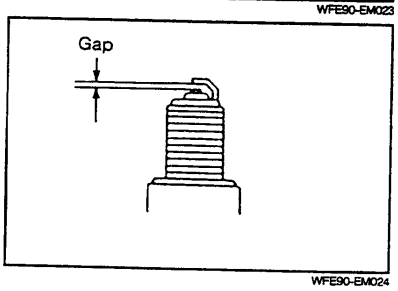
4. Inspection of battery
(See the Charging System Section.)


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:

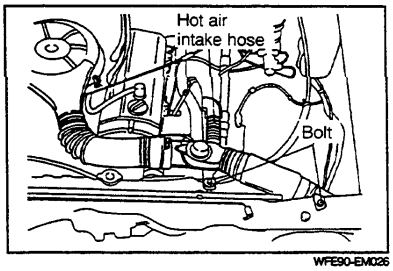
- **The valve clearance adjustment is performed normally when the engine is in a hot condition.**
- **"Hot engine condition" denotes a condition in which the cooling water temperature is 75 - 85°C and the engine oil temperature is above 65°C.**
  However, when the engine has been overhauled, it is necessary 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

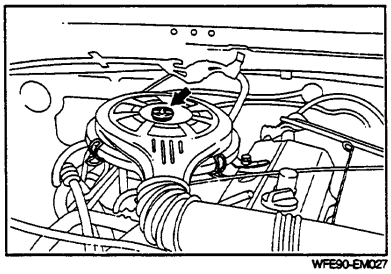
[HD-C Engine]

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



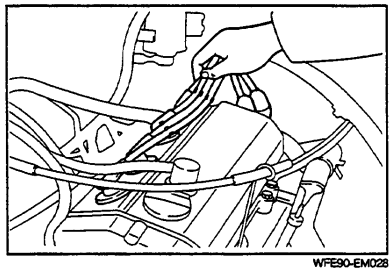
WFE90-EM026

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



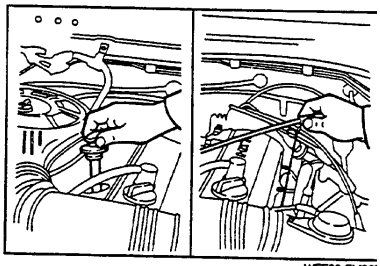
WFE90-EM027

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

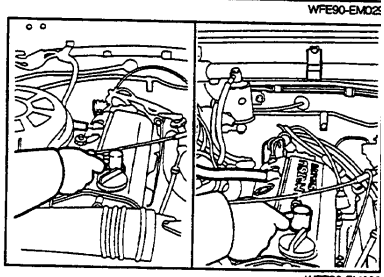


WFE90-EM028

(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

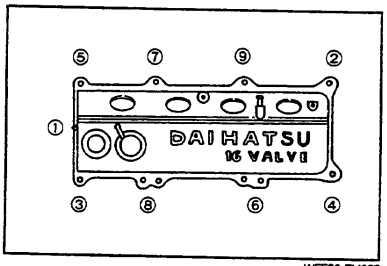
(5) Disconnect the PCV hoses from the cylinder head cover.


WFE90-EM030

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

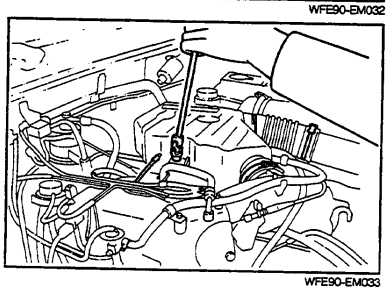
WFE90-EM031

(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.

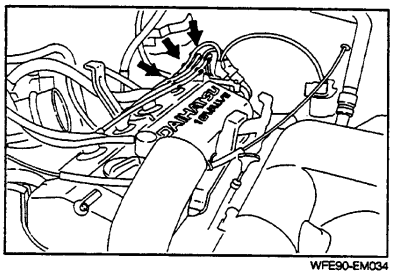


WFE90-EM032

[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.

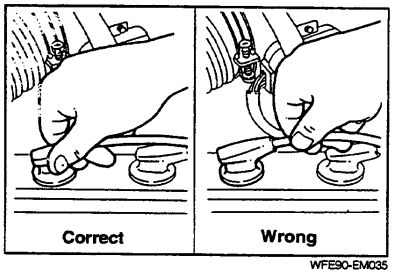

WFE90-EM033

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



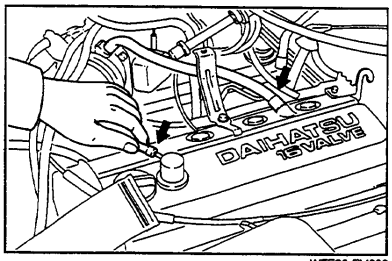
WFE90-EM034

(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.

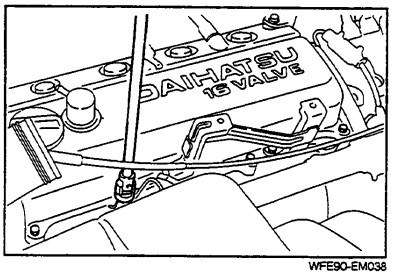


WFE90-EM036

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

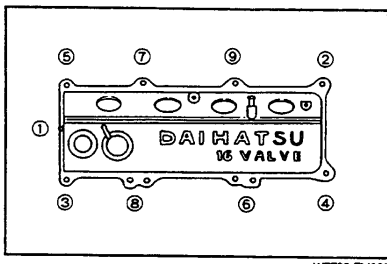
WFE90-EM037

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



WFE90-EM038

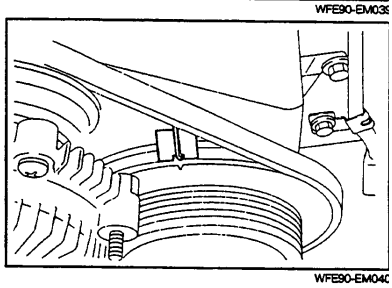
(7) Loosen the nine bolts (10 mm) over two or three stages in the sequence shown in the right figure. After removing the bolts, proceed to remove the cylinder head cover.



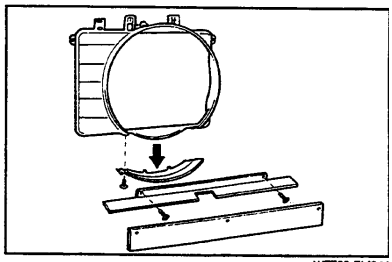
WFE90-EM03

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.

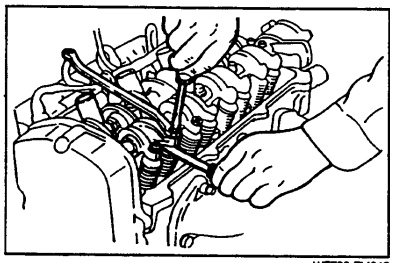
2. Inspection and adjustment of valve clearances
(1) Turn the crankshaft until the recessed mark on the crankshaft pulley is aligned with the indicator mark on the timing belt cover.


WFE90-EM04

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.

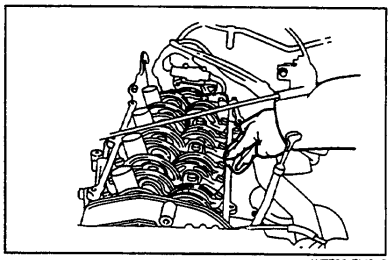
WFE90-EM044

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.

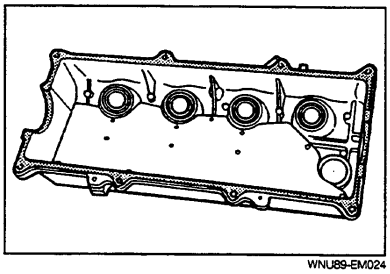


WFE90-EM045

(2) Check the cylinder head cover gasket for evidence of damage.
Replace the gasket, as required.

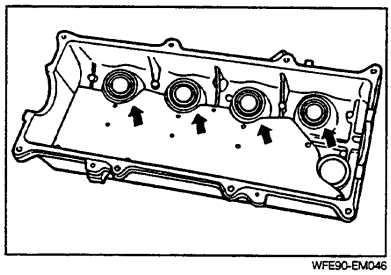
NOTE:

- Install the cylinder head cover gasket in such a direction that the identification mark may come at the intake side.



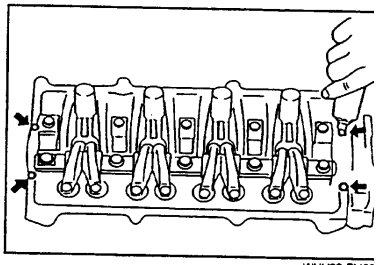
WNU89-EM024

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

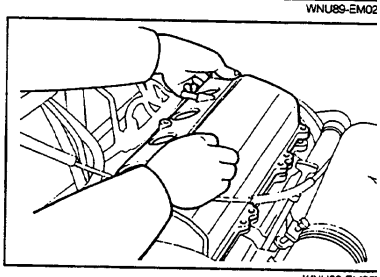


WFE90-EM046

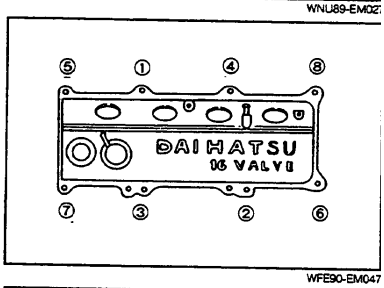
(4) Install the cylinder head cover gasket on the cylinder head. Apply the Three Bond 1104 to the four points on the cylinder head, as indicated in the figure.


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.

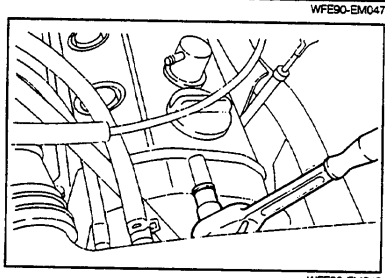

WNU89-EM02

(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)

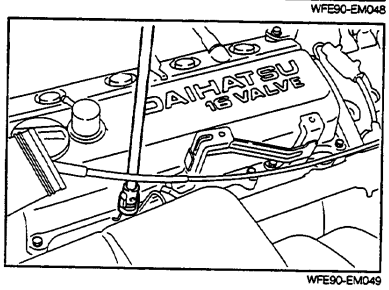


WFE90-EM047

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

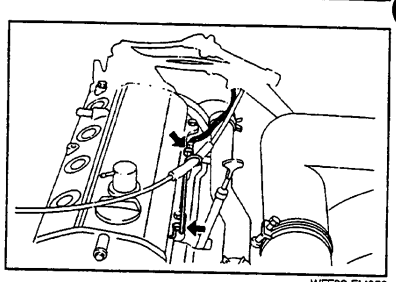

WFE90-EM048

(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)

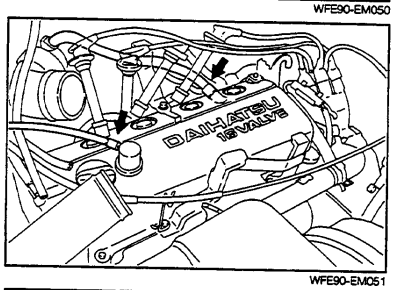


WFE90-EM049

(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)

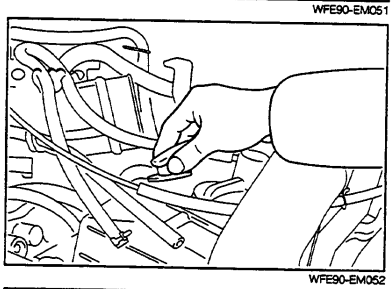

WFE90-EM050

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

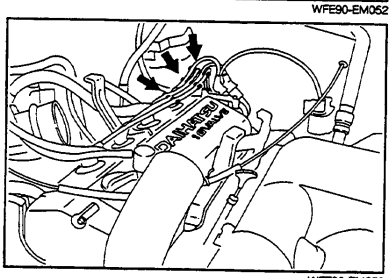


WFE90-EM051

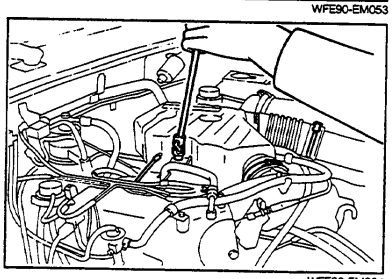
(11) Install the spark plug wires to the spark plugs.
NOTE:
- Be sure that the spark plug wire is connected securely to each spark plug.
- Care should be exercised not to damage the spark plug wire rubber grommet with the spark plug tube.


WFE90-EM052

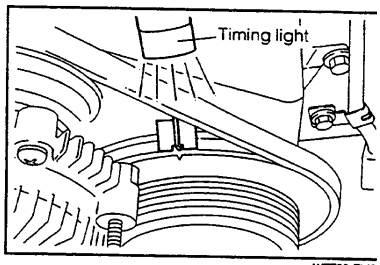
(12) Install the spark plug wires to the clamp.


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.

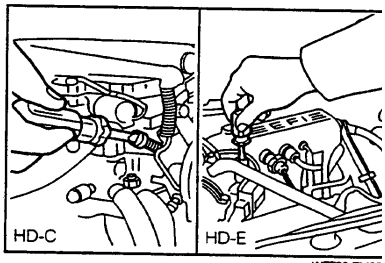


WFE90-EM0

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

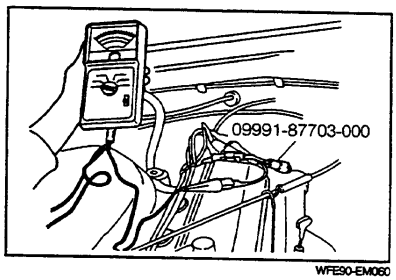
[HD-C Engine]
Preparation to be made prior to fast idle check
- All accessory switches are turned OFF.
  On those vehicles equipped with a day-lamp system, set the lamp control switch to the first stage.
- The air cleaner element is installed.
- All vacuum hoses are connected.
- Ensure that the intake 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.

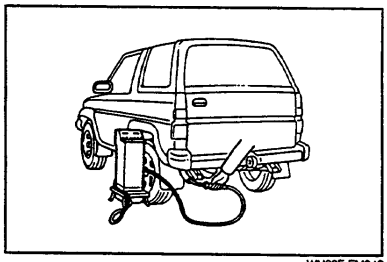
CO adjustment

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

WFE90-EM062

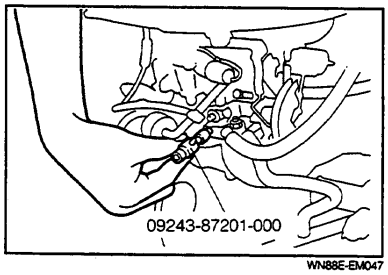
3. Measure the CO concentration at the idle speed. Check to see if the CO concentration conforms to the specification.
   Specified CO Concentration: 1.5 ± 0.5%

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



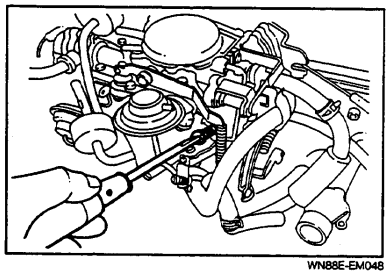
WN88E-EM046

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.

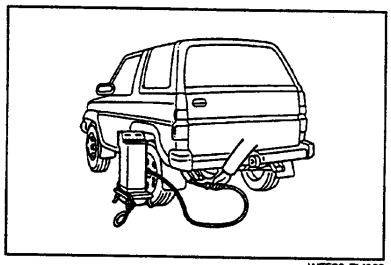


WN88E-EM048

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

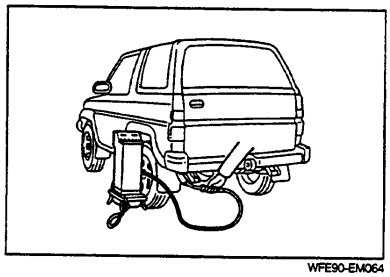
Item / Possible cause	CO concentration	HC concentration	Remarks
Ignition timing		O	
Valve clearances		O	
Improper valve seating		O	Compression pressure
Ignition system problems Spark plugs Resistive cord Distributor Ignition coil	O	O	
Air leakage in intake system	O	O	
ITC valve malfunctioning	O	O	
Great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

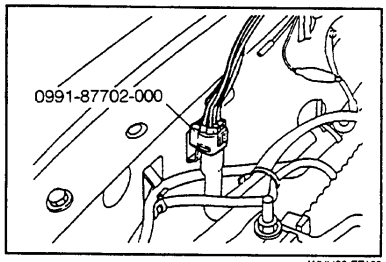


WFE90-EM064

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.

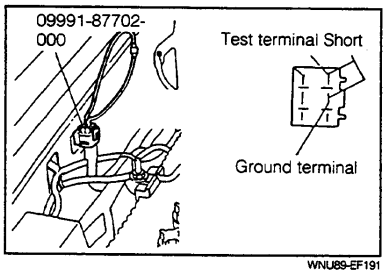
WFE90-EM065

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



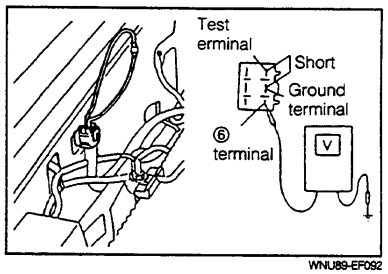
WNU89-EF190

   (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.

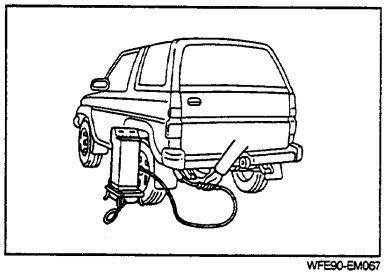


WNU89-EF092

   (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

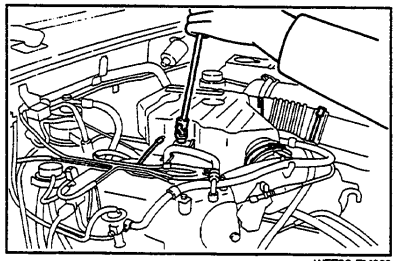
COMPRESSION CHECK

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.

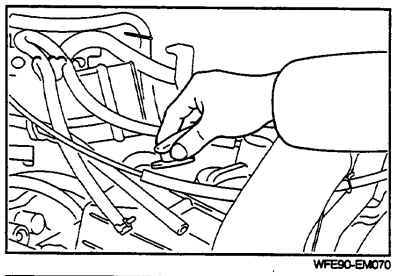
3. Removal of spark plugs
   (1) Disconnect the vacuum hoses from the air intake chamber.
   Remove the air intake chamber by removing the three attaching screws and two clamps.

WFE90-EM042



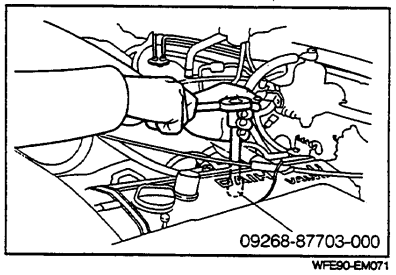
WFE90-EM069

   (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-EM070

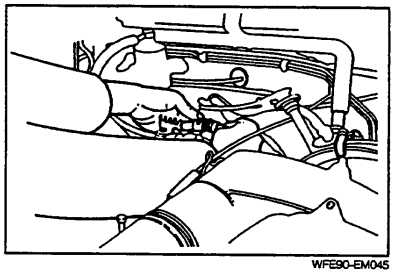
   (4) Remove the all spark plugs, using the following SST {Plug wrench (16 mm)}.
   SST: 09268-87703-000



WFE90-EM071

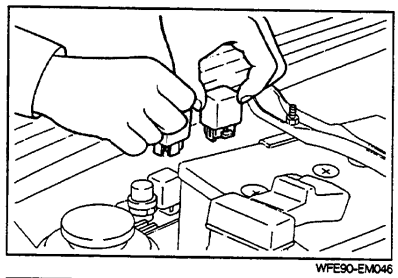
WARNING:
- **Be very careful not to burn yourself.**

4. Disconnect the distributor connector.



WFE90-EM045

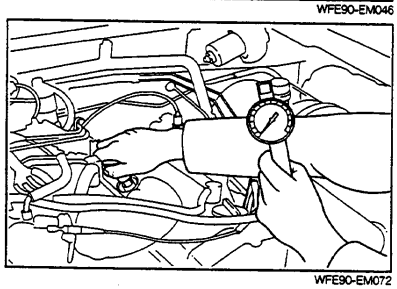
5. Pull out the injector relay and fuel pump relay from the relay block.



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.**



WFE90-EM072

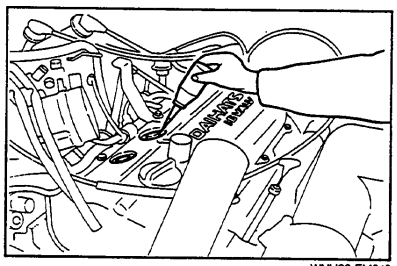
   (4) Repeat the steps (1) through (3) for each cylinder.

   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

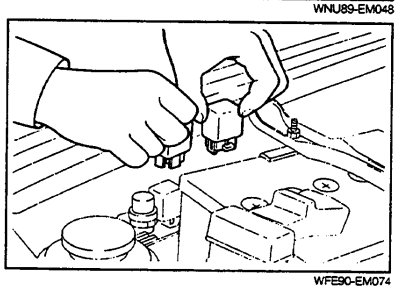
WFE90-EM073

   (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.



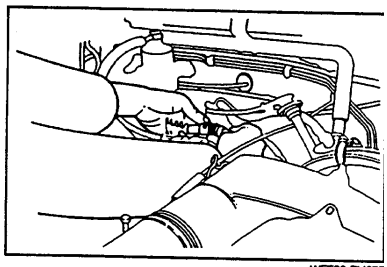
WNU89-EM048

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

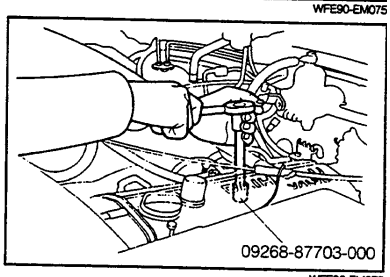


WFE90-EM074

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


WFE90-EM075

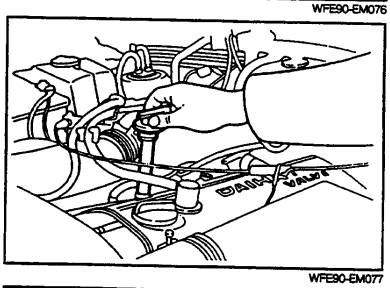
9. Install the spark plugs using the following SST.
   SST: 09268-87703-000
   Tightening Torque: 14.7 - 21.6 N·m (1.5 - 2.2 kgf-m)



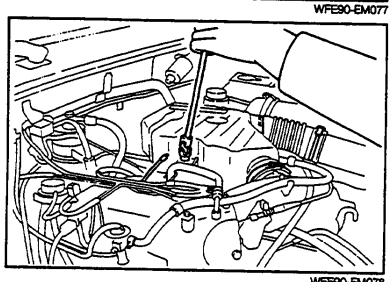
WFE90-EM076

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.

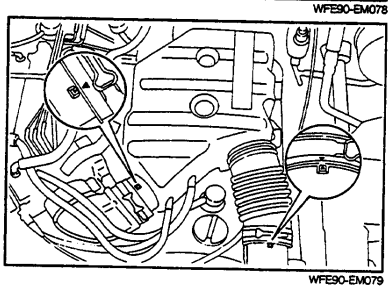
11. Attach the spark plug wires to the clamp.


WFE90-EM077

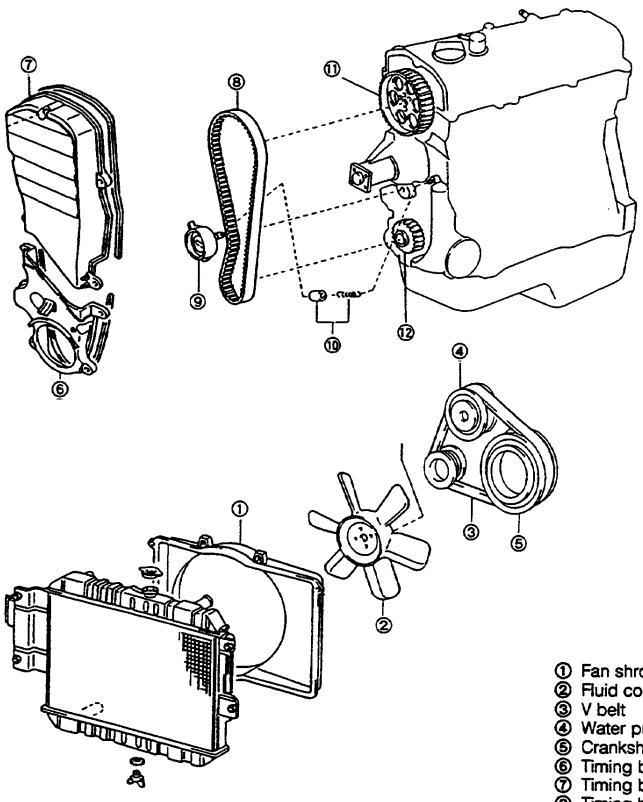
12. Insert the intake air chamber into the intake air hose. Secure it with the three attaching bolts.


WFE90-EM078

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


WFE90-EM079

TIMING BELT
COMPONENTS



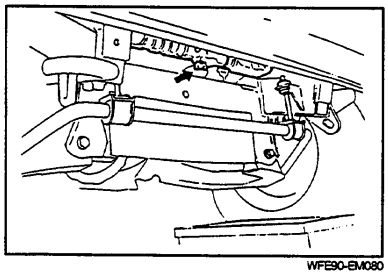
① Fan shroud
② Fluid coupling fan
③ V belt
④ Water pump pulley
⑤ Crankshaft pulley
⑥ Timing belt cover No. 1
⑦ Timing belt cover No.2
⑧ Timing belt
⑨ Timing belt tensioner
⑩ Tension spring assy
⑪ Camshaft timing pulley
⑫ Crankshaft timing pulley

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.

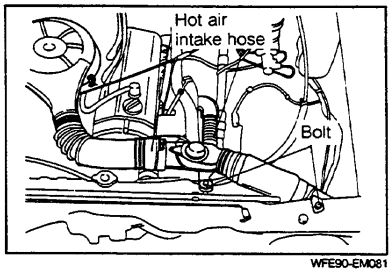
WARNING:
- The engine coolant may be vary hot. Care must be exercised to avoid getting scalded.



WFE90-EM080

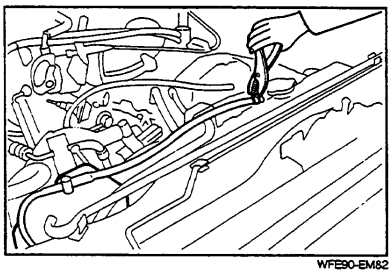
[HD-C Engine]

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).

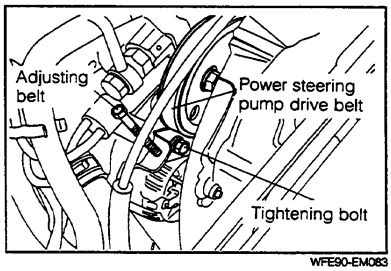


WFE90-EM081

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.

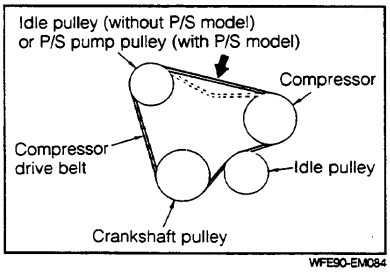

WFE90-EM82

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



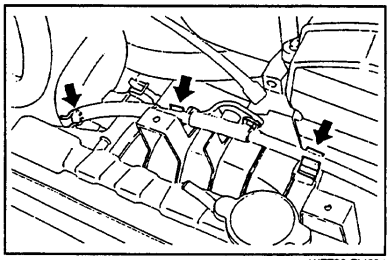
WFE90-EM083

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

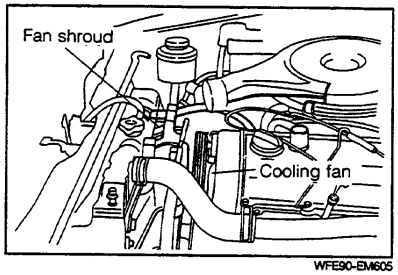


WFE90-EM084

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

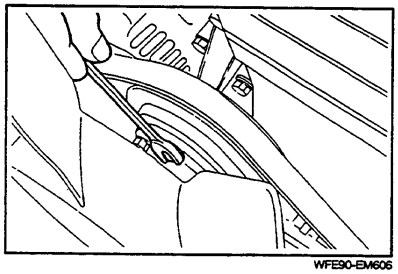

WFE90-EM604

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

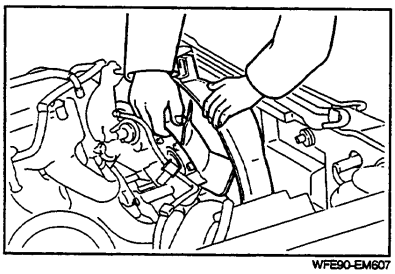


WFE90-EM605

   (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.

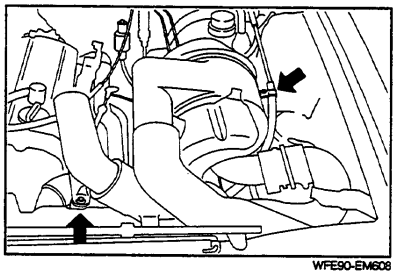

WFE90-EM606

   (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

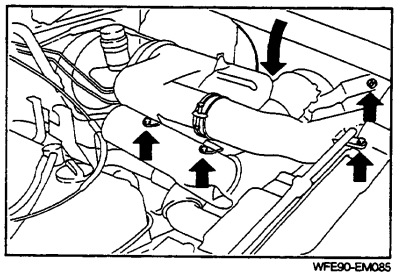

WFE90-EM607

[HD-E Engine]

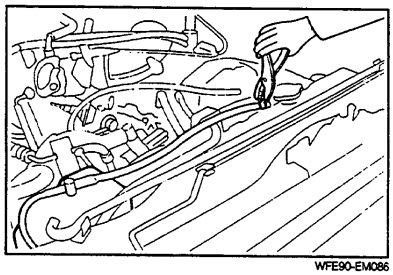
3. Removal of the air cleaner and the air cleaner hose subassembly.
   (1) Remove the tapping screw from the radiator fan shroud upper side.
   (2) Remove the clutch cable clamp provided at the air cleaner.


WFE90-EM608

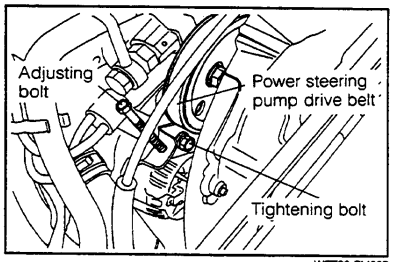
   (3) Remove the air cleaner hose attaching bolts provided at the left fender panel and radiator center support. Remove the three air cleaner attaching bolts. Then remove the air cleaner and air cleaner hose subassembly.


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.

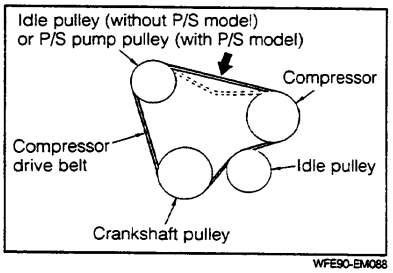

WFE90-EM086

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



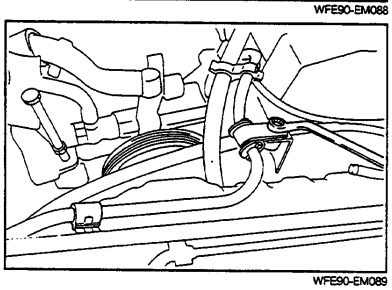
WFE90-EM087

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

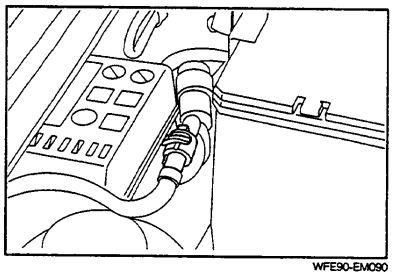


WFE90-EM088

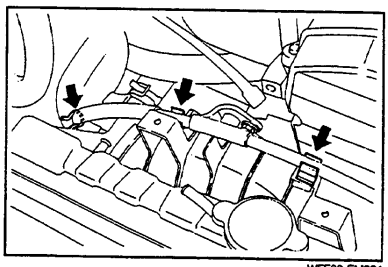
7. Disconnection of the main relay wire
   (1) Remove the clamping bolt and detach the clamp with lock.


WFE90-EM089

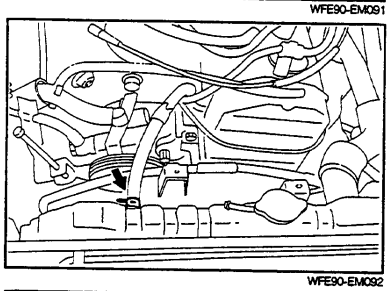
   (2) Disconnect the main relay wire connector at the relay box side.


WFE90-EM090

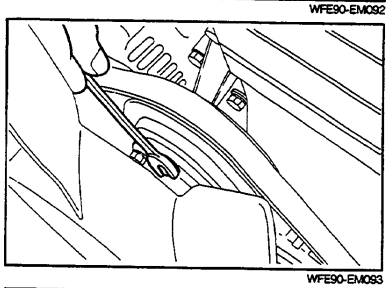
8. Remove the three clamps for clutch cable provide on the fan shroud.


WFE90-EM091

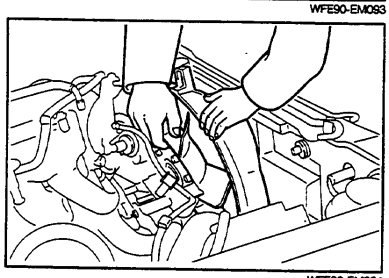
9. Removal of fluid coupling with fan and fan shroud.
   (1) Disconnect the air breather hose from the radiator upper tank.


WFE90-EM092

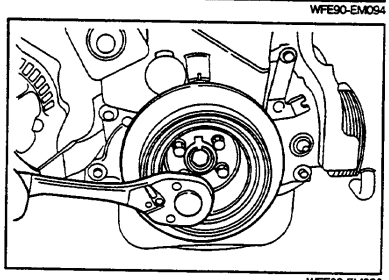
   (2) Remove the four water pump pulley attaching nuts. Then detach the fluid coupling with fan from the water pump pulley tempporarily.
   (3) Remove the drive belt by loosening the alternator pulley adjusting bolt.
   (4) Remove the water pump pulley.


WFE90-EM093

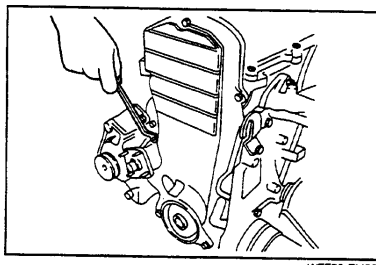
   (5) Remove the two fan shroud attaching bolts from the radiator
   (6) Unlock the lock section of the fan shroud lower part from the radiator by pulling up the fan shroud.
   (7) Remove the fan shroud together with fluid coupling with fan from the engine comportment


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.



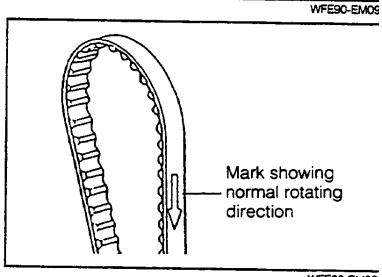
12. Removal of timing belt

NOTE:

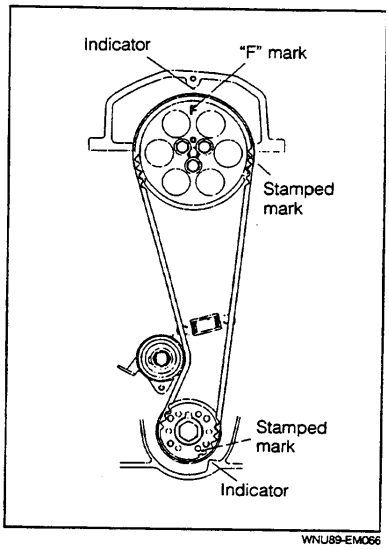
- Prior to removal of the timing belt, put an arrow mark indicating the normal rotating direction on the belt, using a chalk or the like.

CAUTION:

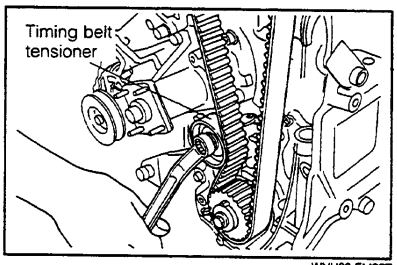
- Do not try to pry the timing belt with a screwdriver or the like during the removal or installation.
- Do not allow the belt to come into contact with oil, water or dust.
- Do not bend the belt at a sharp angle r turn the belt inside out, for it is very vulnerable to bending.
- Do not utilize the tension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



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

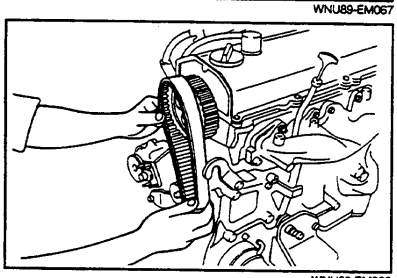


(2) Loosen the attaching bolt of the timing belt tensioner. Move the tensioner to the left as for as it will go and tighten the bolt temporarily.

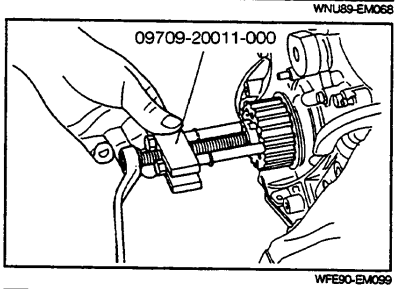


WNU89-EM067

(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

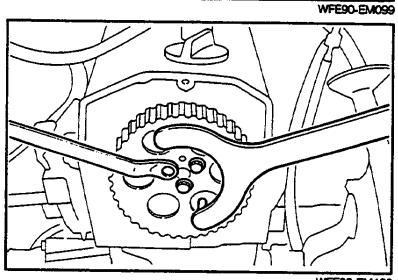


WFE90-EM099

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

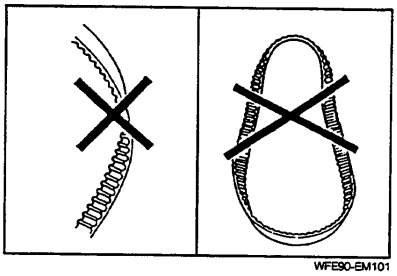
(3) Remove the camshaft timing belt pulley.

15. Remove the timing belt tensioner and tension spring.


WFE90-EM100

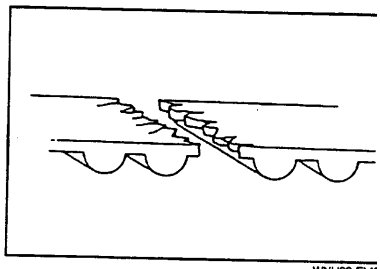
INSPECTION OF COMPONENTS

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.

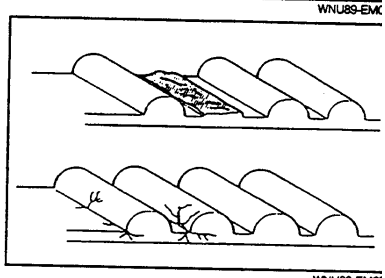

WFE90-EM101

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

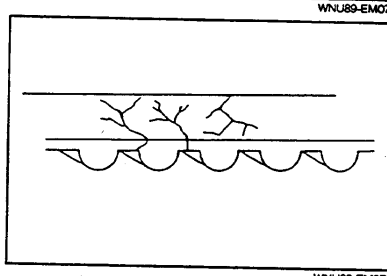
(1) Premature separation
- Check for proper installation.
- Check the timing gear cover gaskets for damage and check for correct installation.



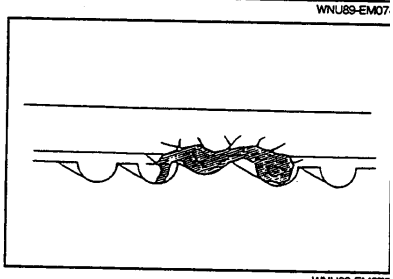
(2) If the belt teeth are cracked or damaged, check to see if the camshaft is seized.



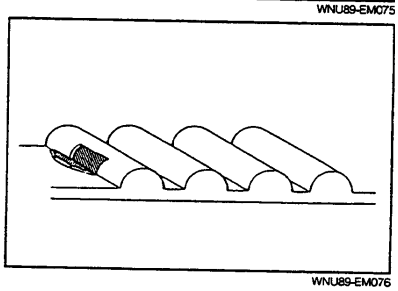
(3) If there is noticeable wear or cracks on the belt face, check to see if there are nicks on one side of the idler pulley lock.



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

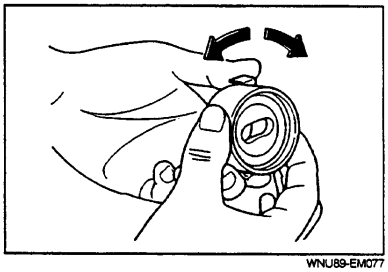


(5) If there is noticeable wear on the belt teeth, check the timing cover gasket for damage and check for correct gasket installation. Check for foreign material on the pulley teeth.



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

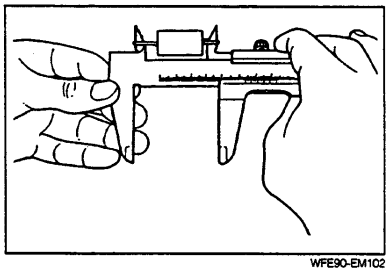
   If necessary, replace the timing belt tensioner.
   CAUTION:
   - **Never wash the timing belt tensioner.**


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

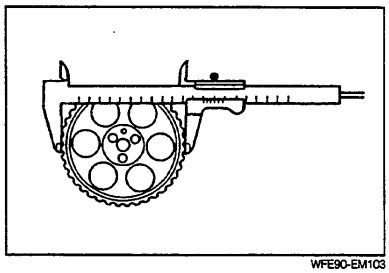
   If the tension does not conform to the specification, replace the spring.


WFE90-EM102

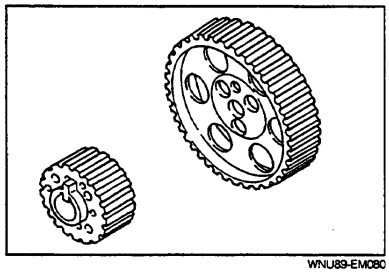
4. Inspection of timing belt pulley
   (1) Measure the maximum diameter of the timing belt pulley, using vernier calipers.

   Reference:

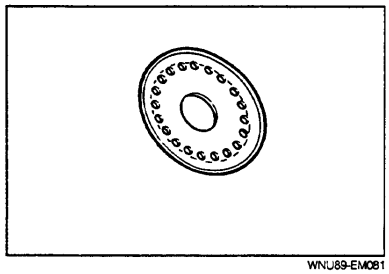
Camshaft timing belt pulley: 119.90 mm
Crankshaft timing belt pulley: 59.37 mm


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

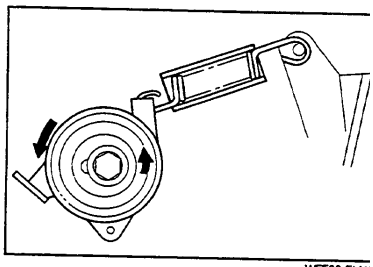
INSTALLATION OF TIMING BELT

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

Repair any water leakage or oil leakage, if necessary.

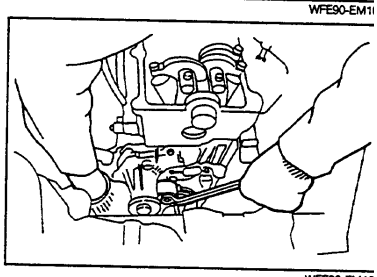
WFE90-EM

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.



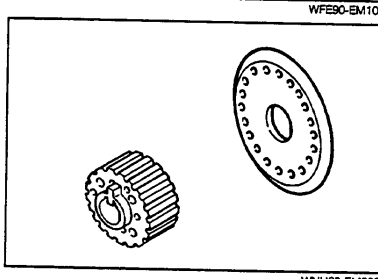
WFE90-EM1

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



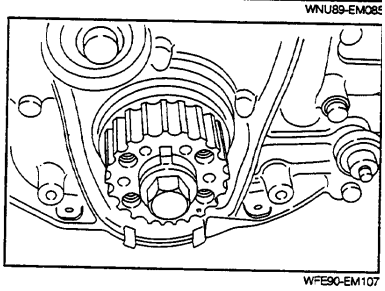
WFE90-EM10

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-EM08

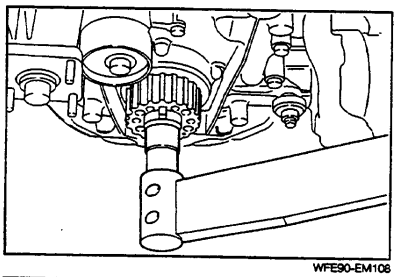
   (2) Install the crankshaft timing belt pulley on the crankshaft by aligning it with the key groove. Install the setting bolt of the crankshaft timing belt pulley. Align the stamped mark of the crankshaft timing belt pulley with the indicator.



WFE90-EM107

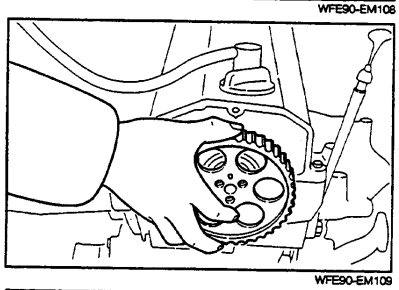
(3) Tighten the crankshaft timing belt pulley bolt.
Tightening Torque: 88.3 - 98.0 N·m (9.0 - 10.0 kgf-m)

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


WFE90-EM108

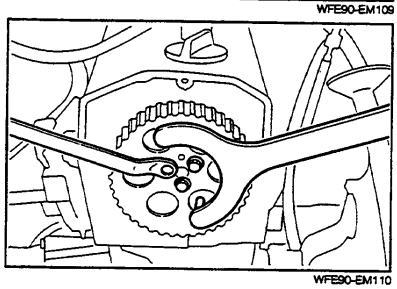
4. Installation of camshaft timing belt pulley
(1) Install the camshaft timing belt pulley on the camshaft in such a way that the "F" mark can be seen and the locating pin hole is aligned.

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.

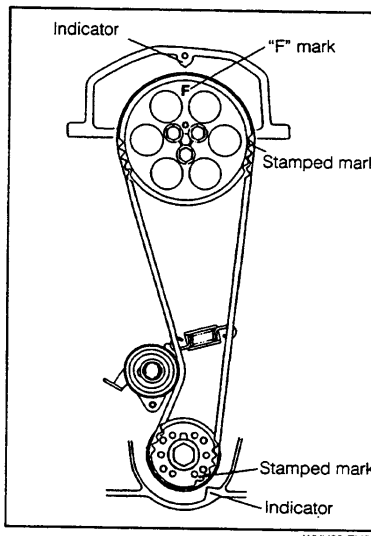
CAUTION:

- 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.

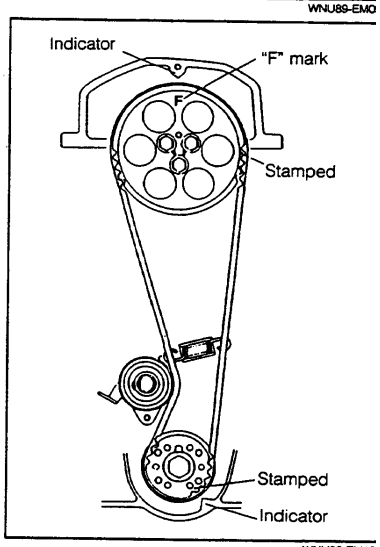


WNU89-EM09

(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.

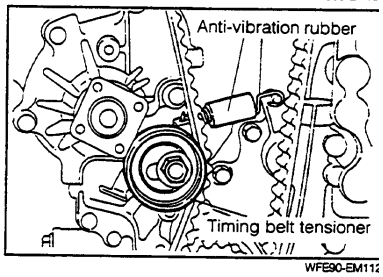


WNU89-EM10

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

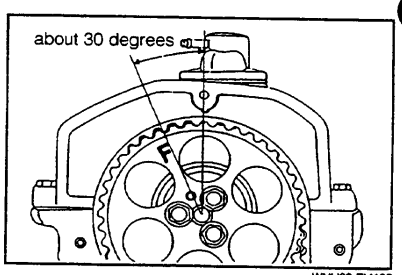
NOTE:

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



WFE90-EM11

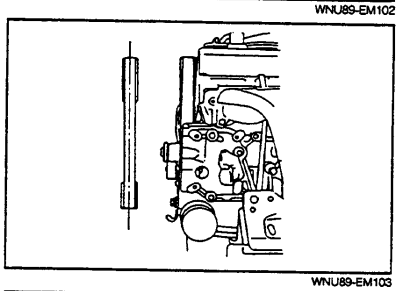
(5) Rotate the crankshaft 1.9 turns in the normal direction (to the right as viewed from the engine cylinder No. 1) so that the "F" mark of the camshaft timing belt pulley comes at a point three teeth in the camshaft timing belt pulley before the indicator of the cylinder head cover.



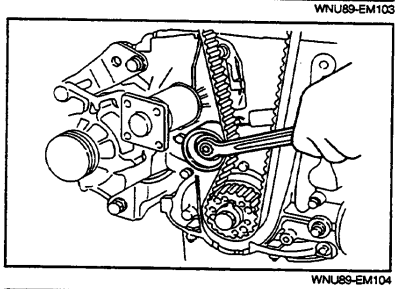
WNU89-EM102

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.

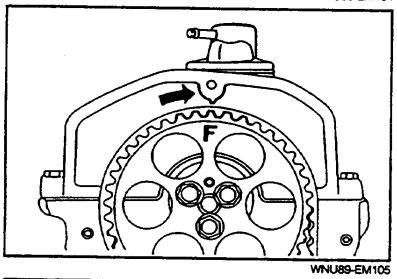

WNU89-EM103

(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.

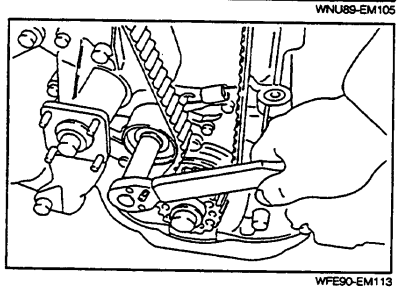
CAUTION:
- Never turn the crankshaft reversely.
- Never turn the crankshaft beyond the point where the "F" mark of the camshaft timing belt pulley is aligned with the indicator.



WNU89-EM105

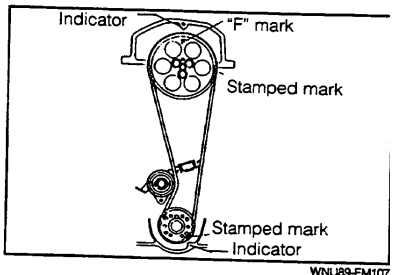
If the crankshaft should be reversed or turned beyond that point, temporarily tighten the tensioner attaching bolt and repeat the operations from the step (5) onward.

(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.

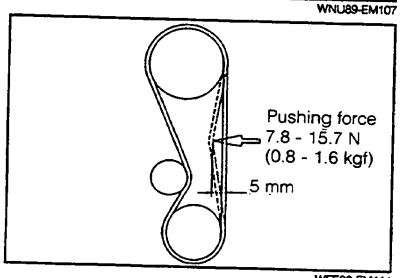
If the stamped mark is not aligned with the indicator, repeat the operations from the step (1) onward.



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.

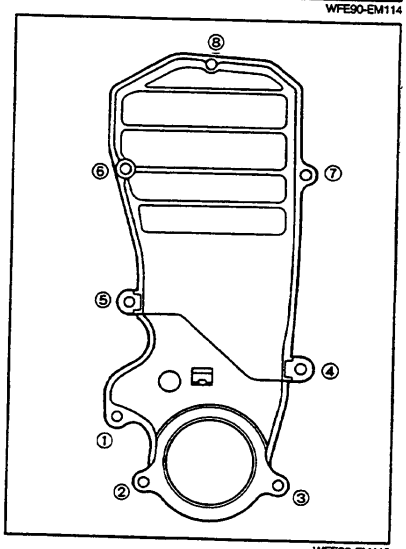


WFE90-EM114

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.**

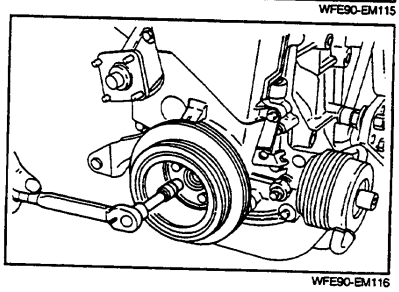
(2) Install the timing belt cover No. 2 (upper side) with five bolts.
Tightening Torque: **2.0 - 3.9 N·m (0.2 - 0.4 kgf-m)**
(For both upper and lower cover)

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



WFE90-EM115

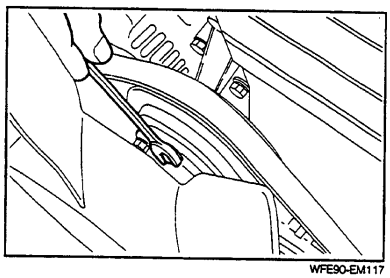
8. Installation of crankshaft pulley
(1) Prevent the crankshaft from turning by placing the gear shift lever in the 5th gear position, and pull the parking break lever.
(2) Install the crankshaft pulley on the crankshaft timing belt pulley with four bolts.
Tightening Torque: **19.6 - 29.4 N·m (2.0 -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

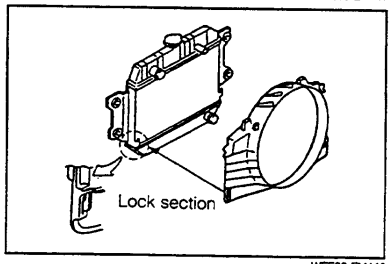

WFE90-EM116

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.

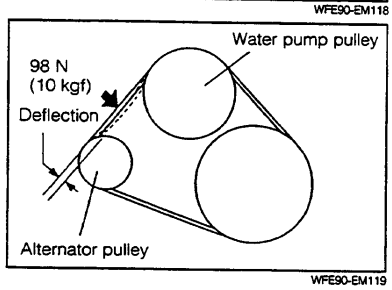

WFE90-EM117



WFE90-EM118

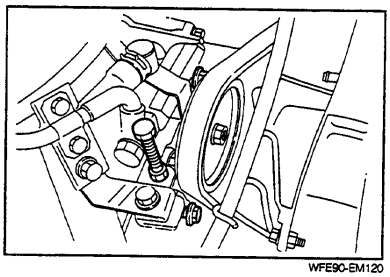
10. Installation of V belt
    (1) Install the V belt.
    (2) Perform the adjustment in such a way that the deflection at the midpoint between the water pump pulley and the alternator may become the specified value when a force of 98 N (10 kgf) is applied to the midpoint.
    Specified Belt Deflection:
    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.**

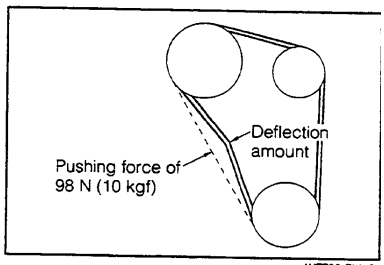


WFE90-EM119

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

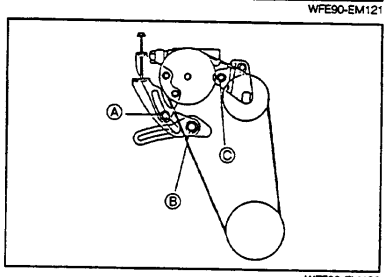

WFE90-EM120

(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]



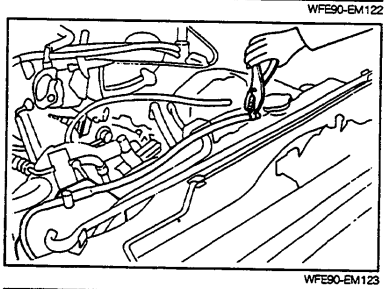
WFE90-EM121

(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)



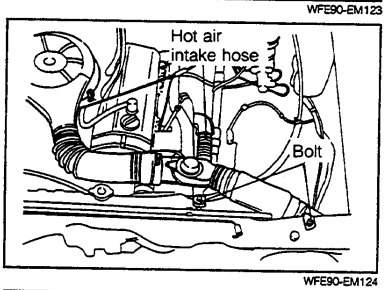
WFE90-EM122

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

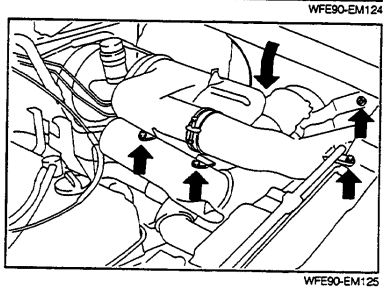
13. Installation of the air cleaner and the air cleaner hose.

[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.

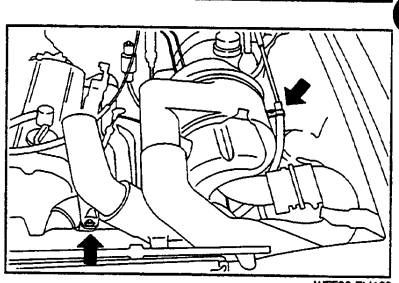


WFE90-EM124

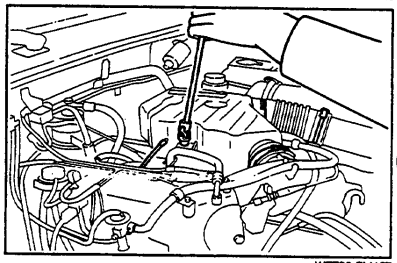
[HD-E Engine]
(1) Put the air cleaner and the air cleaner hose into position.
(2) Tighten the three air cleaner attaching bolts.
(3) Tighten the air cleaner hose attaching bolts provided at the left fender panel and the radiator center support.


WFE90-EM125

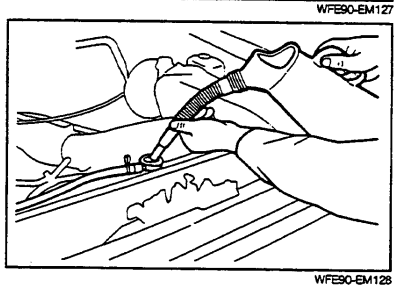
14. Install the clutch cable clamp provided at the air cleaner.
15. Install the tapping screw onto the radiator fan shroud upper side.


WFE90-EM126

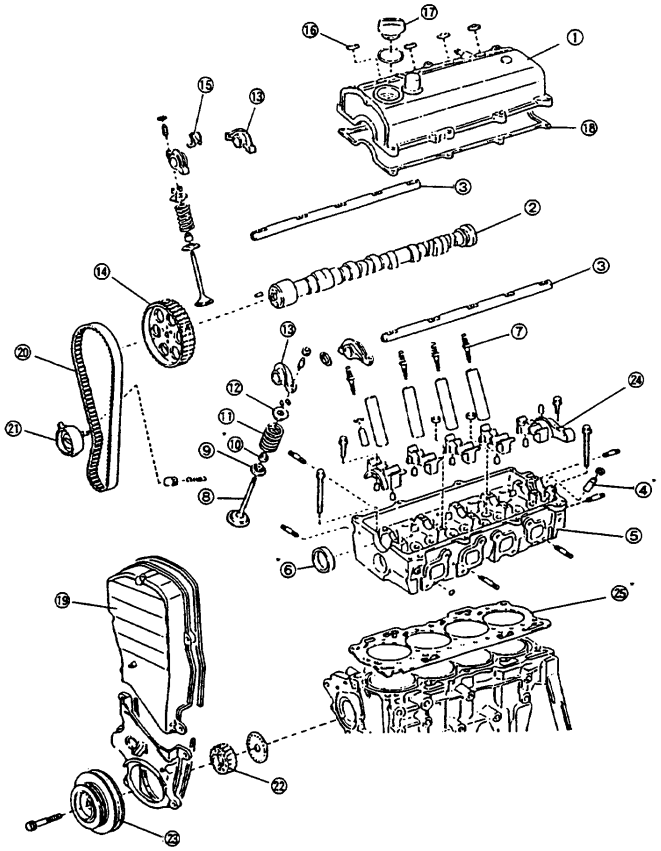
16. Install the air intake chamber.


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



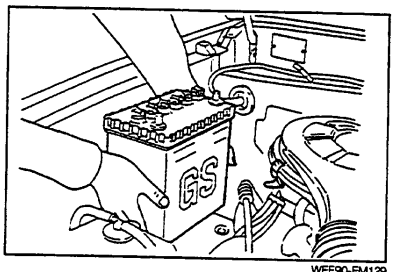
① Cylinder head cover
② Camshaft
③ Valve rocker shaft
④ Valve guide
⑤ Cylinder head
⑥ Oil seal
⑦ Spark plug
⑧ Valve
⑨ Spring seat
⑩ Valve stem oil seal
⑪ Valve spring
⑫ Valve spring retainer
⑬ Valve rocker arm
⑭ Camshaft timing belt pulley
⑮ Spacer
⑯ Grommet
⑰ Oil filler cap
⑱ Gasket
⑲ Timing belt upper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

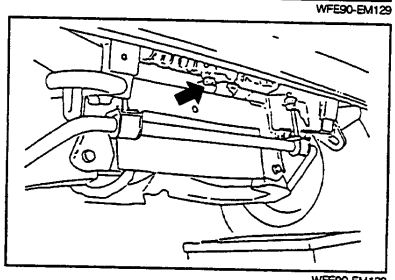
REMOVAL OF CYLINDER HEAD WITH MANIFOLDS

[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.

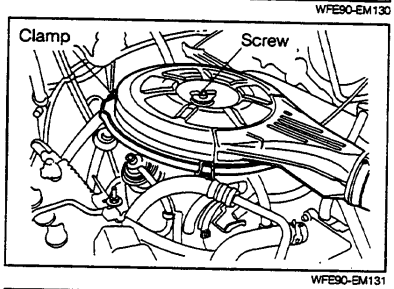

WFE90-EM129

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

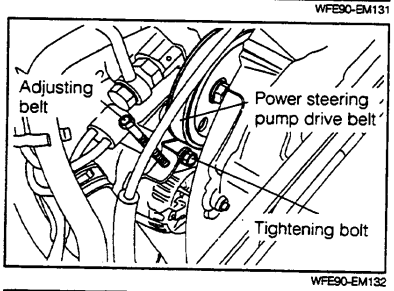
5. Removal of air cleaner assembly.
   (1) Disconnect the flowing hoses at air cleaner side.
   - ITC vacuum hose to carburetor
   - Vacuum hose to TVSV
   - PCV hoses
   - Vacuum hoses for vacuum motor

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



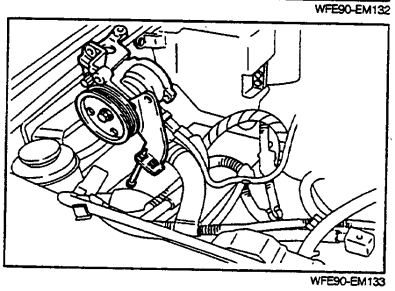
WFE90-EM131

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.

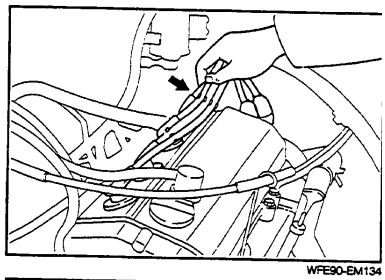


WFE90-EM132

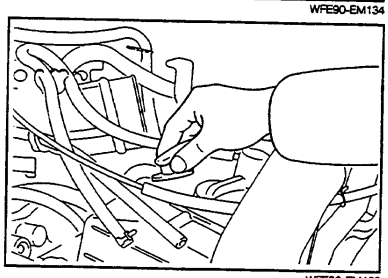
   (4) Remove the power steering pump assembly and put on the battery carrier temprarily.
   (5) Disconnect the vacuum hose for idle up.


WFE90-EM133

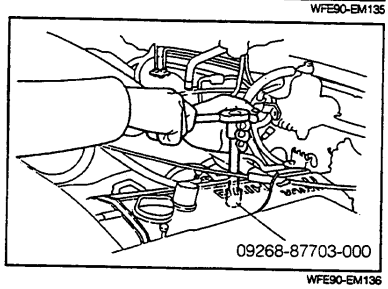
7. Removal of spark plugs.
   (1) Detach the spark plug wires from the clamp.


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

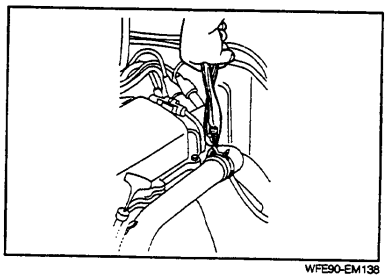


WFE90-EM136

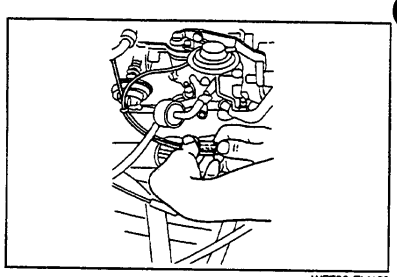
12. Removal of timing velt.
(See Page EM-32.)

WFE90-EM137

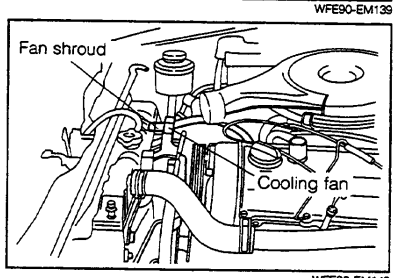
13. Removal of water hose and coupler
   (1) Disconnect the water out let hose at the engine rear side.
   (2) Disconnect the heater hose at the rear right side of engine.
   (3) Disconnect the small water hose at the water inlet side.


WFE90-EM138

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

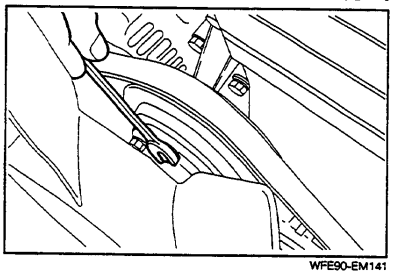

WFE90-EM139

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.

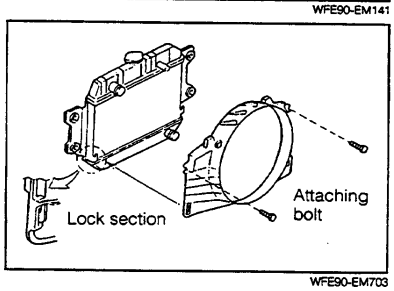


WFE90-EM140

(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.

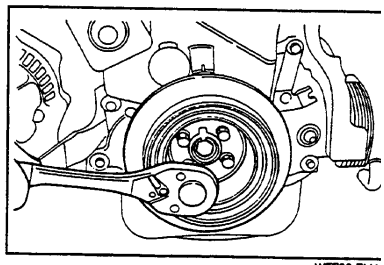


WFE90-EM703

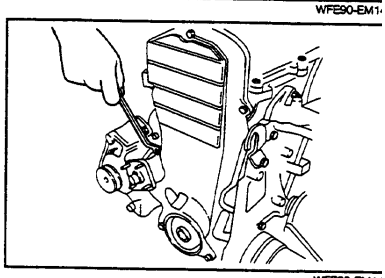
9. Remove the V-ribbed belt and water pump pulley.

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.**

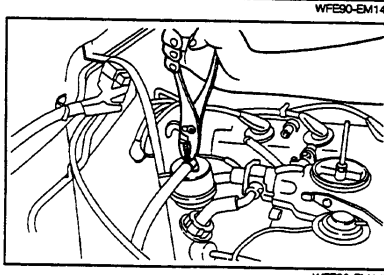

WFE90-EM1

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

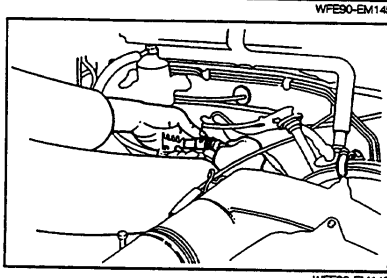

WFE90-EM14

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.**

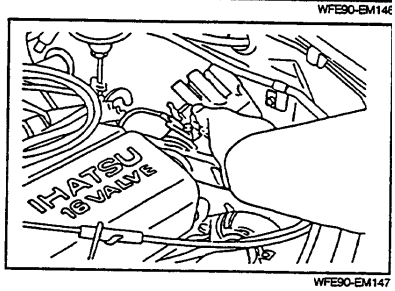
(2) Disconnect the evaporative emission hoses at charcoal canister.


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.

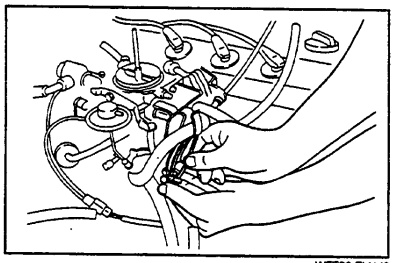

WFE90-EM14

(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.**

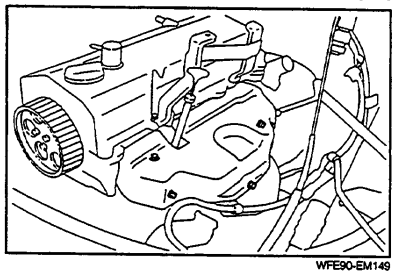


WFE90-EM147

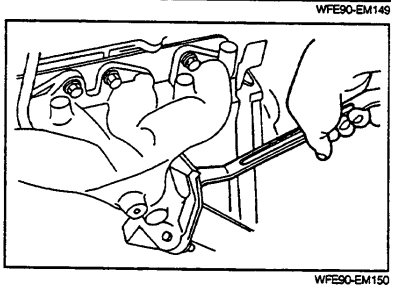
15. Disconnect the accelerator cable from the carburetor.


WFE90-EM148

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

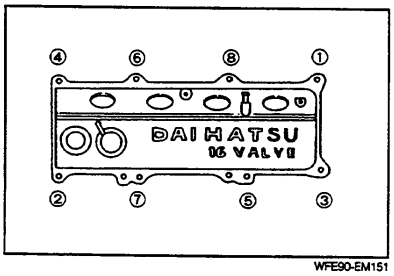

WFE90-EM149

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


WFE90-EM150

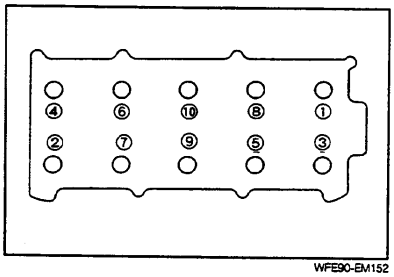
18. Removal of cylinder head cover
    (1) Remove the spark plug wires from the cylinder head.
    (2) Remove the spark plugs, using the SST.
    SST: 09268-877703-000

    (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.

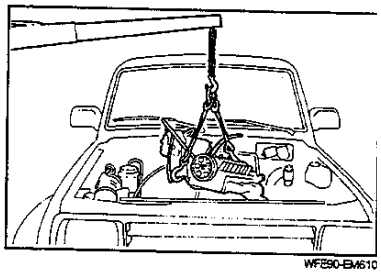
NOTE:

- 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:

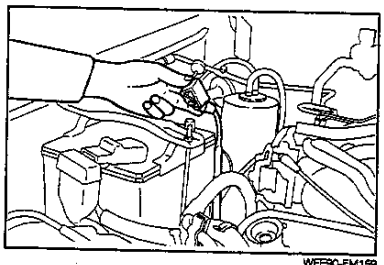
- Be careful not to allow the cylinder head to hit to the vehicle body and/or other parts.
- Place the removed cylinder head on suitable two wooden blocks in order that the cylinder head surface and valve may not be damaged.


WFE90-EM610

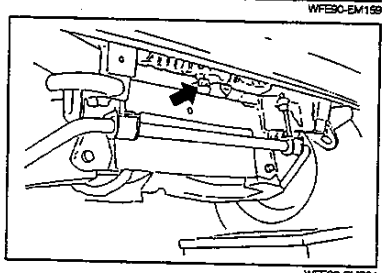
(8) Remove the cylinder head gasket.

[HD-E Engine]

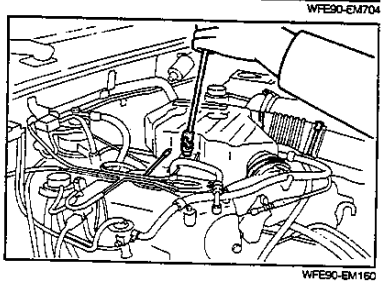
1. Removal of the battery
   (1) Disconnect the battery ground cable from the negtive (–) terminal of the battery.
   Then disconnect the positive cable from the positive (+) terminal.
   (2) Remove the battery from the engine compartment by removing the battery holding clamp.
2. Drain the coolant.
3.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


WFE90-EM159

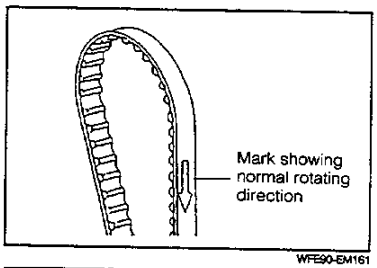
4. Removal of engine hood.
   (1) Disconnect the window shield washer hose.
   (2) Remove the engine hood by removing four bolts.


WFE90-EM704

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

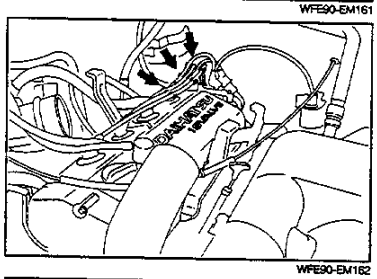

WFE90-EM160

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

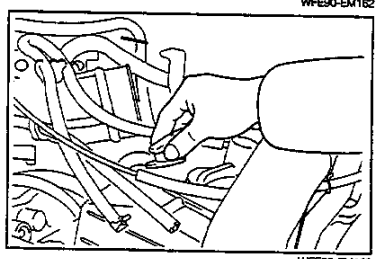


WFE90-EM161

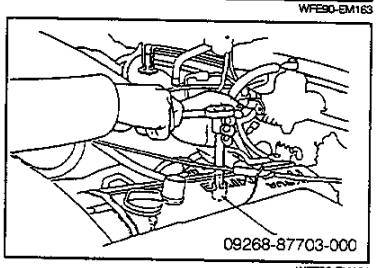
7. Removal of spark plugs.
(1) Remove the spark plug wire clamps.


WFE90-EM162

(2) Remove the spark plug wires.

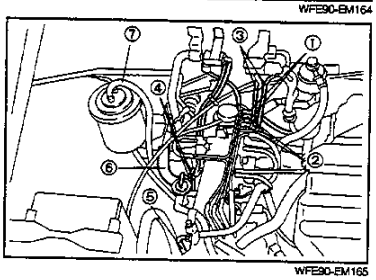

WFE90-EM163

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



WFE90-EM164

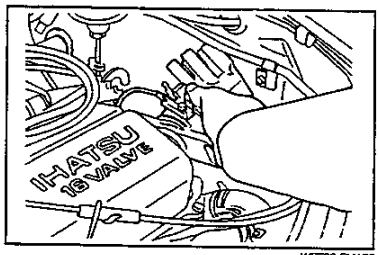
8. Removal of following vacuum hoses at surge tank side.
(1) Distributor diaphram ①
(2) BVSV ②
(3) Pressure VSV ③ (us spc only)
(4) Air conditioner idle up VSV ④
(5) Power steering ACV ⑤
(6) Brake booster ⑥
(7) Charcoal canister ⑦



WFE90-EM165

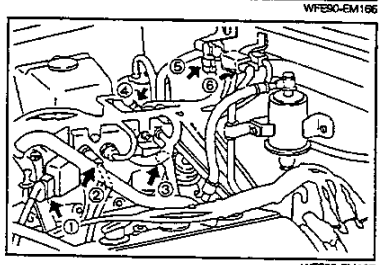
9. Removal of distributor
   (1) Disconnect the distributor wire connector.
   (2) Remove the distributor from the cylinder head by removing the two attaching bolts.

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

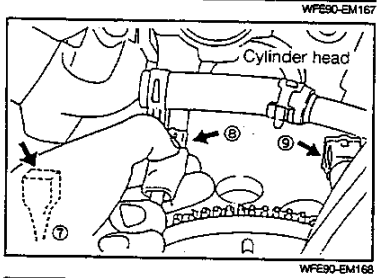


WFE90-EM166

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)

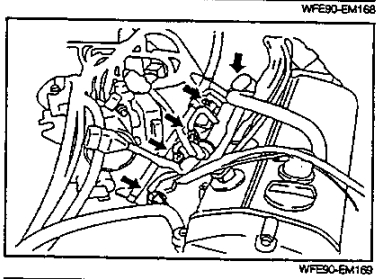

WFE90-EM167

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

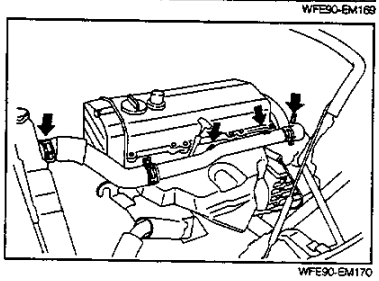


WFE90-EM168

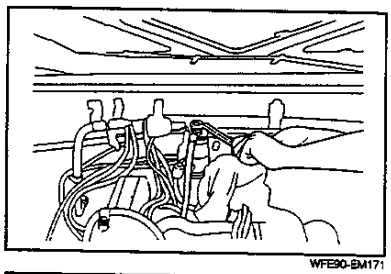
    (2) Disconnect the four injector connectors.
    (3) Remove the engine wire clamps and engine ground cables.


WFE90-EM169

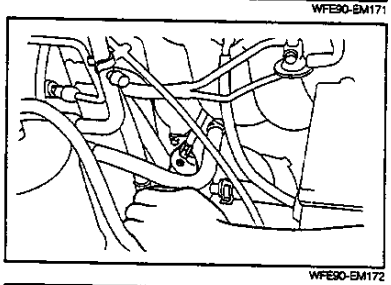
11. Remove the radiator hose No. 1 from the radiator upper tank by loosening the two clamps and attaching bolts.


WFE90-EM170

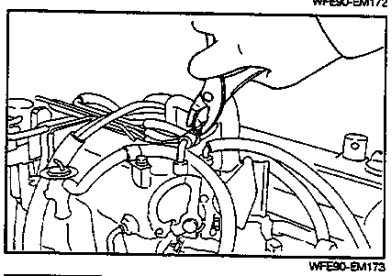
12. Disconnect the hose No. 1 from the fuel filter.
    CAUTION
    - The fuel pressure inside the fuel line is set to a pressure 250 kPa (2.55 kgf/cm²) higher than the atmospheric pressure. Hence, graduall loosen the connection while preventing the fuel from splashing with a cloth or the like.


WFE90-EM171

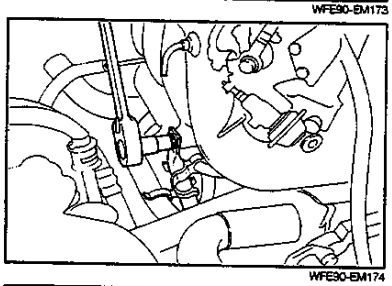
13. Disconnect the fuel return hose from the fuel pipe No.2.
    CAUTION:
    - When disconnecting the fuel hose, take precautionary measures to prevent any dirt from entering the fuel line.
    - Release the inner pressure of fuel tank by removing the fuel filler cap in advance.


WFE90-EM172

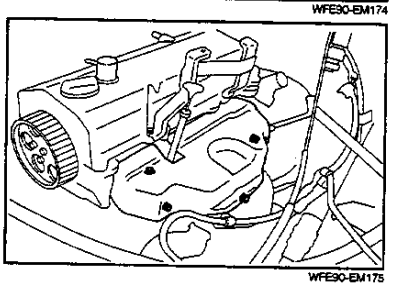
14. Disconnect the water hose from the upper side of the throttle body.


WFE90-EM173

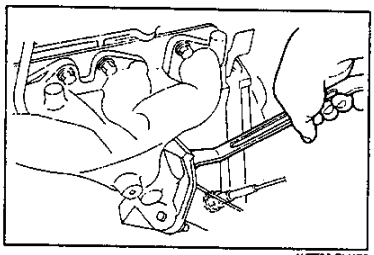
15. Remove the surge tank stay No. 2 from the surge tank.


WFE90-EM174

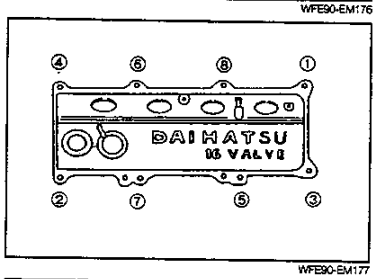
16. Remove the exhaust manifold cover by removing the five bolts.
17. Remove the oil level gauge support by removing the clamping bolt.


WFE90-EM175

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

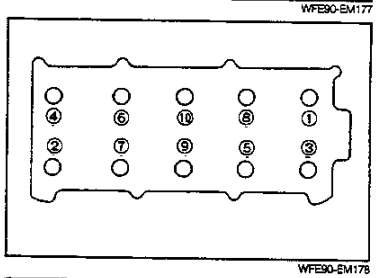

WFE90-EM176

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.



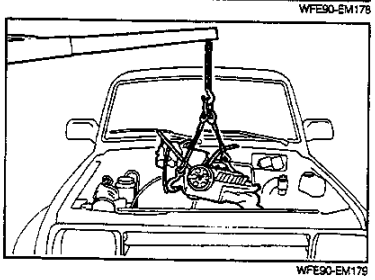
WFE90-EM177

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

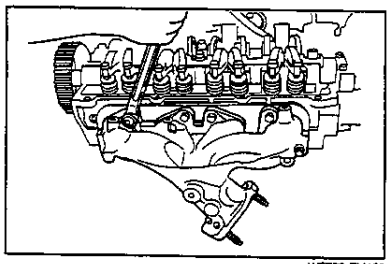
    (2) Remove the cylinder head with intake and exhaust manifold, by using the chain block.
    CAUTION:
    - Be careful not to allow the cylinder head to hit to the vehicle body and/or other parts.
    - Place the removed cylinder head on suitable two wooden blocks in order that the cylinder head surface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


WFE90-EM179

SEPARATION OF INTAKE AND EXHAUST MANIFOLDS

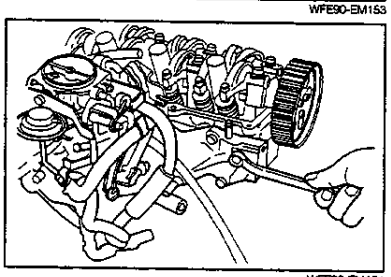
[HD-C Engine]

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



WFE90-EM153

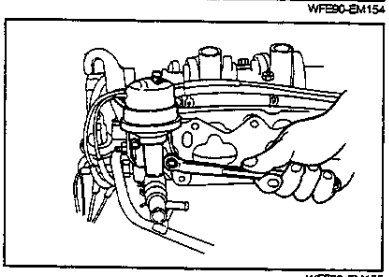
3. Removal of intake manifold
   (1) Disconnect the fuel hose at the carburetor side.
   (2) Disconnect the choke breaker hoses.
   (3) Disconnect the water by-pass hose.
   (4) Remove the intake manifold with carburetor by removing the eight attaching bolts and the four nuts.



WFE90-EM154

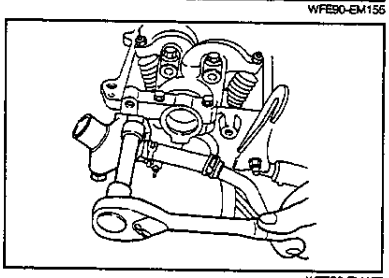
4. Removal of fuel pump
   NOTE:
   - **When disconnecting the fuel pump, take precautionary measures to flow out the engine oil.**

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



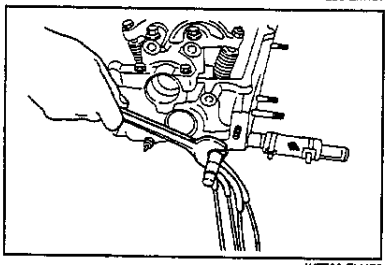
WFE90-EM155

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

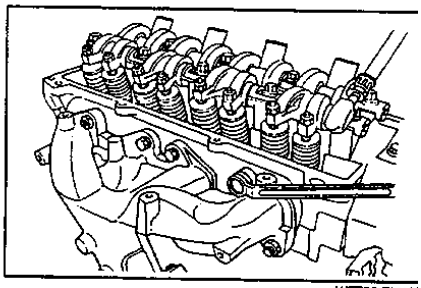
7. Remove the TVSV and water temperature sensor gauge.



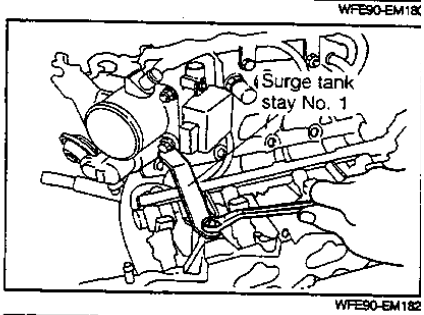
WFE90-EM158

[HD-E Engine]

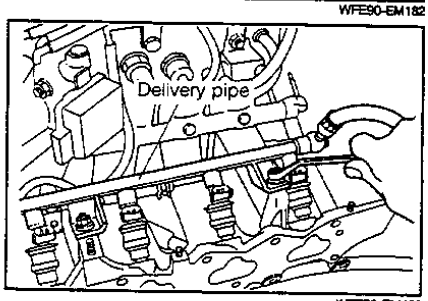
1. Remove the exhaust manifold by removing the six bolts and two nuts.
2. Remove the exhaust manifold gasket.



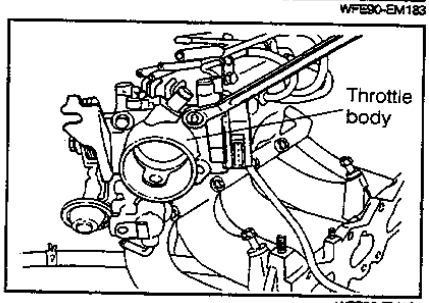
3. Removal of intake manifold assembly.
   (1) Remove the surge tank stay No. 1 by removing the bolt and nut.



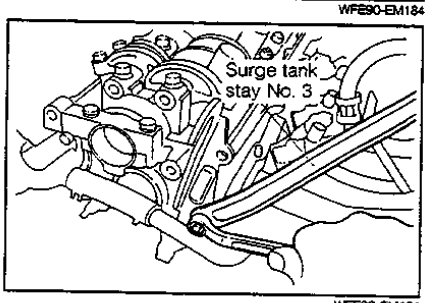
   (2) Remove the delivery pipe by removing the two attaching bolts.



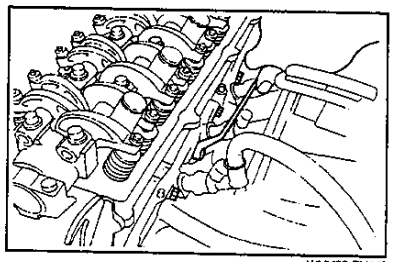
   (3) Remove the throttle body by removing the two bolts and nut.



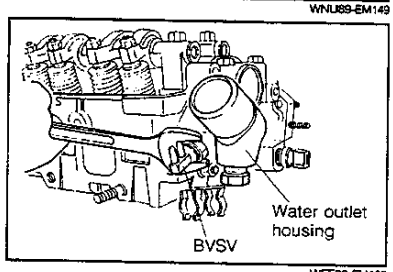
   (4) Remove the surge tank stay No. 3.



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

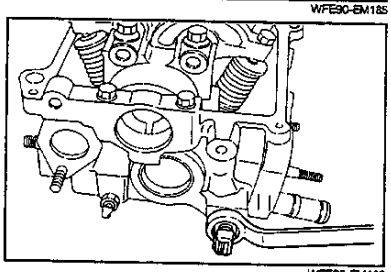

WNU89-EM149

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

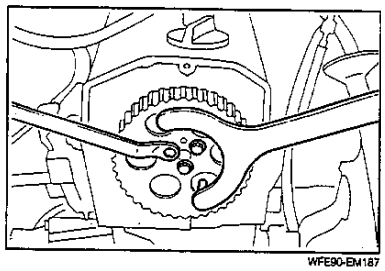
5. Remove the water temperature sensor and water temperature sender gauge.


WFE90-EM186

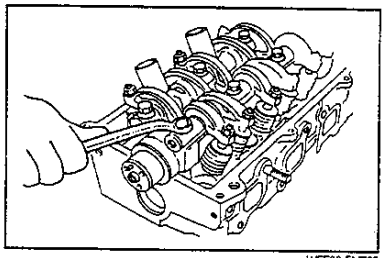
DISASSEMBLY OF CYLINDER HEAD

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.

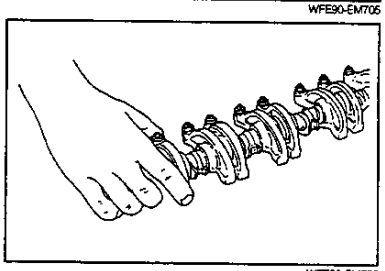

WFE90-EM187

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.**

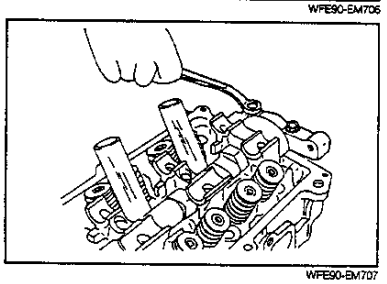

WFE90-EM705

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

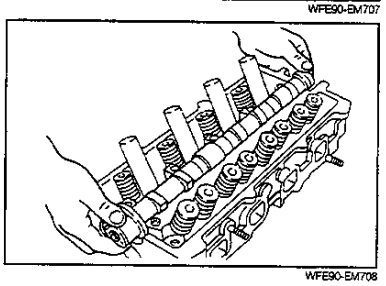
4. Remove the valve rocker arm, spacer and wave washer from valve rocker shaft.


WFE90-EM706

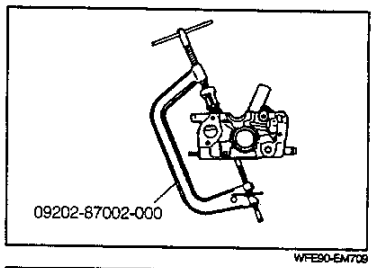
5. Removal of camshaft
   (1) Remove the camshaft bearing cap No. 5 by removing the two attaching bolts.
   (2) Remove the camshaft bearing cap No. 1 to No. 4.


WFE90-EM707

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

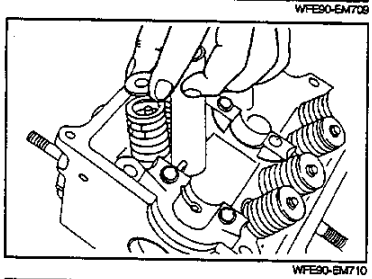

WFE90-EM708

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

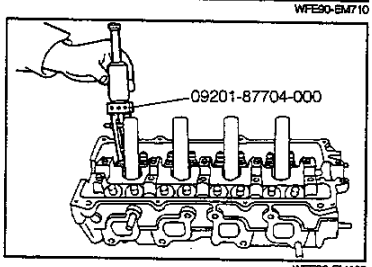


WFE90-EM709

   (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.

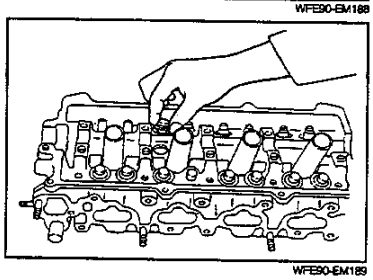

WFE90-EM710

   - 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

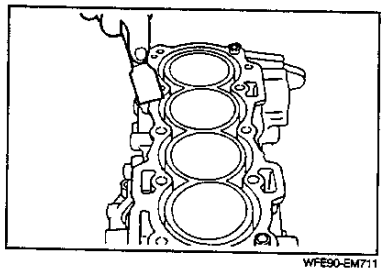
7. Remove the valve spring seats.
   NOTE:
   - Arrange the removed parts in order so that their installing positions may be known easily.


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

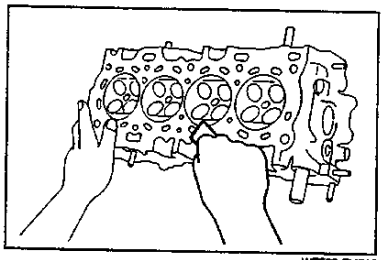
1. Cleaning of top of each piston and cylinder block
   (1) Turn the crankshaft until each piston is brought to the top dead center.
   Using a gasket scraper, remove all carbon deposits from the pistion tops.
   (2) Using a gasket scraper, remove any remaining gasket material from the top of the cylinder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

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

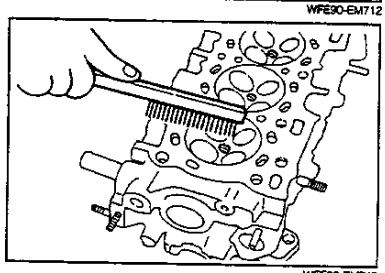
CAUTION:
- **Do not scratch the gasket surfaces of the piston and cylinder block.**

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

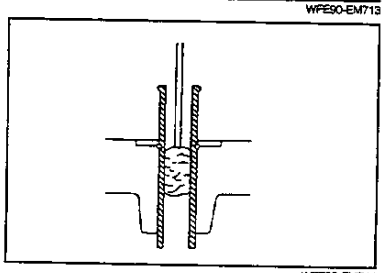
2. Removal of gasket material
   Using a gasket scraper, remove any remaining gasket material from the cylinder head and manifold surfaces.


WFE90-EM712

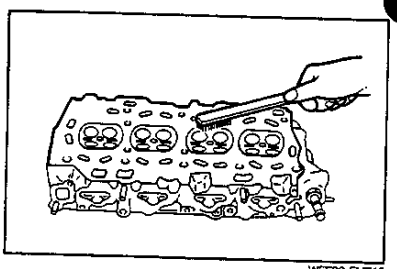
3. Cleaning of combustion chamber
   Using a wire brush, remove all carbon deposits from the combustion chambers.
   CAUTION:
   - **Be careful not to scratch the cylinder head gasket contact surfaces.**


WFE90-EM713

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

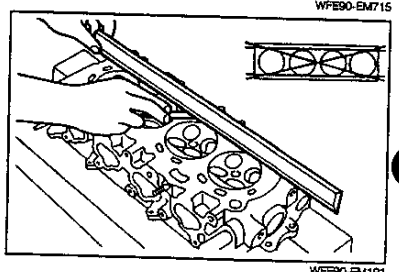

WFE90-EM714

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

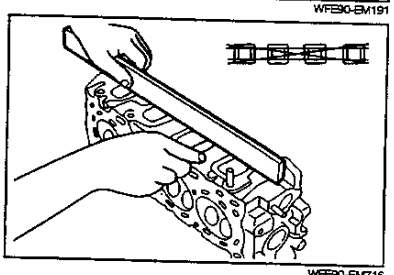

WFE90-EM715

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.

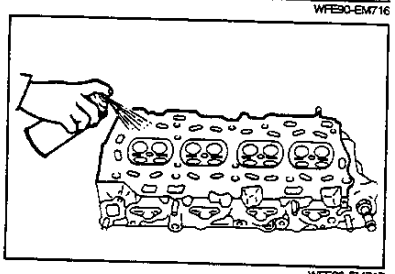
Maximum Surface Warpage:
Cylinder Block Side: 0.10 mm
Intake Manifold Side: 0.10 mm
Exhaust Manifold Side: 0.10 mm


WFE90-EM191

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

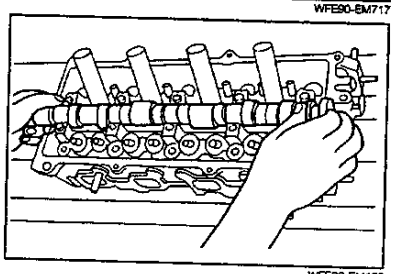

WFE90-EM716

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

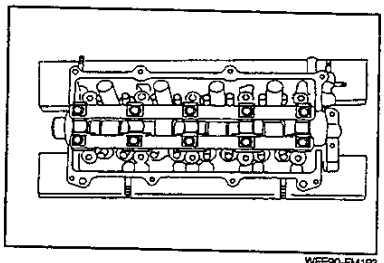
8. Inspection of camshaft oil clearance
NOTE:
- **Prior to this oil clearance check, the camshaft should be checked for bend in advance. (See page EM–76).**

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

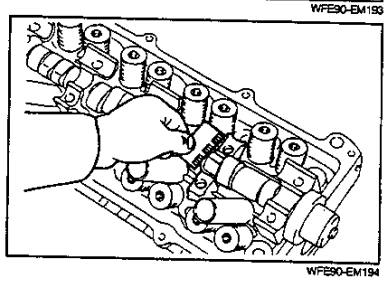

WFE90-EM192

(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

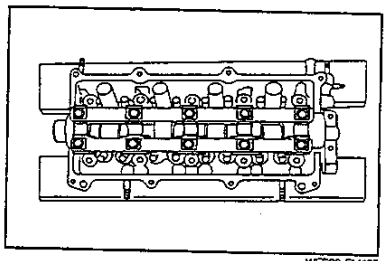
If the oil clearance exceeds the allowable limit, replace the cylinder head and camshaft as a set.

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

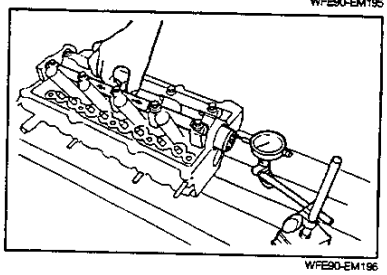
WFE90-EM718

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)

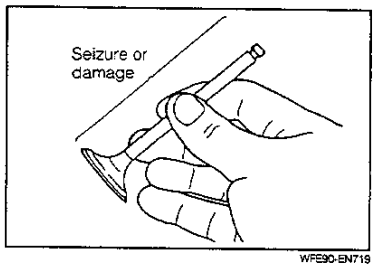
NOTE:
- Ensure that the bolt holes and bolts are dry when tightening the bolts.


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

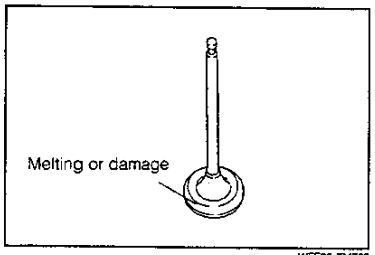

WFE90-EM196

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

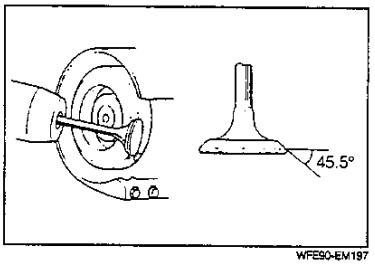
(2) Visually inspect the valve head for melting or damage.
If the valve head exhibits any melting or damage, replace the valve.
If the roughness on the contact surface can be corrected, grind the valve seat contact surface with a valve refacer.



WFE90-EM720

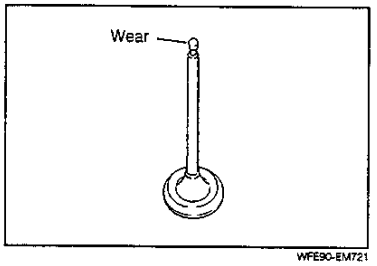
(3) Grind the valves only enough to obtain a smooth contact surface with the valve seat.
Valve Face Angle: 45.5°

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



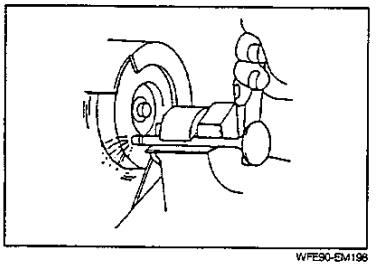
WFE90-EM197

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



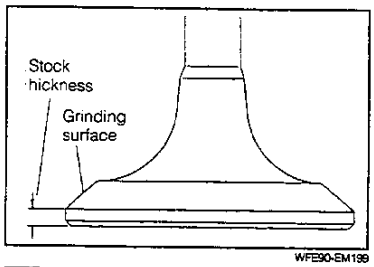
WFE90-EM721

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-EM196

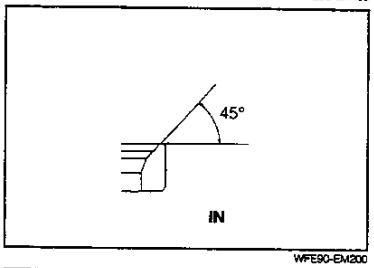
(5) Inspect the valve head for its stock thickness.
Minimum Stock Thickness
Intake Valve: 0.8 mm
Exhaust Valve: 1.0 mm

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



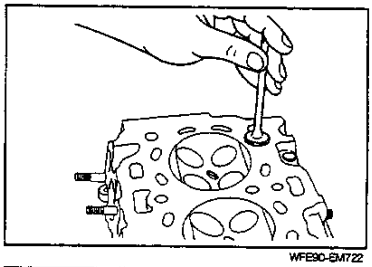
WFE90-EM199

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.



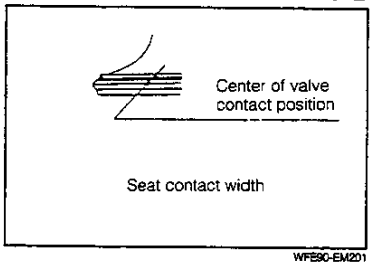
WFE90-EM200

(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

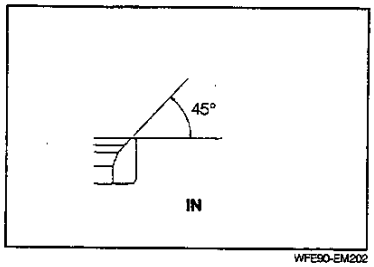
③ Measure the width of the contact surface of valve seat.
Contact Surface of Valve Seat: 1.2 - 1.6 mm

If not, reface the valve seat.



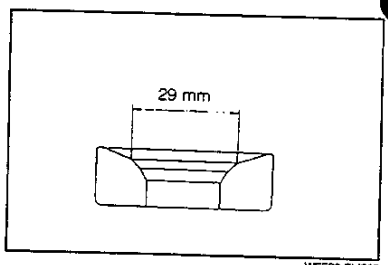
WFE90-EM201

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.



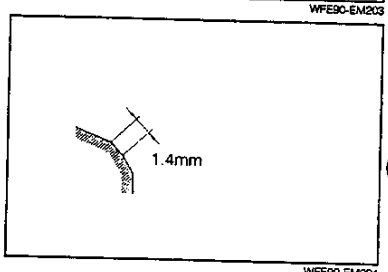
WFE90-EM202

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.



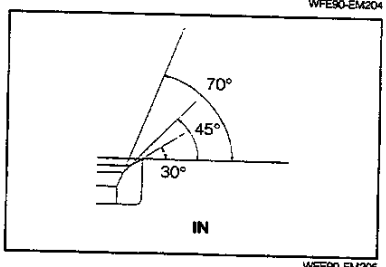
WFE90-EM203

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

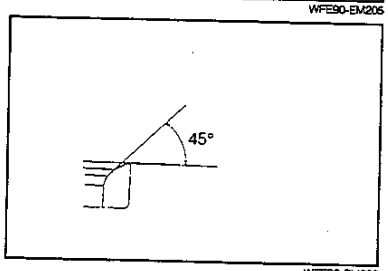
④ Using the 45-degrees cutter, remove burrs produced during the refacing by the 30-degrees and 70-degrees cutters.



WFE90-EM205

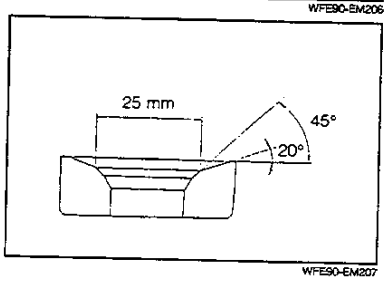
(2) Refacing procedure for exhaust valve seats

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



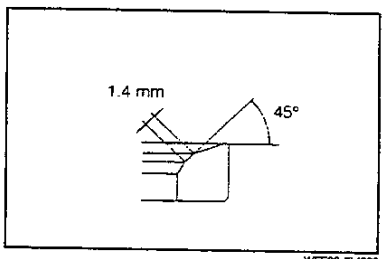
WFE90-EM206

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.



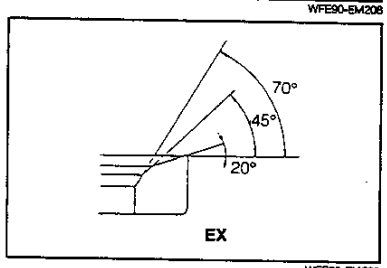
WFE90-EM207

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.



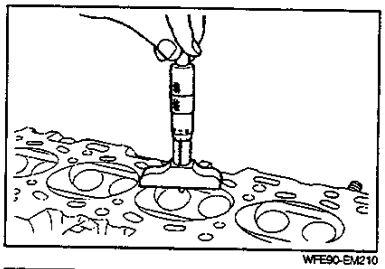
WFE90-EM209

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.

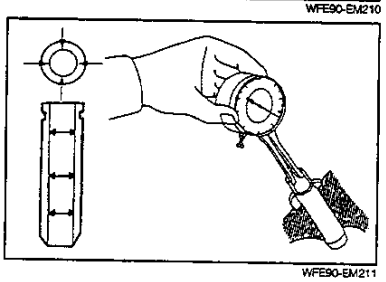
WFE90-EM723

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

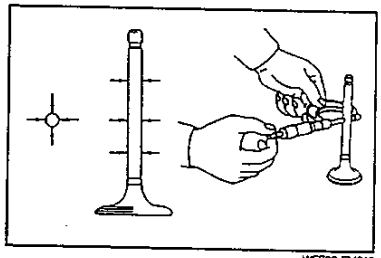
    If the recession exceeds the maximum limit, replace the cylinder head.


WFE90-EM210

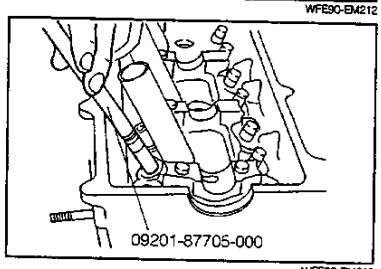
15. Inspection of valve stem-to-guide bushing oil clearance
    (1) Using a caliper gauge, measure the inner diameter of the valve guide at six points.
    Record the measured values.
    Specified Value
    IN: 6,600 - 6;620 mm
    EX: 6,600 - 6,620 mm


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

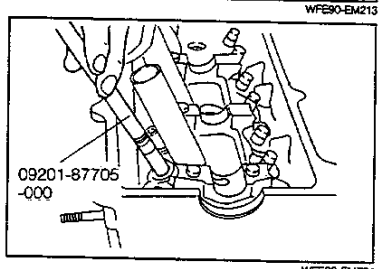
16. Repairs of valve stem-to-guide bushing oil clearance
(1) Intake valve guide bush
① Drive out the valve guide bush from the combustion chamber side, using the following SST.
SST: 09201-87705-000



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

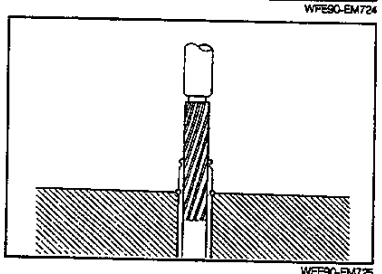
CAUTION:
- Be very careful not to give an excessive impact during the installation. Failure to observe this caution will result in valve guide bush cracks.
- Care should be exercised not to detach the snap ring due to driving the valve guide bush excessively.



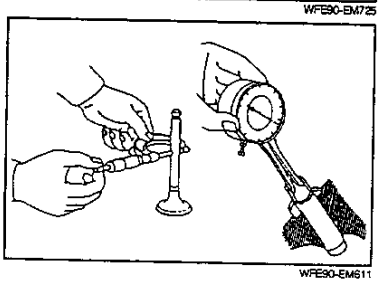
WFE90-EM724

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

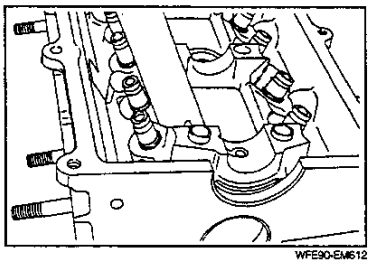
④ Inspection of oil clearance
Ensure that the oil clearance meets the specifications.
Oil Clearance:
Specified Value:
Intake 0.020 - 0.060 mm
Allowable Limit:
Intake 0.08 mm


WFE90-EM611

(2) Exhaust valve guide bush

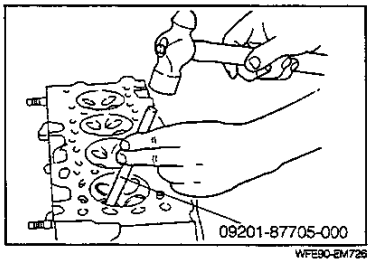
NOTE:

- 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.

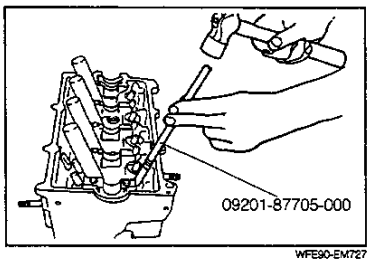
SST: 09201-87705-000



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

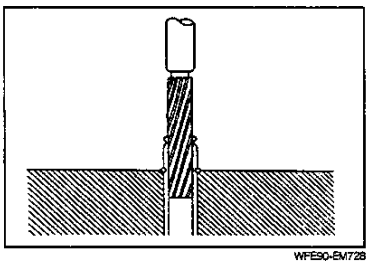
CAUTION:

- 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.

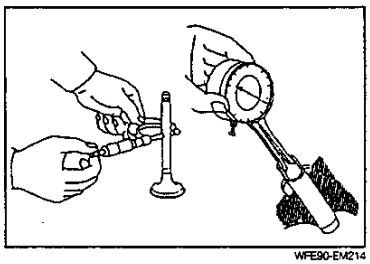
Oil Clearance:

Specified Value:

Exhaust 0.025 - 0.065 mm

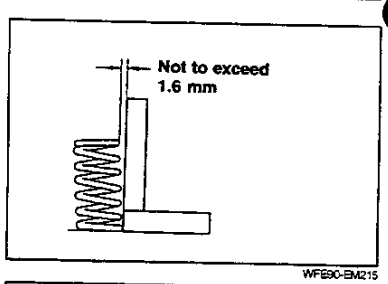
Allowable Limit:

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.

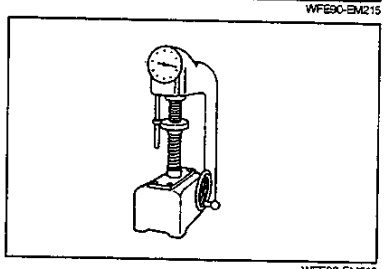


WFE90-EM215

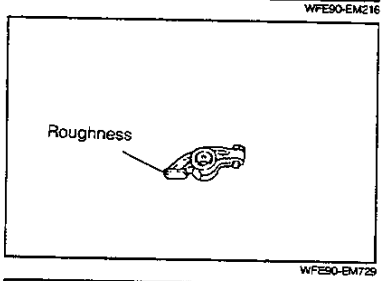
(2) Measure the valve spring for free length and spring tension, using a spring tester.
Minimum Free Length: 44.3 mm
Minimum Tension/Installation Height:
259 N (26.4 kgf)/38.0 mm

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

REFERENCE:
Standard Free Length: 45.2 - 46.0 mm

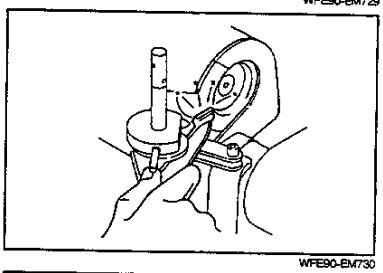

WFE90-EM216

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.

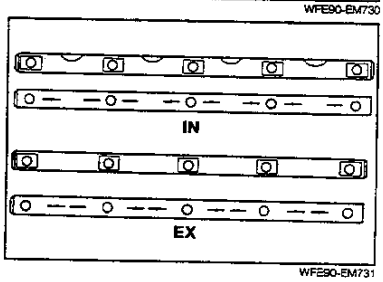


WFE90-EM729

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


WFE90-EM730

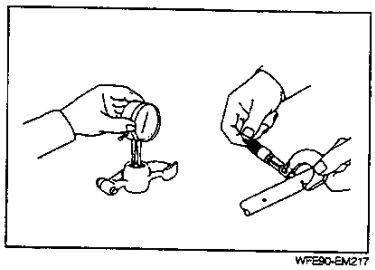
(3) Visually inspect the valve rocker shaft for cracks, seizure or wear.
Replace the valve rocker shaft, if necessary.



WFE90-EM731

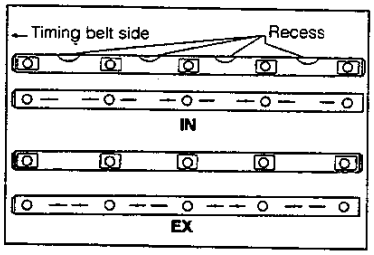
(4) Valve rocker shaft-to-valve rocker arm
- Using a dial gauge, measure the inner diameter of the valve rocker arm in two directions, 90 degrees apart from each other.
- Using a micrometer, measure the outer diameter of the valve rocker arm attaching position of the camshaft in two directions, 90-degrees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

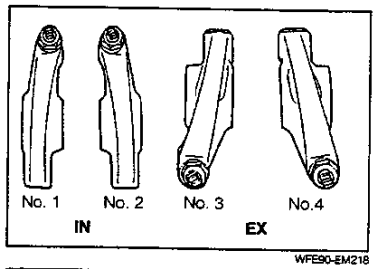
Oil Clearance
Specified Value: 0.012 - 0.053 mm
Allowable Limit: 0.08 mm


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

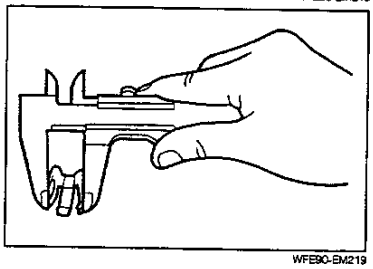




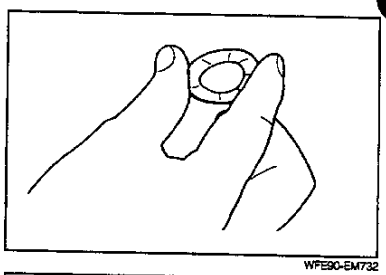
WFE90-EM218

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.

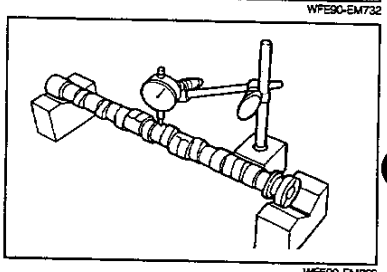

WFE90-EM219

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

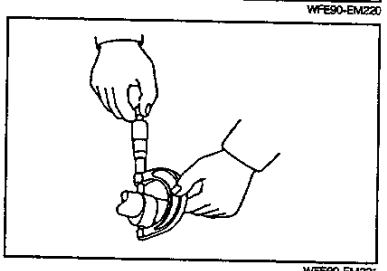

WFE90-EM732

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

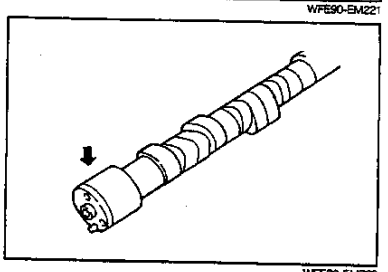
If the runout exceeds the maximum limit, replace the camshaft.


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

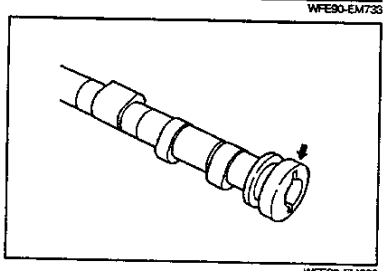

WFE90-EM221

(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.

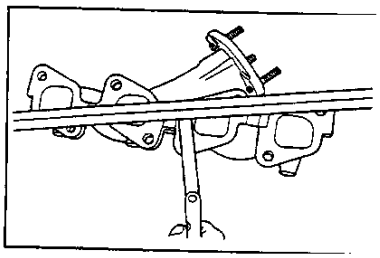

WFE90-EM733

(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.

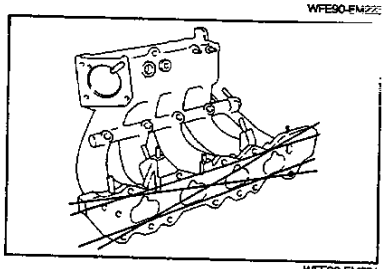
NOTE:
- **If any damage is present, check the distributor side, too.**


WFE90-EM222

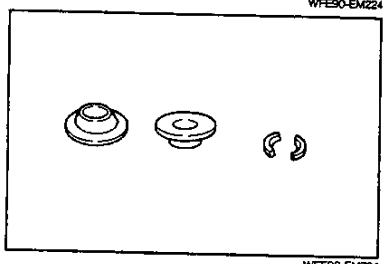
21. Inspection of manifold and surge tank
    (1) Check the cylinder head attaching surface of the exhaust manifold for warpage, using a straight edge and a thickness gauge.
    Maximum Warpage: 0.1 mm


WFE90-EM223

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

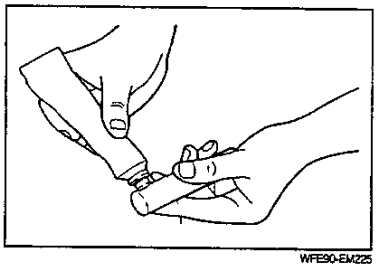

WFE90-EM224

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.

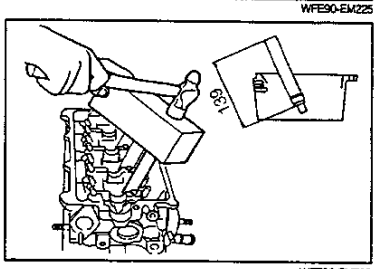

WFE90-EM734

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.

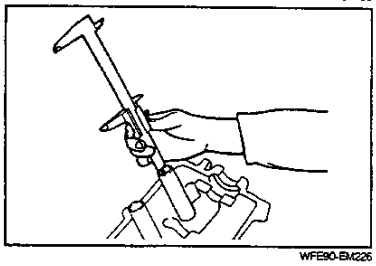

WFE90-EM225

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.

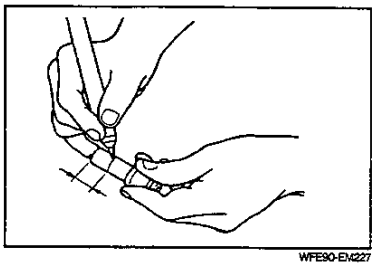


WFE90-EM735

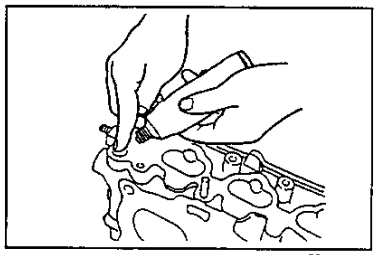
(3) With a wooden piece or the like placed on the upper end of the spark plug tube, drive the spark plug tube to the cylinder head in such an extent that the distance between the spark plug tightening surface and the upper end of the spark plug tube becomes 139 mm.
NOTE:
- Be very careful not to drive 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

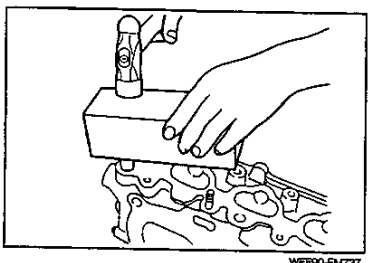
(4) Put mark at a point 45.0 ± 1.0 mm from the forward end of the heater outlet tube.


WFE90-EM227

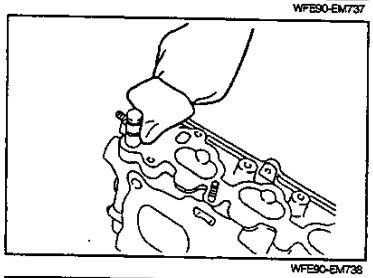
(5) Apply a thin film of the Three Bond 1377B to the attaching section for the heater outlet tube on the cylinder head.


WFE90-EM736

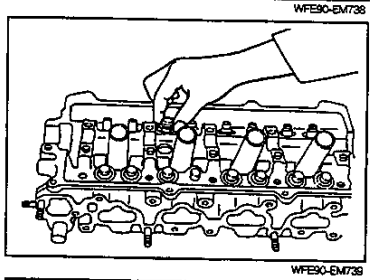
(6) With a wooden piece interposed, drive the heater outlet tube to the point marked in Step (4).


WFE90-EM737

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

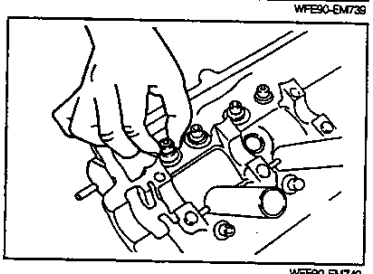

WFE90-EM738

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


WFE90-EM739

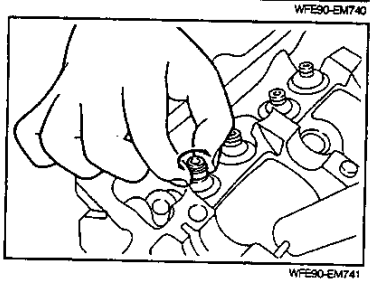
3. Installation of valve stem oil seal
   (1) Apply engine oil to the bore of the valve stem oil seal.
   (2) Drive the valve stem oil seal into the valve stem guide bush by hand.

   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.

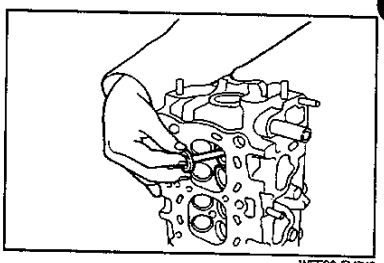

WFE90-EM740

   (3) Turn the oil seal slightly by hand to see if it can be turned.

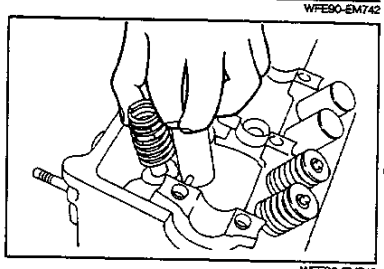
   NOTE:
   - Never rotate the oil seal more than one turn, because excessive turning may cause scratches on the oil seal.
   - If the oil seal can not be turned by hand, it means that the oil seal has been tilted, driven diagonally or press-fitted improperly.
   - Do not reuse any oil seal which was tilted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


WFE90-EM741

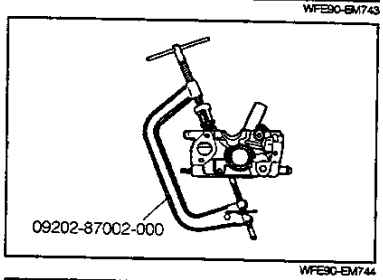
4. Apply oil to the valve stem. Install the valve to the cylinder head.
   NOTE:
   - Care must be exercised as to the installing position. Do not pull out the valve once it has been inserted.
   - If the inserted valve should be pulled out, replace the valve stem oil seal.


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

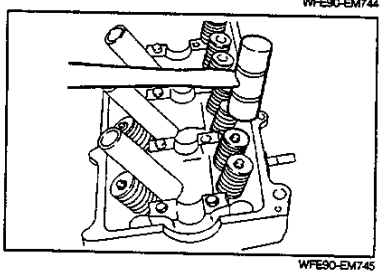
   (2) Install the valve spring retainer to the valve spring. Install the valve spring retainer locks while compressing the valve spring retainer, using the following SST.
   SST: 09202-87002-000



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.

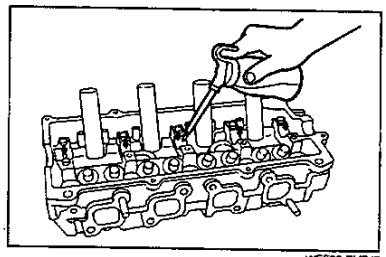

WFE90-EM745

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

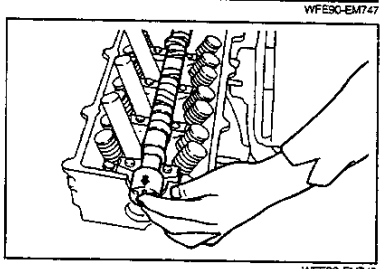
WARNING:
- When using compressed air, protect your eyes with safety goggles.

WFE90-EM746

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


WFE90-EM747

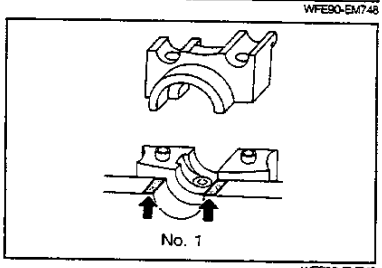
(3) Assemble the camshaft on the cylinder head in such a way that the locating pin for the camshaft timing belt pulley comes exactly at the top position.
Apply engine oil to the camshaft journal section.


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.**

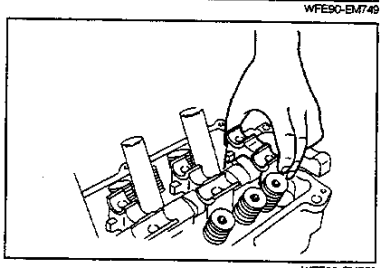


WFE90-EM749

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

NOTE:

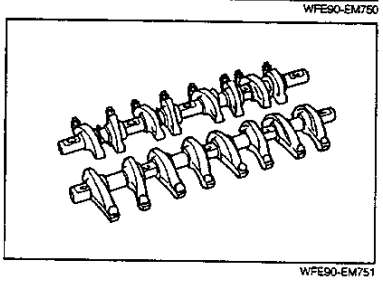
- **Before the camshaft bearing caps are installed, wipe off any bond oozed from the camshaft cap No. 1.**


WFE90-EM750

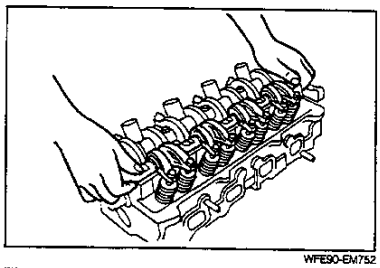
(6) Assemble the valve rocker arms and wave washers onto the valve rocker shaft, while applying engine oil liberally as shown in the right figure.

NOTE:

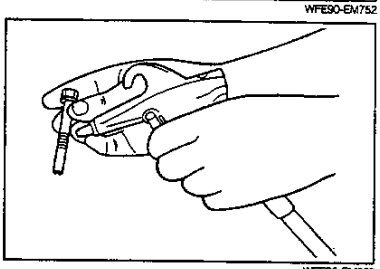
- **The intake valve rocker shaft can be identified by the recessed sections.**


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.

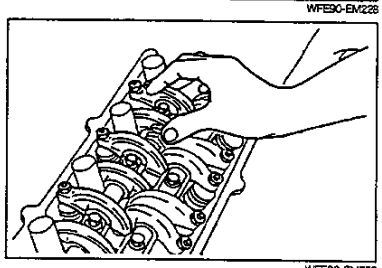

WFE90-EM752

(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]

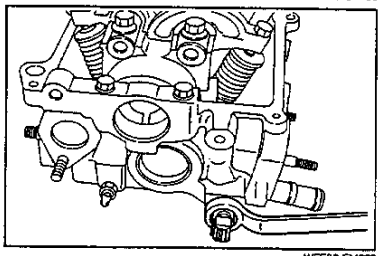

WFE90-EM228

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.

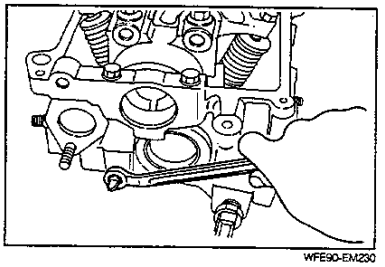

WFE90-EM753

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)


WFE90-EM229

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.

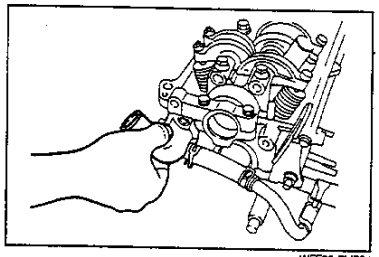
9. Clean the threaded portion of the water temperature sender gauge. Wind seal-tape around the threaded portion. Tighten the gauge to the cylinder head, using the long box wrench.
Tightening Torque: 11.8 - 19.6 N·m (1.2 - 2.0 kgf-m)


WFE90-EM230

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

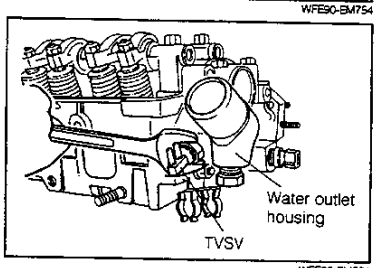
10. Install the water outlet to the cylinder head with a new gasket interposed.

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


WFE90-EM754

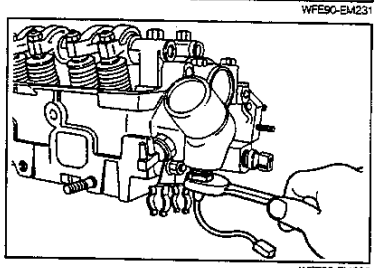
12. Clean the threaded portion of the TVSV. Wind seal tape around the threaded potion and install the TVSV to the cylinder head.
    Tightening Torque: 24.5 - 34.3 N·m (2.5 - 3.5 kgf-m)

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



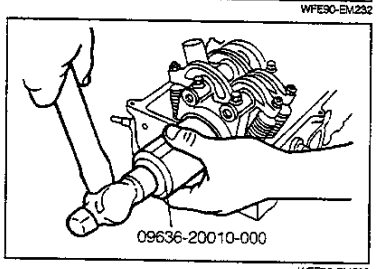
WFE90-EM231

    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

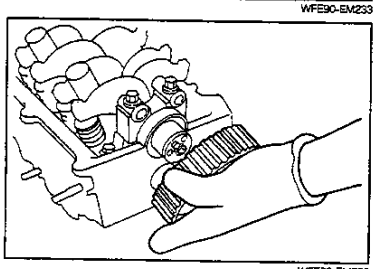
13. Apply engine oil to the bore of the type T oil seal for the camshaft.
    Drive the oil seal into position, using the following SST.
    SST: **09636-20010-000**

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



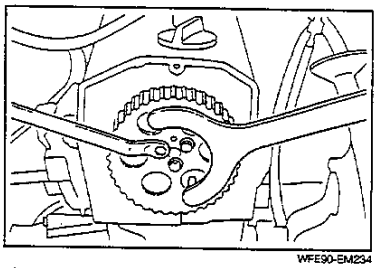
WFE90-EM233

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

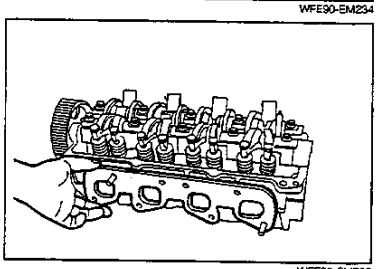
15. Attach the attaching bolts of the camshaft timing belt pulley. Tighten the attaching bolt while preventing the camshaft timing belt pulley from turning, using the flowing SST.
    SST: 09278-87201-000
    Tightening Torque: 14.7 - 21.5 N·m (1.5 - 2.2 kgf-m)

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

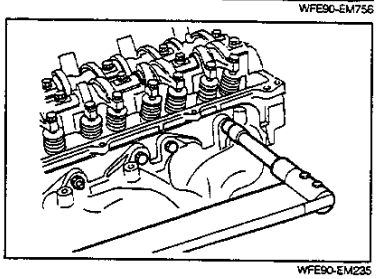

WFE90-EM234

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

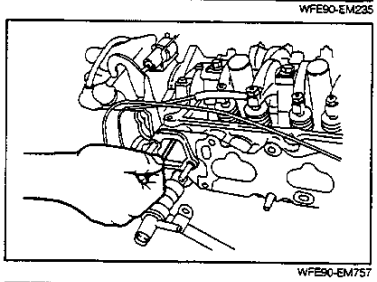
2. Install the exhaust manifold to the cylinder head. Tighten the attaching bolts and nuts evenly over two or three stages.
   Tightening Torque: 29.4 - 44.1 N·m (3.0 - 4.5 kgf-m)


WFE90-EM235

INSTALLATION OF INTAKE MANIFOLD SIDE PARTS

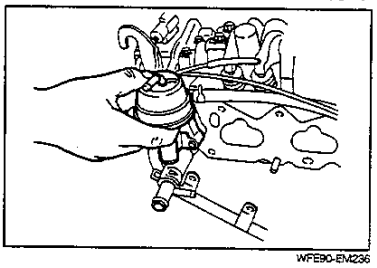
[HD-C Engine]

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.

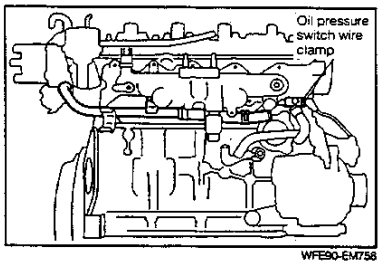

WFE90-EM236

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.

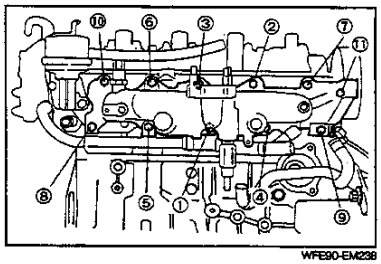
WFE90-EM237

   (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.



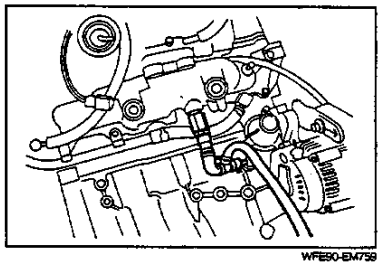
WFE90-EM756

   (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)



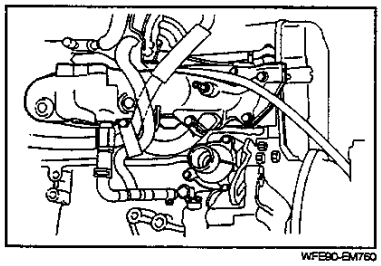
WFE90-EM238

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.



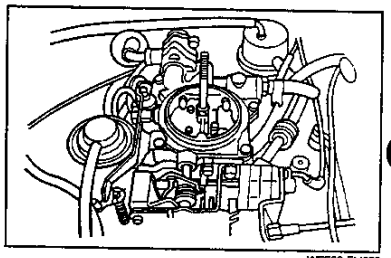
WFE90-EM760

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

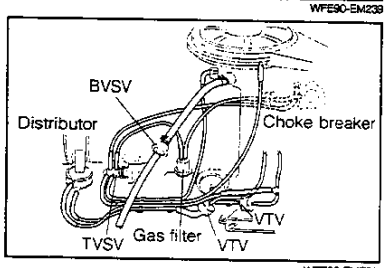
8. Install the carburetor to the intake manifold.
   Tightening Torque: 14.7 - 21.6 N·m (1.5 - 2.2 kgf-m)

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



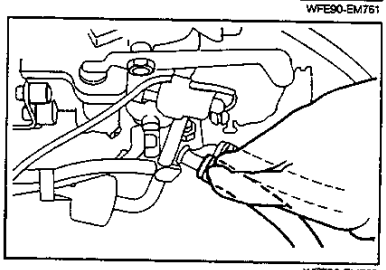
WFE90-EM239

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



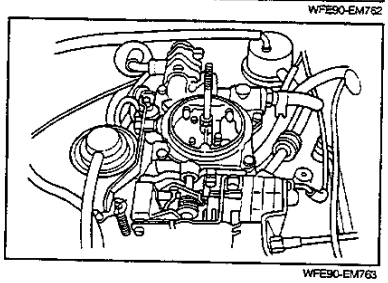
WFE90-EM761

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



WFE90-EM762

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

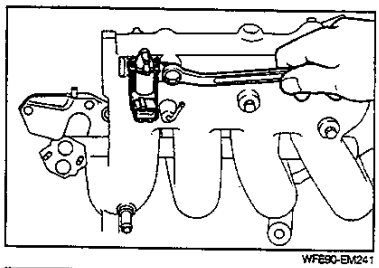
[HD-E engine]

1. Clean the intake manifold.

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

WFE90-EM240

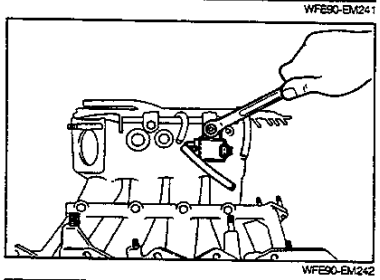
2. Install the EGR VSV to the surge tank. (US spc only)
NOTE:
- Apply thin film of the Three Bond 1104 to the threaded portion of the bolt.



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.

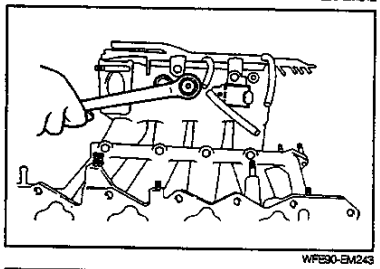
4. Install the ISC VSV to the surge tank. (US spc only)
NOTE:
- Apply thin film of the Three Bond 1104 to the threaded portion of the bolt.



WFE90-EM242

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)

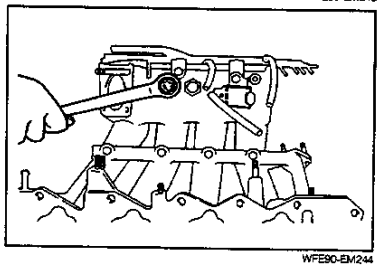
NOTE:
- This operation is required only when the gas filter has been removed.
- Use a hexagonal long box wrench for tightening.



WFE90-EM243

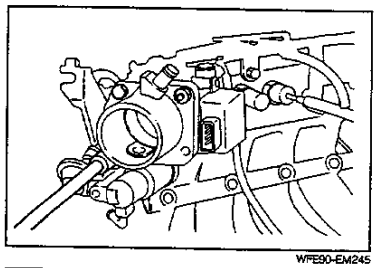
6. Install the intake air temperature sensor to the surge tank with a new washer interposed.
Tightening Torque: 29.4 - 39.2 N·m (3.0 - 4.0 kgf-m)

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

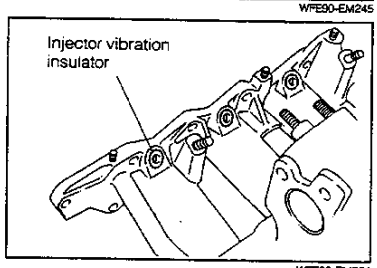


WFE90-EM244

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)

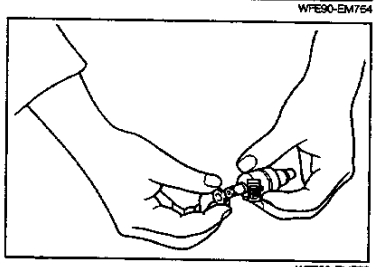

WFE90-EM245

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.

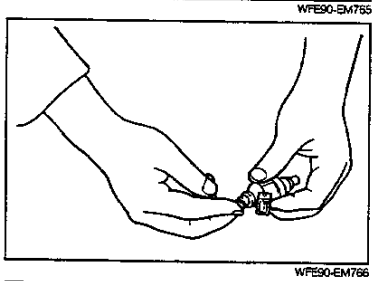


WFE90-EM754

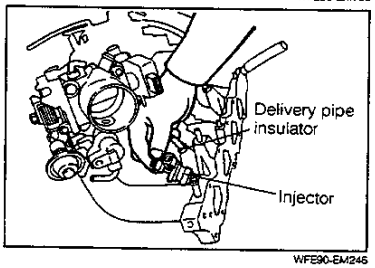
9. Remove the "O" ring of the injector. Remove the grommet and check it for damage or cracks.
   NOTE:
   - If the grommet exhibits any fault, replace it with a new one.


WFE90-EM755

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

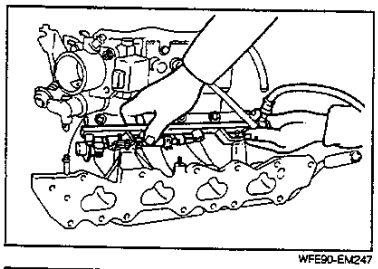

WFE90-EM766

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.

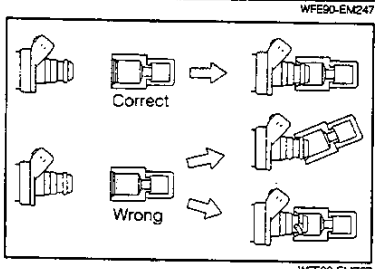


WFE90-EM246

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


WFE90-EM247

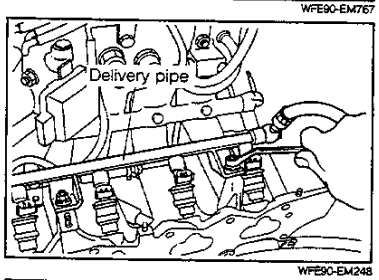
CAUTION:
- Be very careful not to damage the "O" ring of the injector during the delivery pipe installation.
- Do not install the delivery pipe diagonally to the injector.



WFE90-EM767

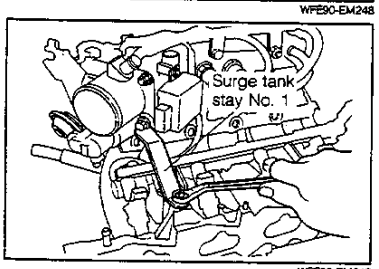
14. Tighten the attaching nuts of the delivery pipe.
Tightening Torque: 14.7 - 21.6 N·m (1.5 - 2.2 kgf-m)

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.



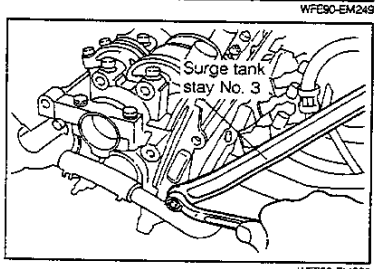
WFE90-EM248

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)

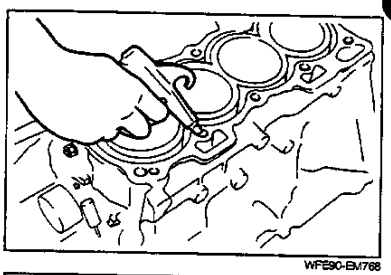


WFE90-EM250

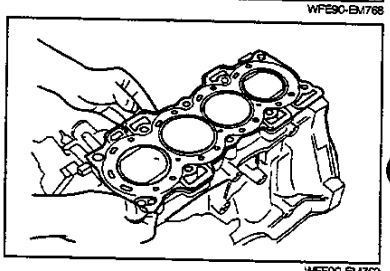
INSTALLATION OF CYLINDER HEAD WITH MANIFOLDS

1. Clean the cylinder block head bolt holes.

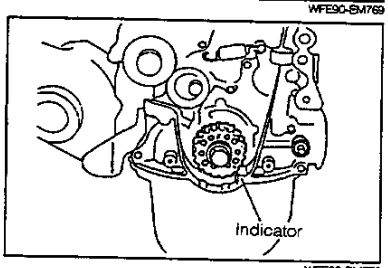
WARNING:
- **Protect your eyes with goggles when using compressed air.**


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.

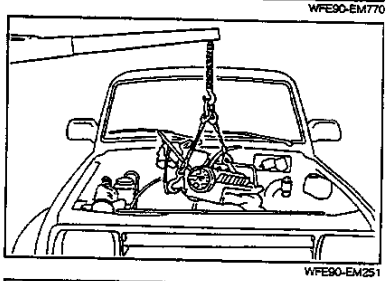

WFE90-EM769

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



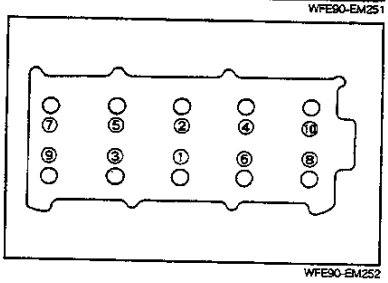
WFE90-EM770

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

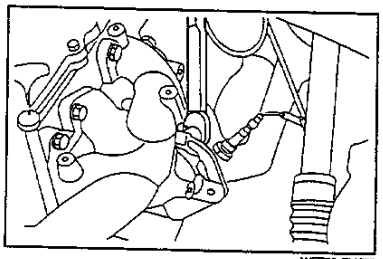
5. Coat each cylinder head bolt with a thin film of engine oil. Using these bolts, install the cylinder head to the cylinder block. Tighten the bolts evenly over two or three stages, following the sequence shown in the right figure.
   Tightening Torque: 58.8 - 66.7 N·m (6.0 - 6.8 kgf-m)

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

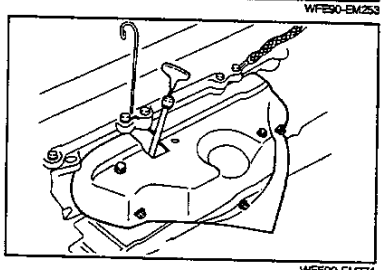


WFE90-EM252

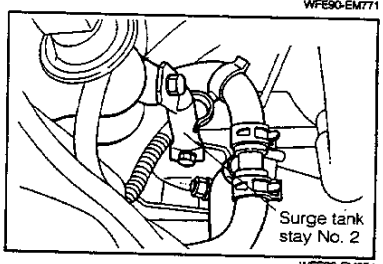
6. Connect the exhaust pipe to the exhaust manifold with a new gasket interposed.
   Then, tighten the attaching nuts.
   Tightening Torque: 34.3 - 49.0 N·m (3.5 - 5.0 kgf-m)


WFE90-EM253

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

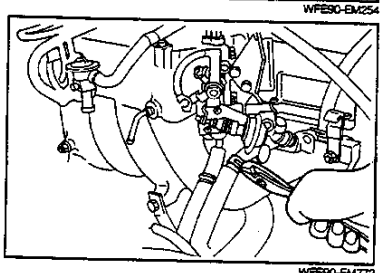

WFE90-EM771

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)

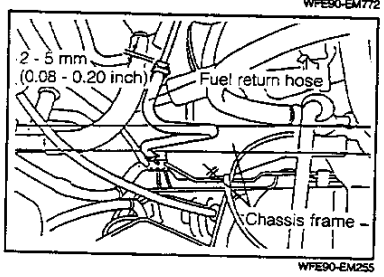


WFE90-EM254

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

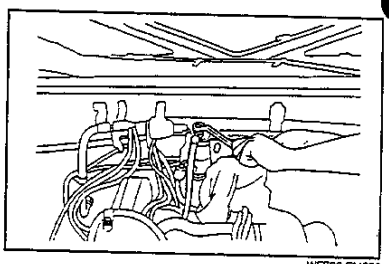

WFE90-EM772

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

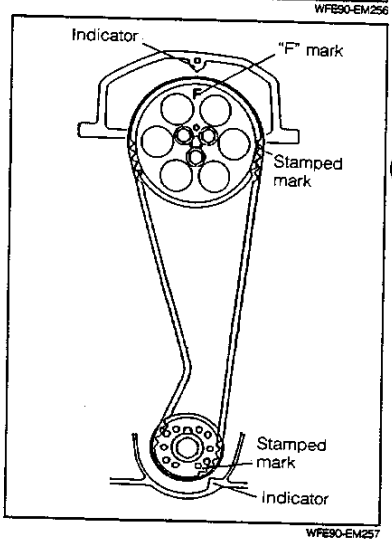
12. Install the fuel hose No. 1 to the fuel filter with a new gasket interposed.
    Tightening Torque: 34.3 - 44.1 N·m (3.5 - 4.5 kgf-m)


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

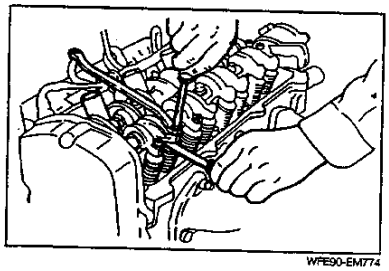
ADJUSTMENT AND INSTALLATION OF OTHER PART

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

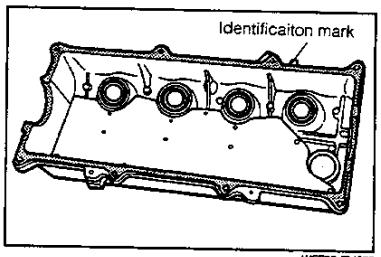
Rocker arm condition \ Cylinder No.		1	2	3	4
(1) When valve rocker arms of No. 1 cylinder is free; "O" marks are available to adjust. (2) Turn the crankshaft 360 degrees. (3) When valve rocker arms of No. 4 cylinder is free; "×" marks are available to adjust.	IN	O	O	×	×
	EX	O	×	O	×

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.

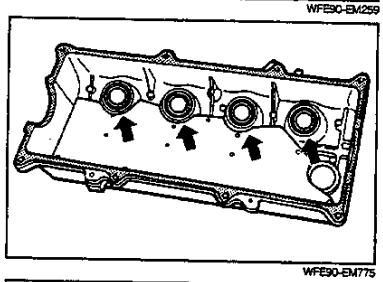
WFE90-EM258

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.

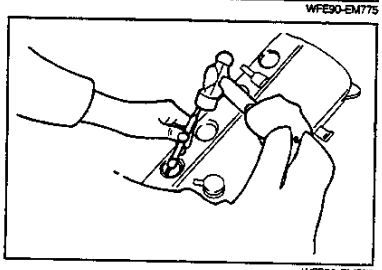


WFE90-EM259

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

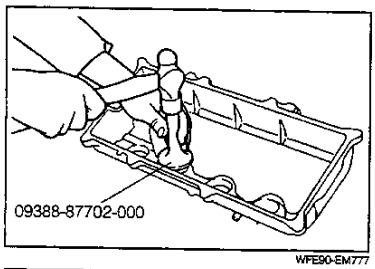

WFE90-EM775

   - 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

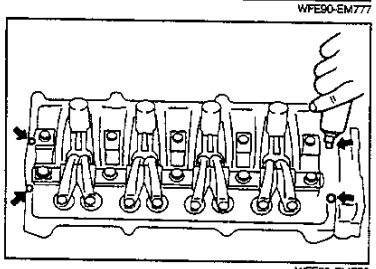


WFE90-EM777

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.

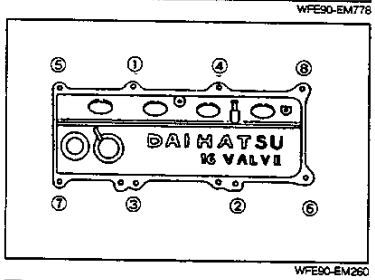
(4) Apply the Three Bond 1104 to the cylinder head at points indicated in the figure.
(5) Install the cylinder head cover to the cylinder head.

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.


WFE90-EM778

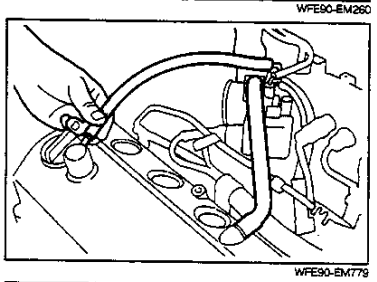
(6) Tighten the cylinder head cover bolts evenly over two or three stages to the specified torque, following the sequence shown at the figure.
Tightening Torque: 2.9 - 4.9 N·m (0.3 - 0.5 kgf-m)

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



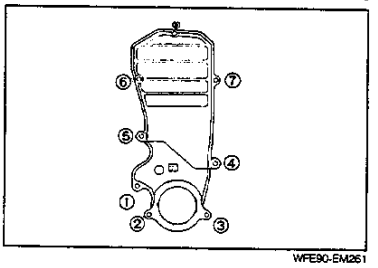
WFE90-EM260

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


WFE90-EM779

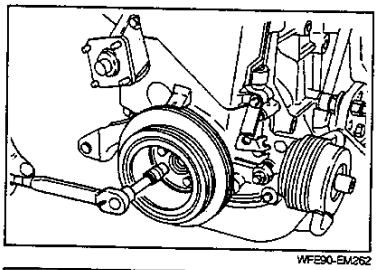
3. Install the timing belt cover.
Tightening Torque: 2.0 - 3.9 N·m (0.2 - 0.4 kgf-m)

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

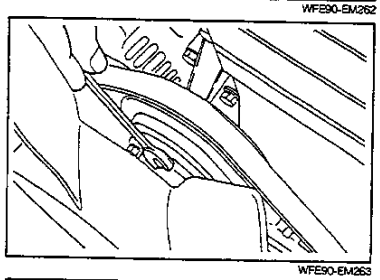


WFE90-EM261

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)

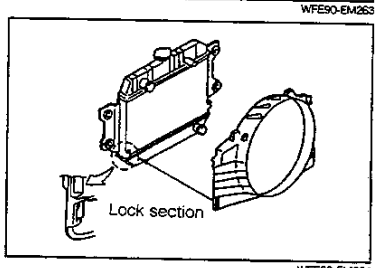

WFE90-EM262

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.**


WFE90-EM263

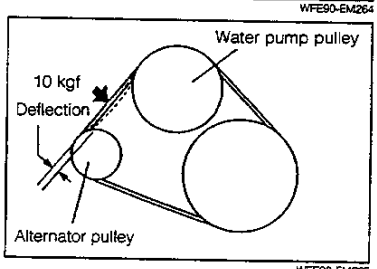
   (3) Install the fluid coupling with fan to the water pump by means of four bolts through water pump pulley.
   Tightening Torque: 9.8 - 17.7 N·m (1.0 - 1.8 kgf-m)

   (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.



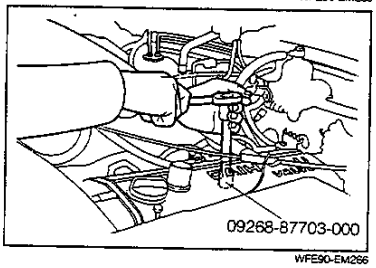
WFE90-EM264

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



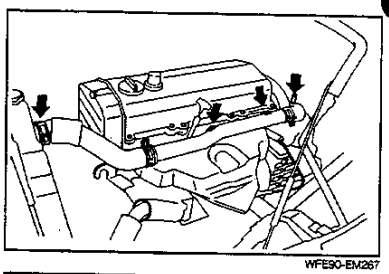
WFE90-EM265

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

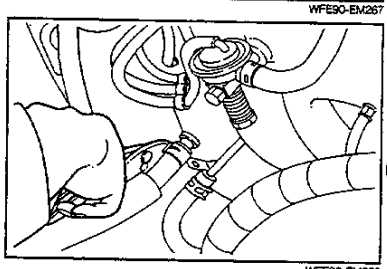


WFE90-EM266

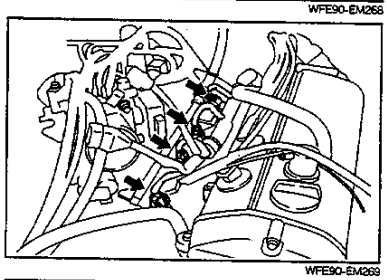
9. Install the radiator hose No. 1 to the radiator upper tank. Tighten the two clamps and two attaching bolts.
   NOTE:
   - Ensure that the clamp are installed as illustrated in right figure.


WFE90-EM267

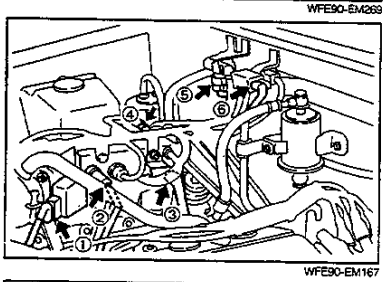
10. Connect the vacuum hose for the brake booster to the intake manifold.


WFE90-EM268

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

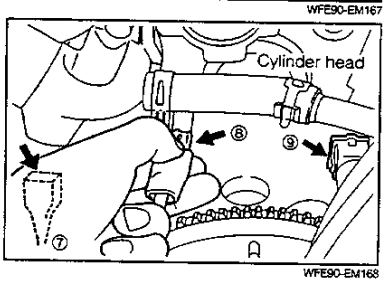

WFE90-EM269

    (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)



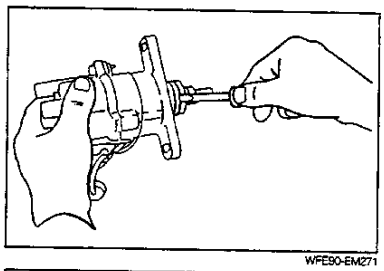
WFE90-EM167

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

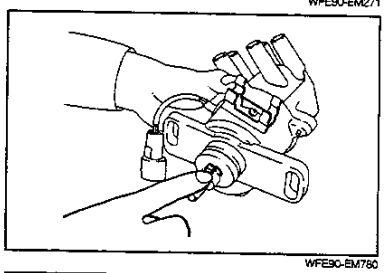


WFE90-EM168

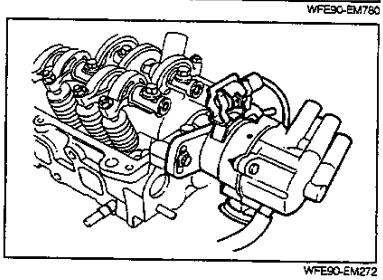
12. Installation of the distributor
    (1) Replace the "O" ring of the distributor body with a new one.
    NOTE:
    - Care must be exercised to avoid scratching the new "O" ring.


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-EM780

    (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)

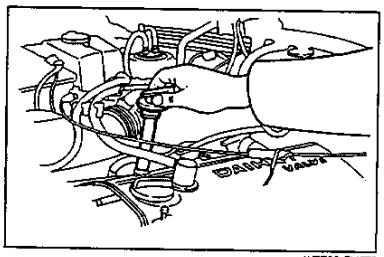

WFE90-EM272

    (4) Connect the distributor connector.

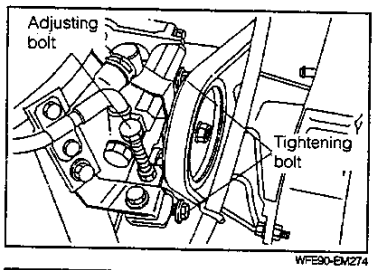
WFE90-EM781

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.

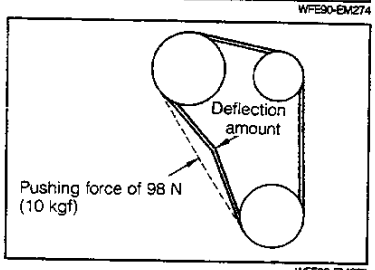

WFE90-EM273

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.



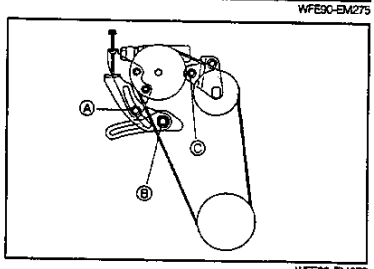
WFE90-EM274

    (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:]



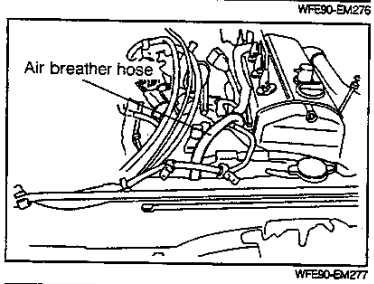
WFE90-EM275

    (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)



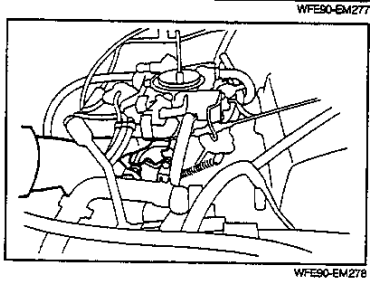
WFE90-EM276

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

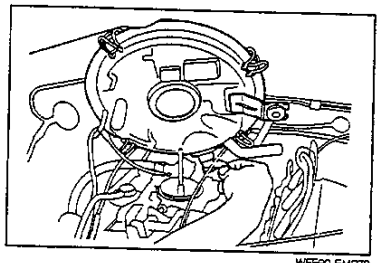


WFE90-EM277

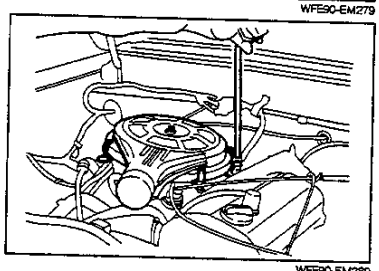
[HD-C engine]
17. Connect the accelerator cable to the carburetor. Adjust the accelerator cable so that the free play in its axial direction may be 3-8 mm.


WFE90-EM278

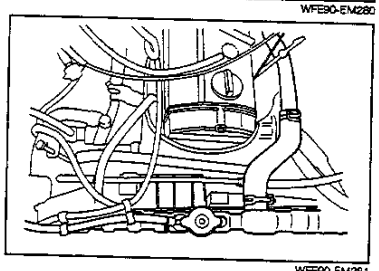
18. Connect the vacuum hoses as follows.
    - Between the air cleaner and the TVSV
    - Between the carburetor and the ITC valve
    - Between the outer vent valve and the BVSV


WFE90-EM279

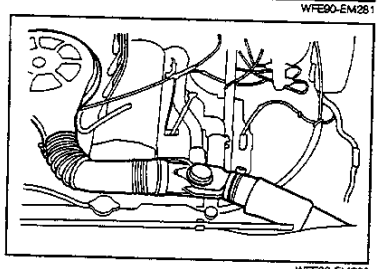
19. Install the air cleaner case onto the carburetor.
    NOTE:
    - In this time, if the gasket is damaged, replace the gasket.


WFE90-EM280

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

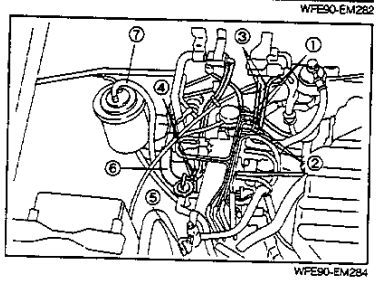

WFE90-EM281

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


WFE90-EM282

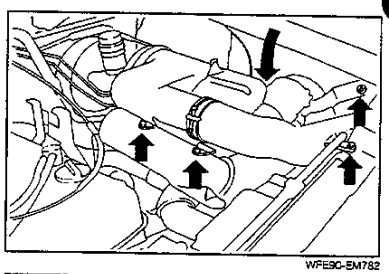
[HD-E Engine]

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

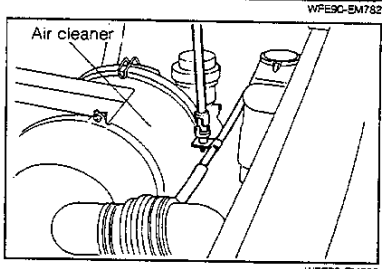


WFE90-EM284

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.

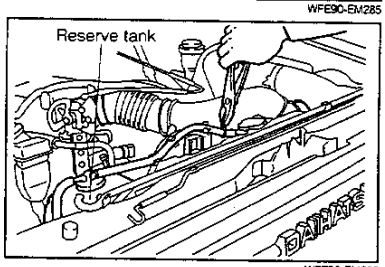

WFE90-EM782

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



WFE90-EM285

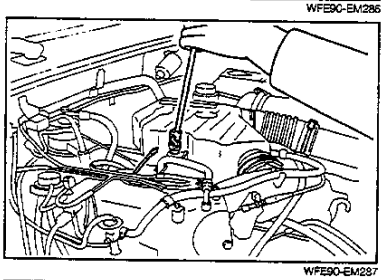
19. Install the radiator reserve tank into position. Clamp the water hose securely.



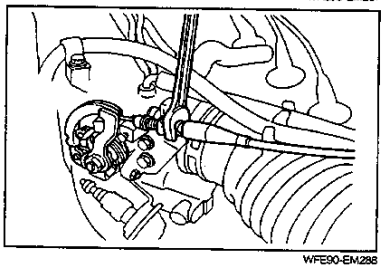
WFE90-EM286

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.

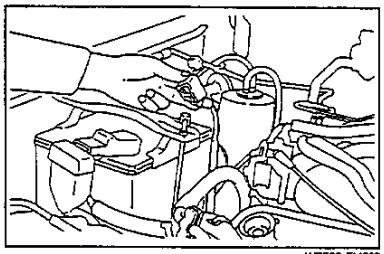
    (2) Install the air intake hoses for air conditioner and power steering idle up.


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

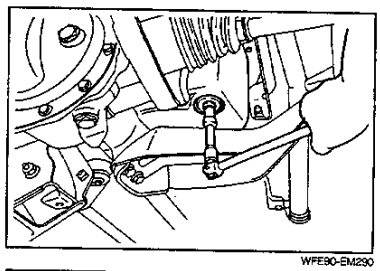
23. Installation of the battery
    (1) Install the battery into position.
    (2) Install the battery holding clamp.
    (3) Connect the positive cable to the positive (+) terminal. Then connect the battery ground cable to the negative (–) terminal of the battery.


WFE90-EM288

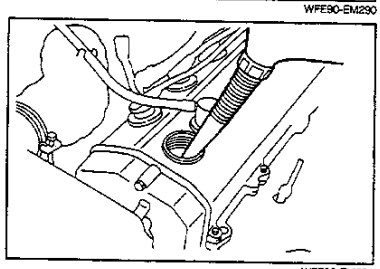
FILLING OF ENGINE OIL AND COOLING WATER

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.

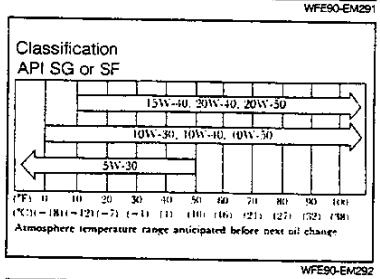
   Tightening Torque: 19.6 - 29.4 N·m (2.0 - 3.0 kgf-m)


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

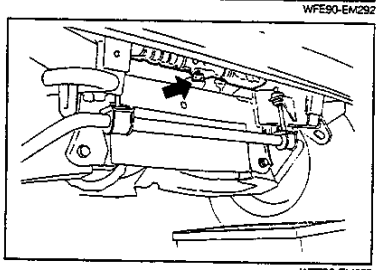

WFE90-EM291

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



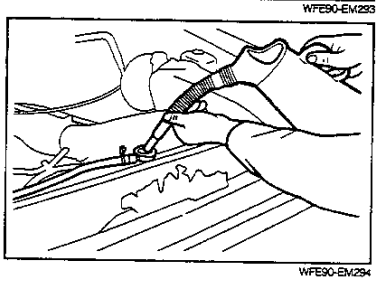
WFE90-EM292

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