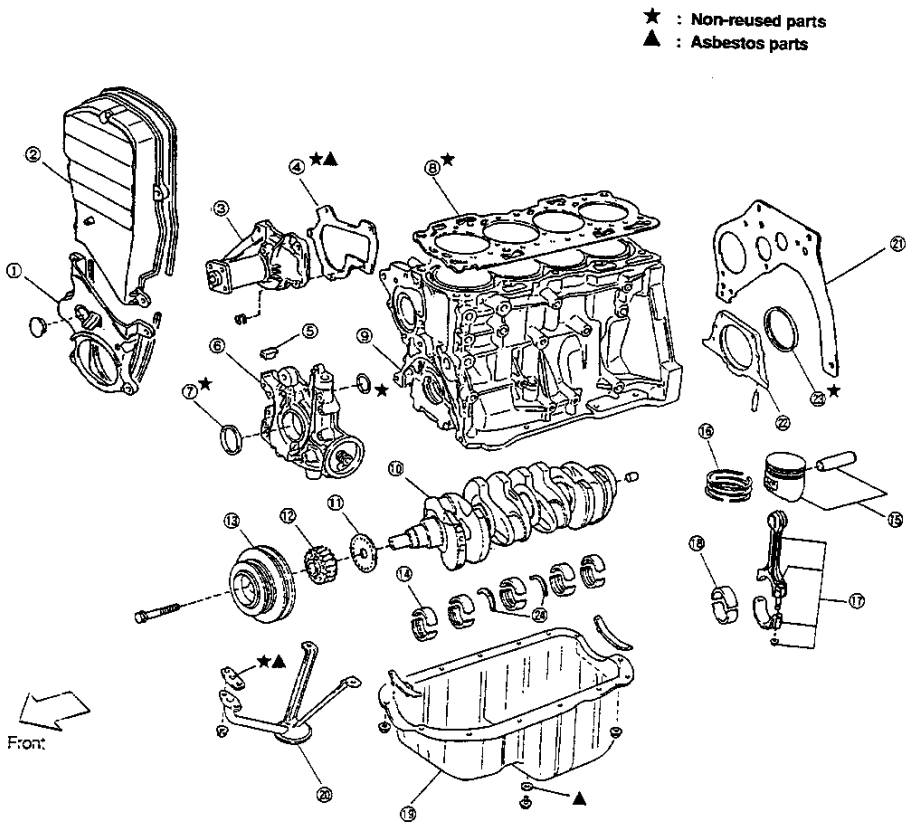
CYLINDER BLOCK

COMPONENTS



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

WFE90-EM295

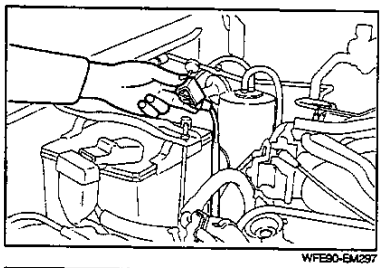
INSTRUCTIONS PRIOR TO OPERATION

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

WFE90-EM296

ENGINE REMOVAL

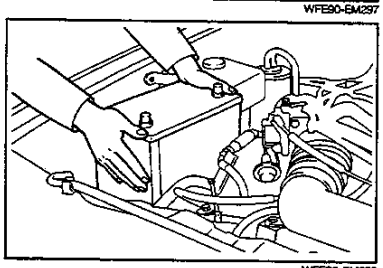
1. Removal of battery
   (1) Disconnect the battery ground cable from the negative (–) terminal of the battery. Then disconnect the wires from the positive (+) terminal of the battery.



WFE90-EM297

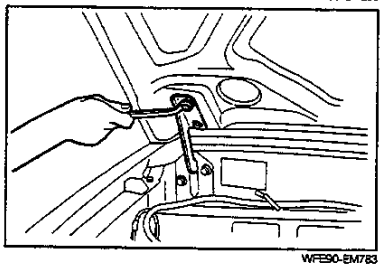
   (2) Remove the battery hold-down clamp and battery clamp bolts.
   (3) Remove the battery from the engine compartment.

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



WFE90-EM298

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



WFE90-EM783

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

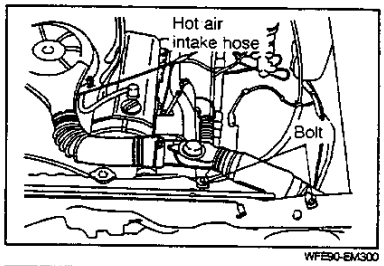
WFE90-EM299

5. Removal of air cleaner assembly with hose

[HD-C Engine]

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

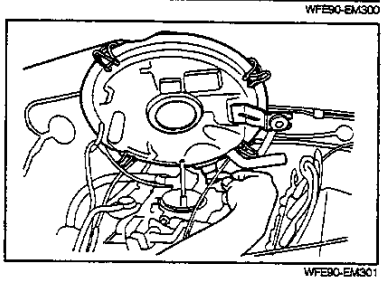
(2) Disconnect the vacuum motor hose and hot air intake hose.
(Except for GCC and tropical specifications)



WFE90-EM300

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

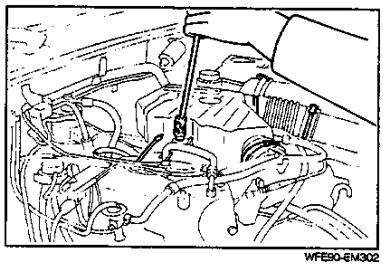
(4) Remove the air cleaner assembly by removing the attaching bolts of the air cleaner bracket and wing nut.


WFE90-EM301

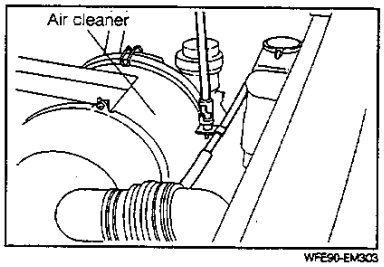
[HD-E Engine]

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

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


WFE90-EM302

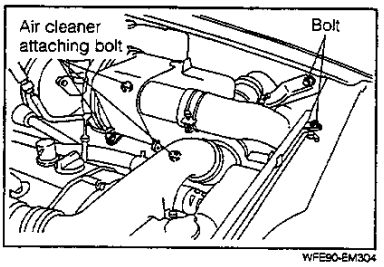
(3) Disconnect the clamp for the clutch cable at the air cleaner.



WFE90-EM303

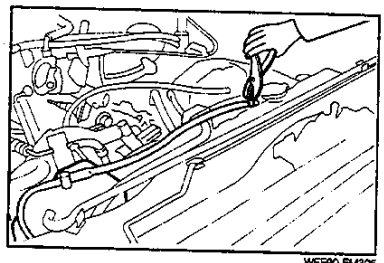
(4) Remove the bolts provided at the left fender panel and radiator center support.

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

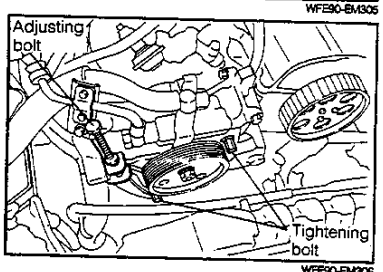


WFE90-EM304

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

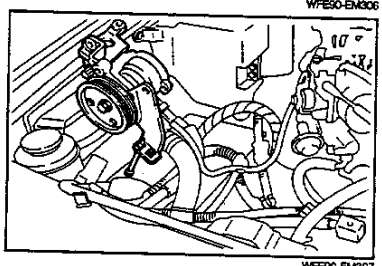

WFE90-EM305

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

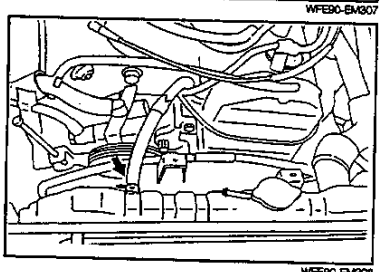


WFE90-EM306

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

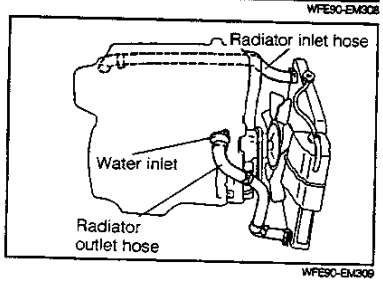

WFE90-EM307

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


WFE90-EM308

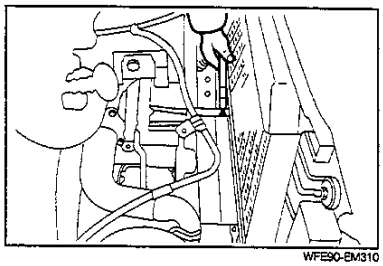
   (2) Remove the radiator inlet hose by disconnecting the radiator and water outlet side clamps.
   (3) Disconnect the radiator outlet hose at the center connection.

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

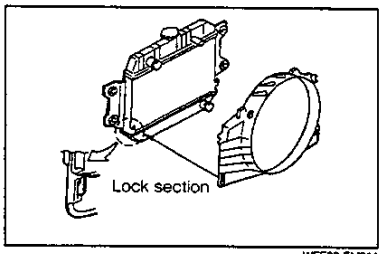


WFE90-EM309

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

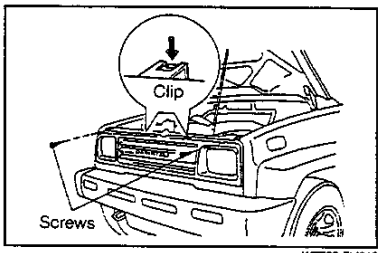

WFE90-EM310

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



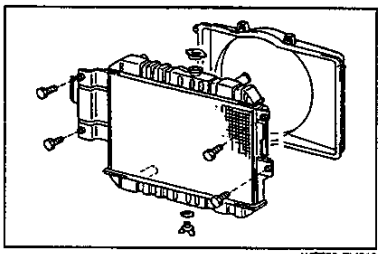
WFE90-EM311

(7) Remove the radiator grille.

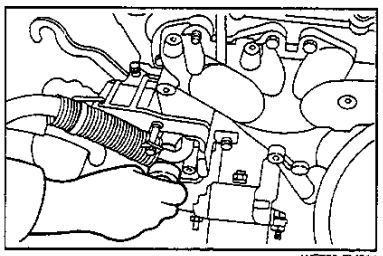


WFE90-EM312

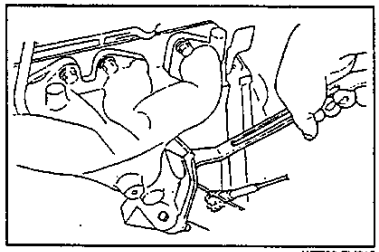
(8) Remove the radiator by removing the four attaching bolts.


WFE90-EM313

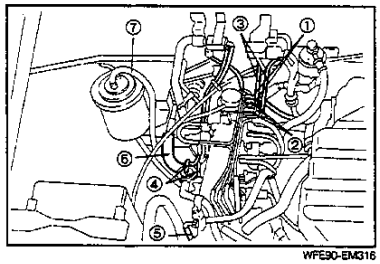
9. Removal of air conditioner compressor
(1) Remove the compressor cover by removing the attaching bolts.
(2) Remove the compressor assembly by removing the attaching bolts. Then, temporarily place the compressor assembly onto the engine compartment left side.


WFE90-EM314

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

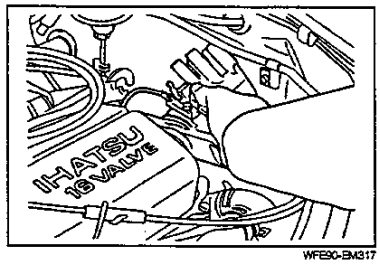

WFE90-EM315

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


WFE90-EM316

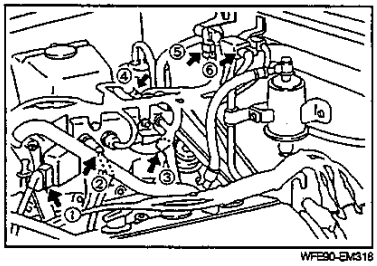
12. Removal of distributor
    (1) Disconnect the distributor wire connector.
    (2) Remove the distributor from the cylinder head by removing the two attaching bolts.

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

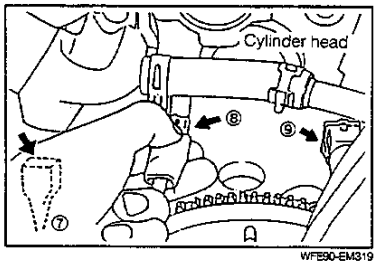


WFE90-EM317

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

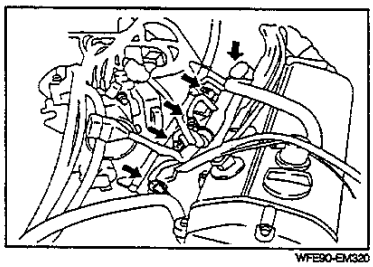

WFE90-EM318

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

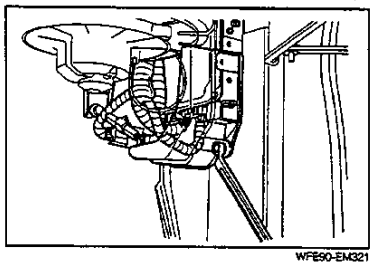


WFE90-EM319

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

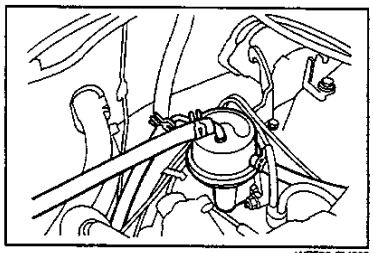

WFE90-EM320

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

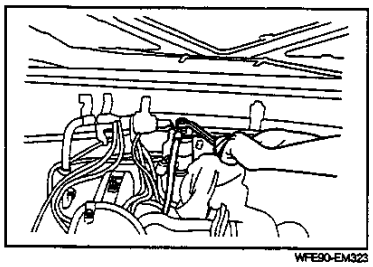

WFE90-EM321

14. Disconnection of fuel line

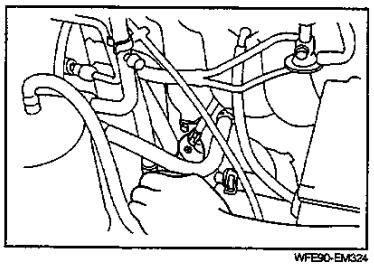
[HD-C Engine]
Disconnect the fuel inlet hose and return hose from fuel pump.
NOTE:
- Make sure to plug the disconnected hose so that no fuel may flow out.


WFE90-EM322

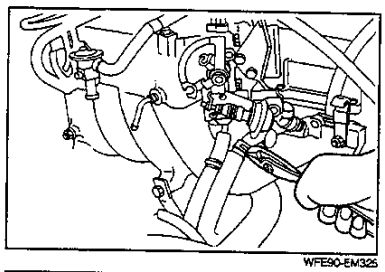
[HD-E Engine]
Disconnect the fuel hose at the upper part of fuel filter.
CAUTION:
- The pressure in the fuel line is kept 250 kPa (2.55 kgf/cm^2) higher than the atmospheric pressure.
- Hence, when the fuel line is loosened, be sure to prevent the fuel from splashing using an adequate cloth or the like.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


WFE90-EM323

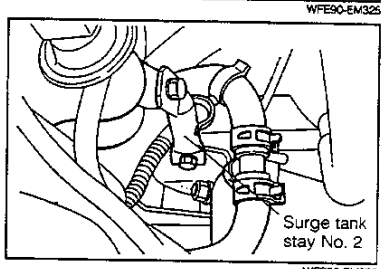
15. Disconnect the fuel return hose from the pressure regulator.
CAUTION:
- When disconnecting the fuel hose, take precautionary measures to prevent any dirt from entering into the fuel line.


WFE90-EM324

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

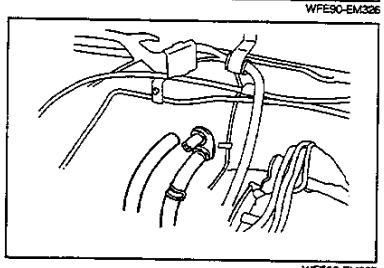

WFE90-EM325

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



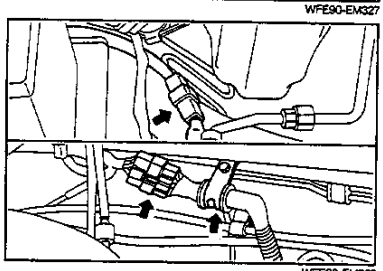
WFE90-EM326

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

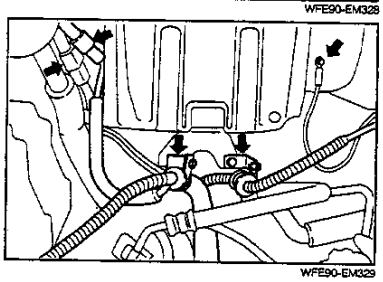

WFE90-EM327

19. Disconnect the following wires and cords.

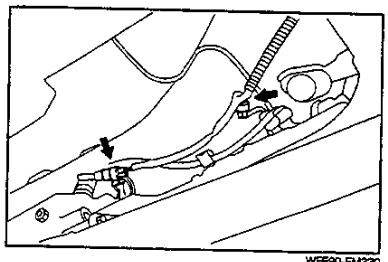
[HD-C Engine]
(1) Clamp of battery negative ⊖ terminal to engine bracket at battery carrier side.
(2) Clamp of battery positive ⊕ terminal to starter at battery carrier side.
(3) Connector of cable leading to battery at battery carrier side.


WFE90-EM328

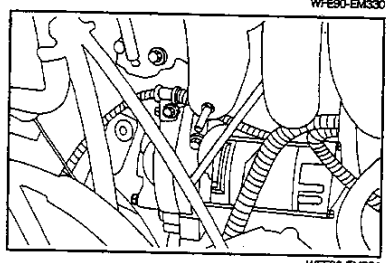
[HD-E Engine]
(1) Clamp of battery negative ⊖ terminal to engine bracket at battery carrier side.
(2) Clamp of battery positive ⊕ terminal to starter at battery carrier side.
(3) Clamp of battery cable ⊕ leading to cowl at battery carrier side.
(4) Three connectors of cable leading to relay box at battery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


WFE90-EM329

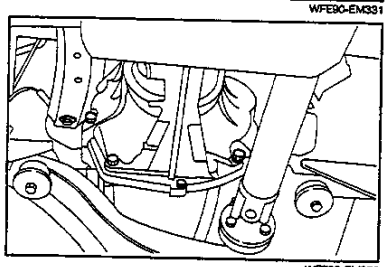
20. Disconnect the connectors from the transmission and transfer by jacking up the vehicle. Disconnect the air breather hose from the transmission.


WFE90-EM330

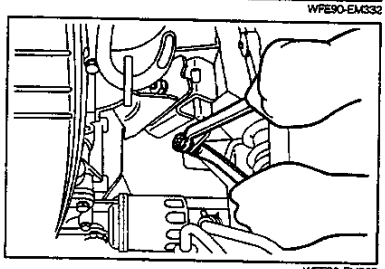
21. Removal of starter
    (1) Disconnect the connector with lock and remove the harness clamping bolt.
    (2) Remove the starter by removing the two attaching bolts.


WFE90-EM331

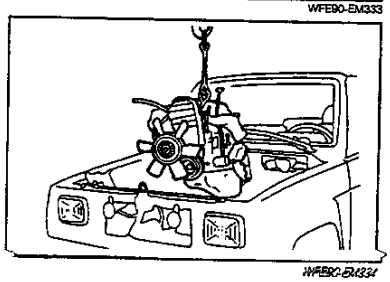
22. Remove the attaching bolts which install the engine to the transmission.


WFE90-EM332

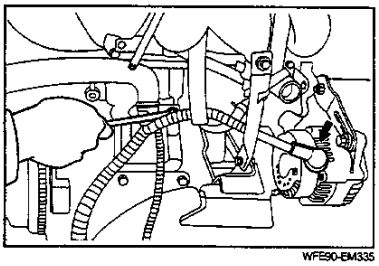
23. Remove the attaching bolts of the engine mountings while suspending the engine, using a chain block.


WFE90-EM333

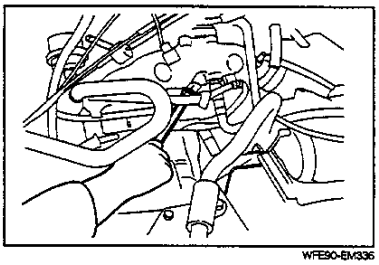
24. Take out the engine from the engine compartment, using a chain block.
    CAUTION:
    - Be careful not to allow the engine to hit the vehicle body or other parts.
    - Make sure that all hoses and wires have been disconnected from the body.


WFE90-EM334

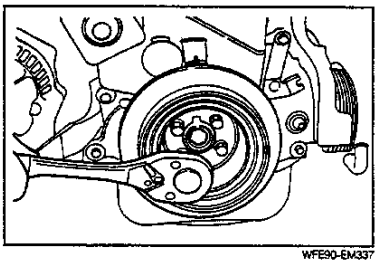
25. Removal of engine harness from engine
    (1) Disconnect the alternator connector.


WFE90-EM335

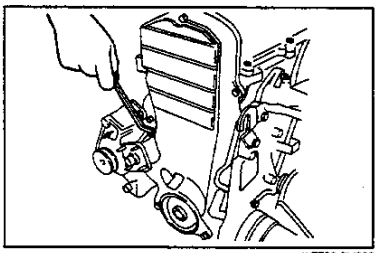
    (2) Remove the engine wire clamp.
    (3) Remove the engine wire from engine.


WFE90-EM336

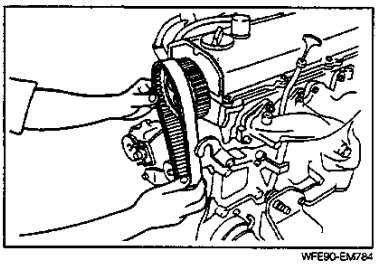
26. Remove the crankshaft pulley by removing the four attaching bolts.
    NOTE:
    - Prevent the crankshaft from turning, using the following SST.
      SST: 09210-87701-000


WFE90-EM337

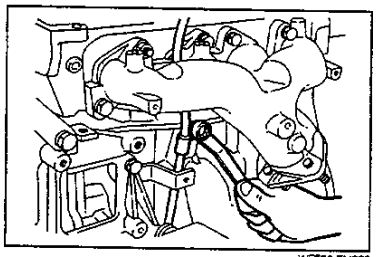
27. Removal of timing belt (See page EM-24.)
    (1) Remove the eight timing belt cover attaching bolts.
    (2) Remove the timing belt covers No. 1 and No. 2.


WFE90-EM338

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

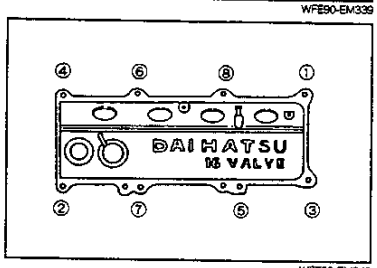

WFE90-EM784

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


WFE90-EM339

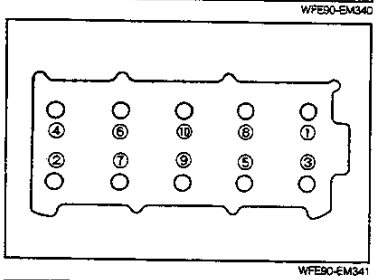
30. Removal of cylinder head cover
    (1) Remove the ground cable from the cylinder head cover.
    (2) Remove the spark plugs, using the SST.
    SST: 09268-87703-000

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



WFE90-EM340

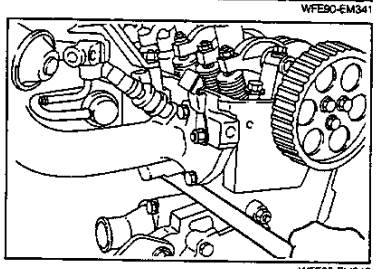
31. Removal of cylinder head
    (1) Loosen the cylinder head bolts, using a hexagon wrench.
    CAUTION:
    - Loosen the cylinder head bolts evenly over two or three stages in the sequence indicated in the figure.



WFE90-EM341

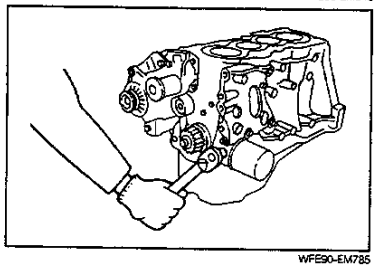
    (2) Remove the cylinder head with the intake and exhaust manifolds.
    NOTE:
    - If it is difficult to remove the cylinder head, pry up the cylinder head, using an iron bar.

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

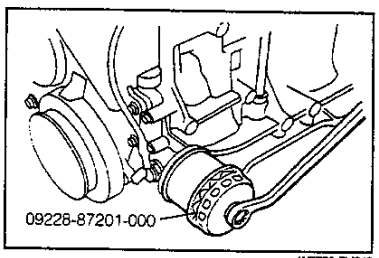

WFE90-EM342

DISASSEMBLY OF CYLINDER BLOCK

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

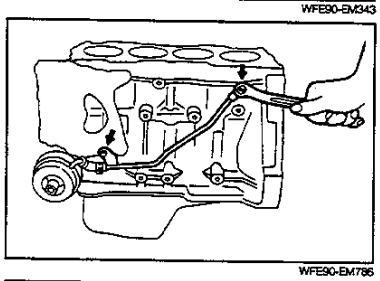

WFE90-EM785

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



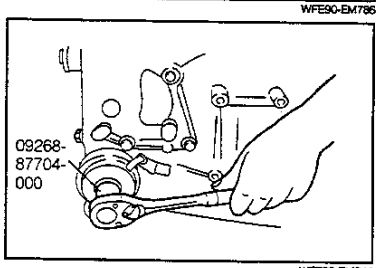
WFE90-EM343

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


WFE90-EM786

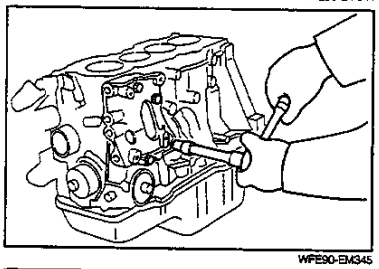
   (3) Remove the oil cooler from the cylinder block, using the following SST.
   SST: 09268-87704-000

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

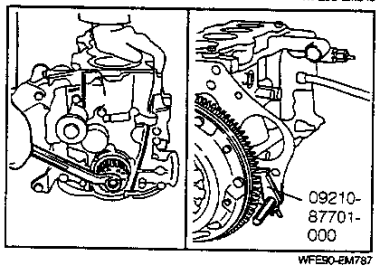


WFE90-EM344

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

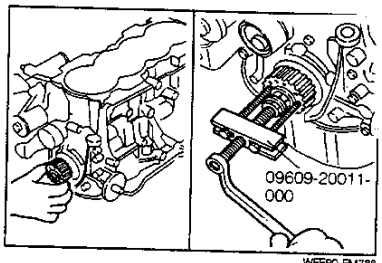

WFE90-EM345

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



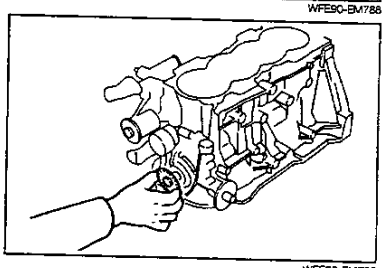
WFE90-EM787

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

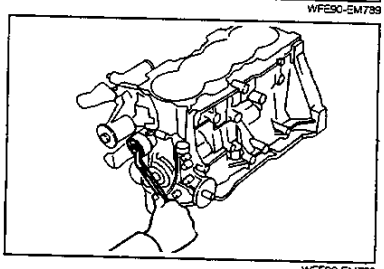


WFE90-EM788

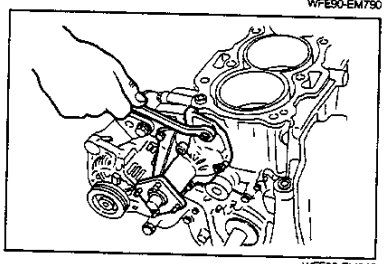
7. Remove the crankshaft pulley flange.


WFE90-EM789

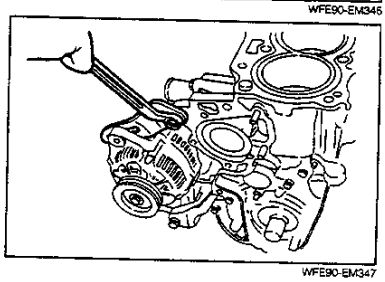
8. Remove the tensioner and tension spring.


WFE90-EM790

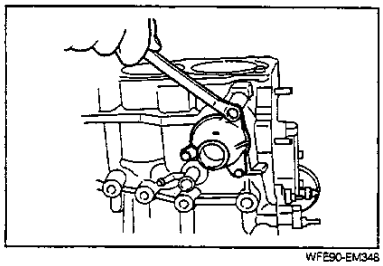
9. Remove the water pump by removing the three attaching bolts and two nuts.
10. Remove the water pump gasket.


WFE90-EM345

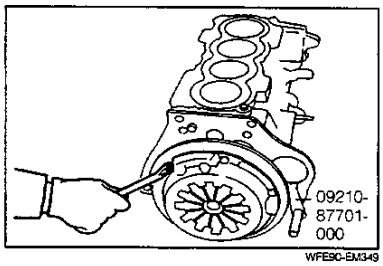
11. Remove the alternator assembly with bracket by removing the two attaching bolts and one adjusting bolt.


WFE90-EM347

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

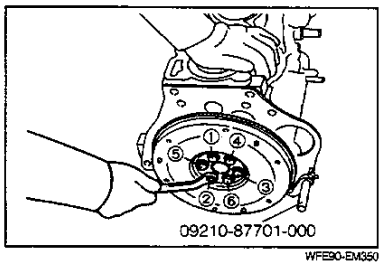

WFE90-EM348

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



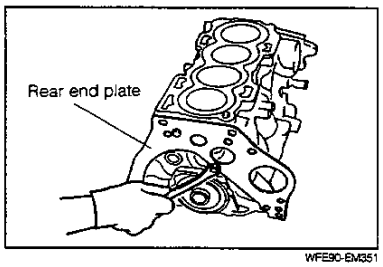
WFE90-EM349

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



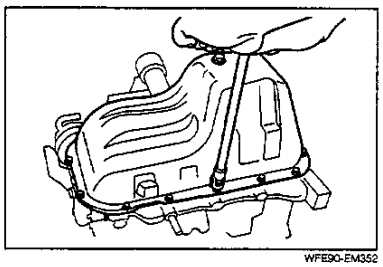
WFE90-EM350

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

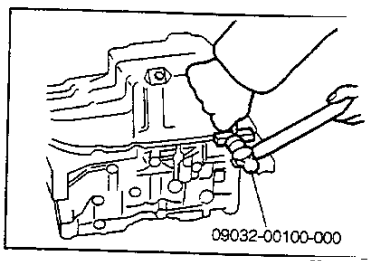


WFE90-EM351

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

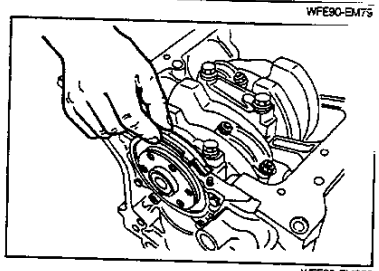

WFE90-EM352

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

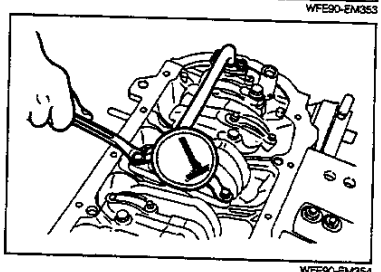


WFE90-EM75

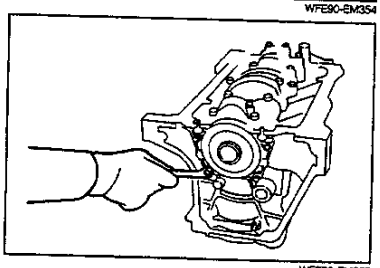
17. Remove the oil pan gasket.


WFE90-EM353

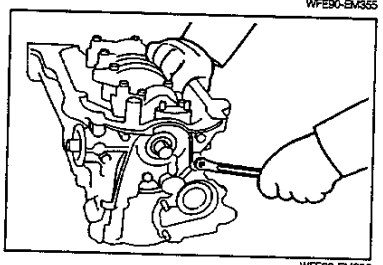
18. Remove the oil pump strainer by removing the two attaching bolts and two nuts.


WFE90-EM354

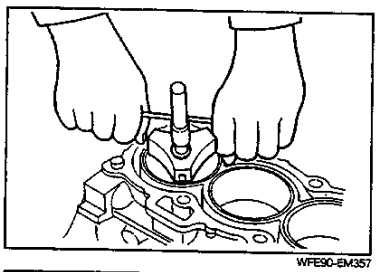
19. Remove the rear oil seal retainer.


WFE90-EM355

20. Remove the oil pump.

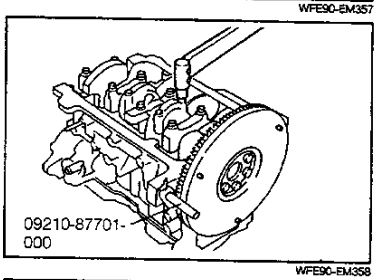

WFE90-EM356

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


WFE90-EM357

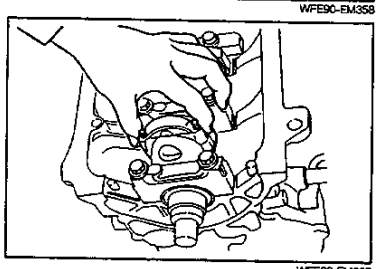
(3) Lock the flywheel to prevent the crankshaft from turning, using the following SST.
SST: 09210-87701-000

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

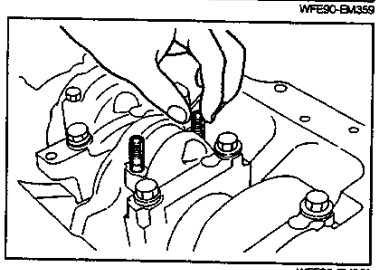


WFE90-EM358

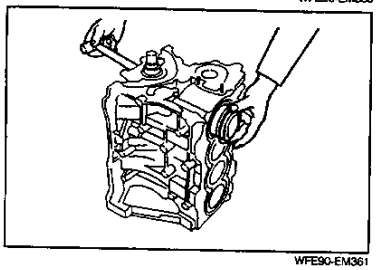
(5) Remove the bearing cap.
NOTE:
- Replace the crankshaft if the crankpin journals exhibit damages, such as seizure.
(See page EM–121.)


WFE90-EM359

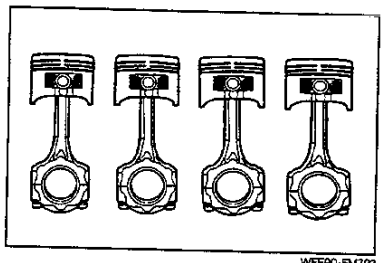
(6) Cover each connecting rod bolt with a short piece of hose to protect the crankpin journal from damage.


WFE90-EM360

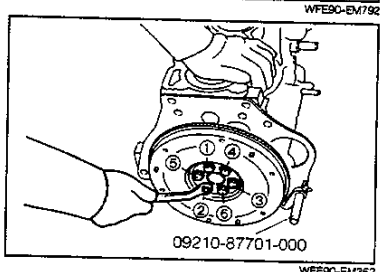
(7) Push out the piston and connecting rod assembly and the upper bearing through the top of the cylinder block.


WFE90-EM361

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

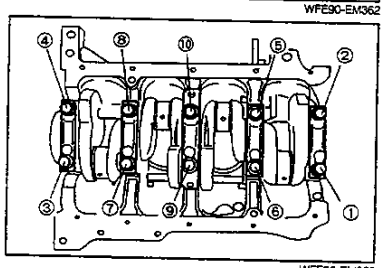

WFE90-EM792

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

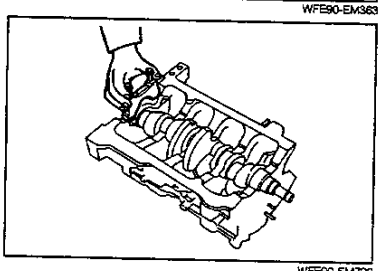


WFE90-EM362

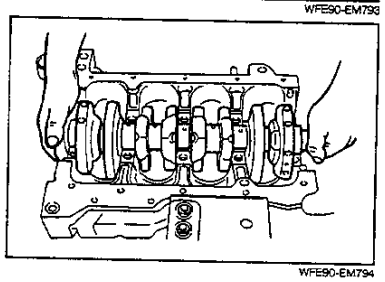
23. Removal of crankshaft
(1) Gradually loosen the main bearing cap bolts over three stages in the numerical sequence shown in the figure. Remove the bearing cap bolts.


WFE90-EM363

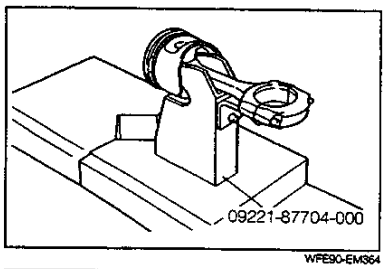
(2) With the main bearing cap bolts inserted into the bolt holes of the main bearing cap, wiggle the bearing cap back and forth. Remove the bearing cap together with the lower bearing.
NOTE:
- Keep the lower bearing fitted to the main bearing cap.
- Arrange the removed main bearing caps in order.


WFE90-EM793

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

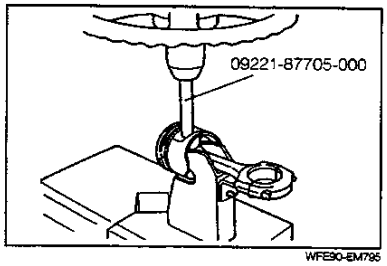

WFE90-EM794

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



WFE90-EM364

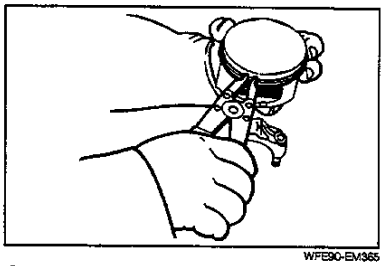
    (2) Insert the longer SST into the piston pin hole. Press off the piston, using a hydraulic press.
    SST: 09221-87705-000



WFE90-EM795

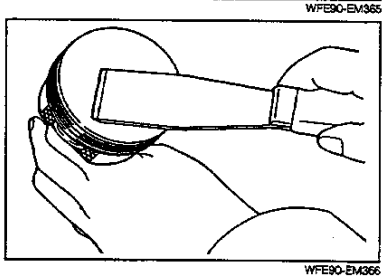
25. Removal of piston rings
    NOTE:
    - Arrange the removed piston rings in order so that their installation positions may be known readily.
    - Do not expand the piston ring unnecessarily beyond the required extent.

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


WFE90-EM365

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

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

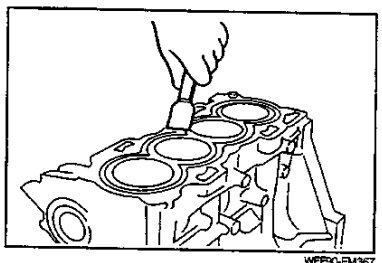

WFE90-EM366

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

INSPECTION OF EACH PART

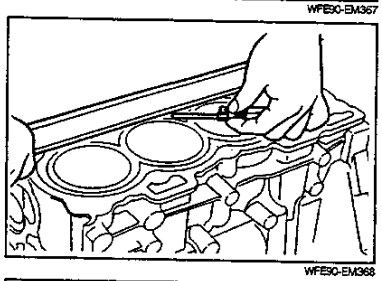
INSPECTION OF CYLINDER BLOCK

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


WFE90-EM367

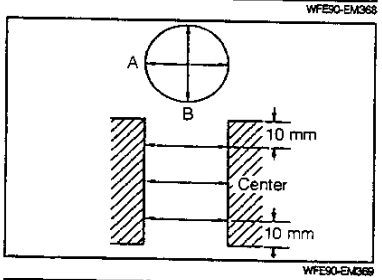
3. Inspection of top surface of cylinder block
   Using a precision straight edge and a thickness gauge, check the surface contacting the cylinder head gasket for warpage in the four directions as shown in the figure.
   Allowable Warpage: 0.1 mm

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


WFE90-EM368

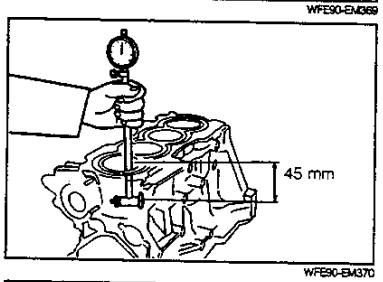
4. Measurement of cylinder bore
   (1) Measure the bore diameter of each cylinder at the six points shown in the right figure. Ensure that the difference between the maximum and minimum bore diameters of each cylinder is within 0.1 mm.

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



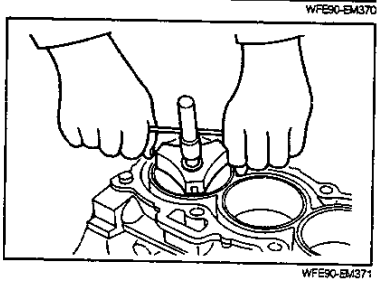
WFE90-EM369

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



WFE90-EM370

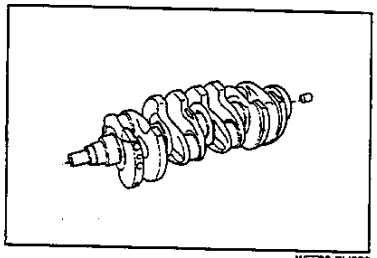
5. Removal of cylinder ridges
   If ridges are formed at the upper parts of the cylinder bores, use a ridge reamer to remove the ridges.


WFE90-EM371

INSPECTION OF CRANKSHAFT

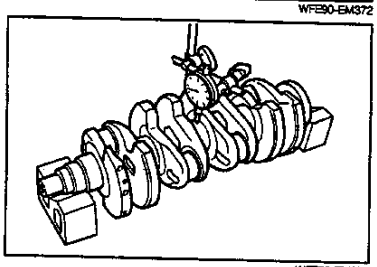
1. Visually inspect the main journals and crankpin journals for pitting or scratches.

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


WFE90-EM372

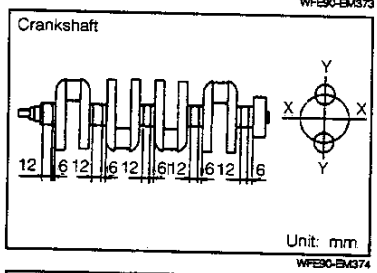
2. Measurement of crankshaft runout
   (1) Support the both ends of the crankshaft with a V-shaped blocks.
   Measure the crankshaft runout with a dial gauge.
   Allowable Runout Limit: 0.6 mm

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


WFE90-EM373

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

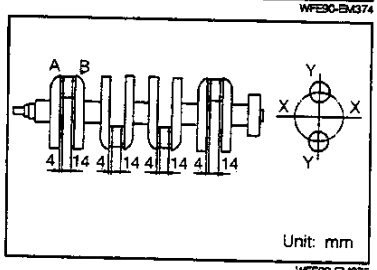
   If the variation in the measured diameters exceeds 0.026 mm, replace the crankshaft.



WFE90-EM374

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

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

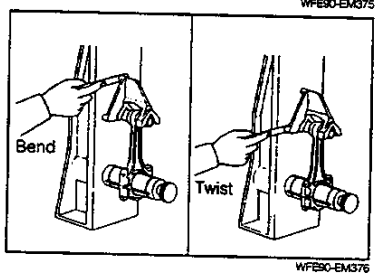


WFE90-EM375

IINSPECTION OF CONNECTING ROD

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

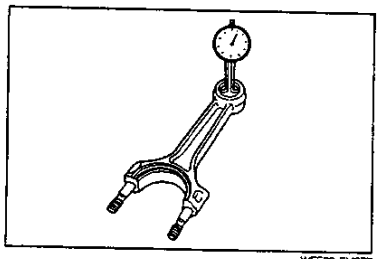
   If the bend or twist is greater than the allowable limit, replace the connecting rod assembly.



WFE90-EM376

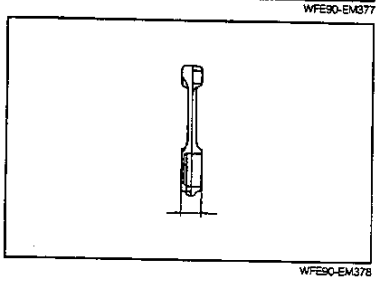
3. Measure the inner diameter of the connecting rod small end, using a bore dial gauge.
   Specified Value: 18.953 - 18.979 mm

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


WFE90-EM377

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

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

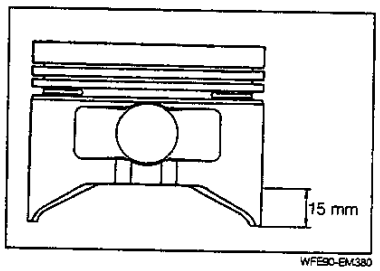

WFE90-EM378

INSPECTION OF PISTONS

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

WFE90-EM379

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



WFE90-EM380

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

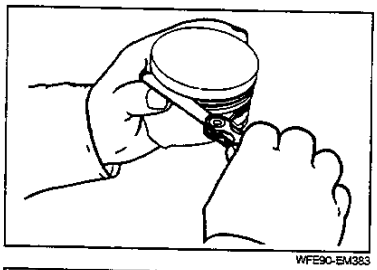
WFE90-EM381

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

WFE90-EM382

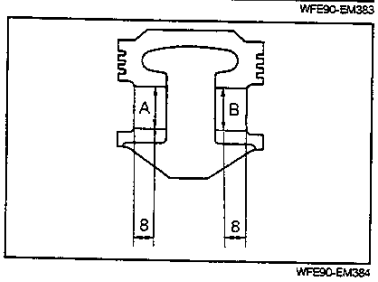
3. Measurement of piston ring groove width
Measure the groove width of the piston rings No. 1, No. 2 and No. 3 with a thickness gauge.
Specified Value:

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



WFE90-EM383

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



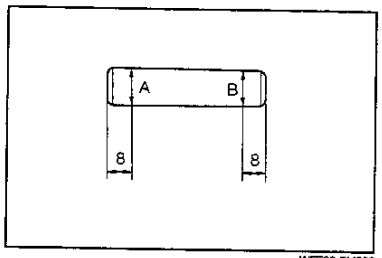
WFE90-EM384

INSPECTION OF PISTON PIN

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

WFE90-EM385

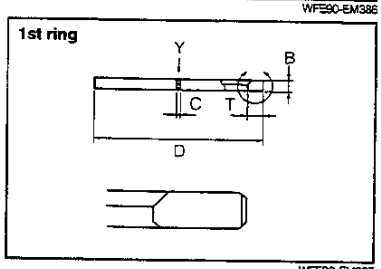
2. Measure the outer diameter of the piston pin at the two points as shown in the right figure, using a micrometer.
   Specified Value: 18.991 - 18.997 mm



WFE90-EM386

INSPECTION OF PISTON RINGS

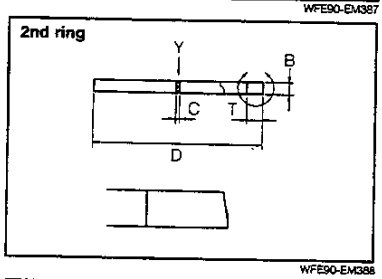
1. Visually inspect the piston ring for excessive uneven wear or scratches. If any abnormality exists, replace the piston ring with a new part.



WFE90-EM387

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

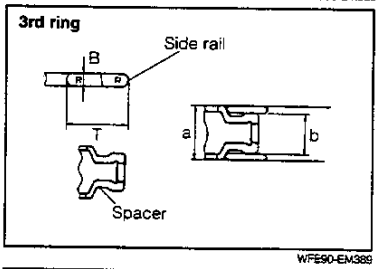
1st		2.80 - 3.00
2nd		3.00 - 3.20
3rd	Side rail	2.25 - 2.45
	Spacer	-



WFE90-EM388

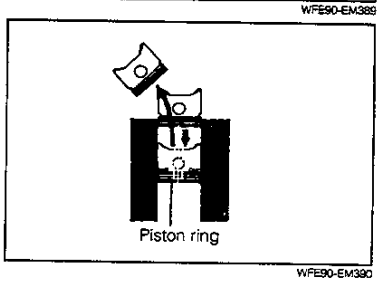
   (2) Measure the length of the piston ring.

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



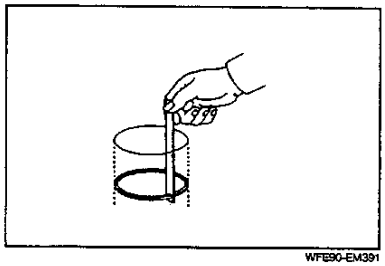
WFE90-EM389

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



WFE90-EM390

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



WFE90-EM391

Piston ring end gap

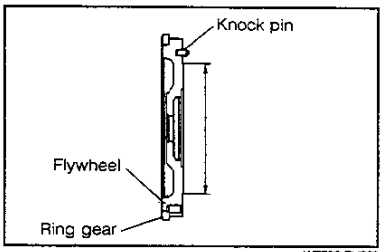
	Specified value mm	Allowable limit mm
Compression ring No. 1	0.27 - 0.42	0.7
Compression ring No. 2	0.35 - 0.50	0.8
Oil ring	0.20 - 0.70	1.0

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

WFE90-EM392

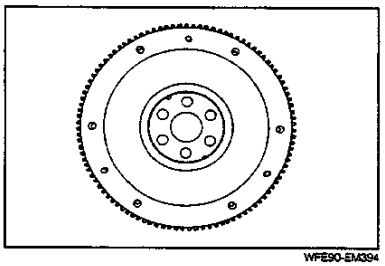
INSPECTION OF FLYWHEEL

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



WFE90-EM393

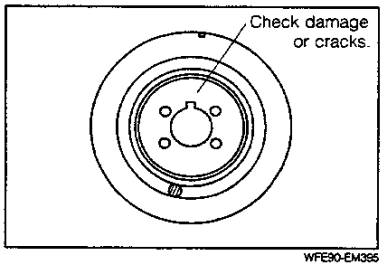
2. While holding the flywheel by your hands, ensure that there is no excessive play or displacement.
   If any abnormality exists, replace the flywheel.



WFE90-EM394

INSPECTION OF CRANKSHAFT PULLEY

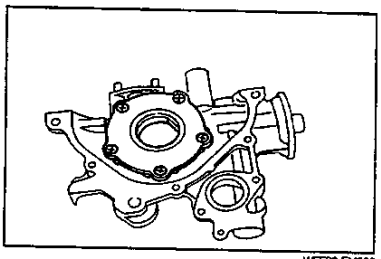
1. Visual inspection of crankshaft pulley
   (1) Check the crankshaft pulley attaching seat for deformation, wear or cracks.
   (2) Check the V-ribbed belt attaching surface for scratches, deformation or wear.
   Replace the crankshaft pulley, as required.



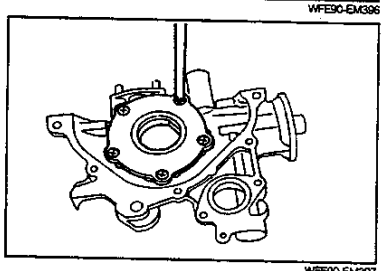
WFE90-EM395

INSPECTION OF OIL PUMP

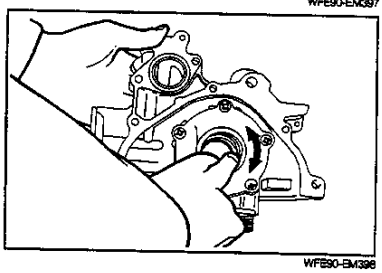
1. Visually inspect the rotor surface and oil seal section of the oil pump for scratches, wear and so forth.
   If any abnormality exists, replace the oil seal or rotor.


WFE90-EM396

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

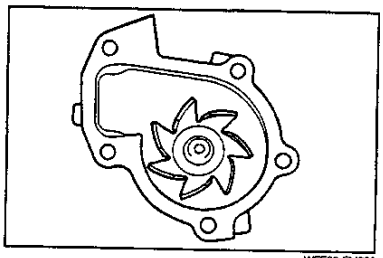

WFE90-EM397

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

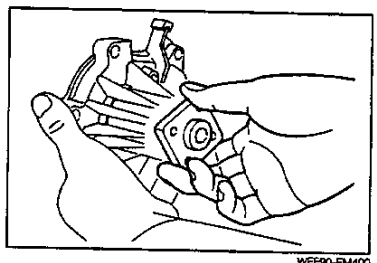

WFE90-EM398

INSPECTION OF WATER PUMP

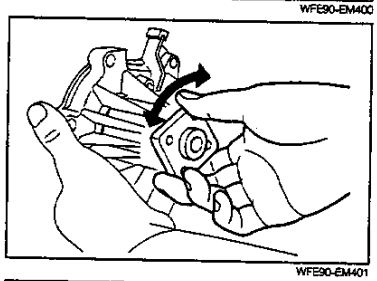
1. Visually inspect the water pump.
   (1) Mechanical seal section for evidence of water leakage
   (2) Rotary fin of water pump for scratches, deformation or cracks
   (3) Water pump attaching surface for scratches
   (4) Water pump pulley attaching seat for scratches or flattened condition
   Replace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


WFE90-EM399

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

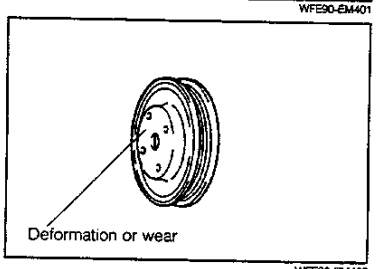

WFE90-EM400

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


WFE90-EM401

WATER PUMP PULLEY

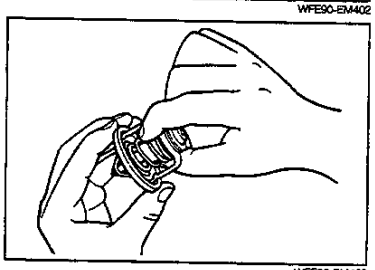
1. Visual inspection of water pump pulley
   (1) Inspect the water pump pulley attaching section for deformation or wear.
   (2) Inspect the V-ribbed belt attaching surface for deformation or wear.
   Replace the water pump pulley, as required.



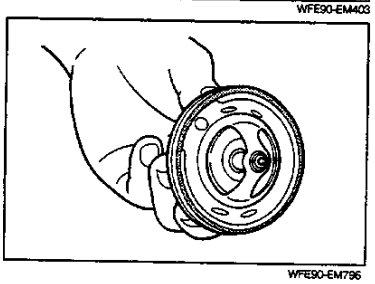
WFE90-EM402

INSPECTION OF THERMOSTAT

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


WFE90-EM403

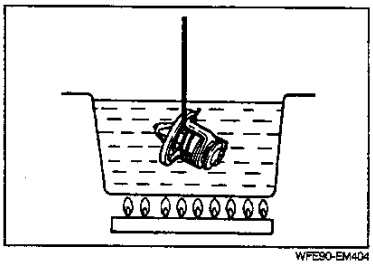
2. Check the rubber grommet of the thermostat for damage or crack.
   Replace the thermostat if the rubber grommet exhibits damage or crack.


WFE90-EM796

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

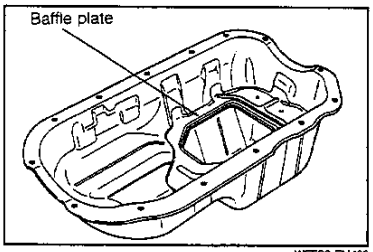
Specifications	Valve opening temperature °C	Valve lift
Standard specifications	76 - 80	8.5 mm or more at 91°C
Cold area specifications	82 - 86	8.5 mm or more at 98°C

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


WFE90-EM404

INSPECTION OF OIL PAN

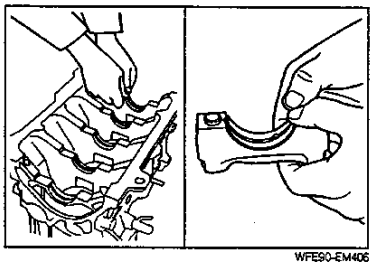
1. Visually inspect the oil pan for damage or cracks. Replace the oil pan, as required.



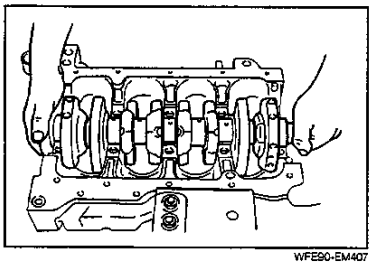
WFE90-EM405

INSPECTION OF OIL CLEARANCE AND SELECTION OF BEARING

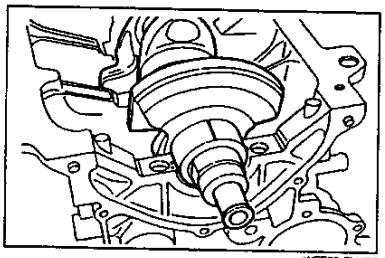
1. Measurement of main journal oil clearance
   (1) Install the main bearings to the cylinder block and crankshaft main bearing cap.
   NOTE:
   - **Do not touch the metal surface of the bearing.**


WFE90-EM406

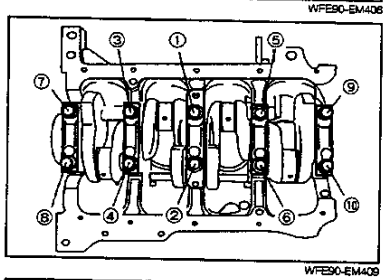
   (2) Place the crankshaft in the cylinder block.


WFE90-EM407

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

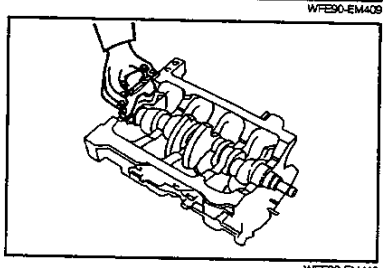

WFE90-EM408

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



WFE90-EM409

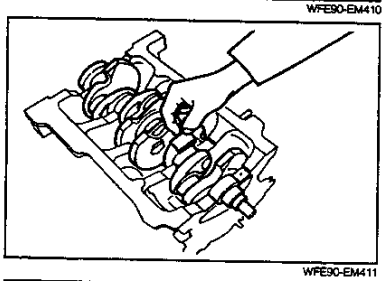
(5) Remove the main bearing caps with the lower bearings fitted on them.


WFE90-EM410

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

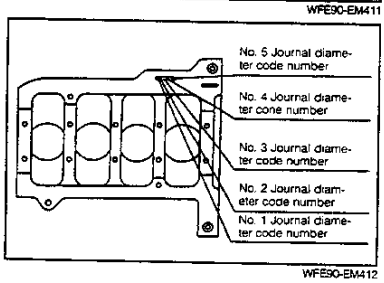
If the oil clearance fails to conform to the specified value, measure the crankshaft main journal diameter and select suitable crankshaft main journal bearings or replace the crankshaft.
(See page EM–131.)

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


WFE90-EM411

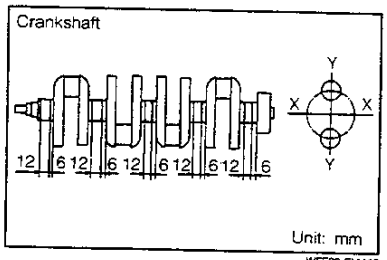
2. Selection of crankshaft bearings
NOTE:
- **The replacement of the crankshaft bearings should be performed after all inspections have been finished.**

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



WFE90-EM412

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



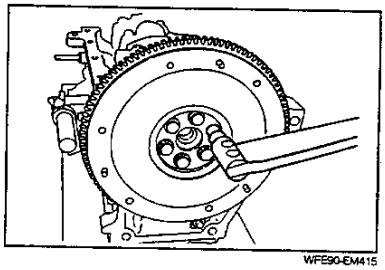
WFE90-EM413

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

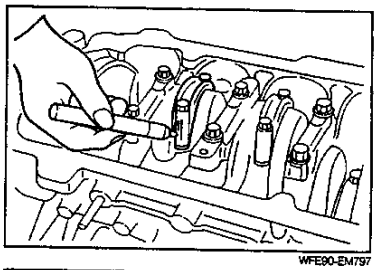
Main journal diameter code	Crankshaft main journal diameter mm	Bearing classification number (color)	Remarks
5	49.995 - 50.000	1 (Yellow)	—
	49.989 - 49.994	2 (Green)	—
	49.983 - 49.988	3 (Brown)	—
	49.976 - 49.982	4 (Black)	—
	49.975 or less	—	Crankshaft replacement
6	49.995 - 50.000	2 (Green)	—
	49.989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

WFE90-EM414

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

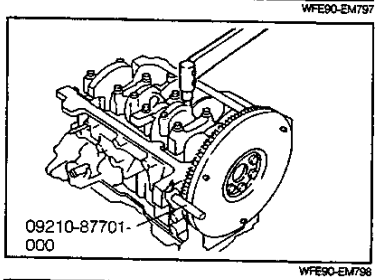

WFE90-EM415

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


WFE90-EM797

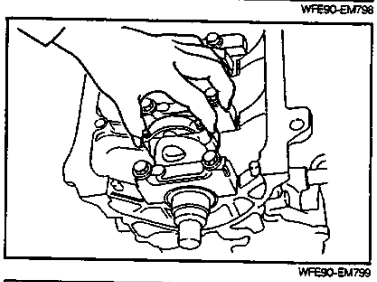
(4) Lock the flywheel to prevent the crankshaft from turning, using the following SST.
SST: 09210-87701-000

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

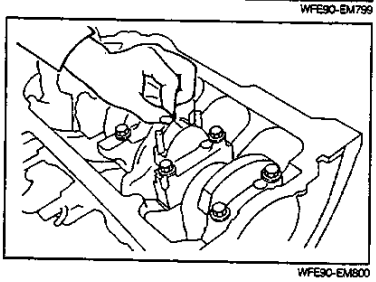


WFE90-EM798

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

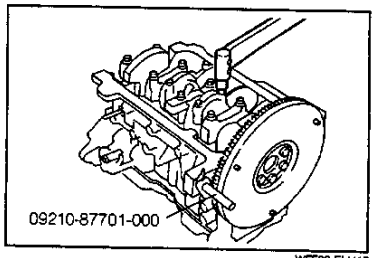

WFE90-EM799

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


WFE90-EM800

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

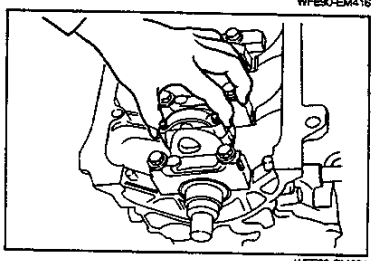
NOTE:
- When tightening the bearing cap nuts, apply engine oil to the bearing cap nuts.
- Prevent the crankshaft from turning, using the following SST.
  SST: 09210-87701-000



WFE90-EM416

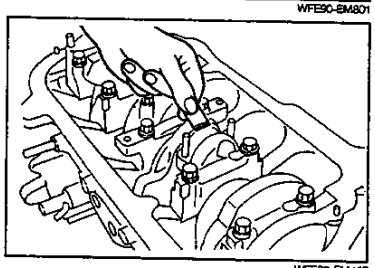
(9) Loosen the connecting rod bearing cap nuts evenly over two or three stages. Then, remove the connecting rod bearing cap.

NOTE:
- Prevent the crankshaft from turning, using the SST.
  SST: 09210-87701-000


WFE90-EM801

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

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


WFE90-EM417

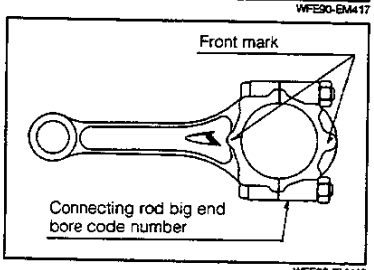
(11) Remove the plastigage from the crankpin journal.
(12) Measure the oil clearances of the remaining crankpin journals.

4. Selection of connecting rod bearings

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

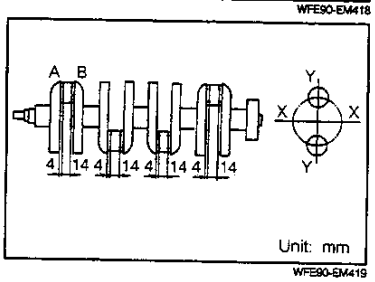
(1) Read the connecting rod big end bore code number.

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



WFE90-EM418

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



WFE90-EM419

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

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

WFE90-EM420

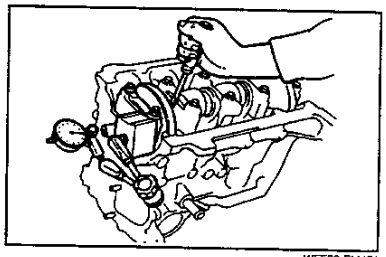
5. Check of crankshaft thrust clearance

NOTE:

- Measure the thrust clearance, using a dial gauge.

Thrust Clearance:

Specified Value: 0.02 - 0.22 mm
Allowable Limit: 0.30 mm



WFE90-EM421

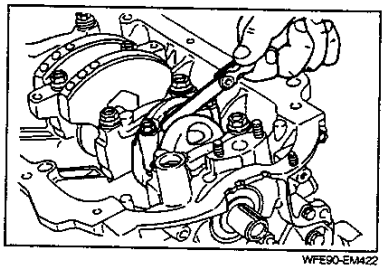
If the thrust clearance exceeds the allowable limit, measure the width of the crankshaft thrust bearing contact surface. If the measured value is less than 39.92 mm, replace the thrust washer. If the measured value exceeds 39.92 mm, replace the crankshaft and thrust washer.

6. Measurement of connecting rod thrust clearance

Measure the thrust clearance between the connecting rod and the crankshaft, using a thickness gauge.

Thrust clearance:

Standard: 0.15 - 0.40 mm
Maximum: 0.45 mm



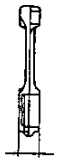
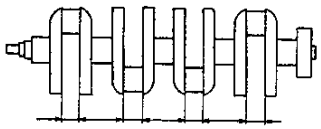
WFE90-EM422

NOTE:

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

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

Reference

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

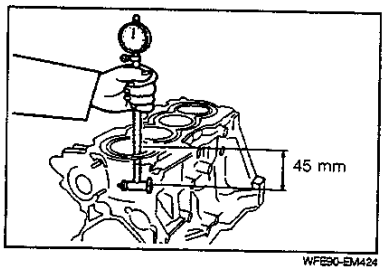
WFE90-EM423

CYLINDER BORING

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

WFE90-EM802

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



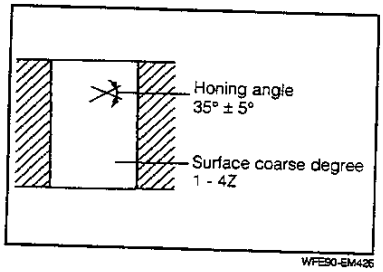
WFE90-EM424

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

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

WFE90-EM425

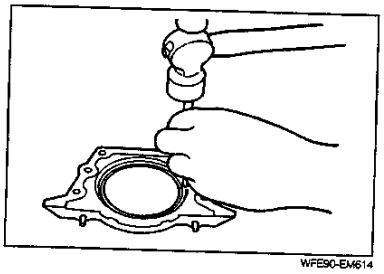
3. Hone the cylinder after the boring.
   (1) Bore the cylinder, leaving a honing allowance of 0.02 mm.
   (2) Hone the cylinder.
   Honing Angle: 35 ± 5°
   Surface Coarse Degree: 1 - 4Z



WFE90-EM426

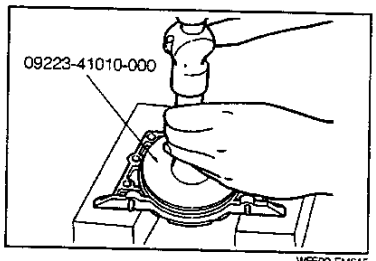
REPLACEMENT OF REAR OIL SEAL

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


WFE90-EM614

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

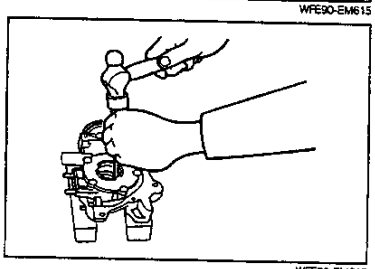
   NOTE:
   - Care must be exercised to ensure that the oil seal is not driven in a tilted state.



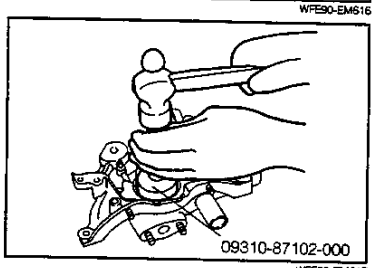
WFE90-EM615

REPLACEMENT OF FRONT OIL SEAL

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


WFE90-EM616

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

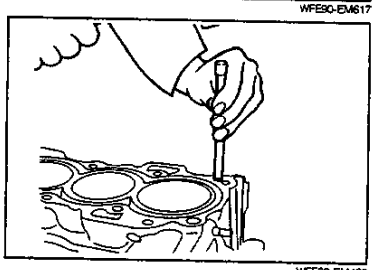


WFE90-EM617

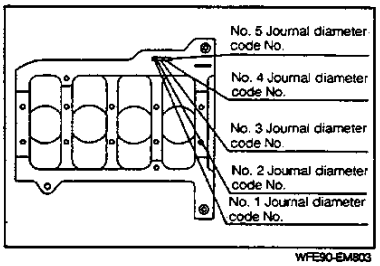
REPLACEMENT OF CYLINDER BLOCK

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

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

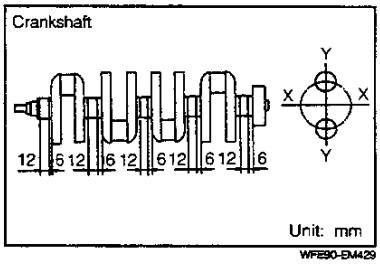

WFE90-EM428

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



WFE90-EM803

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



WFE90-EM429

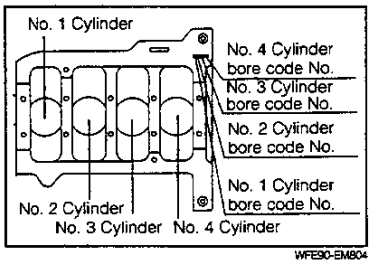
   (3) Select the crankshaft bearings in accordance with the table in the next page.

WFE90-EM430

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

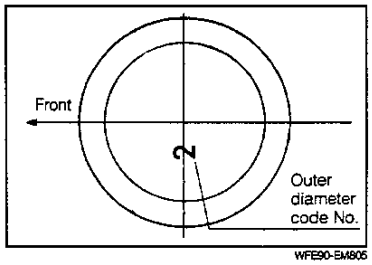
WFE90-EM431

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



WFE90-EM804

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



WFE90-EM805

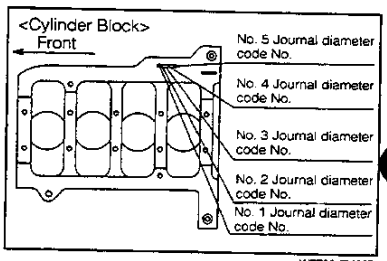
REPLACEMENT OF CRANKSHAFT

(Replacement of the crankshaft only)

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

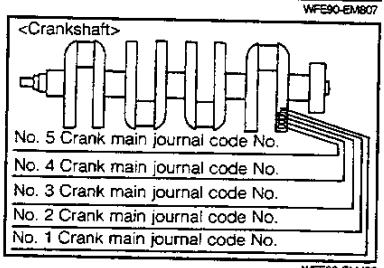
WFE90-EM805

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



WFE90-EM807

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



WFE90-EM432

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

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

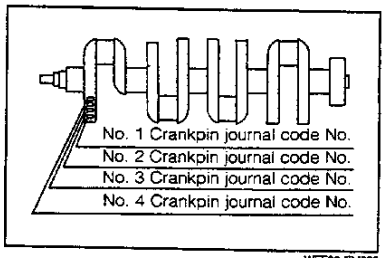
WFE90-EM433

Reference

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

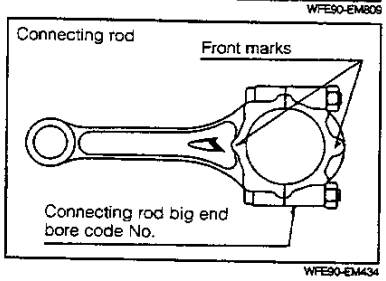
WFE90-EM808

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



WFE90-EM808

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



WFE90-EM434

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

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

WFE90-EM810

Reference

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

WFE90-EM811

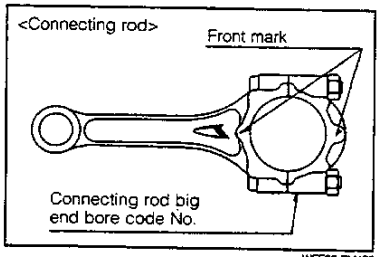
REPLACEMENT OF CONNECTING RODS

1. Wash the connecting rods using cleaning solvent.

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

WFE90-EM812

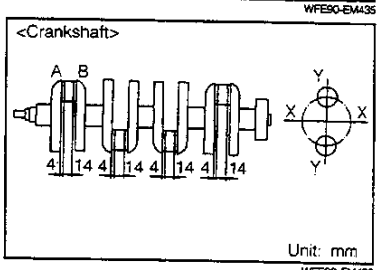
2. Selection of connecting rod bearings
   (1) Read the connecting rod bid end bore code number.



WFE90-EM435

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

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



WFE90-EM436

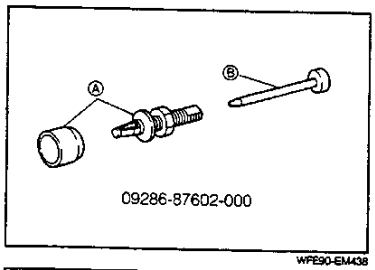
   (3) Select the connecting rod bearing in accordance with the table below.

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

WFE90-EM437

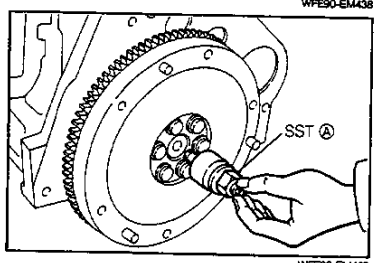
REPLACEMENT OF CRANKSHAFT REAR END BEARING

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



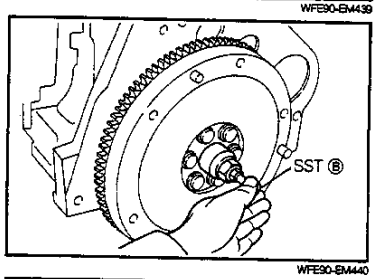
WFE90-EM438

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



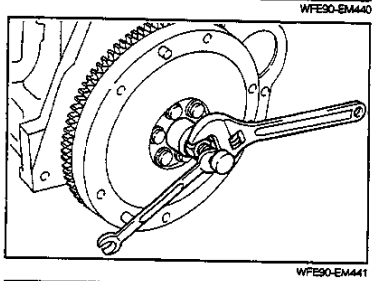
WFE90-EM439

(2) Insert the SST Ⓑ into the SST Ⓐ.

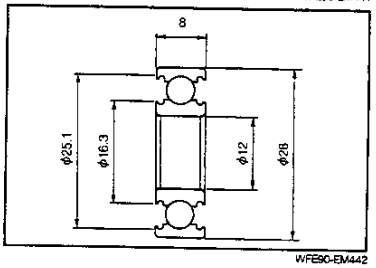


WFE90-EM440

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

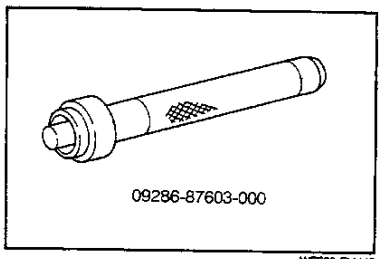

WFE90-EM441

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



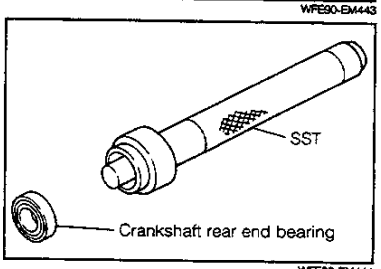
WFE90-EM442

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



WFE90-EM443

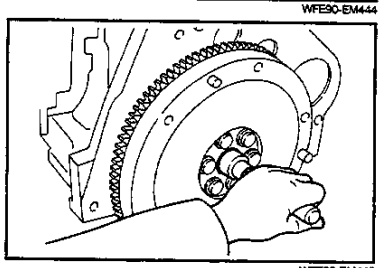
   (1) Install the crankshaft rear end bearing to the SST.



WFE90-EM444

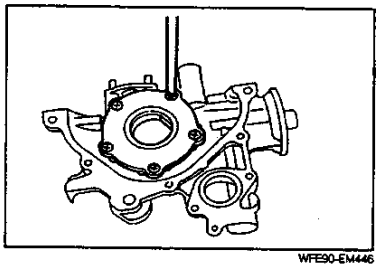
   (2) Press the crankshaft rear end bearing into the crankshaft rear end.

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

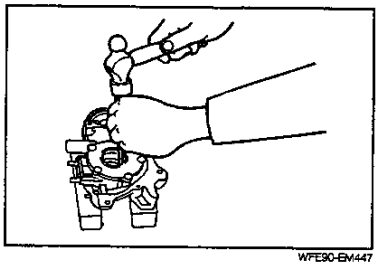

WFE90-EM445

DISASSEMBLY OF OIL PUMP

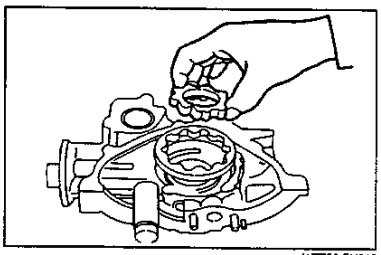
1. Detach the oil pump cover.
   Disconnect the five attaching bolts.


WFE90-EM446

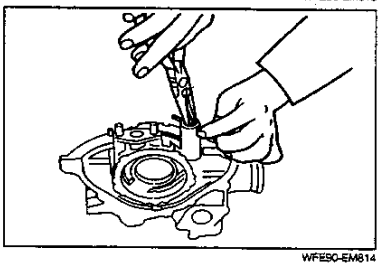
2. Remove the front oil seal.


WFE90-EM447

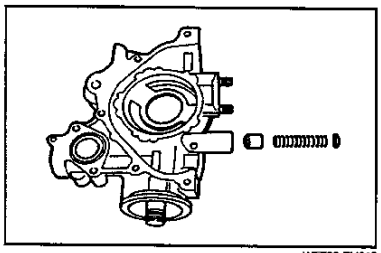
3 Remove the oil pump rotor set.


WFE90-EM813

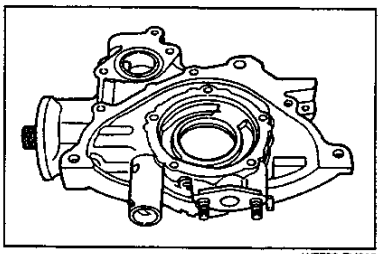
4. Pull out the cotter pin, while pushing the spring retainer with nose pliers or the like.
NOTE:
- Put an appropriate cloth, etc. on the retainer spring so that it may not jump out.


WFE90-EM814

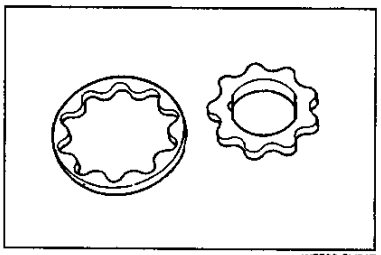
5. Remove the oil pump relief valve spring retainer, compression spring and oil pump relief valve.
NOTE:
- Wash the disassembled parts in cleaning solvent.


WFE90-EM815

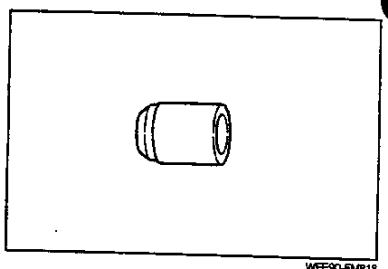
6. Inspection of each part
(1) Check the pump body for damage.
Replace the pump body if it exhibits damage.


WFE90-EM816

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

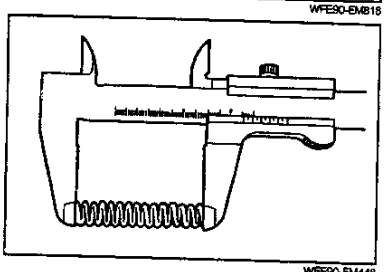

WFE90-EM817

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

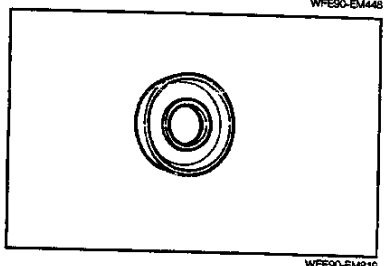

WFE90-EM818

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

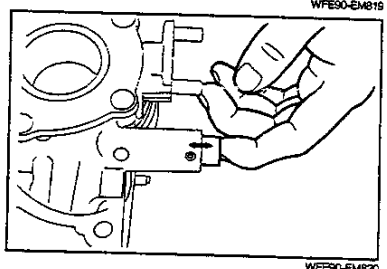
Replace the compression spring if it exhibits damage or the free length is less than the specified value.


WFE90-EM448

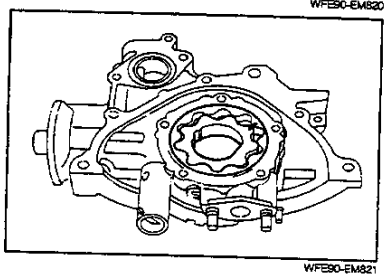
(5) Check the oil pump relief valve spring retainer for damage.
Replace the retainer if it exhibits damage.


WFE90-EM819

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

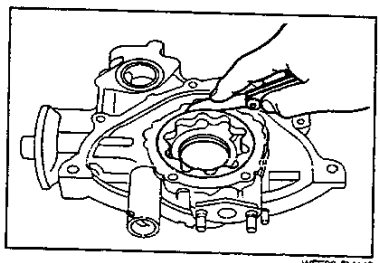

WFE90-EM820

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


WFE90-EM821

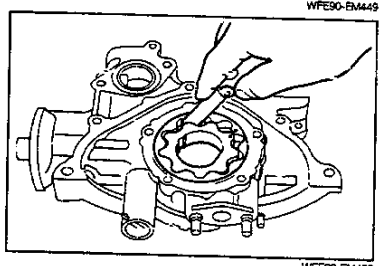
(2) Measure the body clearance between the oil pump body and the outer rotor, using a thickness gauge.
Body Clearance: 0.20 - 0.28 mm

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


WFE90-EM449

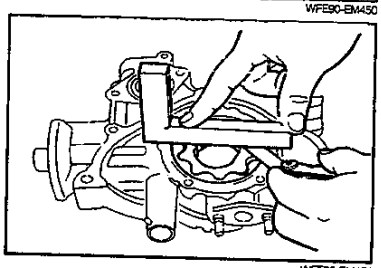
(3) Measure the tip clearance of the rotor set, using a thickness gauge.
Tip Clearance: 0.16 - 0.24 mm

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

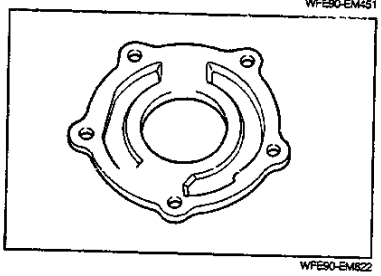

WFE90-EM450

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

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


WFE90-EM451

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


WFE90-EM822

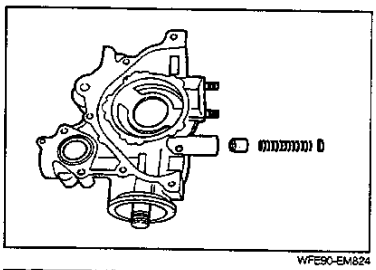
ASSEMBLY OF OIL PUMP

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

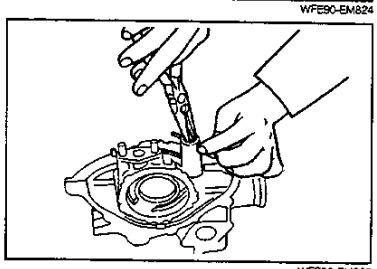
WARNING:
- **When you use compressed air, be sure to protect your eyes, wearing goggles.**

WFE90-EM823

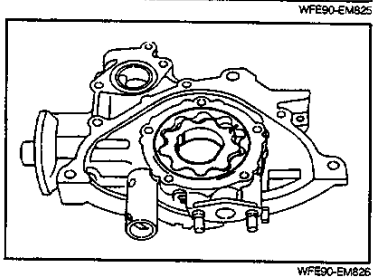
1. Apply engine oil to the relief valve. Then, insert the relief valve into the oil pump body.
2. Insert the compression spring and retainer into the oil pump body.
   NOTE:
   - Install the retainer in such a direction that its projected side may come at the compression spring side.


WFE90-EM824

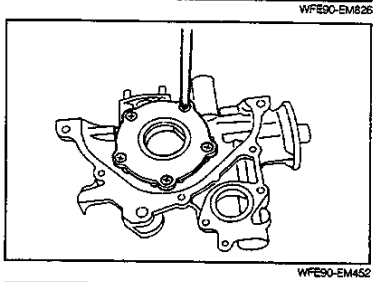
3. Insert a new cotter pin into the retainer while the retainer is being compressed with pliers, etc. Split the end of the cotter pin to form an anchor-like shape.


WFE90-EM825

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

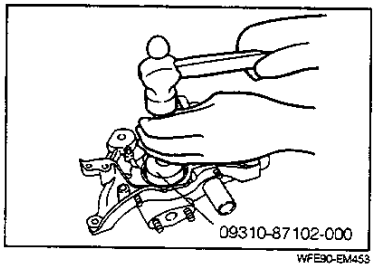

WFE90-EM826

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


WFE90-EM452

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

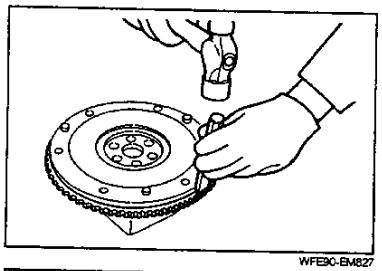
   NOTE:
   - Be very careful not to damage the oil pump during the installation.
   - Make sure that the oil seal is not driven into position in a tilted state.



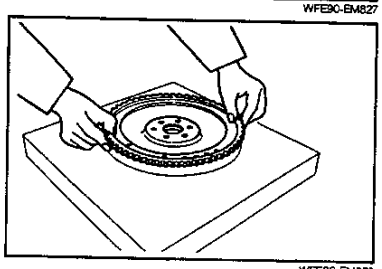
WFE90-EM453

REMOVAL/INSTALLATION OF RING GEAR

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

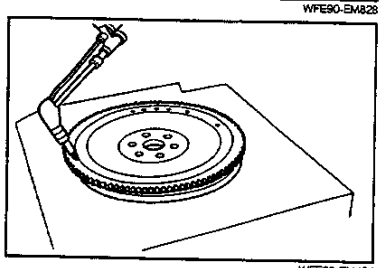

WFE90-EM827

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


WFE90-EM828

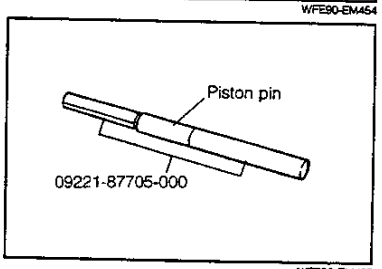
3. Using a gas burner, heat the ring gear evenly, until the ring gear due to its own weight fits onto the flywheel .
   NOTE:
   - Do not tap the ring gear using a hammer or the like.
   - Never cool the ring gear quickly using water or the like.

4. Allow the ring gear to cool naturally.


WFE90-EM454

ASSEMBLY OF PISTON AND CONNECTING ROD

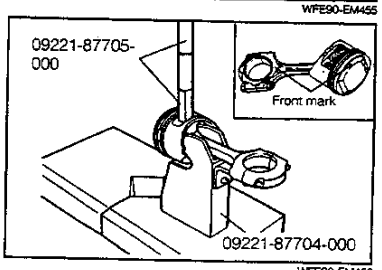
1. Install the piston pin to the following SST in a way shown in the right figure.
   SST: 09221-87705-000



WFE90-EM455

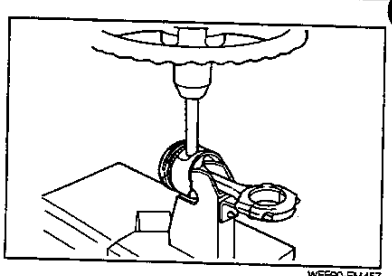
2. Install the piston and connecting rod in the SST in a way shown in the right figure. Insert the SST installed with the piston pin into the piston pin hole.
   SST: 09221-87704-000
   09221-87705-000

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

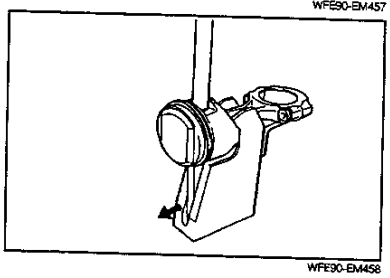


WFE90-EM456

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


WFE90-EM457

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


WFE90-EM458

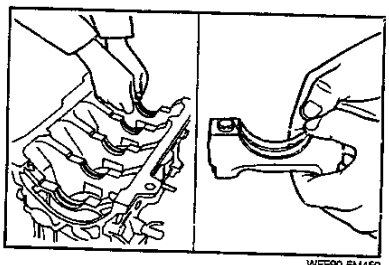
ASSEMBLY OF CYLINDER BLOCK

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

WFE90-EM829

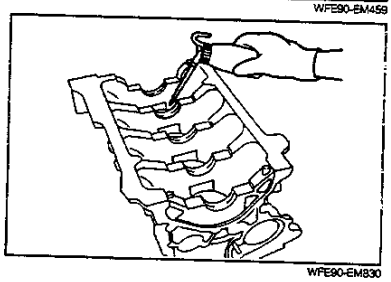
1. Installation of crankshaft
   (1) Install the bearings to the cylinder block and crankshaft bearing caps.

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

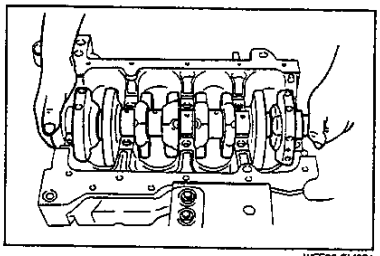

WFE90-EM459

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

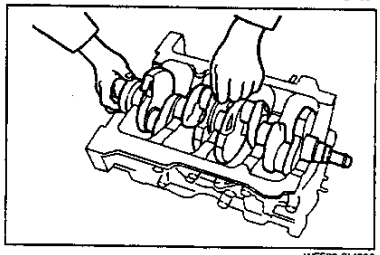
NOTE:
- Do not touch with the front and back surfaces of each bearing.
- Never apply engine oil to the crankshaft bearing caps.


WFE90-EM830

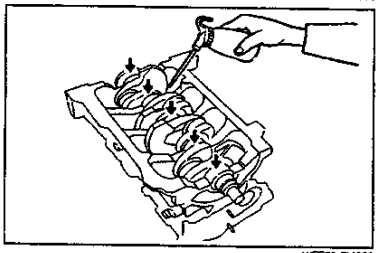
(3) Install the crankshaft in the cylinder block.


WFE90-EM831

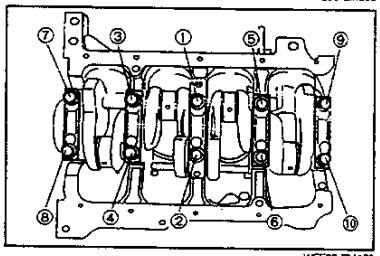
(4) Apply engine oil to the thrust washers. With the side having the oil groove facing toward the crankshaft side, insert each thrust washer between the crankshaft main journal No. 3 and the cylinder block.


WFE90-EM832

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

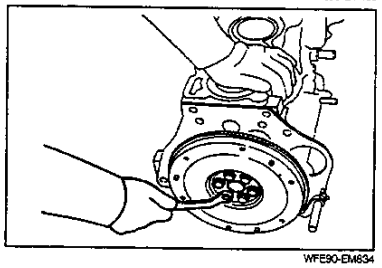

WFE90-EM833

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



WFE9C-EM460

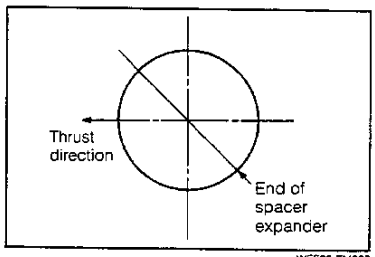
2. Assembly of piston and connecting rod
Install the flywheel on the crankshaft temporarily.
NOTE:
- Care must be exercised to ensure that no oil, etc. gets to the bolts or bolt holes.


WFE90-EM834

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

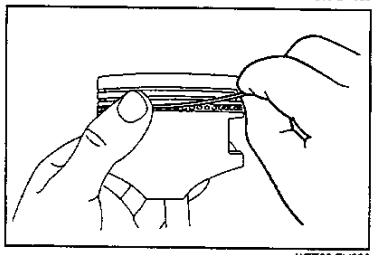
NOTE:

- **Do not expand the spacer expander to an extent more than necessary.**



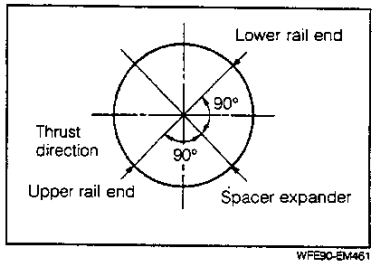
WFE90-EM835

(2) Fit the upper rail into position in such a manner that it is wound up while pushing the edge section of the oil ring spacer expander with your thumb.


WFE90-EM836

NOTE:

- **Ensure that the rail end is deviated 90-degrees to the left from the end of the oil ring spacer expander.**
- **Do not expand the rail to an extent more than necessary.**

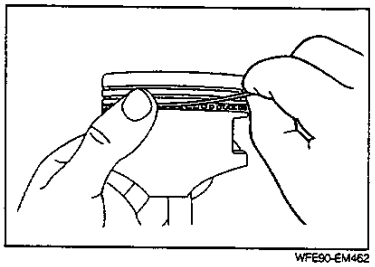


WFE90-EM461

(3) Fit the lower rail into position in such a manner that it is wound up.

NOTE:

- **Ensure that the rail end is deviated 90-degrees to the right from the end of the oil ring spacer expander.**
- **Do not expand the rail to an extent more than necessary.**
- **Make sure that the oil ring can be rotated smoothly.**

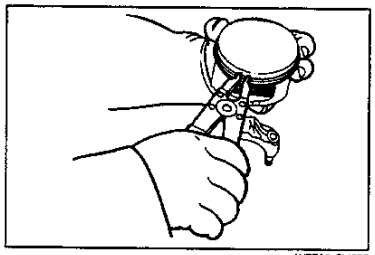

WFE90-EM462

(4) Install the compression ring No. 2 with the stamped mark of T, 2T, N or 2N facing upward, using a piston ring expander.

NOTE:

- **Do not expand the piston ring to an extent more than necessary.**

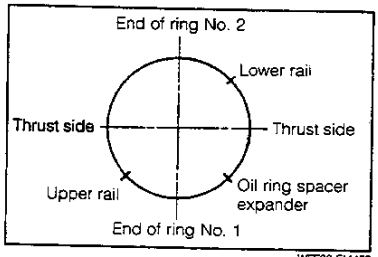
(5) Install the compression ring No. 1 with the stamped mark of T or N facing upward, using a piston ring expander.


WFE90-EM837

(6) Position the piston rings so that each ring end may come at the respective points as indicated in the right figure.

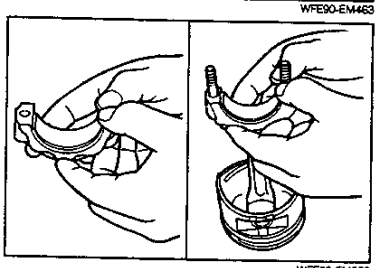
NOTE:

- **It is not necessarily required to follow strictly the right figure. However, be sure that the ring end is not lined up with the thrust direction. Also, each ring should be deviated about 120 to 180 degrees from the adjacent ring.**

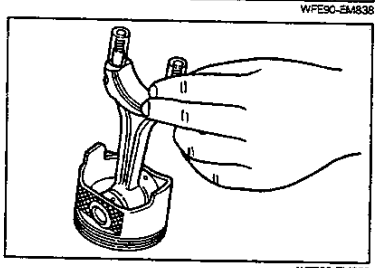


WFE90-EM463

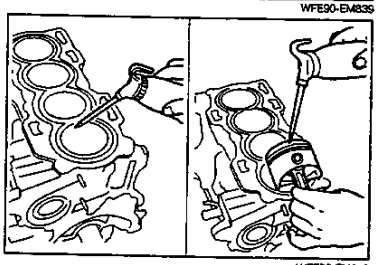
(7) Install the connecting rod bearings on the connecting rod and connecting rod cap, making sure that your fingers will not touch with the front and back surfaces of the bearings.


WFE90-EM838

(8) Cut an appropriate vinyl hose to a suitable length. Fit the vinyl hose to each connecting rod bolt sections.


WFE90-EM839

(9) Apply engine oil to the piston rings, piston pins, connecting rod bearings, cylinder walls and crankpin journals.

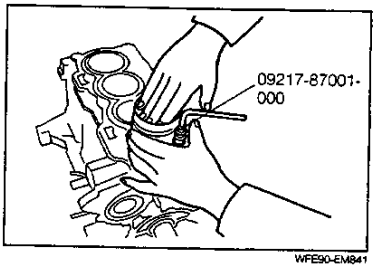

WFE90-EM840

(10) Compress the piston rings by means of the piston ring compressor SST, making sure that the piston ring ends will not move during the installation.
SST: 09217-87001-000

(11) Push the piston by hand into the cylinder bore with the front mark facing toward the oil pump side.

NOTE:

- **Be very careful to avoid damaging the connecting rod bearings during the installation.**
- **Care must be exercised to ensure that the crankpin journal is not scratched by the connecting rod.**

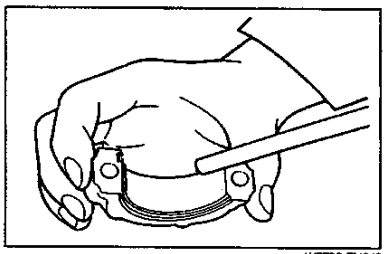


WFE90-EM841

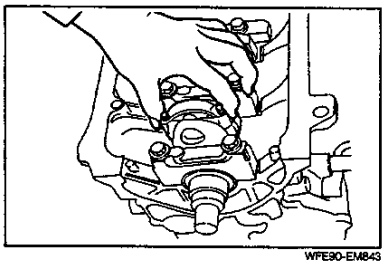
(12) Push the piston by hand until the connecting rod reaches the crankpin journal.

(13) Apply engine oil to the bearing surface of each connecting rod bearing.
NOTE:
- **Do not touch with the bearing front surface.**

(14) Remove the vinyl hoses which were attached to the connecting rod bolt sections.


WFE90-EM842

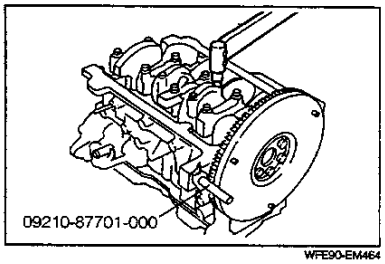
(15) Install the connecting rod cap with the front mark facing toward the oil pump side.


WFE90-EM843

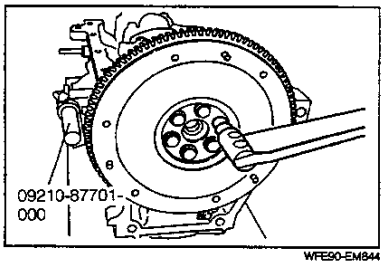
(16) Prevent the crankshaft from turning, using the following SST.
SST: 09210-87701-000

(17) Thinly apply engine oil to the connecting rod cap attaching nuts. Tighten the nuts to the specified torque evenly over two or three stages.
Tightening Torque: 34.3 - 44.1 N·m (3.5 - 4.5 kgf-m)

(18) Perform the operations described in the steps (1) through (18) for each cylinder.
(19) Remove the flywheel.
(20) Remove the following SST.
SST: 09210-87701-000

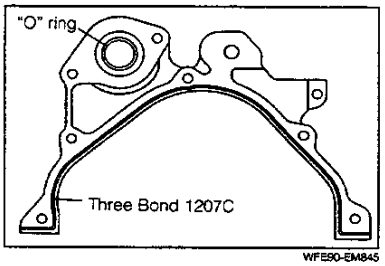


WFE90-EM464



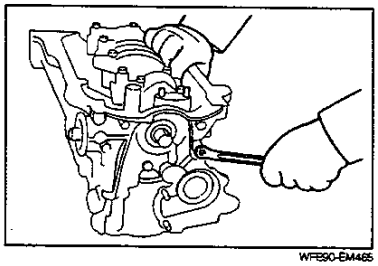
WFE90-EM844

3. Installation of oil pump
(1) Apply the Three Bond 1207C to the oil pump installation surface of the cylinder block, as indicated in the right figure.
(2) Replace the "O" ring of the oil pump with a new part.

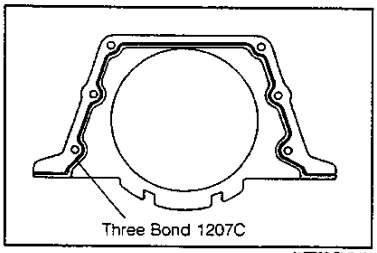


WFE90-EM845

(3) Apply engine oil to the inner surface of the oil seal. Install the oil pump to the cylinder block. Tighten the seven attaching bolts to the specified torque.
Tightening Torque: 5.9 - 8.8 N·m (0.6 - 0.9 kgf-m)

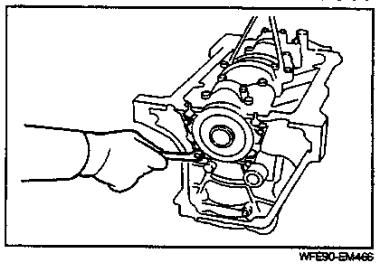

WFE90-EM465

4. Installation of oil seal retainer
(1) Apply the Three Bond 1207C to the oil seal retainer installation surface of the cylinder block, as indicated in the right figure.

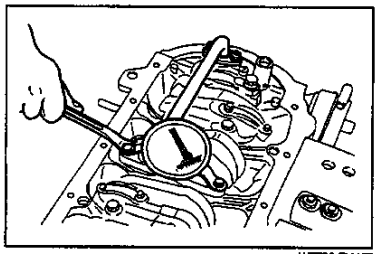


WFE90-EM846

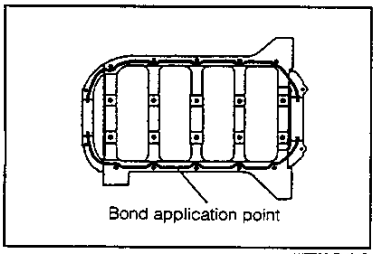
(2) Apply engine oil to the inner surface of the oil seal. Install the oil seal retainer to the cylinder block. Tighten the four attaching bolts to the specified torque.
Tightening Torque: 5.9 - 8.8 N·m (0.6 - 0.9 kgf-m)


WFE90-EM466

5. Install the oil strainer with a new gasket interposed. Tighten the two oil strainer nuts and two bolts to the specified torque.
Tightening Torque: 8.8 - 11.8 N·m (0.9 - 1.2 kgf-m)

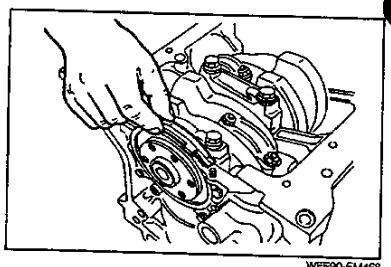

WFE90-EM467

6. Installation of oil pan
(1) Apply the Three Bond 1207C to the oil pan installation surface of the cylinder block, as indicated in the right figure.

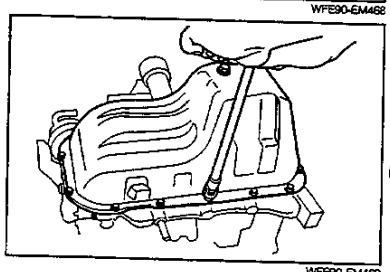


WFE90-EM847

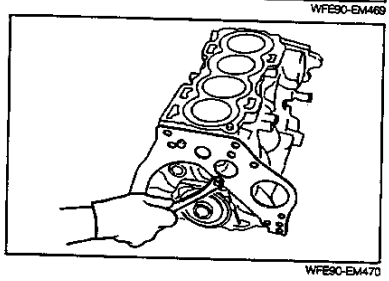
(2) Place the oil pan gasket.
NOTE:
- Ensure that the end section of the oil pan gasket is overlapped at least 10 mm with the Three Bond 1207C.


WFE90-EM468

(3) Install the oil pan. Tighten the four oil pan attaching nuts and ten bolts to the specified torque over two or three stages.
Tightening Torque: 6.9 - 11.8 N·m (0.7 - 1.2 kgf-m)


WFE90-EM469

7. Install the rear end plate.
Tighten the two rear end plate attaching bolts to the specified torque.
Tightening Torque: 9.8 - 14.7 N·m (1.0 - 1.5 kgf-m)

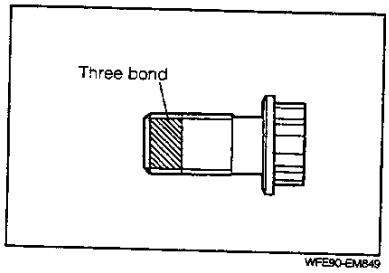

WFE90-EM470

8. Installation of flywheel
(1) Install the flywheel on the crankshaft.

WFE90-EM848

(2) Application of flywheel bolt sealing material
① Wash the flywheel bolts. Then, degrease and dry them.
NOTE:
- When degreasing the bolts, remove any oil completely, using a solvent such as a degreasing spraying agent or alcohol.

CAUTION:
- Make sure that no bond nor other foreign matter, such as dust, gets to the bolts.
- Even when new bolts are used, be sure to perform this operation.



WFE90-EM849

② Check the flywheel bolts for damage. Replace any flywheel bolt which exhibits damage with a new one.
CAUTION:
- Even when a new bolt is used, be sure to perform the operation in the step ①.

③ Clean the flywheel bolt threaded holes at the rear end section of the crankshaft. Degrease and dry them.
CAUTION:
- Make sure that no bond nor other foreign matter, such as dust, gets to the bolt threaded holes.
- As for degreasing, wipe off any oil from the threaded portion with a cloth damped with alcohol.
- Never allow alcohol to get to resin or rubber parts, specifically, the rear oil seal.

④ Clean the bolt seating surface of the flywheel and degrease it.
NOTE:
- As for degreasing, wipe the bolt seating surface with a cloth damped with alcohol.
- Never allow alcohol to get to resin or rubber parts.

⑤ Apply two to three drops of the Three Bond 1324 to the forward end of the threaded portion of each flywheel bolt.
CAUTION:
- If the Three Bond 1324 is applied excessively beyond the specified amount, the bond sealer will penetrate up to the bolt seating surface. This may cause loosening of the bolts.
- Never use bond sealers other than the designated one.
- Never allow the bond sealer to get to resin or rubber parts.

(3) Tighten the flywheel attaching bolts temporarily to the specified torque in the sequence indicated in the right figure.
Tightening Torque: 44.1 - 63.7 N·m (4.5 - 6.5 kgf-m)

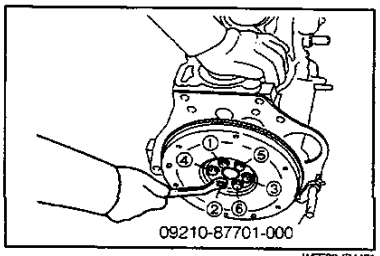
NOTE:
- Prevent the crankshaft from turning at the ring gear section, using the following SST.

SST: 09210-87701-000

WFE90-EM618

CAUTION:
- When tightening the bolt, make sure that no bond is present on the bolt seating surface.
- If the bond oozes out, perform the operations again, starting the step (2).

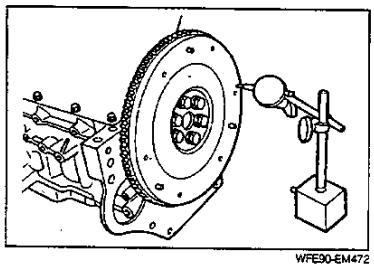
(4) Tighten the flywheel attaching bolts to the specified torque in the sequence indicated in the right figure.
Tightening Torque: 78.5 - 98.0 N·m (8.0 - 10.0 kgf-m)



WFE90-EM471

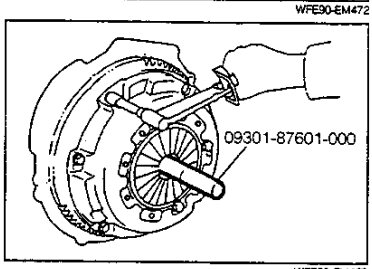
(5) Measure the flywheel runout, using a dial gauge.
Allowable Runout Limit: 0.1 mm

NOTE:
- Replace the flywheel if its runout exceeds the allowable limit.


WFE90-EM472

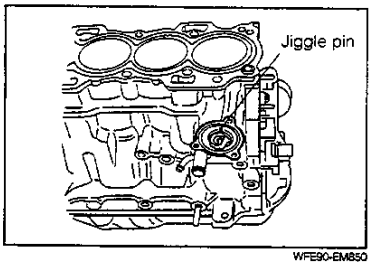
9. Assembly of clutch disc and pressure plate
(1) Insert the following SST into the crankshaft rear end.
SST: 09301-87601-000

(2) Install the clutch disc.
(3) Install the pressure plate, lining up the locating pin of the pressure plate. Tighten the attaching bolts to the specified torque.
Tightening Torque: 14.7 - 21.6 N·m (1.5 - 2.2 kgf-m)



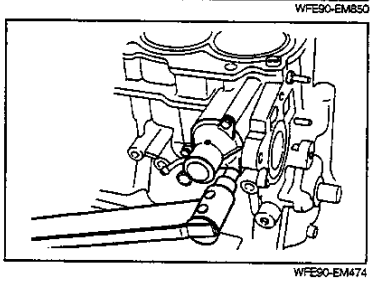
WFE90-EM473

10. Install the thermostat in the cylinder block in such a way that the jiggle pin section may come at the upper side.
CAUTION:
- Make sure to install the jiggle pin of the thermostat in the correct direction. Failure to observe this precaution will be cause of overheating.



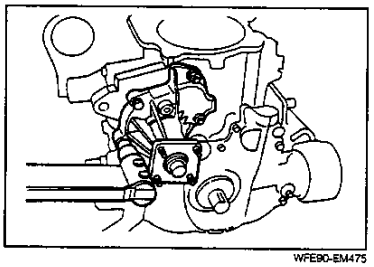
WFE90-EM850

11. Install the water inlet.
Tighten the three water inlet attaching bolts to the specified torque.
Tightening Torque: 5.9 - 8.8 N·m (0.6 - 0.9 kgf-m)

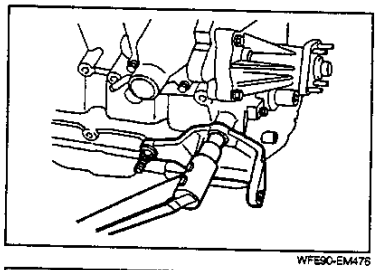

WFE90-EM474

12. Installation of water pump
(1) Install a new water pump gasket on the cylinder block.
(2) Install and tighten the three water pump attaching bolts and two nuts to the specified torque.
Tightening Torque: 14.7 - 21.6 N·m (1.5 - 2.2 kgf-m)

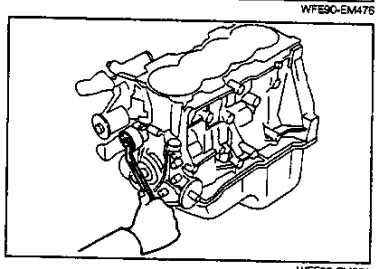
NOTE:
- When the stud bolts have been replaced, apply the Three Bond 1377B to the threaded portion at the cylinder block side.


WFE90-EM475

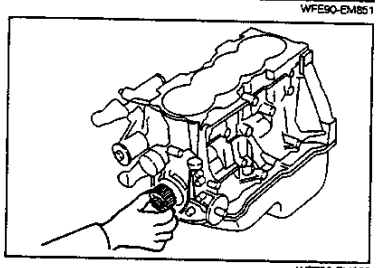
13. Install the alternator bracket.
    Tighten the one alternator bracket attaching bolt and nut to the specified torque.
    Tightening Torque: 34.4 - 49.0 N·m (3.5 - 5.0 kgf-m)


WFE90-EM476

14. Assemble the tensioner tension spring as indicated in the right figure. Push the tensioner to the alternator side as far as it will go. Tighten the tensioner temporarily.


WFE90-EM851

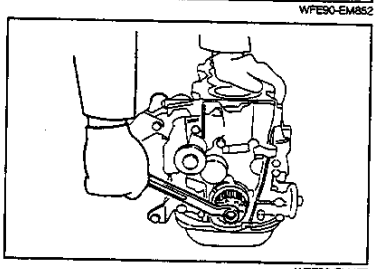
15. Install the crankshaft pulley flange in such a way that its recessed side may come at the cylinder block side.
16. Install the crankshaft timing belt pulley.


WFE90-EM852

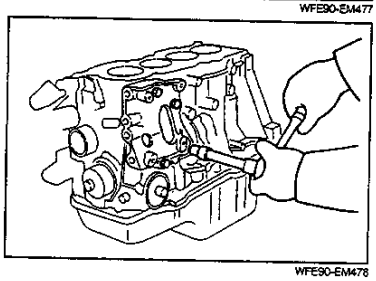
17. Install the crankshaft timing belt attaching bolt. Tighten the bolt to the specified torque.
    Tightening Torque: 88.3 - 98.0 N·m (9.0 - 10.0 kgf-m)

    NOTE:
    - **Prevent the crankshaft from turning, using the following SST.**

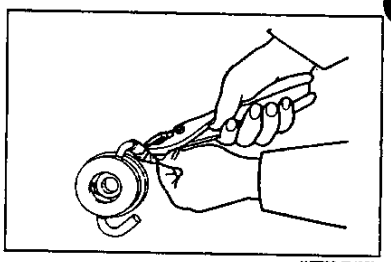
      SST: 09210-87701-000


WFE90-EM477

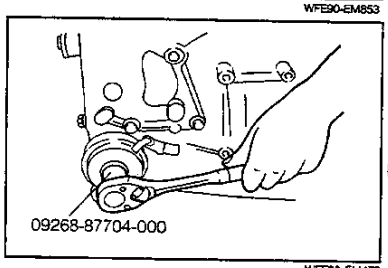
18. Install the compressor mounting bracket.
    (Air conditioner equiped vehicle only)
    Tighten the four compressor mounting bracket attaching bolts to the specified torque.
    Tightening Torque: 29.4 - 44.1 N·m (3.0 - 4.5 kgf-m)


WFE90-EM478

19. Installation of the oil cooler.
    (1) Install a new "O" ring.
    (2) Connect the oil cooler hose to the oil cooler.
    (3) Place the rib for locating the oil cooler to the cylinder block. Then install the oil cooler with the set bolts.

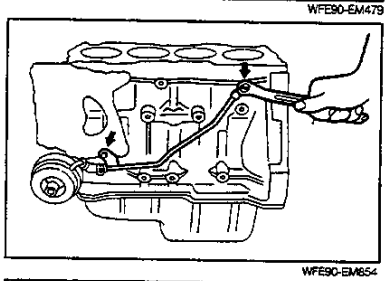

WFE90-EM853

    (4) Tighten the set bolts to the specified torque using the following SST.
    SST: 09268-87704-000
    Tightening Torque: 24.5 - 34.3 N·m (2.5 - 3.5 kgf-m)

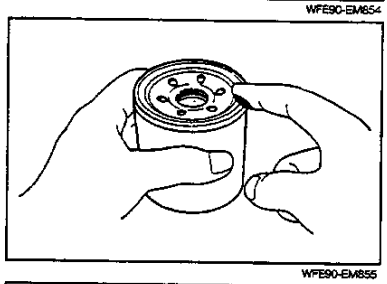


WFE90-EM479

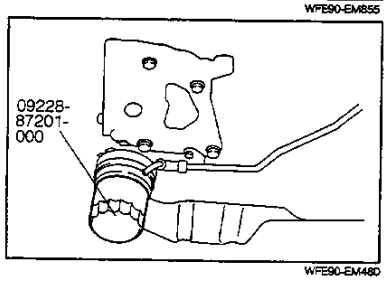
    (5) Connect the oil cooler inlet pipe into the oil cooler hose and install the hose band.
    (6) Install the oil cooler pipe to the cylinder block with a new gasket interposed.


WFE90-EM854

20. Installation of oil filter
    (1) Thinly apply engine oil to the oil seal of the oil filter.

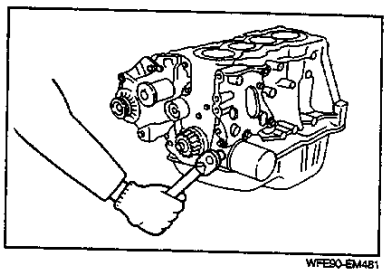

WFE90-EM855

    (2) Screw in the oil filter until the oil seal of the oil filter comes in contact with the oil pump or the contact surface of the oil cooler.
    (3) Then, rotate the oil filter further one complete turn 360-degrees, using the following SST.
    SST: 09228-87201-000



WFE90-EM480

21. Installation of oil pressure switch
    (1) Clean the threaded portion of the oil pressure switch. Wind seal tape around the threaded portion.
    (2) Tighten the oil pressure switch to the specified torque, using a long box wrench having a hexagonal hole.
    Tightening Torque: 11.8 - 19.6 N·m (1.2 - 2.0 kgf-m)



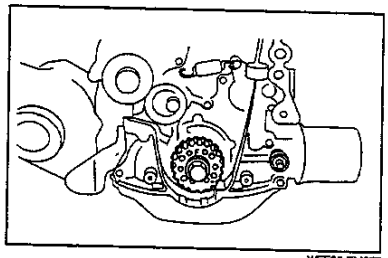
WFE90-EM481

22. Install the alternator.
    At this time, temporarily install the alternator by installing the alternator attaching bolts, adjusting bar, adjusting bar attaching bolt and alternator adjusting bolt.

WFE90-EM856

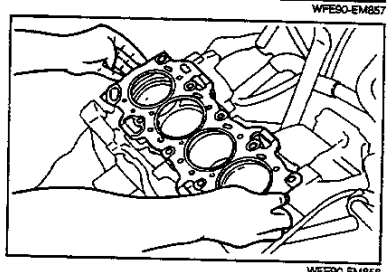
ASSEMBLY OF CYLINDER HEAD

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



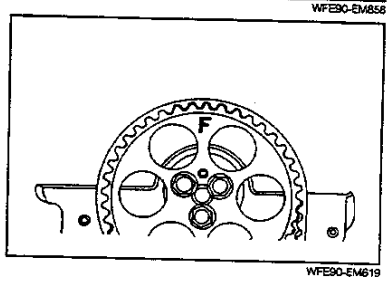
WFE90-EM857

2. Install the cylinder head gasket on the cylinder block.



WFE90-EM858

3. Turn the camshaft, until the "F" mark of the camshaft timing belt pulley comes exactly at the top position.
4. Install the cylinder head assembly on the cylinder block.
   NOTE:
   - **Be very careful not to damage the cylinder head gasket and cylinder head gasket surface.**

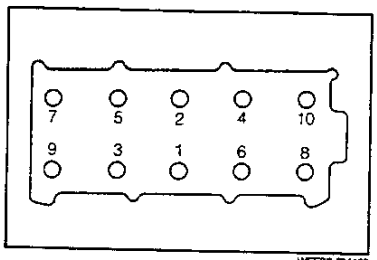


WFE90-EM619

5. Apply engine oil to the threaded portion of each cylinder head bolt. Install the bolts to the cylinder head.
   NOTE:
   - As for the two bolts at the distributor side, use the bolt whose nominal length is 112 mm, which is shorter than that of others.
   - The cylinder head bolt attaching holes provided on the cylinder block should be in dry condition.

WFE90-EM482

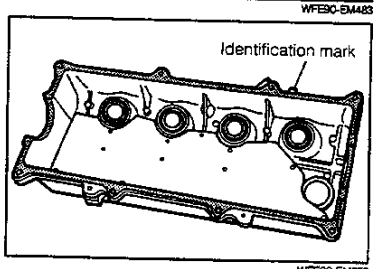
6. Tighten the cylinder head bolts evenly over two or three stages to the specified torque, following the sequence shown in the right figure.
   Tightening Torque: 58.8 - 66.7 N·m (6.0 - 6.8 kgf-m)



WFE90-EM483

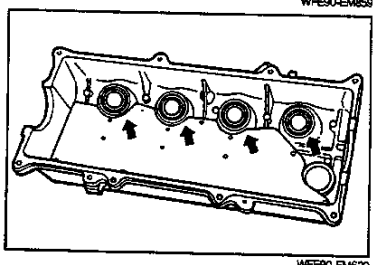
INSTALLATION OF CYLINDER HEAD COVER

1. Check the cylinder head cover gasket for damage.
   Replace the cylinder head cover gasket if it is damaged.
2. Removal of cylinder head cover gasket
   (Only case where such replacement is required:)
   Remove the cylinder head cover gasket from the cylinder head cover. Install a new cylinder head cover gasket in such a way that the identification mark comes at the intake side.



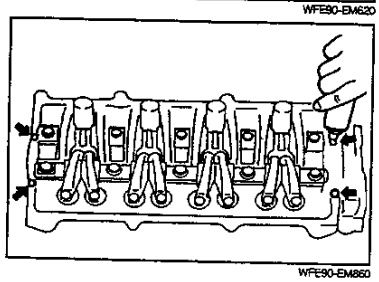
WFE90-EM859

3. Check the spark plug tube grommets for damage.
   Replace any grommet which exhibits damage.



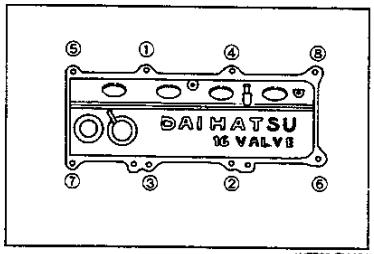
WFE90-EM620

4. Wipe off any oil from the cylinder head cover gasket surface of the cylinder head.
5. Apply the Three Bond 1104 to the mate surface of the cylinder head with the camshaft bearing caps No. 1 and No. 5, but only to those sections which contact the cylinder head gasket.



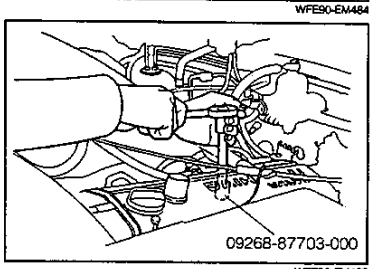
WFE90-EM860

6. Install the cylinder head cover to the cylinder head. Tighten the cylinder head cover attaching bolts to the specified torque, following the sequence in the right figure.
   Tightening Torque: 2.9 - 4.9 N·m (0.3 - 0.5 kgf-m)



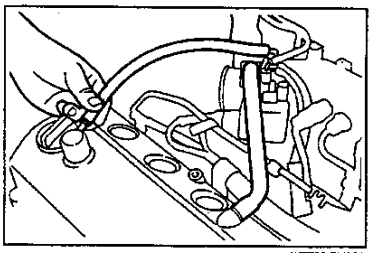
WFE90-EM484

7. Install the spark plugs, using the following SST.
   SST: 09268-87703-000

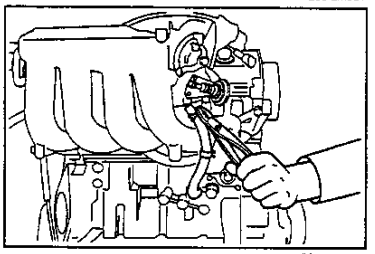


WFE90-EM485

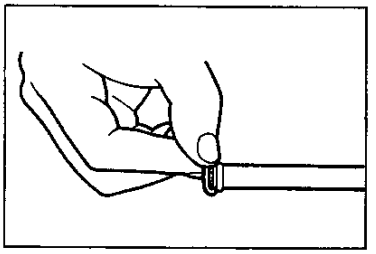
8. Connect the PCV hose to the cylinder head cover.


WFE90-EM861

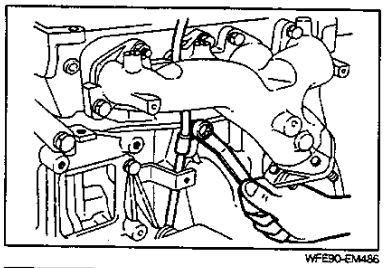
9. Connect the water hose to the throttle body.


WFE90-EM862

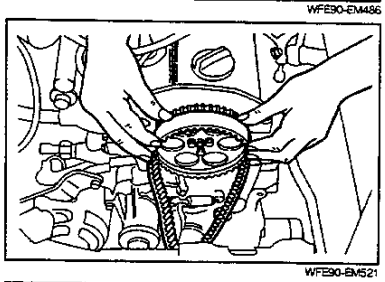
10. Replace the "O" ring of the oil level gauge guide with a new "O" ring.


WFE90-EM863

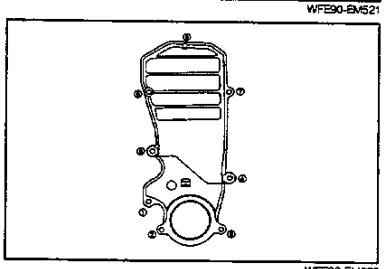
11. Insert the oil level gauge guide into the cylinder block.
12. Install the oil level gauge guide attaching bolts.
    Tightening Torque: 18.6 - 30.4 N·m (1.9 - 3.1 kgf-m)


WFE90-EM486

13. Install the oil level gauge.
14. Installation of timing belt
    (1) Check the timing belt.
    (See page EM-38.)
    (2) Install the timing belt.
    (See page EM-32.)

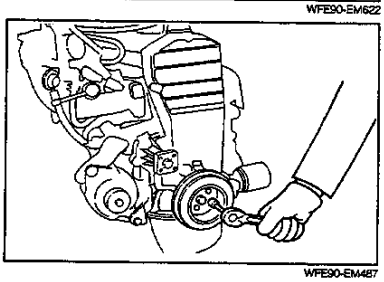

WFE90-EM521

15. Install the timing belt cover.
    (See page EM-45.)

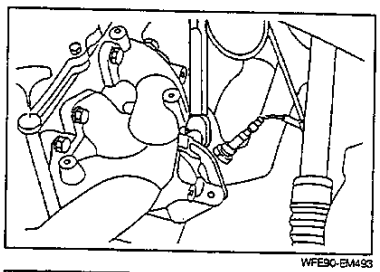

WFE90-EM522

16. Install the crankshaft pulley.
    Tightening Torque: 19.6 - 29.4 N·m (2.0 - 3.0 kgf-m)

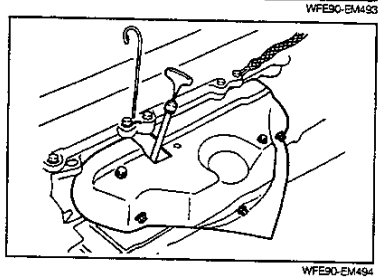
    NOTE:
    - Prevent the crankshaft from turning, using the following SST.
      SST: 09210-87701-000


WFE90-EM487

5. Connection of exhaust pipe
   (1) Connect the exhaust pipe to the exhaust manifold with a new gasket interposed.
   Tightening Torque: 34.3 - 49.0 N·m (3.5 - 5.0 kgf-m)


WFE90-EM493

   (2) Install the exhaust manifold cover with the five attaching bolts.
   Tightening Torque: 5.9 - 8.8 N·m (0.6 - 0.9 kgf-m)

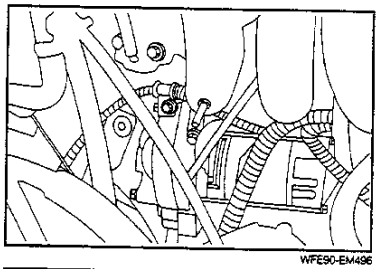

WFE90-EM494

   (3) Connect the exhaust pipe bracket to the side of the transmission.
   Tightening Torque: 15.7 - 21.6 N·m (1.6 - 2.2 kgf-m)

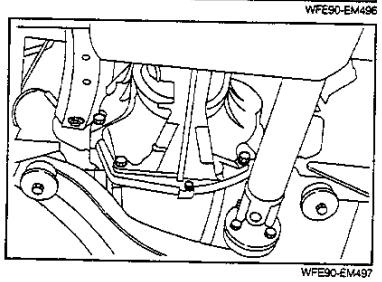
WFE90-EM495

6. Installation of starter
   (1) Install the starter to the engine block with the two attaching bolts.
   Tightening Torque: 49.0 - 68.6 N·m (5.0 - 7.0 kgf-m)

   (2) Connect the connector with lock and the harness clamping bolt.

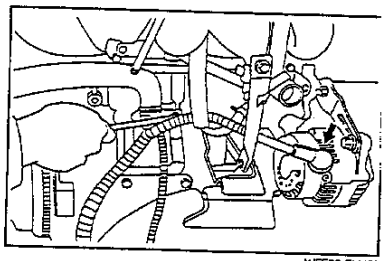

WFE90-EM496

7. Tighten the five attaching bolts between the engine side and the transmission side.
   Tightening Torque: 49.0 - 68.6 N·m (5.0 - 7.0 kgf-m)


WFE90-EM497

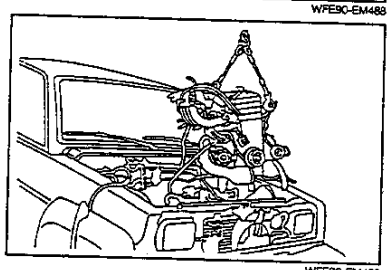
ENGINE INSTALLATION

1. Installation of engine harness onto engine
   (1) Install the engine wire to the engine.
   (2) Connect the engine wire clamp.
   (3) Connect the alternator connector and terminal.



WFE90-EM488

2. Sling the engine, using a chain block. Place the engine in the engine compartment.
   CAUTION:
   - Be very careful not to allow the engine to hit to the vehicle body or other parts.



WFE90-EM489

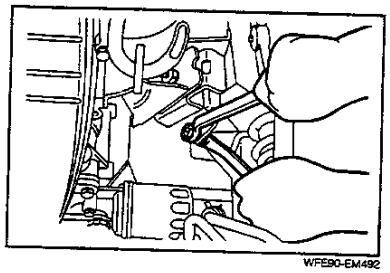
3. Connection of engine and transmission
   (1) Lower the engine down to a height where the engine can be connected to the transmission with ease, using a chain block.
   (2) Carefully bring the engine toward the transmission side. Insert the transmission input shaft into the clutch disc.
   (3) While correcting the angle of the engine, align the attaching bolt holes of the transmission with those of the engine.
   (4) Temporarily connect the engine with the transmission by inserting the attaching bolts so that the transmission may not be detached from the engine.

WFE90-EM490

4. Installation of engine mounting
   (1) Install the engine mounting provided at the left side of the engine to the engine bracket.

WFE90-EM491

   (2) Adjust the engine position. Secure the engine mounting to the engine mounting attaching section at the vehicle body with the four bolts.
   Tightening Torque: 29.4 - 44.1 N·m (3.0 - 4.5 kgf-m)

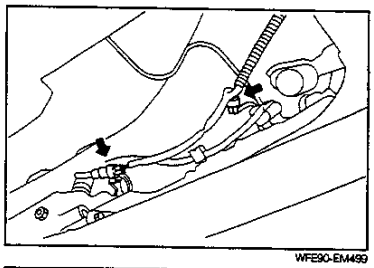


WFE90-EM492

8. Remove the chain block from the engine.

WFE90-EM498

9. Connect the connectors onto the transmission and transfer by jacking up the vehicle. Connect the air breather hose onto the transmission.

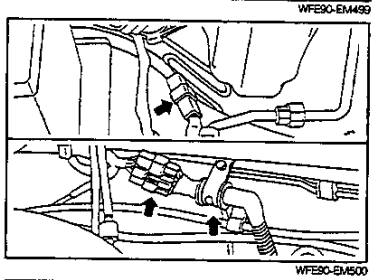


WFE90-EM499

10. Connect the harness and wire.

[HD-C Engine]

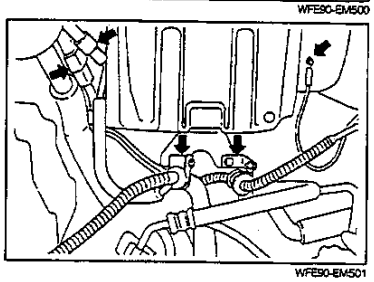
(1) Clamp of battery negative ⊖ terminal to engine bracket at battery carrier side
(2) Clamp of battery positive ⊕ terminal to starter at battery carrier side
(3) Connector of cable leading to battery at battery carrier side



WFE90-EM500

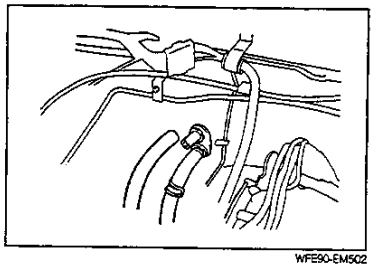
[HD-E Engine]

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



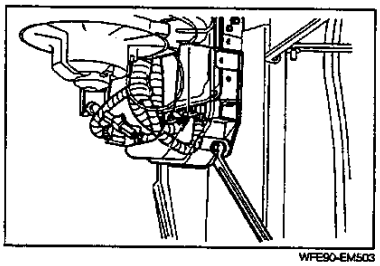
WFE90-EM501

11. Install the inlet and outlet hoses to the heater pipes at the dash panel.

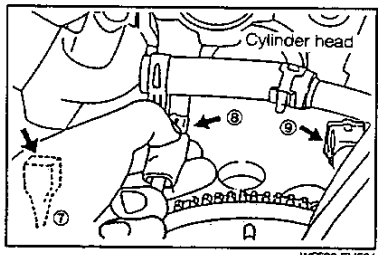


WFE90-EM502

12. Installation of engine wire harness
    (1) Installation of engine wire harness for ECU
        ① Install the engine wire connector for ECU to the cowl side panel at the passenger seat side through the dash panel.
        ② Connect the engine wire connector to the engine control computer assembly.
        ③ Install the ECU cover at the cowl panel of passenger seat side.

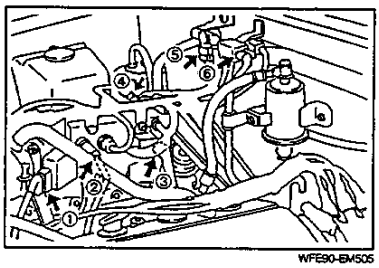

WFE90-EM503

    (2) Connect the following connectors.
        ① Oxygen sensor ⑩
        ② Water temperature sensor ⑨
        ③ Water temperature sender gauge ⑧
        ④ Air conditioner water temperature switch ⑦



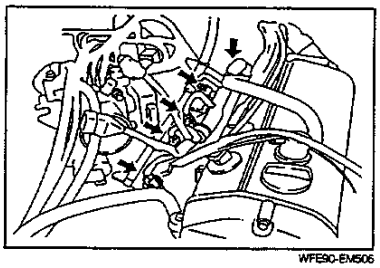
WFE90-EM504

        ⑤ Pressure sensor, pressure VSV and clamp ⑥
        ⑥ Air conditioner idle-up VSV ⑤
        ⑦ EGR VSV ④ (U.S. specifications only)
        ⑧ Idle speed control VSV ③ (U.S. specifications only)
        ⑨ Intake air temperature sensor ②
        ⑩ Throttle position sensor ①

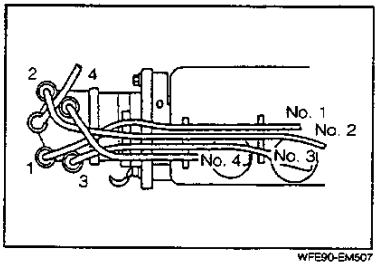


WFE90-EM505

    (3) Connect the four injector connectors.
    (4) Connect the engine wire clamps and engine ground cables.

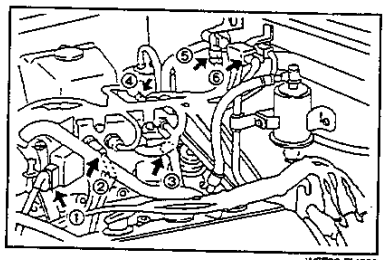

WFE90-EM506

13. Connection of distributor
    (1) Install the distributor into the cylinder head.
    (2) Tighten the two attaching bolts.
    (3) Connect the distributor wire connector.
        Tightening Torque: 14.7 - 21.6 N·m (1.5 - 2.2 kgf-m)

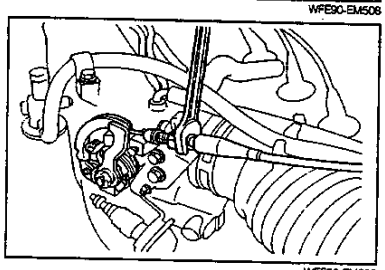


WFE90-EM507

14. Connect the following vacuum hoses at surge tank side.
    (1) Distributor diaphragm ①
    (2) BVSV ②
    (3) Pressure VSV ③
    (4) Air conditioner idle-up VSV ④
    (5) Power steering ACV ⑤
    (6) Brake booster ⑥
    (7) Charcoal canister ⑦

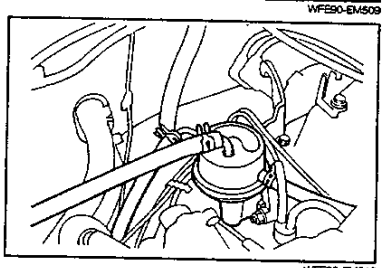

WFE90-EM508

15. Connect the accelerator cable.

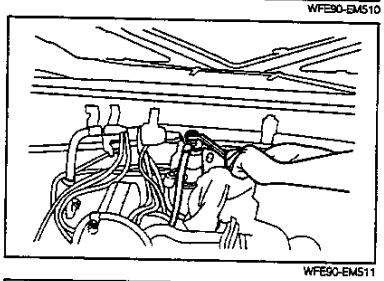

WFE90-EM509

16. Connection of fuel hose

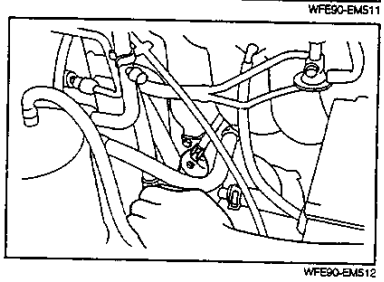
[HD-E Engine]
(1) Connect the fuel hose to the fuel pump. Then, connect the clamp for fuel hose.
(2) Connect the fuel return hose to the fuel pump. Then, connect the clamp for fuel return hose.


WFE90-EM510

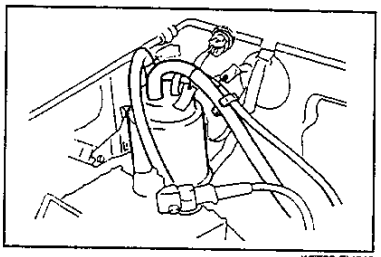
[HD-E Engine]
(1) Connect the fuel hose at the upper part of the fuel filter.
Tightening Torque: 34.3 - 44.1 N·m (3.5 - 4.5 kgf-m)


WFE90-EM511

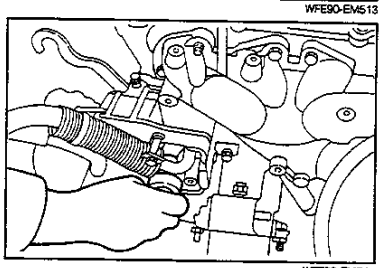
(2) Install the fuel return hose to the fuel pipe No.2.


WFE90-EM512

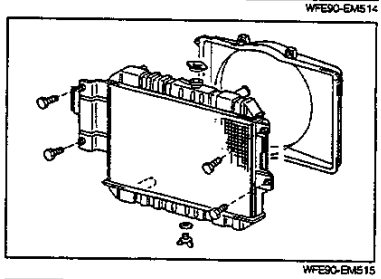
17. Connect the outer vent hose to the charcoal canister.
(HD-C Engine: GCC specifications only)


WFE90-EM513

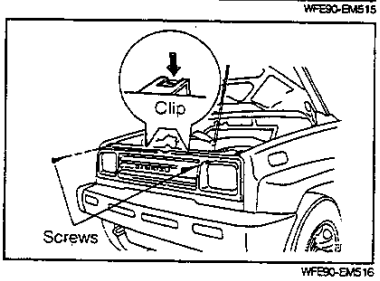
18. Installation of air conditioner compressor
(1) Install the compressor assembly with the attaching bolts.
(2) Install the compressor cover with the attaching bolts.


WFE90-EM514

19. Installation of radiator
(1) Install the radiator with the four attaching bolts.

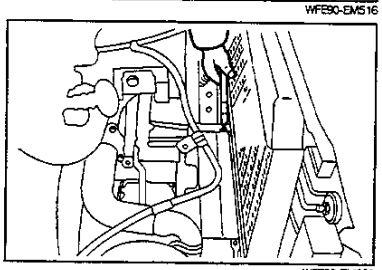

WFE90-EM515

(2) Install the radiator grille.

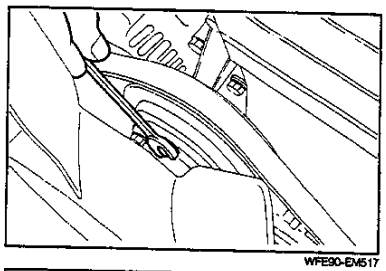


WFE90-EM516

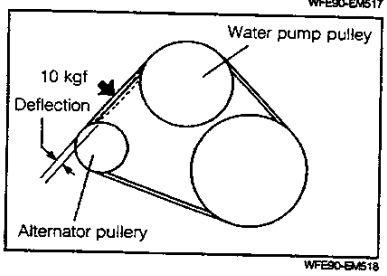
(3) Install the oil cooler hose to the radiator.


WFE90-EM530

(4) Connect the fluid coupling with the fan by means of the four attaching bolts. Then, connect the fluid coupling with fan together with the fan shroud.
Tightening Torque: 9.8 - 17.7 N·m (1.0 - 1.8 kgf-m)


WFE90-EM517

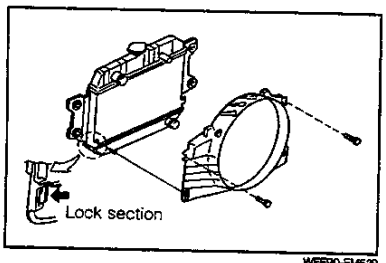
(5) Install the V ribbed belt.
(6) Perform the adjustment in such a way that the deflection at the midpoint between the water pump pulley and the alternator may become the specified value when a force of 10 kg (22 lb) is applied to the midpoint.
Specified Belt Deflection
New Belt: 4.0 - 5.0 mm
Used Belt: 5.0 - 6.0 mm



WFE90-EM518

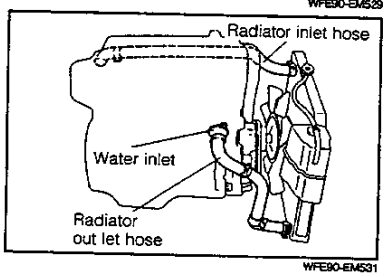
NOTE:
- **"New belt" refers to a belt which has been used less than 5 minutes on a running engine.**
- **"Used 5 belt" refers to a belt which has been used on a running engine 5 minutes or more.**

(7) Insert the lock section of the fan shroud to the radiator. Then, tighten the two attaching bolts at the radiator upper side.



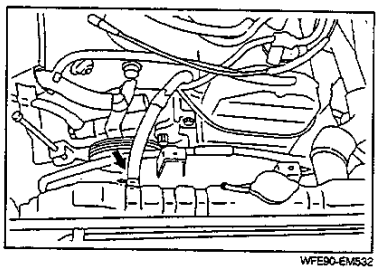
WFE90-EM529

(8) Connect the radiator hose No.1 to the radiator upper tank.
Tighten the two clamps and two attaching bolts.
(9) Connect the radiator outlet hose to the center connection.



WFE90-EM531

(10) Connect the air breather hose from the radiator upper tank.



WFE90-EM532

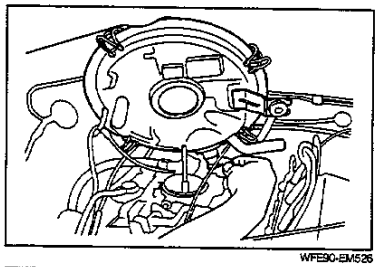
20. Installation of air cleaner and air cleaner hose assembly

[HD-C Engine]

(1) Install the air cleaner assembly with the attaching bolt of the air cleaner bracket and wing nut.

WFE90-EM525

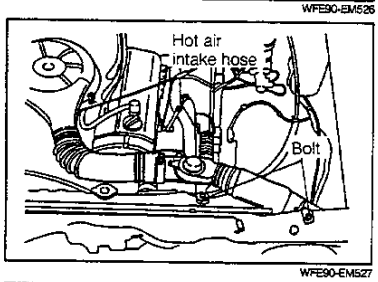
(2) Connect the following hoses to the air cleaner.
① ITC vacuum hoses
② PCV hose
③ Vacuum hose to BVSV



WFE90-EM526

(3) Connect the vacuum motor hose and hot air intake hose.

(4) Connect the air cleaner hose to the air cleaner case with the two bolts.

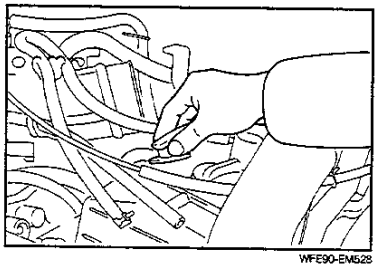


WFE90-EM527

(5) Connect the plug wires to the spark plugs.

NOTE:

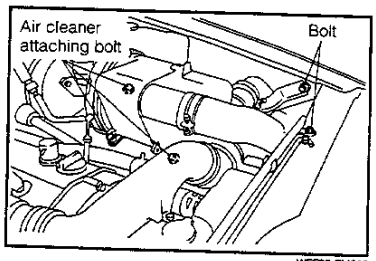
- Make sure that the spark plug wire is connected securely to each spark plug.
- Care should be exercised not to damage the spark plug wire rubber grommet with the spark plug tube.



WFE90-EM528

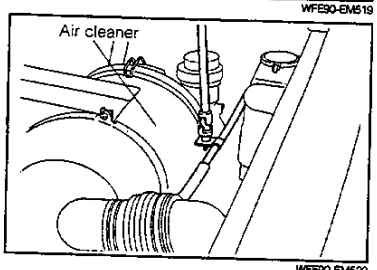
[HD-E Engine]

(1) Place the air cleaner assembly. Then, tighten the three air cleaner attaching bolts.
(2) Connect the bolts provided at the left fender panel and radiator support.
(3) Connect the clamp for clutch cable at the air cleaner.



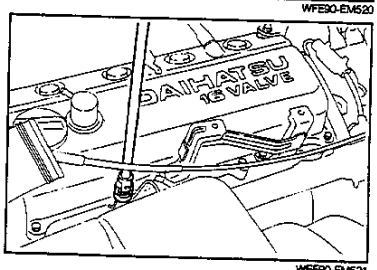
WFE90-EM519

(4) Connect the intake air hose to the throttle body. Tighten the clamp for the intake air hose.



WFE90-EM520

(5) Tighten the air chamber bracket tightening bolts and clamp bolt. Clamp the accelerator cable.
Tightening Torque: 3.0 - 4.9 N·m (0.3 - 0.5 kgf-m)

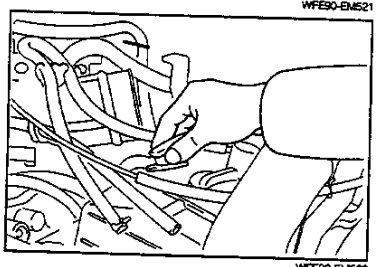


WFE90-EM521

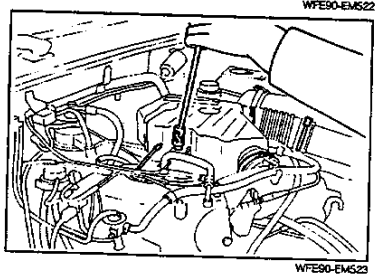
(6) Connect the bond cable to the air chamber bracket. Tighten the attaching bolts.
(Only for the radio-equipped vehicle)
(7) Install the plug wires to the spark plugs.

NOTE:

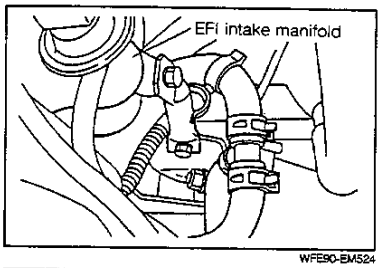
- **Make sure that the spark plug wire is connected securely to each spark plug.**
- **Care should be exercised not to damage the spark plug wire rubber grommet with the spark plug tube.**


WFE90-EM522

(8) Connect the two vacuum hoses for air conditioner idle-up and for power steering.
(9) Install the air intake chamber by tightening the two clamps and three attaching bolts.

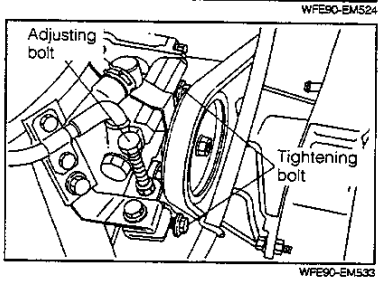

WFE90-EM523

21. Install the surge tank stay No.2 between the engine mounting bracket and the intake manifold.
    Tightening Torque: 14.7 - 21.6 N·m (1.5 - 2.2 kgf-m)



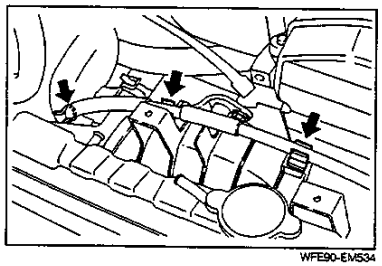
WFE90-EM524

22. Install the power steering pump assembly.
23. Install the drive belt of the power steering pump.



WFE90-EM533

24. Connect the clutch cable onto the fan shroud with the three clamps.
25. Install the reserve tank to the radiator.

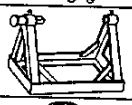
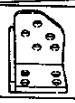
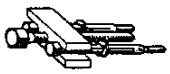
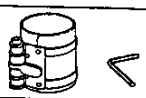
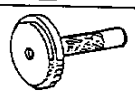
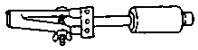

WFE90-EM534

26. Fill the engine coolant.
    (See page CO-12.)
27. Fill the engine oil.
    (See page LU-12.)
28. Place the battery on the battery carrier.
    Then, install the battery hold-down clamp.
    NOTE:
    - Care must be exercised so as not to damage the battery due to excessive tightening of it.

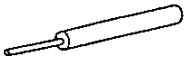
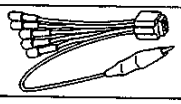
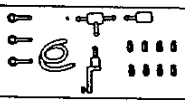
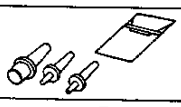
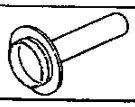
29. Connect the wire of the positive terminal to the battery positive ⊕ terminal.
30. Connect the battery ground cable to the negative ⊖ terminal of the battery.
31. Start the engine. Ensure that the engine exhibits no leakage of cooling water or oil. Then, stop the engine.
32. Install the engine hood.
33. Connect the window screen washer hose.
34. Install the radiator grille.

WFE90-EM535

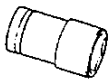
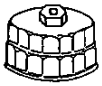
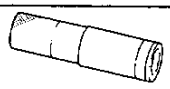
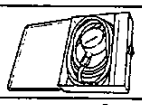
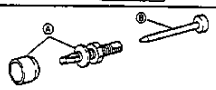
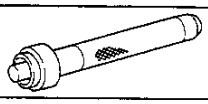
SST (Special Service Tools)

Shape	Part No. and Name	Purpose	Remarks
	09090-04010-000 Engine sling device	Removal and installation of engine	
	09219-87202-000 Engine overhaul stand	Stand for engine overhaul	This stand is to be used in combination with engine overhaul attachment.
	09219-87701-000 Engine overhaul attachment	Attaching engine to overhaul stand (However, it is necessary to modify attachment.)	This attachment is to be used in combination with engine overhaul stand.
	09210-87701-000 Flywheel holder	Preventing crankshaft from turning	
	09609-20011-000 Steering wheel puller	Removal of crankshaft timing belt pulley	
	09636-20010-000 Upper ball joint dust cover replacer	Installation of camshaft oil seal	
	09202-87002-000 Valve cotter remover & replacer	Installation and removal of valves	
	09217-87001-000 Piston replacing guide	Guiding piston during insertion	
	09223-41010-000 Crankshaft rear oil seal replacer	Installation of crankshaft rear oil seal	
	09201-87704-000 Valve stem oil seal cover	Removal of valve stem oil seals	
	09310-87102-000 Counter shaft front bearing replacer	Installation of crankshaft front oil seal	
	09221-87704-000 Piston pin remover & replacer body	Removal and installation of piston pins	This remover & replacer body is to be used in combination with piston pin remover & replacer guide.
	09221-87705-000 Piston pin remover & replacer guide	Removal and installation of piston pins	This remover & replacer guide is to be used in combination with piston pin remover & replacer body.

WFE90-EM536

Shape	Part No. and Name	Purpose	Remarks
	09201-87705-000 Valve guide bush remover & replacer	Removal and installation of valve guide bushes	
	09991-87702-000 Engine control system inspection sub harness	Shorting terminal T Actuating fuel pump, etc.	Only for HD-E engine
	09842-87204-000 EFC-II computer check sub harness	Inspection of computer input/output voltage	General specification
	09842-87704-000 EFC computer check sub harness	Inspection of computer input/output voltage	US specification
	09842-30070-000 EFI inspection wire F	Inspection of fuel injectors	Only for HD-E engine
	09268-87701-000 EFI fuel pressure gauge	Inspection of fuel pressure	Only for HD-E engine
	09283-87703-000 Pressure regulator adopter	* Inspection of injectors * Inspection of pressure regulator * Inspection of fuel pressure	Only for HD-E engine
	09268-87702-000 Injection measuring tool set	* Inspection of injectors * Inspection of pressure * regulator * Inspection of fuel pressure	Only for HD-E engine
	09301-87601-000 Clutch guide tool	Assembling clutch	
	09258-00030-000 Plug set	Plugging rubber hoses	
	09860-11011-000 Carburetor screwdriver set	Overhaul of carburetor	Only for HD-C engine
	09388-87702-000 Transfer replacer	Press-fitting of rubber grommets	

WFE90-EM537

Shape	Parts No. and Name	Purpose	Remarks
	09268-87704-000 Oil cooler set bolt box wrench	Removal and installation of oil cooler (only for oil cooler-equipped vehicle)	Only for oil cooler-equipped vehicle
	09032-00100-000 Oil pan seal cutter	Removal of oil pan	
	09228-87201-000 Oil filter wrench	Removal and installation of oil filter	
	09243-00020-000 Idle adjust wrench	Adjustment of idle mixture adjusting screw	Only for HD-C engine
	09240-00020-000 Wire gauge set	Adjustment of carburetor	Only for HD-C engine
	09240-00014-000 Carburetor adjusting gauge set	Adjustment of carburetor	Only for HD-C engine
	09268-87703-000 Plug wrench	Removal and installation of spark plugs	
	09991-87703-000 Tacho pulse pick-up wire	Connecting engine tachometer	
	09990-87702-000 Engine oil pressure gauge	Measurement of engine oil pressure	
	09286-87602-000 Crankshaft rear end bearing remover	Removal of crankshaft rear end bearing	
	09286-87603-000 Crankshaft rear end bearing replacer	Installation of crankshaft rear end bearing	
	09278-87201-000 Tool timing belt pulley holding	Preventing the crankshaft timing pulley from turning	

WPE90-EM538

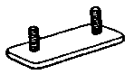
TIGTENING TORQUE FOR MAIN COMPONENTS

1. When you want to find out a suitable tightening torque for a bolt, first determine the strength division of the said bolt, using the table below. Then, locate suitable tightening torque in the tightening torque table described later.
2. As for the tightening torque for a nut, find out suitable tightening torque in the same way as with the paragraph 1 above, based on the mating bolt.
3. Tightening torque posted in the workshop manual is a standard value for steel fasteners. It is, therefore, necessary to modify these tightening torque when you tighten fasteners made of materials other then steel.
   This rule also applies to such instances where bolts are undergoing heat or other stress, such as vibratory loads and so forth.

WFE90-539

METHOD TO IDENTIFY STRENGTH DIVISION OF BOLTS

1. Identification Method by Checking Bolts Themselves

	Configuration and how to determine strength division		Strength division		Configuration and how to determine strength division		Strength division
Hexagon bolt		Bolt having an embossed or stamped figure at its head section	4 = 4T 5 = 5T 5 = 5T 7 = 7T	Welded bolt			4T
		No mark	4T	Stud bolt		No mark	4T
		Bolt having two embossed lines at its head section	5T 6T			Bolt having about 2 mm deep recess at one end or both ends	6T
		Bolt having three embossed lines at its head section	7T				

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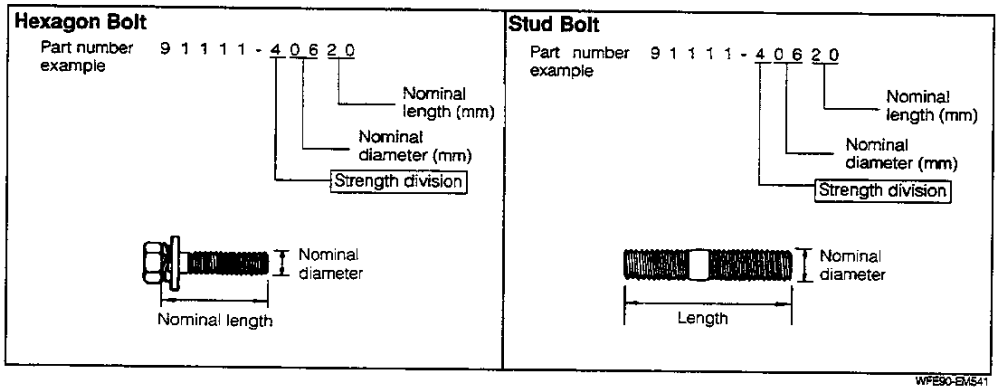
2. Identification Method by Part Numbers



WFE90-EM541

TIGHTENING TORQUE TABLE FOR GENERAL STANDARD BOLTS & NUTS

NOTE:
The table below indicates the tightening torques for those standard bolts and nuts which are not posted in the tightening torque table.

Category	Nominal diameter mm	Pitch mm	Standard tightening torque					
			Target value			Tightening range		
			N·m	kgf-m	ft-lb	N·m	kgf-m	ft-lb
4T (Bolt having a mark of "4" at its head section) Example of part number (91○○○ - 4○○○)	6	1.0	5.39 [5.88]	0.55 [0.60]	3.98 [4.34]	4.31 - 6.47 [4.71 - 7.06]	0.44 - 0.66 [0.48 - 0.72]	3.18 - 4.77 [3.47 - 5.21]
	8	1.25	12.75 [14.22]	1.30 [1.45]	9.40 [10.49]	10.2 - 15.3 [11.38- 17.06]	1.04 - 1.56 [1.16 - 1.74]	7.52 - 11.28 [8.39 - 12.59]
	10	1.25	25.50 [28.44]	2.6 [2.90]	18.81 [20.98]	20.4 - 30.6 [22.75 - 34.13]	2.08 - 3.12 [2.32 - 3.48]	15.04 - 22.57 [16.78 - 25.17]
	12	1.25	47.07 [52.96]	4.8 [5.4]	34.72 [39.06]	37.66 - 56.49 [42.36 - 63.55]	3.84 - 5.76 [4.32 - 6.48]	27.77 - 41.66 [31.25 - 46.87]
5T (Bolt having a mark of "5" at its head section) Example of part number (91○○○ - 5○○○)	6	1.0	6.37 [7.35]	0.65 [0.75]	4.70 [5.42]	5.1 - 7.65 [5.88 - 8.83]	0.52 - 0.78 [0.6 - 0.9]	3.76 - 5.64 [4.34 - 6.51]
	8	1.25	15.69 [17.16]	1.60 [1.75]	11.57 [12.66]	12. 55 - 18.83 [13.73 - 184.66]	1.28 - 1.92 [1.40 - 2.10]	9.26 - 13.89 [10.13 - 15.19]
	10	1.25	32.36 [35.30]	3.3 [3.6]	23.87 [26.04]	25.89 - 38.83 [28.24 - 42.36]	2.64 - 3.96 [2.88 - 4.32]	19.1 - 28.64 [20.83 - 31.25]
	12	1.25	58.84 [65.70]	6.0 [6.7]	43.4 [48.46]	47.07 - 70.61 [52.56 - 78.85]	4.80 - 7.20 [5.36 - 8.04]	34.72 - 52.08 [38.77 - 58.15]
6T (Bolt having a mark of "6" at its head section) Example of part number (91○○○ - 6○○○)	6	1.0	7.85 [8.83]	0.8 [0.9]	5.79 [6.51]	6.28 - 9.41 [7.06 - 10.59]	0.64 - 0.96 [0.72 - 1.08]	4.63 - 6.94 [5.21 - 7.81]
	8	1.25	19.12 [20.59]	1.95 [2.10]	14.10 [15.19]	15.3 - 22.95 [16.48 - 24.71]	1.56 - 2.34 [1.68 - 2.52]	11.28 - 16.93 [12.15 - 18.23]
	10	1.25	39.23 [43.15]	4.00 [4.40]	28.93 [31.83]	31.38 - 47.07 [34.52 - 51.78]	3.20 - 4.80 [3.52 - 5.28]	23.15 - 34.72 [25.46 - 38.19]
	12	1.25	71.59 [79.43]	7.30 [8.10]	52.80 [58.59]	57.27 - 85.91 [63.55 - 95.32]	5.84 - 8.76 [6.48 - 9.72]	42.24 - 63.36 [46.87 - 70.30]
7T (Bolt having a mark of "7" at its head section) Example of part number (91○○○ - 7○○○)	6	1.0	10.79 [11.76]	1.10 [1.20]	7.96 [8.68]	8.63 - 12.94 [9.41 - 14.12]	0.88 - 1.32 [0.96 - 1.44]	6.37 - 9.55 [6.94 - 10.42]
	8	1.25	25.5 [28.44]	2.60 [2.90]	18.81 [20.98]	20.4 - 30.6 [22.75 - 34.13]	2.08 - 3.12 [2.32 - 3.48]	15.04- 22.57 [16.78 - 25.17]
	10	1.25	51.98 [57.86]	5.30 [5.90]	38.33 [42.67]	41.58 - 62.37 [46.29 - 69.43]	4.24 - 6.36 [4.72 - 7.08]	30.67 - 47.95 [34.14 - 51.21]
	12	12.5	95.12 [109.97]	9.70 [10.50]	70.16 [75.94]	76.1 - 114.15 [82.38 - 123.56]	7.76 - 11.64 [8.40 - 12.60]	56.13 - 84.19 [60.76 - 91.14]
Pipe tapered thread	PT8/1 PT1/4 PT3/8 PT1/2	*0.9071 *1.3368 *1.3368 *1.8143	16.67 24.52 29.42 29.42	1.7 2.5 3.0 3.0	12.3 18.08 21.7 21.7	11.76 - 21.57 19.61 - 29.42 24.52 - 34.32 24.52 - 34.42	1.2 - 2.2 2.0 - 3.0 2.5 - 3.5 2.5 - 3.5	8.67 - 15.91 14.46 - 21.67 18.08 - 25.32 18.08 - 25.32

Numerals in [ ] denote those for flange bolts.
The asterisked mark (*) represents pitch conversion value.

WFE90-EM864

TIGHTENING TORQUE

Tightening component	Tightening torque			Remark
	N·m	kgf-m	ft-lb	
Cylinder head × Spark plug	14.7 - 21.6	1.5 - 2.2	10.8 - 15.9	Dry
Cylinder head × Cylinder head cover	2.9 - 4.9	0.3 - 0.5	2.2 - 3.6	Dry
Cylinder head × Rocker shaft M10 Bolt	28.4 - 36.3	2.9 - 3.7	21.0 - 26.8	Dry
M8 Bolt	12.7 - 16.7	1.3 - 1.7	9.4 - 12.3	Dry
Cylinder head × Cylinder block	58.8 - 66.6	6.0 - 6.8	43.4 - 49.2	Wet
Cylinder head × Water tempurature sensor (HD-E engine only)	24.5 - 34.3	2.5 - 3.5	18.1 - 25.3	Dry
Cylinder head × BVSV (HD-C engine only)	24.5 - 34.3	2.5 - 3.5	18.1 - 25.3	Dry
Cylinder head × Water temperature sender gauge	11.8 - 19.6	1.2 - 2.0	8.7 - 14.5	Dry
Cylinder head × Distributor	14.7 - 21.6	1.5 - 2.2	10.8 - 15.9	Dry
Cylinder head × Exhaust manifold	29.4 - 44.1	3.0 - 4.5	21.7 - 32.5	Dry
Cylinder head × Intake manifold	14.7 - 21.6	1.5 - 2.2	10.8 - 15.9	Dry
Cylinder head × Fuel pump (HD-C engine only)	14.7 - 21.6	1.5 - 2.2	10.8 - 15.9	Dry
Cylinder block × Water inlet	5.9 - 8.8	0.6 - 0.9	4.3 - 6.5	Dry
Cylinder block × Crankshaft main bearing cap	29.4 - 53.9	4.5 - 5.5	32.5 - 39.8	Wet
Cylinder block × Oil pump	5.9 - 8.8	0.6 - 0.9	4.3 - 6.5	Dry
Cylinder block × Rear oil seal retainer	5.9 - 8.8	0.6 - 0.9	4.3 - 6.5	Dry
Cylinder block × Water pump	14.7 - 21.6	1.5 - 2.2	10.8 - 15.9	Dry
Cylinder block × Engine mounting bracket	39.2 - 53.9	4.0 - 5.5	28.9 - 39.8	Dry
Cylinder block × Transmission	49.0 - 68.6	5.0 - 7.0	36.2 - 50.6	Dry
Cylinder block × Oil cooler pipe	24.5 - 34.3	2.5 - 3.5	18.1 - 25.3	Dry
Surge tank × Intake air temperature sensor	29.4 - 39.2	3.0 - 4.0	21.7 - 28.9	Dry
Surge tank × Gas filter	11.8 - 19.6	1.2 - 2.0	8.7 - 14.5	Dry
Surge tank × Throttle body	14.7 - 21.6	1.5 - 2.2	10.8 - 15.9	Dry
Crankshaft × Flywheel	78.4 - 98.0	8.0 - 10.0	57.9 - 72.0	Dry non-reusable.
Crankshaft × Crankshaft timing belt pulley	88.2 - 98.0	9.0 - 10.0	65.1 - 72.0	Dry
Intake manifold × Delivery pipe (HD-E engine only)	14.7 - 21.6	1.5 - 2.2	10.8 - 15.9	Dry
Intake manifold × Carburetor (HD-C engine only)	14.7 - 21.6	1.5 - 2.2	10.8 - 15.9	Dry
Exhaust manifold × Exhaust pipe	34.3 - 49.0	3.5 - 5.0	25.3 - 36.2	Dry
Exhaust pipe clamp	29.4 - 44.1	3.0 - 4.5	21.7 - 32.5	Dry
Engine mounting bracket × Engine mounting (bolt)	29.4 - 44.1	3.0 - 4.5	21.7 - 32.5	Dry
Engine mounting bracket × Engine mounting (nut)	29.4 - 44.1	3.5 - 5.5	25.3 - 39.8	Dry

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Tightening component	Tightening torque			Remark
	N-m	kgf-m	ft-lb	
Oil pump body x Oil cooler	24.5 - 34.3	2.5 - 3.5	18.1 - 25.3	Dry
Oil pump x Oil pressure switch	11.8 - 19.6	1.2 - 2.0	8.7 - 14.5	Dry
Oil pan	6.9 - 11.8	0.7 - 1.2	5.1 - 8.7	Dry
Oil pan x Drain plug	19.6 - 29.4	2.0 - 3.0	14.5 - 21.7	Dry
Oil pump body x Oil pump cover	7.8 - 12.7	0.8 - 1.3	5.8 - 9.4	Dry
Oil level gauge guide	18.6 - 30.4	1.9 -3.1	13.7 - 22.4	Dry
Surge tank stay No. 1	14.7 - 21.6	1.5 - 2.2	10.8 - 15.9	Dry
Surge tank stay No. 2	29.4 - 44.1	3.0 - 4.5	21.7 - 32.5	Dry
Surge tank stay No. 3	14.7 - 21.6	1.5 - 2.2	10.8 - 15.9	Dry
Camshaft x Camshaft timing belt pulley	14.7 - 21.6	1.5 - 2.2	10.8 - 15.9	Dry
Timing belt cover	2.0 - 3.9	0.2 - 0.4	1.4 - 2.9	Dry
Timing belt tensioner	29.4 - 44.1	3.0 - 4.5	21.7 - 32.5	Dry
Crankshaft timing belt pulley x Crankshaft pulley	19.6 - 29.4	2.0 - 3.0	14.5 - 21.5	Dry
Fluid coupling x Water pump pulley x Water pump	9.8 - 19.6	1.0 - 1.8	7.2 - 13.0	Dry
Cooling fan x Fluid coupling	4.9 - 5.9	0.5 - 0.6	3.6 - 4.3	Dry
Fuel filter x Fuel hose No. 1	34.3 - 44.1	3.5 - 4.5	25.3 - 32.5	Dry
Fuel filter x Fuel pipe	34.3 - 44.1	3.5 - 4.5	25.3 - 32.5	Dry
Fuel hose No. 1 x Delivery pipe	34.3 - 44.1	3.5 - 4.5	25.3 - 32.5	Dry
Connecting rod x Connecting rod cap	34.3 - 44.1	3.5 - 4.5	25.3 - 32.5	Wet
Clutch cover x Fly wheel	14.7 - 21.6	1.5 - 2.2	10.8 - 15.9	Dry
Transmission x Starter motor	49.0 - 68.6	5.0 - 7.0	36.2 - 50.6	Dry
Front pipe x Rear pipe	36.3 - 51.0	3.7 - 5.2	26.8 - 37.6	Dry
Fuel pump x Fuel pipe	34.3 - 43.1	3.5 - 4.4	25.3 - 31.8	Dry

WFE90-EM544

ENGINE SPECIFICATIONS

Item					Engine type	HD-C	HD-E
Engine proper	Type					Petrol, 4-cycle	Petrol, 4-cycle
	Mounting location					Front	Front
	Number of cylinders and arrangement					4-cylinder-in-line, mounted longitudinally	4-cylinder-in-line, mounted longitudinally
	Combustion chamber type					Pent roof type	Pent roof type
	Valve mechanism					Belt-driven, SOHC	Belt-driven, SOHC
	Bore × stroke				mm	76 × 87.6	76 × 87.6
	Compression ratio					9.5 ± 0.3	9.5 ± 0.3
	Compression pressure				kPa (kgf/cm^2) - rpm)	1373 (14.0) - 300	1373 (14.0) - 300
	Maximum output	SAE net	kW/rpm	General specifications		63/6000	—
		EEC	kW/rpm	Australian specifications		—	70/5700
		EEC DIN	kW/rpm	ECE & EEC specifications		63/6000	70/5700
	Maximum torque	SAE net	kW/rpm	General specifications		126/3500	—
		EEC	kW/rpm	Australian specifications		—	128/4800
		EEC DIN	kW/rpm	ECE & EEC specifications		126/3500	128/4800
	Engine dimensions [Length × width × height]				mm	*693 × 596 × 685	693 × 537 × 673
	Service engine weight				kg	96	95
	Number of piston rings	Compression ring				2	2
		Oil ring				1	1
	Valve timing	Intake	Open			2° BTDC	2° BTDC
			Close			48° ABDC	48° ABDC
		Exhaust	Open			43° BBDC	43° BBDC
			Close			1° ATDC	1° ATDC
	Valve clearance [HOT]				mm	Intake 0.25	0.25
						Exhaust 0.33	0.33
	Idling speed				rpm	850 ± 50	850 ± 50
	Blow-by gas recirculating system					Closed type	Closed type
Lubricating System	Lubricating method					Fully-forced feed method	Fully-forced feed method
	Oil Pump type					Trochoid type	Trochoid type
	Oil filter type					Full-flow filter type, filter paper type	Full-flow filter type, filter paper type
	Lubrication oil capacity dm^3	Whole				3.8	3.8
		When only oil is changed				3.3	3.3
		When oil and oil filter are changed				3.5	3.5
Cooling System	Cooling method					V-belt driven type	V-belt driven type
	Radiator type					Corrugation type forced circulation	Corrugation type forced circulation
	Coolant capacity (Vehicle with front heater)				dm^3	5.5 (excluding 1.0 dm^3 in reserve tank)	5.5 (excluding 1.0 dm^3 in reserve tank)
	Water pump type					Centrifugal type, "V" belt-driven tank	Centrifugal type, "V" belt-driven tank
	Thermostat type					Wax pellet type	Wax pellet type
Air cleaner	Type					Filter unwoven fabric type	Filter paper type
	Number					1	1

* For GCC specifications: 693 × 602 × 685

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Item					Engine type	HD-C	HD-E
Fuel System	Fuel tank	Capacity			liter	60	60
		Location				Underneath rear seat floor	Underneath rear seat floor
	Fuel pipe material					Rubber and steel tube	Rubber and steel tube
	Fuel pump type					Diaphragm type	Electromotor type
	Fuel filter type					Filter paper type	Filter paper type
	Carburetor	Manufacturer				Aisan industry	—
		Type				Down draft, 2-barrel type	—
		Venturi diameter			mm	21, 28	—
		Choke valve type				Wax type automatic choke	—
	Fuel injection device					—	Electronic type
	Injection nozzle or Injector	Type of nozzle retainer				—	With cushion rubber type
		Nozzle type				—	Electronically-controlled throttle type
		Injection pressure			kPa (kgf/cm^2)	—	250 (2.55)
Engine electrical system	Ignition system	Voltage			V	12 [Negative ground]	12 [Negative ground]
		Type				Battery ignition type	Battery ignition type
		Ignition timing			°/rpm	B.T.D.C. 3 ± 2/850 ± 50	B.T.D.C. 3 ± 2/850 ± 50
		Firing order				1-3-4-2	1-3-4-2
		Distributor	Distributor type			Full-transistorized type	Full-transistorized type
			Breaker type			—	—
			Performance of timing advancing mechanism	Centrifugal type		0°/600 rpm 15°/3000 rpm	0°/600 rpm 12°/3000 rpm
				Vacuum type		0°/-13.3 kPa (-100 mmHg) 15°/-53.3 kPa (-400 mmHg)	0°/-20.0 kPa (-150 mmHg) 10°/-56.0 kPa (-420 mmHg)
		Spark plug	Manufacturer			CHAMPION / NIPPONDENSO	NGK
			Type			RC9YC4 / K20PR-U11	BKR6E-11
			Thread			M14 x 1.25 / M14 x 1.25	M14 x 1.25
			Spark plug gap		mm	1.0 - 1.1 / 1.0 - 1.1	1.0 - 1.1
	Battery	Type	General specifications			36B20R (*1 55B24R)	36B20R (*1 55B24R)
			ECE & EEC specifications			36B20R (*1 55B24R)	36B20R (*1 55B24R)
			Australian specifications			36B20R	36B20R
		Capacity AH (5 Hr)	General specifications			28 (*1 36)	28 (*1 36)
			ECE & EEC specifications			28 (*1 36)	28 (*1 36)
			Australian specifications			28	28

WFE90-EM546

SERVICE SPECIFICATIONS
TUNE-UP

Drive belt deflection when pressed with a force of 98N (10 kgf) Alternator	New belt	4 - 5 mm
	Used belt	5 - 6 mm
Coolant capacity w/heater [Excluding 1.0 dm^3 for reserve tank]		5.5 dm^3 [5.8 dm^3 for tropical specifications]
Engine oil capacity Whole amount		3.8 dm^3
When only oil is changed	Full level	3.3 dm^3
	Low level	2.3 dm^3
When oil and filter are changed		3.5 dm^3
		NOTE: For the oil cooler-equipped engine, add 79 cm^3 for whole amount.
Valve clearances (hot)	Intake	0.25 ± 0.05 mm
	Exhaust	0.33 ± 0.05 mm
[Reference (cold)]	Intake	0.18 mm
	Exhaust	0.25 mm

Spark plugs

Manufacturer	NIPPONDENSO	NGK	CHAMPION
Type	K20PR - U11 K22PR - U11	BKR6E - 11 BKR7E - 11	RC9YC4 RC7YC4
Thread	M14 × 1.25		
Spark plug gap mm	1.0 - 1.1		

Ignition timing	B.T.D.C. 3 ± 2°/100 rpm or less (However, engine revolution must be stable.)

Idle speed

Engine type	HD-C	HD-E
Idle speed rpm	850 ± 50	850 ± 50

Fast idle speed adjustment (HD-C)	Full position	1300 - 2000 rpm

Throttle positioner touch revolution (rpm)

HD-C	HD-E (General)	HD-E (US)
1500 ± 50 rpm	1800 ± 50 rpm	1600 ± 100 rpm

Throttle positioner operating time	HD-C	0.5 - 5.0 seconds
	HD-E	0.5 - 5.0 seconds
Compression pressure at 3000 rpm	Standard	1373 kPa (14.0 kgf/cm^2)
	Minimum	1030 kPa (10.5 kgf/cm^2)
	Difference between cylinders	147 kPa (1.5 kgf/cm^2)

WFE90-EM547

ENGINE MECHANICALS

Timing belt pulley	Wear limit	Camshaft	119.80 mm
		Crankshaft	59.37 mm
Timing belt tension spring		Free length	46.5 mm
		Installation load	
Camshaft	Oil clearance (cylinder head-to-camshaft)		0.035 - 0.076 mm
	Maximum limit		0.17 mm
	Thrust clearance		0.1 - 0.25 mm
	Maximum limit		0.45 mm
	Journal diameter		
	Fuel pump cam diameter		
		Minimum	42.65 mm
	Fuel pump cam stroke		
		Standard	5.0 mm
		Minimum	4.8 mm
	Valve cam lobe height		
	Intake	Standard	33.08 - 33.28 mm
		Minimum	32.9 mm
	Exhaust	Standard	33.00 - 33.20 mm
		Minimum	32.85 mm
	Maximum circle runout		0.03 mm
Cylinder head	Warpage	Cylinder block side	0.10 mm
		Intake manifold side	0.10 mm
		Exhaust manifold side	0.10 mm
	Valve seat angle	Intake	30 - 45 - 70°
		Exhaust	20 - 45 - 70°
	Valve contacting angle		45°
	Valve seat contacting width		
		Standard	1.4 mm
		Allowance	1.2 - 1.6 mm
	Maximum valve seat recession		0.5 mm
Valves	Valve stem diameter	Intake valve	6.560 - 6.580 mm
		Exhaust valve	6.555 - 6.575 mm
	Valve length	Intake valve	112.8 mm
		Exhaust valve	114.5 mm
	Valve face angle		45.5°
	Valve stock thickness (Minimum)		
		Intake	0.8 mm
		Exhaust	1.0 mm
	Valve stem oil clearance		
	Intake	Standard	0.020 - 0.060 mm
		Maximum	0.080 mm
	Exhaust	Standard	0.025 - 0.065 mm
		Maximum	0.090 mm

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Valve springs	Free length	Standard	45.2 - 46.0 mm
		Minimum	44.3 mm
	Installed tension at 38.0 mm		258.9 N (26.4 kgf)
	Maximum out-of-squareness		1.6 mm
Valve rocker arm and valve rocker shaft	Oil clearance	Standard	0.012 - 0.053 mm
		Maximum	0.08 mm
	Valve rocker arm bore diameter		19.500 - 19.521
	Valve rocker shaft outer diameter		19.468 - 19.488 mm
Valve rocker arm spacer	Free width		22.00 mm
Exhaust manifold	Warpage		0.1 mm
Intake manifold	Warpage	Cylinder head side	0.1 mm
Cylinder block	Maximum cylinder head surface warpage		0.1 mm
	Cylinder bore diameter		
		Standard	76.000 - 76.030 mm
		O/S 0.25	76.250 - 76.280 mm
	Bore honing angle		35 ± 5°
	Coarse degree		1 - 4 Z
Piston, piston pin and piston rings	Piston-to-cylinder bore clearance		
		Standard	0.025 - 0.045 mm
		Maximum limit	0.11 mm
	Piston ring groove-to-piston ring side clearance		
	Standard.	No. 1	0.03 - 0.07 mm
		No. 2	0.02 - 0.06 mm
	Maximum		0.12 mm
	Piston ring thickness		
	Standard	No. 1	1.17 - 1.19 mm
		No. 2	1.47 - 1.49 mm
Piston, piston pin and piston rings	Piston ring end gap		
	Standard	No. 1	0.27 - 0.42 mm
		No. 2	0.35 - 0.50 mm
		0.1	0.20 - 0.70 mm
	Maximum	No. 1	0.7 mm
		No. 2	0.8 mm
		0.1	1.0 mm
	Piston pin-to-connecting rod interference fit		0.012 - 0.044 mm
	Piston-to-piston pin clearance		0.005 - 0.011 mm
Flywheel	Runout	Maximum	0.1 mm
Connecting rod	Big end thrust clearance		
		Standard	0.15 - 0.4 mm
		Maximum	0.45 mm
	Maximum bend		0.05 mm
	Maximum twist		0.05 mm

WFE90-EM549

Crankshaft	Crankpin journal oil clearance		0.020 - 0.044 mm
	Main journal oil clearance		0.024 - 0.042 mm
	Crankpin journal diameter		44.976 - 45.000 mm
	Main journal diameter		49.976 - 50.000 mm
	Thrust clearance	Standard	0.02 - 0.22 mm
		Maximum limit	0.30 mm
	Runout Maximum		0.06 mm
Thermostat valve (HD-C)	Operating temperature		
		ON	63°C or more
		OFF	55°C or less

WFE90-EM550

FUEL SYSTEM

Carburetor	Float level	Dimension assumed by its own weight	8 mm
		Lip dimension	1.6 mm
	Throttle valve closed angle	Primary	9°
		Secondary	20°
	Throttle valve fully opened angle	Primary	90°
		Secondary	80°
	Kick-up angle		23°
	Secondary touch angle		50°
	• Opening degree of throttle valve at a time when it is set to idling state by means of throttle adjust screw		11.4°
	• Opening degree of throttle valve at a time when throttle positioner is operating		16.0°
	Number of backing-off of idle mixture adjusting screw		$4^{1}/_{2}$ rev
	Solenoid valve resistance		80 - 100 Ω
	Outer vent resistance		30 - 45 Ω
Fuel pump (HD-C)	Suction force at 300 rpm		13.3 kPa (100 mm Hg) or more
	Push rod length	Standard	87.95 - 88.25 mm
		Minimum	87.000 mm
	Push rod stroke	Standard	5.0 mm
		Minimum	4.8 mm

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LUBRICATION SYSTEM

Oil pump	Compression spring free length		57 mm
	Body clearance		0.20 - 0.28 mm
	Tip clearance		0.16 - 0.24 mm
	Side clearance		0.035 - 0.085 mm
	Oil pressure	idling	19.6 kPa (0.2 kgf/cm^2) or more
		3000 rpm	24.5 - 490.4 kPa (0.25 - 5.0 kgf/cm^2)

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COOLING SYSTEM

Radiator cap	Relief valve opening pressure	Standard	73.6 - 103.0 kPa (0.75 - 1.05 kgf/cm²)
		Minimum	58.8 kPa (0.6 kgf/cm²)
Thermostat	Valve opening temperature	General specifications	82 - 86°C
		ECE & EEC specifications	76 - 80°C
	Valve lift	General specifications	8.5 mm or more at 98°C
		ECE & EEC specifications	8.5 mm or more at 91°C

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IGNITION SYSTEM

Ignition timing	No sub vacuum timing advance takes place. Engine revolution must be stable at 1000 rpm or less		BTDC 3 ± 2°
High-tension cord	Resistance	Maximum	15 kΩ per cord
Distributor	Air gap between signal rotor and signal generator		0.2 - 0.4 mm
Ignition coil	Primary coil		1.35 - 1.65 Ω at 20°C
	Secondary coil		22 - 30 k Ω at 20°C

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EFI SYSTEM (General specifications)

Fuel pressure regulator	Fuel pressure at No. vacuum	225 - 275 kPa (2.3 - 2.8 kgf/cm²)
Injector	Resistance at 20°C (approx.)	11.0 - 15.0 Ω
	Injection amount (approx.)	152 - 168 cm³/60 seconds at 20°C
	Difference between each injector	5 cm³ or less
	Fuel leakage	Less than one drop of fuel per minute
EFI main relay injector relay	Between terminals ① - ② ③ - ④	60 - 85 Ω Infinity
Fuel pump relay	Between terminals ① - ② ③ - ④	70 - 90 Ω Infinity
Idle-up VSV	Resistance	30 - 50 Ω at 20°C
Throttle position sensor	Resistance Between terminals ⑩ - ㉑ Throttle valve closed fully	0.2 Ω or less at 20°C
	Throttle valve opened fully	10 kΩ or more at 20°C
	Between terminals bH - bA Throttle valve closed fully	10 kΩ or more at 20°C
	Throttle valve opened fully	5 Ω or less at 20°C
Fuel pump	Fuel flow amount	235 cm³ or more/15 seconds

Water temperature sensor Intake air temperature sensor	Cooling water temperature	Resistance
	80°C	0.322 ± 0.1 kΩ
	60°C	0.584 ± 0.2 kΩ
	40°C	1.14 ± 0.3 kΩ
	20°C	2.45 ± 0.5 kΩ
	0°C	5.88 ± 1.5 kΩ
	-20°C	16.2 ± 3.2 kΩ

Pressure sensor
Output between SST terminals ⑬ - ㉒ (ground) (When engine is stopped.)

Measuring point Altitude (height above sea level) m	Atmospheric pressure kPa (mm Hg)	Voltage V
0	101.3 (760)	3.2 - 4.0
500	95.5 (716)	3.1 - 3.8
1000	89.9 (674)	3.0 - 3.6

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ECU CONNECTORS (General specifications)

No.	Contents of connection	No.	Contents of connection
1	Power ground	15	Cooling water temperature sensor
2	Injector	16	Power ground
3	Battery +B (Main relay)	17	Injector
4	Battery +B (Back-up)	18	Battery +B (Main relay)
5	Idle-up VSV	19	Check engine lamp
6	Feedback check terminal	20	Fuel pump relay
7	Ignition coil (negative)	21	Engine ground
8	Starter switch	22	Pressure sensor ground
9	Test terminal	23	Air conditioner magnet clutch
10	Idle switch	26	Vehicle speed sensor
11	Electric load signal	28	Power switch
12	Sensor power supply (approx. 5V)	29	Oxygen sensor
13	Pressure sensor	30	Sensor ground
14	Intake air temperature sensor		

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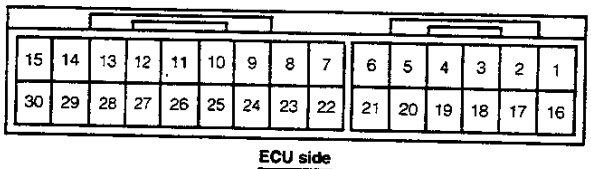
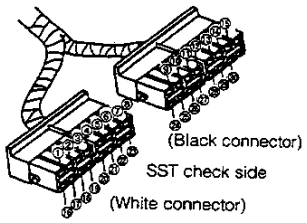


ECU side



VOLTAGES AT ECU WIRING CONNECTORS (General specifications)

Terminals	STD voltage or resistance	Conditions	Remedies
(1) - (21)	Less than 1 Ω	Ignition switch OFF.	Proceed to flow chart (2).
(2) - (21)	Less than 1V	Ignition switch OFF (after more than one minute).	Check power supply.
	About battery voltage	Ignition switch ON.	
(3) - (21)	Less than 0.1V	Ignition switch OFF (after more than ten seconds).	Check power supply.
	About battery voltage	Ignition switch ON.	
(4) - (21)	About battery voltage	At all times (Measured voltage is lower than specified voltage only during starting period.)	Check power supply.
(5) - (21)	About battery voltage	Engine fully warmed up. All accessary switches turned OFF.	Check power supply.
	Less than 3V	Idle-up VSV ON.	Check idle-up VSV control.
(6) - (21)	4.5 - 5.5V	Ignition switch ON. T-terminal shorted with ground terminal. Throttle valve fully closed.	Proceed to flow chart (2).
	Less than 1V		Check diagnosis code.
	0 - 4.5 to 5.5V (Measured voltage varies)	Ignition switch ON. T-terminal shorted with ground terminal. Engine revolution speed builds at 3000 rpm after it has fully warmed up.	Oxygen sensor system.
(7) - (21)	Less than 0.1V	Ignition switch OFF.	Check power supply.
	About battery voltage	Ignition switch ON.	
(8) - (21)	Less than 0.1V	Ignition switch OFF.	Check power supply.
	More than 6V	When ignition switch is set to ST position.	
(9) - (21)	Less than 0.1V	Ignition switch OFF.	Check T-terminal wiring.
	About battery voltage	Ignition switch ON.	
(10) - (21)	Less than 0.5V	Ignition switch ON. Throttle valve fully closed.	Throttle position sensor system.
	About battery voltage	Ignition switch ON. Throttle valve fully opened.	
(11) - (21)	Less than 0.1V	Ignition switch ON. Headlamp switch and/or defogger switch OFF.	Check idle-up VSV control.
	More than 9V	Ignition switch ON. Headlamp switch and/or defogger switch ON.	
(12) - (22)	Less than 0.1V	Ignition switch OFF.	Check VCC wiring.
	4.5 - 5.5V	Ignition switch ON.	
(13) - (22)	3.2 - 4.0V	Ignition switch ON. Atmospheric pressure is 101.3 kPa (760 mmHg).	Check pressure sensor.
(14) - (30)	1.5 - 3.0V	Ignition switch ON. Air temperature inside surge tank: 20°C	Check intake air temperature sensor.
(15) - (30)	0.40 - 0.65V	Ignition switch ON. After engine has been warmed up fully. (Cooling water temperature: 80 - 90°C.	Check cooling water temperature sensor.
(16) - (1)	Less than 1Ω	Ignition switch OFF.	Proceed to flow chart (2).
(17) - (21)	Less than 1V	Ignition switch OFF (after more than one minute).	Check/repair injector power supply.
	About battery voltage	Ignition switch ON.	

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Terminals	STD voltage or resistance	Conditions	Remedies
(18) - (21)	Less than 0.1V	Ignition switch OFF.	Check/repair ECU power supply.
	About battery voltage	Ignition switch ON.	
(19) - (21)	Less than 3V	Ignition switch ON. (Check engine lamp illuminated.)	Check power supply for check engine lamp.
	About battery voltage	Engine is rotating. (Check engine lamp not illuminated).	
(20) - (21)	Less than 1V	Ignition switch ON. Fuel pump is operating.	Check/repair fuel pump power supply.
	About battery voltage	Ignition switch ON. Fuel pump is stopped.	
(21) - Engine ground	Less than 0.2Ω	Ignition switch OFF.	Check ground wiring.
(22) - (21)	Less than 0.5Ω	Ignition switch OFF.	Replace ECU.
(23) - (21)	About battery voltage	Engine is rotating. Air conditioner compressor is rotating. (Genuine air conditioner-equipped vehicle.)	Check air conditioner wiring.
(26) - (21)	0 to Approx battery voltage	Ignition switch ON. When vehicle is moved. (Measured voltage changes 4 times for movement of 1.5 m.)	Check speed sensor
(28) - (21)	About battery voltage	Ignition switch ON. Throttle valve fully closed.	Check throttle position sensor.
	Less than 0.5V	Ignition switch ON. Throttle valve fully opened.	
(29) - (21)	Less than 0.1V	Ignition switch ON (after more than 60 seconds).	Check oxygen sensor.
	Voltage varies within 0 - 1.0V.	After engine has warmed up fully. When engine revolution is held at 3000 rpm for more than two minutes:	Check fuel system.
(30) - (21)	Less than 1Ω	Ignition switch ON.	Proceed to flow chart (2).

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EFI SYSTEM (U.S. specifications)

Fuel pressure regulator	Fuel pressure at No. vacuum	225 - 275 kPa (2.3 - 2.8 kgf/cm²)
Injector	Resistance at 20°C (approx.)	11.0 - 15.0 Ω
	Injection amount (approx.)	152 - 168 cm³/60 seconds at 20°C
	Difference between each injector	5 cm³ or less
	Fuel leakage	Less than one drop of fuel per minute
EFI main relay Injector relay	Between terminals ① - ② ③ - ④	60 - 85 Ω Infinity
Fuel pump relay	Between terminals ① - ② ③ - ④	70 - 90 Ω Infinity
Idle-up VSV	Resistance	30 - 50 Ω at 20°C
Throttle position sensor	Resistance Between terminals ⑫ - ⑱ Throttle valve closed fully	0.2 Ω or less at 20°C
	Throttle valve opened fully	10 kΩ or more at 20°C
	Between terminals ⑫ - ⑱ Throttle valve closed fully	10 kΩ or more at 20°C
	Throttle valve opened fully	5 Ω or less at 20°C
Fuel pump	Fuel flow amount	235 cm³ or more/15 seconds
Water temperature sensor Intake air temperature sensor	Cooling water temperature	Resistance
	80°C	0.322 ± 0.1 kΩ
	60°C	0.584 ± 0.2 kΩ
	40°C	1.14 ± 0.3 kΩ
	20°C	2.45 ± 0.5 kΩ
	0°C	5.88 ± 1.5 kΩ
	-20°C	16.2 ± 3.2 kΩ

Pressure sensor
Output between SST terminals ⑬ - ⑫ (ground) (When engine is stopped.)

Measuring point Altitude (height above sea level) m	Atmospheric pressure kPa (mmHg)	Voltage V
0	101.3 (760)	3.2 - 4.0
500	95.5 (716)	3.1 - 3.8
1000	89.9 (674)	3.0 - 3.6

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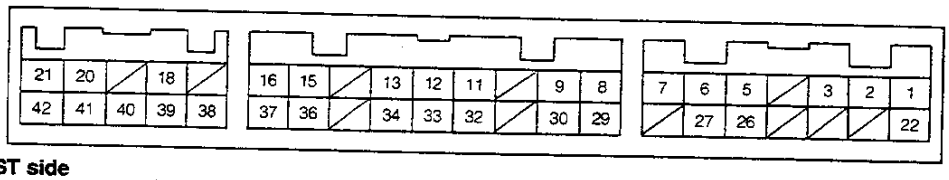
ECU CONNECTORS (U.S. specifications)

The figure below shows the arrangement of the ECU connector terminals.

ECU side



SST side

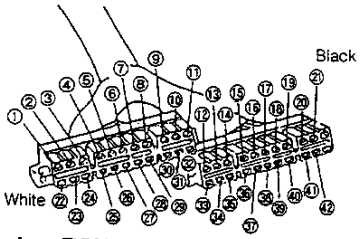


Table Showing ECU Connections (US Specification)

WFE90-EM560

Terminal code	Contents of connection	Terminal code	Contents of connection
1	Main relay (Power supply)	22	Main relay (Power supply)
2	Battery (Backup power supply)	23	
3	Ignition coil primary voltage	24	
4		25	
5	Pressure sensor power supply	26	Oxygen sensor
6	Pressure sensor	27	Intake air temperature sensor
7	Cooling water temperature sensor	28	
8	Vehicle speed sensor	29	Operation system ground (Engine)
9	Electrical load (Headlamp and defogger)	30	Electrical load (Blower fan)
10		31	
11	Check connector (Test terminal)	32	Throttle position switch (Power switch)
12	Throttle position switch (Idle switch)	33	Stop lamp
13	Starter	34	Air conditioner magnet switch
14		35	
15	Oxygen sensor feedback check terminal	36	Operation system ground
16	Check engine lamp	37	Fuel pump relay
17		38	Pressure VSV
18	EGR VSV	39	System ground
19		40	Idle speed control VSV
20	Injector	41	Injector
21	Actuator drive ground (Engine)	42	Actuator drive ground (Engine)

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Voltages at ECU connectors

Terminals	STD voltage or resistance	Condition		Remedies
① — ㉙	About battery voltage	Ignition switch ON		Check power supply.
② — ㉙	About battery voltage	At all time		Check power supply.
③ — ㉙	About battery voltage	Ignition switch ON	When engine is stopped:	Check power supply.
⑤ — ㉚	4.5 - 5.5 V	Ignition switch ON		Check power supply.
⑥ — ㉙	3.2 - 4.0 V	Ignition switch ON	When atmospheric pressure of 101.3 kPa (760 mmHg) exists.	Check pressure sensor.
⑦ — ㉟	0.4 - 0.65 V	Ignition switch ON	When cooling water temperature is 80°C:	Check water temperature sensor.
⑦ — ㉘	0.322 ± 0.1 W	When cooling water temperature is 80°C		
⑧ — ㉚	0 - About battery voltage	Ignition switch ON	Measured voltage changes when vehicle is moved 1.5 m.	Check speed sensor.
⑨ — ㉚	Less than 5.0 V	Ignition switch ON	When defogger and headlamp switches are turned OFF:	Check TSC VSV.
	About battery voltage	Ignition switch ON	When defogger and/or headlamp switches are turned ON:	
⑪ — ㉙	About battery voltage	Ignition switch ON	When test terminal of check connector is not connected with ground terminal:	Check T-terminal wiring.
	Less than 1.0 V	Ignition switch ON	When test terminal of check connector is connected with ground terminal:	
⑫ — ㉚	Less than 5.0 V	Ignition switch ON	Throttle valve fully closed	Check throttle position system.
	About battery voltage	Ignition switch ON	Throttle valve fully opened	
⑫ — ㉙	Less than 29 Ω	Throttle valve fully closed		
	More than 1000 Ω	Throttle valve fully opened		
⑬ — ㉚	0 V	Ignition switch ON		Check power supply.
	More than 6 V	When ignition switch is set to ST position:		
⑮ — ㉚	Measured voltage changes at a point between 0 - 5.0 V.	After warming up engine completely, connect test terminal of check connector with ground terminal. Hold engine revolution speed at 3000 rpm for two minutes.		Check fuel system.
⑯ — ㉚	Less than 3.0 V	Ignition switch ON	• Engine is stopped. • When check engine lamp is illuminated:	Check power supply for engine lamp.
	About battery voltage	Ignition switch ON	• After engine starts: • When check engine lamp is extinguished:	

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Terminals	STD voltage or resistance	Condition		Remedies
⑯ — ㉚	About battery voltage	Ignition switch ON	• After engine starts: • Cooling water temperature is below 40°C.	Check power supply.
	Less than 3.0 V	Ignition switch ON	• After engine starts: • Cooling water temperature is above 41°C.	Check ESV wiring.
㉔ — ㉙	Less than 1.0 V	At least 30 seconds have elapsed after turning OFF ignition switch.		Check power supply.
	About battery voltage	Ignition switch ON	• Engine is stopped.	
㉑ — ㉚	Less than 0.01 V	Ignition switch ON		Proceed to flow chart (2).
㉒ — ㉚	About battery voltage	Ignition switch ON		Check power supply.
㉖ — ㉚	Change in output voltage	Ignition switch ON	After warming up engine completely, hold engine revolution speed at 3000 rpm for two minutes.	Check fuel system.
㉗ — ㉚	1.5 - 3.0 V	Ignition switch ON	Air temperature inside intake manifold is 20°C:	Check intake air temperature sensor.
㉗ — ㉘	2.45 ± 0.5 Ω	When air temperature inside intake manifold is 20°C:		
㉘ — ㉚	Less than 0.1 V	Ignition switch ON		Check ground wiring.
㉚ — ㉚	About battery voltage	Ignition switch ON	• Blower fan switch turned OFF	Check ISC.
	Less than 2.0 V	Ignition switch ON	When blower fan switch turned ON:	
㉜ — ㉚	About battery voltage	Ignition switch ON	Throttle valve fully closed	Check throttle system.
	Less than 5.0 V	Ignition switch ON	Throttle valve fully opened	
㉜ — ㉘	More than 1000 Ω	Throttle valve fully closed		
	Less than 29 Ω	Throttle valve fully opened		
㉝ — ㉚	Less than 1 V	Ignition switch ON	When brake pedal is not depressed:	Check brake wiring.
	About battery voltage	At all time	When brake pedal is depressed:	

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Terminals	STD Voltage or resistance	Condition		Remedies
㉞ — ㊴	Less than 1 V	Ignition switch ON	When compressor magnet switch of air conditioner is turned OFF:	Check air conditioner idle-up VSV.
	About battery voltage	Ignition switch ON	When compressor magnet switch of air conditioner is turned ON:	
㉟ — ㊴	Less than 0.1 V	Ignition switch ON		Check ground wiring.
㊲ — ㉙	About battery voltage	Ignition switch ON	When fuel pump is stopped:	Check or repair pump power supply.
	Less than 2.0 V	Ignition switch ON	When fuel pump is operating:	
㊳ — ㉙	About battery voltage	Ignition switch ON	When pressure VSV is turned OFF:	Check pressure VSV.
	Less than 3.0 V	Ignition switch ON	For 0.5 second immediately after engine starts	
㊴ — Engine ground	Less than 0.1 V	Ignition switch ON		Check ground wiring.
㊵ — ㊴	Less than 3.0 V	Ignition switch ON	Engine is stopped.	Check ISC VSV.
	About battery voltage	Ignition switch ON	When test terminal of check connector is connected with ground terminal:	
㊶ — ㊴	Less than 1.0 V	At least 30 seconds have elapsed after turning OFF ignition switch.		Check power supply.
	About battery voltage	Ignition switch ON	Engine is stopped.	
㊷ — ㊴	Less than 0.1 V	Ignition switch ON		Check ground wiring.

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