

DAIHATSU

F73, F78

(F70, F75, F77)

EM

☆ **ENGINE MECHANICAL**

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R7EM00001-00000

In the sections bearing "☆" marks, the model codes "F70, 75, 77" should read as "F73 and F78".

After checking the contents of the relevant sections of the F73, F78 manual, we found that the contents remained the same.

Therefore, we are using the sections as they are in this manual.

NO. 9705

PRECAUTIONS

1. Make sure that only the specified bolts and nuts are used. Also, where specified, be sure to employ a torque wrench to tighten bolts or nuts to specifications.
2. Use only genuine parts for every replacement operation.
3. For increased working efficiency and improved accuracy, utilize SSTs (Special Service Tools) effectively.
4. When both front and rear parts of the vehicle or only the rear part thereof is jacked up, make certain to place chocks at the wheels correctly in order to assure safe operations.
5. When the motor vehicle is jacked up, make sure to support the vehicle with safety stands positions at the specified jacking points.
6. Before any repair work is made on the electrical system or the engine is removed or installed, first be sure to disconnect the negative $\ominus$ terminal of the battery.
7. Disassembly.
 - (1) When complicated parts are disassembled, put stamped marks or marks on suitable nonfunctional sections of the parts in order that the said parts may be easily assembled in the correct original positions.
 - (2) Replacements of the cylinder block or crankshaft, etc should be carried out after the engine assembly has been removed from the motor vehicle.
8. Checks to be performed during disassembly.

Each time a part is removed, check conditions under which the part has been assembled. Also, check to see if the part exhibits any evidence of distortion, breakage, wear or scores, etc.
9. Arrangement of disassembled parts.

Put disassembled parts in a good order. Moreover, divide disassembled parts into two groups: those parts to be replaced and those parts which can be reused.
10. Washing disassembled parts.

As for those parts which can be reused, thoroughly clean or wash them.
11. Inspection and measurement.

Those parts which are to be reused must be carefully inspected or measured, as required.
12. Assembly of parts.

Those satisfactory parts only should be assembled in accordance with the prescribed standards (e.g. specified adjustment values, tightening torque and so forth.)
Furthermore, seal packing or grease should be applied, as required.
Furthermore, in respect to packings, gaskets, cotter pins and similar items, be certain to install new parts.
13. Adjustments and checking of service operations.

Service operations must be carried out correctly by means of gauges or testers, if the use of these instruments is required.

WRE91-EM003

TROUBLE SHOOTING

Problem	Possible cases	Remedies	Page
Engine overheat	Cooling system faulty Fuel system faulty Lubrication system faulty	Trouble shoot cooling system. Trouble shoot fuel system. Trouble shoot lubrication system.	
Engine will not crank or crank slowly	Starting system Charging system	Trouble shoot starting system. Trouble shoot charging system.	
Engine will not start/Hard to start (Only cases where cranking by starter motor is normal)	Preheating device problem	Inspect glow plug. Inspect glow plug connector. Inspect glow plug current sensor.	ST-22
	No fuel supply	Check fuel tank and fuel line.	FU-3
	Injection problem	Inspect injection pump. Reset injection timing. Check injection nozzle.	FU-4
Rough idle/Engine stalls	Incorrect valve clearance	Adjust valve clearance.	EM-10
	Incorrect idle speed	Adjust idle speed.	EM-13
	Incorrect injection timing	Reset injection timing.	EM-11
	Low compression	Check compression.	EM-13
	Fuel leakage	Check fuel line.	FU-3
	• Injection pipe • Injection nozzle • Delivery valve		
	Turbo charger problem	Inspect turbo charger.	EM-64
	Injection pump problem	Inspect injection pump.	FU-4
Lock of power	Fuel leakage	Check fuel line.	FU-3
	• Injection pipe • Injection nozzle • Delivery valve		
	Incorrect injection timing	Reset injection timing.	EM-11
	Turbo charger problem	Check turbo charger.	EM-64
	• Waste gate • Boost compensator • Turbo charging pressure		
	Injection pump problem	Inspect injection pump.	FU-4

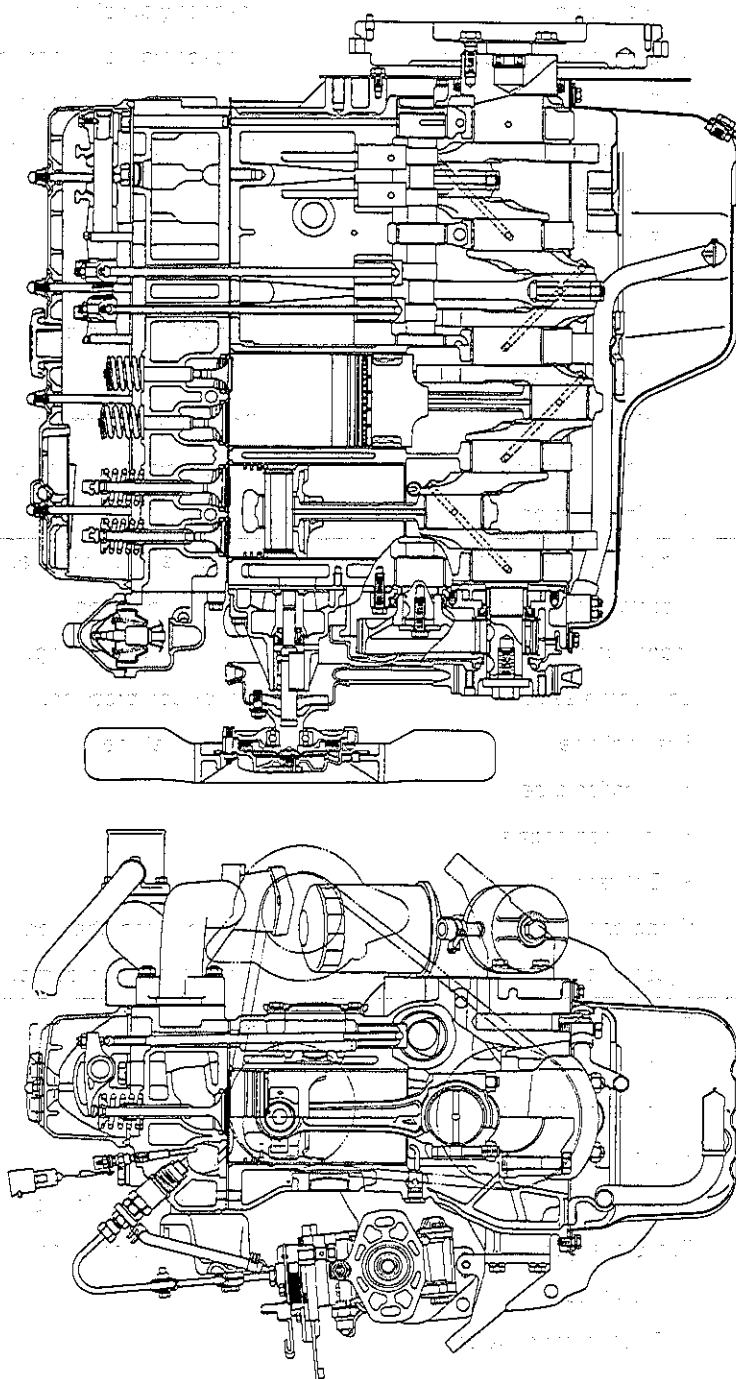
ENGINE MECHANICAL

ENGINE OUTLINE

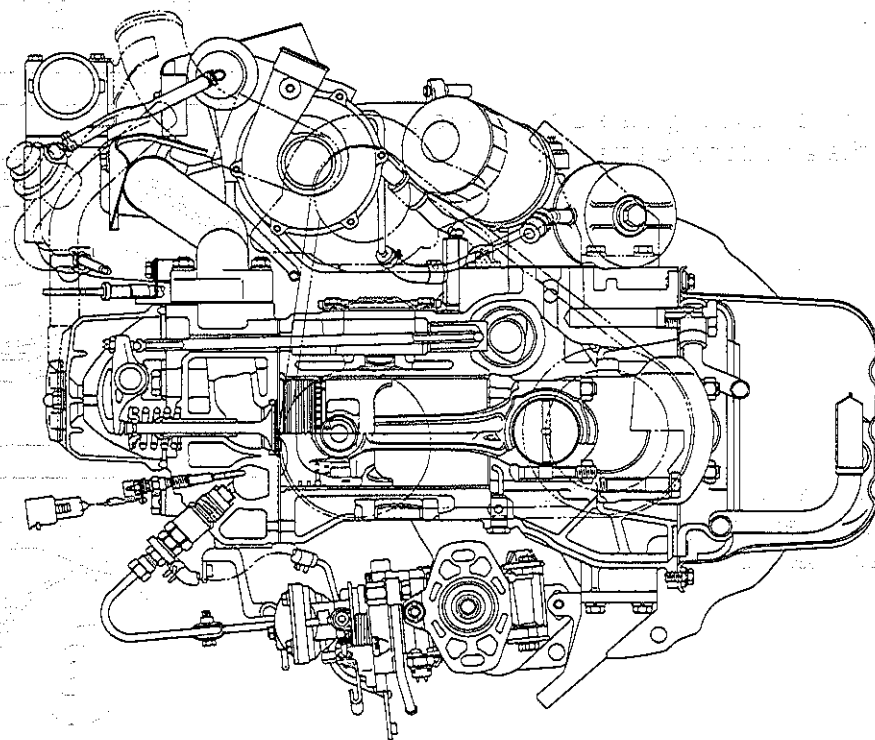
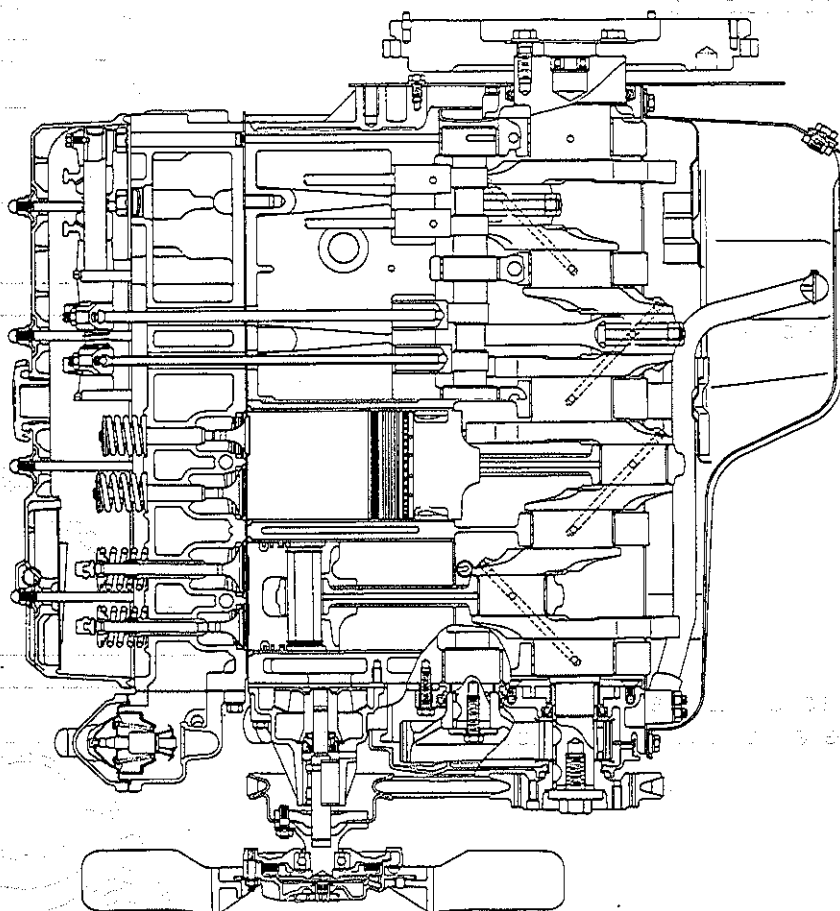
DL Engine

Type DL engine is a water-cooled, 4-cylinder-in-line diesel engine with a total displacement of 2765 cc. The DL engine comes in two types: One is the DL-42 (natural aspiration engine) type and the other is the DL-52 (turbo charged engine) type. On the DL-52 engine, an air-cooled intercooler has been newly provided so as to increase the engine power. Moreover, for improved durability and reliability, the turbo charger employs a water-cooled type.

ENGINE SECTIONAL VIEW



[DL-42 Engine]

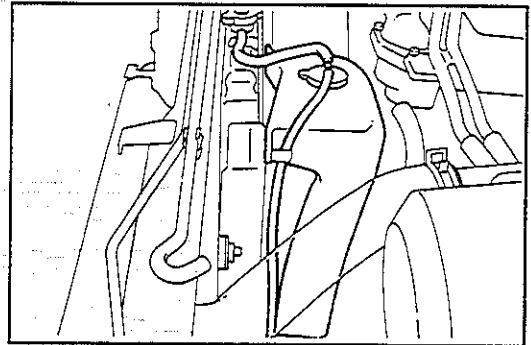


[DL-52 Engine]

ENGINE MECHANICAL

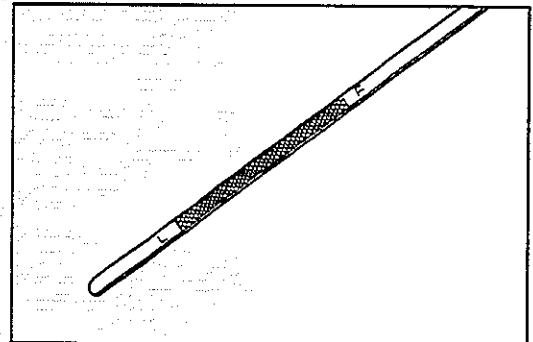
ENGINE TUNE-UP

1. Inspection of engine coolant level
(See page CO-7.)



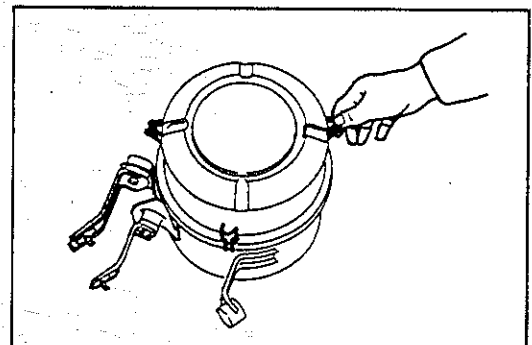
WRE91-EM007

2. Inspection of engine oil level



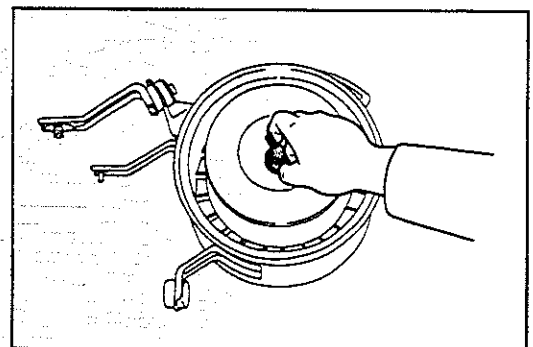
WRE91-EM008

3. Inspection of air cleaner filter element
 - (1) Disconnect the air cleaner cap by loosen the three clamps.



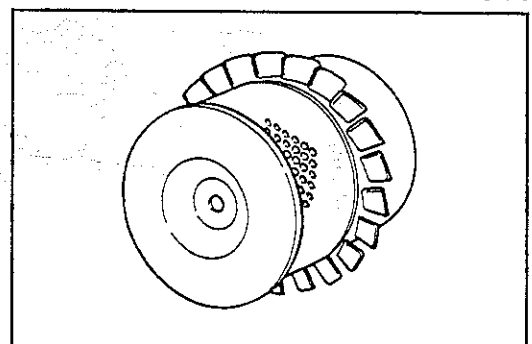
WRE91-EM009

- (2) Loosen the wing bolt retaining the element. Take out the element from the air cleaner element.



WRE91-EM010

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



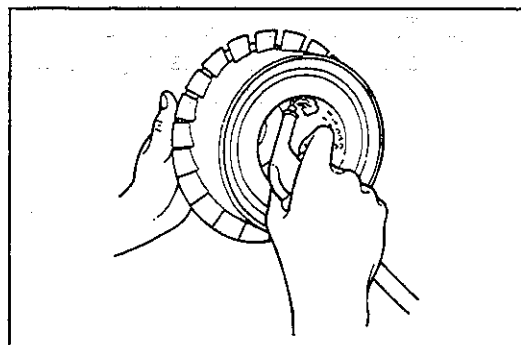
WRE91-EM011

- (4) Clean the element with compressed air.
First, blow compressed air from inner side of the element thoroughly.
Then, blow off the outer side of the element.

CAUTION:

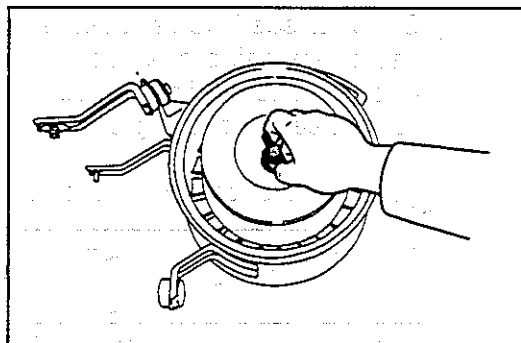
- The air pressure to be used this cleaning operation should not exceed 392. kPa (4.0 kgf/cm²).

Replace the air filter element, if necessary.



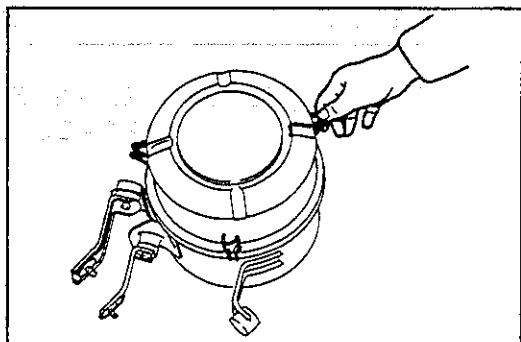
WRE91-EM012

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



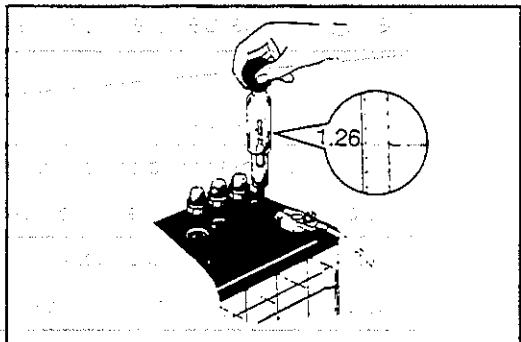
WRE91-EM013

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



WRE91-EM014

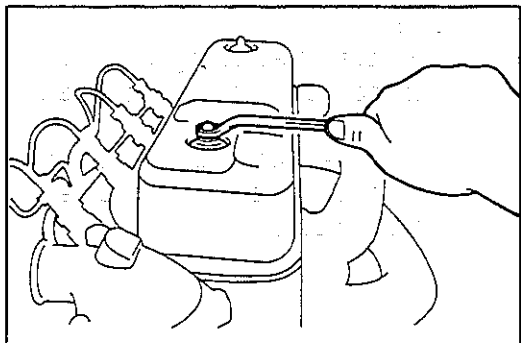
4. Inspection of battery (See the charging system section.)



WRE91-EM015

5. Inspection of valve clearance

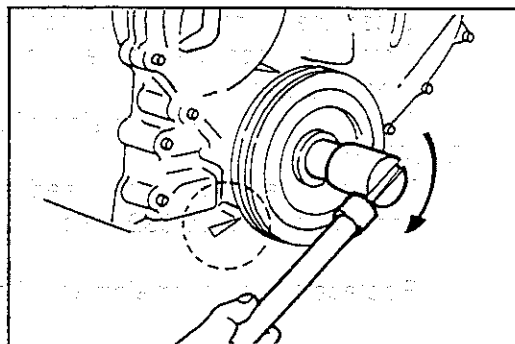
- (1) Warm up the engine completely.
- (2) Remove the cylinder head cover by loosen the four attaching nuts.



WRE91-EM016

ENGINE MECHANICAL

- (3) Turn the crankshaft until the recessed mark on crankshaft pulley is aligned with the indicator mark on timing gear cover.

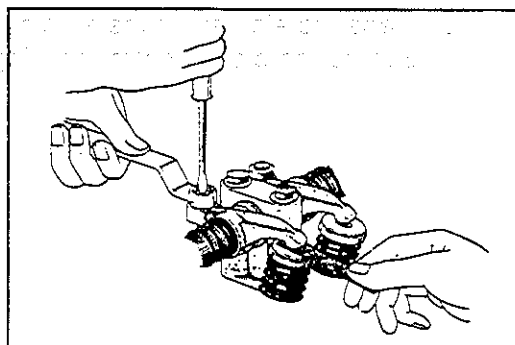


WRE91-EM017

- (4) Check to see if valve rocker arms of No. 1 cylinder are free or are being push up. According to the flowing table, check and/or adjust the valve clearance, using a thickness gauge.

Valve Clearances (Hot condition)

Type	Item	DL-42	DL-52
Intake	(mm)	0.25 ± 0.05	0.25 ± 0.05
Exhaust	(mm)	0.25 ± 0.05	0.25 ± 0.05



WRE91-EM018

Tightening Torque: 19.6 - 24.5 N·m
(2.0 - 2.5 kgf·m)

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

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

WRE91-EM019

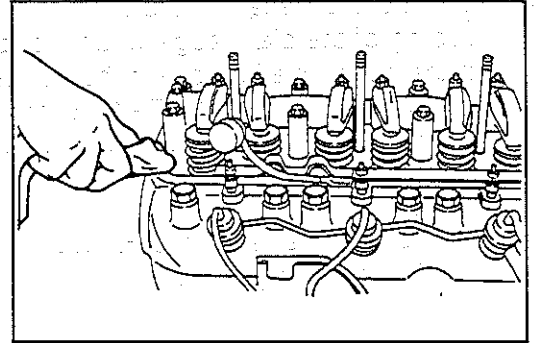
NOTE:

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

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

WRE91-EM020

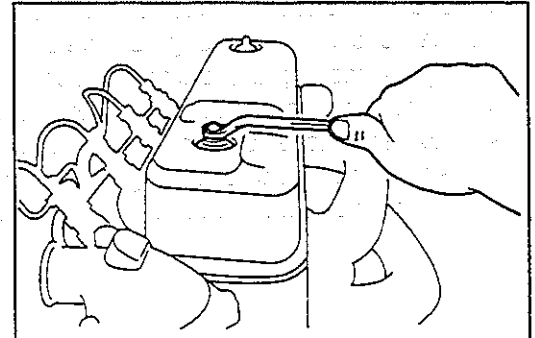
- (6) Wipe off the oil or dirt from the gasket surface of the cylinder head.



WRE91-EM021

- (7) Install the cylinder head cover on the cylinder head.
- (8) Tighten the cylinder head cover nuts over two or three stages in sequence, until they are tightened to the specified torque.

Tightening Torque: 5.4 ± 1.5 N·m
(0.55 ± 0.15 kgf·m)



WRE91-EM022

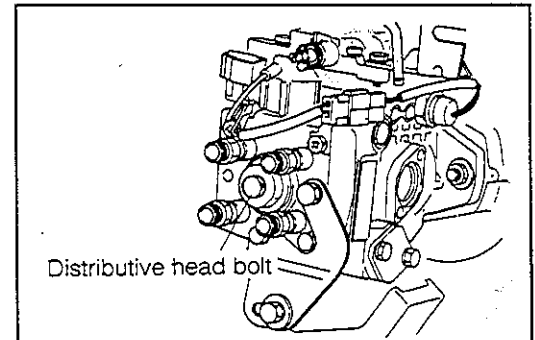
Check and adjustment of injection timing

1. Remove the distributive head bolts on the injection pump. Then, install the SST and set a dial gauge.

SST: 09275-54010-000

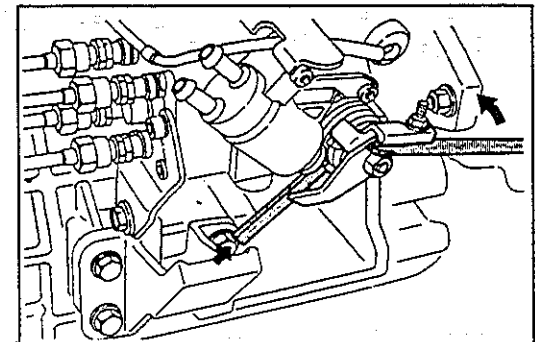
NOTE:

- Since there is a hole-shaped notch at the end of the plunger, the measuring pin of the dial gauge must contact the flat section of the plunger.
- Make sure that no dust gets into the pump.



WRE91-EM023

2. Release automatic cold starting system (ACSD equipped vehicle only)
 - (1) Turn the automatic cold starting lever counterclockwise about 20° degree, using a screwdriver.
 - (2) Put a metal plate 8.0 - 10.0 mm thick between the automatic cold starting lever and thermo wax plunger.

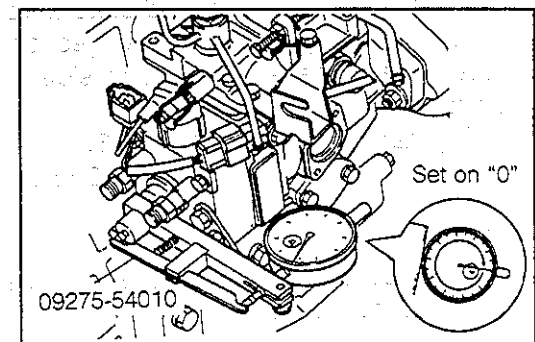


WRE91-EM024

3. Align the top dead center mark on the crankshaft pulley with the top dead center of the No. 1 cylinder under the compression stroke. Then, back off crankshaft approx. 45° and align the pointer of the dial gauge with the zero position.

NOTE:

- At this time, turn slightly the crankshaft pulley to the right and left sides and make sure that the pointer is stable at the zero position.



WRE91-EM025

ENGINE MECHANICAL

4. Turn the crankshaft in the normal direction and take the reading of the dial gauge when the top dead center mark on the pulley is aligned with the pointer.

Specified Value: 1.07 - 1.13 mm

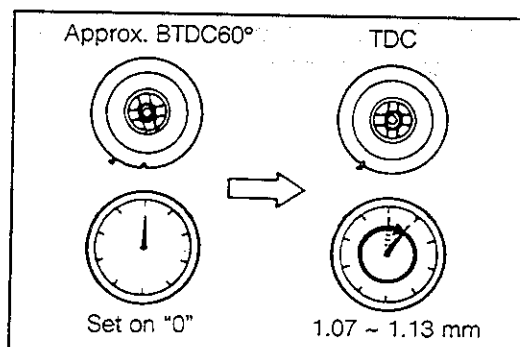
(Injection Timing BTDC 1°)

NOTE:

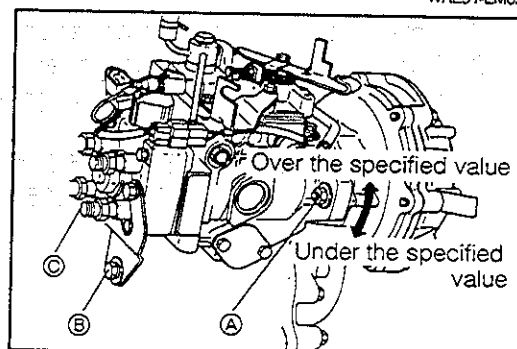
- The gauge's reading of ± 0.03 mm corresponds to the injection timing of $\pm 0.5^\circ$.

5. Slacken the attaching sections of the injection pump proper at the following points given below. Adjust the injection timing by moving the pump proper.

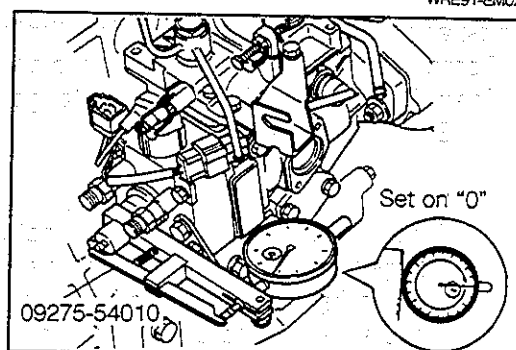
- Injection pump attaching nuts Section A
- Lower bracket attaching bolt Section B
- Attaching nut of each high-pressure pipe (union nut) Section C



WRE91-EM026

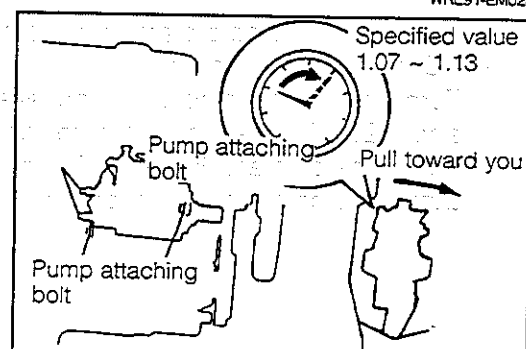


WRE91-EM027



WRE91-EM028

6. Perform the injection timing check again and ensure that the injection timing is proper.



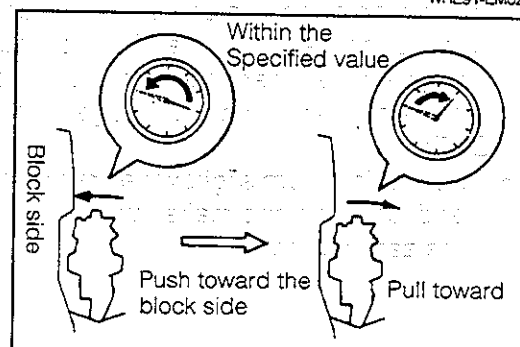
WRE91-EM029

7. When the injection timing is adjusted, make sure that the injection pump is in a pulled state toward you. If the injection timing is adjusted with the injection pump in a pushed state toward the engine block side, the timing may be retarded.

Tightening Torque: 18.1 ± 3.4 N·m
(1.85 ± 0.35 kgf·m)

NOTE:

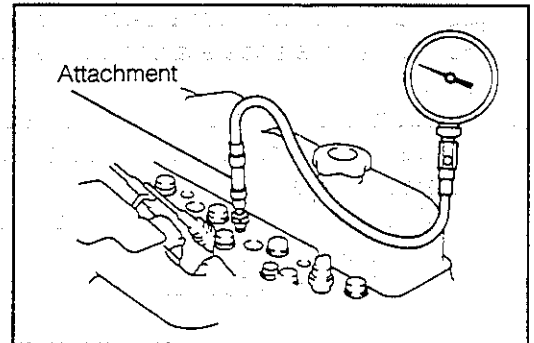
- Replace the copper washer the distributive head bolt with a new one.



WRE91-EM030

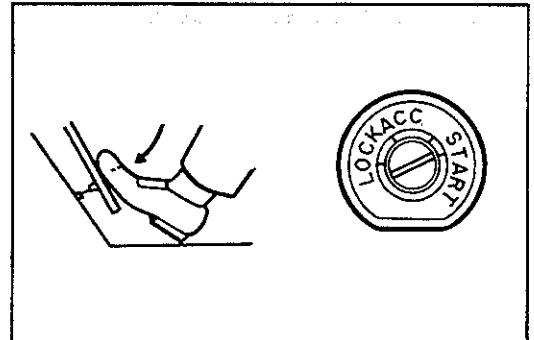
Measurement of compression pressure

1. Warm up the engine
2. Remove all the glow plugs.
3. Position the attachment into the installation hole of the glow plug.
Set the compression gauge in place.



WRE91-EM031

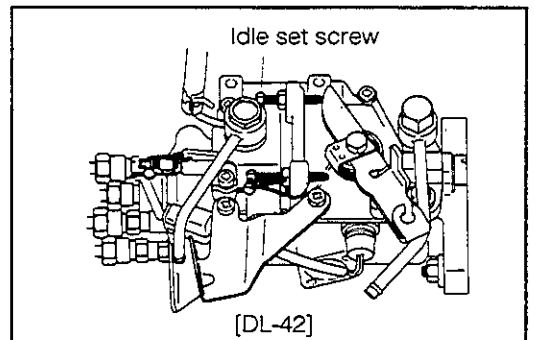
4. With the throttle valve opened fully, crank the engine, using the starter.
5. Cranking speed: 250 rpm
 — Compression Pressure: STD 3138 kPa (32 kgf/cm²)
 Limit 2158 kPa (22 kgf/cm²)
 Variation Between Cylinders: 196 kPa (2.0 kgf/cm²)



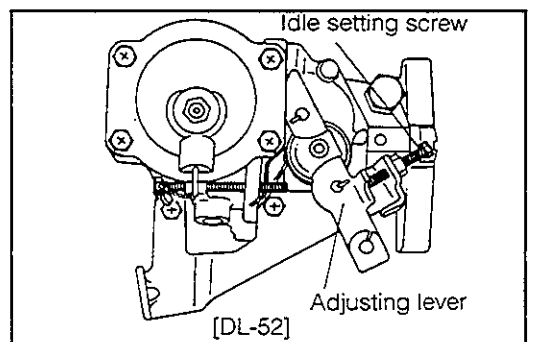
WRE91-EM032

Adjustment of idling speed

1. Warm up the engine.
2. Measure the idling speed.
3. Adjust the idling speed by turning the idling adjusting bolt.
Specified Idling Speed: 650 ± 25 rpm



WRE91-EM033



WRE91-EM034

ENGINE MECHANICAL

Adjustment of maximum no-load revolution speed

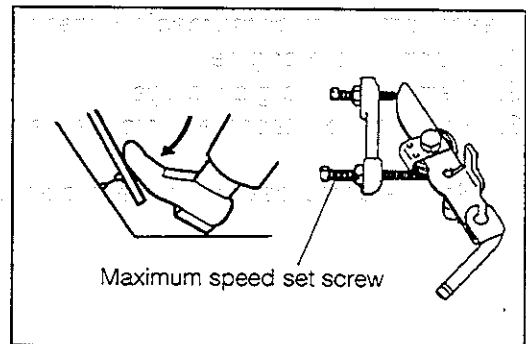
1. Fully when the accelerator pedal is depressed to the fullest extent.
2. Measure the maximum revolution speed at the time when the venturi opens fully because of the fully-depressed accelerator pedal.

Specified Maximum Revolution Speed:

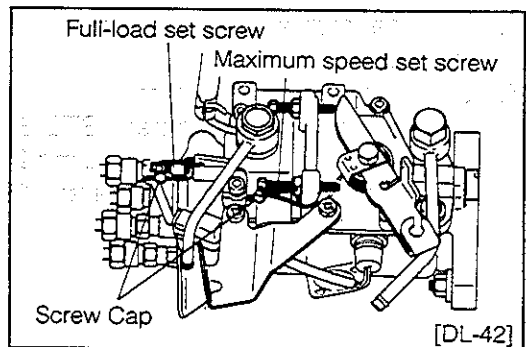
DL-42: 4500 rpm

DL-52: 4500 rpm

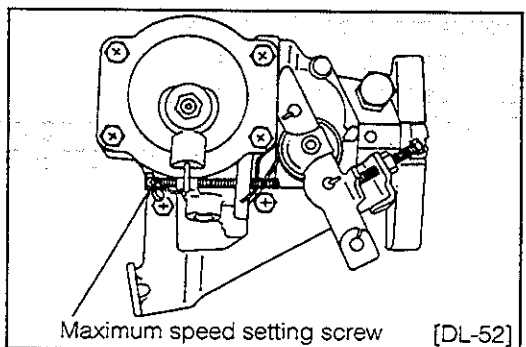
3. Adjust the maximum no-load revolution speed by turning the maximum speed set screw.



WRE91-EM035

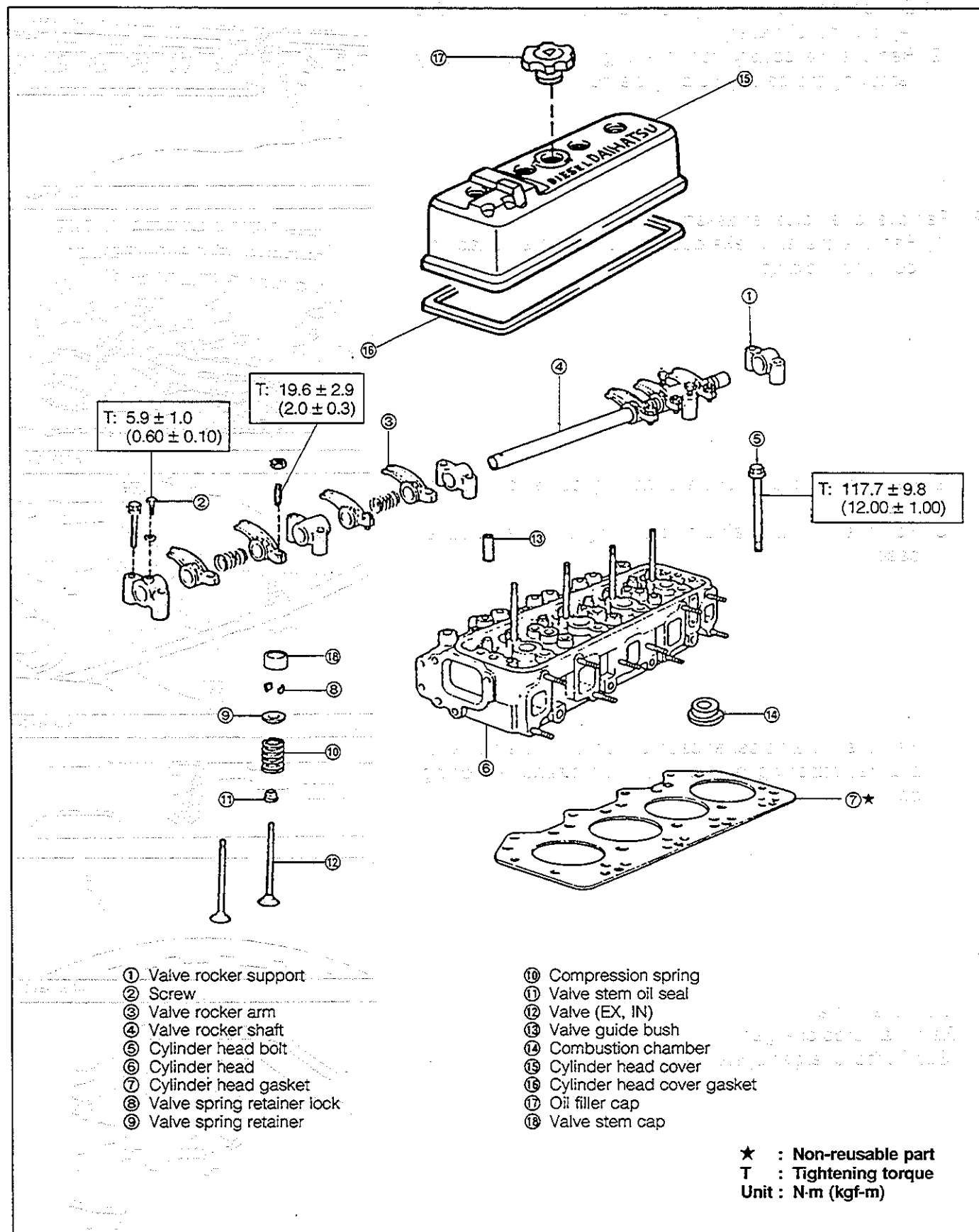


WRE91-EM036



WRE91-EM037

CYLINDER HEAD COMPONENTS



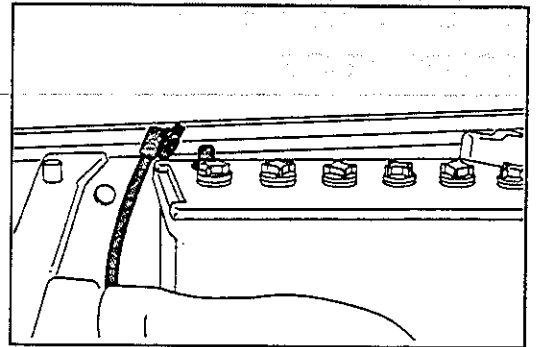
WRE91-EM038

ENGINE MECHANICAL

REMOVAL OF CYLINDER HEAD

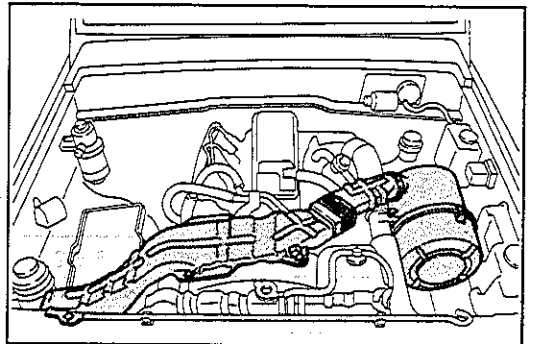
1. Removal of battery

- (1) Disconnect the battery ground cable from the negative (-) terminal of battery
- (2) Remove the battery from the engine compartment by removing the battery holding clamp.



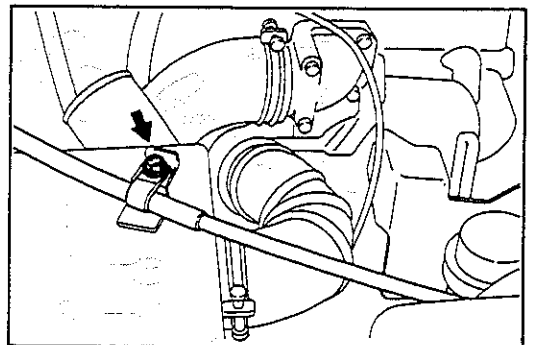
2. Removal of air cleaner assembly

- (1) Remove the air intake duct by loosen three attaching bolt and a clamp.

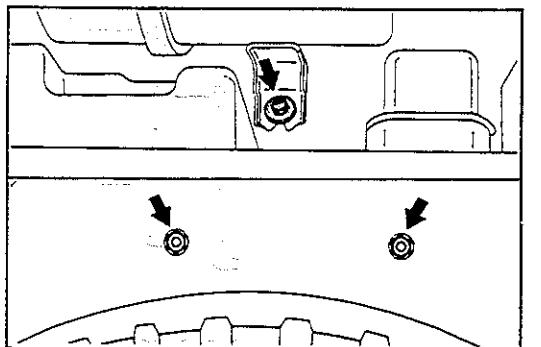


- (2) Remove the clutch cable attaching bolt at air cleaner case.

- (3) Remove the intake air pipe attaching bolt at air cleaner case.



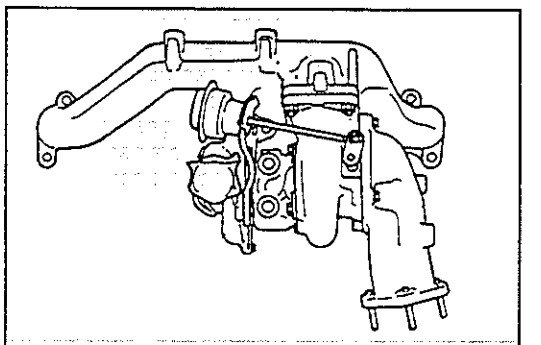
- (4) Remove the air cleaner case by loosen two air cleaner bracket attaching nuts and the air cleaner attaching bolt.



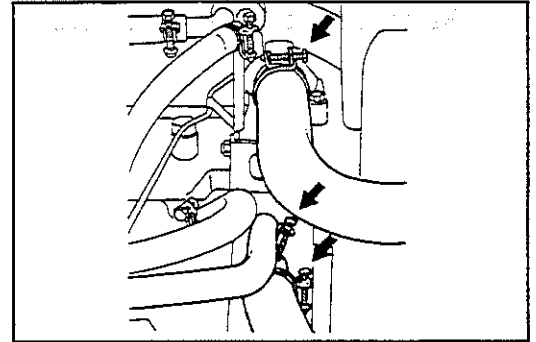
3. Drain the coolant.

4. Removal turbo charger.

(See Turbo Charger System section)

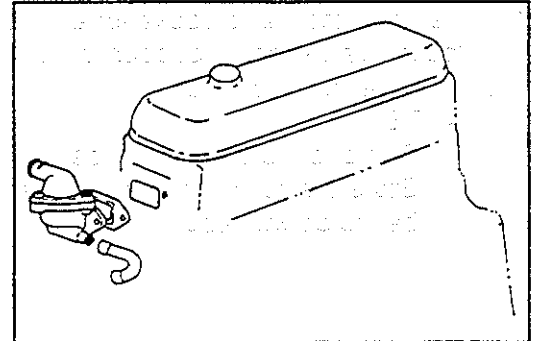


5. Remove the water hoses.
 - Water outlet hose
 - Water by-pass hose
 - Heater hoses
 - Turbo charger cooling hose (DL-52 engine only)
 - ACSD water hose (ACSD equipped vehicle only)



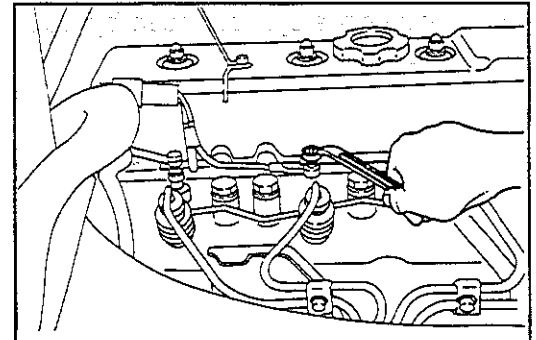
WRE91-EM044

6. Remove water outlet housing.



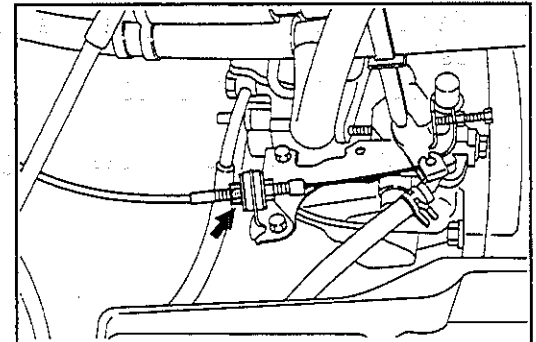
WRE91-EM045

7. Remove the glow plug connector and glow plug.



WRE91-EM046

8. Remove the accelerator cable from the injection pump.



WRE91-EM047

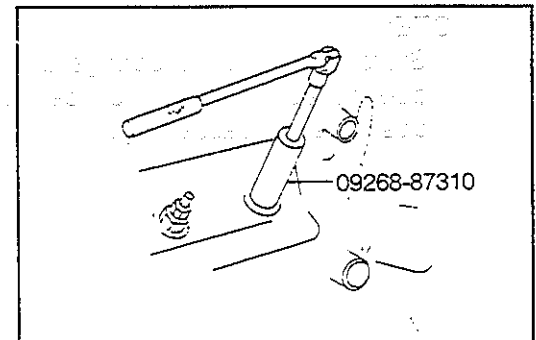
9. Removal of injection nozzle, using SST.

(See page FU-14.)

SST: 09268-87310-000

NOTE:

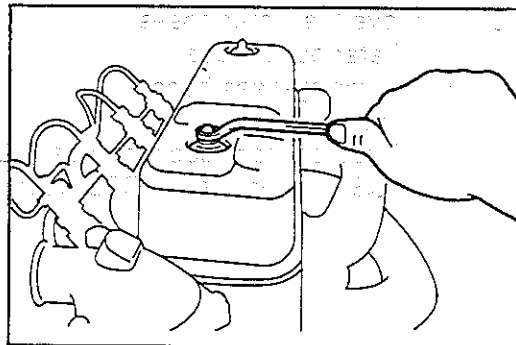
- Arrange the injection nozzle in order.



WRE91-EM048

ENGINE MECHANICAL

10. Remove the cylinder head cover.

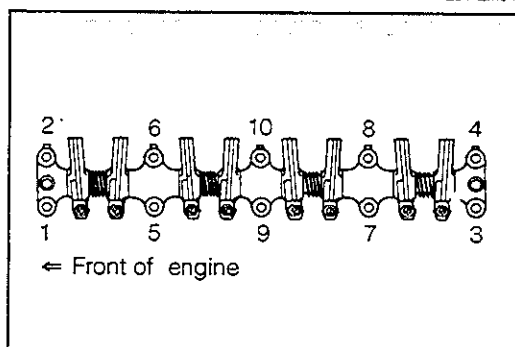


WRE91-EM049

11. Remove the valve rocker-shaft with valve rocker arm by loosen valve rocker support bolts in sight figure.
12. Remove the push rods.

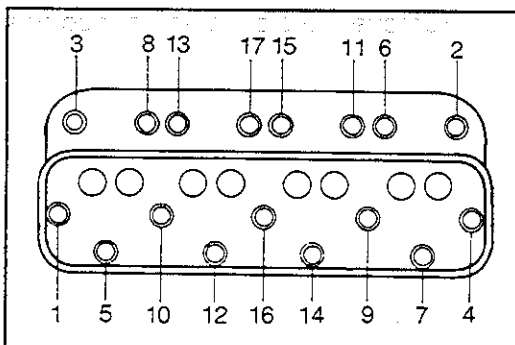
NOTE:

- Remove the parts in the sequence of cylinders. Store the removed parts properly so that they may not be mixed with each other.



WRE91-EM050

13. Remove the cylinder head by loosen cylinder head bolts in right figure.

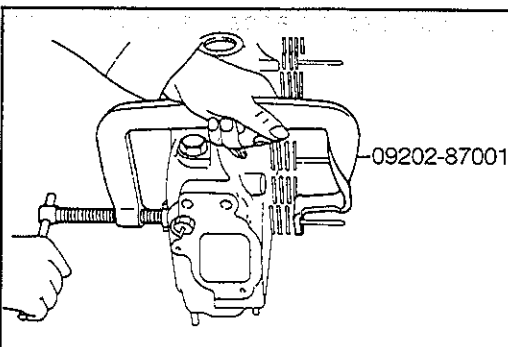


WRE91-EM051

14. Remove the valve spring retainer lock and valve spring, using SST.

SST: 09202-87001-000

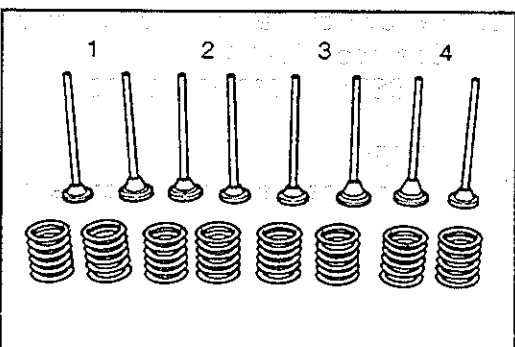
15. Pull out the valve stem oil seal using pliers.



WRE91-EM052

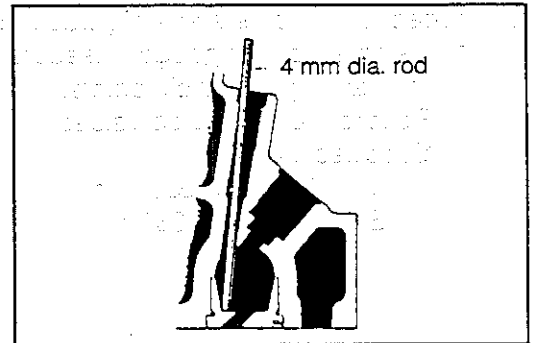
NOTE:

- Store the removed springs and valves in correct sequence so that they may be installed in their original positions on reassembly.



WRE91-EM053

16. Removal of combustion chamber
Drive out the combustion chamber by instaring an about 4 mm dia rod through the glow plug installation hole.

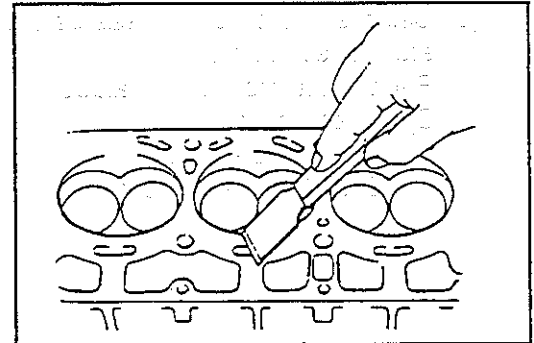


WRE91-EM054

INSPECTION OF CYLINDER HEAD

1. Cleaning of cylinder head

- (1) Remove any remaining gasket material from the cylinder head and manifold surfaces by using a gasket scraper.

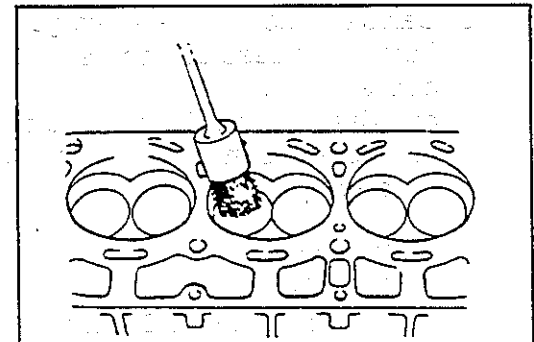


WRE91-EM055

- (2) Remove all carbon deposits from the combustion chambers by using a wire brush.

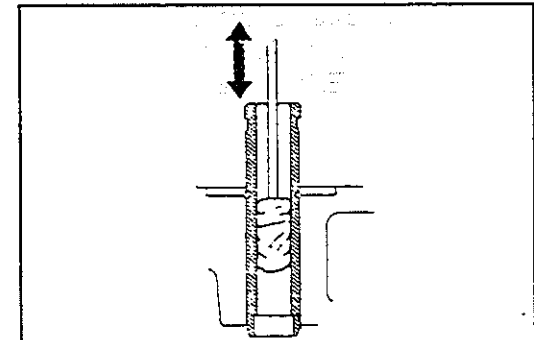
CAUTION:

- Be careful not to scratch the cylinder head gasket contact surfaces.



WRE91-EM056

- (3) Clean all valve guide bushings by using a valve guide brush and solvent.



WRE91-EM057

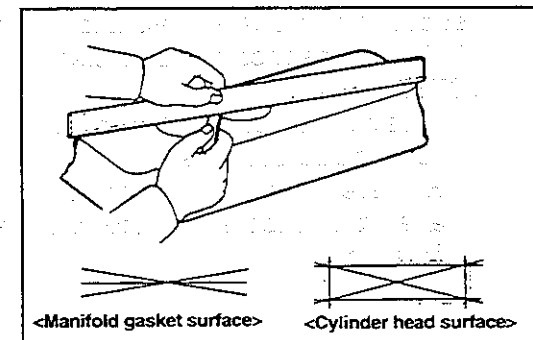
2. Using a precision straight edge and thickness gauge, check the gasket surfaces contacting the cylinder block and manifolds for warpage.

Maximum Surface Warpage:

Cylinder Block Side: 0.10 mm

Intake Exhaust Manifold Side: 0.20 mm

Replace the cylinder head, if surface warpage of the cylinder block side exceeds the maximum limit.



WRE91-EM058

ENGINE MECHANICAL

3. Inspection of valve stem-to-guide bush oil clearance

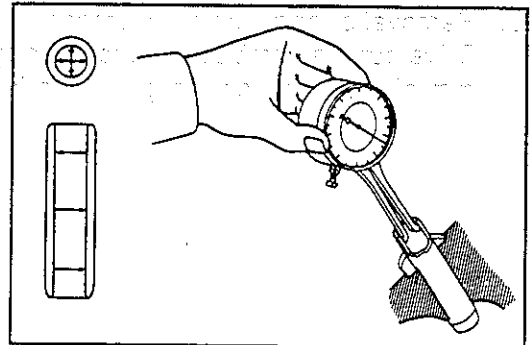
- (1) Using a caliper gauge, measure the inner diameter of the valve guide at six points.

Record the measured values.

Specified Value:

IN: 9.010 - 9.030 mm

EX: 9.010 - 9.030 mm



WRE91-EM059

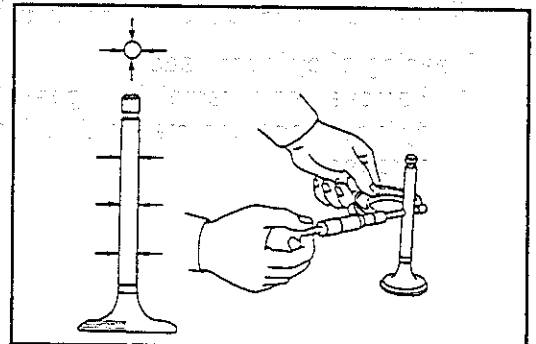
- (2) Using a micrometer, measure the diameter of the valve stem at six points.

Record the measured values.

Specified Value:

IN: 8.968 - 8.984 mm

EX: 8.934 - 8.950 mm



WRE91-EM060

- (3) Calculate the valve stem-to-guide bush oil clearance from the measured results in the steps (1) and (2) above.

a: Measured maximum value of guide bush

b: Measured minimum value of valve stem

$a - b = \text{Oil clearance}$

Oil Clearance:

Specified Value:

IN: 0.026 - 0.062 mm

EX: 0.044 - 0.096 mm

Allowable Limit:

IN: 0.10 mm

EX: 0.12 mm

WRE91-EM062

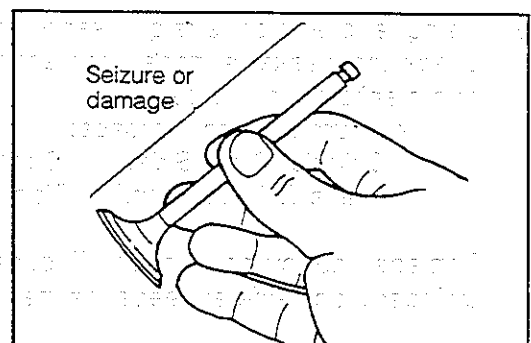
4. Inspection of intake and exhaust valve

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

NOTE:

- If seizure or damage is found, replace the valve and valve guide bush a set.

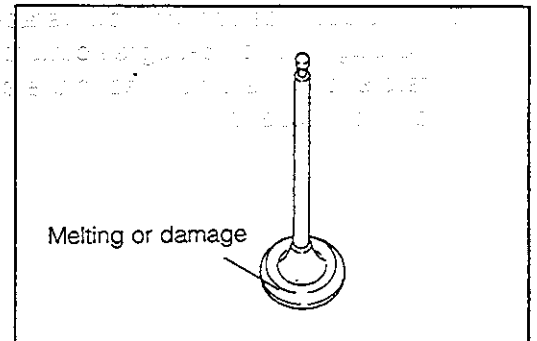
However, this replacement should be performed only after the checks for the cylinder head have been finished.



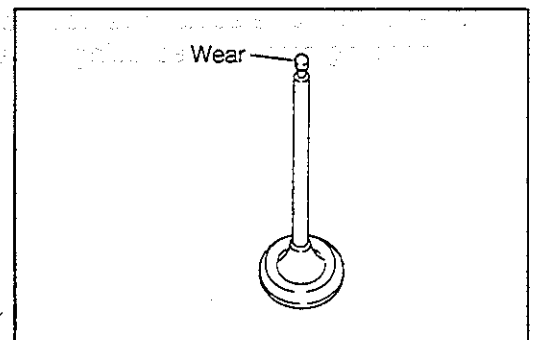
WRE91-EM063

- The valve guide bush hole must be used for refacing only valve seat.
Hence, if the valve guide bush hole exhibits any roughness due to seizure, etc., rectify the hole with an adjustable reamer.

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



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

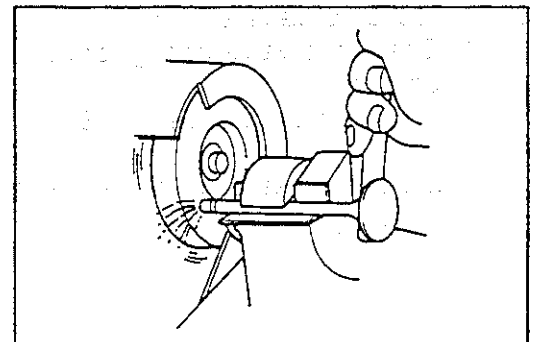


If the valve stem end exhibits abnormal wear, correct the stem end with valve refacer.
However, this correction should be made within a limit from that of standard length.

Standard Length:

IN: 127.5 mm

EX: 127.5 mm

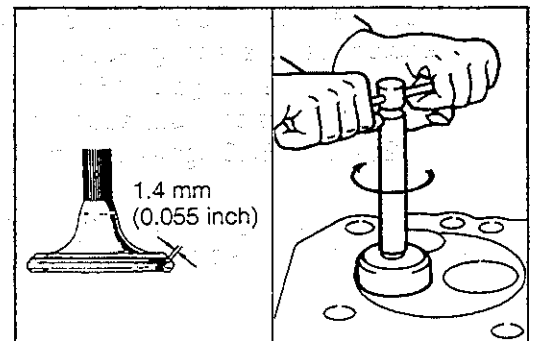


Refacing of valve seats

- ① Apply a film of red lead to the valve seat.
Then, let the valve drop on to the valve seat two or three times by its own weight.
Care must be exercised not to turn the valve during this check.

Specified Seat Width: 1.4 mm (0.055 inch)

- ② Cut the seat surface, using a 45-degree cutter.

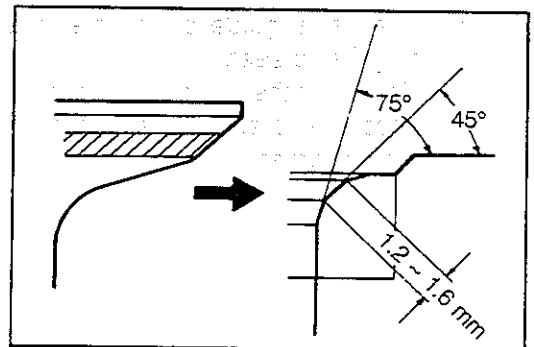


ENGINE MECHANICAL

5. Correction of seat position

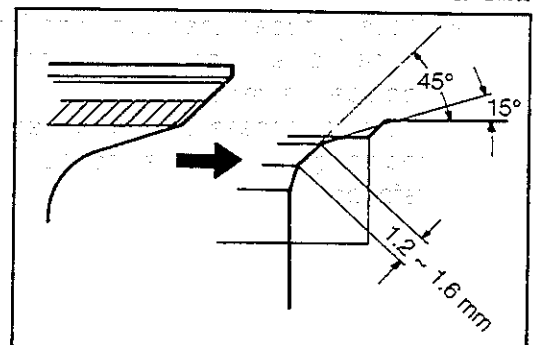
- (1) If the seat position is too high, reface the valve seat, using 45-degree and 75-degree cutters.

These valve seat cutters should be employed in the sequence as indicated by the illustration.



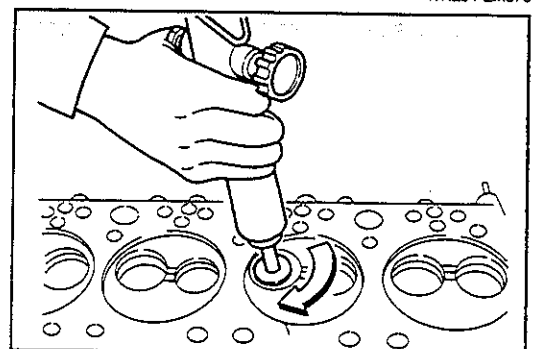
WRE91-EM069

- (2) If the seat position is too low, reface the valve seat, using 45-degree and 15-degree cutters. These valve seat cutters should be employed in the sequence as indicated by the illustration.



WRE91-EM070

- (3) After the valve seats have been refaced, carry out hand grinding of the valves, using valve grinding compound.



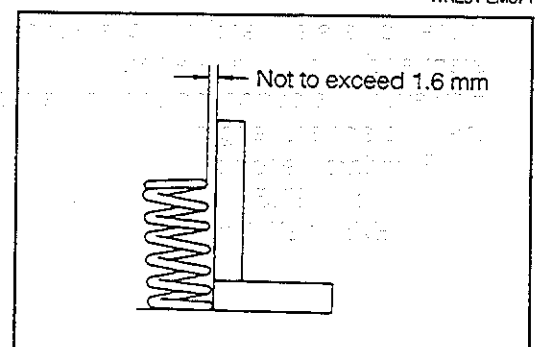
WRE91-EM071

6. Inspection of valve spring

- (1) Check the valve spring for squareness, using a steel square.

Maximum Squareness: 1.6 mm

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



WRE91-EM072

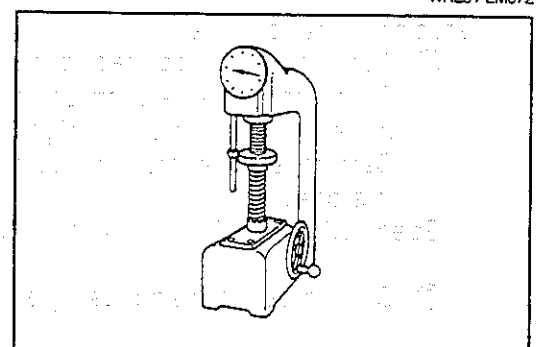
- (2) Measure the valve spring for free length and spring tension, using a spring tester.

Minimum Free Length: 46 mm

Minimum Tension Installation Height:

264.8 N (27.0 kgf)/40.1 mm

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

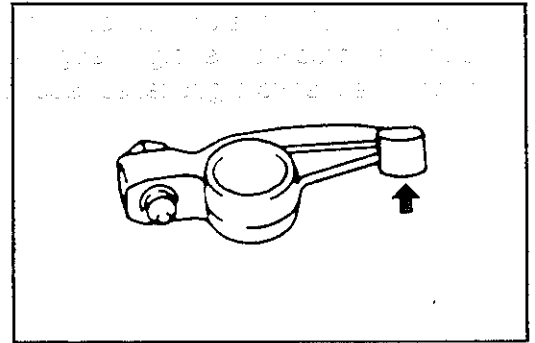


WRE91-EM073

7. Inspection of valve rocker arm and valve rocker shaft

- (1) Visually inspect the valve rocker arm for cracks, seizure or wear.

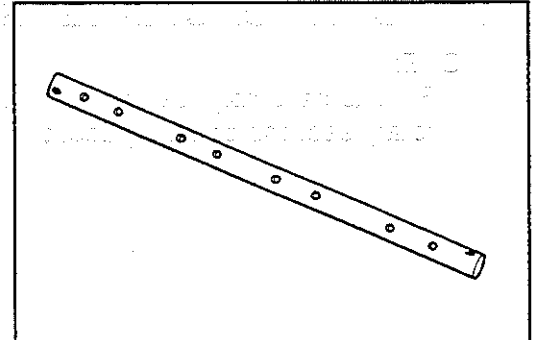
Replace the valve rocker arm, if necessary.



WRE91-EM074

- (2) Visually inspect the valve rocker shaft for cracks, seizure or wear.

Replace the valve rocker shaft, if necessary.

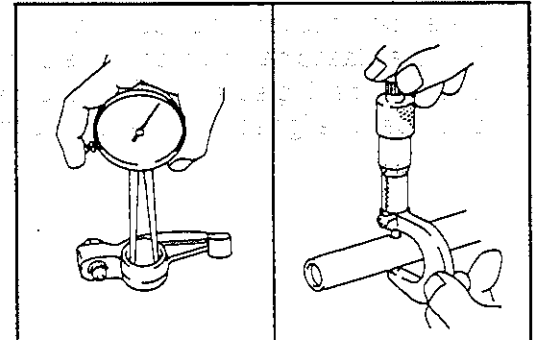


WRE91-EM075

- (3) Check valve rocker shaft-to valve rocker arm

- ① Using a dial gauge, measure the inner diameter of the valve rocker arm in two directions, 90 degrees apart from each other

Specified Value: 18.512 - 18.533 mm



WRE91-EM076

- ② Using a micrometer, measure the outer diameter of valve rocker shaft

Specified Value: 18.472 - 18.493 mm

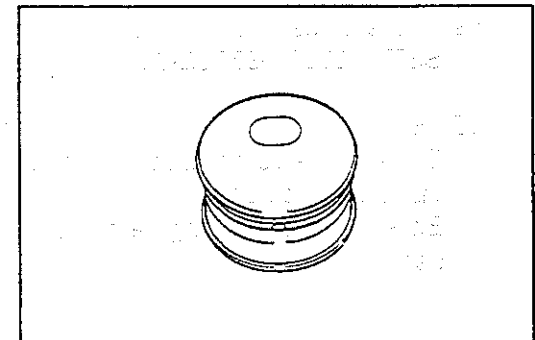
Oil Clearance: 0.022 - 0.733 mm

Limit: 0.1 mm

WRE91-EM078

8. Inspection of combustion chamber

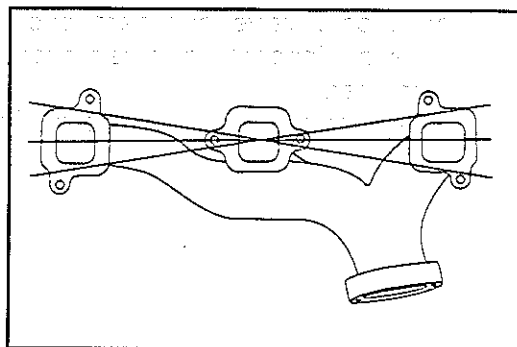
- (1) Visually inspect the combustion chamber for cracks or damage



WRE91-EM079

ENGINE MECHANICAL

9. Inspection of intake and exhaust manifolds
Using a precision straight edge and thickness gauge, check the manifold gasket surface for warpage.



WRE91-EM080

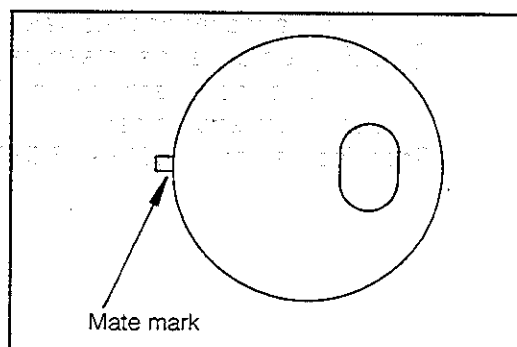
INSTALLATION OF CYLINDER HEAD

NOTE:

- Prior to assembly, be certain to apply engine oil to the rotary sections or sliding sections of the parts.

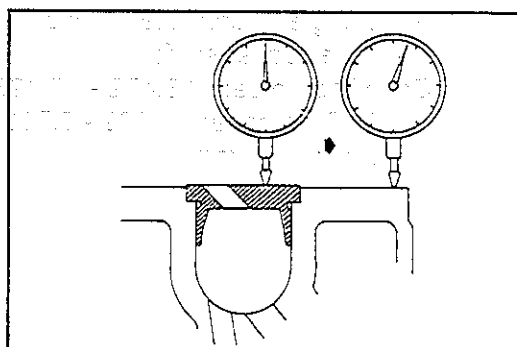
WRE91-EM081

1. Install combustion chamber into cylinder head.
Using a plastic hammer, drive the combustion chamber into position, making sure that the mate mark of the combustion chamber is aligned with that on the cylinder head side.



WRE91-EM082

2. Measure the chamber projection height.
Specified Projection Height: 0 - 0.10 mm

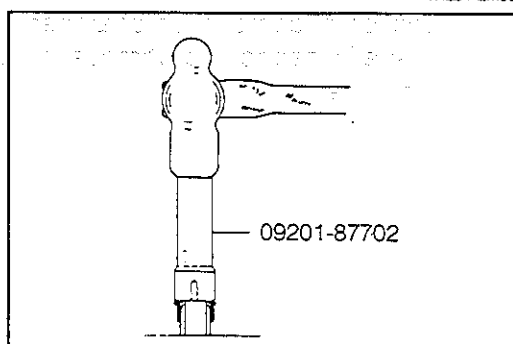


WRE91-EM083

3. Install the oil seal, using the following SST.
SST: 09201-87702-000

NOTE:

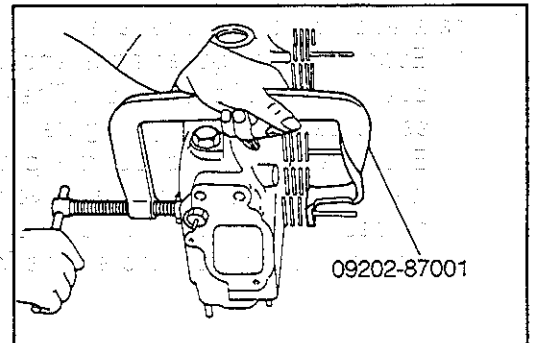
- Once the valve has been removed, be sure to install new valve stem oil seal.
- Be sure to apply engine oil to the lip section of the oil seal.



WRE91-EM084

4. Assemble the parts given below, using the following SST.
SST: 09202-87001-000

- (1) Valve
- (2) Valve spring
- (3) Valve spring retainer
- (4) Valve spring retainer lock

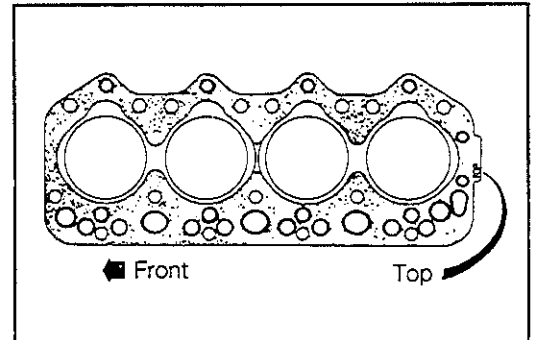


WRE91-EM085

5. Install the cylinder head gasket with its "Top" mark facing upward.

NOTE:

- If the cylinder head gasket should be installed upside down, it would cause the oil passages to be clogged, thereby causing engine seizure.
- Be sure to replace the gasket with a new one.

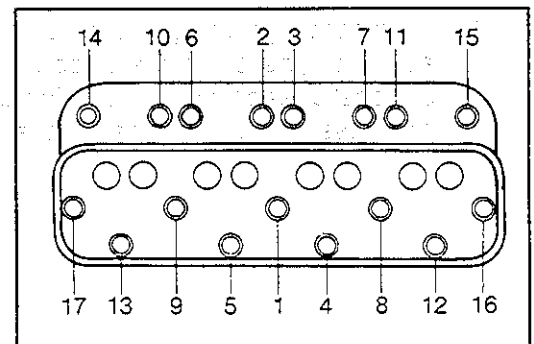


WRE91-EM086

6. Install the cylinder head.

- (1) Apply engine oil to the threaded portion and seating surface of each bolt.
- (2) Tighten the cylinder head bolts progressively in the sequence as indicated by the illustration.

Tightening Torque: $117.7 \pm 9.8 \text{ N}\cdot\text{m}$
($12.0 \pm 1.0 \text{ kgf}\cdot\text{m}$)



WRE91-EM087

7. Install the push rods.

NOTE:

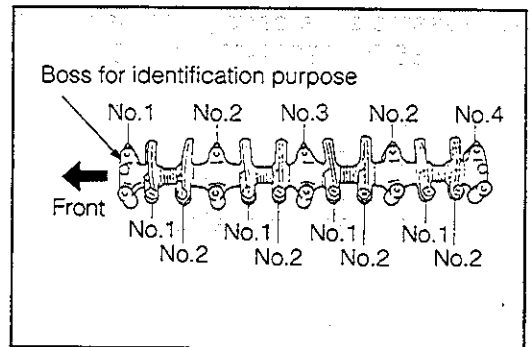
- Those valve push rods which have been stored in order should be installed as a set to the original cylinder, respectively.

ENGINE MECHANICAL

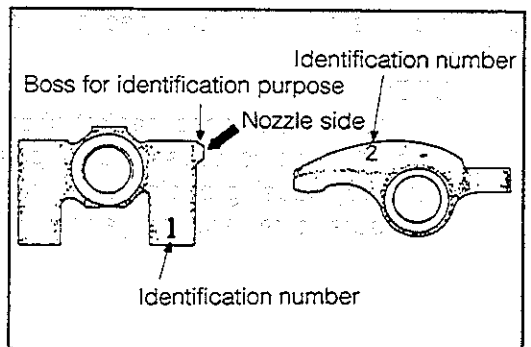
8. Installation of valve rocker shaft.

- (1) Each of valve rocker arms and valve rocker supports bears an identification mark. They should be assembled as indicated in the right figure.

Every valve rocker support is provided with a boss for identification purpose. The valve rocker support should be assembled in such a way the boss comes at the left side as viewed from the engine front side.

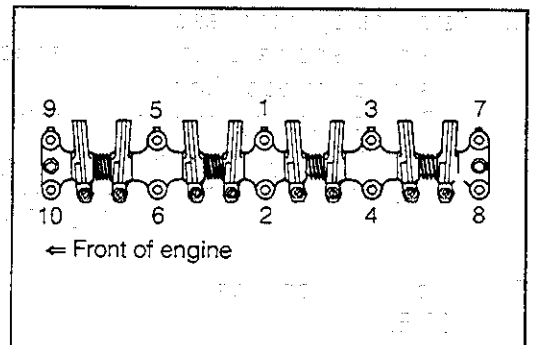


WRE91-EM088



WRE91-EM089

- (2) As for the tightening of the valve rocker supports, first apply engine oil to the threaded portion and seating surface of each bolt. Then, tighten the attaching bolts progressively as indicated in the right figure.



WRE91-EM090

9. Initial setting of valve clearance

IN: 0.30 mm [COLD]

EX: 0.30 mm [COLD]

NOTE:

- After the engine has been assembled to the body, be sure to adjust the valve clearances again.
- As for the adjusting procedure, see the section under "Valve Clearances".

10. Install the intake and exhaust manifolds.

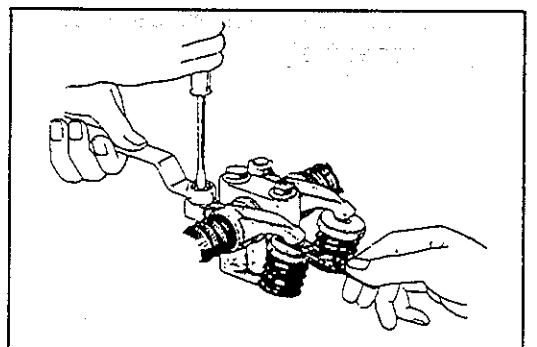
Tightening Torque:

Intake Manifold: 36.8 ± 7.4 N-m
(3.75 ± 0.75 kgf-m)

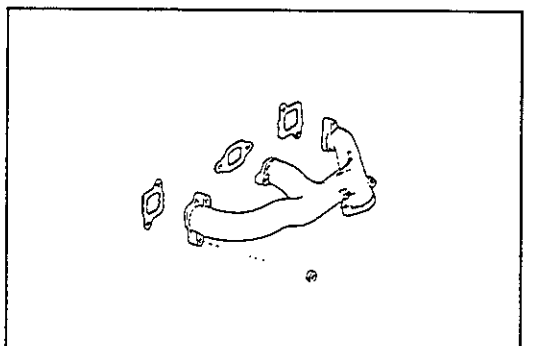
Exhaust Manifold: 46.6 ± 7.4 N-m
(4.75 ± 0.75 kgf-m)

NOTE:

- Be sure to replace the gaskets with new ones.
- On the turbo charged vehicle, be sure to install the turbo charger to the exhaust manifold before installing the exhaust manifold to the cylinder head.
(See the section under "Turbo Charger system.")



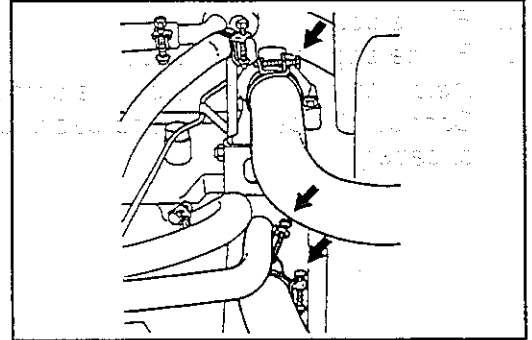
WRE91-EM091



WRE91-EM092

11. Install the water hoses.

- Water outlet hose
- Water by-pass hose
- Heater hoses
- Turbo charger cooling hose (DL 52 engine only)
- ACSD water hose (ACSD equipped vehicle only)

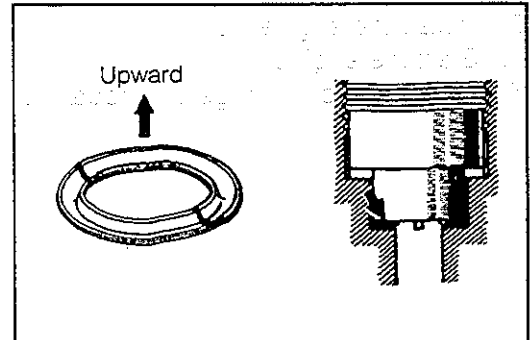


WRE91-EM093

12. Install the injection nozzle seat in the direction as indicated in the right figure.

NOTE:

- Be sure to check the gasket before installing the nozzle holder.

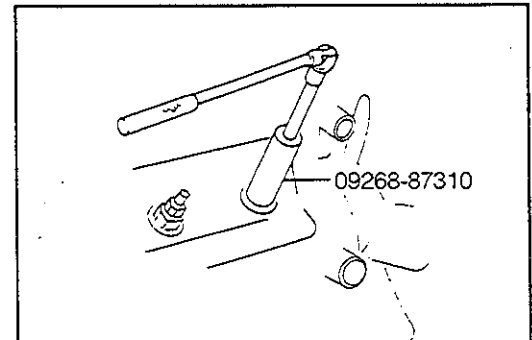


WRE91-EM094

13. Install the injection nozzle.

SST: 09268-87310-000

Tightening Torque: 68.6 ± 9.8 N·m
(7.00 ± 1.00 kgf·m)

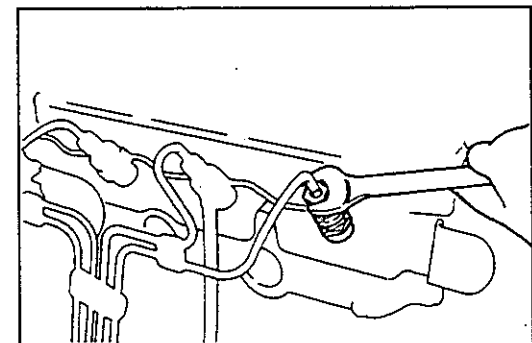


WRE91-EM095

14. Install the injection pipe.

Injection Pipe:

Tightening Torque: 24.5 ± 4.9 N·m
(2.50 ± 0.50 kgf·m)



WRE91-EM096

15. Install the glow plug connector and glow plug.

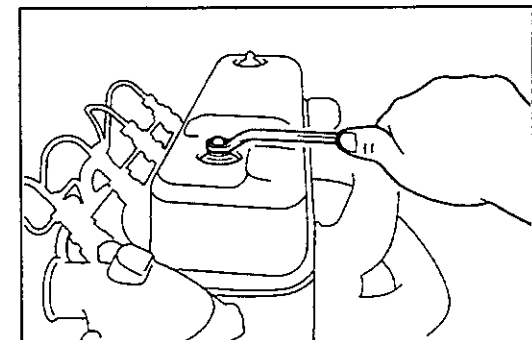
16. Install the cylinder head cover.

17. Install the water outlet housing.

NOTE:

- Be sure to replace the gasket with a new one.

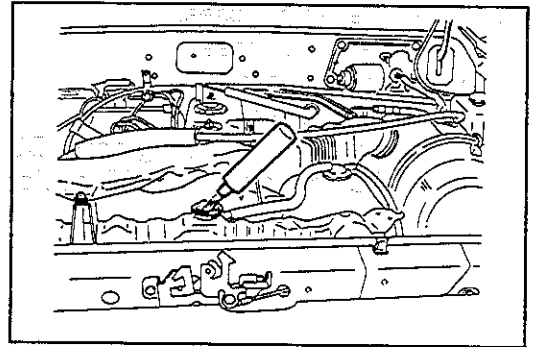
18. Install the water by-pass hose.



WRE91-EM097

ENGINE MECHANICAL

19. Fill the coolant.
20. Fill the engine oil and check it.
21. Install the battery in the engine compartment.
22. Connect the battery ground cable to negative (-) terminal of battery.



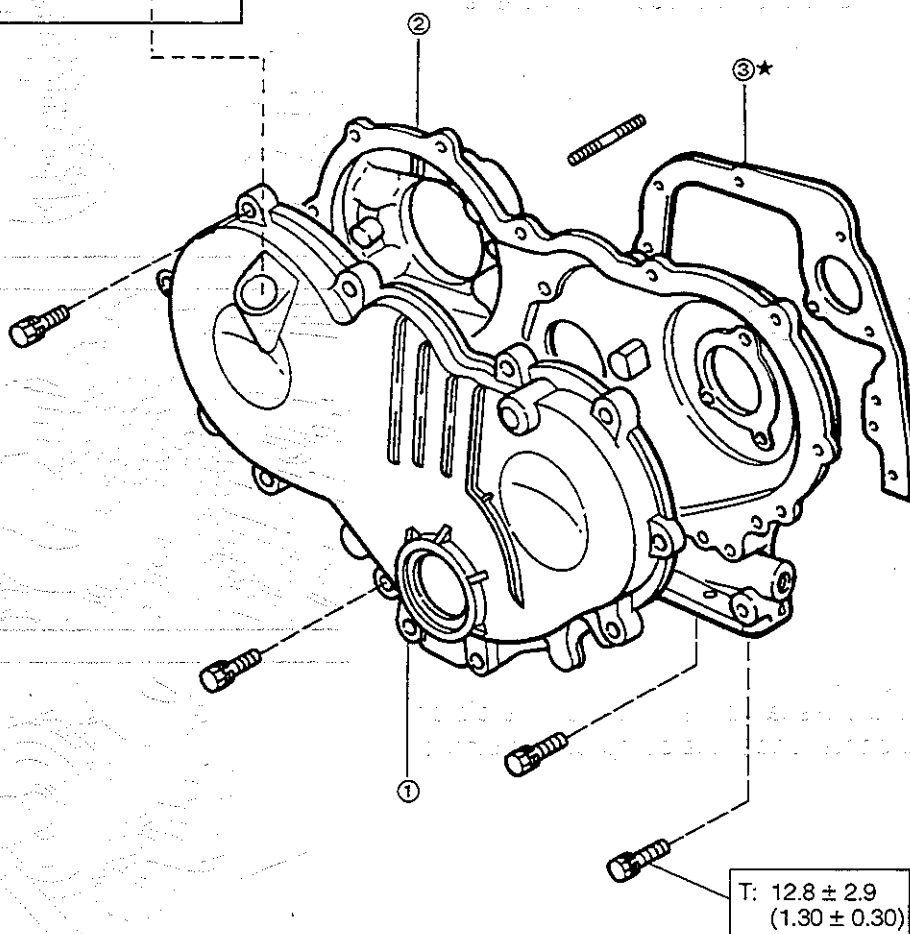
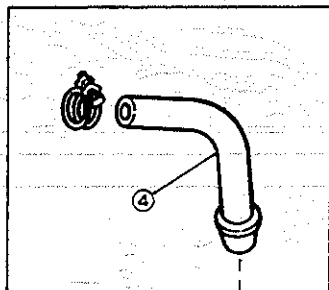
WRE91-EM098

23. Install the engine hood.
24. Start the engine.
25. Check the oil leakage and repair it.

WRE91-EM099

TIMING BELT COVER AND CASE COMPONENTS

General specification



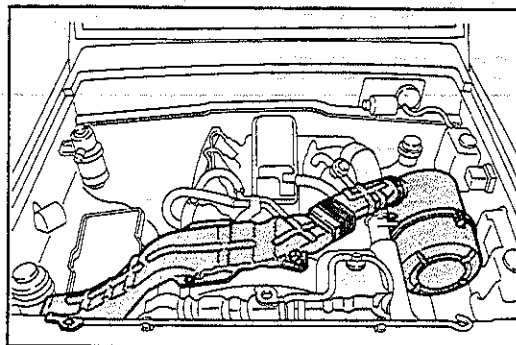
- ① Timing belt cover
- ② Timing belt case
- ③ Timing belt case gasket
- ④ Ventilation tube

★ : Non-reusable part
T : Tightening torque
Unit : N·m (kgf·m)

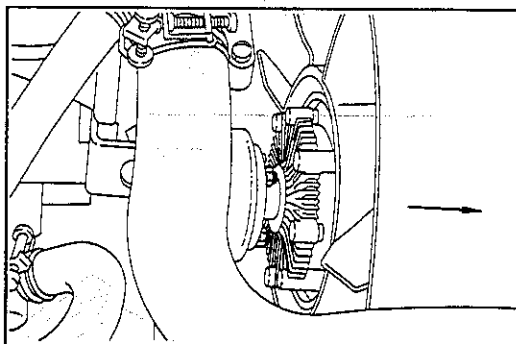
ENGINE MECHANICAL

REMOVAL OF TIMING BELT AND PULLEY

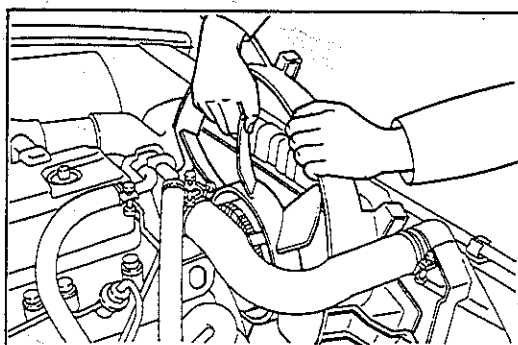
1. Remove the cool air intake duct from air cleaner.
 2. Remove the reserve-tank.
 3. Temporary remove the fluid coupling with fan by loosen four nuts.
 4. Remove the fan shroud and the fluid coupling with the fan.
 5. Loosen the alternator attaching bolt.
 6. Remove the fan pulley and V-belt.
 7. Remove the glow plug No. 1.
 8. Before pulling out the crankshaft pulley, position the piston No. 1 at the top dead center under the compression stroke.
 9. Remove the crankshaft pulley.
- NOTE:**
- Place the gear shift lever in the 5-th gear position so as to prevent the rotation of crankshaft.



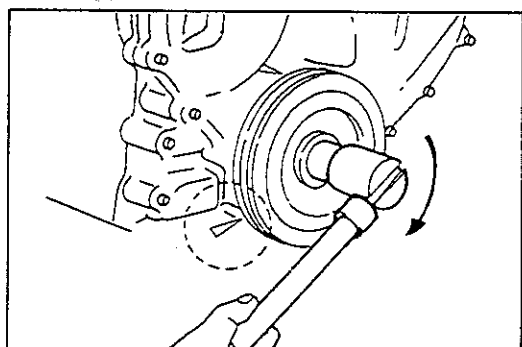
WRE91-EM101



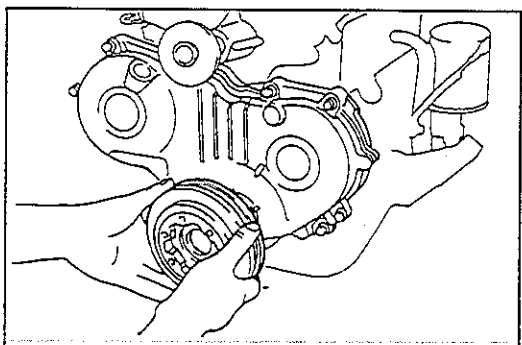
WRE91-EM102



WRE91-EM103

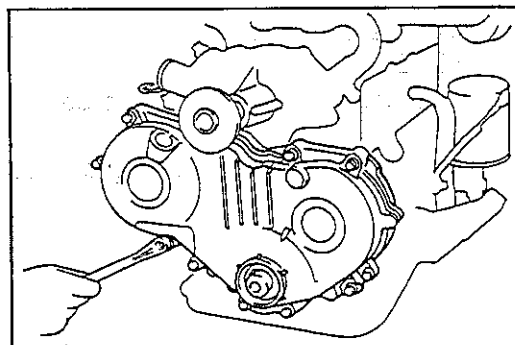


WRE91-EM104



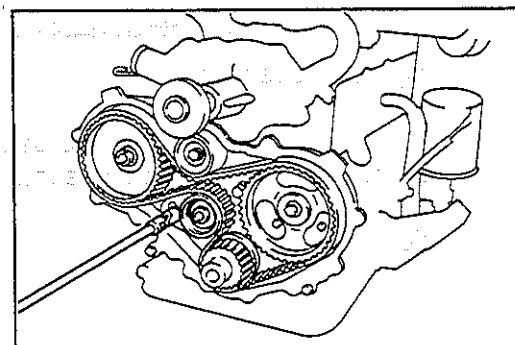
WRE91-EM105

10. Remove the timing belt cover.



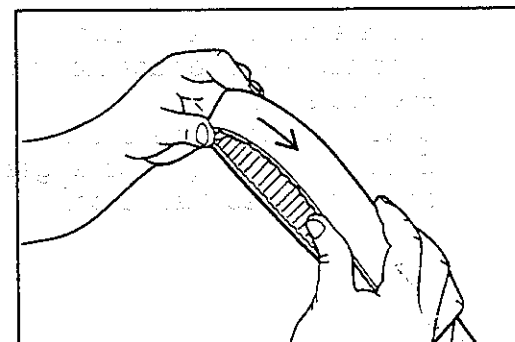
WRE91-EM106

11. Slacken the timing belt tensioner.



WRE91-EM107

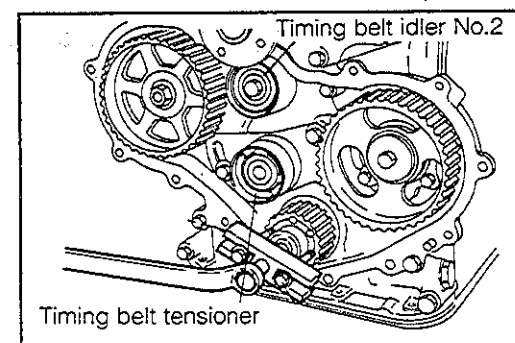
12. Mark the rotation direction on the back side of the timing belt. Then, remove the timing belt.



WRE91-EM108

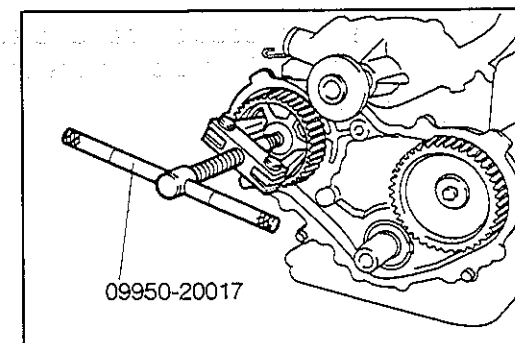
13. Remove the crankshaft timing belt pulley, using the following SST in combination with M6 bolts.
SST: 09213-31021-000 (M6 bolt)

14. Remove the timing belt tensioner and timing belt idler No. 2.



WRE91-EM109

15. Remove the injection timing belt pulley.
SST: 09950-20017-000



WRE91-EM110

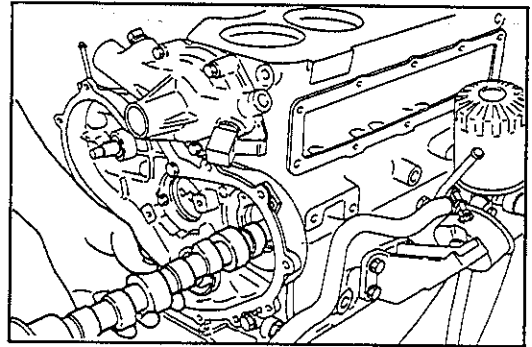
ENGINE MECHANICAL

16. Remove the valve lifters.

NOTE:

- Store the valve lifters in order.

17. Remove the camshaft timing belt pulley with camshaft.



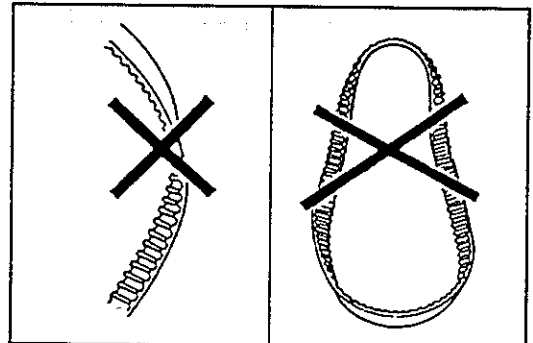
WRE91-EM111

INSPECTION OF COMPONENTS

1. Timing belt inspection

CAUTION:

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



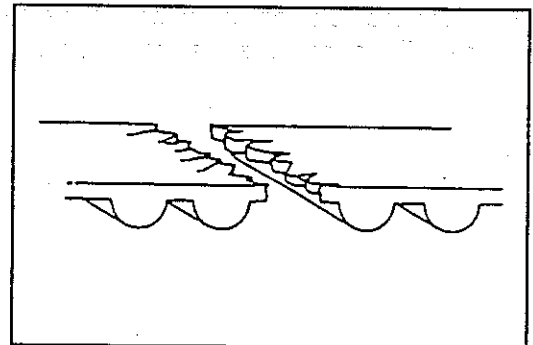
WRE91-EM112

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

- (1) Premature separation

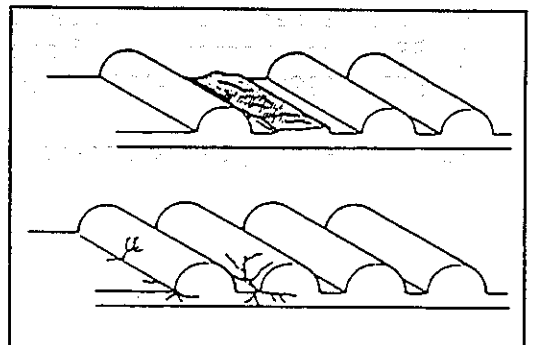
Check for proper installation.

Check the timing gear cover gaskets for damage and check for correct installation.



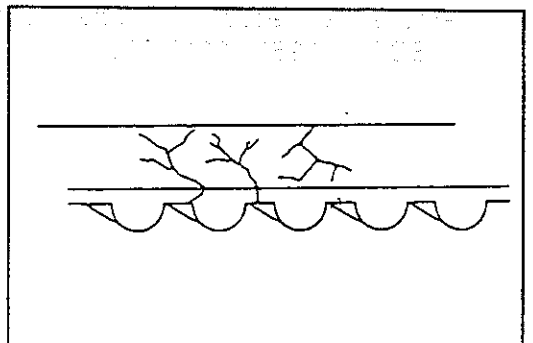
WRE91-EM113

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



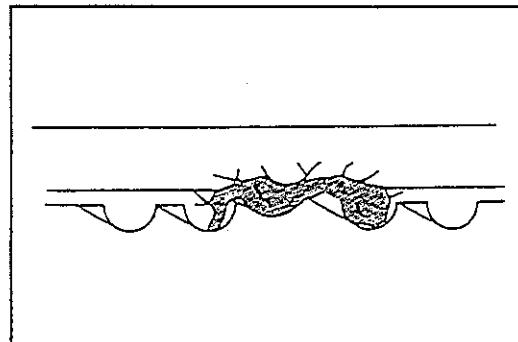
WRE91-EM114

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



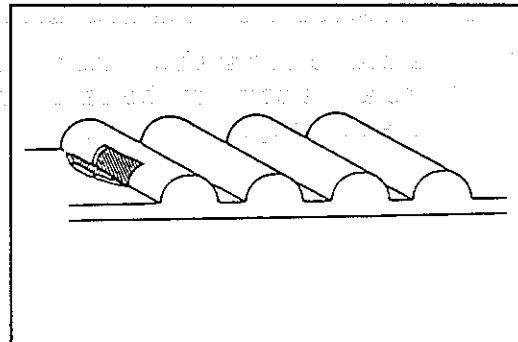
WRE91-EM115

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



WRE91-EM116

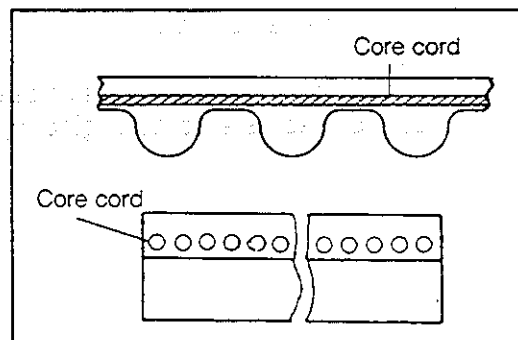
- (5) If there is noticeable wear on the belt teeth, check the timing cover gasket for damage and check for correct gasket installation. Check for foreign material on the pulley teeth.



WRE91-EM117

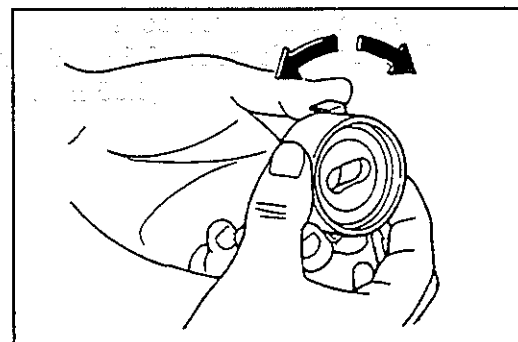
Timing Belt Specifications:

Engine type		DL 42-52
Item		
Pitch peripheral length	(mm)	1028.7
Pitch	(mm)	9.525
Number of teeth		108
Belt width	(mm)	31.8
Belt thick	(mm)	5.4



WRE91-EM118

2. Timing belt tensioner inspection
- Check the timing belt tensioner for smooth turning.
 - Check the belt contact surface for damage.
- If necessary, replace the timing belt tensioner.
- CAUTION:**
- Never wash the timing belt tensioner.



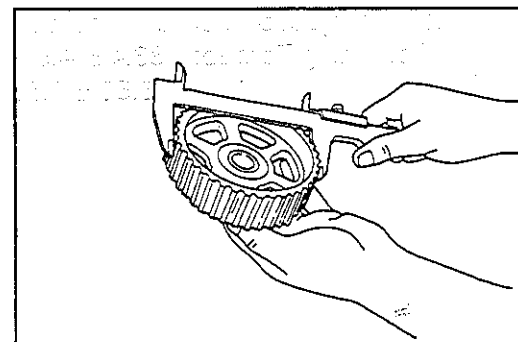
WRE91-EM119

3. Inspection of timing belt pulley

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

Specified Value:

Component	Item	Outer diameter (mm)	Pulley width (mm)	Number of teeth
Crankshaft timing pulley		59.37	33	20
Camshaft timing pulley		119.95	36	40
Injection pump pulley		119.904	36	40



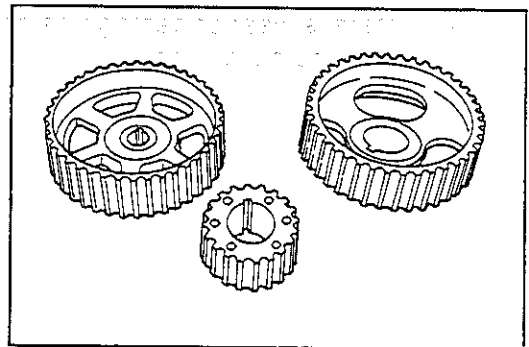
WRE91-EM120

ENGINE MECHANICAL

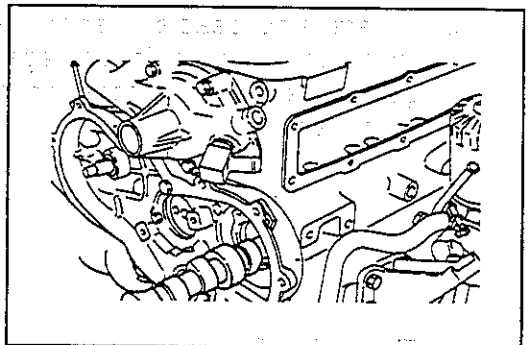
INSTALLATION OF TIMING BELT

1. Installation of camshaft with the camshaft timing belt pulley.

- (1) Install the camshaft, be careful not to damage the camshaft bearings.



WRE91-EM121

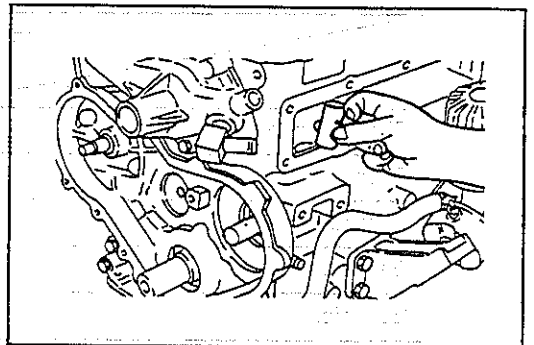


WRE91-EM122

- (2) Install the valve lifter.

NOTE:

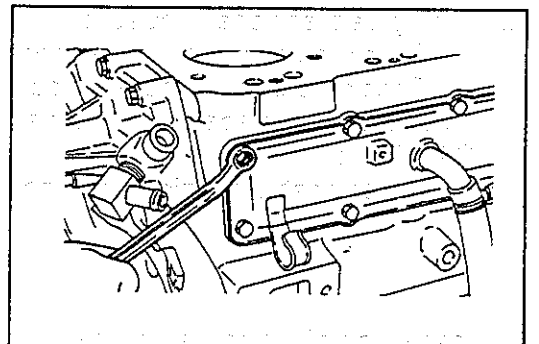
- Those valve lifters which have been stored in order should be installed as a set to original cylinders, respectively.



WRE91-EM123

- (3) Install the push rod cover.

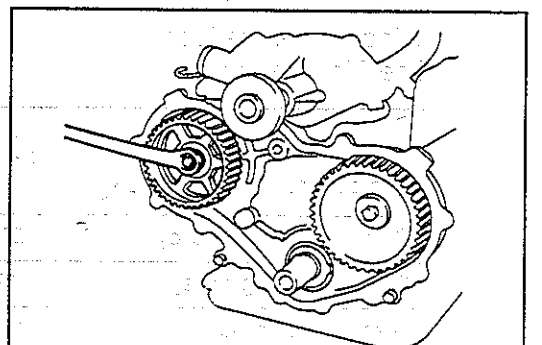
Tightening Torque: 9.3 ± 2.5 N·m
(0.95 ± 0.25 kgf·m)



WRE91-EM124

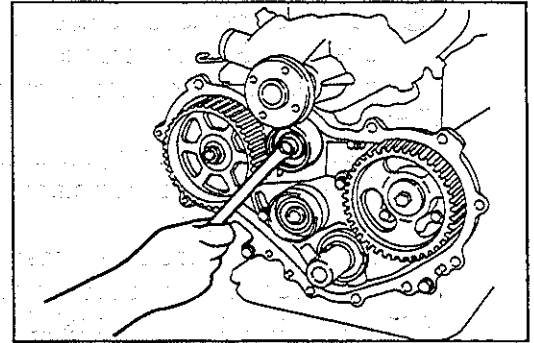
2. Install the injection pump timing belt pulley.

Tightening Torque: 83.4 ± 4.9 N·m
(8.50 ± 0.52 kgf·m)



WRE91-EM125

3. Install the timing belt idler No. 2.
4. Temporarily install the timing belt tensioner.

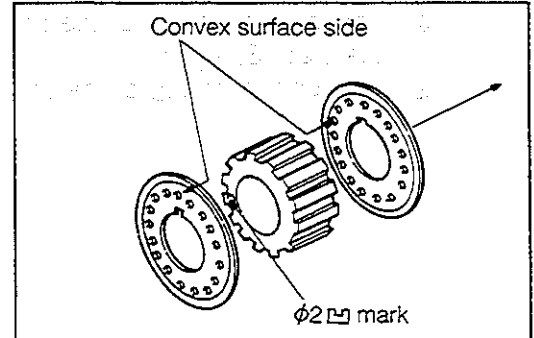


WRE91-EM126

5. Install the crankshaft timing belt pulley.

NOTE:

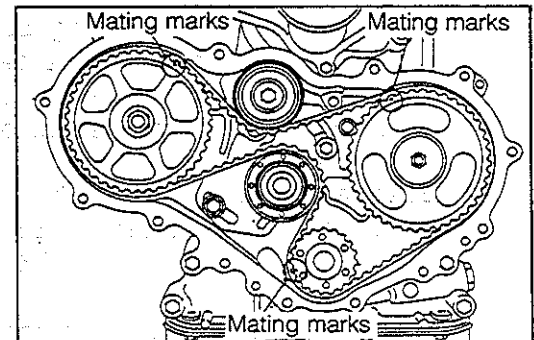
- The flange should be installed only in the correct installing direction.
- Be sure to install the crankshaft timing belt pulley in such a direction that the recessed mark stamped on the pulley comes at the front side.



WRE91-EM127

6. Adjustment of timing belt tension

- (1) Align each of the three mating marks of the timing belt pulleys for the crankshaft, camshaft and injection pump with each corresponding mark of the three mating marks on the timing belt case. Under this condition, the piston No. 1 is set to about 30 degrees before the top dead center.



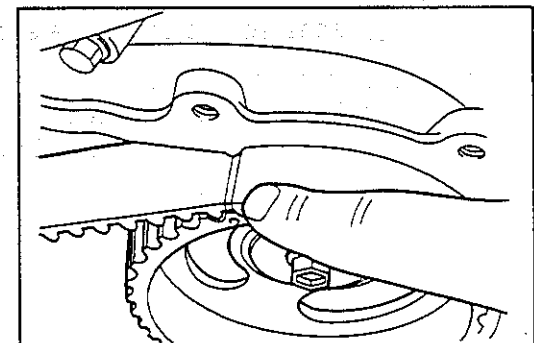
WRE91-EM128

- (2) Assembling of timing belt

Assemble the belt in such a way that the marks (yellow lines) at the back and side of the timing belt may come at the same position on the front.

NOTE:

- Be sure to displace the front end surface of the timing belt about 2 mm toward the timing belt case from the front end surface of each pulley.

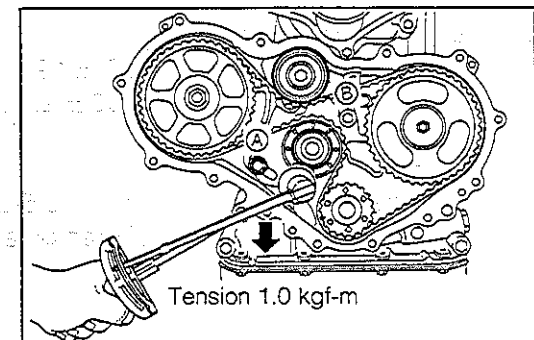


WRE91-EM129

- (3) Adjust timing belt tension.

- ① Insert a hexagonal wrench into the hexagonal hole of the timing tensioner. Tighten the bolt ① of the timing tensioner by applying tension to the wrench at about 90 degrees.

Tension: 9.8 N-m (1 kgf-m)



WRE91-EM130

ENGINE MECHANICAL

- ② Turn the crankshaft smoothly in the normal rotating direction. Stop the crankshaft at the third tooth from the mating mark of the camshaft pulley.

NOTE:

- Before securely tightening the attaching bolt of the timing tensioner, under no circumstance should the crankshaft be turned reversely.
- If the crankshaft should be turned reversely, back off the crankshaft one turn, or advance the crankshaft two turns and stop it at the normal position.

- ③ Loosen the bolt ① of the timing tensioner. Perform the step (3) again.
- ④ Tighten the bolt ② of the timing tensioner.

- ⑤ To check that the timing belt tension meets the specification, measure the deflection of the timing belt between the crankshaft timing belt pulley and the camshaft timing belt pulley when the specified pushing force is applied.

Specified Deflection: 1.8 mm

Specified Pushing Force: 18.6 ± 6.9 N
(1.9 ± 0.7 kgf-m)

If the measured deflection and pushing force do not meet the specification, perform the steps ① through ⑤ repeatedly to obtain the specified deflection.

7. Install the timing belt cover.

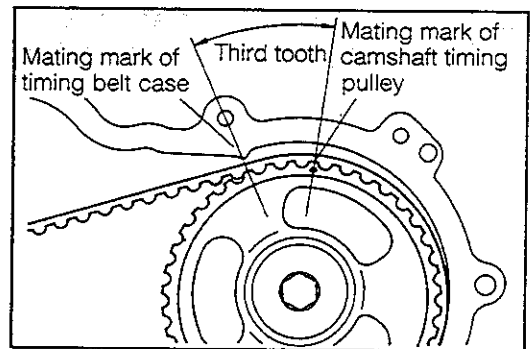
Tightening Torque: 18.1 ± 3.4 N-m
(1.85 ± 0.35 kgf-m)

8. Install the crankshaft pulley.

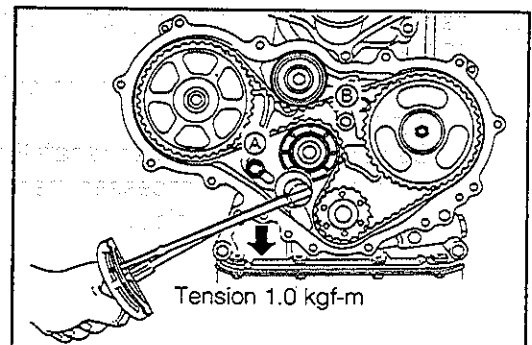
Tightening Torque: 215.7 ± 19.6 N-m
(22.00 ± 2.0 kgf-m)

NOTE:

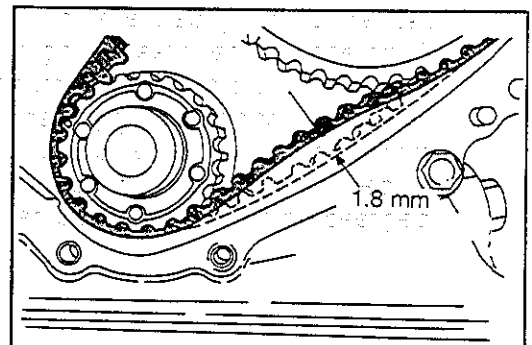
- Place the gear shift lever in the 5-th gear position so as to prevent the rotation of crankshaft.



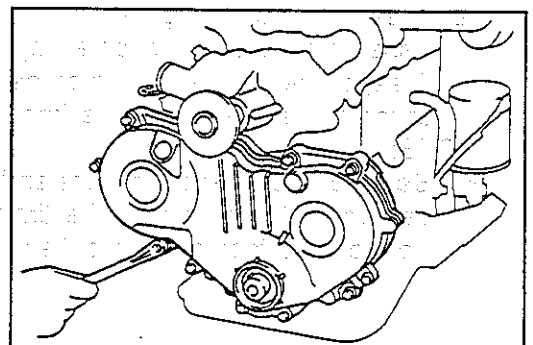
WRE91-EM131



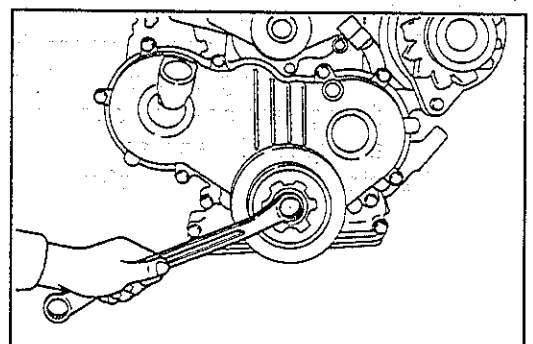
WRE91-EM132



WRE91-EM133



WRE91-EM134



WRE91-EM135

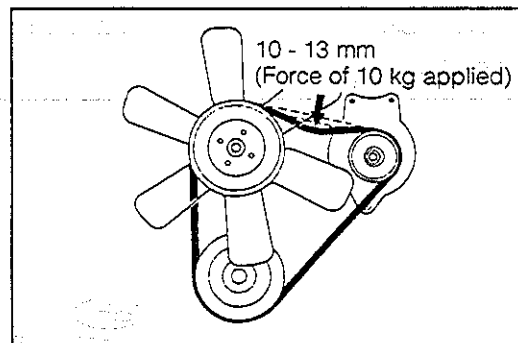
9. Install the radiator fan shroud.
10. Install the fan pulley and V-belt.
11. Install the fluid coupling with fan.

Specified V-belt Tension:

New belt: 10 - 13 mm

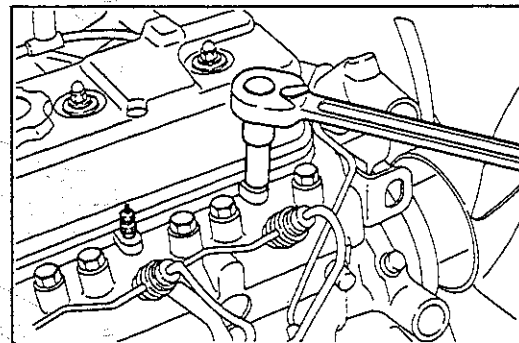
Used belt: 8 - 11 mm

[With a force of 98 N (10 kgf) applied]



WRE91-EM136

12. Install the glow plug.
Tightening Torque: 12.8 ± 2.9 N·m
(1.30 ± 0.3 kgf·m)

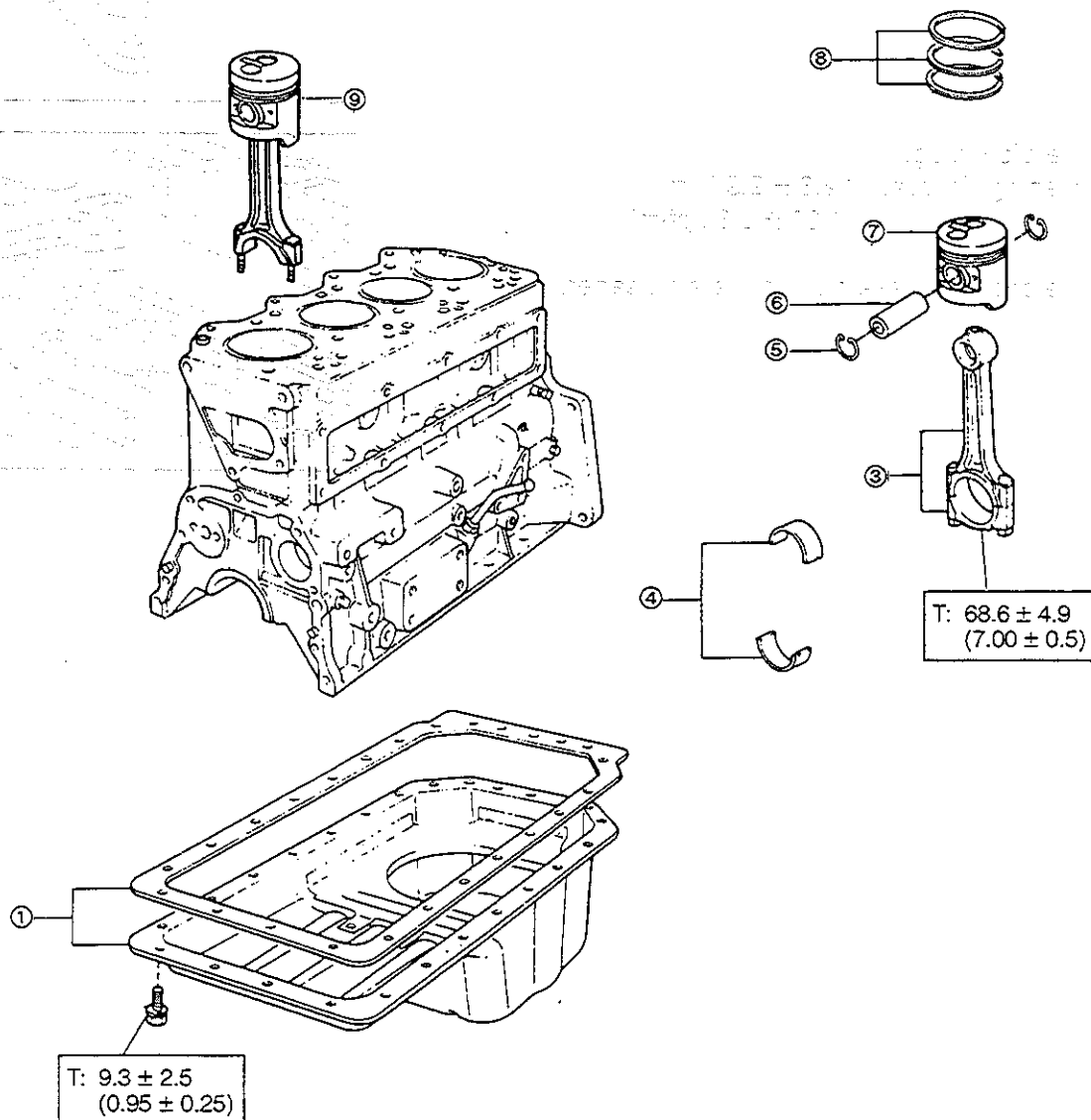


WRE91-EM138

13. Install the cool air intake duct in the air cleaner.

ENGINE MECHANICAL

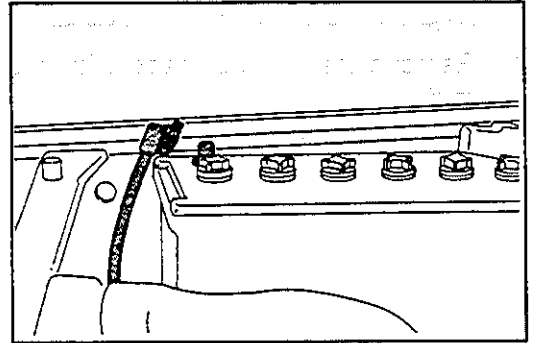
PISTON AND CONNECTING ROD COMPONENTS



T : Tightening torque
Unit : N·m (kgf·m)

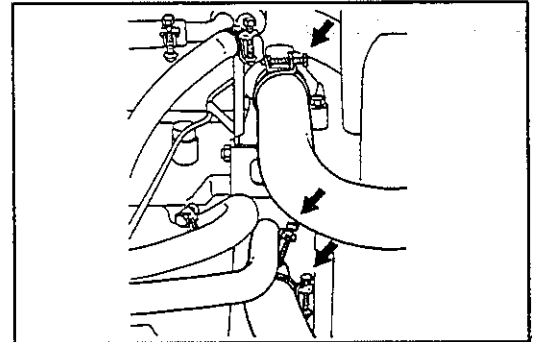
REMOVAL OF ENGINE ASSY

1. Drain the coolant and engine oil.
2. Remove the battery.



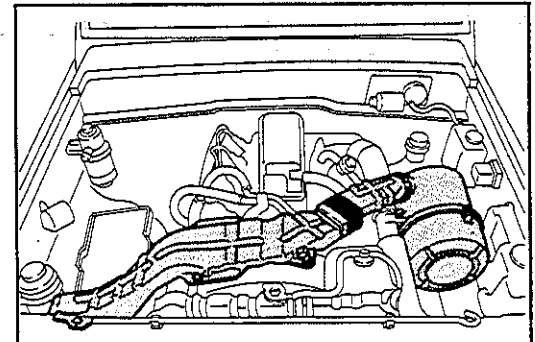
WRE91-EM350

3. Remove the engine hood.
4. Remove the air cleaner sub-assy.



WRE91-EM351

5. Remove the water hoses, radiator and cooling fan.
6. Disconnect the fuel pipes and hoses.



WRE91-EM352

7. Disconnect the engine harness.
8. Disconnect the exhaust pipe and temporary remove it.
9. Remove the transmission attaching bolts.
10. Disconnect the engine mounting.
11. Remove the engine assy by using chaine block.

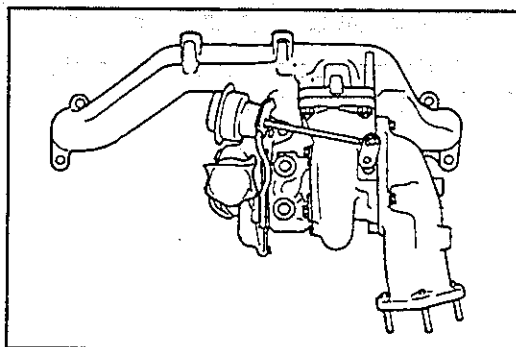
WRE91-EM353

ENGINE MECHANICAL

DISASSEMBLY OF CYLINDER BLOCK

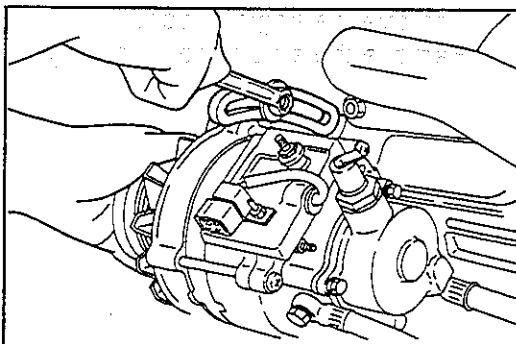
1. Remove the cylinder head with intake and exhaust manifold.

(See page EM-60.)



WRE91-EM141

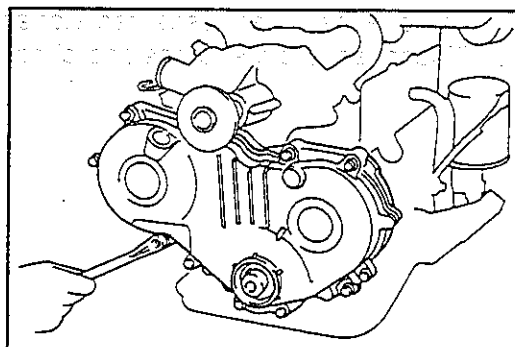
2. Remove the alternator.



WRE91-EM142

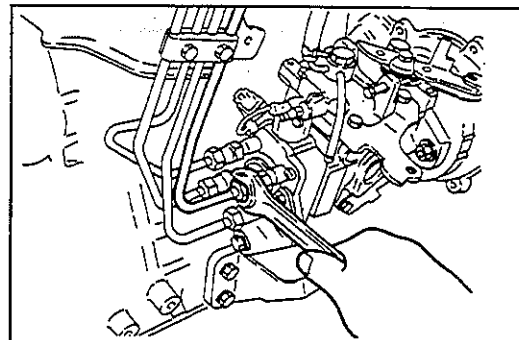
3. Remove the timing belt cover and the timing belt.

(See page EM-30.)



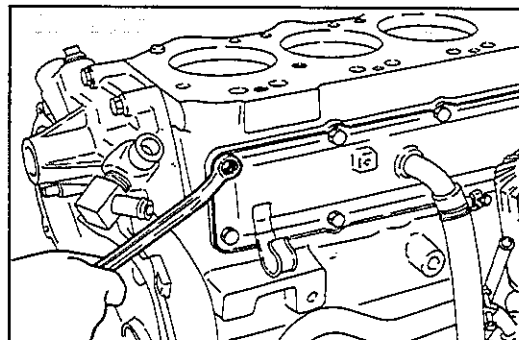
WRE91-EM143

4. Remove the injection pump.
(See page FU-6.)



WRE91-EM144

5. Removal of the camshaft.
(1) Remove the push rod cover.

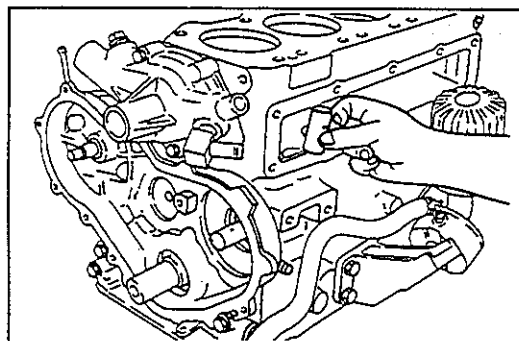


WRE91-EM145

- (2) Remove the push rod and the valve lifter.

NOTE:

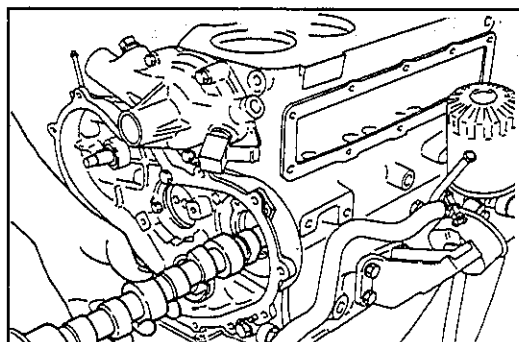
- Remove the parts in the sequence of cylinders.
- Store the removed parts properly so that they may not to be mixed with each other.



WRE91-EM146

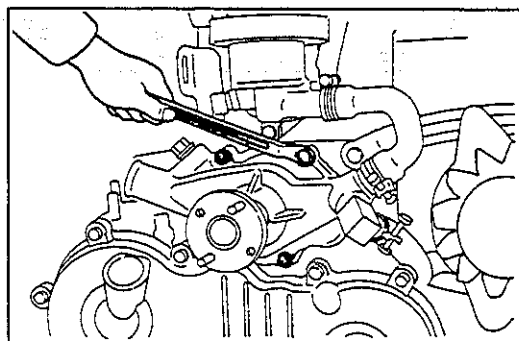
- (3) Remove the thrust plate attaching bolts.

- (4) Remove the camshaft with the camshaft timing belt pulley.



WRE91-EM147

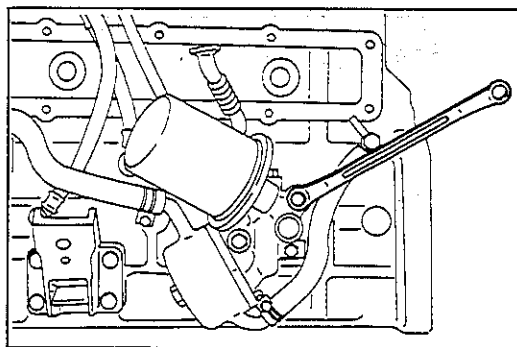
6. Remove the water pump by loosen four bolts.



WRE91-EM148

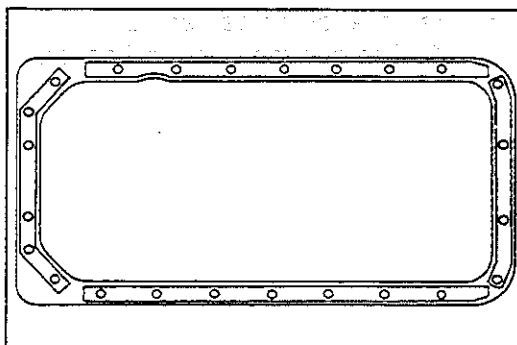
ENGINE MECHANICAL

7. Remove the oil filter bracket with oil filter.



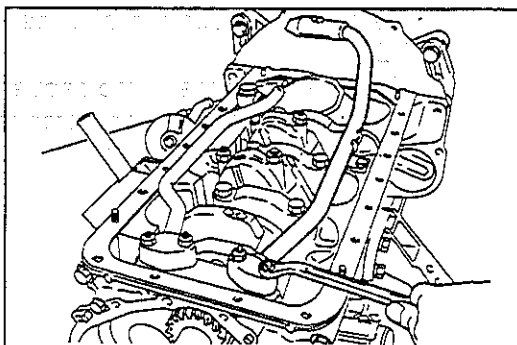
WRE91-EM149

8. Remove the oil pan by loosen 20 bolts and 4 nuts.



WRE91-EM150

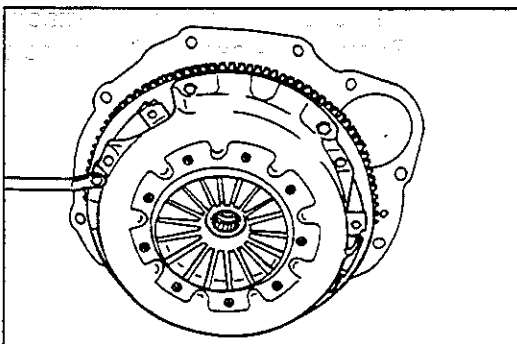
9. Remove the oil pipes.



WRE91-EM151

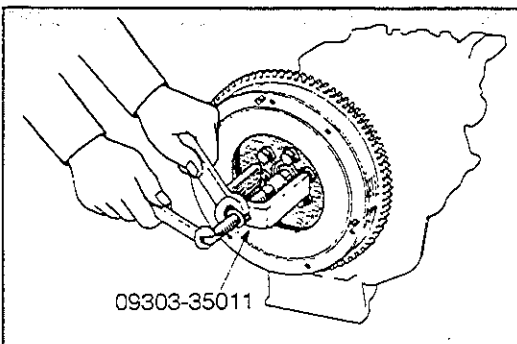
10. Remove the clutch cover.

11. Remove the clutch disc.



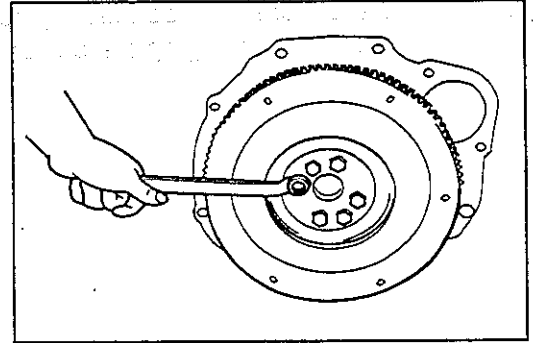
WRE91-EM152

12. Remove the bearing, using the SST.
SST: 09303-35011-000



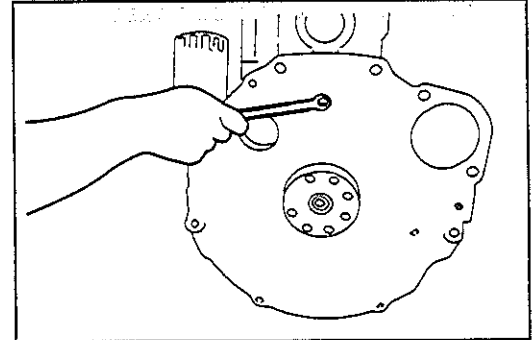
WRE91-EM153

13. Remove the flywheel.



WRE91-EM154

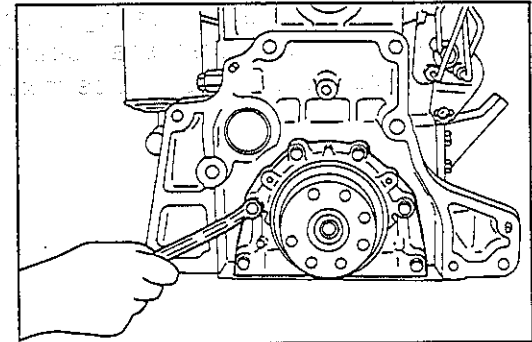
14. Remove the rear end plate.



WRE91-EM155

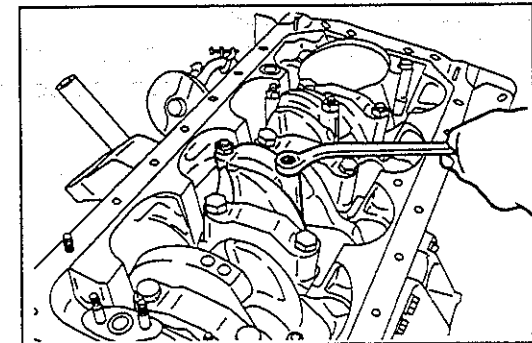
15. Remove the rear oil seal retainer.

16. Remove the oil seal.



WRE91-EM156

17. Remove the connecting rod bearing cap.

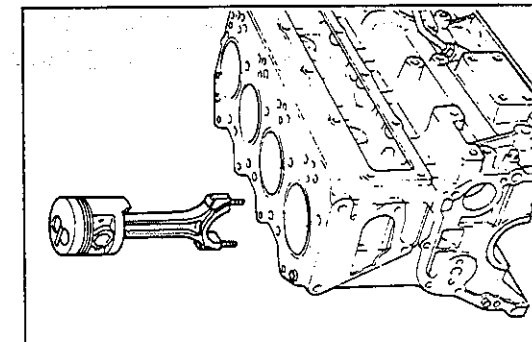


WRE91-EM157

18. Pull out the piston toward the cylinder head side.

NOTE:

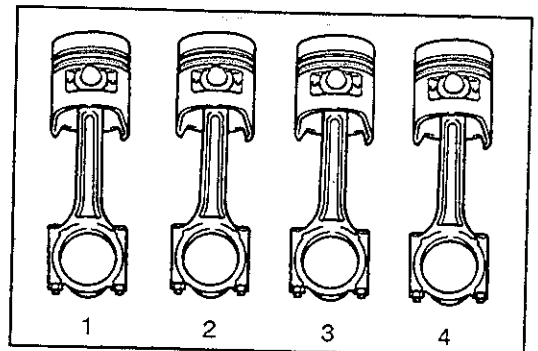
- When pulling out the piston, be very careful not to scratch the cylinder liner.



WRE91-EM158

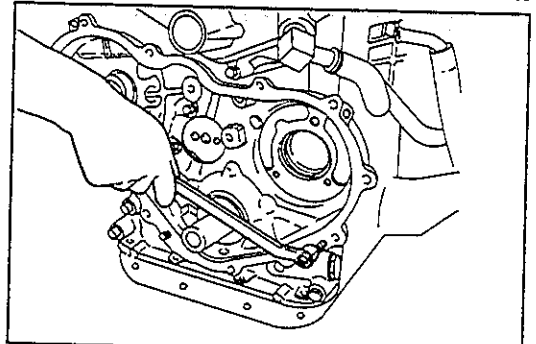
ENGINE MECHANICAL

19. Store the pistons and connecting rod caps in correct sequence without changing the correct combination of these parts.



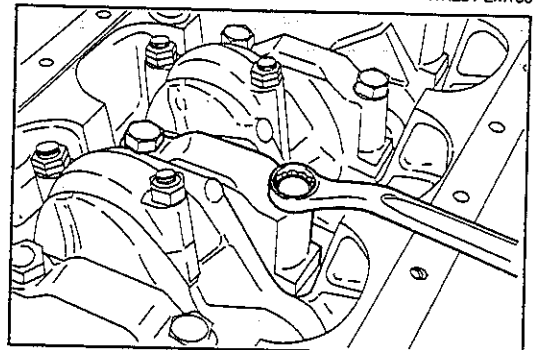
WRE91-EM159

20. Remove the timing belt case.



WRE91-EM160

21. Remove the crankshaft bearings. Remove the crankshaft. Place the removed crankshaft bearings in the correct sequence so that they may not be mixed with each other.

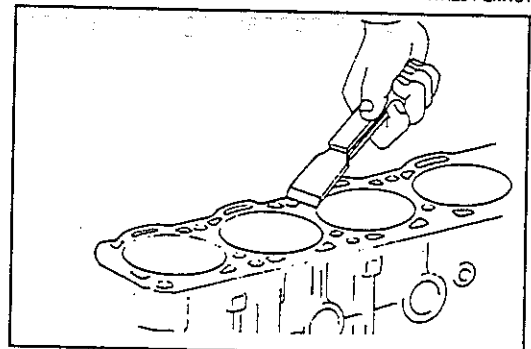


WRE91-EM161

22. Clean cylinder block.
(1) Remove all the gasket material from the top of the block.
(2) Blow carbon and oil from the bolt holes.

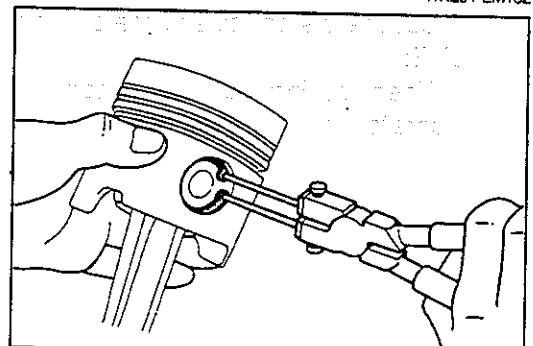
WARNING:

- Protect your eyes when using compressed air.



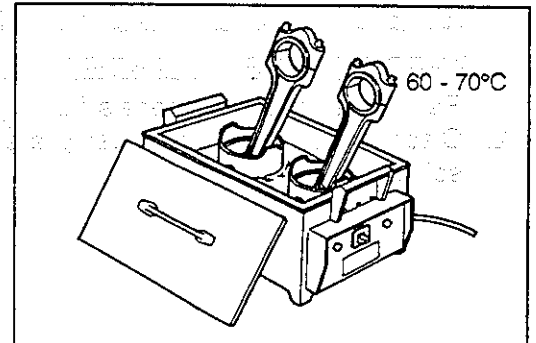
WRE91-EM162

23. Disconnect the connecting rod from piston.
(1) Remove the snap ring, using needlenose pliers.



WRE91-EM163

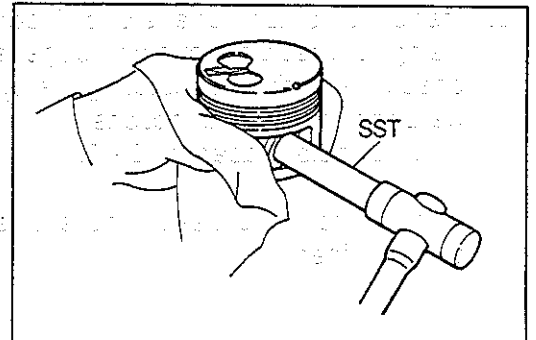
(2) Gradually heat the piston to about 60°C to 70°C.



WRE91-EM164

(3) Proceed to drive the piston pin by tapping it lightly, using a plastic hammer in combination with the following SST.

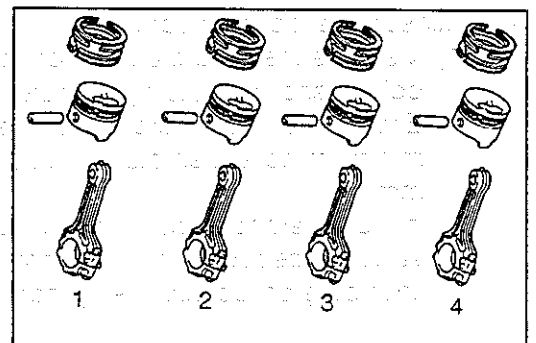
SST: 09221-87601-000



WRE91-EM165

NOTE:

- The piston and pin are a matched set.
- Keep the piston, pin, rings and connecting rod together for each cylinder.



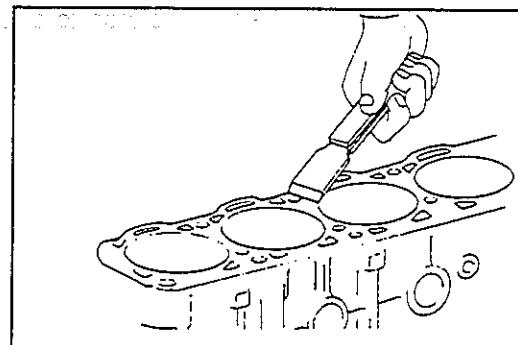
WRE91-EM166

ENGINE MECHANICAL

INSPECTION OF COMPONENTS

INSPECTION OF CYLINDER BLOCK

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

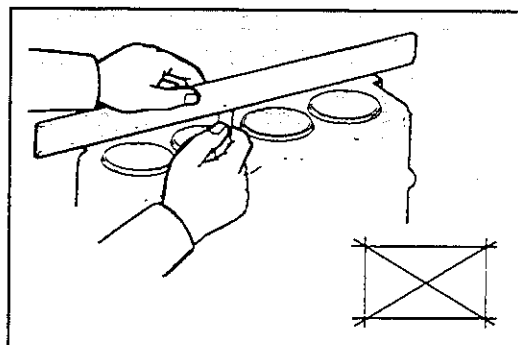


WRE91-EM167

3. Inspection of top surface of cylinder block
Using a precision straight edge and thickness gauge, check the surface contacting the cylinder head gasket for warpage in the six directions.

Allowable Warpage: 0 - 0.1 mm

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



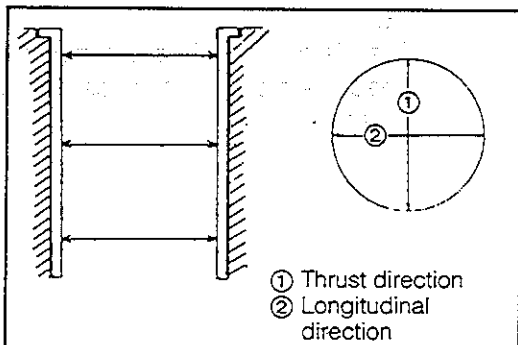
WRE91-EM168

4. Measurement of cylinder liners

- (1) Measure the bore diameter of each cylinder liner at 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.

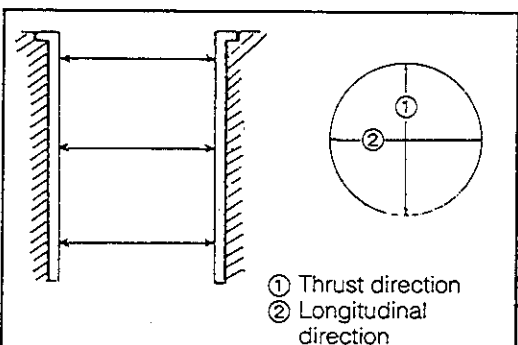
If the difference between the maximum and minimum values exceeds 0.1 mm, perform boring for the cylinder liner bore or replace the cylinder liner.



WRE91-EM169

- (2) Measure the bore diameter of each cylinder at a point shown in right figure. The measured value is regarded as cylinder bore diameter.

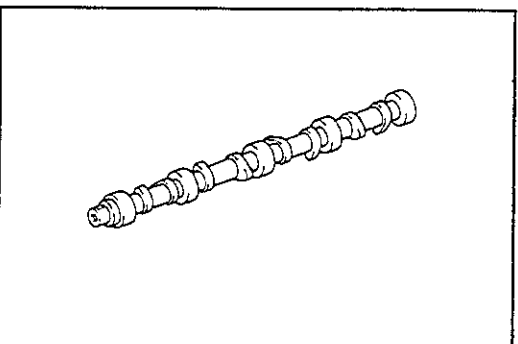
Specified Bore Diameter: 92.00 - 92.03 mm



WRE91-EM170

INSPECTION OF CAMSHAFT

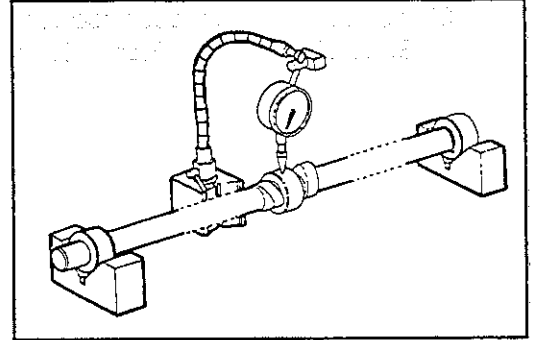
1. Visually inspect the camshaft for wear or damage.
Replace the camshaft if the cam surface and/or journal section exhibits any wear and damage.



WRE91-EM171

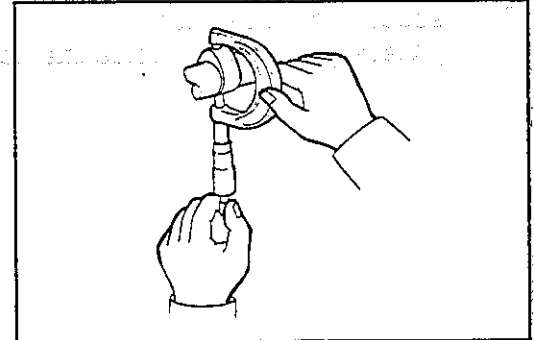
2. Inspection camshaft for runout
Support the camshaft at its both ends with V-shaped blocks.
Set a dial gauge to mid-point of center journal section of camshaft.
Turn the camshaft one turn, making sure that camshaft will not move in the axial direction. Take a reading on dial gauge during the turning.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

Maximum Runout: 0.05 mm



WRE91-EM172

3. Inspection of cam lobe height
Measure the cam lobe height, using a micrometer.
Specified Cam Lobe Height
IN-EX: 37.717 - 37.817 mm

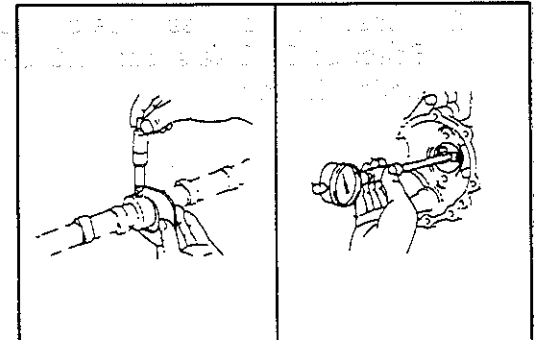


WRE91-EM173

4. Inspection of journal section.
Measure the camshaft journal section diameter, using a micrometer.

Specified Value:

- 1st journal: 46.559 - 46.575
- 2nd journal: 46.259 - 46.275
- 3rd journal: 45.959 - 45.975
- 4th journal: 45.659 - 46.675
- 5th journal: 45.359 - 45.375



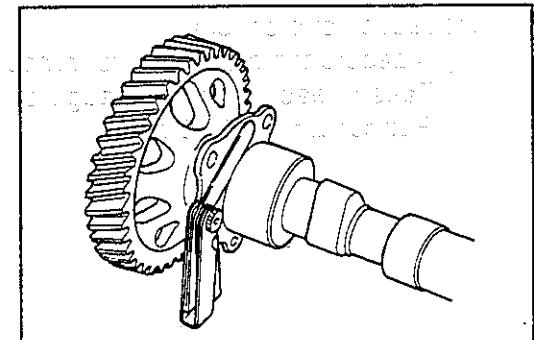
WRE91-EM174

5. Inspection of camshaft thrust clearance
(1) Measure the camshaft thrust clearance.
Specified Value: 0.10 - 0.19 mm

NOTE:

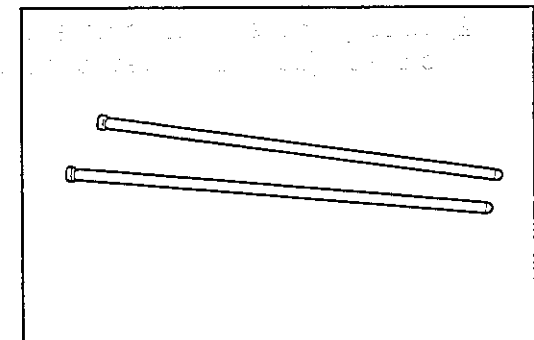
- Prior to the measurement of the camshaft thrust clearance, tighten the camshaft timing belt pulley to the camshaft to the specified torque.

- (2) If the camshaft thrust clearance exceeds the limit, replace the camshaft thrust plate.



WRE91-EM175

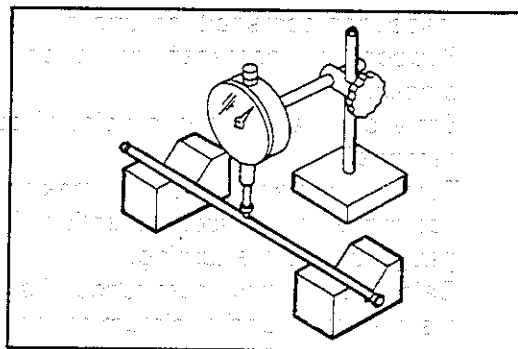
6. Inspection of valve push rod
(1) Visually inspect the valve push rod for damage or wear.



WRE91-EM176

ENGINE MECHANICAL

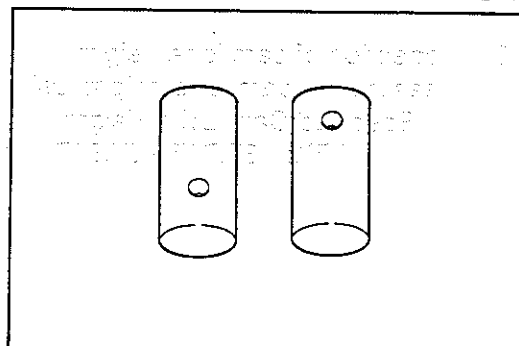
- (2) Inspect the valve push rod for bend.
Bend Limit of Push Rod: 0.4 mm



WRE91-EM177

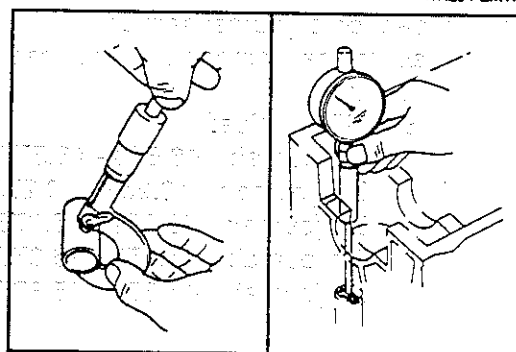
7. Inspection of value lifter

- (1) Visually inspect the value lifter for wear or damage.



WRE91-EM178

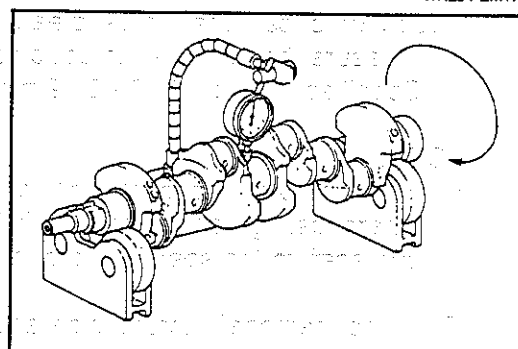
- (2) Measure the oil clearance of value lifter.
Specified Oil Clearance: 0.015 - 0.049 mm
Limit: 0.1 mm



WRE91-EM179

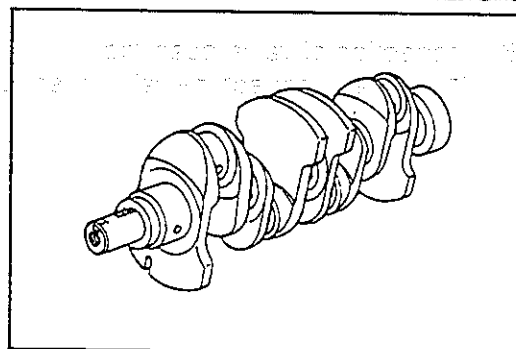
8. Inspection of crankshaft

- (1) Measure the crankshaft for runout.
Take a reading on dial gauge during the turning.
Runout Limit: 0.05 mm



WRE91-EM180

- (2) Visually inspect the crankshaft main journals and crankpin journals for wear or damage.



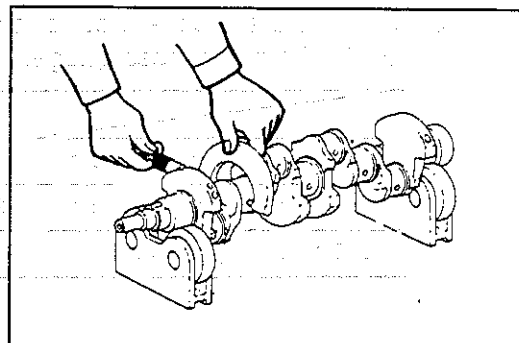
WRE91-EM181

- (3) Measure the diameter of crankshaft main journal and crankpin journal.

Specified Value:

Main Journal: 67.955 - 67.970

Crankpin Journal: 55.075 - 55.990



WRE91-EM182

- (4) Measure the thrust clearance of the crankshaft.

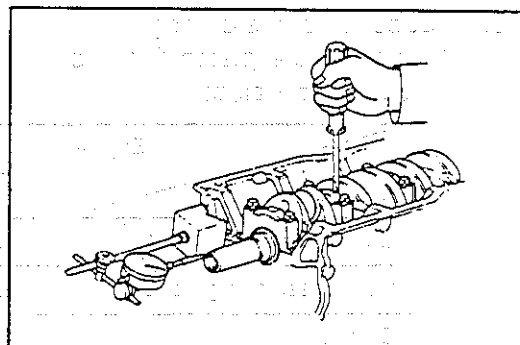
Specified Value: 0.050 - 0.159 mm

Limit: 0.25 mm

NOTE:

- Tighten the crankshaft bearing cap to the specified torque in advance.

Tightening Torque: 103.0 ± 6.9 N·m
(10.50 ± 0.70 kgf·m)



WRE91-EM183

- (5) Measure the oil clearance of the main journal of the crankshaft, using a plastigage.

Specified Value:

No.1 and No.5 journals: 0.025 - 0.060 mm

No.2, No.3 and No.4 journals: 0.030 - 0.065 mm

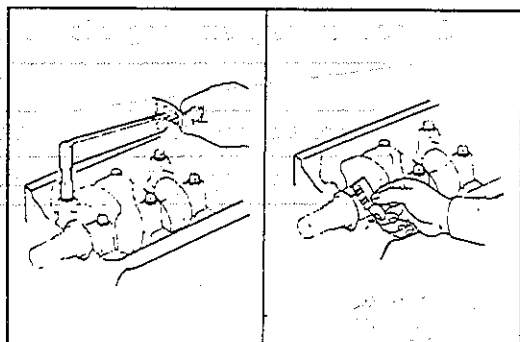
Limit: 0.12 mm

If the oil clearance exceeds the limit, replace the bearing.

NOTE:

- Wipe off the oil or the like getting to the main journal section in advance.
- Tighten the crankshaft bearing cap to the specified torque.

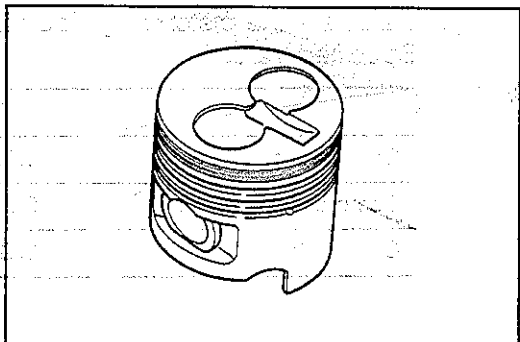
Tightening Torque: 103.0 ± 6.9 N·m
(10.50 ± 0.70 kgf·m)



WRE91-EM185

9. Inspection of piston

- (1) Visually inspect the piston for wear or damage.



WRE91-EM186

- (2) Measure the piston outer diameter in thrust direction at a point about 24 mm above from lower edge of the piston skirt.

Then, calculate the piston clearance.

Specified Value:

Piston Outer Diameter:

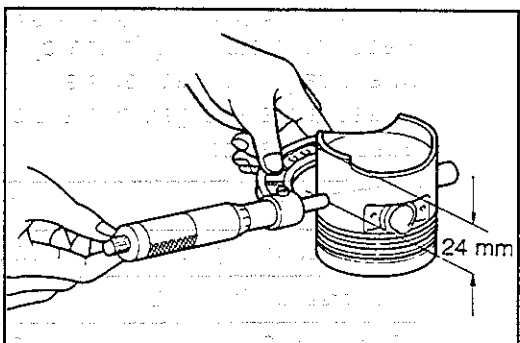
DL-42: 91.93 - 91.96 mm

DL-52: 91.92 - 91.95 mm

Piston Clearance:

DL-42: 0.06 - 0.08 mm

DL-52: 0.07 - 0.09 mm

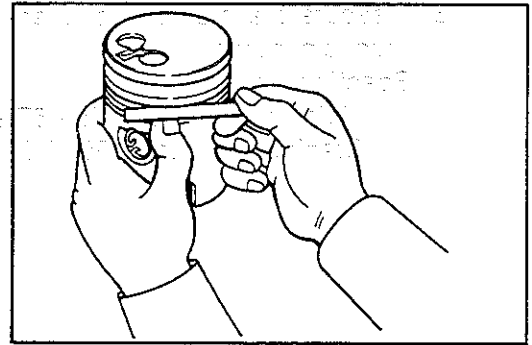


WRE91-EM187

ENGINE MECHANICAL

- (3) Measure the groove width of piston rings No. 1, No. 2, No. 3 with a thickness gauge.

	DL-42	DL-52
No. 1 piston ring groove width	2.55 - 2.57	7° key stone
No. 2 piston ring groove width	2.03 - 2.05	2.06 - 2.08
No. 3 piston ring groove width	4.01 - 4.03	4.01 - 4.03

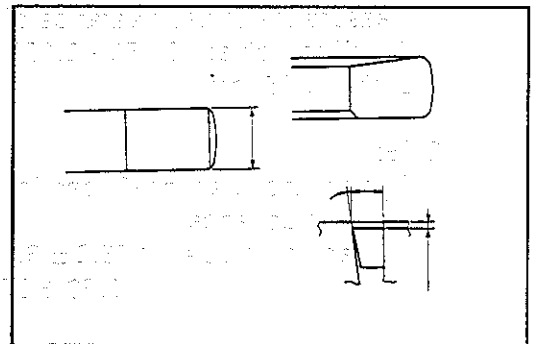


WRE91-EM188

10. Inspection of piston ring

- (1) Inspect the piston ring width
Specified Value:

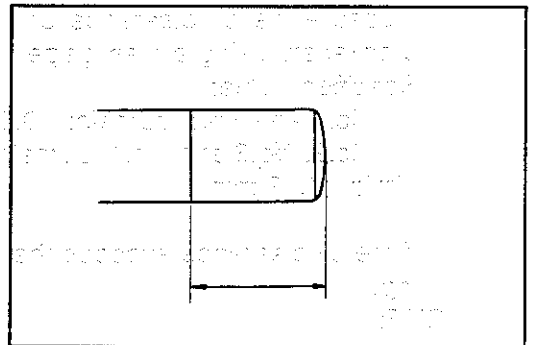
Engine	DL-42	DL-52
Component		
Compression ring No. 1	2.5 $\begin{smallmatrix} -0.01 \\ -0.03 \end{smallmatrix}$	7° key stone
Compression ring No. 2	2.0 $\begin{smallmatrix} -0.01 \\ -0.03 \end{smallmatrix}$	2.0 $\begin{smallmatrix} -0.01 \\ -0.03 \end{smallmatrix}$
Oil ring	4.0 $\begin{smallmatrix} -0.01 \\ -0.03 \end{smallmatrix}$	4.0 $\begin{smallmatrix} -0.01 \\ -0.03 \end{smallmatrix}$



WRE91-EM189

- (2) Inspect the piston ring thickness.

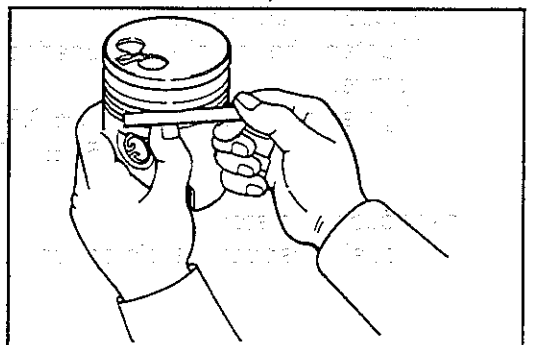
	DL-42	DL-52
Compression ring No. 1	3.8 ± 0.1	3.8 ± 0.12
Compression ring No. 2	3.8 ± 0.1	3.8 ± 0.10



WRE91-EM190

- (3) Calculate the piston ring side clearance.
Specified Value:

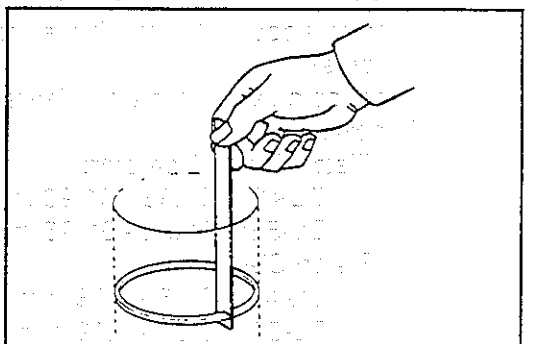
	DL-42	DL-52
Compression ring No. 1	0.06 - 0.10	—
Compression ring No. 2	0.04 - 0.08	0.07 - 0.11
Oil ring No. 3	0.02 - 0.06	0.02 - 0.06



WRE91-EM191

- (4) Measure the piston ring end gap.
Place the piston ring in the cylinder bore at lower part where very little wear exists.
Measure the end gap of the piston ring.
Specified Value:

	DL-42	DL-52
Compression ring No. 1	0.30 - 0.45	0.35 - 0.50
Compression ring No. 2	0.30 - 0.45	0.30 - 0.45
Oil ring No. 3	0.30 - 0.50	0.30 - 0.50

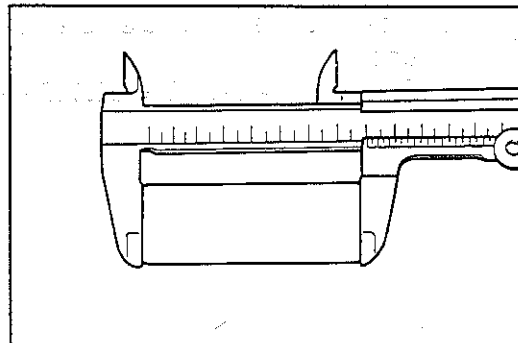


WRE91-EM192

11. Inspection of piston pin

- (1) Measure the length of piston pin.

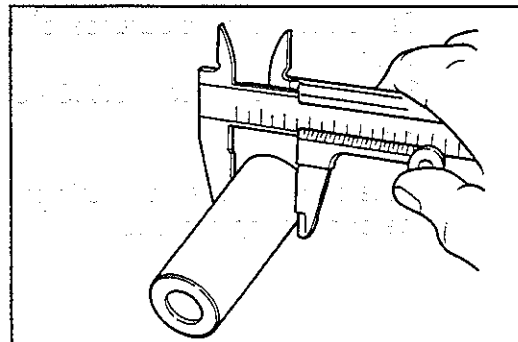
Specified Value: $L = 74.8 - 75.0$



WRE91-EM193

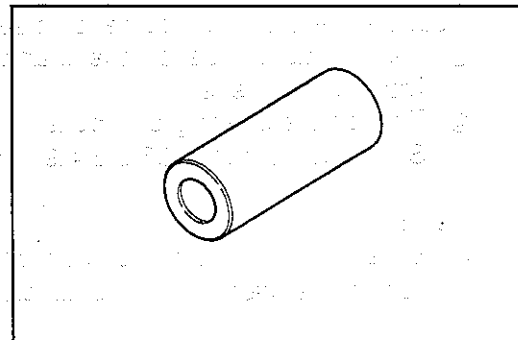
- (2) Measure the diameter of piston pin.

Specified Value: $D = 27.993 - 28.000$



WRE91-EM194

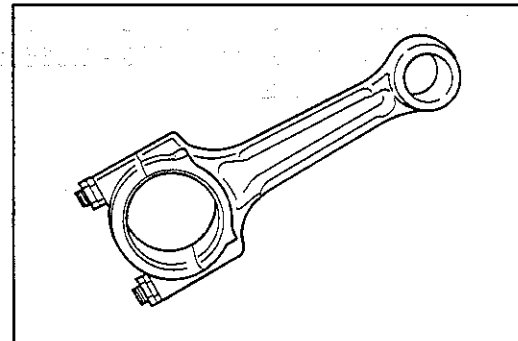
- (3) Visually inspect the piston pin for wear or damage.



WRE91-EM195

12. Inspection of connecting rod

- (1) Visually inspect the connecting rod for damage.



WRE91-EM196

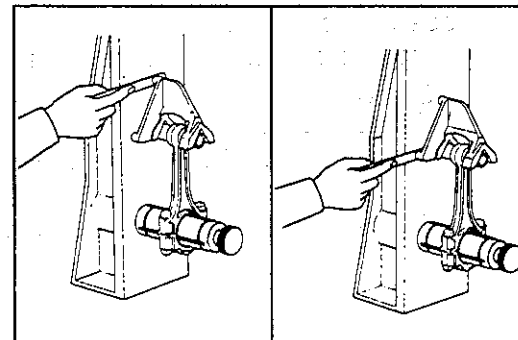
- (2) Check the connecting rods alignment using a rod aligner.

If the rod is bend or twisted, replace the connecting rod.

Specified Value:

Bend Limit: 0.05 mm

Twist Limit: 0.05 mm

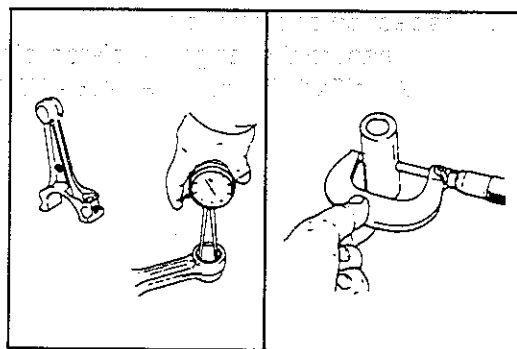


WRE91-EM197

ENGINE MECHANICAL

- (3) Measure the inner diameter of connecting rod small end.

Specified Value: $D = 28.005 - 28.020$



WRE91-EM198

- (4) Calculate the oil clearance of piston pin to piston pin bush.

Specified Clearance: $0.005 - 0.027 \text{ mm}$

Limit: 0.05 mm

If the clearance is not within the specification, replace the connecting rod bush.

WRE91-EM199

- (5) Measure the crankpin journal oil clearance.

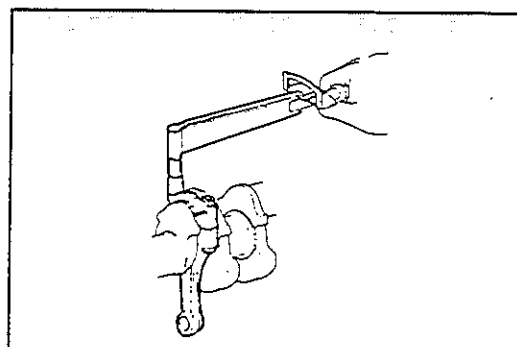
① Place plastigauge on the crankpin journal in parallel with the crankshaft.

② Tighten the bearing cap bolts to the specified torque.

Specified Torque: $68.6 \pm 4.9 \text{ N}\cdot\text{m}$ ($7.0 \pm 0.5 \text{ kgf}\cdot\text{m}$)

NOTE:

- Be sure not to turn the crankshaft or connecting rod during this crankpin journal oil clearance measurement.

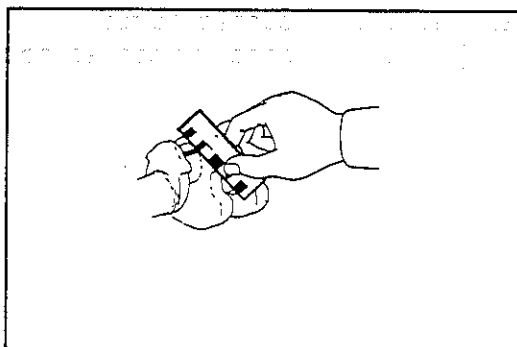


WRE91-EM200

- ③ Measure the largest width of flattened plastigauge.

Specified Value: $0.030 - 0.065 \text{ mm}$

Limit: 0.012 mm



WRE91-EM201

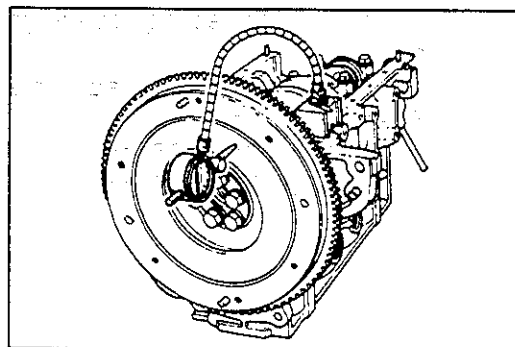
13. Inspection of flywheel

- (1) Install the flywheel and measure the runout, using a dial gauge.

Tightening Torque: $11.5 - 14.0 \text{ kg}\cdot\text{m}$ ($83 - 101 \text{ ft}\cdot\text{lb}$)

Runout Limit: 0.2 mm (0.0079 inch)

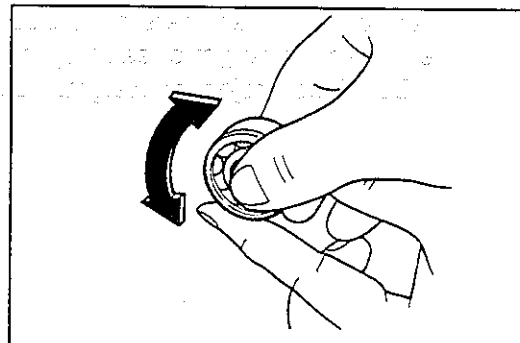
- (2) Check the flat plane of the flywheel for roughness.



WRE91-EM202

(3) Bearing

Rotate the bearing, while applying force to the bearing by your finger. If you do not feel any binding, it means that the bearing is satisfactory.

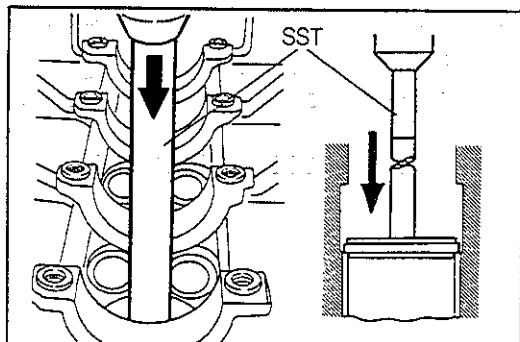


WRE91-EM203

REPLACEMENT OF CYLINDER LINER

1. Remove the cylinder liner by using SST.

SST: 09221-87301-000



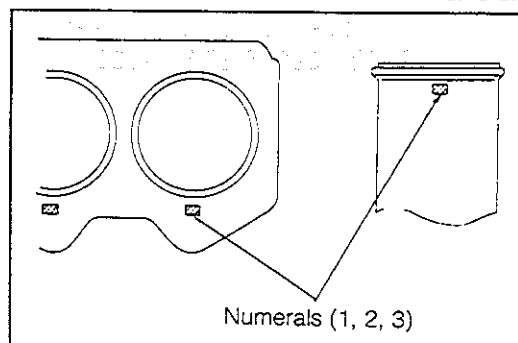
WRE91-EM204

2. Combination of cylinder liners and cylinder bores. Each cylinder bore bears a mate number stamped on the top surface of the cylinder block. Likewise, each liner bears a mate number stamped at the side of the liner. When a liner is press-fitted into a cylinder bore having the same number as the liner, you can get a proper combination of liner and bore.

Relationship Between Stamped Numbers and
Cylinder Liner & Cylinder Block

mm

Dimensions Stamped number	Cylinder liner outer diameter	Cylinder block bore inner diameter
1	96.025 - 96.040	96.000 - 96.015
2	96.040 - 96.055	96.015 - 96.030
3	96.055 - 96.070	96.030 - 96.045



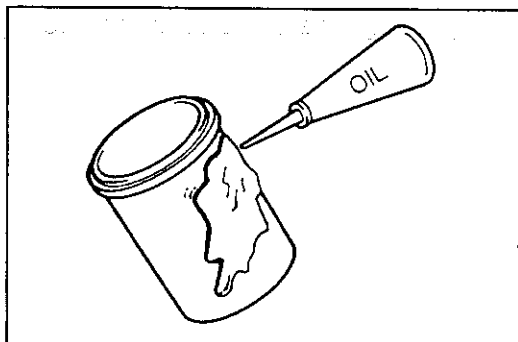
WRE91-EM205

NOTE:

- After new cylinder liners have been press-fitted, boring machining and honing operation should be carried out for each bore in accordance with the STD piston outer diameter.

3. Apply engine oil to the outer circumference of each cylinder liner. Then, press each cylinder liner into position, using a press.

Force to be applied for press-fitting: 24518 N
(2500 kgf)

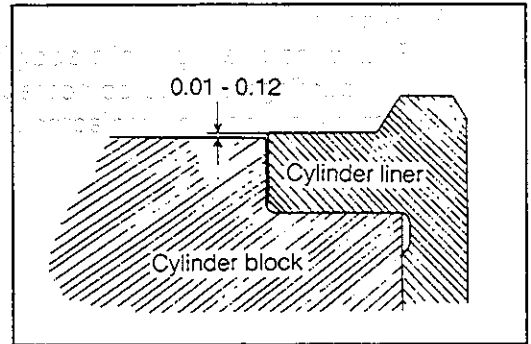


WRE91-EM206

ENGINE MECHANICAL

4. After new cylinder liners have been press-fitted, measure the projection height of each cylinder liner.

Specified Projection Height: 0.01 - 0.12 mm



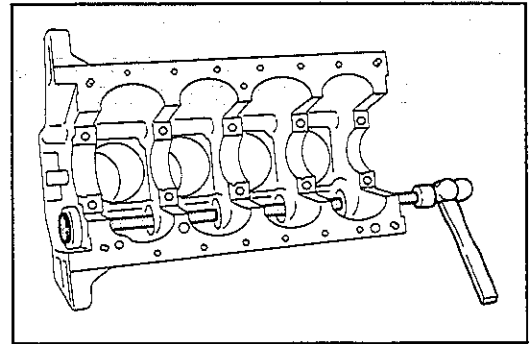
WRE91-EM207

REPLACEMENT OF CAMSHAFT BEARING

1. Removal of camshaft bearing

- (1) Remove the expansion plug by using SST and a hammer.

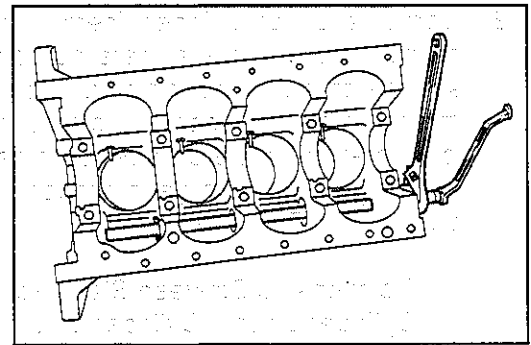
SST: 09215-87601-000



WRE91-EM208

- (2) Remove the camshaft bearings by using SST.

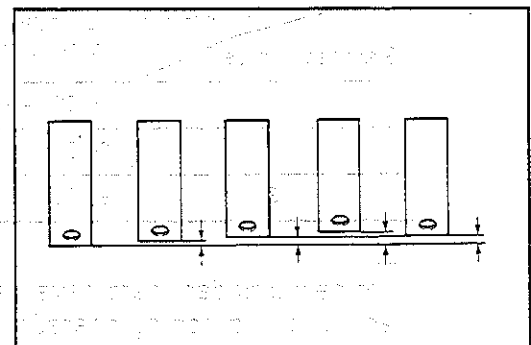
SST: 09215-87601-000



WRE91-EM209

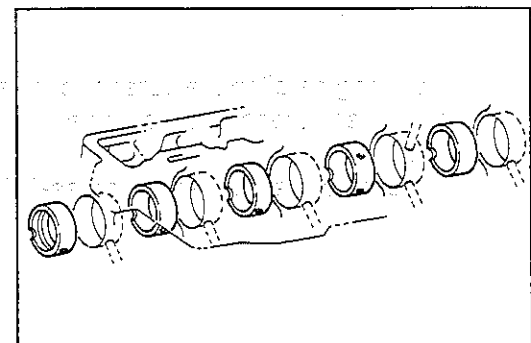
2. Installation of camshaft bearing

- (1) Install new bearings in their proper location.



WRE91-EM210

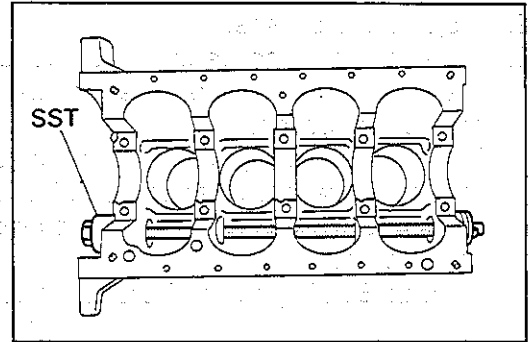
- (2) Align the oil holes of the bearing and cylinder block.



WRE91-EM211

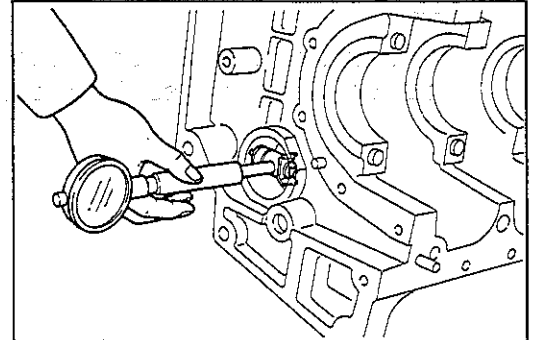
- (3) Install the camshaft bearings by using SST.

SST: 09215-87601-000



WRE91-EM212

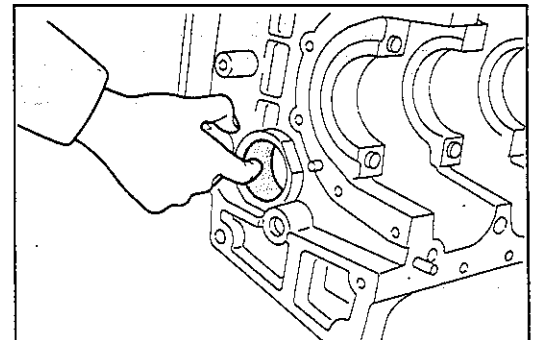
3. Check the camshaft oil clearance.



WRE91-EM213

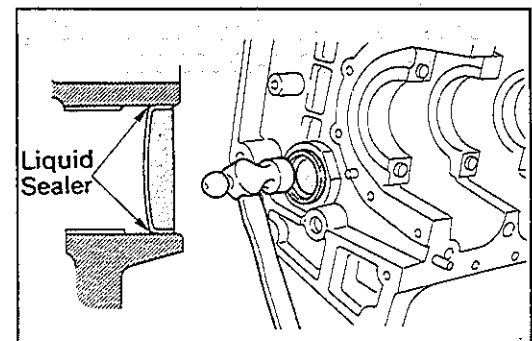
4. Installation of the expansion plug

- (1) Apply liquid sealer to expansion plug surface of the cylinder block.



WRE91-EM214

- (2) Install the expansion plug into the cylinder block by using a hammer.

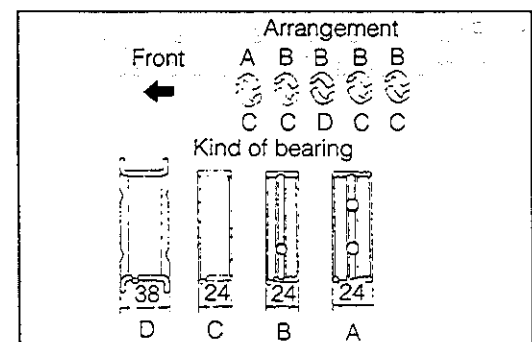


WRE91-EM215

ASSEMBLY OF CYLINDER BLOCK

1. Install the crankshaft bearing.

- (1) Prior to the installation, thoroughly wipe the backside of each bearing so as to remove any oil.
- (2) Apply a thin film of engine oil to the rotary section of each bearing.



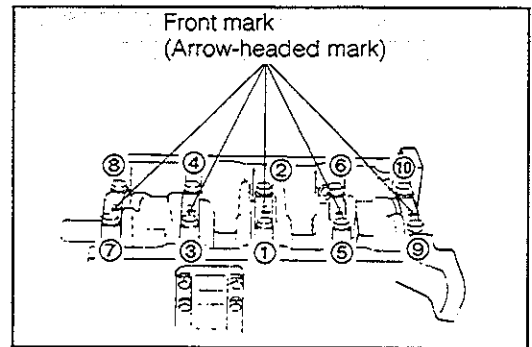
WRE91-EM216

ENGINE MECHANICAL

2. Install the crankshaft.
3. Install the bearing caps in the sequence of numbers with the arrow-headed mark on each bearing cap faced toward the front direction.

Tighten the bearing cap bolts in the sequence as indicated in the illustration. After the bearing cap bolts have been tightened, make sure that the crankshaft can be turned lightly by hands.

Cap Bolt Tightening Torque: $103.0 \pm 6.9 \text{ N}\cdot\text{m}$
($10.50 \pm 0.7 \text{ kgf}\cdot\text{m}$)



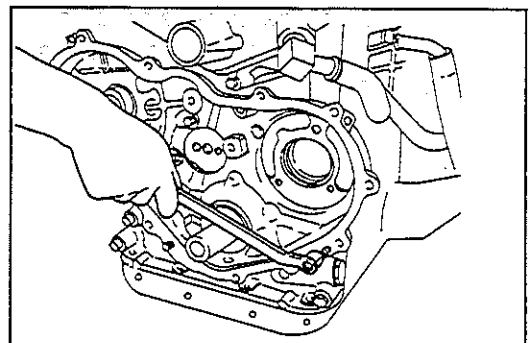
NOTE:

- Prior to the assembly, apply engine oil to the threaded portion and bearing section of each cap bolt.

4. Install the timing belt case.

Tightening Torque: $18.1 \pm 3.4 \text{ N}\cdot\text{m}$
($1.85 \pm 0.35 \text{ kgf}\cdot\text{m}$)

WRE91-EM217

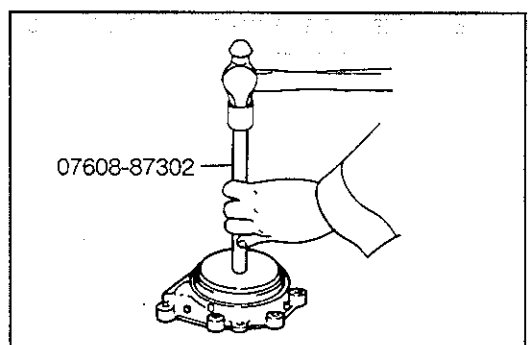


WRE91-EM218

5. Drive the oil seal into position, using the SST.

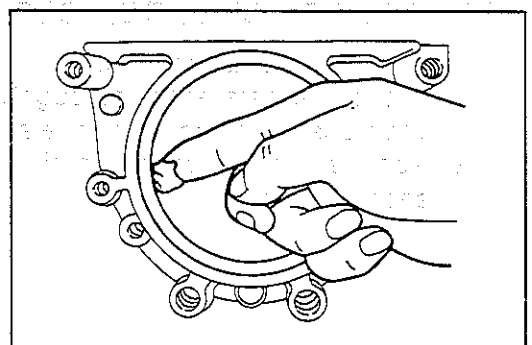
SST: 09608-87302-000

07608-87302



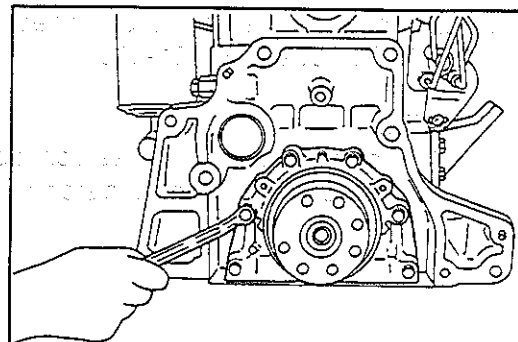
WRE91-EM219

6. Prior to the installation, apply a small amount of MP grease to the lip-section of the oil seal.



WRE91-EM220

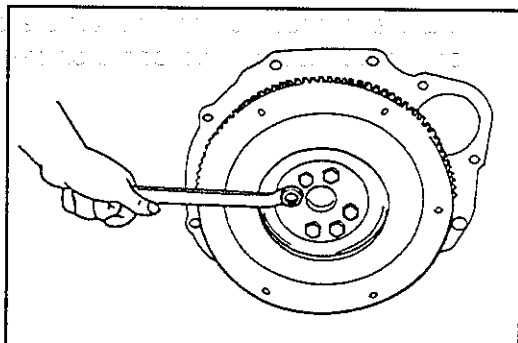
7. Install the oil seal retainer.
8. Install the rear end plate.



WRE91-EM221

9. Install the flywheel.

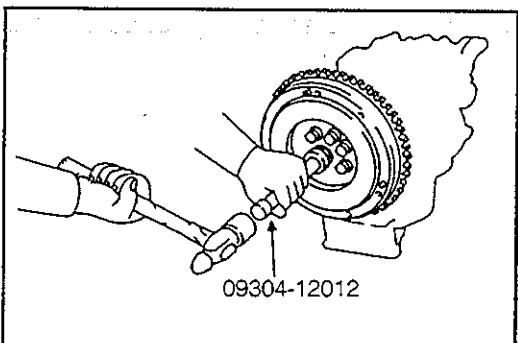
Tightening Torque: $125.0 \pm 12.3 \text{ N}\cdot\text{m}$
 $(12.75 \pm 1.25 \text{ kgf}\cdot\text{m})$



WRE91-EM222

10. Drive the bearing into position, using the SST.

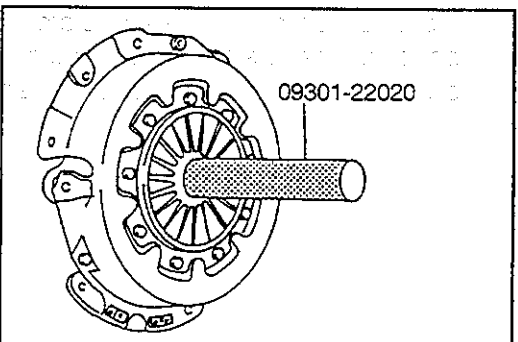
SST: 09304-12012-000



WRE91-EM223

11. Install the clutch disc and clutch cover, using the SST.

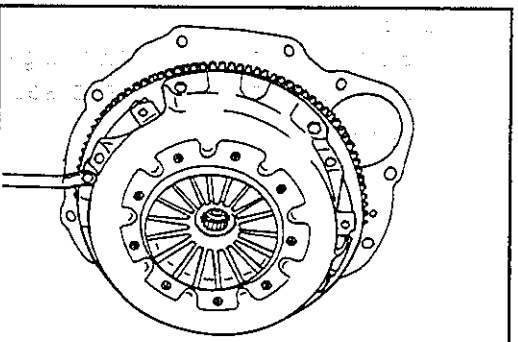
SST: 09301-22020-000



WRE91-EM224

12. Install the clutch cover.

Tightening Torque: $19.6 \pm 4.9 \text{ N}\cdot\text{m}$
 $(2.00 \pm 0.50 \text{ kgf}\cdot\text{m})$



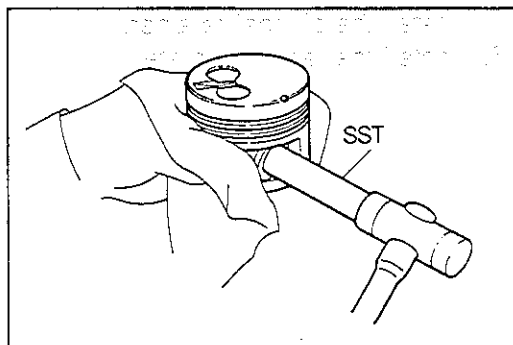
WRE91-EM225

ENGINE MECHANICAL

13. Assemble the piston in the connecting rod, using the SST.
SST: 09221-87601-000

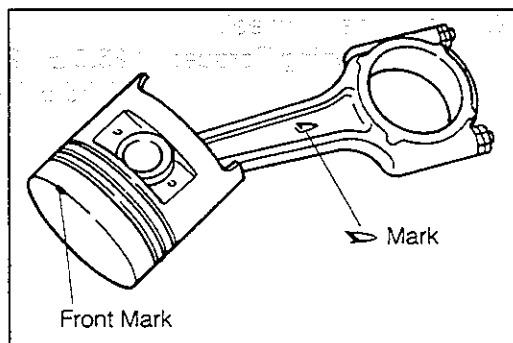
NOTE:

- Prior to the piston pin insertion, be sure to heat the piston at about 60°C, using a piston heater.



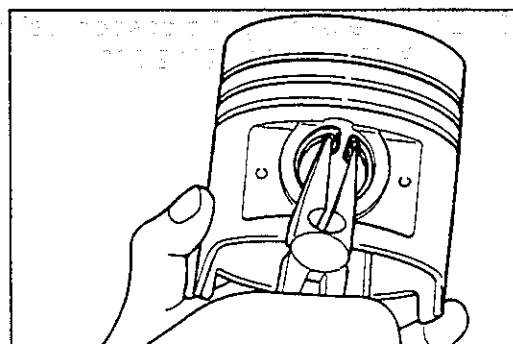
WRE91-EM226

14. Make sure that the front mark in the piston and the "D" mark on the connecting rod come on the same side.



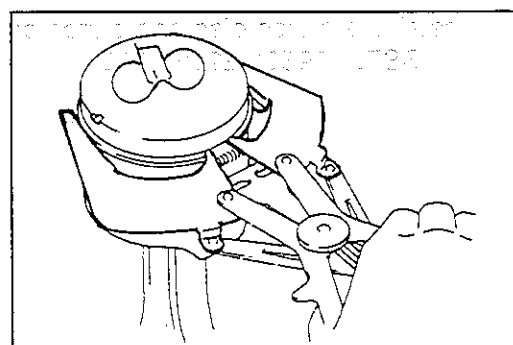
WRE91-EM227

15. Install hole snap rings securely in position.



WRE91-EM228

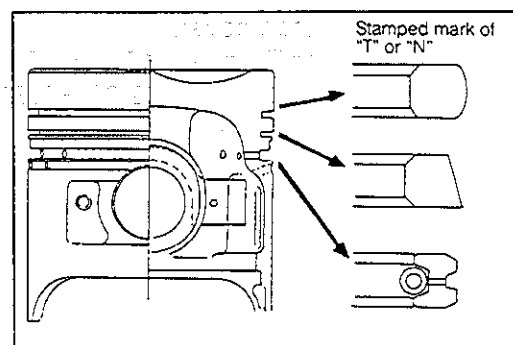
16. Install piston rings on each piston, using a piston ring expander. The piston rings should be installed in the sequence of the oil ring, No. 2 ring and No. 1 ring.



WRE91-EM229

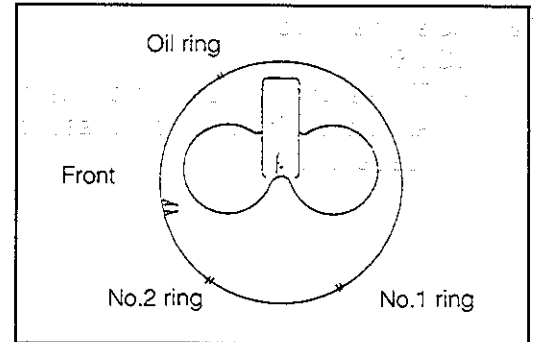
NOTE:

- Be certain to install piston rings in such a way that the stamped mark at the end section of each ring faces upward.



WRE91-EM230

17. Set the piston rings in such a way that their end gaps assume the respective positions as shown in the illustration.

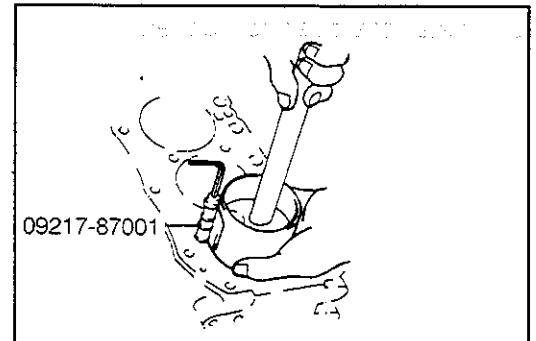


WRE91-EM231

18. Install the pistons in the cylinder block, using the SST.
- SST: 09217-87001-000

NOTE:

- When installing the pistons, make sure that the front mark of each piston faces toward the front of the engine.

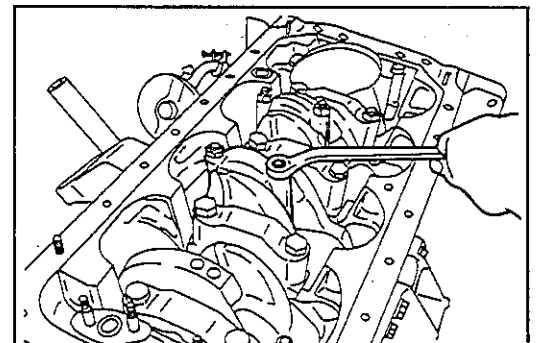


WRE91-EM232

19. Install the connecting rod bearing cap.
- Tightening Torque: 68.6 ± 4.9 N·m
(7.00 ± 0.50 kgf·m)

NOTE:

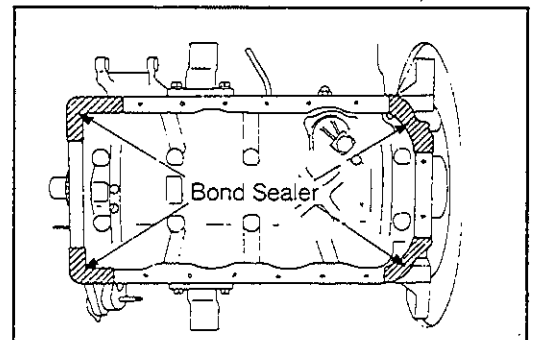
- Tighten the connecting rod bearing cap with the front mark facing forward.
- Prior to the assembly, coat the inside of each bearing with a film of engine oil.
- Also, apply engine oil to the threaded portion of each bolt and the bearing section of each nut.



WRE91-EM233

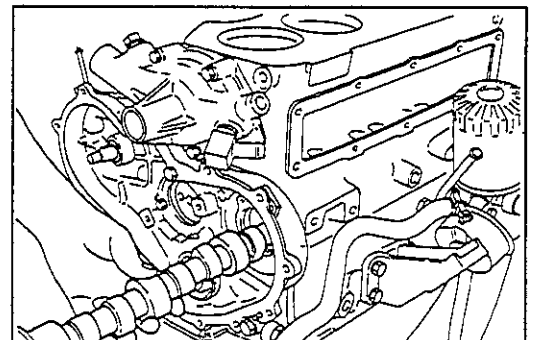
20. Install the oil pan. When installing the oil pan, apply bond sealer to the gasket installation surface on the cylinder block side.

Tightening Torque: 9.3 ± 2.5 N·m
(0.95 ± 0.25 kgf·m)



WRE91-EM234

21. Install the camshaft, using care not to damage the camshaft bearings.



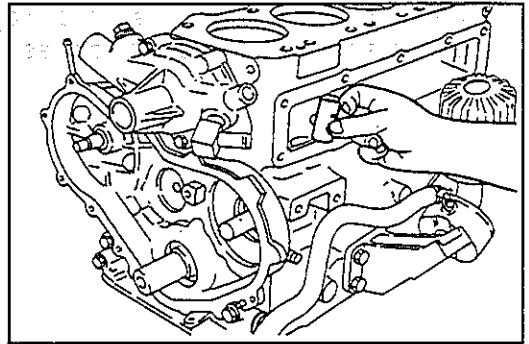
WRE91-EM235

ENGINE MECHANICAL

22. Install the valve lifter.

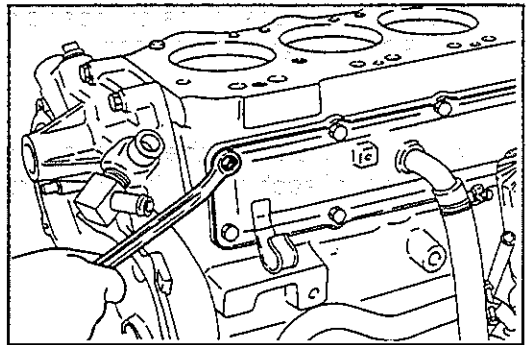
NOTE:

- Those valve lifters which have been stored in order should be installed as a set to the original cylinders, respectively.



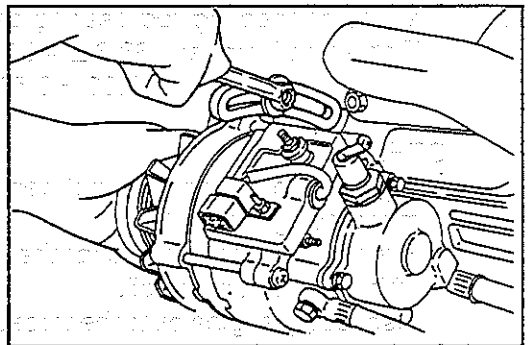
WRE91-EM236

23. Install the push rod cover.



WRE91-EM237

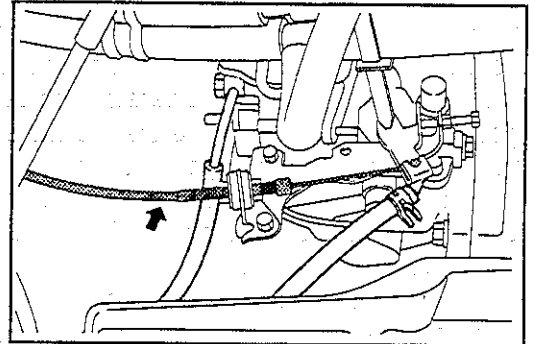
24. Install the alternator.



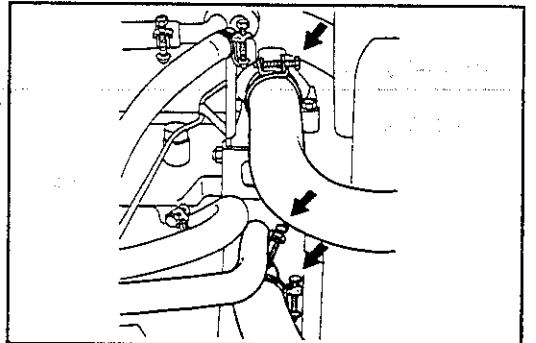
WRE91-EM238

INSTALLATION OF ENGINE ASSY

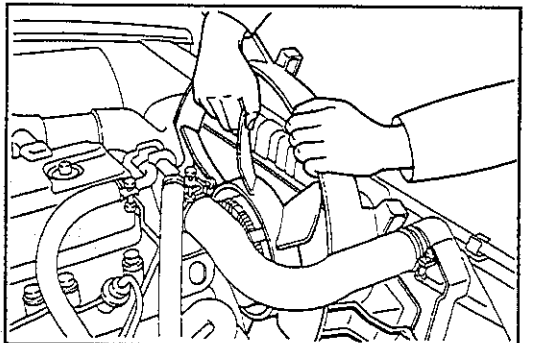
1. Place the engine assy into engine compartment by using chain block.
2. Connect the engine mounting.
3. Install the transmission into the engine installation part and tighten attaching bolts.
4. Connect the exhaust pipe.
5. Connect the engine harness.
6. Connect the fuel pipes and hoses.
7. Connect the water hoses.
8. Install the radiator and cooling fan.
9. Install the air cleaner sub-assy.
10. Install the battery.
11. Fill the coolant and engine oil.
12. Install the engine hood.
13. Start the engine.
14. Check and tune up the engine.



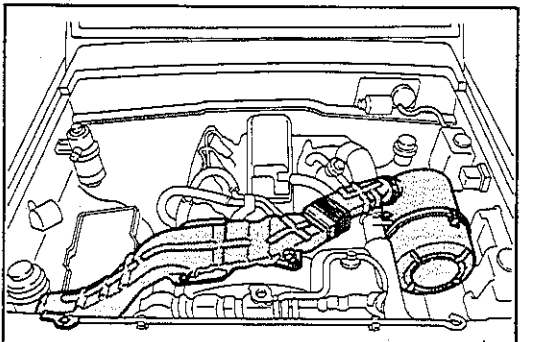
WRE91-EM355



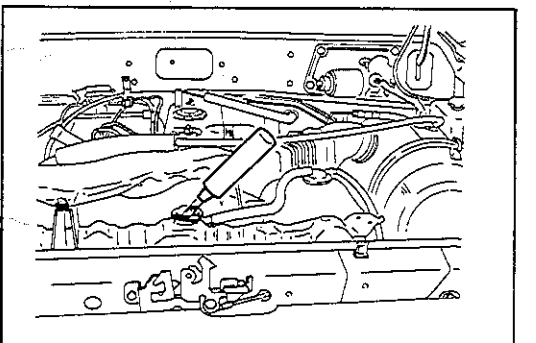
WRE91-EM356



WRE91-EM357



WRE91-EM358



WRE91-EM359

ENGINE MECHANICAL

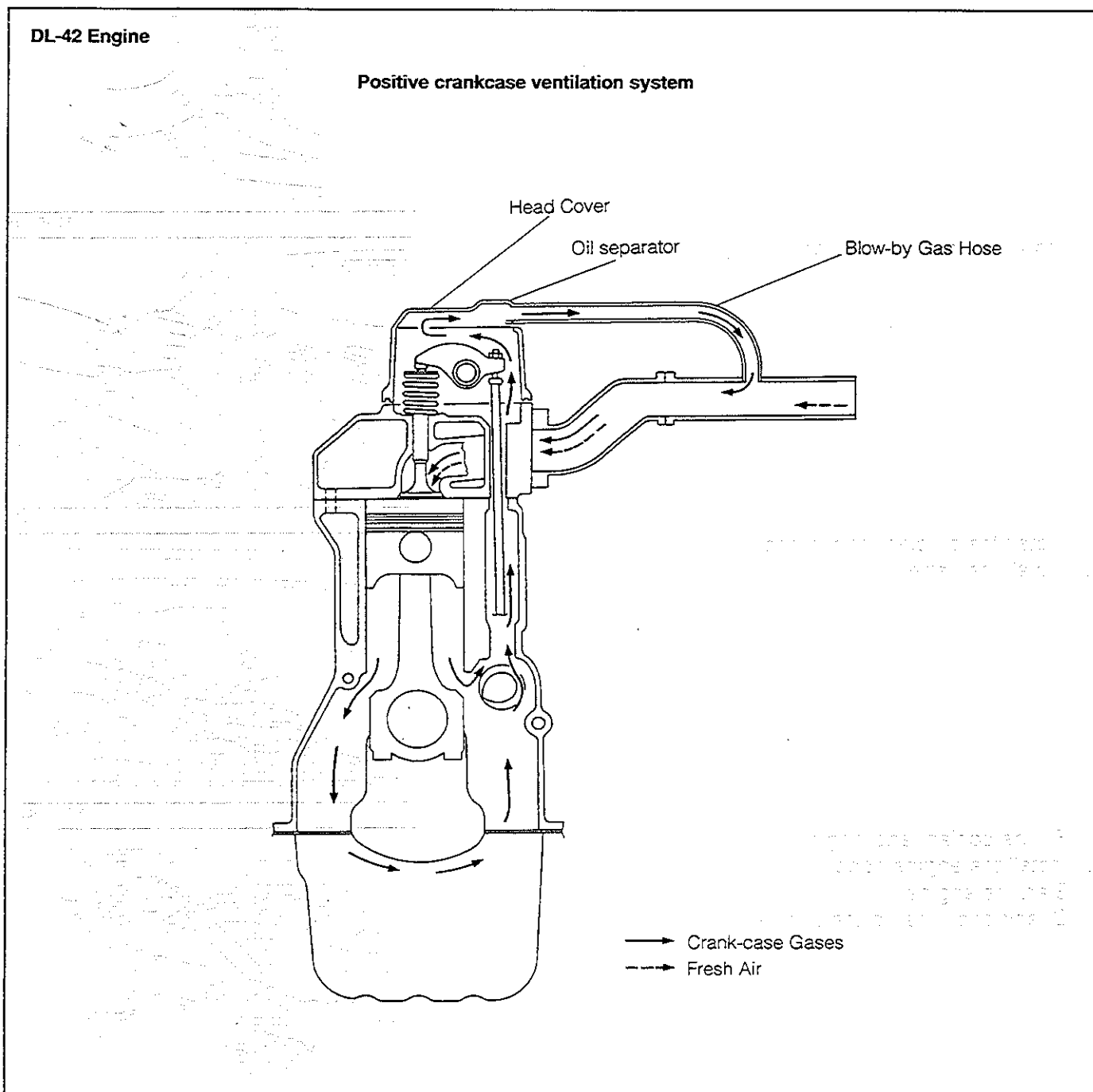
POSITIVE CRANKCASE VENTILATION (PCV)

To combat with air pollution problems, the engine is equipped with a sealed type PCV system in order to prevent blow-by gases generated inside the crankcase from being released into the atmosphere. Blow-by gases generated inside the crankcase pass the side of the camshaft and push rod in the cylinder block and flow into the cylinder head. The blow-by gases which entered the cylinder head is introduced into the intake manifold (the entrance of the turbo charger in the case of type DL-52 engine) through the cylinder head cover and blow-by gas hose. Then, the blow-by gases are sucked into the combustion chamber and burnt there together with intake air.

When blow-by gases pass through the cylinder head cover, oil mist component is separated at the oil separator section provided at the cylinder head cover.

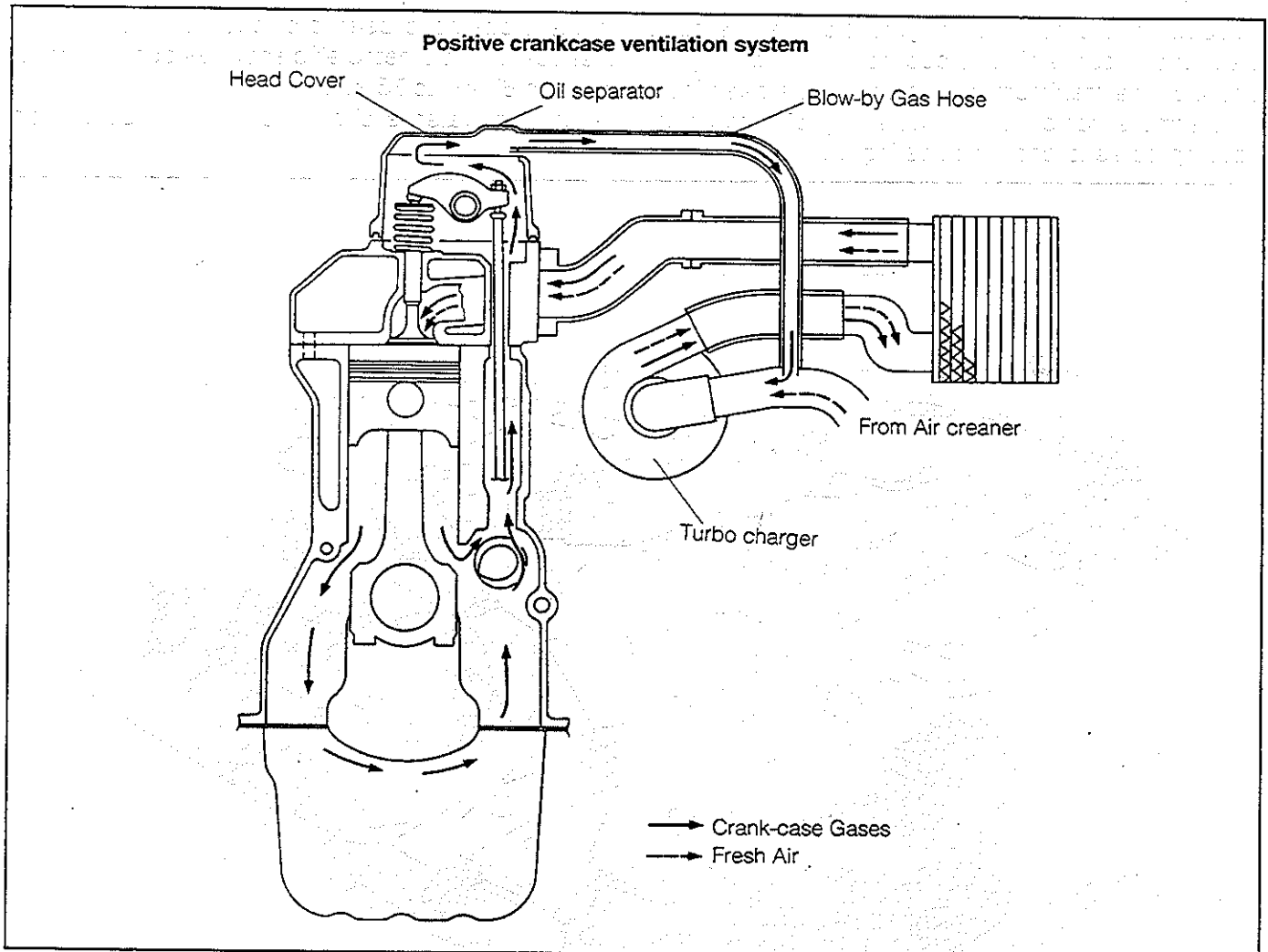
In this way, the oil carrying-out is reduced and the intake manifold is prevented from being contaminated.

DL-42 Engine



WRE91-EM240

DL-52 Engine



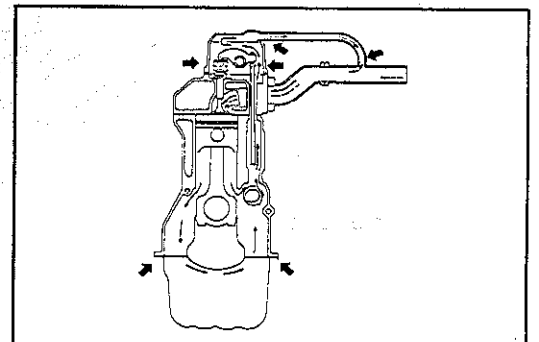
WRE91-EM241

Inspection of PCV Hose & Connection

Visual inspection of hose and connection

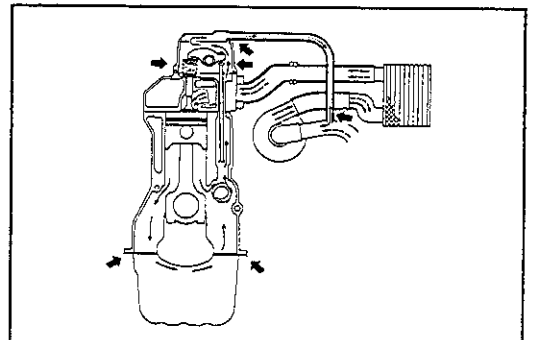
Check the hose for improper connections, cracks, leak or damage.

Check the cylinder block to oil pan and cylinder head cover contact surface for leak or damage.



WRE91-EM242

Replace or repair any part which exhibits defects.



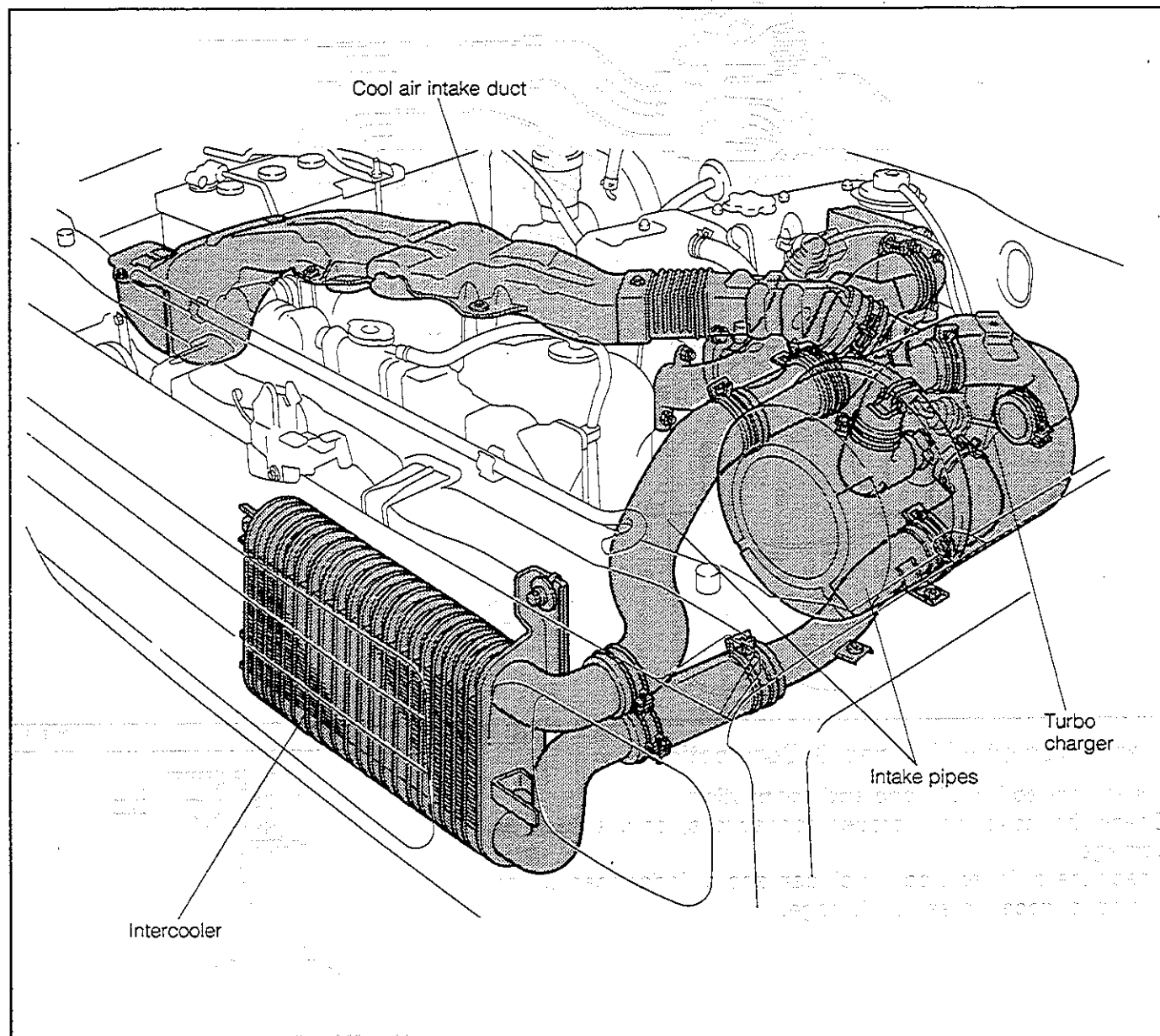
WRE91-EM243

ENGINE MECHANICAL

TURBO CHARGER SYSTEM

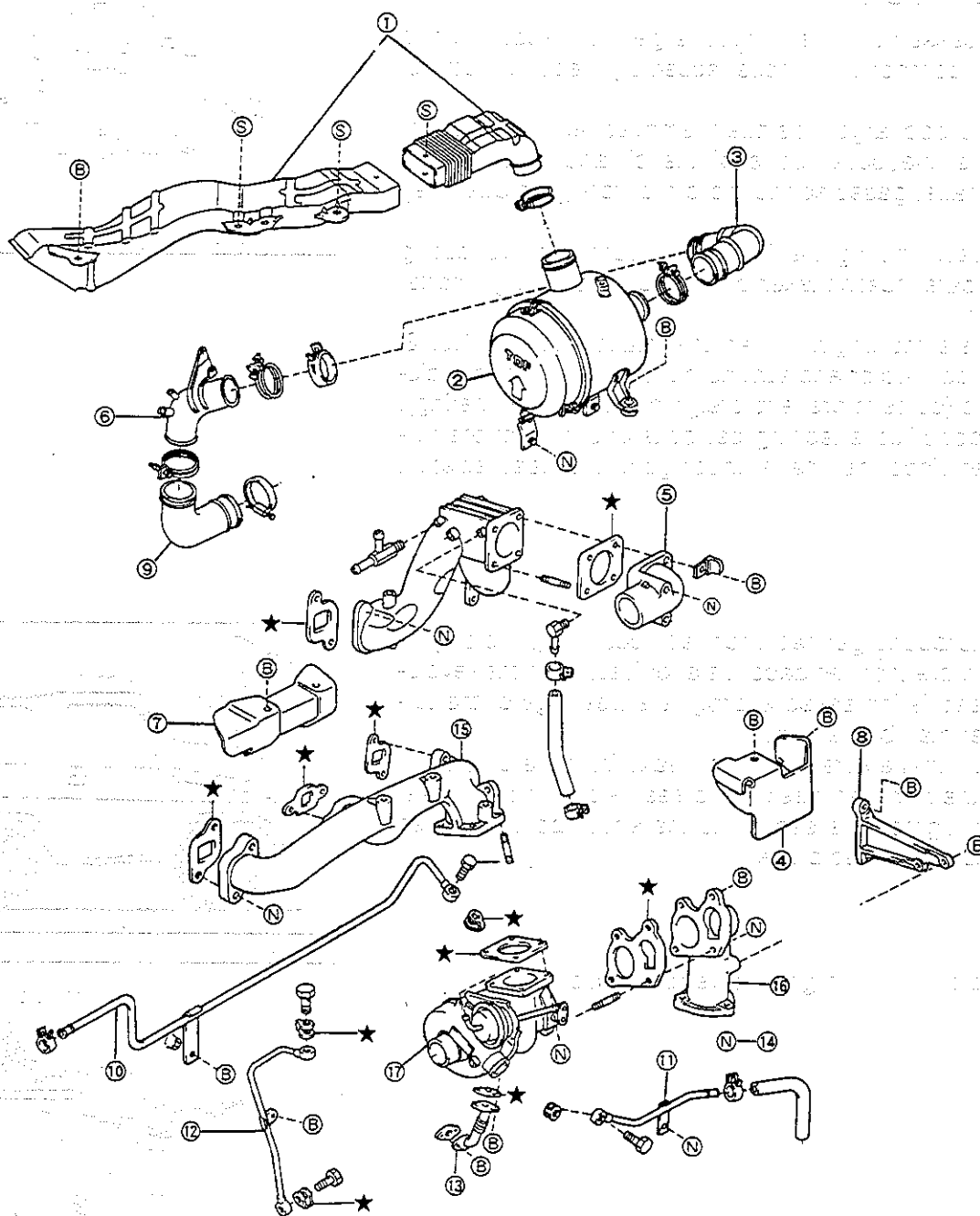
Because of the newly employment of the intercooler, intake pipes have been provided newly and the air cleaner and cool air intake duct have been changed. Consequently, volumetric efficiency has been improved and also the maximum output power has been increased from 67 kW to 75 kW.

Furthermore, for enhanced durability and reliability, the cooling water is circulated in the turbo charger housing so as to cool the floating metal.



WRE91-EM244

COMPONENTS



★ : Non-reusable part

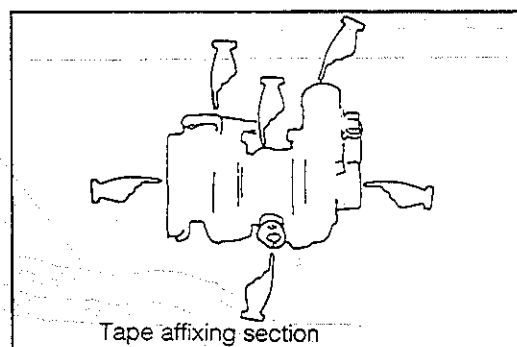
- ① Cool air intake duct S/A
- ② Air cleaner Ay W/element
- ③ Air hose No. 1
- ④ Exhaust manifold cover
- ⑤ Intake manifold No. 2
- ⑥ Air intake No. 1
- ⑦ Exhaust manifold heat insulator No. 1
- ⑧ Turbo charger stay
- ⑨ Air hose No. 2

- ⑩ Water bypass pipe No. 2
- ⑪ Water bypass pipe No. 1
- ⑫ Nut
- ⑬ Turbo charger outlet pipe S/A
- ⑭ Turbo charger inlet pipe S/A
- ⑮ Exhaust manifold
- ⑯ Turbine outlet elbow
- ⑰ Turbo charger S/A

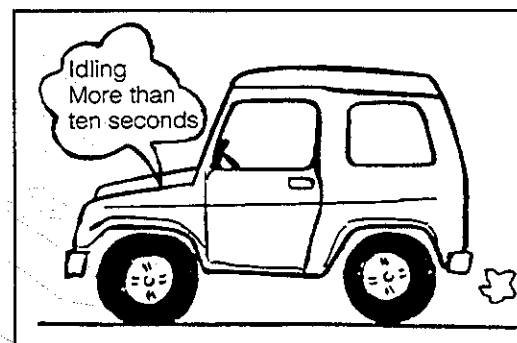
ENGINE MECHANICAL

SERVICING INSTRUCTIONS FOR TURBOCHARGER

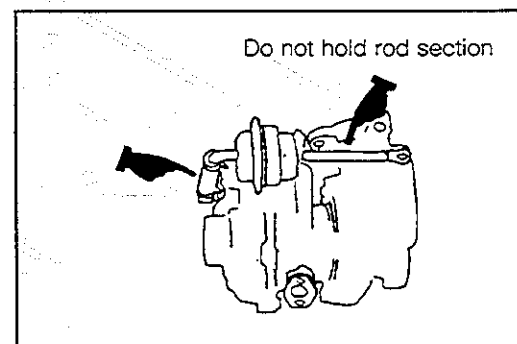
1. Never disassemble the turbocharger, because it is a precision component whose assembly requires utmost care.
2. After the turbocharger has been removed, affix gum tapes, etc. to the inlet/outlet ports of the oil and those of the intake/exhaust gases so that no dirt or foreign matter may enter.
3. When disassembling the intake, exhaust and lubricating systems, care must be taken so that no dirt or foreign matter may enter.
4. Never rotate the engine when the intake manifold No. 2, intake air connector and turbine outlet elbow, etc. are disconnected (so as to prevent foreign matters from entering).
5. Use the specified attaching set bolts and nuts of the turbocharger since they have under-gone the heat-resistant treatment.
6. After the turbocharger has been replaced, keep the engine idling for more than ten seconds after it starts. If the revolutionary speed is increased sharply, the bearings of the turbocharger may be damaged.
In addition, make sure that no oil leaks from the oil pipe.
7. Replace the removed gasket and seal, etc. with new ones. Moreover, tighten the section to the specified torques so that no leakage takes place.
8. Do not hold the waste gate valve rod section.
9. Since the turbocharger is a precision part, do not drop it.
10. Do not remove the residual oil completely from the bearing section. (The residual oil refers to such an amount of oil that remains on the surface after the oil has flown naturally.)
11. Do not place the turbocharger vertically:
Under such condition, the oil in the shaft section flows to the impeller room and this may be mistakenly regarded as an oil leakage.



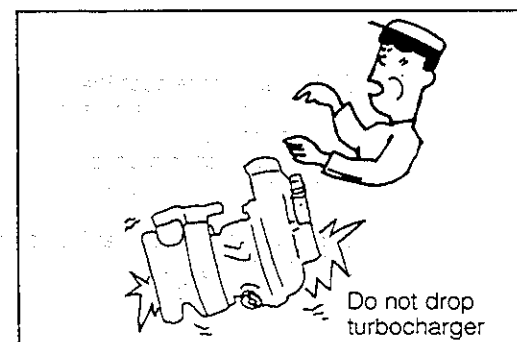
WRE91-EM245



WRE91-EM246



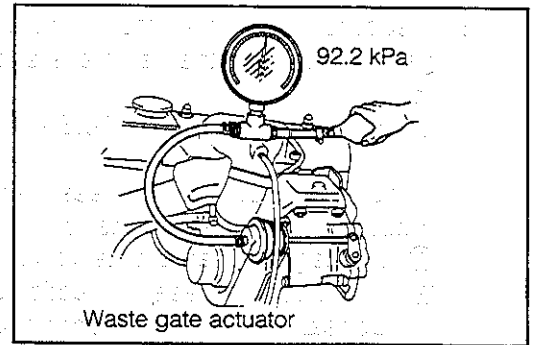
WRE91-EM247



WRE91-EM248

1. Checking operation of turbocharger waste gate valve
 - (1) Remove the waste gate actuator hose at the actuator side.
 - (2) Connect the turbocharger pressure gauge. Ensure that the rod and link operate when a pressure of 92.2 kPa (0.94 kgf/cm²) is applied and that the valve returns to the original position smoothly when the pressure is released.

Specified Value:
Shaft Stroke: About 2 mm With a pressure of 92.2 kPa (0.94 kgf/cm²)



WRE91-EM262

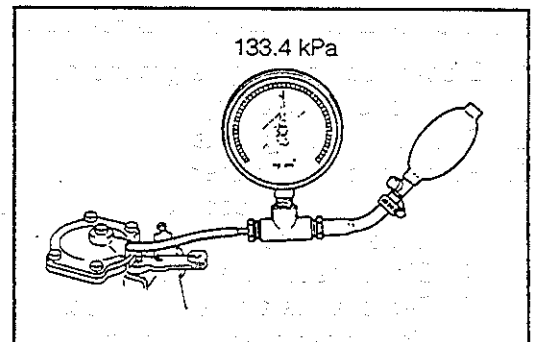
NOTE:

- If the pressure exceeding 117.7 kPa (1.2 kgf/cm²) should be applied to the waste gate actuator, the diaphragm may be damaged.

- (3) Check the hose for crack and damage.

2. Checking air-tightness of boost compensator
 - (1) Connect the turbocharger to the boost compensator.
 - (2) Apply a positive pressure of 133.4 kPa (1.36 kgf/cm²) and measure the time required for the pressure to drop to 130.4 kPa (1.33 kgf/cm²).

Specified Value: Not less than 10 seconds



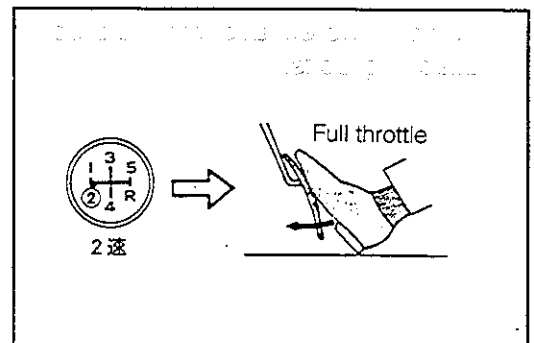
WRE91-EM263

3. Check of supercharging pressure (running test)

To obtain total evaluation, perform a running test and measure the supercharging pressure.

The running test must be carried out at a place where the vehicle can be accelerated safely with full throttle of the accelerator pedal in the second gear. One person drives a vehicle and the other person performs measurement. (Two persons aboard)

 - (1) Connect a turbo charger pressure gauge to the vacuum hose of the intake manifold with a three-way joint interposed. Place the gauge in the vehicle interior.
 - (2) After the engine has warmed up, accelerate the vehicle at full throttle up to 3,500 rpm with the second gear.



WRE91-EM264

ENGINE MECHANICAL

- (3) Measure the maximum supercharging pressure generated while the vehicle is accelerated up to 3,500 rpm.

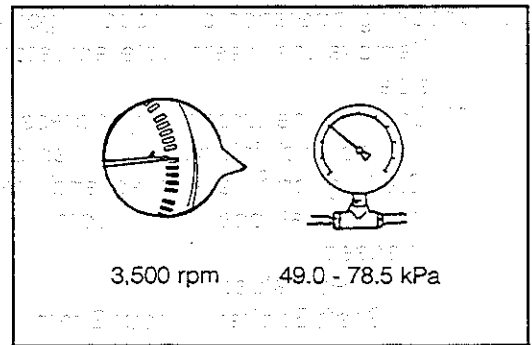
Specified Value: 49.0 - 78.5 kPa (0.50 - 0.80 kgf/cm²)

If the measured value is less than the specified value, most likely there exists the following malfunction.

- ① Leakage at waste gate valve
- ② Improper increase in injection amount of boost compensator or bent vacuum hose
- ③ Leakage at intake or exhaust system
- ④ Air cleaner, muffler, fuel filter and so forth restricted
- ⑤ Turbo charger malfunction
- ⑥ The engine proper faulty

If the measured value exceeds the specified value, most likely there exists the following malfunction.

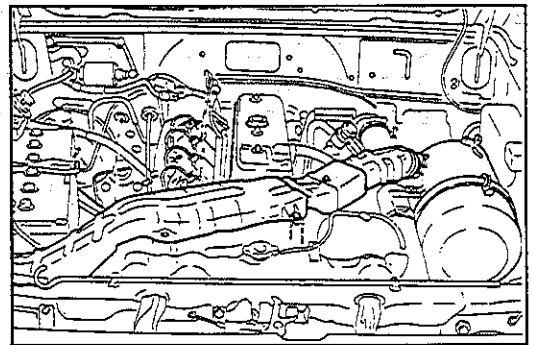
- ① Malfunctioning injection pump



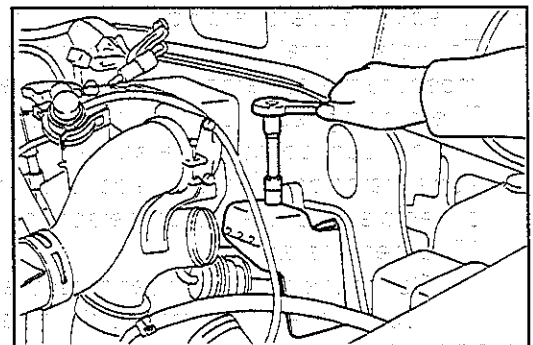
WRE91-EM265

REMOVAL OF TURBO CHARGER

1. Disconnect the engine ground cable from the negative (-) terminal of the battery.
2. Drain the cooling water.
3. Removal of air cleaner
 - (1) Remove the cool air intake duct subassembly by loosening the three screws.
 - (2) Disconnect the air hose No.1.
 - (3) Remove the air cleaner assembly by loosening the four air cleaner attaching bolts.
4. Remove the exhaust manifold cover by loosening the two attaching bolts.



WRE91-EM249

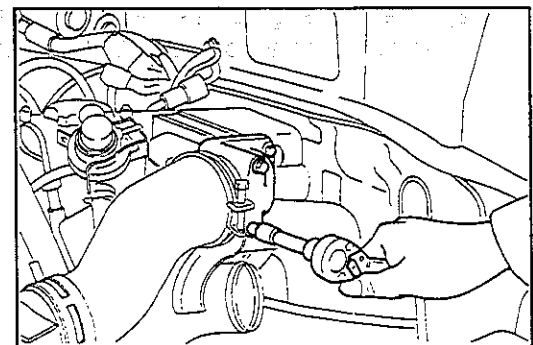


WRE91-EM250

5. Remove the intake manifold No.2 by loosening the two attaching bolts and two attaching nuts.

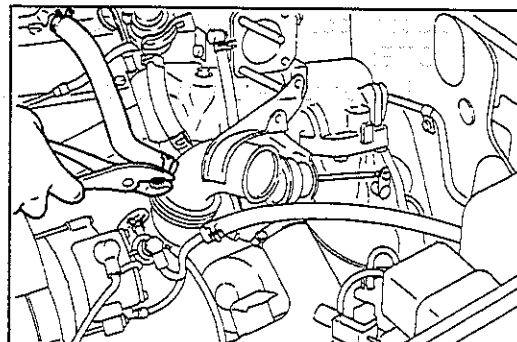
NOTE:

- Never reuse the removed gasket.



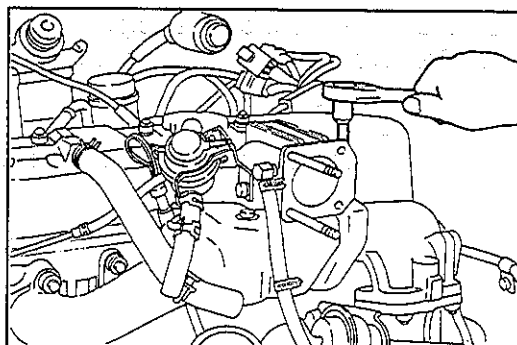
WRE91-EM251

6. Disconnect the following hoses from the air intake No.1.
Then, remove the air intake No.1 from the turbo charger.
 - PCV hose
 - PCS hose
 - Turbo charger actuator hose



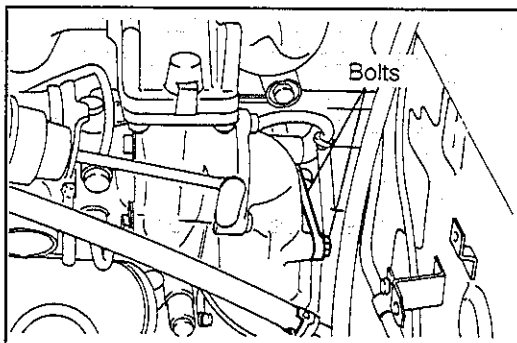
WRE91-EM252

7. Remove the exhaust manifold heat insulator No.1 by loosening the two bolts.



WRE91-EM253

8. Remove the two attaching bolts of the turbo charger stay and turbine outlet elbow.

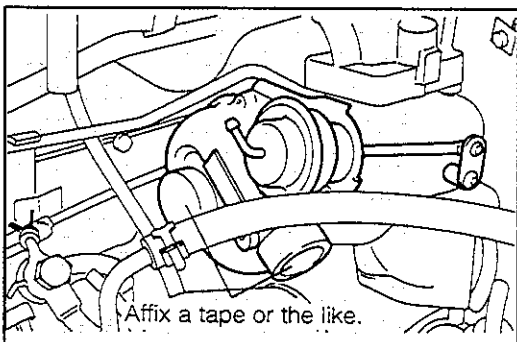


WRE91-EM254

9. Disconnect the air hose No.2 from the turbo charger.

NOTE:

- Seal the suction port with a tape or like so as to prevent dust from entering the turbo charger.

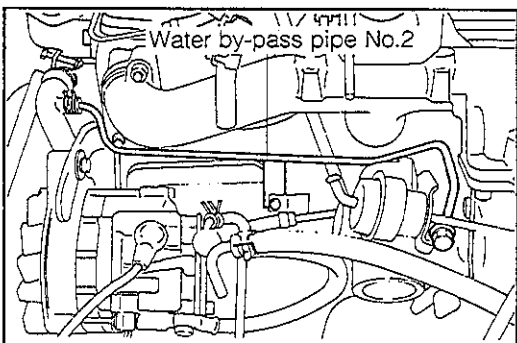


WRE91-EM255

10. Disconnect the water by-pass hose No.2.

NOTE:

- Never reuse the removed gasket.



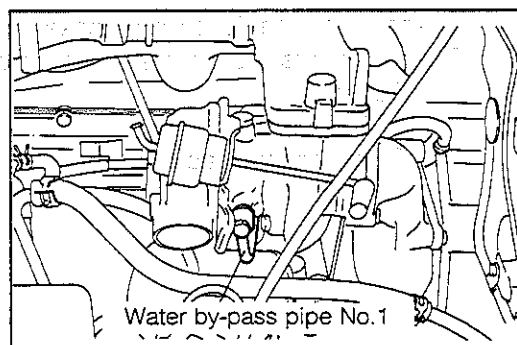
WRE91-EM256

ENGINE MECHANICAL

11. Disconnect the water by-pass hose No.1.

NOTE:

- Never reuse the removed gasket.

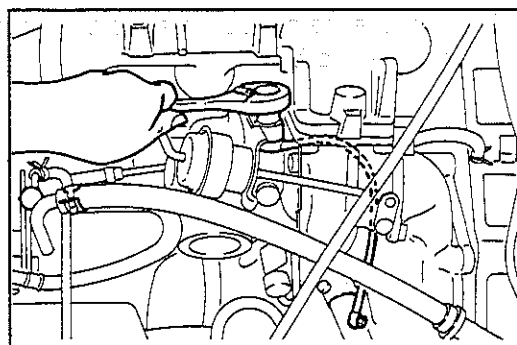


WRE91-EM257

12. Disconnect the oil inlet pipe of the turbo charger.
13. Remove the two attaching bolts of the oil outlet pipe at the turbo charger side.

NOTE:

- Never reuse the removed gasket.

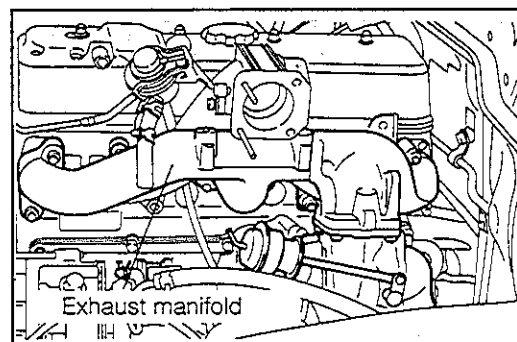


WRE91-EM258

14. Move the front exhaust pipe downward by removing the three attaching nuts of the front exhaust pipe.
15. Remove the exhaust manifold together with the turbo charger by loosening the six attaching nuts of the exhaust manifold.

NOTE:

- Never reuse the removed gasket.



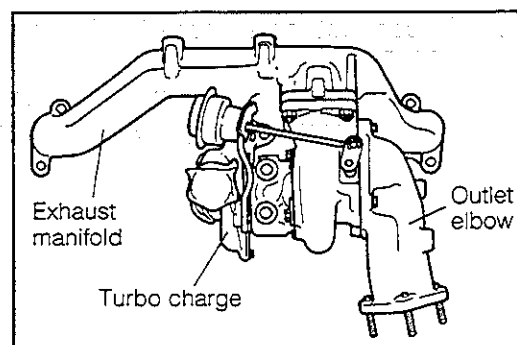
WRE91-EM259

16. Removal of turbo charger

- (1) Remove the turbine outlet elbow from the turbo charger by loosening the two bolts and two nuts.
- (2) Remove the turbo charger from the exhaust manifold by loosening the four attaching nuts.

NOTE:

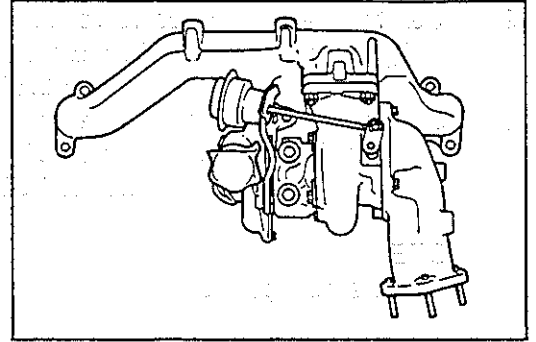
- Never reuse the removed gasket.
- Never hold the actuator rod section during the removal of the turbo charger.
- Affix a tape or the like so as to prevent any foreign matters from entering each of water port and oil port of the turbo charger.



WRE91-EM260

INSTALLATION OF TURBO CHARGER

1. Clean each gasket installing surface of the turbo charger.
2. Install the exhaust manifold to the turbo charger.
Tightening Torque: $24.5 \pm 4.9 \text{ N-m}$ ($2.5 \pm 0.5 \text{ kgf-m}$)



WRE91-EM266

3. Install the turbine outlet elbow to the turbo charger.
Tightening Torque: $24.5 \pm 4.9 \text{ N-m}$ ($2.5 \pm 0.5 \text{ kgf-m}$)

NOTE:

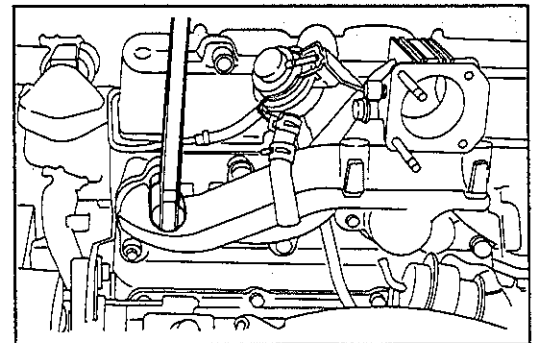
- Be very careful not to deform the turbo charger actuator rod.
- Never disassemble the turbo charger or tighten the bolts further.
- Use a new gasket.

WRE91-EM267

4. Temporarily install the exhaust manifold together with the turbo charger to the engine.

NOTE:

- Use a new gasket.



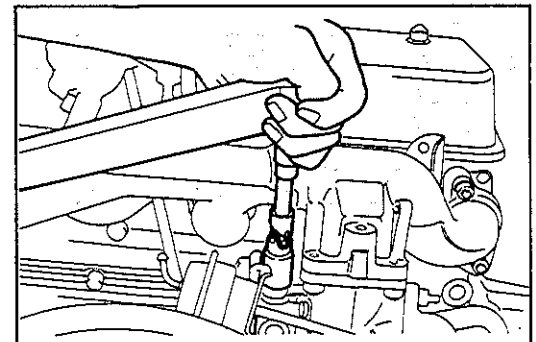
WRE91-EM268

5. Connect the oil outlet pipe to the turbo charger.
Tightening Torque: $7.4 \pm 1.5 \text{ N-m}$ ($0.75 \pm 0.15 \text{ kgf-m}$)

6. Connect the oil inlet pipe of the turbo charger.
Tightening Torque: $17.2 \pm 2.5 \text{ N-m}$ ($1.75 \pm 0.25 \text{ kgf-m}$)

NOTE:

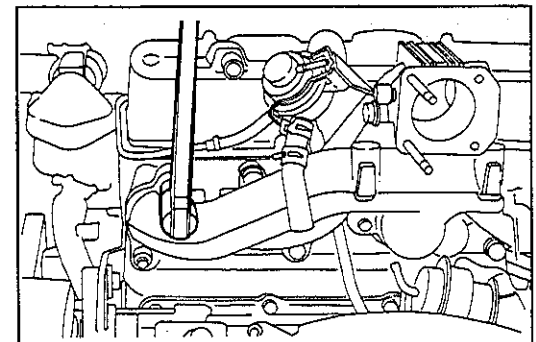
- Use a new gasket.



WRE91-EM269

7. Fully tighten the exhaust manifold.
Tightening Torque: $46.6 \pm 4.9 \text{ N-m}$ ($4.75 \pm 0.75 \text{ kgf-m}$)

8. Install the front exhaust pipe.
Tightening Torque: $49.0 \pm 4.9 \text{ N-m}$ ($5.00 \pm 0.50 \text{ kgf-m}$)



WRE91-EM271

ENGINE MECHANICAL

9. Install the water by-pass valve No.1.
Tightening Torque: 29.4 ± 4.9 N-m
(3.00 ± 0.50 kgf-m)
10. Install the water by-pass valve No.2.
Tightening Torque: 29.4 ± 4.9 N-m
(3.00 ± 0.50 kgf-m)

NOTE:

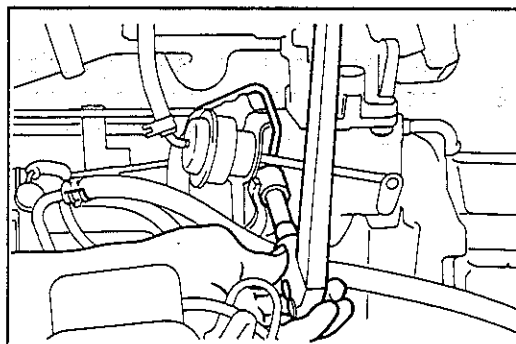
- Use a new gasket.

11. Connect the air hose No.2.
12. Tighten the turbo charger stay and turbine outlet elbow.
Tightening Torque: 18.1 ± 3.4 N-m
(1.85 ± 0.35 kgf-m)

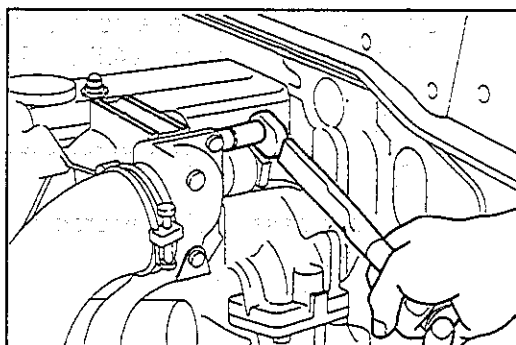
13. Install the exhaust manifold heat insulator No.1.

14. Install the air intake No.1 to the turbo charger.
15. Insert the following hoses into the air intake No.2. Attach clips.
 - PCV hose
 - PCS hose
 - Turbo charger actuator hose

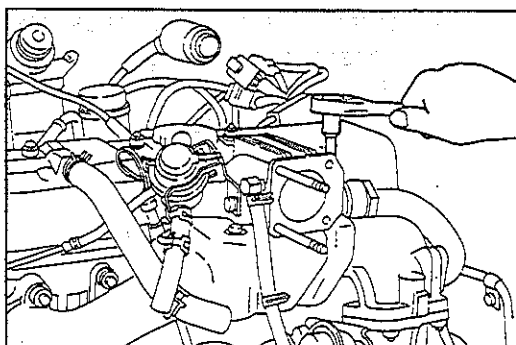
16. Install the intake manifold No.2.



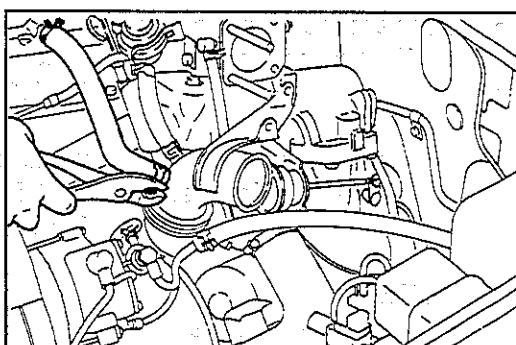
WRE91-EM272



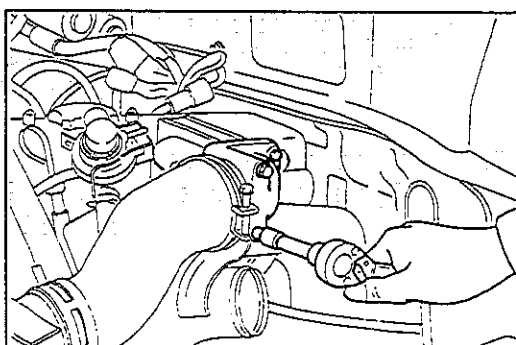
WRE91-EM273



WRE91-EM274

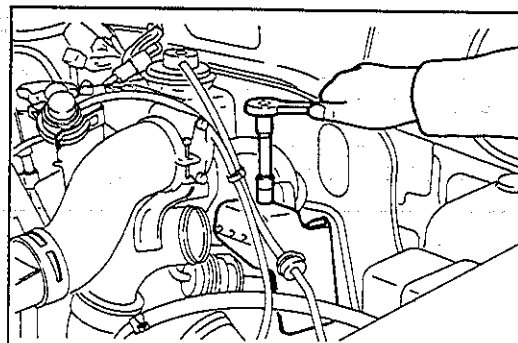


WRE91-EM275



WRE91-EM276

17. Install the exhaust manifold cover.



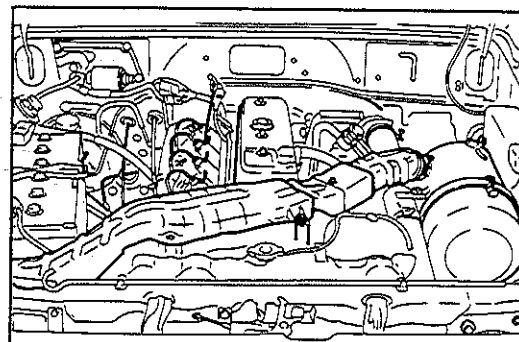
WRE91-EM277

18. Installation of air cleaner

- (1) Install the air cleaner assembly.
- (2) Connect the air hose No.1 between the air cleaner and the turbo charger.
- (3) Install the cool air duct.

19. Fill cooling water.

20. Connect the ground cable to the negative (-) terminal of the battery.

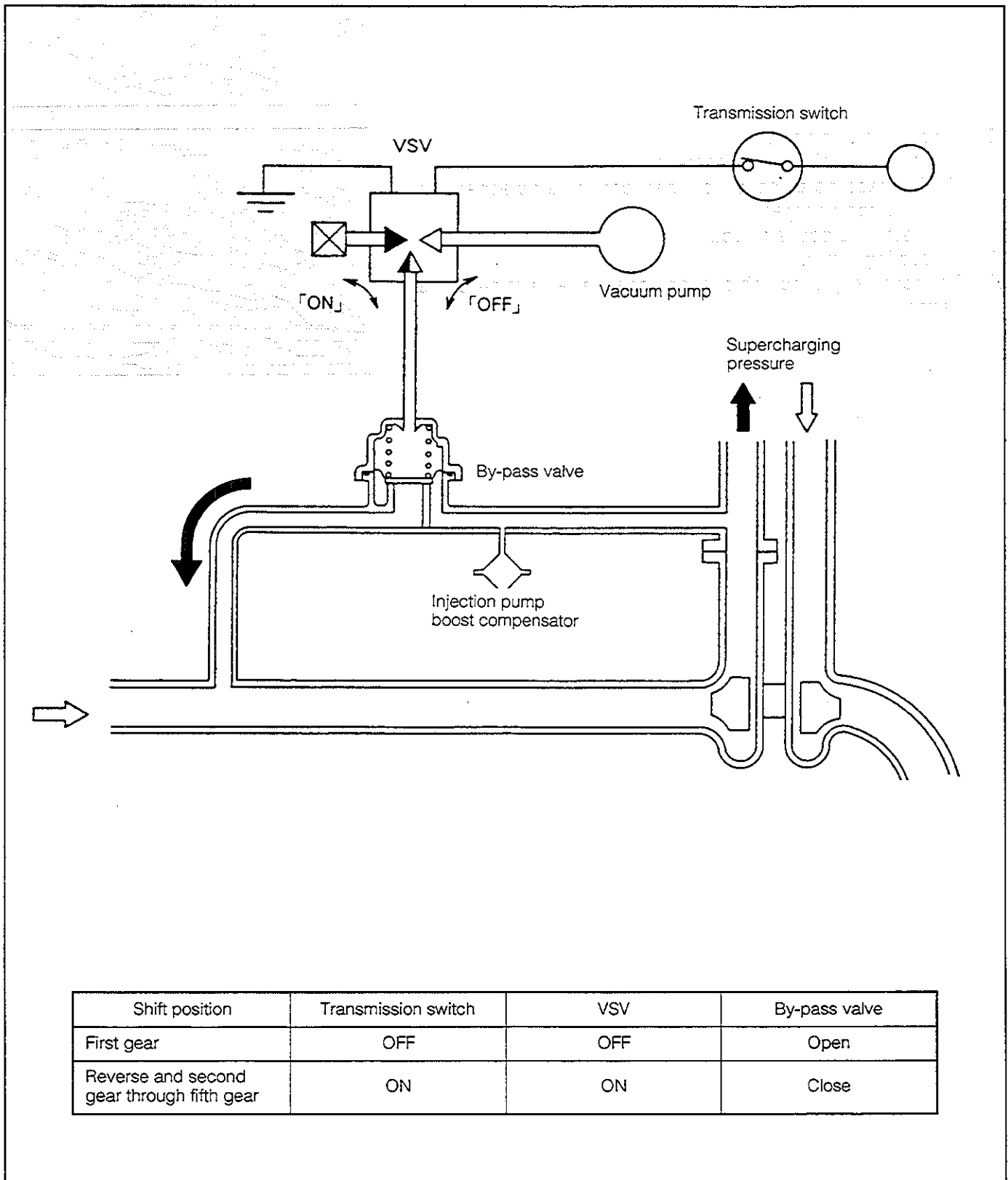


WRE91-EM278

ENGINE MECHANICAL

POWER CONTROL SYSTEM

When the transmission is set to the first gear, this system controls the surge tank pressure by means of the transmission switch, VSV and by-pass valve, thereby controlling the supercharging pressure. In this way, the power control system controls the output power by reducing the boost compensator pressure of the injection pump and by reducing the fuel injection amount.

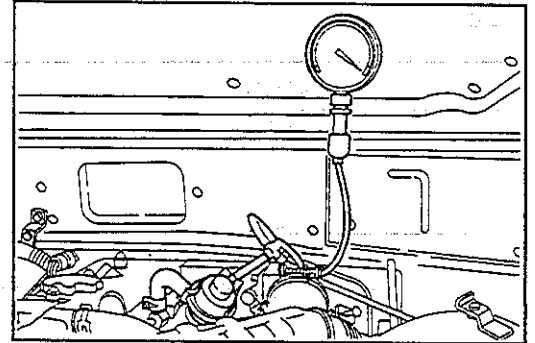


WRE91-EM279

1. Inspection of power control system

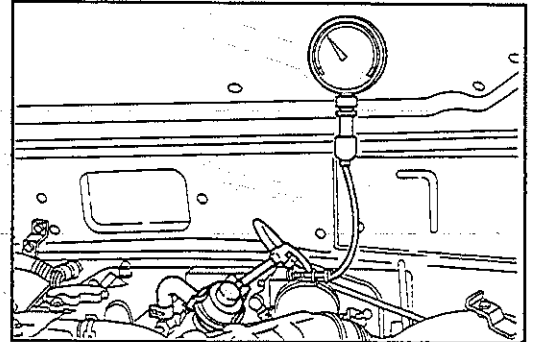
(1) Connect a vacuum gauge between the by-pass valve and the VSV with the three-way interposed.

(2) Start the engine and depress the clutch pedal. When the shift lever is placed in R, 2, 3, 4 and 5 positions, ensure that the pointer of the vacuum gauge registers zero.



WRE91-EM280

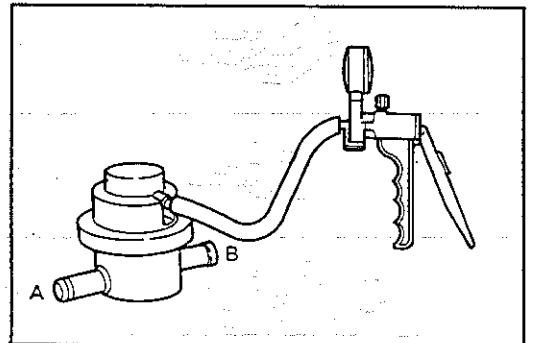
(3) Start the engine and depress the clutch pedal. When the shift lever is set to the 1st position, ensure that negative pressure is applied to the vacuum gauge.



WRE91-EM281

2. Check the by-pass valve.

(1) Connect a MityVac to the by-pass valve. When a negative pressure of 56.0 kPa (420 mmHg) or more is applied, ensure that air continuity exists between the ports A and B.



WRE91-EM282

3. Check the VSV.

(1) When the battery voltage (12V) is applied between the terminals, confirm the following items.

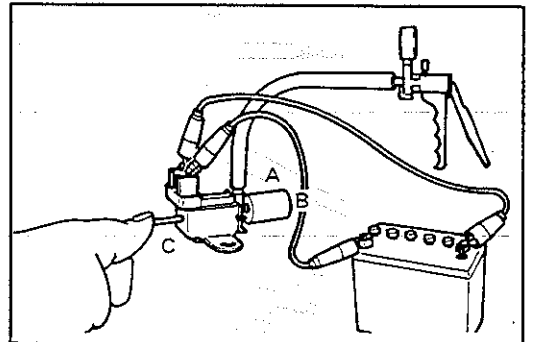
Between A and B: Air continuity exists.

Between A and C: No air continuity exists.

(2) When no battery voltage (12V) is applied between the terminals, confirm the following items.

Between A and B: No air continuity exists.

Between A and C: Air continuity exists.



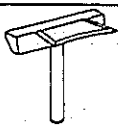
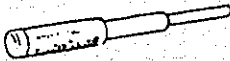
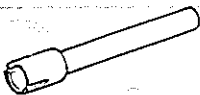
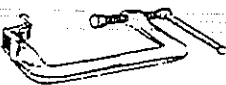
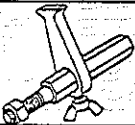
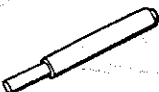
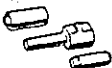
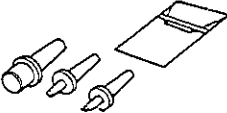
WRE91-EM283

(3) Measure the resistance between the terminals.

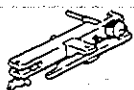
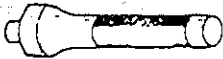
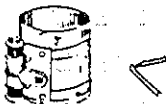
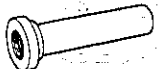
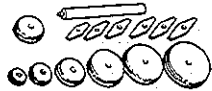
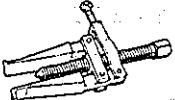
Specified Value: 37 - 40Ω (at 20°C)

ENGINE MECHANICAL

SST

Shape	Part number & name	Remark
	09032-00100-000 Oil Pan Seal Cutter	Used for removing oil pan
	09201-60011-000 Valve guide bush remover & replacer	Used for removing/replace valve guide, bush
	09201-87703-000 Valve stem oil seal replacer	Used for replace valve stem oil seal
	09202-87002-000 Valve cutter remover & replacer	Used for remove/replace valve spring
	09210-87701-000 Flywheel holder	Prevent crankshaft from turning
	09213-31021-000 Crankshaft pulley puller	Used for remove crankshaft timing pulley
	09214-60010-000 Crankshaft pulley gear replacer	Used for replace crankshaft timing pulley
	09215-87601-000 Camshaft bearing remover & replacer	Used for remove/replace camshaft bearing
	09221-87301-000 Cylinder liner remover & replacer	Used for remove/replace cylinder liner
	09221-87601-000 Piston pin remover & replacer	Used for remove/replace piston pin
	09222-87303-000 Connecting rod bush remover & replacer	Used for remove/replace connecting rod bush
	09258-00030-000 Plug set	Plugged lubber hose
	09253-87201-000 Crankshaft bearing No.1 inner race replacer	Used for press fit seal set
	09268-87310-000 Nozzle holder wrench	Used for remove/replace injection nozzle

ENGINE MECHANICAL

Shape	Part number & name	Remark
	09275-87701-000 Pluger stroke measuring tool	Used for adjust injection timing
	09301-20020-000 Clutch guide tool	Used for assemble clutch disc
	09303-35011-000 Input shaft front bearing puller	Used for remove flywheel bearing
	09304-12012-000 Input shaft front bearing replacer	Used for pressfit flywheel bearing
	09950-20017-000 Universal puller	Used for remove injection pump timing pulley
	09217-87001-000 Piston ring compressor	Used for guide piston inset
	09310-87302-000 Counter shaft rear bearing replacer	Used for pressfit crankshaft front oil seal
	09608-87302-000 Drive pinion bearing tool set	Used for pressfit crankshaft rear oil seal
	09308-10010-000 Oil seal puller	Used for remove crankshaft rear/front oil seal

WRE91-EM284

ENGINE MECHANICAL

TIGHTENING TORQUE

Tightening component		Tightening torque			Remark
		N·m	kgf·m	ft·lb	
Cylinder head	× Cylinder head cover	5.4 ± 1.5	0.55 ± 0.15	4.0 ± 1.1	
	× Intake manifold	36.8 ± 7.4	3.75 ± 0.75	27.1 ± 5.4	
	× Exhaust manifold	46.6 ± 7.4	4.75 ± 0.75	34.4 ± 5.4	
	× Glow plug	12.8 ± 2.9	1.30 ± 0.30	9.4 ± 2.2	
	× Injector pipe bracket	18.1 ± 3.4	1.85 ± 0.35	13.4 ± 2.5	
	× Water temperature sender	22.1 ± 2.5	2.25 ± 0.25	16.3 ± 1.8	
Cylinder block	× Cylinder head	117.7 ± 9.8	12.00 ± 1.00	86.8 ± 7.2	Wet
	× Crankshaft bearing cap	103.0 ± 6.9	10.50 ± 0.70	75.9 ± 5.1	Wet
	× Push rod cover	9.3 ± 2.5	0.95 ± 0.25	6.9 ± 1.8	
	× Oil pan	9.3 ± 2.5	0.95 ± 0.25	6.9 ± 1.8	
	× Engine mounting bracket (front)	36.8 ± 7.4	3.75 ± 0.75	27.1 ± 5.4	
	× Camshaft retainer × belt case	18.1 ± 3.4	1.85 ± 0.35	13.4 ± 2.5	
	× Oil hose No.1	17.2 ± 2.5	1.75 ± 0.25	12.7 ± 1.8	
	× Oil hose No.2	22.1 ± 2.5	2.25 ± 0.25	16.3 ± 1.8	
	× Oil pump inlet pipe	18.1 ± 3.4	1.85 ± 0.35	13.4 ± 2.5	
	× Oil pump outlet pipe	44.1 ± 7.4	4.50 ± 0.75	32.5 ± 5.4	
	× Idle shaft	34.3 ± 4.9	3.50 ± 0.50	25.3 ± 3.6	Wet
	× Injection pump	18.1 ± 3.2	1.85 ± 0.35	13.4 ± 2.5	
	× Timing belt cover	12.8 ± 2.9	1.30 ± 0.30	9.4 ± 2.2	
	× Oil pump inlet pipe	18.1 ± 3.4	1.85 ± 0.35	13.4 ± 2.5	
	× Oil pump outlet pipe	18.1 ± 3.4	1.85 ± 0.35	13.4 ± 2.5	
	× Oil pump relief plug	39.2 ± 4.9	4.00 ± 0.50	28.9 ± 3.6	
	× Oil filter bracket	36.8 ± 7.4	3.75 ± 0.75	27.1 ± 5.4	
Connecting rod	× Connecting rod cap	68.6 ± 4.9	7.00 ± 0.50	50.6 ± 3.6	Wet
Crankshaft	× Flywheel	125.0 ± 12.3	12.75 ± 1.25	92.3 ± 9.0	Wet
Crankshaft	× Crankshaft pulley	215.7 ± 19.6	22.00 ± 2.00	159.1 ± 14.5	Wet
Camshaft	× Camshaft pulley	41.7 ± 7.4	4.25 ± 0.75	30.8 ± 5.4	
Rocker arm	× Adjusting screw	19.6 ± 2.9	2.00 ± 0.30	14.5 ± 2.2	Wet
Valve rocker shaft	× Valve rocker support	5.9 ± 1.0	0.60 ± 0.10	4.3 ± 0.7	
Oil filter bracket	× T/C oil inlet pipe	12.8 ± 2.9	1.30 ± 0.30	9.4 ± 2.2	
Oil filter bracket	× Oil cooler	49.0 ± 9.8	5.00 ± 1.00	36.2 ± 7.2	
Oil filter bracket	× Oil pressure valve	39.2 ± 4.9	4.00 ± 0.50	28.9 ± 3.6	
T/C	× T/C oil outlet pipe	7.4 ± 1.5	0.75 ± 0.15	5.4 ± 1.1	
Oil filter	× Oil filter bracket	19.6 ± 2.0	2.00 ± 0.20	14.5 ± 1.5	

Tightening component		Tightening torque			Remark
		N-m	kgf-m	ft-lb	
Injection pump	× Injection pump drive pulley	83.4 ± 4.9	8.50 ± 0.50	61.5 ± 3.6	
	× Injection pipe	24.5 ± 4.9	2.50 ± 0.50	18.1 ± 3.6	
	× Delivery valve holder	49.0 ± 4.9	5.00 ± 0.50	36.2 ± 3.6	
	× Nozzle leakage No.2	36.8 ± 2.5	3.75 ± 0.25	27.1 ± 1.8	
	× Union (fuel return)	24.5 ± 4.9	2.50 ± 0.50	18.1 ± 3.6	
	× Union	24.5 ± 4.9	2.50 ± 0.50	18.1 ± 3.6	
	× Distributive head bolt	17.2 ± 2.9	1.75 ± 0.30	12.7 ± 2.2	
	× Screw Ay overflow	7.4 ± 1.5	0.75 ± 0.15	5.4 ± 1.1	
Nozzle holder	× Cylinder head	68.6 ± 9.8	7.00 ± 1.00	50.6 ± 7.2	
	× Injection pipe	24.5 ± 4.9	2.50 ± 0.50	18.1 ± 3.6	
	× Nozzle leakage No.1	44.1 ± 4.9	4.50 ± 0.50	32.5 ± 3.6	
Alternator	× Alternator bclaket	36.8 ± 7.4	3.75 ± 0.75	27.1 ± 5.4	
Vacuum pump	× Oil hose No.1	17.2 ± 2.5	1.75 ± 0.25	12.7 ± 1.8	
	× Oil hose No.2	22.1 ± 2.5	2.25 ± 0.25	16.3 ± 1.8	
	× Union	22.1 ± 2.5	2.25 ± 0.25	16.3 ± 1.8	
Alternator	× Adjusting bar	29.4 ± 5.9	3.00 ± 0.60	21.7 ± 4.3	
Oil pan	× Drain plug	34.3 ± 4.9	3.50 ± 0.50	25.3 ± 3.6	
T/C	× Exhaust manifold	24.5 ± 4.9	2.50 ± 0.50	36.2 ± 3.6	
	× Outlet elbow	24.5 ± 4.9	2.50 ± 0.50	36.2 ± 3.6	
Glow plug	× Glow plug connector	1.5 – 2.9	0.15 – 0.30	1.1 – 2.2	
Crankshaft pulley	× Crankshaft pulley No.2	18.1 ± 3.4	1.85 ± 0.35	13.4 ± 2.5	
Radiator		9.8 ± 15.7	1.0 ± 1.6	7.2 ± 11.6	
Radiator	× Fan shroud	5.4 ± 1.5	0.55 ± 1.5	4.0 ± 1.1	
Exhaust manifold	× Exhaust manifold cover	12.7 ± 2.9	1.3 ± 0.3	9.4 ± 2.2	
Air cleaner		12.7 ± 2.9	1.3 ± 0.3	9.4 ± 2.2	
Inter cooler		18.1 ± 3.4	1.85 ± 0.35	13.4 ± 2.5	
Fuel filter flange		18.1 ± 3.4	1.85 ± 0.35	13.4 ± 2.5	
	× Fuel filter	18.1 ± 3.4	1.85 ± 0.35	13.4 ± 2.5	
	× Union	36.8 ± 7.4	3.75 ± 0.75	27.2 ± 5.4	
Glow plug connector		0.15 – 0.29	0.015 – 0.030	0.11 – 0.22	
Clamp injection pipe		24.5 ± 4.9	2.50 ± 0.50	18.1 ± 3.6	
Oil pressure switch		32.4 ± 10.8	3.30 ± 1.10	23.9 ± 8.0	

WRE91-EM285

ENGINE MECHANICAL

ENGINE SERVICE SPECIFICATION

Item			Engine type	DL-42	DL-52	
Cylinder capacity			cm ³	2,765		
Engine proper	Kind			Diesel, 4 cycle		
	Cylinder number and arrangement			4 cylinder-in-line, mounted longitudinally		
	Combustion chamber type			Swirl chamber type		
	Valve mechanism			Belt Drive OHV		
	Bore × Stroke			mm	92 × 104	
	Compression ratio			21.2		
	Compression pressure kPa (kgf/cm ²)/rpm	STD		3150 (32)/250		
		Minimum		2150 (22)/250		
		Difference between cylinders		490 (5)/250		
	Maximum Power	kW/rpm	SAE net	56/3800	—	
			DIN	54/3800	75/3400	
	Maximum Torque	Nm/rpm	SAE net	170/2200	—	
			DIN	170/2200	245/1900	
	Engine dimensions (Length × width × height)			mm	763 × 548 × 696	763 × 611 × 724
	Service engine weight			kg	236	250
	Value Timing	Intake	Open	25° BTDC		
			Close	55° ABDC		
Exhaust		Open	60° BBDC			
		Close	20° ATDC			
Valve clearance	Intake	mm	0.25 ± 0.05			
	Exhaust	mm	0.25 ± 0.05	0.35 ± 0.05		
Idle speed			rpm	650 ± 25		
Blow-by gas recirculating			Closed Type			
Lubricating system	Lubricating method			Fully forced feed method		
	Oil pump type			Trochoid Type		
	Oil capacity			dm ³	6.4	
Cooling system	Cooling method			Water cooled, V-belt type		
	Coolant capacity (with reserve tank)			dm ³	10.6	
	Thermostat type			wax type		

ENGINE MECHANICAL

Item		Engine type		DL-42	DL-52
Air cleaner type		Cyclone type, paper filter type			
Fuel system	Fuel tank capacity		dm ³	60	
	Injection pump	Injection Timing		1° BTDC (High altitude speed: 3°)	1° BTDC
		Plunger diameter		mm	9.0
		Cam lift		mm	2.2
		Governor type		Centrifugal type	
		Timer type		Hidraulic pressure type	
	Injection nozzle or injector	Nozzle retainer type			
		Nozzle type			
		Injection pressure kPa (kgf/cm ²)		10788 ± 1079 (110 ± 10)	(130 ± 10)
Engine electrical system	Voltage		V	12 (negative ground)	
	Firing order			1 - 3 - 4 - 2	
	Glow plug	Type		Sheathed type	
		Voltage, current		V-A	10.5 - 8.5, 7.0 - 8.5
	Battery Type			N100 or 95E41R	
	Alternator		Output V-A	12 - 45	
	Starter		Output V-kW	12 - 2.2	

WRE91-EM286

ENGINE MECHANICAL

THE ENGINE PROPER SPECIFICATIONS

NOTE:

- The entry figures are those values at a temperature of 20°C.

Cylinder liner outer diameter × Cylinder block bore diameter

mm

Combination number / Item	Cylinder liner outer diameter	Cylinder block bore diameter	Interference
1	96.025 - 96.040	96.000 - 96.015	0.01 - 0.04
2	96.040 - 96.055	96.015 - 96.030	0.01 - 0.04
3	96.055 - 96.070	96.030 - 96.045	0.01 - 0.04

WRE91-EM287

Cylinder liner inner diameter × Piston outer diameter (DL-42)

mm

Combination alphabetical letter / Item	Cylinder liner inner diameter	Piston outer diameter
A	92.02 - 92.03	91.95 - 91.96
B	92.01 - 92.02	91.94 - 91.95
C	92.00 - 92.01	91.93 - 91.94

WRE91-EM288

Cylinder liner inner diameter × Piston outer diameter (DL-52)

mm

Combination alphabetical letter / Item	Cylinder liner inner diameter	Piston outer diameter
A	92.02 - 92.03	91.94 - 91.95
B	92.01 - 92.02	91.93 - 91.94
C	92.00 - 92.01	91.92 - 91.93

WRE91-EM289

Cylinder block × Crankshaft × Crankshaft bearing

mm

Combination number / Item	Cylinder block main journal inner diameter	Crankshaft bearing thickness	Crankshaft main journal outer diameter
Journal No.			
No. 1, 5 Journal	1	72.000 - 72.010	67.960 - 67.975
	2	72.010 - 72.020	
No. 2, 3, 4 Journal	1	72.000 - 72.010	67.955 - 67.970
	2	72.010 - 72.020	

WRE91-EM290

Connecting rod large end × Crankshaft × Connecting rod bearing

mm

Combination No.	Connecting rod large end inner diameter	Crankshaft crankpin diameter	Connecting rod bearing thickness
1	58.000 - 58.010	54.975 - 54.990	1.485 - 1.490 [Blown]
2	58.010 - 58.020		1.490 - 1.495 [Black]

WRE91-EM291

Piston pin × Connecting rod small end × Piston pin hole

mm

Piston pin outer diameter	Connecting rod small end inner diameter	Piston pin hole inner diameter
27.993 - 28.000	28.005 - 28.020	27.985 - 27.995

WRE91-EM292

Valve lifter × Cylinder block

mm

Valve lifter outer diameter	Cylinder block valve lifter inner diameter
23.972 - 23.985	24.000 - 24.021

WRE91-EM293

Valve stem × Valve guide bush

mm

	Valve stem outer diameter	Valve guide bush inner diameter
Intake valve	8.968 - 8.984	9.01 - 9.03
Exhaust valve	8.934 - 8.950	9.01 - 9.03

WRE91-EM294

Valve rocker shaft × Valve rocker arm

mm

Valve rocker shaft outer diameter	Valve rocker arm inner diameter
18.472 - 18.493	18.512 - 18.533

WRE91-EM295

Connecting rod × Crankshaft

mm

Connecting rod large end thickness	Crankshaft pin journal thickness
33.90 - 33.95	34.10 - 34.15

WRE91-EM296

Pre combustion chamber × Cylinder head

mm

Pre combustion chamber outer diameter	Cylinder head pre combustion chamber inner diameter	Interference
37.030 - 37.045	37.000 - 37.030	0 - 0.045

WRE91-EM297

Valve guide bush × Cylinder head

mm

Valve guide bush outer diameter	Cylinder head valve guide bush inner diameter	Interference
14.035 - 14.053	14.000 - 14.018	0.018 - 0.053

WRE91-EM298

ENGINE MECHANICAL

Camshaft bearing × Cylinder block

mm

	Camshaft bearing outer diameter	Cylinder block Camshaft bearing inner diameter	Interference
No. 1	50.675 - 50.715	50.600 - 50.625	0.050 - 0.115
No. 2	50.375 - 50.415	50.300 - 50.325	0.050 - 0.115
No. 3	50.075 - 50.115	50.000 - 50.025	0.050 - 0.115
No. 4	49.775 - 49.815	49.700 - 49.725	0.050 - 0.115
No. 5	50.075 - 50.115	50.000 - 50.025	0.050 - 0.115

WRE91-EM299

Valve guide bush × Valve stem oil seal

mm

Valve guide bush outer diameter	Valve stem oil seal inner diameter	Interference
14.023 - 14.041	13.91 - 13.99	0.024 - 0.131

WRE91-EM300

Valve rocker shaft × Valve rocker support

mm

Valve rocker shaft outer diameter	Valve rocker support inner diameter No. 1, 2, 3, 4
18.472 - 18.493	18.500 - 18.521

WRE91-EM301

Camshaft × Camshaft bearing

mm

	Camshaft journal outer diameter	Camshaft bearing inner diameter
No. 1	46.559 - 46.575	46.600 - 46.625
No. 2	46.259 - 46.275	46.300 - 46.325
No. 3	45.969 - 45.975	46.000 - 45.025
No. 4	45.659 - 45.675	45.700 - 45.725
No. 5	45.359 - 45.375	45.400 - 45.425

WRE91-EM302

Piston ring × Piston (DL-42)

mm

	Piston ring thickness	Piston ring groove thickness
Compression ring No. 1	2.47 - 2.49	2.55 - 2.57
Compression ring No. 2	1.97 - 1.99	2.03 - 2.05
Oil ring	3.97 - 3.99	4.01 - 4.03

WRE91-EM303

Piston ring × Piston (DL-52)

mm

	Piston ring thickness	Piston ring groove thickness
Compression ring No. 1	7° Keystone ring	7° Keystone ring
Compression ring No. 2	1.97 - 1.99	2.06 - 2.08
Oil ring	3.97 - 3.99	4.01 - 4.03

WRE91-EM304

Connecting rod × Connecting rod small end bush

Connecting rod small end inner diameter	Connecting rod small end bush outer diameter	Interference
31.070 - 31.110	31.000 - 31.025	0.045 - 0.110

WRE91-EM305

Cylinder liner × Cylinder block upper gasket surface

Cylinder liner flange section thickness	Depth of cylinder block flange section	Amount of protrusion
3.01 - 3.04	2.92 - 3.00	0.01 - 0.12

WRE91-EM306

Valve × Cylinder head lower gasket surface

	Valve recession amount
Intake valve	1.00 - 1.70
Exhaust valve	1.00 - 1.70

WRE91-EM307

Camshaft × Camshaft timing belt pulley

Camshaft outer diameter	Camshaft timing belt pulley inner diameter	Interference
28.008 - 28.021	28.000 - 28.021	-0.013 - 0.021

WRE91-EM308

Precombustion chamber × Cylinder head lower gasket surface

Precombustion chamber flange height	Depth of cylinder head section	Amount of protrusion
6.000 - 6.005	5.950 - 0	0 - 0.100

WRE91-EM309

Cylinder Head

Cylinder head lower gasket surface distortion		mm	0.1	
Manifold gasket surface distortion		mm	0.2	
Valve seat	Seat width	mm	Intake	1.4
			Exhaust	1.4
	Correction angle		Intake	15, 45, 75
			Exhaust	15, 45, 75
Guide bush striking temperature		°C	Normal temperature	

WRE91-EM310

ENGINE MECHANICAL

Valve Spring

Item	Specified value	Allowable limit
Free length mm	46.0	43.7
Length installed mm	40.1	—
Tension as installed N(kgf)	264.8 (27.0)	225.6 (23.0)
Out-of-squareness mm	—	1.6

WRE91-EM311

Valve Lifter, Push Rod

Item	Specified Value	Allowable limit
Valve lifter oil clearance mm	0.015 - 0.049	0.1
Push rod bend mm	—	0.4

WRE91-EM312

Valve Rocker Arm & Shaft

Item	Specified value	Allowable limit
Oil clearance mm	0.019 - 0.061	0.1

WRE91-EM313

Valve Guid Bush

Protrusion from cylinder head (IN & EX) mm	16.0
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WRE91-EM314

Valve

Item	Specified value	Allowable limit
Stem oil clearance mm	Intake 0.026 - 0.062	0.10
	Exhaust 0.044 - 0.096	0.12
Head stock thickness mm	Intake 0.90 - 1.30	0.5
	Exhaust 0.90 - 1.30	0.5

WRE91-EM315

Camshaft & Bearing

Item	Specified value	Allowable limit
Run-out mm	—	0.05
Thrust clearance mm	0.10 - 0.19	0.30
Bearing oil clearance mm	No. 1 to No. 5 0.025 - 0.066	0.10
Cam lobe height mm	Intake 37.767	1.0
	Exhaust 37.767	1.0

WRE91-EM316

Valve Rocker Arm & Shaft

Item		Specified value	Allowable limit
Top gasket surface distortion		—	0.1
Cylinder liner	Wear	—	0.15
	Out-of roundness, taper	—	0.02
	Protrusion	0.01 - 0.12	—
	Pressing force	24518 (2500)	—

WRE91-EM313

Connecting Rod

Item		Specified value	Allowable limit
Big end thrust clearance		0.15 - 0.25	0.30
Bearing oil clearance		0.030 - 0.065	0.15
Piston pin oil clearance		0.005 - 0.027	0.05
Bend limit		—	0.05
Twist limit		—	0.05

WRE91-EM318

Crankshaft

Item			Specified value	Allowable limit	
Run-out			—	0.05	
Thrust clearance			0.050 - 0.159	0.25	
Journal uneven wear or taper			—	0.015	
Journal diameter [U/S finished diameter] mm	STD	No. 1, 5	67.960 - 67.975	—	
		No. 2, 3, 4	67.955 - 67.970		
	U/S 0.25	No. 1, 5	68.210 - 68.225	—	
		No. 2, 3, 4	68.205 - 68.220		
	U/S 0.50	No. 1, 5	68.460 - 68.475	—	
		No. 2, 3, 4	68.455 - 68.470		
	U/S 0.75	No. 1, 5	68.710 - 68.725	—	
		No. 2, 3, 4	68.705 - 68.720		
	U/S 1.00	No. 1, 5	68.960 - 68.975	—	
		No. 2, 3, 4	68.955 - 68.970		
Stem oil clearance		mm	No. 1, 5	0.025 - 0.060	0.15
			No. 2, 3, 4	0.030 - 0.065	
Crankpin diameter [U/S finished diameter] mm	STD		54.975 - 54.990	—	
	U/S 0.25		54.725 - 54.740	—	
	U/S 0.50		54.475 - 54.490	—	
	U/S 0.75		54.225 - 54.240	—	
	U/S 1.00		53.975 - 53.990	—	

WRE91-EM319

ENGINE MECHANICAL

Flywheel

Item	Specified value	Allowable limit
Run-out mm	—	0.2

WRE91-EM320

Intake, Exhaust Manifold

Item	Specified value	Allowable limit
Gasket surface distortion mm	Intake	—
	Exhaust	—
		0.4
		0.4

WRE91-EM321

Piston, Piston Ring

Item		Specified value	Allowable limit	
Piston mm	STD	91.93 - 91.96	—	
	O/S 1.00	92.93 - 92.96	—	
Piston oil clearance mm	DL-42	0.060 - 0.080	0.12	
	DL-52	0.070 - 0.090	0.12	
Piston ring end gap mm	No. 1	0.35 - 0.50	—	
	No. 2	0.30 - 0.45	—	
	OIL	0.30 - 0.50	—	
Piston ring side clearance mm	No. 1	DL-42	0.06 - 0.10	—
		DL-52	7° Keystone ring	—
	No. 2	DL-42	0.04 - 0.08	—
		DL-52	0.07 - 0.11	—
	OIL	0.02 - 0.06	—	
Piston pin installing temperature °C		60 - 70	—	

WRE91-EM322

Camshaft timing pulley, Crankshaft timing pulley, Injection timing pulley

Item	Specified value	Allowable limit
Timing pulley diameter mm	Camshaft timing pulley	119.95 - 120.07
	Crankshaft timing pulley	59.37 - 59.47
	Injection pump timing pulley	119.904 - 120.044
		119.85

WRE91-EM323

Oil pump

Item	Specified value	Allowable limit
Relief valve opening pressure kPa (kgf/cm ²)	441.3 - 539.4 (4.5 - 5.5)	—
Side clearance mm	0.03 - 0.085	0.15
Body clearance mm	0.1 - 0.16	0.40

WRE91-EM324

Radiator

Item	Specified value	Allowable limit
Radiator cap relief valve opening pressure kPa (kgf/cm ²)	73.6 - 103.0 (0.75 - 1.05)	58.8 (0.60)
Radiator leak test pressure kPa (kgf/cm ²)	117.7 (1.2)	—

WRE91-EM325

Waterpump

Item	Specified value	Allowable limit
Bearing installing temperature °C	80 - 90	—
Clearance between body and rotor mm	0.5	—

WRE91-EM326

Thermostat

Item	Specified value	Allowable limit
Valve opening temperature (Start to open at) °C	80 - 84	62
Valve full opening temperature °C	95 (High temp type 100)	—
Valve opening travel mm	10	6.0

WRE91-EM327

Waste gate valve, Turbo indicator lamp

Item	Specified value
Checking turbo indicator lamp	When pressure exceeds 23.5 kPa (0.34 kgf/cm ²) Turbo indicator lamp goes on. When pressure is below 19.6 kPa (0.20 kgf/cm ²) Turbo indicator lamp goes off.
Checking operation of waste gate valve	Shaft stroke: About 2 mm (With a pressure of 89.2 kPa (0.91 kgf/cm ²) applied)
Checking supercharging pressure (Running test)	58.9 - 83.4 kPa (0.55 - 0.85 kgf/cm ²)/At 3400 rpm

WRE91-EM328

Starter

Item		Specified value
Motor type		12V type
Nominal output kW		2.2
No-load characteristics	Voltage V	11.5
	Current A	120
	Revolution speed rpm	Not less than 4000

WRE91-EM329

ENGINE MECHANICAL

Alternator

Item	Specified value
Type	12V type
Maximum output	45 A
Output revolution speed	rpm Not more than 3500

WRE91-EM330

Alternator Regulator

Item	Specified value
Regulating voltage	V 13.8 - 14.8
Voltage relay actuating voltage	V 4.0 - 5.8

WRE91-EM331

Injection Nozzle, Nozzle Holder

Item	Specified value	Allowable limit
Nozzle opening pressure	kPa (kgf/cm ²) 10297 - 11278 (105 - 115)	
Adjusting shim thickness (For adjusting nozzle opening pressure)	20 sizes in 0.05 mm (0.002 inch) increment	

WRE91-EM332

INJECTION PUMP

		DL-42		DL-52	
		STD	OPT	General	Austria, Switzerland
Pump specifications	Plunger diameter mm	9	9	9	9
	Cam lift mm	2.2	2.2	2.2	2.2
	Suction return amount mm ³	40	40	37.5	37.5
	Injection order	A B C D	A B C D	A B C D	A B C D
	Governor specifications	All speeds	All speeds	All speeds	All speeds
Characteristics	Overflow amount l/h/rpm	21 - 47/1900	21 - 47/1900	17 - 37/1700	17 - 37/1700
	Injection amount	Increase amount during starting period mm ³ /st/rpm	66 - 85/100	66 - 85/100	66 - 85/100
		End of increase effect mm ³ /st/rpm	41.5 - 50.5/400	41.5 - 50.5/400	50 - 58/350
		Full load mm ³ /st/rpm	42.15 - 43.65/1100	39.25 - 40.75/1100	65.75 - 67.75/1100
			38 - 43/500	35.1 - 40.1/500	42.7 - 45.7/500
			44 - 49/1450	41.1 - 46.1/1450	51 - 54/680
			40.5 - 44.5/1900	38.6 - 43.6/1900	65 - 70/1700
	Governor	High-speed side mm ³ /st/rpm	16.5 - 24.5/2250	17.5 - 23.5/2250	*17.75 - 27.75/2250
			24.5 - 32.5/2100	35 - 43/2100	56.5 - 64.5/1800
		Low-speed side	2 or less/2600	2 or less/2450	2 or less/2500
			6.5 - 11.5/350	6.5 - 11.5/350	*26.5 - 11.5/350
	Timer	mm/rpm	0 - 1.0/700	0 - 0.98/700	*10.7 - 1.7/700
			2.0 - 3.0/1100	1.85 - 1.85/1100	*0.6 - 1.6/750
			3.7 - 4.7/1450	3.5 - 4.5/1450	2.2 - 3.2/1100
			5.7 - 6.5/2250	6.16 - 6.95/2250	3.4 - 4.4/1500
	Altitude compensator (N = 1100 rpm with lever positioned at full stroke position) mm ³ /st/kPa (mmHg)		—	38.5 - 41/94.6 (710)	—
			—	33.8 - 37.8/82.7 (620)	—
			—	30.3 - 33.7/70.7 (530)	—
			—	—	—
	Boost compensator (Np = 1100 rpm) mm/kPa (mmHg)		—	42.7 - 49.7/0	42.7 - 49.7/0
			—	51.2 - 55.2/24.0 (180)	51.2 - 55.2/24.0 (180)
			—	55.6 - 59.6/33.3 (250)	55.6 - 59.6/33.3 (250)
			—	65.75 - 67.25/66.7 (500)	65.75 - 67.25/66.7 (500)
	Load sension timer mm/mm ³ /st		—	—	1.53 - 2.53/50
			—	—	3.38 - 4.38/Full
	Automatic cold start device mm/°C		—	—	2.05/-10
			—	—	0.6 - 0.9/25
			—	—	0/45

*1: Characteristics when Pb = 66.7 kPa (500 mmHg)

*2: Characteristics when Pb = 0 kPa (0 mmHg)