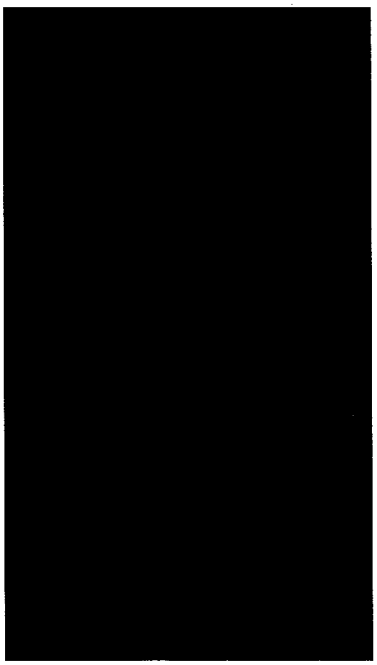
SERVICE MANUAL



MITSUBISHI DIESEL ENGINE

D04FD-TAA

for HYUNDAI HEAVY INDUSTRIES CO.,LTD.

November 2006

MITSUBISHI HEAVY INDUSTRIES, LTD.

INTRODUCTION

This service manual describes the specifications, maintenance and service procedures for Mitsubishi diesel engines.

To maintain the performance of the engine for many years and to ensure safe operation, it is important to use the engine correctly and conduct regular inspection and maintenance, and also to take necessary measures which involves the disassembly, inspection, repair and reassembly of the engine and engine parts.

Read this manual carefully and understand the work procedures fully before disassembling, inspecting, repairing or reassembling the engine.

The contents of the manual are based on the engine models that are being produced at the time of publication. Due to improvements made thereafter, the actual engine that you work on may differ partially from the one described in this manual.

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How to use this manual

This service manual consists of several Groups, which are arranged so as to allow you to make reference quickly to specifications, maintenance standards, adjustment procedures and service procedures including methods for disassembly, inspection, repair and reassembly of the Mitsubishi Diesel Engine (standard model for land use).
A short summary describing the content of each Group is given in the General Contents page, and there is also a detailed table of contents at the beginning of each Group.
Regarding the procedures for operation and periodical maintenance of the engine, refer to the Operation and Maintenance Manual. For information on the engine components and ordering of service parts, refer to the Parts Catalogue. Structure and function of the engine are described in the relevant training manuals.

Methods of presentation

(1)Index numbers alloted to parts in exploded views are not only a call-out of part names listed in the text but also an indication of the sequence of disassembly.
(2)Inspections to be conducted during disassembly process are indicated in boxes in the relevant exploded views.
(3)Maintenance standards required for inspection and repair works are indicated in the appropriate positions in the text. They are also collectively indicated in Group 2, the General Contents group.
(4)Fasteners to be tightened in "wet" condition, or with engine oil applied, are identified by [Wet] placed after tightening torque values. If no such indication is suffixed, the fastener should be tightened in "dry" condition, or without lubricating with engine oil.
(5)In this manual, important safety or other cautionary instructions are emphasized with the following marks headed.

⚠ DANGER

Indicates an immediately hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION

Indicates an immediately hazardous situation which, if not avoided, may result in minor or moderate injury.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, can result in property damage.

Note:

Indicates important information or information useful for operation or maintenance of the engine.

Terms used in this manual

Nominal

means the rated (design) size or magnitude of a part to be measured.

Standard

means the quantitative requirement for dimension of a part, clearance between parts and performance. This is given in a form of tolerance. Therfore, the values shown are not in agreement with the design values.

Limit

means that, if this value is reached, the part must be repaired or replaced with a new part.

Abbreviations

- BTDC: Before Top Dead Center
- ATDC: After Top Dead Center
- BBDC: Before Bottom Dead Center
- ABDC: After Bottom Dead Center
- TIR: Total Indicated Runout
- API: American Petroleum Institute
- ASTM: American Society for Testing and Materials
- JIS: Japanese Industrial Standards
- LLC: Long Life Coolant
- MIL: Military Specifications and Standards (U.S.)
- MSDS: Material Safety Data Sheet
- SAE: Society of Automotive Engineers (U.S.)

Units of Measurement

Measurements are based on the International System of Units (SI), and their converted metric values are indicated in parentheses { }. For metric conversion, the following rates are used.

- Pressure: 1 MPa = 10.197 kgf/cm^2
- Torque: 1 N·m = 0.10197 kgf·m
- Force: 1 N = 0.10197 kgf
- Horsepower: 1 kW = 1.341 HP = 1.3596 PS
- Meter of mercury: 1 kPa = 0.7 cmHg
- Meter of water: 1 kPa = 10.197 cmH_2O (cmAq)
- Rotational speed: 1min^{-1} = 1 rpm

Safety Cautions

⚠ WARNING

Fire and explosion

Keep flames away

Store fuel and engine oil in a well-ventilated designated area.
Make sure that the caps of fuel and engine oil containers are tightly closed.
Do not use flames, do not smoke, or do not work near heater or other fire hazards where fuel or oil is handled or when cleaning solvent is being used for washing parts.
Wipe off spilled fuel, oil and LLC immediately and thoroughly. Spilled fuel, oil and LLC may ignite and cause a fire.

Keep surrounding area neat and clean

Do not leave combustible or explosive materials, such as fuel, engine oil and LLC, near the engine. Such substances can cause fire or explosion.
Remove dust, dirt and other foreign materials accumulated on the engine and sorrounding parts thoroughly. Such materials can cause fire or the engine to overheat. In particular, clean the top surface of the battery thoroughly. Dust can cause a short-circuit.
Always operate the engine at a position at least 1 m [3.28 ft.] away from buildings and other equipment to prevent possible fire caused by engine heat.

Care about fuel, oil and exhaust gas leakage

If any fuel, oil or exhaust gas leakage is found, immediately take corrective measures to stop it.
Such leakages, if left uncorrected, can cause fuel or engine oil to reach hot engine surfaces or hot exhaust gas to contact flammable materials, possibly leading to personal injury and/or damage to equipment.

Use explosion-proof lighting apparatus

When inspecting fuel, engine oil, coolant, battery electrolyte, etc., use a flameproof light. An ordinary light, if it accidentally broken, may ignite and cause an explosion.

Prevent electrical wires from short-circuiting

Avoid inspecting or servicing the electrical system with the ground cable connected to the battery. Otherwise, a fire could result from short-circuiting. Be sure to disconnect the battery cable from the negative (-) terminal before beginning with the work procedure.
Short-circuits, possibly resulting in fire, may be caused by a loose terminal or damaged cable/wire. Inspect the terminals, cables and wires, and repair or replace the faulty parts before beginning with the service procedure.

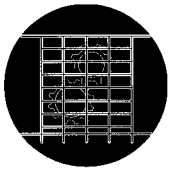
Keep fire extinguishers and first-aid kit handy

Keep a fire extinguisher handy and be familiarized with their usage.
Keep a first-aid kit at a designated place, and make sure it is easily accessible whenever needed.
Establish emergency procedures to follow in the event of fire or accident, and keep the personnel informed of emergency contact locations and contact methods.

⚠ WARNING

Stay clear of all rotating and moving parts

Install protective covers on rotating parts



Make sure the protective covers for engine rotating parts are properly installed as intended. Repair loose or damaged protective covers as necessary.

Never remove the covers guarding personnel from rotating parts, when the engine is operating.

When combining the engine with the engine-driven machine or radiator, always provide a cover on every exposed moving part such as driving belt and coupling. Never remove protective covers.

Ensure safety of neighboring people before starting engine

Before starting the engine, ensure that there is nobody in the neighborhood and no tools are left on or near the engine. Be sure to give a sign with a shout when starting the engine.

When a tag saying "Do not operate" is attached on or near the starter switch, never start the engine.

Stay clear of moving parts during engine running

Do not approach rotating or sliding parts of the engine when the engine is in operation.

Keep objects likely to be caught by rotating parts away from such parts.

If any part of the clothing or outfitting is caught by a rotating part, serious bodily injuries could result.

Lockout and Tagout

Be sure to lockout and tagout before starting inspection and maintenance.

Lockout and tagout are effective methods of cutting off machines and equipment from energy sources.

To accomplish the lockout/tagout, remove the starter switch key, set the battery switch to OFF and attach a "Do Not Run" or similar caution tag to the starter switch. The starter switch key must be kept by the person who performs inspection and maintenance during the work.

In the case of pneumatic starting type, close the main valve of the air tank and post a tag saying "Do Not Open the Valve" or the like.

Keep engine stopped during servicing

Be sure to stop the engine before proceeding to inspection and service procedure. Never attempt to make adjustments on the engine parts while the engine is running. Rotating parts such as belt can entangle your body and cause serious injuries.

Always restore engine turning tools after use

Do not forget to remove the tools which have been used for turning the engine during inspection or servicing, after the procedure is finished. Remember also that the turning gear must be returned to the operating condition before starting the engine.

Starting the engine with the turning tools inserted or with the turning gear in engagement can lead to not only engine damage but also personal injuries.

⚠ WARNING

Be careful of burns

Do not touch engine during or immediately after operation

Do not touch the engine during or immediately after operation to avoid risk of burns.

To conduct maintenance and inspection work, wait until the engine has cooled sufficiently, checking the temperature gauge.

Slowly and carefully open radiator cap

Never attempt to open the radiator cap while the engine is running or immediately after the engine stops. Give a sufficient cooling time to the engine coolant before opening the cap.

When opening the radiator cap, slowly turn the cap to release internal pressure. To prevent scalds with steam gushing out, wear thick rubber gloves or cover the cap with a cloth.

Close the radiator cap tightly without fail.

The coolant is very hot and under pressure during engine running or just after the engine stops. If the radiator cap is not closed tightly, steam and hot coolant may gush out and can cause scalds.

Add coolant only after coolant temperature dropped

Do not add coolant immediately after the engine stops. Wait until the coolant temperature lowers sufficiently to avoid a risk of burns.

⚠ WARNING

Protect ears from noises

Wear ear plugs

Always wear ear plugs when entering the machine room (engine room). Combustion sound and mechanical noise generated by the engine can cause hearing problems.

⚠ WARNING

Be careful of falling down

Lift engine correctly

For lifting the engine, always use a correct wire rope capable of withstanding the engine weight.
Also, attach the wire rope to the correct lifting hangers originally fitted on the engine using a correct sling.
During lifting process, keep the engine in a well-balanced position by taking the center of gravity of the engine into consideration.
During lifting process, keep the engine in a well-balanced position by taking the center of gravity of the engine into consideration.
If the wire rope contacts the engine directly, place a cloth or other soft padding between them to prevent damage to the engine and wire rope.

Do not get on engine

Do not get on top of the engine, nor step on any engine parts located on the lateral sides.
To work on parts located on the upper section of engine, use a ladder, stool, etc., firmly secured not to fall down.
Falling down of such footholds could result in not only to damage of the engine parts but also personal injuries.

⚠ CAUTION

Be careful of handling fuel, engine oil and LLC

Use only specified fuel, engine oil and coolant (LLC)

Use fuel, oil and LLC specified in this manual, and handle them carefully.
Use of any other fuel, oil or LLC, and improper handling may cause various engine problems and malfunctions.
Obtain the MSDSs issued by the fuel, oil and LLC suppliers, and follow the directions in the MSDSs for proper handling.

Handle LLC (long life coolant) carefully

When handling LLC, always wear rubber gloves and protective face mask. If LLC or cooling water containing LLC comes into contact with your skin or eyes, or if it is swallowed, you would suffer from inflammation, irritation or poisoning.
Should LLC be accidentally swallowed, induce vomiting immediately and seek medical attention. Should LLC enter your eyes, flush them immediately with plenty of water and seek medical attention. If LLC splashes onto your skin or clothing, wash it away immediately with plenty of water.
Keep flames away from LLC. The LLC can catch flames, causing a fire.
Drained coolant (containing LLC) is harmful. Do not dispose of it in unauthorized manner. Abide by the applicable law and regulations when discarding drained coolant.

Proper disposal of waste oil and coolant (LLC)

Do not discharge waste engine oil or coolant into sewerage, river, lake or other similar places. Such a way of disposal is strictly prohibited by laws and regulations.
Dispose of waste oil, coolant and other environmentally hazardous waste in accordance with the applicable law and regulations, or consult a Mitsubishi dealer.

⚠ CAUTION

Service battery

Handle battery correctly

- Never use flames or allow sparks to generate near the battery. The battery releases flammable hydrogen gas and oxygen gas. Any flames or sparks in the vicinity could cause an explosion.
- Do not use the battery the fluid level of which is lowered below the lower limit line. Sustained use of the battery could result in an explosion.
- Do not short the battery terminals with a tool or other metal object.
- When disconnecting battery cables, always remove the cable from the negative (-) terminal first. When reconnecting the cables, attach the cable to the positive (+) terminal first.
- Charge the battery in a well-ventilated area, with all filling hole plugs removed.
- Make sure the cable clamps are securely installed on the battery terminals. A loose cable clamp can cause sparks that may result in an explosion.
- Before servicing electrical components or conducting electric welding, set the battery switch to the [Open/OFF] position or disconnect the cable from the negative (-) battery terminal to cut off the electrical current.
- Electrolyte (battery fluid) contains dilute sulfuric acid. Careless handling of the battery can lead to the loss of sight and/or skin burns. Also, keep the battery fluid off the mouth.
- Wear protective goggles and rubber gloves when working with the battery (when adding water, charging, etc.).
- If electrolyte is spilled onto the skin or clothing, immediately wash it away with lots of water. Use soap to thoroughly clean.
- The battery fluid can cause blindness if splashing into eyes. If it gets into eyes, immediately flush it away with plenty of clean fresh water, and seek immediate medical attention.
- If the battery fluid is accidentally swallowed, gargle with plenty of water, then drink lots of water, and seek immediate medical attention.

⚠ CAUTION

When abnormality occurs

Stop overheated engine after cooling run

Even if the engine comes to overheat, do not stop the engine immediately. Abrupt stopping of an overheated engine can cause the coolant temperature to rise, resulting in seized engine parts. If the engine comes to overheat, run the engine at low idling speed (cooling operation), and stop the engine after the coolant temperature lowers sufficiently.

Do not add coolant immediately after stopping the engine. Adding coolant to a hot engine can cause the cylinder heads to crack due to sudden change in temperature. Add coolant little by little after the engine cools down to room temperature.

Avoid immediate restart after abnormal stop

If the engine stops abnormally, do not restart the engine immediately. If the engine stops with an alarm, check and remedy the cause of the problem before restarting. Sustained use of the engine without any remedy could result in serious engine problems.

Avoid continued engine operation with too low oil pressure

If an abnormal engine oil pressure drop is indicated, stop the engine as immediately as possible, and inspect the lubrication system to locate the cause. Continuing to operate the engine with low oil pressure may cause seizure of the bearings and other parts.

Stop the engine immediately if fan belt is broken

If the fan belt is broken, stop the engine immediately. Continued operation of the engine with the fan belt broken could cause the engine to overheat and thereby the coolant to boil into steam, which may gush out from the reserve tank or radiator, and cause personal injuries.

⚠ CAUTION

Other cautions

Modification of engine prohibited

Unauthorized modification of the engine will void the manufacturer's warranty.
Modification of the engine may not only cause engine damage but also produce personal injuries.

Pre-operational check and periodic inspection/maintenance

Be sure to perform the pre-operational checks and periodic inspection/maintenance as described in this manual.
Neglecting the pre-operational check or periodic inspection/maintenance can arouse various engine troubles such as damage to parts, eventually leading to serious accidents.

Break-in operation

A new engine needs to be broken in for the first 50 hours of operation. During this period, do not subject the engine to heavy loads.
Operating a new engine under high loads or severe conditions during the break-in period can shorten the service life of the engine.

Warming-up operation

After starting the engine, run the engine at low idling speeds for 5 to 10 minutes for warming-up. Start the work after this operation is completed.
Warm-up operation circulates the lubricant through the engine. Therefore, individual engine parts are well lubricated before they are subjected to heavy loads. This is very important for longer service life, high-performance and economical operation.
Do not conduct warm-up operation for a longer time than necessary. Prolonged warm-up operation causes carbon build-up in the cylinders that leads to incomplete combustion.

Avoid engine operations under overload condition

If the engine is considered to be in an overloaded condition which is identified by too much black smoke, etc., immediately reduce the load on the engine such that the correct output and load condtions may be achieved.
Overloading the engine causes not only high fuel consumption but also excessive carbon deposits inside the engine. Excessive carbon deposits can cause various engine problems and shorten the service life of the engine remarkably.

Cooling operation before stopping engine

Always conduct the cooling operation (low speed idling) for 5 to 6 minutes before stopping the engine.
Abruptly stopping the engine immediately after high-load operation can cause partial overheating and shorten the service life of the engine.
During cooling operation, check the engine for abnormalities.

Protection of engine against water entry

Do not allow rainwater, etc. to enter the engine through the air inlet or exhaust openings.
Do not wash the engine while it is operating. Cleaning fluid (water) can be sucked into the engine.
Starting the engine with water inside the combustion chambers can cause the water hammer action which may result in internal engine damage and serious accidents.

Maintenance of air cleaner or pre-cleaner

The major cause of abnormal wear on engine parts is dust entering with intake air. Worn parts produce many problems such as an increase of oil consumption, decrease of output, and starting difficulties. For effective removal of dust from intake air, conduct maintenance of the air cleaner according to the following instructions.

- Do not conduct maintenance of the air cleaner/pre-cleaner while the engine is operating. Engine operation without the air cleaner/precleaner in place allows foreign matters to enter the turbocharger, causing it to damage seriously.
- Remove the air cleaner/pre-cleaner slowly to prevent dust accumulated on the element from falling off. After removing the air cleaner or pre-cleaner, immediately cover the opening (inlet port in case of air cleaner; port in body in case of pre-cleaner) with plastic sheet or similar means to prevent dust from entering the engine.
- Air cleaners equipped with a dust indicator will issue an alarm if the element gets clogged. Service the cleaner as soon as possible if an alarm is issued.

Safety rules at work site

When operating or servicing the engine, always observe the applicable safety rules established at each work site.

If you are feeling ill, do not operate the machine, but inform the supervisor of your condition.

Unsatisfactory physical condition reduces the concentration. Operation of the machine with reduced concentration may cause operation errors that may result in accidents.

When working in a group, use specified hand signals to communicate among the workers.

Work clothing and protective gear

Wear a hardhat, face shield, safety shoes, dust mask, gloves and other protective gear as needed.

When handling compressed air, wear safety goggles, hardhat, gloves and other necessary protective gear. Works without wearing proper protective gear could result in serious injuries.

Use of tools optimum for each work

Always keep in mind to select most appropriate tools for the work to be performed and use them correctly. If tools are damaged, replace with new tools.

Avoidance of prolonged time of starter operation

Do not operate the starter for more than 10 seconds at a time even if the engine does not start. Wait for at least 30 seconds before next engine cranking.

Continuous operation of the starter will drain the battery power and cause seizing of the starter.

Do not turn off battery switch during operation

If the battery switch is turned OFF when the engine is running, not only various meters will stop working but also the alternator may have its diode and transistor deteriorated.

Cautionary instructions for transporting engine

When transporting the engine on a truck, consider the engine weight, width and height to ensure safety. Abide by road traffic law, road vehicles act, vehicle restriction ordinance and other pertinent laws.

Avoid continuous engine operation under low load conditions

Do not operate the engine continuously for more than 10 minutes with a load of less than 30%. Engine operation under low load conditions increases the emission of unburned fuel. Therefore, a prolonged time of engine operation under low load conditions increases the quantity of unburned fuel adhering to engine parts, provoking the possibility of engine malfunctioning and shortening the service life of the engine.

Ventilation of engine room

Always keep the engine room well-ventilated. Insufficient amount of intake air causes the operating temperature to rise, resulting in poor output and lowered performance.

It is highly recommended to calculate the required amount of air supply to the engine and install an adequate ventilation system before putting the engine to use.

Avoid contact with high-pressured fuel

Should fuel leak from a fuel injection pipe, do not touch the spouting fuel directly.

Fuel in the fuel injection pipes is under high pressure. If high-pressured fuel contacts you skin, it penetrates through the skin and may result in gangrene.

⚠ CAUTION

About warning labels

Maintenance of warning labels

Make sure all warning/caution labels are legible.

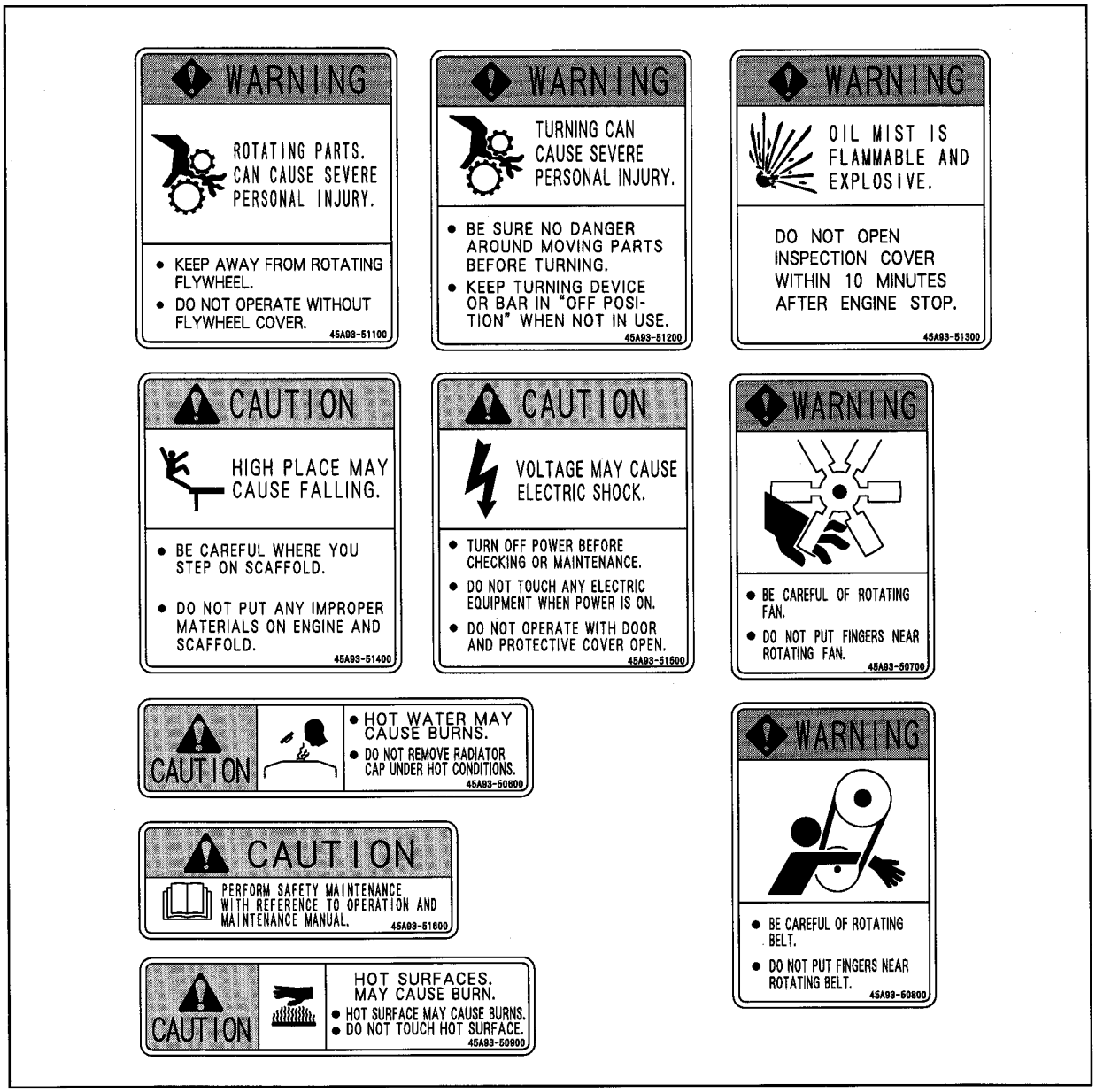
Clean or replace the warning/caution labels the description and/or illustration of which cannot be seen clearly.

For cleaning the warning/caution labels, use a cloth, water and soap. Do not use cleaning solvents, gasoline or other chemicals to prevent the letters from getting blurred or the adhesion from being weakened.

Replace damaged or fractured labels with new ones.

If any engine part on which a warning label is attached is replaced with a new one, attach a new identical warning label to the new part.

To obtain replacement warning labels, contact a Mitsubishi dealer.



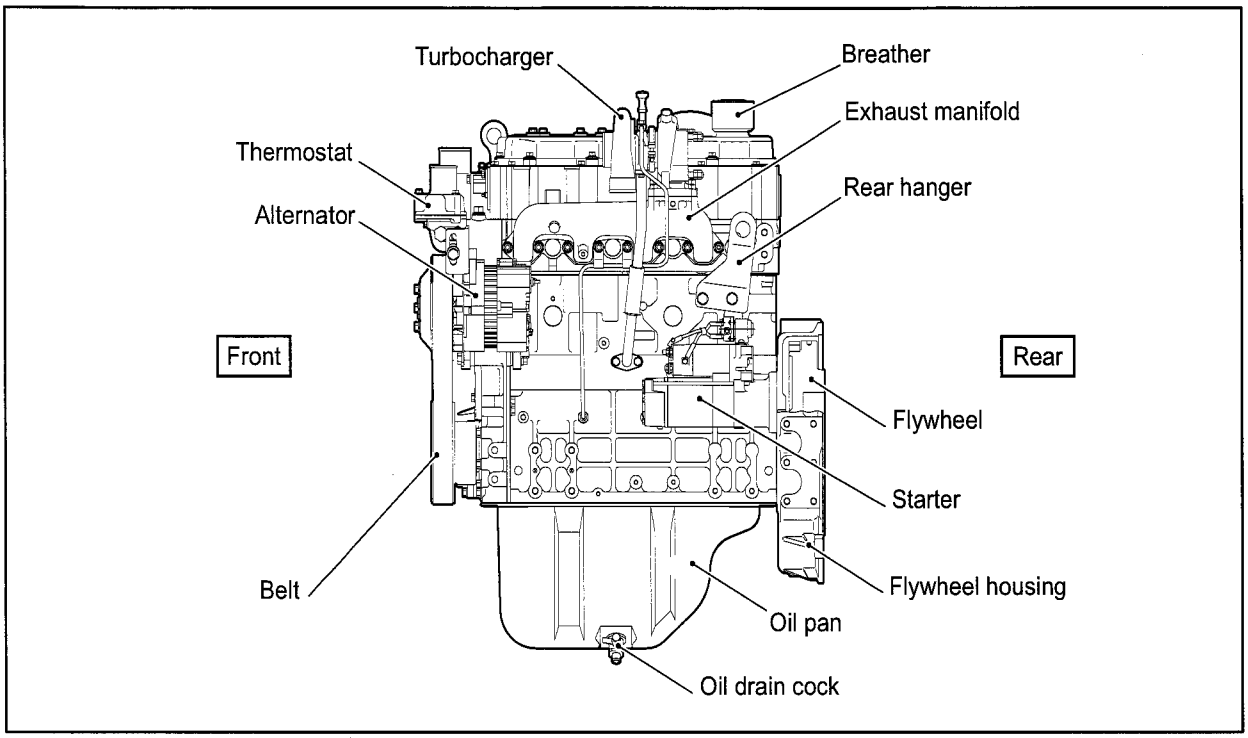
Warning labeles

GENERAL CONTENTS

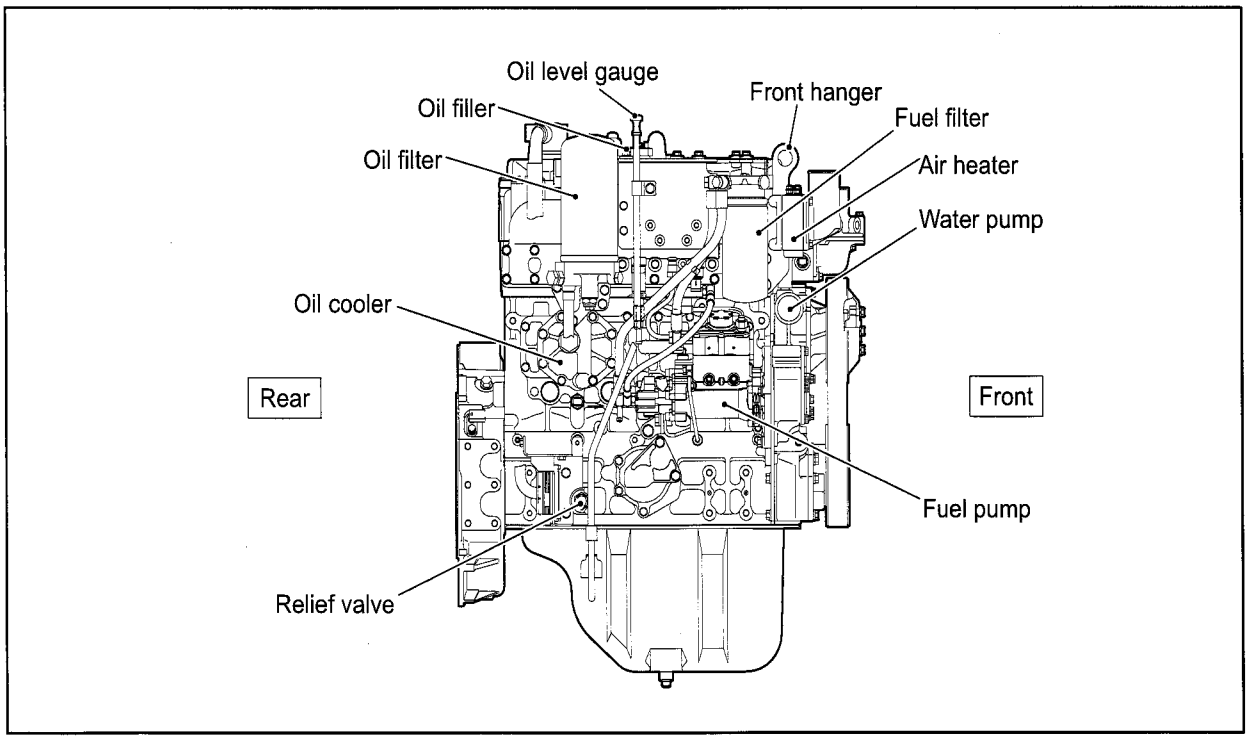
GENERAL

1. Outline drawings

1.1 D04FD-TAA Outline drawings



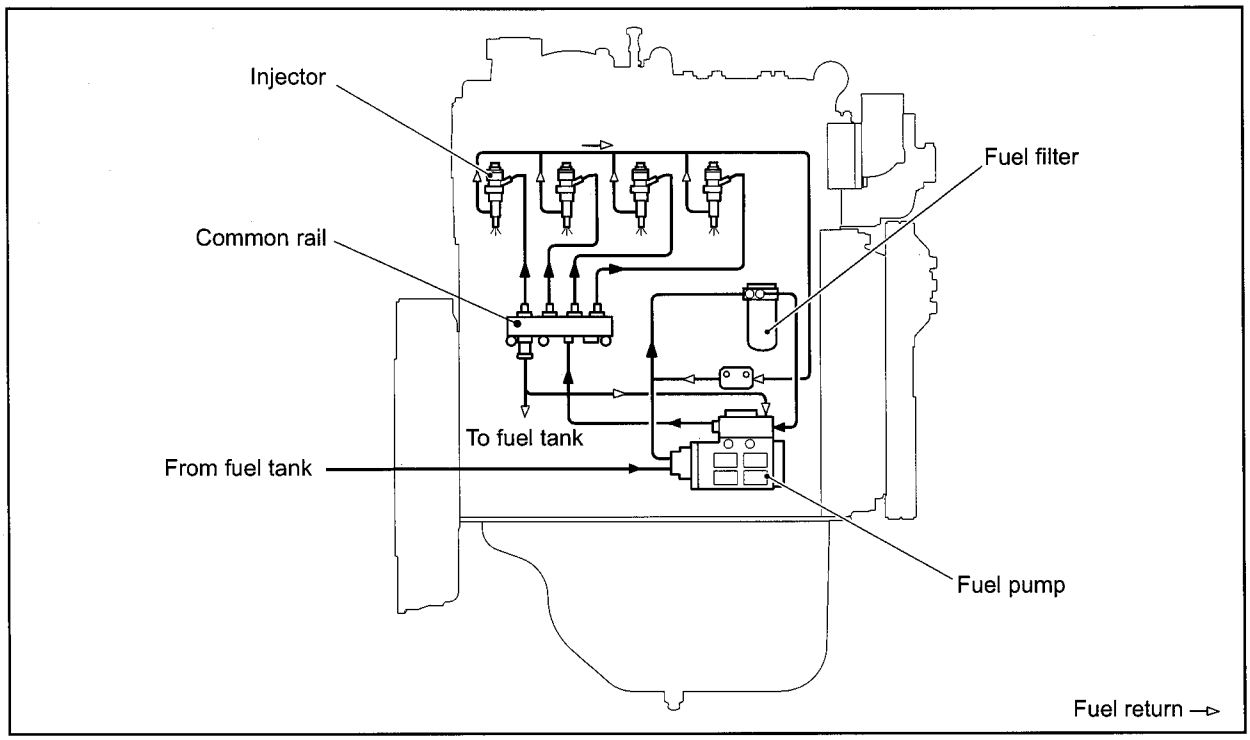
Engine left view



Engine right view

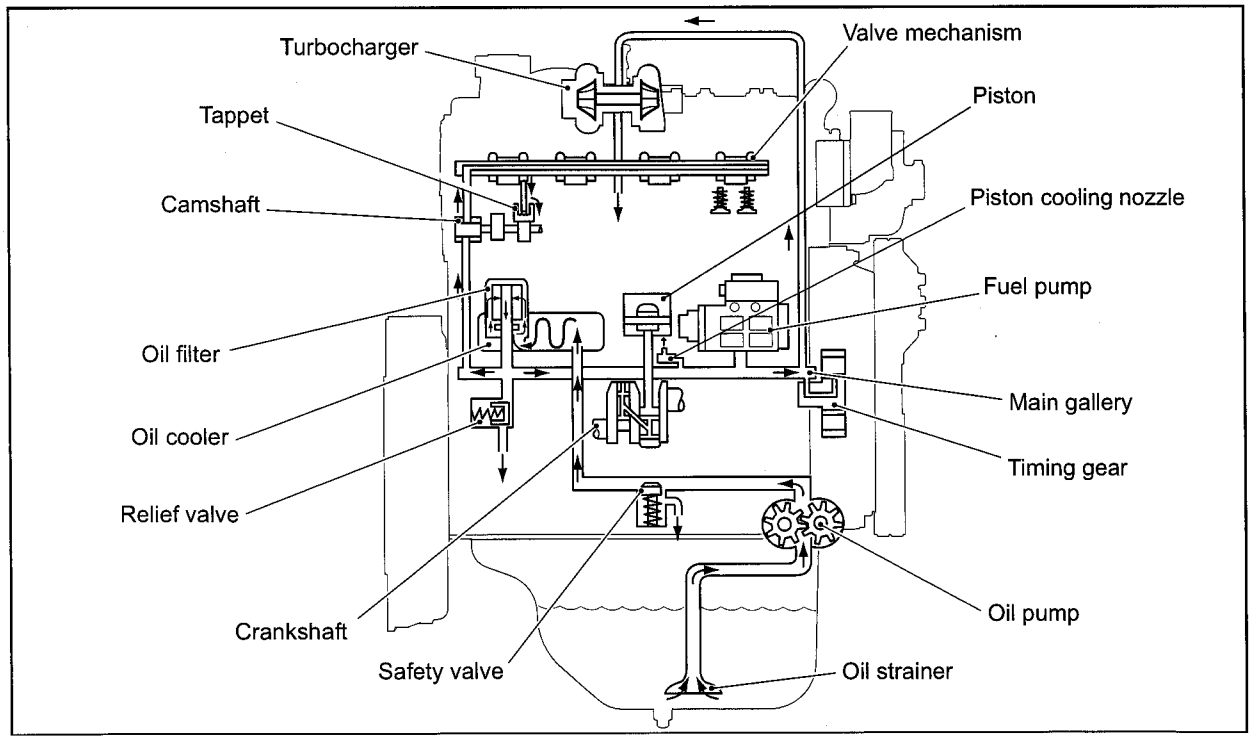
2. System flow

2.1 Fuel flow



Fuel flow

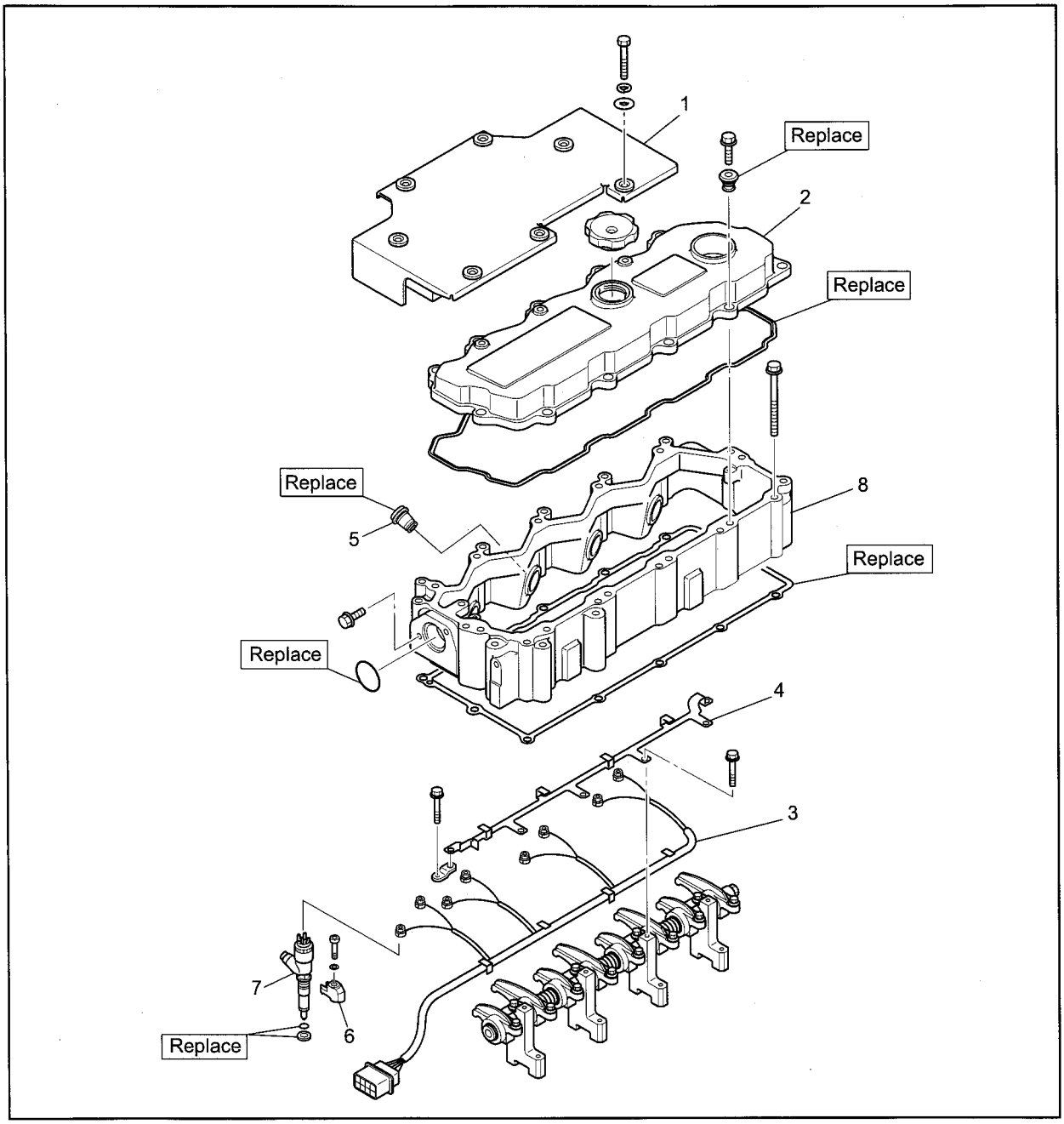
2.2 Oil flow



Oil flow

DISASSEMBLING ENGINE MAIN PARTS

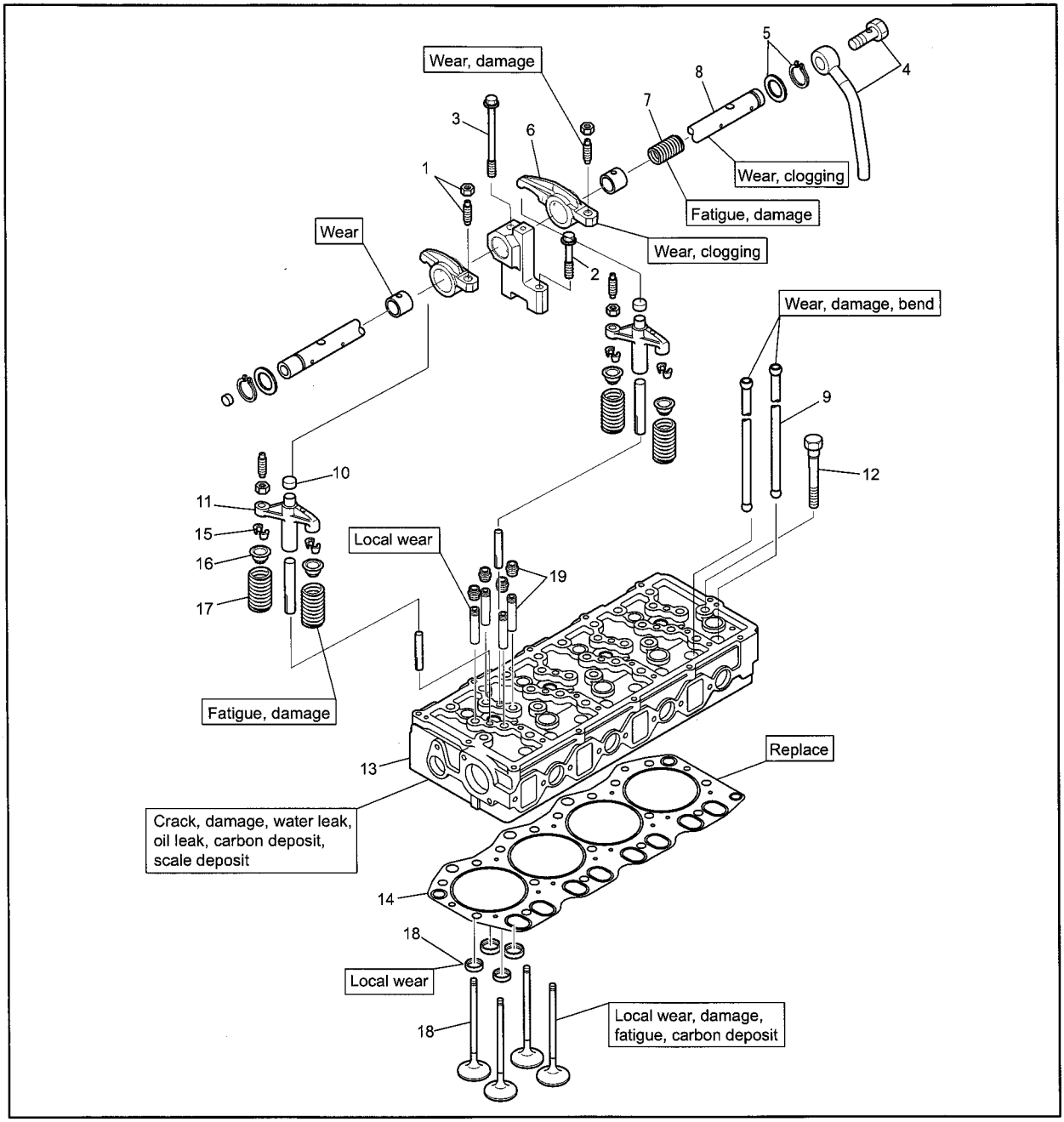
1. Disassembling and inspecting cylinder head and valve mechanism



Removing rocker case and injector

Disassembling sequence

1 Pipe cover
2 Rocker cover
3 Harness
4 Harness bracket
5 Injection seal
6 Nozzle gland
7 Injector
8 Rocker case



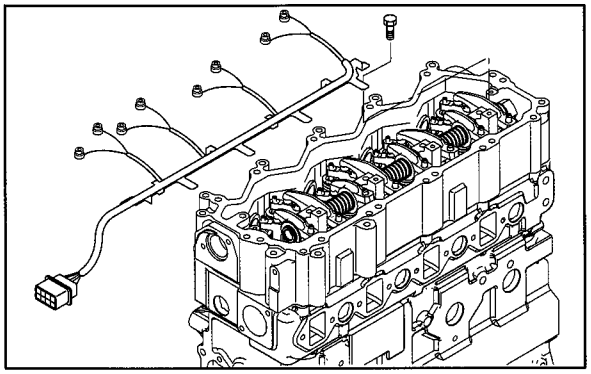
Disassembling and inspecting cylinder head and valve mechanism

Disassembling sequence

1 Adjusting screw
2 Bolt (short)
3 Bolt (long)
4 Eye bolt , oil pipe
5 Snap ring , spacer
6 Rocker arm
7 Rocker shaft spring
8 Rocker shaft
9 Pushrod
10 Bridge cap
11 Valve bridge
12 Cylinder head bolt
13 Cylinder head
14 Gasket
15 Valve cotter
16 Valve retainer
17 Valve spring
18 Valve , valve seat
19 Stem seal , valve guide

1.1 Removing harness

(1) Loosen the nuts of harness, and disconnect the harness from the injector.
(2) Remove the harness bracket together with the harness.

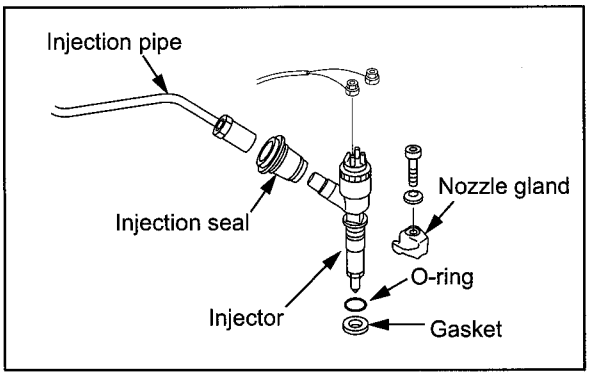


Removing harness

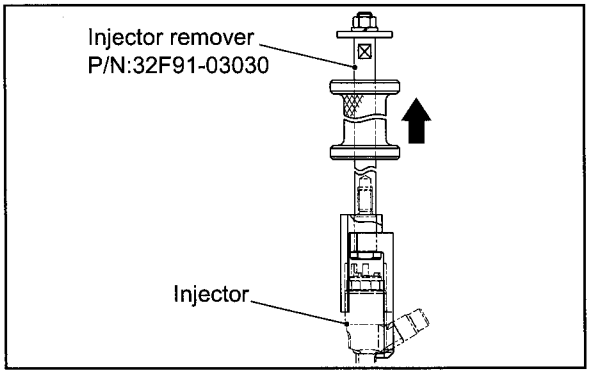
1.2 Removing injector

(1) Remove the injection pipe.
(2) Remove the injection seal.
(3) Using an injector remover, remove the injector together with the nozzle gland.
(4) Remove the gasket from cylinder head injector insertion opening.

Note: Make a note of the injector serial number of each cylinder. If reusing the injector, be sure to reinstall the injector to the same cylinder.
When replacing the injector with a new one, refer to "Troubleshooting."



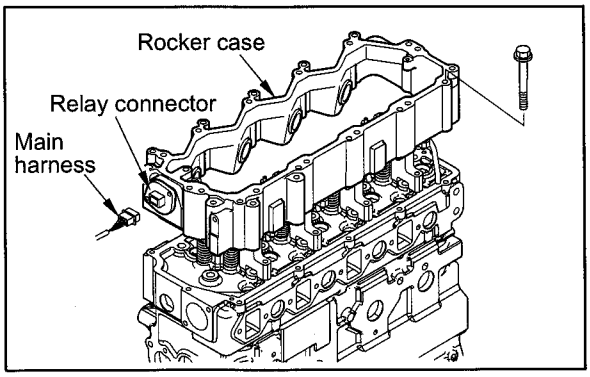
Removing injector



Pulling out injector

1.3 Removing rocker case

(1) Disconnect the relay connector from the main harness.
(2) Loosen the rocker case mounting bolts, and remove the rocker case from the cylinder head.



Removing rocker case

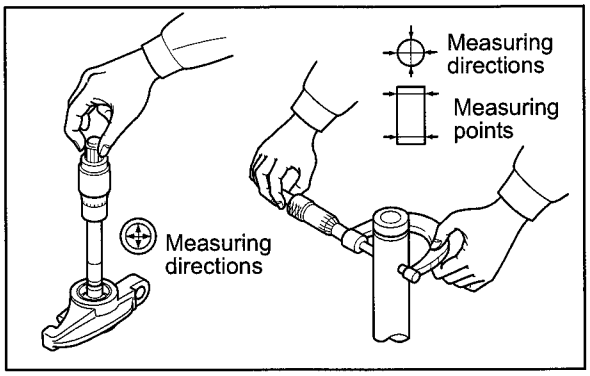
INSPECTING AND REPAIRING ENGINE MAIN PARTS

1. Inspecting and repairing cylinder head and valve mechanism

1.1 Measuring clearance between rocker bushing and rocker shaft

Measure the rocker bushing inside diameter and the rocker shaft diameter. If the clearance exceeds the limit, replace either rocker bushing or rocker shaft with a new one.

Item	Nominal	Standard	Limit
Rocker bushing inside diameter	ø 25 mm [0.98 in.]	24.949 to 24.975 mm [0.9822 to 0.9833 in.]	–
Rocker shaft outside diameter	ø 25 mm [0.98 in.]	24.915 to 24.928 mm [0.9809 to 0.9814 in.]	–
Clearance between rocker bushing and shaft	–	0.021 to 0.060 mm [0.0008 to 0.0024 in.]	0.078 mm [0.0031 in.]

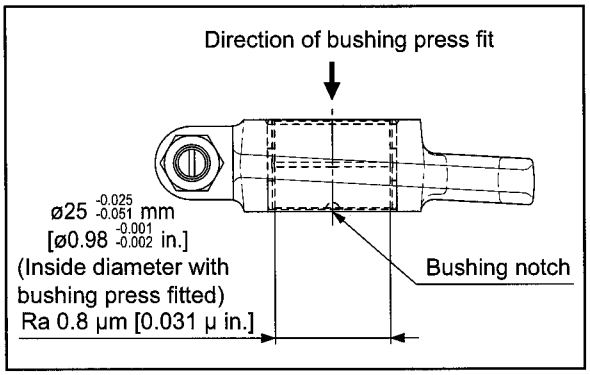


Measuring rocker bushing and rocker shaft

1.2 Replacing rocker bushing

To replace rocker bushings, use a hydraulic jack.

With the rocker bushing and the rocker arm oil holes mated, and the bushing joint faced upward, press fit the rocker bushing.

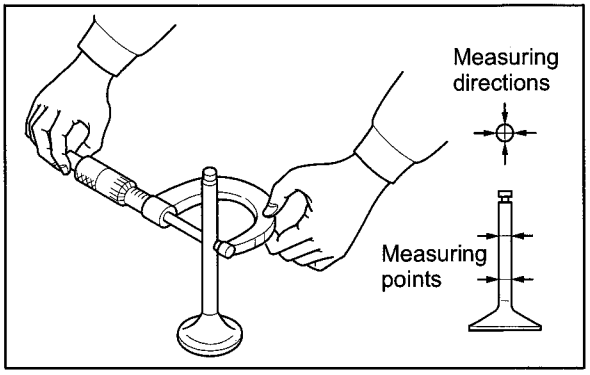


Replacing rocker bushing

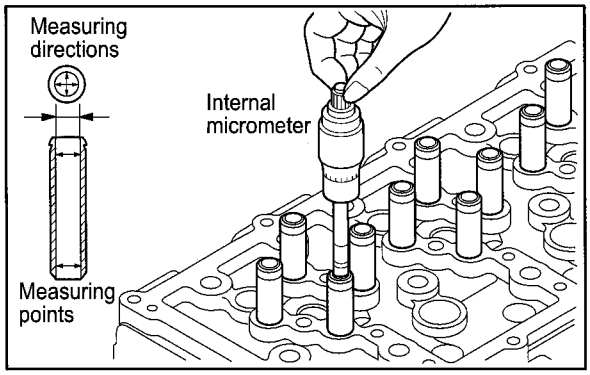
1.3 Measuring valve stem outside diameter and valve guide inside diameter

Measure the diameter at the top and bottom ends at right angles to the outer and inner surfaces, since valve stems and valve guides are subject to wear at both ends. If the outside diameter is less than the limit, or the clearance exceeds the limit, replace either the valve or the valve guide with a new one.

Item		Nominal	Standard	Limit
Valve stem outside diameter	Inlet	ø 6.6 mm [0.260 in.]	6.565 to 6.580 mm [0.2585 to 0.2591 in.]	6.500 mm [0.2559 in.]
	Exhaust	ø 6.6 mm [0.260 in.]	6.530 to 6.550 mm [0.2571 to 0.2579 in.]	6.500 mm [0.2559 in.]
Clearance between valve stem and valve guide	Inlet	–	0.020 to 0.050 mm [0.0008 to 0.0020 in.]	0.100 mm [0.0039 in.]
	Exhaust	–	0.050 to 0.085 mm [0.0020 to 0.0034 in.]	0.150 mm [0.0059 in.]
Valve guide mounting dimension		ø 16 mm [0.63 in.]	–	–



Measuring valve stem outside diameter



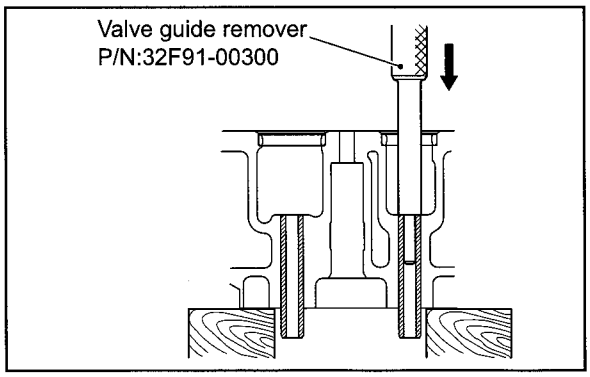
Measuring valve guide inside diameter

1.4 Replacing valve guide

CAUTION

Because valve guides must be inserted to the specified amount, be sure to use a valve guide installer.

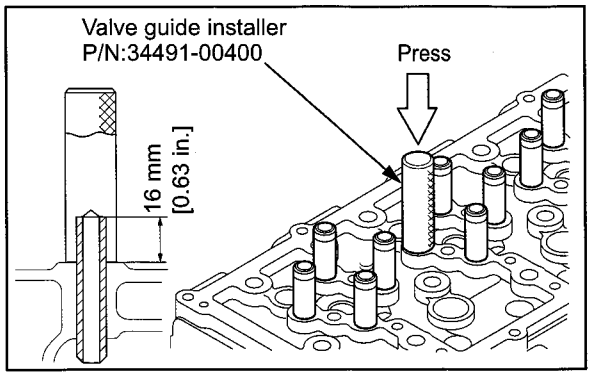
(1) To remove valve guides, use a valve guide remover.



Removing valve guide

(2) To press-fit valve guides, use a valve guide installer.

(3) Check contacts between valves and valve seats after replacing valve guides.



Press-fitting valve guide