OPERATION & MAINTENANCE MANUAL

MITSUBISHI DIESEL ENGINE

S6A3

500KW

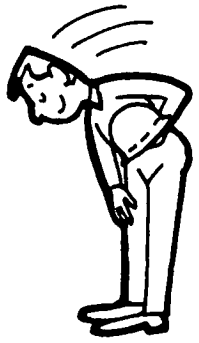
APPLICATIONS

- Generator drive
- General mechanical drive
- Locomotive drive
- Construction machinery drive
- Marine generator drive
- Marine general mechanical drive

MITSUBISHI HEAVY INDUSTRIES, LTD.

WE WELCOME YOU TO THE GROWING LIST OF PEOPLE WHO OWN AND USE OUR DIESEL ENGINE

S6A3



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This manual is written to familiarize you with the operation and maintenance of your S6A3 diesel engine, and provide important safety information. We suggest that you carefully read this manual to learn about your new engine.

After reading this manual, be sure to keep it near your engine as a ready reference when you need it. See your Mitsubishi dealer for any further information you feel you need. He will be glad to help you and answer any questions you may have about handling of your new engine.

The engine described in this manual is for industrial drive and marine auxiliary drive (such as generator drive).

The descriptions, illustrations and specifications contained in this manual were in effect at the time it was approved for printing. Mitsubishi reserves the right to change specifications or design without notice and without incurring obligation.

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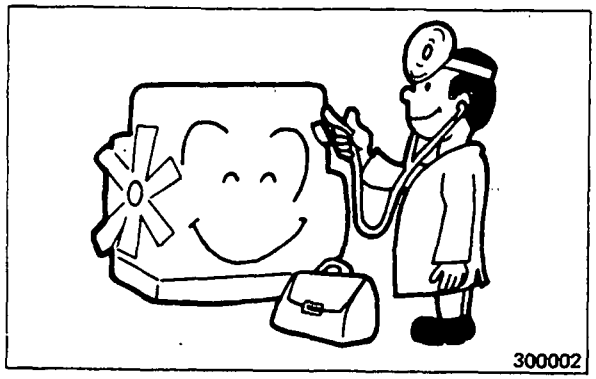
YOUR ENGINE AND MITSUBISHI

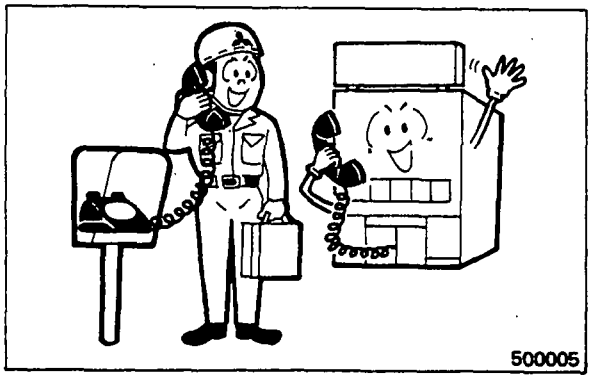
SERVICE ASSISTANCE

Your Mitsubishi dealer is vitally interested in your complete satisfaction with the Mitsubishi engine you purchased from him. He is anxious to know that all of your service needs are quickly and courteously filled.

Mitsubishi has established district and regional offices throughout the world to help each dealer make himself more helpful to you. Should you feel that you require service assistance beyond that which your dealer is providing, the Mitsubishi office in your area will be pleased to work with you and your dealer.

If your engine is transferred to elsewhere from the original place of use registered with Mitsubishi, be sure to have the registration changed. Consult your Mitsubishi dealer for the necessary procedure.





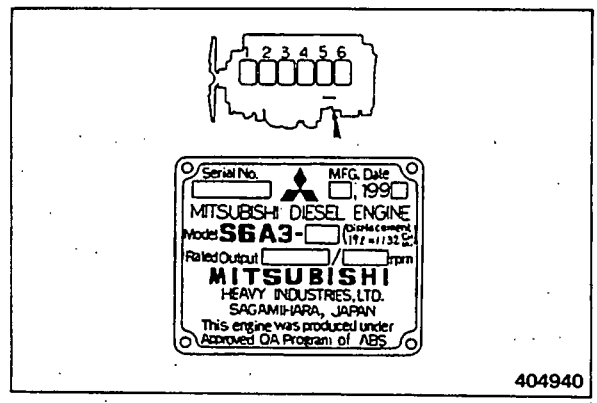
LOCATION OF ENGINE SERIAL NUMBER

The engine serial number is stamped on the nameplate attached to the left rear side of the engine.

Example

Model	Serial number
S6A3	30125

On the nameplate are also stamped the output and rated speed. The numbers in the illustrations show cylinder numbers.



ENGINE MODEL AND APPLICATION CODES

S□□-□T "T" stands for turbocharged unit.
S□□-□TA "TA" stands for turbocharged, aftercooled unit.
S□□-□TK "TK" stands for turbocharged, intercooled unit.

- Application code
  - P : Generator drive and general mechanical drive
  - L : Locomotive drive
  - MP : Marine generator drive and marine general mechanical drive
- Series code
- No.-of-cylinders code
- Sagamihara Machinery Works

SAFETY RULES

WARNINGS, CAUTIONS and NOTES are used in this manual to emphasize important and critical instructions. They are used for the following conditions:

⚠ WARNING ..... Operating procedures, practices, etc., which if not correctly followed, will result in personal injury or loss of life.

⚠ CAUTION ..... Operating procedures, practices, etc., which if not strictly observed, will result in damage to or destruction of engine.

NOTE ..... An operating procedure, condition, etc., which is essential to highlight.

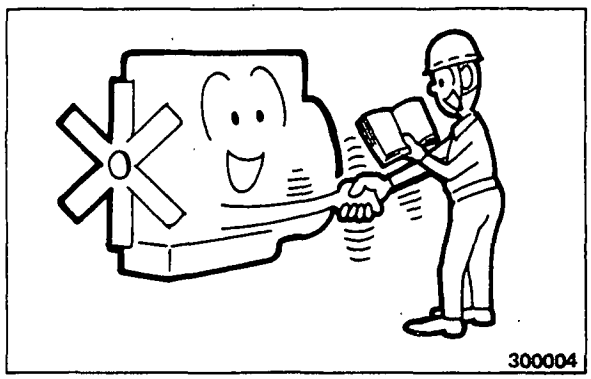
✓ ..... Right or normal

× ..... Wrong or abnormal (service needed)

Recommendation of daily operation record

It is obvious to every engine user and operator that an engine should not be run to destruction. Daily recording is a preventive maintenance program and will serve as a guide for:

- Effective troubleshooting (to help a serviceman of your Mitsubishi pin-point the trouble)
- Quick servicing and less downtime (to help him save time for servicing)
- Grasp of operating conditions (to help you recognize conditions, signs or indications of approaching trouble)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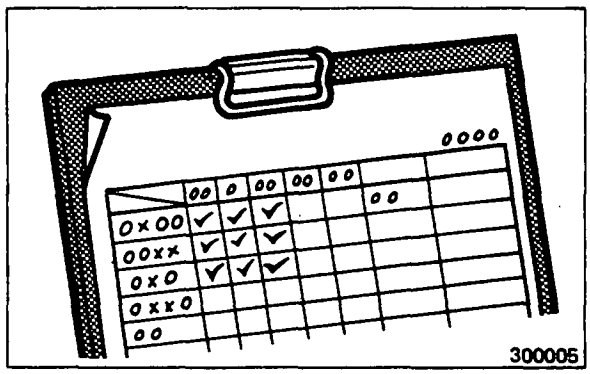
Items to be recorded

The following items are recommended to be recorded as "daily readings":

1. Operating hours (hour meter reading)
2. Quantities of engine oil, fuel oil and water (coolant) used for refilling.
3. Engine oil and coolant change periods
4. Engine oil pressure, exhaust temperature and supply air pressure
5. Parts serviced, kinds of service (adjustment, repair or replacement) and results of service
6. Changes in operating conditions (for example, "Exhaust smoke turned black")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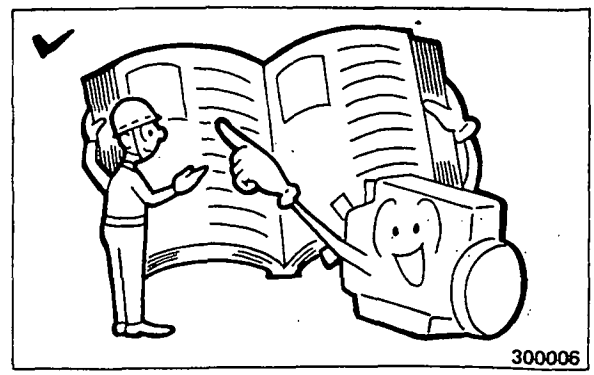
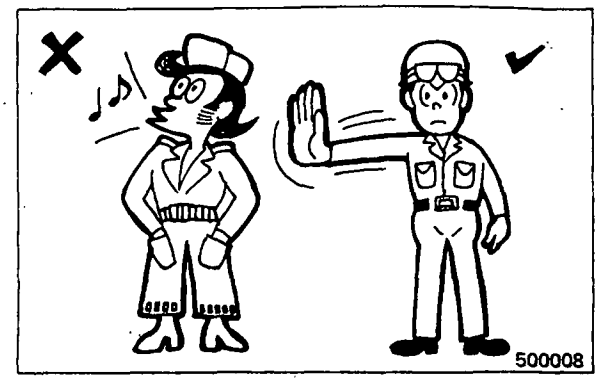
⚠ Study OPERATION & MAINTENANCE MANUAL to become thoroughly familiar with all engine controls and instruments – and service procedures.

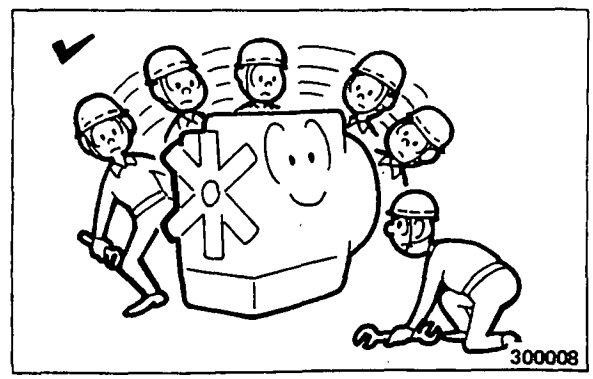


⚠ Wear hard hat and safety shoes – and, if job conditions require, safety goggles, heavy gloves, car protectors, respirators, etc.

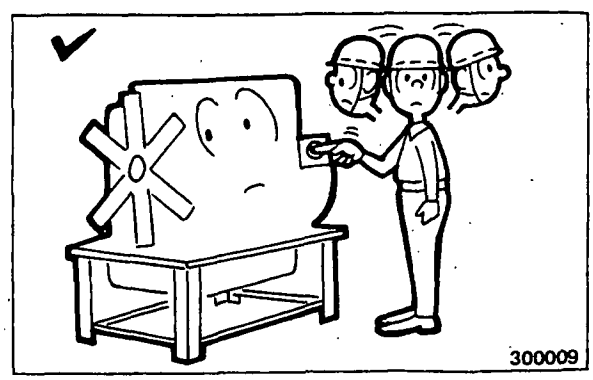


Before operation

Before starting and during warm up period, check under and around engine for visual defects – leaks of fuel, oil and coolant, loose or missing part.

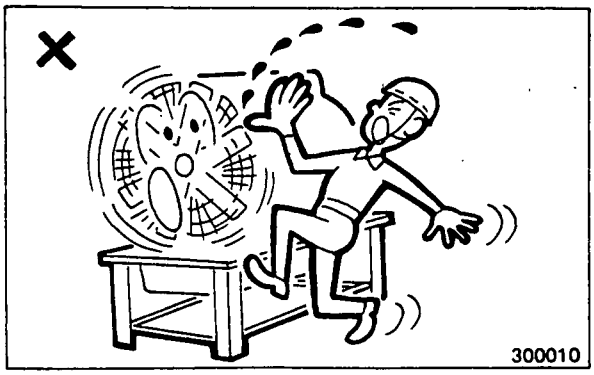


⚠ When starting engine, walk around it once more – open eyes and be alert to people and obstacles that may be within operating range.

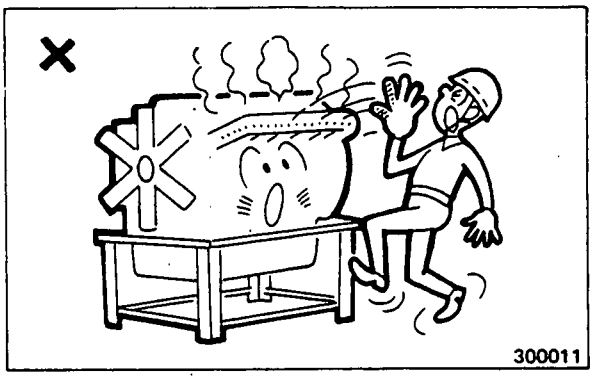


During operation

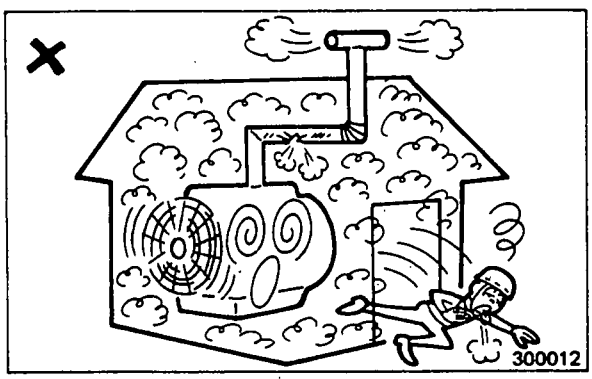
⚠ Do not touch any moving part of a running engine, or clothing or hair can be caught in moving parts, resulting in personal injury or loss of life.



⚠ Keep hands off hot parts – turbocharger, exhaust pipe, etc. – during operation or immediately after shutting off engine.

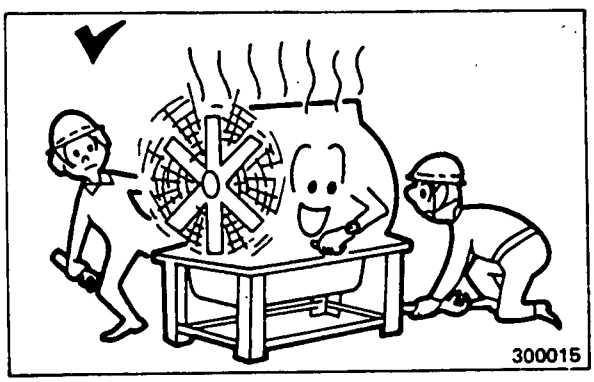


⚠ If necessary to operate engine within an enclosed area, provide adequate ventilation – and pay attention to exhaust piping and exhaust gas leaks.



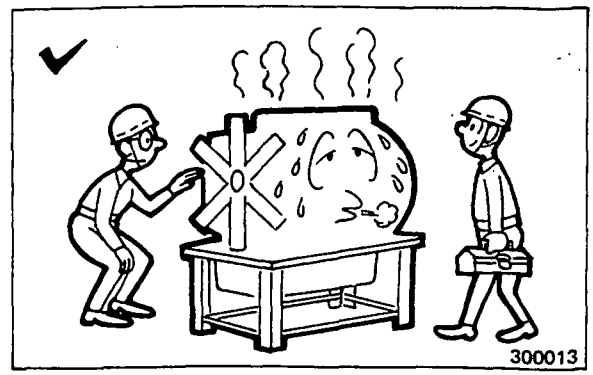
Idling operation for engine cooling

After the load is removed, allow the engine to idle for about 5 to 6 minutes. Shutting off the engine immediately after removing the load is very hard on the engine parts.



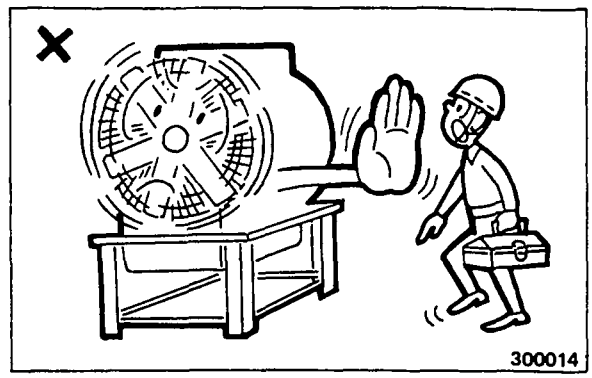
After operation

At end of operating period, walk around engine to check for any defects, and make repairs to prepare for the next day.

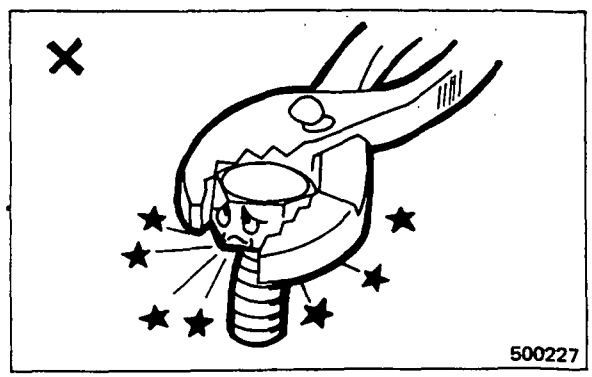


Maintenance

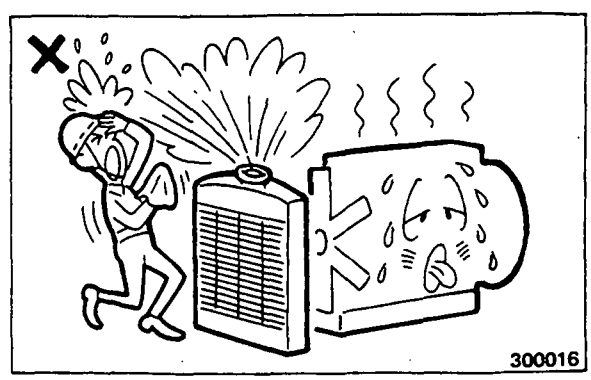
⚠ Be sure to shut off engine, and turn off battery main switch (or close air tank valve) before servicing engine. If necessary to crank engine for inspection, signal to other man before cranking. After cranking, be sure to remove cranking bar.



⚠ Use right tools correctly. Thoughtless use of tools including use of a wrong tool can cause personal injury and damage to engine.

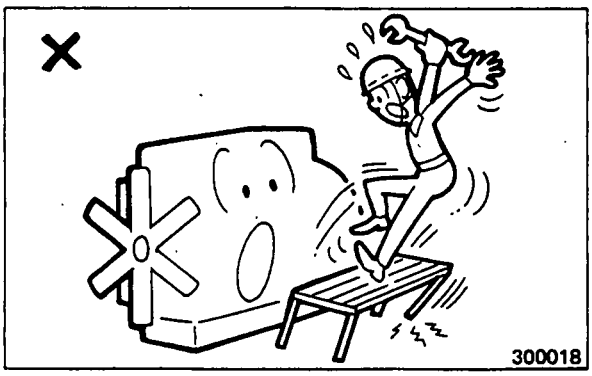


⚠ When removing radiator filler cap immediately after shutting off engine, be sure to release pressure to avoid having scalding by hot water or steam spouted out from radiator.



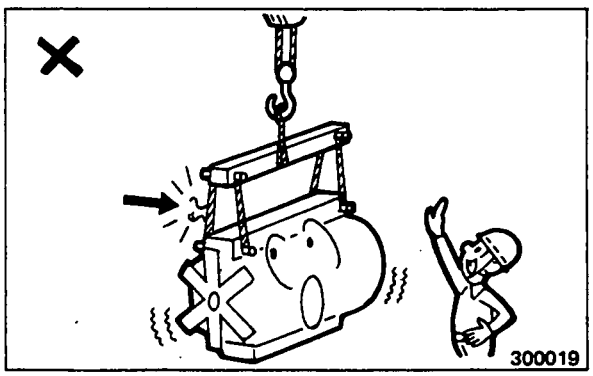
⚠ Do not smoke while handling highly flammable materials. Do not use open cans of gasoline or diesel fuel for cleaning parts near any open flame. Good commercial, nonflammable solvents are preferred.

⚠ Do not attempt to "climb up" engine for access to upper parts. Use a safe footstool for maintenance without accidents.

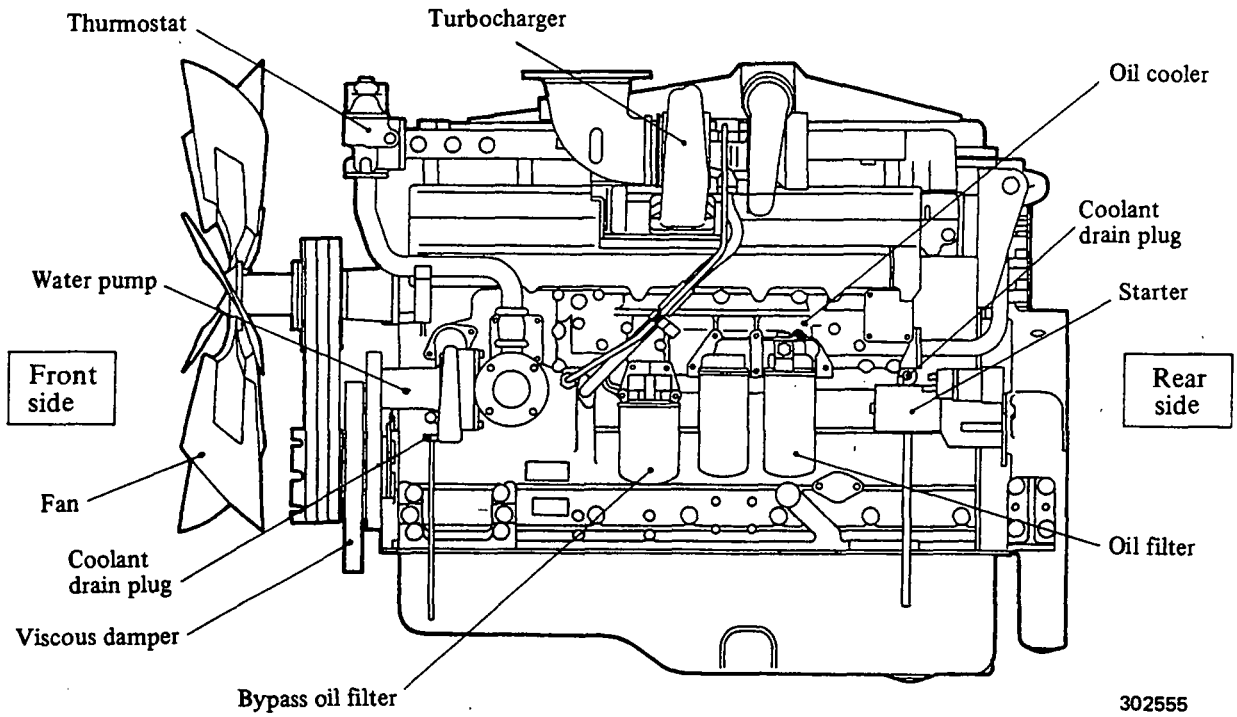


⚠ When lifting engine, use slings free of broken strands. Be sure that the crane has enough capacity for engine to be lifted. Make use of hangers provided on engine, and lift it carefully.

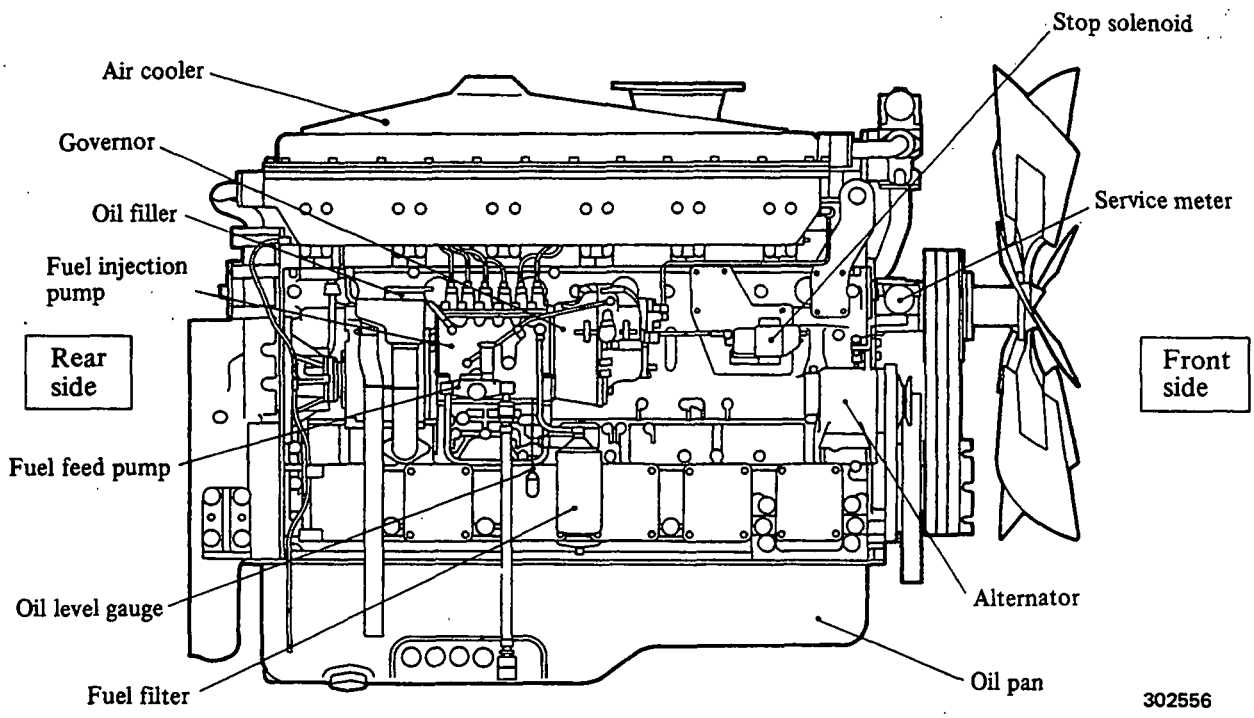
Put wads to sling contacting surfaces of engine to protect both slings and engine.



NOMENCLATURE



Left side



Right side

NOTE: Direction of rotation of this engine is counterclockwise as seen from rear side.

OPERATION INSTRUCTIONS

BEFORE OPERATION

Anyone charged with the care and operation of the engine is responsible for "new engine initial service" – service for a new or reconditioned engine or an engine which has been stored for any length of time. Check the following points before starting the engine for the first time. For the second and subsequent services, refer to Maintenance Schedule.

Walk-around checks

- Check for damage or missing parts.
- Check for loose bolts or nuts.

Cooling system

- Fill cooling system.
- Check for leaks.
- Check fan and water pump drive belt.

Fuel system

- Fill fule tank.
- Prime fuel system.
- Check for leaks.

Electrical system

- Check battery electrolyte level and specific gravity.
- Check for loose terminal.
- Check gauges and lamps for operation.

Lubrication system

- Fill oil pan.
- Check for oil leaks.

Air inlet system

- Check air cleaner for clogging.
- Check gauges and lamps for operation.

After initial 50 service hours, perform the following services:

Change of engine oil

Change of oil filter

Retightening of bolts and nuts

⚠ CAUTION

During break-in period of a new or reconditioned engine, avoid sudden application of load and high-speed operation for engine life.

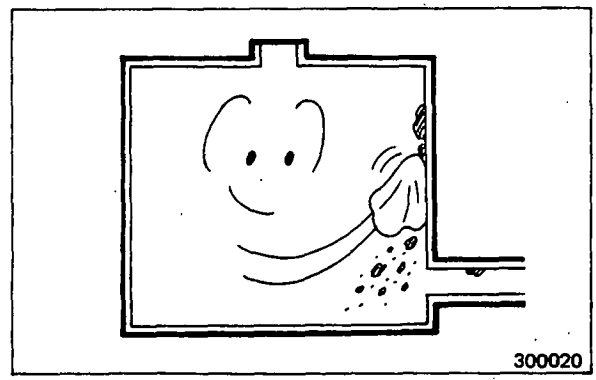
WALK-AROUND CHECKS

- Damage or missing parts → Engine
- Loose bolts and nuts →
  - Cylinder heads
  - Timing gear case
  - Crankshaft pulley
  - Fuel injection pump coupling and drive shaft
  - Mounting brackets
  - Turbocharger
  - Exhaust pipe

FUEL SYSTEM

Filling fuel tank

Before filling the fuel tank, check to be sure that the tank is free of dirt, water or other foreign substances. After filling, check the oil level in the tank with the level gauge.

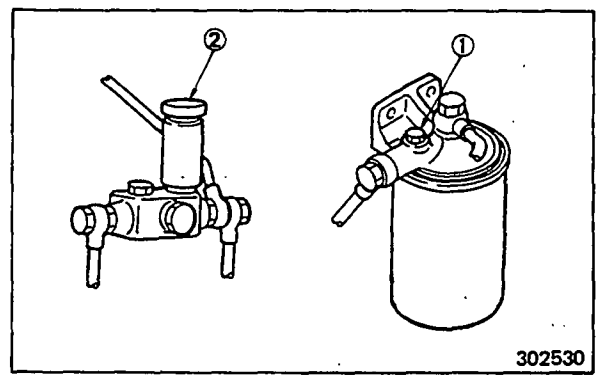


Priming fuel system

Prime the fuel filters and injection pumps in that order – that is, from the fuel tank side.

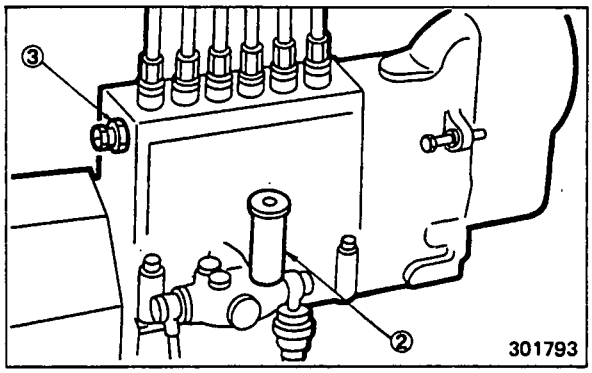
- **Fuel filters**

1. Loosen air vent plug (1) about 1-1/2 turns on the secondary filter.
2. Unlock priming pump handle (2) of fuel feed pump by twisting it counterclockwise, and operate.
3. Tighten plug (1) when the flow of fuel at the plug is free of air bubbles.



- **Fuel injection pumps**

1. Loosen air vent plug (3) about 1-1/2 turns on the injection pump.
2. Operate priming pump (2) until the flow of fuel at the plug is free of air bubbles. Lock the priming pump by twisting it clockwise while depressing it, and then tighten vent plug (3).



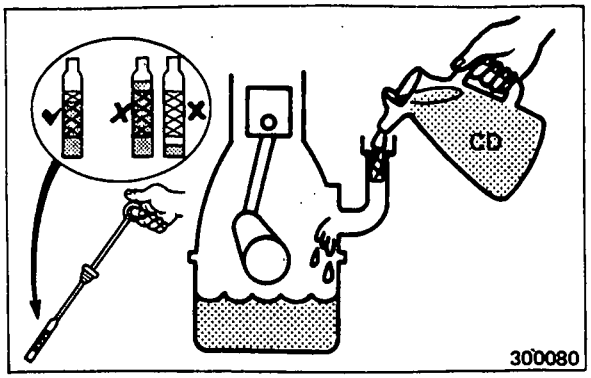
⚠ CAUTION

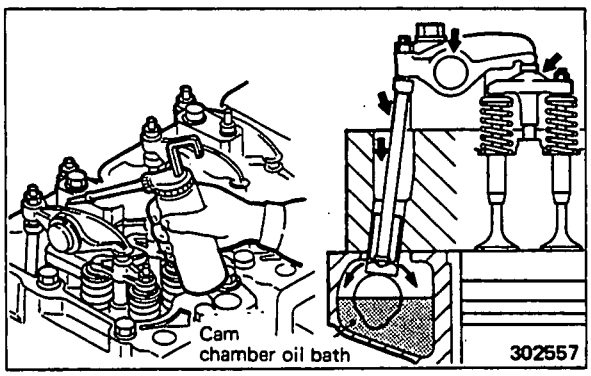
1) If all vent plugs are tightened before priming pump is locked, pressure acts on feed pump, making it difficult to lock the priming pump.
2) Wipe off fuel spilled out of each vent plug hole with wiping rag.

LUBRICATION SYSTEM

Filling oil pan

1. Use a clean jug to pour oil into the oil pan. Use engine oil of API service classification "CD."
2. After filling, check the oil level with the level gauge. The level should be within the operating range on the gauge.
3. Remove the rocker cover, and apply oil to the valve mechanism. Pour oil into the cam chamber oil bath through tappet hole.
4. Check the oil pan and other parts for oil leaks.
5. Start and run the engine for a while. Stop the engine and, after waiting for about 10 minutes, add oil up to the level specified in 2 above.

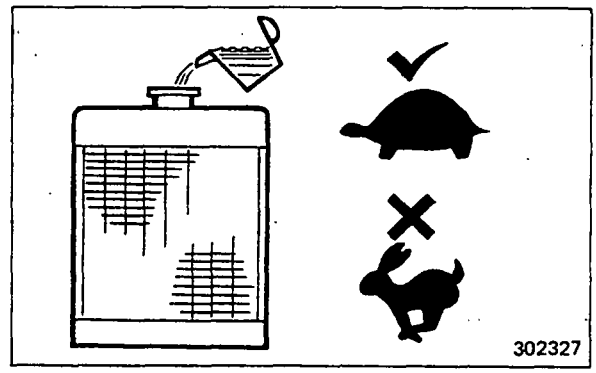




COOLING SYSTEM

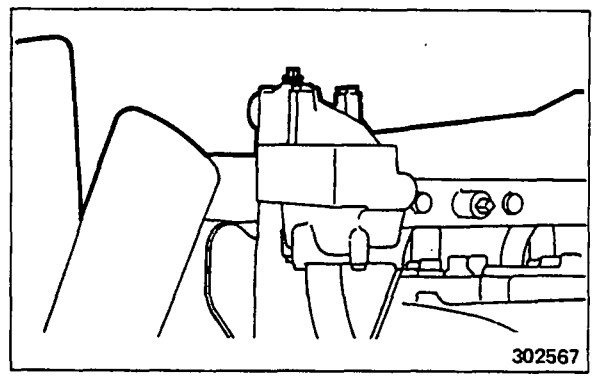
Filling cooling system

1. Tighten the engine and water pump drain plugs (or the radiator drain plug on a radiator-cooled engine). The engine is shipped from the factory with its cooling system drained.
2. Use clean water that is low in scale forming mineral. Do not use any water pumped out of ground in a mining or hot-spring area because it contains active impurities harmful to the metal of cylinder liners.



NOTE

1) Use an all-season type antifreeze of 30% to 60% concentration throughout the year.
2) For the concentration of antifreeze, see page 39.

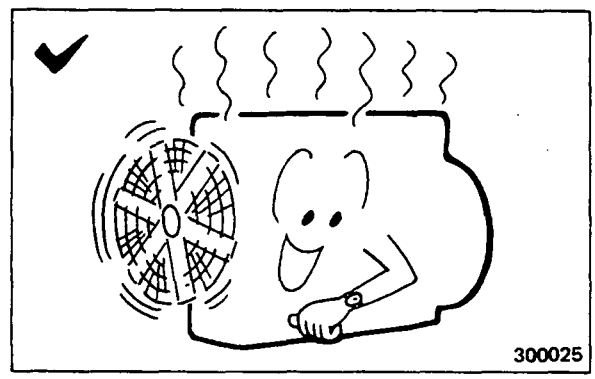


a) Remove the radiator filler cap. Put antifreeze in the radiator, then pour water into the radiator until it is full.

⚠CAUTION

To bleed air out the cooling system completely, be sure to remove the air vent plug located at the top of thermostat.

b) With the radiator filler cap removed, crank the engine with the starter three times, for 5 to 6 seconds each time, at intervals of about 20 seconds, in order to bleed air out of the water pump.



⚠CAUTION

To crank the engine for air bleeding, keep the stop lever in STOP position. (See page 15.)

c) Check the coolant level in the radiator, and add water if necessary.

d) Crank the engine with the fuel supply shut off for 10 seconds to make sure that the

oil pressure rises normally. If the pressure does not rise in 10 seconds, wait for about 1 minute, and crank it again.

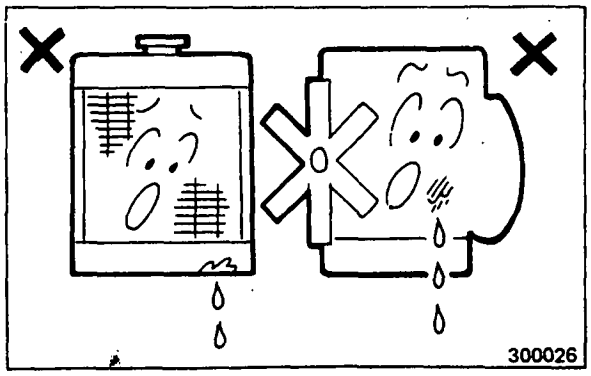
e) Start the engine, and run it at 600 rpm until the coolant temperature rises up to 75°C to 80°C (167°F to 176°F) to make antifreezing solution and water mix well.

f) Stop the engine, and check the coolant level in the radiator again. If the level is low, refill the radiator fully, and install the cap.

g) Check the hose joints for coolant leaks.

NOTE

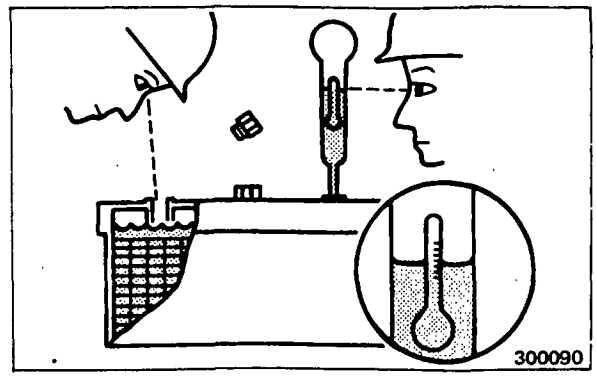
When adding antifreeze, maintain the prescribed concentration.



ELECTRICAL SYSTEM

Checking battery electrolyte level

1. Remove the filler caps, and check the electrolyte level in each cell. It should be 1 cm (0.4 in.) above the cell plates.
2. When filling the cells of the battery for the first time, slowly pour dilute sulfuric acid (electrolyte) in the cells.
3. If the battery is already in service, check the electrolyte level and, if the level is low, add distilled water.



Checking specific gravity

Check the specific gravity of electrolyte. If the SG is below 1.22 at 20°C (68°F), recharge the battery.

⚠ WARNING

1) Electrolyte, sulfuric acid, is very corrosive. If you drip it on your skin or clothing, flush it off at once with water.
2) Do not allow sparks or open flame near the battery.

Checking circuits

Check each circuit for loose terminals.

OTHERS

Check the following valves and plugs to make sure they are opened or closed properly:

- Fuel supply valve . . . . . Open
- Coolant drain plug (radiator) . . . . Closed
- Coolant drain plug (engine) . . . . Closed
- Coolant drain plug (water pump) . . Closed
- Oil drain valve . . . . . Closed
- Air supply valve (air tank) . . . . . Open

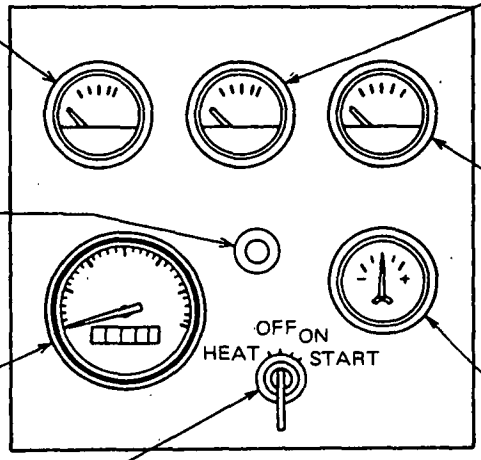
OPERATING THE ENGINE

Instruments

- **Water temperature gauge**
  Indicates temperature of engine coolant.
  Normal range:
  75 to 85°C
  (167 to 185°F)

- **Oil filter alarm lamp (pilot lamp)**
  Glows when oil filter element is clogged.

- **Tachometer**
  Indicates engine speed in rpm (revolutions per minute).



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- **Oil temperature gauge**
  Indicates temperature of engine lubricating oil.
  Normal range:
  70 to 110°C
  (158 to 230°F)

- **Oil pressure gauge**
  Indicates pressure of lubricating oil.
  Normal range:
  5 to 6.5 kgf/cm²
  (71 to 92 psi)
  [0.5 to 0.6 MPa]

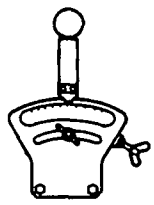
- **Ammeter**
  Indicates battery charging current.
  Normal indication: (+) side

- **Starter switch**

HEAT:	Operates air heater (when so equipped) to start engine easily in cold weather.
OFF:	Insert and pull out key. All electrical circuits are OFF.
ON:	Keep engine running. Charging and lamp circuits are ON.
START:	Start engine. Key will return to ON when released.

Controls

- **Speed control lever**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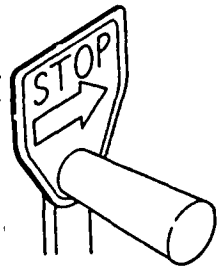
Use the lever to control engine speed. Pull it to stop engine.

- **Stop lever**



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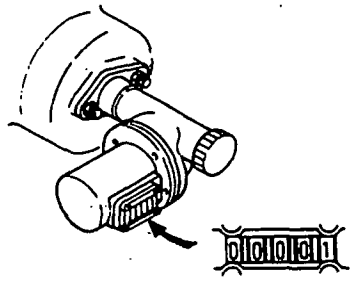
Pull the lever to stop a generator drive engine in case of emergency.

- **Service meter**


301587

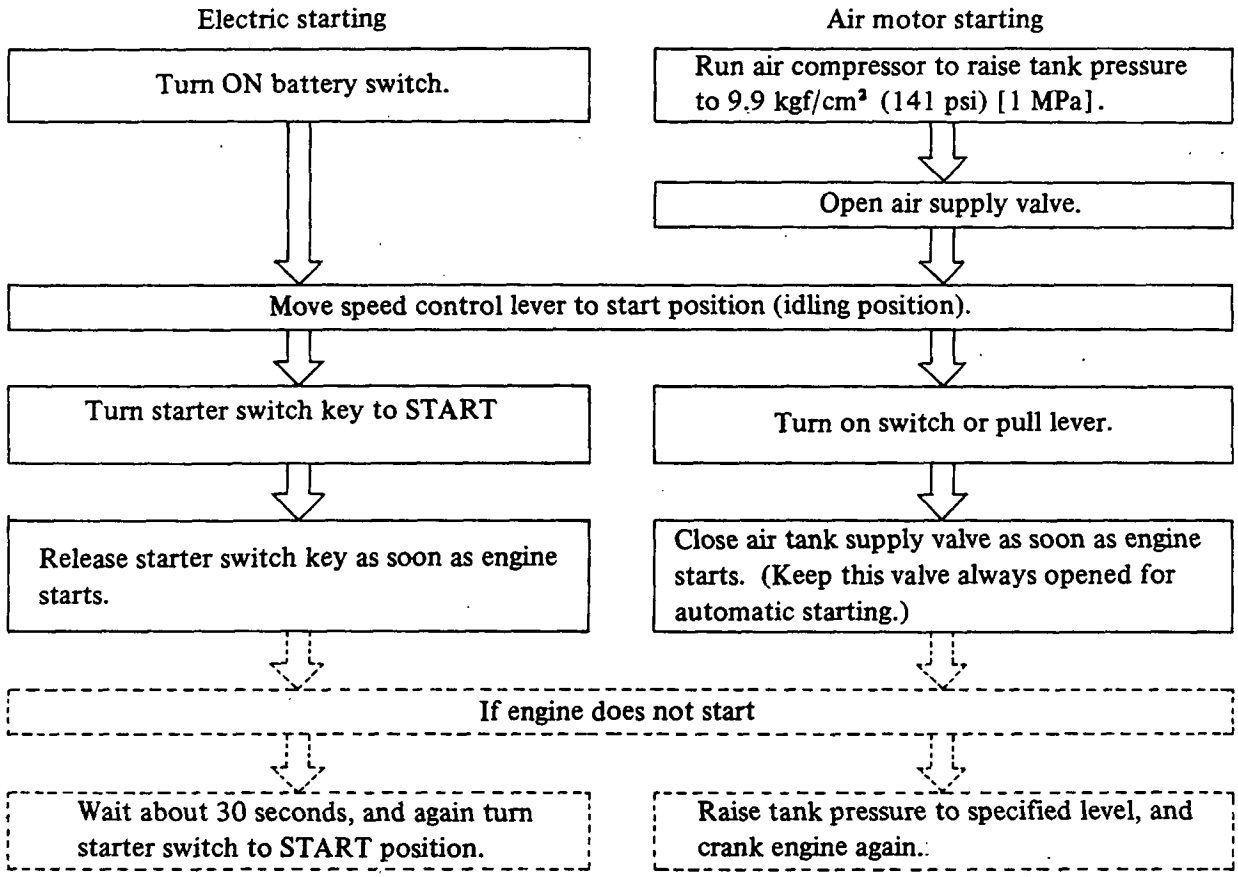
Rely on this meter to check, service or lubricate engine.

NOTE: Dial advances one number when engine is operated for 1 hour at 1500 rpm.

After performing daily (10-hour) servicing, operate the engine as follows:

STARTING

There are two methods available for starting the engine – electric starting and air motor starting. Disengage the clutch (when so equipped) or remove any load possible from the engine.



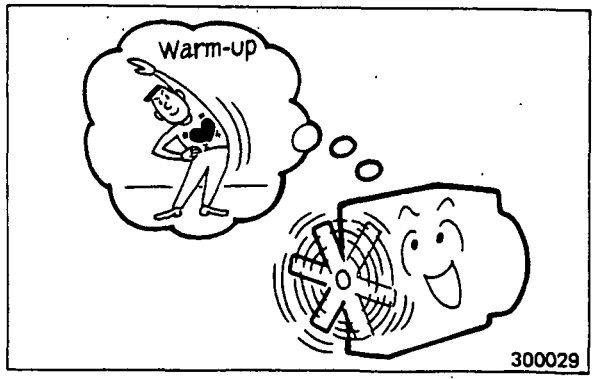
⚠ CAUTION

1) Do not run the starter for more than 10 seconds at a time.
2) Keep the starter switch in ON position during operation. Never move it to START or OFF position.
3) On the air-motor engine, open the air tank drain valve, and drain water every 50 hours or monthly.

WARMING UP

After starting up, allow the engine to idle at about 1000 rpm for 5 minutes to warm it up. During this warm-up period, check to be sure that oil pressure rises properly. The pressure will be 2 to 3 kgf/cm² (28 to 43 psi) [0.2 to 0.3 MPa] during low idling.

It will be sometimes higher than the standard level – 5 to 6.5 kgf/cm² (71 to 92 psi) [0.5 to 0.6 MPa] if the engine is revved up immediately after it has been started, that is, when the oil temperature is low. The pressure will become normal as the oil temperature rises.



⚠ CAUTION

It is not necessary to warm up a stand-by engine. Instead, be sure to perform periodical testing items described in "Maintenance Instructions."

STARTING THE LOAD

After warming up the engine, apply the load. During the operation, check to be sure –

1. The engine makes no abnormal sound and vibration.
2. Exhaust smoke color is normal.
3. There is no fuel, coolant and engine oil leakage.
4. Meters and gauges are indicating normally.

- Tachometer
- Engine oil pressure gauge
  5 to 6.5 kgf/cm² (71 to 92 psi) [0.5 to 0.6 MPa]
- Water temperature gauge
  75°C to 85°C (167°F to 185°F)
- Ammeter
  (+) side
- Engine oil temperature gauge
  70°C to 110°C (158°F to 230°F)
- Oil filter alarm lamp – OFF

STOPPING

1. After the load is removed, allow the engine to idle for about 5 to 6 minutes.
2. Shutting off the engine immediately after removing the load is very hard on the engine parts.

⚠ CAUTION

Keep on pulling the stop lever until the engine stops "rocking" to prevent it from turning in reverse direction.

Engine equipped with speed control lever	Engine equipped with stop lever
Move speed control lever to STOP position.	Pull stop lever on governor to STOP position.

Turn starter switch to OFF position, pull out the key, and turn OFF battery switch (electric starting).

MAINTENANCE INSTRUCTIONS

1. Use hour-meter or calendar intervals whichever occur first.
2. The established intervals in the schedule are for an average job application. Service the engine earlier than scheduled intervals if necessary. (Service intervals depends on application, operating conditions, fuel oil and lubricating oil used in the engine. Adjust the service intervals to meet the actual operating conditions.)
3. Perform previous interval items at multiples of the original requirement.

   Example: At 250 hours or 1 year, also perform those items listed in "10 hours or daily" and "50 hours or monthly."

Where the engine is used for stand-by duty, it must be thoroughly checked and kept in perfectly operable condition at all times. This is because it has to be started and run under severe conditions and is expected to give full performance no matter when it is put in operation. Test the engine periodically by running it in no-load condition, as follows:

Periodical testing

Test run	Once-a-week no-load test run for 5 to 10 minutes	Check for: Ease of starting Lube oil pressure Color of exhaust smoke Abnormal vibration and others
	Once-a-month load test run for 15 to 30 minutes (Operate at 1/2 load, min.)	

○ Check, clean, wash, adjust, etc.
● Change.
Ⓢ Rely on your Mitsubishi dealer if necessary.
* Item to be performed after initial 50 hours of operation of a reconditioned or long-stored engine.

MAINTENANCE SCHEDULE

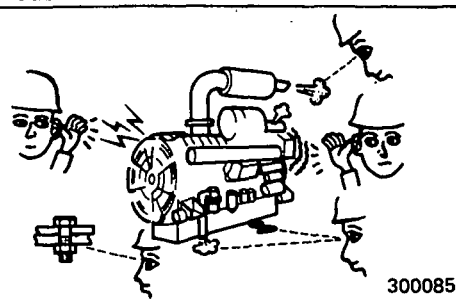
Group	Service		Service intervals						Remarks
			Every 10 hours or daily	Every 50 hours or monthly	Every 250 hours or 1 year	Every 500 hours or 2 years	Every 1000 hours or 3 years	Every 2000 hours or 5 years	
Engine	Valve clearance	Check			*		○		Ⓢ
	Bolts and nuts	Retighten		*			○		Ⓢ
	Walk-around checks		○						
	Fan, water pump and alternator drive belt	Check tension			○				
Lubrication system	Oil pan	Check oil level	○						
		Check for water or fuel in oil		○					
		Change oil		*	●				Ⓢ
	Oil filter	Change		*	●				Also change when oil filter alarm lamp glows.
	Bypass oil filter	Change			●				Ⓢ
	Governor oil filter	Change				●			
Fuel system	Fuel tank	Check level	○						
		Drain water		○					
	Fuel filter	Change					●		Ⓢ
	Injection nozzles	Check and adjust					○		Ⓢ
	Injection timing	Check and adjust					○		Ⓢ
Cooling system	Coolant	Check level	○						
		Change	Change coolant every 1 year.						
	Radiator fins	Clean			○				Ⓢ
	Heat exchanger	Clean						○	Ⓢ
	Zinc rods	Change				●			Ⓢ

Group	Service			Service intervals						Remarks
				Every 10 hours or daily	Every 50 hours or monthly	Every 250 hours or 1 year	Every 500 hours or 2 years	Every 1000 hours or 3 years	Every 2000 hours or 5 years	
Air inlet and exhaust systems	Air cleaner (paper-element type)		Check indicator	○						
			Clean element			○				Ⓢ
			Change element					●		
	Precleaner (silencer type)		Clean			○				Ⓢ
	Exhaust muffler		Drain water			○				
	Air cooler		Clean						○	Ⓢ
	Turbo-charger		Check						○	Ⓢ
Starting system	Electric starting	Battery	Check electrolyte level/ specific gravity	○						Check specific gravity from time to time
		Alter-nator	Check						○	Ⓢ
		Starter	Check						○	Ⓢ
	Air starting	Oiler	Check oil level	○						
		Air filter	Drain water		○					
			Clean				○			Ⓢ
		Air tank	Check air pressure	○						Before starting
			Drain water		○					
			Check safety valve for operation			○				Ⓢ
Protective devices operation	Water temperature rise 98 ± 2°C (208 ± 3.6°F)									
	Engine oil pressure drop Rated speed: 4 ± 0.2 kgf/cm² (57 ± 2.8 psi) [0.4 ± 0.02 MPa] Low idle: 1.5 ± 0.15 kgf/cm² (21 ± 2.1 psi) [0.1 ± 0.014 MPa]							○		Ⓢ Check when malfunction is suspected (Check engine for stand-by every year.)
	Overspeeding (112 to 115%)									

Group	Service		Service intervals						Remarks
			Every 10 hours or daily	Every 50 hours or monthly	Every 250 hours or 1 year	Every 500 hours or 2 years	Every 1000 hours or 3 years	Every 2000 hours or 5 years	
Others	Viscous damper	Check						○	Leaks, cracks in rubber or flaw
		Change							Every 8000 hours
	Coupling (rubber bushings)	Check			○				Ⓢ Cracks or other defects
	Valves in pipeline	Check for setting	○						
	Speed control lever	Check	○						

EVERY 10 HOURS OR DAILY

Walk-around checks

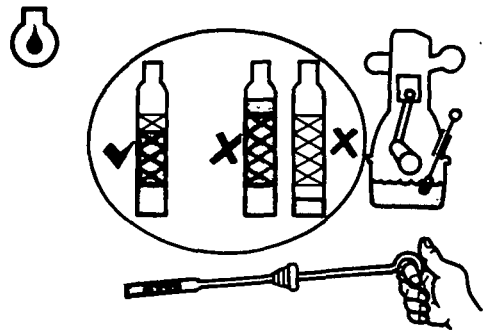


300085

Check for:

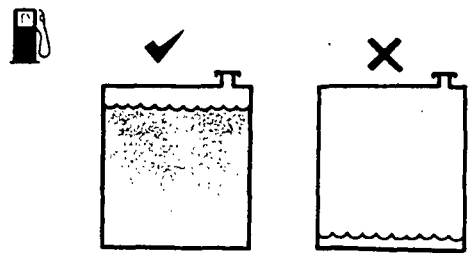
- Loose or missing bolts and nuts
- Abnormal vibration, noise and exhaust color
- Water, oil, air and gas leaks
- Broken electric wire and loose terminals
- Loose pipe joints
- The amount and color of mist from breather

Oil pan – Check oil level.



Maintain oil level in operating range. 301272

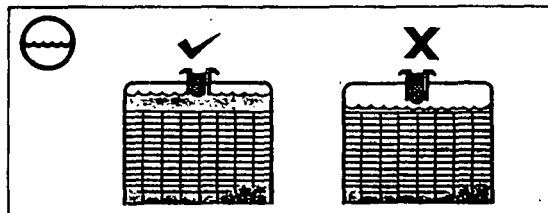
Fuel tank – Check level.



300087

Check the amount of fuel in the tank before the day's operation. Be sure to fill the tank at the end of the day's operation.

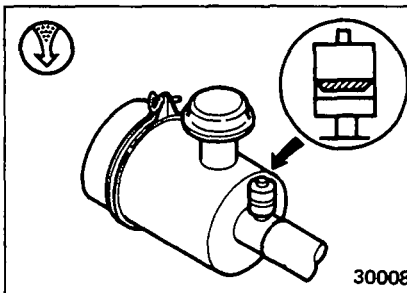
Radiator – Check coolant level.



300160

Remove radiator filler cap and check. Coolant should be visible in filler neck. Check level in sight gauge on expansion tank when so equipped. Add coolant containing antifreeze of the prescribed concentration to radiator or tank if coolant level is low.

Air cleaner indicator – Check.

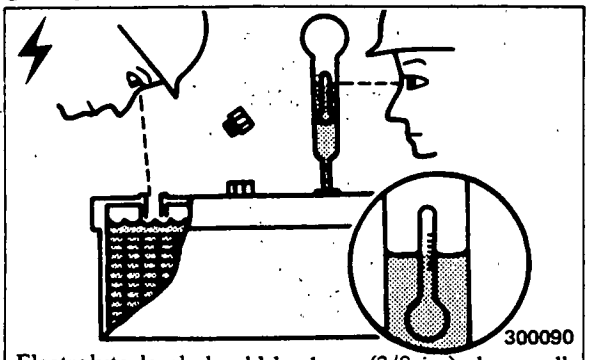


300089

Clean or change element when indicator shows RED.

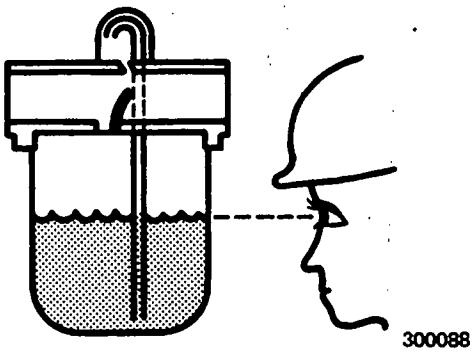
EVERY 10 HOURS OR DAILY – continued

Battery – Check electrolyte level and specific gravity.



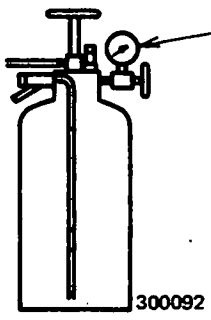
Electrolyte level should be 1 cm (3/8 in.) above cell plates.
Check specific gravity from time to time, and recharge before it drops to 1.22.

Oiler (air-motor engine) – Check oil level.



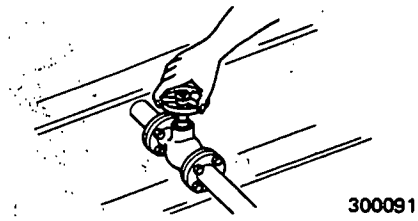
Oil level should be up to upper limit line.
Use turbine oil (viscosity: ISO VS32)

Air tank (air-motor engine) – Check air pressure.



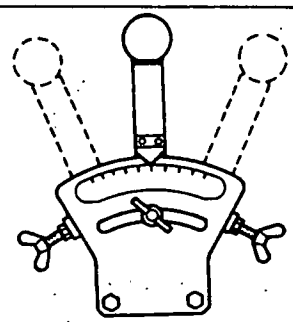
Before starting engine, check to be sure air pressure gauge registers at specified level.

Valves in pipeline – Check for setting.



Check each valve for setting – closed or opened

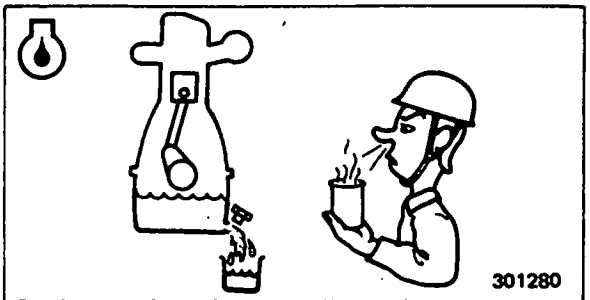
Speed control lever – Check.



Check to be sure linkage moves smoothly without any sign of interference.

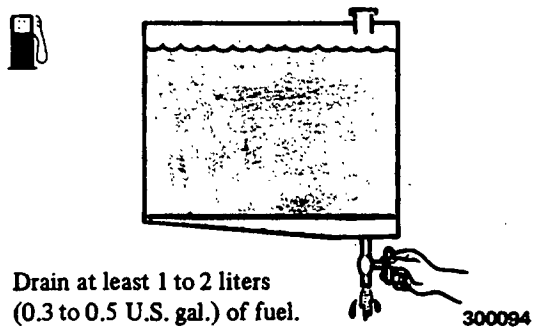
EVERY 50 HOURS OR MONTHLY

Oil pan – Check for water or fuel in oil.



Catch 1 to 2 liters (0.3 to 0.5 U.S. gal.) of oil in a can, and smell or visually check for presence of fuel or water. Fuel smells as such if present. Water leakage is often evidenced by emulsified oil.

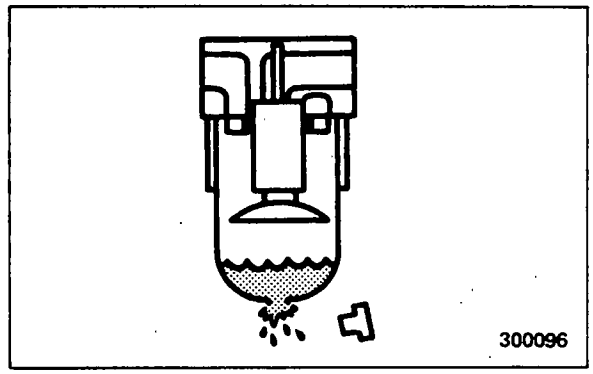
Fuel tank – Drain water.



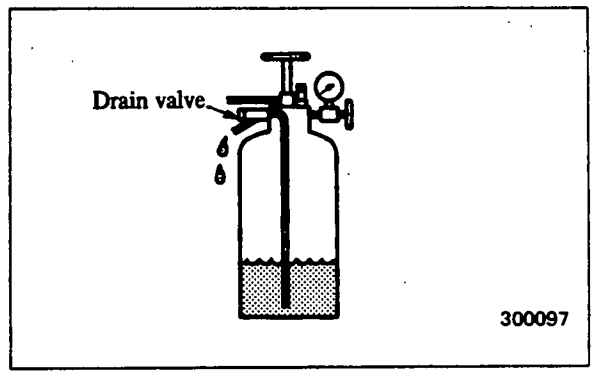
WARNING

Keep flames or sparking devices away.

Air filter (air-motor engine) – Drain water.

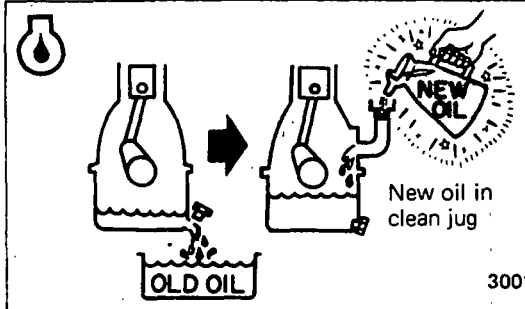


Air tank (air-motor engine) – Drain water.



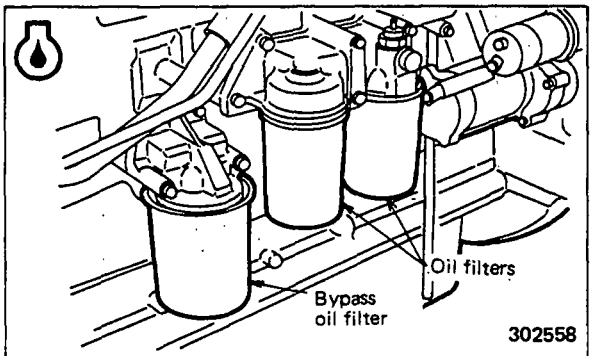
EVERY 250 HOURS OR 1 YEAR

Oil pan – Change oil.



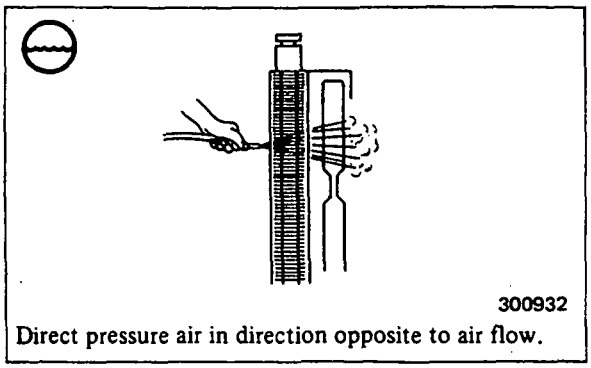
Drain out oil when engine is still hot after operation. Use engine oil of API service classification "CD."

Oil filter and bypass oil filter – Change.



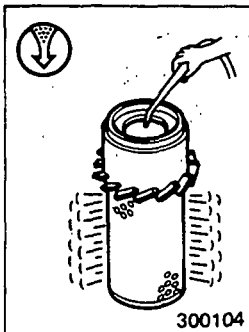
Disassemble element and check for metal particles trapped in it. If such particles are found, consult your Mitsubishi dealer for seizure or abnormal wear of moving parts.

Radiator fins – Clean.



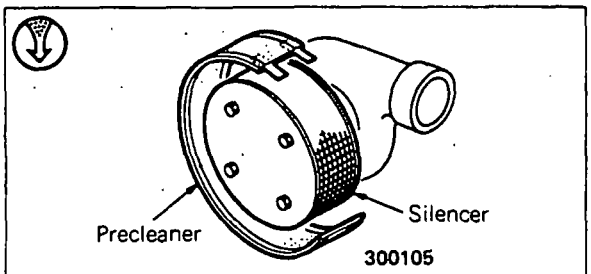
Direct pressure air in direction opposite to air flow.

Air cleaner (paper-element type) – Clean element.



Use pressure air – 7 kgf/cm² (100 psi) maximum. Insert light inside clean, dry element and check. Replace element if pinholes or tears are found. Clean air cleaner case. Replace element if dust indicator still shows RED shortly after installation of clean element.

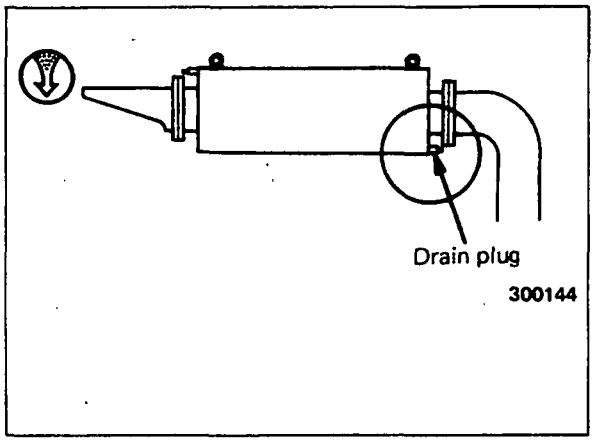
Precleaner – Clean.



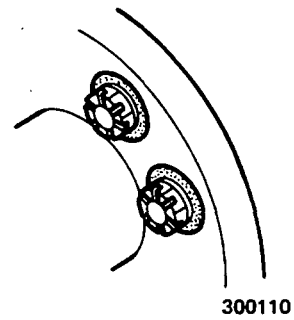
Remove precleaner, and wash it with neutral cleaning solvent.

EVERY 250 HOURS OR 1 YEAR – continued

Exhaust muffler – Drain water.

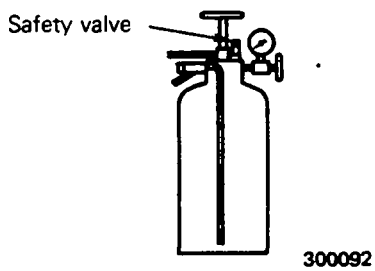


Coupling (rubber-bushing type) – Check.



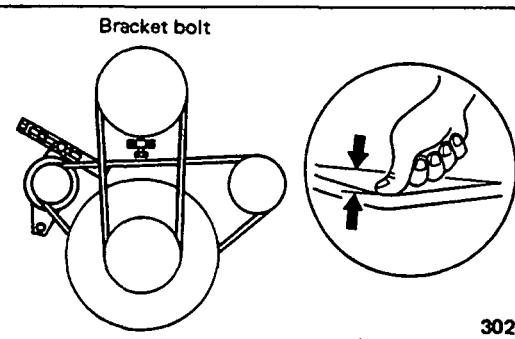
Check bushings for cracks or other defects.

Air tank (air-motor engine) – Check safety valve for operation.



Make sure that safety valve opens when air pressure rises higher than 9.9 kgf/cm² (141 psi) [971 kPa].

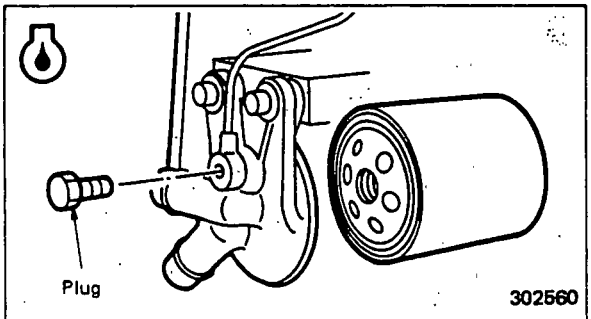
Fan, water pump and alternator drive belts – Check tension.



Push belt inward between puleys with 10 to 15 kgf (22 to 33 lbf) [98 to 147 N] force. Belt should deflect 10 to 15 mm (0.4 to 0.6 in.).

EVERY 500 HOURS OR 2 YEARS

Governor oil filter (Woodward type) – Change.

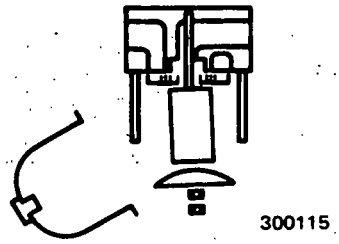


Do not reuse oil filter by washing.

NOTE

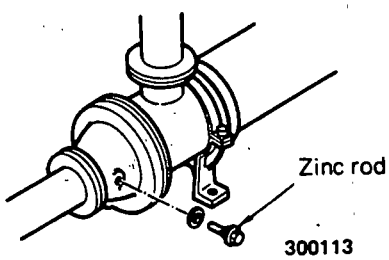
After installing a new filter, remove plug from filter bracket and fill up filter with clean engine oil.

Air filter (air-motor engine) – Wash element.



Wash element with diesel fuel.

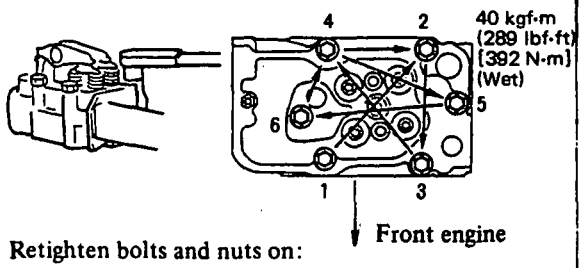
Zinc rods (sea-water cooling) – Change.



Change zinc rods of heat exchanger, marine gear oil cooler, air cooler, etc.

EVERY 1000 HOURS OR 3 YEARS

Bolts and nuts – Retighten.



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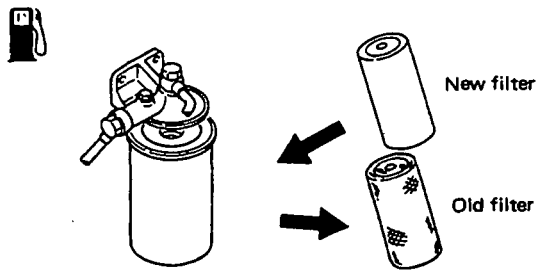
Retighten bolts and nuts on:

- Cylinder heads
- Timing gear case
- Crankshaft pulley
- Injection pump coupling and shaft
- Mounting brackets
- Exhaust manifolds
- Turbocharger

Retighten cylinder head bolts in sequence (1 → 2 → 3 → 4 → 5 → 6 → 4 → 2) shown above.

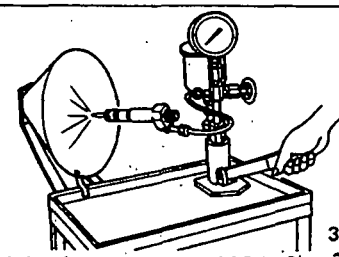
Fuel filter – Change.



302545

Apply diesel fuel to gasket of a new cartridge. Bring gasket into contact with sealing face of bracket, and tighten cartridge 1/2 to 3/4 rotation by hands.

Fuel injection nozzles – Check



300518

Standard injection pressure: 220 kgf/cm² (3128 psi) [22 MPa]

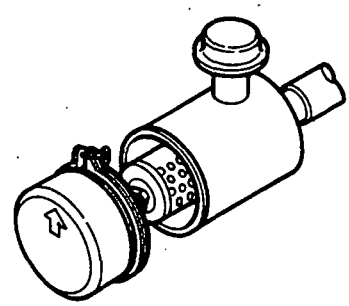
Make sure spray occurs from all eight orifices at the same time.

NOTE

If exhaust smoke is abnormal, check nozzles for spray pattern. See Fuel Injection Nozzles – Check and adjust, page 30.

pages 29,

Air cleaner – Change element.



300121

Be sure to stop engine before removing element.

EVERY 1000 HOURS OR 3 YEARS – *continued*

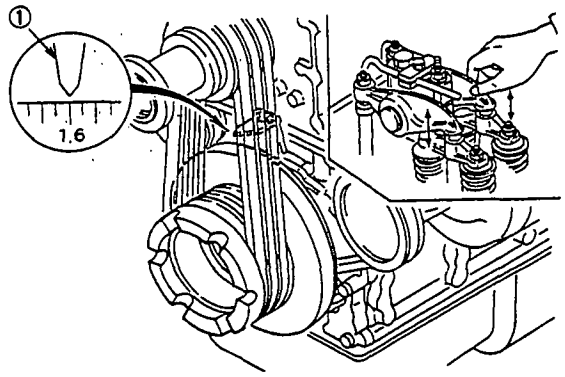
Injection timing – Check and adjust.

To adjust injection timing, proceed as follows:

1. Injection timing is indicated on caution plate attached to rocker cover.

300247

2. Using a turning bar, turn crankshaft in normal direction (clockwise as seen from front side), bringing timing pointer into alignment with 1.6 index number mark punched on damper. This crank position corresponds to top dead center on compression stroke in No. 1 cylinder.

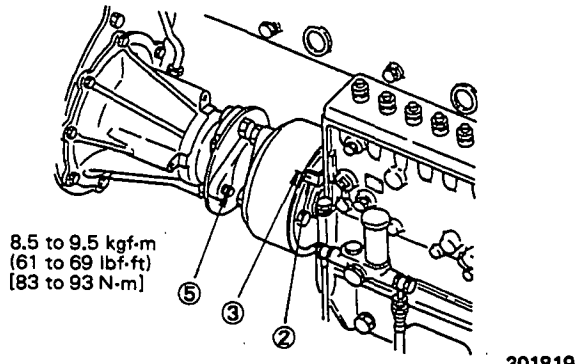


404944

⚠ CAUTION

Be careful not to confuse No. 1 cylinder with No. 6. When No. 1 is in the above-mentioned position, its inlet and exhaust valves are both fully seated, presenting valve clearance.

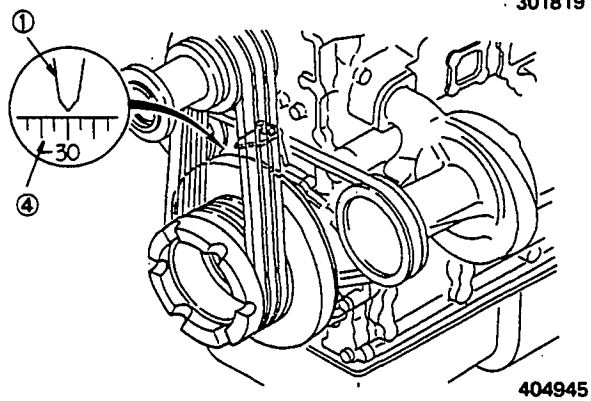
3. Turn back crankshaft about 60°, and turn it forward slowly until timing mark (3) on coupling aligns to pointer (2) on end face of pump case. In this position of crankshaft, read degrees of angle (injection timing) on scale (4) provided on damper, indicated by pointer (1). Minus (–) mark on scale and "B.T.D.C." on caution plate means BEFORE top dead center.



301819

4. To adjust injection timing, proceed as follows:

   Make sure that pointer (1) is aligned with injection timing mark for No. 1 cylinder on damper, displace injection pump by loosening two coupling bolts (5) to align pointer (2) on pump case with timing mark (3) on coupling. Then, tighten one bolt and, after turning crankshaft, tighten another. Again check injection timing by cranking engine.



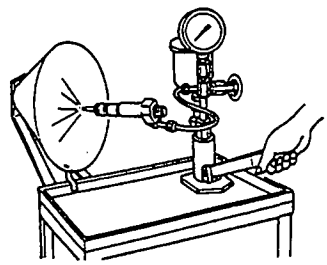
404945

EVERY 1000 HOURS OR 3 YEARS – continued

Fuel injection nozzles – Check and adjust.

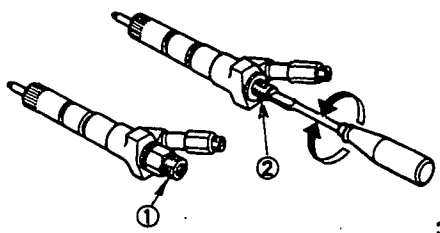
Injection pressure adjustment

1. Mount injection nozzle in a tester. Push down tester lever gently to read a pressure at which injection begins.
   Injection pressure is specified to be 220 kgf/cm² (3128 psi) [22 MPa]. If the pressure is incorrect, readjust it as follows:



300518

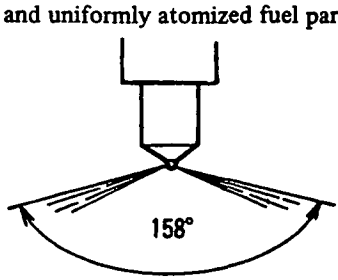
2. Remove cap nut (1) on nozzle holder, and tighten or loosen adjusting screw (2). Tightening screw will increase pressure, and vice versa.
3. After adjusting, put back on cap nut (1) and tighten it to 4 to 5 kgf·m (29 to 36 lbf·ft) [39 to 49 N·m].



300386

Fuel spray pattern

1. Check fuel spray pattern, along with injection pressure.
2. Fuel spray pattern is normal if the following requirements are met:
   (1) Spray should occur from all of the eight orifices at the same time.
   (2) Spray should take a cone shape with an angle of 158 degrees and consist of finely and uniformly atomized fuel particles.



302562

   (3) Spray should contain no large fuel particles.
   (4) Spray should be terminated without any after-dribble.
3. If spray pattern is poor, remove nozzle tip and wash needle valve (3) and body (4).
4. To remove the tip, remove cap nut (1), loosen adjusting screw (2) with a screwdriver, and loosen retaining nut (5). Be sure to follow these steps in order because the tip is spring-loaded.

⚠ CAUTION

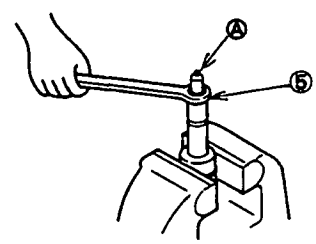
When removing nozzle tip, be careful not to tap part (A) of the tip.

5. For cleaning fluid, use clean gasoline. After cleaning, assemble needle valve (3) and body (4) in clean diesel fuel.

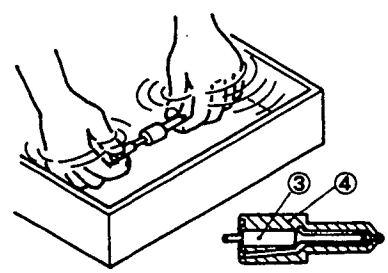
⚠ CAUTION

Needle valve and body are selectively fitted: never change this combination by replacing either part.

6. Tighten retaining nut (5) to 6 to 8 kgf·m (43 to 58 lbf·ft) [59 to 78 N·m].
7. If the foregoing adjustment and cleaning do not improve spray pattern, replace nozzle tip.



300123



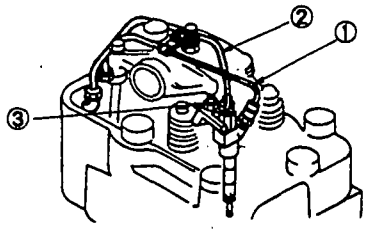
300337

EVERY 1000 HOURS OR 3 YEARS – continued

Injection nozzle – Removal and installation.

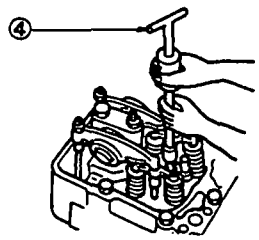
Removal

1. Remove fuel pipe (1) and fuel leak-off pipe (2) by loosening nuts on each cylinder head.
2. Unscrew gland nut (3) and, after taking off gland and spacer, remove nozzle from cylinder head.



300523

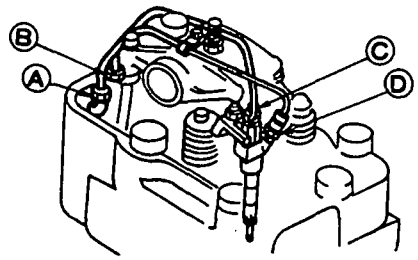
3. To remove nozzle, use nozzle remover (4) (36291-00900).



300165

Installation

1. To install, use reverse of removal procedure. To install nozzle, tighten nut to 6 kgf·m (43.4 lbf·ft) [58.8 N·m] while keeping the gap between nozzle body and valve spring equally. After installing nozzle, check each fuel pipe joints for fuel leaks.
2. Remove rocker cover, and run engine at about 600 rpm. Under this condition, check to be sure that no fuel leaks at points (A), (B), (C) and (D). Then, stop engine, and install rocker cover.



300523

EVERY 1000 HOURS OR 3 YEARS – continued

Valve clearance – Check.

Check valve clearance in firing order (injection sequence) shown below. To turn crankshaft, use a turning bar.

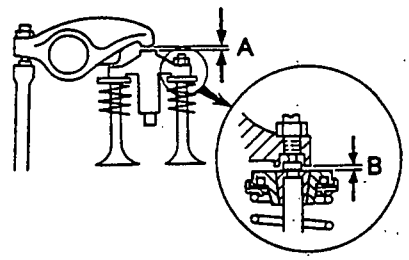
Firing order	1–5–3–6–2–4

	Valve clearance (A) (cold)	Bridge-to-valve rotator clearance (B)
Inlet valve	0.4 mm (0.016 in.)	1.5 mm (0.059 in.), minimum
Exhaust valve	0.5 mm (0.020 in.)	

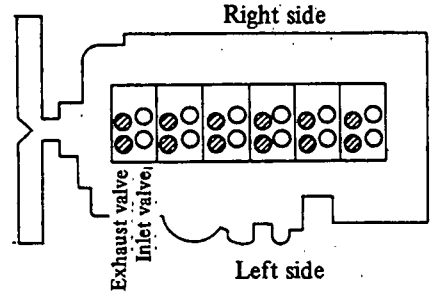
Adjust valve clearance if it is incorrect.

NOTE

Inlet valves are on left side and exhaust valves on right side as seen from right (injection pump) side of engine.



300516

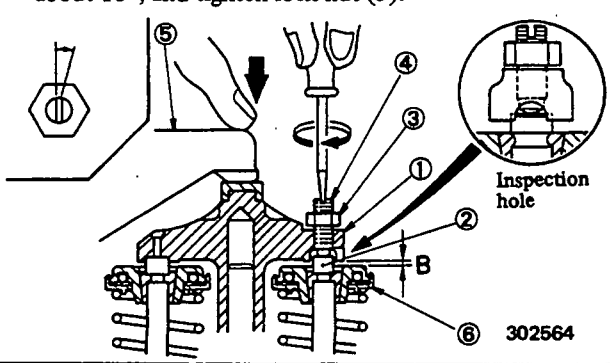


302563

Valve clearance – Adjust.

Adjusting valve heights by means of valve bridge

1. Before adjusting valve clearance, adjust and equalize heights of two valves by bringing valve bridge (1) into contact with tops of their stems. If seat for one valve is more worn than that for the other, for instance, valve heights become unequal to produce some clearance between bridge (1) and stem (2), resulting in difference in height (clearance) between two valves.
2. Loosen lock nut (3), and back off adjusting screw (4).
3. Hold rocker arm (5) by finger, and slowly turn in adjusting screw (4) until it touches top of valve stem (2). From that position, further turn it in about 10°, and tighten lock nut (3).



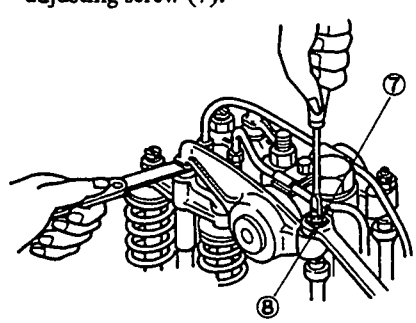
302564

NOTE

Be sure to adjust clearance (B) between bridge (1) and valve rotator (6) to 1.5 mm (0.059 in.) or more. If this clearance is less than 0.5 mm (0.020 in.), valve cotters may come off.

Adjusting valve clearance

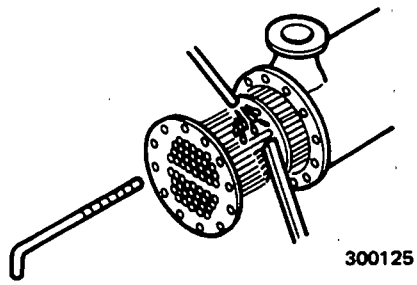
1. Loosen lock nut (8) of adjusting screw (7) on pushrod side of rocker.
2. While measuring clearance with a feeler gauge, turn adjusting screw (7) in either direction.
3. After adjustment, tighten lock nut (8) to secure adjusting screw (7).



300147

EVERY 2000 HOURS OR 5 YEARS

Heat exchanger – Wash.



300125

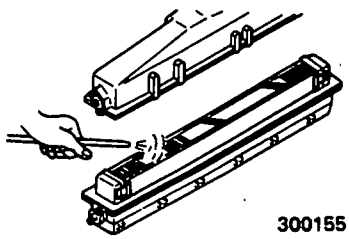
Wash outside surfaces of pipes with a brush by dashing fresh water over them.

Remove scale from inside of pipes by inserting a bar.

NOTE

Use a fine, soft wire brush.

Air cooler – Clean.

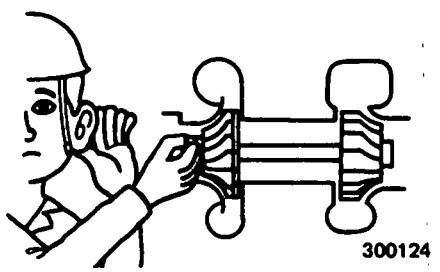


300155

Remove air cooler, and direct pressure air in direction opposite to air flow.

Remove scale from inside of fresh-water or sea-water pipes by inserting a bar.

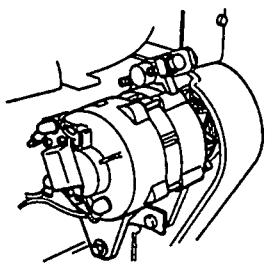
Turbocharger – Check.



300124

Turn compressor wheel by hand to listen for abnormal noise. If wheel is noisy, replace bearings.

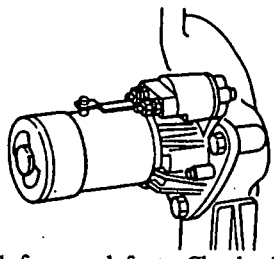
Alternator – Check.



301820

Visually check for any defects. Check for abnormal rotation when belt is put out.

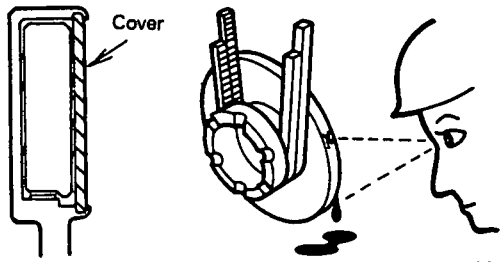
Starter – Check.



300525

Visually check for any defects. Check pinion for operation.

Viscous damper – Check.



302565

Check for oil leakage, flaws, distortion, discolored or flaked painting. Also check cover (1) for swelling (with a scale), oil leakage from staked portion or other defects.

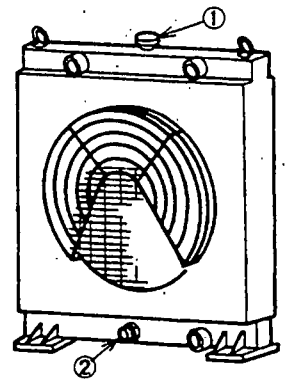
EVERY 1 YEAR

Cooling system – Change coolant.

1. Change coolant every 1 year.
2. For fresh water, use water that is soft, or as free as possible from scale forming minerals.
3. Use antifreeze of all-season type through the year. For concentration, see page 39.

NOTE

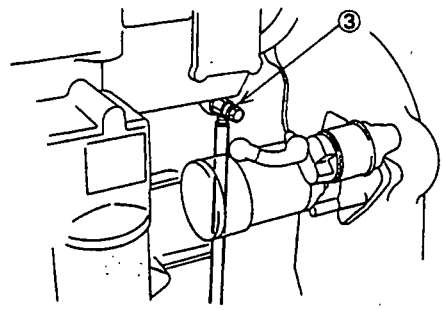
1) Determine the amount of antifreeze by estimating the capacity of cooling system.
2) Stick with one and the same antifreeze concentration when adding coolant.



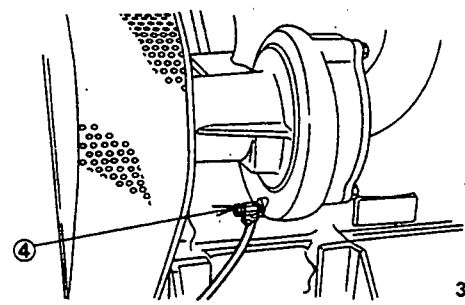
300102

How to change coolant

1. Start engine and run it until coolant temperature reaches 75°C to 85°C (167°F to 185°F). Stop engine.
2. After engine has cooled down, raise radiator cap lever to relieve pressure and remove cap (1).
3. Open radiator drain plug (2), engine drain plug (3) and water pump drain plug (4) to drain coolant.
4. Close these drain plugs and fill colling system with flushing solvent (which does not attack rubber and metal). After running engine at 800 to 900 rpm for about 15 minutes, open drain plugs and drain the solvent.
5. Close drain plugs, fill cooling system with fresh water and run engine at 800 to 900 rpm for about 10 minutes.
6. Stop engine and open drain plugs. Rinse cooling system with water until water flowing out of engine is clean.
7. Close drain plugs. First put antifreeze in radiator, then slowly fill it up with soft water.
8. Start engine and run it until coolant temperature reaches 75°C to 85°C (167°F to 185°F). Stop engine. Check coolant level in radiator and add antifreeze coolant of the same concentration if necessary.



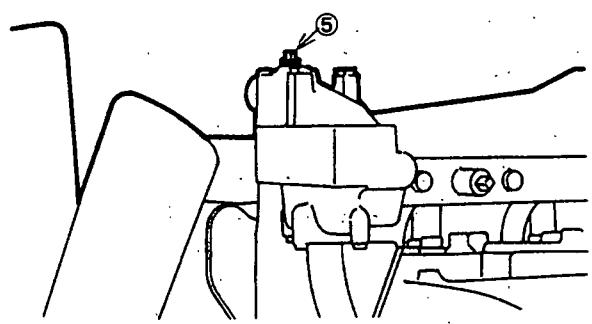
302566



301824

CAUTION

Remove air vent plug (5) located at the top of thermostat case to bleed air completely.

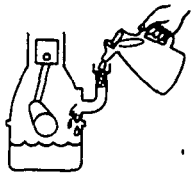


302567

STORAGE

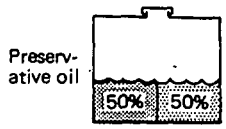
Preparation for prolonged storage (3 months or more)

Drain out engine oil, and fill in preservative oil such as "P-10."



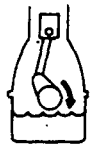
300127

Use a mixture of "P-9" preservative oil and fuel oil in 50-to-50 ratio.



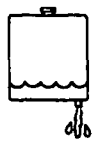
300128

Run engine at 800 to 1000 rpm for 5 to 10 minutes under no-load condition.



300129

After stopping engine, drain out fuel and coolant.

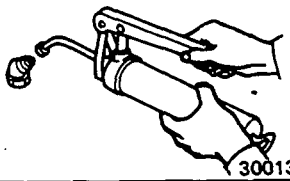


301468

Put volatile preservative compound in air inlet and exhaust system in amount of 2 to 4 g (0.07 to 0.14 oz) of the compound per cubic foot.

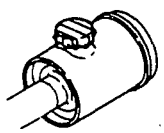
300131

Lubricate fitting or linkage of tension pulley, etc.



300132

Cover up air cleaner, air inlet pipe, exhaust pipe, breather and turbocharger with adhesive tapes.

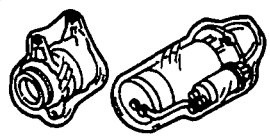


300133

Loosen V-belts.

300134

Cover up starter and alternator with polyethylene sheet.



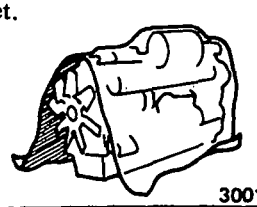
300135

⚠ CAUTION

1) When storing engine, keep it indoors whenever possible.
2) Do not use a vinyl sheet for covering purposes.
3) Attach caution tags reading "Preservative oil in engine," and "Before placing engine in service, fill in coolant and fuel." Adjust antifreeze concentration to 30% to 60%. (See page 39.)

Add distilled water and recharge batteries. Remove batteries, clean terminals and keep batteries in a dry, cool place.

Cover engine with an awning sheet.



300136

NOTE

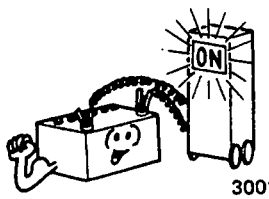
It is not necessary to change engine oil if storage period is shorter than 6 months.

Recommended preservative oils

Specification	Brand name
P – 9	US Horton Rustbet Cosmolin
P – 10	US Horton Rustbet Cosmolin 1051, 1049

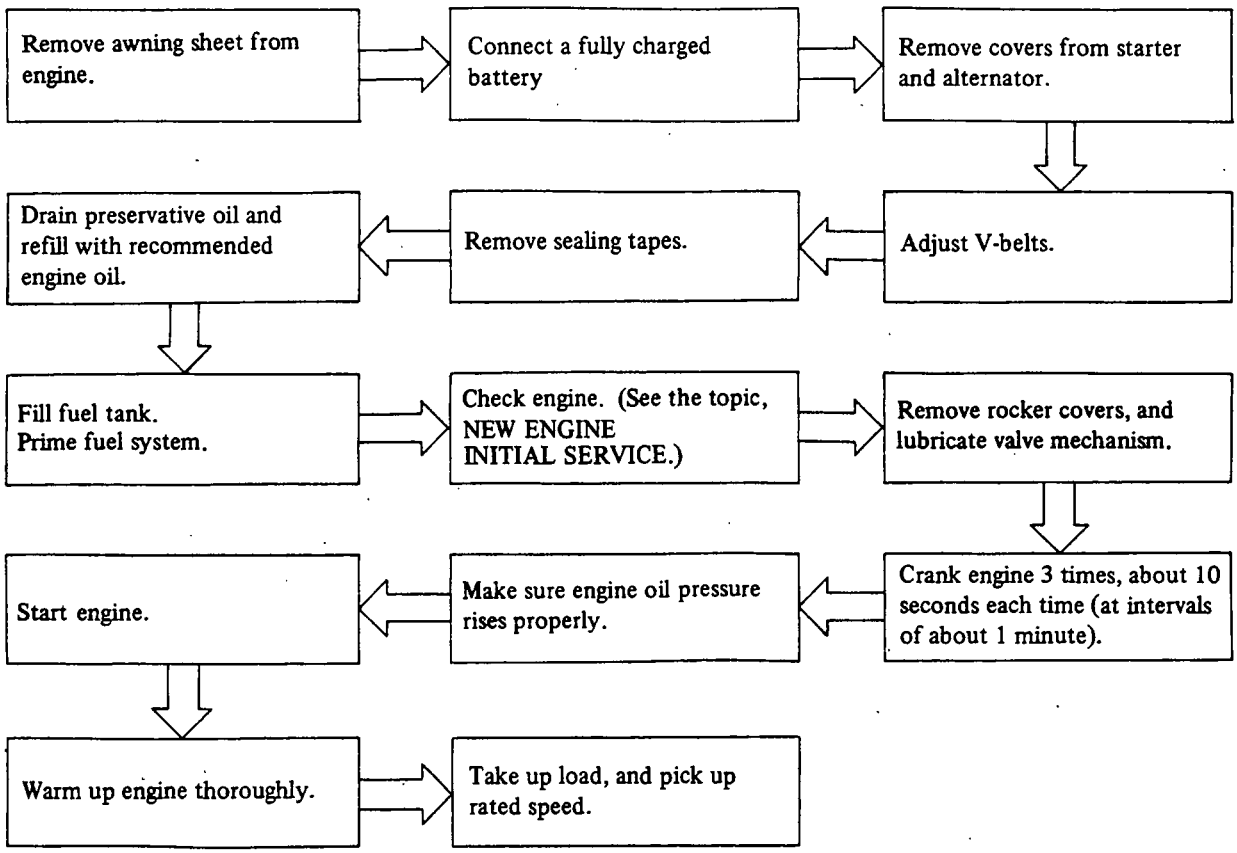
Service during storage

Recharge batteries at least once a month.



300137

Preparing a stored engine for service



FUELS, COOLANT AND LUBRICANTS

FUELS FOR MITSUBISHI ENGINES

Mitsubishi diesel engines are designed to use diesel fuel oil meeting the requirements of JIS (Japanese Industrial Standard) K2204. JIS K2204 diesel fuel oil nearly corresponds to Class 2-D fuel oil specified by ASTM (American Society for Testing and Materials) D975. For pour point, refer to the following chart:

Ambient temp. °C (°F)	−30 (−22)	−20 (4)	−10 (14)	0 (32)	10 (50)	20 (68)	30 (86)	40 (104)
Gas oil (JIS K2204)		No. 3, special	No. 3	No. 2	No. 1	No. 1, special		

NOTE

The fuel should be fluid enough to flow from the fuel tank to the injection pump. The pour point of the fuel should be at least 18°C (10°F) below the lowest atmospheric temperature at which the engine should start and operate. This will generally provides a fuel that will flow readily from the fuel tank to the injection pump.

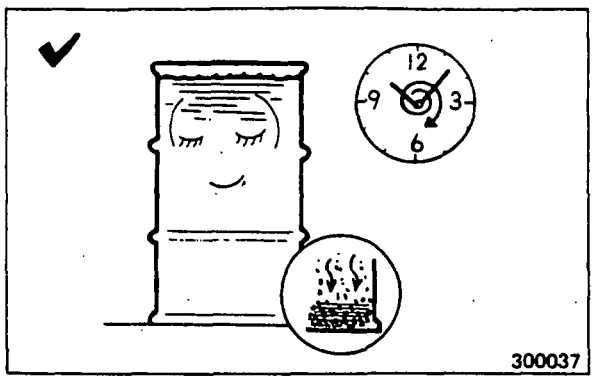
Fuel cleanliness

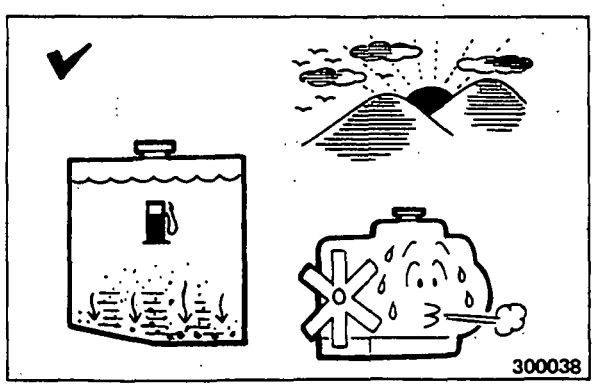
1. Use a storage tank, and allow fuel to stand at least 24 hours in this tank before pumping it to the diesel fuel tank. Be sure to drain all water and sediment that has settled to the bottom of the storage tank before the diesel fuel tank is refilled.

2. Fill the diesel fuel tank at the end of the day. This will drive out moisture-laden air and prevent condensation.

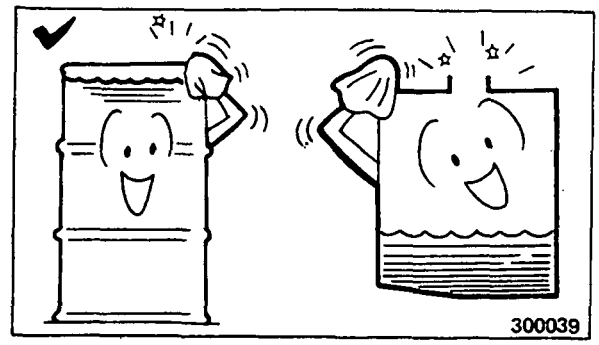
⚠ CAUTION

Filters for burner fuels (furnace oils or domestic heating fuels) differ from those for diesel fuels. Never use burner fuel in an engine equipped with a filter for diesel fuel.

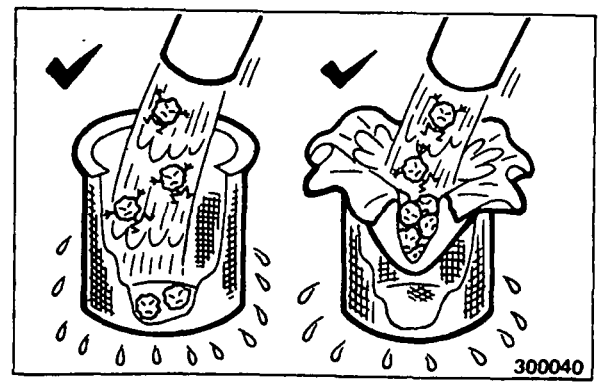




3. When refilling the diesel fuel tank, use clean tools, such as a hand pump, funnels, containers, hoses, etc. Wipe filler cap clean before removing it. When operating the hand pump, keep in mind that there could be water and sediment that has settled to the bottom of storage tank; tap the needed amount of fuel from clean top portion.



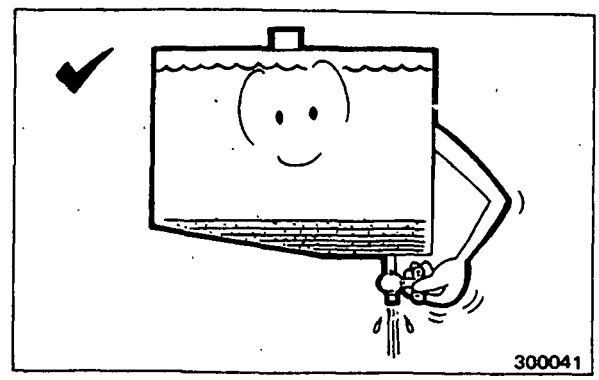
4. Be sure to pour fuel through strainer in the filler opening. Use of a lint-free cheese cloth is a good practice for keeping dirt out.



5. Occasionally, open the drain cock of the storage and diesel fuel tank to drain off any water or sediment that may have settled.

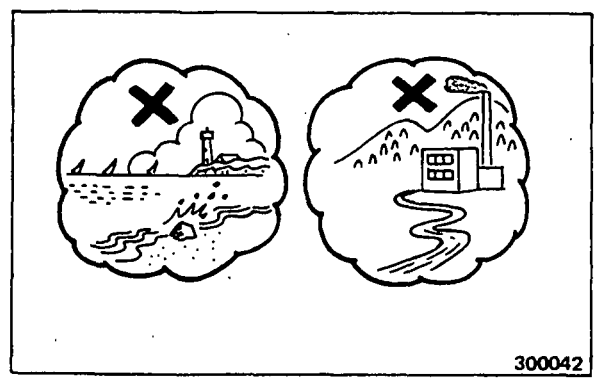
⚠ CAUTION

Even clean top portion of fuel oil contains more or less dirt and water. Such dirt and water should be removed before they get inside the engine. This method of cleaning fuel oil is called "draining."



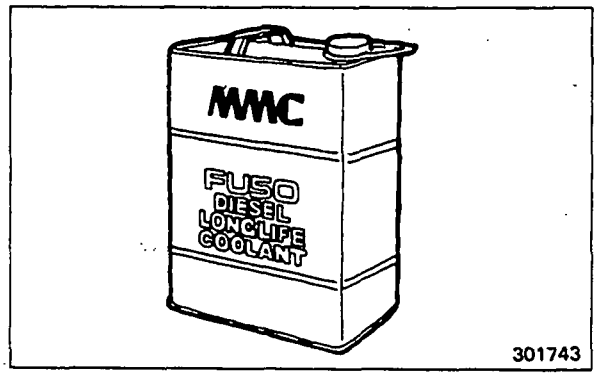
COOLANT

1. Water used in the cooling system must be soft, or as free from scale forming minerals as possible. Water of drinking quality is generally soft enough for the engine.
2. River water and well water are most likely to contain large amount of scale forming minerals and should not be used. Remember, some waters, particularly those pumped from ground in a mining or hot-spring area, contain



active impurities harmful to cylinder liners of your engine.

3. Be sure to service the zinc rods installed in the sea-water circuits at regular intervals.
4. Use antifreeze of all-season type through the year. Use antifreeze concentration of 30% to 60% by volume through the year. Antifreeze of less than 30% concentration does not provide sufficient corrosion protection. Concentrations over 60% adversely affect freeze protection and heat transfer rates.

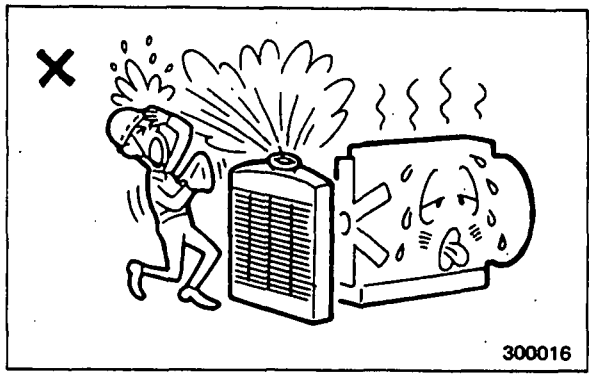


301743

Temperature, °C (°F)	Above -10 (14)	Above -20 (-4)	Above -30 (-22)	Above -45 (-49)
Recommended antifreeze concentration, % by volume	30	40	50	60
Amount of water, % by volume	70	60	50	40

Care in hot weather

"Overheated" condition shows up on the water temperature gauge and oil pressure gauge. When this condition is noted, remove the load rather slowly and let the engine idle to cool off.


300016

⚠ WARNING

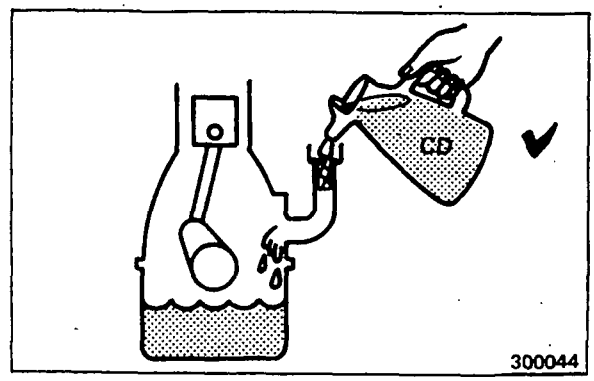
Do not attempt to pour cold water into the radiator of an overheated engine. To avoid having scalding hot coolant or steam blow out of the radiator, do not remove the radiator filler cap unless the engine is cool. Muffle the cap in a thick cloth and turn it slowly to release all pressure before removing the cap.

LUBRICANTS

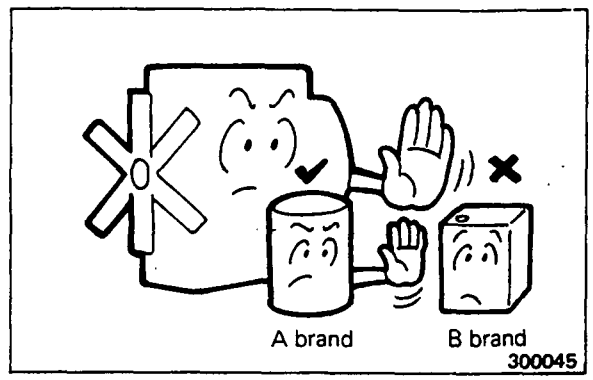
Engine oil

Careful attention to the following information on engine oil and its proper selection will add much to performance, economy and long life of your engine – a high-speed, high-load diesel engine.

1. Be sure to use engine oil of the API (American Petroleum Institute) service classification "CD."

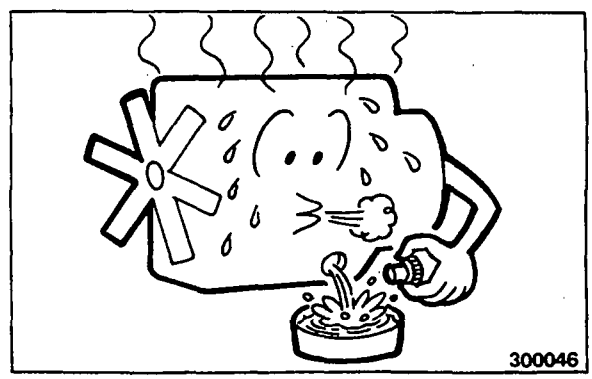


2. Avoid mixing engine oils of different brands. In some cases, different brands are not compatible with each other and, when mixed, can seize parts such as piston rings, cylinder liners, etc. or abnormally wear moving parts. It is best to stick with one and the same brand of engine oil at successive service intervals.



3. Draining and refilling

   To change the oil, drain it out while the engine is still hot after a duty operation: the oil is hot and will rush out, washing out the sludge. After draining, allow the engine to idle for about 5 minutes with a flushing oil in the oil pan and refill with fresh oil upon draining the flushing oil.



⚠ CAUTION

For discarding of waste oil which is prohibited by law, consult Mitsubishi dealer.

Grease

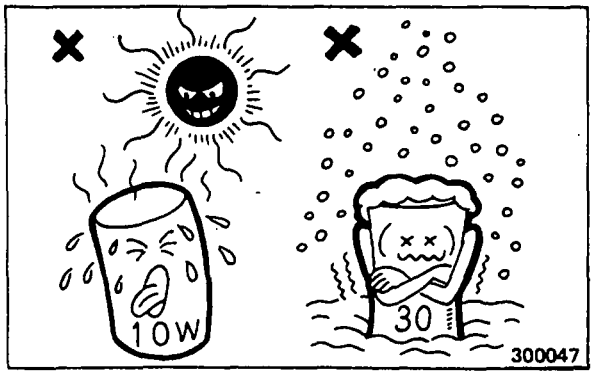
Use clean multi-purpose grease for your engine.

⚠ CAUTION

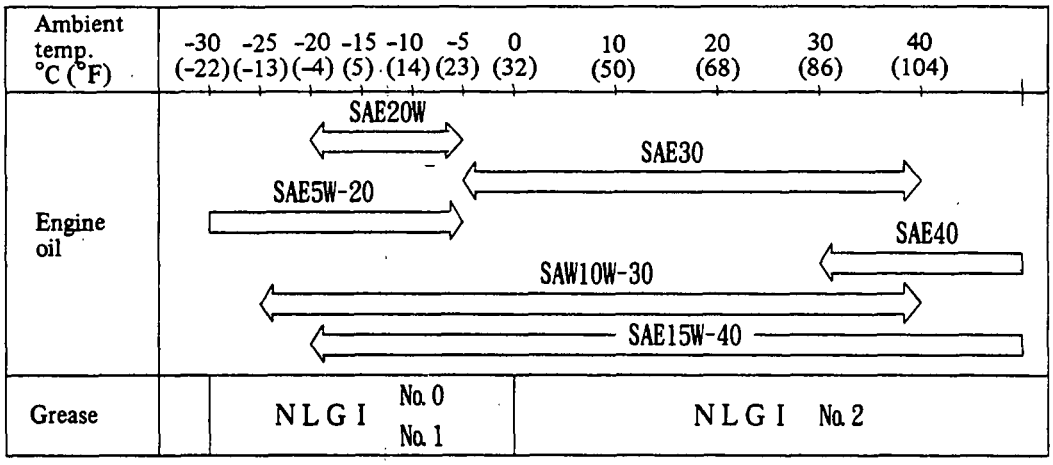
Cleanliness is important for handling the engine oil and grease. Use clean handling tools; wipe the filler cap, grease fittings and plugs clean; and handle them in a dust-free condition.

Selection

Refer to the following charts in selecting engine oil and grease:



Starting temperatures and grades of lubricants



Recommended engine oils ["CD" (API service classification)]

Manufacturer	Brand name	SAE viscosity number
Mitsubishi	Diamond HDS-3 Engine oil	10W, 20W, 30, 40, 50
Esso	Essolube D-3	10W, 20W, 30, 40, 50
General	General Gemico Super S-3	10W, 20W, 30, 40
Idemitsu	Apollo Oil Diesel Motive Custom	10W, 20, 30, 40
Kygnus	Mighty Oil S-3	10W, 20W/20, 30, 40, 50
Kyodo	Kyoseki Delmate D	10W, 20, 30, 40
Maruzen	Sawavis S-3	10W, 30, 40, 50
Mobil	Mobil Delvac 1300 series	10W/20, 30, 40
Nippon	High Diesel S-3	10W, 20W/20, 30, 40, 50
Shell	Shell Rimula Z Oil	10W, 20W/20, 30, 40, 50
Showa	White Parrot Super S-3	10W, 20W/20, 30, 40
Taikyo	Pioneer Diesel S-3	10W, 20, 30, 40

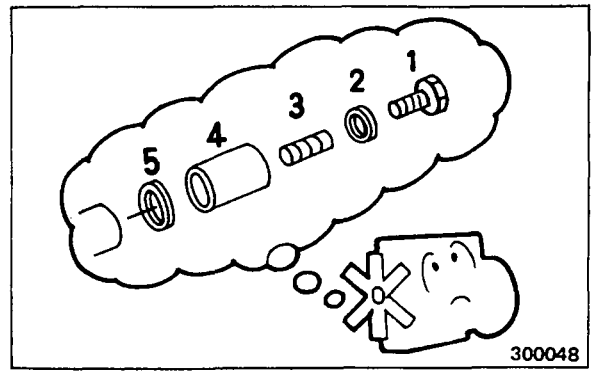
These recommended oils should be in API service classification "CD" and meet the requirements of MIL-L-2104C.

TROUBLESHOOTING

General instructions

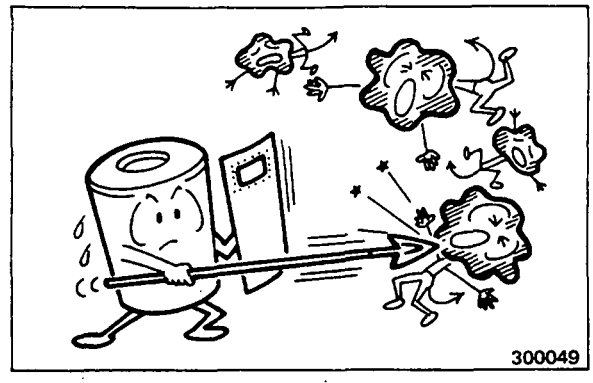
(1) Think before acting

Upon noting an abnormal symptom, recall what you did the last time when you ran across the same symptom. If what you did was correct and successful, do the same. If the symptom noted is new to you, think of possible causes in accordance with the troubleshooting procedure which follows.



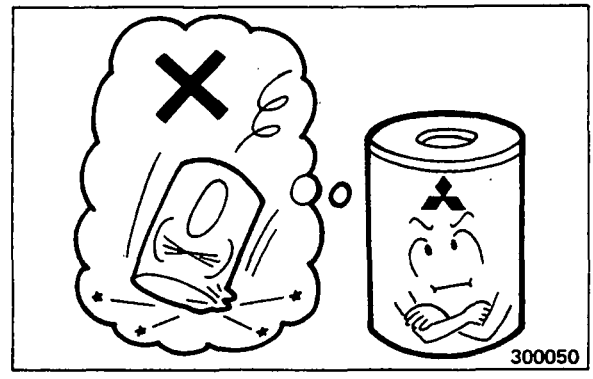
(2) Dust and dirt are often the ultimate causes.

"Wear" is usually a result of abrasive particles. When disconnecting or disassembling a part or component, be sure to keep off dust and dirt.



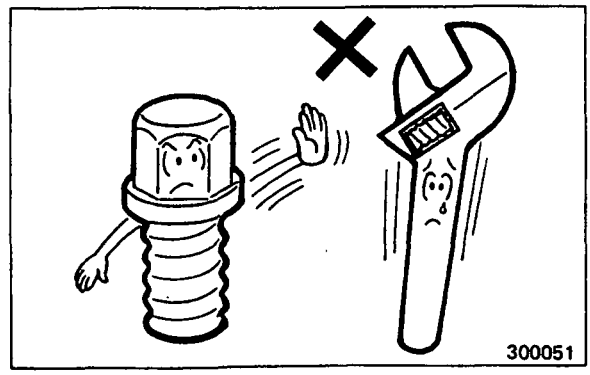
(3) Use genuine Mitsubishi parts.

Use only genuine parts to replace those that have failed or reached the service limit. When ordering, specify the needed replacement parts by referring to the Mitsubishi Parts Catalogues.



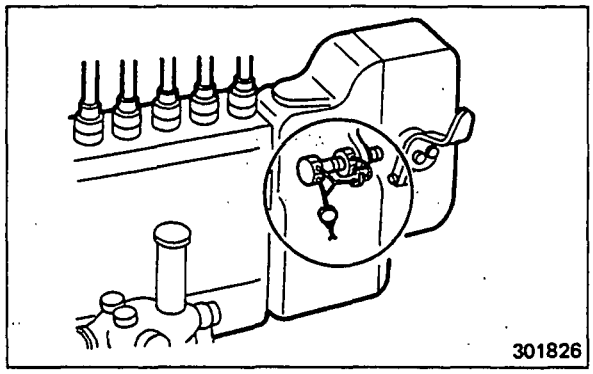
(4) Perform servicing work safely.

Use the right kind of hand tool to carry on each working step in repair work. Avoid injury to yourself and damage to the parts by using improper tool. When lifting or carrying a part too heavy for one person to handle, get another person's help and, if necessary, use a jack or a chain block to avoid personal injury.



⚠ CAUTION

1) Never attempt to break the seals of the governor for maximum speed setting and maximum injection quantity setting.
2) The maximum injection quantity of injection pumps has been set on the basis of the output horsepower of each engine verified in the bench test. Never attempt to vary this injection quantity in field.



Electric-starting engine

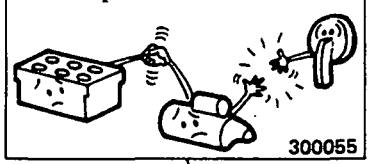
Starter will not crank engine or cranks slowly, resulting in a failure of engine to start

Electrical system

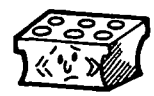
O.K.

Battery ~ starter switch circuit open → Repair or replace

Battery ~ starter ~ starter switch circuit open → Repair or replace



Battery weak → Adjust alternator drive belt



Starter, starter relay defective

Consult Mitsubishi dealer

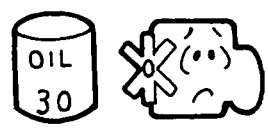
Electrolyte specific gravity low → Recharge

Battery will not recover even if recharged → Replace

Lubrication system

O.K.

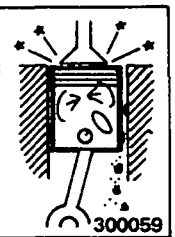
Engine oil viscosity too high



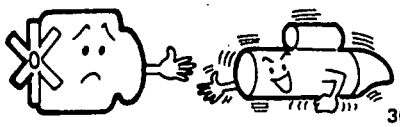
Refill with oil of proper viscosity

Engine proper

Running parts defective
Interference between pistons and valves
Foreign matter in cylinder



Consult Mitsubishi dealer


300060

Starter will crank engine, but engine will not start

Fuel system → Fuel tank

O.K.

Empty → Refuel


300061

Filled


300062

Consult Mitsubishi dealer ← *Fuel leaks from pipe connection

Air in fuel system → Prime

Wrong type of fuel → Refill with correct type of fuel

Dirt or water in fuel


300064

→ Remove dirt or drain

Fuel filter clogged → Change filter

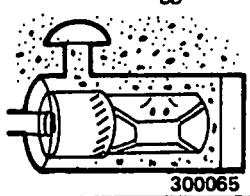
Fuel pipe clogged or leaky → Clean or repair

Injection pump defective → Consult Mitsubishi dealer

Air inlet system

O.K.

Air cleaner clogged


300065

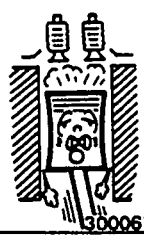
Clean element


300066

→ Change element

Engine proper

Compression pressure low
Cylinders, pistons and piston rings worn
Valve springs broken
Valve seats and injection nozzle packings defective


300067

→ Consult Mitsubishi dealer

Air-starting engines

- **Air-motor type**

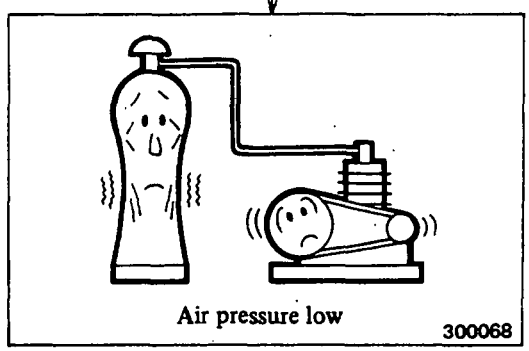
Starter will not crank engine

- Air pressure low → Run air compressor to increase air pressure
- Starter switch defective → Repair or replace → Consult Mitsubishi dealer
- Magnetic valve defective → Repair or replace → Consult Mitsubishi dealer

Starter will run, but starter pinion will not engage with flywheel ring gear

- Ring gear or pinion defective → Consult Mitsubishi dealer

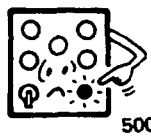
Starter pinion engages with ring gear, but starter will not crank engine



→ Run air compressor to increase air pressure

Others

Complaint	Possible causes	Remedy
Engine lacks power  500040	• Incorrect grade of oil	• Use recommended type and SAE number of oil.
	• Wrong type of fuel	• Change.
	• Insufficient air (air cleaner clogged)	• Clean or change element.
	• Engine overcooled	• Use radiator cover, replace parts.
	• Feed pump gauge filter clogged	* Clean.
	• Engine overheating	• Flush cooling system or replace parts.
	• Valve clearance incorrect	• Readjust.
	• Injection pump defective	* Readjust or replace.
	• Injection nozzles defective	* Readjust or replace.
	• Injection timing incorrect	* Readjust.
	• Compression pressure low (cylinders and pistons worn)	* Disassemble and replace parts.
White or blue exhaust smoke  500041	• Too much oil in crankcase	• Fill only to correct level on gauge.
	• Oil viscosity too low	• Refill with correct viscosity of oil.
	• Engine overcooled	• Use radiator cover, or replace parts.
	• Thermostat defective	* Replace.
	• Injection timing incorrect	* Readjust.
	• Compression pressure low	* Disassemble and replace parts.
Black or gray exhaust smoke  500042	• Wrong type of fuel	• Refill with correct type of fuel
	• Valve clearance incorrect	• Readjust.
	• Injection pump defective	* Readjust or replace.
	• Compression pressure low	* Disassemble and replace parts.
	• Insufficient air (air cleaner clogged)	• Clean or change element.
High fuel consumption  500043	• Injection pump defective	* Readjust or replace.
	• Injection nozzles defective	* Readjust or replace.
	• Injection timing incorrect	* Readjust.
	• Wrong type of fuel	• Refill with correct type of fuel.
	• Compression pressure low	* Disassemble and replace parts.
	• Insufficient air	• Clean or change air cleaner element. Check turbocharger.
High oil consumption  500044	• Too high oil level in crankcase	• Maintain oil level in operating range on gauge.
	• Incorrect grade of oil	• Use recommended type and SAE number of oil.
	• Oil leaks	• Retighten or replace.
	• Cylinder liners and piston rings worn	* Disassemble and replace parts.
	• Valve stem seals worn	* Disassemble and replace parts.

Complaint	Possible causes	Remedy
Engine overheats  500047	• Radiator or heat exchanger dirty • Fan belt loose • Lack of coolant • Water pump defective • Thermostat defective	• Wash. • Readjust. • Refill. * Replace. * Replace.
Low oil pressure (Oil pressure alarm lamp glows)  500045	• Lack of oil • Oil viscosity too low • Oil filter clogged • Oil pump defective • Oil pressure regulating valve defective • Oil pressure sensor circuit defective	• Refill up to level. • Refill with correct viscosity of oil. • Replace element. * Clean, readjust or replace. * Readjust or replace. * Replace.

NOTE

1. Consult your Mitsubishi dealer for items marked with asterisk (*).
2. Consult your Mitsubishi dealer for any item other than those listed above.
3. When communicating with your Mitsubishi dealer, give model designation, serial number and hour meter reading of your engine.

SPECIFICATIONS

Model designation		S6A3	
		TA	TK
Type		Water-cooled, 4-stroke cycle, turbocharged	
		With aftercooler	With intercooler
Number of cylinders – arrangement		6 – L	
Bore x stroke		150 mm x 175 mm (5.91 in. x 6.89 in.)	
Piston displacement		18.56 liters (1133 cu in.)	
Fuel injection system		Direct-injection	
Compression ratio		14.5 : 1	
Firing order		1–5–3–6–2–4	
Rotation		Counterclockwise as seen from flywheel side	
Dimensions	Length	1532 mm (60.3 in.)	
	Width	930 mm (36.6 in.)	
	Height	1311 mm (51.6 in.)	
Dry weight		1650 kg (3638 lb)	
Fuel system	Fuel	Diesel fuel or burner fuel	
	Injection pump	Bosch P type	
	Governor	Mechanical (all-speed or constant speed control)	
	Filter	Paper-element type	
	Injection nozzles	Hole type	
	Injection pressure	220 kgf/cm^2 (3128 psi) [21.6 MPa]	
Lubrication system	Type	Pressure lubrication by gear pump	
	Oil	API CD class	
	Capacity (engine)	80 liters (21.1 U.S. gal.), approx.	
	Oil filter	Paper-element type (spin-on type)	
	Oil cooler	Fresh water-cooled multi-plate type	
Cooling system	Type	Forced circulation by centrifugal pump	
	Capacity (engine)	36 liters (10 U.S. gal.), approx.	
Starter		Electric starter (24 V – 6 kW) or air starter (air motor)	
Alternator		24 V – 25 A, minimum	
Turbocharger		MITSUBISHI TD10 or TD13	
Flywheel		S.A.E. in.18	
Flywheel housing		S.A.E. #0	

TIGHTENING TORQUE

Important bolts and nuts

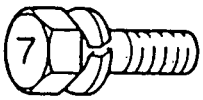
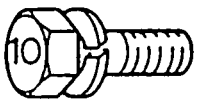
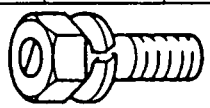
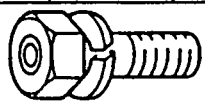
Description	M-thread Dia x Pitch	Width across flats, mm	Torque			Remarks
			kgf·m	lbf·ft	N·m	
Cylinder heads	M20 x 2.5	30	40	290	392	[Wet]
Rocker shaft brackets	M12 x 1.75	17	5	36	49	
Main bearing caps	M24 x 3	36	60	435	588	[Wet]
Main bearing cap side bolts	M16 x 1.5	22	15	108	147	[Wet]
Oil jets	M12 x 1.75	17	3 to 4	22 to 29	29 to 39	
Timing gear case	M12 x 1.25	17	15	108	147	
Oil pan	M10 x 1.25	14	4	29	39	
Mounting brackets	M18 x 1.5	24	25	181	245	
Connecting rod bearing caps	M18 x 1.5	27	35	253	343	[Wet]
Crankshaft pulley, damper	M22 x 1.5	32	40	290	392	
Flywheel	M22 x 1.5	32	55	400	539	[Wet]
Exhaust manifold	M10 x 1.5	14	5 to 6	36 to 43	49 to 59	
Idler gears	M10 x 1.25	14	4	29	39	
Camshaft gears	M30 x 1.5	50	40	290	392	Left-hand thread
Injection pump gear	M30 x 1.5	46	40	290	392	
Idler shaft	M12 x 1.25	17	5.5	40	54	
Oil pump gear	M27 x 1.5	41	30	220	294	
Water pump pulley	M24 x 1.5	36	25	180	245	
Water pump impeller	M22 x 1.5	32	20	145	196	
Injection pump coupling	M10 x 1.5	19	8.5 to 9.5	60 to 69	83 to 93	
Injection pump coupling shaft	M12 x 1.75	17	8.5 to 9.5	60 to 69	83 to 93	
Glands (nozzle holders)	M12 x 1.25	17	6	43	59	
Nozzle holder set screw cap nuts	M14 x 1.5	19	4 to 5	29 to 36	39 to 49	
Nozzle tip nuts	M19 x 1	19	6 to 8	43 to 58	59 to 78	

Remarks: 1) Apply engine oil to threads of parts specified to be [Wet].

2) Tighten main bearing cap side bolts after tightening main bearing cap bolts. (Consult your Mitsubishi dealer.)

3) Tighten connecting rod bolts in two steps. (Consult your Mitsubishi dealer.)

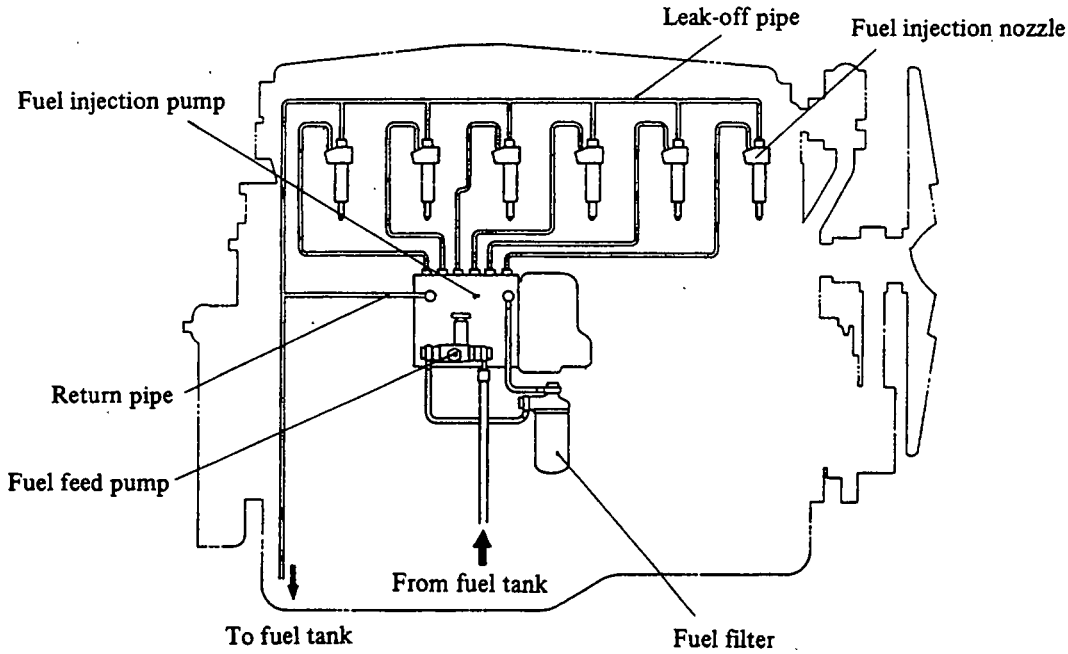
Standard bolts and nuts

	M-thread Dia x Pitch	Width across flats, mm (in.)	Strength classification					
			7T			10.9		
			kgf·m	lbf·ft	N·m	kgf·m	lbf·ft	N·m
Metric automotive thread								
	M8 x 1.25	12 (0.47)	1.7	12	17	3.1	22	30
	M10 x 1.25	14 (0.55)	3.4	25	33	6.1	44	60
	M12 x 1.25	17 (0.67)	6.1	44	60	11.0	80	108
	M14 x 1.5	22 (0.87)	9.9	72	97	17.9	129	176
	M16 x 1.5	24 (0.94)	14.8	107	145	26.7	193	262
	M18 x 1.5	27 (1.06)	21.4	155	210	38.5	278	378
	M20 x 1.5	30 (1.18)	29.7	215	291	53.4	386	524
	M22 x 1.5	32 (1.26)	39.3	284	385	70.8	512	694
	M24 x 1.5	36 (1.42)	49.7	359	487	89.5	647	878
Metric coarse thread								
	M10 x 1.5	14 (0.55)	3.3	24	32	5.9	43	58
	M12 x 1.75	17 (0.67)	5.8	42	57	10.4	75	102
	M14 x 2	22 (0.87)	9.5	69	93	17.0	123	167
	M16 x 2	24 (0.94)	14.2	103	139	25.6	185	251
	M18 x 2.5	27 (1.06)	19.8	143	194	35.7	258	350
	M20 x 2.5	30 (1.18)	27.7	200	272	49.9	361	489
	M22 x 2.5	32 (1.26)	37.0	268	363	66.6	482	653
	M24 x 3	36 (1.42)	47.7	345	468	86.0	622	843

Remarks: (a) Use these torques for bolts and nuts with spring washers.
(b) The tolerance of these torques is ±10%.
(c) Do not coat threads with oil.

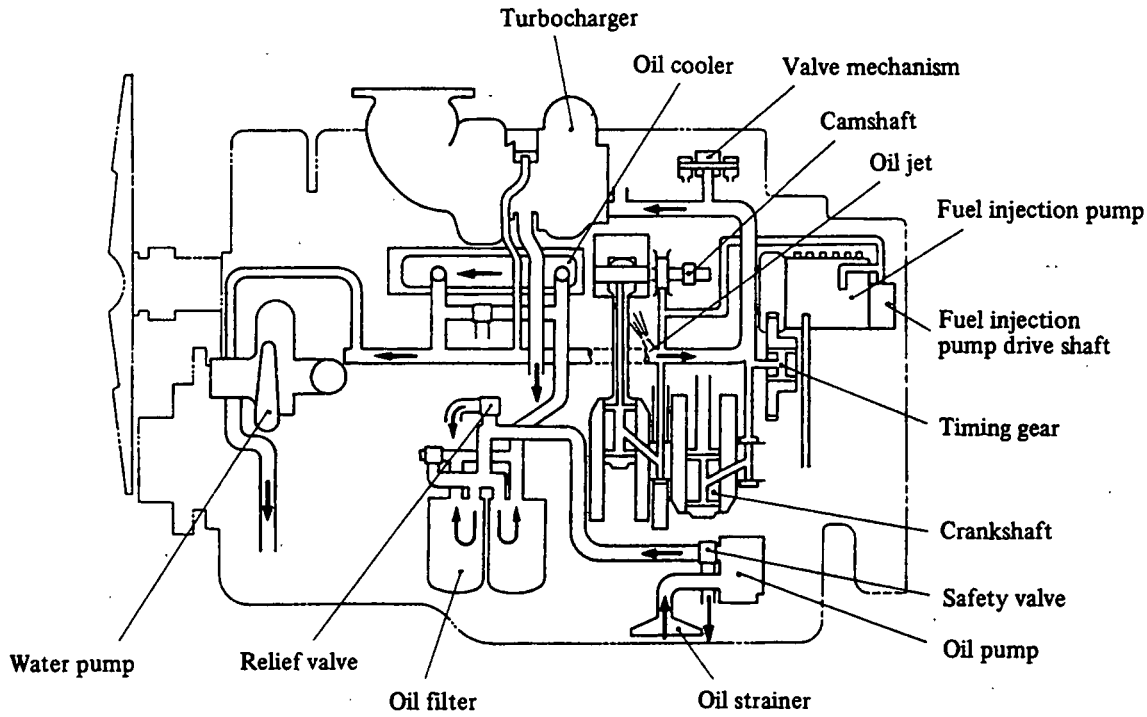
SCHEMATICS

FUEL SYSTEM



405051

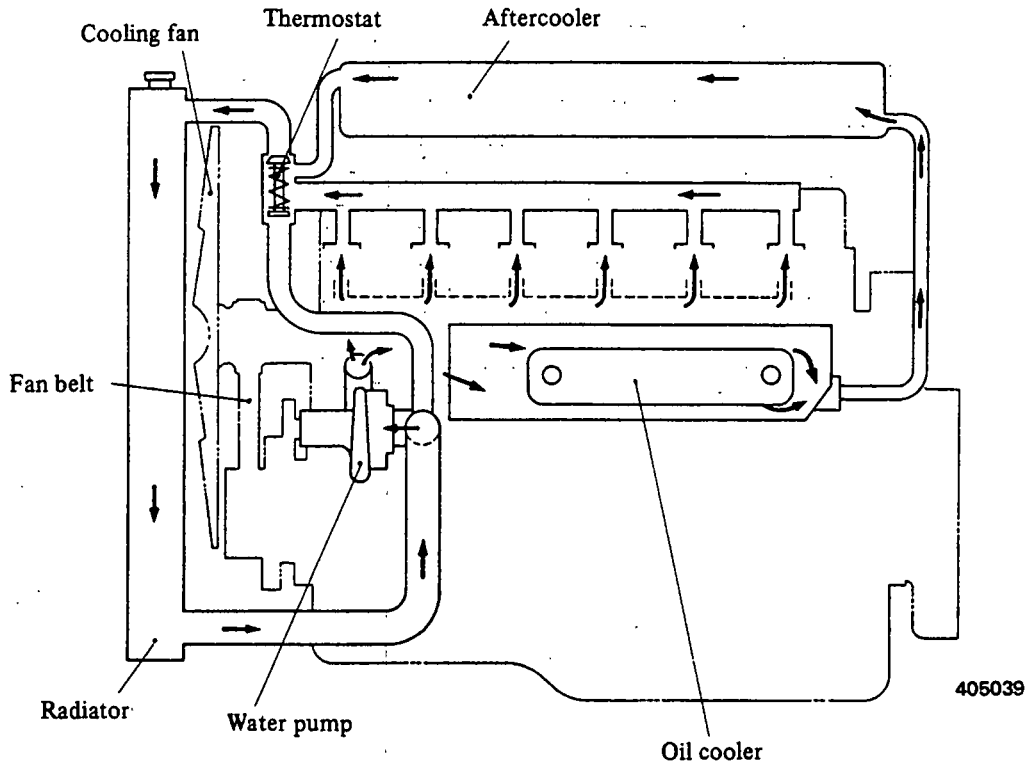
LUBRICATION SYSTEM



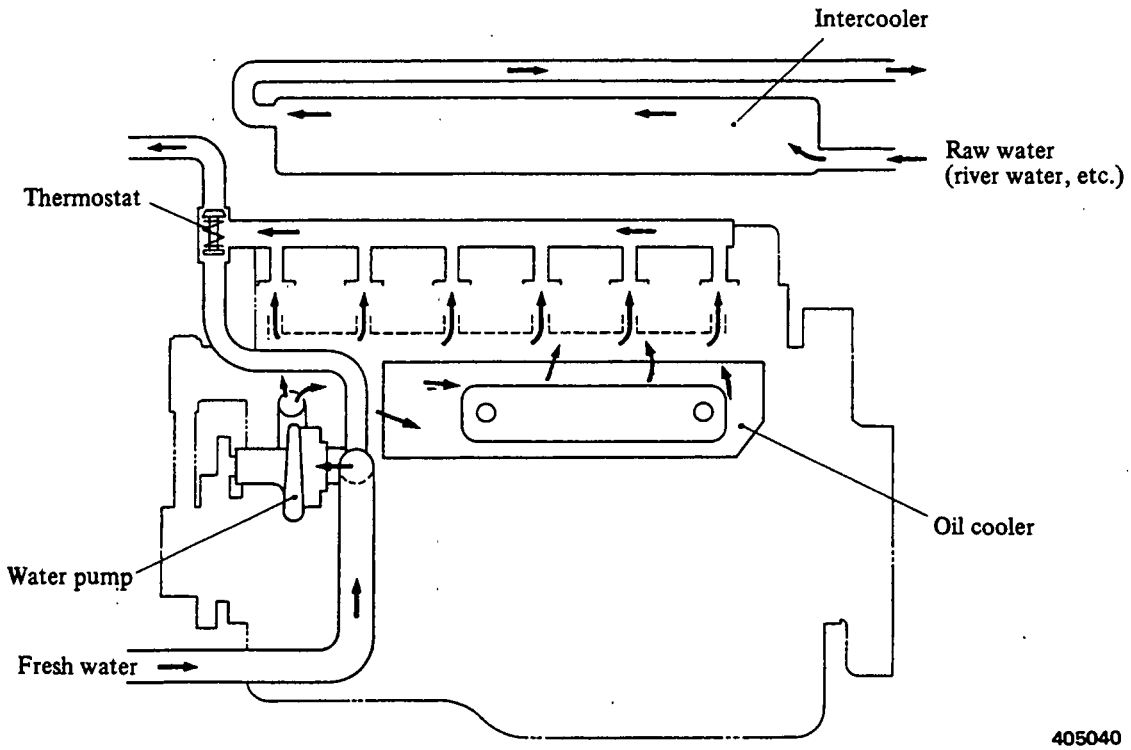
405025

COOLING SYSTEM

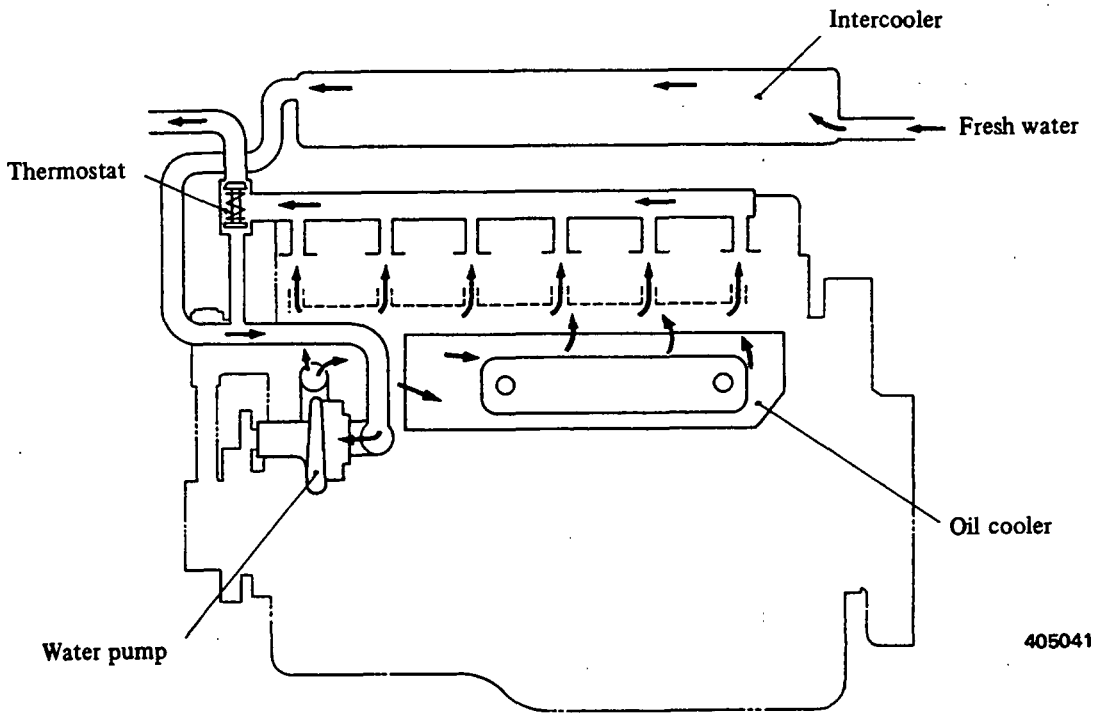
W/Radiator (PTA)



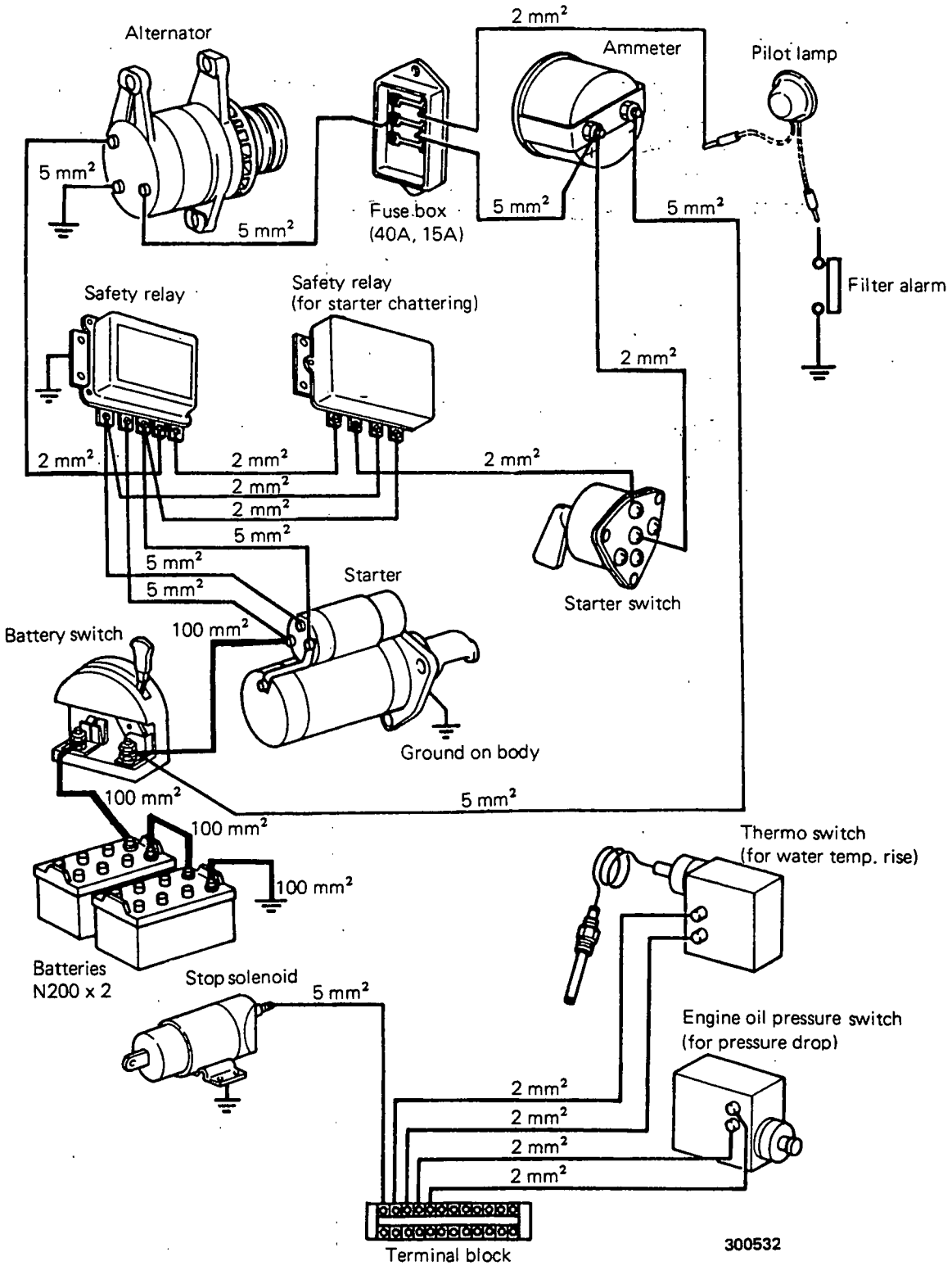
Dual cooling system (parallel type) (PTK)



Single cooling system (fresh water series type) (PTK)



ELECTRICAL SYSTEM



AIR-STARTING SYSTEM

Air-motor engine