

OPERATION MANUAL

三菱ディーゼルエンジン
MITSUBISHI
DIESEL ENGINES

S2E, S2E2

S3E, S3E2

S4E, S4E2, S4E2-T

S6E, S6E2 X

 **MITSUBISHI**
HEAVY INDUSTRIES, LTD.

INTRODUCTION

Mitsubishi welcomes you to the list of Mitsubishi diesel engine owners. We feel sure you will obtain from your new engine the economical superior performance it is designed to give.

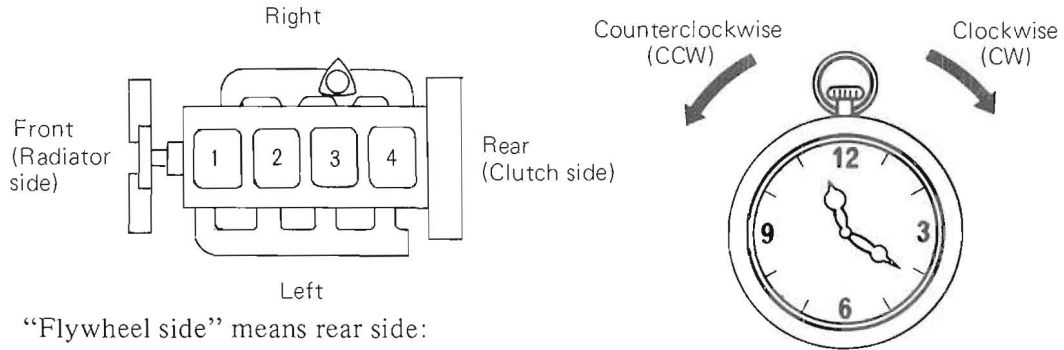
This manual is written to familiarize you with the operation and service of your SE-series and provides important safety information. We suggest that you carefully read each section of this manual to know about your new engine.

January 1980



DEFINITION OF LOCATIONAL TERMS

The words "left," "right," "front" and "rear" are used in the senses illustrated below:



"Flywheel side" means rear side:
 "fan side" means front side.

NOTES, CAUTIONS AND WARNINGS

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

- NOTE** An operating procedure, condition, etc., which it is essential to highlight.
- CAUTION** Operating procedures, practices, etc., which if not strictly observed, will result in damage to or destruction of engine.
- WARNING** Operating procedures, practices, etc., which if not correctly followed, will result in personal injury or loss of life.

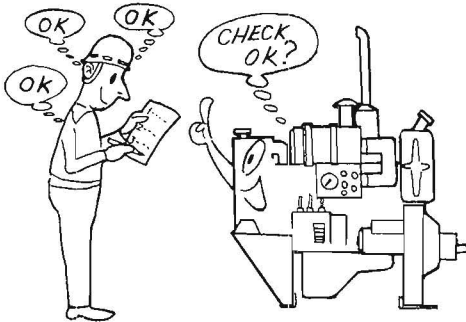
ENGINE MODELS COVERED

Application code	
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S3E2	<input style="width: 50px; height: 15px;" type="text"/>
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S6E	<input style="width: 50px; height: 15px;" type="text"/>
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Application codes
 P: Generator drive; general mechanical drive
 C: Construction machine drive

BE SAFETY-MINDED

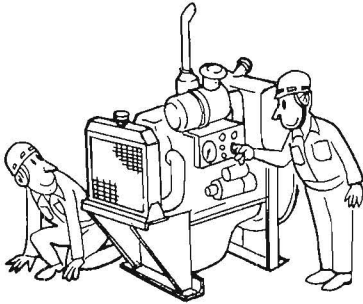
Any accident is not accidental. A careless moment can cause an accident or fire. Here are basic DO'S AND DON'T'S.



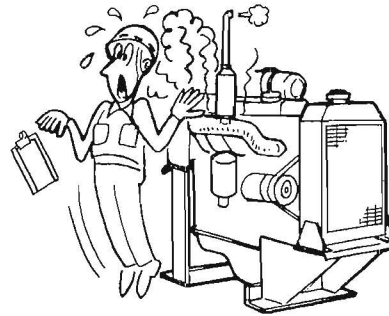
DO walk-around checks before starting your engine.



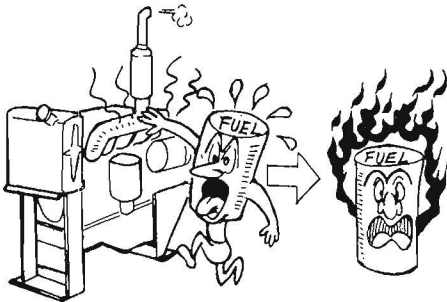
DON'T touch any running part of your engine during operation.



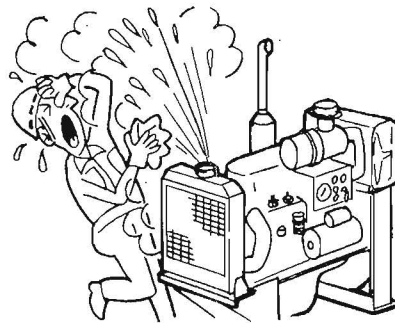
DO walk around your engine once more — eyes open and alert to people and obstacles.



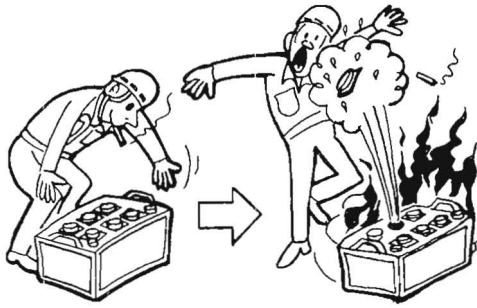
DON'T touch hot part of your engine such as exhaust manifold.



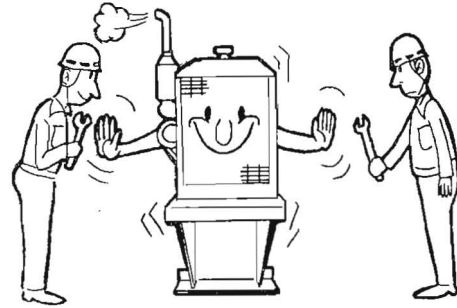
DO keep fuel away from your engine at all times. Check for fuel leaks anywhere.



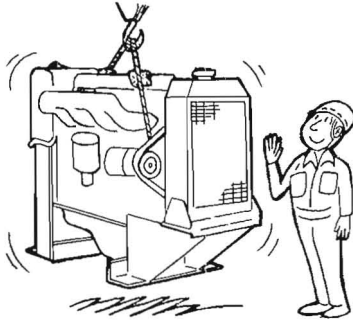
DON'T remove radiator filler cap immediately after shutting down your engine.



DON'T smoke near battery. Never use an open flame as a light anywhere on or around battery. Battery gas is highly flammable. Electrolyte is sulfuric acid and can destroy most things it touches. If you get it on your skin, wash it off at once with water.



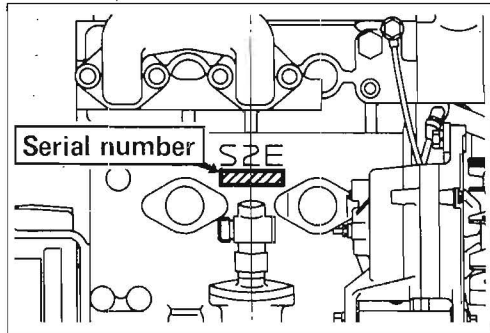
DON'T work on a running engine. If necessary to make checks with unit running, use two men and signal each other.



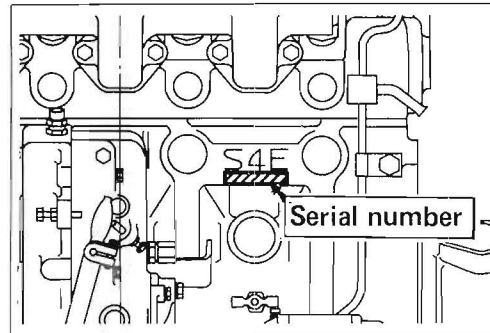
DO check capacity of sling and hoist when lifting engine. Use hangers and a wad of cloth in between sling and unit.

ENGINE SERIAL NUMBER LOCATION

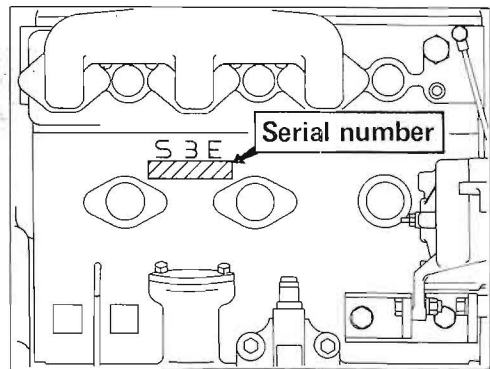
Be sure to give the serial number when contacting your Mitsubishi dealer for service or when ordering spare parts.



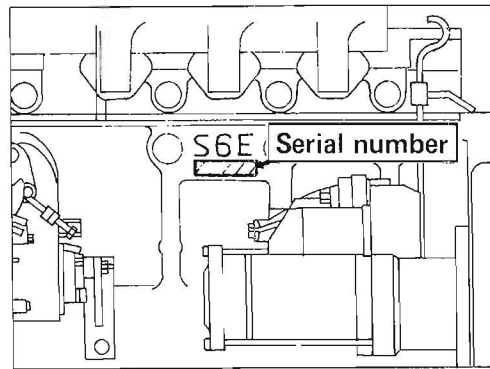
S2E



S4E



S3E



S6E

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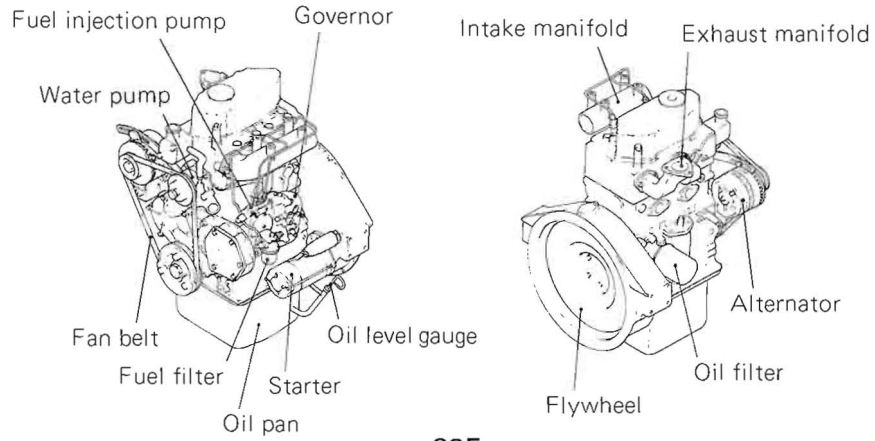
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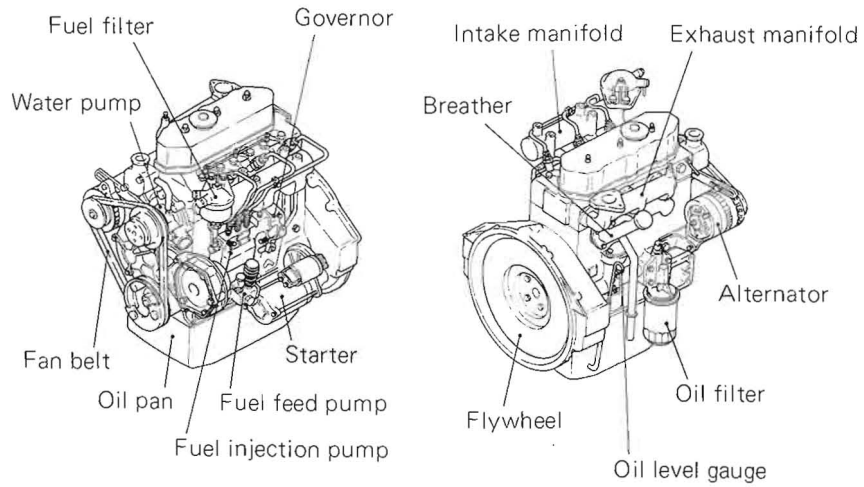
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Horizontal line at the bottom of the page.

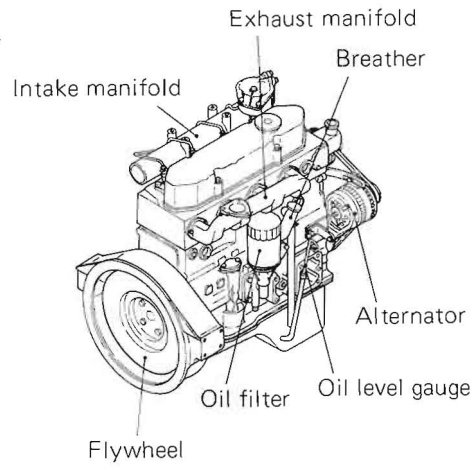
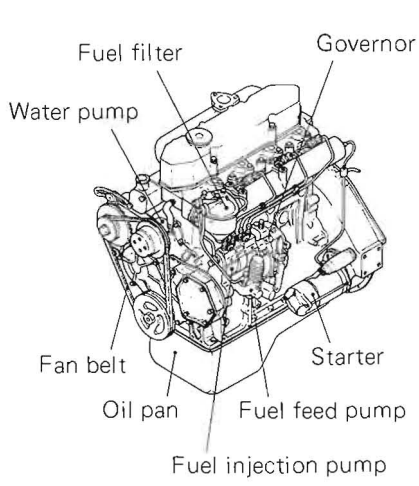
GETTING TO KNOW YOUR ENGINE



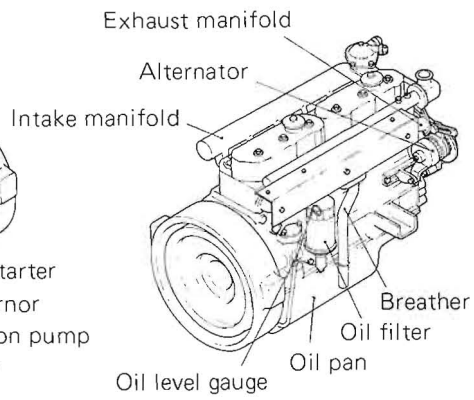
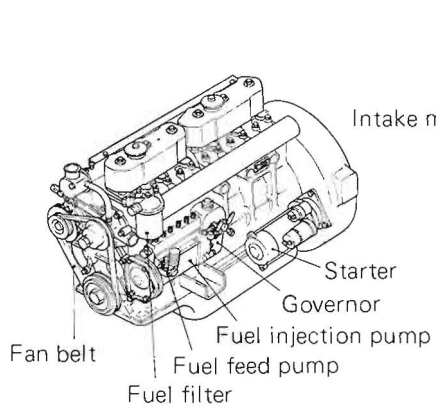
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S3E



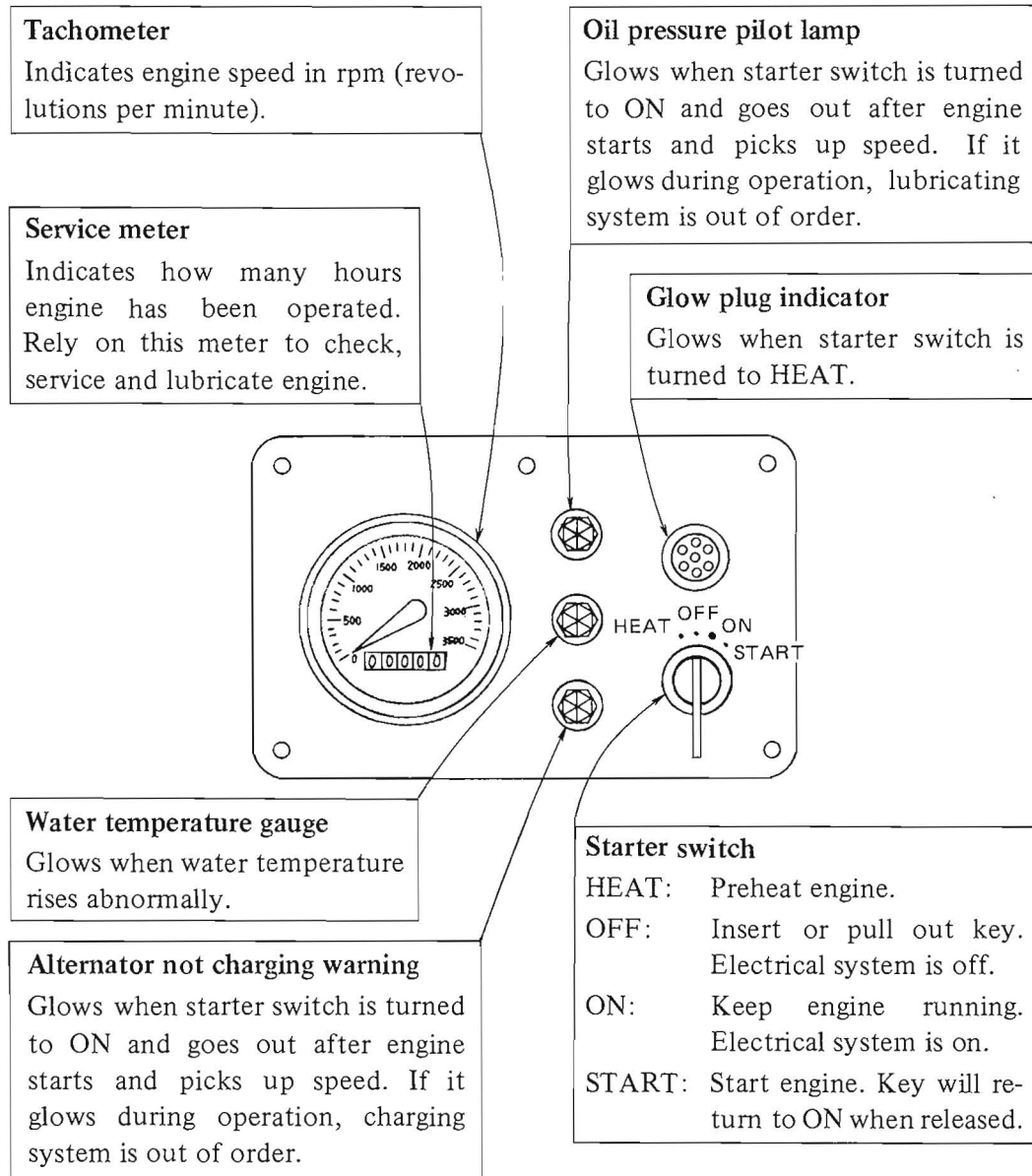
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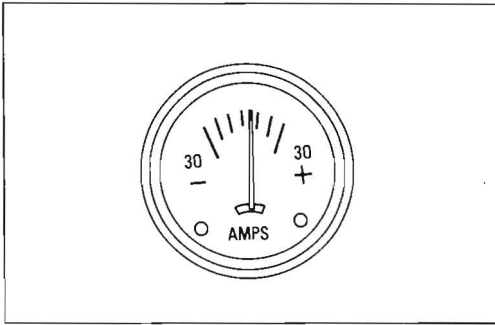
S6E

CONTROLS AND INSTRUMENTS

The controls and instruments may be varied from one engine specification (application) to another. This section covers the standard controls and instruments. Learn about controls and instruments peculiar to your engine.



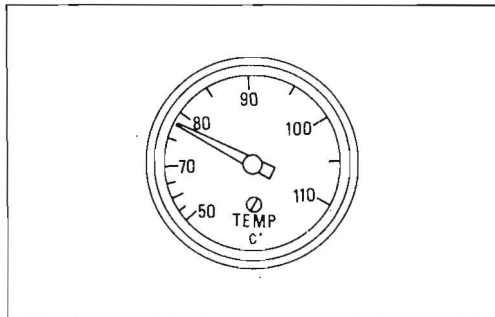
Ammeter



Shows the amount the battery is being charged.

During operation, the needle should remain on the “+” side of center.

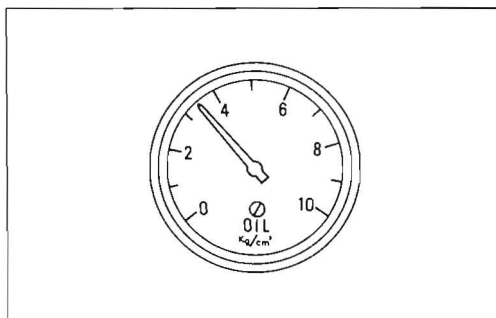
Water temperature gauge



Indicates the temperature of engine coolant.

During operation, it should be indicating 70°C ~ 85°C (158°F ~ 185°F).

Engine oil pressure gauge



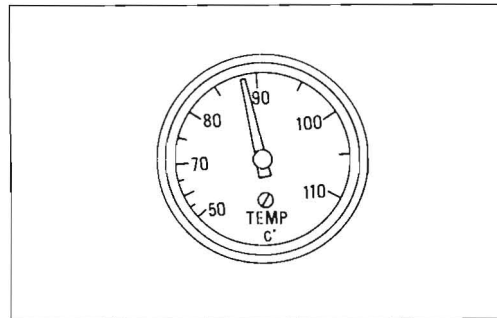
Indicates the pressure of lube oil.

The needle should indicate:

3 ~ 4 kg/cm² (43 ~ 57 psi) (at rated speed)

1 ~ 2 kg/cm² (14 ~ 28 psi) (at idling speed)

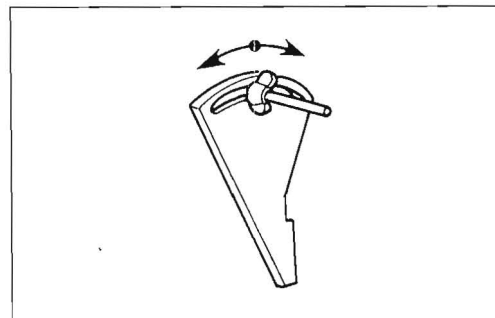
Engine oil temperature gauge



Indicates the temperature of engine oil.

During operation, it should indicate below 95°C (203°F). The maximum permissible temperature is 110°C (230°F).

Fuel control lever (for general mechanical drive)



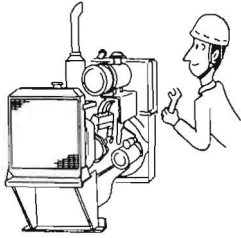
Use this lever to control engine speed.

NEW ENGINE INITIAL SERVICE

Before starting your engine for the first time, check on the following items:

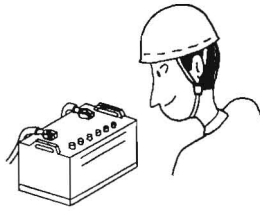
Appearance

Check for any missing part, loose bolt or nut, or any sign of damage.



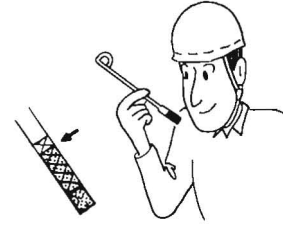
Electrical system

Check battery electrolyte level. Check connections for tightness and instruments and pilot lamps for operation.



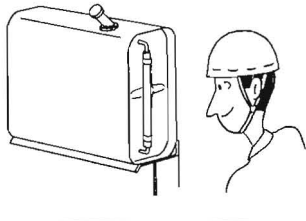
Lubrication system

Check oil level in oil pan. Check for leaks.



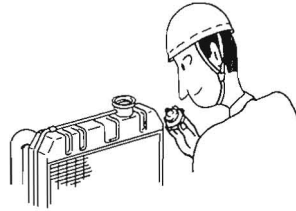
Fuel system

Check fuel level in tank. Check piping for leaks. Prime fuel system.



Cooling system

Check water level in radiator. Vent air out of system.



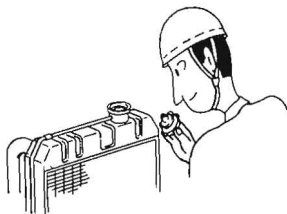
During initial 60 service hours of operation of a new or overhauled unit:

- Change engine oil (page 13).
- Change engine oil filter element (page 14).
- Retighten bolts and nuts (page 15).

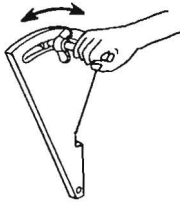
WALK-AROUND CHECKS

For safety of operator and maximum service life of your engine, check under and around to make sure your answers to questions on these items are YES:

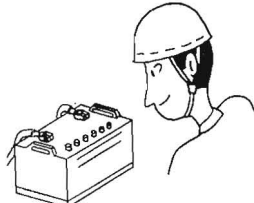
Cooling system
Is coolant up to level in radiator filler?



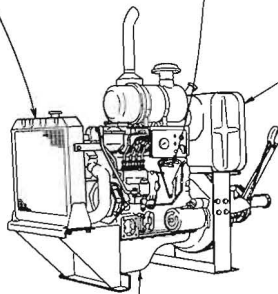
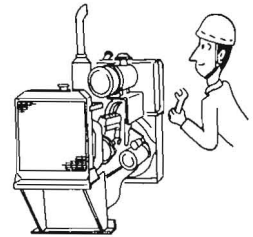
Fuel control lever
Does it move with reasonable ease?



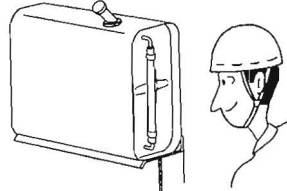
Battery switch
Are cables tight on terminal posts?




Others
Are electrical connections O.K.? No oil or water leaks? Are bolts and nuts tight?



Fuel
Is fuel enough for the day's operation?

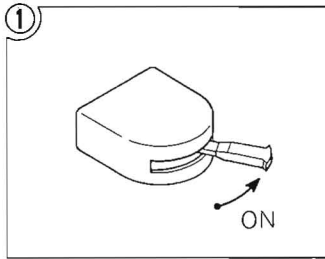


Engine oil
Is oil level just below FULL marks on level gauge?

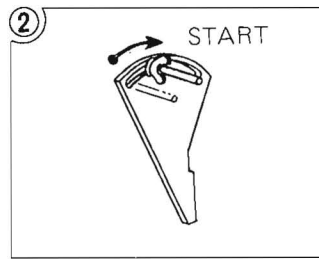


OPERATING YOUR ENGINE

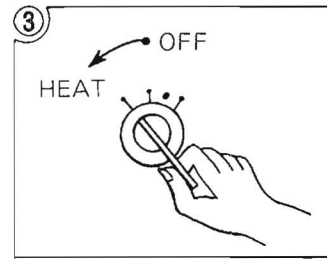
STARTING



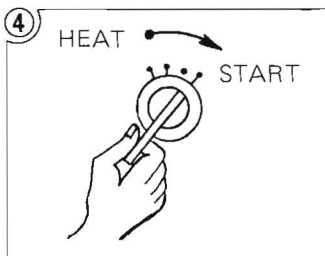
1. Move battery switch lever to ON position.



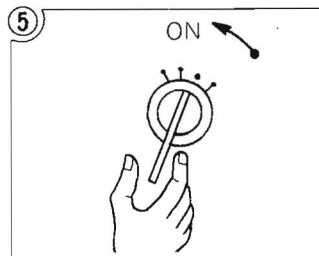
2. Move fuel control lever to START position.



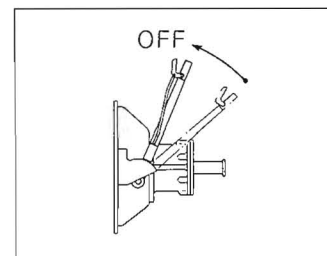
3. Insert key into starter switch and turn it to HEAT position.



4. Turn starter switch to START position.



5. As soon as engine starts, release starter switch.

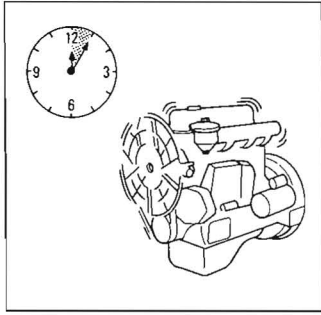


Move clutch lever to OFF position before starting if equipped.

CAUTION

- Do not turn starter switch to START nor to OFF position while engine is running.
- Hold starter switch in HEAT position for about 15 seconds. Hold it there for about 30 seconds in extremely cold weather.
- Do not operate starter for periods longer than 30 seconds at a time. Observe an interval of at least 2 minutes between such cranking periods to protect starter and battery.
- Re-crank engine after it comes to a complete stop. This is for preventing engine from rotating in reverse direction.

WARMING UP

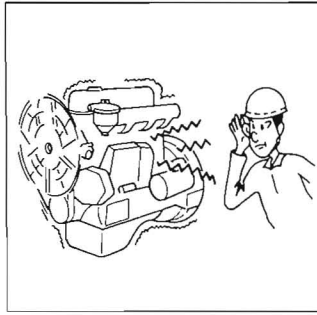


Warm up engine for about 5 minutes.

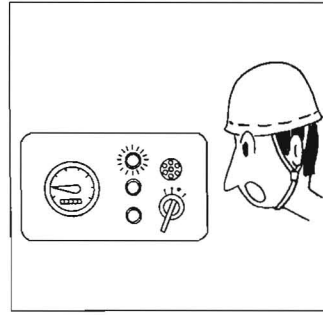


Do not warm up engine for periods longer than 15 minutes.

DURING OPERATION, BE SURE:

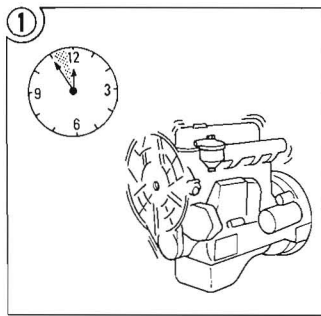


- Engine is running without any abnormal noise or vibration.
- Exhaust smoke color is normal.

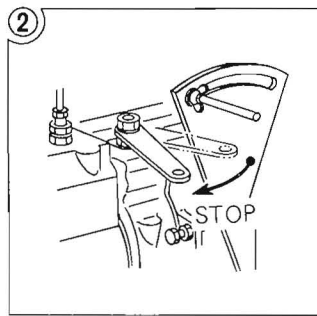


- Pilot lamps do not glow.

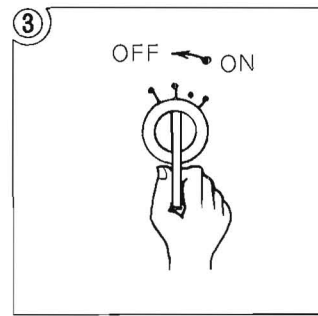
STOPPING



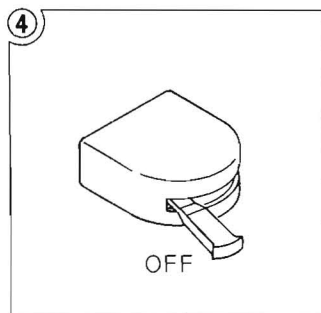
1. Let engine idle for 3 to 5 minutes.



2. Pull stop lever to STOP position.



3. Pull key off starter switch.



4. Move battery switch lever to OFF position.



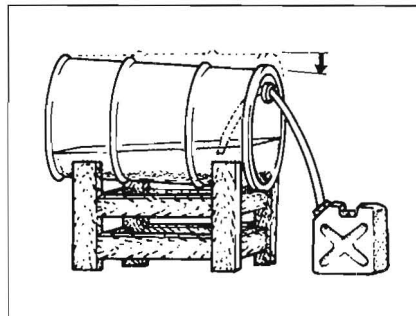
Stopping engine immediately after taking load is very hard on running parts of engine.

DIESEL FUEL, ENGINE OIL AND COOLING WATER

DIESEL FUEL

Care of the fuel supply

Using only clean fuel is of extreme importance. It is important to buy clean fuel, and keep it clean. The best fuel can be rendered unsatisfactory by careless handling or improper storage facilities. To assure that fuel going into tank of your engine daily is clean and pure, the following practice is advisable.



Fuel storage tank

- Use a storage tank to keep fuel. A drum mounted on a stand, as shown here, serves the purpose. Slight tilt given to drum will allow water and sediment to settle to corner. Have a cock installed at lowest point of drum for use in draining out water and sediment.
- Let fuel stand in this storage tank for at least 24 hours before you pump fuel from storage tank to tank of your engine.
- Effort should be constantly expended to prevent contamination of fuel. Important steps are to use clean siphon or funnel.

ENGINE OIL

American Petroleum Institute (API) has classified high-speed diesel engine services (operating conditions) for lube oils in conjunction with the Society of Automotive Engineers (SAE). For your engine, use lube oils in "CC" or severer classification.



Do not allow two or more brands of engine oil to get mixed. Each brand contains its own additives; additives of different brands could react in the mixture to produce properties deterious to your engine.

COOLING WATER

Use only water that is soft, or as free as possible from scale forming minerals.

Use anti-freeze when the temperature is below freezing.

ROUTINE SERVICE

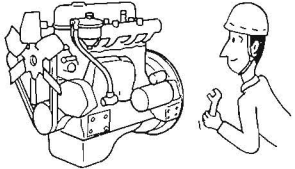
★ Rely on service meter to perform routine services.

Item	Service	Remarks
EVERY 10 SERVICE HOURS OR DAILY		
①	Walk-around check	
②	Crankcase	Check oil level in oil pan
③	Fuel tank	Check fuel left in tank
④	Radiator	Check coolant level
EVERY 60 SERVICE HOURS		
⑤	Battery	Check electrolyte level
⑥	Air cleaner indicator	Check
⑦	Fuel tank	Drain water and sediment
⑧	Fuel filter	Drain water and sediment
EVERY 250 SERVICE HOURS		
⑨	Crankcase	Change oil S2E 4 liters S3E 6 liters S4E 8 liters S6E 11 liters
⑩	Radiator	Clean fins
EVERY 500 SERVICE HOURS		
⑪	Fuel filter	Change element
⑫	Oil filter	Change element
⑬	Air cleaner	Clean element
⑭	Fan belt	Check and adjust tension Deflection: About 12 mm
EVERY 1000 SERVICE HOURS		
⑮	Cooling system	Flush system – change coolant
⑯	Alternator	Check for operation
⑰	Starter	Check for operation
⑱	Turbocharger	Check for operation (S4E2-T)
⑲	Bolts and nuts	Retighten

EVERY 10 SERVICE HOURS OR DAILY

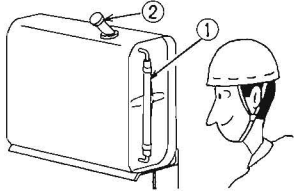
① **Walk around engine to check for:**

- Exhaust smoke color, vibration, etc.
- Water and oil leaks
- Dust accumulation




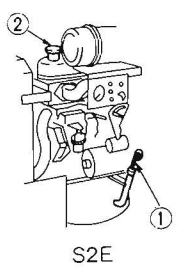
③ **Check the amount of fuel left in tank**

- See level gauge (1).
- Refill through filler (2).

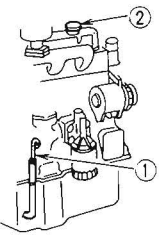


② **Check oil level in oil pan**

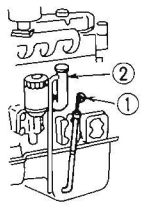
- Use level gauge (1).
- Refill through filler (2).

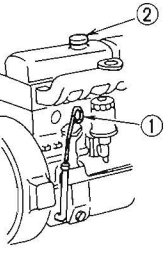
S2E



S3E



S4E



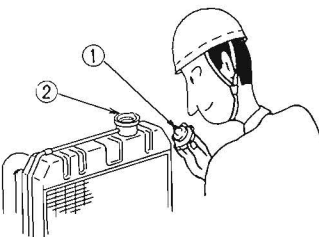
S6E

④ **Check coolant level in radiator**

- Remove cap (1) to check.
- Refill through filler (2).

⚠ WARNING

★ Do not remove filler cap when coolant is hot.



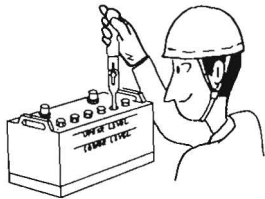
EVERY 60 SERVICE HOURS

⑤ Check battery electrolyte

- Level should be 1 cm above cell plates. If not, add distilled water.
- See if level is correct; add distilled water.
- See if gravity is normal; recharge battery if it is below 1.22.

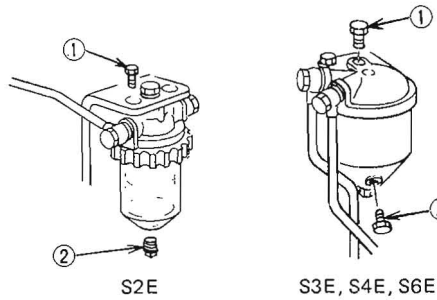


- ★ If you drip electrolyte on your skin or engine, flush it off at once with water.
- ★ Keep open flame away from battery.



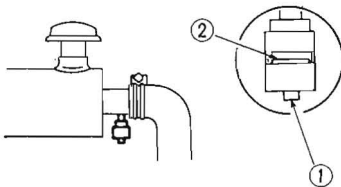
⑧ Drain fuel filter of water and sediment

1. Remove air vent plug (1).
2. Remove drain plug (2) to drain.
3. Prime fuel system.



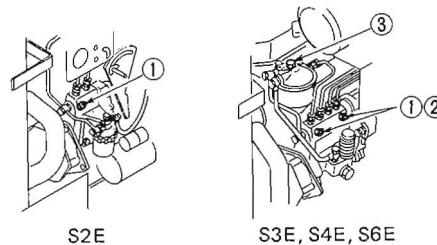
⑥ Check air cleaner indicator

1. Clean element if indicator shows RED.
2. After cleaning, push indicator reset button (1).



WHEN REQUIRED prime fuel system

1. To prime injection pump, loosen air vent plugs (1) (2) and operate priming handle (S3E, S4E, S6E).
 2. To prime fuel filter, loosen plug (3) and operate the handle.
- ★ S2E is not equipped with priming pump; prime its fuel system by using tank pressure.



⑦ Drain fuel tank of water and sediment

- Before starting engine, drain water and sediment that has settled to bottom of tank.

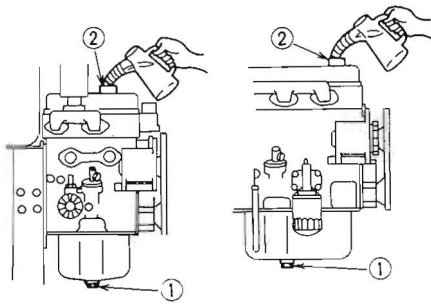


EVERY 250 SERVICE HOURS

9) Change engine oil

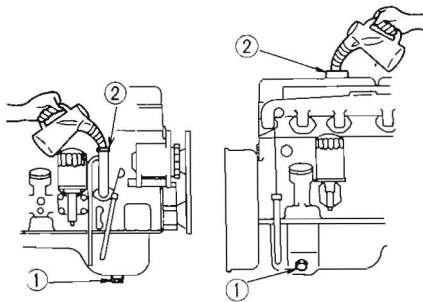
- Remove drain plug (1) and allow to drain.
- Refill through filler (2).
- Run engine and again check oil level: add oil if necessary.

- ★ Capacities: S2E 4 liters
S3E 6 liters
S4E 8 liters
S6E 11 liters



S2E

S3E

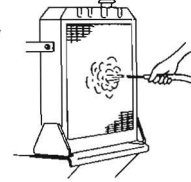


S4E

S6E

10) Clean radiator fins

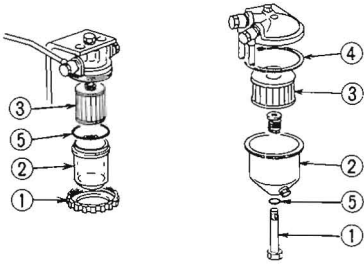
- Direct air against flow of air given by fan.
- ★ Clean more frequently when operating in dusty conditions.



EVERY 500 SERVICE HOURS

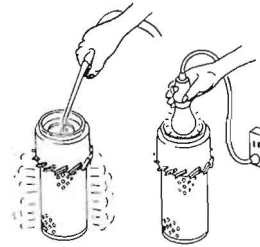
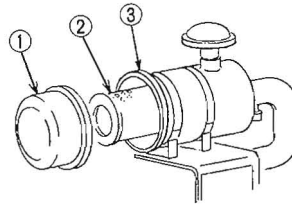
11 Change fuel filter element

1. Remove bolt or ring (1) and take off filter case (2).
 2. Clean case interior and install new element (3).
 3. Prime fuel system.
- ★ Take care not to damage gasket (4) and "O" ring (5) when installing filter case.



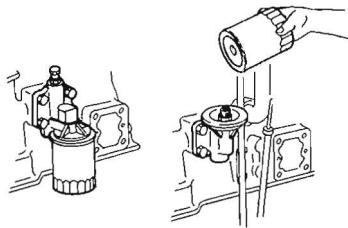
13 Clean air cleaner element

- Remove cover (1) to take out element (2). Clean cover, element and case (3).
 - If indicator shows RED shortly after installation of cleaned element, replace element.
- ★ Replace element at least once a year.
- ★ Clean element with pressure air or water. After cleaning, check for pinholes or tears.



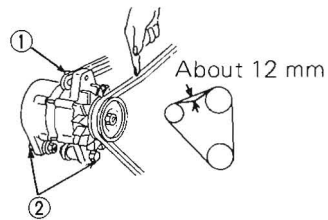
12 Change oil filter element

- Use filter wrench to remove.
- To install, tighten with handle. Do not use wrench.



14 Check fan belt tension

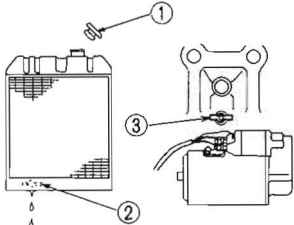
- Deflection: About 12 mm between pulleys
- Loosen bolts (1) (2) and move alternator to adjust belt tension.



EVERY 1000 SERVICE HOURS

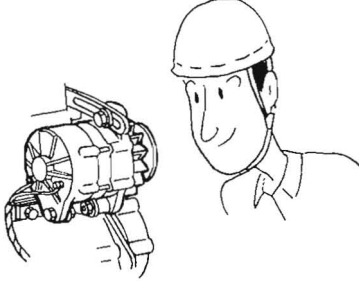
15) Flush cooling system and change coolant

- Remove radiator filler cap (1).
- Remove drain plugs (2) (3) to drain.
- Refill with soft water.
- Use anti-freeze in freezing weather.



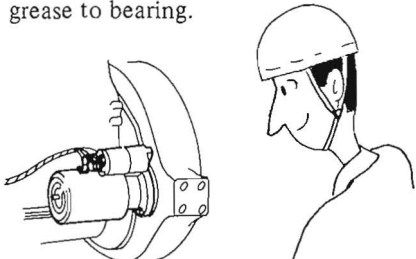
16) Check alternator for operation

- ★ Alternator bearings are factory-lubricated and need no lubrication until overhauling.



17) Check starter for operation and lubricate bearing

- Apply small amount of multipurpose grease to bearing.

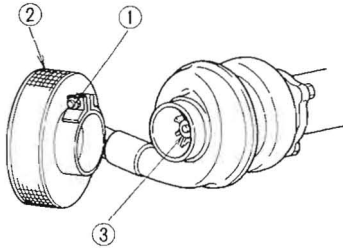


18) Check turbocharger for condition (S4E2-T)

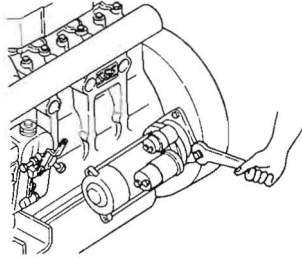
1. Loosen clamp bolt (1) on compressor side, and remove silencer (2) or air cleaner pipe.
2. Turn compressor wheel (3) with finger through air inlet port, making sure it rotates smoothly.

⚠ WARNING

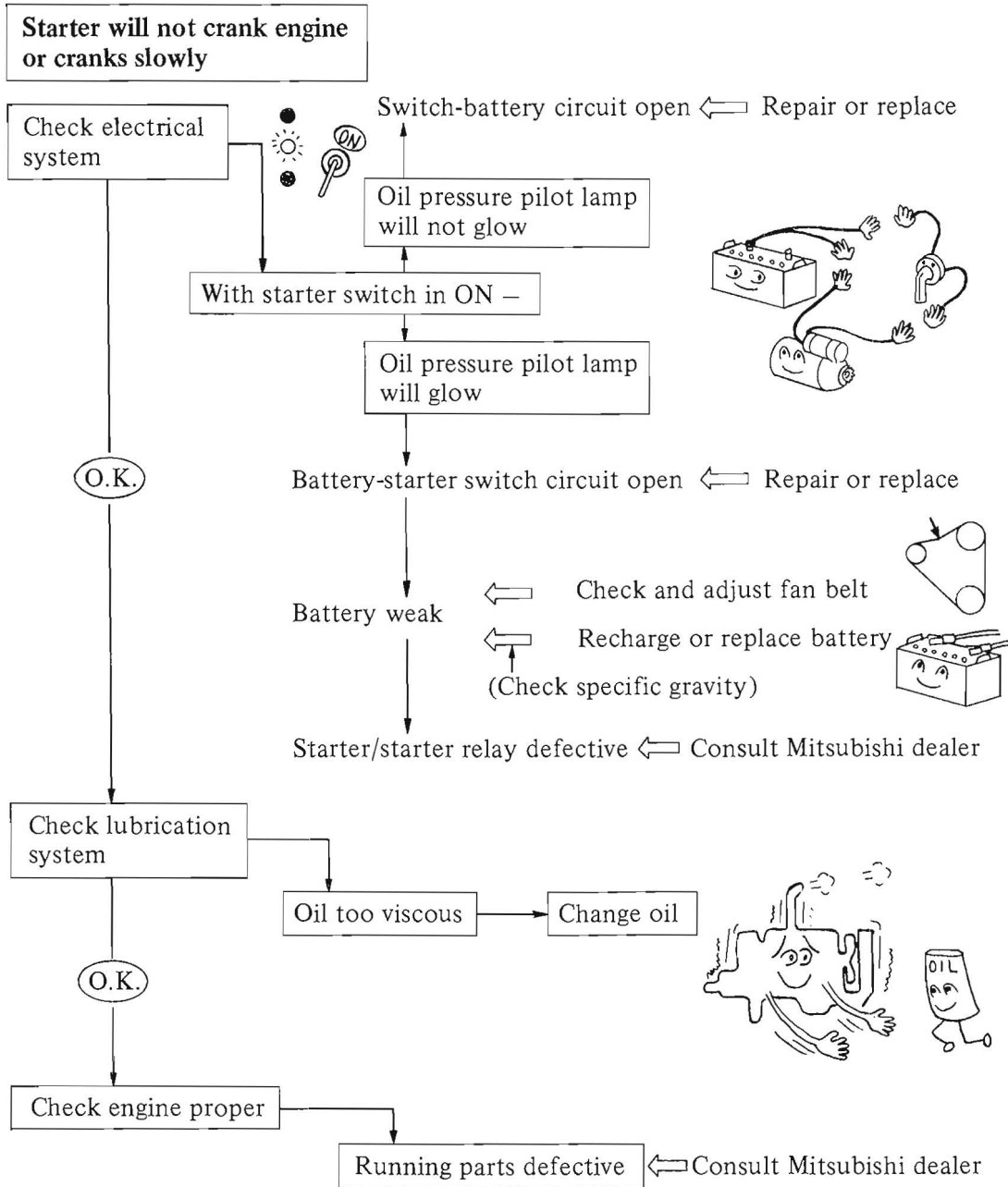
- ★ Check turbocharger with engine cold.

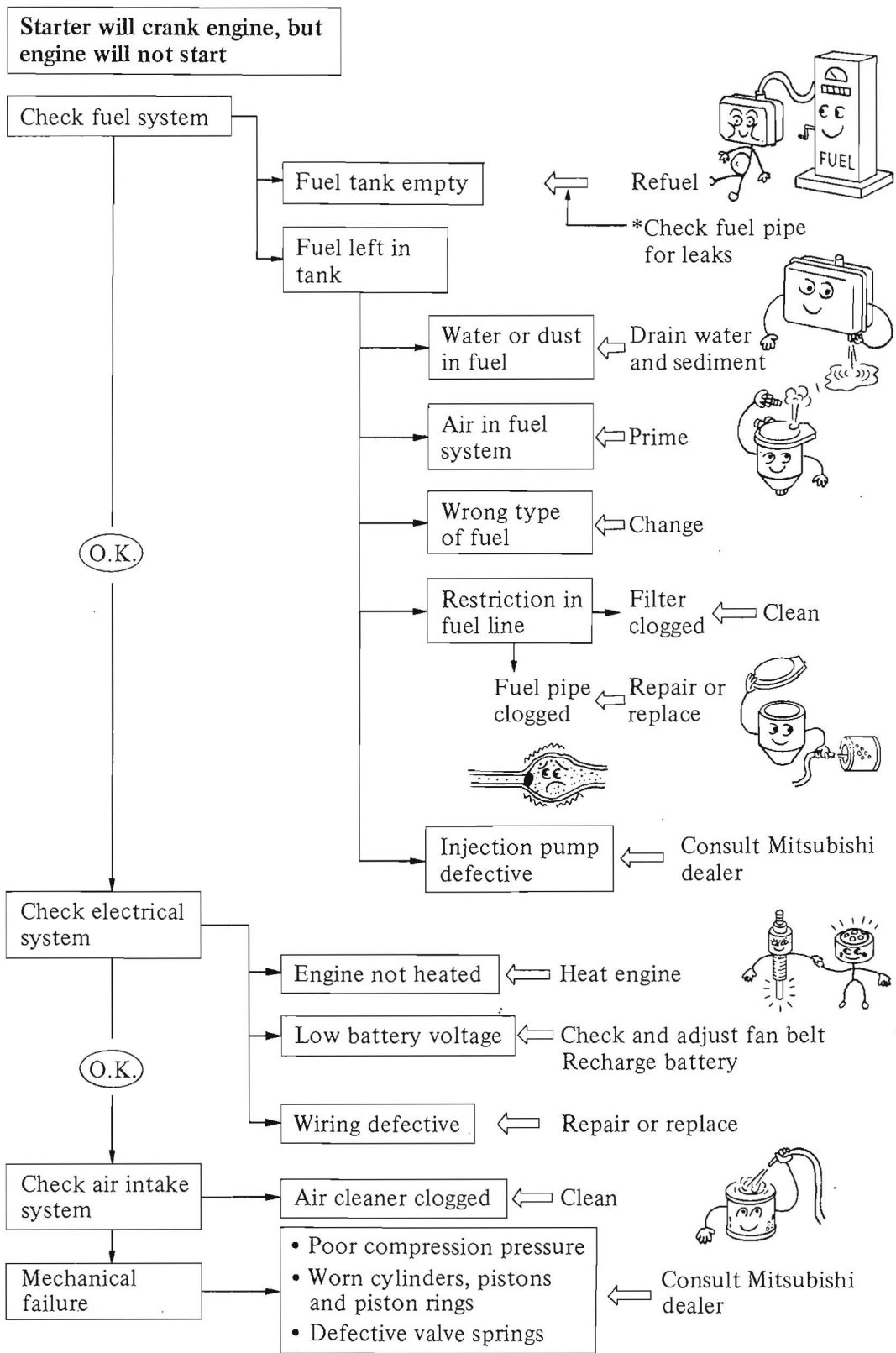


19) Retighten bolts and nuts



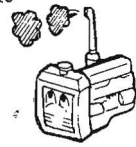






FIRST-AID TROUBLESHOOTING





TROUBLESHOOTING

Complaint	Cause	Remedy
<p>Insufficient power</p> 	<ul style="list-style-type: none"> a) Incorrect grade of oil b) Wrong type of fuel c) Air cleaner clogged d) Engine overcooled e) Engine overheating f) Valve clearance incorrect g) Injection pump defective h) Injection nozzles defective i) Injection timing incorrect j) Poor compression pressure 	<ul style="list-style-type: none"> a) Use recommended type and SAE number of oil. b) Change. c) Clean or change element. d) Use radiator cover, or clean, test and replace thermostat. e) Check coolant level, adding water if necessary. f) Readjust. g) *Readjust or replace. h) *Readjust or replace. i) *Retime. j) *Overhaul.
<p>White or blue exhaust smoke</p> 	<ul style="list-style-type: none"> a) Too much oil in crankcase b) Oil too light – diluted c) Engine overcooled d) Injection timing incorrect e) Poor compression pressure 	<ul style="list-style-type: none"> a) Fill only to correct level on gauge. b) Change oil. c) Use radiator cover, or clean, test and replace thermostat. d) *Retime. e) *Overhaul.
<p>Black or gray exhaust smoke</p> 	<ul style="list-style-type: none"> a) Wrong type of fuel b) Valve clearance incorrect c) Injection pump defective d) Poor compression pressure e) Air cleaner clogged 	<ul style="list-style-type: none"> a) Change. b) Readjust. c) *Readjust or replace. d) *Overhaul. e) Clean or change element.
<p>High fuel consumption</p> 	<ul style="list-style-type: none"> a) Injection pump defective b) Injection nozzles defective c) Injection timing incorrect d) Wrong type of fuel e) Poor compression pressure f) Air cleaner clogged 	<ul style="list-style-type: none"> a) *Readjust or replace. b) *Readjust or replace. c) *Retime. d) Change. e) *Overhaul. f) Clean or change element.

Complaint	Cause	Remedy
High oil consumption 	a) Too high oil level in crankcase b) Incorrect grade of oil c) Oil leaks d) Cylinders and piston rings worn	a) Maintain oil level between marks on gauge. b) Use recommended type and SAE number of oil. c) Locate and repair. d) *Replace.
Engine overheats 	a) Too loose fan belt b) Lack of coolant c) Too low oil level d) Water pump defective e) Thermostat defective f) Cooling system dirty g) Restricted radiator air passages	a) Readjust. b) Refill. c) Maintain oil level between marks on gauge. d) *Replace. e) *Replace. f) Clean and flush. g) Clean. Straighten bent fins, if any.
Low oil pressure (Pilot lamp glows) 	a) Lack of oil b) Oil too light – diluted c) Oil filter clogged d) Oil pump defective e) Oil pressure regulating valve defective	a) Refill up to level. b) Change oil. c) Replace element. d) *Readjust or replace. e) *Readjust or replace.

IMPORTANT

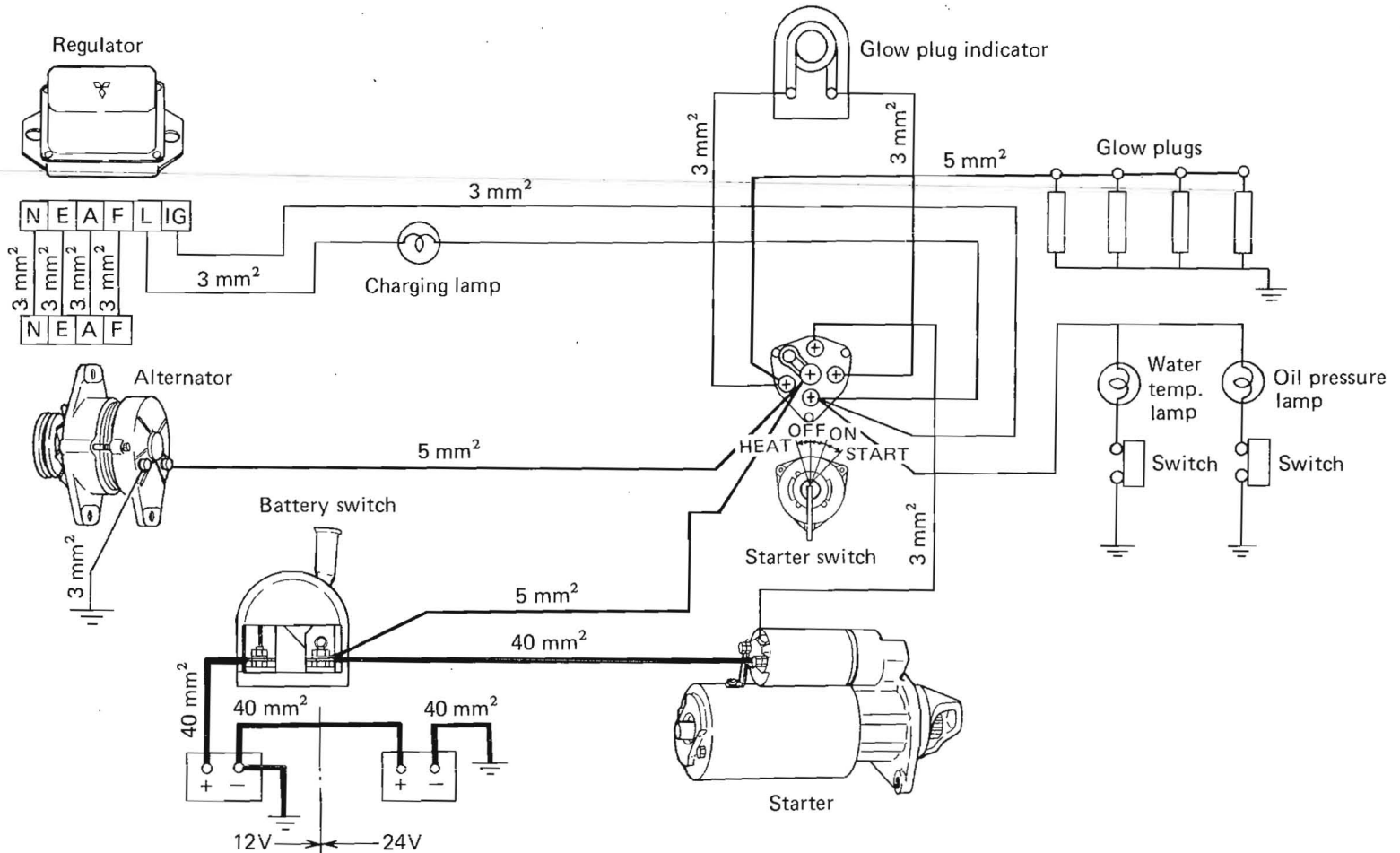
- a) Have your Mitsubishi dealer perform service jobs marked with asterisk (*).
- b) Do not hesitate to consult your Mitsubishi dealer in the matters of troubleshooting and routine services.
- c) When contacting your Mitsubishi dealer for help, be sure to let him know serial number and service-meter reading of your engine.

SPECIFICATIONS

Model	S2E	S2E2	S3E	S3E2
Type	4-cycle, water-cooled, in line			
No. of cylinders	2		3	
Bore × stroke (mm)	94 × 94	98 × 98	94 × 94	98 × 98
Piston displacement (liter)	1.305	1.478	1.956	2.217
Type of combustion chamber	Swirl			
Compression ratio	19 : 1			
Firing order	1-2		1-3-2	
Direction of rotation	Counterclockwise as viewed from flywheel side			
Dimensions (length × width × height)	573×551×734	573×551×736	661×515×729	661×515×731
Weight, dry (kg)	180		230	
Burns	Diesel fuel			
Fuel injection pump	Bosch PES4-A			
Governor	Mechanical (all-speed or constant-speed)			
Fuel injection nozzles	Throttle type			
Fuel injection pressure (kg/cm ²)	120			
Lubrication system	Pressure feed by trochoid pump			
Lubrication system capacity (liter)	4		6	
Cooling system	Forced circulation by centrifugal pump			
Cooling system capacity (engine proper) (liter)	3		4	
Starter	12V-2kW			
Alternator	12V-15A			
Turbocharger	-			

S4E	S4E2	S4E2-T	S6E	S6E2
4-cycle, water-cooled, in line				
4			6	
94 X 94	98 X 98		94 X 94	98 X 98
2.609	2.957		3.913	4.435
Swirl				
19 : 1				
1-3-4-2			1-5-3-6-2-4	
Counterclockwise as viewed from flywheel side				
783x511x729	783x511x731	783x511x841	1121x609x728	1121x609x730
270		275	360	
Diesel fuel				
Bosch PES4-A				
Mechanical (all-speed or constant-speed)				
Throttle type				
120				
Pressure feed by trochoid pump				
8			11	
Forced circulation by centrifugal pump				
4.6			6.5	
24V-3kW			24V-5kW	
24V-20A				
-		Mitsubishi turbocharger TC-05	-	

WIRING DIAGRAM



Battery N70 x 1 S2E Battery N70 x 2 S4E, S6E
 Battery N100 x 1 S3E

klep spelmg. inl. 0,25 mm ontst. volg.
 uitl. 0,25. 1-5-3-6-2-4.
 Aanb. verstuiv. 5 kgm.

TIGHTENING TORQUE

Important bolts and nuts

kg-m (lb-ft) 50 N.M.

Secured part or component	Tightening torque
Cylinder head bolts	12 ± 0.5 (86.8 ± 3.6)
Main bearing cap bolts	10.4 ± 0.5 (75.2 ± 3.6)
Connecting rod bearing cap bolts	8.5 ± 0.5 (61.5 ± 3.6)
Flywheel bolts	8.5 ± 0.5 (61.5 ± 3.6)
Camshaft thrust plate bolts	1.8 ± 0.5 (13.0 ± 3.6)
Front plate bolts	1.8 ± 0.5 (13.0 ± 3.6)
Timing gear case bolts	1.0 ± 0.5 (7.2 ± 3.6)
Crank pulley bolts	40 ± 0.5 (289.3 ± 3.6)
Camshaft gear bolt	3.5 ± 0.5 (25.3 ± 3.6)
Idler thrust plate bolts	3.5 ± 0.5 (25.3 ± 3.6)
Rear oil seal bolts	0.4 (2.9)
Oil pan bolts	0.7 (5.1)
Oil case bolts	0.7 (5.1)
Oil pan drain plug	10.0 ± 0.5 (72.3 ± 3.6)
Oil pump fixing connector	5.5 ± 0.5 (39.8 ± 3.6)
Oil filter center bolt	2.3 ± 0.5 (16.6 ± 3.6)
Nozzle holder retaining nuts	5.0 ± 0.5 (36.2 ± 3.6)
Injection pump delivery valve holders	3.0 ± 0.5 (21.7 ± 3.6)
Flywheel housing bolts	3.5 ± 0.5 (25.3 ± 3.6)

General bolts and nuts

Screw thread		Tightening torque			
		With spring washer		Without spring washer	
dia.	pitch	kg-m	lb-ft	kg-m	lb-ft
8	1.0	1.8	13	2.2	16
	1.25	1.8	13	2.1	15
10	1.25	3.6	26	4.2	30
	1.5	3.4	25	4.0	29
12	1.25	6.5	47	7.6	55
	1.75	6.0	43	7.1	51
14	1.5	10.4	75	12.2	88
	2.0	9.8	71	11.5	83
16	1.5	15.8	114	18.6	135
	2.0	15.0	108	17.6	127
18	1.5	22.9	166	26.9	195
	2.5	20.7	150	24.4	176



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