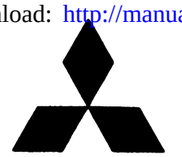

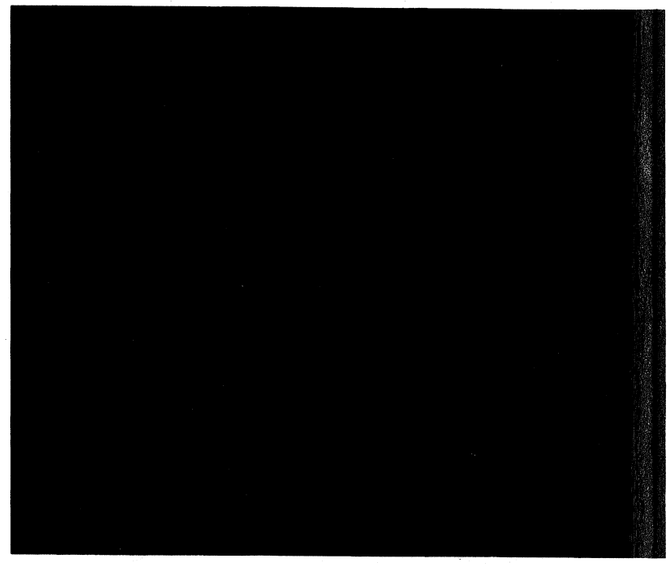

APRIL 2001 SERVICE MANUAL

SL-SERIES S3L,S3L2,S4L,S4L2

Pub.No. 99619-12130

SERVICE MANUAL

MITSUBISHI DIESEL ENGINES

SL-SERIES
S3L, S3L2
S4L, S4L2

APRIL 2001

MITSUBISHI HEAVY INDUSTRIES, LTD.

Printed in Japan

Pub.No. 99619-12130

INTRODUCTION

This service manual has instructions and procedures for the subject on the front cover.

The information, specifications and illustrations in this manual are on the basis of the information that was current at the time this issue was written.

Correct servicing, test and repair procedures will give the engine a long service life. Before starting a test, repair or rebuild job, the serviceman must read the respective sections of this manual to know all the components he will work on.

Continuing improvement of product design may have caused changes to your engine which are not included in this manual.

Whenever a question arises regarding your engine, or this manual, consult your Mitsubishi dealer for the latest available information.

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HOW TO USE THIS MANUAL

1. Exploded views

   In the exploded views, the component parts are separated but so arranged to show their relationship to the whole. Index numbering is used to identify the parts and to indicate a sequence in which the parts are to be removed for disassembly, or they are to be installed for assembly.

2. Symbols

   The following symbols are used in this manual to emphasize important and critical instructions:

   NOTE ..... Indicates a condition that is essential to highlight.

   CAUTION ..... Indicates a condition that can cause engine damage.

   WARNING ..... Indicates a condition that can cause personal injury or death.

3. Definition of locational terms

   The fan end is "front" and the flywheel end is "rear." The words "left" and "right" are as these directions would appear from the flywheel end.

4. Dimensional or specification terms

   Nominal size ..... Is the named size which has no specified limits of accuracy.

   Standard ..... Is the dimension of a part to be attained at the time of assembly, or the standard performance.

   Limit ..... Is the maximum or minimum permissible limit beyond which a part must be repaired or replaced.

5. Tightening torques

   Tighten bolts, nuts, etc. in a wet condition (apply oil to threads) when specified as [WET]. Tighten them in a dry condition unless so specified. Use the general torques unless otherwise specified.

INDEX

GENERAL INFORMATION

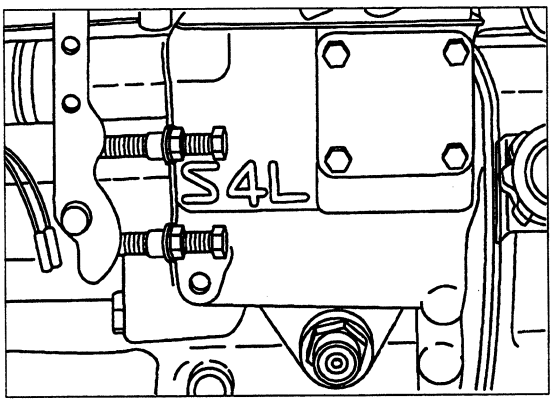
MODEL IDENTIFICATION AND SERIAL NUMBER LOCATION

1. Model identification location

(a) The model identification is embossed on the right side of the cylinder block, near the fuel injection pump mount.

(b) The model identifications and displacements of the engines in current production are as listed below:

	Displacement
S3L	1.125 liters (68.7 cu in.)
S3L2	1.318 liters (80.4 cu in.)
S4L	1.500 liters (91.5 cu in.)
S4L2	1.758 liters (107.3 cu in.)



Model identification location

(c) A scheme of coding used for identifying the engines in current production is as follows:

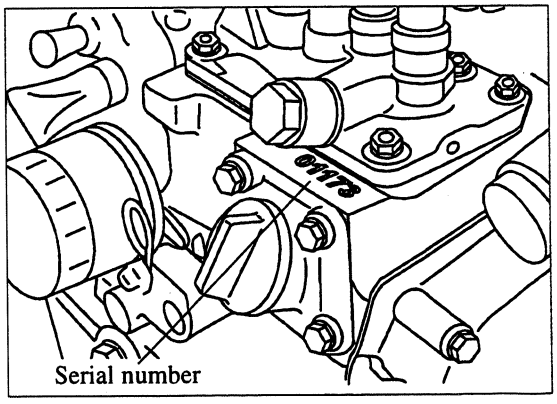
Example: Coded designation

S 4 L (2) – 61 A

- A — Specification code
- 61 — Export code
- (2) — Stroke code (No code: 78.5 mm (3.09 in.), 2: 92 mm (3.62 in.)
- L — Series code [Bore: 78 mm (3.07 in.)]
- 4 — Number-of-cylinders code ["4" stands for four cylinders]
- S — Identification of "Sagamihara Machinery Works"

2. Serial Number Location

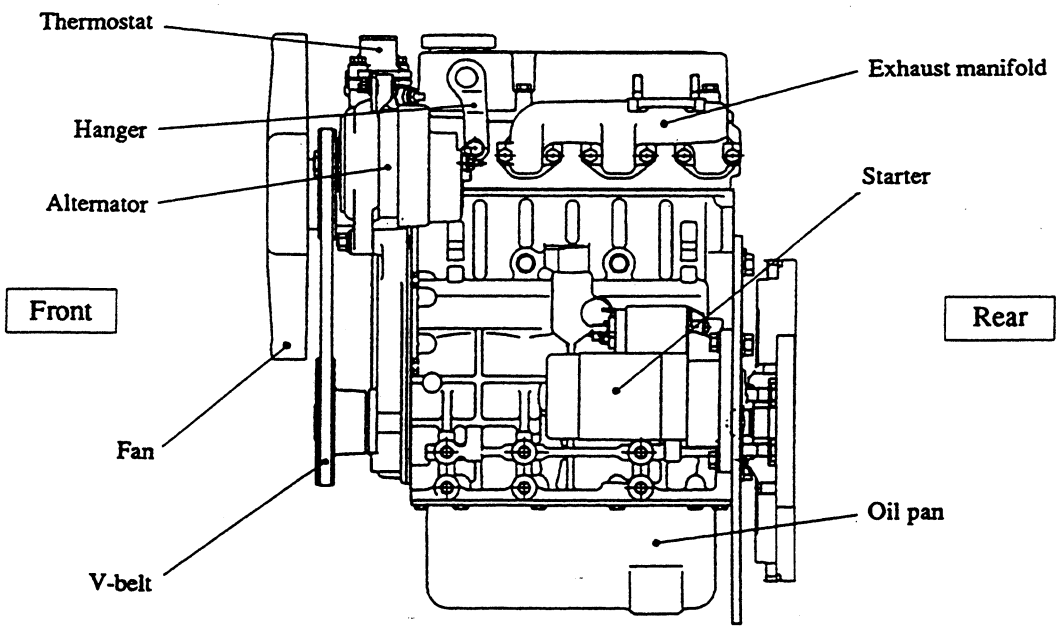
The serial number is punched on the cylinder block, near the fuel injection pump mount.



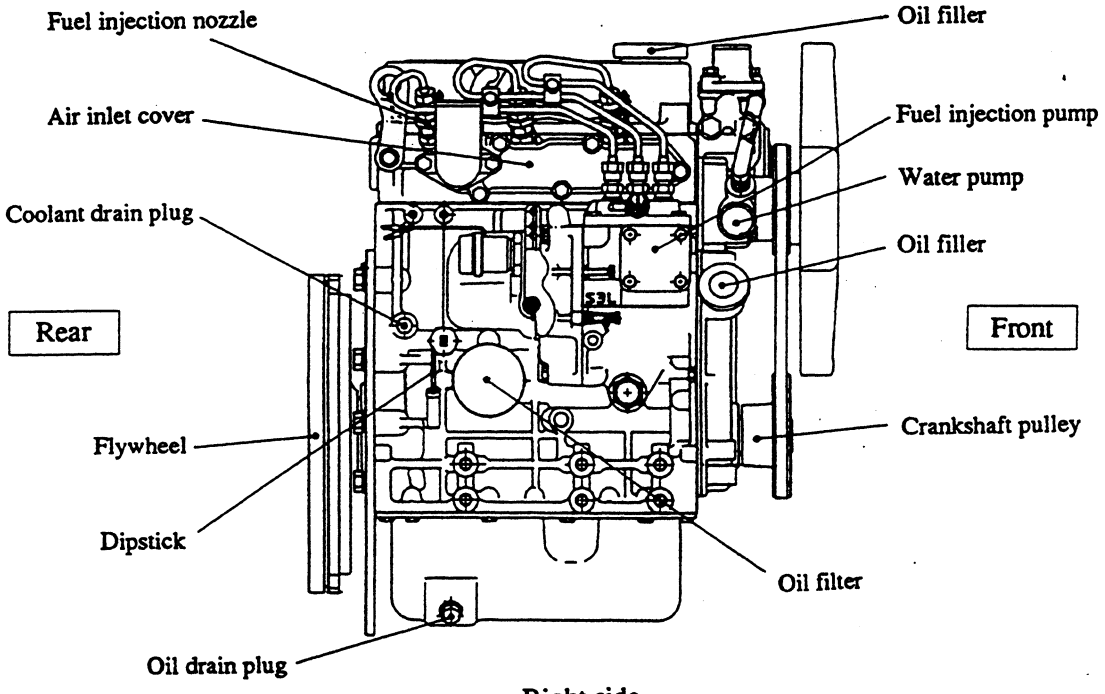
Serial number location

COMPONENT LOCATION

S3L/S3L2

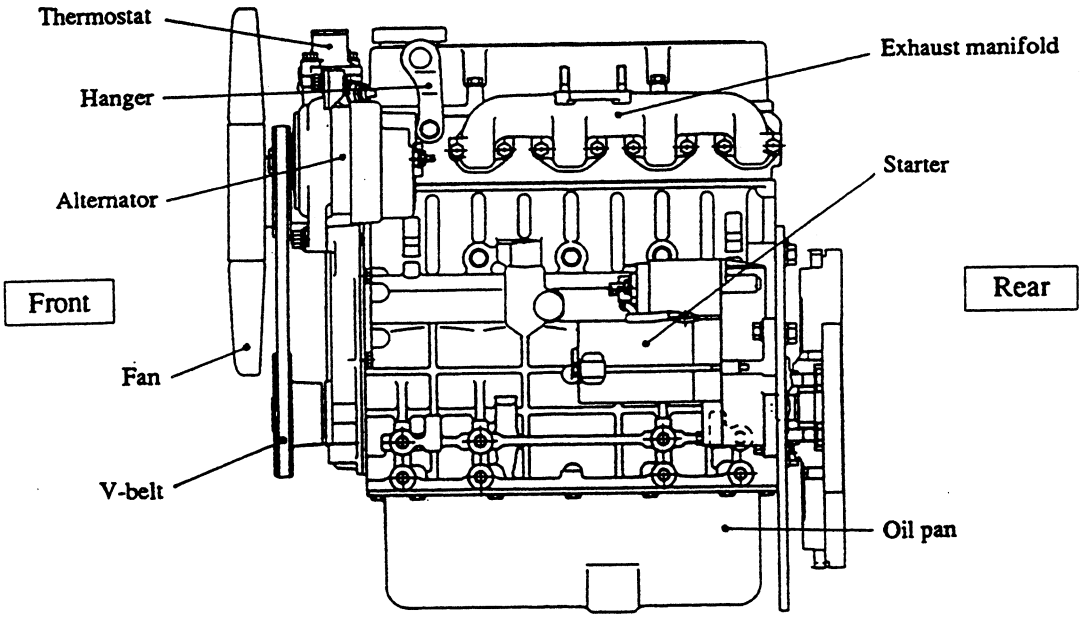


Left side

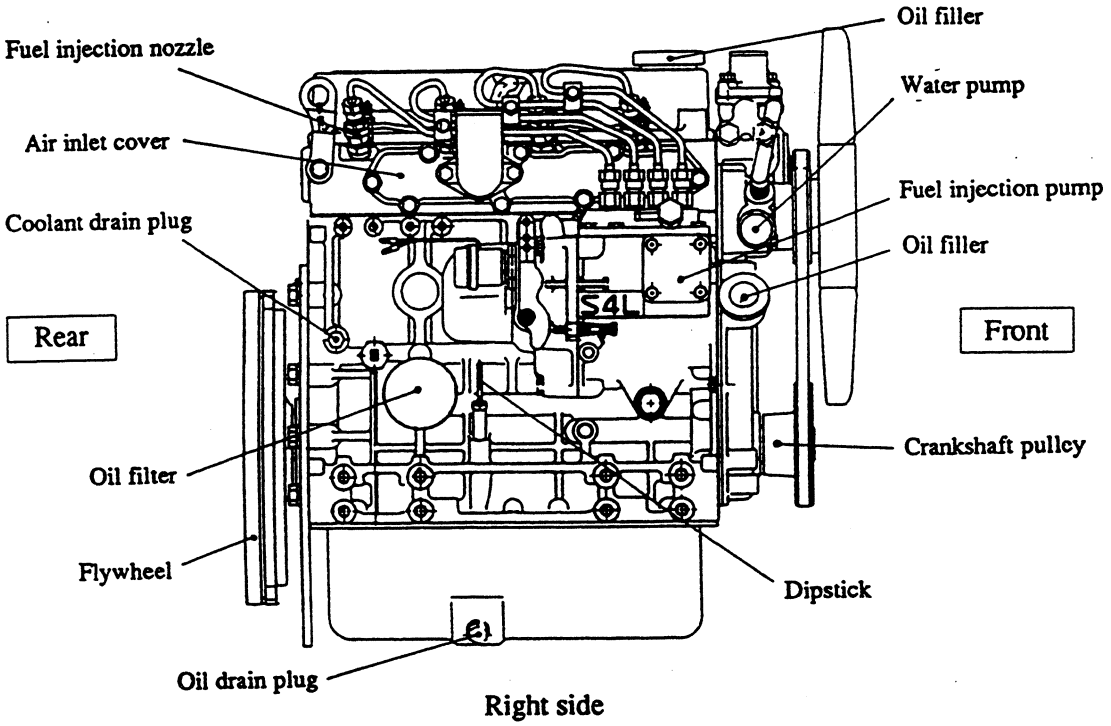


Right side

S4L/S4L2



Left side

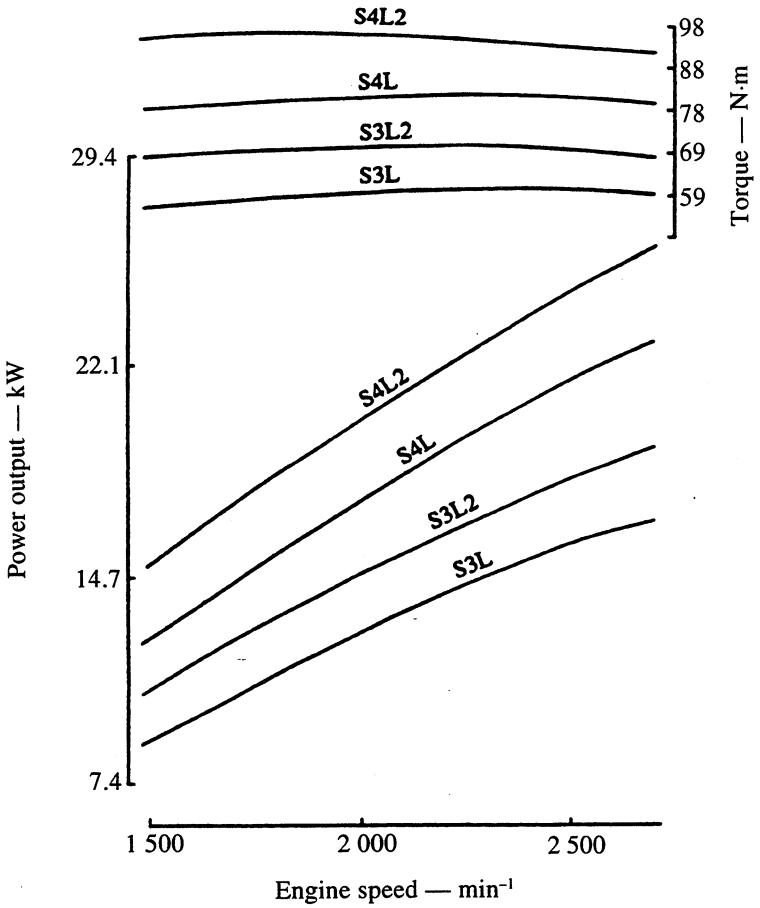


Right side

SPECIFICATIONS

Model		S3L	S3L2	S4L	S4L2
Type		Water-cooled, 4-stroke cycle, in-line diesel engine			
Firing order (injection sequence)		1 - 3 - 2		1 - 3 - 4 - 2	
Compression ratio		22			
Combustion chamber, type		Swirl			
Weight, kg (lb)		125 (276)		150 (331)	
No. of cylinders		3		4	
Bore x Stroke, mm (in.)		78 x 78.5 (3.07 x 3.09)	78 x 92 (3.07 x 3.62)	78 x 78.5 (3.07 x 3.09)	78 x 92 (3.07 x 3.62)
Displacement, liter (cu in.)		1.125 (68.7)	1.318 (80.4)	1.500 (91.5)	1.758 (107.3)
Fuel system	Injection pump, type	Bosch M			
	Injection nozzle, type	Throttle			
	Governor, type	Centrifugal flyweight			
	Fuel	ASTM No. 2-D			
Lubrication system	Type	Force feed (by trochoid pump)			
	Engine oil	API Service Classification CD			
	Oil filter	Paper-element (full-flow)			
	Capacity (high level excl. 0.5 liter (0.13 U.S. gal) of oil in oil filter), liter (U.S. gal)	5.7 (1.5) (with deep oil pan) 3.7 (1.0) (with standard oil pan)		7.7 (2.0) (with deep oil pan) 5.4 (1.4) (with standard oil pan)	
Cooling system	Type	Forced cooling			
	Capacity (approximate), liter (U.S. gal)	1.8 (0.5)		2.5 (0.7)	
Starter, V – kW		12 – 1.7		12 – 2.0	
Alternator, V – A		12 – 50			

PERFORMANCE CURVES (ONE-HOUR RATING, WITH FAN)



PRIME POWER OUTPUT CHART

Unit: kW

Rating	Engine model / min⁻¹	S3L	S3L2	S4L	S4L2
		With fan	With fan	With fan	With fan
One-hour (no overload)	1 500	8.8	10.7	12.5	15.1
	1 800	11.0	13.2	15.4	18.4
	2 000	12.5	14.7	17.3	20.2
	2 200	14.0	16.2	19.1	22.1
	2 500	15.8	18.0	21.3	24.6
Continuous	1 500	8.4	10.1	11.9	14.3
	1 800	10.5	12.6	14.7	17.5
	2 000	11.9	14.0	16.4	19.2
	2 200	13.3	15.4	18.2	21.0
	2 500	15.0	17.1	20.3	23.4

OVERHAUL INSTRUCTIONS

DETERMINING WHEN TO OVERHAUL THE ENGINE

Generally, when to overhaul the engine is to be determined by taking into account a drop in compression pressure as well as an increase in lube oil consumption and excessive blowby gases.

Lower power or loss of power, an increase in fuel consumption, a drop in lube oil pressure, hard starting and excessive abnormal noise are also troubles. These troubles, however, are not always the result of low compression pressure and give no valid reason for overhauling the engine.

The engine develops troubles of widely different varieties when the compression pressure drops in it. Following are the typical troubles caused by the compression pressure failure:

(1) Low power or loss of power

(2) Increase in fuel consumption

(3) Increase in lube oil consumption

(4) Excessive blowby through breather due to worn cylinders, pistons, etc.

(5) Excessive blowby due to poor seating of worn inlet and exhaust valves

(6) Hard starting or failure to start

(7) Excessive engine noise

In most cases, these troubles occur concurrently. Some of them are directly caused by low compression pressure, but others are not. Among the troubles listed above, (2) and (6) are caused by a fuel injection pump improperly adjusted with respect to injection quantity or injection timing, worn injection pump plungers, faulty injection nozzles, or poor care of the battery, starter and alternator.

The trouble to be taken into account as the most valid reason for overhauling the engine is (4): in actually determining when to overhaul the engine, it is reasonable to take this trouble into account in conjunction with the other ones.

COMPRESSION PRESSURE MEASUREMENT

1. Inspection

Check to make sure —

(1) The crankcase oil level is correct, and the air cleaner, starter and battery are all in normal condition.

(2) The engine is at the normal operating temperature.

2. Measurement

(1) Move the control lever to a position for shutting off fuel supply.

(2) Remove all glow plugs from the engine. Install the compression gauge and adaptor (ST332270) combination to a cylinder on which the compression pressure is to be measured.

(3) Turn the engine with the starter and read the gauge pressure at the instant the gauge pointer comes to stop.

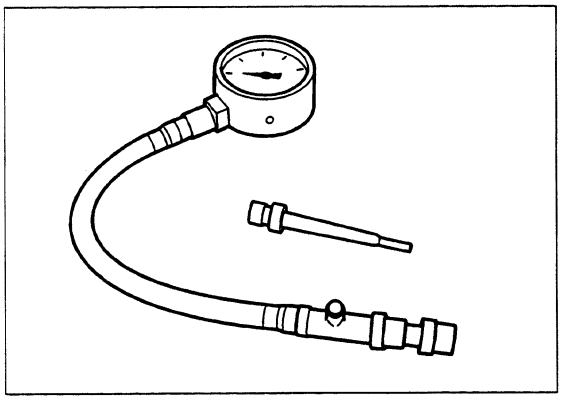
(4) If the gauge reading is below the limit, overhaul the engine.

⚠ CAUTION

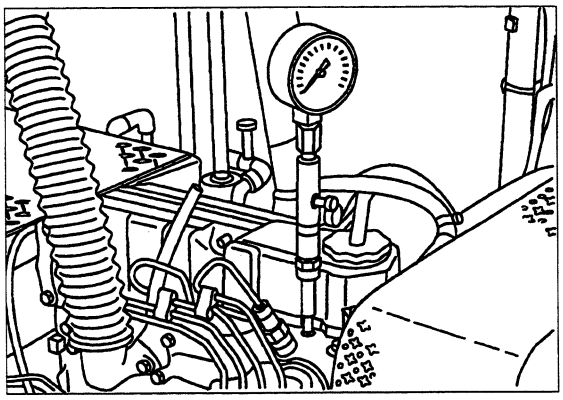
a) Be sure to measure the compression pressure on all cylinders.

b) The compression pressure varies with change of engine rpm. This makes it necessary to check engine rpm at the time of measuring the compression pressure.

Item	Standard		Limit
Engine speed, rpm	290		—
Compression pressure, kgf/cm² (psi) [kPa]	SL	30 (427) [2 942]	23 (327) [2 256]
	SL2	32 (455) [3 138]	25 (356) [2 452]
Maximum permissible difference between average compression pressure of all cylinders in one engine, kgf/cm² (psi) [kPa]	3 (42.7) [294]		—



Compression gauge and adaptor



Measuring compression pressure

⚠ CAUTION

a) It is important to measure the compression pressure at regular intervals to obtain the data on the gradual change of the compression pressure.

b) The compression pressure would be slightly higher than the standard in a new or overhauled engine owing to breaking-in of the piston rings, valve seats, etc. It drops as the engine components wear down.

TROUBLESHOOTING

1. General

The diagnosis of troubles, especially those caused by a faulty fuel injection pump or injection nozzles, or low compression pressure, can be difficult. It requires a careful inspection to determine not which item is the cause, but how may causes are contributing to the trouble, someone of which is the primary cause. Several causes may be contributing to a single trouble.

On the following pages, there are troubleshooting charts on which engine troubles can be traced to their causes. Each chart has items to be verified ahead and suggested inspection procedure.

Diesel engines exhibit some marked characteristics during operation. Knowing these characteristics will help minimize time lost in tracing engine troubles to their source. Following are the characteristics of diesel engines you should know about for diagnosis:

- Combustion knock (diesel knock)
- Some black exhaust smoke (when the engine picks up load)
- Vibration (due to high compression pressure and high torque)
- Hunting (when the engine speed is quickly decreased)
- Some white exhaust smoke (when the engine is cold, or shortly after the engine has been started)

2. Engine troubleshooting

Problem 1: Hard starting

(1) Items to be checked for ahead

- Clogged air cleaner
- Wrong oil grade for weather conditions
- Poor quality fuel
- Low cranking speed

(2) Inspection procedure

Is heating system normal? — No ⇨ Glow plugs are energized shortly after starter switch is turned to ON. — No ⇨ Check control timer unit.

⇩ Yes

Are fuel lines free of restriction? (Is fuel pump operating properly when starter switch in ON position?) — No ⇨ Check fuel filter, fuel lines and fuel tank.

⇩ Yes

Are fuel injection timing and valve clearance correct? — No ⇨ Make adjustment to the timing and clearance.

⇩ Yes

Is fuel injection nozzle discharge pattern normal? Is injection pressure correct? — No ⇨ Make adjustment to the nozzles.

⇩ Yes

Is compression pressure correct? — No ⇨ Check valves, piston rings and cylinder head gasket.

⇩ Yes

Fuel injection pump is faulty.

Problem 2: Fuel knock

More or less fuel knock occurs in diesel engines. This may be caused either by an excessively large delay period or by a too fast rate of fuel injection.

(1) Items to be checked for ahead

- Clogged air cleaner
- Poor quality fuel

(2) Inspection procedure

Is injection timing correct (not too advanced)? → No ⇨ Make adjustment to the timing.

⇩ Yes

Is solenoid switch normal? → No ⇨ Check the switch.

⇩ Yes

Is injection pressure (injection nozzle valve opening pressure) correct (not too low)? → No ⇨ Make adjustment to the pressure.

⇩ Yes

Is compression pressure correct? → No ⇨ Check valves, piston rings, and cylinder head gasket.

⇩ Yes

Fuel injection pump is faulty.

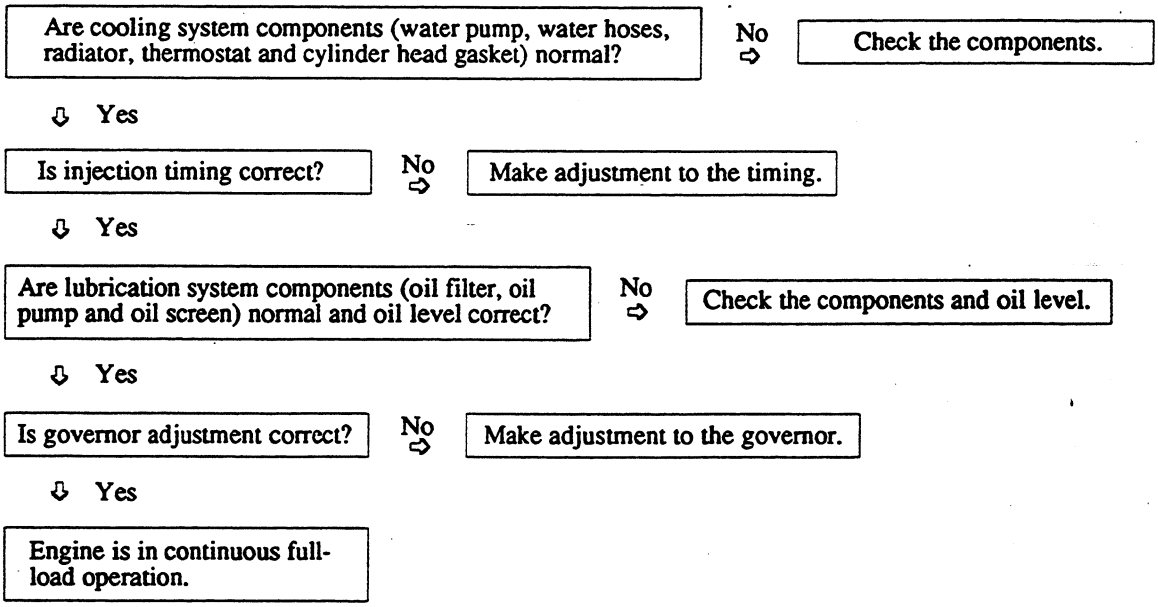
Problem 3: Overheating

(1) Items to be checked for ahead

Overheating might also be caused by abnormal operating conditions. If the engine is overheating but its cooling system is not contributing to this trouble, it is necessary to check the difference between the ambient temperature and coolant temperature when the engine is in normal operation (with the thermostat fully open). If the ambient temperature is higher than the normal coolant temperature by more than 60°C (108°C), investigate other items than those related to the engine cooling system.

- Insufficient coolant and exterior coolant leaks
- Loose fan belt
- Radiator core openings plugged with dirt

(2) Inspection procedure



Problem 4: Black exhaust smoke

(1) Items to be checked for ahead

- Clogged air cleaner
- Poor quality fuel

(2) Inspection procedure

Are valve clearance and injection timing correct? → No → Make adjustment to the clearance and timing.

⇩ Yes

Is injection nozzle discharge pattern normal? Is injection pressure correct (not too high)? → No → Make adjustment to the nozzles.

⇩ Yes

Is compression pressure correct? → No → Check valves, piston rings and cylinder head gasket.

⇩ Yes

Fuel injection pump is faulty.

Problem 5: Erratic idle speeds

(1) Items to be checked for ahead

- Maladjusted engine control
- Wrong oil grade for weather conditions
- Poor quality fuel

(2) Inspection procedure

Are valve clearance and injection timing correct? → No → Make adjustment to the clearance and timing.

⇩ Yes

Is injection nozzle discharge pattern normal? Is injection pressure constant? → No → Make adjustment to the nozzles.

⇩ Yes

Is compression pressure correct (no difference in compression pressure between cylinders)? → No → Check valves, piston rings and cylinder head gasket.

⇩ Yes

Fuel injection pump is faulty.