3. Troubleshooting

3.1 Preparation before troubleshooting

If the signs of a trouble appear, it is important to lecture on the countermeasure and treatment before becoming a big accident not to shorten the engine life.

When the signs of a trouble appear in the engine or a trouble occurs, grasp the trouble conditions fully by the next point and find out the cause of sincerity according to the troubleshooting. Then repair the trouble, and prevent the recurrence of the trouble.

1) What's the occurrence phenomenon or the trouble situation?
   (e.g. Poor exhaust color)
2) Investigation of the past records of the engine
   Check a client control ledger, and examine the history of the engine.
- Investigate the engine model name and the engine number. (Mentioned in the engine label.)
  Examine the machine unit name and its number in the same way.
- When was the engine maintained last time?
- How much period and/or time has it been used after it was maintained last time?
- What kind of problem was there on the engine last time, and what kind of maintenance was dane?

3) Hear the occurrence phenomenon from the operator of the engine in detail.
   5W1H of the occurrence phenomenon : the investigation of when (when), where (where), who (who), what (what), why (why) and how (how)
- When did the trouble happen at what kind of time?
- Was there anything changed before the trouble?
- Did the trouble occur suddenly, or was there what or a sign?
- Was there any related phenomenon.
  (e.g. Poor exhaust color and starting failure at the same time)

4) After presuming a probable cause based on the above investigation, investigate a cause systematically by the next troubleshooting guide, and find out the cause of sincerity.

3.2 Quick reference chart for troubleshooting

It is important to thoroughly under stand each system and the function of all of the parts of terse systems. A careful study of the engine mechanism will make this possible. When problems arise, it is important to carefully observe and analyze the indications of trouble in order to save time in determining their cause. Begin by checking the most easily identifiable causes of difficulty. Where the cause of the difficulty is not readily apparent, make a thorough examination of the system from the very beginning, proceeding until the point of trouble can be determined. While experience is an important factor in pinpointing engine problems, careful study and understanding of the engine mechanism combined with good common sense will help you to rapidly become more expert at troubleshooting.

Chart 1

TROUBLE AND TROUBLESHOOTING

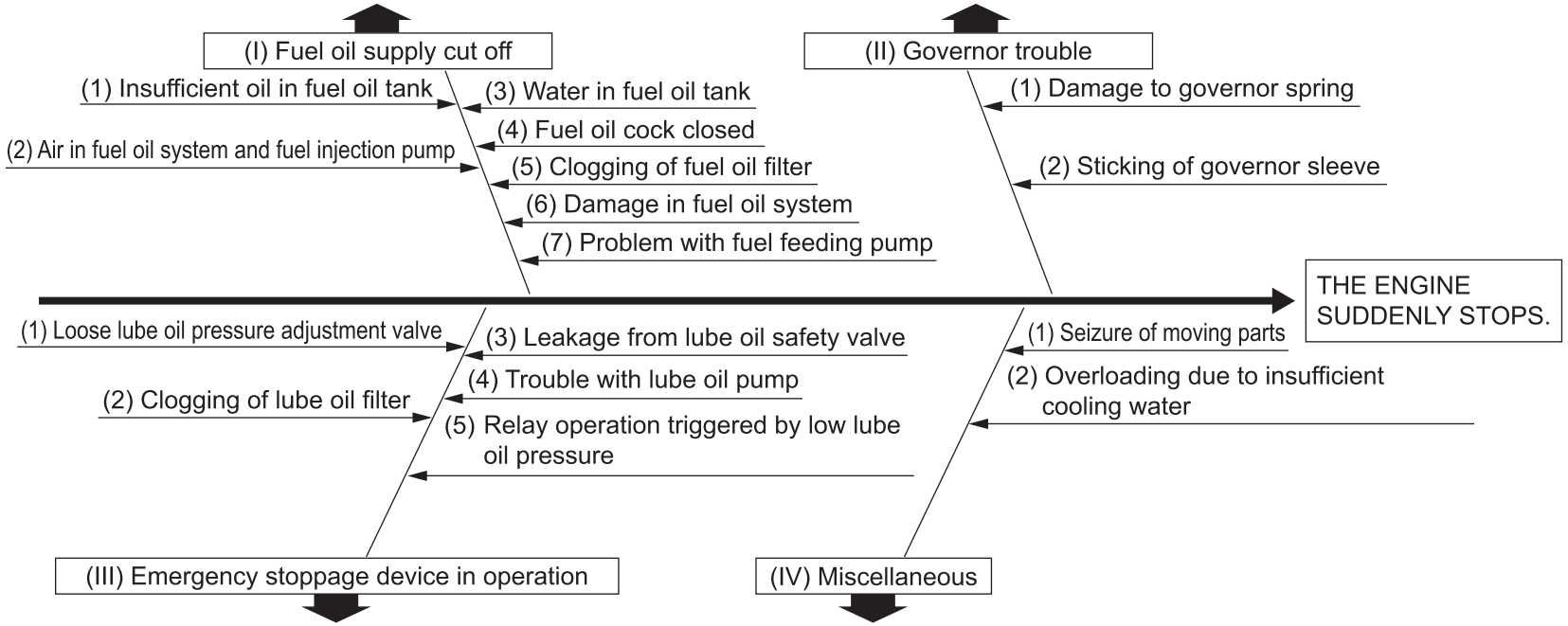
THE ENGINE SUDDENLY STOPS.

Countermeasure

(I-1) Add fuel oil and prime.
(I-2) Bleed air.
(I-3) Remove water from drain and fuel oil system and prime.
(I-4) Check and make necessary repairs.
(I-5) Clean.
(I-6) Replace.
(I-7) Check and make necessary repairs.

(II-1) Replace.
(II-2) Clean carefully to insure good working order.

Cause and Effect



Countermeasure

(III-1) Tighten adjustment valve.
(III-2) Clean.
(III-3) Tighten safety valve.
(III-4) Remove and repair or replace.
(III-5) Return to original condition.

(IV-1) Remove and repair or replace.
(IV-2) Disassemble and clean cooling water pump and check cooling water system.

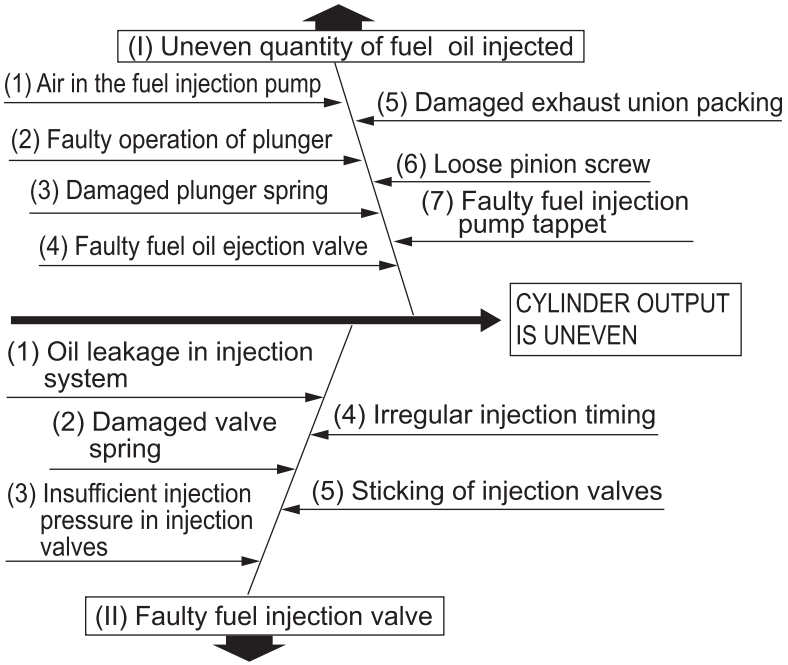
Chart 2

TROUBLE AND TROUBLESHOOTING	CYLINDER OUTPUT IS UNEVEN COUNTERMEASURE

Countermeasure

(I-1) Bleed air.
(I-2) Disassemble and clean.
(I-3) Replace.
(I-4) Repair or replace.
(I-5) Replace.
(I-6) Tighten firmly.
(I -7) Disassemble and clean and repair replace.

Cause and Effect



Countermeasure

(II-1) Check and repair.
(II-2) Replace.
(II-3) Adjust.
(II-4) Adjust.
(II-5) Clean.

Chart 3

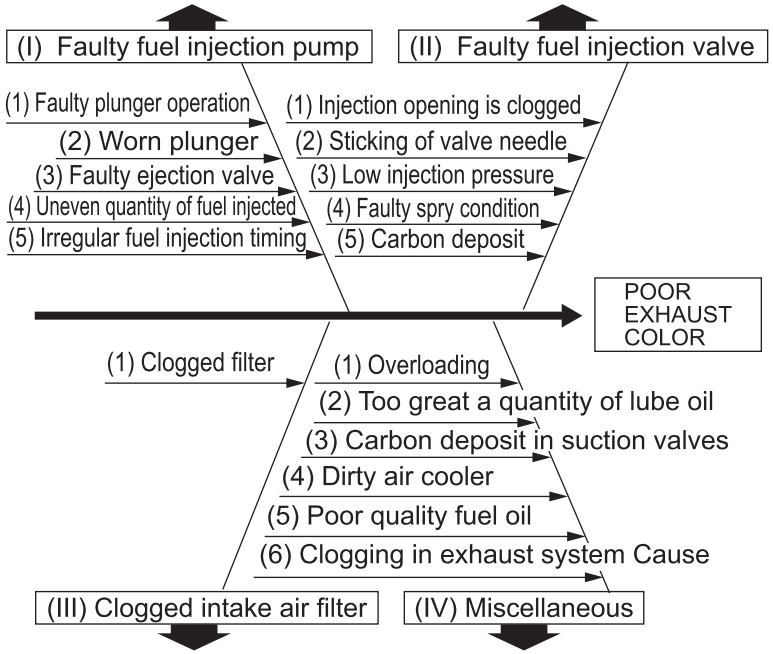
Trouble and Troubleshooting	POOR EXHAUST COLOR

Countermeasure

(I-1) Check, repair or replace.
(I-2) Replace.
(I-3) Check, repair or replace.
(I-4) Adjust.
(I-5) Adjust.

(II-1) Clean.
(II-2) Check, repair or replace.
(II-3) Adjust.
(II-4) Check, repair or replace.
(II-5) Clean.

Cause and Effect



Countermeasure

(III-1) Clean.

(IV-1) Reduce load.
(IV-2) Adjust quantity of oil.
(IV-3) Clean.
(IV-4) Clean.
(IV-5) Reduce. with new oil.
(IV-6) Clean.

Chart 4

TROUBLE AND TROUBLESHOOTING

TROUBLE WITH MARINE GEAR

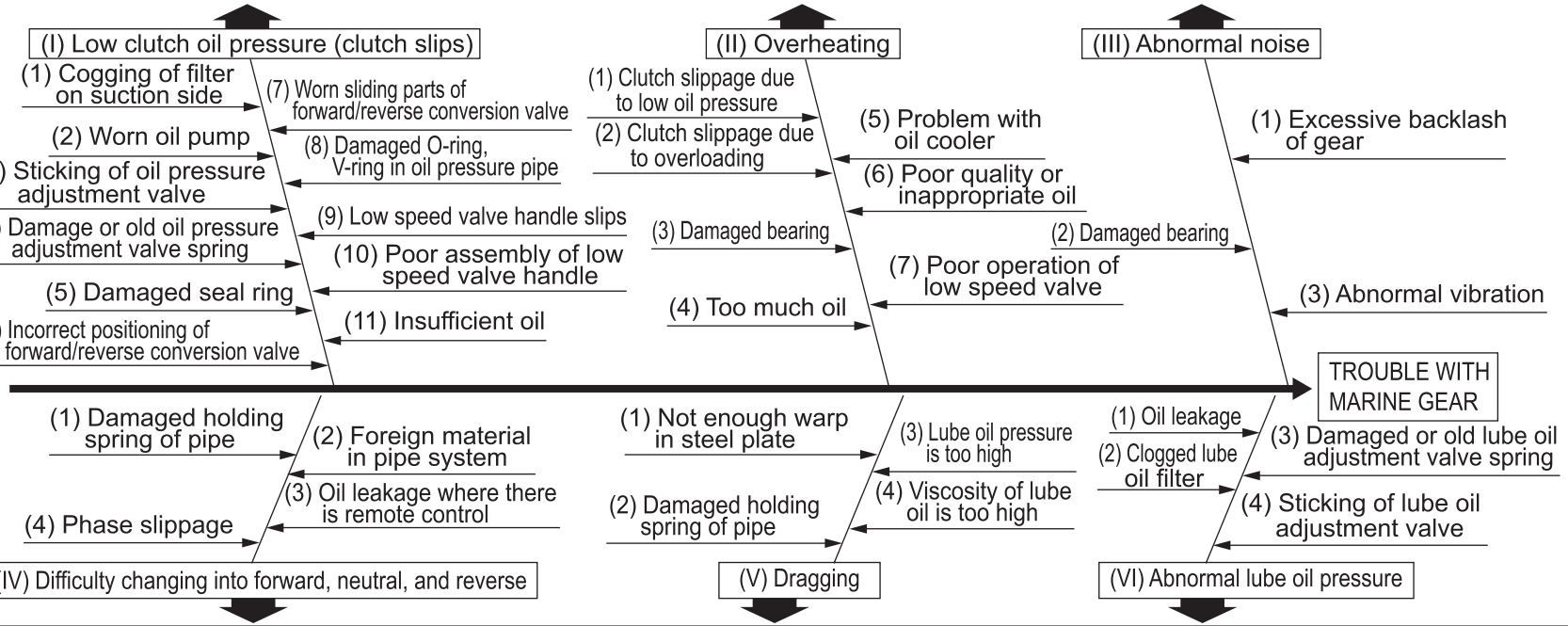
Countermeasure

(I-1) Disassemble and clean.
(I-2) Repair or replace.
(I-3) Repair or replace.
(I-4) Replace.
(I-5) Repair.
(I-6) Adjust.
(I-7) Replace.
(I-8) Replace.
(I-9) Adjust to correct position.
(I-10) Reassemble.
(I-11) Check for oil leakage and replenish.

(II-1) Review (I-1, I-11).
(II-2) Reduce load.
(II-3) Replace.
(II-4) Check oil level and adjust.
(II-5) Check water level and adjust.
(II-6) Change oil.
(II-7) Review manual.

(III -1) Replace.
(III -2) Replace.
(III -3) Eliminate dangerous rotation.

Cause and Effect



Countermeasure

(IV-1) Replace.
(IV-2) Clean.
(IV-3) Replenish oil and check. Replace bellofrom.
(IV-4) Repair link system.

(V-1) Replace.
(V-2) Replace.
(V-3) Adjust lube oil adjustment valve.
(V-4) Change oil.

(VI-1) Check and repair.
(VI-2) Disassemble and clean.
(VI-3) Replace.
(VI-4) Repair or replace.

Chart 5

TROUBLE AND TROUBLESHOOTING

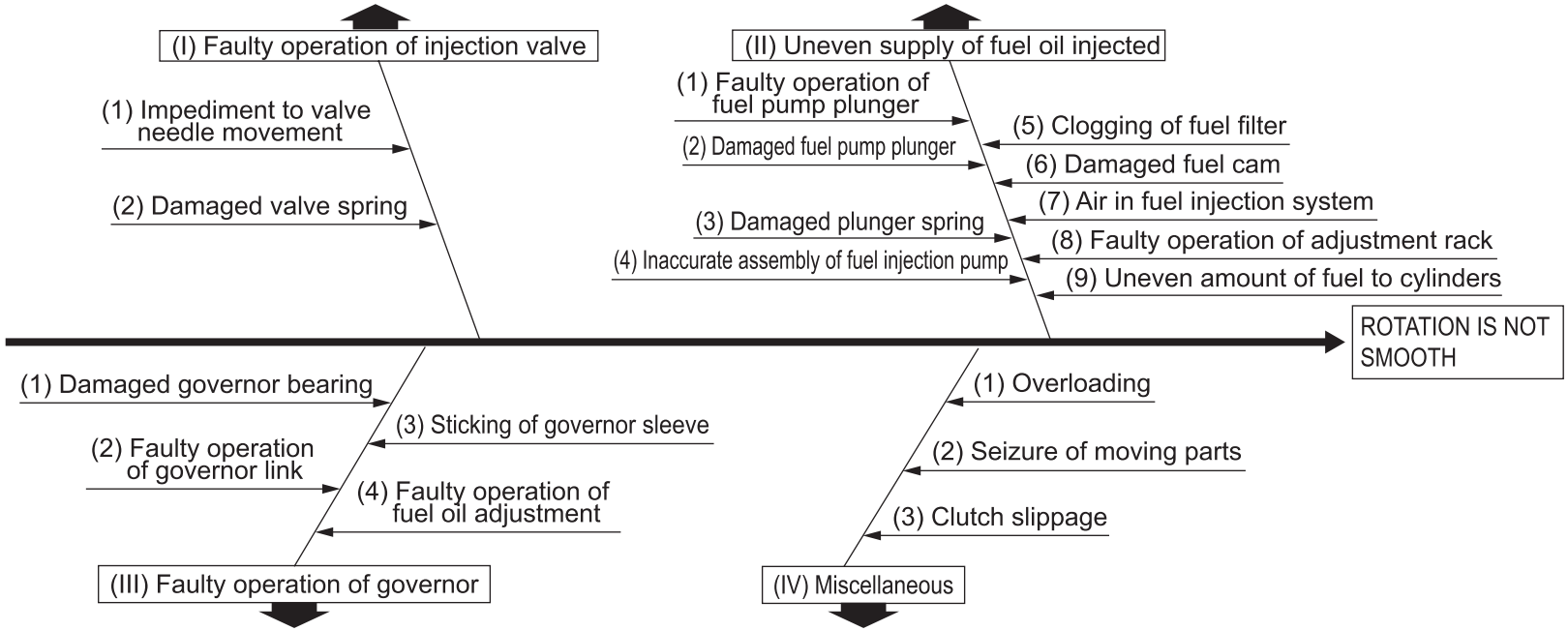
ROTATION IS NOT SMOOTH

Countermeasure

(I-1) Lap.
(I-2) Replace.

(II-1) Clean.
(II-2) Replace.
(II-3) Replace.
(II-4) Correctly install pump.
(II-5) Clean.
(II-6) Replace.
(II-7) Bleed air and prime.
(II-8) Adjust.
(II-9) Adjust.

Cause and Effect



Countermeasure

(III-1) Replace.
(III-2) Adjust.
(III-3) Clean.
(III-4) Disassemble, wash and repair.

(IV-1) Reduce load.
(IV-2) Disassemble, check and repair.
(IV-3) Check and adjust.

Chart 6

TROUBLE AND TROUBLESHOOTING

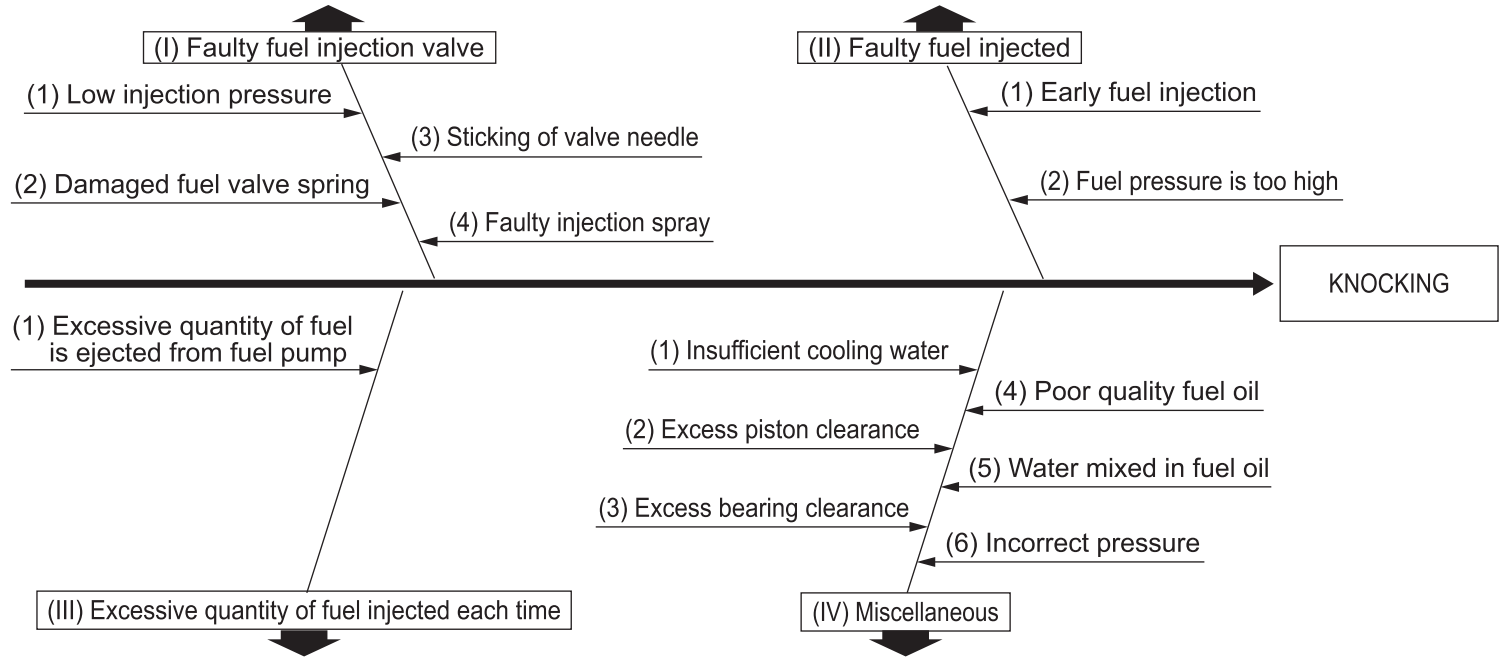
KNOCKING

Countermeasure

(I-1) Increase injection pressure.
(I-2) Replace.
(I-3) Disassemble and lap.
(I-4) Disassemble and repair.

(II-1) Delay injection timing.
(II-2) Adjust standard injection pressure.

Cause and Effect



Countermeasure

(III-1) Adjust pump adjustment rack.

(IV-1) Check cooling water pump and lap valves.
(IV-2) Replace.
(IV-3) Replace.
(IV-4) Replace with good fuel oil.
(IV-5) Replace with good fuel oil.
(IV-6) Check and repair.

Chart 7

TROUBLE AND TROUBLESHOOTING

TROUBLE WITH STARTING

Countermeasure

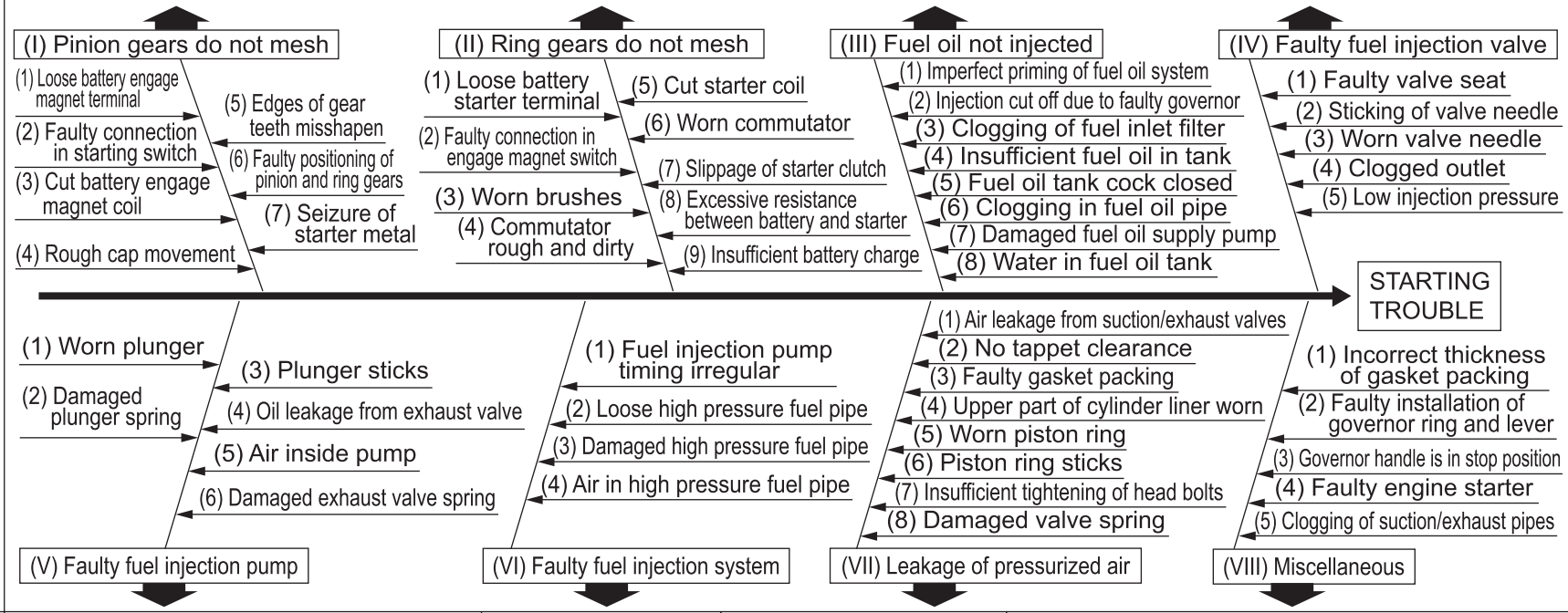
(I-1) Tighten.
(I-2) Repair using sandpaper or replace.
(I-3) Replace.
(I-4) Repair using sandpaper and then grease.
(I-5) Adjust.
(I-6) Adjust.
(I-7) Replace.

(II-1) Tighten.
(II-2) Repair using sandpaper.
(II-3) Replace.
(II-4) Repair using sandpaper (Type 500～600).
(II-5) Replace.
(II-6) Undercut and repair or replace.
(II-7) Replace.
(II-8) Replace with thicker or shorter wire.
(II-9) Charge.

(III-1) Prime well.
(III-2) Adjust.
(III-3) Clean out matter causing clogging.
(III-4) Add fuel to fuel tank.
(III-5) Open cock.
(III-6) Clean.
(III-7) Disassemble and repair or replace.
(III-8) Drain water from fuel system and prime.

(IV-1) Lap.
(IV-2) Lap.
(IV-3) Replace.
(IV-4) Clean or replace.
(IV-5) Adjust.

Cause and Effect



Countermeasure

(V-1) Replace plunger and barrel as a unit.
(V-2) Replace.
(V-3) Disassemble and repair or replace.
(V-4) Lap valves.
(V-5) Bleed air.
(V-6) Replace.

(VI-1) Adjust.
(VI-2) Tighten firmly.
(VI-3) Replace.
(VI-4) Bleed air.

(VII-1) Lap valves.
(VII-2) Adjust .
(VII-3) (VII-4) (VII-5) Replace.
(VII-6) Disassemble and repair or replace.
(VII-7) Tighten tightening nuts uniformly.
(VII-8) Replace.

(VII-1) Replace.
(VII-2) Adjust .
(VII-3) Move governor handle to acceleration position.
(VII-4) Check and repair.
(VII-5) Clean.

Chart 8

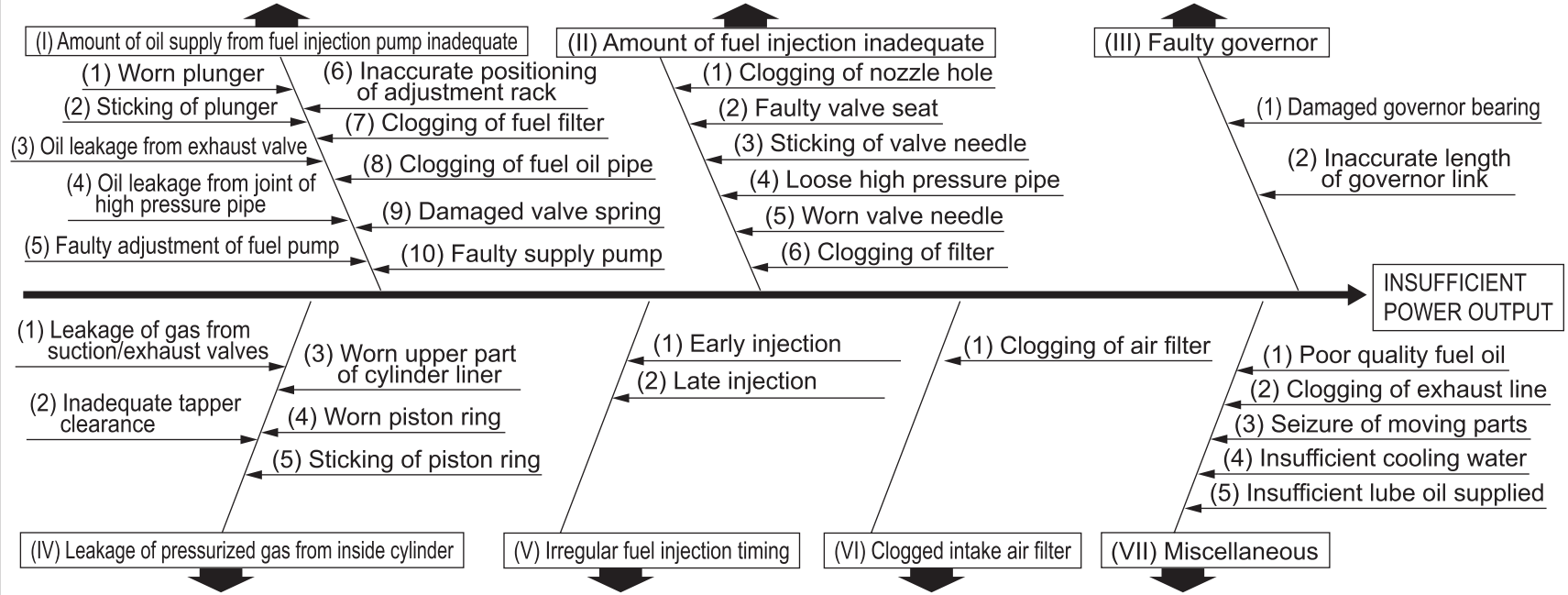
TROUBLE AND TROUBLESHOOTING

INSUFFICIENT POWER OUTPUT

Countermeasure

(I-1) Replace. (I-2) Disassemble and repair or replace. (I-3) Lap valves. (I-4) Tighten firmly. (I-5) (I-6) Adjust. (I-7) (I-8) Clean. (I-9) Replace. (I-10) Repair.	(II-1) Clean nozzle hole or replace. (II-2) Lap or replace. (II-3) Lap or replace. (II-4) Tighten firmly. (II-5) Replace. (II-6) lean.	(III-1) Replace. (III-2) Repair.

Cause and Effect



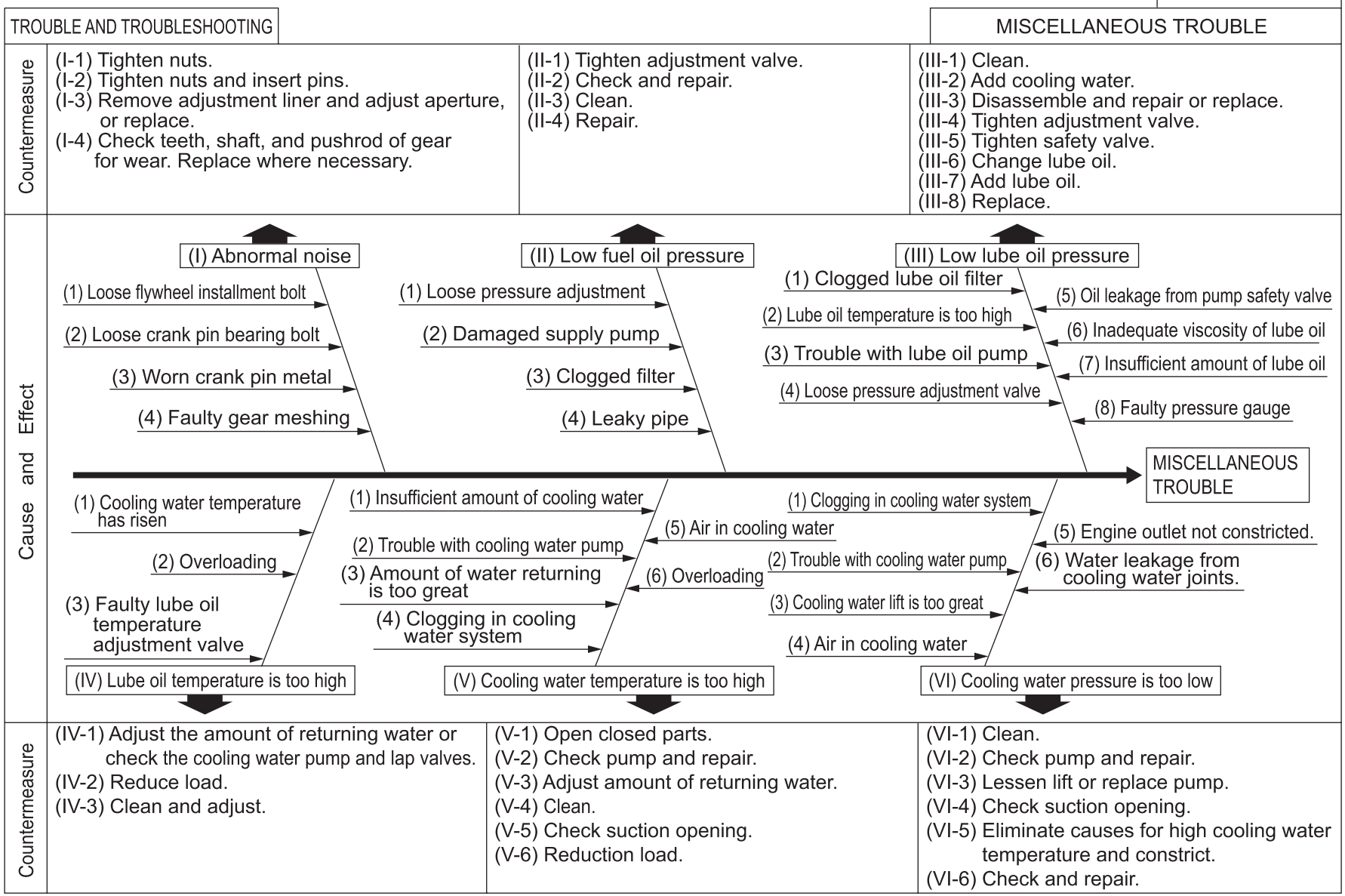
Countermeasure

(IV-1) Lap valves. (IV-2) Adjust. (IV-3) Replace. (IV-4) Replace. (IV-5) Disassemble and repair or replace.	(V-1) Adjust timing to delay injection. (V-2) Adjust timing to speed injection.	(VI-1) Clean.	(VII-1) Replace with good fuel oil. (VII-2) Clean. (VII-3) Disassemble, check and repair. (VII-4) Lap cooling water pump suction/exhaust valves. (VII-5) Disassemble and clean lube oil pump and filter.

Chart 9

TROUBLE AND TROUBLESHOOTING

MISCELLANEOUS TROUBLE



3.3 Troubleshooting (Concerning engine and fuel injection equipment)

Malfunctions	Causes	Remedies
The engine does not operate		
1. Fuel oil is not injected from the injection pump	1. There is no fuel oil in the fuel tank	Supply fuel and bleed the system
	2. The fuel line from the fuel tank is blocked	Clean or replace
	3. The fuel is clogged	Clean or replace
	4. There is air in the fuel filter or the pump chamber	Bleed the system
	5. The accelerator linkage is not properly connected	Repair
	6. The magnet valve wiring is broken or its armature is sticking	Repair or replace
	7. The feed pump blades are sticking, and therefore not operating	Repair or replace
	8. The drive gear or woodruff key is broken	Replace
2. Injection timing is incorrect	1. The drive gear or belt connections are incorrect	Repair
	2. The injection pump is incorrectly installed on the engine	Repair and adjust injection timing
	3. The roller holder assembly's roller or pin is worn excessively	Replace the assembly
	4. The plunger is worn excessively	Replace the distributor assembly
3. The nozzle does not operate	1. The nozzle or nozzle holder is functioning incorrectly	Inspect, then repair or replace
4. The engine operates but only for short time	1. The pipe(s) to the injection pump is blocked or the fuel filter is clogged	Clean or replace the pipe(s) or fuel filter
	2. The fuel oil contains air or water	Bleed of air or replace the fuel oil
	3. The feed pump's delivery quantity (or pressure) is insufficient	Repair or replace
5. The engine "knocks"	1. The injection timing is too advanced	Readjust the timing
	2. The nozzle or nozzle holder is functioning incorrectly	Inspect, then repair or replace

Malfunctions	Causes	Remedies
The engine exhaust contains smoke and the engine “knocks”	1. The injection timing is incorrect	Readjust the timing
	2. The nozzle or nozzle holder is functioning incorrectly	Inspect, then repair or replace
	3. The injection quantity is excessive	Readjust
The engine output is unstable	1. The fuel filter element is clogged and fuel oil delivery is poor	Clean or replace
	2. The amount of fuel or pressure delivered by the feed pump is too little	Inspect and repair
	3. The injection pump is sucking air	Inspect and repair
	4. The regulating valve is stuck in the open position	Replace
	5. The plunger is sticking and does not travel its full stroke	Replace the distributor assembly
	6. The plunger spring is broken	Replace
	7. The control sleeve is not sliding smoothly	Repair or replace
	8. The governor lever is not operating properly or is worn excessively	Repair or replace
	9. The delivery valve spring is broken	Replace
	10. The delivery valve is not sliding properly	Repair or replace
	11.The nozzle or the nozzle holder is not functioning properly	Inspect, and then repair or replace
	12.The injection timing is incorrect	Readjust
Insufficient output 1. The injection quantity is insufficient	1. The specified full-load injection quantity is not delivered	Readjust
	2. The control lever is not reaching the maximum speed position	Readjust
	3. The governor spring is weak and therefore the governed speed is too low	Replace
	4. The plunger is worn	Replace the distributor assembly
	5. The delivery valve seating portions are damaged	Replace
2. The injection timing is too advanced and the engine is “knocking”		Readjust
3. The injection timing is too retarded and the engine is overheating or the exhaust contains smoke		Readjust

Malfunctions	Causes	Remedies
4. The nozzle or the nozzle holder is not functioning properly		Inspect and then repair or replace
The engine cannot reach its maximum speed	1. The governor spring is too weak or is improperly adjusted	Readjust or replace
	2. The control lever is not reaching the maximum-speed position	Readjust
	3. The nozzle's injection operation is poor	Repair or replace
The engine's maximum speed is too high	1. The governor spring is too strong or is improperly adjust	Readjust or replace
	2. The governor flyweights or governor sleeve movement is not smooth	Repair or replace
Idling is unstable	1. The injection quantities are not uniform (the delivery valve is not operating properly)	Inspect or replace
	2. The governor's idling adjustment is improperly adjusted	Readjust
	3. The plunger is worn	Replace the distributor assembly
	4. The plunger spring is broken	Replace
	5. The rubber damper is worn.	Replace
	6. The governor lever shaft pin is worn excessively	Replace
	7. The feed pump blades are not operating properly	Repair or replace
	8. The regulating valve is stuck in the open position	Replace
	9. The fuel filter element is clogged and therefore fuel oil delivery is poor	Clean or replace
	10. The nozzle or the nozzle holder is not functioning properly	Inspect and then repair or replace

3.4 Troubleshooting by measuring compression pressure

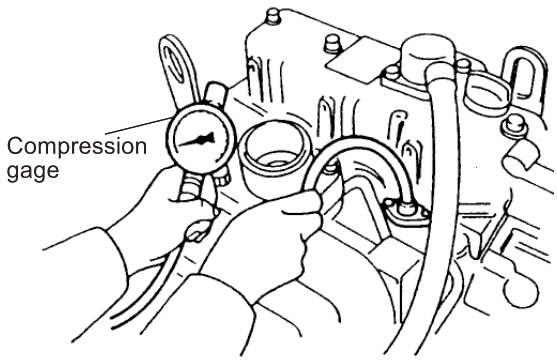
Compression pressure drop is one of major causes of increasing blowby gas (lubricating oil contamination or increased lubricating oil consumption as a resultant phenomenon) or starting failure. The compression pressure is affected by the following factors:

1) Degree of clearance between piston and cylinder
2) Degree of clearance at intake/exhaust valve seat
3) Gas leak from nozzle gasket or cylinder head gasket

In other words, the pressure drops due to increased parts wear and reduced durability resulting from long use of the engine.
A pressure drop may also be caused by scratched cylinder or piston by dust entrance from the dirty air cleaner element or worn or broken piston ring. Measure the compression pressure to diagnose presence of any abnormality in the engine.

(1) Compression pressure measurement method

1) After warming up the engine, remove the fuel injection pipe and valves from the cylinder to be measured.
2) Crank the engine before installing the compression gage adapter.
   a) Perform cranking with the stop handle at the stop position (no injection state).
   b) See 4.2.3(2) in Chapter 4 for the compression gage and compression gage adapter.
3) Install the compression gage and compression gage adapter at the cylinder to be measured.
   a) Never forget to install a gasket at the tip end of the adapter.
4) With the engine set to the same state as in 2)a), crank the engine by the starter motor until the compression gage reading is stabilized.



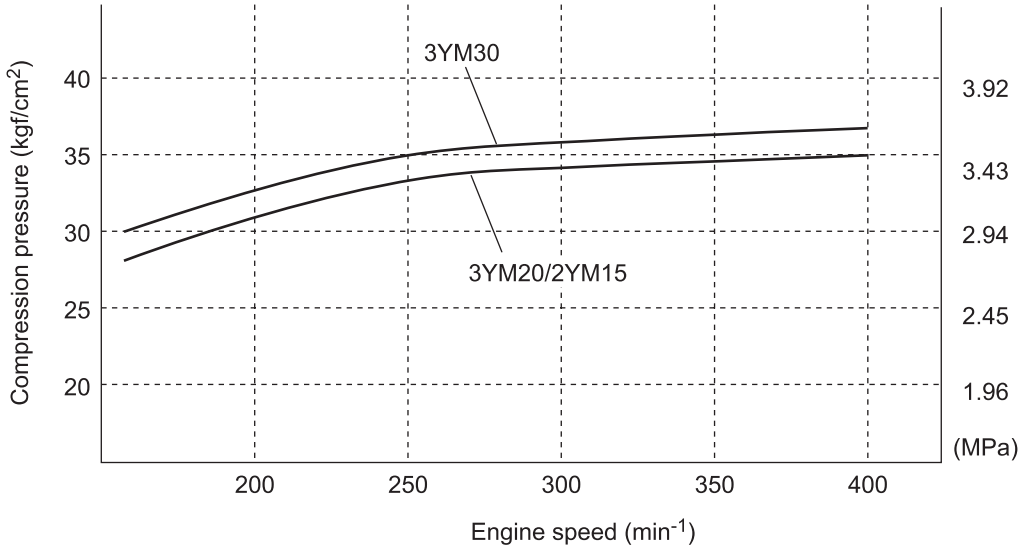
(Measurement of the compression pressure)

(2) Standard compression pressure

Engine compression pressure list (reference value)

Model	Compression pressure at 250 min^{-1} MPa (kgf/cm^2)		Deviation among cylinders MPa (kgf/cm^2)
	Standard	Limit	
3YM30	3.43 ± 0.1 (35 ± 1)	2.75 ± 0.1 (28 ± 1)	0.2 ± 0.3 (2 ± 3)
3YM20/2YM15	3.23 ± 0.1 (33 ± 1)	2.55 ± 0.1 (26 ± 1)	0.2 ± 0.3 (2 ± 3)

(3) Engine speed and compression pressure (for reference)



(4) Measured value and troubleshooting

When the measured compression pressure is below the limit value, inspect each part by referring to the table below.

No.	Item	Cause	Corrective action
1	• Air cleaner element	• Clogged element • Broken element • Defect at element seal portion	• Clean the element. • Replace the element.
2	• Valve clearance	• Excessive or no clearance	• Adjust the valve clearance. (See 2.2.2(5) in Chapter 2.)
3	• Valve timing	• Incorrect valve clearance	• Adjust the valve clearance. (See in Chapter2.)
4	• Cylinder head gasket	• Gas leak from gasket	• Replace the gasket. • Retighten the cylinder head bolts to the specified torque. (See 5.2.5 in Chapter 5.)
5	• Intake / exhaust vale • Valve seat	• Gas leak due to worn valve seat or foreign matter trapping • Sticking valve	• Lap the valve seat. (See 5.2.2 in Chapter 5.) • Replace the intake/exhaust valve.
6	• Piston • Piston ring • Cylinder	• Gas leak due to scratching or wear	• Perform honing and use an oversized part.