KOBELCO

SERVICE MANUAL

NISSAN DIESEL ENGINE

Models PD6 and PD6T

Applicable Machine: LK850 II~

SMEPDS1E00-00 08/89

NISSAN DIESEL ENGINE

LK 850 II

MODELS PD6 & PD6T

SERVICE MANUAL

NISSAN DIESEL MOTOR CO., LTD.
TOKYO, JAPAN

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ENGINE SERVICE MANUAL

MODELS
PD6 and PD6T

Applicable Engine Numbers
PD6 070000-
PD6T 048000T-

FOREWORD

This service manual covers repair procedure of the PD6 and PD6T diesel engines. In order for the engine displays 100% performance at all times, and to expand the life of each part, daily inspection and servicing must, of course, be performed according to a plan, but proper overhaul and repair in accordance with the maintenance standards is also vital.

Keep this manual in the shop for everyone engaging in servicing of the engine.

Nissan Diesel reserves the right to make changes for improvement at any time without notice.

Accordingly, some of the descriptions contained in this manual may not be applicable to your particular vehicle.

QUICK REFERENCE INDEX

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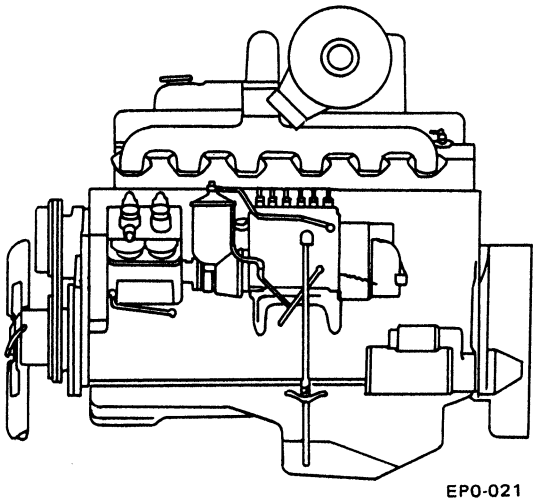
1. GENERAL



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This chapter describes handling cautions of this manual and engine general. Therefore, when repairing the PD6 and PD6T engines by using this manual, first read this chapter.

ENGINE SPECIFICATIONS

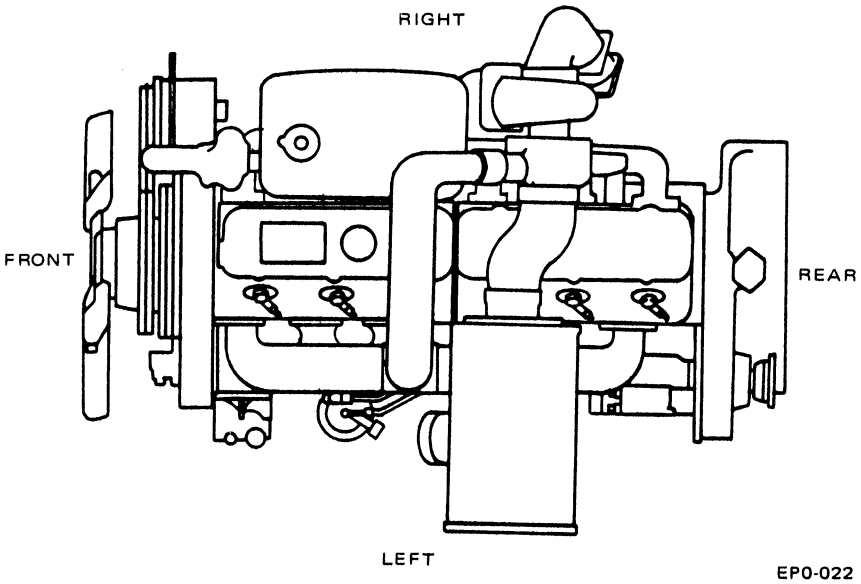
Model			PD6	PD6T
Type			Diesel	
Cooling system			Water cooled	
Number of cylinders and cylinder configuration			6, in-line	
Number of circles			4	
Type of combustion chamber			Direct fuel injection	
Valve mechanism			Overhead	
Type of cylinder liner			Dry	
Bore x stroke [mm]			125 x 140	
Total displacement [cc]			10,308	
Compression ratio			17 : 1	16 : 1
Cylinder compression [kg/cm²-rpm]			30 - 200 ±20	
Number of piston rings		Compression ring	2	
		Oil ring	1	
Intake valve timing		Open	16° B.T.D.C.	
		Close	56° A.B.D.C.	
Exhaust valve timing		Open	52° B.B.D.C.	
		Close	20° A.T.D.C.	
Valve clearance [mm]		Intake	0.4 (.01574 IN)	
		Exhaust	0.4 (.01574 IN)	
Fuel system	Ignition system		Compression ignition	
	Fuel injection timing [B.T.D.C.]		13°	16°
	Ignition order		1-4-2-6-3-5	
	Fuel injection pump	Type	Bosch P type	
		Plunger diameter [mm]	10.0	11.0
		Cam lift (Feed pump side) [mm]	10 (4)	
		Governor	Centrifugal	
		Timer	Centrifugal	
	Fuel injection nozzle	Nozzle holder	Flange type	
		Nozzle	Multi-hole type	
		Number of injection nozzle	4	
		Injection pressure [kg/cm²]	200	230

Model				PD6	PD6T
Intake system	Air cleaner	Type		Cyclone or oil bath	
		Element	Cyclone type	Dry paper element	
			Oil bath type	Steel wool	
	Air heater	Type		Ribbon type	
		Voltage [V] x Current [A] x number		22 x 160 x 1	
	Turbocharger	Type		—	TE0644
		External dimensions (Length x Width x Height)		—	280 x 250 x 220
		Turbine type		—	Radial-flow
		Impeller type		—	Centrifugal
		Max. permissible continuous speed (rpm) at 650°C (gas temperature)		—	100,000
		Direction of rotation		—	Counterclockwise as viewed from the exhaust turbine side
		Air volume (maximum) (kg/min)		—	25
		Compression ratio		—	3.0
Lubricating system	Type			Forced circulation	
	Oil pump			Gear pump	
	Oil filter	Fullflow		Mat	
		By-pass		Depth	Filter paper
	Lubrication oil capacity [ℓ]			22	25
	Oil cooler			Water cooled flat tube type	
Cooling system	Type			Forced circulation	
	Cooling water capacity (Engine only) [ℓ]			30	
	Water pump			Centrifugal	
	Thermostat			Wax pellet type	
Electrical system	Charging system	Type		AC, diode-rectified	
		Output [V-A]		24 - 35, 24 - 25	24 - 35
		Voltage regulator		Tirrill type	
	Starting motor	Type		Shift type	
		Output [V-kW]	S28-23B	24 - 6.0	
			S210-98	24 - 5.5	

METHOD OF USING THIS MANUAL

STANDARDIZATION OF TERMS

ENGINE POSITION



1 mm . . . . . 0.0394 in.
1 kg . . . . . 2.205 lb.
1 kgm . . . . . 7.23 lb. ft.
1 kg/cm^2 . . . . . 14.223 psi.
1 liter . . . . . 0.220 Imp. gal.
1 liter . . . . . 0.264 U.S. gal.

$$t\,(°F) = 32 + \frac{9}{5}\,T\,(°C)$$

However, the unit of horsepower uses France horsepower.

ABBREVIATION

In this manual, the following abbreviations are used.

O.D.	Outside Diameter
I.D.	Inside Diameter
O.S.	Over Size
U.S.	Under Size
B.T.D.C.	Before Top Dead Center
A.B.D.C.	After Bottom Dead Center
B.B.D.C.	Before Bottom Dead Center
A.T.D.C.	After Top Dead Center
P.T.O.	Power Take Off

MAINTENANCE STANDARD TERMS

Maintenance standard

"Maintenance standard" indicates the standard clearance when parts are assembled or the standard performances of assembly parts.

Repair limit

"Repair limit" indicates that repair is necessary if the clearance between parts or the parts are to meet the values given in the repair limit are to be attained.

Wear limit

"Wear limit" indicates that the part has exceeded the given wear limit and must be replaced.

UNITS

The units of measures used throughout this manual, are in accordance with the metric system. When conversion to the corresponding English units (Foot pound system) is necessary, utilize the following.

USING THIS MANUAL

This manual consits of each chapter. When the trouble points are unclear, refer to chapter 2 "Disassembly judgement" and locate the trouble point. Then, refer to chapter 3 "Engine disassembly and reassembly" and remount the trouble components, and repair by referring to the chapter for each components (chapter 4 to chapter 11). For check of the engine performance, refer to chapter 12 "Engine test procedures". Moreover, maintenance standards and tightening torque are collected in the chapter 13 "Service data".

LUBRICATION AND FUEL

ENGINE OIL

The use of proper engine oil for heavy duty is essential. NISSAN DIESEL engine should be lubricated with oil of a performance level not less than the requirements based on API service classification CD or CC class oil and SAE viscosity grades. However, use classification CD class oil in engines equipped with a turbocharger.

Recommended Viscosity (SAE) Grades

Atmospheric temperature	Recommended SAE viscosity	
–18 to +10°C	10W	10W/30
–7 to +25°C	20W/20	
–12 to +40°C	15W/40, 20W/40	
+5 to +40°C	30	
More than + 30°C	40	

A.P.I.: American Petroleum Institute
S.A.E.: Society of Automotive Engineers

BEARING GREASE

(Brand recommended: N.L.G.I. No. 2, Li, -Soap base)

This grease may be used on generator, fan pulley bracket, starting motor, and etc. Be careful of contamination while grease is in storage.

N.L.G.I.: National Lubricating Grease Institute

COOLING SYSTEM WATER

Be sure to use clean, soft water such as city water in the cooling system. Do not use hard water such as well water or river water, because such water can easily form scale in the system. Note that scale attached to the water passage in the cooling system (particularly in the radiator) can cause engine overheating.

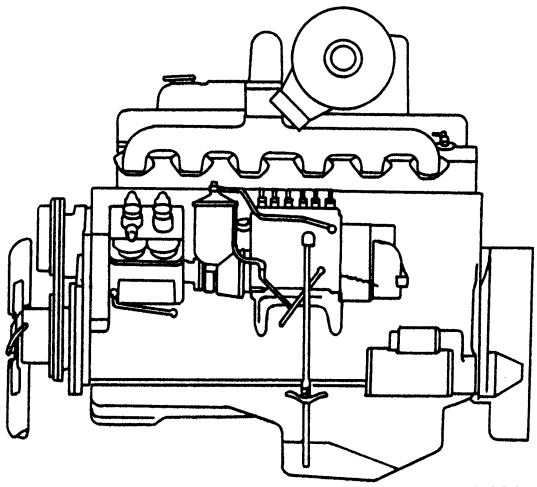
FUEL

The Nissan Diesel engine is designed to produce power by using light oil as fuel. Do not use any fuel except light oil; otherwise, engine trouble will result.
The light oil should have a cetane number greater than 45, specific gravity of 0.81 to 0.85, boiling point ranging from 180 to 350°C, sulfer content of less than 0.5%, and should prove neutral in a chemical reaction test. It should be clean, possess the proper viscosity, and contain no water or sediment.

CAPACITIES OF UNIT

Engine oil sump
  Total capacity
    25 liters
  Oil pan capacity
    H level 18 liters
    L level 14 liters
Cooling system water (Engine only)
    30 liters
Air cleaner (oil bath type)
    3 liters

2. DISASSEMBLY JUDGMENT



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This chapter covers the judgment of disassembling the PD6 and PD6T engines.

DETERMINING THE NEED FOR ENGINE OVERHAUL

Whether an engine needs overhauling or not is determined by considering various factors including reduction in output, difficulty in starting, deterioration in oil or fuel consumption, reduction in oil pressure, and the increased need for periodic maintenance. It is desirable, however, to judge whether or not the engine actually requires overhauling by conducting various checks, as many of the above factors can often be corrected through minor service operation rather than a complete overhaul.

REDUCTION IN COMPRESSION PRESSURE

The compression pressure of the engine lowers as the cylinder liner, piston, piston rings and valves become worn. If compression pressure drops to the repair limit, the engine must be overhauled.

Compression pressure (Warm engine and engine rpm; 180 to 220)
Maintenance standard
30.0 kg/cm^2
Repair limit
20.0 kg/cm^2
Difference between cylinders
Maintenance standard
4.0, max. kg/cm^2

DETERIORATION IN FUEL CONSUMPTION (FC)

Deterioration of FC is also attributable to the operating conditions of the vehicle (including road condition, load weight, driving habits) and poor maintenance of parts. Therefore, deterioration of FC is not always a sign that engine overhaul is required. However, if the operating conditions are unchanged from the new car period, it is possible to determine whether or not the engine requires overhauling by using the FC value of the new car period as a reference. If the FC value drops below 60% of the reference value, the engine should be overhauled.

DETERIORATION IN ENGINE OIL CONSUMPTION (OC)

The OC value changes according to various factors including operating conditions of vehicle, quality of engine oil, etc. However, if the OC value drops below 40% of its initial value during the new car period, it can be regarded as a sign that engine overhaul is required. Before making the final decision to overhaul, it is also necessary to check compression pressure, blowby gas pressure and other factors, and to thoroughly inspect the engine.

REDUCTION IN ENGINE OIL PRESSURE

If the engine oil pressure drops to the maintenance standard, the engine including the lubricating system should be overhauled.

Engine oil pressure
(Oil temperature; 70 to 80°)
At idling
Maintenance standard
More than
0.5, min. kg/cm^2 (PD6)
More than
1.0, min. kg/cm^2 (PD6T)
At 2,000 rpm (PD6)
2,200 rpm (PD6T)
Maintenance standard
More than
3.5, min. kg/cm^2

TROUBLESHOOTING TESTS

MEASURING COMPRESSION PRESSURE

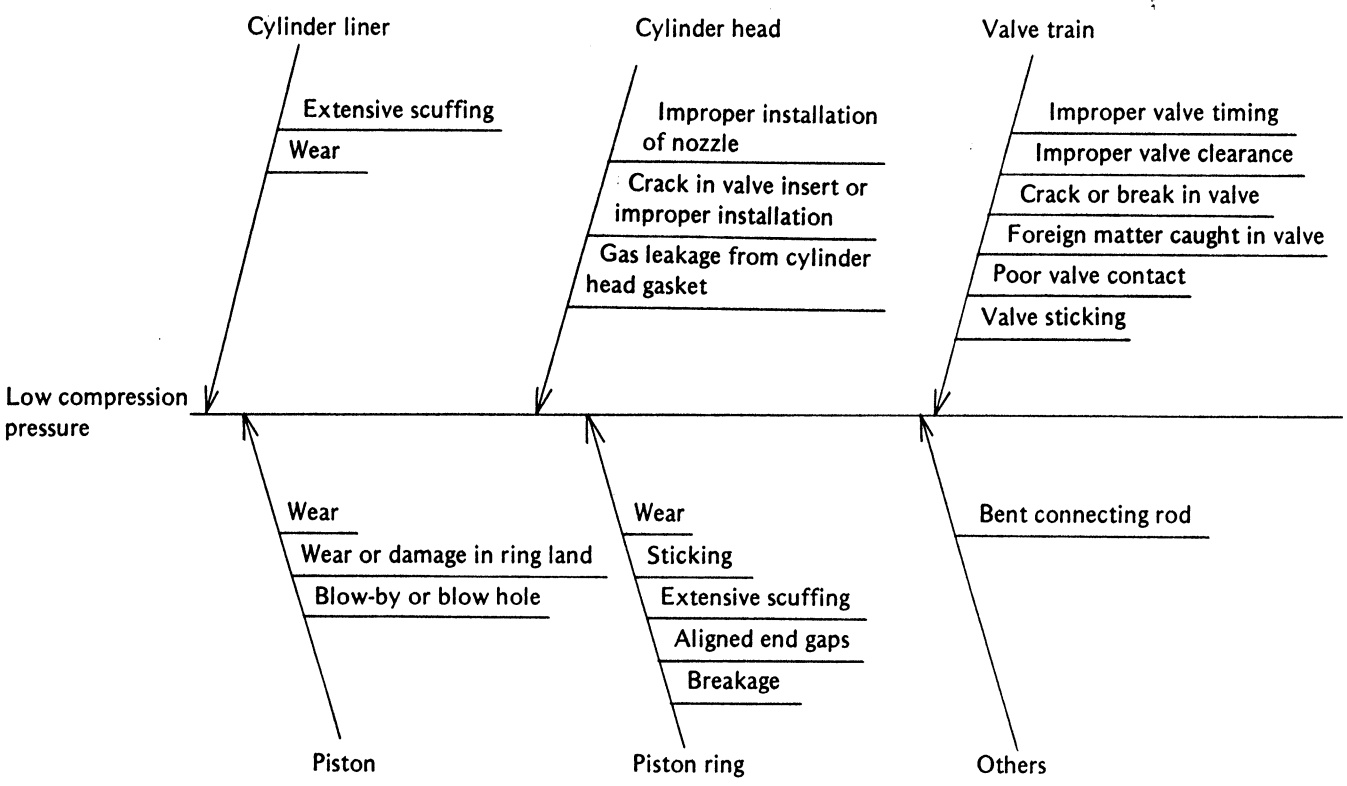
The measurement value of the compression pressure is important in determining the time that engine overhaul is needed. It is therefore necessary to periodically measure and record engine compression pressure.

Compression pressure (Warm engine and engine rpm; 180 to 220)
Maintenance standard
More than 28.0 kg/cm^2
Repair limit
Less than 20.0 kg/cm^2
Difference between cylinders
Maintenance standard
4.0, max. kg/cm^2

Examples of trouble

Trouble symptoms that are attributable to incorrect compression pressure are: low engine output, deteriorated oil consumption, deteriorated fuel consumption, emission of white smoke during high speed travelling, difficulty in starting, irregular engine operation, diesel knock, overheating, etc. If compression pressure drops below the repair limit, the cause must be examined, and the engine overhauled.

Factors that may cause reduction in compression pressure



MEASURING BLOW-BY GAS PRESSURE

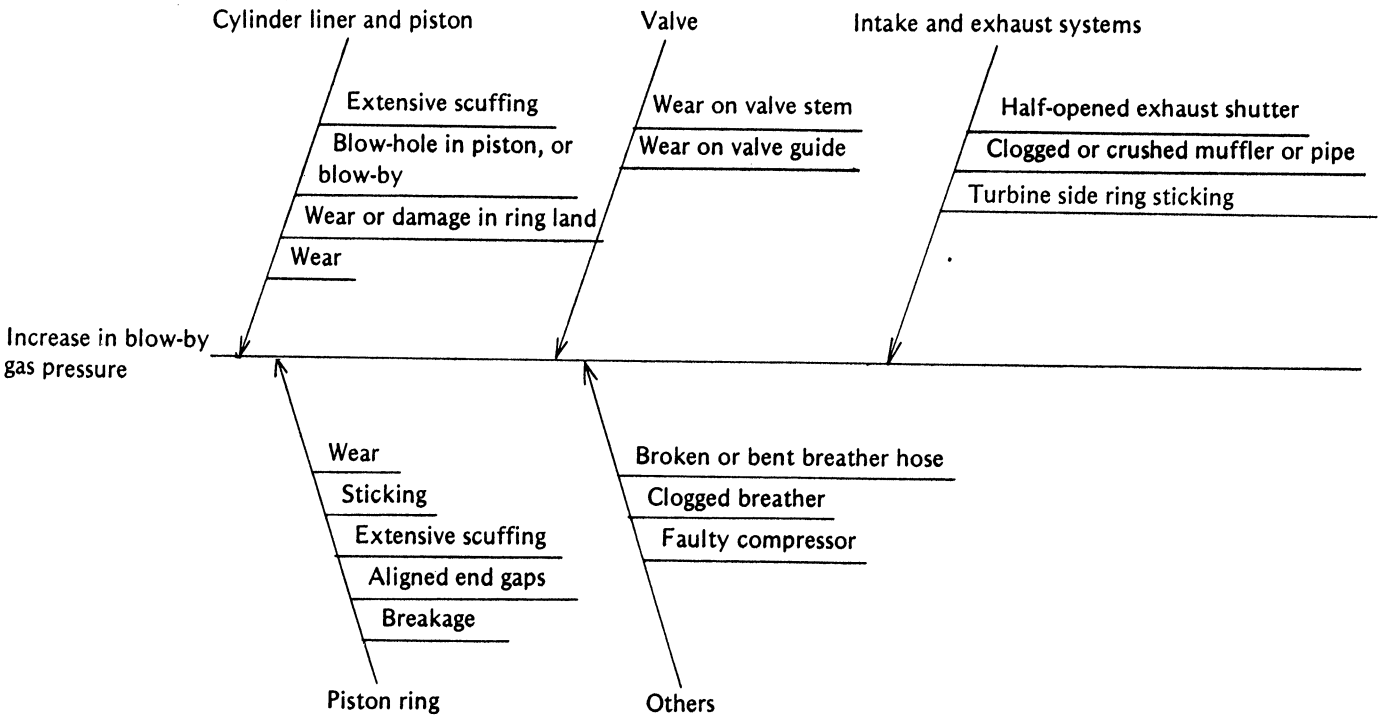
Measurement of blow-by gas pressure like measurement of compression pressure provides an important information, in deciding whether or not an engine should be overhauled.

Blow-by gas pressure (Warm engine at maximum rpm under no-load)
Maintenance standard
15, max. mmAq

Trouble symptom

Trouble symptoms that are attributable to excessive blow-by gas pressure are: low engine output, deterioration in oil or fuel consumption, emission of white smoke during high speed travelling, difficulty in starting, irregular engine operation, diesel knock, overheating, oil leakage from air breather or other areas, etc. If the blow-by gas pressure exceeds the service standard, compression pressure should also be measured, and then a decision should be made whether the engine requires overhauling.

Factors that may cause an increase in blow-by gas pressure



MEASURING BOOST PRESSURE

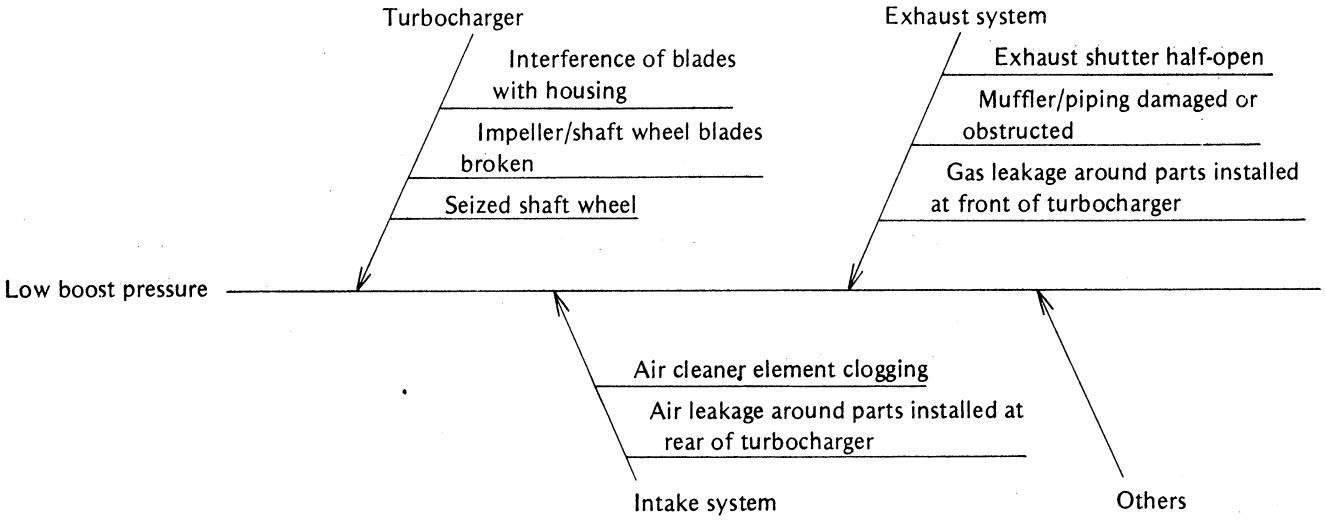
Should the turbocharger become inoperative, boost pressure should be measured to diagnose the intake and exhaust systems.

When engine speed is
1,000 rpm/113PS
Maintenance standard
160 mmHg
(Measured at the intake duct of the turbocharger)

Examples of turbocharger failure

Turbocharger failure is evidenced by decreased engine output, excessive fuel consumption or black exhaust smoke. Abnormal boost pressure indicates the necessity of inspection and possible overhaul of the turbocharger intake and exhaust systems.

Factors which may cause low boost pressure



NO-LOAD ACCELERATION AND DECELERATION TEST

The condition of an engine can be judged by checking its acceleration and deceleration speeds. This test is performed under a no-load condition.

No-load acceleration and deceleration test (Warm engine)
Acceleration
Maintenance standard
2.0, max. sec.
Deceleration
Maintenance standard
3.5, max. sec. (PD6)
5.0, max. sec. (PD6T)

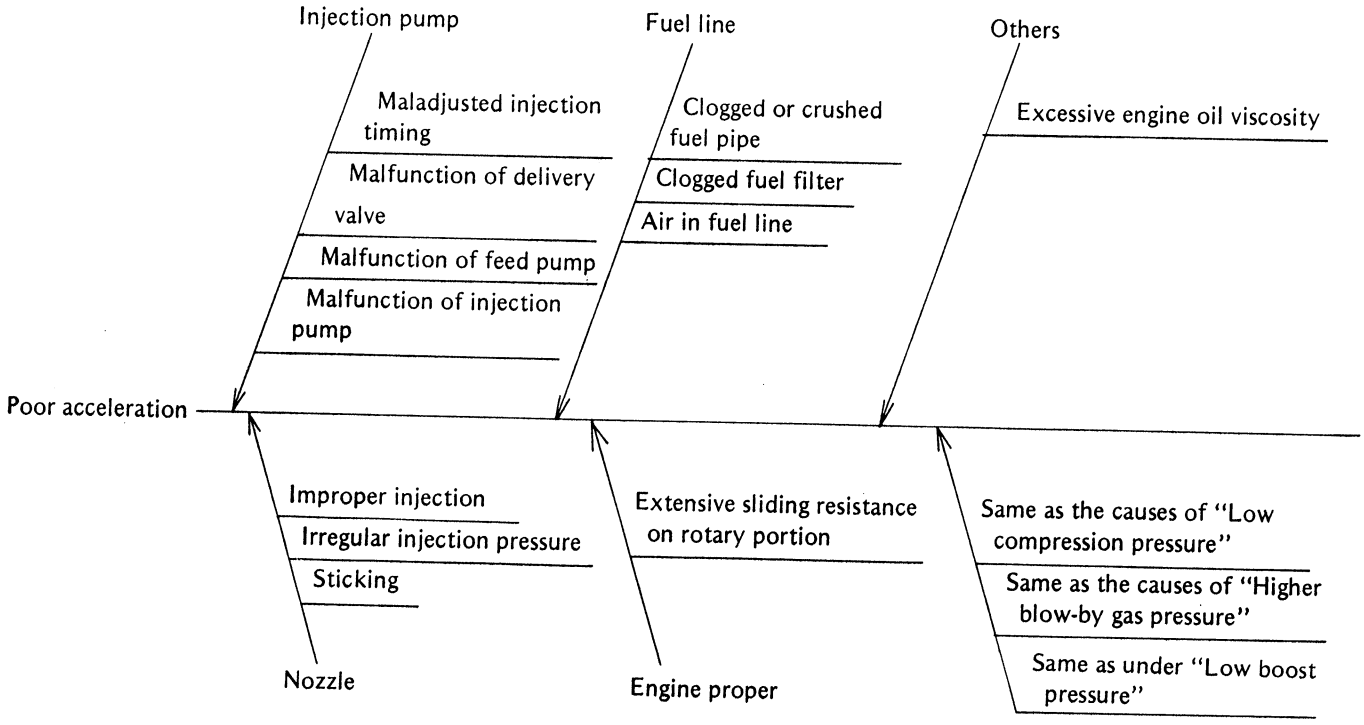
Trouble symptom

Trouble symptoms relating to improper acceleration or deceleration are as follows: low engine output, deteriorated fuel consumption and difficulty in shifting of transmission.

Causes of slow acceleration or deceleration

Slow acceleration is caused by low compression pressure, increase in blow-by gas pressure, and failure in fuel system.

Slow deceleration is generally caused by poor governor performance, such as improper adjustment of damper spring, or idle spring, or too high idling adjustment by control knob.



MEASURING WATER TEMPERATURE DIFFERENCE BETWEEN RADIATOR INLET AND OUTLET

This test is performed to check whether the radiator is functioning normally. It is desirable to examine temperature during the running state using a thermister.

Water temperature difference between radiator inlet and outlet
Maintenance standard
Approx. 5 to 7°C

Trouble symptom

Excessive temperature differences can cause engine overheating.

Possible causes

1) Extreme water temperature differences are caused by water scale or foreign matter obstructing normal water flow in the radiator.
2) Slight water temperature differences are caused by foreign matter such as mud and insects accumulated on the radiator core fin, obstructing smooth flow of air through the fins.

LITMUS TEST OF COOLING WATER

Check the pH value of the cooling water using the litmus paper. (Use blue litmus paper.)

Trouble symptom

If the acidity of cooling water is excessively high, engine overheating or reduction in the quantity of cooling water may result.

Causes of higher acidity

If the burnt gases leak through the cylinder head gasket into cooling water, the sulfurous acid gas in the burnt gases dissolves into water, thus increasing the acidity of the water.

PRESSURE TEST OF WATER TANK CAP

Faulty water tank cap can cause the amount of cooling water to be reduced or the engine to overheat. Therefore, the water tank cap should be checked periodically.

Water tank cap open valve pressure (Pressure side)
Maintenance standard
0.45 to 0.7 kg/cm² (PD6)
0.30 to 0.55 kg/cm² (PD6T)
Repair limit
0.9, min. kg/cm² (PD6)
0.7, min. kg/cm² (PD6T)

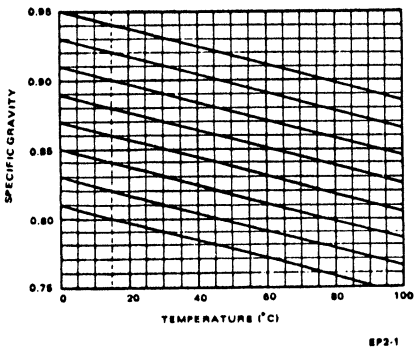
ENGINE OIL SPOT TEST

The engine oil spot test is performed to evaluate the condition of the engine oil, thereby judging whether or not the engine oil requires changing.
A spot test kit is available from the petroleum manufacturer, and the spot test should be performed by referring to the Instructions given in the kit.

MEASURING SPECIFIC GRAVITY OF FUEL

Poor quality fuel not only causes reduction in engine output, but also causes failure in the nozzle and plunger and clogging in the fuel filter element. If any of these failures is observed, it is also necessary to measure the viscosity of fuel in order to judge whether fuel quality is acceptable. Generally speaking, reduction of 10% in the specific gravity can cause 5 to 7% increase in the fuel consumption, and alike decrease in engine output.

Relation between temperature and specific gravity



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CAUSE OF TROUBLE AND ITS CORRECTION

PRECAUTIONS ON TROUBLE-SHOOTING AND REPAIRING

1) Prior to disassembly, confirm the nature of the problem. Determine the following points and the conditions before and after the occurrence of trouble by asking the user.
   1. Did the trouble occurred suddenly?
   2. Was there anything unusual before occurrence of the trouble?
   3. Under what condition did the trouble occur?
   4. Was there any repair work done recently?
   5. Is there any other unusual phenomenon?
2) Confirm the nature of the problem in the shop (by the service mechanic himself).
   Reconfirm the nature of the problem complained of by user, and perform tests using various testing equipment in the shop. Then, make a guess as to the cause of the trouble.
3) Thorough investigation of the trouble prior to disassembly can prevent unnecessary procedures, enabling quick and efficient repair work. Note that disassembly without preliminary investigation often makes reproduction of the problem difficult, thus making trouble-shooting impossible.
4) Always start with a simple operation.
   After making a guess as to the cause of the trouble, perform investigation or repair work starting with the simpliest operation.
5) Always consider the cause of the trouble.
   The same problem will occur repeatedly if the symptoms only are corrected without removing the real cause of the trouble. Be sure to seek out the origin of the trouble and remove it completely.
   Example: An engine was brought to the shop because of oil leakage from the crankshaft front oil seal, and the problem was repaired by simply replacing the oil seal.
   If the cause of this problem is faulty oil seal, there is no problem. However, oil leakage is often a secondary problem resulting from another primary cause, and the primary cause must be removed without fail.
   In the case of the above example, the cause of the trouble may be one of the following:
   - The blow-by gas pressure is excessively high, and engine oil spirts out due to the high pressure.
   - Mis-aligned crankshaft due to wear on main bearing shell.

DIAGNOSIS GUIDE

The diagnosis guide is a table which can be used for seeking out the cause of trouble without disassembling the engine on the basis of the symptoms of the problem and the result of checks performed in the shop.

HOW TO USE THE GUIDE

1) Open the page of the guide corresponding to the trouble symptom complained of by the user.
2) Check all of the points listed in the page.
3) If there is any applicable item in the checking points, the cause of the trouble may be assumed in the following manner.
   - Each item in the "Symptoms and checking points" section corresponds to one or more items in the "Cause of trouble" section through the dot mark "●". If there are more than one applicable "Cause of trouble" items, the item having the largest number of dot marks should be regarded as the central cause of the trouble.
   - The "cause" items having no dot mark can be regarded as not being the cause of the trouble.

Note
If more than one cause is assumed, repair operation should begin with the simplest operation.