KOBELCO

SERVICE MANUAL

MITSUBISHI DIESEL ENGINE

4D3, DR

For Industrial Use

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Applicable Engine Models: 4D31, 4D31-T, 4D30
4DR5, 6DR5

97811-03020-00 04/04

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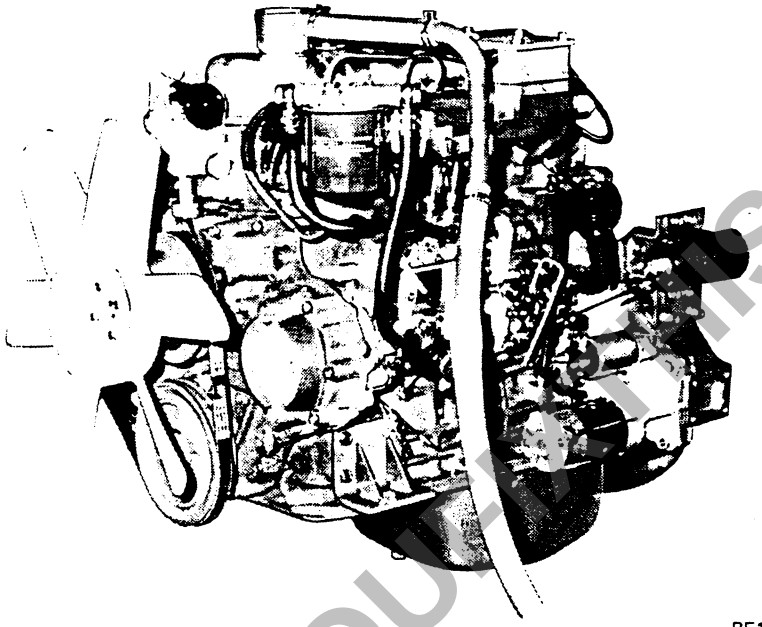
PARKING BRAKE 36

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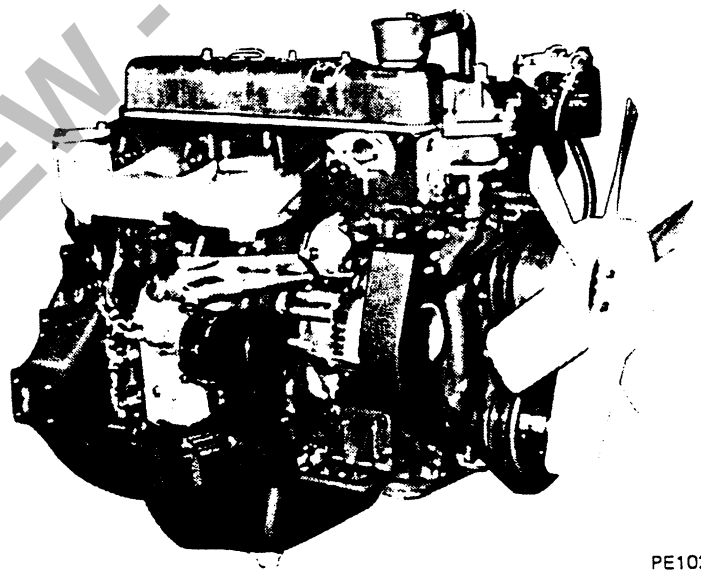
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1. EXTERNAL VIEW

4D31 Model



PE1021



PE1022

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- Limit

  Shows the value of a part at which the part is no longer serviceable from the performance as well as strength viewpoints, requiring replacement or repair.

(4) Tightening Torque

Over- or undertightening of bolts and nuts has critical effects on performance and functions. Tightening torque is therefore specified for some tightening points.

All tightening torque specifications may be considered as "dry" unless "wet" is specified.

Where no tightening torque is specified, use a torque value specified in the general bolts and nuts tightening torque table.

(5) Units

For length, weight, area, and volume, the SI unit (International System of units) is used with the metric notation jointly shown in parentheses.

Temperature is shown in centigrade (°C).

4. Table of Conversion Rate for Foot-pound Units into SI Units

Unit	Sign of SI unit	Sign of foot-pound unit	Conversion rate
Mass quantity of matter	kg g	lb oz	1 kg = 2.2046 lb 1 g = 0.035274 oz
Dimension	m mm	ft. in.	1 m = 3.2808 ft. 1 mm = 0.03937 in.
Capacity	lit. cc	gal. oz	1 lit. = 0.2642 gal. (U.S.) 1 lit. = 0.220 gal. (Imp.) 1 cc = 0.033814 oz (U.S.) 1 cc = 0.035195 oz (Imp.)
Force	N (Newton)	lbf	1 N = 0.2248 lbf
Pressure	kPa (kilopascal)	$lbf/in.^2$	1 kPa = 0.145 $lbf/in.^2$ 1 kPa = 0.2953 in.Hg
Stress	N/cm^2	$lbf/in.^2$	1 N/cm^2 = 1.45 $lbf/in.^2$
Moment of force	N m	ft. lbf	1 N m = 0.7375 ft. lbf
Output	kW (kilowatt)	HP	1 kW = 1.34 HP
Temperature	°C	°F	t°C = (1.8t°C + 32)°F

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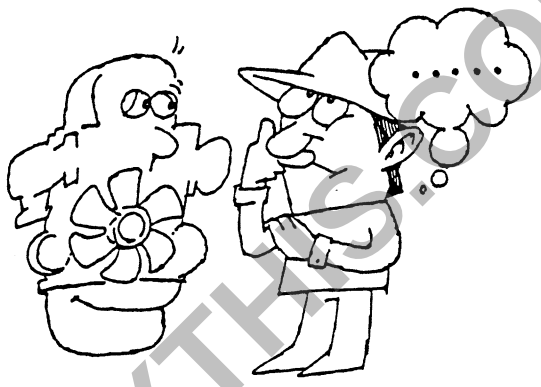
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2. General Precautions for Servicing

Before starting the service procedures, check the vehicle for total time driven, use conditions, and user's complaints and requests to know exactly the engine conditions. Record information where necessary.

To ensure you are doing correct and efficient service jobs, observe the following precautions.

(1) Before performing the service procedures given in this manual, know the trouble spots and isolate the possible cause to determine whether the removal or disassembly procedure is required.



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(2) Select a flat surface for the service job.

(3) When servicing the electrical system, be sure to disconnect the negative cable from the battery.

(4) Carefully check parts for oil leaks before cleaning. After cleaning, it may become difficult to spot defective areas.

(5) Ready and make the most of the special tools required for servicing. Use the right tools (specified special tools) in the right place to prevent damages to parts and personal injury.

(6) Make alignment marks and keep disassembled parts neatly arranged to ensure that they are reassembled into the right positions.

- Special care must be taken for assemblies involving a number of parts, similar parts, or parts identical at right- and left-hand sides to ensure correct reassembly.
- For alignment and punching markings, select a position that would not mar the appearance and function.
- Clearly distinguish parts to be replaced from those reused.

(7) The oil seals, packings, O-rings, and other rubber parts, gaskets, and split pins must be replaced with a new one whenever they are removed. For replacement, use Mitsubishi Genuine Parts.



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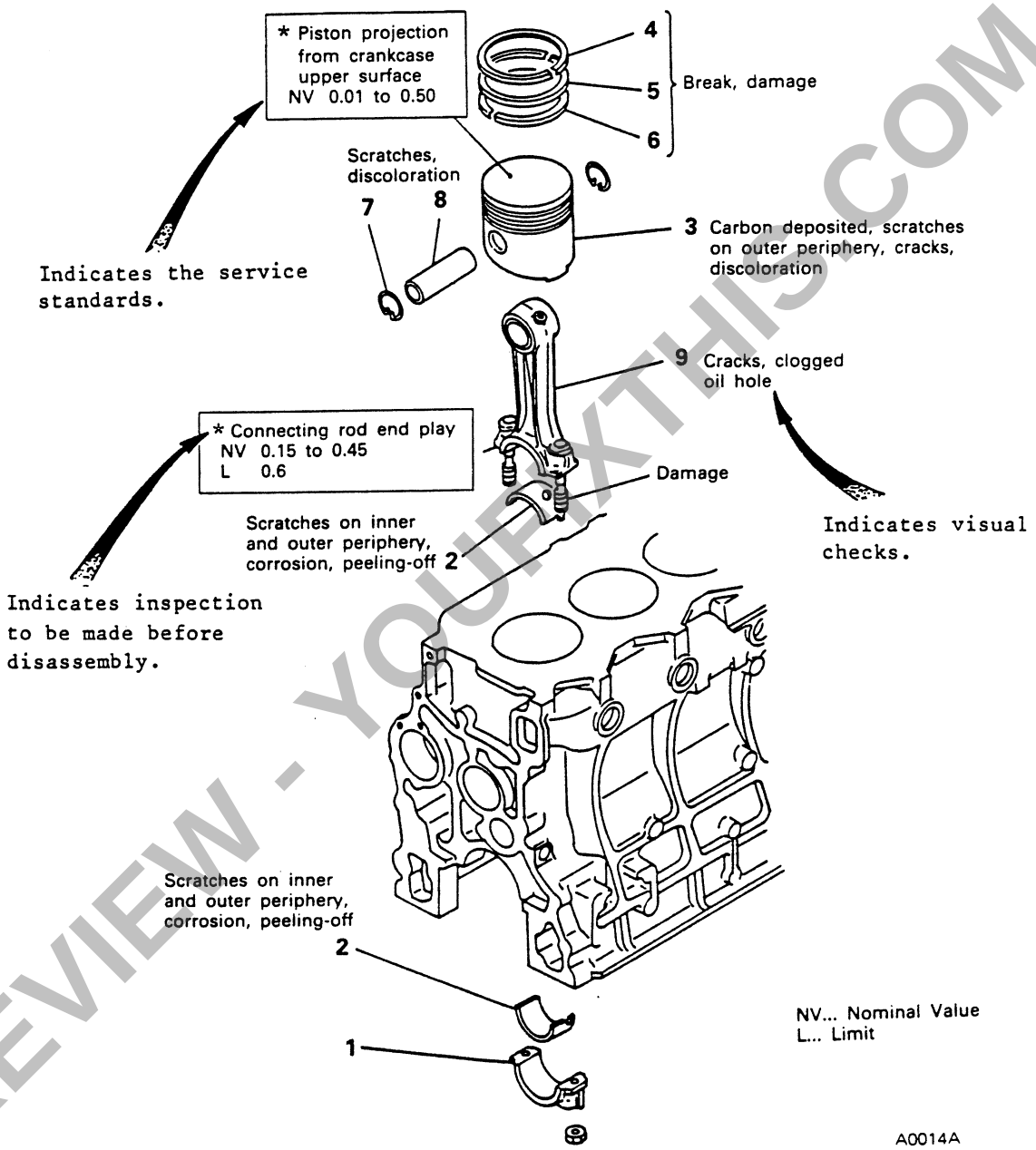
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5. Reading the Illustration

(Ex. 1: Disassembly and Inspection)



Numbers assigned indicate a typical disassembly sequence.

1 Connecting rod cap	④ 1st compression ring	7 Snap ring
2 Connecting rod bearing	⑤ 2nd compression ring	8 Piston pin
3 Piston	⑥ Oil ring	9 Connecting rod

Indicates that the disassembly procedure is explained in the text.

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FOREWORD

This shop manual contains the specification, construction, operation, adjustment and service procedures of the Model **4D31, 4D31-T, 4D30, 4DR5, 6DR5** diesel engine for service mechanics engaged in servicing of the Mitsubishi diesel engines.

Please make the most of this shop manual to perform correct servicing and wasteless operations.

Note that some of the contents of this shop manual are subject to change owing to improvements, etc. that may be introduced after publication of this shop manual.

Applicable Engine Models

4D31 4D31-T 4D30 4DR5 6DR5	For industrial use

Applicable Engine No.

4D31-472830 and up <4D31>
4D31-473044 and up <4D31-T>
4D30-475518 and up
4DR5-783628 and up

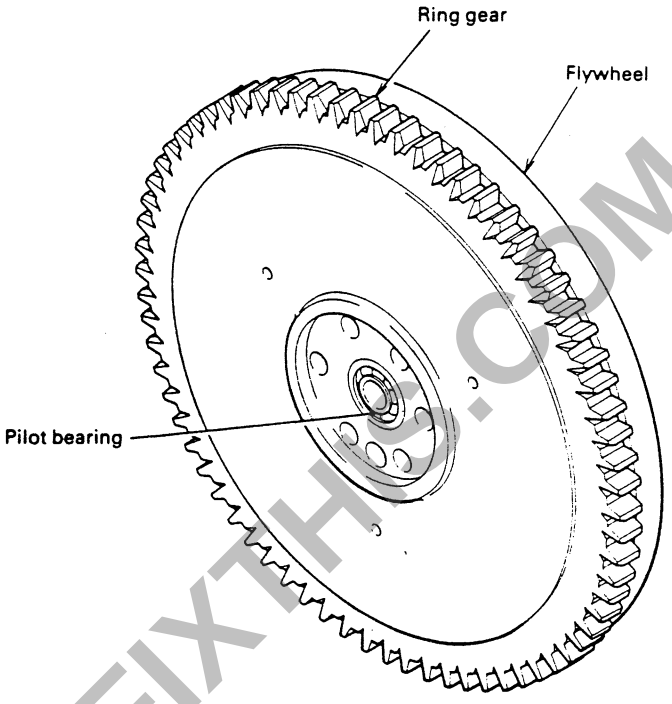
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(8) Flywheel

The flywheel is made of cast iron. The pilot bearing of the transmission drive pinion is installed at its center. On its periphery, the ring gear is shrink-fitted that meshes with the starter pinion.

The ring gear tooth crests are induction-heardened for greater durability. At the same time, one side of the crests is chamfered to ensure that the starter pinion meshes easily when starter is operated.



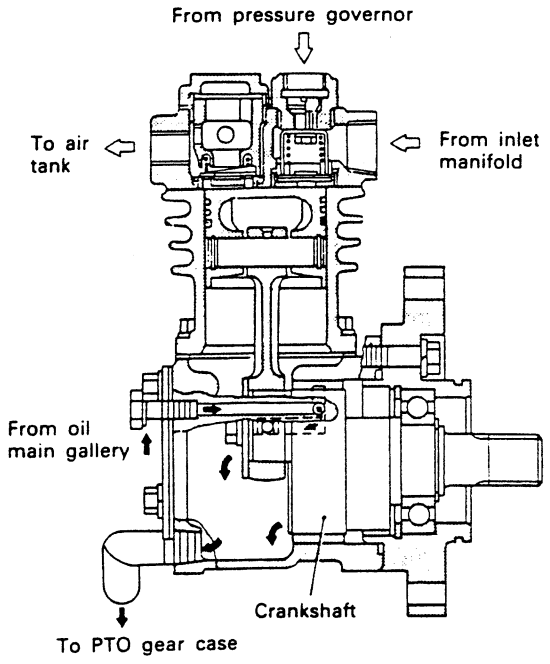
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1–2 Air Compressor <Option: 4D31>

The air compressor is installed on the flywheel PTO gear cover at the rear of the engine and is driven by the crankshaft that is in mesh with the PTO shaft.

The piston is made of aluminum alloy and carries two compression rings and one oil ring.

The bearings are lubricated by engine oil supplied from the oil main gallery through oil pipe and oil hole of the crankshaft. The cylinder liner and the connecting rod small end are splash lubricated by rotation of the crankshaft. Excess oil is returned to the oil pan from the crankcase end through an oil pipe and the PTO gear case.



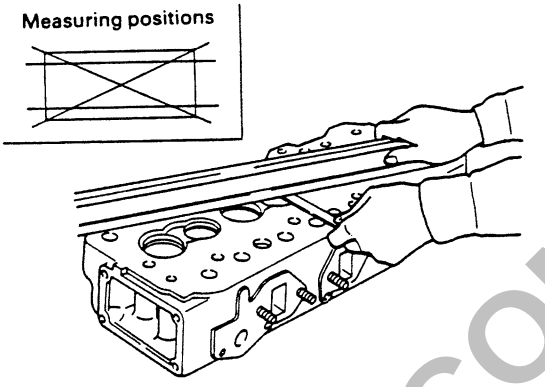
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4) Cylinder head bottom surface distortion

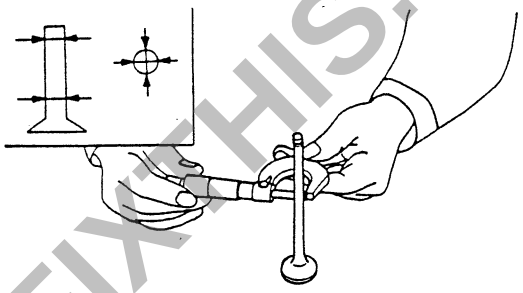
If the limit is exceeded, correct with a surface grinder.

If the cylinder head height from top to bottom surface is below the limit, replace.

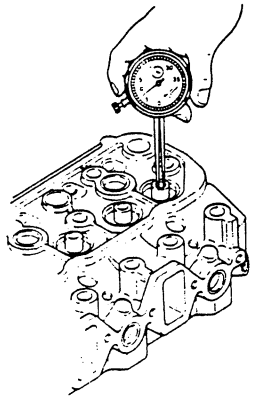


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5) Measure the valve stem O.D. and, if the measurement is below the limit, replace.


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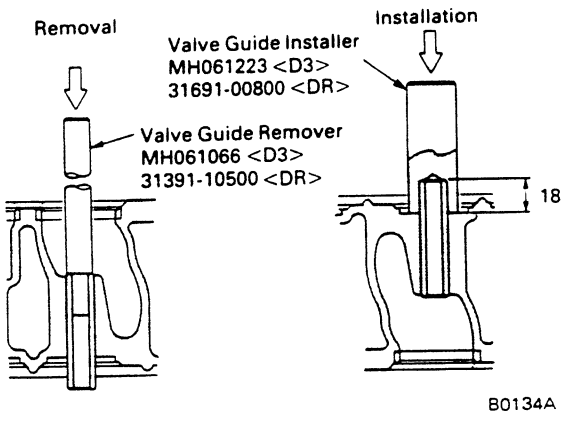
6) Calculate the clearance with the valve guide I.D. and valve stem O.D. If the limit is exceeded, replace the valve guide.


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7) Replacement of valve guide

For removal of the valve guide, use the Valve Guide Remover (special tool).

To install, use Valve Guide Installer (special tool) and ensure that the special tool is positively seated on the cylinder head. The pressing force is specified for the valve guide, which must be reached by using the special tool.



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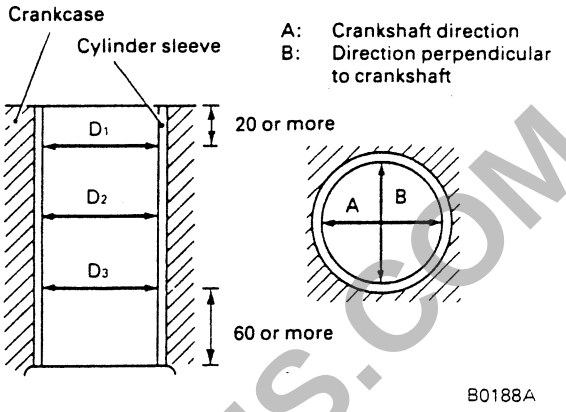
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(a) Measurement of cylinder sleeve I.D.

Measure the cylinder sleeve I.D. at the six points shown in illustration.

If the I.D. exceeds the limit, replace or bore to oversize.

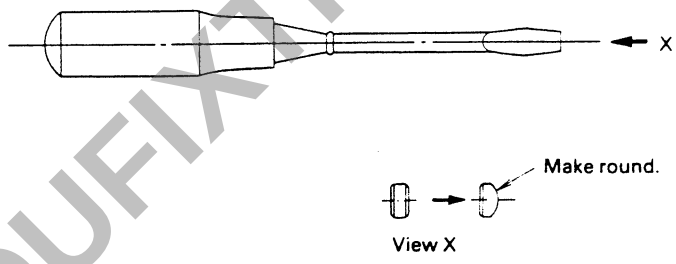
If the cylinder sleeve is to be used without being bored, correct the ring ridge wear at its top by grinding with a ridge reamer.



(b) Replacement of cylinder sleeve

1) Removal

a) With a boring machine fixed in the crankcase, center the machine. Make sure that the machine is centered at the bottom of the cylinder sleeve which develops uneven wear least.



b) Bore until the wall thickness is reduced down to approximately 0.5 mm.

c) Insert a screwdriver (machined as illustrated) between the crankcase and cylinder sleeve. Tap the screwdriver to break and remove the sleeve.

Make sure that the rounded part of the screwdriver faces to the case.

2) Installation

After the cylinder sleeve has been removed, check the crankcase sleeve hole for damage and proper interference.

If defects are evident, bore the crankcase sleeve hole.

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GROUP 12 LUBRICATION

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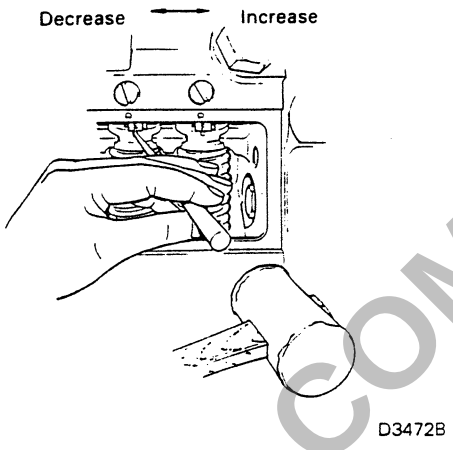
<DR>

Item		Specification	
		<4DR5> (Nippondenso products)	<6DR5> ←
Injection pump proper	Type	BOSCH A	←
	Model	ND-PES4A65	ND-PES6A65
Turning direction (As viewed from drive side)		Clockwise	←
Plunger	Diameter	6.5 mm	←
	Lead	R.H. single-step	←
Governor	Type	RSV, all speed mechanical or RU, minimum-maximum mechanical, MZ, all speed, pneumatic	RSV, all speed mechanical
Feed pump	Model	ND-FP/KS22AC	←
Auto-timer	Type	SCZ, mechanical	← <Option>
Injection nozzle	Type	Throttle	←
	Model	ND-DNOSD2110	ND-DN4SDND62
	No. of orifices	1	←
	Orifice diameter	1.00 mm	←
	Orifice angle	0°	4°
	Injection pressure	11.8 MPa (120 kgf/cm^2)	←
Fuel filter	Type	Spin-on, filter paper	
Water separator <Option>	Type	Sediment trap	
Secondary fuel filter <Option>	Type	Filter paper	

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(8) Adjustment of Fuel Injection Rate



Measure the fuel injection rate and uneven ratio with the specified rack position and speed.

If the injection rate is out of specification, adjust as follows.

- Slightly back off the pinion clamp screw.
- With the control rack fixed at a position, turn the control sleeve with the adjusting rod.
- Tighten the pinion clamp screw.

NOTE: 1. Use special care to make the correct adjustment. Improper or failure of adjustment greatly affects engine performance.

2. Observe measurement conditions strictly, as the fuel injection rate varies with different nozzle and pipe used.

3. Uneven ratio = Max. injection rate in each cylinder - Min. injection rate in eacy cylinder.

(9) Adaptation to Engine

After the governor has been adjusted, measure the fuel injection rate adaptable to the engine.

(10) Inspection of Fuel and Oil Leaks

Check the delivery valve mounting position and other parts for fuel leak.

Check oil seals and other parts for oil leak.

(11) Inspection of Unusual Conditions

Check for unusual noise, heat, and other abnormal conditions.

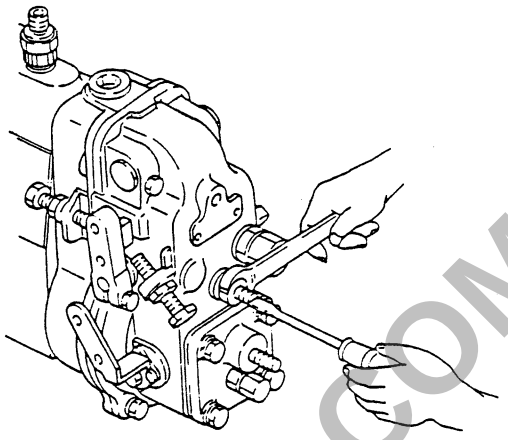
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(b) Adjustment of idling subspring

Adjust the idling subspring so that the rack is positioned at Rh when the pump is running at a speed of Nh.

Then, decrease the pump speed and check that the rack is positioned at Rg at the pump speed of Ng.



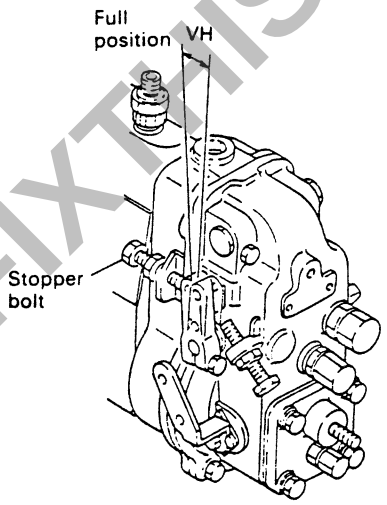
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(6) Adjustment of High Speed Control

(a) Adjustment of maximum speed stopper

Tilt the adjusting lever and set the maximum control speed of the governor.

Tilt the adjusting lever and adjust the maximum speed stopper so that the control rack is moved from the Rc position when the pump speed increased slowly from Nc reaches Nd.



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(b) Adjustment of speed variation rate

Increase the pump speed from Nd and check to see that when the speed reaches Ne, the rack position is pulled back to Re.

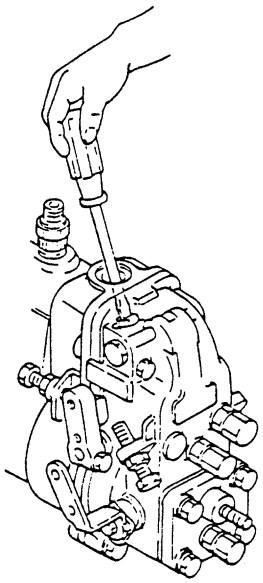
If it is out of specification, adjust the amount the adjusting screw of the swivel lever is turned down.

Tightening the screw will improve the speed variation rate.

Loosening it will worsen the speed variation rate.

Speed variation rate

$$= \frac{Ne - Nd}{Nd} \times 100\ (\%)$$



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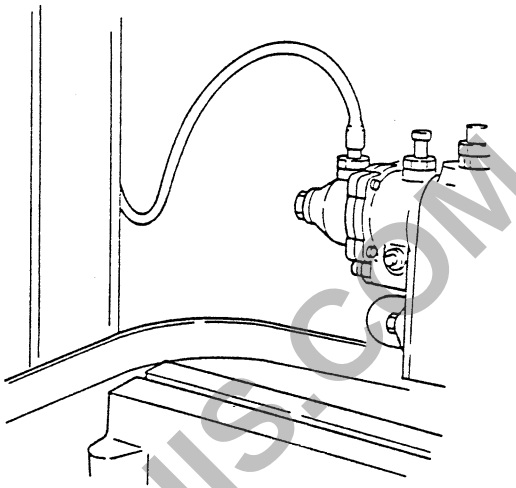
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(3) Air Tightness Test

With the negative pressure in the negative pressure chamber set to 500 mmAq, measure the time taken for the pressure to reach 480 mmAq, which should be 10 seconds or more.

If not air tight, tighten the housing again or check the diaphragm.

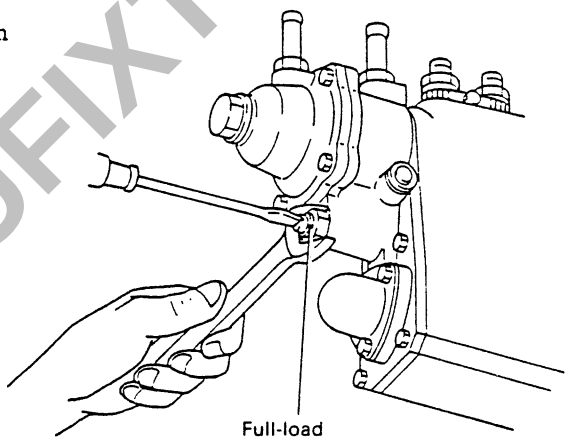


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(4) Adjusting Main Spring

(a) Adjusting initial rack position

Adjust the full-load spring capsule so that the rack position becomes R_1 at negative pressure P_1.



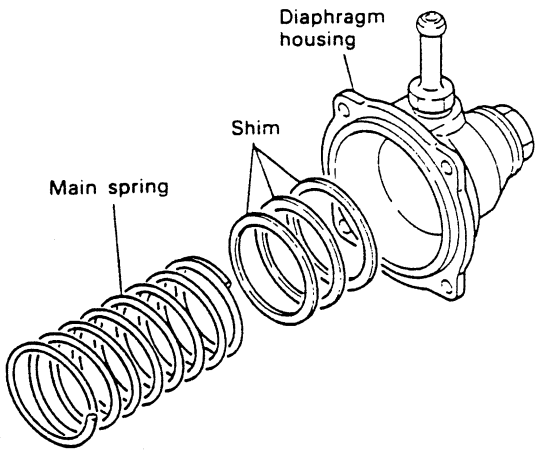
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(b) Check that the rack position is R_1 at negative pressure P_2 and it is R_2 at negative pressure P_3. If not, adjust the number (thickness) of shims of the main spring.

Shim Thickness

0.5, 1.0, 2.0, 3.0 mm

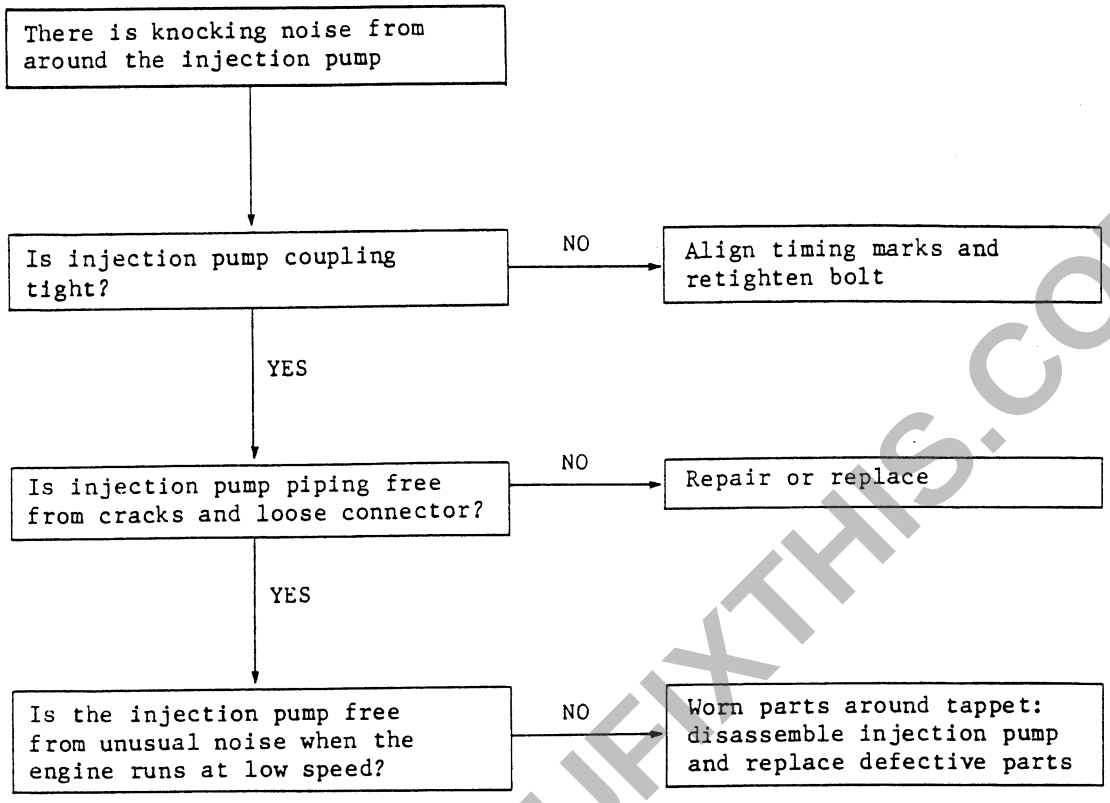
NOTE: After adjustment, check the initial rack setting again.



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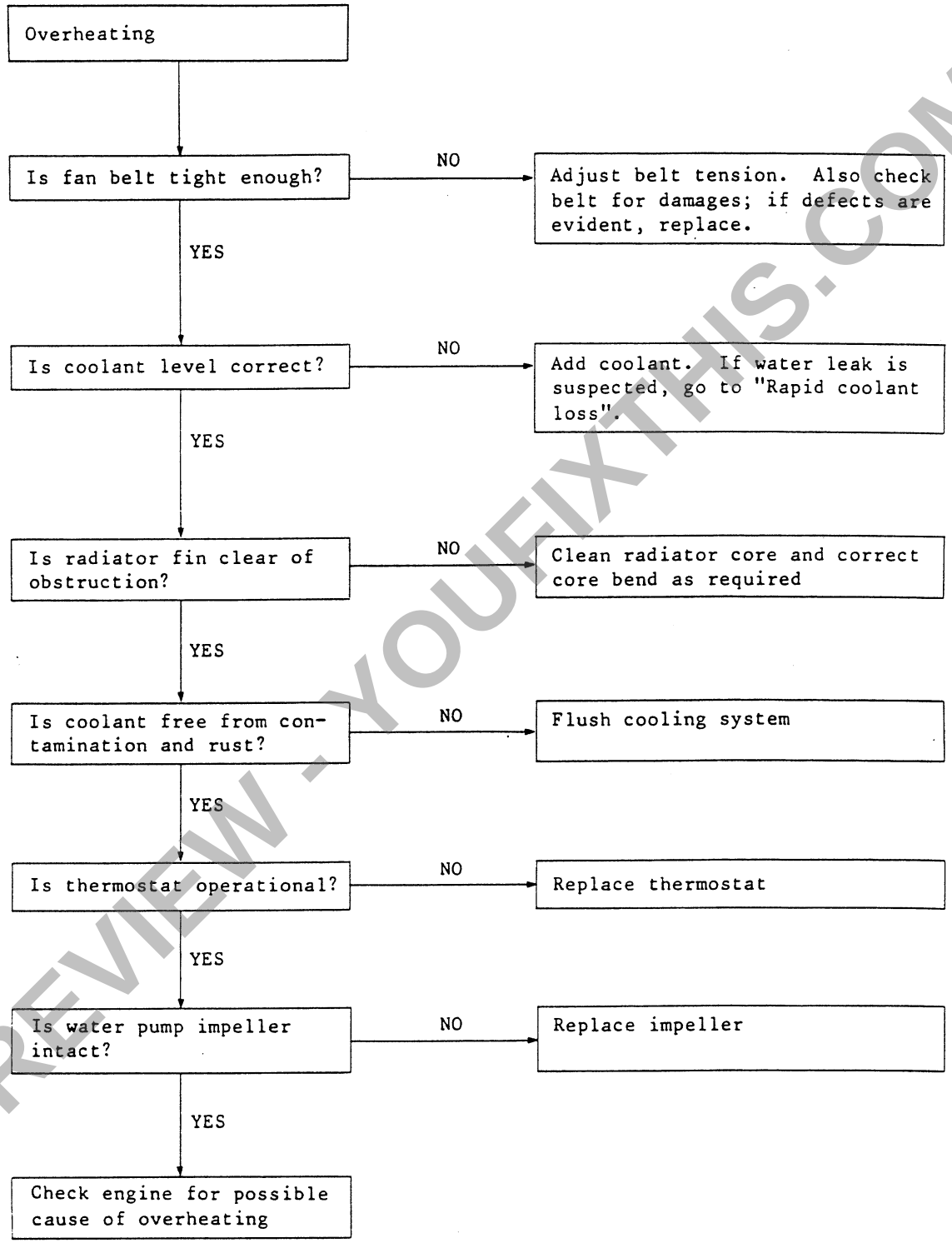
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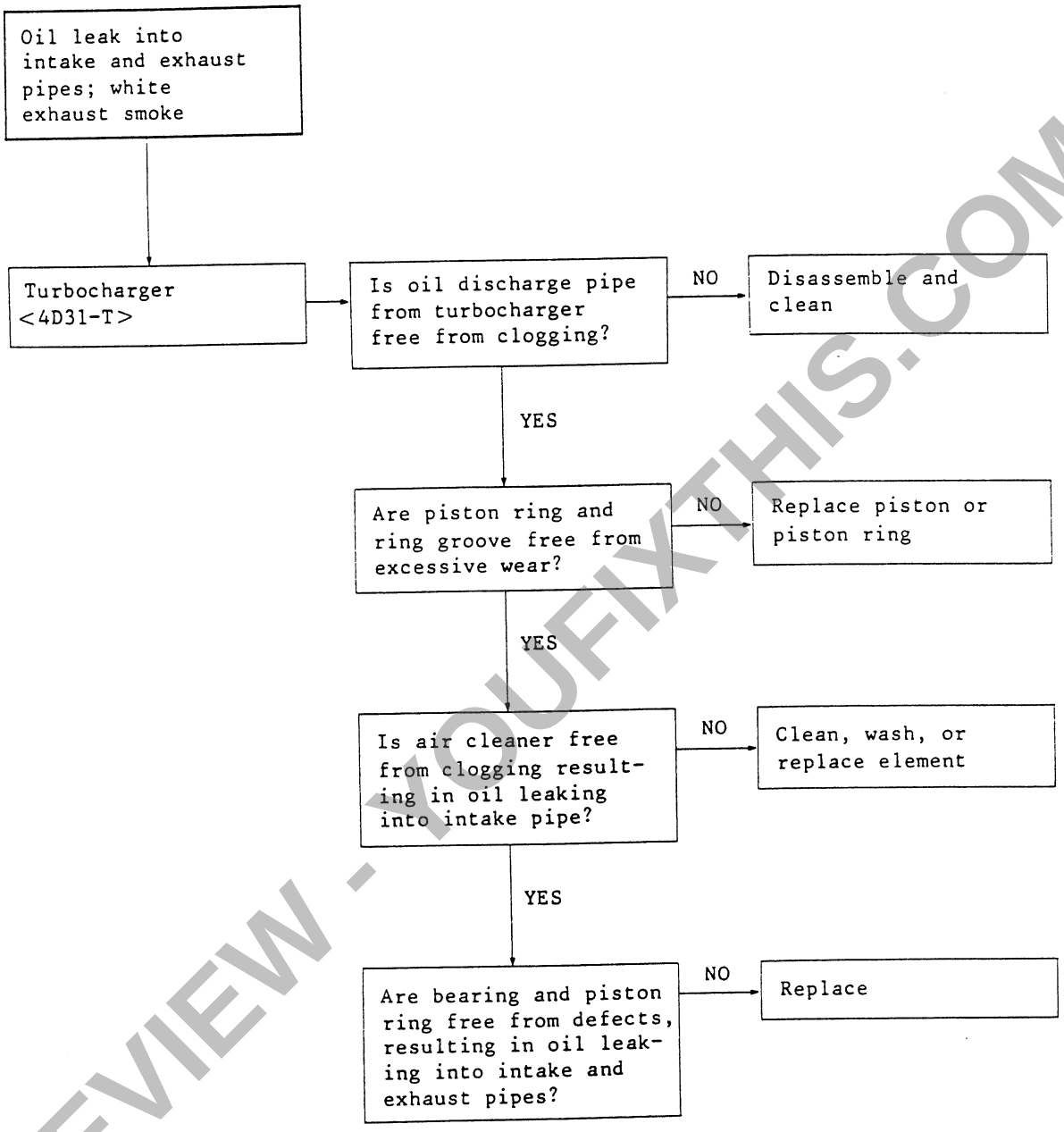
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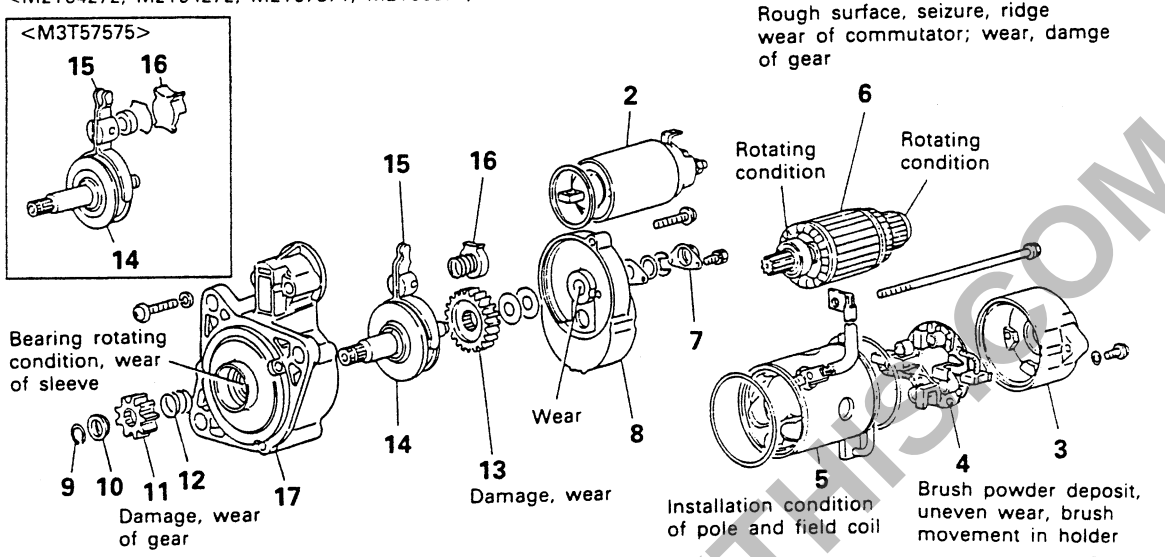
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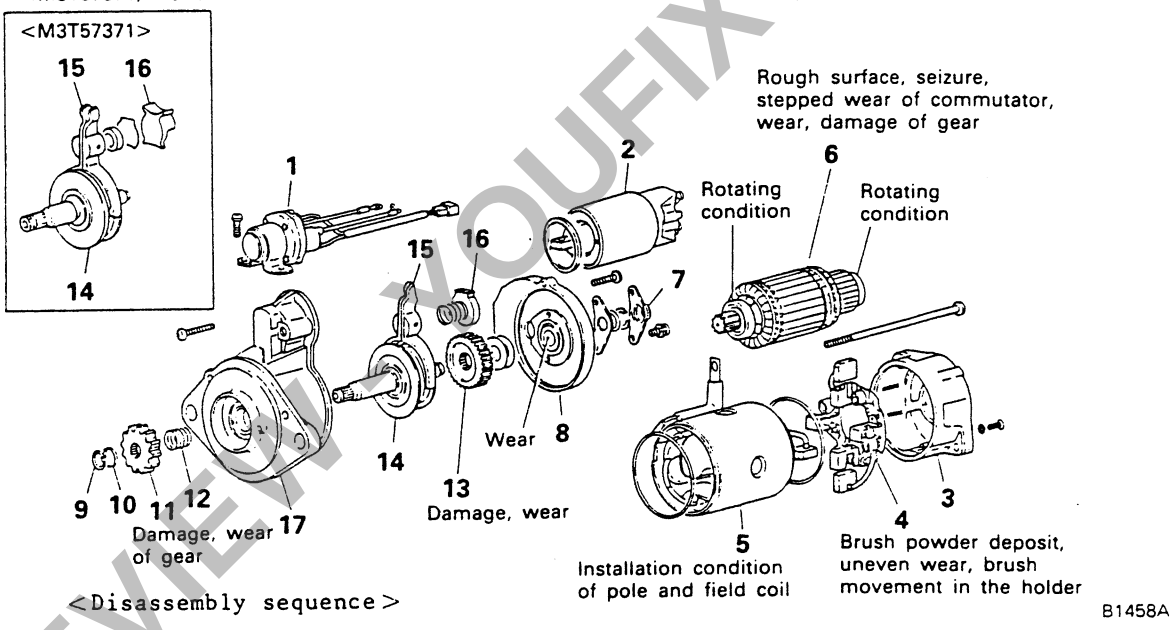
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<M2T64272, M2T54272, M2T67871, M2T56871, M3T57575>



<M3T57371, M3T66871>



<Disassembly sequence>

1	Starter relay <M3T57371, M3T66871>	7	Cover	14	Pinion shaft
2	Magnetic switch	8	Center bracket	15	Lever assembly
3	Rear bracket	9	Ring	16	Spring set <Except M3T57575, M3T57371> Packing <M3T57575, M3T57371>
4	Brush holder	10	Pinion stopper		
5	Yoke	11	Pinion		
6	Armature	12	Spring	17	Front bracket
		13	Gear		

For disassembly of parts with an encircled number, see following items.

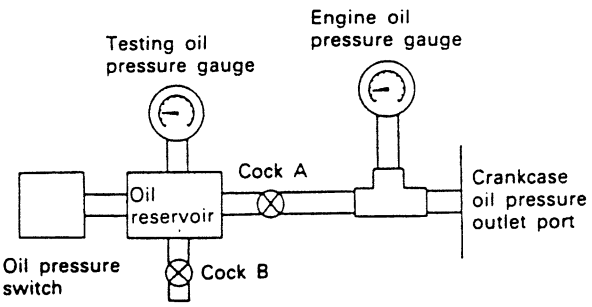
NOTE: 1. Do not remove the bearings on both ends of the armature unless defective.

2. Note the installed direction of the lever to avoid wrong reassembly.

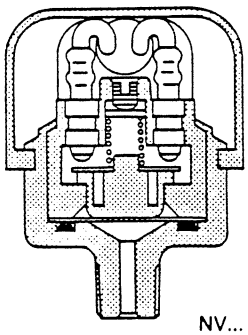
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(4) Oil Pressure Switch



D9560A



NV... Nominal Value

Operating pressure
NV 79 to 118 kPa
(0.8 to 1.2 kgf/cm²) or less

D9565A

Connect the pipes as shown above, close the cocks A and B, and start the engine. After the oil pressure has risen, fully open the cock A to lead the oil pressure to the oil pressure switch. Then close the cock A to shut off the oil passage to the engine and hold the oil pressure directly in the oil reservoir.

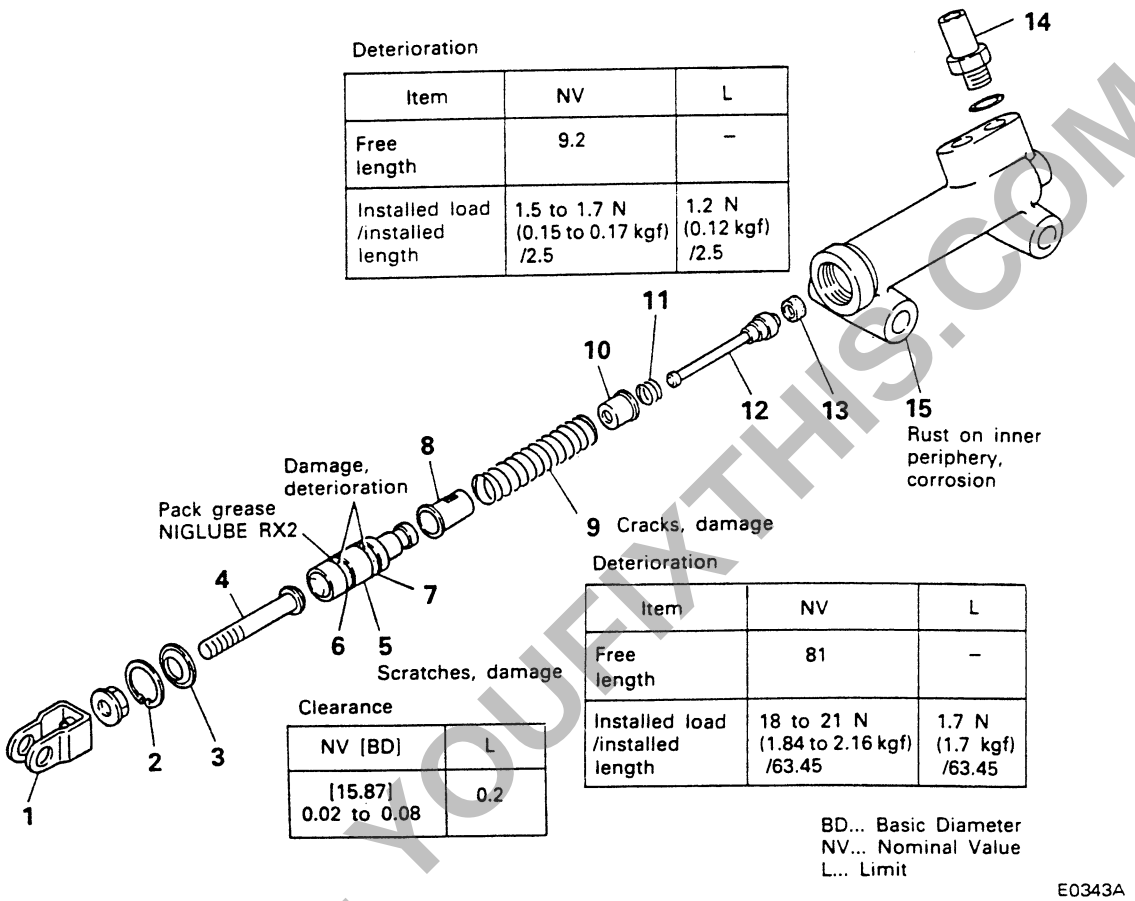
Slowly open the cock B to lower the oil pressure and check the oil pressure switch operating oil pressure with the test oil pressure gauge.

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5-2-2 Clutch Master Cylinder

(1) Disassembly and Inspection



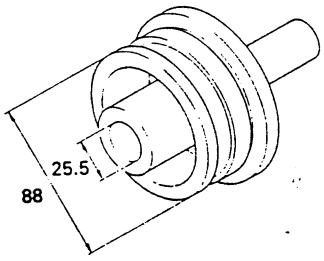
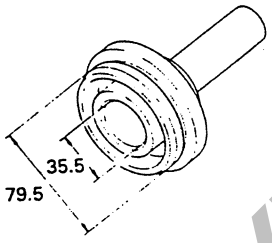
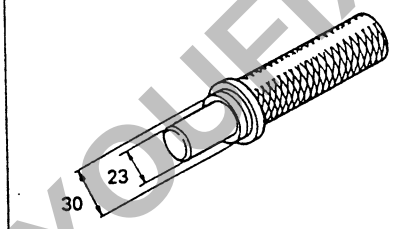
<Disassembly sequence>

1	Clevis	6	Secondary cup	11	Valve spring
2	Circlip	7	Pressure cup	12	Valve stem
3	Stopper	8	Spring seat	13	Valve seal
4	Push rod	9	Return spring	14	Union
⑤	Piston	10	Valve case	15	Master cylinder body

For disassembly of parts with an encircled number, see following items.

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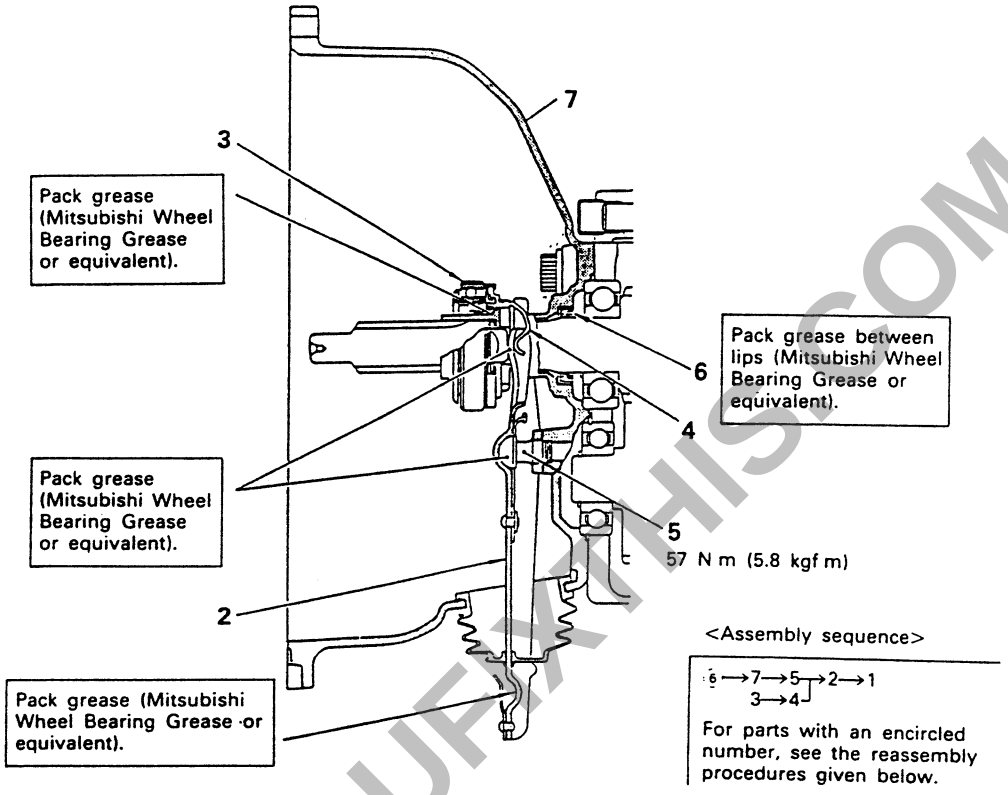
Tool name	Part No.	Shape (Unit: mm)	Use
Drive pinion dummy bearing	MH061317	 F0061A	For main shaft bearing
Counter shaft dummy bearing	MH061318	 F0060A	For counter shaft
Installer	03726-83000	 F0003A	For removal and installation of clutch housing needle roller bearing

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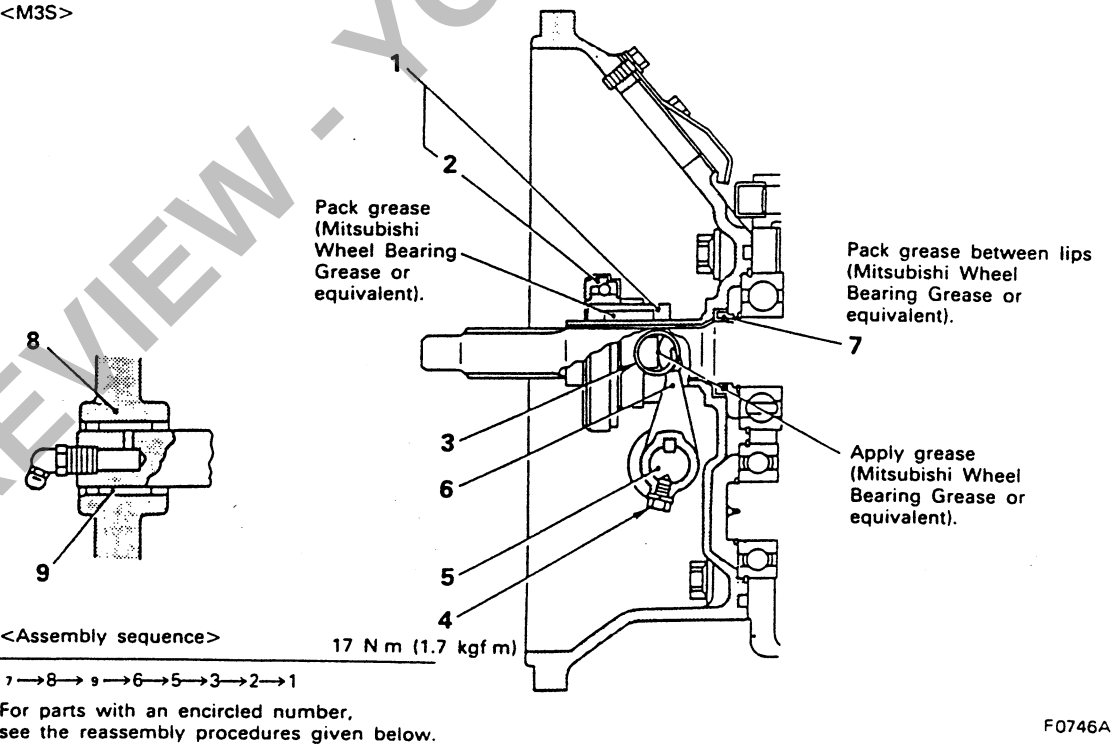
(2) Reassembly

<M2S>



F0591B

<M3S>



F0746A

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