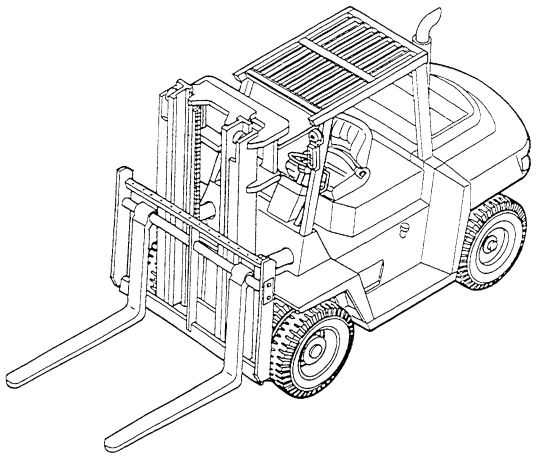
MITSUBISHI
FORKLIFT TRUCKS

SERVICE MANUAL

DIESEL ENGINE

6D16 687548-UP

for FD80 F32-00011-UP
FD90 F32-50001-UP

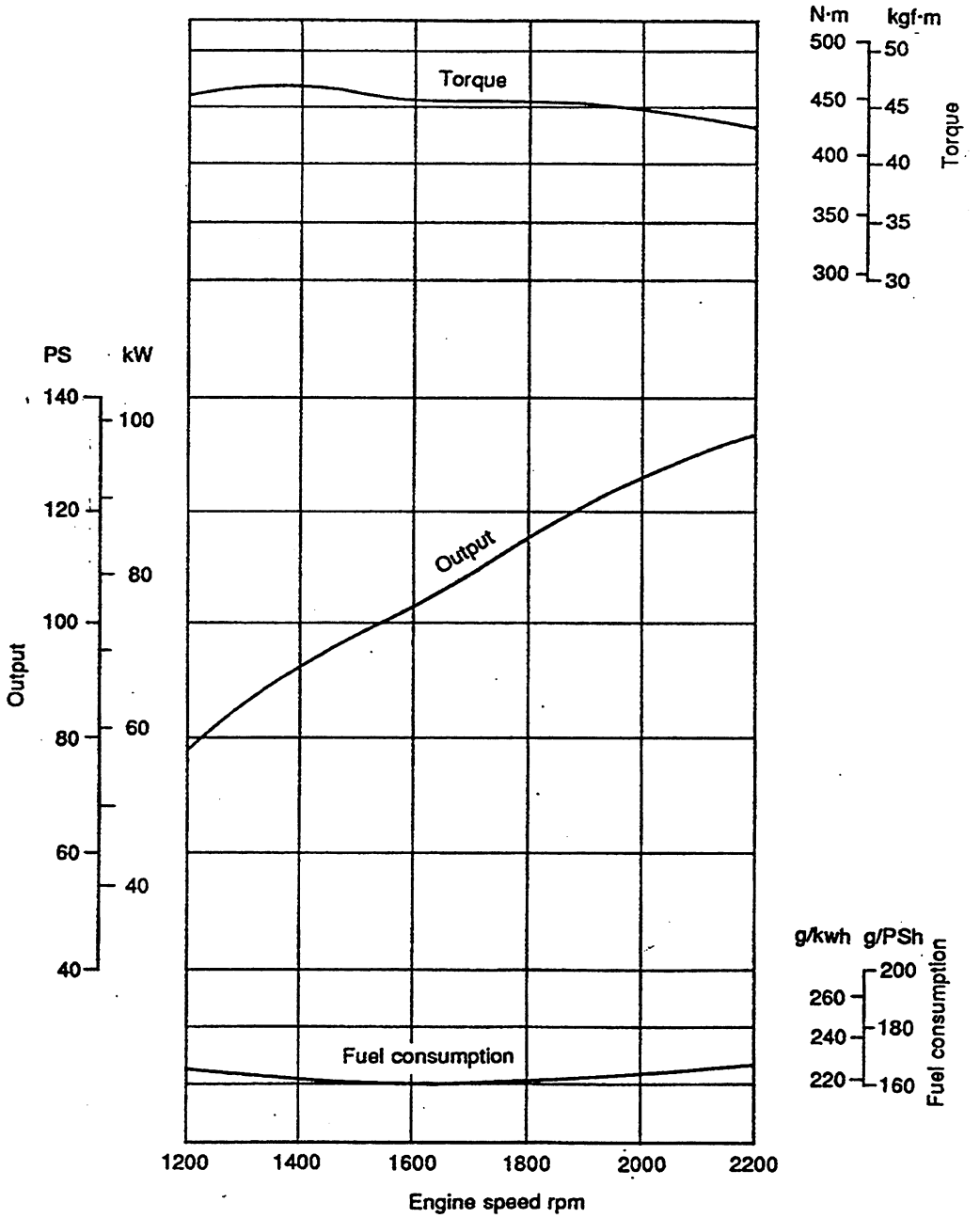


Quality Makes the Difference

Jan. 1994

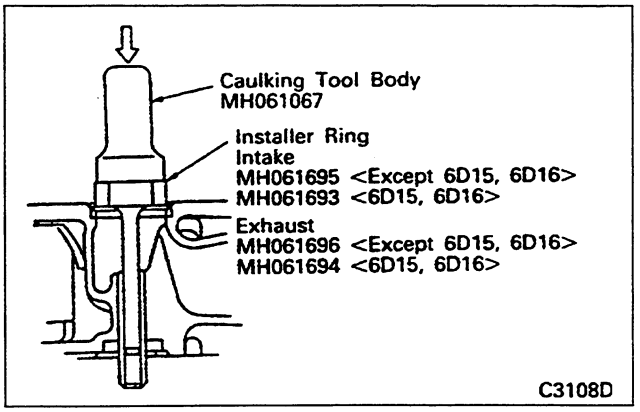
2.1.2 Performance Curves for 6D16

These curves show torque, output and fuel consumption of the engine complete with air cleaner and alternator (without fan and muffler) and corrected to temperature of 25°C, barometer reading of 750 mmHg (100 kPa) and partial vapor pressure of 7.5 mmHg (1 kPa). The curves are made in conformity to JIS D 1005 — 1986.

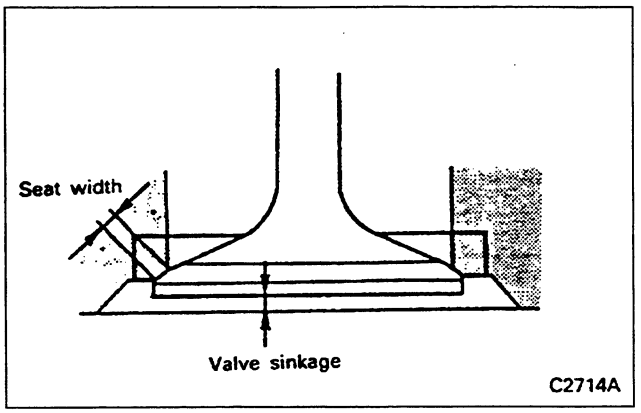


Unit: mm

Maintenance item			Nominal value (Basic diameter in [ ])	Limit	Remedy and remarks
Piston ring to ring groove clearance	1st	6D14	0.09 to 0.13	0.2	Replace piston ring
		6D14-T, 6D15-T (Type B), 6D16-T	0.05 to 0.10	0.15	
		6D15	0.13 to 0.18	0.2	
		6D15-T (Type A)	0.10 to 0.15		
		6D16	0.11 to 0.15		
	2nd	6D14, 6D15 6D15-T (Type A) 6D16	0.05 to 0.08	0.15	
		6D14-T, 6D15-T (Type B), 6D16-T	0.07 to 1.10		
	Oil ring		0.03 to 0.06	0.15	
Piston ring end gap	1st	6D14, 6D14-T 6D15-T (Type B)	0.3 to 0.45	1.5	Replace piston ring
		6D15, 6D15-T (Type A)	0.3 to 0.5		
		6D16, 6D16-T	0.35 to 0.55		
	2nd	6D14	0.3 to 0.5	1.5	
		6D14-T, 6D15 6D15-T	0.3 to 0.45		
		6D16, 6D16-T	0.35 to 0.55		
	Oil ring	6D14, 6D14-T 6D15, 6D15-T	0.3 to 0.5	1.5	
		6D16, 6D16-T	0.35 to 0.55		
Bend and torsion of connecting rod			-	0.05	Correct or replace
Distortion of crankcase upper surface			0.07 or less	0.2	Grind if it is slight
Cylinder liner	Projection of flange		0.03 to 0.10	-	Replace
	I.D.	6D14, 6D14-T	110 to 110.035	110.25	Correct to oversize or replace
		6D15, 6D15-T (Type A)	113 to 113.035	113.25	Replace
		6D15-T (Type B)	113 to 113.03		
		6D16, 6D16-T	118 to 118.03	118.25	
	Cylindricity	6D14, 6D14-T 6D15, 6D15-T	0.02 or less	-	Correct or replace
		6D16, 6D16-T	0.03 or less	-	
Connecting rod bearing	Oil clearance		[65] 0.06 to 0.11	0.2	Replace
	Tension at free		-	Less than 69.5	
Main bearing	Oil clearance		[80] 0.05 to 0.10	0.15	Replace
	Tension at free		-	Less than 85.5	
Valve clearance			0.4	-	Adjust (on cold engine, both intake and exhaust valves)



d) Using Caulking Tool Body and Installer Ring (special tools), install the valve seat.

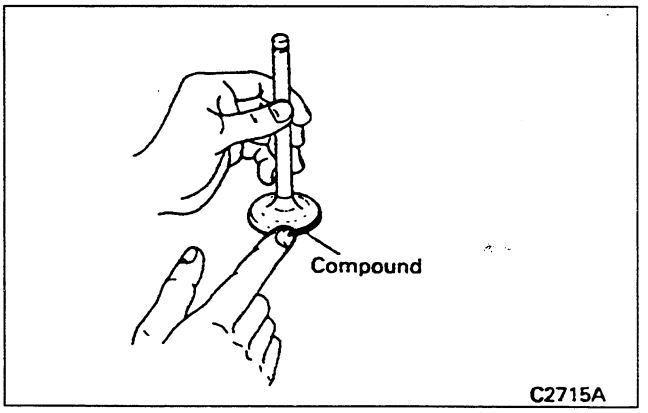


e) Reface the valve seat to obtain the nominal values for the seat width and valve sinkage.

12) Lapping the valve and valve seat

The valve and valve seat must be in even contact on all surfaces.

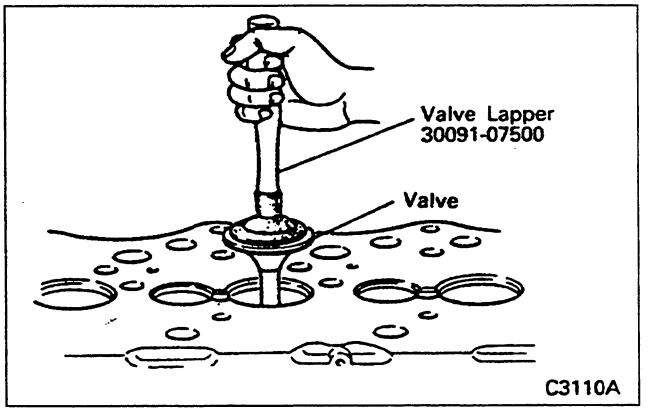
Whenever the valve or valve seat is corrected or replaced, they must be seated.



a) Apply a thin coat of compound evenly to the seating surface of the valve .

NOTE

1. Make sure that there is no compound on the stem of the valve.
2. Use intermediate mesh compound (120 to 150 meshes) first and then use fine mesh compound (200 meshes or more) for the finish.
3. By mixing the compound with a small amount of engine oil, the compound can be applied evenly.



b) Using Valve Lapper (special tool), seat the valve on the valve seat.

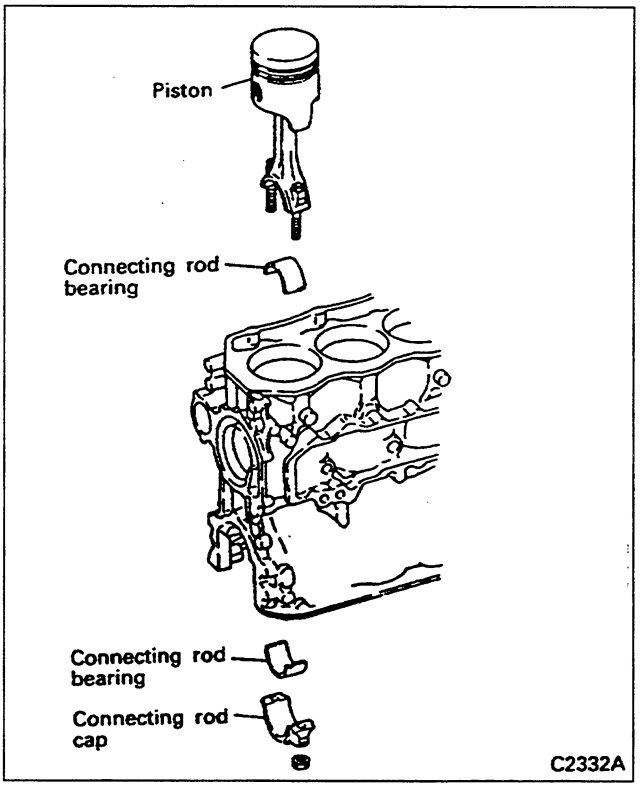
While turning the valve slightly each time, strike it against the valve seat.

c) Wash off the compound with gas oil or similar substance.

d) Seat the contact surfaces with engine oil.

e) Check if they are properly seated.

(d) Removal of piston

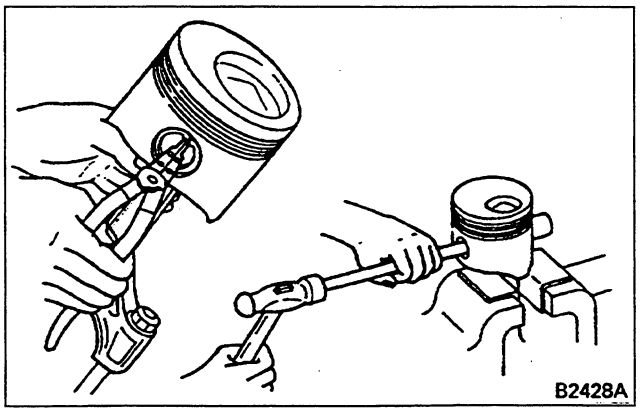


Withdraw the piston from the crankcase, pushing it up together with the connecting rod.

NOTE

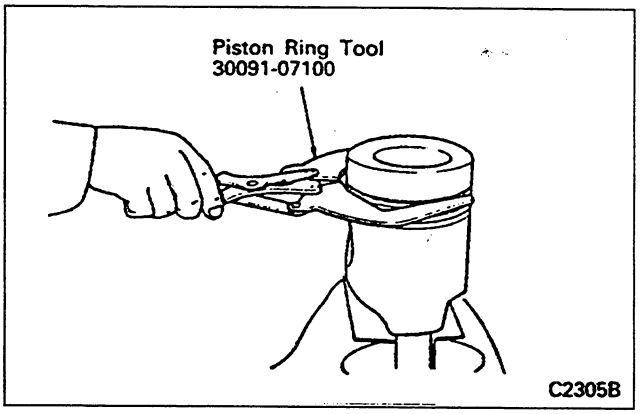
1. If the piston pin is hard to remove, heat the piston with a piston heater or hot water.
2. Do not remove the connecting rod bolts from the connecting rod unless defective. If the bolt is damaged, install a new connecting rod bolt by referring to Item (3) - (d), Section 5.1.4

(e) Separation of piston and connecting rod from each other



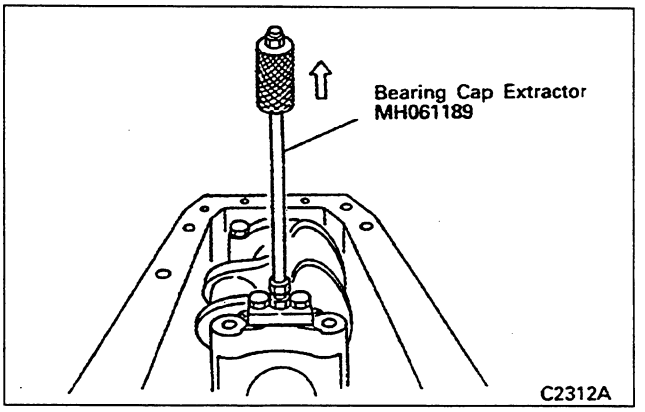
Remove the snap ring and remove the piston pin by hammering with a rod in between. If the piston pin is hard to remove, heat it with a piston heater or in hot water.

(f) Removal of piston ring



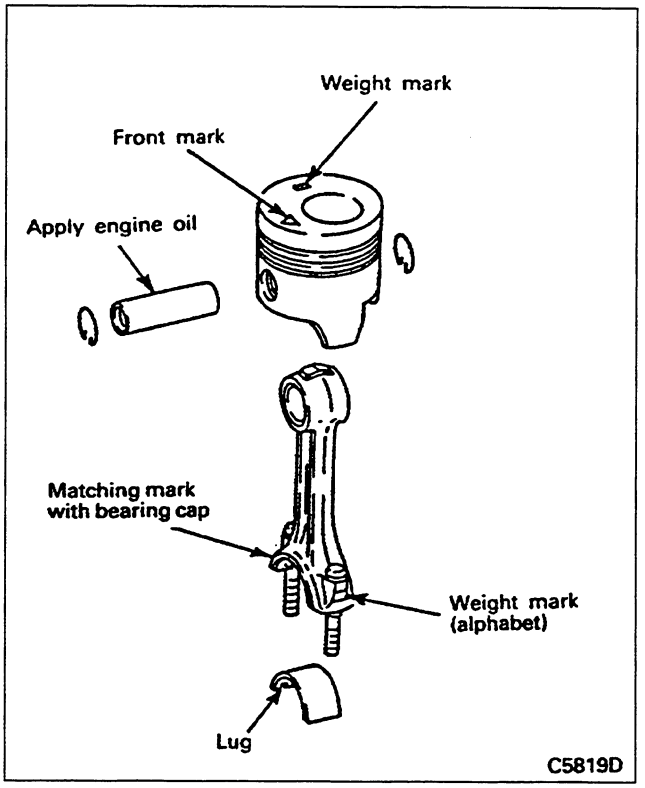
To remove the piston rings, use Piston Ring Tool (special tool).

(g) Removal of main bearing cap



To remove the main bearing cap, use Bearing Cap Extractor (special tool).

(d) Reassembly of piston and connecting rod

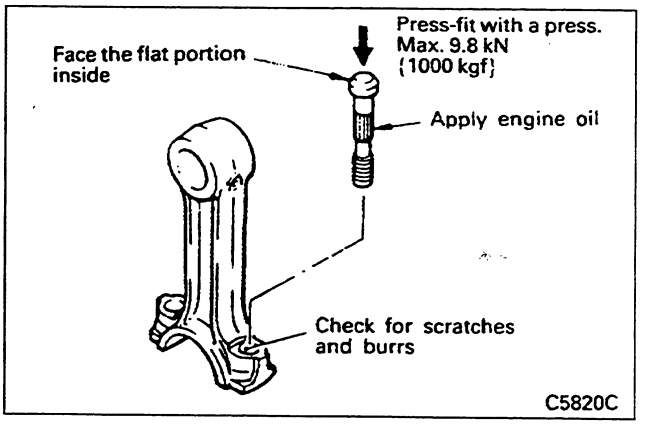


1) Assemble the piston and the connecting rod ensuring correct direction as illustrated.

2) Insert the piston pin to couple the piston and connecting rod. Mount the snap ring to hold the piston pin in position. The piston pin is a clearance fit in the piston. If the piston pin is hard to fit, however, heat the piston with a piston heater or hot water.

NOTE

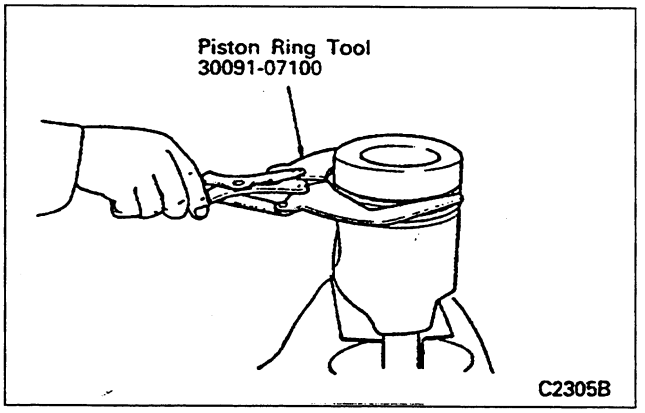
1. Keep the piston weight difference for one engine within 10 g.
2. Use connecting rod assembly of same weight mark for an engine.
3. Check to see that the size mark of the piston is same as that of the cylinder liner.
4. Apply engine oil to sliding surfaces.



3) The connecting rod bolts do not normally need removal; however, where replacement is necessary for damaged bolt, install new bolts by using the following procedures.

Make sure that the connecting rod bolt hole is free from damage and burrs. Then, with engine oil applied to the connecting rod bolt, press it into position with a press. [Pressing load: Max. 9.8 kN {1000 kgf}]

(e) Installation of piston rings

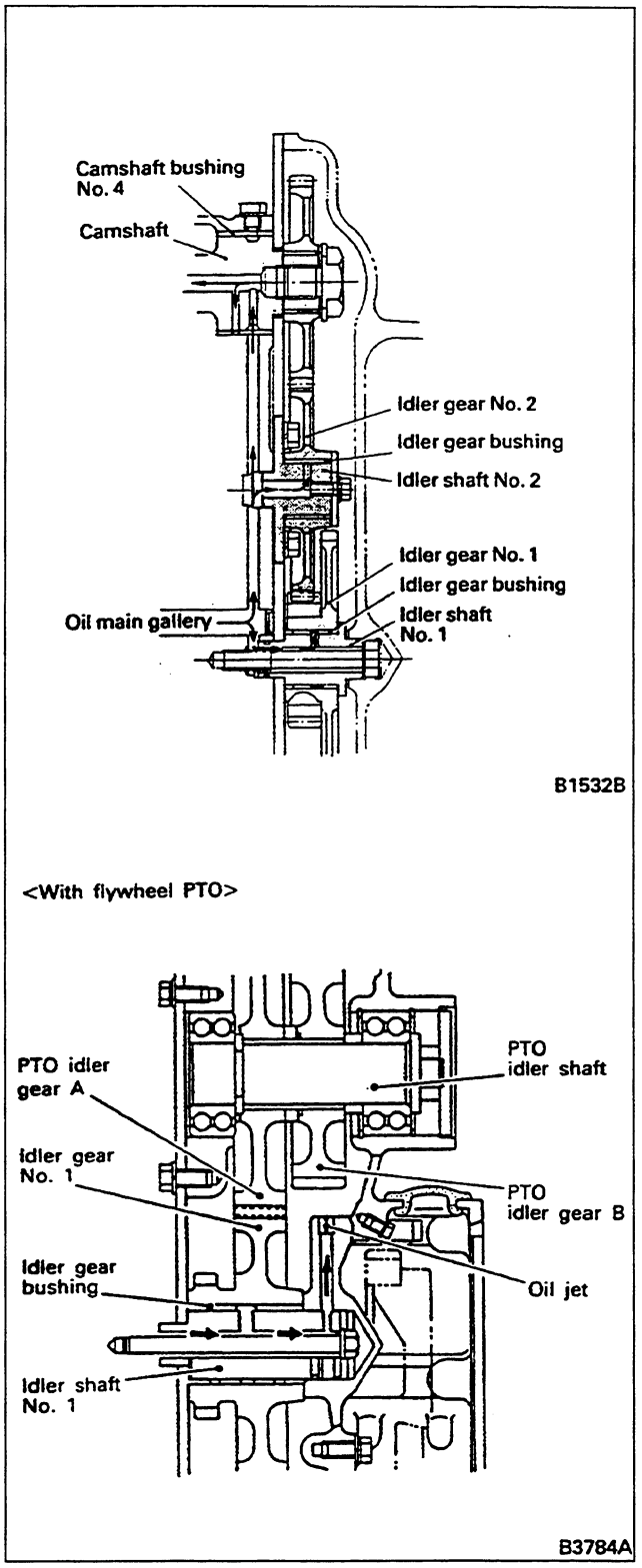


To install piston rings, use Piston Ring Tool (special tool).

NOTE

A manufacturer's mark is stamped near the piston ring ends. Install with the mark up.

(b) Timing gear and camshaft

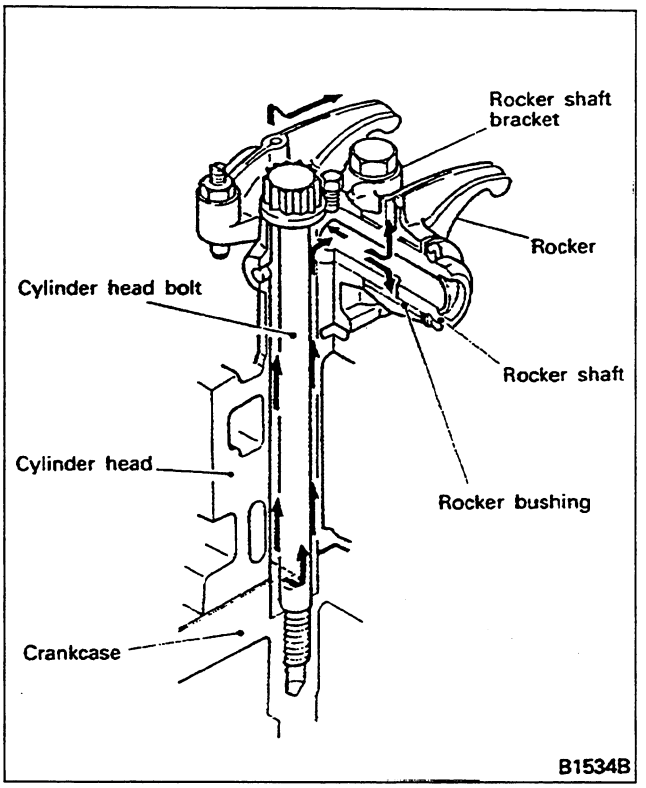


Oil from the main gallery also flows through the oil holes to bushings for timing gear lubrication.

As for lubrication of the camshaft bushing, the oil from the main gallery lubricates camshaft bushing No. 4 and flows through the oil hole in camshaft axial direction to lubricate other camshaft bushings.

In the case of engine wit flywheel PTO, oil flows through the oil hole in the flywheel housing to lubricate the PTO idler gear B from he oil jet.

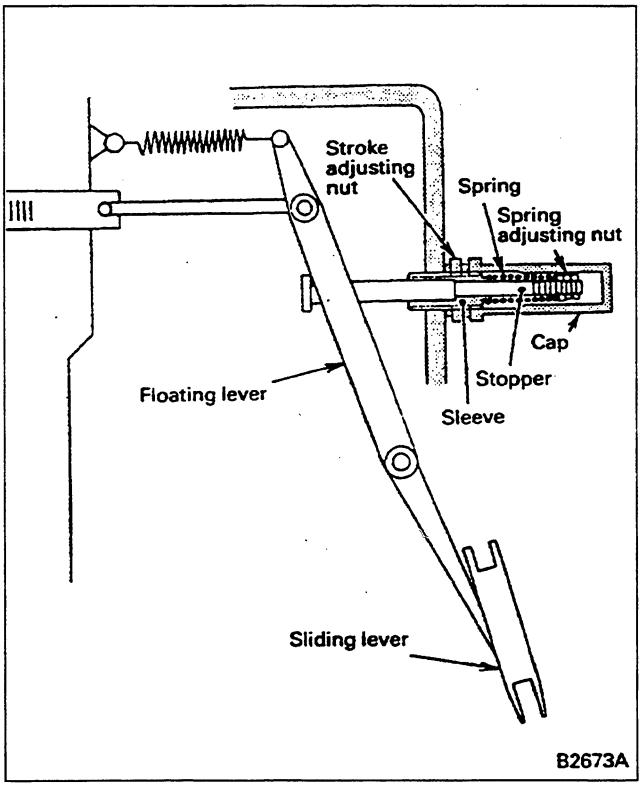
(c) Valve mechanism



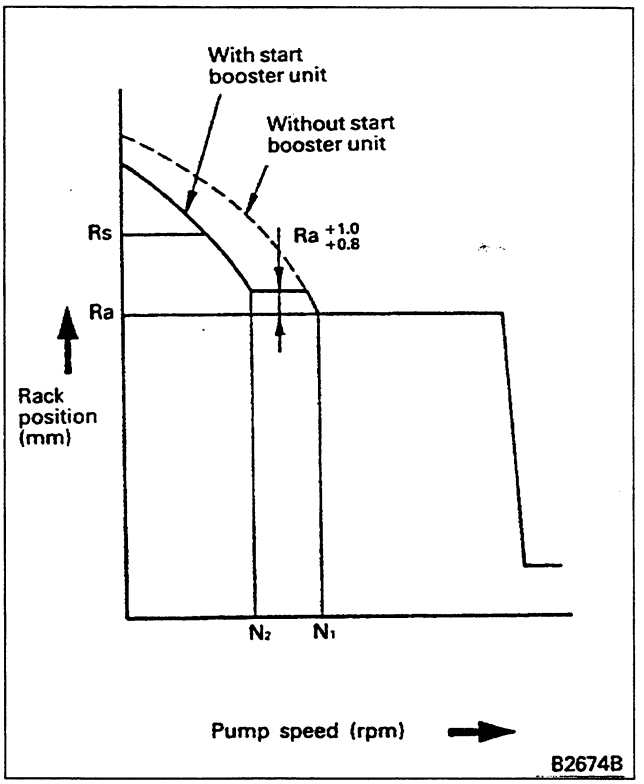
Rocker bushing is lubricated by engine oil from camshaft bushing No. 4. Engine oil flow is as follows: camshaft bushing No. 4 ⟶ oil holes to cylinder head bolt ⟶ space around cylinder head ⟶ rocker shaft bracket ⟶ rocker shaft center oil hole ⟶ rocker bushing. After lubrication of the rocker bushing, the oil is injected from the rocker oil hole to lubricate the valve cap sliding portion and valve stem. It then flows through the push rod hole of the cylinder head into the oil sump of the camshaft.

Engine oil overflowing this sump returns to the oil pan.

4) Start booster (smoke set assembly)



The start booster unit installed to the rear of the governor has a spring with setting force and a stopper as functional parts. It also has sleeve, stroke adjusting nut, spring adjusting nut and cap.



As indicated by the governor characteristics shown above, when without the start booster unit (smoke set assembly), the shifter and floating lever are pushed back by the idling spring force, moving the control rack toward fuel increasing direction when pump speed reaches N_1. Namely, N_1 is the smoke limit in this case.

When with the start booster unit (smoke set assembly), the spring force of the unit overcomes that of the idling spring so that the floating lever motion is inhibited until the speed reaches N_2. Thus, the smoke limit decreases from N_1 to N_2.

It is also possible to secure rack position Rs needed at time of start.

5.2 A and AD Type Injection Pump (ZEXEL Products)

NOTE

1. When disassembling the injection pump, keep work bench clean and disassembled parts neatly arranged for each cylinder. Use special care to ensure correct combination of plunger and plunger barrel and of delivery valve and delivery valve seat.
2. Scrupulous care must be exercised when disassembling and reassembling critical parts.
3. Use the specified ZEXEL special tools for disassembly and reassembly; never apply excessive force or handle parts carelessly.

5.3 A Type Injection Pump (NIPPONDENSO Products)

NOTE

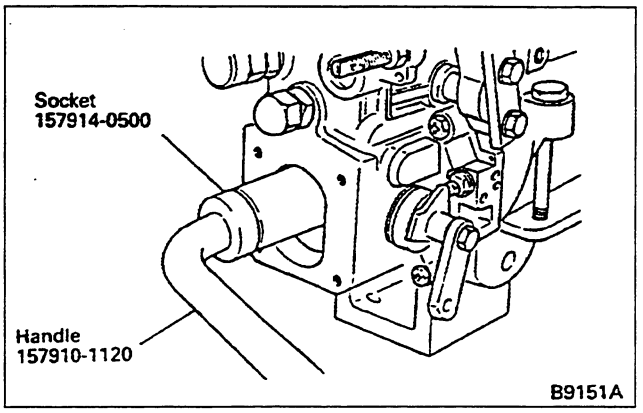
1. When disassembling the injection pump, keep work bench clean and disassembled parts neatly arranged for each cylinder. Use special care to ensure correct combination of plunger and plunger barrel and of delivery valve and delivery valve seat.
2. Scrupulous care must be exercised when disassembling and reassembling critical parts.
3. Use the specified NIPPONDENSO special tools for disassembly and reassembly; never apply excessive force or handle parts carelessly.

Use the following NIPPONDENSO special tools to service the injection pump.

Tool name		NIPPONDENSO part No.	Application
Pump	Pump Body Tool Kit (*: Component)	95092-00010	Set of tools for disassembly and reassembly of injection pump body
	Injection Pump Mounting Base	95092-00050	Work bench for disassembly and reassembly of injection pump
	Pump Setting Angle	95092-10470	
	Tappet Insert	*95092-10510	Removal and installation of camshaft
	Roller Clamp	*95092-10161	Removal and installation of tappet
	Tappet Clamp	*95092-10210	
	Plunger Clamp	*95092-10200	Removal and installation of plunger
	Box Wrench	*95990-10020	Removal and installation of delivery valve holder
	Delivery Valve Extractor	*95092-10140	Removal of delivery valve
	Spot Facing Cutter	*95092-10010	Correction of pump housing
	Camshaft Outer Race Extractor	*95092-10190	Removal of outer bearing
	Delivery Valve Gasket Mounting Tool	*95092-10170	Seating of delivery valve gasket
Measurement	Camshaft Clearance Gauge	95092-10930	Measurement of camshaft clearance
	Rack position scale	95091-00051	Measurement of rack position
	Prestroke Scale	95091-00060	Measurement of prestroke and tappet clearance

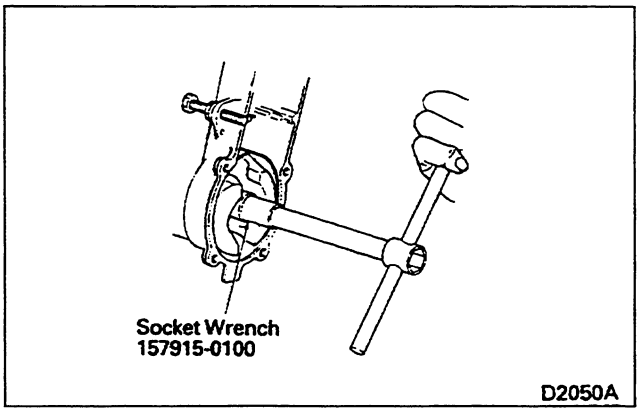
Disassembly and Reassembly Procedure

(1) Removal of idling spring or Ungleich spring

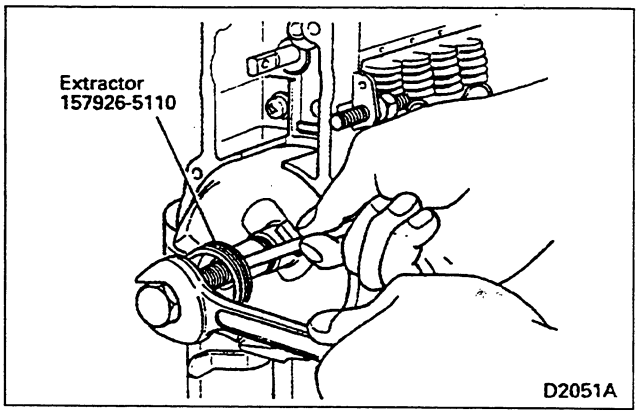


Using Socket (special tool), remove the lock nut from the tension lever and remove the idling spring (or Ungleich spring).

(2) Removal of flyweight

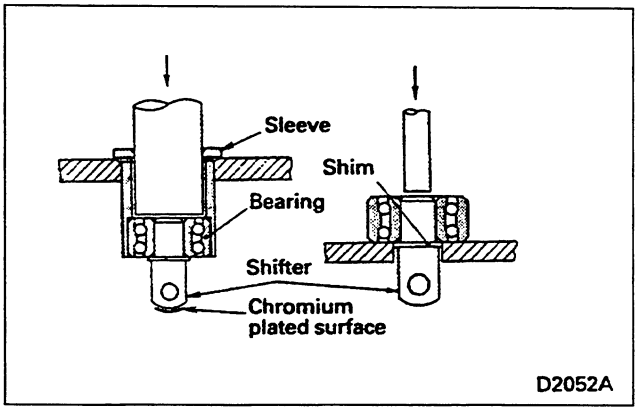


(a) Using Socket Wrench (special tool) and locking the drive end against rotation, remove the flyweight attaching round nut.



(b) Install Extractor (special tool) to the flyweight and remote the flyweight from the camshaft.

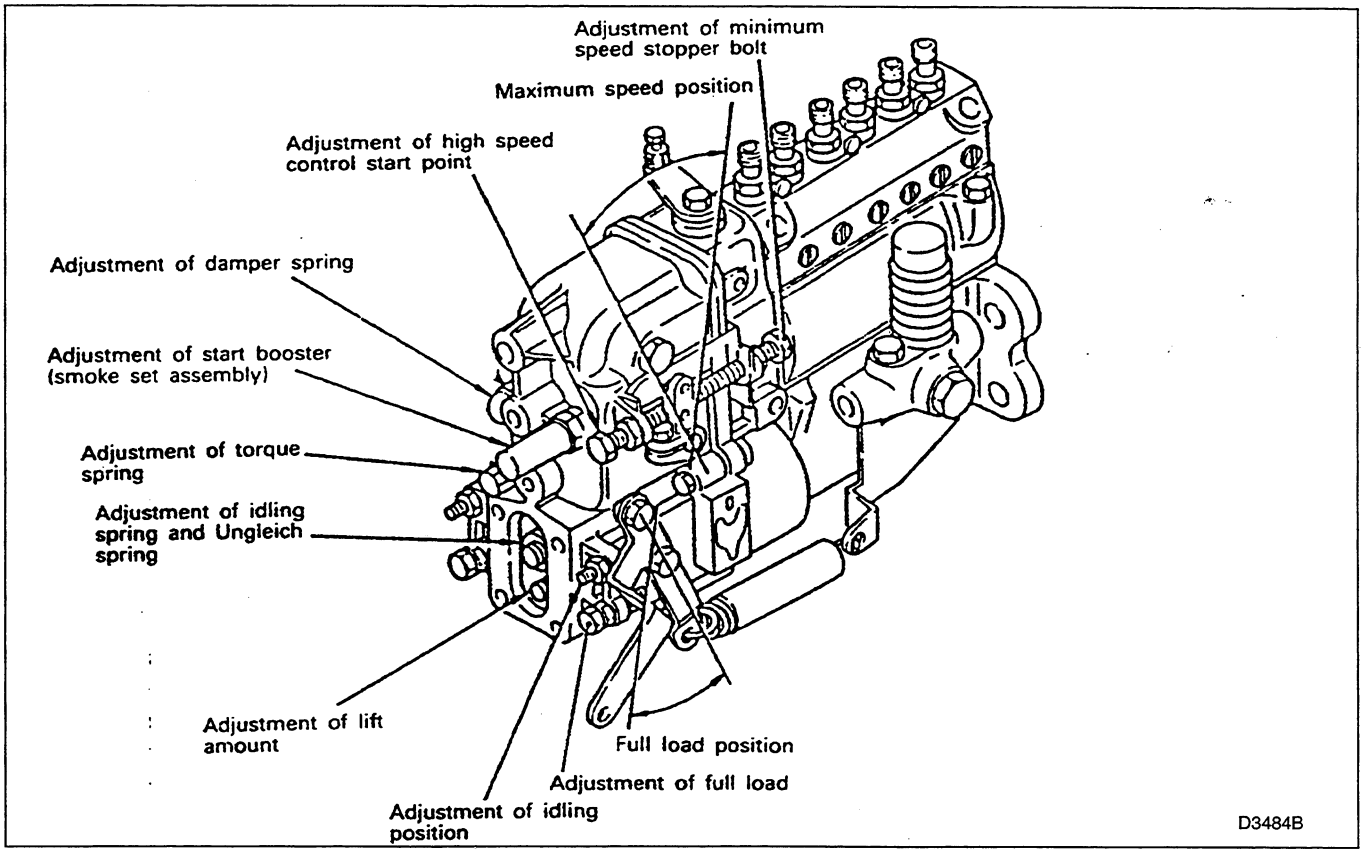
(3) Replacement of sleeve or guide lever



(a) Using a press, remove the bearing in the sleeve and remove the guide lever assembly shifter from the bearing.

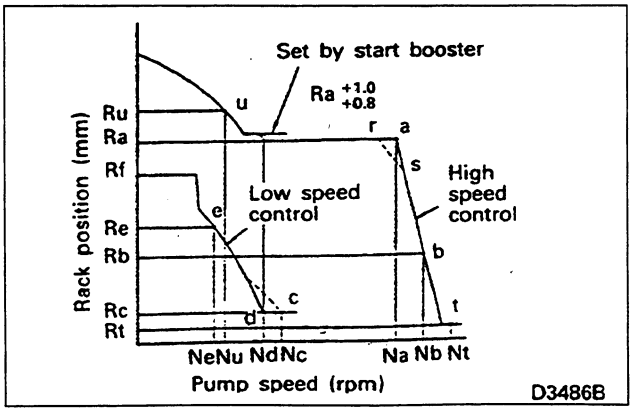
5.6.2 Adjustment after reassembly

For governor performance, curve, see Service Information published separately.



NOTE

1. Remove the damper spring.
2. Remove the Ungleich spring (or idling spring)
3. Remove the start booster (smoke set assembly).
4. Loosen the speed control lever stopper bolt.
5. Loosen the load control lever stopper bolt.

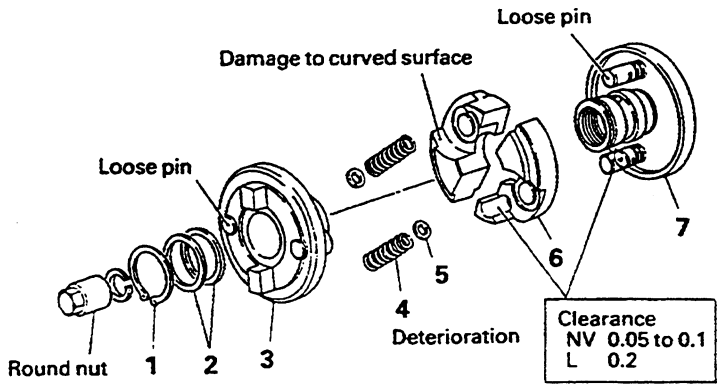


Adjust the relationship between the pump speed and the rack position to specified governor performance curve by the following procedure.

(1) "0" position setting of control rack [See Item (1), 5.2.4]

(2) Install the angle scale plate for fixing the control lever.

5.10.2 Disassembly and inspection



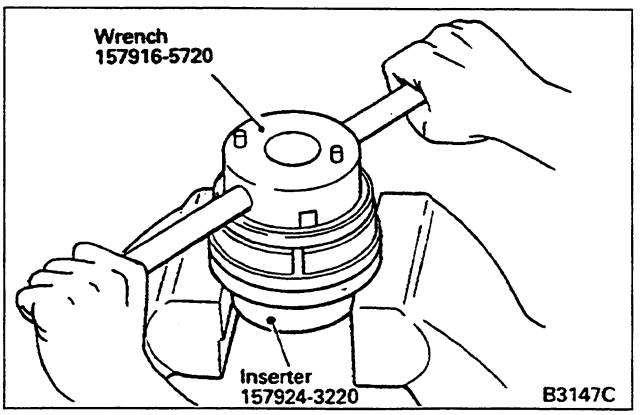
Disassembly sequence

1 Snap ring
2 Shim
(3) Flange
4 Timer spring
5 Shim
6 Flyweight
7 Flyweight holder

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

Disassembly Procedure

Removal of flange



Install the automatic timer to Inserter (special tool), and fit Wrench (special tool) onto the pawls of the flange to turn it in the direction to compress the spring (clockwise). In this state, lift up the flange until its pins clear the flyweights.

Problem	Cause	Correction	Ref. Group
Smoky exhaust gas and engine knocking	Poor quality fuel in use	Replace	
	Defective injection nozzle • Valve opening pressure too low	Adjust	
	• Broken spring	Replace	
	• Clogged injection orifice	Clean	
Unstable engine output	Defective injection pump • Insufficient plunger stroke	Replace	
	• Broken plunger spring		
	• Control rack not sliding smoothly	Correct	
	• Worn or sticky tappet	Replace	
	• Broken delivery valve spring		
	• Loss of air-tightness due to loose delivery valve holder	Correct	
	• Delivery valve not functioning normally	Replace	
	Defective injection nozzle • Needle valve not sliding smoothly	Replace	
	• Broken spring		
	• Valve opening pressure too low	Adjust	
	Defective feed pump • Check valve not functioning normally	Replace	
	• Worn piston		
	Air or water trapped in fuel system	Bleed or replace	
	Clogged fuel filter (or secondary filter)	Replace	
	Incorrect injection timing	Adjust	
	Control lever not on contact with full speed set bolt		
Loss of engine output	Defective injection nozzle • Nozzle not air-tight	Correct or replace	
	• Broken spring	Replace	
	• Clogged injection orifice	Clean	
	Defective injection pump • Worn plunger	Replace	
	• Broken delivery valve		
	• Defective delivery valve seat		
	• Loss of air-tightness due to loose delivery valve holder	Correct	

(3) Cooling water

(a) When Long Life Coolant is used:

D1322B

In order to prevent freezing of cooling water and corrosion of the cooling system, add FUSO Diesel Long Life Coolant at a ratio of 30 to 60% of quantity of water.

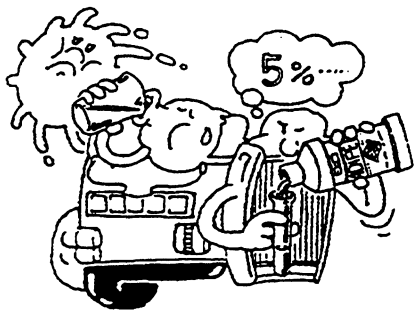
Replace the coolant once every two years to retain its anti-freeze and anti-rust effects.

For usage of Long Life Coolant, refer to its instruction manual.

NOTE

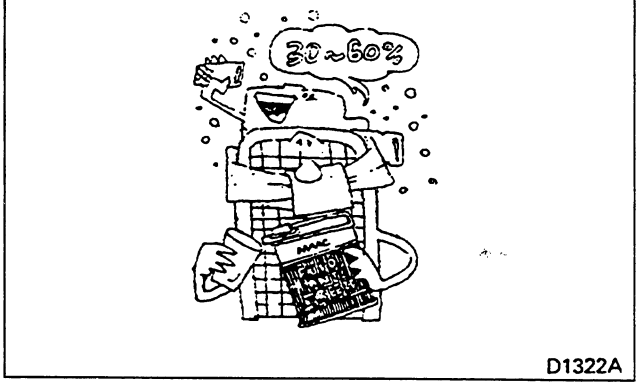
1. Be sure to use FUSO Diesel Long Life Coolant.
2. Never mix it with DIAQUEEN Long Life Coolant or other commercial long life coolants, anti-freezes or anti-rusts.

(b) When anti-rust and anti-freeze are used:



D1310A

1) After cleaning, add FUSO Radiator Anti-rust (Radipet-9B or equivalent) at a ratio of 5% to the coolant quantity to prevent corrosion in summer.



D1322A

2) In winter, add the Fuso Anti-freeze or equivalent at a ratio of 30 to 60% to prevent freezing. For usage of anti-rust and anti-freeze, see respective instruction manuals.

NOTE

When the anti-rust or anti-freeze is used, never use with other long life coolants.

5.7 Bleeding the Cooling System

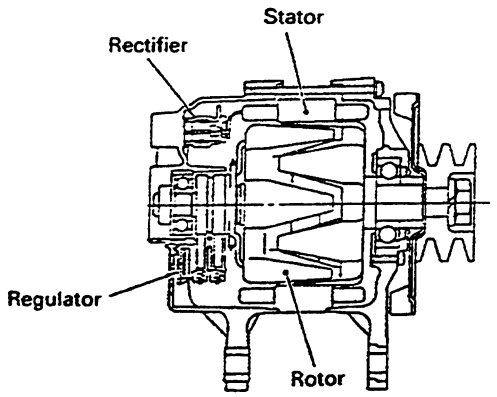
(1) With the pressure cap removed from the radiator, let the engine run at idle with coolant temperature of about 90°C to bleed the system completely.

(2) After the system has been bled of air, add coolant to radiator and reserve tank as required.

1.2 Alternator

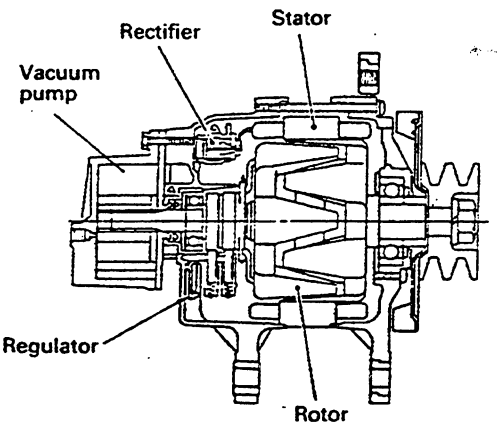
(1) Model A2T72986, A4T57886, A4T57986, **A4T59086,** A2T32386, A6T75386 Alternator

(Without vacuum pump: Except A4T57886)



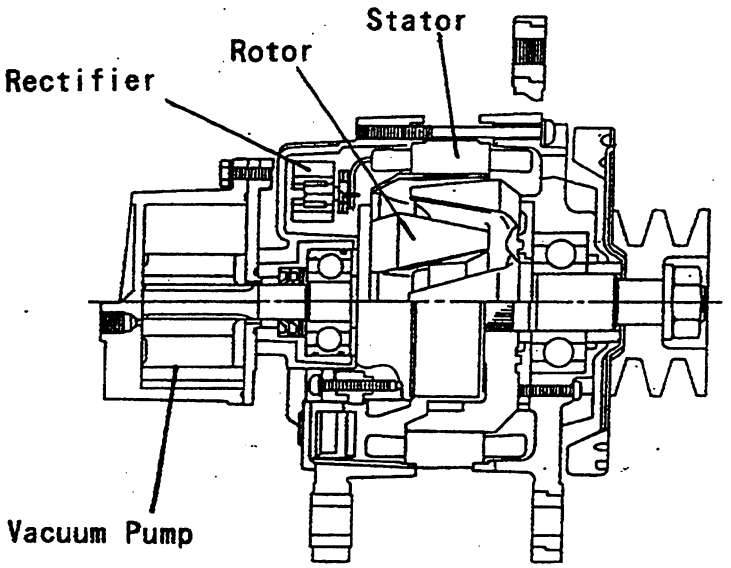
B1172D

(With vacuum pump: A4T57886)



B1172E

(With vacuum pump: A4T59086)



(6D16)

207229

The alternator is a brush type in which a current flows from the brushes through the slip ring to the field coil in the rotor.

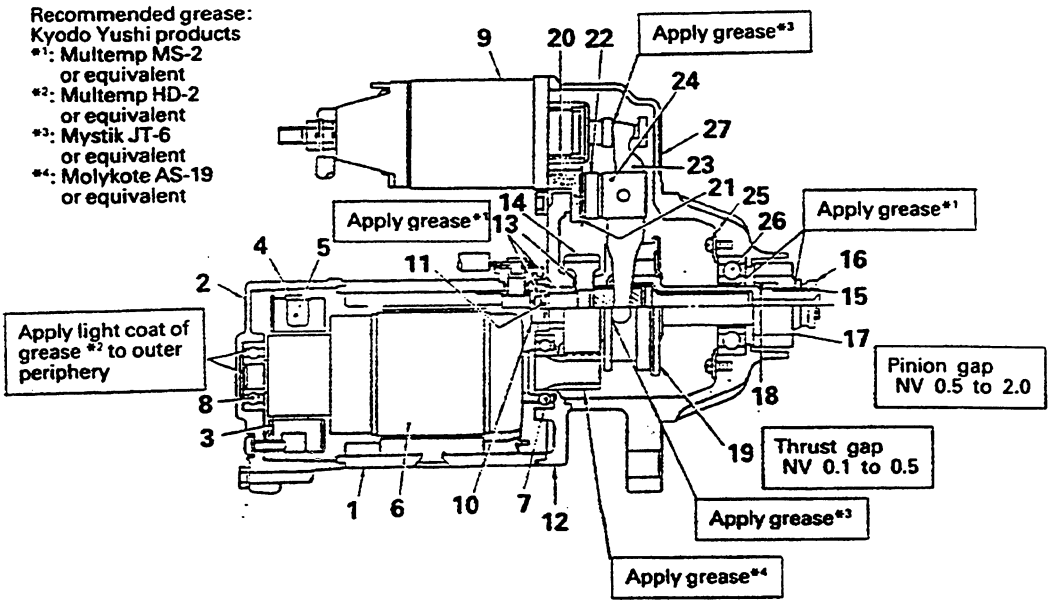
Major components include: the rotor (field coil) that generates magnetic field; the stator that generates electromotive force; the rectifier that rectifies electromotive force so generated; the regulator that keeps generated voltage constant.

(4) Automatic stop device (Option)

Item		Specifications	
Type		<Energize-to-stop type>	<Energize-to-run type>
Stop solenoid (Nippondenso Co., Ltd. product)	Model	Electromagnetic type	
Solenoid relay (Nikko Denki product)	Model	0 – 25000 – 5592 <24V>	0 – 25000 – 6720 <24V>
		0 – 25000 – 6361 <12V>	0 – 25000 – 6990 <12V>
Oil pressure switch	Model	Diaphragm with built-in contact	
Thermo switch	Model	Wax with built-in contact	

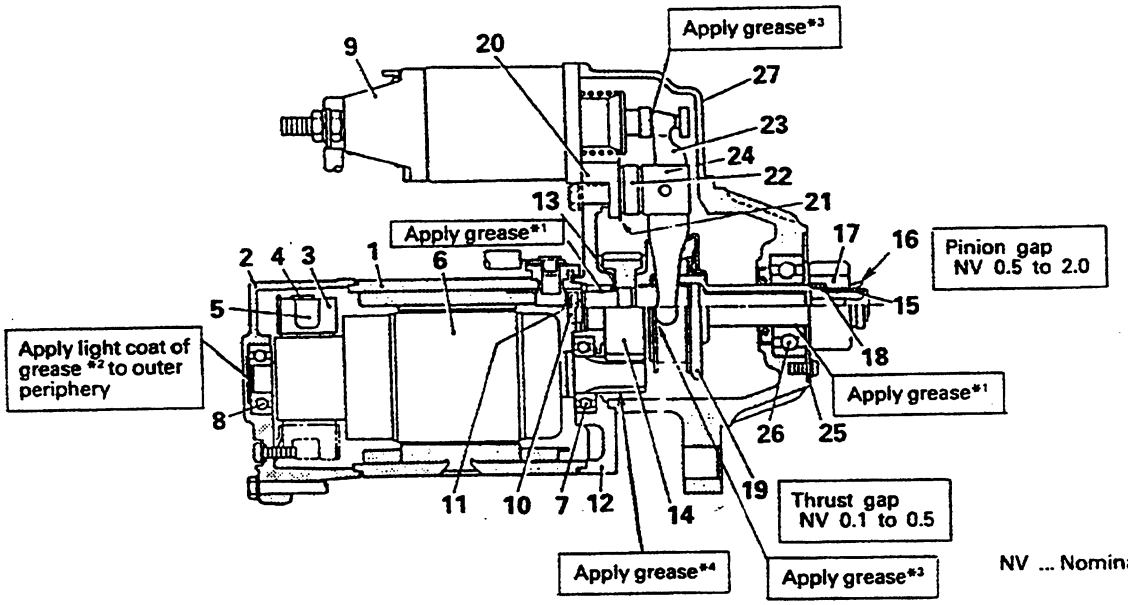
4.1.4 Reassembly

(M3T56072, M3T56073, M3T56082)



D7548B

(M3T56076)



NV ... Nominal Value

Assembly sequence

20→21→22→24→23→27→26→25→19→18→17→16→15→14→13→12→11→10→9→3→4→5→1→2→⑥→7→8→

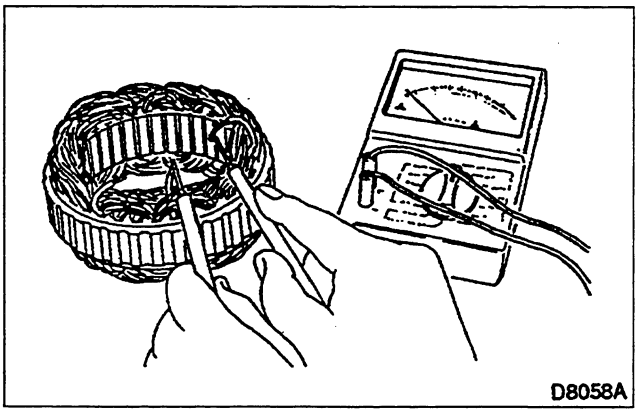
For reassembly of parts with an encircled number, see following items

D7558B

Inspection Procedure

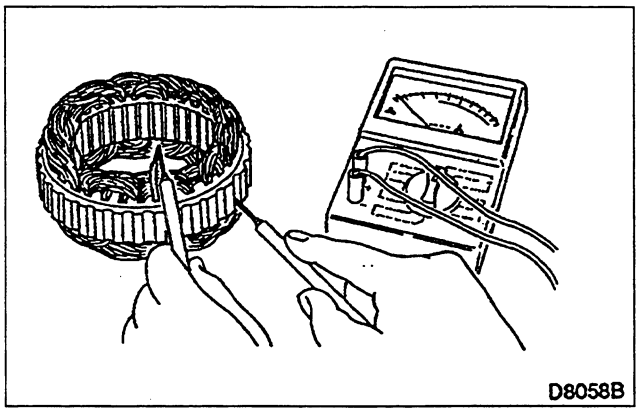
(1) Inspection of stator

(a) Continuity across lead wires



Check that there is continuity between the lead wires. If there is no continuity indicating a broken wire, replace the stator.

(b) Continuity between the lead wire and core

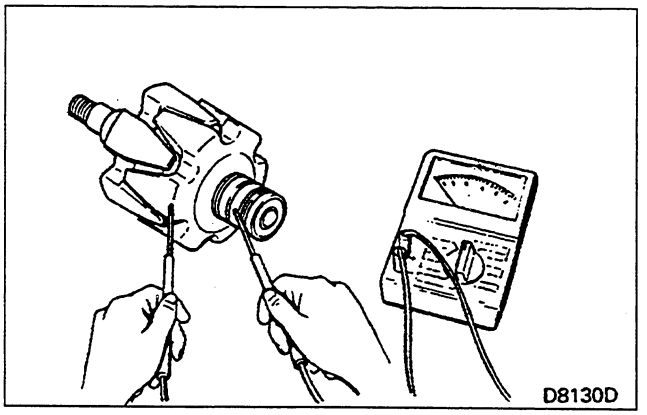


Check that there is no continuity between each lead wire and core.

If there is continuity, replace the stator as it is grounded.

(2) Inspection of rotor

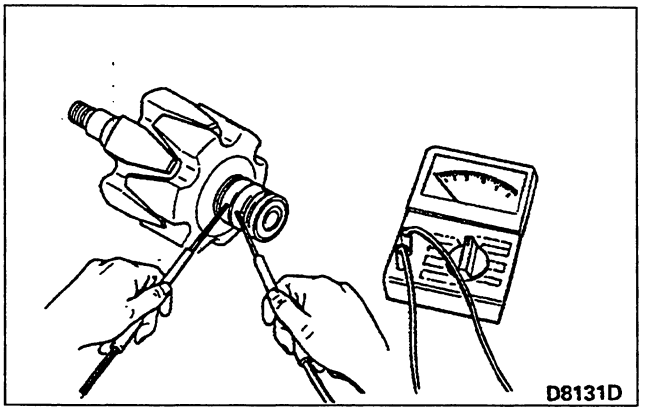
(a) Continuity between slip ring and core



Check that there is no continuity between the slip ring and core.

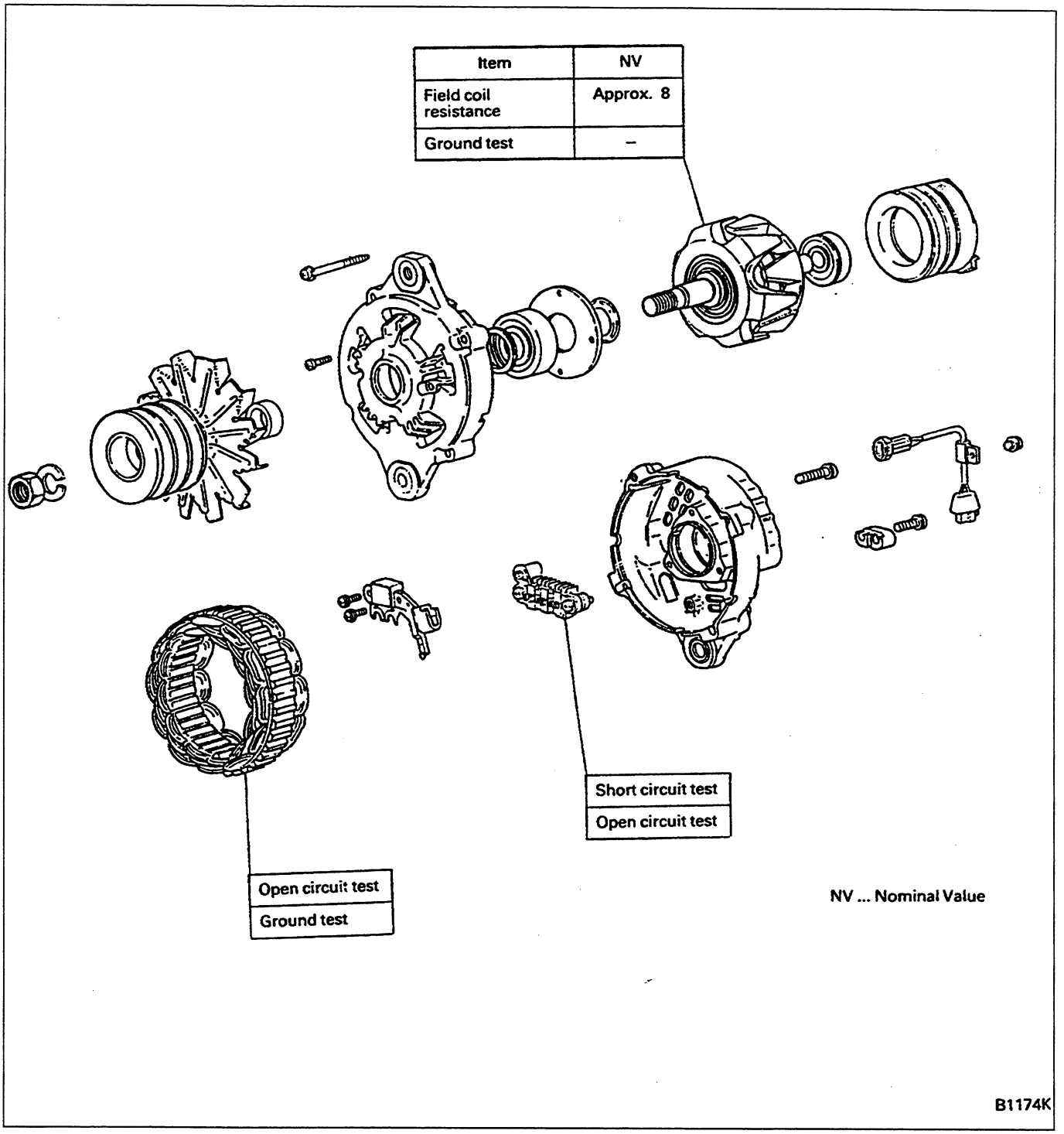
If there is continuity, replace the rotor as it is grounded.

(b) Field coil resistance



Measure the resistance between slip rings. Replace the rotor if the resistance is not within the specification.

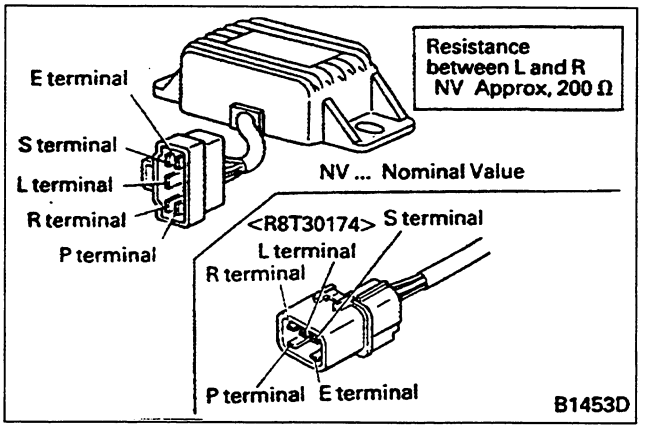
4.8.3 Inspection



4.11 Safety Relay

(1) R8T30171 or R8T30174 Safety Relay

Inspection



Measure voltage at each terminal in the sequence shown below to identify faulty parts.

(a) On-vehicle Test

Sequence	Engine operation	Voltage at terminal "P"	Voltage at terminal "S"	Voltage at terminal "R" or "L"
1	Starter switch ON	• 1 V or less • (+) diode shorted if close to battery voltage	–	Terminal "R" • Approx. 24 V • If 0 V, wiring is faulty Terminal "L" (with charge lamp) • Approx. 24 V Terminal "L" (without charge lamp) • Approx. 3 V or less • If close to battery voltage, wiring or alternator is faulty
2	During cranking	–	• Approx. 1 V or less • If close to battery voltage, safety relay is faulty (cranking impossible)	–
3	Idling (600 rpm or higher)	• Approx. 13 to 16 V	• A bulb connected between battery and terminal "S" does not come one • If bulb comes on despite normal terminal "P" voltage (shown) at left), replace safety relay and test again	–

(b) Component Test

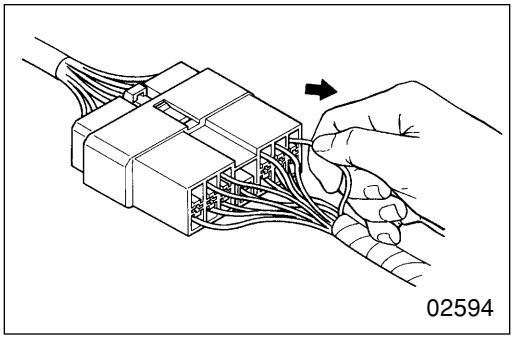
The resistance value between terminals "R" and "L" shall be within specified range.

HOW TO READ THIS MANUAL

How This Manual Is Compiled

- This manual is compiled by classifying various systems into certain groups.
- Each group contains specifications; troubleshooting; maintenance service standards; ❶ tightening torque; 🔏 lubricant, fluid and sealant; 🔧 special tools; and service procedure.
- Page enumeration is independent by every group where first page is always 1.

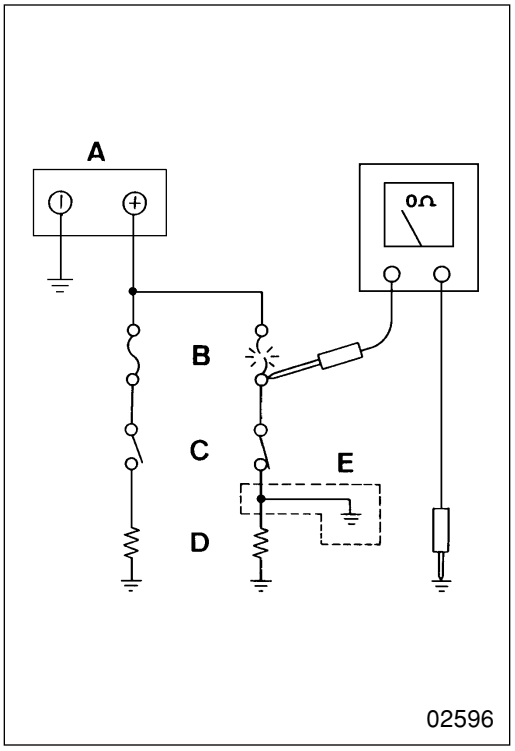
Group No.	Group denomination	Contents
00	General	General specifications, engine No. and name plate, precautions for maintenance operations, table of standard tightening torques
11	Engine	Engine body
12	Lubrication	Lubrication system
13	Fuel and engine control	Fuel system
14	Cooling	Cooling system
15	Intake and exhaust	Intake and exhaust system, intercooler
54	Electrical system	Alternator, starter, preheating system, engine start system, automatic stop system
61	Special equipment	Air compressor



Connector pin fall out inspection

Damaged connector pin stoppers can cause poor engagement of the terminals (male and female pins) even if the connector body is secured, and might cause some pins to fall out. Check if the pins have fallen out from the connector by pulling each harness gently.

Inspection Procedures for Blown Fuses



Remove fuse B and measure resistance between the loaded side of the fuse and ground.

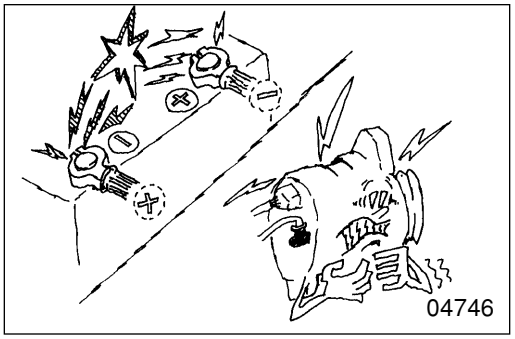
Turn on all circuit switches (connected to the fuse). If the resistance value reading is approximately 0, a short has occurred between the switch and the loaded point. A value of other than zero may indicate that the fuse was blown by a temporary short but the short is no longer present.

The major causes of a short circuit are as follows:

- Harness stuck onto the vehicle body.
- Harness sheath damaged by friction or heat.
- Water in connectors or circuits.
- Mistakes (accidental short circuits)

A: Battery
B: Fuse
C: Loaded switch
D: Load
E: Short circuit

Precautions for Handling Alternator



When servicing the alternator, pay attention to the following:

- Do not connect the alternator with battery polarities reversed.
  If the alternator is connected with reversed polarities, a large current flow from the battery to the alternator occurs, and the diode or regulator might be damaged.

2. Inspecting and Adjusting Valve Clearances

Service standards

Unit: mm (in.)

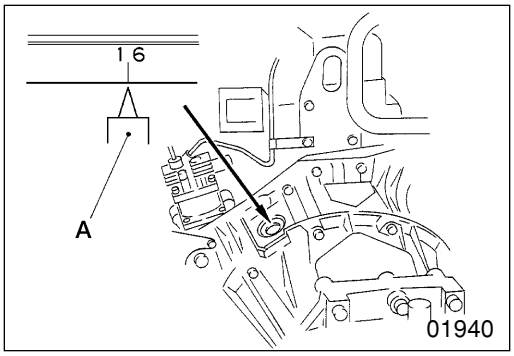
Location	Maintenance item	Standard value	Limit	Remedy
–	Valve clearance (when cold)	0.4 (0.0158)	–	Adjust

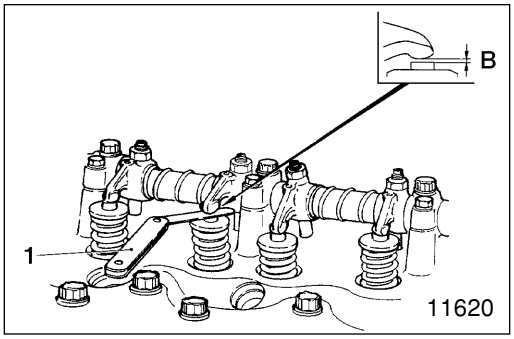
ⓣ Tightening torques

Unit: N·m (kgf·m) [lbf·ft]

Location	Parts to be tightened	Tightening torque	Remarks
2, 3	Rocker arm adjusting screw lock nut	34 (3.5) [25.1]	–

Valve clearances should be checked and adjusted when the engine is cold.





[Inspection]

- Bring piston No. 1 or piston No. 6 to the top-dead-centre (TDC) position of its compression stroke. To do this, crank the engine until the "**1.6**" mark inscribed on the flywheel is aligned with the pointer **A** in the flywheel housing inspection window.

NOTE

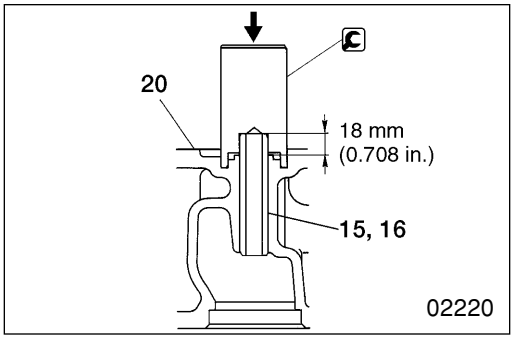
Pistons whose push rods are not pushing up their rockers are at top-dead-centre (TDC) of their compression strokes.

- When piston No. 1 or piston No. 6 is at the TDC position of its compression stroke, measure the clearance **B** of every valve marked "○" in the following table.

Piston No.	1		2		3		4		5		6	
Valve arrangement	In.	Ex.	In.	Ex.	In.	Ex.	In.	Ex.	In.	Ex.	In.	Ex.
No. 1 piston at TDC of compression stroke	○	○	○	×	×	○	○	×	×	○	×	×
No. 6 piston at TDC of compression stroke	×	×	×	○	○	×	×	○	○	×	○	○

NOTE

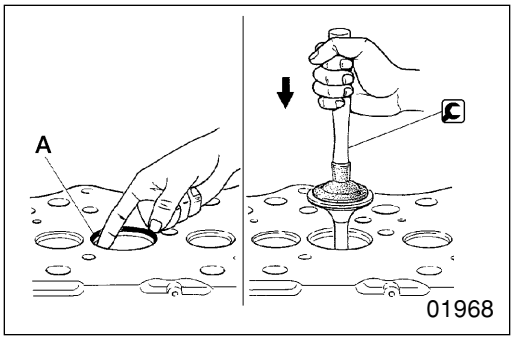
To measure the clearance, insert a feeler gauge 1. The gauge should be able to move in the gap, albeit not loosely. Accurate measurements cannot be taken if the gauge moves loosely in the gap.



[Installation]
Install the valve guides **15**, **16** using the Valve Guide Installer. Strike the Valve Guide Installer until it sits snugly on the cylinder head **20**.

CAUTION

- **The valve guides 15, 16 must be pressed in to the specified depth. Be sure to use the Valve Guide Installer for this operation.**
- **Exhaust valve guides 15 are longer than inlet valve guides 16. Be sure to install the correct type of guide in each location.**

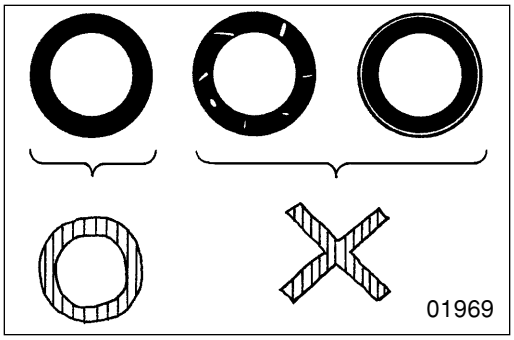


7 8 17 18 Valves and valve seats
[Inspection]

- Apply an even coat of minium to the valve seats **17**, **18** surface **A** that makes contact with the valves **7**, **8**.
- Using the Valve Lapper, strike the valves **7**, **8** against the valve seats **17**, **18** once. Do not rotate the valve during this operation.

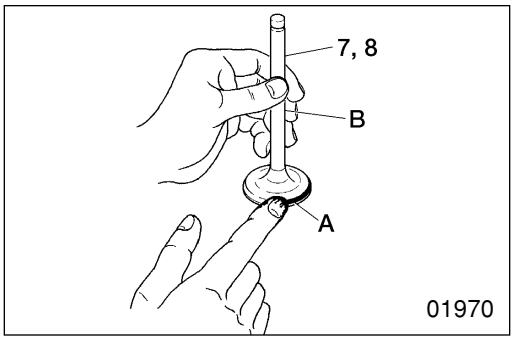
NOTE

Carry out these inspections after inspecting the valves and valve guides.



- If the minium deposited on the valves **7**, **8** indicate a poor contact pattern, rectify the contact pattern as follows:

Contact	Corrective action
Minor defect	Lapping
Serious defect	Reface or replace valve and valve seat



[Refacing]
Lap the valve in accordance with the following procedure:

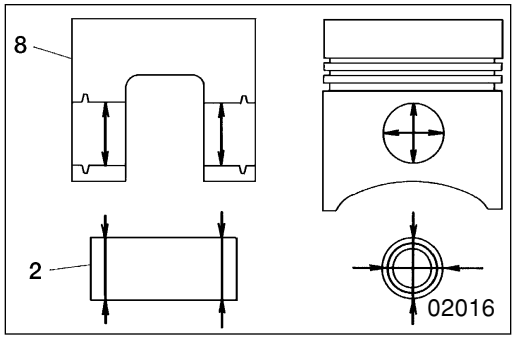
- Apply a thin, even coat of lapping compound to the surface **A** of the valves **7**, **8** that makes contact with the valve seats **17**, **18**.

CAUTION

Ensure that no compound adheres to the stem B of the valves 7, 8.

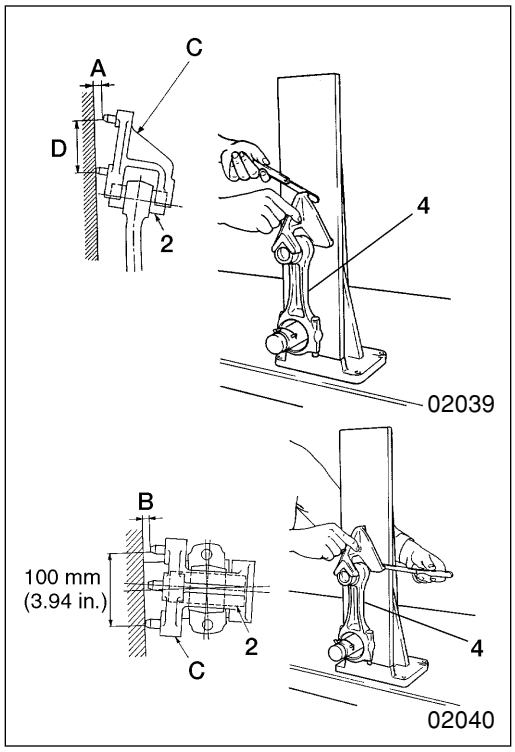
NOTE

- **Start with intermediate-mesh compound (120 to 150 mesh) and finish with fine-mesh compound (200 mesh or more).**
- **The addition of a small amount of engine oil makes lapping compound easier to apply.**



2 8 Piston pin-to-piston clearance

If the clearance exceeds the specified limit, replace the defective part(s).



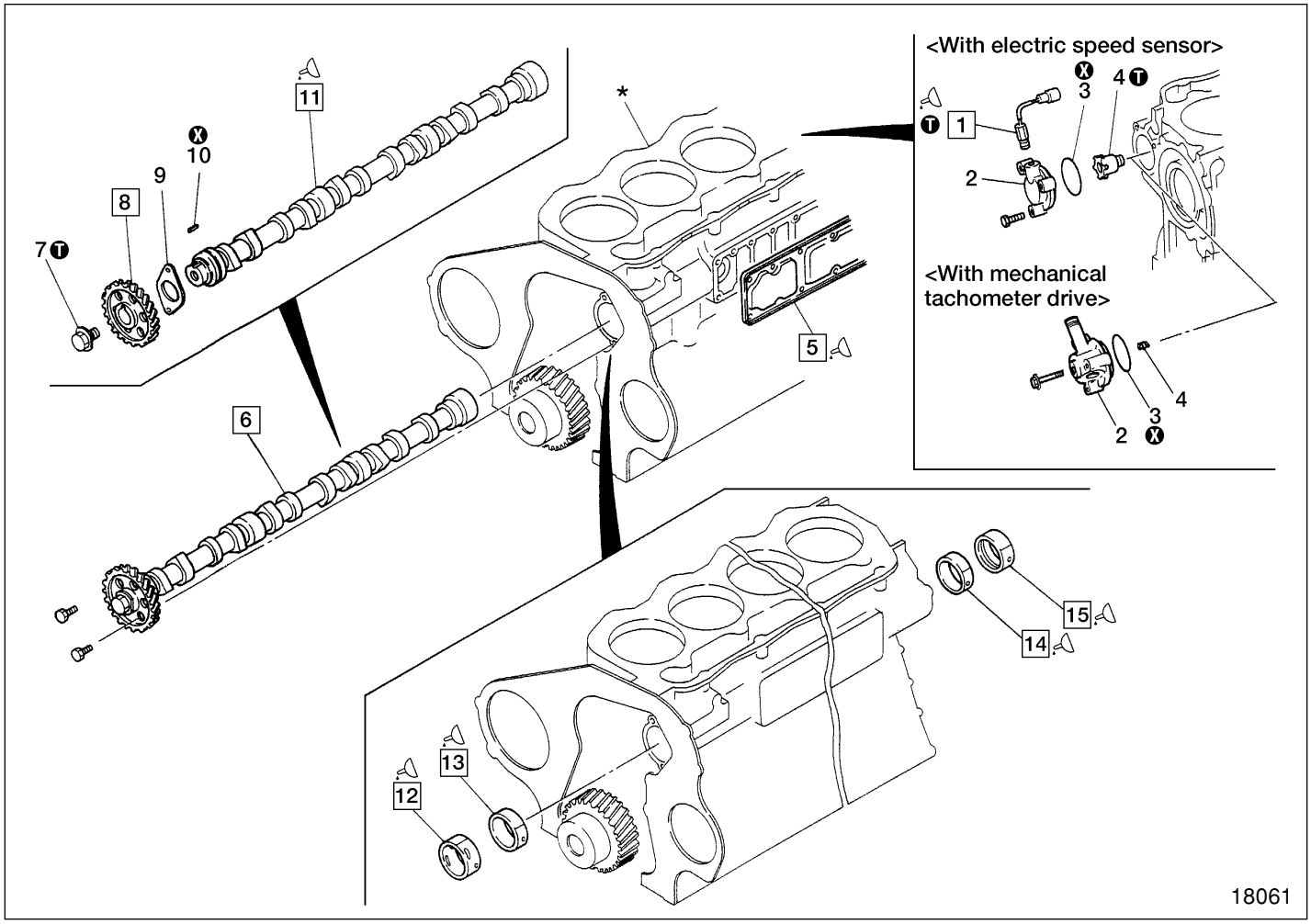
4 Connecting rod bend and twist

- Fit the connecting rod bushing **3** and piston **2** in their respective positions of the connecting rod **4**.
- Measure the extent of bending **A** and twisting **B** in the connecting rod **4**.
- If either measurement exceeds the specified limit, replace the connecting rod **4** or rectify it.

C: Connecting rod **4** aligner (measurement device)

NOTE

- **Before mounting the connecting rod 4 on the connecting rod aligner C, install the upper and lower connecting rod bearings in their respective positions.**
- **Measurements must be made with the connecting rod cap mounting nuts tightened to their specified torque.** **P.11-31**



● **Pre-disassembly inspection**

📖 P.11-60

● **Disassembly sequence**

1 Engine speed sensor <models with electric speed sensor>
2 Adapter <models with electric speed sensor>
Tachometer drive case <models with mechanical tachometer>
3 O-ring
4 Pulse rotor <models with electric speed sensor>
Tachometer drive coupling <models with mechanical tachometer>
5 Side cover
6 Camshaft assembly
7 Bolt
8 Camshaft gear
9 Thrust plate
10 Key
11 Camshaft
12 No. 4 camshaft bushing
13 No. 3 camshaft bushing
14 No. 2 camshaft bushing
15 No. 1 camshaft bushing

∗: Crankcase 📖 P.11-66
Ⓧ: Non-reusable part

NOTE

- **Do not remove the engine speed sensor 1 unless defects are evident.**
- **Do not remove the camshaft gear 8 unless defects are evident.**

● **Assembly sequence**

Reverse the order of disassembly.

GROUP 12 LUBRICATION

<6D16-TLE>

Service standards

Unit: MPa (kgf/cm²) [psi]

Location	Maintenance item		Standard value	Limit	Remedy
–	Oil pressure [at oil temperature 70 to 90 °C (158 to 194 °F)]	At no-load minimum speed	0.1 (1.0) [14.5] or higher	Up to 0.1 (1.0) [14.5]	Adjust
		At no-load maximum speed	0.2 to 0.6 (2.0 to 6.1) [29.0 to 87.0]	Up to 0.2 (2.0) [29.0]	

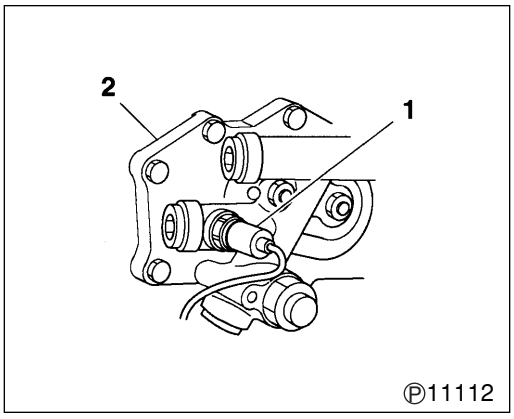
❶ Tightening torque

Unit: N·m (kgf·m) [lbf·ft]

Location	Parts to be tightened	Tightening torque	Remarks
1	Engine oil pressure switch	15 to 22 (1.5 to 2.2) [11.1 to 16.2]	Check with engine cold

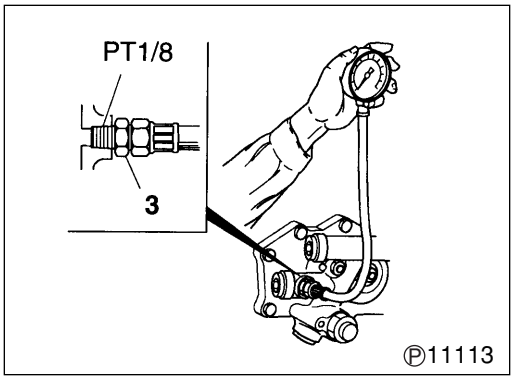
Sealant

Location	Points of application	Specified sealant	Quantity
1	Wrap around thread of engine oil pressure switch	Teflon tape	3 1/2 turns



- Remove engine oil pressure gauge unit **1**.

  2: Oil cooler



- Fit adapter **3** into the opening from which the engine oil pressure switch has been removed. Install an oil pressure gauge onto the adapter.
- Run the engine until oil temperature reaches 70 to 90°C. (158 to 194°F).
- Measure the oil pressure at both no-load minimum and maximum speeds. If either of the measured values is below the limit pressures, overhaul the lubrication system.
- Fit engine oil pressure switch **1** and tighten it to the specified torque.

NOTE

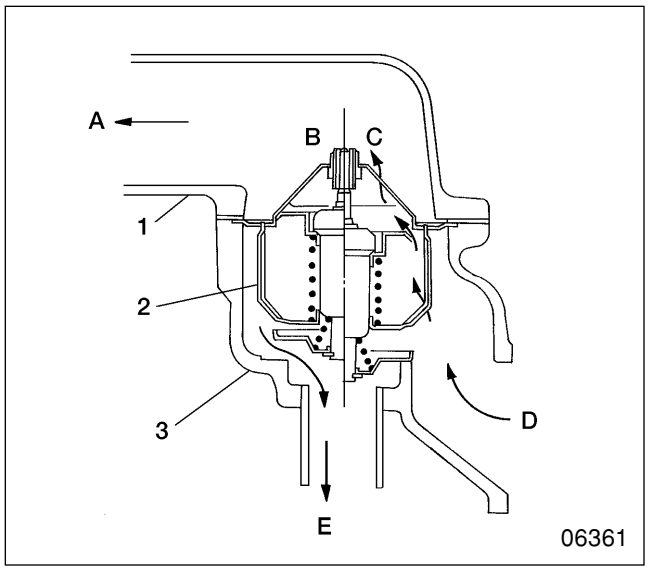
Installation of engine oil pressure switch 1 must be performed while the engine is cold.

GROUP 13 FUEL AND ENGINE CONTROL

M E M O

M E M O

3. Thermostat

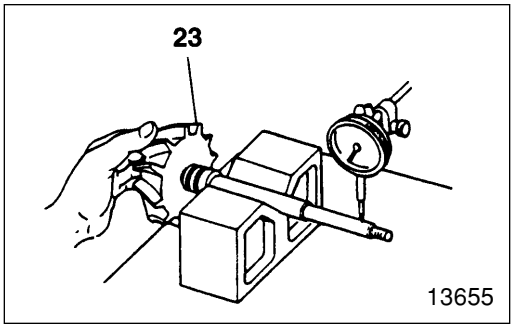


1 Thermostat cover
2 Thermostat
3 Thermostat case

A: To radiator
B: With low coolant temperature
C: With high coolant temperature
D: From cylinder head
E: To water pump

Thermostat **2** is a bottom bypass type that uses wax-charged pellets as its regulating element. As the wax changes from solid to liquid in line with temperature increases, the total wax volume changes. As a result, the position of the valve, changed by the coolant temperature, regulates the flow of coolant to the radiator and water pump (bypass side) and controls the coolant temperature.

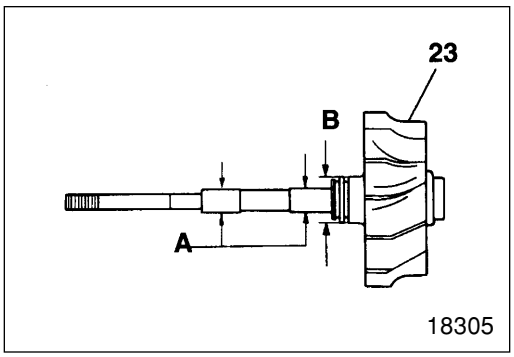
GROUP 15 INTAKE AND EXHAUST



[Inspection]

(1) Bend of shaft

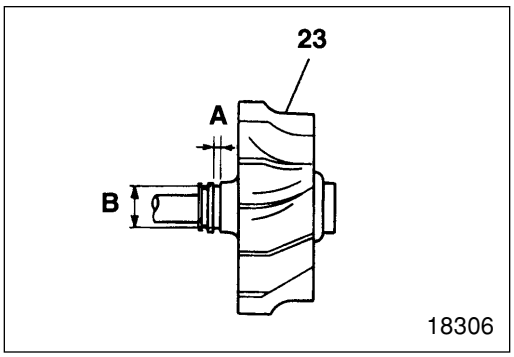
- Using the dial indicator, measure at the illustrated position.
- If the reading exceeds the limit, replace the turbine wheel **23**.



(2) Outside diameters of journal and hub

If any reading exceeds the limit, replace the turbine wheel **23**.

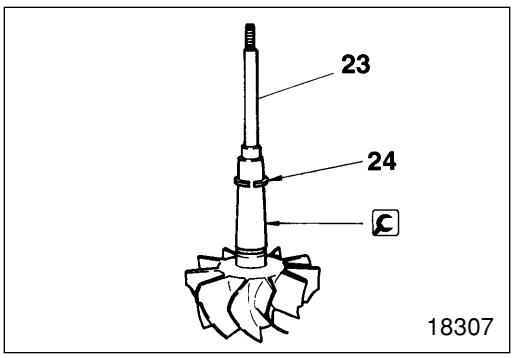
A: Journal
B: Hub



(3) Width and outside diameter of piston ring groove

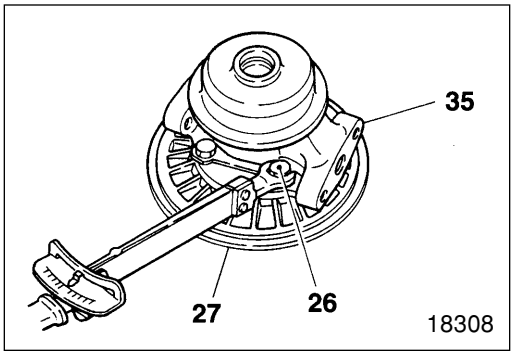
If any reading exceeds the limit, replace the turbine wheel **23**.

A: Width
B: Outside diameter



24 Installation of piston ring

Insert the Piston Ring Inserter into the turbine wheel **23** and install the piston ring **24**.

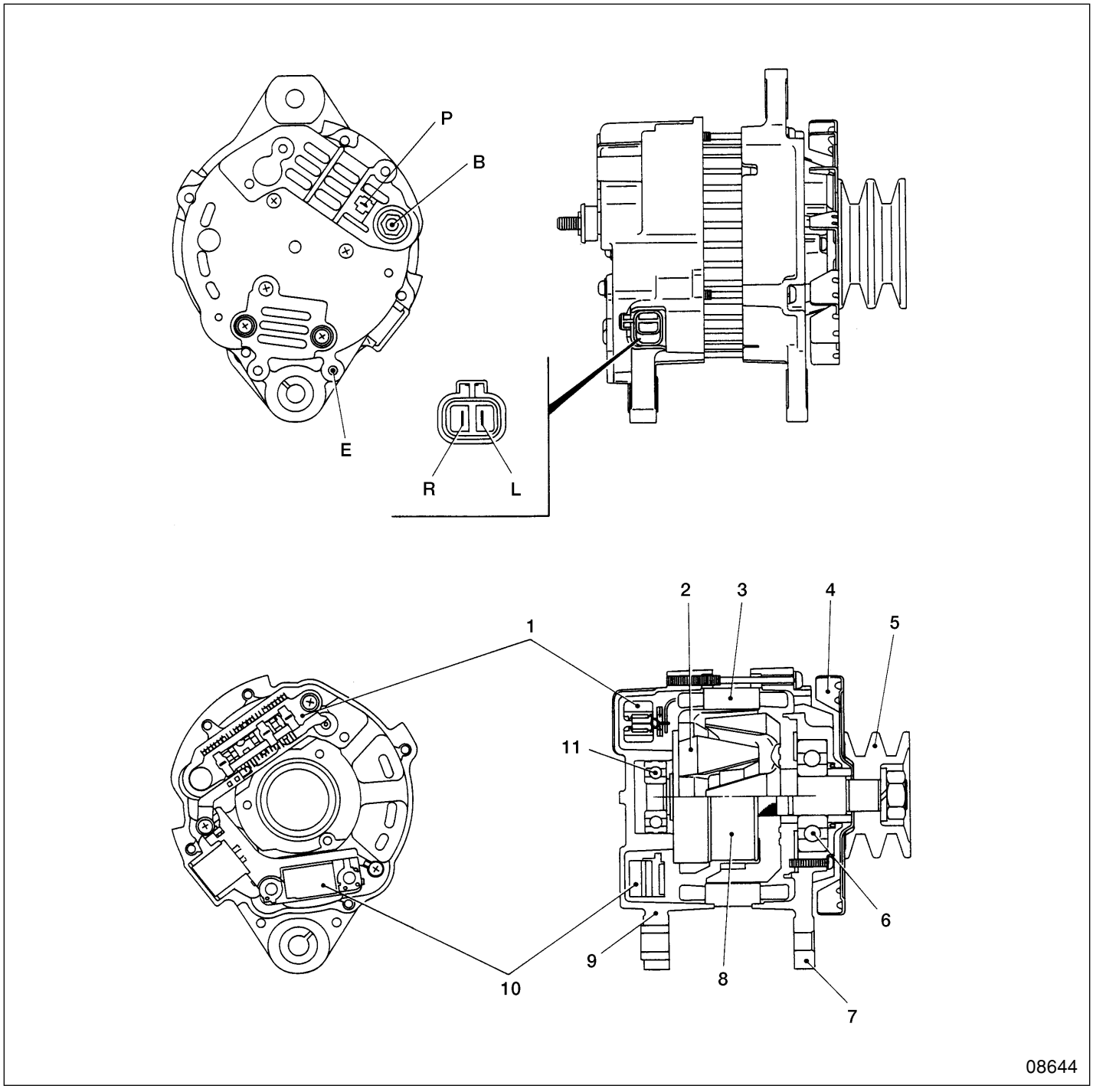


27 Back plate

[Installation]

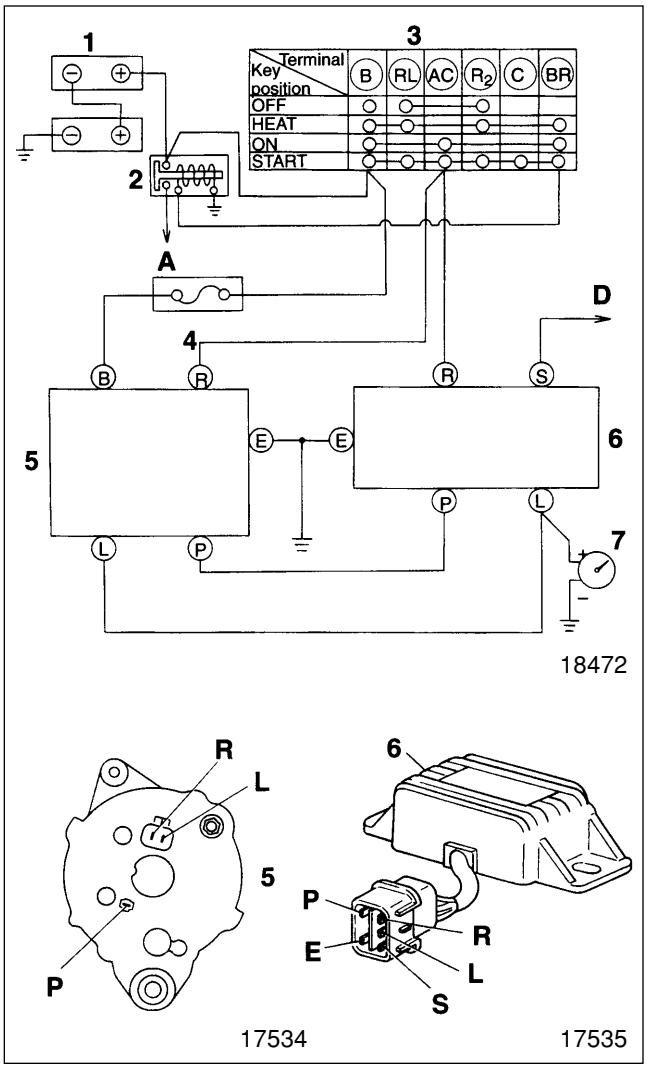
Slowly install the back plate **27** on the center housing **35**, while lining up the alignment marks made before disassembly, and tighten the bolt **26** to the specified torque.

<24V–40A (without vacuum pump), 12V–80A>



1 Rectifier
2 Rotor assembly
3 Stator assembly
4 Fan
5 Pulley
6 Front bearing
7 Front bracket
8 Field coil
9 Rear bracket
10 Regulator
11 Rear bearing

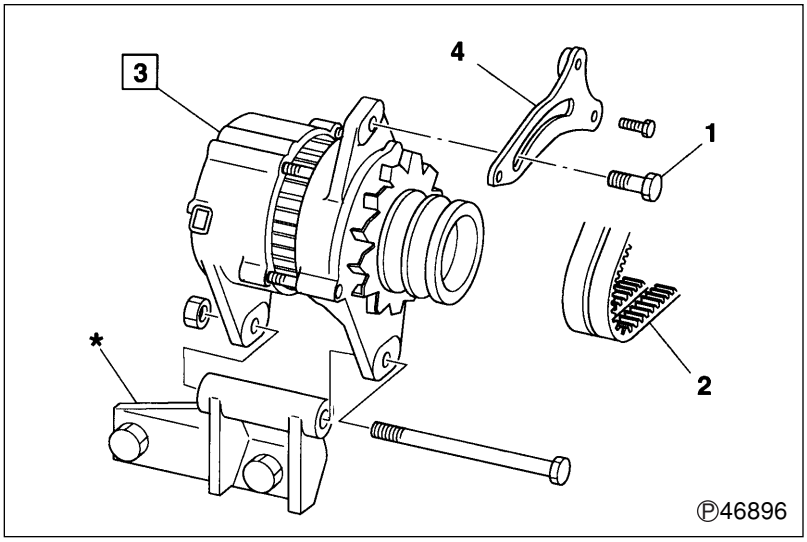
B: Terminal B
E: Terminal E
L: Terminal L
P: Terminal P
R: Terminal R



(4) Checking output voltage at terminal L (where no charge lamp is provided)

- Connect the voltmeter **7** as shown.
- Place the starter switch **3** in the ON position and measure the voltage.
- If the reading is out of the standard value, replace the safety relay **6**.
  If the reading is close to the battery voltage, check the alternator **5** and wiring, and replace if defective.

ALTERNATOR <24V–50A>



● **Removal sequence**
1 Adjust bolt
2 V-belt
3 Alternator assembly 🕮 P.54-40
4 Adjust plate

*: Alternator bracket

WARNING ⚠

Before removing the alternator 3, be sure to disconnect the negative ⊖ terminal of the battery and insulate it with a tape or something else. If the negative ⊖ terminal is not disconnected, the battery voltage is always available at terminal B and is dangerous.

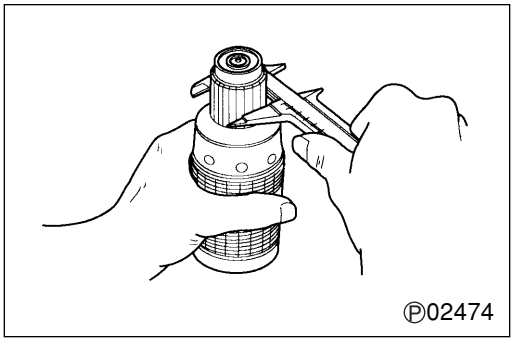
● **Installation sequence**
Reverse the order of removal.

● **Adjustment after installation**
Adjust the tension of the V-belt 2. 🕮 Gr 14

Service standards

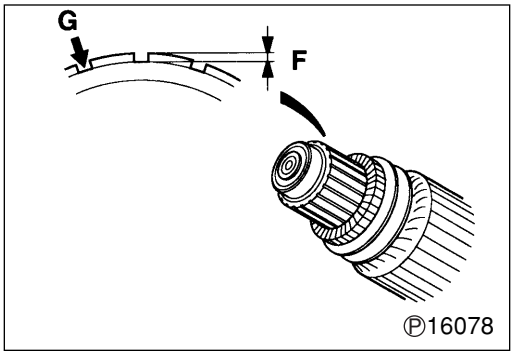
Location	Maintenance item			Standard value	Limit	Remedy
3	Alternator output current (* When hot, when 27V is generated)	Alternator speed	1500 rpm	24A or more	–	Check
			2500 rpm	38A or more	–	
			5000 rpm	45A or more	–	
	Regulator regulated voltage (5000 rpm, loads 5A or less)			28.5 ± 0.5V	–	Replace

*: "When hot" refers to the state of the engine after 30 minutes of maximum output operation at 5000 rpm at a normal ambient temperature.



(5) Outside diameter of commutator

If the reading is more than the limit, replace the armature assembly **16**.



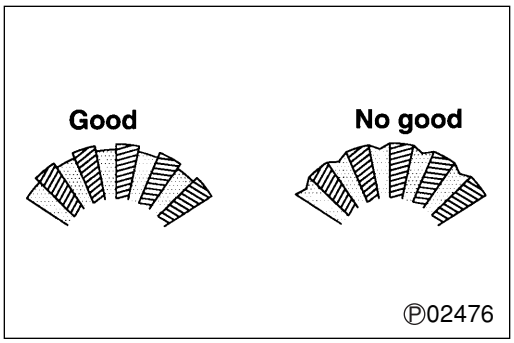
(6) Depth of mold between segments

Before inspection, clean the mold portions.

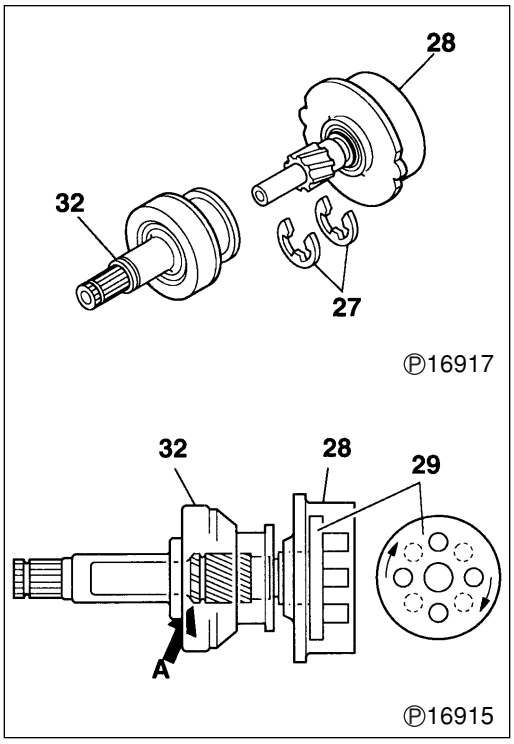
- If the reading is less than the limit, repair or replace the armature assembly **16**.

  F: Depth of mold

- Make repairs by grinding the illustrated portion **G**.



- If the mold portion is as shown, repair or replace the armature assembly **16**.



28 Removal of gear shaft and internal gear assembly

Remove the E-rings **27** and then the gear shaft and internal gear assembly **28** from the overrunning clutch **32**.

Proceed as follows if the assembly **28** cannot be removed due to interference of the splined section **A** of gear shaft assembly **29** with internal parts of the overrunning clutch.

- Press the gear shaft assembly **29** against the overrunning clutch **32**.
- Turn the gear shaft assembly **29** approx. 1/8 of a turn to change the position of splined section **A**.

● **Disassembly sequence**

1 Nut
2 Lock washer
3 Compressor gear
4 Spacer
5 Bolt
6 Coupling
7 Bolt
8 Connector
9 Gasket
10 Snap ring
11 Unloader valve
12 Unloader valve spring
13 Unloader valve guide
14 Suction valve holder
15 Suction valve spring
16 Suction valve
17 Suction valve seat
18 Suction valve gasket
19 Nut
20 Delivery valve holder
21 Suction valve gasket
22 Delivery valve
23 Delivery valve spring
24 Spring holder
25 Gasket
26 Cylinder head
27 Bolt
28 Cylinder liner
29 O-ring
30 1st compression ring
31 2nd compression ring
32 3rd compression ring
33 Oil ring
34 Snap ring
35 Piston pin
36 Piston
37 Nut
38 Lock washer
39 Connecting rod
40 Bearing
41 Bolt
42 Connecting-rod cap
43 Crankshaft
44 Bolt
45 Plate
46 Bearing
47 Crankcase

Ⓧ: Non-reusable parts
Ⓟ: Locating pin

● **Reassembly sequence**

Reverse the order of disassembly.

Service standards

Unit: mm (in.)

Location	Maintenance item		Standard value	Limit	Remedy
15	Suction valve spring load [Installed length: 9 mm (0.354 in.)]		2.3 N (0.23 kgf) [0.52 lbf]	1.3 N (0.13 kgf) [0.29 lbf]	Replace
23	Suction valve spring load		3.2 N (0.33 kgf) [0.72 lbf]	2.4 N (0.24 kgf) [0.54 lbf]	Replace
29, 36	Clearance between piston and cylinder liner [Basic diameter: 80 mm (3.15 in.)]	Top	0.27 to 0.33 (0.016 to 0.0130)	0.35 (0.0138)	Replace cylinder liner
		Skirt	0.11 to 0.17 (0.00433 to 0.00670)	0.19 (0.00748)	
30 to 33	Piston ring gap (as measured inside cylinder liner)	Compression ring	–	1.0 (0.0394)	Replace
		Oil ring	–	1.0 (0.0394)	
30 to 33, 36	Clearance between piston ring and piston groove	Compression ring	–	0.08 (0.00315)	Replace
		Oil ring	–	0.08 (0.00315)	
35, 36	Clearance between piston pin and piston [Basic diameter: 16 mm (0.630 in.)]		–	0.08 (0.00315)	Replace piston pin
35, 39	Clearance between piston pin and connecting-rod small end [Basic diameter: 16 mm (0.630 in.)]		–	0.07 (0.00276)	Replace connecting rod
39	Connecting rod end play		–	0.5 (0.0197)	Replace connecting rod
42, 43	Clearance between connecting-rod bearing and crankshaft [Basic diameter: 34 mm (1.34 in.)]		–	0.1 (0.0394)	Replace
43	Crankshaft end play		–	1.0 (0.0394)	Replace crankshaft
43, 47	Clearance between crankshaft and crankcase bushing I.D. [Basic diameter: 76.5 mm (3.01 in.)]		–	0.12 (0.00472)	Replace crankshaft

SAFETY

⚠ WARNING

The proper and safe lubrication and maintenance for this machine, recommended by Mitsubishi, are outlined in the OPERATION & MAINTENANCE MANUAL for these machines.

Improper performance of lubrication or maintenance procedures is dangerous and could result in injury or death. Read and understand the OPERATION & MAINTENANCE MANUAL before performing any lubrication or maintenance.

The serviceman or mechanic may be unfamiliar with many of the systems on this machine. This makes it important to use caution when performing service work. A knowledge of the system and/or components is important before the removal or disassembly of any component.

Because of the size of some of the machine components, the serviceman or mechanic should check the weights noted in this Manual. Use proper lifting procedures when removing any components.

Following is a list of basic precautions that should always be observed.

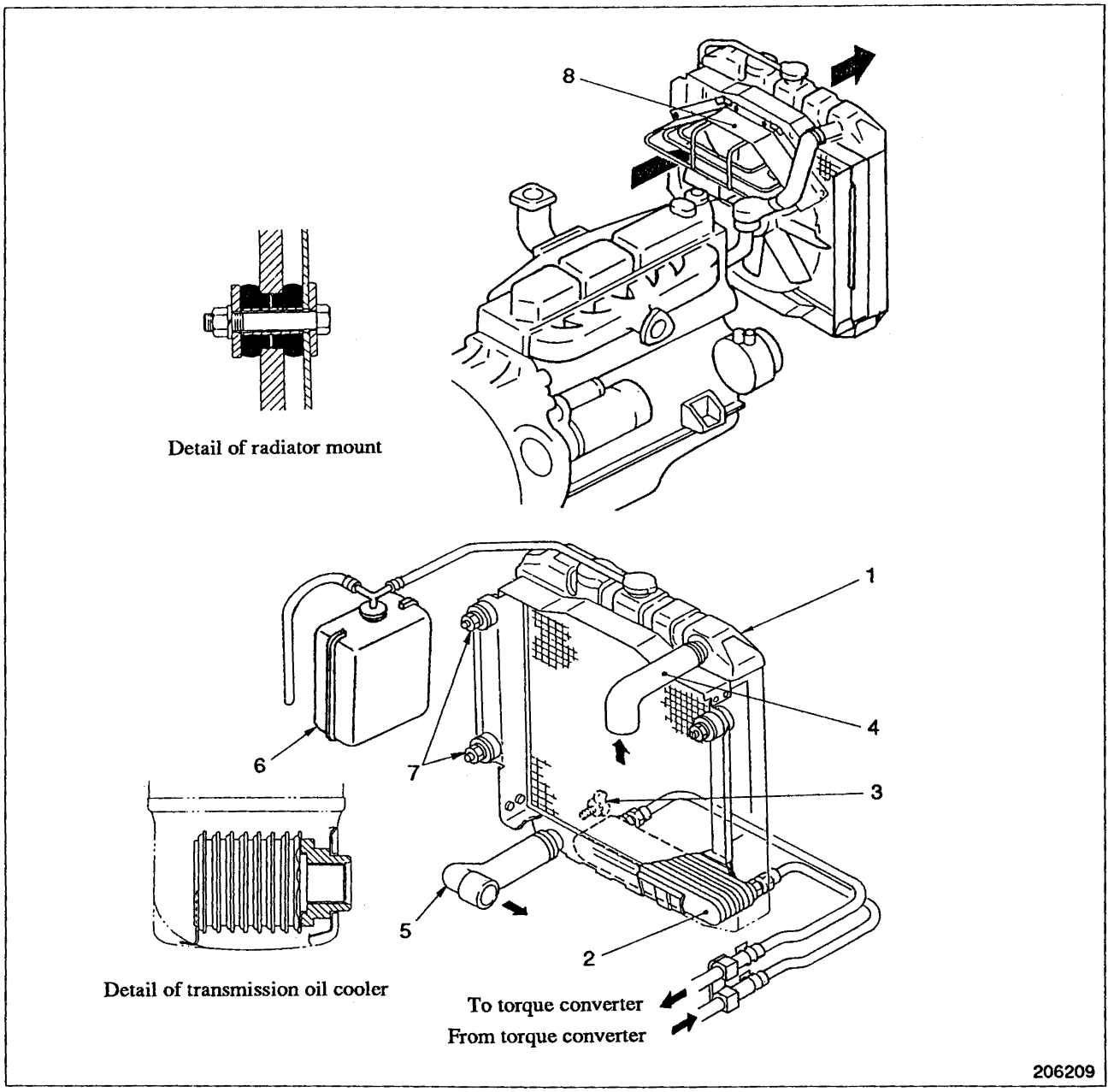
1. Read and understand all warning plates and decals on the machine before operating, lubricating or repairing the product.
2. Always wear protective glasses and protective shoes when working around machines. In particular, wear protective glasses when pounding on any part of the machine or its attachments with a hammer or sledge. Use welders gloves, hood/goggles, apron and other protective clothing appropriate to the welding job being performed. Do not wear loose-fitting or torn clothing. Remove all rings from fingers when working on machinery.
3. Do not work on any machine that is supported only by lift jacks or a hoist. Always use blocks or jack stands to support the machine before performing any disassembly.
4. Lower the forks or other implements to the ground before performing any work on the machine. If this cannot be done, make sure the forks or other implements are blocked correctly to prevent them from dropping unexpectedly.

⚠ WARNING

Do not operate this machine unless you have read and understand the instructions in the OPERATOR'S MANUAL. Improper machine operation is dangerous and could result in injury or death.

5. Use steps and grab handles (if applicable) when mounting or dismounting a machine. Clean any mud or debris from steps, walkways or work platforms before using. Always face machine when using steps, ladders and walkways. When it is not possible to use the designed access system, provide ladders, scaffolds, or work platforms to perform safe repair operations.
6. To avoid back injury, use a hoist when lifting components which weigh 23 kg [50 lb.] or more. Make sure all chains, hooks, slings, etc., are in good condition and are of the correct capacity. Be sure hooks are positioned correctly. Lifting eyes are not to be side loaded during a lifting operation.
7. To avoid burns, be alert for hot parts on machines which have just been stopped and hot fluids in lines, tubes and compartments.
8. Be careful when removing cover plates. Gradually back off the last two bolts or nuts located at opposite ends of the cover or device and pry cover loose to relieve any spring or other pressure, before removing the last two bolts or nuts completely.
9. Be careful when removing filler caps, breathers and plugs on the machine. Hold a rag over the cap or plug to prevent being sprayed or splashed by liquids under pressure. The danger is even greater if the machine has just been stopped because fluids can be hot.
10. Always use tools that are in good condition and be sure you understand how to use them before performing any service work.
11. Reinstall all fasteners with same part number. Do not use a lesser quality fastener if replacements are necessary. Do not mix metric fasteners with standard nuts and bolts.

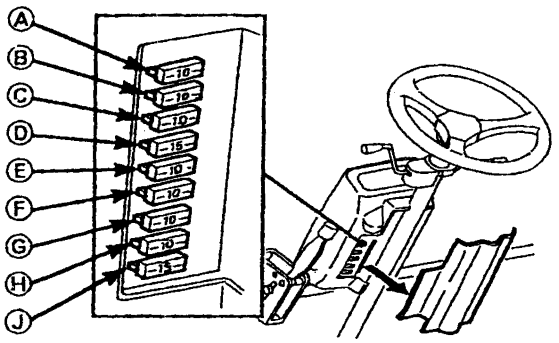
DESCRIPTION



1 Radiator
2 Transmission oil cooler
3 Drain cock
4 Radiator hose (upper)
5 Radiator hose (lower)
6 Reserve tank
7 Radiator guard
8 Fan guard

The radiator with a tube-and-fin type core comes standard. The fins are corrugated. The cooling fan is of pusher type and has eight blades to provide high cooling efficiency. The lower tank has a built-in transmission oil cooler which, in operation, is constantly removing heat from the transmission oil returning from the torque converter.

Fuses

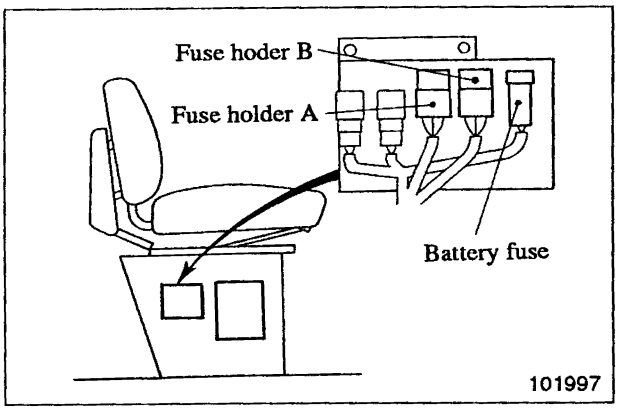


102762

Symbol	Amps	Circuit
A	10	Direction solenoid
B	10	Turn signals, instrument light
C	10	Spare power source
D	15	Front combination lights, head lights, tail & stop lights
E	10	Horn
F	10	Spare fuse
G	10	Tail & stop lights, vacuum buzzer
H	10	Backup lights
J	15	Spare fuse

Optional fuses

Fuse	Amps	Circuit
Battery fuse	15	
Fuse holder A	15	Working lights
	10	Revolving light
	10	Air dryer relay
Fuse holder B	15	Air conditioner
	5	Car heater
	20	Windshield wiper
	10	Cab

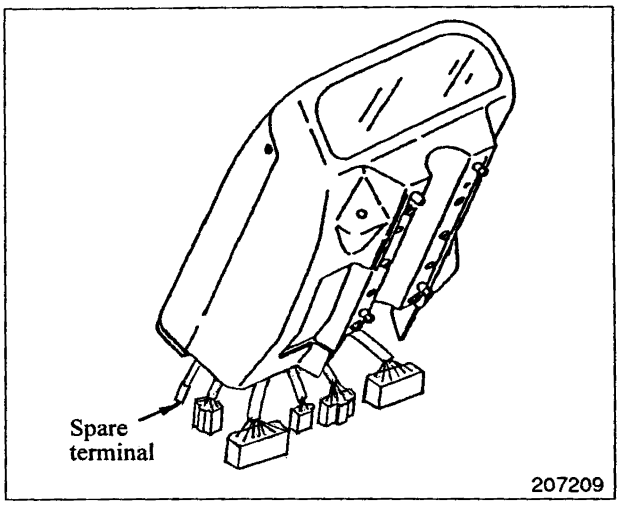


101997

Spare terminals

The spare terminal is extends from the fuse box in the control box.

Cord color: LG (light green)



207209

POWER TRAIN

(4) Tighten the universal joint to the specified torque.

Tightening torque for universal joint	71 ± 10 N·m (7.2 ± 1.0 kgf·m) [52 ± 7 lbf·ft]

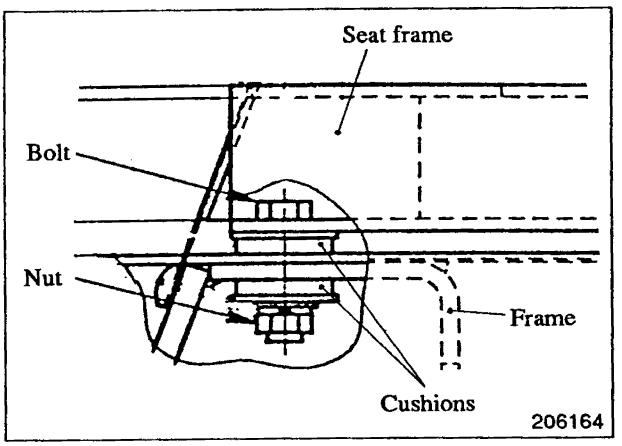
(5) Install the exhaust pipe with new gasket.

(6) Install the harnesses, making sure their connectors and terminals are tightened properly.

(7) Install the seat frame in position. When the self-lock nuts contact the plain washers, tighten 2 turns (3 mm [0.12 in.]) more.

(8) Install the overhead guard or cab in position and tighten the mounting bolts to the specified torque.

Tightening torque for overhead guard or cab bolts	145 N·m (14.8 kgf·m) [107 lbf·ft]



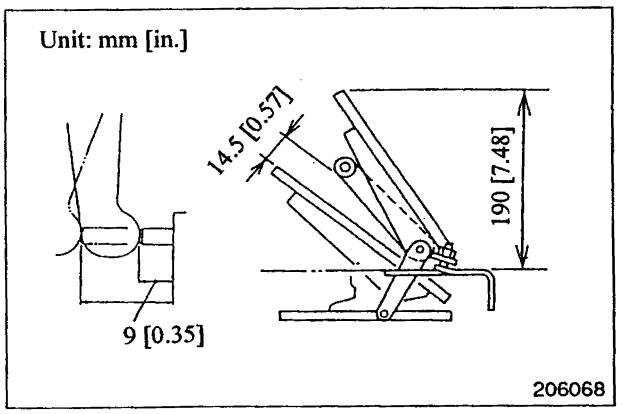
(9) Connect the parking brake cable to the brake lever with ball and nut. Make sure the operating effort of the parking brake lever is correct.

Operating effort of parking brake lever	245 to 294 N (25 to 30 kgf) [55 to 66 lbf]

(10) Connect the control cable to the inching pedal. Make sure the height of the inching pedal and the projection of the clutch valve plunger are correct.

Unit: mm [in.]

Height of inching pedal	190 [7.48]
Projection of clutch valve plunger with inching pedal released	9 [0.35]



(11) Connect the control cable to the accelerator pedal. Depress the accelerator pedal fully to make sure the injection pump lever is in the maximum injection position when the pedal is so depressed.

SUGGESTIONS FOR REMOVAL AND INSTALLATION

To remove the transmission assembly from the machine, remove it together with the engine. Make reference to POWER TRAIN.

Start by:

a) drain the transmission oil from the drain plug

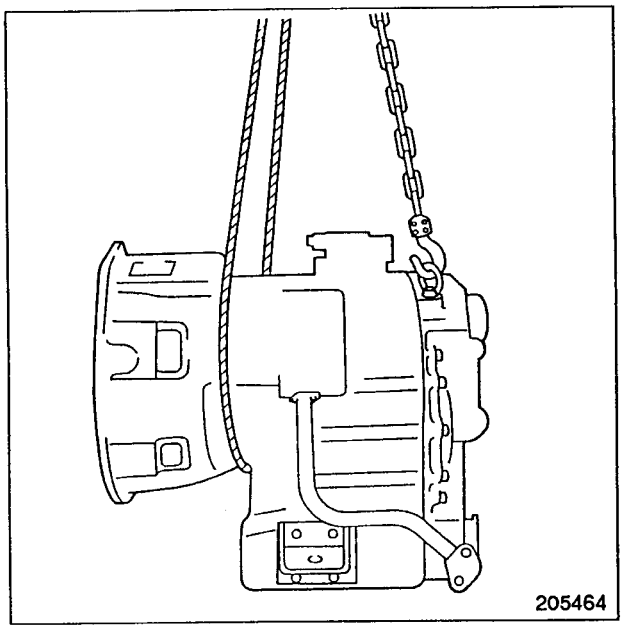
b) disconnect the wire harnesses from the transmission

Transmission removal

(1) To separate the transmission from the engine, put the engine on a stable stand, and support the transmission with wood blocks.

(2) Remove the hydraulic pump from the transmission.

(3) Fasten a hoist to the transmission and lift the transmission just enough to take the weight of the transmission. To lift the transmission, tie a wire rope around the torque converter case and install an eye bolt to the transmission cover, hitching a chain with lever block to the eye bolt as shown.



(4) Remove the bolts that hold the flexible plate through the access hole in the torque converter case.

(5) Separate the transmission from the engine by lifting it with a hoist.

Torque converter removal

Remove the torque converter as an assembly from the transmission by separating the stator shaft from the transmission input shaft.

Torque converter installation

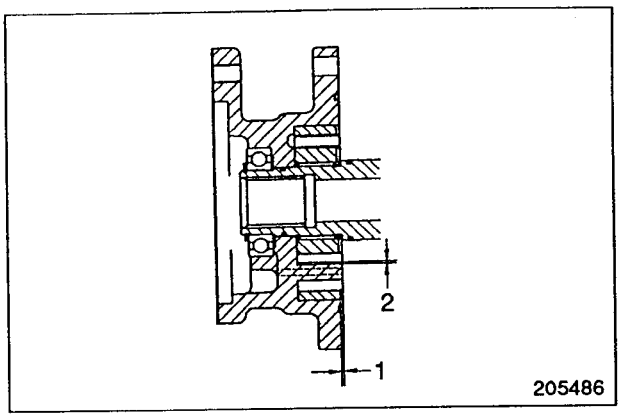
(1) Couple the torque converter to the transmission. Make sure that the distance between the end face of the torque converter case and the mating face of the flexible plate is 25 mm [0.984 in.]. If this

Inspection

Oil pump

(1) Put the internal gear and pump gear in the pump case, and measure top clearance 2.

(2) Using a dial indicator, measure side clearance 1 between the gears and pump case.



A = Assembly standard
B = Repair or service limit

Side clearance 1, mm [in.]	A	0.040 to 0.078 [0.001 57 to 0.003 07]
	B	0.09 [0.003 5]
Top clearance 2, mm [in.]	A	0.3 to 0.345 [0.011 8 to 0.013 6]
	B	0.35 [0.013 8]

Stator shaft

(1) Check the splines for wear or damage.

(2) Check the oil passages for clogging.

Friction plates and mating plates

(1) Check for sign of seizure, uneven contact, warpage or excessive wear.

(2) Check the splines for wear or damage.

Clutch drums

(1) Check the mating plate sliding surfaces for wear or damage.

(2) Check the clutch piston sliding surfaces for wear or damage.

TESTING AND ADJUSTING

Oil Pressure Measurement

(1) Connect a pressure gauge (1 961 kPa (20 kgf/cm^2) [285 psi]) to the tap for the main pressure.

Special tools:
* Connector 64309-17733
* Hose 64309-17722
* Connector 64309-17731
* Gauge 64309-17713

Tools marked with an asterisk (*) are involved in the gauge kit 64309-17701.

(2) Start and run the engine at low idler. Check to make sure that the oil level is correct in the transmission.

(3) Warm up transmission oil until the temperature gauge needle moves to the black line of the white zone.

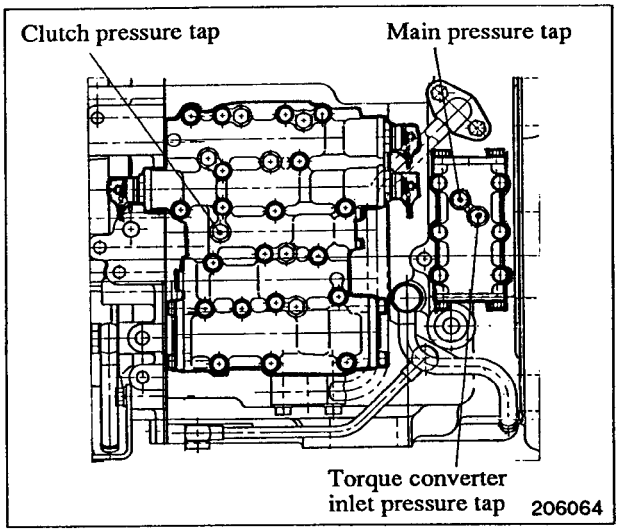
(4) Run the engine at 1,000 to 1,500 rpm.

NOTE

Measure the low idle speed of the engine with an engine tachometer.

A = Assembly standard

Main pressure (engine at 1,500 ± 100 rpm)	A	1,226 to 147 kPa (12.5 ± 1.5 kgf/cm^2) [178 ± 21 psi]
Clutch pressure (engine at 1,500 ± 100 rpm)		
Torque converter inlet pressure (engine at 1,500 ± 100 rpm)	A	686 ± 98 kPa (7 ± 1 kgf/cm^2) [100 ± 14 psi]
Lubrication line pressure (engine at 1,500 ± 100 rpm)	A	98 ± 49 kPa (1.0 ± 0.5 kgf/cm^2) [14 ± 7 psi]



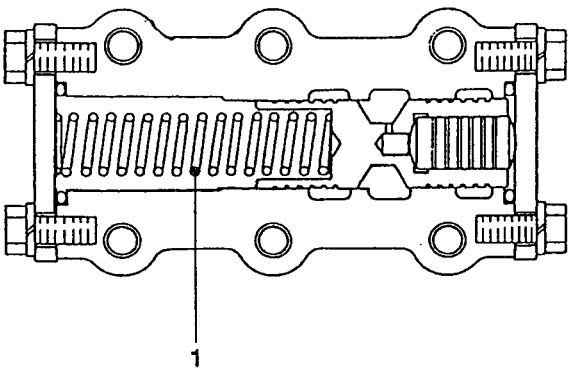
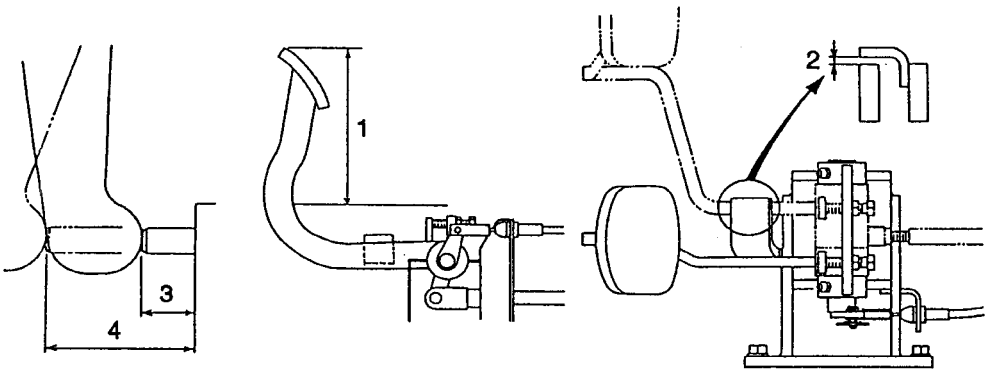
Other hydraulic pressure test tools (reference)

Tools for connecting a pressure gauge (588 kPa (6 kgf/cm^2) [85 psi]) to the torque converter inlet pressure tap

Special tools:
* Connector 64309-17733
* Hose 64309-17722
* Connector 64309-17731
* Gauge 64309-17714

Tools marked with an asterisk (*) are involved in the gauge kit 64309-17701.

A = Assembly standard B = Repair or service limit

Item		Truck model	FD100	FD115	FD135	FD150A
Main regulator valve	Free length of main regulator valve spring 1, mm [in.] {Spring rate: N/mm (kgf/mm) [lbf/in.]}	A	112 [4.41] {k = 4.989 (0.508 7) [28.486]}			
		B	109 [4.29]			
	 200554A					
Inching pedal control	Inching pedal height 1, mm [in.] (from frame to top of pedal pad)	A	190 [7.5]			
	Clearance between inching cam follower and brake pedal 2, mm [in.]	A	14.5 [0.57]			
	Clutch valve plunger stroke with inching pedal released 3,mm [in.]	A	9 [0.35]			
	Clutch valve plunger stroke at which brakes start to be applied 4, mm [in.]	A	14 [0.55]			
	 205476					

Inspection

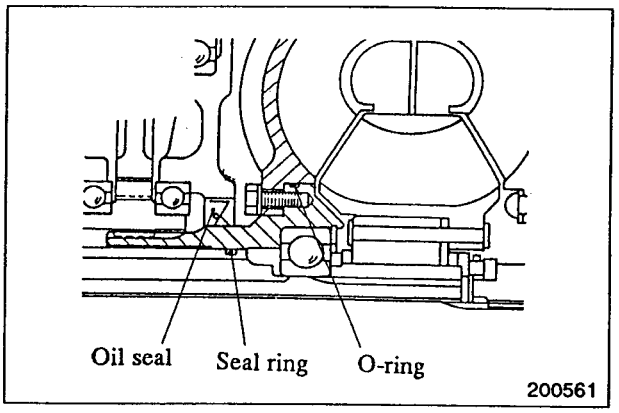
Pump (impeller)

(1) Check for cracks.

(2) Check for oil leaks due to looseness of the bolts holding the boss to the pump, or defective O-ring.

(3) Check the face of the pump boss in contact with the oil seal for wear

(4) Check the face of the pump boss in contact with the seal ring.



Stator

(1) Check the blades for cracks. Also check the fit of the stator on the clutch cam.

(2) Check the clutch hub and cam for wear or flaws.

(3) Check the springs for damage. Also check the spring caps for wear or distortion.

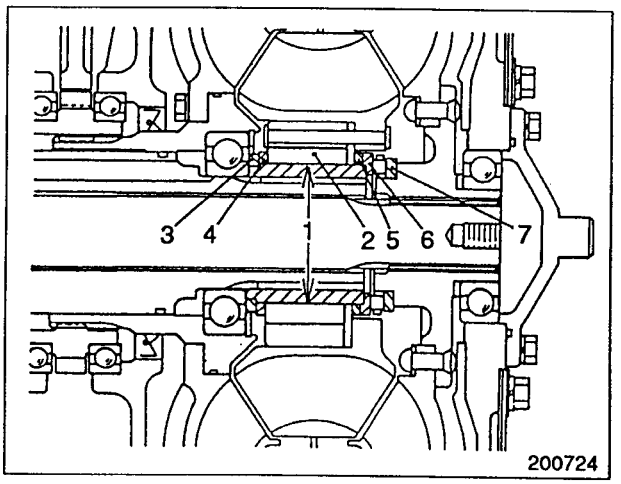
(4) Check the rollers for flaws, distortion or flat spots due to wear.

(5) Check the clutch hub splines for defects.

(6) Check the thrust washers for wear or other defects.

A = Assembly standard
B = Repair or service limit

Outside diameter of clutch hub 1, mm [in.]	A	67.97 to 67.951 [2.676 0 to 2.675 23]
	B	67.8 [2.669]
Diameter of clutch rollers 2, mm [in.]	A	10.185 to 10.2 [0.400 98 to 0.402]
	B	10.1 [0.398]
Thickness of thrust washer 3, mm [in.]	A	4.95 to 5 [0.194 9 to 0.197]
	B	4.8 [0.189]
Thickness of thrust washer 4, mm [in.]	A	3.95 to 4 [0.155 5 to 0.157]
	B	3.8 [0.150]
Thickness of thrust washer 5, mm [in.]	A	2.9 to 3 [0.114 to 0.118]
	B	2.8 [0.11]



Thickness of thrust washer 6, mm [in.]	A	4.9 to 5 [0.193 to 0.197]
	B	4.8 [0.189]
Thickness of thrust washer 7, mm [in.]	A	4.95 to 5 [0.194 9 to 0.197]
	B	4.8 [0.189]

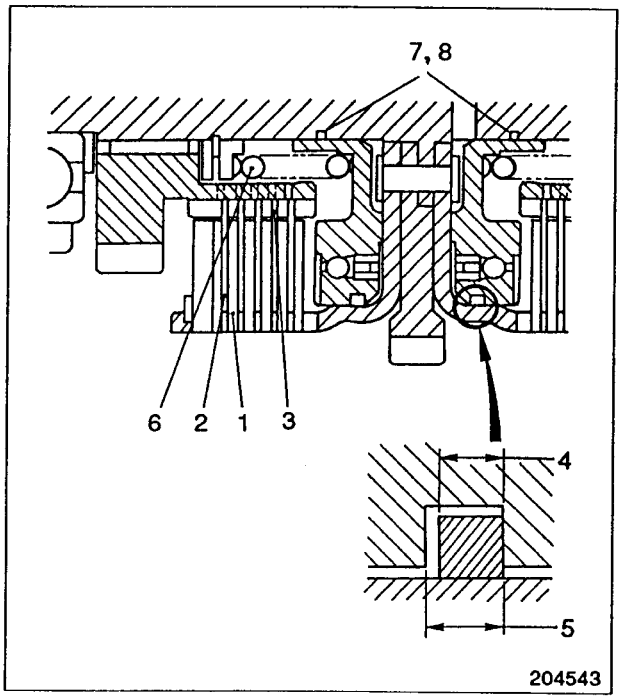
Gears (F1, F2, F3, R1, R2, R3 drive)

(1) Check the gears and splines for wear or damage.

(2) Check the gear surfaces in contact with the needle roller bearings for wear or damage.

A = Assembly standard
B = Repair or service limit

Thickness of mating plate 1, mm [in.]	A	2.3 ± 0.07 [0.091 ± 0.002 8]
	B	2.1 [0.083]
Thickness of friction plate 2, mm [in.]	A	2.6 ± 0.1 [0.102 ± 0.004]
	B	2.2 [0.087]
Free movement of friction plate on gear 3, mm [in.]	A	0.10 to 0.30 [0.003 9 to 0.011 8]
Width of piston seal ring 4, mm [in.]	A	$4\ ^{-0.01}_{-0.03}$ [$0.16\ ^{-0.000\ 4}_{-0.001\ 2}$]
	B	3.5 [0.138]
Width of piston seal ring groove in piston 5, mm [in.]	A	$4\ ^{+0.2}_{+0.1}$ [$0.16\ ^{+0.008}_{+0.004}$]
	B	4.5 [0.177]
Free length of clutch spring 6, mm [in.] {Spring rate: N/mm (kgf/mm) [lbf/in.]}	A	62.9 [2.48] {k = 39.148 (3.992) [223.541]
	B	60 [2.36]
Width of clutch piston seal ring 7, mm [in.]	A	2.5 ± 0.05 [0.098 ± 0.002 0]
	B	2.0 [0.079]
Width of clutch piston seal ring groove 8, mm [in.]	A	$2.5\ ^{+0.2}_{+0.1}$ [$0.098\ ^{+0.008}_{+0.004}$]
	B	3.0 [0.118]



(5) Move the direction lever to the forward position, and gradually depress the accelerator pedal all the way. Under this condition, measure the stall speed with an engine tachometer.

Stall speed (tolerance: ±100 rpm)	1,760 rpm

⚠ CAUTION

Do not attempt to depress the inching pedal. Do not continue operation in stall condition for more than 30 seconds. A failure to follow this precaution would result in destruction of the torque converter.

(6) Similarly measure the stall speed for reverse drive.

NOTE

1) Any stall speed within ±100 rpm tolerance of the specification is satisfactory.
2) If the engine or torque converter is changed, the stall speed will vary since the stall speed is determined by the combination of engine and torque converter.

10-m [33-ft] Start Acceleration Test

(1) Stand ready to start with the engine running at low idle, the direction lever in the neutral position and the speed selector switch in D (automatic 3-speed) position.

(2) At the signal, move the direction lever to the forward position and, at the same time, depress the accelerator pedal all the way.

(3) Measure the time required for the truck to travel 10 meters [33 feet] with a stop watch.

(4) Conduct the same test for reverse travel, too.

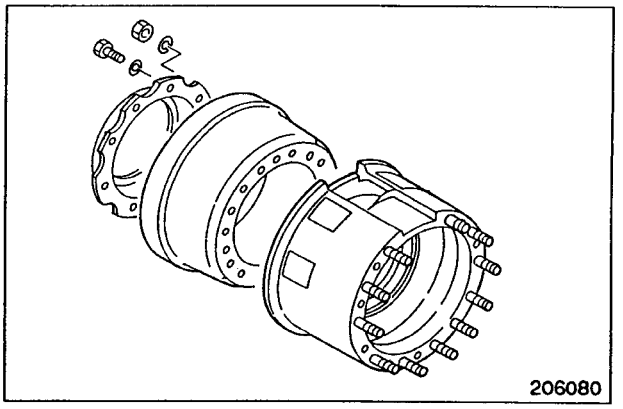
Travel time (no load)	5 seconds, maximum

FRONT AXLE AND REDUCTION DIFFERENTIAL

b) when assembling the hub and drum after replacing the parts, tighten the drum nuts with washers to the specified torque and upset the head of each bolt crosswise

c) use gasket adhesive (Three Bond No. 1215) on the mating surface of the oil deflector when installing the deflector

Tightening torque for brake drum nuts	359 ± 36 N·m (36.6 ± 3.7 kgf·m) [265 ± 27 lbf·ft]


206080

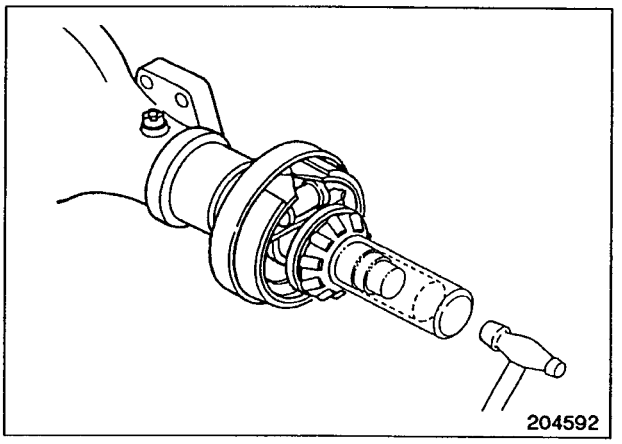
NOTE

Replace the oil seals of the front axle housing.

Suggestions

(1) Tapered roller bearing (inner race) installation

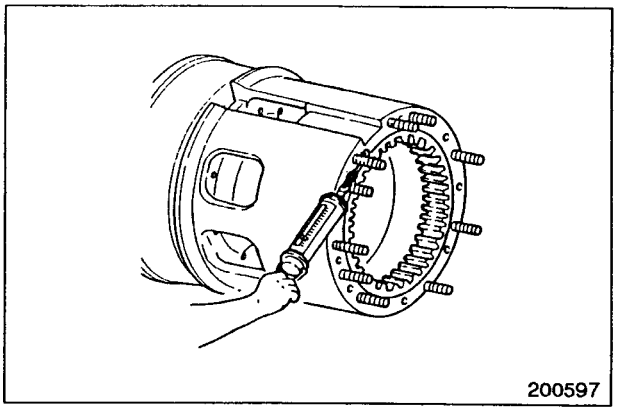
Using an installer, install the tapered roller bearing inner race in position, along with the oil seal retainer.


204592

(2) Wheel hub bearing preload adjustment

Hook a spring scale to one of the hub bolts. Pull the scale in the tangential direction and take a reading on the scale just when the hub begins to rotate. Adjust the preload by means of the nut that holds the ring gear. If the bearings have long been in service, it is advisable to aim at a value of preload in the lower half of the range.

Preload for wheel hub bearing (force applied in tangential direction)	118 to 157 N (12 to 16 kgf) [26 to 35 lbf]


200597

NOTE

Adjust the hub bearing preload every 2,400 hours or 1 year.

REAR AXLE

Inspection

(1) Cylinder tube

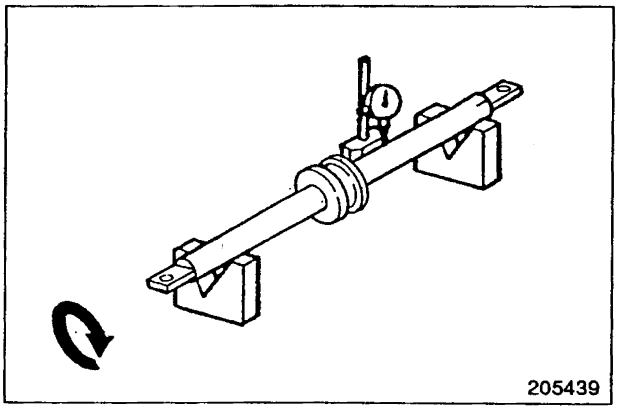
(a) Check the bore surface for wear, scuffs, scratches or rust.

(b) Check the welds for cracks.

(2) Piston rod

(a) Using V-blocks and a dial indicator, check runout at the center.

(b) Check the rod surface for rust, scratches or dents. Replace the rod if the threads are stripped or badly damaged.



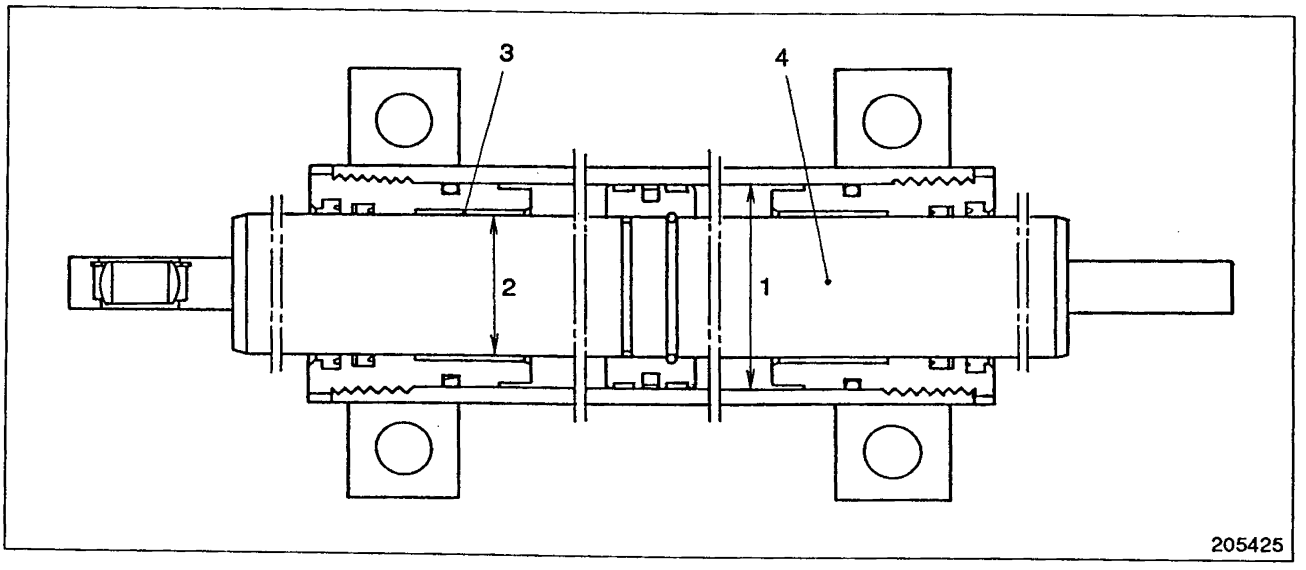
(3) Rings and packings

(a) Check the packings and rings for damage or distortion.

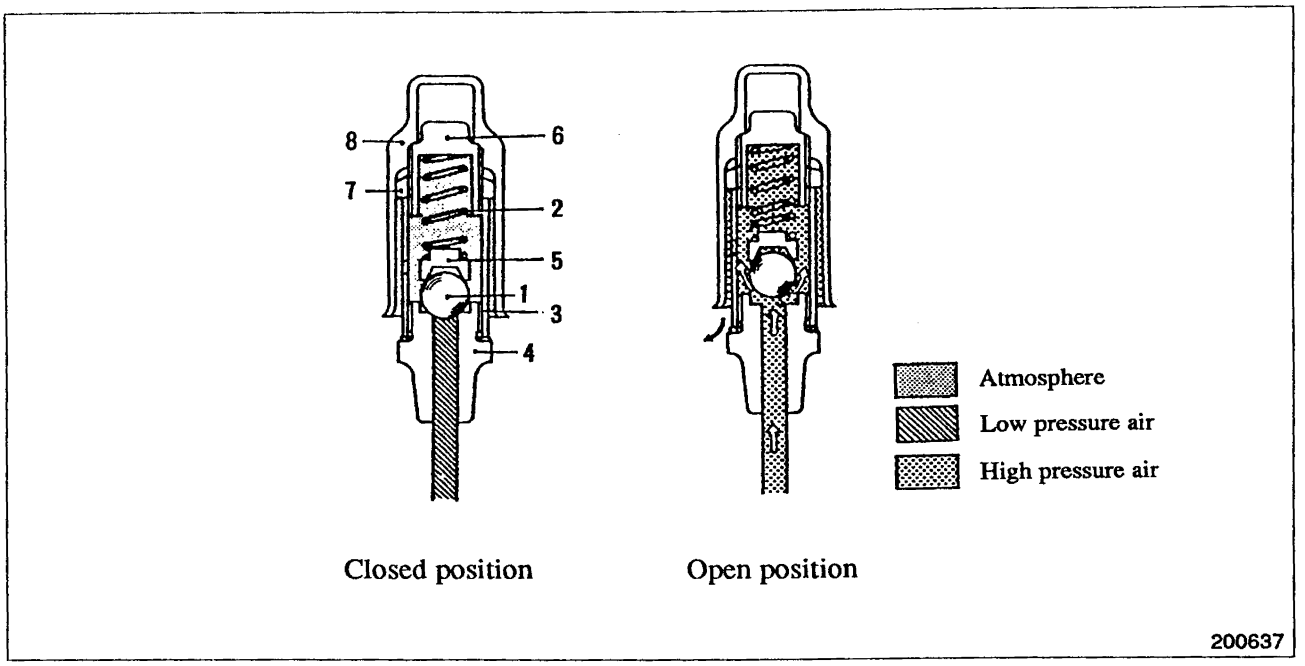
(b) Also check for deterioration due to aging.

Item		Service data
Inside diameter of cylinder tube 1, mm [in.]	A	115 [4.53]
	B	115.15 [4.533 5]
Diameter of piston rod 2, mm [in.]	A	80 [3.15]
Clearance between piston rod and bushing 3, mm [in.]	A	0.1 [0.004]
	B	0.2 [0.008]
Runout of piston rod 4, mm [in.]	B	0.3 [0.012]

A = Assembly standard
B = Repair or service limit



Safety valve

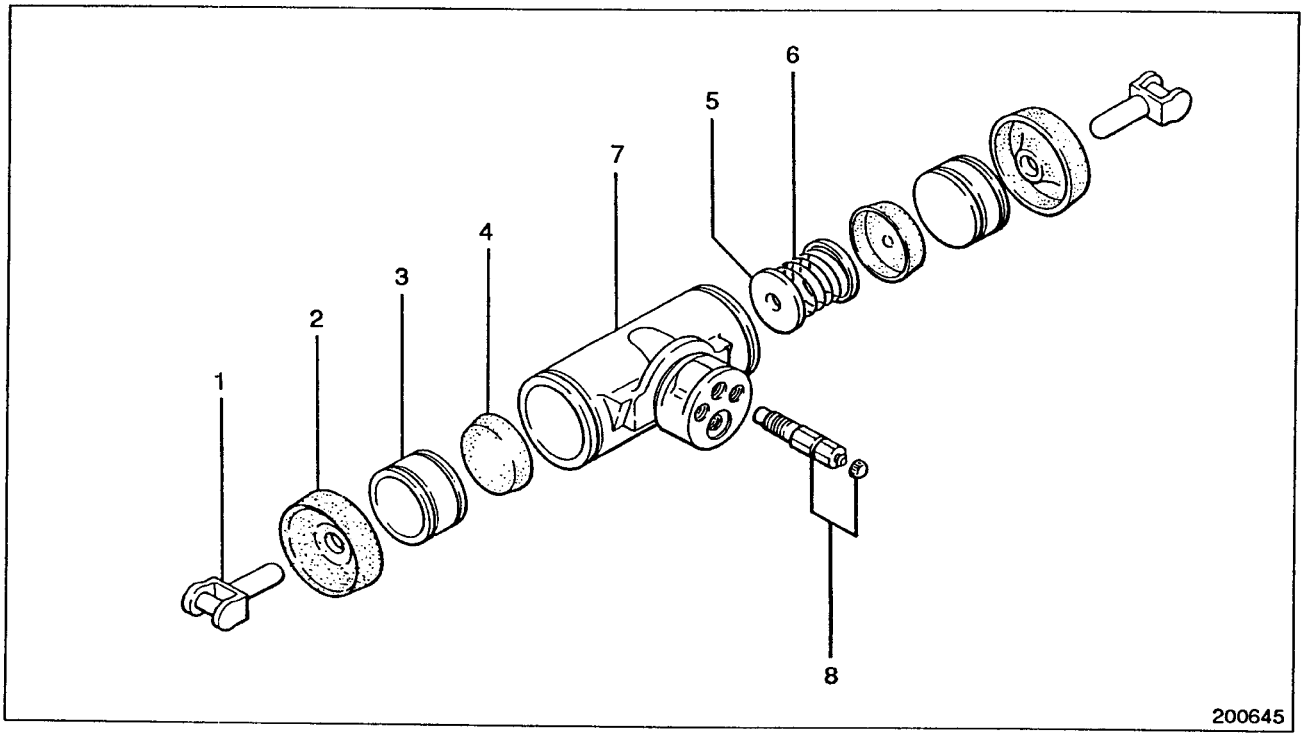


1 Valve ball
2 Spring
3 Valve case
4 Valve body
5 Spring retainer
6 Adjusting screw
7 Nut
8 Dust cover

The safety valve is a spring-loaded ball valve. Normally, the ball is being pushed down against its seat formed of the valve body by the force of the spring seated on the retainer. As the air tank pressure, acting on the bottom side of the ball, rises abnormally, the force created by this pressure overcomes the spring force to lift the ball off its seat and thus bleed the pressure out to the atmosphere.

WHEEL CYLINDERS

Disassembly



Sequence

1 Push rod
2 Dust cover
3 Piston
4 Piston cup
5 Spring seat
6 Return spring
7 Cylinder body
8 Bleeder screw

Brake Control Valve

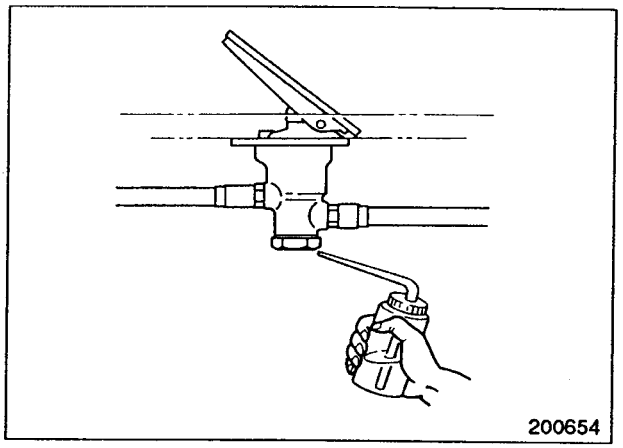
(1) Air leak test

(a) Make sure the air tank pressure is correct.

(b) Release the brake pedal. Apply soapy water to the exhaust port of the control valve to see if any air bubble forms there. Air bubbles mean that the exhaust valve inside is not seated tight.

(c) Depress the brake pedal all the way, and conduct the same test on the exhaust valve to check for air leaks.

(d) If air leaks, remove the plug from the exhaust port and take out the exhaust valve for inspection.



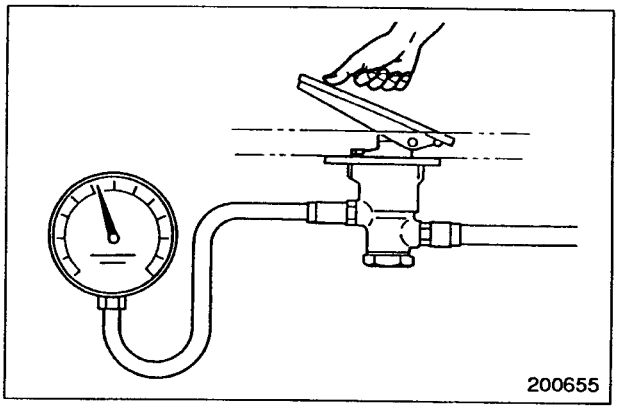
(2) Function test

(a) Connect a test pressure gauge with PT 3/8 connector to the outlet port of the brake control valve.

(b) Start the engine and raise the tank pressure to the normal level, then stop the engine.

(c) Have someone get into the truck and keep on depressing the brake pedal. Compare the reading of the test pressure gauge with the indication of the pressure gauge on the instrument panel, making sure these pressure gauge readings are coincide with each other.

(d) If the pressure gauge indicate pressure drop when the pedal is kept depressed, check the air system for leakage, or adjust the air governor.

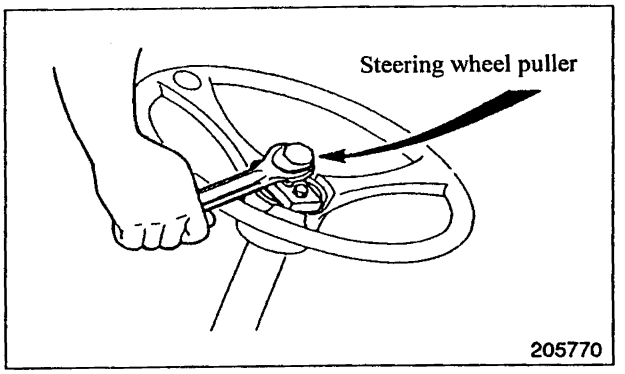


Suggestion for removal

Steering wheel removal

Use Steering Wheel Puller (special tool).

Special tool:
Steering wheel puller 91268-10600



⚠CAUTION

Do not hit the end of steering shaft when the steering wheel is removed.

Inspection

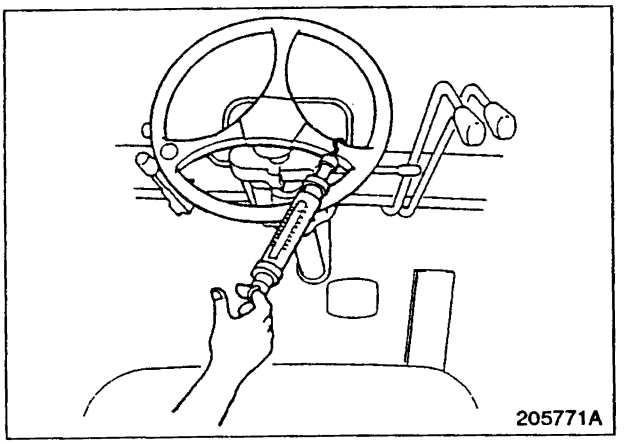
(1) Steering wheel free play

Check the free play with the engine running at low idle.

(2) Steering effort

(a) Set the parking brake. Run the engine until the hydraulic oil temperature is 40°C to 60°C [104°F to 140°F].

(b) Hook a spring scale to the rim of the steering wheel. Pull the scale in the tangential direction and look at the reading on the scale just when the wheel begins to turn to find the free play. Keep the ports open.



Steering effort	16 N·m (1.65 kgf·m) [12 lbf·ft]
Spring scale reading	98 N (10 kgf) [22 lbf]

(3) Air bleeding

If any air is in the steering system, the system could have noise or vibration. To bleed air from the steering system, use the following procedure:

(a) Raise the rear wheels with a jack. Refer to REAR AXLE.

(b) Depress the accelerator pedal several times and turn the steering wheel from lock to lock.

SPECIFICATIONS

Item \ Truck model			FD100	FD115	FD135	FD150A
Gear pump		Type	Gear			
		Model	P20300			
		Rated output, liter [U.S. gal]/rpm	205 [54]/2 200 rpm			
		Drive	Directly driven by torque converter			
Priority valve		Model	VLE61C120B			
		Relief valve setting, kPa (kgf/cm²) [psi]	11 768 (120) [1 706]			
Control valve		Relief valve setting, kPa (kgf/cm²) [psi]	$17\ 162^{+490}_{0}$ (175^{+5}_{0}) [$2\ 489^{+71}_{0}$]			
Flow regulator valve		Control flow, liter [U.S. gal]/min	150 [40]			
3.3 m [130 in.] mast	Lift cylinders	Inside diameter, mm [in.]	115 [4.53]		125 [4.92]	
		Stroke, mm [in.]	1 650 [64.96]			
	Tilt cylinders	Inside diameter, mm [in.]	120 [4.72]		130 [5.12]	
		Stroke, mm [in.]	395 [15.55]			
Hydraulic tank capacity, liter [U.S. gal]			H level: 186 [49] N level: 172 [45] L level: 141 [37]		H level: 218 [58] N level: 204 [54] L level: 173 [46]	

(2) Slowly push the lift control lever to lower the inner mast.

(3) Remove high-pressure hoses as follows:

Disconnect the high-pressure hose from the connector at the bottom of each lift cylinder. Direct the oil flow into a container.

(4) Remove stopper bolts as follows:

(a) Remove the stopper bolt at the top of each lift cylinder. Lift the inner mast to separate it from the lift cylinders. To lift the inner mast, hitch a sling to the mast with protective wad as shown.

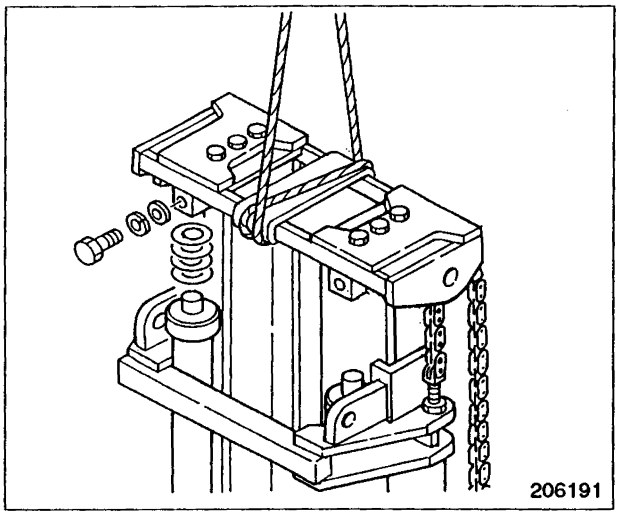
NOTE

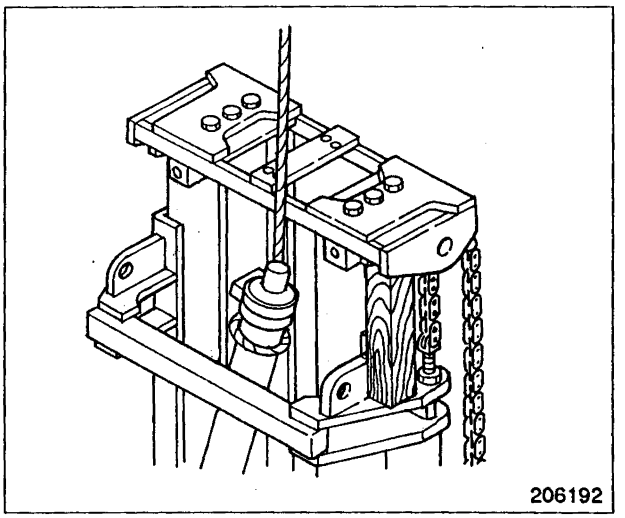
The rod end of either lift cylinder is shimmed. Before removing the stopper bolts, make a record of the amount of shims and a shimmed cylinder.

(b) Put wood blocks under the inner mast and detach the sling. Use the blocks strong enough to support the mast.

(5) Remove lift cylinders as follows:

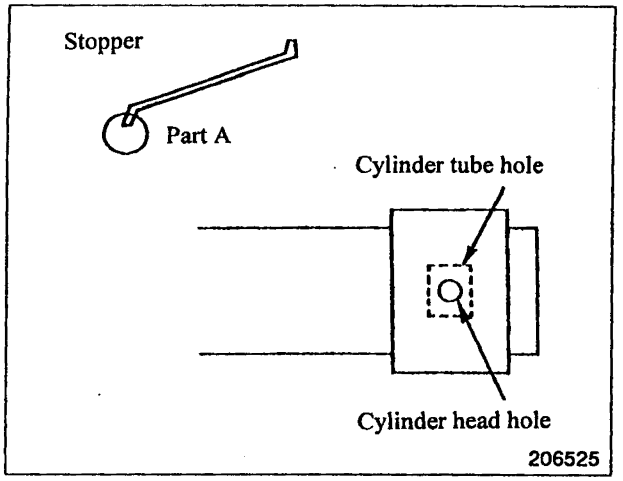
Fasten a hoist to the lift cylinder from the rear side of the mast, and remove the cylinder. Fasten the hoist to the cylinder before removing the cylinder clamp.





(6) Stopper installation

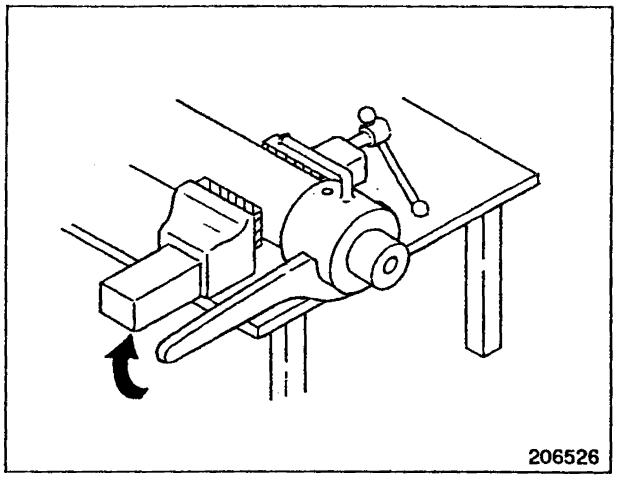
Align the stopper holes in the cylinder tube and head. Put the part "A" of the stopper in the holes.



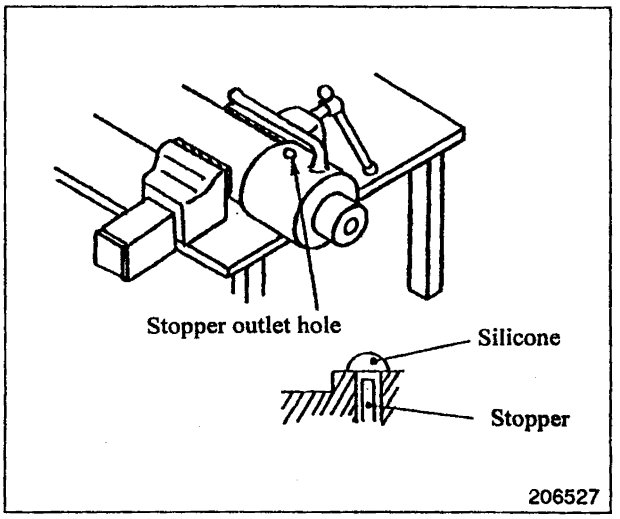
Using a hook wrench, turn the head slowly in the direction of the arrow to install the stopper until its outer end sinks into the hole.

NOTE

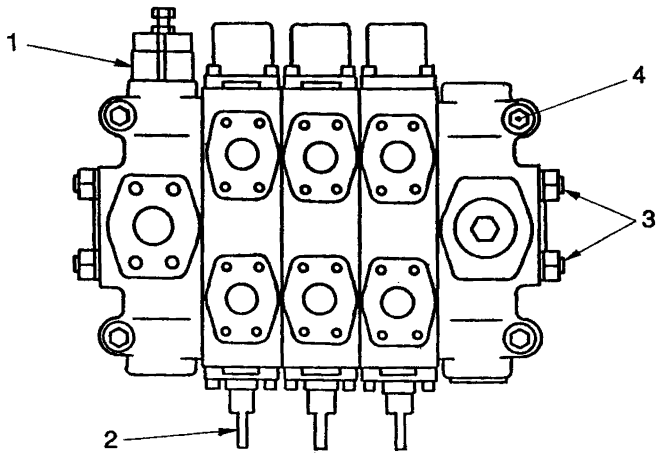
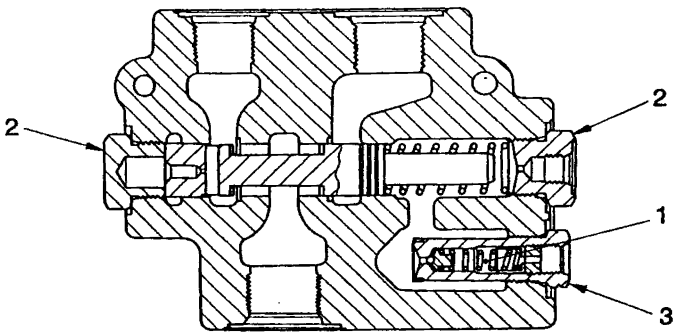
Do not damage the O-rings when installing the stopper.



After the stopper has been installed properly, fill the stopper hole with sealing (silicone) compound.



A = Assembly standard B = Repair or service limit

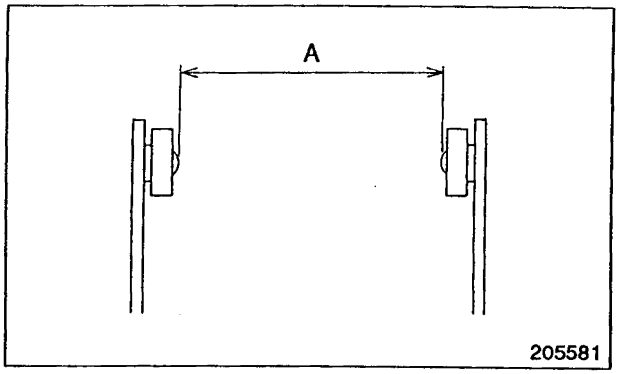
Item			Truck model	FD100	FD115	FD135	FD150A
Control valve	Main relief valve setting 1, kPa (kgf/cm²) [psi]		A	17 162$^{+490}_{0}$ (175$^{+5}_{0}$) [2 489$^{+71}_{0}$]			
	Spool operating effort, N (kgf) [lbf]		A	294 (30) [66] maximum			
	Tightening torque, N·m (kgf·m) [lbf·ft]	Tie bolts 2	A	98 to 118 (10 to 12) [72 to 87]			
		Control valve bolts 3	A	60 (6.1) [44]			
	 206207						
Priority valve	Relief valve setting 1, kPa (kgf/cm²) [psi]		A	11 768 (120) [1 706]			
	Tightening torque, N·m (kgf·m) [lbf·ft]	Plugs 2	A	44 (4.5) [33]			
		Relief valve 3	A	21 (2.1) [15]			
	 200662						

(3) Lateral clearance between outer and inner masts

(a) Measure the distance A between the side rollers, left and right, of the outer mast, and adjust this distance to the specification.

Unit: mm [in.]

Item	FD100/FD115/ FD135	FD150A
Distance A	754 ± 0.5 [29.86 ± 0.020]	748 ± 0.5 [29.45 ± 0.020]



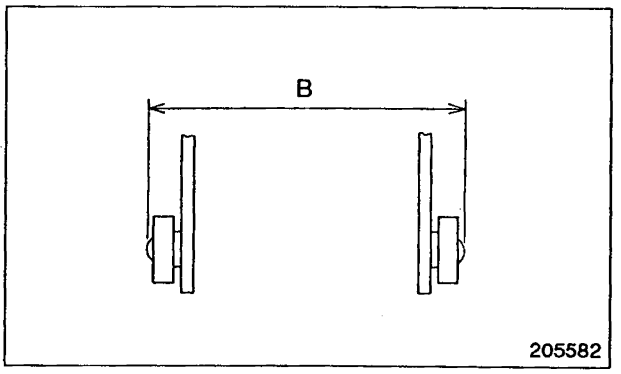
NOTE

Measure the distance A between the innermost points of the rollers.

(b) Measure the distance B between the side rollers, left and right, of the inner mast, and adjust this distance to the specification.

Unit: mm [in.]

Item	FD100/FD115/ FD135	FD150A
Distance B	890 ± 0.5 [35.04 ± 0.020]	884 ± 0.5 [34.80 ± 0.020]



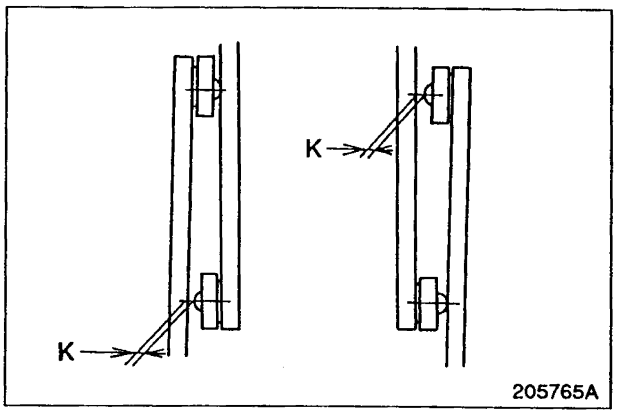
NOTE

Measure the distance B between the outermost points of the rollers.

(c) At the maximum fork height, push the inner mast to one side of the outer mast and measure the clearance K on the other side.

Unit: mm [in.]

Clearance K	0.5 to 1.5 [0.020 to 0.059]



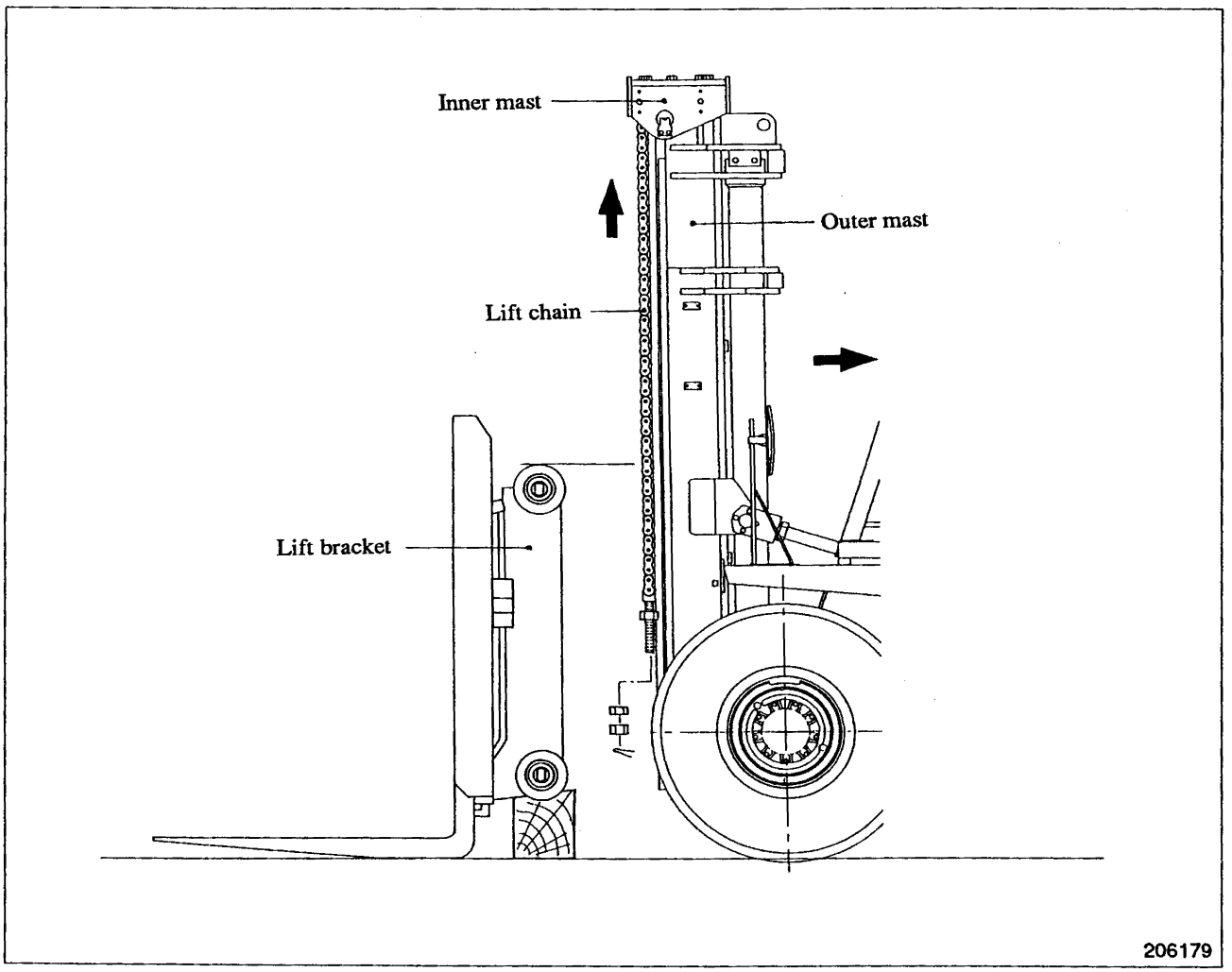
REMOVAL AND INSTALLATION

Removal

Start by:

a) start the engine and move the forks to the minimum spread position

b) tilt the mast to vertical position, lower the forks to level floor and support the lift bracket with wood block



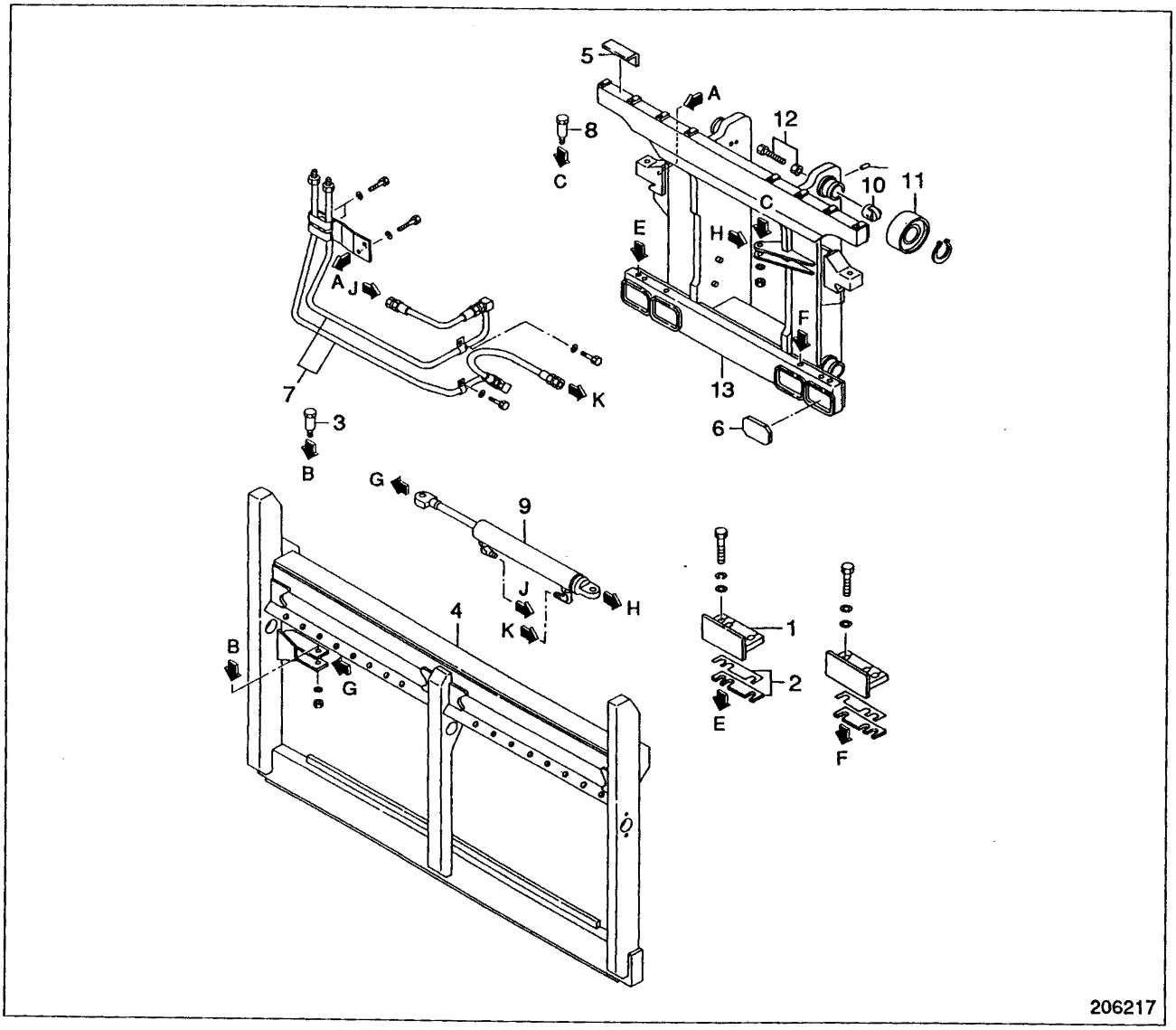
SIDE SHIFTER ASSEMBLY

Disassembly

Start by:

a) lay the side shifter assembly on the wood blocks with the lift bracket down

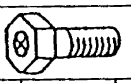
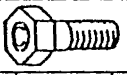
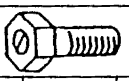
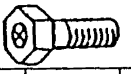
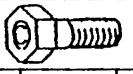
b) have a container available for catching the oil that will flow out of the cylinder and hoses.

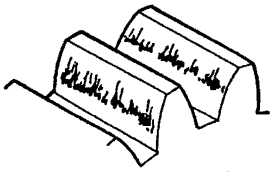
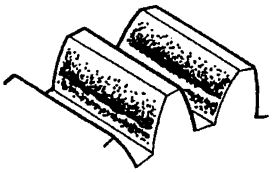
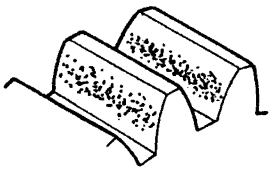
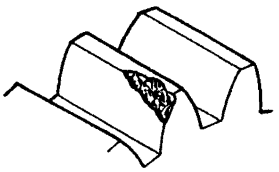
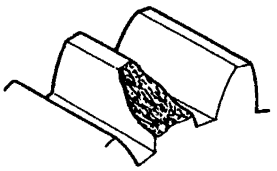
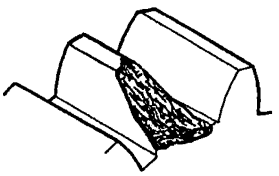


Sequence

1 Support [Bolts and nuts]
2 Shims
3 Bolt [Nut and washer]
4 Fork carriage
5 Slider block
6 Slider block
7 Pipes and hoses [Clamp, bolts, washers and plate]
8 Bolt [Nut and washer]
9 Hydraulic cylinder
10 Side roller [Pin]
11 Main roller [Snap ring]
12 Bolt and nut
13 Lift bracket

TIGHTENING TORQUES FOR STANDARD BOLTS AND NUTS

	Nominal size		Pitch		With spring washer 101656								
													
Metric fine thread	mm	in.	mm	in.	N·m	kgf·m	lbf·ft	N·m	kgf·m	lbf·ft	N·m	kgf·m	lbf·ft
	6	0.24	1	0.04	7.4	0.75	5.4	9.6	0.98	7.1	12.7	1.3	9.4
	8	0.32	1.25	0.05	16.7	1.7	12.3	22.6	2.3	16.6	30.4	3.1	22.4
	10	0.39	1.25	0.05	34.3	3.5	25.3	45.1	4.6	33.3	69.6	7.1	51.4
	12	0.47	1.25	0.05	63.7	6.5	47.0	82.4	8.4	60.8	122.6	12.5	90.4
	14	0.55	1.5	0.06	102.0	10.4	75.2	132.4	13.5	97.6	192.2	19.5	141.8
	16	0.63	1.5	0.06	154.9	15.8	114.3	202.0	20.6	149.0	287.3	29.3	211.9
	18	0.71	1.5	0.06	224.6	22.9	165.6	292.2	29.8	215.5	413.8	42.2	305.2
	20	0.79	1.5	0.06	310.9	31.7	229.3	404.0	41.2	298.0	573.7	58.5	423.1
	22	0.87	1.5	0.06	413.8	42.2	305.2	537.4	54.8	396.4	763.0	77.8	562.7
	24	0.95	1.5	0.06	547.2	55.8	403.6	711.0	72.5	524.4	1 006.2	102.6	742.1
	27	1.06	1.5	0.06	794.3	81.0	585.9	1 032.6	105.3	761.6	1 451.4	148.0	1 070.5
	30	1.18	1.5	0.06	1 100.3	112.2	811.5	1 430.8	145.9	1 055.3	2 012.3	205.2	1 484.2
	33	1.30	1.5	0.06	1 467.1	149.6	1 082.1	1 907.4	194.5	1 406.8	2 680.2	273.3	1 976.8
	36	1.42	1.5	0.06	1 918.2	195.6	1 414.8	2 493.8	254.3	1 839.4	3 497.1	356.6	2 579.3
	39	1.54	1.5	0.06	2 461.5	251.0	1 815.5	3 198.9	326.2	2 359.4	4 469.9	455.8	3 296.8
	Nominal size		Pitch		Without spring washer 101656								
													
	6	0.24	1	0.04	8.6	0.88	6.4	10.8	1.1	8.0	14.7	1.5	10.8
	8	0.32	1.25	0.05	19.6	2.0	14.5	26.5	2.7	19.5	36.3	3.7	26.8
	10	0.39	1.25	0.05	41.2	4.2	30.4	53.0	5.4	39.1	81.4	8.3	60.0
	12	0.47	1.25	0.05	74.5	7.6	55.0	97.1	9.9	71.6	144.2	14.7	106.3
	14	0.55	1.5	0.06	119.6	12.2	88.2	155.9	15.9	115.0	226.5	23.1	167.1
	16	0.63	1.5	0.06	182.4	18.6	134.5	237.3	24.2	175.0	338.3	34.5	249.5
	18	0.71	1.5	0.06	263.8	26.9	194.6	343.2	35.0	253.2	487.4	49.7	359.5
	20	0.79	1.5	0.06	365.8	37.3	269.8	475.6	48.5	350.8	674.7	68.8	497.6
	22	0.87	1.5	0.06	486.4	49.6	358.8	632.5	64.5	466.5	897.3	91.5	661.8
	24	0.95	1.5	0.06	643.3	65.6	474.5	836.5	85.3	617.0	1 183.7	120.7	873.0
	27	1.06	1.5	0.06	934.6	95.3	689.3	1 216.0	123.9	896.2	1 707.3	174.1	1 259.3
	30	1.18	1.5	0.06	1 294.5	132.0	954.8	1 682.8	171.6	1 241.2	2 367.3	241.4	1 746.0
	33	1.30	1.5	0.06	1 726.0	176.0	1 273.0	2 243.8	228.8	1 654.9	3 153.8	321.6	2 326.1
	36	1.42	1.5	0.06	2 256.5	230.1	1 664.3	2 934.1	299.2	2 164.1	4 114.0	419.6	3 035.0
	39	1.54	1.5	0.06	2 896.0	295.3	2 135.9	3 763.8	383.8	2 776.0	5 258.3	536.2	3 878.3

Check:	For (item or defect):	How
Gears	c) Abrasive wear (caused by fine particles carried in lubricant) 	Visually.
	d) Overload wear 	Visually.
	e) Pitting 	Visually.
	f) Spalling 	Visually.
	g) Overload breakage 	Visually.
	h) Fatigue breakage 	Visually.

Suggestion

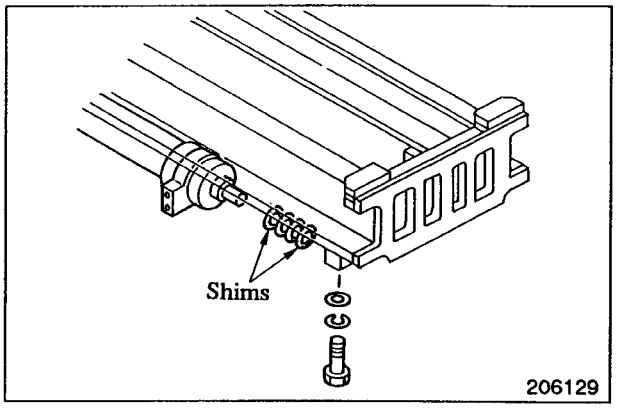
Inner mast removal

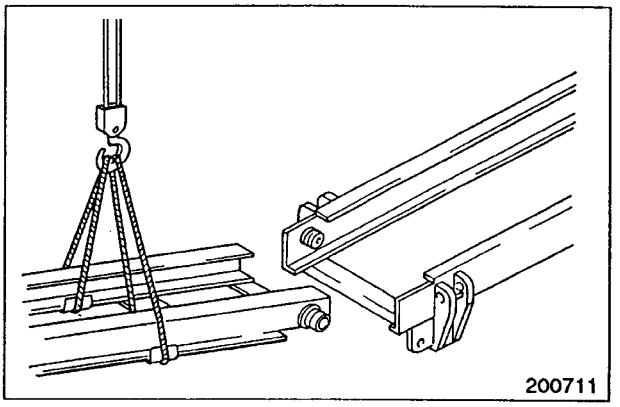
(a) The cylinder stroke is adjusted by means of the shims fitted to the rod end. Before disassembling, write down a cylinder on which shim adjustment has been made and the amount of shims used.

(b) Remove the bolts that holds the cylinder clamp to free each cylinder. Retract the piston rods all the way and cross the top ends of the cylinders.

(c) Slide the inner mast toward the bottom of the outer mast. Remove the main rollers, side rollers and mast strips from the outer mast and the main and side rollers from the inner mast.

(d) After removing the main rollers and the side rollers, slide the inner mast out the top of the outer mast.





HYDRAULIC FORK POSITIONERS

MODEL NOMENCLATURE

Model nomenclature	Applicable truck	Applicable mast	Mast piping
(1) 3SS115AM2	FD100/FD115: F15C-50001-up	3V115A Simplex	Side pulley type
(2) 3SS135AM2	FD135: F15C-50001-up	3V135A Simplex	Side pulley type
(3) 3SS150AM3	FD150A: F24A-50011-up	3B150A Simplex	Side pulley type

SPECIFICATIONS

Unit: mm [in.]

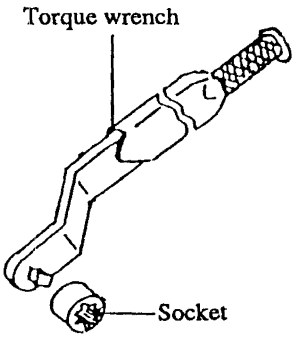
Item \ Model		3SS115AM2	3SS135AM2	3SS150AM3
1. Side shift (each side)		230 [9.1]	228.5 [9.0]	
2. Load center		600 [24]		
3. Free lift		0		
4. Fork spread – out-to-out		2 032 [80]		2 286 [90]
5. Tilt of mast (forward – backward)		15° – 12°		
6. Type of forks	MCFA/MCFE	Heel free		
	MCFS	Heel hold		
7. Forks	Length	1 220 [48], 1 525 [60], 1 830 [72], 2 440 [96]		
	Width × thickness	180 × 70 [7.1 × 2.8]		180 × 90 [7.1 × 3.5]
8. Front overhang		841.5 [33]	900 [35.4]	
9. Weight, kg [lb]		1 171 [2 582]	1 642 [3 621]	1 705 [3 760]

Item		How to check	Intervals					Service data			
			Daily (pre-start)	Every 50 hours or weekly	Every 200 hours or monthly	Every 1,200 hours or 6 months	Every 2,400 hours or 1 year	FD100	FD115	FD135	FD150A
Anchor brackets	Distortion, cracks or damage	Dye check					○				
Powershift transmission	Oil level and oil leaks	Visual	○	○	⊗	⊗	⊗	Change oil every 1,200 hours or 6 months. 22 liters [5.8 U.S. gal]			
	Strainer — clogging	Visual			○	⊗	⊗	Clean or change every 1,200 hours or 6 months.			
	Control valve filter	Visual				⊗	⊗				
	Inching pedal — adjustment	Measure/ test			○	○	○	Inching pedal height (above floor): 190 mm [7.5 in.] Valve plunger projection: 9 mm [0.35 in.] with inching pedal released 14 mm [0.55 in.] when brakes start to be applied			

Pressure (engine at 1 500 ± 100 rpm)	Specification, kPa (kgf/cm²) [psi]		
	2-speed transmission	3-speed transmission	
Main	1,226 ± 147 (12.5 ± 1.5) [178 ± 21]	1,177 ± 98 (12 ± 1) [171 ± 14]	
Clutch	1,226 ± 147 (12.5 ± 1.5) [178 ± 21]	Speed	1,177 ± 98 (12 ± 1) [171 ± 14]
		Direction	981 ± 98 (10 ± 1) [142 ± 14]
Torque converter inlet	686 ± 98 (0.5 to 5.0) [7 to 71]	441 ± 49 (4.5 ± 0.5) [64 ± 7]	
Lubrication line	98 ± 49 (1.0 ± 0.5) [14 ± 7]	20 to 98 (0.2 to 1.0) [3 to 14]	
Stall speed	1,760 ± 100 rpm		
10 m [33 ft] start acceleration (no load)	5 seconds, maximum		

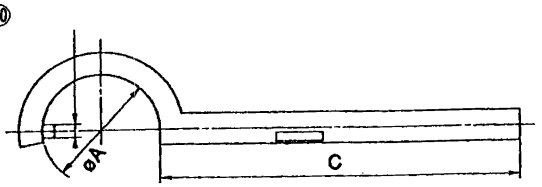
Front axle	Cracks, distortion or other defects	Dye check/ visual					○	
Front axle and differential	Oil level and oil leaks	Visual			○	○	○	25 liters [6.6 U.S. gal]
	Mounting bolts — tightness	Torque wrench					○	
	Front wheel bearings — preload	Spring scale					○	127 to 166 N (13 to 17 kgf) [28 to 37 lbf] (as tangential force applied to hub bolt)

⑰ ⑱



206492

⑲ ⑳



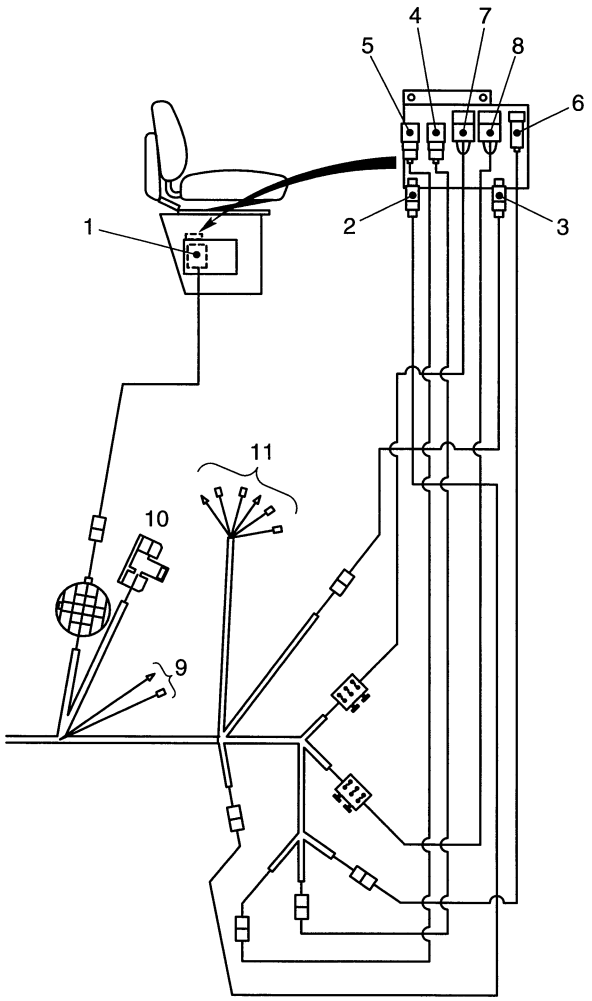
	φA, mm [in.]	C , mm [in.]	Maker No.
19	148 [5.83]	400 [15.75]	MH148
20	160 [6.30]	500 [19.69]	MH160

206496

Technical Data

Item \ Truck Model			FD100	FD115	FD135	FD150A
Designation			F15C			F24A
Type			Standard (with 3-speed powershift transmission)			
General	Capacity/load center kgf/mm (lbf/in.)		10000/600 (22000/24)	11500/600 (25000/24)	13500/600 (30000/24)	15000/600 (33000/24)
	Lift mm (in.)		3000 (120)		3300 (130)	
	Lift speed (unloaded/loaded) mm/sec (fpm)		360/300 (71/65)	360/340 (71/67)	310/290 (61/57)	310/280 (61/55)
	Lowering speed (unloaded/loaded) mm/sec (fpm)		500/450 (98/89)		420/380 (83/75)	
	Tilt angle (forward – backward)		15° – 12°			
	Free lift mm (in.)		0			
Performance	Travel speeds (unloaded/loaded) km/h (mph)	Forward	31.5/24.5 (20/15)		33.0/22.0 (20/14)	
		Reverse				
	Minimum turning radius mm (in.)		4000 (157)	4060 (160)	4160 (164)	4550 (179)
	Turning angle	Inside	78°27'			
		Outside	51°14'			
	Minimum intersecting aisle mm (in.)		3550 (140)	3590 (141)	3680 (145)	3830 (151)
Tires	Gradeability (rated load)	At 1.6 km/h (1 mph)	32%	29%	23%	
		At 2 km/h (1.2 mph)	21%	19%	15%	14%
	Size of tires (front and rear)		10.00-20-14PR (I)	10.00-20-16PR (I)	12.00-20-18PR (I)	
	Inflation pressure of tires (front and rear) kPa (kgf/cm²) [psi]		700 (7.0) [101]	800 (8.0) [116]	800 (8.0) [116]	
Weight and axle loading (unloaded)	Weight kg (lb)		14450 (31860)	15330 (33800)	17320 (38190)	17760 (39160)
	Front axle loading kg (lb)		7090 (15630)	6950 (15320)	7460 (16450)	7940 (17510)
	Rear axle loading kg (lb)		7360 (16230)	8380 (18480)	9860 (21740)	9820 (21650)

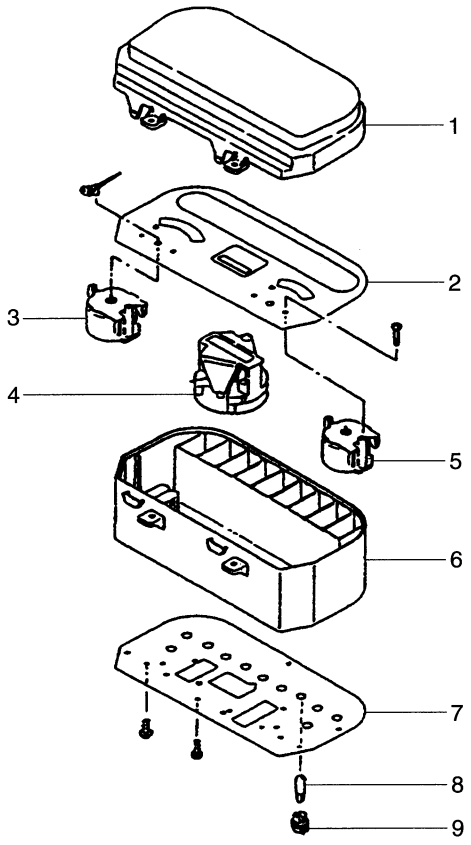
Harness A (located under the seat frame) Part 2



210318

Combination Meter

Disassembly



Sequence

1. Instrument panel
2. Dial
3. Engine coolant temperature gauge
4. Service hourmeter
5. Fuel gauge
6. Meter case
7. Printed circuit plate
8. Bulb
9. Socket

⚠ CAUTION

Be careful not to damage the printed circuit plate when disassembling the combination meter.

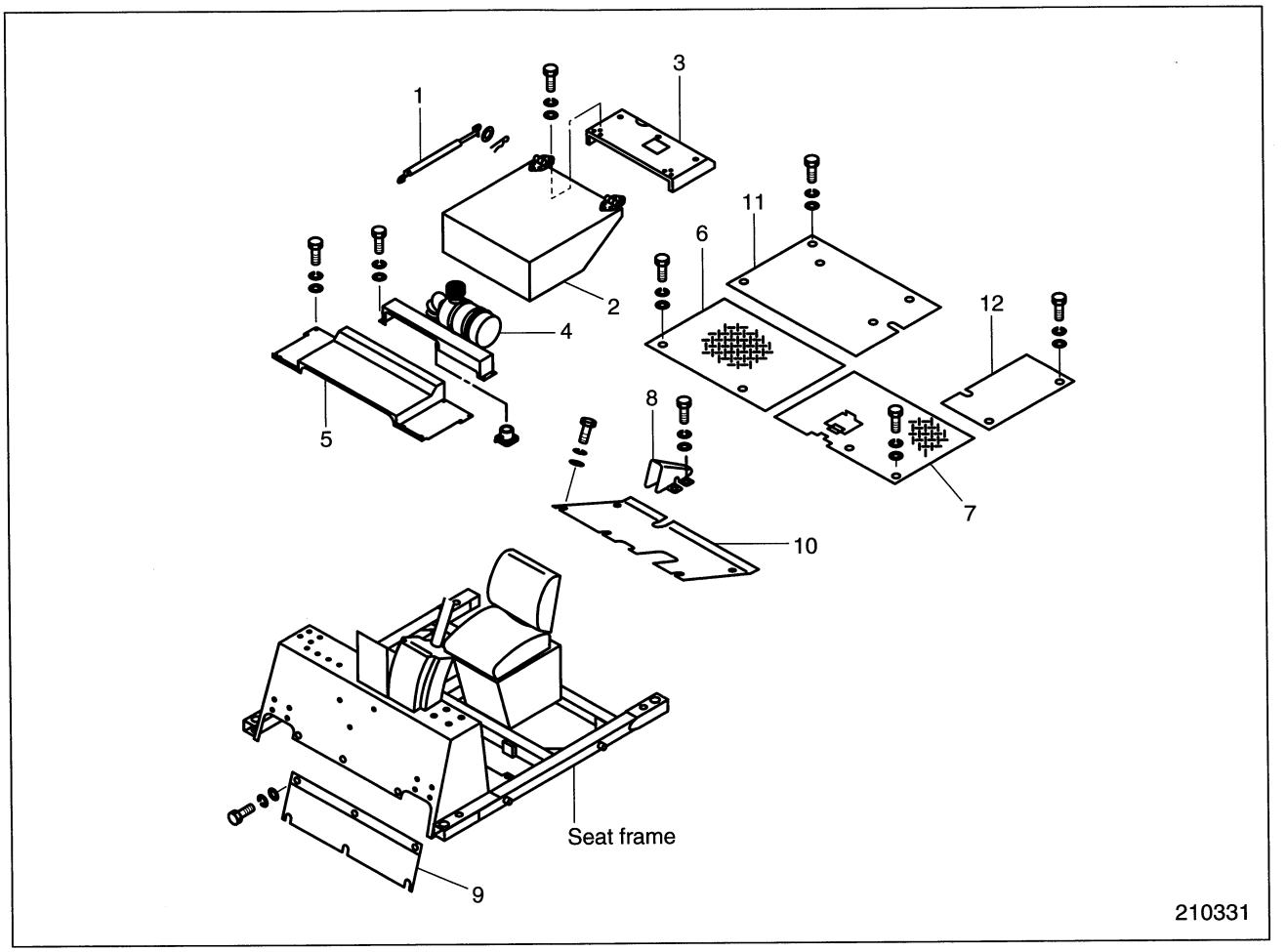
Reassembly

To reassemble the combination meter, follow the reverse of disassembly sequence.

Bulb replacement

For bulb replacement, remove the socket from the printed circuit plate by turning it counterclockwise. For configuration of the indicator lights, refer to "OK Monitor."

2. Removal of Covers and Plates



Sequence

1. Gas spring (LH, RH)
2. Engine cover
3. Radiator cover
4. Front cover B, Air cleaner
5. Front cover A
6. Floor plate A (RH)
7. Floor plate A (LH)
8. Cover (brake pedal)
9. Cover (front)
10. Toe board
11. Floor plate D
12. Floor plate C

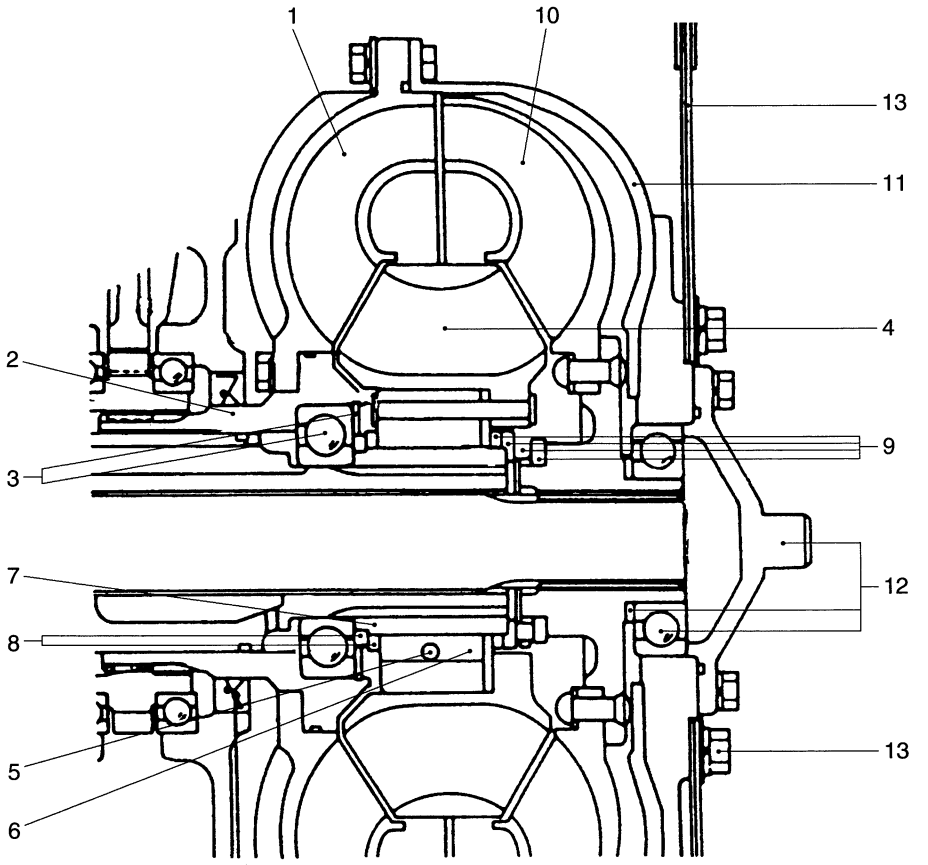
Suggestions for Removal

(1) Leave the seat bracket attached to the seat frame.

(2) Leave the accelerator pedal, brae pedal, inching pedal, brake control valve, etc. attached to the seat frame.

(3) Disconnect the air cleaner hose at the engine side, then remove the hose and air cleaner attached to the front cover B.

Reassembly



Sequence

1. Pump (impeller)
2. Pump boss, O-ring, Bolts, Washers
3. Ball bearing, Snap ring
4. Stator assembly
5. Springs, Spring caps
6. Rollers
7. Hub
8. Thrust washer
9. Thrust bearing, Thrust washers
10. Turbine
11. Drive cover, O-ring, Bolts, Washers
12. Spacer, Ball bearing, Pilot boss, O-ring, Bolts, Washers
13. Flexible plates, Plate, Bolts, Washers

Suggestions for Reassembly

1. Piston installation

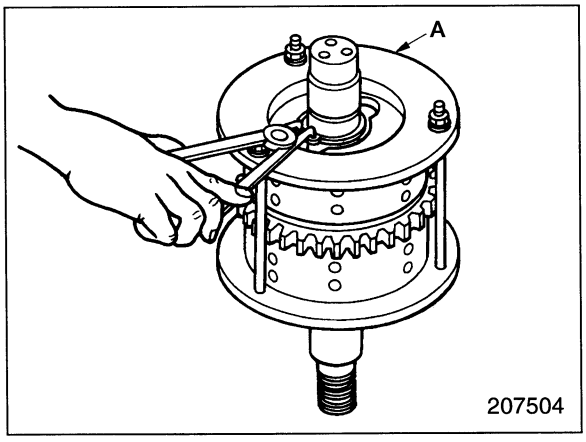
When putting pistons 3 in the clutch drum, apply ATF (automatic transmission fluid) to their seal ring contact surfaces.

2. Return spring installation

Using the Piston Tool A (special tool) or an arbor press, compress springs 4 and retainers 5, and install snap rings 6.

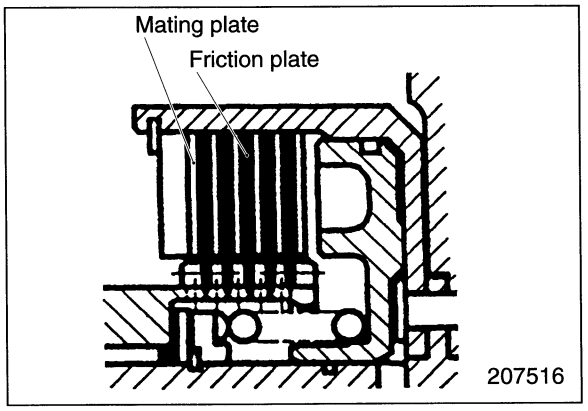
Special tool needed

Piston tool A	92267 - 00300



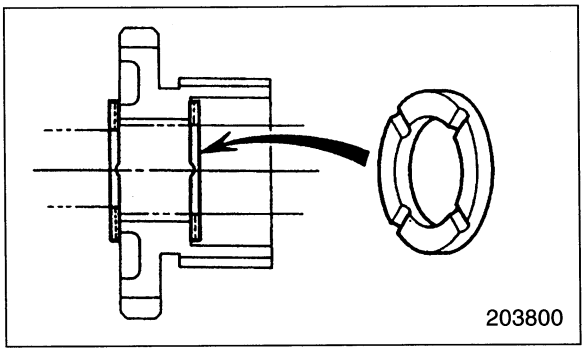
3. Friction and mating plate installation

(1) Make sure that the position and number of the plates are correct. Install the plates while applying ATF to them. When replacing the friction plates, replace the mating plates as a set.



(2) Thrust washer installation

Install thrust washers 11, 14, 16 and 19 with the side that has oil grooves toward the gear.



4. Piston testing

After having assembled the clutch, apply pressure air of approximately 690 kPa (7 kgf/cm^2) [100 psi] to the oil hole to make sure that the piston move freely without any sign of air leaks.

(5) Move the transmission shift lever to the forward position, and gradually depress the accelerator pedal all the way. Under this condition, measure the stall speed with an engine tachometer.

Stall speed (tolerance: ±100 rpm)	1760 rpm

⚠ CAUTION

Do not attempt to depress the inching pedal. Do not continue operation in stall condition for more than 30 seconds. A failure to follow this precaution would result in destruction of the torque converter.

(6) Similarly measure the stall speed for reverse drive.

NOTE

(a) Any stall speed within ±100 rpm tolerance of the specification is satisfactory.

(b) If the engine or torque converter is changed, the stall speed will vary since the stall speed is determined by the combination of engine and torque converter.

10 m (33 ft) Start Acceleration Test

(1) Stand ready to start with the engine running at low idle, the transmission shift lever in the neutral position and the travel speed select switch in "Automatic 2-speed" position.

(2) At the signal, move the transmission shift lever to the forward position and, at the same time, depress the accelerator pedal fully.

(3) Measure the time required for the truck to travel 10 m (33 ft) with a stopwatch.

(4) Conduct the same test for reverse travel, too.

Travel time (no load)	5 seconds, maximum

Specifications

Item \ Truck Model			FD100	FD115	FD135	FD150A
Torque converter	Type		3-element, 1-stage, 2-phase			
	Model		MI 16			
	Stall torque ratio		2.88			
Transmission	Control		Direction control: Electric, column shift Speed control: Automatic			
	Gear ratio	Forward	1st: 2.402 2nd: 1.010 3rd: 0.532			
		Reverse				

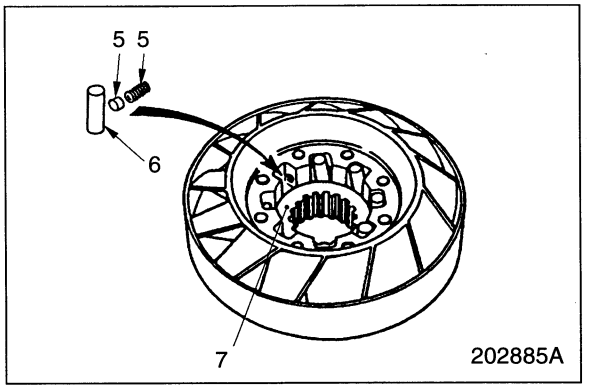
Suggestions for Reassembly

1. Stator assembly

(1) Put hub 7 in the stator as shown. Put spring 5 and spring cap 5 in each hole, and press in roller 6 while pushing the spring cap.

(2) Install a total of ten rollers, and restore the hub to its original position.

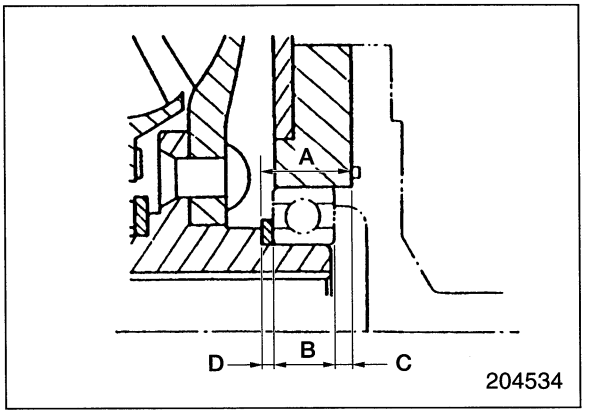
(3) After having assembled the stator, turn the hub by hand, making sure that it rotates in only one direction.



2. Selection of spacer

Measure the dimensions A, B and C. Select a spacer equal to the clearance (dimension D) and put it in position.

Part number	Thickness of spacer
92322 - 14700	2.9 mm (0.114 in.)
92322 - 14800	3.0 mm (0.118 in.)
92322 - 14900	3.2 mm (0.126 in.)
92322 - 06600	3.4 mm (0.134 in.)
92322 - 06700	3.5 mm (0.138 in.)



Standard dimensions mm (in.)	A	26.3 (1.035)
	B	19 (0.75)
	C	$4\ {}^{0}_{-0.1}$ $(0.16\ {}^{0}_{-0.004})$

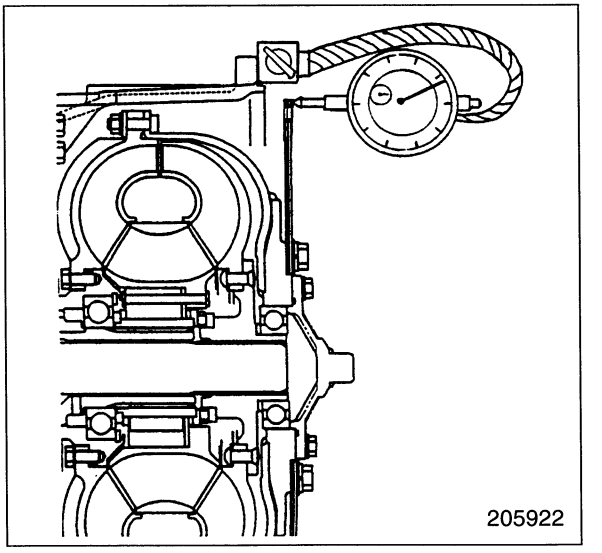
3. Flexible plate

After having installed the flexible plate, measure the face runout of the plates with a dial indicator. Replace the plates if the runout has exceeded the service limit.

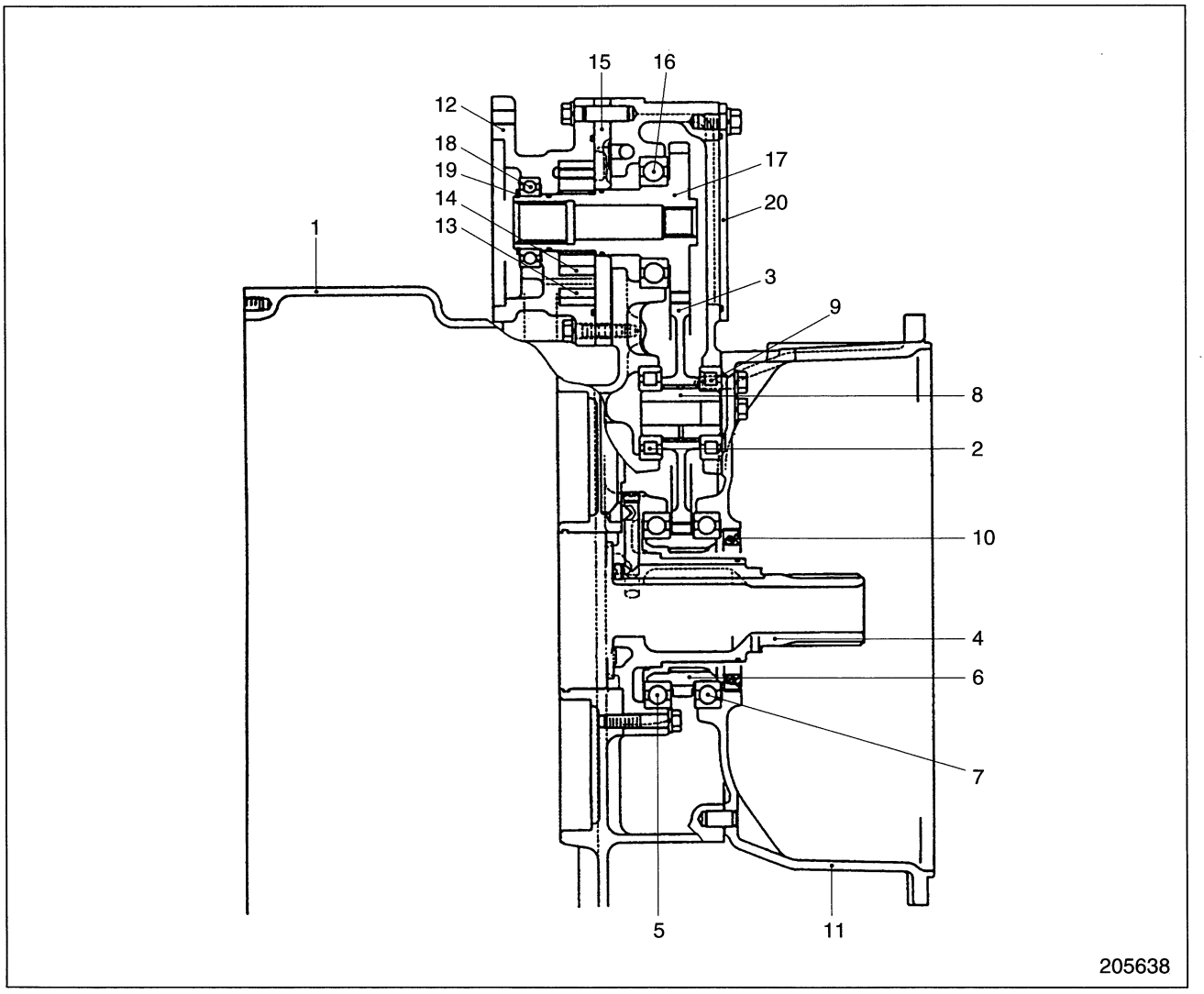
A: Standard value B: Repair or service limit

Unit: mm (in.)

Face runout of flexible plate (in free state)	A	0.2 (0.008)
	B	0.5 (0.020)



2. Stator shaft and oil pump



Sequence

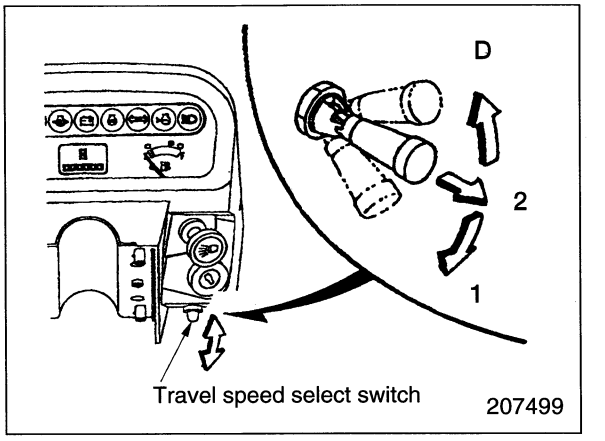
1. Transmission case, Dowels
2. Roller bearing
3. Idler gear
4. Stator shaft, Seal ring, Bolts, Washers
5. Ball bearing
6. PTO drive gear
7. Ball bearing
8. Idler gear shaft
9. Roller bearing
10. Oil seal
11. Torque converter housing, Gasket, Bolts, Washers
12. Pump case, O-ring, Bolts, Washers
13. Internal gear
14. Pump gear
15. Pump plate, O-ring, Gasket, Bolts, Washers
16. Ball bearing
17. Pump drive gear, Seal rings
18. Ball bearing
19. Snap ring
20. PTO cover, O-ring, Bolts, Washers

NOTE

The dowels fitted into the transmission case should not been removed. These dowels are for locating the pump case, torque converter housing and transmission cover subassembly for installation.

Travel Speed Select Switch

Move the travel speed select switch mounted on the console box to each position, and make sure that the speed selector system functions properly. Move the switch when the truck is at standstill.



FD100, FD115

(1) In the "Fixed 1st speed" position, the truck runs at a maximum speed of 8 km/hr (5.0 mph) and a greater torque is available.

(2) In the "Automatic 2-speed" position, the transmission automatically shifts from the 1st to the 2nd speed when the travel speed reaches 6.5 km/hr (4.0 mph) to allow the truck to run at a maximum speed of 18.5 km/hr (11.5 mph).

(3) In the "Automatic 3-speed" position, the transmission automatically shifts from the 1st to the 2nd speed when the travel speed reaches 6.5 km/h (4.0 mph). It automatically shifts from the 2nd to the 3rd speed when the travel speed reaches 15 km/h (9.3 mph) to allow the truck to run at a maximum speed of 27 km/h (16.5 mph).

FD135, FD150A

(1) In the "Fixed 1st speed" position, the truck runs at a maximum speed of 8.5 km/hr (5.3 mph) and a greater torque is available.

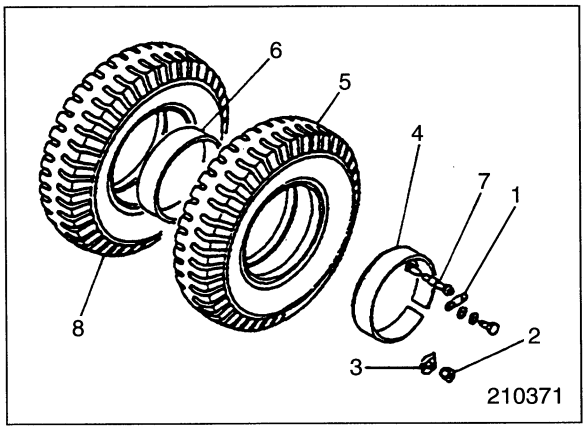
(2) In the "Automatic 2-speed" position, the transmission automatically shifts from the 1st to the 2nd speed when the travel speed reaches 6.5 km/hr (4.0 mph) to allow the truck to run at a maximum speed of 19 km/hr (11.8 mph).

(3) In the "Automatic 3-speed" position, the transmission automatically shifts from the 1st to the 2nd speed when the travel speed reaches 6 km/h (3.7 mph). It automatically shifts from the 2nd to the 3rd speed when the travel speed reaches 12.5 km/h (7.8 mph) to allow the truck to run at a maximum speed of 32 km/h (19.6 mph).

Removal and Installation

Front Wheels (Tires)

Removal



Sequence

1. Extension bracket
2. Wheel nuts
3. Clamp
4. Wedge band
5. Front wheel (Tire) (outer)
6. Spacer
7. Extension valve
8. Front wheel (Tire) (inner)

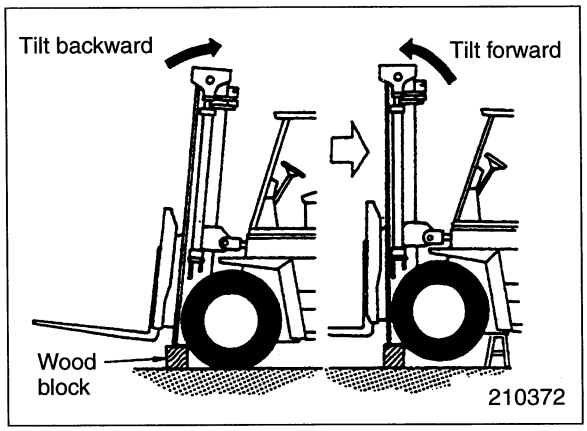
Start by:

Loosen the outer wheel nuts about two full turns, and block the rear wheels.

Truck lifting

(1) Lifting with lift equipment

Tilt the mast fully backward, place wood blocks under the mast, and tilt the mast forward.



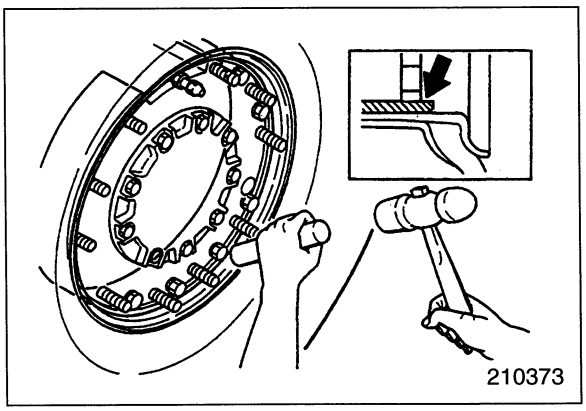
WARNING

After raising the front end of the truck, securely support the truck by putting wood blocks under the frame. Block the rear wheels.

(2) Tire removal

(a) Position the extension valve atop.

(b) Release air from the tire.



NOTE

Air is compressed. Keep your face away.

(c) Hammer and remove the wedge band with a dolly bar applied to it.

Inspection

1. Reduction bevel gear and reduction bevel pinion

Check the reduction bevel gear and reduction bevel pinion for tooth contact. Check the gear teeth for wear, pitting, flaking or chipping. Minor flaws on the tooth surfaces can be repaired by grinding with an oil stone or a sand paper. If the gear is badly damaged to require replacement, replace the gear and pinion as a set.

2. Differential

(1) Check the differential case for damage. Check, in particular, the seat formed of each case for carrying the taper roller bearing inner race to see whether the seat surface is fretted or not.

(2) Check the sliding surfaces of the washers and gears for wear or damage.

(3) Check the teeth of the differential bevel pinions and bevel gears for wear, pitting, chipping, galling, etc.

(4) Check the play of each pinion on the shaft.

A: Standard value B: Repair or service limit

Unit: mm (in.)

Play between differential bevel pinion inner diameter and shaft outer diameter	A	0.169 to 0.278 (0.00665 to 0.01094)
	B	0.35 (0.0138)

(5) Check the free movement of the differential bevel gears on the axle shafts (looseness of mating splines).

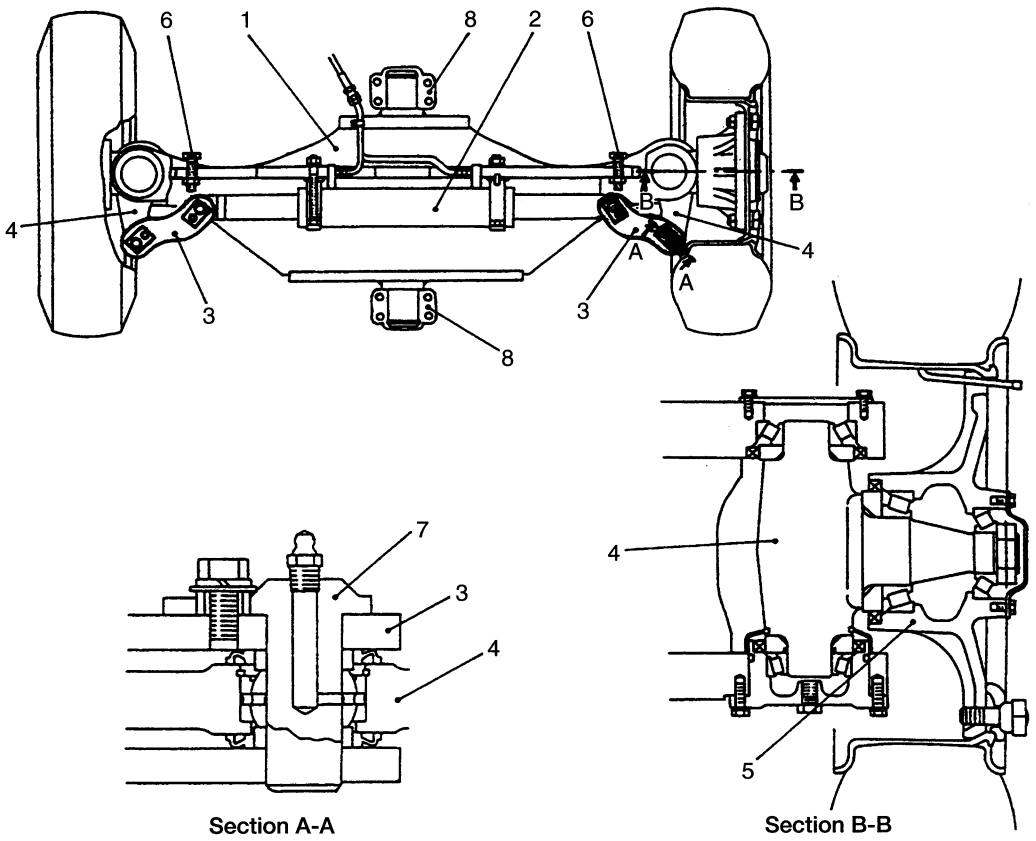
B: Repair or service limit

Unit: mm (in.)

Free movement of differential bevel gears on axle shafts (looseness of mating splines)	B	0.5 (0.020)

Description

Rear Axle

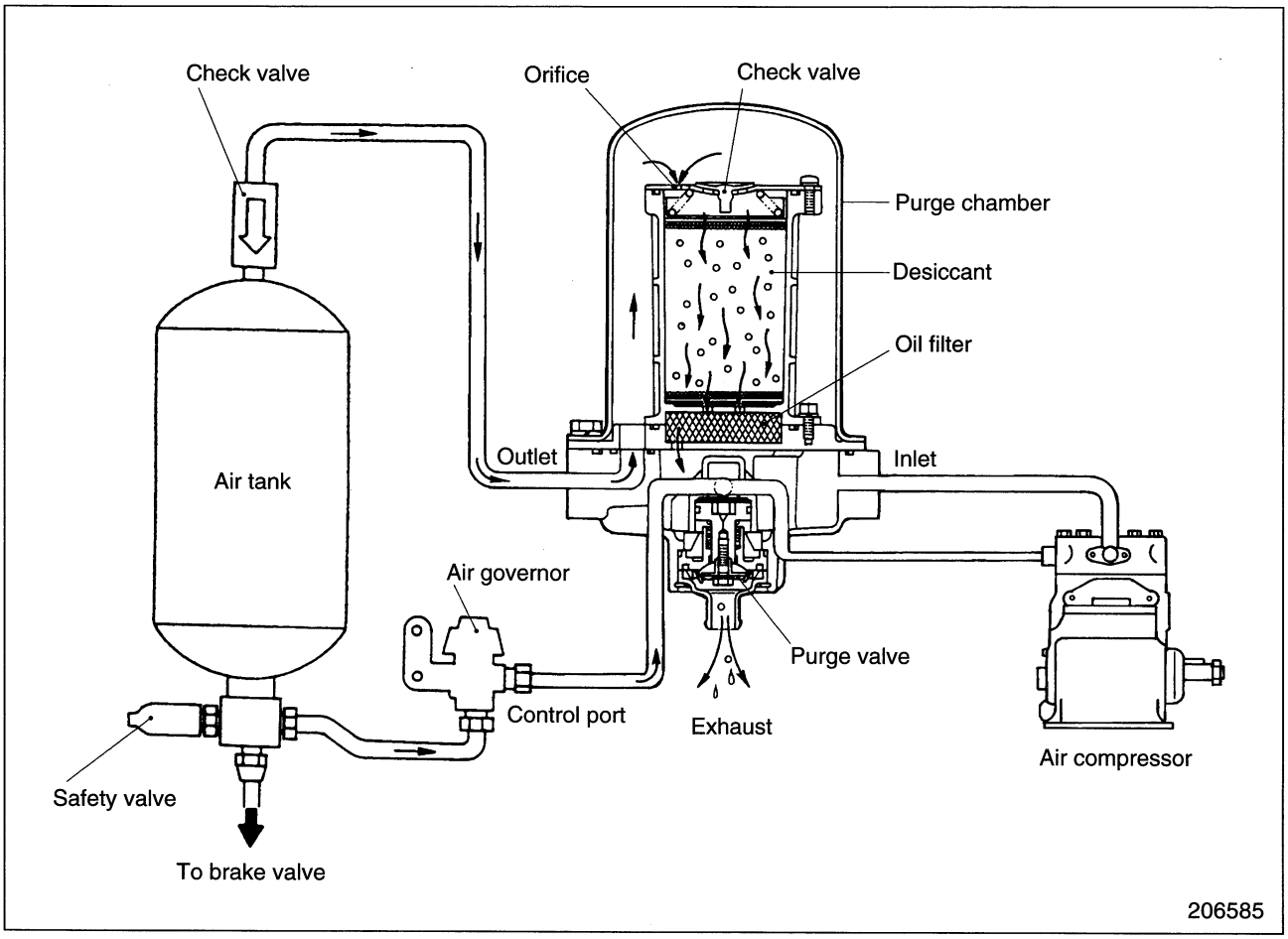


1. Rear axle housing
2. Power cylinder
3. Tie rods (left and right)
4. Steering knuckles (left and right)
5. Wheel hubs (left and right)
6. Stopper bolts (left and right)
7. Pins (two on each side)
8. Rear axle supports (front and rear)

Troubleshooting

Heavy steering	Incorrect toe-in	— Readjust.
	Excessive friction in steering or rear axle linkage due to poor lubrication	— Lubricate.
	Low tire pressure	— Inflate properly.
Steering – poor centering (or recovery from turns)	Joints and connections in steering or rear axle linkage too tight	— Retighten to specified torque.
Truck pulls to one side during normal driving	Tire diameter differs between left and right	— Replace tire.
	Uneven tire pressure	— Inflate properly.
Shimmy	Taper roller bearings badly worn or damaged in hub	— Replace.
	Steering system maladjusted	— Check and adjust. (Refer to "GROUP 10 STEERING SYSTEM.")
Rear wheel tires wear rapidly or unevenly	Wheel alignment maladjusted	— Readjust.
	Different tires are mixed, or uneven tire pressure	— Replace tires and reinflate.

Air dryer operation – reconditioning cycle

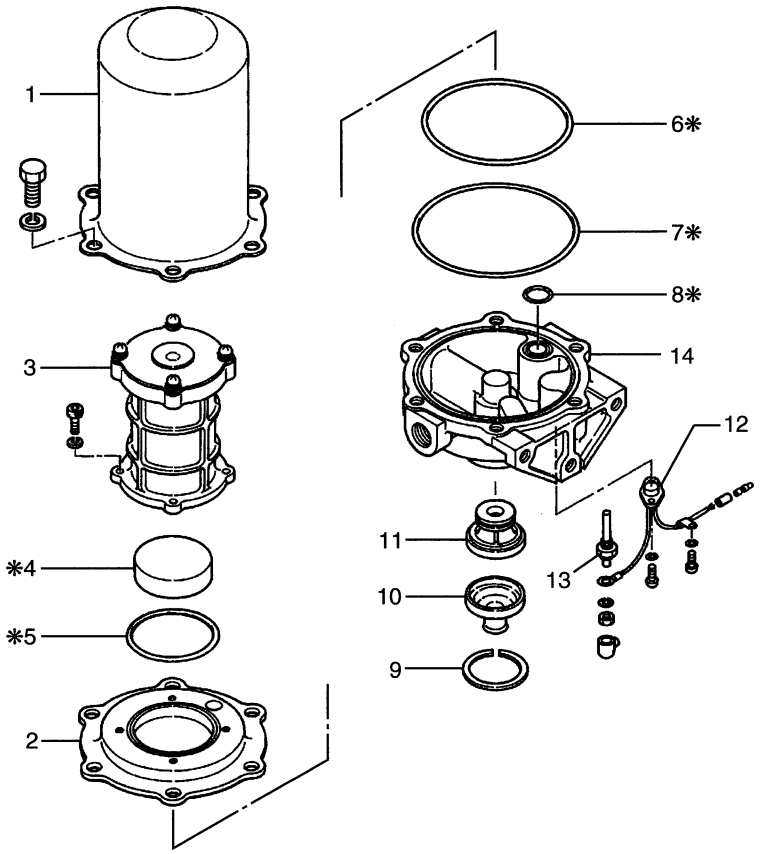


When the air pressure in the system rises to the upper limit, the pressure signal from the air governor unloads the air compressor. This signal also goes to the control port of the air dryer to open the purge valve. When the purge valve is so opened, it lets out the air in the desiccant tube to the atmosphere quickly, thereby cleaning the filter and exhausting moisture and oil mist to the atmosphere. This sudden drop of the pressure causes the air (dry) in the purge chamber to expand through the orifice and flow through the desiccant in the reverse direction to remove moisture from the desiccant. At the end of reconditioning cycle, the purge valve is closed by the signal from the air governor to cause the air dryer to start a new cycle for dehydrating.

Air Dryer

Disassembly

1. Air dryer disassembly



Note: Parts marked with * are repair kit parts.

210437

Sequence

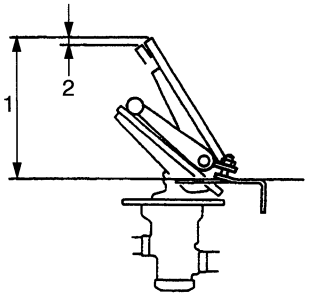
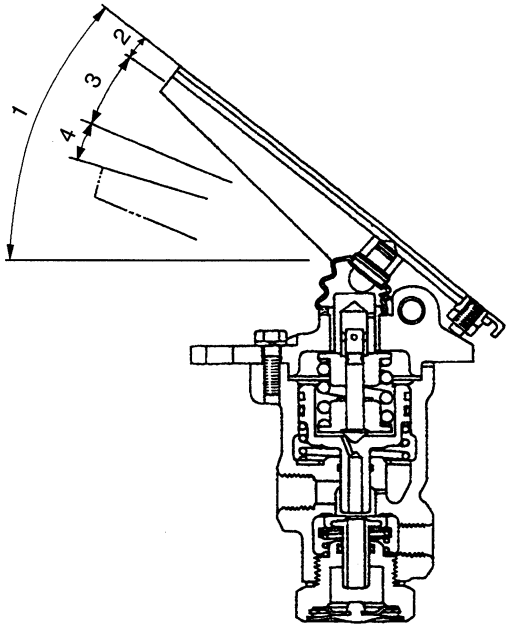
1. Purge chamber
2. Cover
3 Cartridge
4. Filter
5. O-ring
6. O-ring
7. Gasket ring
8. O-ring
9. Retaining ring
10. Exhaust cover
11. Valve assembly
12. Thermostat assembly
13. Heater assembly
14. Body

Start by:

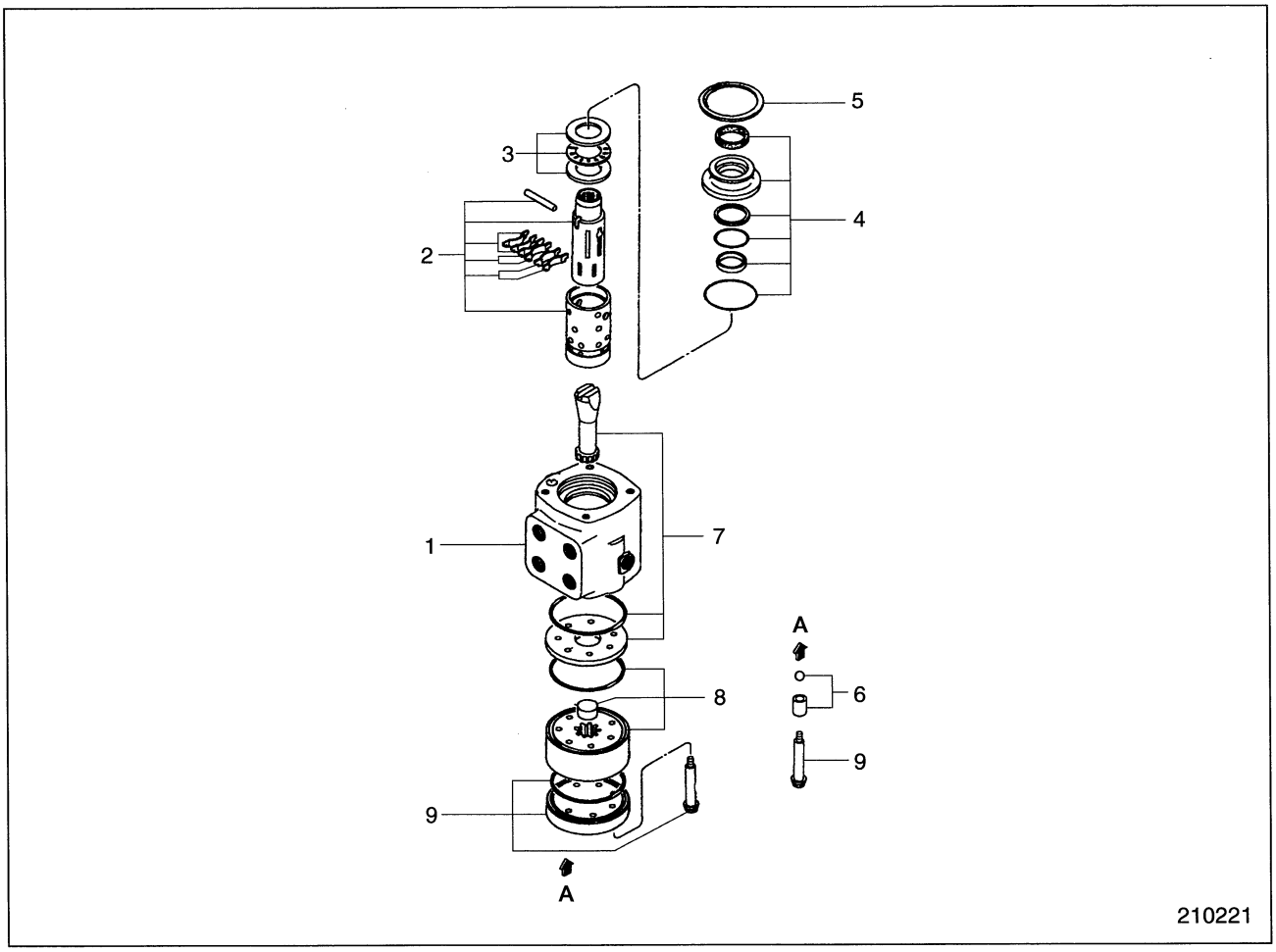
(1) Before disassembling the air dryer, hold its body 14 with a vise.

Service Data

A: Standard value
Unit: mm (in.)

Item		Truck Model	FD100	FD115	FD135	FD150A
Brake pedal	Height 1 (from floor to pedal top)	A	190 (7.48)			
	Free play 2	A	15 (0.59)			
	 210444					
Brake control valve	Pedal set angle 1	A	39±1.5°			
	Free play 2	A	4±1.5°			
	Normal braking 3	A	12±1°			
	Emergency braking 4	A	6±1°			
	 200629A					

Reassembly



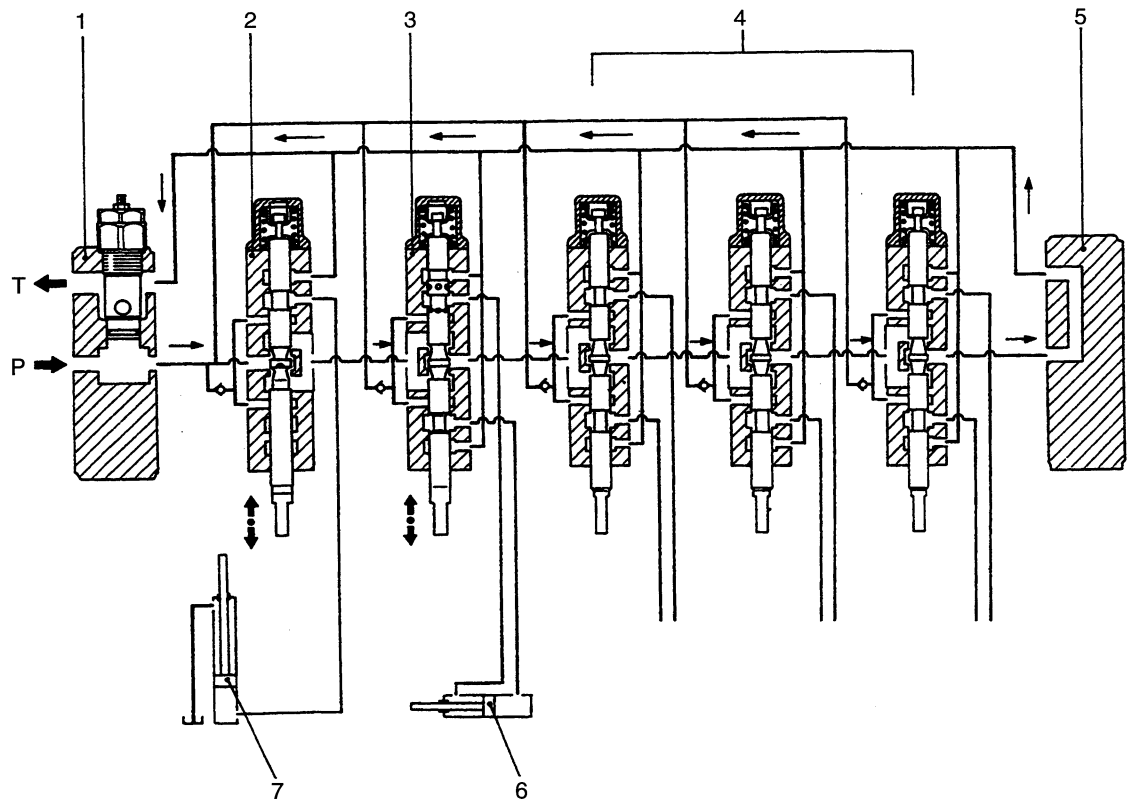
Sequence

1. Housing
2. Spool and sleeve assembly
3. Thrust needle bearing, Bearing race
4. Seal gland bushing assembly
5. Retaining ring
6. Ball, Adaptor
7. Wear plate, Drive, O-ring
8. Gerotor set, O-ring, Spacer
9. End cap, Screw, O-ring

NOTE

Replace all seals with new ones once disturbed. Lubricate all seals with clean petroleum jelly such as Vaseline.

Operation



1. Inlet cover
2. Lift valve block
3. Tilt valve block
4. Attachment valve blocks
5. End cover
6. Tilt cylinder
7. Lift cylinder

T: Tank port
P: Pump port

When the control valve is in neutral, the oil from the pump flows from the pump port through the center bypass ports in the valve blocks and covers to the tank port. There is a continuous flow of oil through this circuit as long as the engine is running.

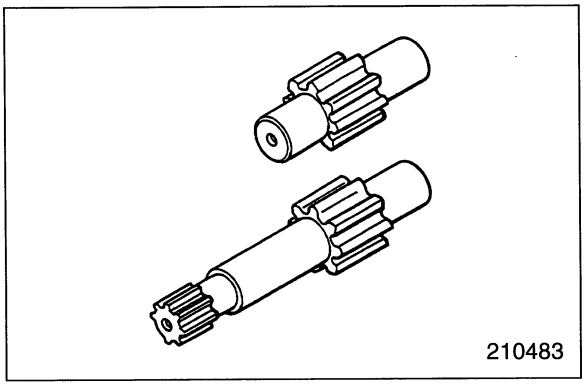
Inspection

1. Drive and driven gears

(1) Check the teeth of each gear for wear or damage.

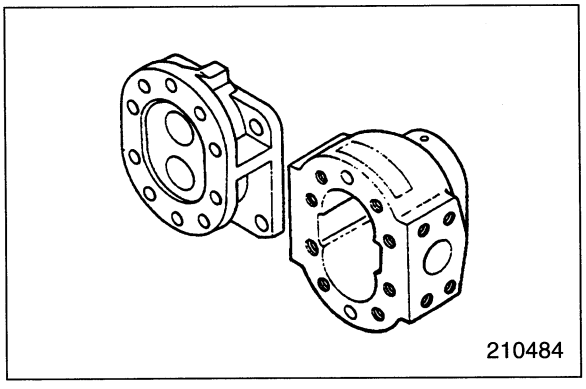
(2) Check the end faces of the gears for wear or damage.

(3) Check the shaft portion of each gear for wear or damage.



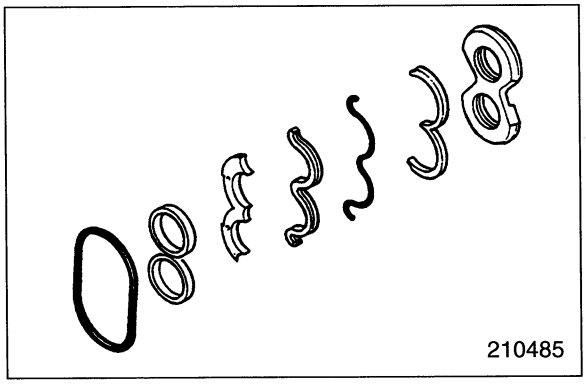
2. Cover, body and pressure plate

Check for wear or damage.

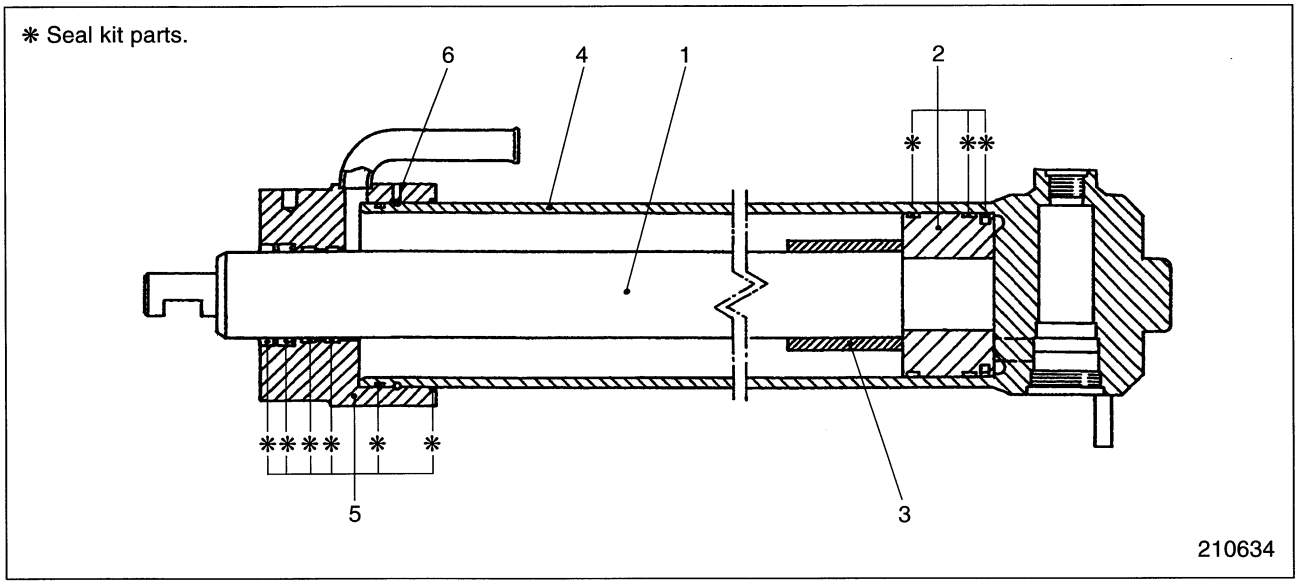


3. Oil seal and O-rings

Check for wear, cuts or hardening due to deterioration.



Reassembly



Sequence

1. Piston rod
2. Piston, Bushings, Piston seal
3. Spacer
4. Cylinder tube
5. Cylinder head, Wiper ring, Bushing, U-ring, Bushing, O-ring, Back-up ring, O-ring
6. Stopper

Suggestions for Reassembly

(1) Replace the seal kit parts.

(2) Clean the parts thoroughly before installing them.

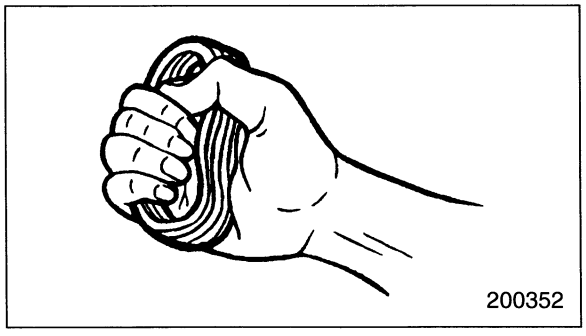
(3) When installing the wiper ring, apply LOCTITE 242 to the ring.

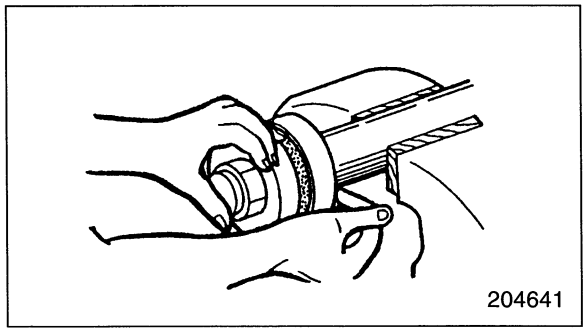
(4) Apply hydraulic oil to the bushings, piston seals, spacer, piston rod and the inside surface of cylinder tube.

(5) Install the piston seal as follows:

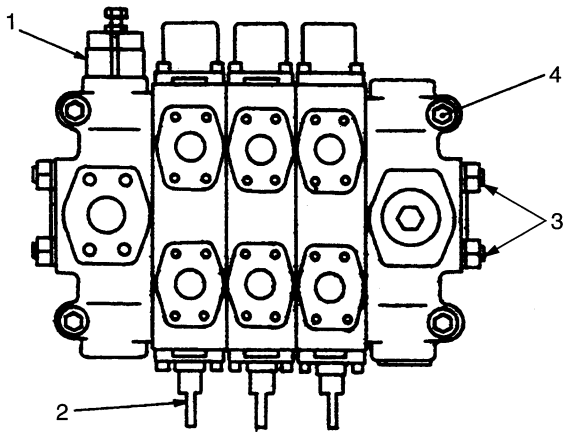
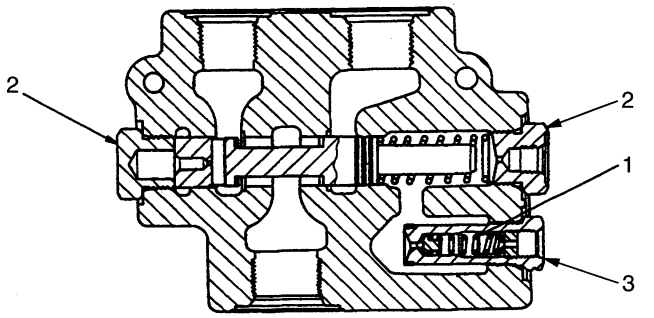
(a) Before fitting the piston seal, squeeze it by hand 5 or 6 times to soften it.

(b) Wrap the piston rod with rag or cloth, and hold it in a vise. Pay attention not to deform the piston. Apply a small amount of hydraulic oil to the seal. Fit a portion of the seal to the groove, and push the other portion into the groove as shown.



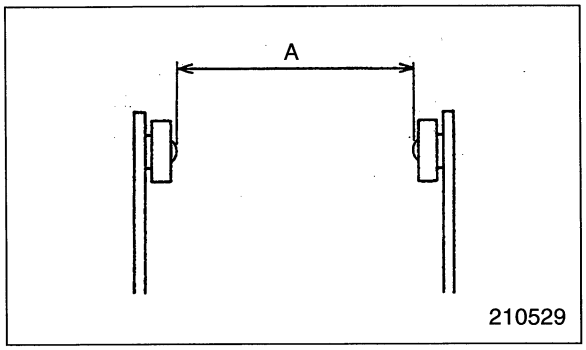


A: Standard value
Unit: mm (in.)

Item			Truck Model FD100	FD115	FD135	FD150A
Control valve	Main relief valve setting 1 MPa (kgf/cm²) [psi]	A	17.2 $^{+0.5}_{0}$ (175 $^{+5}_{0}$) [2489 $^{+71}_{0}$]			
	Spool operating effort 2 N (kgf) [lbf]	A	294 (30) [66], maximum			
	Tightening torque for tie bolts 3 N·m (kgf·m) [lbf·ft]	A	98 to 118 (10 to 12) [72 to 87]			
	Tightening torque for control valve bolt 4 N·m (kgf·m) [lbf·ft]	A	60 (6.1) [44]			
	 210505					
Priority valve	Relief valve pressure 1 MPa (kgf/cm²) [psi]	A	11.8 (120) [1707]			
	Tightening torque for plug 2 N·m (kgf·m) [lbf·ft]	A	44.1 (4.5) [33]			
	Tightening torque for relief valve 3 N·m (kgf·m) [lbf·ft]	A	21 (2.1) [15]			
	 210506					

3. Lateral clearance between outer and inner masts

(1) Measure the distance A between the side rollers, left and right, of the outer mast, and adjust this distance to the specification.



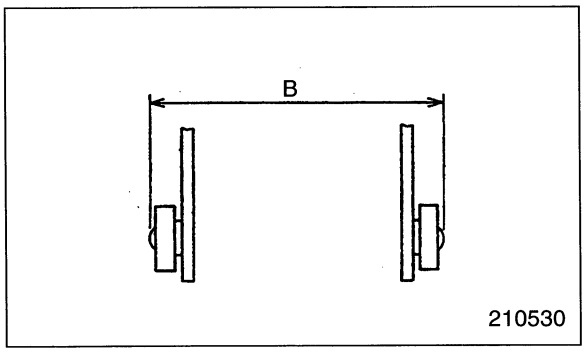
Unit: mm (in.)

Item \ Truck Model	FD100, FD115, FD135	FD150A
Distance A	754±0.5 (29.69±0.020)	748±5 (29.45±0.020)

NOTE

Measure the distance A between the innermost points of the rollers.

(2) Measure the distance B between the side rollers, left and right, of the inner mast, and adjust this distance to the specification.



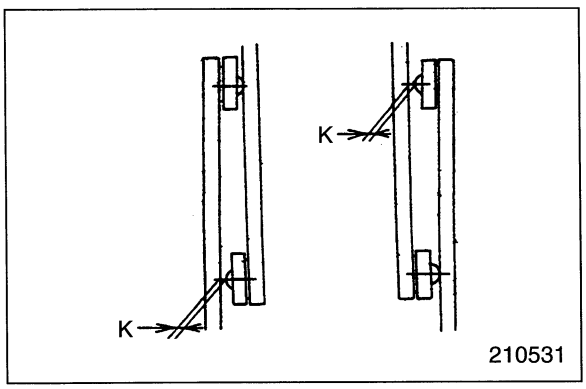
Unit: mm (in.)

Item \ Truck Model	FD100, FD115, FD135	FD150A
Distance B	890±0.5 (35.04±0.020)	884±0.5 (34.80±0.020)

NOTE

Measure the distance B between the outermost points of the rollers.

(3) At the maximum fork height, push the inner mast to one side of the outer mast and check clearance K with feeler gauges on the other side.



Unit: mm (in.)

Clearance K	0.5 to 1.5 (0.020 to 0.059)