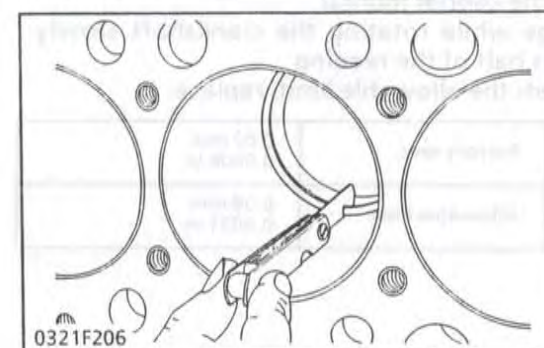
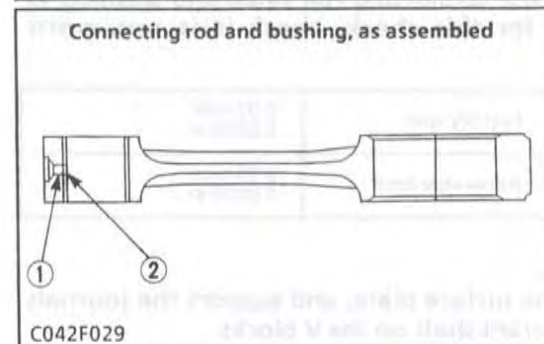
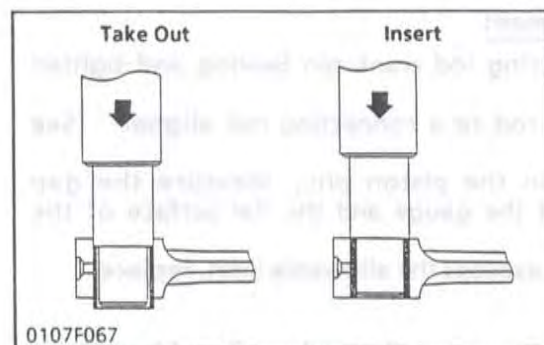




Replace the Small End Bushing

1. Prepare the necessary tool. (See page S.G-38)
2. Press out the used bushing and, using this tool, press a new bushing in, taking due care to see that the connecting rod hole matches the bushing hole.
3. After pressing in the bushing, finish with a reamer to the specified factory specification.

[D1102]

Small end bushing I.D.	Factory spec.	23.025 to 23.040 mm 0.9065 to 0.9071 in.
------------------------	---------------	---

[D1402-DI, D1462-DI, V1902-DI]

Small end bushing I.D.	Factory spec.	25.025 to 25.040 mm 0.9852 to 0.9858 in.
------------------------	---------------	---

(1) Connecting Rod Hole (2) Bushing Hole

Piston Ring Gap

1. Put the piston ring in the cylinder.
2. Turn the piston upside down and push the ring into the cylinder with the piston head.
3. Insert a feeler gauge into the piston ring gap.
4. If the clearance exceeds the allowable limit, replace.

■ IMPORTANT

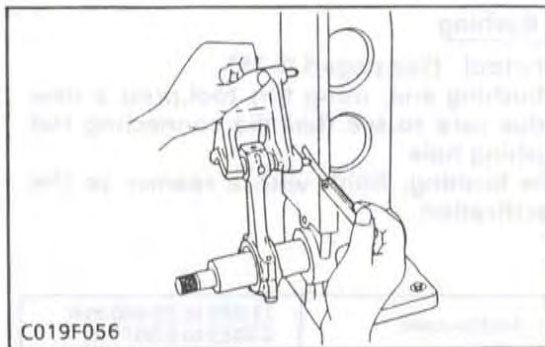
- Measure the piston ring gap at the point of the minimum inside diameter of the cylinder liner.

Top ring Second ring	Factory spec.	0.30 to 0.45 mm 0.0118 to 0.0177 in.
	Allowable limit	1.25 mm 0.0492 in.
Oil ring	Factory spec.	0.25 to 0.45 mm 0.0098 to 0.0177 in.
	Allowable limit	1.25 mm 0.0492 in.

Piston Ring Clearance

1. Clean the rings and the ring grooves.
2. Measure the clearance between the ring and the groove with a feeler gauge.
3. If the clearance exceeds the allowable limit, replace the piston rings.
4. If the clearance still exceeds the allowable limit with new ring, replace the piston.

Piston ring clearance	Second ring	Factory spec.	0.093 to 0.120 mm 0.00366 to 0.00472 in.
		Allowable limit	0.20 mm 0.0079 in.
	Oil ring	Factory spec.	0.020 to 0.052 mm 0.00079 to 0.00205 in.
		Allowable limit	0.15 mm 0.0059 in.



C019F056

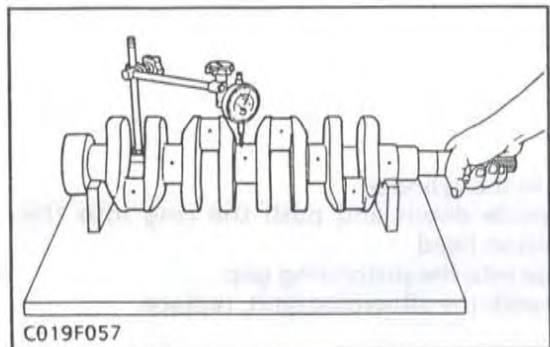
Connecting Rod Alignment

1. Remove the connecting rod crank pin bearing and tighten the rod screws.
2. Set the connecting rod to a connecting rod aligner. (See page S.G-34)
3. Place the gauge on the piston pin. Measure the gap between the pin of the gauge and the flat surface of the aligner.
4. If the measurement exceeds the allowable limit, replace.

■ IMPORTANT

- Because the I.D. of the connecting rod small end bushing is used as the basis for this check, check it is not worn beforehand.

Connecting rod alignment	Factory spec.	0.02 mm 0.0008 in.
	Allowable limit	0.05 mm 0.0020 in.

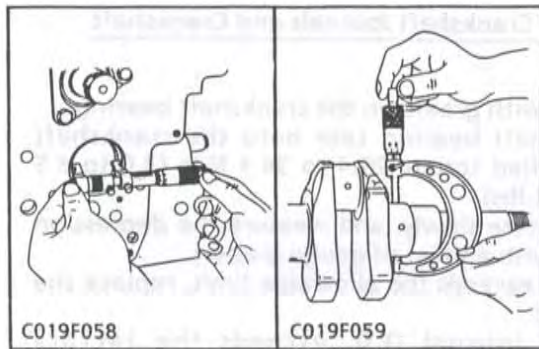


C019F057

Crankshaft Alignment

1. Place V blocks on the surface plate, and support the journals at both ends of the crankshaft on the V blocks.
2. Set a dial gauge to the central journal.
3. Read the dial gauge while rotating the crankshaft slowly. Crankshaft flexure is half of the reading.
4. If the reading exceeds the allowable limit, replace.

Crankshaft alignment	Factory spec.	0.02 mm 0.0008 in.
	Allowable limit	0.08 mm 0.0031 in.

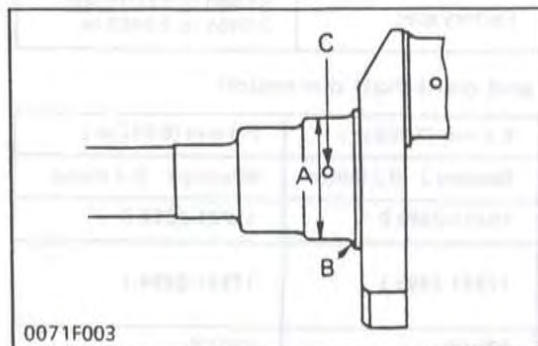


Oil Clearance between Crankshaft Journal and Crankshaft Bearing 1

Bearing 1

1. Measure the crankshaft journal (on the side of the crankshaft bearing 1) with an outside micrometer.
2. Measure the crankshaft bearing 1 with an inside micrometer. Calculate the clearance.
3. If the clearance exceeds the allowable limit, replace the crankshaft bearing 1.
4. If the crankshaft journal O.D. exceeds the factory specification, machine the crankshaft journal, and use an undersize crankshaft bearing 1.

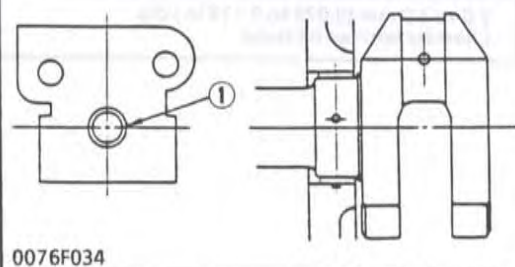
Oil clearance between crankshaft journal and crankshaft bearing 1	Factory spec.	0.040 to 0.118 mm 0.0016 to 0.0047 in.
	Allowable limit	0.2 mm 0.0079 in.
Crankshaft journal O.D.	Factory spec.	51.921 to 51.940 mm 2.0441 to 2.0449 in.
Crankshaft bearing 1 I.D.	Factory spec.	51.980 to 52.039 mm 2.0465 to 2.0488 in.



• Undersize bearing 1 and crankshaft dimension

Undersize	0.2 mm (0.008 in.)	0.4 mm (0.016 in.)
Bearing	Bearing 1 0.2 minus	Bearing 1 0.4 minus
Code Number	17331-2391-1	17331-2392-1
Marking	020 US	040 US
A	51.721 to 51.740 mm 2.03626 to 2.03701 in.	51.521 to 51.540 mm 2.02839 to 2.02914 in.
B	2.8 to 3.2 mm (0.110 to 0.126 in.) radius Grind with a wheel which has specified round corner and width not to shape shoulder.	
C	2.0 to 3.0 mm (0.079 to 0.118 in.) dia. Chamfer with an oil stone.	

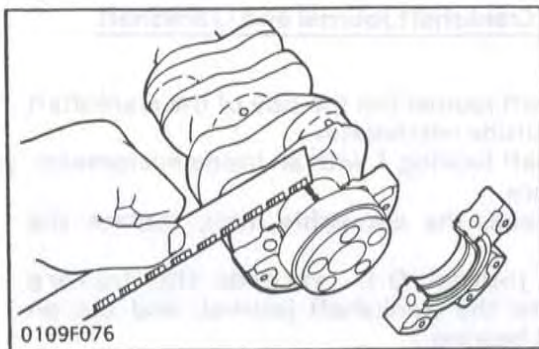
Crankshaft and crankshaft bearing 1, as assembled



(1) Seam

Replace the Crankshaft Bearing 1

1. Prepare the necessary tool. (See page S.G-40)
2. Press out the bearing 1, using the extracting tool.
3. Insert a new bearing 1, using the inserting tool, taking due care to see that the seam of bearing 1 faces the exhaust manifold side.



Oil Clearance between Crankshaft Journals and Crankshaft Bearings 2

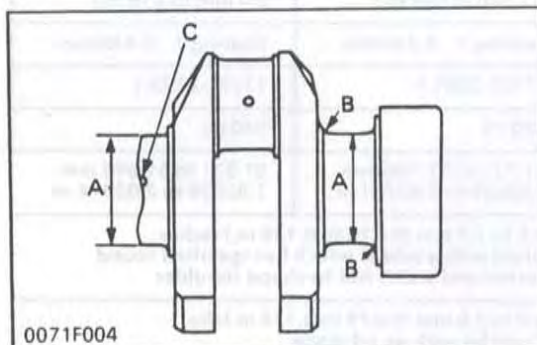
1. Paste a press gauge with grease on the crankshaft bearing.
2. Tighten the crankshaft bearing case onto the crankshaft journal to the specified torque 29.4 to 34.3 N·m (3.0 to 3.5 kgf·m, 21.7 to 25.3 ft-lbs).
3. Detach the bearing case slowly, and measure the depression of the press gauge with a sheet of gauge (paper).
4. If the measurement exceeds the allowable limit, replace the crankshaft bearing 2.
5. If the crankshaft journal O.D. exceeds the factory specification, machine the crankshaft journal, and use an undersize crankshaft bearing 2.

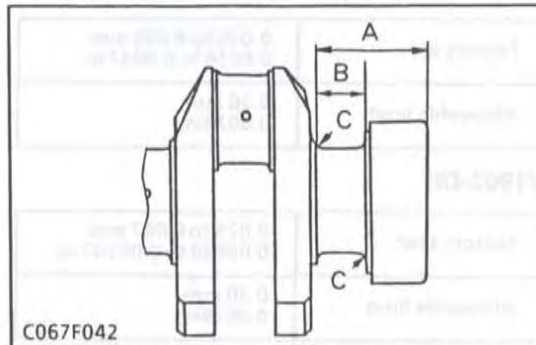
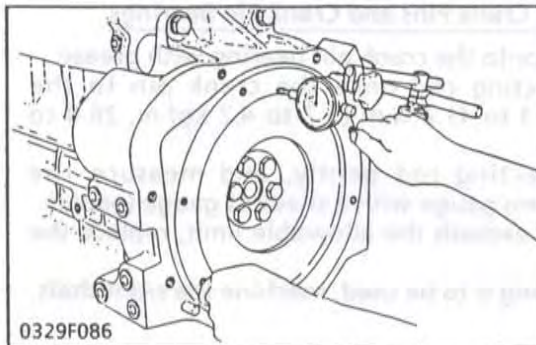
Oil clearance between crankshaft journal and crankshaft bearing 2	Factory spec.	0.040 to 0.104 mm 0.0016 to 0.0041 in.
	Allowable limit	0.20 mm 0.0079 in.

Crankshaft journal O.D.	Factory spec.	51.921 to 51.940 mm 2.0441 to 2.0449 in.
Crankshaft bearing 2 I.D.	Factory spec.	51.980 to 52.025 mm 2.0465 to 2.0482 in.

• Undersize bearing 2 and crankshaft dimension

Undersize		0.2 mm (0.008 in.)	0.4 mm (0.016 in.)
Bearing		Bearing 2 0.2 minus	Bearing 2 0.4 minus
Code Number	D1102	15221-2393-0	15221-2394-0
	D1402-DI D1462-DI V1902-DI	17331-2393-1	17331-2394-1
	Marking	020 US	040 US
A		51.721 to 51.740 mm 2.03626 to 2.03701 in.	51.521 to 51.540 mm 2.02839 to 2.02914 in.
B		2.8 to 3.2 mm (0.110 to 0.126 in.) radius Grind with a wheel which has specified round corner and width not to shape shoulder.	
C		2.0 to 3.0 mm (0.079 to 0.118 in.) dia. Chamfer with an oil stone.	





Flywheel Sway and Crankshaft Side Clearance

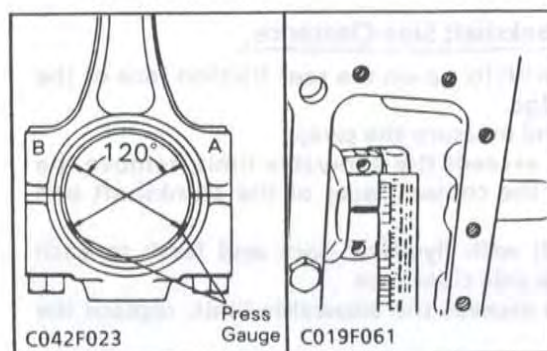
1. Set a dial indicator with its tip on the rear friction face of the flywheel near the edge.
2. Turn the flywheel and measure the sway.
3. If the measurement exceeds the allowable limit, remove the flywheel and check the contact faces of the crankshaft and flywheel.
4. Move the crankshaft with flywheel back and forth to each end and measure the side clearance.
5. If the side clearance exceeds the allowable limit, replace the side bearing.
6. If an oversize bearing is to be used, machine the crankshaft.

Sway	Allowable limit	0.05 mm 0.0020 in.
Side clearance	Factory spec.	0.15 to 0.31 mm 0.0059 to 0.0122 in.
	Allowable limit	0.5 mm 0.020 in.

● Oversize bearing and crankshaft dimension

Undersize		0.2 mm (0.008 in.)		0.4 mm (0.016 in.)	
Bearing		Side bearing 1 0.2 plus	Side bearing 2 0.2 plus	Side bearing 1 0.4 plus	Side bearing 2 0.4 plus
Code Number	D1102	15521-2395-0	19202-2397-1	15521-2396-0	19202-2398-1
	D1402-DI D1462-DI V1902-DI	15221-2395-1		15221-2396-1	
Marking		020 OS		040 OS	
A		54.6 to 54.8 mm 2.150 to 2.157 in.		54.8 to 55.0 mm 2.157 to 2.165 in.	
B		26.40 to 26.45 mm 1.0394 to 1.0413 in.		26.80 to 26.85 mm 1.0551 to 1.0571 in.	
C		2.8 to 3.2 mm (0.110 to 0.126 in.) radius Grind with a wheel which has specified round corner and width not to shape shoulder.			





Oil Clearance between Crank Pins and Crank Pin Bearings

1. Paste a press gauge onto the crank pin bearing with grease.
2. Tighten the connecting rod onto the crank pin to the specified torque 36.3 to 41.2 N·m (3.7 to 4.2 kgf·m, 26.8 to 30.4 ft-lbs).
3. Remove the connecting rod gently, and measure the depression of the press gauge with a sheet of gauge (paper).
4. If the measurement exceeds the allowable limit, replace the crankpin bearing.
5. If an undersize bearing is to be used, machine the crankshaft.

[D1102]

Oil clearance between crank pins and crank pin bearings	Factory spec.	0.035 to 0.093 mm 0.0014 to 0.0037 in.
	Allowable limit	0.20 mm 0.0079 in.

[D1402-DI, D1462-DI, V1902-DI]

Oil clearance between crank pins and crank pin bearings	Factory spec.	0.025 to 0.087 mm 0.00098 to 0.00343 in.
	Allowable limit	0.20 mm 0.0079 in.

● Undersize bearing and crankshaft dimension

Undersize		0.2 mm (0.008 in.)	0.4 mm (0.016 in.)
Bearing		Connecting rod bearing 0.2 minus	Connecting rod bearing 0.4 minus
Code Number	D1102	15471-2297-0	15471-2298-0
	D1402-DI D1462-DI V1902-DI	17331-2297-1	17331-2298-1
	Marking	020 US	040 US
A	D1102	43.759 to 43.775 mm 1.72280 to 1.72343 in.	43.559 to 43.575 mm 1.71492 to 1.71555 in.
	D1402-DI D1462-DI V1902-DI	46.759 to 46.775 mm 1.84091 to 1.84154 in.	46.559 to 46.575 mm 1.83303 to 1.83366 in.
B	3.3 to 3.7 mm (0.130 to 0.146 in.) radius Grind with a wheel which has specified round corner and width not to shape shoulder.		
C	2.0 to 3.0 mm (0.079 to 0.118 in.) dia. Chamfer with an oil stone.		

Crankshaft Sleeve Wear

1. Measure the wear of the crankshaft sleeve with a surface roughness tester.
2. If the wear exceeds the allowable limit, replace the crankshaft sleeve.

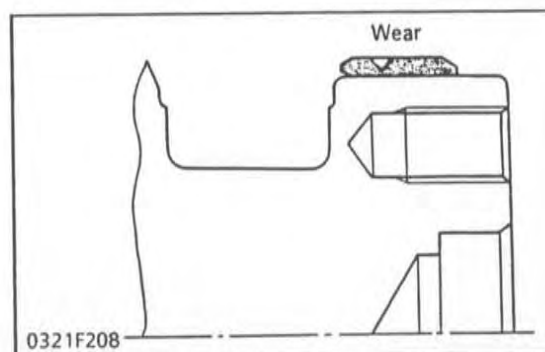
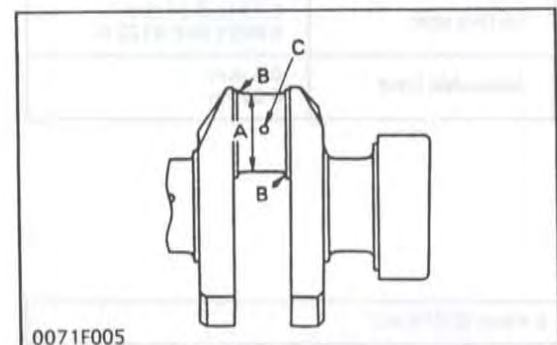
Wear	Allowable limit	0.1 mm 0.0039 in.
------	-----------------	----------------------

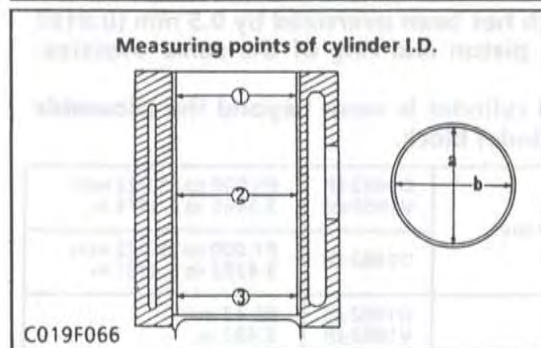
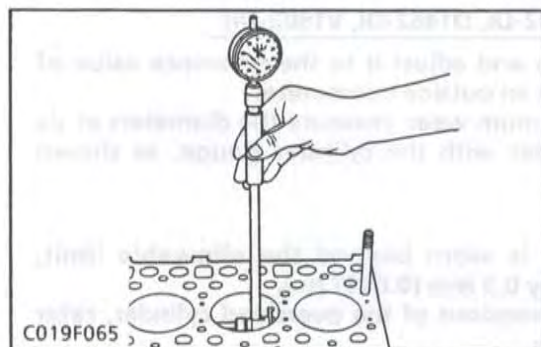
(When removing)

- Pull out the crankshaft sleeve with a special-use puller set (Code No: 07916-09032)

(When installing)

- Heat a new sleeve to a temperature between 150 to 200°C (302 to 392°F), and fix the sleeve to the crankshaft.
- Press fit the crankshaft sleeve using an auxiliary socket (Code No: 07916-32091)





- (1) Top
(2) Middle
(3) Bottom (Skirt)
- (a) Right-angle to the Piston Pin
(b) Parallel to the Piston Pin

Wear of Cylinder Liner [D1102]

1. Set a cylinder gauge and adjust it to the reference value of the cylinder liner with an outside micrometer.
2. To find out the maximum wear, measure the diameters at six points on the cylinder liner with the cylinder gauge, as shown below.

NOTE

- When the cylinder liner is worn beyond the allowable limit, rebore and hone it by 0.5 mm (0.0197 in.).
- For the finish dimensions of the cylinder liners, refer to the table below.
- The cylinder liner which has been oversized by 0.5 mm (0.0197 in.) should use a piston and ring of the same oversize. (See the Table 2)
- When the oversized cylinder liner is worn beyond the allowable limit, replace the cylinder liner, and rebore and hone it.

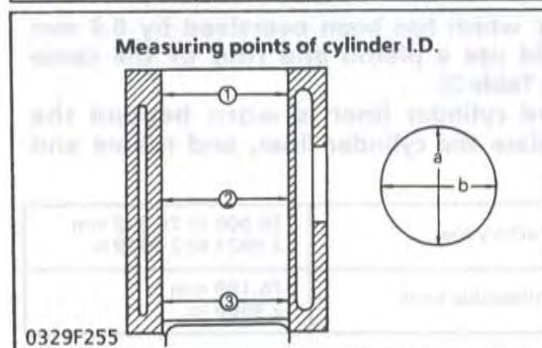
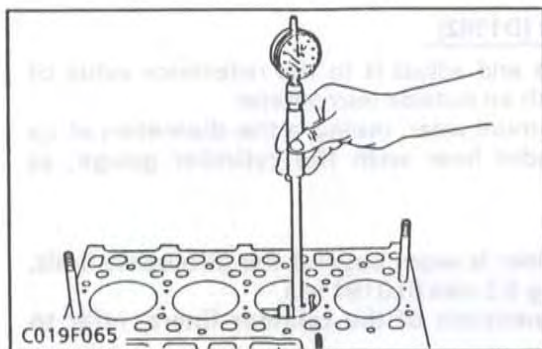
Cylinder I.D.	Factory spec.	76.000 to 76.019 mm 2.9921 to 2.9929 in.
	Allowable limit	76.169 mm 2.9988 in.

Table 1

Oversized Cylinder I.D.	Finishing
76.500 to 76.519 mm 3.0118 to 3.0126 in.	Hone to 1.2 to 2.0 μ R max.

Table 2

Oversize	Part name	Code number	Mark
0.5 mm 0.0197 in.	Piston 05	15221-2191-1	050S
	Piston ring 05 assembly	15501-2109-0	



- (a) Right-angle to the Piston Pin
(b) Parallel to the Piston Pin
- (1) Top
(2) Middle
(3) Bottom (Skirt)

Wear of Cylinder [D1402-DI, D1462-DI, V1902-DI]

1. Set a cylinder gauge and adjust it to the reference value of the cylinder I.D. with an outside micrometer.
2. To find out the maximum wear, measure the diameters at six points on the cylinder with the cylinder gauge, as shown below.

NOTE

- When the cylinder is worn beyond the allowable limit, rebore and hone it by 0.5 mm (0.0197 in.).
 - For the finish dimensions of the oversized cylinder, refer to the table below.
 - The cylinder which has been oversized by 0.5 mm (0.0197 in.) should use a piston and ring of the same oversize. (See the Table 2)
- When the oversized cylinder is worn beyond the allowable limit, replace the cylinder block.

Cylinder I.D.	Factory spec.	D1402-DI V1902-DI	85.000 to 85.022 mm 3.3465 to 3.3473 in.
		D1462-DI	87.000 to 87.022 mm 3.4252 to 3.4261 in.
	Allowable limit	D1402-DI V1902-DI	85.17 mm 3.432 in.
		D1462-DI	87.67 mm 3.452 in.

Table 1

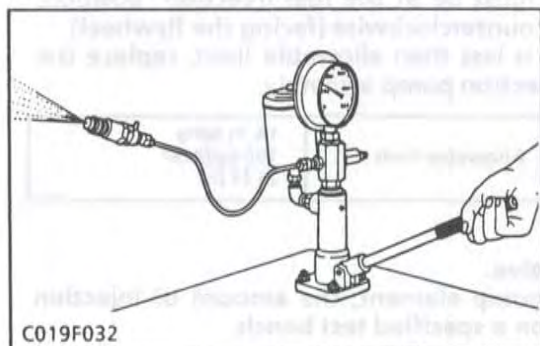
	Oversized Cylinder I.D.	Finishing
D1402-DI V1902-DI	85.500 to 85.522 mm 3.3661 to 3.3670 in.	Hone to 1.2 to 2.0 μ R max.
D1462-DI	87.500 to 87.522 mm 3.4449 to 3.4457 in.	

Table 2

Oversize	Part name	Model	Code number	Mark
0.5 mm 0.0197 in.	Piston 05	D1402-DI	19821-2191-1	050S
		D1462-DI	17367-2191-1	
		V1902-DI	17365-2192-1	
	Piston ring 05 assembly	D1402-DI V1902-DI	15521-2109-2	
		D1462-DI	17331-2109-1	

[4] FUEL SYSTEM (D1102)

CHECKING AND ADJUSTING



Fuel Injection Pressure

1. Set a nozzle to a nozzle tester.
2. Move the tester handle up and down to prime fuel. Measure the pressure of fuel jetting from the nozzle tip.
3. If the measurement is not within the factory specification, adjust with the adjustment washer inside the nozzle holder. (See page S.1-48) Each extra 0.1 mm (0.0039 in.) of washer thickness causes an approximate 980.6 kPa (10 kgf/cm², 142.2 psi) increase in fuel injection pressure.

CAUTION

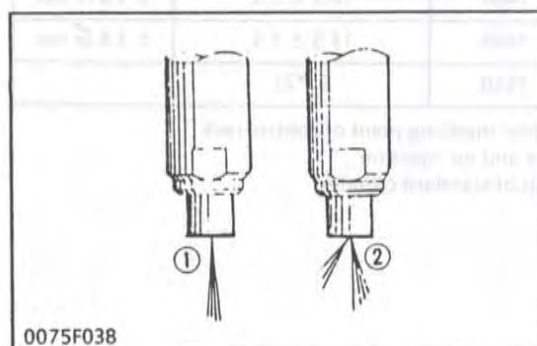
- Be careful not to come into direct contact with the injected fumes. The fumes destroy any cells they may touch. They may also cause blood poisoning.

Opening pressure of nozzle	Factory spec.	13.7 to 14.7 MPa 140 to 150 kgf/cm ² 1990 to 2133 psi
----------------------------	---------------	--

Fuel Tightness of Nozzle Valve Seat

1. Set a nozzle to a nozzle tester.
2. Apply a pressure 12.7 MPa (130 kgf/cm², 1848.6 psi).
3. After keeping the nozzle under this pressure for 10 seconds, check to see if fuel leaks from the nozzle valve seat.
4. If fuel should leak, replace the nozzle piece.

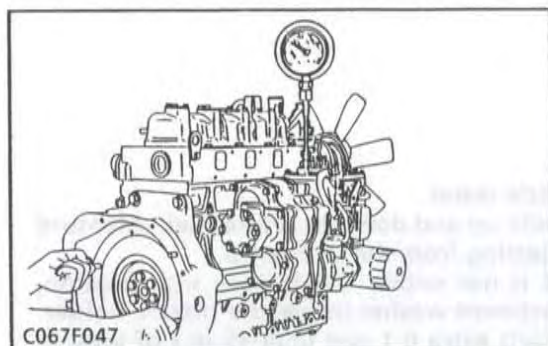
Factory spec.
When the pressure is 12.7 MPa (130 kgf/cm ² , 1848.6 psi), in the valve seat must be oil-tight.



Shape of Fumes Across Nozzle Tip

1. Set the nozzle to a nozzle tester and shoot it in the air. Check the shape of the fumes.
2. If the shape is defective, replace the nozzle piece.

- (1) Good
(2) Bad



Fuel Tightness of Pump Element

1. Remove the injection pipes, glow plug and the inlet manifold, and install the pressure tester (See page S.G-39)
2. Speed control lever must be at the fuel injection position, turn the crankshaft counterclockwise (facing the flywheel).
3. If the measurement is less than allowable limit, replace the pump element or injection pump assembly.

Fuel tightness of pump element	Allowable limit	14.71 MPa 150 kgf/cm ² 2133 psi
--------------------------------	-----------------	--

■ IMPORTANT

- Use good delivery valve.
- After replace only pump element, the amount of injection should be adjusted on a specified test bench.

[Test Conditions]

Nozzle	DN12SD12
Opening pressure	13.73 MPa (140 kgf/cm ² , 1991 psi)
Injection pipe	6mm dia. x 2 mm dia. x 600 mm long 0.24 in. dia x 0.08 in. dia. x 23.62 in. long
Fuel feed pressure	20 kPa (0.2 kgf/cm ² , 3 psi)
Test fuel	Diesel fuel No. 2-D
Pre-stroke	2.15 to 2.25 mm, 0.0846 to 0.0886 in.
Cam profile	See figure

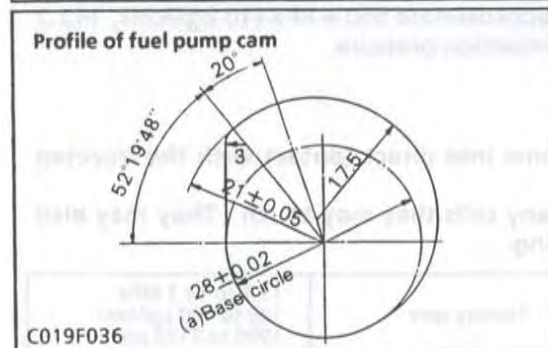
[Adjustment Reference Data]

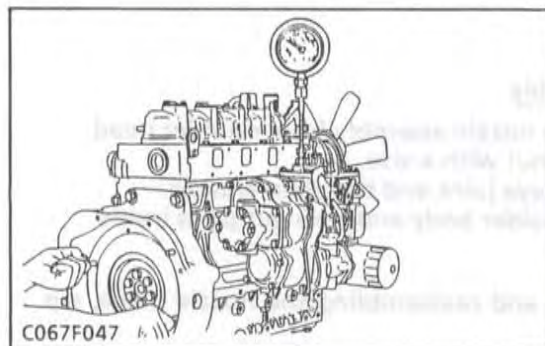
Control rack position (*1)	Speed (rpm)	Amount of injection (mm ³ /st)	Allowance (mm ³) (*3)
9	1400	23 ± 1.5	± 1.5 or less
8	1400	18.5 ± 7.5	± 3.8 or less
7	1400	13.5 ± 7.5	± 3.8 or less
0 to 3.5	1550	0 (*2)	

*1: Travel distance from non-injecting point of control rack

*2: Zero opening pressure and no injection

*3: Allowance on the basis of standard cylinder

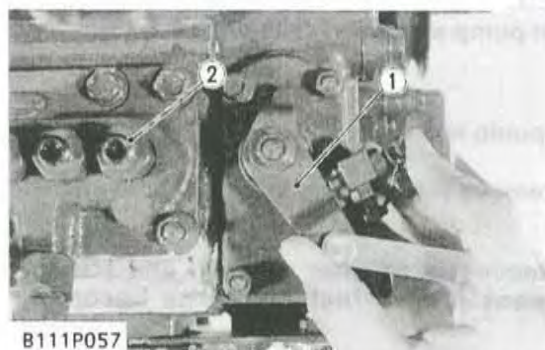




Fuel Tightness of Delivery Valve of Fuel Injection Pump

1. Remove the injection pipes, glow plugs and the inlet manifold, and install the pressure tester (See page S.G-39).
2. With the speed control lever at the fuel injection position, turn the crankshaft counterclockwise (facing the flywheel) until the pressure build up to 9.8 MPa (100kgf/cm², 1422 psi).
3. Release the pressure in the delivery chamber by moving down the plunger to bottom dead center (turn the crankshaft clockwise approx. 1.57 rad (90°) from the FI timing).
4. Measure the time needed to decrease the initial pressure from 9.81 to 9.32 MPa (100 to 95 kgf/cm², 1422 to 1351 psi).
5. If measurement is less than allowable limit, replace the delivery valve.
6. If the pressure does not build up, replace the pump element with new one and test again.

Fuel tightness of delivery valve of fuel injection pump	Allowable limit	5 seconds
---	-----------------	-----------

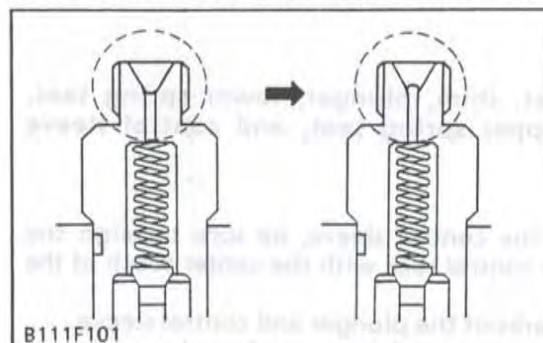


(1) Speed Control Lever (2) Delivery Valve Holder

Injection Timing

1. Disconnect the injection pipes from the injection pump.
2. Position the speed control lever (1) at maximum speed.
3. Rotate the flywheel counterclockwise to verify that the fuel flows from the delivery valve holder (2) of the injection pump.
4. Rotate the flywheel clockwise by about 0.7 rad. (40°).
5. Slowly rotate the flywheel counterclockwise again, find out an instance when the fuel level rises from the delivery valve holder (2), and stop flywheel rotation immediately.
6. Read the injection timing of the window on the flywheel housing.
7. The fuel injection timing lines are issued each 0.09 rad. (5°) from the TC mark on the flywheel. Therefore, reading of the fuel injection timings are roughly.
8. If the timing is out of adjustment, readjust with shim.

Injection timing	Factory spec.	0.401 to 0.436 rad (23° to 25°) before T.D.C.
------------------	---------------	---



Timing Window

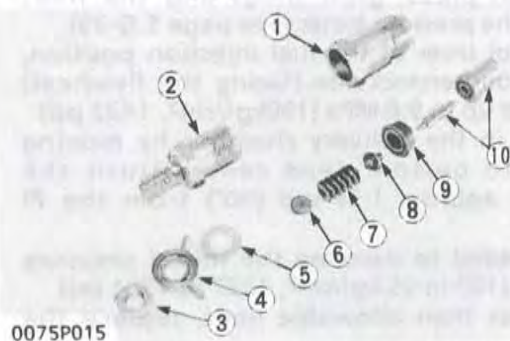


(Reference)

- The timing advances by removing 0.15 mm (0.006 in.) of shim and retard by adding one, approx. 0.26 rad (1.5°) of crank angle.
- Approx. 3.6 mm (0.142 in.) of turn at outer rim of flywheel equals 0.26 rad (1.5°) of crank angle.
- Thickness of adjusting shims:

0.15 mm (0.0059 in.)	[Code No. 15321-52113]
0.30 mm (0.0118 in.)	[Code No. 15521-52111]
0.45 mm (0.0177 in.)	[Code No. 15511-52111]

DISASSEMBLING AND ASSEMBLING



- 0075P015
- | | |
|------------------------|----------------------|
| (1) Retaining Nut | (6) Adjusting Washer |
| (2) Nozzle Holder Body | (7) Nozzle Spring |
| (3) Nut | (8) Push Rod |
| (4) Eye Joint | (9) Distance Piece |
| (5) Plain Washer | (10) Nozzle Piece |

Injection Nozzle Assembly

1. Remove the injection nozzle assembly from cylinder head.
2. Secure the retaining nut with a vise.
3. Remove the nut, the eye joint and the plain washer.
4. Remove the nozzle holder body and take out parts inside.

(When reassembling)

- When disassembling and reassembling the nozzle piece, dip it in clean fuel.
- Install the push rod, don't refit it upside down.
- Do not tighten it too much, or the needle valve will not slide easily and the injection performance will be decreased.

Tightening torque	Nozzle holder body to retaining nut	58.8 to 78.4N·m 6.0 to 8.0 kgf·m 43.4 to 57.9 ft-lbs
-------------------	-------------------------------------	--

Injection Pump Assembly

1. Remove the injection pump assembly. (See page S.1-25)

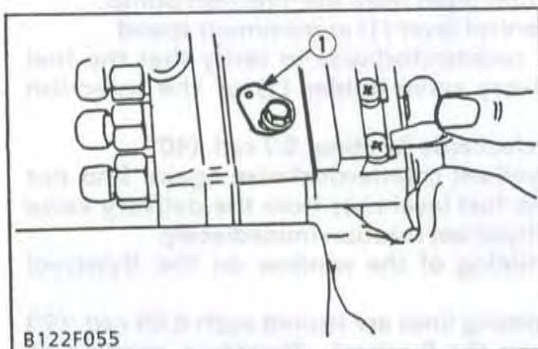
Tappet Guide Pin

1. Clamp the injection pump in a vice.
2. Flatten the plate.
3. Push in the tappet, remove the tappet guide pin.

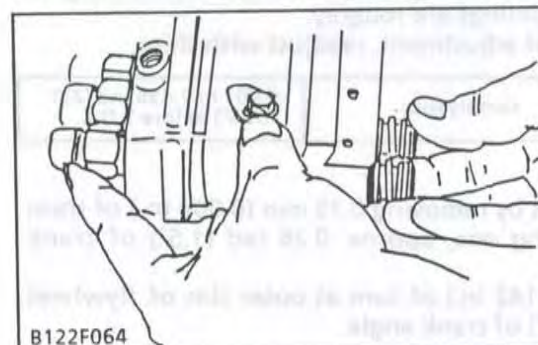
■ IMPORTANT

- Never loosen or remove the adjuster plate (1) and screws unless the adjustment of the fuel discharge becomes necessary.

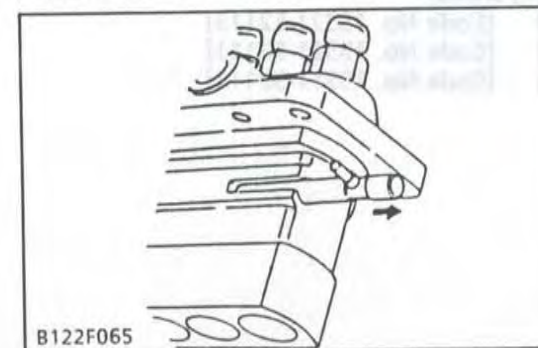
- (1) Adjuster Plate



B122F055



B122F064



B122F065

Tappet, Other Parts

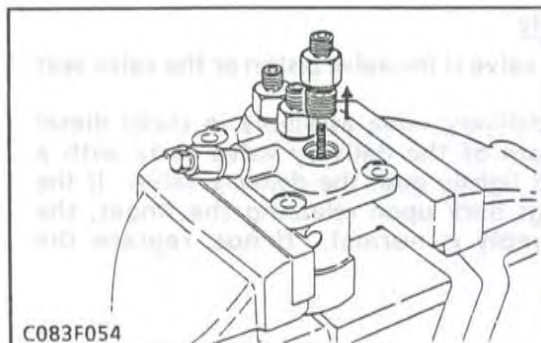
1. Remove the tappet, shim, plunger, lower spring seat, plunger spring, upper spring seat, and control sleeve together.

(When reassembling)

- Before assembling the control sleeve, be sure to align the stamped line of the control rack with the center tooth of the control sleeve.
- Set the assembly marks of the plunger and control sleeve.
- Do not force the plunger into the plunger barrel.

Control Rack

1. Remove the control rack.



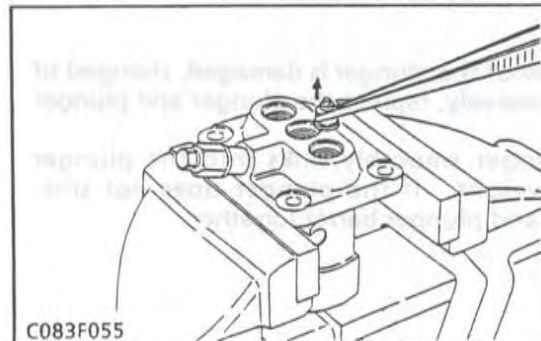
Delivery Valve, Plunger Barrel

1. Loosen and remove the delivery valve holder.
2. Remove the delivery valve spring, delivery valve assembly and gasket.
3. Remove the plunger barrel.

(When reassembling)

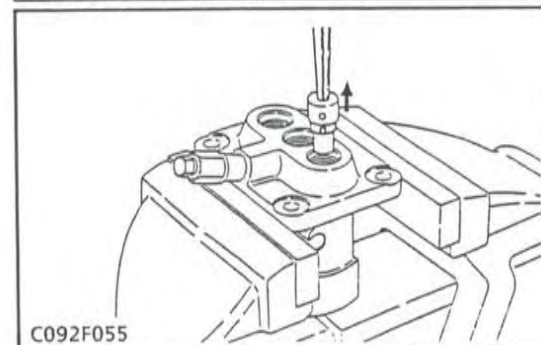
- Install the plunger barrel so that its locator groove fits the eccentric pin.

Tightening torque	Delivery valve holder	39.2 to 44.1 N·m 4.0 to 4.5 kgf·m 28.9 to 32.5 ft-lbs
-------------------	-----------------------	---

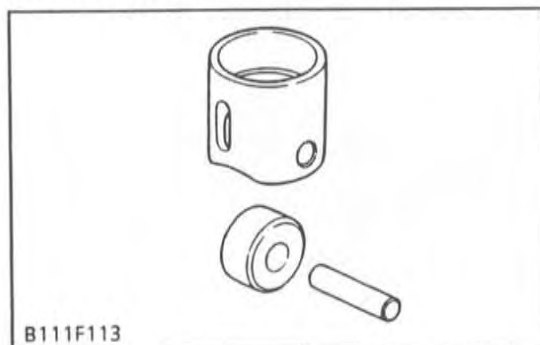


■ IMPORTANT

- Always disassemble and assemble the delivery valve and plunger barrel in clean diesel fuel.
- Attach tags to all removed parts for proper matching in reassembling and enter notes on installation, place and sequences of assembling.

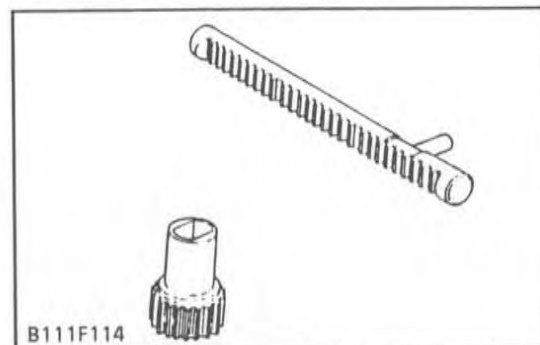


SERVICING



Tappet Assembly

1. Replace the tappet assembly if the outer circumference of the tappet, roller and roller pin are damaged or excessively worn.



Control Rack

1. Replace the control rack if it is bent, damaged or the tooth is excessively worn.

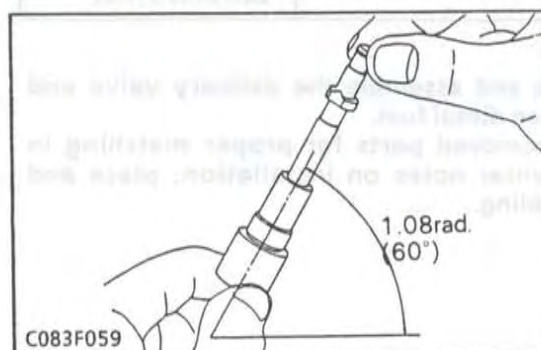
Control Sleeve

1. Replace the control sleeve if the teeth or groove of the control sleeve is excessive worn.



Delivery Valve Assembly

1. Replace the delivery valve if the valve piston or the valve seat is damaged or worn.
2. After washing the delivery valve assembly in clean diesel fuel, close the bottom of the delivery valve body with a finger as shown and lightly push the delivery valve. If the delivery valve springs back upon releasing the finger, the delivery valve assembly is normal. If not, replace the assembly.



Pump Element

1. If the notch or groove of the plunger is damaged, changed of its color or worn excessively, replace the plunger and plunger barrel together.
2. Verify that the plunger smoothly sinks into the plunger barrel by its own weight. If the plunger does not sink, replace the plunger and plunger barrel together.

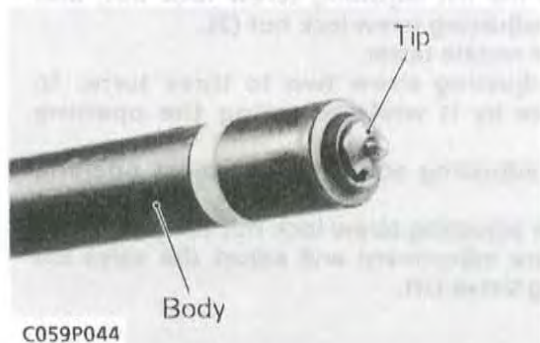


SEALING



[5] FUEL SYSTEM (D1402-DI, D1462-DI, V1902-DI)

CHECKING AND ADJUSTING



Injection Nozzle

1. Remove the injection nozzle assembly. (See page S.1-17)

Nozzle Body and Tip

1. Check the nozzle body and tip.
2. If the body is deformed, replace the nozzle.
3. If any orifices are chipped at the edges or eroded to an extent that the spray pattern is affected, replace the nozzle.



Fuel Injection Pressure

1. Set the injection nozzle to the nozzle tester.
2. Measure the injection pressure.
3. If the measurement is not within the factory specification, adjust the opening pressure and the valve lift referring to **Adjusting Opening Pressure** and **Adjusting Valve Lift**, (See page S.1-52).

Fuel injection pressure	Factory spec.	22.41 to 23.44 MPa 228.5 to 239.0 kgf/cm ² 3250 to 3400 psi
-------------------------	---------------	--

CAUTION

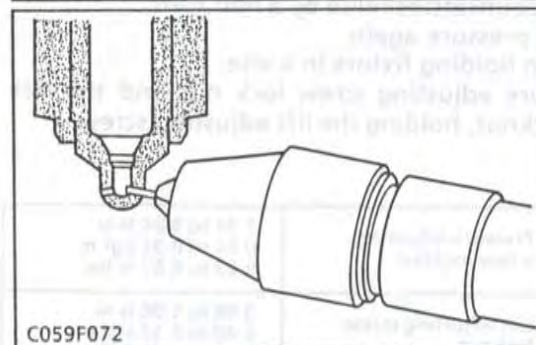
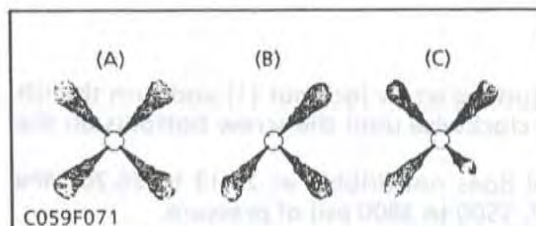
- Never contact with spraying diesel fuel under pressure, which can have sufficient force to penetrate the skin, causing serious personal injury.
- Be sure nobody is in the direction of the spray.

Spray Pattern

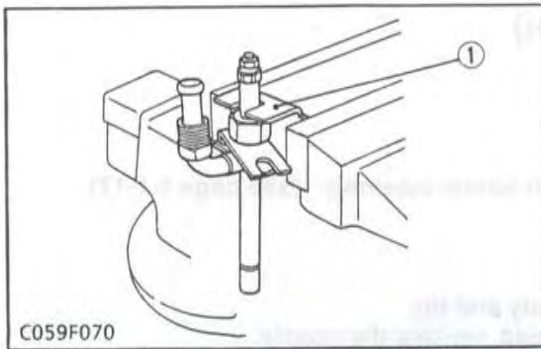
1. After checking the opening pressure, operate the tester at 30 downward strokes per minute and observe spray pattern.
2. If the spray pattern is affected by the chipped or eroded edge of orifices, replace the nozzle.
3. If the spray pattern is not **Typical**, clean the orifices as follows or replace the nozzle.
4. At first, secure the 0.19 mm (0.008 in.) DIA. of wire in the cleaning wires (Code No: 07916-32731) in pin vise with the end protruding approx. 1.0 mm (0.04 in.).
5. Insert the cleaning wire into each orifice and rotate it until free and progress to the 0.22 mm (0.009 in.) wire and repeat the process.
6. Finally clean the orifices with the 0.24 mm (0.01 in.) and wipe off and inspect the tip.

NOTE

- Clean orifice only after it is disassembled.



- (A) Typical Spray Pattern
(B) One Orifice is Plugged
(C) One Edge of Orifice is Chipped or Eroded

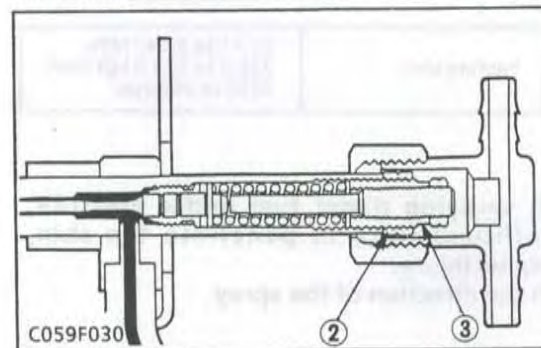
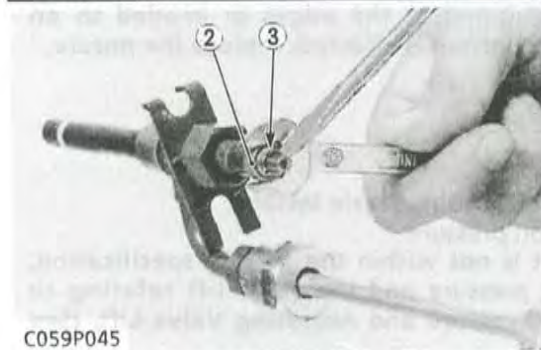


Adjusting Valve Opening Pressure

1. Secure the nozzle in holding fixture (1) (See page S.G-41) in a vise and remove the leak-off cap.
2. Loosen and remove the lift adjusting screw lock nut, and loosen the pressure adjusting screw lock nut (2).
3. Set the nozzle to the nozzle tester.
4. Back out the lift adjusting screw two to three turns, to prevent interference by it while adjusting the opening pressure.
5. Turn the pressure adjusting screw (3) to adjust opening pressure.
6. Tighten the pressure adjusting screw lock nut temporarily to maintain the pressure adjustment and adjust the valve lift referring to **Adjusting Valve Lift**.

(Reference)

Opening pressure	Factory spec.	22.41 to 23.44 MPa 228.5 to 239.0 kgf/cm ² 3250 to 3400 psi
Tightening torque	Pressure adjusting screw lock nut	7.91 to 9.04 N·m 0.81 to 0.92 kgf·m 5.83 to 6.67 ft-lbs



- (1) Holding Fixture
(2) Pressure Adjusting Screw Locknut

- (3) Pressure Adjusting Screw

Adjusting Valve Lift

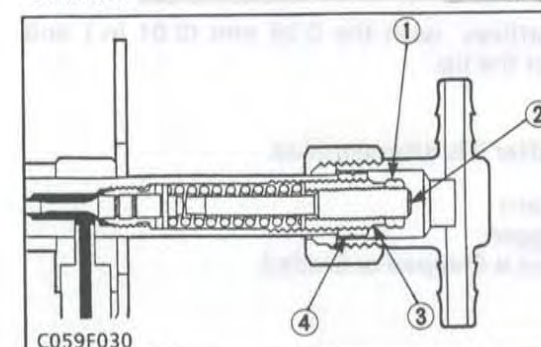
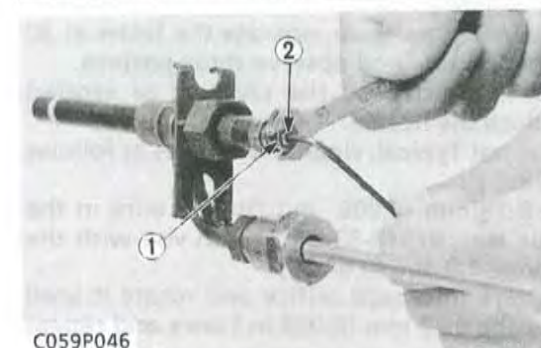
1. Remove the lift adjusting screw lock nut (1) and turn the lift adjusting screw (2) clockwise until the screw bottoms on the valve.
2. Check that the fuel does not dribble at 24.13 to 26.20 MPa (246 to 267 kgf/cm², 3500 to 3800 psi) of pressure.
3. Turn the lift screw counterclockwise by a half turn.
4. Check the opening pressure again.
5. Secure the nozzle in holding fixture in a vise.
6. Tighten the pressure adjusting screw lock nut and the lift adjusting screw locknut, holding the lift adjusting screw.

(Reference)

Tightening torque	Pressure adjusting screw locknut	7.91 to 9.04 N·m 0.81 to 0.92 kgf·m 5.83 to 6.67 ft-lbs
	Lift adjusting screw locknut	3.96 to 5.08 N·m 0.40 to 0.52 kgf·m 2.92 to 3.75 ft-lbs

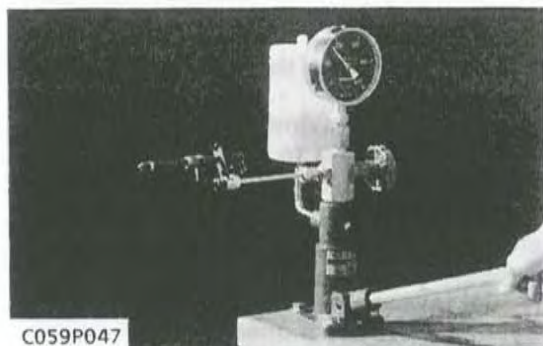
■ IMPORTANT

- Do not turn the lift adjusting screw excessively, as bending of the valve may result.

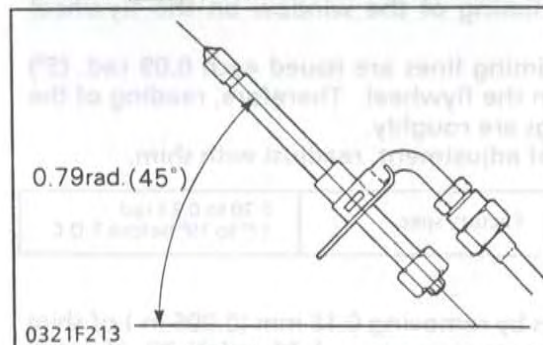


- (1) Lift Adjusting Screw Locknut
(2) Lift Adjusting Screw

- (3) Pressure Adjusting Screw
(4) Pressure Adjusting Screw Locknut



C059P047



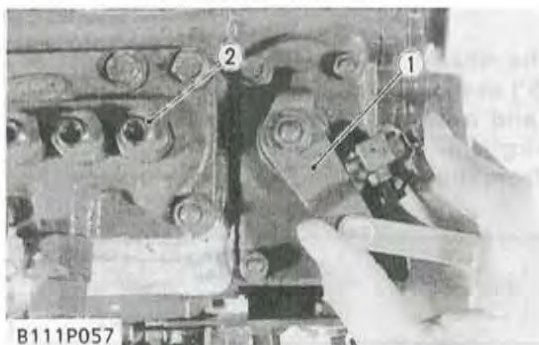
Valve Seat Tightness

1. Set the nozzle to the nozzle tester with the tip highest at approx. 0.79 rad. (45°) as shown in the figure.
2. Dry the nozzle tip and raise the pressure to 18.96 to 20.00 Mpa (193.3 to 203.9 kgf/cm², 2750 to 2900 psi).
3. If the fuel dribbles from the tip within 5 seconds, replace the nozzle.

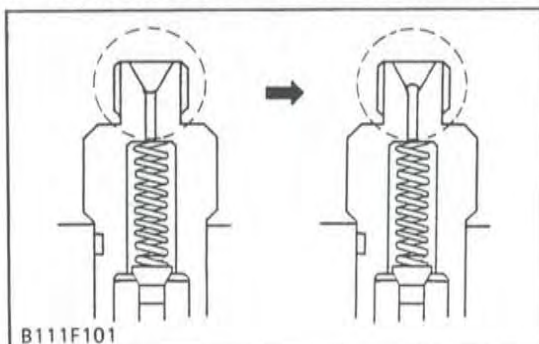
Valve seat tightness	Factory spec.	No leaks for 5 seconds at 18.96 to 20.00 MPa (193.3 to 203.9 kgf/cm ² , 2750 to 2900 psi)
----------------------	---------------	--



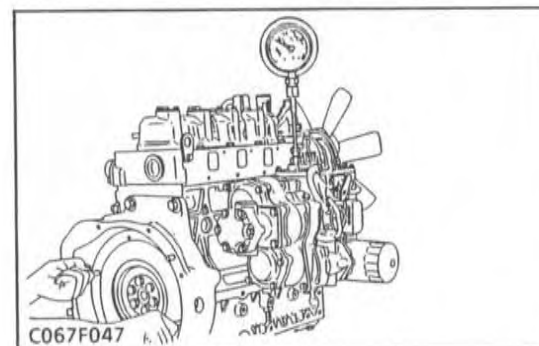
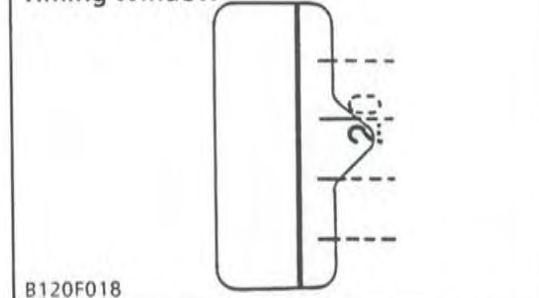
Fuel tightness test	Fuel tightness test	
	Factory spec.	Adjusted limit
	10 seconds or more 18.96 ~ 20.00 MPa (193.3 ~ 203.9 kgf/cm ² , 2750 ~ 2900 psi)	5 seconds or more 18.96 ~ 20.00 MPa (193.3 ~ 203.9 kgf/cm ² , 2750 ~ 2900 psi)



(1) Speed Control Lever (2) Delivery Valve Holder



Timing Window



Injection Timing

1. Remove the injection pipe and remove the timing inspection hole of the flywheel housing.
2. Position the speed control lever at maximum speed.
3. Rotate the flywheel counterclockwise to verify that the fuel flows from the delivery valve holder (2) of the injection pump.
4. Rotate the flywheel clockwise by about 0.7 rad. (40°).
5. Slowly rotate the flywheel counterclockwise again, find out an instance when the fuel level rises from the delivery valve holder (2), and stop flywheel rotation immediately.
6. Read the injection timing of the window on the flywheel housing.
7. The fuel injection timing lines are issued each 0.09 rad. (5°) from the TC mark on the flywheel. Therefore, reading of the fuel injection timings are roughly.
8. If the timing is out of adjustment, readjust with shim.

Injection timing	Factory spec.	0.30 to 0.33 rad 17° to 19° before T.D.C.
------------------	---------------	--

(Reference)

- The timing advances by removing 0.15 mm (0.006 in.) of shim and retard by adding one, approx. 0.26 rad (1.5°) of crank angle.
- Approx. 3.6 mm (0.142 in.) of turn at outer rim of flywheel equals 0.26 rad (1.5°) of crank angle.
- Thickness of adjusting shims:

0.15 mm (0.0059 in.)	[Code No. 15321-52113]
0.30 mm (0.0118 in.)	[Code No. 15521-52111]
0.45 mm (0.0177 in.)	[Code No. 15511-52111]

 for 3 cylinders.

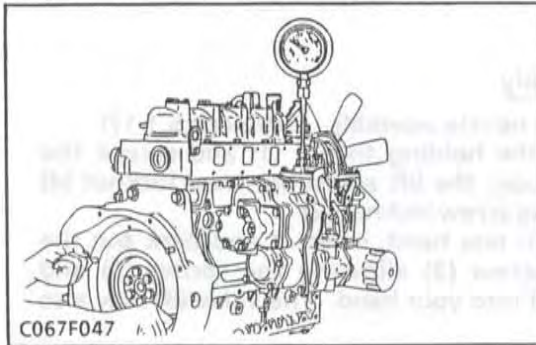
0.15 mm (0.0059 in.)	[Code No. 15401-52112]
0.30 mm (0.0118 in.)	[Code No. 15471-52111]
0.45 mm (0.0177 in.)	[Code No. 15461-52111]

 for 4 cylinders.

Delivery Valve Fuel Tightness

1. Remove the injection pipe, inlet manifold and glow plugs, and install a pressure tester on the delivery valve holder of the injection pump. (See page S.G-39)
2. Position the speed control lever at the maximum speed.
3. Rotate the flywheel counterclockwise until the pressure tester indicates 18.63 MPa (190 kgf/cm², 2702 psi).
4. When the pressure has reached 18.63 MPa (190 kgf/cm², 2702 psi), immediately stop rotating the flywheel and measure the time required for the pressure to lower down to 17.65 MPa (180 kgf/cm², 2560 psi).
5. Measure all delivery valves. If the fuel tightness is below the allowable limit, replace the applicable delivery valve assembly or replace the injection pump assembly.

Fuel tightness of delivery valve	Factory spec.	10 seconds or more 18.63 → 17.65 MPa 190 → 180 kgf/cm ² 2702 → 2560 psi
	Allowable limit	5 seconds 18.63 → 17.65 kPa 190 → 180 kgf/cm ² 2702 → 2560 psi



Pump Element Fuel Tightness

1. Remove the injection pipe, inlet manifold and glow plugs, and install a pressure tester on the delivery valve holder of the injection pump.
2. Position the speed control lever at the maximum speed.
3. Rotate the flywheel counterclockwise until the pressure tester indicates 39.23 MPa (400 kgf/cm², 5689 psi).
4. As soon as the pressure has reached 39.23 MPa (400 kgf/cm², 5689 psi), stop rotating the flywheel and measure the time required for the pressure to lower down to 34.32 MPa (350 kgf/cm², 4978 psi).
5. Measure all pump elements. If the fuel tightness is below the allowable limit, replace the applicable pump element assembly or replace the injection pump assembly.

Fuel tightness of pump element	Factory spec.	60 seconds or more 39.23 → 34.32 MPa 400 → 350 kgf/cm ² 5689 → 4978 psi
	Allowable limit	30 seconds 39.23 → 34.32 kPa 400 → 350 kgf/cm ² 5689 → 4978 psi

■ IMPORTANT

- After replacing only pump element, the amount of injection should be adjusted on a specified test bench.

(Reference)

- Test condition

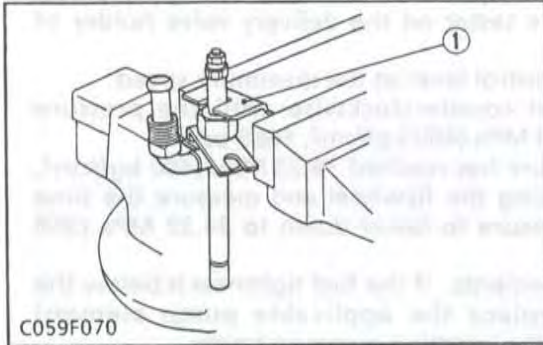
Nozzle	Stanadyne Pencil Nozzle	
Opening pressure	22.41 to 23.44 MPa (228.5 to 239.0 kgf/cm ² , 3250 to 3400 psi)	
Injection pipe	6 mm (0.24 in.) dia. x 1.4 mm (0.055 in.) / 1.2 mm (0.047 in.) dia. x 410 (16.14 in.) long	
Fuel feed pressure	20 kPa (0.2 kgf/cm ² , 3 psi)	
Fuel	Diesel fuel No.2-D	
Pre-stroke	2.94 mm (0.1157 in.)	
Cam profile	a. 0.35 rad. (20°) b. 0.9133 rad. (52.33°) c. 3 mm (0.12 in.) d. 20.95 to 21.05 mm (0.8248 to 0.8287 in.) e. 17.5 mm (0.689 in.) f. 27.98 to 28.02 mm (1.1016 to 1.1032 in.) C019F036	

- Fuel discharge

Control rack position (mm)	Camshaft speed (rpm)	Fuel discharge (cc/100 stroke)	Difference between two units (%)
A + 1	1300	—	less than ± 5
*A	1300	2.425 to 2.575	less than ± 2
A - 2	1300	—	less than ± 8
A - 2	350	—	less than ± 15

* A is the rack position where the fuel is discharged by the reference amount in one temporary unit, and should be 8 to 10 mm (0.31 to 0.39 in.) of rack travel from no injection.

DISASSEMBLING AND ASSEMBLING



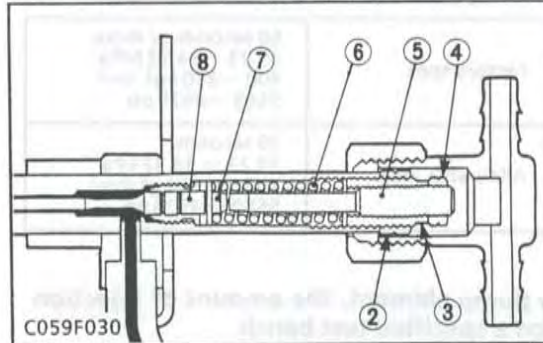
Injection Nozzle Assembly

1. Remove the injection nozzle assembly. (See page S.1-17)
2. Place the nozzle in the holding fixture (1) and secure the fixture in a vise. Loosen the lift adjusting screw locknut (4) and pressure adjusting screw locknut (2).
3. Holding the nozzle in one hand, invert it and back out the pressure adjusting screw (3) allowing the spring (6) and spring seats (7) to fall into your hand. The valve (8) may also slide out.

■ IMPORTANT

- Handle parts and components with due care.
- Always disassemble and assemble the injection nozzle assembly in clean diesel fuel.

- | | |
|--------------------------------------|--------------------------|
| (1) Holding Fixture | (5) Lift Adjusting Screw |
| (2) Pressure Adjusting Screw Locknut | (6) Spring |
| (3) Pressure Adjusting Screw | (7) Spring Seat |
| (4) Lift Adjusting Screw Locknut | (8) Valve |



Injection Pump Assembly

1. Remove the injection pump assembly. (See page S.1-25)

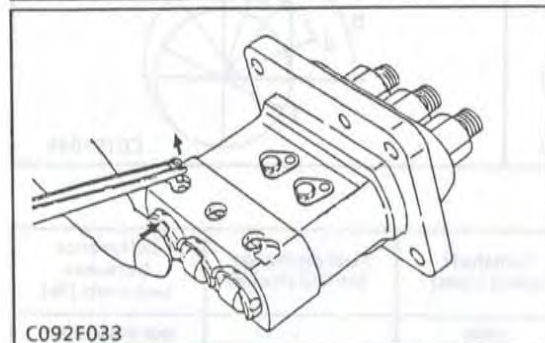
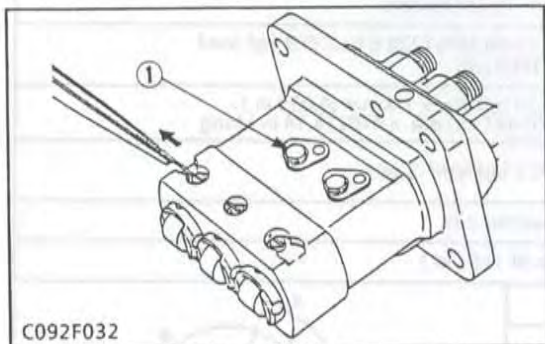
Tappet Pin

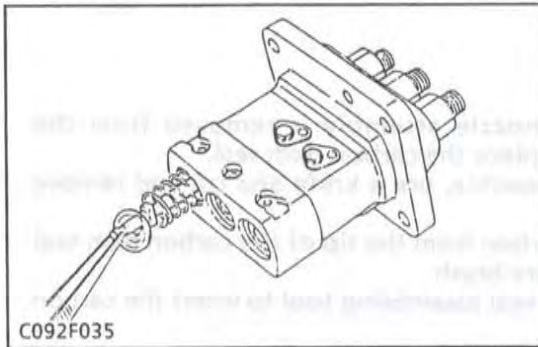
1. Clamp the injection pump in a vice.
2. Pull out the crank pin.
3. Push in the tappet, remove the tappet guide pin.

■ IMPORTANT

- Never loosen or remove the adjuster plate (1) and screws unless the adjustment of the fuel discharge becomes necessary.

- (1) Adjuster Plate



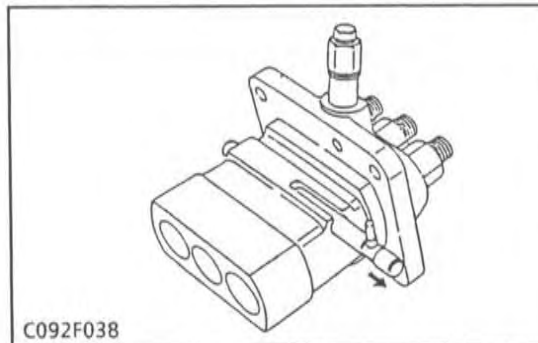


Tappet, Other Parts

1. Remove the tappet, shim, plunger, lower spring seat, plunger spring, upper spring seat, and control sleeve together.

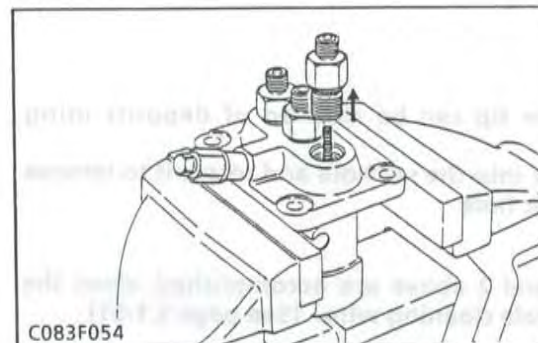
(When reassembling)

- Before assembling the control sleeve, be sure to align the stamped line of the control rack with the center tooth of the control sleeve.
- Set the assembly marks of the plunger and control sleeve.
- Do not force the plunger into the plunger barrel.



Control Rack

1. Remove the control rack.



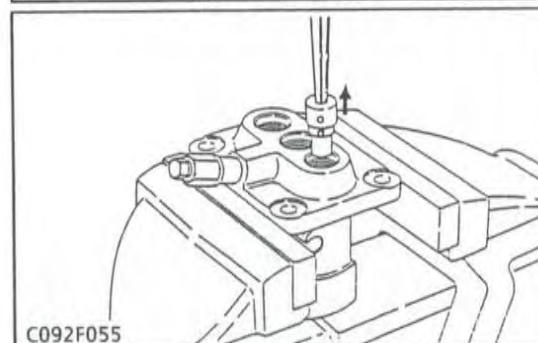
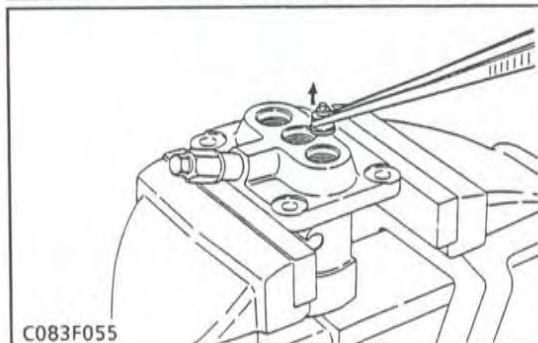
Delivery Valve, Plunger Barrel

1. Loosen and remove the delivery valve holder.
2. Remove the delivery valve spring, delivery valve assembly and gasket.
3. Remove the plunger barrel.

(When reassembling)

- Install the plunger barrel so that its locator groove fits the eccentric pin.

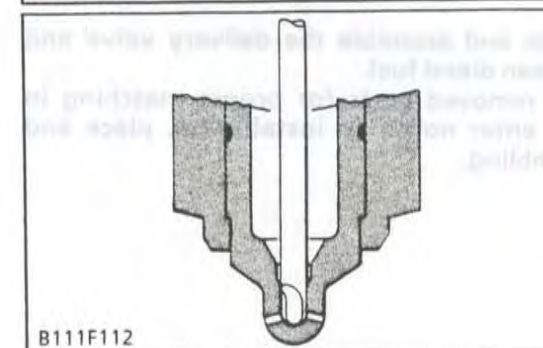
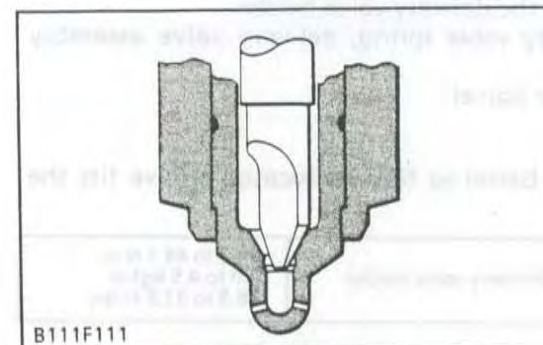
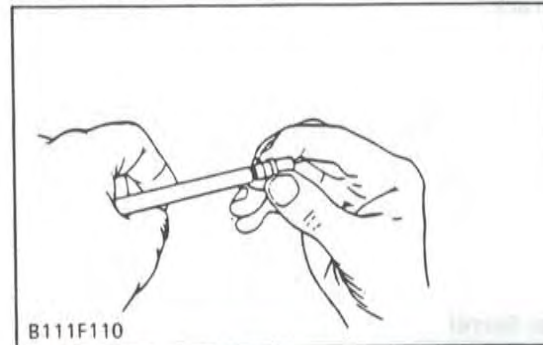
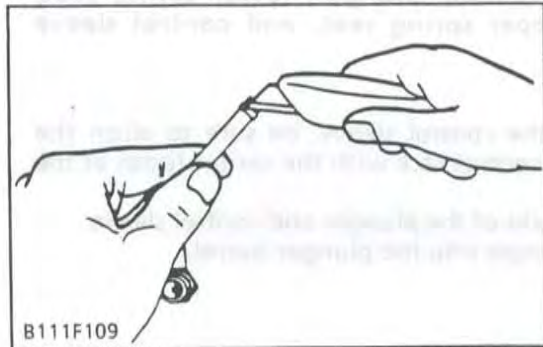
Tightening torque	Delivery valve holder	39.2 to 44.1 N·m 4.0 to 4.5 kgf·m 28.9 to 32.5 ft-lbs
-------------------	-----------------------	---



■ IMPORTANT

- Always disassemble and assemble the delivery valve and plunger barrel in clean diesel fuel.
- Attach tags to all removed parts for proper matching in reassembling and enter notes on installation, place and sequences of assembling.

SERVICING

**Carbon Dam Seal**

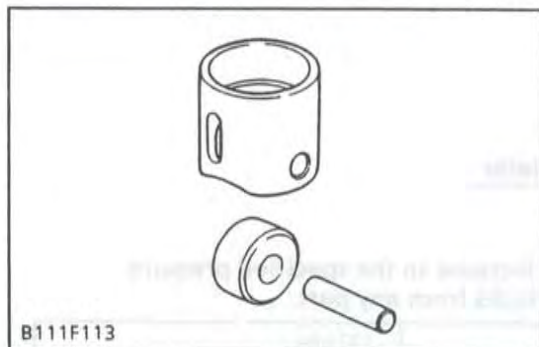
1. After the injection nozzle assembly is removed from the engine, be sure to replace the carbon dam seal.
2. Since removal is impossible, use a knife and cut and remove the carbon dam seal.
3. Remove the loose carbon from the tip of the carbon dam seal groove with brass wire brush.
4. Use the carbon dam seal assembling tool to insert the carbon dam seal.

Valve Seat Cleaning

1. The seat area in the tip can be cleaned of deposits using scraper.
2. Insert the tip scraper into the sac hole and rotate it to remove deposits from the sac hole.

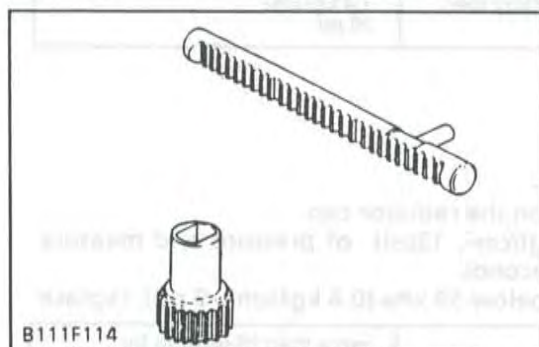
■ IMPORTANT

- After the items 1 and 2 above are accomplished, clean the nozzle with the nozzle cleaning wire. (See page S.1-51)



Tappet Assembly

1. Replace the tappet assembly if the outer circumference of the tappet, roller and roller pin are damaged or excessively worn.

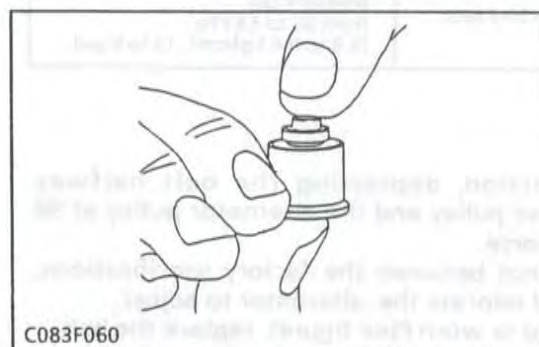


Control Rack

1. Replace the control rack if it is bent, damaged or the tooth is excessively worn.

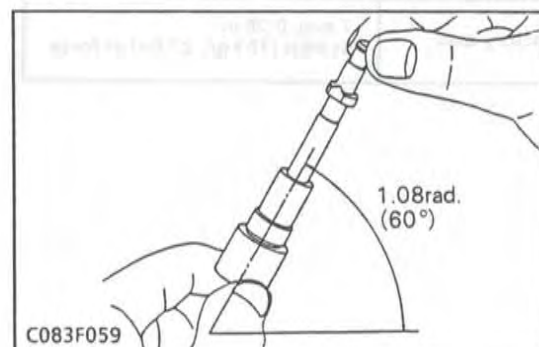
Control Sleeve

1. Replace the control sleeve if the teeth or groove of the control sleeve is excessive worn.



Delivery Valve Assembly

1. Replace the delivery valve if the valve piston or the valve seat is damaged or worn.
2. After washing the delivery valve assembly in clean diesel fuel, close the bottom of the delivery valve body with a finger as shown and lightly push the delivery valve. If the delivery valve springs back upon releasing the finger, the delivery valve assembly is normal. If not, replace the assembly.

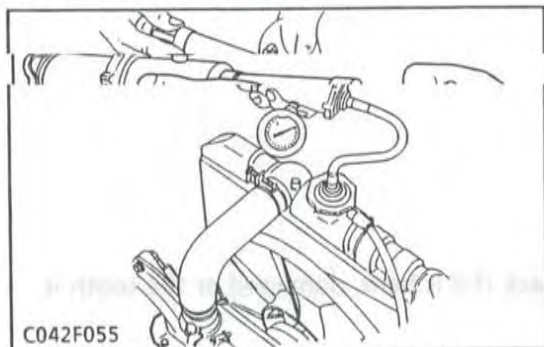


Pump Element

1. If the notch or groove of the plunger is damaged, changed of its color or worn excessively, replace the plunger and plunger barrel together.
2. Verify that the plunger smoothly sinks into the plunger barrel by its own weight. If the plunger does not sink, replace the plunger and plunger barrel together.

[6] COOLING SYSTEM

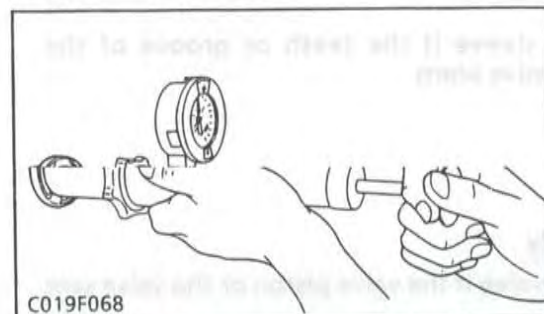
CHECKING AND ADJUSTING



Water Tightness of Radiator

- the radiator cap.
- Warm up the engine.
- Set a radiator tester. Increase to the specified pressure.
- Check to see if water leaks from any part.

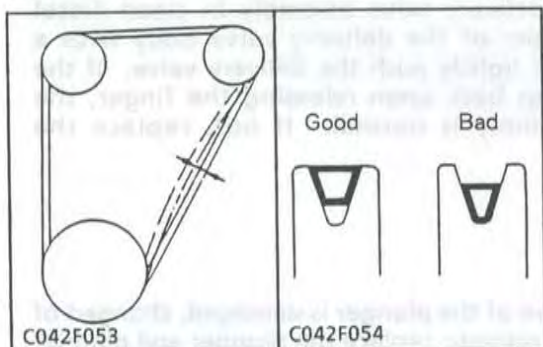
Water tight at the specified pressure	Factory spec.	137 kPa 1.4 kgf/cm ² 20 psi
---------------------------------------	---------------	--



Radiator Cap Tightness

- Set a radiator tester on the radiator cap.
- Apply 88 kPa (0.9 kgf/cm², 13psi) of pressure and measure the pressure for 10 seconds.
- If the pressure falls below 59 kPa (0.6 kgf/cm², 9 psi), replace

Radiator cap tightness	Factory spec.	more than 10 seconds for pressure fall from 88 to 59 kPa (0.9 to 0.6 kgf/cm ² , 13 to 9 psi)
------------------------	---------------	---

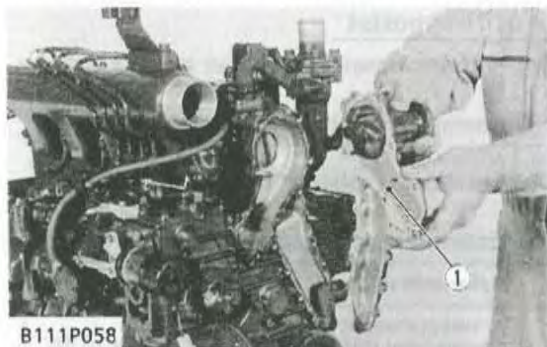


Fan Belt Tension

- Measure the deflection, depressing the belt halfway between the fan drive pulley and the alternator pulley at 98 N (10 kgf, 22 lbs) of force.
- If the deflection is not between the factory specifications, loosen the bolts, and relocate the alternator to adjust.
- If the belt is damaged or worn (See figure), replace the belt.

Belt tension (deflection)	Factory spec.	7 mm, 0.28 in. at 98 N (10 kgf, 22 lbs) of force
---------------------------	---------------	--

DISASSEMBLING AND ASSEMBLING

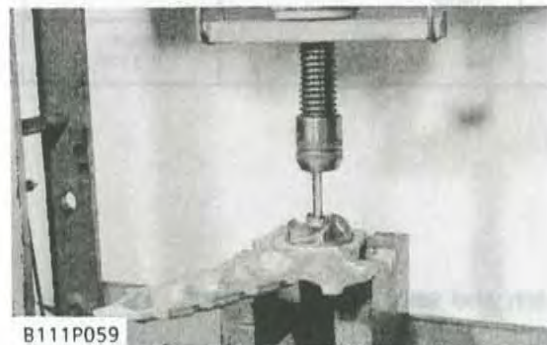


B111P058

Water Pump Assembly

1. Loosen the alternator mounting bolts and remove the fan belt.
2. Remove the fan pulley.
3. Remove the water pump assembly mounting screws and remove the water pump assembly.

(1) Water Pump Assembly



B111P059

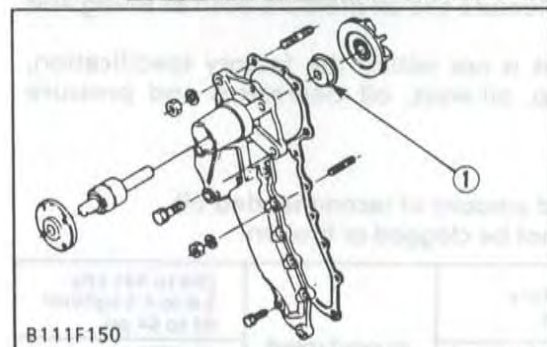
Mechanical Seal Assembly

1. Use a press and press out the water pump shaft from the water pump impeller side.
2. Remove the mechanical seal assembly from the water pump body.

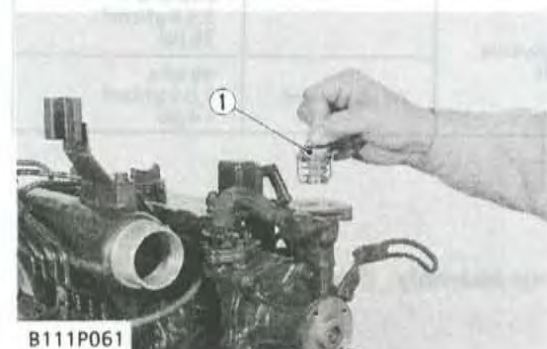
■ IMPORTANT

- Do not disassemble the mechanical seal assembly.

(1) Mechanical Seal Assembly



B111F150



B111P061

Thermostat Assembly

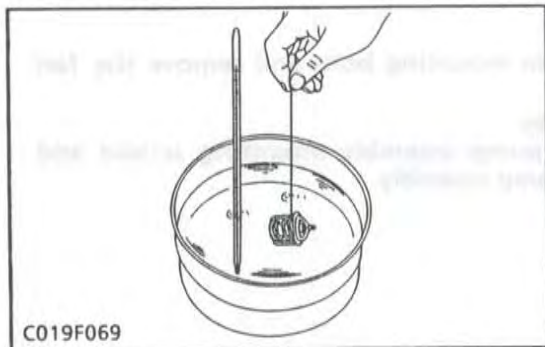
1. Remove the thermostat cover mounting bolts and remove the thermostat cover.
2. Remove the thermostat assembly.

(When reassembling)

- Put the rib of the thermostat assembly in place in the recess of the water flange.

(1) Thermostat Assembly

SERVICING

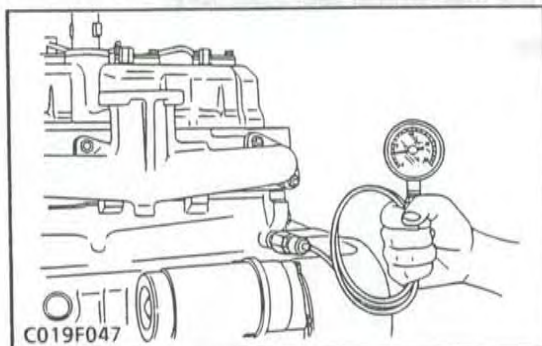


Operating Temperature of Thermostat

1. Place a thermostat and a thermometer in water and heat the water.
2. Check to see if the thermostat begins to open at 80.5 to 83.5°C (176.9 to 182.3°F).
3. Check to see if the thermostat opens fully around 95°C (203°F).
4. If the measurement is defective, replace the thermostat.

Reference value		
Temperature at which thermostat should start to open	Temperature at which thermostat completely opens	Distance of lift
80.5 to 83.5°C 176.9 to 182.3°F	95°C 203°F	8 mm 0.3150 in.

[7] LUBRICATING SYSTEM CHECKING AND ADJUSTING



Oil Pressure

1. Remove the oil switch and set a pressure gauge. (See page S.G-33)
2. Start the engine. Measure the oil pressure both at idling and at the rated speed.
3. If the measurement is not within the factory specification, check the oil pump, oil-ways, oil clearances and pressure regulating valve.

(When reassembling)

- Supply the specified amount of recommended oil.
- The oil filter must not be clogged or broken.

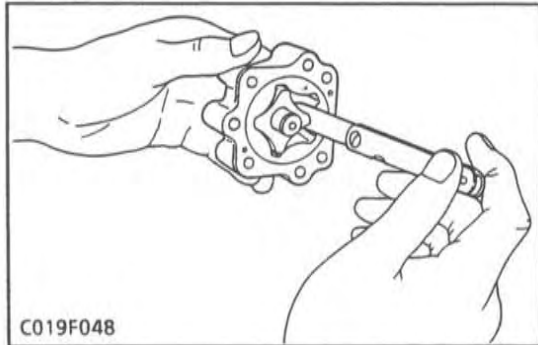
Oil pressure	Factory spec.	At rated speed	294 to 441 kPa 3.0 to 4.5 kgf/cm ² 43 to 64 psi
	Allowable limit		245 kPa 2.5 kgf/cm ² 36 psi
Oil pressure	Allowable limit	At idle speed	98 kPa 1.0 kgf/cm ² 14 psi

DISASSEMBLING AND ASSEMBLING

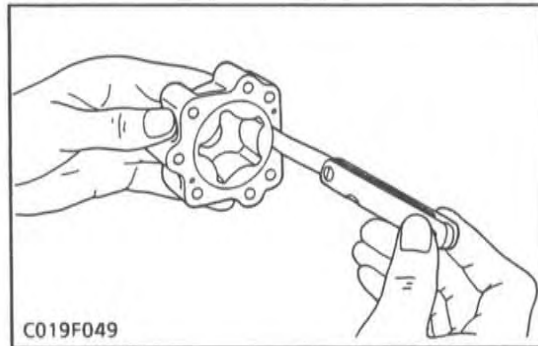
Oil Pump Assembly

1. Remove the oil pump assembly. (See page S.1-28)

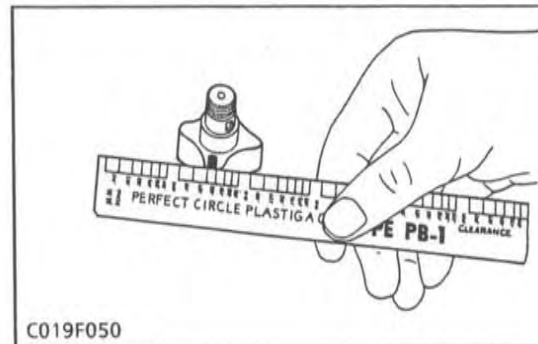
SERVICING



C019F048



C019F049



C019F050

Oil Pump (Rotor type)

1) Checking Rotor Lobe Clearance

1. Insert a feeler gauge into the gap between the inner and outer rotors and measure the clearance.
2. If the clearance exceeds the allowable limit, replace the pump.

Outer and inner rotor clearance	Factory spec.	0.10 to 0.16 mm 0.0039 to 0.0063 in.
	Allowable limit	0.20 mm 0.0079 in.

2) Radial Clearance between Outer Rotor and Pump Body

1. Insert a feeler gauge into the gap between the oil pump body and the outer rotor and measure the clearance.
2. If the measurement exceeds the allowable limit, replace the pump.

Radial clearance between outer rotor and pump body	Factory spec.	0.11 to 0.19 mm 0.0043 to 0.0075 in.
	Allowable limit	0.25 mm 0.0098 in.

3) End Clearance between Rotor and Cover

1. Paste a press gauge to the surface of the gear with grease.
2. Attach the cover.
3. Gently remove the cover. Measure the clearance by placing the gauge (paper) on the press gauge where it is crushed.
4. If the measurement is not within the factory specification, replace the pump.

End clearance between rotor and cover	Factory spec.	0.105 to 0.150 mm 0.0041 to 0.0059 in.
	Allowable limit	0.20 mm 0.0079 in.

S.2 CLUTCH

CONTENTS

TROUBLESHOOTING	S.2-1
SERVICING SPECIFICATIONS	S.2-3
TIGHTENING TORQUES	S.2-5
CHECKING, DISASSEMBLING AND SERVICING	S.2-6
[1] DRY TYPE, SINGLE STAGE CLUTCH	S.2-6
CHECKING AND ADJUSTING	S.2-6
DISASSEMBLING AND ASSEMBLING	S.2-7
SERVICING	S.2-7
[2] DRY TYPE, DUAL STAGE CLUTCH	S.2-10
CHECKING AND ADJUSTING	S.2-10
DISASSEMBLING AND ASSEMBLING	S.2-10
SERVICING	S.2-12

TROUBLESHOOTING

Before troubleshooting, confirm symptoms of trouble and inspect the affected sections.

(1) Basic Inspection

No.	Contents	Reference Page
1	Clutch pedal free play	S.G-20

(2) Troubleshooting

[DRY TYPE, SINGLE STAGE CLUTCH]

Symptom	Probable Cause	Solution	Reference Page
Clutch Drags	• Clutch disc boss spline sticking or rusted	Replace or remove rust	S.2-7
	• Dust on clutch disc generated from clutch disc facing	Remove rust	—
	• Release fork broken	Replace	S.2-7
	• Grease or oil on clutch disc facing	Replace	S.2-7
	• Clutch disc or pressure plate warped	Replace	S.2-9
	• Wire ring worn or broken (pressure plate side)	Replace (Pressure plate assembly)	S.2-7
	• Pilot bearing sticking or worn	Replace	S.2-8
Clutch Slips	• Clutch disc excessively worn	Replace	S.2-8
	• Grease or oil on clutch disc facing	Replace	S.2-7
	• Clutch disc or pressure plate warped	Replace	S.2-9
	• Diaphragm spring weaken or broken	Replace	S.2-8
	• Wire ring worn or broken (clutch cover side)	Replace (Pressure plate assembly)	S.2-7
Chattering	• Grease or oil on clutch disc facing	Replace	S.2-7
	• Clutch disc or pressure plate warped	Replace	S.2-8
	• Clutch disc boss spline worn or rusted	Replace or remove rust	S.2-7
	• Main shaft bent	Replace	S.3-19, 67
	• Pressure plate or flywheel face cracked or scored	Replace	S.2-8
	• Clutch disc boss spline and main shaft spline worn	Replace	S.2-7
	• Diaphragm spring strength uneven or diaphragm spring broken	Replace	S.2-8
Rattle During Running	• Clutch disc boss spline worn	Replace	S.2-7
	• Thrust ball bearing worn or sticking	Replace	S.2-8
	• Pilot bearing worn or sticking	Replace	S.2-8
Clutch Squeaks	• Thrust ball bearing sticking or dry	Replace or lubricate	S.2-8
	• Pilot bearing worn or sticking	Replace	S.2-8
	• Clutch disc excessively worn	Replace	S.2-8
Vibration	• Main shaft bent	Replace	S.3-19, 67
	• Clutch disc rivet worn or broken	Replace	S.2-8
	• Clutch parts broken	Replace	—

[DRY TYPE, DUAL STAGE CLUTCH]

Symptom	Probable Cause	Solution	Reference Page
Clutch Drags	- Release lever improperly adjusted - Clutch disc boss spline sticking or rusted	Adjust Replace or remove rust Remove dust	S.2-13 S.2-10, 11 —
	- Dust on clutch disc generated from clutch disc facing - Grease or oil on clutch disc facing - Clutch disc or pressure plate warped - Pilot bearing sticking or worn	Replace Replace Replace	S.2-11 S.2-14 S.2-12
Clutch Slips	- Release lever improperly adjusted - Clutch disc excessively worn - Grease or oil on clutch disc facing - Clutch disc or pressure plate warped - Belleville spring weaken or broken	Adjust Replace Replace Replace Replace	S.2-13 S.2-12 S.2-11 S.2-14 S.2-14
Chattering	- Grease or oil on clutch disc facing - Clutch disc or pressure plate warped - Clutch disc boss spline worn, sticking or rusted - Main shaft and gear shaft bented - Pressure plate or flywheel face cracked or scored - Clutch disc boss spline and main shaft spline worn - Belleville spring strength uneven or broken	Replace Replace Replace or remove rust Replace Replace Replace Replace	S.2-11 S.2-14 S.2-10, 11, 12 S.3-32 S.2-14 S.2-12 S.2-14
Rattle During Running	- Thrust ball bearing worn or sticking - Pilot bearing worn or sticking	Replace Replace	S.2-12 S.2-12
Clutch Squeaks	Thrust ball bearing sticking or dry	Replace or lubricate	S.2-12
	- Pilot bearing worn or sticking - Clutch disc excessively worn	Replace Replace	S.2-12 S.2-12
Vibration	- Main shaft and gear shaft bented - Clutch disc rivet worn or broken - Clutch parts broken	Replace Replace Replace	S.3-32 — —

SERVICING SPECIFICATIONS

[DRY TYPE, SINGLE STAGE CLUTCH]

Item		Factory Specification	Allowable Limit
Clutch Pedal	Free play	20 to 30 mm 0.79 to 1.20 in.	—
Safety Switch to Clutch Lever [L2350]	Clearance	0 to 1.0 mm 0 to 0.039 in.	—
Clutch Disc	Disc Facing Surfaces to Rivet Top (Depth)	—	0.3 mm 0.012 in.
Clutch Disc Spline Boss to Main Shaft	Backlash (Displacement around disc edge)	—	2.00 mm 0.0787 in.
Pressure Plate	Flatness	—	0.2 mm 0.008 in.
Brake Pedal Shaft to Clutch Pedal Bushing	Clearance	0.05 to 0.20 mm 0.0020 to 0.0079 in.	1.0 mm 0.039 in.
Brake Pedal Shaft	O.D.	24.9 to 25.0 mm 0.980 to 0.984 in.	—
Clutch Pedal Bushing	I.D.	25.05 to 25.10 mm 0.9862 to 0.9882 in.	—
Clutch Lever	Wear	14.967 to 15.000 mm 0.5893 to 0.5906 in.	14.30 mm 0.5630 in.

[DRY TYPE, DUAL STAGE CLUTCH]

Clutch Pedal	Free play	20 to 30 mm 0.79 to 1.20 in.	—
Release Lever	Height	Less than 0.3 mm 0.012	—
	Mutual Difference	Less than 0.2 mm 0.008 in.	—

[DRY TYPE, DUAL STAGE CLUTCH (Continued)]

Item		Factory Specification	Allowable Limit
Travelling Clutch Disc	Disc Facing Surface to Rivet Top (Depth)	—	0.3 mm 0.012 in.
Travelling Belleville Spring	Free Height [L2650]	7.24 mm 0.2850 in.	6.76 mm 0.2661 in.
	[L2950, L3450] [L3650]	7.72 mm 0.3039 in.	7.22 mm 0.2843 in.
Travelling Clutch Disc Spline Boss to Main Shaft	Backlash (Displacement around disc edge)		2.0 mm 0.079 in.
PTO Clutch Disc	Disc Facing Surfaces to Rivet Top (Depth)	—	0.3 mm 0.012 in.
PTO Belleville Spring	Free Height [L2650]	7.24 mm 0.2850 in.	6.76 mm 0.2661 in.
	[L2950, L3450] [L3650]	7.72 mm 0.3039 in.	7.22 mm 0.2843 in.
PTO Clutch Disc Spline Boss to Gear Shaft 16T Gear Shaft [L2650, L2950] 17T Gear Shaft [L3450, L3650]	Backlash (Displacement around disc edge)	—	2.0 mm 0.079 in.
Pressure Plate 2 (PTO) to Adjusting Screw	Clearance	0.9 to 1.0 mm 0.035 to 0.039 in.	—
Pressure Plate	Flatness		0.2 mm 0.008 in.
Brake Pedal Shaft to Clutch Pedal Bushing	Clearance	0.05 to 0.20 mm 0.0020 to 0.0079 in.	1.0 mm 0.039 in.
Brake Pedal Shaft	O.D.	24.9 to 25.0 mm 0.980 to 0.984 in.	—
Clutch Pedal Bushing	I.D.	25.05 to 25.10 mm 0.9862 to 0.9882 in.	—
Clutch Lever	Wear	14.967 to 15.000 mm 0.5893 to 0.5906 in.	14.30 mm 0.5630 in.

TIGHTENING TORQUES

Tightening torques of screws and nuts on the table below are especially specified.
(For general use screws and nuts: See page S.G-8)

Screws and Nuts	N·m	kgf·m	ft-lbs
[Single Stage Clutch]			
Clutch mounting screws and reamer screws	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Release fork setting screw	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Clutch rod lock nut	39.2 to 49.0	4.0 to 5.0	28.9 to 36.2
[Dual Stage Clutch]			
Clutch mounting screws	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Release fork setting screws	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Clutch rod lock nut	39.2 to 49.0	4.0 to 5.0	28.9 to 36.2
Release lever adjusting screw lock nut	14.7 to 19.6	1.5 to 2.0	10.8 to 14.5
Pressure plate adjusting screw lock nut	15.7 to 21.6	1.6 to 2.2	11.6 to 15.9



Distance between Safety Switch and Clutch Lever (L1720)

1 Measure the distance between safety switch and clutch lever with a feeler gauge.

2 If the measurement is not within the factory specification, adjust the adjuster.

[Reference]

Clutch lever	Factory spec	2 to 3 mm 0.07 to 0.12 in
--------------	--------------	------------------------------

IMPORTANT

* After adjustment, check that the starter runs when clutch pedal is depressed for the stroke and turn the main switch to start position.

CHECKING, DISASSEMBLING AND SERVICING

[1] DRY TYPE, SINGLE STAGE CLUTCH

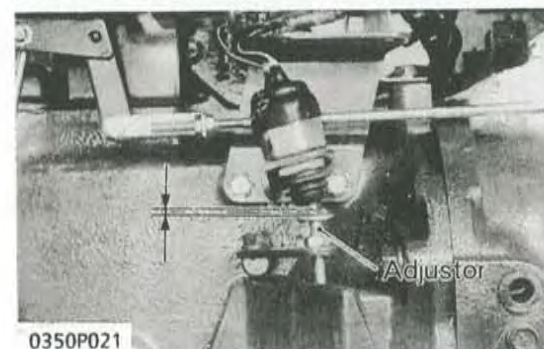
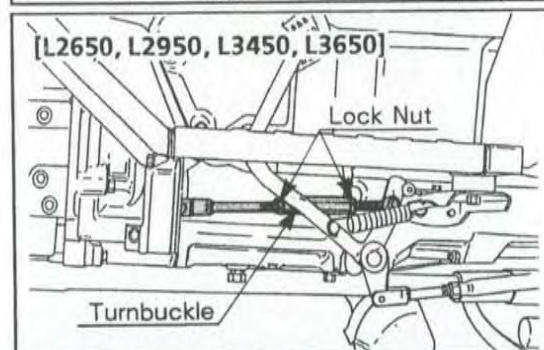
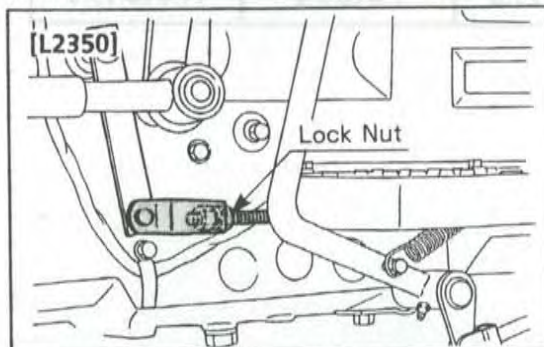
CHECKING AND ADJUSTING



Clutch Pedal Free Play

1. Measure the free play by depressing the clutch pedal.
2. If the measurement is not within the factory specifications, adjust the play by changing the length of clutch rod.
3. After adjustment, tighten the lock nut on the turnbuckle firmly.

Clutch pedal free play	Factory spec.	20 to 30 mm 0.79 to 1.20 in.
Tightening torque	Lock nut	39.2 to 49.0 N·m 4.0 to 5.0 kgf·m 28.9 to 36.2 ft-lbs



Clearance between Safety Switch and Clutch Lever [L2350]

1. Measure the clearance between safety switch and clutch lever with a feeler gauge.
2. If the measurement is not within the factory specifications, adjust the adjuster.

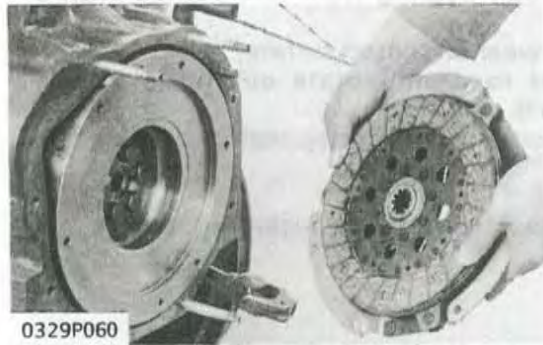
(Reference)

Clearance between safety switch and clutch lever	Factory spec.	0 to 1.0 mm 0 to 0.039 in.
--	---------------	-------------------------------

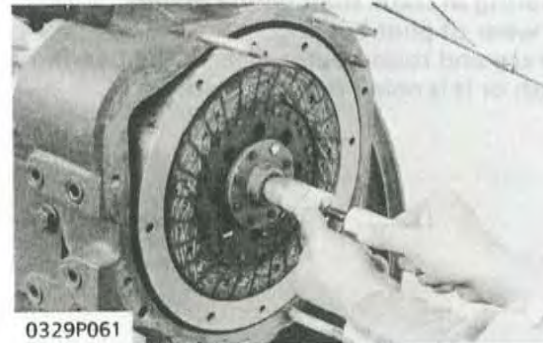
■ IMPORTANT

- After adjustment, check that the starter runs when clutch pedal is depressed to the stroke end and turn the main switch to start position.

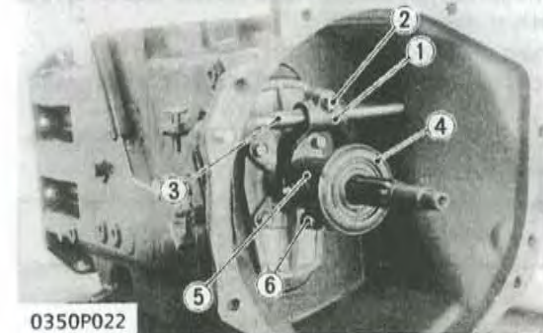
DISASSEMBLING AND ASSEMBLING



0329P060



0329P061



0350P022

- | | |
|------------------|-------------------------|
| (1) Release Fork | (4) Thrust Ball Bearing |
| (2) Screw | (5) Release Hub |
| (3) Clutch lever | (6) Hub Return Spring |

Removing Clutch

1. Remove the clutch from the flywheel.

(When reassembling)

■ IMPORTANT

- Be sure to align the center of disc and flywheel by inserting the clutch center tool (Code No. 07916-51051).
- Direct the shorter end of the clutch disc boss toward the flywheel.
- Apply molybdenum disulphide (Three Bond 1901 or equivalent) to the splines of clutch disc boss.
- Install the pressure plate, noting the position of reamer screws.

■ NOTE

- Do not allow grease and oil on the clutch disc facing.

Tightening torque	Clutch mounting screw	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft·lbs
-------------------	-----------------------	---

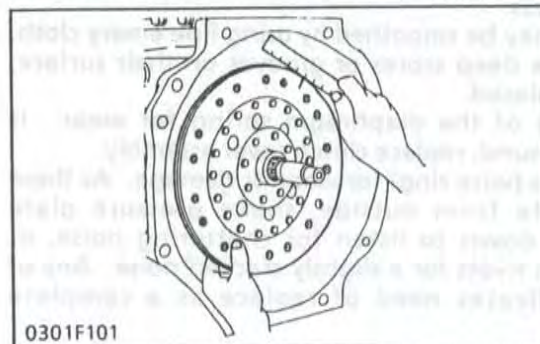
Release Hub and Clutch Lever

1. Remove the release fork (1) mounting screw (2).
2. Draw out the clutch lever (3) to remove the release fork (1).
3. Remove the hub return spring (6).
4. Remove the thrust ball bearing (4) and release hub (5) as a unit.

(When reassembling)

- Make sure the direction of the release fork (1) is correct.
- Inject grease to the release hub (5).
- Be sure to set the hub return spring (6).

SERVICING

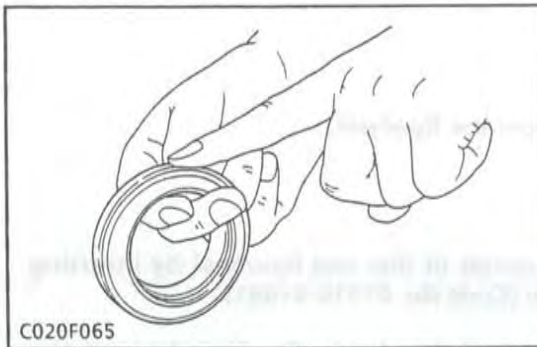


0301F101

Backlash between Clutch Disc Boss and Main Shaft

1. Mount the clutch disc to the main shaft.
2. Hold the main shaft so that it may not turn.
3. Rotate disc lightly and measure the displacement around the disc edge.
4. If the measurement exceeds the allowable limit, replace disc.

Displacement around disc edge	Allowable limit	2.0 mm 0.079 in.
-------------------------------	-----------------	---------------------

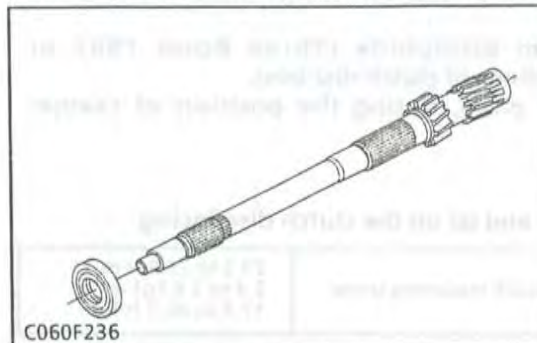


Thrust Ball Bearing

1. Remove the thrust ball bearing from release hub with a puller.
2. Check for abnormal wear on contact surface.
3. Hold bearing inner race and rotate outer race, while applying pressure to it.
4. If the bearing rotation is rough or noisy, replace bearing.

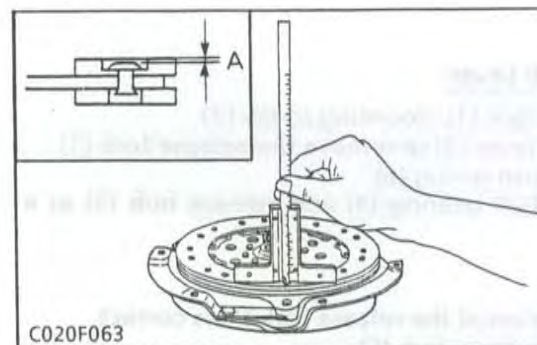
NOTE

- Do not depress outer race, when installing thrust ball bearing.



Pilot Bearing

1. Remove the pilot bearing in crank shaft with a puller.
2. Check for abnormal wear of pilot bearing.
3. Hold bearing inner race and rotate outer race. If the bearing rotation is not smooth or it is noisy, replace bearing.

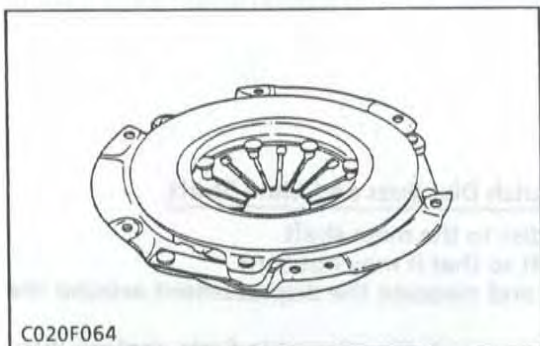


Clutch Disc Wear

1. Measure the depth from clutch disc surface to the top of rivet at least 10 points with a depth gauge.
2. If the depth is less than the allowable limit, replace.
3. If oil is sticking to clutch disc, or disc surface is carbonized, replace.
In this case, inspect transmission main shaft oil seal, engine rear oil seal and other points for oil leakage.

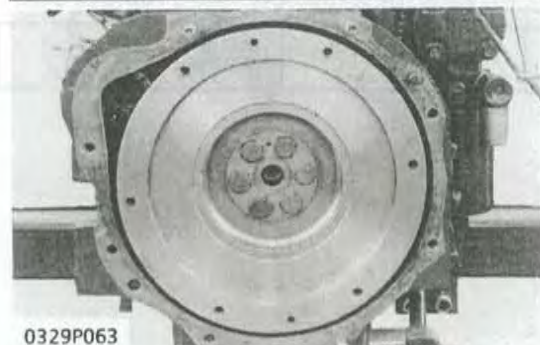
Depth to rivet top	Allowable limit	0.3 mm 0.012 in.
--------------------	-----------------	---------------------

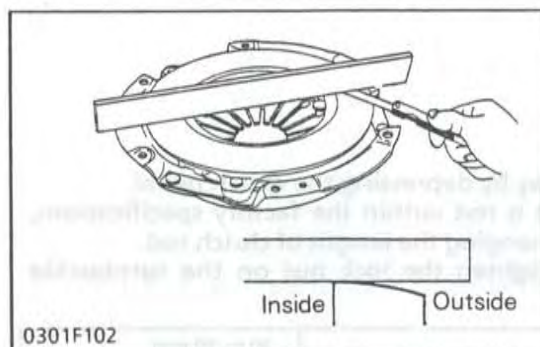
A: More than 0.3 mm (0.012 in.)



Checking Pressure Plate Assembly and Flywheel

1. Wash the disassembling parts except clutch disc with a suitable cleaning solvent to remove dirt and grease before making inspection and adjustment.
2. Check friction surface of pressure plate and flywheel for scoring or roughness.
 - Slight roughness may be smoothed by using fine emery cloth.
 - If these parts have deep scores or grooves on their surface, they should be replaced.
3. Check the surface of the diaphragm spring for wear. If excessive wear is found, replace clutch cover assembly.
4. Inspect thrust rings (wire ring) for wear or damage. As these parts are invisible from outside, shake pressure plate assembly up and down to listen for chattering noise, or lightly hammer on rivets for a slightly cracked noise. Any of these noises indicates need of replace as a complete assembly.





Pressure Plate Flatness

1. Place a straightedge on the pressure plate and measure clearance with a feeler gauge at several points.
2. If the clearance exceeds the allowable limit, replace.
3. When the pressure plate is worn around its outside and its inside surface only is in contact with the straightedge, replace even if the clearance is within the allowable limit.

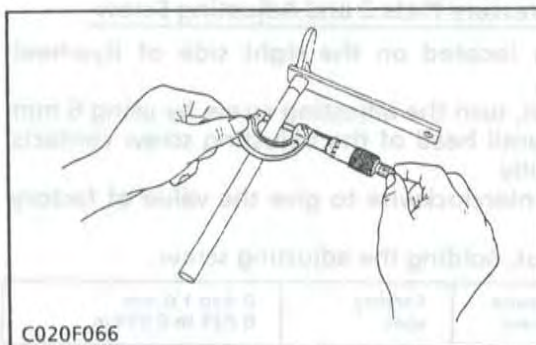
Clearance between pressure plate and straightedge	Allowable limit	0.2 mm 0.008 in.
---	-----------------	---------------------



Clearance between Brake Pedal Shaft and Clutch Pedal Bushing

1. Measure the bearing portion O.D. of the brake pedal shaft with an outside micrometer.
2. Measure the clutch pedal bushing I.D. with a caliper gauge.
3. Calculate the clearance.
4. If the clearance exceeds the allowable limit, replace.

Clearance between brake pedal shaft and clutch pedal bushing	Factory spec.	0.05 to 0.20 mm 0.0020 to 0.0079 in.
	Allowable limit	1.0 mm 0.039 in.
Brake pedal shaft O.D.	Factory spec.	24.9 to 25.0 mm 0.980 to 0.984 in.
Clutch pedal bushing I.D.	Factory spec.	25.05 to 25.10 mm 0.9862 to 0.9882 in.



Clutch Lever Wear

1. Measure the bearing portion O.D. of the clutch lever with an outside micrometer.
2. If the measurement exceeds the allowable limit, replace.

Clutch lever O.D.	Factory spec.	14.967 to 15.000 mm 0.5893 to 0.5906 in.
	Allowable limit	14.130 mm 0.5630 in.

[2] DRY TYPE, DUAL STAGE CLUTCH

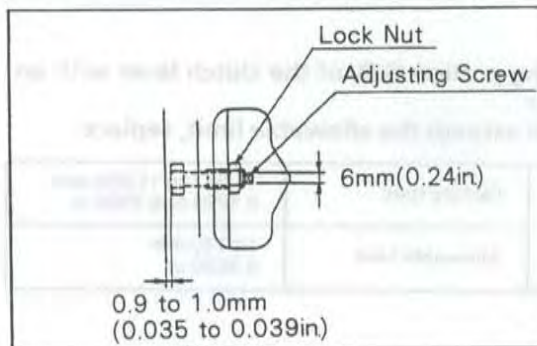
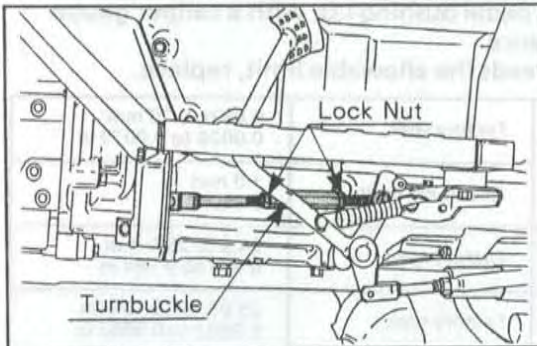
CHECKING AND ADJUSTING



Clutch Pedal Free Play

1. Measure the free play by depressing the clutch pedal.
2. If the measurement is not within the factory specifications, adjust the play by changing the length of clutch rod.
3. After adjustment, tighten the lock nut on the turnbuckle firmly.

Clutch pedal free play	Factory spec.	20 to 30 mm 0.79 to 1.20 in.
Tightening torque	Lock nut	39.2 to 49.0 N·m 4.0 to 5.0 kgf·m 28.9 to 36.2 ft·lbs



Clearance between Pressure Plate 2 and Adjusting Screw

1. Remove the cover located on the right side of flywheel housing case.
2. Loosen the lock nut, turn the adjusting screw by using 6 mm (0.24 in.) wrench until head of the adjusting screw contacts pressure plate slightly. Make 3/4 turn counterclockwise to give the value of factory specification.
3. Tighten the lock nut, holding the adjusting screw.

Clearance between pressure plate 2 and adjusting screw	Factory spec.	0.9 to 1.0 mm 0.035 to 0.039 in.
Tightening torque	Lock nut	15.7 to 21.6 N·m 1.6 to 2.2 kgf·m 11.6 to 15.9 ft·lbs

DISASSEMBLING AND ASSEMBLING



Removing Clutch

1. Insert the clutch center tool (Code No: 07916-90052).
2. Remove the clutch assembly.

(When reassembling)

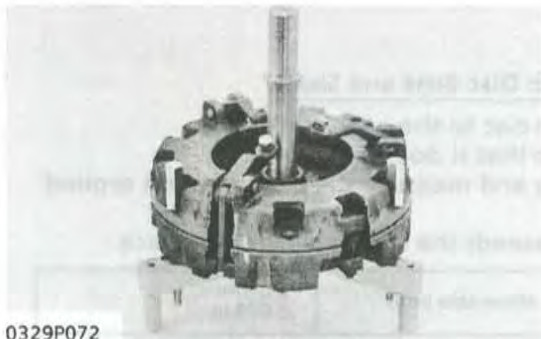
■ IMPORTANT

- Be sure to align the center of disc (Travelling) and flywheel by inserting the clutch center tool (Code No. 07916-90052).

Tightening torque	Clutch mounting screw	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft·lbs
-------------------	-----------------------	---

■ NOTE

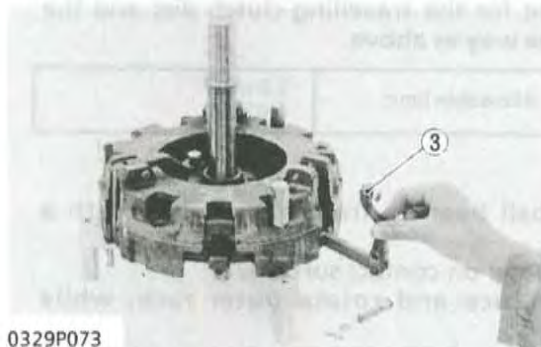
- Do not allow grease and oil on the clutch disc facing.



0329P072

Mounting to Main Clutch Assembling Tool

1. Put parting marks on clutch cover and pressure plate.
2. Mount clutch on dual stage clutch exclusive tool (Code No: 07916-90052).



0329P073

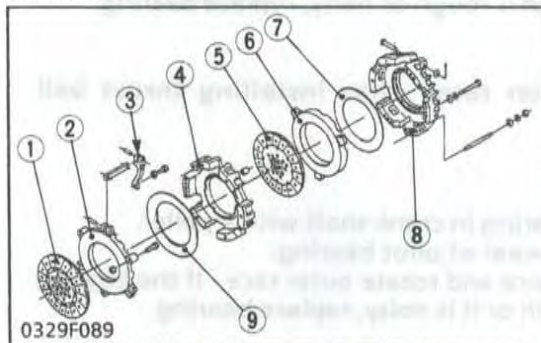
Disassembling Clutch Assembly

1. Draw out the clevis pins and remove the release levers (3).
2. Loosen the three mounting screws evenly and remove them.
3. Remove the clutch cover 2 (8), belleville spring (7), pressure plate 2 (PTO) (6), and clutch disc (PTO) (5) in order.
4. Remove the clutch cover 1 (4), belleville spring (9), and pressure plate 1 (Travelling) (2) in order.

(When reassembling)

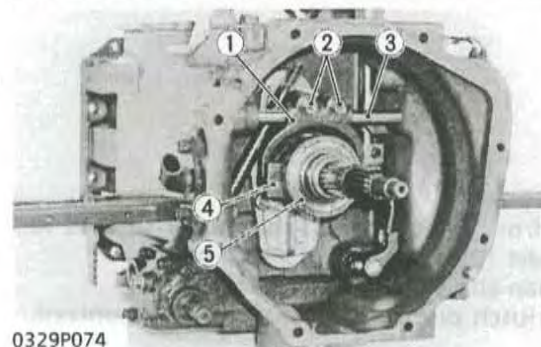
■ IMPORTANT

- When assembling the clutch covers and pressure plates, be sure to align the parting marks to insure proper dynamic balance.



0329F089

- | | |
|-----------------------------------|----------------------------|
| (1) Clutch Disc (Travelling) | (6) Pressure Plate 2 (PTO) |
| (2) Pressure Plate 1 (Travelling) | (7) Belleville Spring |
| (3) Release Lever | (8) Clutch Cover 2 |
| (4) Clutch Cover 1 | (9) Belleville Spring |
| (5) Clutch Disc (PTO) | |



0329P074

Release Hub and Clutch Lever

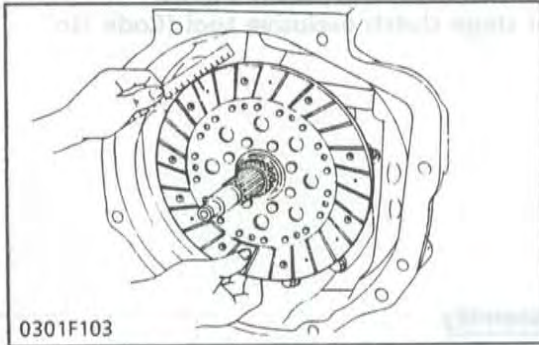
1. Remove the release fork (1) mounting screws (2).
2. Draw out the clutch lever (3) to remove the release fork (1).
3. Remove the thrust ball bearing (5) and release hub as a unit.

(When reassembling)

- Make sure the direction of the release fork (1) is correct. Inject grease to the release hub (4).

- | | |
|------------------|-------------------------|
| (1) Release Fork | (4) Release Hub |
| (2) Screws | (5) Thrust Ball Bearing |
| (3) Clutch Lever | |

SERVICING

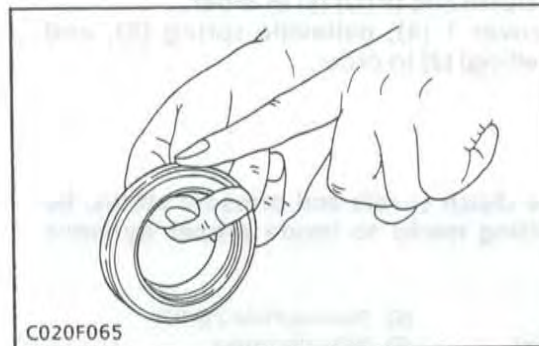
**Backlash between Clutch Disc Boss and Shaft**

1. Mount the PTO clutch disc to the gear shaft.
2. Hold the gear shaft so that it does not turn.
3. Rotate the disc lightly and measure the displacement around the disc edge.
4. If the displacement exceeds the allowable limit, replace.

Displacement around disc edge (PTO)	Allowable limit	2.0 mm 0.079 in.
-------------------------------------	-----------------	---------------------

5. Perform measurement for the travelling clutch disc and the main shaft in the same way as above.

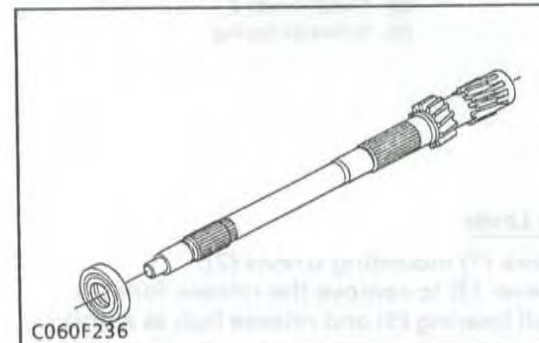
Displacement around disc edge (travelling)	Allowable limit	2.0 mm 0.079 in.
--	-----------------	---------------------

**Thrust Ball Bearing**

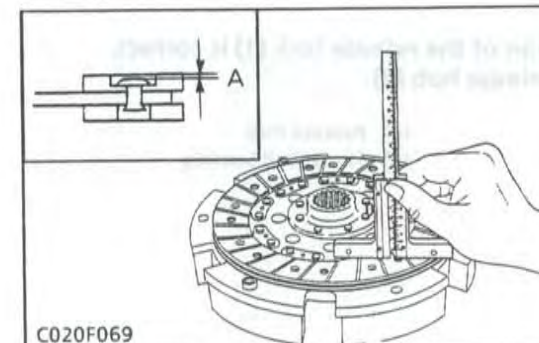
1. Remove the thrust ball bearing from release hub with a puller.
2. Check for abnormal wear on contact surface.
3. Hold bearing inner race and rotate outer race, while applying pressure to it.
4. If the bearing rotation is rough or noisy, replace bearing.

NOTE

- Do not depress outer race, when installing thrust ball bearing.

**Pilot Bearing**

1. Remove the pilot bearing in crank shaft with a puller.
2. Check for abnormal wear of pilot bearing.
3. Hold bearing inner race and rotate outer race. If the bearing rotation is not smooth or it is noisy, replace bearing.



A: More than 0.3 mm (0.012 in.)

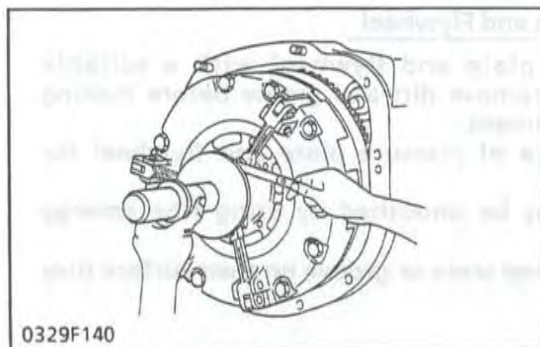
Clutch Disc Wear

1. Measure the depth from the travelling clutch disc surface to the top of rivet at least 10 points with a depth gauge.
2. If the depth is less than allowable limit, replace.
3. If oil is sticking to clutch disc, or disc surface is carbonized, replace.

In this case, inspect transmission main shaft oil seal, engine rear oil seal and other points for oil leakage.

4. Check the same at the PTO clutch disc as travelling clutch disc.

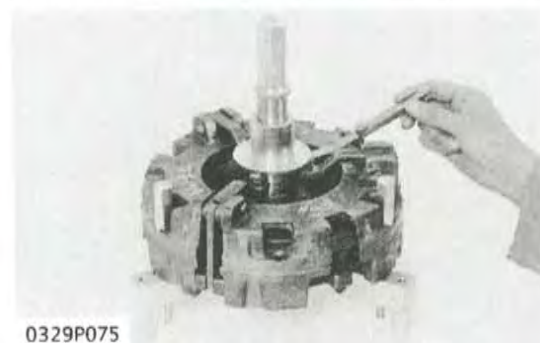
Depth to rivet top (travelling clutch disc and PTO clutch disc)	Allowable limit	0.3 mm 0.012 in.
---	-----------------	---------------------



Mutual Difference of Release Lever

1. Insert the dual stage clutch exclusive tool (Code No: 07916-90052).
2. Measure the clearance between gauge ring and the top of adjusting screws with a feeler gauge.
3. If the clearance is not within the factory specifications, adjust with the adjusting screws.

Mutual difference of release lever	Factory spec.	0.0 to 0.2 mm 0.000 to 0.008 in.
------------------------------------	---------------	-------------------------------------



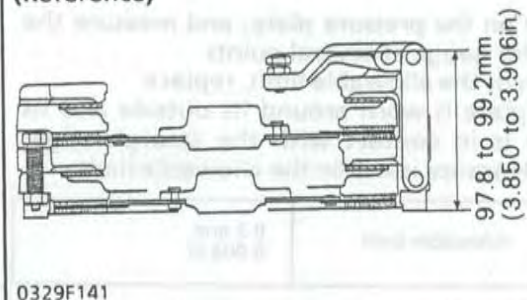
Release Lever Hight

1. Mount the dual stage clutch exclusive tool (Code No: 07916-90052).
2. Measure the clearance between gauge ring and the top of adjusting screws with a feeler gauge.
3. If the clearance is not within the factory specifications, adjust with the adjusting screws.

Clearance between gauge ring and the top of adjusting screws	Factory spec.	0.0 to 0.7 mm 0.000 to 0.028 in.
--	---------------	-------------------------------------

Tightening torque	Adjusting screw lock nut	14.7 to 19.6 N·m 1.5 to 2.0 kgf·m 10.8 to 14.5 ft·lbs
-------------------	--------------------------	---

(Reference)



■ IMPORTANT

- Be sure to adjust the mutual difference of release lever to within the factory specifications.

■ NOTE

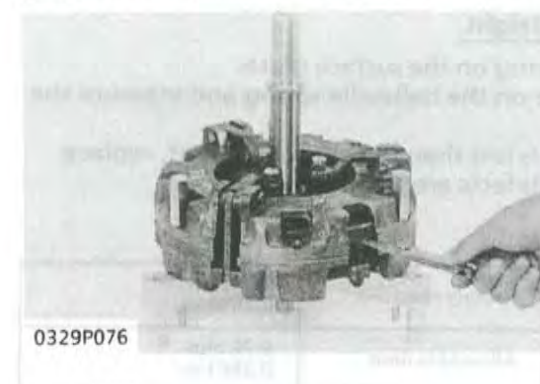
- Apply adhesive (Camedine No. 110 by Cemedine Industry Co., Ltd. or equivalent) to the adjusting screws, replace lever and lock nuts.

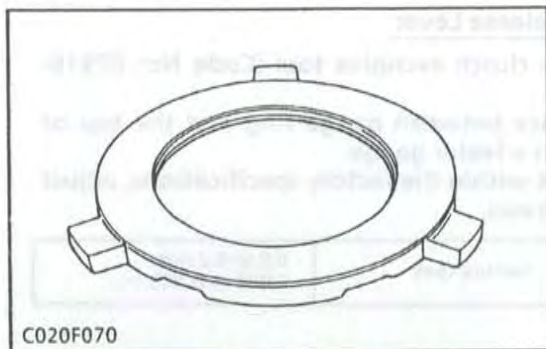
Clearance between Pressure Plate 2 and Adjusting Screws

1. Measure the clearance between pressure plate 2 and the top of adjusting screws with a feeler gauge.
2. If the clearance is not within the factory specifications, adjust with the adjusting screws.

Clearance between pressure plate 2 and adjusting screws	Factory spec.	0.95 to 1.00 mm 0.0374 to 0.0394 in.
---	---------------	---

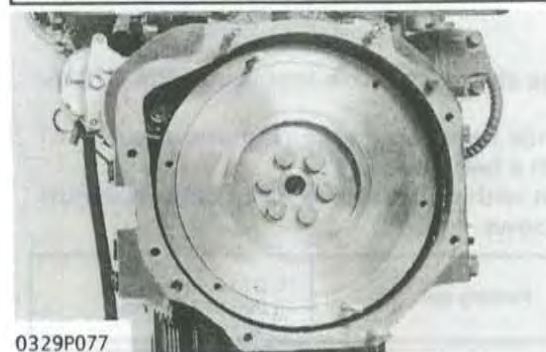
Tightening torque	Pressure plate 2 height adjusting screw lock nut	15.7 to 21.6 N·m 1.6 to 2.2 kgf·m 11.6 to 15.9 ft·lbs
-------------------	--	---





Checking Pressure Plate and Flywheel

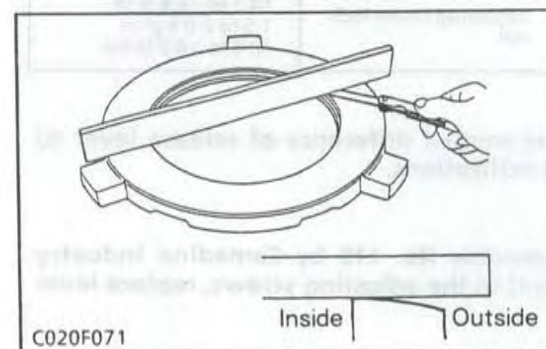
1. Wash the pressure plate and flywheel with a suitable cleaning solvent to remove dirt and grease before making inspection and adjustment.
2. Check friction surface of pressure plate and flywheel for scoring or roughness.
 - Slight roughness may be smoothed by using fine emery cloth.
3. If these parts have deep score or groove on their surface they should be replaced.



Pressure Plate Flatness

1. Place a straightedge on the pressure plate, and measure the clearance with a feeler gauge at several points.
2. If the clearance exceeds the allowable limit, replace.
3. When the pressure plate is worn around its outside and its inside surface only is in contact with the straightedge, replace even if the clearance is within the allowable limit.

Clearance between pressure plate and straightedge	Allowable limit	0.2 mm 0.008 in.
---	-----------------	---------------------



Belleville Spring Free Height

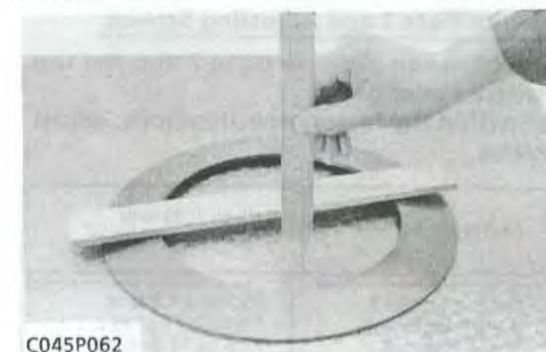
1. Put the belleville spring on the surface plate.
2. Place a straightedge on the belleville spring and measure the free height.
3. If the measurement is less than the allowable limit, replace.
4. Check for cracks, if defects are found, replace.

[L2650]

Belleville spring free height	Factory spec.	7.24 mm 0.2850 in.
	Allowable limit	6.76 mm 0.2661 in.

[L2950, L3450, L3650]

Belleville spring free height	Factory spec.	7.72 mm 0.3039 in.
	Allowable limit	7.22 mm 0.2843 in.



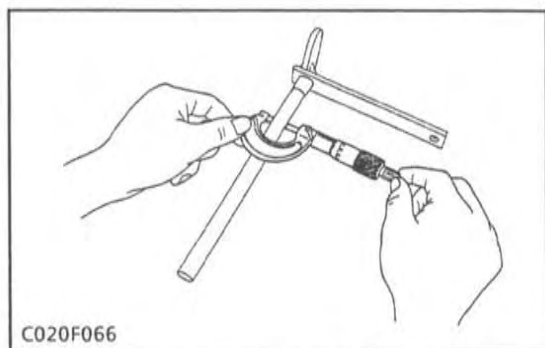


0350P023

Clearance between Brake Pedal Shaft and Clutch Pedal Bushing

1. Measure the bearing portion O.D. of the brake pedal shaft with an outside micrometer.
2. Measure the clutch pedal bushing I.D. with a caliper gauge.
3. Calculate the clearance.
4. If the clearance exceeds allowable limit, replace.

Clearance between brake pedal shaft and clutch pedal bushing	Factory spec.	0.05 to 0.20 mm 0.0020 to 0.0079 in.
	Allowable limit	1.0 mm 0.039 in.
Brake pedal shaft O.D.	Factory spec.	24.9 to 25.0 mm 0.980 to 0.984 in.
Clutch pedal bushing I.D.	Factory spec.	25.05 to 25.10 mm 0.9862 to 0.9882 in.



C020F066

Clutch Lever Wear

1. Measure the bearing portion O.D. of the clutch lever with an outside micrometer.
2. If the measurement exceeds the allowable limit, replace.

Clutch lever O.D.	Factory spec.	14.967 to 15.000 mm 0.5893 to 0.5906 in.
	Allowable limit	14.30 mm 0.5630 in.

S.3 TRANSMISSION

CONTENTS

TROUBLESHOOTING	S.3-1
SERVICING SPECIFICATIONS	S.3-6
TIGHTENING TORQUES	S.3-14
CHECKING, DISASSEMBLING AND SERVICING	S.3-16
[1] L2350	S.3-16
[1]-1 CLUTCH HOUSING	S.3-16
DISASSEMBLING AND ASSEMBLING	S.3-17
SERVICING	S.3-20
[1]-2 TRANSMISSION CASE	S.3-22
CHECKING AND ADJUSTING	S.3-23
DISASSEMBLING AND ASSEMBLING	S.3-24
SERVICING	S.3-27
[2] L2650, L2950, L3450, L3650	S.3-28
[2]-1 CLUTCH HOUSING	S.3-28
DISASSEMBLING AND ASSEMBLING	S.3-29
SERVICING	S.3-34
[2]-2 MID CASE	S.3-37
DISASSEMBLING AND ASSEMBLING	S.3-38
SERVICING	S.3-40
[2]-3 TRANSMISSION CASE	S.3-41
CHECKING AND ADJUSTING	S.3-42
DISASSEMBLING AND ASSEMBLING	S.3-43
SERVICING	S.3-51
[3] L2650GST, L2950GST, L3450GST, L3650GST	S.3-53
[3]-1 SHIFT CABLE, SIDE COVER, FILTER BRACKET	S.3-53
CHECKING AND ADJUSTING	S.3-53
DISASSEMBLING AND ASSEMBLING	S.3-57
[3]-2 MID CASE	S.3-62
DISASSEMBLING AND ASSEMBLING	S.3-63
SERVICING	S.3-63
[3]-3 CLUTCH HOUSING	S.3-64
DISASSEMBLING AND ASSEMBLING	S.3-65
SERVICING	S.3-69
[3]-4 TRANSMISSION CASE	S.3-75
CHECKING AND ADJUSTING	S.3-76
DISASSEMBLING AND ASSEMBLING	S.3-77
SERVICING	S.3-82

TROUBLESHOOTING

[L2350, L2650 (GST), L2950 (GST), L3450 (GST), L3650 (GST)]

Symptom	Probable Cause	Solution	Reference Page
Excessive Transmission Noise	- Transmission fluid insufficient - Gear worn or backlash improper - Improper backlash between spiral bevel pinion and bevel gear - Improper backlash between differential pinion and side gear - Improper clearance between gear and spline boss on counter shaft 1 [L2650, L2950, L3450, L3650]	Replenish Replace Adjust Adjust Adjust	S.G-7, 14, 15 S.3-20,35, 69 S.3-23,42, 76 S.4-8, 10 S.3-34
	- Bearings worn - Counter shaft 2 lock nut and spiral bevel pinion lock nut improperly tightened [L2650, L2950, L3450, L3650] - Spiral bevel pinion lock nut improperly tightened [L2350] - Counter shaft lock nut (22 nut) and spiral bevel pinion lock nut improperly tightened [L2650GST, L2950GST, L3450GST, L3650GST]	Replace Tighten Tighten Tighten	– S.3-38 S.3-24 S.3-67,78
Gears Slip Out of Mesh	- Shift linkages maladjusted - Improper clearance between gear and spline boss on counter shaft 1 [L2650, L2950, L3450, L3650] - Shifter or shift fork worn or damaged	Adjust Adjust Replace	– S.3-34 S.3-21,35, 69
	- Shift fork interlock ball spring weaken or damaged [L2350, L2650, L2950, L3450, L3650] - Interlock ball fallen - Synchronizer unit damaged [Synchromesh Type, GST]	Replace Ressemble Repair or replace	– – S.3-36,37, 70
Hard Shifting	Shifter or shift fork worn or damaged	Replace	S.3-21,35, 69
	- Shift fork bent - Synchronizer unit damaged [Synchromesh Type, GST] - Shift linkage maladjusted or rusted [L2650, L2950, L3450, L3650] - Shaft part of shift arms rusted.	Replace Repair or replace Adjust or repair Repair	– S.3-36,37, 70 – –
Gears Clash When Shifting	- Clutch does not release - Synchronizer unit defective [Synchromesh Type, GST]	Adjust or repair Repair or replace	S.2-6, 9 S.3-36,37, 70

Symptom	Probable Cause	Solution	Reference Page
Differential Lock Can Not Be Set	• Differential lock shift fork damaged	Replace	S.3-24,43, 77
	• Differential lock shift fork mounting clevis pin damaged [L2650 (GST), L2950 (GST), L3450 (GST), L3650 (GST)]	Replace	S.3-43,77
	• Differential lock shifter pin bent or damaged	Replace	S.4-6, 8
	• Differential lock fork shaft bent or damaged	Replace	S.3-24,43, 77
Differential Lock Pedal Does Not Return	• Differential lock pedal return spring weaken or damaged	Replace	—
	• Differential shifter pin bent or damaged	Replace	S.4-6, 8
	• Differential lock fork shaft bent	Replace	S.3-24,43, 77

[L2650GST, L2950GST, L3450GST, L3650GST]

The tractor does not stop at the shift lever neutral position or does not move at 1st position.

Inspection method	Probable cause or solution	Reference page
	Faulty adjustment of shift cable	S.3-54

The tractor does not move.

Inspection method	Probable cause or solution	Reference page
Type and amount of transmission oil conform to specifications.	No Replace with or add Kubota lubricant.	S.G-7, 15
Front loader or lower link rise up correctly	No Clogged hydraulic oil filter or faulty hydraulic pump	S.G-12, 16 S.8-7, 10
Power steering operates	No Faulty hydraulic pump for the power steering side	S.7-50, 52
* Measure the pressure of P5. Pressure rise conforms to the pressure table (P5). See S.3-5.	Yes Worn clutch pack disk, steel plate. Fault other than GST system (Broken shift fork, worn main clutch etc.)	S.3-73, 74
Measure the pressure of P6. Pressure rise conforms to the pressure table (P6). See S.3-5.	No Prescribed pressure is achieved only in shift position "N" and the other positions are below it.	Faulty clutch pack sealing S.3-74
Measure the pressure of P7. Pressure rise conforms to the pressure table (P7). See S.3-5.	Yes Fault in reducing valve, rotary valve, modulating valve, gate valve, or shuttle shift spool valve.	S.3-55, 58, 59, 60
1		
2		

Inspection method	Probable cause or solution	Reference page
1 ↓ Yes Measure the pressure of P3. Pressure rise conforms to the pressure table (P3). See S.3-5 ↓ Yes Measure the pressure of P4. Pressure rise conforms to the pressure table (P4).. See S.3-5 ↓ Yes Measure the pressure of P1. Pressure rise conforms to the pressure table (P1).. See S.3-5 ↓ Yes Measure the pressure of P2. Pressure rise conforms to the pressure table (P2).. See S.3-5 ↓ Yes	No Fault in relief valve or reducing valve Fault in shuttle shift spool valve, gate valve (shuttle gate) or rotary valve Fault in Hi-Lo shift spool valve, gate valve (Hi-Lo gate) or rotary valve. Fault in 3-4th shift spool valve, gate valve (3-4 gate) or rotary valve Fault in 1-2nd shift spool valve, gate valve (1-2 gate) or rotary valve Fault of modulating valve or gate valve	S.3-55, 60 S.3-59 S.3-59 S.3-59 S.3-59 S.3-58, 59

Time needed to start the tractor has increased. Clutch slips.

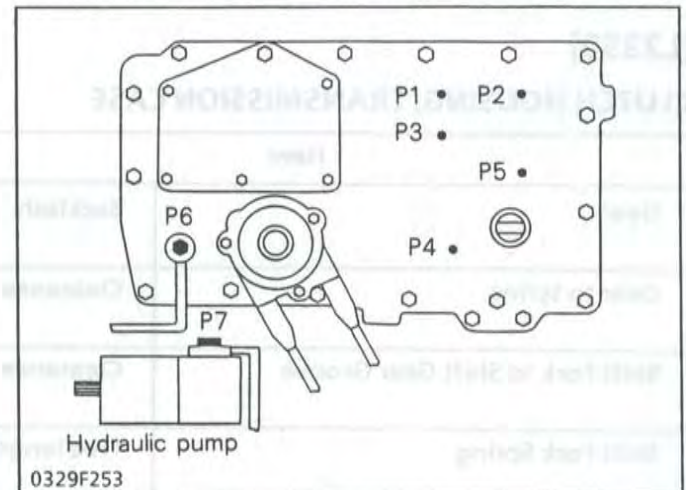
Inspection method		Probable cause or solution	Reference page
Type and amount of transmission oil conforms to specification.	No	Replace or add with Kubota lubricant.	S.G-7, 15
Yes			
Oil temperature in use is over 45°C (113°F).	No	Warm up the engine sufficiently to raise oil temperature before starting.	—
Yes			
Refer to * mark onwards for "The tractor does not move."			

■ Pressure Table

○----- Pressure is 2.4 MPa (24 kgf/cm², 341 psi)
 ◎----- Pressure is 3.1 MPa (32 kgf/cm², 455 psi)

Shift Position	P1	P2	P3	P4	P5	P6	P7
Neutral			○			○	◎
1st Shift		○	○	○	○	○	◎
2nd Shift		○	○	○	○	○	◎
3rd Shift	○		○	○	○	○	◎
4th Shift	○		○	○	○	○	◎
5th Shift		○	○	○	○	○	◎
6th Shift		○	○	○	○	○	◎
7th Shift	○		○	○	○	○	◎
8th Shift	○		○	○	○	○	◎

■ Pressure discharging port diagram



■ IMPORTANT

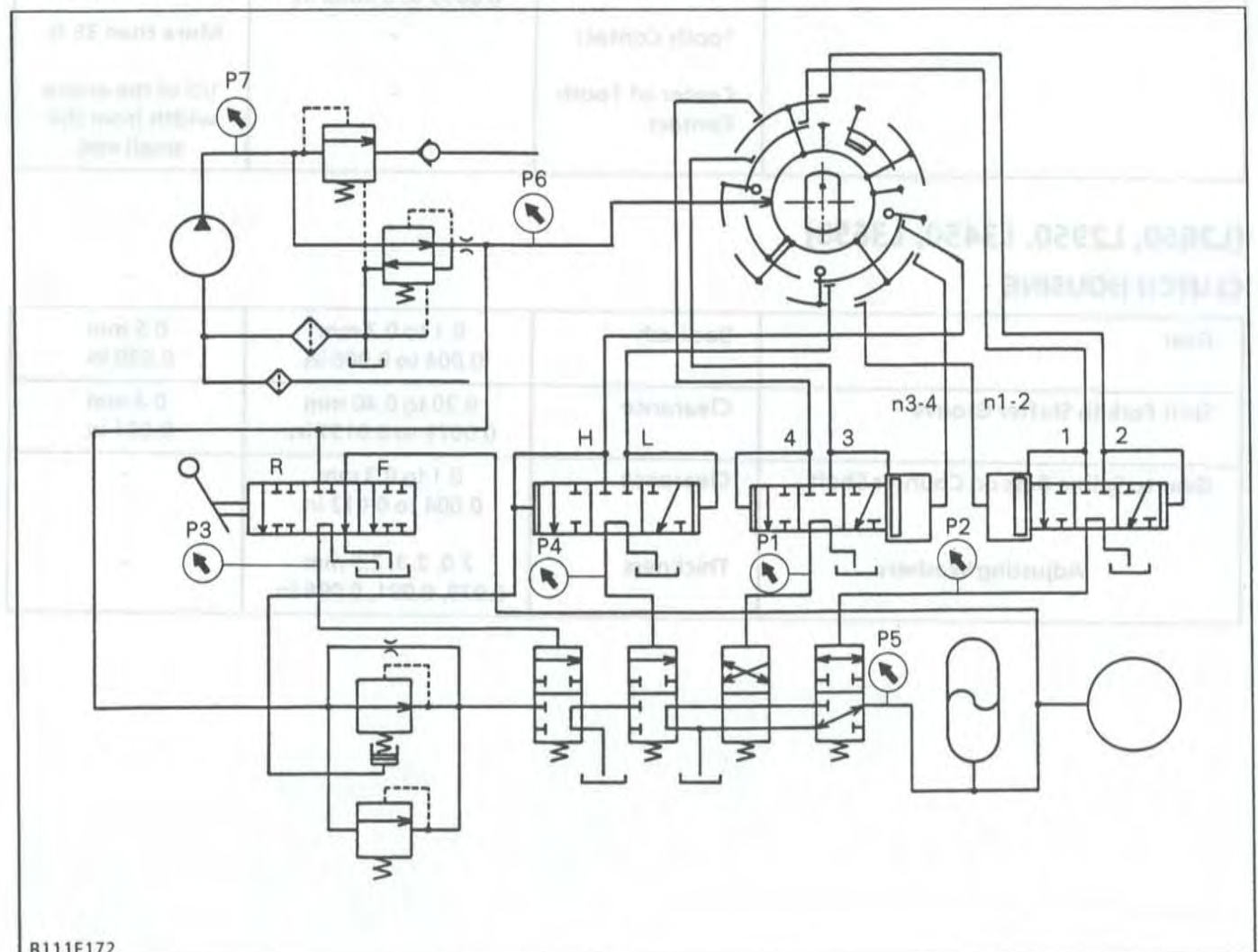
- Shuttle lever must be at "Forward" or "Reverse" position when checking the pressure.



CAUTION

- Depress the clutch pedal when checking the pressure.

■ GST Hydraulic System Circuit Diagram and Positions of Pressure Gauges



SERVICING SPECIFICATIONS

[L2350]

CLUTCH HOUSING, TRANSMISSION CASE

Item		Factory Specification	Allowable Limit
Gear	Backlash	0.1 to 0.3 mm 0.004 to 0.012 in.	0.4 mm 0.0157 in.
Gear to Spline	Clearance	0.030 to 0.078 mm 0.0012 to 0.0031 in.	0.2 mm 0.0079 in.
Shift Fork to Shift Gear Groove	Clearance	0.15 to 0.40 mm 0.0059 to 0.0157 in.	0.6 mm 0.0236 in.
Shift Fork Spring	Free length	22 mm 0.8661 in.	20 mm 0.7874 in.
Reverse Gear Bushing to Reverse Shaft	Clearance	0.020 to 0.054 mm 0.0008 to 0.0021 in.	0.3 mm 0.0118 in.
Spiral Bevel Pinion and Differential Assembly	Combined Turning Torque	4.41 to 9.32 N·m 0.45 to 0.95 kgf·m 0.3 to 0.7 ft-lbs	—
Spiral Bevel Pinion to Bevel Gear	Backlash	0.15 to 0.25 mm 0.0059 to 0.0098 in.	—
	Tooth Contact	—	More than 35 %
	Center of Tooth Contact	—	1/3 of the entire width from the small end

[L2650, L2950, L3450, L3650]

CLUTCH HOUSING

Gear	Backlash	0.1 to 0.2 mm 0.004 to 0.008 in.	0.5 mm 0.020 in.
Shift Fork to Shifter Groove	Clearance	0.20 to 0.40 mm 0.0079 to 0.0157 in.	0.8 mm 0.031 in.
Gear to Spline Boss on Counter Shaft	Clearance	0.1 to 0.3 mm 0.004 to 0.012 in.	—
Adjusting Washers	Thickness	2.0, 2.3, 2.5 mm 0.079, 0.091, 0.098 in.	—

CLUTCH HOUSING (Continued)

Item		Factory Specification	Allowable Limit
45T Gear to Counter Shaft	Clearance	0.020 to 0.055 mm 0.00079 to 0.00217 in.	0.1 mm 0.004 in.
45T Gear	I.D.	32.025 to 32.050 mm 1.26083 to 1.26181 in.	—
Counter Shaft	O.D.	31.995 to 32.005 mm 1.25965 to 1.26004 in.	—
Gear to Inner Races on Counter Shaft	Clearance	0.017 to 0.058 mm 0.00067 to 0.00228 in.	0.1 mm 0.004 in.
Gears on Counter Shaft	I.D.	32.025 to 32.050 mm 1.26083 to 1.26181 in.	—
Inner Races	O.D.	31.992 to 32.008 mm 1.25953 to 1.26016 in.	—
Synchronizer Ring to Gear [Synchronesh Type]	Side Clearance	—	More than 0.35 mm 0.0138 in.
	Contact Condition on Taper Portion	—	More than 80 %
Bushing to PTO Counter Shaft	Clearance	0.012 to 0.078 mm 0.00047 to 0.00307 in.	0.2 mm 0.0079 in.
Bushing	I.D.	14.021 to 14.060 mm 0.55165 to 0.55354 in.	—
PTO Counter Shaft End	O.D.	13.982 to 14.000 mm 0.55047 to 0.55118 in.	—
16T or 17T Gear Shaft to Main Shaft	Clearance	0.016 to 0.057 mm 0.00063 to 0.00224 in.	0.1 mm 0.004 in.
16T or 17T Gear Shaft	I.D.	31.009 to 31.025 mm 1.22083 to 1.22146 in.	—
Main Shaft	O.D.	24.980 to 24.993 mm 0.98347 to 0.98398 in.	—
Needle	O.D.	2.994 to 3.000 mm 0.11787 to 0.11811 in.	—

MID CASE

Gear	Backlash	0.1 to 0.2 mm 0.004 to 0.008 in.	0.5 mm 0.020 in.
Shift Fork to Shifter Groove	Clearance	0.20 to 0.40 mm 0.0079 to 0.0157 in.	0.8 mm 0.031 in.
Gear to Spline	Clearance	0.030 to 0.078 mm 0.00118 to 0.00307 in.	0.2 mm 0.0079 in.

MID CASE (Continued)

Item		Factory Specification	Allowable Limit
23T Gear to Inner Race on Counter Shaft 2	Clearance	0.003 to 0.042 mm 0.00012 to 0.00165 in.	0.1 mm 0.004 in.
23T Gear	I.D.	39.009 to 39.025 mm 1.53578 to 1.53641 in.	—
Inner Race	O.D.	31.995 to 32.006 mm 1.25964 to 1.26008 in.	—
Needle	O.D.	3.494 to 3.500 mm 0.13756 to 0.13780 in.	—
Reverse Shaft 2 to 15T Gear	Clearance	0.002 to 0.036 mm 0.00008 to 0.00142 in.	0.1 mm 0.004 in.
15T Gear	I.D.	26.007 to 26.020 mm 1.02390 to 1.02441 in.	—
Reverse Shaft 2	O.D.	19.996 to 20.005 mm 0.78724 to 0.78760 in.	—
Needle	O.D.	2.994 to 3.000 mm 0.11787 to 0.11811 in.	—

TRANSMISSION CASE

Shift Fork to Shifter Groove [Hi-Lo Shift]	Clearance	0.2 to 0.4 mm 0.008 to 0.016 in.	0.8 mm 0.031 in.
Gear or Spline Boss to Spline	Clearance	0.030 to 0.078 mm 0.00118 to 0.00307 in.	0.2 mm 0.0079 in.
Gears to Inner Races on 8T Spiral Bevel Pinion	Clearance	0.055 to 0.090 mm 0.00217 to 0.00354 in.	0.2 mm 0.0079 in.
Gears	I.D.	36.025 to 36.050 mm 1.41831 to 1.41929 in.	—
Inner Races	O.D.	35.960 to 35.970 mm 1.41575 to 1.41614 in.	—
8T Spiral Bevel Pinion and Differential Assembly	Turning Torque Combined	4.41 to 9.32 N·m 0.45 to 0.95 kgf·m 3.25 to 6.87 ft-lbs	—
Adjusting Shims (Differential Bearing Case)	Thickness	0.1, 0.2, 0.5 mm 0.004, 0.008, 0.020 in.	—

TRANSMISSION CASE (Continued)

Item		Factory Specification	Allowable Limit
8T Spiral Bevel Pinion to Bevel Gear	Backlash	0.15 to 0.25 mm 0.0059 to 0.0098 in.	—
	Tooth Contact	—	More than 35%
	Center of Tooth Contact	—	1/3 of the entire width from the small end
	Adjusting Shims (Differential Bearing Case)	Thickness 0.1, 0.2, 0.5 mm 0.004, 0.008, 0.020 in.	—
	(Pinion Bearing Case)	Thickness 0.1, 0.2, 0.5 mm 0.004, 0.008, 0.020 in.	—
8T Spiral Bevel Pinion Only	Turning Torque	2.0 to 2.9 N·m 0.2 to 0.3 kgf·m 1.4 to 2.2 ft-lbs	—
20T Gear to PTO Drive Shaft [L2650-L2950-L3450] 20T Gear	Clearance	0.015 to 0.046 mm 0.00059 to 0.00181 in.	0.1 mm 0.004 in.
	I.D.	30.020 to 30.041 mm 1.18189 to 1.18272 in.	—
	PTO Drive Shaft	O.D. 29.995 to 30.005 mm 1.18091 to 1.18130 in.	—
19-34T Gear to Inner Race on PTO Drive Shaft [L2650 4WD, L2950 4WD] 19-34T Gear	Clearance	0.004 to 0.043 mm 0.00016 to 0.00169 in.	0.1 mm 0.004 in.
	I.D.	37.009 to 37.025 mm 1.45705 to 1.45768 in.	—
	Inner Race	O.D. 29.996 to 30.005 mm 1.18095 to 1.18130 in.	—
	Needle	O.D. 3.493 to 3.500 mm 0.13752 to 0.13780 in.	—
19-32T Gear to PTO Drive Shaft [L3450 4WD, L3650 4WD] 19-32T Gear	Clearance	0.009 to 0.052 mm 0.00035 to 0.00205 in.	0.1 mm 0.004 in.
	I.D.	37.009 to 37.025 mm 1.45705 to 1.45768 in.	—
	PTO Drive Shaft	O.D. 29.987 to 30.000 mm 1.18059 to 1.18110 in.	—
	Needle	O.D. 3.493 to 3.500 mm 0.13752 to 0.13780 in.	—

[L2650GST, L2950GST, L3450GST, L3650GST]**GST SYSTEM**

Item		Factory Specification	Allowable Limit
GST System Pressures Condition ● Engine Speed Maximum rpm ● Oil Temperature 45 to 55 °C 113 to 131 °F	Relief Valve	3.14 to 3.23 MPa 32.0 to 33.0 kgf/cm ² 455 to 469 psi	—
	System Pressure	2.35 to 2.45 MPa 24.0 to 25.0 kgf/cm ² 341 to 356 psi	—
	Modulating Valve	1.37 to 1.42 MPa 14.0 to 14.5 kgf/cm ² 199 to 206 psi	—
Clutch Park	Clutch Disk	Thickness 2.2 to 2.3 mm 0.0866 to 0.0906 in.	1.9 mm 0.0748 in.
	Steel Plate 1.2	Thickness 1.10 to 1.20 mm 0.0433 to 0.0472 in.	0.90 mm 0.0354 in.
	Steel Plate 4.0	Thickness 3.89 to 4.05 mm 0.1531 to 0.1594 in.	3.70 mm 0.1457 in.
	Piston	Flatness —	0.15 mm 0.0059 in.
	Steel Plate 1.2, 4.0	Flatness —	0.30 mm 0.0118 in.
	Spring	Length 20.3 to 20.7 mm 0.799 to 0.815 in.	17.4 mm 0.685 in.
	Seal Ring	Thickness 2.45 to 2.50 mm 0.0965 to 0.0984 in.	20.00 mm 0.0787 in.

CLUTCH HOUSING

Gear	Backlash	0.1 to 0.2 mm 0.004 to 0.008 in.	0.5 mm 0.020 in.
Shift Fork to Shifter Groove	Clearance	0.25 to 0.45 mm 0.0098 to 0.0177 in.	0.8 mm 0.031 in.
Gear to Spline Boss on PTO Counter Shaft [L2650GST, L2950GST, L3450GST] Adjusting Washers	Clearance	0.1 to 0.3 mm 0.004 to 0.012 in.	0.1 mm 0.004 in.
	Thickness	2.0, 2.3, 2.5 mm 0.079, 0.091, 0.098 in.	—
46T Gear to Counter Shaft	Clearance	0.020 to 0.055 mm 0.0008 to 0.0022 in.	0.1 mm 0.004 in.
46T Gear	I.D.	32.025 to 32.050 mm 1.2608 to 1.2618 in.	—
Counter Shaft	O.D.	31.995 to 32.005 mm 1.2597 to 1.2600 in.	—

CLUTCH HOUSING (Continued)

Item		Factory Specification	Allowable Limit
Gear to Inner Races on Counter Shaft	Clearance	0.017 to 0.058 mm 0.0007 to 0.0023 in.	0.1 mm 0.004 in.
Gears on Counter Shaft	I.D.	32.025 to 32.050 mm 1.2608 to 1.2618 in.	—
Inner Races	O.D.	31.992 to 32.008 mm 1.2596 to 1.2602 in.	—
Synchronizer Ring to Gear	Side Clearance	—	More than 0.35 mm 0.0138 in.
	Contact Condition on Taper Portion	—	More than 80 %
Gear to Inner Races on PTO Counter Shaft	Clearance	0.017 to 0.058 mm 0.00067 to 0.00228 in.	0.1 mm 0.004 in.
Gears on PTO Counter Shaft	I.D.	32.025 to 32.050 mm 1.26083 to 1.26181 in.	—
Inner Races	O.D.	31.992 to 32.008 mm 1.25953 to 1.26016 in.	—
27T Gear to Inner Race on Shuttle Shaft	Clearance	0.017 to 0.052 mm 0.00067 to 0.00205 in.	0.1 mm 0.004 in.
27T Gear	I.D.	37.025 to 37.034 mm 1.45768 to 1.45803 in.	—
Inner Race	O.D.	31.992 to 32.008 mm 1.25953 to 1.26016 in.	—
Needle	O.D.	2.495 to 2.500 mm 0.09823 to 0.09843 in.	—
17-32T or 17-33T Gear to Shuttle Shaft	Clearance	0.0005 to 0.038 mm 0.00002 to 0.00150 in.	0.1 mm 0.004 in.
17-32T or 17-33T Gear	I.D.	29.007 to 29.020 mm 1.14200 to 1.14252 in.	—
Shuttle Shaft	O.D.	24.994 to 25.0065 mm 0.98402 to 0.98452 in.	—
Needle	O.D.	1.994 to 2.000 mm 0.07850 to 0.07874 in.	—

CLUTCH HOUSING (Continued)

Item		Factory Specification	Allowable Limit
Hi-Lo Shaft to 17-17T or 18-17T Gear	Clearance	0.002 to 0.041 mm 0.00008 to 0.00161 in.	0.1 mm 0.004 in.
17-17T or 18-17T Gear	I.D.	33.009 to 33.025 mm 1.29957 to 1.30020 in.	—
Hi-Lo Shaft	O.D.	27.994 to 28.007 mm 1.10213 to 1.10264 in.	—
Needle	O.D.	2.495 to 2.500 mm 0.09823 to 0.09843 in.	—
42T Gear to Inner Race on Hi-Lo Shaft	Clearance	0.017 to 0.058 mm 0.00067 to 0.00228 in.	0.1 mm 0.004 in.
42T Gear	I.D.	32.025 to 32.050 mm 1.26083 to 1.26181 in.	—
Inner Race	O.D.	31.992 to 32.008 mm 1.25953 to 1.26016 in.	—

MID CASE

Reverse Shaft to Reverse Gear	Clearance	0.015 to 0.044 mm 0.00059 to 0.00173 in.	0.1 mm 0.004 in.
Reverse Gear	I.D.	26.020 to 26.028 mm 1.02441 to 1.02472 in.	—
Reverse Shaft	O.D.	19.996 to 20.005 mm 0.78724 to 0.78760 in.	—
Needle	O.D.	2.994 to 3.000 mm 0.11787 to 0.11811 in.	—

TRANSMISSION CASE

Gear to 6T Spiral Bevel Pinion	Clearance	0.030 to 0.078 mm 0.00118 to 0.00307 in.	0.2 mm 0.0079 in.
20T Gear to PTO Drive Shaft [L2650GST, L2950GST, L3450GST]	Clearance	0.015 to 0.046 mm 0.00059 to 0.00181 in.	0.1 mm 0.004 in.
20T Gear	I.D.	30.020 to 30.041 mm. 1.18189 to 1.18272 in.	—
PTO Drive Shaft	O.D.	29.995 to 30.005 mm 1.18091 to 1.18130 in.	—

TRANSMISSION CASE (Continued)

Item		Factory Specification	Allowable Limit
21-34T Gear to Inner Race on PTO Drive Shaft [L2650GST, L2950GST]		0.004 to 0.043 mm 0.00016 to 0.00169 in.	0.1 mm 0.004 in.
21-34T Gear	I.D.	37.009 to 37.025 mm 1.45705 to 1.45768 in.	—
Inner Race	O.D.	29.996 to 30.005 mm 1.18095 to 1.18130 in.	—
Needle	O.D.	3.493 to 3.500 mm 0.13752 to 0.13780 in.	—
21-32T or 19-32T Gear to PTO Drive Shaft [L3450GST, L3650GST]		0.009 to 0.052 mm 0.00035 to 0.00205 in.	0.1 mm 0.004 in.
21-32T or 19-32T Gear	I.D.	37.009 to 37.025 mm 1.45705 to 1.45768 in.	—
PTO Drive Shaft	O.D.	29.987 to 30.000 mm 1.18059 to 1.18110 in.	—
Needle	O.D.	3.493 to 3.500 mm 0.13752 to 0.13778 in.	—
6T Spiral Bevel Pinion and Differential Assembly		Turning Torque Combined 4.41 to 9.32 N·m 0.45 to 0.95 kgf·m 3.25 to 6.87 ft-lbs	—
Adjusting Shims (Differential Bearing Case)		Thickness 0.1, 0.2, 0.5 mm 0.004, 0.008, 0.020 in.	—
6T Spiral Bevel Pinion to Bevel Gear		Backlash 0.15 to 0.25 mm 0.0059 to 0.0098 in.	—
		Tooth Contact —	More than 35%
		Center of Tooth Contact —	1/3 of the entire width from the small end
Adjusting Shims (Differential Bearing Case)		Thickness 0.1, 0.2, 0.5 mm 0.004, 0.008, 0.020 in.	—
(Pinion Bearing Case)		Thickness 0.1, 0.2, 0.5 mm 0.004, 0.008, 0.020 in.	—
6T Spiral Bevel Pinion Only		Turning Torque 2.0 to 2.9 N·m 0.2 to 0.3 kgf·m 1.4 to 2.2 ft-lbs	—

TIGHTENING TORQUES

Tightening torques of screws, bolts and nuts on the table below are especially specified.
(For general use screws, bolts and nuts: See page S.G-8)

[L2350]

Item	N·m	kgf·m	ft-lbs
Engine mounting screw and nut to clutch housing	48.1 to 55.8	4.9 to 5.7	35.5 to 41.2
Main shaft case mounting screw	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Clutch housing mounting nut to transmission case	48.1 to 55.9	4.9 to 5.7	35.5 to 41.2
Spiral bevel pinion lock nut	147 to 196	15 to 20	108 to 145
Pinion bearing case mounting screw	48.1 to 55.8	4.9 to 5.7	35.5 to 41.2
Differential bearing case mounting screw	48.1 to 55.8	4.9 to 5.7	35.5 to 41.2

[L2650, L2950, L3450, L3650]

Engine mounting screw and nut to clutch housing	48.1 to 55.8	4.9 to 5.7	35.5 to 41.2
Main shaft case mounting screw	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Clutch housing mounting nut to mid case	77.5 to 90.2	7.9 to 9.2	57.1 to 66.5
Mid case mounting nut to transmission case	77.5 to 90.2	7.9 to 9.2	57.1 to 66.5
Counter shaft 2 lock nut	39.2 to 58.8	4.0 to 6.0	28.9 to 43.4
Spiral bevel pinion lock nut	147 to 196	15 to 20	108 to 145
Pinion bearing case mounting screw	48.1 to 55.8	4.9 to 5.7	35.5 to 41.2
Differential bearing case mounting screw	48.1 to 55.8	4.9 to 5.7	35.5 to 41.2
PTO shaft lock nut	147 to 196	15 to 20	108 to 145
PTO shift fork setting screw	9.81 to 11.28	1.0 to 1.15	7.23 to 8.32
PTO shifter setting screw	9.81 to 11.28	1.0 to 1.15	7.23 to 8.32

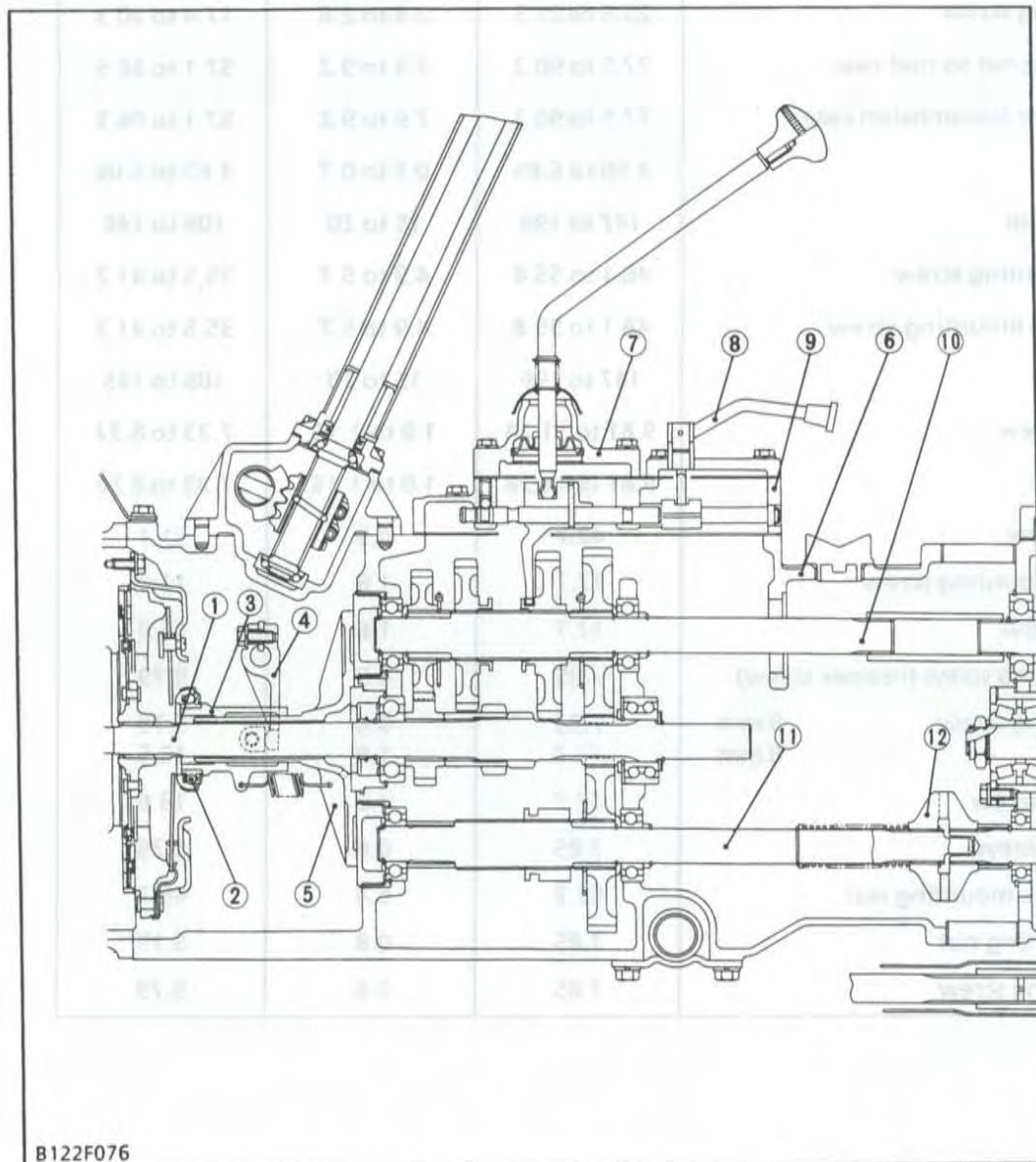
[L2650GST, L2950GST, L3450GST, L3650GST]

Item		N·m	kgf·m	ft-lbs
Engine mounting screw and nut to clutch housing		48.1 to 55.8	4.9 to 5.7	35.5 to 41.2
Main shaft case mounting screw		23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Clutch housing mounting nut to mid case		77.5 to 90.2	7.9 to 9.2	57.1 to 66.5
Mid case mounting nut to transmission case		77.5 to 90.2	7.9 to 9.2	57.1 to 66.5
Counter shaft 22 nut		4.90 to 6.86	0.5 to 0.7	3.62 to 5.06
Spiral bevel pinion lock nut		147 to 196	15 to 20	108 to 145
Pinion bearing case mounting screw		48.1 to 55.8	4.9 to 5.7	35.5 to 41.2
Differential bearing case mounting screw		48.1 to 55.8	4.9 to 5.7	35.5 to 41.2
PTO shaft lock nut		147 to 196	15 to 20	108 to 145
PTO shift fork setting screw		9.81 to 11.28	1.0 to 1.15	7.23 to 8.32
PTO shifter setting screw		9.81 to 11.28	1.0 to 1.15	7.23 to 8.32
Side cover mounting screw		42.2	4.3	31.1
Hi-Lo shift spool valve mounting screw		17.7	1.8	13.0
Gate valve mounting screw		17.7	1.8	13.0
Shuttle shift fork mounting screw (reamer screw)		7.85	0.8	5.79
Main shift valve mounting screw	6 mm	7.85	0.8	5.79
	8 mm	17.7	1.8	13.6
Accumulator mounting screw		17.7	1.8	13.6
Rotary valve mounting screw		7.85	0.8	5.79
Rotary valve detent plate mounting nut		62.8	6.4	46.3
Modulating valve mounting nut		7.85	0.8	5.79
Reducing valve case fixing screw		7.85	0.8	5.79

CHECKING, DISASSEMBLING AND SERVICING

[1] L2350

[1]-1 CLUTCH HOUSING



- (1) Main Shaft
- (2) Thrust Ball Bearing
- (3) Release Hub
- (4) Release Fork
- (5) Main Shaft Case
- (6) Clutch Housing
- (7) Shift Base
- (8) PTO Shift Lever
- (9) Shift Cover
- (10) Counter Shaft
- (11) PTO Counter Shaft
- (12) One-way Clutch (Slant Cam)

B122F076

DISASSEMBLING AND ASSEMBLING

Separating Clutch Housing

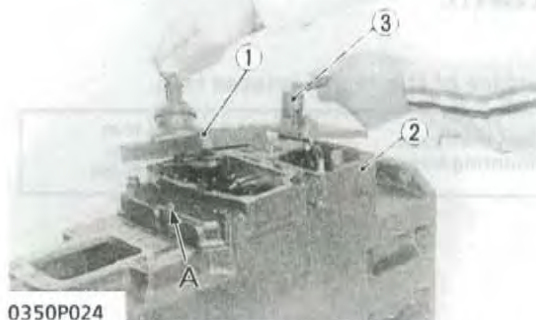
(See page S.5-6)

Shift Base and Cover

1. Detach shift base (1) and PTO shift base (3) from shift cover (2).
2. Remove shift cover (2).

(When reassembling)

- Take care not to drop springs and balls in the transmission.
- Use a seal washer at the single specified point "A".



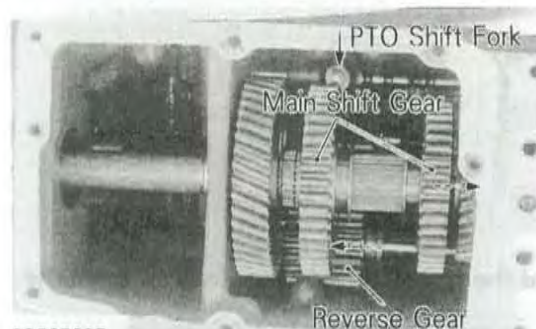
0350P024

- (1) Shift Base (3) PTO Shift Base
(2) Shift Cover

Tightening torque	Bolt with seal washer	11.8 to 20.6 N·m 1.2 to 2.1 kgf·m 8.7 to 14.5 ft-lbs
-------------------	-----------------------	--

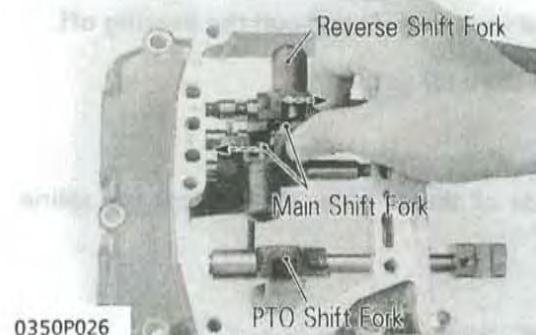
- The shift forks should be fitted onto the gear fork grooves as follows.

1. Shift the PTO shift forks to neutral.
2. Shift the main shift gear to F4 (F8).
3. Retreat the reverse gear until it touches the 48T gear.



0350P025

4. Shift the main shift fork to F4 (F8).
5. Retreat the reverse shift fork approx. 6 mm (0.24 in.).
6. Shift the PTO shift forks to neutral.



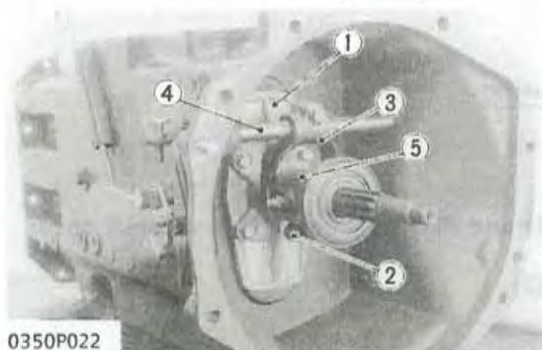
0350P026

7. Hold the three main shift forks with fingers to prevent the neutral piece from coming off.
8. Securely fit the three main shift forks into the gear shift fork grooves.
9. Fit the PTO levers onto the shift fork pins by slightly lifting the left side of the speed change cover.

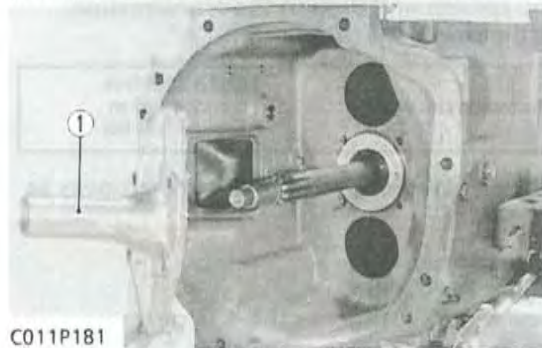


0350P027

Tightening torque	Speed change cover mounting screw	24 to 28 N·m 2.4 to 2.8 kgf·m 174.0 to 202.8 ft-lbs
-------------------	-----------------------------------	---



0350P022



C011P181

- (1) Main Shaft Case (4) Clutch Lever
(2) Hub Return Spring (5) Release Hub
(3) Release Fork

Main Shaft Case

1. Remove the release fork (3) mounting screws.
2. Draw out clutch lever (4) to remove release fork (3).
3. Remove hub return spring (2).
4. Remove the thrust ball bearing and release hub (5) together.
5. Remove main shaft case (1).

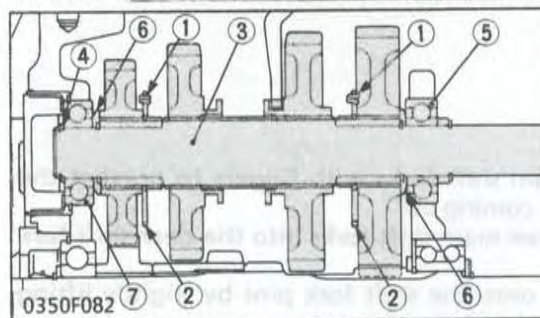
(When reassembling)

- Grease the sliding surface of the clutch release hub.

Tightening torque	Main shaft case mounting screw	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft·lbs
-------------------	--------------------------------	---



C011P184



0350F082

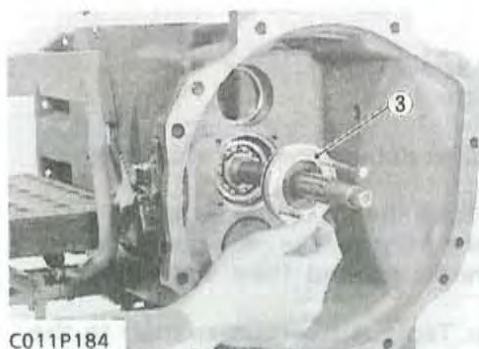
- (1) Wire (5) Bearing
(2) Snap Ring (6) Thrust Collar
(3) Counter Shaft (7) Bearing Cover
(4) Snap Ring

Counter Shaft

1. Remove wire (1) and the two external snap rings (2) from the counter shaft (3).
2. Tap the counter shaft (3) off the front of the bearing cover (8).
3. Remove the external snap ring (4) and pull the bearing off.
4. Remove the thrust collar (6).
5. Tap out the counter shaft (3) to the rear.

(When reassembling)

- Bind the wires (1) to the rings (2).
- Point oil groove side of thrust collar (6) towards the spline boss.

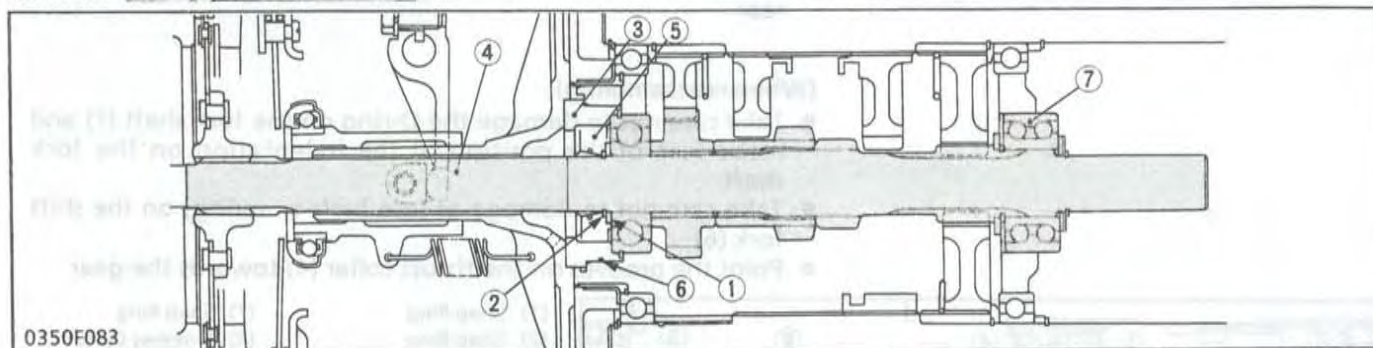


Main Shaft

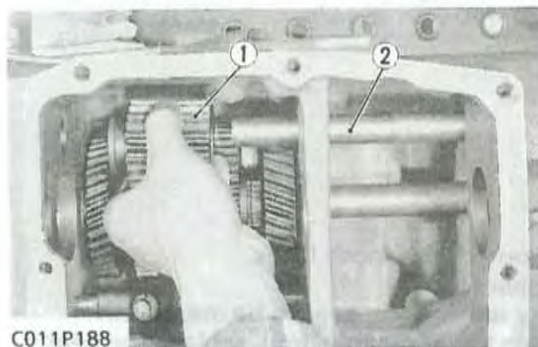
1. Screw the two screws into the spacer (3) and pull it out.
2. Remove the external snap ring (2).
3. Remove the collar (1).
4. Tap out the main shaft (4) to the rear.

(When reassembling)

- Apply grease to oil seal (5).
- Point the outer raceway of bearing (7) towards the differential gear.



- | | | | |
|------------------------|----------------|--------------|------------------|
| (1) Washer | (3) Spacer | (5) Oil Seal | (7) Ball Bearing |
| (2) External Snap Ring | (4) Main Shaft | (6) O-ring | |

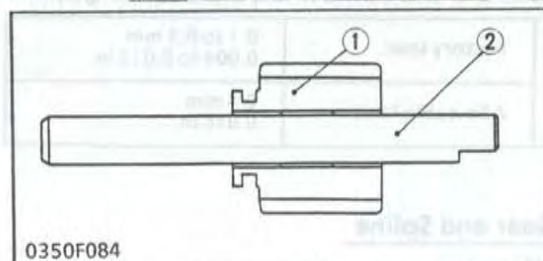


Reverse Shaft

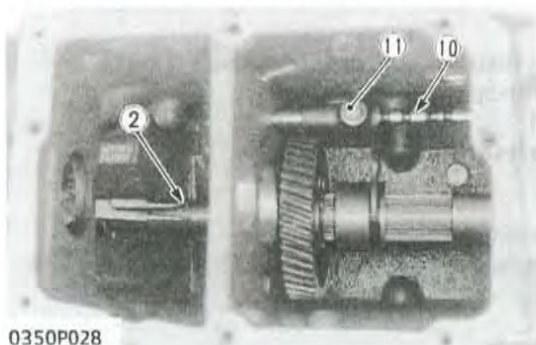
1. Remove the set screw on the reverse shaft.
2. Draw out the reverse shaft and remove the gear.

(When reassembling)

- Make sure of the direction of the reverse shaft and of the position of the indentation on the reverse shaft.



- | | |
|------------------|-------------------|
| (1) Reverse Gear | (2) Reverse Shaft |
|------------------|-------------------|



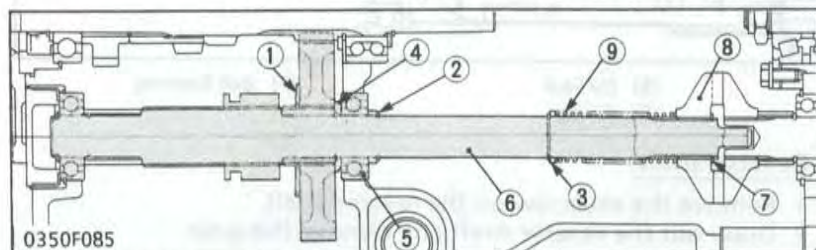
0350P028

PTO Counter Shaft

1. Remove the fork shaft set screw.
2. Tap out fork shaft (10) to the front.
3. Remove shift fork (11).
4. Remove snap rings (7), (3) to detach one way clutch (8) and spring (9).
5. Remove the snap ring (1) from the PTO counter shaft (6).
6. Tap the counter shaft to the front to take off bearing cover.
7. Remove the external snap ring and then draw out the bearing.
8. Detach the thrust collar. Tap out the counter shaft to the rear.

(When reassembling)

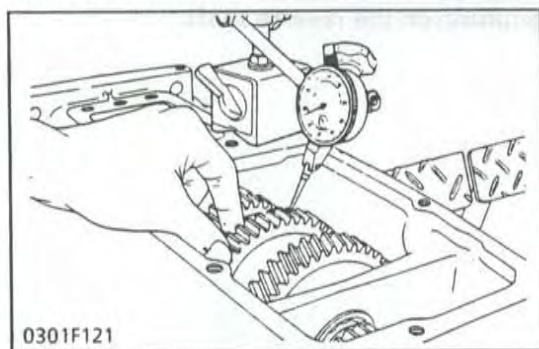
- Take care not to damage the O-ring on the fork shaft (7) and make sure of the position of the indentation on the fork shaft.
- Take care not to damage or lose balls or springs on the shift fork (6).
- Point the grooves on the thrust collar (4) towards the gear.



0350F085

- | | |
|-----------------------|-------------------|
| (1) Snap Ring | (7) Snap Ring |
| (2) Snap Ring | (8) Oneway Clutch |
| (3) Snap Ring | (9) Spring |
| (4) Thrust Collar | (10) Fork Shaft |
| (5) Bearing | (11) Shift Fork |
| (6) PTO Counter-shaft | |

SERVICING

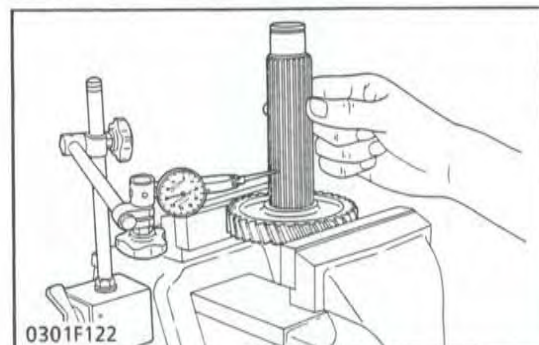


0301F121

Gear Backlash

1. Set a dial gauge on one of the tooth faces.
2. Clamp the mating gear.
3. Measure backlash by turning the gear to be measured.
4. If the reading exceeds the allowable limit, replace the gear.

Gear backlash	Factory spec.	0.1 to 0.3 mm 0.004 to 0.012 in.
	Allowable limit	0.4 mm 0.016 in.

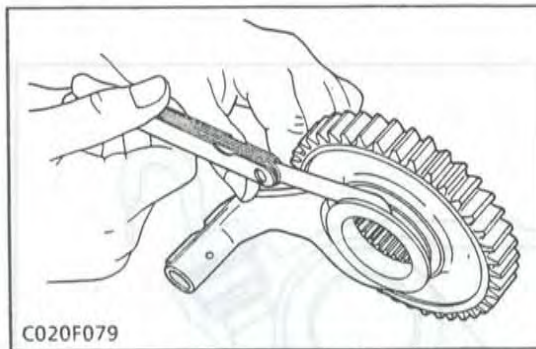


0301F122

Clearance between Gear and Spline

1. Secure the gear with a vise.
2. Set the dial indicator (lever type) with its finger on the spline.
3. Move the shaft to measure clearance.
4. If the clearance exceeds allowable limit, replace.

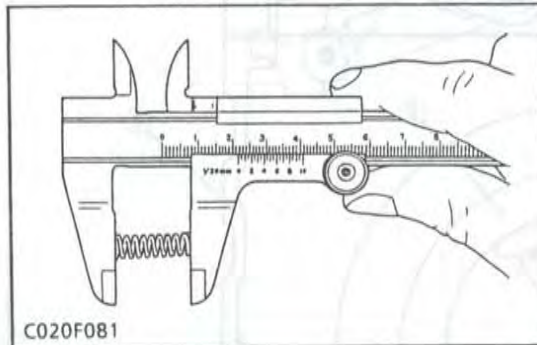
Clearance between gear and spline	Factory spec.	0.030 to 0.078 mm 0.0012 to 0.0031 in.
	Allowable limit	0.2 mm 0.0079 in.



Clearance between Shift Fork and Shift Gear Groove or Shifter Groove

1. Place for in the groove to check clearance with feeler gauge.
2. If the clearance exceeds allowable limit, replace.

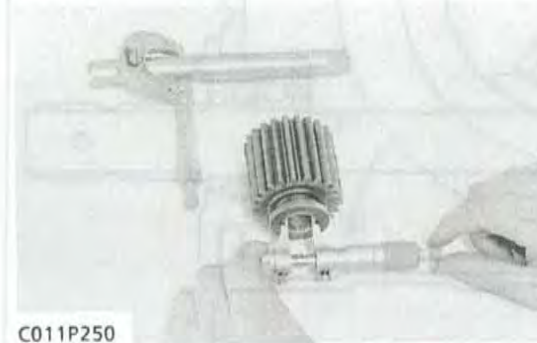
Clearance between shift fork and shift gear groove	Factory spec.	0.15 to 0.40 mm 0.006 to 0.016 in.
	Allowable limit	0.6 mm 0.024 in.
Clearance between shift fork and shifter groove	Factory spec.	0.20 to 0.40 mm 0.008 to 0.016 in.
	Allowable limit	0.6 mm 0.024 in.



Free Length of the Shift Fork Spring

1. Measure free length of spring with vernier caliper.
2. If the free length is less than the allowable limit, replace.

Free length of the shift fork spring	Factory spec.	22 mm 0.866 in.
	Allowable limit	20 mm 0.787 in.



Clearance between Reverse Gear Bushing and Reverse Shaft

1. Measure the outside diameter of the reverse shaft.
2. Measure the inside diameter of the reverse gear bushing and take the difference for the clearance.
3. If the clearance exceeds the allowable limit, replace.

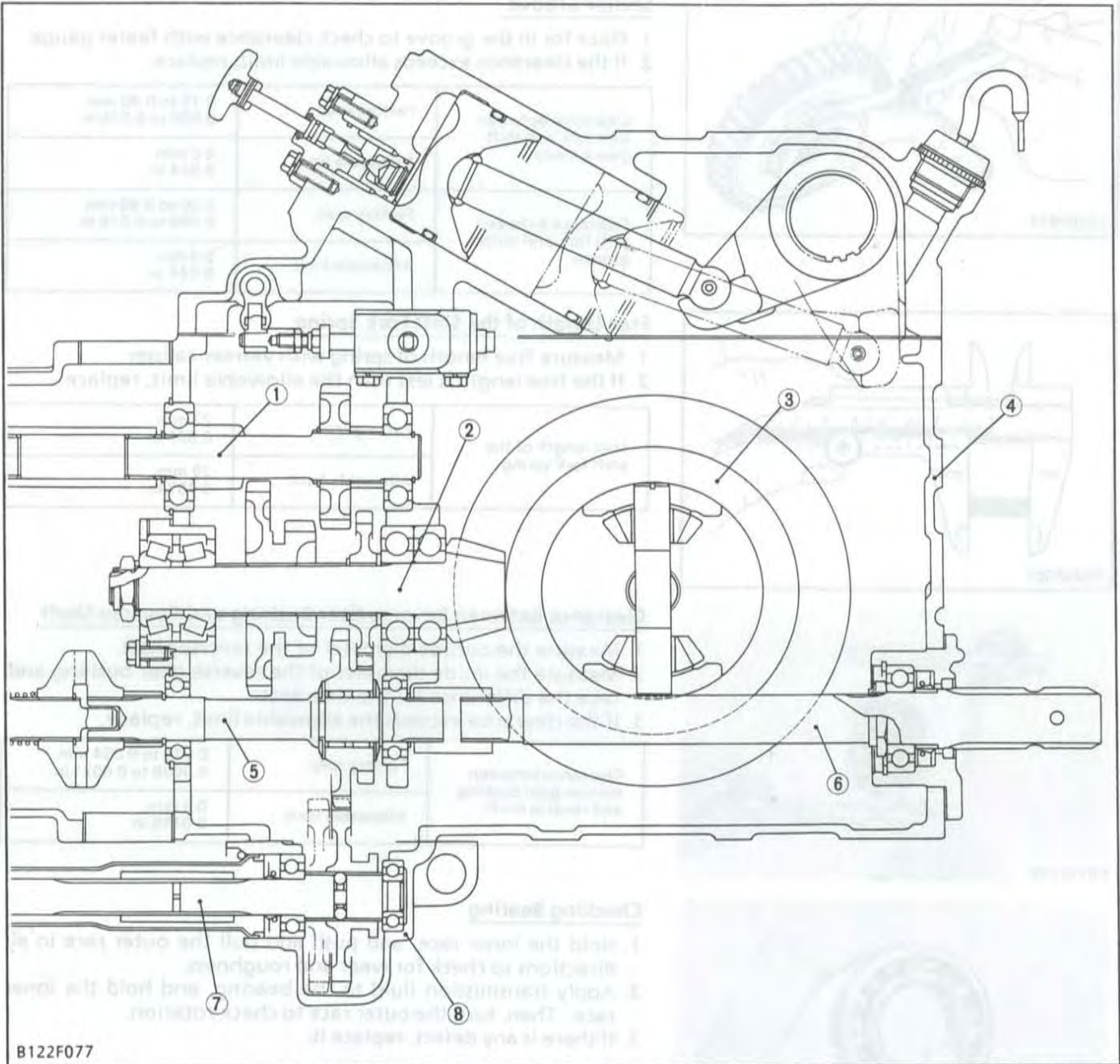
Clearance between reverse gear bushing and reverse shaft	Factory spec.	0.020 to 0.054 mm 0.0008 to 0.0021 in.
	Allowable limit	0.3 mm 0.0118 in.



Checking Bearing

1. Hold the inner race, and push and pull the outer race in all directions to check for wear and roughness.
2. Apply transmission fluid to the bearing, and hold the inner race. Then, turn the outer race to check rotation.
3. If there is any defect, replace it.

[1]-2 TRANSMISSION CASE



B122F077

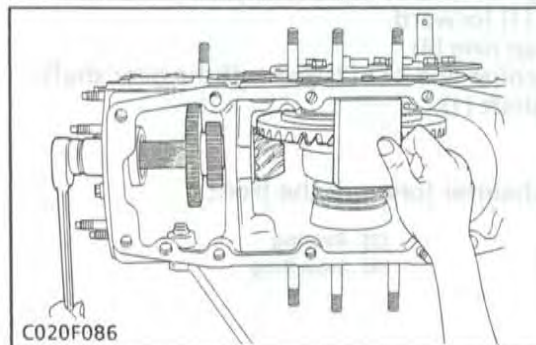
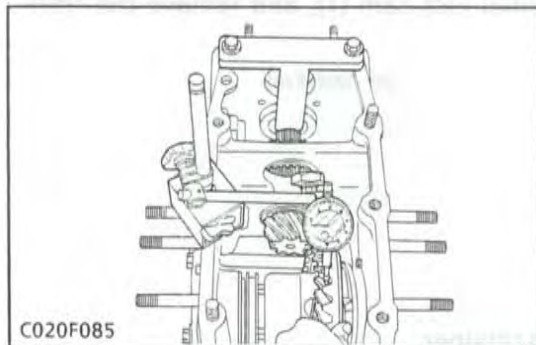
- | | | | |
|-------------------------|-----------------------|---------------------|----------------------------|
| (1) 12T Gear Shaft | (3) Differential Gear | (5) PTO Drive Shaft | (7) Front Axle Drive Shaft |
| (2) Spiral Bevel Pinion | (4) Transmission Case | (6) PTO Shaft | (8) Front Axle Drive Case |

CHECKING AND ADJUSTING

Separating Transmission Case

(See page S.5-9.)

Backlash and Tooth Contact between Bevel Gear and 8T Spiral Bevel Pinion



1. Set a dial gauge with its finger on the tooth surface of bevel gear.
2. Measure the backlash by fixing the 8T spiral bevel pinion and moving bevel gear by hand.
3. If the backlash exceeds the factory specification, decrease the number of shims at right bearing case (right) and insert the removed shims to the left bearing case (left). If the backlash is less than the factory specification, decrease the number of shims at left bearing case (left) and insert the removed shims to the right bearing case (right).
4. Adjust the backlash properly by repeating the above procedures.

Backlash between bevel gear and 8T spiral bevel pinion	Factory spec.	0.15 to 0.25 mm 0.0059 to 0.0098 in.
--	---------------	---

5. Apply red lead lightly over several teeth at three positions equally spaced on the bevel gear.
6. Turn the 8T spiral bevel pinion while pressing a wooden piece against the periphery of the bevel gear.
7. Check the tooth contact. If not proper, adjust according to the instructions below.

(Reference)

- Thickness of differential side shims:
 - 0.1 mm (0.004 in.) [Code No. 37150-26171]
 - 0.2 mm (0.008 in.) [Code No. 37150-26161]
 - 0.5 mm (0.020 in.) [Code No. 37150-26181]
- Thickness of spiral bevel pinion shims:
 - 0.1 mm (0.004 in.) [Code No. 34150-22631]
 - 0.2 mm (0.008 in.) [Code No. 34150-22621]
 - 0.5 mm (0.020 in.) [Code No. 34150-22611]

• Proper Contact



C065F198

More than 35% red lead contact area on the gear tooth surface. The center of tooth contact at 1/3 of the entire width from the small end.

• Heel Contact



• Tip Contact



0329F097

Replace adjusting shim with thinner one to move the bevel pinion shaft backward.
And place the left side shim to the right to move the bevel gear rightward.
Repeat above until the proper tooth contact and backlash are achieved.

• Toe Contact



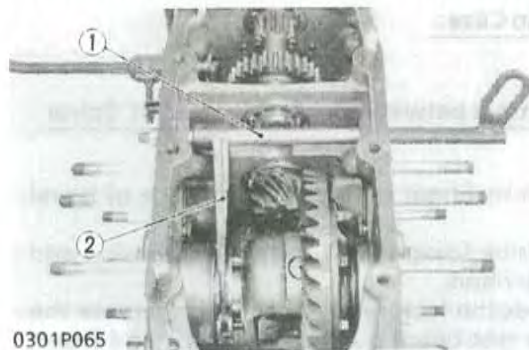
• Base Contact



0329F098

Replace adjusting shim with thicker one to move the bevel pinion shaft forward.
And place the right side shim to the left to move the bevel gear leftward.
Repeat above until the proper tooth contact and backlash are achieved.

DISASSEMBLING AND ASSEMBLING



0301P065

Differential Lock

1. Drive out the spring pin.
2. Pull out the differential lock cam (1), and remove the shift fork (2).

(1) Differential Lock Cam

(2) Shift Fork



C011P192

12T Gear Shaft

1. Remove the bearing retainer.
2. Shift 12T gear shaft (1) forward.
3. Remove external snap ring (4).
4. Pull the bearing (3) collar and 31T (2) gear off the gear shaft.
5. Draw out 12T gear shaft (1).

(When reassembling)

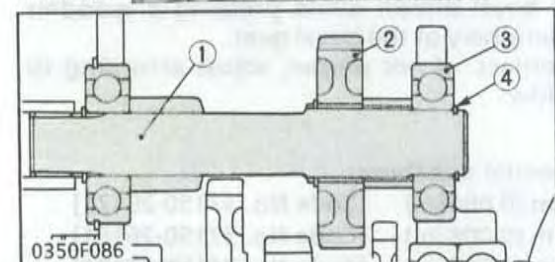
- Point the 31T gear chamfer forwards the front.

(1) 12T Gear Shaft

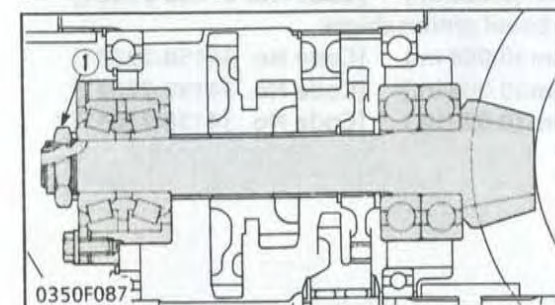
(2) 31T Gear

(3) Bearing

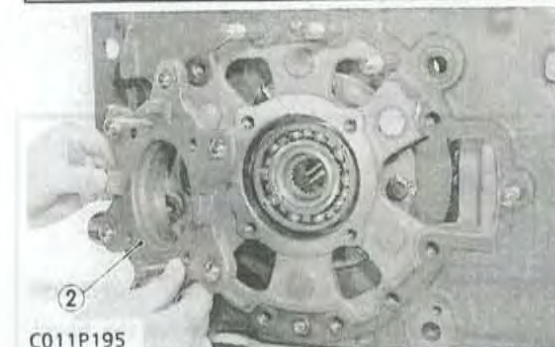
(4) Snap Ring



0350F086



0350F087



C011P195

Differential Gear Assembly

1. Unlock and remove the lock nut (1).
2. Remove the differential bearing case (2) mounting screws.
3. Detach the case by screwing two M8 screws.

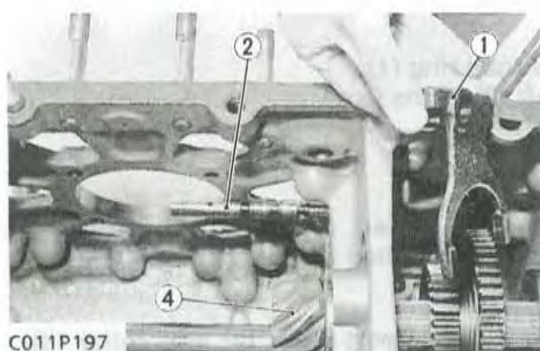
(When reassembling)

- Use same number of shims as before disassembling.
- Replace the left and right bearing cases on the same sides as before.
- Apply grease to ball and ball seats.

Tightening torque	Lock Nut	147 to 196 N·m 15 to 20 kgf·m 109 to 145 ft·lbs
-------------------	----------	---

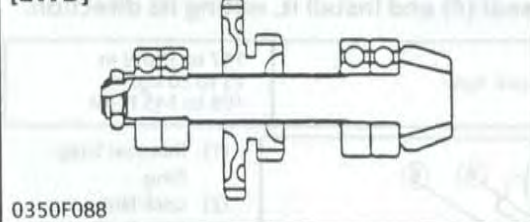
(1) Lock Nut

(2) Bearing Case

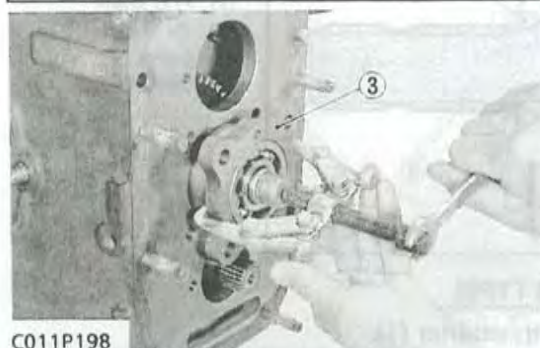


C011P197

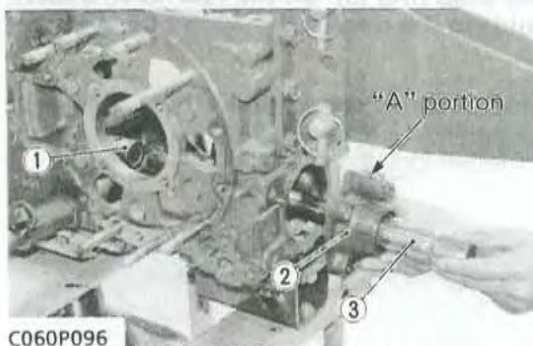
[2WD]



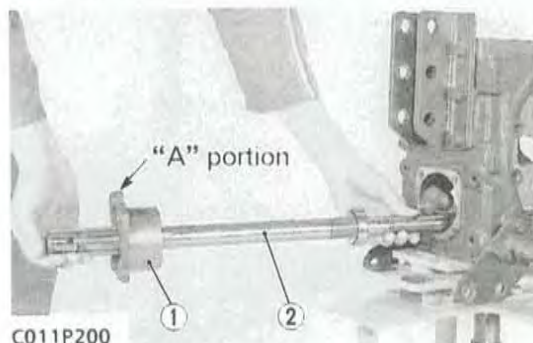
0350F088



C011P198



C060P096



C011P200

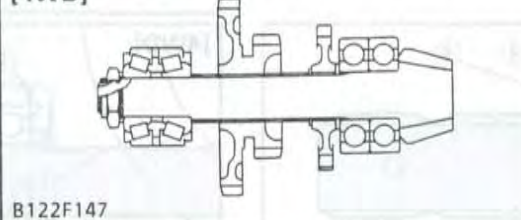
Spiral Bevel Pinion Shaft

1. Remove the fork shaft set screw.
2. Remove the fork shaft snap pin.
3. Pull the fork shaft (2) off the rear.
4. Remove the shift fork (1).
5. Remove the bearing cover (3).
6. Remove the bearing case mounting screws.
7. Pull out the bearing case (3) with a gear puller.
8. Pull the spiral bevel pinion shaft (4) off the rear.
9. Pull out the 29-48T gears.

(When reassembling)

- Take gear case not to lose or damage the balls and spring in fork (1) in refitting fork shaft (2) to fork (1).
- Make sure of the number of shims in the bearing case.

[4WD]



B122F147

- (1) Shift Fork
(2) Fork Shaft

- (3) Bearing Case
(4) Spiral Bevel Pinion Shaft

PTO Bearing Case [4WD TYPE]

1. Remove the bearing case (2) mounting screws, and draw out the PTO shaft (3) with bearing case.
2. Take out the coupling (1).

(When reassembling)

- Direct the boss "A" portion on bearing case (2) upward.

- (1) Coupling
(2) Bearing Case

- (3) PTO Shaft

PTO Shaft [2WD TYPE]

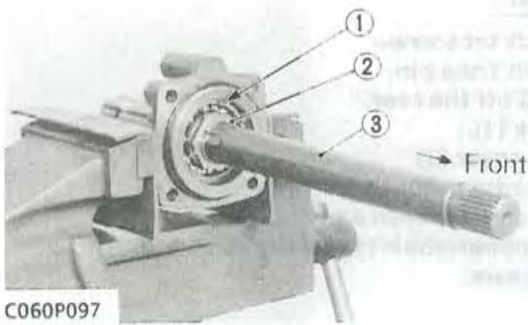
1. Remove the bearing case (1) mounting screws.
2. Pull PTO shaft (2) and bearing base (1) off the rear.

(When reassembling)

- Direct the boss "A" portion on bearing case (1) upward.

- (1) Bearing Case

- (2) PTO Shaft

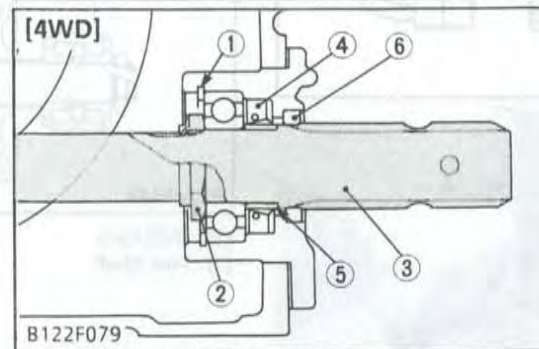
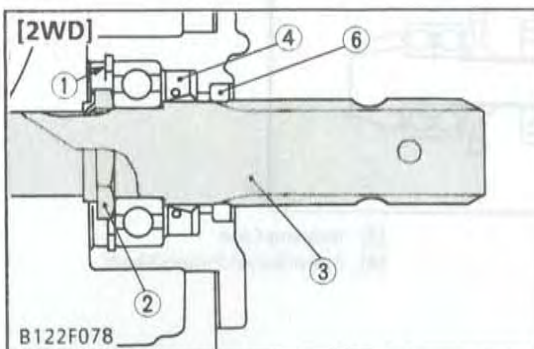
**PTO Shaft**

1. Remove the internal snap ring (1).
2. Tap out the PTO shaft (3) to the front.

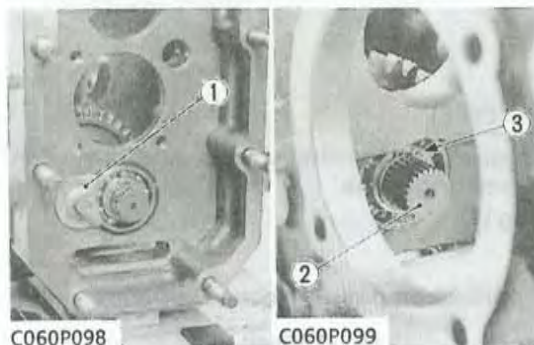
(When reassembling)**NOTE**

- In the lock nut (2) was removed, replace a new one, and after tightening it to the specified torque, be sure to lock it firmly.
- Install the slinger (6) firmly.
- After applying grease to the PTO shaft (3) and collar (5), insert the collar to PTO shaft. [4WD TYPE]
- Apply grease to oil seal (4) and install it, noting its direction.

Tightening torque	Lock nut	147 to 196 N·m 15 to 20 kgf·m 108 to 145 ft-lbs
-------------------	----------	---



- (1) Internal Snap Ring
- (2) Lock Nut
- (3) PTO Shaft
- (4) Oil Seal
- (5) Collar
- (6) Slinger

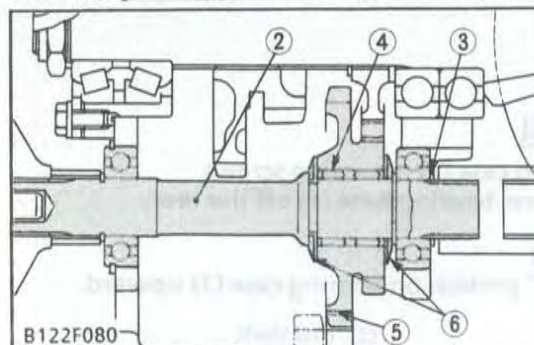
**PTO Drive Shaft [4WD TYPE]**

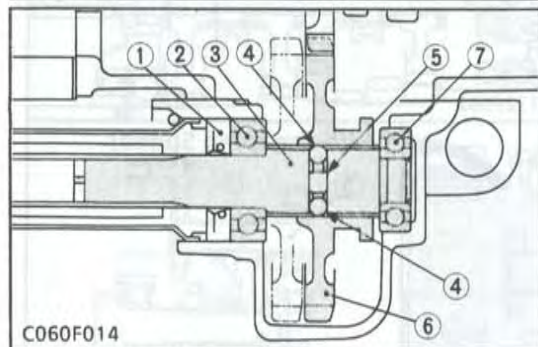
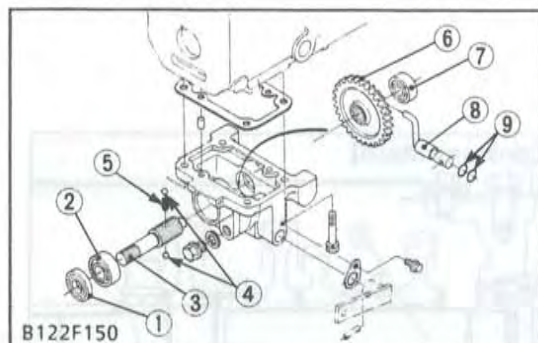
1. Remove the bearing retainer (1).
2. Remove the external snap ring (3) on the rear of PTO drive shaft (2), and tap out it to the front.

(When reassembling)

- Direct the groove side of thrust collars (6) to the 19-34T gear side.

- (1) Bearing Retainer
- (2) PTO Drive Shaft
- (3) External Snap Ring
- (4) Needle Bearing
- (5) 19-34T Gear
- (6) Thrust Collars





SERVICING

Front Drive Case

1. Removing front drive case.
2. Remove the oil seal (1).
3. Tap out the propeller shaft 1 (3) to the front.
4. Take out the shift gear (6).

(When reassembling)

- Replace the oil seal (1) with new one and apply grease to its inside.

Tightening torque	Front drive case mounting screws	77.5 to 90.2 N·m 7.9 to 9.2 kgf·m 57.1 to 66.5 ft·lbs
-------------------	----------------------------------	---

- | | |
|-----------------------|-------------------|
| (1) Oil Seal | (6) Shift Gear |
| (2) Ball Bearing | (7) Ball Bearing |
| (3) Propeller Shaft 1 | (8) Shift Lever |
| (4) Balls | (9) O-ring |
| (5) Spring | (10) Change Lever |

Checking Bearing

(See page S.3-21)

Gear Backlash

(See page S.3-20)

Clearance between Gear and Spline

(See page S.3-20)

Clearance between Shift Fork and Shifter Groove

(See page S.3-21)

Differential Gear Rotating Torque

1. Grip the spiral bevel pinion nut with a torque wrench and measure the rotating torque.
2. Adjust the torque by altering the differential bearing case shim thickness.

Shim thickness: 0.1 mm, 0.2 mm (0.0039 in., 0.0079 in.)

Differential gear rotating torque (Combined)	Factory spec.	4.41 to 9.32 N·m 0.45 to 0.95 kgf·m 3.25 to 6.87 ft·lbs
--	---------------	---



[2] L2650, L2950, L3450, L3650**[2]-1 CLUTCH HOUSING**

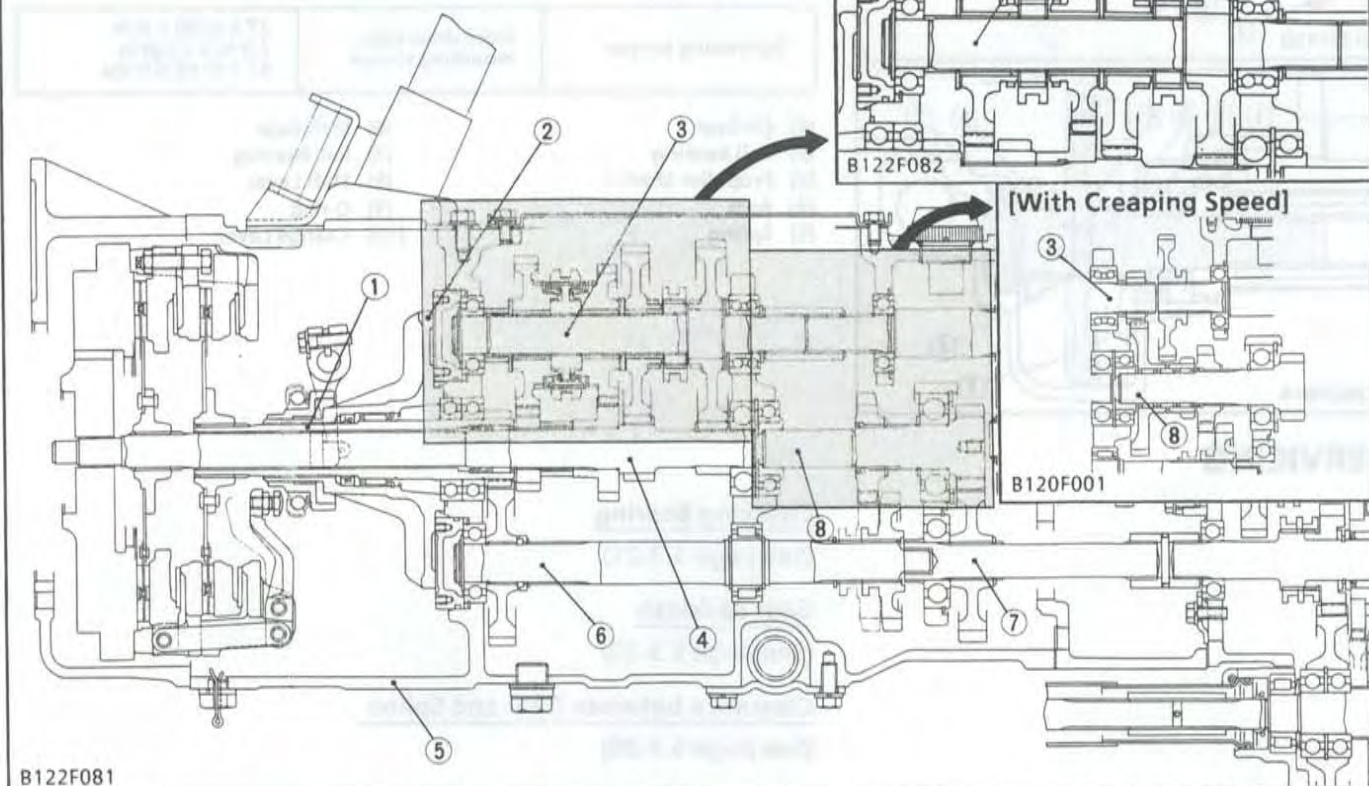
[Partial Synchromesh-Type and Dual Stage Clutch Type Transmission]

[Constant-Mesh]

B122F082

[With Creeping Speed]

B120F001



B122F081

(1) Gear Shaft
(2) Main Shaft Case

(3) Counter Shaft
(4) Main Shaft

(5) Clutch Housing
(6) PTO Counter Shaft 1

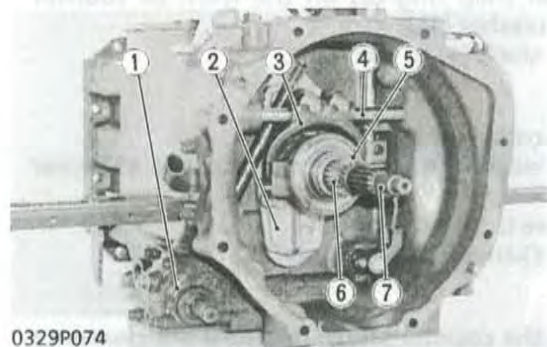
(7) PTO Counter Shaft 2
(8) PTO Gear Shaft

DISASSEMBLING AND ASSEMBLING

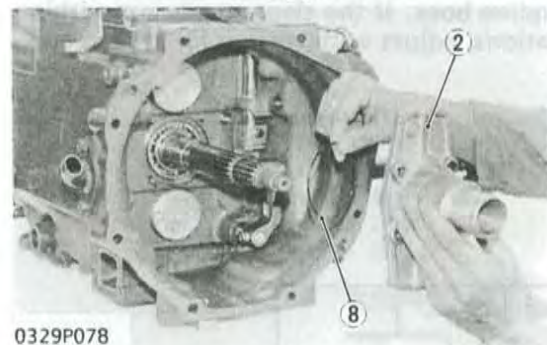
Separating Clutch Housing

(See page S.5-20.)

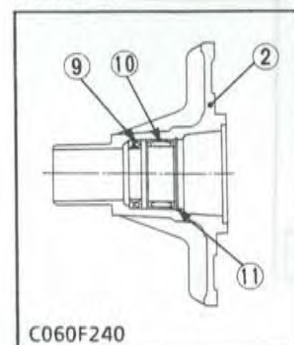
Main Shaft Case



0329P074



0329P078



C060F240

1. Remove the steering gear case (1).
2. Remove the release fork (3) mounting screws.
3. Draw out the clutch lever (4) to remove the release fork (3).
4. Remove the thrust ball bearing and release hub (5) as a unit.
5. Remove the main shaft case (2).
6. Remove the O-ring (8).

(When reassembling)

- Apply grease to O-ring (8) and install it to the clutch housing.
- Apply grease to the oil seal and needle bearing in the main shaft case (2).
- After reassembling the main shaft case, check that gear shaft (6) and main shaft (7) rotate respectively and that they have a little axial play.

Tightening torque	Main shaft case mounting screw	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft-lbs
-------------------	--------------------------------	---

(When replacing Bearing and Oil Seal in Main Shaft Case)

- Install the oil seal (9) as shown in the figure, noting its direction.
- Apply grease to needle bearing (10) and press-fit it up to the groove of internal snap ring (11).

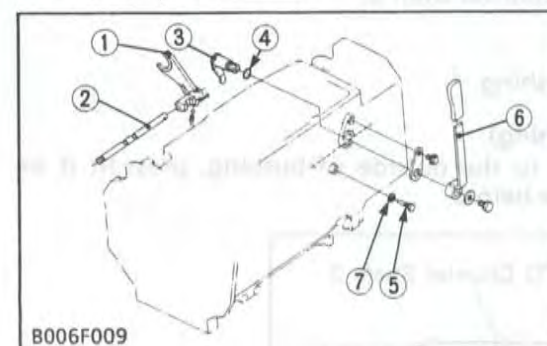
- | | |
|------------------------|-------------------------|
| (1) Steering Gear Case | (7) Main Shaft |
| (2) Main Shaft Case | (8) O-ring |
| (3) Release Fork | (9) Oil Seal |
| (4) Clutch Lever | (10) Needle Bearing |
| (5) Release Hub | (11) Internal Snap Ring |
| (6) Gear Shaft | |

Shift Fork and Shift Lever [Only with creeping Speed]

1. Remove the shift rod setting screw (5).
2. Screw in the M6 screw (6 mm, 0.236 in. DIA.) to the rear end of fork rod (2) and pull out it.
3. Remove the shift fork (1) and 42T gear.
4. Remove the shift lever (6) and shift arm (3) with O-ring (4).

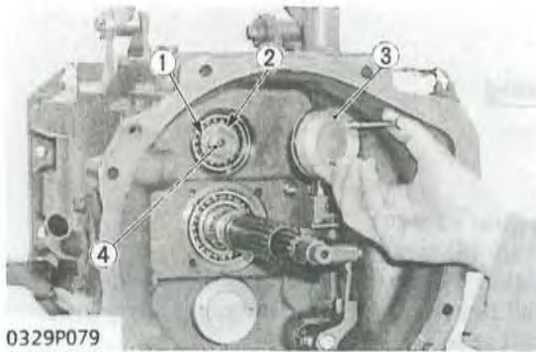
(When reassembling)

- Apply grease to O-ring (4) on shift arm (3).
- Set the sealing washer (7) to fork rod setting screw (5), and insert it to groove on fork rod (2).
- Be sure to align the alignment marks on the shift arm (3) and shift lever (6).

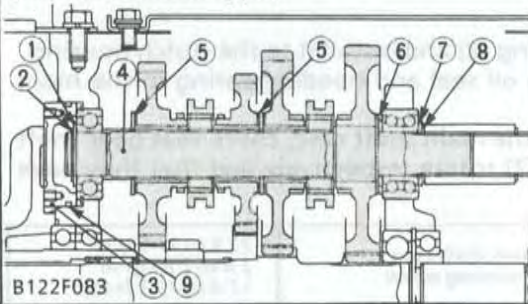


B006F009

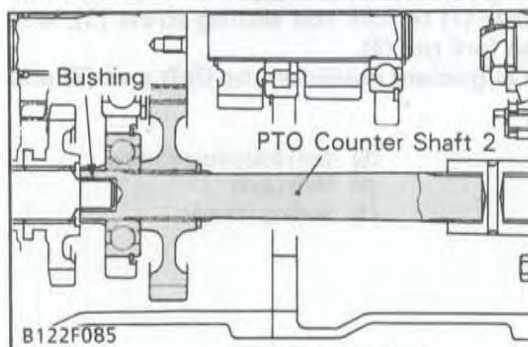
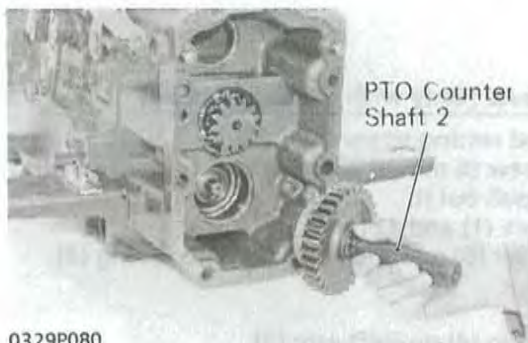
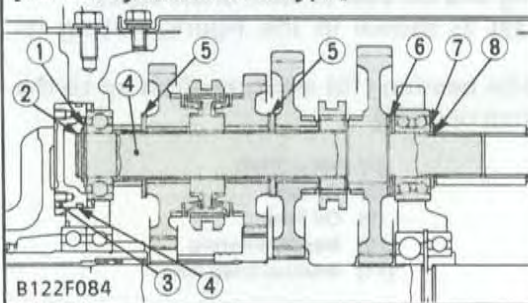
- | | |
|----------------|-----------------------------|
| (1) Shift Fork | (5) Shift Rod Setting Screw |
| (2) Shift Rod | (6) Shift Lever |
| (3) Shift Arm | (7) Sealing Washer |
| (4) O-ring | |



[Constant-mesh Type]



[Partial Synchromesh Type]



Counter Shaft

1. Remove the speed change cover.
2. Remove the bearing cover (3) using screws (6 mm, 0.236 in. DIA.).
3. Remove the external snap ring (2) on the front of counter shaft. Take out the washer (1).
4. Tap out the counter shaft (4) to the rear.

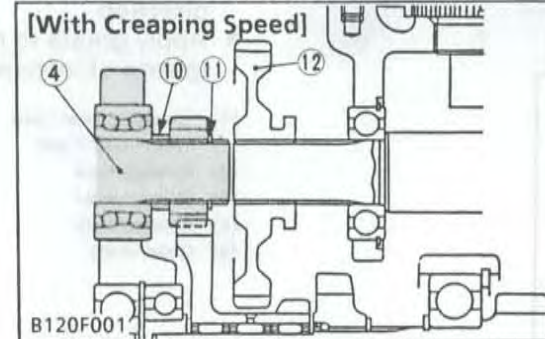
(When reassembling)

- Apply grease to the collars and inner races.
- Direct the grooved side of thrust collars (6) to the 45T gear side.
- Thrust collars (5) have both sided groove.
- Apply grease to the O-ring (9) on the bearing cover (3).

■ IMPORTANT

- After reassembling the counter shaft, measure the clearance between gear and spline boss. If the clearance is not within the factory specifications, adjust with washer (1). (See page S.3-34)

- | | |
|------------------------|-------------------------|
| (1) Washer | (7) Washer |
| (2) External Snap Ring | (8) External Snap Ring |
| (3) Bearing Cover | (9) O-ring |
| (4) Counter Shaft | (10) Collar |
| (5) Thrust Collar | (11) External Snap Ring |
| (6) Thrust Collar | (12) 42T Gear |



PTO Counter Shaft 2

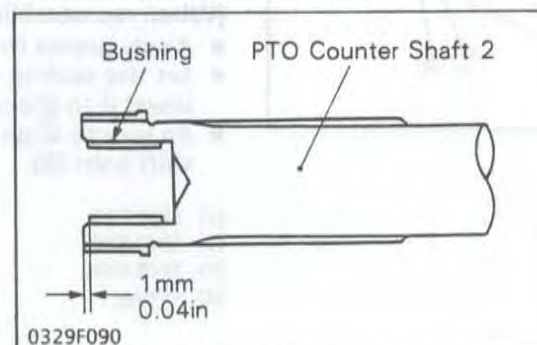
1. Draw out the PTO counter shaft 2.

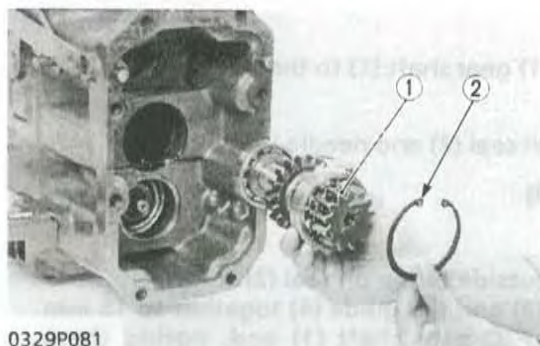
(When reassembling)

- Apply grease to bushing.

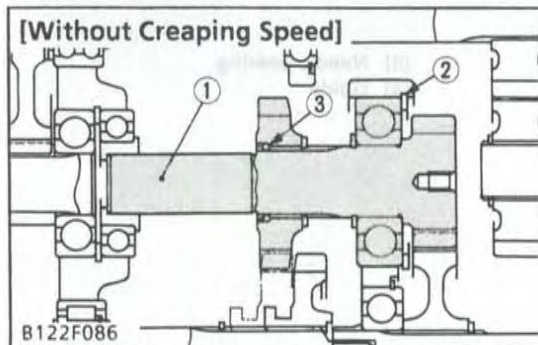
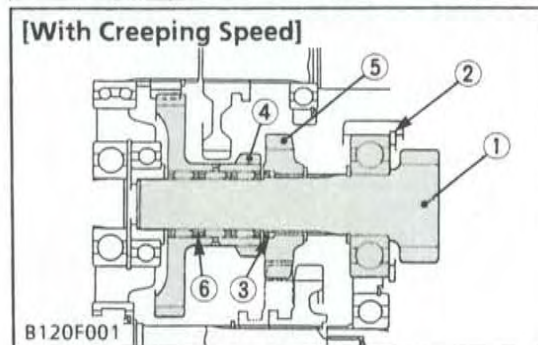
(When replacing bushing)

- After applying oil to the outside of bushing, press-fit it as shown in the figure below.





0329P081

[Without Creeping Speed]**[With Creeping Speed]****PTO Gear Shaft**

1. Remove the internal snap ring (2).
2. Draw out the PTO gear shaft (1) to the rear.
3. Pick the 17-45T gear (4) up. [Only with creeping speed.]

(When reassembling)

- Install the stopper (3) to the inside of 18T gear (5), and direct the longer boss side of 18T gear (5) to the rear.
- Apply grease to the needle bearings (6) on PTO gear shaft (1) for 17-45T gear (4). [Only with creeping speed.]

- (1) PTO Gear Shaft
(2) Internal Snap Ring
(3) Stopper

- (4) 17-45T Gear
(5) 18T Gear
(6) Needle Bearing

Main Shaft

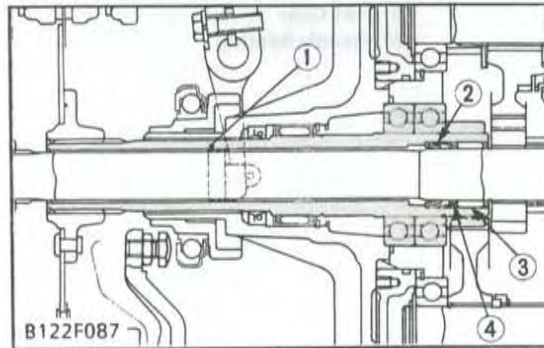
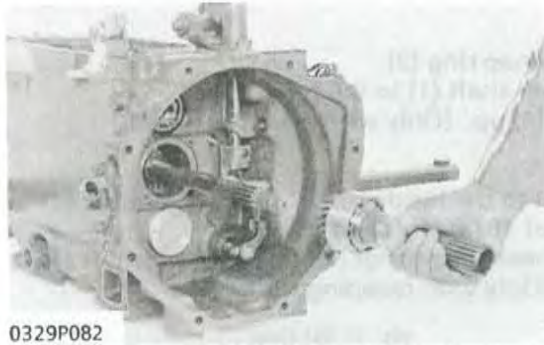
1. Remove the internal snap ring (2).
2. Tap out the main shaft (1) to the rear.

(When reassembling)

- Install the stopper (3) to the front of 18T gear.

• Apply grease to the

- (1) Main Shaft
(2) Internal Snap Ring
(3) Stopper



16T (17T) Gear Shaft

1. Draw out the 16T (17T) gear shaft (1) to the front.

(When reassembling)

- Apply grease to the oil seal (2) and needle bearing (3).

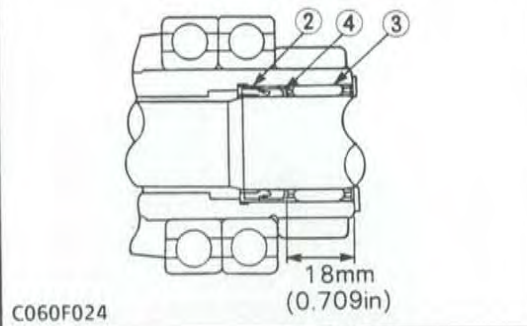
(When replacing oil seal)

■ IMPORTANT

- Apply grease to the outside of the oil seal (2).
- Press-fit the oil seal (2) and the guide (4) together to 18 mm (0.709 in.) inside of PTO gear shaft (1) end, noting them direction.

- (1) PTO Gear Shaft
(2) Oil Seal

- (3) Needle Bearing
(4) Guide



Main Shaft

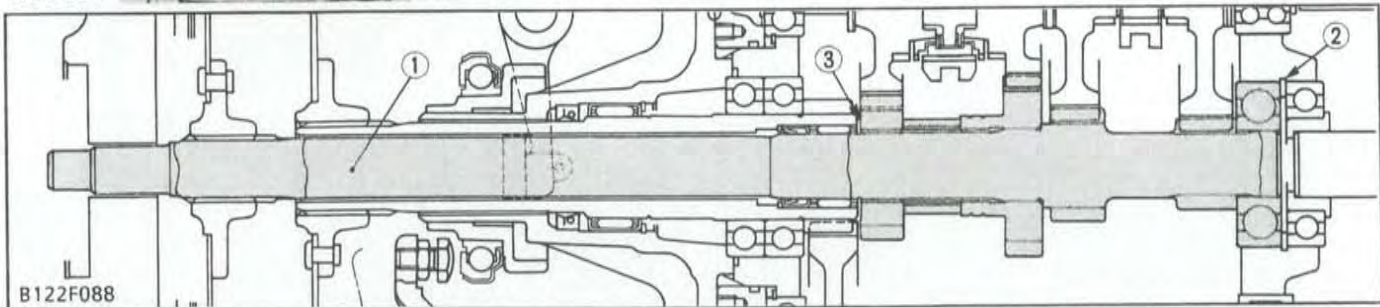
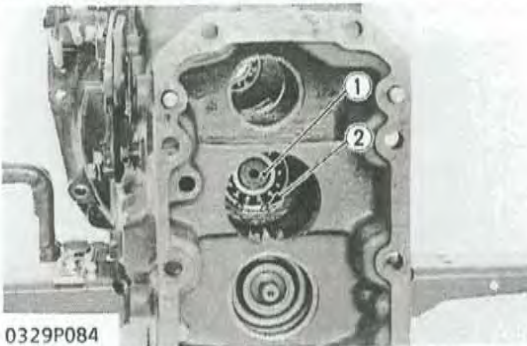
1. Remove the internal snap ring (2).
2. Tap out the main shaft (1) to the rear.

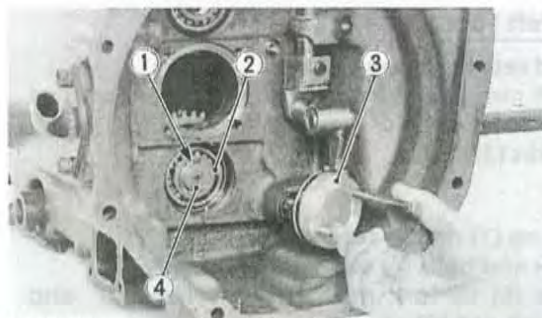
(When reassembling)

- Install the copper washer (3) to the front of 18T gear.

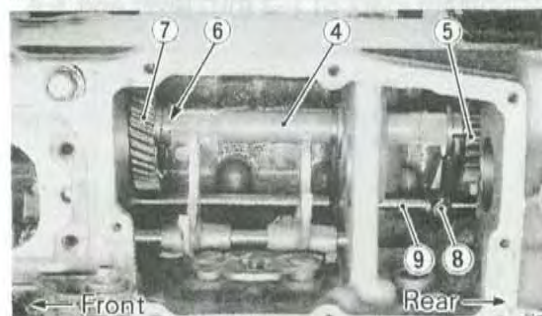
- (1) Main Shaft
(2) Internal Snap Ring

- (3) Copper Washer

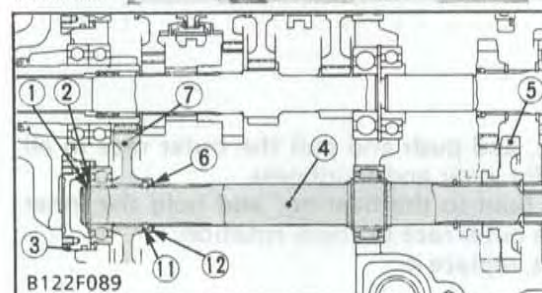




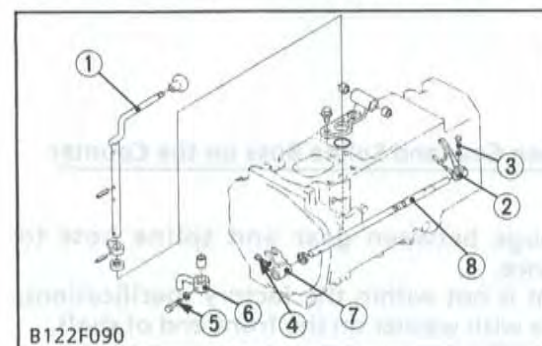
0329P086



0329P087



B122F089



B122F090

PTO Counter Shaft 1

1. Remove the bearing cover (3) using screws (6 mm, 0.236 in. DIA.), and remove the external snap ring (1) and washer (2).
2. Slide the external snap ring (6) on the rear of 39T (37T) gear (7) to the rear. Take out the set collar (11).
3. Tap the PTO counter shaft 1 (4) to the front to remove the 23T gear (5).
4. Tap out the PTO counter shaft 1 (4) to the rear.

(When reassembling)

- Install the collar cover (12) so as to prevent the set collar (11) from falling off.
- When tap the PTO counter shaft 1 (4) to the front, use the soft hammer to prevent damage of the PTO counter shaft 1 (4).

- | | |
|-------------------------|---------------------|
| (1) External Snap Ring | (7) 39T or 37T Gear |
| (2) Washer | (8) PTO Shift Fork |
| (3) Bearing Cover | (9) PTO Fork Rod |
| (4) PTO Counter Shaft 1 | (10) Shifter |
| (5) 23T Gear | (11) Set Collar |
| (6) External Snap Ring | (12) Collar Cover |

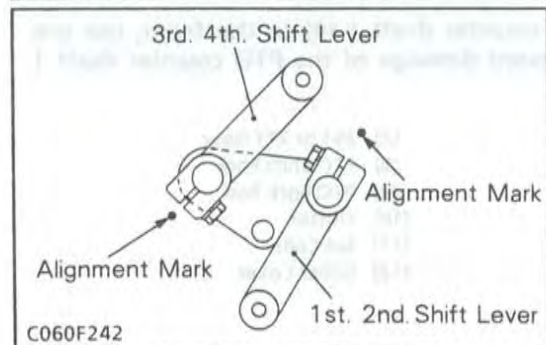
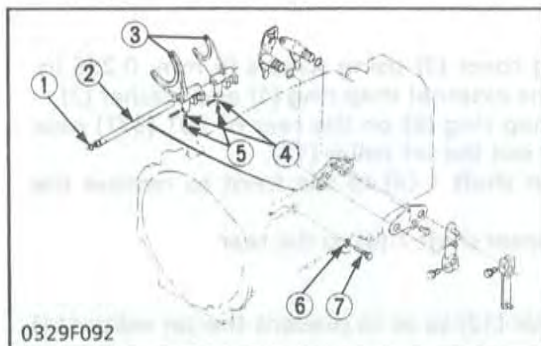
PTO Shift fork and Lever

1. Remove the mounting screws (3), (4), (5) of the arm (6), shifter (7) and shift fork (2).
2. Pull out the PTO shift lever (1).
3. Tap out the PTO fork rod (8) to the front and take out the PTO shift fork (2).

(When reassembling)

Tightening torque	Shift fork and shifter mounting screw	9.81 to 11.28 N·m 1.00 to 1.15 kgf·m 7.23 to 8.32 ft·lbs
-------------------	---------------------------------------	--

- | | |
|---------------------|--------------|
| (1) PTO Shift Lever | (5) Screw |
| (2) Shift Fork | (6) Arm |
| (3) Screw | (7) Shifter |
| (4) Screw | (8) Fork Rod |



Main Speed Change Shift Fork

1. Remove the fork rod setting screw (7).
2. Screw a M6 screw (6 mm, 0.236 in. DIA.) to the front end of fork rod (2) and pull out it.
3. Remove the shift forks (3).

(When reassembling)

- Apply grease to O-ring (1) on the fork rod (2).
- Install the springs (5) and balls (4) to shift fork firmly.
- Set the seal washer (6) to fork rod setting screw (7), and insert it to hole on fork rod (2).
- Be sure to align the alignment mark of 1-2 shift lever and 3-4 shift lever.

- | | |
|----------------|-------------------|
| (1) O-ring | (5) Spring |
| (2) Fork Rod | (6) Seal Washer |
| (3) Shift Fork | (7) Setting Screw |
| (4) Ball | |

SERVICING



Checking Bearing

1. Hold the inner race, and push and pull the outer race in all directions to check for wear and roughness.
2. Apply transmission fluid to the bearing, and hold the inner race. Then, turn the outer race to check rotation.
3. If there is any defect, replace it.



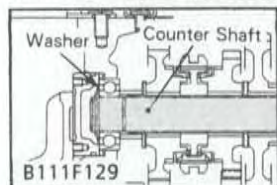
Side Clearance between Gear and Spline Boss on the Counter Shaft

1. Insert a feeler gauge between gear and spline boss to measure the clearance.
2. If the measurement is not within the factory specifications, adjust the clearance with washer on the front end of shaft.

(Reference)

- Thickness of washers:
 - 2.0 mm (0.079 in.) [Code No. 34150-21561]
 - 2.3 mm (0.091 in.) [Code No. 38450-23781]
 - 2.5 mm (0.098 in.) [Code No. 38450-23791]

Side clearance between gear and spline boss	Factory spec.	0.1 to 0.3 mm 0.004 to 0.012 in.
---	---------------	-------------------------------------





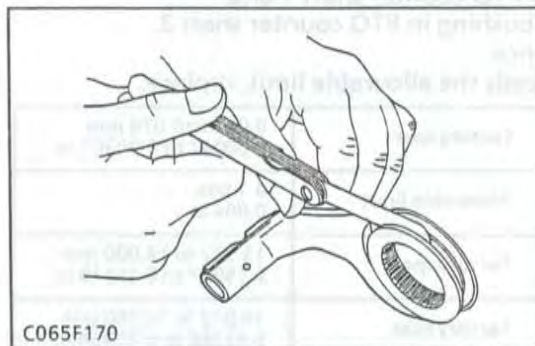
Gear Backlash

1. Set a dial gauge (lever type) with its finger on the gear tooth surface.
2. Move the gear to measure the backlash.
3. If the measurement exceeds the allowable limit, replace.

■ IMPORTANT

- Measure the backlash at three equally spaced positions on the gear, and obtain the average.

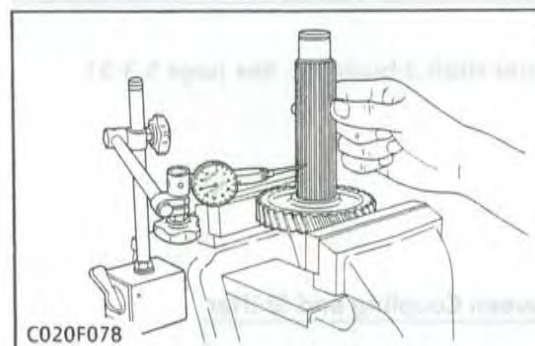
Gear backlash	Factory spec.	0.1 to 0.2 mm 0.004 to 0.008 in.
	Allowable limit	0.5 mm 0.020 in.



Clearance between Shift Fork and Shifter Groove

1. Place the shift fork in the shifter groove to measure the clearance.
2. If the measurement exceeds the allowable limit, replace them.

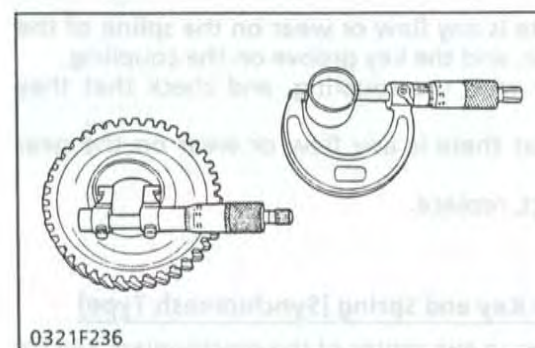
Clearance between shift fork and shifter groove	Factory spec.	0.20 to 0.40 mm 0.008 to 0.016 in.
	Allowable limit	0.8 mm 0.031 in.



Clearance between Gear and Spline

1. Secure the gear in a vise.
2. Set a dial gauge (lever type) with its finger on the spline.
3. Move the shaft to measure the clearance.
4. If the clearance exceeds the allowable limit, replace.

Clearance between gear and spline	Factory spec.	0.030 to 0.078 mm 0.0012 to 0.0031 in.
	Allowable limit	0.2 mm 0.008 in.



Clearance between Gear and Inner Race (or Shaft)

1. Measure the gear I.D. and inner race (or shaft) O.D.
2. Calculate the clearance.
3. If the clearance exceeds the allowable limit, replace.

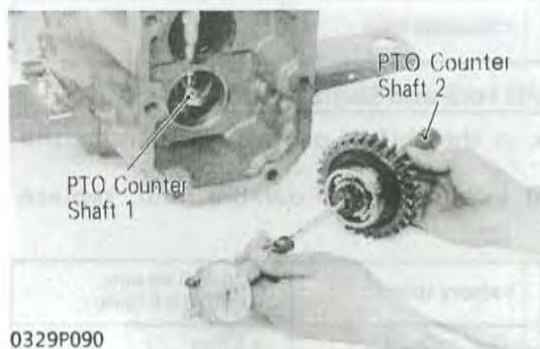
Clearance between gear and counter shaft	Factory spec.	0.020 to 0.055 mm 0.0008 to 0.0022 in.
	Allowable limit	0.1 mm 0.004 in.
45T gear I.D.	Factory spec.	32.025 to 32.050 mm 1.2608 to 1.2618 in.
Counter shaft O.D.	Factory spec.	31.995 to 32.005 mm 1.2597 to 1.2600 in.
Clearance between gears and inner races on counter shaft or PTO counter shaft	Factory spec.	0.017 to 0.058 mm 0.0007 to 0.0023 in.
	Allowable limit	0.1 mm 0.004 in.
Gear I.D.	Factory spec.	32.025 to 32.050 mm 1.2608 to 1.2618 in.
Inner Race O.D.	Factory spec.	31.992 to 32.008 mm 1.2597 to 1.2601 in.



C060P101

Eccentricity of Main Shaft and 16T (17T) Gear Shaft

1. Check the eccentricity of main shaft and that it does not contact with 16T (17T) gear shaft while turning the front end of main shaft.
2. If the eccentricity is large or main shaft contacts with 16T (17T) gear shaft, replace the main shaft.



0329P090

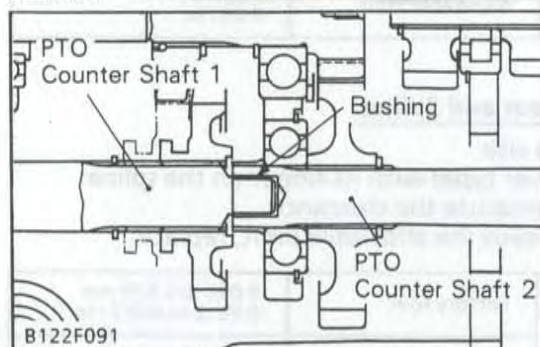
Clearance between PTO Counter Shaft 1 and Bushing

1. Measure the O.D. of PTO counter shaft 1 end.
2. Measure the I.D. of bushing in PTO counter shaft 2.
3. Calculate the clearance.
4. If the clearance exceeds the allowable limit, replace.

Clearance between bushing and shaft end	Factory spec.	0.012 to 0.078 mm 0.00047 to 0.00307 in.
	Allowable limit	0.1 mm 0.004 in.
Shaft end O.D.	Factory spec.	13.982 to 14.000 mm 0.55047 to 0.55118 in.
Bushing I.D.	Factory spec.	14.012 to 14.060 mm 0.55165 to 0.55354 in.

(Reference)

- Replacing PTO counter shaft 2 bushing: See page S.3-31.

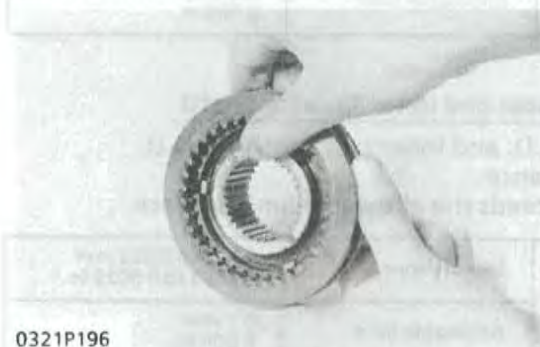


B122F091

Checking Contact between Coupling and Shifter

[Synchronesh Type]

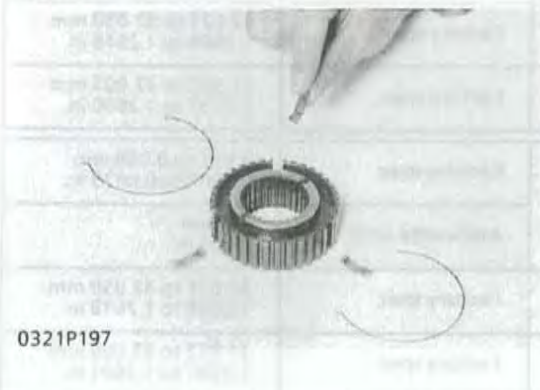
1. Check to see if there is any flaw or wear on the spline of the coupling and shifter, and the key groove on the coupling.
2. Engage the shifter with the coupling, and check that they slide smoothly.
3. Similarly, check that there is any flaw or wear on the gear splines.
4. If there is any defect, replace.



0321P196

Flaw on Synchronizer Key and Spring [Synchronesh Type]

1. Check the projection in the center of the synchronizer key for wear.
2. Check the spring for fatigue or wear on the area where the spring contacts with the keys.
3. If there is any defect, replace.



0321P197



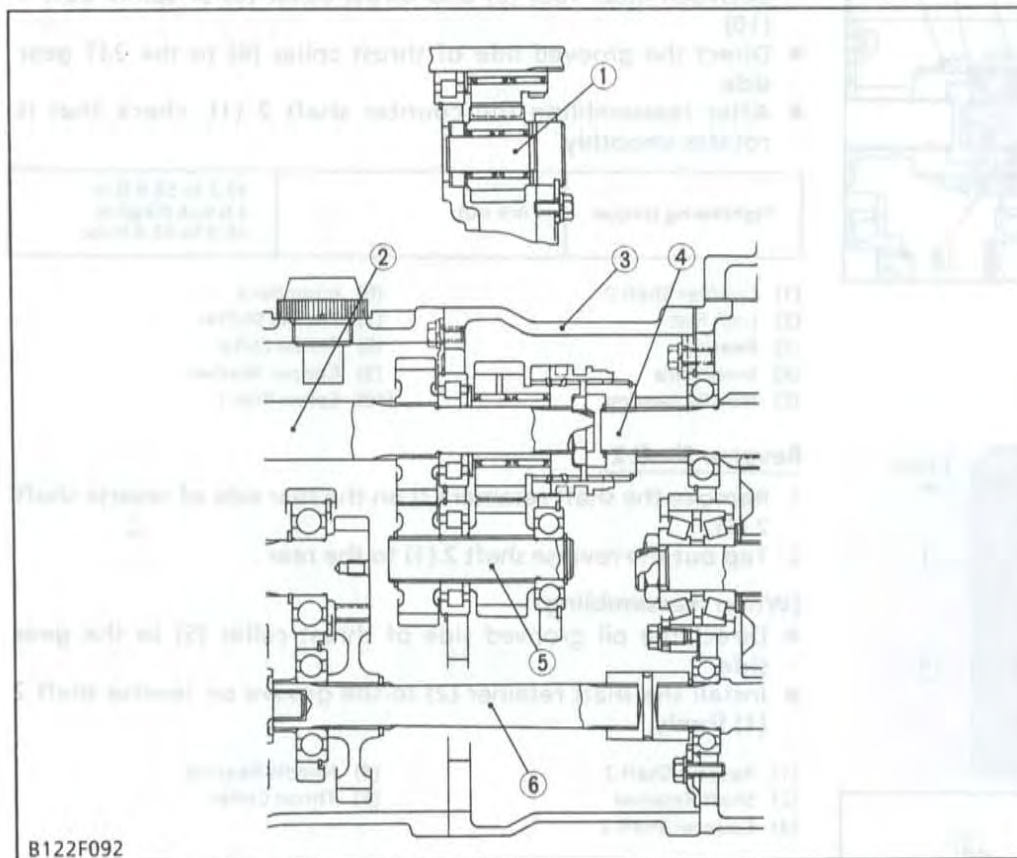
0321P198

Side Clearance between Synchronizer Ring and Gear (in Contact) [Synchromesh Type]

1. Press the synchronizer ring against the tapered portion of the gear, and measure the side clearance.
2. Apply a thin film of red lead to the tapered portion, press the ring against it by hand, rub them together a few times, and check the contact.
3. Check the tooth surface and key grooves of the ring for wear.
4. If the side clearance exceeds the allowable limit or if there is any defect, replace the synchronizer ring.

Side clearance	Allowable limit	0.35 mm 0.0138 in.
Contact condition on tapered portion	Allowable limit	More than 80 %

[2]-2 MID CASE



B122F092

- (1) Reverse Shaft
- (2) Counter Shaft 2
- (3) Mid Case
- (4) 13T Gear Shaft
- (5) Reverse Shaft 1
- (6) PTO Counter Shaft 2

DISASSEMBLING AND ASSEMBLING

Separating Mid Case

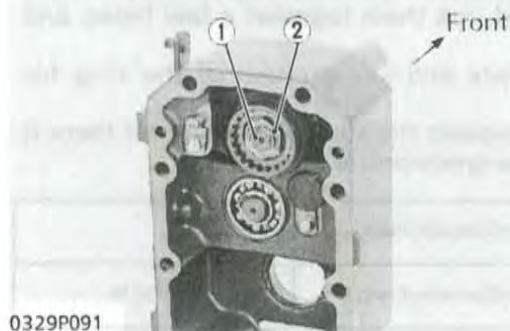
(See page S.5-19.)

Counter Shaft 2

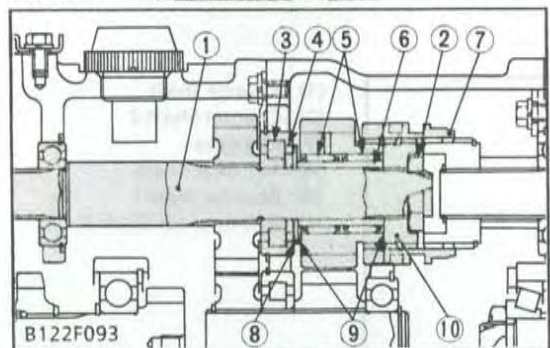
1. Remove the stake of lock nut (2) and take out it.
2. Tap out the counter shaft 2 (1) to the front.

(When reassembling)

- Be sure to direct the chamfered side of shuttle shifter (7) to the 23T gear side.
- Be sure to install the inner race (4) of bearing (3).
- Two types of needle bearings (5) are used for 23T gear. Assemble the shorter one to the bearing (3) side.
- Install the bearing (3) so that snap ring thereon may face outward as shown in the figure.
- Install the copper washers (9) so that they may not fall between inner race (6) and thrust collar (8) or spline boss 1 (10).
- Direct the grooved side of thrust collar (8) to the 23T gear side.
- After reassembling the counter shaft 2 (1), check that it rotates smoothly.



0329P091



B122F093

Tightening torque	Lock nut	39.2 to 58.8 N·m 4.0 to 6.0 kgf·m 28.9 to 43.4 ft·lbs
-------------------	----------	---

- | | |
|---------------------|---------------------|
| (1) Counter Shaft 2 | (6) Inner Race |
| (2) Lock Nut | (7) Shuttle Shifter |
| (3) Bearing | (8) Thrust Collar |
| (4) Inner Race | (9) Copper Washer |
| (5) Needle Bearing | (10) Spline Boss 1 |

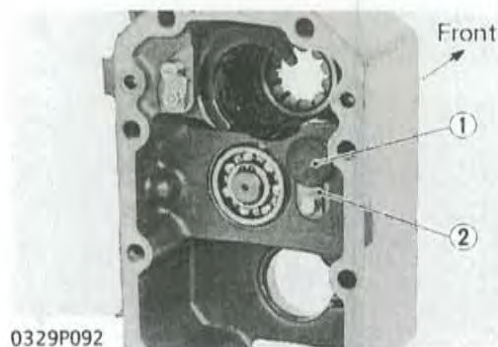
Reverse Shaft 2

1. Remove the shaft retainer (2) on the rear side of reverse shaft 2 (1).
2. Tap out the reverse shaft 2 (1) to the rear.

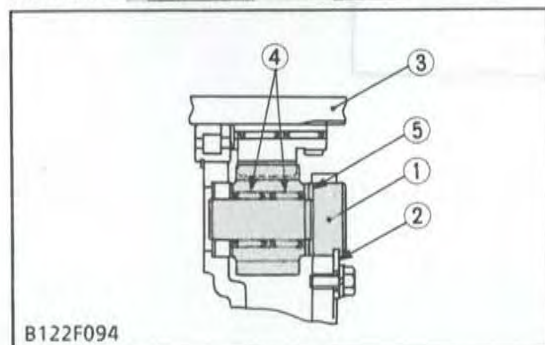
(When reassembling)

- Direct the oil grooved side of thrust collar (5) to the gear side.
- Install the shaft retainer (2) to the groove on reverse shaft 2 (1) firmly.

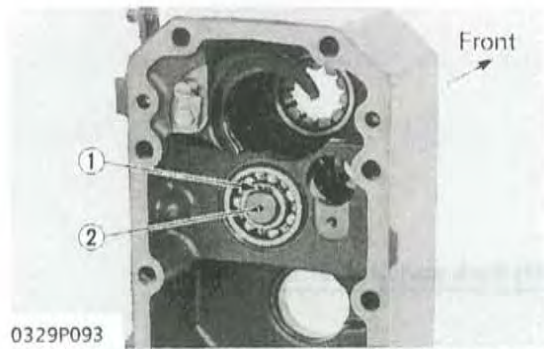
- | | |
|---------------------|--------------------|
| (1) Reverse Shaft 2 | (4) Needle Bearing |
| (2) Shaft Retainer | (5) Thrust Collar |
| (3) Counter Shaft 2 | |



0329P092



B122F094



Reverse Shaft 1

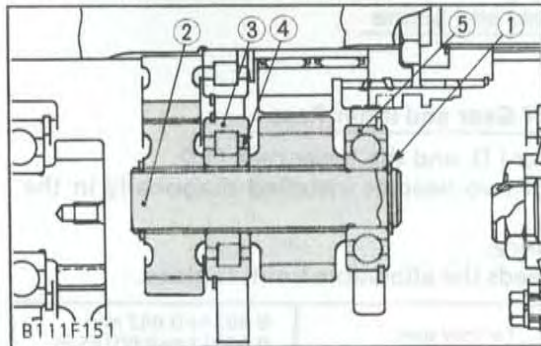
1. Remove the external snap ring (1) on the rear side of reverse shaft 1 (2).
2. Tap out the reverse shaft 1 (2) to the front.

(When reassembling)

- Be sure to install the inner race (4) of bearing (3).
- Install the bearings (3), (5) so that the snap ring on them may direct to outside as shown in figure.

- (1) External Snap Ring
(2) Reverse Shaft 1
(3) Bearing

- (4) Inner Race
(5) Bearing

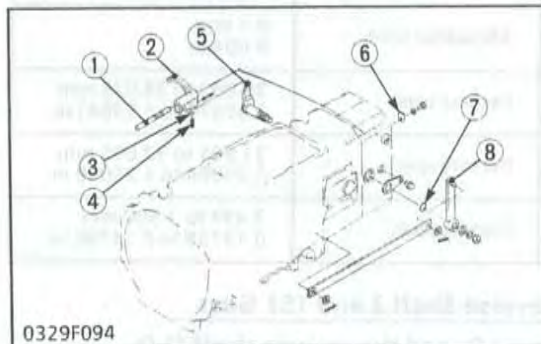


Shuttle Shift Fork

1. Remove the shuttle fork rod setting plate (6).
2. Tap out the shuttle fork rod (1) to the front.
3. Remove the shuttle arm mounting screw and take out the shuttle arm (5).

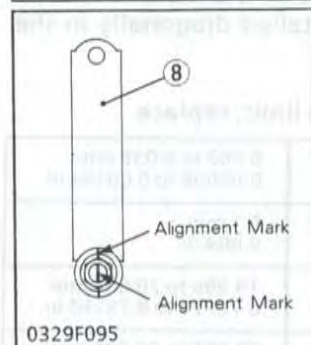
(When reassembling)

- Apply grease to O-ring (7) on shuttle arm (5).
- Be sure to align the alignment marks on the shuttle arm (5) and shuttle lever (8).
- Install the spring (4) and ball (3) to shift fork firmly.



- (1) Shuttle Fork Rod
(2) Shuttle Shift Fork
(3) Ball
(4) Spring

- (5) Shuttle Arm
(6) Setting Plate
(7) O ring
(8) Shuttle Lever



SERVICING

Checking Bearing

(See page S.3-34.)

Gear Backlash

(See page S.3-35.)

Clearance between Shift Fork and Shifter Groove

(See page S.3-35.)

Clearance between Gear and Spline

(See page S.3-35.)

Clearance between 23T Gear and Inner Race

1. Measure the 23T gear I.D. and the inner race O.D.
2. Measure the O.D. of two needles installed diagonally in the needle bearing.
3. Calculate the clearance.
4. If the clearance exceeds the allowable limit, replace.

Clearance between 23T gear and inner race	Factory spec	0.003 to 0.042 mm 0.00012 to 0.00165 in.
	Allowable limit	0.1 mm 0.004 in.
23T gear I.D.	Factory spec	39.009 to 39.025 mm 1.53578 to 1.53641 in.
Inner race O.D.	Factory spec	31.995 to 32.005 mm 1.25964 to 1.26008 in.
Needle O.D.	Factory spec	3.494 to 3.500 mm 0.13756 to 0.13780 in.

Clearance between Reverse Shaft 2 and 15T Gear

1. Measure the 15T gear I.D. and the reverse shaft O.D.
2. Measure the O.D. of two needles installed diagonally in the needle bearing.
3. Calculate the clearance.
4. If the clearance exceeds the allowable limit, replace.

Clearance between reverse shaft 2 and 15T gear	Factory spec	0.002 to 0.036 mm 0.00008 to 0.00142 in.
	Allowable limit	0.1 mm 0.004 in.
Reverse shaft 2 O.D.	Factory spec	19.996 to 20.005 mm 0.78724 to 0.78760 in.
15T gear I.D.	Factory spec	26.007 to 26.020 mm 1.02390 to 1.02441 in.
Needle O.D.	Factory spec	2.994 to 3.000 mm 0.11787 to 0.11811 in.

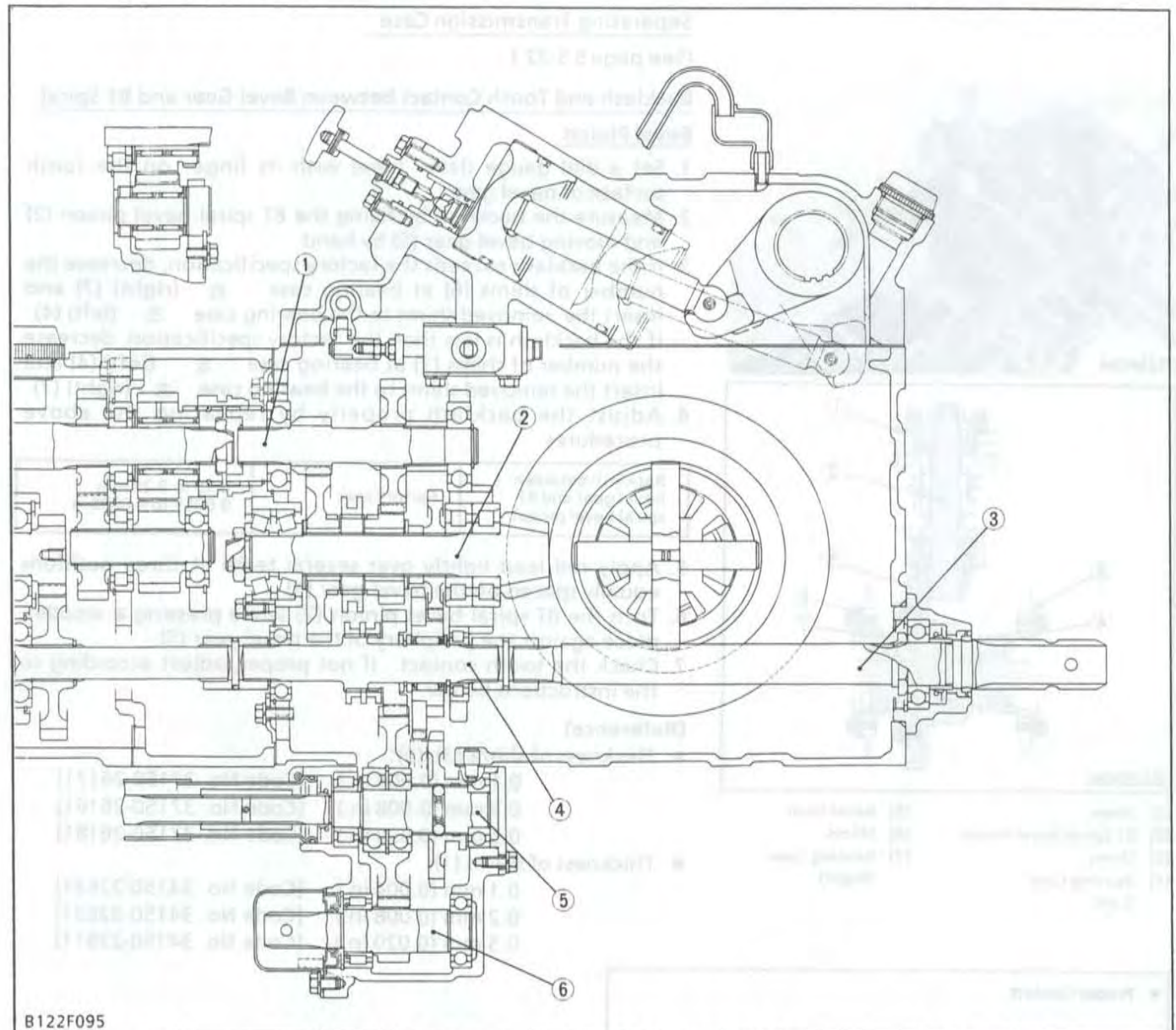


0329P094



0329P095

[2]-3 TRANSMISSION CASE



(1) 13T Gear Shaft
(2) Spiral Bevel Pinion

(3) PTO Shaft
(4) PTO Drive Shaft

(5) Front Drive Shaft

(6) Mid PTO Shaft

CHECKING AND ADJUSTING

Separating Transmission Case

(See page S.5-22.)

Backlash and Tooth Contact between Bevel Gear and 8T Spiral

Bevel Pinion

1. Set a dial gauge (lever type) with its finger on the tooth surface of bevel gear.
2. Measure the backlash by fixing the 8T spiral bevel pinion (2) and moving bevel gear (5) by hand.
3. If the backlash exceeds the factory specification, decrease the number of shims (6) at bearing case 右 (right) (7) and insert the removed shims to the bearing case 左 (left) (4). If the backlash is less than the factory specification, decrease the number of shims (3) at bearing case 左 (left) (4) and insert the removed shims to the bearing case 右 (right) (7).
4. Adjust the backlash properly by repeating the above procedures.

Backlash between bevel gear and 8T spiral bevel pinion	Factory spec.	0.15 to 0.25 mm 0.0059 to 0.0098 in
--	---------------	--

5. Apply red lead lightly over several teeth at three positions equally spaced on the bevel gear (5).
6. Turn the 8T spiral bevel pinion (2) while pressing a wooden piece against the periphery of the bevel gear (5).
7. Check the tooth contact. If not proper, adjust according to the instructions below.

(Reference)

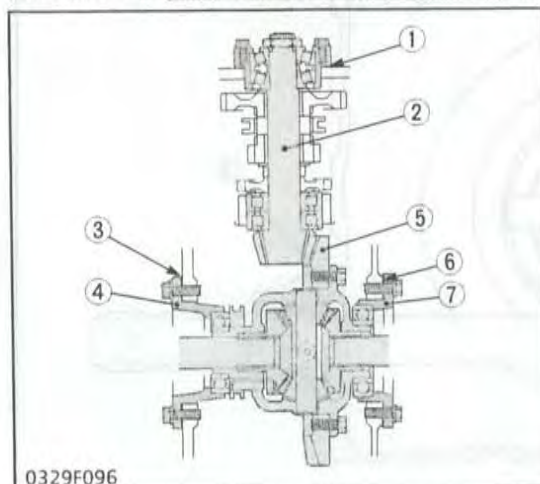
- Thickness of shims (3), (6):

0.1 mm (0.004 in.)	[Code No. 37150-26171]
0.2 mm (0.008 in.)	[Code No. 37150-26161]
0.5 mm (0.020 in.)	[Code No. 37150-26181]
- Thickness of shims (1):

0.1 mm (0.004 in.)	[Code No. 34150-22631]
0.2 mm (0.008 in.)	[Code No. 34150-22621]
0.5 mm (0.020 in.)	[Code No. 34150-22611]



0329P094



0329F096

- | | |
|----------------------------|--------------------------|
| (1) Shims | (5) Bevel Gear |
| (2) 8T Spiral Bevel Pinion | (6) Shims |
| (3) Shims | (7) Bearing Case (Right) |
| (4) Bearing Case (Left) | |

• Proper Contact



More than 35% red lead contact area on the gear tooth surface. The center of tooth contact at 1/3 of the entire width from the small end.

C065F198

• Heel Contact



• Tip Contact



0329F097

Replace adjusting shim (1) with thinner one to move the bevel pinion shaft backward. And place the left side shim (3) to the right to move the bevel gear rightward. Repeat above until the proper tooth contact and backlash are achieved.

• Toe Contact



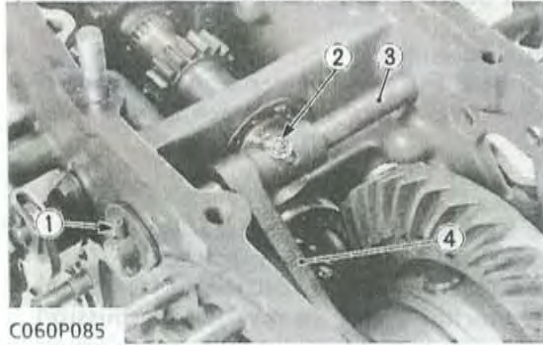
• Base Contact



0329F098

Replace adjusting shim (1) with thicker one to move the bevel pinion shaft forward. And place the right side shim (6) to the left to move the bevel gear leftward. Repeat above until the proper tooth contact and backlash are achieved.

DISASSEMBLING AND ASSEMBLING

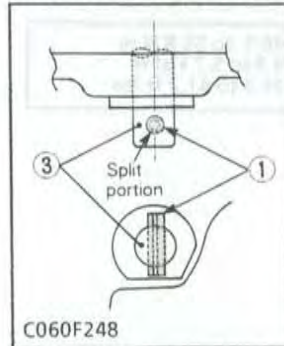


Differential Lock Shift Fork

1. Tap out the spring pin (1).
2. Remove the cotter pin and take out the clevis pin (2).
3. Draw out the differential lock fork shaft (3) and take out the differential lock shift fork (4).

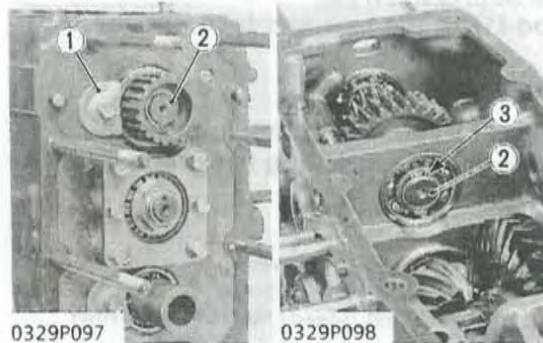
(When reassembling)

- Apply grease to the left and right oil seals on the transmission case.
- Insert the clevis pin (2) from under and install the washer and cotter pin.
- Tap in the spring pin (1) so that its split portion may face outward as shown in the figure.



(1) Spring Pin
(2) Clevis Pin

(3) Differential Lock Fork Shaft
(4) Differential Lock Shift Fork

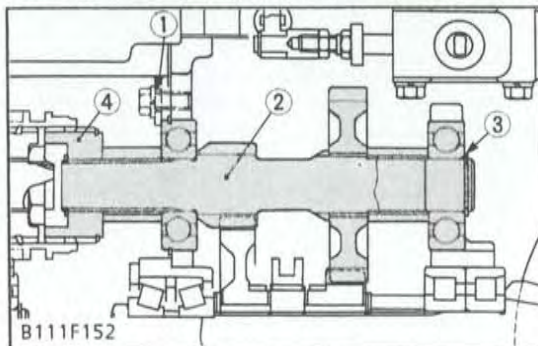


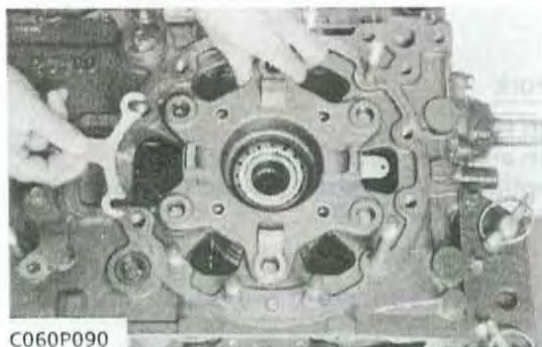
13T Gear Shaft

1. Remove the bearing retainer (1) on the front of 13T gear shaft (2).
2. Remove the external snap ring (3) on the rear of 13T gear shaft (2).
3. Tap out the 13T gear shaft to the front.

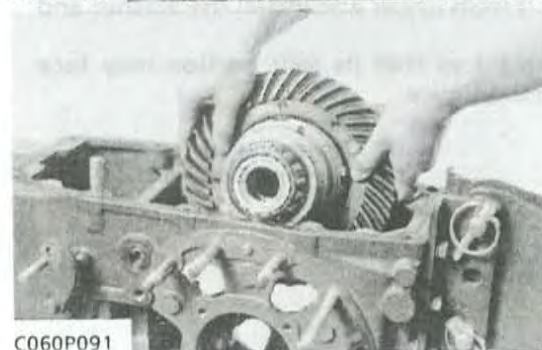
(1) Bearing Retainer
(2) 13T Gear Shaft

(3) External Snap Ring
(4) Spline Boss 2





C060P090



C060P091

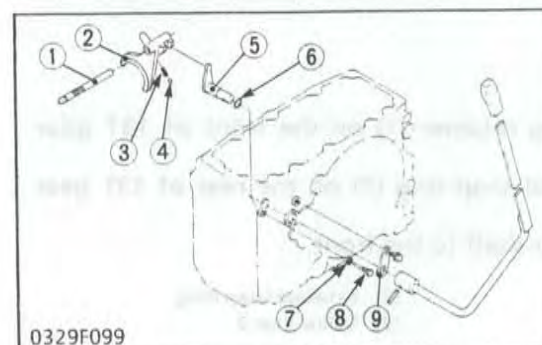
Differential Gear Assembly

1. Remove the differential bearing cases, noting the number of left and right shims.
2. Take out the differential assembly.
3. Check the spiral bevel gear for wear or damage. If it is no longer serviceable, replace it. Then, also replace spiral bevel pinion.

(When reassembling)

- Be sure to install the differential bearing case marked 右 in the right side, and marked 左 in the left side.
- Be sure to align the ball hole portion on the differential bearing case with the machined surface on the transmission case.

Tightening torque	Differential bearing case mounting bolts	48.1 to 55.8 N·m 4.9 to 5.7 kgf·m 35.5 to 41.2 ft-lbs
-------------------	--	---



0329F099

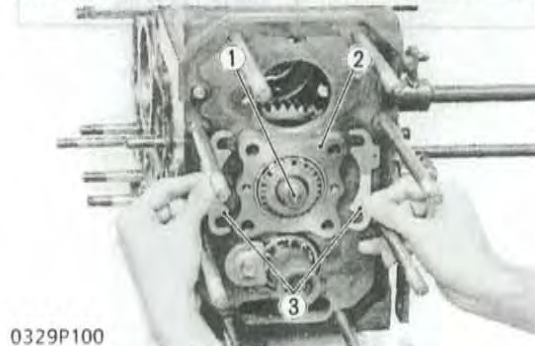
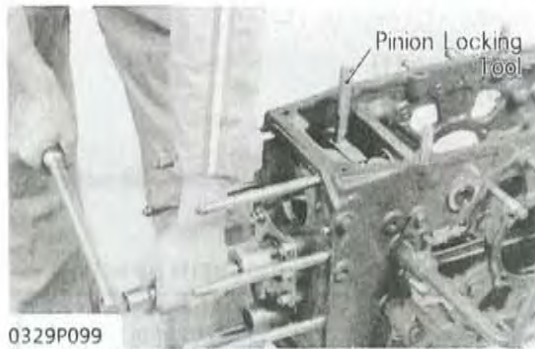
Hi-Lo Range Shift Fork

1. Remove the fork rod setting screw (8).
2. Tap out the fork rod (1) to the rear and take out the shift fork (2).

(When reassembling)

- Install the spring (3) and ball (4) to shift fork firmly.
- Set the seal washer (7) to fork rod setting screw and insert it to hole on fork rod.

- | | |
|--------------------------|-------------------------------|
| (1) Hi-Lo Range Fork Rod | (6) O-ring |
| (2) Shift Fork | (7) Seal Washer |
| (3) Spring | (8) Setting Screw |
| (4) Ball | (9) Speed Change Arm Retainer |
| (5) Hi-Lo Range Arm | |



Spiral Bevel Pinion

1. Remove the stake of lock nut (4).
2. Set the pinion locking tool (Code No. 07916-52311), and remove the lock nut.
3. Remove the pinion bearing retainer (7).
4. Tap the spiral bevel pinion (1) to the front.
5. Take the pinion bearing case shims (3), noting the number of them.
6. Remove the pinion bearing case (2) with a puller.
7. Take out the distance collar (5).
8. Hammer out the spiral bevel pinion (1) to the rear.

Tightening torque	Lock nut	147 to 196 N·m 15 to 20 kgf·m 109 to 145 ft·lbs
-------------------	----------	---

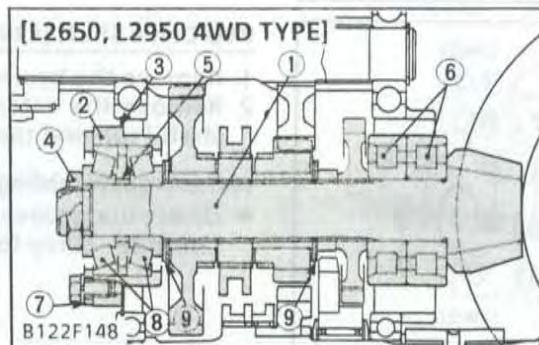
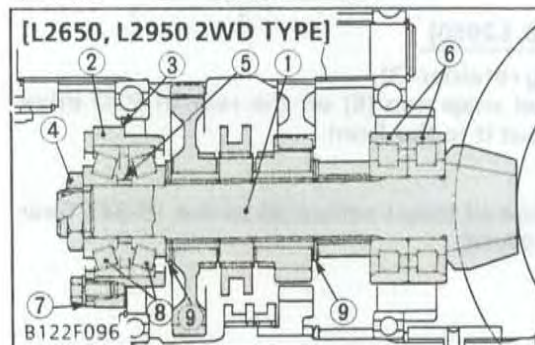
※

NOTE

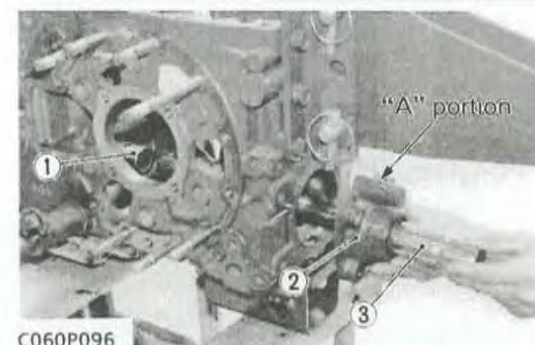
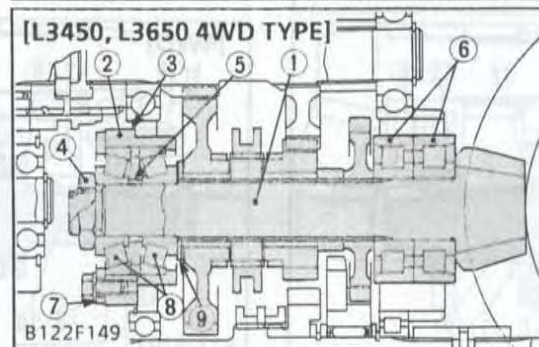
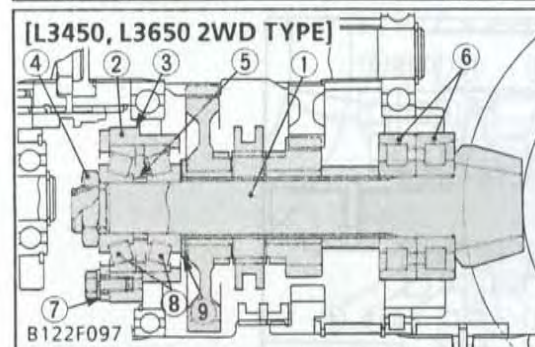
- The ball bearings are used for the following tractor serial No.

L2650 (2WD) : 19999 and below

L2650 (4WD) : 50001 to 59999



- (1) Spiral Bevel Pinion
- (2) Pinion Bearing Case
- (3) Shims
- (4) Lock Nut
- (5) Distance Collar
- (6) Bearings ※
- (7) Pinion Bearing Retainer
- (8) Bearings
- (9) Thrust Washers



PTO Bearing Case

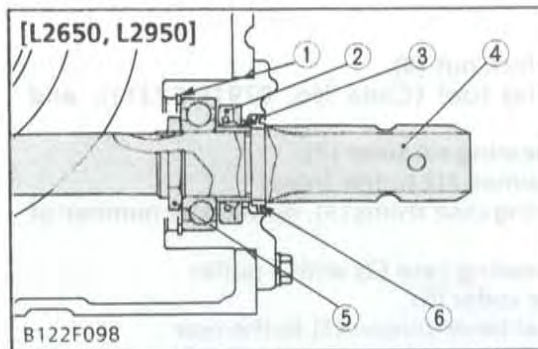
1. Remove the bearing case (2) mounting screws, and draw out the PTO shaft (3) with bearing case.
2. Take out the coupling (1)

(When reassembling)

- Direct the boss A portion on bearing case (2) upward.

- (1) Coupling
- (2) Bearing Case

- (3) PTO Shaft

**PTO Shaft**

1. Remove the internal snap ring (1).
2. Tap out the PTO shaft (4) to the front.

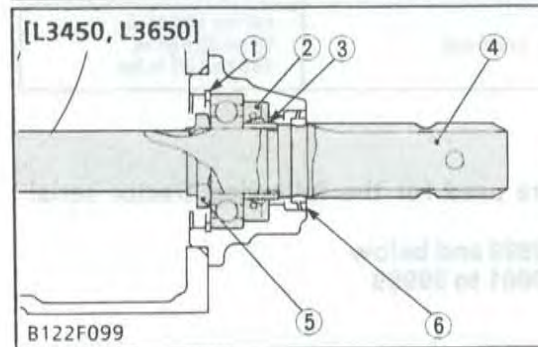
(When reassembling)

- If the lock nut (5) was removed, replace a new one, be sure to stake it firmly.
- Install the slinger (6) firmly.
- Apply grease to oil seal (2) and install it, noting its direction.

Tightening torque	Lock nut	147 to 196 N·m 15 to 20 kgf·m 108 to 145 ft-lbs
-------------------	----------	---

- (1) Internal Snap Ring
(2) Oil Seal
(3) Collar

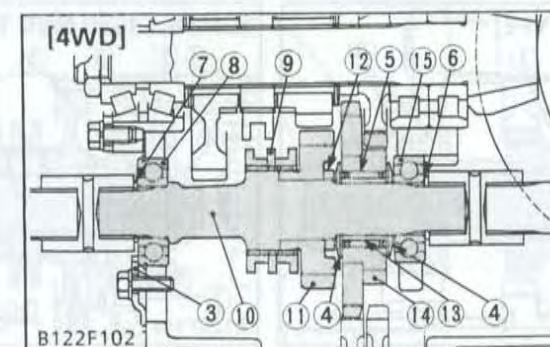
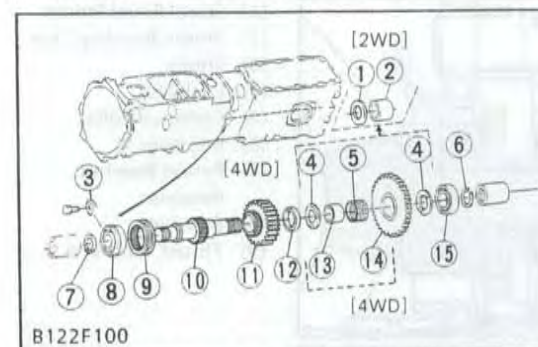
- (4) PTO Shaft
(5) Lock Nut
(6) Slinger

**PTO Drive Shaft [L2650, L2950]**

1. Remove the bearing retainer (3).
2. Remove the external snap ring (6) on the rear of PTO drive shaft (10), and tap out it to the front.

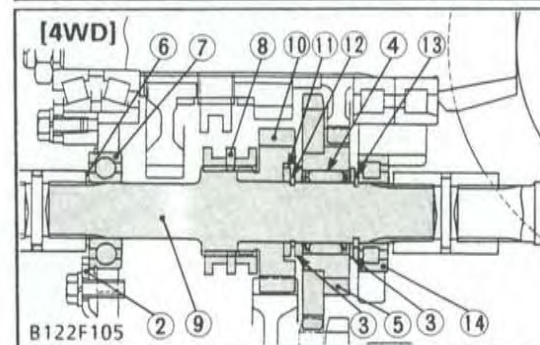
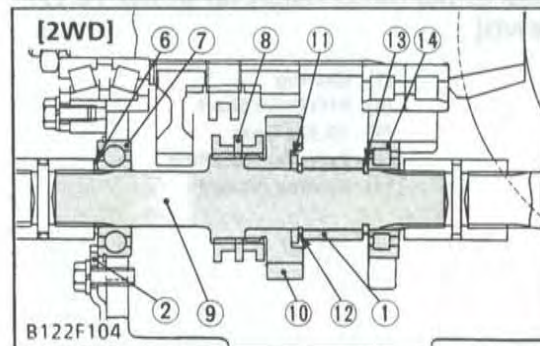
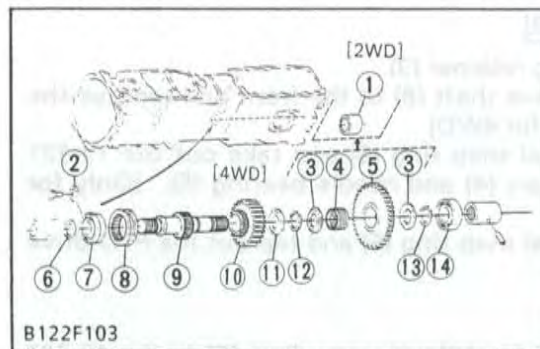
(When reassembling)

- Direct the groove side of thrust collars (4) to the 19-34T Gear (14) side. [Only for 4WD]



- (1) Washer
(2) Collar
(3) Bearing Retainer
(4) Thrust Collars
(5) Needle Bearing
(6) External Snap Ring
(7) External Snap Ring
(8) Bearing

- (9) Shifter
(10) PTO Drive Shaft
(11) 20T Gear
(12) Collar
(13) Inner Ring
(14) 19-34T Gear
(15) Bearing



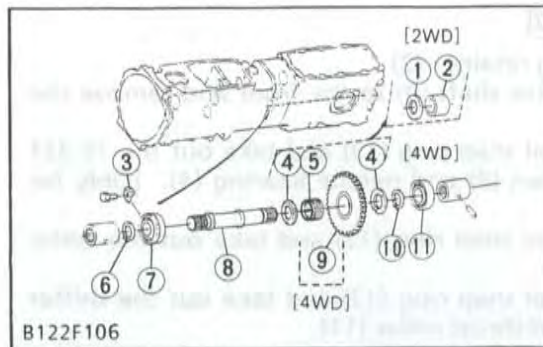
PTO Drive Shaft [L3450]

1. Remove the bearing retainer (2).
2. Tap out the PTO drive shaft (9) to the front and remove the bearing (14).
3. Remove the external snap ring (13) and take out the 19-32T gear (5), thrust collars (3) and needle bearing (4). [Only for 4WD]
4. Remove the external snap ring (12) and take out the collar (1). [Only for 2WD]
5. Remove the external snap ring (12) and take out the shifter (8), 20T gear (10) and thrust collar (11).
6. Remove the external snap ring (6) and tap out the PTO drive shaft (9) to the rear.

(When reassembling)

- Direct the groove side of the thrust collars (3) to the 19-32T gear (5) side. [Only for 4WD]
- Direct the groove side of the thrust collar (11) to the 20T gear side.

- | | |
|------------------------|-------------------------|
| (1) Collar | (9) PTO Drive Shaft |
| (2) Bearing Retainer | (10) 20T Gear |
| (3) Thrust Collars | (11) Thrust Collar |
| (4) Needle Bearing | (12) External Snap Ring |
| (5) 19-32T gear | (13) External Snap Ring |
| (6) External Snap Ring | (14) Bearing (Roller) |
| (7) Bearing | |
| (8) Shifter | |

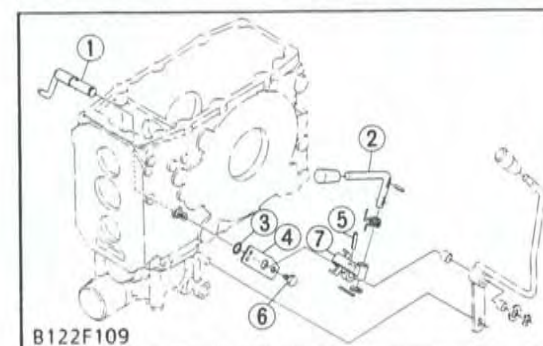
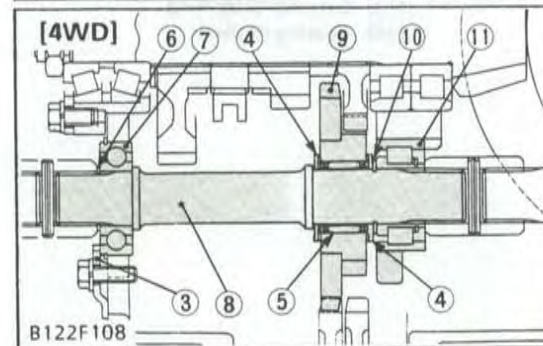
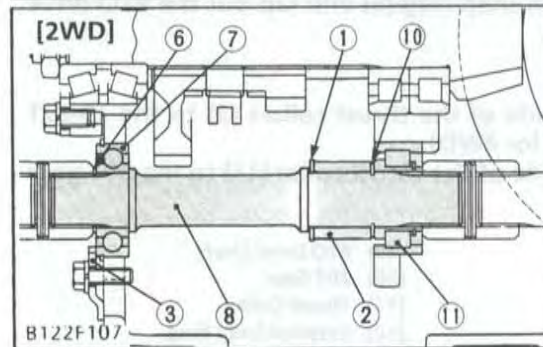
**PTO Drive Shaft [L3650]**

1. Remove the bearing retainer (3).
2. Tap out the PTO drive shaft (8) to the front and remove the bearing (11). [Only for 4WD]
3. Remove the external snap ring (6) and take out the 19-32T gear (9), thrust collars (4) and needle bearing (5). [Only for 4WD]
4. Remove the external snap ring (6) and tap out the PTO drive shaft (8) to the rear.

(When reassembling)

- Direct the groove side of the thrust collars (4) to the 19-32T gear (9). [Only for 4WD]

- | | |
|------------------------|-------------------------|
| (1) Washer | (7) Bearing |
| (2) Collar | (8) PTO Drive Shaft |
| (3) Bearing Retainer | (9) 19-32T Gear |
| (4) Thrust Collars | (10) External Snap Ring |
| (5) Needle Bearing | (11) Bearing (Roller) |
| (6) External Snap Ring | |

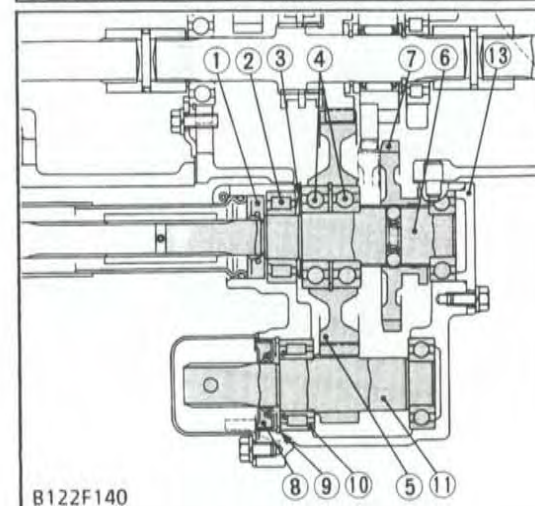
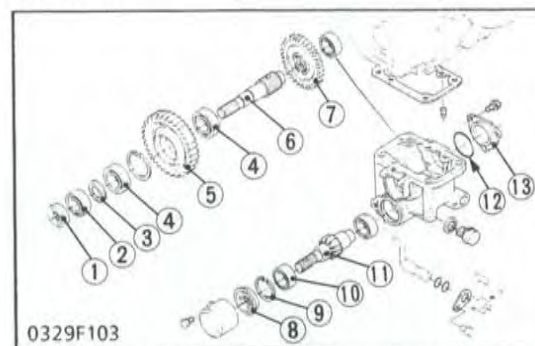
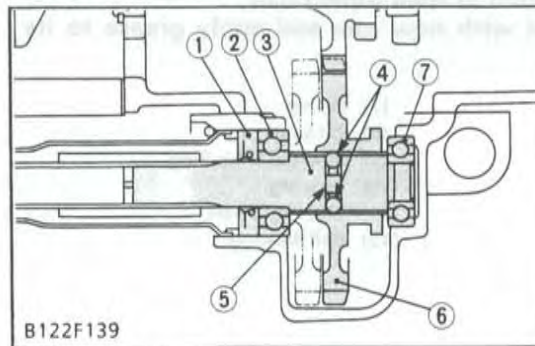
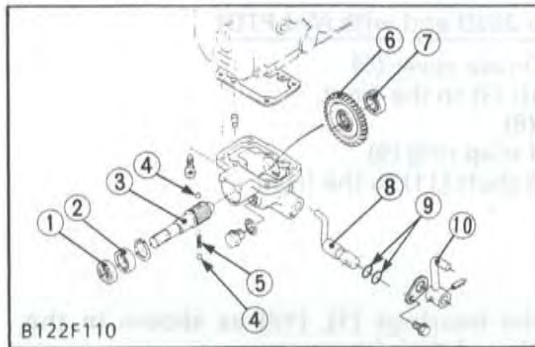
**Mid PTO Shift Lever [L2650, L2950, L3450]**

1. Remove the shift levers (2), (7) and guide (4).
2. Take out the shift lever 3 (1).

(When reassembling)

- Tighten the screw (6) of the guide (4) after installing the spring pin (5).

- | | |
|-------------------|-------------------|
| (1) Shift Lever 3 | (5) Spring Pin |
| (2) Shift Lever 1 | (6) Screw |
| (3) O-ring | (7) Shift Lever 2 |
| (4) Guide | (8) Holder |



Front Drive Case [Only for 4WD and without Mid-PTO]

1. Removing front drive case.
2. Remove the oil seal (1).
3. Tap out the propeller shaft 1 (3) to the front.
4. Take out the shift gear (6).

(When reassembling)

- Replace the oil seal (1) with new one and apply grease to its inside.

Tightening torque	Front drive case mounting bolts	77.5 to 90.2 N·m 7.9 to 9.2 kgf·m 57.1 to 66.5 ft-lbs
-------------------	---------------------------------	---

- | | |
|-----------------------|-------------------|
| (1) Oil Seal | (6) Shift Gear |
| (2) Ball Bearing | (7) Ball Bearing |
| (3) Propeller Shaft 1 | (8) Shift Lever |
| (4) Balls | (9) O-rings |
| (5) Spring | (10) Change Lever |

Front Drive Case [Only for 4WD and with Mid-PTO]

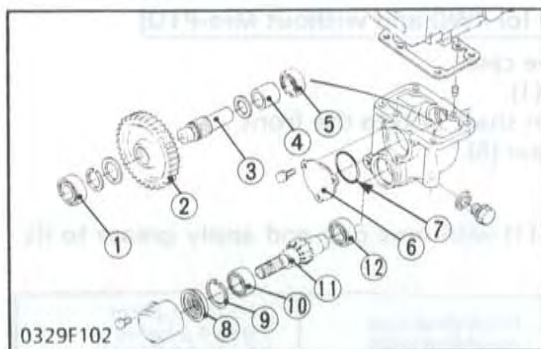
1. Remove the drive case cover (13).
2. Tap out the propeller shaft 1 (6) to the rear.
3. Take out the shift gear (7).
4. Remove the oil seal (8).
5. Remove the internal snap ring (9).
6. Tap out the mid PTO shaft (11) to the front.

(When reassembling)

■ IMPORTANT

- Be sure to install the bearings (2), (10) as shown in the figure, noting direction of their inner races.
- Direct the longer boss side of the 37T gear (5) to the front.
- Direct the oil grooved side of thrust collar (3) to the gear side.
- Replace the oil seal with new one and apply grease to its inside.

- | | |
|-----------------------|------------------------|
| (1) Oil Seal | (8) Oil Seal |
| (2) Ball Bearing | (9) Internal Snap Ring |
| (3) Thrust Collar | (10) Bearing |
| (4) Ball Bearing | (11) Mid PTO Shaft |
| (5) 37T Gear | (12) O-ring |
| (6) Propeller Shaft 1 | (13) Drive Case Cover |
| (7) Shift Gear | |

**Mid PTO Case [Only for 2WD and with Mid-PTO]**

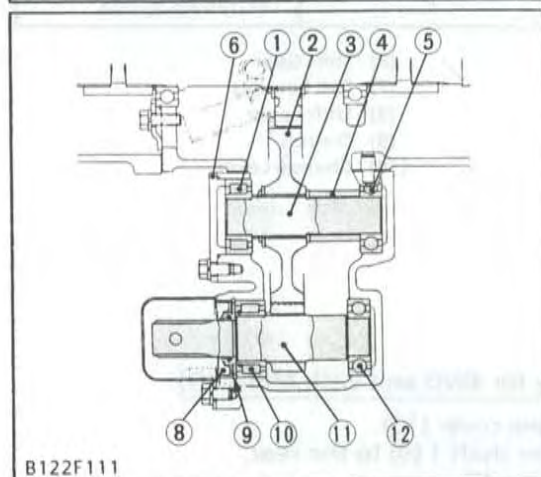
1. Remove the mid PTO case cover (6).
2. Tap out the idle shaft (3) to the front.
3. Remove the oil seal (8).
4. Remove the internal snap ring (9).
5. Tap out the mid PTO shaft (11) to the front.

(When reassembling)**■ IMPORTANT**

- Be sure to install the bearings (1), (10) as shown in the figure, noting direction of their inner races.
- Replace the oil seal with new one and apply grease to its inside.

- | | |
|------------------------|------------------------|
| (1) Bearing | (7) O-ring |
| (2) 37T Gear | (8) Oil Seal |
| (3) Idle Shaft | (9) Internal Snap Ring |
| (4) Spacer | (10) Bearing |
| (5) Ball Bearing | (11) Mid PTO Shaft |
| (6) Mid PTO Case Cover | (12) Ball Bearing |

- | |
|------------------------|
| (7) O-ring |
| (8) Oil Seal |
| (9) Internal Snap Ring |
| (10) Bearing |
| (11) Mid PTO Shaft |
| (12) Ball Bearing |



SERVICING

Checking Bearing

(See page S.3-34.)

Gear Backlash

(See page S.3-35.)

Clearance between Gear and Spline

(See page S.3-35.)

Clearance between Shift Fork and Shifter Groove

(See page S.3-35.)

Differential Gear Turning Torque

1. Grip the spiral bevel pinion nut with a torque wrench and measure the turning torque.
2. Adjust the torque by altering the differential bearing case shim thickness.
Shim thickness: 0.1 mm, 0.2 mm (0.0039 in., 0.0079 in.)

Differential gear turning torque (Combined)	Factory spec.	4.41 to 9.32 N·m 0.45 to 0.95 kgf·m 3.25 to 6.87 ft-lbs
---	---------------	---



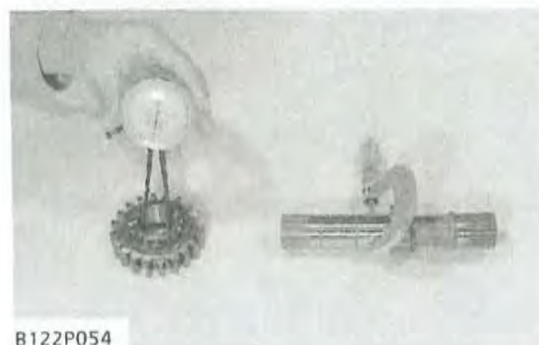
C011P254

Clearance between 20T Gear and PTO Drive Shaft

[L2650, L2950, L3450]

1. Measure the 20T gear I.D. and the PTO drive shaft O.D.
2. Calculate the clearance.
3. If the clearance exceeds the allowable limit, replace.

Clearance between 20T gear and PTO drive shaft	Factory spec.	0.015 to 0.046 mm 0.00059 to 0.00181 in.
	Allowable limit	0.1 mm 0.004 in.
20T gear I.D.	Factory spec.	30.020 to 30.041 mm 1.18189 to 1.18272 in.
PTO drive shaft O.D.	Factory spec.	29.995 to 30.005 mm 1.18091 to 1.18130 in.



B122P054

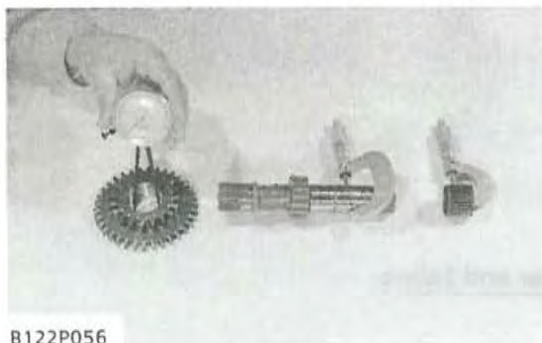
Clearance between 19-34T Gear and Inner Race on PTO Drive Shaft [L2650 4WD, L2950 4WD]

1. Measure the 19-34T gear I.D. and the inner race O.D.
2. Measure the O.D. of needle installed diagonally in the needle bearing.
3. Calculate the clearance.
4. If the clearance exceeds the allowable limit, replace.

Clearance between 19-34T gear and inner race	Factory spec.	0.004 to 0.043 mm 0.00016 to 0.00169 in.
	Allowable limit	0.1 mm 0.004 in.
19-34T gear I.D.	Factory spec.	37.009 to 37.025 mm 1.45705 to 1.45768 in.
Inner race O.D.	Factory spec.	29.995 to 30.005 mm 1.18095 to 1.18130 in.
Needle O.D.	Factory spec.	3.493 to 3.500 mm 0.13752 to 0.13780 in.



B122P055



Clearance between 19-32T Gear and PTO Drive Shaft

[L3450 4WD, L3650 4WD]

1. Measure the 19-32T gear I.D. and the PTO drive shaft O.D.
2. Measure the O.D. of needle installed diagonally in the needle bearing.
3. Calculate the clearance.
4. If the clearance exceeds the allowable limit, replace.

Clearance between 19-32T gear and PTO drive shaft	Factory spec.	0.009 to 0.052 mm 0.00035 to 0.00205 in.
	Allowable limit	0.1 mm 0.004 in.
19-32T gear I.D.	Factory spec.	37.009 to 37.025 mm 1.45705 to 1.45768 in.
PTO drive shaft O.D.	Factory spec.	29.987 to 30.000 mm 1.18059 to 1.18110 in.
Needle O.D.	Factory spec.	3.493 to 3.500 mm 0.13752 to 0.13780 in.

[3] L2650GST, L2950GST, L3450GST, L3650GST**[3]-1 SHIFT CABLE, SIDE COVER AND FILTER BRACKET****CHECKING AND ADJUSTING****Checking of main Shift Lever Position**

1. Check the shift position of the main shift lever. If the tractor moves with the main shift lever is "Neutral" position, adjust the shift cable.

Adjusting of Shift Cable

1. Set the main gear shift lever to "Neutral" and the shuttle shift lever to F or R position.
2. Adjust the adjustor A (1) and the adjustor B (2) so that the tractor does not move with the shift lever is "NEUTRAL" position but moves when the shift lever is 1st position.
3. After the adjustment, confirm that part C (3) and part D (4) sections are free from play and tighten the lock nuts of the cable adjustors A (1) and B (2).
4. Confirm that the tractor can be started by setting the main gear shift lever to all speed positions.

(Reference)

- Extend the cable adjustor B and shorten the cable adjustor A.



When the tractor starts with the main gear shift lever at "Neutral" position.

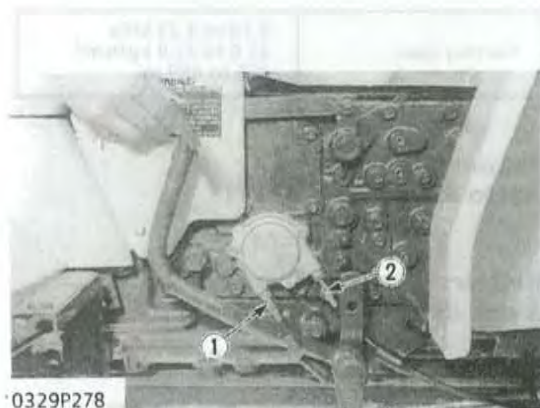
- Shorten the cable adjustor B and extend the cable adjustor A.



When the tractor does not start with the main gear shift lever at 1st speed position.

⚠ CAUTION

- Do not adjust with main clutch engaged to avoid personal injury.
Adjust the this adjustment with disengaged the main clutch, after that engage it to confirm the adjustment.



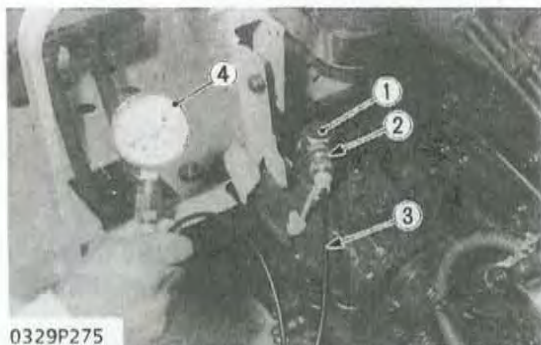
0329P278



0329P279

(1) Cable Adjustor A
(2) Cable Adjustor B

(3) Part C
(4) Part D



Checking and Adjusting of Relief Valve Pressure (P7)

1. Replace the delivery pipe mounting joint for power steering pump with the adaptor E (1) (Code No: 07191-50392).
2. Set the threaded joint (2) (Code No: 07191-50392) and the cable (3) (Code No: 07916-50331), and pressure gauge (4) (Code No: 07916-52961) on the adaptor E.
3. Start the engine and measure the pressure.
4. For adjustment, use the relief valve adjustor (5) of the filter bracket.

Relief valve set pressure	Factory spec.	3.14 to 3.23 MPa 32.0 to 33.0 kgf/cm ² 455 to 469 psi
---------------------------	---------------	--

Condition

- Engine speed Maximum rpm.
- Oil temperature 45° to 55°C (113° to 131°F)

(Reference)

- Turn to clockwise direction → Pressure increase.
Turn to counterclockwise direction → Pressure decrease.

- | | |
|--------------------|-----------------------------|
| (1) Adaptor E | (4) Pressure Gauge |
| (2) Threaded Joint | (5) Relief Valve Adjustor |
| (3) Cable | (6) Reducing Valve Adjustor |

Checking and Adjusting of GST System Pressure (P6)

1. Remove the left step and the left foot cover (1).
2. Remove the plug (PT 1/8) on the orifice bolt.
3. Set the threaded joint (3) (Code No: 07191-50392), cable (4) (Code No: 07916-50331), and pressure gauge (2) (Code No: 07916-52961) on the orifice bolt (1).
4. Start the engine and measure the pressure.
5. For adjustment, use the reducing valve adjustor (6) of the filter bracket.

GST system pressure	Factory spec	2.35 to 2.45 MPa 24.0 to 25.0 kgf/cm ² 341 to 356 psi
---------------------	--------------	--

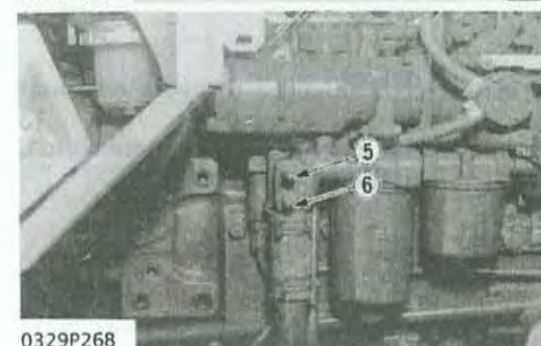
Condition

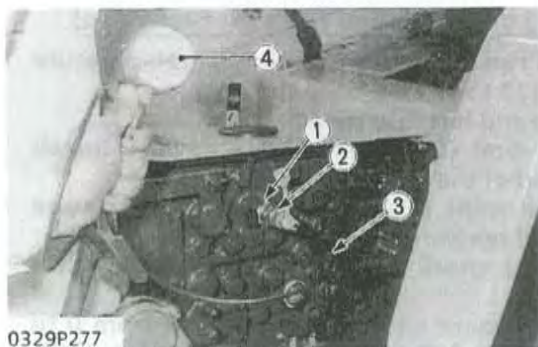
- Engine speed Maximum rpm.
- Oil temperature 45° to 55°C (113° to 131°F)

(Reference)

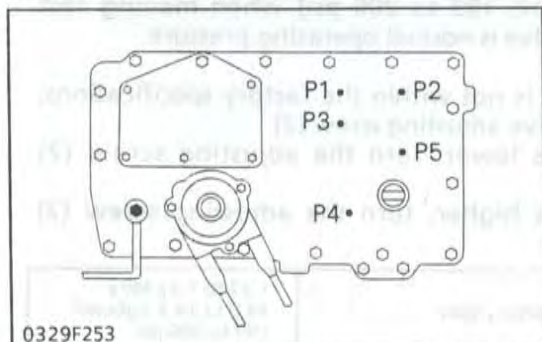
- Turn to clockwise direction → Pressure increase.
- Turn to counterclockwise direction → Pressure decrease
- Pressure change per half rotation of the adjustor.
Approx: 0.196 MPa
2.0 kgf/cm²
28 psi

- | | |
|--------------------|-----------------------------|
| (1) Orifice Bolt | (4) Cable |
| (2) Pressure Gauge | (5) Relief Valve Adjustor |
| (3) Threaded Joint | (6) Reducing Valve Adjustor |





Pressure discharging port diagram



- (1) Adaptor D (3) Cable
(2) Threaded Joint (4) Pressure Gauge

Checking and Adjusting of GST System Pressure (P1 to P5)

1. Remove the left step and the left foot cover.
2. Remove the each plugs of P1 to P5 and set the adaptor D (1) (Code No: 07916-50381), threaded joint (2) (Code No: 07916-50392), cable (3) (Code No: 07916-50331), and pressure gauge (4) (Code No: 07916-52961).
3. Start the engine and measure the pressure of each port and each main shift lever position as the pressure table.

GST system pressure	Factory spec.	2.35 to 2.45 MPa 24.0 to 25.0 kgf/cm ² 341 to 356 psi
---------------------	---------------	--

Condition

- Engine speed Maximum rpm.
- Oil temperature 45 to 55°C (113 to 131°F)

Pressure Table

○ — Pressure is 24 kgf/cm² (341 psi)

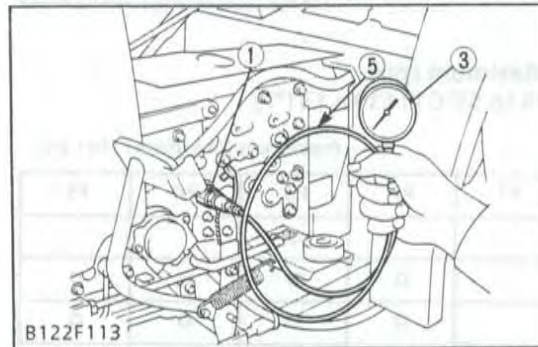
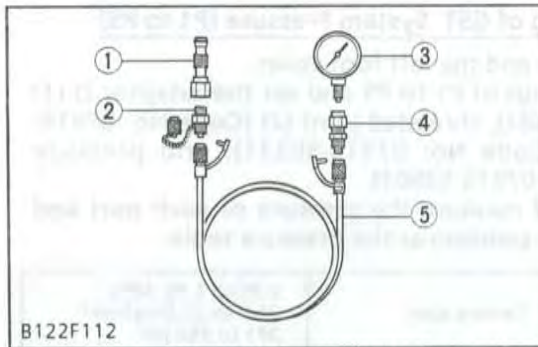
Shift Position	P1	P2	P3	P4	P5
Neutral			○		
1st Shift		○	○	○	○
2nd Shift		○	○	○	○
3rd Shift	○		○	○	○
4th Shift	○		○	○	○
5th Shift		○	○	○	○
6th Shift		○	○	○	○
7th Shift	○		○	○	○
8th Shift	○		○	○	○

NOTE

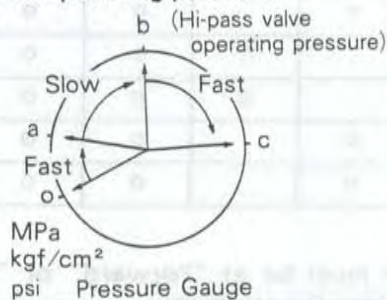
- Shuttle shift lever must be at "Forward" or "Reverse" position when checking the pressure.
- Measure the pressure according to P1 to P5 and use the results of measurement to locate causes of trouble when performing trouble-shooting. (Refer to page S.3-3, 4, 5)
- This pressure adjustment can be made by the reducing valve adjuster but individual and separate pressure change is not possible.

CAUTION

- Disengage the main clutch when checking the pressure.

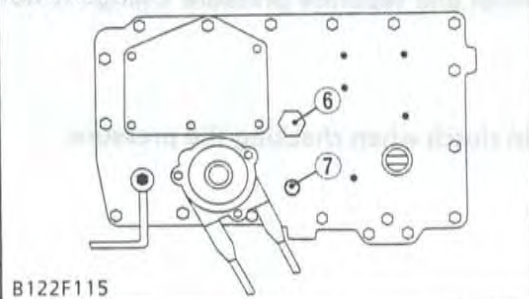


Hi-pass valve operating pressure



- (a) 0.22 MPa (2.2 kgf/cm², 31.3 psi)
 (b) 1.37 MPa (14.0 kgf/cm², 199 psi)
 (c) 2.35 MPa (24.0 kgf/cm², 341 psi)

Side cover



- (1) Adaptor 72 07916-53791
 (2) Threaded Joint 07916-50341
 (3) Pressure Gauge 50 07916-52961
 (4) Pressure Gauge Threaded Joint 07916-50401
 (5) Cable 07916-50331
 (6) Orifice Bolt
 (7) Hi-pass Valve Adjusting Screw

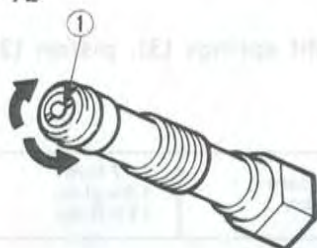
Checking and Adjusting of Modulating Valve (Hi-Pass Valve)

1. Start the engine and run it until transmission oil temperature reaches 45 to 55 °C (113 to 131 °F). Stop the engine.
2. Remove the left step and left foot cover.
3. Remove the orifice bolt (6) from the side cover. Install adaptor 72 (1) instead of the orifice bolt (6).
4. Install the threaded joint (2), cable (5), pressure gauge threaded joint (4) and pressure gauge (3) to adaptor 72 (1).
5. Start the engine and check the hi-pass valve operating pressure.
6. The pointer of the pressure gauge (3) moves fast from 0 to 0.22 MPa (0 to 2.2 kgf/cm², 0 to 31.3 psi), slows down, then, speeds up again. If the pointer indicates 1.37 to 1.42 MPa (14.0 to 14.5 kgf/cm², 199 to 206 psi) when moving fast again, the Hi-pass valve is normal operating pressure.
7. Stop the engine.
8. If the measurement is not within the factory specifications, adjust the hi-pass valve adjusting screw (2)
 - If the pressure is lower, turn the adjusting screw (2) clockwise.
 - If the pressure is higher, turn the adjusting screw (2) counter clockwise.

Modulating valve (Hi-pass valve) operating pressure	Factory spec.	1.37 to 1.42 MPa 14.0 to 14.5 kgf/cm ² 199 to 206 psi
---	---------------	--

Condition

- Engine speed Maximum rpm
- Oil temperature 45 to 55 °C (113 to 131 °F)

Adaptor 72

B122F116

(1) Adjusting Screw

NOTE

If the pointer of the pressure gauge moves too fast or too slow, adjust with the adjusting screw of adaptor 72 until the gauge is read more easily.

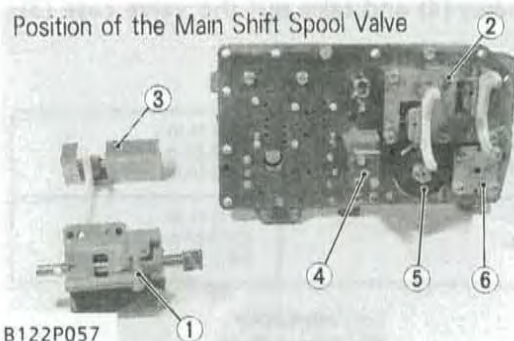
- If the pointer moves too fast. → "Clockwise"
- If the pointer moves too slow. → "Counterclockwise"

**CAUTION**

- Shift the shift levers to "Neutral" position when checking the pressure.

DISASSEMBLING AND ASSEMBLING**Side Cover Assembly, Gate Valve and Hi-Lo Shift Spool Valve**

(See page S.3-29)

Position of the Main Shift Spool Valve

B122P057

Main Shift Spool Valve

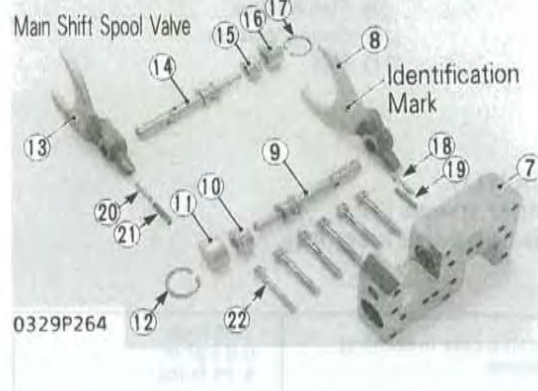
1. Remove the six screws (22).
2. Take out the main shift spool valve (2).

(When reassembling)

Tightening torques	Main shift spool valve mounting screw	6 mm (0.24 in.)	7.85 N·m 0.8 kgf·m 5.79 ft·lbs
		8 mm (0.31 in.)	17.7 N·m 1.8 kgf·m 13.0 ft·lbs

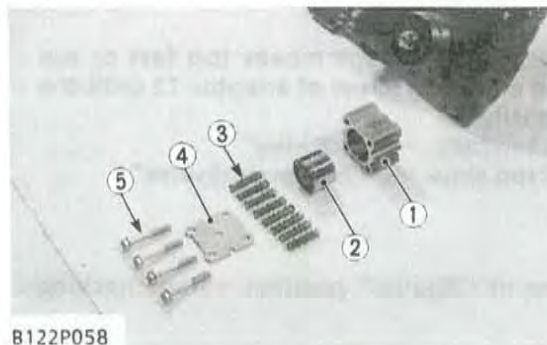
IMPORTANT

- Do not disassemble inside of the main shift spool valve (2).



0329P264

- | | |
|---|-------------------------|
| (1) Gate Valve
(Shuttle Shift Spool Valve) | (12) Snap Ring |
| (2) Main Shift Spool Valve | (13) 3-4th Shift Fork |
| (3) Hi-Lo Shift Spool Valve | (14) Spool Valve |
| (4) Modulating Valve | (15) Neutral Piston |
| (5) Rotary Valve | (16) Shift Piston Cover |
| (6) Accumulator | (17) Snap Ring |
| (7) Main Shift Valve Case | (18) Pin |
| (8) 1-2nd Shift Fork | (19) Spring Pin |
| (9) Spool Valve | (20) Pin |
| (10) Neutral Piston | (21) Spring Pin |
| (11) Shift Piston Cover | (22) Screws |



B122P058

Accumulator

1. Remove four screws (5).
2. Take out the cover (4), eight springs (3), piston (2), and accumulator case (1).

(When reassembling)

Tightening torque	Accumulator case mounting screw	17.7 N·m 1.8 kgf·m 13.0 ft-lbs
-------------------	---------------------------------	--------------------------------------

- | | |
|----------------------|------------|
| (1) Accumulator Case | (4) Cover |
| (2) Piston | (5) Screws |
| (3) Springs | |

Rotary Valve Assembly

1. Remove the snap ring and take out the rotary valve assembly from the side cover.
2. Remove the nut (11) and take out the detent plate (8) from the valve body (7).
3. Remove the three screws (4) and take out the valve case (3) from the side cover.

(When reassembling)

Tightening torques	Valve case mounting screw	7.85 N·m 0.8 kgf·m 5.79 ft-lbs
	Nut	62.8 N·m 6.4 kgf·m 46.3 ft-lbs

- | | |
|----------------|--------------------|
| (1) Snap Ring | (7) Valve Body |
| (2) Collar | (8) Detent Plate |
| (3) Valve Case | (9) Flat Washer |
| (4) Screws | (10) Spring Washer |
| (5) Springs | (11) Nut |
| (6) Balls | |

Modulating Valve

1. Remove the orifice bolt (1).
2. Remove the two longer screws (2).
3. Take out the modulating valve assembly.

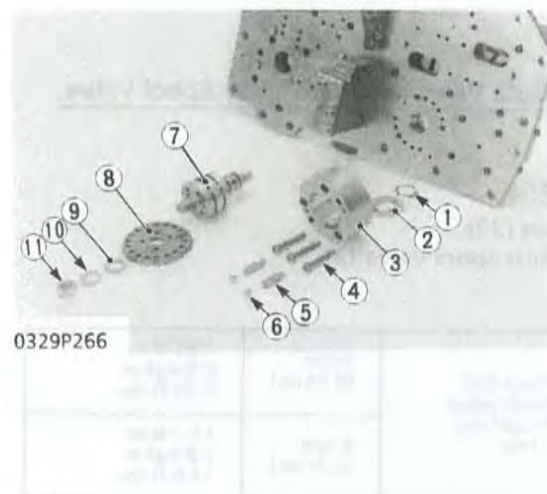
(When reassembling)

Tightening torque	Valve case mounting screw	7.85 N·m 0.8 kgf·m 5.79 ft-lbs
-------------------	---------------------------	--------------------------------------

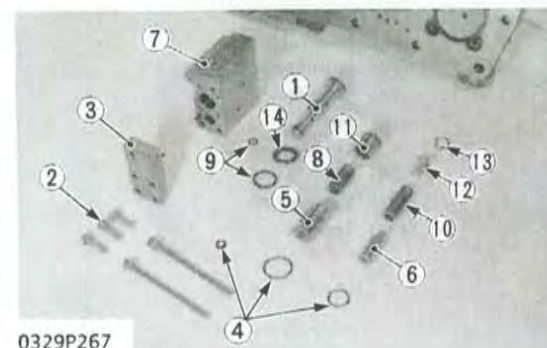
■ IMPORTANT

- Do not disassemble inside of the modulating valve.
- Do not remove the hi-pass valve adjusting screw, if removed it, adjust it correctly. (See page S.3-56, 57)

- | | |
|---------------------------|------------------------------|
| (1) Orifice Bolt | (8) Spring |
| (2) Screws | (9) O-rings (2 pieces) |
| (3) Valve Cover | (10) Spring |
| (4) O-rings (3 pieces) | (11) Lo-pass Piston |
| (5) Lo-pass Valve | (12) Hi-pass Spring Retainer |
| (6) Hi-pass Valve | (13) Snap Ring |
| (7) Modulating Valve Case | (14) Seal Washer |



0329P266



0329P267



0329P261

- | | |
|--------------------------|--------------------------|
| (1) Shift Fork | (5) Shift Piston Cover F |
| (2) Spring Pin | (6) Hi-Lo Shift Case |
| (3) Hi-Lo Shift Spool | (7) Snap Ring |
| (4) Shift Piston Cover R | (8) Snap Ring |

Hi-Lo Shift Spool Valve

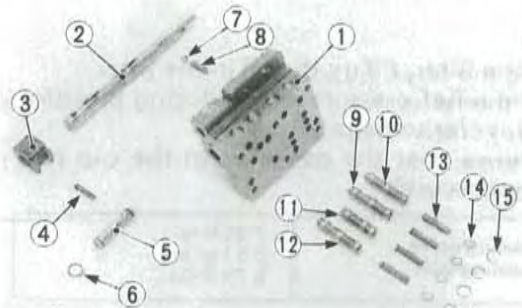
(When reassembling)

- Take care to mount the Hi-Lo shift spool valve assembly. (See page S.5-29, 30)

Tightening torque	Hi Lo shift spool valve mounting screw	17.7 N·m 1.8 kgf·m 13.0 ft-lbs
-------------------	--	--------------------------------------

■ IMPORTANT

- Do not disassemble inside of the Hi-Lo shift spool valve assembly.



0329P262

- | | |
|-------------------------|---------------------------------|
| (1) Gate Valve Case | (9) Pilot Valve (3-4 gate) |
| (2) Shuttle Shift Spool | (10) Pilot Valve (1-2 gate) |
| (3) Shift Fitting | (11) Pilot Valve (Hi-Lo gate) |
| (4) Spring Pin | (12) Pilot Valve (Shuttle gate) |
| (5) Pipe | (13) Spring |
| (6) Snap ring | (14) Washer |
| (7) Ball | (15) Snap Ring |
| (8) spring | |

Gate Valve (Shuttle Shift Spool Valve)

(When reassembling)

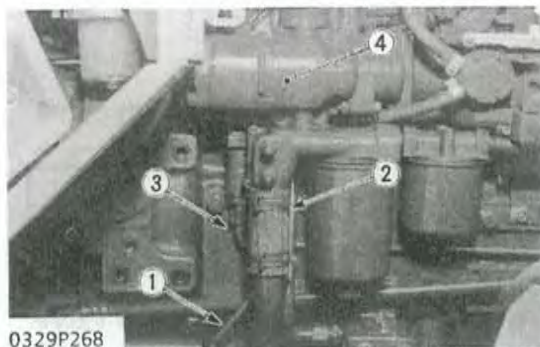
- Take care to mount the gate valve assembly. (See page S.5-29, 30)

Tightening torque	Gate valve mounting screw	17.7 N·m 1.8 kgf·m 13.0 ft-lbs
-------------------	---------------------------	--------------------------------------

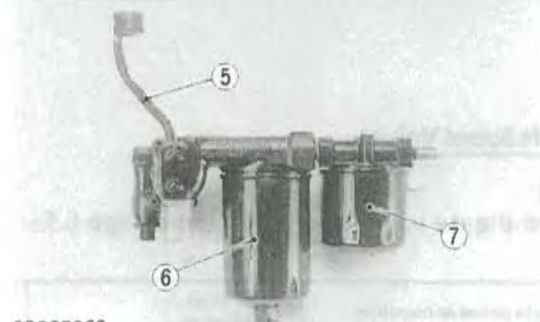
■ IMPORTANT

- Do not disassemble inside of the gate valve assembly.





0329P268



0329P269

- | | |
|---------------------------------|------------------------|
| (1) Delivery Pipe Comp. 2 | (4) Oil Pump |
| (2) Delivery Pipe Comp. | (5) Delivery Pipe P-RE |
| (3) Power Steering Pipe 1 Comp. | (6) Filter Cartridge |
| | (7) Paper Filter |

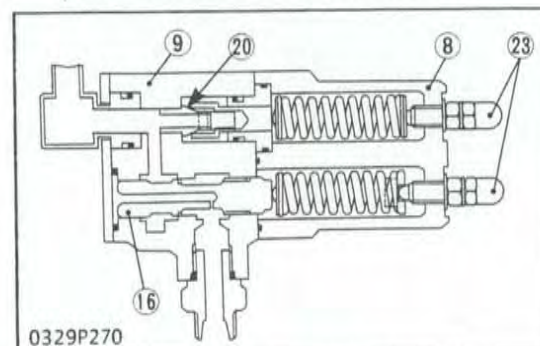
Filter Bracket Assembly

1. Remove the delivery pipe comp. 2 (1) and power steering pipe 1 comp. (3) on the filter bracket side.
2. Remove the delivery pipe comp. (2) on the oil pressure block side.
3. Remove the delivery pipe P-RE (5) on the pump side.
4. Remove the power steering return pipe before the paper filter.
5. Remove the oil pump (4) as a complete unit.
6. Remove the filter bracket as a complete unit.
7. Remove the filter cartridge (6) and the paper filter (7).
8. Remove bolts (11), (21) and remove the reducing valve (16), relief poppet (20) etc.
9. Confirm the protruding allowance of the adjusting bolt (22) and disassemble.
10. Remove the nipple (14) and the poppet (13).

(When reassembling)

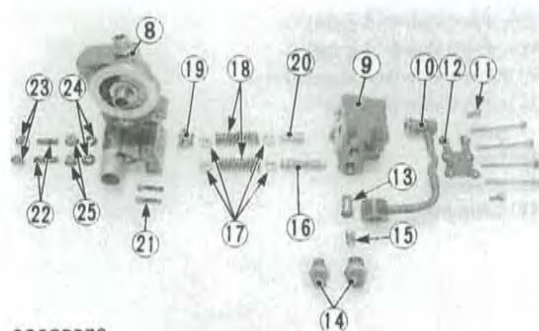
- Before reassembling the filter, fill up the oil in the filter.
- For adjustments of the relief pressure and reducing pressure (GST system pressure), refer to page 5.3-54.
- After adjustment, ensure that the gasket is in the cap nut and tighten the cap nut securely.

Tightening torque	Reducing valve mounting bolt	7.85 N·m 0.8 kgf·m 5.79 ft·lbs
-------------------	------------------------------	--------------------------------------



0329P270

- | | |
|---------------------------|-----------------------|
| (8) Filter Bracket | (16) Reducing Valve |
| (9) Reducing Valve Case | (17) Spring Retainers |
| (10) Delivery Pipe P-RE | (18) Springs |
| (11) Screw | (19) Relief Bushing |
| (12) Reducing Valve Cover | (20) Relief Poppet |
| (13) Poppet | (21) Screw |
| (14) Nipples | (22) Adjusting Screw |
| (15) Spring | (23) Cap Nut |
| | (24) Seal Washers |
| | (25) Nuts |



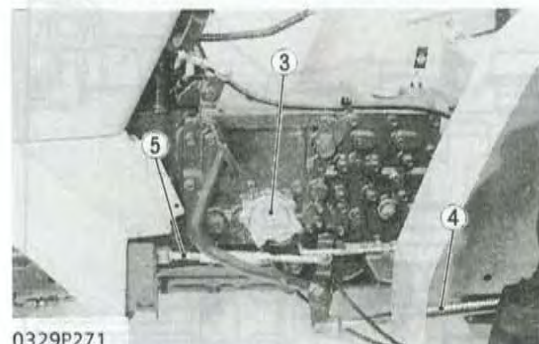
0329P270



0329P256

(1) Left Foot Cover

(2) Left Step



0329P271

(3) Shift Cable

(4) Brake Rod

(5) Clutch Rod



0329P272

(6) Shift Guide Cover

(7) Rear Step

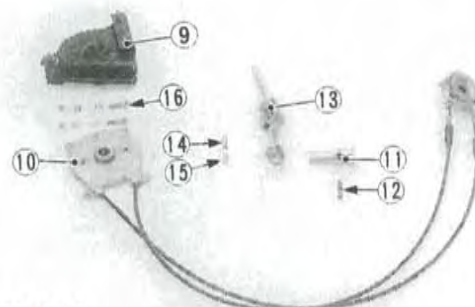


0329P273

(8) Shift Guide Assembly

Shift Cable

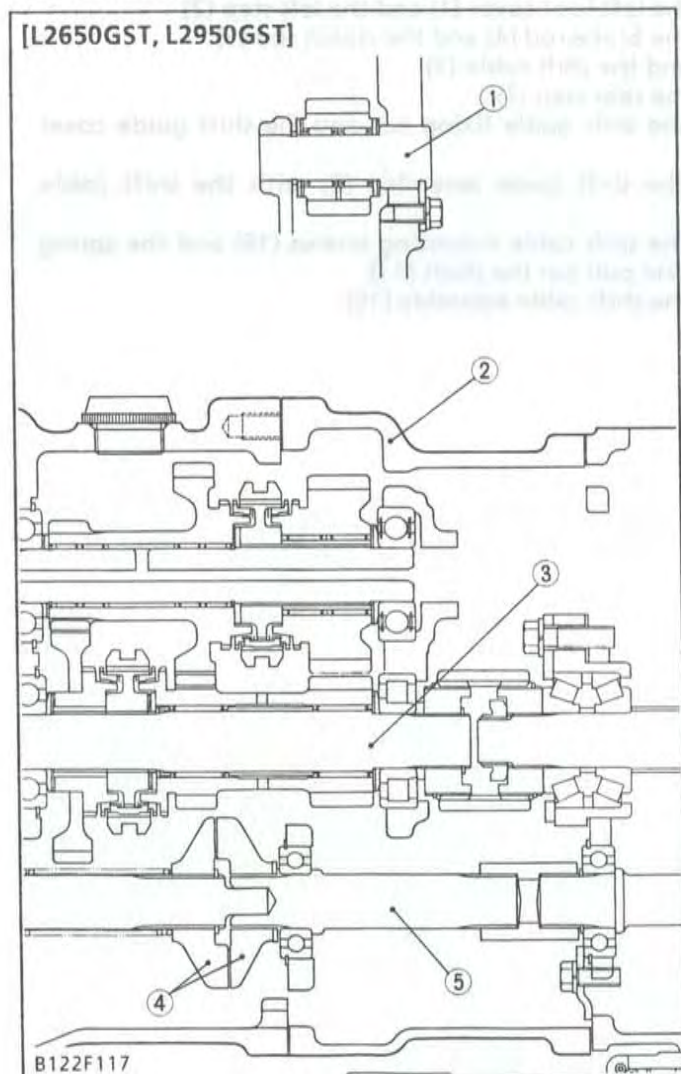
1. Remove the left foot cover (1) and the left step (2).
2. Remove the brake rod (4) and the clutch rod (5).
3. Remove the shift cable (3).
4. Remove the rear step (7).
5. Remove the shift guide fixing nut and the shift guide cover (6).
6. Remove the shift guide assembly (8) with the shift cable fitted.
7. Remove the shift cable mounting screws (16) and the spring pin (12), and pull out the shaft (11).
8. Remove the shift cable assembly (10).



0329P274

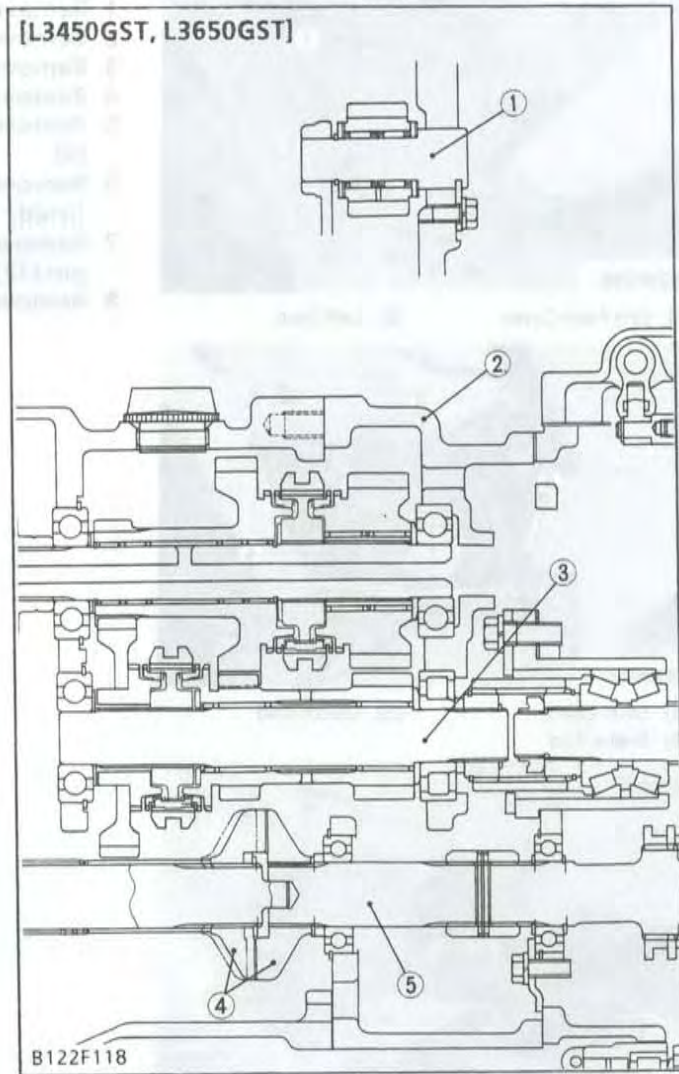
- (9) Shift Guide
(10) Speed Change
Cable Assembly
(11) Shaft
(12) Spring Pin

- (13) Lever
(14) Spring
(15) Detent
(16) Mounting Bolts

[3]-2 MID CASE

- (1) Reverse Shaft
(2) Mid Case

(3) Hi-Lo Shaft



(4) One-way Clutch

(5) PTO Drive Shaft

DISASSEMBLING AND ASSEMBLING

Separating Mid Case

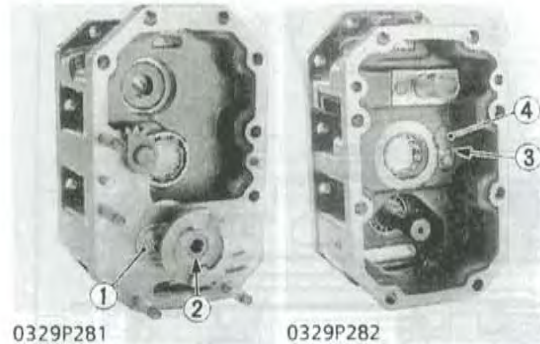
(See page S.5-30.)

Reverse Shaft and PTO Drive Shaft

1. Remove the reverse shaft holder (3).
2. Remove the snap ring (5) on the reverse shaft.
3. Remove the reverse gear (6) of the reverse shaft.
4. Remove the bearing retainer (1) and pull out the PTO drive shaft (2).

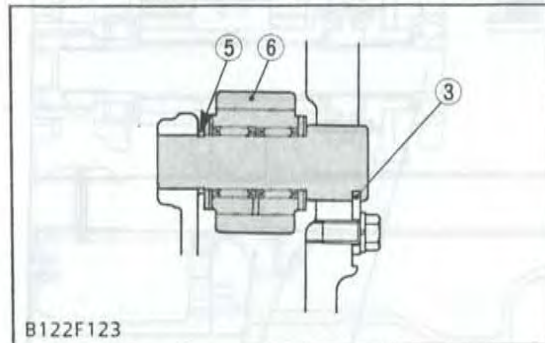
- (1) PTO Bearing Retainer
(2) PTO Drive Shaft
(3) Reverse Shaft Holder

- (4) Reverse Shaft
(5) Snap Ring
(6) Reverse Gear



0329P281

0329P282



B122F123

SERVICING



C045P124

Checking Bearing

1. Hold the inner race, and push and pull the outer race in all directions to check for wear and roughness.
2. Apply transmission fluid to the bearing, and hold the inner race. Then, turn the outer race to check rotation.
3. If there is any defect, replace it.



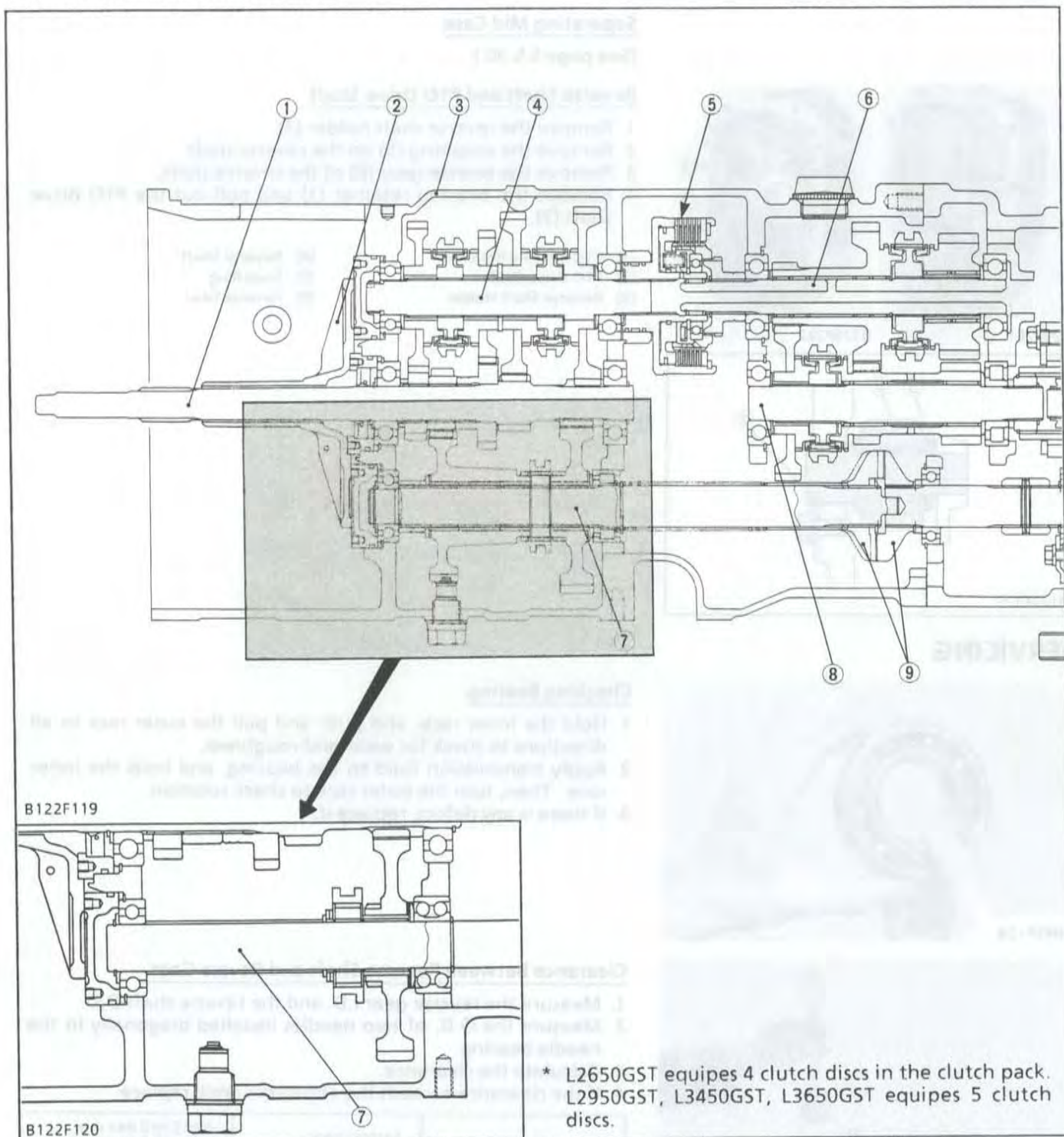
0329P095

Clearance between Reverse Shaft and Revers Gear

1. Measure the reverse gear I.D. and the reverse shaft O.D.
2. Measure the O.D. of two needles installed diagonally in the needle bearing.
3. Calculate the clearance.
4. If the clearance exceeds the allowable limit, replace.

Clearance between reverse shaft and 1ST gear	Factory spec.	0.015 to 0.044 mm 0.00059 to 0.00173 in.
	Allowable limit	0.1 mm 0.004 in.
Reverse shaft O.D.	Factory spec.	19.996 to 20.005 mm 0.78724 to 0.78760 in.
Reverse gear I.D.	Factory spec.	26.020 to 26.028 mm 1.02441 to 1.02472 in.
Needle O.D.	Factory spec.	2.994 to 3.000 mm 0.11787 to 0.11811 in.

[3]-3 CLUTCH HOUSING



- (1) Main Shaft
- (2) Main Shaft Case
- (3) Clutch Housing

- (4) Counter Shaft
- (5) CLutch Pack

- (6) Shuttle Shaft
- (7) PTO Counter Shaft

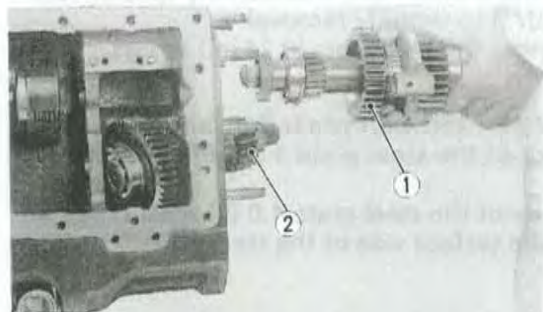
- (8) Hi-Lo Shaft
- (9) One-way Clutch

DISASSEMBLING AND ASSEMBLING

Separating Clutch Housing

(See page S.5-30.)

Shuttle Shaft

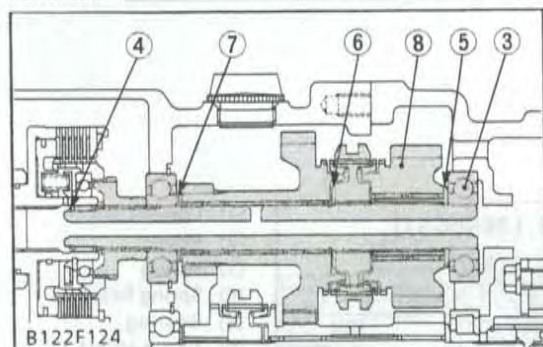


0329P283

1. Remove the Hi-Lo shaft (2) as a complete unit and drop it as a unit.
2. Remove the complete shuttle shaft (1) as a unit.
3. Remove the bearing (3) and the snap ring (4), and remove the gears.

(When reassembling)

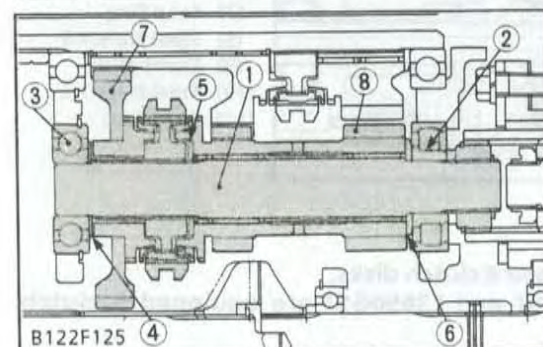
- Apply grease to the collar and the inner race.
- Thrust collars (6), (7) can be installed in any direction.
- The groove of the thrust collar (5) must face the 27T gear (8).



B122F124

- (1) Complete Shuttle Shaft
- (2) Complete Hi-Lo Shaft
- (3) Bearing
- (4) Snap Ring

- (5) Thrust Collar
- (6) Thrust Collar
- (7) Thrust Collar
- (8) 27T Gear



B122F125

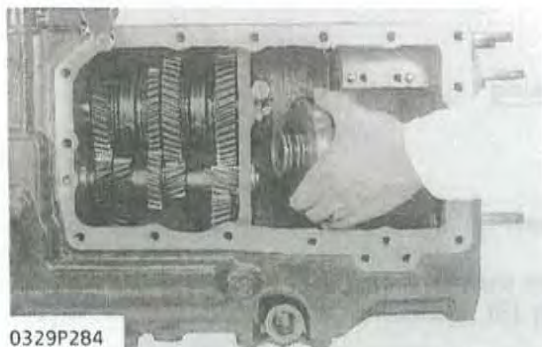
Hi-Lo Shaft

1. Remove the Hi-Lo shaft (1) as a complete unit.
2. Remove the bearing (3) and the inner race (2), and pull out the gears.

(When reassembling)

- Apply grease to the collars and the inner races.
- Thrust collar (5) can be fit in any direction.
- The groove of the thrust collar (4) must face the 42T gear (7).
- The groove of the thrust collar (6) must face the 17-17T gear or the 17-18T gear (8).

- | | |
|-------------------|----------------------------|
| (1) Hi-Lo Shaft | (6) Thrust Collar |
| (2) Inner Race | (7) 42T Gear |
| (3) Bearing | (8) 17-17T Gear (L2650GST) |
| (4) Thrust Collar | 17-18T Gear (L2950GST, |
| (5) Thrust Collar | L3450GST, L3650GST) |

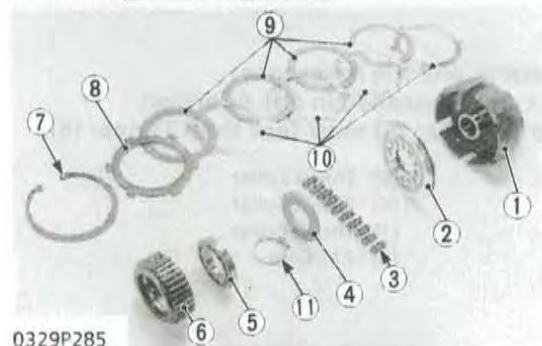


Clutch Pack

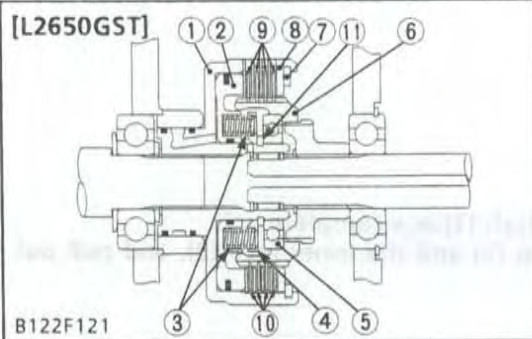
1. Remove the clutch pack as a complete set.
2. Remove the clutch hub 1 (6), steel plate (8), (9), and disk (10).
3. Remove the snap ring (11), spring retainer (4) and spring (3) in that order. Use the Clutch Pack Disassembly special tool (Code No: 07916-52071) to simplify removal.
4. Pull out the piston using the two 6 mm (0.24 in.) screws.

(When reassembling)

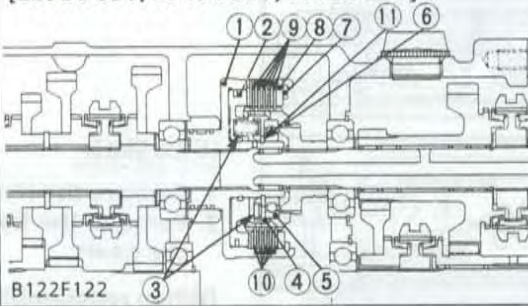
- The steel plates 1.2 (10) can be installed in any direction, because both surface of the steel plate 1.2 (10) are polished up.
- Mark "O" surface side of the steel plate 4.0 (8) must face the rear, because only one surface side of the steel plate 4.0 (8) is polished up.



[L2650GST]



[L2950GST, L3450GST, L3650GST]



- (1) Clutch Case
- (2) Piston
- (3) Spring
- (4) Spring Retainer
- (5) Bearing
- (6) Clutch Hub 1
- (7) Snap Ring
- (8) Steel Plate 4.0
- (9) Clutch Disk
- (10) Steel Plate 1.2
- (11) Snap Ring

CAUTION

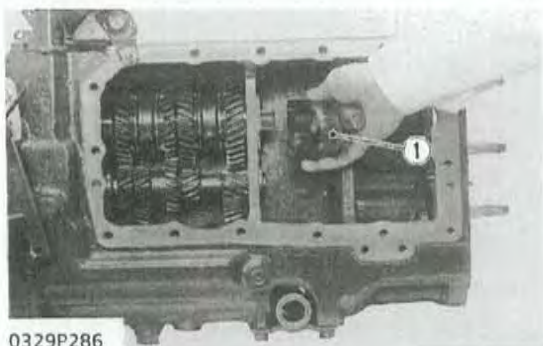
- L2650GST is equipped 4 clutch disks.
- L2950GST, L3450GST and L3650GST are equipped 5 clutch disks.

Clutch Pack Support

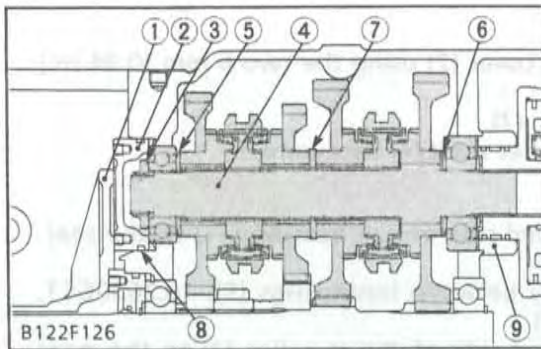
1. Remove screws. Note that one of the three screws is the reamer screw for positioning.
2. Remove the clutch pack support (1).

(When reassembling)

- Check that the inner surface is free from scratches and burrs before reassembling.



(1) Clutch Pack Support



- | | |
|---------------------|-------------------|
| (1) Main Shaft Case | (6) Thrust Collar |
| (2) Bearing Cover | (7) Thrust Collar |
| (3) Nut 22 | (8) O-ring |
| (4) Counter Shaft | (9) Support |
| (5) Thrust Collar | |

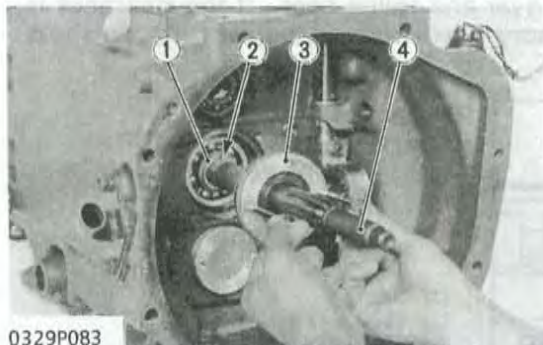
Counter Shaft

1. Remove the main shaft case (1).
2. Remove the bearing cover (2) using the two 6 mm (0.24 in.) screws.
3. Release the caulking of the nut 22 (3) and remove it.
4. Tap out the counter shaft (4) backward.
5. Remove the gears.

(When reassembling)

- Apply grease to the collar and inner race.
- The groove of the thrust collars (5), (6) must face inside.
- The thrust collar (7) can be fitted in any direction.
- Apply grease to the O-ring (8) of the bearing cover (2) before reassembling.

Tightening torque	22 Nut	4.90 to 6.86 N·m 0.5 to 0.7 kgf·m 3.62 to 5.06 ft·lbs
-------------------	--------	---



Main Shaft

1. Remove the spacer (3) using the two 6 mm (0.24 in.) screws.
2. Remove the snap ring (2) on the main shaft and remove the washer (1).
3. Tap out the main shaft backward.

(When reassembling)

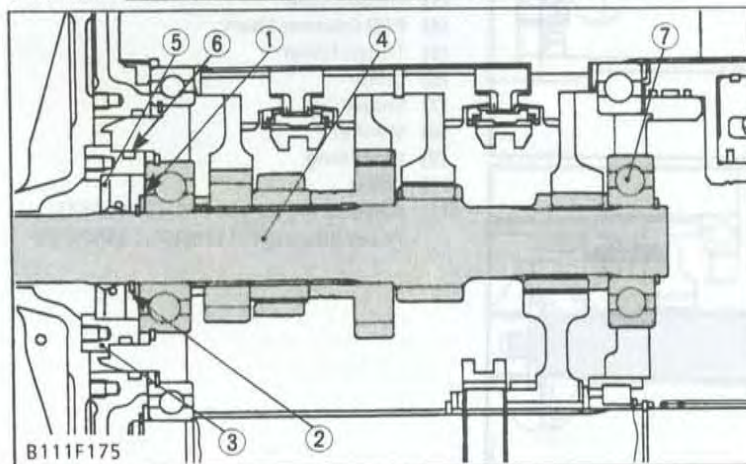
- Apply grease to the O-ring (6) and oil seal (5).

■ IMPORTANT

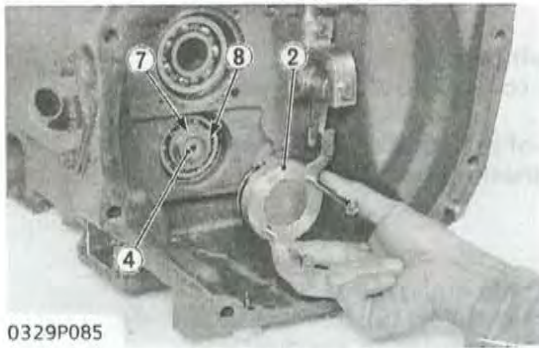
- After reassembling the main shaft, check the clearance between bearing and washer. If the clearance is too much, adjust with washers (1).

(Reference)

- Thickness of washers (1):
2.0 mm (0.079 in.)
2.3 mm (0.090 in.)
2.5 mm (0.098 in.)



- | | |
|----------------|--------------|
| (1) Washer | (5) Oil Seal |
| (2) Snap Ring | (6) O-ring |
| (3) Spacer | (7) Bearing |
| (4) Main Shaft | |



PTO Counter Shaft

1. Remove the bearing cover (2) using the two 6 mm (0.24 in.) screws.
2. Remove the snap ring (7).
3. Tap out the PTO counter shaft (4) backward.

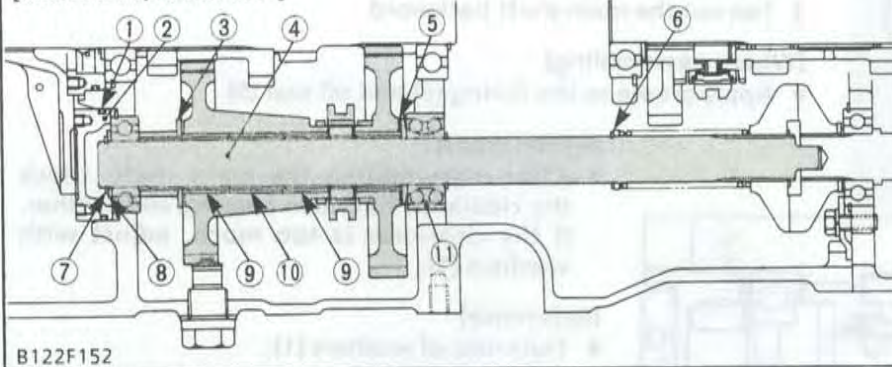
(When reassembling)

- Direct the ball grooved side of ball bearing (11) to the rear. (L2650GST, L2950GST)
- Install the collar (10) between inner rings (9). (L2650GST, L2950GST, L3450GST)
- Direct the oil grooved side of thrust collar (3) to the gear side.
- Install the collar (6) of one-way clutch certainly.
- Apply grease to O-ring (1) on the bearing cover.

■ IMPORTANT

- After reassembling the PTO counter shaft, measure the clearance between gear and spline boss. If the clearance is not within the factory specifications, adjust with washers (8).

[L2650GST, L2950GST]

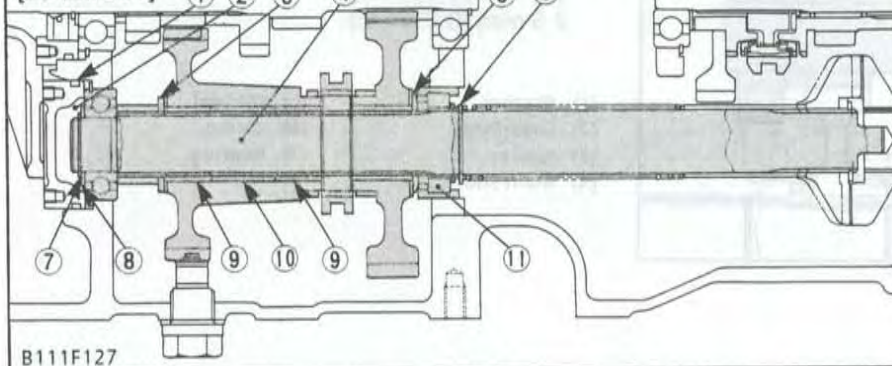


(Reference)

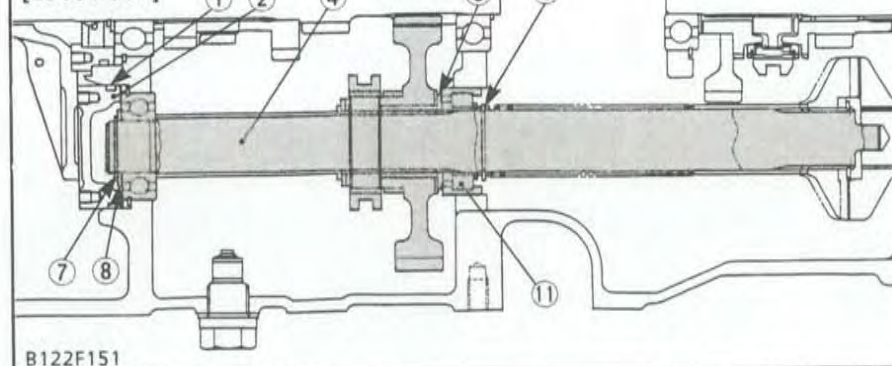
- Thickness of washers (8):
2.0 mm (0.079 in.)
2.3 mm (0.090 in.)
2.5 mm (0.098 in.)

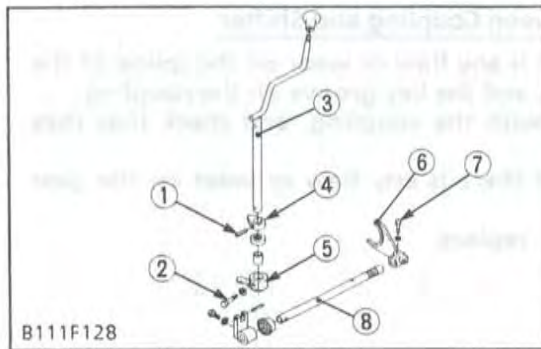
- (1) O-ring
- (2) Bearing Cover
- (3) Thrust Collar
- (4) PTO Counter Shaft
- (5) Thrust Collar
- (6) Collar
- (7) Snap Ring
- (8) Washer
- (9) Inner Ring
- (10) Collar
- (11) Ball Bearing [L2650GST, L2950GST]
Roller Bearing [L3450GST, L3650GST]

[L3450GST]



[L3650GST]



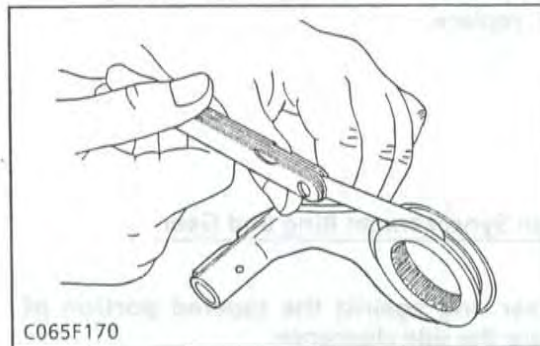


PTO Shift Fork and Lever

1. Remove the PTO shift fork mounting screw (2).
2. Pull out the PTO shift rod (8) and take out the PTO shift fork (1).
3. Remove the speed change arm mounting screw (2).
4. Tap out the spring pin (1).
5. Pull out the PTO shift lever (3).

- | | |
|------------------------|----------------------|
| (1) Spring Pin | (5) Speed Change Arm |
| (2) Screw | (6) PTO Shift Fork |
| (3) PTO Shift Lever | (7) Screw |
| (4) Neutral Switch Cam | (8) PTO Shift Rod |

SERVICING



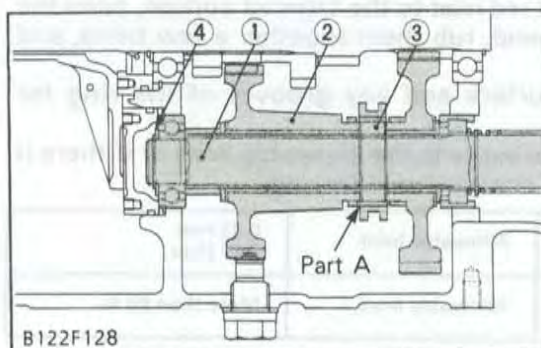
Checking Bearing

(See page S.3-62.)

Clearance between Shift Fork and Shifter Groove

1. Place the shift fork in the shifter groove to measure the clearance.
2. If the measurement exceeds the allowable limit, replace them.

Clearance between shift fork and shifter groove	Factory spec	0.25 to 0.45 mm 0.0098 to 0.0177 in.
	Allowable limit	0.8 mm 0.031 in.



- | | |
|-----------------------|-------------------|
| (1) PTO Counter Shaft | (3) Spline Boss |
| (2) 39T Gear | (4) Adjust Washer |

Side Clearance between Gear and Spline Boss on the PTO Counter Shaft [L2650GST, L2950GST, L3450GST]

1. Insert a feeler gauge between gear and spline boss (Part A) to measure the clearance.
2. If the measurement is not within the factory specifications, adjust the clearance with washer (4) on the front end of shaft.

(Reference)

- Thickness of washers:
 - 2.0 mm (0.079 in.) [Code No. 34150-21561]
 - 2.3 mm (0.091 in.) [Code No. 38450-23781]
 - 2.5 mm (0.098 in.) [Code No. 38450-23791]

Side clearance between gear and spline boss	Factory spec	0.1 to 0.3 mm 0.004 to 0.012 in.
---	--------------	-------------------------------------

Gear Backlash

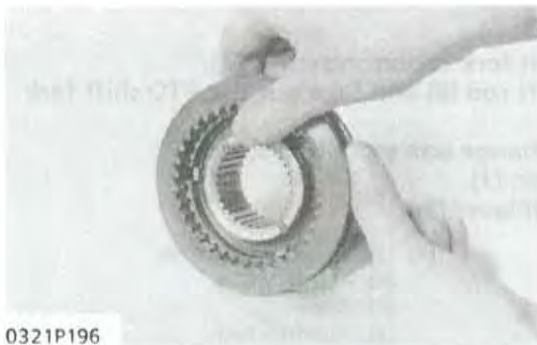
1. Set a dial gauge (lever type) with its finger on the gear tooth surface.
2. Move the gear to measure the backlash.
3. If the measurement exceeds the allowable limit, replace.

■ IMPORTANT

- Measure the backlash at three equally spaced positions on the gear, and obtain the average.

Gear backlash	Factory spec	0.1 to 0.2 mm 0.004 to 0.008 in.
	Allowable limit	0.5 mm 0.020 in.

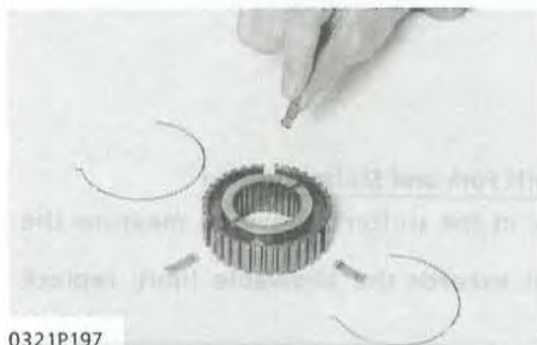




Checking Contact between Coupling and Shifter

1. Check to see if there is any flaw or wear on the spline of the coupling and shifter, and the key groove on the coupling.
2. Engage the shifter with the coupling, and check that they slide smoothly.
3. Similarly, check that there is any flaw or wear on the gear splines.
4. If there is any defect, replace.

0321P196



Flaw on Synchronizer Key and Spring

1. Check the projection in the center of the synchronizer key for wear.
2. Check the spring for fatigue or wear on the area where the spring contacts with the keys.
3. If there is any defect, replace.

0321P197

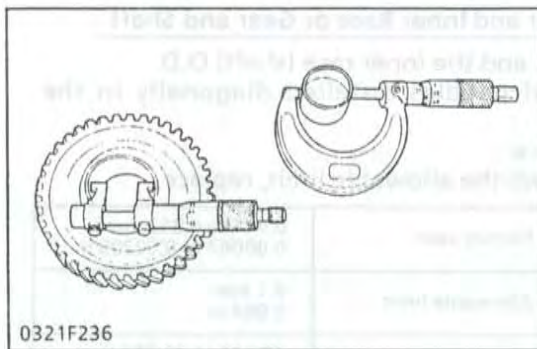


Side Clearance between Synchronizer Ring and Gear (in Contact)

1. Press the synchronizer ring against the tapered portion of the gear, and measure the side clearance.
2. Apply a thin film of red lead to the tapered portion, press the ring against it by hand, rub them together a few times, and check the contact.
3. Check the tooth surface and key grooves of the ring for wear.
4. If the side clearance exceeds the allowable limit or if there is any defect, replace the synchronizer ring.

0321P198

Side clearance	Allowable limit	0.35 mm 0.0138 in.
Contact condition on tapered portion	Allowable limit	More than 80 %



Clearance between Gear and Inner Race (or Shaft)

1. Measure the gear I.D. and inner race (or shaft) O.D.
2. Calculate the clearance.
3. If the clearance exceeds the allowable limit, replace.

Clearance between 46T gear and counter shaft	Factory spec.	0.020 to 0.055 mm 0.0008 to 0.0022 in.
	Allowable limit	0.1 mm 0.004 in.
46T gear I.D.	Factory spec.	32.025 to 32.050 mm 1.2608 to 1.2618 in.
Counter shaft O.D.	Factory spec.	31.995 to 32.005 mm 1.2597 to 1.2600 in.

Clearance between gears and inner races on counter shaft or PTO counter shaft	Factory spec.	0.017 to 0.058 mm 0.0007 to 0.0023 in.
	Allowable limit	0.1 mm 0.004 in.
Gear I.D.	Factory spec.	32.025 to 32.050 mm 1.2608 to 1.2618 in.
Inner race O.D.	Factory spec.	31.992 to 32.008 mm 1.2596 to 1.2602 in.

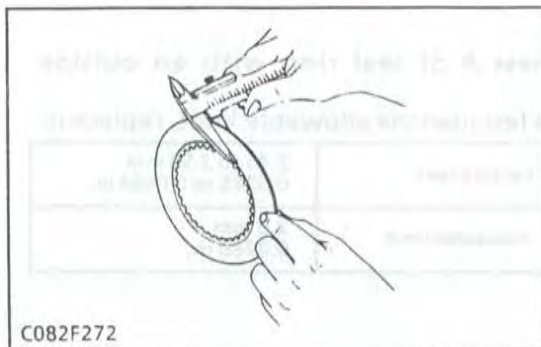
Clearance between 42T gear and inner race on Hi-Lo shaft	Factory spec.	0.017 to 0.058 mm 0.0007 to 0.0023 in.
	Allowable limit	0.1 mm 0.004 in.
42T gear I.D.	Factory spec.	32.025 to 32.050 mm 1.2608 to 1.2618 in.
Inner race O.D.	Factory spec.	31.992 to 32.008 mm 1.2596 to 1.2602 in.

0329P094

Clearance between Gear and Inner Race or Gear and Shaft

1. Measure the gear I.D. and the inner race (shaft) O.D.
2. Measure the O.D. of needles installed diagonally in the needle bearing.
3. Calculate the clearance.
4. If the clearance exceeds the allowable limit, replace.

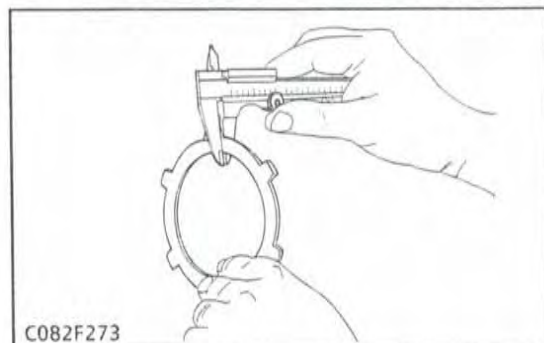
Clearance between 27T gear and inner race	Factory spec.	0.017 to 0.052 mm 0.00067 to 0.00205 in.
	Allowable limit	0.1 mm 0.004 in.
27T gear I.D.	Factory spec.	37.025 to 37.034 mm 1.45768 to 1.45803 in.
Inner race O.D.	Factory spec.	31.992 to 32.008 mm 1.25953 to 1.26016 in.
Needle O.D.	Factory spec.	2.459 to 2.500 mm 0.09823 to 0.09843 in.
Clearance between 17-32T or 17-33T gear and shuttle shaft	Factory spec.	0.005 to 0.038 mm 0.00002 to 0.00150 in.
	Allowable limit	0.1 mm 0.004 in.
17-32T or 17-33T gear I.D.	Factory spec.	29.007 to 29.020 mm 1.14200 to 1.14252 in.
Shuttle shaft O.D.	Factory spec.	24.9940 to 25.0065 mm 0.98402 to 0.98452 in.
Needle O.D.	Factory spec.	1.994 to 2.000 mm 0.07850 to 0.07874 in.
Clearance between 17-17T or 18-17T gear and Hi-Lo shaft	Factory spec.	0.002 to 0.041 mm 0.00008 to 0.00161 in.
	Allowable limit	0.1 mm 0.004 in.
17-17T or 18-17T gear I.D.	Factory spec.	33.009 to 33.025 mm 1.29957 to 1.30020 in.
Hi-Lo shaft O.D.	Factory spec.	27.994 to 28.007 mm 1.10213 to 1.10264 in.
Needle O.D.	Factory spec.	2.495 to 2.500 mm 0.09823 to 0.09843 in.



Clutch Disc Wear

1. Measure the thickness of the clutch disc with vernier calipers.
2. If the thickness is less than the allowable limit, replace it.

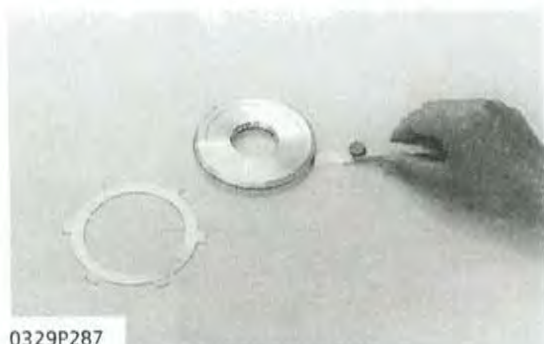
Thickness of clutch disk	Factory spec.	2.2 to 2.3 mm 0.0866 to 0.0906 in.
	Allowable limit	1.9 mm 0.0748 in.



Steel Plate Wear

1. Measure the thickness of the steel plate with vernier calipers.
2. If the thickness is less than the allowable limit, replace it.

Thickness of steel plate 1.2	Factory spec.	1.10 to 1.20 mm 0.0433 to 0.0472 in.
	Allowable limit	0.90 mm 0.0354 in.
Thickness of plate 4.0	Factory spec.	3.89 to 4.05 mm 0.1531 to 0.1594 in.
	Allowable limit	3.70 mm 0.1457 in.



Flatness of Piston Plate 1.2 and Plate 4.0

1. Place the part on a surface plate and check it unable to insert a feeler gauge (allowable limit size) underneath it at opposite locations at least four points.
2. If the gauge can be inserted, grind the plate with sandpaper using a circular motion or replace.

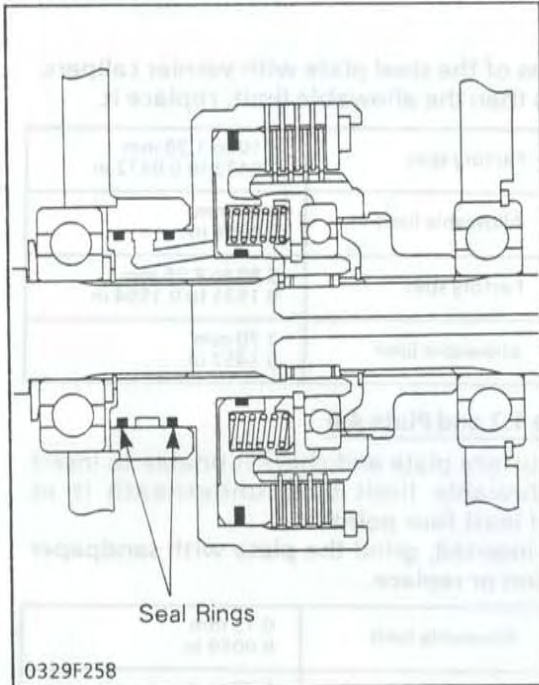
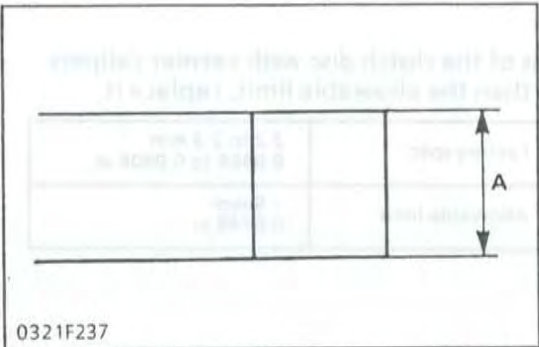
Flatness of piston	Allowable limit	0.15 mm 0.0059 in.
Flatness of plate 1.2 and plate 4.0	Allowable limit	0.30 mm 0.0118 in.



Piston Return Spring Free Length

1. Measure the piston return spring using calipers.
2. If the measurement is smaller than the using limit, replace the piston return spring.

Free length	Factory spec.	20.3 to 20.7 mm 0.799 to 0.815 in.
	Allowable limit	17.4 mm 0.685 in.



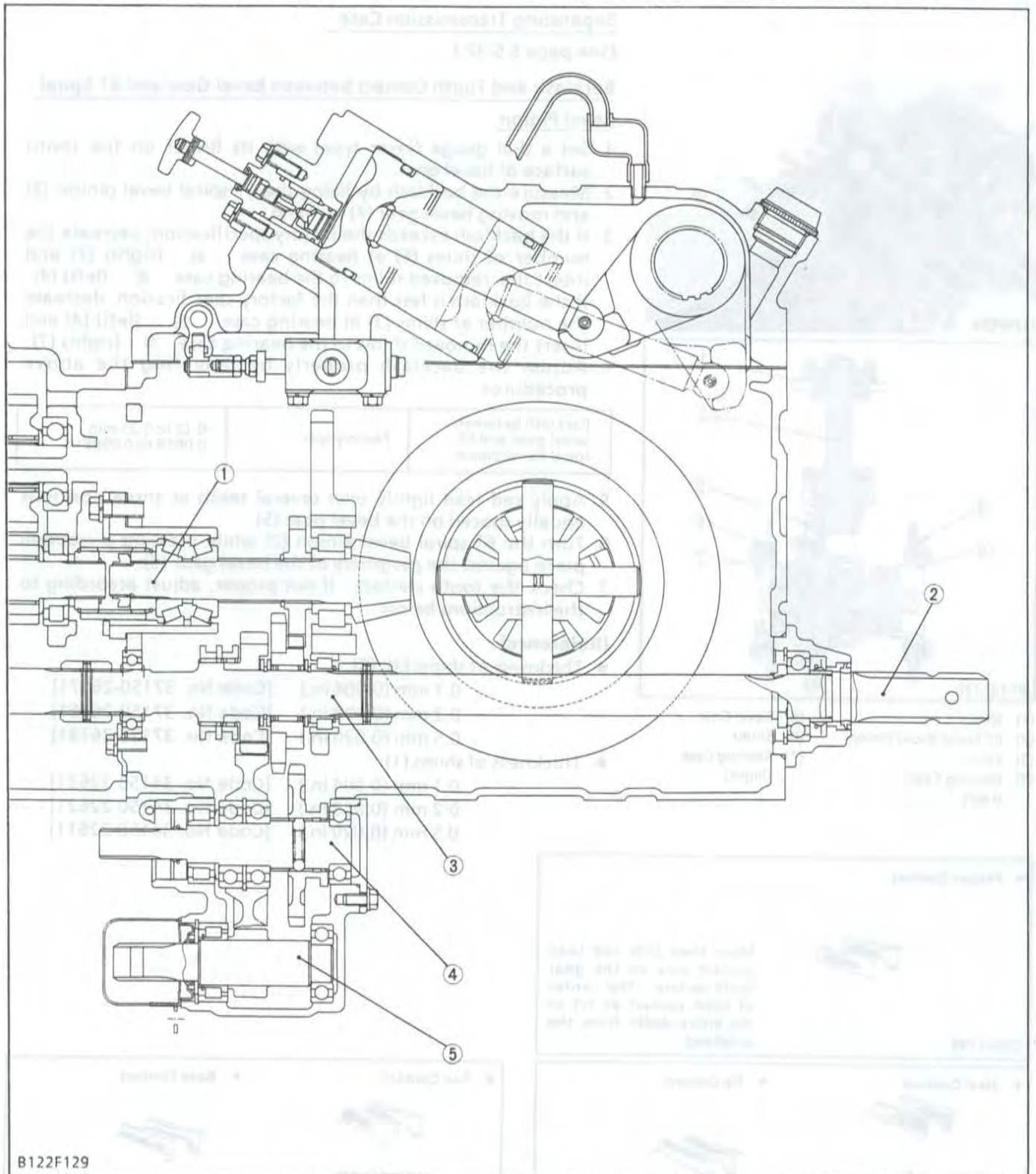
Thickness of Seal Ring

1. Measure the thickness A of seal ring with an outside micrometer.

2. If the measurement is less than the allowable limit, replace it.

Thickness of seal ring	Factory spec.	2.45 to 2.50 mm 0.0965 to 0.0984 in.
	Allowable limit	2.0 mm 0.0788 in.

Pin height		
Factory spec.	20.3 to 20.7 mm 0.799 to 0.819 in.	
Allowable limit	17.5 mm 0.689 in.	

[3]-4 TRANSMISSION CASE

B122F129

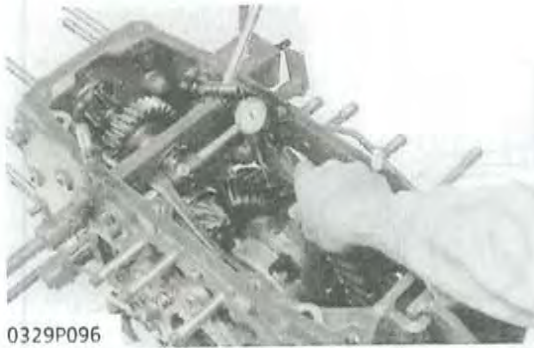
(1) 6T Spiral Bevel Pinion
(2) PTO Shaft

(3) PTO Drive Shaft

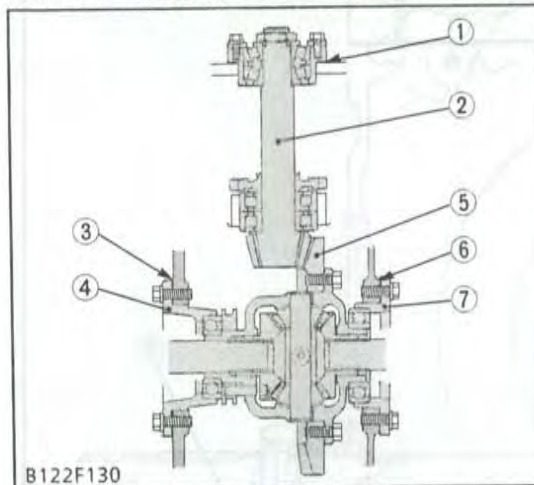
(4) Front Drive Shaft

(5) Mid PTO Shaft

CHECKING AND ADJUSTING



0329P096



B122F130

- | | |
|----------------------------|--------------------------|
| (1) Shims | (5) Bevel Gear |
| (2) 6T Spiral Bevel Pinion | (6) Shims |
| (3) Shims | (7) Bearing Case (Right) |
| (4) Bearing Case (Left) | |

Separating Transmission Case

(See page S.5-32.)

Backlash and Tooth Contact between Bevel Gear and 6T SpiralBevel Pinion

1. Set a dial gauge (lever type) with its finger on the tooth surface of bevel gear.
2. Measure the backlash by fixing the 6T spiral bevel pinion (2) and moving bevel gear (5) by hand.
3. If the backlash exceeds the factory specification, decrease the number of shims (6) at bearing case 右 (right) (7) and insert the removed shims to the bearing case 左 (left) (4). If the backlash is less than the factory specification, decrease the number of shims (3) at bearing case 左 (left) (4) and insert the removed shims to the bearing case 右 (right) (7).
4. Adjust the backlash properly by repeating the above procedures.

Backlash between bevel gear and 6T spiral bevel pinion	Factory spec.	0.15 to 0.25 mm 0.0059 to 0.0098 in
--	---------------	--

5. Apply red lead lightly over several teeth at three positions equally spaced on the bevel gear (5).
6. Turn the 6T spiral bevel pinion (2) while pressing a wooden piece against the periphery of the bevel gear (5).
7. Check the tooth contact. If not proper, adjust according to the instructions below.

(Reference)

- Thickness of shims (3), (6):

0.1 mm (0.004 in.)	[Code No. 37150-26171]
0.2 mm (0.008 in.)	[Code No. 37150-26161]
0.5 mm (0.020 in.)	[Code No. 37150-26181]

- Thickness of shims (1):

0.1 mm (0.004 in.)	[Code No. 34150-22631]
0.2 mm (0.008 in.)	[Code No. 34150-22621]
0.5 mm (0.020 in.)	[Code No. 34150-22611]

• Proper Contact



More than 35% red lead contact area on the gear tooth surface. The center of tooth contact at 1/3 of the entire width from the small end.

C065F198

• Heel Contact



• Tip Contact



0329F097

Replace adjusting shim (1) with thinner one to move the bevel pinion shaft backward.
And place the left side shim (3) to the right to move the bevel gear rightward.
Repeat above until the proper tooth contact and backlash are achieved.

• Toe Contact



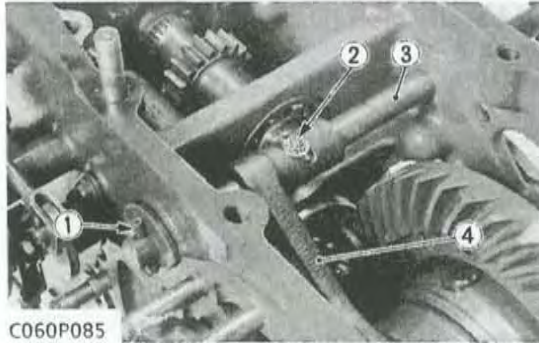
• Base Contact



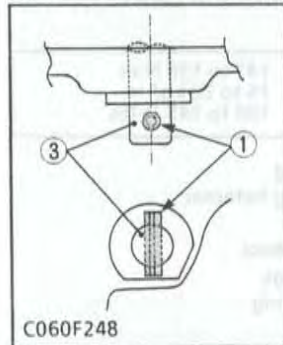
0329F098

Replace adjusting shim (1) with thicker one to move the bevel pinion shaft forward.
And place the right side shim (6) to the left to move the bevel gear leftward.
Repeat above until the proper tooth contact and backlash are achieved.

DISASSEMBLING AND ASSEMBLING



C060P085



C060F248

Differential Lock Shift Fork

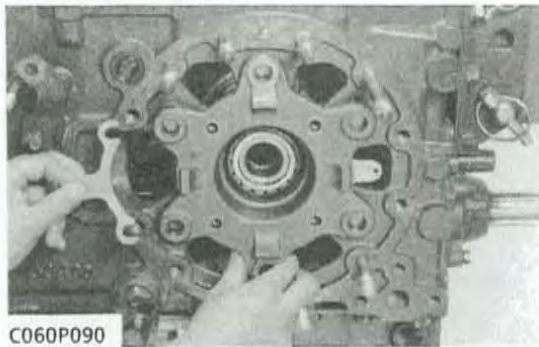
1. Tap out the spring pin (1).
2. Remove the cotter pin and take out the clevis pin (2).
3. Draw out the differential lock fork shaft (3) and take out the differential lock shift fork (4).

(When reassembling)

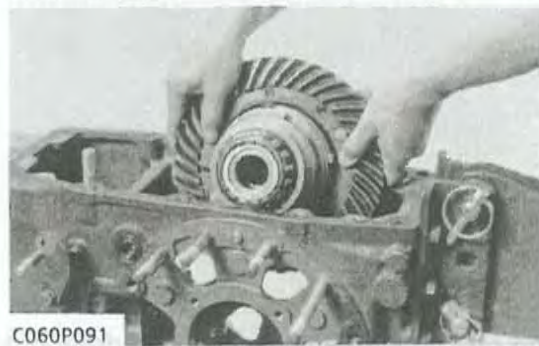
- Apply grease to the left and right oil seals on the transmission case.
- Insert the clevis pin (2) from under and install the washer and cotter pin.
- Tap in the spring pin (1) so that its split portion may face outward as shown in the figure.

(1) Spring Pin
(2) Clevis Pin

(3) Differential Lock Fork Shaft
(4) Differential Lock Shift Fork



C060P090



C060P091

Differential Gear Assembly

1. Remove the differential bearing cases, noting the number of left and right shims.
2. Take out the differential assembly.
3. Check the spiral bevel gear for wear or damage. If it is no longer serviceable, replace it. Then, also replace spiral bevel pinion.

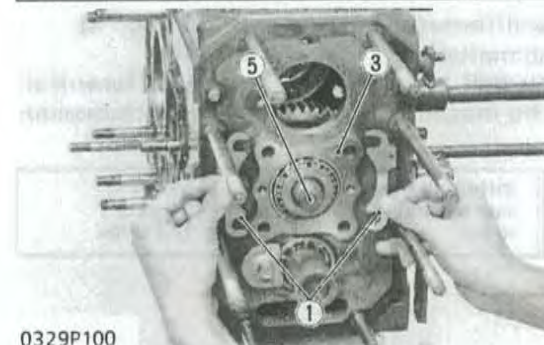
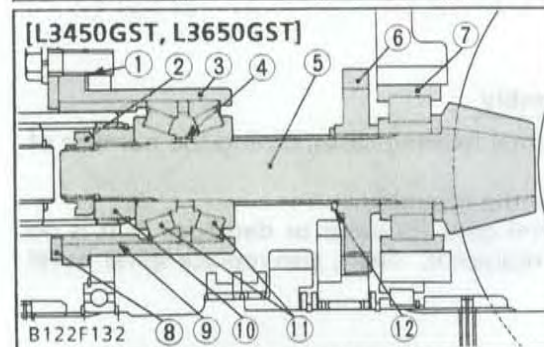
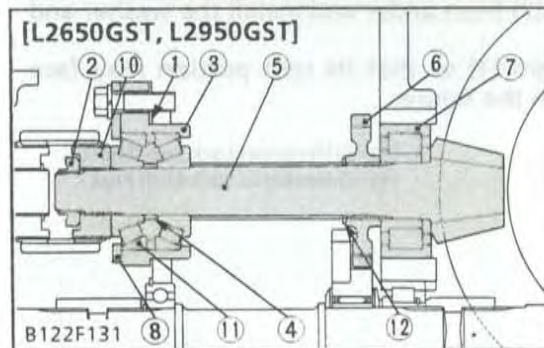
(When reassembling)

- Be sure to install the differential bearing case marked 右 in the right side, and marked 左 in the left side.
- Be sure to align the ball hole portion on the differential bearing case with the machined surface on the transmission case.

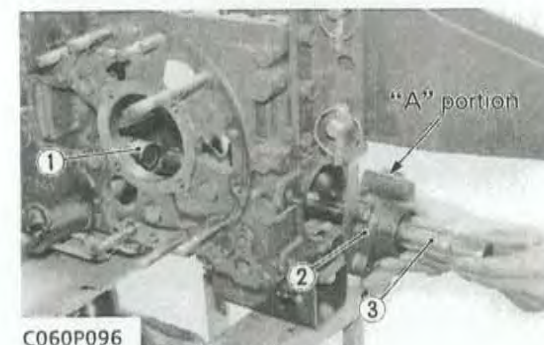
Tightening torque	Differential bearing case mounting screw	48.1 to 55.8 N·m 4.9 to 5.7 kgf·m 35.5 to 41.2 ft·lbs
-------------------	--	---



0329P099



0329P100



C060P096

6T Spiral Bevel Pinion

1. Remove the stake of lock nut (2).
2. Lock up the 6T spiral bevel pinion (5), and remove the lock nut (2) and spline boss (10).
3. Remove the pinion bearing retainer (8). [L2650GST, L2950GST]
Remove the pinion bearing retainer (8) and collar (9). [L3450GST, L3650GST]
4. Take the pinion bearing case shims (1), noting the number of them.
5. Remove the pinion bearing case (3) with a puller.
6. Take out the distance collar (4).
7. Move the snap ring (12) to the front.
8. Hammer out the 6T spiral bevel pinion (5) to the rear.
9. Take out the 21T gear (6).

Tightening torque	Lock nut	147 to 196 N·m 15 to 20 kgf·m 109 to 145 ft-lbs
-------------------	----------	---

- | | |
|----------------------------|----------------------|
| (1) Shims | (7) Bearing |
| (2) Lock Nut | (8) Bearing Retainer |
| (3) Bearing Case | (9) Collar |
| (4) Distance Collar | (10) Spline Boss |
| (5) 6T Spiral Bevel Pinion | (11) Bearings |
| (6) 21T Gear | (12) Snap Ring |

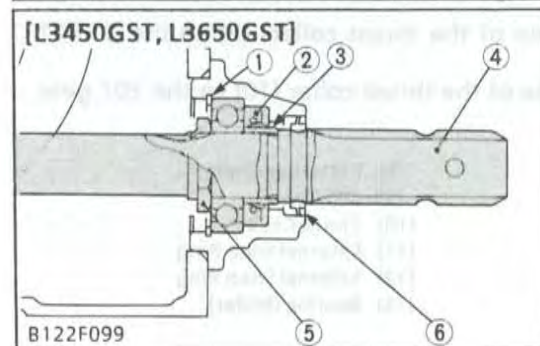
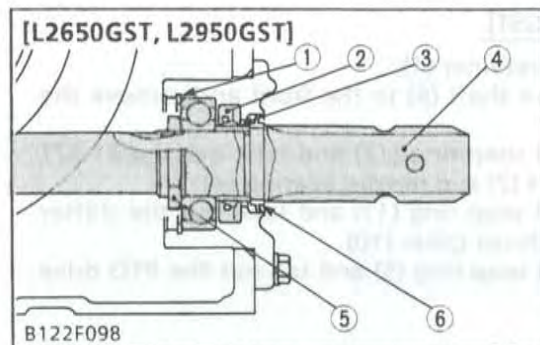
PTO Bearing Case

1. Remove the bearing case (2) mounting screws, and draw out the PTO shaft (3) with bearing case.
2. Take out the coupling (1).

(When reassembling)

- Direct the boss A portion on bearing case (2) upward.

- | | |
|------------------|---------------|
| (1) Coupling | (3) PTO Shaft |
| (2) Bearing Case | |



PTO Shaft

1. Remove the internal snap ring (1).
2. Tap out the PTO shaft (4) to the front.

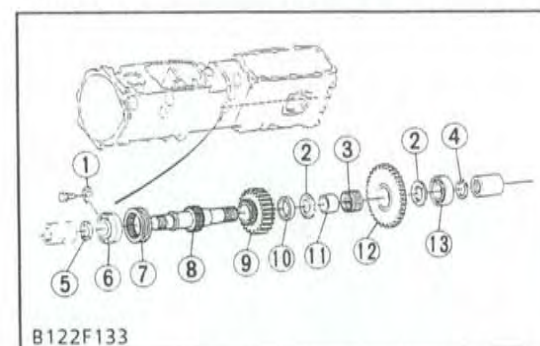
(When reassembling)

- If the lock nut (5) was removed, replace a new one, be sure to stake it firmly.
- Install the slinger (6) firmly.
- Apply grease to oil seal (2) and install it, noting its direction.

Tightening torque	Lock nut	147 to 196 N·m 15 to 20 kgf·m 108 to 145 ft-lbs
-------------------	----------	---

- (1) Internal Snap Ring
(2) Oil Seal
(3) Collar

- (4) PTO Shaft
(5) Lock Nut
(6) Slinger



PTO Drive Shaft [L2650GST, L2950GST]

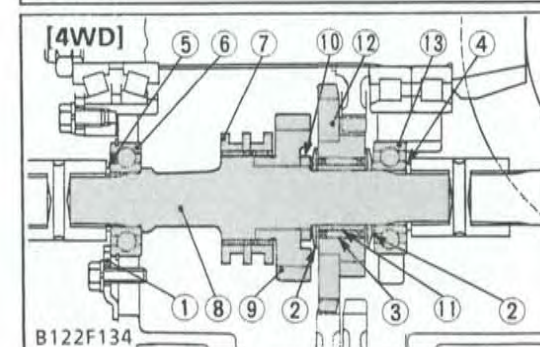
1. Remove the bearing retainer (1).
2. Remove the external snap ring (4) on the rear of PTO drive shaft (8), and tap out it to the front.

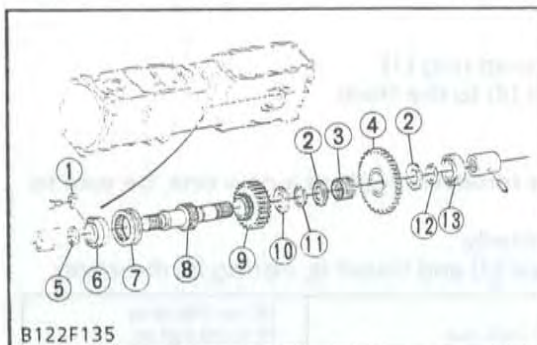
(When reassembling)

- Direct the groove side of thrust collars (2) to the 21-34T Gear (12) side.

- (1) Bearing Retainer
(2) Thrust Collars
(3) Needle Bearing
(4) Snap Ring
(5) Snap Ring
(6) Bearing
(7) Shifter

- (8) PTO Drive Shaft
(9) 20T Gear
(10) Collar
(11) Inner Ring
(12) 21-34T
(13) Bearing





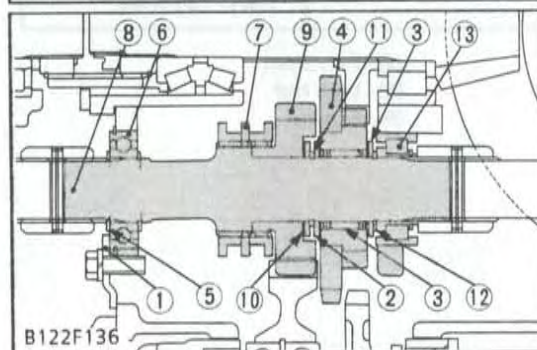
PTO Drive Shaft [L3450GST]

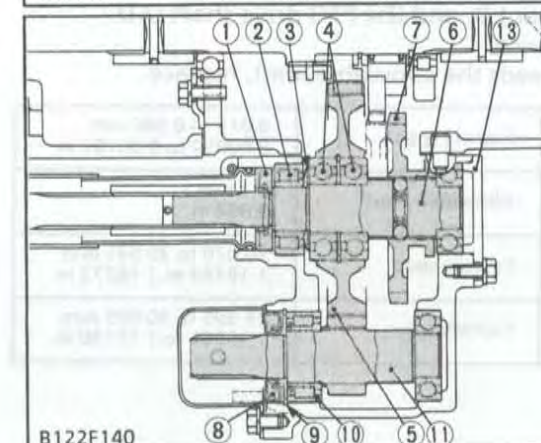
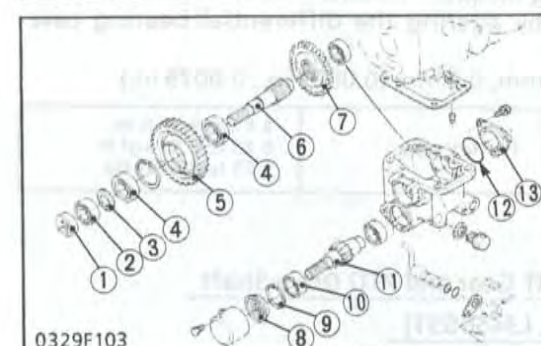
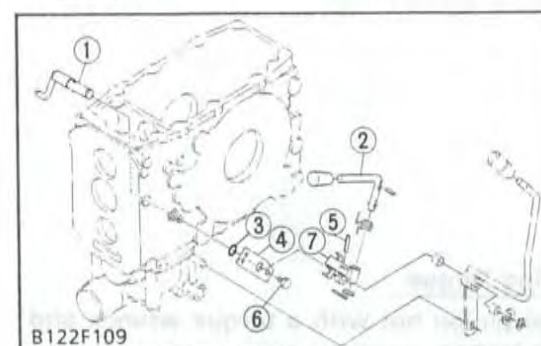
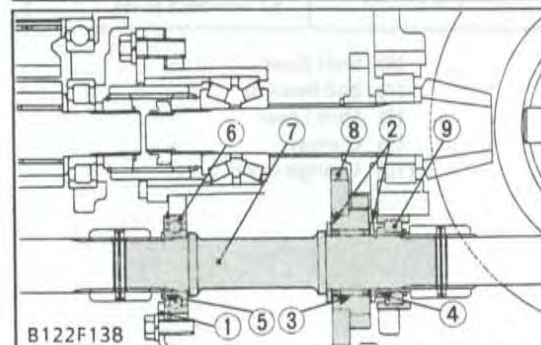
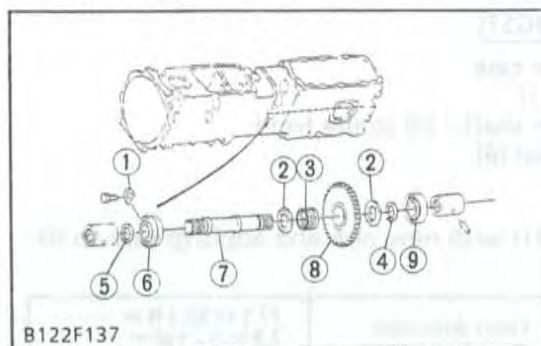
1. Remove the bearing retainer (1).
2. Tap out the PTO drive shaft (8) to the front and remove the bearing (13).
3. Remove the external snap ring (12) and take out the 21-32T gear (4), thrust collars (2) and needle bearing (3).
4. Remove the external snap ring (11) and take out the shifter (7), 20T gear (9) and thrust collar (10).
5. Remove the external snap ring (5) and tap out the PTO drive shaft (8) to the rear.

(When reassembling)

- Direct the groove side of the thrust collars (2) to the 21-32T gear (4) side.
- Direct the groove side of the thrust collar (10) to the 20T gear side.

- | | |
|------------------------|-------------------------|
| (1) Bearing Retainer | (8) PTO Drive Shaft |
| (2) Thrust Collars | (9) 20T Gear |
| (3) Needle Bearing | (10) Thrust Collar |
| (4) 21-32T gear | (11) External Snap Ring |
| (5) External Snap Ring | (12) External Snap Ring |
| (6) Bearing | (13) Bearing (Roller) |
| (7) Shifter | |





PTO Drive Shaft [L3650GST]

1. Remove the bearing retainer (1).
2. Tap out the PTO drive shaft (7) to the front and remove the bearing (9).
3. Remove the external snap ring (4) and take out the 21-32T gear (8), thrust collars (2) and needle bearing (3).
4. Remove the external snap ring (5) and tap out the PTO drive shaft (7) to the rear.

(When reassembling)

- Direct the groove side of the thrust collars (2) to the 21-32T gear (8).

- | | |
|------------------------|----------------------|
| (1) Bearing Retainer | (6) Bearing |
| (2) Thrust Collars | (7) PTO Drive Shaft |
| (3) Needle Bearing | (8) 21-32T Gear |
| (4) External Snap Ring | (9) Bearing (Roller) |
| (5) External Snap Ring | |

Mid PTO Shift Lever [L2650GST, L2950GST, L3450GST]

1. Remove the shift levers (2), (7) and guide (4).
2. Take out the shift lever 3 (1).

(When reassembling)

- Tighten the screw (6) of the guide (4) after installing the spring pin (5).

- | | |
|-------------------|-------------------|
| (1) Shift Lever 3 | (5) Spring Pin |
| (2) Shift Lever 1 | (6) Screw |
| (3) O-ring | (7) Shift Lever 2 |
| (4) Guide | (8) Holder |

Front Drive Case [L2650GST, L2950GST, L3450GST]

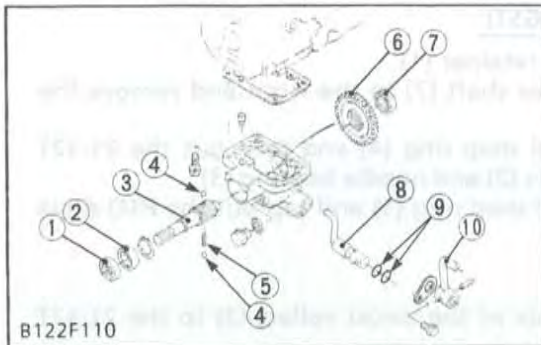
1. Remove the front drive case cover (13).
2. Tap out the propeller shaft 1 (6) to the rear.
3. Take out the shift gear (7).
4. Remove the oil seal (8).
5. Remove the internal snap ring (9).
6. Tap out the mid PTO shaft (11) to the front.

(When reassembling)

■ IMPORTANT

- Be sure to install the bearings (2), (10) as shown in the figure, noting direction of their inner races.
- Direct the longer boss side of the 37T gear (5) to the front.
- Direct the oil grooved side of thrust collar (3) to the gear side.
- Replace the oil seal with new one and apply grease to its inside.

- | | |
|-----------------------|------------------------|
| (1) Oil Seal | (8) Oil Seal |
| (2) Bearing | (9) Internal Snap Ring |
| (3) Thrust Collar | (10) Bearing |
| (4) Ball Bearing | (11) Mid PTO Shaft |
| (5) 37T Gear | (12) O-ring |
| (6) Propeller Shaft 1 | (13) Drive Case Cover |
| (7) Shift Gear | |

**Front Drive Case [L3650GST]**

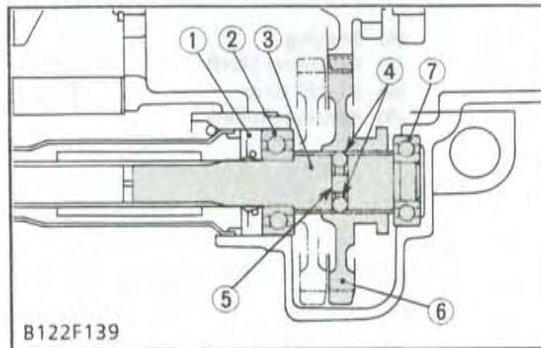
1. Removing front drive case.
2. Remove the oil seal (1).
3. Tap out the propeller shaft 1 (3) to the front.
4. Take out the shift gear (6).

(When reassembling)

- Replace the oil seal (1) with new one and apply grease to its inside.

Tightening torque	Front drive case mounting screws	77.5 to 90.2 N·m 7.9 to 9.2 kgf·m 57.1 to 66.5 ft-lbs
-------------------	----------------------------------	---

- | | |
|-----------------------|-------------------|
| (1) Oil Seal | (6) Shift Gear |
| (2) Ball Bearing | (7) Ball Bearing |
| (3) Propeller Shaft 1 | (8) Shift Lever |
| (4) Balls | (9) O-rings |
| (5) Spring | (10) Change Lever |

**SERVICING****Checking Bearing**

(See page S.3-62.)

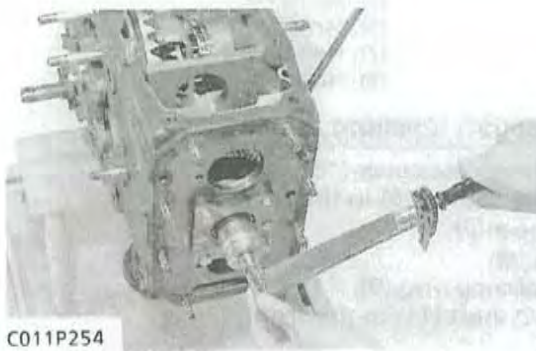
Gear Backlash

(See page S.3-68.)

Differential Gear Turning Torque

1. Grip the spiral bevel pinion nut with a torque wrench and measure the turning torque.
2. Adjust the torque by altering the differential bearing case shim thickness.
Shim thickness: 0.1 mm, 0.2 mm (0.0039 in., 0.0079 in.)

Differential gear turning torque (Combined)	Factory spec.	4.41 to 9.32 N·m 0.45 to 0.95 kgf·m 3.25 to 6.87 ft-lbs
---	---------------	---

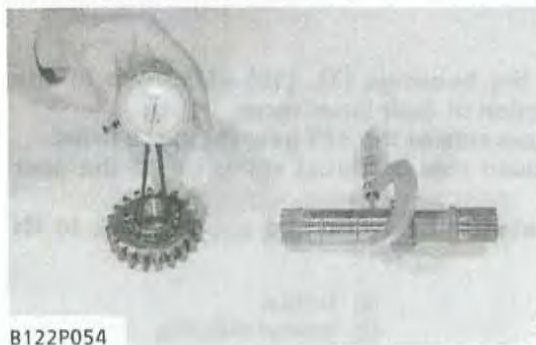


C011P254

**Clearance between 20T Gear and PTO Drive Shaft
[L2650GST, L2950GST, L3450GST]**

1. Measure the 20T gear I.D. and the PTO drive shaft O.D.
2. Calculate the clearance.
3. If the clearance exceeds the allowable limit, replace.

Clearance between 20T gear and PTO drive shaft	Factory spec.	0.015 to 0.046 mm 0.00059 to 0.00181 in.
	Allowable limit	0.1 mm 0.004 in.
20T gear I.D.	Factory spec.	30.020 to 30.041 mm 1.18189 to 1.18272 in.
PTO drive shaft O.D.	Factory spec.	29.995 to 30.005 mm 1.18091 to 1.18130 in.



B122P054



B122P055

Clearance between 21-34T Gear and Inner Race on PTO Drive Shaft [L2650GST, L2950GST]

1. Measure the 21-34T gear I.D. and the inner race O.D.
2. Measure the O.D. of needle installed diagonally in the needle bearing.
3. Calculate the clearance.
4. If the clearance exceeds the allowable limit, replace.

Clearance between 21-34T gear and inner race	Factory spec.	0.004 to 0.043 mm 0.00016 to 0.00169 in.
	Allowable limit	0.1 mm 0.004 in.
21-34T gear I.D.	Factory spec.	37.009 to 37.025 mm 1.45705 to 1.45768 in.
Inner race O.D.	Factory spec.	29.995 to 30.005 mm 1.18095 to 1.18130 in.
Needle O.D.	Factory spec.	3.493 to 3.500 mm 0.13752 to 0.13780 in.



B122P056

Clearance between 21-32T Gear and PTO Drive Shaft [L3450GST, L3650GST]

1. Measure the 21-32T gear I.D. and the PTO drive shaft O.D.
2. Measure the O.D. of needle installed diagonally in the needle bearing.
3. Calculate the clearance.
4. If the clearance exceeds the allowable limit, replace.

Clearance between 21-32T gear and PTO drive shaft	Factory spec.	0.009 to 0.052 mm 0.00035 to 0.00205 in.
	Allowable limit	0.1 mm 0.004 in.
21-32T gear I.D.	Factory spec.	37.009 to 37.025 mm 1.45705 to 1.45768 in.
PTO drive shaft O.D.	Factory spec.	29.987 to 30.000 mm 1.18059 to 1.18110 in.
Needle O.D.	Factory spec.	3.493 to 3.500 mm 0.13752 to 0.13780 in.

S.4 REAR AXLE

CONTENTS

TROUBLESHOOTING	S.4-1
SERVICING SPECIFICATIONS	S.4-2
TIGHTENING TORQUES	S.4-3
CHECKING, DISASSEMBLING AND SERVICING	S.4-4
[1] REAR AXLE (L2350)	S.4-4
DISASSEMBLING AND ASSEMBLING	S.4-4
SERVICING	S.4-5
[2] REAR AXLE (L2650, L2950, L3450, L3650)	S.4-5
DISASSEMBLING AND ASSEMBLING	S.4-5
SERVICING	S.4-6
[3] DIFFERENTIAL GEAR (L2350, L2650)	S.4-6
DISASSEMBLING AND ASSEMBLING	S.4-6
SERVICING	S.4-7
[4] DIFFERENTIAL GEAR (L2650, L2950, L3450, L3650)	S.4-8
DISASSEMBLING AND ASSEMBLING	S.4-8
SERVICING	S.4-10

TROUBLESHOOTING

Before troubleshooting, confirm symptoms and accomplish basic inspection.

(1) Basic Inspection

No.	Contents	Reference Page
1	Inflation pressure of tire	M.11-5
2	Tightening torque Front wheels screws and nuts Rear wheels screws and nuts Rim bolts and nuts	S.S-1, 2
3	Transmission fluid	S.G-14, 15

(2) Troubleshooting

Symptom	Probable Cause	Solution	Reference Page
Excessive or Unusual Noise At All Time	● Improper backlash between 8T spiral bevel pinion and bevel gear	Adjust	S.3-23, 42, 76
	● Improper backlash between differential pinion and differential side gear	Adjust	S.4-8, 10
	● Bearings worn	Replace	—
Noise While Turning	● Differential pinions or differential side gears worn or damaged	Replace	S.4-6, 8
	● Differential lock binding (does not disengage)	Replace	—
	● Bearings worn	Replace	—
Differential Lock Can Not Be Set	● Differential lock shift fork damaged	Replace	S.3-24, 43, 77
	● Differential lock shift fork mounting pin damaged	Replace	S.3-24, 43, 77
	● Differential lock shifter pin damaged	Replace	S.3-24, 43, 77
Differential Lock Pedal Does Not Return	● Differential lock pedal return spring weaken or damaged	Replace	—
	● Differential lock shifter pin damaged	Replace	—

SERVICING SPECIFICATIONS

DIFFERENTIAL GEAR

Item			Factory Specification	Allowable Limit
Differential Case Bore to Differential Side Gear Boss	Clearance		0.050 to 0.151 mm 0.00197 to 0.00594 in.	0.35 mm 0.0138 in.
Differential Case Bore	I.D.	L2350 L2650*1	38.000 to 38.062 mm 1.49606 to 1.49850 in.	—
		L2650*2 L2950 L3450 L3650	40.500 to 40.562 mm 1.59449 to 1.59693 in.	—
Differential Side Gear Boss	O.D.	L2350 L2650*1	37.911 to 37.950 mm 1.49256 to 1.49410 in.	—
		L2650*2 L2950 L3450 L3650	40.411 to 40.450 mm 1.59099 to 1.59252 in.	—
Differential Pinion Shaft to Differential Pinion	Clearance	L2350 L2650*1	0.100 to 0.142 mm 0.00394 to 0.00559 in.	0.30 mm 0.0118 in.
		L2650*2 L2950 L3450 L3650	0.060 to 0.102 mm 0.00236 to 0.00402 in.	0.25 mm 0.0098 in.
Differential Pinion Shaft	O.D.	L2350 L2650*1	19.939 to 19.960 mm 0.78500 to 0.78583 in.	—
		L2650*2 L2950 L3450 L3650	19.959 to 19.980 mm 0.78579 to 0.78661 in.	—
Differential Pinion	I.D.	L2350 L2650*1	20.060 to 20.081 mm 0.78976 to 0.79059 in.	—
		L2650*2 L2950 L3450 L3650	20.040 to 20.061 mm 0.78898 to 0.78980 in.	—
Differential Pinion to Differential Side Gear	Backlash		0.15 to 0.30 mm 0.0059 to 0.0118 in.	—
Differential Side Gear Washer 1	Thickness		1.5 (1.46 to 1.54) mm 0.059 (0.0575 to 0.0606) in.	—
Differential Side Gear Washer 2	Thickness		1.6 (1.56 to 1.64) mm 0.063 (0.0614 to 0.0646) in.	—
Differential Side Gear Washer 3	Thickness		1.7 (1.66 to 1.74) mm 0.067 (0.0654 to 0.0685) in.	—

NOTE

- The tractor serial No. affected to L2650 is as follows.

L2650*1 : L2650 (2WD) ; 10001 to 19999, L2650 (4WD) ; 50001 to 59999

L2650*2 : L2650 (2WD) ; 20001 and above, L2650 (4WD) ; 60001 and above

TIGHTENING TORQUES

Tightening torques of screws and nuts on the table below are especially specified.
(For general use screws and nuts: See page S.G-8)

REAR AXLE CASE

Item	N·m	kgf·m	ft-lbs
Rear axle case mounting screws and nuts [L2350]	48.1 to 55.8	4.9 to 5.7	35.5 to 41.2
Rear axle case mounting screws [Except L2350]	48.1 to 55.8	4.9 to 5.7	35.5 to 41.2
Rear axle case mounting nut [Except L2350]	77.5 to 90.1	7.9 to 9.2	57.2 to 66.5
Rear axle lock nut	196 to 245	20 to 25	145 to 181

DIFFERENTIAL GEAR

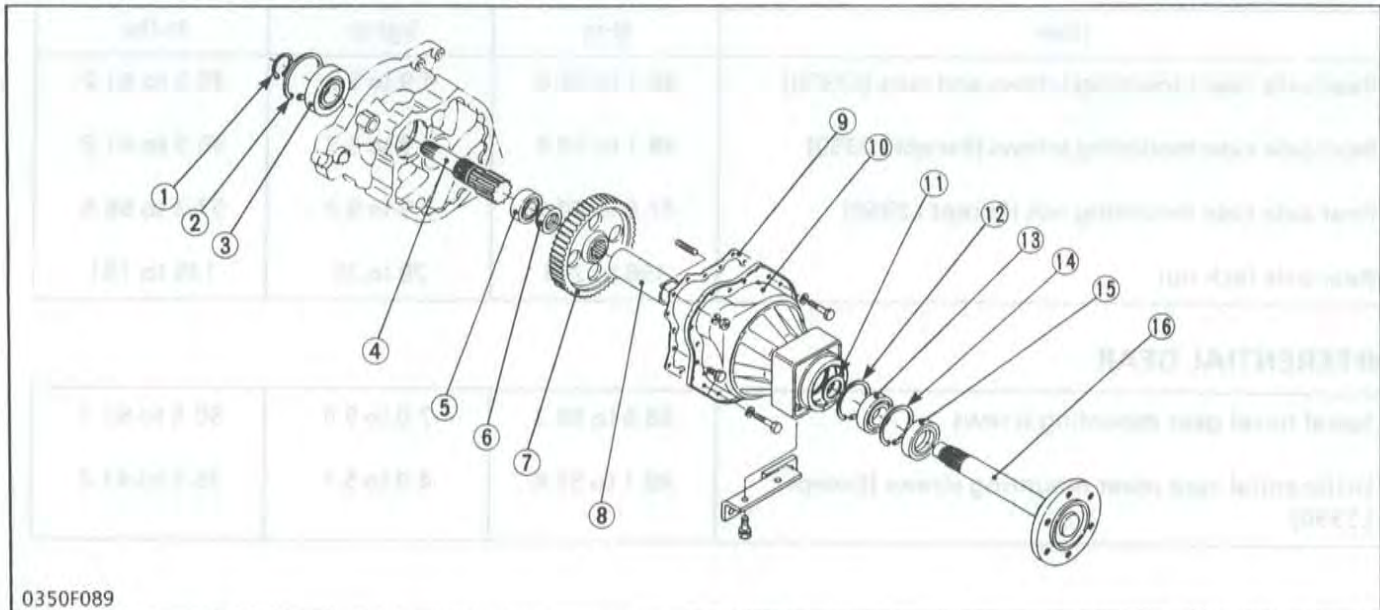
Spiral bevel gear mounting screws	68.6 to 88.3	7.0 to 9.0	50.6 to 65.1
Differential case cover mounting screws [Except L2350]	48.1 to 55.8	4.9 to 5.7	35.5 to 41.2



CHECKING, DISASSEMBLING AND SERVICING

[1] REAR AXLE (L2350)

DISASSEMBLING AND ASSEMBLING

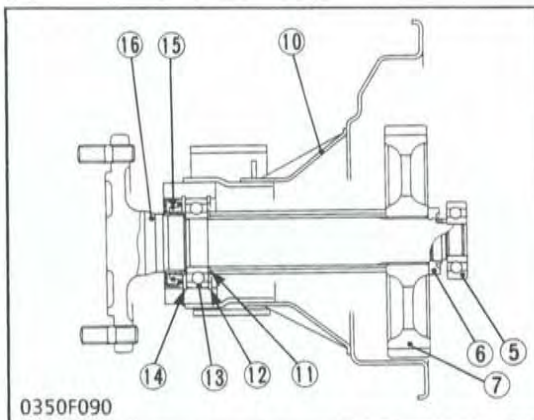


0350F089

- | | | | |
|-----------------------------|------------------|-------------------------|-------------------------|
| (1) External Snap Ring | (5) Ball Bearing | (9) Gasket | (13) Ball Bearing |
| (2) Internal Snap Ring | (6) Lock Nut | (10) Rear Axle Case | (14) Internal Snap Ring |
| (3) Ball Bearing | (7) 53T Gear | (11) Thrust Washer | (15) Oil Seal |
| (4) Differential Gear Shaft | (8) Spacer | (12) Internal Snap Ring | (16) Rear Axle |

Separating Rear Axle

(See page S.5-7)



0350F090

Rear Axle

1. Remove ball bearing (3) with a puller.
2. Remove pin from lock nut (6).
3. Hold rear axle (16) in a vise and remove lock nut (6).
4. Take out 53T gear (7), spacer (8) and thrust washer (11).
5. Tap out rear axle (16).
6. Remove internal snap ring (12) and ball bearing (13).
7. Remove internal snap ring (14) and oil seal (15).

(When reassembling)

- Apply grease to oil seal (15).
- Place thrust washer (11) between spacer (8) and ball bearing (13).
- Replace the lock nut with new one, and after tightening it to specified torque, pin it securely.

Tightening torque	Lock nut	196 to 245 N·m 20 to 25 kgf·m 145 to 181 ft·lbs
-------------------	----------	---

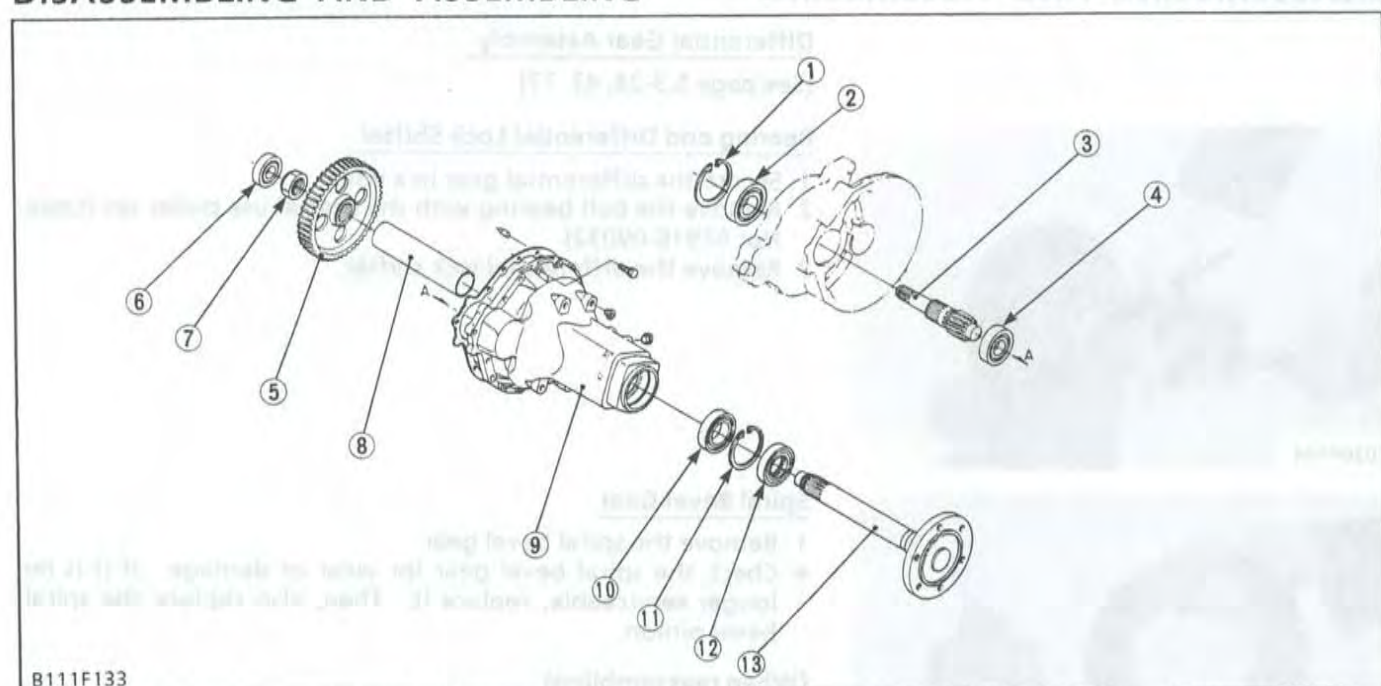
SERVICING



C045P124

Checking Bearing

1. Hold the inner race, and push and pull the outer race in all directions to check for wear and roughness.
2. Apply transmission fluid to the bearing, and hold the inner race. Then, turn the outer race to check rotation.
3. If there is any defect, replace it.

[2] REAR AXLE (L2650, L2950, L3450, L3650)**DISASSEMBLING AND ASSEMBLING**

- (1) Internal Snap Ring
(2) Ball Bearing
(3) Differential Gear Shaft
(4) Ball Bearing

- (5) 53T Gear
(6) Ball Bearing
(7) Lock Nut

- (8) Spacer
(9) Rear Axle Case
(10) Ball Bearing

- (11) Internal Snap Ring
(12) Oil Seal
(13) Rear Axle

Separating Rear Axle

(See page S.5-21)

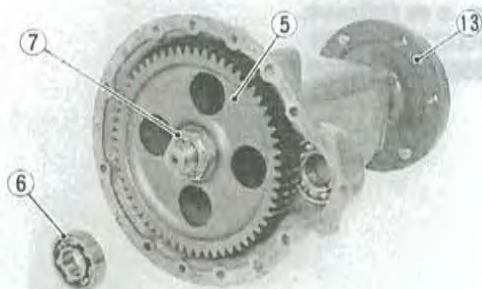
Rear Axle

1. Remove the ball bearing (6) with a puller.
2. Remove the stake of lock nut (7).
3. Secure the rear axle (13) in a vise and remove the lock nut.
4. Take out the 53T gear (5) and spacer (8).
5. Tap out the rear axle (3).

(When reassembling)

- Apply grease to the oil seal (12) and install it.
- Replace the lock nut with new one, and after tightening it to specified torque, stake it firmly.

0329P104



Tightening torque	Lock nut	196 to 245 N·m 20 to 25 kgf·m 145 to 181 ft·lbs
-------------------	----------	---

SERVICING



C045P124

Checking Bearing

1. Hold the inner race, and push and pull the outer race in all directions to check for wear and roughness.
2. Apply transmission fluid to the bearing, and hold the inner race. Then, turn the outer race to check rotation.
3. If there is any defect, replace it.

[3] DIFFERENTIAL GEAR (L2350, L2650※)**DISASSEMBLING AND ASSEMBLING**Differential Gear Assembly

(See page S.3-24, 43, 77)

Bearing and Differential Lock Shifter

1. Secure the differential gear in a vise.
2. Remove the ball bearing with the special use puller set (Code No: 07916-09032).
3. Remove the differential lock shifter.



C020P104

Spiral Bevel Gear

1. Remove the spiral bevel gear.
- Check the spiral bevel gear for wear or damage. If it is no longer serviceable, replace it. Then, also replace the spiral bevel pinion.

(When reassembling)

- Apply liquid lock (Three Bond 1372 or equivalent) to the spiral bevel gear mounting screws.



C020P105

Tightening torque	Spiral bevel gear mounting screws	68.6 to 88.3 N·m 7.0 to 9.0 kgf·m 50.6 to 65.1 ft·lbs
-------------------	-----------------------------------	---

※

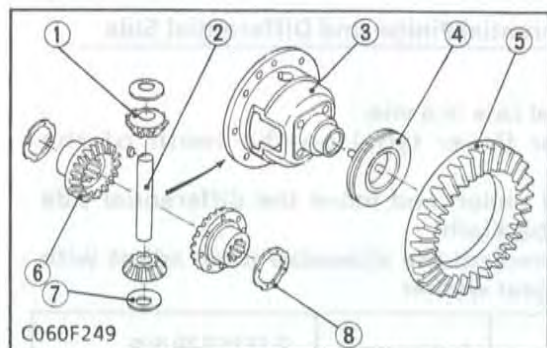
NOTE

- The tractor serial No. is as follows.

L2650 (2WD) : 10001 to 19999

L2650 (4WD) : 50001 to 59999

in 1995 to 2000 to 1995 to 2000 to 1995 to 2000	to 1995 to 2000	to 1995 to 2000
---	-----------------	-----------------



- | | |
|-------------------------------|-----------------------------------|
| (1) Differential Pinion | (6) Differential Side Gear |
| (2) Differential Pinion Shaft | (7) Differential Pinion Washer |
| (3) Differential Case | (8) Differential Side Gear Washer |
| (4) Differential Lock Shifter | |
| (5) Spiral Bevel Gear | |

Differential Pinion and Differential Side Gear

1. Draw out the differential pinion shaft (2).
2. Take out the differential pinions (1) and the differential side gears (6).

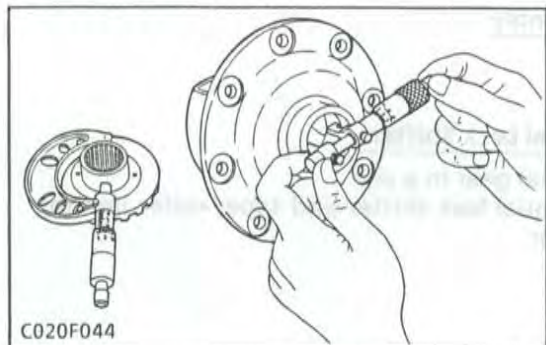
NOTE

- Arrange the parts to know their original position.

(When reassembling)

- Examine the thrust and bearing surface of both differential side gears (6). If they are worn or damaged, bores in the differential case may also be damaged.
- Check the differential pinions (1) and pinion shaft (2) for excessive wear. If these parts are damaged or excessively worn, also replace parts they are in mesh with, or they are sliding on.
- Apply molybdenum disulfide (Three Bond 1901 or equivalent) to the inner circumferential surface of the differential pinions.
- Install the parts to their original position.

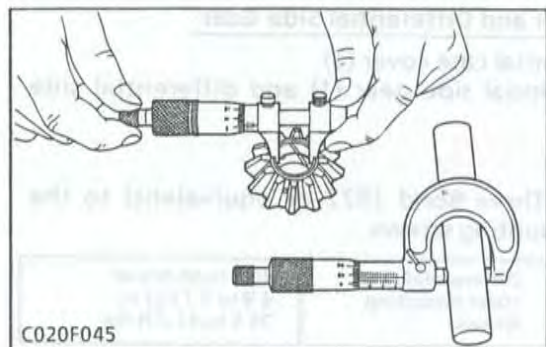
SERVICING



Clearance between Differential Case Bore and Differential Side Gear Boss

1. Measure the bore I.D. of the differential case.
2. Measure the boss O.D. of the differential side gear and calculate the clearance.
3. If the clearance exceeds the allowable limit, replace.

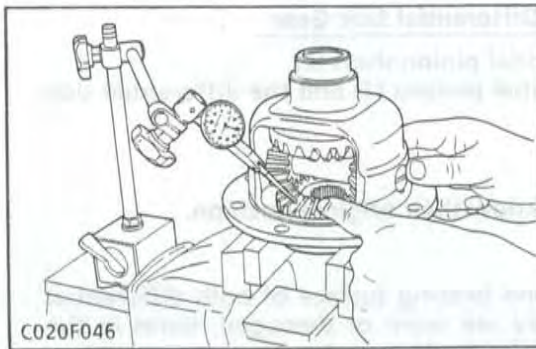
Clearance between differential case bore and differential side gear boss	Factory spec.	0.050 to 0.151 mm 0.00197 to 0.00594 in.
	Allowable limit	0.35 mm 0.0138 in.
Differential case bore I.D.	Factory spec.	38.000 to 38.062 mm 1.49606 to 1.49850 in.
Differential side gear boss O.D.	Factory spec.	37.911 to 37.950 mm 1.49256 to 1.49410 in.



Clearance between Differential Pinion Shaft and Differential Pinion

1. Measure the differential pinion shaft O.D.
2. Measure the differential pinion I.D. and calculate the clearance.
3. If the clearance exceeds the allowable limit, replace.

Clearance between differential pinion shaft and pinion	Factory spec.	0.100 to 0.142 mm 0.00394 to 0.00559 in.
	Allowable limit	0.30 mm 0.0118 in.
Differential pinion shaft O.D.	Factory spec.	19.939 to 19.960 mm 0.78500 to 0.78583 in.
Differential pinion boss I.D.	Factory spec.	20.060 to 20.081 mm 0.78976 to 0.79059 in.



Backlash between Differential Pinion and Differential Side Gear

Gear

1. Secure the differential case in a vise.
2. Set a dial indicator (lever type) on the tooth of the differential side gear.
3. Hold the differential pinion and move the differential side gear to measure the backlash.
4. If the measurement exceeds the allowable limit, adjust with the differential side gear washer.

Backlash between differential pinion and differential side gear	Factory spec.	0.15 to 0.30 mm 0.0059 to 0.0118 in.
---	---------------	---

(Reference)

- Thickness of differential side gear washers :

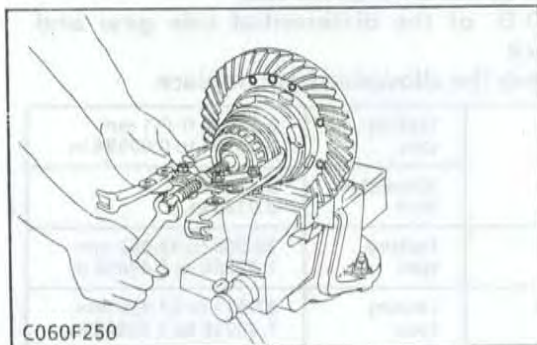
1.5 mm (0.059 in.)	[Code No. 31331-26471]
1.6 mm (0.063 in.)	[Code No. 31331-26481]
1.7 mm (0.067 in.)	[Code No. 31331-26491]

[4] DIFFERENTIAL GEAR (L2650※, L2950, L3450, L3650)

DISASSEMBLING AND ASSEMBLING

Differential Gear Assembly

(See page S.3-43, 77)



Bearing and Differential Lock Shifter

1. Secure the differential gear in a vise.
2. Remove the differential lock shifter and taper roller bearing as a unit with a puller.

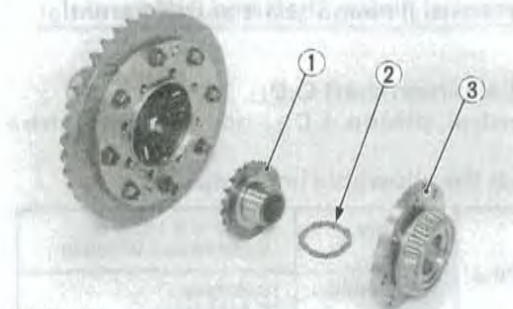
Differential Case Cover and Differential Side Gear

1. Remove the differential case cover (3).
2. Remove the differential side gear (1) and differential side gear washer (2)

(When reassembling)

- Apply liquid lock (Three Bond 1372 or equivalent) to the differential case mounting screws.

Tightening torque	Differential case cover mounting screws	48.1 to 55.8 N·m 4.9 to 5.7 kgf·m 35.5 to 41.2 ft·lbs
-------------------	---	---



C060P107

- (1) Differential Side Gear
(2) Differential Side Gear Washer

- (3) Differential Case Cover

※

NOTE

- The tractor serial No. is as follows.
L2650 (2WD) : 20001 and above
L2650 (4WD) : 60001 and above



C060P108

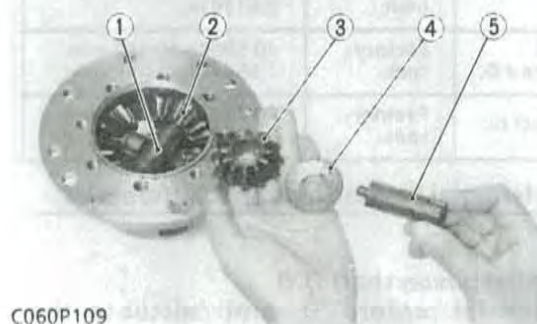
Spiral Bevel Gear

1. Remove the spiral bevel gear.
 - Check the spiral bevel gear for wear or damage. If it is no longer serviceable, replace it. Then, also replace the spiral bevel pinion.

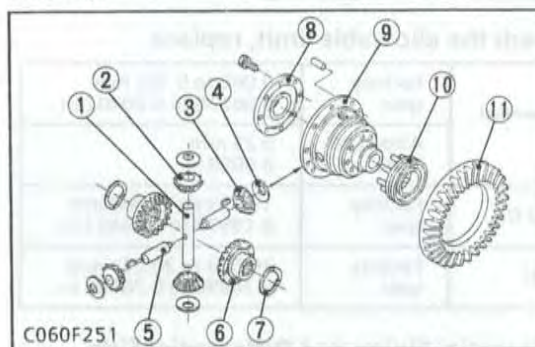
(When reassembling)

- Apply liquid lock (Three Bond 1372 or equivalent) to the spiral bevel gear UBS screws.

Tightening torque	Spiral bevel gear UBS screws	68.6 to 88.3 N·m 7.0 to 9.0 kgf·m 50.6 to 65.1 ft·lbs
-------------------	---------------------------------	---



C060P109



C060F251

Differential Pinion Shaft and Differential Pinion

1. Draw out the differential pinion shaft 2 (5), and take out the differential pinion (3) and differential pinion washer (4).
2. Draw out the differential pinion shaft (1) and take out the differential pinion (2) and differential pinion washer.
- Check the differential pinions (2), (3) and pinion shaft (1), (5) for excessive wear. If these parts are damaged or excessively worn, also replace parts they are in mesh with, or they sliding on.

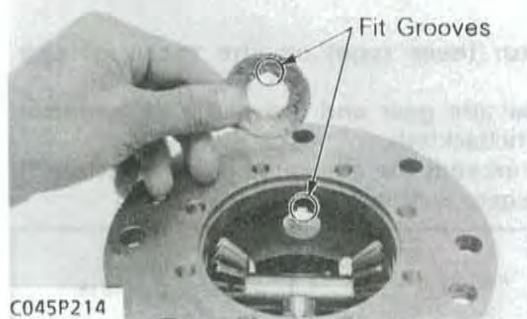
- | | |
|---------------------------------|-----------------------------------|
| (1) Differential Pinion Shaft | (7) Differential Side Gear Washer |
| (2) Differential Pinion | (8) Differential Case Cover |
| (3) Differential Pinion | (9) Differential Case |
| (4) Differential Pinion Washer | (10) Differential Lock Shifter |
| (5) Differential Pinion Shaft 2 | (11) Spiral Bevel Gear |
| (6) Differential Side Gear | |

NOTE

- Arrange the parts to know their original position.

(When reassembling)

- Apply molybdenum disulfide (Three Bond 1901 or equivalent) to the inner circumferential surface of the differential pinions.
- Install the parts to their original position.
- Install the differential pinion washer (4), noting its groove position.

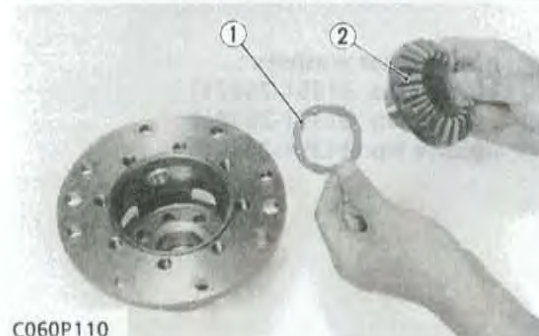


C045P214

Differential Side Gear

1. Take out the differential side gear (2) and differential side gear washer (1).
- Examine the thrust and bearing surface of both differential side gears (2). If they are worn or damaged, bores in the differential case may also be damaged.

- | |
|-----------------------------------|
| (1) Differential Side Gear Washer |
| (2) Differential Side Gear |

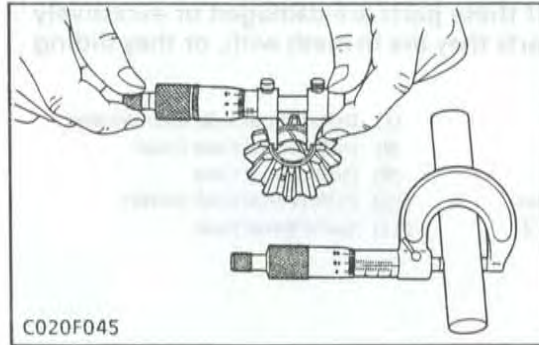


C060P110

SERVICING



C045P215



C020F045



C045P217

Clearance between Differential Case Bore-Differential Case Cover Bore and Differential Side Gear Boss

1. Measure the bore I.D. of the differential case and differential case cover
2. Measure the differential side gear boss O.D. and calculate the clearance.
3. If the clearance exceeds the allowable limit, replace.

Clearance between differential case bore differential case cover bore and differential side gear boss	Factory spec.	0.050 to 0.151 mm 0.00197 to 0.00594 in.
	Allowable limit	0.35 mm 0.0138 in.
Differential case bore I.D., Differential case cover bore I.D.	Factory spec.	40.500 to 40.562 mm 1.59449 to 1.59693 in.
Differential side gear boss O.D.	Factory spec.	40.411 to 40.450 mm 1.59099 to 1.59252 in.

Clearance between Differential Pinion Shaft and Differential Pinion

1. Measure the differential pinion shaft O.D.
2. Measure the differential pinion I.D. and calculate the clearance.
3. If the clearance exceeds the allowable limit, replace.

Clearance between differential pinion shaft and pinion	Factory spec.	0.060 to 0.102 mm 0.00236 to 0.00402 in.
	Allowable limit	0.25 mm 0.0098 in.
Differential pinion shaft O.D.	Factory spec.	19.959 to 19.980 mm 0.78579 to 0.78661 in.
Differential pinion boss I.D.	Factory spec.	20.040 to 20.061 mm 0.78898 to 0.78980 in.

Backlash between Differential Pinion and Differential Side Gear

Gear

1. Set a dial indicator (lever type) on the tooth of the differential pinion.
2. Hold the differential side gear and move the differential pinion to measure the backlash.
3. If the measurement exceeds the allowable limit, adjust with the differential side gear washer.

Backlash between differential pinion and differential side gear	Factory spec.	0.15 to 0.30 mm 0.0059 to 0.0118 in.
---	---------------	---

(Reference)

- Thickness of differential side gear washers :
 - 1.5 mm (0.059 in.) [Code No. 31351-26471]
 - 1.6 mm (0.063 in.) [Code No. 31351-26481]
 - 1.7 mm (0.067 in.) [Code No. 31351-26491]

S.5 BRAKES

CONTENTS

TROUBLESHOOTING	S.5-1
SERVICING SPECIFICATIONS	S.5-2
TIGHTENING TORQUES	S.5-2
CHECKING, DISASSEMBLING AND SERVICING	S.5-3
[1] BRAKE PEDAL	S.5-3
CHECKING AND ADJUSTING	S.5-3
DISASSEMBLING AND ASSEMBLING	S.5-4
SERVICING	S.5-4
[2] BRAKE CASE	S.5-5
DISASSEMBLING AND ASSEMBLING	S.5-5
SERVICING	S.5-6

TROUBLESHOOTING

Before troubleshooting, confirm symptoms of trouble and accomplish basic inspection.

Because the trouble in the brake system is directly related to the human life, utmost care and attention must be used in inspection and maintenance. To accomplish careful works, it is important to make it a rule to reconfirm the work after the work is done.

(1) Basic Inspection

No.	Contents	Reference Page
1	Play of brake pedal	S.5-3
2	Brake linkage	S.5-3
3	Transmission fluid	S.G-14, 15

(2) Troubleshooting

Symptom	Probable Cause	Solution	Reference Page
Uneven Braking Force	● One side brake disc worn away	Replace	S.5-4
	● Cam plate warped	Replace	S.5-3
Brake Drags	● Ball holes of cam plate for uneven wear	Replace	S.5-4
	● Brake pedal return spring weaken or broken	Replace	—
	● Brake cam rusted	Repair	S.5-3
Poor Braking Force	● Brake disc worn	Replace	S.5-4
	● Cam plate warped	Replace	S.5-3
	● Brake cam or lever damaged	Replace	S.5-2

Item	mm	in	kgf·m	ft·lb
Brake case mounting screw and nut (1) screw (Marked 1 on the head) (2) screw (Marked 2 on the head) (Spec. 1.250)	10.0	10.0	1.0	7.2
Brake disc mounting screw and nut	10.0	10.0	1.0	7.2

SERVICING SPECIFICATIONS

Item		Factory Specification	Allowable Limit
Brake Pedal	Free Play	20 to 30 mm 0.8 to 1.2 in.	—
Right and Left	Difference	Less than 5 mm 0.20 in.	—
Brake Pedal Shaft to Bushing	Clearance	0.020 to 0.153 mm 0.00079 to 0.00602 in.	1.0 mm 0.039 in.
Brake Pedal Shaft	O.D.	24.9 to 25.0 mm 0.980 to 0.984 in.	—
Brake Pedal Bushing	I.D.	25.020 to 25.053 mm 0.98504 to 0.98634 in.	—
Brake Pedal Shaft to Support Bushing	Clearance	0.05 to 0.20 mm 0.0020 to 0.0079 in.	1.0 mm 0.039 in.
Support Bushing	I.D.	25.05 to 25.10 mm 0.9862 to 0.9882 in.	—
Cam Plate	Flatness	—	0.3 mm 0.012 in.
Cam Plate and Ball	Height	20.09 to 20.10 mm 0.7909 to 0.7913 in.	20.06 mm 0.7898 in.
Brake Disc	Thickness	4.6 to 4.8 mm 0.181 to 0.189 in.	4.2 mm 0.165 in.

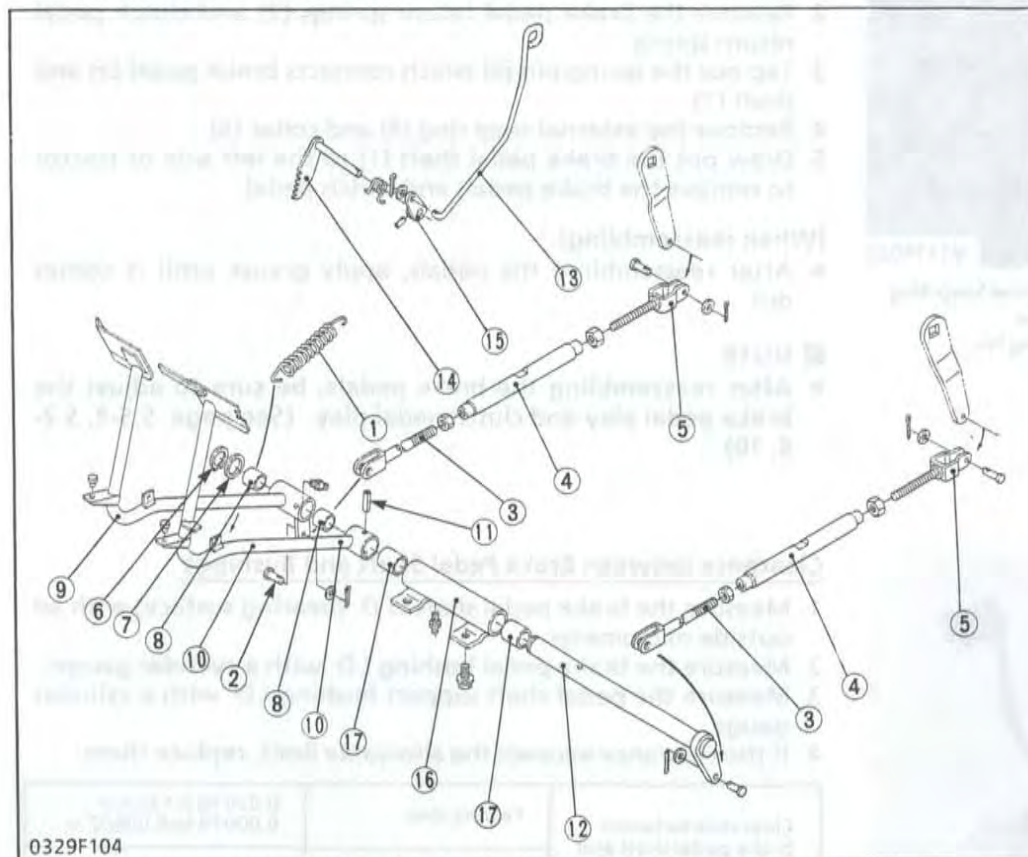
TIGHTENING TORQUES

Tightening torques of screws and nuts on the table below are especially specified.
(For general use screws and nuts: See page S.G-8)

Item	N·m	kgf·m	ft-lbs
Brake case mounting screw and nut			
7T screw (Marked 7 on its head)	77.5 to 90.1	7.9 to 9.2	57.2 to 66.5
9T screw (Marked 9 on its head) [Except L2350]	103 to 117	10.5 to 12.0	76.0 to 86.8
Nut	77.5 to 90.1	7.9 to 9.2	57.2 to 66.5

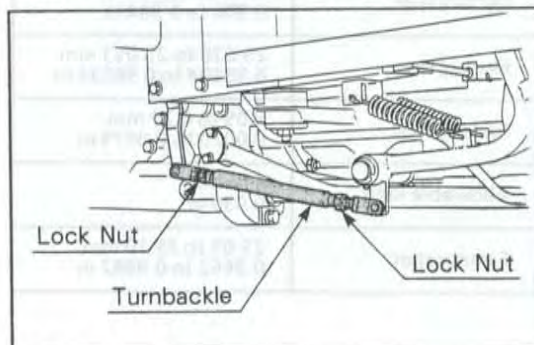
CHECKING, DISASSEMBLING AND SERVICING

[1] BRAKE PEDAL



- (1) Return Spring
- (2) Clevis Pin
- (3) Brake Rod 1
- (4) Turnbuckle
- (5) Brake Rod 2
- (6) External Snap Ring
- (7) Collar
- (8) Bushing
- (9) Brake Pedal RH
- (10) Brake Pedal LH
- (11) Spring Pin
- (12) Brake Pedal Shaft
- (13) Parking Rod
- (14) Brake Lock
- (15) Parking Lever
- (16) Pedal Shaft Support
- (17) Bushing

CHECKING AND ADJUSTING



Brake Pedal Free Play

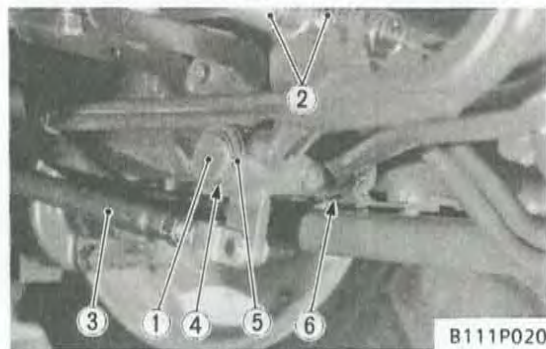
1. Press the center of the pedal with a force of approx. 39 to 59 N (4 to 6 kgf, 9 to 13 lbs.), and measure the free play of the brake pedal as shown in Fig.
2. If the measurement is not within the factory specifications, turn the turnbuckle of brake rod to adjust.
3. After adjustment, tighten the turnbuckle lock nut firmly.

Brake pedal free play	Factory spec.	20 to 30 mm 0.8 to 1.2 in.
-----------------------	---------------	-------------------------------

NOTE

- The difference between the right and left pedal plays must be less than 5 mm (0.20 in.).
- After checking brake pedal free play, be sure to engage the parking brake lock fully and check to see that the brake pedals are securely locked.

DISASSEMBLING AND ASSEMBLING



- (1) Brake Pedal Shaft (4) External Snap Ring
(2) Return Spring (5) Collar
(3) Brake Rod (6) Spring Pin

Brake Pedals and Clutch Pedal

1. Remove the clevis pins of brake rods (3) and clutch rod.
2. Remove the brake pedal return springs (2) and clutch pedal return spring.
3. Tap out the spring pin (6) which connects brake pedal LH and shaft (1).
4. Remove the external snap ring (4) and collar (5).
5. Draw out the brake pedal shaft (1) to the left side of tractor to remove the brake pedals and clutch pedal.

(When reassembling)

- After reassembling the pedals, apply grease until it comes out.

■ **NOTE**

- After reassembling the brake pedals, be sure to adjust the brake pedal play and clutch pedal play. (See page S.5-3, S.2-6, 10)

SERVICING

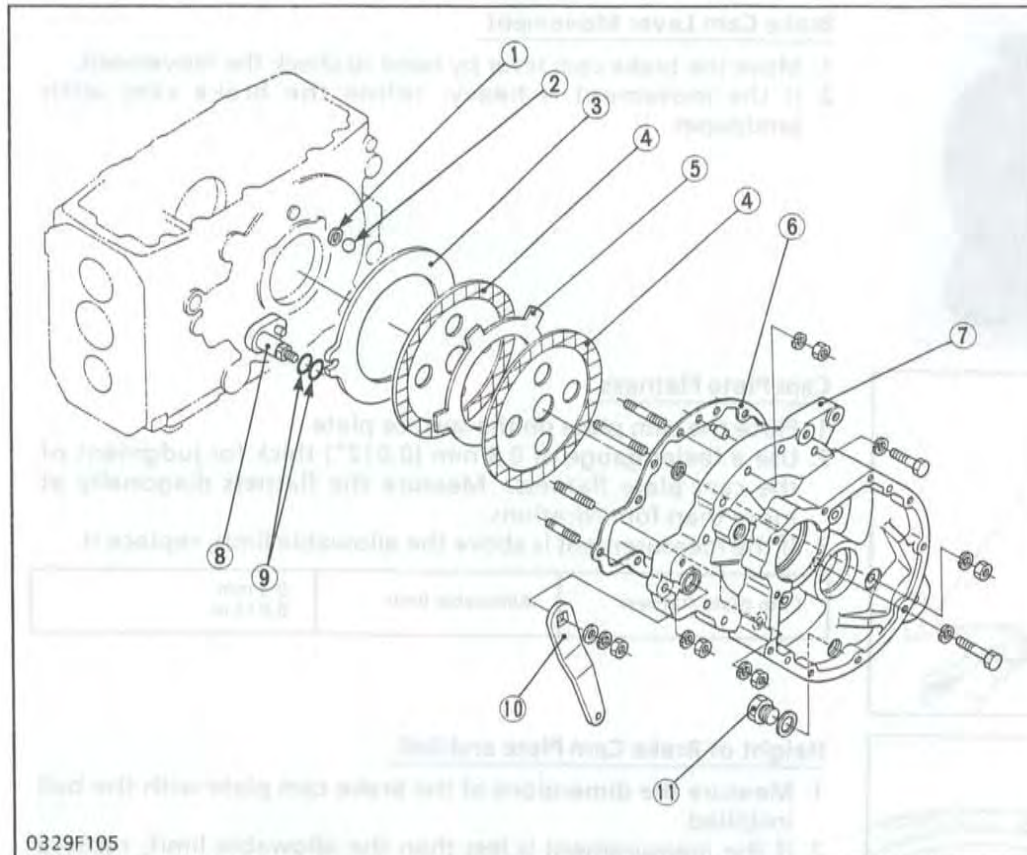
Clearance between Brake Pedal Shaft and Bushings

1. Measure the brake pedal shaft O.D. (bearing surface) with an outside micrometer.
2. Measure the brake pedal bushing I.D. with a cylinder gauge.
3. Measure the pedal shaft support bushing I.D. with a cylinder gauge.
4. If the clearance exceeds the allowable limit, replace them.

Clearance between brake pedal shaft and brake pedal bushing	Factory spec	0.020 to 0.153 mm 0.00079 to 0.00602 in.
	Allowable limit	1.0 mm 0.039 in.
Brake pedal shaft O.D.	Factory spec	24.9 to 25.0 mm 0.980 to 0.984 in.
Brake pedal bushing I.D.	Factory spec	25.020 to 25.053 mm 0.98504 to 0.98634 in.
Clearance between brake pedal shaft and pedal shaft support bushing	Factory spec	0.05 to 0.20 mm 0.0020 to 0.0079 in.
	Allowable limit	1.0 mm 0.039 in.
Pedal shaft support bushing I.D.	Factory spec	25.05 to 25.10 mm 0.9862 to 0.9882 in.



[2] BRAKE CASE



- (1) Ball Seat
- (2) Ball
- (3) Cam Plate
- (4) Brake Disc
- (5) Plate
- (6) Gasket
- (7) Brake Case
- (8) Brake Cam
- (9) O-ring
- (10) Brake Cam Lever
- (11) Drain Plug

DISASSEMBLING AND ASSEMBLING

Rear Axle Case

(See page S.5-7, 21)

Brake Case

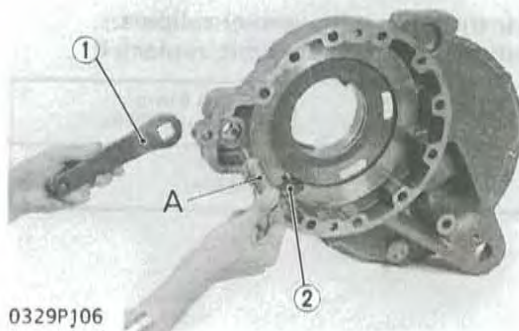
(See page S.5-7, 21)

Brake Cam

1. Remove the nut on the brake cam.
2. Remove the brake cam (2) and brake cam lever (1).

(When reassembling)

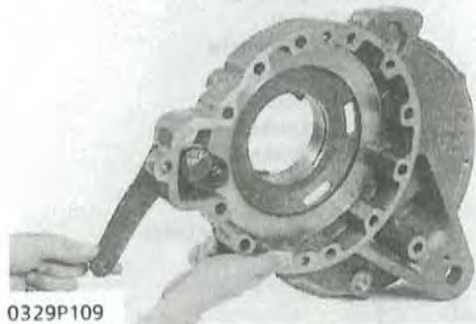
- Apply grease to the O-ring and the care not to damage it.
- Apply small amount of grease to the journal A to prevent rust problem that leads to lock up.



(1) Brake Cam Lever

(2) Brake Cam

SERVICING



0329P109

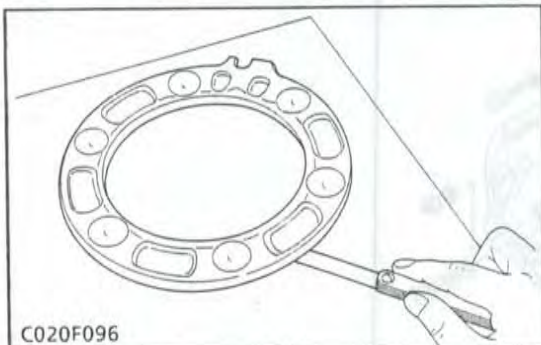
Brake Cam Lever Movement

1. Move the brake cam lever by hand to check the movement.
2. If the movement is heavy, refine the brake cam with sandpaper.

Cam Plate Flatness

1. Place the cam plate on the surface plate.
2. Use a feeler gauge of 0.3 mm (0.012") thick for judgment of the cam plate flatness. Measure the flatness diagonally at more than four locations.
3. If the measurement is above the allowable limit, replace it.

Cam plate flatness	Allowable limit	0.3 mm 0.012 in.
--------------------	-----------------	---------------------

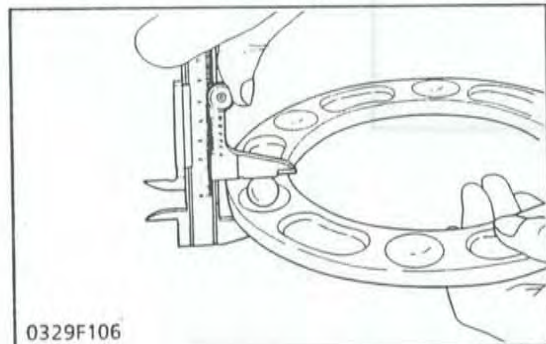


C020F096

Height of Brake Cam Plate and Ball

1. Measure the dimensions of the brake cam plate with the ball installed.
2. If the measurement is less than the allowable limit, replace the cam plate and balls.
3. Inspect the ball holes of cam plate for uneven wear. If the uneven wear is found, replace it.

Height of brake cam plate and ball	Factory spec.	20.09 to 20.10 mm 0.7909 to 0.7913 in.
	Allowable limit	20.06 mm 0.7898 in.

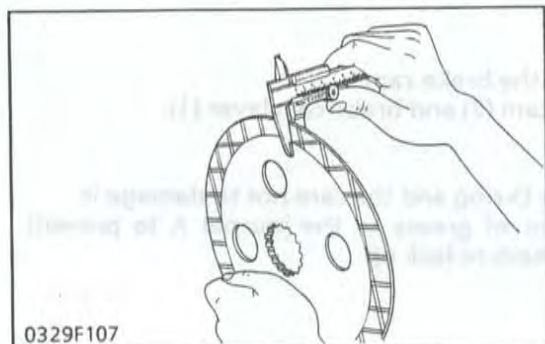


0329F106

Brake Disc Wear

1. Measure the brake disc thickness with vernier calipers.
2. If the thickness is less than the allowable limit, replace it.

Brake disc thickness	Factory spec.	4.6 to 4.8 mm 0.181 to 0.189 in.
	Allowable limit	4.2 mm 0.165 in.

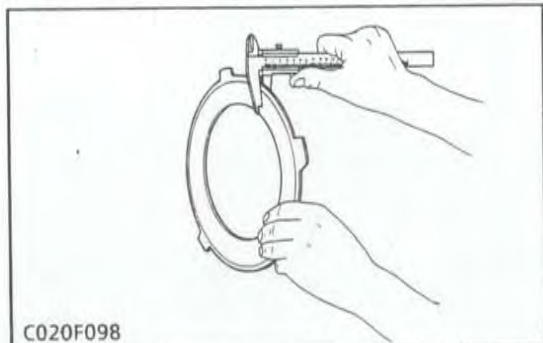


0329F107

Plate Wear

1. Measure the plate thickness with vernier calipers.
2. If the thickness is less than the allowable limit, replace it.

Plate thickness	Factory spec.	2.54 to 2.66 mm 0.1000 to 0.1047 in.
	Allowable limit	2.10 mm 0.0827 in.



C020F098

S.6 FRONT AXLE

CONTENTS

TROUBLESHOOTING	S.6-1
SERVICING SPECIFICATIONS	S.6-2
TIGHTENING TORQUES	S.6-5
CHECKING, DISASSEMBLING AND SERVICING	S.6-6
CHECKING AND ADJUSTING	S.6-6
DISASSEMBLING AND ASSEMBLING	S.6-7
[2WD TYPE]	S.6-7
[4WD TYPE]	S.6-8
SERVICING	S.6-13
[2WD TYPE]	S.6-13
[4WD TYPE]	S.6-14

TROUBLESHOOTING

Before troubleshooting, confirm symptoms of trouble and accomplish basic inspection.

(1) Basic Inspection

No.	Contents	Reference Page
1	Toe-in	S.6-6
2	Inflation pressure of tire	M.11-5
3	Front axle case fluid [4WD TYPE]	S.G-17
4	Transmission fluid	S.G-14, 15
5	Steering wheel free play	S.7-10, 22, 25

(2) Troubleshooting

Symptom	Probable Cause	Solution	Reference Page
Front Wheels Wander to Right or Left	- Excessive clearance between front axle center pivot and front axle bracket's bushing - Small rocking force of front axle - Excessive sway of front wheel - Air sucked in power steering circuit - Knuckle shaft bushings worn [2WD TYPE] - Tie-rod end loose	Replace Adjust Replace Bleed air Replace Tighten	S.6-13, 18, 19 S.6-7 S.6-6 S.7-28, 38 S.6-13 -
Shimmy	- Air sucked in power steering circuit - Incorrect backlash between sector gear shaft and ball nut	Bleed air Adjust	S.7-28, 38 -
Front Wheels Can Not be Driven [4WD TYPE]	- Propeller shaft broken - Front wheel drive gears broken - Front differential gear broken - Shift fork broken - Slipped off coupling	Replace Replace Replace Replace Replace	- S.3-27, 49, 82 S.6-8, 9, 10, 11, 12 S.6-11 S.3-27, 49, 82 S.5-3, 15
Noise [4WD TYPE]	- Excessive backlash of gear - Incorrect turning torque of differential gear - Bearings damaged or broken - Gears damaged or broken	Adjust Adjust Replace Replace	S.6-14, 15, 16, 17 S.6-15 - -

SERVICING SPECIFICATIONS

[2WD TYPE]

Item		Factory Specification	Allowable Limit
Front Wheel Alignment	Toe-in	2 to 8 mm 0.08 to 0.32 in.	-
	Camber Angle	0.026 to 0.044 rad. 1.5 to 2.5°	-
	Caster Angle	0.017 to 0.035 rad. 1.0 to 2.0°	-
	King Pin Angle	0.166 to 0.183 rad. 9.5 to 10.5°	-
Front Wheel	Axial Sway	Less than 2 mm 0.08 in.	-
	Radial Sway	Less than 4 mm 0.16 in.	-
Front Axle	Rocking Force	49.0 to 117.7 N 5.0 to 12.0 kgf 11.0 to 26.5 lbs	-
Knuckle Shaft to Bushing	Clearance	0.000 to 0.285 mm 0.0000 to 0.0112 in.	0.4 mm 0.016 in.
Knuckle Shaft	O.D.	27.880 to 27.900 mm 1.0976 to 1.0984 in.	-
Bushing	I.D.	27.900 to 28.165 mm 1.0984 to 1.1087 in.	-
Front Axle Middle Boss to Front Axle Bracket Bushing	Clearance	0.000 to 0.177 mm 0.0000 to 0.0070 in.	0.3 mm 0.012 in.
Front Axle Middle Boss	O.D.	39.938 to 40.000 mm 1.5724 to 1.5748 in.	-
Bushing	I.D.	40.000 to 40.115 mm 1.5748 to 1.5793 in.	-

[4WD TYPE]

Item		Factory Specification	Allowable Limit
Front Wheel Alignment	Toe-in	2 to 8 mm 0.08 to 0.32 in.	-
	Camber Angle	0.026 to 0.044 rad. 1.5 to 2.5°	-
	Caster Angle	0.017 to 0.035 rad. 1.0 to 2.0°	-
	King Pin Angle	0.166 to 0.183 rad. 9.5 to 10.5°	-
Front Wheel	Axial Sway	Less than 2 mm 0.08 in.	-
	Radial Sway	Less than 4 mm 0.16 in.	-
Front Axle	Rocking Force	49.0 to 117.7 N 5.0 to 12.0 kgf 11.0 to 26.5 lbs	-
Differential Case to Differential Side Gear	Clearance	0.050 to 0.151 mm 0.0020 to 0.0059 in.	0.35 mm 0.0138 in.
Differential Case	I.D.	32.000 to 32.062 mm 1.2598 to 1.2623 in.	-
Differential Side Gear	O.D.	31.911 to 31.950 mm 1.2563 to 1.2579 in.	-
Spiral Bevel Gear to Differential Side Gear	Clearance	0.050 to 0.114 mm 0.0020 to 0.0045 in.	0.35 mm 0.0138 in.
Spiral Bevel Gear	I.D.	32.000 to 32.025 mm 1.2598 to 1.2608 in.	-
Differential Side Gear	O.D.	31.911 to 31.950 mm 1.2563 to 1.2579 in.	-
Differential Pinion Shaft to Differential Pinion Gear	Clearance	0.064 to 0.100 mm 0.0025 to 0.0039 in.	0.25 mm 0.0098 in.
Differential Pinion Shaft	O.D.	13.950 to 13.968 mm 0.5492 to 0.5499 in.	-
Differential Pinion Gear	I.D.	14.032 to 14.050 mm 0.5524 to 0.5532 in.	-
Differential Pinion to Differential Side Gear	Backlash	0.15 to 0.30 mm 0.0059 to 0.0118 in.	0.40 mm 0.016 in.
Shim	Thickness	0.4 mm 0.016 in.	-
		0.6 mm 0.024 in.	-
		0.8 mm 0.031 in.	-
		1.0 mm 0.039 in.	-
		1.2 mm 0.047 in.	-

Item		Factory Specification	Allowable Limit
Differential Bevel Pinion Shaft to Bevel Gear	Backlash	0.15 to 0.30 mm 0.0059 to 0.0118 in.	0.40 mm 0.016 in.
	Shim		
	Thickness	0.4 mm 0.016 in.	—
		0.6 mm 0.024 in.	—
		0.8 mm 0.031 in.	—
		1.0 mm 0.039 in.	—
		1.2 mm 0.047 in.	—
Bevel Gears in Bevel Gear Case (13T Bevel Gear to 15T Bevel Gear)	Backlash	0.15 to 0.30 mm 0.0059 to 0.0118 in.	0.40 mm 0.016 in.
	Shim		
	Thickness	0.4 mm 0.016 in.	—
		0.6 mm 0.024 in.	—
		0.8 mm 0.031 in.	—
		1.0 mm 0.039 in.	—
		1.2 mm 0.047 in.	—
Bevel Gears in Front Axle Case	Backlash	0.15 to 0.30 mm 0.0059 to 0.0118 in.	0.40 mm 0.016 in.
	Shim		
	Thickness	0.8 mm 0.031 in.	—
		1.2 mm 0.047 in.	—
		1.6 mm 0.063 in.	—
		1.8 mm 0.071 in.	—
		2.0 mm 0.079 in.	—
		2.3 mm 0.091 in.	—
		2.6 mm 0.102 in.	—
Bevel Pinion Shaft (Pinion Shaft Only)		Turning Torque	1.118 to 1.373 N·m 0.114 to 0.140 kgf·m 0.825 to 1.013 ft-lbs
Pinion Bearing Case to Front Axle Bracket Bushing (Rear)		Clearance	0.060 to 0.220 mm 0.0024 to 0.0087 in.
Pinion Bearing Case		O.D.	64.970 to 65.000 mm 1.3755 to 1.3780 in.
Bushings		I.D.	65.060 to 65.190 mm 2.5614 to 2.5665 in.

Item		Factory Specification	Allowable Limit
Front Axle Case Center Pivot to Front Axle Bracket Bushing (Front)	Clearance [L2350]	0.000 to 0.147 mm 0.0000 to 0.0058 in.	0.3 mm 0.012 in.
	L2650, L2950 L3450, L3650	0.000 to 0.177 mm 0.0000 to 0.0060 in.	0.3 mm 0.012 in.
Front Axle Case Center Pivot	O.D. [L2350]	34.938 to 35.000 mm 1.3755 to 1.3780 in.	—
	L2650, L2950 L3450, L3650	39.938 to 40.000 mm 1.5724 to 1.5748 in.	—
Bushings	I.D. [L2350]	35.000 to 35.085 mm 1.3780 to 1.3813 in.	—
	L2650, L2950 L3450, L3650	40.000 to 40.115 mm 1.5748 to 1.5793 in.	—

TIGHTENING TORQUES

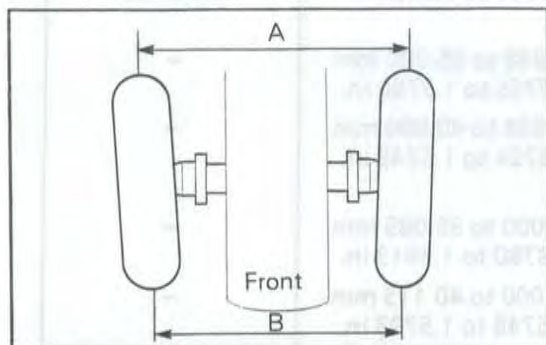
Tightening torques of especially screws, bolts and nuts.
(For general use screws, bolts and nuts: See page S.G-8)

Item	N·m	kgf·m	ft·lbs
Front axle bracket mounting screws			
Front (Thread size: 14 mm, 0.55 in. DIA.)	123.6 to 147.1	12.6 to 15.0	91.1 to 108.5
Rear (Thread size: 12 mm, 0.47 in. DIA.)	103.0 to 117.7	10.5 to 12.0	75.9 to 86.8
Slotted nuts of tie rod end	49.0 to 68.6	5.0 to 7.0	36.2 to 50.6
Slotted nuts of tie rod end [Full hydrostatic power steering type]	39.2 to 45.1	4.0 to 4.6	28.9 to 33.3
Front wheel mounting screws and nuts	123.6 to 147.1	12.6 to 15.0	91.1 to 108.5
Bevel gear case mounting screws [4WD Type]	166.7 to 196.1	17.0 to 20.0	123.0 to 144.7
Pinion bearing case mounting screws and nuts [4WD Type]	48.1 to 55.9	4.9 to 5.7	35.4 to 41.2
Differential adjusting screw [4WD Type]	9.8 to 29.4	1.0 to 3.0	7.2 to 21.7
Differential supports mounting screws [4WD Type]	48.1 to 55.9	4.9 to 5.7	35.4 to 41.2
Spiral bevel gear mounting screws [4WD Type]			
9T	122.6 to 130.4	12.5 to 13.3	90.4 to 96.2
10T	127.5 to 142.2	13.0 to 14.5	94.0 to 104.8
Knuckle arm mounting screw and nut [2WD Type]	77.5 to 90.2	7.9 to 9.2	57.1 to 66.5
Front wheel hub slotted nut [2WD Type]	78.5 to 117.7	8.0 to 12.0	57.9 to 86.8

CHECKING, DISASSEMBLING AND SERVICING

CHECKING AND ADJUSTING

Park the tractor on a flat place, apply the hand brake and verify that the brake has been applied securely. Stop the engine and set the wheel stoppers before starting work.



Toe-in

1. Inflate the tires to the specified pressure.
2. Turn the front wheels straight ahead.
3. Measure the toe-in.
4. If the measurement is not within the factory specifications, adjust the tie rod length.

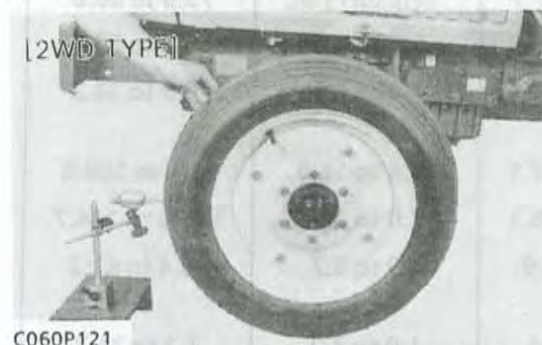
Toe-in	Factory spec.	2 to 8 mm 0.08 to 0.32 in.
--------	---------------	-------------------------------



Axial Sway of Front Wheel

1. Jack up the front side of tractor.
2. Set a dial gauge on the outside of rim.
3. Turn the wheel slowly and read the runout of rim.
4. If the runout exceeds the specified limit, check the bearing, rim, and front wheel hub.

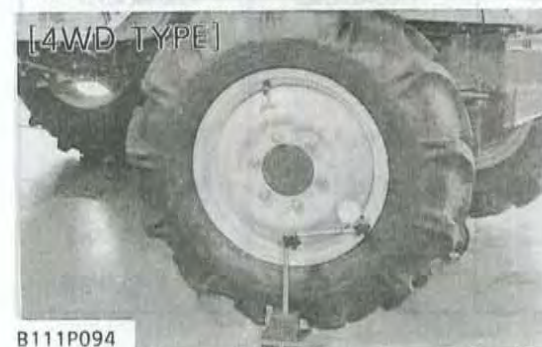
Axial sway	Factory spec.	Less than 2.0 mm 0.08 in.
------------	---------------	------------------------------

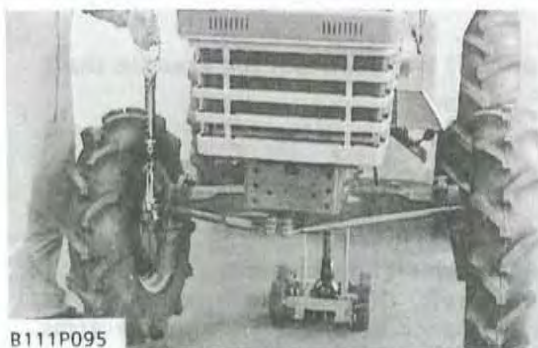


Radial Sway of Front Wheel

1. Jack up the front side of tractor.
2. Set a dial gauge on the tire tread. [2WD TYPE]
Set a dial gauge on the wheel. [4WD TYPE]
3. Turn the wheel slowly and read the dial gauge.
4. If the runout exceeds the specified limit, check the bearing, rim, and front wheel hub.

Radial sway	Factory spec.	Less than 4.0 mm 0.16 in.
-------------	---------------	------------------------------



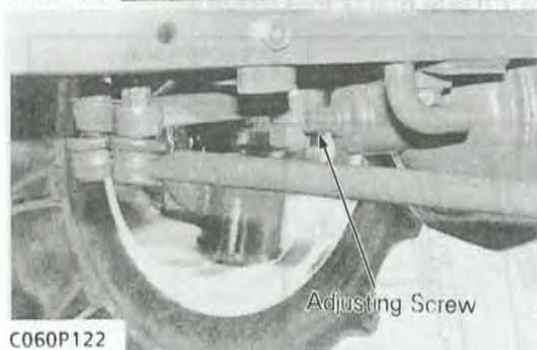


B111P095

Front Axle Rocking Force

1. Jack up the front side of tractor.
2. Set a spring balance to the tie rod end.
3. Measure the front axle rocking force.
4. If the measurement is not within the factory specifications, adjust with the adjusting screw.
5. Tight the lock nut firmly.

Front axle rocking force	Factory spec.	49.0 to 117.7 N·m 5.0 to 12.0 kgf·m 11.0 to 26.5 ft·lbs
--------------------------	---------------	---

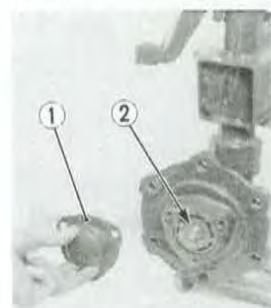


C060P122

Adjusting Screw

DISASSEMBLING AND ASSEMBLING

[2WD TYPE]



C060P126

- (1) Front Wheel Cap
(2) Slotted Nut



C060P127

- (3) Front Wheel Hub

Front Wheel Hub

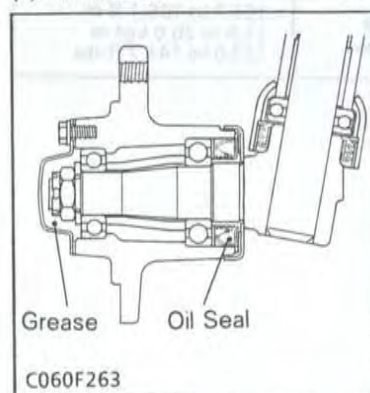
1. Remove the front wheel cap (1).
2. Draw out the cotter pin.
3. Remove the slotted nut (2).
4. Remove the collar.
5. Remove the front wheel hub (3) with a puller.

(When reassembling)

- Replace cotter pin with a new one.
- Apply grease to the oil seal in the front wheel hub.

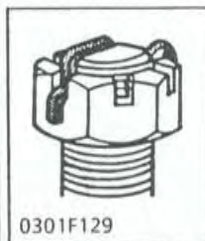
■ IMPORTANT

- After tightening the slotted nut to the specified torque, insert a cotter pin and bend it as shown in the figure.
- Pack in the grease to the bearing in the front wheel hub.



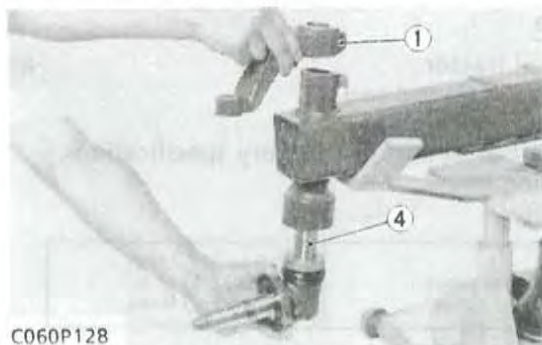
C060F263

Grease Oil Seal

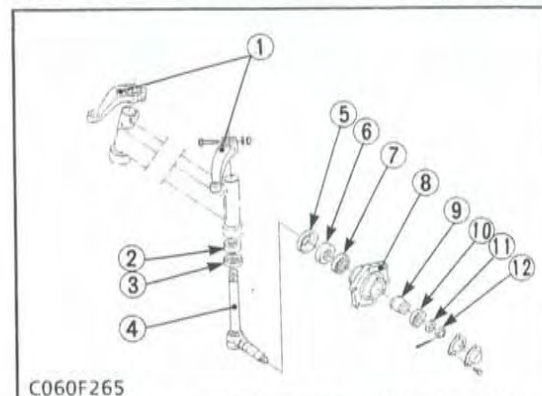


0301F129

Tightening torque	Front wheel hub slotted nut	78.5 to 117.7 N·m 8.0 to 12.0 kgf·m 57.9 to 86.8 ft·lbs
-------------------	-----------------------------	---



C060P128



C060F265

- | | |
|-------------------------|---------------------|
| (1) Knuckle Arm | (7) Ball Bearing |
| (2) Thrust Ball Bearing | (8) Front Wheel Hub |
| (3) Oil Seal | (9) Spacer |
| (4) Knuckle Arm Shaft | (10) Ball Bearing |
| (5) Dust Cover | (11) Washer |
| (6) Oil Seal | (12) Slotted Nut |

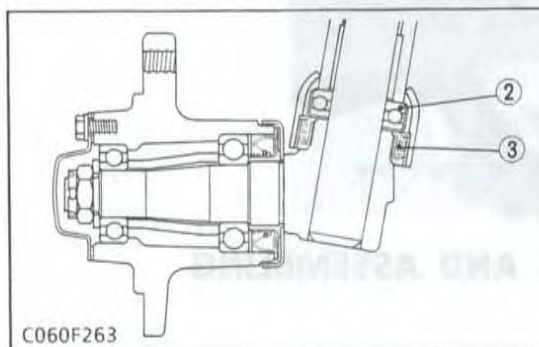
Knuckle Shaft

1. Remove the knuckle arm (1) and draw out the knuckle shaft (4) from the front axle.

(When reassembling)

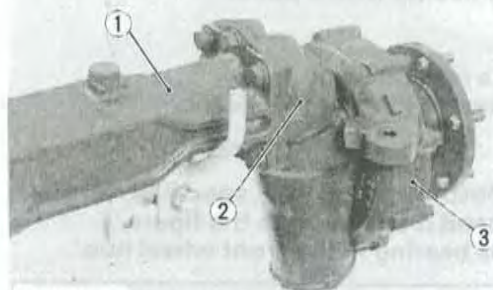
- Install the thrust ball bearing (2) and oil seal (3), noting its direction.
- Apply grease to the oil seals (3), (6).
- Do not interchange right and left knuckle arms.
- When lift the knuckle shaft, the knuckle arms must be mounted so that the clearance between the knuckle arms and front axle is 0.3 to 1.0 mm (0.012 to 0.039 in.).

Tightening torque	Knuckle arm mounting bolt and nut	77.5 to 90.2 N·m 7.9 to 9.2 kgf·m 57.1 to 66.5 ft-lbs
-------------------	-----------------------------------	---



C060F263

[4WD TYPE]



0329P112

- | | |
|---------------------|---------------|
| (1) Front Axle Case | (3) Axle Case |
| (2) Bevel Gear Case | |

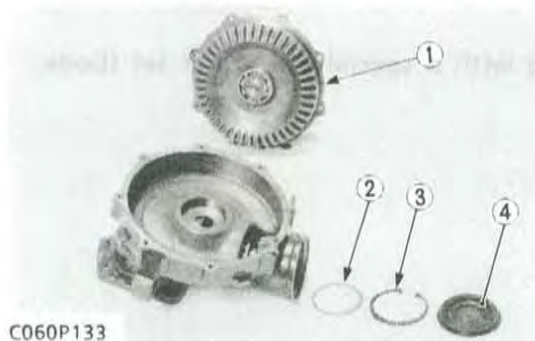
Axle Case and Bevel Gear Case

1. Remove the axle case (3) and bevel gear case (2) as a unit from the front axle case (1).

(When reassembling)

- When installing the O-rings, apply grease to them.
- Do not interchange right and left bevel gear case assemblies and axle case assemblies.

Tightening torque	Bevel gear case mounting screws	166.7 to 196.1 N·m 17.0 to 20.0 kgf·m 123.0 to 144.7 ft-lbs
-------------------	---------------------------------	---



C060P133

- (1) Axle Flange
(2) Shim
(3) Internal Snap Ring
(4) Plug

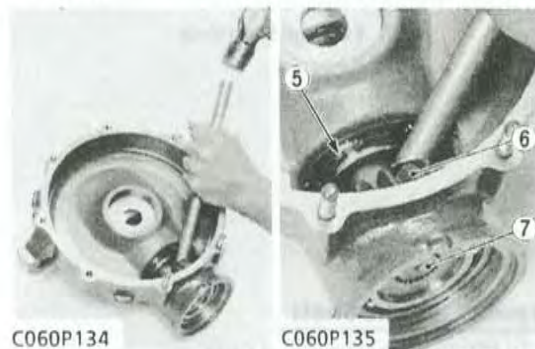
Bevel Gear Case, Axle Flange and Axle Case

1. Remove the plug (4).
2. Remove the internal snap ring (3) and shim (2).
3. Remove the axle flange (1).

(When reassembling)

- Apply grease to the O-rings of axle flange (1).
- Tighten the axle flange mounting screws and nuts diagonally in several steps.

Tightening torque	Axle flange mounting screws and nuts	23.6 to 27.4 N·m 2.4 to 2.8 kgf·m 17.4 to 20.2 ft·lbs
-------------------	--------------------------------------	---



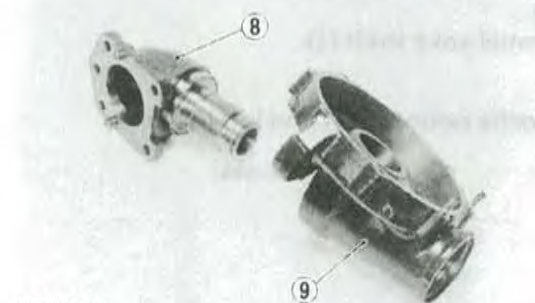
C060P134

C060P135

4. Tap out the bevel gear (6) and ball bearing.
5. Draw out the bevel gear shaft (7).
6. Remove the external snap ring (5).

- (5) External Snap Ring
(6) 12T Bevel Gear

- (7) Bevel Gear Shaft



C060P136

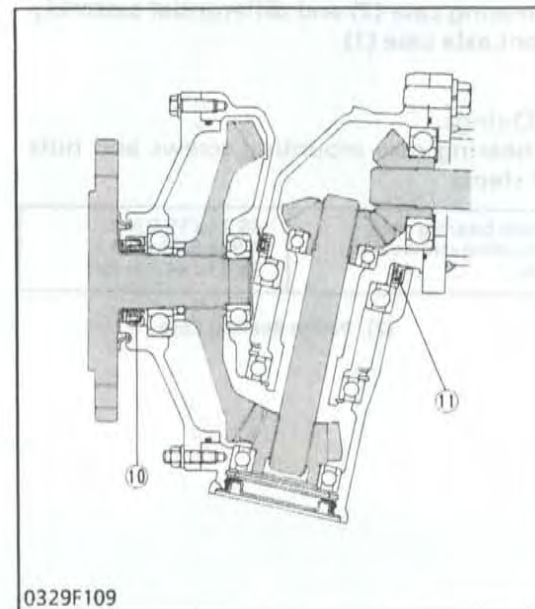
7. Tap the bevel gear case (8), and separate it from the axle case (9).

- (8) Bevel Gear Case

- (9) Axle Case

(When reassembling)

- Install the oil seals (10), (11) of bevel gear case and axle case, noting their direction as shown in the figure.



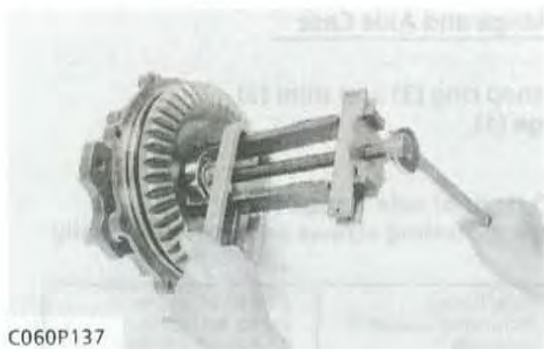
0329F109

- (10) Oil Seal

- (11) Oil Seal

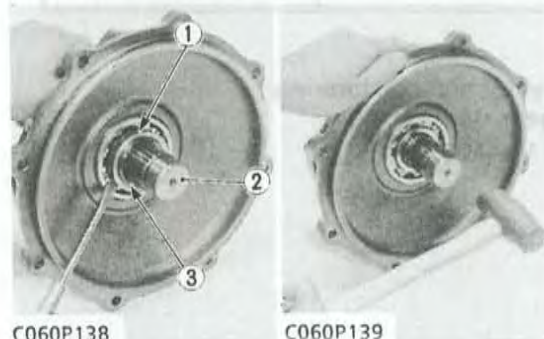
Bevel Gear

1. Remove the bearing with a special use puller set (Code No:07916-09032).



C060P137

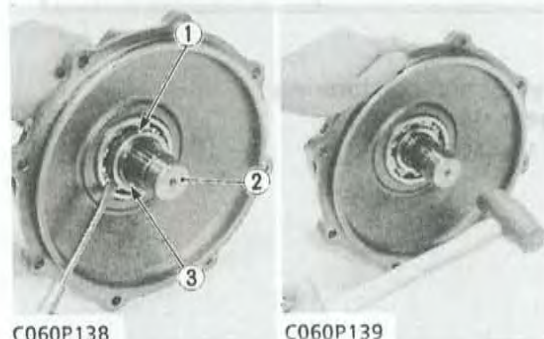
2. Remove the collar (1), external snap ring (3) and thrust collar.
3. Tap out the axle (2).



C060P138

- (1) Collar
(2) Axle

- (3) External Snap Ring



C060P139

13T Bevel Gear and Differential Yoke Shaft

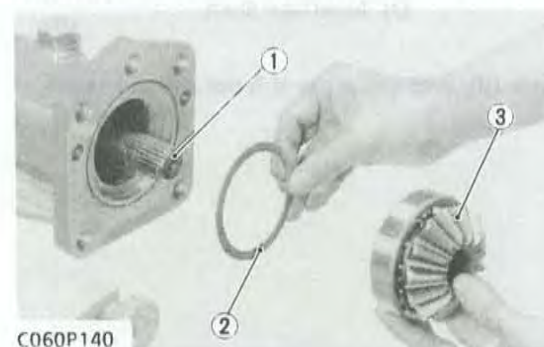
1. Remove the bevel gear (3) and bearing as a unit.
2. Remove the shims (2).
3. Draw out the differential yoke shaft (1).

(When reassembling)

- Install the shims correctly noting right and left location.

- (1) Differential Yoke Shaft
(2) Shims

- (3) 13T Bevel Gear



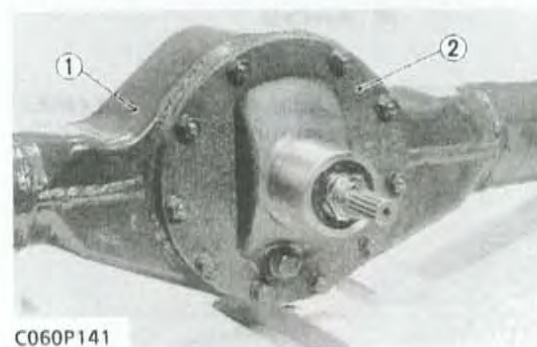
C060P140

Pinion Bearing Case

1. Remove the pinion bearing case (2) and differential assembly as a unit from the front axle case (1).

(When reassembling)

- Apply grease to the O-rings.
- Tighten the pinion bearing case mounting screws and nuts diagonally in several steps.

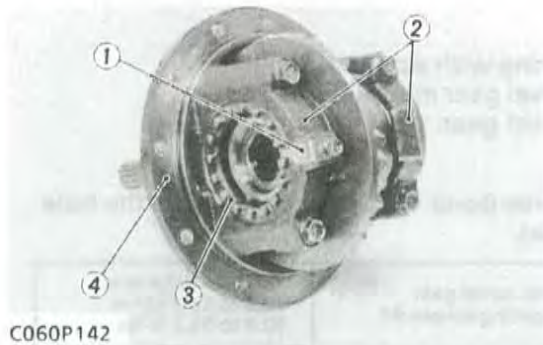


C060P141

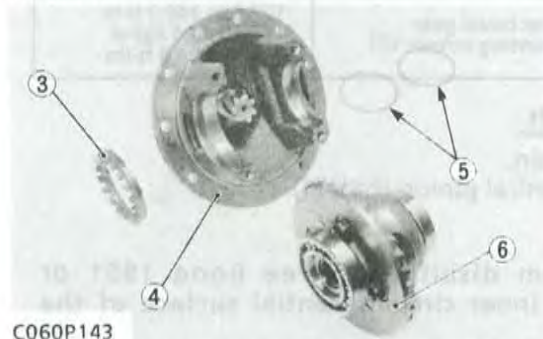
- (1) Front Axle Case

- (2) Pinion Bearing Case

Tightening torque	Pinion bearing case mounting screws and nuts	48.1 to 55.9 N·m 4.9 to 5.7 kgf·m 35.4 to 41.2 ft·lbs
-------------------	--	---



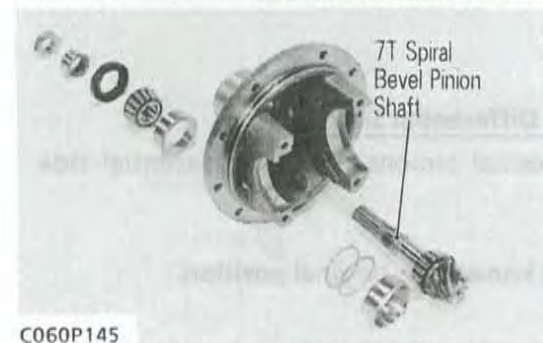
C060P142



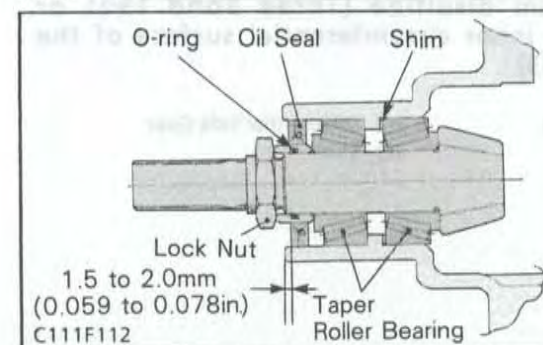
C060P143



C060P144



C060P145



C111F112

Differential Assembly

1. Remove the lock plate (1) and the adjusting screw (3).
2. Remove the differential supports (2).
3. Remove the differential assembly (6) and the shims (5) from the pinion bearing case (4).

- | | |
|---------------------------|---------------------------|
| (1) Lock Plate | (4) Pinion Bearing Case |
| (2) Differential Supports | (5) Shims |
| (3) Adjusting Screw | (6) Differential Assembly |

(When reassembling)

- Tighten the adjusting screw (3) by hand, and lock it with the lock plate (1) firmly.
- Do not change the combination of pinion bearing case (4) and differential supports (2), because both parts are proceeded as a unit.

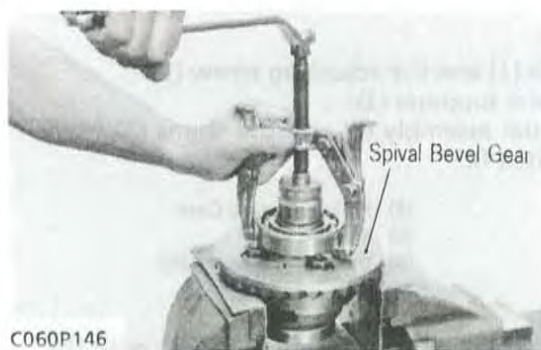
Tightening torque	Differential adjusting screw	9.8 to 29.4 N·m 1.0 to 3.0 kgf·m 7.2 to 21.7 ft-lbs
	Differential support (left-right) mounting screws	48.1 to 55.9 N·m 4.9 to 5.7 kgf·m 35.0 to 41.2 ft-lbs

7T Spiral Bevel Pinion Shaft

1. Secure the 7T spiral bevel pinion shaft in a vise.
2. Remove the stake of lock nut and then remove the lock nut.

(When reassembling)

- Apply grease to the O-ring and oil seal.
- Install the same shims as before they are removed.
- Install the taper roller bearing correctly, noting their direction, and apply gear oil to them.
- When press-fitting a oil seal, observe the dimension described in the figure.
- Replace the lock nuts with a new one.
- Install the 7T spiral bevel pinion shaft and tighten the lock nut.
- Stake the lock nut.



Spiral Bevel Gear

1. Remove the ball bearing with a puller.
2. Remove the spiral bevel gear mounting UBS screws.
3. Remove the spiral bevel gear.

(When reassembling)

- Apply liquid lock (Three Bond 1372 or equivalent) to the hole and tighten the screws.

Tightening torque	Spiral bevel gear mounting screws 9T	122.6 to 130.4 N·m 12.5 to 13.3 kgf·m 90.4 to 96.2 ft·lbs
	Spiral bevel gear mounting screws 10T	127.5 to 142.2 N·m 13.0 to 14.5 kgf·m 94.0 to 104.8 ft·lbs

Differential Pinion Shaft

1. Take out the dowel pin.
2. Draw out the differential pinion shaft (1).

(When reassembling)

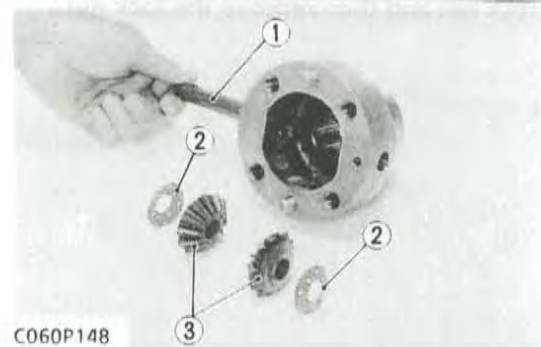
- Apply molybdenum disulfide (Three Bond 1901 or equivalent) to the inner circumferential surface of the differential case.
- Install the pinion shaft (1) so that the hole on it may align with the hole on differential case, and install the dowel pin.

- (1) Differential Pinion Shaft
(2) Pinion Thrust Collars

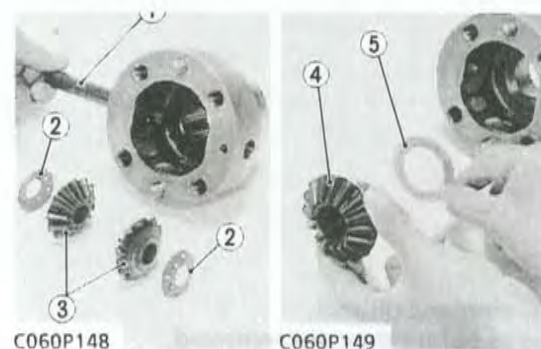
- (3) Differential Pinions



C060P147



C060P148



C060P148

C060P149

Differential Pinion and Differential Side Gear

1. Take out the differential pinions (3) and differential side gears (4).

■ NOTE

- Arrange the parts to know their original position.

(When reassembling)

- Apply molybdenum disulfide (Three Bond 1901 or equivalent) to the inner circumferential surface of the differential pinions (3).

- (1) Differential Pinion Shaft
(2) Pinion Thrust Collars
(3) Differential Pinions

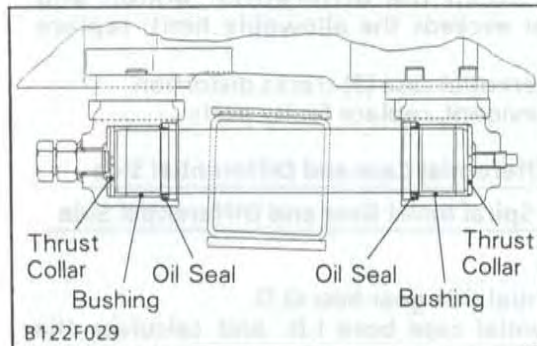
- (4) Differential Side Gear
(5) Shim

SERVICING

[2WD TYPE]



C060P129



B122F029



C060P130

Clearance between Front Axle Middle Boss and BracketBushing

1. Measure the front axle middle boss O.D. at several points where it contacts with the bushing.
2. Measure the front axle bracket 1 bushing I.D. and bracket 2 bushing I.D. in the same method, and calculate the clearance.
3. If the clearance exceeds the allowable limit, replace them.

(When reassembling)

- Before press-fitting the bushing, install the new thrust collar.
- Install the oil seals, noting their direction.

■ **IMPORTANT**

- After replacing the bush, be sure to adjust the front axle rocking force.

Clearance between front axle middle boss and bushing	Factory spec.	0.000 to 0.177 mm 0.0000 to 0.0070 in.
	Allowable limit	0.3 mm 0.012 in.
Front axle middle boss O.D.	Factory spec.	39.938 to 40.000 mm 1.5724 to 1.5748 in.
Bushing I.D.	Factory spec.	40.000 to 40.115 mm 1.5748 to 1.5793 in.

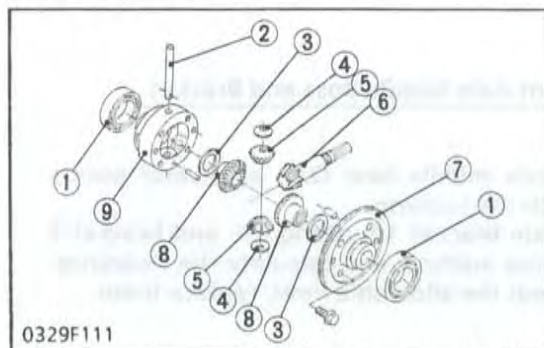
Clearance between Knuckle Shaft (King pin) and Bushing

1. Measure the shaft O.D. at several points where it contacts with the bushings.
2. Measure the bushing I.D. in the same method, and calculate the clearance.
3. If the clearance exceeds the allowable limit, replace.

(When reassembling)

- Remove the bushing with a bushing puller set (Code No: 07916-51031).

Clearance between front axle middle boss and bushing	Factory spec.	0.000 to 0.285 mm 0.0000 to 0.0112 in.
	Allowable limit	0.4 mm 0.016 in.
Front axle middle boss O.D.	Factory spec.	27.880 to 27.900 mm 1.0976 to 1.0984 in.
Bushing I.D.	Factory spec.	27.900 to 28.165 mm 1.0984 to 1.1087 in.

[4WD TYPE]

- (1) Ball Bearing (6) 7T Spiral Bevel Pinion Shaft
 (2) Pinion Shaft (7) Spiral Bevel Gear
 (3) Shims (8) Differential Side Gears
 (4) Pinion Thrust Collars (9) Differential Case
 (5) Differential Pinions

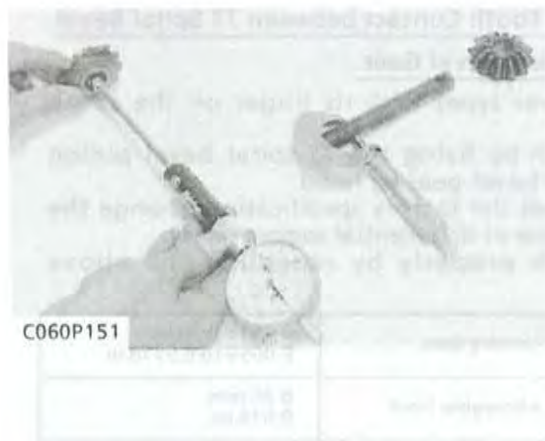
Inspection

1. Thoroughly clean all disassembled parts.
2. Check gear teeth for scoring, cracking or chipping, and make sure that tooth contact pattern indicates meshing depth. If any fault is evident, replace parts as required.
3. Check pinion shaft (2) and differential pinions (5) scores and signs of wear, and replace as required. Follow the same procedure for differential side gears (8) and their seats on differential case.
4. Inspect ball bearings (1) races and rollers for scoring, chipping or evidence of excessive wear.
5. Inspect pinion thrust collars (4) surface. Small faults can be corrected with a sandpaper. If the backlash between the differential pinion and differential side gear exceeds the allowable limit, replace pinion thrust collars.
6. Inspect gear and differential case (9) cracks distortion. If either condition is evident, replace faulty parts.

Clearances between Differential Case and Differential Side Gear and between 34T Spiral Bevel Gear and Differential Side Gear

1. Measure the differential side gear boss O.D.
2. Measure the differential case bore I.D. and calculate the clearance.
3. Measure the 34T spiral bevel gear I.D. and calculate the clearance.
4. If the clearance exceeds the allowable limit, replace faulty parts.

Clearance between differential case and differential side gear	Factory spec.	0.050 to 0.151 mm 0.0020 to 0.0059 in.
	Allowable limit	0.35 mm 0.0138 in.
Clearance between 34T spiral bevel gear and differential side gear	Factory spec.	0.050 to 0.114 mm 0.0020 to 0.0045 in.
	Allowable limit	0.35 mm 0.0138 in.
Differential case bore I.D.	Factory spec.	32.000 to 32.062 mm 1.2598 to 1.2623 in.
Spiral bevel gear bore I.D.	Factory spec.	32.000 to 32.025 mm 1.2598 to 1.2608 in.
Differential side gear O.D.	Factory spec.	31.911 to 31.950 mm 1.2563 to 1.2579 in.



C060P151

Clearance between Differential Pinion Shaft and Pinion

1. Measure the differential pinion shaft O.D.
2. Measure the differential pinion I.D. and calculate the clearance.
3. If the clearance exceeds the allowable limit, replace faulty parts.

Clearance between differential pinion shaft and pinion	Factory spec.	0.064 to 0.100 mm 0.0025 to 0.0039 in.
	Allowable limit	0.25 mm 0.0096 in.
Differential pinion shaft O.D.	Factory spec	13.950 to 13.968 mm 0.5492 to 0.5499 in.
Differential pinion I.D.	Factory spec	14.032 to 14.050 mm 0.5524 to 0.5532 in.



C060P152

Backlash between Differential Pinion and Differential Side Gear

1. Set a dial gauge (lever type) on a tooth of the differential pinion.
2. Fix the differential side gear and move the differential pinion to measure the backlash.
3. If the measurement exceeds the allowable limit, adjust with the differential side gears shims.

Backlash between differential pinion and differential side gear	Factory spec	0.15 to 0.30 mm 0.0059 to 0.0118 in.
	Allowable limit	0.40 mm 0.016 in.

(Reference)

- Thickness of adjusting shims

0.4 mm (0.016 in.)	1.0 mm (0.039 in.)
0.6 mm (0.024 in.)	1.2 mm (0.047 in.)
0.8 mm (0.031 in.)	

Turning Torque of Bevel Pinion Shaft

1. Secure the spacer with a vise.
2. Wind a string around the bevel pinion shaft and attach spring balance to the tip of the string.
3. Slowly pull the spring balance in a direction at right angle to the bevel pinion shaft to measure the turning force.
4. If the turning torque is not within the factory specifications, adjust with the lock nut.



C060P153

Turning force	Factory spec	111.8 to 137.3 N 11.4 to 14.0 kgf 82.5 to 101.3 lbs
Turning torque	Factory spec	1.118 to 1.373 N m 0.114 to 0.140 kgf m 0.825 to 1.013 ft-lbs

NOTE

- The turning torque is figured by multiplying the radius (distance from the center of the bevel pinion shaft to a point on the circumference from which the string is pulled) by the reading on the spring balance.
- After turning torque adjustment, be sure to stake the lock nut (1).

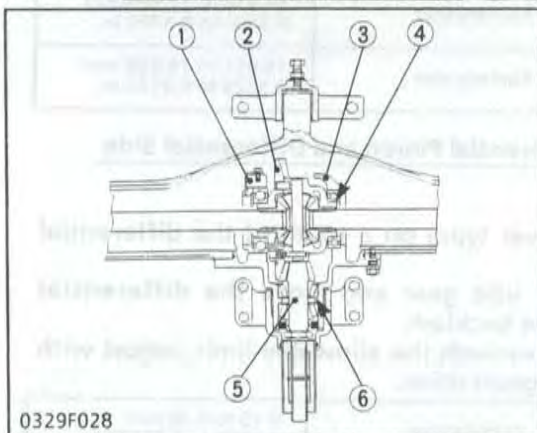


B111P096

(1) Lock Nut



C060P154



0329F028

- (1) Differential Support (Left)
 (2) 34T Spiral Bevel Gear
 (3) Differential Support (Right)
 (4) Shim
 (5) 7T Spiral Bevel Pinion Shaft
 (6) Shim

Adjusting Backlash and Tooth Contact between 7T Spiral Bevel Pinion Shaft and 34T Spiral Bevel Gear

1. Set a dial gauge (lever type) with its finger on the tooth surface.
2. Measure the backlash by fixing the 7T spiral bevel pinion shaft and moving the bevel gear by hand.
3. If the backlash exceeds the factory specification, change the shim (4) for thinner one at differential support R (3).
4. Adjust the backlash properly by repeating the above procedures.

Backlash between 34T spiral bevel gear and 7T bevel pinion shaft	Factory spec.	0.15 to 0.30 mm 0.0059 to 0.0118 in.
	Allowable limit	0.40 mm 0.016 in.

5. Apply red lead lightly over several teeth at three positions equally spaced on the bevel gear.
6. Turn the 7T spiral bevel pinion shaft (5) while pressing a wooden piece against the periphery of the 34T spiral bevel gear (2).
7. Check the tooth contact. If not proper, adjust with shims (4), (6) according to the instructions below:

(Reference)

- Thickness of adjusting shims (4), (6)
 0.4 mm (0.016 in.) 1.0 mm (0.039 in.)
 0.6 mm (0.024 in.) 1.2 mm (0.047 in.)
 0.8 mm (0.031 in.)

NOTE

- Be careful the 7T spiral bevel pinion shaft (5) may not contact with differential case by adjusting the tooth contact with shims (4), (6).

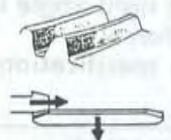
• Proper Contact



C065F198

More than 35% red lead contact area on the gear tooth surface. The center of tooth contact at 1/3 of the entire width from the small end.

• Heel Contact



• Tip Contact



0329F097

Replace the shim (6) with a thinner one to move the bevel pinion shaft toward inside (toward the pinion bearing case), and repeat above until the proper backlash and tooth contact are achieved. For adjusting the tip contact, replace the shim (4) with a thinner one and repeat this procedure until the proper tip contact is achieved.

If the backlash is small, replace the shim (4) with a thicker one and repeat this procedure until the proper backlash is achieved. Confirm the backlash and tooth contact again. Repeat above until the proper backlash and tooth contact are achieved.

• Toe Contact



• Base Contact



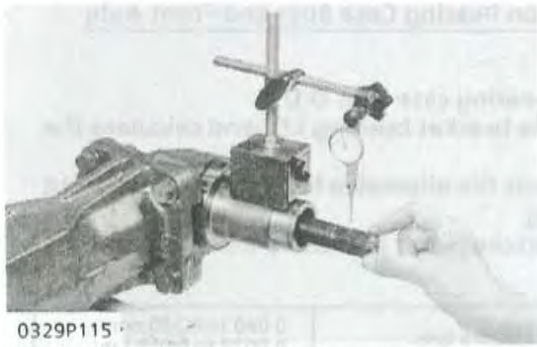
0329F098

Replace the shim (6) with a thinner one to move the bevel pinion shaft backward. Repeat above until the proper backlash and tooth contact are achieved.

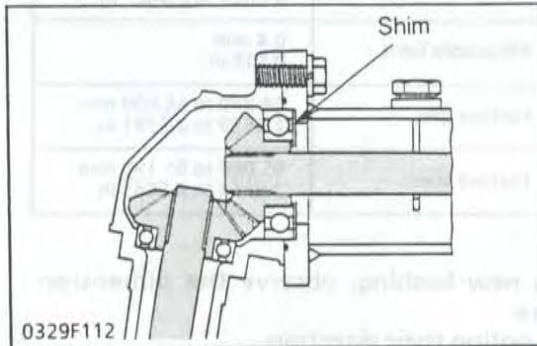
For adjusting the base contact, replace the shim (4) with thicker one until the proper contact is achieved.

If the backlash grows, replace the shim (4) with a thinner one until the proper backlash is achieved.

Confirm the backlash and tooth contact again. Repeat above using the shims (4), (6) until the proper tooth contact is achieved.



0329P115



0329F112

Backlash between 13T Bevel Gear and 15T Bevel Gear

1. Set a dial gauge (lever type) on the bevel gear shaft.
2. Move the bevel gear shaft by hand to measure the circumferential play of the bevel gear shaft.
3. Calculate the backlash from the ratio of the shaft diameter to the gear diameter.

Backlash	Play x 2.18
----------	-------------

4. If the backlash exceeds the allowable limit, adjust with shims.

Backlash between 13T bevel gear and 15T bevel gear	Factory spec.	0.15 to 0.30 mm 0.0059 to 0.0118 in.
	Allowable limit	0.40 mm 0.016 in.

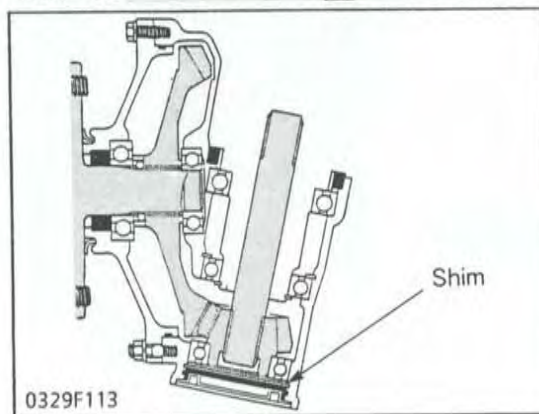
(Reference)

- Thickness of adjusting shims

0.4 mm (0.016 in.)	1.0 mm (0.039 in.)
0.6 mm (0.024 in.)	1.2 mm (0.047 in.)
0.8 mm (0.031 in.)	



C060P156



0329F113

Backlash between 12T Bevel Gear and 40T (42T) Bevel Gear

1. Fix the front axle case and front axle shaft (1).
2. Set a dial gauge (lever type) on a spline tooth of the bevel gear shaft (2).
3. Move the bevel gear shaft (2) by hand, and measure the circumferential play of the bevel gear shaft (2).
4. Calculate the backlash from the ratio of the shaft diameter to the gear diameter.

Backlash	Play x 1.92
----------	-------------

5. If the backlash exceeds the allowable limit, adjust with shims (3).

Backlash between 12T bevel gear and 40T (42T) bevel gear	Factory spec.	0.15 to 0.30 mm 0.0059 to 0.0118 in.
	Allowable limit	0.40 mm 0.016 in.

(Reference)

- Thickness of adjusting shims:

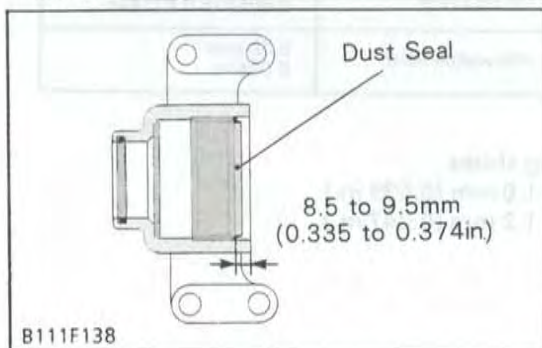
0.8 mm (0.031 in.)	2.0 mm (0.079 in.)
1.2 mm (0.047 in.)	2.3 mm (0.091 in.)
1.6 mm (0.063 in.)	2.6 mm (0.102 in.)
1.8 mm (0.071 in.)	

- (1) Front Axle Shaft
(2) Bevel Gear Shaft

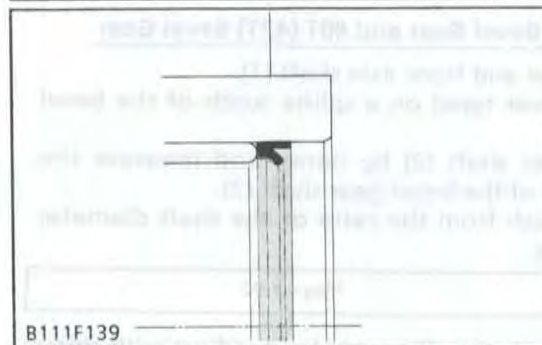
- (3) Shims



C060P157



B111F138



B111F139

Clearance between Pinion Bearing Case Boss and Front Axle

Bracket (Rear) Bushing

1. Measure the pinion bearing case boss O.D.
2. Measure the front axle bracket bushing I.D. and calculate the clearance.
3. If the clearance exceeds the allowable limit, replace the front axle bracket's bushing.
4. If the clearance still exceeds the allowable limit, replace the pinion bearing case.

Clearance between pinion bearing case boss and front axle bracket bushing	Factory spec.	0.060 to 0.220 mm 0.0024 to 0.0087 in.
	Allowable limit	0.4 mm 0.016 in.
Pinion bearing case boss O.D.	Factory spec.	64.970 to 65.000 mm 2.5579 to 2.5591 in.
Bushing I.D.	Factory spec.	65.060 to 65.190 mm 2.5614 to 2.5665 in.

■ Press-fitting Bushing

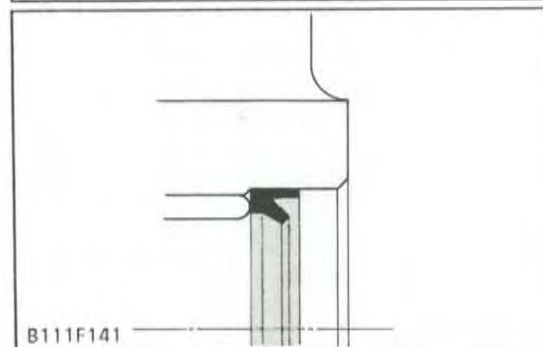
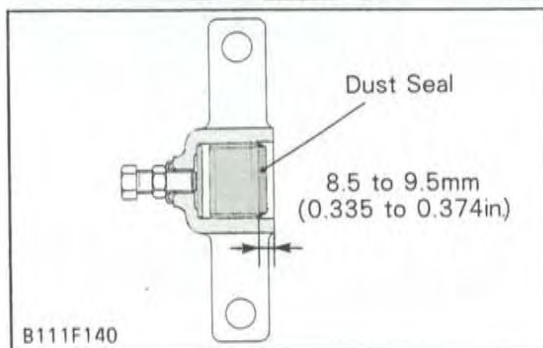
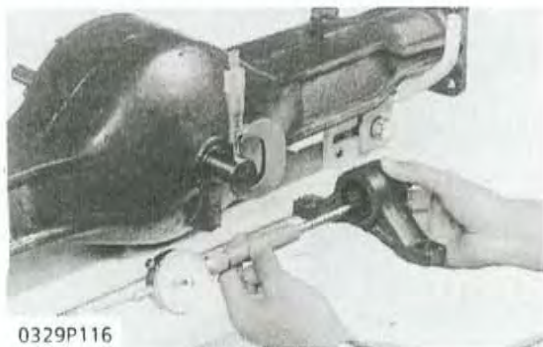
- When press-fitting a new bushing, observe the dimension described in the figure.
- Install the dust seals, noting their direction.

Press-fit depth of bushing	Factory spec.	8.5 to 9.5 mm 0.335 to 0.374 in.
----------------------------	---------------	-------------------------------------

■ NOTE

- After replacing the bushing, be sure to adjust the front axle rocking force.





Clearance between Front Axle Center Pivot and Front Axle

Bracket (Front) Bushing

1. Measure the front axle center pivot O.D.
2. Measure the front axle bracket bushing I.D. and calculate the clearance.
3. If the clearance exceeds the allowable limit, replace the front axle bracket (front) bushing.
4. If the clearance still exceeds the allowable limit, replace the front axle case.

[L2350]

Clearance between front axle center pivot and front axle bracket bushing	Factory spec.	0.000 to 0.147 mm 0.0000 to 0.0058 in.
	Allowable limit	0.3 mm 0.012 in.
Front axle center pivot O.D.	Factory spec.	34.938 to 35.000 mm 1.3755 to 1.3780 in.
Bushing I.D.	Factory spec.	35.000 to 35.085 mm 1.3780 to 1.3813 in.

[L2650, L2950, L3450, L3650]

Clearance between front axle center pivot and front axle bracket bushing	Factory spec.	0.000 to 0.177 mm 0.0000 to 0.0060 in.
	Allowable limit	0.3 mm 0.012 in.
Front axle center pivot O.D.	Factory spec.	39.938 to 40.000 mm 1.5724 to 1.5748 in.
Bushing I.D.	Factory spec.	40.000 to 40.115 mm 1.5748 to 1.5793 in.

■ Press-fitting Bushing

- When press-fitting a new bushing, observe the dimension described in the figure.
- Install the dust seals, noting their direction.

Press-fit depth of bushing	Factory spec.	8.5 to 9.5 mm 0.335 to 0.374 in.
----------------------------	---------------	-------------------------------------

■ NOTE

- After replacing the bushing, be sure to adjust the front axle rocking force.

S.7 STEERING

CONTENTS

TROUBLESHOOTING	S.7-1
SERVICING SPECIFICATIONS	S.7-4
TIGHTENING TORQUES	S.7-9
CHECKING, DISASSEMBLING AND SERVICING	S.7-10
[1] L2350	S.7-10
[1]-1 MANUAL STEERING	S.7-10
CHECKING AND ADJUSTING	S.7-10
DISASSEMBLING AND ASSEMBLING	S.7-10
SERVICING	S.7-11
[1]-2 POWER STEERING	S.7-12
CHECKING AND ADJUSTING	S.7-12
DISASSEMBLING AND ASSEMBLING	S.7-13
SERVICING	S.7-15
[2] L2650 2WD, L2950 2WD, L3450 2WD, L3650 2WD	S.7-20
[2]-1 STEERING POST AND STEERING GEAR	S.7-20
DISASSEMBLING AND ASSEMBLING	S.7-20
SERVICING	S.7-21
[2]-2 MANUAL STEERING	S.7-22
CHECKING AND ADJUSTING	S.7-22
DISASSEMBLING AND ASSEMBLING	S.7-23
[2]-3 POWER STEERING	S.7-25
CHECKING AND ADJUSTING	S.7-25
DISASSEMBLING AND ASSEMBLING	S.7-28
SERVICING	S.7-34
[2]-4 POWER STEERING HYDRAULIC PUMP	S.7-35
CHECKING AND ADJUSTING	S.7-35
DISASSEMBLING AND ASSEMBLING	S.7-36
SERVICING	S.7-37
[3] L2650 4WD, L2950 4WD, L3450 4WD, L3650 4WD	S.7-38
[3]-1 POWER STEERING	S.7-38
CHECKING AND ADJUSTING	S.7-38
DISASSEMBLING AND ASSEMBLING	S.7-38
SERVICING	S.7-44
[3]-2 STEERING CYLINDER	S.7-47
DISASSEMBLING AND ASSEMBLING	S.7-47
SERVICING	S.7-48
[3]-3 POWER STEERING HYDRAULIC PUMP	S.7-50
CHECKING AND ADJUSTING	S.7-50
DISASSEMBLING AND ASSEMBLING	S.7-51
SERVICING	S.7-52

TROUBLESHOOTING

MANUAL STEERING TYPE

Symptom	Probable Cause	Solution	Reference Page
Excessive Steering Wheel Play	• Back lash between sector gear shaft and ball nut too large	Adjust	S.7-10, 22
	• Steering linkage worn	Replace	–
	• Sector gear shaft worn	Replace	S.7-11, 24
Steering Wheel Does not Return to Neutral Position	• Ball nut malfunctioning • Bevel gear, bearing sticking or damaged [L2650 2WD, L2950 2WD]	Replace Repair or replace	S.7-11, 24 S.7-21
Hard Steering	• Steering wheel play too small • Improper front wheel alignment • Insufficient tire pressure • Thrust ball bearing damaged • Insufficient steering gear case oil • Bevel gear, bearing sticking or damaged [L2650 2WD, L2950 2WD] • Insufficient steering gear box oil	Adjust Adjust Inflate Replace Refill Replace Refill	S.7-10, 22 S.6-6 M.11-5 S.7-11, 24 S.G-7 S.7-21 S.G-7
Tractor Pulls to Right or Left	• Tire pressure uneven • Steering wheel play too small • Improper toe-in adjustment • Front wheel hub ball bearing worn or damaged • Brake pedal play unevenly adjusted	Adjust Adjust Adjust Replace Adjust	– S.7-10, 22 S.6-6 S.6-7 S.5-3
Front Wheels Vibrate	• Steering linkage worn • Improper toe-in adjustment • Knuckle shaft bushing worn • Clearance between front axle middle and bushing excessive	Replace Adjust Replace Replace	– S.6-6 S.6-13 S.6-13

INTERGRAL POWER STEERING TYPE

Excessive Steering Wheel Play	• Back lash between sector gear shaft and ball nut too excessive	Adjust	S.7-10, 27
	• Steering linkage worn	Replace	–
	• Sector gear shaft worn	Replace	S.7-14, 31
	• Centering spring weaken or broken	Replace	S.7-15, 30
Tractor Pulls to Right or Left	• Tire pressure uneven	Adjust	–
	• Steering wheel play too small	Adjust	S.7-10, 25
	• Improper toe-in adjustment	Adjust	S.6-6
	• Front wheel hub ball bearing worn or damaged	Replace	S.6-7
	• Brake pedal play unevenly adjusted	Adjust	S.5-3

INTEGRAL POWER STEERING TYPE (Continued)

Symptom	Probable Cause	Solution	Reference Page
Front Wheels Vibrate	- Steering linkage worn - Improper toe-in adjustment - Knuckle shaft bushing worn - Clearance between front axle middle boss and bushing excessive	Replace Adjust Replace Replace	– S.6-6 S.6-13 S.6-13
Hard Steering	- Transmission fluid improper or insufficient - Oil leak from pipe joint - Hydraulic pump malfunctioning - Relief valve malfunctioning - Control valve malfunctioning - Seals in the steering gear box damaged - Back lash between sector gear shaft and ball nut too small - Air in the hydraulic pipes - Low operating pressure	Change Retighten Replace Adjust or replace Replace Replace Adjust Bleed Refer to next item	S.G-7 S.7-35 S.7-12, 26 S.7-15, 30 S.7-16, 17, 32, 33 S.7-10, 27 S.7-28 –
Low Operating Pressure	- Hydraulic pump malfunctioning - Improper relief valve adjustment - Control valve malfunctioning - Seals in the steering gear box damaged - Ball nut malfunctioning - Oil leak from pipe or pipe broken	Replace Adjust Replace Replace Replace ball nut assembly Replace	S.7-35 S.7-12, 27 S.7-15, 30 S.7-16, 17, 32, 33 S.7-14, 32 –
Steering Wheel Does Not Return to Neutral Position	- Control valve malfunctioning - Valve spool and valve housing jammed - Centering spring weaken or broken	Replace Repair or replace Replace	S.7-15, 30 S.7-15, 30 S.7-15, 30
Steering Force Fluctuates	- Insufficient oil - Insufficient bleeding - Control valve malfunctioning	Replenish Bleed Replace	S.G-7 S.7-28 S.7-15, 30
Noise	- Insufficient oil - Air sucked in pump from suction circuit - Pipe deformed	Replenish Repair Replace	S.G-7 – –

FULL HYDROSTATIC POWER STEERING TYPE

Symptom	Probable Cause	Solution	Reference Page
Tractor Can Not Be Steered	- Hydraulic pump malfunctioning - Valve plate malfunctioning	Replace Replace	S.7-50 S.7-40
Front Wheels Vibrate	- Centering spring weaken or broken - Improper toe-in adjustment - Air in the hydraulic system - Improperly mounted wheels - Tie rod end loose or worn - Front wheel hub bearings worn - Clearance between center pivot and bushing, front wheel differential gear case and bushing excessive	Replace Adjust Bleed Retighten Retighten or replace Replace Replace	S.7-40, 41 S.6-6 S.7-38 – S.5-14 S.6-10 S.6-18, 19
Hard Steering	- Hydraulic pump malfunctioning - Overload - Transmission fluid improper or insufficient - Oil leak from pipe joint - Insufficient tire pressure - Valve plate malfunctioning - Relief valve malfunctioning	Replace – Change Retighten Inflate Replace Replace	S.7-50 – S.G-7 – M.11-5 S.7-40 S.7-38
Steering Force Fluctuates	- Air sucked in pump due to leaking or missing of oil - Air sucked in pump from suction circuit	Replenish Repair	S.G-7 –
Front Wheels Wander to Right and Left	- Centering spring weaken or broken - Air sucked in pump due to leak of oil - Air sucked in pump from suction circuit - Tire pressure uneven - Insufficient bleeding - Improper toe-in adjustment - Clearance between center pivot and bushing, front wheel differential gear case and bushing excessive - Tie rod end loose or worn	Replace Replenish Repair Inflate Bleed Adjust Replace Retighten or replace	S.7-40, 41 S.G-7 – M.11-5 S.7-38 S.6-6 S.6-18, 19 S.5-14
Wheels Are turned to a Direction Opposite to Steering Direction	Piping connected in reverse	Repair	–
Noise	- Air sucked in pump due to lack of oil - Air sucked in pump from suction circuit - Pipe deformed	Replenish Repair Replace	S.G-7 – –

SERVICING SPECIFICATIONS

MANUAL STEERING [L2350]

Item		Factory Specification	Allowable Limit
Steering Wheel	Play	20 to 50 mm 0.79 to 1.97 in.	—
Drag Link End and Tie-rod	Play	—	0.3 mm 0.0118 in.
Steering Shaft	Initial turning torque	Less than 1.72 N·m Less than 0.175 kgf·m Less than 1.26 ft-lbs	—
Steering Shaft (Without bushing and seal)	Turning torque	0.25 to 0.44 N·m 0.025 to 0.045 kgf·m 0.181 to 0.326 ft-lbs	—

POWER STEERING [L2350]

Steering Wheel	Play	20 to 50 mm 0.79 to 1.97 in.	—
Relief Valve Condition - Engine Speed Approx. 2800 rpm - Oil Temperature 45 to 55°C 113 to 131°F	Setting Pressure	10.0 to 10.6 MPa 102 to 108 kgf/cm ² 1451 to 1536 psi	—
Steering Gear Box and Ball Nut	Clearance	0.030 to 0.079 mm 0.0012 to 0.0031 in.	0.079 mm 0.0031 in.
Ball Nut Assembly	Axial Play	0.02 mm 0.0008 in.	0.12 mm 0.0047 in.
Worm Shaft	O.D.	28.562 to 28.575 mm 1.1245 to 1.1250 in.	28.475 mm 1.1211 in.
Valve Housing and Spool	Clearance	0.008 to 0.015 mm 0.0003 to 0.0006 in.	0.025 mm 0.0010 in.
Sector Shaft	O.D.	38.059 to 38.075 mm 1.4984 to 1.4990 in.	38.025 mm 1.4970 in.
Sector Gear and Ball Nut	Backlash	0 to 0.4 mm 0 to 0.016 in.	—
Sector Shaft	Initial Turning torque	1.177 or less 0.12 kgf·m or less 0.87 ft-lbs or less	—

STEERING GEAR CASE [L2650 2WD, L2950 2WD, L3450 2WD, L3650 2WD]

Item		Factory Specification	Allowable Limit
Bevel Gears in Steering Gear Case (14T Bevel Gears) Adjusting Shim	Backlash	0.1 to 0.3 mm 0.004 to 0.012 in.	0.4 mm 0.016 in.
	Thickness	0.8 mm (0.031 in.) 1.0 mm (0.039 in.) 1.2 mm (0.047 in.)	—

MANUAL STEERING [L2650 2WD, L2950 2WD]

Steering Wheel	Play	20 to 50 mm 0.79 to 1.97 in.	—
Sector Gear Shaft to Ball Nut	Backlash	0 to 0.33 mm 0 to 0.013 in.	—
Worm Shaft	Turning Torque	Less than 0.98 N·m 0.10 kgf·m 0.72 ft-lbs	—

POWER STEERING [L2650 2WD, L2950 2WD, L3450 2WD, L3650 2WD]

Steering Wheel	Play	20 to 50 mm 0.79 to 1.97 in.	—
Relief Valve Condition - Engine Speed Max. rpm - Oil Temperature 45 to 55°C 113 to 131°F	Setting Pressure	11.28 to 11.77 MPa 115 to 120 kgf/cm ² 1636 to 1707 psi	—
Steering Gear Box to Ball Nut	Clearance	0.030 to 0.079 mm 0.00118 to 0.00311 in.	0.15 mm 0.0059 in.
Gear Box bore	I.D.	61.000 to 61.030 mm 2.40158 to 2.40276 in.	—
Ball Nut	O.D.	60.951 to 60.970 mm 2.39965 to 2.40040 in.	—
Ball Nut Assembly	Axial Play	Less than 0.020 mm 0.00079 in.	—

POWER STEERING [L2650 2WD, L2950 2WD, L3450 2WD, L3650 2WD] (Continued)

Item		Factory Specification	Allowable Limit
Worm Shaft	O.D.	24.996 to 25.009 mm 0.98410 to 0.98461 in.	—
Valve Housing to Spool	Clearance	0.008 to 0.015 mm 0.0031 to 0.0059 in.	0.025 mm 0.00098 in.
Sector Gear Shaft Steering Gear Box Side	O.D.	31.987 to 32.000 mm 1.25933 to 1.25984 in.	31.900 mm 1.25591 in.
Side Cover Side	O.D.	27.987 to 28.000 mm 1.10185 to 1.10236 in.	27.900 mm 1.09843 in.
Sector Gear Shaft to Ball Nut	Backlash	0 to 0.30 mm 0 to 0.0130 in.	—
Warm Shaft	Turning Torque	Less than 1.18 N·m 0.12 kgf·m 0.87 ft-lbs	—

POWER STEERING [L2650 4WD, L2950 4WD, L3450 4WD, L3650 4WD]

Relief Valve Condition	Setting Pressure	10.30 to 11.28 MPa 105 to 115 kgf/cm ² 1493 to 1636 psi	—
- Engine Speed Max. rpm - Oil Temperature 45 to 55°C 113 to 131°F			
Rotor Set	Clearance	—	0.08 mm 0.003 in.

STEERING CYLINDER [L2650 4WD, L2950 4WD, L3450 4WD, L3650 4WD]

Cylinder Tube	I.D.	50.000 to 50.062 mm 1.9685 to 1.9709 in.	50.100 mm 1.9724 in.
Rod to flange	Clearance	0.020 to 0.062 mm 0.0008 to 0.0024 in.	—
Rod	O.D.	29.959 to 29.980 mm 1.1795 to 1.1803 in.	—
Flange	I.D.	30.000 to 30.021 mm 1.1811 to 1.1819 in.	—

POWER STEERING HYDRAULIC PUMP [L2650 2WD, L2950 2WD, L3450 2WD, L3650 2WD]

Item		Factory Specification	Allowable Limit
Hydraulic Pump Condition	Delivery at No Pressure [L2650, L2950]	Above 10.5 l/min 2.77 U.S.gal/min 2.31 Imp.gal/min	-
	[L3450]	Above 11.7 l/min 3.09 U.S.gal/min 2.57 Imp.gal/min	-
	[L3650]	Above 12.1 l/min 3.20 U.S.gal/min 2.66 Imp.gal/min	-
	Delivery at Rated Pressure [L2650, L2950]	Above 10.2 l/min 2.69 U.S.gal/min 2.24 Imp.gal/min	9.1 l/min 2.40 U.S.gal/min 2.00 Imp.gal/min
	[L3450]	Above 11.3 l/min 2.99 U.S.gal/min 2.49 Imp.gal/min	10.2 l/min 2.69 U.S.gal/min 2.24 Imp.gal/min
	[L3650]	Above 11.7 l/min 3.09 U.S.gal/min 2.57 Imp.gal/min	10.5 l/min 2.77 U.S.gal/min 2.31 Imp.gal/min
Housing	Depth of Scratch	-	0.09 mm 0.0035 in.
Bushing to Gear Shaft	Clearance	-	0.15 mm 0.0059 in.
Bushing	Length	16.99 to 17.00 mm 0.6689 to 0.6693 in.	16.80 mm 0.6614 in.

POWER STEERING HYDRAULIC PUMP [L2650 4WD, L2950 4WD, L3450 4WD, L3650 4WD]

Item		Factory Specification	Allowable Limit
Hydraulic Pump Condition • Engine Speed L2650, L2950, L3650 2600 rpm L3450 2500 rpm • Rated Pressure 10.30 to 11.28 MPa 105 to 115 kgf/cm² 1493 to 1636 psi • Oil Temperature 45 to 55°C 113 to 131°F	Delivery at No Pressure [L2650, L2950]	Above 17.1 ℓ/min 4.52 U.S.gal/min 3.76 Imp.gal/min	—
	[L3450]	Above 14.7 ℓ/min 3.88 U.S.gal/min 3.23 Imp.gal/min	—
	[L3650]	Above 15.3 ℓ/min 4.04 U.S.gal/min 3.37 Imp.gal/min	—
	Delivery at Rated Pressure [L2650, L2950]	Above 16.6 ℓ/min 4.39 U.S.gal/min 3.65 Imp.gal/min	14.9 ℓ/min 3.94 U.S.gal/min 3.28 Imp.gal/min
	[L3450]	Above 14.3 ℓ/min 3.78 U.S.gal/min 3.15 Imp.gal/min	12.8 ℓ/min 3.38 U.S.gal/min 2.82 Imp.gal/min
	[L3650]	Above 14.8 ℓ/min 3.91 U.S.gal/min 3.26 Imp.gal/min	13.3 ℓ/min 3.51 U.S.gal/min 2.93 Imp.gal/min
	Housing	Depth of Scratch	0.09 mm 0.0035 in.
	Bushing to Gear Shaft	Clearance	0.15 mm 0.0059 in.
	Bushing	Length	15.79 to 15.80 mm 0.6217 to 0.6220 in.

TIGHTENING TORQUES

Tightening torques of screws and nuts on the table below is especially specified.
(For general use screws and nuts: See page S.G-8)

[L2350]

Item	N·m	kgf·m	ft-lbs
Tie-rod end mounting nut	49.0 to 68.6	5.0 to 7.0	36.2 to 50.6
Pitman arm mounting nut	118 to 157	12.0 to 16.0	87.0 to 115.9
Steering wheel mounting nut	29.4 to 49.0	3.0 to 5.0	21.7 to 36.2
Jam nut (Manual steering)	157 to 196	16.0 to 20.0	115.8 to 144.6
Column lock nut (Power steering)	98 to 127	10.0 to 13.0	72.3 to 94.0
Special nut (Power steering)	58.8 to 78.4	6.0 to 8.0	43.4 to 57.9

[L2650 2WD, L2950 2WD, L3450 2WD, L3650 2WD]

[Manual Steering Type]			
Steering shaft and joint shaft mounting screw	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Tie rod end mounting nut	49.0 to 68.6	5.0 to 7.0	36.2 to 50.6
Pitman arm mounting nut	117.7 to 156.9	12.0 to 16.0	86.8 to 115.7
Steering gear box mounting screw	123.6 to 147.1	12.6 to 15.0	91.1 to 108.5
Steering wheel mounting nut	29.4 to 49.0	3.0 to 5.0	21.7 to 36.2
Side cover mounting screw	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
[Power Steering Type]			
Steering shaft and joint shaft mounting bolt	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Tie rod end mounting nut	49.0 to 68.6	5.0 to 7.0	36.2 to 50.6
Pitman arm mounting nut	147.1 to 196.1	15.0 to 20.0	108.5 to 144.7
Power steering assembly mounting screw	123.6 to 147.1	12.6 to 15.0	91.1 to 108.5
Power steering delivery pipe end eye joint screw (at steering gear box)	49.0 to 58.8	5.0 to 6.0	36.2 to 43.4
Steering wheel mounting nut	29.4 to 49.0	3.0 to 5.0	21.7 to 36.2
End cover mounting screw	37.3 to 56.9	3.8 to 5.8	27.5 to 42.0
Relief valve lock nut	49.0 to 58.8	5.0 to 6.0	36.2 to 43.4
Side cover lock nut	19.6 to 29.4	2.0 to 3.0	14.5 to 21.7
Side cover mounting screw	34.3 to 54.9	3.5 to 5.6	25.3 to 40.5

[L2650 4WD, L2950 4WD, L3450 4WD, L3650 4WD]

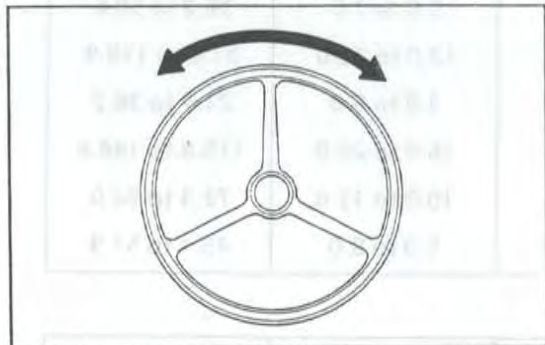
[Steering Controller]			
Steering controller mounting nuts	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Flared pipes	34.3 to 39.2	3.5 to 4.0	25.3 to 28.9
Retaining nuts	27.0 to 33.0	2.8 to 3.4	20.0 to 24.0
Hex. socket head cap screws	1.24 to 1.47	0.13 to 0.15	0.94 to 1.08
Steering wheel mounting nut	29.4 to 49.0	3.0 to 5.0	21.7 to 36.2
[Steering Cylinder]			
Steering cylinder mounting screws	77.5 to 90.2	7.9 to 9.2	57.1 to 66.5
Tie rod end mounting nuts	39.2 to 45.1	4.0 to 4.6	28.9 to 33.3
Tie rod screws of rod side	98.1 to 117.7	10 to 12	72.3 to 86.8
Hydraulic hoses	24.5 to 29.4	2.5 to 3.0	18.1 to 21.7

CHECKING, DISASSEMBLING AND SERVICING

[1] L2350

[1]-1 MANUAL STEERING

CHECKING AND ADJUSTING



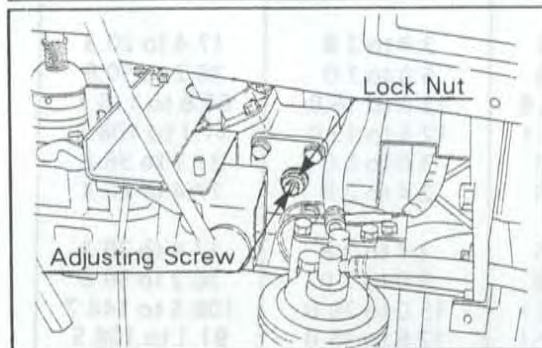
Steering Wheel Play

1. Turn the front wheels straight ahead.
2. Rotate the steering wheel lightly by hand, and measure the play.
3. If the play is not within the factory specifications, turn the adjusting screw to adjust.

Steering wheel play	Factory spec.	20 to 50 mm 0.79 to 1.97 in.
---------------------	---------------	---------------------------------

(Adjusting)

1. Loosen the lock nut and turn the adjusting screw with a screwdriver to adjust the play.
When the adjusting screw is turned clockwise, the play decreases.
2. After adjustment, while holding the adjusting screw, fix it with lock nut.



DISASSEMBLING AND ASSEMBLING



Pitman Arm

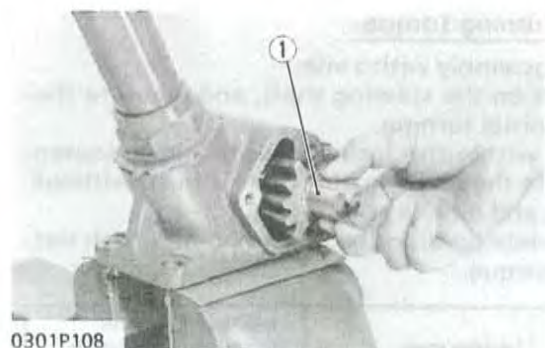
1. Remove the pitman arm from the sector shaft with the pitman arm puller. (Code No: 07909-39011).

(When reassembling)

- Install the pitman arm to the sector shaft making sure that the marks are aligned.

Tightening torque	Pitman arm mounting nut	118 to 157 N·m 12.0 to 16.0 kgf·m 87.0 to 115.9 ft·lbs
-------------------	-------------------------	--





0301P108

Side Cover and Sector Gear Shaft

1. Drain the oil.
2. Remove the side cover mounting screws.
3. Remove the lock nut and cap nut at the center of the side cover.
4. Turn the adjusting screw to remove the side cover.
5. Tap out sector gear shaft (1) toward the side cover.

(When reassembling)

- Apply liquid gasket (Three Bond No.4 or equivalent) to the mounting surface of side cover gasket.



0350P034

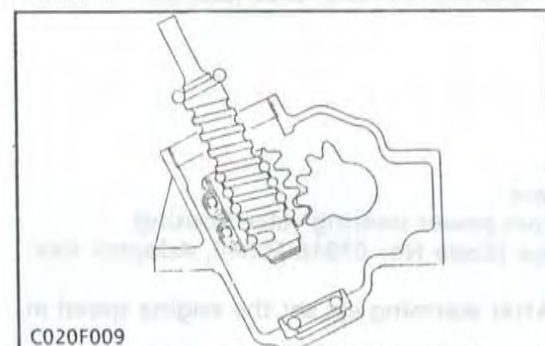
Steering Column, Steering Shaft and Ball Nut Assembly

1. Remove the nut and steering column.
2. Remove the steering shaft and ball nut assembly.

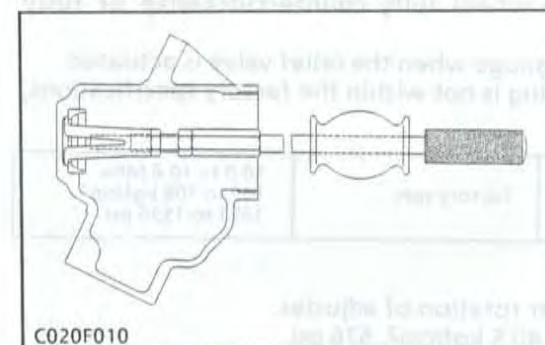
(When reassembling)

- Steering box assembly.
 - Install the sector gear shaft, and turn it clockwise fully.
 - Install the ball nut assembly and mesh it with the sector gear, making sure that the thrust bearing does not leave the outer race.
- Adjust the steering shaft initial turning torque.
(See page S.7-12)

(1) Sector Gear Shaft



C020F009

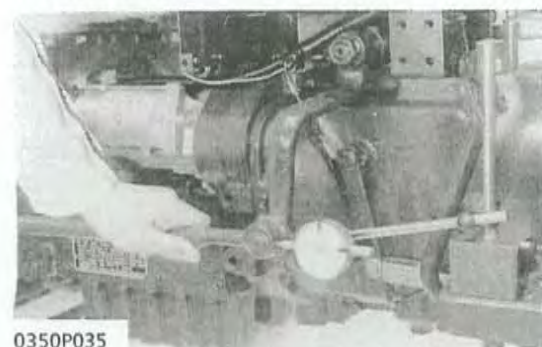


C020F010

Thrust Ball Bearing

1. Draw out the bearing outer with the bushing replacement tool. (Code No: 07916-51031).

SERVICING

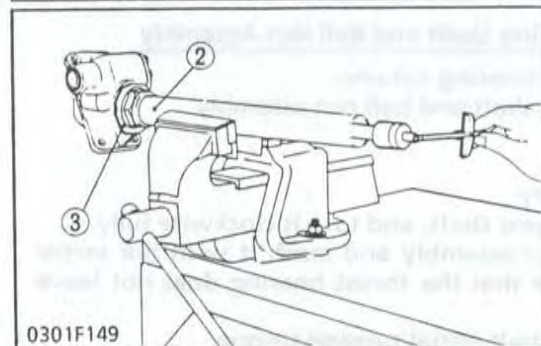
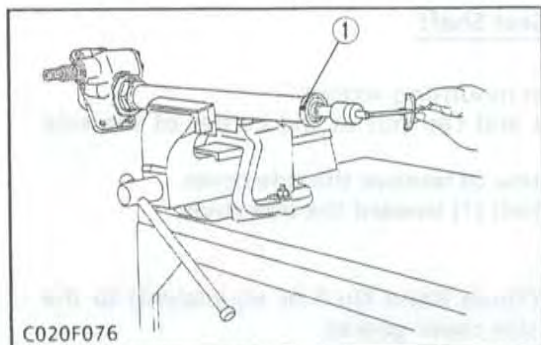


0350P035

Tie Rod End Play

1. Remove either one of the tie rod ends.
2. Set a dial indicator with its finger on the tie rod end.
3. Move the tie rod lightly and measure the play.
4. If the play exceeds the allowable limit, replace the tie rod end.

Play of tie rod end	Allowable limit	0.3 mm 0.012 in.
---------------------	-----------------	---------------------



Steering Shaft Initial Turning Torque

1. Secure the steering assembly with a vise.
2. Set a torque wrench on the steering shaft, and measure the torque required to initial turning.
3. If the torque is not within the factory specifications, loosen the nut (3) and rotate the steering post (2) to adjust, without the column bushing and oil seal (1).
4. After adjustment, while holding the column, jam it with nut (3) to the specified torque.

Steering shaft initial turning torque	Factory spec.	less than 1.72 N·m less than 0.175 kgf·m less than 1.26 ft-lbs
Initial turning torque (without bushing and seal)	Factory spec.	0.25 to 0.44 N·m 0.025 to 0.045 kgf·m 0.181 to 0.326 ft-lbs
Tightening torque	Jam nut	157 to 196 N·m 16 to 20 kgf·m 115.8 to 144.6 ft-lbs

(1) Oil Seal

(2) Steering Post

(3) Nut

[1]-2 POWER STEERING CHECKING AND ADJUSTING



Relief Valve Pressure

1. Remove the shift base.
2. Remove the plug from power steering valve housing.
3. Set a pressure gauge (Code No: 07916-50040, Adaptor size: PT 1/8).
4. Start the engine. After warming up, set the engine speed at max. speed.
5. Turn the steering wheel fully counterclockwise or fully clockwise and hold.
6. Read the pressure gauge when the relief valve is actuated.
7. If the pressure setting is not within the factory specifications, adjust.

Relief valve setting pressure	Factory spec	10.0 to 10.6 MPa 102 to 108 kgf/cm ² 1451 to 1536 psi
-------------------------------	--------------	--

(Reference)

- Pressure change per rotation of adjuster.
Approx. 3.97 MPa, 40.5 kgf/cm², 576 psi.

(1) Adjuster

DISASSEMBLING AND ASSEMBLING



B122P040

Power Steering Unit

1. Turn the steering shaft clockwise and counterclockwise several times to drain oil from the gear box.
2. Secure the power steering unit with a vise.



0301P112

Pitman Arm

1. Remove nut and spring washer.
2. Temporarily remount the nut.
3. Remove pitman arm with the pitman arm puller. (Code No: 07909-39011).

(When reassembling)

- Install the pitman arm to the sector gear shaft, aligning their aligning marks.

Tightening torque	Pitman arm mounting nut	118 to 157 N·m 12.0 to 16.0 kgf·m 87 to 116 ft-lbs
-------------------	-------------------------	--



0301P113



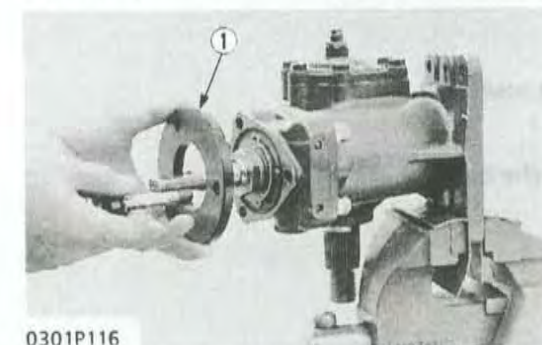
0301P115

Steering Shaft

1. Remove the column.
2. Draw out the rivet and drive out the spring pin.
3. Remove the steering shaft.

(When reassembling)

Tightening torque	Column lock nut	98 to 127 N·m 10 to 13 kgf·m 72.3 to 94.0 ft-lbs
-------------------	-----------------	--

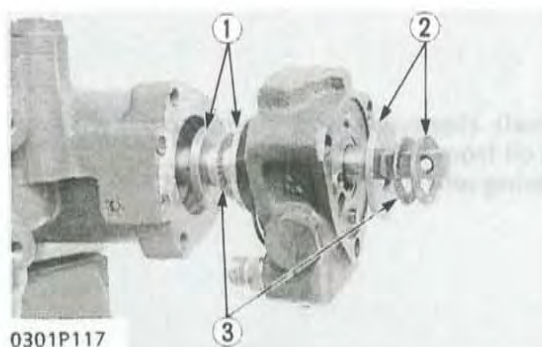


0301P116

Rear Cover

1. Remove the rear cover.
2. Install the mounting plate (See page S.G-35) with three screws.

(1) Special Mounting Plate



0301P117

Valve Assembly

1. Flatten the staking of the lock nut.
2. Fix the worm shaft with a plier so that it does not rotate, and remove the lock nut.

(When reassembling)

- Screw the worm shaft clockwise, tighten the lock nut by hand, and stake the lock nut with a pin punch.
- Be sure to mount O-ring.

(1) Thrust Race

(3) Needle Bearing

(2) Thrust Race

Side Cover

1. Remove the special nut and gasket from the adjuster section.
2. Remove the side cover mounting screws, turn the adjusting screw clockwise, and remove the side cover.

(When reassembling)

Tightening torque	Special nut	58.8 to 78.4 N·m 6.0 to 8.0 kgf·m 43.4 to 57.9 ft·lbs
-------------------	-------------	---



0301P118



0301P120

Sector Gear Shaft

1. Remove the sector gear shaft from the side cover.



0301P121

Front Cover

1. Remove the internal snap ring and the front cover.



0301P122

Ball Nut

1. Pull out the ball nut assembly.

■ NOTE

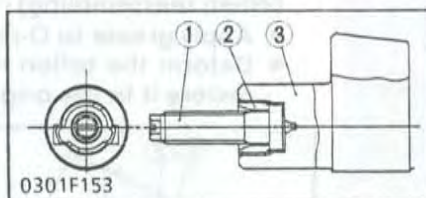
- Never disassemble the ball nut assembly.



0301P123

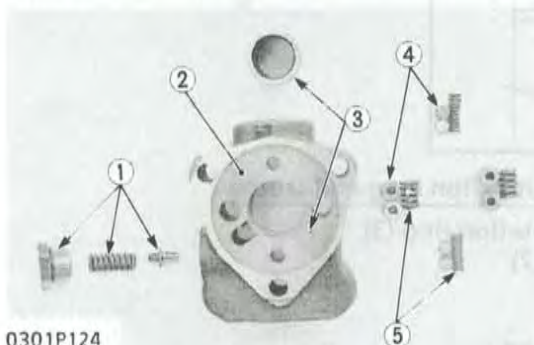
Adjustor

1. Remove the adjuster.



0301F153

- (1) Adjuster Screw
- (2) Adjuster
- (3) Sector Shaft



0301P124

Control Valve

1. Remove the relief valve (1).
2. Remove the spool, reaction pistons (4) and springs (5).

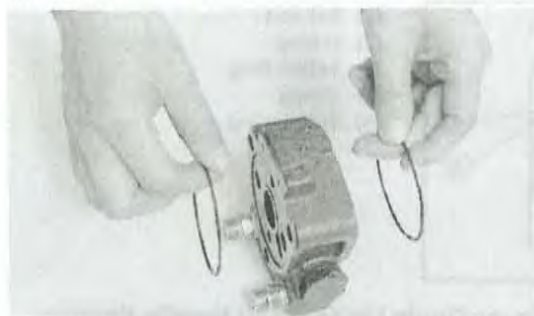
(When reassembling)

- Align P marks on the sleeve and spool to assemble.
- Apply grease to O-ring.
- After assembling, adjust the power steering relief pressure. (See page S.7-12)

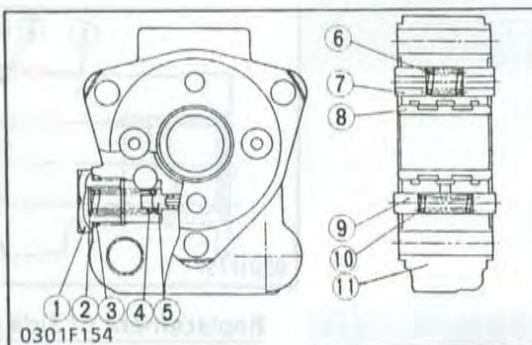
NOTE

- Replace the spool and valve housing as an assembly.

- (1) Relief Valve
- (2) Valve Housing
- (3) P Mark
- (4) Reaction Piston
- (5) Coil Spring



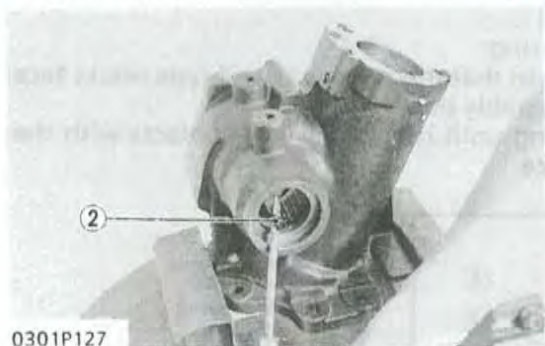
0301P125



0301F154

- (1) Adjuster
- (2) Jam Nut
- (3) O-ring
- (4) Coil Spring
- (5) Poppet
- (6) Coil Spring
- (7) Reaction Piston
- (8) Spool
- (9) Reaction Piston
- (10) Coil Spring
- (11) Valve Housing

SERVICING



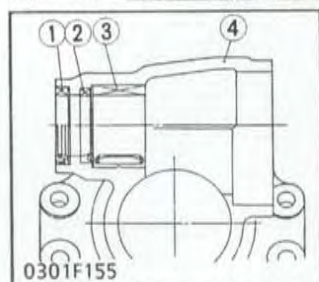
0301P127

Replacement of Seals and Bearing

1. Remove the oil seal (1) with screwdriver.
2. Remove the single lip seal (2) with screwdriver.
3. Remove the needle bearing (3) from the gear box with the puller.

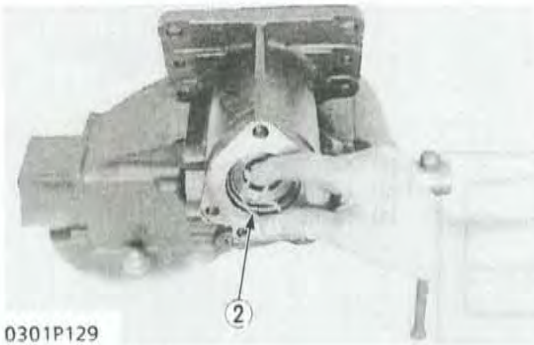
(When reassembling)

- Apply grease to oil seal and single lip seal, and insert them.
- Install the bearing so that manufacturer marks and type marks face to the inside of the gear box.
- Press fit the bearing until its race surface contacts with the housing end surface.



0301F155

- (1) Oil Seal
- (2) Single Lip Seal
- (3) Needle Bearing
- (4) Gear Box



0301P129

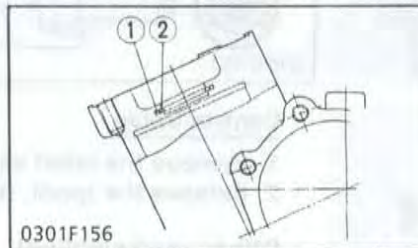
(2) Teflon Ring

Replacement of Gear Box Teflon Ring and O-ring

1. Cut and remove the teflon ring (2).
2. Remove the O-ring (1).

(When reassembling)

- Apply grease to O-ring.
- Deform the teflon ring into a shape by hand, install it, and restore it to the original form.



0301F156

- (1) O-ring
(2) Teflon Ring



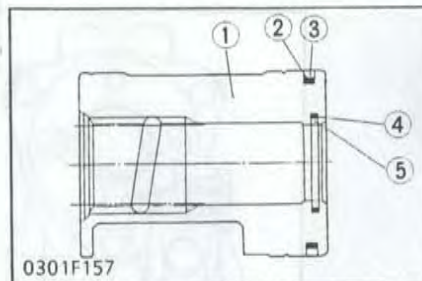
0301P130

Replacement of Ball Nut Teflon Ring and O-ring

1. Cut and remove the teflon ring (3).
2. Remove the O-ring (2).

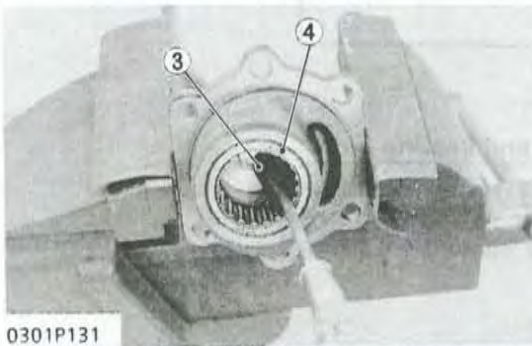
(When reassembling)

- Apply grease to O-ring
- Stretch the teflon ring by hand, install it on the ball nut, and press it so that it is restored to its original form.



0301F157

- (1) Ball Nut
(2) O-ring
(3) Teflon Ring
(4) O-ring
(5) Teflon Ring



0301P131

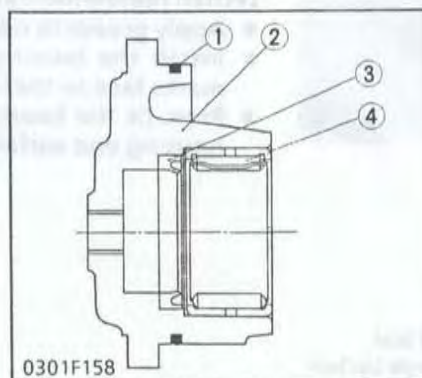
(3) Single Lip Seal
(4) Needle Bearing

Replacement of Side Cover Single Lip Seal and Needle Bearing

1. Remove the single lip seal (3) with a screwdriver.
2. Pull out the needle bearing (4) with a puller.

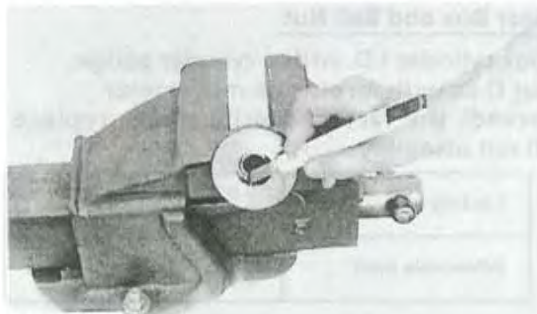
(When reassembling)

- Apply grease to O-ring.
- Install the bearing so that manufacturer and type marks face to the gear box assembly side.
- Press fit the bearing until its race surface contacts with the housing end surface.

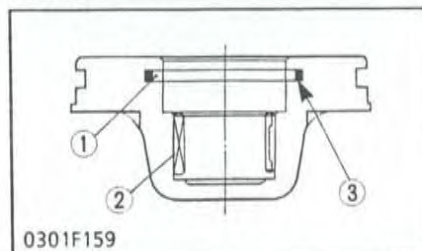


0301F158

- (1) O-ring
(2) Side Cover
(3) Single Lip Seal
(4) Needle Bearing



0301P132



0301F159

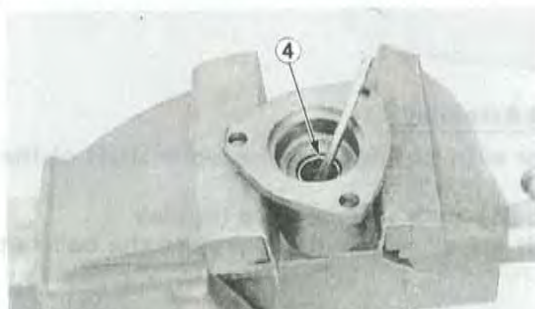
- (1) Teflon Ring
(2) Needle Bearing
(3) O-ring

Replacement of Front Cover Teflon Ring and Needle Bearing

1. Cut and remove the teflon ring (1).
2. Pull out the needle bearing (2) with a puller.
3. Remove the O-ring (3).

(When reassembling)

- Apply grease to O-ring.
- Deform the teflon ring into a shape by hand, install it, and restore it to its original form.
- Install the bearing so that manufacturer and type marks face forward.
- Press fit bearing until its race surface contacts with the housing end surface.



0301P135

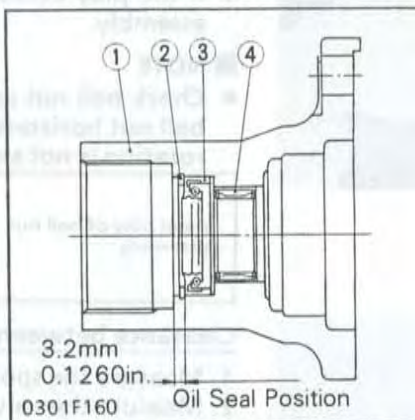
(4) Needle Bearing

Replacement of Rear Cover Oil Seal and Needle Bearing

1. Remove the internal snap ring.
2. Remove the oil seal (3).
3. Draw out the needle bearing (4).

(When reassembling)

- Install the bearing so that manufacturer and type marks face to the column side.



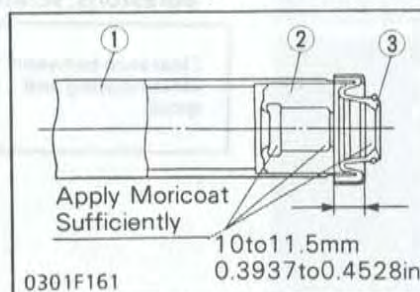
- (1) Rear Cover
(2) Snap Ring
(3) Oil Seal
(4) Needle Bearing

Replacement of Column Oil Seal

1. Remove the oil seal and column cap (seal cap) as an assembly.

(When reassembling)

- Apply molybdenum disulfide (Three Bond 1901 or equivalent) to the column bushing.



- (1) Steering Post
(2) Column Bushing
(3) Oil Seal

0301F161

0301P136



0301P137

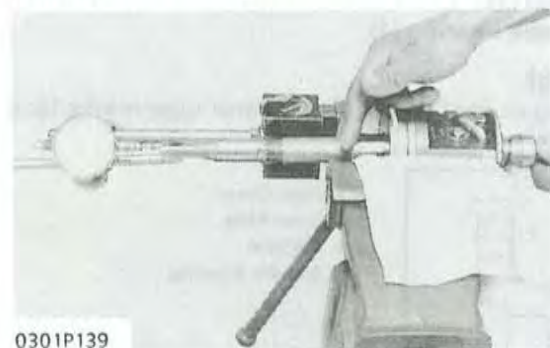


0301P138

Clearance between Gear Box and Ball Nut

1. Measure the gear box cylinder I.D. with a cylinder gauge.
2. Measure the ball nut O.D. with an outside micrometer.
3. If the clearance exceeds the factory specifications, replace the gear box or ball nut assembly.

Clearance between gear box and ball nut	Factory spec.	0.030 to 0.079 mm 0.0012 to 0.0031 in.
	Allowable limit	0.079 mm 0.0031 in.



0301P139

Axial Play of Ball Nut Assembly

1. Set a dial indicator with its finger on the worm shaft of the ball nut assembly.
2. Move the worm shaft axially and measure the play.
3. If the play exceeds the allowable limit, replace the ball nut assembly.

NOTE

- Check ball nut assembly for smooth rotation by holding the ball nut horizontally, and slowly rotating the worm shaft. If rotation is not smooth, replace the ball nut assembly.

Axial play of ball nut assembly	Factory spec.	0.02 mm 0.0008 in.
	Allowable limit	0.12 mm 0.0047 in.



0301P141



0301P142

Clearance between Valve Housing and Spool

1. Measure the spool O.D. with an outside micrometer.
2. Measure the valve housing I.D. with a caliper gauge.
3. If the clearance exceeds the allowable limit, replace the valve housing and spool as an assembly.

NOTE

- Check that the spool slides smoothly and rotates in the sleeve.
- Check that the spool and sleeve edges are free from abrasions, scratches, etc.

Clearance between valve housing and spool	Factory spec.	0.008 to 0.015 mm 0.0003 to 0.0006 in.
	Allowable limit	0.025 mm 0.0010 in.



0301P140

Worm Shaft Wear

1. Measure the worm shaft O.D. with an outside micrometer.
2. If the measurement is less than the allowable limit, replace the ball nut assembly.

Worm shaft O.D.	Factory spec	28 562 to 28 575 mm 1 1245 to 1.1250 in.
	Allowable limit	28 475 mm 1.1211 in.

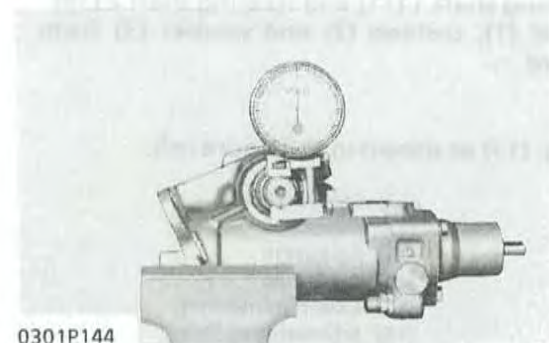


0301P143

Sector Gear Shaft Wear

1. Measure the sector gear shaft O.D. with an outside micrometer.
2. If the measurement is less than the allowable limit, replace.

Sector gear shaft O.D.	Factory spec.	38 059 to 38 075 mm 1.4984 to 1.4990 in.
	Allowable limit	38 025 mm 1.4970 in.

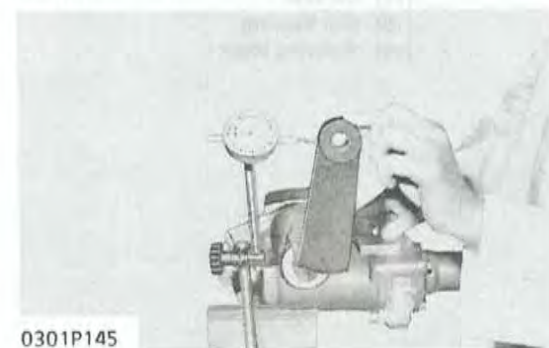


0301P144

Sector Shaft Working Angle

1. Set an angle gauge on the sector shaft.
2. Measure the angle over the rotation range of the steering shaft.
3. If the measurement is less than the factory specifications, overhaul.

Sector shaft working angle	Factory spec	(32° to 35°) × 2
----------------------------	--------------	------------------

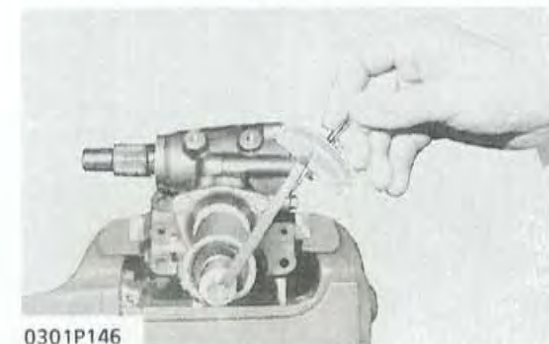


0301P145

Backlash between Sector Gear and Ball Nut

1. Set a dial indicator with its finger on the pitman arm.
2. Move the pitman arm lightly, and measure the pitman arm deflection.
3. If the measurement is not within the factory specifications, adjust the backlash with the adjusting screw.

Backlash between sector gear and ball nut	Factory spec.	0 to 0.4 mm 0 to 0.016 in.
---	---------------	-------------------------------



0301P146

Steering Shaft Initial Turning Torque

1. Secure the steering assembly with a vise.
2. Set a torque wrench on the steering shaft and measure the torque required to initial turning.
3. If the measurement exceeds the factory specifications, overhaul.

Steering shaft initial turning torque	Factory spec.	1 177 N·m or less 0.12 kgf·m or less 0.87 ft-lbs or less
	Allowable limit	1 961 N·m 0.2 kgf·m 1.477 ft-lbs

[2] L2650 2WD, L2950 2WD, L3450 2WD, L3650 2WD**[2]-1 STEERING POST AND STEERING GEAR****DISASSEMBLING AND ASSEMBLING****Steering Wheel**

1. Remove the steering wheel with a steering wheel puller (Code No: 07916-51090).

(When reassembling)

Tightening torque	Steering wheel mounting nut	29.4 to 49.0 N·m 3.0 to 5.0 kgf·m 21.7 to 36.2 ft·lbs
-------------------	-----------------------------	---

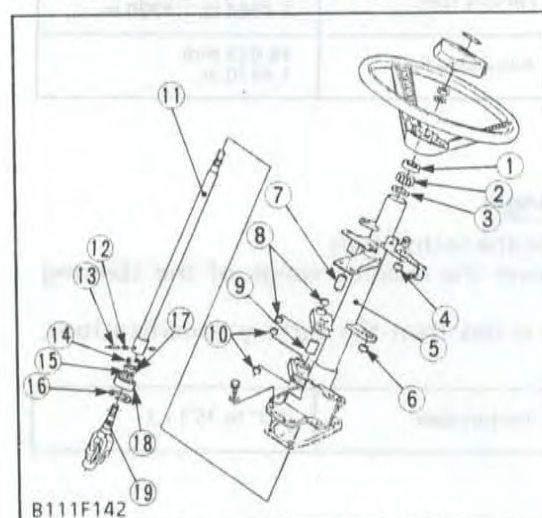
Steering Post

1. Remove the steering post assembly.
2. Remove the internal snap ring (16) and then tap out the steering shaft 1 (11) to downward.
3. Remove the set spring (14), spring pin (13), and cushions (12) to separate the steering shaft 1 (11) and steering shaft 2 (19). Push out the oil seal (1), cushion (2) and washer (3) from downward to upward.

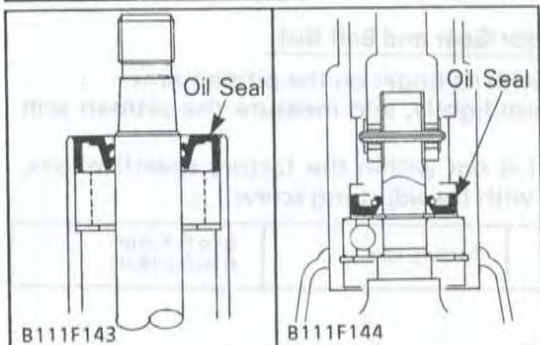
(When reassembling)

- Install the oil seal (1), (17) as shown in the figure left.

- | | |
|-------------------|-------------------------|
| (1) Oil Seal | (11) Steering Shaft |
| (2) Cushion | (12) Cushion |
| (3) Washer | (13) Spring Pin |
| (4) Bushing | (14) Set Spring |
| (5) Steering Post | (15) External Snap Ring |
| (6) Bushing | (16) Internal Snap Ring |
| (7) Bushing | (17) Oil Seal |
| (8) Bushing | (18) Ball Bearing |
| (9) Bushing | (19) Steering Shaft |
| (10) Bushing | |

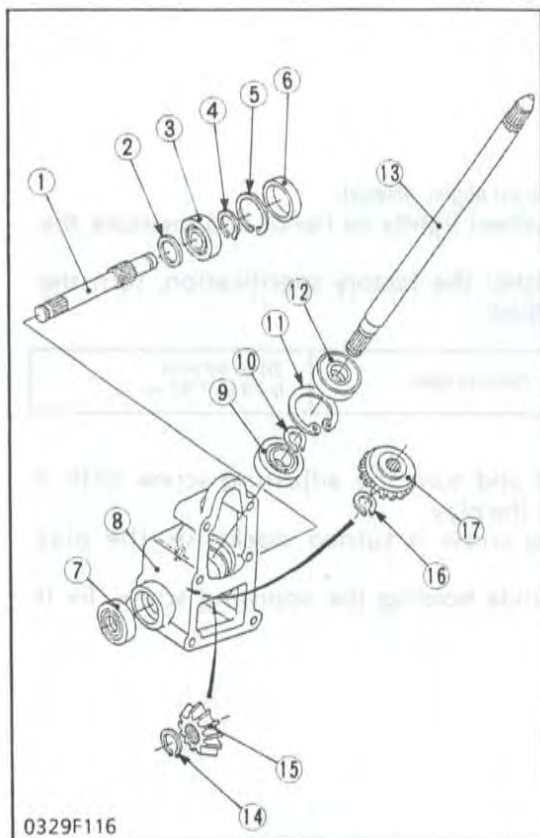


B111F142



B111F143

B111F144



0329F116

Steering Gear case

1. Remove the steering gear case from the clutch housing.
2. Remove the plug (6).
3. Remove the internal snap ring (5) and external snap ring (14).
4. Tap out the joint shaft 2 (1).
5. Remove the external snap ring (4), and pull out the ball bearing (3), shim (2) on the joint shaft 2 (1).
6. Take out the bevel gear (15) and remove the oil seal (12).
7. Remove the internal snap ring (11), external snap ring (16), and the joint shaft 1 (13).
8. Remove the external snap ring (10).
9. Remove the ball bearing (9).
10. Take out the bevel gear (17) from the steering gear case.
11. Remove the oil seal (7).

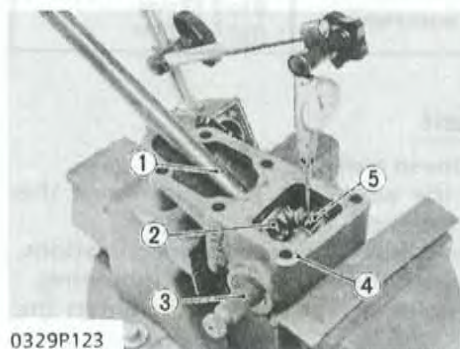
(When reassembling)

- Replace the oil seal, plug and snap ring with new ones.
- When installing the oil seals (7), (12), direct the lip of them to the inside.
- After installing steering gear case (8), fill transmission fluid up to the level of oil filling plug.

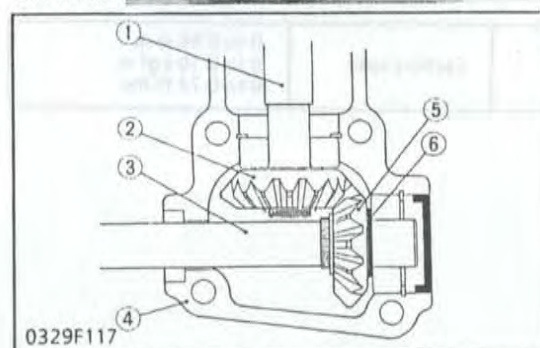
Tightening torque	Steering gear case mounting bolt	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft·lbs
-------------------	----------------------------------	---

- | | |
|------------------------|-------------------------|
| (1) Joint Shaft 2 | (10) External Snap Ring |
| (2) Shim | (11) Internal Snap Ring |
| (3) Ball Bearing | (12) Oil Seal |
| (4) External Snap Ring | (13) Joint Shaft 1 |
| (5) Internal Snap Ring | (14) External Snap Ring |
| (6) Plug | (15) Bevel Gear |
| (7) Oil Seal | (16) External Snap Ring |
| (8) Steering Gear Case | (17) Bevel Gear |
| (9) Ball Bearing | |

SERVICING



0329P123



0329F117

Backlash between 14T Bevel Gears

1. Secure the steering gear case (4) in a vise.
2. Set a dial indicator (lever type) on the tooth of the 14T bevel gear (2).
3. Push the 14T bevel gear (2) on joint shaft 1 (1) to upward and fix it, move the 14T bevel gear (5) to measure the backlash.
4. If the backlash exceeds the allowable limit, adjust it by shims (6).

(Reference)

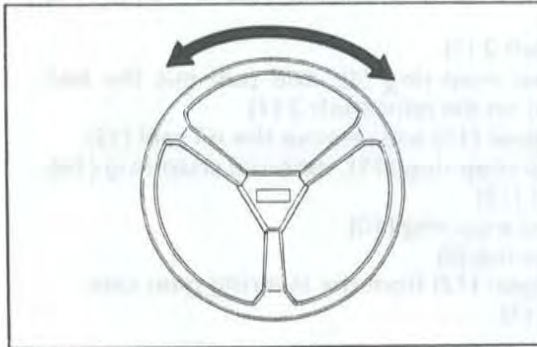
- Thickness of shims: 0.8 mm (0.031 in.)
1.0 mm (0.039 in.)
1.2 mm (0.047 in.)

Backlash between 14T bevel gears	Factory spec.	0.1 to 0.3 mm 0.004 to 0.012 in.
	Allowable limit	0.4 mm 0.016 in.

- | | |
|--------------------|------------------------|
| (1) Joint Shaft 1 | (4) Steering Gear Case |
| (2) 14T Bevel Gear | (5) 14T Bevel Gear |
| (3) Joint Shaft 2 | (6) Shim |

[2]-2 MANUAL STEERING

CHECKING AND ADJUSTING



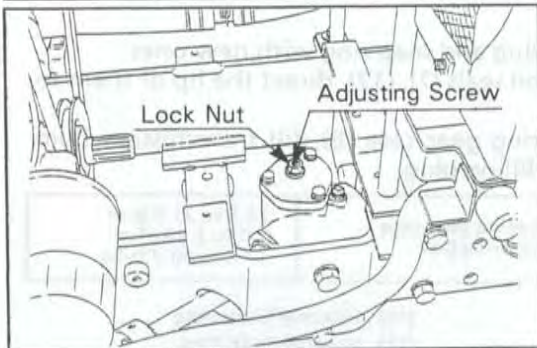
Steering Wheel Play

1. Turn the front wheels straight ahead.
2. Rotate the steering wheel lightly by hand, and measure the play.
3. If the play is not within the factory specification, turn the adjusting screw to adjust.

Steering wheel play	Factory spec	20 to 50 mm 0.79 to 1.97 in.
---------------------	--------------	---------------------------------

(Adjusting)

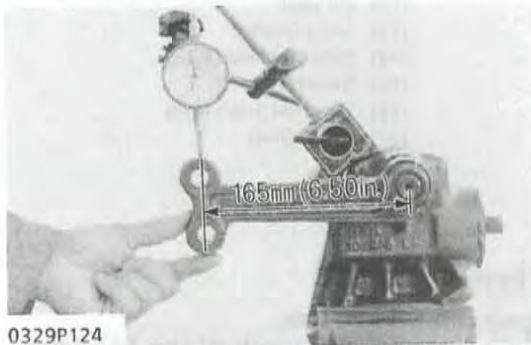
1. Loosen the lock nut and turn the adjusting screw with a screwdriver to adjust the play.
When the adjusting screw is turned clockwise, the play decreases.
2. After adjustment, while holding the adjusting screw, fix it with lock nut.



Backlash between Sector Gear Shaft and Ball Nut

1. Secure the steering gear box in a vise.
2. Set a dial indicator with its finger on the pitman arm.
3. Move the pitman arm lightly, and measure the pitman arm deflection.
4. If the backlash is not within the factory specifications, adjust the backlash with the adjusting screw.

Backlash between sector gear shaft and ball nut	Factory spec.	0 to 0.33 mm 0 to 0.0130 in.
---	---------------	---------------------------------

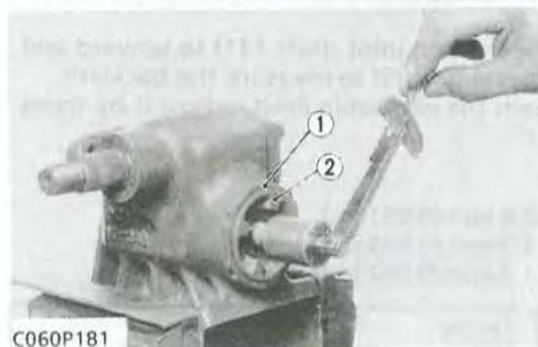


0329P124

Turning Torque of Worm Shaft

1. Secure the steering gear box in a vise.
2. Set a torque wrench on the worm shaft and measure the torque required to initial turning.
3. If the measurement is not within the factory specifications, adjust the turning torque with the rear cover (2) tightening.
4. After adjustment, while holding rear cover (2), tighten the lock nut (1).

Turning torque of worm shaft	Factory spec	0 to 0.98 N·m 0 to 0.10 kgf·m 0 to 0.72 ft·lbs
------------------------------	--------------	--



C060P181

(1) Lock Nut

(2) Rear Cover

DISASSEMBLING AND ASSEMBLING

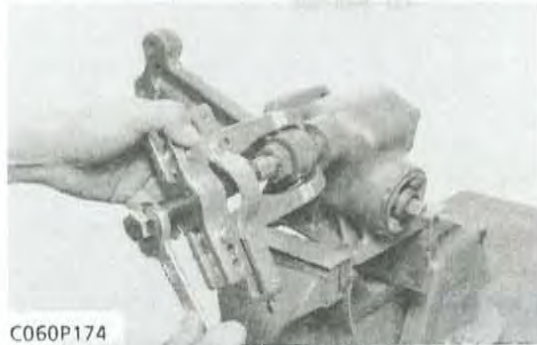


C060P173

Draining Oil

1. Secure the steering gear box in a vise.
2. Remove the drain plug and drain the used oil from the gear box.

Steering gear box oil	Lubricant	Gear oil SAE 80 or SAE 90
	Capacity	0.2ℓ 0.21 U.S.qts. 0.18 Imp.qts.



C060P174

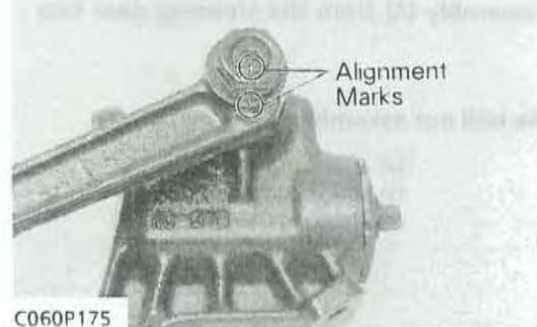
Pitman Arm

1. Loosen the pitman arm mounting nut to the sector gear shaft end.
2. Remove the pitman arm with the pitman arm puller (Code No: 07909-39011).

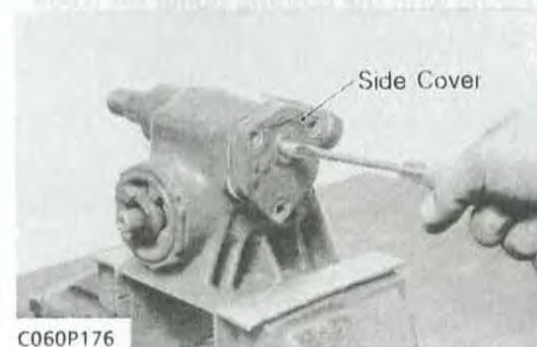
(When reassembling)

- Install the pitman arm to the sector gear shaft, aligning their alignment marks.

Tightening torque	Pitman arm mounting nut	117.7 to 156.9 N·m 12 to 16 kgf·m 86.8 to 115.7 ft-lbs
-------------------	-------------------------	--



C060P175



C060P176

Side Cover

1. Remove the side cover mounting screws and remove the adjusting lock nut.
2. Turn the adjusting screw clockwise to remove the side cover.

(When reassembling)

- Apply grease to the O-ring.
- Apply liquid gasket (Three bond 1211 or equivalent) to the seam of the side cover gasket.
- Take care not to damage the O-ring.
- After reassembling the side cover, be sure to adjust the backlash.

Tightening torque	Side cover mounting screw	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft-lbs
-------------------	---------------------------	---



Sector Gear Shaft

1. Tap out the sector gear shaft toward the side cover.

(When reassembling)

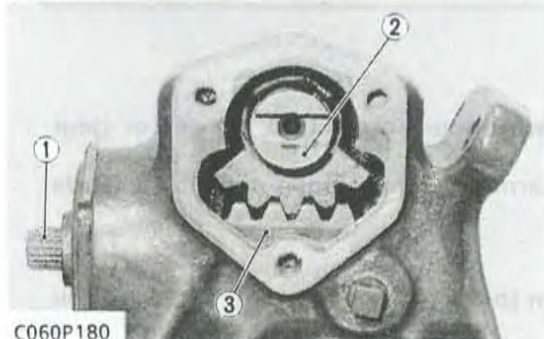
- Apply grease to the oil seal which is installed the inside of steering gear box.

NOTE

- Turn the worm shaft (1) so that the ball nut (3) is centered in its travel. Then, install the sector gear shaft (2) so that center tooth of it engages the center of the ball nut (3).
- Adjust the turning torque of worm shaft (1) to the factory specification and tighten the lock nut.

- (1) Worm Shaft
(2) Sector Gear Shaft

- (3) Ball Nut



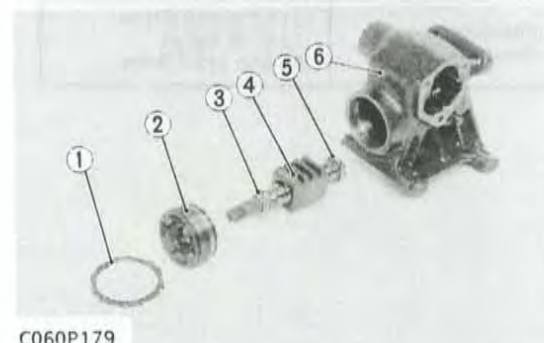
Rear Cover and Ball Nut Assembly

1. Remove the lock nut (1) and then, remove the rear cover (2).
2. Pull out the ball nut assembly (4) from the steering gear box (6).

IMPORTANT

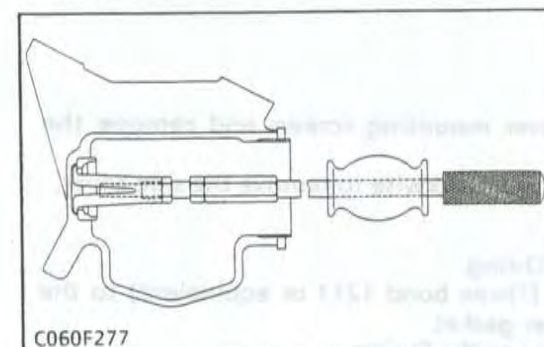
- Never disassemble the ball nut assembly (4).

- (1) Lock Nut
(2) Rear Cover
(3) Thrust Ball Bearing
(4) Ball Nut Assembly
(5) Thrust Ball Bearing
(6) Steering Gear Box



Thrust Bearing

1. Remove the thrust bearing with the bushing puller set (code No: 07916-51031).



[2]-3 POWER STEERING

CHECKING AND ADJUSTING



Steering Wheel Play

1. Turn the front wheels straight ahead.
2. Rotate the steering wheel lightly by hand, and measure the play.
3. If the play is not within the factory specifications, turn the adjusting screw to adjust.

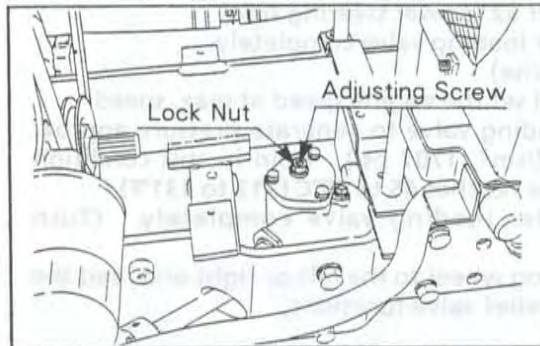
Steering wheel play	Factory spec.	20 to 50 mm 0.79 to 1.97 in.
---------------------	---------------	---------------------------------

(Adjusting)

1. Loosen the lock nut and turn the adjusting screw with a screwdriver to adjust the play.
When the adjusting screw is turned clockwise, the play decreases.
2. After adjustment, while holding the adjusting screw, fix it with lock nut.

■ NOTE

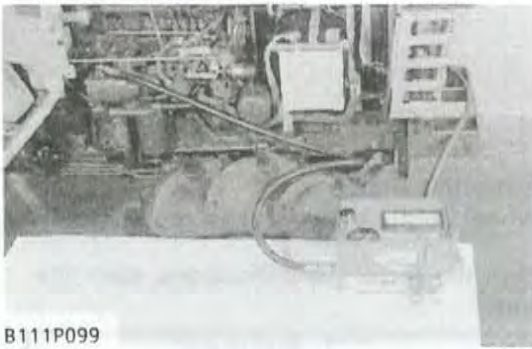
- Do not include spring movement of the spool in the power steering to the steering wheel play.



1. Connect the delivery pipe joint which connects delivery pipe and power steering pump.	2. Check the adjuster (Code No. 03910-0030) of relief valve setting pressure. (Code No. 03910-0030) is hydraulic pump, and then set a pressure gauge (Code No. 03910-0031) cable (Code No. 03910-0031) and linked joint (Code No. 03910-0031).
3. Start the engine and set the engine speed at max. speed.	4. Fully turn the steering wheel to the left or right and read the pressure when the relief valve functions.
5. Stop the engine.	6. If the pressure is not within the factory specification, check the pump delivery line, adjust the relief valve setting pressure (see the next item) or repair the power steering pressure (see the next item) to repair the power steering pressure.

1. Connect the delivery pipe joint which connects delivery pipe and power steering pump.	2. Check the adjuster (Code No. 03910-0030) of relief valve setting pressure. (Code No. 03910-0030) is hydraulic pump, and then set a pressure gauge (Code No. 03910-0031) cable (Code No. 03910-0031) and linked joint (Code No. 03910-0031).
3. Start the engine and set the engine speed at max. speed.	4. Fully turn the steering wheel to the left or right and read the pressure when the relief valve functions.
5. Stop the engine.	6. If the pressure is not within the factory specification, check the pump delivery line, adjust the relief valve setting pressure (see the next item) or repair the power steering pressure (see the next item) to repair the power steering pressure.

1. Connect the delivery pipe joint which connects delivery pipe and power steering pump.	2. Check the adjuster (Code No. 03910-0030) of relief valve setting pressure. (Code No. 03910-0030) is hydraulic pump, and then set a pressure gauge (Code No. 03910-0031) cable (Code No. 03910-0031) and linked joint (Code No. 03910-0031).
--	--



B111P099

Condition

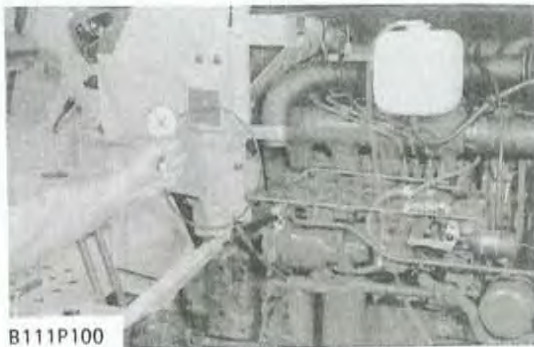
- Engine speed Max. rpm
- Oil temperature..... 45 to 55°C
113 to 131°F

Relief Valve Setting Pressure Test Using Flowmeter**■ IMPORTANT**

- When using a flowmeter other than KUBOTA specified flowmeter (Code No: 07916-52791), be sure to use the instructions with that flowmeter.
- Do not close the flowmeter loading valve completely, before testing, because it has no relief valve.

1. Disconnect the delivery pipe which is connected from hydraulic pump to power steering.
2. Install the two adaptor 52 (Code No: 07916-52841) to pump and power steering inlet port.
3. Connect the hydraulic test hose (Code No.: 07916-52651) to the adaptor 52 (pump side) and flowmeter inlet port. Connect the other hydraulic test hose to flowmeter outlet port and the adaptor 52 (power steering side).
4. Open the flowmeter loading valve completely. (Turn counterclockwise)
5. Start the engine and set the engine speed at max. speed.
6. Slowly close the loading valve to generate pressure approx. 11.77 MPa (120 kgf/cm², 1707 psi). Hold in this condition until oil temperature reaches 45 to 55°C (113 to 131°F).
7. Open the flowmeter loading valve completely. (Turn counterclockwise)
8. Fully turn the steering wheel to the left or right and read the pressure when the relief valve functions.
9. Stop the engine.
10. If the pressure is not within the factory specifications, check the pump delivery line, adjust the relief valve setting pressure (See the next page) or repair the power steering.

Relief valve setting pressure	Factory spec.	11.28 to 11.77 N·m 115 to 120 kgf·m 1636 to 1707 ft-lbs
Tightening torque	Power steering delivery pipe end joint bolt (at steering gear box)	49.0 to 58.8 N·m 5.0 to 6.0 kgf·m 36.2 to 43.4 ft-lbs



B111P100

Condition

- Engine speed Max. rpm
- Oil temperature..... 45 to 55°C
113 to 131°F

Relief Valve Setting Pressure Test Using Pressure Tester

1. Disconnect the delivery pipe joint which connects delivery pipe and power steering pump.
2. Install the adaptor E (Code No: 07916-50392) of relief valve setting pressure tester (Code No: 07916-50040) to hydraulic pump, and then set a pressure gauge (Code no: 07916-50321), cable (Code No: 07916-50331) and thread joint (Code No: 07916-50341).
3. Start the engine and set the engine speed at max. speed.
4. Fully turn the steering wheel to the left or right and read the pressure when the relief valve functions.
5. Stop the engine.
6. If the pressure is not within the factory specifications, check the pump delivery line, adjust the relief valve setting pressure (See the next item) or repair the power steering.

Power steering relief valve setting pressure	Factory spec.	11.28 to 11.77 MPa 115 to 120 kgf/cm ² 1636 to 1707 psi
--	---------------	--

**Condition**

- Engine speed Max. rpm
- Oil temperature 45 to 55°C
113 to 131°F

Adjusting Relief Valve Setting Pressure

1. Loose the lock nut of adjusting screw.
2. Adjust the relief pressure by turning the adjusting screw, while the relief valve is operating. When the adjusting screw is turned clockwise, the relief pressure increases.
3. After adjustment, fix the adjusting screw with lock nut, while holding it.

Relief valve setting pressure	Factory spec	11.28 to 11.77 MPa 115 to 120 kgf/cm ² 1636 to 1707 psi
Tightening torque	Lock nut	49.0 to 58.8 N·m 5.0 to 6.0 kgf·m 36.2 to 43.4 ft·lbs

(Reference)

- Pressure change per 1/4 turn of adjusting screw.
Approx. 1.27 MPa
13.0 kgf/cm²
185 psi

**Backlash between Sector Gear Shaft and Ball Nut**

1. Found and set the steering wheel center position.
2. Set a dial indicator with its finger on the pitman arm.
3. Move the pitman arm lightly, and measure the pitman arm deflection.
4. If the backlash is not within the factory specifications, adjust the backlash with the adjusting screw. (See page 5.7-25)

Backlash between sector gear shaft and ball nut	Factory spec.	0 to 0.33 mm 0 to 0.0130 in
---	---------------	--------------------------------

**Turning Torque of Worm Shaft**

1. Secure the steering gear box in a vise.
2. Set a torque wrench on the worm shaft and measure the torque required to initial turning.
3. If the measurement is not within the factory specifications, disassemble the steering gear box to check inside.

Turning torque of worm shaft	Factory spec.	0 to 1.18 N·m 0 to 0.12 kgf·m 0 to 0.87 ft·lbs
------------------------------	---------------	--

DISASSEMBLING AND ASSEMBLING

■ IMPORTANT

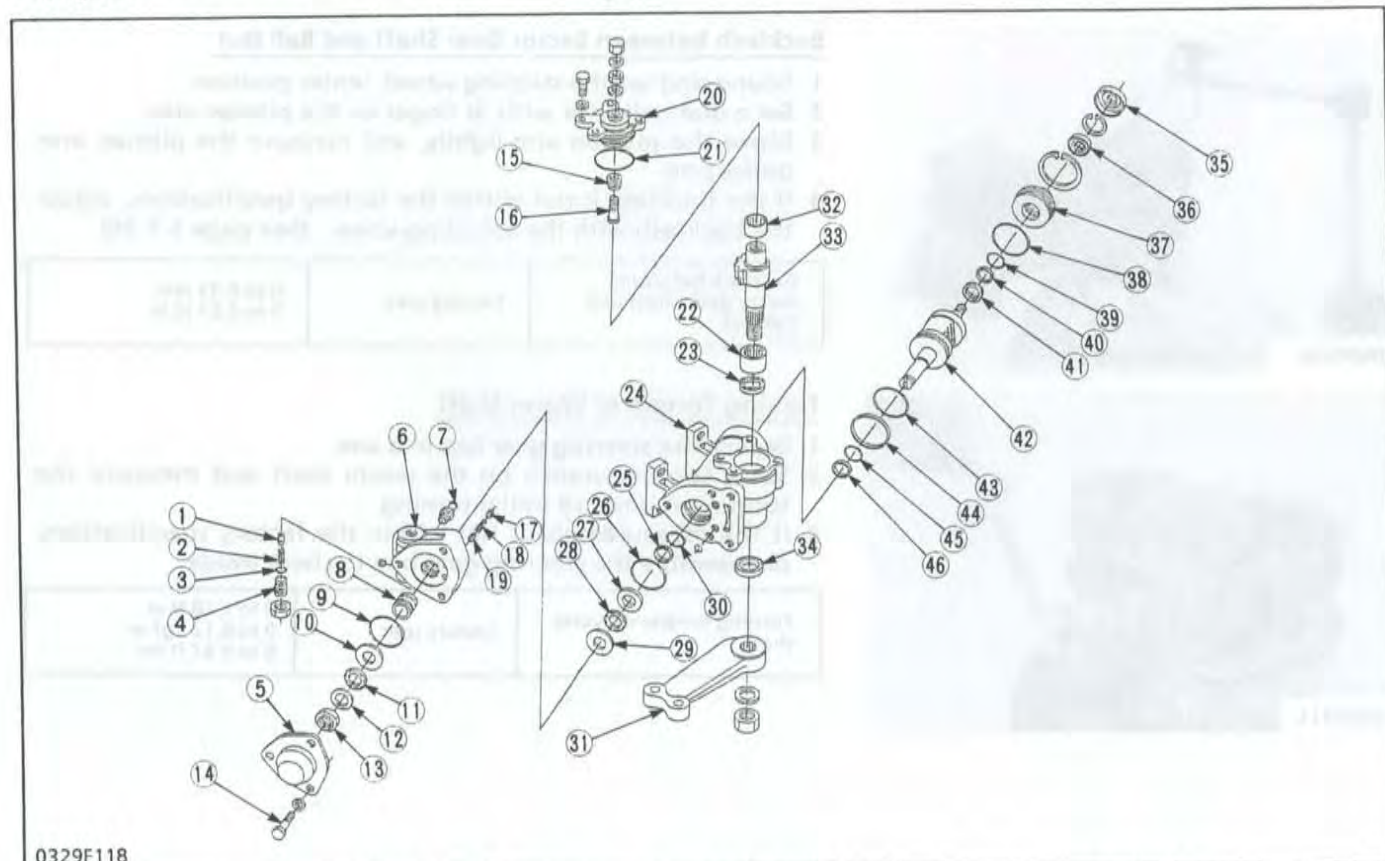
- Use only the transmission fluid (See page S.G-7), in no case use mixture of oils of different brands.
- Before disassembling the power steering system hydraulic components, check the performance of hydraulic pump and power steering using a flowmeter (Code No: 07916-52791). Do not disassemble the power steering needlessly.
- After removing or disassembling the power steering hydraulic components, be sure to bleed air.

- If disassembly of power steering is needed, perform disassembly carefully following the instructions given below.

1. Since the sliding surfaces of those parts have been precisely finished, do not brush or grind with sandpaper. Use transmission fluid for cleaning and compressed air for blowing off.
2. When reassembling, inspect each part for wear and damage. If seriously damaged, replace parts as sub-assembly or assembly. It is desirable to replace O-rings and seals with new ones.

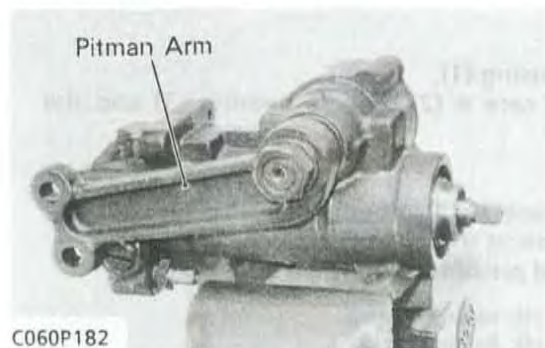
[Bleeding]

1. Start the engine.
2. Turn the steering wheel slowly in both directions all the way alternately several times, and stop the engine.



0329F118

- | | | | |
|---------------------|---------------------|------------------------|---------------------|
| (1) Poppet | (13) Lock Nut | (25) Seal Ring | (37) Top Cover |
| (2) Spring | (14) Flange Bolt | (26) O-ring | (38) O-ring |
| (3) O-ring | (15) Adjuster | (27) Bearing Race D | (39) O-ring |
| (4) Adjusting Screw | (16) Adjust Screw | (28) Needle Bearing | (40) Seal Ring |
| (5) End Cover | (17) Piston | (29) Bearing Race A | (41) Needle Bearing |
| (6) Valve Housing | (18) Spring | (30) O-ring | (42) Ball Nut |
| (7) Joint Pipe | (19) Piston | (31) Pitman Arm | (43) Seal Ring |
| (8) Spool | (20) Side Cover | (32) Needle Bearing | (45) O-ring |
| (9) O-ring | (21) O-ring | (33) Sector Gear Shaft | (46) Seal Ring |
| (10) Bearing Race A | (22) Needle Bearing | (34) Oil Seal | |
| (11) Needle Bearing | (23) Oil Seal | (35) Dust Seal | |
| (12) Bearing Race D | (24) Gear Box | (36) Oil Seal | |



Pitman Arm

1. Secure the steering gear box in a vise.
2. Swing the pitman arm several times to drain oil from the gear box.
3. Loosen the pitman arm mounting nut to the sector gear shaft end.
4. Remove the pitman arm with the pitman arm puller (Code No:07909-39011).

NOTE

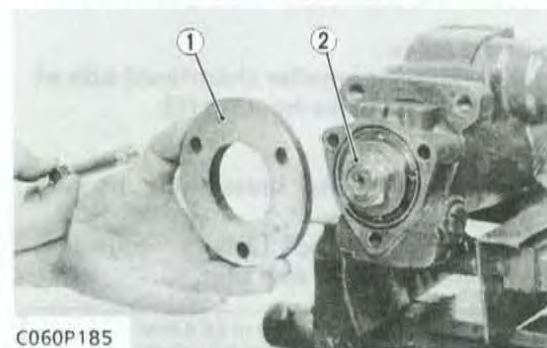
- When secure the gear box in a vise, not grasp cylinder of gear box.

(When reassembling)

- Install the pitman arm to the sector gear shaft, aligning their alignment marks.



Tightening torque	Pitman arm mounting nut	147.1 to 196.1 N·m 15 to 20 kgf·m 108.5 to 144.7 ft-lbs
-------------------	-------------------------	---



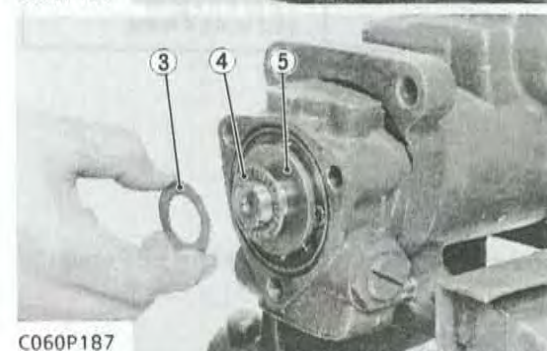
End Cover and 22 Nut

1. Remove the end cover and mount the power steering valve holder (Code No: 07916-52891).
2. Remove the stake of 22 nut (2).
3. Remove the power steering valve holder (1), bearing race D (3), needle bearing (4) and bearing race A (5).

(When reassembling)

- Assembling 22 nut (2).

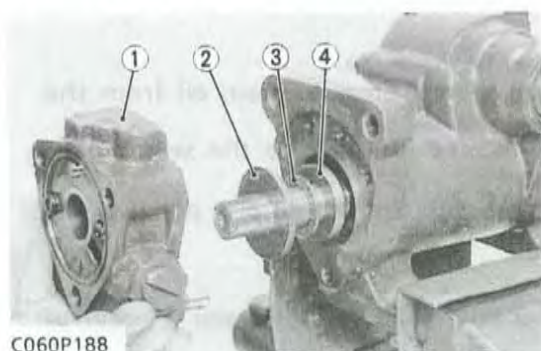
1. Install the power steering valve holder (1).
2. Protect the sedation of input shaft by a socket or cloth.
3. While turning the input shaft to counterclockwise fully, tighten the 22 nut (2) by hand. Do not use a wrench.
4. Install the bearing race D (3), needle bearing (4) and the bearing race A (5), noting its direction.



Tightening torque	End cover mounting screws	34.3 to 56.9 N·m 3.5 to 5.8 kgf·m 25.3 to 42.0 ft-lbs
-------------------	---------------------------	---

- | | |
|---------------------------------|--------------------|
| (1) Power Steering Valve Holder | (4) Needle Bearing |
| (2) 22 Nut | (5) Bearing Race A |
| (3) Bearing Race D | |





C060P188

Valve Housing

1. Remove the valve housing (1).
2. Remove the bearing race A (2), needle bearing (3) and the bearing race D (4).

(When reassembling)

- Install the bearing race A (2), needle bearing (3) and the bearing race D (4), noting their position.
- Install the springs and pistons in the valve housing.

- | | |
|--------------------|--------------------|
| (1) Valve Housing | (3) Needle Bearing |
| (2) Bearing Race A | (4) Bearing Race D |

Disassembling Valve Housing

■ IMPORTANT

- Do not disassemble the relief valve needlessly, since it has been factory-adjusted. If disassembly is needed, perform disassembly carefully following the instructions given below.

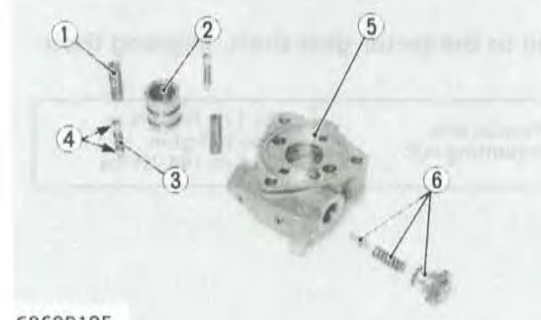
1. Remove the springs (1), (3) and piston (4).
2. Remove the spool (2).
3. Remove the relief valve (6).

(When reassembling)

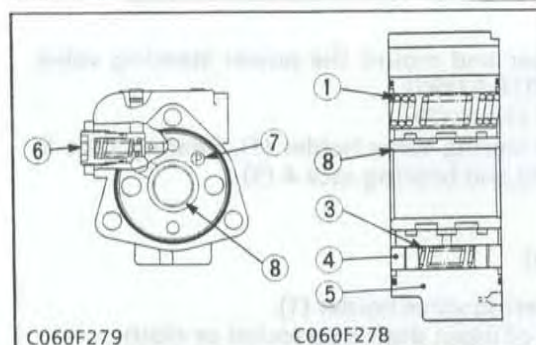
- Apply grease to seals in the valve.
- When installing the spool, face the smaller chamfered side of the spool to the mark P (7) on the valve housing (5).

■ IMPORTANT

- If disassemble the relief valve (6), after reassembly, be sure to adjust the setting pressure.
- When the valve housing (5) or spool (2) are damaged, replace valve housing (5) and spool (2) as a unit.



C060P195



C060F279

C060F278

- | | |
|------------|-------------------|
| (1) Spring | (5) Valve Housing |
| (2) Spool | (6) Relief Valve |
| (3) Spring | (7) Mark P |
| (4) Piston | (8) Chamfer |

Tightening torque	Relief valve lock nut	49.0 to 58.8 N·m 5.0 to 6.0 kgf·m 36.2 to 43.4 ft-lbs
-------------------	-----------------------	---

Side Cover

1. Remove the adjusting nut and O-ring.
2. Remove the side cover mounting screws.
3. Turn the adjusting screw clockwise to remove the side cover.

(When reassembling)

- Apply grease to the O-ring.

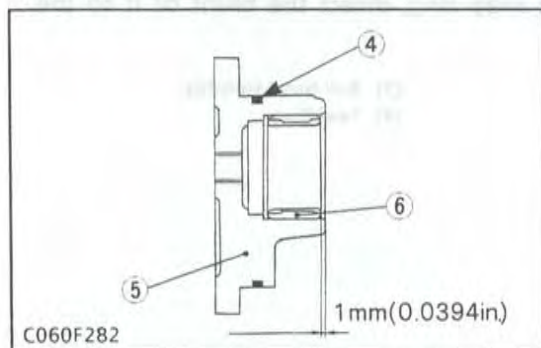
Tightening torque	Lock nut	19.6 to 29.4 N·m 2.0 to 3.0 kgf·m 14.5 to 21.7 ft-lbs
	Side cover mounting screws	35.3 to 54.9 N·m 3.6 to 5.6 kgf·m 26.0 to 40.5 ft-lbs



C060P189



C060P189



C060F282

Needle Bearing on Side Cover

1. Remove the needle bearing.

■ IMPORTANT

- Do not remove the needle bearing except that it is replaced.

(When reassembling)

- Manufacturer's mark and type mark face must be to the gear box side to install the needle bearing.
- When press-fitting the needle bearing, observe the dimensions described in the figure.

- | | |
|-------------------------|--------------------|
| (1) Type Mark | (4) O-ring |
| (2) Needle Bearing | (5) Side Cover |
| (3) Manufacturer's Mark | (6) Needle Bearing |



C060P190

Sector Gear Shaft

1. Tap out the sector gear shaft (2) toward the side cover.

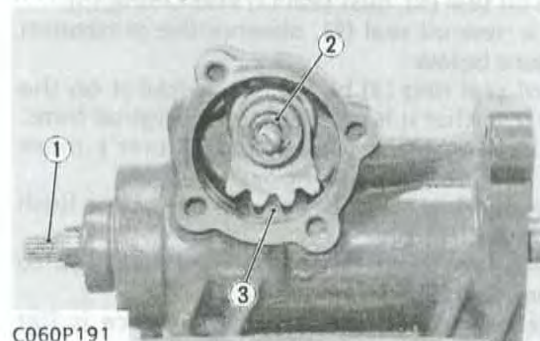
(When reassembling)

- Turn the worm shaft (1) so that the ball nut (3) is centered in its travel. Then, install the sector gear shaft (2) so that center tooth of it engages the center of the ball nut (3).

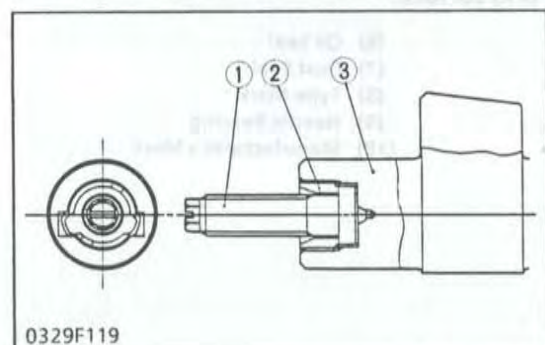
■ NOTE

- When setting the sector gear shaft (2), take care not to damage the oil seal and U-seal.

- | | |
|-----------------------|--------------|
| (1) Worm Shaft | (3) Ball Nut |
| (2) Sector Gear Shaft | |



C060P191



0329F119

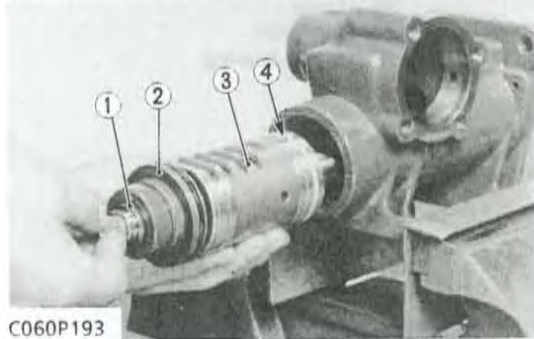
Adjuster of Sector Gear Shaft

1. Remove the adjuster with screw driver. After that take out the adjusting screw.

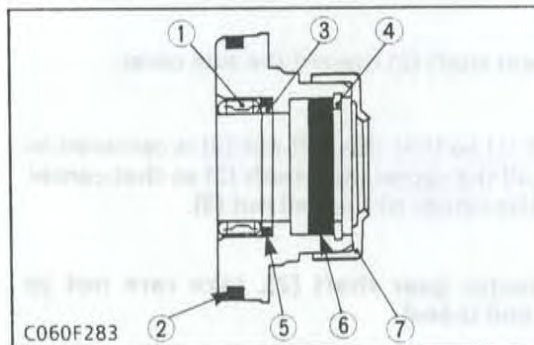
- | | |
|------------------|-----------------------|
| (1) Adjust Screw | (3) Sector Gear Shaft |
| (2) Adjuster | |



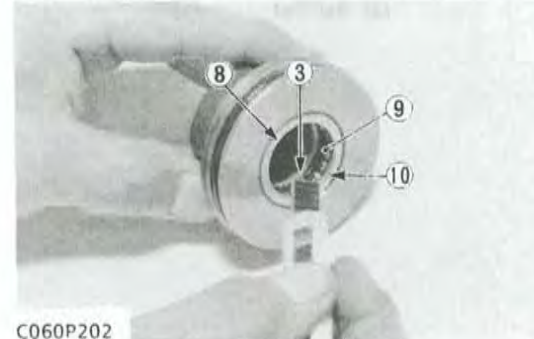
C060P192



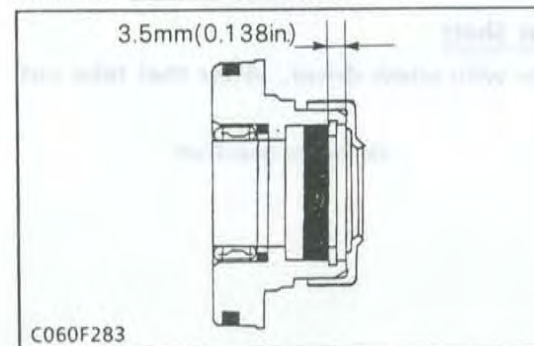
C060P193



C060F283



C060P202



C060F283

Top Cover and Ball Nut

1. Remove the internal snap ring.
2. Tap out the worm shaft toward the valve side, and remove the ball nut assembly (3), top cover (2) and the dust seal (1) as a unit.

NOTE

- When drawing out the ball nut assembly (3), take care not to damage the seal ring (4) on the ball nut and the ball nut circuit face.
- Never disassemble the ball nut assembly (3).
- When installing the snap ring, direct the blunt of it to the top cover side.

- (1) Dust Seal
(2) Top Cover

- (3) Ball Nut Assembly
(4) Seal Ring

Disassembling of Top Cover

1. Remove the dust seal (7).
2. Remove the snap ring (4).
3. Draw out the oil seal (6).
4. Cut the seal ring (3) with a knife and remove it.
5. Remove the needle bearing (1).
6. Remove the O-ring (5).

(When reassembling)

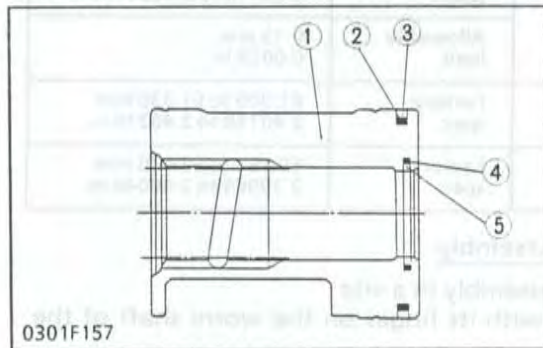
- Replace the dust seal (7), oil seal (6), needle bearing (1), O-ring (2) and seal ring (3) with new ones.
- Apply grease to the oil seal (6), dust seal (7) and O-ring (5).
- When press-fitting a new oil seal (6), observe the dimension described in the figure below.
- Change the shape of seal ring (3) by fingers, install it on the gear box, and press it so that it is restored to its original form.
- Install the needle bearing (9) so that manufacturer's mark (10) and type mark (8) face to the gear box.
- Press fit the needle bearing (1) until its race surface is flush with the top cover end surface.
- Manufacturer's mark face must be to the gear box side to install the needle bearing (1).
- Press fit the needle bearing (1) until its race surface is flat with the top cover end surface.

- (1) Needle Bearing
(2) O-ring
(3) Seal Ring
(4) Snap Ring
(5) O-ring

- (6) Oil Seal
(7) Dust Seal
(8) Type Mark
(9) Needle Bearing
(10) Manufacturer's Mark



C060P200



0301F157

Seal Ring on Ball Nut

1. Cut the seal ring (3) with a knife and remove it.
2. Remove the O-ring (2).

(When reassembling)

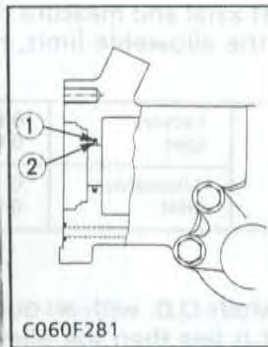
- Apply grease to the ring groove.
- Replace the seal rings with new ones.
- Stretch the seal ring by hand, install it on the ball nut (1), and press it so that it is restored to its original form.

- (1) Ball Nut
(2) O-ring
(3) Seal Ring

- (4) O-ring
(5) Seal Ring



C060P199



C060F281

Seal Ring and O-ring on Gear Box

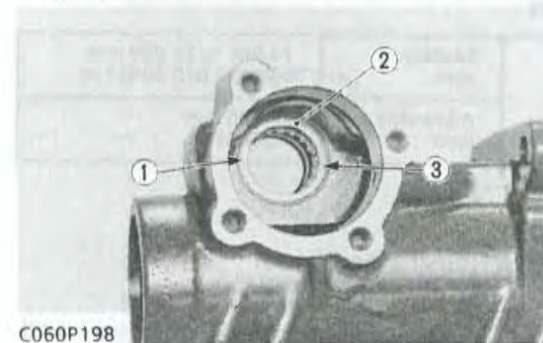
1. Cut the seal ring (2) with a knife and remove it.
2. Remove the O-ring (1).

(When reassembling)

- Apply grease to the ring groove.
- Replace the seal ring (2) and O-ring (1) with new ones.
- Change the shape of seal ring (2) by fingers, install it on the gear box, and press it so that it is restored to its original form.

- (1) O-ring

- (2) Seal Ring



C060P198

- (1) Type Mark
(2) Needle Bearing
(3) Manufacturer's Mark

Needle Bearing on Gear Box

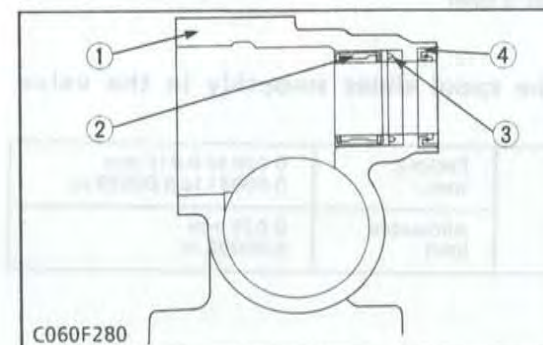
1. Remove the needle bearing (2).

■ IMPORTANT

- Do not remove the needle bearing (2) except that it is replaced.

(When reassembling)

- Manufacturer's mark face must be to the gear box side to install the needle bearing (1).
- Press fit the needle bearing until its race surface is flat with inside surface.



C060F280

Oil Seal and U-Seal on Gear Box

1. Remove the oil seal (4).
2. Remove the U-seal (3) with a sharp tool.

(When reassembling)

- When installing the oil seal (4), direct the lip to outside.
- Replace oil seal (4) and U-seal (3) with new ones.

- (1) Gear Box
(2) Needle Bearing

- (3) U-Seal
(4) Oil Seal

SERVICING

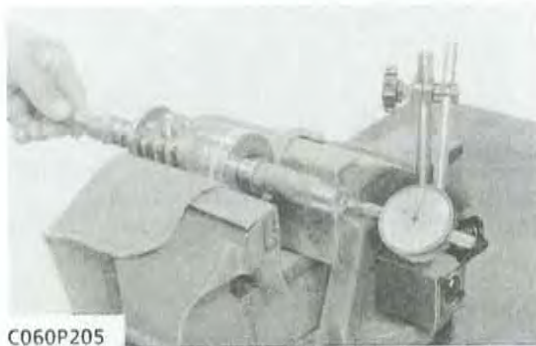


C060P204

Clearance between Steering Gear Box and Ball Nut

1. Measure the steering gear box cylinder I.D. with a cylinder gauge.
2. Measure the ball nut O.D. with an outside micrometer, and calculate the clearance.
3. If the clearance exceeds the allowable limit, replace the steering gear box or ball nut assembly.

Clearance between steering gear box and ball nut	Factory spec.	0.030 to 0.079 mm 0.00118 to 0.00311 in.
	Allowable limit	0.15 mm 0.0059 in.
Gear box bore I.D.	Factory spec.	61.000 to 61.030 mm 2.40158 to 2.40276 in.
Ball nut O.D.	Factory spec.	60.951 to 60.970 mm 2.39965 to 2.40040 in.



C060P205

Axial Play of Ball Nut Assembly

1. Secure the ball nut assembly in a vise.
2. Set a dial indicator with its finger on the worm shaft of the ball nut assembly.
3. Move the worm shaft axial and measure the play.
4. If the play exceeds the allowable limit, replace the ball nut assembly.

Axial play of ball nut assembly	Factory spec.	0 to 0.020 mm 0 to 0.00079 in.
	Allowable limit	0.100 mm 0.00394 in.



C060P206

Worm Shaft Wear

1. Measure the worm shaft O.D. with an outside micrometer.
2. If the measurement is less than the allowable limit, replace the ball nut assembly.

Worm shaft O.D.	Factory spec.	24.966 to 25.009 mm 0.98291 to 0.98461 in.
	Allowable limit	24.900 mm 0.98032 in.



C060P207

Clearance between Valve Housing and Spool

1. Measure the valve housing I.D. with a cylinder gauge.
2. Measure the spool O.D. with an outside micrometer, and calculate the clearance.
3. If the clearance exceeds the allowable limit, replace the spool and valve housing as a unit.

■ IMPORTANT

- Check to see if the spool slides smoothly in the valve housing.

Clearance between valve housing and spool	Factory spec.	0.008 to 0.015 mm 0.00031 to 0.00059 in.
	Allowable limit	0.025 mm 0.00098 in.



C060P208

Sector Gear Shaft

1. Measure the sector gear shaft O.D.s (steering gear box side, side cover side) with an outside micrometer.
2. If the measurement exceeds the allowable limit, replace the sector gear shaft.

Sector gear shaft O.D.	Steering gear box side	Factory spec.	32.000 to 32.987 mm 1.25984 to 1.29870 in.
		Allowable limit	31.900 mm 1.25591 in.
	Side cover side	Factory spec.	27.987 to 28.000 mm 1.10185 to 1.10236 in.
		Allowable limit	27.900 mm 1.09843 in.

[2]-4 POWER STEERING HYDRAULIC PUMP CHECKING AND ADJUSTING



B111P099

Condition

- Engine speed
(L2650-L2950-L3650) Approx.2600 rpm
(L3450) Approx.2500 rpm
- Rated pressure..... 11.76MPa
120 kgf/cm²
1706 psi
- Oil temperature..... 45 to 55°C
113 to 131°F

Pump Test

NOTE

- Before pump testing, perform the Flowmeter Connecting and Test Preparation.
(Refer to No.1 to 7 of Relief Valve Setting Pressure Test Using Flowmeter on page S.7-26).

1. Confirm the flowmeter loading valve opens completely.
2. Start the engine and set the engine speed.
3. Read the pump delivery at no pressure.
4. Slowly close the loading valve to increase pressure approx. 11.77 MPa (120 kgf/cm², 1707 psi). As load is increased, engine speed drops, therefore, reset the engine speed.
5. Read the pump flow at rated pressure.
6. Open the loading valve and stop the engine.
7. If the pump delivery does not reach the factory specification, check the pump suction line, oil filter or hydraulic pump.

Hydraulic pump delivery at no pressure	Factory spec.	L2650 L2950	Above 10.5 ℓ/min 2.77 U.S.gal/min. 2.31 Imp.gal/min.
		L3450	Above 11.7 ℓ/min 3.09 U.S.gal/min. 2.57 Imp.gal/min.
		L3650	Above 12.1 ℓ/min 3.20 U.S.gal/min. 2.66 Imp.gal/min.
	Factory spec.	L2650 L2950	Above 10.2 ℓ/min 2.69 U.S.gal/min. 2.24 Imp.gal/min.
		L3450	Above 11.3 ℓ/min 2.99 U.S.gal/min. 2.49 Imp.gal/min.
		L3650	Above 11.7 ℓ/min 3.09 U.S.gal/min. 2.57 Imp.gal/min.
Hydraulic pump delivery at rated pressure	Allowable limit	L2650 L2950	9.1 ℓ/min 2.40 U.S.gal/min. 2.00 Imp.gal/min.
		L3450	10.2 ℓ/min 2.69 U.S.gal/min. 2.24 Imp.gal/min.
		L3650	10.5 ℓ/min 2.77 U.S.gal/min. 2.31 Imp.gal/min.

DISASSEMBLING AND ASSEMBLING

■ IMPORTANT

- The hydraulic pump is precision machined and assembled: if disassembled once, it may be unable to maintain its original performance. Therefore, when the hydraulic pump fails, replacement should be carried out with the hydraulic pump assembled except when emergency repair is unavoidable.
- When repair is required, follow the disassembly

and servicing procedures shown below with utmost care.

- Be sure to test the hydraulic pump with a flowmeter before disassembling.
- After reassembly, be sure to perform break-in operation and ensure that there is nothing abnormal with the hydraulic pump.

Disassembling Pump

1. Remove the pump cover.
2. Remove the O-ring (5) and seal ring (1).
3. Remove the bushings (2), (4) of cover (6) side as a unit.
4. Take out the drive gear (8) and driven gear (3).
5. Take out the bushings (2), (4) in back of pump housing (7) as a unit.

(When reassembling)

- Install the driven gear (3), noting its original direction.
- When installing the bushings (2), (4) be sure to reassemble them to the each original position.
- Take care not to damage the seal rings and O-rings.
- After reassembling the power steering hydraulic pump, mount an arm approx. 100 mm (3.93 in.) long to the drive gear to check for smooth rotation.

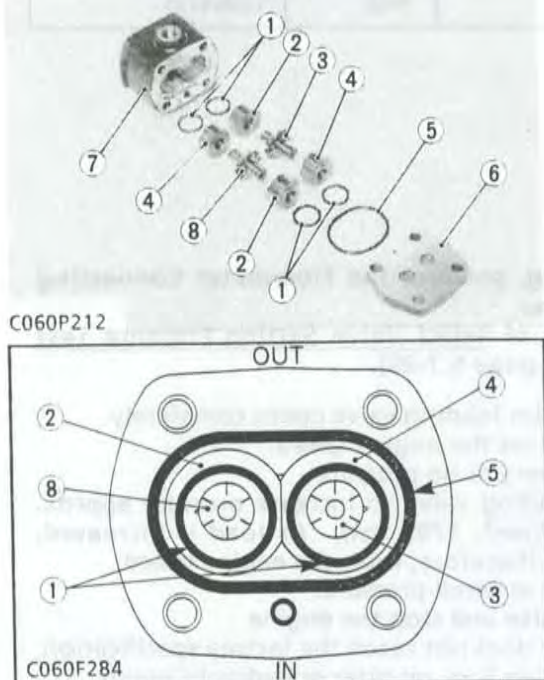
- (1) Seal Ring
(2) Bushing
(3) Driven Gear
(4) Bushing

- (5) O-ring
(6) Cover
(7) Pump Housing
(8) Drive Gear

Hydraulic Pump Running-In

After reassembly, perform break-in operation in the following manner, and check the pump for abnormality before use. If the pump temperature should rise noticeably during running-in, recheck should be performed.

1. Install the hydraulic pump to the tractor, and mount the suction pipe and delivery pipe securely.
2. Set the engine speed at 1300 to 1500 rpm, and operate the hydraulic pump at no load for about 10 minutes.
3. Set the engine speed at 2000 to 2200 rpm, and with the hydraulic pump applied with 2.94 MPa (30 kgf/cm², 427 psi) to 4.90 MPa (50 kgf/cm², 711 psi) pressure, operate it for approx. 15 minutes.
4. With the engine set to maximum speed, fully turn the steering wheel to the left or right, then actuate the relief valve five times for 25 seconds (one time 5 seconds).



SERVICING



C060P219

Housing Bore (Depth of scratch)

1. Measure the housing I.D. where the interior surface is not scratched, and measure the housing I.D. where the interior surface is scratched.
2. If the values obtained in the two determinations differ by more than the allowable limit, replace the hydraulic pump as a unit.

Depth of scratch	Allowable limit	0.09 mm 0.0035 in.
------------------	-----------------	-----------------------



C045P249

Clearance between Bushing and Gear Shaft

1. Measure the gear shaft O.D. with an outside micrometer.
2. Measure the bushing I.D. with a inside micrometer, and calculate the clearance.
3. If the clearance exceeds the allowable limit, replace the gear shaft and the bushings as a unit.

Clearance between bushing and gear shaft	Allowable limit	0.15 mm 0.0059 in.
--	-----------------	-----------------------

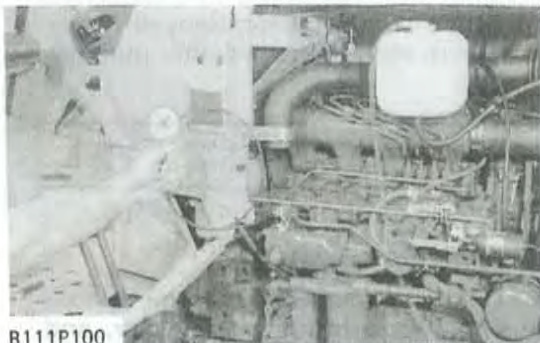


C021P015

Bushing Length

1. Measure the bushing length with an outside micrometer.
2. If the length is less than the allowable limit, replace the bushings and gears as a unit.

Bushing length	Factory spec	16.99 to 17.00 mm 0.6689 to 0.6693 in.
	Allowable limit	16.80 mm 0.6614 in.

[3] L2650 4WD, L2950 4WD, L3450 4WD, L3650 4WD**[3]-1 POWER STEERING****CHECKING AND ADJUSTING**

B111P100

Condition

- Engine speed Max. rpm
- Oil temperature..... 45 to 55°C
113 to 131°F

Relief Valve Setting Pressure Test

1. Disconnect the delivery pipe joint which connects delivery pipe and power steering pump.
2. Install the adaptor E (Code No: 07916-50392) of relief valve setting pressure tester (Code No: 07916-50040) to hydraulic pump, and then set a pressure gauge (Code no: 07916-50321), cable (Code No: 07916-50331) and thread joint (Code No: 07916-50341).
3. Start the engine and set the engine speed at max. speed.
4. Fully turn the steering wheel to the left or right and read the pressure when the relief valve functions.
5. Stop the engine.
6. If the pressure is not within the factory specifications, check the pump delivery line, replace the relief valve assembly or repair the power steering.

Power steering relief valve setting pressure	Factory spec.	10.30 to 11.28 MPa 105 to 115 kgf/cm ² 1493 to 1636 psi
--	---------------	--



B122P038

Removing Relief Valve Assembly

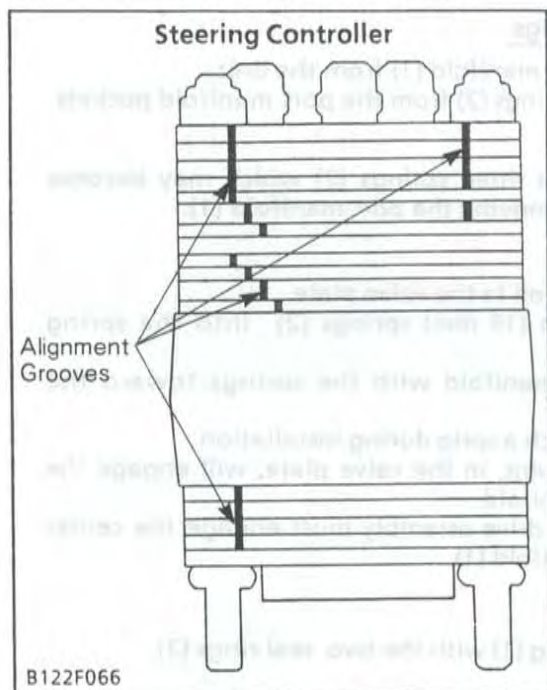
1. Remove the covers (See page S.5-11) and pull out the shuttle rod.
2. Remove the relief valve plug and relief valve assembly.

DISASSEMBLING AND ASSEMBLING**■ IMPORTANT**

- Use only the transmission fluid (See page S.G-7), in no case use mixture of oils of different brands.
- Before disassembling the power steering system hydraulic components, check the performance of hydraulic pump and power steering using a flowmeter (Code No: 07916-52791). Do not disassemble the power steering needlessly.
- After removing or disassembling the power steering hydraulic components, be sure to bleed air.
- If disassembly of power steering is needed, perform disassembly carefully following the instructions given below.
 1. Since the sliding surfaces of those parts have been precisely finished, do not brush or grind with sandpaper. Use transmission fluid for cleaning and compressed air for blowing off.
 2. When reassembling, inspect each part for wear and damage. If seriously damaged, replace parts as sub-assembly or assembly. It is desirable to replace O-rings and seals with new ones.

[Bleeding]

1. Start the engine.
2. Turn the steering wheel slowly in both directions all the way alternately several times, and stop the engine.



■ IMPORTANT

- Components of the steering controller with alignment grooves must be assembled so that their alignment grooves are positioned as figured for the unit to function.

Steering Controller Assembly

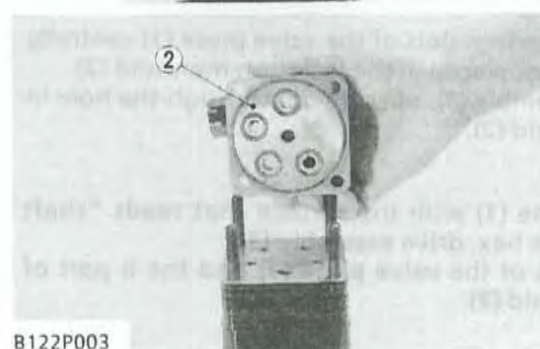
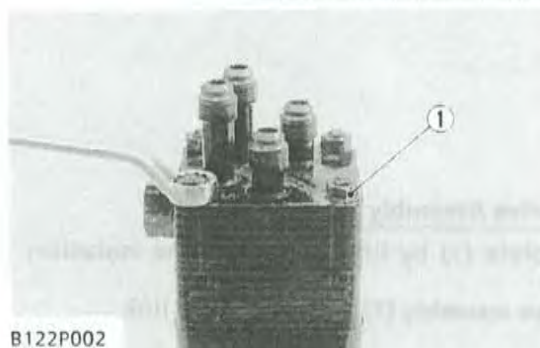
1. Remove the steering controller assembly. (See page S.5-11)

Port Cover Assembly

1. Slightly hold the steering controller assembly with a vise.
2. Remove the four retaining nuts (1) from the port cover assembly (2).
3. Remove the port cover assembly (2).

(When reassembling)

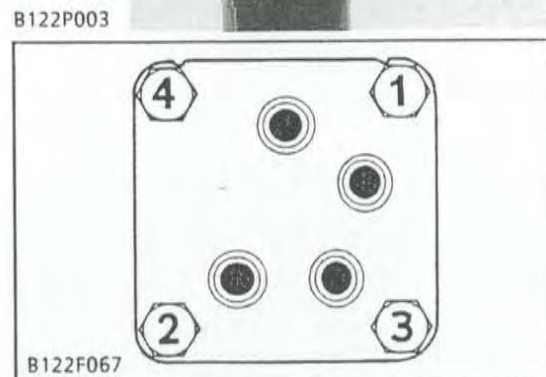
- The retaining nut (1) are a special self-locking type. Do not substitute any other. Use only genuine parts.
- Apply clean grease to the four O-rings and seal ring.
- Install self-locking nuts onto bolts. Tighten each one gradually until resistance is felt.

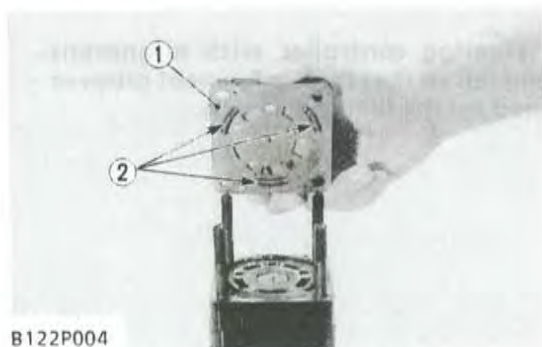


Tightening torque	Retaining nuts	27 to 33 N·m 2.8 to 3.4 kgf·m 20 to 24 ft·lbs
-------------------	----------------	---

(1) Retaining Nut

(2) Port Cover Assembly





B122P004

(1) Port Manifold (2) Springs

Port Manifold and Springs

1. Carefully lift the port manifold (1) from the unit.
2. Remove the three springs (2) from the port manifold pockets.

NOTE

- Be prepared to catch three springs (2) which may become disengaged when removing the port manifold (1).

(When reassembling)

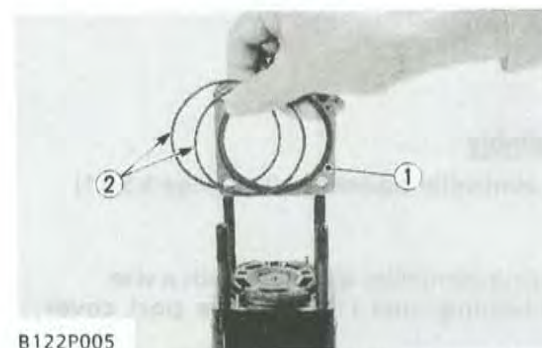
- Apply a few drops of oil to the valve plate.
- Install three 3/4 inch (19 mm) springs (2) into the spring pockets.
- Assemble the port manifold with the springs toward the valve plate.
- Be careful not to pinch a spring during installation.
- The two alignment pins, in the valve plate, will engage the holes in the port manifold.
- The pin on the hex. drive assembly must engage the center hole in the port manifold (1).

Valve Ring

1. Remove the valve ring (1) with the two seal rings (2).

(When reassembling)

- Apply clean grease to the seal rings (2).
- Install the valve ring (1) over the bolts and alignment pins with seal ring facing the isolation manifold.



B122P005

(1) Valve Ring (2) Seal Rings

Valve Plate and Hex. Drive Assembly

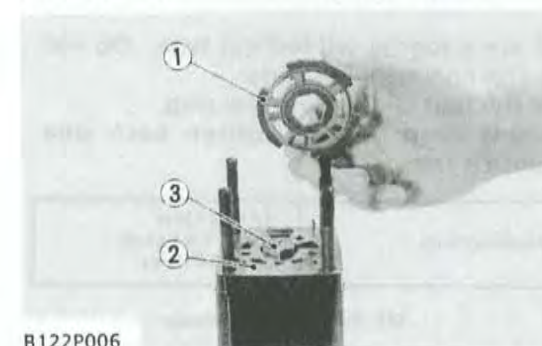
1. Remove the valve plate (1) by lifting it from the isolation manifold (2).
2. Pull out the hex. drive assembly (3) from the drive link.

(When reassembling)

- Aligning the three springs slots of the valve plate (1) centrally over the three springs placed in the isolation manifold (2).
- Place hex. drive assembly (3), pin side up, through the hole in the isolation manifold (2).

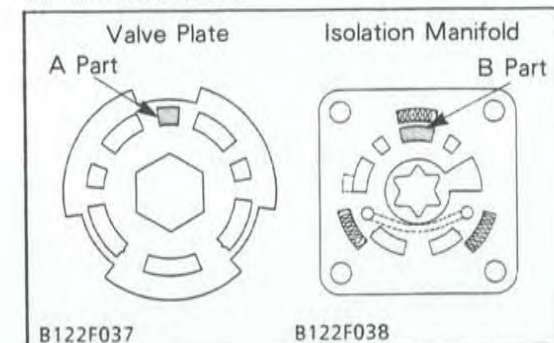
IMPORTANT

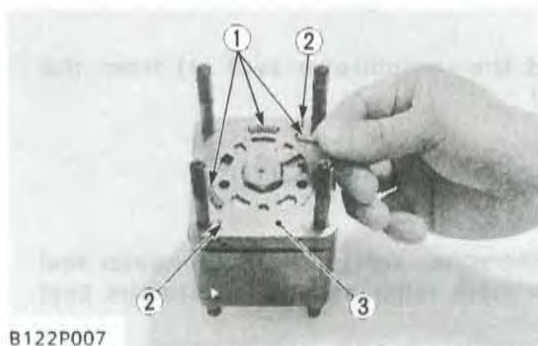
- Place the valve plate (1) with the surface that reads "shaft side" down over the hex. drive assembly (3).
- Aligning the A part of the valve plate (1) and the B part of the isolation manifold (2).



B122P006

(1) Valve Plate (2) Isolation Manifold (3) Hex. Drive Assembly





B122P007

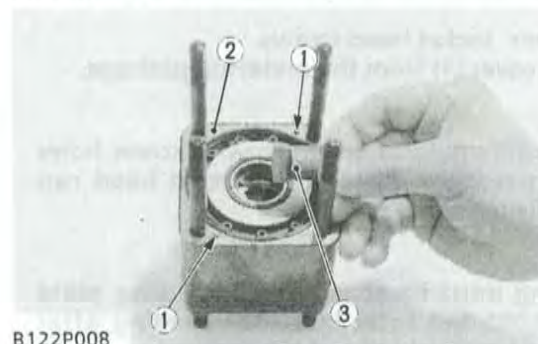
- (1) Springs (3) Isolation Manifold
(2) Alignment Pins

Springs and Isolation Manifold

1. Remove the three springs (1) from the isolation manifold pockets.
2. Remove the two alignment pins (2).
3. Remove the isolation manifold (3).

(When reassembling)

- Install three 1/2 inch (13 mm) springs (1) into the spring pockets.



B122P008

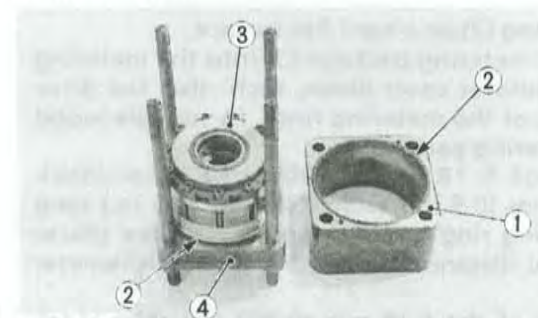
- (1) Alignment Pins (3) Drive Link
(2) Metering Ring

Alignment Pins and Drive Link

1. Remove the two alignment pins (1) from the metering ring (2).
2. Remove the drive link (3) from the metering package.

(When reassembling)

- Insert large tang of the drive link (3) into the slot in the rotor.



B122P009

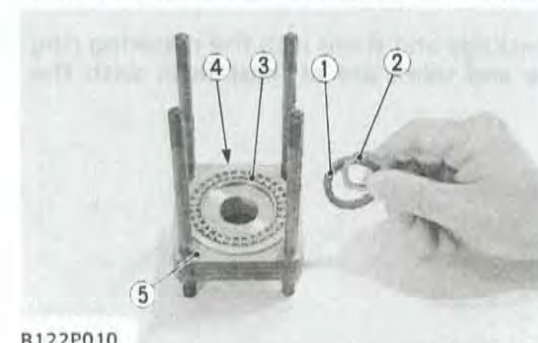
- (1) Metering Ring (3) Metering Package
(2) Seal Ring (4) Upper Cover Plate

Metering Ring and Metering Package

1. Remove the metering ring (1) and discard the two seal rings (2).
2. Lift the metering package (3) from the upper cover plate (4).

(When reassembling)

- Apply clean grease to the metering seal rings (2).
- Apply a small amount of clean grease on the drive plate.



B122P010

- (1) Face Seal (4) Bearing Spacer
(2) Face Seal Spacer (5) Upper Cover Plate
(3) Thrust Bearing

Face Seal, Face Seal Spacer, Thrust Bearing and Bearing Spacer

1. Remove the face seal (1), face seal spacer (2), thrust bearing (3) and bearing spacer (4) from the upper cover plate (5).

(When reassembling)

- Apply clean grease to the thrust bearing (3).



(1) Commutator Seal (2) Commutator Cover

Commutator Seal

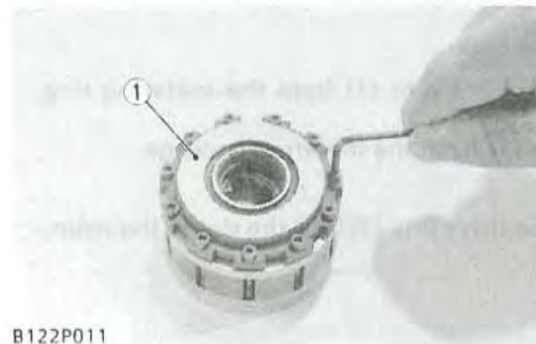
1. Remove and discard the commutator seal (1) from the commutator cover (2).

(When reassembling)

- Apply clean grease to the commutator seal (1).

■ IMPORTANT

- The rubber portion (the softer side) of the commutator seal (1) with the yellow mark must be placed into the seal groove.



(1) Commutator Cover

Commutator Cover

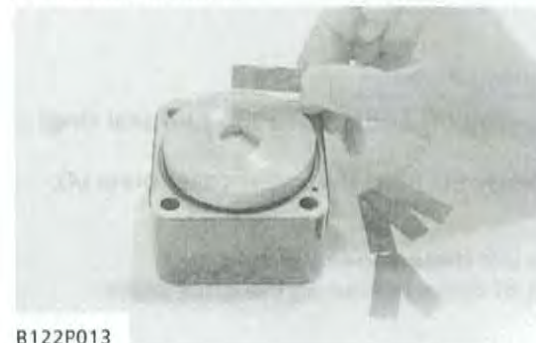
1. Remove the eleven hex. socket head screws.
2. Lift the commutator cover (1) from the metering package.

(When reassembling)

- Align screw holes in commutator cover(1), with screw holes in drive plate then screw the eleven hex. socket head cap screws loosely into the metering package.

■ IMPORTANT

- The Commutator ring must be concentric with drive plate within 0.127 mm (0.005 in.) total indicator reading after tightening the eleven hex. socket head cap screws.
- The next procedures are a method of achieving the concentricity.

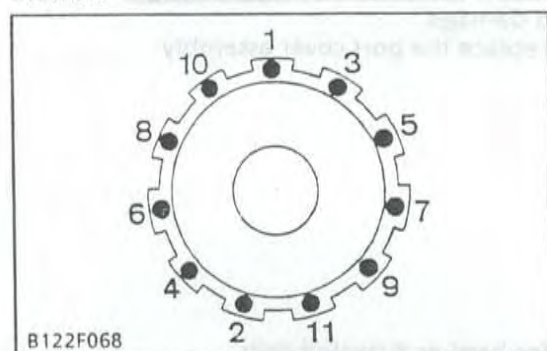


B122P013

1. Place the metering ring (2) on a hard flat surface.
2. Place the assembled metering package (3) into the metering ring with the commutator cover down, such that the drive plate is partially out of the metering ring. (A suitable wood block under the metering package.)
3. Place one piece of 0.18 mm (0.007 in.) shim stock approximately 13 mm (0.5 in.) wide x 38 mm (1.5 in.) long between the metering ring and drive plate in three places approximately equal distance around the outside diameter of the drive plate.
4. Place another piece of the 0.18 mm (0.007 in.) shim stock between the drive plate and each of the three pieces of shim stock already in place.
5. Lift the metering ring and metering package and remove the wood block.
6. Push the metering package and shims into the metering ring until the drive plate and shims are at least flush with the metering ring.



B122P014



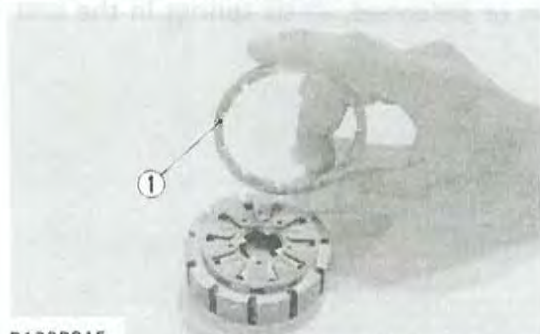
B122F068

7. Reverse the metering ring and metering package as a unit on the flat surface.
8. Push down on the metering package until the drive plate is on the flat surface.
9. Be sure the cap screws are loose enough to allow the commutator ring and drive plate to align themselves concentrically in the metering ring bore.
10. Gradually tighten the eleven cap screws, following the sequence shown in figure.
11. Remove the metering package and shims from the metering ring.

Tightening torque	Hex. socket head cap screw	1.24 to 1.47 N·m 0.13 to 0.15 kgf·m 0.94 to 1.08 ft-lbs
-------------------	----------------------------	---

⚠ CAUTION

- Use care and eye protection while adding and removing shims from metering ring as the shims will be under spring tension and could fly into the air causing injury.

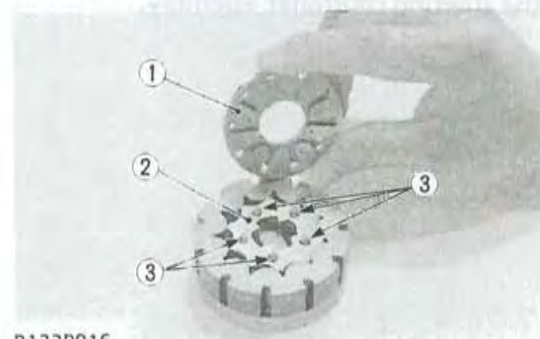


B122P015

(1) Commutator Ring

Commutator Ring

1. Remove the commutator ring (1).



B122P016

(1) Commutator
(2) Rotor

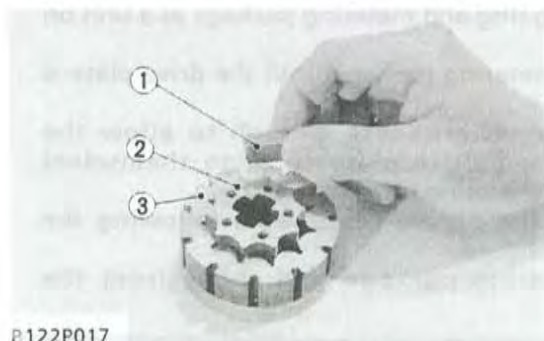
(3) Alignment Pins

Commutator and Alignment Pins

1. Remove the commutator (1) from the rotor (2).
2. Pull out the five alignment pins (3).

(When reassembling)

- Make sure the five alignment pins (3) are pressed below the surface of the commutator (1).
- Place a few drops of oil into each recess in the commutator (1).



B122P017

(1) Drive Link Spacer

(3) Stator

(2) Rotor

Drive Link Spacer and Rotor Set

1. Remove the drive link spacer (1).
2. Remove the rotor (2) and the stator (3) as a unit.

(When reassembling)

- Apply small amount of clean grease to drive link spacer (1) and insert it into the drive slot in the rotor (2).

■ IMPORTANT

- Handle the rotor set carefully to avoid nicks and scratches.

SERVICING



B122P018

Port Cover

1. Inspect the port cover for port fitting sealing surface scratches and thread damage.
2. If these conditions, replace the port cover assembly.



B122P019

Springs

1. Inspect the springs for bent or distorted coils.
2. If a spring is broken or deformed, all six springs in the unit should be replaced.



B122P020

Port manifold

1. Inspect the ground surface of the port manifold.
2. If the port manifold shows nicks or scoring or the edges are not sharp, replace the steering controller assembly.



B122P021

Valve Plate

1. Inspect the slot edges and ground surface.
2. If the valve plate shows nicks or scoring or the edges are not sharp, replace the steering controller assembly.



B122P022

Hex. Drive Assembly

1. The pin in the hex. drive assembly should not show wear and must be firmly pressed in place.
2. The sides of the hex. and the slot should not have grooves or scoring.
3. If the hex. drive assembly shows signs of this type of wear, replace the steering controller assembly.



B122P023

Isolation Manifold

1. Inspect the ground surface of the isolation manifold.
2. If the isolation manifold shows nicks or scoring or the edges are not sharp, replace the steering controller assembly.



B122P024

Drive Link

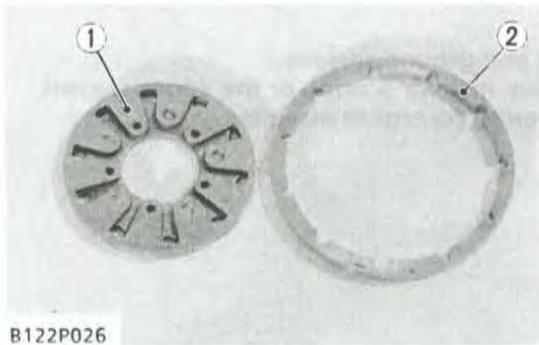
1. Inspect each end of the drive link.
2. If the drive link shows wear or scoring, replace the steering controller assembly.



B122P025

Commutator Cover

1. Inspect the ground surfaces of the commutator cover.
2. If the commutator cover has nicks, burrs or scoring, replace the steering controller assembly.



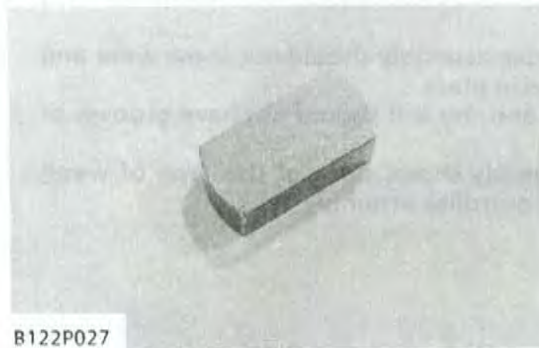
B122P026

Commutator Ring and Commutator

1. Inspect the ground surfaces of the commutator (1) and inside surfaces of the commutator ring (2).
2. If either is worn or damaged, replace the steering controller assembly.

(1) Commutator

(2) Commutator Ring



B122P027

Drive Link Spacer

1. Inspect the drive link spacer.
2. If the drive link spacer is grooved or worn, replace the steering controller assembly.



B122P028

Rotor Set

1. Measure the rotor lobe tip to stator lobe tip clearance, using the appropriate feller gauge.
2. If the clearance exceeds the allowable limit, replace the steering controller assembly.

Clearance between rotor lobe tip and stator lobe tip	Allowable limit	0.08 mm 0.003 in.
--	-----------------	----------------------

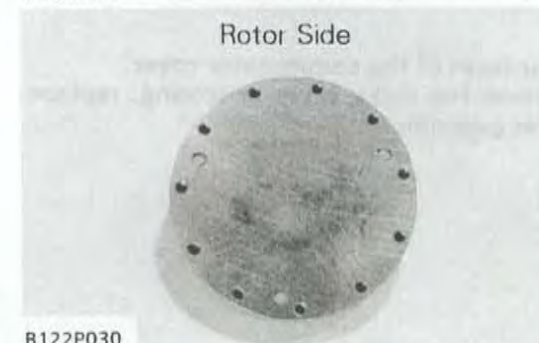


B122P029

Input Shaft Side

Drive Plate

1. The rotor side of the drive plate should show the "normal" spiral pattern due to rotor movement.
2. Inspect the thrust bearing side of the plate for brinelling (dents) or spalling (flaking).
3. The flat sides of the input shaft engagement hole should not be grooved or worn.
4. If any of these conditions are present, replace the steering controller assembly.



B122P030

Rotor Side



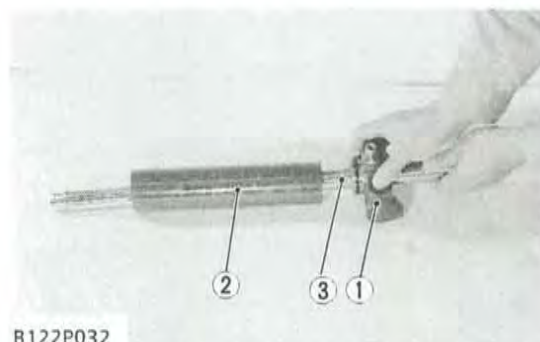
B122P031

Bearing and Spacers

1. Inspect the thrust bearing for brinelling (dents) or spalling (flaking).
2. If either exists, or if one or more of the rolls are lost or broken, replace the steering controller assembly.
3. If the seal spacer or bearing spacer are worn or broken, replace the steering controller assembly.

[3]-2 STEERING CYLINDER

DISASSEMBLING AND ASSEMBLING



B122P032

Steering Cylinder Assembly

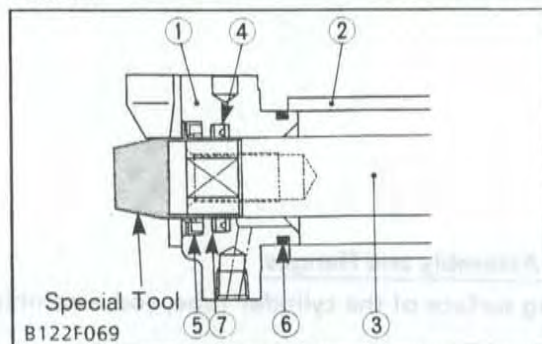
1. Remove the steering cylinder assembly. (See page S.5-13)

Flange Assembly

1. Pull out the flange assembly (1) from the cylinder tube (2).

(When reassembling)

- Insert the rod assembly (3) to the flange assembly (1), it must be used the special tool (See page S.G-42).
- Do not spin or drive in the rod assembly (3) while installing.
- Apply clean grease to the rod gasket (4), dust seal (5) and O-ring (6).
- Change the shape of rod gasket (4) as shown in the figure left, install it to the flange.
- Install the back up gasket (7) as shown in the figure below.



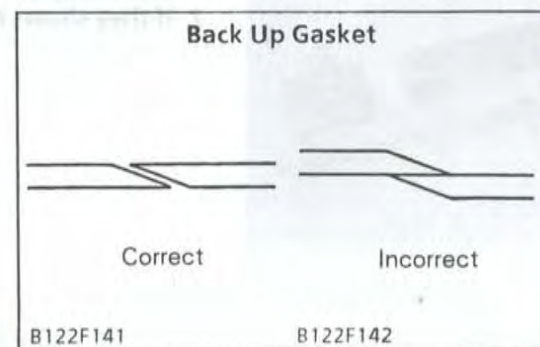
B122F069



B122P039

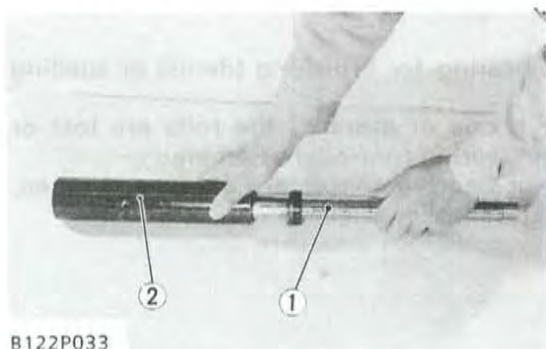
- (1) Flange Assembly
- (2) Cylinder Tube
- (3) Rod Assembly
- (4) Rod Gasket

- (5) Dust Seal
- (6) O-ring
- (7) Back Up Gasket

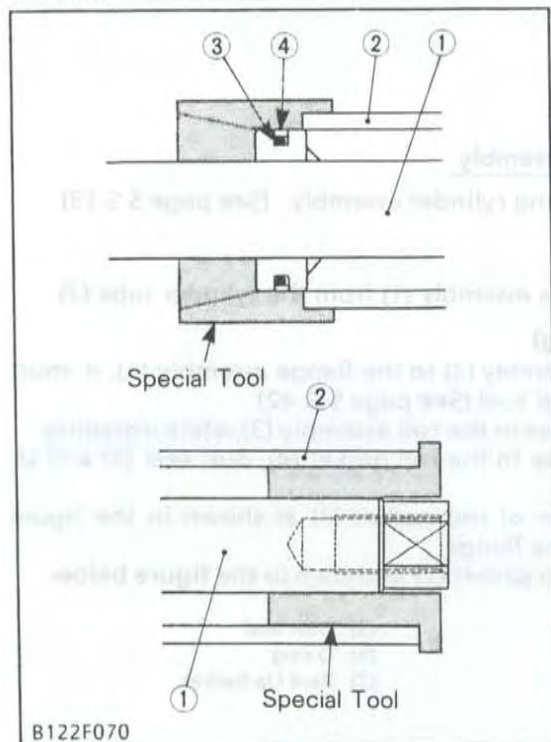


B122F141

B122F142



B122P033



B122F070

Rod Assembly

1. Pull out the rod assembly (1) from the cylinder tube (2).

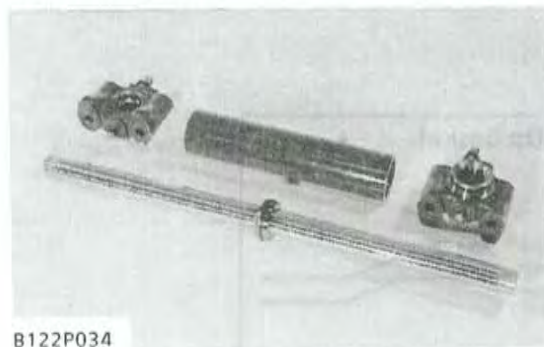
(When reassembling)

- Insert the rod assembly (1) to the cylinder tube (2), it must be used the special tools (See page S.G-42) to both sides of cylinder tube (2).
- Do not spin the rod assembly (1) while inserting.
- Apply clean transmission oil to the O-ring (3) and piston gasket (4).

- (1) Rod Assembly
(2) Cylinder Tube

- (3) O-ring
(4) Piston Gasket

SERVICING



B122P034

Cylinder Tube, Rod Assembly and Flanges

1. Inspect the sliding surface of the cylinder tube, rod assembly and flanges.
2. If they shows nicks or scoring, they must be replaced.



B122P035

Clearance between Rod and Flange

1. Measure the rod O.D. with an outside micrometer.
2. Measure the flange I.D. with a inside micrometer, and calculate the clearance.
3. If the clearance exceeds the allowable limit, replace the rod assembly or flange.

Clearance between rod and flange	Factory spec.	0.020 to 0.062 mm 0.0008 to 0.0024 in.
	Allowable limit	0.1 mm 0.0039 in.
Flange I.D.	Factory spec.	30.000 to 30.021 mm 1.1811 to 1.1819 in.
Rod O.D.	Factory spec.	29.959 to 29.980 mm 1.1795 to 1.1803 in.



R122P036

Cylinder Tube Wear

1. Measure the cylinder tube I.D. with a cylinder gauge.
2. If the measurement exceeds the allowable limit, replace the cylinder tube.

Cylinder tube I.D.	Factory spec	50.000 to 50.062 mm 1.9685 to 1.9709 in.
	Allowable limit	50.100 mm 1.9724 in.

[3]-3 POWER STEERING HYDRAULIC PUMP

CHECKING AND ADJUSTING



B122P037

Condition

- Engine speed
(L2650-L2950-L3650) Approx. 2600 rpm
(L3450) Approx. 2500 rpm
- Rated pressure..... 11.28MPa
115 kgf/cm²
1636 psi
- Oil temperature..... 45 to 55°C
113 to 131°F

Pump Test Using Flowmeter

■ IMPORTANT

- When using a flowmeter other than KUBOTA specified flowmeter (Code No: 07916-52791), be sure to use the instructions with that flowmeter.
- Do not close the flowmeter loading valve completely, before testing, because it has no relief valve.

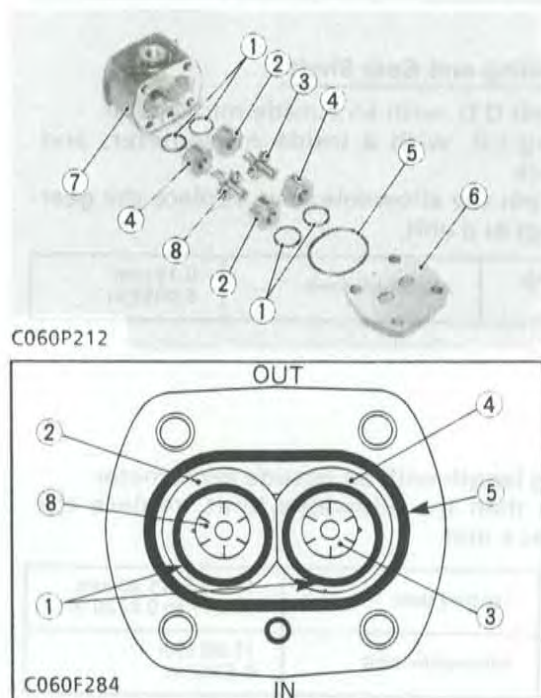
1. Disconnect the delivery pipe which is connected from hydraulic pump to power steering.
2. Install the adaptor 52 (Code No: 07916-52841) to pump.
3. Connect the hydraulic test hose (Code No.: 07916-52651) to the adaptor 52 (pump side) and flowmeter inlet port. Connect the other hydraulic test hose to flowmeter outlet port and to transmission case filling plug hole.
4. Open the flowmeter loading valve completely. (Turn counterclockwise)
5. Start the engine and set the engine speed at max. speed.
6. Slowly close the loading valve to generate pressure approx. 11.28 MPa (115 kgf/cm², 1636 psi). Hold in this condition until oil temperature reaches 45 to 55°C (113 to 131°F).
7. Open the flowmeter loading valve completely. (Turn counterclockwise)
8. Set the engine speed at rated revolution.
9. Read the pump delivery at no pressure.
10. Slowly close the loading valve to increase pressure approx. 11.28 MPa (115 kgf/cm², 1636 psi). As load is increased, engine speed drops, therefore, reset the engine speed.
11. Read the pump flow at rated pressure.
12. Open the loading valve and stop the engine.
13. If the pump delivery does not reach the factory specification, check the pump suction line, oil filter or hydraulic pump.

Hydraulic pump delivery at no pressure	Factory spec.	L2650 L2950	17.1 ℓ/min Above 4.52 U.S.gal/min. 3.76 Imp.gal/min.
		L3450	14.7 ℓ/min Above 3.88 U.S.gal/min. 3.23 Imp.gal/min.
		L3650	15.3 ℓ/min Above 4.04 U.S.gal/min. 3.37 Imp.gal/min.
Hydraulic pump delivery at rated pressure	Factory spec.	L2650 L2950	16.6 ℓ/min Above 4.39 U.S.gal/min. 3.65 Imp.gal/min.
		L3450	14.3 ℓ/min Above 3.78 U.S.gal/min. 3.15 Imp.gal/min.
		L3650	14.8 ℓ/min Above 3.91 U.S.gal/min. 3.26 Imp.gal/min.
	Allowable limit	L2650 L2950	14.9 ℓ/min 3.94 U.S.gal/min. 32.8 Imp.gal/min.
		L3450	12.8 ℓ/min 3.38 U.S.gal/min. 2.82 Imp.gal/min.
		L3650	13.3 ℓ/min 3.51 U.S.gal/min. 2.93 Imp.gal/min.

DISASSEMBLING AND ASSEMBLING

■ IMPORTANT

- The hydraulic pump is precision machined and assembled: if disassembled once, it may be unable to maintain its original performance. Therefore, when the hydraulic pump fails, replacement should be carried out with the hydraulic pump assembled except when emergency repair is unavoidable.
- When repair is required, follow the disassembly and servicing procedures shown below with utmost care.
- Be sure to test the hydraulic pump with a flowmeter before disassembling.
- After reassembly, be sure to perform break-in operation and ensure that there is nothing abnormal with the hydraulic pump.



Disassembling Pump

1. Remove the pump cover.
2. Remove the O-ring (5) and seal ring (1).
3. Remove the bushings (2), (4) of cover (6) side as a unit.
4. Take out the drive gear (8) and driven gear (3).
5. Take out the bushings (2), (4) in back of pump housing (7) as a unit.

(When reassembling)

- Install the driven gear (3), noting its original direction.
- When installing the bushings (2), (4) be sure to reassemble them to the each original position.
- Take care not to damage the seal rings and O-rings.
- After reassembling the power steering hydraulic pump, mount an arm approx. 100 mm (3.39 in.) long to the drive gear to check for smooth rotation.

- | | |
|-----------------|------------------|
| (1) Seal Ring | (5) O-ring |
| (2) Bushing | (6) Cover |
| (3) Driven Gear | (7) Pump Housing |
| (4) Bushing | (8) Drive Gear |

Hydraulic Pump Running-In

After reassembly, perform break-in operation in the following manner, and check the pump for abnormality before use. If the pump temperature should rise noticeably during running-in, recheck should be performed.

1. Install the hydraulic pump to the tractor, and mount the suction pipe and delivery pipe securely.
2. Set the engine speed at 1300 to 1500 rpm, and operate the hydraulic pump at no load for about 10 minutes.
3. Set the engine speed at 2000 to 2200 rpm, and with the hydraulic pump applied with 2.94 MPa (30 kgf/cm², 427 psi) to 4.90 MPa (50 kgf/cm², 711 psi) pressure, operate it for approx. 15 minutes.
4. With the engine set to maximum speed, fully turn the steering wheel to the left or right, then actuate the relief valve five times for 25 seconds (one time 5 seconds).

SERVICING



C060P219

Housing Bore (Depth of scratch)

1. Measure the housing I.D. where the interior surface is not scratched, and measure the housing I.D. where the interior surface is scratched.
2. If the values obtained in the two determinations differ by more than the allowable limit, replace the hydraulic pump as a unit.

Depth of scratch	Allowable limit	0.09 mm 0.0035 in.
------------------	-----------------	-----------------------

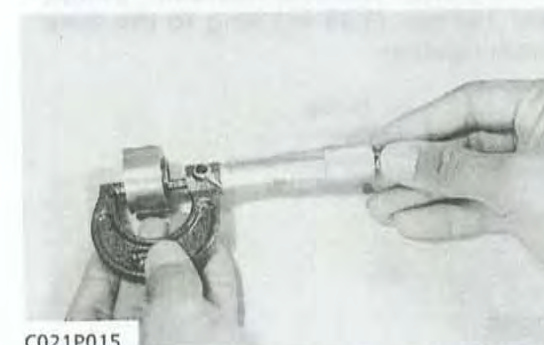


C045P249

Clearance between Bushing and Gear Shaft

1. Measure the gear shaft O.D. with an outside micrometer.
2. Measure the bushing I.D. with a inside micrometer, and calculate the clearance.
3. If the clearance exceeds the allowable limit, replace the gear shaft and the bushings as a unit.

Clearance between bushing and gear shaft	Allowable limit	0.15 mm 0.0059 in.
--	-----------------	-----------------------



C021P015

Bushing Length

1. Measure the bushing length with an outside micrometer.
2. If the length is less than the allowable limit, replace the bushings and gears as a unit.

Bushing length	Factory spec.	15.79 to 15.80 mm 0.6217 to 0.6220 in.
	Allowable limit	15.60 mm 0.6142 in.

S.8 HYDRAULIC SYSTEM

CONTENTS

TROUBLESHOOTING	S.8-1
SERVICING SPECIFICATIONS	S.8-3
TIGHTENING TORQUES	S.8-5
CHECKING, DISASSEMBLING AND SERVICING	S.8-6
[1] HYDRAULIC PUMP	S.8-6
CHECKING AND ADJUSTING	S.8-6
DISASSEMBLING AND ASSEMBLING	S.8-8
SERVICING	S.8-10
[2] POSITION CONTROL VALVE	S.8-11
CHECKING AND ADJUSTING	S.8-11
DISASSEMBLING AND ASSEMBLING	S.8-12
SERVICING	S.8-15
[3] DRAFT CONTROL VALVE	S.8-16
CHECKING AND ADJUSTING	S.8-16
DISASSEMBLING AND ASSEMBLING	S.8-16
[4] FLOW PRIORITY VALVE (POWER STEERING TYPE OF L2350)	S.8-18
DISASSEMBLING AND ASSEMBLING	S.8-18
[5] RELIEF VALVE (L2350)	S.8-18
CHECKING AND ADJUSTING	S.8-18
DISASSEMBLING AND ASSEMBLING	S.8-19
[6] RELIEF VALVE (L2650, L2950, L3450, L3650)	S.8-19
CHECKING AND ADJUSTING	S.8-19
DISASSEMBLING AND ASSEMBLING	S.8-20
[7] HYDRAULIC CYLINDER	S.8-20
DISASSEMBLING AND ASSEMBLING	S.8-20
SERVICING	S.8-22

TROUBLESHOOTING

Before troubleshooting, confirm symptoms of trouble and accomplish basic inspection.

(1) Basic Inspection

No.	Contents	Reference Page
1	Transmission fluid	S.G-14, 15
2	Hydraulic oil filter	S.G-16
3	Suction pipe	-
4	Delivery pipe	-
5	Top link length	-
6	Lifting rod holes	-
7	Weight of implement	M.11-10, 11
8	Lever guide stopper position	S.8-11
9	Relief valve function	S.8-18, 19
10	Lowering speed adjusting valve	-

(2) Troubleshooting

Symptom	Probable Cause	Solution	Reference Page
Implement Does Not Rise (Not Noise)	- Control linkage improperly adjusted - Control linkage improperly assembled or damaged - Position control valve malfunctioning (unload poppet, spool, poppet 1, 2, 3) - Relief valve spring weaken or broken	Adjust Repair or replace	S.8-11 S.8-11
	- Hydraulic piston O-ring, cylinder damaged - Relief valve setting pressure too low - Hydraulic pump malfunctioning	Repair or replace Replace	S.8-12,13, 14 S.8-18,19, 20
(Noise)		Replace Adjust Repair or replace	S.8-20 S.8-18, 19 S.8-7,8,9
Implement Does Not Reach Maximum Height	- Position control rod improperly adjusted - Position control valve spool joint 1 improperly adjusted - Hydraulic arm shaft, hydraulic arm, lift arm improperly assembled	Adjust Adjust	S.8-11 S.8-15
		Adjust	S.8-21
Implement Does Not Lower	- Control valve malfunctioning - Spool damaged	Replace	S.8-12,13, 14
	Poppet valve adjusting nut improperly adjusted	Adjust	S.8-15

Symptom	Probable Cause	Solution	Reference Page
Implement Drops by Weight	- Hydraulic cylinder worn or damaged - Hydraulic piston and O-ring worn or damaged - Position control valve malfunctioning	Replace Replace	S.8-20 S.8-20
	Poppet 1 seat surface damaged	Replace	S.8-12,13,14
	Poppet 1 O-ring damaged	Replace	S.8-12,13,14
	Poppet 2 seat surface damaged	Replace	S.8-12,13,14
	Poppet 2 O-ring damaged	Replace	S.8-12,13,14
	- Poppet 3 seat surface damaged - Poppet 3 O-ring damaged	Replace Replace	S.8-13 S.8-13
Implement Hunts (Moves Up and Down)	Poppet 1, poppet 2, poppet 3 seat surface damaged	Replace	S.8-12,13,14
	Control valve O-rings worn or damaged	Replace	S.8-12,13,14
	Poppet 2 adjusting nut improperly adjusted	Adjust	S.8-15
Draft Control Malfunctioning	Draft control valve malfunctioning	Replace	S.8-16, 17
	Draft control linkage improperly adjusted	Adjust	S.8-16
	Torsion bar weaken or broken	Replace	-
Oil Temperature Increases Rapidly	Relief valve operating	Adjust	S.8-18,19
	Hydraulic pump leak or damaged	Replace or repair	S.8-6,7,8,9
	Oil leaks from valves	Replace or repair	-
	Gear or bearing damaged in the transmission case	Replace	-

SERVICING SPECIFICATIONS

HYDRAULIC PUMP

Item		Factory Specification	Allowable Limit
Hydraulic Pump Condition - Engine Speed [L2350] Approx. 2800 rpm [L2650, L2950, L3650] Approx. 2600 rpm [L3450] Approx. 2500 rpm - Oil Temperature 45 to 55°C 113 to 131°F	Delivery at No Pressure [L2350 2WD]	Above 17.3 l/min. 4.57 U.S. gal/min. 3.81 Imp.gal/min.	-
	[L2350 4WD]	Above 27.2 l/min. 7.19 U.S. gal/min. 5.98 Imp.gal/min.	-
	[L2650, L2950]	Above 25.4 l/min. 6.71 U.S. gal/min. 5.59 Imp.gal/min.	-
	[L3450]	Above 28.4 l/min. 7.50 U.S. gal/min. 6.25 Imp.gal/min.	-
	[L3650]	Above 29.5 l/min. 7.79 U.S. gal/min. 6.49 Imp.gal/min.	-
Hydraulic Pump Condition - Engine Speed [L2350] Approx. 2800 rpm [L2650, L2950, L3650] Approx. 2600 rpm [L3450] Approx. 2500 rpm - Rated pressure [L2350] 15.19 MPa 155 kgf/cm² 2204 psi [L2650, L2950, L3450, L3650] 17.16 MPa 175 kgf/cm² 2489 psi - Oil Temperature 45 to 55°C 113 to 131°F	Delivery at Rated Pressure [L2350 2WD]	Above 16.8 l/min. 4.44 U.S. gal/min. 3.70 Imp.gal/min.	15.1 l/min. 3.99 U.S. gal/min. 3.32 Imp.gal/min.
	[L2350 4WD]	Above 26.4 l/min. 6.97 U.S. gal/min. 5.81 Imp.gal/min.	23.7 l/min. 6.26 U.S. gal/min. 5.21 Imp.gal/min.
	[L2650, L2950]	Above 24.6 l/min. 6.50 U.S. gal/min. 5.41 Imp.gal/min.	22.1 l/min. 5.84 U.S. gal/min. 4.86 Imp.gal/min.
	[L3450]	Above 27.5 l/min. 7.26 U.S. gal/min. 6.05 Imp.gal/min.	24.7 l/min. 6.53 U.S. gal/min. 5.43 Imp.gal/min.
	[L3650]	Above 28.6 l/min. 7.56 U.S. gal/min. 6.29 Imp.gal/min.	25.7 l/min. 6.79 U.S. gal/min. 5.65 Imp.gal/min.

HYDRAULIC PUMP

Item		Factory Specification	Allowable Limit
Gear (Drive, Driven)	O.D.	33.47 to 33.48 mm 1.3177 to 1.3181 in.	
Housing	Depth of Scratch	—	0.09 mm 0.0035 in.
Bushing to Gear Shaft	Clearance	—	0.12 mm 0.0043 in.
Bushing	Length [L2350 2WD]	18.99 to 19.00 mm 0.7476 to 0.7480 in.	18.80 mm 0.7402 in.
	[L2350 4WD, L2650, L2950]	22.99 to 23.00 mm 0.9051 to 0.9055 in.	22.80 mm 0.8976 in.
	[L3450, L3650]	20.49 to 20.50 mm 0.8067 to 0.8071 in.	20.30 mm 0.7992 in.

RELIEF VALVE

Relief Valve Condition • Engine Speed Maximum • Oil Temperature 45 to 55°C 113 to 131°F	Setting Pressure [L2350]	14.70 to 15.19 MPa 150 to 155 kgf/cm ² 2133 to 2204 psi	—
	[L2650, L2950] [L3450, L3650]	16.67 to 17.16 MPa 170 to 175 kgf/cm ² 2418 to 2489 psi	—

HYDRAULIC CYLINDER

Cylinder Bore	I.D. [L2350]	75.000 to 75.050 mm 2.9528 to 2.9547 in.	75.150 mm 2.9587 in.
	[L2650, L2950] [L3450, L3650]	85.000 to 85.050 mm 3.3465 to 3.3484 in.	85.150 mm 3.3524 in.
Hydraulic Piston	Stroke	90 mm 3.54 in.	—
Hydraulic Arm Shaft to Bushing	Clearance (Right)	0.125 to 0.230 mm 0.0049 to 0.0091 in.	0.50 mm 0.02 in.
	(Left)	0.125 to 0.220 mm 0.0049 to 0.0087 in.	0.50 mm 0.02 in.
Hydraulic Arm Shaft	O.D. (Right)	44.920 to 44.950 mm 1.7685 to 1.7697 in.	—
	(Left)	39.920 to 39.950 mm 1.5717 to 1.5728 in.	—
Bushing	I.D. (Right)	45.075 to 45.150 mm 1.7746 to 1.7776 in.	—
	(Left)	40.075 to 40.140 mm 1.5778 to 1.5803 in.	—

CONTROL LINKAGE

Item		Factory Specification	Allowable Limit
Lift Arm Stroke Angle (Angle of Lift Arm) (Upward)	Angle	0.767 to 0.802 rad. 44 to 46°	-
	Angle	0.384 to 0.419 rad. 22 to 24°	-
Position Control Lever and Draft Control Lever		14.7 to 34.3 N 1.5 to 3.5 kgf 3.3 to 7.7 lbs	-

TIGHTENING TORQUES

Tightening torques of screws and nuts on the table below is especially specified.
(For general use screws and nuts: See page S.G-8)

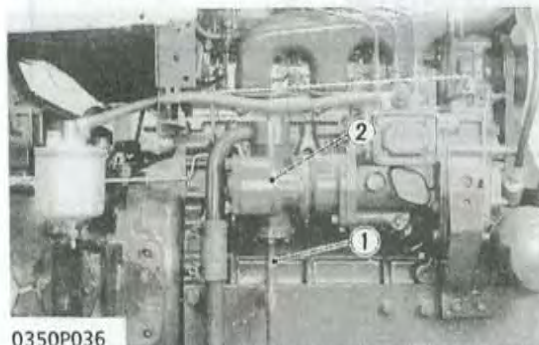
Item	N·m	kgf·m	ft-lbs
Relief valve plug	49.0 to 68.6	5.0 to 7.0	36.2 to 50.6
Position control valve lock nut	13.7 to 19.6	1.4 to 2.0	10.1 to 14.5
Position control valve plug	39.2 to 58.8	4.0 to 6.0	28.9 to 43.4
Position control valve seat plug	29.4 to 49.0	3.0 to 5.0	21.7 to 36.2
Position control valve mounting screws	23.6 to 27.4	2.4 to 2.8	17.4 to 20.2
Draft control valve mounting screws	23.6 to 27.4	2.4 to 2.8	17.4 to 20.2
Draft control valve plug	58.8 to 68.6	6.0 to 7.0	43.4 to 50.6

CHECKING, DISASSEMBLING AND SERVICING

[1] HYDRAULIC PUMP

CHECKING AND ADJUSTING

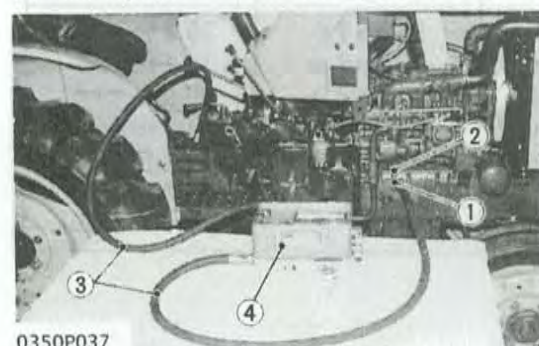
[L2350]



0350P036

(1) Delivery Pipe

(2) Hydraulic Pump



0350P037

(1) Adaptor 53

(2) Adaptor 54

(3) Hydraulic Test Hose

(4) Flowmeter

Hydraulic Flow Test

1. Disconnect the delivery pipe which is connected from hydraulic pump to hydraulic cylinder.
2. Install the adaptor **54** (Code No: 07916-52861) and adaptor **53** (Code No: 07916-52851) to the pump discharge port.
3. Connect the hydraulic test hose (Code No: 07916-52651) to the adaptor **53** and flowmeter (Code No: 07916-52791) inlet port.
4. Connect the other hydraulic test hose to flowmeter outlet port and to transmission case oil filling plug hole.
5. Open the flowmeter loading valve completely. (Turn counterclockwise)
6. Start the engine and set the engine speed at **2000 to 2200 rpm**.
7. Slowly close the loading valve to generate pressure approx. **14.7 MPa (150 kgf/cm², 2133 psi)**. Hold in this condition until oil temperature reaches approx. **45°C (113°F)**.
8. Open the loading valve completely.
9. Set the engine speed at approx. **2800 rpm**.
10. Read and note the pump delivery at no pressure.
11. Slowly close the loading valve to increase pressure approx. **15.19 MPa (155 kgf/cm², 2204 psi)**. As the load is increased, engine speed drops, therefore, reset the engine speed.
12. Read and note the pump flow at rated pressure.
13. Open the loading valve and stop the engine.
14. If the pump delivery does not reach the allowable limit, check the pump suction line, oil filter or hydraulic pump.

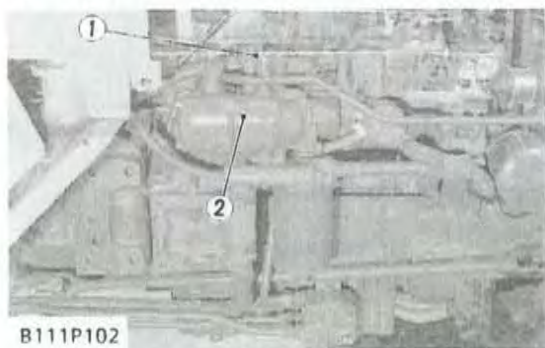
■ IMPORTANT

- In this hook-up, there is no relief valve. Therefore, while testing, do not close the flow meter loading valve completely.

Hydraulic pump delivery at no pressure	Factory spec.	L2350 2WD	Above 17.3 ℓ/min 4.57 U.S.gal/min. 3.81 Imp.gal/min.
		L2350 4WD	Above 27.2 ℓ/min 7.19 U.S.gal/min. 5.98 Imp.gal/min.
Hydraulic pump delivery at rated pressure	Factory spec.	L2350 2WD	Above 16.8 ℓ/min 4.44 U.S.gal/min. 3.70 Imp.gal/min.
		L2350 4WD	Above 26.4 ℓ/min 6.97 U.S.gal/min. 5.81 Imp.gal/min.
	Allowable limit	L2350 2WD	15.1 ℓ/min 3.99 U.S.gal/min. 3.32 Imp.gal/min.
		L2350 4WD	23.7 ℓ/min 6.26 U.S.gal/min. 5.21 Imp.gal/min.

Condition

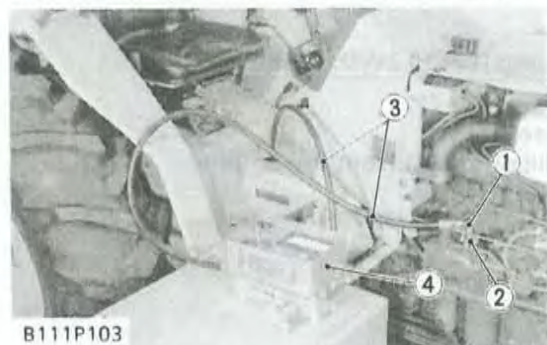
- Engine speed..... approx.2800 rpm
- Rated pressure..... 15.19 MPa
155 kgf/cm²
2204 psi
- Oil temperature..... 45 to 55 °C
113 to 131 °F

[L2650, L2950, L3450, L3650]

B111P102

(1) Delivery Pipe

(2) Hydraulic Pump



B111P103

(1) Adaptor 53

(2) Adaptor 54

(3) Hydraulic Test Hose

(4) Flowmeter

Condition

- Engine speed
[L2650,L2950,L3650] approx.2600 rpm
[L3450] approx.2500 rpm
- Rated pressure..... 17.16 MPa
175 kgf/cm²
2489 psi
- Oil temperature..... 45 to 55°C
113 to 131°F

Hydraulic Flow Test

1. Disconnect the delivery pipe which is connected from hydraulic pump to hydraulic block.
2. Install the adaptor 54 (Code No: 07916-52861) and adaptor 53 (Code No: 07916-52851) to the pump discharge port.
3. Connect the hydraulic test hose (Code No: 07916-52651) to the adaptor 53 and flowmeter (Code No: 07916-52791) inlet port.
4. Connect the other hydraulic test hose to flowmeter outlet port and to transmission case oil filling plug hole.
5. Open the flowmeter loading valve completely. (Turn counterclockwise)
6. Start the engine and set the engine speed at 2000 to 2200 rpm.
7. Slowly close the loading valve to generate pressure approx. 17.16 MPa (175 kgf/cm², 2489 psi). Hold in this condition until oil temperature reaches approx. 45°C (113°F).
8. Open the loading valve completely.
9. Set the engine speed at approx. 2600 rpm. (L3450, 2500 rpm)
10. Read and note the pump delivery at no pressure.
11. Slowly close the loading valve to increase pressure approx. 17.16 MPa (175 kgf/cm², 2489 psi). As the load is increased, engine speed drops, therefore, reset the engine speed.
12. Read and note the pump flow at rated pressure.
13. Open the loading valve and stop the engine.
14. If the pump delivery does not reach the allowable limit, check the pump suction line, oil filter or hydraulic pump.

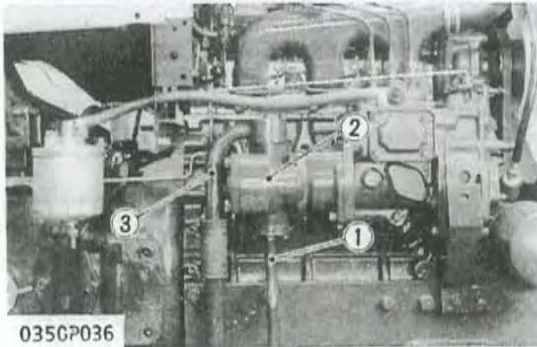
■ IMPORTANT

- In this hook-up, there is no relief valve. Therefore, while testing, do not close the flow meter loading valve completely.

Hydraulic pump delivery at no pressure	Factory spec.	L2650 L2950	Above 25.4 ℓ/min 6.71 U.S.gal/min. 5.59 Imp.gal/min.
		L3450	Above 28.4 ℓ/min 7.50 U.S.gal/min. 6.25 Imp.gal/min.
		L3650	Above 29.5 ℓ/min 7.79 U.S.gal/min. 6.49 Imp.gal/min.
Hydraulic pump delivery at rated pressure	Factory spec.	L2650 L2950	Above 24.6 ℓ/min 6.50 U.S.gal/min. 5.41 Imp.gal/min.
		L3450	Above 27.5 ℓ/min 7.26 U.S.gal/min. 6.05 Imp.gal/min.
		L3650	Above 28.6 ℓ/min 7.56 U.S.gal/min. 6.29 Imp.gal/min.
	Allowable limit	L2650 L2950	22.1 ℓ/min 5.84 U.S.gal/min. 4.86 Imp.gal/min.
		L3450	24.7 ℓ/min 6.53 U.S.gal/min. 5.43 Imp.gal/min.
		L3650	25.7 ℓ/min 6.79 U.S.gal/min. 5.65 Imp.gal/min.

DISASSEMBLING AND ASSEMBLING

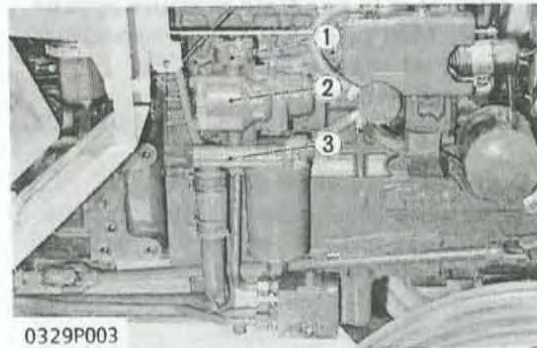
[L2350, MANUAL STEERING TYPE OF L2650 2WD AND L2950 2WD]

**Removing Hydraulic Pump [L2350]**

1. Disconnect the delivery pipe (1).
2. Remove the inlet pipe (3).
3. Remove the hydraulic pump (2) from the engine.

(1) Delivery Pipe
(2) Hydraulic Pump

(3) Inlet Pipe

**Removing Hydraulic Pump [L2650 2WD, L2950 2WD]**

1. Disconnect the delivery pipe (1).
2. Remove the filter bracket (3).
3. Remove the hydraulic pump (2) from the engine.

(1) Delivery Pipe
(2) Hydraulic Pump

(3) Filter Bracket

Disassembling Hydraulic Pump

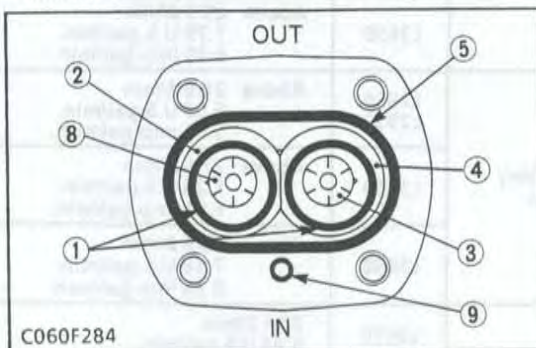
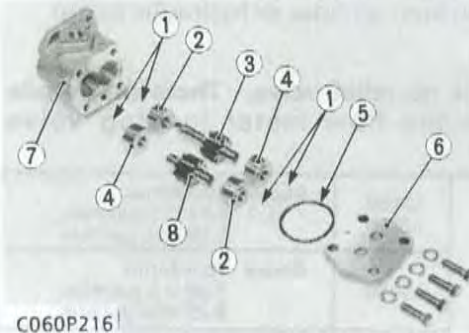
1. Remove the pump cover (6).
2. Remove the seal rings (1) and O-ring (5).
3. Remove the bushings (2), (4) of cover side as a unit.
4. Take out the drive gear (3) and driven gear (8).
5. Take out the bushings (2), (4) in back of the pump body (7) as a unit.

(When reassembling)

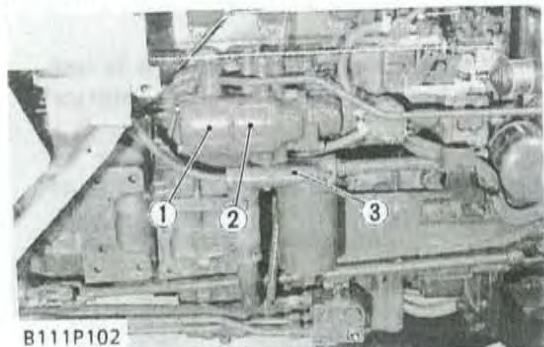
- Install the driven gear (8), noting its original direction.
- When installing the bushings (2), (4), be sure to reassemble them to the each original position.
- Take care not to damage the seal rings (1) and O-ring (5).
- After reassembly, mount an arm approx. 100 mm (4 in.) long, etc. to the drive gear to check for smooth rotation.

(1) Seal Ring
(2) Bushing
(3) Drive Gear
(4) Bushing
(5) O-ring

(6) Cover
(7) Pump Body
(8) Driven Gear
(9) O-ring



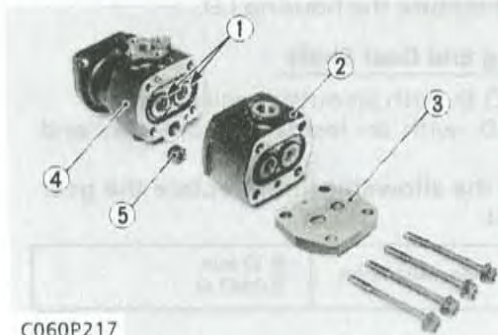
[POWER STEERING TYPE OF L2650, L2950, L3450 AND L3650]



Removing Three Point Hydraulic Pump and Power Steering Hydraulic Pump

1. Disconnect the delivery pipes from the three point hydraulic pump and power steering pump.
2. Remove the filter bracket (3).
3. Remove the power steering hydraulic pump (1) and three point hydraulic pump (2) as a unit from the engine.

- | | |
|-----------------------------------|--------------------|
| (1) Power Steering Hydraulic Pump | (3) Filter Bracket |
| (2) Three Point Hydraulic Pump | |



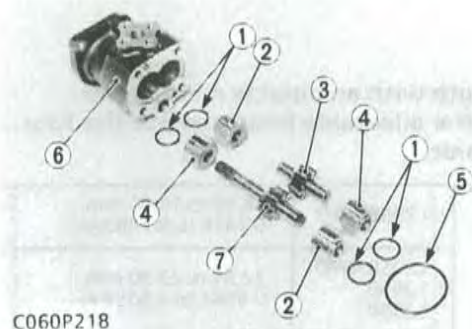
Separating Three Point Hydraulic Pump

1. Remove four screws from the power steering hydraulic pump (2), and separate it from the three point hydraulic pump (4).

(When reassembling)

- Install the cover (3), noting the position of oil port.
- Take care not to damage the O-rings.

- | | |
|-------------------------|--------------------------------|
| (1) Seal Ring | (4) Three Point Hydraulic Pump |
| (2) Power Steering Pump | (5) Coupling |
| (3) Cover | |

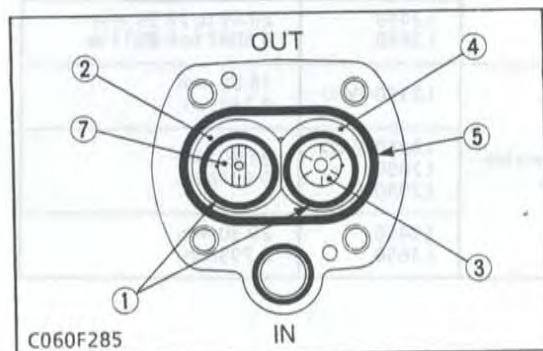


Disassembling Three Point Hydraulic Pump

1. Remove the seal rings (1) and O-ring (5).
2. Remove the bushings (2), (4) of cover side as a unit.
3. Take out the drive gear (7) and driven gear (3).
4. Take out the bushings (2), (4) in back of the pump body as a unit.

(When reassembling)

- Install the driven gear (3), noting its original direction.
- When installing the bushings (2), (4), be sure to reassemble them to the each original position.
- Take care not to damage the seal rings (1) and O-ring (5).



- | | |
|-----------------|----------------|
| (1) Seal Ring | (5) O-ring |
| (2) Bushing | (6) Pump Body |
| (3) Driven Gear | (7) Drive Gear |
| (4) Bushing | |

SERVICING



C060P219

Housing Bore (Depth of Scratch)

1. Measure the housing I.D. where the interior surface is not scratched, and measure the housing I.D. where the interior surface is scratched.
2. If the values obtained in the two determinations differ by more than the allowable limit, replace the hydraulic pump as a unit.

Depth of scratch	Allowable limit	0.09 mm 0.0035 in.
------------------	-----------------	-----------------------

(Reference)

- Use a cylinder gauge to measure the housing I.D.



C045P249

Clearance between Bushing and Gear Shaft

1. Measure the gear shaft O.D. with an outside micrometer.
2. Measure the bushing I.D. with an inside micrometer, and calculate the clearance.
3. If the clearance exceeds the allowable limit, replace the gear and the bushing as a unit.

Clearance between bushing and gear shaft	Allowable limit	0.12 mm 0.0043 in.
--	-----------------	-----------------------



C021P015

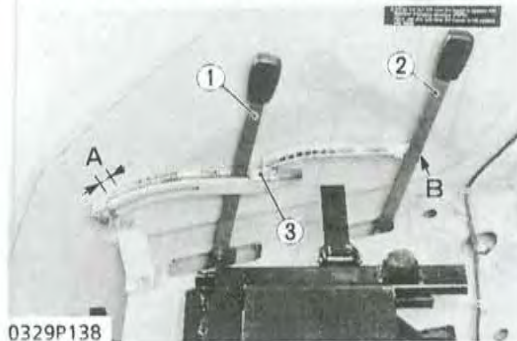
Bushing Length

1. Measure the bushing length with an outside micrometer.
2. If the length is less than the allowable limit, replace the four bushings and gears as a unit.

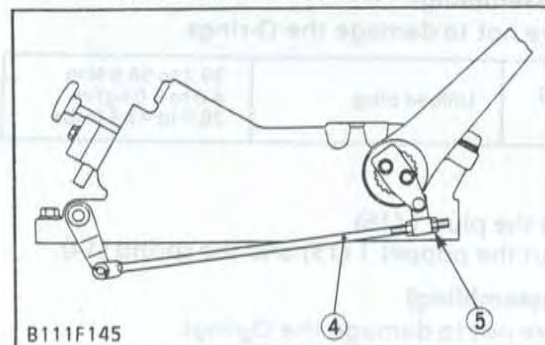
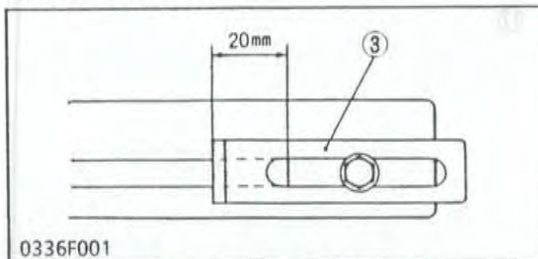
Bushing length	Factory spec.	L2350 2WD	18.99 to 19.00 mm 0.7476 to 0.7480 in.
		L2350 4WD L2650 L2950	22.99 to 23.00 mm 0.9051 to 0.9055 in.
		L3450 L3650	20.49 to 20.50 mm 0.8067 to 0.8071 in.
	Allowable limit	L2350 2WD	18.80 mm 0.7402 in.
		L2350 4WD L2650 L2950	22.80 mm 0.8976 in.
		L3450 L3650	20.30 mm 0.7992 in.

[2] POSITION CONTROL VALVE

CHECKING AND ADJUSTING



(1) Position Control Lever (3) Lever Stopper
(2) Draft Control Lever



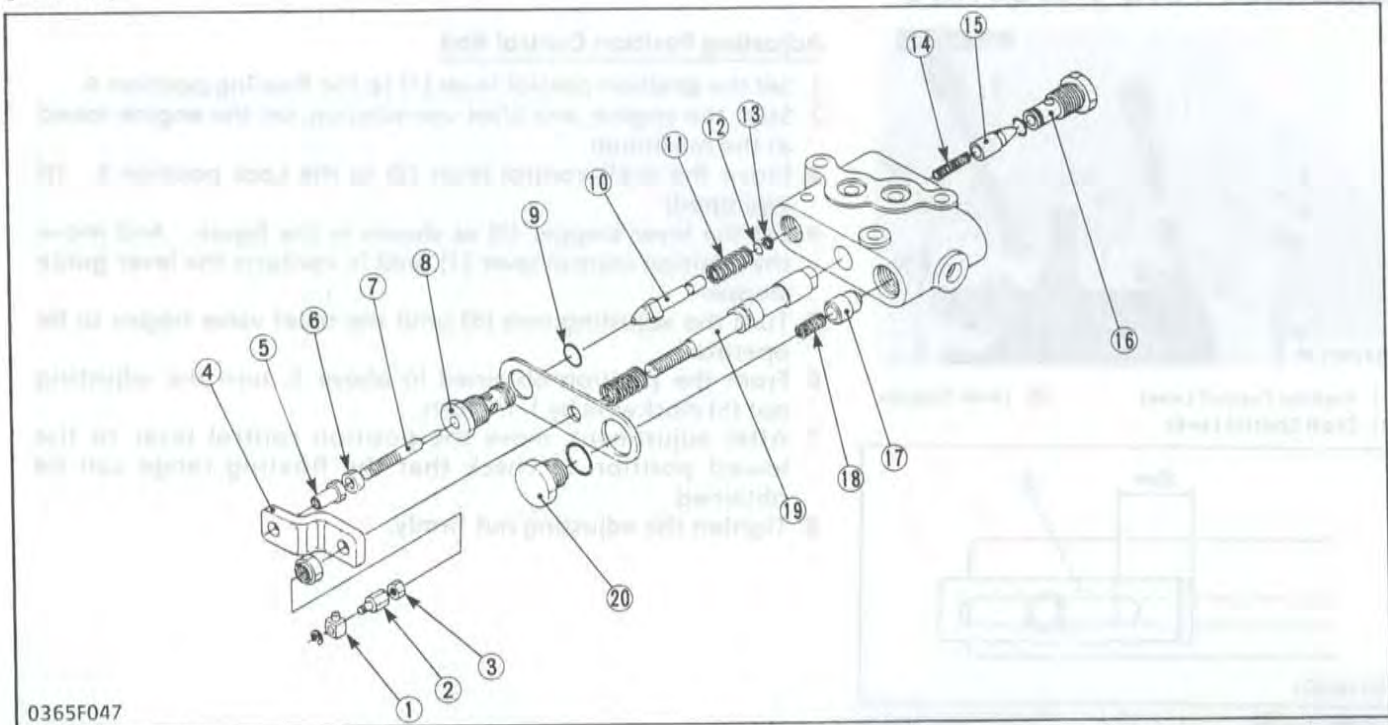
(4) Position Control Rod (5) Adjusting Nut

Adjusting Position Control Rod

1. Set the position control lever (1) to the floating position A.
2. Start the engine, and after warming-up, set the engine speed at the maximum.
3. Move the draft control lever (2) to the Lock position B. (If equipped)
4. Set the lever stopper (3) as shown in the figure. And move the position control lever (1) until it contacts the lever guide stopper.
5. Turn the adjusting nuts (5) until the relief valve begins to be operated.
6. From the position obtained in above 5, turn the adjusting nut (5) clockwise by 1-1/4 turn.
7. After adjustment, move the position control lever to the lowest position to check that the floating range can be obtained.
8. Tighten the adjusting nut firmly.

DISASSEMBLING AND ASSEMBLING

[L2350]



0365F047

- | | | | |
|-------------------|---------------|------------------|--------------------|
| (1) Spool Joint 2 | (6) Lock Nut | (11) Spring 2 | (16) Plug 1 |
| (2) Spool Joint 1 | (7) Push Rod | (12) O-ring | (17) Unload Poppet |
| (3) Lock Nut | (8) Plug 2 | (13) Backup Ring | (18) Spring |
| (4) Plate | (9) O-ring | (14) Spring | (19) Spool |
| (5) Adjusting Nut | (10) Poppet 2 | (15) Poppet 1 | (20) Unload Plug |

Position Control Valve Assembly

1. Separate the hydraulic cylinder assembly. (See page S.5-8)
2. Remove the position control valve assembly.

IMPORTANT

- Measure the distance between the spool edge and spool joint 2 edge before disassembling.

Spool

1. Remove the spool joint 1 (2) and the spool joint 2 (1).
2. Remove the plate (4).
3. Remove the spool (19).

(When reassembling)

Tightening torque	Lock nut	13.7 to 19.6 N·m 1.4 to 2.0 kgf·m 10.1 to 14.5 ft-lbs
-------------------	----------	---

Poppet 2

1. Draw out the push rod (7).
2. Remove the plug 2 (8) and draw out the poppet 2 (10) and the spring 2 (11).

(When reassembling)

- Take care not to damage the O-rings.

Tightening torque	Plug 2	29.4 to 49.0 N·m 3.0 to 5.0 kgf·m 21.7 to 36.2 ft-lbs
-------------------	--------	---

Unload Poppet

1. Remove the unload plug (20).
2. Draw out the unload poppet (17) and the spring (18).

(When reassembling)

- Take care not to damage the O-rings.

Tightening torque	Unload plug	39.2 to 58.8 N·m 4.0 to 6.0 kgf·m 28.9 to 43.4 ft-lbs
-------------------	-------------	---

Poppet 1

1. Remove the plug 1 (16).
2. Draw out the poppet 1 (15) and the spring (14).

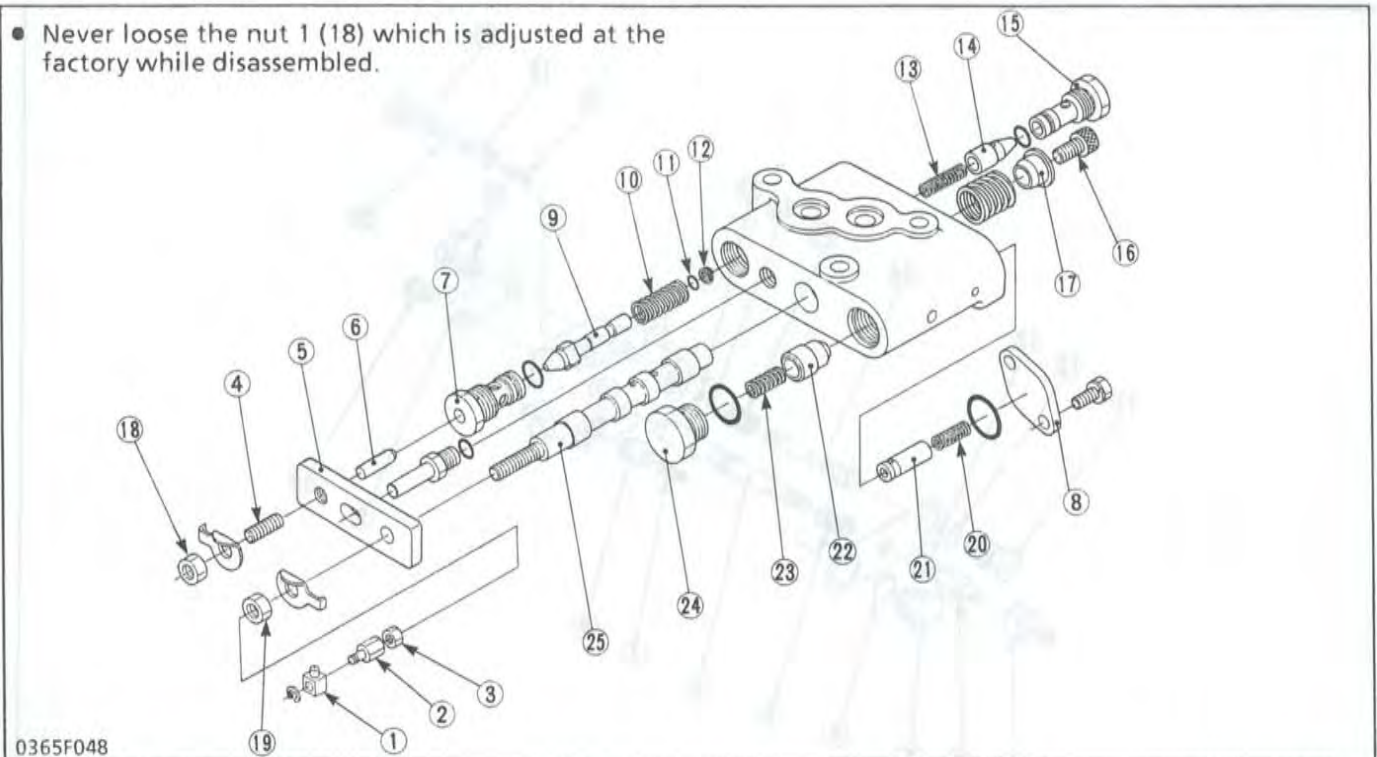
(When reassembling)

- Take care not to damage the O-rings.

Tightening torque	Plug 1	29.4 to 49.0 N·m 3.0 to 5.0 kgf·m 21.7 to 36.2 ft-lbs
-------------------	--------	---

[L2350 WITH DRAFT CONTROL (if equipped)]

- Never loose the nut 1 (18) which is adjusted at the factory while disassembled.



- | | | | | |
|-------------------|---------------|------------------|--------------------|--------------------|
| (1) Spool Joint 2 | (6) Push Rod | (11) O-ring | (16) Screw | (21) Poppet 3 |
| (2) Spool Joint 1 | (7) Plug 2 | (12) Backup Ring | (17) Spring Holder | (22) Unload Poppet |
| (3) Lock Nut | (8) Plate 2 | (13) Spring | (18) Nut 1 | (23) Spring |
| (4) Set Screw | (9) Poppet 2 | (14) Poppet 1 | (19) Nut 2 | (24) Unload Plug |
| (5) Plate 1 | (10) Spring 2 | (15) Plug 1 | (20) Spring | (25) Spool |

Position Control Valve Assembly

1. Separate the hydraulic cylinder assembly. (See page S.5-8)
2. Remove the position control valve assembly.

■ IMPORTANT

- Measure the distance between the spool edge and spool joint 2 edge before disassembling.

Spool

1. Remove the spool joint 1 (2) and the spool joint 2 (1).
2. Remove the nut 2 (19).
3. Remove the spool (25) and spring (5).

(When reassembling)

Tightening torque	Lock nut	13.7 to 19.6 N·m 1.4 to 2.0 kgf·m 10.1 to 14.5 ft-lbs
-------------------	----------	---

Poppet 2

1. Draw out the push rod (6).
2. Remove plug 2 (7) and draw out the poppet 2 (9) and spring 2 (10).

(When reassembling)

- Take care not to damage the O-rings.

Tightening torque	Plug 2	29.4 to 49.0 N·m 3.0 to 5.0 kgf·m 21.7 to 36.2 ft-lbs
-------------------	--------	---

Unload Poppet

1. Remove the unload plug (24).
2. Draw out the unload poppet (22) and the spring (23).

(When reassembling)

- Take care not to damage the O-rings.

Tightening torque	Unload plug	39.2 to 58.8 N·m 4.0 to 6.0 kgf·m 28.9 to 43.4 ft-lbs
-------------------	-------------	---

Poppet 3

1. Remove the plate 2 (8).
2. Draw out the spring (20) and the poppet 3 (21).

(When reassembling)

- Take care not to damage the O-rings.

Poppet 1

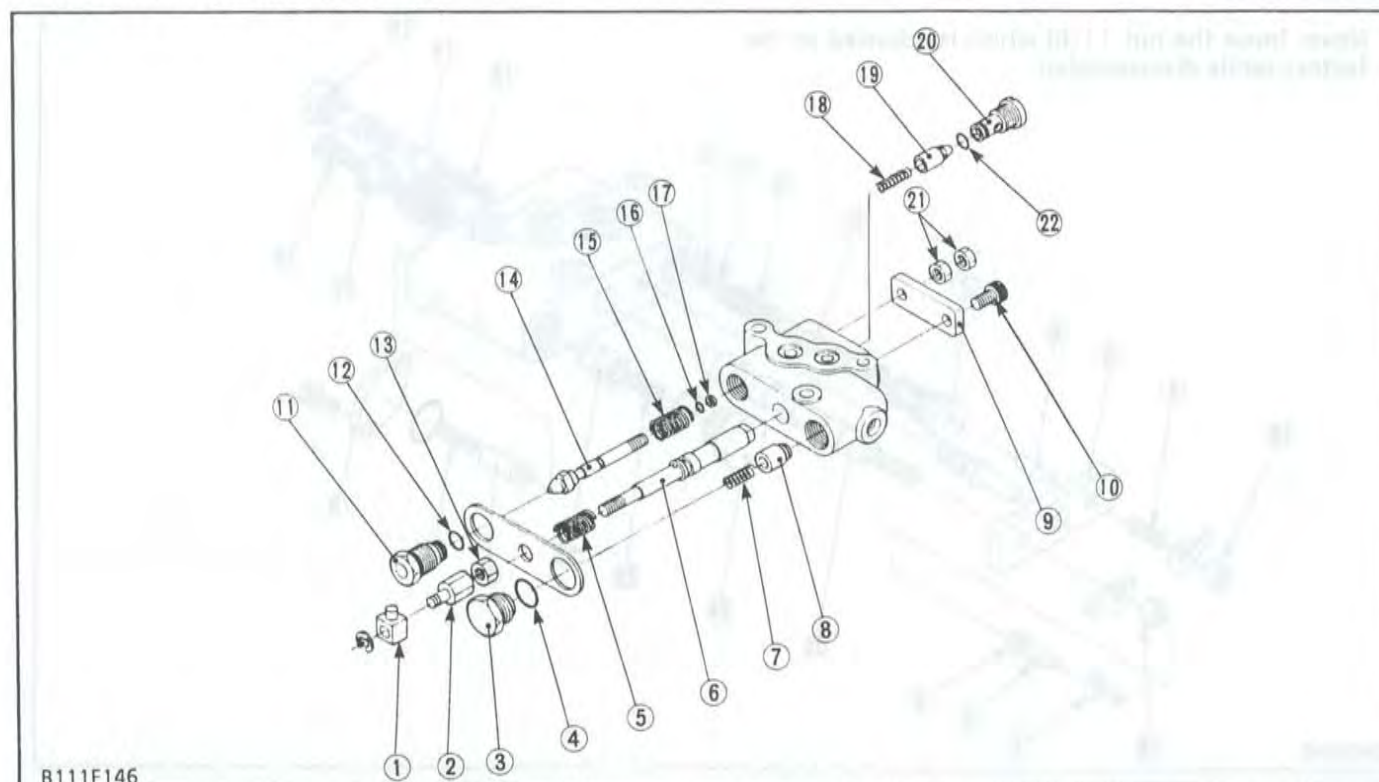
1. Remove the plug 1 (15).
2. Draw out the poppet 1 (14) and the spring (13).

(When reassembling)

- Take care not to damage the O-rings.

Tightening torque	Plug 1	29.4 to 49.0 N·m 3.0 to 5.0 kgf·m 21.7 to 36.2 ft-lbs
-------------------	--------	---

[L2650, L2950, L3450, L3650]



- (1) Spool Joint 2
(2) Spool Joint 1
(3) Unload Plug
(4) O-ring
(5) Spool Spring

- (6) Spool
(7) Spring
(8) Unload Poppet
(9) Plate
(10) Screw

- (11) Plug 2
(12) O-ring
(13) Lock Nut
(14) Poppet 2

- (15) Spring
(16) O-ring
(17) Back Up Ring
(18) Spring

- (19) Poppet 1
(20) Plug 1
(21) Nuts
(22) O-ring

Position Control Valve Assembly

1. Separate the hydraulic cylinder assembly. (See page S.5-22, 31)
2. Remove the position control valve assembly.

■ IMPORTANT

- Measure the distance between the spool edge and spool joint 2 edge before disassembling.

Spool

1. Remove the spool joint 1 (2) and spool joint 2 (1).
2. Remove the screw (10).
3. Pull out the spool (6) and spring (5).

(When reassembling)

Tightening torque	Lock nut	13.7 to 19.6 N·m 1.4 to 2.0 kgf·m 10.1 to 14.5 ft-lbs
-------------------	----------	---

Poppet 1

1. Remove the screw (10).
2. Remove the plug 1 (20) then pull out the poppet 1 (19) and the spring (18).

(When reassembling)

- Take care not to damage the O-rings.

Tightening torque	Plug 2	29.4 to 49.0 N·m 3.0 to 5.0 kgf·m 21.7 to 36.2 ft-lbs
-------------------	--------	---

Unload Poppet

1. Remove the unload plug (3).
2. Draw out the spring (7) and unload poppet (8).

(When reassembling)

- Take care not to damage the O-rings.

Tightening torque	Unload plug	39.2 to 58.8 N·m 4.0 to 6.0 kgf·m 28.9 to 43.4 ft-lbs
-------------------	-------------	---

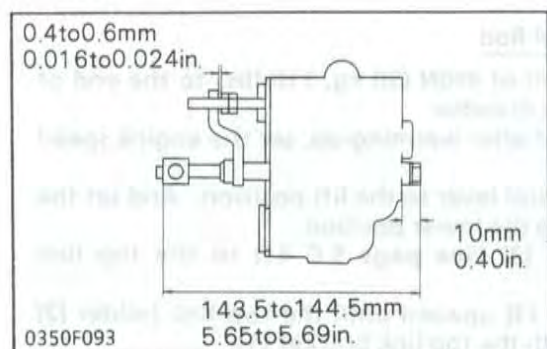
Poppet 2

1. Remove the plug 2 (11) and nuts (21).
2. Pull out the poppet 2 (14) and the spring (15).

(When reassembling)

- Take care not to damage the O-rings.

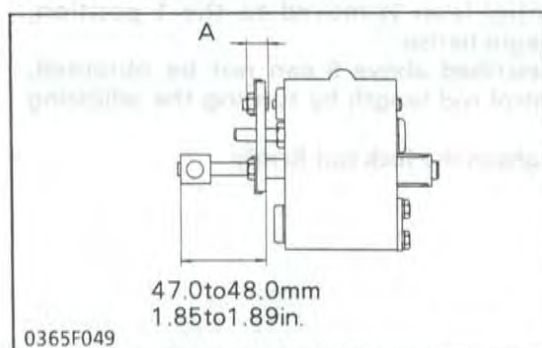
Tightening torque	Plug 1	29.4 to 49.0 N·m 3.0 to 5.0 kgf·m 21.7 to 36.2 ft-lbs
-------------------	--------	---

SERVICING**[L2350]****Clearance between Plate and Adjusting Nut**

1. Put the control valve on the block (height 10 mm, 0.40 in.)
2. Hold the control valve and measure the clearance between plate and adjusting nut with a feeler gauge.
3. If the clearance is not within the factory specifications, adjust with the adjusting nut.

Spool Joint 2

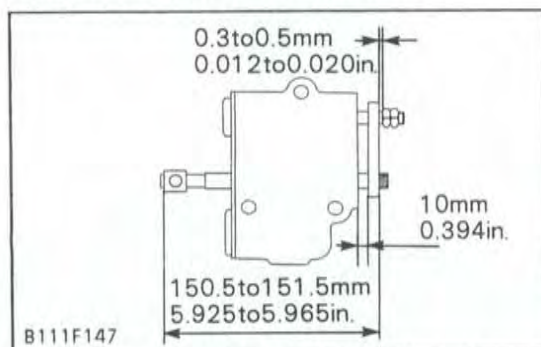
1. Measure the length of the spool from end to end. (See diagram)
2. If the length is not within the factory specifications, adjust spool joint 2.

[L2350 WITH DRAFT CONTROL (if equipped)]**Spool Joint 2**

1. Measure the length of the spool from end to plate. (See diagram)
2. If the length is not within the factory specifications, adjust spool joint 2.

NOTE

- Measure and record the distance "A" before to disassembling.
- Distance "A" is approx. 17 mm (0.67 in.).

[L2650, L2950, L3450, L3650]**Clearance between Plate and Adjusting Nut**

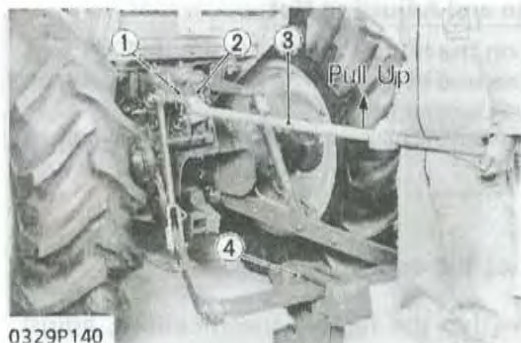
1. Hold 10 mm (0.40 in.) clearance between the valve body and the plate with using the 10 mm (0.40 in.) block gauge.
2. Hold the control valve and measure the clearance between plate and adjusting nut with a feeler gauge.
3. If the clearance is not within the factory specifications, adjust with the adjusting nut.

Spool Joint 2

1. Measure the length of the spool from end to end. (See diagram)
2. If the length is not within the factory specifications, adjust spool joint 2.



[3] DRAFT CONTROL VALVE CHECKING AND ADJUSTING



0329P140

Adjusting Draft Control Rod

1. Attach the weight (4) of 490N (50 kg, 110 lbs) to the end of lower link or linkage drawbar.
2. Start the engine, and after warming-up, set the engine speed at approx. 2000 rpm.
3. Set the position control lever to the lift position. And set the draft control lever to the lower position.
4. Attach the test bar (3) (See page S.G-41) to the top link holder (2).
5. Pull up the test bar (3) upward until the top link holder (2) comes in contact with the top link bracket (1).
6. In this condition, check the followings.
 - When the draft control lever is set to the **DEEP** position on the lever guide label, lower links should not rise.
 - When the draft control lever is moved to the **1** position, lower links should begin to rise.
7. If the operations described above 6 can not be obtained, adjust the draft control rod length by turning the adjusting nut.
8. After adjustment, tighten the lock nut firmly.

- (1) Top Link Bracket
(2) Top Link Holder
(3) Test Bar
(4) Weight

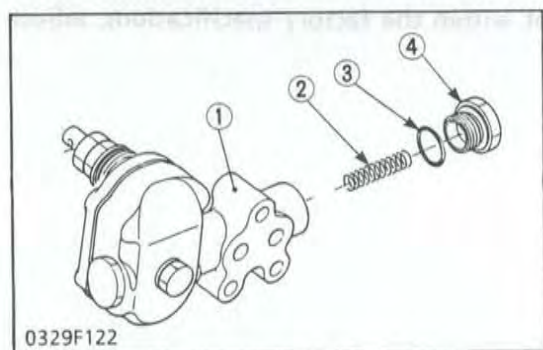


0329P141



0329P142

DISASSEMBLING AND ASSEMBLING



0329F122

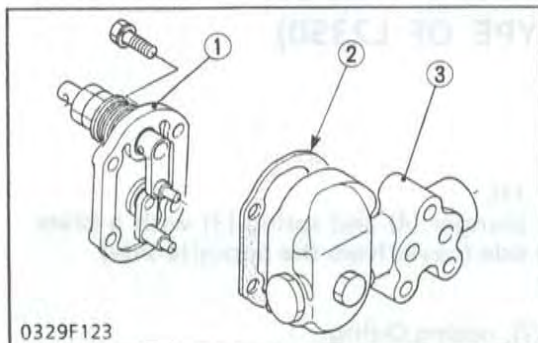
- (1) Valve Body
(2) Spring
(3) O-ring
(4) Plug

Spool Return Spring

1. Remove the plug (4).
2. Remove the spool return spring (2).

(When reassembling)

- Install the plug (4), noting O-ring (3).



Valve Cover

1. Remove four screws, and separate the valve cover (1) from valve body (3).

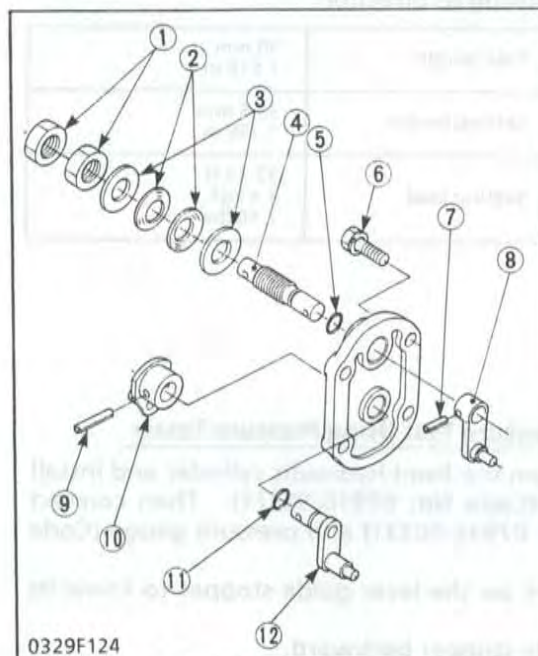
(When reassembling)

- Install the plug (4), noting O-ring (3).

(1) Valve Cover

(2) Gasket

(3) Valve Body



Control Lever Shaft and Feedback Lever Shaft

1. Tap out the spring pin (7).
2. Remove the draft control lever (8) and take out draft control lever shaft (4).
3. Tap out the spring pin (9).
4. Remove the feedback lever (10), and draw out the feedback lever shaft (12).

(When reassembling)

- Take care not to damage the O-rings.

(1) Nuts

(2) Disc Springs

(3) Washers

(4) Control Lever Shaft

(5) O-ring

(6) Screws

(7) Spring Pin

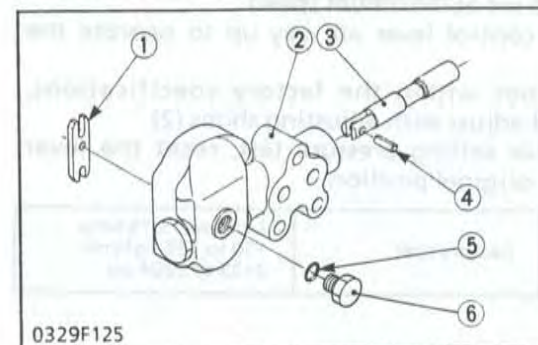
(8) Draft Control Lever

(9) Spring Pin

(10) Feedback Lever

(11) O-ring

(12) Feedback Lever Shaft



Spool and Spool Drive Lever

1. Remove the plug (6).
2. Remove the spring pin (4).
3. Draw out the spool (3).
4. Remove the spool drive lever (1).

(1) Spool Drive Lever

(2) Valve Body

(3) Spool

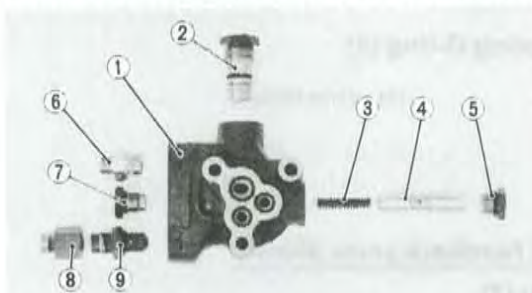
(4) Spring Pin

(5) O-ring

(6) Plug

[4] FLOW PRIORITY VALVE (POWER STEERING TYPE OF L2350)

DISASSEMBLING AND ASSEMBLING



0301P162

- | | |
|----------------|---------------|
| (1) Valve Body | (6) Connector |
| (2) Plug | (7) Plug |
| (3) Spring | (8) Connector |
| (4) Plunger | (9) Connector |
| (5) Plug | |

Flow Priority Valve

1. Remove the plugs (5), (7).
2. Lightly push out the plunger (4) and spring (3) with a brass rod from the plug (7) side (never from the opposite side).

(When reassembling)

- Install the plugs (5), (7), noting O-ring.
- Install the plunger, noting its direction.

Spring specification	Free length	40 mm 1.576 in.
	Setting length	35.5 mm 1.399 in.
	Setting load	33.32 N 3.4 kgf 7.48 lbs

[5] RELIEF VALVE (L2350)

CHECKING AND ADJUSTING



0350P039



0350P040

Relief Valve Setting Pressure Test Using Pressure Tester

1. Remove the plug from the front hydraulic cylinder and install the threaded joint (Code No: 07916-50371). Then connect the cable (Code No: 07916-50331) and pressure gauge (Code No: 07916-50322).
2. Put the parting mark on the lever guide stopper to know its original position.
3. Move the lever guide stopper backward.
4. Start the engine and set at maximum speed.
5. Move the position control lever all way up to operate the relief valve.
6. If the pressure is not within the factory specifications, remove plug (3) and adjust with adjusting shims (2).
7. After the relief valve setting pressure test, reset the lever guide stopper to its original position.

Relief valve setting pressure	Factory spec.	14.70 to 15.19 MPa 150 to 155 kgf/cm ² 2133 to 2204 psi
-------------------------------	---------------	--

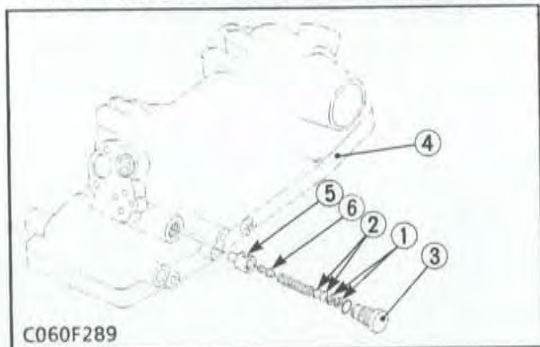
Condition

- Engine speed Maximum
- Oil temperature 45 to 55°C
113 to 131°F

(Reference)

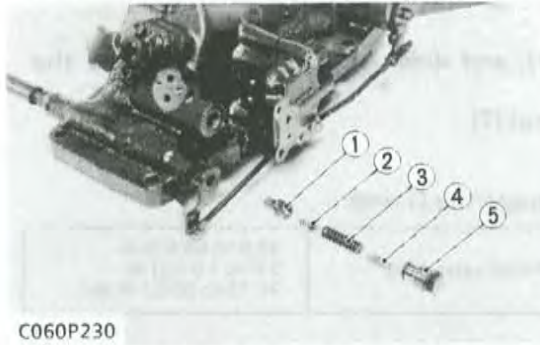
- Thickness of shim (2): 0.1 mm (0.0039 in.)
0.2 mm (0.0078 in.)
0.4 mm (0.0157 in.)
- Pressure change per 0.1 mm (0.0039 in.) shim
Approx. 264.8 kPa
2.7 kgf/cm²
38.4 psi

- | | |
|------------|------------------------|
| (1) Washer | (4) Hydraulic Cylinder |
| (2) Shim | (5) Seat |
| (3) Plug | (6) Poppet |



C060F289

DISASSEMBLING AND ASSEMBLING



Relief Valve Assembly

1. Remove the plug (5) and take out the other parts.

(When reassembling)

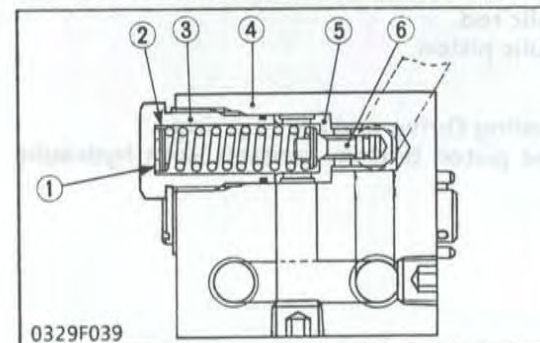
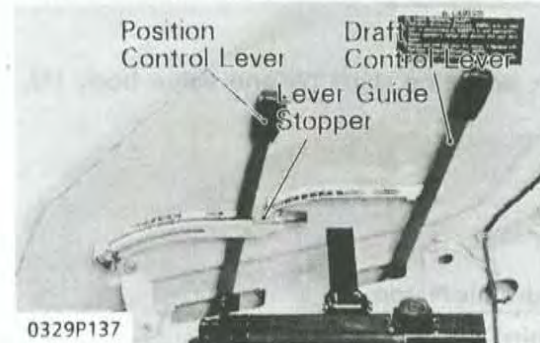
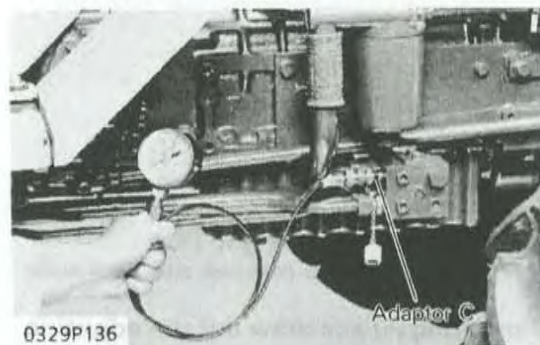
Tightening torque	Plug	49 to 69 N·m 5.0 to 7.0 kgf/cm ² 36 to 51 ft-lbs
-------------------	------	---

- (1) Seat
(2) Poppet
(3) Spring

- (4) Shim
(5) Plug

[6] RELIEF VALVE (L2650, L2950, L3450, L3650)

CHECKING AND ADJUSTING



- (1) Washer
(2) Adjusting Shims
(3) Relief Valve Plug
(4) Front Hydraulic Block
(5) Seat
(6) Poppet

Relief Valve Setting Pressure Test Using Pressure Tester

1. Remove the plug from the front hydraulic block and install the hydraulic adaptor C (screw size: PT 1/4) (Code No: 07916-50371). Then connect the cable (Code No: 07916-50331) and pressure gauge (Code No: 07916-50332) to adaptor C.
2. Mark on the lever guide stopper to know its original position.
3. Move the lever guide stopper backward.
4. Start the engine and set at maximum speed.
5. Set the draft control lever to the Lock position. (If equipped)
6. Move the position control lever all way up to operate the relief valve.
7. If the pressure is not within the factory specifications, remove the plug (3) and adjust with the adjusting shims (2).
8. After the relief valve setting pressure test, reset the lever guide stopper to its original position.

Relief valve setting pressure	Factory spec.	16.67 to 17.16 MPa 170 to 175 kgf/cm ² 2418 to 2489 psi
-------------------------------	---------------	--

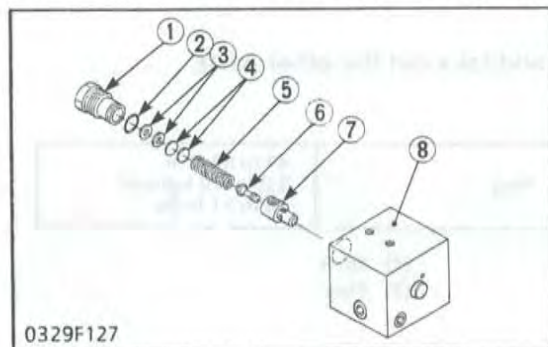
Condition

- Engine speed Maximum
- Oil temperature 45 to 55°C
113 to 131°F

(Reference)

- Thickness of shim (2) : 0.1 mm (0.0039 in.)
0.2 mm (0.0078 in.)
0.4 mm (0.0157 in.)
- Pressure change per 0.1 mm (0.0039 in.) shim:
Approx. 264.8 kPa
2.7 kgf/cm²
38.4 psi

DISASSEMBLING AND ASSEMBLING



- | | |
|---------------------|---------------------------|
| (1) Plug | (5) Spring |
| (2) O-ring | (6) Poppet |
| (3) Washers | (7) Valve Seat |
| (4) Adjusting Shims | (8) Front Hydraulic Block |

Relief Valve

1. Remove the plug (1), and draw out the spring (5) and the poppet (6).
2. Take out the valve seat (7).

(When reassembling)

- Take care not to damage the O-ring.

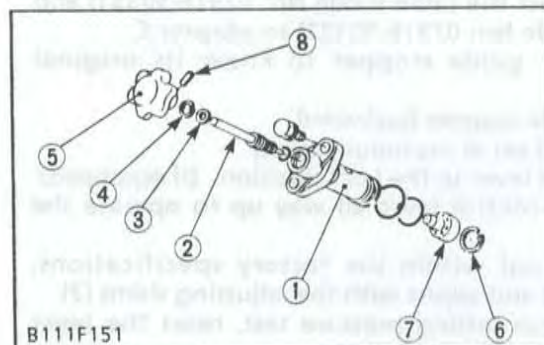
Tightening torque	Relief valve plug	49.0 to 68.6 N·m 5.0 to 7.0 kgf·m 36.15 to 50.61 ft-lbs
-------------------	-------------------	---

■ **IMPORTANT**

- After disassembling and assembling the relief valve, be sure to adjust the relief valve setting pressure. (See page S.8-19)

[7] HYDRAULIC CYLINDER

DISASSEMBLING AND ASSEMBLING



- | | |
|-------------------------------|------------------------|
| (1) Valve Body | (5) Grip |
| (2) Hydraulic Adjusting Shaft | (6) Internal Snap Ring |
| (3) Washer | (7) Adjusting Collar |
| (4) Internal Snap Ring | (8) Spring Pin |

Lowering Speed Adjusting Valve

1. Remove the lowering speed adjusting valve from hydraulic cylinder block.
2. Tap out the spring pin (8), and remove the grip (5).
3. Remove the internal snap ring (4), and remove the hydraulic adjusting shaft (2).
4. Remove the internal snap ring (6) and draw out the adjusting collar (7).

(When reassembling)

- Install the hydraulic adjusting shaft (2) and valve body (1), noting O-ring.

Hydraulic Rod and Hydraulic Piston

1. Tap out the spring pin.
2. Remove the hydraulic rod.
3. Push out the hydraulic piston.

(When reassembling)

- Install the piston, noting O-ring and back-up ring.
- Apply grease to the piston bottom contacts with hydraulic rod.





C060P235

C060P236

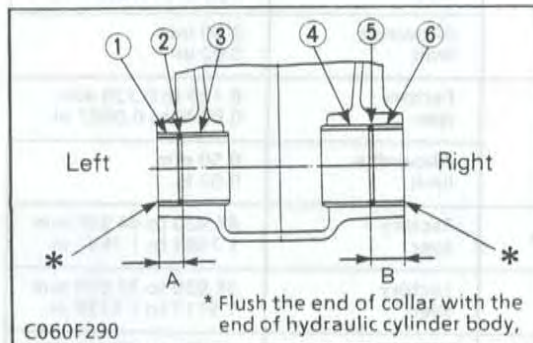
Lift Arm, Hydraulic Arm and Hydraulic Arm Shaft

1. Disconnect the feedback rod from feedback lever.
2. Remove the lift arm setting screws.
3. Draw out the hydraulic arm shaft (5) and right lift arm (6) as a unit.
4. Take out the hydraulic arm (1).
5. Remove the collar (3) and O-ring (2).

(When reassembling)

- Align the alignment marks of the hydraulic arm (1) and hydraulic arm shaft (5).
- Align the alignment marks of the lift arm and hydraulic arm shaft (5).
- Apply grease to the right and left bushes of hydraulic cylinder block and O-rings (2).
- Take care not to damage the O-rings (2).

- | | |
|--|-------------------------|
| (1) Hydraulic Arm | (4) Lift Arm (Left) |
| (2) O-rings | (5) Hydraulic Arm Shaft |
| (3) Collar | (6) Lift Arm (Right) |
| (7) Alignment Mark (Hydraulic Arm Shaft and Hydraulic Arm) | |
| (8) Alignment Mark (Hydraulic Arm Shaft and Lift Arm) | |



C060F290

- | | |
|--------------------|---------------------|
| (1) Collar (Left) | (4) Bushing (Right) |
| (2) O-ring | (5) O-ring |
| (3) Bushing (Left) | (6) Collar (Right) |

Bushings

1. Remove the bushings right (4) and left side (3).

(When reassembling)

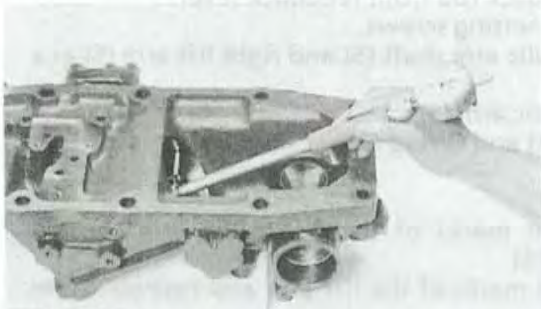
- When press-fitting new bushings (3), (4) with a press-fitting tool (See page S.G-41) observe the dimensions described in the figure.
- Apply transmission fluid to the hydraulic cylinder liner boss and bushing.
- Press-fit the bushing so that each seam face upward.

Press-fit location of bushings	Factory spec.	A	21.75 to 22.75 mm 0.856 to 0.895 in.
		B	26.50 to 27.50 mm 1.043 to 1.082 in.

SERVICING

Hydraulic Cylinder Bore

1. Check the cylinder internal surface for scoring or damage.
2. Measure the cylinder I.D. with a cylinder gauge.
3. If the measurement exceeds the allowable limit, replace.



C060P238

Cylinder I.D.	Factory spec.	L2350	75.000 to 75.050 mm 2.9528 to 2.9547 in.
		L2650, L2950 L3450, L3650	85.000 to 85.050 mm 3.3465 to 3.3484 in.
	Allowable limit	L2350	75.150 mm 2.9587 in.
		L2650, L2950 L3450, L3650	85.150 mm 3.3524 in.

Clearance between Hydraulic Arm Shaft and Bushing

1. Measure the hydraulic arm shaft O.D. with an outside micrometer.
2. Measure the bushing I.D. with a cylinder gauge.
3. If the clearance exceeds the allowable limit, replace.



C060P239

Clearance between hydraulic arm shaft and bushing	Right	Factory spec.	0.125 to 0.230 mm 0.0049 to 0.0091 in.
		Allowable limit	0.50 mm 0.02 in.
	Left	Factory spec.	0.125 to 0.220 mm 0.0049 to 0.0087 in.
		Allowable limit	0.50 mm 0.02 in.
Hydraulic arm shaft O.D.	Right	Factory spec.	44.920 to 44.950 mm 1.7685 to 1.7697 in.
	Left	Factory spec.	39.920 to 39.950 mm 1.5717 to 1.5728 in.
Bushing I.D. (after press fitted)	Right	Factory spec.	45.075 to 45.150 mm 1.7746 to 1.7776 in.
	Left	Factory spec.	40.075 to 40.140 mm 1.5778 to 1.5803 in.

S.9 ELECTRICAL SYSTEM

CONTENTS

TROUBLESHOOTING	S.9-1
SERVICING SPECIFICATIONS	S.9-5
CHECKING, DISASSEMBLING AND SERVICING	S.9-6
[1] BATTERY	S.9-6
CHECKING	S.9-6
SERVICING	S.9-8
[2] STARTING SYSTEM	S.9-10
CHECKING	S.9-10
DISASSEMBLING AND ASSEMBLING	S.9-13
SERVICING	S.9-14
[3] ENGINE KEY SWITCH SHUT-OFF SYSTEM	
(L2650, L2950, L3450, L3650)	S.9-17
CHECKING	S.9-17
[4] CHARGING SYSTEM (L2350)	S.9-19
CHECKING	S.9-19
DISASSEMBLING AND ASSEMBLING	S.9-24
SERVICING	S.9-25
[5] CHARGING SYSTEM (L2650, L2950, L3450, L3650)	S.9-27
CHECKING	S.9-27
DISASSEMBLING AND ASSEMBLING	S.9-27
SERVICING	S.9-29
[6] LIGHTING SYSTEM	S.9-32
CHECKING	S.9-32
[7] WARNING LAMPS	S.9-35
CHECKING	S.9-35
[8] GAUGE	S.9-36
CHECKING	S.9-36

TROUBLESHOOTING

Before troubleshooting, confirm symptoms of trouble, and accomplish basic inspection.

(1) Basic Inspection

No.	Contents	Reference Page
1	Battery	S.9-6
2	Battery terminals	S.9-6
3	Slow blow fuse or fusible link	—
4	Fuses	—
5	Connectors	—

(2) Troubleshooting

Symptom	Probable Cause	Solution	Reference Page
Fuse Blown Frequently	Short-circuited	Repair or replace	—

BATTERY

Battery Discharges Too Quickly	- Alternator defective - Regulator relay defective [L2350] - Wiring harness disconnected or improperly connected (between battery positive terminal and alternator B terminal, between battery positive terminal and regulator relay B terminal [L2350]) - Cooling fan belt slipping	Repair or replace Replace Repair or replace	S.9-18,19,26 S.9-20,21,22 M.10-1,2,3
		Adjust tension	S.G-23

STARTING SYSTEM

Starter Motor Does Not Operate	Safety switch improperly adjusted or defective [L2350]	Adjust or replace	S.9-11
	Starter relay defective [L2650, L2950, L3450, L3650]	Replace	S.9-12
	Shuttle limit switch improperly adjusted or defective [L2650, L2950, L3450, L3650]	Adjust or replace	S.9-11
	PTO limit switch improperly adjusted or defective [L2650, L2950, L3450, L3650]	Adjust or replace	S.9-11
	Wiring harness disconnected or improperly connected [L2350]	Repair or replace	M.10-1, 2, 3
	(between main switch ST terminal and safety switch, between safety switch and starter motor, between battery positive terminal and starter motor)		M.10-1, 2

Symptom	Probable Cause	Solution	Reference Page
Starter Motor Does Not Operate (Continued)	[L2650, L2950, L3450, L3650] (between main switch ST terminal and shuttle limit switch, between shuttle limit switch and PTO limit switch, between PTO limit switch and starter relay, between starter relay and ground, between main switch B terminal and starter relay, between starter relay and starter motor S terminal, between battery positive terminal and starter motor B terminal) ● Starter motor defective ● Main switch defective	Repair or replace Replace	M.10-3 S.9-13 S.9-10, 11
Glow Plug Indicator Does Not Glow [L2350]	● Wiring harness disconnected or improperly connected (between main switch G1 terminal and glow plug indicator, between glow plug indicator and glow plugs) ● Main switch defective ● Glow plug indicator defective	Repair or replace Replace Replace	M.10-1, 2 S.9-10, 11 —

ENGINE KEY SWITCH SHUT-OFF SYSTEM [L2650, L2950, L3450, L3650]

Engine Does Not Stop When Main Switch is Turned OFF	● Timer relay defective ● Wiring harness disconnected or improperly connected (between main switch AC terminal and timer relay 4 terminal, between timer relay 1 terminal and fuel cut off solenoid)	Replace Repair or replace	S.9-16 M.10-3
	● Fuel cut off solenoid defective	Replace	S.9-17
Engine Does Not Start	● Timer relay defective	Replace	S.9-16
	● Fuel cut off solenoid defective	Replace	S.9-17

CHARGING SYSTEM

Charging Lamp Does Not Light When Main Switch is Turned ON	Wiring harness disconnected or improperly connected [L2350] (between main switch AC terminal and hour meter, between hour meter and regulator L terminal) [L2650, L2950, L3450, L3650] (between main switch AC terminal and panel board, between panel board and alternator L terminal)	Repair or replace	M.10-1,2,3 M.10-1,2
	- Regulator relay defective [L2350] - IC regulator defective [L2650, L2950, L3450, L3650]	Repair or replace Repair or replace	M.10-3 S.9-20,21,22 S.9-30

CHARGING SYSTEM (Continued)

Symptom	Probable Cause	Solution	Reference Page
Charging Lamp Does Not Go OFF When Engine is Running	- Wiring harness disconnected or improperly connected [L2350] (between alternator N terminal and regulator N terminal, between main switch B terminal and regulator B terminal, between hour meter and regulator L terminal) [L2650, L2950, L3450, L3650] (between panel board and alternator L terminal)	Repair or replace	M.10-1,2,3 M.10-1,2 M.10-3

LIGHTING SYSTEM

Headlight Does Not Light	- Bulb blown - Wiring harness disconnected or improperly connected (between main switch AC terminal and combination switch B1 terminal, between combination switch 1 terminal and headlight, between combination switch 2 terminal and headlight)	Replace Repair or replace	– M.10-1,2,3
Illumination Light Does Not Light	- Bulb blown - Wiring harness disconnected or improperly connected (between combination switch T terminal and panel board)	Replace Repair or replace	– M.10-1,2,3
Tail Light Does Not Light	- Bulb blown - Wiring harness disconnected or improperly connected (between combination switch T terminal and tail light)	Replace Repair or replace	– M.10-1,2,3
Hazard Light Does Not Light	- Bulb blown - Wiring harness disconnected or improperly connected (between main switch AC terminal and hazard unit, between hazard unit and combination switch B2 terminal, between combination switch R or L terminal and hazard lights) - Hazard unit defective - Combination switch defective	Replace Repair or replace Replace Replace	– M.10-1,2,3 S.9-33 S.9-32
Hazard Indicator Lamp Does Not Light [L2650, L2950, L3450, L3650]	- Bulb blown - Wiring harness disconnected or improperly connected (between combination switch R or L terminal and panel board)	Replace Repair or replace	– M.10-3
Hazard Light Does Not Go ON and OFF	Hazard unit defective	Replace	S.9-33

WARNING LAMPS

Symptom	Probable Cause	Solution	Reference Page
Clogged Air Cleaner Lamp Lights Up [L2650, L2950 L3450, L3650]	• Air cleaner clogged • Air cleaner sensor defective • Short circuit between air cleaner sensor lead and chassis • Circuit in panel board defective	Clean or replace Replace Repair or replace Replace	S.G-21, 28 S.9-35 M.10-3 -
Clogged Air Cleaner Lamp Does Not Light When Air Cleaner Clogged [L2650, L2950 L3450, L3650]	• Bulb blown • Air cleaner sensor defective • Wiring harness disconnected or improperly connected (between panel board and air cleaner sensor, between air cleaner sensor and ground)	Replace Replace Repair or replace	- S.9-35 M.10-3
Oil Pressure Lamp Lights Up When Engine is Running	• Engine oil pressure too low • Engine oil insufficient • Oil pressure switch defective • Short circuit between oil pressure switch lead and chassis • Circuit in panel board defective	Repair engine Replenish Replace Repair Replace	- S.G-13 S.9-34 M.10-3 -
Oil Pressure Lamp Does Not Light When Main Switch is turned ON and Engine is Not Running	• Bulb blown • Oil pressure switch defective • Wiring harness disconnected or improperly connected (between panel board and oil pressure switch) • Circuit in panel board defective	Replace Replace Repair or replace Replace	- S.9-34 M.10-1,2,3 -

GAUGES

Fuel Gauge Does Not Function [L2350 4WD, L2650, L2950 L3450, L3650]	• Fuel gauge defective • Fuel level sensor (tank unit) defective • Wiring harness disconnected or improperly connected (between panel board and fuel level sensor) • Circuit in panel board defective	Replace Replace Repair or replace Replace	S.9-36,38 S.9-35,37 M.10-2,3 -
Coolant Temperature Gauge Does Not Function [L2650, L2950 L3450, L3650]	• Coolant temperature gauge defective • Coolant temperature sensor defective • Wiring harness disconnected or improperly connected (between panel board and coolant temperature sensor) • Circuit in panel board defective	Replace Replace Repair or replace Replace	S.9-36,38 S.9-36,37 M.10-3 -

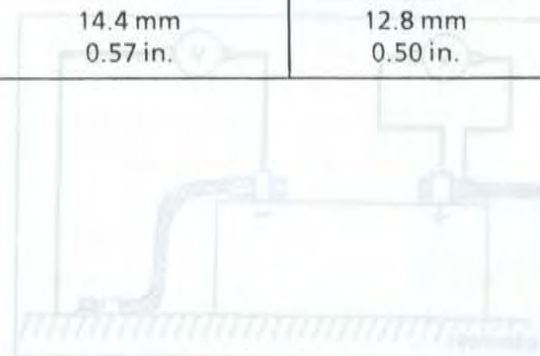
SERVICING SPECIFICATIONS

STARTER MOTOR

Item		Factory Specification	Allowable Limit
Commutator	O.D.	30.0 mm 1.181 in.	29.0 mm 1.142 in.
Mica	Undercut	0.50 to 0.80 mm 0.02 to 0.03 in.	0.2 mm 0.008 in.
Brush	Length [L2350]	13.0 mm 0.51 in.	11.3 mm 0.44 in.
	[L2650, L2950]	15.0 mm	11.0 mm
	[L3450, L3650]	0.59 in.	0.43 in.

ALTERNATOR

Brush	Length [L2350]	12.5 mm 0.49 in.	5.5 mm 0.22 in.
	[L2650, L2950] [L3450, L3650]	10.5 mm 0.41 in.	8.4 mm 0.33 in.
	O.D. [L2350]	32.5 mm 1.28 in.	32.1 mm 1.26 in.
Slip Ring	[L2650, L2950] [L3450, L3650]	14.4 mm 0.57 in.	12.8 mm 0.50 in.



CHECKING, DISASSEMBLING AND SERVICING

■ IMPORTANT

- If the tractor is to be operated for a short time without battery (using a slave battery for starting), do not, under any circumstances, interrupt the circuit by switching off the key switch before stopping the engine by pulling engine stop knob. Use additional current (lights) while engine is running. Insulate terminal of battery. If this advice is disregarded, damage to alternator and regulator may result.

⚠ CAUTION

- To avoid accidental short circuit, be sure to attach the positive cable to the positive terminal before the ground cable is attached to the negative terminal.

■ NOTE

- In this section, when measuring resistance, voltage and amperage, leads of ohmmeter, voltmeter and ammeter are represented by — marks in figure.

[1] BATTERY

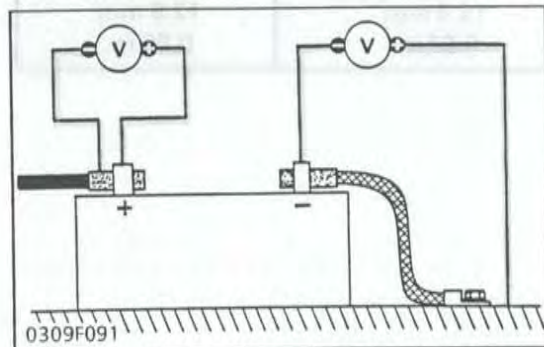
CHECKING



Battery Voltage

1. Stop the engine and turn the main switch off.
2. Connect the COM (–) lead of the voltmeter to the battery's negative terminal post and the (+) lead to the positive terminal post, and measure the battery voltage.
3. If the battery voltage is less than the factory specifications, check the battery condition. (See the next page.)

Battery voltage	Factory spec.	More than 12 V
-----------------	---------------	----------------



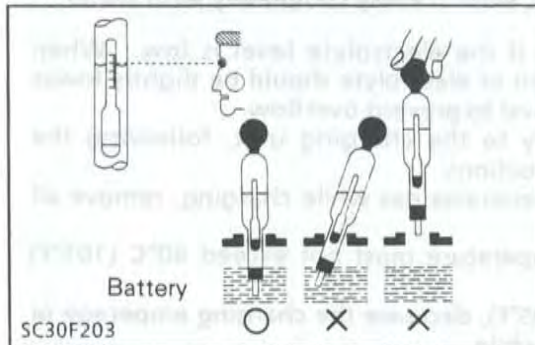
Battery Terminal Connection

1. Turn the main switch on, and turn on the headlight.
2. Measure the voltage with a voltmeter across the battery's positive terminal post and the cable terminal, and the voltage across the battery's negative terminal post and the chassis.
3. If the measurement exceeds the factory specifications, clean the battery terminal posts and cable clamps, and tighten them firmly.

Factory spec.	Less than 0.1 V
---------------	-----------------



0321P303



SC30F203

Specific Gravity	State of Charge
1.260 Sp. Gr.	100% Charged
1.230 Sp. Gr.	75% Charged
1.200 Sp. Gr.	50% Charged
1.170 Sp. Gr.	25% Charged
1.140 Sp. Gr.	Very Little Useful Capacity
1.110 Sp. Gr.	Discharged

At an electrolyte temperature of 20°C (68°F)



C012P081

Battery Specific Gravity

1. Check the specific gravity of the electrolyte in each cell with a hydrometer.
2. When the electrolyte temperature differs from that at which the hydrometer was calibrated, correct the specific gravity reading following the formula mentioned in (Reference) below.
3. If the specific gravity is less than 1.215 (after it is corrected for temperature), charge or replace the battery.
4. If the specific gravity differs between any two cells by more than 0.05, replace the battery.

NOTE

- Hold the hydrometer tube vertical without removing it from the electrolyte.
- Do not suck too much electrolyte into the tube.
- Allow the float to move freely and hold the hydrometer at eye level.
- The hydrometer reading must be taken at the highest electrolyte level.

CAUTION

- Keep electrolyte away from eyes, hands and clothes. If you are spattered with it, wash it away completely with water.

(Reference)

- Specific gravity slightly varies with temperature. To be exact, the specific gravity decreases by 0.0007 with an increase of 1°C (0.0004 with an increase of 1°F) in temperature, and increases by 0.0007 with a decrease of 1°C (0.0004 with a decrease of 1°F).

Therefore, using 20°C (68°F) as a reference, the specific gravity reading must be corrected by the following formula:

- Specific gravity at 20°C = Measured value + 0.0007 x (electrolyte temperature - 20°C)
- Specific gravity at 68°F = Measured value + 0.0004 x (electrolyte temperature - 68°F)

High-rate Discharge Test

1. Connect the battery tester to the battery, following the manufacturer's instructions.
2. Discharge the battery for the specified time under the fixed load, following the manufacturer's instructions.
3. Read the indication and follow the instructions.

Battery 20 ampere-hour rate	Factory spec.	75D26R(L)	65 Ah
		75D31R	70 Ah

SERVICING

Recharging-Slow Charging

CAUTION

- After the battery is activated, hydrogen and oxygen gases in the battery are very explosive. Keep open sparks and flames away from the battery at all times, especially when charging the battery.
- Keep electrolyte away from eyes, hands and clothes. If you are splattered with it, wash it away completely with water.

1. Add distilled water if the electrolyte level is low. When charging, the amount of electrolyte should be slightly lower than the specified level to prevent overflow.
2. Connect the battery to the charging unit, following the manufacturer's instructions.
3. As the electrolyte generates gas while charging, remove all port caps.
4. The electrolyte temperature must not exceed 40°C (105°F) during charging.
If it exceed 40°C (105°F), decrease the charging amperage or stop charging for a while.
5. When charging several batteries in series, charge at the rate of the smallest battery in the line.

(Reference)

- **Charging Amperage**
The charging amperage must be 1/20 to 1/10 of the battery ampere-hour rate.

Battery 20 ampere-hour rate	Factory spec.	75D26R(L)	65 Ah
		75D31R	70 Ah

- **Discharged Percentage**
Measure the specific gravity of the electrolyte, and obtain the discharged percentage based on the electrolyte's specific gravity, referring to the diagram.
- **Charging Time**
Calculate the charging time using the following formula.

Charging time (H)

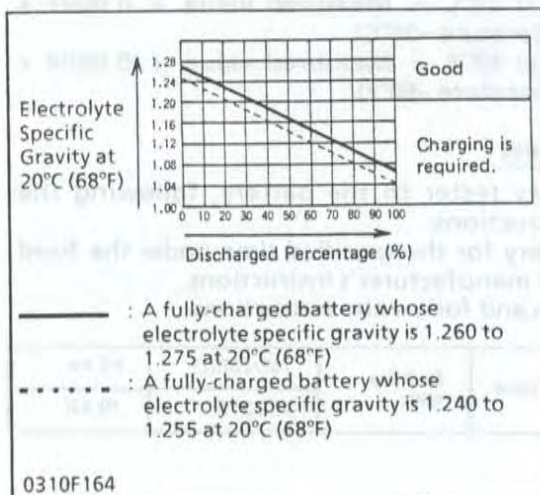
$$= \frac{[\text{Battery Ampere-hour (Ah)}] \times \text{Discharge percentage (\%)}}{[\text{Charging Amperage (A)}] \times 100} \times (1.2 \text{ to } 1.5)$$

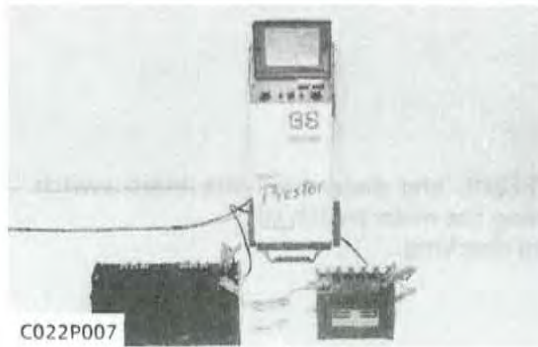
NOTE

- Slow charger operation differs with the type used. For details, refer to the manufacturer's instructions.



C022P006





Recharging-Quick Charging

1. Add distilled water if electrolyte is insufficient. The amount of electrolyte should be slightly lower than the specified level to prevent overflow while charging.
2. Connect the battery and the charging unit, following the manufacturer's instructions.
3. Determine the proper charging amperage and charging time using the tester provided with the quick charger, or following the manufacturer's instructions.
4. As the electrolyte generates gas while charging, remove all port caps.
5. The electrolyte temperature must not exceed 40°C (105°F) during charging. If it exceeds 40°C (105°F), decrease the charging amperage or stop charging for a while.
6. When charging several batteries in series, charge at the rate of the smallest battery in the line.

NOTE

- Quick charger operation differs with the type used. For details, refer to the manufacturer's instructions.

(Reference)

- Generally, the ratio of the charging amperage to the battery ampere-hour rate is 1:1. However, if the battery ampere-hour rate exceeds 50 Ah, the maximum charging amperage must be 50 Ah.

Battery 20 ampere-hour rate	Factory spec	75D26R(L)	65 Ah
		75D31P	70 Ah

(Reference)

Self-discharge Rate

Temperature	Self-discharge rate
30°C (86°F)	Approx. 1.0% per day
20°C (68°F)	Approx. 0.5% per day
10°C (50°F)	Approx. 0.25% per day

Directions for Storage

1. When shutting down the tractor for long periods of time, remove the battery from the tractor, adjust the electrolyte to the proper level, and after fully charging, store the battery in a well ventilated place where it is not exposed to direct sunlight.
2. Since the battery self-discharges by approx. 0.5% per day even in storage, it must be once every two months in cold season.
3. When storing the battery mounted on the tractor, disconnect the ground cable from the battery's negative terminal post.



[2] STARTING SYSTEM

CHECKING



B111P113

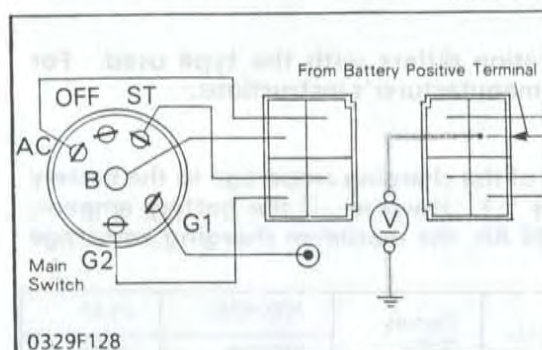
Main Switch

- Remove the switch board, and disconnect the main switch connectors after turning the main switch off. Perform the following checking.

Connector Voltage

- Measure the voltage with a voltmeter across the connector B terminal and chassis.
- If the voltage differs from the battery voltage (11 to 14 V), the wiring harness is faulty.

Voltage	Connector B terminal – Chassis	Approx. battery voltage
---------	--------------------------------	-------------------------

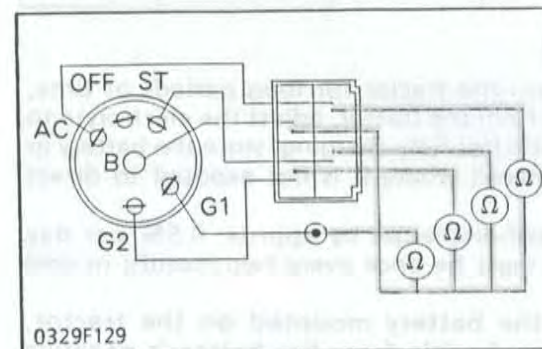


0329F128

Main Switch Key at OFF Position

- Turn the main switch off.
- Measure the resistances with an ohmmeter across the B terminal and the AC terminal, B terminal and ST terminal, B terminal and G1 terminal, and B terminal and G2 terminal.
- If infinity is not indicated, the contacts of the main switch are faulty.

Resistance	B – AC	Infinity
	B – ST	Infinity
	B – G1	Infinity
	B – G2	Infinity

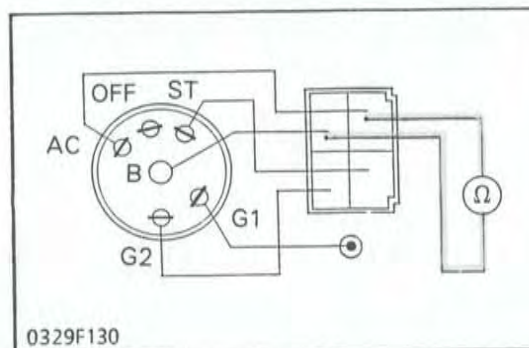


0329F129

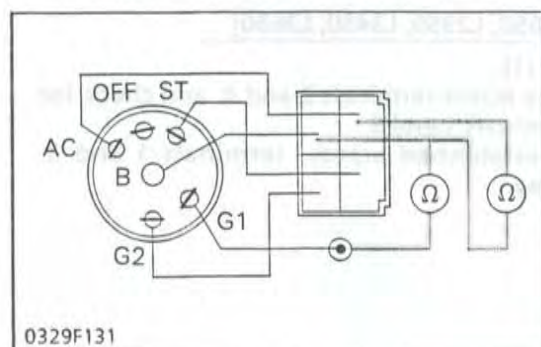
Main Switch Key at ON Position

- Turn the main switch on.
- Measure the resistances with an ohmmeter across the B terminal and the AC terminal.
- If 0 ohm is not indicated, the B – AC contacts of the main switch are faulty.

Resistance	B – AC	0 ohm
------------	--------	-------



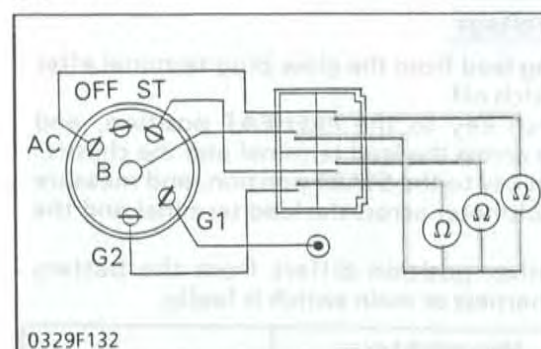
0329F130



Main Switch Key at PREHEAT Position

1. Turn and hold the main switch key at the **PREHEAT** position.
2. Measure the resistances with an ohmmeter across the **B** terminal and the **G1** terminal, and measure the resistance across the **B** terminal and the **AC** terminal.
3. If 0 ohm is not indicated, these contacts of the main switch are faulty.

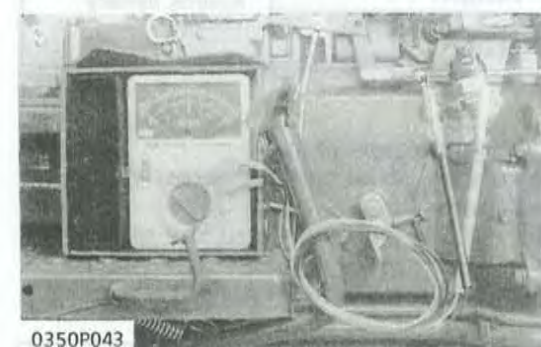
Resistance	B – G1	0 ohm
	B – AC	



Main Switch Key at START Position

1. Turn and hold the main switch key at the **START** position.
2. Measure the resistances with an ohmmeter across the terminal and the **G2** terminal, and across the **B** terminal and the **AC** terminal.
3. If 0 ohm is not indicated, these contacts of the main switch are faulty.

Resistance	B – G2	0 ohm
	B – ST	
	B – AC	



Safety Starter Switch [L2350]

NOTE

- Be sure to measure the safety starter switch resistance after adjusting the clearance between the safety starter switch and clutch pedal.

1. Disconnect the safety starter switch leads.
2. Connect the leads of an ohmmeter to the safety starter switch lead terminals.
3. Measure the resistance while pressing the clutch pedal.
4. If 0 ohm is not indicated, the safety starter switch is faulty or improperly mounted.
5. Measure the resistance while the clutch pedal is released.
6. If infinity is not indicated, the safety starter switch is faulty.

Resistance Across switch terminals	When switch push is pushed	0 ohm
	When switch push is released	Infinity

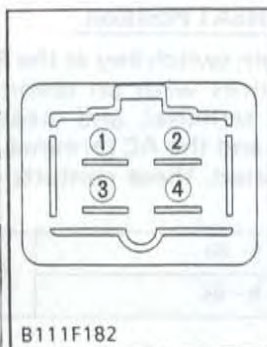


Check for Mismatching of the Shuttle and PTO Limit Switches [L2650, L2950, L3450, L3650]

1. Disconnect the leads from shuttle and PTO limit switches.
2. Measure the resistance with an ohmmeter across the limit switch wiring lead and lead.
3. If the ohmmeter reads 0 ohm when the shift lever is in neutral, and infinity when the lever is in other positions, it is an indication that the switch is normal.



B111P122



B111F182

Check Starter Relay [L2650, L2950, L3450, L3650]

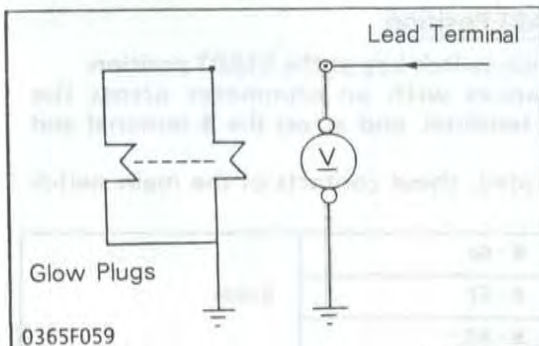
1. Remove starter relay (1).
2. Apply battery voltage across terminals 2 and 4, and check for continuity across terminals 1 and 3.
3. If continuity is not established across terminals 1 and 3, renew the starter relay.

(1) Starter Relay

Pre-heating Terminal Voltage

1. Disconnect the wiring lead from the glow plug terminal after turning the main switch off.
2. Turn the main switch key to the **PREHEAT** position, and measure the voltage across the lead terminal and the chassis.
3. Turn the main switch key to the **START** position, and measure the voltage with a voltmeter across the lead terminal and the chassis.
4. If the voltage at either position differs from the battery voltage, the wiring harness or main switch is faulty.

Voltage	Main switch key at PREHEAT	Approx. battery voltage
	Main switch key at START	

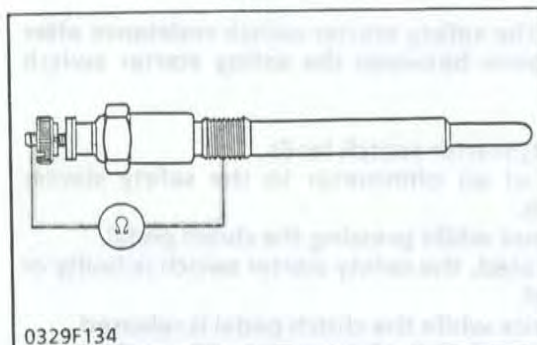


0365F059

Glow Plug

1. Disconnect the leads from the glow plugs.
2. Measure the resistance with an ohmmeter across the glow plug terminal and the chassis.
3. If 0 ohm is indicated, the screw at the tip of the glow plug and the housing are short-circuited.
4. If the factory specifications is not indicated, the glow plug is faulty.

Glow plug resistance	Factory spec.	Approx. 1.5 ohms.
----------------------	---------------	-------------------



0329F134

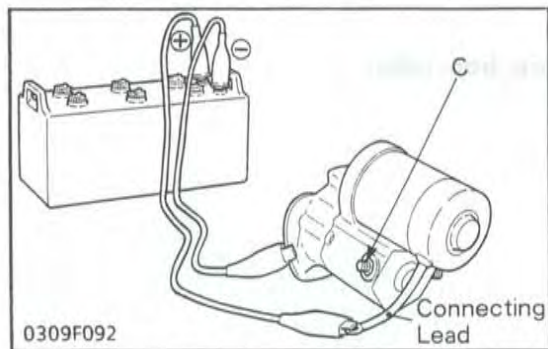
Starter Motor B Terminal Voltage

1. Measure the voltage with a voltmeter across the **B** terminal and chassis.
2. If the voltage differs from the battery voltage, the battery's positive cable or the battery negative cable is faulty.

Voltage	B terminal-chassis	Approx. battery voltage
---------	--------------------	-------------------------



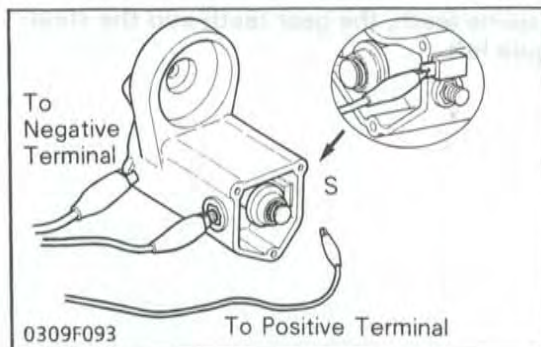
0329P148

**Motor Test**

1. Disconnect the ground cable clamp from the battery negative terminal post.
2. Disconnect the battery positive cable and the leads from the starter.
3. Remove the starter motor from the engine.
4. Disconnect the connecting lead from the starter C terminal.
5. Connect a jumper lead from the connecting lead to the battery positive terminal post.
6. Connect a jumper lead momentarily between the starter motor housing and the battery negative terminal post.
7. If the motor does not run, check the motor.

CAUTION

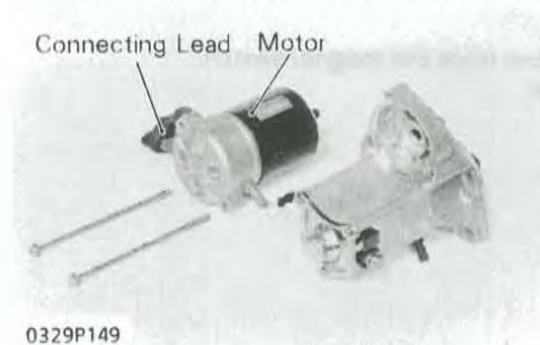
- Secure the starter in a vise to prevent it from jumping up and down while testing the motor.

**Magnet Switch Test (Pull-in, Holding Coils)**

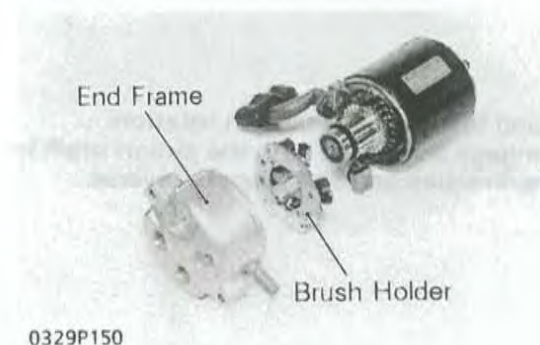
1. Remove the motor from the starter housing.
2. Prepare a 6 V battery for the test.
3. Connect jumper leads from the battery negative terminal to the housing and the starter C terminal.
4. The plunger should be attached and the pinion gear should pop out when a jumper lead is connected from the battery positive terminal to the S terminal. It's a correct.
5. Disconnect the jumper lead to the starter C terminal. Then the pinion gear should remain popped out. It's a correct.

CAUTION

- Testing time must be 3 to 5 sec.

DISASSEMBLING AND ASSEMBLING**Motor**

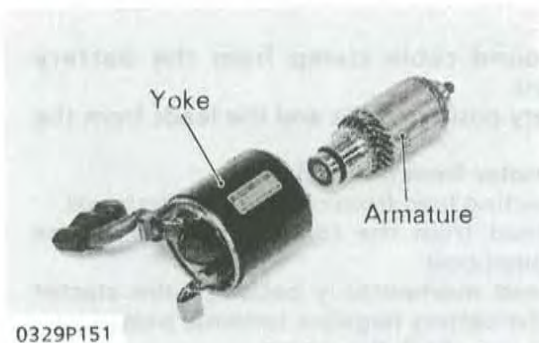
1. Disconnect the connecting lead.
2. Remove the through screws.
3. Remove the motor.

**Brush Holder**

1. Remove the end frame.
2. Draw out the brushes from each holder while lifting the spring up.
3. Remove the brush holder.

Armature

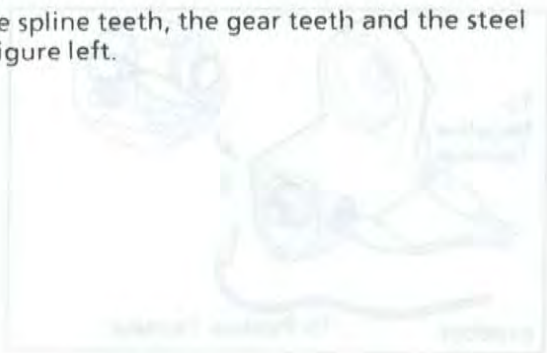
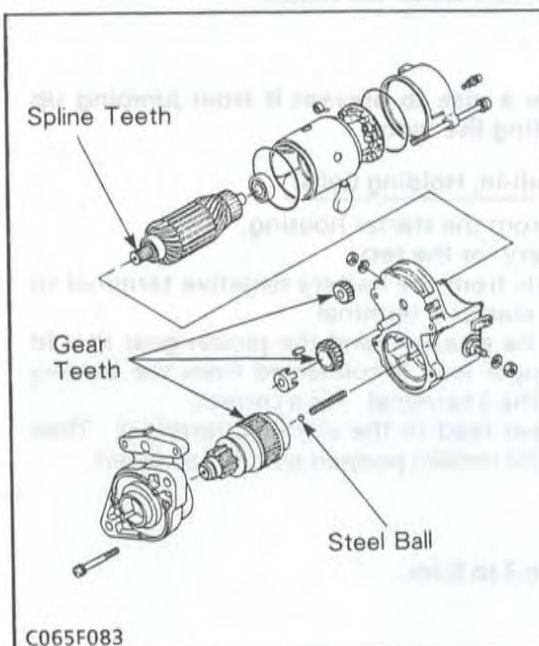
1. Draw out the armature, from yoke.

Drive End Frame

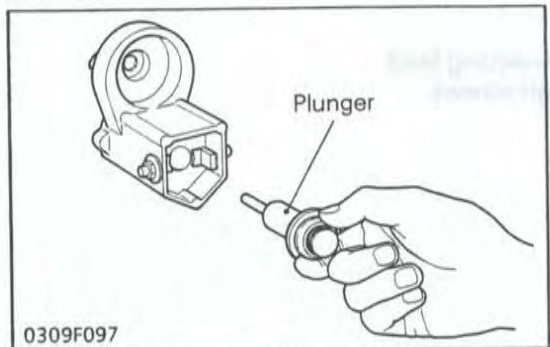
1. Separate the drive end frame and the magnet switch.
2. Remove the gears and clutch.

(When reassembling)

- Apply grease to the spline teeth, the gear teeth and the steel ball shown in the figure left.

Plunger

1. Remove the end cover from the magnet switch.
2. Remove the plunger

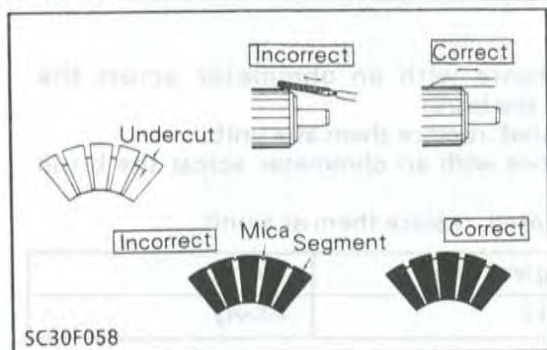
**SERVICING**Bearing and Clutch

1. Check the bearing and the clutch for smooth rotation.
The clutch should engage and rotate with the pinion shaft in the forward driving direction and disengage in reverse.

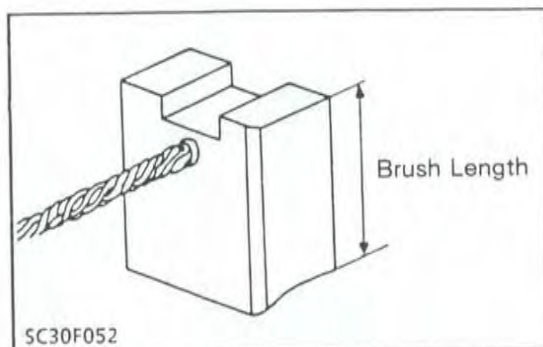




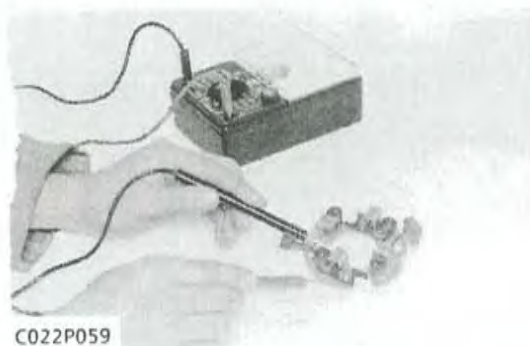
C044P082



SC30F058



SC30F052



C022P059

Commutator and Mica

1. If the commutator surface is dirty or dusty, clean it with sandpaper.
2. Measure the commutator O.D. with an outside micrometer at several points.
3. If the minimum O.D. is less than the allowable limit, replace the armature.
4. If the difference of the outer diameters exceeds the allowable limit, use a lathe to adjust the outer diameter to within the allowable limit.
5. Measure the mica undercut.
6. If the undercut is less than the allowable limit, correct it with a saw blade and chamfer the segment edges.

Commutator O.D.	Factory spec.	30.0 mm 0.181 in.
	Allowable limit	29.0 mm 1.142 in.
Difference of max. O.D. and min. O.D.	Factory spec.	Less than 0.02 mm 0.0008 in.
	Allowable limit	0.05 mm 0.0020 in.
Mica undercut	Factory spec.	0.50 to 0.80 mm 0.02 to 0.03 in.
	Allowable limit	0.2 mm 0.008 in.

Brush Wear

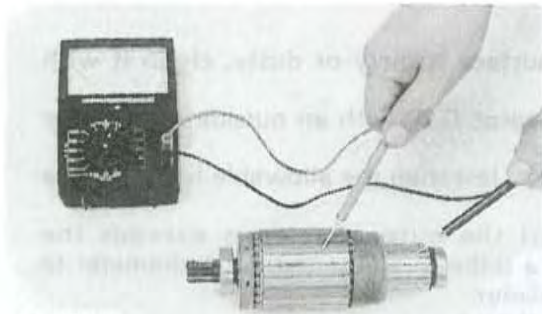
1. If the contact face of the brush is dirty or dusty, clean it with sandpaper.
2. Measure the brush length.
3. If the length is less than the allowable limit, replace it.

Brush length	Factory spec.	L2350	13.0 mm 0.51 in.
		L2650, L2950 L3450, L3650	15.0 mm 0.59 in.
	Allowable limit	L2350	11.3 mm 0.44 in.
		L2650, L2950 L3450, L3650	11.0 mm 0.43 in.

Brush Holder

1. Measure the resistance with an ohmmeter across the brush holder and the holder support.
2. If infinity is not indicated, replace them as a unit.

Resistance	Brush holder - Holder support	Infinity
------------	-------------------------------	----------

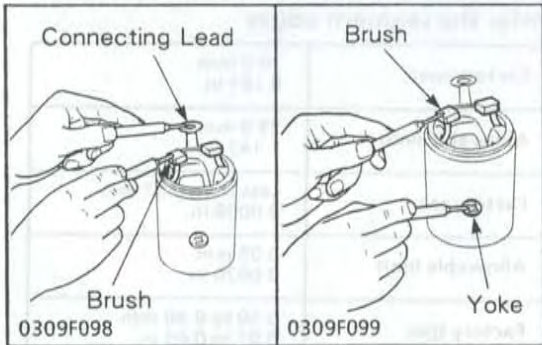


C044P084

Armature Coil

- 1. Measure the resistance with an ohmmeter across the commutator and the armature shaft.
- 2. If infinity is not indicate, replace them as a unit.

Resistance	Commutator – Armature	Infinity
------------	-----------------------	----------



Field coil

- 1. Measure the resistance with an ohmmeter across the connecting lead and the brush.
- 2. If 0 ohm is not indicated, replace them as a unit.
- 3. Measure the resistance with an ohmmeter across the brush and the yoke.
- 4. If infinity is not indicated, replace them as a unit.

Resistance	Connecting lead – Brush	0 ohm
	Brush – Yoke	Infinity

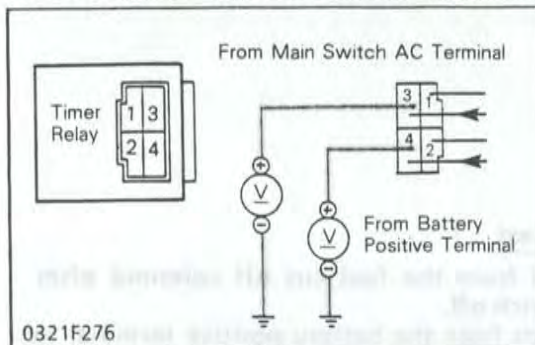
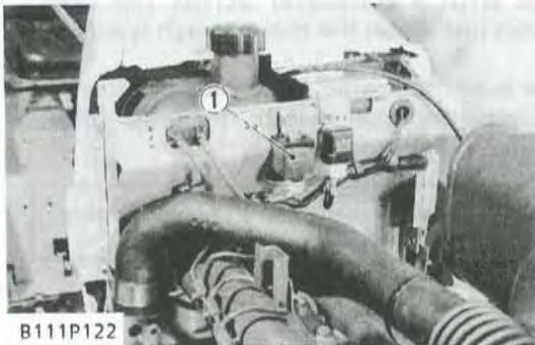


1.5 to 2.0 mm (0.06 to 0.08 in)	Brush holder	Brush holder	Brush holder
1.5 to 2.0 mm (0.06 to 0.08 in)	Brush holder	Brush holder	Brush holder
1.5 to 2.0 mm (0.06 to 0.08 in)	Brush holder	Brush holder	Brush holder
1.5 to 2.0 mm (0.06 to 0.08 in)	Brush holder	Brush holder	Brush holder

1.5 to 2.0 mm (0.06 to 0.08 in)	Brush holder	Brush holder	Brush holder
1.5 to 2.0 mm (0.06 to 0.08 in)	Brush holder	Brush holder	Brush holder
1.5 to 2.0 mm (0.06 to 0.08 in)	Brush holder	Brush holder	Brush holder
1.5 to 2.0 mm (0.06 to 0.08 in)	Brush holder	Brush holder	Brush holder

[3] ENGINE KEY SWITCH SHUT-OFF SYSTEM (L2650,L2950,L3450,L3650)

CHECKING



Timer Relay Connector Voltage

1. Disconnect the connector from the timer relay after turning the main switch off.
2. Measure the voltage with a voltmeter across the connector 4 terminal and chassis.
3. Turn the main switch on, and measure the voltage across the connector 3 terminal and chassis.
4. If these voltages differ from the battery voltage, the wiring harness or main switch is faulty.

Voltage	Connector 4 terminal – chassis	Approx. battery voltage
	Connector 3 terminal – chassis	

NOTE

- If the fuel cut off solenoid is burnt, replace it together with the timer relay (1).
- When installing the timer relay, it shall be installed upward. (See the upper left photo.) If it is mounted up-side-down or inclined sideways, water may intrude to lead to timer relay failure and solenoid burning.
- When washing the tractor, be very careful to prevent direct water from splashing onto the timer relay.

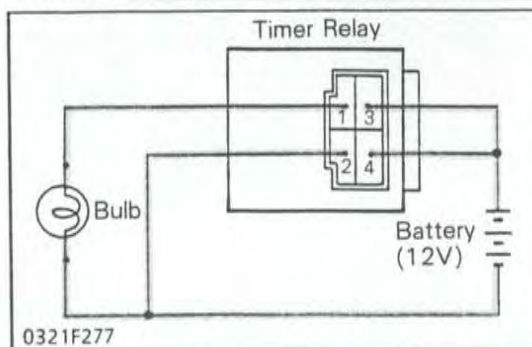
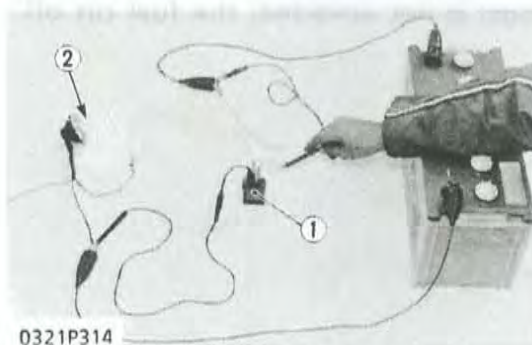
(1) Timer Relay

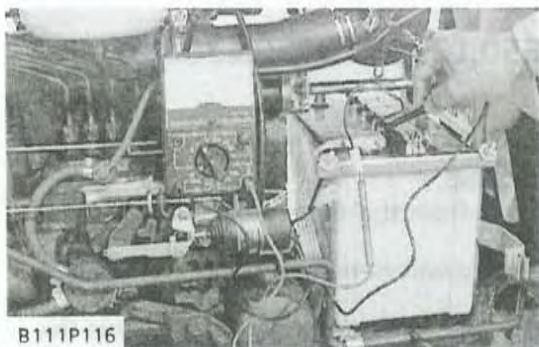
Test of Timer Relay

1. Remove the timer relay from the tractor.
2. Connect jumper leads across the battery positive terminal and the timer relay 3 terminal, and across the battery positive terminal and the timer relay 4 terminal.
3. Connect jumper leads across the battery negative terminal and the timer relay 2 terminal, and across the battery negative terminal and the bulb terminal.
4. Connect jumper lead across the timer relay 1 terminal and the bulb terminal.
5. The bulb lights up when disconnecting a jumper lead from the 3 terminal and goes off 6 to 13 seconds late, the timer relay is proper.

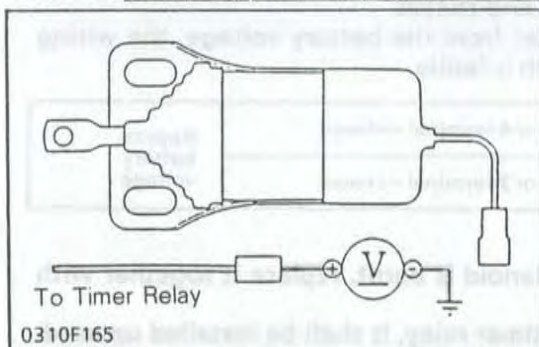
(1) Timer Relay

(2) Load (Lamp)





B111P116



0310F165

Fuel Cut Off Solenoid Lead Terminal Voltage

1. Disconnect the lead from the fuel cut off solenoid after turning the main switch off.
2. Start the engine.
3. Measure the voltage with a voltmeter across the lead terminal and the chassis just when the main switch is turned off.
4. If the battery voltage is not indicated for a certain seconds, check the wiring harness, the main switch, the timer relay, the regulator, a fuse and the alternator.

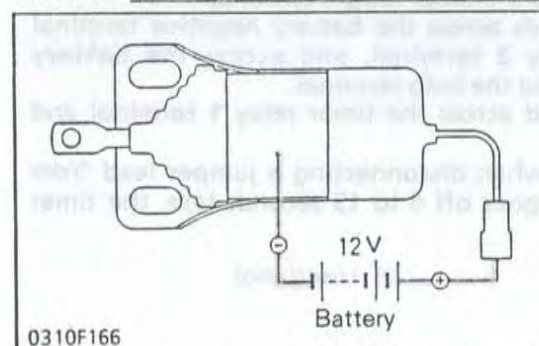
Voltage	Across lead terminal and chassis when main switch turned off	Approx. battery voltage
---------	--	-------------------------



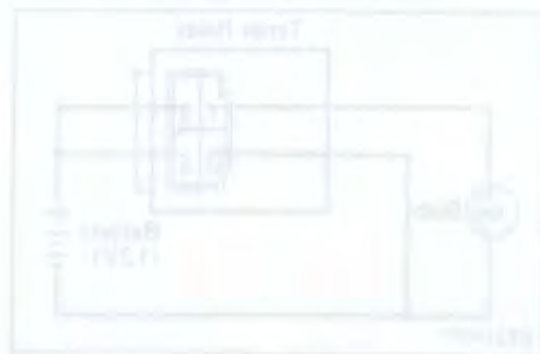
B111P117

Fuel Cut Off Solenoid Test

1. Disconnect the lead from the fuel cut off solenoid after turning the main switch off.
2. Connect jumper leads from the battery positive terminal to the fuel cut off solenoid lead terminal, and from the battery negative terminal to the fuel cut off solenoid body.
3. If the solenoid plunger is not attracted, the fuel cut off solenoid is faulty.

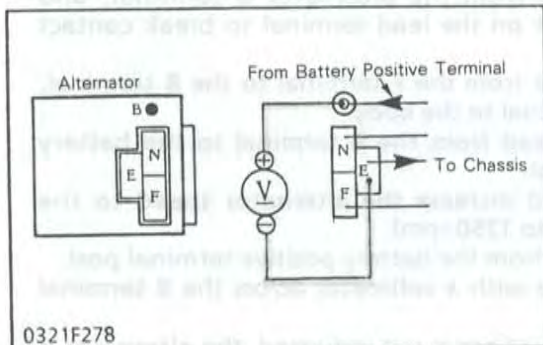


0310F166



[4] CHARGING SYSTEM (L2350)

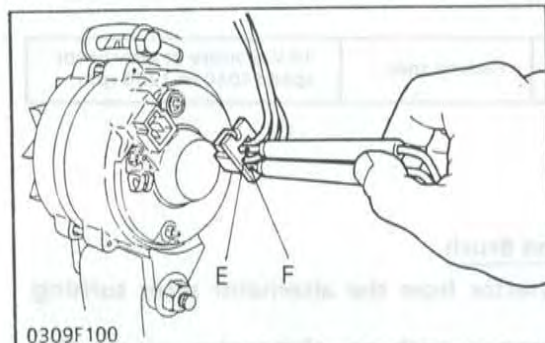
CHECKING



Alternator Terminal Voltage

1. Measure the voltage with a voltmeter across the lead B terminal and connector E terminal.
2. If the voltage differs from the battery voltage, the wiring harness is faulty.

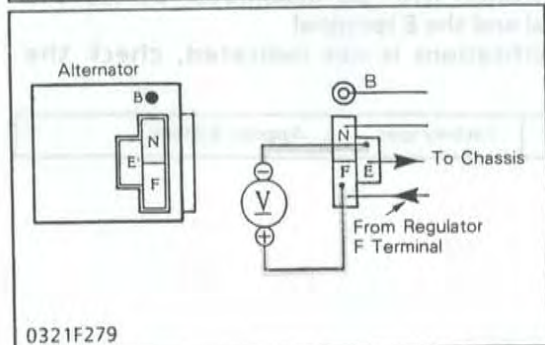
Voltage	Lead B terminal – Connector E terminal.	Approx. battery voltage
---------	--	----------------------------

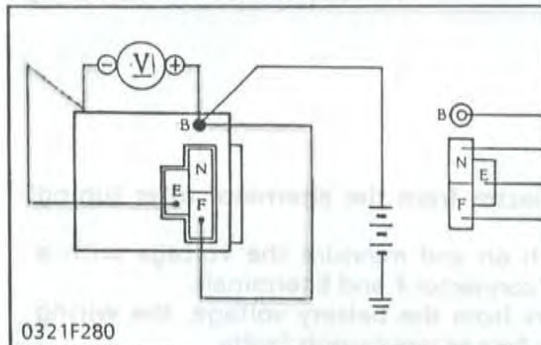
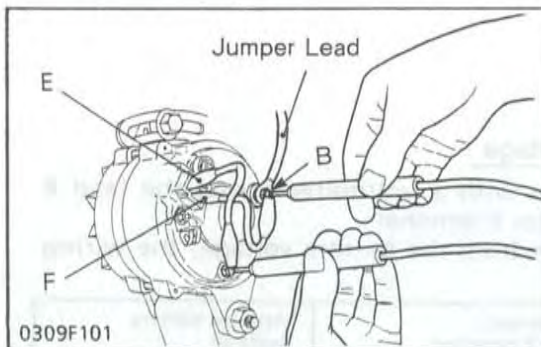


Connector Voltage

1. Disconnect the connector from the alternator after tuning the main switch off.
2. turn the main switch on and measure the voltage with a voltmeter across the connector F and E terminals.
3. If the voltage differs from the battery voltage, the wiring harness, main switch fuse or regulator is faulty.

Voltage	F – E	Approx. battery voltage
---------	-------	----------------------------

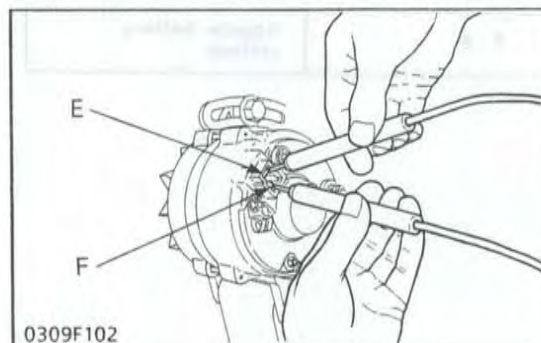




No-Load Test

1. Disconnect the connector from the alternator after turning the main switch off.
2. Disconnect the lead from the alternator B terminal, and wind insulation tape on the lead terminal to break contact with the chassis.
3. Connect jumper lead from the F terminal to the B terminal, and from the E terminal to the body.
4. Connect a jumper lead from the B terminal to the battery positive terminal post.
5. Start the engine and increase the alternator speed to the specified rate (1050 to 1250 rpm).
6. Disconnect the lead from the battery positive terminal post.
7. Measure the voltage with a voltmeter across the B terminal and the body.
8. If the factory specifications is not indicated, the alternator is faulty.

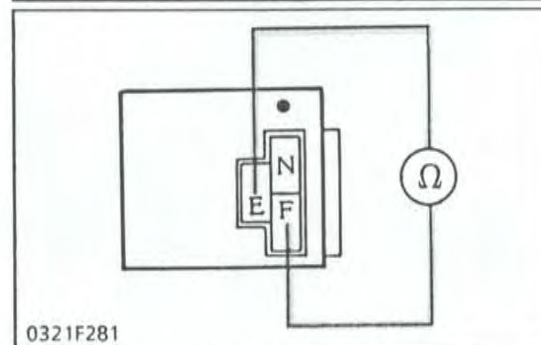
Voltage	B terminal - Body	Factory spec.	14 V or more at alternator speed 1050 to 1250 rpm
---------	-------------------	---------------	---



Rotor Coil, Slip Ring and Brush

1. Disconnect the connector from the alternator after turning the main switch off.
2. Measure the resistance with an ohmmeter across the alternator F terminal and the E terminal.
3. If the factory specifications is not indicated, check the alternator.

Resistance	F - E	Factory spec.	Approx. 6 ohms
------------	-------	---------------	----------------

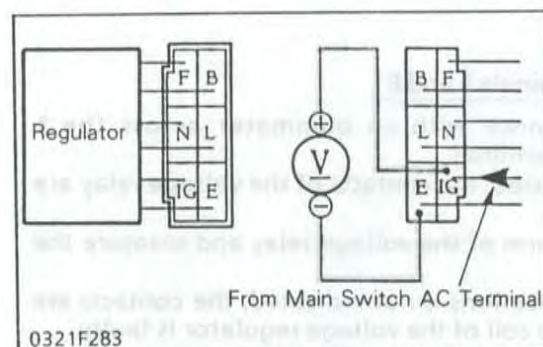
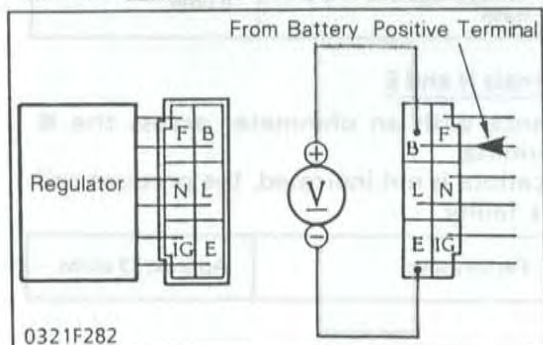




Regulator Relay Voltage across B and E

1. Disconnect the connector from the regulator after turning the main switch off.
2. Measure the voltage with a voltmeter across the connector B terminal and the E terminal.
3. If the voltage differs from the battery voltage, the wiring harness or the main switch is faulty.

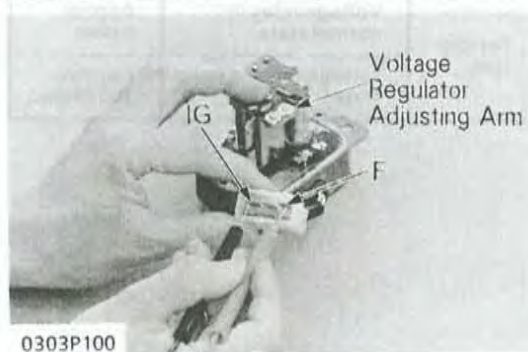
Voltage	B - E	Approx. battery voltage
---------	-------	-------------------------



Voltage across IG and E

1. Disconnect the connector from the regulator after turning the main switch off.
2. Turn the main switch on and measure the voltage with a voltmeter across the connector IG terminal and the E terminal.
3. If the voltage differs from the battery voltage, the main switch, fuse or wiring harness is faulty.

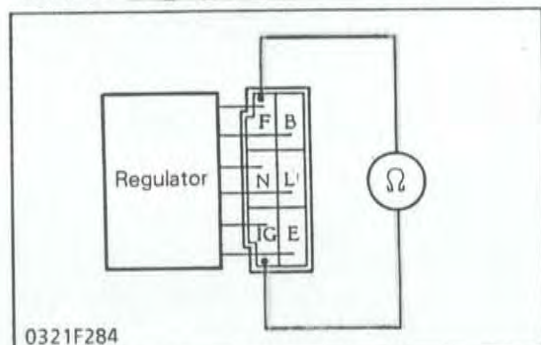
Voltage	IG - E	Approx. battery voltage
---------	--------	-------------------------

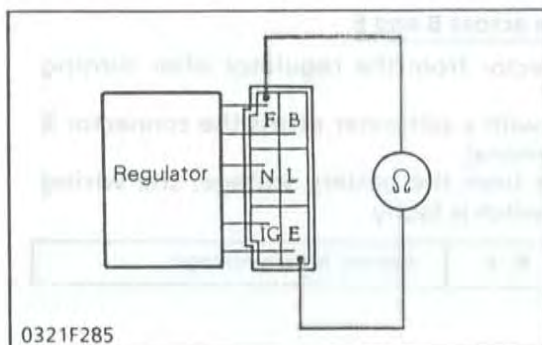


Resistance across Terminals IG and F

1. Measure the resistance with an ohmmeter across the IG terminal and the F terminal.
2. If 0 ohm is not indicated, the contacts of the voltage regulator are faulty.
3. Press the adjusting arm of the voltage regulator and measure the resistance.
4. If the factory specifications is not indicated, the contacts are faulty or the control resistor is faulty.

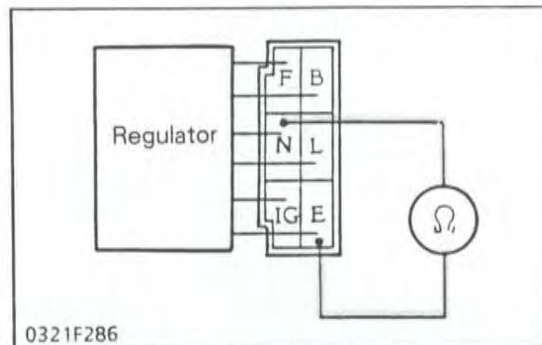
Resistance	IG - F	Factory spec.	Voltage regulator in normal state	0 ohm
			voltage regulator in pull state	Approx. 11 ohms



**Resistance across Terminals F and E**

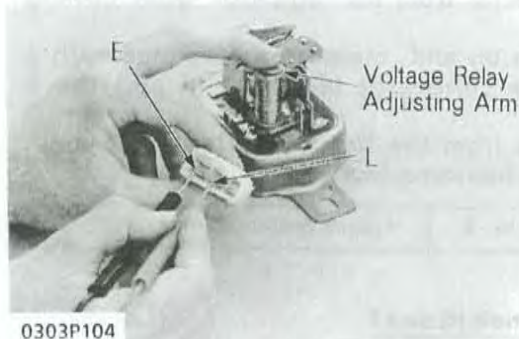
1. Measure the resistance with an ohmmeter across the F terminal and the E terminal.
2. If infinity is not indicated, the contacts of the voltage regulator are faulty.
3. Press the adjusting arm of the voltage regulator and measure the resistance.
4. If 0 ohm is not indicated, the contacts are faulty.

Resistance	F - E	Voltage regulator in normal state	Infinity
		voltage regulator in pull state	0 ohm

**Resistance across Terminals N and E**

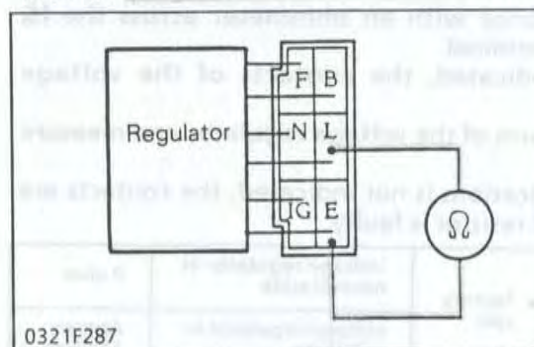
1. Measure the resistance with an ohmmeter across the N terminal and the E terminal.
2. If the factory specifications is not indicated, the pressure coil of the voltage relay is faulty.

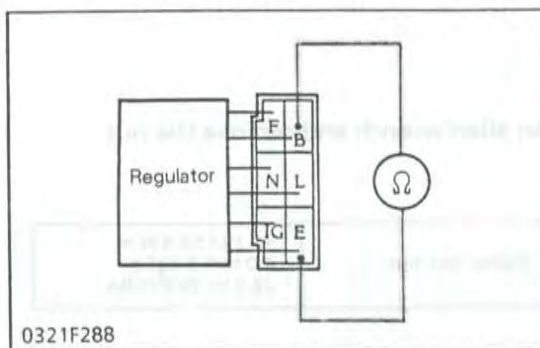
Resistance	N - E	Factory spec.	Approx. 23 ohms
------------	-------	---------------	-----------------

**Resistance across Terminals L and E**

1. Measure the resistance with an ohmmeter across the L terminal and the E terminal.
2. If 0 ohm is not indicated, the contacts of the voltage relay are faulty.
3. Press the adjusting arm of the voltage relay and measure the resistance.
4. If the factory specifications is not indicated, the contacts are faulty or the voltage coil of the voltage regulator is faulty.

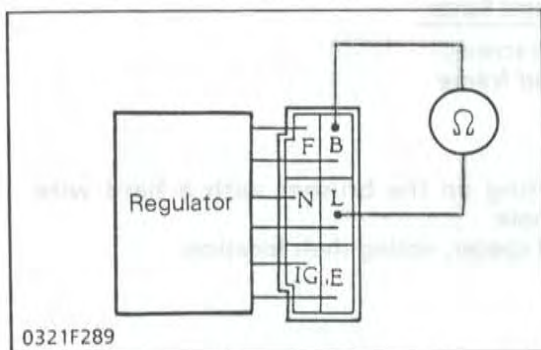
Resistance	L - E	Factory spec.	Voltage relay in normal state	Approx. 0 ohm
			voltage relay in pull state	Approx. 100 ohms



**Resistance across Terminals B and E**

1. Measure the resistance with an ohmmeter across the **B** terminal and the **E** terminal.
2. If infinity is not indicated, the contacts of the voltage relay are faulty.
3. Press the adjusting arm of the voltage relay and measure the resistance.
4. If the factory specifications is not indicated, the contacts are faulty or the voltage coil of the voltage regulator is faulty.

Resistance	B - E	Factory spec.	Voltage relay in normal state	Infinity
			voltage relay in pull state	Approx. 100 ohms

**Resistance across Terminals B and L**

1. Measure the resistance with an ohmmeter across the **B** terminal and the **L** terminal.
2. If infinity is not indicated, the contacts of the voltage relay are faulty.
3. Press the adjusting arm of the voltage relay and measure the resistance.
4. If the 0ohm is not indicated, the contacts are faulty.

Resistance	B - L	Factory spec.	Voltage relay in normal state	Infinity
			voltage relay in pull state	0 ohm

DISASSEMBLING AND ASSEMBLING

Pulley

1. Hold the shaft with an allen wrench and remove the nut.
2. Remove the pulley
3. Remove the fan.

Tightening torque	Pulley lock nut	39.2 to 53.9 N·m 4.0 to 5.5 kgf·m 28.9 to 39.8 ft-lbs
-------------------	-----------------	---

C022P018

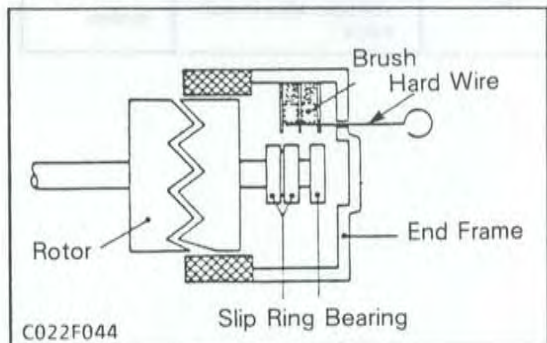
Drive Side End Frame and Rotor

1. Remove the through screws.
2. Remove the drive end frame.
3. Draw out the rotor.

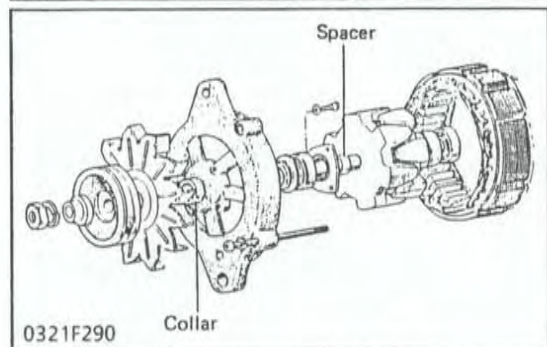
(When reassembling)

- Install the rotor, lifting up the brushes with a hard wire through the access hole.
Install the collar and spacer, noting their location.

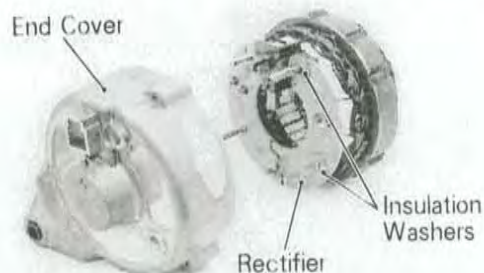
C022P019



C022F044



0321F290



C022P022

Rectifier

1. Remove the nuts.
2. Remove the end frame.
3. Remove the rectifier.

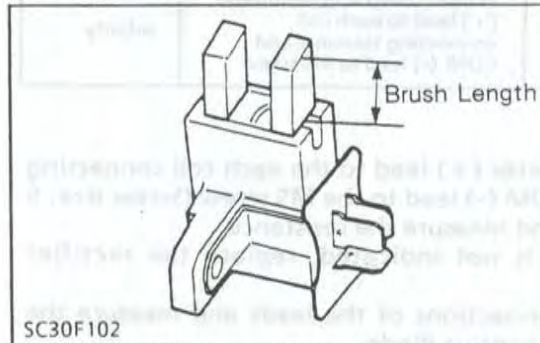
(When reassembling)

- Be sure to install the insulation washers on the screws at the positive diode side.

SERVICING



C022P023



SC30F102

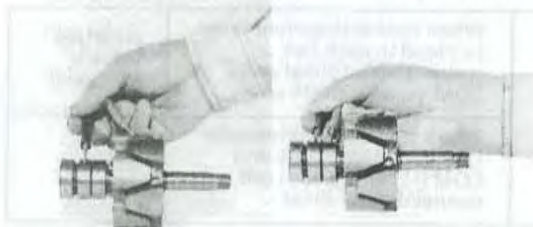
Alternator Slip Ring

1. Check the slip ring for scoring.
2. If scored, correct with sandpaper or a lathe.

Brush Wear

1. Check the length of the brush. If the length is shorter than the allowable limit, replace it.
2. Make sure that the brush moves smoothly.
3. If the brush is defective, replace it.

Brush length	Factory spec.	12.5 mm 0.49 in.
	Allowable limit	5.5 mm 0.22 in.



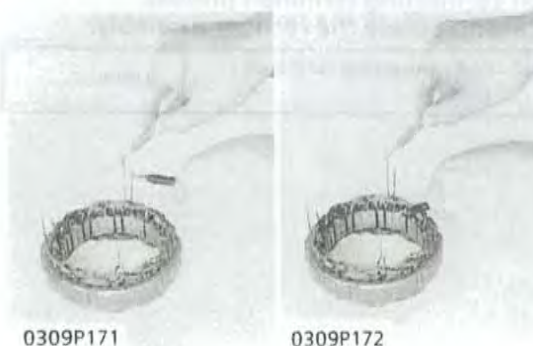
C022P025

C022P024

Rotor Coil

1. Measure the resistance with an ohmmeter across the slip ring and the core.
2. If infinity is not indicated, replace them as a unit.
3. Measure the resistance with an ohmmeter across the slip rings.
4. If the factory specifications is not indicated, replace them as a unit.

Resistance	Factory spec.	Slip ring-Core	Infinity
		Across slip ring	Approx. 4 ohms



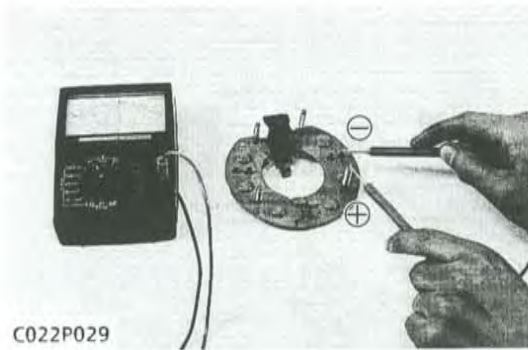
0309P171

0309P172

Stator Coil

1. Measure the resistance with an ohmmeter across each lead of the stator coil.
2. If 0 ohm is not indicated, replace the stator coil and core as a unit.
3. Measure the resistance with an ohmmeter across each stator coil lead and core.
4. If infinity is not indicated, replace them as a unit.

Resistance	Across stator coil leads	0 ohm
	Stator coil lead-Core	Infinity

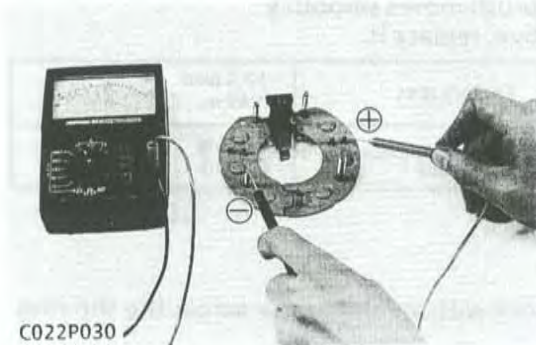


C022P029

Positive Diodes

1. Connect the ohmmeter (+) lead to the M6 screw (Screw size: 6 mm, 0.24 in. DIA) and the COM (-) lead to each coil connecting terminal, and measure the resistance.
2. If a certain value is not indicated, replace the rectifier assembly.
3. Interchange the connections of the leads and measure the resistance of each positive diode.
4. If infinity is not indicated, replace the rectifier assembly.

Resistance	Factory spec.	When connecting ohmmeter (+) lead to M6 screw and COM (-) lead to each coil connecting terminal	A certain value is indicated
		When connecting ohmmeter (+) lead to each coil connecting terminal and COM (-) lead to M6 screw	Infinity

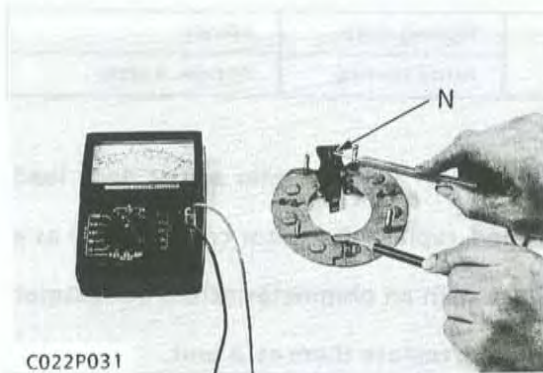


C022P030

Negative Diodes

1. Connect the ohmmeter (+) lead to the each coil connecting terminal and the COM (-) lead to the M5 screw (Screw size: 5 mm, 0.20 in. DIA) and measure the resistance.
2. If a certain value is not indicated, replace the rectifier assembly.
3. Interchange the connections of the leads and measure the resistance of each negative diode.
4. If infinity is not indicated, replace the rectifier assembly.

Resistance	Factory spec.	When connecting ohmmeter (+) lead to each coil connecting terminal and COM (-) lead to M5 screw	A certain value is indicated
		When connecting ohmmeter (+) lead to M5 screw and COM (-) lead to each coil connecting terminal	Infinity



C022P031

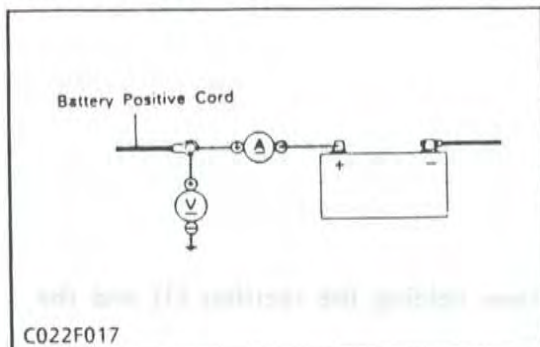
N Terminal and Coil Connecting Terminal

1. Measure the resistance with an ohmmeter across the N terminal and the coil connecting terminals (inside).
2. If 0 ohm is not indicated, replace the rectifier assembly.

Resistance	N terminal – Coil connecting terminals (inside)	0 ohm
------------	---	-------

[5] CHARGING SYSTEM (L2650, L2950, L3450, L3650)

CHECKING



Battery Charging Current

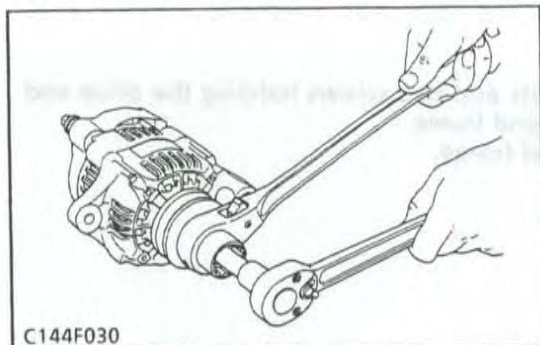
1. After starting the engine, disconnect the battery positive cord (+), and connect an ammeter and voltmeter. Then switch on all electrical loads (such as headlights) and measure the charging current.

NOTE

- Connect an ammeter only after starting the engine.
- When the electrical loads is considerably low or the battery is fully charged, the specified reading may not be obtained.

Factory spec.	Current	14 to 15A
	Voltage	14 to 15V
	Dynamo speed	5200 r.p.m

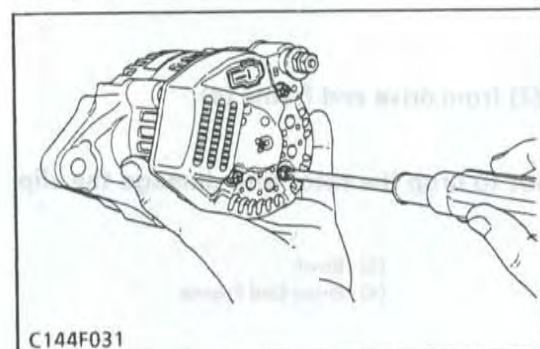
DISASSEMBLING AND ASSEMBLING



Pulley

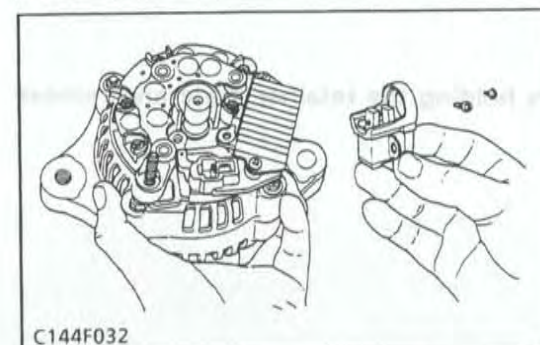
1. Secure the hexagonal end of the pulley shaft with a double-ended ratchet wrench as shown in the photo, loosen the nut with a socket wrench and remove it.

Tightening torque	Pulley lock nut	58.3 to 78.9 N·m 5.95 to 8.05 kgf·m 43.0 to 58.2 ft-lbs
-------------------	-----------------	---



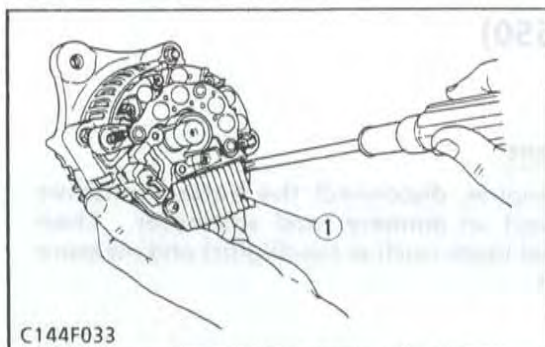
Rear End Cover

1. Unscrew the three rear end cover screws and the terminal B nut and remove the rear end cover.



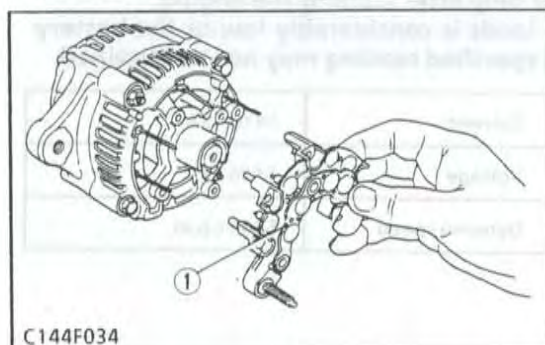
Brush Holder

1. Unscrew the two screws holding the brush holder and remove the brush holder.

**IC Regulator**

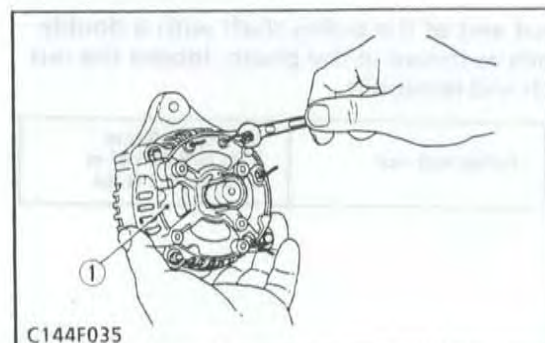
1. Unscrew the three screws holding the IC regulator (1) and remove it.

(1) IC Regulator

**Rectifier**

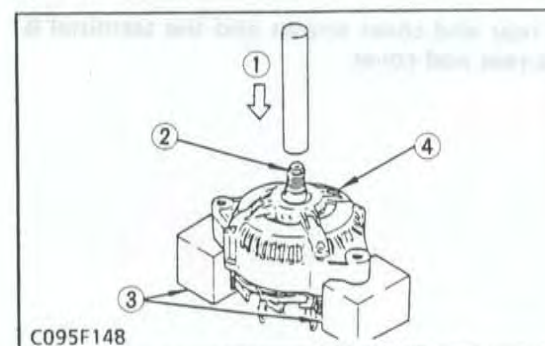
1. Remove the four screws holding the rectifier (1) and the stator lead wires.

(1) Rectifier

**Rear End Frame**

1. Remove the two nuts and two screws holding the drive end frame and the rear end frame.
2. Remove the rear end frame.

(1) Rear End Frame

**Rotor**

1. Press out the rotor (2) from drive end frame (4).

■ IMPORTANT

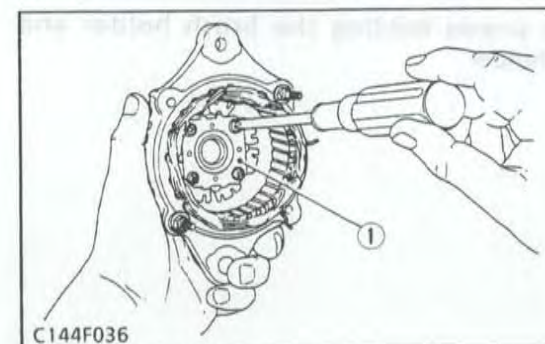
- Take special care not to drop the rotor and damage the slip ring or fan, etc.

(1) Press

(2) Rotor

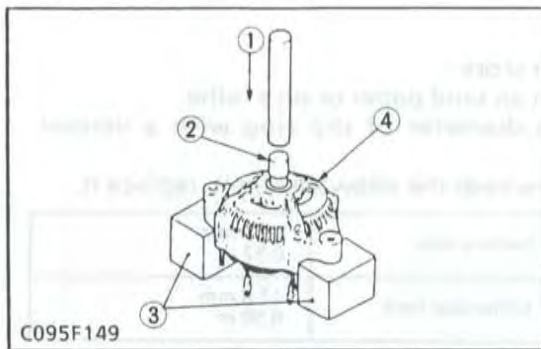
(3) Block

(4) Drive End Frame

**Retainer Plate**

1. Remove the screws holding the retainer plate and remove the retainer plate.

(1) Retainer Plate

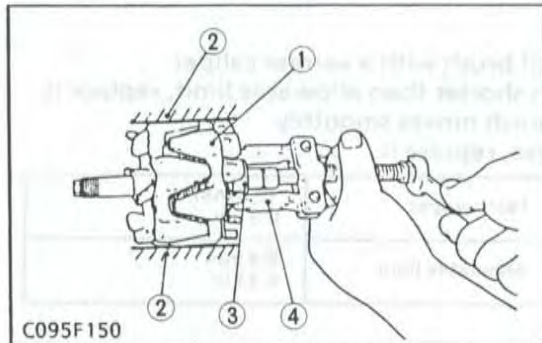


Bearing on the Drive End Side

1. Press out the bearing from drive end frame (4) using with press (1) and jig (2).

(1) Press
(2) Jig

(3) Block
(4) Drive End Frame



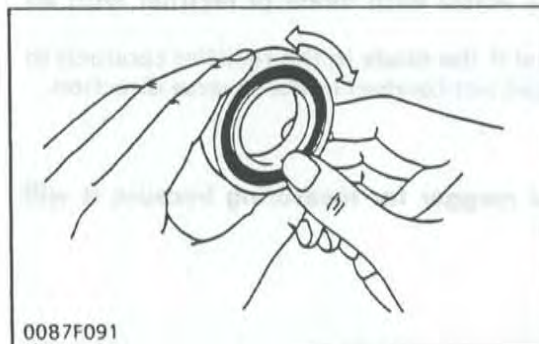
Bearing at the Slip Ring Side

1. Lightly secure the rotor (1) with a vise (2) to prevent damage and remove the bearing using with puller (4).

(1) Rotor
(2) Vise

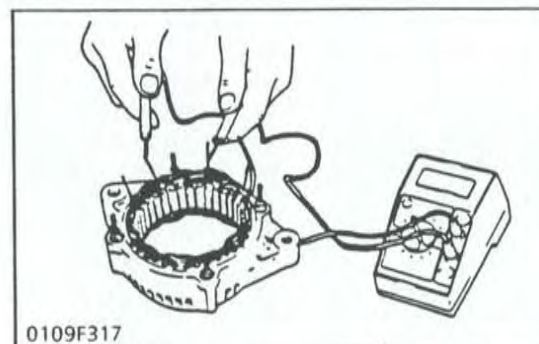
(3) Bearing
(4) Puller

SERVICING



Bearing

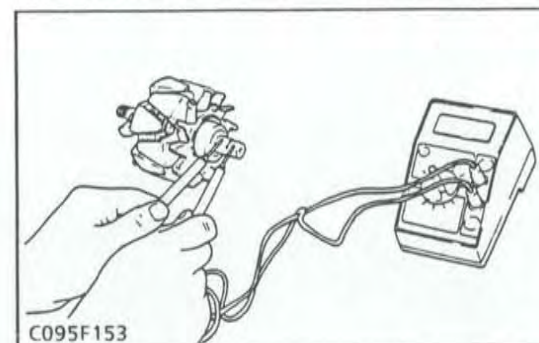
1. Check the bearing for smooth rotation.
2. If it does not rotate smoothly, replace it.



Stator

1. Measure the resistance with an ohmmeter across each lead of the stator coil.
2. If the measurement is not within factory specification, replace it.
3. Check the continuity across each stator coil lead and core with an ohmmeter.
4. If infinity is not indicated, replace it.

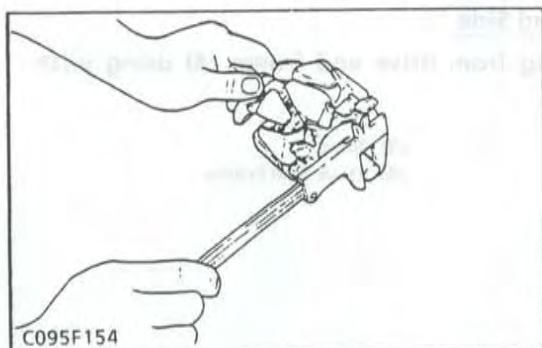
Resistance	Factory spec.	Less than 1.0 ohm
------------	---------------	-------------------



Rotor

1. Measure the resistance across the slip rings.
2. If the resistance is not the factory specification, replace it.
3. Check the continuity across the slip ring and core with an ohmmeter.
4. If infinity is not indicated, replace it.

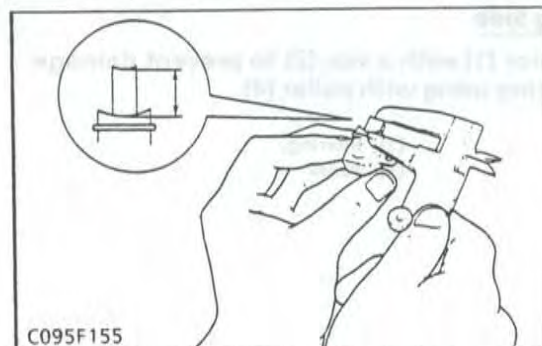
Resistance	Factory spec.	2.9 ohm
------------	---------------	---------



Slip Ring

1. Check the slip ring for score.
2. If scored, correct with an sand paper or on a lathe.
3. Measure the outside diameter of slip ring with a vernier caliper.
4. If the measurement exceeds the allowable limit, replace it.

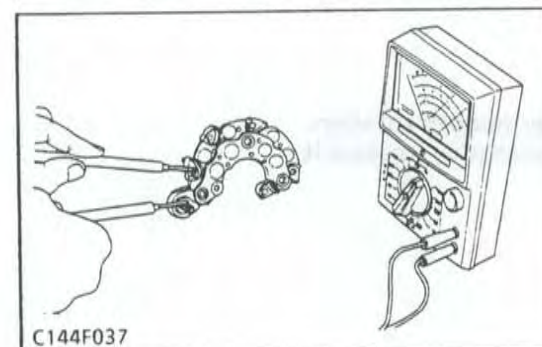
Slip ring O D	Factory spec.	14.4 mm 0.57 in.
	Allowable limit	12.8 mm 0.50 in.



Brush Wear

1. Measure the length of brush with a vernier caliper.
2. If the measurement is shorter than allowable limit, replace it.
3. Make sure that the brush moves smoothly.
4. If the brush is defective, replace it.

Brush length	Factory spec.	10.5 mm 0.41 in.
	Allowable limit	8.4 mm 0.33 in.



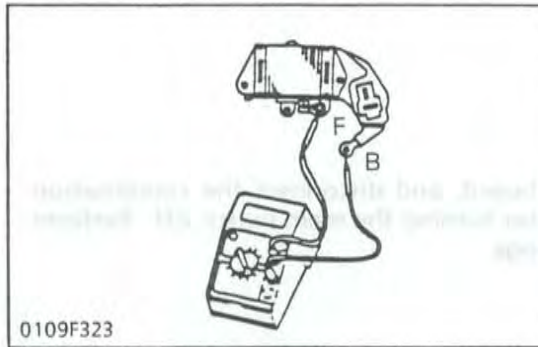
Rectifier

1. Check the continuity across each diode of rectifier with an ohmmeter.
2. The rectifier is normal if the diode in the rectifier conducts in one direction and does not conduct in the reverse direction.

⚠ CAUTION

- Do not use a 500 V megger for measuring because it will destroy the rectifier.



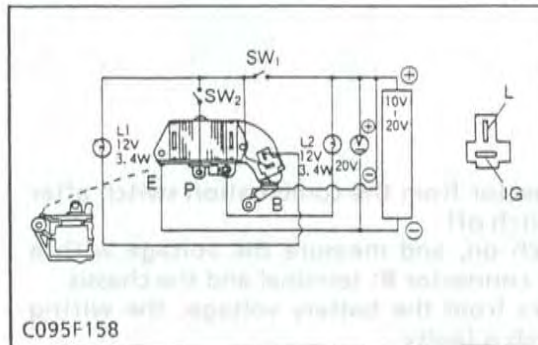


IC Regulator

1. Check the continuity across the **B** terminal and the **F** terminal of IC regulator with an ohmmeter.
2. The IC regulator is normal if the conducts in one direction and does not conduct in the reverse direction.

CAUTION

- Do not use a 500 V megger for measuring because it will destroy the rectifier.



IC Regulator Test

1. Connect the IC regulator unit, variable DC source, voltmeter, lamps and etc. so that they form a circuit as shown in the figure. (**SW1** and **SW2** shall be kept in the "OFF" position.)
2. Adjust the source voltage to 12 V.
3. Turn **SW1** "ON" check if **L1** (charge lamp substitution) is lit brilliantly and **L2** (rotor coil substitution) is dimly.
4. Then, turn **SW2** "ON" while **SW1** is still turned "ON". Check if **L1** is turns "OFF" and **L2** is lit brilliantly.
5. While keeping **SW1** and **SW2** in the "ON" position, raise the variable DC source voltage gradually from 12 V and check if the **L2** lamp is turned "OFF" at a voltage of 13.9 to 15.1 V at 25°C (45°F).

CAUTION

- A wrong connection in the IC regulator may destroy the regulator in a short time, therefore, inspection of the IC regulator is to be done only after the wiring diagram in the maintenance standard has been thoroughly studied.

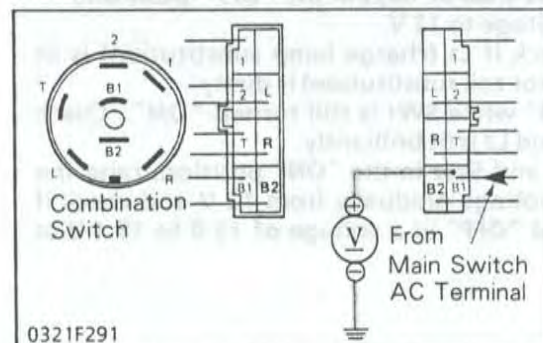
[6] LIGHTING SYSTEM

CHECKING



Combination Switch

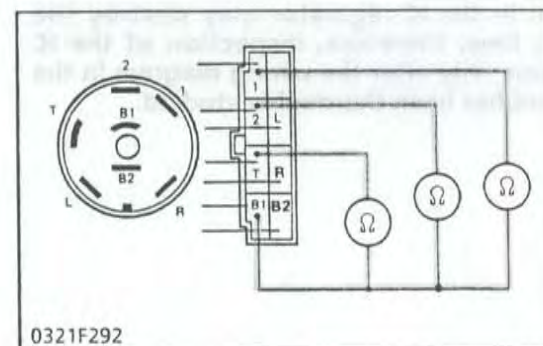
- Remove the switch board, and disconnect the combination switch connectors after turning the main switch off. Perform the following checkings.



Connector Voltage

- Disconnect the connector from the combination switch after turning the main switch off.
- Turn the main switch on, and measure the voltage with a voltmeter across the connector B1 terminal and the chassis.
- If the voltage differs from the battery voltage, the wiring harness or main switch is faulty.

Voltage	B1 - Chassis	Approx. battery voltage
---------	--------------	-------------------------

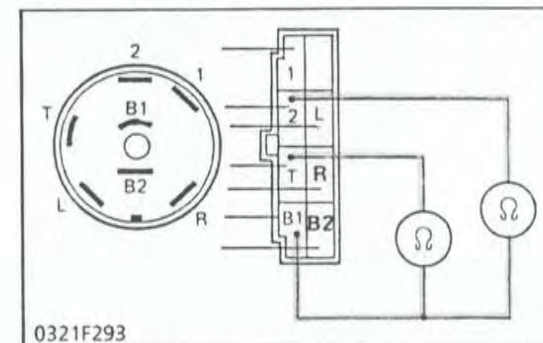


Headlight Switch Continuity When Setting Switch Knob at OFF Position

Position

- Disconnect the connector from the combination switch after turning the main switch off.
- Set the light switch knob to the **OFF** position.
- Measure the resistances with an ohmmeter across the B1 terminal and 1 terminal, across the B1 terminal and 2 terminal, and across the B1 terminal and the T terminal.
- If infinity is not indicated, the combination switch is faulty.

Resistance (Switch knob at OFF position)	B1 - 1	Infinity
	B1 - 2	
	B1 - T	

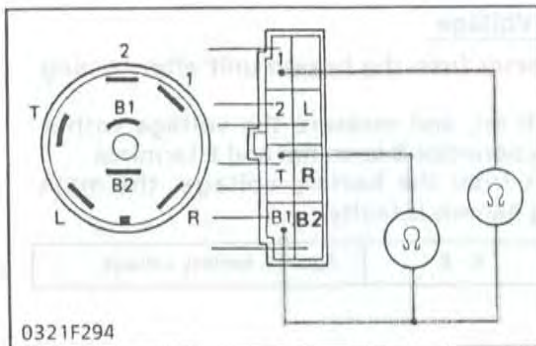


Headlight Switch Continuity When Setting Switch Knob at

LOW-BEAM Position

- Measure the resistances with an ohmmeter across the B1 terminal and 2 terminal, and across the B1 terminal and T terminal.
- If 0 ohm is not indicated, the combination switch is faulty.

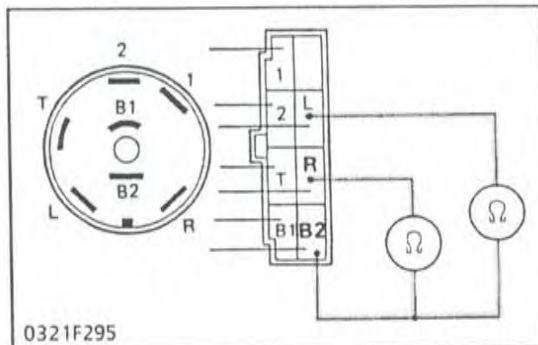
Resistance (Switch knob at LOW-BEAM position)	B1 - 2	0 ohm
	B1 - T	



Headlight Switch Continuity When Setting Switch Knob at HI-BEAM Position

1. Measure the resistances with an ohmmeter across the B1 terminal and 1 terminal, and across the B1 terminal and T terminal.
2. If 0 ohm is not indicated, the combination switch is faulty.

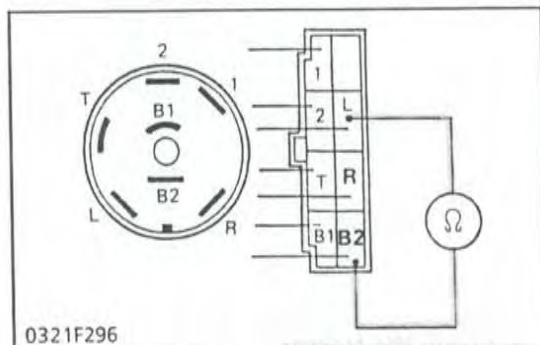
Resistance (Switch knob at HI-BEAM position)	B1 - 1	0 ohm
	B1 - T	



Hazard Switch Continuity When Setting Switch Knob at OFF Position

1. Disconnect the connector from the combination switch after turning the main switch off.
2. Set the hazard switch knob to the OFF position.
3. Measure the resistances with an ohmmeter across the B2 terminal and L terminal, and across the B2 terminal and R terminal.
4. If infinity is not indicated, the combination switch is faulty.

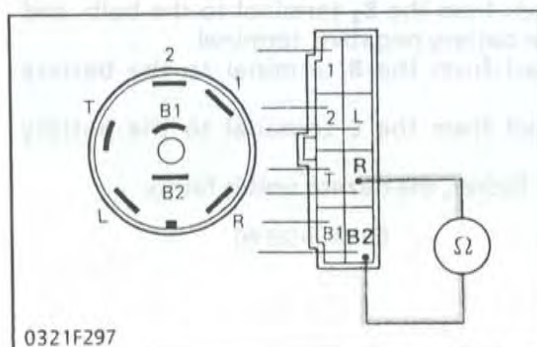
Resistance (Switch knob at OFF position)	B2 - L	Infinity
	B2 - R	



Hazard Switch Continuity When Setting Switch Knob at L Position

1. Set the hazard switch knob to the L position.
2. Measure the resistance with an ohmmeter across the B2 terminal and L terminal.
3. If 0 ohm is not indicated, the combination switch is faulty.

Resistance (Switch knob at L position)	B2 - L	0 ohm
--	--------	-------



Hazard Switch Continuity When Setting Switch Knob at R Position

1. Set the hazard switch knob to the R position.
2. Measure the resistance with an ohmmeter across the B2 terminal and R terminal.
3. If 0 ohm is not indicated, the combination switch is faulty.

Resistance (Switch knob at R position)	B2 - R	0 ohm
--	--------	-------

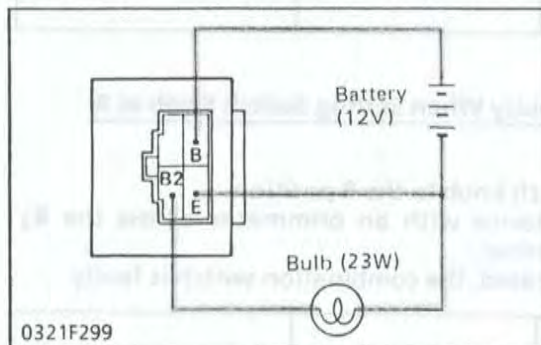
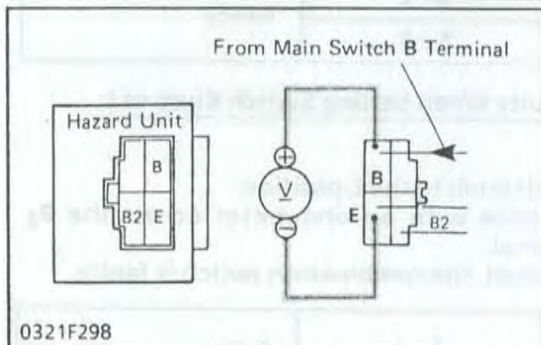


Hazard Unit Connector Voltage

1. Disconnect the connector from the hazard unit after turning the main switch off.
2. Turn the main switch on, and measure the voltage with a voltmeter across the connector **B** terminal and **E** terminal.
3. If the voltage differs from the battery voltage, the main switch, fuse or wiring harness is faulty.

Voltage	B - E	Approx. battery voltage
---------	-------	-------------------------

(1) Hazard Unit



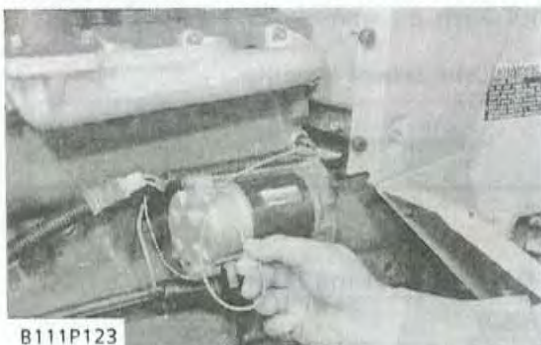
Hazard Unit Test

1. Remove the hazard unit from the tractor.
2. Connect jumper leads from the **B₂** terminal to the bulb, and from the bulb to the battery negative terminal.
3. Connect jumper lead from the **B** terminal to the battery positive terminal.
4. Connect jumper lead from the **E** terminal to the battery negative terminal.
5. If the bulb does not flicker, the hazard unit is faulty.

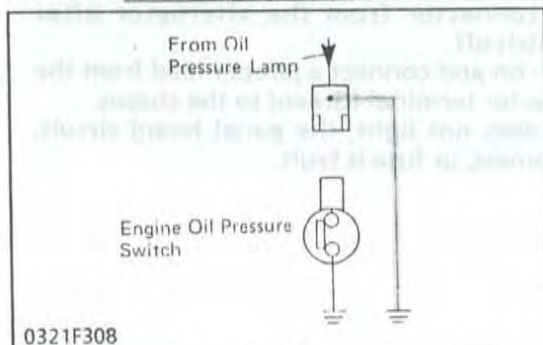
(1) Hazard Unit
(2) Battery (12 V)

(3) Bulb (23 W)

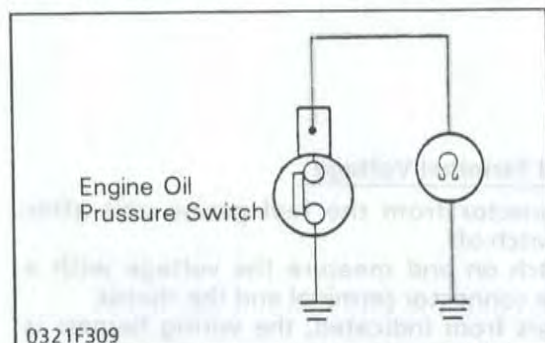
[7] WARNING LAMPS CHECKING



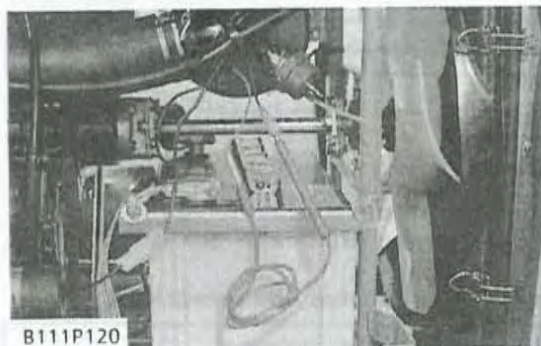
B111P123



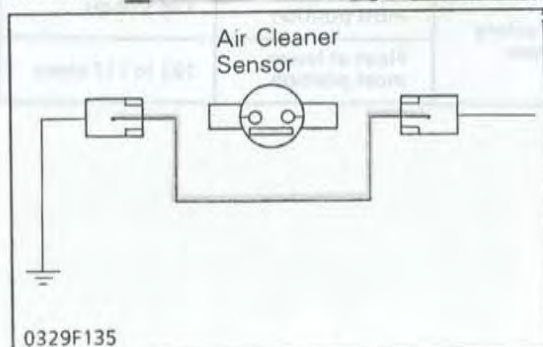
0321F308



0321F309



B111P120



0329F135

Engine Oil Pressure Switch Panel Board and Wiring Harness

1. Disconnect the lead from the engine oil pressure switch after turning the main switch off.
2. Turn the main switch on and connect a jumper lead from the lead terminal to the chassis.
3. If the engine oil pressure indicator lamp does not light, the panel board circuit or the wiring harness is faulty.

Engine Oil Pressure Switch Continuity

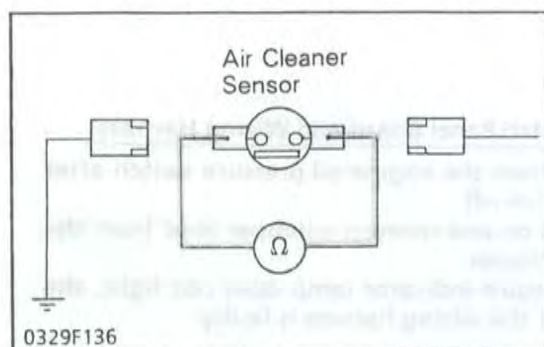
1. Measure the resistance with an ohmmeter across the switch terminal and the chassis.
2. If 0 ohm is not indicated in the normal state, the switch is faulty.
3. If infinity is not indicated at pressure over 4.9 kPa (0.5 kgf/cm², 7 psi), the switch is faulty.

Resistance (Switch terminal) - Chassis	In normal state	0 ohm
	At pressure over approx. 4.9 kPa (0.5 kgf/cm ² , 7 psi)	Infinity

Air Cleaner Sensor Panel Board and Wiring Harness

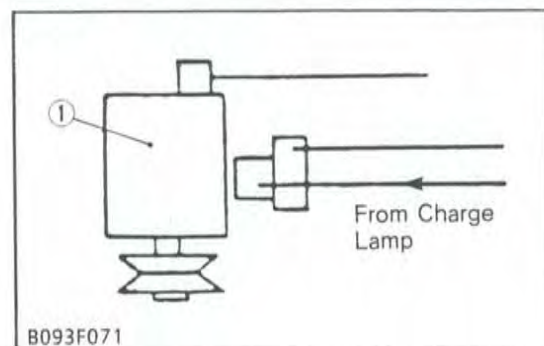
[L2650, L2950, L3450, L3650]

1. Disconnect the connectors from the air cleaner sensor after turning the main switch off.
2. Start the engine and connect a jumper lead between the connector terminals.
3. If the air cleaner indicator lamp does not light, the panel board circuit or wiring harness is faulty.

**Air Cleaner Sensor Continuity [L2650, L2950, L3450, L3650]**

1. Disconnect the two 1P connectors from the air cleaner sensor after turning the main switch off.
2. Measure the resistance with an ohmmeter across the two terminals.
3. If infinity is not indicated, the sensor is faulty.

Resistance (Across sensor) (terminals)	In normal state	Infinity
--	-----------------	----------

**Charging Circuit (Panel Board and Wiring Harness)****[L2650, L2950, L3450, L3650]**

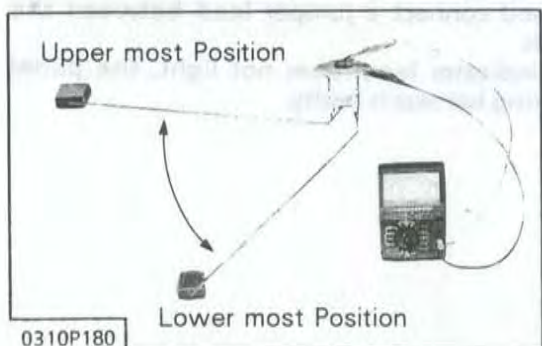
1. Disconnect the 2P connector from the alternator after turning the main switch off.
2. Turn the main switch on and connect a jumper lead from the wiring harness connector terminal (Green) to the chassis.
3. If the charge lamp does not light, the panel board circuit, alternator, wiring harness, or fuse is fault.

(1) Alternator

**[8] GAUGE
CHECKING****[L2350 4WD]****Fuel Level Sensor Lead Terminal Voltage**

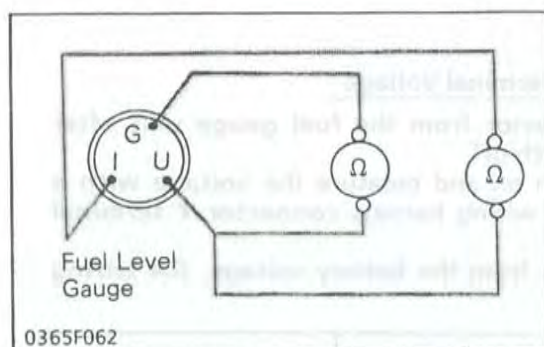
1. Disconnect the connector from the fuel gauge unit after turning the main switch off.
2. Turn the main switch on and measure the voltage with a voltmeter across the connector terminal and the chassis.
3. If the voltage differs from indicated, the wiring harness is faulty.

Voltage	Lead terminal - Chassis	4 to 7 voltage
---------	-------------------------	----------------

**Fuel Level Sensor Continuity**

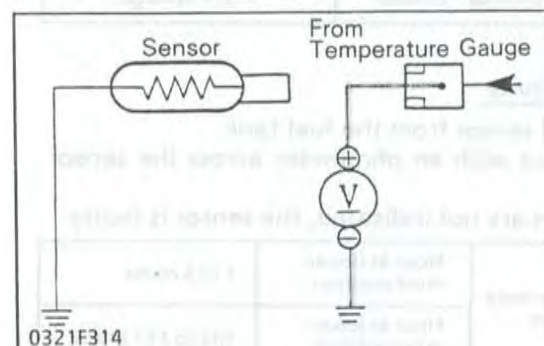
1. Remove the fuel level sensor from the fuel tank.
2. Measure the resistance with an ohmmeter across the sensor terminal and its body.
3. If the measurement are not indicated, the sensor is faulty.

Resistance (Sensor terminal) - its body	Factory spec.	Float at upper- most position	1 to 5 ohms
		Float at lower- most position	103 to 117 ohms

**Fuel Level Gauge**

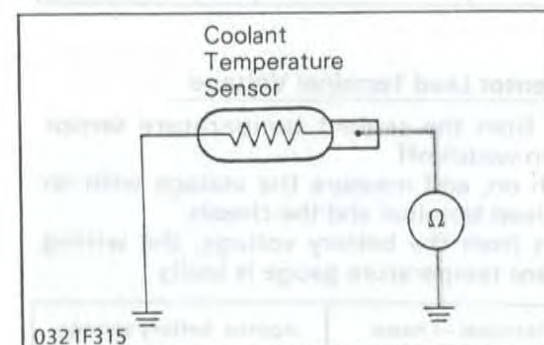
1. Remove the fuel level gauge.
2. Measure the resistance with an ohmmeter across the U terminal and I terminal, U terminal and G terminal.
3. If the measurements are not indicated, the gauge is faulty.

Resistance	U - I	70 to 100 ohms
	U - G	100 to 120 ohms

**Coolant Temperature Sensor Lead Terminal Voltage**

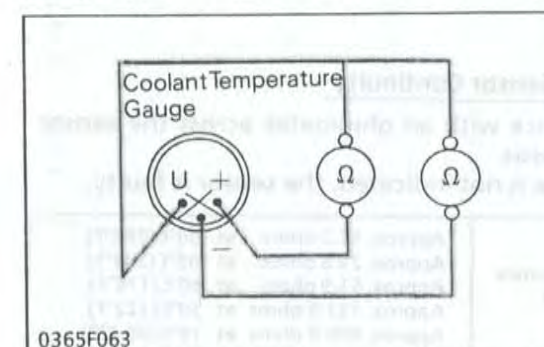
1. Disconnect the lead from the coolant temperature sensor after turning the main switch off.
2. Turn the main switch on, and measure the voltage with an voltmeter across the lead terminal and the chassis.
3. If the voltage differs from the battery voltage, the wiring harness, fuse or coolant temperature gauge is faulty.

Voltage	Lead terminal - Chassis	Approx. battery voltage
---------	-------------------------	-------------------------

**Coolant Temperature Sensor Continuity**

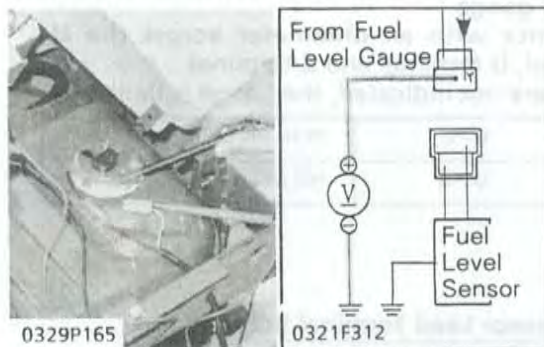
1. Measure the resistance with an ohmmeter across the sensor terminal and the chassis.
2. If the measurement is not indicated, the sensor is faulty.

Resistance (Sensor terminal) - Chassis	Factory spec	Approx. 12.2 ohms at 130°C (266°F) Approx. 23.6 ohms at 105°C (221°F) Approx. 51.9 ohms at 80°C (176°F) Approx. 153.9 ohms at 50°C (122°F) Approx. 800.0 ohms at 19°C (66.2°F)
--	-----------------	--

**Coolant Temperature Gauge**

1. Remove the coolant temperature gauge.
2. Measure the resistance with ohmmeter across the U terminal and + terminal, U terminal and - terminal.
3. If the measurement is not indicated, the gauge is faulty.

Resistance	U - +	100 to 120 ohms
	U - -	70 to 100 ohms

[L2650, L2950, L3450, L3650]**Fuel Level Sensor Lead Terminal Voltage**

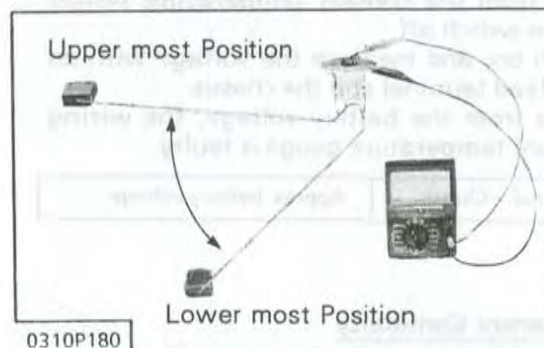
1. Disconnect the connector from the fuel gauge unit after turning the main switch off.
2. Turn the main switch on and measure the voltage with a voltmeter across the wiring harness connector Y terminal and the chassis.
3. If the voltage differs from the battery voltage, the wiring harness is faulty.

Voltage	Lead terminal - Chassis	4 to 7 voltage
---------	-------------------------	----------------

Fuel Level Sensor Continuity

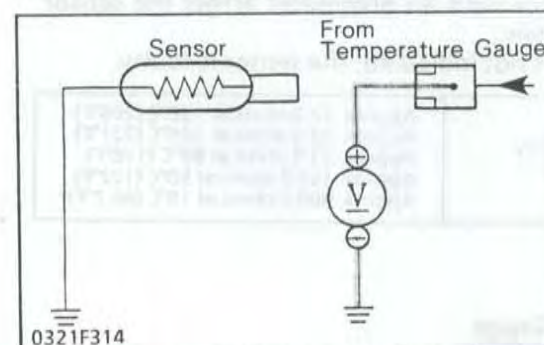
1. Remove the fuel level sensor from the fuel tank.
2. Measure the resistance with an ohmmeter across the sensor terminal and its body.
3. If the reference values are not indicated, the sensor is faulty.

Resistance (Sensor terminal - its body)	Reference value	Float at upper- most position	1 to 5 ohms
		Float at lower- most position	103 to 117 ohms

**Coolant Temperature Sensor Lead Terminal Voltage**

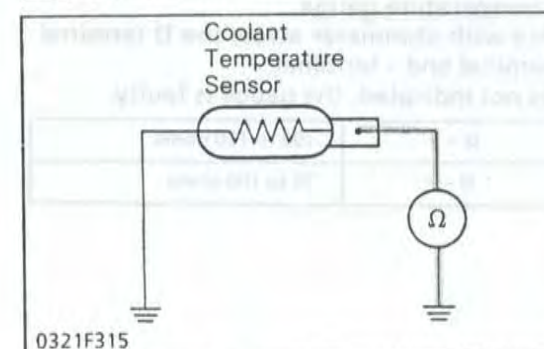
1. Disconnect the lead from the coolant temperature sensor after turning the main switch off.
2. Turn the main switch on, and measure the voltage with an voltmeter across the lead terminal and the chassis.
3. If the voltage differs from the battery voltage, the wiring harness, fuse or coolant temperature gauge is faulty.

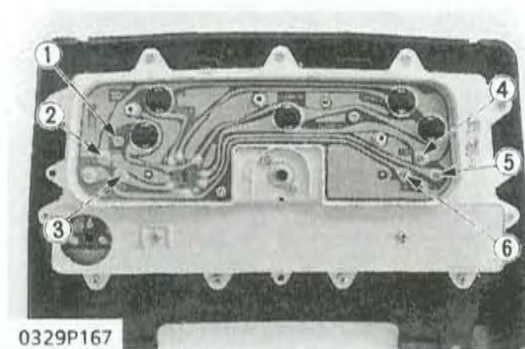
Voltage	Lead terminal - Chassis	Approx. battery voltage
---------	-------------------------	-------------------------

**Coolant Temperature Sensor Continuity**

1. Measure the resistance with an ohmmeter across the sensor terminal and the chassis.
2. If the reference value is not indicated, the sensor is faulty.

Resistance (Sensor terminal - Chassis)	Reference value	Approx. 12.2 ohms	at 130°C(266°F)
		Approx. 23.6 ohms	at 105°C(221°F)
		Approx. 51.9 ohms	at 80°C(176°F)
		Approx. 153.9 ohms	at 50°C(122°F)
		Approx. 800.0 ohms	at 19°C(66.2°F)





- (1) **GND** Terminal
(2) **IG** Terminal
(3) **Tu** Terminal

- (4) **GND** Terminal
(5) **Fu** Terminal
(6) **IG** Terminal

Fuel Gauge, Coolant Temperature Gauge

1. Remove the panel board from the tractor.
2. Measure the resistances with an ohmmeter across the **FU** terminal (5) and **IG** terminal (6) and across the **FU** terminal (5) and **GND** terminal (4).
3. If the reference values are not indicated, the fuel gauge is faulty.
4. Measure the resistances with an ohmmeter across the **TU** terminal (3) and **IG** terminal (2) and across the **TU** terminal (3) and **GND** terminal (1).
5. If the reference values are not indicated, the coolant temperature gauge is faulty.

Fuel Gauge			
Resistance	Reference value	FU – IG	60 to 68 Ω
		FU – GND	166.5 to 171.5 Ω

Coolant Temperature Gauge			
Resistance	Reference value	TU – IG	86 to 94 Ω
		TU – GND	155.3 to 160.3 Ω

(29°C, 84°F)



KUBOTA TRACTOR CORPORATION

CORPORATE OFFICE: 3401 DEL AMO BOULEVARD, TORRANCE, CA 90503

WESTERN DIVISION: 1175 S. Guild Ave., Lodi, CA 95240 • (209) 334-9910

CENTRAL DIVISION: 14855 F.A.A. Blvd., Fort Worth, TX 76155 • (817) 871-0900

NORTHERN DIVISION: One Kubota Way, Groveport, OH 43125 • (614) 835-1100

SOUTHEAST DIVISION: 1025 Northbrook Parkway, Suwanee, GA 30024 • (770) 995-8855



PRINTED IN U.S.A.
May 2002
Code No. 97897-11222



