Service Manual

Chassis & Mast

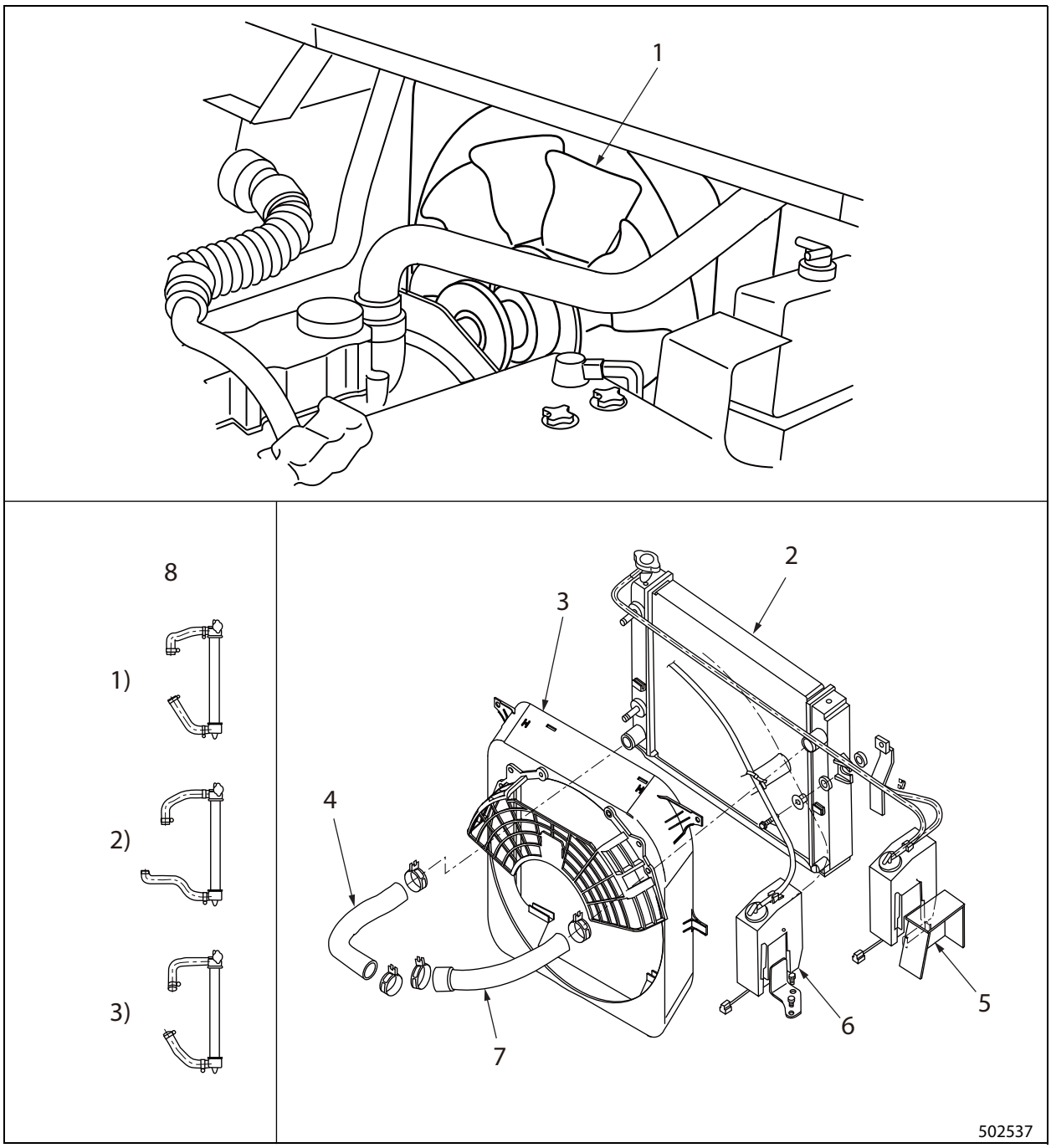
MC

GP15N	CT25C-55001-up	GPE15N	CT34-00001-up	DP15N	CT16D-54001-up
GP15ZN	CT34-52001-up	GPE18N	CT34-40001-up	DP18N	CT16D-74001-up
GP18N	CT25C-75001-up	GPE20CN	CT34-30001-up	DP20CN	CT16D-24001-up
GP18ZN	CT34-72001-up	GPE20N	CT17D-20001-up	DP20N	CT18C-20001-up
GP20CN	CT34-22001-up	GPE20ZN	CT35-20001-up	DP25N	CT18C-70001-up
GP20N	CT17D-10001-up	GPE25N	CT17D-70001-up	DP30N	CT14E-10001-up
GP20ZN	CT35-10001-up	GPE25ZN	CT35-70001-up	DP35N	CT14E-80001-up
GP25N	CT17D-60001-up	GPE30N	CT13F-10001-up		
GP25ZN	CT35-60001-up	GPE35N	CT13F-80001-up		
GP30N	CT13F-40001-up				
GP35N	CT13F-60001-up				

For use with K15, K21, K25, S4Q2 and S4S Engine Service Manuals.

99719-3F110

2. Structure



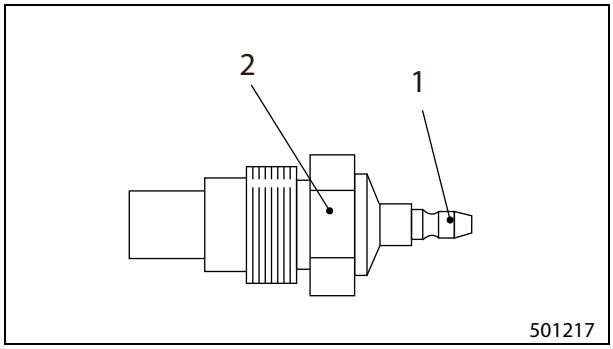
1. Fan (coupled directly to engine crankshaft)
2. Radiator
3. Shroud
4. Lower hose
5. Reserve tank (gasoline engine)
6. Reserve tank (S4Q2 and S4S)
7. Upper hose
8. Hose arrangement

1) S4Q2 engine
2) Gasoline engine
3) S4S engine

3.22 Thermoswitch (Engine Coolant Temperature)

(1) Apply a tester between the terminal and the body and check for continuity (resistance value).
(2) Replace if there is no continuity or if the measurement does not meet the standard resistance value.

Note: The figure shown is for gasoline model.



1. Terminal 2. Body

Gasoline model

Temperature [°C (°F)]	60 ± 0.2 (108±0.4)	65 ± 0.2 (117±0.4)	80 ± 0.2 (144±0.4)	100 ± 0.3 (180±0.5)	125 ± 0.3 (225±0.5)	130 ± 0.3 (234±0.5)
Standard resistance (ohm)	80 ± 10	67 ± 7.8	40.6 ± 3.7	22.2 ± 1.4	11.3 ± 0.4	10 ± 0.3

Diesel model

Temperature [°C (°F)]	50 ± 0.2 (90±0.4)	60 ± 0.2 (108±0.4)	80 ± 0.2 (144±0.4)	100 ± 0.3 (180±0.5)	105 ± 0.3 (189±0.5)	120 ± 0.3 (216±0.5)
Standard resistance (ohm)	80 ± 10	56.3 ± 5	29.5 ± 2.5	16.5 ± 0.8	14.3 ± 0.5	10 ± 0.3

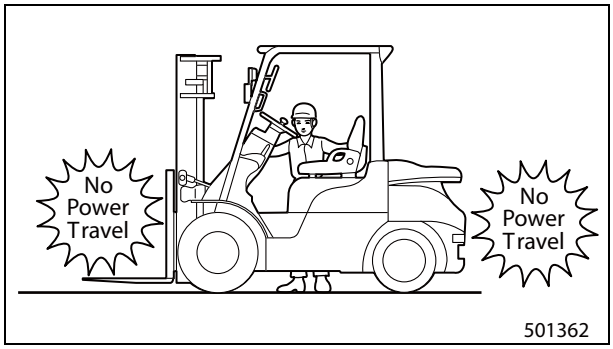
7.4 Warning System Problem

Condition		Possible cause	Action
Horn	Horn does not sound	Burned-out fuse	Check and correct the cause, then replace
		Disconnection or poor connection	Repair or replace
		Horn button continuity is faulty	Repair or replace
		Horn switch is faulty	Replace
		Horn is faulty	Replace
	Sound quality is bad	Horn switch is faulty	Replace
		Horn is faulty	Replace

5. Driving Interlock System

5.1 Controller Function

(1) The controller monitors the conditions below. If all the conditions are met, the controller activates the driving interlock system.
- The operator is not seated. (Seat switch and seat switch timer [OFF])
- Truck speed is less than 4 km/h (2.5 mph). (Speed sensor value)
- The parking brake is released (at pulled position). (Parking brake switch is ON)



(2) The controlled condition by the driving interlock system will vary depending on truck speed.
- If the speed is more than 4 km/h (2.5 mph), the driving interlock control is de-activated.
- If the speed is less than 4 km/h (2.5 mph), the transmission solenoid F and R are turned OFF, and the power from the engine is cut off.
- If the speed is less than 1 km/h (0.62 mph), the parking brake solenoid is turned OFF, and the parking brake (negative brake) is activated to stop the truck.

Note: Because the controller electrically controls the system, there is no physical movement of the direction lever and the parking brake switch.

⚠ CAUTION

(1) Be alert when the truck is on a grade. The truck may move and accelerate, instead of being stopped, depending on a road condition.

(2) Be sure to check the driving interlock function before operating the truck.

(3) This interlock system is provided only for risk reduction in case of a contingency. Always drive the truck properly with safety in mind.

(4) When restoring the truck to its normal driving condition, be sure to observer the instructions below.
- Sit properly in the operator seat.
- Press the brake pedal to completely stop the truck.
- Place the direction lever to the NEUTRAL position once, and then shift it back to the forward or reverse position.
- Push down the parking brake switch in the lock position, and then pull it back to bring to the released position.

(5) When replacing the operator seat with a new one, be sure to use the Mitsubishi genuine seat with an operator presence switch.

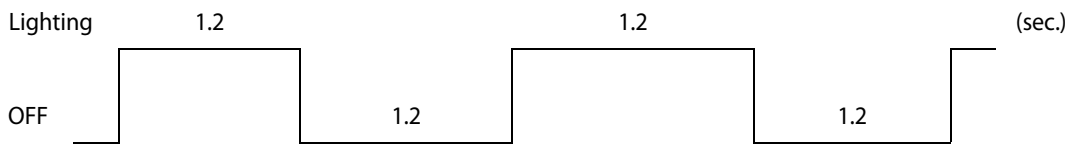
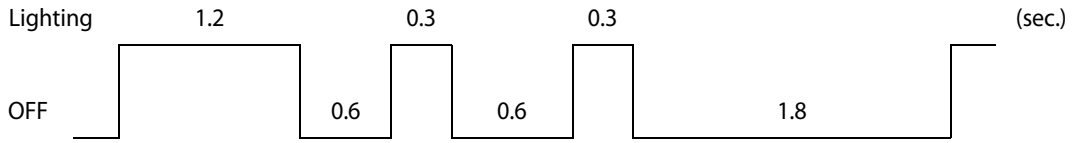
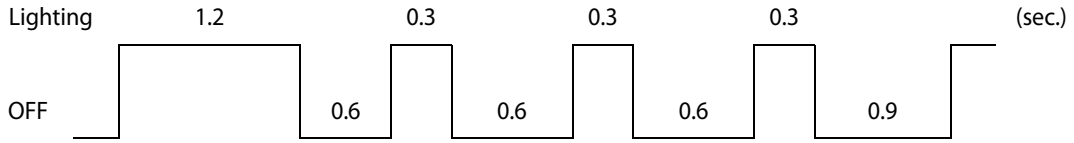
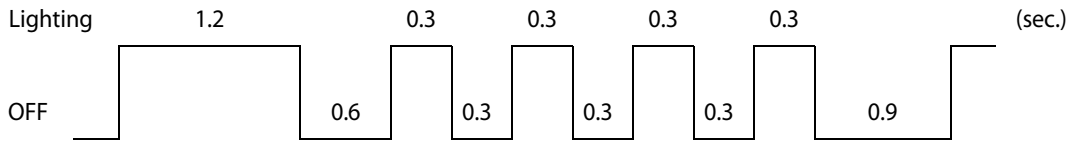
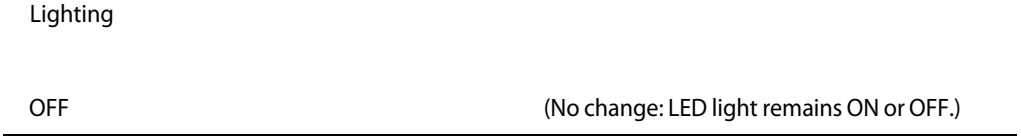
Controller function

The controller monitors the seat switch and if the operator is not seated, automatically locks the shift position in NEUTRAL when the speed is 4 km/h (2.5 mph) or less.

10.3 LED Blink Pattern

When diagnostic codes cannot be identified due to meter panel failure etc., or due to a VCM1-M communication circuit problem, GSE cable damage or no presence of GSE, diagnostic codes can be identified, to some extent, by the LED blink pattern of the VCM1-M controller.

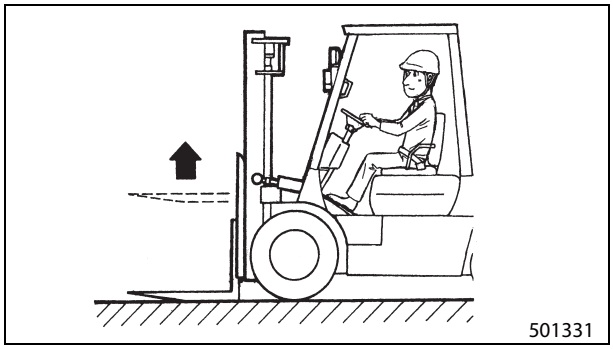
Note: Place the key switch in the ON position for checking.

LED blink pattern	LED blinking status
A	
B	
C	
D	
E	
F	

4.2 VCM-1M Controller, Mast Interlock System Checking Procedure

Mast interlock system

- Raise the forks high enough to see them from the operator seat.
- Apply the parking brake and place the direction lever to the NEUTRAL position. Then, with the engine idling (the status when the accelerator pedal is not being pressed), half rise from the operator seat.
- Check that the mast interlock indicator light blinks in a few seconds. Operate the lift lever to make sure that the forks will not move up and down.
- Operate the tilt lever to ensure the mast does not tilt forward or backward.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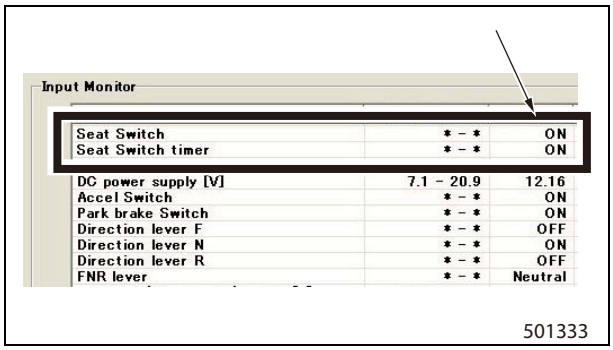
⚠ CAUTION

Make sure that sufficient space is available for the truck to move around and that no one or no obstacle is around the truck.

VCM-1M controller, Mast interlock system checking procedure

(1) Connect the service tool to the VCM-1M controller.
(2) Turn the key switch to the ON position and start the engine.
(3) Display the input monitor screen of the service tool.
(4) Sit in the operator seat and make sure that the seat switch status and the seat switch timer are ON on the input monitor screen.



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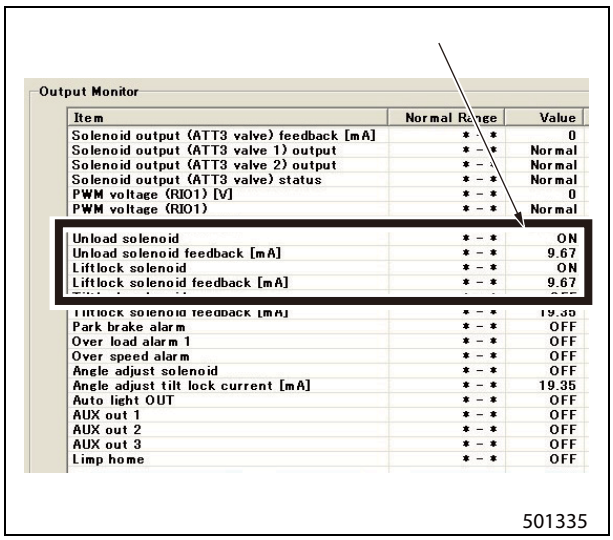
(5) Display the service tool output monitor screen. When the status of the seat switch timer is ON, the controller unlocks the mast interlock and turns the unload output and the lift lock output ON.
You can operate the mast system under this condition.
- Operate the lift lever to check that the forks move up and down, and operate the tilt lever to check that the mast tilts forward and backward.



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Diagnosis	TMS communication warning (F08)
Logic conditions	· No CAN received from TMS. (2-second continuity) ——— F08
Recovery	Auto recovery
Action	· Activates with default values of TMS incoming data.
LED blink pattern	B

Diagnosis	Lift Lever Neutral Warning (F10)
Logic conditions	· Lift lever open angle is 20% or more. (when key switch is ON) ——— F10
Recovery	Auto recovery when the lever is placed in neutral.
Action	· Turn OFF all solenoid outputs of operating functions. · Turn OFF the unload solenoid.
LED blink pattern	C

Diagnosis	Tilt Lever Neutral Warning (F11)
Logic conditions	· Tilt lever open angle is 20% or more. (when key switch is ON) ——— F11
Recovery	Auto recovery when the lever is placed in neutral.
Action	· Turn OFF all solenoid outputs of operating functions. · Turn OFF the unload solenoid.
LED blink pattern	C

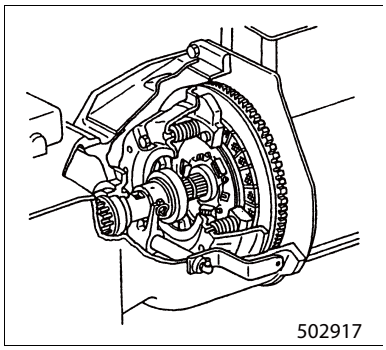
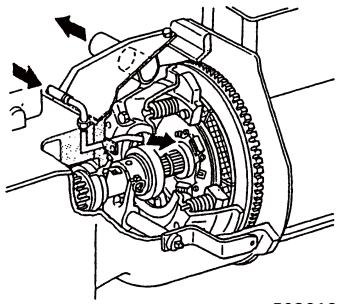
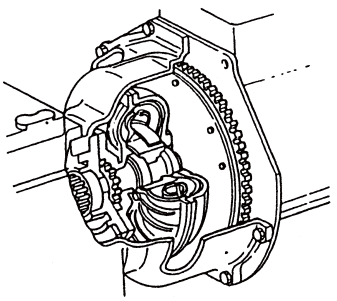
Diagnosis	Attachment 1 Lever Neutral Warning (F12)
Logic conditions	· Attachment 1 lever open angle is 20% or more. (when key switch is ON) ——— F12
Recovery	Auto recovery when the lever is placed in neutral.
Action	· Turn OFF all solenoid outputs of operating functions. · Turn OFF the unload solenoid.
LED blink pattern	C

Diagnosis	Attachment 2 Lever Neutral Warning (F13)
Logic conditions	· Attachment 2 lever open angle is 20% or more. (when key switch is ON) ——— F13
Recovery	Auto recovery when the lever is placed in neutral.
Action	· Turn OFF all solenoid outputs of operating functions. · Turn OFF the unload solenoid.
LED blink pattern	C

Chapter 6 CLUTCHES

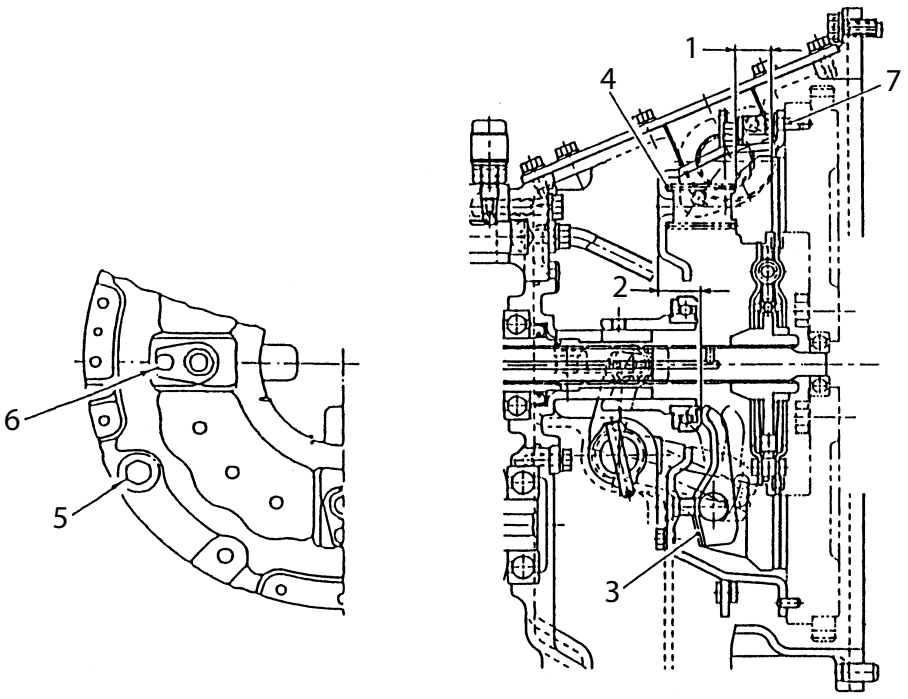
1. Structure

1.1 Advantages and Disadvantages of Clutches by Type of Drive System

Specification		Advantage/Disadvantage	Structure
Direct drive	Dry type clutch	- A half-clutch operation allows a delicate loading and unloading operation. This clutch contributes to the fuel economy because it allows economical use of engine output with limited power transmission loss. Depending on the nature of loading/unloading - operation, excessive half-clutch operation shortens the service life of clutch disc and increases maintenance cost. The operation of the truck with this type of clutch requires more kill than powershift model.	 502917
	Wet type clutch	- Although this type of clutch is equal to the dry-type in pedal operation feeling and contribution to fuel economy, the wet-type clutch has a significantly longer - service life than the dry-type even if half-clutch operation is frequently performed. For the users who operate the truck for long periods under severe condition, or for the trucks with attachments like roll camp that requires frequent half-clutch operation, or for the trucks with hinged forks that requires traction force, the wet-type clutch has a huge economic advantage than the dry type owing its longer service life.	 502918
Torque converter drive		- Operation is easy. This results in minimum operator fatigue and improves work efficiency. (Efficiency is improved by about 10% compared to direct drive - model although it depends on the operation.) Hydraulically operated wet-type clutch incorporated in the transmission lasts longer, offering the same advantage as that of wet-type clutch (direct drive) - trucks mentioned above. In fuel consumption versus work load, a torque converter truck is inferior to the direct drive model by about 10% due to power transmission loss. (About 20% loss per hour, and workload increases by about 10%. This is for reference only because these percentages differ depending on the nature of operation.)	 502919

Pressure plate

Item			Specified value	
-	Flatness of plate		Standard	0.05 mm (0.0020 in.) or less
			Limit	0.2 mm (0.008 in.)
1	Thickness of plate (from spring seat to friction plate)		Standard	22.8 mm (0.898 in.)
			Limit	21.0 mm (0.827 in.)
2	Release lever height (with 2.1 mm (0.0827 in.) of the disc wear amount)		Standard	26.5 mm (1.043 in.)
			Limit	16.5 mm (0.650 in.)
3	Maximum permissible difference between heights of all release levers		Standard	0.7 mm (0.028 in.)
4	Pressure spring	Quantity per clutch	Standard	S4Q2,S4S models: 12 pcs K15,K21,K25 models: 10 pcs
		Free length	Standard	78.8 mm (3.102 in.)
		Installed length/installed load	Standard	48.2 mm (1.898 in.)/643 ± 5% N
5	Washer mounting bolt		Tightening torque	39 to 59 N·m (4.0 to 6.0 kgf·m) [28.76 to 43.52 lbf·ft]
6	Lockplate mounting bolts		Tightening torque	5.8 to 7.8 N·m (0.59 to 0.80 kgf·m) [4.278 to 5.753 lbf·ft]
7	Pressure plate		Tightening torque	17 N·m (1.7 kgf·m) [12.54 lbf·ft]



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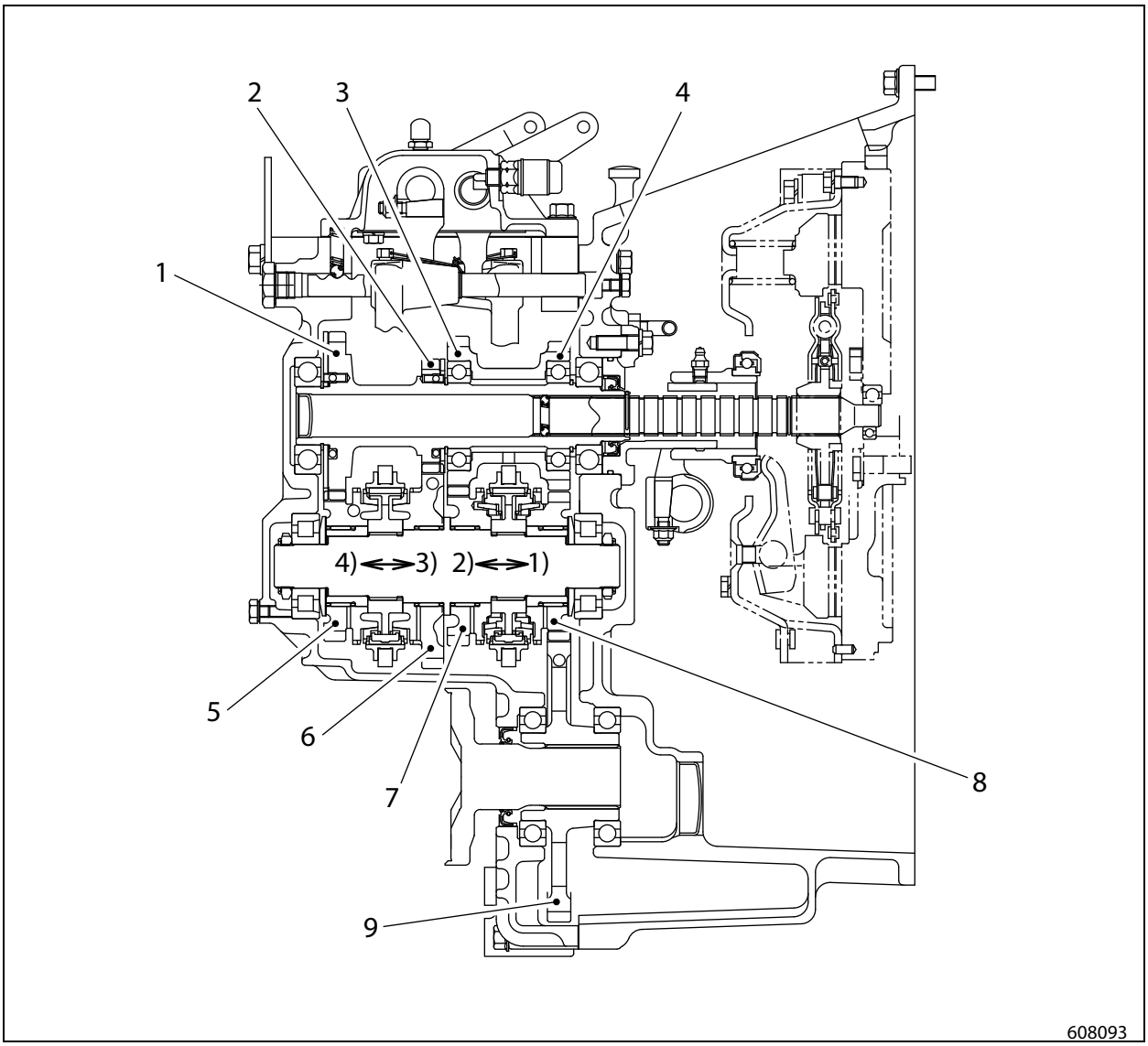
Chapter 7 MANUAL TRANSMISSION

1. Structure

1.1 Components of Transmission

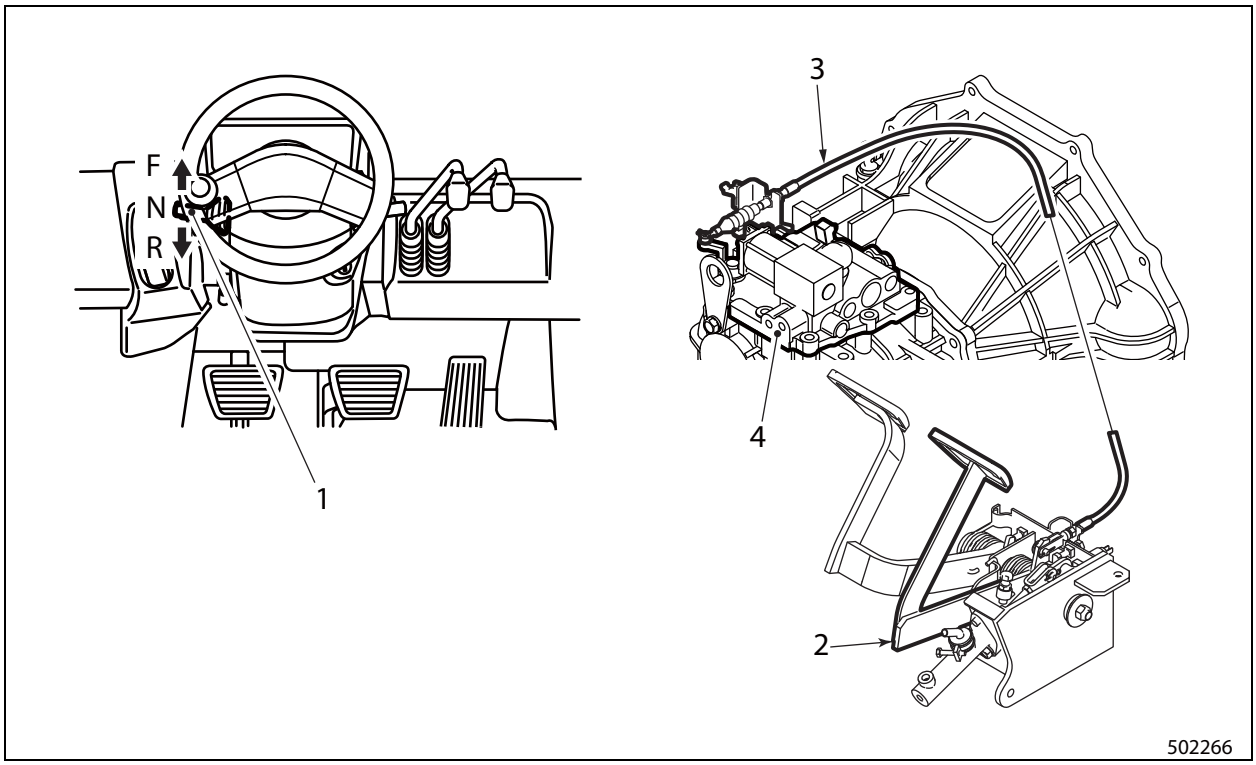


Note: Number of gear teeth is shown in the ( ).

1. Input gear (35)
2. Input gear (23)
3. Idler gear (33)
4. Idler gear (30)
5. High gear (31)
6. Low gear (43)
7. Reverse gear (33)
8. Forward gear (30)
9. Output gear (61)

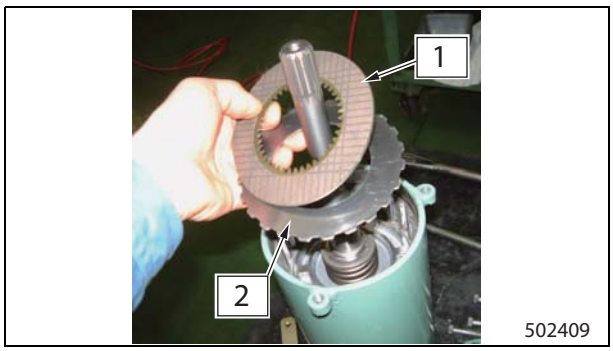
1) F: Forward
2) R: Reverse
3) L: 1st gear
4) H: 2nd gear

1.5 Torque Converter Drive Control Components

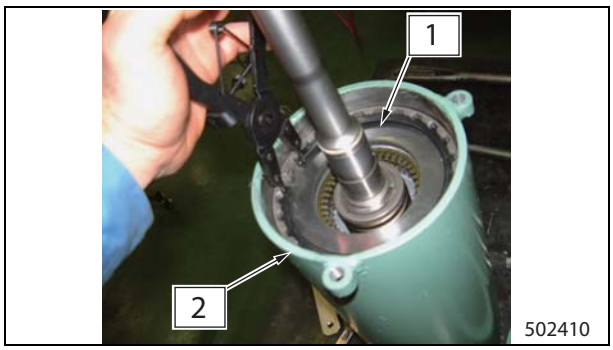


1. Direction lever
2. Clutch (inching) pedal
3. Cable (inching)
4. Control valve assembly

(3) Instal snapring.



1. Friction plate
2. Mating plate



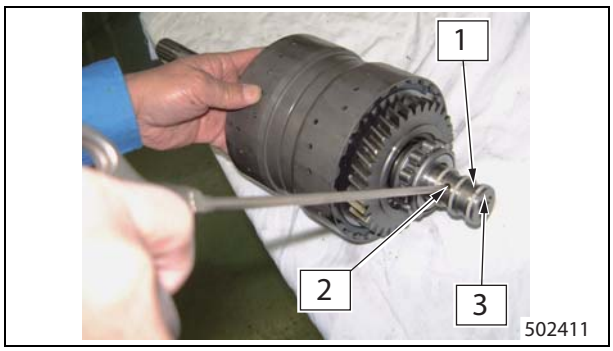
1. Snapring
2. Special tool (Stand)

Part name	Part number	Qty
Snapring	58622-03001	1

Forward clutch piston movement, Checking

Blow compressed air through forward side oil hole and ensure clutch piston moves properly.

Note: Be sure to use clean compressed air which is filtered through an air filter.



1. Forward side oil hole
2. Reverse side oil hole
3. Set screw

Forward gear assembly, Installing

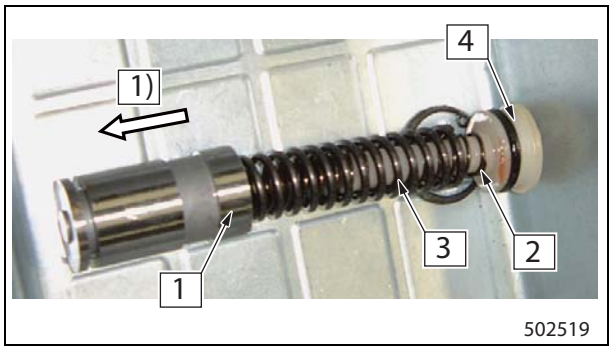
(1) Install forward gear.

1. Forward gear

7.6 Accumulator Valve Section, Assembling

Accumulator piston, Installing

Install accumulator piston on accumulator valve section.



1. Accumulator piston
2. Inner spring
3. Outer spring
4. Accumulator spring seat

1) Inching lever direction

Accumulator spring seat, Installing

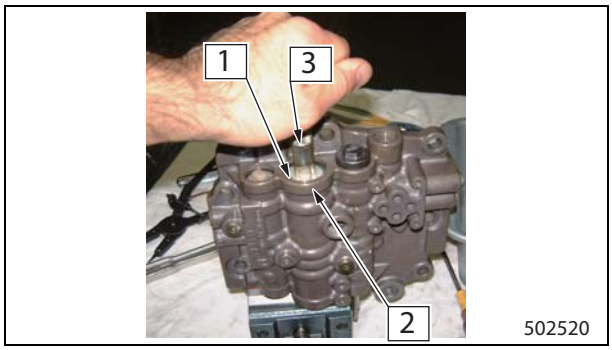
(1) Insert inner and outer springs.

(2) Install O-ring on accumulator spring seat and apply a thin coat of grease to O-ring.

(3) Insert accumulator spring seat on accumulator valve section.

Note: Do not reuse accumulator spring seats and O-rings. Always install new ones.

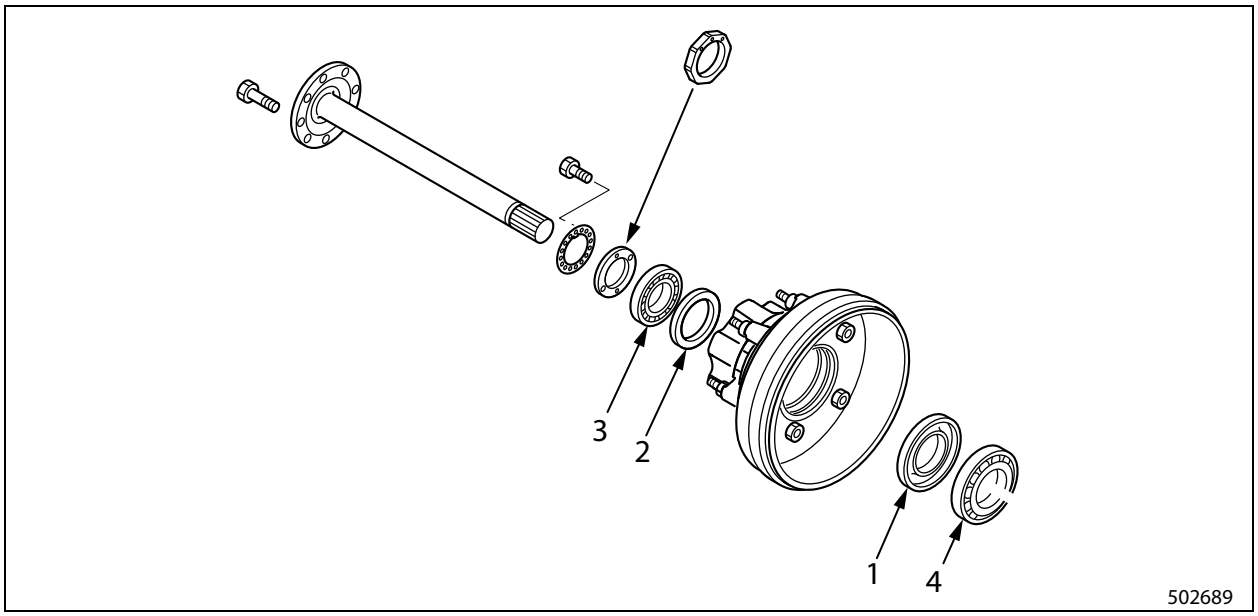
(4) While holding down accumulator spring seat, install snapring with the installer (special tool).



1. Accumulator spring seat
2. Accumulator valve section

3. Special tool (Installer)

Special tool	Part number
Installer	91A68-03100



1. Oil seal
2. Oil seal
3. Tapered roller bearing
4. Tapered roller bearing

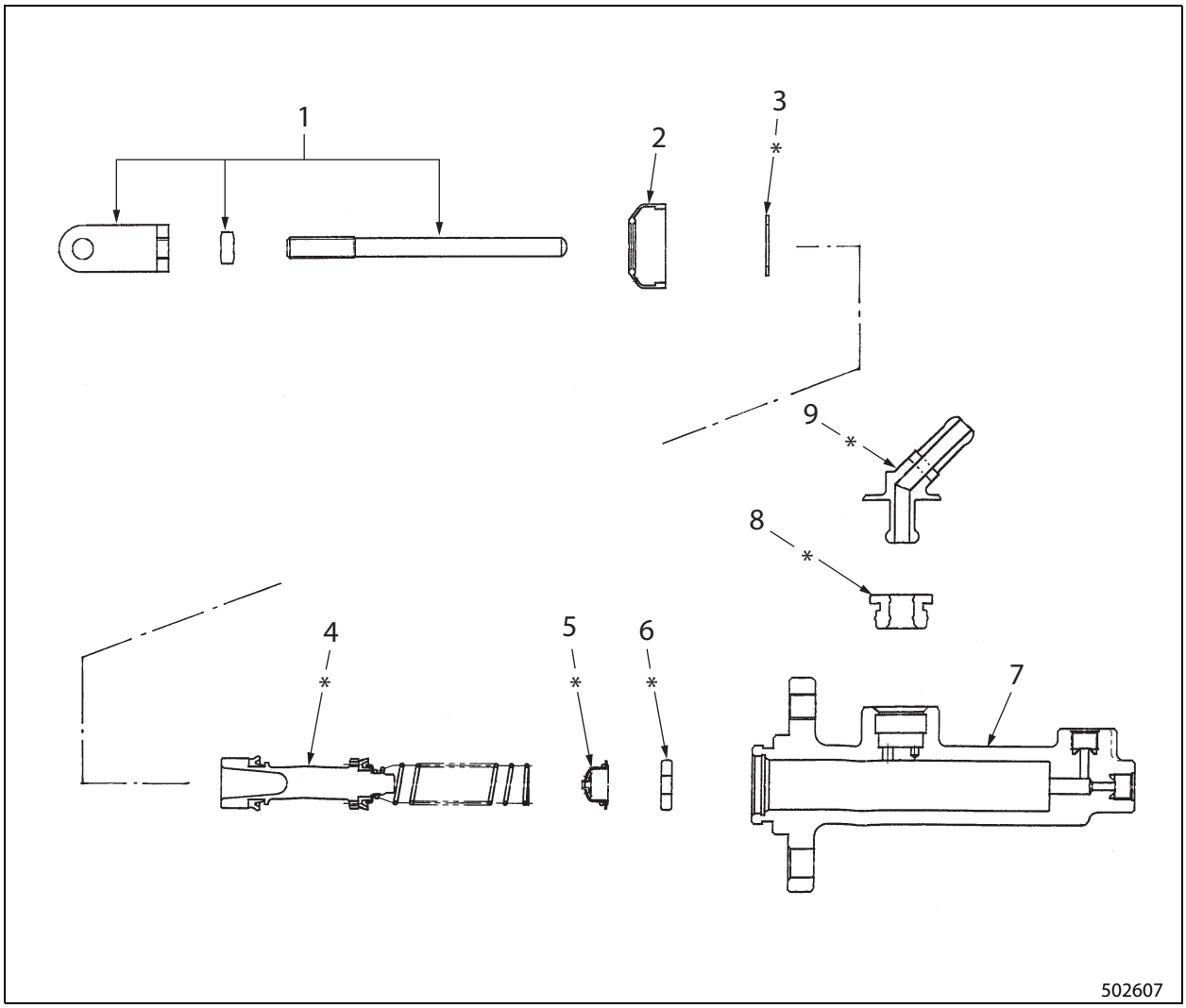
Special tool (Installer)		Truck classifications	
		1 ton class	2, 3 ton classes
1	Oil seal	91A68-00500	
2	Oil seal	91B68-00900	91E68-00700
3	Tapered roller bearing		91E68-00900
4	Tapered roller bearing		91E68-00800

- Apply sealant (ThreeBond 1184) to the flange surfaces of the axle shaft.

Note: DO NOT apply grease or oil to outer peripheral portion of oil seal when installing.

2. Master Cylinder, Disassembling

2.1 Disassembly Sequence



1. Clevis, Nut, Push rod
2. Boot
3. Snapring*
4. Piston assembly*
5. Valve assembly*
6. Valve seat*
7. Cylinder
8. Bushing*
9. Filler union*

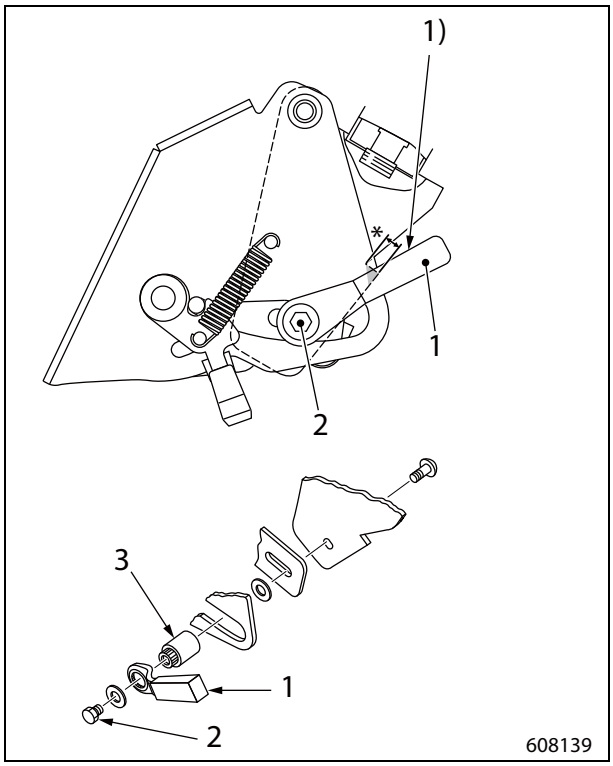
Note: The parts marked with * are included in the repair kit.

9. Tilt Lock Lever, Assembling

If the matchmark which made earlier, have disappeared, or when the lever is replaced with a new one, install the lever as instructed below:

(Figure shows relative positioning of tilt-neutral and column lock lever-lock)

(1) Tighten nut 3 to specified torque. (This is a lever locked state.)
(2) With the lever locked, select optimal position for the tilt lock lever and fit tilt lock lever into the serration of nut 3. The optimal position is within the range where bracket notch marked with * is crossing the upper aspect of the lever.
(3) Tighten lever mounting bolt 2.
(4) Loosen the tilt lock lever and make sure the bracket slides in the entire tilting area without interfering with other parts.



1. Tilt lock lever
2. Lever mounting bolt
3. Nut

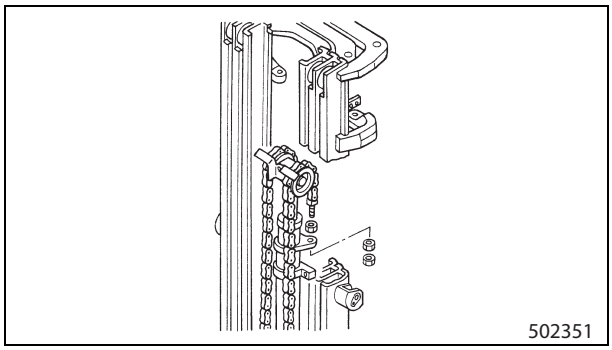
1) Lever aspect

Ref.	Item	Tightening torque
2	Lever mounting bolt	23 to 25 N·m (2.3 to 2.5 kgf·m) [16.96 to 18.44 lbf·ft]
3	Nut	11 to 15 N·m (1.1 to 1.5 kgf·m) [8.11 to 11.06 lbf·ft]

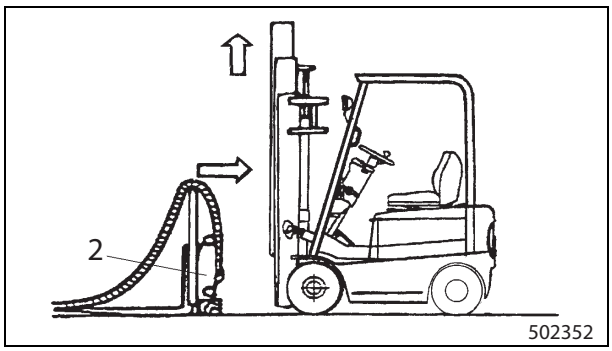
9.2 Suggestions for Removal

Removing lift bracket assembly

(1) Lower the lift bracket assembly onto wood blocks. Tilt the mast forward, and lower the inner mast to the ground to provide slack in chains. Remove nuts from the anchor bolts of the first lift chains.



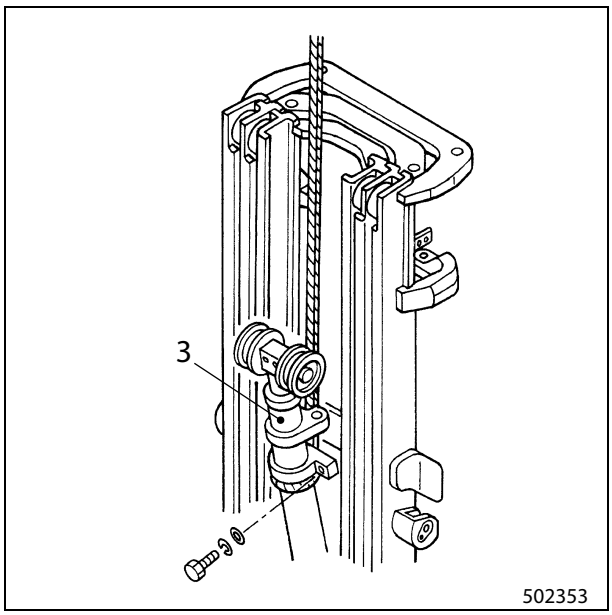
(2) Place the mast in a vertical position, and lift the inner mast until the upper rollers of the lift bracket 2 become free. Then, slowly move the truck backward.

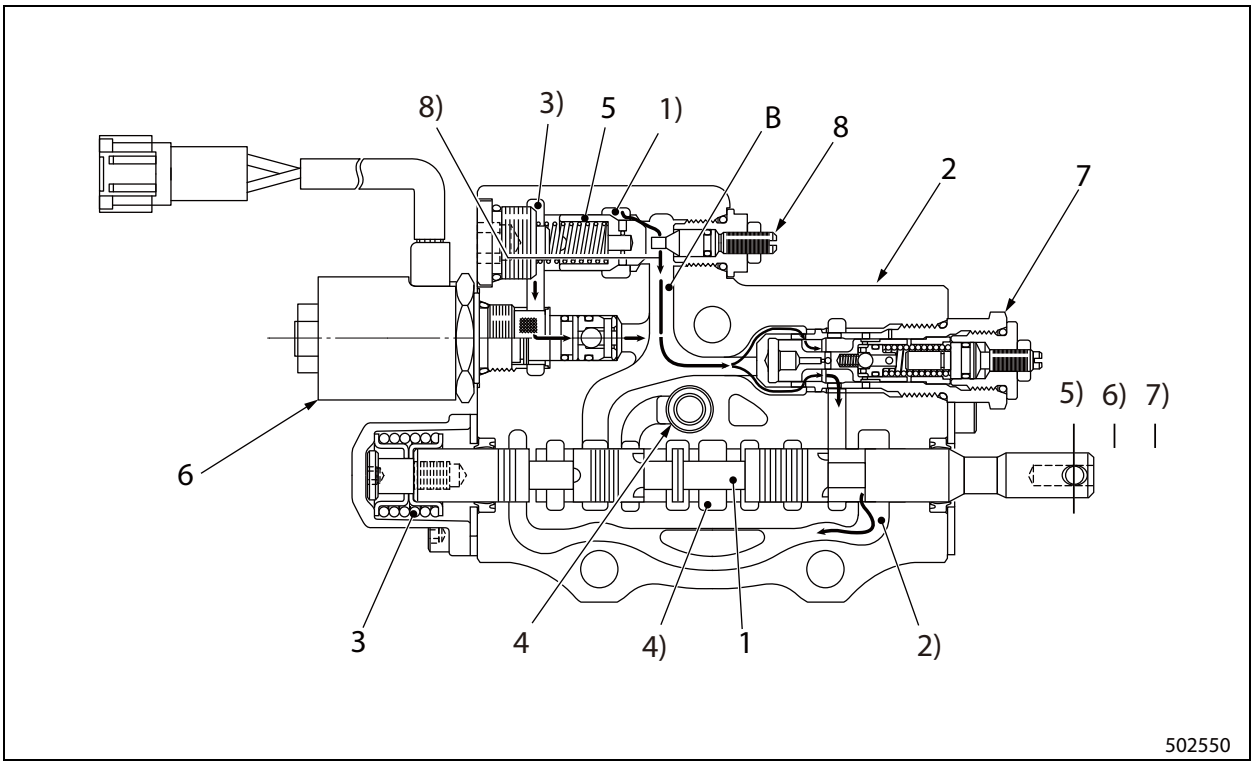


9.3 Removing First Lift Cylinders

(1) Attach a wire rope to the first lift cylinder, and suspend it with a hoist. Secure the wire rope firmly so that it will not slip.

(2) Remove the mounting bolts from the first lift cylinder, and slowly raise the first lift cylinder to remove.





1. Lift spool
2. Valve body
3. Return spring
4. Check valve
5. Load check valve
6. Solenoid valve
7. Flow regulator valve
8. Shut-off valve

1) Lift cylinder port
2) Tank port
3) Oil passage for opening load check valve
4) Center bypass port
5) Descent
6) Neutral
7) Ascent
8) Pilot oil

Descending position of lift cylinder

The figure above shows the lift control valve when spool 1 is at "descending position".

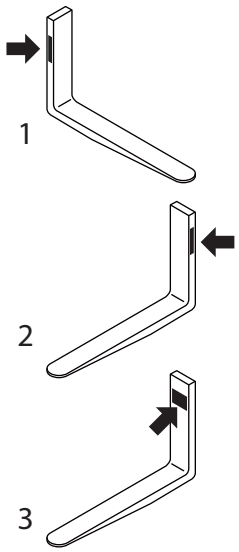
Spool 1, pushed into body 2, is at position as shown in the figure. The center bypass port is not blocked. The secondary port of flow regulator valve 7 is open to port T2 (return passage).

When the operator sits in the seat, Vehicle Control Module (VCM-1M) detect it, making an electric current flow to solenoid valve 6 to activate the solenoid.

When the solenoid activates, pilot oil 8) behind load check valve 5 is released to passage B. Thereby, load check valve 5 moves to the left (figure) by pressure of port A1 and oil in the port A1 flows into port T2 through flow regulator valve 7.

Shut-off valve 8 forcibly opens load check valve 5 if the load check valve does not automatically activate due to malfunction of solenoid 6 or any other reason. Just loosen the locknut and push the screw in.

Model	Type		Blade size	Limit
1 to 2tC	1	HX**** x 500	35 x 100 x 770 to 1970	32.5 mm (1.280 in.)
	2	T****	35 x 100 x 770 to 1520	31.5 mm (1.240 in.)
	3	Without Mark **** or U**** or UQ****	37 x 100 x 1370 to 1970	32.5 mm (1.280 in.)
2 to 2.5t	1	HX**** x 500	40 x 122 x 920 to 1970	35.5 mm (1.398 in.)
	2	T****	40 x 122 x 920 to 1370	35.0 mm (1.378 in.)
			45 x 122 x 1520 to 1970	40.0 mm (1.575 in.)
	3	Without Mark **** or U**** or UQ****	42 x 110 x 920 to 1070	40.0 mm (1.575 in.)
			42 x 125 x 1150 to 1970	40.0 mm (1.575 in.)
3 to 3.5t	1	HX**** x 500	50 x 125 x 1070 to 1970	45.0 mm (1.772 in.)
			50 x 122 x 1070 to 1970	45.0 mm (1.772 in.)
	2	T****	50 x 122 x 1070 to 1520	45.0 mm (1.772 in.)
	3	Without Mark **** or U**** or UQ****	50 x 125 x 1070 to 1970	45.0 mm (1.772 in.)



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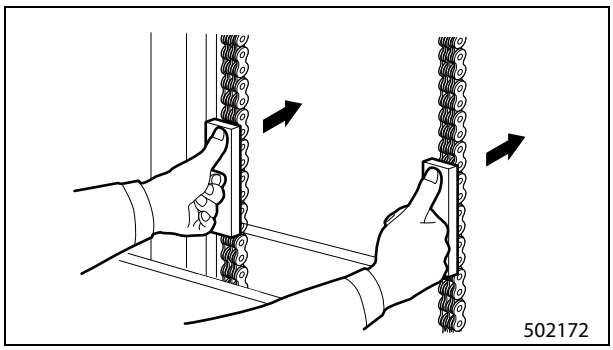
2.21 Chain Tension, Inspection and Adjustment (All Mast Models)

⚠ CAUTION

Be sure to turn the key switch to the OFF position before inspecting or adjusting lift chains, anchor bolts and nuts in order to prevent serious injury or death caused by a sudden movement of the mast and the lift bracket. Also be sure to place wood blocks under the forks in order to prevent serous injury or death caused by a sudden movement of the forks when they are raised.

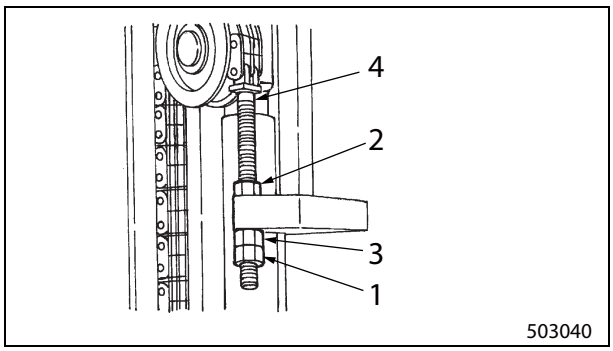
Inspecting chain tension

(1) Place the mast vertically on level ground, then lower the forks to the ground. Make sure that the lift cylinders are fully retracted.
(2) Raise the forks approximately 10 cm (0.4 in.) off the ground.
(3) Turn the key switch to the OFF position.
(4) Place wood blocks with the height of approximately 9 cm (0.4 in.) under forks.
(5) Push both chains at the midpoint between the chain wheel and the fixed chain end on the lift bracket.
Make sure the tension in the right and left chains are the same.
If uneven, adjust the chain tension.



Adjusting right and left chain balance

(1) Remove the wood blocks under the forks.
Start the engine.
(2) Lower the forks to the ground. Tilt the mast forward to allow slack in the chain.
(3) Turn the engine OFF.
(4) Loosen the double nut (lower).
Loosen the upper nut.
(5) Adjust chain tension by turning the double nut (upper).
(6) Start the engine and place the mast in a vertical position.
(7) Repeat above Steps 2 through 5 of "Inspecting chain tension" to check chain tension and adjust as needed.



1. Double nut (lower)
2. Clamp
3. Double nut (upper)
4. Anchor bolt

Tightening nuts after adjustment

(1) Hold the anchor bolt with a spanner wrench and tighten the clamp.
(2) Hold the double nut (upper) with a wrench and tighten the double nut (lower) to the specified torque.

Item		Specified value	
		1-2 ton class	3 ton class
Nut (upper and lower)	Tightening torque	98^{+49}_{0} N·m ($9.99^{+5.0}_{0}$ kgf·m) [$72.28^{+36.14}_{0}$ lbf·ft]	147^{+49}_{0} N·m ($14.99^{+5.0}_{0}$ kgf·m) [$108.42^{+36.14}_{0}$ lbf·ft]

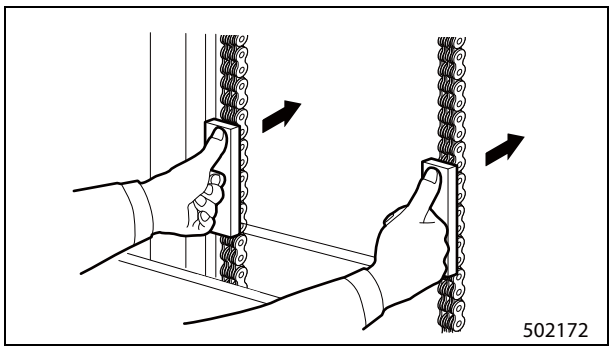
3.21 Chain Tension, Inspection and Adjustment (All Mast Models)

⚠ CAUTION

Be sure to turn the key switch to the OFF position before inspecting or adjusting lift chains, anchor bolts and nuts in order to prevent serious injury or death caused by a sudden movement of the mast and the lift bracket. Also be sure to place wood blocks under the forks in order to prevent serous injury or death caused by a sudden movement of the forks when they are raised.

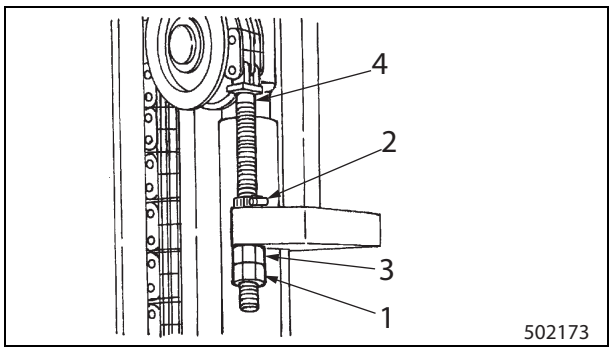
Inspecting chain tension

(1) Place the mast vertically on level ground, then lower the forks to the ground. Make sure that the lift cylinders are fully retracted.
(2) Raise the forks approximately 10 cm (0.4 in.) off the ground.
(3) Turn the key switch to the OFF position.
(4) Place wood blocks with the height of approximately 9 cm (0.4 in.) under forks.
(5) Push both chains at the midpoint between the chain wheel and the fixed chain end on the lift bracket.
Make sure the tension in the right and left chains are the same.
If uneven, adjust the chain tension.



Adjusting right and left chain balance

(1) Remove the wood blocks under the forks.
Start the engine.
(2) Lower the forks to the ground.
Tilt the mast forward to allow slack in the chain.
(3) Turn the engine OFF.
(4) Loosen the double nut (lower).
Then loosen the clamp.
(5) Adjust chain tension by turning the double nut (upper).
(6) Start the engine and place the mast in a vertical position.
(7) Repeat above Steps 2 through 5 of "Inspecting chain tension" to check chain tension and adjust as needed.



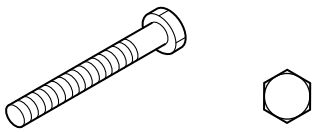
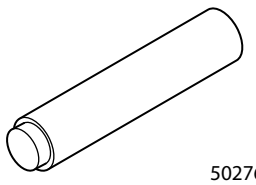
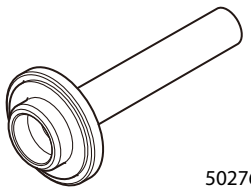
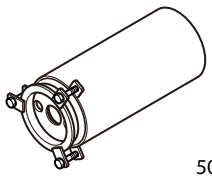
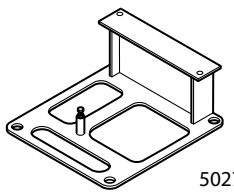
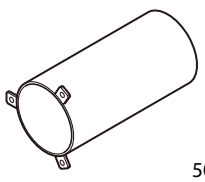
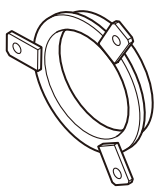
1. Double nut (lower)
2. Clamp
3. Double nut (upper)
4. Anchor bolt

Tightening nuts after adjustment

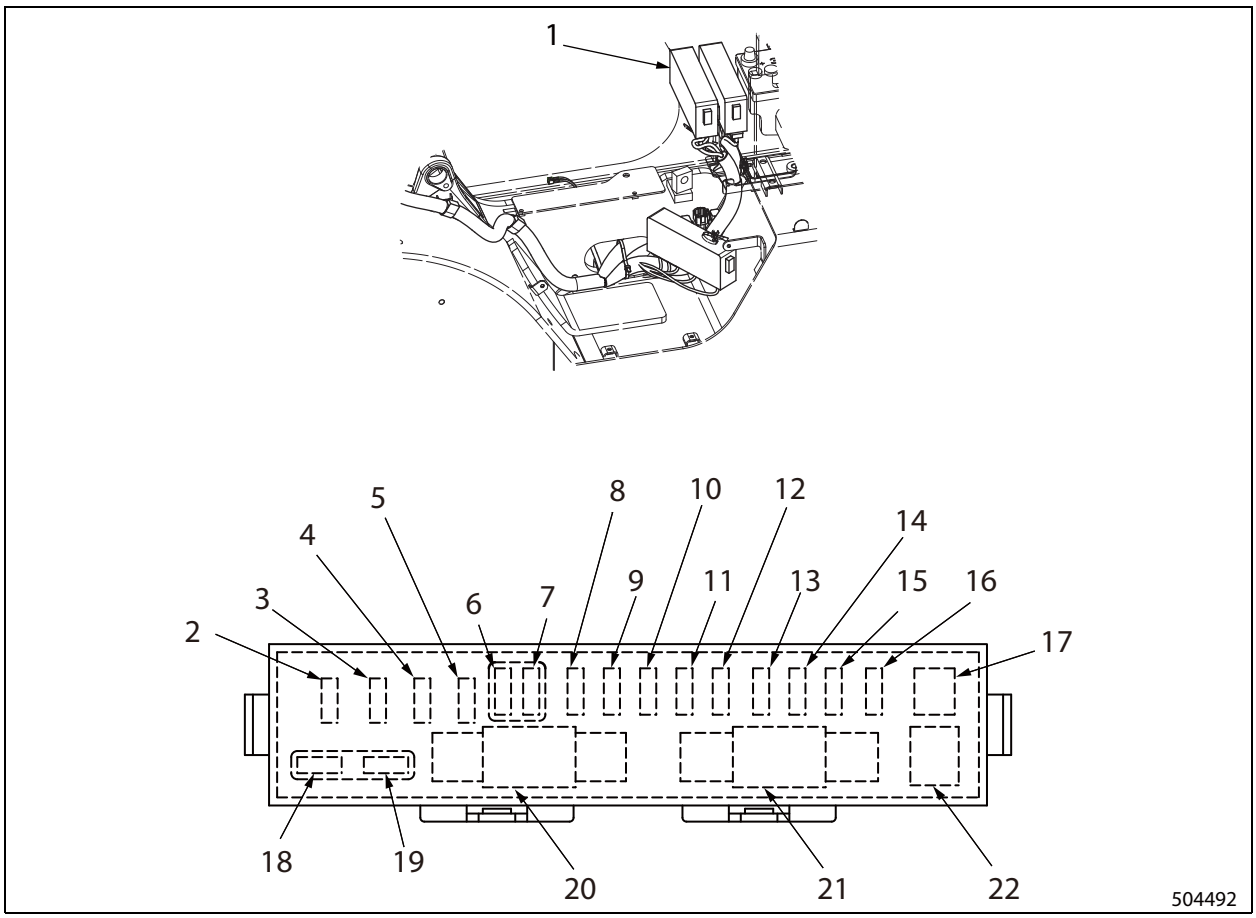
(1) Hold the anchor bolt with a spanner wrench and tighten the clamp.
(2) Hold the double nut (upper) with a wrench and tighten the double nut (lower) to the specified torque.

Item		Specified value	
		1-2 ton class	3 ton class
Nut (upper and lower)	Tightening torque	98^{+49}_{0} N·m ($9.99^{+5.0}_{0}$ kgf·m) [$72.28^{+36.14}_{0}$ lbf·ft]	147^{+49}_{0} N·m ($14.99^{+5.0}_{0}$ kgf·m) [$108.42^{+36.14}_{0}$ lbf·ft]

5.2 Special Service Tools (For Powershift Transmission)

No.	Name	Part number	Figure	Use	Truck classifications		
					1 ton class	2 ton class	3 ton class
1	Bolt	67281-05100	 502766	Oil pump removal Idler gear bearing outer race removal	×	×	×
2	Installer	91268-04100	 502767	Angular bearing removal Input spacer installation Bearing installation	×	×	×
3	Installer	91268-05500	 502768	Output gear oil seal installation	×	×	×
4	Clutch pack stand kit	91A68-00010	 502769	Disassembling and Assembling Clutch Pack	×	×	×
5	Stand kit	91A68-00020	 502770	Holding transmission assembly	×	×	×
6	Stand	91A68-01300	 502771	Holding idler shaft assembly Output gear stand Input shaft assembly stand	×	×	×
7	Plate 1	91A68-01400	 502772	Retracting clutch springs	×	×	×

3.12 Fuse Box



1	Fuse box			12	Head light	15 A	
2	VCM	20A		13	Horn	10A	
3	Glow timer, etc.	10A		14	Stop light	10A	
4	Meter panel	10A		15	EGI	30A	*1
5	Backup light, etc.	15 A		16	EGI	30A	*1
6	Spare fuse	20A		17	Fuse puller		
7	Spare fuse	30A	*1	18	Spare fuse	10A	
8	Working light	15 A		19	Spare fuse	15 A	
9	ETC	15 A	*1	20	SBF battery	100A	
10	A/C	20A		21	SBF alternator	100A	
11	Windshield wiper	15 A		22	SBF glow	50A	*2

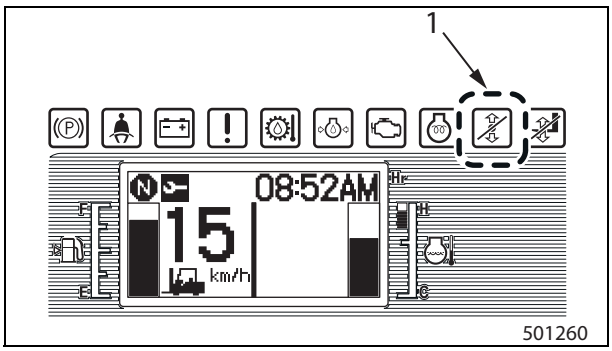
Note: The figure shown is for diesel model.
*1: Gasoline model only
*2: Diesel model only

Note: Set up the no setting on both screen A and B when the exterior alarm functions are unnecessary.

Smart shift display (Maker option)

The smart shift display function will notify an operator of the lift truck condition by the smart shift light glowing when the smart shift function activates against a full reverse or sudden acceleration. For setting up the smart shift display, use the service tool. (For details, see the service tool manual.)

Note: ONLY a service engineer should perform the smart shift function setting.



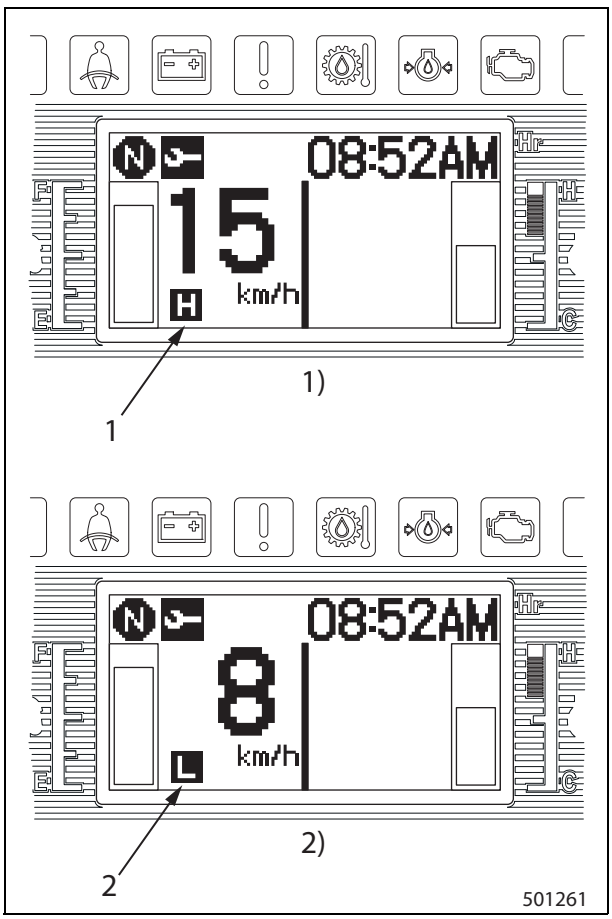
1. Smart shift indicator light

Speed restriction function (Manufacturer's option for diesel model only)

Speed restriction function will limit the maximum speed to both high and low pre-set speeds. H/L selector switch is used to change between high and low speeds. For setting up the speed restriction function, use the service tool. (For details, see the service tool manual.)

Note:

- Service engineers should perform the speed restriction function setting.
- Gasoline modeled include this function as a standard function.



1. High speed symbol
2. Low speed symbol

1) High speed limit display
2) Low speed limit display

Item			Specified value		
			2C ton class	2ton class	2ton class
			Diesel		Gasoline
Alternator drive belt deflection-when pushed inward with 98 N (10.0 kgf) [22.03 lbf] pressure			10 to 12 mm (0.39 to 0.47 in.)		11 to 13 mm (0.43 to 0.51 in.)
Spark plug type			-		FR2A-D
Spark plug gap			-		0.8 to 0.9 mm (0.032 to 0.035 in.)
Engine idling speed			750 mm (29.53 in.)		700 mm (27.56 in.)
Steering wheel free play (when measured at rim with engine idling)			15 to 30 mm (0.59 to 1.18 in.)		
Clutch pedal free play (dry type)			0 to 6 mm (0.00 to 0.24 in.)		
Clutch pedal free play (wet type)			0 to 6 mm (0.00 to 0.24 in.)		
Inching pedal free play			7 mm (0.28 in.)		
Brake pedal free play	Manual Truck		7 mm (0.28 in.)		
	Powershift Truck		7 mm (0.28 in.)		
Parking brake lever operating effort			150 to 200 N (15.3 to 20.4 kgf) [33.72 to 44.96 lbf]	200 to 250 N (20.4 to 25.5 kgf) [44.96 to 56.20 lbf]	
Tire size	Front tire	Single	6.50-10/5.00PR	7.00-12-12PR	
		Dual	-	5.50-15-8PR	
	Rear tire		5.00-8/3.00PR	6.00-9-10PR	
Tire pressure	Front tire	Single	-	700 kPa (7 kgf/cm^2) [101 psi]	
		Dual	-	700 kPa (7 kgf/cm^2) [101 psi]	
	Rear tire		-	700 kPa (7 kgf/cm^2) [101 psi]	
Tightening torque for wheel nuts	Front tire		156.9 ± 15.7 N·m (16.00 ± 1.60 kgf·m) [115.723 ± 11.57 lbf·ft]	377.6 ±37.8 N·m (38.50 ± 3.85 kgf·m) [278.503 ± 27.87 lbf·ft]	
	Rear tire	2P	141.2 to 172.6 N·m (14.40 to 17.60 kgf·m) [104.144 to 127.303 lbf·ft]	210.1 to 256.7 N·m (21.42 to 26.18 kgf·m) [154.962 to 189.332 lbf·ft]	
		4P			
Lift chain elongation limit (20 links)			327 mm (12.87 in.)	392 mm (15.43 in.)	

Chapter 14 MAST AND FORKS

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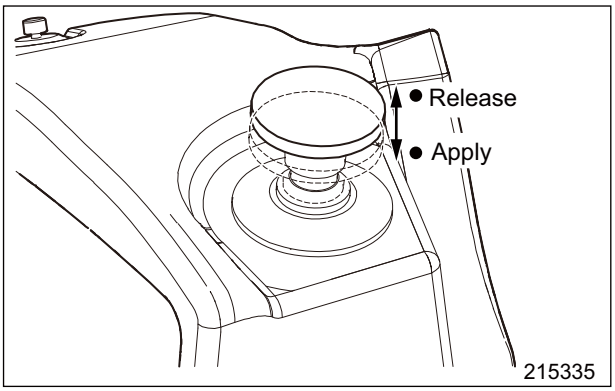
4.3 How to Check the Parking Brake Warning Buzzer and Warning Lamp Operations When the Key is OFF

(1) Keep the parking brake switch locked. Place the forward/reverse lever in the neutral position. Turn the key switch OFF to stop the engine. This deactivates both the VCM-1M controller and instrument panel because the power to them is turned off.

(2) Make sure that the parking brake warning buzzer activates when the parking brake switch is released. (This operation is not affected by the seat switch conditions.)

(3) Make sure that the parking brake warning buzzer stops if the parking brake switch is in the locked condition.

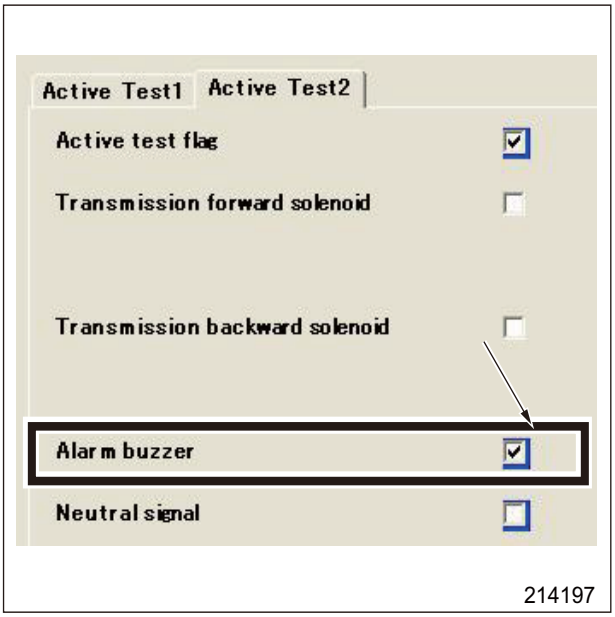


⚠ CAUTION

This function must be checked on flat and solid pavement.

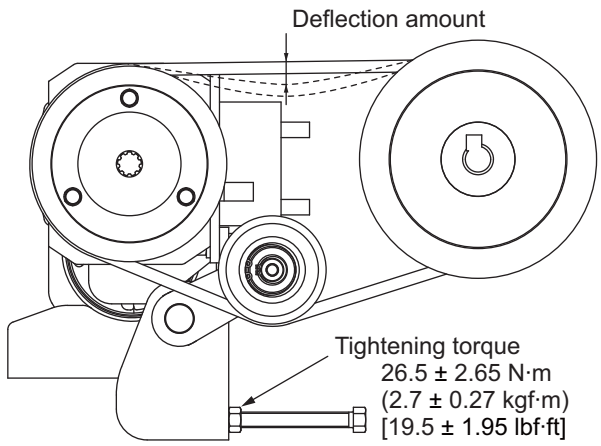
- If the seat switch does not turn on
  Refer to "8. List of Harness Wire Numbers", "9.1 VCM-1M Controller", and "9.2 Seat Switch and Seat Belt Switch", and perform the seat switch operation and wiring checks, etc.
- If the parking brake switch does not turn on
  Refer to "8. List of Harness Wire Numbers", "9.1 VCM-1M Controller", and "9.3 Parking Brake Switch", and perform the parking brake switch operation and wiring checks, etc.
- If the warning buzzer does not turn on
  Refer to "4.3 Inspection Method with an Active Test", and check the warning buzzer output with any applicable active test. If the warning buzzer does not activate after checking with the active test, perform wiring checks while referring to "8. List of Harness Wire Numbers", "9.1 VCM-1M Controller", "9.9 Warning Buzzer", "9.10 Relay for Warning Buzzers", and "9.11 Warning Buzzer Circuit."

Note: For the references shown above, refer to the Service Manual for standard lift trucks.



2.2.3 Reinstallation (Gasoline-engine models)

Reinstall in the reverse order of removal, noting the following points.



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(1) Check the following points before reinstalling the V-belt:

(a) Check the belt for contamination with oil, grease and dust, etc., and replace it, if necessary. If the contamination is not significant, clean with a rag or paper towel. Do not use gasoline, oil or any other solvent to clean the belt.

(b) If the belt is damaged, replace it with a new one.

(2) During the inspection of bearings, confirm that each bearing rotates smoothly and generates no abnormal noises.

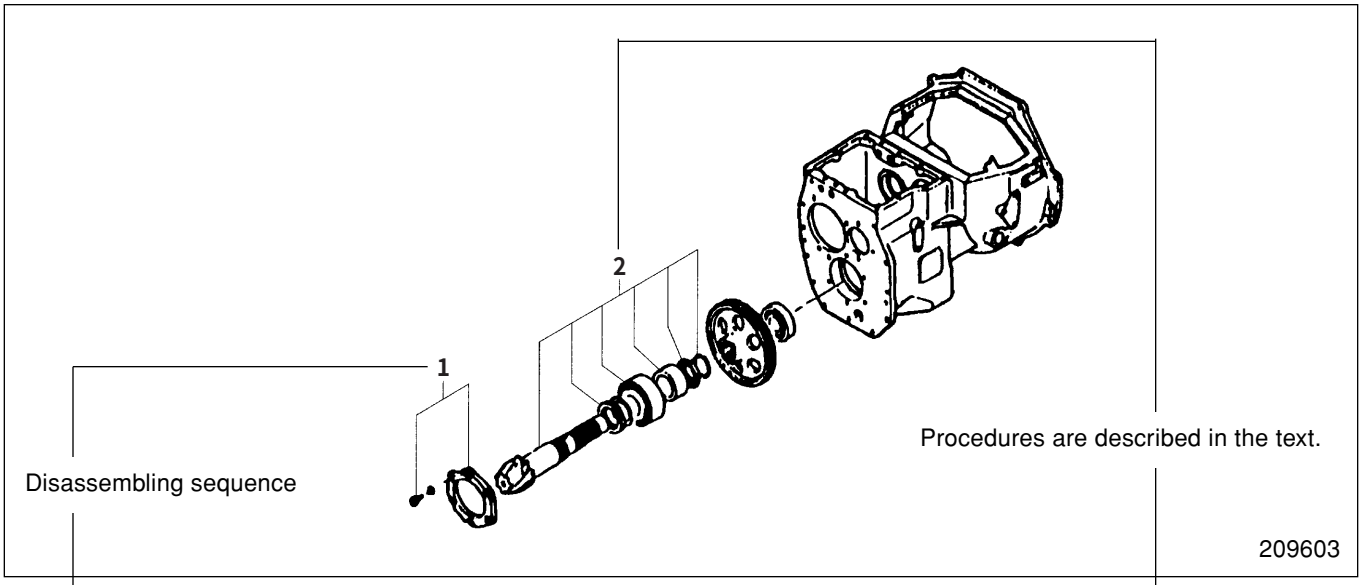
(3) Make sure that the V-belt is not twisted. Adjust it, to obtain the deflection shown in the table. Use the tension adjustment belt and nut on the tension assembly.

	Deflection amount	Pressing force
New part	14^{0}_{-2} mm ($0.55^{0}_{-0.08}$ in.)	98 N (10 kgf) [22 lbf]
Reinstalled part	16^{0}_{-2} mm ($0.62^{0}_{-0.08}$ in.)	

(4) After reinstalling the gear pump, make sure there are no oil leaks.

HOW TO USE THIS MANUAL (continued)
(Removal, Installation, Assembly and Disassembly)

Disassembly diagram (example)



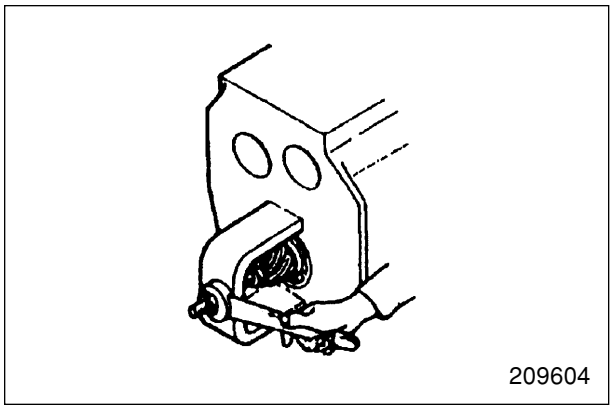
Sequence

1 Cover, Bolt, Washer (part name)
2 Snap ring ..... (part name)

Suggestion for disassembling

1. Output shaft, Removing

   Remove output shaft using a special tool.



Service Data

Gear Backlash	A	0.11 to 0.28 mm (0.0043 to 0.0110 in.)
	B	0.5 mm (0.020 in.)

A: Standard Value
B: Repair or Service Limit

Battery

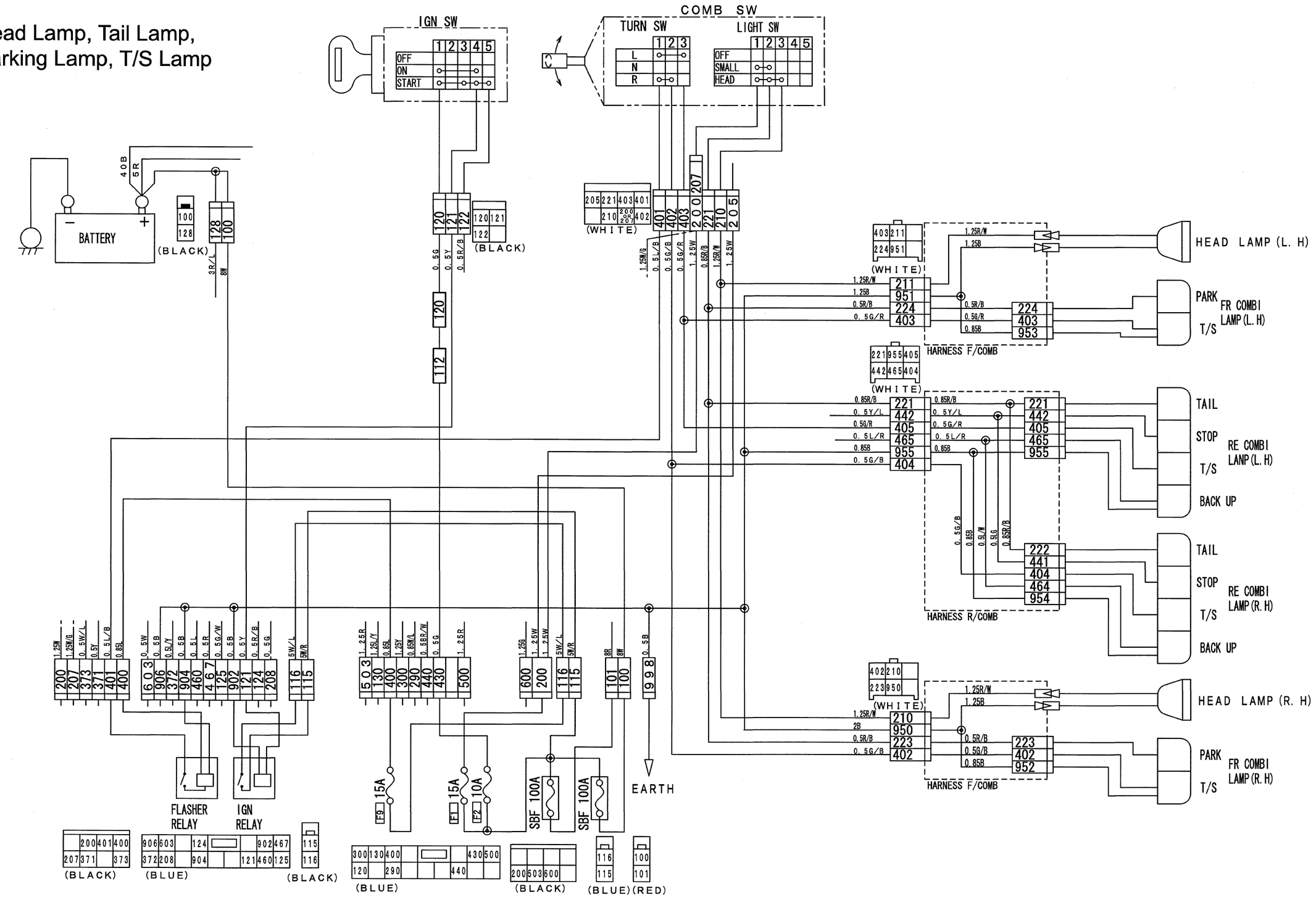
Tends to run down rapidly

- Drive belt slipping — Readjust.
- ✻ **Alternator**
- Stator coil grounded or open-circuited — Repair or replace.
- Rotor coil open — Replace.
- Brushes poorly seating on slip rings — Replace brushes if worn. Clean holder and polish slip rings.
- Diode ruptured — Replace.
- ✻ **Regulator**
- Regulated voltage setting too low — Replace.
- ✻ **Battery**
- Not enough electrolyte or wrong concentration of acid to water — Refill and check specific gravity.
- Battery cell plates deteriorated (forming, possibly internal short-circuit) — Replace.
- Terminal connections loose — Clean and retighten.
- ✻ **Wiring**
- Open or loose connection between starter switch and regulator IC terminal — Repair.
- Fuse blown, or loosely set in holder — Replace and repair.
- Open or loose connection between F terminals of regulator and alternator — Repair.

Tends to get overcharged

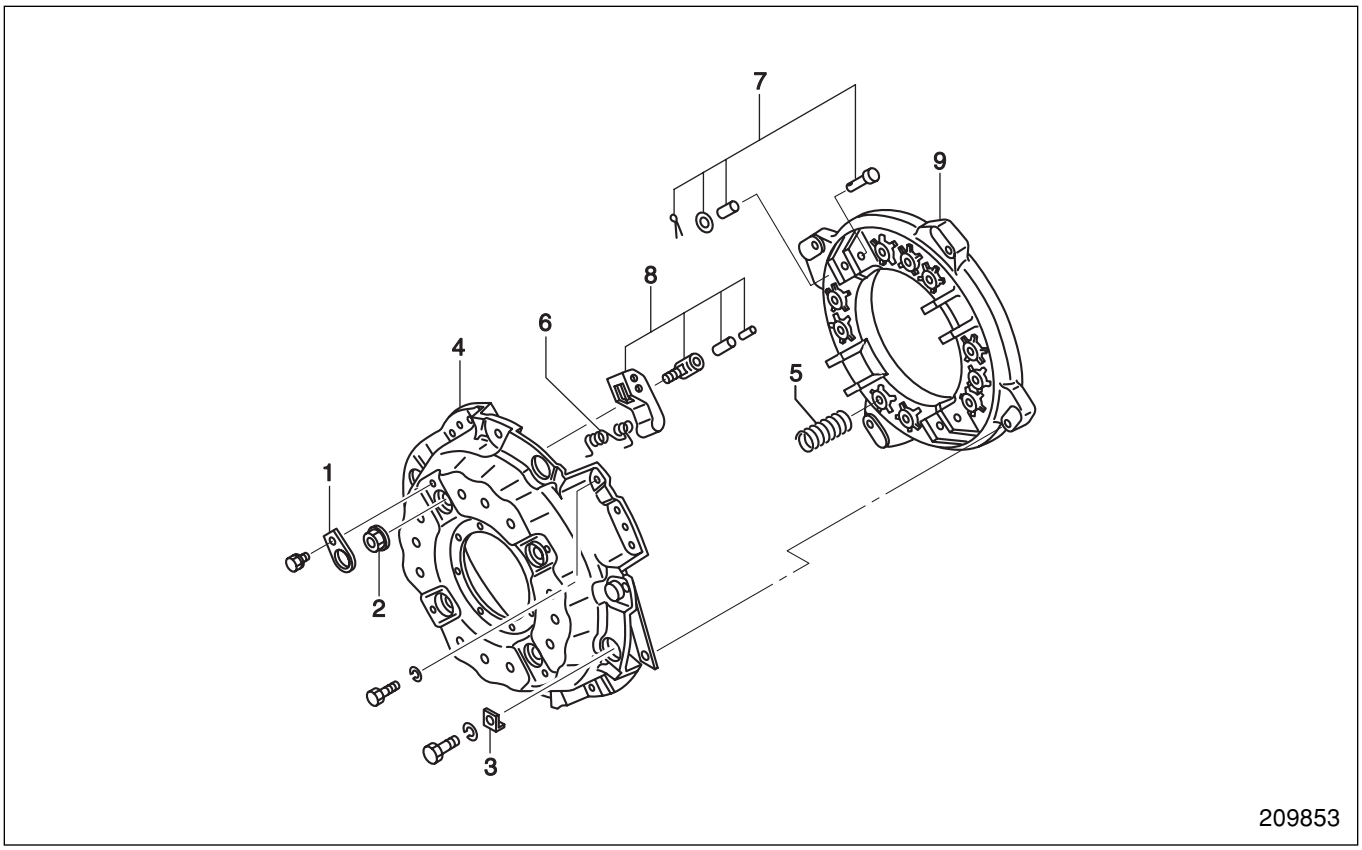
- ✻ **Wiring**
- Regulator IC and F terminals shorted or miswired — Repair.
- Poor grounding of regulator F terminal — Repair.
- ✻ **Regulator**
- Pressure coil open-circuited — Replace.
- Regulated voltage too high — Replace.

Head Lamp, Tail Lamp, Parking Lamp, T/S Lamp



Pressure Plate Assembly

Disassembly

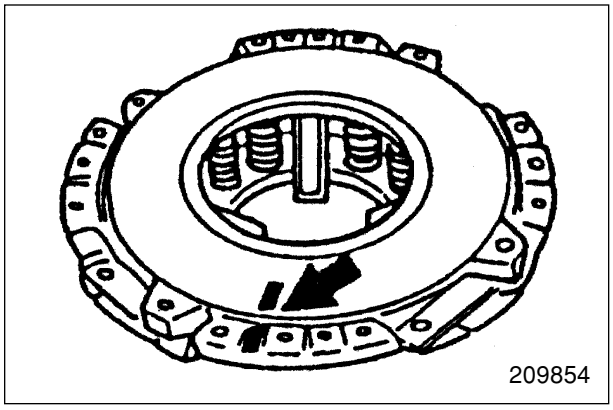


Sequence

1 Lock plate
2 Lever nut
3 Strap fastening washer
4 Clutch cover
5 Pressure spring
6 Return spring
7 Split Pin, Washer, Pin
8 Release lever, Lever support assembly, Pin
9 Pressure plate

Suggestions for Disassembly

(1) Provide a matching mark across the clutch cover and pressure plate beforehand.



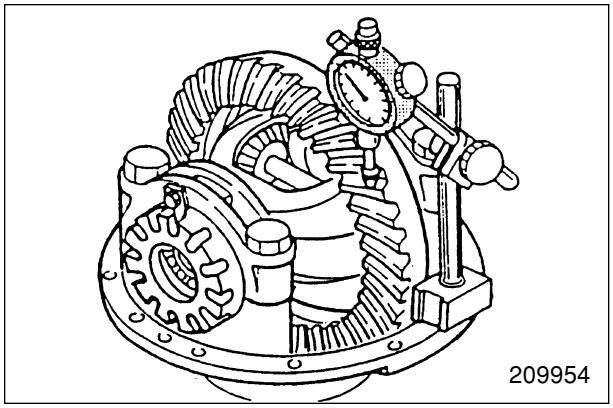
Suggestions for Disassembly

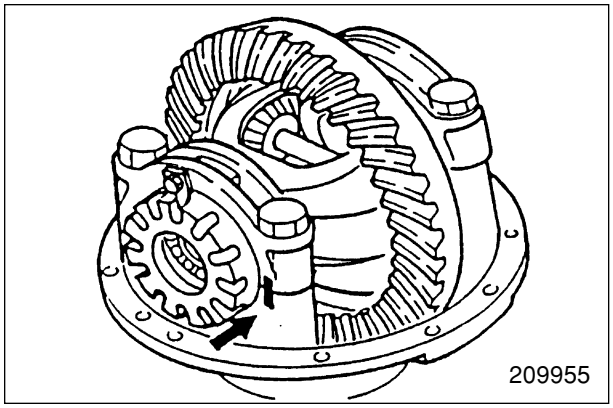
NOTE

(a) Before disassembling the differential, except for replacement of the reduction gear set, be sure to measure the gear backlash to ensure correct backlash at the time of reassembly.

(b) Provide a matching mark across the bearing cap, adjusting screw and carrier on each side to ensure correct refitting.

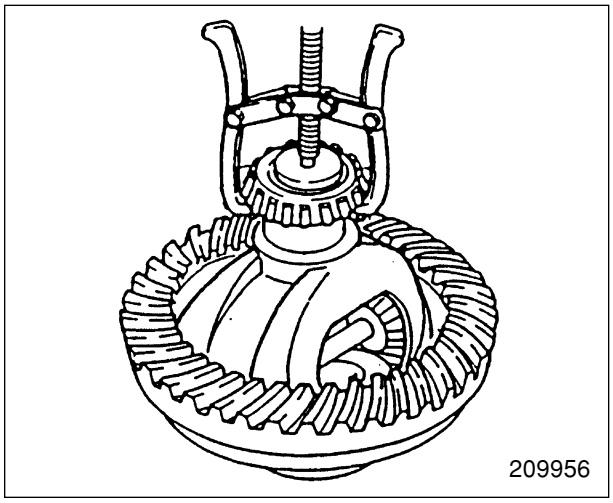
Item \ Truck Model	1, 2 ton classes	3 ton class
Backlash between reduction gear and reduction pinion	0.20 to 0.28 mm (0.0079 to 0.0110 in.)	0.25 to 0.33 mm (0.0098 to 0.0130 in.)





(1) Removing bearing

Use a bearing puller to remove the inner bearing.



(2) Removing shims

After removing the lock nut 5 and shims, check and record the total thickness of the shims. Tie the shims to the lock nut so as not to be lost.

3. Brake drums

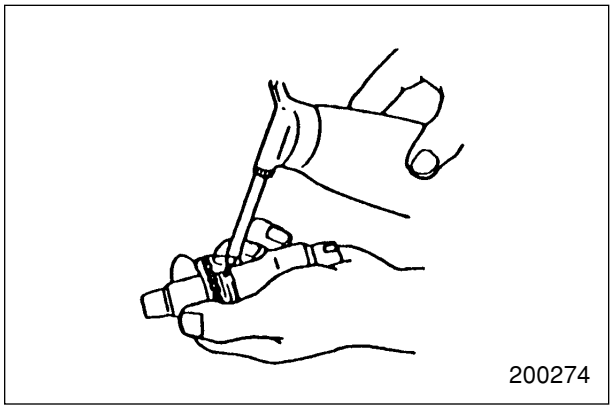
Check the inside (friction) surface of the drum for abnormal wear, grooving and other defects. Minor grooving can be removed by grinding, provided that the inside diameter does not exceed the service limit.

A: Standard value B: Service limit

Item \ Truck Model		1 ton class	2, 3 ton classes
Inside diameter of brake drum	A	254 mm (10.0 in.)	310 mm (12.2 in.)
	B	256 mm (10.1 in.)	312 mm (12.3 in.)

4. Adjusting screws

Check the wheel teeth for wear. Turn the screw by hand to see if its rotating parts turn smoothly.



5. Parking brake cable

Replace a cable if it shows stretching, rust or damage.

6. Other parts

(1) Check the shoe return springs for cracks or fatigue.

(2) Check the adjusting springs for cracks or fatigue.

(3) Check the cable with spring for stretching.

Inspection and Adjustment ..... 13 – 33
1. Hydraulic Tank ..... 13 – 33
2. Control Valve ..... 13 – 34
3. Descent Test ..... 13 – 35
4. Forward Tilt Test ..... 13 – 35
Troubleshooting ..... 13 – 36
Service Data ..... 13 – 39
MC Control Valve ..... 13 – 44
FC Control Valve ..... 13 – 60

Inspection and Adjustment

1. Hydraulic tank

(1) Daily check of oil

Check oil for level, dirt and white turbidity (entry of air, mixing of water).

(2) Adequate oil level during daily check

Check the oil level with the mast lowered.

Simplex mast: Between N and L level

Triplex mast: Between H and L level

- The oil level must not exceed the H level with any mast and attachment when they are lowered.

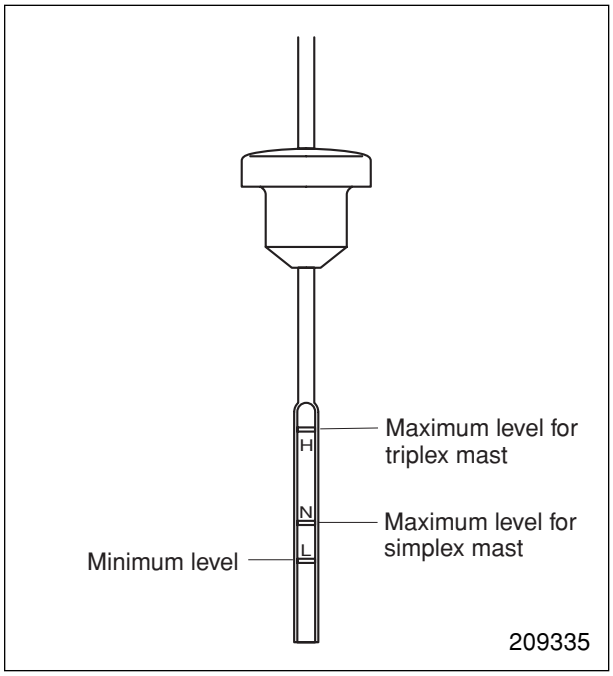
(3) Method of filling hydraulic tank with oil

- Use hydraulic oil SAE10W.

(a) Fill the hydraulic tank with oil with the mast lowered.

(b) Repeat ascent and descent of the mast a few times, and then lower the mast.

(c) Check the oil level with a level gauge. The maximum acceptable level is the N level for the simplex mast and the H level for the triplex mast. If the level is low, replenish oil.



⚠ CAUTION

The oil level in the tank must not exceed the H level with any combination of the mast and attachment when the mast is lowered.

(4) Inspection of suction strainer

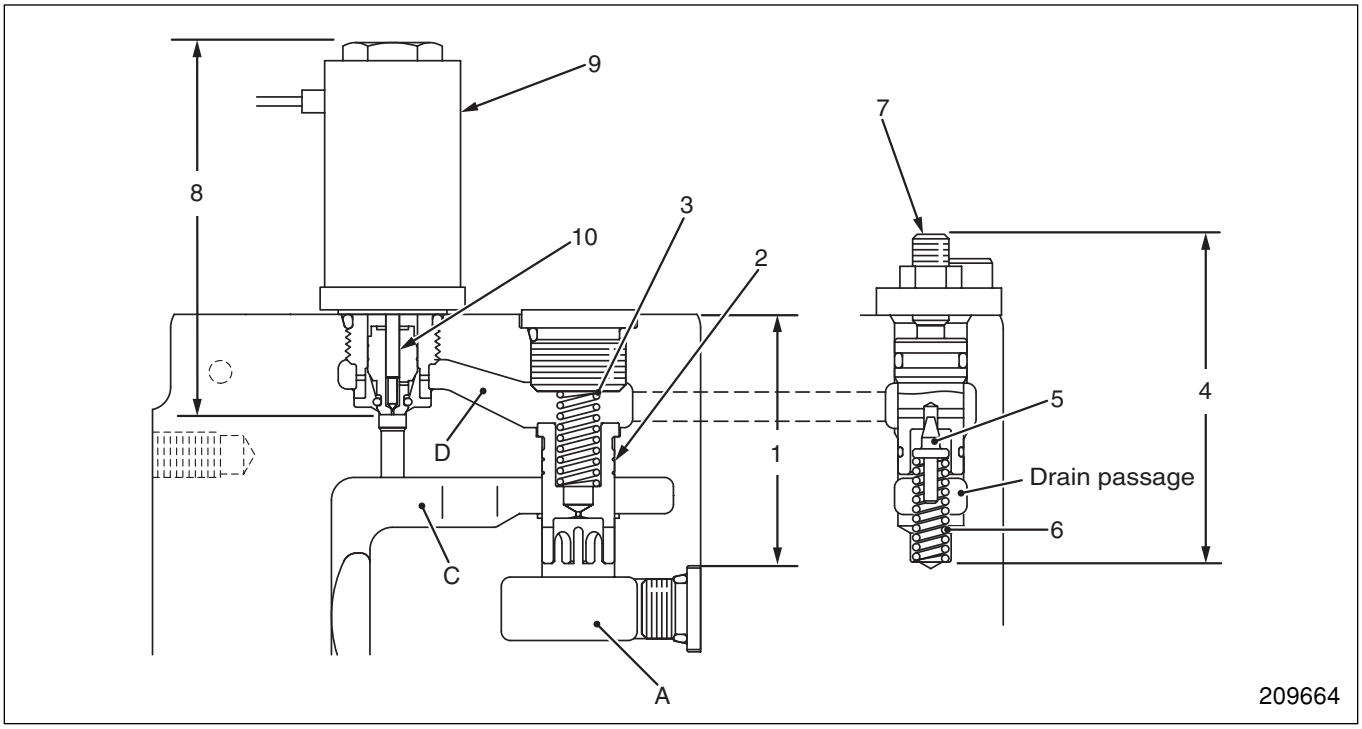
Check the suction strainer for damage and clogging. Clean it if it is dirty.

(5) Inspection of return filter

Check the return filter for damage. As this part needs periodic replacement, replace it when the replacement interval is reached.

Refer to page 13-32 “Removal and Installation of Suction Strainer and Return Filter.”

Main Relief Valve, Pilot Relief Valve and Unloader Valve



1	Main relief valve	6	Spring	A:	Extra flow (EF flow) passage
2	Dump valve	7	Pressure adjusting screw	C:	Drain passage
3	Spring	8	Unloader valve	D:	Oil passage
4	Pilot relief valve	9	Solenoid		
5	Poppet valve	10	Needle valve		

Function of Component Valves

The pilot relief valve 4 and unloader valve 8 are arranged in parallel to serve as pilot valves for the main relief valve 1. To be more specific, when either valve 4 or 8 opens, the dump valve 2 overcomes the force of the spring 3 to lift, releasing high pressure oil in the oil passage A into the drain passage C.

Pilot Relief Valve 4

This is a pilot valve for the main relief valve. When pressure in the system exceeds the specified limit, the poppet valve 5 overcomes the force of the spring 6 to move downward, releasing oil in the back of the dump valve 2 into the drain passage. As a result, the dump valve of the main relief valve lifts to release some of EF flow into the drain passage.

The screw 7 is for set pressure adjustment. Tightening it clockwise increases set pressure. For set pressure and setting procedure, refer to “Inspection and Adjustment.”

Unloader Valve

The unloader valve 8, located between the back of the dump valve 2 and an oil passage connecting to the drain passage C as shown in the illustration, is a solenoid valve serving as a pilot relief valve for the main relief valve 1. When the solenoid is energized by electric current that flows through it, the needle valve 10 protrudes to close the oil passage D. When the solenoid is not energized, it has the needle valve 10 retracted in it. Therefore, the oil passage D is open.

When the operator leaves the seat and the cargo handling levers are in the neutral position, the solenoid is not activated and oil in the passage D is released into the drain passage C. This causes the dump valve 2 of the main relief valve to lift, releasing all extra flow of oil into the drain passage C. This valve thus ensures safety and helps save engine output.

When the operator moves a cargo-handling lever, the solenoid 9 is energized. The needle valve 10 protrudes to close the oil passage D, making the entire extra flow line (including pilot oil for proportional electromagnetic pressure reducing valve) ready to work normally.

• Clearance G1

Clearance between side roller circumference and inner mast side roller thrust surface:
Move the side roller to the upper end of the inner mast and press the lift bracket to either the leftmost or rightmost position.
Take measurement of clearance G1 between the roller circumference and inner mast.
Adjust the clearance with shims to the specification.

Clearance G1	0.1 to 0.5 mm (0.004 to 0.020 in.)

(1) Choosing correct roller diameters

• Measure clearance F for upper rollers 2, middle rollers 3 and lower rollers 4. If the measured clearances do not conform to the standard values, replace with rollers of correct diameters listed in the table to the right.

Notice: For measuring procedures, refer to "Inspection and Adjustment."

• The rollers installed should rotate smoothly.

(2) Adjusting clearance G between the middle roller and thrust plate

Notice: The following adjustment is not required for the upper roller.

• Measure clearance G between the middle roller and thrust plate. If the measured clearance does not conform to the standard value, adjust clearance G in the manner described below.

Notice: For measuring procedures, refer to "Inspection and Adjustment."

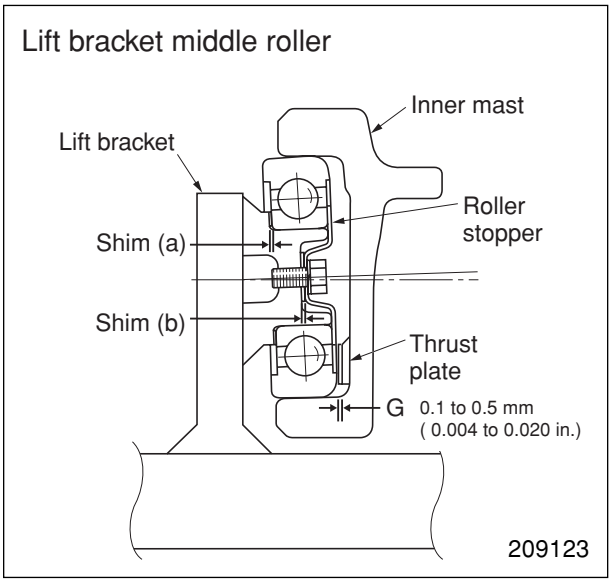
• Adjustment

If clearance G is excessive, increase the thickness of shims (a) as required. Increase the thickness of shims (b) by the same amount that are added to shims (a).
Shim (a) is available in two sizes: 1 mm (0.04 in.) and 0.5 mm (0.020 in.). Shim (b) is available in only one size, 1 mm (0.04 in.).
If shims (a) are increased by 0.5 mm (0.020 in.), shims (b) do not need to be increased by the equal amount.

Remarks: At the manufacturing facility, shims (a) and (b) are usually adjusted to the values shown in the table to the right for the shipment.

Unit: mm (in.)

Size (Diameter) \ Truck Model	1 ton class	2, 3 ton classes
S	99 (3.90)	113.8 (4.48)
M	100 (3.94)	115 (4.53)
L	101 (3.98)	116 (4.57)
LL	102 (4.02)	117 (4.61)



Unit: mm (in.)

Item \ Truck Model	1 ton class	2, 3 ton classes
Shim (a)	2 (0.079)	1.5 (0.059)
Shim (b)	2 (0.079)	

7. Installing Hydraulic Lines

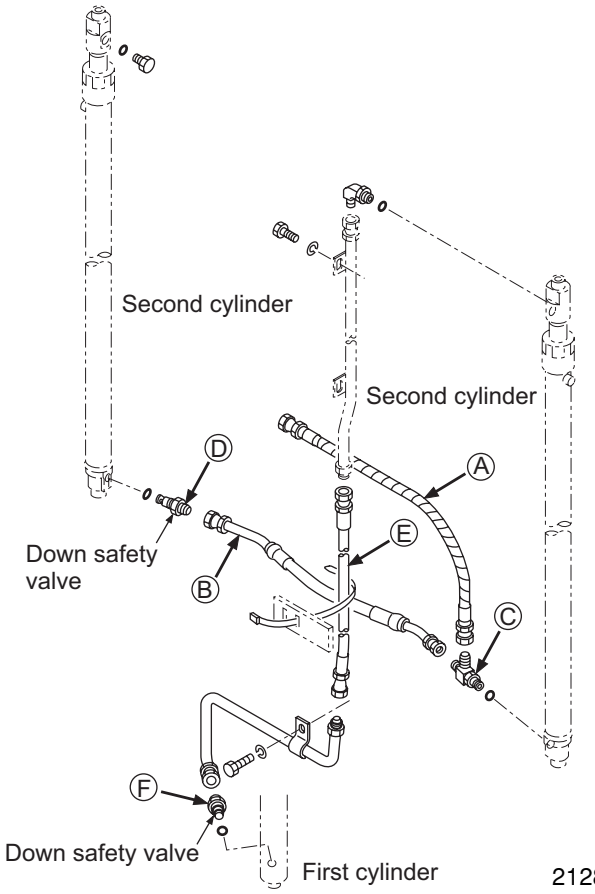
General precautions

- Use care not to let abrasive dust or dirt to enter the hydraulic system.
- Apply a film of oil to O-rings before installation.
- For assembling Elbow Connector (a fitting with straight threads and O-ring seal) indicated by Ⓒ, follow the procedure in "Installation of a fitting with straight threads and O-ring seal" shown on the next page.

Tightening torque

Unit: N ·m (kgf ·m) [lbf· ft]

Item \ Truck Model	1, 2 ton classes	3 ton class
Ⓐ	58.8±5.9 (6.0 ± 0.6) [43.4 ± 4.3]	58.8±5.9 (6.0 ± 0.6) [43.4 ± 4.3]
Ⓑ	49±4.9 (5.0 ± 0.5) [36.1 ± 3.6]	49±4.9 (5.0 ± 0.5) [36.1 ± 3.6]
Ⓒ	39.2 ± 3.9 (4.0 ± 0.4) [28.9 ± 2.9]	58.8±5.9 (6.0 ± 0.6) [43.4 ± 4.3]
Ⓓ	39.2 ± 3.9 (4.0 ± 0.4) [28.9 ± 2.9]	58.8±5.9 (6.0 ± 0.6) [43.4 ± 4.3]
Ⓔ	58.8±5.9 (6.0 ± 0.6) [43.4 ± 4.3]	58.8±5.9 (6.0 ± 0.6) [43.4 ± 4.3]
Ⓕ	58.8±5.9 (6.0 ± 0.6) [43.4 ± 4.3]	58.8±5.9 (6.0 ± 0.6) [43.4 ± 4.3]



(4) Place the middle mast lower than the outer mast as follows:

(a) Lift the inner mast to the height of the middle mast, then place wood blocks for support.

(b) Hitch slings to both middle mast and inner mast, and lift them with a hoist.

(c) Remove set bolts from the upper sections of the second lift cylinders, then lift the middle mast and inner mast to separate the second lift cylinder from the middle mast.

(d) Remove two lift cylinder clamps, dismount the second lift cylinders from the mounting sections at the lower outer mast section. Tilt the cylinders by moving the top sections towards the center of the truck. Using a rope, fix the cylinders onto the cross member.

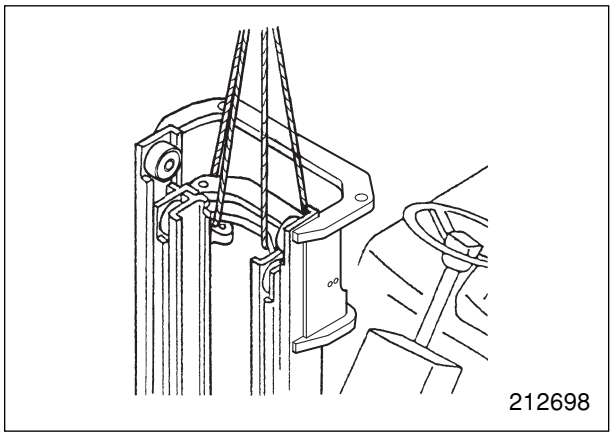
(e) Lower the middle mast and inner mast until mast rollers (outer mast upper roller and middle mast lower roller) can be removed.

(f) Support the middle mast and inner mast with wood blocks.

(g) The main rollers of the inner and outer masts can now be removed. It is recommended that before attempting to remove the main rollers, remove the mast strips and shims as they tend to drop easily.

(h) Adjust shims for the main rollers and mast strips as required.

- For reassembling, follow the disassembly sequence in reverse.



FOREWORD

This service manual is a guide for servicing Cat®Lift Trucks. For your convenience the instructions are grouped by systems as an easy reference.

The long productive life of your lift truck(s) depends on regular and proper servicing. Servicing consistent with what you will learn by reading this service manual.

Read the respective sections of this manual carefully and familiarize yourself with all of the components before attempting to start a test, repair or rebuild job.

The descriptions, illustrations and specifications contained in this manual are for trucks with serial numbers in effect at the time of printing.

Cat Lift Trucks reserves the right to change specifications or designs without notice and without incurring obligations.

The trucks listed in this manual are powered by K15, K21 or K25 gasoline engines or S4Q2/S4S diesel engines.

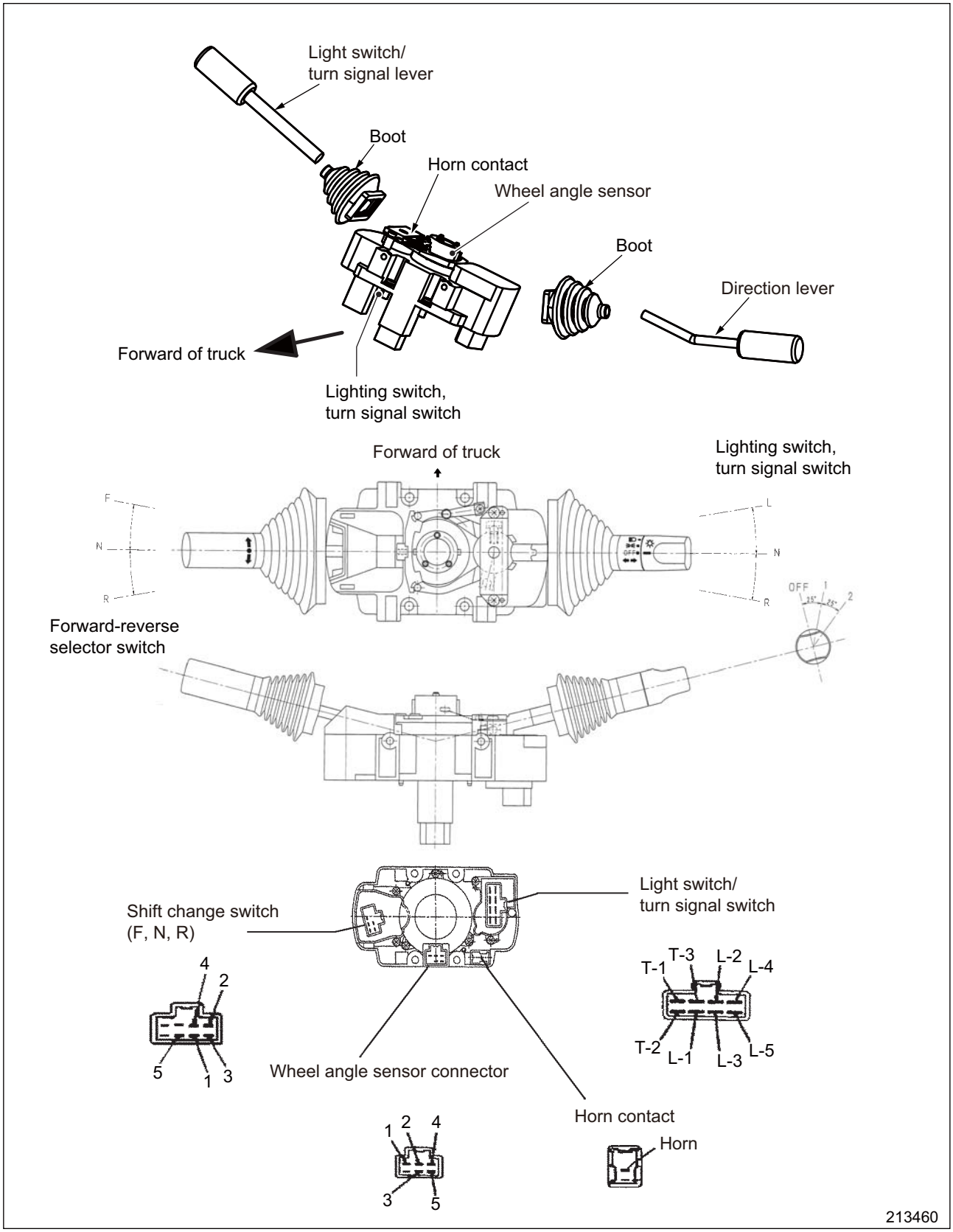
For engine servicing, please refer to the applicable engine service manual.

K15, K21 or K25	Gasoline engine
S4Q2, S4S	Diesel engine

<Safety Related Signs>

WARNING	Indicates a potentially hazardous situation which, it not avoided, could result in death or serious injury.
CAUTION	Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury, or damage to your machine.
NOTE	Indicates a condition that can cause damage to, or shorten service life of, the machine.

2.2.2 Lighting switch, turn signal switch



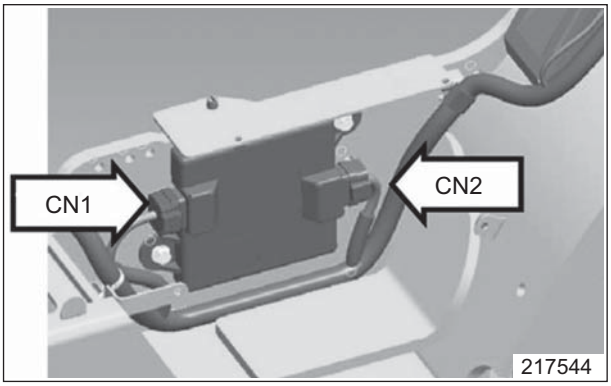
5.7.3 Applying specified grease to VCM connecter

Apply the specified grease to the VCM connecter (CN1, CN2) for waterproof property.

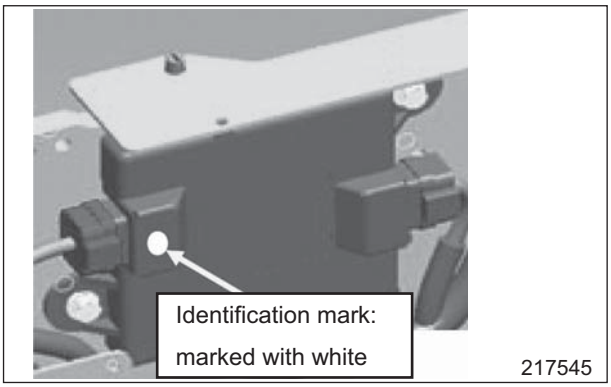
Parts name	Parts No.
GREASE KIT	91A93-08600

⚠ CAUTION

Do not apply other grease. Doing so may cause a electrical problem by corrosion

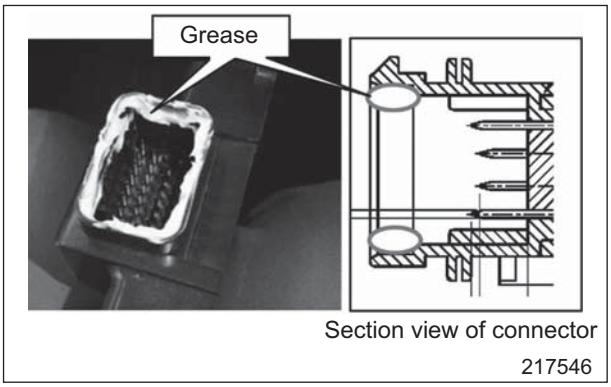


When the specified grease had been applied on the VCM, it is marked with white paint near the connecter.



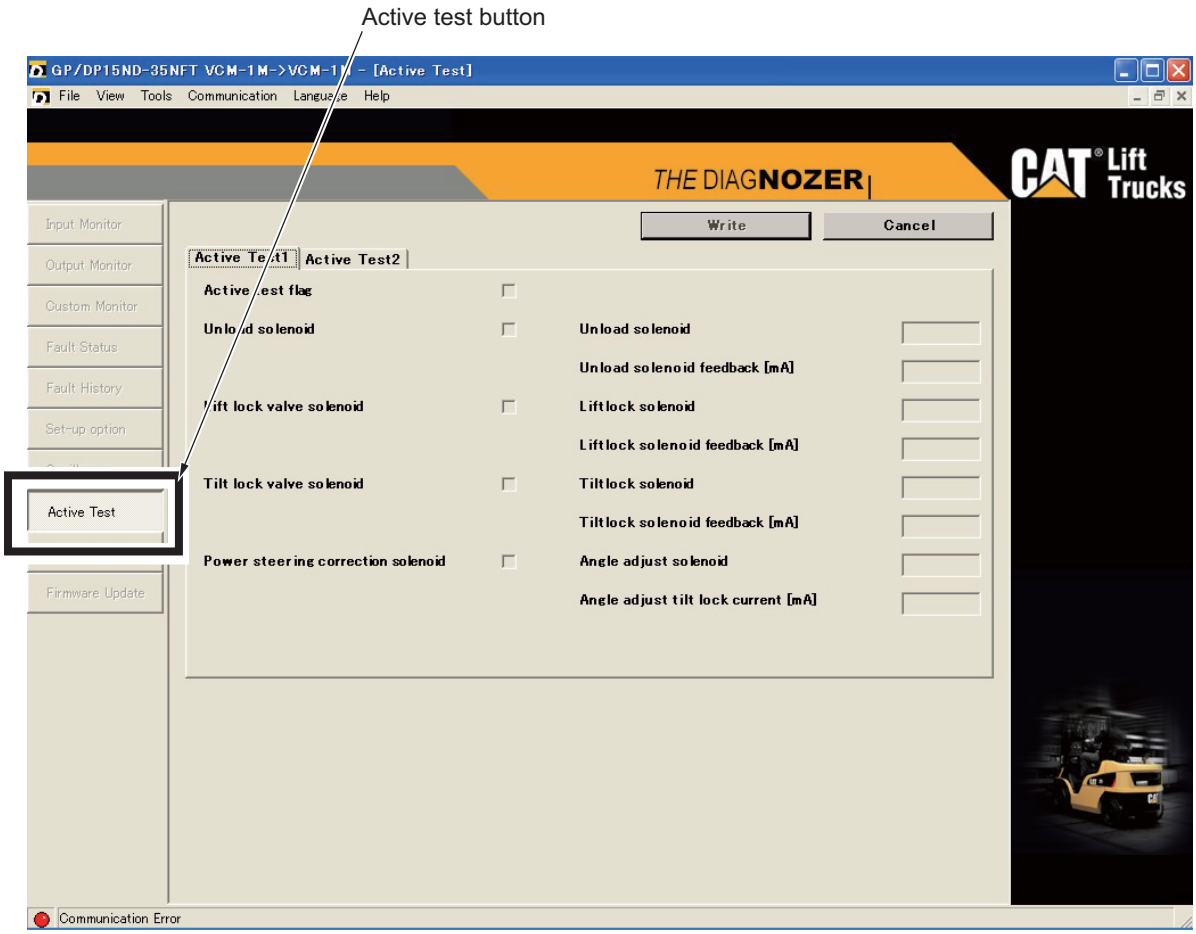
(1) Wipe off the grease with a cloth when removing the connecter.

(2) Apply the grease as shown in the figure when attaching the connector. Bridge the groove of connecter with about 1g grease.



(8) Active Test

Click the active test button from the menu or toolbox to display the active test screen in the main window.
In active test, signals are sent out to check the operating condition. The active test screen shows the output signal names on the left side of screen and the monitor items corresponding to the output signals on the right side of screen.



214901

Diagnosis	VCM communication error (F03)
Logic conditions	CAN transmission from VCM1-M is impractical. (2-second continuity) ——— F03
Recovery	Recovers automatically
Action	Error indication only, the operation continues.
LED blink pattern	B

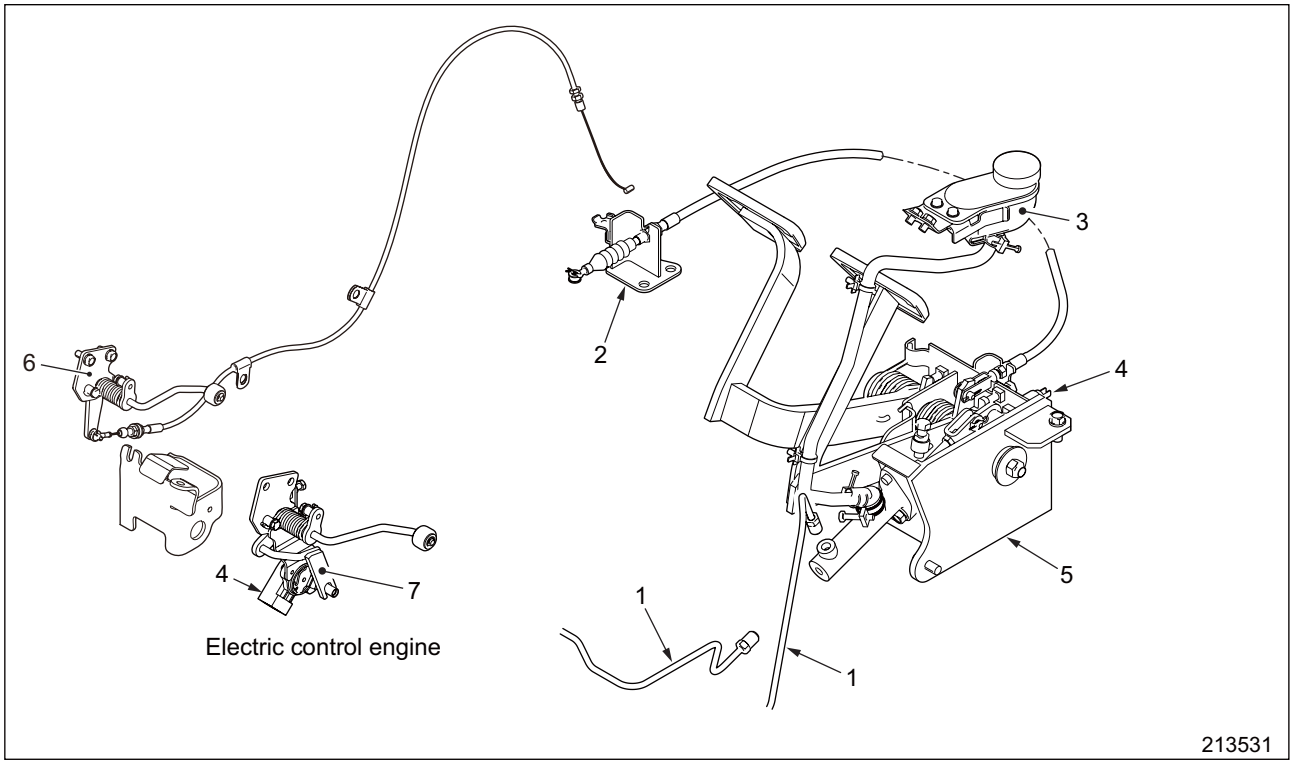
Diagnosis	ECM communication error (F04)
Logic conditions	CAN receiving from ECM is impractical. (2-second continuity) ——— F04
Recovery	Recovers automatically
Action	Activates with default values of ECM incoming data.
LED blink pattern	B

Diagnosis	DCM communication error (F05)
Logic conditions	CAN receiving from DCM is impractical. (2-second continuity) ——— F05
Recovery	Recovers automatically
Action	Activates with default values of DCM incoming data.
LED blink pattern	B

Diagnosis	OCM communication error (F06)
Logic conditions	CAN receiving from OCM is impractical. (2-second continuity) ——— F06
Recovery	Recovers automatically
Action	Activates with default values of OCM incoming data.
LED blink pattern	B

Diagnosis	MP communication error (F07)
Logic conditions	CAN receiving from instrument panel is impracti-cal. (2-second continuity) ——— F07
Recovery	Recovers automatically
Action	Activates with default values of instrument panel incoming data.
LED blink pattern	B

1.1.3 Controls (Trucks with Powershift Transmission)



Removal sequence

1 Brake pipe
2 Inching cable, Clevis pin, Washer, Snap pin
3 Reservoir tank
4 Connector (Throttle, Stop lamp switch)
5 Pedal assembly
6 Throttle cable (non-electric control engine)
7 Accelerator bracket

Suggestions for Removal

(1) To remove the inching cable 2, disconnect the inching pedal end and the transmission end and then loosen the lock nuts.

(2) For trucks with non-electric control engine, disconnect the throttle cable from the engine.

Installation

To install, follow the removal sequence in reverse.

For brake pedal adjustment, refer to Chapter 8 POWERSHIFT TRANSMISSION, "8.2 Brake (Inching) Pedal Adjustment" and Chapter 11 BRAKE SYSTEM, "3.4 Brake Pedal Adjustment." For inching cable adjustment, refer to Chapter 8 POWERSHIFT TRANSMISSION, "8.3 Inching Cable Adjustment."

3.6.3 Reassembly

To reassemble, follow the disassembly sequence in reverse. Also follow the instructions given below.

(1) Tightening bolts

(a) Tighten the bolts with strap fixing washers 3 to the torque specified below.

Item		Dry-type	Wet-type
Tightening torque	A	39 to 59 N·m (3.97 to 6.01 kgf·m) [28.78 to 43.54 lbf·ft]	

A: Standard value

(b) Tighten the bolts that hold locking plates 1 to the torque specified below.

Item		Dry-type	Wet-type
Tightening torque	A	5.8 to 7.8 N·m (0.59 to 0.79 kgf·m) [4.28 to 5.75 lbf·ft]	

A: Standard value

(2) Applying grease

Apply molybdenum disulfide grease (Never Seez or equivalent) to the pressure plate of the dry-type clutch at the following places.

(a) Contact surfaces of release lever and pressure plate.

(b) Contact surfaces of release lever and lever support. Also apply anti-seize & lubricating compound (Never Seez grease) to the following parts.

(c) Support nut threaded portion.

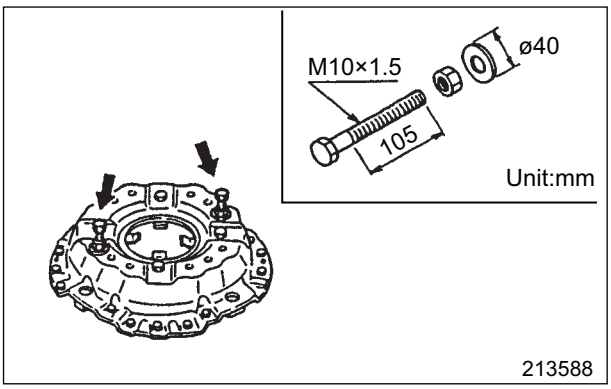
(d) Support nut spherical portion.

(3) Installing pressure plate assembly

(a) Identifying by identification mark (Gasoline engine, dry-type clutch)

Item	Dry-type			Wet-type	
Engine mounted	S4Q2 K21	S4S K25	K15	S4S K25	S4Q2 K21, K15
Identification mark	Yellow	Blue	Black	Brown	Pink
Pressure Spring	12 pcs	12 pcs	8 pcs	12 pcs	10 pcs

(b) Using bolts (for removal and installation of pressure plate), compress the pressure springs and install the pressure plate assembly into place in the clutch housing.



Special tool needed

Bolt	91268-01900
Washer	92301-02700
Nut	F2300-10000

Suggestions for Reassembly

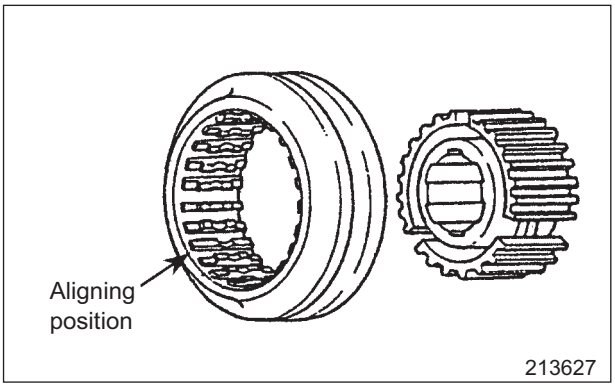
(1) Needle roller bearing

(a) Apply gear oil to the needle bearings before they are installed.

(2) Synchromesh assembly

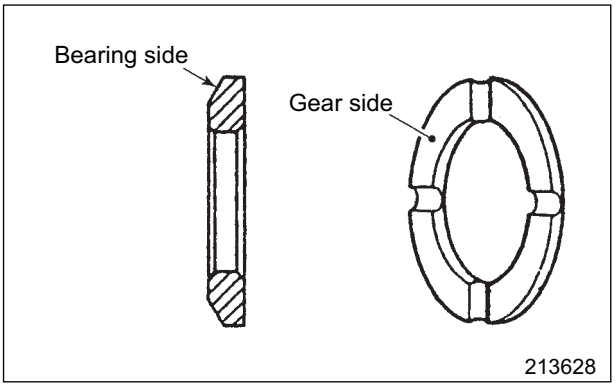
(a) Align three grooves on the outer circumference of the synchronizer hub with the synchronizer sleeve before the sleeve and hub are assembled together.

(b) Apply molybdenum disulfide grease (Neverseez or equivalent) to the contact faces of the cone on the gear and the cones of the synchronizer rings.



(3) Thrust washer

(a) One side of the thrust washer faces the bearing and the other side faces the gear. Make sure that the thrust washers are installed correctly.



(4) Nut

(a) Tighten the nut to the specified torque. Do not use a impact wrench.

Tightening torque	A	245 ± 24.5 N·m (24.98 ± 2.49 kgf·m) [180.81 ± 18.08 lbf·ft]

A: Standard value

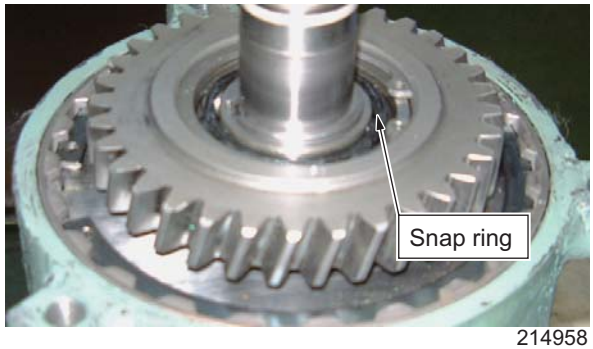
4.10.2 Forward gear assembly, Disassembly

(1) Remove snap ring.

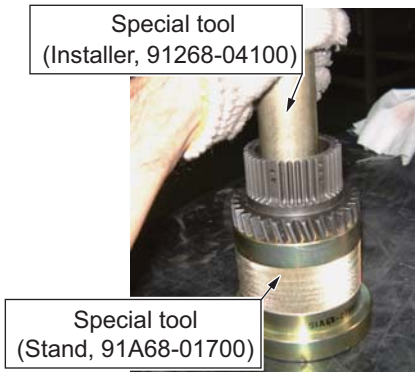
(2) With gear faced downward, place forward gear assembly on the special tool (stand, 91A68-01700).

(3) Remove angular bearing using special tool (installer, 91268-04100).

Part name	Part number
Installer	91268-04100



214958



214959

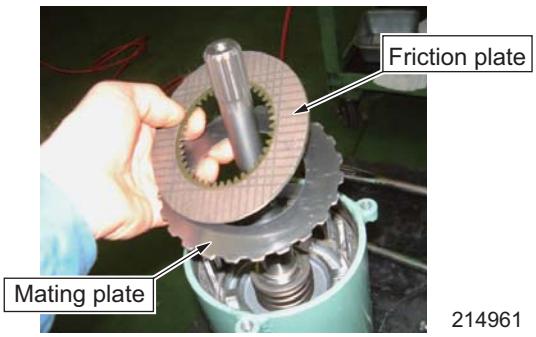
4.10.3 Forward side gear input shaft, Disassembly

(1) Remove snap ring.

(2) Remove one pressure plate, one Belleville spring, six mating plates, and five friction plates.

Note: When disassembling plates, record the position of each plate so that they can be reassembled as they were.

214960



214961

5.12.3 Oil strainer assembly, Installation

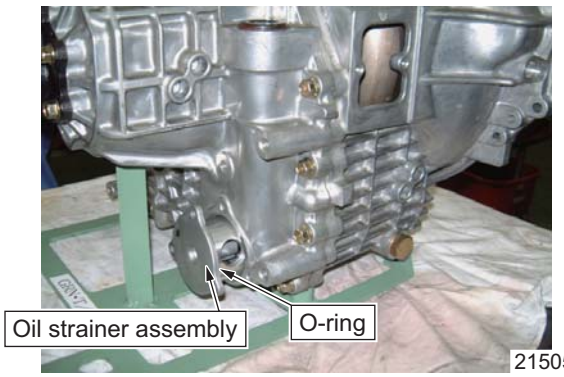
(1) Install O-ring to oil strainer assembly and install the oil strainer assembly to the transmission.

Note: If strainer is clogged, do not use the strainer. Replace it with a new one.

(2) Install bolts and tighten them to the specified torque.

Unit: N·m (kgf·m) [lbf·ft]

Oil strainer assembly	16.7 ± 1.7 (1.70 ± 0.17) [12.3 ± 1.25]



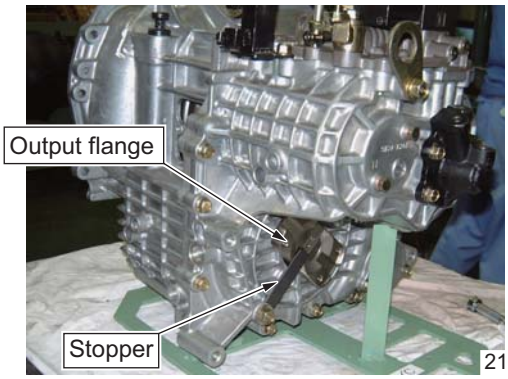
215050

5.12.4 Output flange, Installation

(1) Apply grease to the lip portions of oil seals of output gear assembly.

(2) Install output flange.

(3) Install stopper to output flange.



215051

5.12.5 Speed sensor and oil temperature switch, Installation

(1) Install speed sensor together with O-ring, and tighten it to the specified torque.

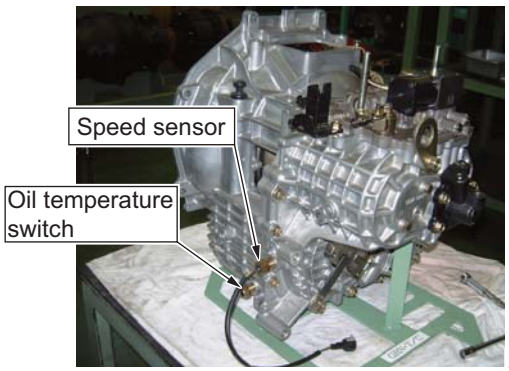
Unit: N·m (kgf·m) [lbf·ft]

Speed sensor	29.4 ± 2.9 (3.00 ± 0.30) [21.7 ± 2.14]

(2) Install oil temperature switch, and tighten it to the specified torque.

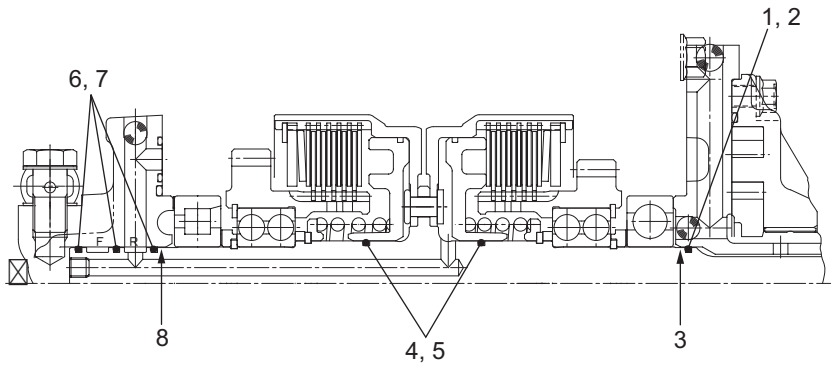
Unit: N·m (kgf·m) [lbf·ft]

Speed sensor	39.3 ± 7.9 (4.01 ± 0.81) [29.0 ± 5.83]



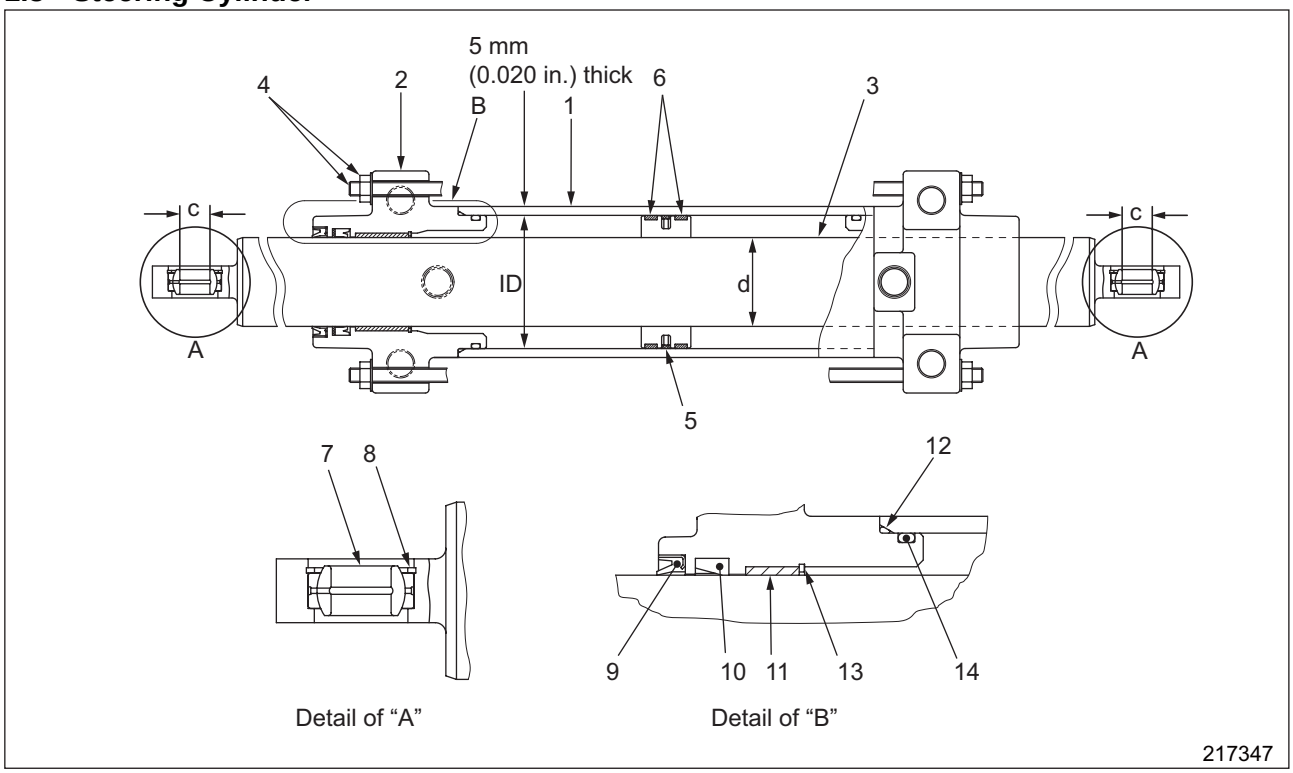
215052

Unit: mm (in.)

Item			Truck type		
			1 ton class	2 ton class	3 ton class
Input shaft	Turbine shaft seal ring width 1	A	2.5 ± 0.05 (0.0987 ± 0.0020)		
		B	2.0 (0.0787)		
	Turbine shaft piston seal ring groove width 2	A	$2.5\ ^{+0.2}_{+0.1}$ ($0.098\ ^{0.0079}_{0.0039}$)		
		B	3.0 (0.1181)		
	Stator shaft inside diameter contacting seal ring 3	A	$30\ ^{+0.021}_{0}$ ($1.1811\ ^{0.0008}_{0}$)		
		B	30.2 (1.1890)		
	Clutch piston seal ring width 4	A	2.5 ± 0.05 (0.0984 ± 0.0020)		
		B	2.0 (0.0787)		
	Clutch piston seal ring groove width 5	A	2.8 ± 0.05		
		B	3.0 (0.1181)		
	Clutch shaft seal ring width 6	A	2.5 ± 0.05 (0.0987 ± 0.0020)		
		B	2.0 (0.0787)		
	Clutch shaft seal ring groove width 7	A	$2.5\ ^{+0.2}_{+0.1}$ ($0.098\ ^{0.0079}_{0.0039}$)		
		B	3.0 (0.1181)		
	Servo case inside diameter contacting seal ring 8	A	$30\ ^{+0.021}_{0}$ ($1.1811\ ^{0.0008}_{0}$)		
		B	30.2 (1.1890)		
	 213680				

A: Standard value B: Repair or service limit

1.3 Steering Cylinder



Unit: mm (in.)

Dimension	Truck type		
	1 ton class	2 ton class	3 ton class
ID	70 (2.76)	75 (2.95)	75 (2.95)
d	45 (1.77)	50 (1.97)	50 (1.97)
c	17 (0.67)	17 (0.67)	17 (0.67)

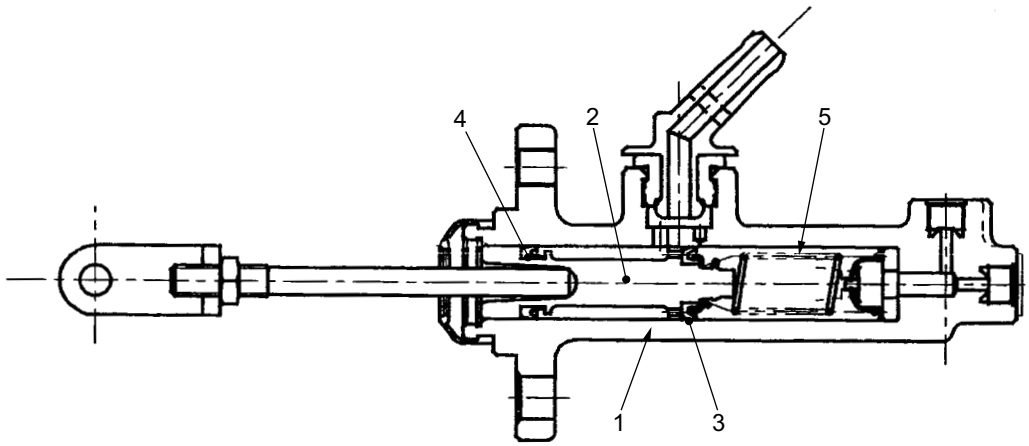
Main Components

1 Body
2 Header
3 Rod assembly
4 Stay rod, Nut, Washer
5 Piston seal
6 Guide ring
7 Bushing
8 Snap ring
9 Dust seal
10 Rod seal
11 Bushing
12 O-ring
13 Snap ring
14 O-ring

5. Service Data

Unit: mm (in.)

Item			Truck type	
			1 ton class	2-3 ton class
Master cylinder	Inside diameter of cylinder body 1	A	19.05 (0.75)	
	Diameter of piston 2	A	19.05 (0.75)	
	Clearance between piston and cylinder	A	0.020 to 0.105 (0.00079 to 0.00413)	
		B	0.15 (0.0059)	
	Primary cup tightness 3	A	1.0 (0.039)	
		B	0.4 (0.016) (Replace every year or whenever overhauling)	
	Secondary cup tightness 4	A	1.1 (0.043)	
		B	0.4 (0.016) (Replace every year or whenever overhauling)	
	Free length of return spring 5	A	59.2 (2.3)	
		B	53.9 (2.1) (Replace every year or whenever overhauling)	



213769

A: Standard value B: Repair or service limit

1.9 Lift Cylinder

Second lift cylinder for simplex mast and triplex mast

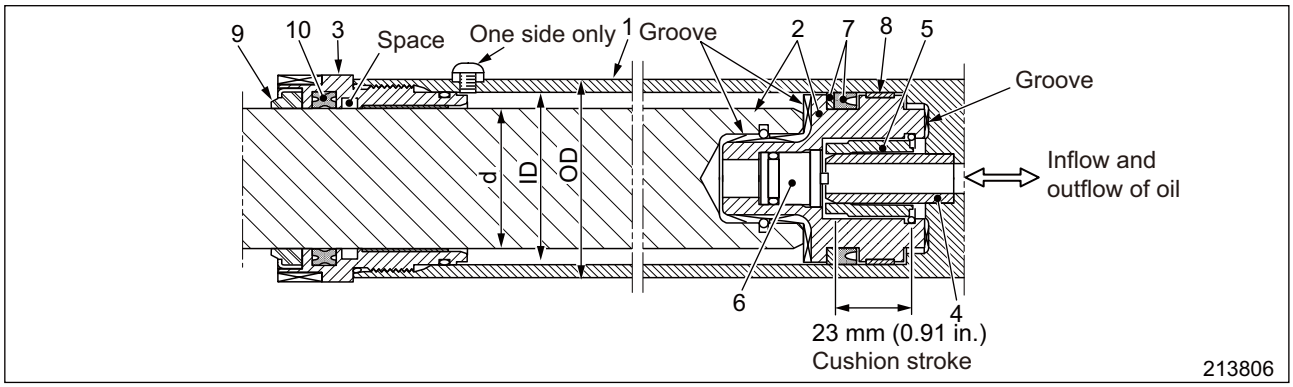
- There are two types for the above lift cylinder: one with a return pipe and the other without a return pipe. The internal drain pipe cylinder is a lift cylinder without a return pipe and with a check valve in the piston instead of a return pipe.
- Regardless of presence or absence of a return pipe, the bottom of the piston is provided with a cushion mechanism for soft landing.

(1) Cylinder without a return pipe
Mast used

(a) Simplex mast with lift height of 3.4 m (133.9 in.) or less

(b) All triplex masts

Detail of inside



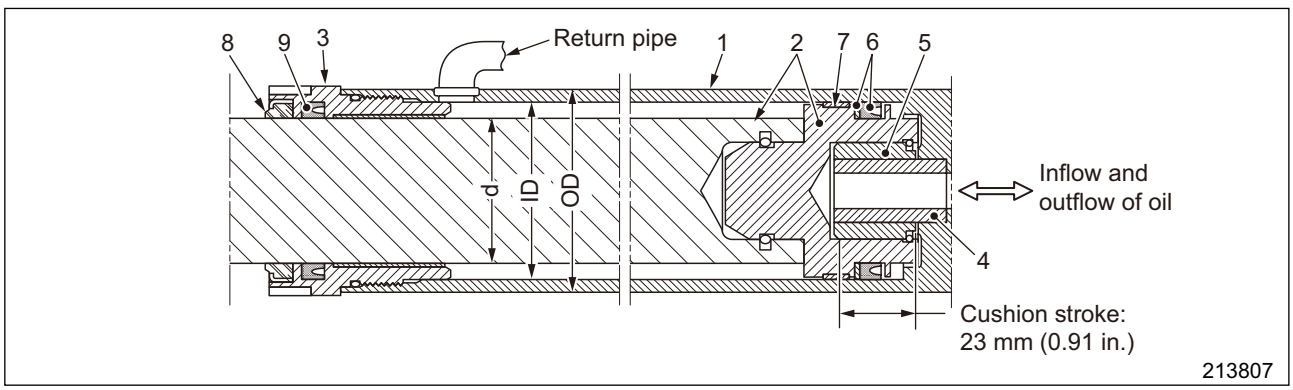
Main Components

1 Cylinder tube
2 Piston rod assembly
3 Cylinder head
4 Pipe (integrated with cylinder tube)
5 Cushion bearing
6 Check valve
7 U-ring, Backup ring
8 Bushing
9 Wiper ring
10 X-ring

(2) Cylinder with a return pipe
Mast used

- Simplex mast with raised height of 3.5 m (137.8 in.) or higher

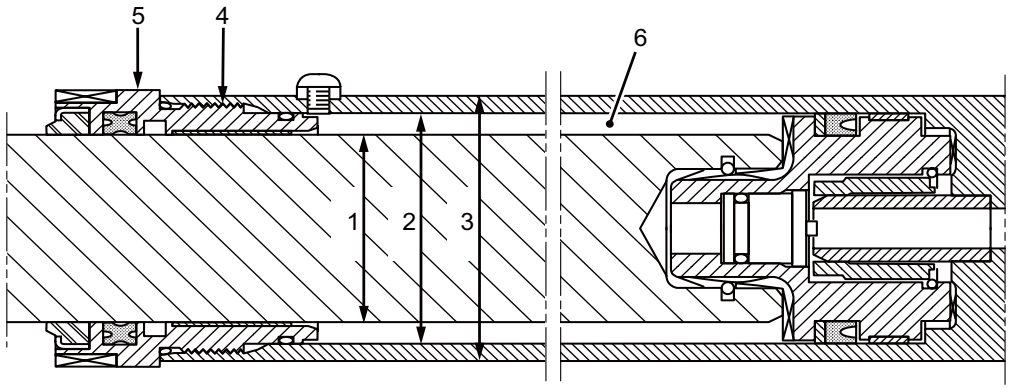
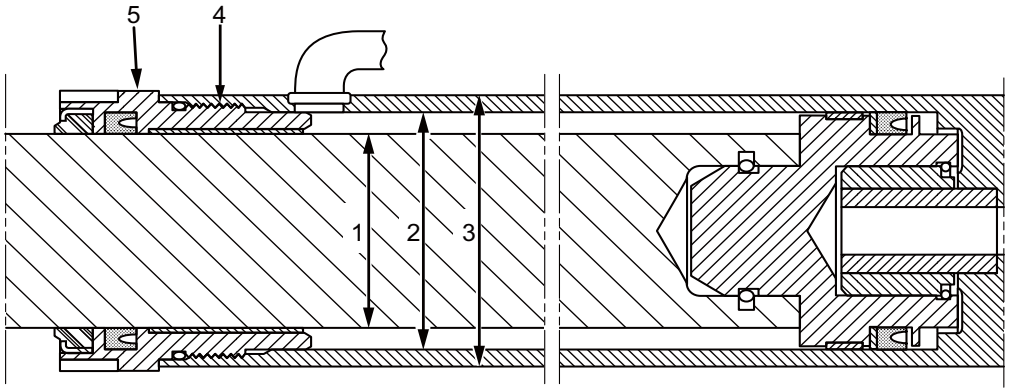
Detail of inside



Main Components

1 Cylinder tube
2 Piston rod assembly
3 Cylinder head
4 Pipe (integrated with cylinder tube)
5 Cushion bearing
6 U-ring, Backup ring
7 Bushing
8 Wiper ring
9 U-ring

Unit: mm (in.)

Item			Truck type		
			1 ton class	2 ton class	3 ton class
Second cylinder for simplex mast and triplex mast	Rod outside diameter 1	A	35 (1.38)	40 (1.57)	45 (1.77)
	Cylinder inside diameter 2	A	45 (1.77)	50 (1.97)	55 (2.17)
	Cylinder outside diameter 3	A	52 (2.05)	57 (2.24)	63 (2.48)
	Thread size of cylinder head 4	A	M49	M54	M59
	Tightening torque of cylinder head 5 N·m (kgf·m) [lbf·ft]	A	196 ± 45.1 (20 ± 4.6) [145 ± 33]	235 ± 53.9 (24 ± 5.5) [173 ± 40]	275 ± 61.8 (28 ± 6.3) [203 ± 46]
	 213851				
	 213852				

A: Standard value

7.1.6 Actuation of Electromagnetic Proportional Pressure Control Valve

This is a solenoid-aided reducing valve that regulates (reduces) pilot oil pressure from the reducing valve in the inlet section to necessary level proportional to the travels of load-handling lever before it is delivered to the chamber 2.

Pressure in the chamber 2 is proportional to travel of load-handling lever; the larger the travel, the higher the pressure, hence the stroke of the main spool 3 increases. Inversely, if the travel is small, the pressure is low and the stroke of the main spool 3 is short.

The valve consists of a solenoid part A and a pressure regulator part B.

The solenoid part A is activated by electric current fed from the controller to protrude the solenoid rod 4 and push the spool 5. The force of the solenoid rod 4 to push the spool 5, that is thrust F, is proportional to the travel of the lever, this is variance of electric current.

Flow of Oil with Cargo-Handling Lever in "Neutral" Position

When the load-handling lever is in the "neutral" position, the solenoid is inactive with its rod retracted. Solenoid rod 4 remains in the retracted position. There is no pressure of pilot oil from the reducing valve in the inlet section because the unload valve is open and extra flow is released from the main relief valve into the drain passage. Also, the pilot oil passage 7 is closed by the spool 5.

Oil in the chamber 2 flows to the drain passage through the passages 8, (d), (c), (e), 9 and 10 in that order.

Flow of Oil When Solenoid is Activated

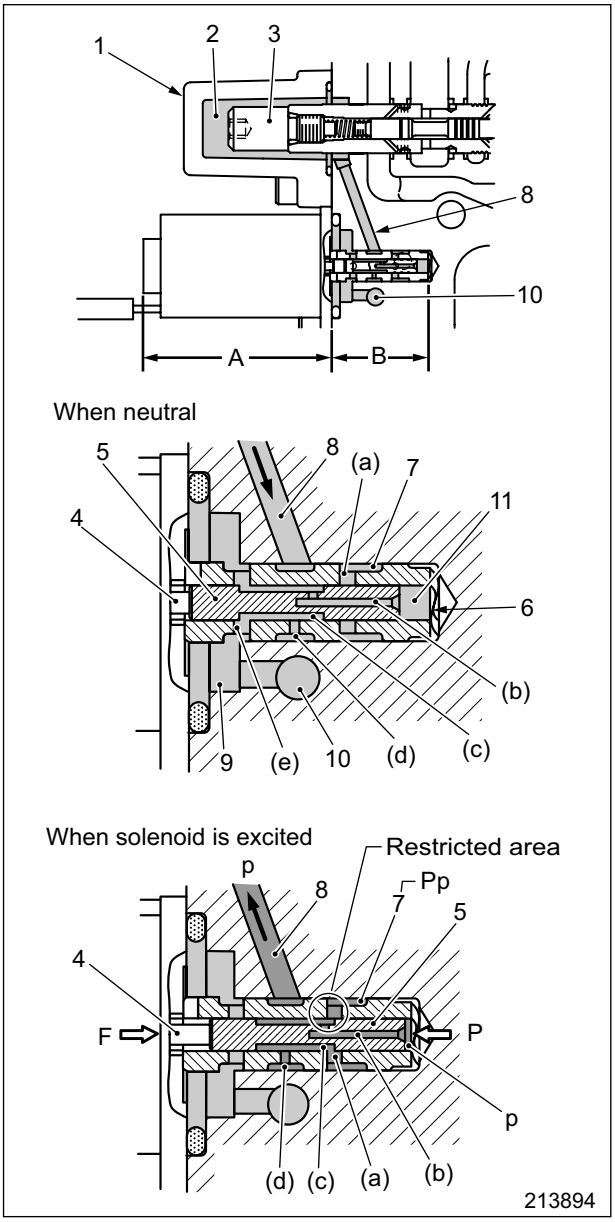
When the solenoid is activated, the solenoid rod 4 protrudes and the spool 5 moves to the right.

Pilot oil (Pp) entering the oil passage 7 flows through the oil passages (a), (c) and (d) into the chamber 2 via the passage 8.

At the same time, oil flows into the chamber 11 from the oil passage (b) and pushes the spool 5 to the left against the thrust of the solenoid rod 4.

- When the pressure of oil supplied into the chamber 2 overcomes the thrust of the solenoid rod 4, the spool 5 is allowed to push the rod to the left, closing the restricted area to the oil passages (a) and (c). The pressure of supplied oil lowers as a result. Inversely, when the pressure of oil supplied into the chamber 2 is overcome by the thrust of the solenoid rod 4, the spool 5 moves to the right, opening the restricted area to the oil passages (a) and (c). The pressure of supplied oil rises as a result.

In this way, the pressure in the chamber 2 is maintained proportional to the thrust of the solenoid rod 4.



1 Cap
2 Chamber
3 Main spool
4 Solenoid rod
5 Spool
6 Wave washer
7 Oil passage receiving pilot oil from reducing valve
8 Passage of pilot oil for actuating valve spool
9 Return oil passage
10 Drain passage
11 Chamber

(a), (b), (c), (d), (e): Small oil passages

p: Reduced oil pressure

P: Force to push spool to left with p

F: Thrust of solenoid rod

6.3 Checking Chain Elongation

(1) Apply maximum load evenly on both forks and expand the chains.

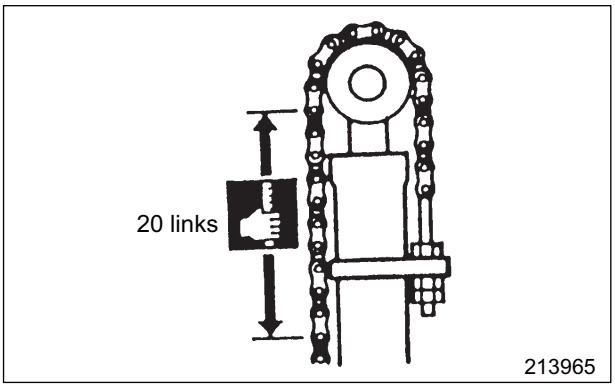
(2) Measure 20 links of chain. When the length exceeds the service limit specified in the table below, replace the chain.

Chain elongation

Unit: mm (in.)/20 links

Item		Truck type		
		1 ton class	2 ton class	3 ton class
Simplex Mast	A	317.5 (12.5)	381 (15)	508 (20)
	B	327 (12.9)	392 (15.4)	523 (20.6)

A: Standard value (new) B: Service limit



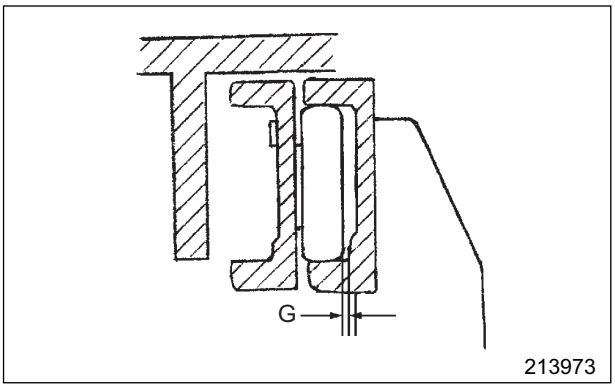
(d) Insert a bar between the outer and inner masts on the indicator side, and push the inner mast to the opposite side.

(e) Read the indicator. This reading is clearance G between the outer mast roller and inner mast.

Unit: mm (in.)

G	0.1 to 0.5 (0.004 to 0.020)

(f) If clearance G is out of specification, adjust it by shims.
For adjustment and installation procedures, refer to "Installing Mast Rollers" on 12.2.2 Installing Mast Rollers.

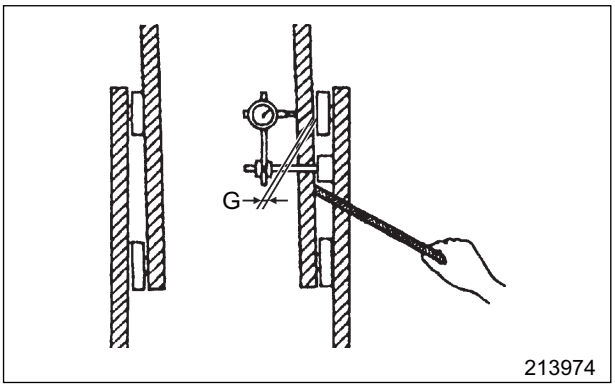


(3) Right-to-left clearance check on outer mast main rollers

(a) Raise the mast to the top.

(b) Set a dial indicator on the outer mast with its contact point rested on the inner mast.

(c) Go over to the opposite side of the mast, and push the outer mast against the inner mast with a bar. Set the indicator to zero (0).



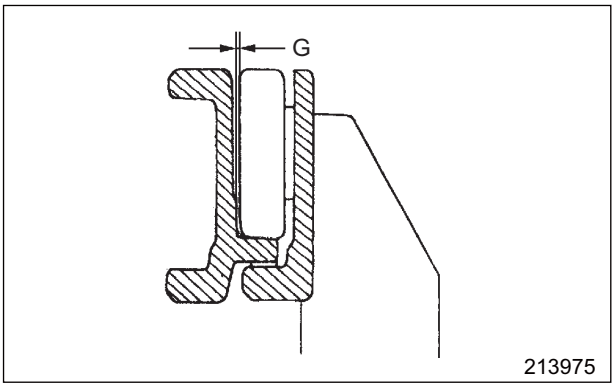
(d) Insert a bar between the outer and inner masts on the indicator side, and push the inner mast to the opposite side.

(e) Read the indicator. This reading is clearance G between the outer mast roller and inner mast.

Unit: mm (in.)

G	0.1 to 0.5 (0.004 to 0.020)

(f) If clearance G is out of specification, adjust it by shims.
For adjustment and installation procedures, refer to "Installing Mast Rollers" on 12.2.2 Installing Mast Rollers.



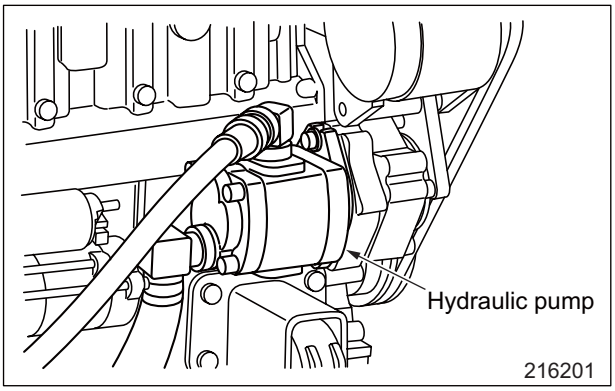
23.Troubleshooting (Triplex Mast)

Lift bracket and inner mast do not move smoothly.	Clearance between lift rollers and side rollers incorrect	Readjust clearance.
	Rollers not rotating smoothly on their shafts	Relubricate side rollers and replace other rollers.
	Mast strip clearance incorrect	Adjust shims.
Lift bracket or inner mast are not in a level position.	Too much clearance on side rollers	Readjust by adding shims.
	Lift chains unequally tensioned	Readjust chain tension.
	Shim adjustments unequally made on between left and right lift cylinders (at maximum height)	Remove or add shims.
Mast makes noise.	Rollers not rotating smoothly on their shafts	Check and adjust or replace rollers.
Lift cylinder descends due to a load (Drift).	Lift cylinder packing damaged	Replace.
	Sliding (inside) surface of lift cylinder tube damaged	Replace.
Whole mast shakes.	Mast-support bushing or metal worn	Retighten or replace.
Mast is distorted.	Off-center loading or overload	Replace mast assembly.
Fork tips differ in height.	Distortion of finger bar	Repair or replace.
	Distortion of forks	
	Uneven loading	

(4) Check hydraulic pump.

Service hours	Yearly (2000 hrs)

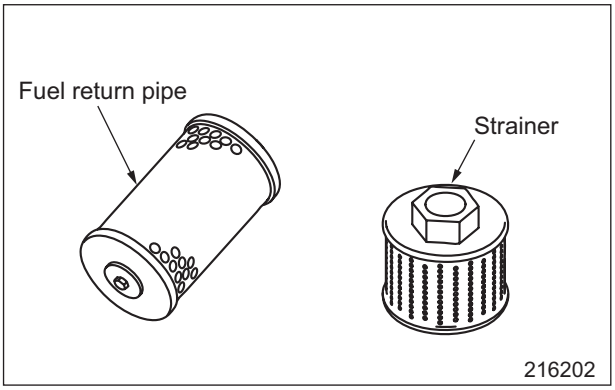
♦Check the hydraulic pump for damages, loosening or missing bolts and nuts, and oil leaks.



(5) Clean hydraulic tank strainer.

Service hours	Every 6 months (1000 hrs)

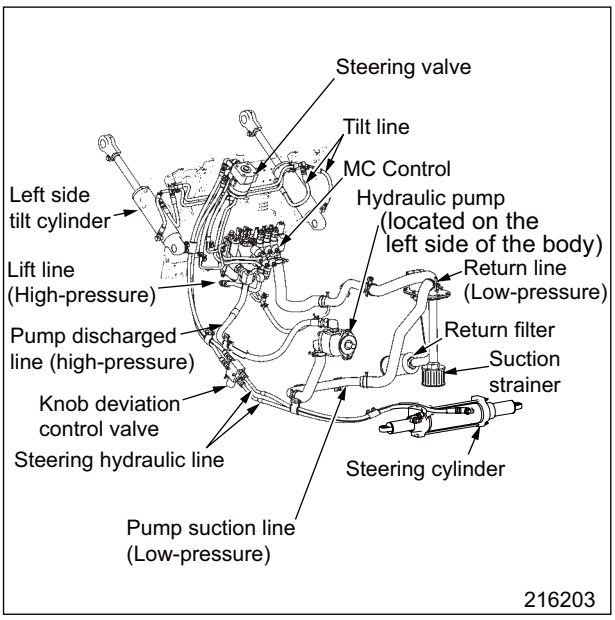
♦Clean the hydraulic tank strainer.

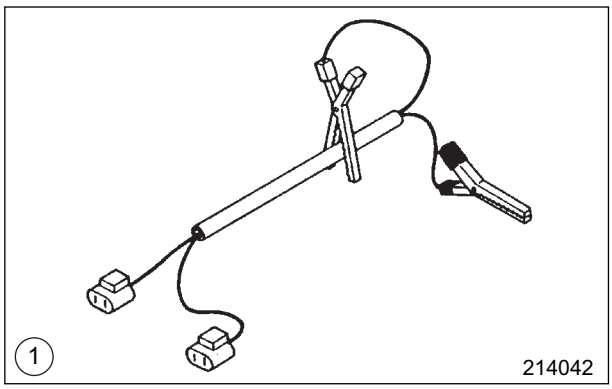


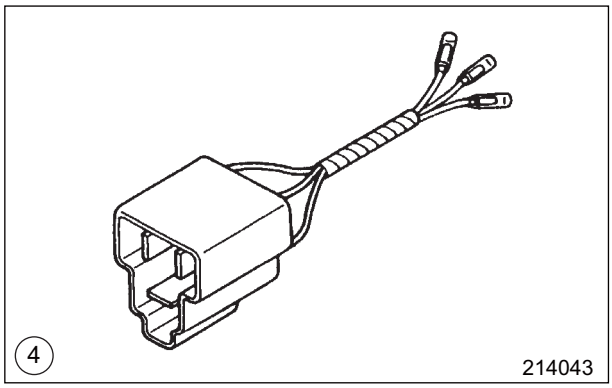
(6) Change hydraulic hose. (High-pressure hose)

Service hours	Change in every 1-2 years

♦Replace the hydraulic hoses (high-pressure hoses) with new ones.







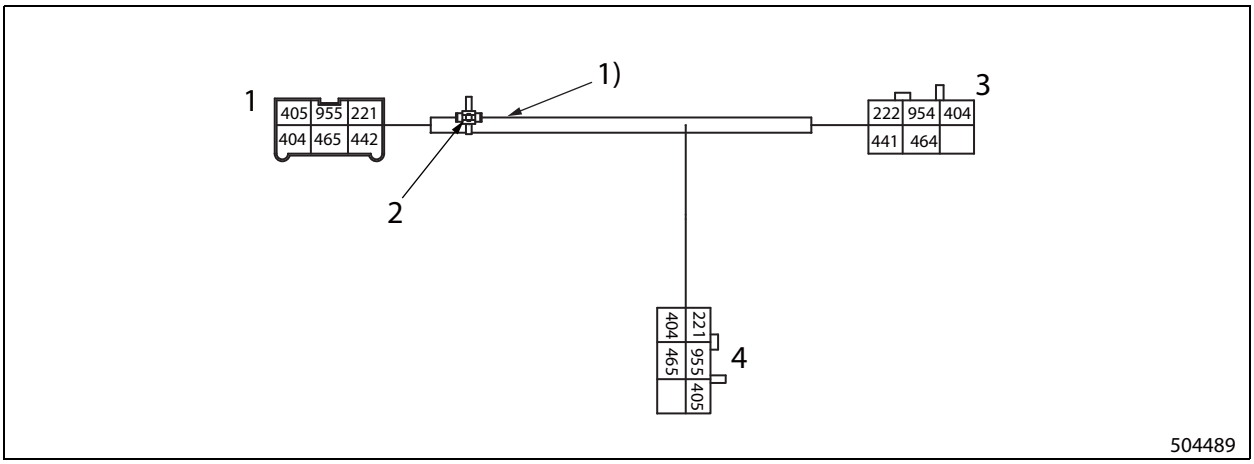
Note: There are a total of 19 types of the inspection connectors 2 thru 20. They are supplied as a set or individually. The connector 4 is shown.

5. Technical Data

Unit: mm (in.)

Truck model		Class	1 ton class		
		Gasoline engine truck	GP15N GPE15N GP15ZN	GP18N GPE18N GP18ZN	GP20CN GPE20CN
		Diesel engine truck	DP15N	DP18N	DP20CN
1	Maximum lift		3000 (118.1)	3000 (118.1)	3000 (118.1)
2	Free lift height		115 (4.5)	115 (4.5)	120 (4.7)
3	Minimum turning radius		1950 (76.8)	1980 (78.0)	2020 (79.5)
4	Overall length		3180 (125.2)	3220 (126.8)	3280 (129.1)
5	Overall width (outside-to-outside of tires)	Single	1065 (41.9)	1065 (41.9)	1065 (41.9)
		Double	1330 (52.4)	1330 (52.4)	-
6	Overall height (with mast lowered)		1990 (78.3)	1990 (78.3)	1990 (78.3)
7	Overall height (with mast extended)		4055 (159.6)	4055 (159.6)	4055 (159.6)
8	Height of the overhead guard		2065 (81.3)	2065 (81.3)	2065 (81.3)
9	Fork size (T x W x L)		35 x 100 x 920 (1.4 x 3.9 36.2)	35 x 100 x 920 (1.4 x 3.9 36.2)	40 x 122 x 920 (1.6 x 4.8 x36.2)
10	Fork spread		200 to 920 (7.9 to 36.2)	200 to 920 (7.9 to 36.2)	200 to 920 (7.9 to 36.2)
11	Front overhang		400 (15.7)	400 (15.7)	415 (16.3)
12	Wheel base		1400 (55.1)	1400 (55.1)	1400 (55.1)
13	Tread (front wheel)	Single	890 (35.0)	890 (35.0)	890 (35.0)
		Double	1025 (40.4)	1025 (40.4)	-
14	Tread (rear wheel)		1025 (40.4)	1025 (40.4)	1025 (40.4)
15	Under clearance (at center of frame)		152 (6.0)	152 (6.0)	152 (6.0)
16	Tilt angle (forward – backward)		6 - 12°	6 - 12°	6 - 12°

3.16 Rear Combination Harness



1. Harness
2. Clip
3. Rear combination light (R.H.)
4. Rear combination light (L.H.)
1) Protect with corrugated tube

Note: Use AVS, CAVS or AVSS as the power source.

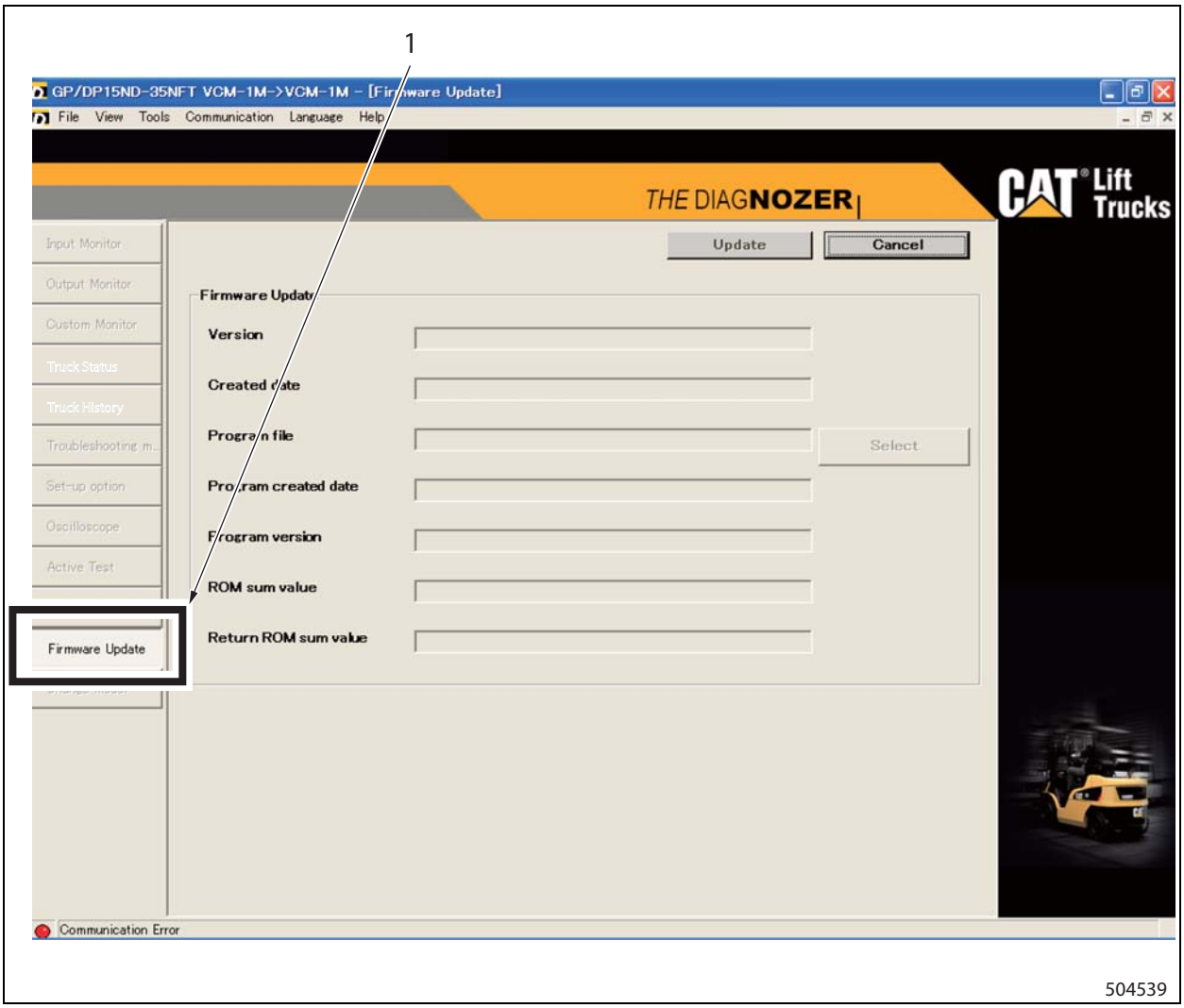
Circuit	Wire diameter	Wire color code	Destination
955	0.85	B	Rear combination light LH (GND) to harness
954	0.85	B	Rear combination light RH (GND) to 955
465	0.5	L/R	Rear combination light LH (backup light) to harness
464	0.5	L/R	Rear combination light RH (backup light) to 465
442	0.5	Y/L	Rear combination light LH (stop light) to harness
441	0.5	Y/L	Rear combination light RH (stop light) to 442
405	0.5	G/R	Rear combination light LH (turn signal light) to harness
404	0.5	G/B	Rear combination light RH (turn signal light) to harness
221	0.85	R/B	Rear combination light LH (tail light) to harness
222	0.5	R/B	Rear combination light RH (tail light) to 221

5.9 Troubleshooting

Condition	Possible cause	Action
The fuel gauge indicates the presence of fuel, but the truck runs out of gas	On gasoline LPG dual fuel lift truck, the fuel gauge shows only gasoline amount LPG amount is not shown	To know if LPG is running out, use LPG fuel warning
Back-up light went off	Back-up light goes off when the temperature on the meter panel becomes high (105°C (221°F) or higher) to protect the back-up light	Park the truck in the shade to cool it down
LCD is not displayed	The LED is automatically turned off if the internal temperature of the meter panel becomes 85 °C (185 °F) or higher to protect LCD	Park the truck in the shade to cool it down
	LCD contrast may be adjusted to its minimum	Adjust contrast with buttons
Display switching speed is slow	When the temperature in the meter panel becomes low [0 °C (32 °F) or lower], the screen switching speed becomes slower because of the characteristic of LCD	-
LCD screen is too dark	The screen display becomes darker when the temperature on the meter panel becomes high (105°C (221°F) or higher) because of the characteristic of LCD	Adjust contrast with buttons
LCD screen is too dim	The screen display becomes dim when the temperature in the meter panel becomes low [0 °C (32 °F) or lower] because of the characteristic of LCD	Adjust contrast with buttons
Button operation (long press) is ineffective	When the engine is running, long press of a button is ineffective	Turn the key switch to the OFF position once to stop the engine, then turn the key switch to the ON position
Time becomes 00:00 AM	Changing battery will reset the time	Refer to 3-40 "Time setting" to set the time
Unable to register "0000" and "1111" passwords	You cannot register "0000" and "1111"	-
Unable to use overload warning function	This function is only available for the trucks equipped with the load meter display option	Use the load meter display (Manufacturer's option)
Exterior alarm lights do not glow (The buzzer does not sound)	Trigger speed setting should be 20km/h (12.4 mph) or less and trigger load setting should be 3.5 ton or less (depending on the truck models)	Check the exterior alarm function setting
Diagnostic code (F-73) occurs	This is caused by a difference in hour meter readings between the VCM and the meter panel when the hour meter is transferred	Update the hour meter using the service tool
The screen returns to the standard screen while conducting the clock time setting or exterior alarm setting, or while checking the truck history	If the buttons are left untouched for more than three minutes, or if the engine is started during the setting procedure, the setting being conducted becomes ineffective and its screen returns to the standard screen. Restart the setting procedure from the beginning	-
Fuel gauge and water temperature gauge display glows	Check the fuel sensor and the water temperature sensor, or all the connected wires to both sensors for electrical short circuit	-

Firmware update

Click the Firmware Update button from the menu or toolbox to display the firmware update screen. The displayed contents vary depending on the controller being connected. On firmware update screen, the user selects software version of controller that is connected, or the user can select a write software, or conduct update. Firmware can be updated in a setup mode only. Note that updates are available at any time on the controller without entering the setup mode.

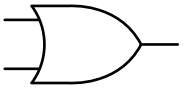
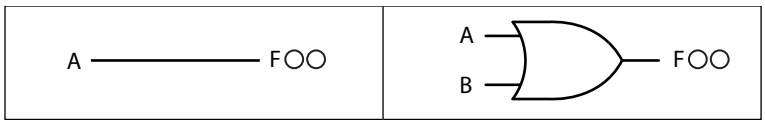


1. Firmware update button

10.2 Diagnosis Table (F Code)

Diagnostic code table

Warning descriptions

Diagnosis	Lift Lever Neutral Warning (F10) — Diagnostic name and diagnostic code
Logic conditions	· Input signal<2.3 V · Input signal>2.7V (when key switch is ON) — Warning threshold   Warning occurs under condition A Warning occurs under condition A or B
Recovery	Auto recovery when the lever is placed in neutral. — Warning recovery condition
Action	· Turn OFF all solenoid outputs of operating functions. — Control action when warning occurs
LED blink pattern	C — See "10.3 LED blink pattern."

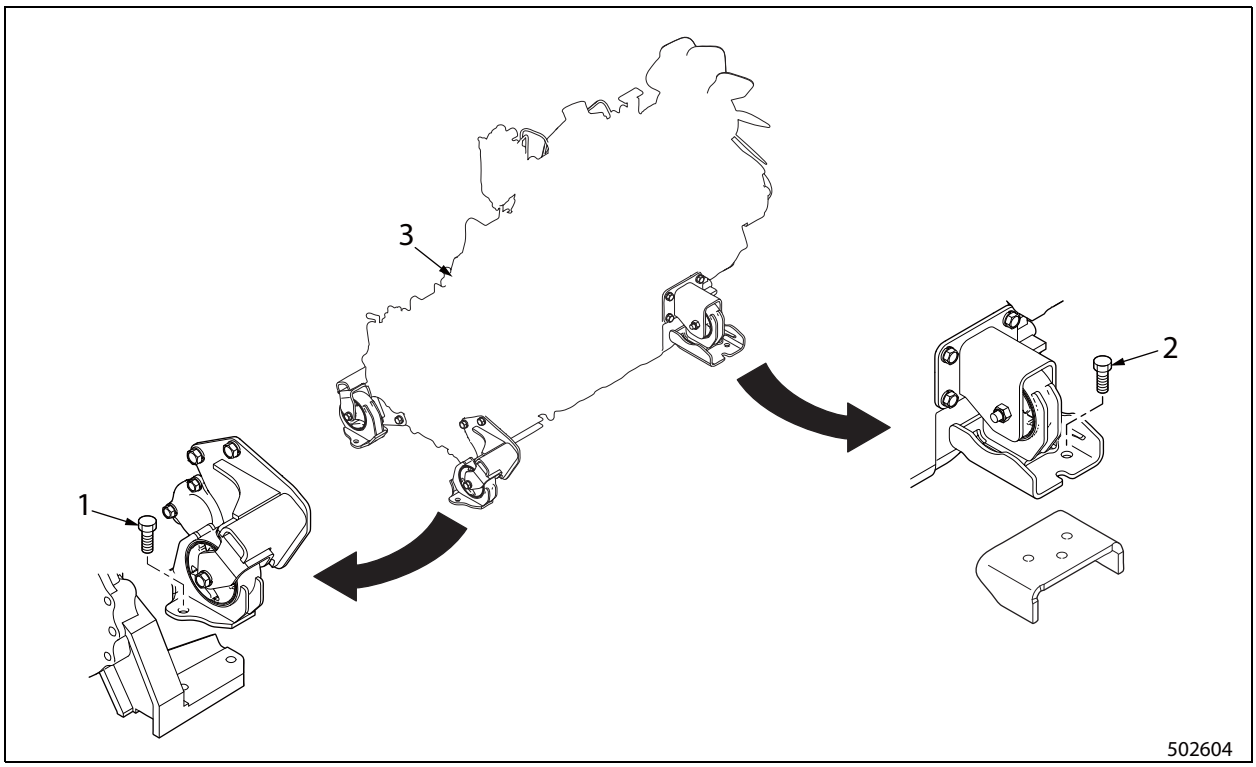
Diagnosis	VCM Memory warning (F01)
Logic conditions	· EEPROM Sum check value (when key switch is ON) — F01
Recovery	Turn on power again.
Action	· Stop the operation of controller (GSE and CAN communication will not stop)
LED blink pattern	B

2.12 Preparation for Removing Engine and Transmission Assembly

Lift the engine and transmission assembly with a hoist and slings.

Item	Weight
Engine and transmission assembly	Approx. 350kg (771.6 lb.)

2.13 Removal Sequence of Engine and Transmission Assembly



1. Transmission mounting bolt
2. Engine mounting bolt
3. Engine and transmission assembly

2.14 Suggestions for Removing Engine and Transmission Assembly

(1) To remove mounting bolts, lift the engine and transmission assembly high enough to lighten the weight from the mount cushions. Remove the engine mounting bolts of engine mounting.

(2) Hitch slings to the three hooks, slowly lift the engine and transmission assembly by moving it backwards while maintaining its balance.

Note:

- With the engine and transmission assembly suspended, drain the transmission oil and clutch oil.
- Only one drain plug is provided on the powershift transmission.

2.15 Suggestions for Installing Engine and Transmission Assembly

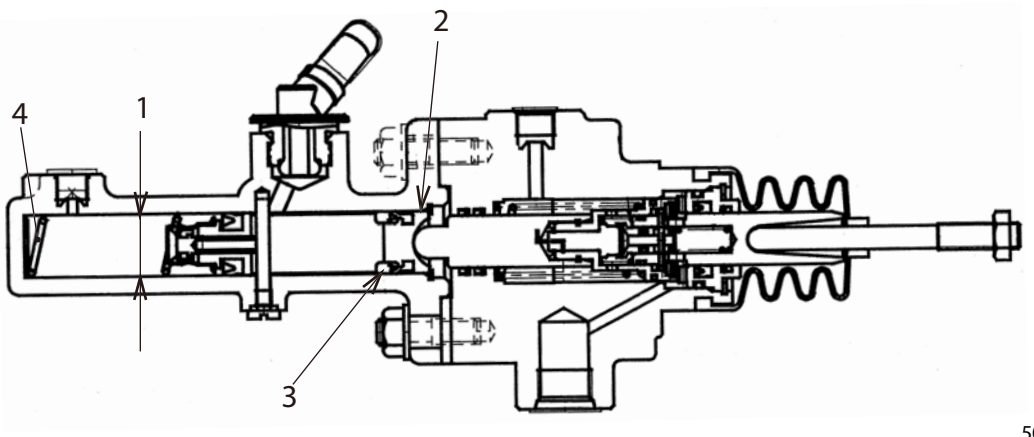
This section describes only removal and installation procedures specific to diesel engine trucks. Follow the instructions for the gasoline engine trucks in the preceding sections for the common procedures.

Difference from the gasoline engine truck

Connect the accelerator pedal linkage on the floor plate to the throttle cable. Check that the injection pump lever is at the full-open position when the accelerator pedal is fully pressed.

Clutch master cylinder (Wet type)

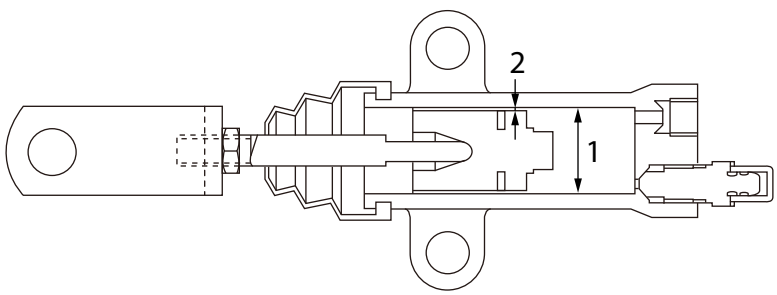
Item		Specified value	
1	Inside diameter of cylinder body	Standard	19.05 mm (0.7500 in.)
2	Clearance between cylinder body and piston	Standard	0.020 to 0.105 mm (0.0008 to 0.0041 in.)
		Limit	0.15 mm (0.0059 in.)
3	Secondary cup outside diameter	Standard	20.2 ± 0.2 mm (0.795 ± 0.007 in.)
4	Free length of return spring	Standard	81.3 mm (3.201 in.)



502976

Clutch master cylinder (Wet type)

Item		Specified value	
1	Inside diameter of cylinder body	Standard	22.22 mm (0.8748 in.)
2	Clearance between cylinder body and piston	Standard	0.020 to 0.105 mm (0.0008 to 0.0041 in.)
		Limit	0.15 mm (0.0059 in.)
3	Diameter of piston cup	Standard	24 ± 0.2 mm (0.94 ± 0.007 in.)
4	Free length of return spring	Standard	43 mm (1.69 in.)



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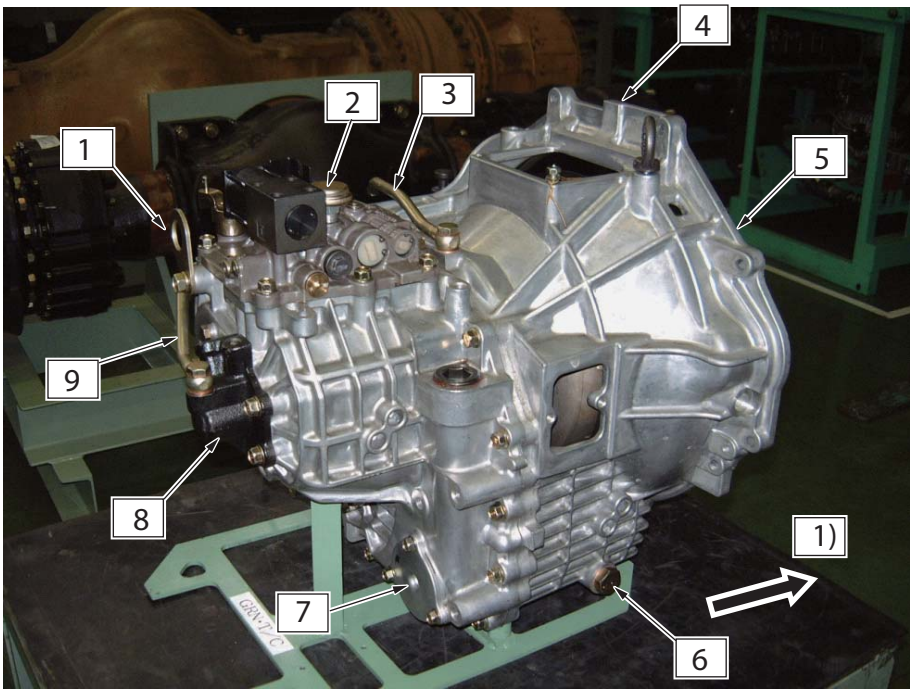
Chapter 8 POWERSHIFT TRANSMISSION

1. Structure

1.1 External View of Torque Converter Transmission

Left side view



502261

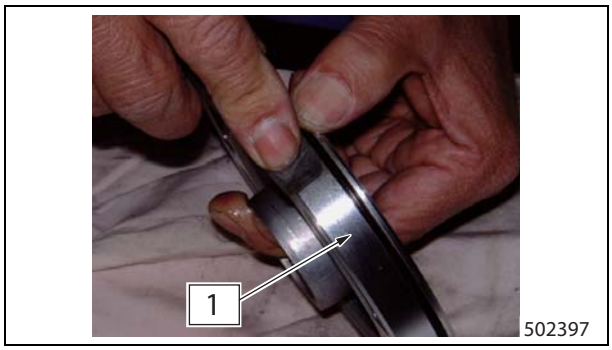
1. Hanger
2. Control valve
3. Cooler inlet pipe
4. Serial number
5. Torque converter
6. Oil drain plug
7. Oil strainer assembly
8. Servo case
9. Cooler outlet pipe

1) Engine side

5.4 Input Shaft Gear Assembly, Inspecting

Clutch piston

Inspect sliding area for wear and damage.
If any scratches are found, polish with a fine grit sandpaper and wash the surface.
If scratches are deep, replace.



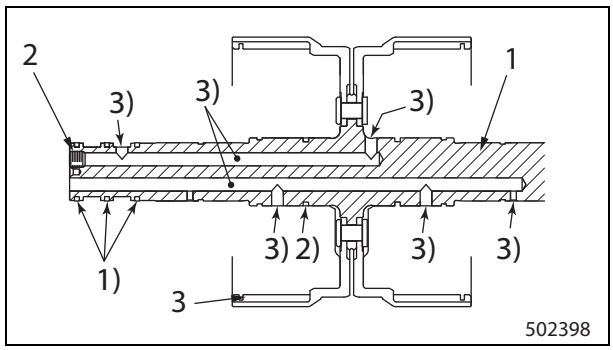
1. Clutch piston

Input shaft

(1) Inspect spline for wear and damage.
(2) Inspect grooves for wear and damage. Also check the width of grooves.
(3) Inspect oil passage for clogging.
If the passage is clogged, remove set screw, and clean the passage with compressed air.

Note:

- When set screw has been removed, apply Loctite 242 to the set screw before installing.
- Be sure to use clean compressed air which is filtered through an air filter.



Cross-section of input shaft

1. Input shaft
2. Set screw
3. Clutch drum
1) Groove
2) Groove
3) Oil passage

Item		Specifications	
		1) Groove	2) Groove
Input shaft groove	Standard	2.5 mm (0.098 in.)	2.8 mm (0.110 in.)
	Limit	3.0 mm (0.118 in.)	3.0 mm (0.118 in.)

(4) Inspect clutch drum and input shaft for looseness.

Gear

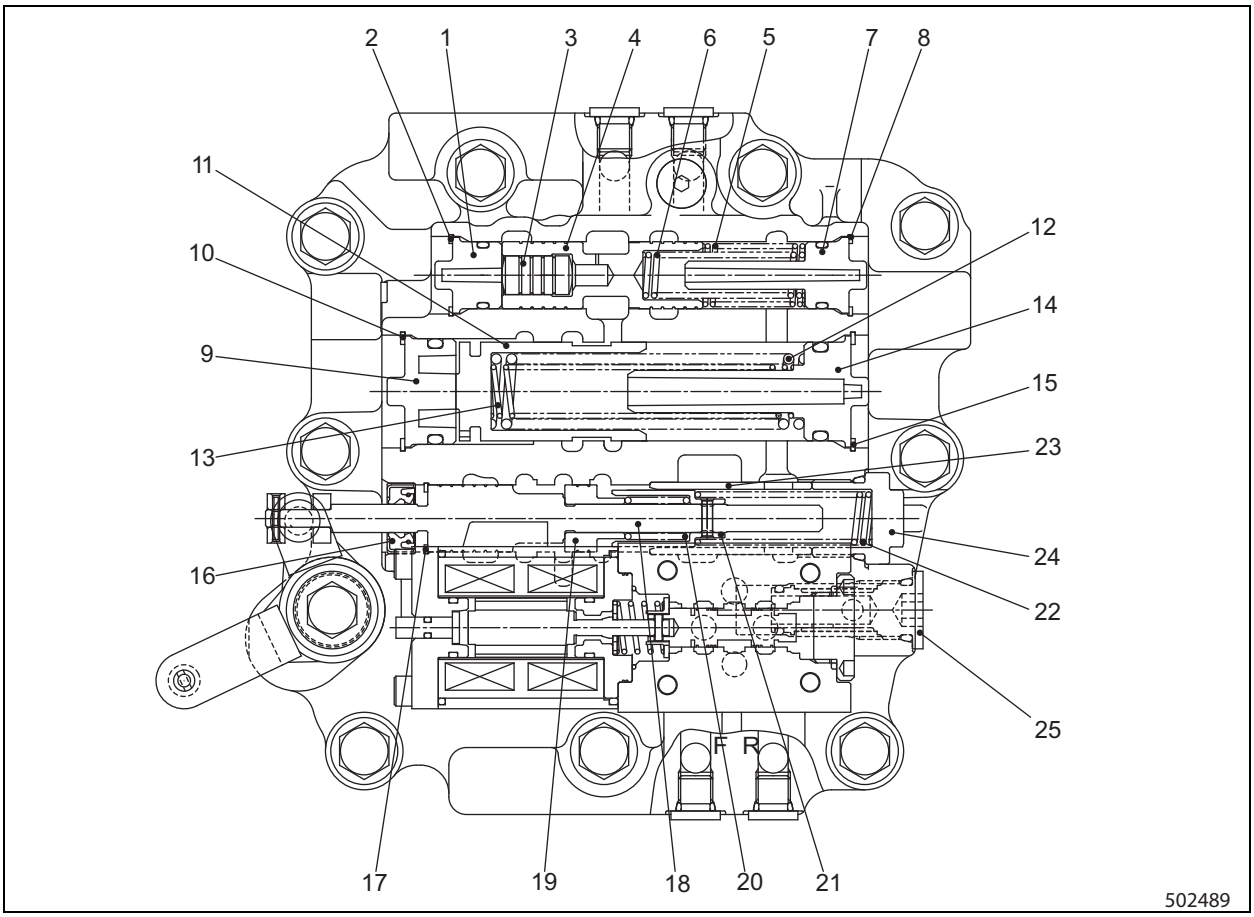
Inspect gear and spline for wear or damage.

Drum

Inspect piston clutch sliding area for wear and damage.

7. Control Valve, Assembling

7.1 Control Valve, Assembly Sequence

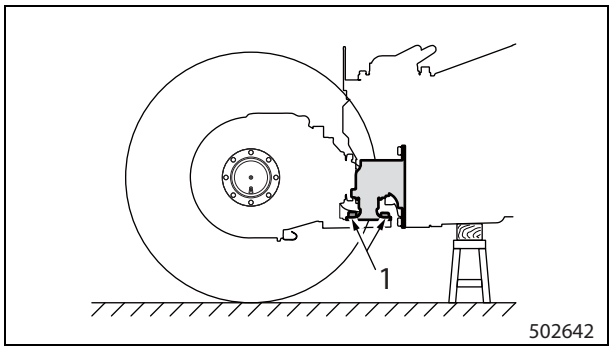


1. Main relief plug, O-ring
2. Snapring
3. Slug
4. Regulator valve
5. Main relief spring (thick)
6. Main relief spring (thin)
7. Main spring seat, O-ring
8. Snapring
9. Accumulator plug, O-ring
10. Snapring
11. Accumulator piston
12. Outer spring
13. Inner spring
14. Accumulator spring seat, O-ring
15. Snapring
16. Oil seal
17. Snapring
18. Inching rod
19. Inching valve
20. Inching valve spring
21. Inching stopper, Spring pin
22. Inching return spring
23. Inching stopper
24. Inching plug, O-ring
25. Strainer, O-ring

5.2 Suggestions for Removal

Bolt, removing

The transmission is connected with differential case by bolt. When removing this bolt, place a wood block under the transmission to prevent it from falling.



1. Bolt

Parking brake cable, removing

To remove the parking brake cable, remove the parking brake lever assembly from the dashboard and disconnect the cable from the lever.

Note: To dismount the reduction differential alone, remove the front axle first. If the engine and transmission assembly has been removed, remove reduction differential without removing front axle from the frame.

6. Front Axle and Reduction Differential, Installing

For installation, follow the removal sequence in reverse and observe the instructions below.

(1) After connecting the parking brake cable, make sure that brake lever operating effort is within the specification.

Item	Truck classifications		
	1 ton class	2 ton class	3 ton class
Parking brake lever operating effort	150 to 200 N (15.3 to 20.4 kgf) [33.72 to 44.96 lbf]	200 to 250 N (20.4 to 25.5 kgf) [44.96 to 56.20 lbf]	230 to 250 N (23.5 to 25.5 kgf) [51.71 to 56.20 lbf]

(2) Before installing the mast, bleed trapped air in the brake oil lines. Refer to CHAPTER "BRAKE SYSTEM".

(3) After installing the mast, make sure that tilt angles, both forward and backward, are correct and that the lift chains, right and left, are equal in tension. Refer to CHAPTER "MAST AND FORKS".

(4) Fill the front axle housing with oil up to the plug hole level.

Item	Truck classifications	
	1 ton class	2, 3 ton classes
Refill capacity of transfer and differential oil	5.0 L (1.321 US gal.)	8.5 L (2.246 US gal.)

12. Knuckle Section (Kingpin), Assembling

12.1 Suggestions for Assembly

For assembly, follow the disassembly sequence in reverse and observe the instructions below.:

(1) Reassemble the kingpin from the lower side toward the upper side.

Note: If assembled the other way around, shims may be damaged.

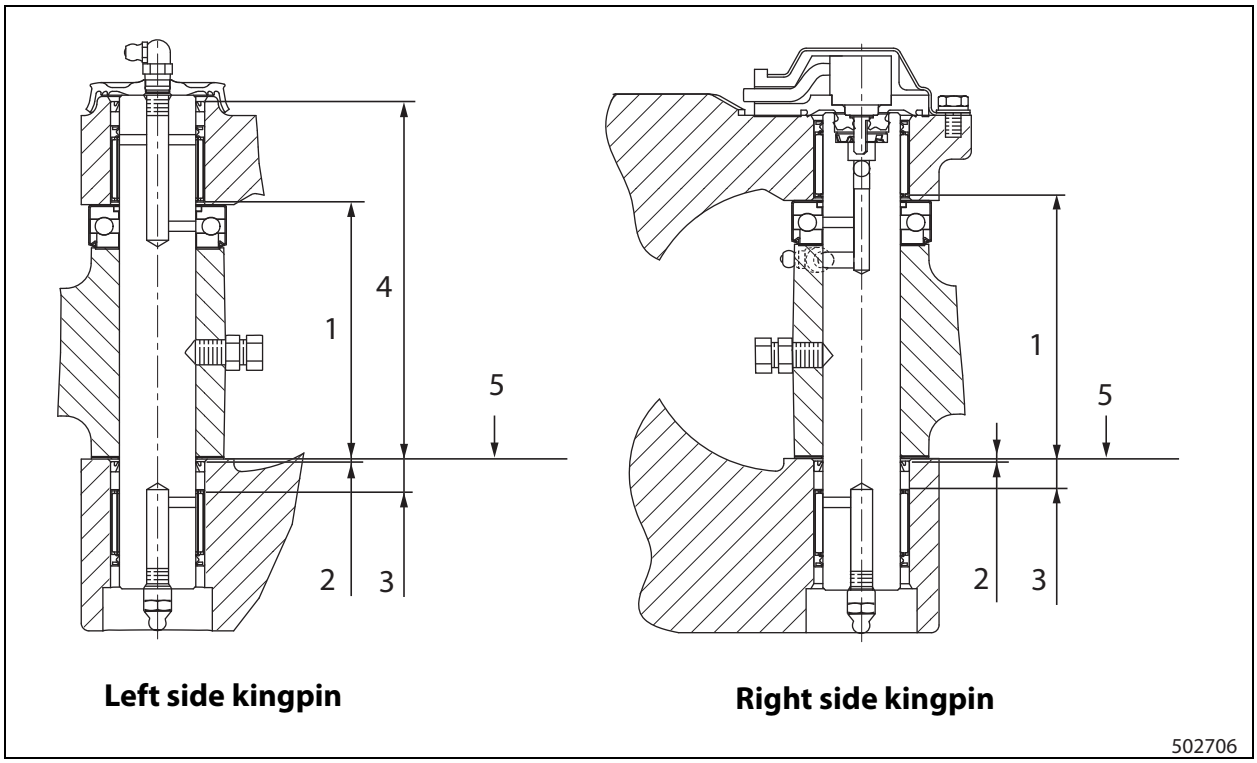
(2) Orient thrust bearing in the direction shown in the figure. Obtain 0.2 mm (0.008 in.) clearance in the axial direction using shims.

(3) To install dust seal and needle bearing, use a driving tool.

(4) Orient tabs of plate (3 places) upward. Align the notch to the locating spring pin, which protruding from the kingpin. Install snugly to the full depth.

(5) After assembly, lubricate sufficiently. Apply grease until it overflows from the boundary between axle and knuckle.

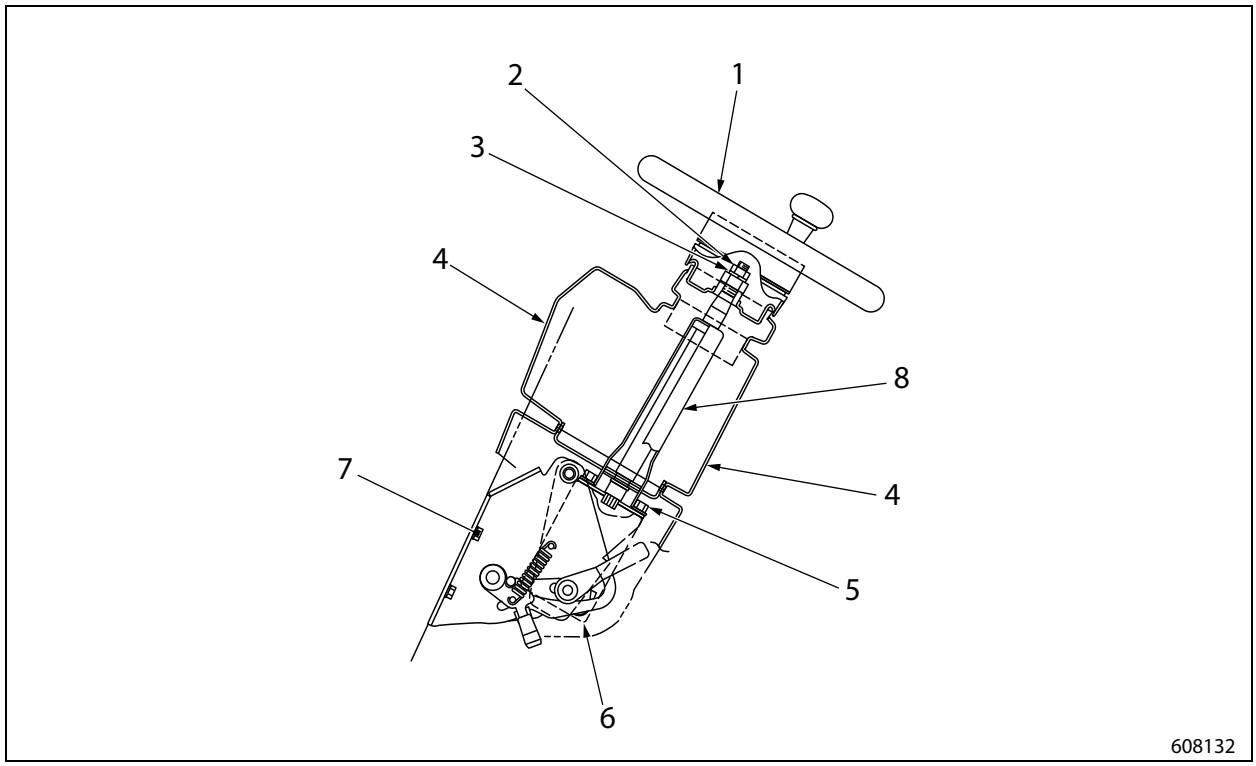
(6) Dimensions after assembly are shown below.



1. Bearing end face (101 mm(3.976 in.))
2. Seal end face (1 mm(0.039 in.))
3. Bearing end face (12 mm(0.472 in.))
4. Seal end face (140.5 mm(5.5315 in.))
5. Base level

3. Steering Wheel and Steering Valve, Disassembling

3.1 Disassembly Sequence



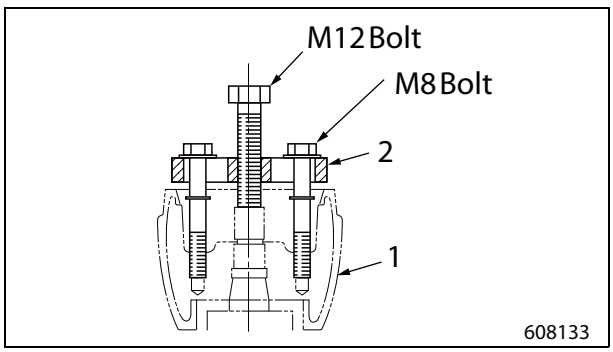
1. Steering wheel
2. Nut
3. Spring washer
4. Cover
5. Steering valve mounting bolt
6. Steering valve
7. Steering column assembly mounting bolt
8. Steering column assembly

3.2 Suggestions for Disassembly

Steering wheel, Removing

(1) Remove the horn button.

(2) Remove steering wheel nut and remove steering wheel using a wheel puller.



1. Steering wheel 2. Wheel puller

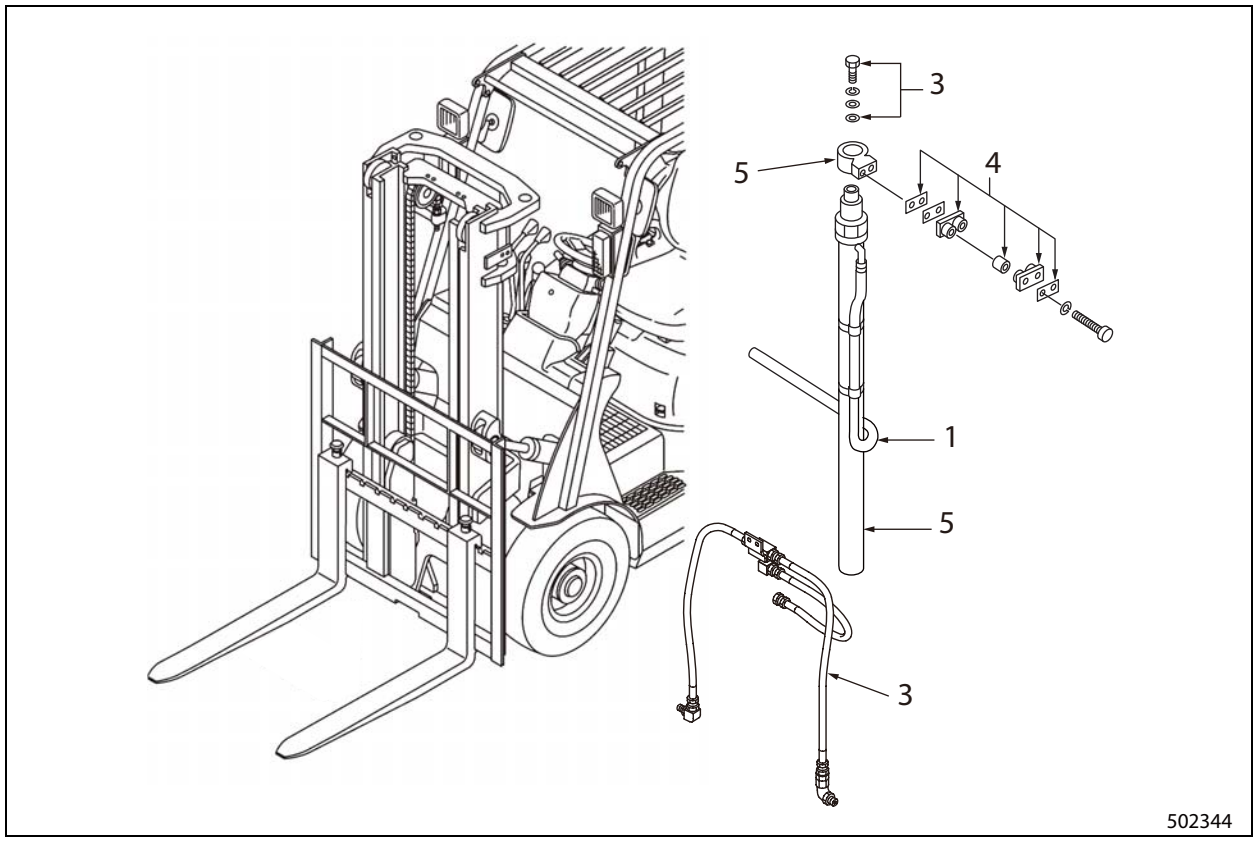
Ref.	Special tool	Part number
2	Wheel puller	91268-10600

⚠ CAUTION

When removing steering wheels, do not tap the top end of the steering shaft.

7. Lift Cylinders (Simplex Mast), Removing

7.1 Removal Sequence



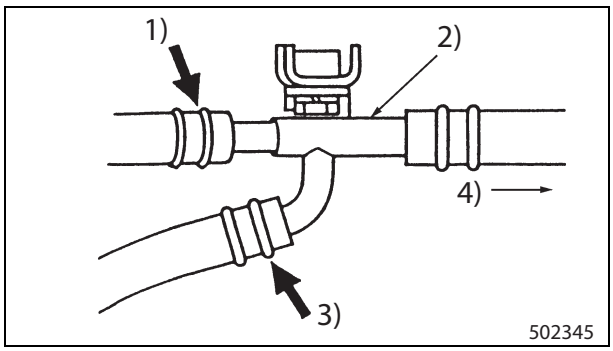
1. Return hose (if equipped)
2. High-pressure hose
3. Set bolt, Shim
4. Cylinder clamp (Cushion, Collar, Shim)
5. Lift cylinder, Bracket

7.2 Suggestions for Removal

Removing return hose (if equipped)

Remove the hose guard. Start the engine, raise the lift bracket to the top, and then turn the engine OFF. Disconnect the right and left cylinder return hoses from the connectors.

Note: DO NOT touch the lift lever during removal.

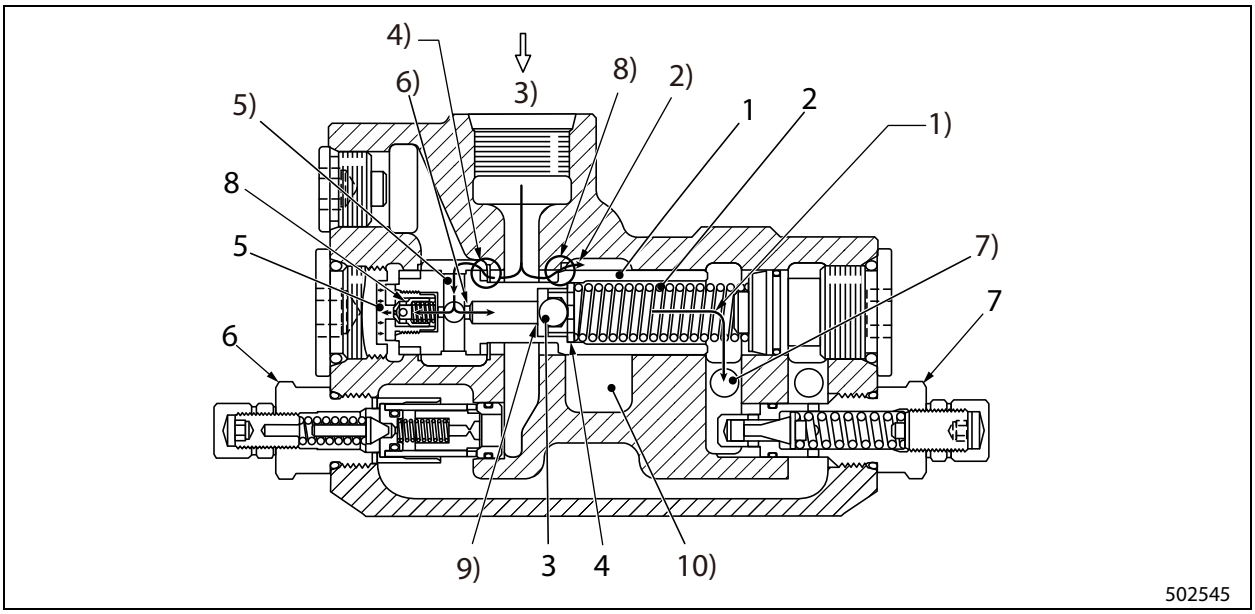


1) Right side lift cylinder
2) Connector
3) Left side lift cylinder
4) To tank

Lowering lift bracket

Slowly lower the lift bracket with the lift lever.

32.2 Inlet Cover Section



1. Priority valve spool
2. Spring
3. Ball check
4. Ball retainer
5. Damper chamber
6. Main relief valve
7. Steering system relief valve (PF relief valve)
8. Valve

1) Priority flow (PF flow)
2) Excess flow (EF flow)
3) P: From hydraulic pump (pump port)
4) PF: Restricted area
5) Hole A
6) Control orifice
7) PF: To steering valve (priority port)
8) EF: Restricted area
9) Ball check seat face
10) Excess flow passage (EF flow)

The inlet section of the control valve consists of the main relief valve 6, which limits the maximum pressure of the hydraulic system. The priority valve which feeds the pressure oil preferentially to the steering system, and the steering system relief valve 7, which limits maximum pressure of the supplied pressure oil.
The priority valve is a flow divider valve which divides supplied oil to a predetermined volume of priority flow (PF flow) and excess flow (EF flow). PF flow is supplied to the steering system and EF flow to the load valves, respectively.

The figure above shows the position of priority valve spool 1 during operation (pump rotation).

Priority flow that enters port P will be as follows: PF restricted area Hole (A) Control orifice Groove between Ball check 3 and Ball retainer 4 Spring chamber PF port.

This passage is always open and a certain volume of oil is flowing toward the steering valve during the engine is running.

Excess flow enters EF port through EF restricted area and goes into the center bypass port of load valve.

When the flow volume from pump to port P is increased, PF flow passing through the control orifice is also increased. Then, differential pressure across the orifice becomes greater.
Hydraulic pressure before the control orifice, namely pump pressure, acts on the left edge of valve spool 1 and PF flow pressure acts on the right edge face of the spool.
Therefore, when differential pressure becomes greater, the valve moves to the right, closes PF restricted area and opens EF restricted area, releasing excess flow to the EF port. As a result, PF flow decreases and so does the differential pressure.

On the other hand, when oil flow volume into port P decreases, PF flow through the control orifice decreases and so does the differential pressure. The spool moves to the left and restricts excess flow. As a result, PF flow increases and so does the differential pressure.
Differential pressure between excess flow and PF flow will vary not only by flow volume but also by operation of forks. Differential pressure across the control orifice is maintained constant by adjusting the opening angles of PF and EF restricted areas.

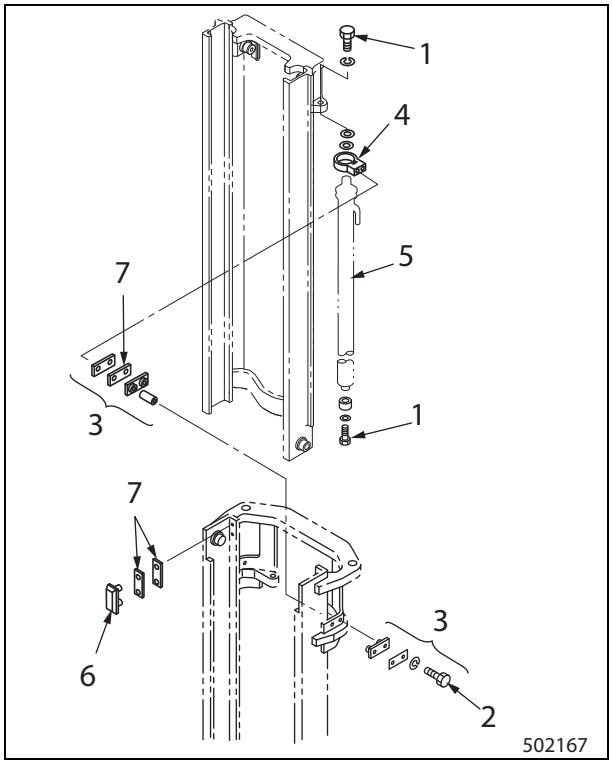
As differential pressure is constant, PF flow becomes constant.

1.16 Mast Rollers and Strips, Removal and Installation Without Removing Mast from Truck

The mast rollers and strips can only be removed or installed when the inner mast is positioned lower than the outer mast. This can be achieved as follows:

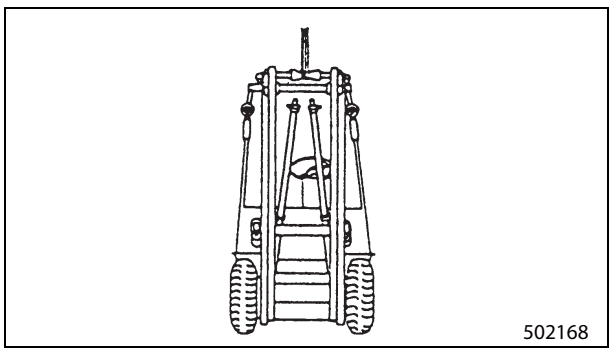
(1) Disconnect the lift bracket assembly from the mast.
(2) Lift the front side of the lift truck by 15 to 20 cm (0.6 to 0.8 in.) and place wood blocks underneath.

(3) Remove the set bolts located on the top of the lift cylinders. Place a sling around the inner mast. Lift the inner mast using a hoist connected to the sling in order to disengage the lift cylinders' piston rods from the inner mast.
(4) Remove lift cylinder clamp bolts and remove lift cylinder set bolt at the bottom and separate lift cylinder from outer mast. Pull out the lift cylinders from the mounting seats at the bottom of the outer mast. Tilt the cylinder tops inward until they rest on the outer mast cross member. Using a rope, fix the cylinders onto the cross member.
(5) Using a hoist, slowly lower the inner mast until it comes in contact with lift cylinders.
(6) The main rollers of the inner and outer masts can now be removed. Before attempting to remove the main rollers, remove the mast strips and shims first as they tend to drop easily.
(7) Adjust shim thickness for main rollers and mast strips as required.



1. Lift cylinder set bolt
2. Clamp bolt
3. Parts for cylinder clamp
4. Cylinder bracket
5. Lift cylinder
6. Mast strip
7. Shim

Note: For assembly, follow the disassembly sequence in reverse.

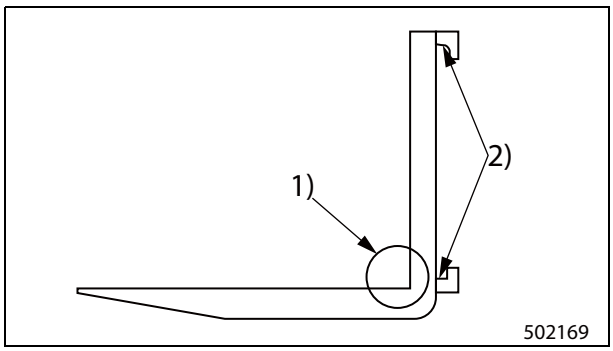


2.19 Inspection and Adjustment

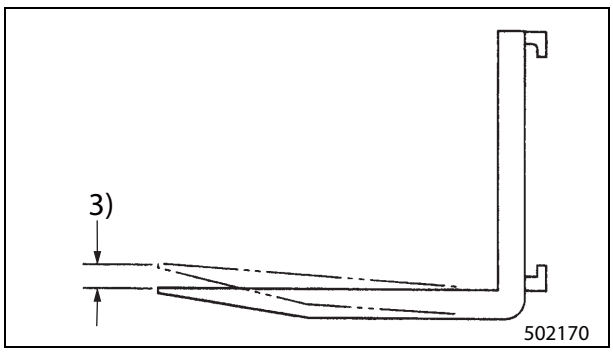
This section covers inspection and adjustment that does not involve any removal or disassembly of parts. Conduct this inspection and adjustment whenever a defect is suspected.

2.20 Inspecting Forks (All Mast Models)

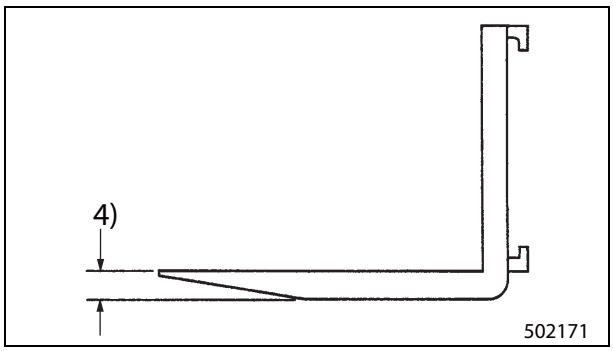
(1) Check the forks for cracks or damage. Special attention should be given to the heel section 1) as well as all weld areas 2). Do not use a fork that has a crack.
Magnetic particle inspection which features subsurface detection capability is recommended for inspection of the root of the forks because most of the load weight rests on the root. Color check flaw detection is not effective unless the paint on the surface is removed.



(2) Check both forks for height difference 3) between the fork tips and for any differences in shape. A slight difference between fork tips may cause difficulty in inserting the forks into a pallet, which results in load imbalance. The maximum allowable difference 3) in fork tip elevation is 5 mm (0.20 in.) for pallet forks. Also check each fork for its deviation by setting a straight fork length pole against the fork to measure a difference in height between the fork tip and pole. Replace one or both forks when the difference in fork tip height exceeds the maximum allowable difference.



(3) Check fork blade thickness 4). If thickness 4) is worn down and exceeds the service limit, do not use.



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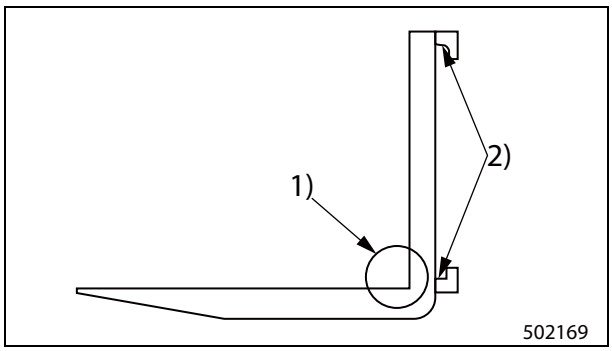

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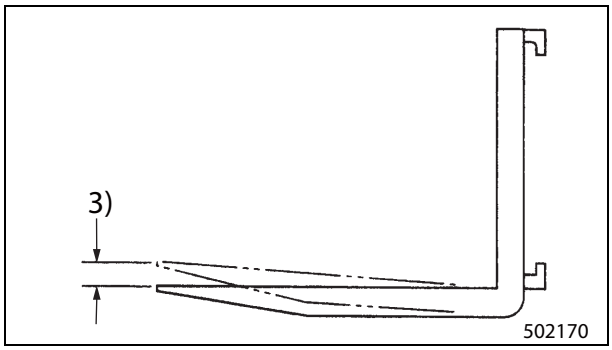
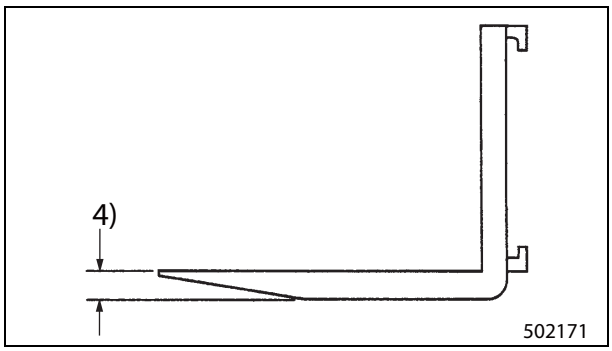
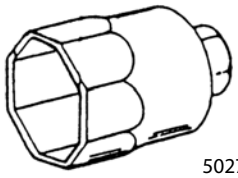
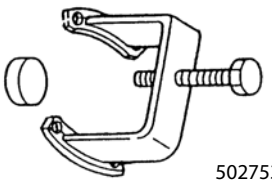
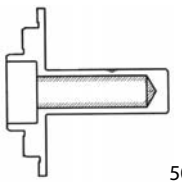
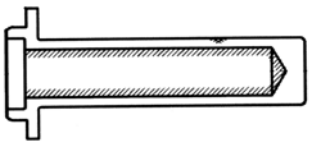
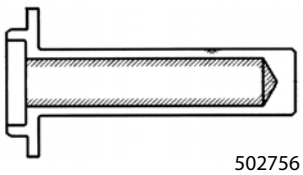
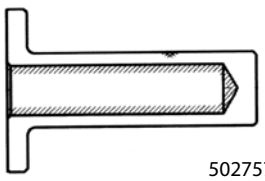
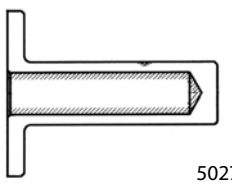


(3) Check fork blade thickness 4). If thickness 4) is worn down and exceeds the service limit, do not use.



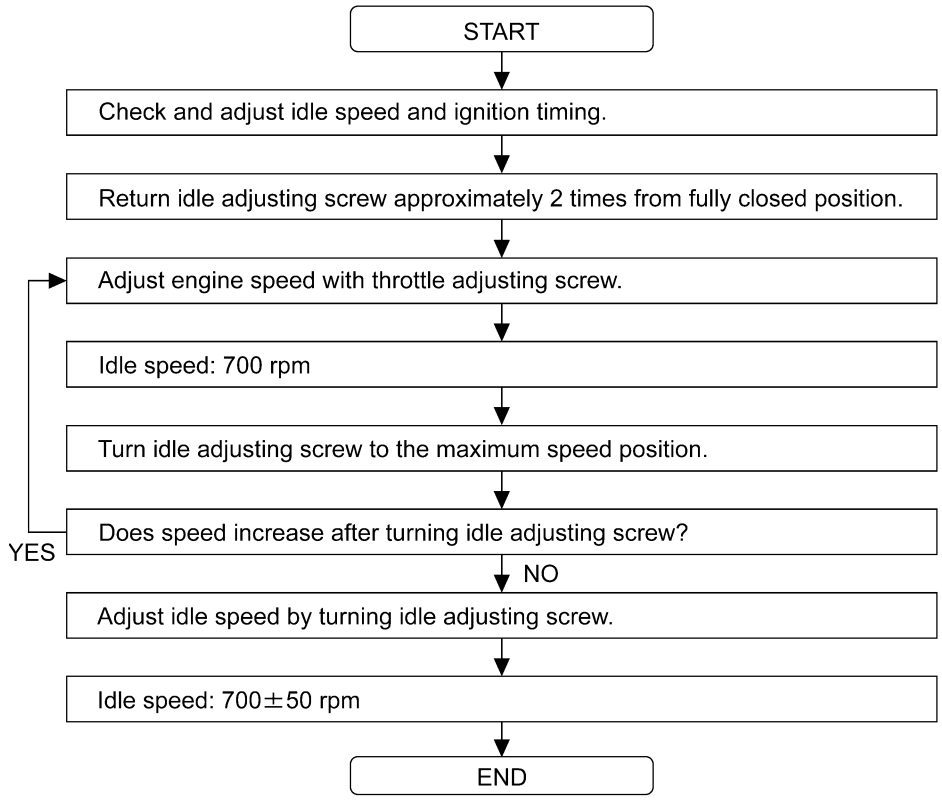
No.	Name	Part number	Figure	Use	Truck classifications		
					1 ton class	2 ton class	3 ton class
8	Socket wrench	03703-59001	 502752	The same as above	-	×	×
9	Wheel hub puller Seat puller Hub puller	64309-40100 64309-10601 MH061017	 502753	Front wheel hub removal	× × -	- - ×	- - ×
10	Installer	91A68-00500	 502754	Front hub oil seal installation	×	×	×
11	Installer	91B68-00900	 502755	Front hub oil seal installation	×	-	-
12	Installer	91E68-00700	 502756	Front hub oil seal installation	-	×	×
13	Installer	91B68-01100	 502757	Front hub bearing (outer) installation	×	-	-
14	Installer	91E68-00900	 502758	Front hub bearing (outer) installation	-	×	×

Engine Adjust. (Cont'd)

Condition	Possible causes	Action
No or slow cranking	• Inappropriate engine oil grade	Replace oil with a proper one.
	• Battery is discharged	Charge battery.
	• Battery damage	Replace battery.
	• Loose fan belt	Belt tension Adjust.
	• Incident in charge system	Check.
	• Incident in starter system wiring	Repair.
	• Starter switch malfunction	Repair or replace.
	• Starter motor malfunction	Repair or replace. (Starter circuit diagnosis procedure) If the light turns off or dims when the starter switch is turned to "ON" with the headlights on: a: Check the battery. b: Check the electric connections and wirings. c: Check the starter motor. If the light remains bright when the starter switch is turned to "ON" with the headlights on: a: Check the wiring between battery and starter motor. b: Check the starter switch. c: Check the starter motor.
Engine is cranked but not started. Refer to EF section for the LPG model.	Such incidents are attributed to the following factors, but most likely, the ignition system or the fuel system is the main cause.	
	• Incident in ignition system	(Diagnosis procedure)
	• Incident in fuel system	Check the spark plug following the steps below.
	• Dynamic valve system does not operate normally.	Disconnect the high-tension cable from the No. 1 plug and keep it 10 mm away from the engine metal portions. Then crank the engine. If a good spark is available: a. Check the ignition plugs. b. Check the ignition timing. c. Check the fuel system. d. Check the compression pressure. If no spark is available: a. Check the primary coil current. b. If the current level is high, check the primary coil for short circuit.
	• Poor compression	
Inappropriate idling		
Incident in fuel system Refer to EF section for the LPG model.	• Plugged or damaged carburetor jet	Clean or replace.
	• Damaged or plugged fuel injector	Clean or replace.
	• Inappropriate idle Adjust.	Adjust.
	• Plugged air cleaner	Replace element.
	• Damaged manifold gasket or carburetor insulator	Replace gasket or insulator.
	• Inappropriate carburetor float level Adjust.	Adjust.
Lowered compression pressure		Already described.
Engine power does not increase to an appropriate level Lowered compression pressure		Adjust. Already described.
Incident in ignition system	• Inappropriate ignition timing	Adjust.
	• Spark plug malfunction	Clean, adjust or replace.

Ignition and Fuel Systems (Cont'd)

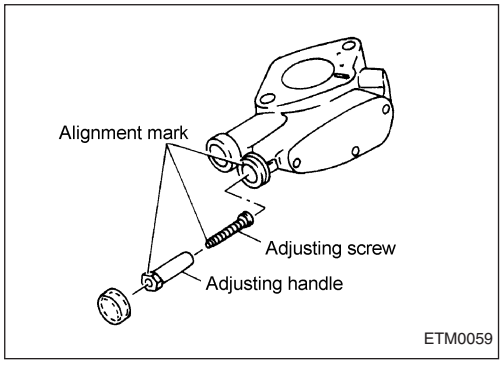
INSPECTION AND ADJUSTMENT OF AIR-FUEL RATIO (CARBURETOR MODEL ONLY)



ETM0063

GOVERNOR DEVICE

The governor requires no adjustment because it is adjusted properly before shipment.
If it must be adjusted by any means, follow the procedure below.



ETM0059

ADJUSTING MAXIMUM RPM WITH NO LOAD

1. Set the forward/reverse shift lever to the neutral position.
2. Start the engine and fully open the throttle. Monitor the engine speed.
   Maximum engine speed with no load (rpm)
   K15 2,900
   K21 2,750
   K25 2,750
3. If the engine speed does not fall in the specified range, adjust by turning the governor adjusting handle.

Inspection and Correction (Cont'd)

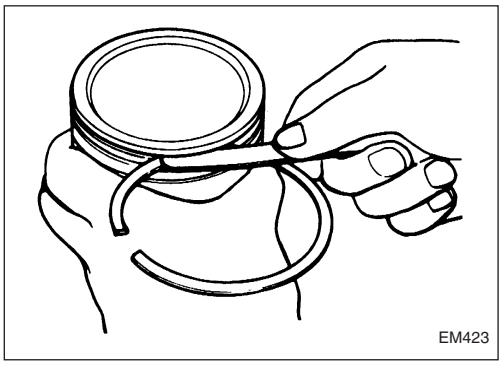
Oversize piston

Piston size	Diameter mm	
	K21, K25	K15
STD	88.965 - 89.015	75.465 - 75.515
0.50 OS	89.465 - 89.515	75.965 - 76.015
1.00 OS	89.965 - 90.015	76.465 - 76.515

Standard measurements for piston and cylinder

Specified clearance mm (in)	0.025 - 0.045 (0.0010 - 0.0018) [20˚C (68˚F)]
Filler gauge N (Kgf, lb) Drawing force	4.9 to 14.7 (0.5 - 1.5,1.1 - 3.3)
Filler gauge in use Thickness mm (in)	0.04(0.0016)

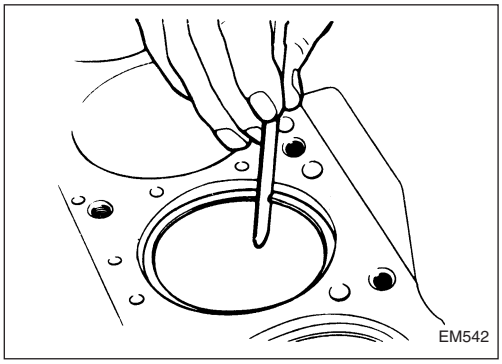
7. Measuring piston wear
   - Inspect the piston sliding face. Replace it if significant sticking damage or wear is observed.
   - Measuring piston ring-to-groove clearance
     Measure the clearance between the piston ring groove and the piston ring. If excessive wear is observed, replace the piston ring along with the piston.


EM423

(mm)

	Standard	Limit
Top	0.045 - 0.080	0.1
Second	0.030 - 0.070	0.1
Oil	—	—

8. Piston ring
   - Measuring piston ring closed gap
   - Put the piston ring into the cylinder bore and measure the ring closed gap.


EM542

(mm)

	Standard	Limit
Top	0.28 - 0.43	1.0
Second	0.45 - 0.60	1.0
Combined rail	0.20 - 0.60	1.0

Measure the end gap of the piston ring with a feeler gauge. If the gap exceeds 1 mm, replace the piston ring. If the gap is 0.15 mm or less, correct the ring ends with an oil stone or replace the piston ring.

⚠ **CAUTION:**
Always measure the ring gap near the bottom of the cylinder where the wear is relatively small when replacing the piston ring without correcting the cylinder bore.

Accelerator Pedal Released Position Learning (Cont'd)

With ST

1. Start engine.
2. Select "Fuel Pressure Release" in ECM Active Test, and then press "OK."
3. Crank engine 2 or 3 times to consume the fuel in the fuel line after it stalls.
4. Turn ignition switch OFF.

Without ST

1. Disconnect fuel pump fuse.
2. Start engine.
3. Crank engine 2 or 3 times to consume the fuel in the fuel line after it stalls.
4. Turn OFF the ignition switch, and install the fuel pump fuse.

FUEL PRESSURE INSPECTION

⚠ **CAUTION:**

- **Safely and securely remove and install fuel hose.**
- **Use the fuel pressure gauge for fuel pressure inspection.**
- **Do not inspect fuel pressure while other systems are operating. Malfunctions may occur in fuel pressure value.**

1. Release the fuel pressure.
2. Install fuel pressure gauge using fuel hose for fuel pressure inspection.
3. Remove fuel hose, and then install fuel hose for fuel pressure inspection.

⚠ **CAUTION:**
Usable period of fuel hose for fuel pressure inspection is 30 times or less. (Fuel hoses that are damaged and allow fuel leakage are not contained above.)

4. Turn ignition switch ON, and then make sure that there is no fuel leakage.
5. Start engine, and check for fuel leakage.
6. Make sure that fuel pressure is within the standard.
   At idle: 0.35MPa (3.6 kgf/cm2)

- If the vehicle shows poor starting, check fuel pressure with fuel pump operating for approximately 1 second after ignition switch is turned ON, and during cranking.
  For 1 second after ignition switch is turned ON and during cranking: 0.35Mpa (3.6 kgf/cm2)

- Check the following items if a malfunction is detected.

⚠ **CAUTION:**
Also check fuel pressure at increased engine speed.

- Malfunctioning pressure regulator (integrated with fuel pump)
- Clogged fuel piping
- Clogged fuel filter (with fuel pump)
- Poor fuel pump discharge

ST (Cont'd)

ACTIVE TEST

Use this mode to determine and identify the details of a malfunction, based on self-diagnosis test results and data obtained from DATA MONITOR mode. ST, instead of the ECM on the vehicle, sends a drive signal to actuators to check their operation.

Display Item List

Active test item	Description
FUEL INJECTION	• Can increase or decrease the amount of fuel injection (±25%).
	• Can reproduce conditions resulting from air-fuel ratio related malfunctions (e.g. hesitation, poor acceleration, poor racing, etc.) and can help solve these malfunctions by pinpointing the causes.
IGNITION TIMING	• Allows setting a correction coefficient for retarding (-10 - 0˚)
POWER BALANCE	• Stops operation of specified injector. Also, displays the condition at that time.
	• Mainly used to inspect for misfiring cylinders.

Self-Diagnosis Function (Without ST)

DESCRIPTION

- In self-diagnosis, when any of the critical sensors or actuator and exhaust gas control systems necessary for ECM control return a malfunction and self-diagnosis detection conditions are satisfied, a DTC corresponding to the suspect system is stored in ECM for easier trouble diagnosis. Self-diagnostic results can be displayed with either ST or MWL in the (combination) meter. MWL indication is explained here.
- The trouble diagnosis mode has two types: mode 1 and mode 2. Mode 1 is normal mode and mode 2 is self-diagnosis or heated oxygen sensor monitor function.

OPERATION PROCEDURE

- Refer to the following for how to activate self-diagnosis mode or erase heated oxygen sensor monitor and self-diagnostic results.

⚠ **CAUTION:**
When a malfunction occurs in accelerator pedal position sensors, self-diagnosis (without ST) cannot be activated. Thus, use ST to perform self-diagnosis, and repair malfunctioning part.

ENGINE LUBRICATION & COOLING SYSTEMS

SECTION LC

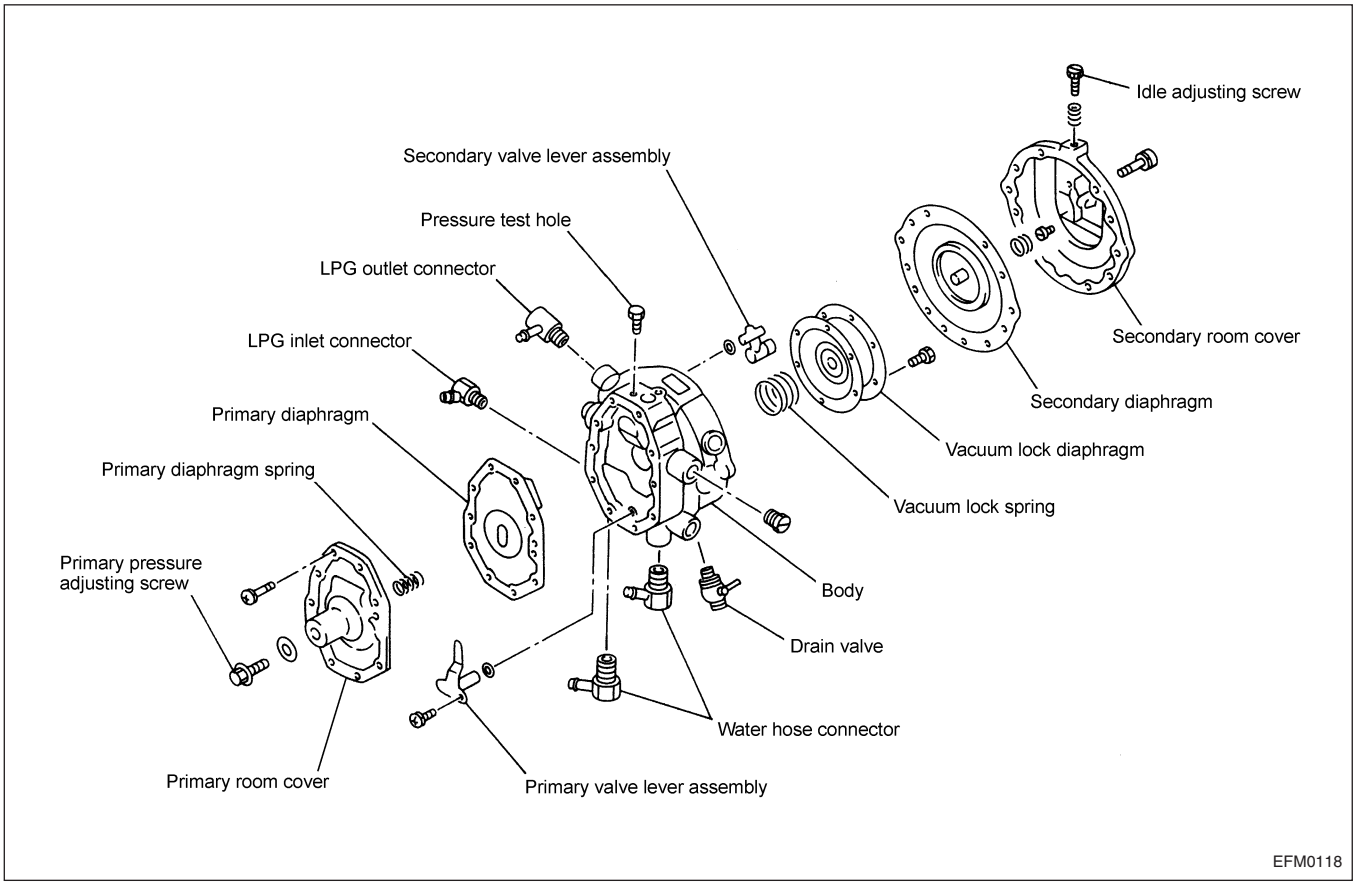
CONTENTS

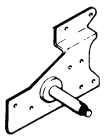
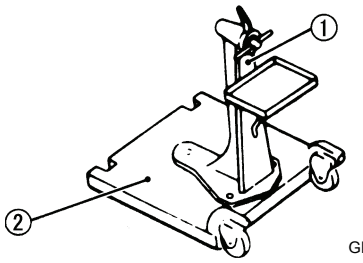
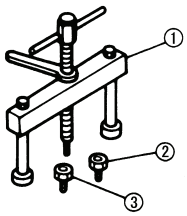
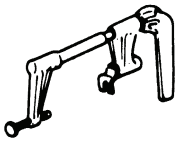
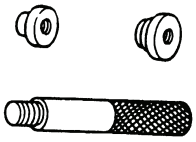
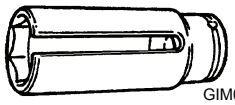
LUBRICATION SYSTEM LC-2
- Specifications LC-2
- Adjustment Value LC-2
- Oil Pressure LC-2
- Tightening Torque LC-2
- Trouble Diagnosis LC-3
- Lubrication Schematic Diagram LC-4
- Oil Pump LC-5

ENGINE COOLANT SYSTEM LC-6
- Specifications LC-6
- Adjustment Value LC-6
- Tightening Torque LC-6
- Trouble Diagnosis LC-6
- Cooling System Configuration LC-7
- Water Pump LC-8
- Thermostat LC-9

Secondary Valve Room (Cont'd)

CARBURETOR SPECIFICATION VAPORIZER COMPONENTS



Tool number	Tool name	
91H20-09080	Engine attachment  GIM0066	
91H-20-09090 (1) 91H20-09091 (2) 91H20-09092	Engine stand assembly Engine stand Stand  GIM0067	
91H20-09100 (1) 91H20-09110 (2) 91H20-09111 (3) 91H20-09112	Crankshaft main bearing cap puller Crankshaft main bearing puller Adapter Adapter  GIM0068	
91H20-09120	Valve lifter  GIM0069	
91H20-09150 91H20-09160 91H20-09170	Front oil seal drift Rear oil seal drift Drift rod  GIM0071	
91H20-09020	Heated oxygen sensor wrench  GIM0072	Removing and installing heated oxygen sensor

Condition	Possible causes	Action
No or slow cranking	• Inappropriate engine oil grade	Replace oil with a proper one.
	• Battery is discharged	Charge battery.
	• Battery damage	Replace battery.
	• Loose fan belt	Belt tension adjustment
	• Incident in charge system	Inspection
	• Incident in starter system wiring	Repair
	• Starter switch malfunction	Repair or replace
	• Starter motor malfunction	Repair or replace (Starter circuit diagnosis procedure) If the light turns off or dims when the starter switch is turned to “ON” with the headlights on: a: Inspect the battery b: Inspect the electric connections and wirings c: Inspect the starter motor If the light remains bright when the starter switch is turned to “ON” with the headlights on: a: Inspect the wiring between battery and starter motor b: Inspect the starter switch c: Inspect the starter motor
Engine is cranked but not started. Refer to EF section for the LPG model.	Such incidents are attributed to the following factors, but most likely, the ignition system or the fuel system is the main cause.	
	• Incident in ignition system	(Diagnosis procedure) Inspect the spark plug following the steps below Disconnect the IGN/coil from the No. 1 plug and keep it 10 mm (0.394 in) away from the engine metal portions. Then crank the engine. If a good spark is available: a. Inspect the ignition plugs. b. Inspect the ignition timing c. Inspect the fuel system d. Inspect the compression pressure. If no spark is available: a. Inspect the primary coil current b. If the current level is high, check the primary coil for short circuit
	• Incident in fuel system	
	• Dynamic valve system does not operate normally.	
	• Poor compression	

CAUTION:
- **Always pay attention to safety.**
- **Do not remove engine until exhaust system and engine coolant have completely cooled off.**
- **Support the vehicle at the specified lift points.**
- **For operation procedure for components other than engine, refer to appropriate sections.**

Removal

[OPERATION DESCRIPTION]
- Remove engine by pulling up after removing transmission.

[PREPARATION WORK]
1. Release the fuel pressure. Refer to “Release of Fuel Pressure” in EC section.
2. Remove radiator drain plug and drain engine coolant.
3. Remove the following parts.
   - Undercover of battery
   - Radiator, shroud, and radiator hose
   - Engine drive belt and cooling fan
4. Disconnect accelerator cable from throttle drum and move it out of position.

[LEFT SIDE OF ENGINE ROOM]
5. Remove air duct and air cleaner case.
6. Disconnect heated oxygen sensor harness connector and ground (between exhaust manifold cover and body).

[RIGHT SIDE OF ENGINE ROOM]
7. Disconnect vacuum hose (for brake booster and for differential lock) on engine side.
8. Remove fuel hose.

CAUTION:
After disconnecting hoses, plug them immediately to prevent fuel from draining.

9. Disconnect all harness connectors on engine side, and then move harnesses to body side.
10. Remove starter motor.
11. Remove transmission.

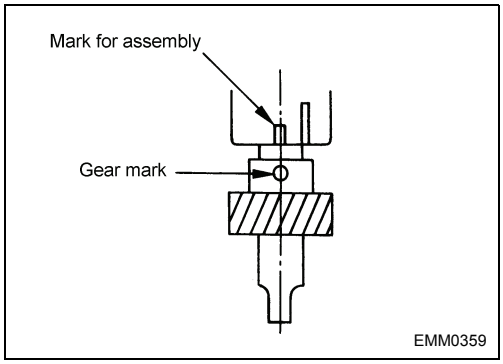
[REMOVAL]
12. Engage chain block hook in front/rear engine slingers and support.

CAUTION:
Be careful not to contact hook and chain with body and piping when engaging hook in slingers

13. Remove engine mount insulator LH/RH nuts.
14. Pull up and remove engine by adjusting the position diligently.

CAUTION:
- **Make sure that all wires and piping were disconnected while removing.**
- **Be careful not to contact with body side parts.**

Engine Assembly (Cont'd)



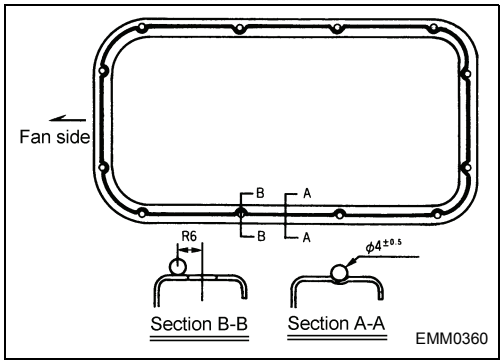
(4) Align the distributor gear mark to the short mark on the housing.

CAUTION:
Do not align the gear mark to the gear installation pin or the long mark.

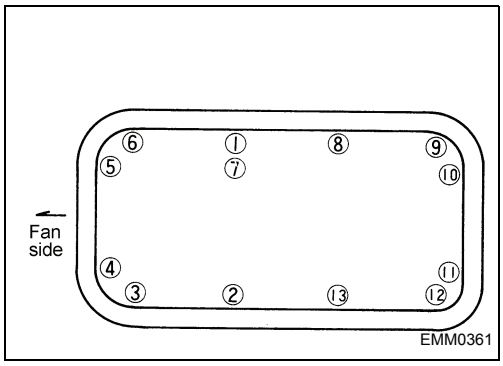
(5) Tentatively tighten the retaining bolts.
(6) After installing the distributor gear, adjust the ignition timing by using a timing light. Then, fully tighten the retaining bolts.

Idle speed and ignition timing (BTDC°/rpm)	Electric controlled specifications 0°/700 rpm Carburetor specifications K15 4°/700 rpm K21 2°/700 rpm K25 0°/700 rpm

(7) Installation of oil pan



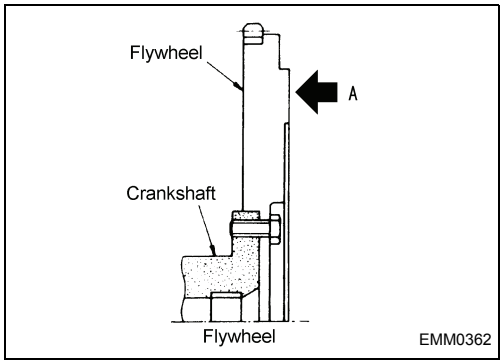
- Before installing the oil pan, apply liquid packing to the oil pan flange as shown in the figure.



- Tighten the oil pan retaining bolts to the specified torque in the order shown in the left figure.
- Tightening torque for oil pan retaining bolt:
  : 8.43 - 10.8 N·m
  (0.86 - 1.1 kgf-m)
  M6 x 12 (thread length) 7T bolt

(8) Installation of flywheel housing (or rear plate)
- Install flywheel housing.
- Tightening torque for housing retaining bolt
  : 44.1 - 58.8 N·m (4.5 - 6.0 kgf-m)

(9) Installation of flywheel



- Install flywheel.

Description

- "When" a malfunction occurs that is caused by the sensors of engine or the air-fuel ratio control, ECM warning lamp "{  }" of the meter panel illuminates. Then, Diagnostic Trouble Code (DTC) is displayed on the meter.
- When a malfunction has occurred, check the symptom and perform the trouble diagnosis using "Diagnosis history", "ECM input/output monitor" and "Active test" of service tool.

Fail-Safe Function

When any of the critical sensors or systems sends a malfunction message, the fail-safe function estimates the driving conditions with other input signals and selects safer conditions for engine (vehicle) control, based on data previously stored in ECM.

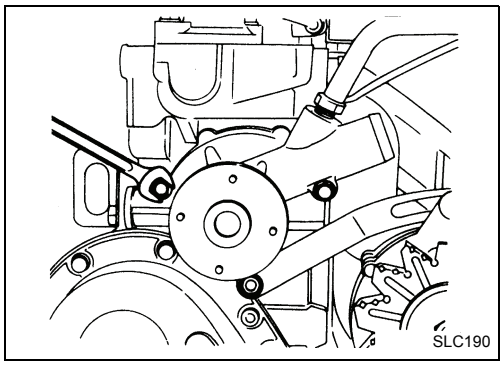
Related sensors	Malfunction condition	Fail-safe	Engine Warning lamp
Mass air flow sensor	Same as self-diagnosis malfunction detection conditions.	• Selects fuel injection pulse width depending on engine speed and throttle position so the vehicle can be driven. However, fuel injection will be inhibited (fuel cut off) when engine speed exceeds approximately 800 - 1,600 rpm. • Idle speed is 800 rpm.	ON
Engine coolant temperature sensor		• Uses the estimated engine coolant temperature (varies with elapsed time after start) to perform controls so the vehicle can be driven.	ON
Accelerator pedal position sensor		• Fuel injection will be inhibited when 1 circuit is opened. Release valve mechanically until it can drive at low speed when disconnecting connector.	ON
Throttle position sensor		• Fixes output to a preset value so the vehicle can be driven. However, fuel injection will be inhibited (fuel cut off) when engine speed exceeds approximately 2,500 rpm.	ON

Water Pump

1. Open the drain of the radiator and extract coolant into an appropriate container.

CAUTION:
Do not drain coolant when engine is still hot. Hot coolant may result in burns and injury.

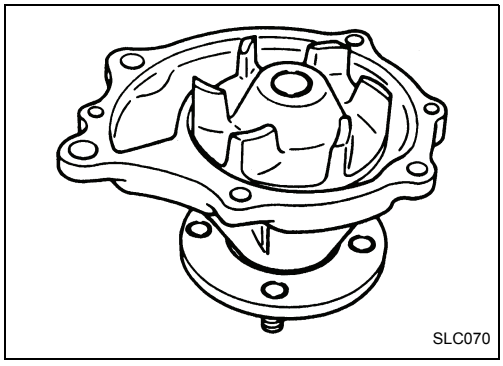
2. Remove the radiator shroud.
3. Loosen the fan belt.
   - Loosen the alternator adjusting bolt.
   - Fully put aside the alternator toward the engine.
   - Remove fan and fan pulley.
   - Remove the water pump together with the gasket.


SLC190

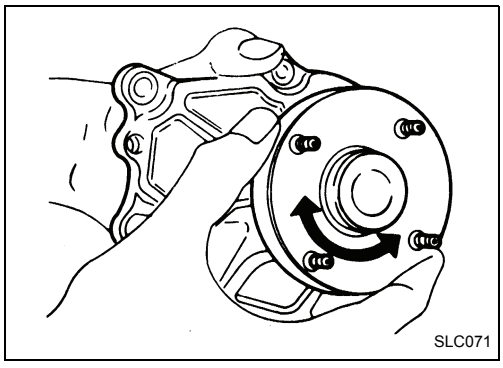
INSPECTION

Do not disassemble water pump. If any non-standard condition is found, replace the water pump.

1. Check the water pump vanes for rust and pitching.


SLC070

2. Check the water pump bearing for proper end play and smooth operation.


SLC071

ASSEMBLY

1. Install the water pump in the reverse order of removal. Always use a new gasket.
2. Adjust the fan belt tension. For the adjustment value, refer to page MA-section.

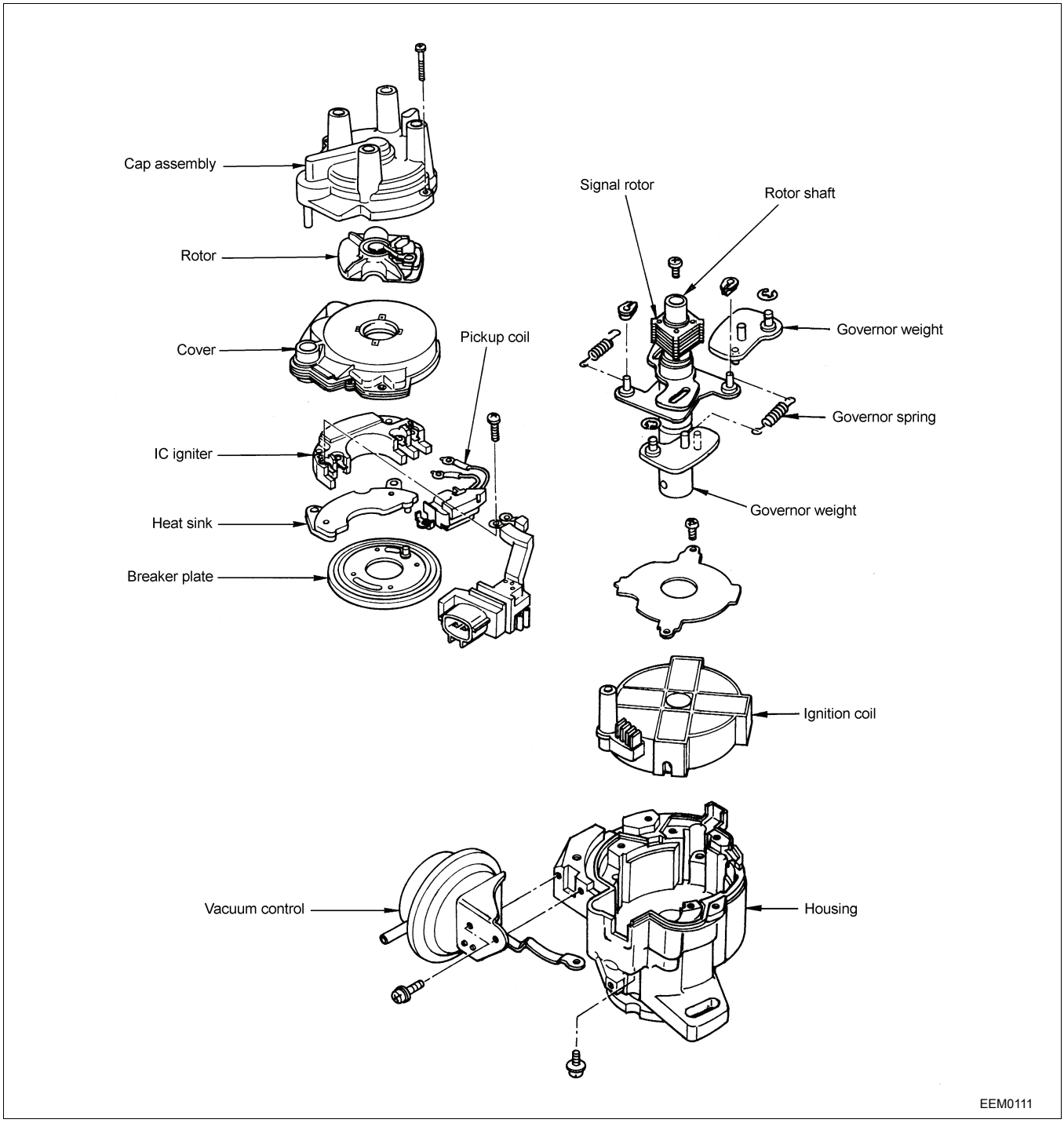
CAUTION:
- **Before filling with coolant, always loosen the air purge plug.**
- **After refilling, make sure to tighten the plug.**

IGNITION SYSTEM

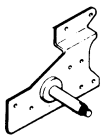
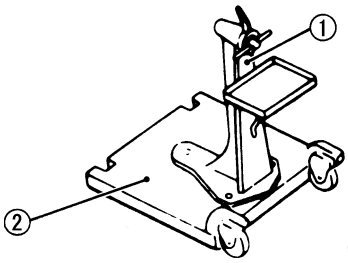
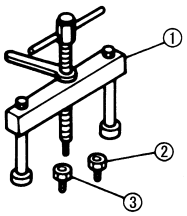
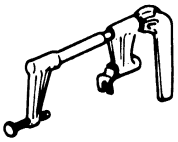
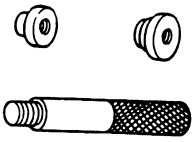
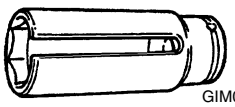
CAUTION:
Before starting the task, turn off the ignition switch and disconnect the battery cable.

Structure

FULL SOLID-STATE TYPE

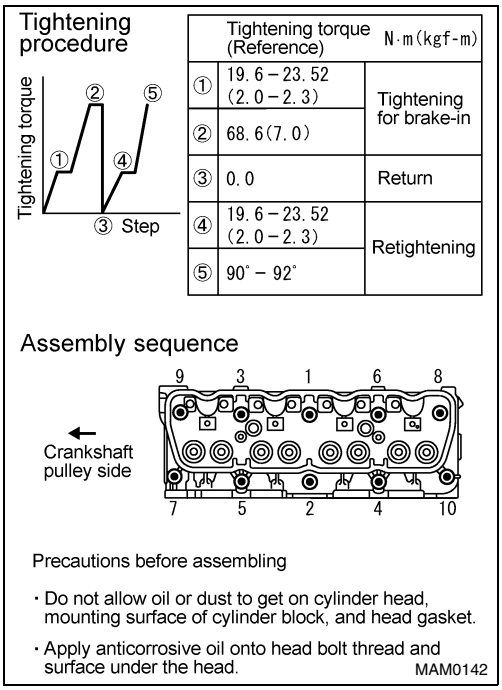


A low-voltage electronic distribution system is adopted for the electric control.
Refer to EC section.

Tool number	Tool name	
91H20-09080	Engine attachment  GIM0066	
91H-20-09090 (1) 91H20-09091 (2) 91H20-09092	Engine stand assembly Engine stand Stand  GIM0067	
91H20-09100 (1) 91H20-09110 (2) 91H20-09111 (3) 91H20-09112	Crankshaft main bearing cap puller Crankshaft main bearing puller Adapter Adapter  GIM0068	
91H20-09120	Valve lifter  GIM0069	
91H20-09150 91H20-09160 91H20-09170	Front oil seal drift Rear oil seal drift Drift rod  GIM0071	
91H20-09020	Heated oxygen sensor wrench  GIM0072	Removing and installing heated oxygen sensor

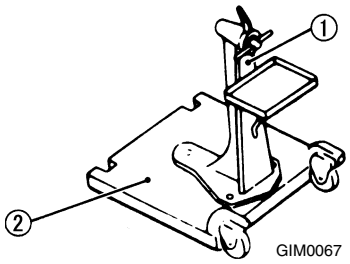
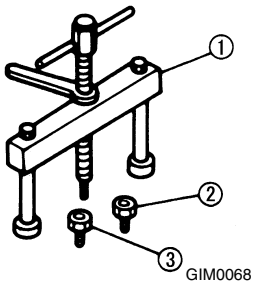
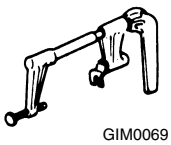
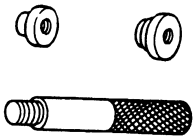
Unit : N·m (kgf-m)

Cylinder head bolt	See the figure on the left
Manifold nut	41.2 - 48.1 (4.2 - 4.91)
Oil pan drain plug	29.4 - 39.2 (3.0 - 4.0)
Spark plug	19.6 - 29.9 (2.0 - 3.0)

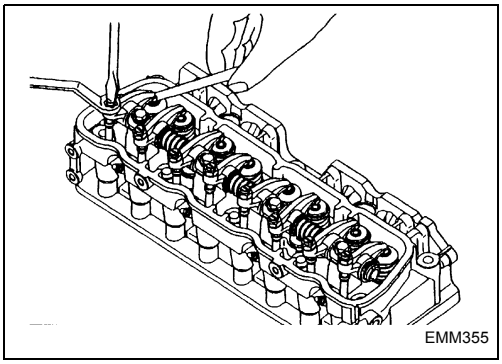


CYLINDER HEAD

Tightening torque for general service is 68.6 N·m (7.0 kgf-m) in the location of the tightening torque (5) as shown in the figure.
Apply antirust oil or engine oil to the threads and head bottom of each head bolt.

Tool number	Tool name	
91H20-09080	Engine attachment	 GIM0066
91H20-09090 (1) 91H20-09091 (2) 91H20-09092	Engine stand assembly Engine stand Stand	 GIM0067
91H20-09100 (1) 91H20-09110 (2) 91H20-09111 (3) 91H20-09112	Crankshaft main bearing Crankshaft main bearing cap puller Ring puller Adapter Adapter	 GIM0068
91H20-09120	Valve lifter	 GIM0069
91H20-09150 91H20-09160 91H20-09170	Front oil seal drift Rear oil seal drift Drift rod	 GIM0071

Engine Assembly (Cont'd)

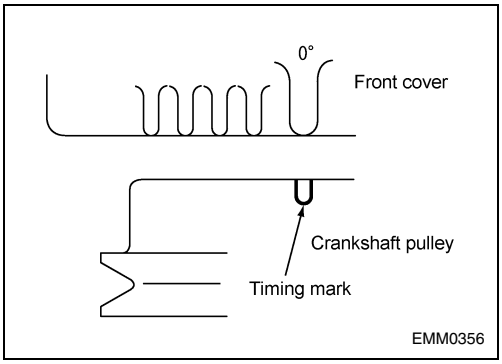

EMM355

(3) Adjust the valve clearance.
Valve clearance:
Both intake and exhaust
0.38 mm (Engine coolant temperature: 70-90°C)

CAUTION:
The valve clearance must be finally adjusted when the engine is hot. However, preliminary adjustment in cold state will make the final adjustment easier.

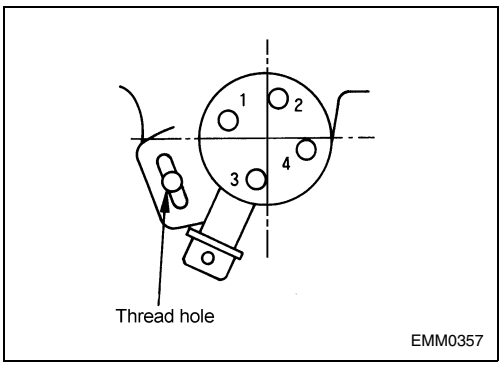
(4) Assemble the rocker cover.
: 13.7 - 15.7 N·m (1.4 - 1.6 kgf-m)

19. Installation of engine accessories
    - Install the oil pressure switch.
    - Installing oil pump (all models) and distributor (carburetor model)



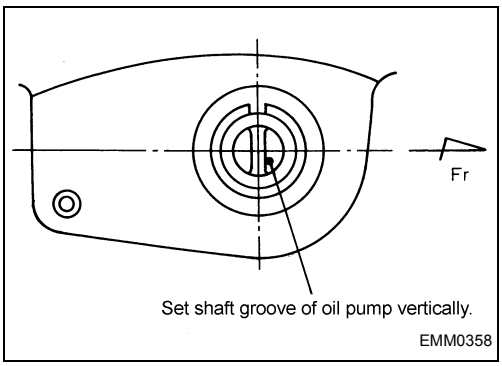
EMM0356

(1) Set the crankshaft position to the compression TDC for cylinder No.1.



EMM0357

(2) Locate the distributor so that the center of its flange long hole aligns to the bolt hole on the cylinder block, and insert the distributor. (Do not turn the distributor to align the holes)



EMM0358

(3) Align the drive shaft groove of the engine lubricating oil pump.