Service Manual

Chassis & Mast

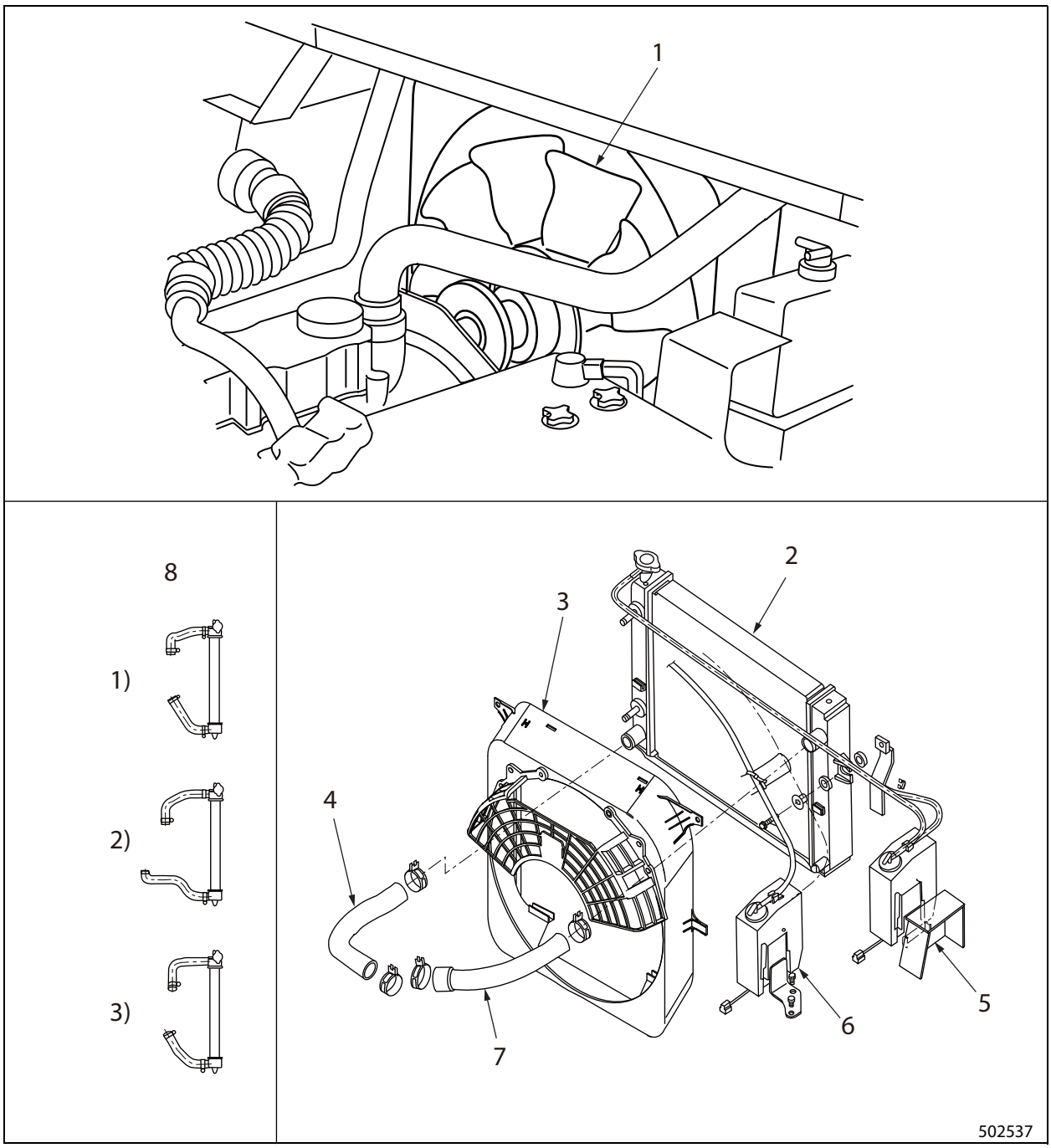
MC

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



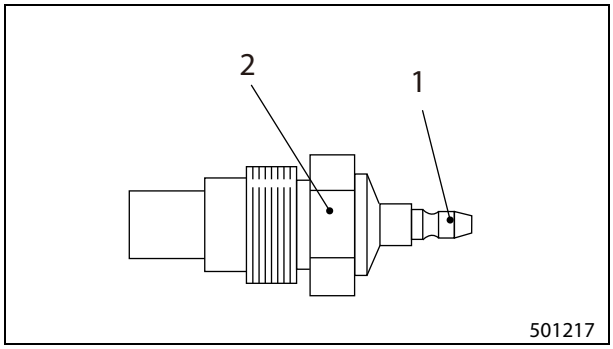
1. Fan (coupled directly to engine crankshaft)
2. Radiator
3. Shroud
4. Lower hose
5. Reserve tank (gasoline engine)
6. Reserve tank (S4Q2 and S4S)
7. Upper hose
8. Hose arrangement

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

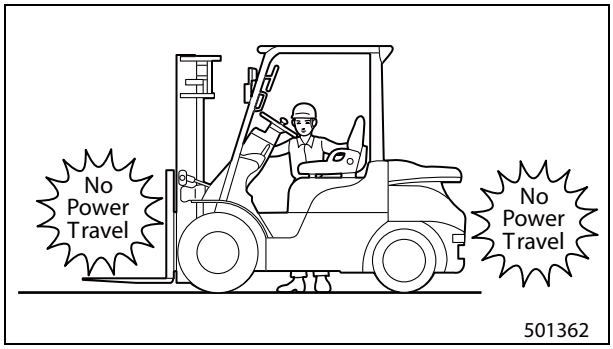
7.4 Warning System Problem

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.

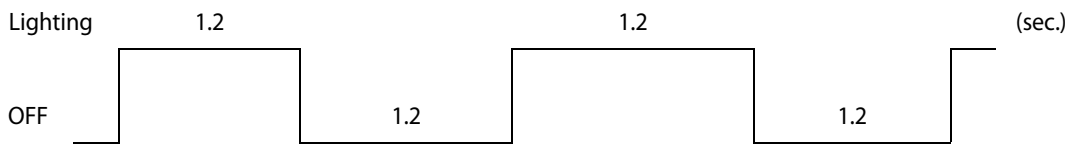
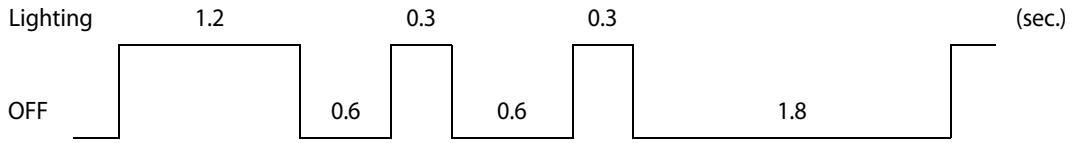
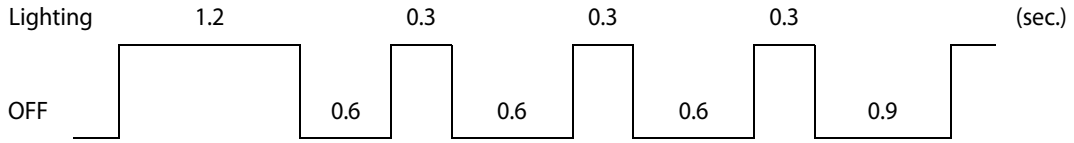
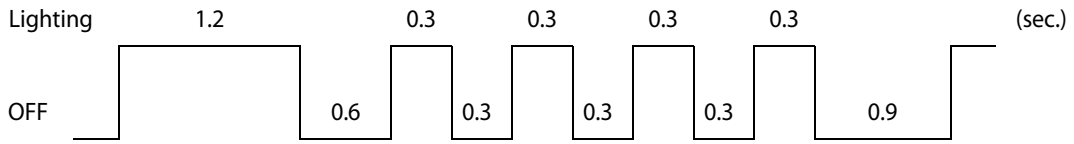
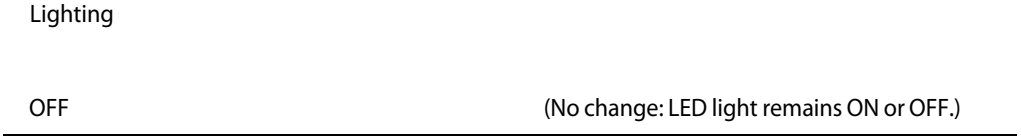
Controller function

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.

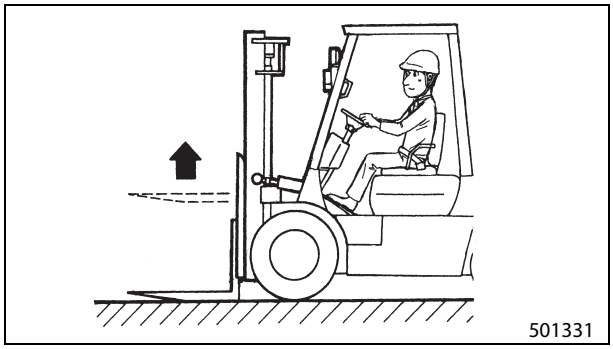
Note: Place the key switch in the ON position for checking.

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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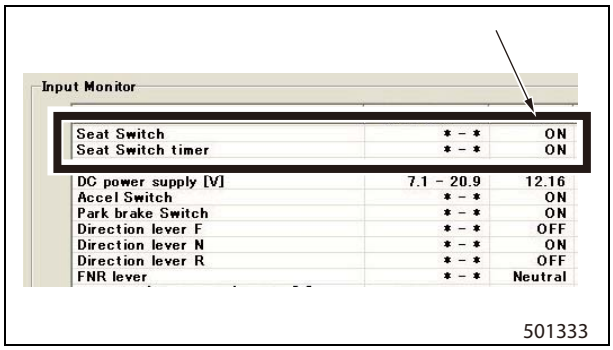
⚠ CAUTION

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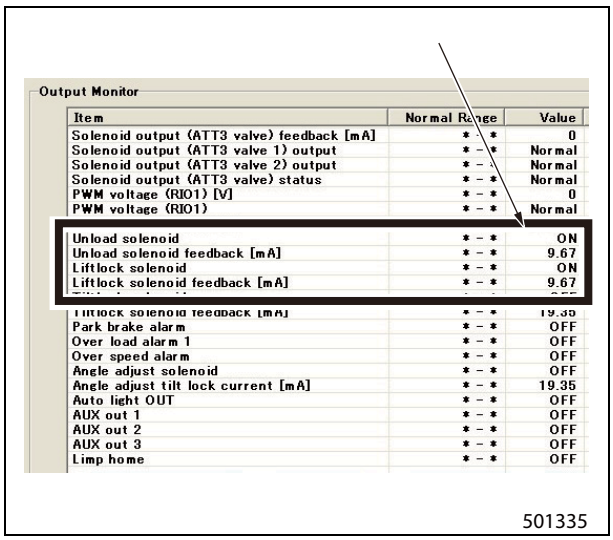
(5) Display the service tool output monitor screen. When the status of the seat switch timer is ON, the controller unlocks the mast interlock and turns the unload output and the lift lock output ON.
You can operate the mast system under this condition.
- Operate the lift lever to check that the forks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

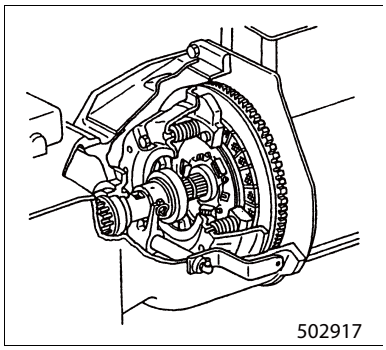
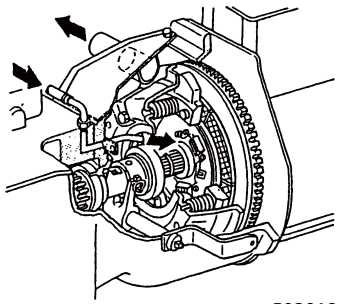
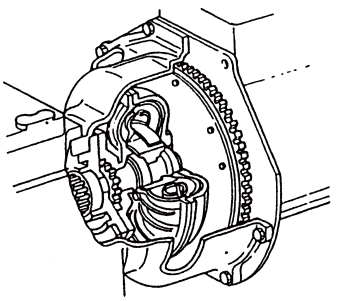
Diagnosis	Attachment 1 Lever Neutral Warning (F12)
Logic conditions	· Attachment 1 lever open angle is 20% or more. (when key switch is ON) ——— F12
Recovery	Auto recovery when the lever is placed in neutral.
Action	· Turn OFF all solenoid outputs of operating functions. · Turn OFF the unload solenoid.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

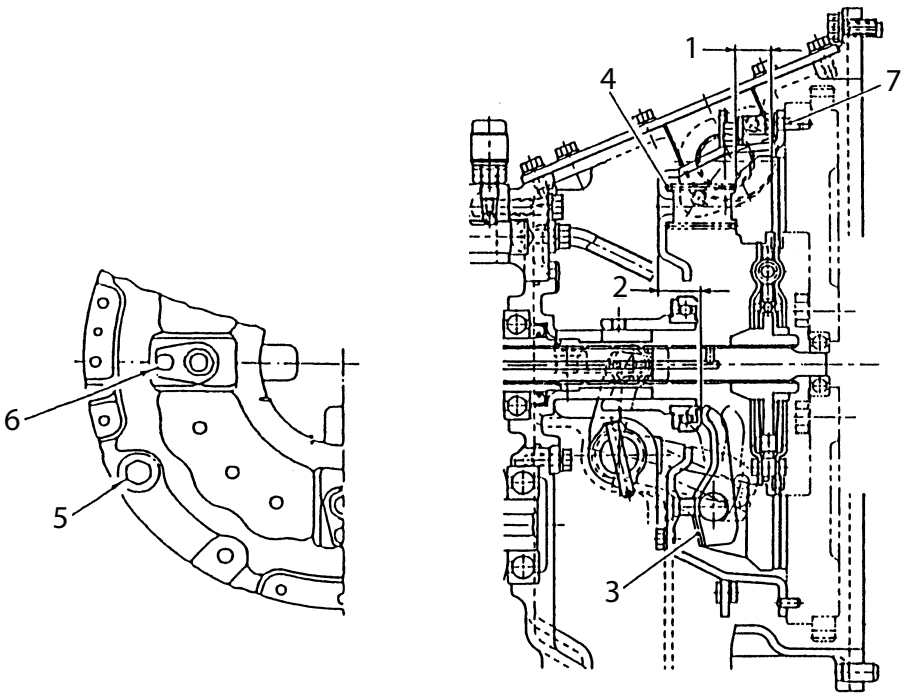
1. Structure

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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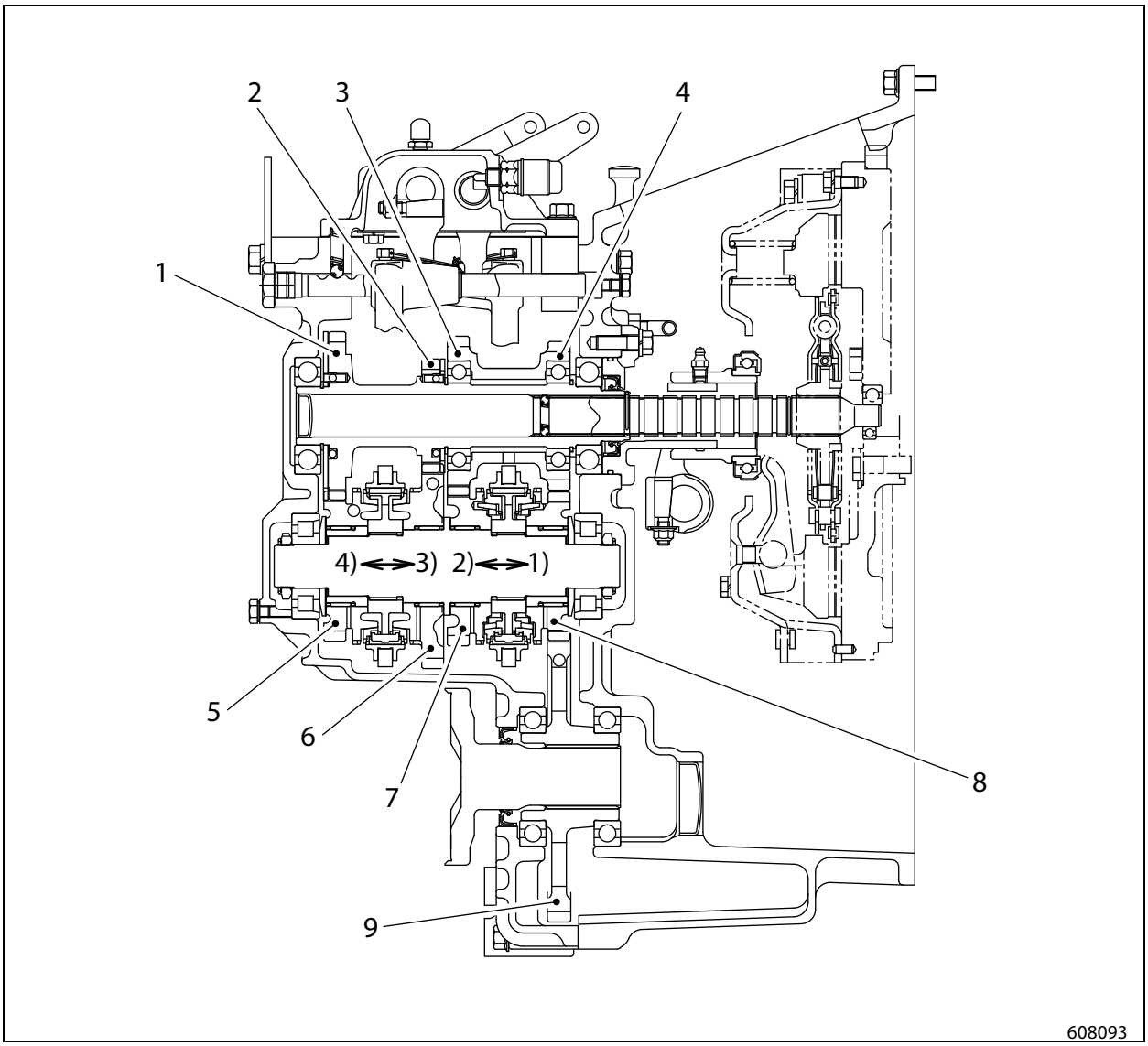
Chapter 7 MANUAL TRANSMISSION

1. Structure

1.1 Components of Transmission

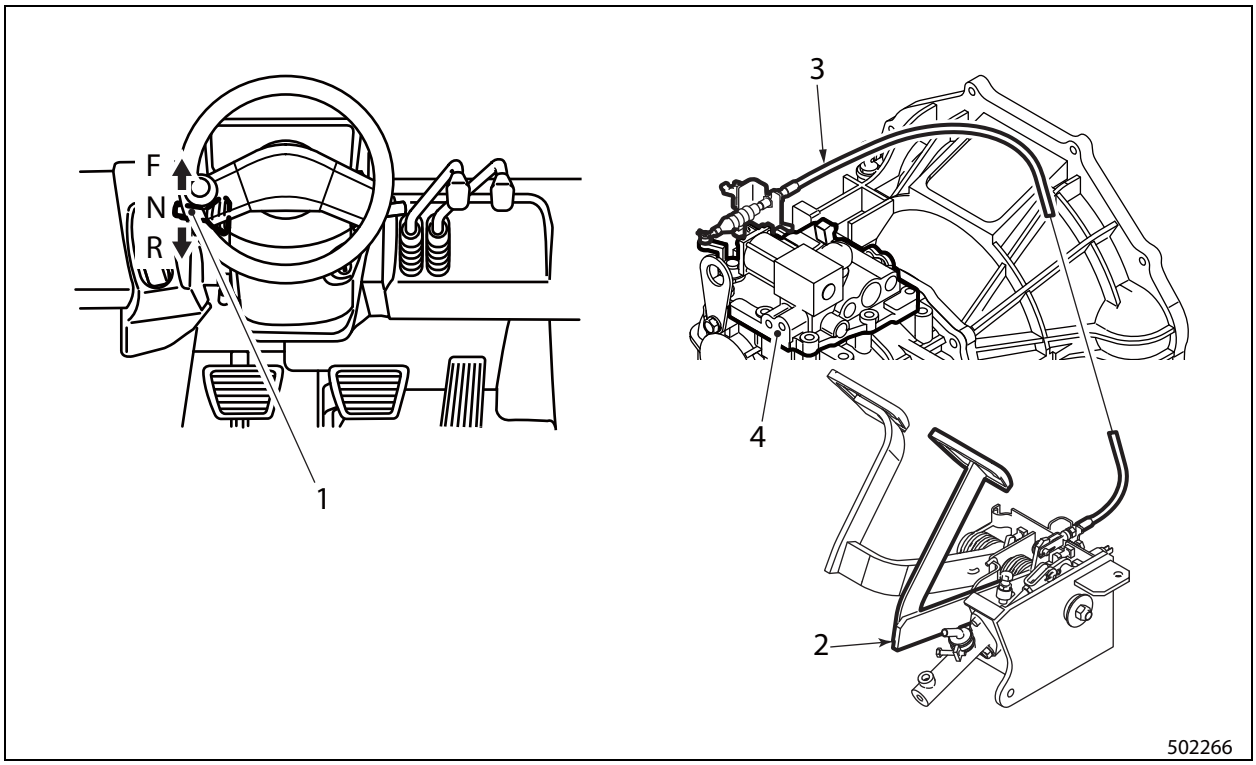


Note: Number of gear teeth is shown in the ( ).

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)

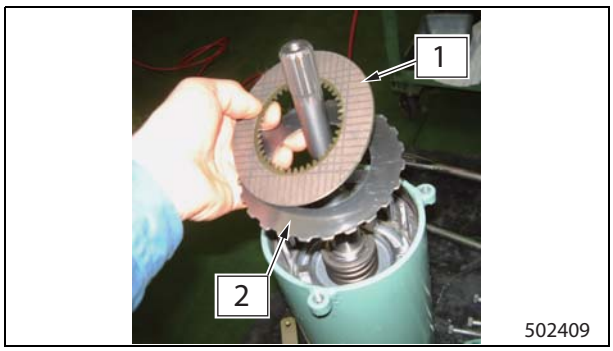
1) F: Forward
2) R: Reverse
3) L: 1st gear
4) H: 2nd gear

1.5 Torque Converter Drive Control Components

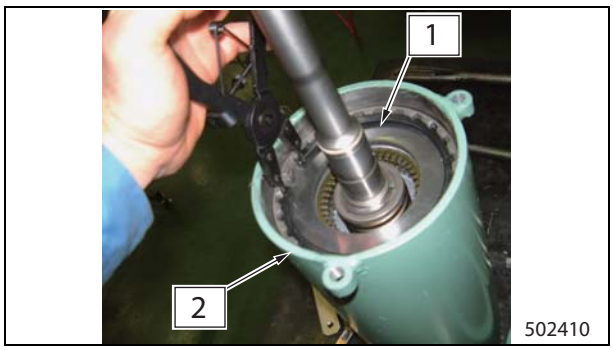


1. Direction lever
2. Clutch (inching) pedal
3. Cable (inching)
4. Control valve assembly

(3) Instal snapring.



1. Friction plate
2. Mating plate



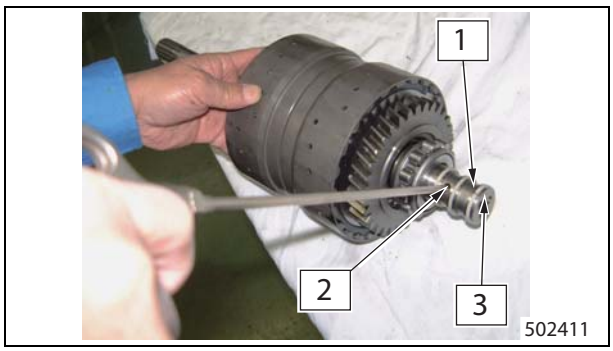
1. Snapring
2. Special tool (Stand)

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

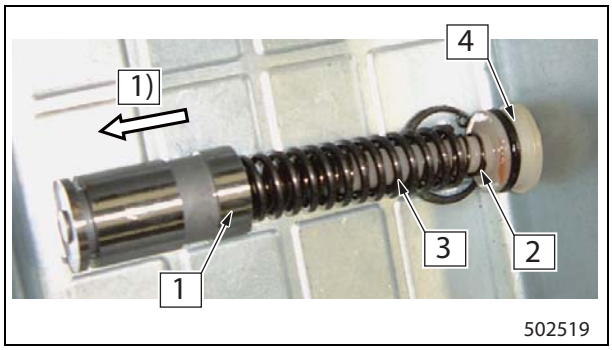
(1) Install forward gear.

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

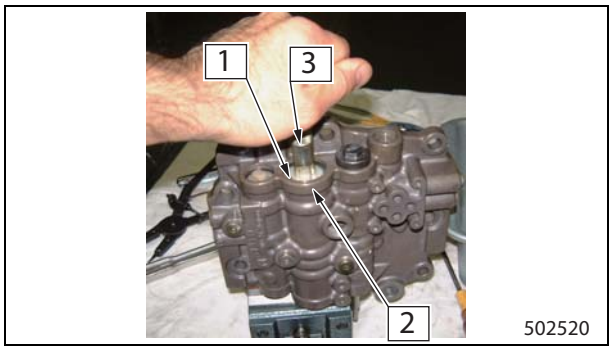
(1) Insert inner and outer springs.

(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.

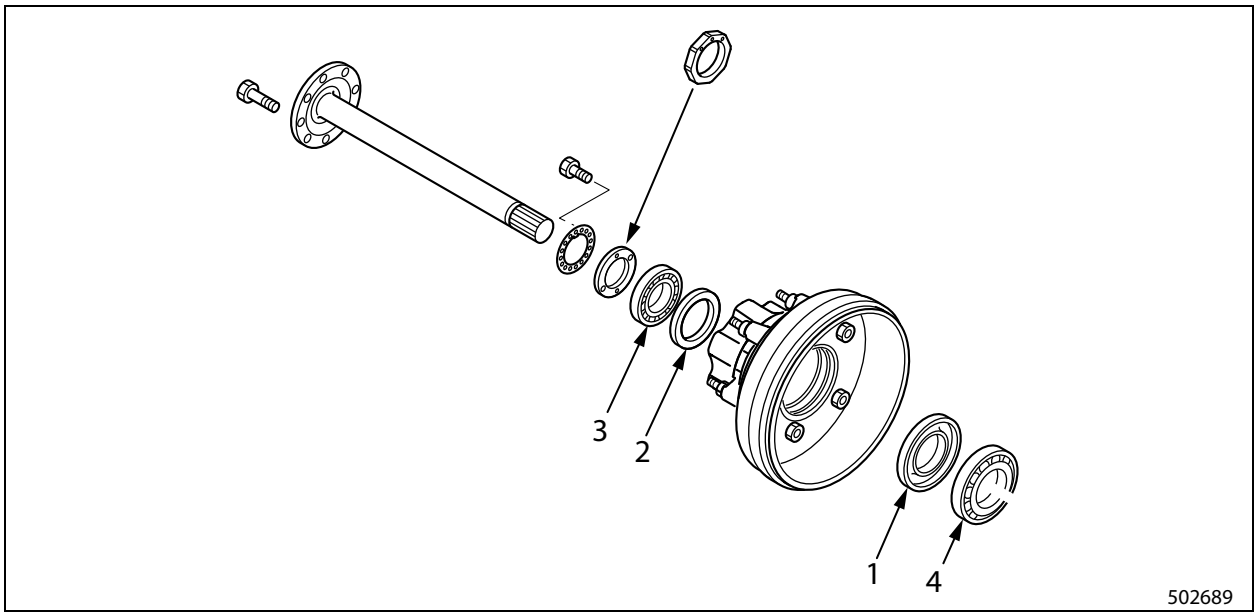
(4) While holding down accumulator spring seat, install snapring with the installer (special tool).



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

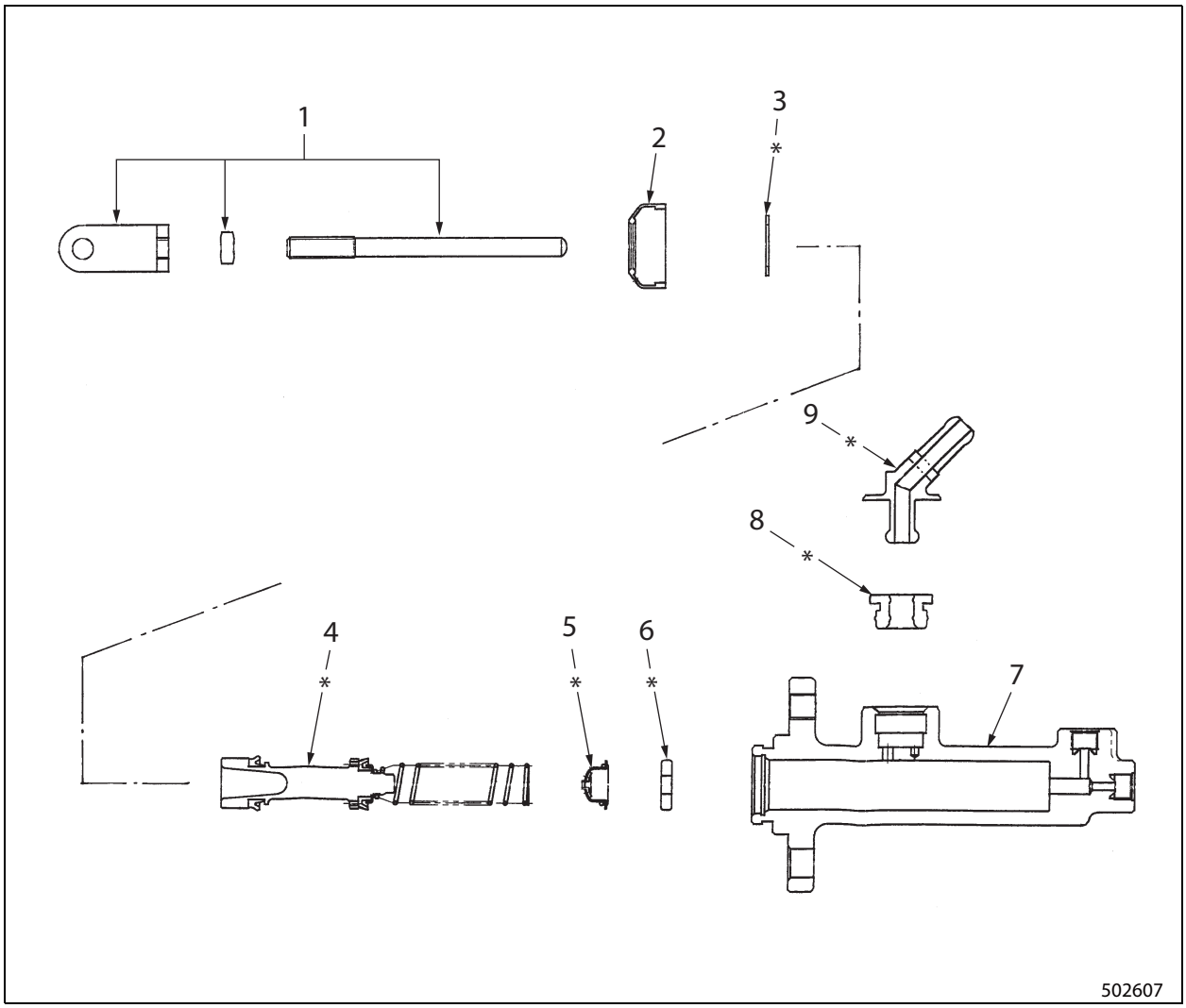
Special tool (Installer)		Truck classifications	
		1 ton class	2, 3 ton classes
1	Oil seal	91A68-00500	
2	Oil seal	91B68-00900	91E68-00700
3	Tapered roller bearing		91E68-00900
4	Tapered roller bearing		91E68-00800

- 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*

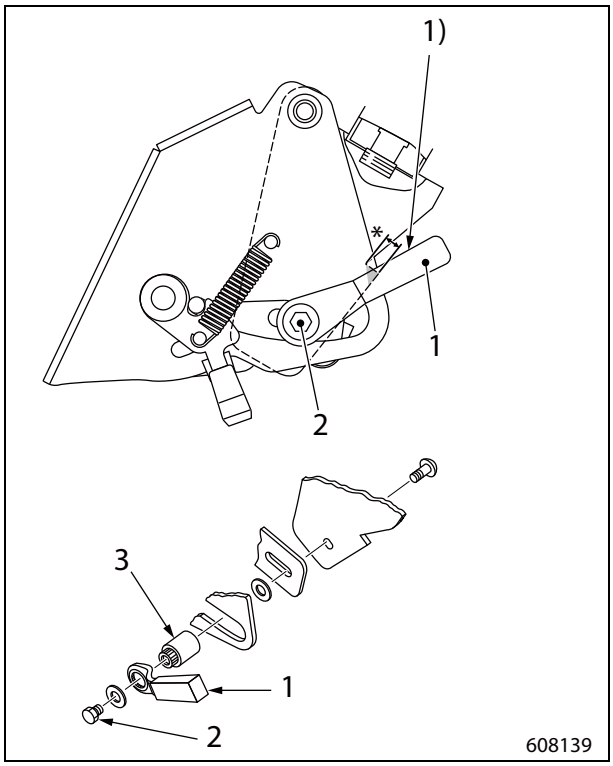
Note: The parts marked with * are included in the repair kit.

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

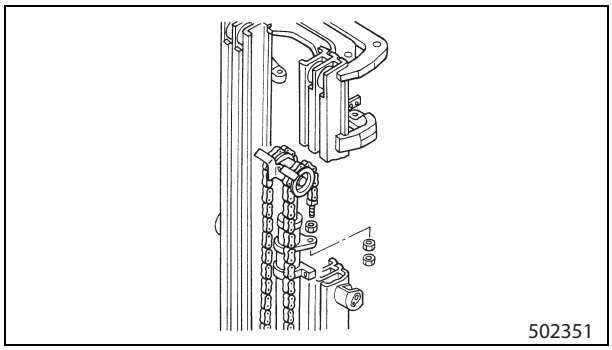
1) Lever aspect

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]

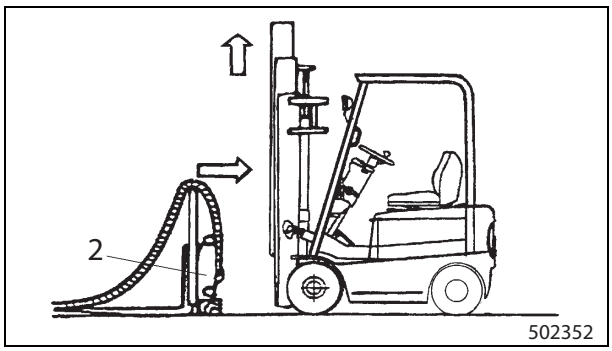
9.2 Suggestions for Removal

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.



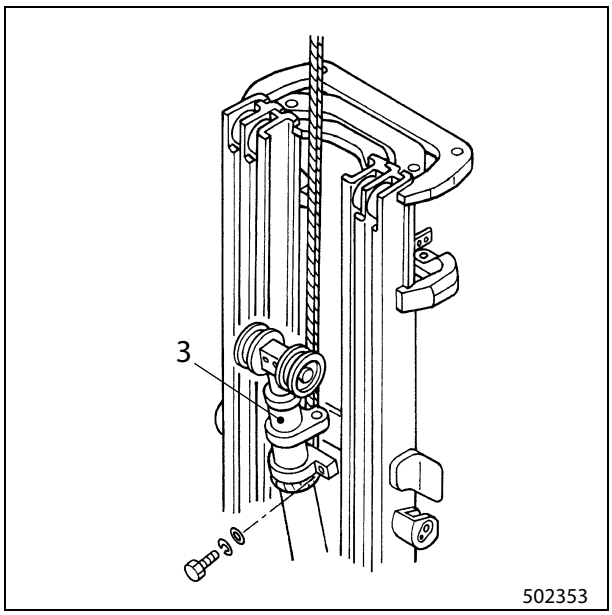
(2) Place the mast in a vertical position, and lift the inner mast until the upper rollers of the lift bracket 2 become free. Then, slowly move the truck backward.

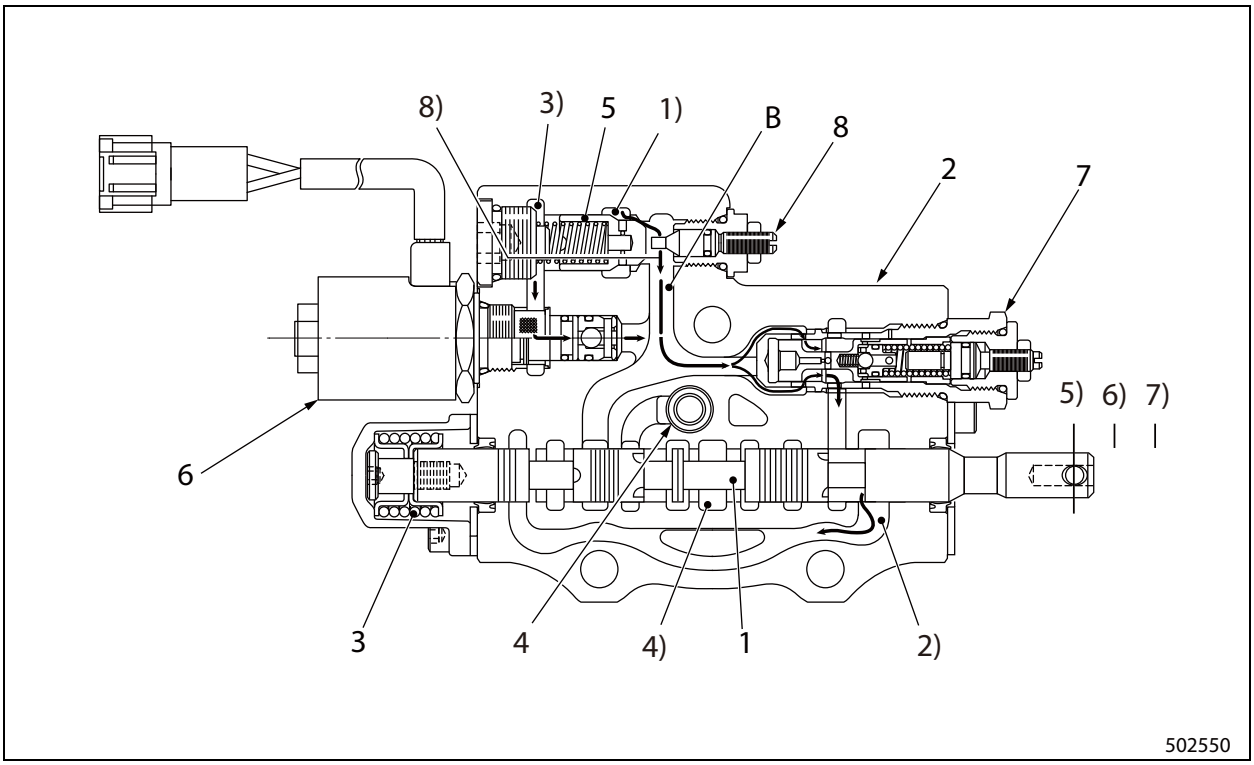


9.3 Removing First Lift Cylinders

(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".

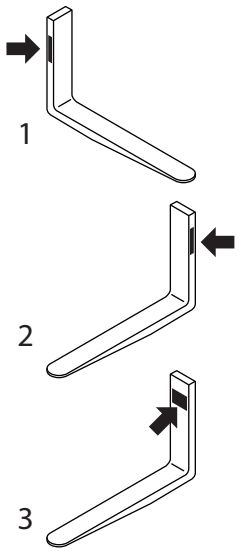
Spool 1, pushed into body 2, is at position as shown in the figure. The center bypass port is not blocked. The secondary port of flow regulator valve 7 is open to port T2 (return passage).

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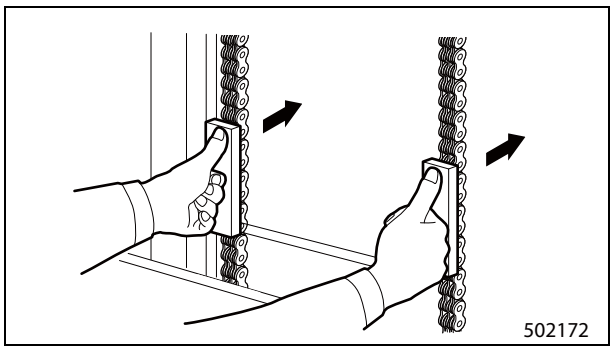
2.21 Chain Tension, Inspection and Adjustment (All Mast Models)

⚠ 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.

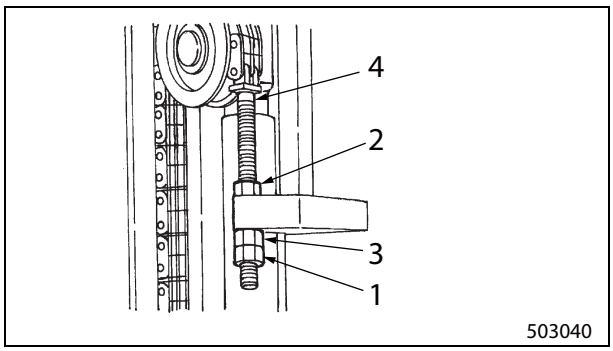
Inspecting chain tension

(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]

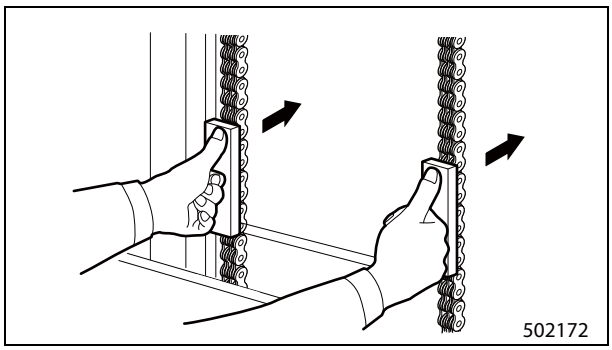
3.21 Chain Tension, Inspection and Adjustment (All Mast Models)

⚠ 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.

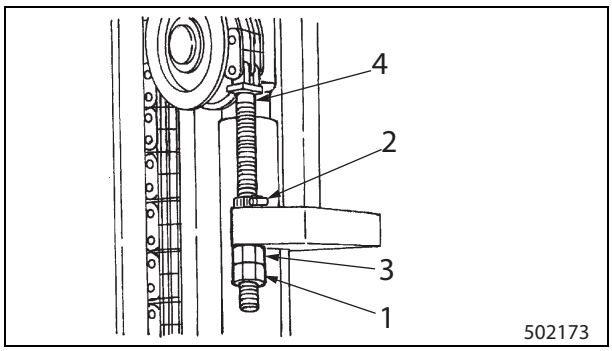
Inspecting chain tension

(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.



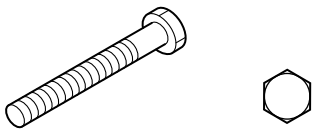
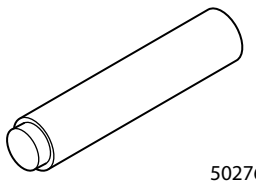
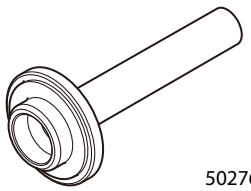
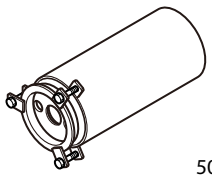
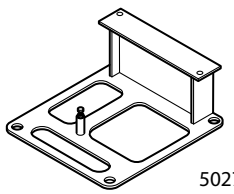
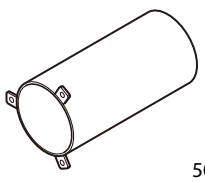
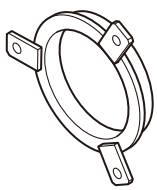
1. Double nut (lower)
2. Clamp
3. Double nut (upper)
4. Anchor bolt

Tightening nuts after adjustment

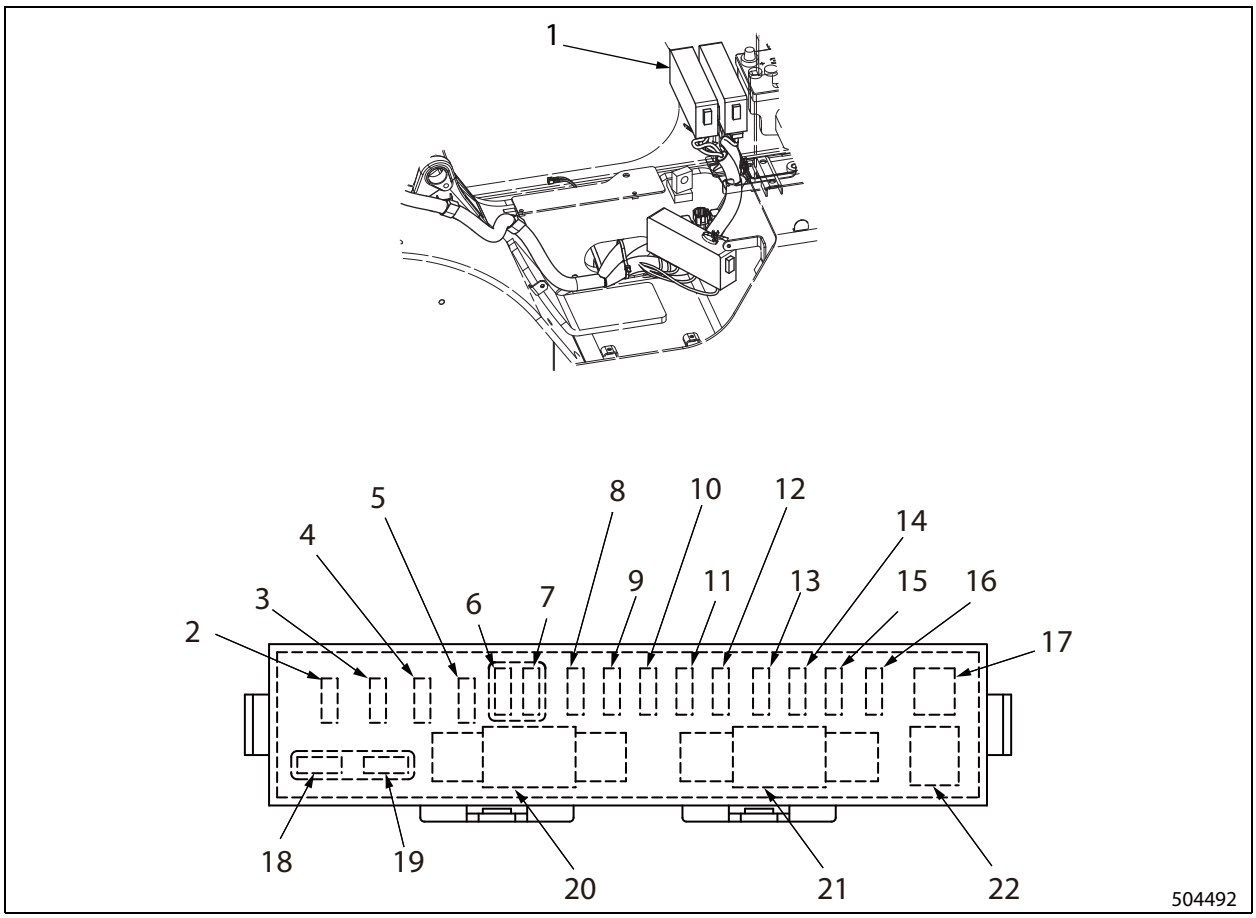
(1) Hold the anchor bolt with a spanner wrench and tighten the clamp.
(2) Hold the double nut (upper) with a wrench and tighten the double nut (lower) to the specified torque.

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

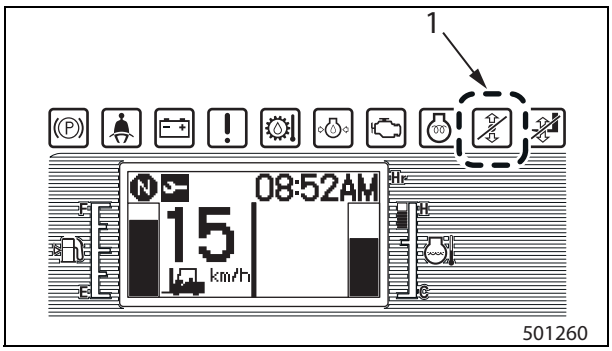
Note: The figure shown is for diesel model.
*1: Gasoline model only
*2: Diesel model only

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.



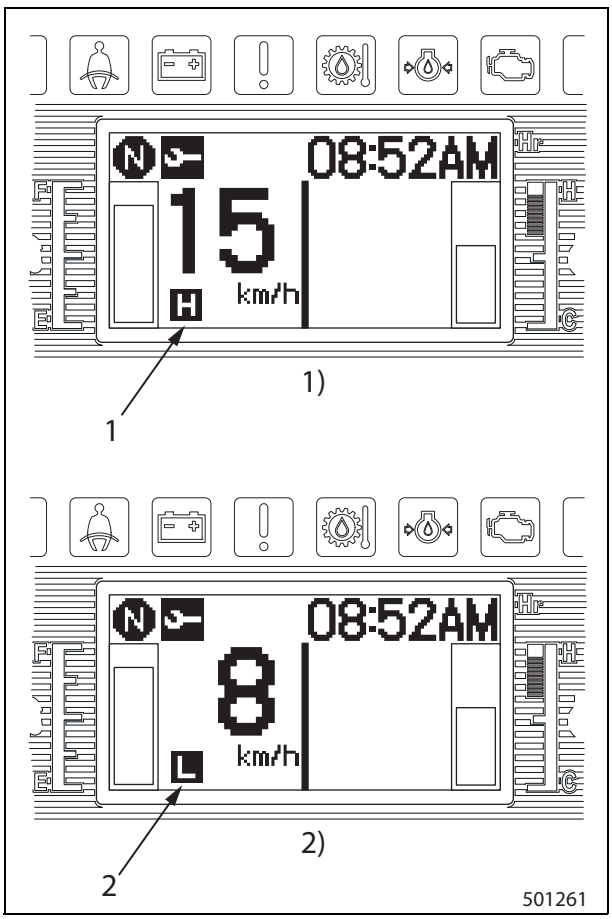
1. Smart shift indicator light

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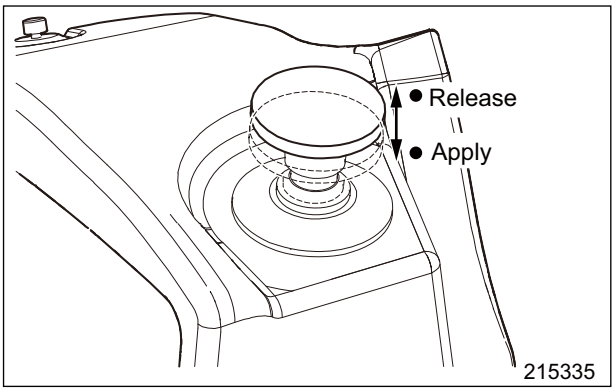
4.3 How to Check the Parking Brake Warning Buzzer and Warning Lamp Operations When the Key is OFF

(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.

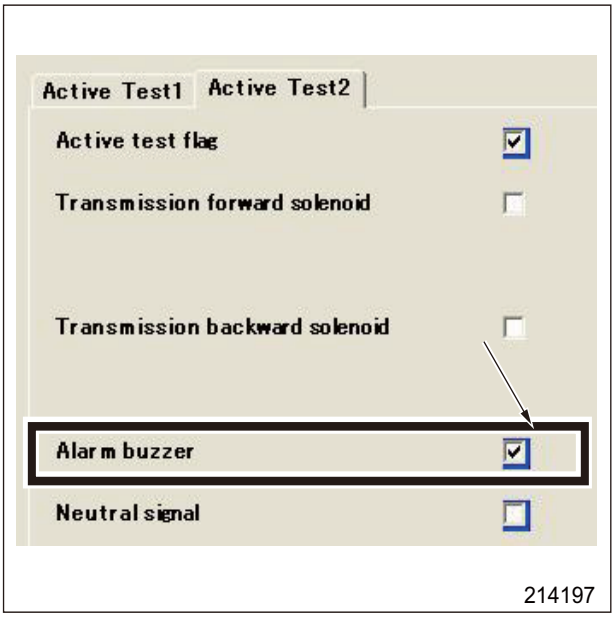


⚠ CAUTION

This function must be checked on flat and solid pavement.

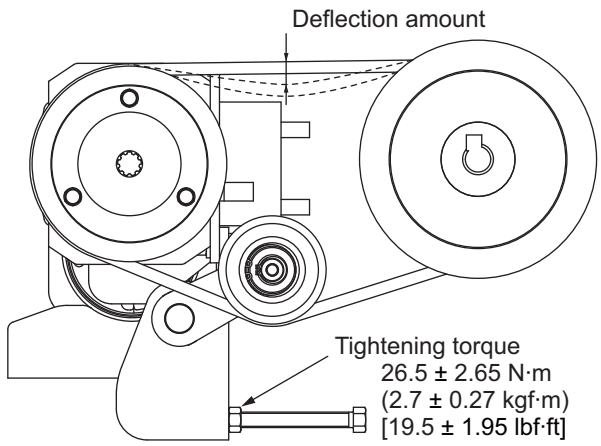
- If the seat switch does not turn on
  Refer to "8. List of Harness Wire Numbers", "9.1 VCM-1M Controller", and "9.2 Seat Switch and Seat Belt Switch", and perform the seat switch operation and wiring checks, etc.
- If the parking brake switch does not turn on
  Refer to "8. List of Harness Wire Numbers", "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.

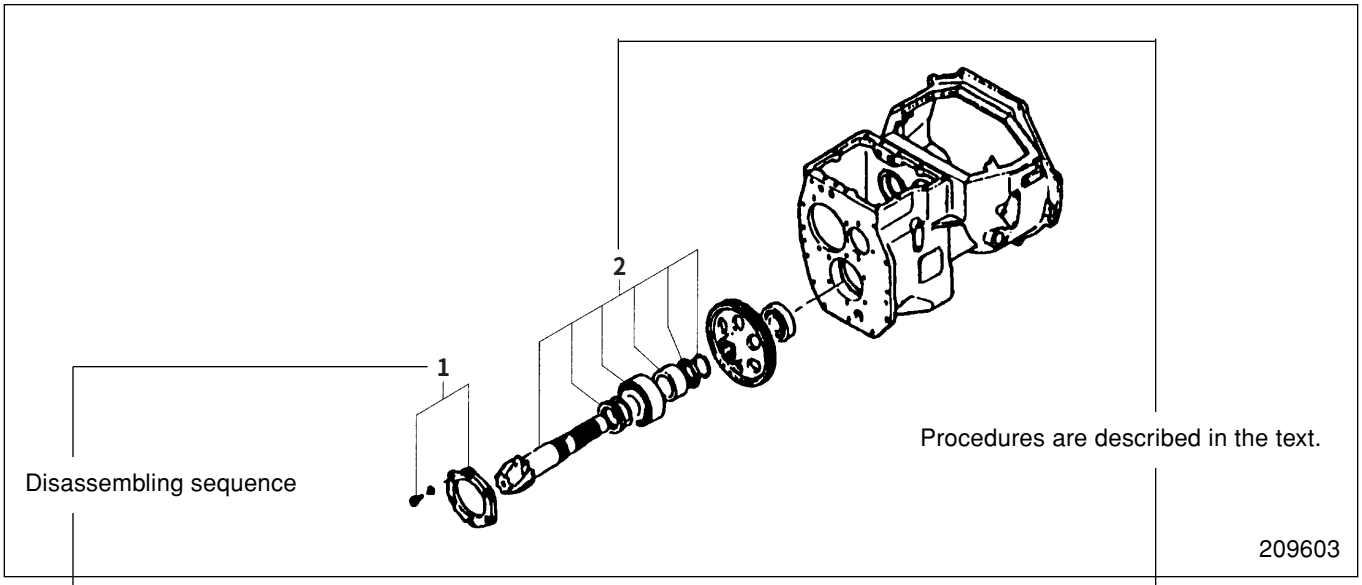
(3) Make sure that the V-belt is not twisted. Adjust it, to obtain the deflection shown in the table. Use the tension adjustment belt and nut on the tension assembly.

	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)



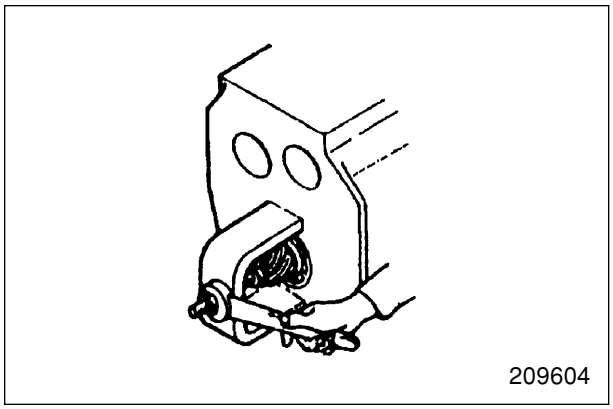
Sequence

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

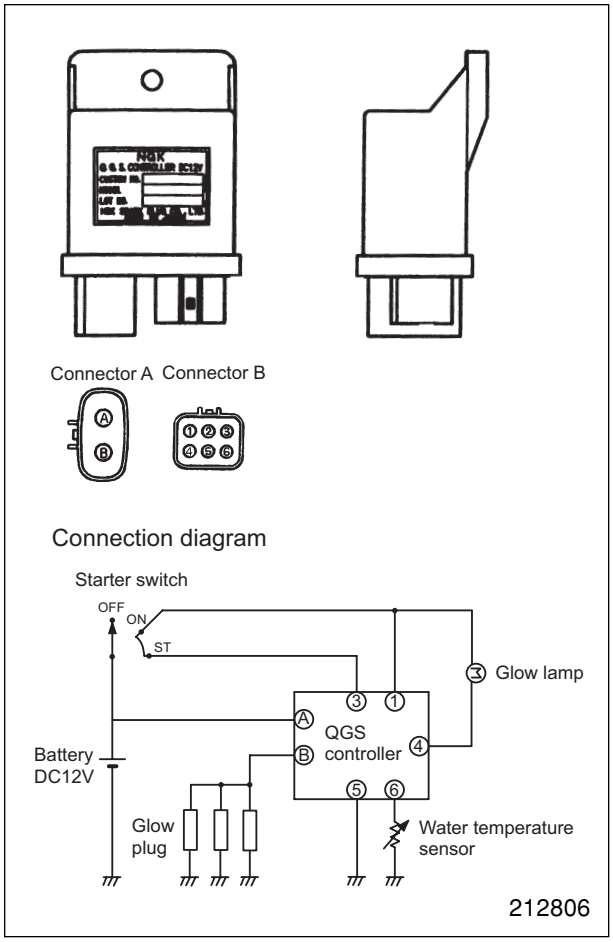
QGS controller (diesel-engine truck)

The QGS controller turns on the glow lamp and glow plugs during the time indicated in the following table, when the starter switch is turned from OFF to ON position.

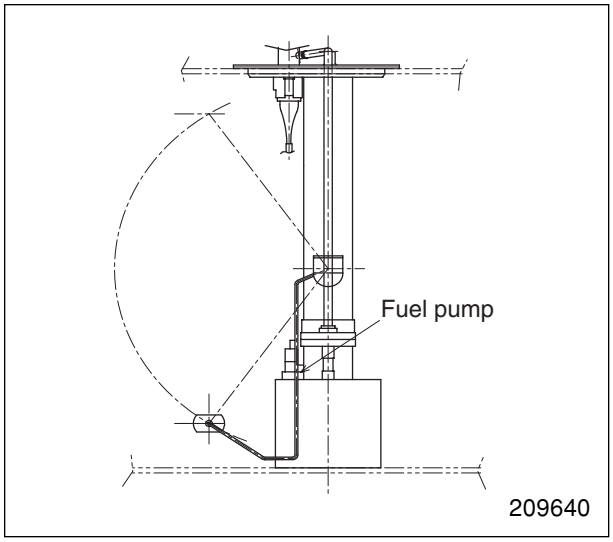
It turns on the glow lamp and glow plugs while the starter switch is turned to START position.

Item	Water temperature (Sensor resistance value)	Time turned on
Glow lamp, Glow plugs	-15 °C [+5 °F] (12.1 kΩ)	10.0 ± 2.0 sec.
	0 °C [32 °F] (5.9 kΩ)	6.4 ± 1.3 sec.
	+10 °C [50 °F] (3.8 kΩ)	3.0 ± 0.6 sec.

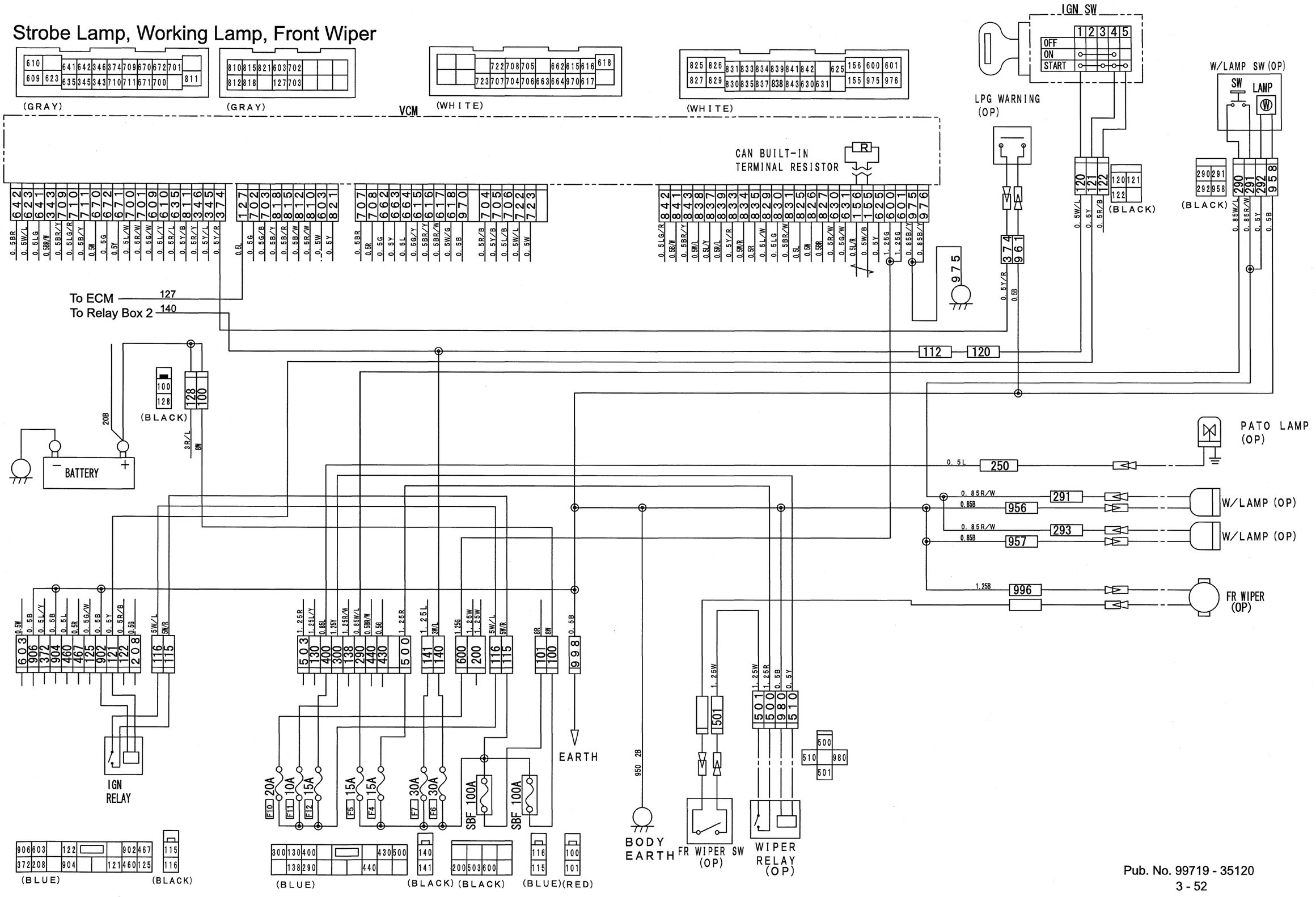
Rated operating voltage: DC 12 V



Fuel pump (gasoline-engine truck)

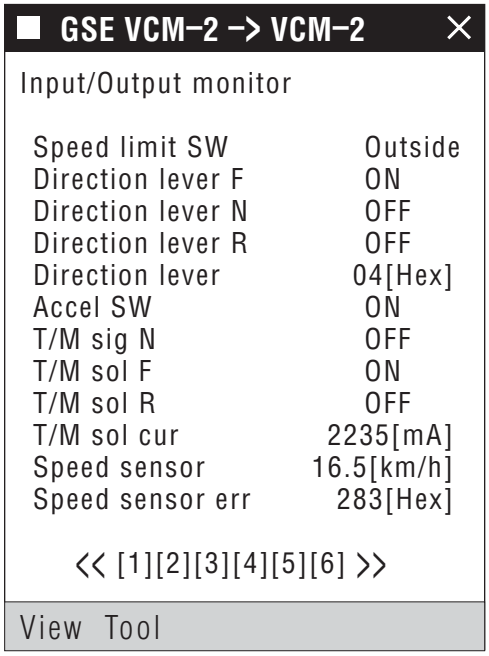


Strobe Lamp, Working Lamp, Front Wiper



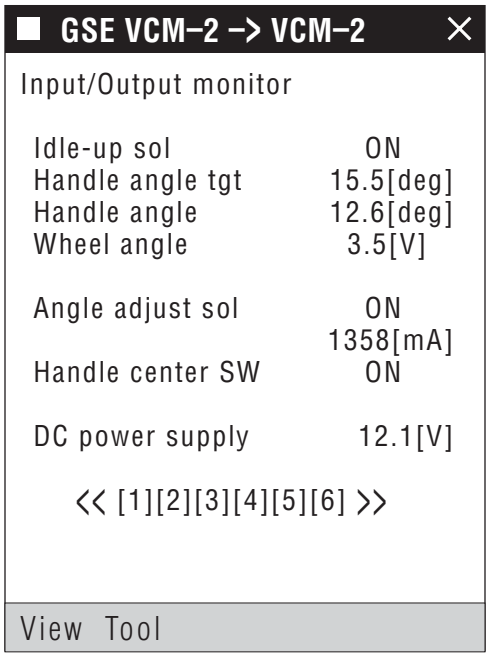
3. VCM-2 I/O Monitor: Engine and T/M control

Speed limit SW Outside	Outside/Inside
Direction lever F	ON/OFF
Direction lever N	ON/OFF
Direction lever R	ON/OFF
Direction lever	[Hex]
Accel SW	ON/OFF
T/M sig N	ON/OFF
T/M sol F	ON/OFF
T/M sol R	ON/OFF
Idle-up sol	ON/OFF
T/M sol cur	[Hex, mA]
Speed sensor	[Hex, Hz, km/h]



4. VCM-2 I/O Monitor: Steering control

Speed sensor err	[Hex, V]
Handle angle tgt	[Hex, deg]
Handle angle	[Hex, deg]
Wheel angle	[Hex, V]
Angle adjust sol	ON/OFF
Angle adjust tilt lock cur	[Hex, mA]
Handle center SW	ON/OFF
DC power supply	[Hex, V]



Err code	Description	Probable cause	Check point
F67	Att2B sol err	1. Connector contact bad	1. Connector connection check
		2. Diode bad	2. Diode connection check
		3. Harness bad	3. Harness connection check
		4. Att2B sol bad	4. Att2B sol connection check
		5. Controller bad	
F69	Att2 sol leak	1. Connector contact bad	1. Connector connection check
		2. Diode bad	2. Diode connection check
		3. Harness bad	3. Harness connection check
		4. Att2 sol bad	4. Att2 sol connection check
		5. Controller bad	
F70	Att3A sol err	1. Connector contact bad	1. Connector connection check
		2. Diode bad	2. Diode connection check
		3. Harness bad	3. Harness connection check
		4. Att3A sol bad	4. Att3A sol connection check
		5. Controller bad	
F72	Att3B sol err	1. Connector contact bad	1. Connector connection check
		2. Diode bad	2. Diode connection check
		3. Harness bad	3. Harness connection check
		4. Att3B sol bad	4. Att3B sol connection check
		5. Controller bad	

Installation

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.

Suggestions for Installation (those not shared with gasoline-engine trucks)

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

Removal and Installation (FC Models)

Removal of engine and transmission assembly

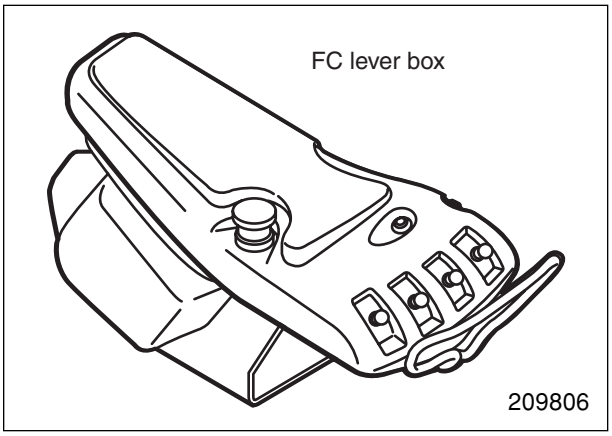
The main difference between the MC and the FC models is the control valve operation. In the MC models, the control valve plunger is operated manually. In the FC models, the valve operation is electronically controlled by way of a finger-tip control hydraulic lever. This section provides only the information specific to removal and installation of the FC model power train.

Suggestions for Removal

(1) Engine cover/seat

When removing the engine cover, disconnect the connectors behind the engine cover. Be careful not to damage the FC lever box, emergency stop button, and other items located to the right of the engine cover/seat.

Notice: For the application of optional five-valve control, connectors and terminals are changed accordingly.



(2) Harnesses and cables
(between the transmission and frame)

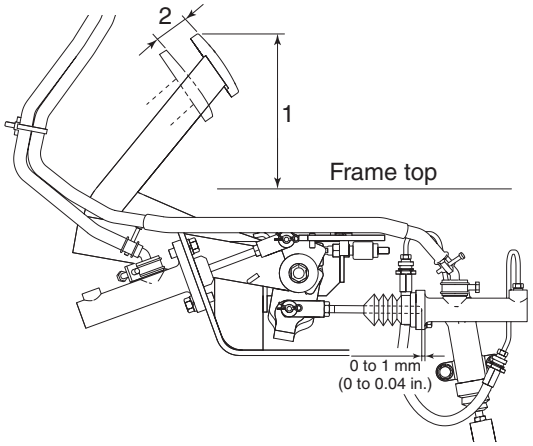
FC model harnesses are added to MC model harnesses on both gasoline-engine and diesel-engine FC trucks.

Service Data

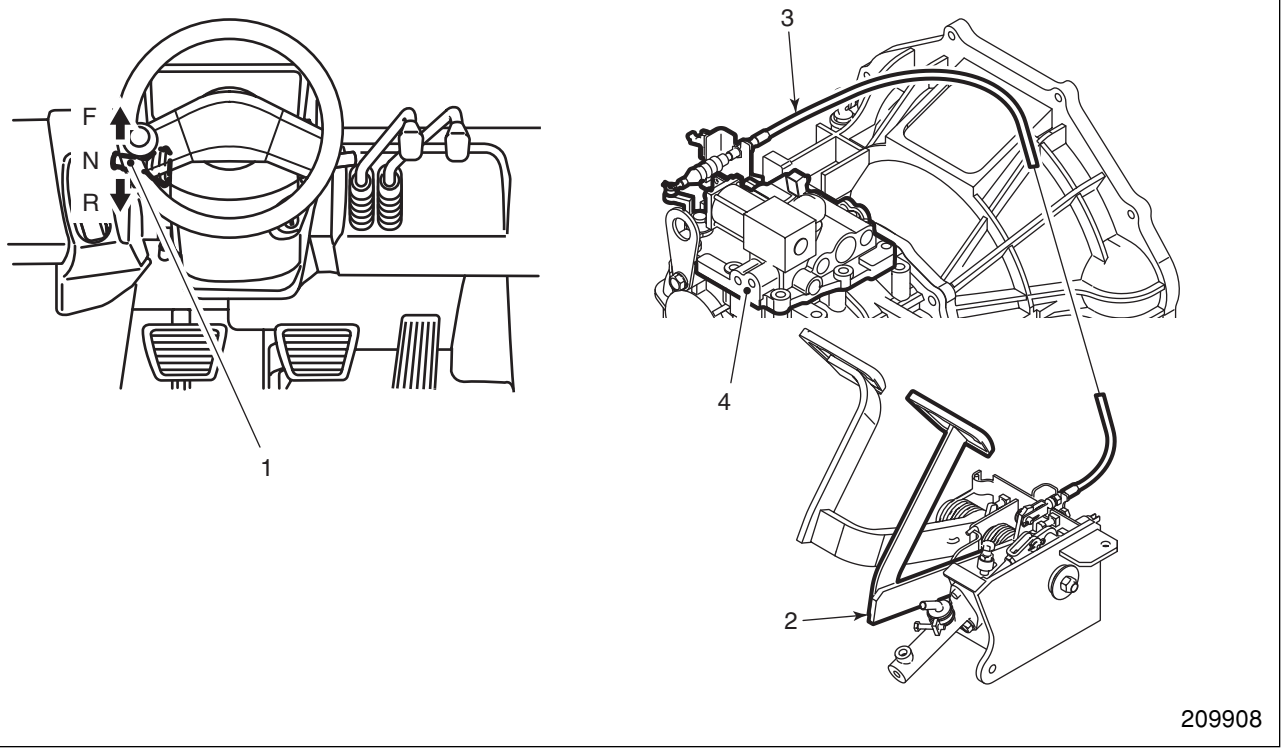
Dry-type Clutch

A: Standard value B: Repair or service limit

Unit: mm (in.)

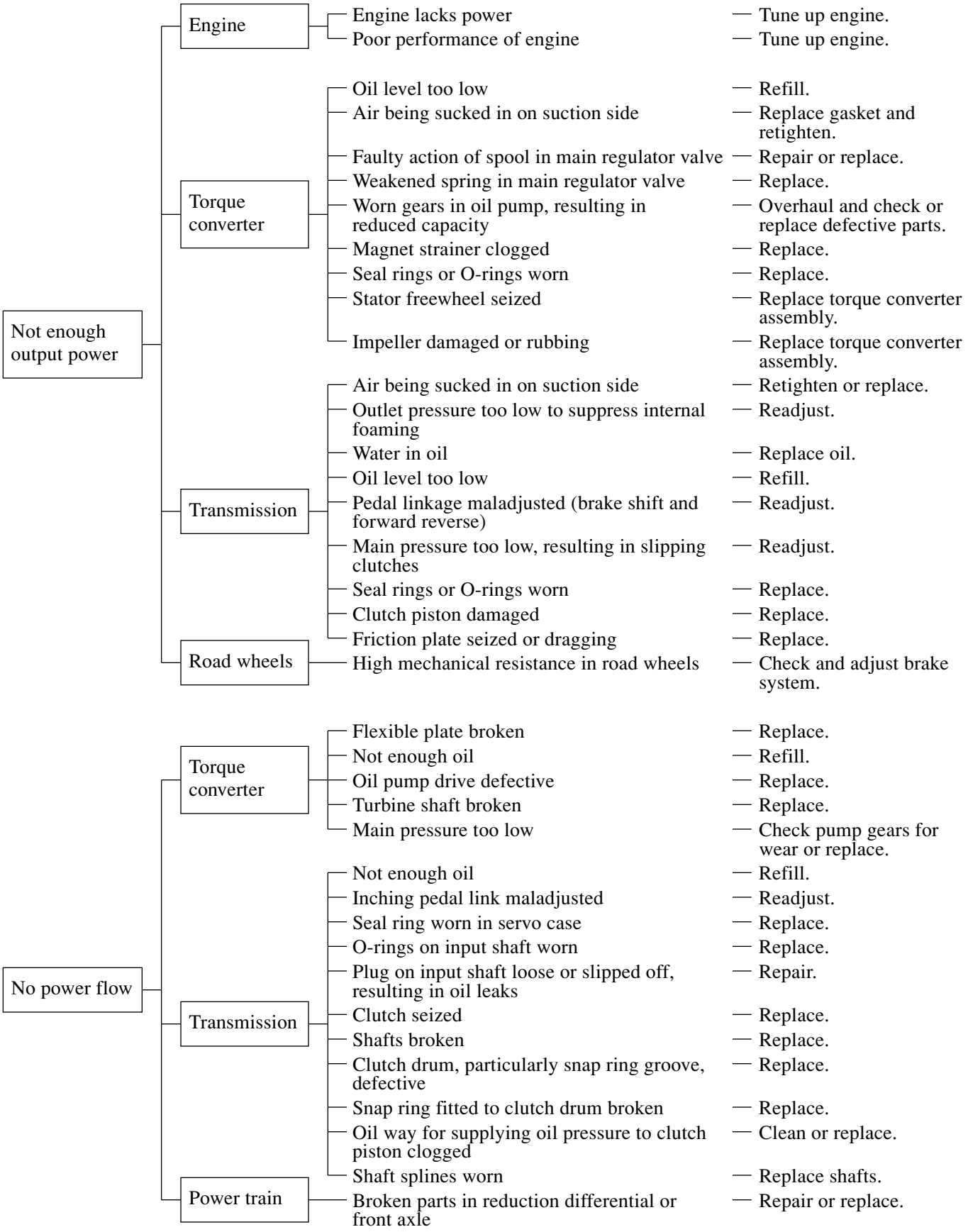
Item			Truck Model: 1 ton class	2 ton class	3 ton class
Clutch pedal	Height (from frame to top of pedal pad) 1	A	191.6 (7.54)		
	Free play 2	A	0 to 6 (0 to 0.24)		
	 209864				
Input shaft	Spline diameter 1 Free movement of clutch disc (looseness of mating splines) at rim of disc	A	$27.25\ {}^{0}_{-0.2}$ $(1.0728\ {}^{0}_{-0.008})$		
		B	6 (0.24)		
	 200396				
Clutch disc	Facing thickness (total) 1	A	9.2 ± 0.3 (0.36 ± 0.01)		
		B	1.5 (0.06), each 2.1 (0.08), both		
	Face runout (at rim)	A	1.0 (0.04), maximum		
	 200062				

Control System of Powershift Transmission



1 Forward-reverse shift lever
2 Clutch (inching) pedal
3 Cable (inching)
4 Control valve assembly

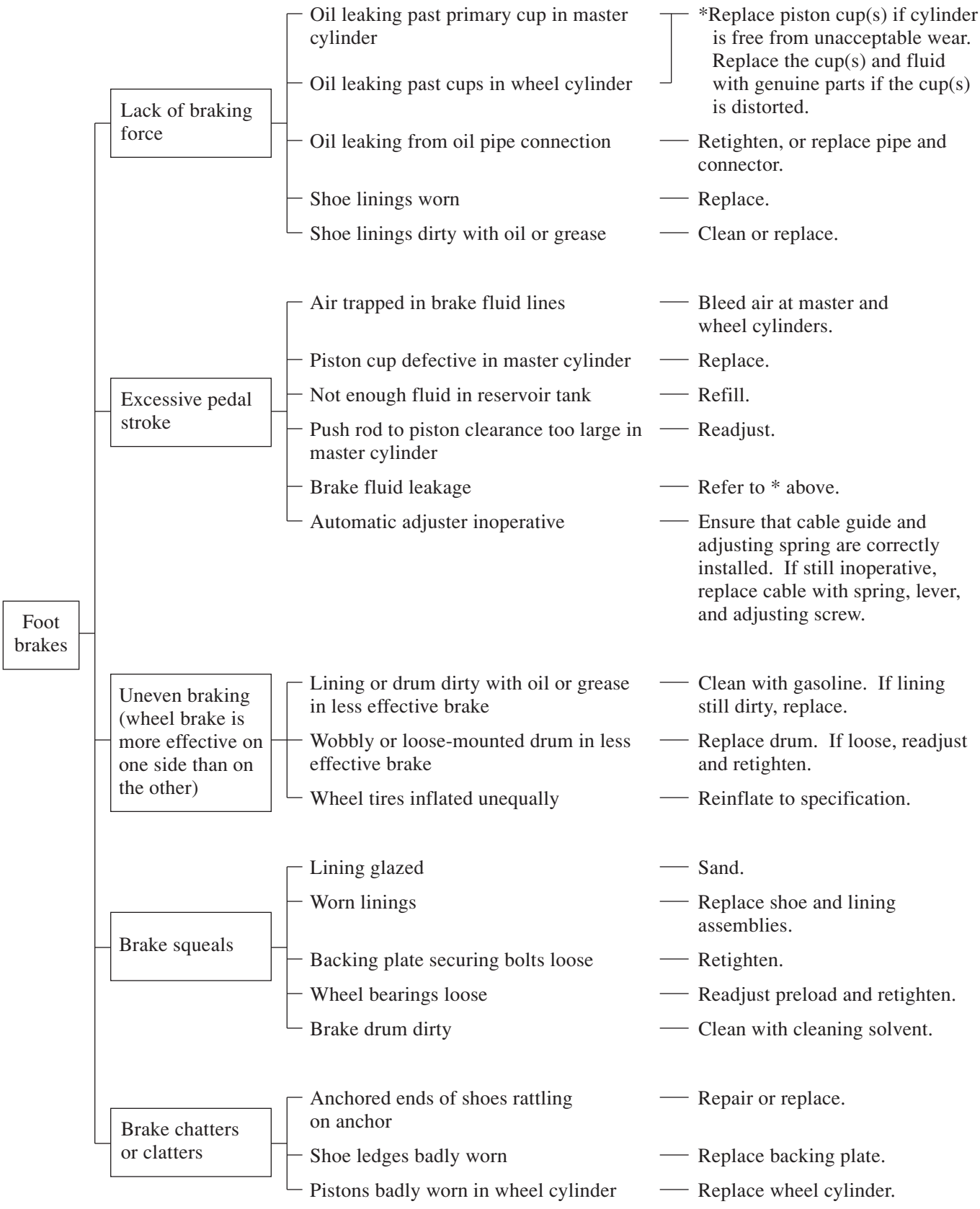
Troubleshooting



Troubleshooting

Gear noise comes out continuously during traveling	Reduction bevel gear teeth badly worn	— Replace.
	Bearing preload too much or too little, or bearings worn excessively	— Readjust or replace.
	Hub bearings damaged	— Replace.
	Improper tooth contact between reduction bevel pinion and reduction gear	— Readjust.
Irregular noise comes out during traveling	Reduction taper roller bearings or hub bearings broken	— Replace.
	Differential gears having broken teeth, or thrust washers worn	— Replace gears or washers.
	Foreign substance in axle housing	— Clean and replace oil.
	Bolts securing axle shaft or differential carrier	— Retighten.
Abnormal noise comes out when turning a corner	Fit of differential gears in differential case out of specification due to wear	— Replace worn parts.
	Differential gear teeth broken or seized on spider, or damaged by wear gear or pinions.	— Replace defective parts.
Overheated reduction case after traveling	Bearings damage due to excessive preload	— Replace bearings and readjust preload.
	Backlash between reduction bevel pinion (on output shaft) and reduction bevel gear too small	— Readjust tooth contact and backlash.

Troubleshooting



Action

Pressure oil first flows through the hollow area inside piston rod 2 and enters the first lift cylinder. As the inside diameter of the first lift cylinder is larger than that of the second lift cylinder, the first lift cylinder ascends first. The second lift cylinder starts to ascend after the first lift cylinder has completed ascent.

This cylinder is provided with a cushion mechanism which prevents the piston bottom from impulsively contacting the cylinder bottom during piston descent. (Refer to the illustration below.)

Bleed valve 9 is a valve for bleeding air when the hydraulic system is overhauled.

Action during piston descent

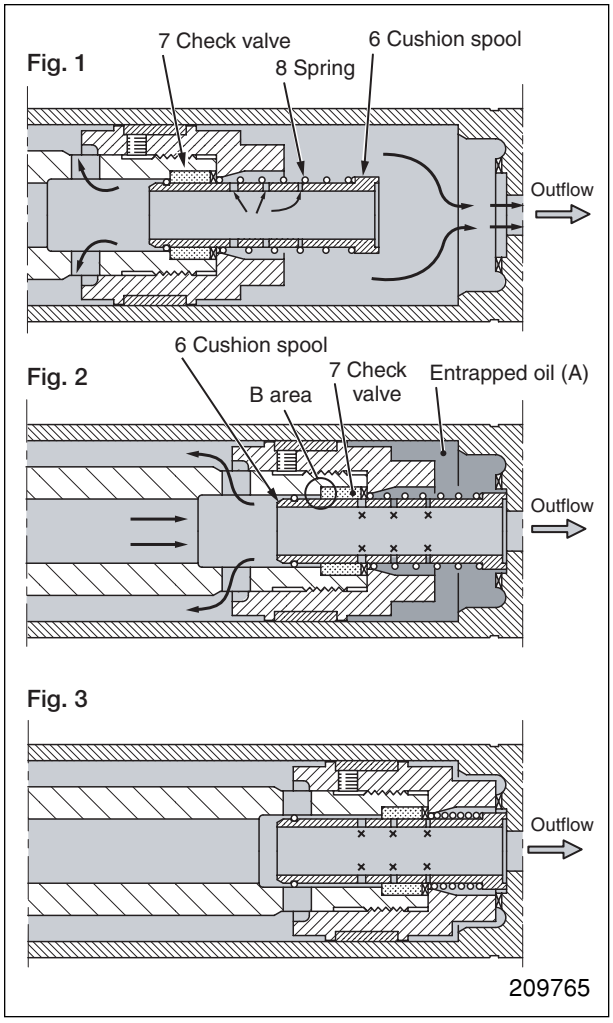
The illustration on the right explains movement of cushion spool 6 when the piston descends. (To the right of the illustration is the piston bottom.)

Fig. 1: This illustration shows a condition in which cushion spool 6 does not contact the cylinder bottom. Cushion spool 6 extends out by spring 8.

Fig. 2: This illustration shows a condition in which cushion spool 6 contacts the cylinder bottom and gets under check valve 7 slightly. The check valve moves to the left, blocking the B area. Oil (A) below the underside of the piston is discharged through holes (two rows on the right) of cushion spool 6.

For the shape of the check valve, refer to the image drawing on the following page.

Fig. 3: As the piston descends, cushion spool 6 gets under the check valve further. As a result, the number of holes through which oil can pass decreases and discharge of entrapped oil (A) is restricted. The descending speed of the piston becomes slower and impulsive contact is avoided.



MC Control Valve

Structure and Operation ..... 13 – 45
MC Control Valve ..... 13 – 45
Hydraulic Circuit Diagram of MC Hydraulic Control Valve ..... 13 – 46
Inlet Cover Section ..... 13 – 47
Lift Valve ..... 13 – 49
Tilt Valve ..... 13 – 51
Unloader Valve ..... 13 – 53
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Removal and Installation ..... 13 – 54
Disassembly and Reassembly ..... 13 – 55
Valve of Inlet Cover Section ..... 13 – 55
Combination Section ..... 13 – 56
End Cover Section ..... 13 – 58

Inspection after Disassembly

Check valves for burrs, scratches, dents and other surface defects.

(1) Check that all moving and sliding contact parts move smoothly.

(2) Check for clogged orifices.

(3) Replace springs if they are broken or bent. Measure the free length of springs.

Reassembly

(1) Select a dust-free, clean place for reassembly.

(2) Perform reassembly, not section by section but by first assembling spool-less housing and tightening tie rod nuts to specified torque before proceeding to install spools and poppets.

(3) Tighten nuts on tie rod bolts to specified torque. Tighten bolts evenly. Tightening bolts unevenly or to improper torque may distort the valve body and make the movement of spool unsmooth.

(4) Reassemble each valve with proper knowledge of it. Pay particular attention to the position (direction) of valve.

(5) Reassemble valves with great care. Take care that parts do not hit each other or metal tools. Metal-to-metal collision damages the surfaces.

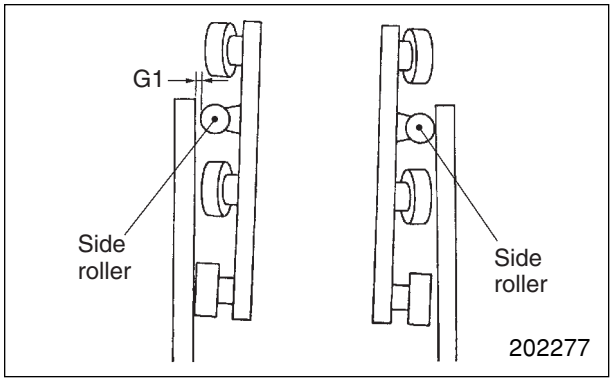
(6) Apply hydraulic oil to parts before they are installed. Do not install them dry. Application of grease facilitates the fitting of O-rings. Do not use grease in excess of necessary minimum quantity. Grease used must be clean.

(7) Replace all O-rings. When fitting O-rings in the seal grooves, apply grease to them and seat them firmly in the grooves using care not to damage.

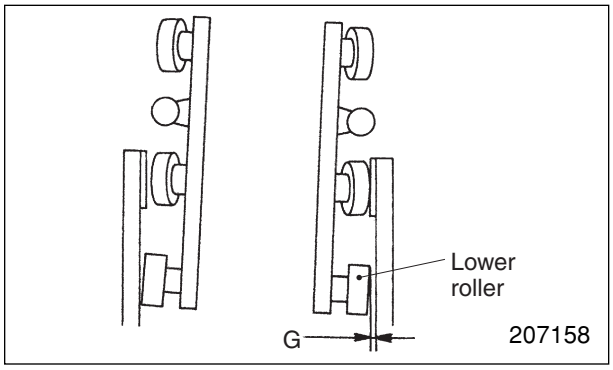
(8) After the spools are installed, check that they move smoothly.

(9) For reassembly of individual valves, refer to "Reassembly of Valves."

(f) Lower the lift bracket sligtly from the top, so that the side roller comes in contact with the inner mast, then check clearance G1 between the side roller and inner mast. If clearance G1 is out of specification, it is necessary to add shims to the seat of the roller bracket to adjust to correct clearance. Remove the lift bracket from the mast and adjust the shim thickness. For adjustment and installation procedures, refer to "Adjusting clearance G1 between the side roller and inner mast" on page 14-11.



(g) With the lift bracket at the top, check clearance G between the lower roller and inner mast. If clearance G is out of specification, it is necessary to add shims to the seat of the roller to adjust to correct clearance. Remove the lift bracket from the mast and adjust the shim thickness for the rollers. For adjustment and installation procedures, refer to "Adjusting clearance G between the lower rollers and inner mast" on page 14-11.



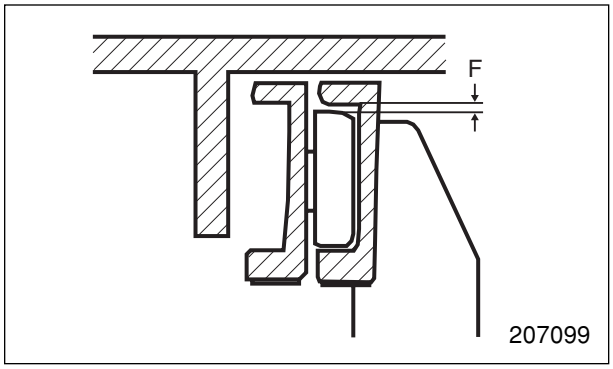
5. Mast Roller Clearance Adjustment

(1) Back-to-front clearance inspection on mast main rollers

(a) Tilt the mast fully backward.

(b) Using feeler gauges, measure clearance F between the inner mast lower roller and outer mast.

Clearance F	1.0 mm (0.04 in.) or less



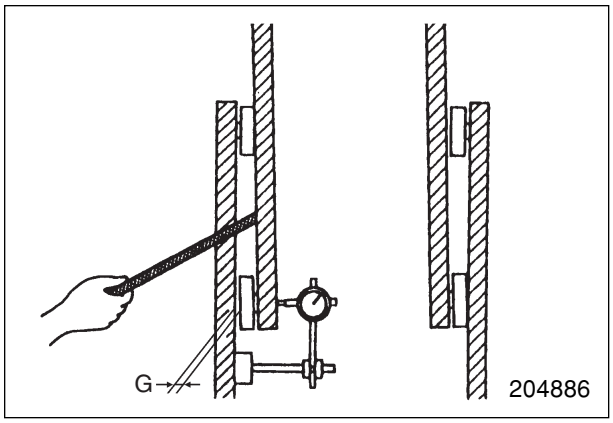
(c) If clearance F is out of the specification, use oversize rollers. For mast roller replacement and installation procedures, refer to "Installing mast rollers" on page 14-12.

(2) Right-to-left clearance inspection on inner mast main rollers

(a) Raise the mast to the top.

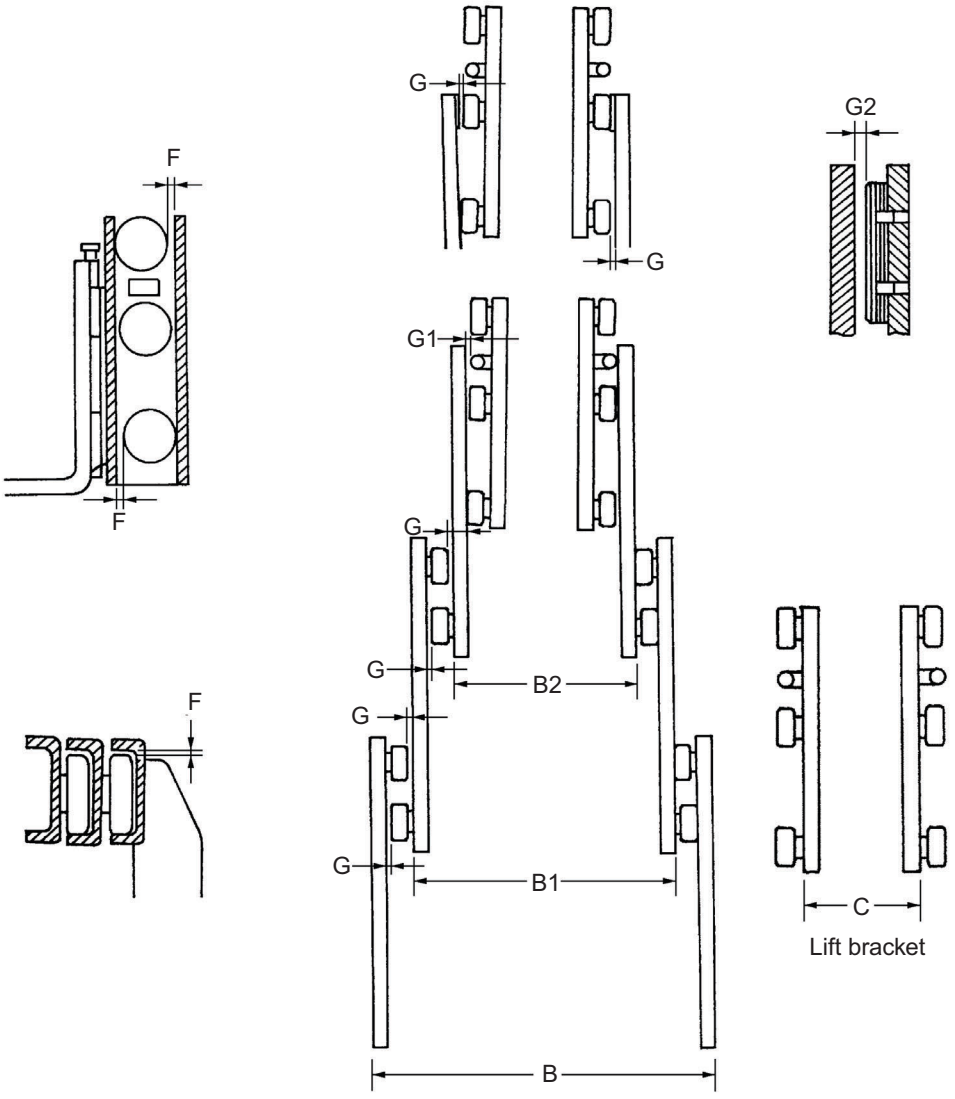
(b) Set a dial indicator on the inside of the outer mast with its contact point rested on the inner mast.

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



Troubleshooting (Duplex Mast)

Lift bracket and inner mast will not move smoothly.	Clearance between lift rollers and side rollers incorrect	Readjust clearance.
	Rollers binding on their shafts	Relubricate or replace.
	Mast strip clearance incorrect	Shim adjustment 0.1 to 0.5 mm (0.004 to 0.020 in.)
Lift bracket or inner mast binds.	Too much clearance on side rollers	Readjust by adding shims.
	Lift chains unequally tensioned	Readjust.
	Shim adjustments unequally made on between left and right lift cylinders (at maximum height)	Readjust.
Mast makes noise.	Rollers not rotating smoothly on their shafts	Relubricate or replace.
Load descends. (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.	Finger bar bent	Repair or replace.
	Forks bent	
	Un-even loading	



Mast width is slightly wide at the lower portion than at the upper portion.
Measure the clearance at the mast upper position.

212699

4. Battery Maintenance

4.1 State of Charge and Electrolyte Specific Gravity (S.G.) Adjustment

Specific gravity reading at 20°C (68°F)	Condition	Adjustment
1.280 to 1.265	Good	If the difference in S.G. between any two cells is 0.020 or less, continue to use as is. If the difference is more than 0.020, discharge the battery in an efficient manner. If the battery recovers, charge the battery to adjust the electrolyte S.G.
1.260 to 1.225	Half charged	Recharge battery to adjust electrolyte S.G. Check for any short-circuited cables or corroded cable connections in the electrical system.
1.220 or less	Battery low (caution required)	Recharge battery. If the difference in S.G. is too much, charge the battery to adjust the electrolyte S.G.
If the difference in S.G. is more than 0.040.	A cell with a low S.G. may cause a short circuit. It is caused when electrolyte leaks or electrolyte rate is too high or too low.	Recharge the battery until its voltage and S.G. stabilize and remain constant for more than 2 hours. Charge the battery to adjust the electrolyte S.G. It should read between 1.280 and 1.265. If the difference in S.G. is more than 0.040 and a low S.G. is found in any of the cells, replace the battery with a new one. Conduct a high current discharge test after leaving the battery for 12 to 96 hours.

4.2 Specific Gravity Reading and State of Charge

Fully charged condition can be verified by the electrolyte S.G. (1.280 to 1.265), and also the reduction speed of electrolyte implies the battery condition. If the electrolyte in the battery cell decreases to the level where the pole plates are exposed within one month, it may be overcharged. If the electrolyte amount remains sufficient for more than three months, the battery may discharge.

4.3 Charging Precautions

(1) In slow charging, the charging current should be about 1/10 the capacity of the battery being charged.

(2) In quick charging, the battery capacity in ampere should not be exceeded.

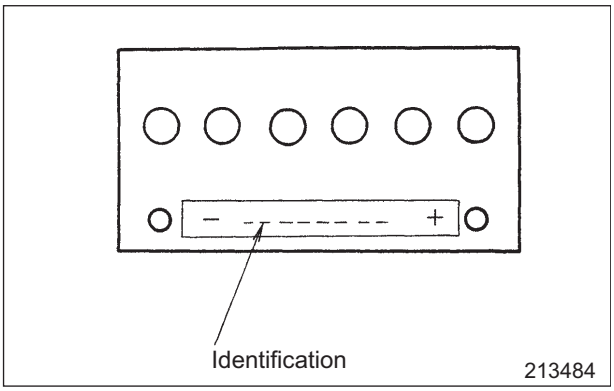
(3) During charging, adjust the charging current so that the electrolyte temperature does not exceed 45°C (113°F).

(4) When connecting cables to battery terminals, always connect the (+) terminal first, and when disconnecting, remove the (-) terminal first.

(5) During charging, hydrogen gas is generated, which requires attention to ventilation.

⚠ CAUTION

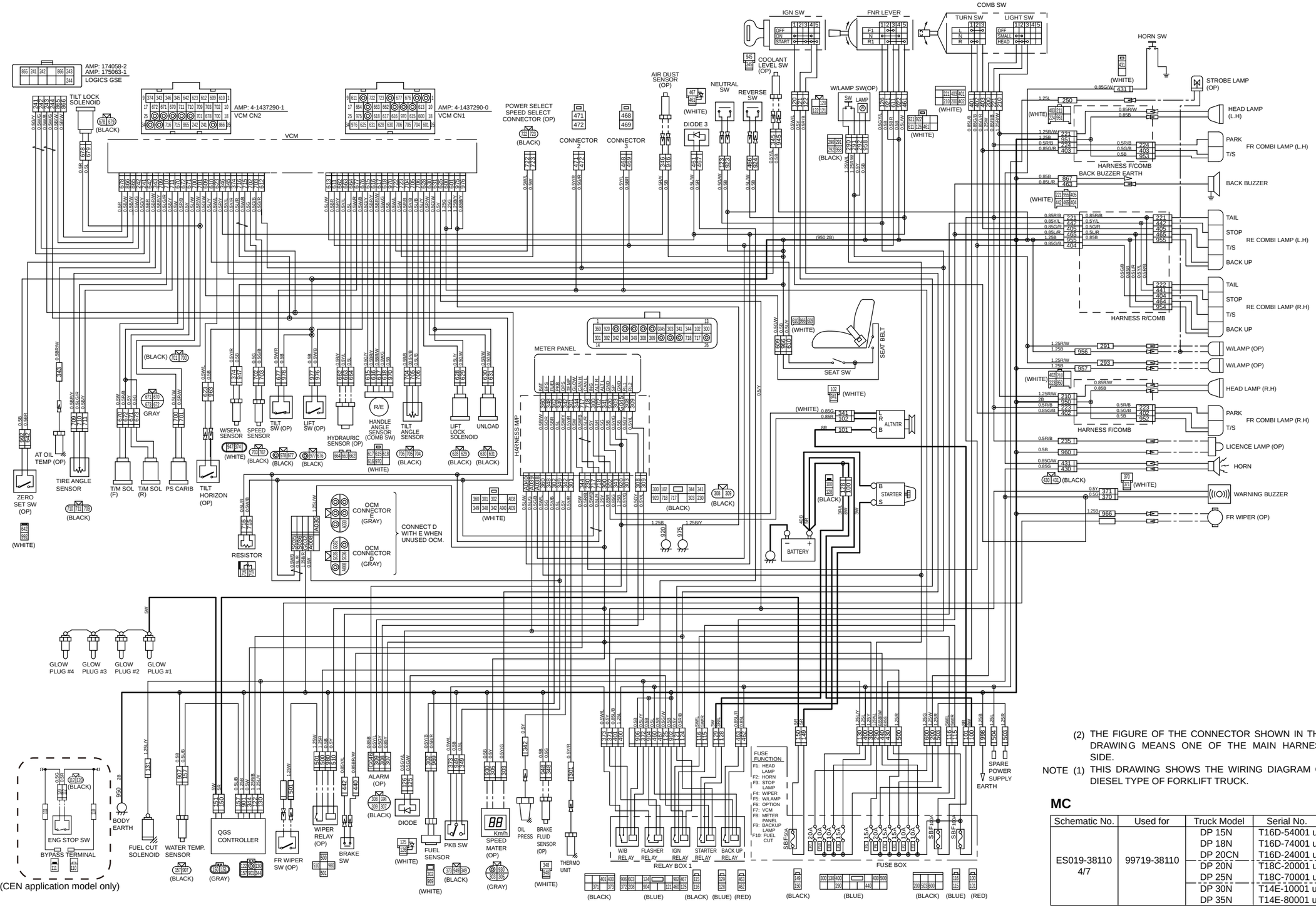
Be sure to turn OFF the key switch and lighting switch before disconnecting or connecting the battery cables (to prevent IC regulator from damage).



Identification

34B19L	(Gasoline-engine truck)
55D23L	
75D26L	(Diesel-engine truck)
95D31L	

Electrical Schematic (4/7)



(2) THE FIGURE OF THE CONNECTOR SHOWN IN THIS DRAWING MEANS ONE OF THE MAIN HARNESS SIDE.

NOTE (1) THIS DRAWING SHOWS THE WIRING DIAGRAM OF DIESEL TYPE OF FORKLIFT TRUCK.

MC

Schematic No.	Used for	Truck Model	Serial No.
ES019-38110 4/7	99719-38110	DP 15N	T16D-54001 up
		DP 18N	T16D-74001 up
		DP 20CN	T16D-24001 up
		DP 20N	T18C-20001 up
		DP 25N	T18C-70001 up
		DP 30N	T14E-10001 up
		DP 35N	T14E-80001 up

5.2 Checking Procedure

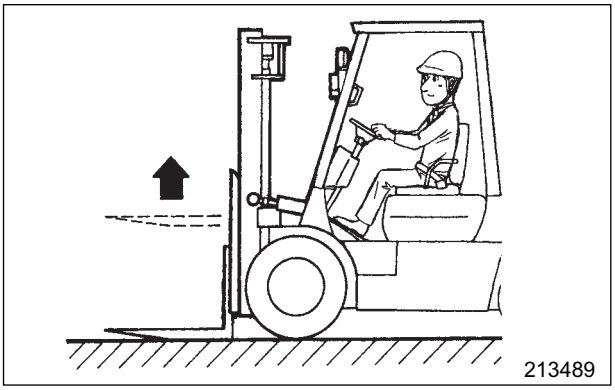
Travel interlock system (powershift truck)

(1) Slightly lift the forks from the ground.

(2) With the engine idling (not pressing on the accelerator pedal), place the direction lever to the forward or reverse position, and then half rise from the operator seat.

(3) In a few seconds, the lift truck should stop with the driving interlock indicator lamp blinking.

(4) To restore the lift truck to its normal driving condition, sit properly on the operator seat and press the brake pedal to stop the lift truck. Place the direction lever to the neutral position once, and then shift it back into the forward or reverse position.



⚠ CAUTION

- Be sure to check the driving interlock system on level and hard ground. On grade or ramp, the lift truck moves due to its own weight.
- Make sure that sufficient space is available for the lift truck to move around and that no one or no obstacle is around the truck.

♦Checking Procedure on the service tool

(1) Connect the service tool to the VCM1-M controller.

(2) Turn the key switch to the ON position and start the engine.

(3) Open the input monitor screen (VCM1-M) of service tool.

(4) While sitting in the operator seat and monitoring the input monitor screen, make sure the seat switch and seat switch timer is ON. (Fig. 2-1)

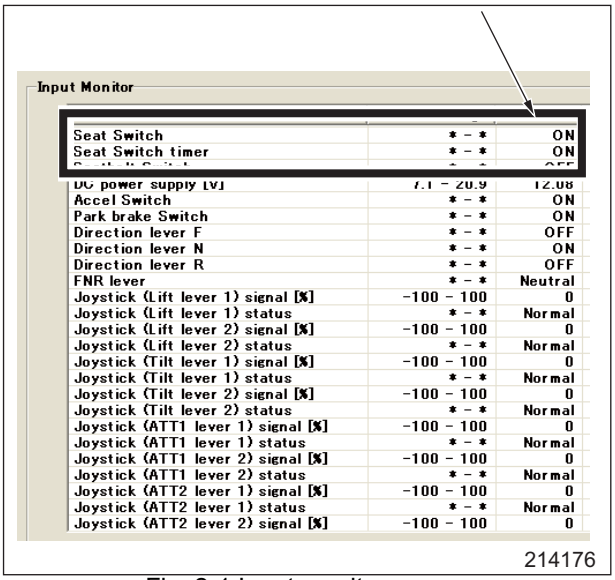


Fig. 2-1 Input monitor screen

Diagnosis	T/M solenoid leak (F89)
Logic conditions	Current value is 280mA or more with output OFF (600-millisecond continuity) ——————— F89
Recovery	Recovers automatically
Action	Turn OFF the T/M forward and backward solenoids.
LED blink pattern	E

2. Removal and Installation (FC Models)

2.1 Removal of Engine and Transmission Assembly

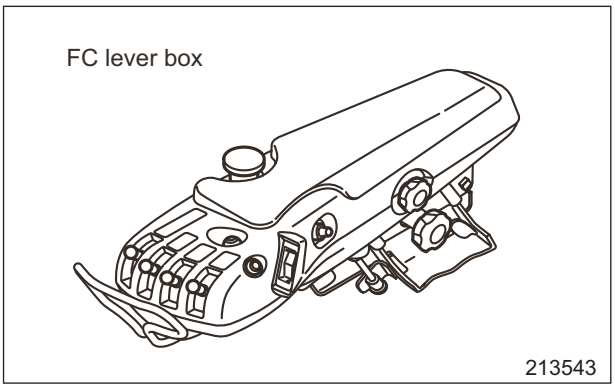
The main difference between the MC and the FC models is the control valve operation. In the MC models, the control valve plunger is operated manually. In the FC models, the valve operation is electrically controlled by way of a finger-tip control hydraulic lever. This section provides only the information specific to removal and installation of the FC model power train.

Suggestions for Removal

(1) Engine cover, Seat
When removing the engine cover, disconnect the connectors behind the engine cover. Be careful not to damage the FC lever box, emergency stop button, and other items located to the right of the engine cover/seat.

Note: For the application of optional five-valve control, connectors and terminals are changed accordingly.

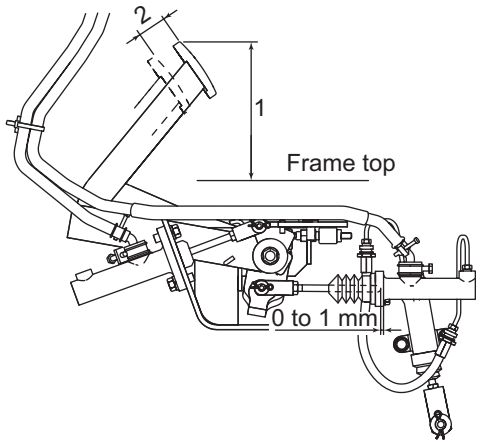
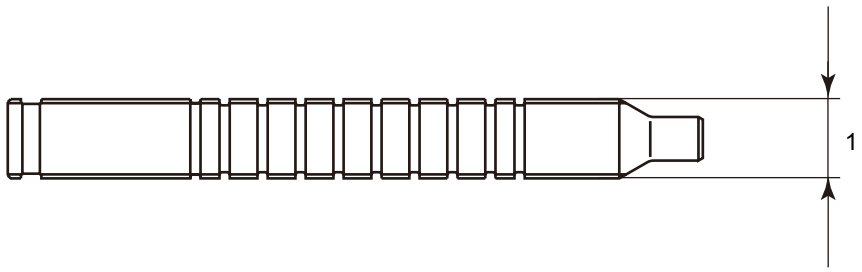
(2) Harnesses and cables
(between the transmission and frame)
FC model harnesses are added to MC model harnesses on both gasoline-engine and diesel-engine FC trucks.



6. Service Data

6.1 Dry-Type Clutch

Unit: mm (in.)

Item			Truck type		
			1 ton class	2 ton class	3 ton class
Clutch pedal	Pedal height from floor panel 1 (from the top of pedal pad to the frame top)	A	191.6 (7.54)		
	Clutch pedal free play 2	A	0 to 6 (0 to 0.24)		
	 213597				
Input shaft	Spline diameter 1	A	$27.25\ ^{0}_{-0.2}$ ($1.07\ ^{0}_{-0.008}$)		
	Free movement of clutch disc (looseness of mating splines) at rim of disc.	B	6 (0.24)		
	 213598				

A: Standard value B: Repair or service limit

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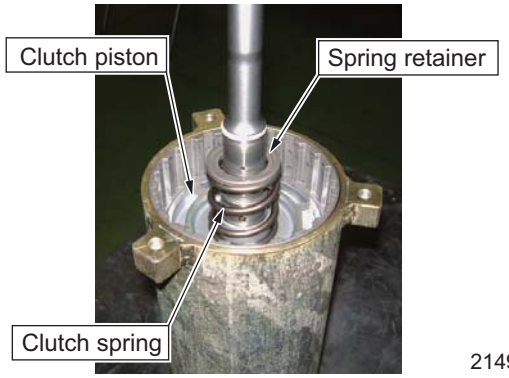
(8) Using special tools; Stand, 91A68-01300, Plate 1, 91A68-01400 and Plate 2, 91A68-01500, compress the spring retainer together with clutch spring.

(9) Install snap ring, and loosen the bolt of special tool.

Note: Be sure to install new snap ring. Do not reuse once it is removed.

Part name	Part number
Clutch pack stand kit	91A68-00010
Stand	91A68-01300
Plate 1	91A68-01400
Plate 2	91A68-01500



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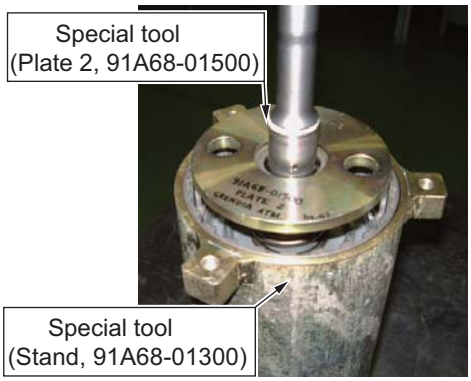

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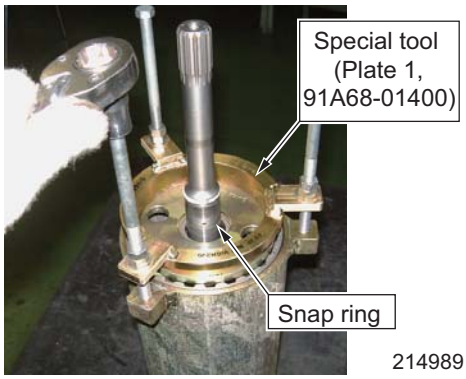


214989

7.3 Valve Plug and Oil Seal, Installation

7.3.1 Plugs, Installation

(1) With inching lever mounting portion faced upward, hold the control valve body in a vise.

Note: When holding in a vise, use aluminum plates to prevent direct contact with the vise.

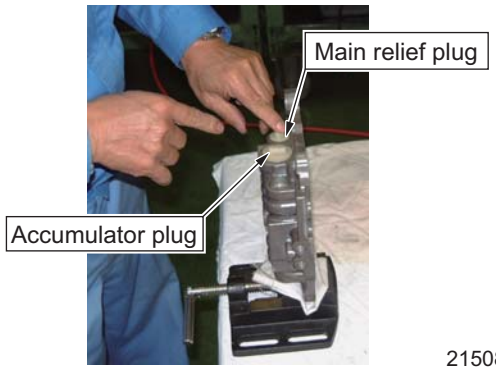
(2) Install O-ring to both main relief plug and accumulator plug, and apply grease to the circumference of O-rings, and install main relief plug and accumulator plug.

Note: 1. Do not reuse resin plugs and O-rings. Make sure to use new ones.

2. Grease should be applied in thin coats.

(3) Install snap ring to main relief plug and accumulator plug respectively.

Part name	Part number	Quantity
Snap ring (Main relief plug)	F3202-02200	1
Snap ring (Accumulator plug)	F3202-03200	1



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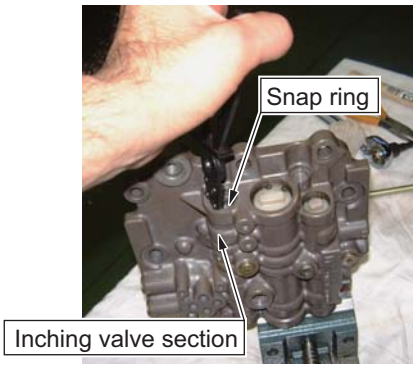
215081

7.3.2 Oil seal, Installation

(1) Install snap ring to inching valve section.



215082

(2) Using special tool (installer, 91A68-02800), install oil seal to inching valve section.

Part name	Part number
Installer	91A68-02800

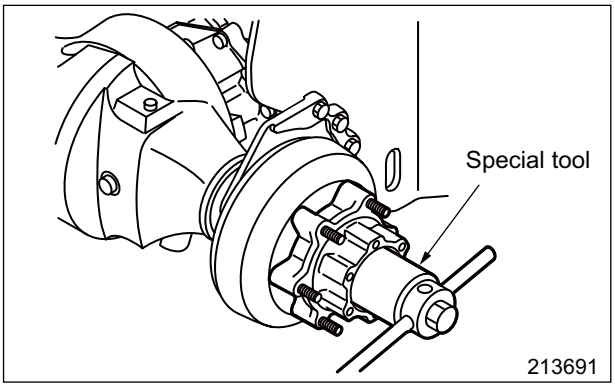
215083

Suggestions for Disassembly

(1) Use the lock nut wrench (special tool) to loosen the lock nut.

Special tool needed

1 ton class	91A67-00300
2 ton and 3 ton classes	03703-59001

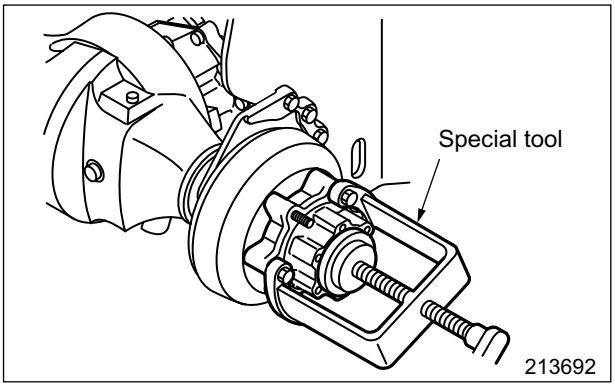


(2) Removing front wheel hub
Use the wheel hub puller (special tool).

Special tool needed

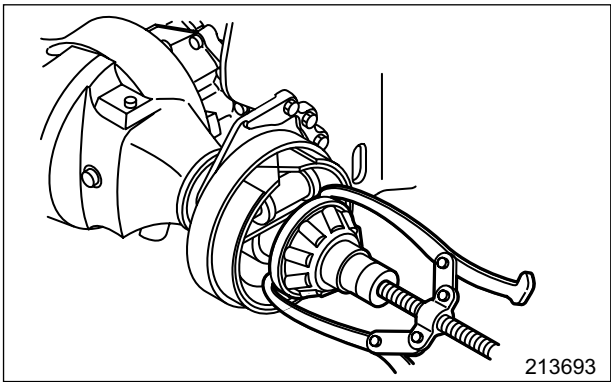
1 ton class	64309-40100 (64309-10601)
2 ton and 3 ton classes	MH061017

Note: It is not necessary to remove the oil seal from the hub unless the seal is defective.



(3) Removing bearing
The inner race of the tapered roller bearing remains in the axle housing when the hub is drawn out. Remove this race together with the seal retainer with a bearing puller.

Note: Trucks of 1 ton class do not have the seal retainer.



2.3.2 Installation

Install in the following sequence.

(1) Turn the projection (a) on the steering wheel angle sensor of the combination switch by hand to orient the same direction as shown in the illustration.

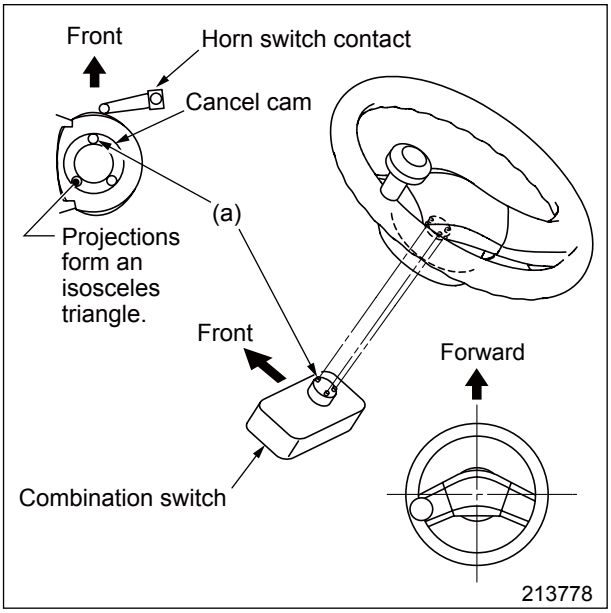
(2) Apply a thin coat of grease to the sliding area of the horn contact underneath the steering wheel boss.

(3) Orient the steering wheel to the forward driving position. Install the steering wheel so that its concave point fits the projection of the combination switch. Rotate the steering wheel to both directions several times to make sure the complete fit.

(4) Before tightening the steering wheel nut, make sure that the automatic return of the combination switch functions properly.

(5) If automatic return does not function, repeat the step (3) and (4).

(6) Tighten the steering wheel nut to the specified torque.



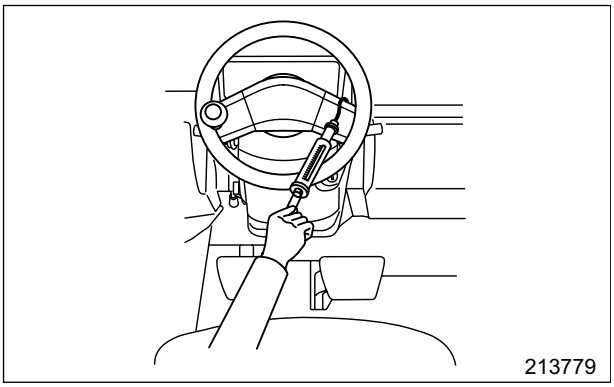
Inspection after Installation

Steering effort

(1) Pull the hand brake lever.

(2) Run the engine to warm the hydraulic oil temperature up to between 40 and 60 °C (104 and 140 °F).

(3) Attach a spring scale to the rim (or a spoke) of the steering wheel, and measure the steering effort required to turn the steering wheel clockwise or counterclockwise from the straight-ahead position. Steering effort should be the value specified below or lower.



Unit: N (kgf) [lbf]

Steering effort (at steering wheel rim)	13 (1.3) [2.92]

2.4 Steering Valve

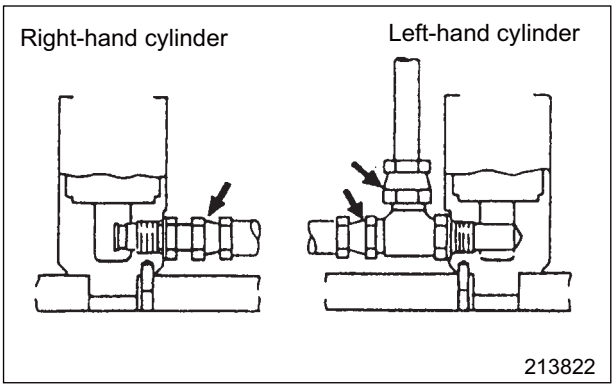
2.4.1 Removal

(1) Remove the cover 4 around the steering column.

(2) Disconnect four hoses from the steering valve.

(3) Remove the bolt 5 and then, remove the steering valve 6.

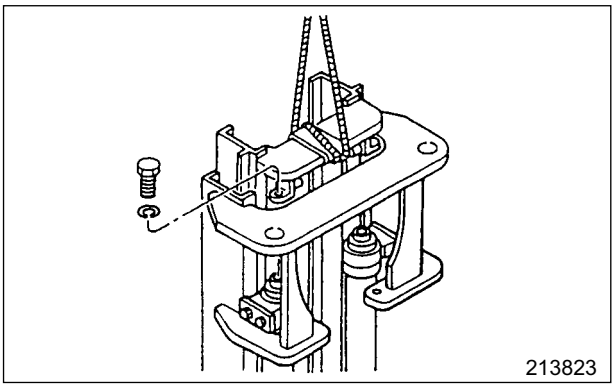
(3) Disconnecting high-pressure hoses
Disconnect the high-pressure hoses at the joints indicated by arrows. Use a drip pan to catch oil flowing out of the hoses.



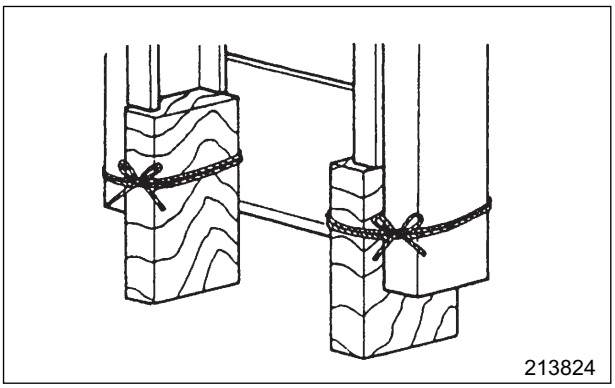
(4) Removing set bolts

(a) Remove the set bolt at the top of each lift cylinder. Lift the inner mast to separate the cylinder rod ends. To lift the inner mast, hitch a sling around the mast with protective rag.

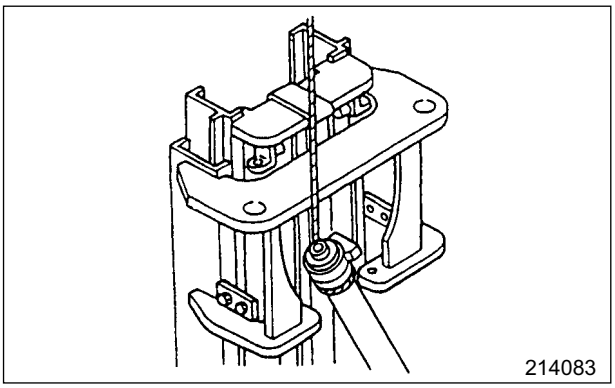
Note: The rod end of either lift cylinder is shim adjusted to eliminate the difference in stroke between the cylinders. Before removing the set bolts, make a record of the amount of shims fitted to each cylinder.

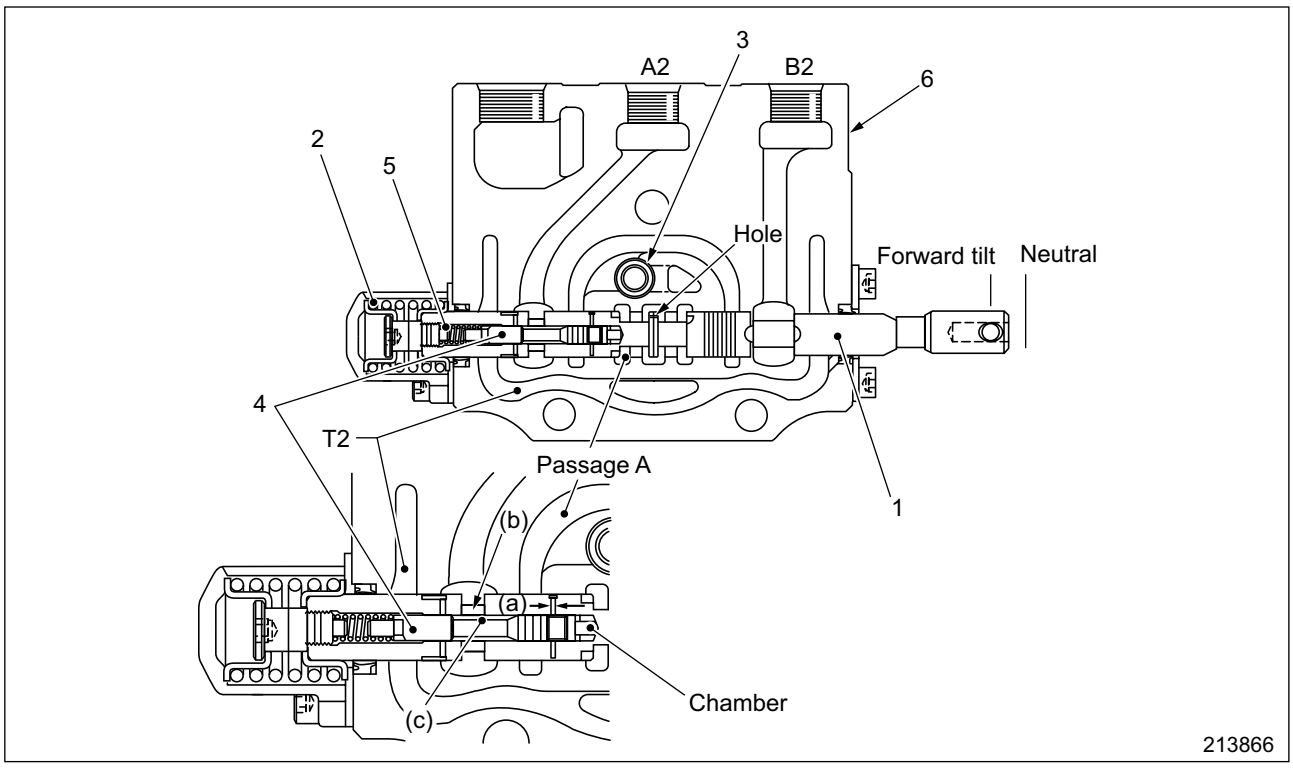


(b) Tie wood blocks under the inner mast and detach the sling. Use blocks strong enough to support the mast.



(5) Removing lift cylinders
Attach a lifting sling before removing the cylinder clamp and mounting bolt. Lift the cylinder from the rear side of the mast, and remove the cylinder.





Mast forward tilt position

The above illustration shows the tilt control valve when spool 1 is at the "forward tilt position."

Spool 1 is pushed into body 6. Then, the B2 port is connected to passage A.

At the same time the center bypass port is blocked. This blockage, however, is not complete because there is a hole under the land. This is designed to prevent abrupt movement of the cylinder, a characteristic of this valve.

As the center bypass port is blocked, pressure in the parallel feeder rises, pushing open check valve 3 and pressure oil flows to passage A.

Oil in passage A flows to the tilt cylinder head from the B2 port and acts to push out the cylinder rod.

At the same time, pressure oil in passage A flows to the chamber on the right end of tilt lock valve 4 via orifice (a) and pushes the tilt lock to the left against spring 5.

Then, return oil from the A2 port flows to the hole (b), passage (c), orifice (d) and passage T2.

The tilt cylinder tilts forward due to pressure oil supplied from the B2 port and "opening" of the return passage of the A2 port.

Tilt lock valve 4 does not operate unless the engine runs and pressure oil is supplied from the pump.

This valve is a kind of a safety valve.

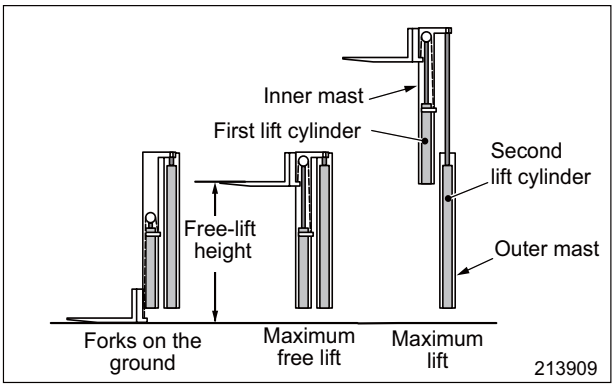
10.2 Mast Operation

10.2.1 Operation of Duplex Mast

The first lift cylinder extends, bringing the forks to the maximum free-lift height.

When the first lift cylinder rod has reached the end of the stroke, the second lift cylinders take over to directly lift the inner mast to the maximum lift height.

Reverse the lifting sequence to activate the lowering mechanism.



19.1.2 Triplex Mast Installation

To install, follow the removal sequence in reverse. Also follow the instructions given below.

(1) Mast Support

(a) Apply grease to the inner surfaces of caps and mast support bushings.

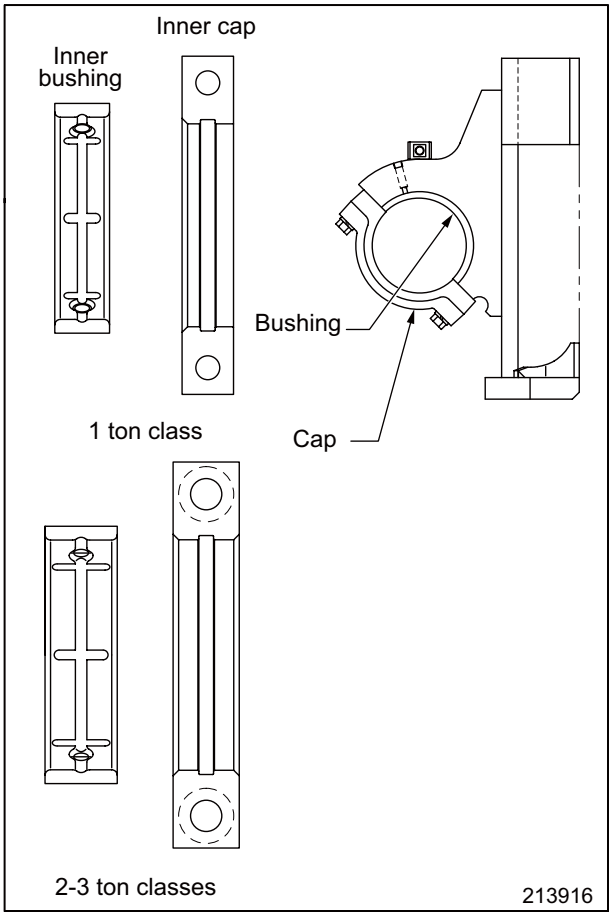
(b) 1 ton class:
When installing caps, make sure the wider chamfered side faces toward the center of the chassis.

(c) 2, 3 ton classes:
Chamfering is the same both in the right and left sides. Be sure to reassemble in the same position as it was.

(d) In order to easily grease, place wood blocks underneath the mast. By doing so, it is easily greased.

(2) Adjusting chain tension
Refer to the "22.2 Chain Tension Inspection and Adjustment."

(3) Bleeding lift cylinders
Start the engine, raise and lower the lift bracket with several strokes to bleed the cylinder.
After proper operation is confirmed, check the oil level in the hydraulic tank.



2. Maintenance Note

2.1 Brake System

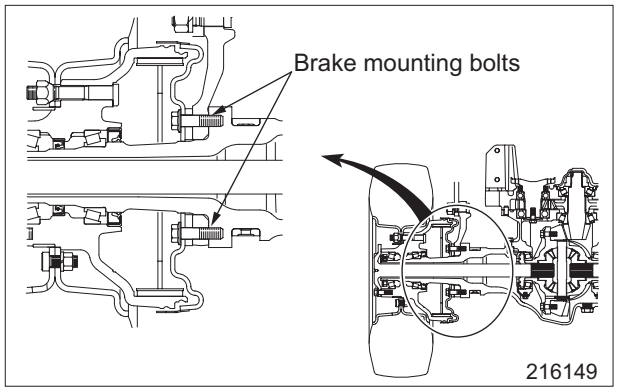
⚠ CAUTION

- Be sure to conduct maintenance work on level and hard ground.
- Stop the engine, and remove the starter key.
- Make sure that sufficient space is available for the lift truck to move around and that no one or no obstacle is around the lift truck.

(1) Check brake drum bolts.

Service Hours	Every 3 months (500 hrs)

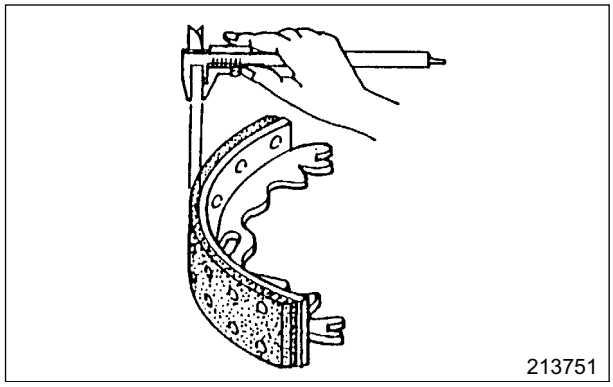
- Check the threads for damage or burrs.



(2) Check brake drum and shoes.

Service Hours	Every 3 months (500 hrs)

- Check the drum inner surface for uneven wear or scratches.
- Check shoes and lining for cracks or damage.
- If oil contamination or deformation is found, replace the brake lining with a new one.
- Measure the brake lining thickness. If the lining thickness exceeds a service limit, replace the lining with a new one.



Unit: mm (in.)

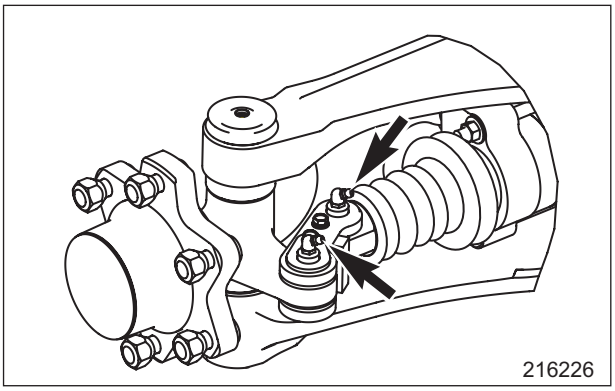
Items		Weight class	
		1 ton class	2 ton class 3 ton class
Thickness of linings	A	4.87 (0.19)	5.7 (0.22)
	B	1.0 (0.04)	

Note: Refer to Chapter 11 BRAKE SYSTEM, 2.2 Wheel Brakes for details.

(8) Lubricate tie rod pins.

Service hours	1st Month (200 hrs) only
	Every 3 months (500 hrs)

♦Lubricate the right and left tie rods.

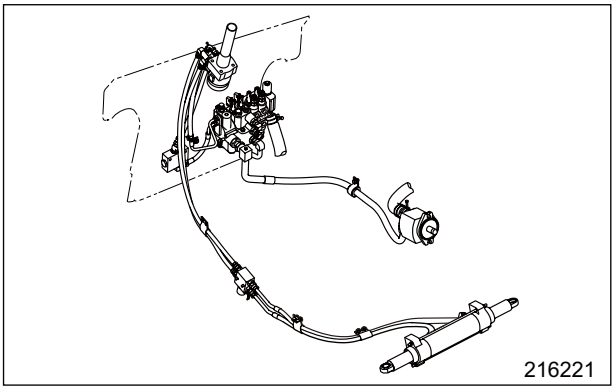


(9) Change power steering cylinder hoses and rubber parts.

Service hours	Change in every 2 years

♦Replace the power steering hydraulic hose with a new one.

♦Replace rubber parts such as seals and packings with new ones when the steering valve or steering cylinder is disassembled.

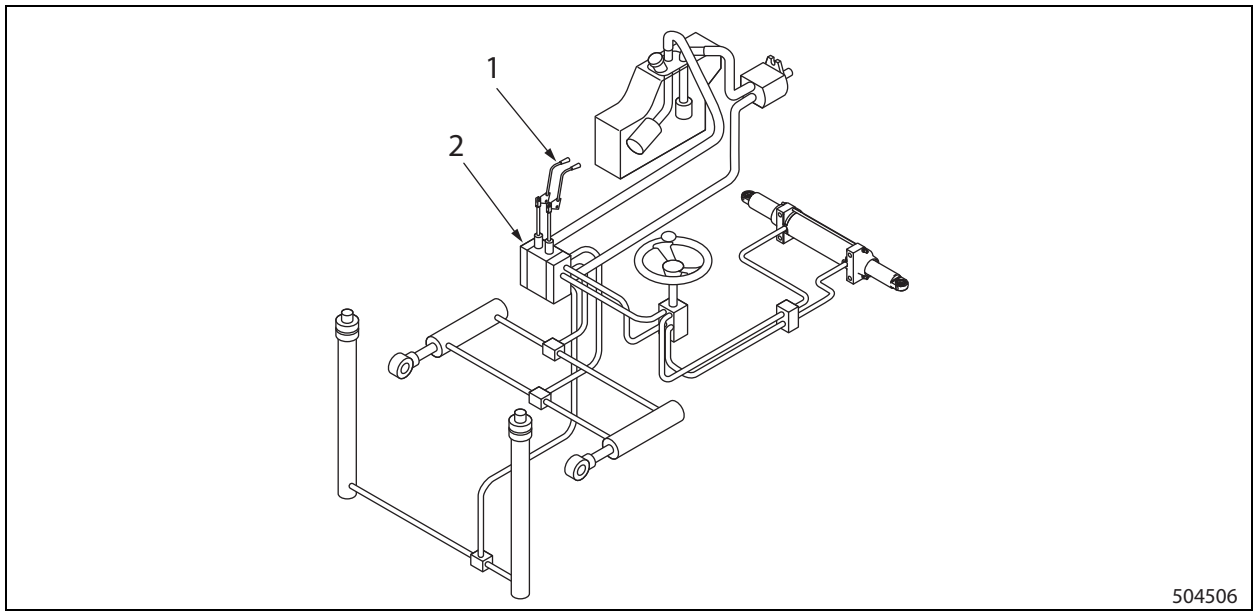


2. HOW TO USE THIS MANUAL

2.1 Truck Models

MC (Mechanical Control System) model

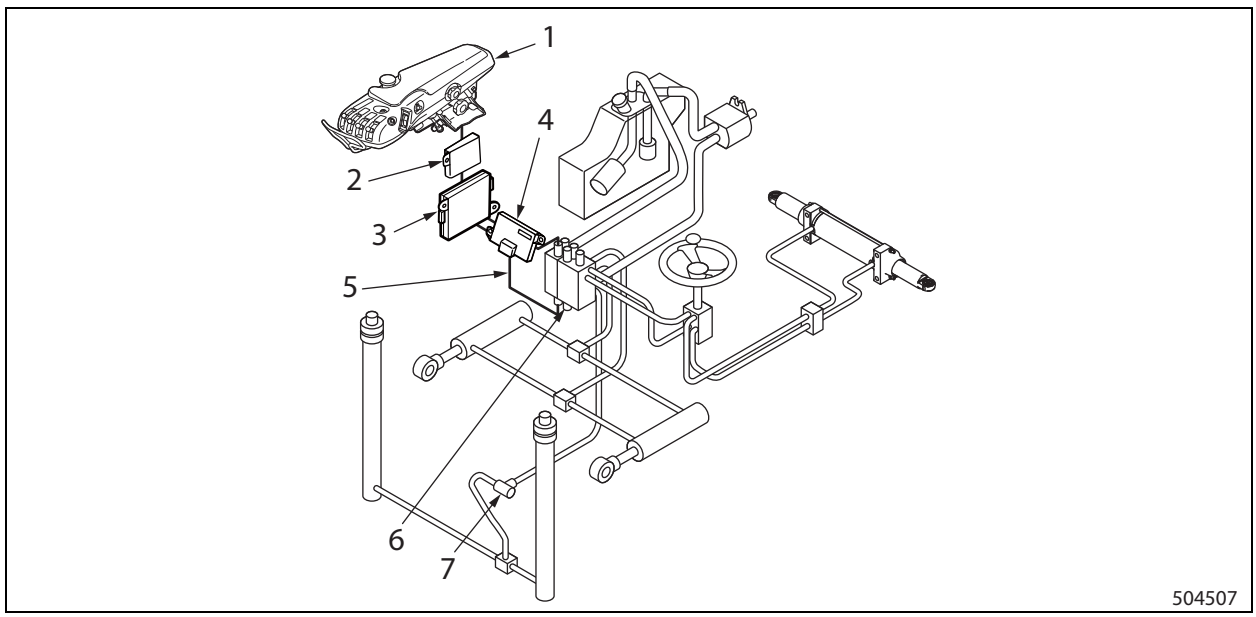
The truck equipped with mechanically controlled hydraulic system (conventional lever system)



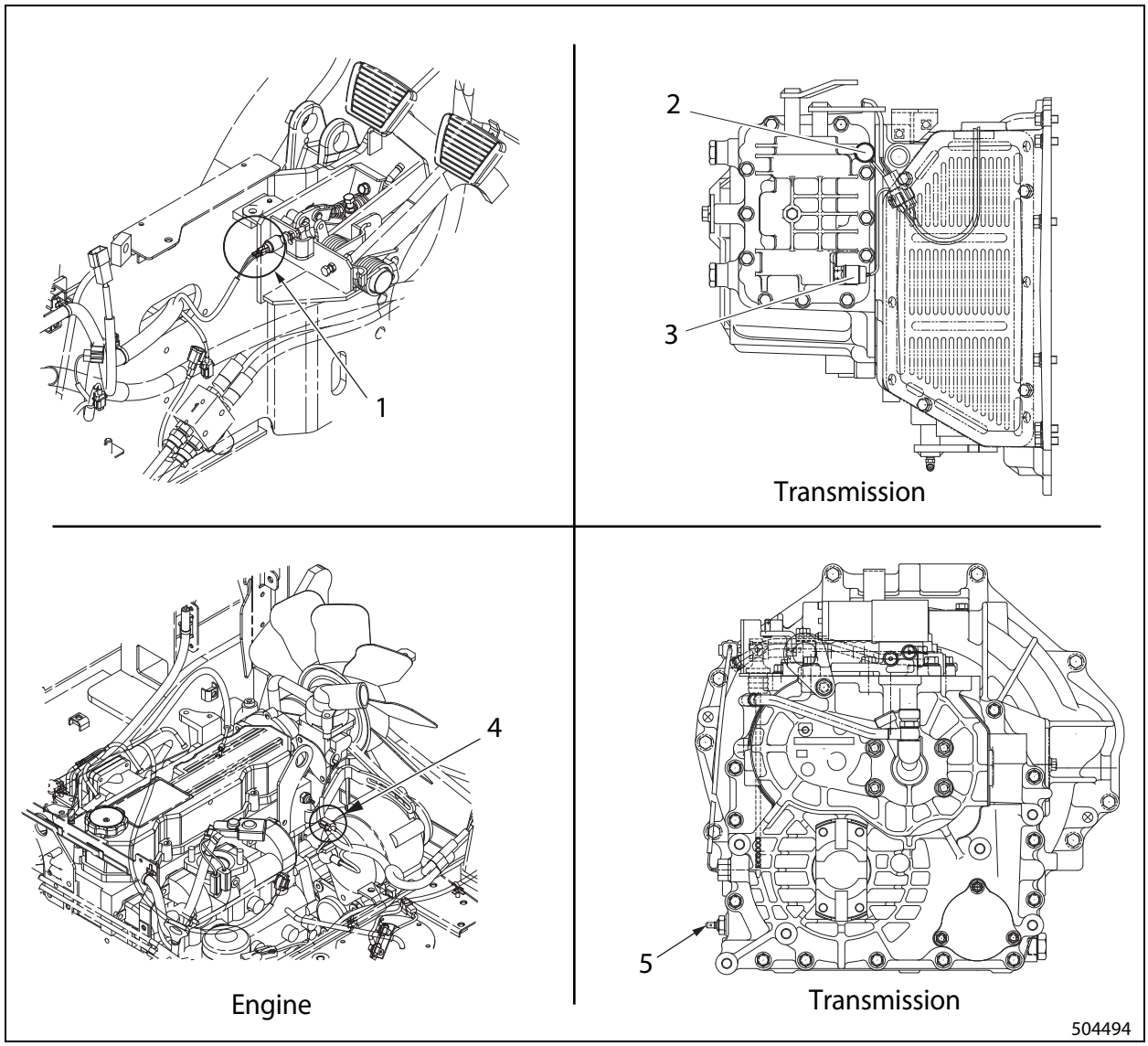
1. Implement lever
2. Control valve

FC (Fingertip Control System) model

The truck equipped with electronically controlled hydraulic system (fingertip control system)



1. FC lever box
2. Input unit
3. VCM Controller
4. Output unit
5. Electric wiring
6. Electromagnetic control valve
7. Flow regulator valve



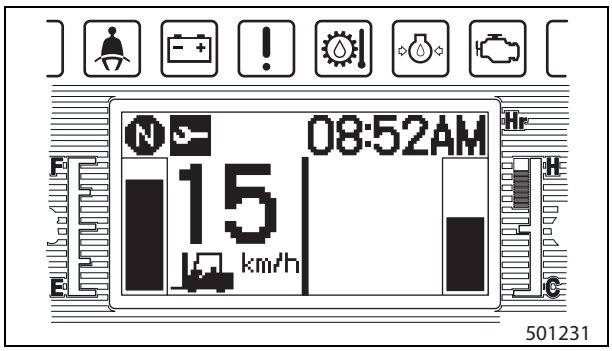
1. Stop light switch
2. Neutral switch (Manual T/M truck)
3. Backup light switch (Manual T/M truck)
4. Thermoswitch (Engine cooling water temperature)
5. Thermoswitch (T/C Oil)

Password authentication screen
(Select this option to display)

The truck operation is available by inputting registered password.

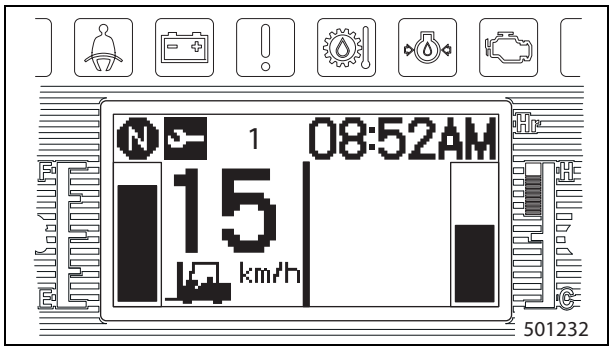
Standard screen display

The screen that shows the status of truck will appear.



Speed meter display

This display will show real-time truck speed.

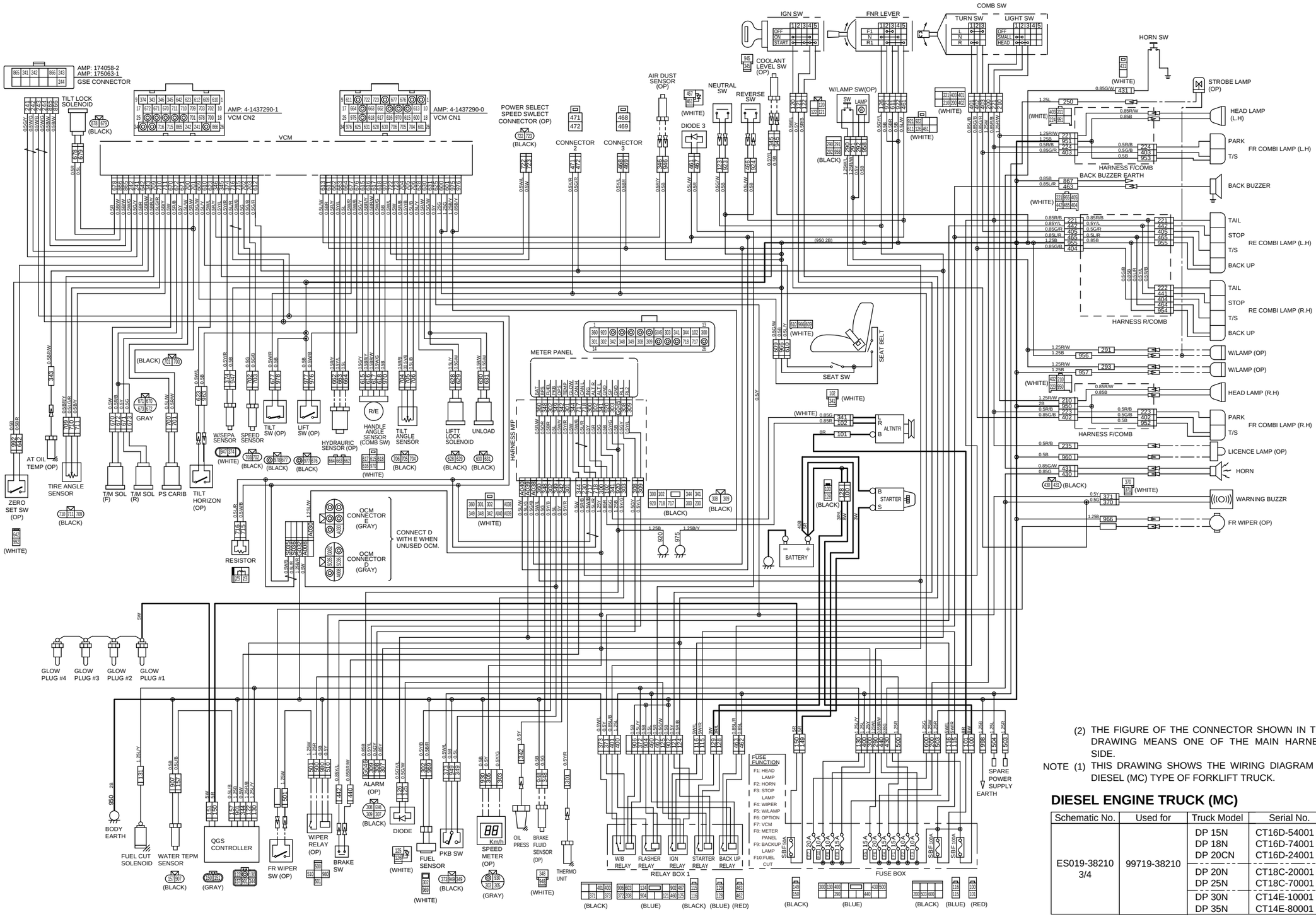


1. Speed meter display

Actual speed	Display
0.1 to 1.0 km/h (0.06 to 0.62 mph)	1 km/h (0.6 mph)
1.1 to 2.0 km/h (0.68 to 1.24 mph)	2 km/h (1.2 mph)
. . . . 19.1 to 20.0 km/h (11.84 to 12.40 mph)	. . . . 20 km/h (12.4 mph)

A rounded up speed meter reading will be displayed.

Electrical Schematic (3/4)



(2) THE FIGURE OF THE CONNECTOR SHOWN IN THIS DRAWING MEANS ONE OF THE MAIN HARNESS SIDE.

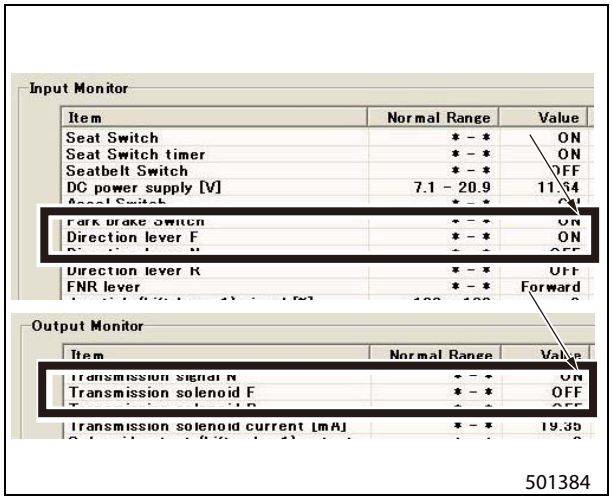
NOTE (1) THIS DRAWING SHOWS THE WIRING DIAGRAM OF DIESEL (MC) TYPE OF FORKLIFT TRUCK.

DIESEL ENGINE TRUCK (MC)

Schematic No.	Used for	Truck Model	Serial No.
ES019-38210 3/4	99719-38210	DP 15N	CT16D-54001 up
		DP 18N	CT16D-74001 up
		DP 20CN	CT16D-24001 up
		DP 20N	CT18C-20001 up
		DP 25N	CT18C-70001 up
		DP 30N	CT14E-10001 up
		DP 35N	CT14E-80001 up

Pub. No. 99719-38210

(9) When the driving interlock is activated, T/M control valve (F) output is not turned on even if the status of the direction lever (F) input is ON.



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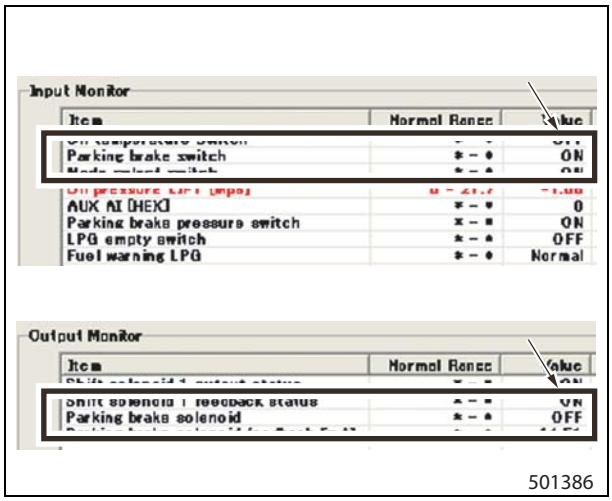
(10) When the driving interlock is activated, make sure that the parking brake solenoid is OFF even if the parking brake switch is ON.



501386

(11) To unlock the interlock, sit on the operator seat and return the direction lever to the NEUTRAL position. At this time, make sure that the driving interlock indicator light (N) changes from blinking to a steady glow.

If Seat switch is not turned on

Check the seat switch operation and wiring connections by referring to 4-38 "Harness Codes", 4-40 "VCM-1M Controller", and 4-44 "Seat Switch".

When T/M forward/backward solenoid warning occurs

Check the solenoid output by referring to 4-31 "Active Test Inspection Procedure". If the solenoid output will not turn ON even after the active test inspection, refer to the 4-51 "Truck Status Display and Troubleshooting". Check for the possible causes of the diagnostic code F-85, F-87 and F-89.

When a speed or speed sensor warning occurs

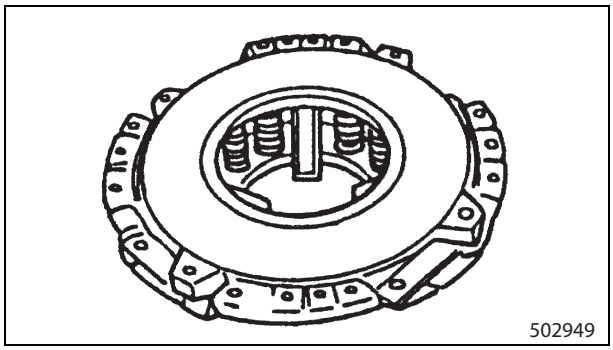
Refer to 4-51 "Truck Status Display and Troubleshooting" and check for the possible causes of the diagnostic code F-17 and F-34.

Diagnostic code	Diagnostic code name	Probable cause	Check items
F-38	Tilt angle sensor warning	1. Connector contact bad	1. Link connection and damage check
			2. Connector connection check
		2. Harness bad	3. Harness connection check
		3. Tilt angle sensor bad	4. Sensor connection check
		4. Controller bad	
F-40	Steering warning	1. Connector contact bad	1. Connector connection check
		2. Harness bad	2. Harness connection check
		3. Wheel angle sensor bad	3. Sensor connection check
		4. Controller bad	
F-73	Hour meter gap warning	1. Hour meter time difference between VCM and M/P.	1. Connect service tool and update #252 M/P hour meter.
F-75	Unload solenoid warning	1. Connector contact bad	1. Connector connection check
		2. Diode bad	2. Diode connection check
		3. Harness bad	3. Harness connection check
		4. Unload solenoid bad	4. Unload solenoid connection check
		5. Controller bad	
F-77	Lift lock solenoid warning	1. Connector contact bad	1. Connector connection check
		2. Diode bad	2. Diode connection check
		3. Harness bad	3. Harness connection check
		4. Lift lock solenoid bad	4. Lift lock solenoid connection check
		5. Controller bad	
F-79	Unload solenoid leak	1. Connector contact bad	1. Connector connection check
		2. Diode bad	2. Diode connection check
		3. Harness bad	3. Harness connection check
		4. Unload solenoid bad	4. Unload solenoid connection check
		5. Controller bad	
F-80	Power steering correction valve solenoid warning	1. Connector contact bad	1. Connector connection check
		2. Diode bad	2. Diode connection check
		3. Harness bad	3. Harness connection check
		4. Power steering correction valve solenoid bad	4. Power steering correction valve solenoid connection check
		5. Controller bad	

3. Clutch Assembly, Inspection and Repair After Disassembly

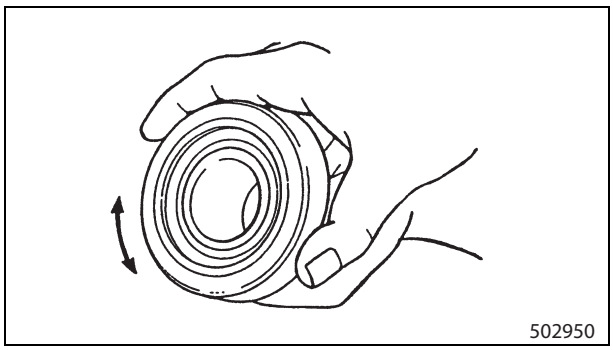
Pressure plate assembly

- Check the friction surface of the pressure plate for burns and striations.
- Check the friction surface of the pressure plate for distortion.



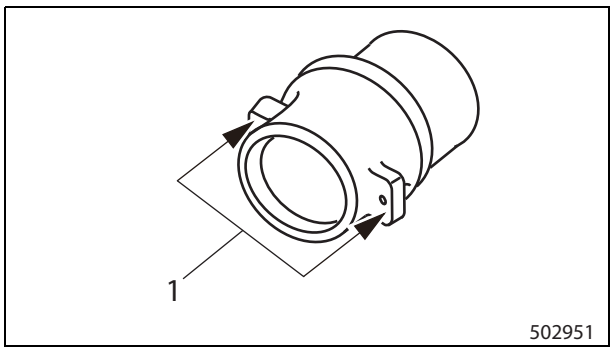
Release bearing

- Check the release bearing for smoothness of rotation with the bearing mounted on the clutch shifter.
- Replace the bearing if it spins rough, makes abnormal noises or its end face in contact with the release levers is badly worn.



Shifter

Check the fork groove for wear. Ensure the shifter slides smoothly without any sign of binding.



1. Clutch fork groove

Input shaft

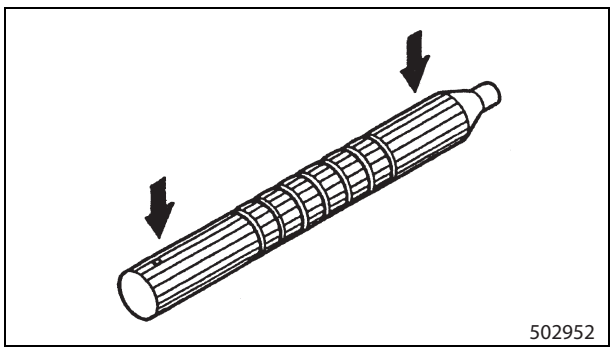
- Check for ridged splines.

Flywheel and pilot bearing

- Check the friction surface of the flywheel for burns and striations.
- Check the pilot bearing for wear.

Other parts

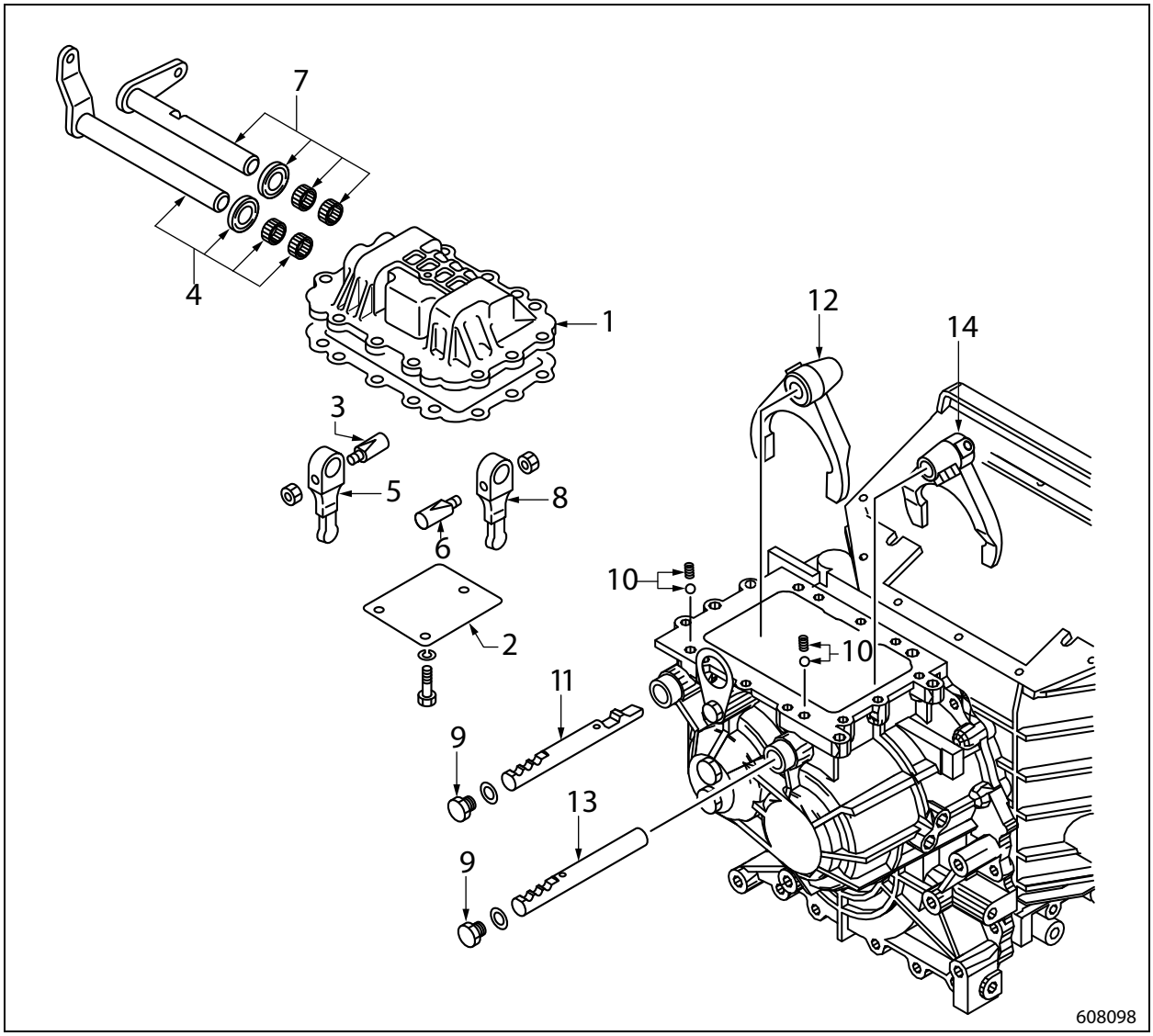
- Check the clutch fork and clutch shifter shaft for bend and/or runout.
- Check the needle roller bearing for damage.



Item	Specified value	
Release fork, clutch shifter shaft runout	Standard	0.05 mm (0.0020 in.)
	Limit	0.1 mm (0.004 in.)

5. Control Covers, Shift Rails and Forks, Disassembly

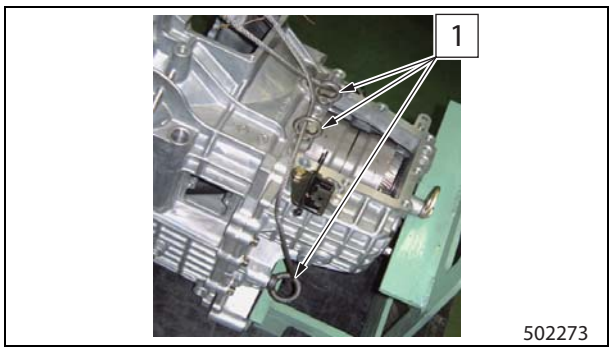
5.1 Disassembly Sequence



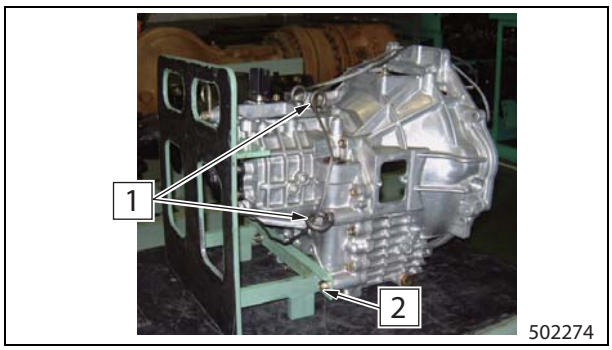
1. Control cover
2. Control cover plate, Bolts, Washers
3. Lock pin, Nut
4. Control lever, Needle roller bearing, Oil Seal
5. Fork lever
6. Lock pin, Nut
7. Control lever, Needle roller bearing, Oil Seal
8. Fork lever
9. Plug, Gasket
10. Spring and Steel ball
11. Shift Rail (F-R)
12. Shift fork (F-R)
13. Shift rail (H-L)
14. Shift fork (H-L)

Torque converter assembly, Removing

(1) Install eye bolts.

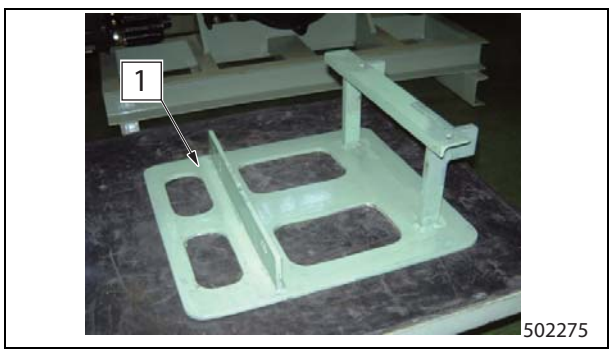


1. Eye bolt

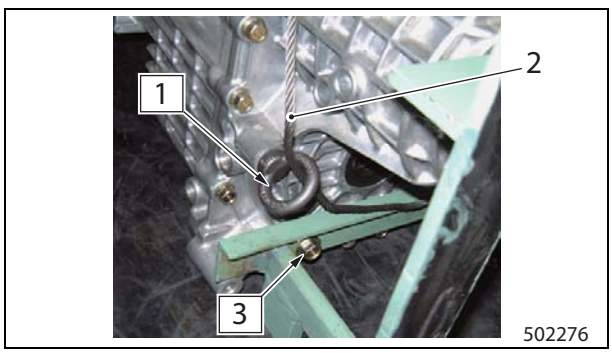


1. Eye bolt
2. Bolt

(2) Insert a wire through eye bolts. Lift the transmission and mount on the stand kit (special tool) with 2 bolts.



1. Special tool (stand kit)



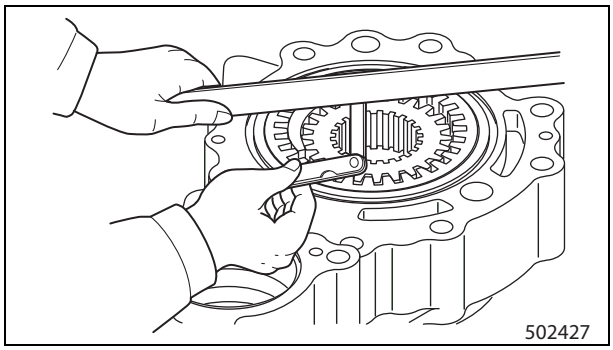
1. Eye bolt
2. Wire
3. Bolt

Special tool	Part number
Stand kit	91A68-00020

(4) Measure the clearance between pump drive gear and crescent-shaped part

Item	Specified value	
Clearance between pump drive gear and crescent-shaped part	Standard	0.04 to 0.10 mm (0.0016 to 0.0039 in.)
	Limit	0.15 mm (0.0059 in.)

(5) Measure the clearance between gear pump case mounting surface and gear.

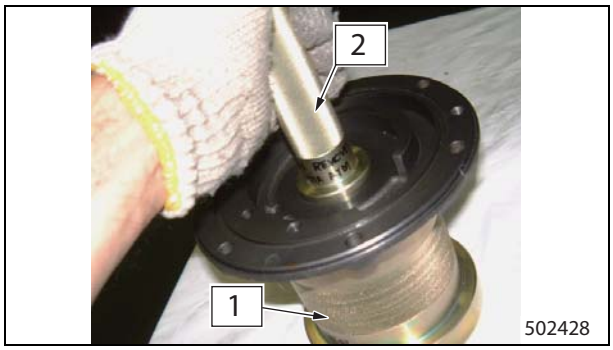


Item	Specified value	
Clearance between gear pump case mounting surface and gear	Standard	0.04 to 0.08 mm (0.0016 to 0.0031 in.)
	Limit	0.15 mm (0.0059 in.)

Bushing, Installing

Note: In general, replace the oil pump assembly if the bushing is badly damaged or worn.
When bushing has been replaced, finish the inner bore of bushing as shown on the drawing on the next page.
Failure to do so could result in serious damage of the oil pump assembly and transmission.

(1) Remove internal gear and drive gear from pump body and place the pump body on the stand (special tool).
(2) Install bushing using installer (special tool).



1. Special tool (Stand) 2. Special tool (Installer)

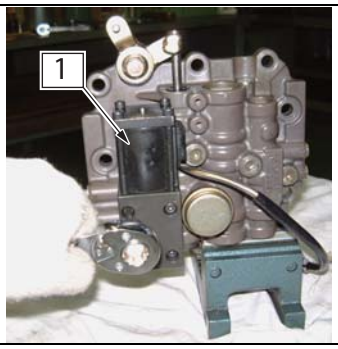
Special tool	Part number
Stand	91A68-01700
Installer	91A68-01600

(3) Finish the bore of bushing.

Solenoid valve, Installing

Install solenoid valve together with O-ring by tightening to the specified torque.

Note: Do not reuse solenoid valve mounting bolts and O-rings. Always install new ones.

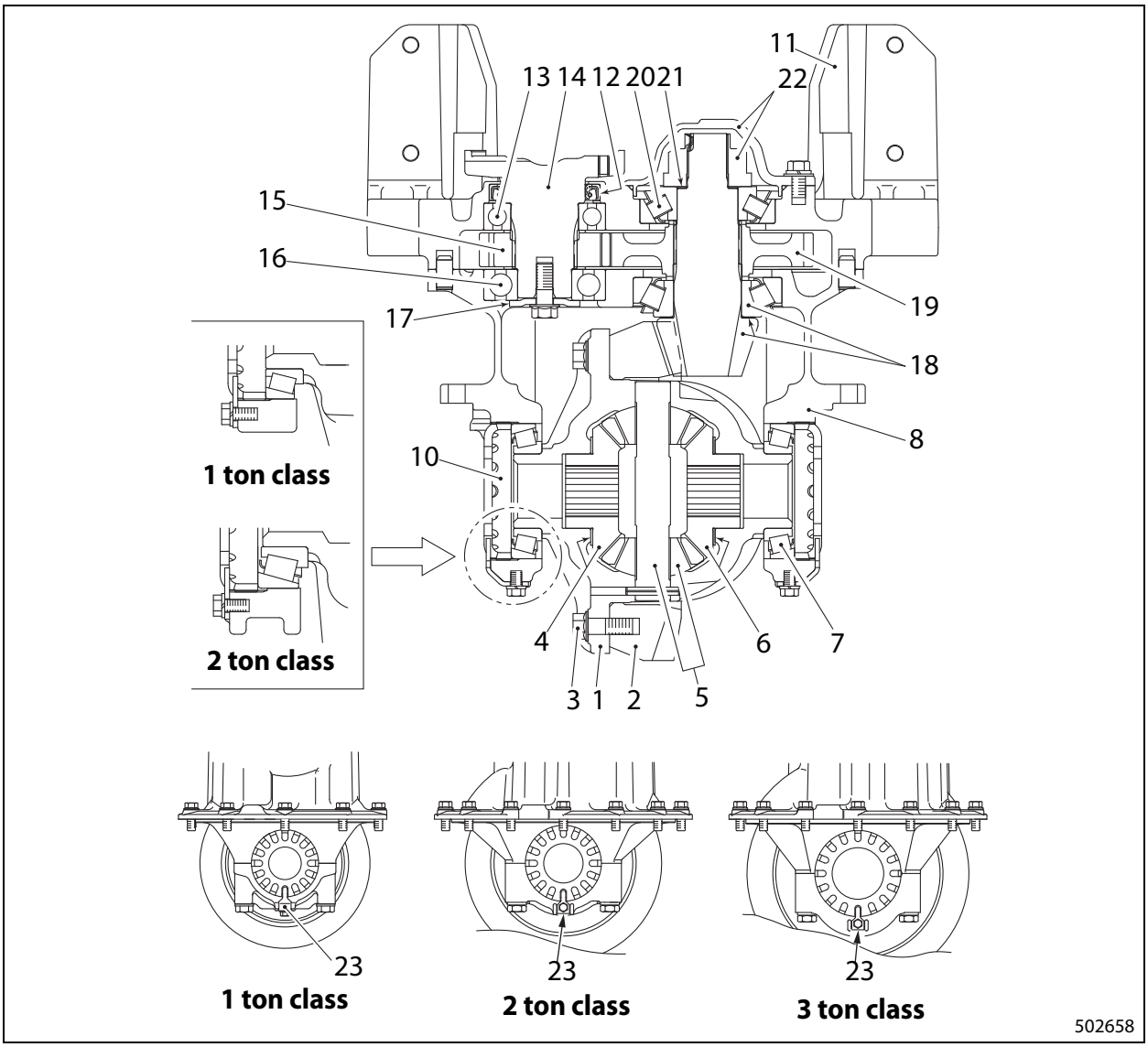


1. Solenoid valve

Ref.	Tightening torque
1	6 to 8 N·m (0.6 to 0.8 kgf·m) [4.43 to 5.90 lbf·ft]

12. Reduction Differential, Assembling

12.1 Assembly Sequence



1. Differential case
2. Reduction gear
3. Bolt
4. Differential gear, Thrust washer
5. Differential pinion, Pinion thrust, Washer (except 1 ton class) Differential shaft, Spring pin
6. Differential gear, Thrust washer
7. Tapered roller bearing
8. Differential carrier
9. Bearing cap
10. Adjusting screw
11. Carrier cover
12. Oil seal
13. Ball bearing
14. Input flange
15. Drive gear
16. Ball bearing
17. Plate
18. Reduction pinion, Shims, Tapered roller bearing (inner race)
19. Driven gear
20. Tapered roller bearing
21. Shim
22. Locknut, O-ring, Cover
23. Lockplate

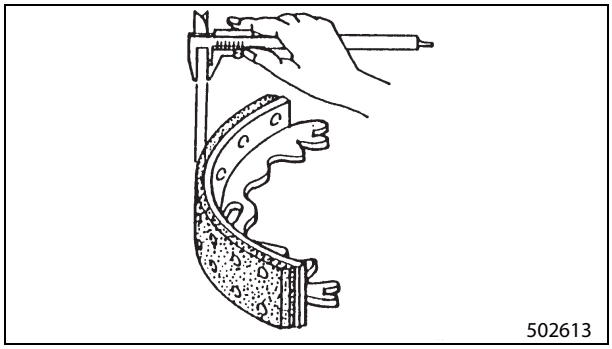
7. Wheel Brakes, Inspection and Repair After Disassembly

Backing plate

Inspect backing plates for cracks.

Shoe and lining assembly

- Inspect each shoe and lining for cracks.
- Replace the lining if it is heavily soiled with grease, burnt or deteriorated.
- Measure the lining thickness. If it exceeds the limit, replace.



Item		Specified value	
		1 ton class	2, 3 ton classes
Lining thickness	Standard	4.87 mm (0.1917 in.)	5.7 mm (0.224 in.)
	Limit	1.0 mm (0.039 in.)	1.0 mm (0.039 in.)

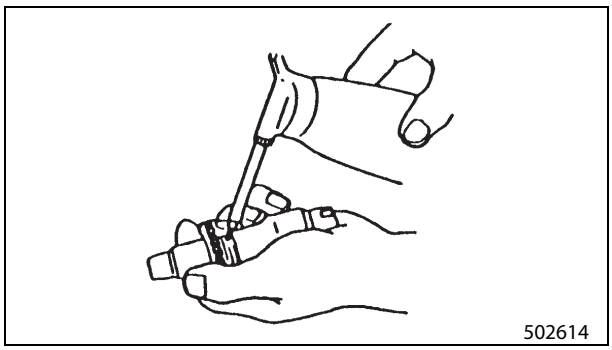
Brake drum

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.

Item		Specified value	
		1 ton class	2, 3 ton classes
Brake drum inside diameter	Standard	254 mm (10.00 in.)	310 mm (12.20 in.)
	Limit	256 mm (10.08 in.)	312 mm (12.28 in.)

Adjusting screw

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



Parking brake cable

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

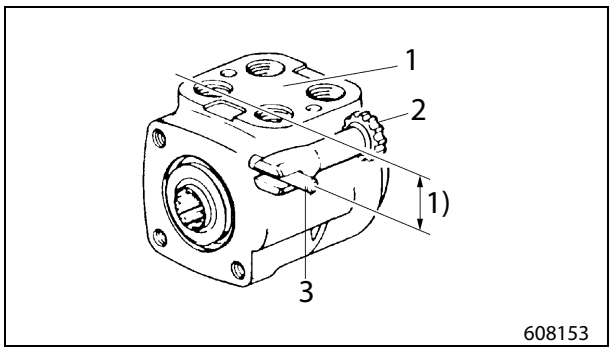
Inspecting other parts

- Inspect shoe return springs for cracks or settling.
- Inspect adjusting springs for cracks or settling.
- Inspect the cable with spring for stretching.

(7) Installing drive shaft:

Rotate the control spool and sleeve assembly to position the housing port face parallel with the pin.

Insert drive shaft, and engage the pin with the yoke of drive shaft. With a felt-tip pen, make a matchmark, like a line B shown in the figure in the step below, on the end face of drive shaft spline for proper positioning in the subsequent step.



1. Port face
2. Drive shaft
3. Pin

1) Pin should be parallel to port face.

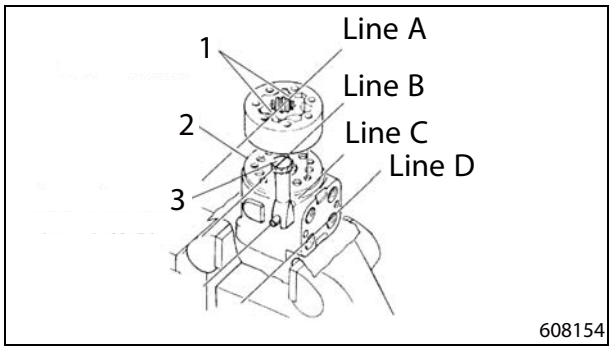
(8) Installing gerotor set:

Face the O-ring side of the rotor set toward the spacer plate side and fit the rotor set into the drive shaft by aligning the root (line A) of the rotor set with line B of the drive shaft.

Ensure that lines A, B, C, and D are in parallel with each other.

Keep the engagement of the drive shaft and gerotor rotor, and align the bolt holes of the gerotor set.

This procedure is important as it determines the valve timing of this unit.

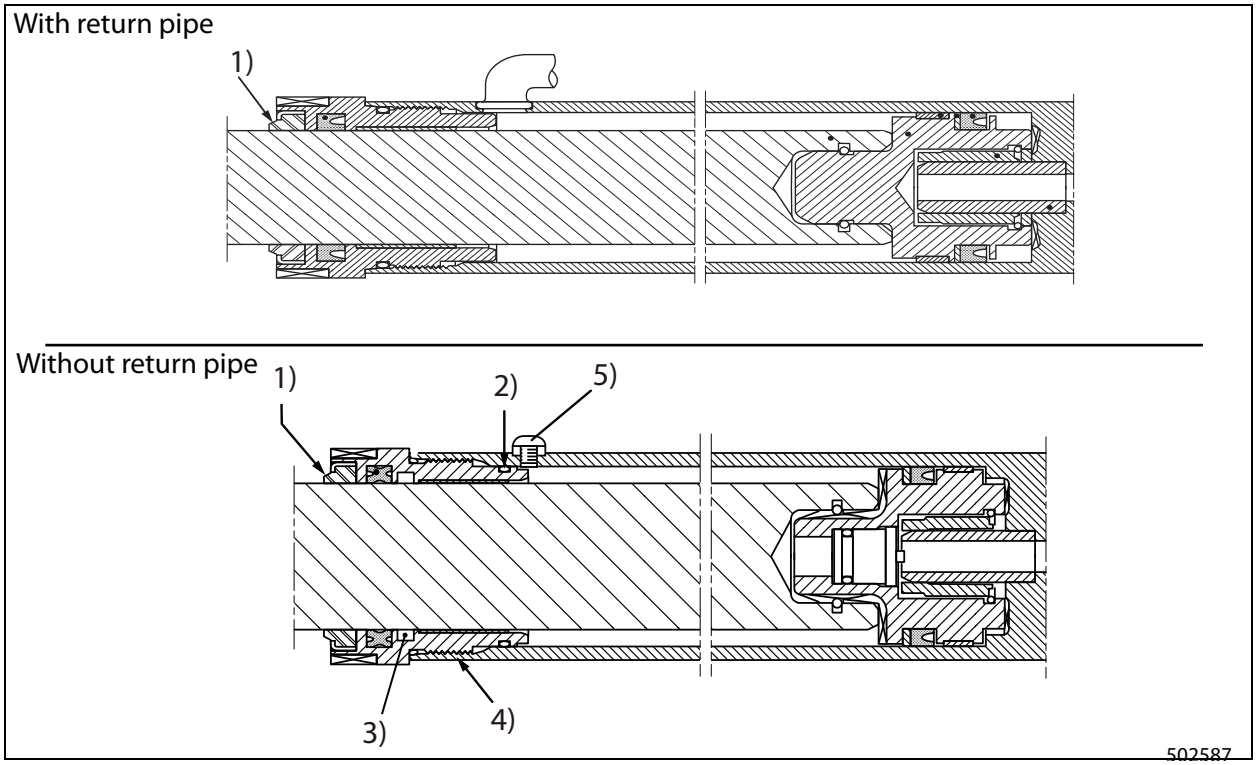


1. Gerotor set, star valley
2. Spacer plate
3. Drive shaft (with a mark)

16. Lift Cylinders, Assembling (Second Cylinder for Simplex Mast and Triplex Mast)

For assembly, follow the disassembly sequence in reverse.

16.1 Suggestions for Assembly



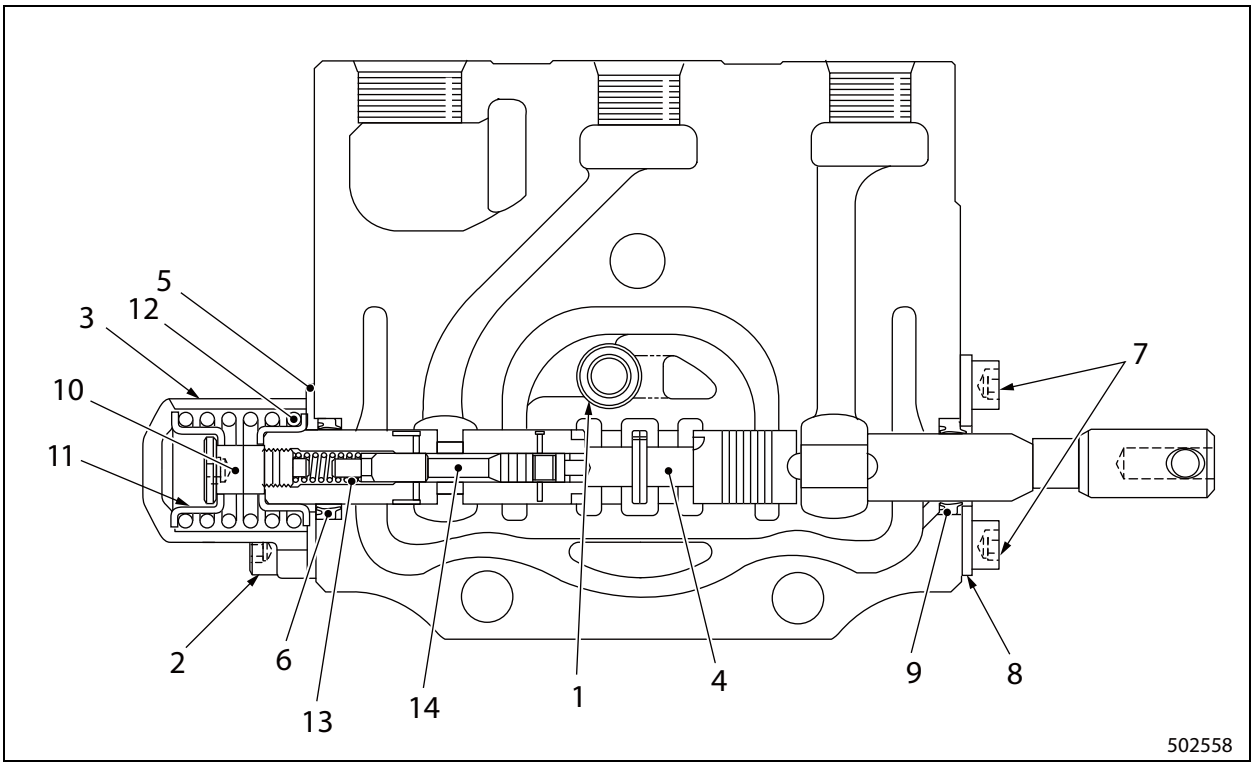
1) Apply liquid packing around the periphery when installing.
2) Apply grease to whole circumference when assembling.
3) Fill with grease (acceptable if adhering to bushing)
4) Apply ThreeBond 1901 when installing
5) 3.92 ± 0.98 N·m (0.400 ± 0.09 kgf·m) [2.8912 ± 0.72 lbf·ft] (M5 x 0.8)

- Clean parts that have been disassembled with a cleaning solvent. Blow off foreign materials such as dust with compressed air. Do not apply compressed air to rubber parts.
- Repair cylinder repair kits with new ones.
- Apply a clean coat of hydraulic oil to every sliding surface and sealing surface.
- Apply ThreeBond 1901 (anti-seize) to the threads of the cylinder head, and tighten the cylinder head to the specified torque with a hook wrench.

Item	Cylinder head tightening torque	Cylinder head thread size
1, 2 ton classes	196 ± 45.1 N·m (20.0 ± 4.59 kgf·m) [144.56 ± 33.26 lbf·ft]	M49 x 1.5
2.5 ton class	235 ± 53.9 N·m (24.0 ± 5.49 kgf·m) [173.33 ± 39.75 lbf·ft]	M54 x 1.5
3 ton class	275 ± 61.8 N·m (28.0 ± 6.30 kgf·m) [202.83 ± 45.58 lbf·ft]	M59 x 1.5
3.5 ton class	304 ± 70.6 N·m (31.0 ± 7.19 kgf·m) [224.22 ± 52.07 lbf·ft]	M64 x 1.5

37. Control Valve - Tilt Valve, Disassembling

37.1 Disassembly Sequence



1. Check valve, Spring
2. Bolt
3. Cap
4. Spool sub-assembly
5. Plate
6. Seal
7. Bolt
8. Plate
9. Seal
10. Cap screw
11. Spring retainer
12. Spring
13. Spring
14. Tilt lock valve

Note: Spool sub-assembly components: Parts 10 thru 14

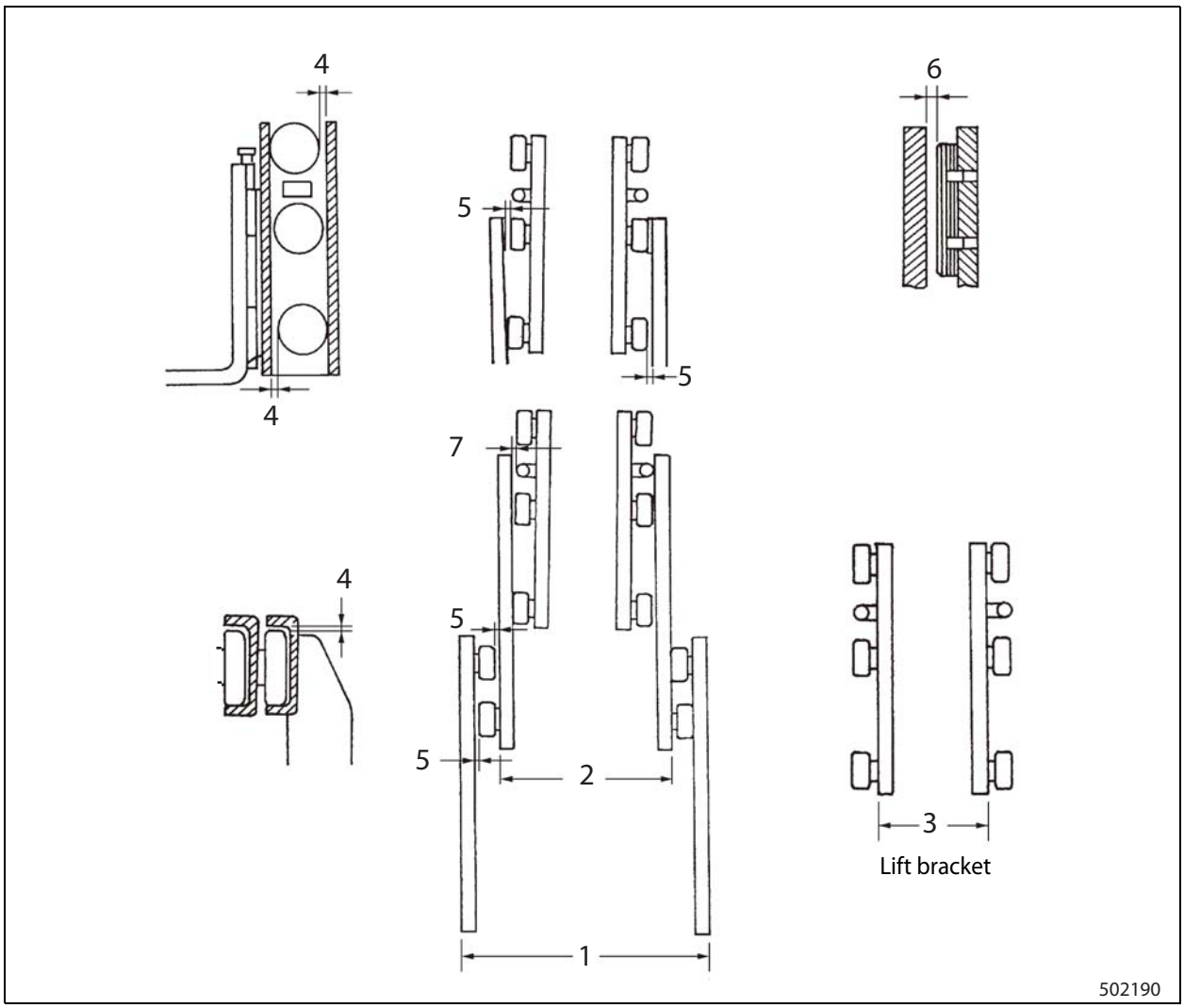
37.2 Suggestions for Disassembly

(1) Remove spool 4 from the body without removing spring 12 and cap screw 10.

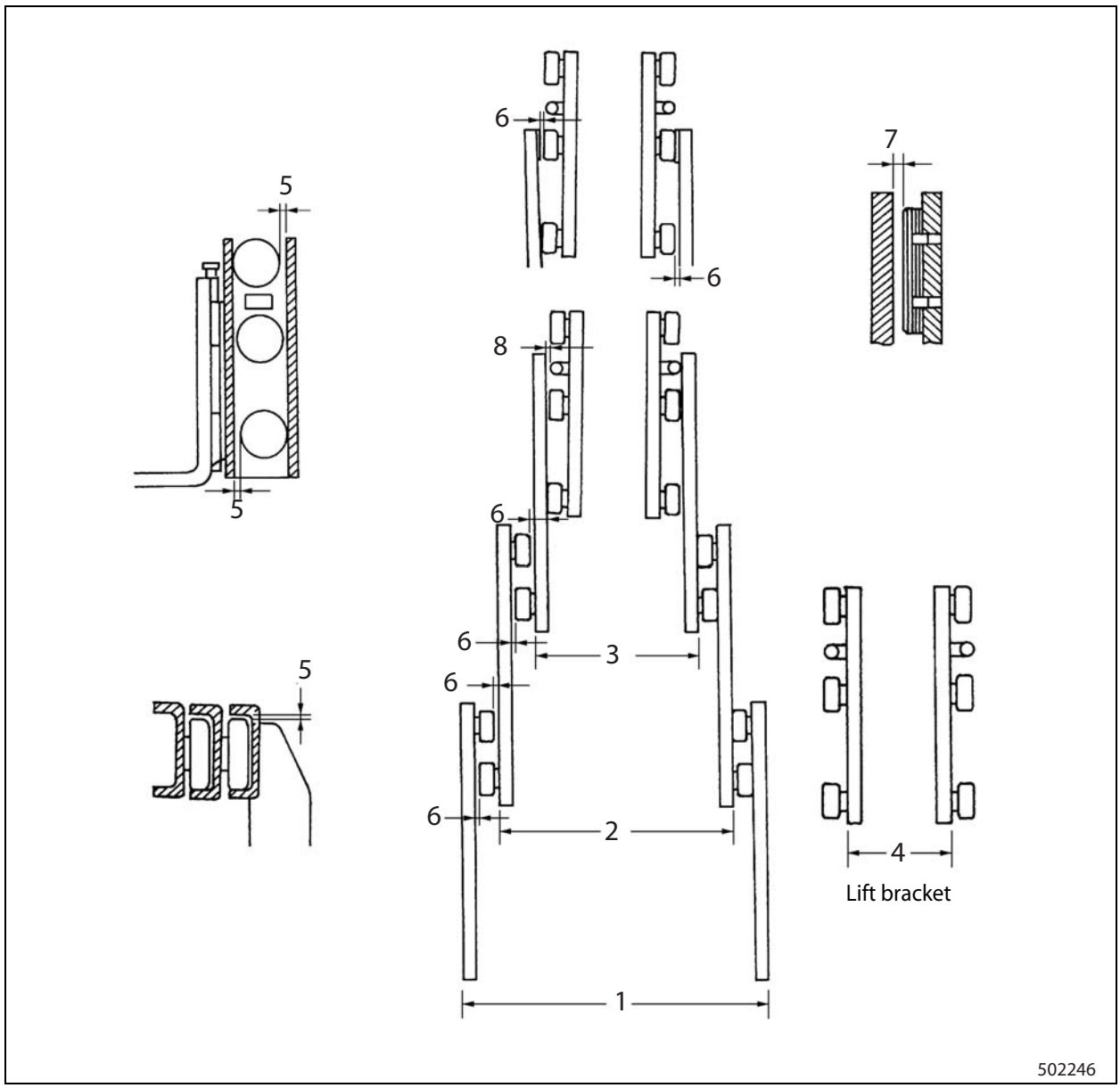
(2) When removing cap screw 10, hold the spool in a vise with soft jaws (hard wooden plate or plastic plate) and remove the cap screw using a hexagon wrench. Be careful because the spring may jump out. Also remove the tilt lock valve.

1.27 Service Data

Item				Specified value		
				1 ton class	2 ton class	3 ton class
Chain length (20 links)			Standard	317.5 mm (12.500 in.)	381 mm (15.00 in.)	508 mm (20.00 in.)
			Limit	327 mm (12.87 in.)	392 mm (15.43 in.)	523 mm (20.59 in.)
Main roller outside diameter		S	Standard	99 mm (3.90 in.)	113.8 mm (4.480 in.)	113.8 mm (4.480 in.)
		M	Standard	100 mm (3.94 in.)	115 mm (4.53 in.)	115 mm (4.53 in.)
		L	Standard	101 mm (3.98 in.)	116 mm (4.57 in.)	116 mm (4.57 in.)
		LL	Standard	102 mm (4.02 in.)	117 mm (4.61 in.)	117 mm (4.61 in.)
Side roller external diameter			Standard	42 mm (1.65 in.)	42 mm (1.65 in.)	42 mm (1.65 in.)
Simplex mast size (reference)	1	Width of outer mast	Standard	610 mm (24.02 in.)	670 mm (26.38 in.)	670 mm (26.38 in.)
	2	Width of inner mast	Standard	516 mm (20.31 in.)	568 mm (22.36 in.)	568 mm (22.36 in.)
	3	Width of lift bracket	Standard	407 mm (16.02 in.)	457 mm (17.99 in.)	457 mm (17.99 in.)
Mast	4	Clearance between main roller rolling face and mast	Standard	1.0 mm (0.039 in.) or less		
	5	Clearance between main roller side face and mast	Standard	0.1 to 0.5 mm (0.004 to 0.020 in.)		
	6	Clearance between mast and mast strip	Standard	0.1 to 0.5 mm (0.004 to 0.020 in.)		
Lift bracket	4	Clearance between main roller rolling face and inner mast	Standard	1.0 mm (0.039 in.) or less		
	5	Clearance between middle roller side face and inner mast thrust face	Standard	0.1 to 0.5 mm (0.004 to 0.020 in.)		
	5	Clearance between lower roller side face and inner mast thrust face	Standard	0.1 to 0.5 mm (0.004 to 0.020 in.)		
	7	Clearance between side roller rolling face and inner mast	Standard	0.1 to 0.5 mm (0.004 to 0.020 in.)		
Distortion of finger bar			Standard	5 mm (0.20 in.) or less		



Note: The mast is slightly wider at the lower side than at the upper side.
Always measure the clearance at the upper side of the mast.



Note: The mast is slightly wider at the lower side than at the upper side.
Always measure the clearance at the upper side of the mast.

Description

This manual explains how to use “removal, installation, disassembly, assembly, inspection and adjustment” and “diagnosis.”

Definition of Terms

⚠ WARNING: Instructions and precautions that may lead to fatal hazards and/or serious injuries if not observed properly.

⚠ CAUTION: Instructions and precautions that require special attention and may lead to problems and/or accidents as well as damages to the vehicle and/or components.

NOTE: Provides additional information that facilitates operation.

Standard: Indicates tolerances for inspection and adjustment.

Repair limit: Indicates maximum or minimum values allowed for inspection and adjustment.

Definition of Units

The units and numerical values in this Standard are SI units, and those given in ( ) in this Standard are based on the conventional unit system and are appended for informative reference.

Example: Tightening torque 59 - 78 N·m (6.0 - 8.0 kgf-m)

SI (Metric system)

Main unit changes

Measure	SI	Conventional unit	Conversion factor to SI
Acceleration	m/s^2	G	9.80665
Torque, moment	N•m	kgf-m	9.80665
Force	N	kgf	9.80665
Pressure	MPa	kgf/cm^2	0.0980665
	kPa	mmHg	0.133322
Power efficiency	kW	PS	0.735499
	W	kcal/h	1.16279
Volume	cm^3	cc	1
Spring constant	N/mm	kgf/mm	9.80665
Fuel consumption	*g/kW•h	g/PS•h	1.3596

* The conventional unit can be used for SI.

Description

⚠ Caution: At the beginning of each section, the precautions exclusive to the section are described.

Preparation: At the beginning of each section and during the trouble diagnosis items, the Special Tools (STs), gauges, and other tools to be prepared before operation are described. Some commercial service tools, assumed to be available in any workshop, are omitted.

Description: To perform correct operations, operational procedures, notes, STs, and other service information are described.

⚠ CAUTION: Descriptions of visual inspections and cleaning of removed parts are generally omitted. Please remember that actual operations require these processes.

Maintenance Schedule

Make sure to perform appropriate maintenance and service work to maintain the initial performances of the Cat Lift Trucks.

PERFORM INSPECTION

Make sure to perform the periodical inspections at appropriate times, according to the month basis or the operating hour basis, whichever comes first. ..... Inspection period

DAILY / WEEKLY INSPECTION

				Operator's inspection
No.	Inspection items	Days of use	Daily	Weekly
		Operation hours	10	50
1	Cooling fan (rotation & damage)		I	
2	Engine coolant level		I	
3	V-belt (fan & alternator) tension			I
4	Battery electrolyte level		I	
5	Engine (exhaust, noise, & vibration)		I	I
6	Engine oil level		I	
7	Fuel hose, pipes & joints	(2) for LPG		I
8	Fuel level		I	
9	Air cleaner element	(1)		I

FIRST MONTH / PLANNED INSPECTION

See "CAUTION" for figures in ( ) and symbols on the next pages.

					Engine system inspection (except LPG fuel system)										
No.	Inspection items		Applicable control system	Months of use	1	2	3	4	5	6	7	8	9	10	11	12
				Operation hours (x 100 hours)	2		5			10			15			20
1	Intake/exhaust valve clearance		ELC/CAB		I		I			I			I			I
2	Cylinder head bolt and manifold nut		ELC/CAB		T											
3	Radiator	Fin	ELC/CAB	(1)	I		I			I			I			I
		Filler cap	ELC/CAB		I											I
4	Engine oil		ELC/CAB	(1)	R		R			R			R			R
					(every 500 hours or 3 months, whichever comes first)												
5	Oil filter		ELC/CAB	(1)	R		R			R			R			R
					(every 500 hours or 3 months, whichever comes first)												
6	Engine coolant		ELC/CAB													R
7	Fuel filter		CAB	(3)	R		C			R			C			R
8	Ignition timing		CAB		I		I			I			I			I
9	Spark plug		ELC/CAB		I		I			I			I			I
10	Injection nozzle		ELC		I		I			I			I			I
11	PCV valve		ELC/CAB	(1)			I			I			I			I
12	PCV hose		ELC/CAB				I			I			I			I
13	Air cleaner element		ELC/CAB							R						R
14	Rubber hose condition		ELC/CAB		I											I
15	Battery electrolyte specific gravity		ELC/CAB		I		I			I			I			I

Abbreviations: ELE = Electronically controlled, CAB: Carburetor

- Camshaft height (mm)
  Standard 36.750 - 36.800 (For both intake and exhaust)
  Size reduction limit 36.5

CRANKSHAFT

- Bend (mm)
  Repair limit 0.05
- End play (mm)
  Standard 0.05 - 0.18
  Repair limit 0.20
- Journal dimensions (mm)
  Standard 62.942 - 62.955
- Pin standard dimension (mm)
  Standard 44.961 - 44.974 (K15, K21, K25)
- Oil clearance at journal (mm)
  Standard 0.020 - 0.062
  Repair limit 0.10

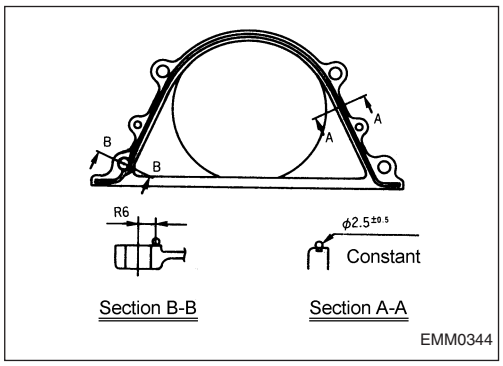
FLATNESS OF FLYWHEEL AND DRIVE PLATE

- Flatness of flywheel (mm)
  Repair limit 0.10
- Runout of drive plate (mm)
  Repair limit 0.20
- Flatness of ring gear (mm)
  Repair limit 0.50
- Flatness (mm)
  Repair limit 0.30

CONNECTING ROD

- Center distance between both end holes (mm)
  Standard 143.970 - 144.030 (K25) 152.47 - 152.53 (K15, K21)
- Large end hole diameter (mm)
  Standard 48.0 - 48.013 (K15, K21, K25)
- Small end hole diameter (mm)
  Standard 19.965 - 19.978 (K15, K21, K25)
- Bend (per 100 mm) (mm)
  Repair limit 0.05
- Twist (per 100 mm) (mm)
  Repair limit 0.05
- Large end thrust clearance
  Standard 0.2 - 0.3
  Repair limit 0.40
- Large end oil clearance (mm)
  Standard 0.030 - 0.066 (K15, K21, K25)
  Repair limit 0.10
- Weight difference (piston combination) (g)
  Standard 5 or less

Engine Assembly (Cont'd)



⚠ **CAUTION:**

- **Before installing the rear oil seal retainer, apply liquid packing to the retainer as shown in the figure.**
- **Once attaching the retainer and tightening the bolts, do not make additional tightening or remove the retainer (and retighten).**
- **For the mounting face, apply a continuous bead of sealant along the groove. For the bolt holes, apply sealant so that it does not run off the inner edges.**
- **Make sure to finish the assembly within 5 minutes after sealant application.**
- **After the assembly, leave the assembled parts as is for 30 minutes or more.**

PRECAUTIONS BEFORE APPLICATION:

- The mounting faces (both sides) shall be free from moisture, oil, grease, waste, dust and other foreign objects.
- Make sure to remove any sealant from the flange/mounting faces and threads when reassembling the part that has once been attached and disassembled.

9. Assembly of piston

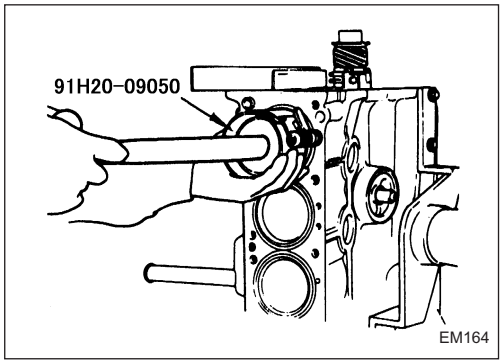
(1) Assemble the bearing to the connecting rod.

(2) To each cylinder, assemble the corresponding connecting rod and piston subassembly according to the cylinder number.

(3) When assembling, turn the bottom mark of the piston toward the front.

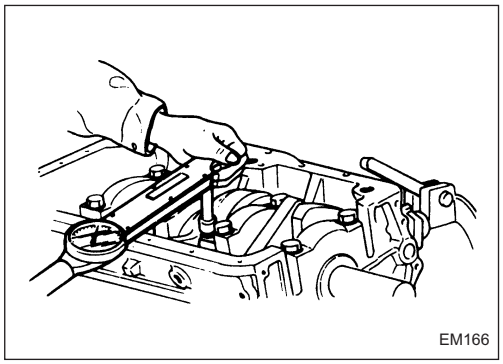
(4) Set the crankshaft pin positions to TDC or BDC.

(5) Insert the pistons into the cylinder block using the piston ring compressor (ST).



⚠ **CAUTION:**
Do not mistake the piston front.

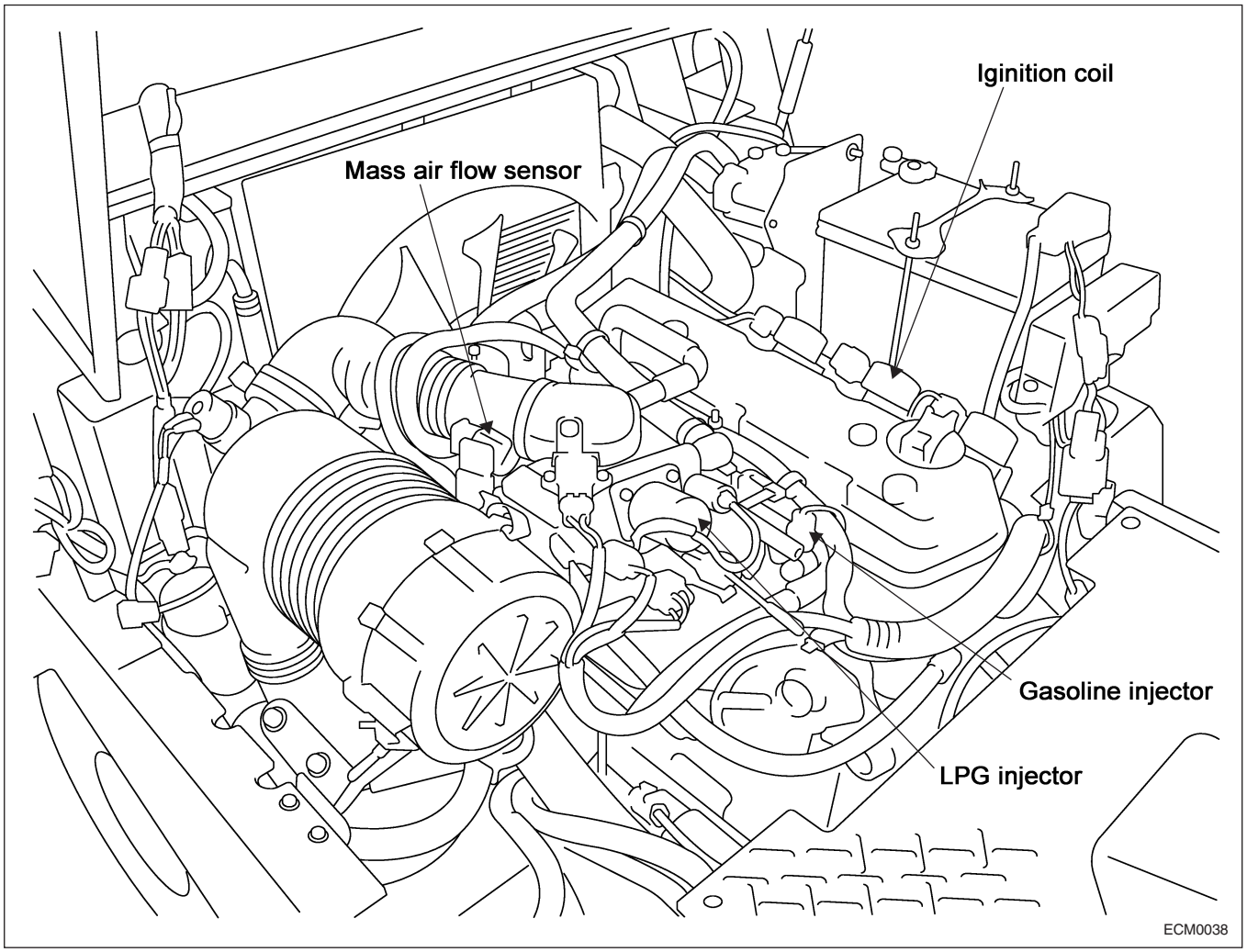
(6) Assemble each connecting rod and connecting rod cap while aligning their matching marks.



(7) Tighten connecting rod cap.
Connecting rod cap bolt:
3.2 - 3.8Kgf-m (K15, K21, K25)

10. Assembly of valve lifter
    - Fit the valve lifter in the correct position. Apply a small amount of oil and press the valve lifter into the hole on the cylinder block.

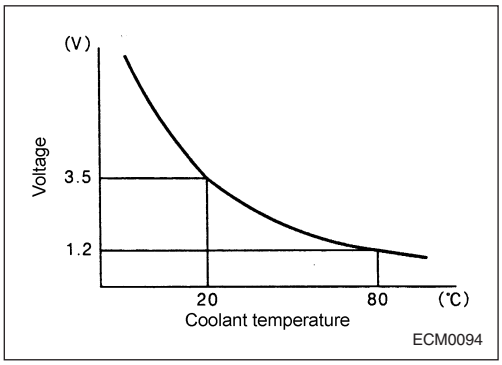
Component Parts Location



Main component part		Type	Location	Specifications		
				Gasoline	LPG	Combined
Actuators	Gasoline injector	High resistance	Intake manifold	√		√
	LPG injector	Gas injection	Integrated in injector holder (on intake manifold)		√	
	Fuel pump	Electric motor/turbine	Integrated in fuel tank	√		√
	Fuel pressure regulator	Diaphragm		√		√
	Throttle control motor	Electric DC motor (DC motor)	Integrated in electronic throttle control actuator	√	√	√
	Ignition coil	Mold (built-in power transistor)	Cylinder head (On each spark plug)	√	√	√

ST Data Monitor Display

Monitor item	At idle after warming up	At approx. 2,000 rpm
Eng. temp	After warming up engine: Approx. 80˚C or more	



ECM Input/Output Signal Specifications

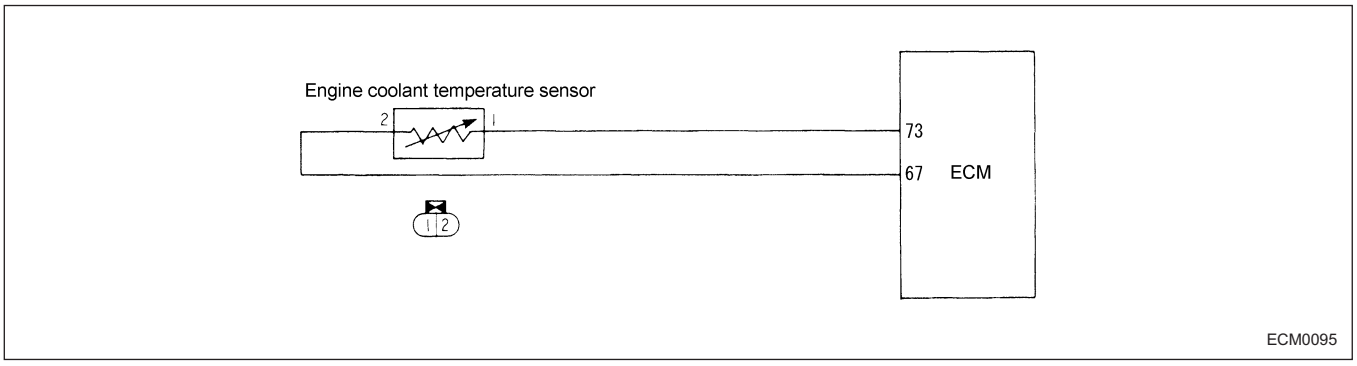
Measure voltage between terminals shown below and ground using a circuit tester.

Terminal	Signal name	At Idle	At approx. 2,000 rpm
73	Engine coolant temperature sensor signal	Engine coolant temperature at approx. 20˚C: Approx. 3.5V	
		Engine coolant temperature at approx. 80˚C: Approx. 1.2V	

NOTE:

- If engine coolant temperature sensor has a malfunction, the value of engine coolant temperature signal is changed along with start-up time by fail-safe to enable normal operation.

Circuit Diagram



Component Parts Inspection

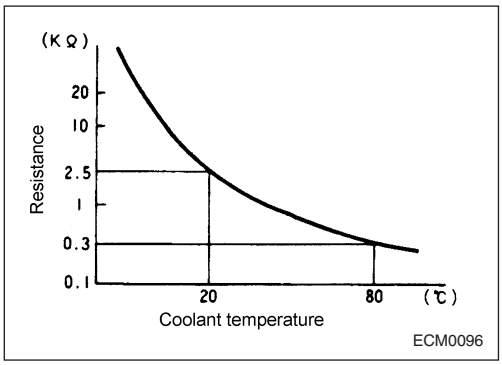
Engine coolant temperature sensor

Check resistance between terminals 1 and 2 on the engine coolant temperature sensor.

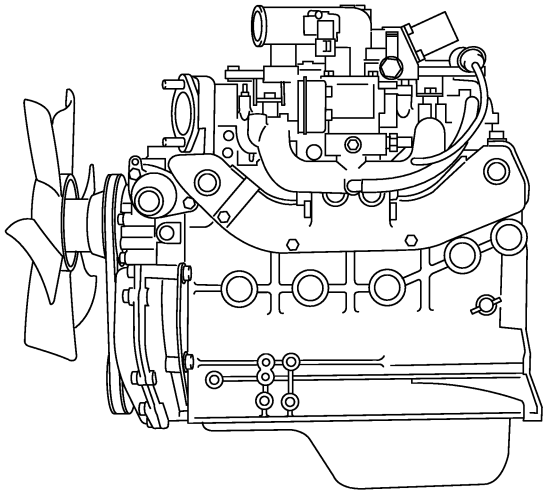
Resistance

Coolant temperature at approx. 20˚C: Approx. 2.5 k Ω

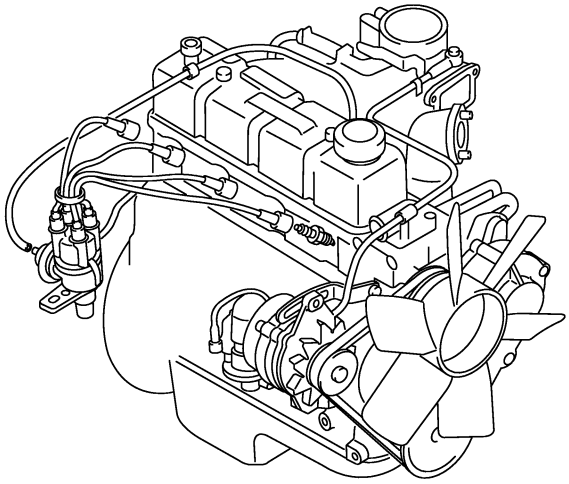
Coolant temperature at approx. 80˚C: Approx. 0.3 k Ω



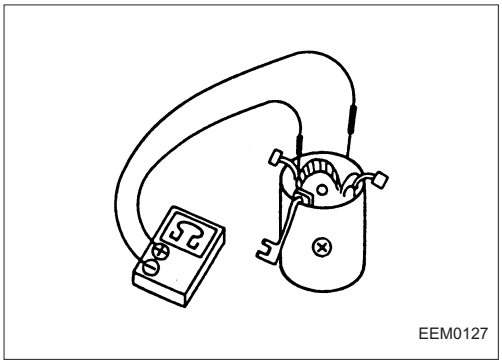
Electronically controlled type



Carburetor type



EFM0089

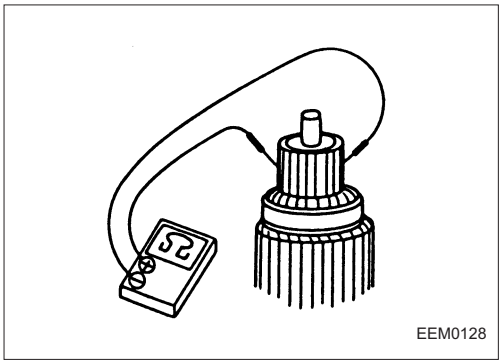

EEM0127

- Check for continuity between the field coil and a ground.

Judgement

If continuity is present, the field coil is shorted. Replace it.
If there is no continuity, the coil is normal.

⚠ **CAUTION:**
Note that, however, a compound-wound motor structurally grounds the field coil. This means that the tester will show continuity between the field coil and a ground.

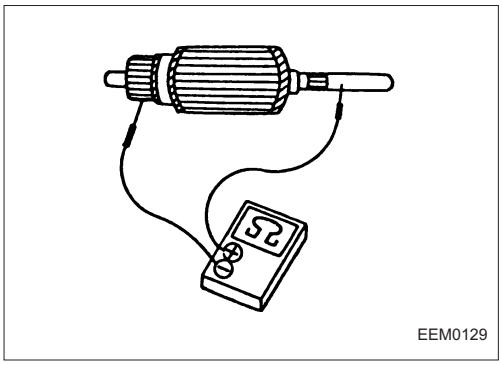

EEM0128

ARMATURE COIL

- Check the continuity between the commutators.

Judgement

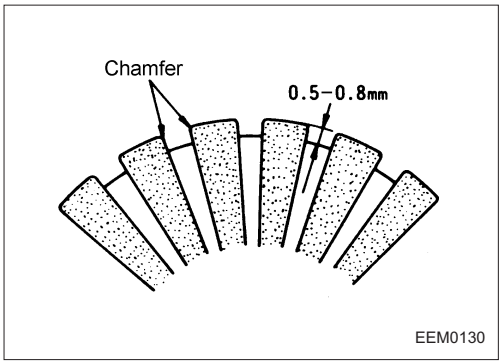
If there is continuity, the armature coil is normal.
If there is no continuity, the coil has an open circuit. Replace it.


EEM0129

- Check for continuity between the armature coil and a ground.

Judgement

If continuity is present, the field coil is shorted. Replace it.
If there is no continuity, the coil is normal.



EEM0130

BRUSH COMMUTATOR RELATED

Brush wear (mm)	10.0 - 18.0 (Wear margin: 8 max.)
Brush spring pressure (kg)	1.4 - 1.8

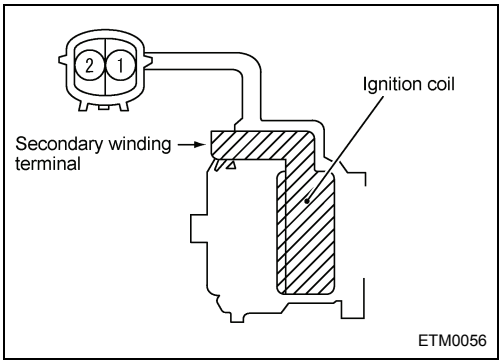
- If the commutator has a rough surface, grind it using sandpaper of #500 or #600.
- If the insulator (high mica) of the commutator is 0.2 mm or less in thickness, replace the commutator.

Refer to each section for details.

Condition	Possible causes	Action	Application		
			Common	Electric controlled specifications	Carburetor specifications
Incident in ignition system	• Malfunction of low-voltage electronic distribution ignition coil	Replace.		√	
	• Condenser malfunction	Replace.	√		
	• Electric leakage from rotor cap and rotor	Clean or replace.			√
	• Spark plug malfunction	Clean, adjust gap or replace.	√		
	• Inappropriate ignition timing	Adjust.			√
	• Ignition coil malfunction	Replace.	√		
	• Open circuit in high-tension cable	Replace.			√
	• Loose or open primary wire connection	Repair or replace.	√		
Incident in fuel system Refer to EF section for the LPG model.	• Insufficient fuel	Fill.	√		
	• Contaminated fuel filter	Replace.	√		
	• Plugged or contaminated fuel piping	Wash.	√		
	• Plugged or contaminated fuel injector	Clean or replace.		√	
	• Fuel pump malfunction	Repair or replace.	√		
	• Carburetor choke malfunction	Check and adjust.			√
	• Inappropriate carburetor float level	Correct.			√
	• Inappropriate idling	Adjust.			√
Lowered compression pressure	• Poor tightening of spark plug or inappropriate gasket	Tighten to correct torque or replace.	√		
	• Inappropriate engine oil grade or deteriorated viscosity	Replace with appropriate grade of oil.	√		
	• Inappropriate valve clearance	Adjust.	√		
	• Compression pressure leak from valve seat	Remove head and perform fine grinding to valve.	√		
	• Stuck valve stem	Repair or replace cylinder head and valve.	√		
	• Broken or chip valve spring	Replace valve spring.	√		
	• Compression pressure leakage from head gasket	Replace head gasket.	√		
	• Worn or stuck piston ring	Replace piston ring.	√		
	• Worn piston ring or cylinder	Engine overhaul (Diagnosis procedure) a. Put a small amount of engine oil from the ignition plug hole and measure the compression pressure. b. If the pressure builds up, a possible cause is in the cylinder or piston ring. c. If the pressure remains unchanged, the leakage can be attributed to the valve, cylinder head or head gasket.	√		

Ignition and Fuel Systems (Cont'd)

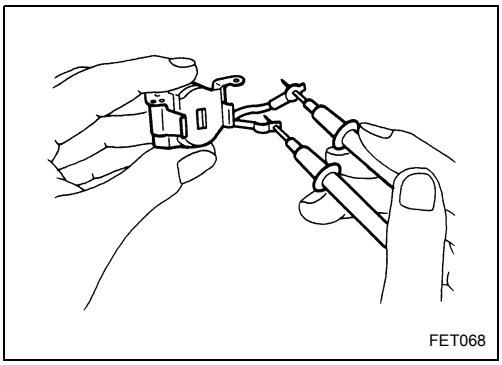
DISTRIBUTOR INSPECTION (CARBURETOR MODEL ONLY)



ETM0056

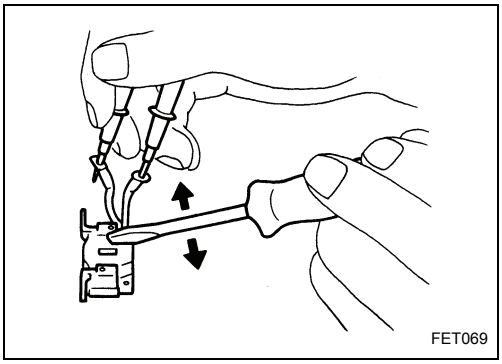
Ignition coil inspection

- Measure resistance terminals (1) and (2) of the primary coil and those of the secondary coil using a circuit tester.
  Primary coil resistance: 0.9 - 1.2Ω
  Secondary coil resistance: 20 - 29KΩ


FET068

Pickup coil inspection

- Measure the pickup coil resistance using a circuit tester.
  Resistance: 420 - 540Ω


FET069

- Move a screwdriver to and fro near the iron core of the pickup coil and make sure that the tester needle fluctuates.

INSPECTION OF DISTRIBUTOR CAP AND CARBON TERMINALS

- If the hemisphere face of a terminal is worn out, replace the cap.

ROTOR HEAD INSPECTION

- Check for cracks and damages.

SIGNAL CORE ROTOR INSPECTION

- Check for bends or damages.

VACUUM CONTROL SYSTEM INSPECTION

- Apply vacuum to the diaphragm with a vacuum pump and check that the link is drawn.

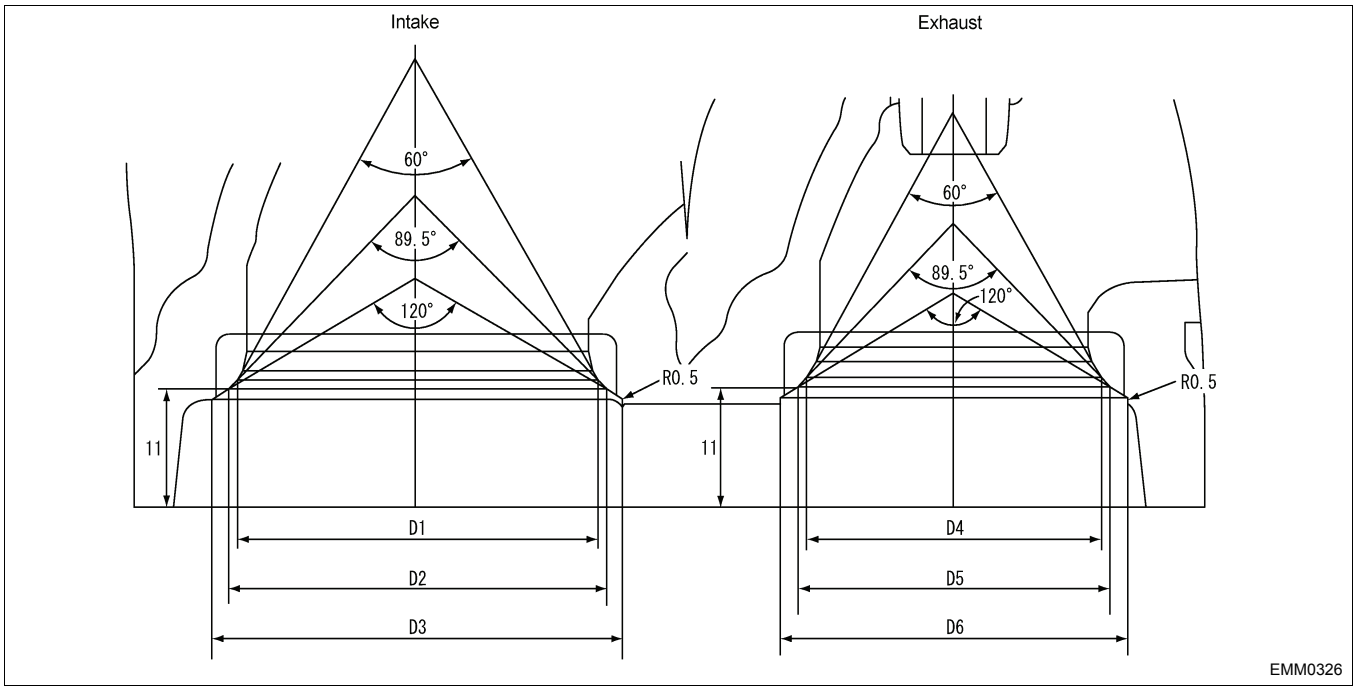
Inspection and Correction (Cont'd)

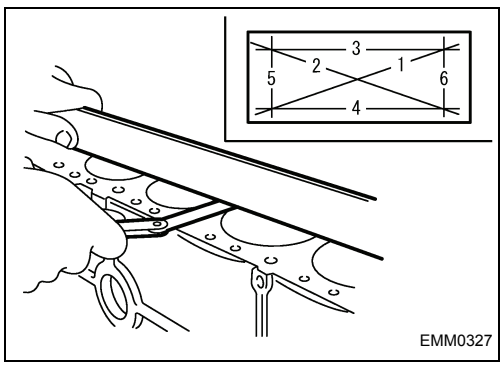
VALVE SEAT PROCESSING

- Cut the valve seat to the specified dimensions using a valve seat cutter set and valve seat grinder (commercial service tool).

CAUTION:
Tightly hold the cutter handle with both hands when using a valve seat cutter, and cut the entire periphery of the contacting face without a break while pressing the cutter.
Poor pressure onto the cutter or repeated cutting may create steps in the seat.

- Cut the valve seat to the dimensions specified in the figure.
  Standard processing dimensions
  D1: 35.9 - 36.1 mm
  D2: 37.6 - 37.8 mm
  D3: 41.0 mm
  D4: 28.6 - 28.8 mm
  D5: 31.4 - 31.6 mm
  D6: 35.0 mm

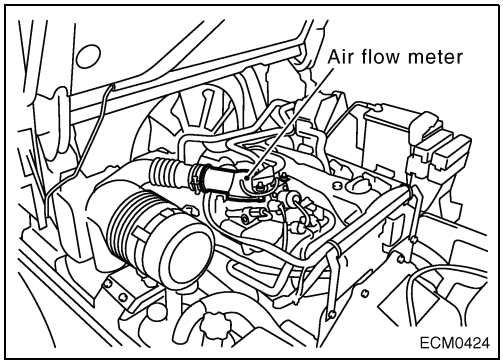




4. Cylinder block

   Measure distortion of the cylinder block top face in the longitudinal and lateral directions.
   Measuring cylinder block distortion.
   - Remove any foreign material deposits such as carbon from the cylinder block.
   - (Use a straight ruler and filler gauge for distortion measurement)
   - Visually check for any cracks and damages.
   - Measure distortion at six points on the head top face. If the measured distortion exceeds the specified limit, correct the head top face with a surface grinder or an equivalent tool, or replace the head.

Component Parts Location



Main component part			Type	Location	Specifications		
					Gasoline	LPG	Combined
Actuators	Gasoline injector		High resistance	Intake manifold	○		○
	LPG injector		Gas injection	Integrated in injector holder (on intake manifold)		○	○
	Fuel pump		Electric motor/turbine	Integrated in fuel tank	○		○
	Fuel pressure regulator		Diaphragm		○		○
	Throttle control motor		Electric DC motor (DC motor)	Integrated in electronic throttle control actuator	○	○	○
	Ignition coil		Mold (built-in power transistor)	Cylinder head (On each spark plug)	○	○	○
Sensors	Crankshaft position sensor	Crankshaft position sensor (POS)	Hall IC (element)	Front cover	○	○	○
		Camshaft position sensor (PHASE)		Chain housing	○	○	○
	Mass air flow sensor		Hot wire	Air horn	○	○	○
	Accelerator pedal position sensors 1 and 2		Variable resistance	Integrated in accelerator work unit (accelerator pedal assembly)	○	○	○
	Throttle position sensors 1 and 2			Integrated in electronic throttle control actuator	○	○	○
	Engine coolant temperature sensor		Thermistor	Water outlet	○	○	○
	Intake air temperature sensor			With air flow meter	○	○	○
	Heated oxygen sensor		Zirconia (with heater)	Exhaust manifold	○	○	○
	LPG fuel pressure sensor		Relative pressure sensor	LPG injector holder		○	○
ECM			121-pin digital control	Vehicle side	○	○	○
ECM & IGN coil relay			Compact general relay (1M X 2)	Vehicle side	○	○	○

Inspection of Idle Speed and Ignition Timing (Cont'd)

CO/HC DENSITY

The vehicle uses an air-fuel ratio feedback system with a self-learning function. Because a wide compensation range is available, no additional CO/HC density adjustment is necessary.

- Warm up engine to normal operating temperature. Confirm idle speed and ignition timing are within the standards. Then, check CO/HC density with a CO/HC measuring device.
- Check condition of air-fuel ratio feedback with the following steps when measured values are outside the standard:

With ECM Input/Output monitor

1. Indicate "O2 sensor rich" in ECM Input/Output monitor.
2. Keep engine speed at approximately 2,000 rpm, and make sure that "ON" and "OFF" are alternately displayed.

Without ECM Input/Output monitor

1. Check it with heated oxygen sensor monitor mode.
2. Keep engine speed at approximately 2,000 rpm, and make sure that Engine Warning lamp blinks at least 5 times within 10 seconds.

NOTE:
Increase engine speed when inspecting while air-fuel ratio feedback control is activated during idle.

Electric Control Throttle Assembly

REMOVAL

1. Remove air duct.
2. Remove harness connector. (Mass air flow sensor, LPG injector, LPG assistance injector, LPG fuel pressure sensor and electric throttle control actuator)
3. Loosen air horn bolts in turns, and then remove them.
4. Loosen injector holder bolts in turns, and then remove them.
5. Also loosen chamber bolt of electric control throttle, and then remove the chamber.

ELECTRIC CONTROLLED SYSTEM COMPONENT VIEW