MITSUBISHI FORKLIFT TRUCKS

Service Manual

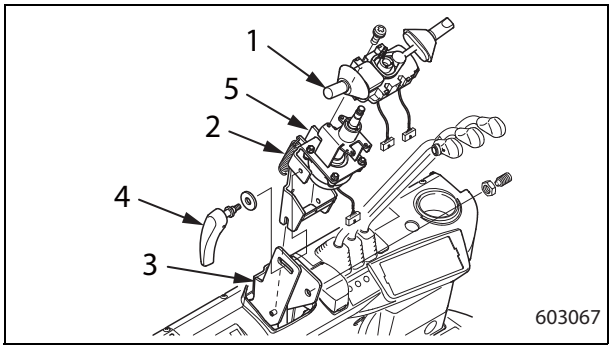
Chassis & Mast

FC/MC

FB16CPN	EFB27-00011-up
FB18CPN	EFB27-50011-up
FB16PN	EFB28-00011-up
FB18PN	EFB28-50011-up
FB20PN	EFB29-00011-up

99759-5M100

(4) Disconnect the harness connector of the combination switch, and remove the switch.
(5) Remove the spring from the pedal bracket.
(6) Remove the handle.
(7) Disconnect the harness connector of the steering column assembly, and remove the column.

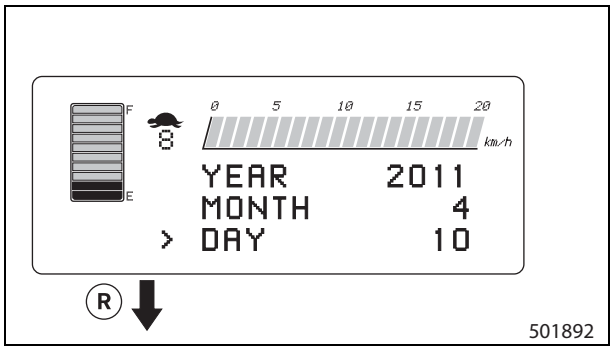


1. Combination switch
2. Spring
3. Pedal bracket
4. Tilt steering column lock/ unlock handle
5. Steering column assembly

3. Reassembling Console

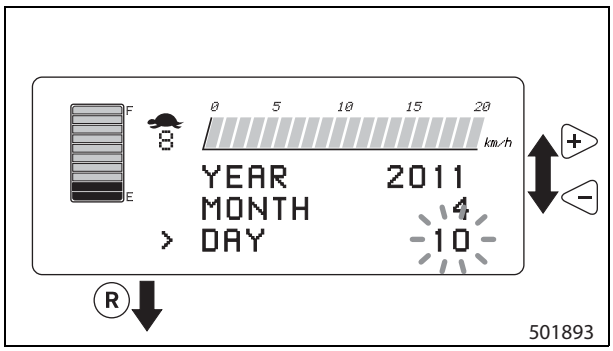
Follow the removal sequence in reverse.

(8) After setting of the month, push (R) button, and then the screen 6 appears.



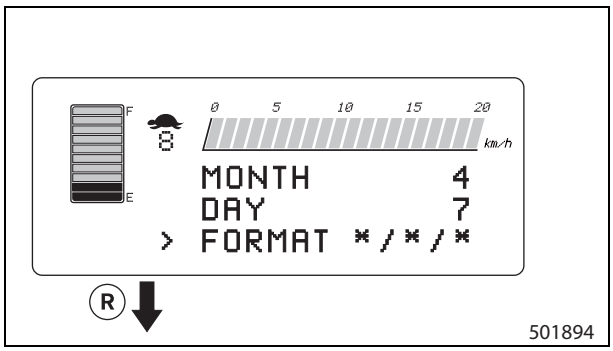
Screen 6

(9) Push (R) button again, and the value of day is blinking.
Set the day by pushing ◁ or ▷ button.



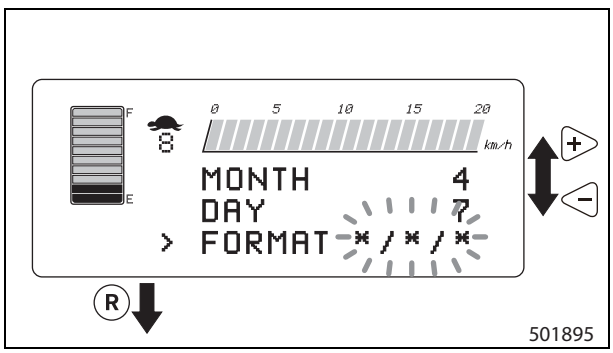
Screen 7

(10) After setting of the day, push (R) button, and then the screen 8 appears.



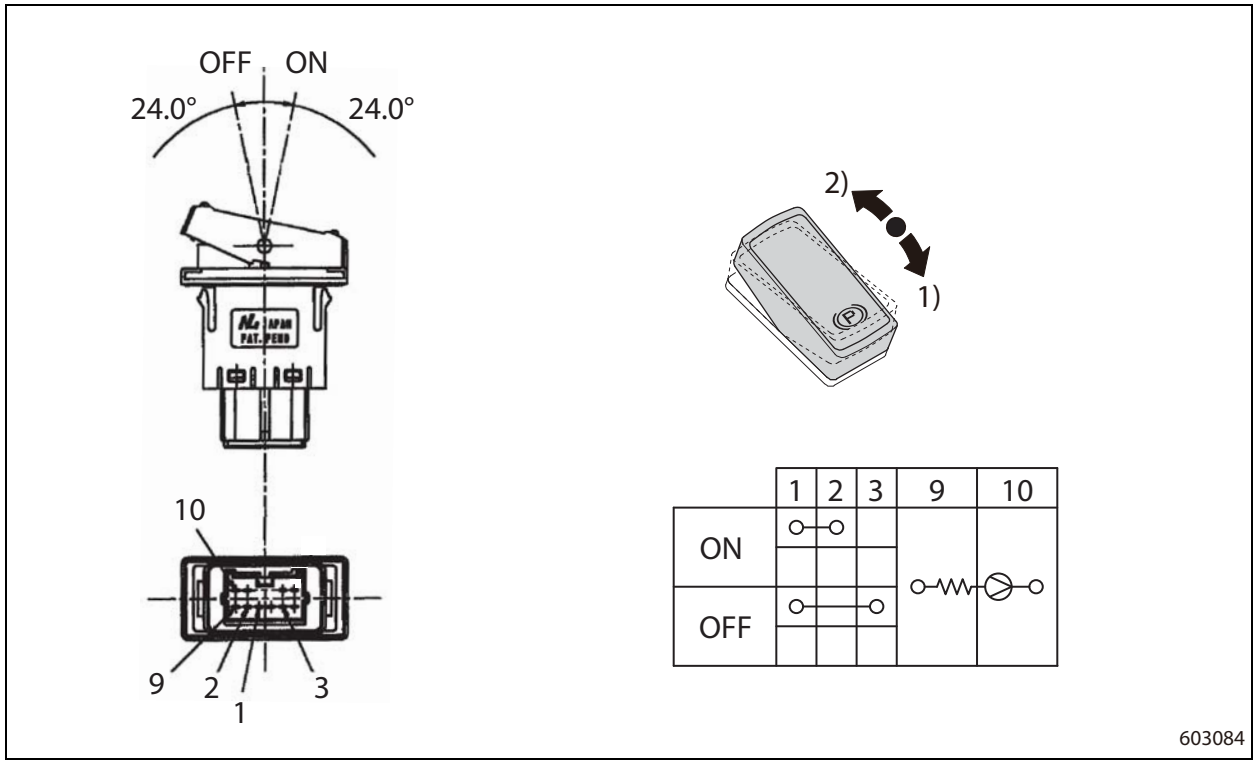
Screen 8

(11) Push (R) button again, and the parameter of format is blinking.
Select the format "US calendar (M/D/Y)" or "EU calendar (D/M/Y)" by pushing ◁ or ▷ button.



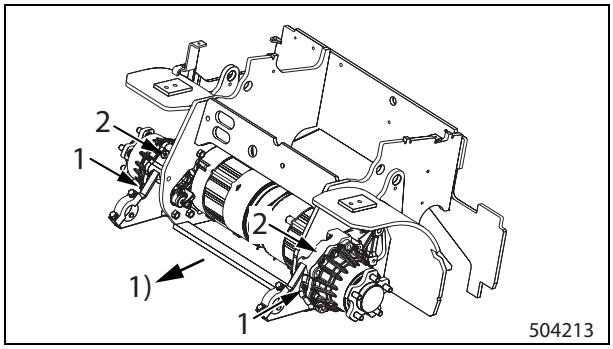
Screen 9

9. Parking Brake Switch



1) Apply
2) Release

(3) Pour oil into the transfer cases:
Remove oil level plug.
Remove oil filler plug.
Pour appropriate oil from the oil inlet. Make sure the oil fills up to the level plug.
Tighten the oil level and inlet plugs.



1. Oil level plug
2. Oil filler plug

1) Front of Vehicle

Item	Value
Oil quantity	0.53 liter (0.14 U.S. gal.)

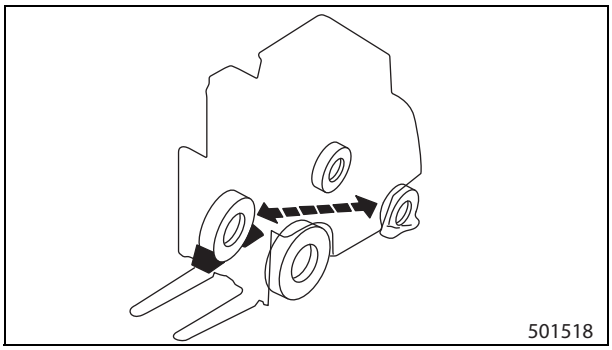
1. Cover
2. Tapered roller bearing (outer race)
3. Tapered roller bearing (outer race)
4. Needle bearing
5. Oil seal
6. Wheel hub
7. Oil seal retainer
8. Tapered roller bearing (inner race)
9. Thrust washer
10. Needle bearing
11. Planetary gear
12. Plate
13. Snap ring
14. Input gear
15. Ball bearing
16. Input plate
17. Snap ring
18. Snap ring
19. Pin (for brake)
20. Pin
21. O-ring
22. Plate
23. Friction plate
24. Disc spring
25. Mating plate
26. Brake cover
27. Bolt
28. Ball bearing
29. 2nd gear
30. Tapered roller bearing (inner race)
31. Output carrier
32. O-ring
33. Washer
34. Lock nut
35. Lock plate
36. Bolt
37. Hub cap
38. Thrust bearing
39. Thrust washer
40. Sun gear
41. Main case
42. Level plug
43. O-ring
44. Drain plug
45. O-ring
46. Bolt
47. Bolt
48. Brake lever
49. Nut
50. Adjusting bolt
51. Bushing
52. Clevis pin
53. Split pin
54. Bolt
55. Brake cylinder assembly
    (Air bleeder, bleeder screw, spring, piston, seal, housing, pin and cover)
56. Traction motor

Note: Do not confuse the mounting position, orientation, and number of the disc springs.
If misassembled, it could cause a premature wear of friction plates and brake force decrease.

2. Removing Rear Wheels

2.1 Preparation

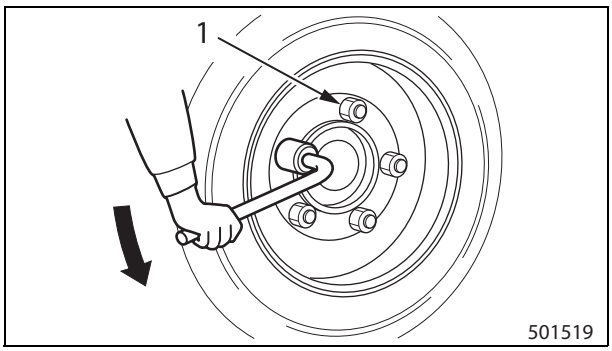
(1) Park the truck on level ground.
(2) Lower the forks until the fork tips touch the floor.
(3) Apply the parking brake.
(4) Place the direction lever in the NEUTRAL position.
(5) Turn the key switch OFF position.
(6) Prepare tools, jack and wheel blocks.
(7) Block the wheel diagonally opposite to a raised wheel.



Jack capacity
3 tons (6700 lbf), minimum

2.2 Removing Wheels

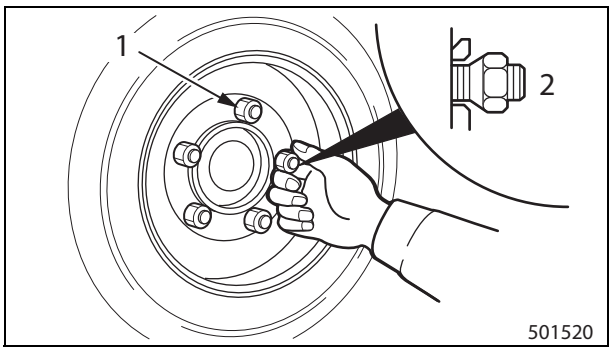
(1) Loosen the wheel nuts about two rotations.
(2) Position the jack under the truck at the specified jacking point.



1. Wheel nut

Note: Only loosen the wheel nuts. Do not remove them.

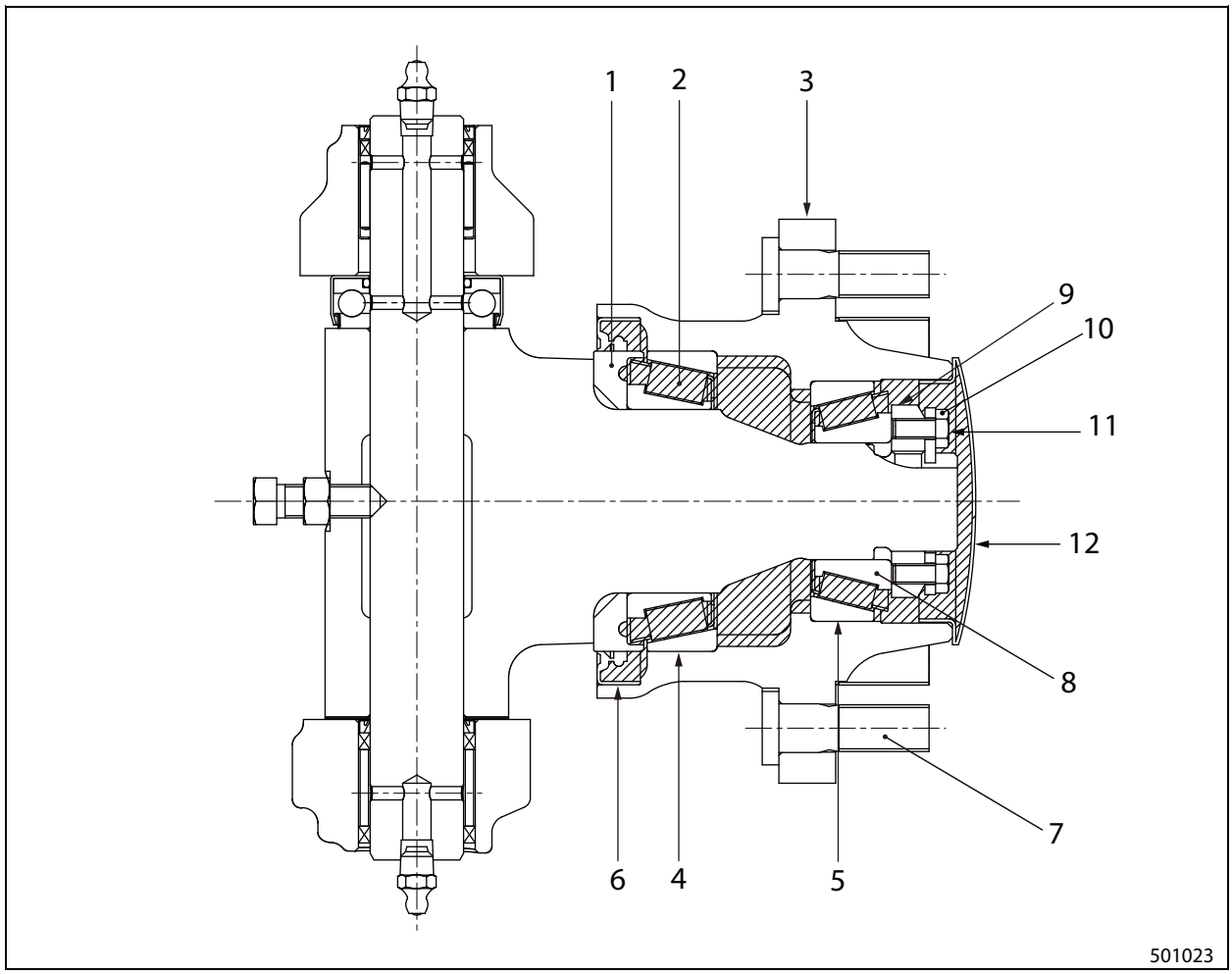
(3) Raise the lift truck by operating the jack until the tire just clears the ground.
(4) Remove the wheel nuts (loosened in step 1).
(5) Firmly hold the wheel with both hands and remove it from the truck.



1. Wheel nut 2. Countersink

10. Assembling Rear Axle Hub

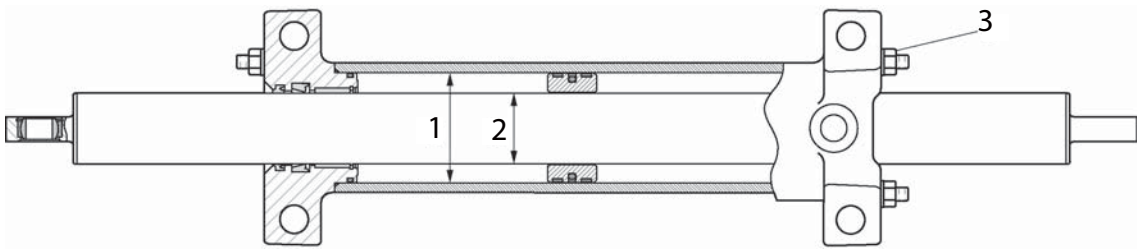
10.1 Assembly Sequence



1. Oil seal retainer
2. Bearing (inner)
- Assemble parts 3 to 7 prior to final assembly.
3. Hub
4. Bearing (outer)
5. Bearing (outer)
6. Oil seal
7. Wheel bolt
8. Bearing (inner)
9. Lock nut
10. Lock plate
11. Bolt
12. Cap

18.2 Steering cylinder

Ref.	Item		Specified value
1	Inside diameter of cylinder tube	Standard	63.0 mm (2.480 in.)
		Limit	63.15 mm (2.486 in.)
2	Diameter of piston rod	Standard	40 mm (1.57 in.)
3	Tightening torque of nut	Standard	21 ± 2 N·m (2.1 ± 0.2 kgf·m) [15.5 ± 1.5 lbf·ft]



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6. Reassembling Master Cylinder

⚠ CAUTION

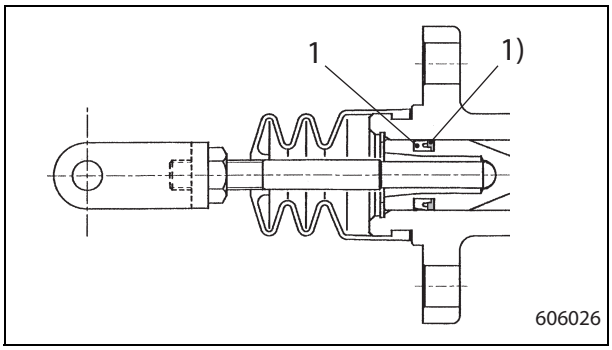
- Do not use any mineral oil as brake fluid.
- Use only specified brake oil DOT-3] or [DOT-4]. Do not mix any mineral oil.

Follow the disassembly sequence in reverse.
Also follow the instructions below.

- Clean metal parts with a volatile cleaning solution, and thoroughly dry using compressed air.
- Apply mineral oil on the surface of each parts
- Apply a thin coat of following grease or brake fluid on the inner surface of the cylinder body and the piston cup.

Specified grease
Metal Rubber #20

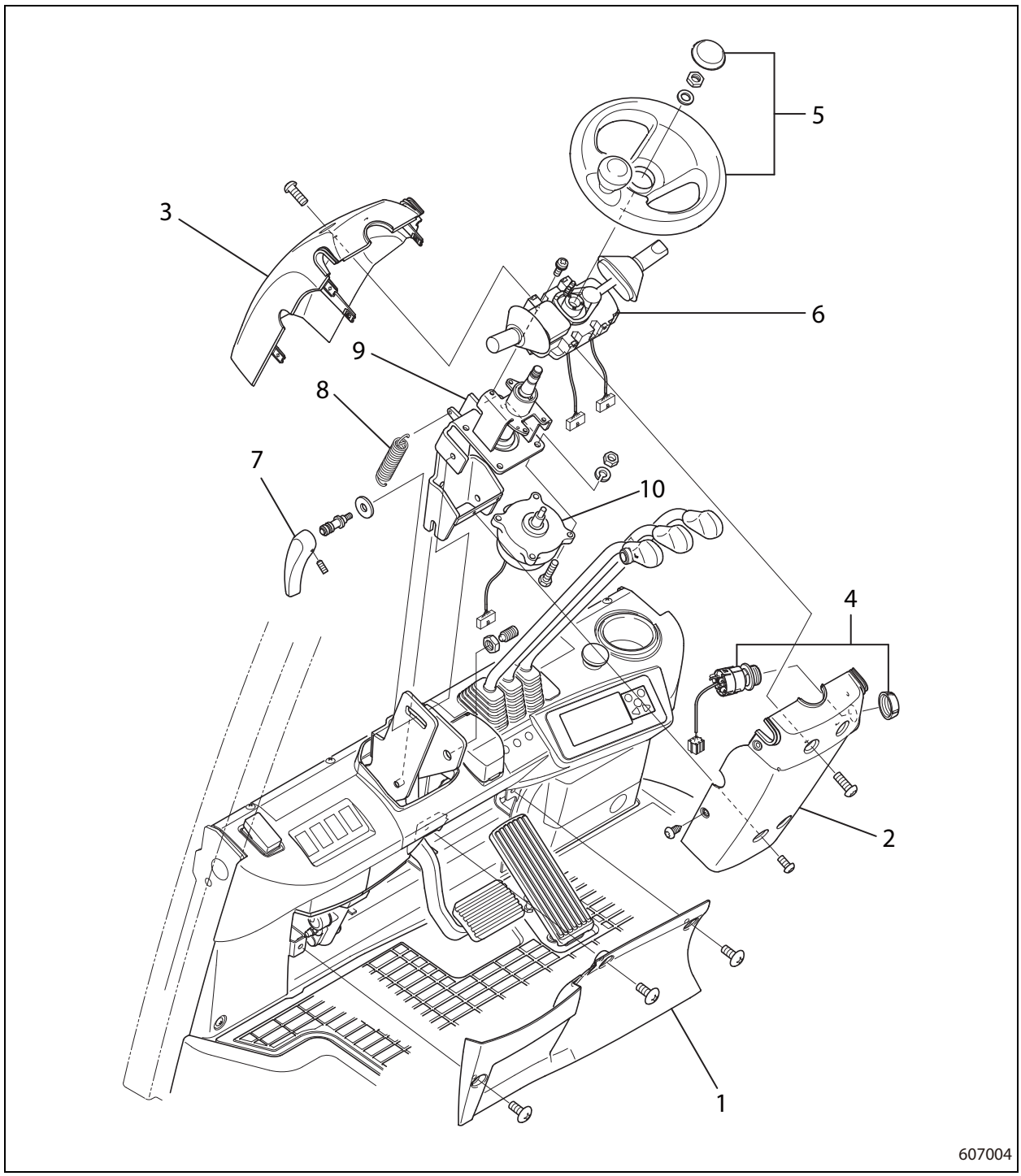
- Fill the rubber grease between the piston and secondary cup.



1. Secondary cup
1) Fill the rubber grease

3. Removing Steering Linkage Assembly

3.1 Removal Sequence



1. Kick panel
2. Column panel (1)
3. Column panel (2)
4. Key switch
5. Steering wheel assembly
6. Combination switch
7. Handle
8. Spring
9. Steering column assembly
10. Steering unit

Chapter 8 HYDRAULIC SYSTEM

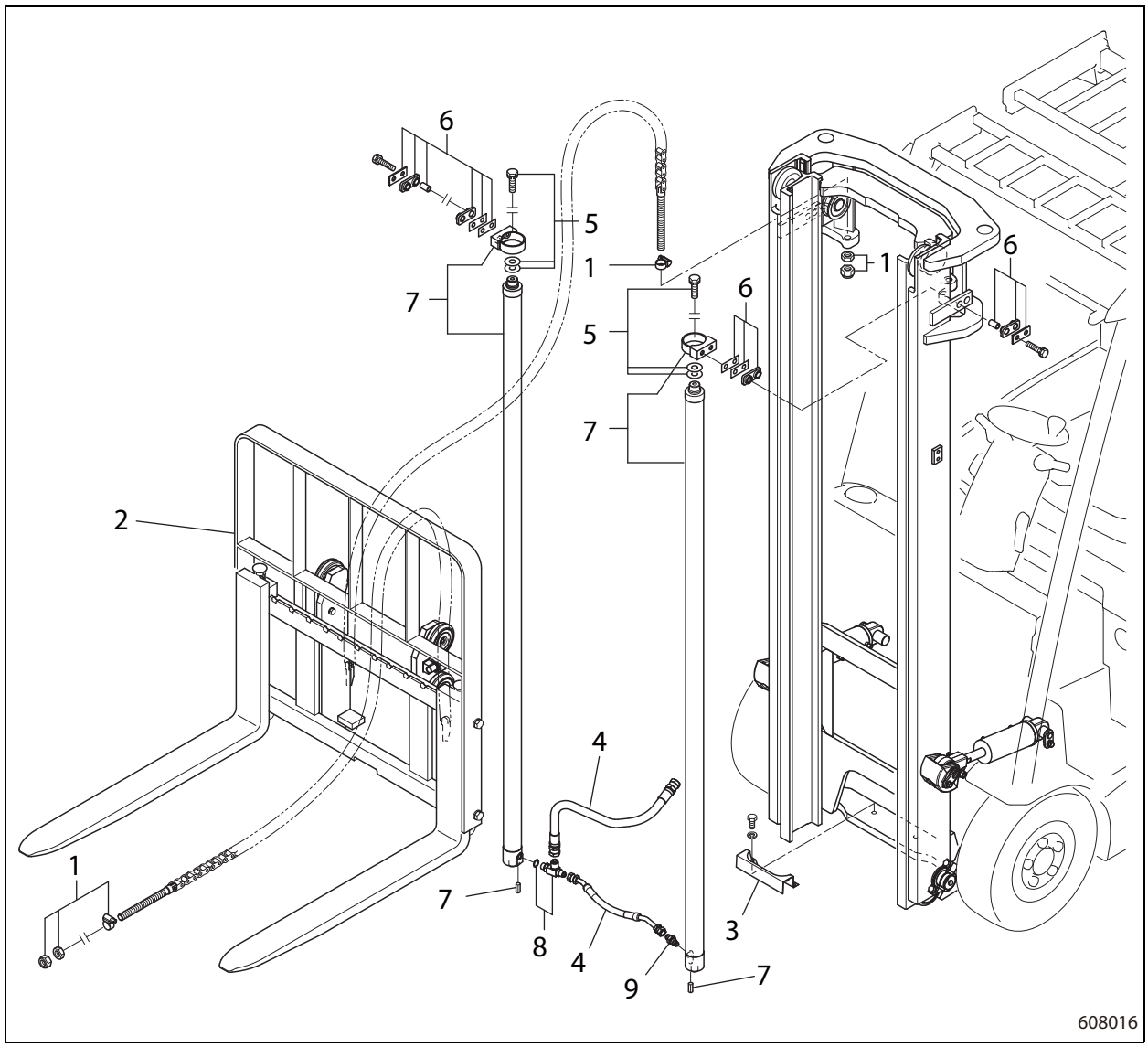
1. Specifications

1.1 MC model

Item			Specification
Hydraulic system	Gear pump	Type	Gear pump
		Model type	TMG1-18
		Displacement	18.9 cc/rev. (1.15 cu.in./rev.)
		Drive system	Direct connection with pump motor
	Control valve	Type	MSV04A8232
		Main relief pressure	18.1 MPa (184.57 kgf ·cm^2) [2625.2 psi]
	Simplex Mast (Dual-stage Panoramic Mast) lift cylinder	Inside diameter	45 mm (1.77 in.)
		Stroke	1645 mm (64.76 in.)
	Simplex Mast (Dual-stage Panoramic Mast) tilt cylinder	Inside diameter	60 mm (2.36 in.)
		Stroke	2000/2560, 4480/5000 : 70 mm (2.76 in.) 2760 - 4090 : 88 mm (3.46 in.) 5500/6000 : 59 mm (2.32 in.)
	Duplex Mast (Dual-stage Full Free Panoramic Mast) first lift cylinder	Inside diameter	45 mm (1.77 in.)
		Stroke	850 mm (33.46 in.)
	Duplex Mast (Dual-stage Full Free Panoramic Mast) second lift cylinder	Inside diameter	45 mm (1.77 in.)
		Stroke	1595 mm (62.80 in.)
	Duplex Mast (Dual-stage Full Free Panoramic Mast) tilt cylinder	Inside diameter	60 mm (2.36 in.)
		Stroke	77 mm (3.03 in.)
	Triplex Mast (Triple-stage Panoramic Mast) first lift cylinder	Inside diameter	45 mm (1.77 in.)
		Stroke	875 mm (34.45 in.)
	Triplex Mast (Triple-stage Panoramic Mast) second lift cylinder	Inside diameter	45 mm (1.77 in.)
		Stroke	1180 mm (46.46 in.)
	Triplex Mast (Triple-stage Panoramic Mast) tilt cylinder	Inside diameter	60 mm (2.36 in.)
		Stroke	3710 - 4750 : 77 mm (3.03 in.) 5090 - 7000 : 59 mm (2.32 in.)
	Operating oil volume	Low level	12.1 L (3.20 U.S. gal)
		High level	13.3 L (3.51 U.S. gal)

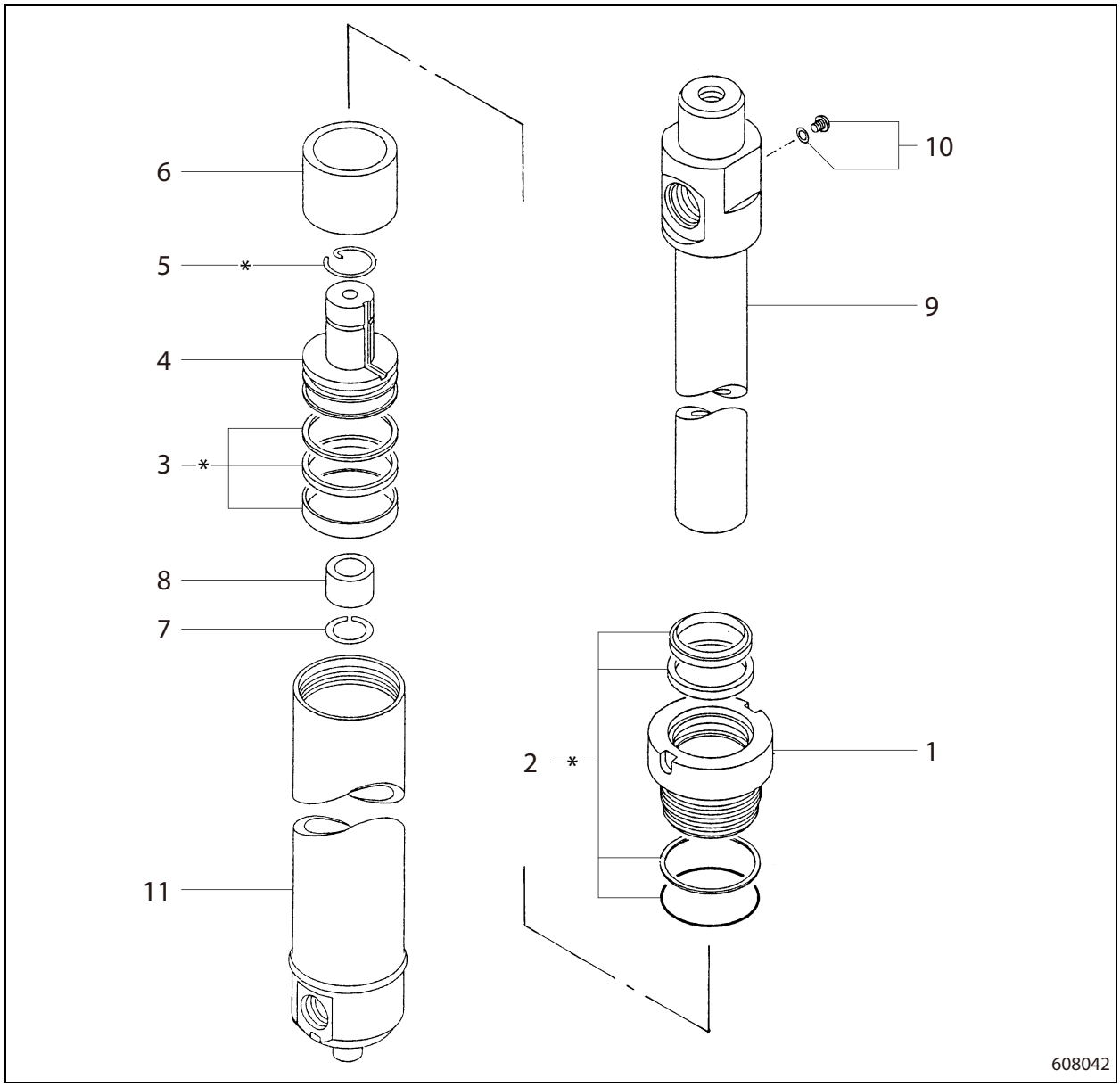
9. Removing Lift Cylinders (Simplex Mast)

9.1 Removal Sequence



1. Nuts, Self locking nuts, Clamps
2. Fork, Lift bracket
3. Hose guard
4. High-pressure hose
5. Washer assembled bolt, Shims
6. Seat, Cushion, Collar, Shims
7. Lift cylinder, Bracket, Spring pin
8. O-ring, T-joint
9. Down safety valve assembly

Duplex Mast Second Lift Cylinder

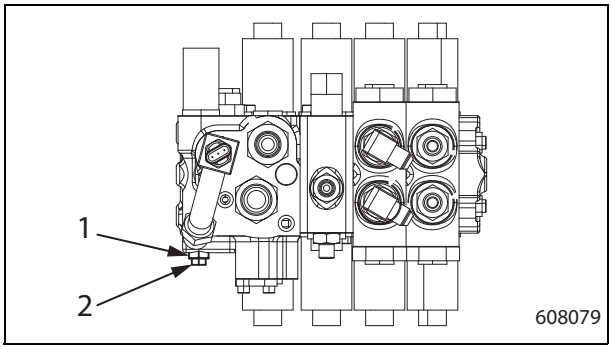


1. Retainer
   Remove parts 3 through 10 as sub-assembly from part 11.
2. Wiper*, Rod seal*, Backup ring*, O-ring*
3. Backup ring*, Piston seal*, Wear ring*
4. Piston
5. Pull-in wire*
6. Spacer
7. Circlip
8. Sleeve
9. Piston rod
10. Bleed screw, Seal washer
11. Cylinder shell

Note: The part marked with * is included in the seal kit.

- Control valve of FC model

(1) Loosen the lock nut and turn the set screw counterclockwise.



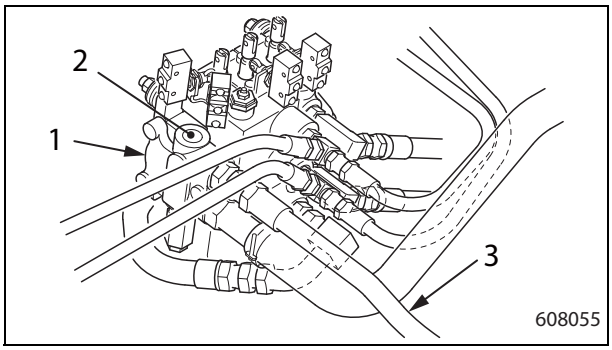
1. Lock nut
2. Screw

17.3 Adjusting Main Relief Valve (MC model)

⚠ CAUTION

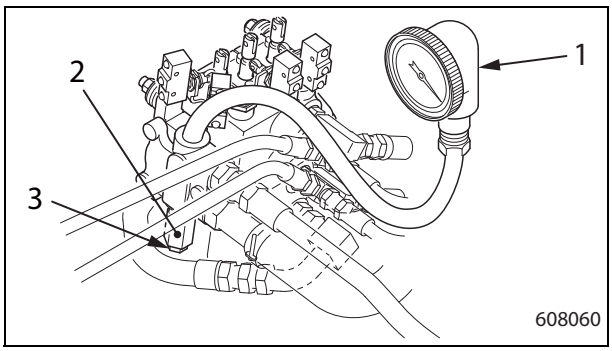
- Use 20 MPa {200 kgf/cm} pressure gauge.
- Turn the adjusting screw of the control valve gradually, because it is very sensitive.

(1) Turn the key switch to OFF position.
(2) Release pressure in the pipings. (Refer to "Preparation" of under "Removing Control Valve")
(3) Remove the gauge port plug and connect the pressure gauge with the adapter.



1. Control valve
2. Gauge port
3. High pressure hose

(4) Turn the key switch to the ON position, and pull the Lift lever to the top end.
(5) Read the indication of the pressure gauge with pulling the Lift lever.

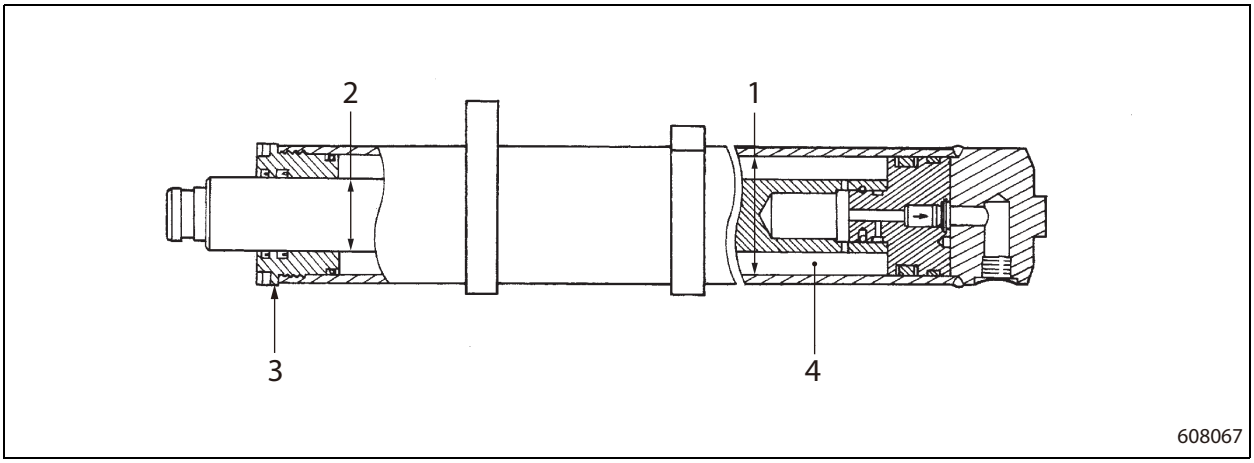


1. Pressure gauge
2. Main relief valve
3. Adjusting screw

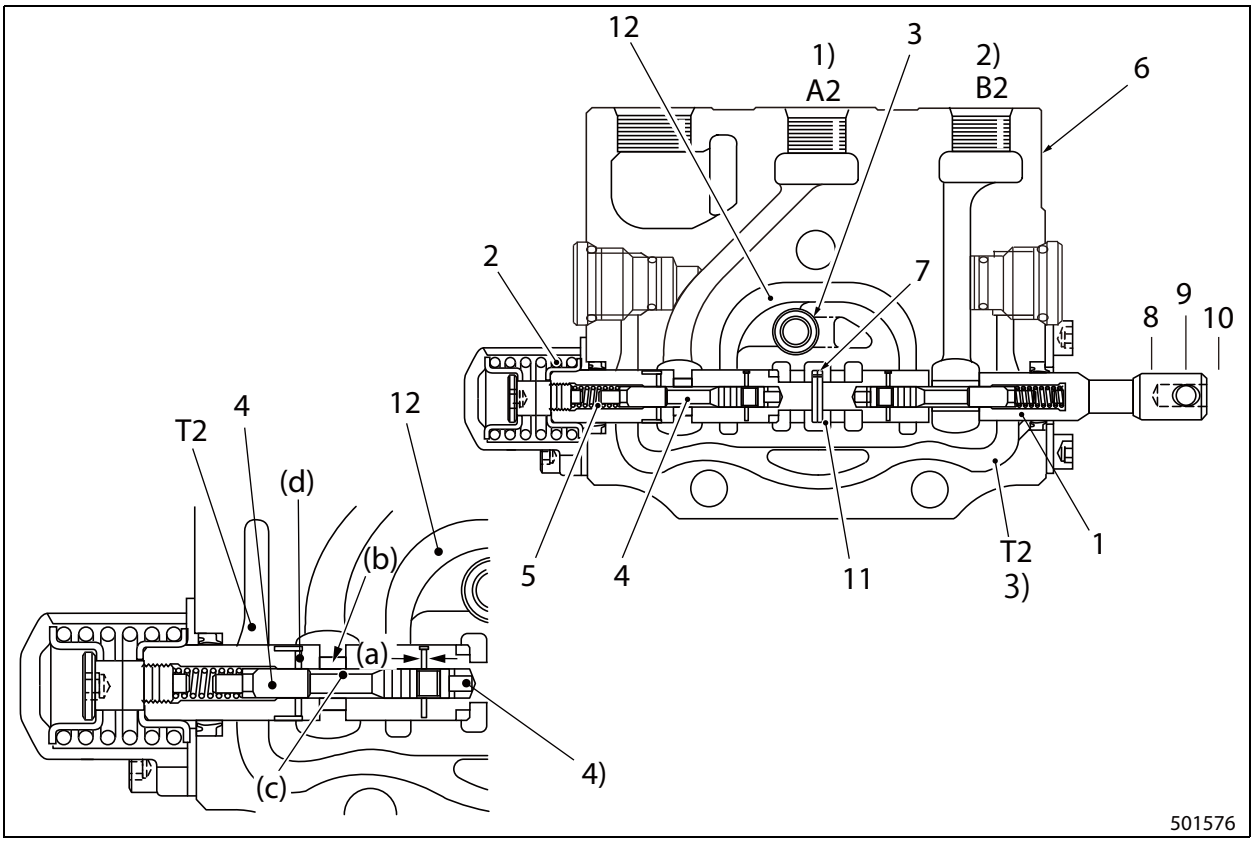
Item	Standard
Main relief valve set pressure	18.1 MPa (184.57 kgf ·cm^2) [2625.2 psi]

Lift Cylinders (Duplex Mast, Triplex Mast First Cylinder)

Ref.	Item		Specified value
1	Inside diameter of cylinder	Standard	70 mm (2.76 in.)
2	Outside diameter of piston rod	Standard	ø50.8 mm (2.00 in.)
3	Tightening torque for retainer	Standard	353 to 380 N·m (36 to 39 kgf·m) [260 to 280 lbf·ft]
4	Amount of hydraulic oil	Standard	20 to 25 cc (1.2 to 1.5 cu.in.)



21.6 Structure - Tilt Valve



1. Tilt spool
2. Return spring
3. Check valve
4. Tilt lock valve
5. Tilt lock valve spring
6. Valve body
7. Hole
8. Forward tilt
9. Neutral
10. Backward tilt
11. Center bypass port
12. Passage A (high-pressure passage)

1) A2 : To tilt cylinder rod
2) B2 : To tilt cylinder head
3) T2 : Tank port (return passage)
4) Chamber

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

Neutral position

Spool 1 is placed at the "neutral position" by return spring 2, and both the A2 port and B2 port are blocked by the spool. As the center bypass valve is open, oil in the bypass port flows in the attachment valve.

Mast backward tilt position :

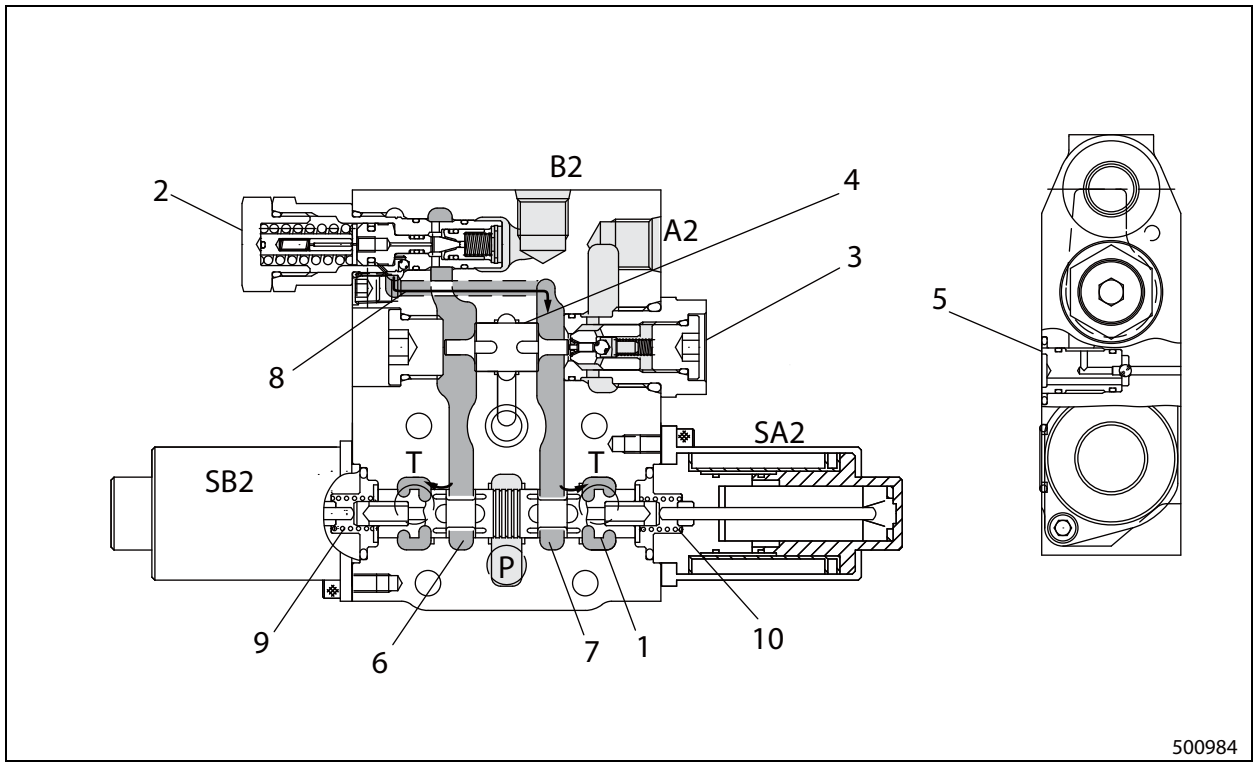
The B2 port is connected to the T2 port and the A2 port is connected to passage A. The spool is positioned to block the center bypass port, but as the spool is provided with a hole under the land, it does not block completely. This is designed to prevent a large amount of oil from flowing at a time to avoid abrupt movement of the cylinder, a characteristic of this valve.

When the center bypass port is blocked, pressure in the parallel feeder rises. Pressure oil pushes open check valve 3, flows in passage A and flows to the tilt cylinder rod from the A2 port.

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. These two actions pull the rod into the tilt cylinder.

22.5 Tilt Valve



1. Tilt spool
2. Tilt lock valve (counter-balance valve)
3. Pilot check valve
4. Piston
5. Shuttle valve
6. Passage to B2 port
7. Passage to A2 port
8. Load pressure passage
9. Spring
10. Spring

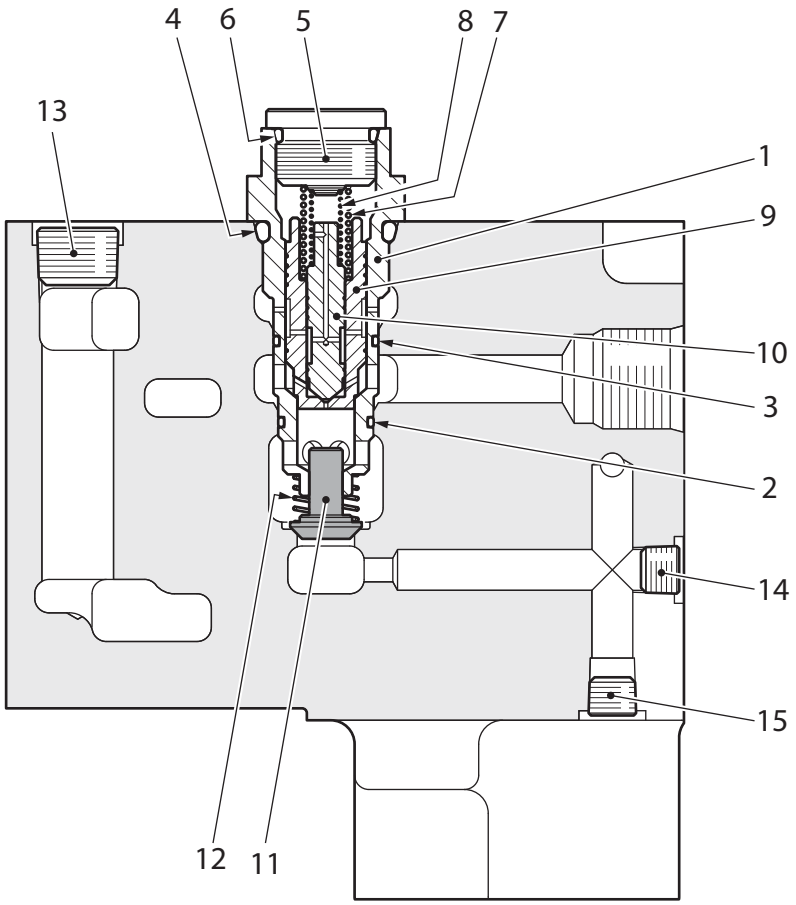
Condition When Joystick is in Neutral Position

Since both of the electromagnetic proportional solenoid valves (SA2 and SB2) are de-energized springs 9 and 10 position in the center, and tilt spool 1 moves in neither direction remaining in the neutral position.

The hydraulic oil of lift/tilt/attachment in bleed-off valve enters oil passage P, and the oil remains there as the exist of the passage P is blocked by the tilt spool 1.

The hydraulic oil from A2 port and B2 port is also blocked by tilt lock valve 2 and pilot check valve 3.

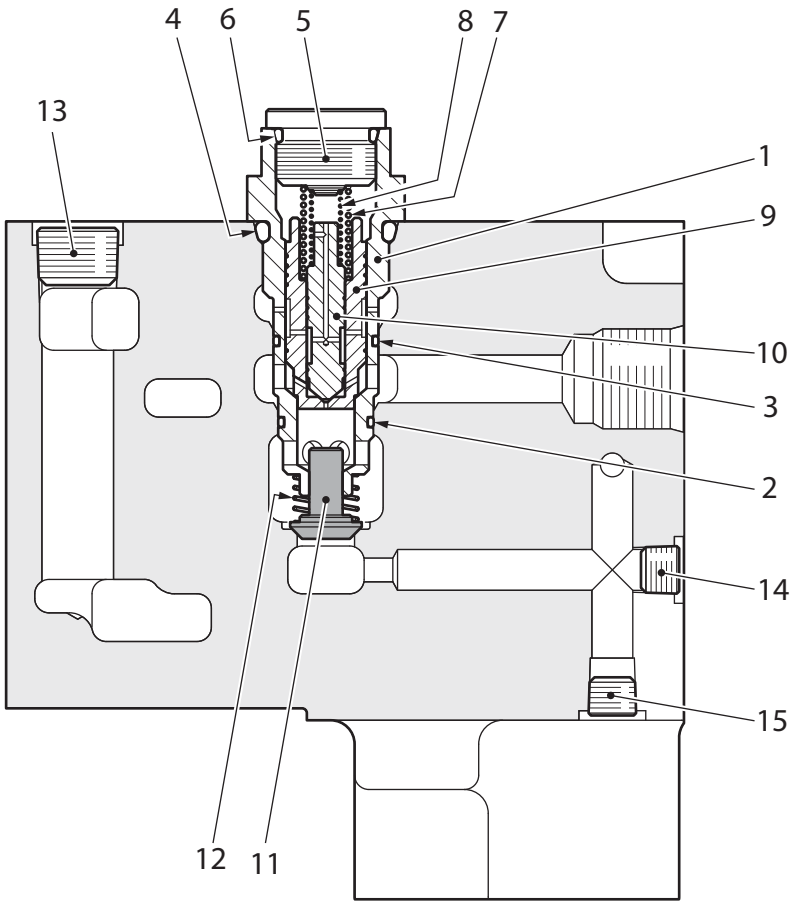
28.3 Disassembly Sequence (Part 3)



1. Valve assembly
2. O-ring
3. O-ring
4. O-ring
5. Plug
6. O-ring
7. Spring
8. Spring
9. Poppet
10. Valve
11. Valve
12. Spring
13. Plug
14. Plug
15. Plug

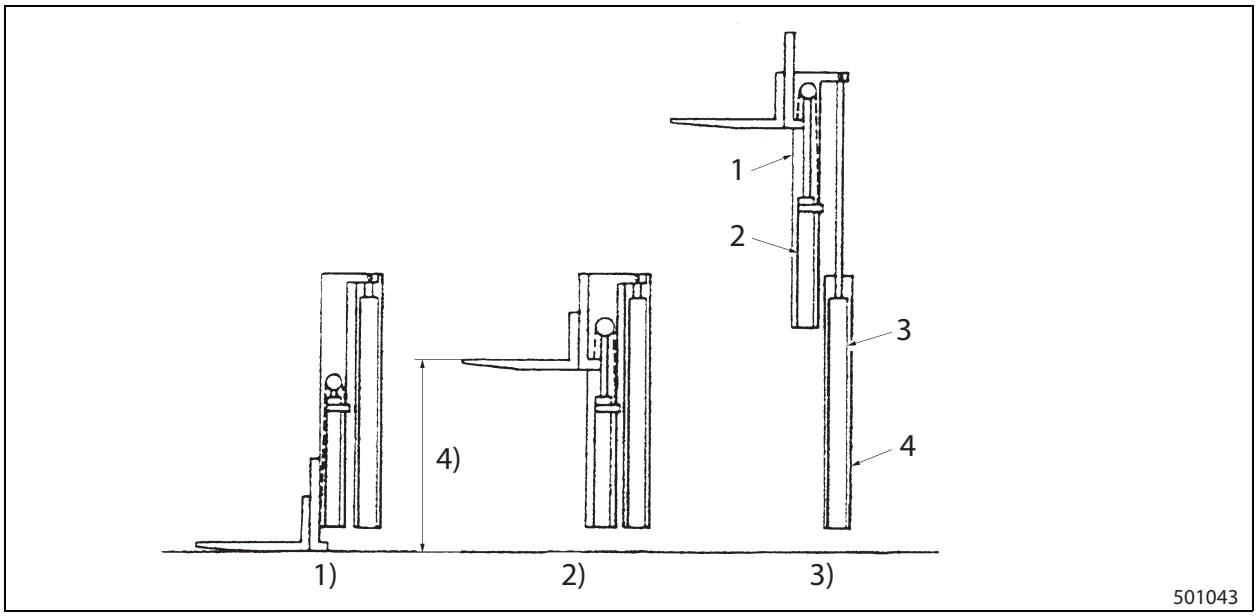
Note: Lift lock valve (1 to 10)

37.2 Disassembly Sequence



1. Body
2. O-ring
3. O-ring
4. O-ring
5. Plug
6. O-ring
7. Spring
8. Spring
9. Poppet
10. Valve
11. Valve
12. Spring
13. Plug
14. Plug
15. Plug

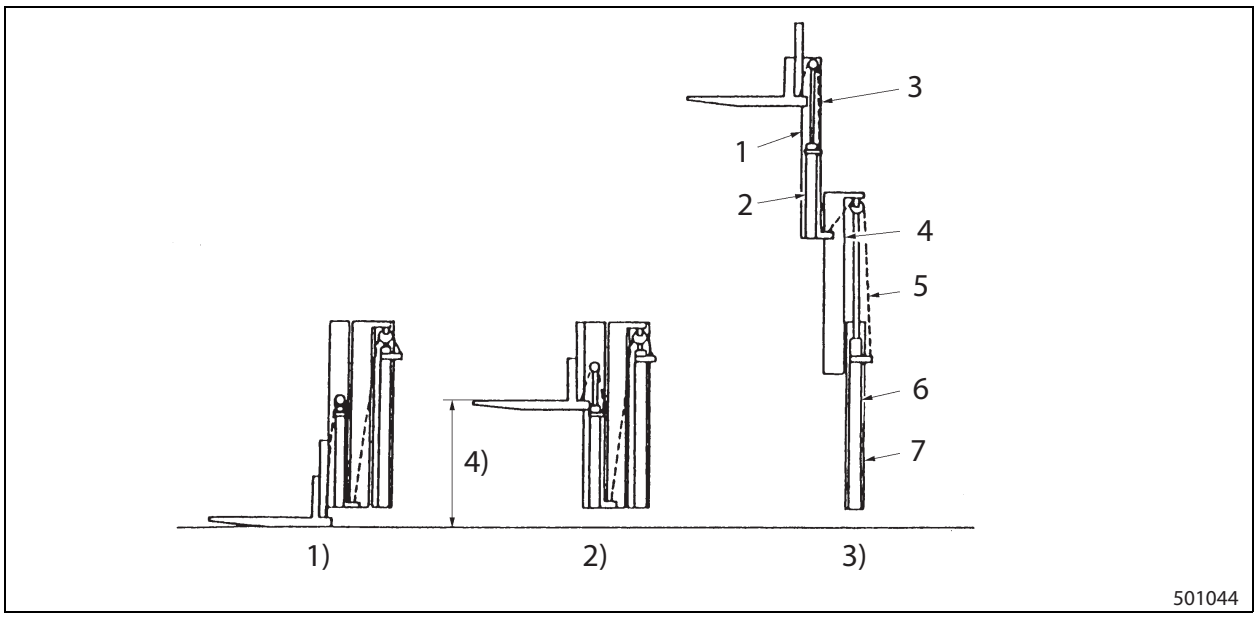
2.4 Operation of Duplex Mast



1. Inner mast
2. First lift cylinder
3. Second lift cylinder
4. Outer mast

1) Forks on the ground
2) Maximum free lift
3) Maximum lift
4) Free-lift height

2.5 Operation of Triplex Mast

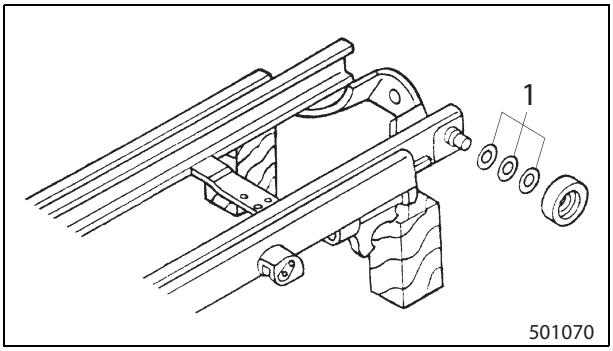


1. Inner mast
2. First lift cylinder
3. First lift chain
4. Middle mast
5. Second lift chain
6. Second lift cylinder
7. Outer mast

1) Forks on the ground
2) Maximum free lift
3) Maximum lift
4) Free-lift height

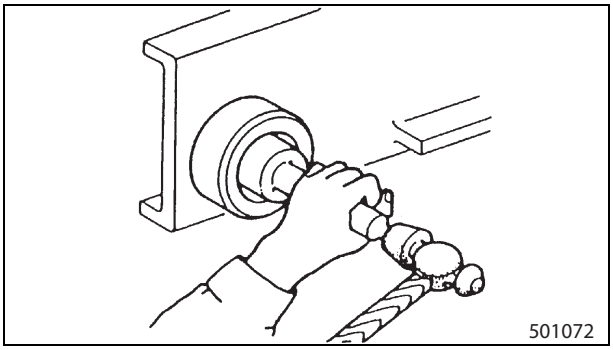
Main rollers

(1) Adjust the right and left clearances by increasing or decreasing the thickness of shims.



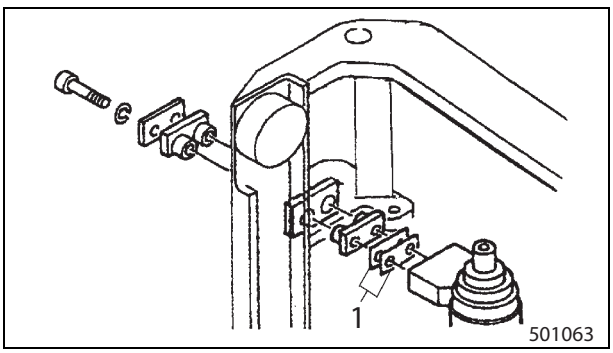
1. Shims

(2) To install main rollers on shafts, use a driving tool. Be careful not to strike the outer roller surface with the driving tool.
Place the roller with its larger chamfered side facing outside.



Cylinder clamp

(3)
Install each lift cylinder in place (in vertical position) by fitting to the support, and see if there is any space between the outer mast and cylinder. Reduce the space, if any, to zero by shimming.



1. Shims

12.2 Chain Tension Adjustment - Simplex Mast

Note: Follow the same chain tightening procedure for all masts except for the Simplex Mast chains on the lift bracket side.

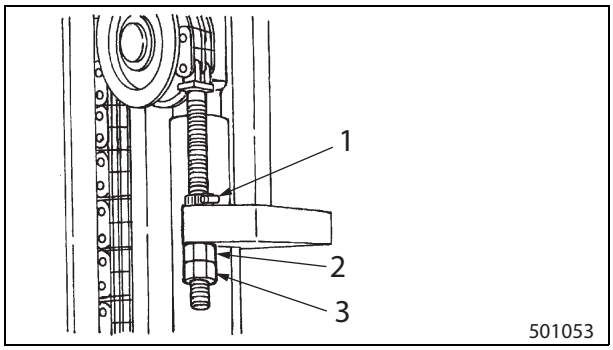
⚠ WARNING

Personal injury can be caused by sudden movement of the mast and lift bracket. Use blocks to fix the mast and lift bracket from any movement while the adjustments are made. Keep hands and feet clear of any parts that can move.

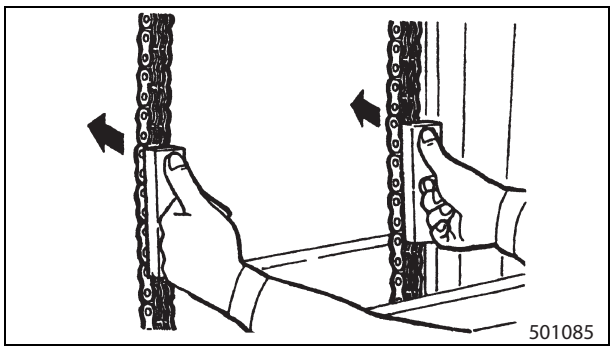
(1) On the level ground, position the mast at a right angle to the ground surface, lower the forks to the ground, and make sure the lift cylinder rods are contracted fully.
(2) Secure the anchor bolts on the lift bracket side by tightening the upper nuts and double nuts.
(3) Adjust the chain tensions by turning the nut on the lift cylinder side. With the mast standing perpendicular to the ground, lift the forks slightly, then press the chains alternately at a midpoint between the chain wheel and the secured end of the chain to make sure the tension is the same in both chains.

Note: Tilting the mast slightly forward causes the chains to sag, thus making it easier to adjust the chain tensions with the double nuts (upper).

(4) Hold the locknut and tighten the locknut to the specified torque.

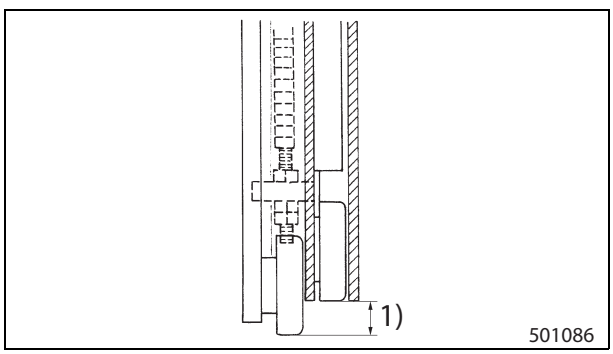


1. Clamp
2. Nut
3. Locknut



Item	Tightening torque
Locknut	98 to 147 N·m (10 to 15 kgf·m) [72.3 to 109 lbf·ft]

(5) With the lift cylinder rods fully contracted, make sure the amount of protrusion of each lift bracket main roller is 40 % of the roller diameter or less.
(6) Make sure that the chain tension is correct with the mast in vertical (0°) position.



1) 40% or less

12.9 Main Roller Shim Replacement - Triplex Mast

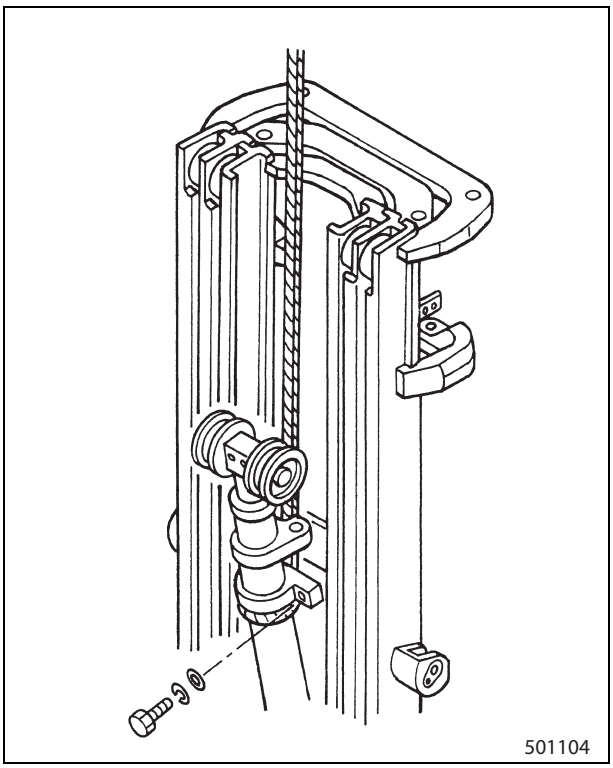
Remove the lift bracket from the mast

Note: Refer to "Removing lift bracket assembly section.

Removing first lift cylinder

(1) Hitch a sling on the first lift cylinder, and suspend it with a hoist. Wind the sling securely to prevent slipping.

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



Position the inner mast lower than the middle mast by following the steps below:

(1) Raise the front end of the truck by 150 to 200 mm (5.91 to 7.87 in.), and place jack stands to support the truck.

(2) Hitch slings to the upper cross-member of the inner mast, and suspend with a hoist.

(3) Remove the chain guards for the second lift chain wheels.

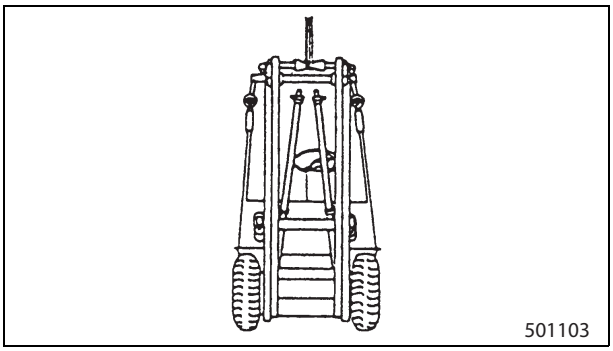
(4) Dismount the second lift chains on the outer mast side, and place them in front of the inner mast.

(5) Lower the inner mast until main rollers can be removed.

(6) Place wood blocks under the inner mast to support.

(7) Now the main rollers can be removed from the inner and outer masts. Remove the mast strips and shims in advance as they drop easily in this condition.

Note: In this condition, second lift cylinders cannot be dismounted.



Inspection/Maintenance Location and Item			Pre-operation Inspection	Periodic Inspection Interval			Remarks Service Standard
				After 1 Months or 200 Hours	Every 6 Months or 1000 Hours	Every 12 Months or 2000 Hours	
Hydraulic system	Cylinders	Looseness, deformation and damage of rods, rod bolts and rod ends				×	
		Cylinder operating condition	×	×	×		
		Drift lowering and forward tilting distances			×		Drift lowering distance: 50 mm (1.97 in.)/15 min Drift forward tilting distance: 22 mm (0.87 in.)/15 min
		Cylinder oil leaks and damage	×	×	×		
		Wear and damage of piston and cylinder shaft bearings				×	
	Oil pump	Oil leaks, abnormal noise, wear in drive unit, and mounting looseness	×	×	×		
	Hydraulic tank	Oil level and contamination	×	×	×	R	N level: 12.1 [11.3] liter (3.2 [2.98] U.S. gal) H level: 13.3 [12.5] liter (3.5 [3.3] U.S. gal) *[ ] is oil circulation
		Suction strainer			C		
		Return filter clogging		R	R		
	Operation levers	Linkage looseness	×	×	×		
		Lever functions	×	×	×		
	Control valves	Oil leaks	×	×	×		
		Safety valves	×	×	×		
		Release pressure measurement				×	18142^{+490}_{0} kPa (185^{+5}_{0} kgf/cm^2) [2631^{+71}_{0} psi]

Chapter 11 Panel Cabin

1. Battery Exchange or Battery Charging

(1) Open the left side steel door (if present)

(2) Open the right side steel door (if present). Unlock the opening mechanism at the top side by pulling knob downwards. Open the door until the mechanism at the top side locks again.

(3) Open the left side PVC door (if present) by unzipping the door from lower front to rear side upper corner. Pull the PVC door to the backside so that it is clear from the battery hood.

(4) Open the right side PVC door (if present) by opening the patch at the top side near the battery slot and fix it to the front side. Unzip the rear zipper to the rear side upper corner. Unzip the front zipper from the bottom side to the top side and separate the zippers. Pull the door to the backside so that it is clear from the battery hood.

(5) Open the rear window (if present) by unlocking both left and right side latches and pushing the rear window to the maximum opening angle.

(6) Open the latch at the roof side by pulling the handle downwards and simultaneously rotating the handle 1/4 turn. Push the latch upwards and backwards until it rests on the rubber stopper on the roof

(7) Open the battery hood and exchange or charge the battery as normal.

(8) Close rear windows and doors in opposite order after battery is exchanged or charged.

Note:

- For zipping up the right hand side PVC door the rear zipper must be kept in the corner position to leave enough slack to fix the front side zipper again. DO NOT use excessive force to connect the front side zipper.
- For closing the right hand side steel door the lock mechanism must be unlocked again by pulling the knob downwards. Taken care that the opening mechanism returns to the original position correctly.

2. Cleaning Top Roof

- Wash polycarbonate top window with a mild soap or detergent and lukewarm water, using a clean sponge or a soft cloth. Rinse well with clean water. DO NOT scrub or use brushes or abrasives on these products.
- Filter for the heater (if present) must be cleaned every 1000 hours or 6 months. Filter must be cleaned with dry air only.

3. Replacing Top Roof

(1) The top roof must be replaced if any scratches are visible or if reduced transparency does not allow safe load handling at heights anymore.

(2) Screws and washers with which window is fixed to Overhead Guard at rear side must be released. Window to be replaced must be cut loose from kit. Take window out and remove kit from Overhead Guard structure.

(3) Clean Overhead Guard and treat with primer

(4) Replace top screen only by OEM original product.

(5) Put foam seal on Overhead Guard structure under dash

(6) Put new screen under rib at front side of Overhead Guard and fix at rear side with screws with washer

(7) Apply kit to fill gap between Overhead Guard structure and top screen to ensure watertight fitment.

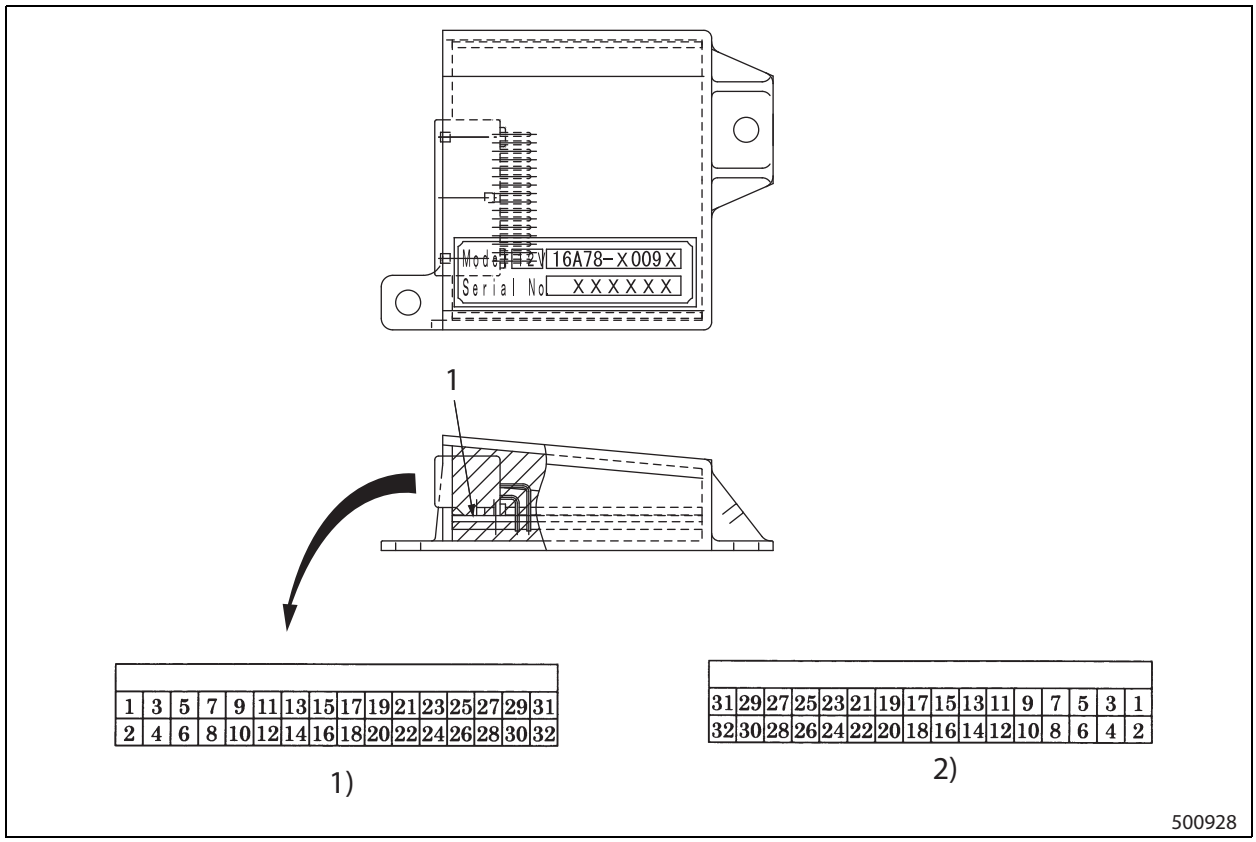
4. Maintenance

- The washer bottle for the front and rear wipers is located under the floor plate. To fill the washer tank please remove the floor mat and floor plates, release the filler cap and fill up. Use appropriate fluids.
- Fuses for all panel cabin features are located in a designated panel cab fuse box integrated into the cabin harness and located near the fixation of the rear right side over head guard leg to the frame. Box can be accessed by opening the battery hood. Fuses are used for;
  - Heater element (2x)
  - Heater fan
  - Wipers
  - 12V connection

1.6 Outline of Input unit

This input unit is connected to the FC specification model.

It is the dedicated input unit for connecting equipment such as the FC control levers and switches. It monitors for the malfunction of connected equipment and its condition. When a malfunction occurs, it informs to the logic unit.



1. Input unit card

1) Input unit card side
2) FC-IN harness side E-12

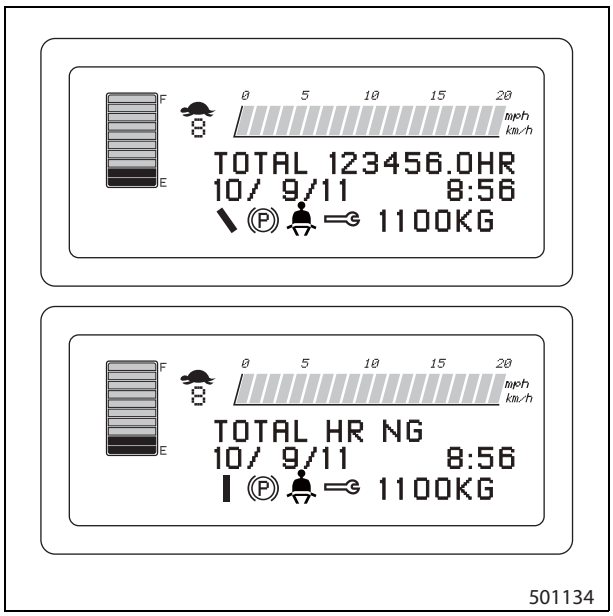
4.6 Hour Meter

The truck hour meter reading is indicated on the display.

Also, the traveling/load, handling/steering hour meter readings can be confirmed using service tool.

When a difference of the hour meter reading between the logistics and EPS controller exceeds 1 hour, “HR NG” will be indicated on the display.

Upon receiving a request of hour meter adjustment from the service tool, the smaller hour meter reading will be rewritten to longer service hour reading so that the hour meter readings between the logics and EPS controller will be matched.



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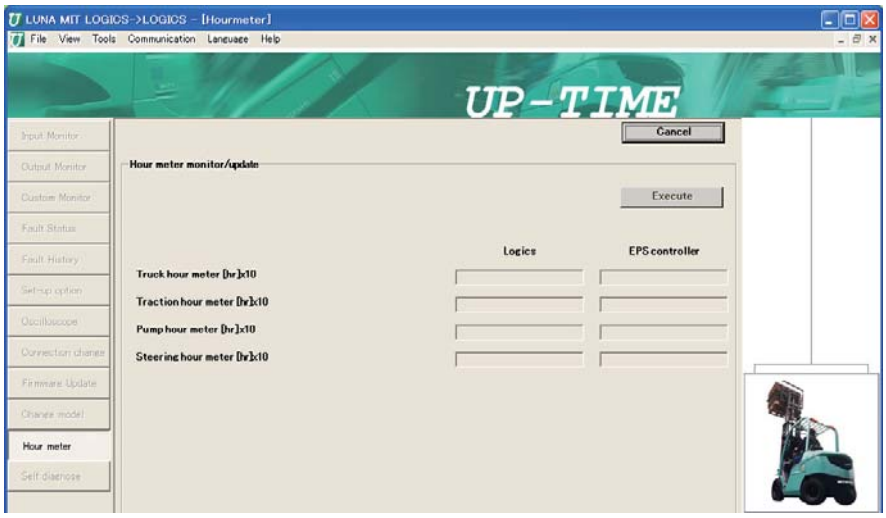

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#43 Hydraulic Control Selection

This setting defines the type of hydraulic control.

0: FC system 1: MC system

#44 Mast Type

This setting defines the type of the mast.
2-FF: 2-stage full-free
3-FF: 3-stage full-free
2-SP: 2-stage panorama

#45 Valve Section

This setting defines the number of valve sections.

1: 3-way (lift, tilt, attachment 1)

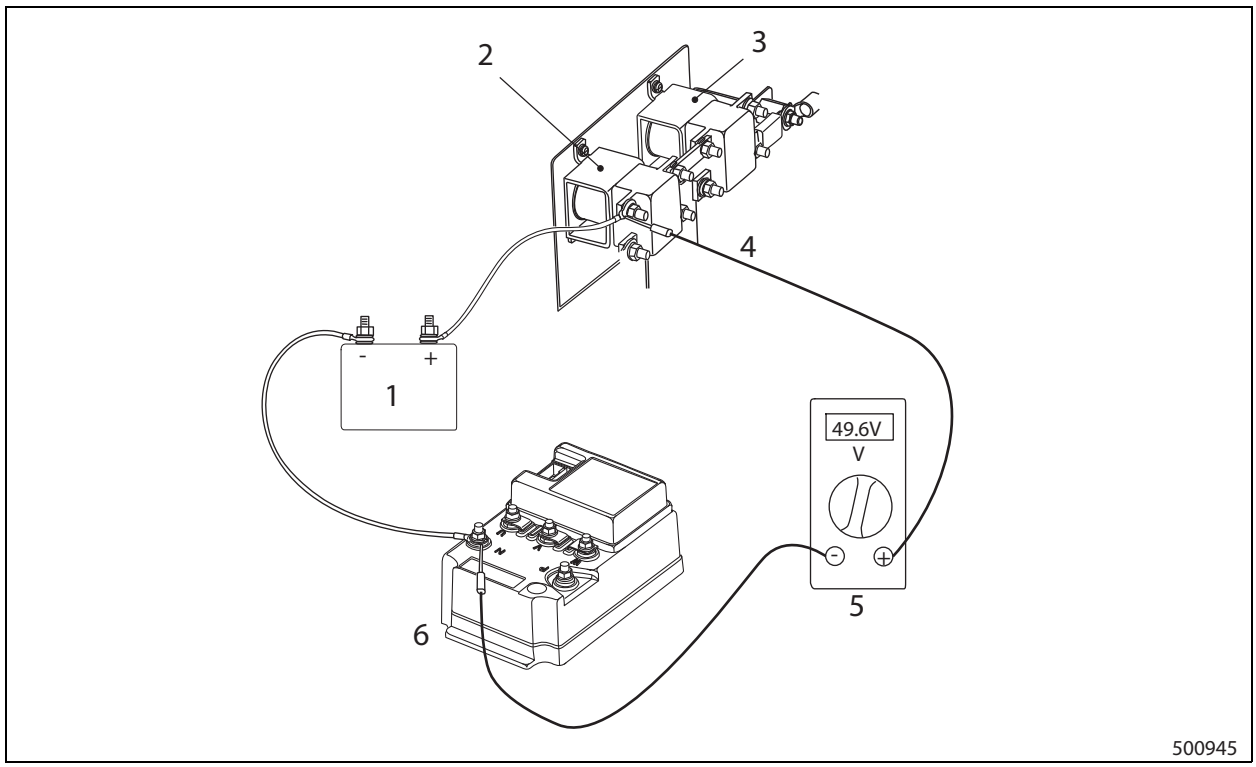
2: 4-way (lift, tilt, attachment 1, 2)

#46 Battery Voltage Adjust

This setting corrects the difference between the actual battery voltage and controller-recognized battery voltage. The display shows battery voltage which the controller recognizes.

Measure actual battery voltage using a tester (or a multi-meter) and operate service tool.

Refer to the "Measurement of battery voltage" below.



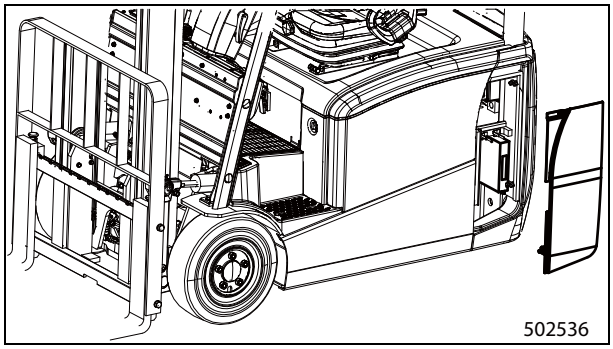
1. Battery
2. Pump contactor
3. Line contactor
4. Contactor
5. Tester or Multi-meter
6. Right traction inverter

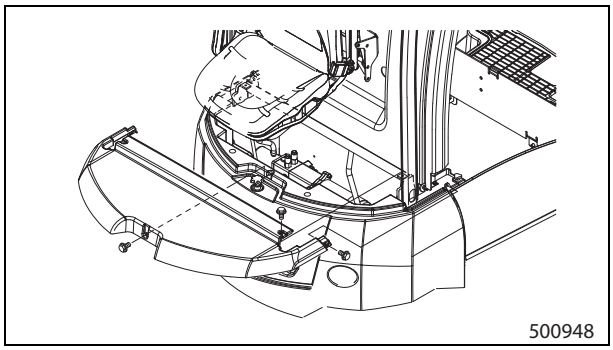
Error Code	Fault	Error condition	Display						Fault history record	Steering operation	Lift lowering	Restriction	To return to normal
			I CON										
			Battery	Brake fluid	Overheat	Mast lock	Neutral lock	Exclamation					
16	Traction Motor R.H., Stall Timer	Stall condition exceeds 7 sec. (estimated time to the boost stop)						*	*	○	○	Normal stop	Turn key OFF
24	Traction Motor L.H. Current Sensor Fault	Current sensor offset mean value is ± 120A or more.						*	*	○	○	Normal stop	Turn key OFF
25	Traction Motor L.H., Over-current	Current value exceeding 586 Arms in 1.6 mm sec. , or exceeding 631 Arms in 1 m sec., or exceeding 781 Arms instantaneously.						*	*	○	○	Normal stop	Turn key OFF
26	Traction Motor L.H., Stall Timer	Stall condition exceeds 7 sec. (estimated time to the boost stop)						*	*	○	○	Normal stop	Turn key OFF
34	Pump Motor Current Sensor Fault	Current sensor offset mean value is ± 120 A or more.						*	*	○	○	Normal stop	Turn key OFF
35	Pump Motor Over-current	Current value exceeding 586 Arms in 1.6 mm sec. , or exceeding 631 Arms in 1 m sec., or exceeding 781 Arms instantaneously.						*	*	○	○	Normal stop	Turn key OFF
40	Line Contactor Fault	The difference in voltage between battery and inverter is 7 V DC or more.						*	*	○	○	Normal stop	Turn key OFF
41	Steering Contactor Fault	The difference in voltage between battery and power steering controller is 7 V DC or more.						*	*	×	○	Steering emergency stop	Turn key OFF
45	Traction Motor R.H. Open	Traction motor disconnected when the power is turned on.						*	*	○	○	Normal stop	Turn key OFF
46	Traction Motor L.H. Open	Traction motor disconnected when the power is turned on.						*	*	○	○	Normal stop	Turn key OFF
47	Pump Motor Open	Pump motor disconnected when the power is turned on.						*	*	○	○	Normal stop	Turn key OFF
49	PS Motor Open	PS motor disconnected when the power is turned on.						*	*	×	○	Steering emergency stop	Turn key OFF
50	Tire Angle Sensor Fault	Tire angle sensor output 0.2 V or lower, or 4.8 V or higher, or inconsistent data.						*	*	○	○	Driving power reduction	Turn key OFF
		Tire angle sensor output 0.2 V or lower, or 4.8 V or higher, or inconsistent data.						*	*	×	○	Steering emergency stop	Turn key OFF

7.4 Replacing Logic Unit

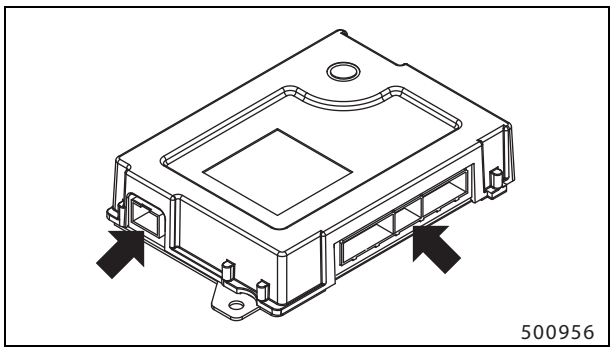
Removal

(1) Turn OFF the key switch.
(2) Disconnect the battery plug/connector.
(3) Remove the side cover. (3-Wheel model)
Remove the rear cover. (4-Wheel model)





(4) Disconnect the connector from the logic card and power supply card.



⚠ CAUTION

When disconnecting the connector, hold the connector housing and plug, and unlock the connector.

Holding the case may cause damage to the inside card, while holding the cable may cause wire breakage.

(5) Remove M8 bolts (two places) and remove the logic unit.

Installation

Follow the removal sequence in reverse.

Output unit card voltage chart

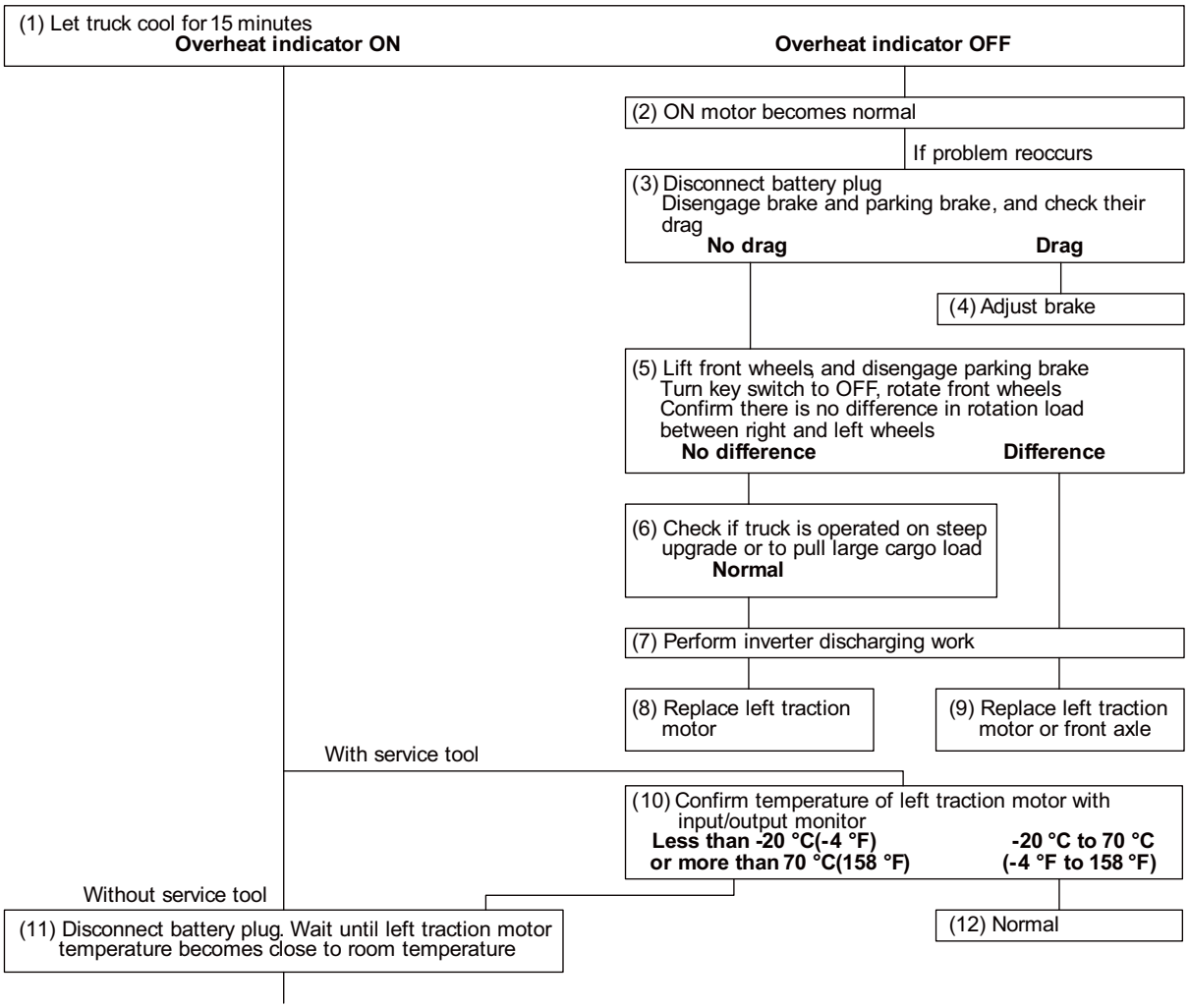
CN3

No.	Name	Stand-by voltage	Active voltage	Note
1	GND	0V	0V	
2	GND	0V	0V	
3	VE	Vbatt	Vbatt	
4	VE	Vbatt	Vbatt	
5	NODE 0	-	-	
6	NODE 1	-	-	
7	GND	0V	0V	
8	GND	0V	0V	
9	GND	0V	0V	
10	RS-232 Tx	0 to 12V	0 to 12V	
11	RS-232 Rx	0 to 12V	0 to 12V	
12	RS-232 GND	0V	0V	
13	CAN H	0 to 5V	0 to 5V	
14	CAN L	0 to 5V	0 to 5V	
15	CAN R+	-	-	
16	CAN R-	-	-	
17	RBOOT MODE	-	-	
18	-			
19	GND	0V	0V	
20	+VL	13.0 to 16.0V	13.0 to 16.0V	
21	SOL PWM 1+	0V	0 to Vbatt	LIFT VALVE A
22	SOL PWM 2+	0V	0 to Vbatt	LIFT VALVE B
23	SOL PWM 1-/2-	0V	0 to 0.5V	LIFT VALVE -
24	SOL PWM 3+	0V	0 to Vbatt	TILT VALVE A
25	SOL PWM 4+	0V	0 to Vbatt	TILT VALVE B
26	SOL PWM 3-/4-	0V	0 to 0.5V	TILT VALVE -
27	SOL PWM 5+	0V	0 to Vbatt	ATTACH 1 VALVE A
28	SOL PWM 6+	0V	0 to Vbatt	ATTACH 1 VALVE B
29	SOL PWM 5-/6-	0V	0 to 0.5V	ATTACH 1 VALVE -
30	SOL PWM 7+	0V	0 to Vbatt	ATTACH 2 VALVE A
31	SOL PWM 8+	0V	0 to Vbatt	ATTACH 2 VALVE B
32	SOL PWM 7-/8-	0V	0 to 0.5V	ATTACH 2 VALVE -
33	SOL PWM 9+	0V	0 to Vbatt	SPEED ALARM +
34	SOL PWM 10+	0V	0 to Vbatt	
35	SOL PWM 9-/10-	0V	0 to 0.5V	SPEED ALARM -
36	-			

3.2 Traction Motor L.H.,Overheating (E1)

Error code: E1	
Situation	Controller/motor overheat indicator ON. Poor pulling power and acceleration. Normal pump motor and power steering operations. Service tool "Alarm status" and "E1" displayed.
Possible cause	Overheating of left traction motor, faulty left traction motor or thermal sensor, faulty or open harness wiring, faulty left traction inverter DSP card, abnormal power supply of logic unit, brake or parking brake drag, abnormality in front axle, faulty display unit
Trigger of the error code	Motor temperature is out of range of -25 °C to 145 °C (-13 °F to 293 °F). Recovers when motor temperature is in range of -20 to 70 °C (-4 to 158 °F).

Checks



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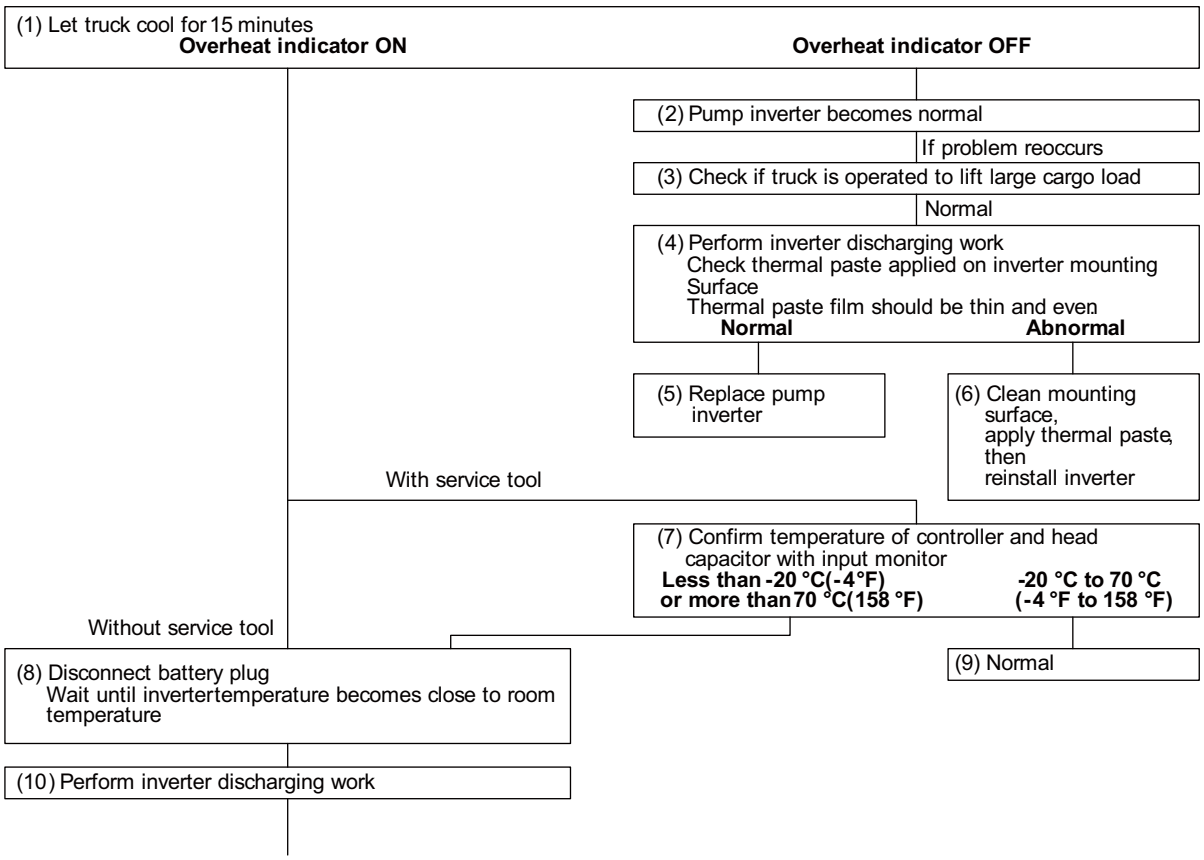
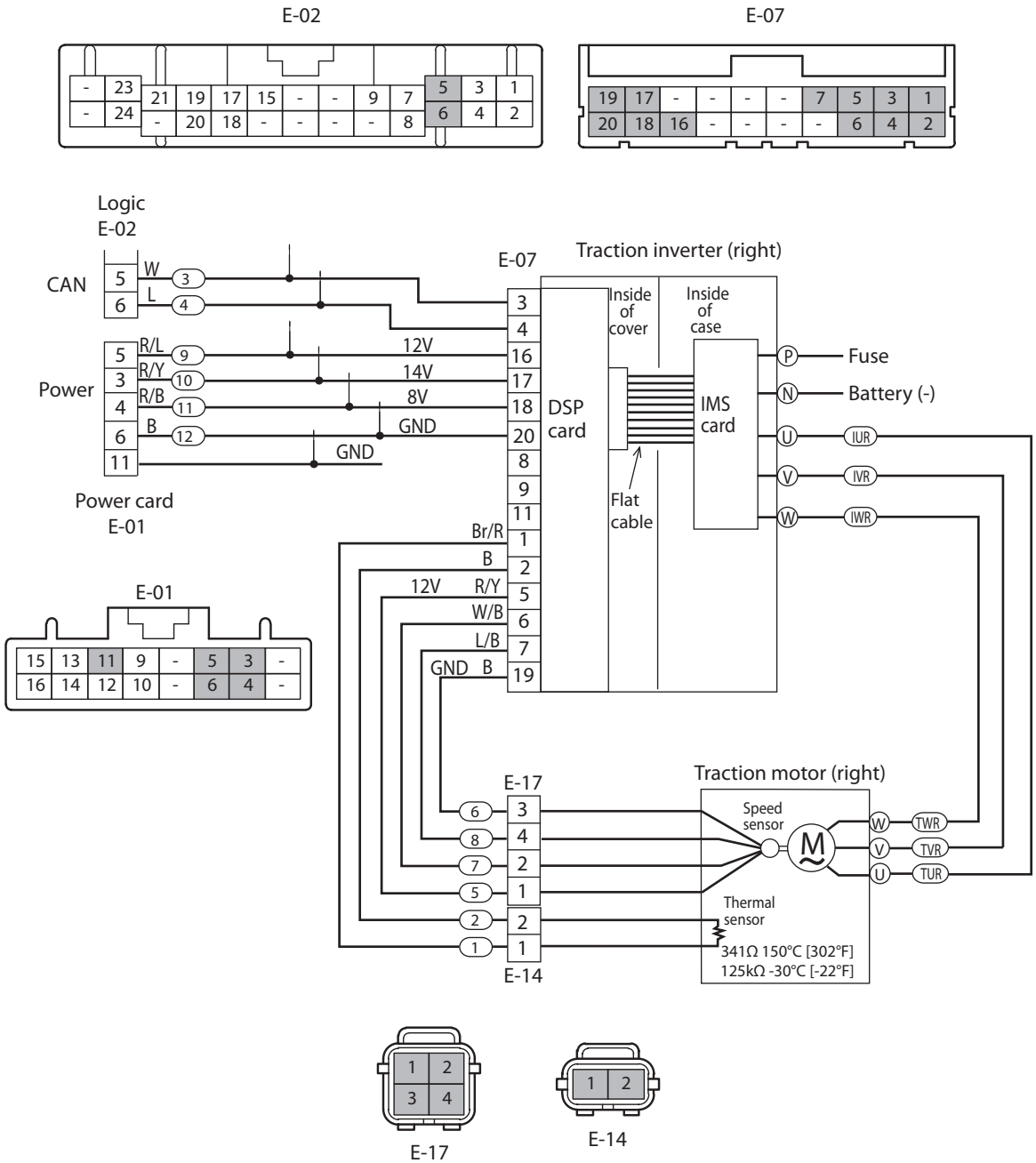
3.6 Pump Inverter, Overheating (E7)

Error code: E7	
Situation	Controller/motor overheat indicator ON. Lifting speed slower than normal. Normal traction motor and power steering operations. Service tool "Alarm status" and "E7" displayed.
Possible cause	Overheating of pump inverter, faulty pump inverter thermal sensor, open harness wiring, faulty pump inverter PC board, abnormal power supply of logic unit, faulty radiation of pump inverter, faulty display unit.
Trigger of the error code	Controller temperature is out of range of -25 °C to 100 °C (-13 °F to 212 °F). Capacitor temperature is out of range of -25 °C to 110 °C (-13 °F to 230 °F). Recovers when temperature is in range of -20 to 70 °C (-4 to 158 °F).

Checks



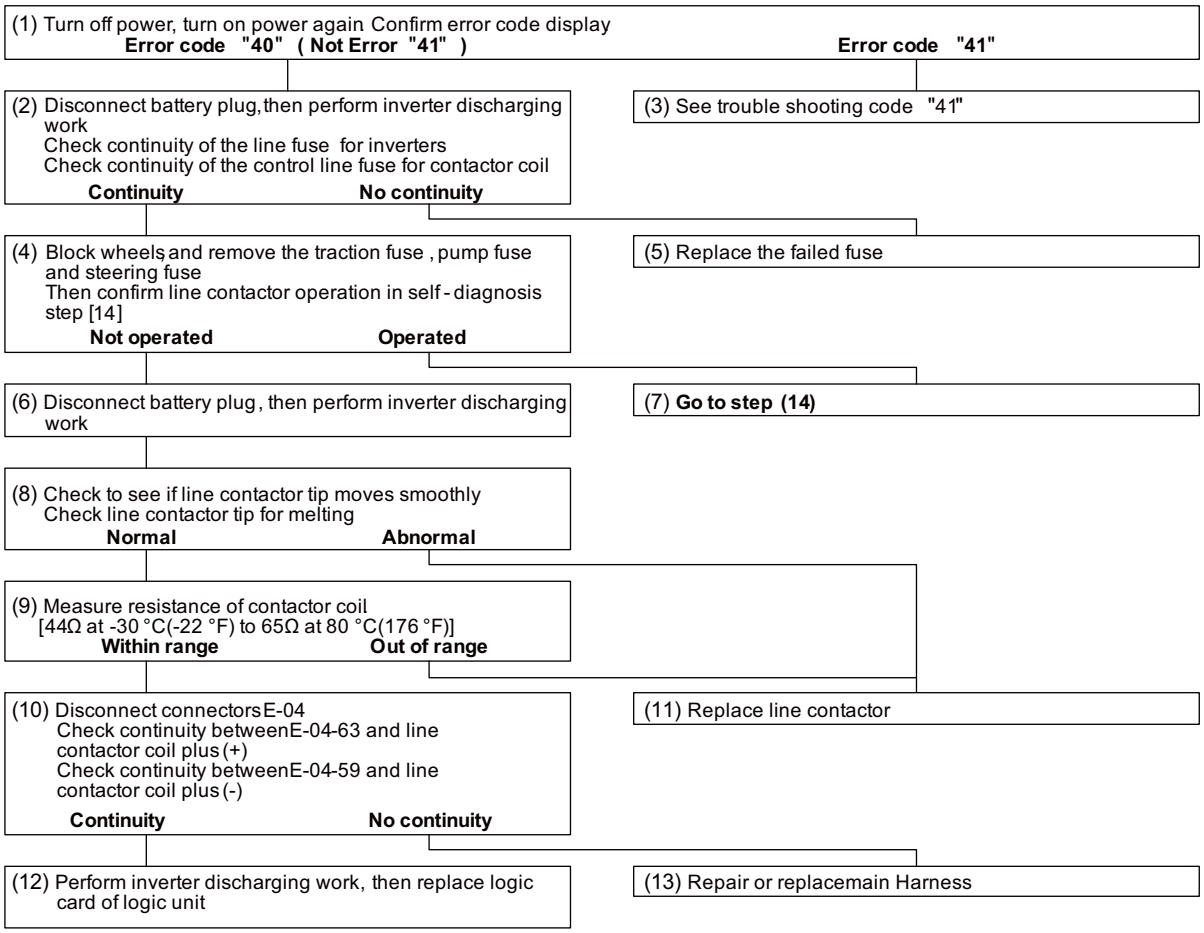
502813


E-02
E-07
Logic
E-02
CAN
Power
Power card
E-01
E-01
Traction inverter (right)
E-07
Inside of cover
Inside of case
DSP card
IMS card
Flat cable
Fuse
Battery (-)
12V
14V
8V
GND
GND
Br/R
B
12V R/Y
W/B
L/B
GND B
Traction motor (right)
E-17
E-14
Speed sensor
Thermal sensor
341Ω 150°C [302°F]
125kΩ -30°C [-22°F]
E-17
E-14
501135

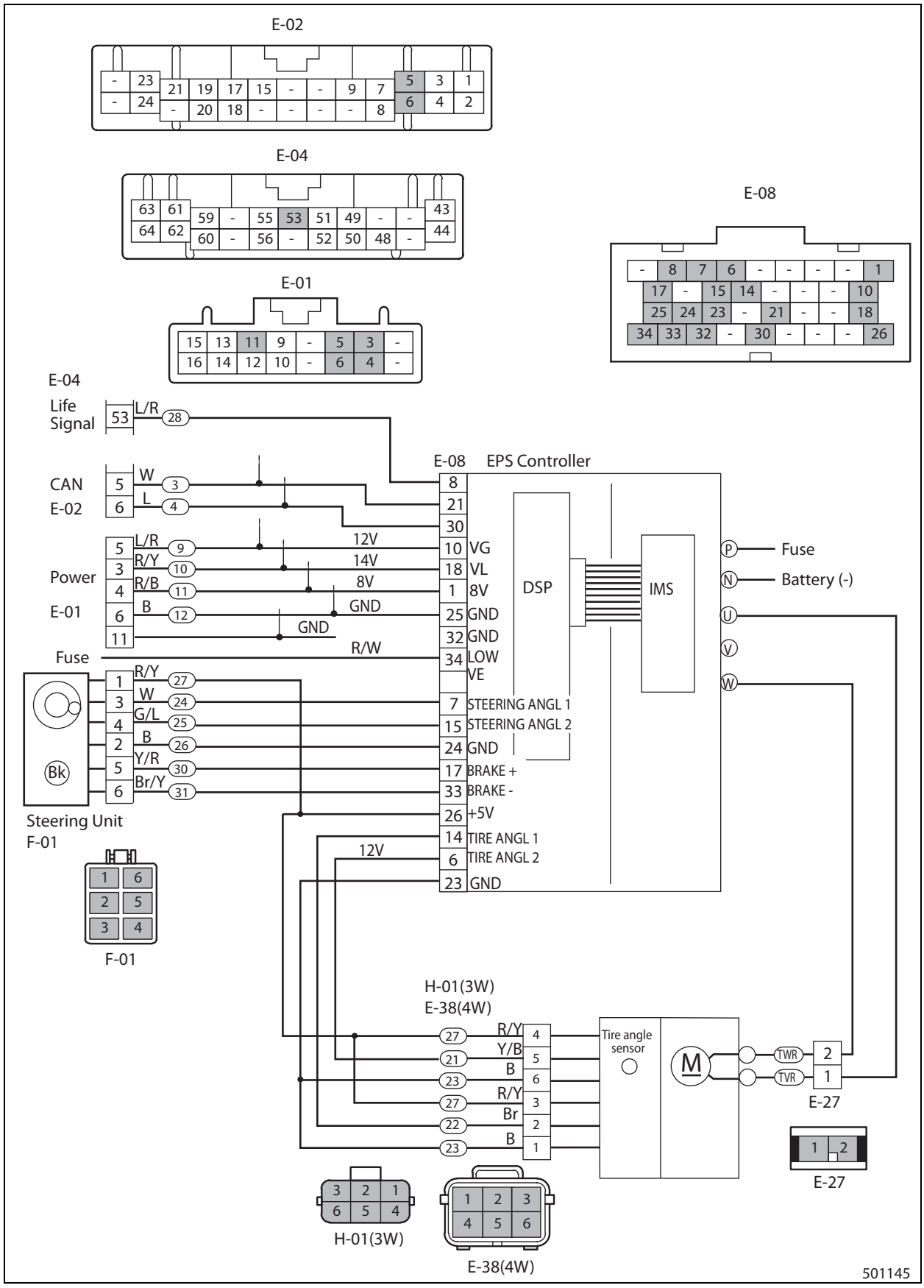
3.16 Line Contactor Fault (40)

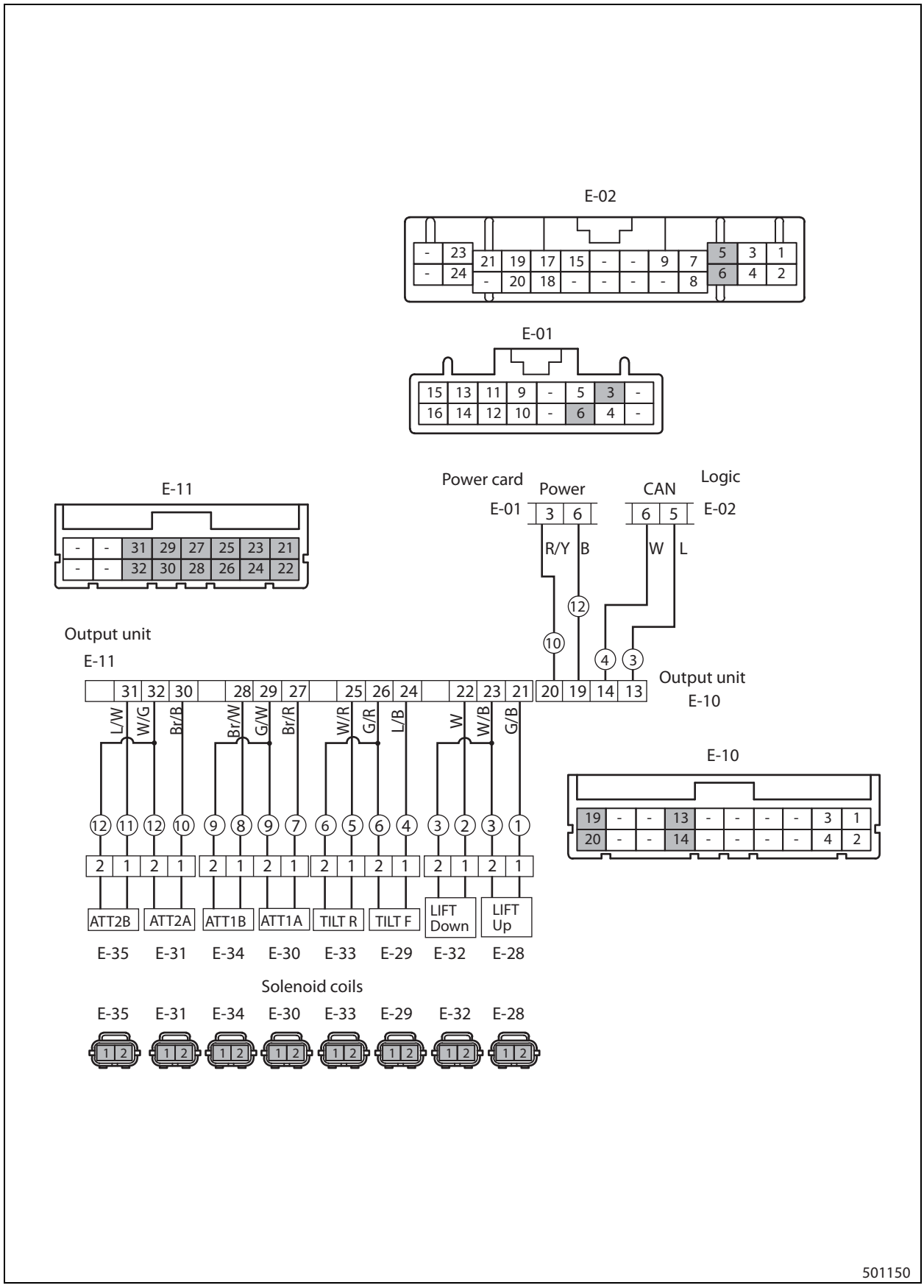
Error code: 40	
Situation	Display: "40". Traction motor and pump motor operation inhibited. Line and steering contactor HOLD. If this fault occurs before steering contactor CLOSE, all operations inhibited except mast lowering operation.
Possible cause	Break of line fuse. Faulty line contactor. Faulty right, left traction inverter or pump inverter. Faulty DSP card in right, left traction inverter. Faulty main harness. Faulty logic unit.
Trigger of the error code	Inverter voltage data is checked when contactor is closed (400 ms).

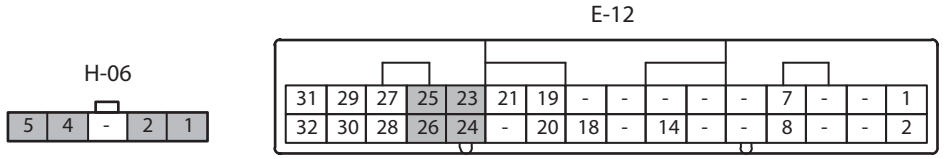
Checks



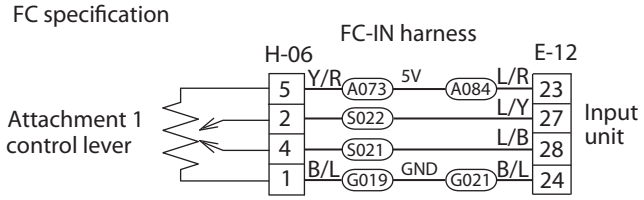
502827


E-02
E-04
E-08
E-01
E-04
Life Signal
53
L/R
28
E-08 EPS Controller
CAN
E-02
5
6
W
L
3
4
8
21
30
Power
E-01
5
3
4
6
11
L/R
R/Y
R/B
B
9
10
11
12
12V
14V
8V
GND
GND
R/W
10 VG
18 VL
1 8V
25 GND
32 GND
34 LOW VE
DSP
IMS
P
N
U
V
W
Fuse
Battery (-)
Fuse
Bk
1
3
4
2
5
6
R/Y
W
G/L
B
Y/R
Br/Y
27
24
25
26
30
31
7 STEERING ANGL 1
15 STEERING ANGL 2
24 GND
17 BRAKE +
33 BRAKE -
26 +5V
14 TIRE ANGL 1
6 TIRE ANGL 2
23 GND
Steering Unit
F-01
F-01
12V
H-01(3W)
E-38(4W)
27
21
23
27
22
23
R/Y
Y/B
B
R/Y
Br
B
4
5
6
3
2
1
Tire angle sensor
M
TWR
TVR
2
1
E-27
E-27
H-01(3W)
E-38(4W)
501145

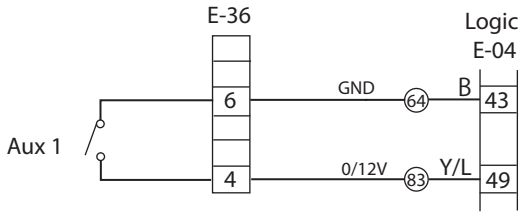

E-02
E-01
E-11
Power card
Power
CAN
Logic
E-01
E-02
R/Y
B
W
L
Output unit
E-11
Output unit
E-10
L/W
W/G
Br/B
Br/W
G/W
Br/R
W/R
G/R
L/B
W
W/B
G/B
ATT2B
ATT2A
ATT1B
ATT1A
TILT R
TILT F
LIFT Down
LIFT Up
E-35
E-31
E-34
E-30
E-33
E-29
E-32
E-28
Solenoid coils
E-10
501150

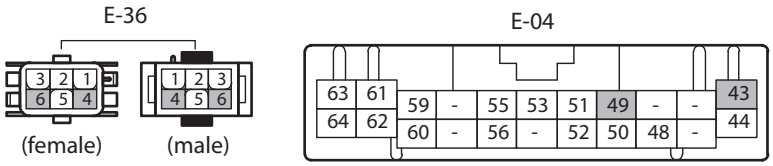


FC specification



MC specification





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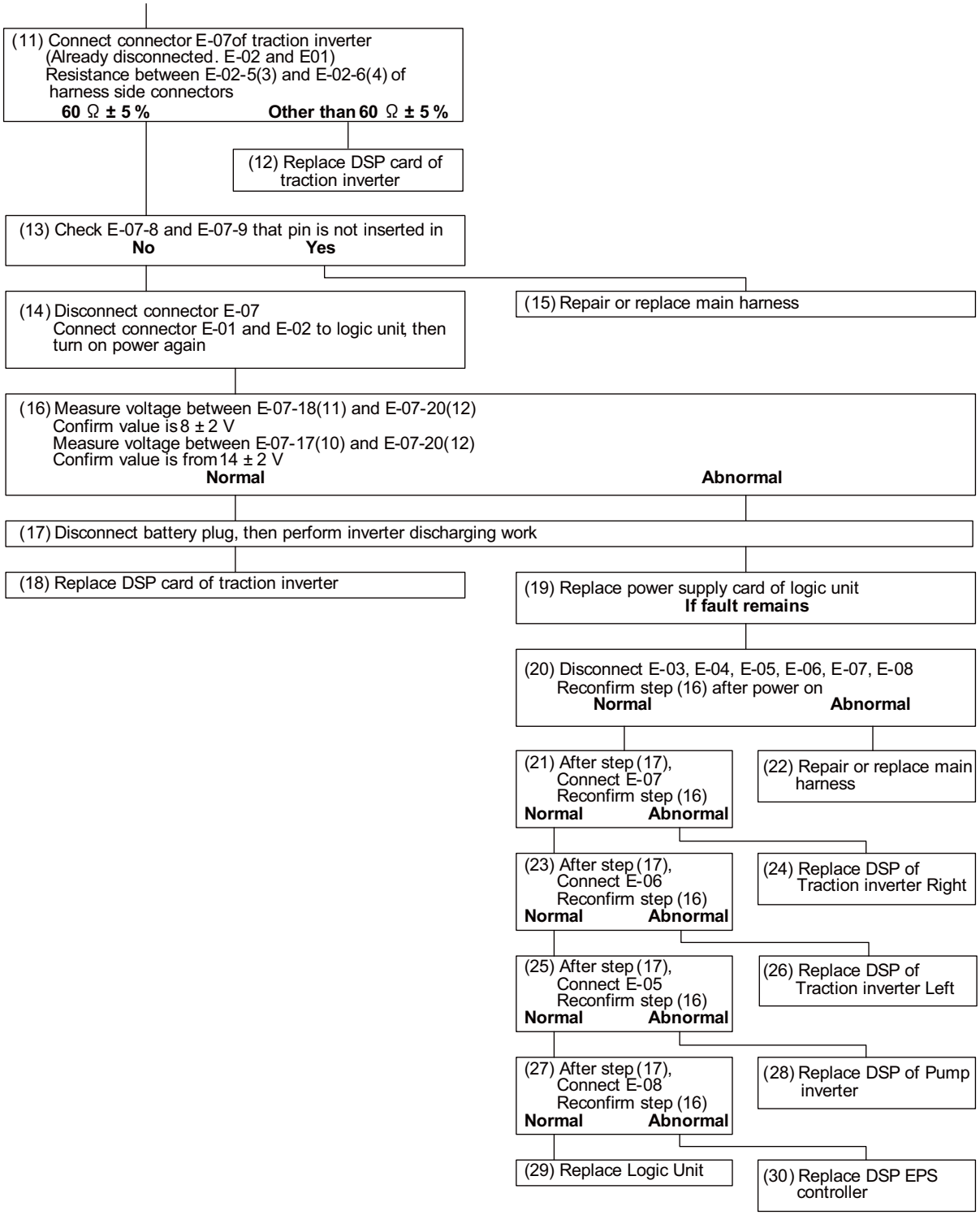
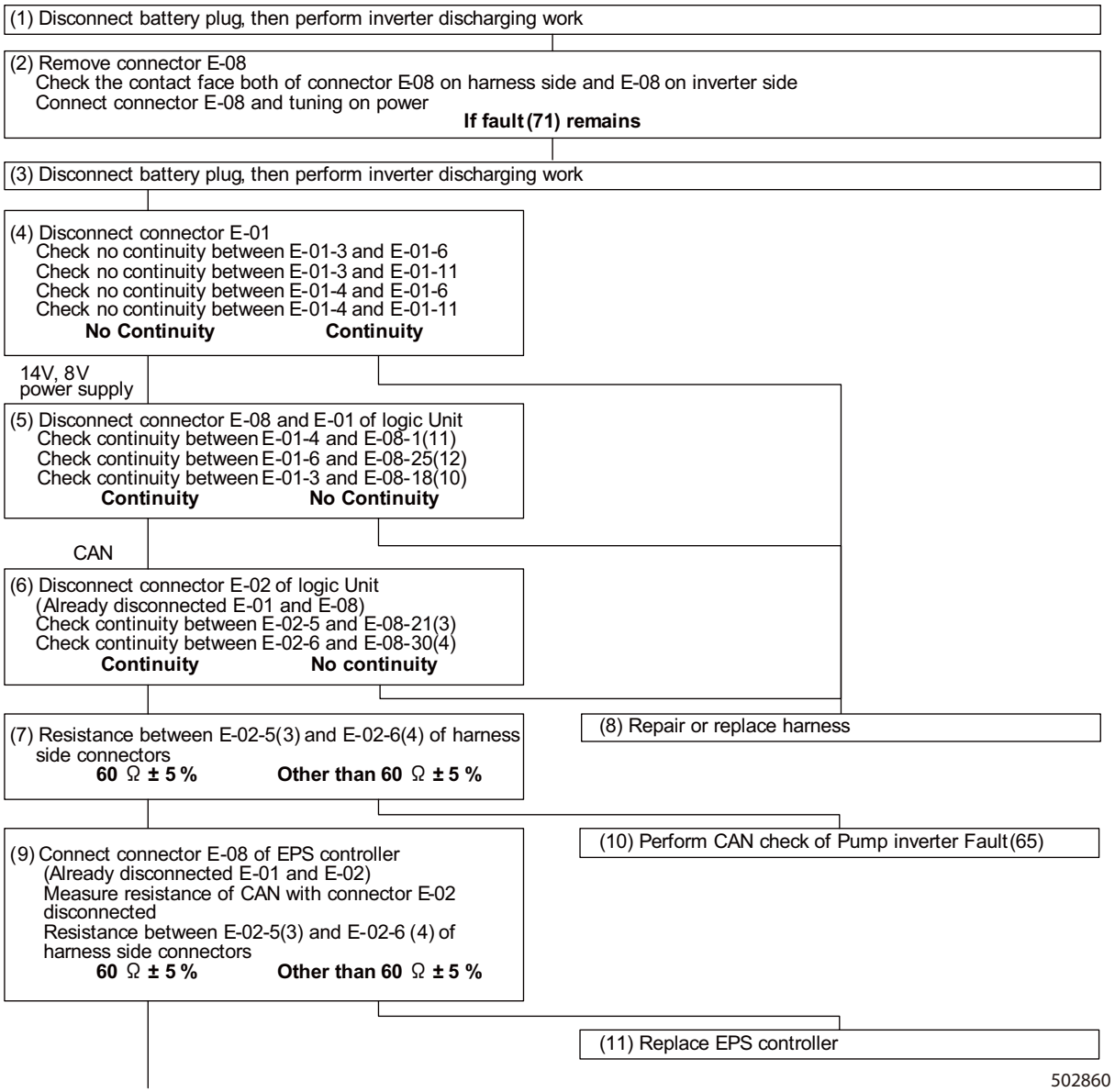

(11) Connect connector E-07of traction inverter
(Already disconnected. E-02 and E01)
Resistance between E-02-5(3) and E-02-6(4) of
harness side connectors
60 Ω ± 5 %
Other than 60 Ω ± 5 %
(12) Replace DSP card of traction inverter
(13) Check E-07-8 and E-07-9 that pin is not inserted in
No
Yes
(14) Disconnect connector E-07
Connect connector E-01 and E-02 to logic unit, then turn on power again
(15) Repair or replace main harness
(16) Measure voltage between E-07-18(11) and E-07-20(12)
Confirm value is 8 ± 2 V
Measure voltage between E-07-17(10) and E-07-20(12)
Confirm value is from 14 ± 2 V
Normal
Abnormal
(17) Disconnect battery plug, then perform inverter discharging work
(18) Replace DSP card of traction inverter
(19) Replace power supply card of logic unit
If fault remains
(20) Disconnect E-03, E-04, E-05, E-06, E-07, E-08
Reconfirm step (16) after power on
Normal
Abnormal
(21) After step (17),
Connect E-07
Reconfirm step (16)
Normal
Abnormal
(22) Repair or replace main harness
(23) After step (17),
Connect E-06
Reconfirm step (16)
Normal
Abnormal
(24) Replace DSP of Traction inverter Right
(25) After step (17),
Connect E-05
Reconfirm step (16)
Normal
Abnormal
(26) Replace DSP of Traction inverter Left
(27) After step (17),
Connect E-08
Reconfirm step (16)
Normal
Abnormal
(28) Replace DSP of Pump inverter
(29) Replace Logic Unit
(30) Replace DSP EPS controller

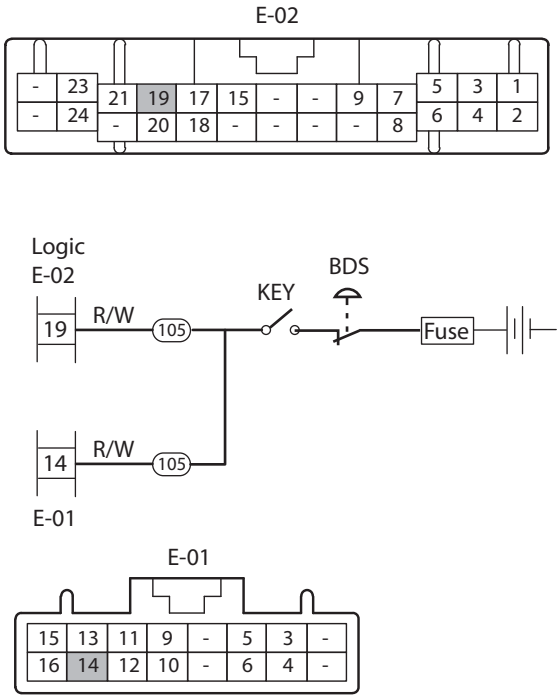
502853

3.45 EPS Controller Fault (71)

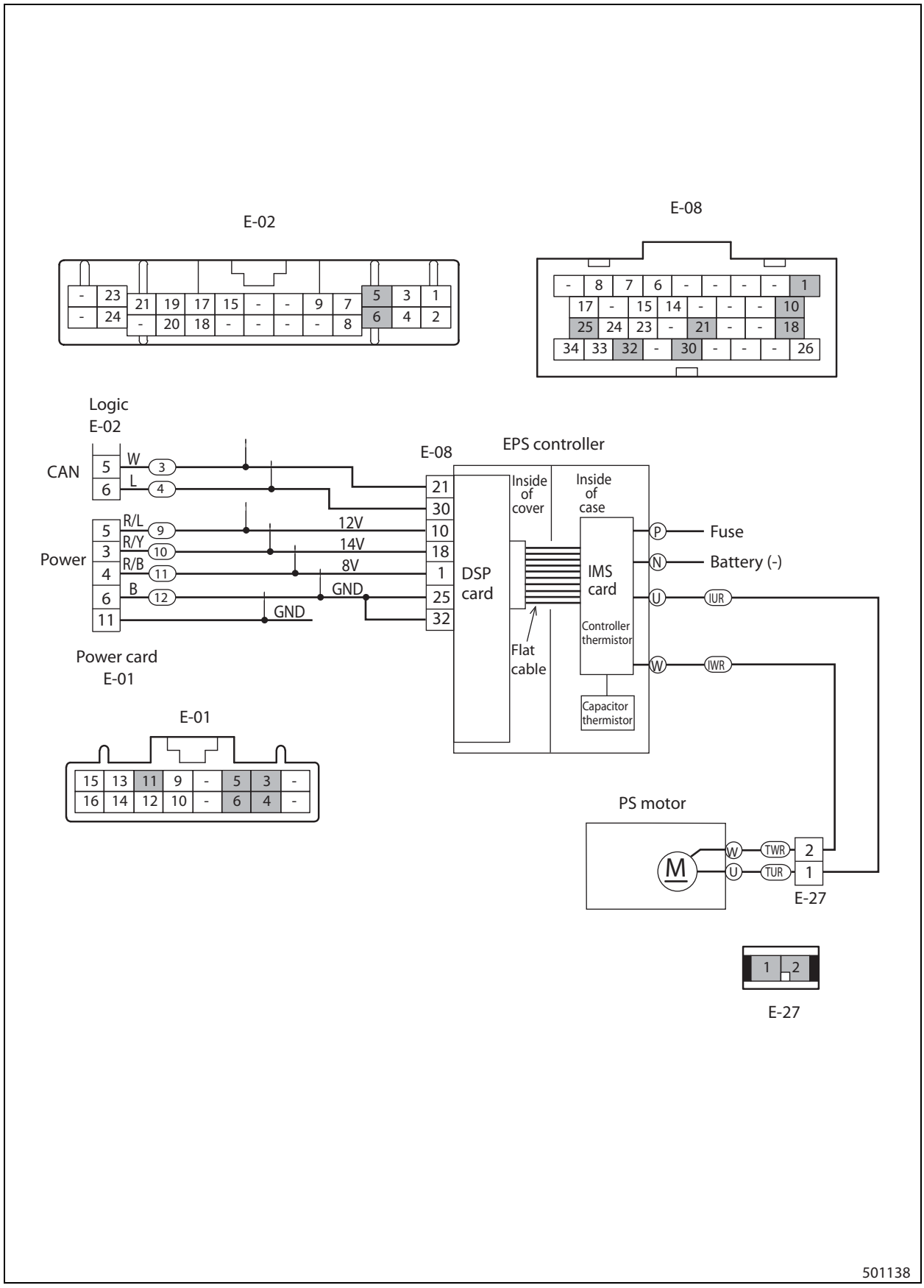
Error code: 71	
Situation	Display: "71". All operations inhibited except mast lowering operation.
Possible cause	Faulty main harness or connector E-08 comes off. (Communication between logic unit and traction inverter.) Faulty logic unit. Display fault. PS Controller fault.
Trigger of the error code	ROM SUM value of pump inverter is different from check data. RAM of pump inverter is faulty. Communication between logic unit and PS controller is impossible. No life signal is inputted.

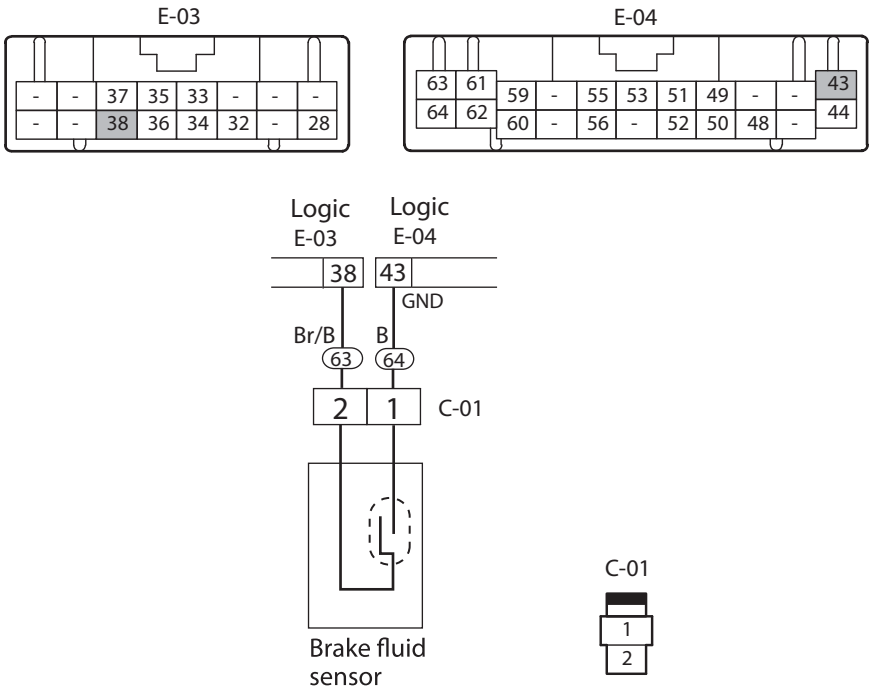
Checks




E-02
- 23
- 24
21 19 17 15 - - 9 7
- 20 18 - - - - 8
5 3 1
6 4 2
Logic
E-02
19
R/W
105
KEY
BDS
Fuse
14
R/W
105
E-01
E-01
15 13 11 9 - 5 3 -
16 14 12 10 - 6 4 -

504221


E-02
E-08
Logic
E-02
CAN
Power
W
L
R/L
R/Y
R/B
B
12V
14V
8V
GND
GND
E-08
EPS controller
DSP card
Inside of cover
Inside of case
IMS card
Controller thermistor
Capacitor thermistor
Flat cable
Fuse
Battery (-)
IUR
IWR
Power card
E-01
E-01
PS motor
TWR
TUR
E-27
E-27
501138

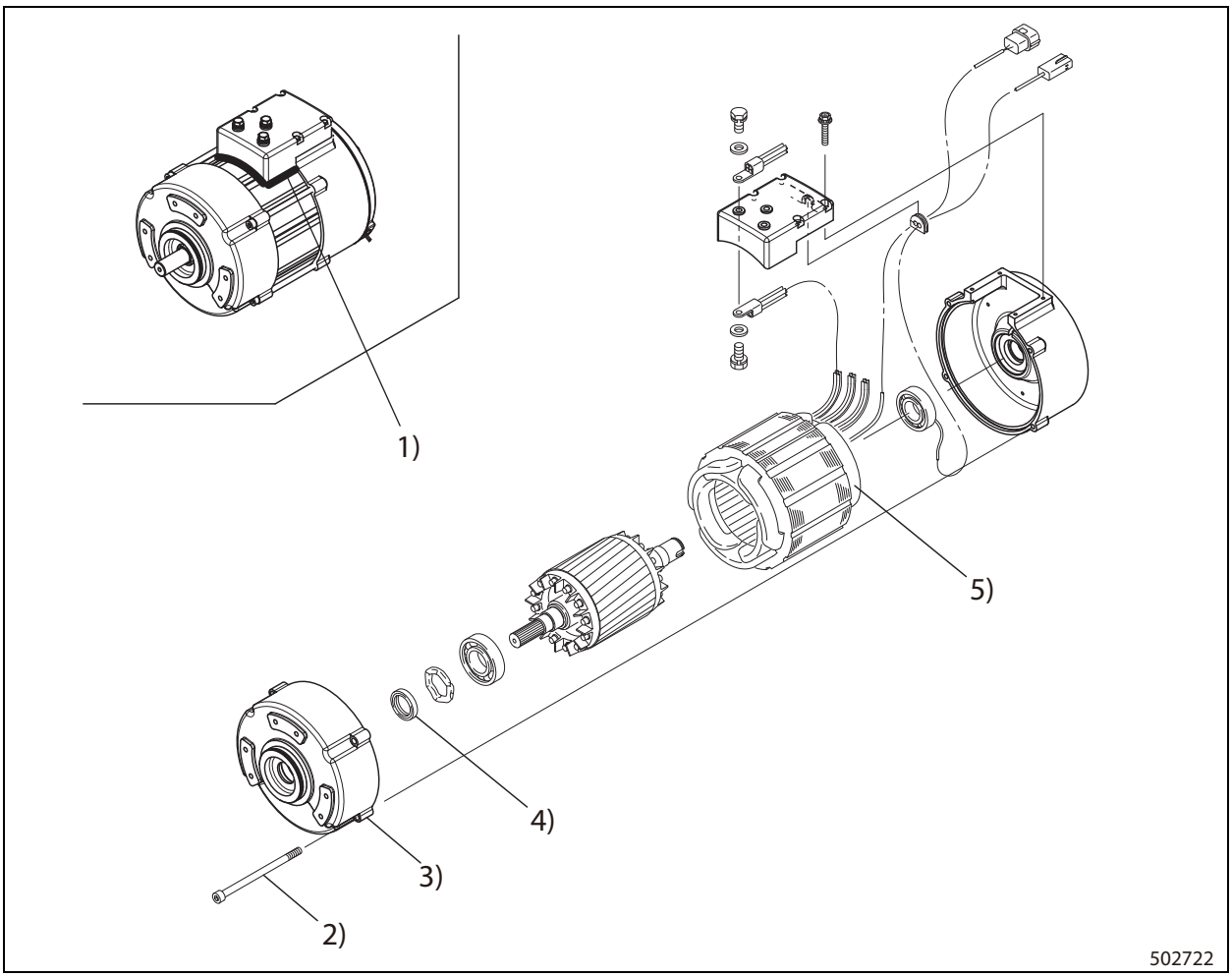

E-03
- - 37 35 33 - - -
- - 38 36 34 32 - 28
E-04
63 61 59 - 55 53 51 49 - - 43
64 62 60 - 56 - 52 50 48 - 44
Logic
E-03
Logic
E-04
38
43
GND
Br/B
B
63
64
2
1
C-01
Brake fluid
sensor
C-01
1
2

501139

7. Resassembling Traction motor

Follow the disassembling in reverse.

7.1 Resassembly Sequence

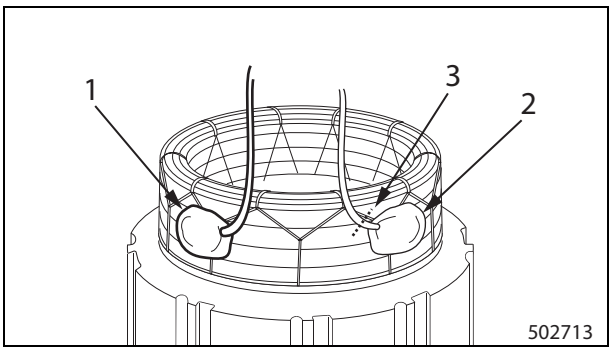


1) Apply silicone adhesive (Toray, Dow Corning SE9188) to the clearance between the terminal and stator core.
2) 11± 1 N·m (1.12 ± 0.1 kgf·m) [8.11 ± 0.74 lbf·ft]
3) Apply LOCTITE [#648], [#262 or an equivalent product in M8 thread holes.]
4) Apply grease on the lip of the oil seal, and apply the THREEBOND [#1104] around the seal.
5) Secure the temperature sensor using Araldite (epoxy paste adhesive AV/HV1580 or equivalent).

Replacing Temperature Sensor

By cutting off the wire of the current temperature sensor (no need to remove the sensor), a new temperature sensor can be mounted on the opposite side.

Use Araldite (epoxy paste adhesive AV/HV158 or equivalent) to secure the temperature sensor.



1. New temperature sensor
2. Current temperature sensor
3. Cut off

15.3 Inspecting Oil Seal and Permanent Magnet

Oil seal

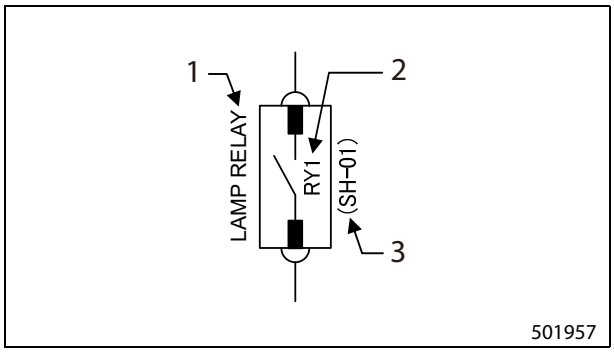
Check Oil seal for wear and damage. If worn or damaged, replace it.

Permanent magnet

Check permanent magnets in the Yoke for damage or sticking metallic dust. If sticking metallic dust, remove it with compressed air. If damaged, replace the whole motor.

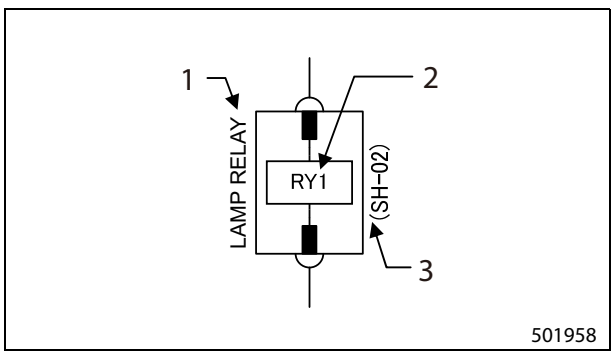
2.5 Relay Contactor and Coil

(1) For the relay contactor (contactor), the sheet symbol in which its coil is represented is provided so that you can find its coil easily. However, when the coil is represented in the same sheet, the sheet symbol is omitted.



1. Equipment name
2. Equipment number
3. Sheet symbol where coil is represented

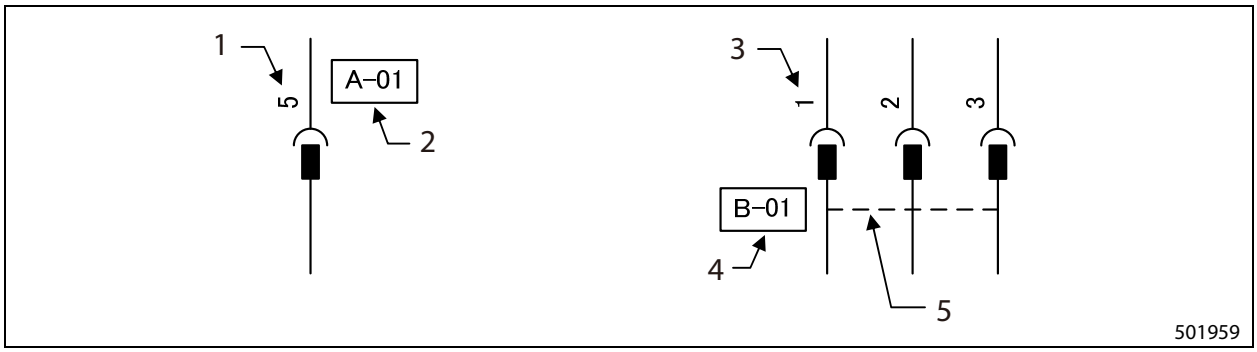
(2) For the relay coil (contactor coil), the sheet symbol in which its contact is represented is provided so that you can find the location of contacts. However, when the contact is represented in the same sheet, the sheet symbol is omitted.



1. Equipment name
2. Equipment number
3. Sheet symbol where the contact is represented

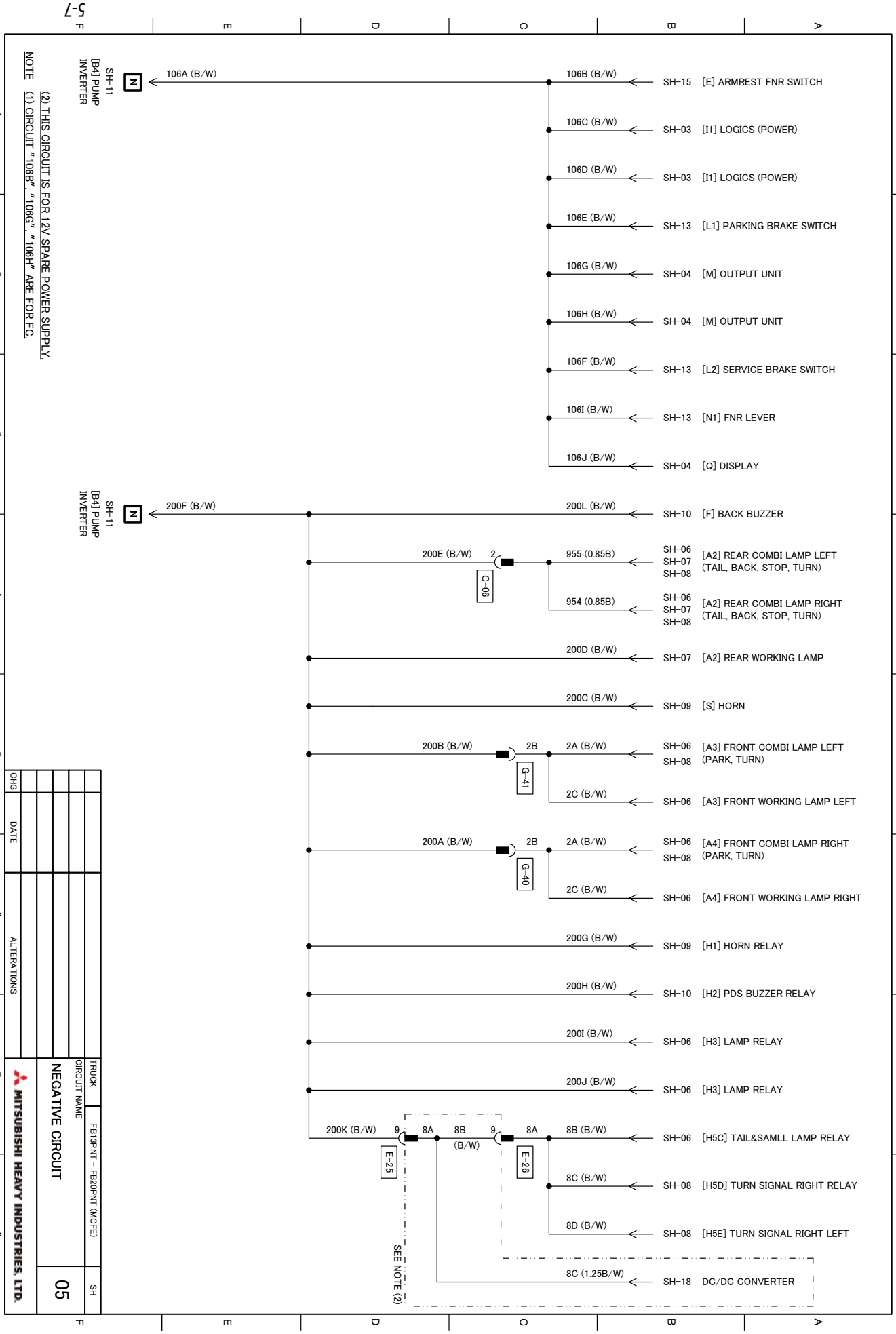
2.6 Connectors

(1) The connectors are represented by the connector number for identification. The connector number is enclosed with a box.
(2) The same connector number is allocated to a plug connector (male connector) and its mating socket connector (female connector) as a pair.
(3) The connector terminal number is indicated next to the connector symbol. However, for the terminals such as round shape terminal, plug terminal and flat shape terminal, etc., the terminal number is indicated.
(4) When the connectors located side by side are the identical but have a different number, the line between the connectors are indicated by a dotted line.



1. Terminal number
2. Connector number
3. Terminal number
4. Connector number
5. Indicates that the connector is the same.

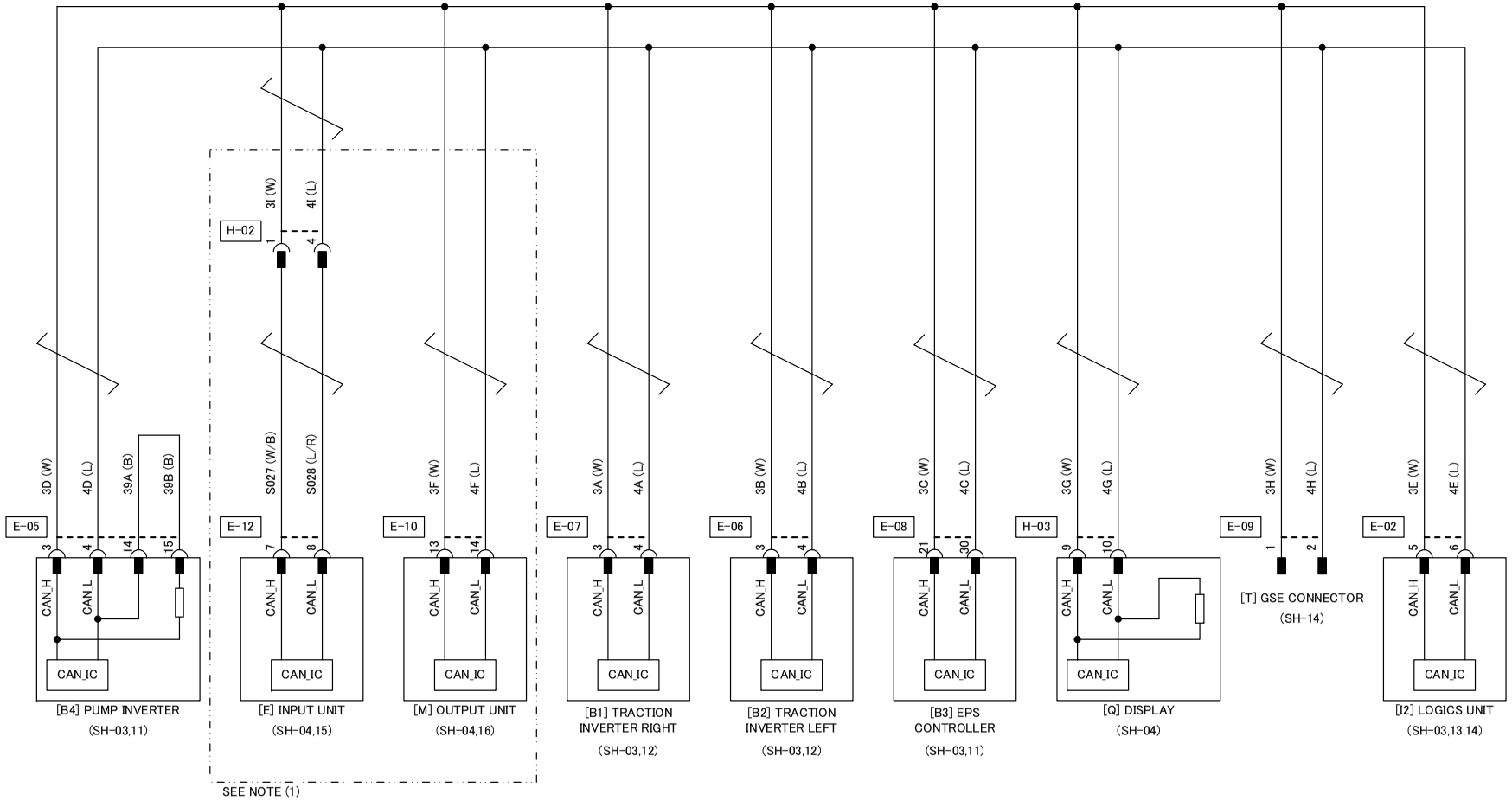
NOTE (1) CIRCUIT "106B", "106G", "106H" ARE FOR F.C.
(2) THIS CIRCUIT IS FOR 12V SPARE POWER SUPPLY.



CHG	DATE	ALTERATIONS

MITSUBISHI HEAVY INDUSTRIES, LTD.

TRUCK	FB13PNT – FB20PNT (MCFE)
CIRCUIT NAME	NEGATIVE CIRCUIT
SH	05



NOTE (1) THIS CIRCUIT IS FOR FC.

CHG	DATE	ALTERATIONS	TRUCK	FB13PNT – FB20PNT (MCFE)	SH
			CIRCUIT NAME	CAN CIRCUIT	17
			MITSUBISHI HEAVY INDUSTRIES, LTD.		

FOREWORD

This service manual is a guide for servicing Mitsubishi Forklift Trucks.
The long productive life of your forklift truck(s) depends on regular and proper servicing, servicing consistent with what you will learn by reading this service manual.
Read the respective sections of this manual carefully and familiarize yourself with all of the components before attempting to start a test, repair or rebuild the forklift truck.

The descriptions, illustrations and specifications contained in this manual are for forklift trucks with serial numbers in effect at the time of printing.
Mitsubishi Forklift Trucks reserves the right to change specifications or designs without notice and without incurring obligations. For your convenience the instructions are grouped by systems as an easy reference.

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

1.2 Controller Area Network (CAN)

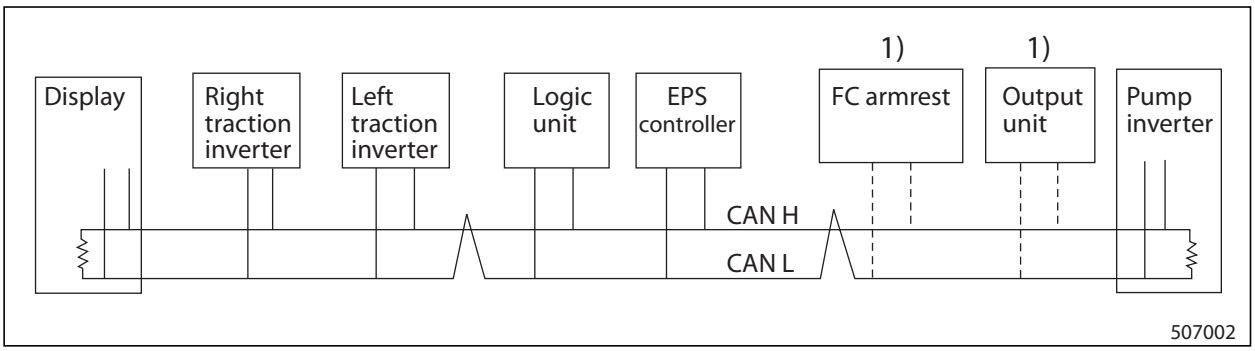
Each controller is linked with the forklift truck harness to form a network as follows.

The terminal resistors are built into the display and the pump inverter.

If the terminal resistors are not properly connected, the communication failure may occur between the logic unit and other controllers.

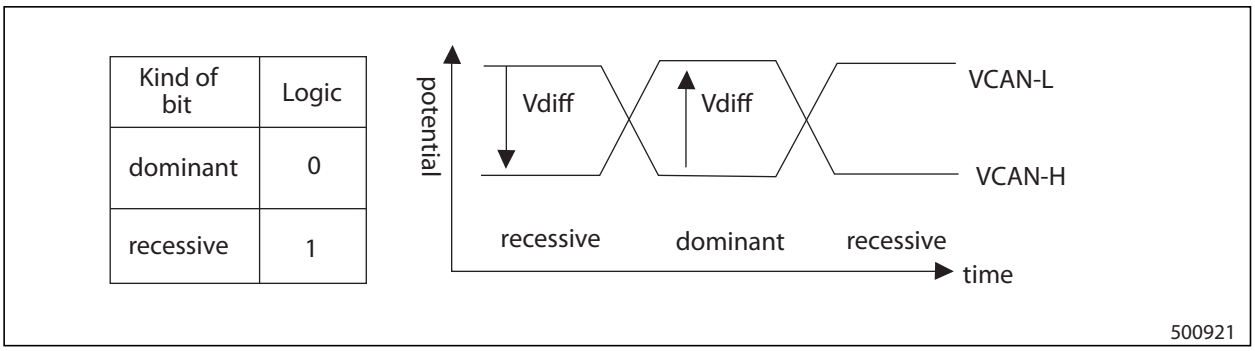
The FC armrest and output unit are used for FC models only.

For details, see the "Traction Inverter R.H. Fault (63)", "Traction Inverter L.H. Fault (64)" and "Pump Inverter Fault (65)", "EPS Controller fault (71)" in "Troubleshooting for Control Circuits".



1) FC armrest and output unit are used for FC model only.

The data are expressed as electric potential difference between high- and low-level signals as follows:
The signals are transferred to each controller through the serial communication protocol.



Main specifications

Item	Specifications	
Communication protocol	CANbus 2.0B passive	Non-Return to Zero method Broadcast communication protocol
Communication line	Dual 2-wire type serial communication	
Communication speed	500 kbps	
Data length	0 to 8 bytes	

3.4 Tilt horizon (Option)

Function

This will stop the tilting operation when the mast is tilting forward or the mast in the horizontal position.

The status of the load will be detected and if the load is being carried, the tilting operation will not be stopped.

Item		Description	SUO No.	Harness Pin No.
Conditional	Tilt horizon function	Optional equipment	#50	E-04-57 E-03-28
	Tilt horizon adjustment	Tilt angle sensor adjustment	#51	-

4. Other Feature

4.1 IPS (Integrated Presence System) Feature

This controller is part of the "Integrated Presence System" (IPS) of the forklift truck. This system features an enhanced, integral computer based feed back system which provides "certain product intelligence" to the operator. The table shows processes for traction and lifting. Refer to the Status Transfer Chart for details.

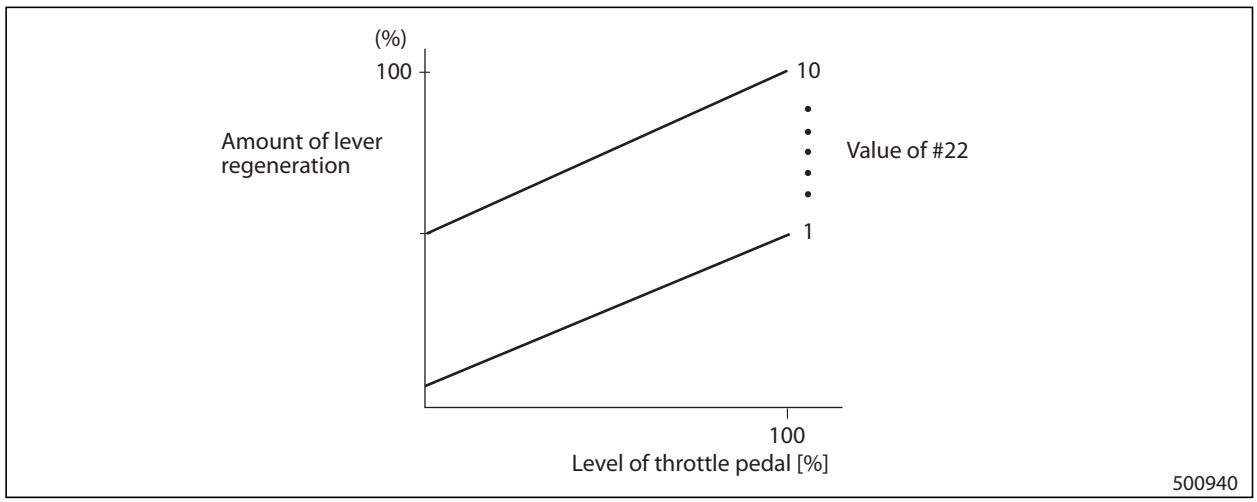
IPS features

Item		Protect condition		Result	Release method
Traction control		Seat	Sit ➡ Leave	Slowdown and Stop	Sit and Direction lever: N Accelerator pedal: Release
		Direction lever	F or R		
Hydraulic control	MC	Seat	Sit ➡ Leave	Stop	Sit and Control valve SW: All open
	FC				Sit and FC control lever: All neutral

#22 Regen Adjustment for Lever Regen

This setting defines the “Lever regen” characteristic.

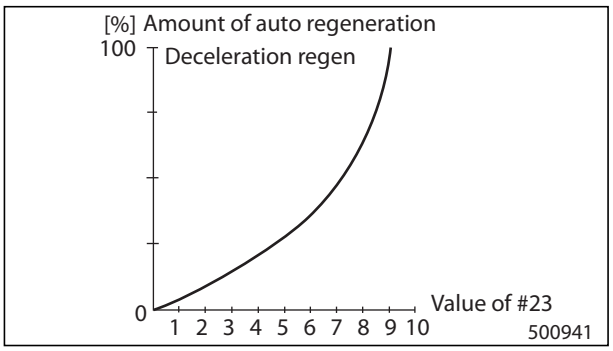
When the direction lever is shifted into the position opposite to the forklift truck’s traveling direction, the “Lever regen” function is activated. The “Lever regen” characteristic is shown in this diagram. The setting range is 1 to 10.

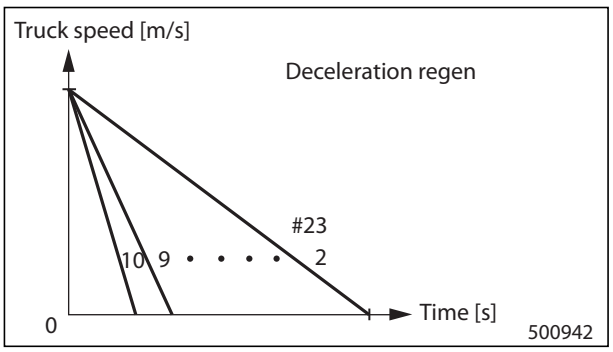


#23 Regen Adjustment for Auto Regen

This setting defines amount of deceleration when "Auto regen" is activated. This setting defines the amount of deceleration when “Auto regen” is activated. (Setting "10") The setting range is 1 to 10.

Note: With “1” setting, regeneration will not work except when going downhill.





Note: *When the setting is “1”, the regenerative braking is not be generated, thus the time for forklift truck to stop is spontaneous.

#25 Steering brake force

Setting of maximum steering brake force when the steering angle is not proportional to the steering force during normal operation of the steering wheel.

Setting is available in 3 steps: strong, medium, and weak

6.3 Self-Diagnostics

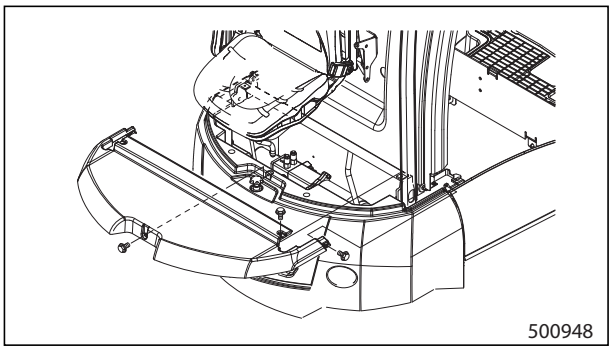
Step	Diagnosis item	Do this	Controller check this	Result	Display	Contactor operation
0	Line voltage	Remove fuse.	Close line contactor and check power line voltage.	Pass	01	Contactor closes and opens.
				Pass	16 (see 1.40)	
				Fail	dd	
1	Seat SW	Release, press and release seat SW.	Input OFF - ON - OFF	Pass	02	
				fail	01	
2	Direction change SW	Cycle direction lever. N - R - N - F - N	Input N - R - N - F - N	Pass	03	
				Fail	02	
3	Parking brake SW	Apply and release parking brake SW.	Input ON - OFF- ON	Pass	04	
				Fail	03	
4	Service brake SW	Release and press service brake SW.	Input OFF - ON - OFF	Pass	05	
				Fail	04	
5	Accel	Press and release accelerator. And see display.		Pass	Note (1)	
				Fail	-	
		Push R button on meter panel.		-	06	
6	Handle , Tire angle sensor	See display.		Pass	Note (2)	
				Fail	-	
		Push R button on meter panel.		-	07	
7	Battery voltage	Automatic	Check battery voltage.	Pass	08	
				Fail	07	
8	Lift lever (up)	Pull and release lift lever.	Input OFF - ON - OFF	Pass	09	
				Fail	08	
9	Tilt lever	Pull and release tilt lever.	Input OFF - ON - OFF	Pass	10	
				Fail	09	
10	Attach 1 lever	Pull and release attachment 1 lever.	Input OFF - ON - OFF	Pass	11	
				Fail	10	
11	Attach 2 lever	Pull and release attachment 2 lever.	Input OFF - ON - OFF	Pass	12	
				Fail	11	
12	Pump speed	Pull any lever and see display.		Pass	Note (3)	
				Fail	-	
		Push R button on meter panel.		-	13	
13	Line contactor	See line contactor close.		Pass	14	Contactor closes.
				Fail	13	Contactor dose not closes.
		Push R button on meter panel.		-	14	

7. Removal and Installation

7.1 Inverter Discharging Procedure

Discharge the inverters by using the following procedure.

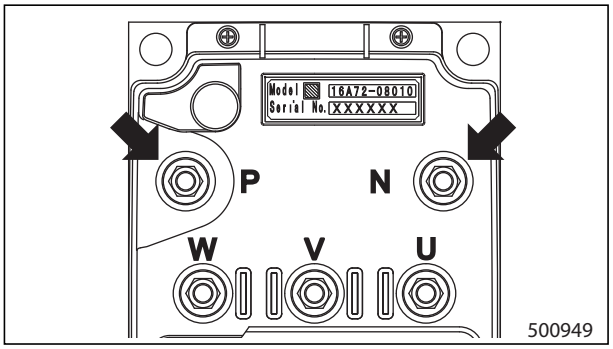
(1) Turn OFF the key switch.
(2) Disconnect the battery plug/connector.
(3) Remove the rear cover.


500948

⚠ CAUTION

Be careful not to be pinched yourself between the head guard and seat.

(4) Place a 150 /25 W resistor between P and N terminals in the right traction inverter to discharge the inverter.
(5) After touching the resistor to the P and N terminals for approximately five seconds, measure the voltage between the terminals with a multimeter and confirm a reading of 5 V or less.
(6) Perform the same procedure for the left traction inverter, pump inverter, and EPS controller in order to discharge all inverters.



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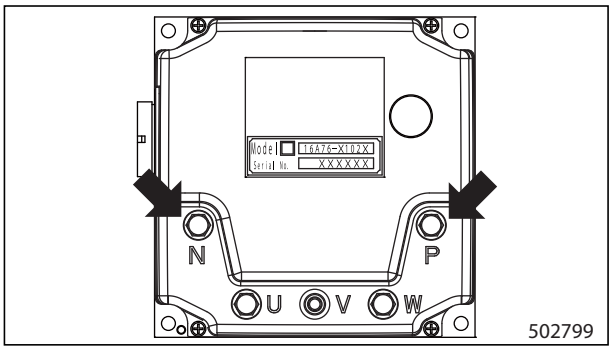
Check whether the resistance between + and - of the battery plug/connector on the forklift truck side is 1 kΩ or more when connecting the battery plug/connector for the first time after maintenance. (Discharge all inverters completely before measuring. Longer measurement time reduces resistance value.)

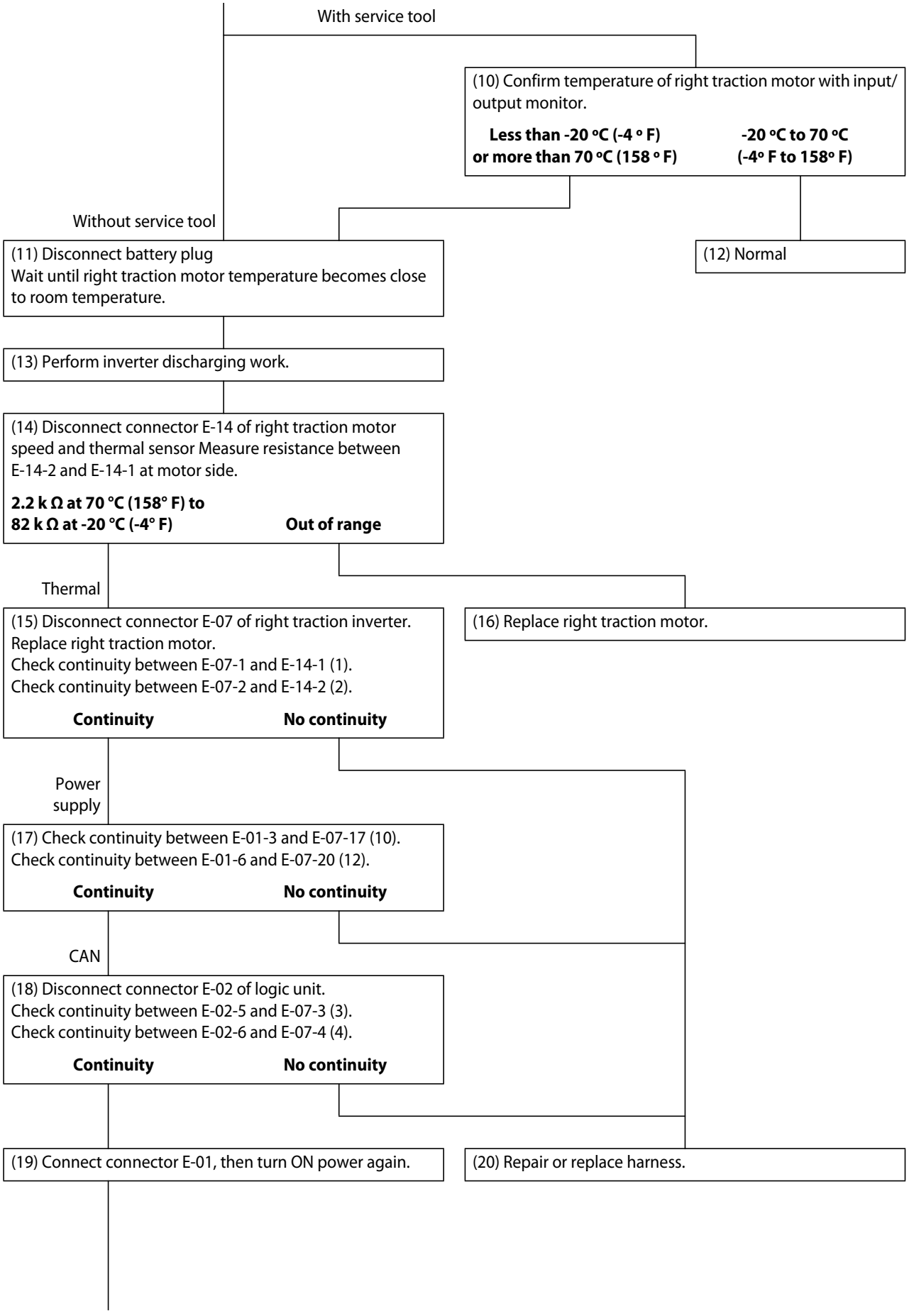


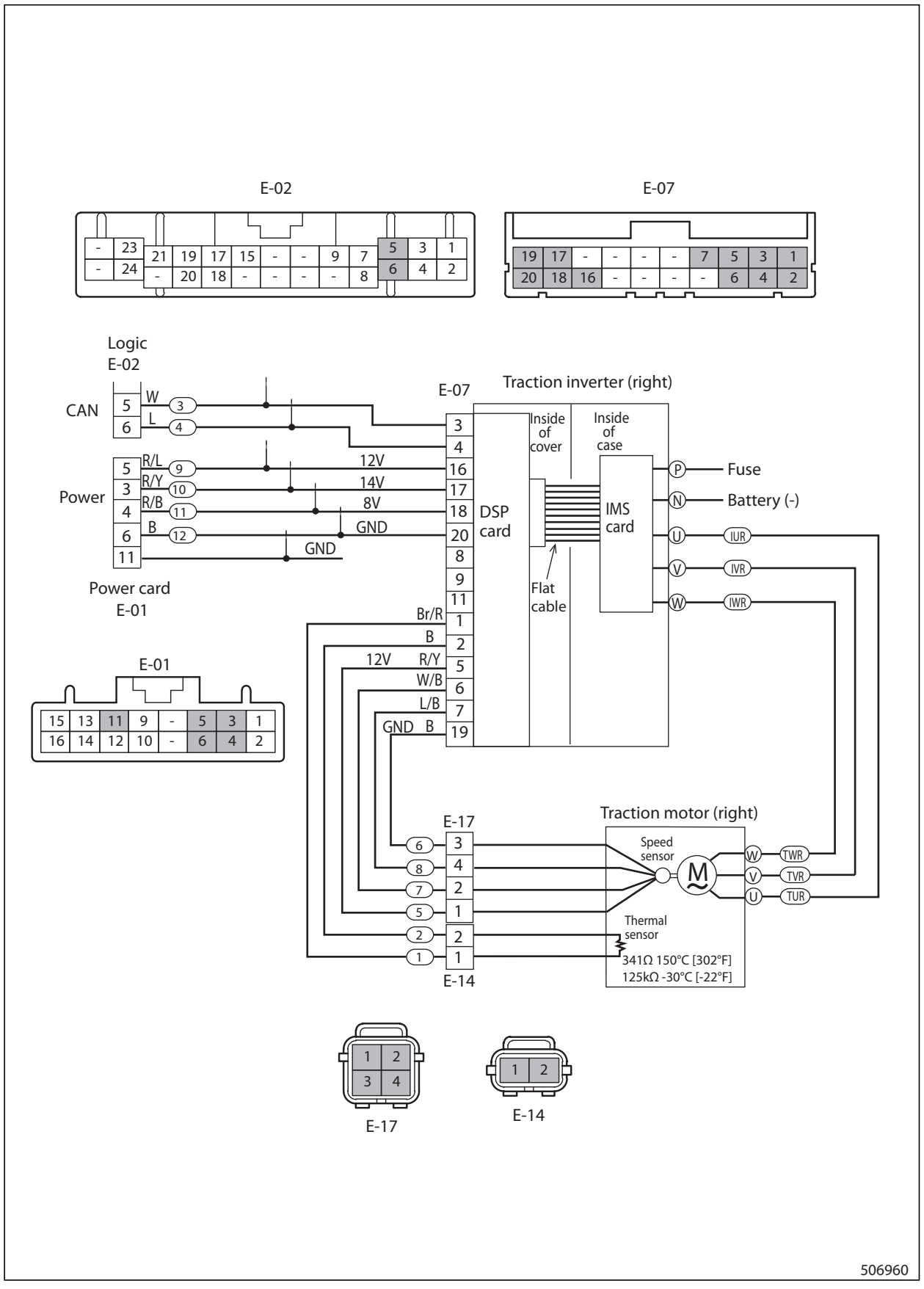
502799

Power supply card voltage chart

CN1

No.	Name	Voltage	Note
1	+12V	12V	
2	GND	0V	
3	+VL	13.0 to 16.0V	DSP
4	+8V	8V	DSP
5	+VG	12V	DSP
6	GND	0V	DSP
7	+VE-L	Vbatt	
8	+VE-L	Vbatt	
9	+VL	13.0 to 16.0V	Logic
10	+5V-L	5V	Logic
11	GND	0V	Logic
12	GND	0V	Logic
13	V POW	Vbatt	Input
14	V POW	Vbatt	Input
15	V GND	0V	Input
16	V GND	0V	Input


With service tool
(10) Confirm temperature of right traction motor with input/ output monitor.
Less than -20 °C (-4 ° F) or more than 70 °C (158 ° F)
-20 °C to 70 °C (-4° F to 158° F)
Without service tool
(11) Disconnect battery plug
Wait until right traction motor temperature becomes close to room temperature.
(12) Normal
(13) Perform inverter discharging work.
(14) Disconnect connector E-14 of right traction motor speed and thermal sensor Measure resistance between E-14-2 and E-14-1 at motor side.
2.2 k Ω at 70 °C (158° F) to 82 k Ω at -20 °C (-4° F)
Out of range
Thermal
(15) Disconnect connector E-07 of right traction inverter.
Replace right traction motor.
Check continuity between E-07-1 and E-14-1 (1).
Check continuity between E-07-2 and E-14-2 (2).
Continuity
No continuity
(16) Replace right traction motor.
Power supply
(17) Check continuity between E-01-3 and E-07-17 (10).
Check continuity between E-01-6 and E-07-20 (12).
Continuity
No continuity
CAN
(18) Disconnect connector E-02 of logic unit.
Check continuity between E-02-5 and E-07-3 (3).
Check continuity between E-02-6 and E-07-4 (4).
Continuity
No continuity
(19) Connect connector E-01, then turn ON power again.
(20) Repair or replace harness.


E-02
E-07
Logic
E-02
CAN
Power
Power card
E-01
E-01
Traction inverter (right)
E-07
Inside of cover
Inside of case
DSP card
IMS card
Flat cable
Fuse
Battery (-)
12V
14V
8V
GND
GND
Br/R
B
12V R/Y
W/B
L/B
GND B
Traction motor (right)
E-17
E-14
Speed sensor
Thermal sensor
341Ω 150°C [302°F]
125kΩ -30°C [-22°F]
E-17
E-14
506960

3.9 Traction Motor R.H., Over-current (15)

Code: 15	
Situation	Display: "15". Traction motor and pump motor operation inhibited. Line and steering contactor HOLD. If this fault occurs before steering contactor CLOSE, all operations inhibited except mast lowering operation.
Possible cause	Faulty traction motor. (Contain the bearing sensor) Faulty contact or wire breakage of traction motor speed sensor harness. Faulty traction inverter. Faulty contact or wire breakage of DSP flat cable in traction inverter. Faulty DSP card of traction inverter. Faulty main harness.
Trigger of the code	Motor current is more than 1105 A (Moment) or 893 A (1 mS) or 829 A (1.6 mS).

Checks

(1) Disconnect battery plug, then perform inverter discharging work.

(2) Check traction motor body and terminal for burning and small.

Normal / **Abnormal**

(3) Check motor terminal (U V W phases) for shorting to the motor body and forklift truck frame.

Not shorting / **shorting**

(4) Replace traction motor.

(5) Remove the all cables of motor and traction inverter terminals (P N U V W).
Check motor terminals for shorting to the motor body.
Check the cables for shorting to the frame.

Not shorting / **shorting**

(6) Replace traction inverter.

(7) Replace traction motor or cables.

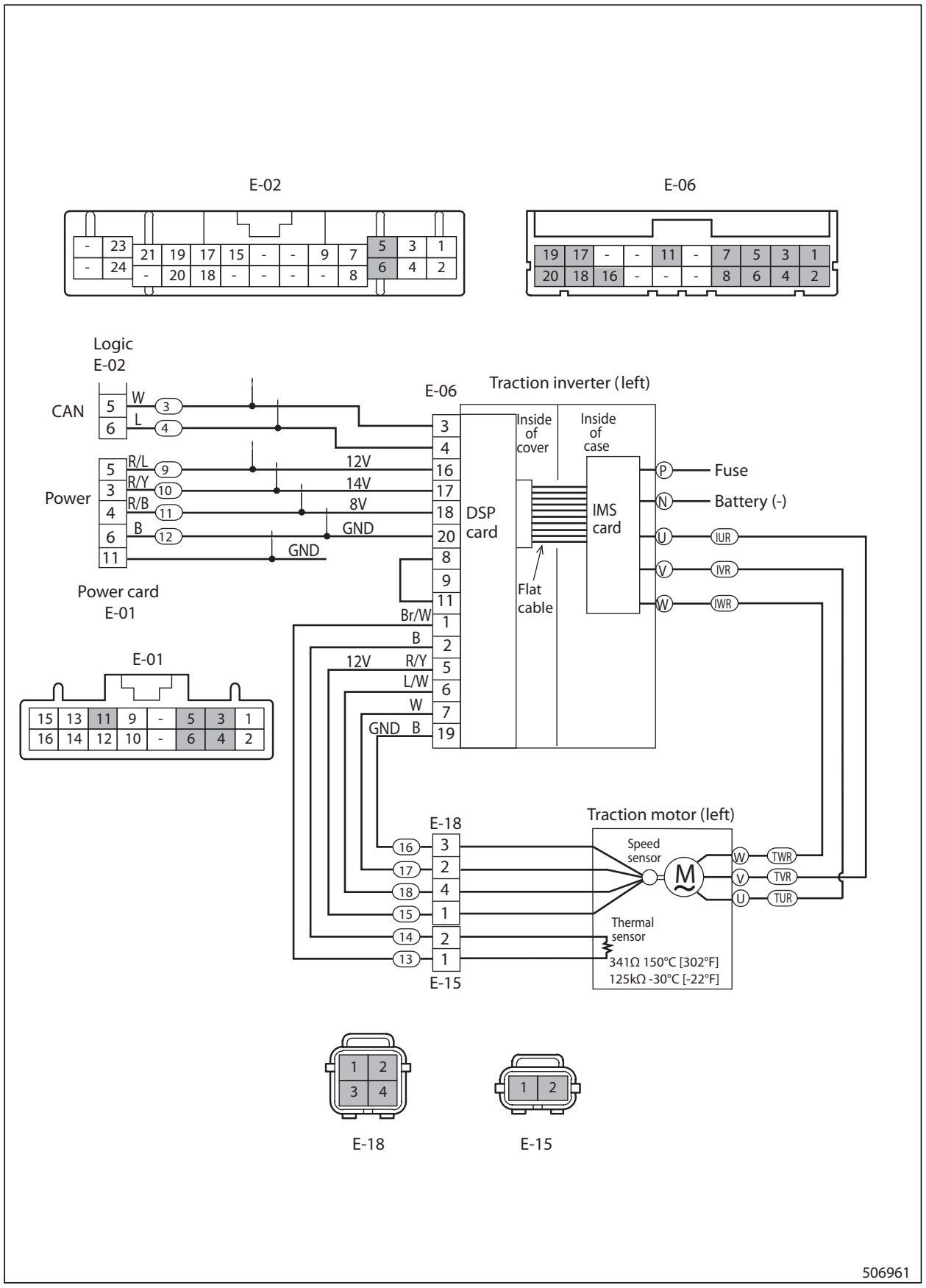
(8) Confirm cable looseness and improper connections (U V W phases) for traction inverter and motor.

Normal / **Abnormal**

(9) Disconnect battery plug, then perform inverter discharge work.
Confirm connection of traction motor speed sensor connector.

Normal / **Abnormal**

(10) Secure cable if loose or connect cable correctly.


E-02
E-06
Logic
E-02
CAN
Power
Power card
E-01
E-01
E-06
Traction inverter (left)
Inside of cover
Inside of case
DSP card
IMS card
Flat cable
Fuse
Battery (-)
12V
14V
8V
GND
GND
Br/W
B
12V
R/Y
L/W
W
GND
B
E-18
E-15
Traction motor (left)
Speed sensor
Thermal sensor
341Ω 150°C [302°F]
125kΩ -30°C [-22°F]
E-18
E-15
506961

3.17 Steering Contactor Fault (41)

Code: 41	
Situation	Display: "41". All operations inhibited except mast lowering operation. Line and steering contactor OPEN.
Possible cause	Faulty steering contactor, faulty main harness, faulty logic unit.
Trigger of the code	Inverter voltage data is checked when contactor is closed (400 mS).

Checks

(1) Turn OFF power, then turn ON power again. Confirm diagnostic code display.

If fault (41) remains

(2) Disconnect battery plug, then perform inverter discharging work.
Check continuity of the steering fuse.
Check continuity of the control line fuse for contactor coil.

Continuity / **No continuity**

(3) Block wheels and remove the traction fuse, pump fuse, steering fuse.
Then confirm pump contactor operation in self-diagnostics step (15).

Not operated / **Operated**

(4) Replace steering fuse.

(5) Disconnect battery plug, then perform inverter discharging work.

(6) Check to see if steering contactor tip moves smoothly.
Check steering contactor tip for melting.

Normal / **Abnormal**

(7) Go to step (13).

(8) Measure resistance of contactor coil.
[61Ω at -30°C (-22°F) to 91Ω at 80°C (176°F)]

Within range / **Out of range**

(9) Disconnect connectors E-04.
Check continuity between E-04-63 and Steering contactor coil plus (+).
Check continuity between E-04-64 and Steering contactor coil minus (-).

Continuity / **No continuity**

(10) Replace steering contactor.

3.21 PS Motor Open (49)

Code: 49	
Situation	Display: "49". All operations inhibited except mast lowering operation. Line and steering contactor OPEN.
Possible cause	Faulty contact or wire breakage of ST motor cable, faulty ST motor, faulty contact or wire breakage of left PS controller connector, wire breakage of main harness, faulty power supply card of logic unit, when restarting after motor shorted
Trigger of the code	Motor voltage is abnormal when power is turned on. Current does not flow when torque instruction is requested.

Checks

(1) Disconnect battery plug, then perform inverter discharging work.

(2) Check EPS controller and motor for cable looseness and improper contact.
Normal **Abnormal**

(4) Secure cable if loose.

(3) Disconnect steering motor cables from EPS controller. Measure resistance of motor cables (U and W phases).
Less than 1Ω **1Ω or more**

(5) Check connector E-08 of EPS controller for looseness.
Normal **Abnormal**

(6) Measure resistance between terminals of both cable ends (between U and U, and W and W).
Less than 1Ω **1Ω or more**

(8) Connect connector securely.

(7) Disconnect connector E-08 of EPS controller and remove DSP cover. Check DSP flat cable for looseness or wire breakage.
Normal **Abnormal**

(9) Replace left traction motor.

(10) Replace motor cables.

Gate power supply

(12) Secure DSP flat cable if loose.
Replace EPS controller if wire breaks.

(11) Disconnect connector E-01 of logic unit.
Check continuity between E-01-5 and E-05-16 (9).
Check continuity between E-01-6 and E-05-20 (12).
Continuity **No continuity**

CAN

3.25 Traction Motor L.H., Pulse Input Fault (53)

Code: 53	
Situation	Display: "53". Traction motor and pump motor operation inhibited. Line and steering contactor HOLD. If this fault occurs before steering contactor CLOSE, all operations inhibited except mast lowering operation.
Possible cause	Faulty contact of left side traction inverter connector, faulty connection of left side traction motor connector and cable, faulty 12V input voltage of left side traction inverter, faulty contact or wire breakage of left side traction motor speed sensor harness, faulty DSP card of left side traction inverter, faulty left side traction motor speed sensor.
Trigger of the code	Motor rotation speed is more than 6000 min^{-1}.

Checks

(1) Disconnect battery plug, then perform inverter discharging work.

(2) Check to see if left traction motor cables (U, V and W-phases) are connected to left traction inverter properly.

Normal **Abnormal**

(4) Connect cables properly.

(3) Check to see if connector E-06 of left traction inverter is fastened securely.

Normal **Abnormal**

(6) Fasten connector securely.

(5) Check to see if connector E-18 of left traction motor speed sensor is fastened securely.

Normal **Abnormal**

Sensor

(8) Fasten connector securely.

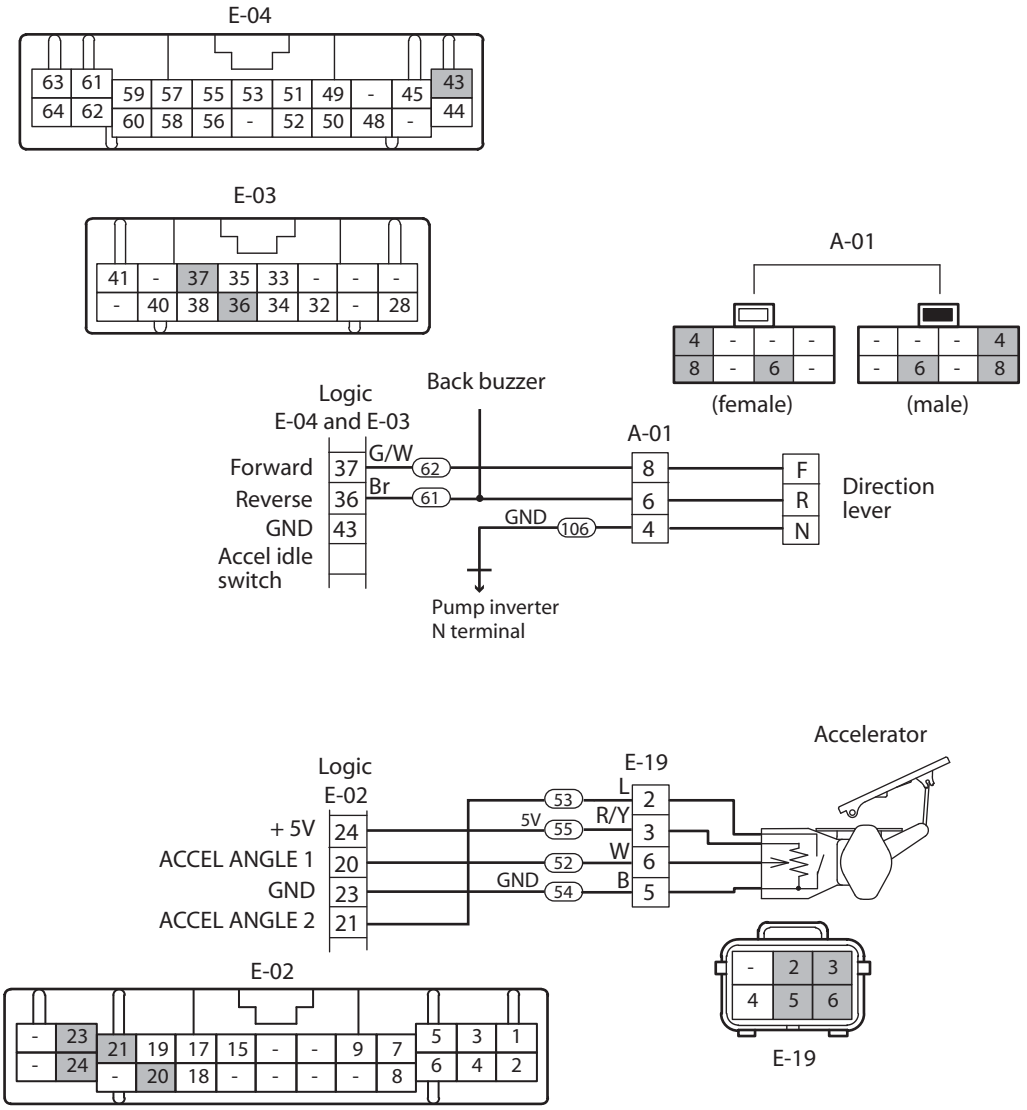
(7) Disconnect connectors E-06 and E-18.
Check continuity between E-06-5 and E-18-1 (15).
Check continuity between E-06-6 and E-18-4 (18).
Check continuity between E-06-7 and E-18-2 (17).
Check continuity between E-06-19 and E-18-3 (16).

Continuity **No continuity**

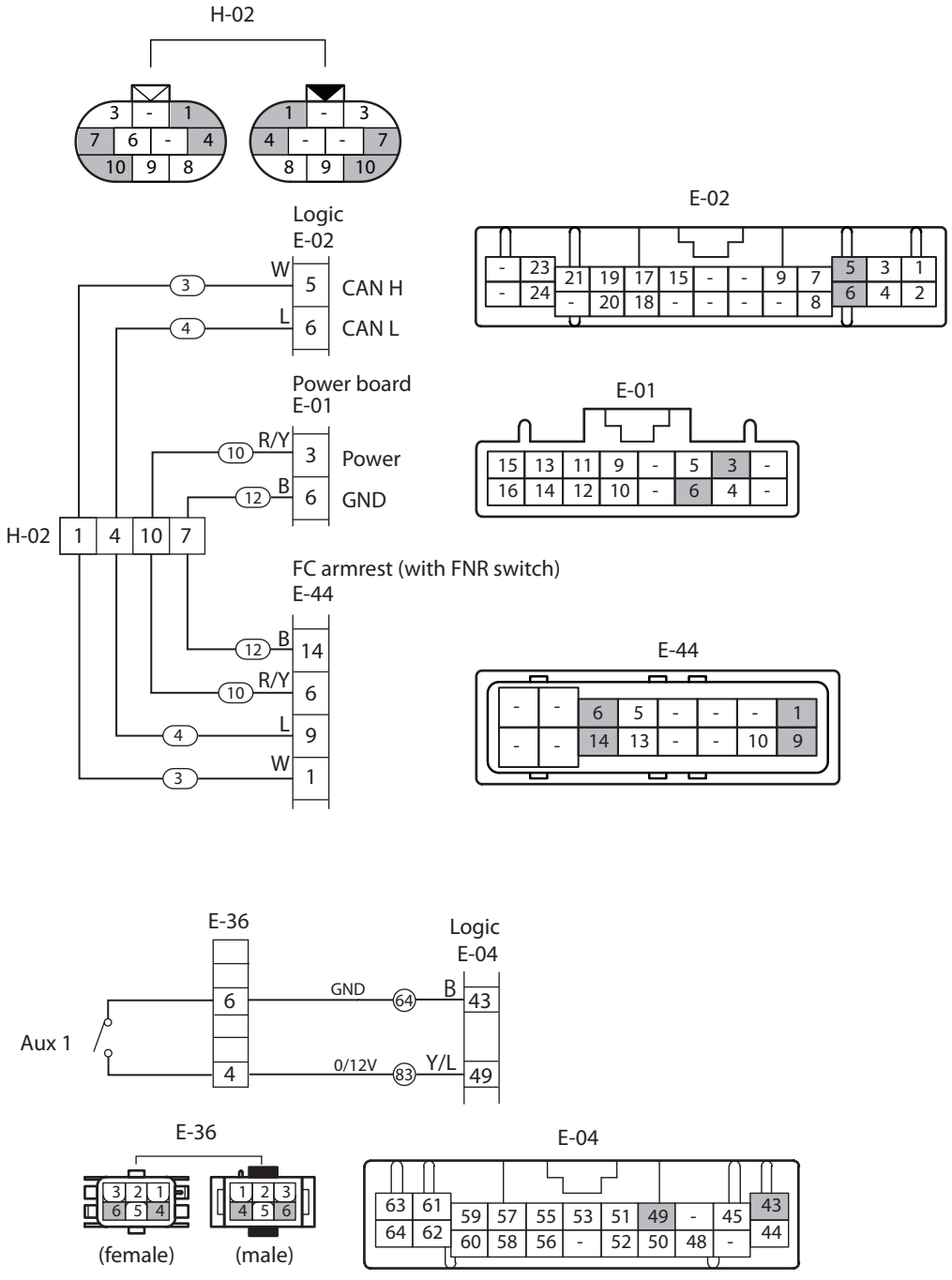
Power supply

(9)Disconnect connector E-01 of logic unit.
Check continuity between E-01-3 and E-06-17 (10).
Check continuity between E-01-6 and E-06-20 (12).

Continuity **No continuity**


E-04
63 61 59 57 55 53 51 49 - 45 43
64 62 60 58 56 - 52 50 48 - 44
E-03
41 - 37 35 33 - - -
- 40 38 36 34 32 - 28
A-01
4 - - -
8 - 6 -
(female)
- - - 4
- 6 - 8
(male)
Logic
E-04 and E-03
Back buzzer
A-01
Forward 37 G/W 62
Reverse 36 Br 61
GND 43
Accel idle switch
GND 106
8 F
6 R
4 N
Direction lever
Pump inverter N terminal
Accelerator
Logic
E-02
E-19
+ 5V 24
ACCEL ANGLE 1 20
GND 23
ACCEL ANGLE 2 21
53 L 2
5V 55 R/Y 3
52 W 6
GND 54 B 5
- 2 3
4 5 6
E-19
E-02
- 23 21 19 17 15 - - 9 7 5 3 1
- 24 - 20 18 - - - - 8 6 4 2

506972


H-02
3 - 1
7 6 - 4
10 9 8
1 - 3
4 - - 7
8 9 10
Logic
E-02
W
5
CAN H
3
L
6
CAN L
4
E-02
- 23 21 19 17 15 - - 9 7 5 3 1
- 24 - 20 18 - - - - 8 6 4 2
Power board
E-01
R/Y
10
3
Power
B
12
6
GND
E-01
15 13 11 9 - 5 3 -
16 14 12 10 - 6 4 -
H-02 1 4 10 7
FC armrest (with FNR switch)
E-44
B
12
14
R/Y
10
6
L
4
9
W
3
1
E-44
- - 6 5 - - - 1
- - 14 13 - - 10 9
E-36
Logic
E-04
6
GND
64
B
43
Aux 1
4
0/12V
83
Y/L
49
E-36
3 2 1
6 5 4
(female)
1 2 3
4 5 6
(male)
E-04
63 61 59 57 55 53 51 49 - 45 43
64 62 60 58 56 - 52 50 48 - 44

506978

3.38 Logic Card Initialize Failure (61)

Code: 61	
Situation	Display: "61". All operations inhibited. Line and steering contactor OPEN.
Possible cause	Setup Option Group 3 data not set, Setup Option Group 1 and 2 default data not set, faulty Setup Option data, faulty logic unit.
Trigger of the code	Setup Option data is in abnormal setting range. MC specification is set at #43 while CAN data is received from FC armrest or output unit.

Checks

(1) Turn OFF power, then turn ON power in Setup Option Group 3 setting.

(2) Set Setup Option Group 3 data.
Confirm that SUO #43 and 50 have been set up correctly and their combination with output unit and FC armrest is correct.

(3) Set Setup Option default data.

(4) Turn ON power.

If fault remains

(5) With service tool, set Setup Option Group 3 data.

(6) With service tool, set Setup Option default data.

If fault remains

(7) Disconnect battery plug.

(8) Replace logic card of logic unit.

(9) With service tool, set Setup Option Group 3 data.

(10) With service tool, set Setup Option default data.

(19) Replace DSP card of left traction inverter.

(20) Replace power supply card of logic unit.

If fault remains

(21) Disconnect E-03, E-04, E-05, E-06, E-07, E-08.
Reconfirm step (17) after power ON.

Normal **Abnormal**

(22) After step (18), connect E-07.
Reconfirm step (17).

Normal **Abnormal**

(23) Repair or replace main harness.

(24) After step (18), connect E-06.
Reconfirm step (17).

Normal **Abnormal**

(25) Replace DSP of traction inverter Right.

(26) After step (18), connect E-05.
Reconfirm step (17).

Normal **Abnormal**

(27) Replace DSP of traction inverter Left.

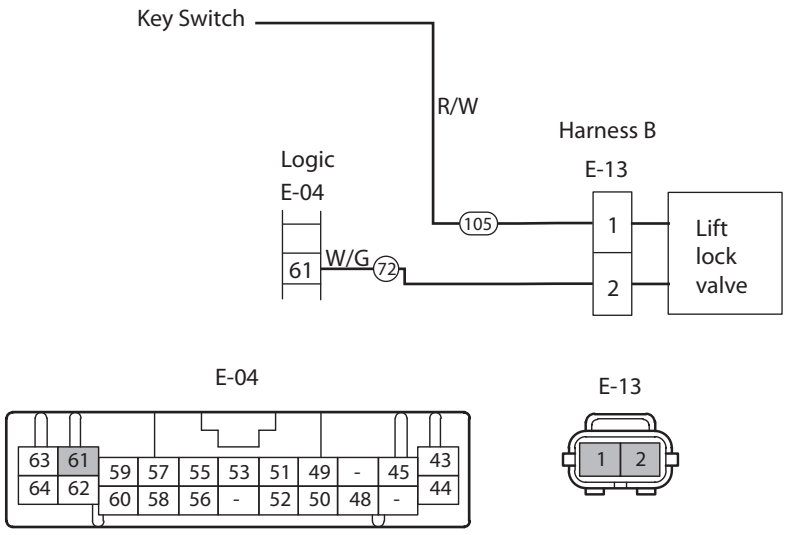
(28) After step (18), connect E-08
Reconfirm step (17).

Normal **Abnormal**

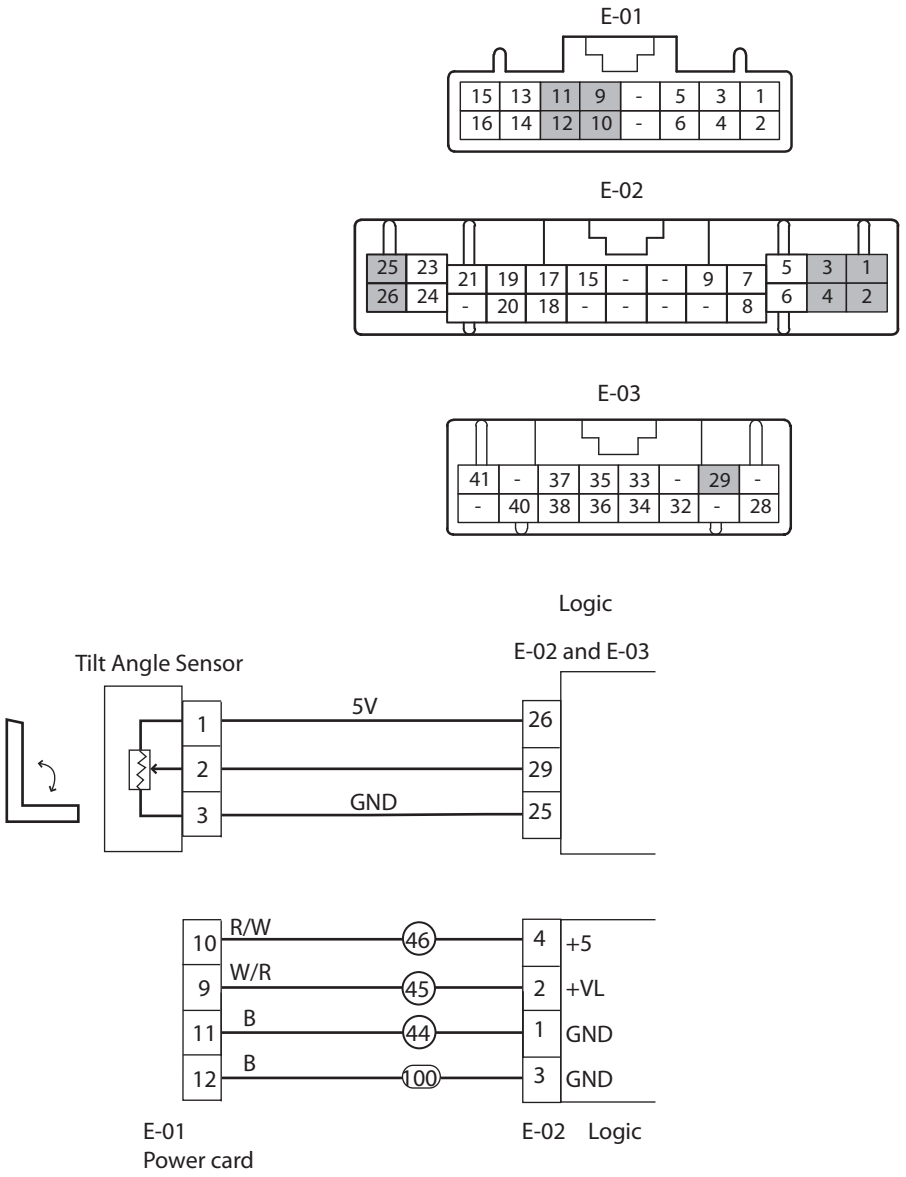
(29) Replace DSP of pump inverter.

(30) Replace logic unit.

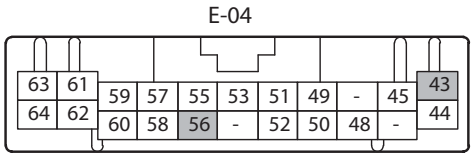
(31) Replace DSP EPS controller.

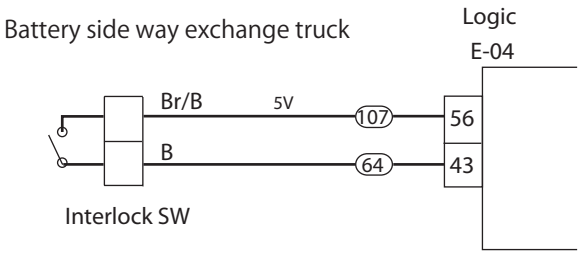

Key Switch
R/W
Harness B
E-13
Logic
E-04
105
1
Lift
lock
valve
61
W/G
72
2
E-04
E-13
63
61
59
57
55
53
51
49
-
45
43
64
62
60
58
56
-
52
50
48
-
44
1
2

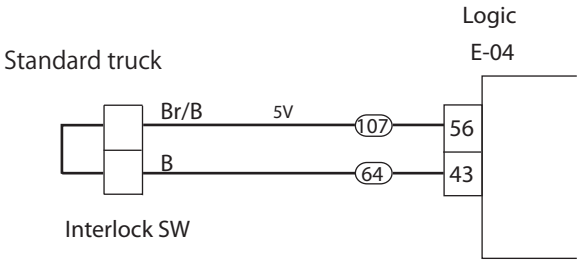
506986


E-01
15 13 11 9 - 5 3 1
16 14 12 10 - 6 4 2
E-02
25 23 21 19 17 15 - - 9 7 5 3 1
26 24 - 20 18 - - - - 8 6 4 2
E-03
41 - 37 35 33 - 29 -
- 40 38 36 34 32 - 28
Logic
E-02 and E-03
Tilt Angle Sensor
1
2
3
5V
GND
26
29
25
10 R/W 46 4 +5
9 W/R 45 2 +VL
11 B 44 1 GND
12 B 100 3 GND
E-01
Power card
E-02 Logic

506993

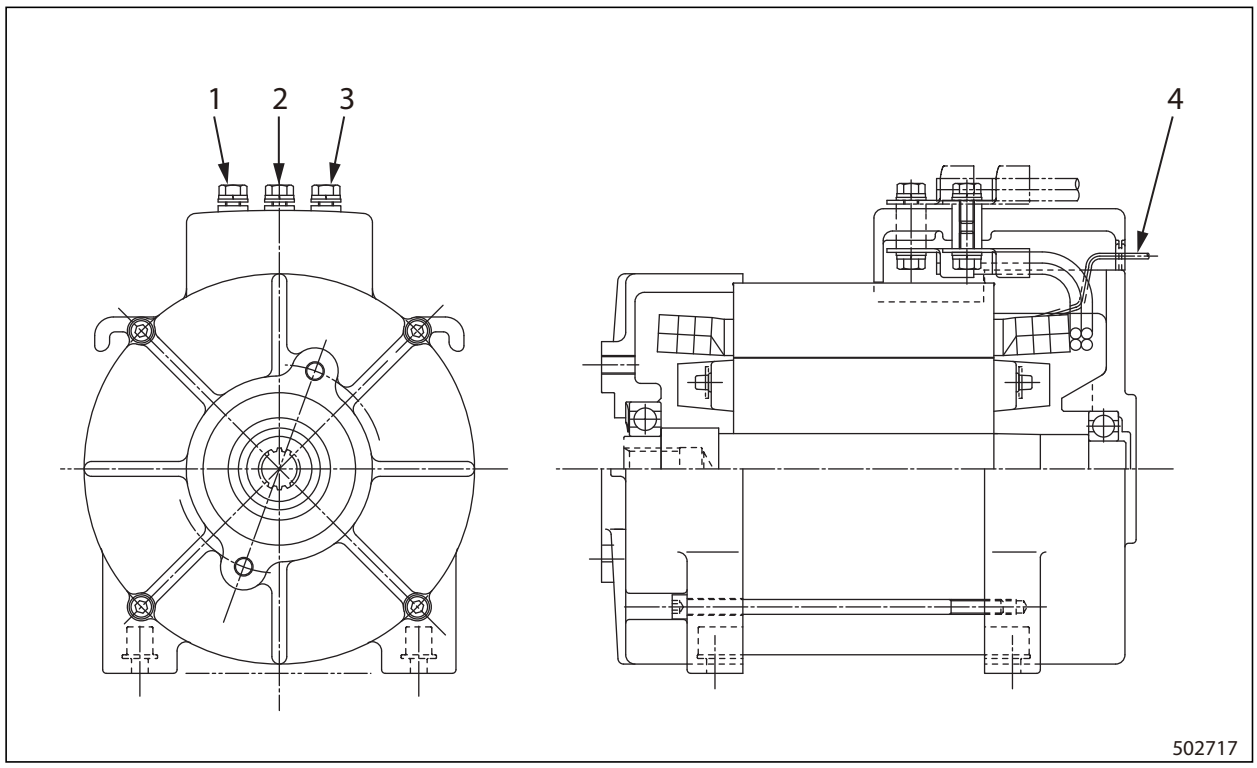

E-04
63
61
64
62
59
57
55
53
51
49
-
45
43
60
58
56
-
52
50
48
-
44


Battery side way exchange truck
Logic
E-04
Br/B
5V
107
56
B
64
43
Interlock SW


Logic
E-04
Standard truck
Br/B
5V
107
56
B
64
43
Interlock SW

506995

3.2 Pump motor

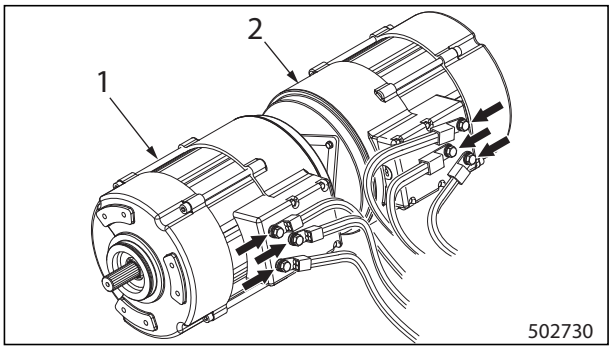


1. W terminal
2. V terminal
3. U terminal
4. Thermal connector

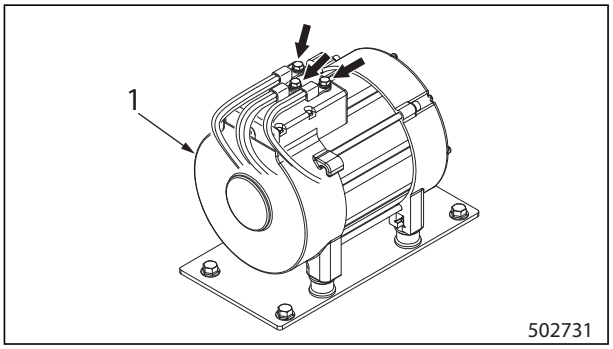
12. Tightening of High-Power Cable Terminals

⚠ CAUTION

If the high-power cable terminals of the battery-operated vehicle are not tightened properly, the increased contact resistance causes excessive heat generation, and could cause a fire in the worst case. To prevent accidents and equipment problems, be sure to regularly check the tightening torque of the high-power cable terminals. Do not pull the cables to check connections or during adjustment. If the cable terminal sections are moved, re-tighten the connections.



1. Left Traction motor (3 terminals)
2. Right Traction motor (3 terminals)



1. Pump motor (3 terminals)

1. Departure equipment name
2. Departure sheet number
3. Cable diameter & color (Description(2))
4. Circuit number
5. Boundary (Description(4))
6. Equipment name
7. Terminal number of connector
8. Connector number (Description(3))
9. Indicate connection with body GND
10. Equipment number
11. Used place of relay coil (Description(1))
12. Indicate same connector
13. Indicate connection with GND circuit
14. Sheet number of GND circuit
15. Used place of relay contact (Description (1))
16. Destination sheet number
17. Destination equipment name
18. Indicate connection with Negative circuit
19. Sheet number of Negative circuit

2.1 Symbols

Symbols are used in the figures for easy reading of circuit diagrams.

General Symbols

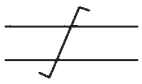
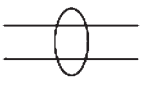
(1) General use symbols

SYMBOL	NAME
	GND (HARNESS)
	GND (BODY)

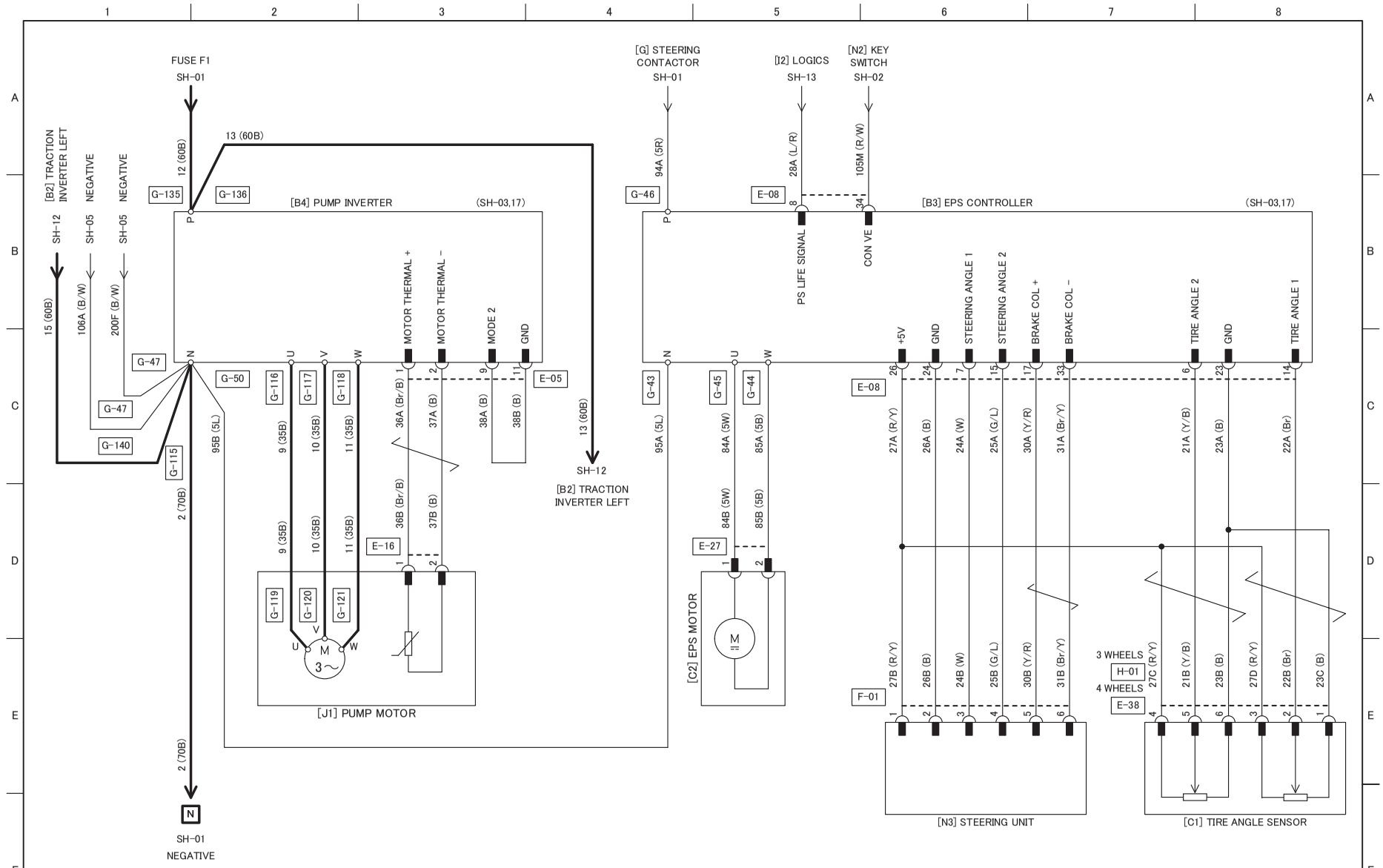
SYMBOL	NAME
	NEGATIVE

(2) Conductors and coupling parts

SYMBOL	NAME
	CONNECTOR (SOCKET/PLUG)
	TERMINAL (SOCKET)
	TERMINAL (PLUG)
	TERMINAL

SYMBOL	NAME
	TWIST WIRE
	SHIELD WIRE
	BRANCHING

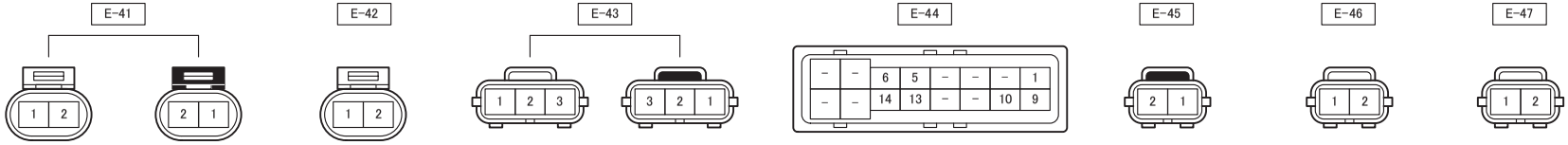
Chapter 5 CIRCUIT DIAGRAM



NOTE (1) CONNECTOR OF TIRE ANGLE SENSOR IS DIFFERENT IN WHEEL TYPE.

CIRCUIT NAME	SH
MOTOR CONTROL	11

GROUP E



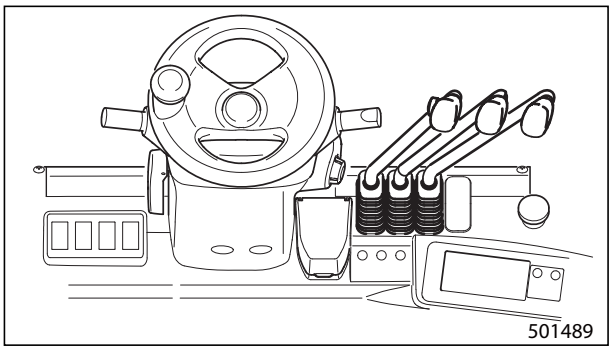
CIRCUIT NAME	SH
CONNECTOR	21A

3. How to Use This Manual

3.1 Forklift Truck Model

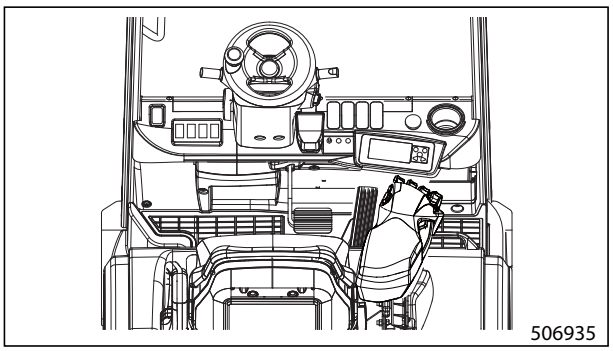
MC model (Mechanical Control System)

Mechanically controlled hydraulic system (conventional lever system).



FC model (Fingertip Control System)

This model allows a fingertip operation of lifting and tilting jobs, and may improve the job efficiency with less operation fatigue.



4. Specifications

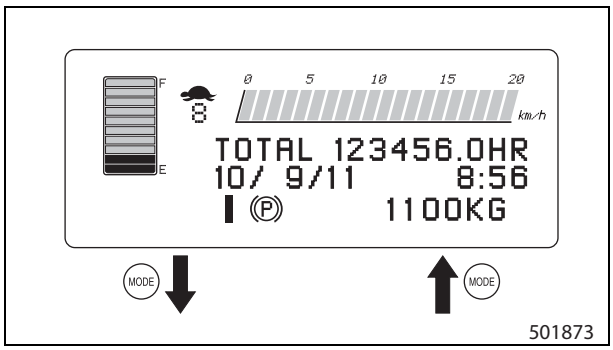
This specification describes the forklift truck with simplex 3.3 m mast.

SPECIFICATION			UNIT	FB16CPN	FB18CPN	FB16PN	FB18PN	FB20PN
PERFORMANCE	RATED CAPACITY, 500 mm (24 in.)		kg (lb)	1600 (2500)	1800 (2900)	1600 (3000)	1800 (3500)	2000 (4000)
	LOAD CENTER		mm (in.)	500 (24)		500 (24)		
	MAXIMUM FORK HEIGHT		mm (in.)	3325 (130.91)		3325 (130.91)		
	FREE LIFT		mm (in.)	115 (4.53)		115 (4.53)		
	LIFT SPEED (UNLOADED/LOADED)		m/s (mph)	0.6/0.5 (118.11/ 98.43)	0.6/0.44 (118.11/ 86.61)	0.6/0.5 (118.11/ 98.43)	0.6/0.44 (118.11/ 86.61)	0.6/0.4 (118.11/ 78.74)
	LOWERING SPEED (UNLOADED/LOADED)		m/s (mph)	0.5/0.52 (98.43/102.36)		0.5/0.52 (98.43/102.36)		
	TILT ANGLE (FORWARD/BACKWARD)		deg	5/7.5		5/7.5		
	TRAVEL SPEED	FORWARD (UNLOADED/ LOADED)	km/h (mph)	17/17 (10.56/10.56)		17/17 (10.56/10.56)		
		REVERSE (UNLOADED/ LOADED)	km/h (mph)	17/17 (10.56/10.56)		17/17 (10.56/10.56)		
	MINIMUM TURNING RADIUS		mm (in.)	1900 (74.80)		2015 (79.33)		
	WORKING AISLE WIDTH 1000 x 1200 mm (39.37 x 47.24 in.) PALLETS		mm (in.)	3473 (136.73)	3473 (136.73)	3588 (141.26)	3588 (141.26)	3599 (141.69)
	WORKING AISLE WIDTH 800 x 1200 mm (31.50 x 47.24 in.) PALLETS		mm (in.)	3273 (128.86)	3273 (128.86)	3388 (133.39)	3388 (133.39)	3399 (133.82)

Icon	Name	When OFF	When ON or flashing	Remarks
	Error warning icon	No abnormalities or errors are detected.	Some abnormalities or errors are detected.	The diagnostic code is displayed instead of hour meter, calendar, clock, and load meter.
	Parking brake warning icon	Parking brake disengaged	ON indicates the parking brake switch is applied. Blink indicates mast inter lock system activated.	
	Seat belt warning icon	Seat belt is fastened.	Seat belt is not fastened when operator sits on seat (Seat switch is turned ON).	
	Battery charge warning icon	Normal battery condition	Blink indicates battery needs to be charged soon. ON indicates battery needs to be charged and lifting function inoperable: BATTERY LOW (BDI=1): Lifting is operable. BATTERY LOW (BDI=0): Lifting speed is reduced (approximately 50%) When concerning the diagnostic code: Lifting is inoperable.	Message “BATTERY LOW” is displayed instead of hour meter.
	Brake fluid level warning icon	Normal fluid level	Low fluid level	
	Overheat warning icon	Controller, traction motors, and pump motor in normal temperature range	Overheating	Overheating causes a significant power output loss. When component temperature returns to normal level, output power returns.
	Service indicator icon	Starts blinking 20 hours before set time. Remains ON when set time is reached.		
	Mast interlock indicator icon	The lift and/or tilt lever is placed to the NEUTRAL position and operator sits in the operator seat properly.	The lift and/or tilt lever can not be operated when operator is not sitting properly in the operator seat for approximately 3 seconds.	
	Driving interlock indicator icon	The accelerator pedal is activated when the direction lever is in NEUTRAL and accelerator pedal is released.	The accelerator pedal can not be operated when operator is not sitting properly in the operator seat for approximately 3 seconds.	

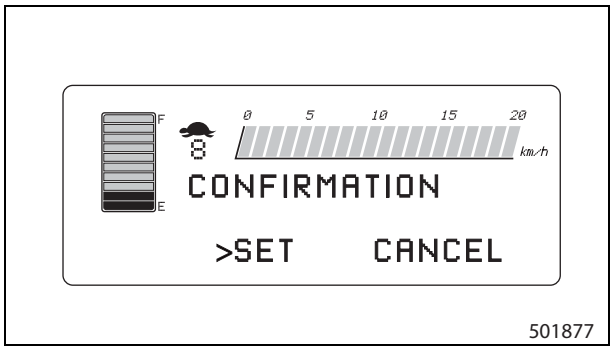
Display contrast setting

(1) Turn the key switch ON and the screen 1 appears.



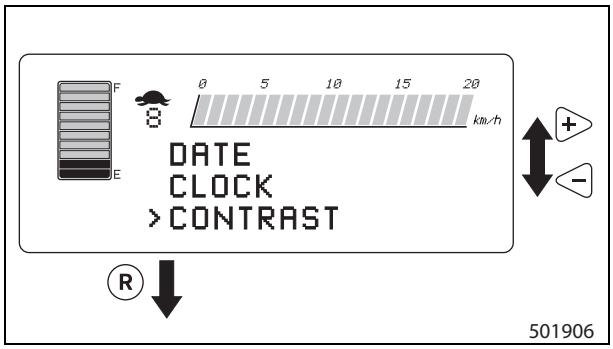
Screen 1

(2) Push MODE button and the screen 2 appears.



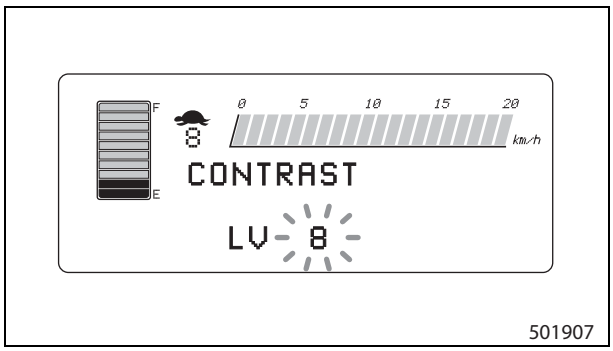
Screen 2

(3) Move the cursor to "CONTRAST" by pushing ◁ or ▷ button.



Screen 3

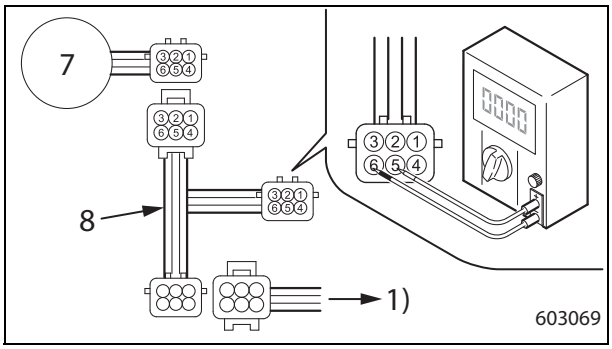
(4) Push (R) button. Then screen 4 appears. The current parameter is blinking.



Screen 4

(2) Turn the key switch to the OFF position.
(3) Unplug the connector of the potentiometer.
(4) Insert the adapter for easy adjustment, then connect the potentiometer again.
(5) Turn the key switch to the ON position.
(6) Apply DC 5 ± 0.5 V voltage between Red (+) and Black (GND).
(7) Measure the voltage at following sections.
- Between White (OUT 1) and Black (GND)
- Between Blue (OUT 2) and Black (GND)

(8) So that the voltage of both sections is 3.10 V or more, adjust dimension 4) of the truss screw.



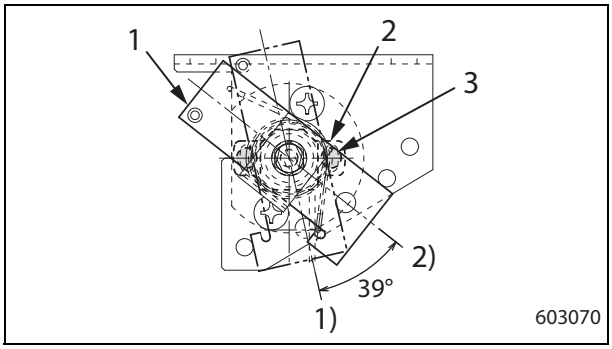
1. Blank
2. Blue (OUT 2)
3. Red (+)
4. Green (Ground line)
5. Black (GND)
6. White (OUT 1)
7. Potentiometer
8. Adapter

1) To body harness

Specified dimension		
4)	Truss screw length	Approximately 27 mm (Approximately 1.063 in.)

Adjusting potentiometer

(1) Perform the step 2 to 7 in Accelerator linkage adjustment procedure.
(2) So that the voltage of both sections is as follows, adjust the mounting angle of the potentiometer by using the flat head screw.



1. Lever
2. Potentiometer
3. Flat head screw

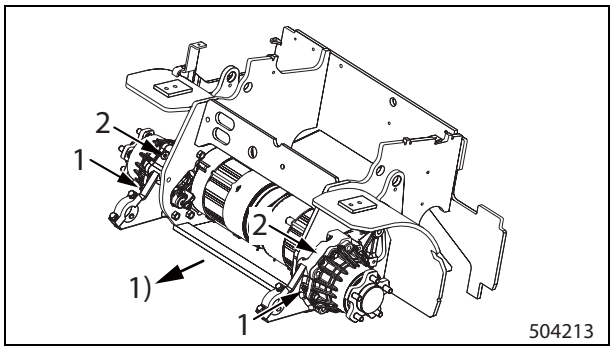
1) At lever rotated 39° position
2) At pedal release position

Specified voltage		
1)	At lever rotated 39° position	More than 3.20 V and less than 4.50 V

Specified voltage		
2)	At pedal released position	0.85 ± 0.1 V

12. FC Armrest

(3) Pour oil into the transfer cases:
Remove oil level plug.
Remove oil filler plug.
Pour appropriate oil from the oil inlet. Make sure the oil fills up to the level plug.
Tighten the oil level and inlet plugs.



1. Oil level plug
2. Oil filler plug

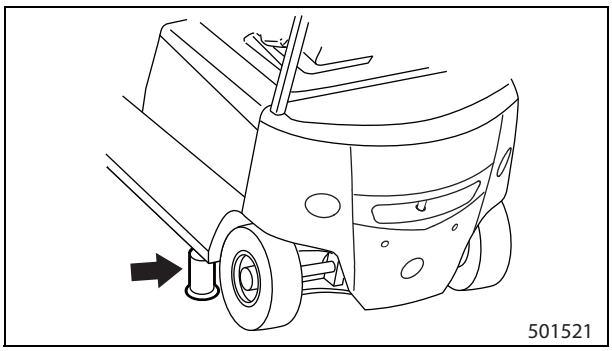
1) Front of Vehicle

Item	Value
Oil quantity	0.53 liter (0.14 U.S. gal.)

1. Cover
2. Tapered roller bearing (outer race)
3. Tapered roller bearing (outer race)
4. Needle bearing
5. Oil seal
6. Wheel hub
7. Oil seal retainer
8. Tapered roller bearing (inner race)
9. Thrust washer
10. Needle bearing
11. Planetary gear
12. Plate
13. Snapring
14. Input gear
15. Ball bearing
16. Input plate
17. Snapring
18. Snapring
19. Pin (for brake)
20. Pin
21. O-ring
22. Plate
23. Friction plate
24. Disc spring
25. Mating plate
26. Brake cover
27. Bolt
28. Ball bearing
29. 2nd gear
30. Tapered roller bearing (inner race)
31. Output carrier
32. O-ring
33. Washer
34. Locknut
35. Lock plate
36. Bolt
37. Hub cap
38. Thrust bearing
39. Thrust washer
40. Sun gear
41. Main case
42. Level plug
43. O-ring
44. Drain plug
45. O-ring
46. Bolt
47. Bolt
48. Brake lever
49. Nut
50. Adjusting bolt
51. Bushing
52. Clevis pin
53. Split pin
54. Bolt
55. Brake cylinder assembly
    (Air bleeder, bleeder screw, spring, piston, seal, housing, pin and cover)
56. Traction motor

Note: Do not confuse the mounting position, orientation, and number of the disc springs.
If assembled incorrectly, it could cause a premature wear of friction plates and brake force decrease.

(6) Position the jack under the counterweight at the recessed point and raise the rear wheel.
(7) Place the jack stand under the frame to support it.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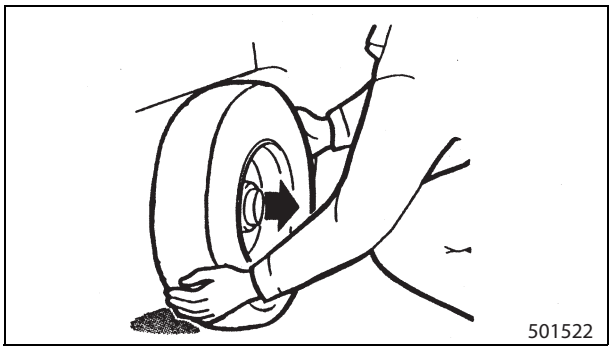
⚠ CAUTION

Be careful NOT to strip the bolt threads when removing the wheel.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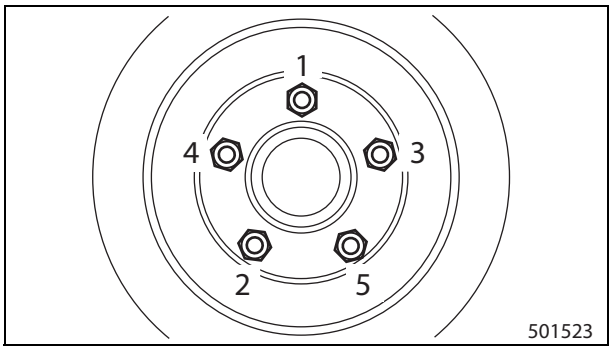
3. Installing Rear Wheel

(1) Install the wheel and tighten the wheel nuts finger tight until their clamping surfaces come into full-face contact with the counter bores in the rim.



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Note: Make sure the clamping surfaces of the wheel nuts and countersinks are free of dirt.

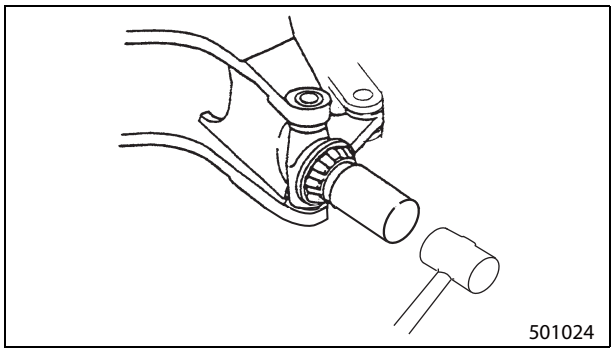
(2) Lower the forklift truck by operating the jack until the tire just touches the ground. Then tighten the wheel nuts in the sequence shown, in two or three steps, to the specified torque.
(3) Lower the forklift truck fully and restore the jack and tire.
(4) Make sure the tire pressure is correct.
(5) After tire replacement, drive the forklift truck for a while and then recheck the torque of the wheel nuts.

Tightening torques for wheel nuts

Torque
156.9±15.7 N·m (16 ± 1.6 kgf·m)[115.7 ± 11.6 lbf·ft)

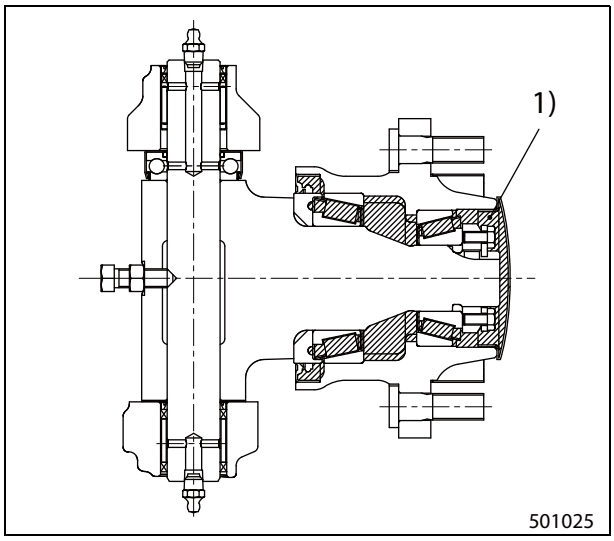
10.2 Suggestions for Assembly

(1) Install the oil seal retainer as shown in the illustrated direction.
(2) Install the bearing (outer).



(3) Tapping with hammer, fit the wheel bolt into the hub bolt hole.

(4) Using the installer, press fit the bearing (outer) to the new hub.
(5) Using the installer, press fit the oil seal to the hub.
(6) Pack grease into the rear axle hubs. See the illustration for proper grease filling condition. Apply grease to the bearing cage. Fill grease to approximately 80% of the cavity. Do not supply grease to the full level. Filling grease to the maximum level causes excessive heat generation and quickly deteriorates the grease. When coating oil seal lips with grease, be careful not to apply too much grease, as an excessive amount of grease can cause leaks.



1) Fill "AUTOLEX A" grease.

Chapter 6 BRAKE SYSTEM

1. Specifications

For the wheel brake, refer to the chapter of "TRANSFER UNITS".

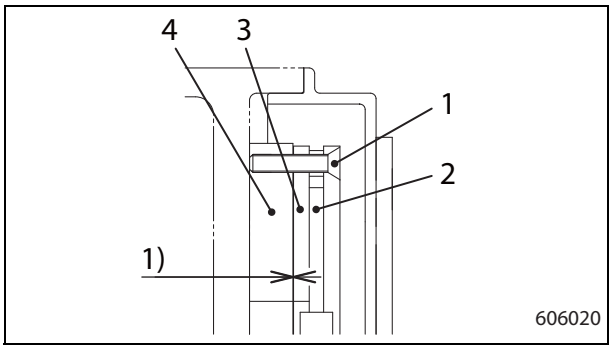
Item		Specification
Parking brake	Type	Electro-magnetic brakes
	Brake outside diameter	167.5 mm (6.595 in.)
	Brake disc effective diameter	166 mm (6.535 in.)
	Clearance between armature and stator	0.10 to 0.25 mm (0.004 to 0.01 in.)
	Voltage	DC 24 V
	Current	1.29 A
	Static friction torque	38 N·m (3.87 kgf·m) [28.03 lbf·ft] or more
	Insulation classification	F type

Adjusting

As a general rule, you don't have to adjust the electromagnetic brake assembly.

- When adjusting out of necessity, loosen or tighten the screw so that the clearance between armature and stator is within following.

Note: Prevent the rotor from interfering with the armature and stator.



1. Screw
2. Rotor
3. Armature
4. Stator
1) Air gap

Specified clearance between armature and stator
Smaller than 1 mm (0.04 in.)

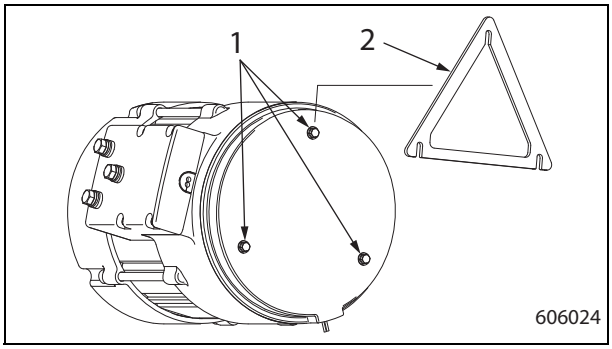
Manual release of magnet brake

When the forklift truck does not start up or cannot move because of electrical abnormality, release the brake using the following methods:

⚠ WARNING

Before starting the forklift truck again, the brake plates must be restored to the original position and all bolts must be tightened. Otherwise, parking brake doesn't work correctly.

(1) Loosen the brake plate mounting bolts, and remove the brake plate.
(2) Tighten the bolts after removing brake plate.



1. Bolt
2. Brake plate

4. Inspecting Steering Linkage Assembly

⚠ CAUTION

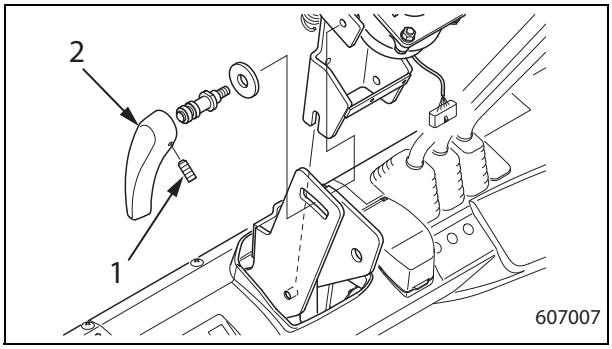
- Park the forklift truck on a level surface, with the forks lowered, parking brake applied, the direction lever in NEUTRAL position.
- Turn the key switch to the off position.

Note: The steering wheel torque reduces by up to about 25% due to aging of components, but it conforms to the specification and it has no practical problem when in use.

5. Installing Steering Linkage Assembly

Follow the removal sequence in reverse.
During installation, conduct the following.

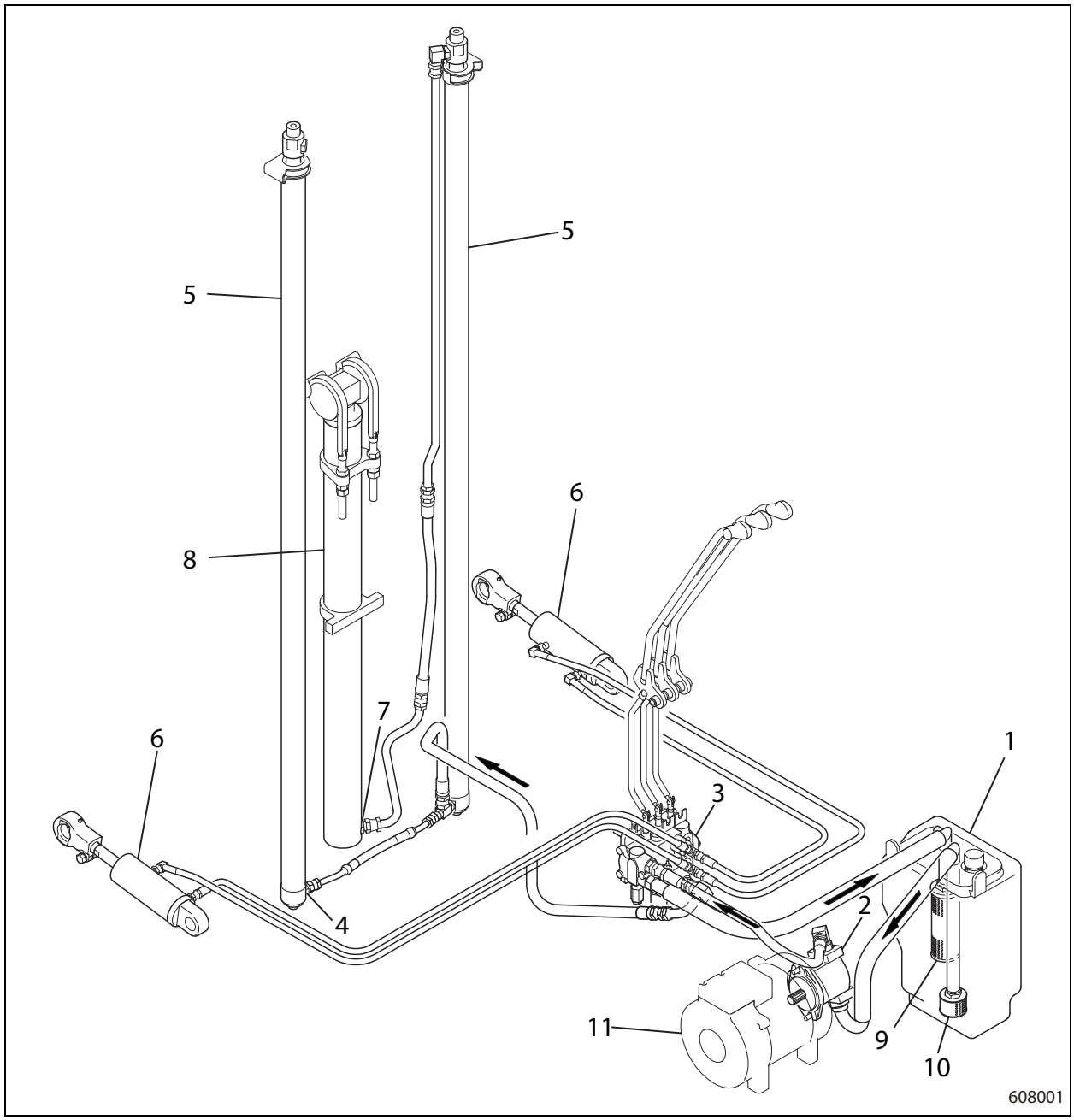
- When install the set screw to the handle, apply THREEBOND® #1401 or equivalent.



1. Set screw 2. Handle

2. Structure

2.1 Hydraulic Line (MC Model)

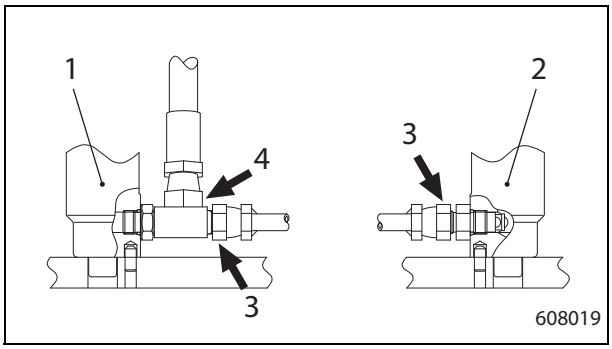


1. Hydraulic tank
2. Gear pump
3. Control valve
4. Down safety valve
5. Lift cylinder
6. Tilt cylinder
7. Down safety valve
8. First lift cylinder (Duplex mast and Triplex mast system)
9. Return filter
10. Suction filter
11. Pump motor

The hydraulic system is constructed as shown above. (The figure shows the hydraulic system for the Duplex mast system.)
The major difference between FC model and MC model is only the control valve.

When the lift lever or tilt lever is operated, the microswitches located in the spool of the control valve send signals to the logic card in the main controller. Based on received signals, the logic card drives the pump motor and operates the oil pump.

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

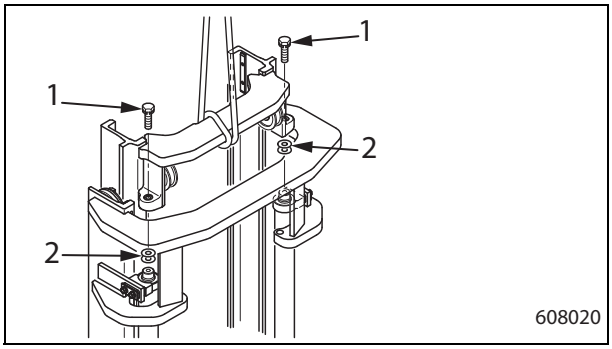


1. Right-hand cylinder 2. Left-hand cylinder

Item	Tightening torque for high-pressure hose
3	49.0 ± 4.9 N·m (5.0 ± 0.5 kgf ·m) [36.1 ± 3.6 lbf·ft]
4	58.8 ± 5.9 N·m (6.0 ± 0.6 kgf ·m) [43.4 ± 4.4 lbf·ft]

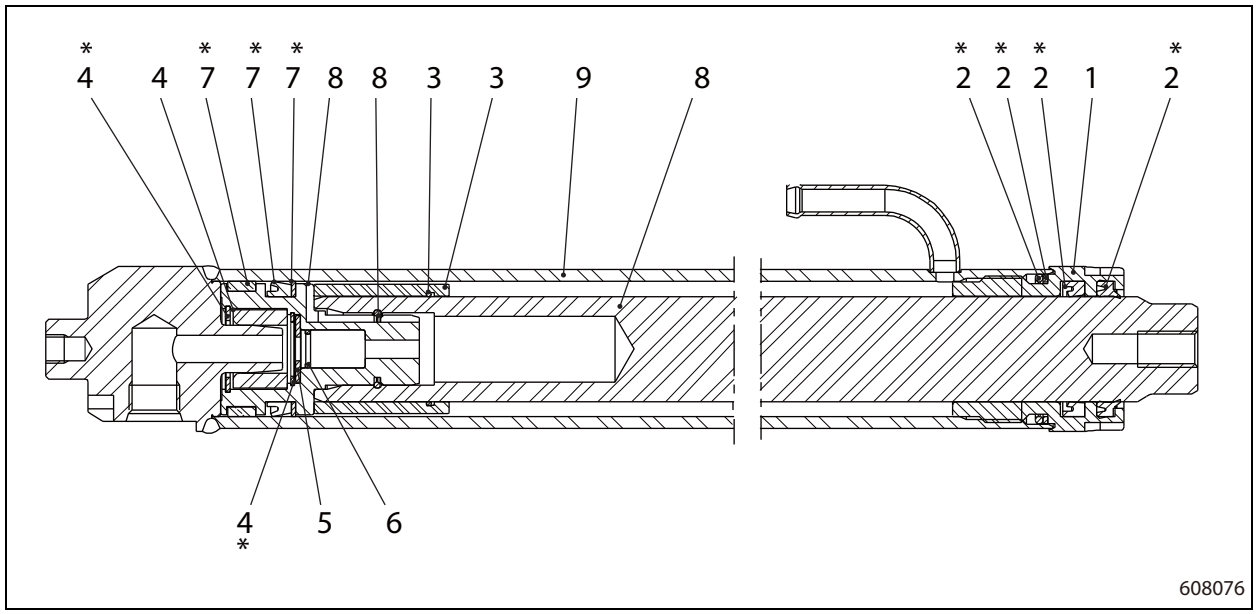
(9) Record the amount and thickness of shims and cylinders to which the shims are fitted.

(10) Remove the washer assembled bolts 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.



1. Washer assembled bolt 2. Shim

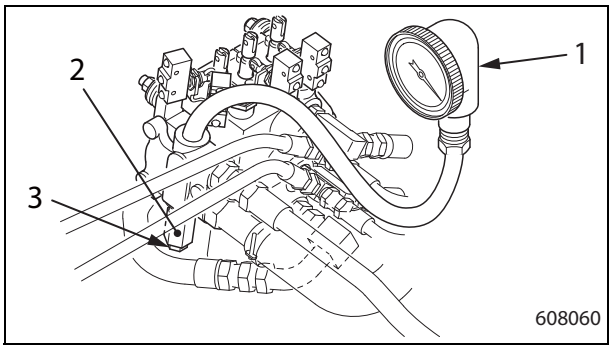
Triplex Mast Second Lift Cylinder (Mast height 6500/7000)



1. Retainer
2. Wiper*, Rod seal*, O-ring*, Backup ring *
3. O-ring, Spacer
4. Circlip*, Sleeve
5. Washer
6. Check valve
7. Piston seal*, Backup ring*, Wear ring*
8. Rod, Wire ring
9. Shell assy

Note: The part marked with * is included in the seal kit.

(4) Turn the key switch to the ON position, and pull the Lift lever to the top end.
(5) Read the indication of the pressure gauge with pulling the Lift lever.



1. Pressure gauge
2. Main relief valve
3. Adjusting screw

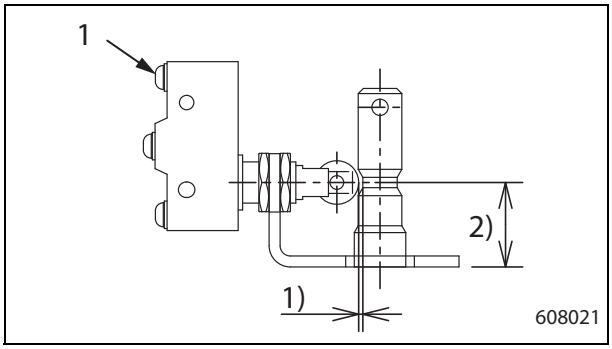
Item	Standard
Main relief valve set pressure	18.1 MPa (184.57 kgf ·cm^2) [2625.2 psi]

(6) If the relief pressure is out of this specification, loosen the locknut of the relief valve, and while observing the gauge indication, adjust the pressure using the adjusting screw.
(7) While pressing the adjusting screw, tighten the locknut securely.
(8) After tightening the locknut, check the set pressure of the relief valve again.

17.4 Adjusting Microswitch

Microswitches of low-speed lift, tilt and attachment

(1) Adjust the microswitch position to activate the switch when the spool moves from 0.7 mm to 1.2 mm from the NEUTRAL position. (the lever is moved from 15 to 25 mm at the top of the lever from the NEUTRAL position.)
(2) After adjustment, apply THREEBOND [#1401] or an equivalent product on both fixing nuts of the switch.

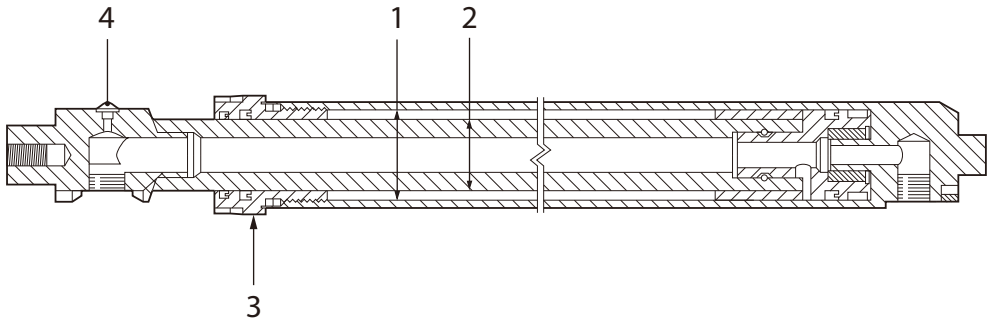


1. Microswitch

Ref.	Item	Standard
1)	Dimension with the hydraulic lever in NEUTRAL position	0.1 to 0.6 mm (0.004 to 0.024 in.)
2)		24.6 mm (0.969 in.)

Lift Cylinders (Duplex Mast Second Cylinder)

Ref.	Item		Specified value
1	Inside diameter of cylinder	Standard	45 mm (1.77 in.)
2	Outside diameter of piston rod	Standard	ø32 mm (1.26 in.)
3	Retainer thread diameter	Standard	M52 x 2
	Tightening torque for retainer	Standard	170 to 240 N·m (17.3 to 24.5 kgf·m) [125.3 to 177.0 lbf·ft]
4	Tightening torque for air bleed screw	Standard	4.5 to 5.0 N·m (0.46 to 0.51 kgf·m) [3.3 to 3.7 lbf·ft]



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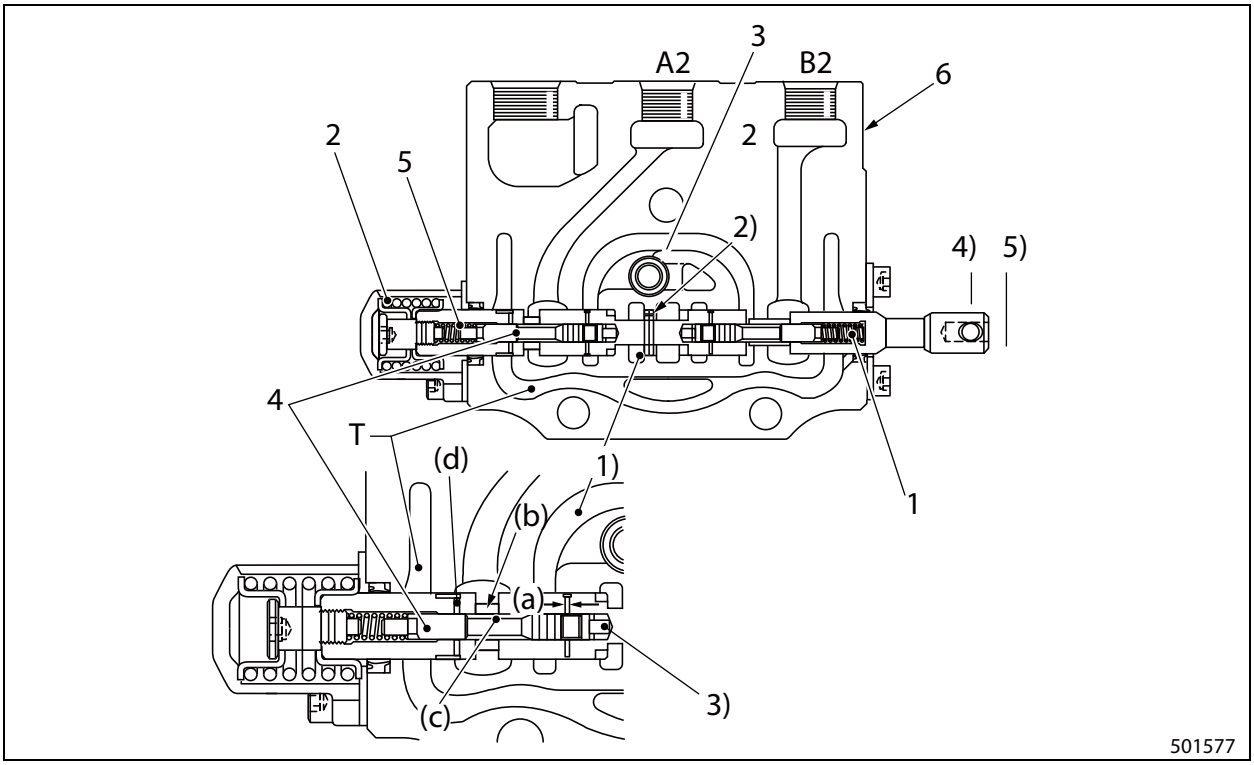


1) Passage A
2) Hole
3) Chamber
4) Forward tilt
5) Neutral

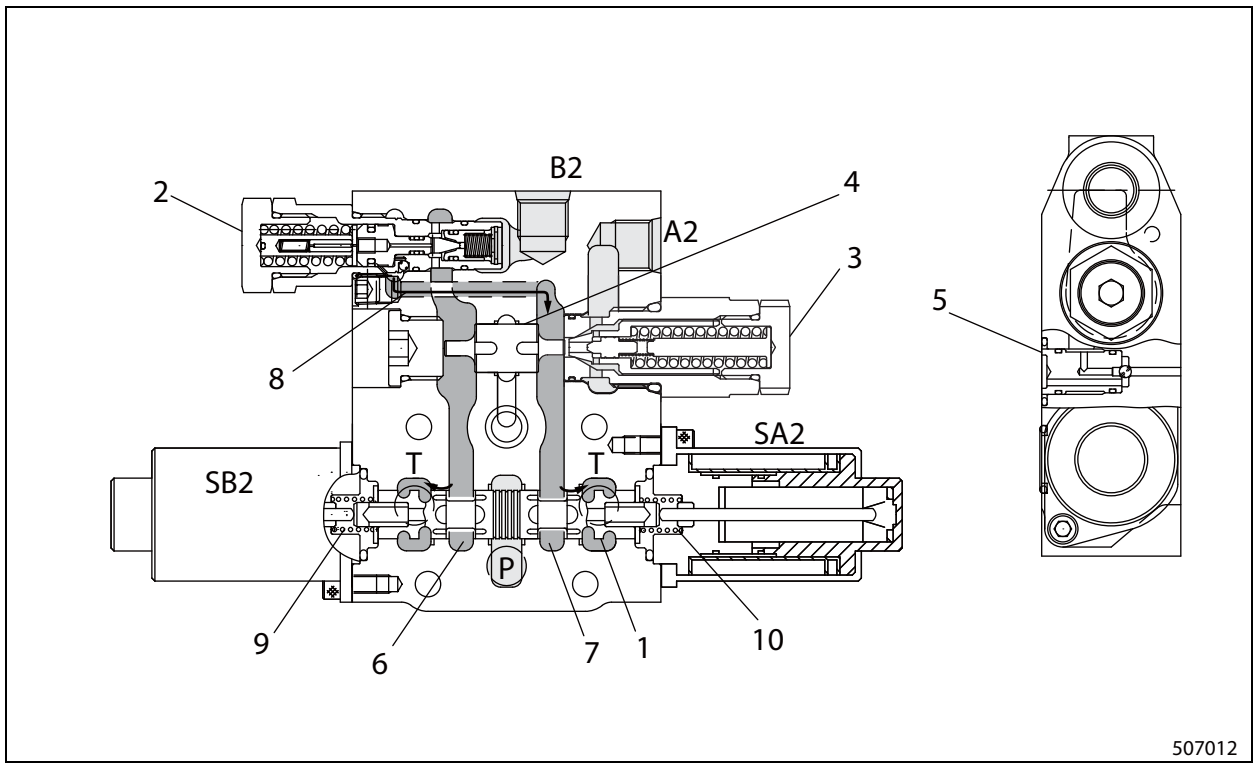
Mast forward tilt position

The above illustration shows the 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 T.

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 pump motor runs and pressure oil is supplied from the pump.
This valve is a kind of an anti-disaster valve.

22.5 Tilt Valve



1. Tilt spool
2. Tilt lock valve (Counterbalance valve for forward)
3. Tilt lock valve (Counterbalance valve for backward)
4. Piston
5. Shuttle valve
6. Passage to B2 port
7. Passage to A2 port
8. Load pressure passage
9. Spring
10. Spring

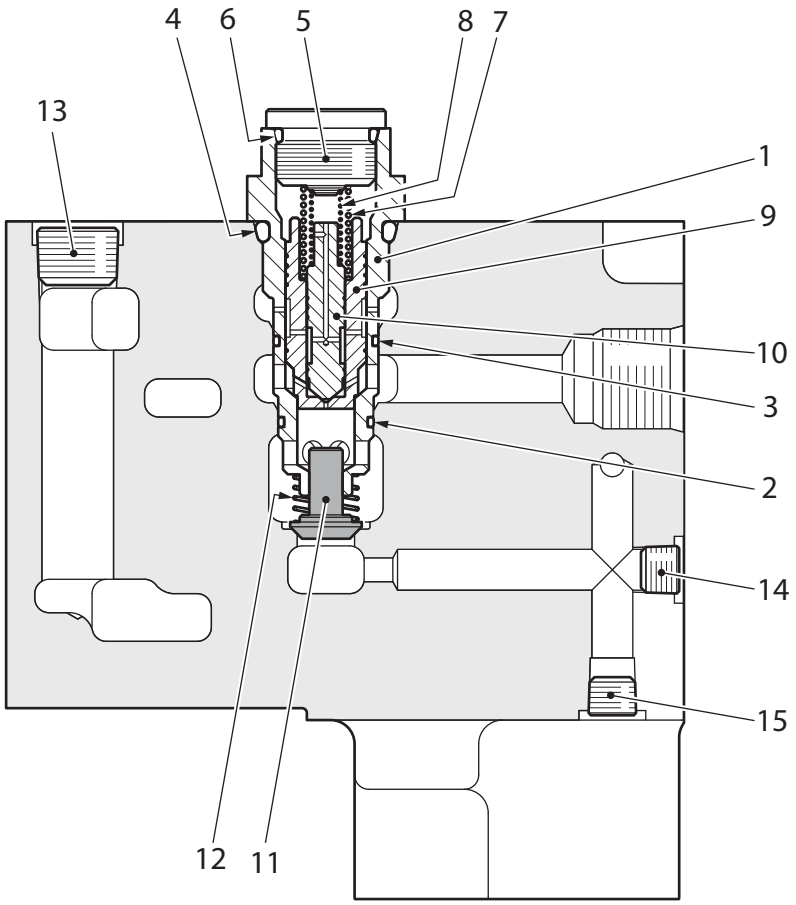
Condition When Joystick is in Neutral Position

Since both of the electromagnetic proportional solenoid valves (SA2 and SB2) are de-energized springs 9 and 10 position in the center, and tilt spool 1 moves in neither direction remaining in the NEUTRAL position.

The hydraulic oil of lift/tilt/attachment in bleed-off valve enters oil passage P, and the oil remains there as the exist of the passage P is blocked by the tilt spool 1.

The hydraulic oil from A2 port and B2 port is also blocked by tilt lock valve 2 and tilt lock valve 3.

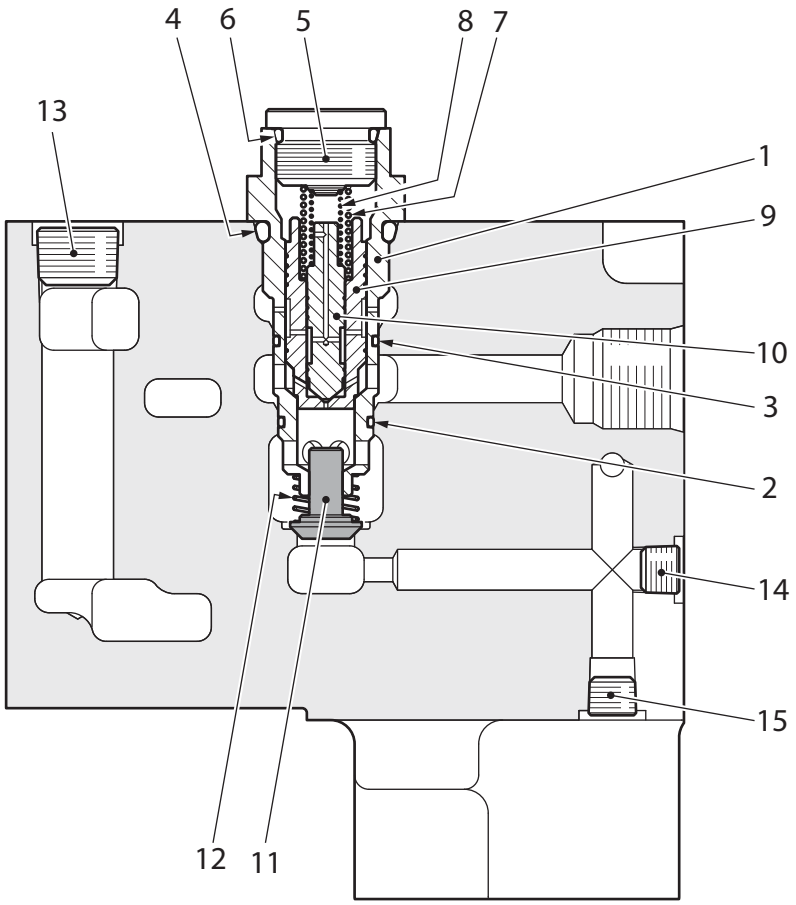
28.3 Disassembly Sequence (Part 3)



1. Valve assembly
2. O-ring
3. O-ring
4. O-ring
5. Plug
6. O-ring
7. Spring
8. Spring
9. Poppet
10. Valve
11. Valve
12. Spring
13. Plug
14. Plug
15. Plug

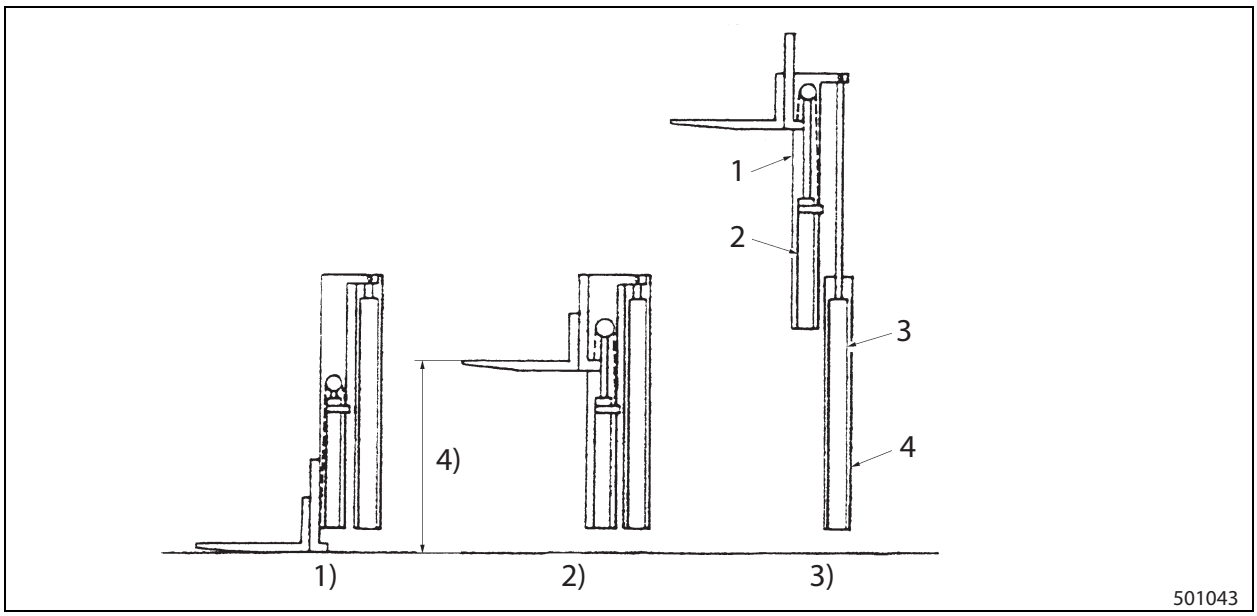
Note: Lift lock valve (1 to 10)

37.2 Disassembly Sequence



1. Body
2. O-ring
3. O-ring
4. O-ring
5. Plug
6. O-ring
7. Spring
8. Spring
9. Poppet
10. Valve
11. Valve
12. Spring
13. Plug
14. Plug
15. Plug

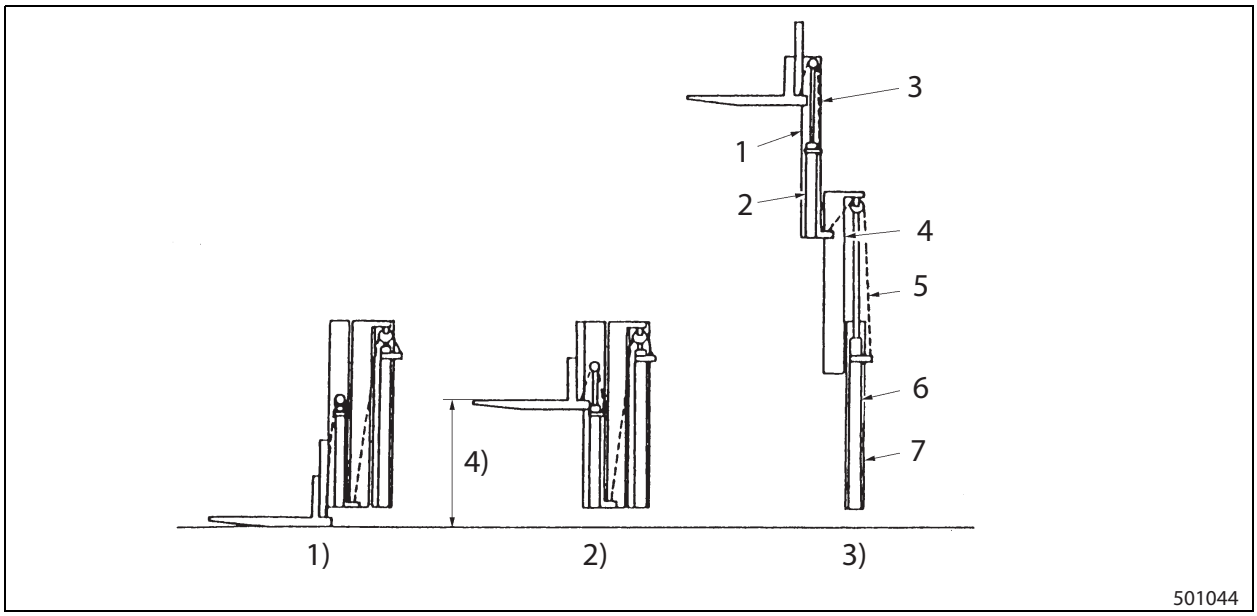
2.4 Operation of Duplex Mast



1. Inner mast
2. First lift cylinder
3. Second lift cylinder
4. Outer mast

1) Forks on the ground
2) Maximum free lift
3) Maximum lift
4) Free-lift height

2.5 Operation of Triplex Mast



1. Inner mast
2. First lift cylinder
3. First lift chain
4. Middle mast
5. Second lift chain
6. Second lift cylinder
7. Outer mast

1) Forks on the ground
2) Maximum free lift
3) Maximum lift
4) Free-lift height