



# Operation & Maintenance Manual

FC/MC

EP13PNT	ETB21-00011-01999 / ETB21-02001-49999
EP15PNT	ETB21-50011-51999 / ETB21-52001-99999
EP16CPNT	ETB22-00011-01999 / ETB22-02001-49999
EP18CPNT	ETB22-50011-51999 / ETB22-52001-99999
EP16PNT	ETB23-00011-01999 / ETB23-02001-49999
EP18PNT	ETB23-50011-51999 / ETB23-52001-99999
EP20PNT	ETB24-00011-01999 / ETB24-02001-99999

EP16CPN	ETB27-00011-01999 / ETB27-02001-49999
EP18CPN	ETB27-50011-51999 / ETB27-52001-99999
EP16PN	ETB28-00011-01999 / ETB28-02001-49999
EP18PN	ETB28-50011-51999 / ETB28-52001-99999
EP20PN	ETB29-00011-01999 / ETB29-02001-99999

Original Instructions

Keep this manual in your lift truck as a ready reference

99750-6M120

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- Please note: If there is no response to CLICKING the link, please download this PDF first and then click on it.

CLICK HERE TO **DOWNLOAD** THE COMPLETE MANUAL

**⚠ WARNING****No smoking while refueling!**

DO NOT fill the fuel tank while the engine is running or the operator is on the lift truck. Keep away from flames or spark sources. Turn OFF all electrical switches on the lift truck. Pump fuel in a well-ventilated area.



D00680

**⚠ WARNING****Know your lift truck is safe!**

DO NOT operate any lift truck that is not safe to operate.



D00288A

**⚠ WARNING****Know all signals and traffic rules!**

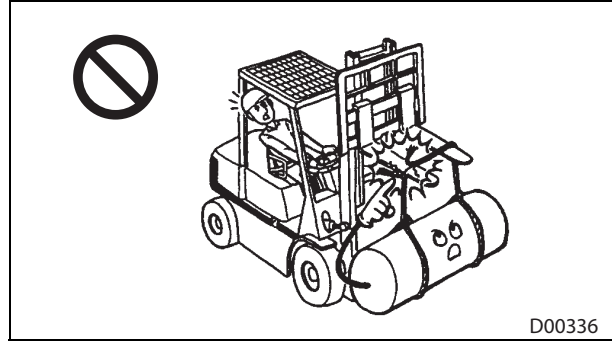
Know who is responsible for signaling. Learn to tell at a glance what the signal means, and what action you must take.



D00280

**⚠ WARNING****Use the proper attachment!**

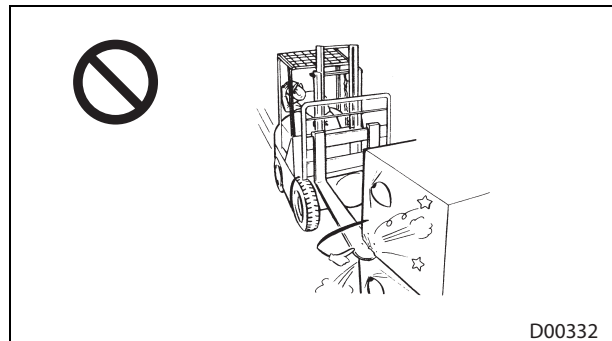
When lifting a load, use the proper attachment designed for the load. DO NOT operate at high speeds.



D00336

**⚠ WARNING****DO NOT speed when approaching loads!**

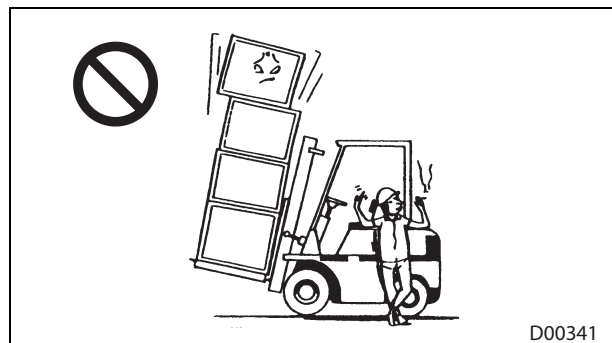
Approaching loads at high speed is dangerous. Also, it could damage loads. Approach the load carefully at slow speeds.



D00332

**⚠ WARNING****Ensure the load is not too high!**

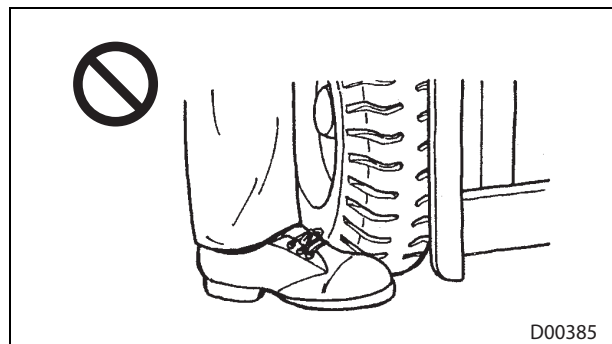
DO NOT pick up unsecured loads that extend above the load backrest extension height.



D00341

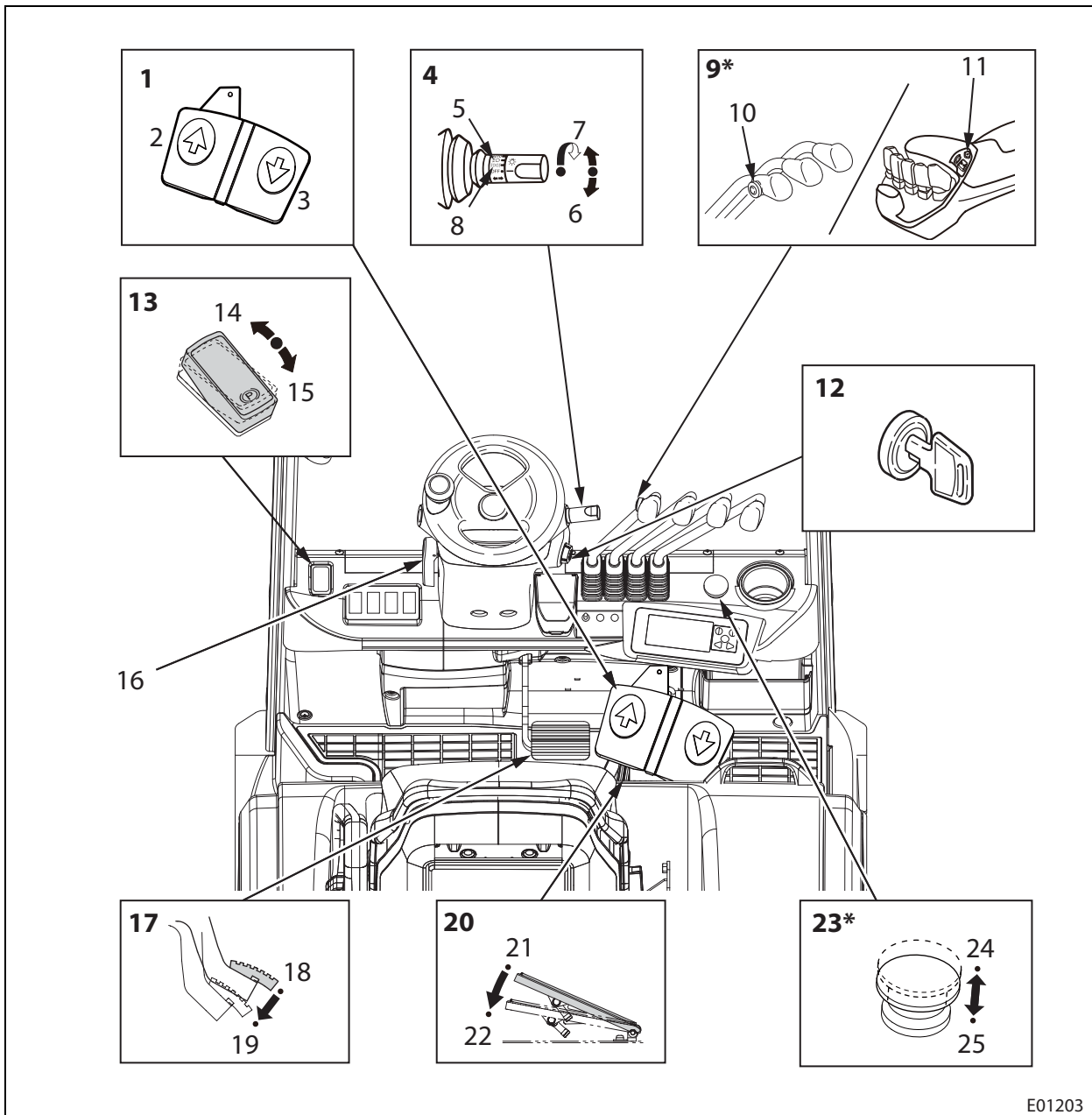
**⚠ WARNING****DO NOT move when someone's next to the lift truck!**

If someone is standing next to the lift truck, DO NOT proceed until they are at a safe distance. DO NOT assume that people are aware of you and will move out of your way.



D00385

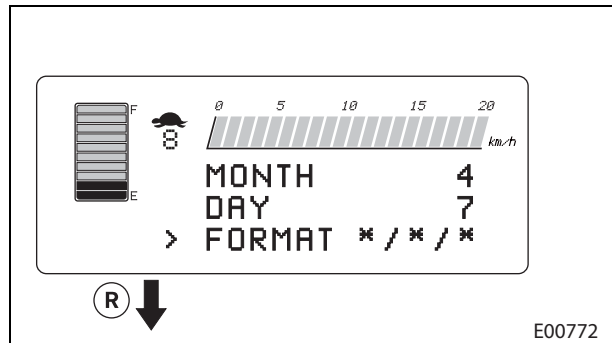
Foot direction control (Option)



E01203

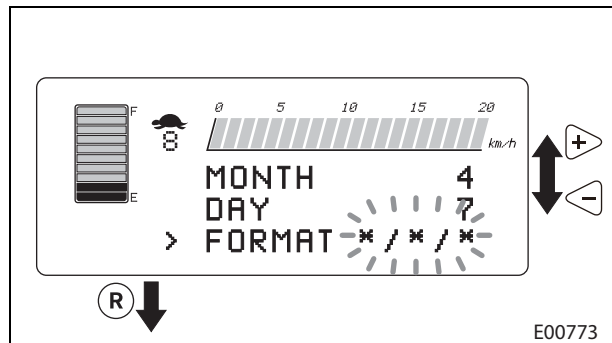
- |   |  |
|---|--|
| <p><b>1. Foot direction control</b><br/>                 2. FORWARD (F)<br/>                 3. REVERSE (R)</p> <p><b>4. Turn Signal / Light Switch</b><br/>                 5. Head Light (Position 2)<br/>                 6. Right turn<br/>                 7. Left turn<br/>                 8. Clearance Light (Position 1, option)</p> <p><b>9. Horn Switch</b><br/>                 *The horn switch is not on the steering wheel.</p> <p>10. Push to activate horn (MC model)<br/>                 11. Push to activate horn (FC model)</p> <p><b>12. Key Switch</b></p> | <p><b>13. Parking Brake Switch</b><br/>                 14. Release<br/>                 15. Apply</p> <p><b>16. Steering Column Tilt Lever</b></p> <p><b>17. Brake Pedal</b><br/>                 18. Release<br/>                 19. Apply</p> <p><b>20. Accelerator Pedal</b><br/>                 21. Release<br/>                 22. Apply</p> <p><b>23. Battery Disconnect Switch</b><br/>                 *This button disconnects the battery.</p> <p>24. Pull the switch to release.<br/>                 25. Push the switch to apply.</p> |
|---|--|

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



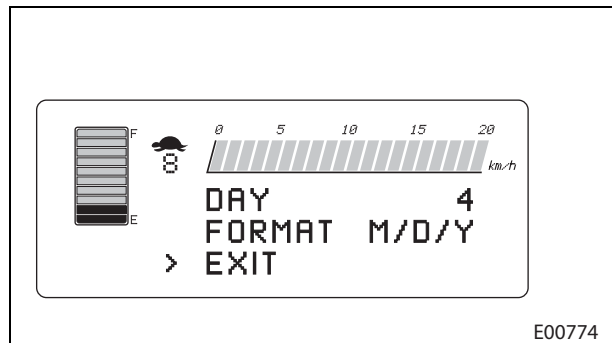
Screen 8

- (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.



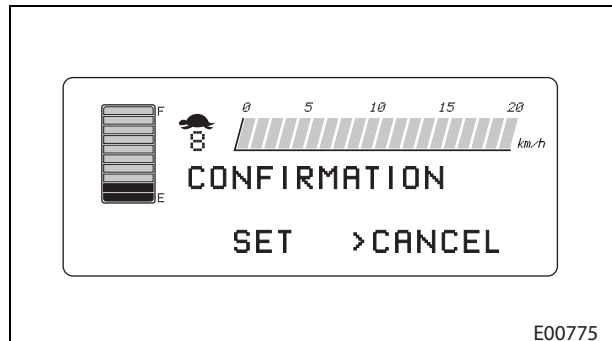
Screen 9

- (12) After setting of the format, push (R) button, and then the screen 10 appears.  
 (13) Push (R) button. Then setting is complete.



Screen 10

- (14) If you want to change the setting, select "CANCEL" on the screen 11.



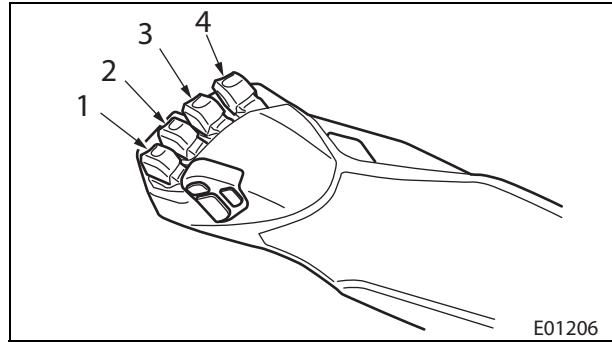
Screen 11

## ◆ Operating Switches and Controls (FC Model)

### Equipped with mast interlock system

The mast interlock will work for the lift, tilt, and attachment switches.

If the operator leaves the operator seat for approximately 3 seconds while the key switch is in the ON position, regardless of whether the pump motor is running or not, the mast and attachment will not lift, lower, or tilt when the lift, tilt, or attachment switch is operated. This is not a failure, but the interlock system is being activated.

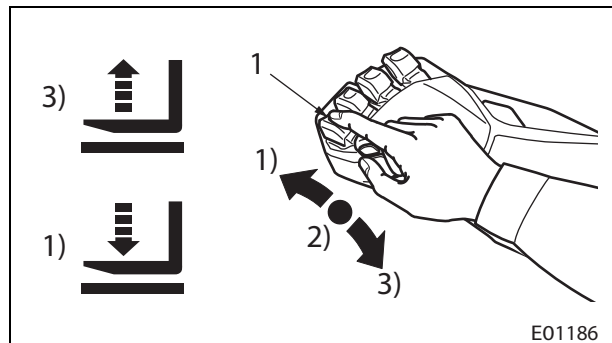


1. Lift switch  
2. Tilt switch  
3. Attachment switch A  
4. Attachment switch B

### ► Lift Switch

Lifting speed is controlled by the speed of the pump motor and the position of the lift switch. Lowering speed is controlled only by the position of the switch lever regardless of the speed of the pump motor. The switch will return to the neutral position when released.

To deactivate the mast interlock system, the operator sits on the operator seat while the key switch is in the ON position with traction motor stopped. Return the lift switch to the NEUTRAL position and then operate the lift switch.

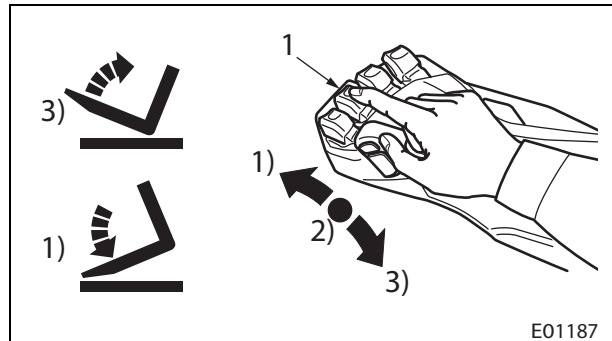


1. Lift switch  
1) Lower  
2) Neutral  
3) Raise


### ► Tilt Switch

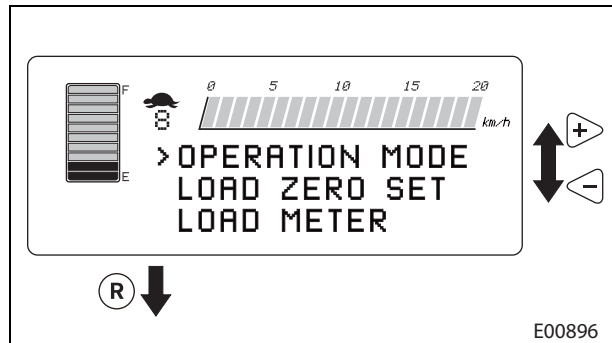
Tilt speed is controlled by the speed of the pump motor and the position of the tilt switch. The switch will return to the neutral position when released.

To deactivate the mast interlock system, the operator sits on the operator seat while the key switch is in the ON position regardless of whether the traction motor is running or not. Return the tilt switch to the NEUTRAL position and then operate the tilt switch.




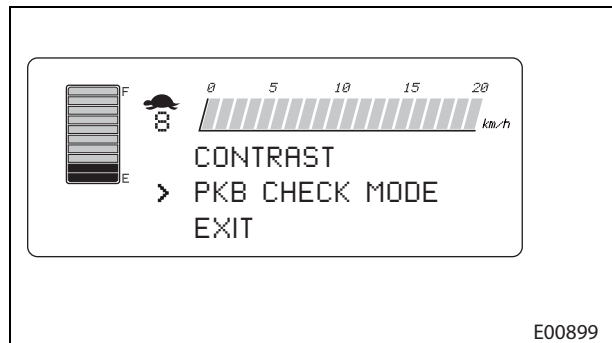
1. Tilt switch  
1) Forward  
2) Neutral  
3) Backward

(2) Push the  button and screen 2 appears.



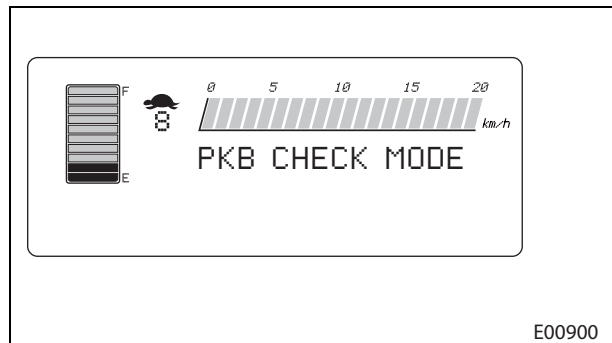
Screen 2

(3) Move the cursor to "PKB CHECK MODE" by pushing the  button twice.



Screen 3

(4) Push the (R) button. Then, screen 4 appears.



Screen 4

**⚠ CAUTION**

In order to move to PKB check mode, below conditions must be satisfied.

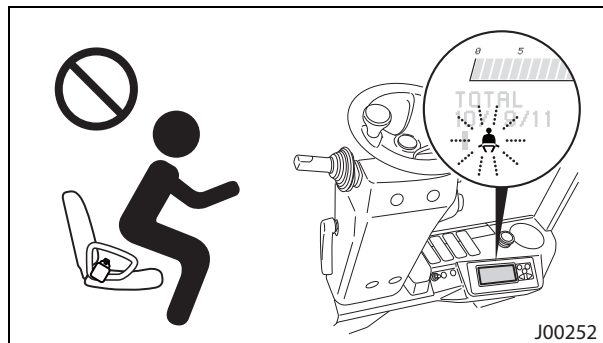
- No diagnostic code is indicated on display.
- Parking brake switch is pushed to apply.
- Accelerator pedal is released.
- Directional lever is in the NEUTRAL position.
- Traveling speed is 0 km/h (0 mph).
- Steering tire angle must be straight by tire indicator on the display.

### ► Mast Interlock System

Your lift truck has an operator presence switch installed in the operator seat.

You are unable to move the mast unless you are properly seated.

In addition, the warning icon blinks when the seat belt is not worn or when it is not inserted into the seat belt buckle properly.



#### FC model

The mast interlock will work for the lift, tilt, and attachment switches. If the pump motor is not running or the key switch is in the OFF position, the lift, tilt, and attachment switches will not activate the hydraulic function regardless of whether the operator presence switch position is ON or OFF.

#### MC model

The mast interlock will work only for the lift and tilt levers. Attachments can be moved regardless of whether the mast interlock function is operating or not. Therefore, when the attachment lever is operated, some of the attachments will move, even though the motor is not running or the key switch is in the OFF position, as a result of the handling load or of its own weight.

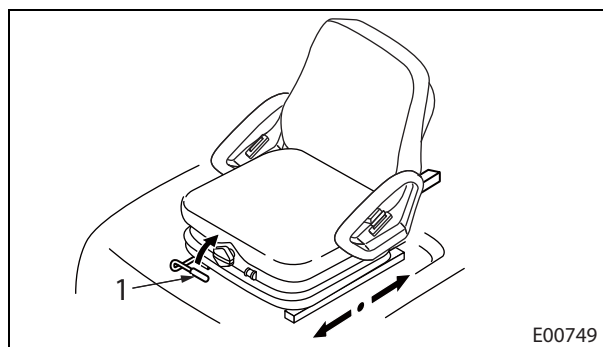
### ► Driving Interlock System

The parking brake is applied by the driving interlock system. You may not drive even though you release the driving interlock system. In this case, sit the operator seat correctly and place the direction lever to the NEUTRAL position.

### ► Seat Adjustment

Can you depress both the accelerator pedal and brake pedal fully down?

Note: See 2-53 "Forward and Back Adjustment".



1. Slide lever

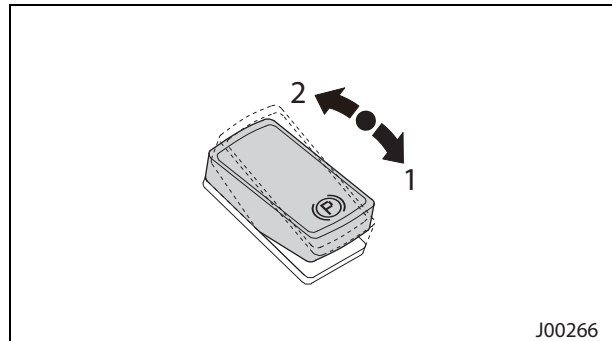
## ◆ Parking Lift Truck (After Stopping)

### ⚠ WARNING

#### Park safely

- Select a hard and level surface.
- BE SURE to park in the designated parking area.
- If the lift mechanism is disabled and the forks cannot be lowered to the floor, attach a warning tag on the tip of the fork and position the forks away from pedestrians.

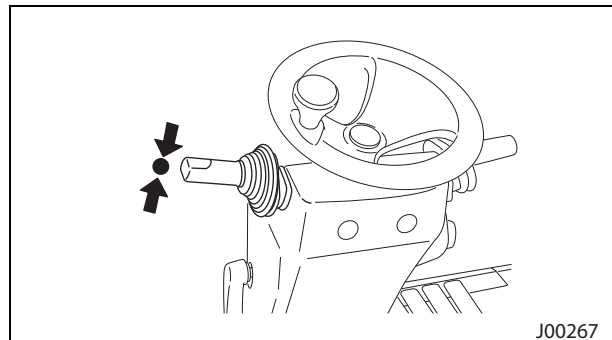
- (1) Push the parking brake switch to apply.



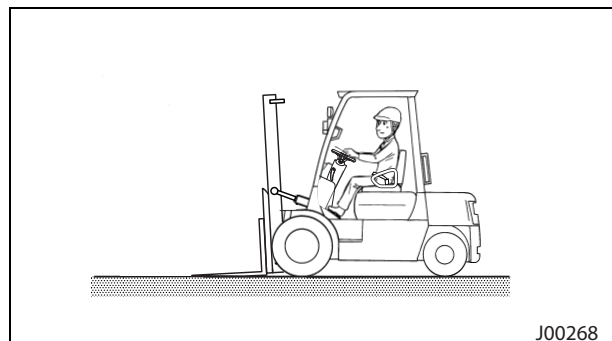
1. Apply

2. Release

- (2) Place the direction lever in the NEUTRAL position.



- (3) Slightly, tilt the mast forward and lower the forks to the floor until the fork tips touch the floor.



J00268

## ■ TRANSPORTATIONS HINTS

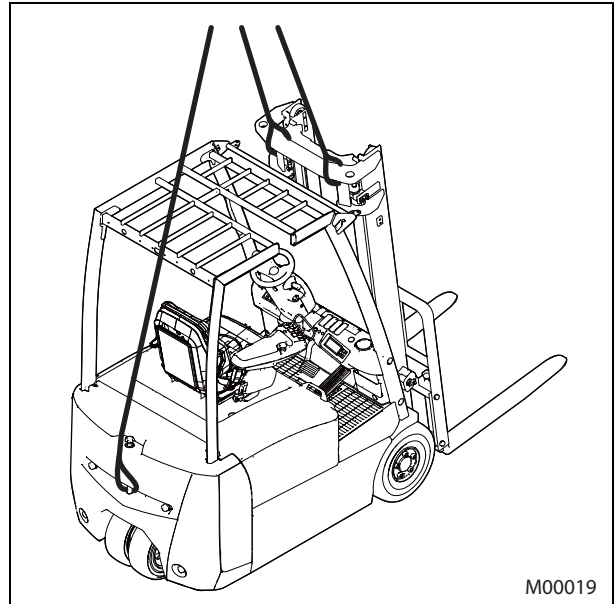
### ◆ Lifting Positions

#### ▲ CAUTION

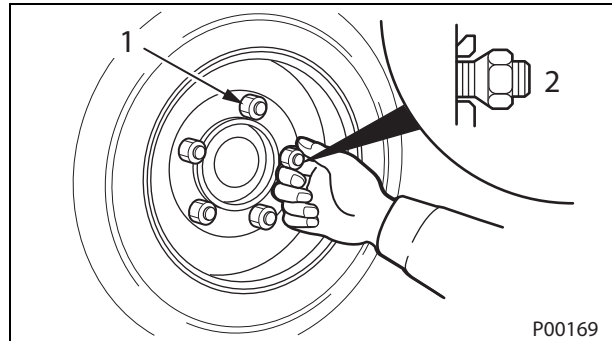
Pay attention to the counterweight, overhead guard bar, lights, operator seat, etc, to avoid breakage by contacting with the lifting sling.

#### Operating steps

- (1) Park the lift truck on a hard and level surface.
- (2) Tilt the mast fully BACKWARD.
- (3) Attach slings on the positions shown.
- (4) Adjust the sling length to level the lift truck.



- (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 lift truck.



1. Wheel nut

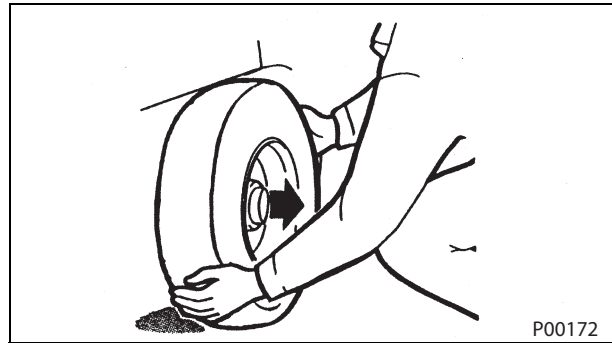
2. Countersink

## ⚠ WARNING

DO NOT loosen rim bolts.

## ⚠ CAUTION

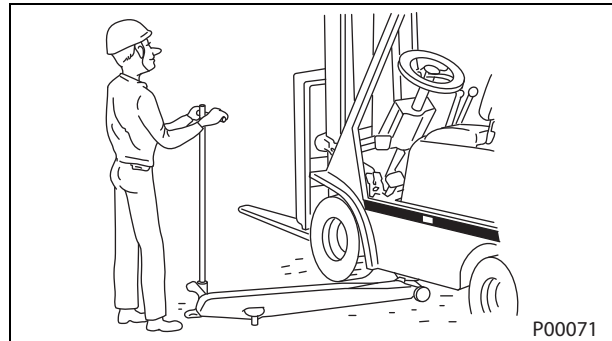
Be careful NOT to strip the bolt threads when removing the wheel.



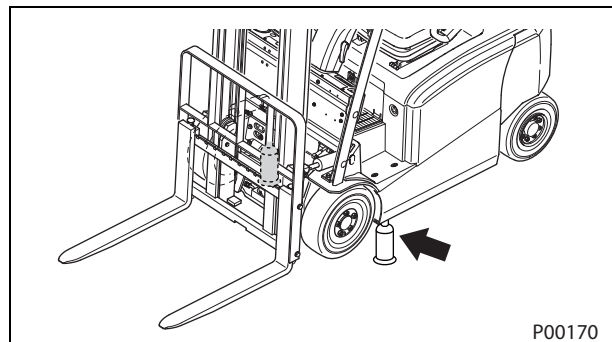
### ► To Raise Front Wheel

#### Jacking Method

- (1) Position the jack under the frame and raise the lift truck with the jack until the front wheel clears the ground.

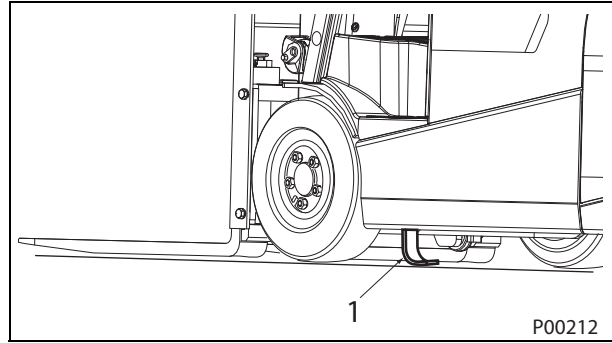


- (2) Place the jack stands on both sides under the frame to support it.

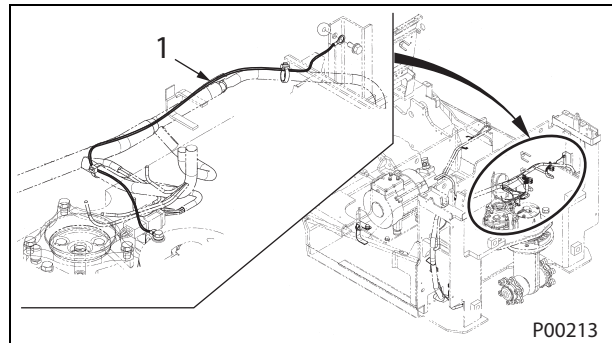


**⚠ WARNING**

- Contact your authorized Cat lift truck dealer for proper tire replacing procedure.
- Earth straps are necessary when using non-marking tires.
- Replacing tires and adjustment procedures must be made by a trained mechanic.
- Perform all maintenance with proper equipment.



1. Earth strap

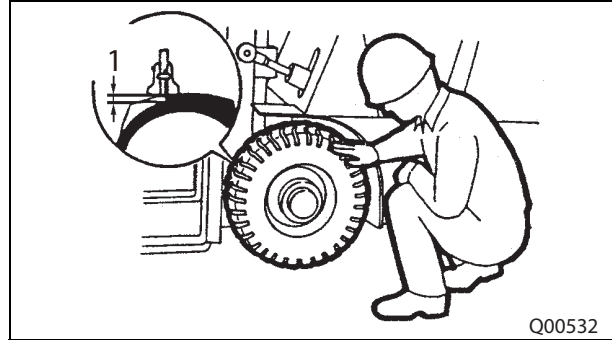


1. Earth strap

**How to check**

- Are all the tires free of cuts, gouges, or foreign objects?
- Are all the rims free of distortion or cracks?
- Is the tread groove depth more than 5 mm (0.2 in.) when checked with a tire depth gauge?

If not, replace the tire.



1. Unit: 5 mm (0.2 in.)

**► Wheel Nuts**

**Check-Tighten When Required**

Wheel nuts must be visually inspected everyday. Any loose nuts must be tightened and any missing or damaged nuts should be changed.

- Are the wheel nuts tightened properly?

Use a torque wrench.

► **Parking Brake Warning Alarm**

**Check**

**⚠ CAUTION**

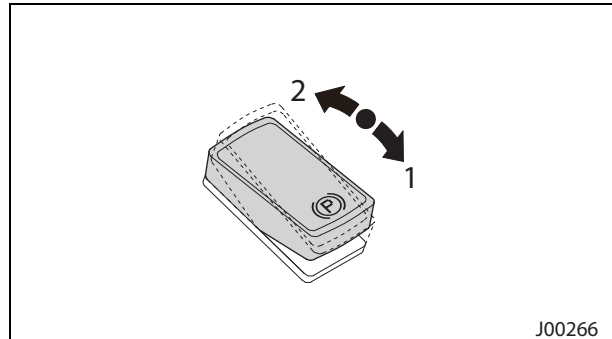
- Check this system on a hard and level surface.
- Make sure no one is around the lift truck.

**Preparation**

- (1) Park the lift truck on a hard and level surface.
- (2) Lower the forks until the fork tips touch the floor.
- (3) Push the parking brake switch to apply.
- (4) Place the direction lever in the NEUTRAL position.
- (5) Block the wheels.
- (6) Remove the key.

**How to check**

- (1) Release the parking brake.
- (2) Check that the warning alarm will activate with the warning icon blinking.
- (3) Push the parking brake switch to apply.



1. Apply

2. Release

► **Driving Control System (Traction Motors, Steering System, and Brake System)**

Slowly drive the lift truck in a safe area.

- Are the traction motors in good operating condition without any abnormal noise?
- Is the steering free from pulls to one side, steering kickback, wandering, hard steering and other defects?
- Are all brakes applied properly without pulling, dragging, chattering, or squealing?



► **Rear Axle Steering Gear (3 Wheel Model)**

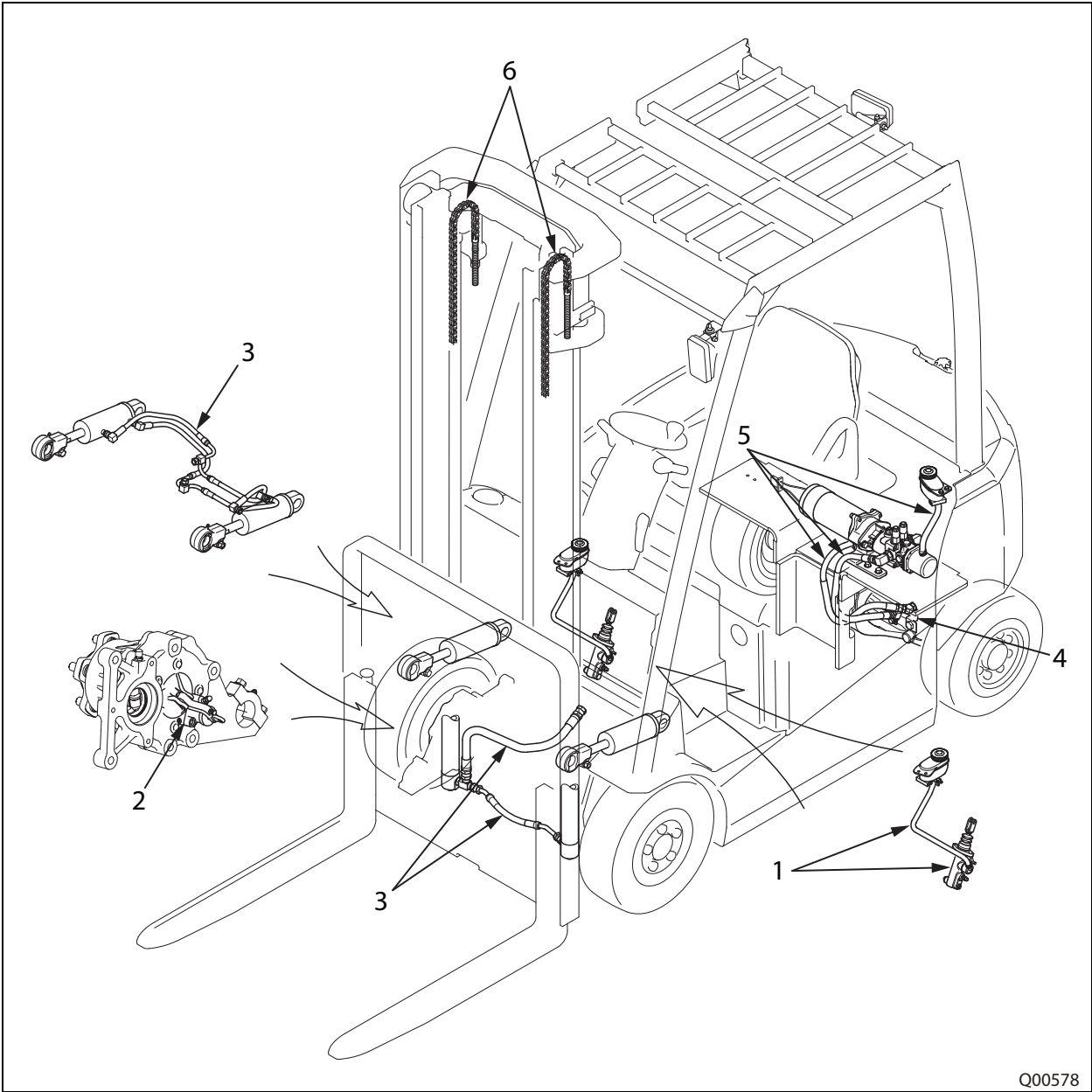
Is the rear axle steering gear in good operating condition without any abnormal noise?

► **Parking Brake (PKB) Check Mode**

**⚠ WARNING**

- Park the lift truck in a safe area. BE SURE to watch for people or hazards in the direction of travel.
- BE SURE to fasten the seat belt before operating the lift truck. Remember, the belt will not restrain you in an accident if it is not fastened properly.

4 wheel model



Specification				EP 16CPN	EP 18CPN	EP 16PN	EP 18PN	EP 20PN
<b>Dimensions</b>								
Dimensions	L2	Length to fork face (includes fork thickness)	mm (in.)	2152 (84.72)		2262 (89.05)		2273 (89.49)
	B	Overall width	mm (in.)	1090 (42.91)				1140 (44.88)
	h1	Height with mast lowered	mm (in.)	2125 (83.66)				
	h4	Height with mast raised	mm (in.)	4342 (170.94)				
	h6	Height to top of overhead guard	mm (in.)	2050 (80.71)				
	h7	Seat height	mm (in.)	976 (38.43)				
Forks	s,e,l	Thickness, Width, Length	mm (in.)	35, 100, 1150 (1.38, 3.94, 45.28)				
Fork carriage	to DIN 15 173 A / B / no			2A				
Load distance	x	Center of front axle to fork face	mm (in.)	373 (14.69)				384 (15.12)
<b>Electric motors</b>								
Battery	Voltage		V	48				
	Capacity		AMP/ 5hr	625		750		
	Maximum weight		kg (lb)	900 (1984)		1075 (2370)		
	Minimum weight		kg (lb)	810 (1786)		975 (2150)		
	Compartment maximum size		mm (in.)	834 × 638 × 630 (32.83 × 25.12 × 24.80)		834 × 748 × 630 (32.83 × 29.45 × 24.80)		
Electric motor	For drive	Type		Induction				
		Output	kw/(ps) 60min	4.5 (6.12) × 2 (2.7)				
	For hydraulic	Type		Induction				
		Output	kw/(ps)	11.5 (15.64)				
Control	Type of drive			Impulse AC				
	Type of hydraulic			Impulse AC				

## ► Lift Truck Models Covered in This Manual

### 3 wheel model

Model	Serial number	Control lever
EP13PNT	ETB21-00011-01999 ETB21-02001-49999	FC/MC
EP15PNT	ETB21-50011-51999 ETB21-52001-99999	
EP16CPNT	ETB22-00011-01999 ETB22-02001-49999	
EP18CPNT	ETB22-50011-51999 ETB22-52001-99999	
EP16PNT	ETB23-00011-01999 ETB23-02001-49999	
EP18PNT	ETB23-50011-51999 ETB23-52001-99999	
EP20PNT	ETB24-00011-01999 ETB24-02001-99999	

### 4 wheel model

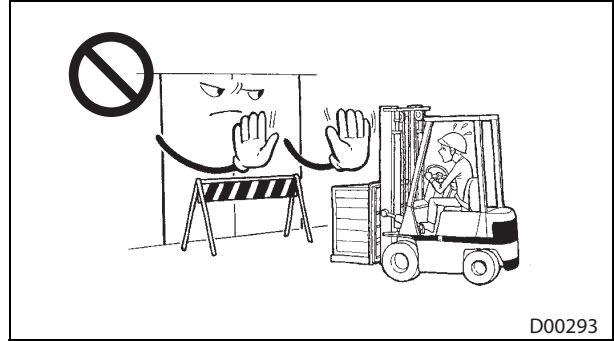
Model	Serial number	Control lever
EP16CPN	ETB27-00011-01999 ETB27-02001-49999	FC/MC
EP18CPN	ETB27-50011-51999 ETB27-52001-99999	
EP16PN	ETB28-00011-01999 ETB28-02001-49999	
EP18PN	ETB28-50011-51999 ETB28-52001-99999	
EP20PN	ETB29-00011-01999 ETB29-02001-99999	

### Abbreviation

- FC is short for fingertip control.
- MC is short for mechanical control.

**⚠ WARNING****Operate only in approved areas!**

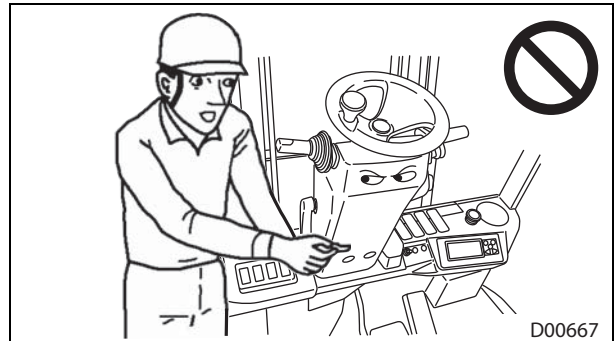
Certain areas such as those containing hazardous flammable gases, liquid or other combustibles require a Safety Rated truck, if your lift truck is not Safety Rated, the area must be avoided.



D00293

**⚠ WARNING****Sit in the operator seat when starting the engine!**

Start the engine only when seated in the normal operating position.



D00667

**⚠ WARNING****DO NOT operate a damaged or defective lift truck!**

If the lift truck is damaged, take it out of service until it has been restored to safe operating condition. Park it in a non-operating area and remove the key. Attach a "DO NOT OPERATE" or similar warning tag to the lift truck.

Contact your authorized Cat lift truck dealer for repairs.

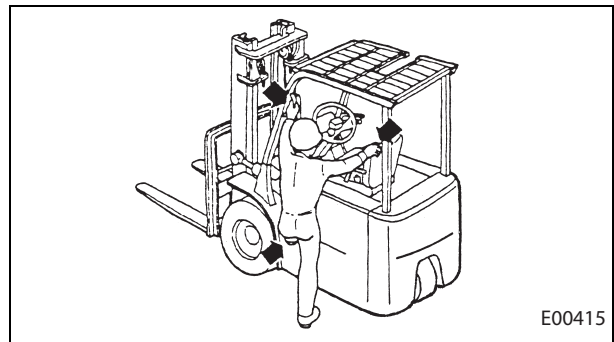


D00378

**⚠ WARNING****Face the lift truck when getting on and off!**

Maintain a three point contact (one foot and two hands) with the foot step, the assist grip, and the seat backrest.

- DO NOT get on or off the moving lift truck.
- DO NOT jump on or off the lift truck.
- DO NOT use the operating control levers or steering wheel as assist grips when entering or leaving the operator compartment.
- DO NOT get on or off the right side of the lift truck.

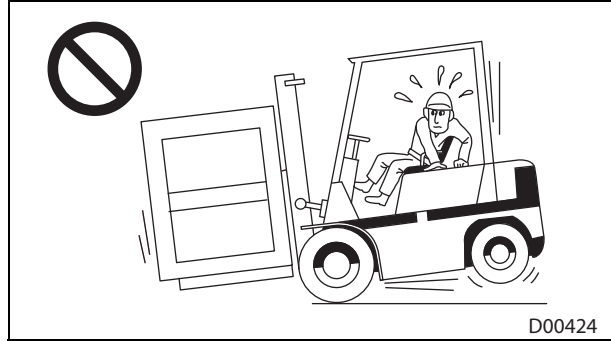


E00415

**⚠ WARNING**

**Always stay within the capacity!**

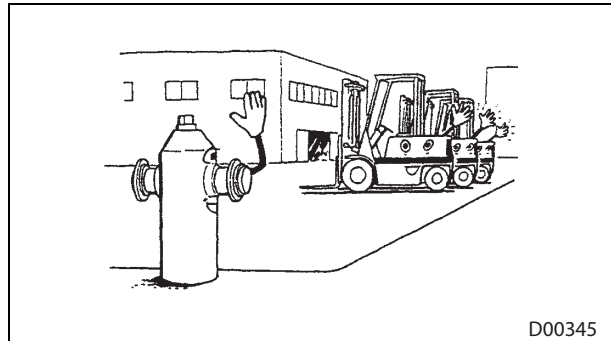
Read the capacity plate to make sure a load is within the capacity of the lift truck before you handle the load.



**⚠ WARNING**

**Park in authorized areas only!**

Park a safe distance from access to fire aisles, stairways and fire equipment. DO NOT park near a flammable material storage area.



**⚠ WARNING**

**Watch out for personnel!**

DO NOT allow anyone to walk or stand under raised forks.



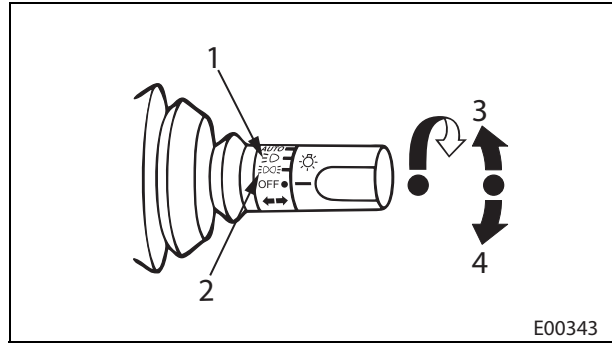
**⚠ WARNING**

**DO NOT lift or transport personnel!**



► Turn Signal / Light Switch

- When turning to the right or to the left, operate the turn signal switch in the direction of the arrow as shown on the left. The turn signal switch automatically returns when the steering wheel is returned, but it can also be returned manually.
- When the light switch is placed to the  $\Xi \text{D} \Xi$  position, tail light and clearance light illuminate. When it is placed to the  $\Xi \text{D}$  position, head light also illuminate in addition to the above lights.



- 1. Head Light (Position 2)
- 2. Clearance Light (Position 1)
- 3. Left turn
- 4. Right turn

E00343

Light	Position		
	1	2	
		Light	Dark
Meter panel light	☉		☉
Tail light (option)	☉		☉
Clearance light (option)	☉		☉
Head light	☉		

Note: The light may be turned ON by placing the light switch in position 1 or 2 regardless of the key switch position. Turn OFF the light when the lift truck is not being operated to prevent the battery from discharging.

► Steering Column Tilt Lever

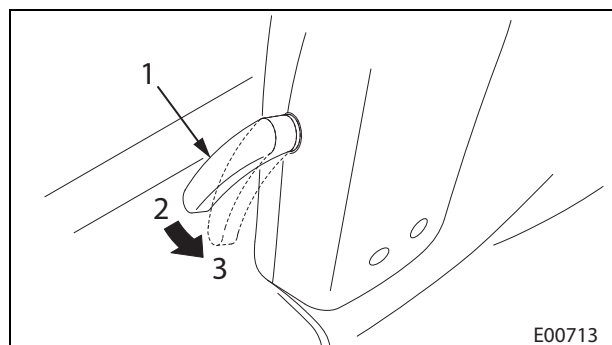
**⚠ WARNING**

Always adjust the steering column tilt angle while stopped at a safe place, as adjustment while driving could lead to accidents. Make sure that the steering column is firmly secured.

The steering column position can be adjusted with the steering column tilt lever to an operator's desired driving position.

**Adjustment of steering column position**

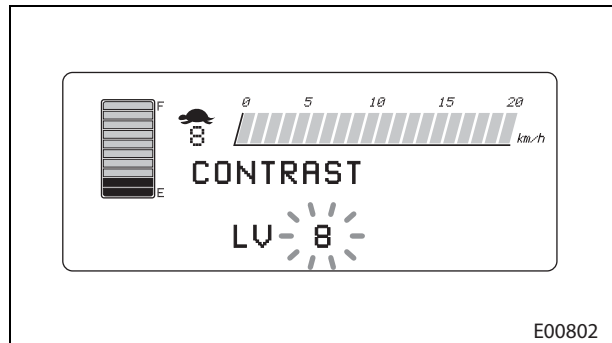
- (1) Unlock the steering column tilt lever.
- (2) Hold the steering column and adjust it to an appropriate position.
- (3) After adjustment, lock the steering column tilt lever.



- 1. Steering column tilt lever
- 2. Lock
- 3. Unlock

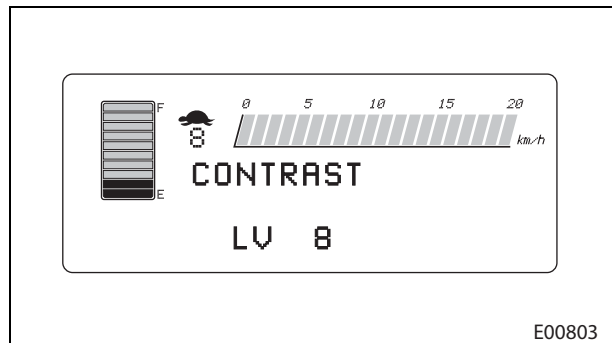
E00713

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



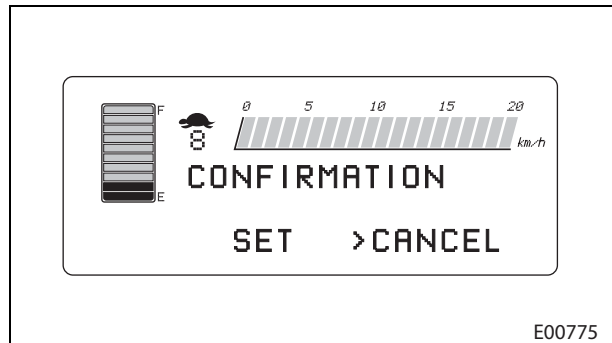
Screen 4

- (5) Select the parameter 1 to 16 by pushing ◀ or ▶ button.



Screen 5

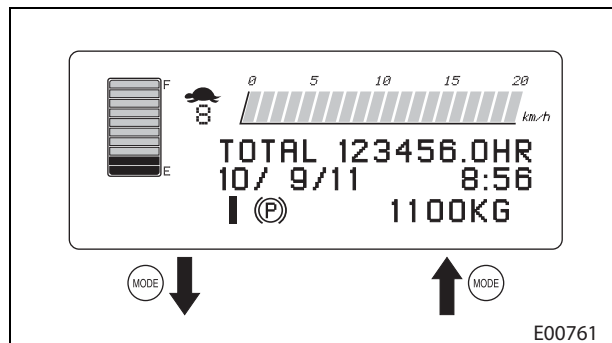
- (6) Push (R) button. Then setting is complete.  
 (7) If you want to change the setting, select "CANCEL" on the screen 6.



Screen 6

**Load zero setting (Option)**

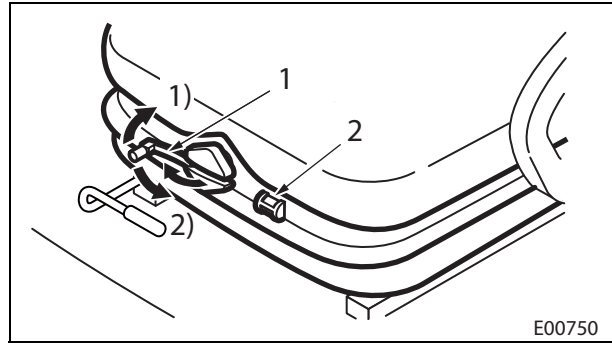
- (1) Turn the key switch ON and the normal screen 1 appears.



Screen 1

► **Adjustment of Suspension**

Adjust the suspension while sitting in the operator seat. Turning the knob clockwise increases suspension (the gauge indication) and turning it counterclockwise decreases suspension (the gauge indication).

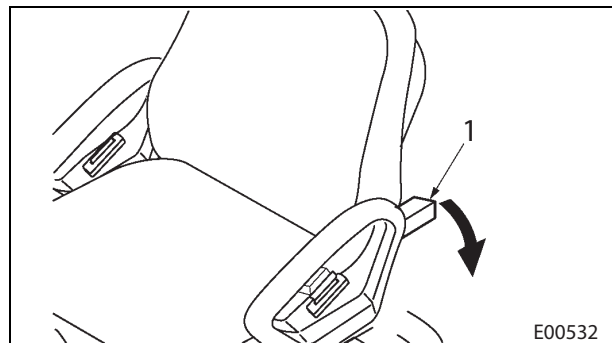


1) Increase  
2) Decrease

1. Adjusting knob  
2. Gauge

► **Backrest Angle Adjustment**

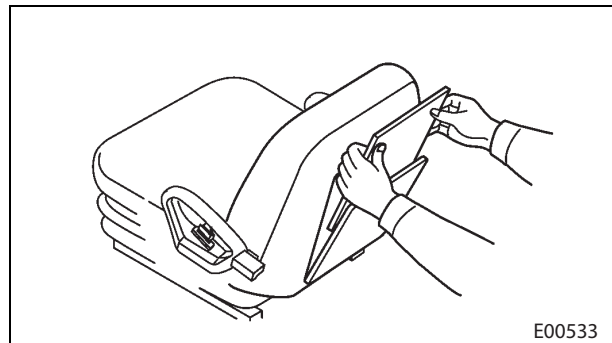
Pull the lever and adjust the backrest to the desired position and release the lever.



1. Reclining lever

► **Pocket for the Manual**

Place the operation and maintenance manual in this pocket. Use both hands to open or close the pocket.



E00533

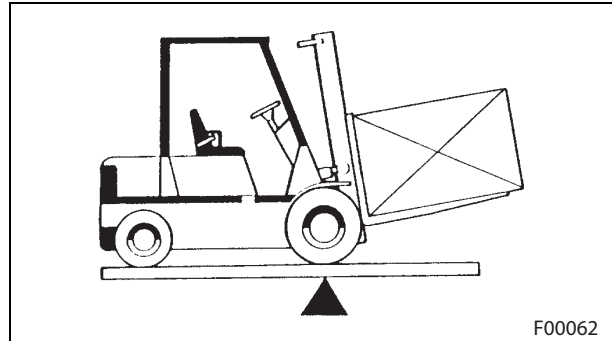
## ■ HOW TO AVOID A TIPOVER; HOW TO SURVIVE ONE

### ◆ Know What Lift Truck Stability Is

Counterbalanced lift truck design is based on the balance of two weights on opposite sides of a fulcrum (the front axle).

The load on the forks must be balanced by the weight of the lift truck. The location of the center of gravity of both the lift truck and the load is also a factor.

This basic principle is used for picking up a load. The ability of the lift truck to handle a load is discussed in terms of center of gravity and both forward and sideways stabilities.

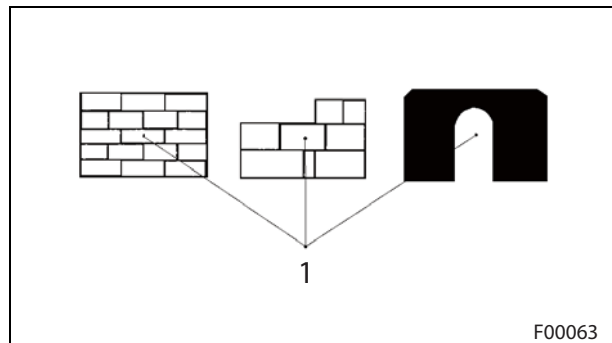


### ◆ Center of Gravity (CG)

Center of Gravity (CG) is defined as the point of an object where its weight is evenly distributed.

If the object is uniform, its geometric center will be the same as its CG. If it is not uniform, the CG could be a point on either side of the normal geometric center.

When the lift truck picks up a load, the lift truck and load have a new, combined CG.

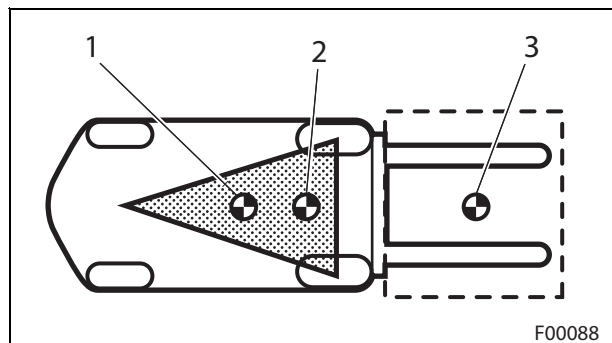


1. CG

### ◆ Stability and Center of Gravity (Top View)

The stability of the lift truck is determined by the location of its CG, or if the lift truck is loaded, the combined CG.

The lift truck has moving parts and, therefore, has a CG that moves. The CG moves forward or backward as the mast is tilted forward or backward. The CG moves up or down as the mast moves up or down.



1. CG truck

2. Combined CG

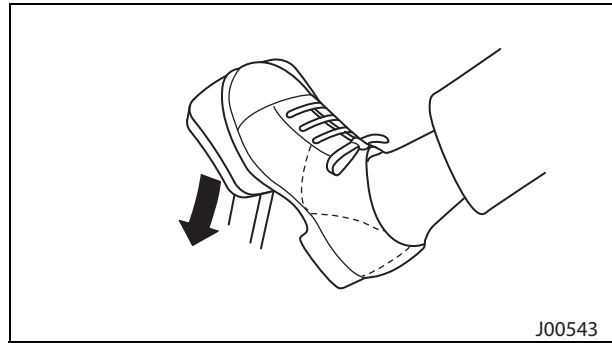
3. CG load

The CG and the stability of the loaded lift truck, are affected by a number of factors such as:

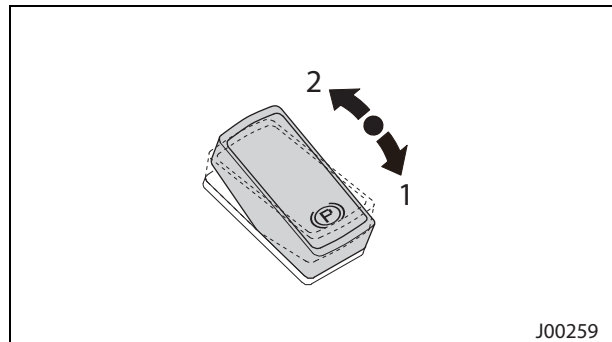
- The size, weight, shape and position of the load.
- The height of the lifted load.
- The amount of forward or backward tilt.
- Dynamic forces created when the lift truck is accelerated, braked or turned.
- Condition and grade of surfaces on which the lift truck is operated.

**Foot direction control (Option)**

- (1) Depress the brake pedal fully.



- (2) Push the parking brake switch to release.

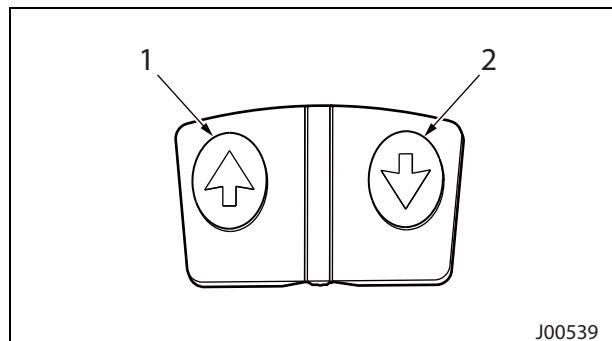


1. Apply

2. Release

- (3) Place your right foot on FORWARD or REVERSE pedal on the foot direction control, and gradually depress the pedal.

Note: Make sure to depress the arrow part on the foot direction control.

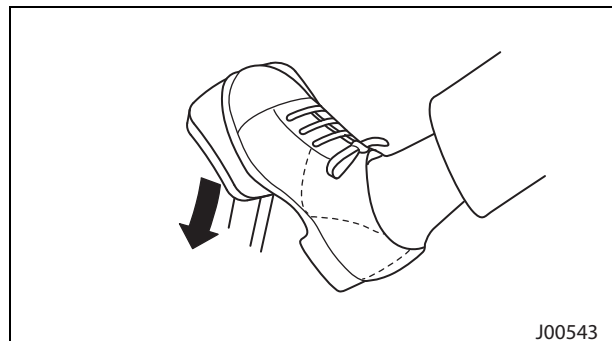


1. FORWARD

2. REVERSE

**Armrest FNR switch (FC model option)**

- (1) Depress the rake pedal.



## ◆ Correct Operating Steps

Follow the correct operating steps 1 through 2 before you operate the lift truck.

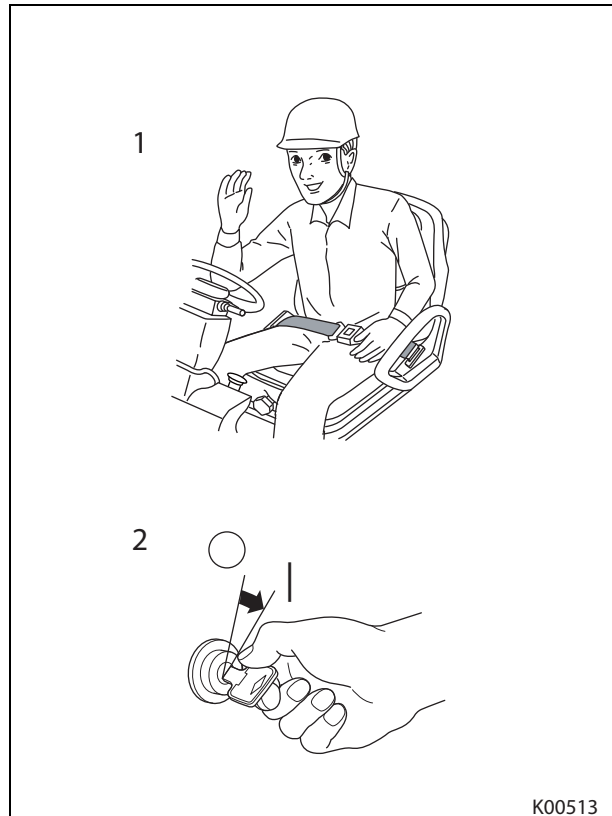
Make sure the mast interlock indicator icon is OUT.

### Operating steps

- (1) Sit properly and buckle the seat belt securely.
- (2) Turn the key switch to the ON position.

Note:

- See 5-6 "Lifting the Load", 5-8 "Traveling with the Load" and 5-9 "Unloading".
- If the mast interlock indicator icon blinks, see 5-4 "Incorrect Operating Steps".

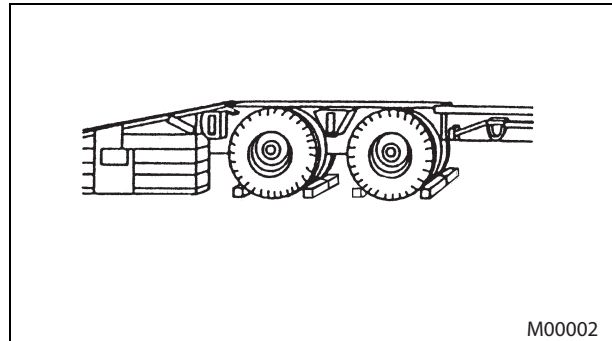


1. Step 1
2. Step 2

## ◆ Lift Truck Loading and Shipping

Be sure to take the following safety precautions before loading and shipping lift trucks:

- Always block the trailer or rail car wheels before loading the lift truck.
- Position the lift truck on the truck bed or rail car.
- Apply the service brake and then apply the parking brake. Place the direction lever in the NEUTRAL position.
- Turn the key switch to the OFF position and remove the key.
- Block the wheels and secure the lift truck with tiedowns.
- DO NOT turn the steering wheel after the lift truck has been secured. It may loosen the tie-downs.



M00002

### ▲ WARNING

Check travel route for overpass clearances. Make sure there is adequate clearance if the lift truck being transported is equipped with a high mast or cab. Remove ice, snow, or other slippery material from the shipping lift truck and loading dock.

### ▲ CAUTION

The parking brake mounted on this lift truck is a negative parking brake, and cannot be released unless the following conditions are fulfilled:

#### PKB releasing conditions

- Key switch: ON
- Direction lever position: FORWARD or REVERSE
- PKB switch: OFF (release)
- Accelerator pedal: ON

To pull the lift truck up on a trailer using a winch or other tools without satisfying the parking brake releasing conditions, follow the instructions in "Operating the Lift Truck Without Power Supply" not to cause parking brake dragging/sticking.

## ◆ Lift Truck Lifting and Tiedown Information

Take the following safety precautions when lifting or tying down lift trucks.

- Weight and instructions given here apply to lift trucks manufactured by Cat lift trucks.
- Use proper rated cables and slings for lifting. Position the crane so the lift truck is level when lifted.
- Spreader bar widths should be sufficient to prevent contact with the lift truck.
- Use the tie-down locations provided for lift truck tiedown.

### ▲ CAUTION

Incorrect lifting or tie-downs could cause a load to shift and cause injury and/or damage.

Note: Check the state and local laws governing weight, width, and length of a load. Contact your authorized Cat lift truck dealer for shipping instructions for your lift truck.

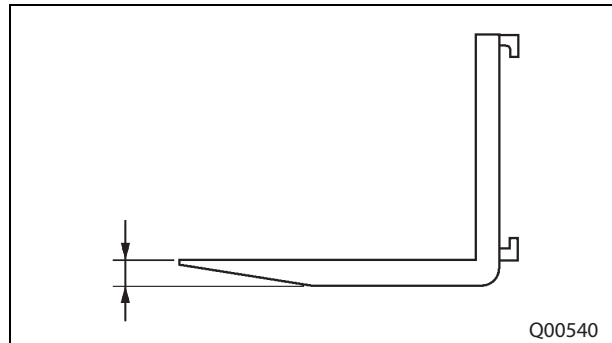
## ◆ Diagnostic Code List

Contact your authorized Cat lift truck dealer when the diagnostic code is displayed.

Code	Description
E0	Traction Motor R.H.,Overheating
E1	Traction Motor L.H.,Overheating
E2	Pump Motor, Overheating
E5	Traction Inverter R.H., Overheating
E6	Traction Inverter L.H., Overheating
E7	Pump Inverter, Overheating
E9	PS Controller, Overheating
14	Traction Motor Current Sensor R.H. Fault
15	Traction Motor R.H. Over-current
16	Traction Motor R.H. Stall Timer
24	Traction Motor Current Sensor L.H. Fault
25	Traction Motor L.H. Over-current
26	Traction Motor L.H. Stall Timer
34	Pump Motor Current Sensor Fault
35	Pump Motor Over-current
40	Line Contactor Fault
41	Steering Contactor Fault
45	Traction Motor R.H. Open
46	Traction Motor L.H. Open
47	Pump Motor Open
49	PS Motor Open
50	Tire Angle Sensor Fault
51	Accelerator Sensor Fault
52	Traction Motor R.H. Pulse Input Fault
53	Traction Motor L.H. Pulse Input Fault
54	FC Lever Fault
55	Output Unit Solenoid Fault
56	Output Unit Solenoid Current Leak
E	FNR Lever or Accelerator, Faulty Setting
(E)	Seat Switch, Faulty Setting For Traction
H1	Lift Lever, Faulty Setting

Code	Description
H2	Tilt Lever, Faulty Setting
H3	Attach1 Lever, Faulty Setting
H4	Attach2 Lever, Faulty Setting
(L)	Seat Switch, Faulty Setting For Hydraulic
EE	FNR Lever Fault
60	Display Communication Fault
61	Logic Card Initialize Failure
62	Logic Fault
63	Traction Inverter R.H. Fault
64	Traction Inverter L.H. Fault
65	Pump Inverter Fault
67	Input Unit Fault
68	Output Unit Fault
71	EPS Controller Fault
72	Contactor Coil Fault
74	Hydraulic Lock Solenoid Fault
75	Parking Brake Fault
76	PDS Buzzer Fault
78	Battery Voltage Too Low
79	Battery Voltage Too High
(Lo)	Battery Consumption Too Much
80	Tilt Angle Sensor Fault
81	Load Sensor Fault
82	Handle Sensor Fault
A4	PS Motor Current Sensor Fault
A5	PS Motor Over-current
A7	PS Handle Brake Fault
A8	Battery side way exchange interlock
A9	Parking Brake Warning
None	High Battery Consumption
None	Brake Oil, Low Level
None	RTC Battery Low

(3) Check the fork blade.

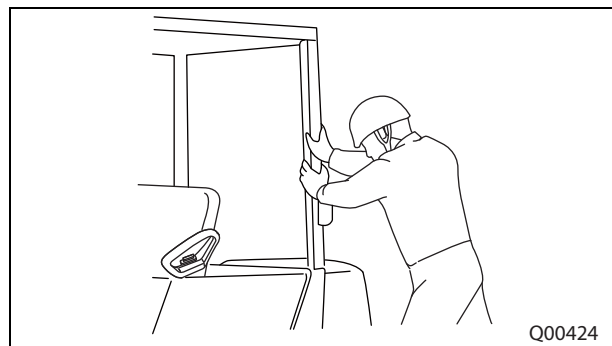


Note: DO NOT use the forks if the thickness is reduced to less than 90% of the original thickness. Fork blade length may also be reduced by wear, especially on tapered forks and platens. DO NOT use the forks when the blade length is no longer adequate for the intended loads.

**► Overhead Guard**

Check the front and rear overhead guard mounting bolts on each side.

- Inspect overhead guard for bent or cracked sections.



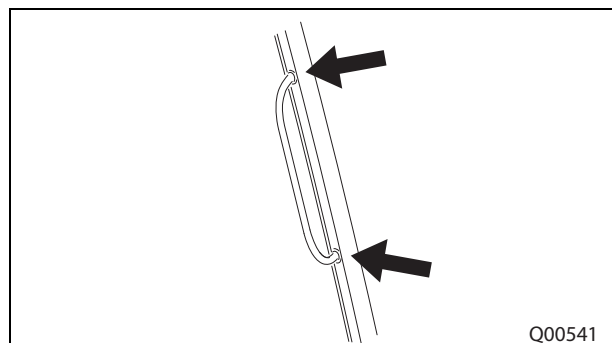
**Tightening torque for the bolt**

Torque
59.8 N·m (6.1 kgf·m) [44.11 lbf·ft]

Note: Contact your authorized Cat lift truck dealer if repairs are needed.

**► Assist Grip**

- Inspect the assist grip for damage or cracks and also check that it is firmly secured.



Note: Contact your authorized Cat lift truck dealer if repairs are needed.

## ◆ One Month (30 days) or 200 Service Hours After Delivery of a New Truck, Whichever Comes First

You must read and understand the warnings and instructions contained in this manual before performing any operation or maintenance procedure.

### ► Electrical Wires

#### Check

- The wire harness damage and clamp looseness  
Any damaged wire should be replaced, and any loose clamp should be retightened.
- The terminal connection looseness and tapping condition  
Any loose connection should be retightened.

### ► Contactors and Fuses

#### ⚠ WARNING

Be sure to disconnect the battery plug/connector from the lift truck to help prevent getting an electric shock.

#### ⚠ CAUTION

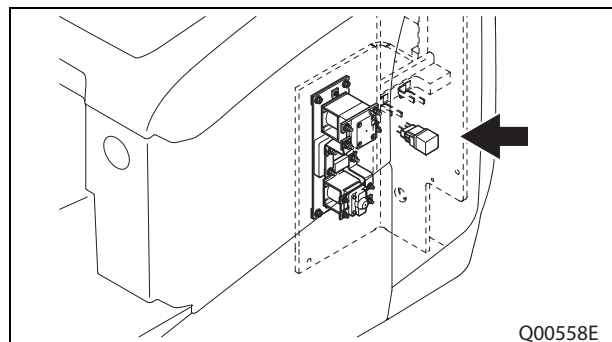
- Park the lift truck on a hard and level surface with the forks lowered until the forklifts touch the ground, parking brake applied, direction lever in the NEUTRAL position.
- Disconnect the battery plug/connector.
- Apply the wheel chocks to tire.

#### How to check (3 wheel model)

- (1) Remove the battery cover (L) and rear side cover (L).
- (2) Clean off dust and dirt from around the contactor.
- (3) Check the terminal for looseness.  
If it is loose, tighten the mounting bolt to the specified torque.

Note: Tighten the mounting bolt periodically to prevent generation of heat and fire due to the looseness of the terminal.

- (4) Check the fuse mounting looseness.

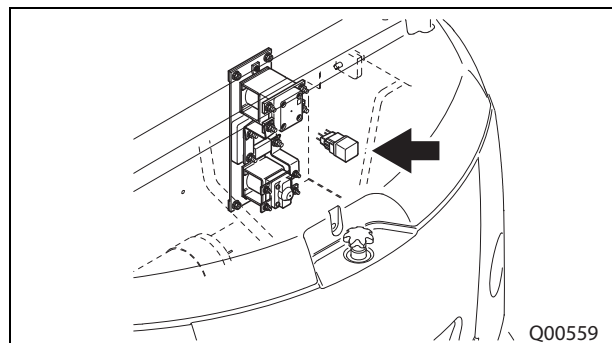


#### How to check (4 wheel model)

- (1) Open the battery cover.
- (2) Remove the rear cover.
- (3) Clean off dust and dirt from around the contactor.
- (4) Check the terminal for looseness.  
If it is loose, tighten the mounting bolt to the specified torque.

Note: Tighten the mounting bolt periodically to prevent generation of heat and fire due to the looseness of the terminal.

- (5) Check the fuse mounting looseness.



## ► 4 Wheel Model

Item				Truck model				
				EP16CPN	EP18CPN	EP16PN	EP18PN	EP20PN
Battery voltage				48 V				
Battery electrolyte gravity				1.28				
Steering wheel free-play				15 to 30 mm (0.6 to 1.2 in.)				
Brake pedal free play				5 to 7 mm (0.20 to 0.28 in.)				
Tire size	Front	Solid pneumatic	Tire	18 x 7-8			200/50-10	
			Rim	4.33R-8			6.50F-10	
		Pneumatic	Tire	18x7-8 16PR 1,000 kPa (10.20 kgf/cm <sup>2</sup> ) [145.04 psi]			Not available	
			Rim	4.33R-8				
		Cushion	Tire	Not available				
			Rim					
	Rear	Solid pneumatic	Tire	16 x 6-8			Not available	
			Rim	4.33R-8				
		Pneumatic	Tire	16x6-8 16PR 1,000 kPa (10.20 kgf/cm <sup>2</sup> ) [145.04 psi]			Not available	
			Rim	4.33R-8				
		Cushion	Tire	Not available				
			Rim					
Tightening torques for wheel nuts		Front	216 to 264 N·m (22 to 27 kgf·m) [159.3 to 194.7 lbf·ft]					
		Rear	156.9 ± 15.7 N·m (16 ± 1.6 kgf·m)[115.72 ± 11.58 lbf·ft]					
Lift chain length limit/20 links				327 mm (12.87 in.)			392 mm (15.43 in.)	
Transfer				0.53 L (0.14 U.S. gal)				
Hydraulic tank	-Simplex mast (less than 6000 mm (236.22 in.) -Duplex mast (less than 4000 mm (157.48 in.) -Triplex mast (less than 6000 mm (236.22 in.)			MIN: 12.1 L (3.20 U.S. gal) MAX: 13.3 L (3.51 U.S. gal)				
	Triplex mast 6500/7000 mm (255.91/275.59 in.)			MIN: 11.3 m (3.0 in.) MAX: 12.5 m (3.3 in.)				
Brake fluid reservoir tank				MIN: 60 cc (3.66 cu in.) MAX: 102 cc (6.22 cu in.)				
PS pump reservoir tank fluid level				850 cc (51.87 cu in.)				

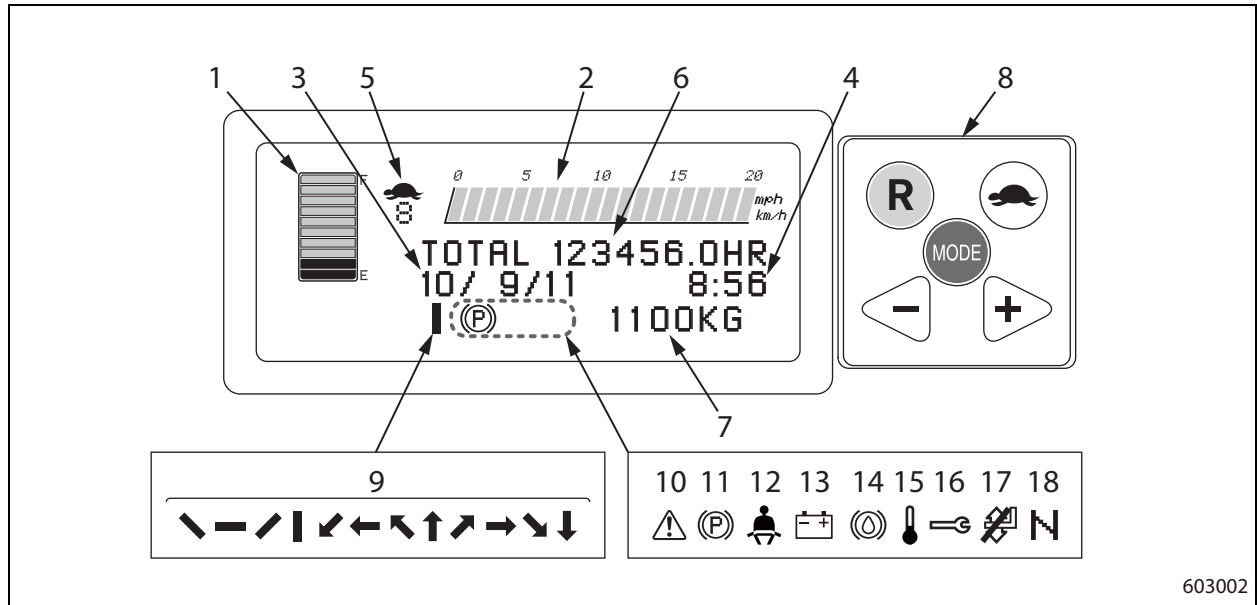
## Chapter 8 HYDRAULIC SYSTEM

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## 4. Meter panel

### 4.1 Functions of Meter panel



603002

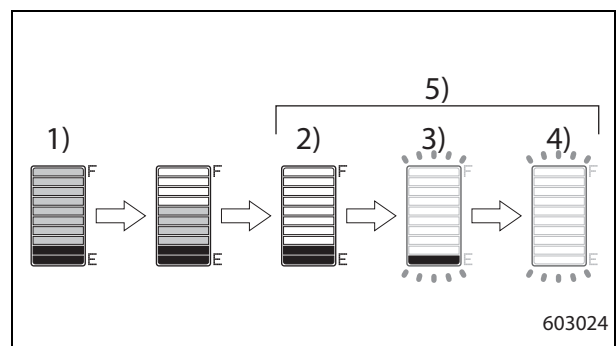
- |   |   |
|---|---|
| <ol style="list-style-type: none"> <li>1. Battery discharge indicator</li> <li>2. Speedometer</li> <li>3. Calendar</li> <li>4. Clock</li> <li>5. Slow speed mode monitor (Turtle mark)</li> <li>6. Hour meter</li> <li>7. Load meter (option)</li> <li>8. Mode select switch</li> <li>9. Wheel indicator</li> </ol> | <ol style="list-style-type: none"> <li>10. Error warning</li> <li>11. Parking brake warning</li> <li>12. Seat belt warning</li> <li>13. Battery warning</li> <li>14. Brake fluid warning</li> <li>15. Overheat warning</li> <li>16. Service indicator</li> <li>17. Mast lock</li> <li>18. Neutral lock</li> </ol> |
|---|---|

#### Battery discharge indicator

The battery discharge indicator shows the discharged status of the battery.

When the battery capacity is less than 20%, all green segments will have disappeared and two red segments stay on.

When the capacity is less than 10%, one red segment is flashed with the outline of the gauge. When the capacity is empty, only the outline of the gauge is flashed.



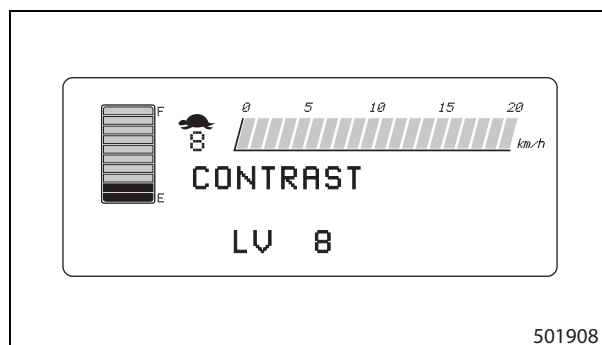
603024

- |  |   |
|--|---|
| <ol style="list-style-type: none"> <li>1) Full charged</li> <li>2) Less than 20 %</li> <li>3) Less than 10%</li> </ol> | <ol style="list-style-type: none"> <li>4) Empty</li> <li>5) Charge the battery immediately</li> </ol> |
|--|---|

### ⚠ CAUTION

- Do not over-discharge. The battery life can be shorten by over-discharging. Charge the battery as soon as possible when all green segments are disappeared.

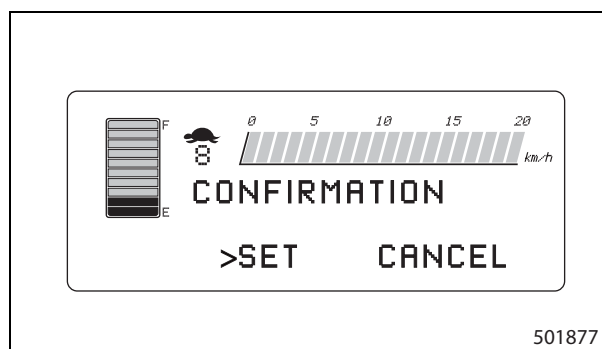
(5) Select the parameter 1 to 16 by pushing ◀ or ▶ button.



Screen 5

(6) Push (R) button. Then setting is complete.

(7) If you want to change the setting, select "CANCEL" on the screen 6.

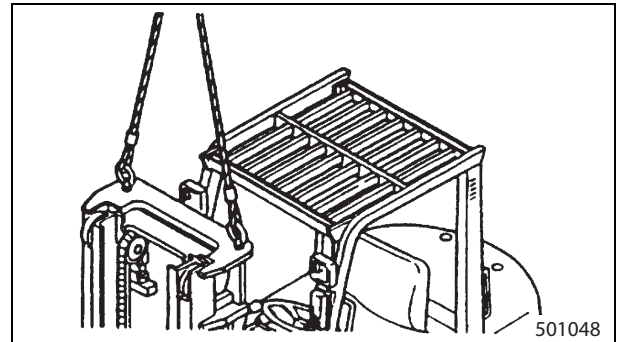


Screen 6

## 2. Removing Front Wheels

- (1) Pull the parking brake switch and block the rear wheels.
- (2) Loosen the wheel nuts by two turns. Then, raise the front end of the truck using a hoist or the hydraulic system.

- Hoisting  
Using a sling and eye-bolts at both ends of the cross member at the top of the outer mast, lift the front end of the truck with a hoist.



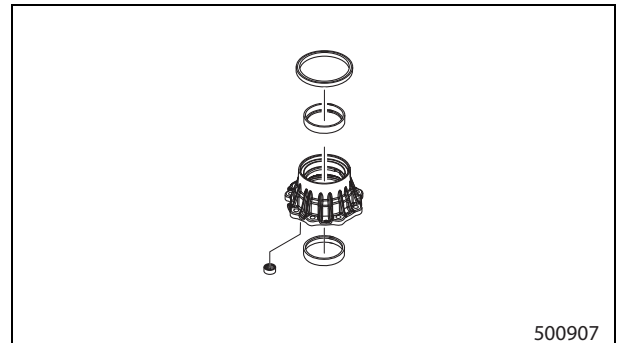
- (3) Remove the wheel nuts.
- (4) Remove the wheel.

Item	1 ton class	2 ton class
Tire size of front wheels	18 x 7-8	200/50-10

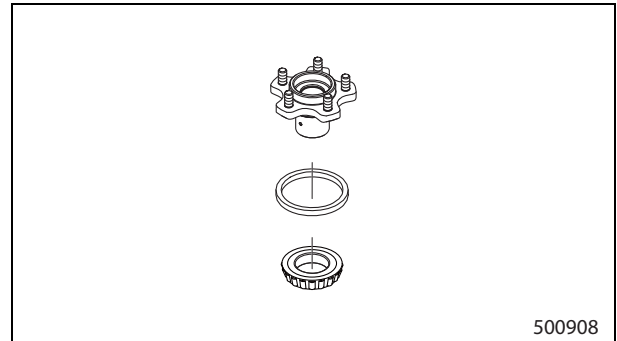
### Assembling procedure

- (1) Cover related parts, assembling
  - Install the tapered roller bearing outer races to the cover.
  - Install the oil seal.
  - Install the needle bearing for input gear by tapping it. (To install the bearing, use a jig appropriate for the diameter of bearing and hold the jig against the bearing and tap the jig with a hammer.

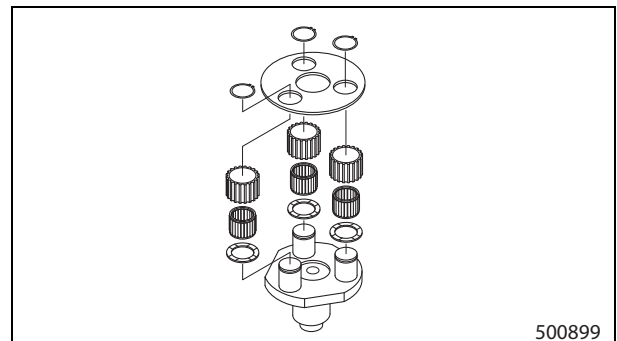
Note: Apply to grease (lithium soap base, consistency NLGI No. 2) the oil seal lip.



- (2) Wheel hub related parts, assembling
  - Install the oil seal retainer while applying liquid packing to the contact surface with the wheel hub.
  - Install the tapered roller bearing inner race.



- (3) Output carrier related parts, assembling (Assembling planetary gear)
  - Insert the planetary pin to the thrust washer, and install the needle bearing and then the planet gear. Lastly, install the plate and snap ring.



### 6.3 Inspection during Disassembling Rear Axle

**Rear axle support**

- Inspect the sliding surface of steering gear for damage. If there are small scratches on the surface, use sandpaper to remove the scratches.

**EPS cover**

- Inspect the surface contacting the rear axle support and EPS motor for damage.

**Steering gear**

- Inspect the tooth surfaces for damage. Inspect the low head screw section mounting steering axle to the steering gear for damage. Inspect the stopper bracket mounting section for damage.

**Steering pinion and gear (1), (2)**

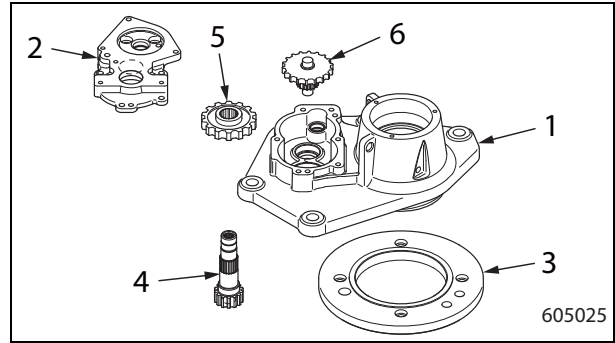
- Inspect the tooth surfaces for damage. Inspect the surface of the oil seal contacting to the steering pinion for damage.

**Radial roller bearing**

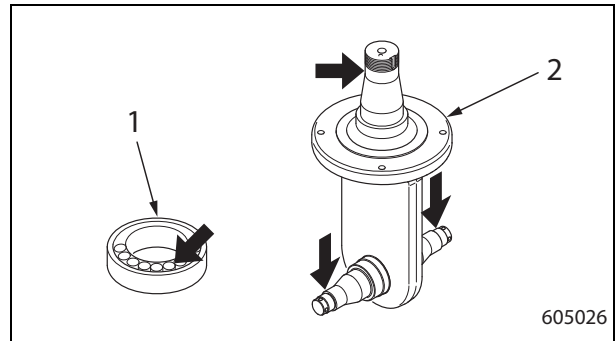
- Inspect the rolling contact surface of the bearing.

**Steering axle**

- Inspect the shaft surfaces for damage.



1. Rear axle support  
 2. EPS cover  
 3. Steering gear  
 4. Steering pinion  
 5. Gear (1)  
 6. Gear (2)



1. Radial roller bearing  
 2. Steering axle

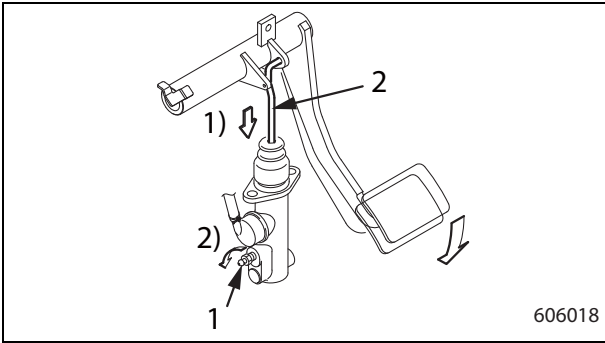
**Radial roller bearing**

- Inspect the rolling contact surface of the bearing.

**Steering axle**

- Inspect the shaft surfaces for damage.

- (5) Tighten bleeder valve.
- (6) Fill the tank with brake fluid. Don't feed with pressure.
- (7) Loosen bleeder valve of master cylinder while pushing brake pedal.

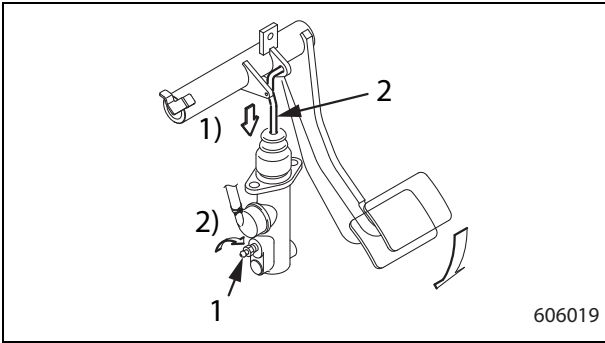


1. Bleeder valve  
2. Special rod  
1) Push  
2) Loosen

- (8) Tighten bleeder valve on the condition that pedal is fully depressed. After tightening, release pedal.
- (9) Repeat step 7 and 8 until internal air is completely come out of cylinder.

Note: Keep the brake oil level in the reservoir tank by refilling.

- (10) Tighten bleeder valve.
- (11) Remove the special rod and install the original push rod.
- (12) Confirm if oil leaks.

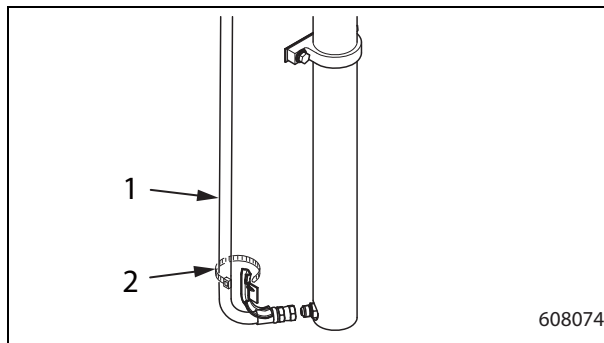


1. Bleeder valve  
2. Special rod  
1) Push to the bottom  
2) Tighten

1.2 FC model

Item		Specification	
Hydraulic system	Gear pump	Type	Gear pump
		Model type	TMG1-18
		Rated discharge volume	18.9 cc/rev. (1.15 cu.in./rev.)
		Drive system	Direct connection with pump motor
	Control valve	Main relief pressure	$18.1^{+0.50}_{-0.00}$ MPa ( $185^{+5.10}_{-0.00}$ kgf/cm <sup>2</sup> ) [ $2625^{+72.50}_{-0.00}$ 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)	

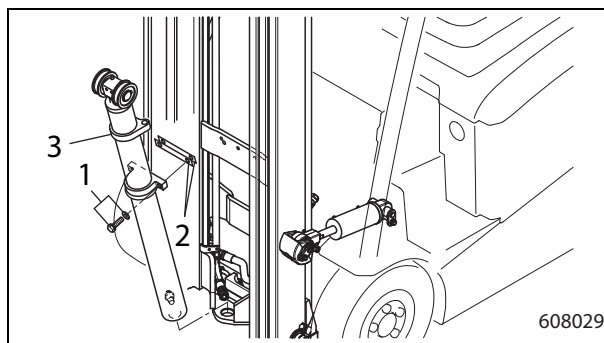
- (3) Disconnect the high-pressure hose from the first cylinder.



1. High-pressure hose                      2. Hose clip

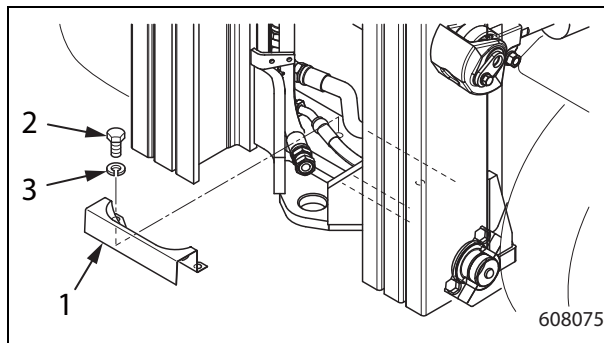
<b>Tightening torque for high-pressure hose</b>
58.8 ± 5.9 N·m (6.0 ± 0.6 kgf·m) [43.4 ± 4.4 lbf·ft]

- (4) Hitch a sling to the first lift cylinder, and suspend the cylinder with a hoist. Wind the sling securely around the lift cylinder to prevent slipping.
- (5) Remove the washer assembled bolts, and gently dismount first lift cylinder.



1. Washer assembled bolt                      3. First lift cylinder  
2. Shim

- (6) Remove the hose guard.



1. Hose guard                                      3. Spring washer  
2. Bolt

- (7) Remove the hose clamp.
- (8) Disconnect the hydraulic piping at the joints indicated by arrows. Use a drip pan to catch oil flowing out of the hoses.

## 17. Inspecting and Adjusting Hydraulic System

### ⚠ WARNING

Provide a fence around the lift truck to prevent the access of unauthorized people, as the front wheels rotates during the oil pressure measurement.

Extend the gauge kit with the extending hose to secure the job safety.

### 17.1 Hydraulic Oil

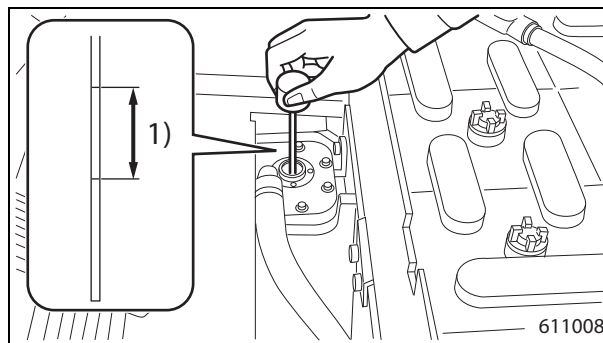
### ⚠ CAUTION

Keep the oil level within "H" and "L" marks on the level gauge.

#### Oil level

- (1) Lower the fork on the flat ground.
- (2) Check the hydraulic oil level using the gauge of the cap.

Note: Be careful when checking oil immediately after the operation of control lever, as bubbles of oil is sometimes mistaken for water contamination.



1. Correct level range

Item	Limit
Lifting height under 6500	Low level : 12.1 L (3.2 U.S. gal) High level : 13.3 L (3.5 U.S. gal)
Lifting height 6500 or more	Low level : 11.3 L (3.0 U.S. gal) High level : 12.5 L (3.3 U.S. gal)

#### Inspecting oil condition

Check for the oil level, contamination and clouding (mixing of air or oil).

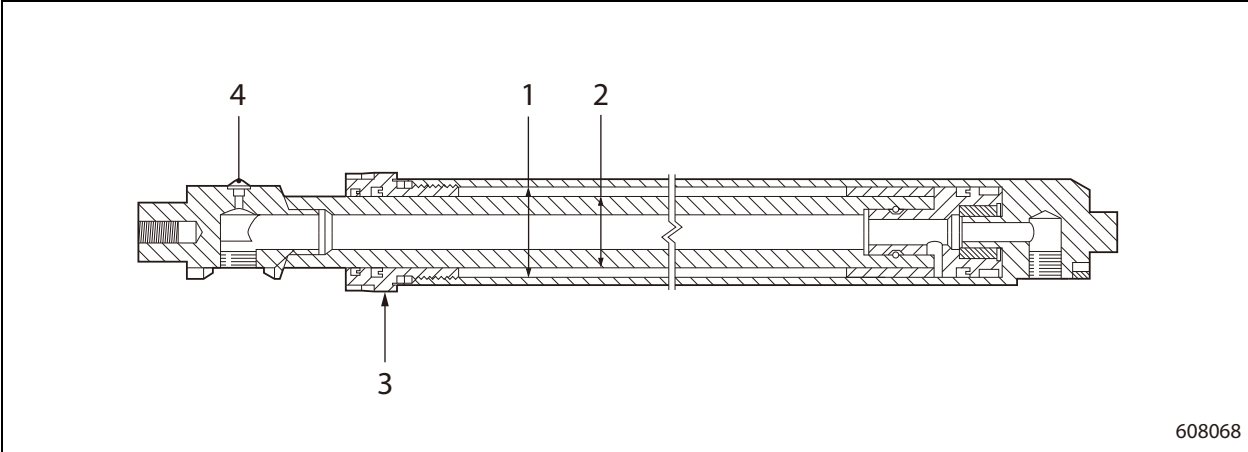
Appearance	Smell	Conditions	Countermeasure
Transparent. Color is almost same as new one.	Normal	Normal	No need to change
Transparent but color is thin.	Normal	Different oil may be mixed.	Check viscosity. If normal, it is usable.
Color is changed to milky white.	Normal	Air and/or water are mixed.	Separate water. Then, it is usable.
Color is changed to dark brown.	Bad	Oxidized	Exchange.
Transparent but with small black dusts.	Good	Foreign article is mixed.	Filter it. Then, it is usable.

#### Suction filter, return filter

Check for damage or clogging, and clean or replace.

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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The FC hydraulic system features the lift/tilt and attachment circuits that are arranged in parallel.

The hydraulic oil from the hydraulic pump flows through the P port into the inlet section of the control valve. The hydraulic oil from the section is directly sent to the bleed-off valve 3, and utilized as a working oil to move the lift/tilt cylinders and hydraulic actuator of the attachment.

The bleed-off valve 3 keeps the differential pressure among lift spool, tilt spool and attachment spool 14 constant. The lift spool 7, tilt spool 11 and attachment spool 14 are installed in the inlet section 1), tilt section 2) and attachment section 3) in control valve. They work as throttles and supply certain amount of oil to the lift/tilt/attachment circuit corresponding to the joystick operation.

Owing to the function of bleed-off valve 3, the cylinder can always extend and retract at a speed proportional only to the amount of the joystick movement under any load conditions.

Load pressure 20 shown by dotted line in the hydraulic circuit diagram on the previous page represents the oil passage that transmits the static pressure, i.e., the load pressure created by passing through the spool (or throttle).

### **Oil flow with all the joysticks in their neutral positions:**

When all the joysticks are in their neutral positions, valves are de-energized without current, allowing the load pressure oil to drain into the return passage, no load pressure builds up.

The electromagnetic proportional solenoid valves of all the control valves are de-energized, so the main control spools are in their neutral positions.

The supply of oil is interrupted with lift, tilt and attachment spools. The load pressure 20 is also interrupted, and the bleed-off valve 3 is relieved.

The oil flowed into the bleed-off valve 3 is sent to the hydraulic tank through the T port.

### **Oil flow with the lift/tilt/attachment joystick moved to an operating position:**

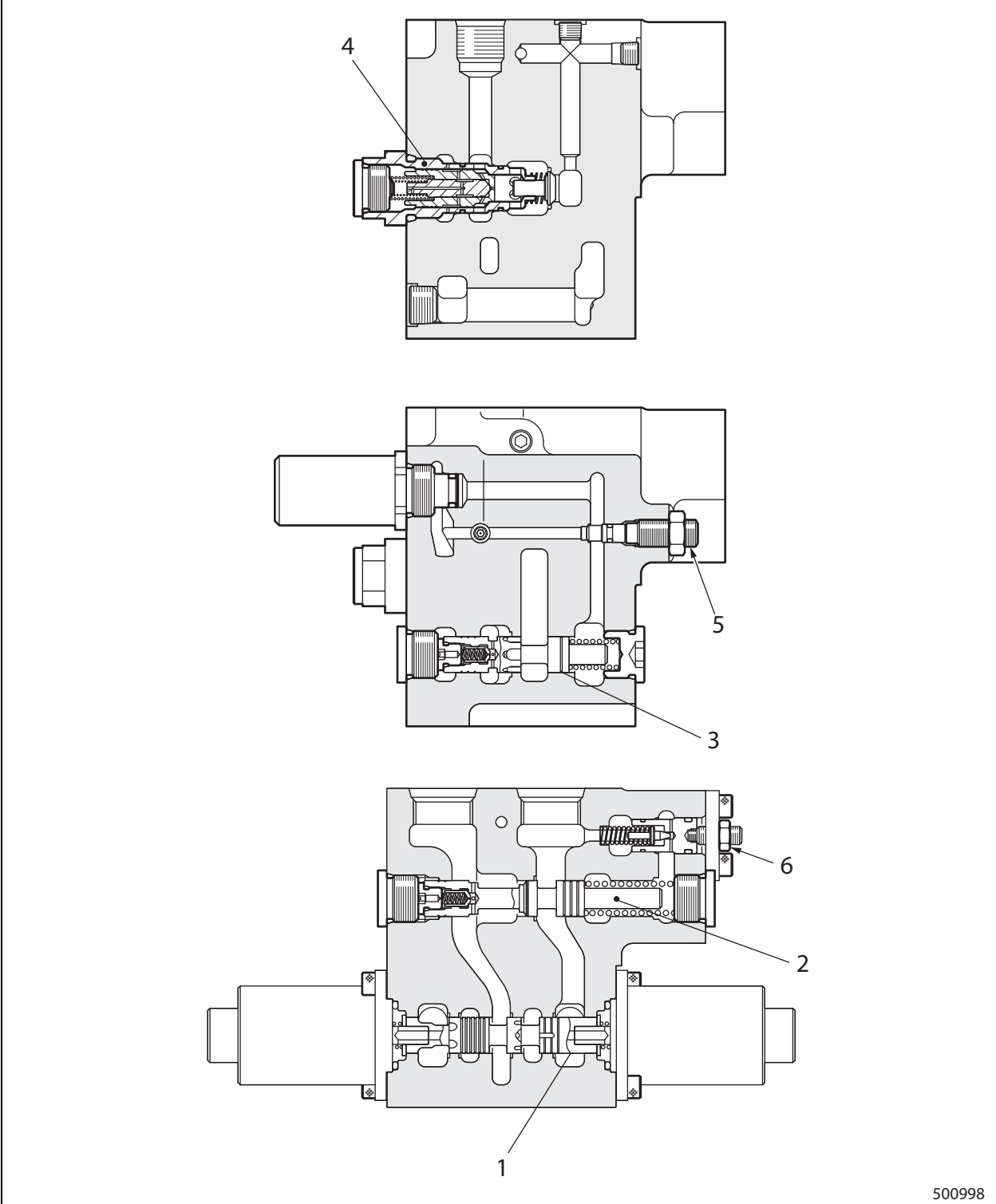
When an electric current goes through the electromagnetic proportional solenoid valve in lift/tilt/attachment control valve, the load pressure 20 is applied to the spool of bleed-off valve 3. The main spool is pushed to the valve housing side in proportion to the amount of joystick movement.

As a result, the oil flowing through supply oil passage 19 to the control valve enters one end of the cylinder and the oil on the opposite side of the piston drains into the return passage.

The oil flows through passage 19 at a constant rate that is made proportional to the amount of the joystick movement by the function of bleed-off valve 3.

The excessive oil flows from bleed-off valve 3 to the hydraulic tank through T port.

27. Valves Included in the Inlet Section



- 1. Lift valve
- 2. Bleed-off valve
- 3. Flow control valve (Pressure-compensated flow control valve)
- 4. Lift lock valve
- 5. Shut-off valve
- 6. Relief valve for lift/tilt /attachment circuit

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### **37.3 Suggestions for Reassembly**

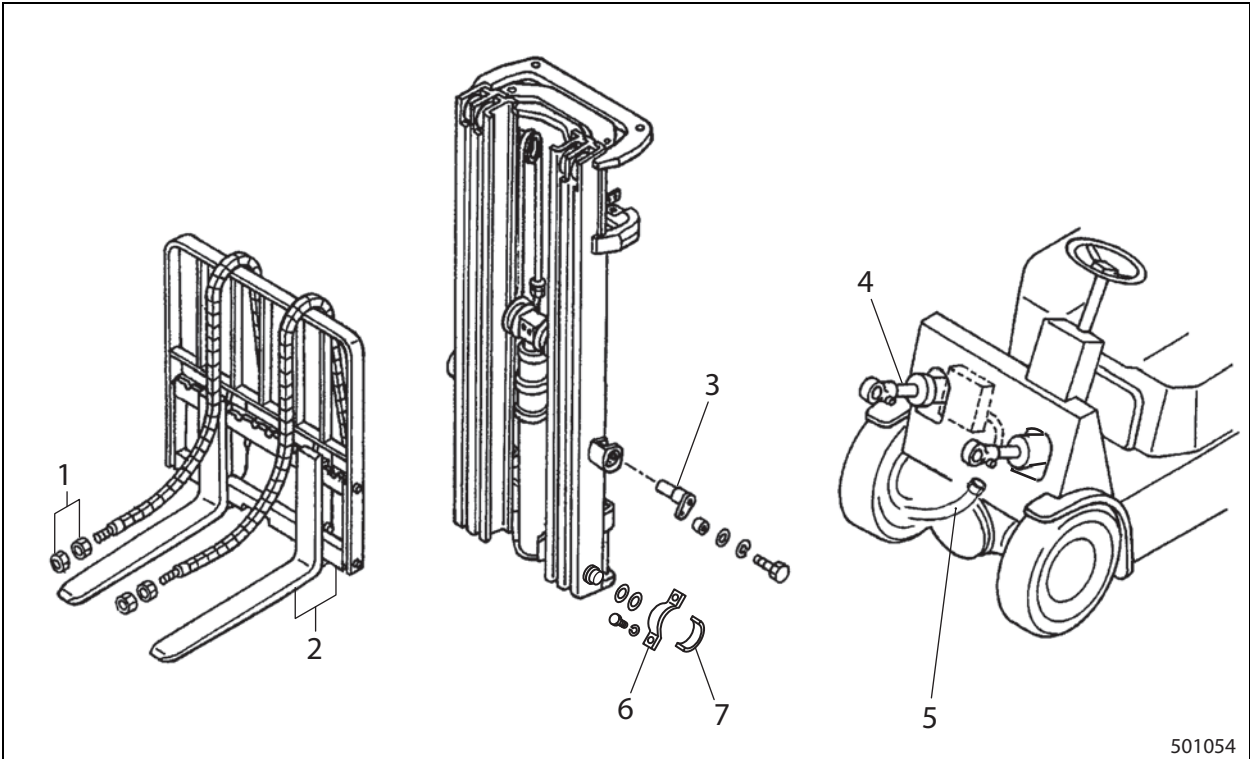
#### **Lift valve**

- (1) Place the housing on a workbench so that spool can be inserted horizontally to the housing, and carefully insert the spool into the housing. Pay attention to the orientation of the spool (see illustration).
- (2) Set the housing to install the lift lock valve vertically when assembling the lift lock valve. Insert valve 11 and spring 12 into the housing, and carefully insert the assembled lift lock valve. (See the illustration.)

### 5. Removing Triplex Mast, Duplex Mast

#### 5.1 Removal Sequence

The following describes the procedures for removing and reinstalling the mast assemblies of Duplex Mast and Triplex Mast. Note that the Triplex Mast is used as an example.



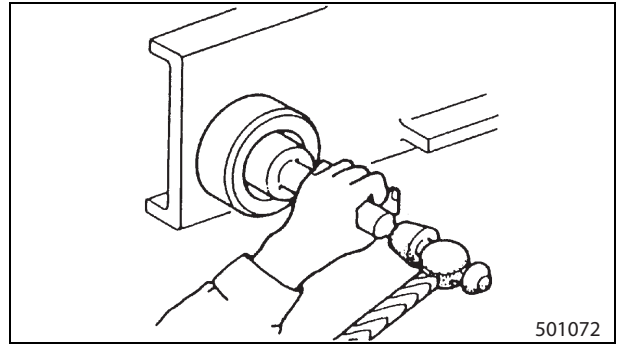
- 1. Nuts
- 2. Fork, Lift bracket assembly
- 3. Tilt socket pin
- 4. Tilt cylinder
- 5. High-pressure hose for lift cylinders
- 6. Mast support cap
- 7. Mast support bushing

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**Roller size**

Diam. of Main Roller	1 ton class	2 ton class
S	99 mm (3.90 in.)	
M	100 mm (3.94 in.)	
L	101 mm (3.98 in.)	
LL	102 mm (4.02 in.)	

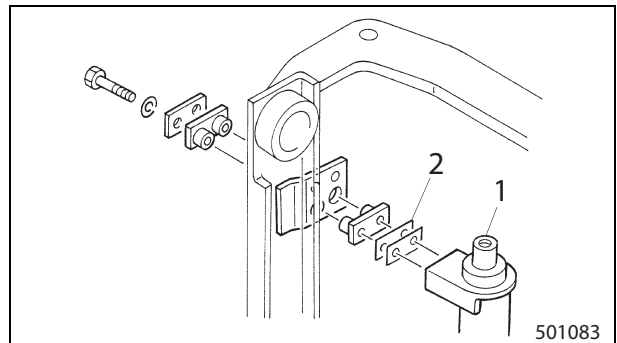
To install main rollers on shafts, use a driving tool. Be careful not to strike the outer roller surface with the driving tool. Position the roller so that its large curved side facing outside.



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**Installing second lift cylinders**

When installing second lift cylinders, make sure the cylinders are parallel to the mast to prevent torsional stress on the lift cylinders when the mast is positioned at the bottom. Adjust the installation positions of lift cylinder brackets with shims.



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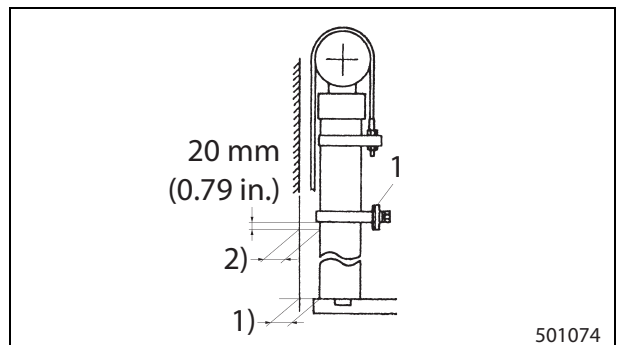
1. Lift cylinder

2. Shim

**Installing first lift cylinders**

The first lift cylinder must be installed parallel to the mast when the lift cylinder rod is contracted.

Make sure the cylinder does not tilt forward. Using shims, adjust the backward inclination so that clearance at section 2) is 0 to +0.5 mm (0 to +0.02 in.) larger than clearance at section 1).

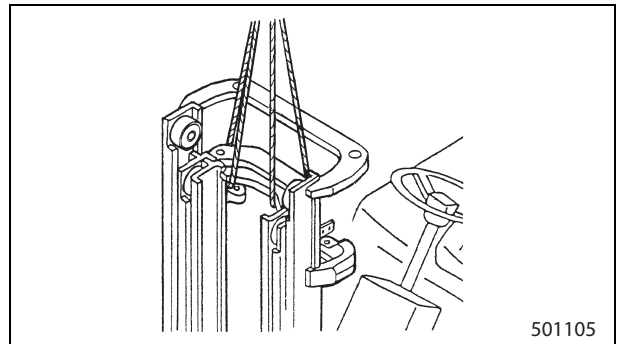


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1. Shim

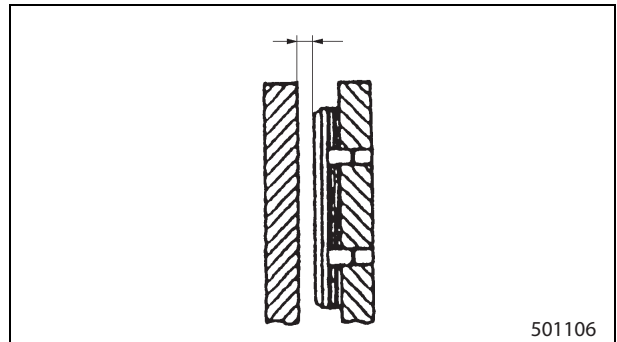
**Position the middle mast lower than the outer mast by following the steps below:**

- (1) Lift the inner mast to the height of the middle mast, then place wood blocks to support.
- (2) Hitch slings to both middle mast and inner mast, and suspend them with a hoist.
- (3) Remove set bolts from the upper sections of the middle mast lift cylinders, then lift the middle mast and inner mast.
- (4) Remove two lift cylinder clamps, dismount the cylinders from the mounting sections at the lower outer mast section. Tilt the cylinders by moving the top sections towards the center of the truck, then secure the cylinders to the cross-member of the outer mast with a rope. For the truck without crossmember, securely fasten to vehicle body with a rope.
- (5) Lower the middle mast and inner mast until main rollers can be removed.
- (6) Place wood blocks under the middle mast and 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.






**12.10 Mast Strip Adjustment**

- (1) Check the clearance with the clearance between the outer mast rollers and inner mast set to zero (0) in maximum lift position.



Item	Standard
Clearance	0.1 to 0.5 mm (0.004 to 0.020 in.)

3.2 Metric coarse thread

Nominal size	Pitch	With spring washer								
		 500247			 500248			 500249		
mm (in.)	mm (in.)	N-m	kgf-m	lbf-ft	N-m	kgf-m	lbf-ft	N-m	kgf-m	lbf-ft
10 (0.39)	1.5 (0.06)	33.3	3.40	24.56	43.1	4.39	31.79	67.7	6.90	49.93
12 (0.47)	1.75 (0.07)	58.8	6.00	43.37	76.5	7.80	56.42	115.7	11.80	85.33
14 (0.55)	2 (0.08)	96.4	9.83	71.10	124.5	12.70	91.82	182.4	18.60	134.53
16 (0.63)	2 (0.08)	147.1	15.00	108.49	191.2	19.50	141.02	274.6	28.00	202.53
18 (0.71)	2.5 (0.10)	203.0	20.70	149.72	264.8	27.00	195.30	383.4	39.10	282.78
20 (0.79)	2.5 (0.10)	286.4	29.20	211.23	371.7	37.90	274.15	536.4	54.70	395.62
22 (0.87)	2.5 (0.10)	383.4	39.10	282.78	499.2	50.90	368.18	725.9	74.02	535.39
24 (0.94)	3 (0.12)	492.3	50.20	363.10	640.4	65.30	472.33	924.8	94.30	682.09
27 (1.06)	3 (0.12)	724.7	73.90	534.50	942.2	96.08	694.92	1350.4	137.70	995.99
30 (1.18)	3.5 (0.14)	969.9	98.90	715.35	1259.2	128.40	928.72	1843.7	188.00	1359.82
33 (1.30)	3.5 (0.14)	1328.8	135.50	980.06	1727.0	176.10	1273.75	2477.2	252.60	1827.06
36 (1.42)	4 (0.16)	1676.0	170.90	1236.13	2180.0	222.29	1607.86	3199.9	326.29	2360.09
39 (1.54)	4 (0.16)	2219.2	226.29	1636.77	2884.1	294.09	2127.17	4118.8	419.99	3037.82
42 (1.65)	4.5 (0.18)	2754.7	280.90	2031.73	3581.4	365.20	2641.46	5137.7	523.89	3789.31

## 2. LOCKOUT/TAGOUT

LOCKOUT is not only used to disconnect a power supply, but also to physically isolate power sources from supplying power to the lift truck, with a lockout device, disabling the lift truck.

TAGOUT also reduces the risk of operating the machine during LOCKOUT with the use of a "DO NOT OPERATE" or similar warning tag. Warning tags are ideally placed on the lockout device to indicate the lift truck must not be operated until the tag is removed. Combined use of LOCKOUT/TAGOUT reduces the risk of accidental or inadvertent operation.

A lift truck that has been LOCKED OUT and TAGGED OUT must not be operated until the required service has been completed and the lift truck is no longer LOCKED OUT and TAGGED OUT.

### WARNING

- Personnel could be exposed to death or serious injury if LOCKOUT/TAGOUT procedure is not performed prior to servicing the lift truck.
- Only the technician who performs the LOCKOUT/TAGOUT procedure must release the lift truck back into service.
- Only authorized LOCKOUT/TAGOUT devices must be used. Contact your authorized Cat lift truck dealer for proper LOCKOUT/TAGOUT devices.

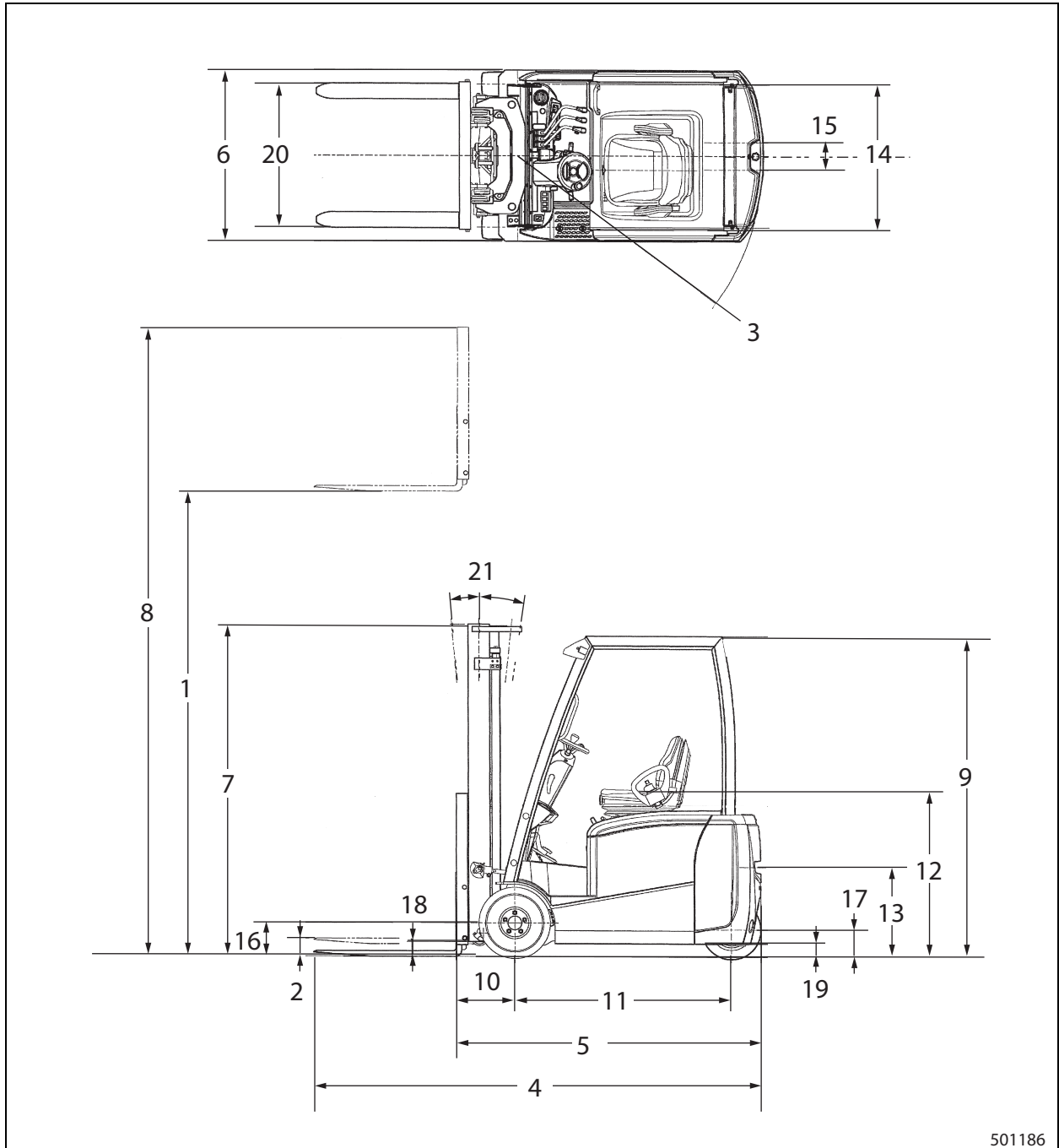
Typical LOCKOUT/TAGOUT procedures are shown below:

#### **Internal combustion (IC) lift truck**

- (1) Remove the key to the lift truck from the key switch and access the battery compartment.
- (2) Remove the negative (-) battery cable from the battery terminal and place in a suitable lockout device.
- (3) Lock the lockout device with the negative (-) battery cable locked inside.
- (4) TAGOUT the lift truck by placing a "DO NOT OPERATE" or similar warning tag where it can be visibly seen.
- (5) After the work is finished, the technician with the key to the lift truck must unlock the lockout device and remove the tag.

#### **Electric lift truck**

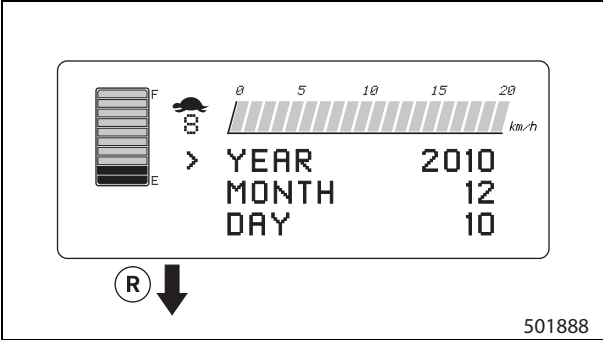
- (1) Remove the key to the lift truck from the key switch and access the battery compartment.
- (2) Disconnect the battery plug/connector and their connections from the lift truck and place in a suitable lockout device.
- (3) Lock the lockout device.
- (4) TAGOUT the lift truck by placing a "DO NOT OPERATE" or similar warning tag where it can be visibly seen.
- (5) After the work is finished, the technician with the key to the lift truck must unlock the lockout device and remove the tag.



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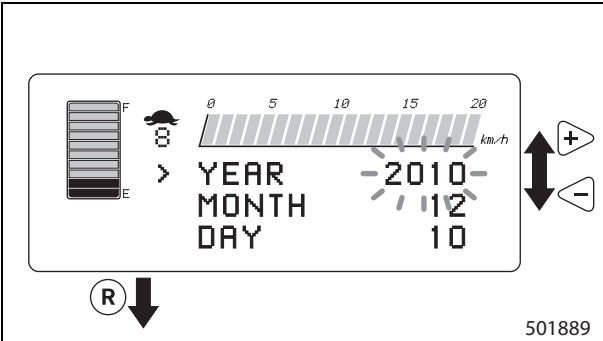
- |  |                                   |
|--|-----------------------------------|
| 1. MAXIMUM FORK HEIGHT                           | 12. SEAT HEIGHT                   |
| 2. FREE LIFT                                     | 13. TOW COUPLING HEIGHT           |
| 3. MINIMUM TURNING RADIUS                        | 14. TREAD FRONT                   |
| 4. OVERALL LENGTH                                | 15. TREAD REAR                    |
| 5. LENGTH TO FORK FACE (INCLUDES FORK THICKNESS) | 16. FRONT TIRE HEIGHT             |
| 6. OVERALL WIDTH                                 | 17. REAR TIRE HEIGHT              |
| 7. OVERALL HEIGHT (TO TOP OF MAST LOWERED)       | 18. GROUND CLEARANCE (AT MAST)    |
| 8. OVERALL HEIGHT (MAST EXTENDED)                | 19. GROUND CLEARANCE (AT FRAME)   |
| 9. OVERALL HEIGHT (TO TOP OF OVERHEAD GUARD)     | 20. FORK SPACING (OUTSIDE)        |
| 10. LOAD DISTANCE                                | 21. TILT ANGLE (FORWARD/BACKWARD) |
| 11. WHEELBASE                                    |                                   |

(4) Push (R) button, and then screen 2 appears.



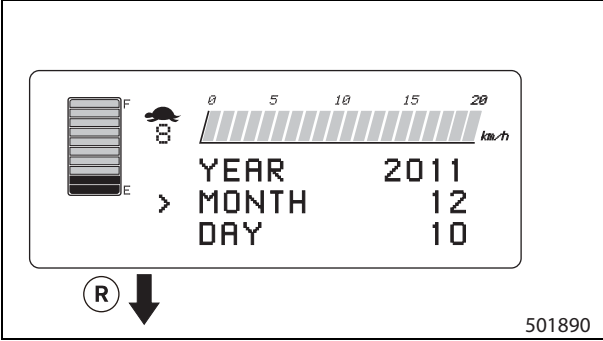
Screen 2

(5) Push (R) button, and the value of year is blinking. Set the year by pushing ◀ or ▶ button.



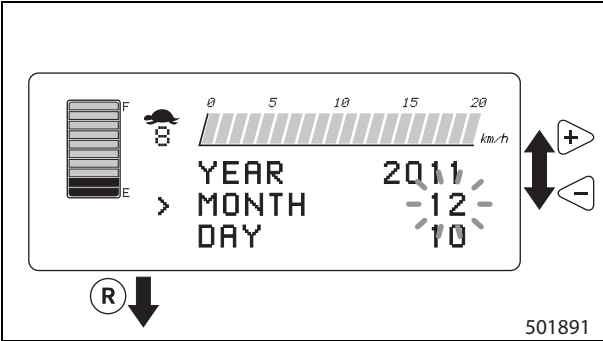
Screen 3

(6) After setting of the year, push (R) button, and then screen 4 appears.



Screen 4

(7) Push (R) button, and the value of month is blinking. Set the month by pushing ◀ or ▶ button.



Screen 5

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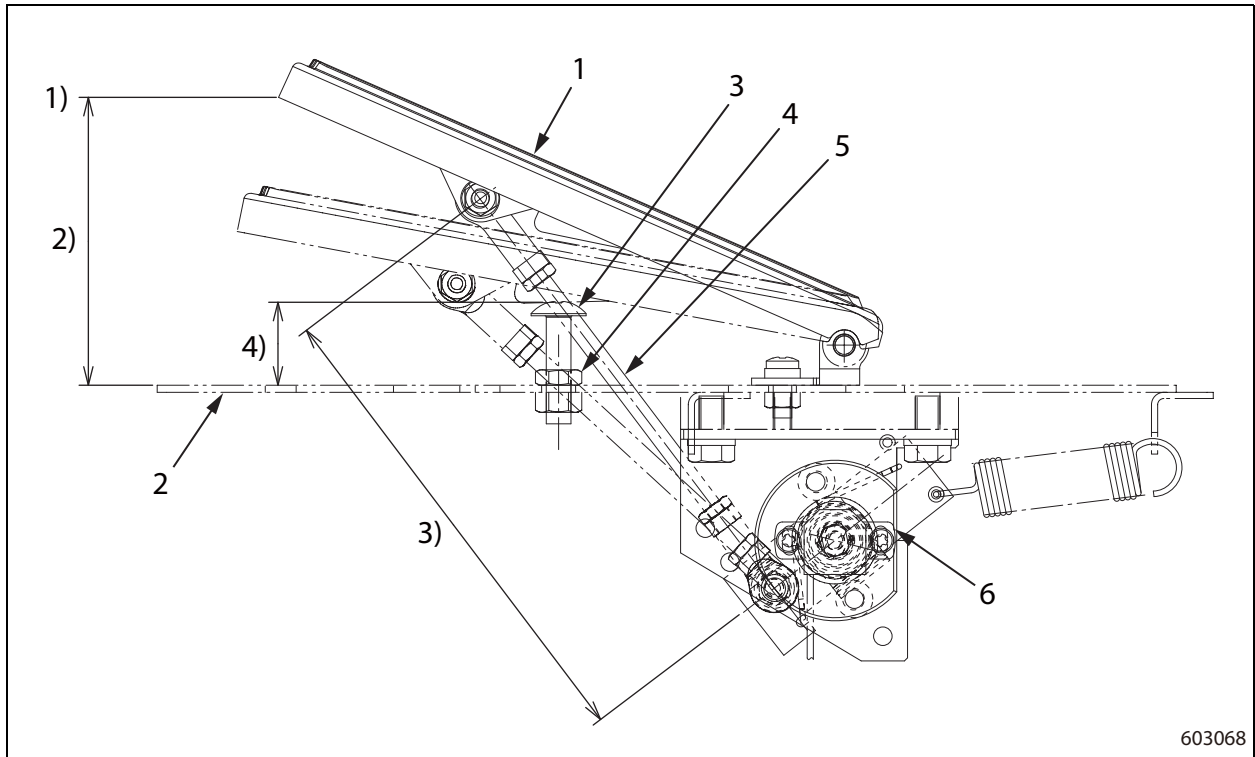
- Thank you very much for reading the preview of the manual.
- You can download the complete manual from: [www.heydownloads.com](http://www.heydownloads.com) by clicking the link below



- Please note: If there is no response to CLICKING the link, please download this PDF first and then click on it.

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11.2 Adjusting



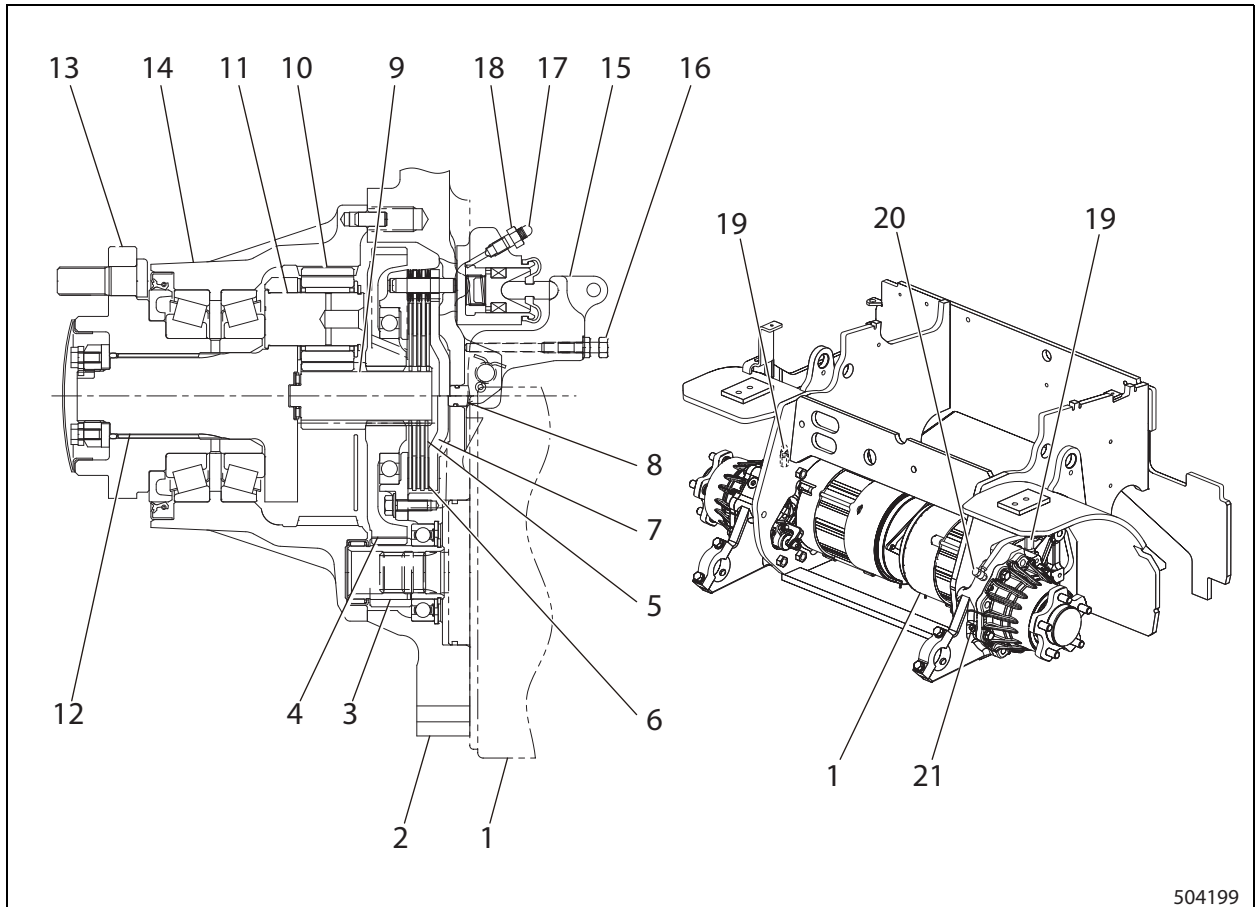
- |                      |                       |
|----------------------|-----------------------|
| 1. Accelerator pedal | 6. Potentiometer      |
| 2. Floor plate       | 1) Released position  |
| 3. Truss screw       | 2) Pedal height       |
| 4. Jam nut           | 3) Rod length         |
| 5. Link ball         | 4) Truss screw length |

**Adjusting accelerator linkage**

- (1) Adjust the rod length to adjust the accelerator pedal height at the released position.

Specified dimension when pedal is released		
2)	Pedal height	93 ± 5 mm (3.661 ± 0.197 in.)
3)	Rod length	Approximately 158 mm (Approximately 6.220 in.)

2.2 Structure



- |                    |   |
|--------------------|---|
| 1. Traction motor  | 12. Output carrier                                  |
| 2. Main case       | 13. Wheel hub                                       |
| 3. Input gear      | 14. Cover   |
| 4. 2nd gear        | 15. Brake lever                                     |
| 5. Friction plate  | 16. Adjusting bolt                                  |
| 6. Mating plate    | 17. Air bleeder                                     |
| 7. Plate           | 18. Bleeder screw                                   |
| 8. Pin             | 19. Breather (Right and left differ in components.) |
| 9. Sun gear        | 20. Plug (oil filler port)                          |
| 10. Planetary gear | 21. Plug (oil level)                                |
| 11. Planetary pin  |   |

The right and left transfers are coupled to the traction motors.

The driving force of the traction motor is transmitted to the wheel through the second gear, planetary gear and output carrier.

The output shaft is equipped with two tapered roller bearings so that it can withstand heavy loads.

In the service brake system, the mating plate and friction plate are brought into contact with each other to brake by actuating the brake lever to compress the plates through the pin.

Item	Value
Transfer reducing gear ratio	26.62



## 8. Inspecting and Adjusting Rear Axle

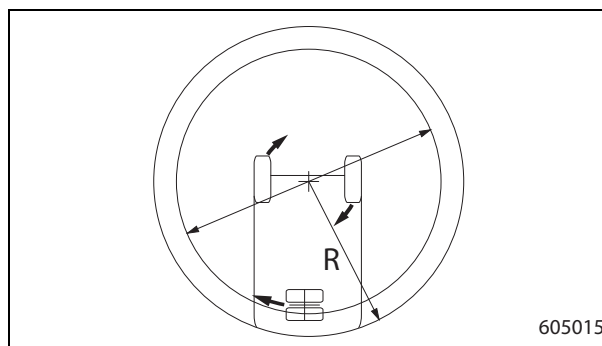
- (1) Install the potentiometer to the axle with the screw position being the center of long hole.
- (2) Connect the harness B connector with potentiometer connector.
- (3) Set the rear tires to the straight position.
- (4) Turn the key switch to the ON position.
- (5) Push the button on the MCPF for zero adjustment.
- (6) Turn the key switch to the OFF position once and turn it to the ON position.
- (7) Turn the steering wheel to confirm the -90 deg to +90 deg stroke.

### 8.1 Measuring Minimum Turning Radius

#### ⚠ WARNING

The area where the measurement to be taken must be surrounded by a fence, etc. or assigned with a watchman so that no unauthorized persons gain access to the area.

- (1) Secure a flat ground of 20 by 20 m (21.9 by 21.9 yd) or more.
- (2) While operating the vehicle at low speed, turn the steering wheel all the way to the right, then to the left, and check the diameter of the tire tracks in both turning operations.
- (3) Calculate minimum turning radius  $R$  by dividing the turning diameter by two then adding the distance between the center of the outside rear wheel and the outside edge of the counterweight.



605015

Lift truck model	Minimum turning radius
13/15	1475 mm (58.07 in.)
16 C/18 C	1585 mm (62.40 in.)
16/18/20	1695 mm (66.73 in.)

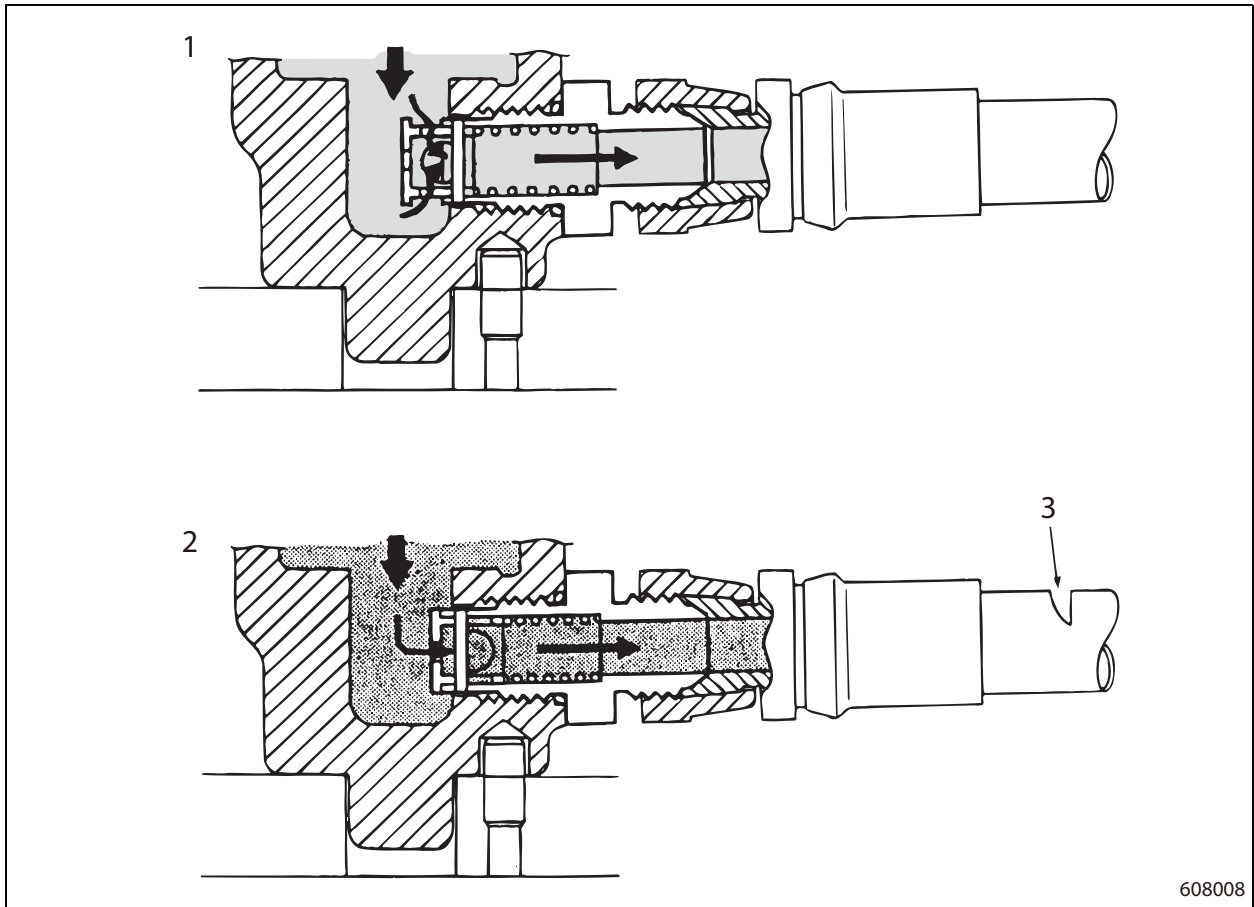
## 9. Troubleshooting

### 9.1 Brake Pedal Assembly

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

Situation	Possible causes	Action
Brake cannot be applied.	Fluid line leak or low fluid level in reserve tank	Repair and add fluid.
	Fluid leak from brake pipe joint	Tighten, or replace pipe and joint.
	Trapped air in hydraulic line	Bleed air from master cylinder.
	Fluid leak caused by piston cup wear of master cylinder	Replace. Change fluid with the recommended type if the cup is distorted.
	Wear of mating plate or uneven contact with friction plate of wheel brake	For the wheel brake, refer to the chapter of "TRANSFER UNITS".
Brake pedal stroke is excessive.	Trapped air in hydraulic line	Bleed air from master cylinder.
	Faulty master cylinder or piston cup	Replace piston cup.
	Low oil level in master cylinder	Add brake fluid.
	Excessive clearance of master cylinder push rod	Adjust.
	Brake fluid leak from master cylinder	Replace piston cup of master cylinder. If piston cup is deformed, replace brake fluid (use genuine brake fluid).
	Fault of microswitch installation	Adjust the microswitch position.
	Malfunction of microswitch	Replace.
Brake cannot be released.	See "TRANSFER UNITS".	
Unbalanced braking		
Brake squeaks.		
Brake drags.		
Braking only at one side		

2.4 Down Safety Valve



- 1. Normal
- 2. When hose burst

- 3. Burst

The down safety valve is located at the bottom of second lift cylinder. This safety valve regulates the flow of oil to prevent the fork from moving down too quickly in the following situations:

If the piping between the lift cylinder and control valve is broken, or if the flow of return oil from the lift cylinder becomes excessive due to a misadjusted control valve or a fault of another component.

## 11. Installing Lift Cylinder

Follow the removal procedure in reverse. Observe the following instructions during installation.

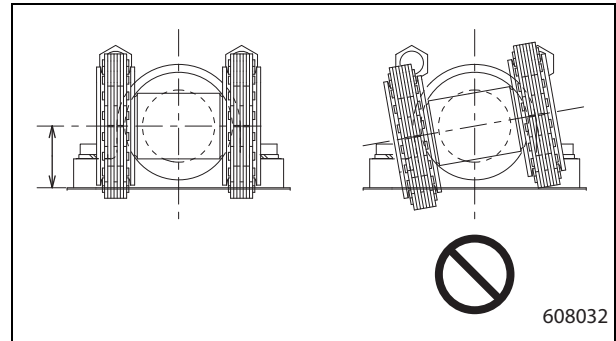
### 11.1 Suggestions for Installation

#### Simplex Mast

- (1) Extend and retract the lift cylinders several times under no load condition to bleed air out of the cylinder circuits and to make sure that the cylinders move smoothly.
- (2) Check the oil level in the hydraulic tank with an oil level gauge. See 8-35 "Inspecting and Adjusting Hydraulic System".
- (3) Check to make sure that the Mast height is correct.
- (4) Check to make sure that the oil is not leaked from anywhere.
- (5) After the lift cylinders or piston rods have been replaced, check for difference in stroke between the two cylinders. See "MAST AND FORK".

#### Triplex Mast and Duplex Mast

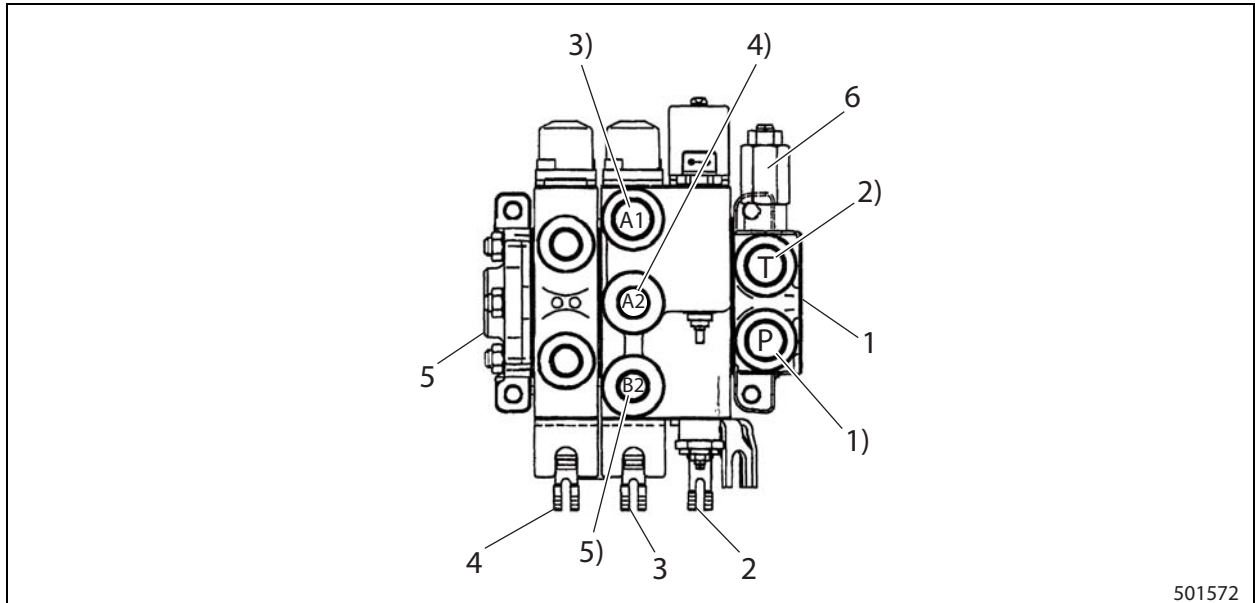
- (1) Install chain wheel support assembly parallel to a line connecting the centers of chain anchor bolt holes on first lift cylinder to prevent chains from twisting.
- (2) Adjust the chain tensions. See 8-35 "Inspecting and Adjusting Hydraulic System".
- (3) Extend and retract the lift cylinders several times under no load condition to bleed air out of the cylinder circuits and to make sure that the cylinders move smoothly.
- (4) After proper operation is confirmed, check the oil level in the hydraulic tank. See 8-35 "Inspecting and Adjusting Hydraulic System".
- (5) Check to make sure that the Mast height is correct.
- (6) Check to make sure that the oil is not leaked from anywhere.
- (7) After the lift cylinders or piston rods have been replaced, check for difference in stroke between the two cylinders. See "MAST AND FORK".





## 21. MC Control Valve

### 21.1 General Description



501572

- |  |  |
|--|--|
| 1. Inlet cover section                             | 1) P: Pressure oil inflow port from pump |
| 2. Lift valve (with built-in flow regulator valve) | 2) T: To hydraulic tank (return line)    |
| 3. Tilt valve                                      | 3) A1: To lift cylinder                  |
| 4. Attachment valve                                | 4) A2: To tilt cylinder rod end          |
| 5. End cover section                               | 5) B2: To tilt cylinder head end         |
| 6. Main relief valve                               |  |

The above illustration shows an external view of the MC control valve. Any one of the three valve to four-valve type valves is installed on a lift truck depending on the lift truck specifications.

The most basic valve configuration is a two-valve type, combination of the lift and tilt. Adding attachment valve(s) to this combination is three-valve type or four-valve type valve.

The inlet cover section is provided with main relief valve 6.

The valve limits the maximum pressure to protect the system.

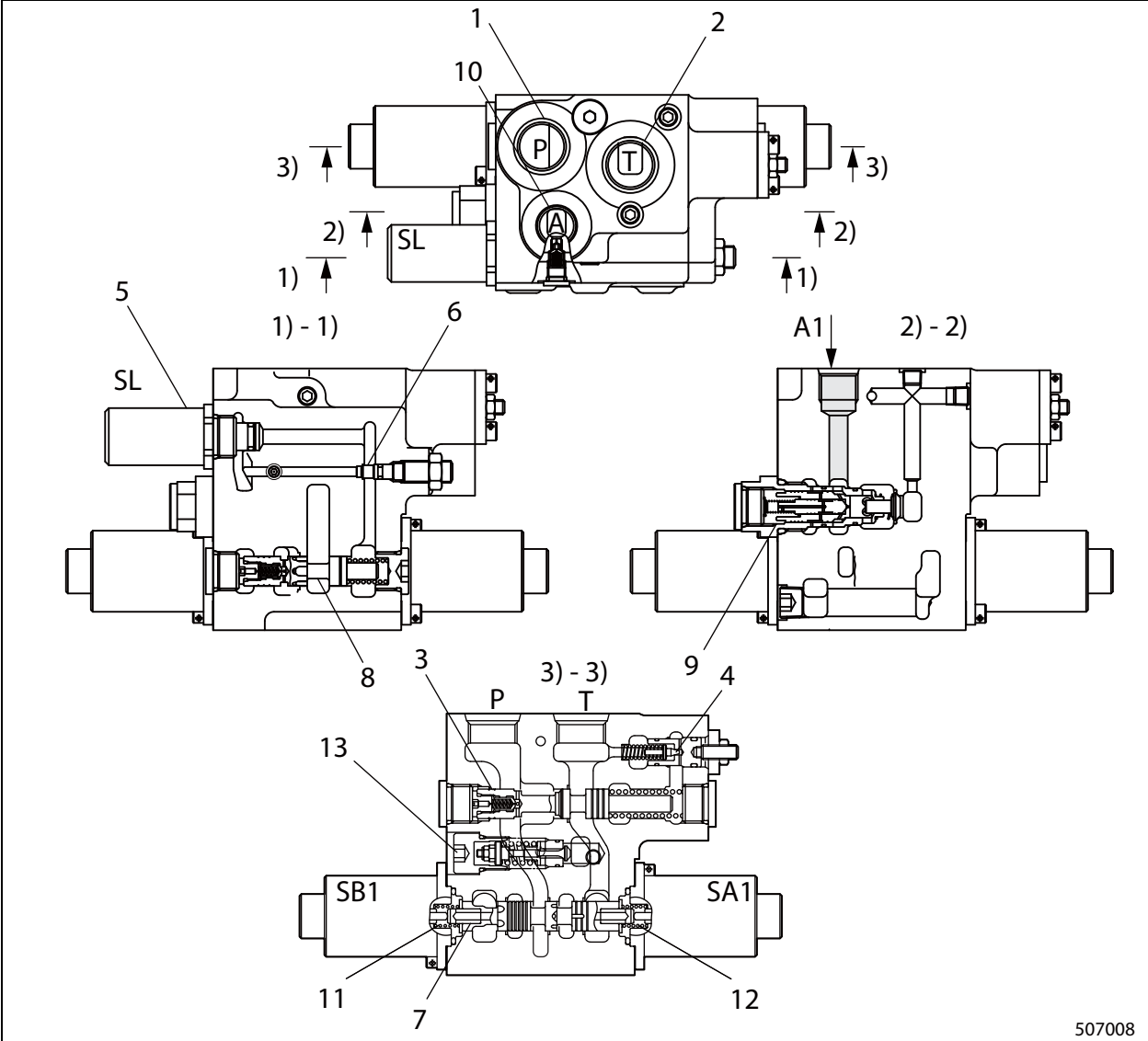
Lift valve 2 and tilt valve 3 are assembled adjacent to the combination section.

Lift valve 2 is a direction control valve which feeds and returns pressure oil to and from the lift cylinder. Oil returns, namely through the descent hydraulic circuit that has a built-in lock valve linked with the flow regulator valve and the seat switch.

Tilt valve 3 feeds and returns pressure oil to and from the tilt cylinder which tilts the mast forward or backward. The tilt lock valve is assembled in the main spool to ensure safety when the mast is tilted forward.

Attachment valves 4 and 5 are direction control valves which feed pressure oil to actuators of the attachments.

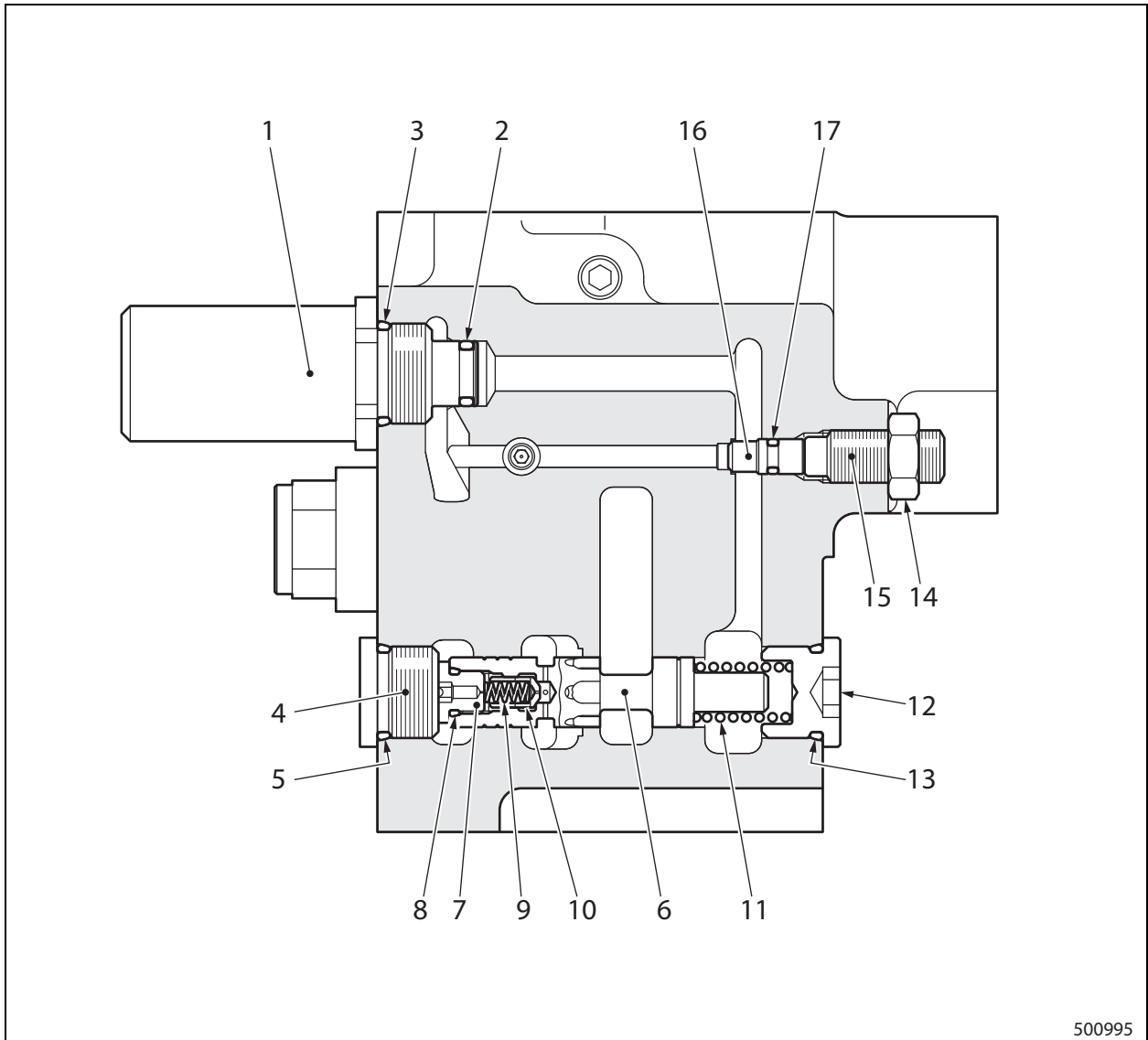
22.4 Lift Valve



507008

- |   |  |
|---|--|
| 1. From hydraulic pump  | 8. Pressure-compensated flow control valve |
| 2. To hydraulic tank  | 9. Lift lock valve                         |
| 3. Bleed-off valve  | 10. To lift cylinder                       |
| 4. Pilot valve (Relief valve)                                       | 11. Spring                                 |
| 5. Lift lock solenoid valve   | 12. Spring                                 |
| 6. Shut-off valve   | 13. Surge cut valve                        |
| 7. Electromagnetic proportional pressure control valve (Lift spool) |  |

28.2 Disassembly Sequence (Part 2)



500995

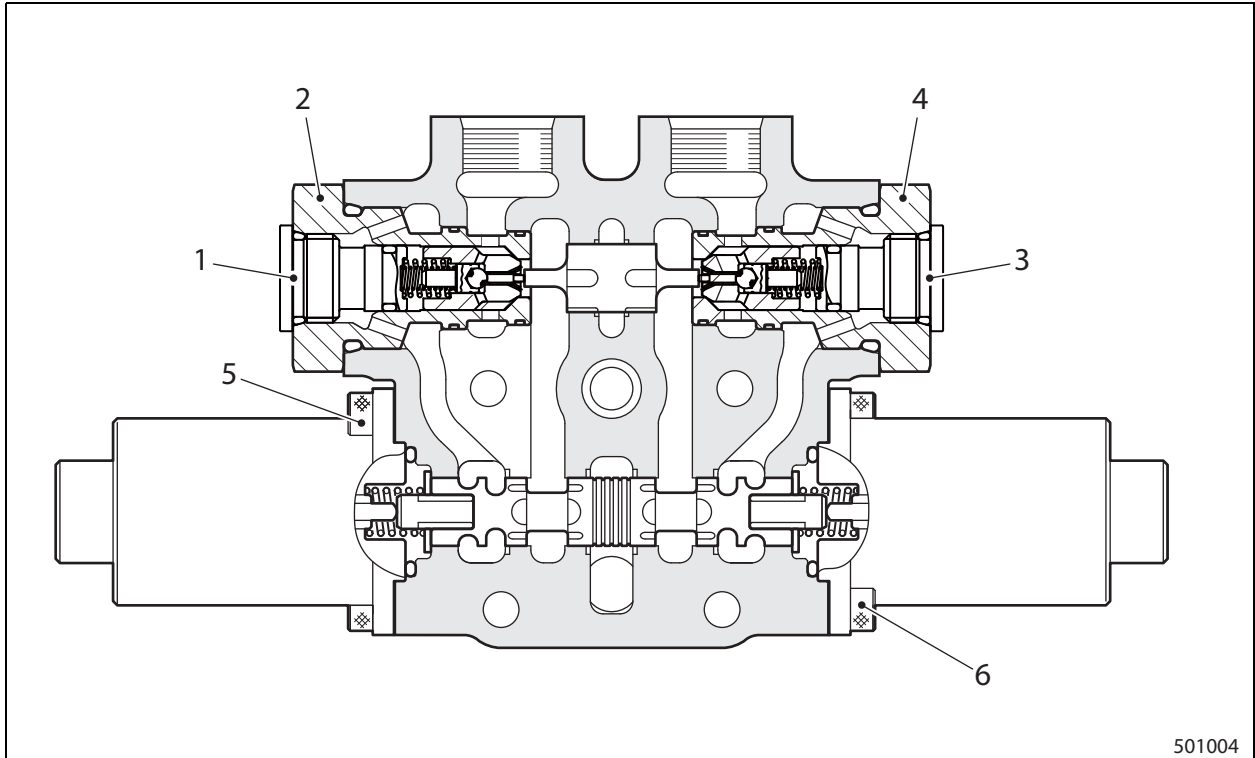
- |                            |            |
|----------------------------|------------|
| 1. Solenoid valve assembly | 10. Valve  |
| 2. O-ring                  | 11. Spring |
| 3. O-ring                  | 12. Plug   |
| 4. Plug                    | 13. O-ring |
| 5. O-ring                  | 14. Nut    |
| 6. Spool                   | 15. Screw  |
| 7. Plug                    | 16. Valve  |
| 8. O-ring                  | 17. O-ring |
| 9. Spring                  |            |

Note: Flow control valve (4 to 13)  
 Shut-off valve (14 to 17)

### 39. Assembling Attachment Section

Follow the disassembly sequence in reverse.

#### 39.1 Suggestions for Assembly

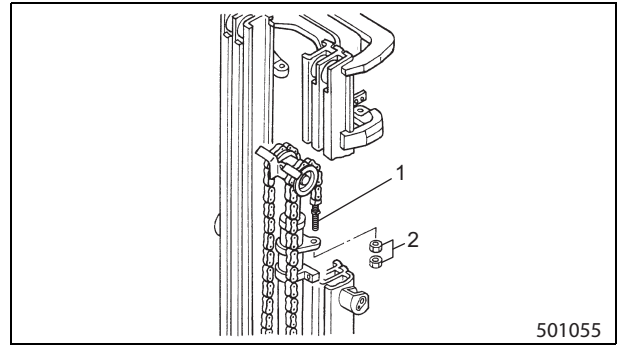


No.	Part name	Procedure	Value
1	Plug	Tightening torque	60 ± 6 N·m (6.12 ± 0.61 kgf·m) [44.25 ± 4.43 lbf·ft]
2	Plug	Tightening torque	126 ± 12.6 N·m (12.85 ± 1.28 kgf·m) [92.93 ± 9.29 lbf·ft]
3	Plug	Tightening torque	60 ± 6 N·m (6.12 ± 0.61 kgf·m) [44.25 ± 4.43 lbf·ft]
4	Plug	Tightening torque	126 ± 12.6 N·m (12.85 ± 1.28 kgf·m) [92.93 ± 9.29 lbf·ft]
5	Solenoid valve assembly tightening bolt	Tightening torque	15.7 ± 1.6 N·m (1.60 ± 0.16 kgf·m) [11.58 ± 1.18 lbf·ft]
6	Solenoid valve assembly tightening bolt	Tightening torque	15.7 ± 1.6 N·m (1.60 ± 0.16 kgf·m) [11.58 ± 1.18 lbf·ft]

## 5.2 Suggestions for Removal

### Removing lift bracket assembly

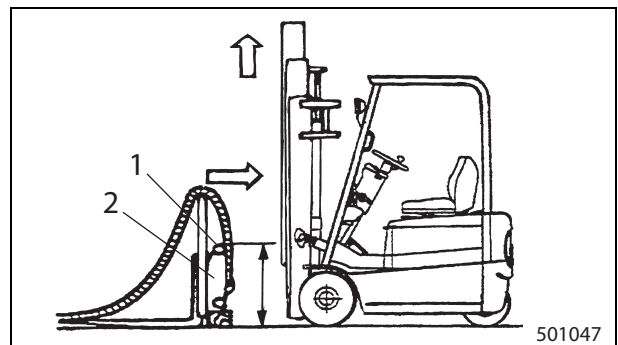
- (1) Lower lift bracket assembly, and place wood blocks under the assembly. Tilt the mast forward, and lower the inner mast to the bottom, then remove nuts from the anchor bolts of the first lift chains.



1. Anchor bolt

2. Nuts

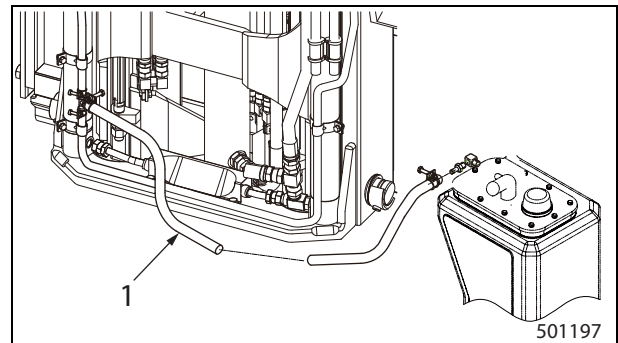
- (2) Tilt the mast back to the vertical position. Raise the inner mast until main rollers of the lift bracket become free. Then, slowly move the vehicle in reverse to separate the lift bracket assembly.



1. Main rollers

2. Lift bracket

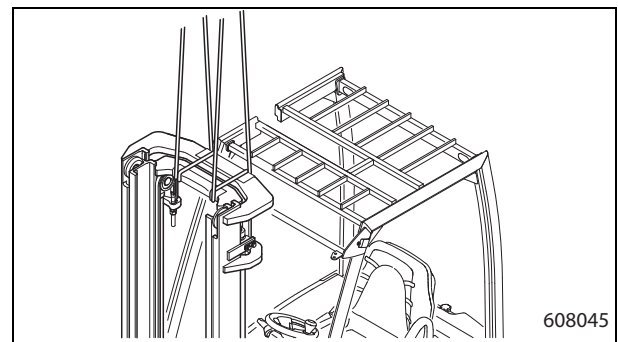
- (3) Disconnecting return hose for lift cylinder  
(For high-lift cylinder model)
  - Turn OFF the engine and disconnect hose at the hose clamp of return connector.
- (4) Removing lift cylinder high pressure hose. Lower the mast to the bottom, and disconnect the lift hose at the flow regulator valve.



1. Return hose (For high-lift cylinder model)

### Separating mast and tilt cylinders

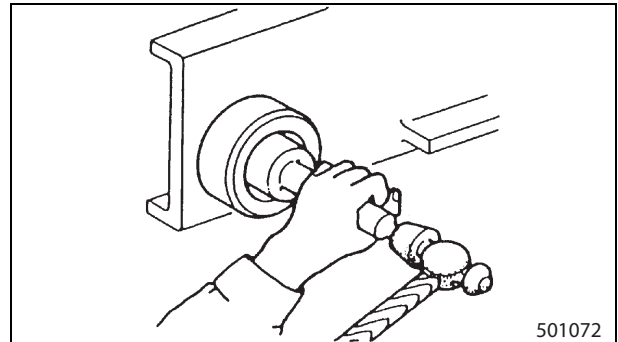
- (1) Hitch a sling to the mast. Using two eye-bolts and a sling as shown, support the mast with a hoist.



**Roller size**

Diameter of Main Roller	1 ton class	2 ton class
S	99 mm (3.90 in.)	
M	100 mm (3.94 in.)	
L	101 mm (3.98 in.)	
LL	102 mm (4.02 in.)	

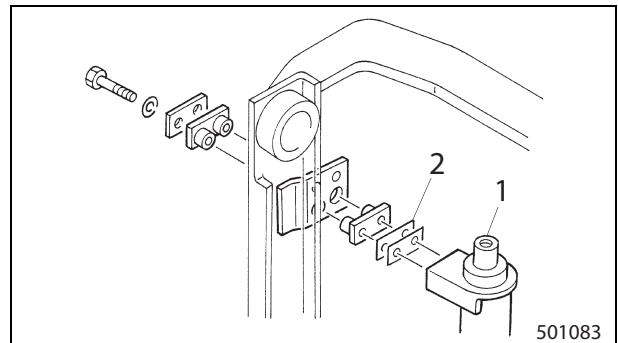
To install main rollers on shafts, use a driving tool. Be careful not to strike the outer roller surface with the driving tool. Position the roller so that its large curved side facing outside.



501072

**Installing second lift cylinders**

When installing second lift cylinders, make sure the cylinders are parallel to the mast to prevent torsional stress on the lift cylinders when the mast is positioned at the bottom. Adjust the installation positions of lift cylinder brackets with shims.



501083

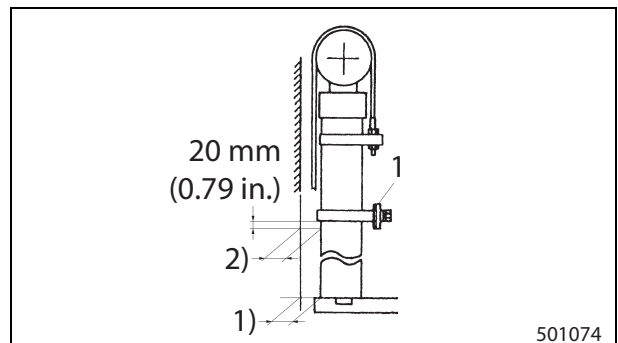
1. Lift cylinder

2. Shim

**Installing first lift cylinders**

The first lift cylinder must be installed parallel to the mast when the lift cylinder rod is contracted.

Make sure the cylinder does not tilt forward. Using shims, adjust the backward inclination so that clearance at section 2) is 0 to +0.5 mm (0 to +0.02 in.) larger than clearance at section 1).



501074

1. Shim

### 13.6 Mast Clearance Adjustment

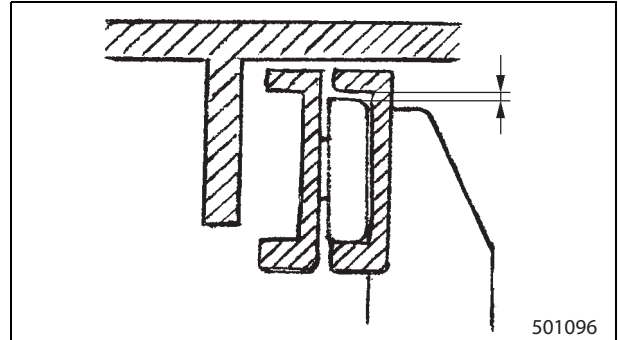
Note:

Adjust mast clearances at the locations indicated below.

- (1) Simplex Mast and Duplex Mast: Main rollers between the outer mast and inner mast
- (2) Triplex Mast: Main rollers between the outer mast and middle mast, and main rollers between the middle mast and inner mast.

#### Longitudinal clearance adjustment on mast main rollers

- (1) Tilt the mast fully backward.
- (2) Using feeler gauges, measure the clearance between the inner mast lower roller and outer mast.



Item	Standard
Clearance	1.0 mm (0.039 in.) or less

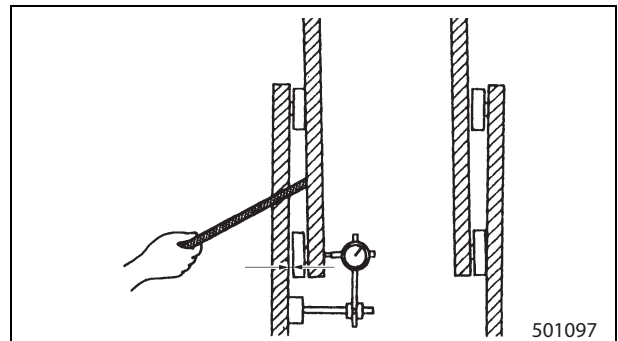
- (3) If the clearance is out of the specification, use oversize rollers.

#### Roller sizes

Diameter of Main Roller	1 ton class	2 ton class
S	99 mm (3.90 in.)	
M	100 mm (3.94 in.)	
L	101 mm (3.98 in.)	
LL	102 mm (4.02 in.)	

#### Lateral clearance adjustment on inner mast main rollers

- (1) Raise the mast to the top.
- (2) Set a dial indicator on the inside of the outer mast with its contact point rested on the inner mast.
- (3) Go over to the opposite side of the mast, and push the inner mast against the outer mast. Set the indicator to zero.



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		
Braking system	Brake cylinder and lever	Clearance between brake cylinder and lever				×		
		Brake cylinder and lever operating condition				×		
		Rusting of pins				×		
		Brake cylinder oil leaks and damage	×	×	×			
Lift system	Forks	Fork and stopper pin damage	×	×	×			
		Forks—wear and distortion	×	×	×			
		Cracking and wear in fork base and tooth weld	×	×	×			
	Masts and lift bracket	Cracking in cross-member welds of outer and inner masts					×	
		Cracking in welds of tilt cylinders and masts					×	
		Cracking in welds of outer masts and cylinder support					×	
		Cracking in lift bracket welds					×	
		Roller bearing rattle					×	
		Wear and damage of mast support metal				×		
		Cracking and damage in rollers, roller pins and welds					×	
	Mast operating condition and mounting looseness	×	×	×	×			
	Chains and chain wheels	Length of lift chains (20 links)	×	×	×			Allowed lift chain stretch: 1 ton class: 327 mm (12.87 in.) 2 ton class: 392 mm (15.43 in.)
		Chain deformation, damage, lubrication and rusting	×	×	×			
		Chain bushing coupling, bolt deformation and damage		×	×			
		Chain wheel deformation and damage					×	
Chain wheel bearing rattle			×	×				
Attachments	Attachment abnormality and mounting conditions	×	×	×				



**Mitsubishi Caterpillar Forklift Europe B.V.  
Hefbrugweg 77  
1332 AM Almere,  
The Netherlands**

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**1.3 Outline of Logic Unit**

This controller includes the power supply card and logic card.

It controls all the jobs for the truck based on the operator's input.

The controller sends a motor control command to the right and left traction inverters from the input of the direction lever or the accelerator pedal. It also monitors malfunctions of the traction system.

The lever input triggers to send the motor control commands to the pump inverter. It also monitors malfunctions in the hydraulic control system. In the FC specifications, this controller sends a control command to the solenoid valves from the output unit by the lever input. A malfunction in the valve control system is also monitored by this controller.

The truck speed and residual battery power are monitored and shown on the display unit.

The logic unit sets its model information and optional default data into internal memory. The information is secured even if the power supply for the logic unit is turned off. This information is set at the factory.

The following table shows the model information. The system will not work properly if the actual controller system is different from the model information.

**Model information**

<b>Item</b>	<b>Description</b>	<b>SUO No.</b>
Truck type	Model set	#40
Battery voltage	36 V, 48 V	#41
Battery type	Battery type	#42
Hydraulic control selection	FC type, MC type	#43
Mast type	Mast type	#44
Valve section	Number of valves	#45
Battery voltage adjustment	Battery voltage adjustment	#46
Foot direction	Optional equipment	#47
Load meter function	Optional equipment	#48
Tilt horizon function	Optional equipment	#50

The current information is available to confirm and modify.

Refer to Setup Option on page 1-22 for details and setting procedure.

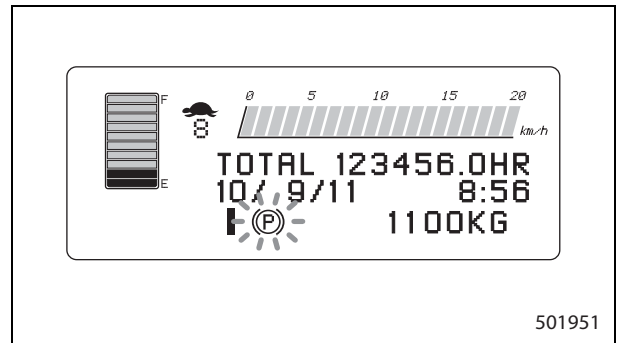
The model information and various features are set by the Setup Option (SUO).

The power supply card changes the battery voltage and supplies power to the logic card and the DSP card.

### 4.3 Parking Brake Interlock

The parking brake (PKB) interlock will be activated and “P” on the display blinks if the operator leaves the seat when the key switch is in ON position and the PKB switch is in OFF position. Also the PKB interlock will be applied when the key switch is turned OFF with the PKB switch in OFF position.

To release the PKB interlock, apply the parking brake, then release it.



### 4.4 BDI (Battery discharge indicator) display features

This feature shows with 11 levels (BDI 0 to BDI 10) of remaining battery capacity of the current battery voltage.

Set SUO No. #41 or #42 depends on installed battery type and voltage.

See the Chassis & Mast Service Manual for details.

#### Warning buzzer features

The buzzer sounds when the key switch is turned OFF or the operator leaves the operator's seat with the parking brake SW is turned off.

### 4.5 Miscellaneous features

The table shows miscellaneous features.

#### Miscellaneous features

Item	Description	SUO No.
Service indicator	Shows or warns maintenance time.	#10
Display unit	Speed, error code, hour-meter, date, clock, ⌚ SW, BDI, etc. are shown.	-

5.6 Setup Options (Group 2)

Option#	Title of Option	Description	Range	Default Value	Harness Pin No.
#11	Aux Input for Lift/ Drive Speed 1	When the auxiliary input 1 signal is on, travel speed or lift speed is limited to the set value. The maximum speed is defined at #12. The amount of power reduction is defined at #13.	0: Disable 1: Disable lift (switch closed) 2: Speed limit (switch closed) 3: Power reduction (switch closed) 4: Disable lift (switch opened) 5: Speed limit (switch opened) 6: Power reduction (switch opened)	0	E-03-40
#12	Aux Travel Speed Limit 1	Travel speed limit for #11	5 to 16 [km/h] (3-Wheel model) 5 to 17 [km/h] (4-Wheel model)	12	E-03-40
#13	Aux Power Reduction Rate 1	Traction power reduction ratio for #11	0 to 100 [%]	70	E-03-40
#14	Aux Input for Lift/ Drive Speed 2	When the auxiliary input 2 signal is on, travel speed or lift speed is limited to set value. The maximum speed is defined at #15. The amount of power reduction is defined at #16.	Same as #11	0	E-03-41
#15	Aux Travel Speed Limit 2	Travel speed limit for #14	5 to 16 [km/h] (3-Wheel model) 5 to 17 [km/h] (4-Wheel model)	12	E-03-41
#16	Aux Power Reduction Rate 2	Traction power reduction ratio for #14	0 to 100 [%]	70	E-03-41
#17	Aux Input for Lift/ Drive Speed 3	When the auxiliary input 3 signal is on, travel speed or lift speed is limited to set value. The maximum speed is defined at #18. The amount of power reduction is defined at #19.	Same as #11	0	E-03-30
#18	Aux Travel Speed Limit 3	Travel speed limit for #17	5 to 16 [km/h] (3-Wheel model) 5 to 17 [km/h] (4-Wheel model)	12	E-03-30
#19	Aux Power Reduction Rate 3	Power reduction ratio for #17	0 to 100 [%]	70	E-03-30
#21	Regen Adjustment for Brake Regen	10 steps for regen power on brake regen	1 to 10 (1: SLOW to 10: FAST)	5	-
#22	Regen Adjustment for Lever Regen	10 steps for regen power on lever regen	1 to 10 (1: SLOW to 10: FAST)	7	-

## **CHAPTER 1 CONTROLLER**

\*1 The function will not be recovered in case of failure and partial failure unless the power is turned off. For degeneracy, the function will be recovered when the condition is removed. The fail-safe is considered to be a normal for partial failure and degeneracy.

\*2 For MC model, only lifting operation can be disabled.

\*3 If error 74 (Hydraulic Lock Solenoid Fault) of lift lock valve coil failure occurs, the lift lock valve is turned OFF.

**Input unit card voltage chart**

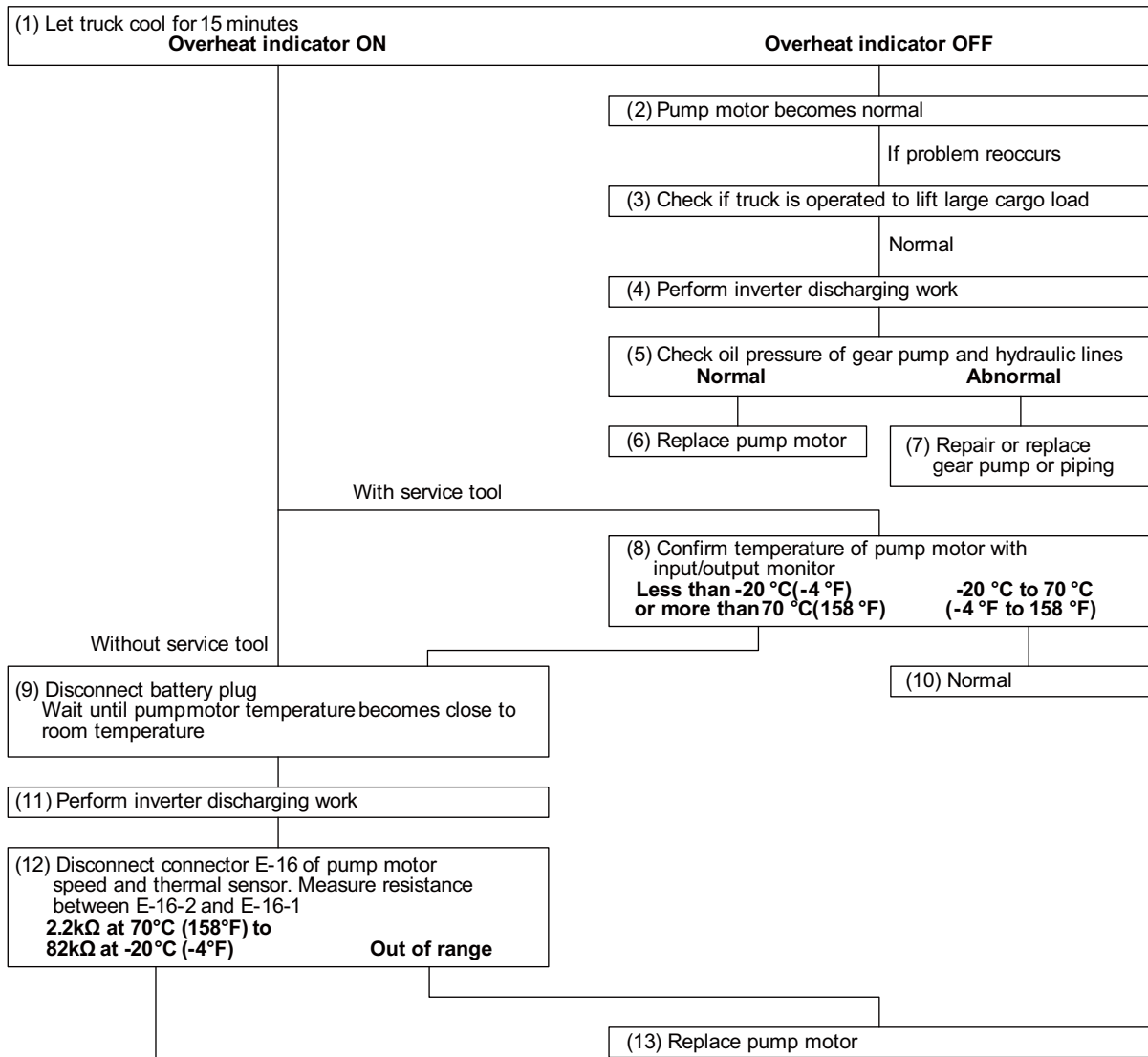
CN1

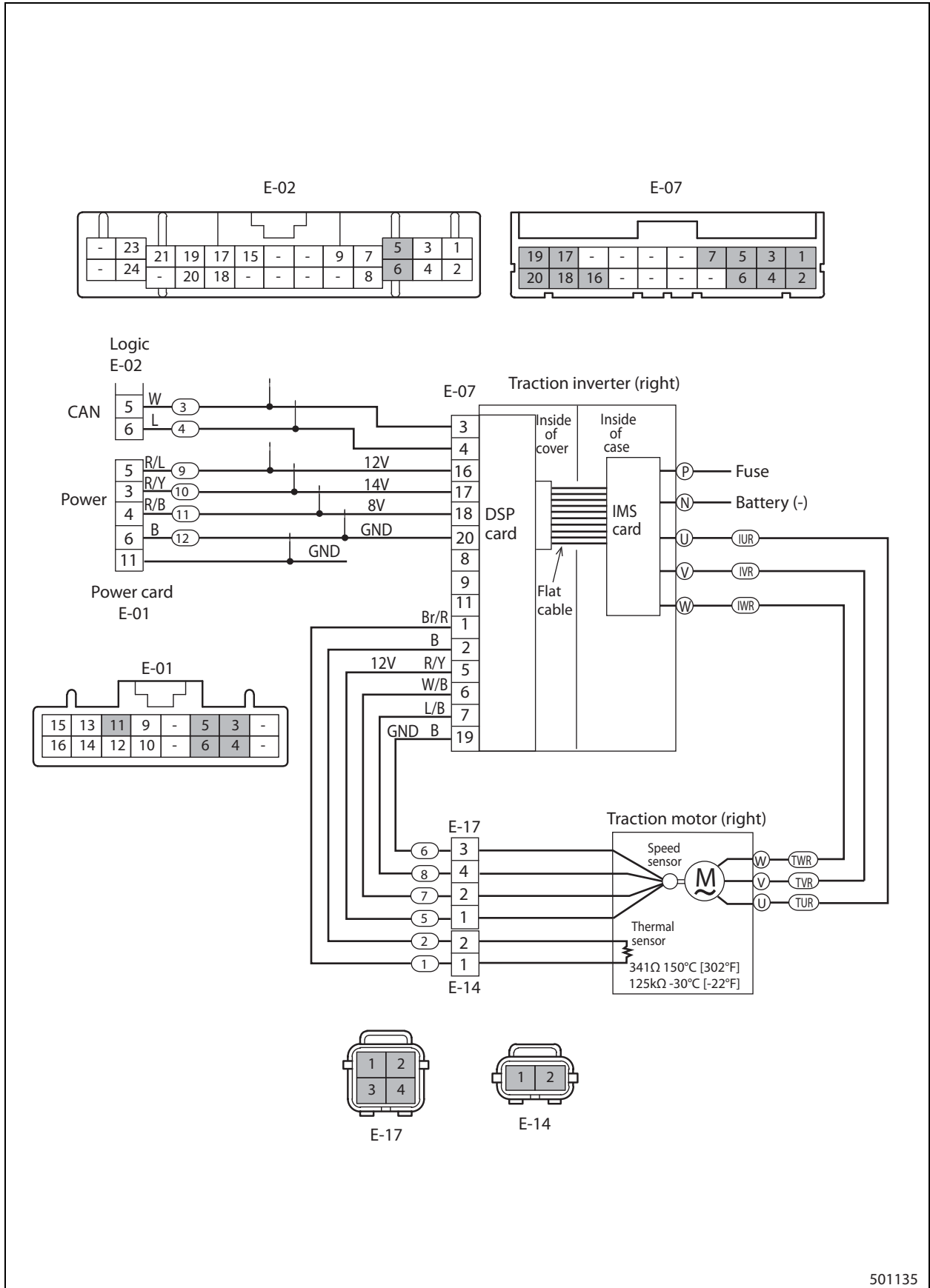
No.	Name	Stand-by voltage	Active voltage	Note
1	GND	0V	0V	
2	+VL	13.0 to 16.0V	13.0 to 16.0V	
3	-			
4	RS-232 Tx	0 to 12V	0 to 12V	
5	RS-232 Rx	0 to 12V	0 to 12V	
6	RS-232 GND	0V	0V	
7	CAN H	0 to 5V	0 to 5V	
8	CAN L	0 to 5V	0 to 5V	
9	CAN R+	-	-	
10	CAN R	-	-	
11	BOOT MODE	-	-	
12	-			
13	-			
14	GND	0V	0V	
15	-	13.0 to 16.0V		
16	-			
17	-	13.0 to 16.0V	0V	
18	PI 4	0 to 15V	0V	FORWARD (ARMREST)
19	PI 5	0 to 15V	0V	NEUTRAL (ARMREST)
20	PI 6	0 to 15V	0V	REVERSE (ARMREST)
21	PI 7	0 to 15V	0V	ALS-SW (FC)
22	-			
23	+5V	5V	5V	
24	GND	0V	0V	
25	AI 1	2.3 to 2.7V	0.1 to 4.9V	LIFT JOYSTICK 1
26	AI 2	2.3 to 2.7V	0.1 to 4.9V	LIFT JOYSTICK 2
27	AI 3	2.3 to 2.7V	0.1 to 4.9V	TILT JOYSTICK 1
28	AI 4	2.3 to 2.7V	0.1 to 4.9V	TILT JOYSTICK 2
29	AI 5	2.3 to 2.7V	0.1 to 4.9V	ATTACH 1 JOYSTICK 1
30	AI 6	2.3 to 2.7V	0.1 to 4.9V	ATTACH 1 JOYSTICK 2
31	AI 7	2.3 to 2.7V	0.1 to 4.9V	ATTACH 2 JOYSTICK 1
32	AI 8	2.3 to 2.7V	0.1 to 4.9V	ATTACH 2 JOYSTICK 2

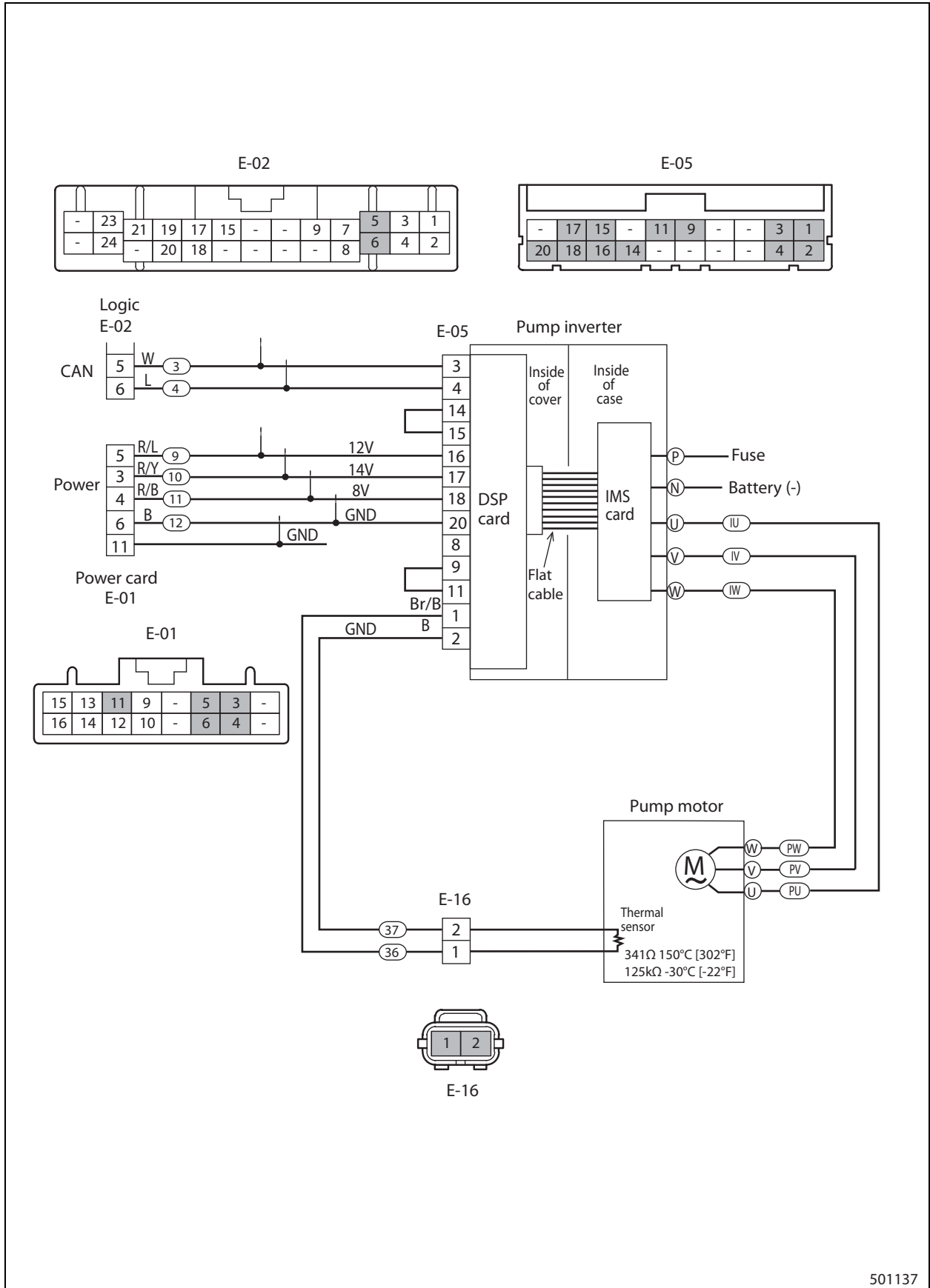
3.3 Pump Motor,Overheating(E2)

<b>Error code: E2</b>	
Situation	Controller/motor overheat indicator ON. Lifting speed slower than normal. Normal traction motor and power steering operations. Service tool "Alarm status" and "E2" displayed.
Possible cause	Overheating of pump motor, faulty pump motor or thermal sensor, faulty or open harness wiring, faulty pump motor inverter DSP card, abnormal power supply of logic unit, abnormal oil pressure of gear pump or hydraulic lines, 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







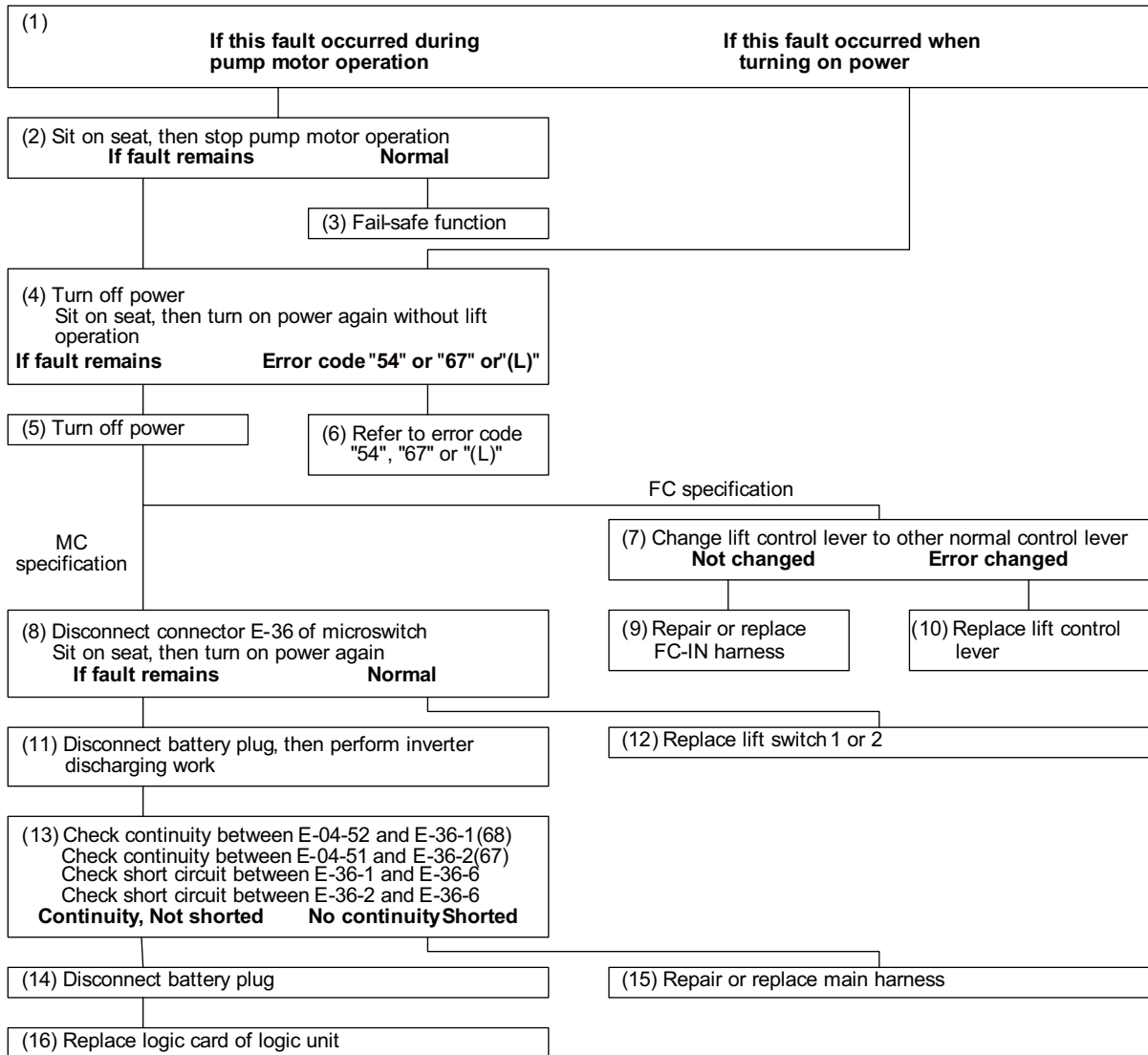
501137



3.31 Lift Lever, Faulty Setting (H1)

<b>Error code: H1</b>	
Situation	Display: "H1" or "Mast lock" icon. Pump motor operation inhibited.
Possible cause	Key switch turned ON while operating lift lever, faulty lift control lever or lift switches 1 and 2, faulty main harness, faulty logic unit, faulty input unit.
Trigger of the error code	Detects lift control lever signal of CAN when turning on power (FC specification). Detects lift microswitch 1 or 2 when turning on power (MC specification).

Checks

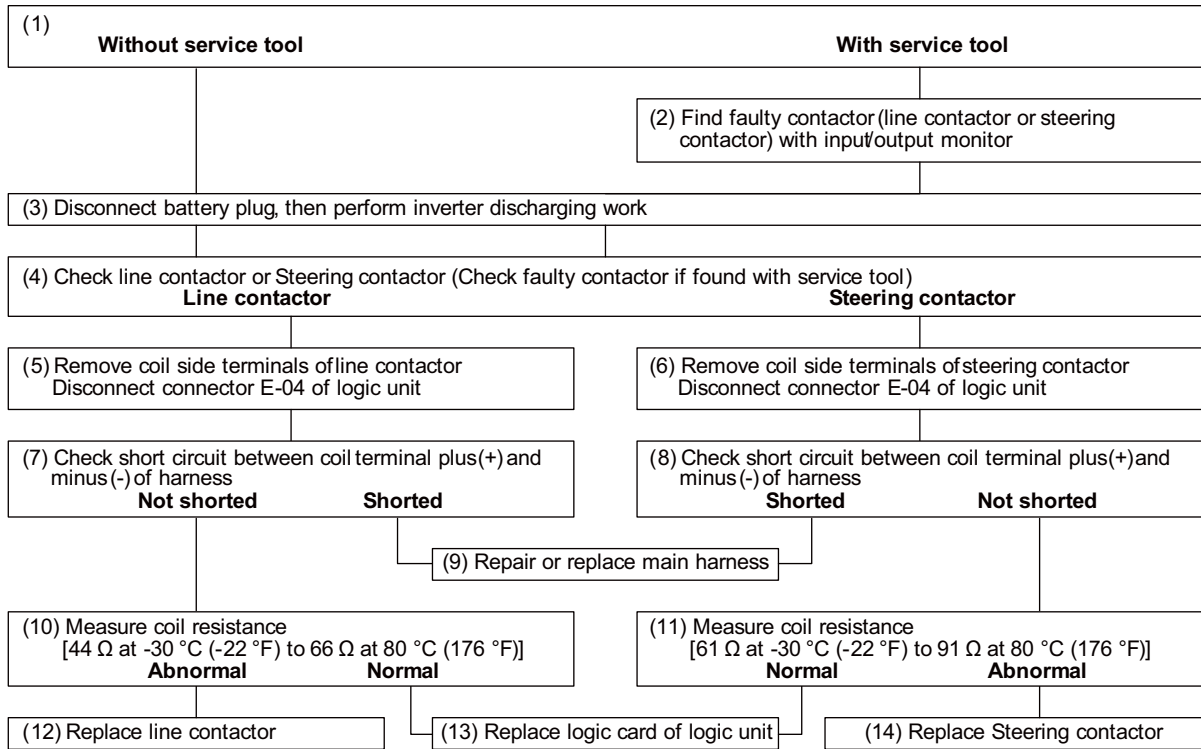




3.46 Contactor Coil Fault (72)

<b>Error code: 72</b>	
Situation	Display: "72". All operations inhibited except mast lowering operation. Line and steering contactor OPEN.
Possible cause	Faulty line contactor, faulty pump contactor, faulty main harness, faulty logic unit.
Trigger of the error code	By short circuit detection signal of logic card.

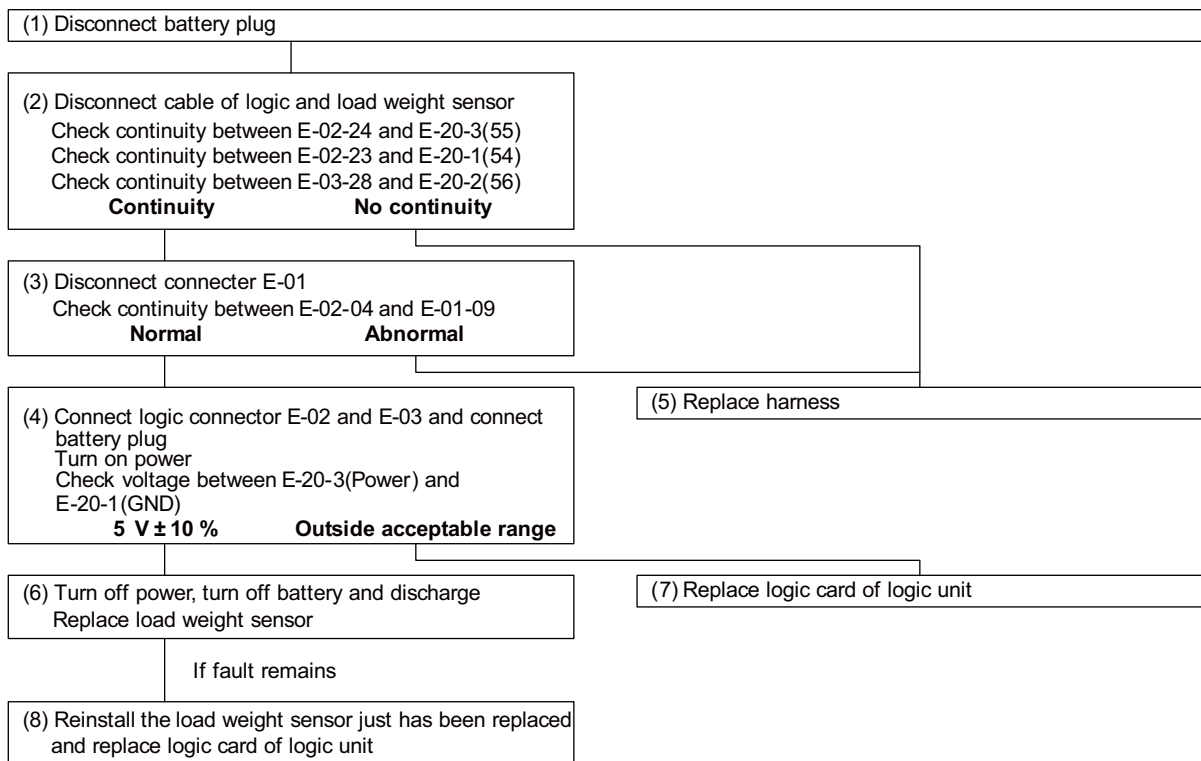
Checks



3.54 Load Sensor Fault (81)

<b>Error code: 81</b>	
Situation	Display: "81". Pitch control and tilt mechanism to secure horizontal operation are disabled. All other operations are available.
Possible cause	Load weight sensor fault, harness fault, logic unit fault
Trigger of the error code	Load weight sensor is more than 4.9 V, or less than 0.1 V.

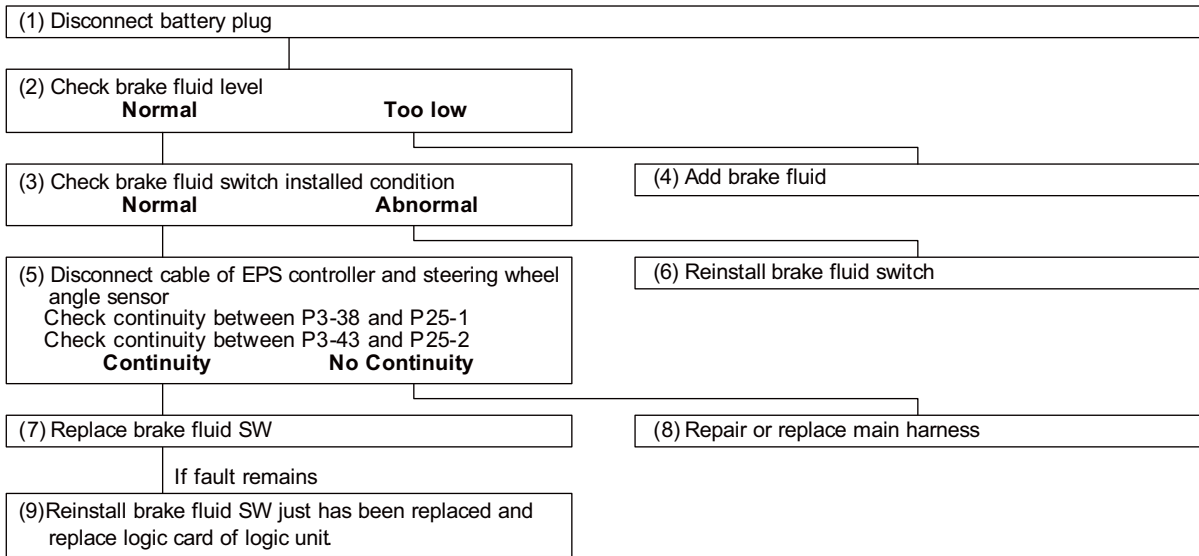
**Checks**



3.62 Brake Oil, Low Level

<b>Error code: None</b>	
Situation	Brake fluid icon displayed. All operations available.
Possible cause	Brake fluid switch fault, harness fault, power steering controller fault
Trigger of the error code	Brake fluid SW is ON.

Checks

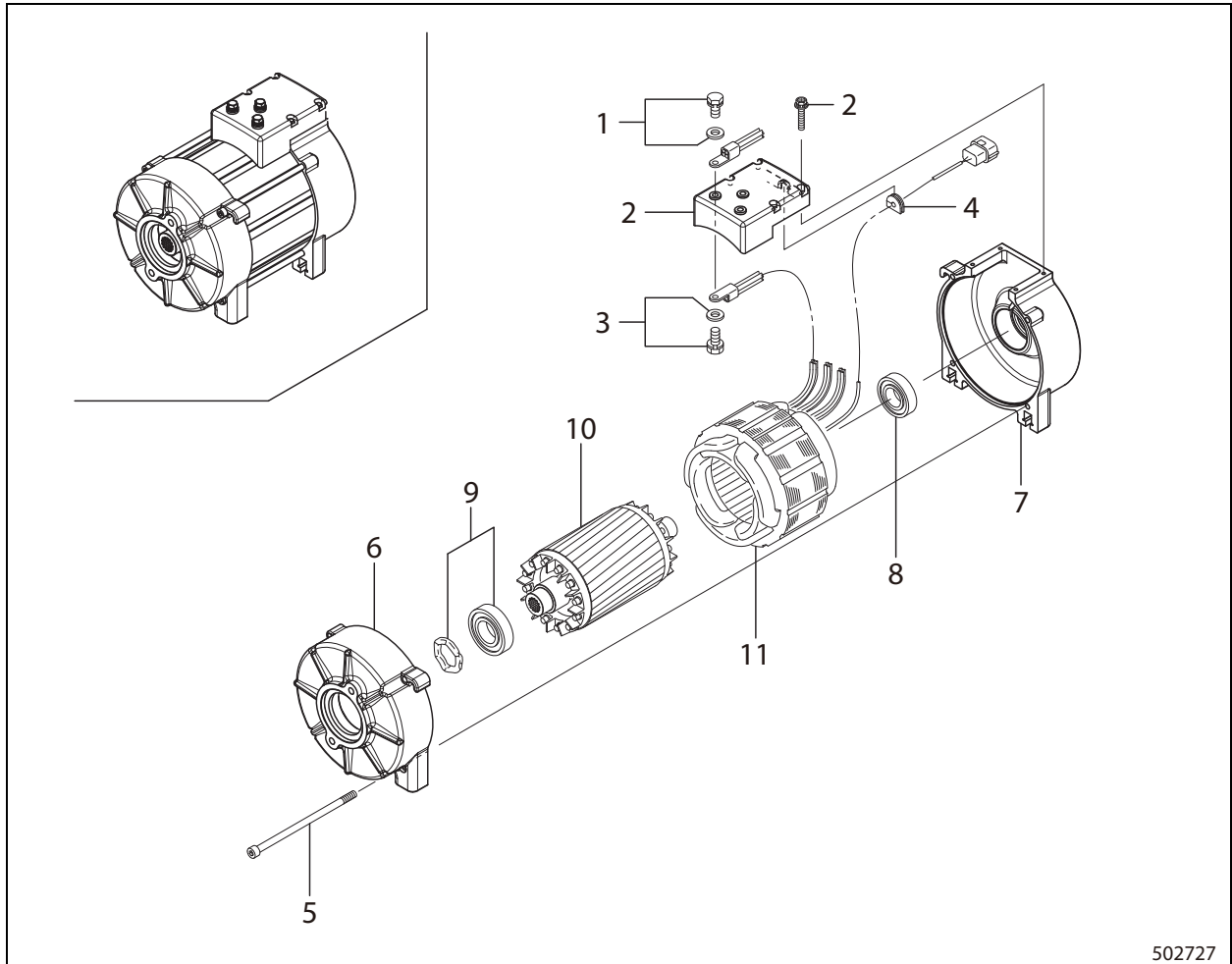


## 9. Disassembling Pump Motor

### ⚠ CAUTION

- Ball bearings at both ends are of maintenance free. If it is necessary to remove the bearings when repairing the motor, the bearings and seals must be replaced.
- If a bearing which is to be replaced has only one sealing lip, it should be greased with quality bearing grease when installing it.
- Replace the bearings and seals after approximately 10,000 operating hours.

### 9.1 Disassembly Sequence




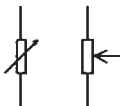
502727

- |                   |                                     |
|-------------------|-------------------------------------|
| 1. Bolt Washer    | 7. End cover                        |
| 2. Terminal, bolt | 8. Radial ball bearing              |
| 3. Bolt Washer    | 9. Wavy washer, Radial ball bearing |
| 4. Grommet        | 10. Rotor                           |
| 5. Cap screw      | 11. Stator                          |
| 6. End cover (D)  |                                     |



**CHAPTER 4 HOW TO READ CIRCUIT DIAGRAMS**


(3) Standard passive parts

SYMBOL	NAME
	RESISTOR




SYMBOL	NAME
	VALIABLE RESISTOR



(4) Semiconductors and electronic tubes

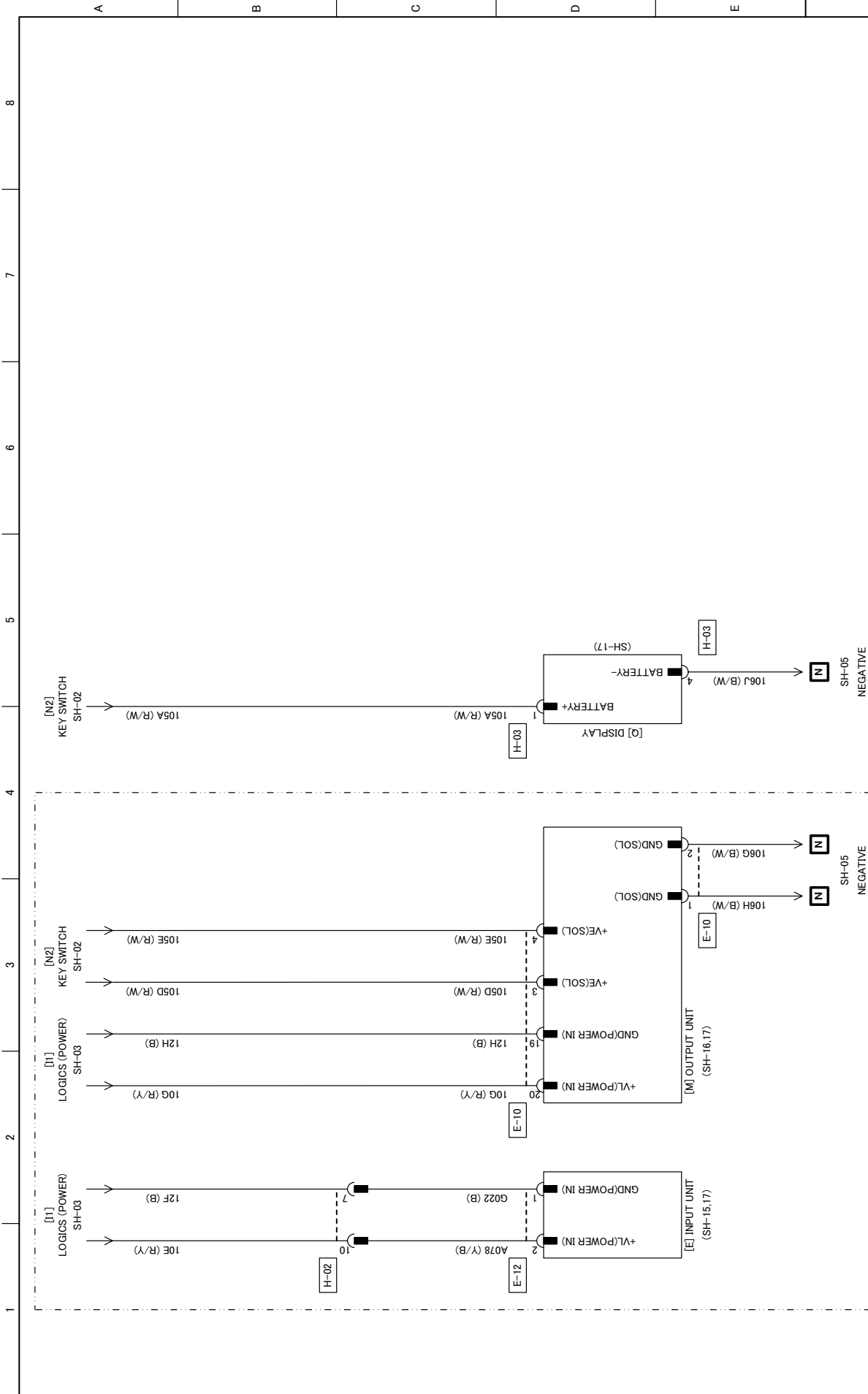
SYMBOL	NAME
	DIODE
	LED

SYMBOL	NAME
	AUTO LIGHT SENSOR (PHOTO DIODE)

(5) Generation and conversion of electric energy

SYMBOL	NAME
	GENERATOR
	THREE-PHASE INDUCTION MOTOR
	DC MOTOR

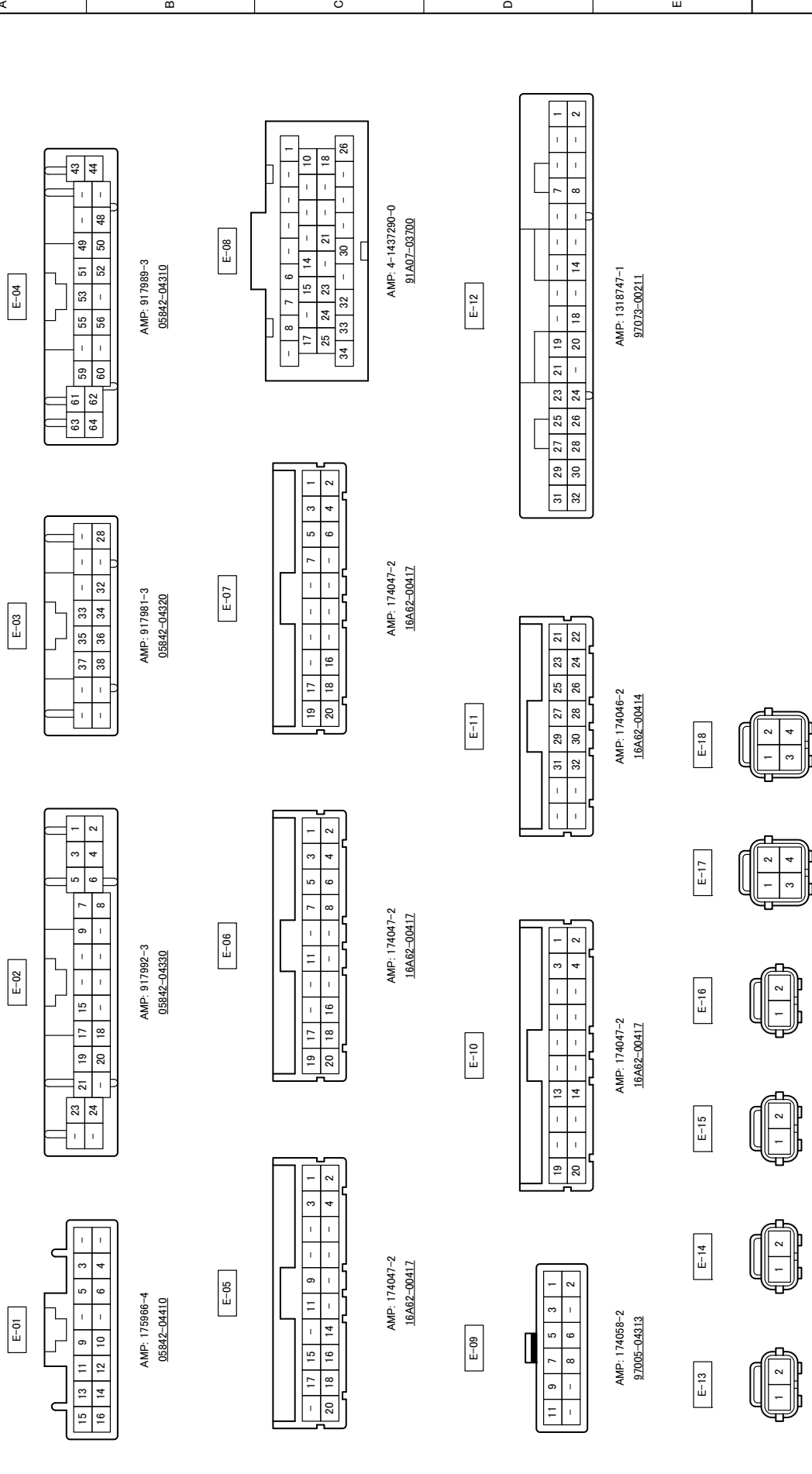
SYMBOL	NAME
	STEPPING MOTOR
	BATTERY



TRUCK	FBI3PNT - FB20PNT (MGFE)	SH
CIRCUIT NAME		
CONTROL POWER SUPPLY		
MITSUBISHI HEAVY INDUSTRIES, LTD.		
CHG	DATE	ALTERATIONS

NOTE (1). THIS CIRCUIT IS FOR EC.

**GROUP E**



TRUCK	FBI3PNT - FB20PNT (MGFE)	SH
		20
<b>CONNECTOR</b>		
<b>MITSUBISHI HEAVY INDUSTRIES, LTD.</b>		
CHG	DATE	ALTERATIONS

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## **Chapter 2 TROUBLESHOOTING FOR CONTROL CIRCUITS**

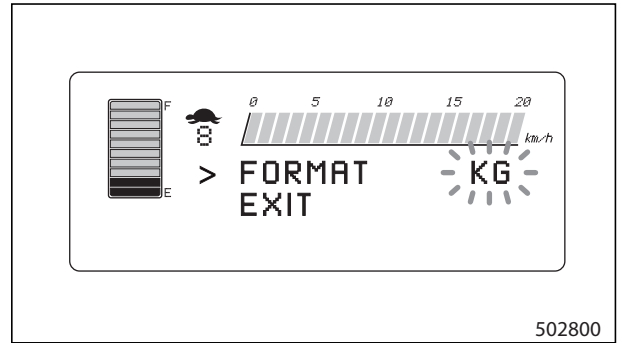
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3.2	Traction Motor L.H.,Overheating (E1) .....	2-8
3.3	Pump Motor, Overheating (E2) .....	2-12
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### 3.3 Load meter (option)

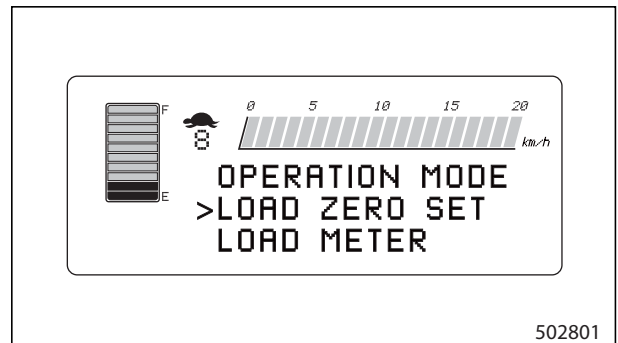
**Function**

This calculates the live load from the pressure sensor input. Zero point can be adjusted by the display. The user can select either "KG" or "LBS" from the display.



**Setting (Zero-setting)**

- (1) Turn ON the key switch.
- (2) Remove the load from the lift truck.
- (3) Raise the mast slightly off the ground.
- (4) Display "LOAD METER ZERO SET" in the Adjustment menu on the display unit.



Note: The load meter indication is affected by the setting of SUO #44. (Mast Type)

**⚠ CAUTION**

The value of the load meter should be used as a reference only, as it is calculated from an oil pressure converted value. Do not use this value for calculation of the rated load for lift truck performance.

	Item	Description	SUO No.	Harness Pin No.
Conditional	Load meter function	Optional equipment	#48	-
	Load adjustment	Pressure sensor zero point adjustment	#55	-

### 5.4 Details of Setup Options (Group-3)

#### #40 Truck Type

This setting defines the type of lift truck.  
The setting value is 3-Wheel or 4-Wheel model.

### ⚠ CAUTION

If the lift truck type setting is incorrect, unexpected movement of the lift truck could occur.

#### #41 Battery Voltage

This setting defines the voltage of battery installed in the lift truck.  
The setting value is 36 or 48 [v].  
No setting shows "II II II II II."

#### #42 Battery Type

This setting defines the type of battery installed in the lift truck.

The setting value is 1, 2 or 3.

1: Normal 2: Tubular 3: Gel

Select an appropriate BDI table from the followings according to the battery type.

**Normal BDI**

BDI#	36V	48V
0	- 34.4	- 45.9
1	34.5 - 34.8	46.0 - 46.4
2	34.9 - 35.2	46.5 - 46.9
3	35.3 - 35.6	47.0 - 47.4
4	35.7 - 36.0	47.5 - 47.9
5	36.1 - 36.4	48.0 - 48.4
6	36.5 - 36.7	48.5 - 48.9
7	36.8 - 37.0	49.0 - 49.8
8	37.1 - 37.3	49.4 - 49.7
9	37.4 - 37.6	49.8 - 50.1
10	37.7 -	50.2 -

**Tubular BDI**

BDI#	36V	48V
0	- 35.2	- 46.9
1	35.3 - 35.5	47.0 - 47.3
2	35.6 - 35.8	47.4 - 47.7
3	35.9 - 36.1	47.8 - 48.1
4	36.2 - 36.4	48.2 - 48.5
5	36.5 - 36.7	48.6 - 48.9
6	36.8 - 37.0	49.0 - 49.2
7	37.1 - 37.2	49.3 - 49.5
8	37.3 - 37.4	49.6 - 49.8
9	37.5 - 37.6	49.9 - 50.1
10	37.7 -	50.2 -

**Gel BDI**

BDI#	36V	48V
0	- 32.9	- 43.8
1	33.0 - 33.5	43.9 - 44.7
2	33.6 - 34.0	44.8 - 45.4
3	34.1 - 34.5	45.5 - 46.1
4	34.6 - 35.0	46.2 - 46.7
5	35.1 - 35.5	46.8 - 47.3
6	35.6 - 35.9	47.4 - 47.8
7	36.0 - 36.2	47.9 - 48.3
8	36.3 - 36.5	48.4 - 48.7
9	36.6 - 36.7	48.8 - 48.9
10	36.8 -	49.0 -

Code	Fault	Error condition	Display						Fault history record	Steering operation	Lift lowering	Restriction	To return to normal
			I CON										
			Battery	Brake fluid	Overheat	Mast interlock	Driving interlock	Exclamation					
76	PDS Buzzer Fault	PDS buzzer short-circuit protection is activated.					*	*	○	○	(Only error display and buzzer stoppage)	Turn key OFF	
78	Battery Voltage Too Low	Battery voltage is less than the value below after 120 m sec from the time the power is applied. Battery voltage 36 V model: Error threshold: 30 V. Battery voltage 48 V model: Error threshold: 42 V.					*	*	×	○	Immediate stop	Turn key OFF	
79	Battery Voltage Too High	Battery voltage is less than the value below after 120 m sec from the time the power is applied. Battery voltage 36 V model: Error threshold: 42 V. Battery voltage 48 V model: Error threshold: 60 V.					*	*	×	○	Immediate stop	Turn key OFF	
80	Tilt Angle Sensor Fault	0.1 V or less or 4.9 V or more of sensor input voltage continues 400 ms or more.					*	*	○	○	(Tilt stop only when ALS SW is ON)	Turn key OFF	
81	Load Sensor Fault	When the lift truck is stopped, 0.1 V or less, or 4.9 V or more of load sensor input voltage continues 400 ms or more.					*	*	○	○	(Pitch control OFF)	Turn key OFF	
82	Handle Angle Sensor Fault	steering angle input cycle 1 and 2.					*	*	○	○	Driving power reduction	Turn key OFF	
		Steering angle input signal cycle 1 and 2 sensors error. Inconsistent 1 and 2 sensors.					*	*	×	○	Steering emergency stop	Turn key OFF	
96	PS PWM1 Fault	PS controller LIFE signal short-circuit protection is activated.					*	*	×	○	Steering emergency stop	Turn key OFF	
		PS controller LIFE signal short-circuit protection is activated.					*	*	×	○	Steering emergency stop	Turn key OFF	
-	High Battery Consumption	Battery voltage is low (25V or less)							○	○	Driving power reduction	Charge battery	
Lo	Battery Consumption Too Much	Battery voltage is low (22 V or less)	*				*	*	○	○	Normal stoppage	Turn key OFF	

## CHAPTER 1 CONTROLLER

### Logic card voltage chart

CN1

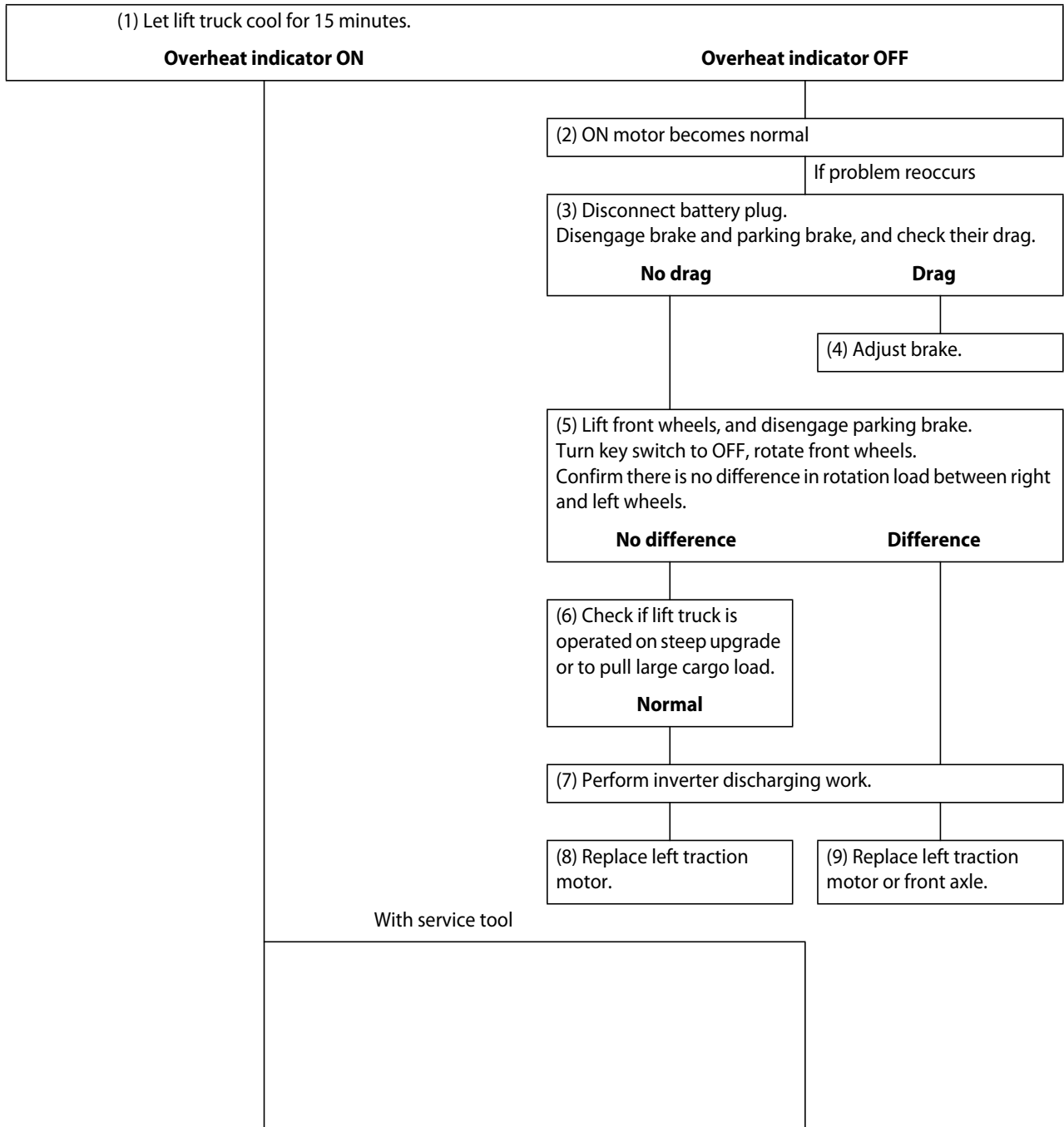
No.	Name	Note
1	GND-L	thick
2	+VL	thick
3	GND-L	thick
4	+5V-L	thick
5	CANH	thick
6	CANL	thick
7	BOOT	
8	FWE	
9	GND	
10		
11		
12		
13		
14		
15	KEY-OFF	
16		
17	GSE-TxD	
18	GSE-RxD	
19	POS VOLTAGE	
20	ACCEL ANGLE 1	
21	ACCEL ANGLE 2	
22		
23	GND	thick
24	+5V	thick
25	GND	thick
26	+5V	thick
27		
28	LIFT PRESSURE	
29	TILT ANGLE	
30	AUX SW3	
31		
32	SEAT BELT SW	
33	SEAT SW	
34	PARK BRAKE SW	
35	SERVICE BRAKE SW	
36	REVERSE SW	

No.	Name	Note
37	FORWARD SW	
38	BRAKE FLUID SW	
39		
40	AUX SW 1	
41	AUX SW 2	
42		
43	GND	thick
44	PDS BUZZER	thick
45	PROX. SENSOR	
46		
47		
48	ATTACH 2 SW	
49	ATTACH 1 SW	
50	TILT SW	
51	LIFT 2 SW	
52	LIFT 1 SW	
53	PS LIFE SIGNAL	
54	ALS SW (MC)	
55	INSPECTION MODE	
56	BATTERY SIDE WAY EXCHANGE IL	
57	BACK OUTPUT RELAY+	
58	BACK OUTPUT RELAY-	
59	LINE CONTACTOR CON	
60	PKB 1	
61	LIFT LOCK	thick
62	PKB 2	thick
63	CON VE	thick
64	STEERING CONTACTOR CON	thick

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

<b>Code: E1</b>	
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 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).

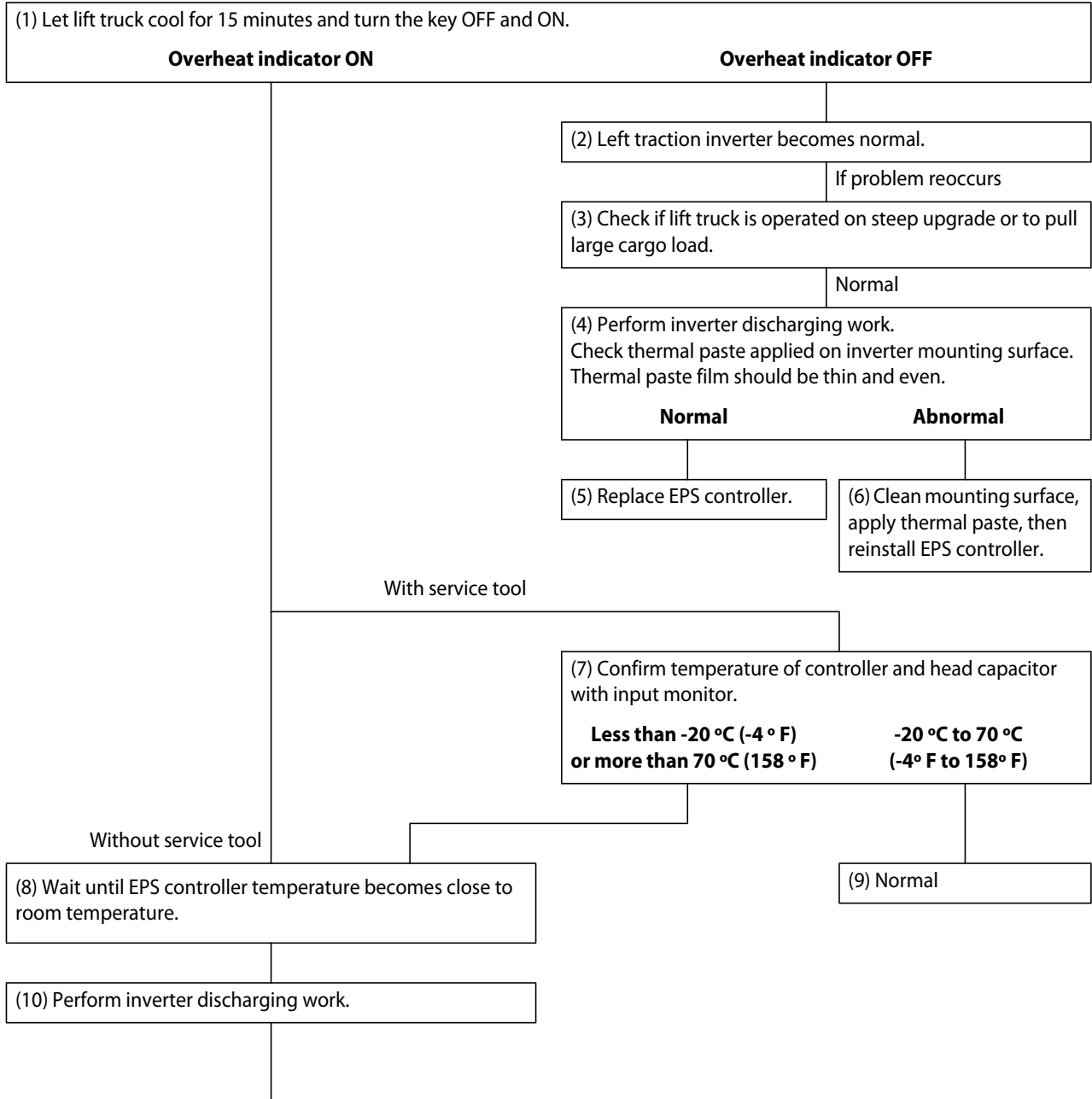
Checks



3.7 PS Controller, Overheating (E9)

<b>Code: E9</b>	
Situation	Controller/motor overheat indicator ON. Poor pulling power and acceleration. Normal pump motor. Service tool "Alarm status" and "E9" displayed.
Possible cause	Overheating of PS controller, faulty PS controller thermal sensor, open harness wiring, faulty PC board, abnormal power supply of logic unit, faulty radiation of left traction inverter, faulty display unit.
Trigger of the 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



(24) Replace the DSP card with the original card again then replace the traction inverter. Please keep the DSP card which is used for inspection at step (21) because the card is normal.

**If fault (25) remains**

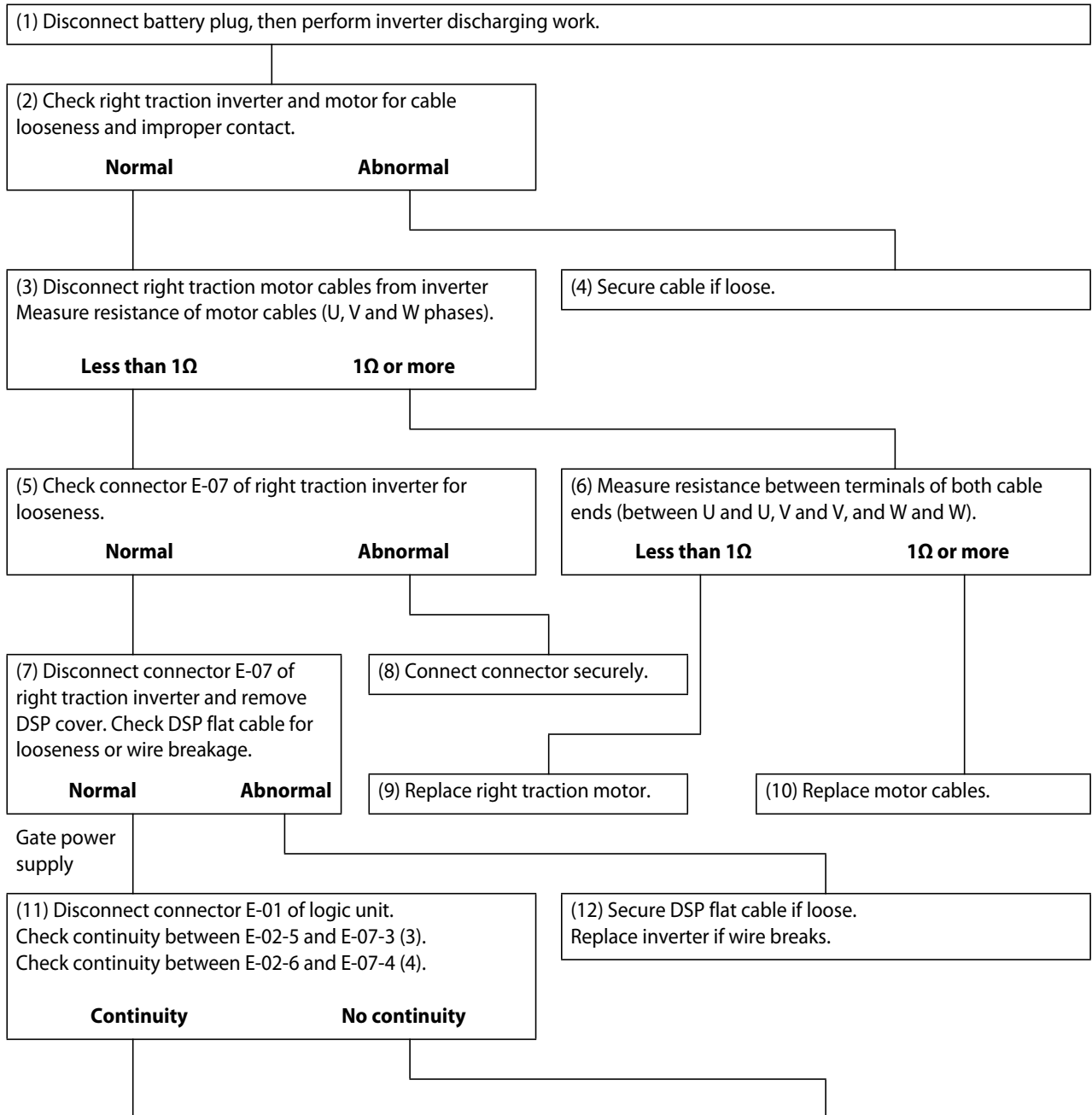
(25) Perform inverter discharging work.

(26) Replace the traction inverter assembly with the original inverter assembly again, then replace the traction motor. Please keep the inverter assembly which is used for inspection at step (24) because the assembly is normal.

3.18 Traction Motor R.H., Open (45)

<b>Code: 45</b>	
Situation	Display: "45". 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 or wire breakage of right side traction motor cable, faulty right side traction motor, faulty contact or wire breakage of right side traction inverter connector, faulty contact of DSP flat cable in right side traction inverter, wire breakage of main harness, faulty power supply card of logic unit, faulty DSP card of right side traction inverter, faulty right side traction inverter, 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**



**CHAPTER 2 TROUBLESHOOTING FOR CONTROL CIRCUITS**

(12) Reinstall accelerator pedal. then replace logic card of logic unit.

(13) Connect connector E-19 and E-02.  
Turn ON power and check voltage between E-19-3 (55) and E-19-5 (54).  
**5V** **Not 5V**

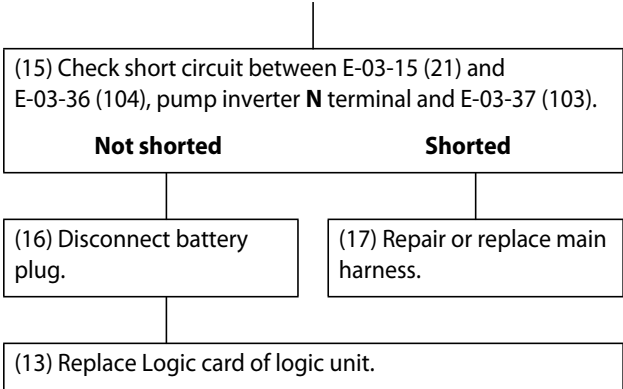
(14) Turn OFF power.  
Short-circuit E-19-3 (55) and E-19-6 (52), E-19-2 (53).  
Turn ON power and check accelerator voltage with service tool.  
**5V** **Not 5V**

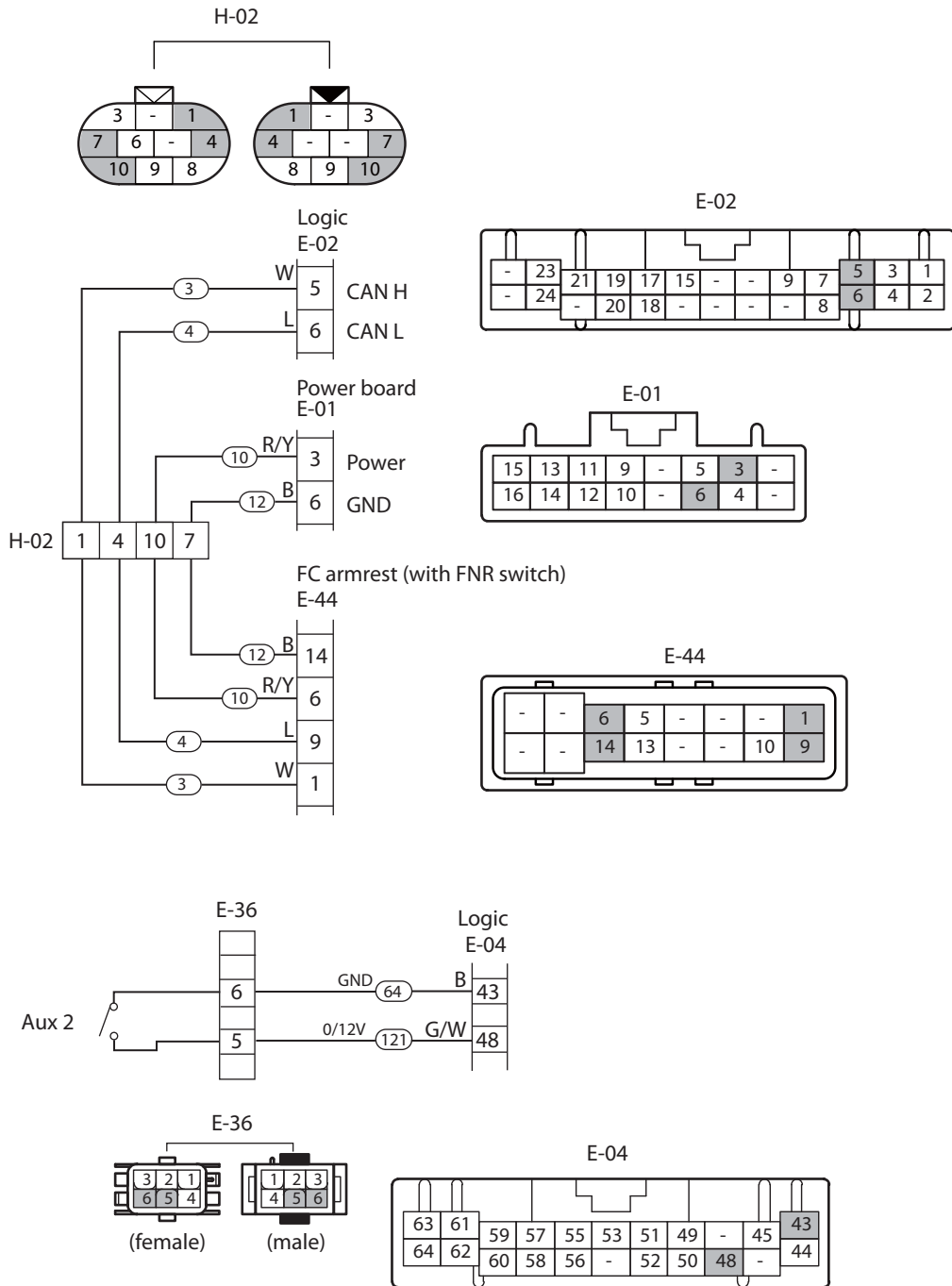
(15) Turn OFF power.  
Open E-19-3 (55) and E-19-6 (52), E-19-2.(53).  
Short-circuit E-19-5 (54) and E-19-6 (52), E-19-2 (53).  
Turn ON power and check accelerator voltage with service tool.  
**0V** **Not 0V**

(16) Replace accelerator pedal.

(17) Disconnect battery plug.

(18) Replace logic unit logic card.



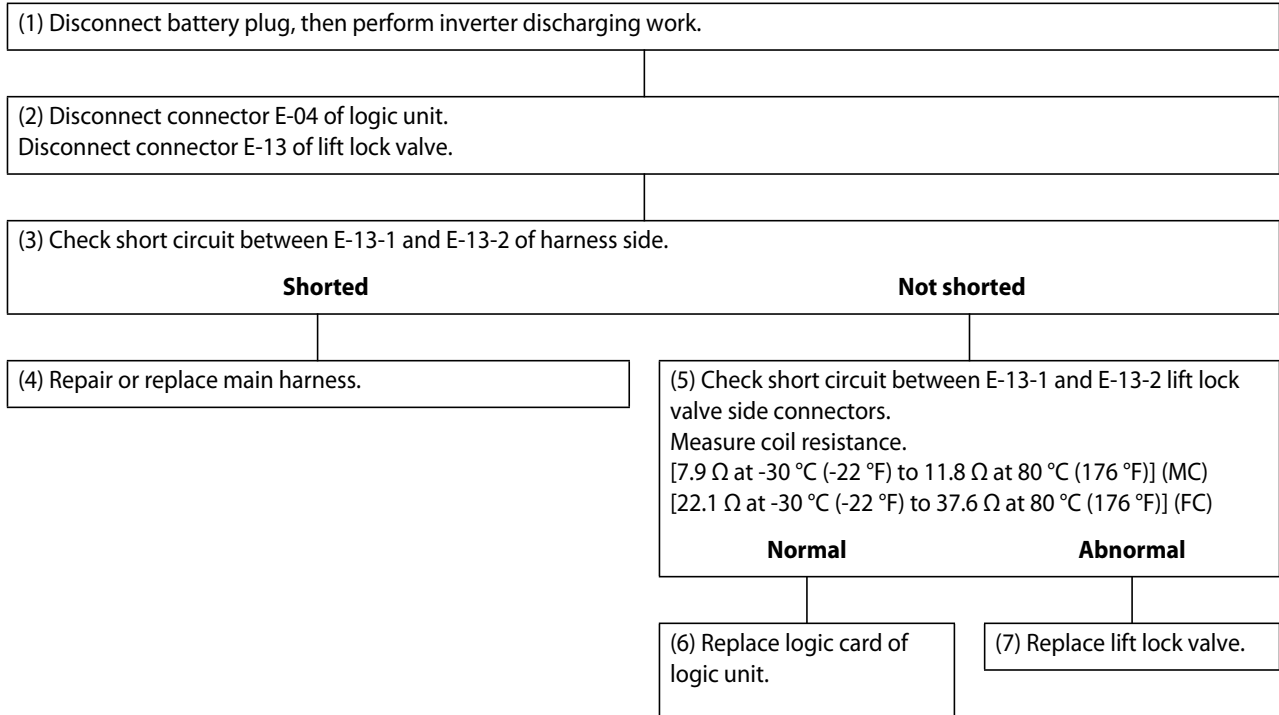




3.47 Hydraulic Lock Solenoid Fault (74)

<b>Code: 74</b>	
Situation	Display: "74". Pump motor operation inhibited. Normal traction motor operation and power steering operation.
Possible cause	Faulty lift lock valve, faulty main harness, faulty logic unit.
Trigger of the code	By short circuit detection signal of logic card.

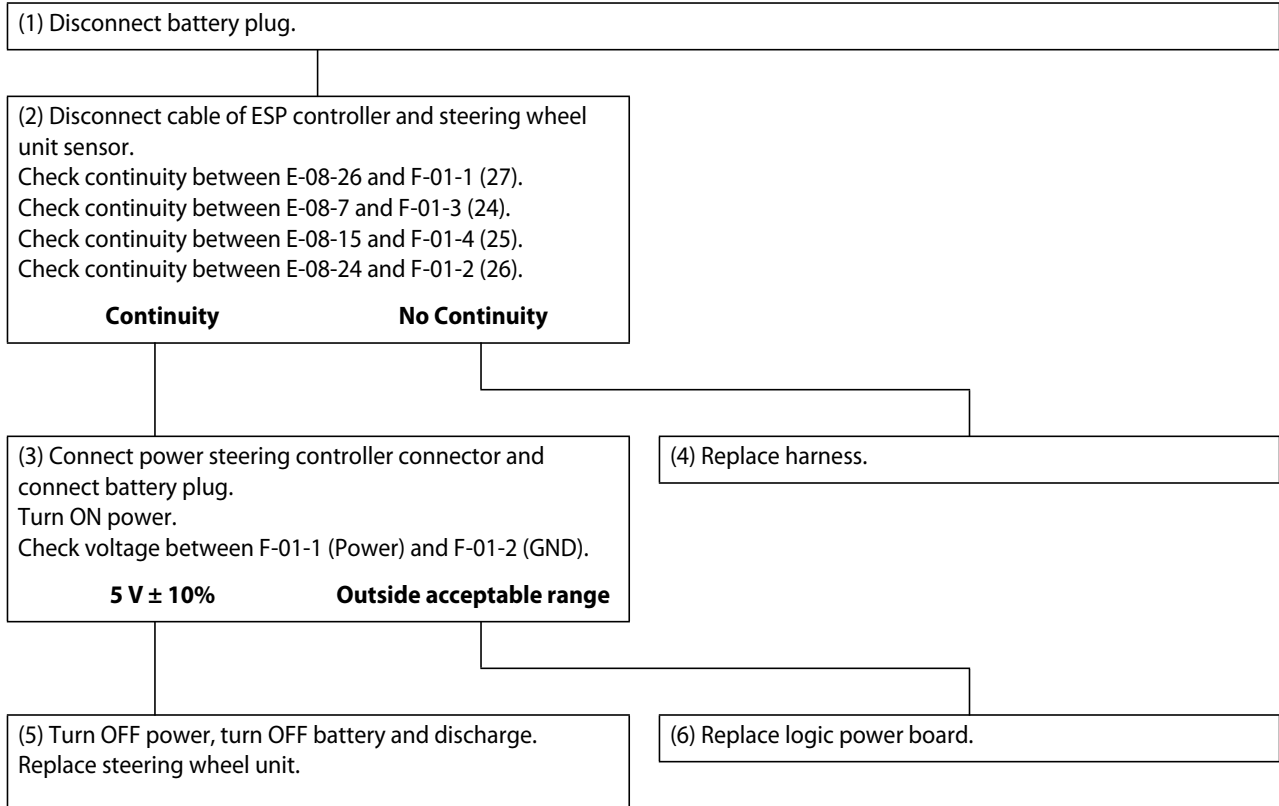
**Checks**



3.55 Handle Sensor Fault (82)

<b>Code: 82</b>	
Situation	Display: "82". All operations inhibited except mast lowering operation. Line and steering contactor OPEN. Or traveling speed limited to 5km/h.
Possible cause	Steering wheel unit fault, harness fault, power steering controller fault
Trigger of the code	One cycle of steering wheel angle input is not within the range between 4 to 6.67 ms. Steering wheel angle input difference between A and B phase is more than 8 degrees.

**Checks**



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