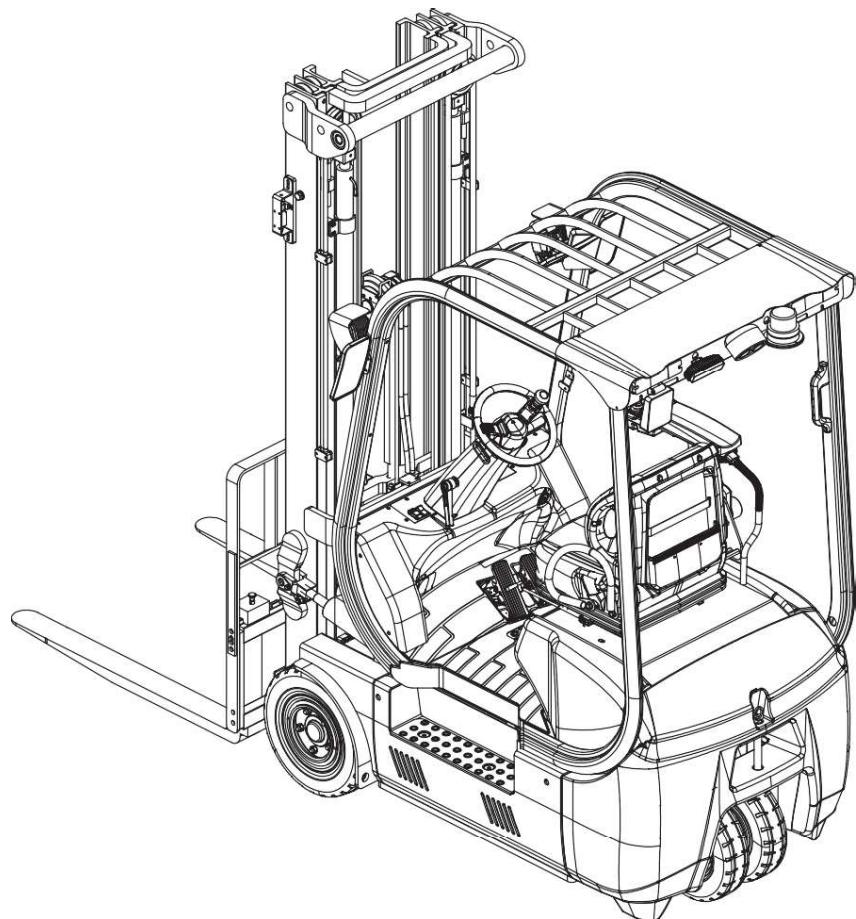


Service Manual

LVE40

Electric Forklift Truck



FOREWORD

This Service Manual can help readers learn more about the truck system components, maintenance, troubleshooting, and other related information. The operation and maintenance personnel must read this manual carefully before using the product. With the constant update and improvement of our products, the equipment you are using may be slightly different from what has been described in this manual; therefore, we must reserve the right to modify the appearance, configuration, and technical specifications. If you have any questions, please contact our sales department or dealer.

This manual applies to:

Release Date	Version No.	Changes (Serial number)
09/2023		
Model	Specifications	
LVE40	4000lb Capacity, Full Height Series, Three-wheel	

Safety Notices and Text Mark-Ups
Safety instructions and important explanations are indicated by the following graphics:

**DANGER**

Means that failure to comply can cause risk to life and/or major damage to property.

**WARNING**

Please strictly adhere to these safety instructions to avoid personal injury or damage to equipment or personal property.

**CAUTION**

Please pay attention to the important safety instructions.

**NOTE**

Pay attention to information that could be helpful.

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⚠ WARNING

- Do not operate this truck unless authorized and trained to do so and have read all warnings and instructions in this Operator's Manual and on this truck. Read, understand, and comply with the information on the truck's nameplate at all times.
- Do not operate this truck until you have performed the Daily Operator Checklist. Report any problems to the designated authority and do not use the truck until they are corrected by a qualified technician.
- If there is a fault code on the BDI/display, recycle the key and see if the code displays again. If the code displays again, do not operate the truck. Investigate the fault code and contact a service technician.
- This truck must not be modified without written manufacturer's consent.
- Operate truck only from designated operating position.
- Operate cautiously on ramps, slopes, and uneven floors. Travel slowly and do not angle or turn. This truck is not for use on mezzanines or balcony areas.
- Before operating, inspect the floor area it will be used on and be certain it will support the truck at full capacity and lift height. Identify and avoid holes, drop-offs, bumps, and obstructions.
- Keep hands, feet, and all body parts inside of the operator's compartment. Never place any part of your body into the mast structure or between the mast and the truck.
- Do not carry passengers.
- Before and during all truck operations ensure that adequate clearance is maintained from overhead obstructions and energized electrical conductors and parts.
- Operate tilting mechanism slowly and smoothly. Do not tilt forward when elevated except when picking up or depositing a load.
- Elevate forks only to pick up a load. Lift and lower with mast vertical or slightly tilted back, never forward. Watch for obstructions overhead.
- Ensure loads are centered and do not contact any obstructions in the truck's vicinity.
- Maintain a clear view of the ground while traveling and a safe distance from obstacles in the truck's path. Ensure personnel in the vicinity are aware of the truck's movement. Travel at a safe speed for the conditions the truck is operating in.
- Observe applicable traffic regulations. Yield right of way to pedestrians. Slow down and sound horn at cross aisles and wherever vision is obstructed. Avoid hazardous locations.
- When leaving the truck unattended, remove the key to prevent unauthorized use.
- Start, stop, travel, steer, and brake smoothly. Slow down for turns and on uneven or slippery surfaces that could cause the truck to slide or overturn. Use special care when traveling without a load as the risk of overturning can be greater.
- Travel with lifting mechanism as low as possible and tilted back. Always look in the direction of travel. Keep a clear view. When the load interferes with visibility, travel with the load trailing.
- Do not handle loads that are taller than the load backrest unless secured to prevent falling.
- Do not expose truck or battery to water as there is no ingress protection.

INFORMATION & SPECIFICATIONS



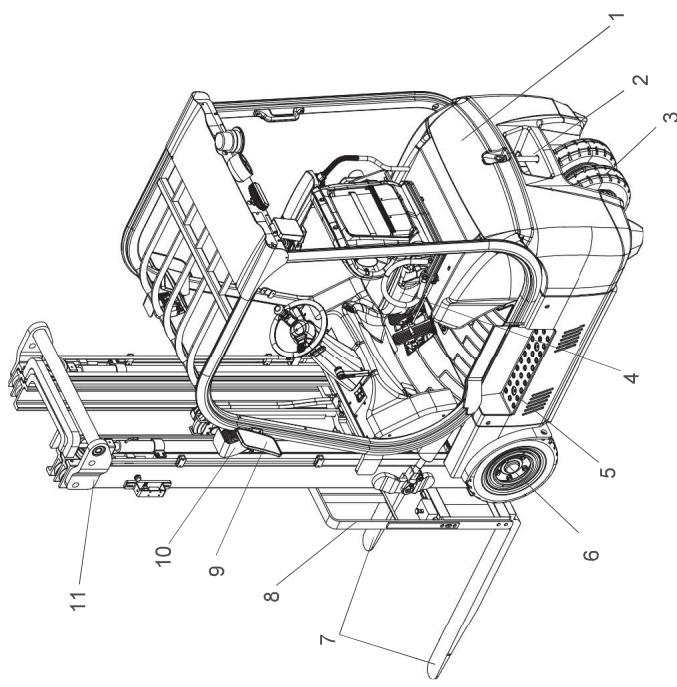
INFORMATION & SPECIFICATIONS

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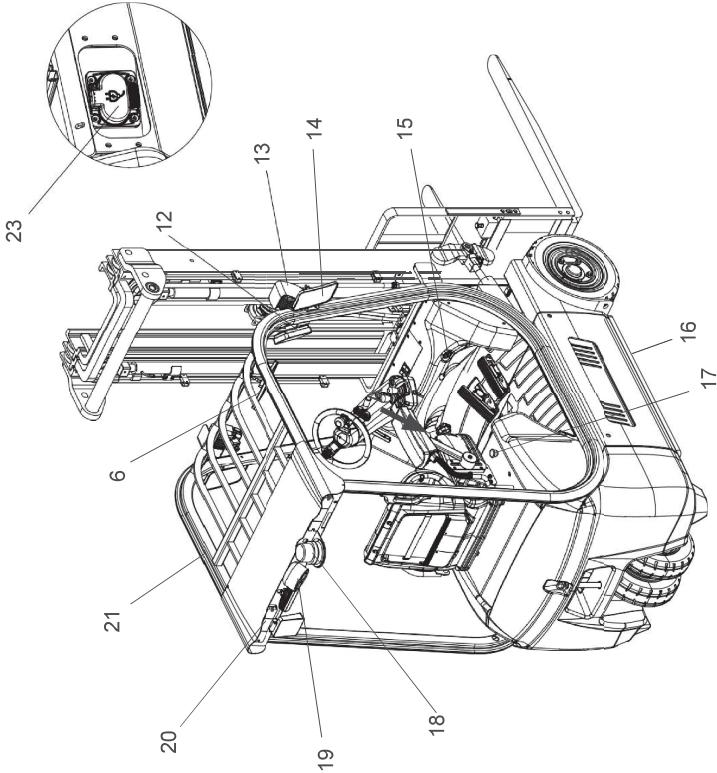
INFORMATION & SPECIFICATIONS

1.1 Introduction



1	Counterweight
2	Towing pin
3	Steer wheels
4	Seat
5	Safety step
6	Drive wheels
7	Forks
8	Load backrest
9	Rearview mirror
10	Headlight
11	Mast

4



12	Display
13	Headlight
14	Rearview mirror
15	Power output port
16	Chassis
17	Emergency stop switch
18	Caution light
19	Blue light (optional)
20	Rear combination lights
21	Overhead guard
22	Rearview mirror
23	Charging port

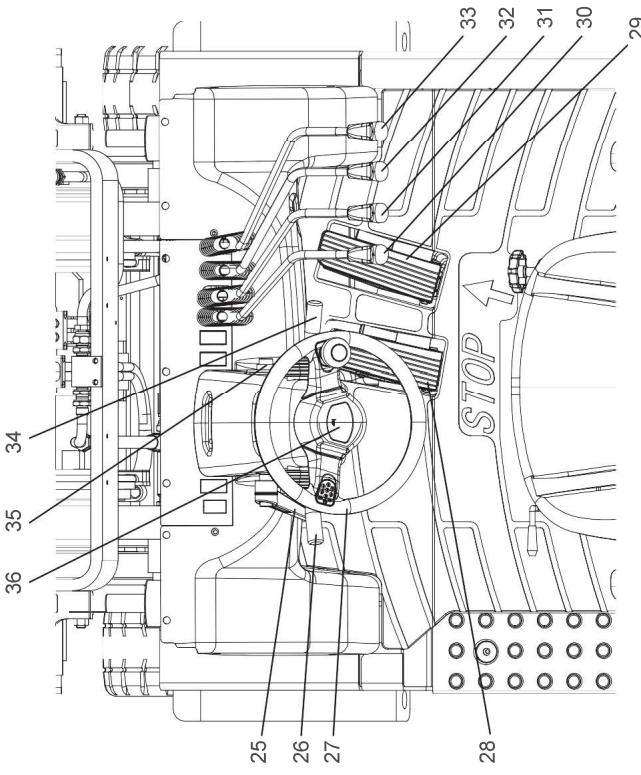
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INFORMATION & SPECIFICATIONS

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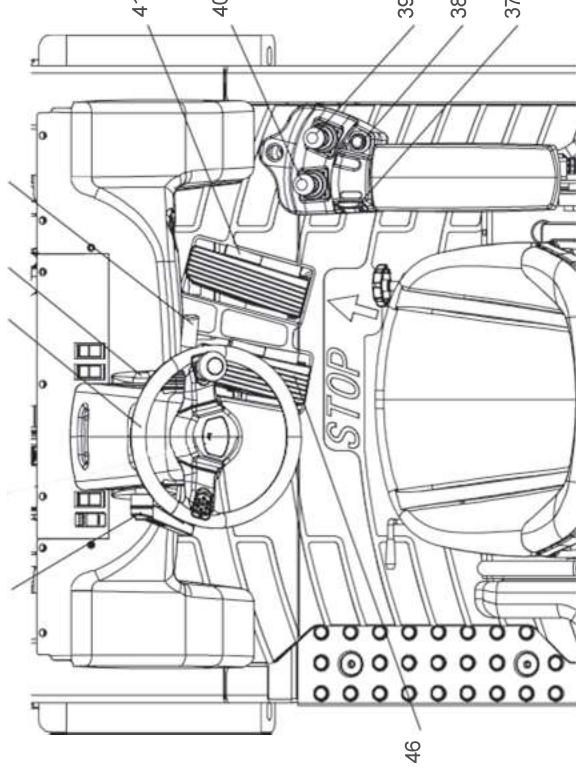
1.2 Display and Controls

Mechanical Valve



Electromagnetic Valve

45



25	Steering Column Tilting Angle Adjuster	31	Tilting Lever
26	Travel Combination Direction Selector	32	Side Shifter Lever
27	Steering Wheel	33	Attachment Lever
28	Brake Pedal	34	Combination Light Switch
29	Accelerator Pedal	35	Key Switch
30	Lifting Lever	36	Horn Button

37	Forward And Backward Button	42	Combination Light Switch
38	Horn Button	43	Key Switch
39	Attachment/Side Lever	44	Steering Wheel
40	Lifting/Lowering/Tilting Lever	45	Steering Column Tilt Lever
41	Accelerator Pedal	46	Brake Pedal

INFORMATION & SPECIFICATIONS

INFORMATION & SPECIFICATIONS



- WARNING**
- Refer to the nameplate for rated load capacity of the vehicle.
 - Do not use truck on a mezzanine or balcony area.



- WARNING**
- Truck can only be operated by single operator; other personnel are forbidden from riding.

1.3 Common Tools

No.	Name	Notes
1	Hex Head Socket Wrench	8#-27# One Set
2	Phillips Screwdriver	2# One Piece
3	Slotted Screwdriver	2# One Piece
4	Sockets and Knobs	One Set
5	Circlip Pliers	One for holes and one for shaft
6	Hammer	One Piece
7	Spreader, Crane	One Pair
8	Cylinder Wrenches	For removal and installation of cylinders
9	Diagonal Pliers	One Piece
10	Cylinder Pliers	One Piece
11	Grease Gun	One Piece
12	Tiger Tooth Wrench	22#/27# One of Each

1.3 General Tightening Torques

- ⚠** Screws or bolts used on the truck are of 8.8 grade or higher performance level.
When conducting truck maintenance, refer to Table 1.4.1 and Table 1.4.2 to select the suitable screws or bolts for replacement.

Table 1.4.1 Screws/Bolts Performance Levels

Performance Level		Material	Specification (mm)
	5.8	5.8 grade Low carbon steel	M6 ~ M48
	8.8	8.8 grade Quenched and tempered medium carbon steel	M6 ~ M48
	10.9	10.9 grade Quenched and tempered medium carbon alloy steel	M6 ~ M48
	12.9	12.9 grade Quenched and tempered medium carbon alloy steel	M6 ~ M48



CAUTION

- The performance levels of screws or bolts are marked on the heads of the screws or bolts.
- If you find screws or bolts in use that are not marked with performance level, please select spare parts with performance level of at least 8.8 grade or higher level for replacement.

INFORMATION & SPECIFICATIONS

Table 14.2 Metric Screws/Bolts Tightening Torque Table (n·m)

Nominal Diameter (mm)	Performance Level				MAINTENANCE
	5.8	8.8	10.9	12.9	
M6	380	600	830	970	
M8	7~8	10~12	14~17	17~20	
M8x1	16~18	25~30	34~41	41~48	
M10	17~20	27~32	37~43	43~52	
M10	31~36	49~59	68~81	81~96	
M10x1	35~41	55~66	76~90	90~106	
M12	55~64	86~103	119~141	141~167	
M12x1.5	57~67	90~108	124~147	147~174	
M14	87~103	137~164	189~224	224~265	
M14x1.5	144~170	149~179	206~243	243~289	
M16	136~160	214~256	295~350	350~414	
M16x1.5	144~170	228~273	314~372	372~441	
M18	186~219	294~353	406~481	481~570	
M18x1.5	210~247	331~397	457~541	541~641	
M20	264~312	417~500	576~683	683~808	
M20x1.5	294~345	463~555	640~758	758~897	
M22	360~431	568~680	786~941	918~1099	
M22x1.5	395~473	624~747	803~1034	1009~1208	
M24	457~547	722~864	996~1195	1167~1397	
M24x2	497~595	785~940	1086~1300	1269~1520	
M27	669~801	1056~1264	1461~1749	1707~2044	
M27x2	723~865	1141~1366	1578~1890	1845~2208	
M30	908~1087	1437~1717	1984~2375	2318~2775	
M30x2	1005~1203	1587~1900	2196~2629	2566~3072	
M36	1587~1900	2506~3000	3466~4150	4051~48850	
M36x3	1680~2011	2653~3176	3670~4394	4289~5135	
M42	2538~3039	4088~4798	5544~6637	6479~7757	
M42x3	2731~3269	4312~5162	5965~7141	6921~8345	
M48	3813~4564	6020~7207	8327~9969	9732~11651	
M48x3	4152~4970	6556~7848	9069~10857	10598~12888	

NOTES:

2.1 Overview

Performing regular vehicle maintenance and repair can help to ensure the continuous and reliable use of the truck.
Only specially trained and qualified personnel should perform maintenance and repair operations on the truck.

NOTE

2
Under harsh working conditions: such as, the external temperature is too high or too low, dusty, or implementing multiple shifts per day, the maintenance and care interval should be shortened.

Prior to lubrications, replacement of filters or operating the hydraulic system, please clean the external parts carefully and use a clean container.

Only compliant lubricants can be used. See Table 2.2 Lubricants.

Working Conditions:

- Truck must be parked on the level ground reserved for maintenance (such area needs to be clean and with less dust), block the wheels with wooden wedges, disconnect the key switch and disconnect the battery connections.
- When lifting the truck, the lifting tools can only be installed on the fixed positions as specified.
- When jacking up the truck, appropriate tools, such as wedge blocks, wooden blocks, and so on, must be used to secure the truck to prevent the occurrence of accidental rolling or tipping over.

WARNING

When lifting load components or during operations under the cabin, sufficiently strong chains or safety device must be used to secure the truck.

CAUTION

It is strictly forbidden to make modifications to the truck without written permission from the manufacturer, especially to the safety devices. It is strictly forbidden to change the working speeds of the truck.

2.2 Maintenance

Regular inspection and maintenance intervals under harsh conditions of use should be shortened by half.

Conditions Such As:

- Dusty environment
- Corrosive environment
- Cold storage environment
- Before starting to clean, all necessary security measures must be taken to prevent sparking (short circuit) during operation. Engage emergency stop switch
- When cleaning electrical and electronic components, use low pressure compressed dry air. Clean surface dust on components with non-conductive and antistatic brush.
- Do not use water to clean the equipment.

2.2.2 Inspection

Regular inspection and maintenance under normal conditions of use:

Operating Hours (h)	Requirements
50	At least once every 7 days
250	At least once every 60 days
500	At least once every 90 days
1000	At least once every 6 months
2000	At least once per year



CAUTION

After break-in phase (approximately 100 hours of operation), check the fastening of the wheel nuts and bolts and re-tighten them if necessary.

Table 2.1 Inspection & Maintenance List

Interval in days/months/years	7 d	60 d	90 d	6 m	1y
Interval in hours	50	250	500	1000	2000
Functions and Control					
Check the functions of the operation switches and display	A				
Check alarm system functions	A				
Check parking brake functions	A				
Check the emergency switch functions	A				
Check the steering wheel functions	A				
Check the cables for damage and if the terminals are secure	A				
Check the seat switch functions	A				
Check and tighten the controllers and contactors	A				
Check accelerator pedal functions	A				
Check fault information records and operating hours	A				
Power Supply & Drive System					
Check the battery cables for damage and replace if necessary		A			
Check the battery charger connector		A			
Check if the cable connections between battery monomers are secure, apply some grease to electrodes if necessary		A			
Check battery temperature		A			
Check and tighten motor mounting bolts		A			
Check the connections of motor connectors		A			

A = Check / Adjust

Please refer to Inspection & Maintenance List for regular inspection and maintenance of the vehicles.

L = Lubrication

Under harsh conditions, the lubrication intervals should be shortened by half.

MAINTENANCE

MAINTENANCE

Table 2.1 Inspection & Maintenance List (Continued)

Interval in days/months/years	7 d	60 d	90 d	6 m	1y	
Interval in hours	50	250	500	1000	2000	
Power Supply & Drive System						
Check the position of various bearings for noise			A			
Replace the gear oil				A		
Replace once every 1000 hours						
Check the gearbox for abnormal noise or leaks				A		
Check the drive wheel and steer wheel for wear or damage	A					
Check and lubricate the wheel bearings				A / L		
Check the travel speed					A	
Frame and Installation						
Mast and tilt cylinders, check fasteners.			A			
Check the counterweight, motors, chassis, speed reduction gearbox, overhead guard, and steering axle fasteners.			A			
Check and lubricate the other pins and swivel points.			A			
Check the chassis for cracks or damages				A		
Operating Devices						
Check the joystick pad			A			
Check and lubricate the pedal mechanisms			A			
Check that the horn works			A			
Hydraulic System						
Check hydraulic system function	A					
Check if the hoses, pipes, and interfaces are fastened or sealed securely, and check for damage			A			
Check the pump motor connections				A		
Check and tighten pump motor mounting bolts				A		
Check to see if gear pump has abnormal sound			A			
Check the gear pump fixation and check for leaks			A			
Check the cylinders for leaks			A			
Check the cylinders for damages and check the fixation				A		
Check the oil tank fixation and check for leaks				A		
Check the hydraulic oil level			A			

Table 2.1 Inspection & Maintenance List (Continued)

Hydraulic System	Replace the hydraulic oil	Replace once every 2000 hours
Check and clean oil tank air filter		
Replace the oil tank air filter and filter		
Check the relief pressure		
Table 2.1 Inspection & Maintenance List (Continued)		
Interval in days/months/years	7 d	60 d
Interval in hours	50	250
Braking System	Check the braking functions	A
Check the brake fluid level		A
Test the release of emergency stop switch is normal	A	
Test parking brakes is normal	A	
Check the brake pump and piping connections for leaks		A
Check the release of brake pedal is normal		A
Check the braking distance of brake		A
Mast System		
Check the mast for damages		
Clean and lubricate the rolling surface of lift mast column with grease	A / L	
Check and lubricate mast rollers		A / L
Check the fixation of lift mast		A
Check the tubing on mast for connections and leaks		A
Check the side shifter functions	A	
Check and lubricate the chains		A / L
Check the lifting chains and chain guides for wear, adjust and grease		A
Check the fork carriages for wear and damage		A
Visual inspection of rollers, sliders, and stoppers		A
Check the lifting and lowering speed		A
Other		
Check if the signs are clear and complete		A
Check the chassis for cracks or damages		A

Table 2.1 Inspection & Maintenance List (Continued)

Interval in days/months/years	7 d	60 d	90 d	6 m	1y
Interval in hours	50	250	500	1000	2000
Other					
Check bolt and nut connections		A		A	
Check the seat fixation and adjustment functions					
Check the seat belt and functions	A			A	
Check the overhead guard and cabin					
Checking covering parts for damages				A	
Check if the optional features are functioning properly	A				

A = Check / Adjust

Please refer to Inspection & Maintenance List
for regular inspection and maintenance of the
vehicles.

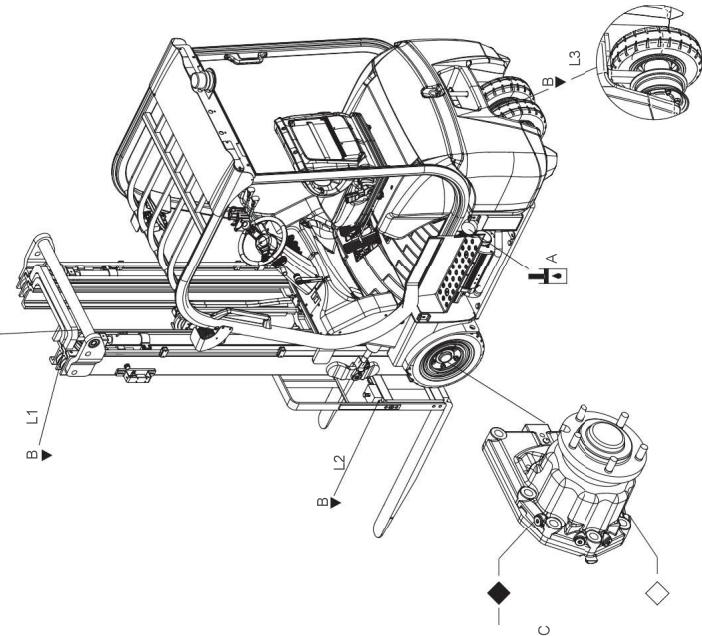
L = Lubrication

Under harsh conditions, the lubrication intervals
should be shortened by half.

Please see Table 2.2 for the lubricants used in
this truck.



CAUTION
The use and disposal of lubricants must be
carried out in strict accordance with the
manufacturer's regulations.



▼ Contact surface



◆ Gear oil fill point



MAINTENANCE

Table 2.2 Lubricants

Code	Type	Specification	Amount	Position
A	Anti-wear hydraulic oil	AW32 Non-detergent hydraulic oil (Cleanliness grade 9, in compliance with NAS1638, ISO 32)	See Table 1	Hydraulic System
B	Multi-purpose grease	Polylub GA352P	Appropriate amount	Contact Surface (See Table 2)
C	Heavy duty gear oil	Mobil ATF220	0.35L (Align with oiling port)	Gearbox
D	SAE 30 or 40 Engine lubricating oil or chain spray.		Appropriate amount	Chain



WARNING
Avoid spilling when refilling lubricants. For chain lubrication, coat the lift guide wheel and the contact surfaces on the inner and outer sides of the mast with a layer of grease.

Table 1 Application Amount of Hydraulic Oil - 1

Mast Series	Lifting height (mm)	Amount (L)	
2-stage Mast	2000	15.3	L1 Steel channel, rollers
	2500	16.1	L2 Side shifter
	2700	16.4	L3 Steer wheel
	3000	16.9	
	3300	17.3	
	3500	17.7	
	3600	17.8	
	4000	18.5	
	4250	18.9	
	4500	19.3	

Table 2 Contact Surface Lubrication Table

Code	Position
L1	Steel channel, rollers
L2	Side shifter
L3	Steer wheel

3. TROUBLESHOOTING

NOTES:**3.1 Preparation Before Troubleshooting**

- Park the truck on level ground and block the wheels with wooden wedges.
- Fully lower the forks and press the emergency stop switch.
- Turn off the key switch.
- Open the cover and check the controller.

**CAUTION**

- Even if key switch is turned off, the controllers are still energized.
- Before checking or repairing the controllers, make sure the emergency switch is engaged.

3.1.1 Basic Battery Check

- Press the button to turn the display ON.
- Press the button on the battery cover, the display will be ON and display information about the battery. This means the battery BMS is not damaged. If an error code is displayed, refer to the error code list for the solution. If the display does not turn ON, the BMS or display may be the issue or the wiring harness may be loose.
- Measure DC voltage between Key and Batt+ pins on the REMA connector. The voltage should be approximately 48VDC. If the multimeter reads 0V, it indicates an open circuit.

Battery	Voltage	Status
48V	Greater than 80V Less than 80V	Normal Needs to be charged

TROUBLESHOOTING

TROUBLESHOOTING

3.2 Troubleshooting Solutions of Common Faults

Table 3.1 lists the common faults that may occur and handling methods. Mainly consists of the following items:

Table 3.1 Troubleshooting of Common Faults

Fault	Fault Symptom	Probable Causes	Troubleshooting
Power supply failure	1. Vehicle dead, no power	<ul style="list-style-type: none"> • Power supply failure • Fuse failure • Emergency stop switch or circuit failure • Key switch or circuit failure 	<ol style="list-style-type: none"> 1. Check the battery 2. Check the fuses 3. Check key switch and its circuit 4. Check emergency stop switch and its circuit
Travel Fault	2. The vehicle can travel at low speed, but cannot travel at high speed	<ul style="list-style-type: none"> • Parking brake switch and seat switch or its circuit connection failure • Gearbox failure • Travel switch or its circuit connection failure • Drive motor or its circuit connection failure • Controller failure 	<ol style="list-style-type: none"> 1. Forward and reverse moving failures of the vehicle, but other functions are normal 2. Controller failure 3. Check the travel switch and its connection circuit. 4. Check the drive motor and its connection circuit. 5. Replace the controller.
Travel Fault	3. Drive axle bearings noise or jammed	<ul style="list-style-type: none"> • Failures due to external factors: • Motor bearing blocked • Gearbox bearing blocked 	<ol style="list-style-type: none"> 1. Replace the bearings

Table 3.1 Troubleshooting of Common Faults

Fault	Fault Symptom	Probable Causes	Troubleshooting
Travel Fault	4. Abnormal tire wear, cracking or degumming	<ul style="list-style-type: none"> • Improper use 	<ol style="list-style-type: none"> 1. Replace the drive wheel 2. Replace the rear steering wheel.
Travel Fault	5. Drive wheel slipping or jumping	<ul style="list-style-type: none"> • Wear 	<ol style="list-style-type: none"> 1. Replace the drive wheel
Motor Fault	6. Vehicle sways while running	<ul style="list-style-type: none"> • Wheel lock nut loosening 	<ol style="list-style-type: none"> 1. Tighten the nuts
Motor Fault	7. Brake performance weakened or failure	<ul style="list-style-type: none"> • Insufficient brake fluid • Brake master pump blocked. • Brake pipeline leaks. 	<ol style="list-style-type: none"> 1. Add brake fluid 2. Replace the master pump. 3. Replace the brake pipeline.
Motor Fault	8. Motor does not rotate	<ul style="list-style-type: none"> • Cable U, V, or W is broken. • Loosen connections to cable U, V or W. • Stator coil open circuit. • Motor bearing damage. • Speed encoder or its circuit failure. 	<ol style="list-style-type: none"> 1. Replace the cable U, V, or W. 2. Tighten the nut. 3. Check the stator coil. 4. Replace the motor bearing. 5. Check the speed encoder, if necessary replace it.
Motor Fault	9. Motor is rotating in slow speed and reverse	<ul style="list-style-type: none"> • Cable connection error. 	<ol style="list-style-type: none"> 1. Remove the cables and re-install.
Motor Fault	10. Motor with abnormal noise or vibration	<ul style="list-style-type: none"> • Uneven clearance between stator and rotor. • Bearing failures. • Loosening fixing screws on motor housing. 	<ol style="list-style-type: none"> 1. Replace the drive motor or pump motor.
Motor Fault	11. Motor smoking or burning smell	<ul style="list-style-type: none"> • Stator winding short circuit, motor burnt. 	<ol style="list-style-type: none"> 1. Replace the drive motor or pump motor.
Motor Fault	12. Motor temperature too high, controller failure	<ul style="list-style-type: none"> • Stator winding short circuit. • Motor U, V and W terminals with surface. • Bearing failure, resulting in severe heating. • Motor cooling duct blockage with foreign material. • Overload. 	<ol style="list-style-type: none"> 1. Refer to the rated capacity marked on the nameplate.

* Carry out troubleshooting in the order listed in the table. It can help quickly identify and resolve problems.

* Carry out troubleshooting in the order listed in the table. It can help quickly identify and resolve problems.

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Table 3.1 Troubleshooting of Common Faults

Fault	Fault Symptom	Probable Causes	Troubleshooting
Motor Fault	6. On load, motor speed is turning slow	<ul style="list-style-type: none"> Insufficient voltage of battery. Overload. U, V, W terminals with abnormal voltage input. Speed encoder or its circuit failure. 	1. Turn truck on and check the battery voltage. 2. Refer to the rated capacity marked on the nameplate. 3. Check the battery output. 4. Replace the speed encoder or wiring harness.
	1. Gearbox Abnormal Noise	<ul style="list-style-type: none"> Supporting bearing wear. Gear wear, the gap is too big. Foreign objects in gear oil. 	1. Replace the gear box.
	2. Gearbox Oil Leaks	<ul style="list-style-type: none"> Oil seal wear or aged. 	
Gearbox Fault	3. Gearbox Stuck	<ul style="list-style-type: none"> Gear fastening screws or nuts loosening. Support bearing damage. Foreign objects in gear oil. 	
	1. Drive Axle Abnormal Noise	<ul style="list-style-type: none"> Supporting bearing wear. Gear wear, the gap is too big. Foreign objects in gear oil. 	1. Replace the bearing. 2. Replace the gear. 3. Replace the gear oil.
Drive Axle Fault	2. Drive Axle Oil Leaks	<ul style="list-style-type: none"> Oil seal wear or aged. 	1. Replace the oil seal.
	3. Drive Axle Stuck	<ul style="list-style-type: none"> Drive Axle fastening screws or nuts loosening. Support bearing damage. Foreign objects in gear oil. 	1. Tighten the screws or nuts. 2. Replace the support bearing. 3. Replace the gear oil.

* Carry out trouble shooting in the order listed in the table. It can help quickly identify and resolve problems.

Table 3.1 Troubleshooting of Common Faults

Fault	Fault Symptom	Probable Causes	Troubleshooting
	1. Pump motor does not work.	<ul style="list-style-type: none"> Parking brake switch and seat switch or its circuit connection failure. Pump motor or its circuit connection failure. Control switch or its circuit connection failure. Controller failure. 	1. Pump motor does not work: i. Check if parking brake switch and seat switch or its circuit connection is normal. ii. Check the pump motor and its connection circuit. iii. Check the control button and its connection circuit. iv. Replace the controller.
	2. Pump motor works:	<ul style="list-style-type: none"> Overloaded. Insufficient hydraulic oil. Hydraulic pipeline leakage. Pump motor reverse rotation. Cylinder failure (blocked). Solenoid valve blocked and cannot reset. Valve body failure. Excessive wear of gear pump, serious internal leaks, insufficient pressure of relief valve or blocked, check valve blocked. 	2. Pump motor works: i. Refer to the rated capacity marked on the nameplate. ii. Lower the mast to the bottom, check if the amount of oil in the oil tank can meet the requirements. iii. Check the pipe and hydraulic components for oil leaks. iv. Check the pump motor wiring. v. Check the cylinder for damage or deformation, remove the cylinder to check for wear or aged seals inside. vi. Wash or replace the solenoid spool. vii. Wash or replace the valve body.
	1. The vehicle cannot lift	Hydraulic Failure	1. Check the lowering button and its connection circuit. 2. Check the solenoid valve and its connection circuit. 3. Check the cylinder for deformation, remove the cylinder to check if the internal assembly is normal. 4. Clean or replace the valve. 5. Replace the explosion-proof valve.

* Carry out trouble shooting in the order listed in the table. It can help quickly identify and resolve problems.

TROUBLESHOOTING

TROUBLESHOOTING

Table 3.1 Troubleshooting of Common Faults

Fault	Fault Symptom	Probable Causes	Troubleshooting
Hydraulic Failure	3. Noisy pump	<ul style="list-style-type: none"> Insufficient oil. High viscosity of oil. Oil suction pipe air leak. Filters clogged by impurities. Hydraulic oil with foam. 	1. Check the hydraulic oil level. 2. Replace the hydraulic oil. 3. Check the oil suction pipe. 4. Clean the oil inlet piping, replace the filter, if necessary. 5. See Fault 2.
	4. Hydraulic oil with foam	<ul style="list-style-type: none"> Pump cavitation. There is water in the oil. 	1. Check the amount of oil. 2. Check if the viscosity of hydraulic oil is normal. 3. Check the oil inlet piping for air leaks. 4. Discharge and clean and replace with new hydraulic oil.
	5. Pump or oil temperature is too high	<ul style="list-style-type: none"> Oil is too thin. Pump cavitation. Valve body internal relief. 	1. Discharge and clean and add new hydraulic oil. 2. Check the oil inlet piping for air leaks. 3. Replace the valve body.
	6. Low System Pressure	<ul style="list-style-type: none"> Insufficient oil. Relief valve failure. Pump wear, internal leakage. 	1. Check the hydraulic oil level. 2. See Fault 6. 3. Replace the gear pump.
	7. On load, declined	<ul style="list-style-type: none"> Solenoid valve failure. 	1. Check and clean the solenoid valve spool. 2. Check the multi-way manual valve and its installation.
	8. Relief valve pressure unstable or too low	<ul style="list-style-type: none"> Pressure adjustment screw too loose. Relief valve spring breakage or deformation. Relief valve spool wear or blocked. 	1. Adjust to proper pressure through hydraulic pressure gauge. 2. Replace the relief valve. 3. Clean or replace the relief valve.

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Table 3.1 Troubleshooting of Common Faults (continued)

Fault	Fault Symptom	Probable Causes	Troubleshooting
Lift Failure	1. Slow Lifting of Vehicle	<ul style="list-style-type: none"> Overload Hydraulic pipeline leakage Valve failure; Gear pump wear, internal leakage occurs Insufficient relief valve pressure or blocked 	1. Refer to the rated capacity marked on the nameplate. 2. Check the pipe and hydraulic components for oil leaks. 3. Wash or replace the valve body
	2. Slow Lowering of Vehicle	<ul style="list-style-type: none"> Solenoid valve blocking Valve body failure; throttle valve failure or blocked 	1. Wash or replace the solenoid pool 2. Wash or replace the valve body
	3. Unstable Lifting / Lowering of Vehicle	<ul style="list-style-type: none"> Chain loosening. Poor lubrication between steel channel and rollers. Improper adjustment of rollers or blocked. 	1. Adjust the chain tension. 2. Check if the steel channel grease is normal, clean and relubricate steel channel and rollers. 3. Adjust the side roller spacing through roller screw, or replace the roller.
Manual Valve Fault		<ul style="list-style-type: none"> Valve seat blocked by large impurities. External leakage: Sealing damaged. i. poor threaded connection ii. valve body dejects. iii. High viscosity of hydraulic oil. High frequency of use, service life has expired already. 	1. Replace the manual valve. 2. Remove and clean the valve seat. 3. Replace the seal. 4. Replace the screwed joint. 5. Replace the manual valve. 6. Replace the hydraulic oil with lower viscosity. 7. Replace the manual valve.
	1. The vehicle cannot perform the hydraulic control instructions	<ul style="list-style-type: none"> i. sealing damaged. ii. poor threaded connection iii. valve body dejects. High viscosity of hydraulic oil. High frequency of use, service life has expired already. 	1. Overflow valve in the connection block started. 2. Valve seat leakage. 3. Valve rod cannot push/pull to bottom; the channel cannot be fully opened. 4. Replace the hydraulic oil with lower viscosity. 5. Replace the manual valve.
	2. Actuator running slow	<ul style="list-style-type: none"> High viscosity of hydraulic oil. High frequency of use, service life has expired already. 	1. Restart the truck. 2. Replace the valve seat. 3. Clean the valve rod, if necessary replace the valve.

* Under the circumstances of normal lifting and lowering, if failure occurs to any of other hydraulic actions (forward/backward shifting, forward/backward tilting and left/right shifting), perform troubleshooting to the corresponding control switch and its control circuit.

*Carry out trouble shooting in the order listed in the table. It can help quickly identify and resolve problems.

TROUBLESHOOTING

Table 3.1 Troubleshooting of Common Faults (continued)

Table 3.1 Troubleshooting of Common Faults (continued)							
Fault	Fault Symptom	Probable Causes	Troubleshooting	Fault	Fault Symptom	Probable Causes	Troubleshooting
1. Oil cannot enter gear pump or small flow	<ul style="list-style-type: none"> Inufficient hydraulic oil. Pump body defects. Poor sealing with leakage. Oil filter clogging. Oil temperature is too high. 		<ol style="list-style-type: none"> Replace the hydraulic oil. Replace the gear pump. Replace the sealing. Clean or replace the oil filter. Cool down the hydraulic oil. 	1. The vehicle cannot be steered (the vehicle can travel)			<ol style="list-style-type: none"> Steering potentiometer or its circuit connection failure Redirector or the tubing connection failure Steering bridge or the tubing connection failure Pump motor failure Gear pump failure Pump controller failure
2. Insufficient gear pump output pressure	<ul style="list-style-type: none"> Pump body defects. Pump body with cracks or leaks. Impurities in the pump, oil filter clogging. Low viscosity of hydraulic oil. Oil temperature is too high. 		<ol style="list-style-type: none"> Replace the gear pump. Replace the gear pump. Replace the hydraulic oil and clean the gear pump. Replace the hydraulic oil with higher viscosity. Cool down the hydraulic oil 	Steering Fault			<ol style="list-style-type: none"> Check if the mechanical connection between steering wheel and redirector is solid. Check the redirector or the tubing connection. Check the steering bridge or the tubing connection. Check the pump motor or its connection circuit. Check the pump controller failure. Check the pump. Replace the controller.
3. Too much vibration and noise	<ul style="list-style-type: none"> Pump body defects. Gear pump inlet tubing diameter is too small. Oil filter clogging, or motor speed is too high. Motor and oil pump shaft misalignment. 		<ol style="list-style-type: none"> Replace the gear pump. Replace the inlet tubing. Clean the oil filter, adjust the motor speed to a lower value. Remove and reinstall the motor. 	2. Steering Bridge Abnormal Noise		<ul style="list-style-type: none"> Supporting bearing wear 	<ol style="list-style-type: none"> Replace the bearing
4. Oil leaks	<ul style="list-style-type: none"> Pump body defects. Seal skeleton spring off. Shaft sealing surface scratched. 		<ol style="list-style-type: none"> Replace the gear pump. Remove and reinstall the seal skeleton. Replace the shaft sealing. 	3. Steering Bridge Oil Leaks		<ul style="list-style-type: none"> Oil seal wear or aged 	<ol style="list-style-type: none"> Replace the oil seal
5. Pump is not functioning properly or blocked	<ul style="list-style-type: none"> Pump body defects. Poor alignment of pump and motor coupling. Impurities in the pump. 		<ol style="list-style-type: none"> Replace the gear pump. Remove and reinstall the gear pump. Remove and clean the gear pump. 	4. Steering Bridge Stuck		<ul style="list-style-type: none"> Support bearing damage. 	<ol style="list-style-type: none"> Replace the bearing
1. Oil leaks	<ul style="list-style-type: none"> Redirector defects. Poor sealing with leakage. 		<ol style="list-style-type: none"> Replace the redirector. Remove and reinstall the redirector, if necessary Replace the redirector. 	Carry out trouble shooting in the order listed in the table. It can help quickly identify and resolve problems.			
2. Redirector is not functioning properly or noise	<ul style="list-style-type: none"> Redirector defects. Insufficient oil. There is air in the oil. High viscosity of oil. 		<ol style="list-style-type: none"> Replace the redirector. Add the hydraulic oil. Discharge the air in the oil. Replace the hydraulic oil with lower viscosity. 				

- * Carry out trouble shooting in the order listed in the table. It can help quickly identify and resolve problems.

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Table 3.1 Troubleshooting of Common Faults (continued)

Table 3.1 Troubleshooting of Common Faults (continued)				
Fault	Fault Symptom	Probable Causes	Troubleshooting	
Steering Fault	<p>1. The vehicle cannot be steered (the vehicle can travel)</p> <ul style="list-style-type: none"> • Steering potentiometer or its circuit connection failure • Redirector or the tubing connection failure • Steering bridge or the tubing connection failure • Pump motor failure • Gear pump failure • Pump controller failure 	<ul style="list-style-type: none"> • Steering potentiometer or its circuit connection failure • Redirector or the tubing connection failure • Steering bridge or the tubing connection failure • Pump motor failure • Gear pump failure • Pump controller failure 	<p>Controller failure error, carry out troubleshooting according to the fault code information on the instrument.</p> <ol style="list-style-type: none"> 1. Check the steering potentiometer or its connection circuit. 2. Check if the mechanical connection between steering wheel and redirector is solid. 3. Check the redirector or the tubing connection. 4. Check the steering bridge or the tubing connection. 5. Check the pump motor or its connection circuit. 6. Check the pump. 7. Replace the controller. 	
2. Steering Bridge Abnormal Noise		<ul style="list-style-type: none"> • Supporting bearing wear 	<ol style="list-style-type: none"> 1. Replace the bearing 	
3. Steering Bridge Oil Leaks		<ul style="list-style-type: none"> • Oil seal wear or aged 	<ol style="list-style-type: none"> 1. Replace the Oil seal 	
4. Steering Bridge Stuck		<ul style="list-style-type: none"> • Support bearing damage. 	<ol style="list-style-type: none"> 1. Replace the bearing 	

TROUBLESHOOTING

Table 3.1 Troubleshooting of Common Faults (continued)

Fault	Fault Symptom	Probable Causes	Troubleshooting
1. Lights do not light	a. Light failure or circuit not conducted b. Lighting combination switch or its circuit connection failure c. Fuse failure d. DC-DC converter failure		1. Check the light and its circuit connection. 2. Check Lighting combination switch and its connection circuit. 3. Check fuse and its connection circuit. 4. Check DC-DC converter and its connection circuit.
Other Failures	2. Horn does not sound	a. Horn switch or its circuit connection failure b. Horn failure c. Fuse failure d. DC-DC converter failure	1. Check the horn button and its connection circuit. 2. Check the horn and its connection circuit. 3. Check fuse and its connection circuit. 4. Check DC-DC converter and its connection circuit.

* Carry out trouble shooting in the order listed in the table. It can help quickly identify and resolve problems.

4. DRIVING SYSTEM

NOTES:

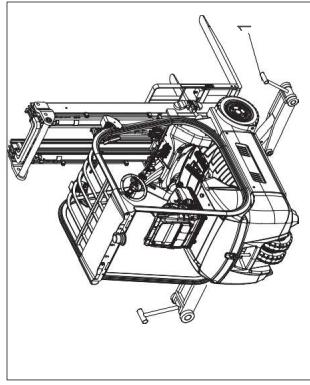
4.1 Drive Wheel

4.1.1 Removal and Installation

Removal

- Turn off the truck power and remove the key.
- Place the jack (1) under the chassis near the drive wheels, make the drive wheels off the ground.

schematic diagrams



- Remove the five protectors if necessary and unscrew the five nuts (2) on the drive wheel assembly (3).
- Install in the reverse order of removal.

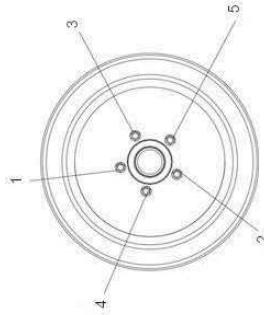
Installation

- Screw the eight nuts as shown in Fig3131-20004SM.
- Tighten the nuts in order and torque to:
162ft lbs (220 Nm).
- Install in the reverse order of removal.



CAUTION

- Screw the eight nuts as shown in Fig3131-20004SM.
- Tighten the nuts in order and torque to:
162ft lbs (220 Nm).



- WARNING**
- Make sure the lifting equipment is solid and secure. The load capacity should be greater than the total weight of the vehicle. Lifting height of not more than 4in (100mm), to help prevent injury to the maintenance personnel working under the vehicle for wheel removal and installation.

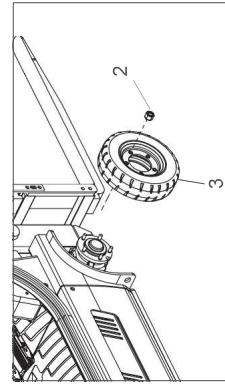


CAUTION

- After installation, check that tire inflation is the specified value. After running for a short distance, check torque of the bolts.



- CAUTION**
- Tire wear can affect the stability of the truck. Replace the drive wheel when heavily worn. Quality of tires directly affects the stability and driving performance of the truck. If you need to replace the factory tires, use original spare parts provided by the equipment manufacturer to maintain the original design performance of the truck.



4.2 Drive Motor

This truck obtains drive force through an AC motor.

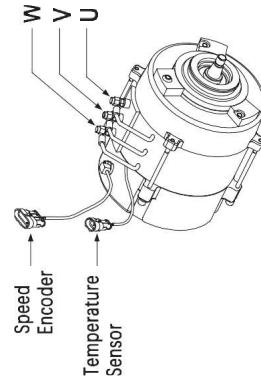


Fig3218-20004SM

4.2.1 Removal and Installation

Drive Motor

Removal

The drive motor is mounted on the gearbox.

- Power off the truck and remove the key.
- Remove the cushion and open the floorboard.
- Remove U, V and W cables on the drive motor.
- Disconnect brake harness.

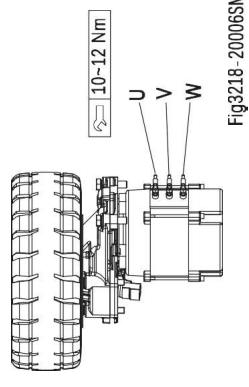


Fig3218-20006SM

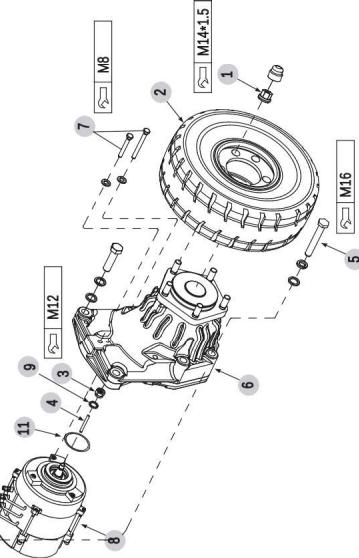
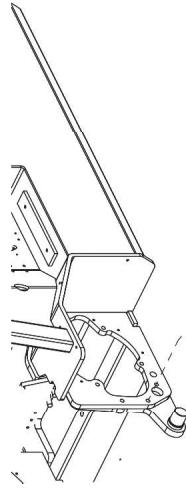


Fig3230-20002SM

Speed Encoder Removal

- Unscrew the six fixing bolts (3) and remove the three plates (4).
- Unscrew seven bolts (5), remove the gearbox (6) and drive motor (8) from the chassis.
- Unscrew three bolts (7), remove the drive motor (8) from the gearbox (6).
- Unscrew the nut (9), remove the motor gear (10) and O-ring (11) from the drive motor (8).

Installation

- Install in the reverse order of removal.



CAUTION

- When installing the motor gear of gearbox onto the shaft of the motor, make sure that the woodruff key on the motor shaft is fully seated on the motor gear.
- Motor gear should fully engage with the gear within the gearbox, rotate the gearbox without blocking, and then fix with four screws.
- Torque requirements on tightening torque of fixing screws: see Figure60207-60210.



Fig3218-20010SM

- Switch off the truck power connections and remove the pedal.
- Unplugging the AMP connector on the speed encoder (2).

DRIVING SYSTEM

DRIVING SYSTEM

- Unscrew the screw (1) from the drive motor and remove the speed encoder.

Installation

- Install in the reverse order of removal.

4.2.2 Faults and Causes

	Fault	On load, motor speed is turning slow
6	Cause	a. Insufficient voltage of battery. b. Overload. c. U, V, W terminals with abnormal voltage input. d. Speed encoder or its circuit failure.

4.2.3 Checking and Testing

U, V, W Terminals

- Identify if the motor windings are normal measuring the resistance of U-V, V-W, and U-W respectively if there is short circuit or breakage.
- As shown in the following table:

⚠ CAUTION

Due to the small size of windings, when measuring with a multimeter, put it on a low resistance range.

Resistance Measurement	Judgment
With readings, but very low	Normal *
0 Ω	Winding internal short circuit (replace the motor)
∞ Ω	Winding internal open circuit (replace the motor)

- * The difference between the resistance values measured at U-V, V-W and U-W shall not be greater than 2%.
- Identify if there is leakage current through measuring the resistance between U, V, W, and motor housing respectively.
- As shown in the following table:

Resistance Measurement	Judgment
0 Ω	Leakage current (replace the motor)
∞ Ω	Normal *

* For normal motor, U, V and W terminals are insulated from motor housing.

Temperature Sensor

Temperature sensor is used to monitor motor temperature.

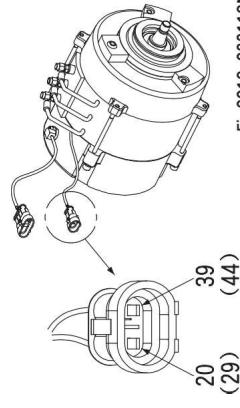


Fig331-200101SM

The vehicle is powered on, measure the voltage between pin connector (19#) and (20#) with a multimeter, normally should be 12V.

- Check if the connection between 30# and 31# is reversed. (If the two circuits are connected reversely, the controller won't report for failure, but the travel speed of the vehicle may slow down)
- Check the "ENCODER" readings on TESTER Menu. Operate the truck if the display is always "0".

Drive Motor - Right

Measure the resistance between pin connector (20#) and (39#) with a multimeter to identify if the temperature sensor is normal.

As shown in the following table:

Drive Motor - Left

Measure the resistance between pin connector (29#) and (44#) with a multimeter to identify if the temperature sensor is normal.

As shown in the following table:

Resistance Measurement	Judgment
With readings	Normal
0 Ω	Sensor short circuit (replace the motor)
∞ Ω	Sensor open circuit (replace the motor)

Speed Encoder

Speed encoder is used to detect the speed of the motor and convert the speed into fixed signals.

Checking

- Check if the motor encoder and the appearance of cables are in good condition, and if the plug connection is secure.
- Remove the speed encoder and check its sensing surface for wear.

Testing

Drive Motor - Right

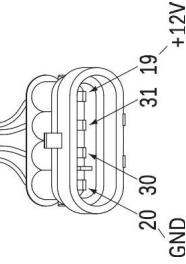


Fig331-200101SM

The vehicle is powered on, measure the voltage between pin connector (19#) and (20#) with a multimeter, normally should be 12V.

- Check if the connection between 30# and 31# is reversed. (If the two circuits are connected reversely, the controller won't report for failure, but the travel speed of the vehicle may slow down)
- Check the "ENCODER" readings on TESTER Menu. Operate the truck if the display is always "0".

Drive Motor - Left

Measure the resistance between pin connector (29#) and (44#) with a multimeter to identify if the temperature sensor is normal.

As shown in the following table:

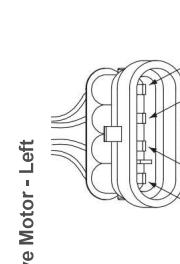


Fig3218-200125M

The vehicle is powered on, measure the voltage between pin connector (28#) and (29#) with a multimeter, normally should be 12V.

- Check if the connection between 37# and 38# is reversed. (If the two circuits are connected reversely, the controller won't report a failure, but the travel speed of the vehicle may slow down).

DRIVING SYSTEM

DRIVING SYSTEM

- Check the "ENCODER" readings on TESTER Menu. Operate the truck if the display is always '0'.
- Speed encoder failure;
- Motor encoder disc failure.

4.3 Gearbox

4.3.1 Removal and Installation

See Section 5.2.1.



Before installing the new gearbox, please add gear oil. (See Section 2.2.3 for specifications and filling amount).

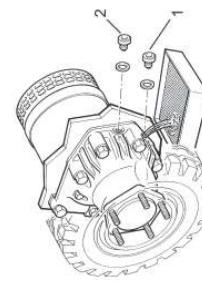
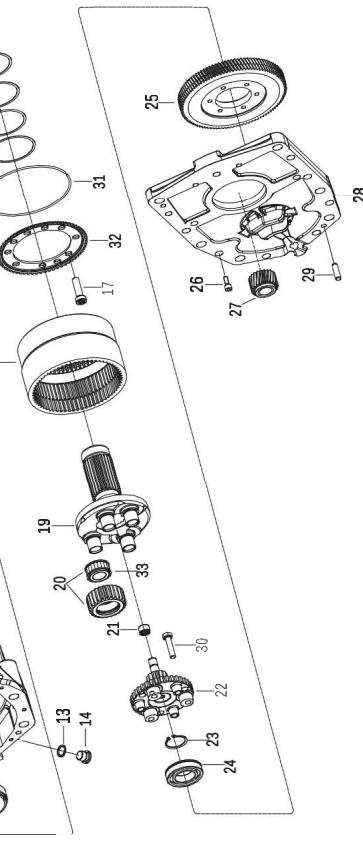
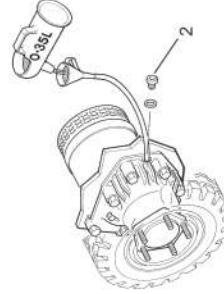
4.3.2 Component

No.	Name	No.	Name	No.	Name	No.	Name
1	Protection Cap	11	Housing-R	20	Repair kit	30	Tors-Screw
2	Slotted Pin	11	Housing-L	21	Needle Sleeve	31	Ring
3	Slotted Nut	12	Tapered Roller Bearing	22	Inner Disc Carrier	32	Toothed Disc
4	Wheel Stud	13	Sealing Ring	23	Retaining Ring	33	Cylinder Roller Bearing
5	Wheel Shaft	14	Screw Plug	24	Ball Bearing	34	
6	O-Ring	15	Set of shims	25	Spur Gear	35	
7	NILOS-Ring	16	Ring gear	26	Cap Screw	36	
8	Tapered Roller Bearing	17	Tors-Screw	27	Gear Shaft	37	
9	Sealing Ring	18	Screw Plug	28	Housing Cover		
10	Breather	19	Planet carrier	29	Cylindrical Pin		

4.3.3 Gear Oil

Check the gear oil level

- Loosen the oiling port plug (2) and observe the oil level.
- If oil level is aligning with lower level of oiling port, it indicates that the oil level is normal.
- If the oil level is below the lower level of oiling port, it is necessary to add gear oil.



Fault	Gearbox Abnormal Noise
1	a. Supporting bearing wear. b. Gear wear: the gap is too big. c. Foreign objects in gear oil.
2	Gearbox Oil Leaks
3	Cause a. Gear fastening screws or nuts loosening. b. Support bearing damage c. Foreign objects in gear oil.
Fault	Gearbox Stuck

4.3.4 Faults and Causes

- Loosen the oil drain plug (1), drain the gear oil within the gearbox.
 - Remount the oil drain plug, and add the gear oil of same specification with tubing through oiling port.
- Gear oil specification: Mobil ATF220
Gear oil filling amount: 0.35 L**

Fig3231-20001SM

DRIVING SYSTEM

DRIVING SYSTEM

- 4.4 Accelerator Pedal and Brake Pedal**
- 4.4.1 Removal and Installation**
- Power off the truck and remove the key.
 - Remove the cushion (1).
 - Disconnect the connection between the accelerator pedal wiring and main wiring harness.
 - Unscrew the two bolts (3) with wrench and remove the accelerator pedal (5) from the chassis.
 - Install in the reverse order of removal.

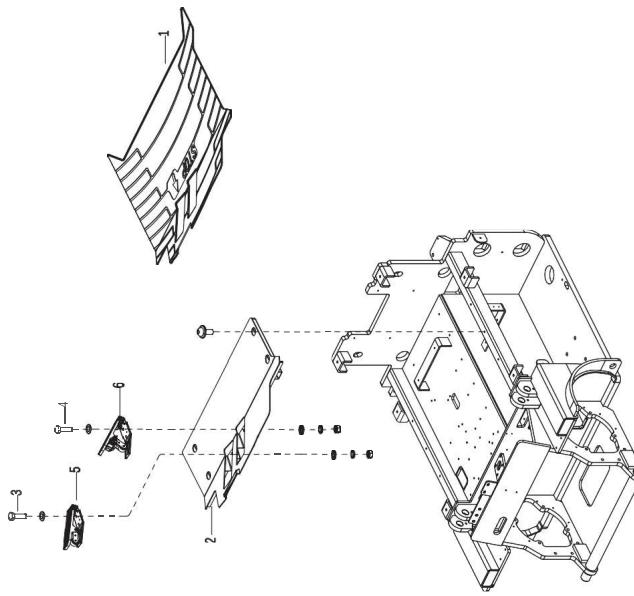


Fig3230-20001SM

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4.4.2 Interface Description

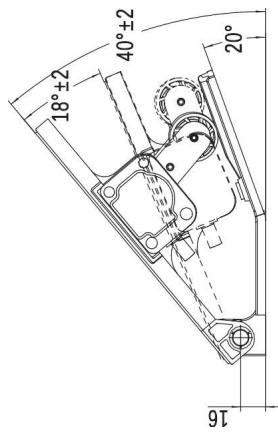
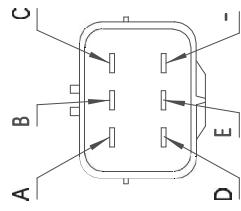


Fig3131-50017SM



4

Interface Description			
Pin	Description	Color	Remark
A	Pedal power supply	Red	10-15Vdc
B	Output signal	White	0.2±0.1V~9±0.3V
C	Pedal signal grounding	Black	-
D	Pedal Switch - Positive Electrode	Green	Switch output (10-60V)
E	Pedal switch output	Grey	Switch output

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DRIVING SYSTEM

4.4.3 Checking and Testing

Checking

- Operate the accelerator pedal to ensure it resets properly.

- Check if the accelerator pedal and its wiring harness are in good condition, and if the connectors are connected securely.

4

- Press the accelerator pedal. Measure the voltage between the interfaces with a multimeter as shown in the following table:

Press Accelerator Pedal		
Connection Interface	Voltage Measurement	
A-C	12 V	
A-B	Changing within the range of 0V to 9V with the level of pressing	
A-E	12 V	
B-C	0 V	

- Press the accelerator pedal, if the accelerator information on the display does not change, it indicates there is failure with the accelerator pedal or its circuit.

- Turn off the vehicle to check the accelerator pedal and its wiring harness. (See Fig3131-50017SM)

- Provide a voltage of 12V between accelerator pedal harness connectors (A) and (C), check the voltage at each port of the wiring harness with a multimeter.

- Place the accelerator pedal at original position Measure the voltage between the interfaces with a multimeter as shown in the following table:

Accelerator pedal at original position

Connection Interface	Voltage Measurement
A-C	12 V
A-B	0 V
A-E	12 V
B-C	0 V

5. STEERING SYSTEM

5

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45

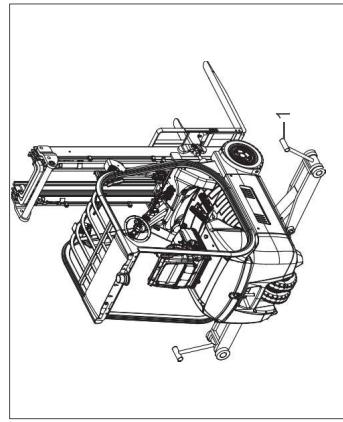
NOTES:

5.1 Rear Steer Wheel

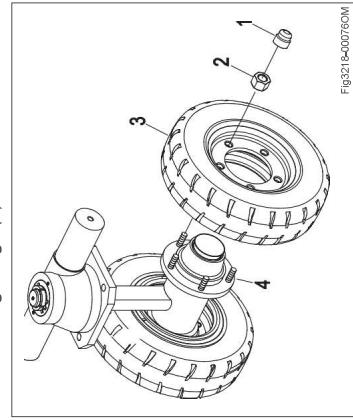
5.1.1 Removal and Installation

Removal

- Turn off the truck power and remove the key.
- Place the jack (1) under the chassis near steering wheels, raising the wheel off the ground.



- Remove the five protectors (1) and unscrew the five nuts (2) on the steer wheel assembly (3).
- Remove the steer wheel assembly (3) from the steering bridge (4).



Installation and Commissioning

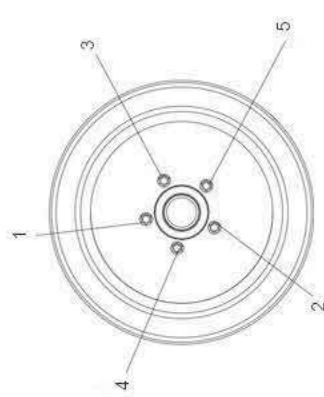
- Install in the reverse order of removal.

CAUTION

- Install the five nuts by hand.

- Tighten the nuts by order and mark with the torque, bolt specification M14x1.5 according to actual grade. Refer to 1.4 General Tightening Torques. Bolt's grade can be found on the head of the bolt

1



WARNING

Make sure the lifting equipment is solid and secure, and that the load capacity is greater than the total weight of the truck. Lifting height of not more than 4in (100mm), to prevent hazards to the maintenance personnel working under the vehicle for wheel removal and installation.

- When replacing wheels, be sure that the truck won't tilt.

- Run the truck to see if the steering wheel is functioning properly. If there is blocking or noise, check if the wheel bearings are functioning properly.

5.2 Steering Bridge

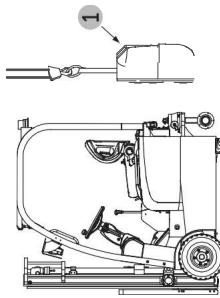
5.2.1 Removal and Installation

Removal



CAUTION
Quality of tires directly affects the stability and driving performance of the device.
If you need to replace the factory-fitted tires, please use original spare parts provided by the equipment manufacturer to maintain the original design performance of the truck.

- Fix the wheels with triangular wooden wedge.
- Open the rear hood, disconnect the cables, and remove the battery.



5.1.2 Faults and Causes

1	Fault	Bearing noise or jammed
1	Cause	Bearing fatigue damage or foreign
2	Fault	Abnormal tire wear, cracking, or degumming
2	Cause	Improper use

- Remove the two tubes (1) from the steering bridge.
- Remove the steering potentiometer; (See Section 8.2).

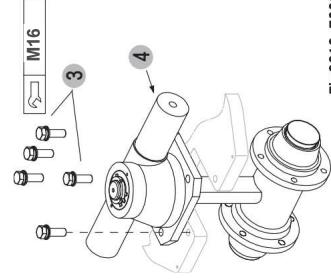


Fig3218-70004SM

- Unscrew the five bolts (3) and remove the steering bridge (4) from the chassis.

Installation

- Install in the reverse order of removal.



WARNING
Make sure the lifting equipment is solid and secure, and the load capacity should be greater than the total weight of the vehicle.



WARNING
When replacing wheels, be sure that the truck won't tilt.

- Remove the steer wheels; (See Section 5.1)

5.2.2 Faults and Causes

1	Fault	Steering Bridge Abnormal Noise.
1	Cause	a. Supporting bearing wear. b. Gear wear; the gap is too big.
2	Fault	Steering bridge oil leaks
2	Cause	Oil seal wear or aged.
3	Fault	Steering Bridge Stuck.
3	Cause	a. Gear damage. b. Support bearing damage.

STEERING SYSTEM

STEERING SYSTEM

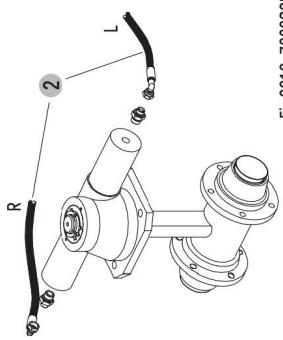
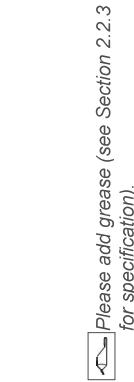


Fig3218-70003SM

5.3 Steering Potentiometer



* Be sure to bend the cotter pin.

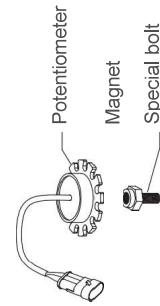
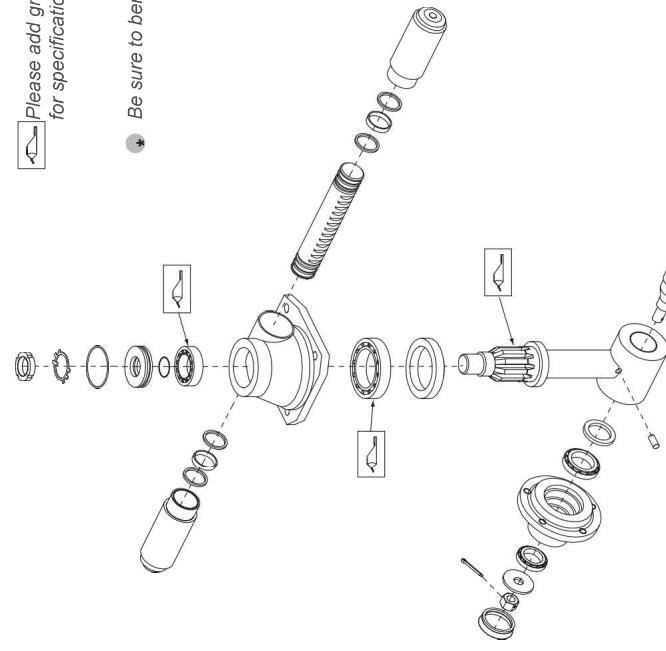
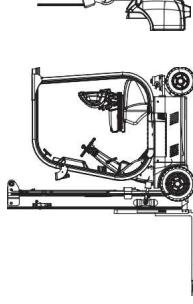


Fig3218-70006SM

5.3.1 Removal and Installation

Removal

- Fix the wheels with triangular wooden wedge.
- Power off the truck.



5.3.2 Faults and Causes

1	Fault	Truck does not travel (the controller reports error, and fault information is displayed on the meter. STEER SENSOR KO)
	Cause	Potentiometer or its circuit failure

Fig3230-70002SM
- Unscrew four bolts and remove the counter-weight (1) and from the chassis.
(See Fig3218-70007SM)

- Remove the main wiring harness from the steering potentiometer (1).

- Unscrew the two mounting screws (2) with hex wrench and remove the steering potentiometer (1).

- Unscrew the two mounting screws (4) with hex wrench and remove the mounting plate (3), from the steering bridge.

- Unscrew the special bolt (5) and washer (6) from the steering bridge.

5	CAUTION	During installation, be sure that the magnet has been installed into the special bolt.
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5.3.3 Checking and Testing

- Check if the steering potentiometer and the appearance of cables are in good condition, and if the plug connection is secure.

Fig3218-70005SM

6. BRAKE SYSTEM

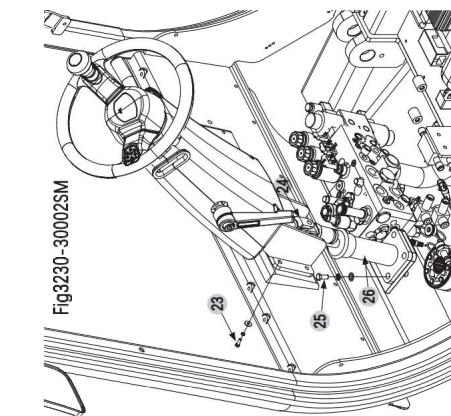
NOTES:

6

6.1 Control Lever

6.1.1 Removal

- Remove the floor mat, floorboard, and front cover.
- Unscrew the four bolts (23, Fig 3230-30002SM) and remove the steering column redirector (21, Fig3230-30001SM).
- Disconnect the harness carefully from the main harness.
- Unscrew four (25, Fig3230-30002SM) and four bolts, remove Steering Assemble from the chassis.
- Remove the horn cover (1) unscrew the nut, and pull up the steering wheel (2).
- Unscrew the four screws (8) and open the back cover plate (7).
- Disconnect the connection between the key switch (9) and main wiring harness, then remove the key switch and back cover plate (7).
- Unscrew the adjusting handle (5) and four screws (10), then remove the front cover plate (6).
- Cut off the connection between the combination switch (12 & 13) and the main wiring harness.
- Unscrew the four screws (11), remove the travel combination switch (12) and lighting combination switch (13) from the steering column (14).
- Unscrew the bolt (18), remove the Redirector Bracket(16), bearing(19) and Steering Shaft(20).
- Unscrew two nuts and remove the Steering Column (14).



Installation
Install in the reverse order of removal.

CAUTION

When removing or installing, please pay attention to protect the cables from being damaged.

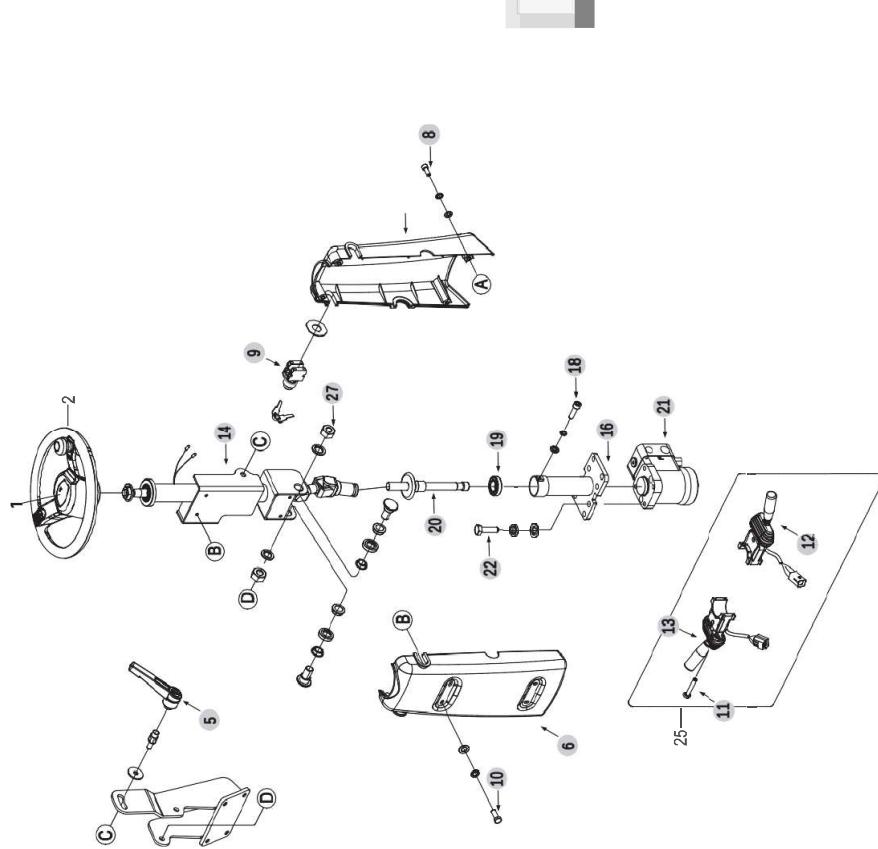


Fig3214-30001SM

NOTES:

7. HYDRAULIC SYSTEM

7

The pressure of the entire hydraulic system is provided by a hydraulic power unit system, which is used for lifting/tilting/ side shifting. While the hydraulic power unit is equipped with a relief valve to ensure that the entire system pressure is always within the safety limits that can lift the maximum load capacity.

Multi-way Manual valve is used for the control of lifting/lowering, tilting and side shifting. Throttle valve is used for the control of lowering speed. Inlet is equipped with a filter to prevent the impurities in the hydraulic oil from entering into the pump.

Oil pipeline explosion-proof valve is installed at the hydraulic cylinder to prevent the explosion of the system pipeline.

Hydraulic Schematic Diagram is as shown in Fig3214-40001SM.
See Section 7.0 for hydraulic symbol descriptions.

7.1 Overview

- Lower the mast to the bottom, remove the air filter on cylinder, observe the oil level with the oil dipstick. When adding hydraulic oil, please use hydraulic oil of the same specifications.
- When the mast occasionally jitters, that may be leaks in the cylinder, or there could be leaks on the valve body. Dismantle and clean (to clean with hydraulic oil of the same specifications) the valve on the valve body, discharge the foreign bodies within the valve body through repeatedly lifting and lowering of the mast.

- If hydraulic oil is becoming less, thoroughly check the hydraulic system for leaks.
- Disassembly of cylinder needs to be performed in a clean environment. Before removing the cylinder, the stains on the cylinder must be removed first. Carefully remove the piston rod to prevent the cylinder wall from being scratched by its end surface or damaged part. When replacing the cylinder, also replace the cylinder seals.

Hydraulic Oil
Hydraulic oil for truck:
Specifications: Anti-wear Hydraulic Oil L-HM46.

Hydraulic Seals

The seals installed within the cylinder are made of rigid polyurethane. The deformation during assembly due to compression will not cause a permanent deformation.

When assembling, prevent the seals from being broken, rolled, and undercut.

Assembly Instructions

The tools used to install the seals must be made of soft metal or suitable plastic, without burrs and sharp edges. Do not use tools that can easily damage the surface of seals, such as a screwdriver or other similar tools with hard front edges.

Where the hydraulic seals are to be installed, it should be free of burrs, sharp edges, and cracks. If the installation of seals needs to cross sharp edges, grooves or cuts, protective devices must be used for protection. Before installing, lubrication should be applied to the seals and the mounting positions.

CAUTION

The lubricant used during assembly must be of the same specifications with the hydraulic oil used in the vehicle.

7.1.1 Hydraulic Schematic Diagram

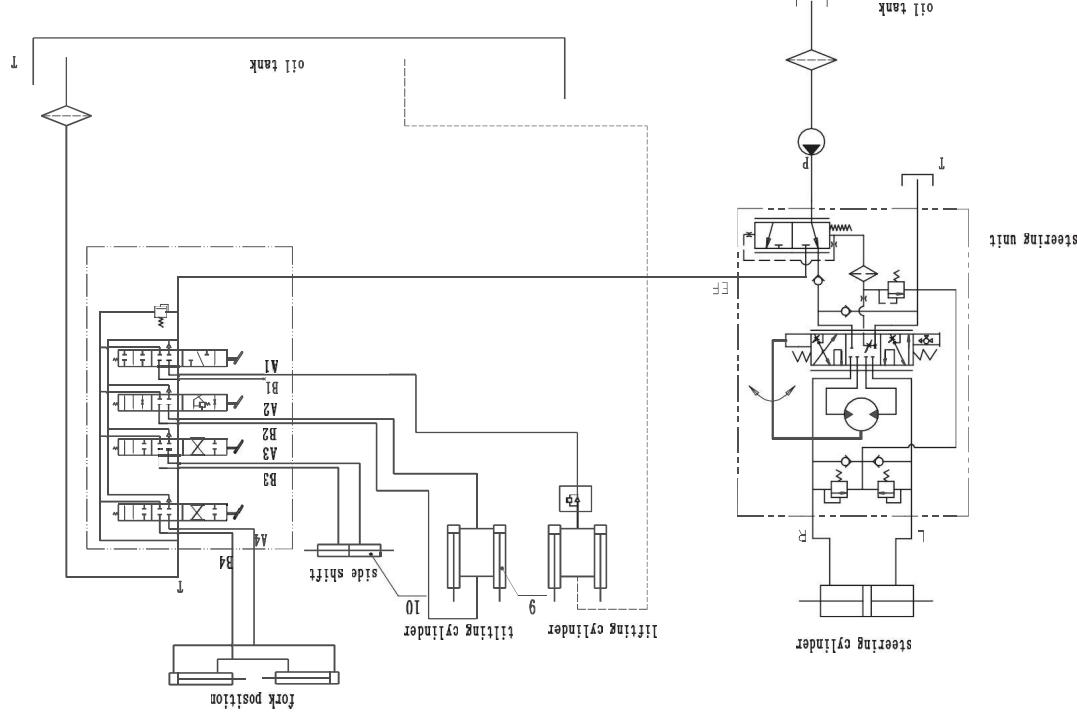


Fig3214-40001SM

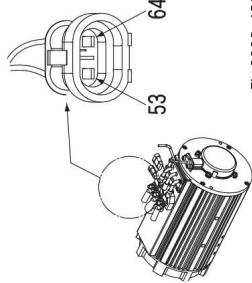


Fig3230-40004SM

Testing

- With the vehicle powered on, measure the voltage between pin connector (52#) and (53#) with a multimeter. This should normally be 12V.

- Check if the connection between 54# and 55# is reversed. (If the two circuits are connected reversely, the controller won't report failure, but the travel speed of the vehicle may slow down).

- Check the "ENCODER" readings on TESTER Menu. Operate the truck if the display is always "0":
Speed encoder failure; Motor encoder disc failure.

Measure the resistance between pin connector (53#) and (6#) with a multimeter to identify if the temperature sensor is normal.
As shown in the following table:

Resistance Measurement	Judgment
With readings	Normal
0 Ω	Sensor short circuit (replace the motor)
∞ Ω	Sensor open circuit (replace the motor)

7.2.6 Speed Encoder

Speed encoder is used to detect the speed of the motor and convert the speed into fixed signals.

7.2.7 Checking

- Check if the motor encoder and the appearance of cables are in good condition, and if the plug connection is secure.
- Remove the speed encoder and check its sensing surface for wear.

7.3 Multifunction Hydraulic Valve

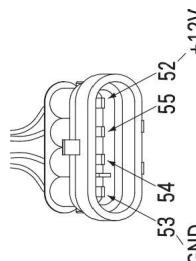
- The valve rod is driven by lever to switch the ON and OFF of tubing within the valve body, thus, to control the Lifting - Lowering, Forward Shifting - Retract, Tilting Forward - Tilting Backward and Left Shifting - Right Shifting of the vehicle.
- Left Shifting- Right Shifting Attachment**
- Unscrew the four screws (16) and remove the multi-way valve and the mounting plate.
- Remove the cotter pin on pin shaft (10).
- Remove the connecting rod (11) between multi-way valve and control lever.
- Unscrew the four bolts (6), then remove the multi-way valve (1) and the bracket (9) from the mounting plate (7).
- Unscrew the four bolts (8) to remove the multi-way valve (1) from the bracket (9).
- Unscrew the two bolts (4) and remove control switch mounting plate (5) from the valve, then loosen the nuts (2) to remove the control switch (3).
- Loosen the bolt (13), remove the main control pin shaft (12) and control lever (14) from the control lever mounting base (17).

Fig3131-40011SM

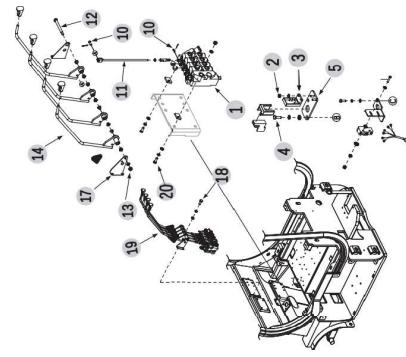
7.3 Removal and Installation**Removal**

- Turn off the truck power and remove the key.
- Remove the floor mat, floorboard, and front cover.
- Disconnect the harness on the Multi-way Reversing Manual Valve.
- Unscrew four bolts (18) and (20) remove the Valve Control Linkage assembly (19).

Fig3131-40008SM

**Installation**

- Install in the reverse order of removal.
- CAUTION**
Some hydraulic oil will be lost when removing the manual multi-way valve. Add appropriate amount of hydraulic oil after the replacement is complete (see Section 2.2.3 for specifications and adding amount).

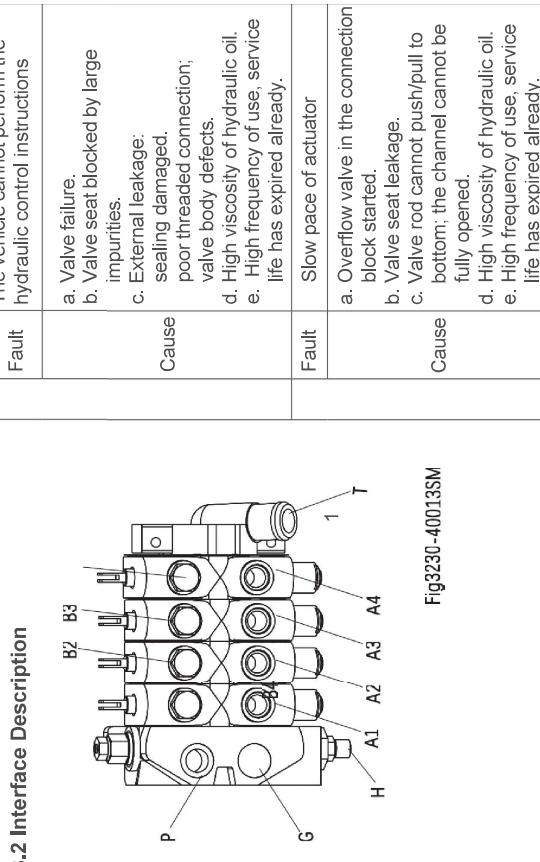
**Adjustment**

- Adjust the length of the connecting rod through operating the nut on the connecting rod (11). When the valve rod of multi-way valve is at original position, adjust the control lever (14) to a vertical position.

Fig3230-40015SM

HYDRAULIC SYSTEM

HYDRAULIC SYSTEM



7.3.2 Interface Description

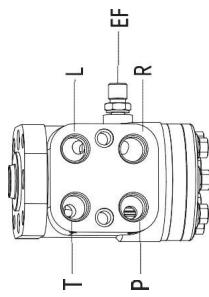
Fault	The vehicle cannot perform the hydraulic control instructions
Cause	<ul style="list-style-type: none"> a. Valve failure. b. Valve seat blocked by large impurities. c. External leakage; sealing damaged, poor threaded connection; valve body defects. d. High viscosity of hydraulic oil. e. High frequency of use, service life has expired already.
Fault	<ul style="list-style-type: none"> a. Overflow valve in the connection block started. b. Valve seat leakage. c. Valve rod cannot push/pull to bottom; the channel cannot be fully opened. d. High viscosity of hydraulic oil. e. High frequency of use, service life has expired already.

7.4 Redirector

- Unscrew the four bolts (3), dismantle the redirector (4).
- Install in the reverse order of removal.



CAUTION
Some hydraulic oil will be lost when removing the redirector. Add appropriate amount of hydraulic oil after the replacement is completed (see Section 2.2.3 for specifications and amount).



7.4.3 Faults and Causes

Fig3230-40006SM

7.4.1 Removal and Installation

- Turn off the truck power and remove the key.
- Remove the cushion and open the floorboard.
- Loosen the joint (1) and remove the tubing (2) on the redirector (4).



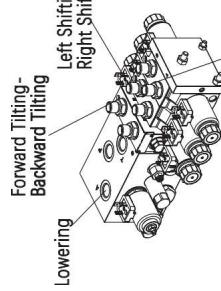
CAUTION
Hydraulic oil may damage truck parts and contaminate the environment. When removing joints or tubing, place a clean container under it for discharge of hydraulic oil.

7.4.2 Interface Description

Symbol	Interface Function	Connection Terminals	Interface Size	Connection Terminals	Interface Size
A1	Lifting / lowering solenoid valve controls	Lift Cylinder	M20x1.5	Tank	M20
A2	Backward tilting, backward tilting solenoid valve controls	Tilt Cylinder	M20x1.5	P	M20x1.5
B2	Forward tilting, forward tilting solenoid valve controls	Tilt Cylinder	M20x1.5	Oil Inlet Valve	M20x1.5
A3	Right shifting, right shifting solenoid valve controls	Side-Shift Cylinder	M20x1.5	Steering Bridge	M20x1.5
B3	Left shifting, left shifting solenoid valve controls	Side-Shift Cylinder	M20x1.5	Steering Bridge	M20x1.5
A4	Reach, reach solenoid valve controls	Reach Cylinder	M20x1.5	Port H of multi-way valve	M12x1.5
B4	Retracting, retracting solenoid valve controls	Reach Cylinder	M20x1.5		
P	Oil Inlet Drain / Test Pressure Port	Gear Pump	M22x1.5		
T	Back	Tank	Φ32-50		
G	Oil inlet, to the Port P of Redirector	Redirector	M16x1.5		
H	Port, to the Port EF of Redirector	Redirector	M14x1.5		

7.5 Multifunction Hydraulic Valve

The ON/OFF of tubing within the valve chamber is controlled through solenoid valve, to control the Lifting - Lowering, Forward Shifting - Retract, Tilting Forward - Tilting Backward and Left Shifting - Right Shifting of the vehicle.



Attachment
Fig3230-40011SM

7.5.1 Removal and Installation

- Removal**
- Turn off the truck power and remove the key.
 - Remove the floor mat and open the floorboard.
 - Remove the tubing on the multi-way valve (1) and disconnect the connection between the control switch and main wiring harness.



CAUTION
Some hydraulic oil will be lost when removing the multi-way solenoid valve, add appropriate amount of hydraulic oil after the replacement is completed. (See Section 2.2.3 for specifications and adding amount).

7.5.2 Interface Description

Removal

- Loosen the two fastening screws (1) on the multi-way solenoid valve (2) with a hex wrench and remove the solenoid valve.

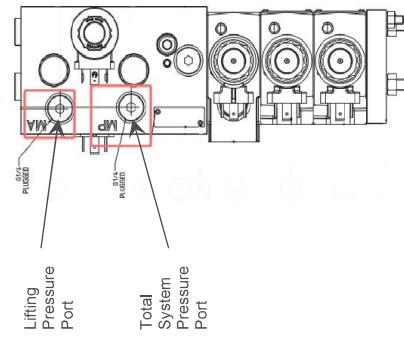
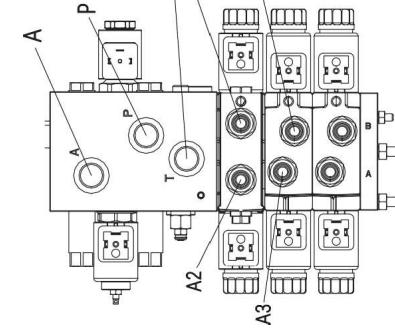


Fig3230-40014SM

- Loosen the two fastening screws (1) on the multi-way solenoid valve (2) with a hex wrench and remove the solenoid valve.

- Install in the reverse order of removal.

Symbol	Interface Function	Connection Terminals	Interface Size
P	Oil Inlet	Redirector	G1/2 -M22x1.5
T	Drain back	Tank	G1/2-Φ32
A	Lifting, lifting / lowering solenoid valve controls	Lift Cylinder	G1/2- M22x1.5
A2	Backward tilting, backward tilting solenoid valve controls	Tilt Cylinder	G3/8- M16x1.5
B2	Forward tilting, forward tilting solenoid valve controls	Tilt Cylinder	G3/8- M16x1.5
A3	Left shifting, left shifting solenoid valve controls	Side-Shift Cylinder	G3/8- M16x1.5
B3	Right shifting, right shifting solenoid valve controls	Side-Shift Cylinder	G3/8- M16x1.5

7.5.3 Faults and Causes

Checking

- Check the valve seat for leakage and damage.
- Check the solenoid valve connector for loosening or poor connection of leads.

Testing

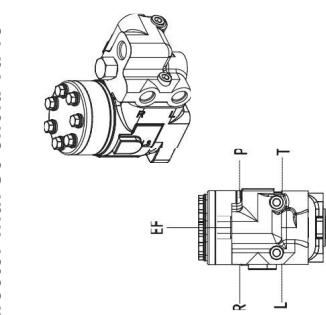
- Switch off the power supply of the truck.
- Measure the resistance between solenoid valve coil end point A and B to identify if the coil is normal. (See Section 7.5.2).
The vehicle cannot perform the hydraulic control instructions

- a. Solenoid valve failure.
b. Insufficient power supply voltage.
c. Valve seat blocked by large impurities.
d. External leakage: sealing damaged.
e. Poor threaded connection; valve body defects.
f. High viscosity of hydraulic oil.
g. High frequency of use, service life has expired already.

Fault	The vehicle cannot perform the hydraulic control instructions
1	a. Solenoid valve failure. b. Insufficient power supply voltage. c. Valve seat blocked by large impurities. d. External leakage: sealing damaged. e. Poor threaded connection; valve body defects. f. High viscosity of hydraulic oil. g. High frequency of use, service life has expired already.
2	a. Overflow valve in the connection block started. b. Valve seat leakage. c. Solenoid valve failure. d. High viscosity of hydraulic oil. e. High frequency of use, service life has expired already.

7.5.4 Checking and Testing

7.6 Redirector with Solenoid Valve



- Unscrew the four bolts (3), dismantle the redirector (4).

Installation

- Install in the reverse order of removal.



Some hydraulic oil will be lost when removing the redirector, please add appropriate amount of hydraulic oil after the replacement is completed (see [Section 2.3](#) for specifications and adding amount).

Fig3230-4001USN

7.6.3 Faults and Causes

Fig3230-4001USN

	Fault	Cause	Oil leaks
1	Fault	a. Redirector defects. b. Poor sealing with leakage.	
2	Fault	a. Redirector is not functioning properly or noise b. Redirector defects. c. There is air in the oil. d. High viscosity of oil. e. Pressure of relief valve adjusted too low or adjustment failure.	



Hydraulic oil may damage truck parts and contaminate the environment. When removing joints or tubing, place a clean container under it for discharge of hydraulic oil.

7.6.2 Interface Description

Symbol	Interface Function	Connection Terminals	Interface Size
T	Drain back	Tank	Φ32-50
P	Oil Inlet	Gear Pump	M22×1.5
L	Left turning, steering wheel controls	Steering Bridge	M18×1.5
R	Right turning, steering wheel controls	Steering Bridge	M18×1.5
EF	Port, to the Port P of multi-way valve	Multi-way Valve	G1/2-M22×1.5

7.7 Tilt Cylinder

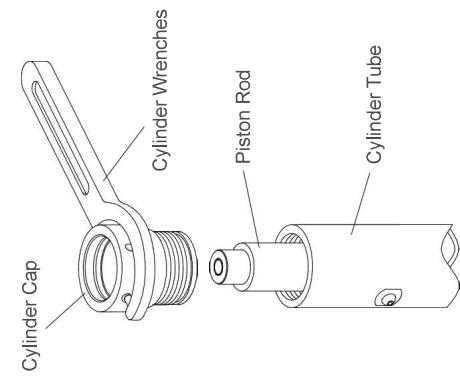
7.7.1 Cylinder Removal Precautions

- To prevent piston rod from bending or deformation, support it with a wooden block.
- When disassembling the cylinder, know the main structure of the cylinder. Due to the different size, structure, purpose of use of the cylinders, the sequences and methods used for removal are also different.
- Prior to removal, be sure the area is clean and free of dust and impurities. All parts should be covered with plastic. Do not use cloth.
- Before removing the cylinder, be sure to relieve the hydraulic circuit first by lowering the lifting mast to the bottom. This relieves the pressure in the tubing, helping to avoid high pressure fluid spraying and possibly causing injury.
- Turn off the power source so the entire hydraulic system stops functioning. To avoid the residual pressure within the circuit, the tubing joint should be loosened slowly. Loosen the joint by half and shake the tubing to see if there is overflow of pressured oil, and then go on with the removal.
- Cylinder is the powered actuator in the hydraulic system. Before removing the cylinder from the equipment, the connection part must be supported with an appropriate support to avoid personal injury or damage to the equipment.
- Do not use excessive force when removing parts, do not hammer forcefully. If some force is needed, lay a copper rod on top to avoid damage to the parts.
- The cylinder cap has fine pitch thread. Loosen it with cylinder wrench using even force.



When the seals need to be replaced, replace them with the complete set of seals in the cylinder repair kit.

Pay special attention to the cylinder tube, piston rod and other moving parts for bumps and scratches. If only minor damage, sand the edge point around the damaged part with fine stone and then polish the part smooth with metalographic sandpaper.



CAUTION

- O-rings and dust rings that are removed must be replaced with new one.
- Do not stretch or roll O-rings during installation.
- Y-ring or X-ring needs to be identified if it is for shaft or hole to avoid misplacement.
- Replacement cylinder parts must be the original products provided by the manufacturer.
- After maintenance and assembly of the cylinder is completed, pressure leak testing must be carried out before it can be put into operation.
- Before the testing, discharge the air within the cylinder, run the cylinder in a small range of movement for several times, and pay attention to if it is moving without blocking and if there is uneven resistance during the movement. Upon the pressure testing, raise the pressure slowly and observe carefully for leaks.

Fig0000-900015M

- * See Section 8.1.4 / Section 8.2.4 or Section 8.3.4 for the removal and installation of lift cylinder and side shift cylinder.
- * See Section 5.3.1 for the removal and installation of steering cylinder.

7.7.2 Cylinder Installation Precautions

- All parts should be cleaned before assembly, then assembled after being dried. During assembly, apply appropriate amount of hydraulic oil for lubrication.
- The tools used to install the seals must be made of soft metal or suitable plastic, without burrs and sharp edges on surfaces. It is prohibited to use the tools that can easily damage the surface of seals, such as, screwdriver or other similar tools with hard front edges.
- The area that the hydraulic seals are to be installed should be free of burrs, sharp edges, and cracks. If the installation of seals needs to cross sharp edges, grooves, or cuts, protective devices must be used for protection. Before installing, lubrication should be performed to the seals and the mounting positions with hydraulic oil.

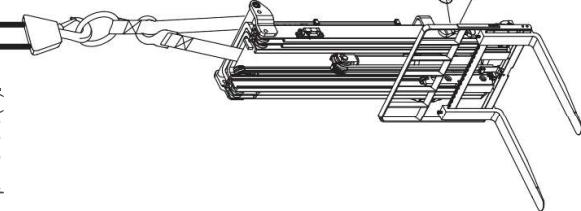
7.7.3 Removal and Installation

Cylinder is installed on the chassis and outer mast.

- Fix the masts, block the truck wheel with a wooden wedge, press the emergency stop switch and disconnect the key switch.
- Remove the Accelerator pedal from the cabin.
- Remove the floor mat (7) floor board (8) and front cover (9).
- Remove the two hydraulic lines (6) from the tilt cylinder (3).

CAUTION

- Hydraulic oil may damage truck parts and contaminate the environment. When removing joints or tubing, place a clean container under it for discharge of hydraulic oil.**
- Unscrew the anchor bolt (1) from the outer mast with socket wrench and pull out the pin shaft (2).



- Pull out emergency switch and turn on the key switch.
- Cycle the tilt cylinder to discharge the air within the hydraulic circuit and cylinder.
- Check the hydraulic oil level and make sure that the liquid is at standard level.

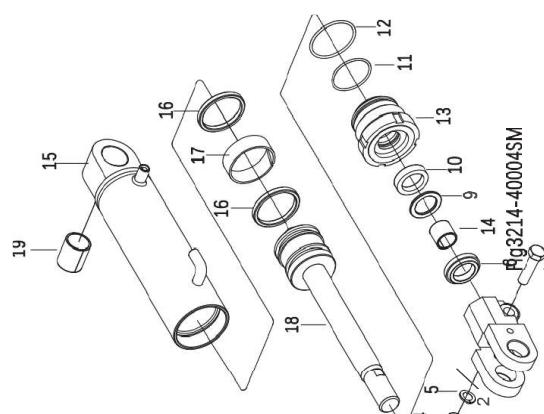
7.7.4 Cylinder Maintenance



CAUTION
Carry out the maintenance work in a clean environment to prevent impurities from entering into cylinder, causing cylinder damage.

During the installation, hydraulic oil of the same specifications must be used for cleaning or lubrication.

- Secure the cylinder to hose clamp and gently clamp the cylinder bottom.
- Unscrew the nut (4, Fig3530-40004SM) and bolt (3), then remove the ear (2) from the piston rod (18).
- Unscrew the cylinder cap (13) with cylinder wrench.
- Remove the dust ring (6), seal (9), and Seal ring (10) from the cylinder cap (13).
- Remove the bearing (14), Rubber ring (11) and O-ring (12) from the cylinder cap (13).
- Pull out the piston rod (18) from cylinder block (15).
- Remove the seal (16) and support ring (17) from the piston rod.
- Clean with hydraulic oil of the same specifications.
- Replace the problem parts and assemble in reverse order.



- CAUTION**
- If the piston rod or cylinder tube is damaged, replace the entire cylinder.
 - If the seals are aged or damaged, replace the complete set of seals.
 - When replacing or repairing the cylinder, refill the lubricant through the grease nipples at both ends of the cylinder.

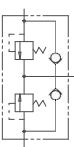


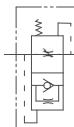
- CAUTION**
- Use suitable hose clamps to avoid cylinder deformation caused by a severely tight hose clamp.
 - Carry out the maintenance work in a clean environment to prevent impurities from entering cylinder, causing cylinder damage.
 - During the installation, hydraulic oil of the same specifications must be used for cleaning or lubrication.

7.8 Hydraulic Symbols

Symbol	Description	Symbol	Description
	Tank Pipe end below liquid level		Explosion-proof valve
	Tank Pipe end above liquid level		Check valve
			Cylinder Single-acting direction
	Filter		Cylinder Double-acting direction
	Service line (Supply line or return line)		Relief valve
	Control line (Drain line)		Solenoid valve Two-way two-pass
	Connecting pipe		Port (Test port)
	Motor		Balancing valve
	Hydraulic pump		Manual valve Three-way six-pass

HYDRAULIC SYSTEM

Symbol	Description
	Brake valve

Symbol	Description
	Speed regulating valve

8. MAST

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NOTES:

8.1 Three-stage Full Free Mast**8.1.1 Removal and Installation****Removal (Fig3124-60003SM)**

- Installation**
Install in the reverse order of removal.
- WARNING**
Make sure the lifting equipment is solid and secure, and the load capacity should be greater than the total weight of the vehicle.
- Disconnect the connections between lifting - lowering tubing, left shifting tubing and right shifting tubing and mast tubing.
 - Wrap the sling (1) around the upper beam of inner and outer masts, slightly lift the mast with crane.
 - Remove the shafts (2) between the outer mast and tilt cylinders (A and B),
 - Unscrew the bolts (3) and remove the fixed plate (4) between the outer mast and chassis (C and D).
 - Remove the mast from the truck.

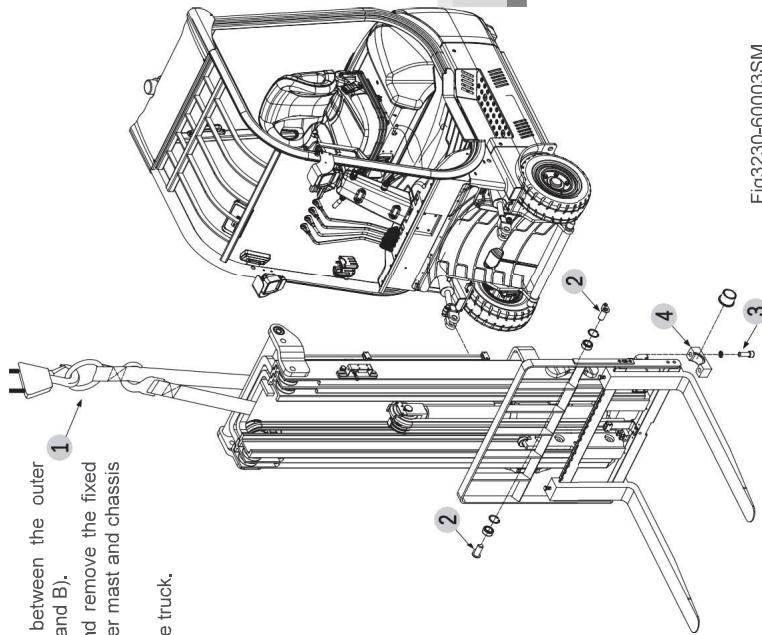


Fig3230-60003SM

8.2 Lifting Chains

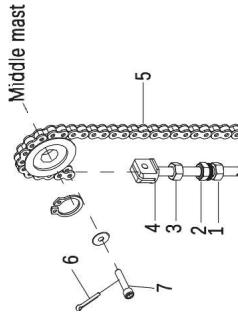
8.2.1 Chain Adjustment

- Lower the mast to the bottom.
- Press the emergency stop switch and disconnect the key switch.



Switch off the power supply before any adjustments or operations!

- Loosen the upper lock nut (3, Fig3214-60001SM) and the lower lock nut (1, Fig3214-60001SM) (8, Fig3214-60002SM) on chain bolt.
- Turning the adjusting nuts (2, Fig3214-60001SM) and (10, Fig3214-60002SM) upward, the chain will slowly tension.
- When the chain is adjusted to be tensioned with no obvious loosening, fasten the upper and lower lock nuts.



8.2.2 Chain Replacement

Mast Chains

- Block the truck wheels with wooden wedges, raise the inner mast for 500mm, insert wooden block between inner mast and the ground for supporting.



Please place supporting under the inner mast to prevent it from falling, resulting in personal injury.

- Unscrew the lock nut (3, Fig3214-60001SM) and adjusting nut (2) from the chain joint (11), then remove the chain joint (11) from middle cylinder.

- Remove the cotter pins (12), pull out the pin shaft (13), separate the chains (7) from the chain joint (11).

- Remove the cotter pins (6), pull out the pin shaft (129), separate the chains (5) from the chain joint (11) on inner mast.

- Remove the chain assembly from the chain sprocket (14, Fig3214-60002SM).

- Replace with new chains and hang the new chain assembly onto the chain sprocket.

- Put the chain connector (4) through chain hole of Chain bracket, insert the pin shaft (12) and pins (13).

- Put the chain connector (4) through the outer mast chain-hanging plate, screw the adjusting nut (2) and lock nut (3), insert the pin shaft (7) and pins (6).

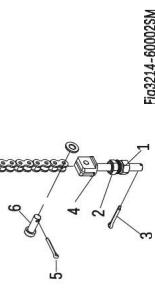
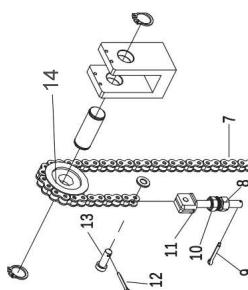
- Adjust the chains according to Section 8.2.1.



When the adjustment is completed, there should be an adjustable distance of at least three pitches over the chain bolts.

Fork Carriage Chains

- Block the truck wheels with wooden wedges, raise the fork carriage 500mm, insert wooden block between inner mast and the ground for supporting.



MAST

NOTES:

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8.2.3 Mast Tubing

HYDRAULIC SYSTEM OF LIFT SYSTEM

Code	Description
A1	Lifting / Lowering Mast Tubing

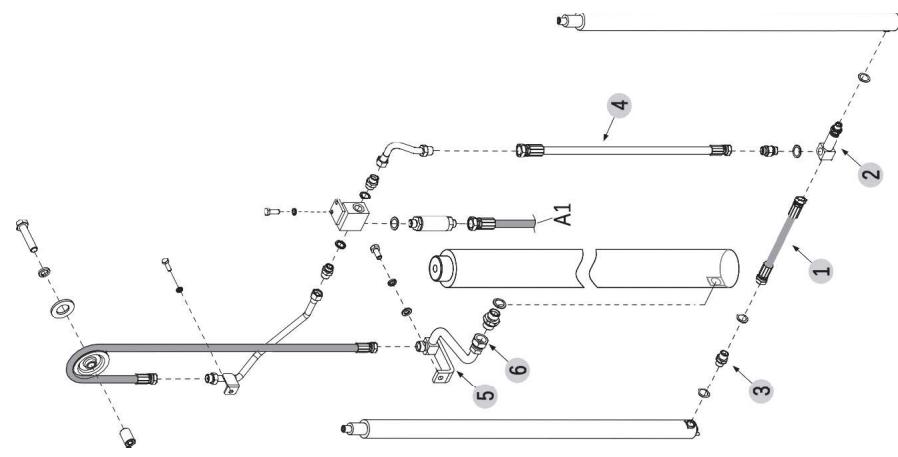
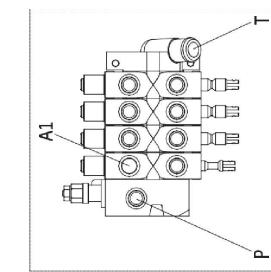


Fig3214-60017SV

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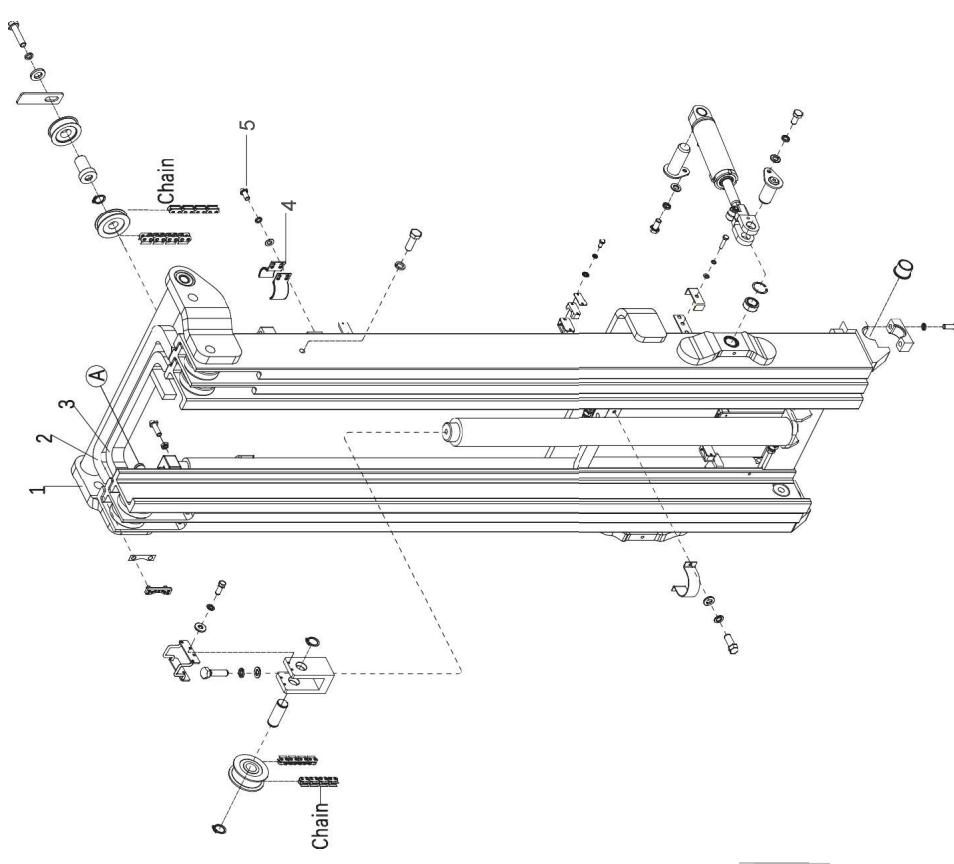


Fig3214-60016SM

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MAST

HYDRAULIC SYSTEM OF THIRD HYDRAULIC LINE

Code	Description
A3	Right Shift Mast Tubing
B3	Left Shift Mast Tubing

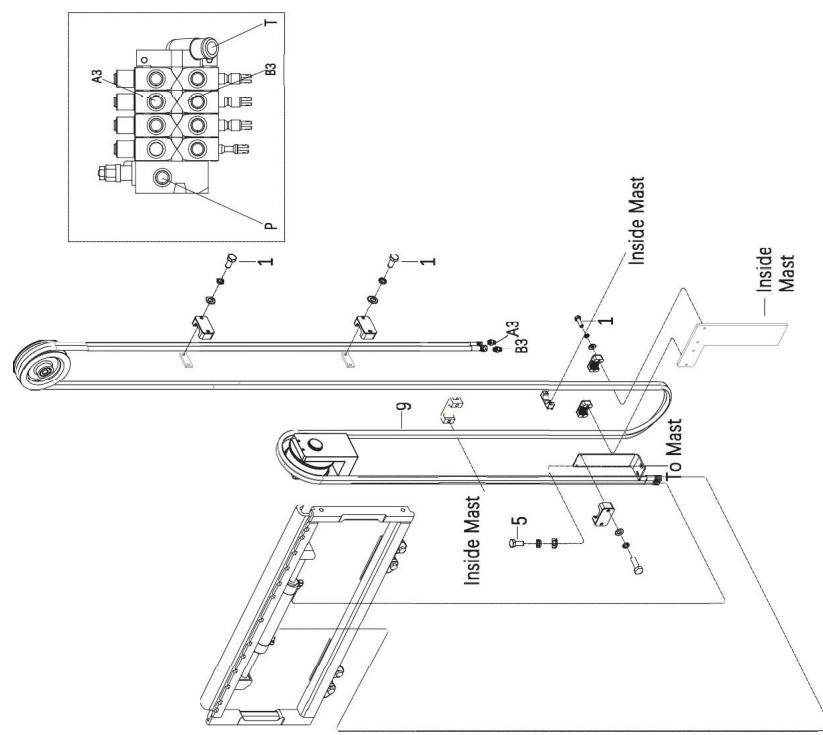


Fig3214-60018SM

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HYDRAULIC SYSTEM OF FOURTH PIPELINE

Code	Description
A4	Attachment
B4	Attachment

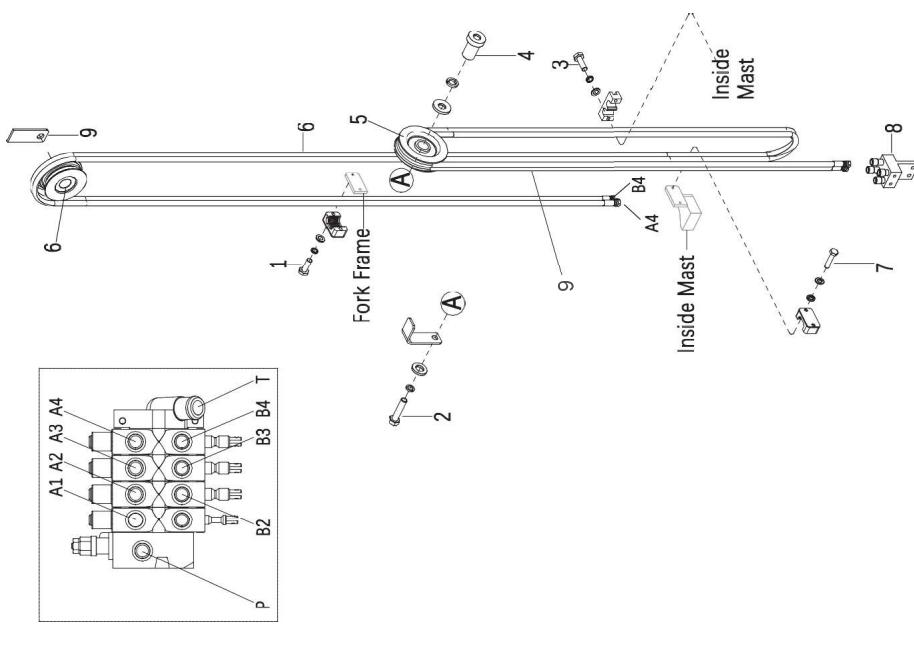


Fig3214-60019SM

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- 8.3 Lift Cylinder**
- 8.3.1 Cylinder Removal**
- Left Cylinder Removal (with mast down)**
- Remove the three-pass component (2, Fig3214-60017SM) from the left cylinder.
 - Remove the mast from the chassis according to Section 8.1.1;
 - Lay down the mast with lifting tools (with outer mast underneath the inner mast), place sleepers at both ends for supporting.
 - Disconnect the connections between the tubing assembly (2).
(1, Fig 3214-60017SM) and three-pass.
 - Remove the tubing (4) from the three-pass component (2).
- CAUTION**
- Hydraulic oil may damage truck parts and contaminate the environment. When removing joints or tubing, place a clean container under it for discharge of hydraulic oil.
- Left Cylinder Removal (with mast down)**
- Remove the mast from the chassis according to Section 8.1.1;
 - Lay down the mast with lifting tools (with outer mast underneath the inner mast), place sleepers at both ends for supporting.
 - Disconnect the connections between the tubing assembly (2).
(1, Fig 3214-60017SM) and three-pass.
 - Remove the tubing (4) from the three-pass component (2).
- CAUTION**
- Hydraulic oil may damage truck parts and contaminate the environment. When removing joints or tubing, place a clean container under it for discharge of hydraulic oil.

- CAUTION**
- Before going on with the next step, please fix the cylinder properly first. Be sure to avoid having the cylinder fall during removal, which could result in personal injury.
- Unscrew bolt (1) and remove the cylinder (7) from the mast.
- Unscrew bolt (2) and remove the cylinder (7) from the mast.

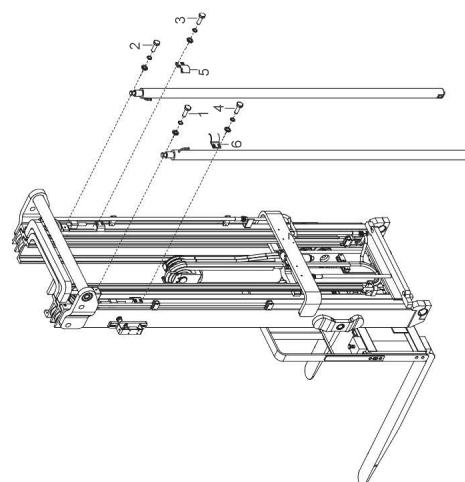


Fig3214-60020SM

- Full Free Middle Cylinder (with mast on the vehicle)**
- Unscrew bolt (5, Fig3124-60016SM) and remove the tubing baffle (4).
 - Remove the clip (7), remove the fork carriage chain, middle cylinder tube roller (6) and shaft (8).
 - Lower the mast to the bottom, press the emergency stop switch and disconnect the key switch.
 - Remove load backrest, see Side Shift Removal.
 - Block the truck wheels with wooden wedges, raise the fork carriage to 500mm with lifting tools, insert wooden block between it and the ground for supporting.
- CAUTION**
- Before going on with the next step, fix the cylinder to prevent it falling during removal, which could result in personal injury.
- Unscrew the bolt (10) and remove the cylinder clamp (11).
 - Remove the cylinder (12) from the mast.

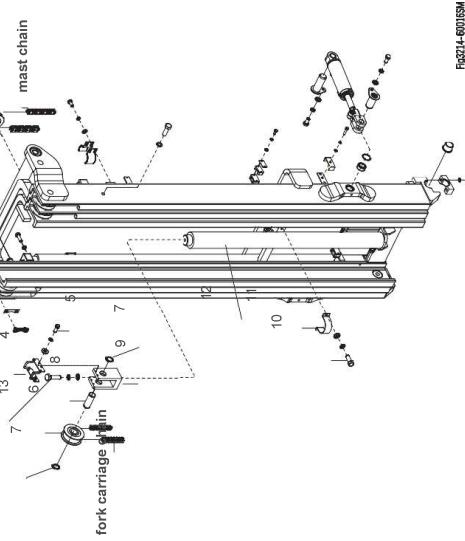


Fig3214-60017SM

- CAUTION**
- Hydraulic oil may damage truck parts and contaminate the environment. When removing joints or tubing, place a clean container under it for discharge of hydraulic oil.
- Loosen the joints (6, Fig3214-60017SM) to separate the middle cylinder and rigid pipe assembly (5).
 - Disconnect the connections between the tubing (2, Figure 3214-60018SM) and (9, Figure 3214-60019SM) if necessary, on the middle cylinder.
 - Remove the fork carriage chains according to Section 8.2.2;
- CAUTION**
- Before going on with the next step, please fix the cylinder properly first. Be sure to avoid having the cylinder fall during removal, which could result in personal injury.
- Unscrew bolt (2) and remove the cylinder (7).

8.3.2 Cylinder Maintenance

Lifting Side Cylinder

⚠ CAUTION

- Use suitable hose clamps to avoid cylinder deformation caused by severely tight hose clamp.
- Carry out the maintenance work in a clean environment to prevent impurities from entering cylinder, causing cylinder damage.

- During the installation, hydraulic oil of the same specifications must be used for cleaning or lubrication.

- Secure the cylinder to hose clamp and gently clamp the cylinder bottom.
- Unscrew the cylinder cap (7, Fig 3132-60022SM) with cylinder wrench.
- Remove the dust ring (1) and O-ring (2) from the cylinder cap.
- Pull out the piston rod (8) from the cylinder tube (10), then remove the piston (9) from the piston rod.
- Remove the support ring (3), snap-ring (5), and seal (4) from the piston.
- Clean with hydraulic oil of the same specifications.
- Replace the problem parts and assembly in reverse steps.

⚠ CAUTION

- If the piston rod or cylinder tube is damaged, replace the entire cylinder.
- If the seals are aged or damaged, replace the complete set of seals.

Fig3214-60021SM

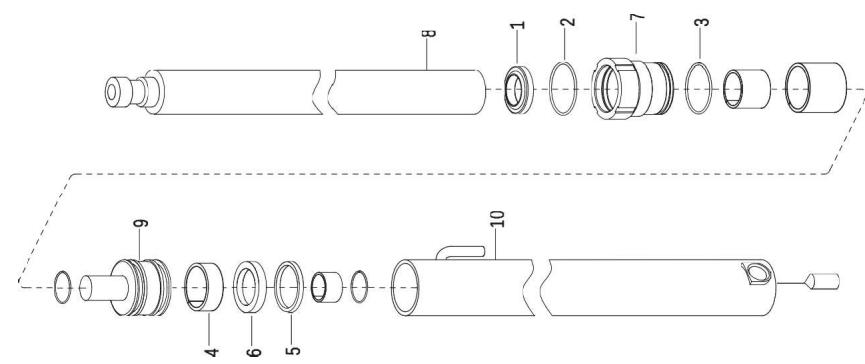


Fig3214-60022SM

⚠ CAUTION

- If the piston rod or cylinder tube is damaged, please replace the entire cylinder.
- If the seals are aged or damaged, please replace the complete set of seals.

Full Free Middle Cylinder

- Secure the cylinder to hose clamp and gently clamp the cylinder bottom.
- Unscrew the cylinder cap (10, Fig3214-60021SM) with cylinder wrench.
- Remove the dust ring (1), snap ring (2), seal ring (3), O-ring (4) and O-ring (5) from the cylinder cap.
- Pull out the piston rod (11) from the cylinder tube (13).
- Remove the piston (12) from the piston rod.
- Remove the support ring (7) and seal (8), snap ring (9) and O-ring (6) from the piston.
- Clean with hydraulic oil of the same specifications.
- Replace the problem parts and assembly in reverse steps.

⚠ CAUTION

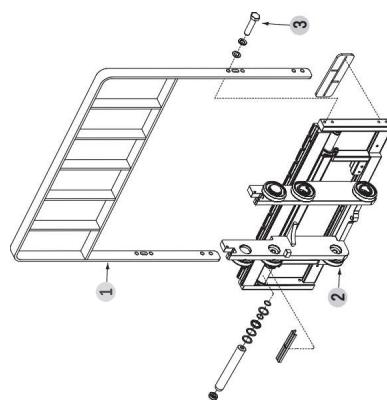
- If the piston rod or cylinder tube is damaged, replace the entire cylinder.
- If the seals are aged or damaged, replace the complete set of seals.

⚠ CAUTION

- Seal kit for cylinder**
Include item 1,2,3,4,5,6,7,8,9 (refer to parts manual).

8.3.3 Cylinder Installation

- Install the cylinder in the reverse order of removal according to Section 8.3.
- Add hydraulic oil of the same specifications into the tank, see Section 2.2.3.
- Pull out emergency stop switch and turn on the key switch.
- Repeat Lift - Lower cylinder to discharge the air within the tubing and cylinder.
- Check the hydraulic oil level and make sure that the liquid is at standard level.

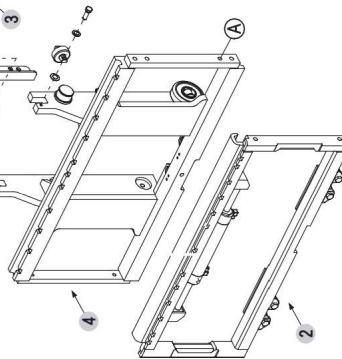
8.4 Built-in Side Shifter**8.4.1 Side Shifter Removal**

- CAUTION**
Hydraulic oil may damage truck parts and contaminate the environment. When removing joints or tubing, place a clean container under it for discharge of hydraulic oil.
- Remove the right shifting tubing (8, Fig3131-60005SM) and left shifting tubing (7) from the built-in side shifter.

- CAUTION**
Before going on with the next step, please fix the side shifter properly first. Be sure to prevent the side shifter falling during removal, which could result in personal injury.
- Remove the chain assembly and remove the side shifter from inner mast.

8.4.2 Side Shifter Installation

- Install the side shifter in the reverse order of removal according to 8.1.5.1.
- Add hydraulic oil of the same specifications into the tank, see Section 2.2.3;
- Pull out emergency stop switch and turn on the key switch.
- Repeat left shifting - right shifting operations to discharge the air within the tubing and side shift cylinder.
- Check the hydraulic oil level and make sure that the liquid is at standard level.

8.5 External Side Shifter**8.5.1 Side Shifter Removal**

- CAUTION**
Hydraulic oil may damage truck parts and contaminate the environment. When removing joints or tubing, place a clean container under it for discharge of hydraulic oil.
- Lower the mast to the bottom, press the emergency stop switch and disconnect the key switch.
 - Block the truck wheel with wooden wedge.
 - Unscrew the four bolts (3, Fig3530-60004SM), remove the load backrest (1) from the external side shifter (2).

8.5.2 Side Shifter Installation

- Add hydraulic oil of the same specifications into the tank, see Section 2.2.3.
- Pull out emergency stop switch and turn on the key switch.
- Repeat left shifting - right shifting operations to discharge the air within the tubing and side shift cylinder.
- Remove the external side shifter (2, Fig3530-60004SM) from fork carriage (4).
- Check the hydraulic oil level and make sure that the liquid is at standard level.

9. ELECTRICAL COMPONENTS

NOTES:

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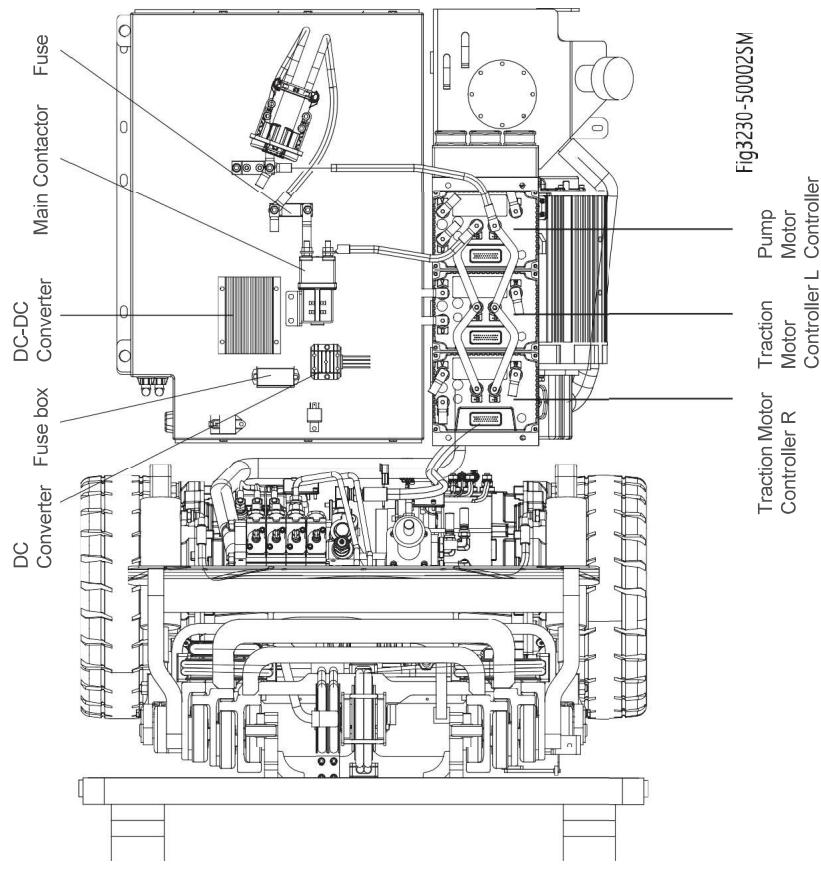
ELECTRICAL COMPONENTS

ELECTRICAL COMPONENTS

9.1 Controller

Controller Functions

Electrical control of this truck is mainly driven by Traction Motor Controller L, Pump Motor Controller and Traction Motor Controller R.



9

Fig3230-50002SM

9.1.1 Removal and Installation

Removal

- Block the wheels with triangular wooden wedge.
- Remove the floor mat and floorboard.
- Remove the wiring harness, cables, and copper strips (3) and (4) on the controller.
- Unscrew the screws (1, Fig3230-50001SM) with a wrench and remove the traction motor controller R (8) from the mounting plate (7).
- Unscrew the screws (2, Fig3230-50001SM) with a wrench and remove the traction motor pump motor controller (10) from the mounting plate (7).
- Unscrew the screws (5, Fig3230-50001SM) with a wrench and remove the traction motor controller L (9) from the mounting plate (7).

- Installation**
 - Apply appropriate amount of thermal grease on the back of controller.
 - Place the controller onto the electrical mounting plate, tighten the screws with a wrench.
 - Plug the wiring harness and cables into corresponding ports.

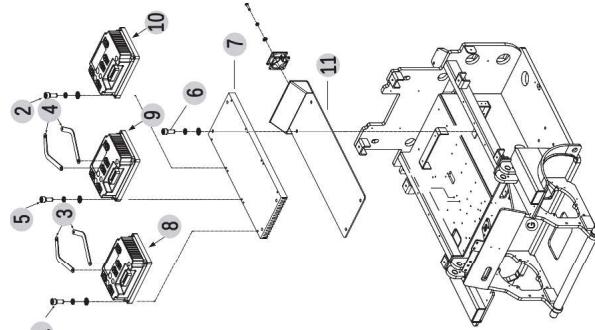


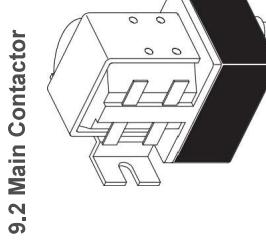
Fig3230-50001SM

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ELECTRICAL COMPONENTS

ELECTRICAL COMPONENTS



9.2 Main Contactor

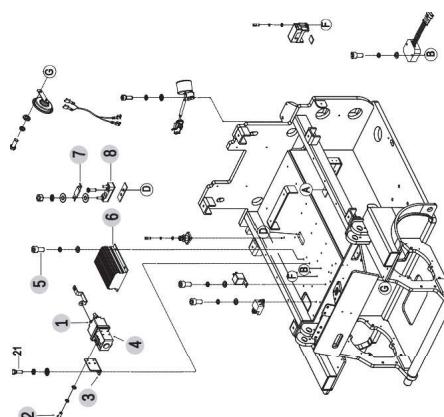


Fig1221-50008SM

This truck uses DC contactors with normally-open contacts. The ON/OFF of the contactors is controlled through controller, to achieve the control of ON/OFF of the truck.

When the contactor coil is energized, the coil current will create a magnetic field, making the static stator core produce a steady magnetic force to absorb the core and drive the contactor actions: normally opened contact connected, so the circuit is disconnected.

When the contactor coil is powered off, the magnetic force disappears, the pressure plate is released along with the release of spring, and the contact recovers: normally opened contact disconnected, so the circuit is disconnected.

9.2.1 Removal and Installation

- Switch off the key switch and remove the key, press the emergency stop switch down.
- Remove the rubber pad and floorboard.
- Unscrew the two nuts (1, Fig3230-50002SM), remove the cables, wirings, and strips from the main contactor (4).
- Unscrew the four screws (2) dismantle the main contactor (4) from the mounting plate (3).
- Install according to the reverse order of removal.

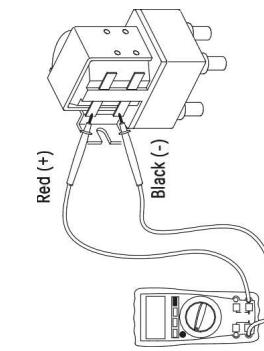


Fig1221-50009SM

Contact Checks

- Check if the surface of contact surface is smooth and symmetrical.
- Separately provide the contact with a voltage of +48V to observe if the contact can absorb.
- If the surface is uneven or the contact does not absorb, replace the main contractor.

9.2.2 Checking and Testing Visual Inspection

- Check the surface and appearance of contactor.
- Visually check the surface of contactor for scratches, damages, and stains.
- If any of the above case is found, replace with new contactor.

Coil Checks

- Disconnect the cables on the contactor.
- Check the resistance of the coil with a multimeter: measurement method is as shown in Fig1221-50009SM.
- Identify if the contactor is normal according to the readings of resistance on the multimeter. As shown in the following table:

Resistance Measurement	Judgment
Approx. 160 Ω	Normal
0 Ω (replace the contactor)	Coil shorting (replace the contactor)
∞ Ω (replace the contactor)	Coil breaking (replace the contactor)

Testing

- Check if the converter circuit is conducted.
- Provide a voltage of 80V between converter interfaces 3 and 18; if there is voltage output of 12V between interfaces 4 and 17, the converter is working properly. If the output voltage is not 12V, the converter needs to be replaced.

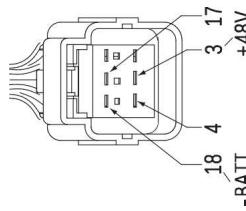


Fig3131-50021SM

9.3 DC-DC Converter

DC-DC converter (6) provides converted voltage for lights, horn, and buzzer.

Working performance: 48V DC to 12V

9.3.1 Removal and Installation

- Switch off the key switch and remove the key, press the emergency stop switch down.
- Remove the rubber pad and floorboard.
- Disconnect the connection between the converter wiring and main wiring harness.
- Unscrew the four screws (3) and remove the converter (4) from the electrical plate.
- Unscrew the two screws (5) and remove the converter (6) from the electrical plate.
- Install in the reverse order of removal.

9.3.2 Checking and Testing

Checking

- Check if the appearance of converter and its wiring harness are in good condition, and if the connectors are connected securely.

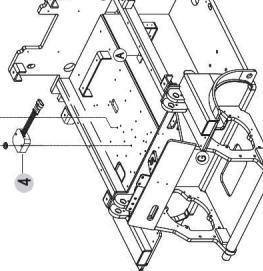


Fig3230-50045M

ELECTRICAL COMPONENTS

ELECTRICAL COMPONENTS

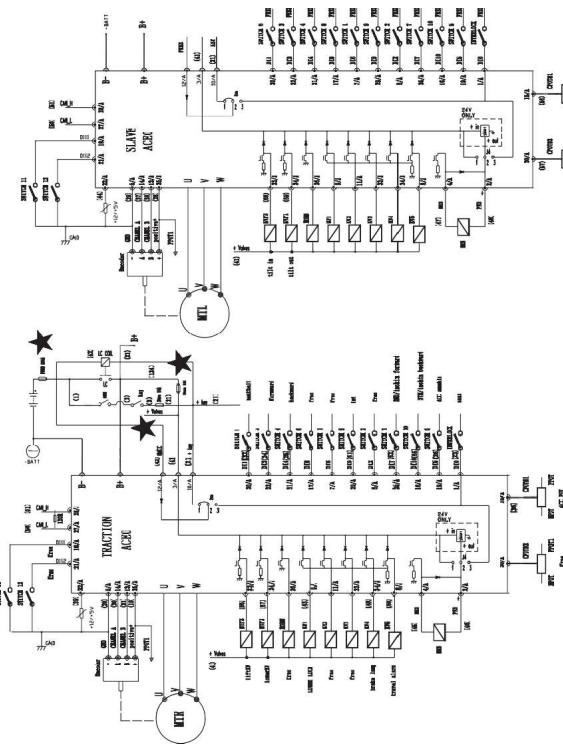
9.4 Fuse

The entire vehicle is installed with six fuses altogether. When there is fuse failure, the truck may not be able to run properly due to that.

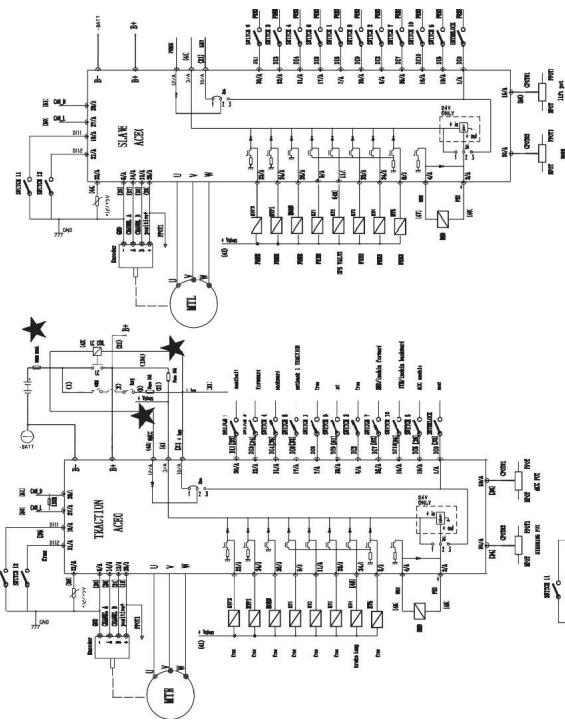
Function	Status					
	Fuse 1	Fuse 2	Fuse 3	Fuse 4	Fuse 5	Fuse 6
Fuse 1 500A	x	o	o	o	o	o
Fuse 2 10A	o	x	o	o	o	o
Fuse 3 10A	o	o	x	o	o	o
Fuse 4 10A	o	o	o	o	o	o
Fuse 5 10A	o	o	x	x	o	o
Fuse 6 10A	o	o	o	o	x	x
1 Drive	x	x	x	o	o	x
2 Hydraulic Action	x	x	x	o	o	x
3 Steering	x	x	x	o	o	x
4 Instrument	x	x	o	o	o	o
5 Turn Signal/Warning Light	x	o	x	o	o	o
6 Horn	x	o	o	x	o	o
7 Brake Light	x	x	x	o	o	x
8 Headlight	x	o	o	x	o	o
9 Reversing Light	x	x	o	x	o	o
10 Buzzer	x	x	o	x	o	o
11 Braking light	x	o	o	x	o	o
12 USB function	x	o	x	o	o	o

x : Failure
o : Normal

Electromagnetic valve



Manual valve



9.4.1 Location of Fuses

- Fuse 1: Installed on fuse holder which installed on the frame
- Fuse 2-6:installed in fuse box

- ★ Fuse position in electrical schematic diagram

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9.9 Controller Error Message

Electrical faults are mainly caused by electrical components failure or electrical circuit failure. When some components fail that may not affect the ON/OFF control circuit, the instrument won't display fault.

9.9.1 Controller

Error	Error text	Possible cause	Fault elimination
8	WATCHDOG	This is a safety related test. It is a self-diagnosis test that involves the logic between master and supervisor microcontrollers.	This alarm could be caused by a CAN bus malfunctioning which blinds master-supervisor communication.
17	LOGIC FAILURE #3	A hardware problem in the logic board due to high currents (overload). An overcurrent condition is triggered even if the power bridge is not driven.	The failure lies in the controller hardware. Replace the controller.
18	LOGIC FAILURE #2	Fault in the hardware section of the logic board which deals with voltage feedbacks of motor phases.	The failure lies in the controller hardware. Replace the controller.
19	LOGIC FAILURE #1	This fault is displayed when the controller detects an undervoltage condition at the KEY input. Undervoltage threshold depends on the nominal voltage of the controller	1-Fault can be caused by a key input signal characterized by pulses below the undervoltage threshold, possibly due to external loads like DC/DC converters starting-up, relays or contactors during switching periods, solenoids energizing or de-energizing. Consider removing such loads. 2-If no voltage transient is detected on the supply line and the alarm is present every time the key switches on, the failure probably lies in the controller hardware. Replace the logic board. 3-If the alarm occurs during motor acceleration or when there is a hydraulic-related request, check the battery charge, the battery health and power-cable connections.

Error	Error text	Possible cause	Fault elimination
28	PUMP VMN LOW	The pump motor output is lower than expected, considering the PWM duty cycle applied.	A) If the problem occurs at start up (the LC does not close at all), check: - Motor internal connections. - Motor power cables connections. - If the motor connection are OK, the problem is inside the controller. B) If the problem occurs after closing the LC (the LC closes and then opens back again), check: - Motor internal connections. - If motor windings/cables have leakages towards truck frame. - If no problem are found on the motors, the problem is inside the controller. C) If the alarm occurs during motor running, check: - Motor internal connections. - If motor windings/cables have leakages towards truck frame. - That the LC power contact closer properly, with a good contact. - If no problem are found on the motors, the problem is inside the controller, it is necessary to replace the logic board.
29	PUMP VMN HIGH	This test is carried out when the pump motor is turning (PWM applied). The pump motor output is higher than expected, considering the PWM applied.	-Motor internal connections -If motor windings/cables have leakages towards truck frame -If no problem are found on the motors, the problem is inside the controller, it is necessary to replace the logic board.

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Error Message	Possible cause	Fault elimination	
Error	Error text		
30 V/MN LOW	Start-up test. Before switching the LC on, the software checks the power bridge; it turns on alternately the high-side power MOSFETs and expects the phase voltages increase toward the positive rail value. If one phase voltage is lower than a certain percentage of the rail voltage, this alarm occurs. Motor running test. When the motor is running, the power bridge is on and the motor voltage feedback tested; if it's lower than expected value (a range of values is considered), the controller enters in fault state.	If the problem occurs at start up (the LC does not close at all), check: - motor power-cables connections - motor internal connections (ohmic continuity); - If the motor connections are OK, the problem is inside the controller; replace it. If the alarm occurs while the motor is running, check: - motor connections. - that the LC power contact closes properly, with a good contact. - if no problem is found, the problem is inside the controller. Replace it.	A) If the problem occurs at start up (the LC does not close), check: - motor power cables connections (ohmic continuity); - If the motor connections are OK, the problem is inside the controller. Replace it. B) If the alarm occurs while the motor is running, check: - that the LC power contact closes properly, with a good contact. - if no problem is found, the problem is inside the controller. Replace it.
31 V/MN HIGH	Before switching the LC on, the software checks the power bridge; it turns on alternatively the low-side power MOSFETs and expects the phase voltages decrease down to B-. If the phase voltages are higher than a certain percentage of the nominal battery voltage, this alarm occurs. This alarm may also occur when the start-up diagnosis has succeeded and so the LC has been closed. In this condition, the phase voltages are expected to be lower than half the battery voltage. If one of them is higher than that value, this alarm occurs.	Before switching the LC on, the software checks the power bridge; it turns on alternatively the high-side power MOSFETs and expects the phase voltages increase down to A+. If the phase voltages are lower than a certain percentage of the nominal battery voltage, this alarm occurs.	

38	CONTACTOR OPEN	The LC coil is driven by the controller, but it seems that the power contacts do not close. In order to detect this condition the controller injects a DC current into the motor and checks the voltage on power capacitor. If the power capacitors get discharged it means that the main contactor is open.	LC contacts are not working. Replace the LC.
52	PUMP I=0 EVER	While the pump motor is running, the current feedback is constantly stuck to zero.	1-Check the motor connection, that there is continuity. If the motor connection is opened, the current cannot flow, so the test fails and the error code is displayed; 2-If everything is ok for what it concerns the motor, the problem could be in the current sensor or in the related circuit.
53	STBY I HIGH	In standby, the sensor detects a current value different from zero.	The current sensor or the current feedback circuit is damaged. Replace the controller.

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62	TH. PROTECTION	<p>The temperature of the controller base plate is above 85 °C. The maximum current is proportionally decreased with the temperature excess from 85 °C up to 105 °C. At 105 °C the current is limited to 0 A.</p>	<p>It is necessary to improve the controller cooling. To realize an adequate cooling in case of fanned heat sink important factors are the air flux and the cooling-air temperature. If the thermal dissipation is realized by applying the controller base plate onto the truck frame, the important factors are the thickness of the frame and the planarity and roughness of its surface.</p> <p>If the alarm occurs when the controller is cold, the possible reasons are a thermal-sensor failure or a failure in the logic board. In the last case, it is necessary to replace the controller.</p>	<p>1- Check the temperature read by the thermal sensor inside the motor through the MOTOR TEMPERATURE reading in the TESTER function.</p> <p>2- Check the sensor ohmic value and the sensor wiring.</p> <p>3- If the sensor is OK, improve the cooling of the motor.</p> <p>4- If the warning is present when the motor is cool, replace the controller.</p>	<p>This warning occurs when the temperature sensor is open (if digital) or if it has overtaken the MAX. MOTOR TEMP. threshold (if analog) (see paragraph 8.2.3).</p>
65	MOTOR TEMPERAT.			<p>1- Check the battery charge and charge it if necessary</p> <p>2- If the battery is actually charged, measure the battery voltage through a voltmeter and compare it with the BATTERY VOLTAGE reading in the TESTER function. If they are different, adjust the ADJUST BATTERY parameter (ADJUSTMENTS list) with the value measured through the voltmeter.</p> <p>3- If the problem is not solved, replace the logic board.</p>	<p>Parameter BATTERY CHECK is other than 0 (SET OPTION) and battery charge is evaluated to be lower than BATT.LOW TRESHLD (ADJUSTMENTS).</p>

74	DRIVER SHORTED	<p>The driver of the LC coil is shorted.</p>	<p>1- Check if there is a short or a low impedance pull-down between NMC (A12) and -B. 2- The driver circuit is damaged; replace the logic board. 3-the SET POSITIVE PEB parameter is not correct</p>	<p>This type of fault is not related to external components; replace the logic board.</p>	<p>1- Check the wirings. 2- Check the mechanical calibration and the functionality of the accelerator potentiometer. 3- Acquire the maximum and minimum potentiometer value through the PROGRAM VACC function. 4- If the problem is not solved, replace the logic board.</p>
75	CONTACTOR DRIVER	<p>The LC coil driver is not able to drive the load. The device itself or its driver circuit is damaged.</p>	<p>At key-on and immediately after that, the travel demands have been turned off. This alarm occurs if the ACCELERATOR reading (in TESTER function) is above the minimum value acquired during the PROGRAM VACC procedure.</p>	<p>1- Check the wirings. 2- Check the mechanical calibration and the functionality of the accelerator potentiometer. 3- Through the TESTER function, check the states of the inputs are coherent with microswitches states. 4- If the problem is not solved, replace the logic board.</p>	<p>1- Check the wirings. 2- Check microswitches for failures. 3- Through the TESTER function, check the states of the inputs are coherent with microswitches states. 4- If the problem is not solved, replace the logic board.</p>
78	VACC NOT OK		<p>INCORRECT START</p> <p>1-A travel demand active at key-on. 2-Man-presence sensor active at key on.</p>	<p>Incorrect starting sequence. Possible reasons for this alarm are:</p> <p>1- A travel demand active at key-on. 2-Man-presence sensor active at key on.</p>	<p>1- Check that travel requests are not active at the same time. 2- Check the FW and BW input states through the TESTER function. 3- Check the wirings relative to the FW and BW inputs. 4- Check if there are failures in the microswitches. 5- If the problem is not solved, replace the logic board.</p>

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		This fault occurs when the frequency supplied to the motor is higher than 30 Hz and the signal feedback from the encoder has a too high jump in few tens of milliseconds. This condition is related to an encoder failure.	1- Check that chain sensor switches are not active. 2- Check the wirings relative to the chain sensor switches. 3- Check if there are failures in the microswitches. 4- If the problem is not solved, replace the logic board.
82	ENCODER ERROR	—	—
86	PEDAL WIRE KO	—	—
126	CHAIN SENSOR KO	the slack chain sensor is not in normal status	1- Check that reach pot is present, but the enable switch is not active 2- check the wiring of the reach pot
129	WRONG CONFIG	wrong set of controller type and model type	1-check the parameter controller type in ""special adjustment"" menu 2-check the parameter model type in ""special adjustment"" menu
130	REACH OUT OF RNG	reach pot out of the normal range	1-do the teaching again 2-check the wiring of the reach pot
131	VACC REACH NOTOK	the output of reach pot is present, but the enable switch is not active	1-check the reach pot 2-check the wiring

		do the wrong way of reach pot teaching	do the teaching in correct way
132	ALL ACQU. REACH	tilt pot out of the normal range	1-do the teaching again 2-check the wiring of the tilt pot
133	TLT OUT OF RANGE	the output of tilt pot is present, but the enable switch is not active	1-check the tilt pot 2-check the wiring
134	VACC TILT NOT OK	side shift pot out of the normal range	1-do the teaching again 2-check the wiring of the side shift pot
135	SFT OUT OF RANGE	the output of side shift pot is present, but the enable switch is not active	1-check the side shift pot 2-check the wiring
136	VACC SHFT NOT OK	do the wrong way of tilt pot teaching	do the teaching in correct way
137	ALL ACQU. TILT	do the wrong way of side shift pot teaching	do the teaching in correct way
138	ALL ACQU. SHIFT	the controller lost the communication with EP tiller at least once when the truck is using	1-check the wiring of can cable 2-try to replace the EP tiller 3-replace the controller
139	NO CAN TILL EP	—	—

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140	WAIT TILL EP	wait the EP tiller CAN-BUS communication when key-on	
141	NO CAN BRAKE EP	if set the PEDAL_BRK TYPE is option#1, but the controller can't get the can message from brake, the alarm occurs	1-check the wiring of can-brake. 2-check if the can-brake is broken. 3-try to set the PEDAL_BRK TYPE=NONE
142	WAIT ACTIVATION	if download a SW with activation function, but haven't do any activation before, the alarm occurs	do activation with EP TOOLS
143	WRONG PASSWORD	if the EP PASSWORD function is active but haven't enter the correct password, the alarm occurs	1-enter the correct password. 2-disable the password function
144	NO CAN DISP EP	When the truck is running, if the DISPLAY TYPE=5, but the controller loses communication with EP DISPLAY, this alarm occurs	1-check the communication wiring between EP DISPLAY and controller. 2-check if the EP DISPLAY is broken. 3-try to set the DISPLAY TYPE into a correct value
145	WAIT DISP EP	if the DISPLAY TYPE=5, but the controller can't get message from EP DISPLAY when the truck start, this alarm occurs	1-check the communication wiring between EP DISPLAY and controller. 2-check if the EP DISPLAY is broken. 3-set the DISPLAY TYPE into a correct value
146	RENTAL TIMEOUT	if the rental function is activated, but the rental enable time is run out, this alarm occurs	1-check the rental hour left in TESTER menu. 2-use EP TOOLS to disable the rental function

147	NO CAN BMS EP	if the communication between BMS and controller is out of time, this alarm occurs	1-check the communication wiring between BMS and controller. 2-there's a fault on BMS can device, replace the BMS
148	EP BMS M/C OPEN	if the battery charge level is to low, the BMS require the main contactor open, this alarm occurs	1-check the battery charge level. 2-check if the battery is ok. 3-replace the BMS
149	EP BMS TRAC CTB	if the battery charge level is to low, the BMS require the controller to reduce the traction speed, this alarm occurs	1-check the battery charge level. 2-check if the battery is ok. 3-replace the BMS
150	EP BMS LIFT STOP	if the battery charge level is to low, the BMS require the controller to stop the lift function, this alarm occurs	1-check the battery charge level. 2-check if the battery is ok. 3-replace the BMS
151	EP BMS TRAC STOP	if the battery charge level is to low, the BMS require the controller to stop the traction function, this alarm occurs	1-check the battery charge level. 2-check if the battery is ok. 3-replace the BMS
153	OFFSET SPD. SENS.	It is necessary to acquire the offset angle between the stator and the speed sensor, i.e. they mutual angular misalignment. An automatic function is dedicated to this procedure.	Perform the teaching procedure: in OPTIONS, select ABS SENS. ACQUIRE.
155	WAIT MOTOR STILL	The controller is waiting for the motor to stop rotating. This warning can only appear in controllers for brushless motors	—

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		Error Message	Possible cause	Fault elimination
	Error	Error text		
161	RPM HIGH	This alarm occurs in Gen. Set versions when the speed exceeds the threshold speed.		
170	WRONG KEY VOLT.	The measured key voltage is not the right one for the inverter.	1- Check if the SET KEY VOLTAGE parameter in the KEY ADJUSTMENTS list is set in accordance with the key voltage. 2- Check if the key voltage is ok using a voltmeter, if not check the wiring. 3- In case the problem is not solved, replace the logic board.	
177	COIL SHOR. EB.	This alarm occurs when an overload of the EB driver occurs.	1- Check the connections between the controller outputs and the loads. 2- Collect information about characteristics of the coil connected to the driver and ask for assistance to a EP technician in order to verify that the maximum current that can be supplied by the hardware is not exceeded. 3- In case no failures/problems have been found, the problem is in the controller, which has to be replaced.	

	Error	Error text		
178	MOTOR TEMP. STOP		The temperature sensor has overtaken the threshold defined by STOP MOTOR TEMP.	1- Check the temperature read by the thermal sensor inside the motor through the MOTOR TEMPERATURE reading in the TESTER function. 2- Check the sensor ohmic value and the sensor wiring. 3- If the sensor is OK, improve the cooling of the motor. 4- If the warning is present when the motor is cool, replace the controller.
179	STEER SENSOR KO		The voltage read by the microcontroller at the steering-STEER RIGHT VOLT + STEER LEFT VOLT range, programmed through the STEER ACQUIRING function	1- Acquire the maximum and minimum values coming from the steering potentiometer through the STEER ACQUIRING function. If the alarm is still present, check the mechanical calibration and the functionality of the potentiometer. 2- If the problem is not solved, replace the logic board.
180	OVERLOAD		The motor current has overcome the limit fixed by hardware.	If the alarm condition occurs again, ask for assistance to a EP technician. The fault condition could be affected by wrong adjustments of motor parameters.
181	WRONG ENC SET		Mismatch between parameters ENCODER PULSES 1 and ENCODER PULSES 2	Set the two parameters with the same value, according to the adopted encoder
182	EVP2 COIL OPEN		No load is connected between the EVP2 output and the electrovalve positive terminal.	1- Check the EVP2 condition. 2- Check the EVP2 wiring. 3- If the problem is not solved, replace the logic board.

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Error Message	Possible cause	Fault elimination
Error	Error text	
183 EVP2 DRIV. SHORT	1- The EVP2 driver is shorted. 2- The microcontroller detects a mismatch between the valve set-point and the feedback of the EVP2 output.	1- Check if there is a short circuit or a low-impedance conduction path between the negative of the coil and -B. 2- Collect information about: o the voltage applied across the EVP2 coil o the current in the coil, o features of the coil. Ask for assistance to EP in order to verify that the software diagnoses are in accordance with the type of coil employed. 3- If the problem is not solved, it could be necessary to replace the controller.
184 EVP2 DRIVER OPEN	The EVP2 driver is not able to drive the EVP2 coil. The device itself or its driving circuit is damaged.	This fault is not related to external components. Replace the logic board.
186 WAIT MOT.P STILL	If DC Pump option is set to ON, the software expects the voltage on -P output to be at a "steady state" value, before switching the LC on. If the voltage is different, it could be due to the fact that the motor connected to -P is not still. For this reason, the software waits 30 seconds for the voltage to be at the "steady state" value (and for the pump motor to be still). After this time, the software assumes that the problem is not due to the fact that the pump motor is not still and show the PUMP VMN NOT OK alarm.	1- If the motor connected to -P is still moving, just wait for it to be still. 2- If not, in 30 seconds the alarm PUMP VMN NOT OK will appear.

Error Message	Possible cause	Fault elimination
Error	Error text	
187 MANY PUMP REQ.	if there's more than one pump function request, e.g. lift+tilt, the alarm occurs	1-check the microswitches status 2-check the wiring of pump functions 3-disconnect the wire on the controller side 4-if the problem is not solved, replace the logic board.
188 PUMP VACC NOT OK	The minimum voltage of the lift potentiometer is not correctly set.	1-It is suggested to repeat the acquiring procedure of MIN LIFT and MAX LIFT 2-check the wiring of the lift pot 3-check if it's the lift pot fault
189 PUMP INC START	Man-presence switch is not enabled at pump request	1- Check wirings. 2- Check microswitches for failures. 3- Through the TESTER function, check the states of the inputs are coherent with microswitches states. 4- If the problem is not solved, replace the logic board.
190 PUMP VMN NOT OK		1- The motor connected to -P must be completely still before this alarm occurs. The software waits 30 seconds before showing this alarm. During this time it shows the WAIT MOTOR STILL warning. 2- Motor internal connections 3- Motor power cables connections 4- Motor leakage to truck frame 5- If the motor connections are ok, the problem is inside the controller it is necessary to replace the logic board.
191 PUMP INO ZERO	In standby condition (pump motor not driven), the feedback coming from the current sensor in the pump chopper gives a value out of a permitted range, because the pump current is not zero.	This type of fault is not related to external components; replace the controller.

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Error	Error Message	Possible cause	Fault elimination
Error	Error text		
192	PUMP VACC RANGE	For COMBIAC0 and COMBIACX, it means the output of lift pot is out of the normal range	<p>1- Verify that the EB coil is connected correctly between pin A2 and pin A4.</p> <p>2- Verify that the parameter POSITIVE E.B. is set in accordance with the actual configuration (see paragraph 8.2.5). The software, in fact, depending on specific parameter value, makes a proper diagnosis; a wrong configuration of this parameter could generate a false fault.</p> <p>3- In case no failures/problems have been found, the problem is in the controller, which has to be replaced.</p>
193	SMARTDRIVER KO	There is a hardware problem in the smart driver circuit. The driver is set to be ON but the output voltage does not increase	<p>For the versions where the smart driver is not installed (36/48V and 80V), it is possible to decide where the positive supply for pin A2 comes from by choosing a dedicated hardware configuration. The parameter POSITIVE E.B. has to be set in accordance with the hardware configuration, because the software makes a proper diagnosis depending on the parameter; a wrong setting could generate a false fault. The available choices are:</p> <ul style="list-style-type: none"> - 0 = PEB is managed by the smart driver (available for 24V version only). - 1 = PEB comes from the TILLER input (A1). - 2 = PEB comes from PEV (A3). <p>PEV must be connected to terminal +B of the controller. This is the default configuration for 36/48V and 80V version.</p> <p>This alarm can only appear if POSITIVE E.B. is set as TILLER/SEAT.</p>

Error	Error Message	Possible cause	Fault elimination
Error	Error text		
195	POS. EB. SHORTED	The voltage on pin A2 is high even if the smart driver is turned OFF with the EB coil.	<p>1- Verify that the parameter POSITIVE E.B. is set in accordance with the actual coil positive supply impedance path between pin A2 and of the +B. In case no failures/problems have been found, the problem is in the controller, which has to be replaced.</p>
196	MOT PHASE SH.	Short circuit between two motor phases. The hexadecimal value "XX" identifies the shorted phases: 36: U – V short circuit 37: U – W short circuit 38: V – W short circuit	<p>1- Verify the motor phases connection on the motor side.</p> <p>2- Verify the motor phases connection on the inverter side.</p> <p>3- Check the motor power cables.</p> <p>4- Replace the controller.</p> <p>5- If the alarm does not disappear, the problem is in the motor. Replace it.</p>
197	WRONG SLAVE VER.	Wrong software version on supervisor uc.	Upload the correct software version
198	M/S PAR CHK MISM	At start-up there is a mismatch in the parameter checksum between the master and the supervisor microcontrollers.	Restore and save again the parameters list.
199	PARAM TRANSFER	Master uc is transferring parameters to the supervisor.	Wait until the end of the procedure. If the alarm remains longer, recycle the key.
200	VDC OFF SHORTED	The logic board measures a voltage value across the DC-link that is constantly out of range, above the maximum allowed value	<p>1- Check that the battery has the same nominal voltage of the inverter.</p> <p>2- Check the battery voltage if it is out of range; replace the battery.</p> <p>3- If the battery voltage is ok, replace the logic board.</p>
201	TORQUE PROFILE	There is an error in the choice of the torque profile parameters.	Check in the HARDWARE SETTINGS list the value of those parameters

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Error Message	Possible cause	Fault elimination
Error	Error text	
202 VDC LINK OVERV.	This fault is displayed when the controller detects an overvoltage condition. Overvoltage threshold depends on the nominal voltage of the controller. Nominal voltage 24V 36/48V 72/80V 96V Overvoltage threshold 35V 65V 115V / 130V As soon as the fault occurs, power bridge and MC are opened. The condition is triggered using the same HW interrupt used for undervoltage detection, uC discerns between the two evaluating the voltage present across DC-link capacitors: - High voltage Overvoltage condition - Low/normal voltage Undervoltage condition	If the alarm happens during the brake release, check the line contactor contact and the battery power-cable connection.
203 HW/FAULT MC	The Mcu and the Scu check the status of the main contactor is different from each other.	This type of fault is related to internal components. Replace the logic board.
204 BRAKE RUN OUT	The CPOT BRAKE input read by the microcontroller is out of the range defined by parameters SET PBRK. MIN and SET PBRK. MAX	1- Check the mechanical calibration and the functionality of the brake potentiometer. 2- Acquire the minimum and maximum potentiometer values. 3- If the alarm is still present, replace the logic board.
205 EPS RELAY OPEN	The controller receives from EPS information about the safety contacts being open.	Verify the EPS functionality

Error Message	Possible cause	Fault elimination
Error	Error text	
206 INIT VMN HIGH	Before closing the LC, the software checks the power-bridge voltage without driving it. The software expects the voltage to be in a "steady state" value. If it is too high, this alarm occurs. The hexdecimal value 'XX' identifies the faulty phase: 81: phase U 82: phase V 83: phase W	1- Check the motor power cables. 2- Check the impedance between U, V and W terminals and -B terminal of the controller. 3- Check the motor leakage to truck frame. 4- If the motor connections are OK and there are no external low impedance paths, the problem is inside the controller. Replace it.
207 INIT VMN LOW	Before closing the LC, the software checks the power-bridge voltage without driving it. The software expects the voltage to be in a "steady state" value. If it is too low, this alarm occurs. The hexdecimal value 'XX' identifies the faulty phase: 01: phase U 02: phase V 03: phase W	1- Check the motor power cables. 2- Check the impedance between U, V and W terminals and -B terminal of the controller. 3- Check the motor leakage to truck frame. 4- If the motor connections are OK and there are no external low impedance paths, the problem is inside the controller. Replace it.
208 EEPROM KO	The connection of the EEPROM is not ok	This type of fault is related to internal components. Replace the logic board.
209 PARAM RESTORE	The controller has restored the default settings. If a CLEAR EEPROM has been made before the last key re-cycle, this warning informs you that EEPROM was correctly cleared.	1- A travel demand or a pump request does cancel the alarm. 2- If the alarm appears at key-on without any CLEAR EEPROM performed, replace the controller.
210 WRONG RAM MEM.	The algorithm implemented to check the main RAM registers finds wrong contents: the register is "dirty". This alarm inhibits the machine operations.	Try to switch the key off and then on again, if the alarm is still present replace the logic board.

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Error Message	Possible cause	Fault elimination
Error	Error text	
211 STALL ROTOR	The traction rotor is stuck or the encoder signal is not correctly received by the controller	<p>1- Check the encoder condition.</p> <p>2- Check the wiring.</p> <p>3- Through the TESTER function, check if the sign of FREQUENCY and ENCODER are the same and if they are different from zero during a traction request.</p> <p>4- If the problem is not solved, replace the logic board.</p>
212 POWER MISMATCH	The error between the power setpoint and the estimated power is out of range.	<p>Ask for assistance to a EP technician about the correct adjustment of the motor parameters.</p>
213 POSITIVE LC OPEN	The positive voltage of LC is different from expected.	<p>1- Verify LC coil is properly connected.</p> <p>2- Verify CONF_POSITIVE LC parameter is set in accordance with the actual coil positive supply (see paragraph 8.2.5). Software, depending on the parameter value, makes a proper diagnosis; a mismatch between the hardware and the parameter configuration could generate a false fault.</p> <p>3- In case no failures/problems have been found, the problem is in the controller, which has to be replaced.</p>
214 EVP COIL OPEN	No load is connected between the EVP output (A24) and the electrovalve positive terminal.	<p>1- Check the EVP condition.</p> <p>2- Check the EVP wiring.</p> <p>3- If the problem is not solved, replace the logic board.</p>

Error Message	Possible cause	Fault elimination
Error	Error text	
215 EVP DRV. SHORT.		<p>1- The EVP driver (output A24) is shorted.</p> <p>2- The microcontroller detects a mismatch between the valve set-point and the feedback of the EVP output.</p> <p>Ask for assistance to EP in order to verify that the software diagnoses are in accordance with the type of coil employed.</p> <p>If the problem is not solved, it could be necessary to replace the controller.</p>
216 EB. COIL OPEN		<p>This fault appears when no load is connected between the NEB output (A4) and the EB positive terminal PEB (A2).</p>
217 PEV NOT OK		<p>Terminal PCOM is not connected to the battery or the voltage is different from that defined by parameter SET_POSITIVE_PEB (see the ADJUSTMENTS list, paragraph 8.2.3). This alarm can occur if output NAUX1 is present (and the related setting is active) or the AUX OUT function is active.</p>
218 SENS MOT TEMP KO		<p>The output of the motor thermal sensor is out of range.</p>
219 PEB-PEVP NOT OK		<p>Only for AC3 and ACE3, the PEB and PEV voltage is not match the parameter setting</p>

1- Check PCOM terminal: it must be connected to the battery.
2- Set the nominal PCOM voltage in parameter SET_POSITIVE_PEB in ADJUSTMENTS list.

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Error	Error Message	Possible cause	Fault elimination
Error	Error text		
220	VKEY OFF SHORTED	At key-on, the logic board measures a voltage value of the KEY input that is constantly out of range, below the minimum allowed value.	1- Check that the battery has the same nominal voltage of the inverter. 2- Check the battery voltage, if it is out of range replace the battery. 3- If the battery voltage is ok, replace the logic board.
221	HANDBRAKE	Handbrake input is active.	1- Check that handbrake is not active by mistake. 2- Check the SR/HB input state through the TESTER function. 3- Check if there are failures in the microswitches. 4- Check if there are failures in the microswitches. 5- If the problem is not solved, replace the logic board.
222	SEAT MISMATCH	This alarm can appear only in a Traction + Pump configuration or in a multimotor one. There is an input mismatch between the traction controller and the pump controller relatively to the TILLER/SEA T input (A1): the two values recorded by the two controllers are different.	"1- Check if there are wrong connections in the external wiring. 2- Using the TESTER function, verify that the seat inputs are in accordance with the actual state of the external switch. 3- In case no failures/problems have been found, the problem is in the controller, which has to be replaced.
223	COIL SHOR. MC (For Combi AC0/ Combi ACX and ACE4) MC-EF COIL SHOR. (For ACE2, ACE3)	This alarm occurs when an overload of the MC driver	1- Check the connections between the controller outputs and the loads. 2- Collect information about characteristics of the coil connected to the driver and ask for assistance to a EP technician in order to verify that the maximum current that can be supplied by the hardware is not exceeded. 3- In case no failures/problems have been found, the problem is in the controller, which has to be replaced.

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Error	Error Message	Possible cause	Fault elimination
Error	Error text		
224	WAITING FOR NODE	The controller receives from the CAN bus the message that another controller in the net is in fault condition; as a consequence the controller itself cannot enter into an operative status, but it has to wait until the other node comes out from the fault status.	Check if any other device on the CAN bus is in fault condition.
225	CURRENT SENS. KO	the current sensor of the controller cannot be driven or always 0	This type of fault is related to internal components. Replace the logic board.
226	VACC OUT RANGE	1- The CPOT input read by the microcontroller is not within the MIN VACC + MAX VACC range, programmed through the PROGRAMM VACC function. 2- The acquired values MIN VACC and MAX VACC are inconsistent.	1- Acquire the maximum and minimum potentiometer values through the PROGRAM VACC function. If the alarm is still present, check the mechanical calibration and the functionality of the accelerator potentiometer. 2- If the problem is not solved, replace the logic board.
227	HW FAULT	At start-up, some hardware circuit intended to enable and disable the power bridge, or the LC driver (output A12) is found to be faulty. The hexadecimal value "XX" facilitates EP technicians debugging the problem.	This type of fault is related to internal components. Replace the logic board.
228	TILLER OPEN	Tiller/seat input has been inactive for more than 120 seconds.	1-Activate the tiller/seat input. 2- Check the tiller/seat input state through the TESTER function. 3- Check the wirings. 4- Check if there are failures in the microswitches. 5- If the problem is not solved, replace the logic board.
229	HWFAULT EB.	At start-up, the hardware circuit dedicated to enable and disable the EB driver (output A4) is found to be faulty. The hexadeciml value "XX" facilitates EP technicians debugging the problem.	This type of fault is not related to external components. Replace the logic board.

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Error	Error Message	Possible cause	Fault elimination
Error	Error text		
230	LC COIL OPEN	This fault appears when no load is connected between the NMC output A12 and the positive voltage (for example the KEY voltage).	<p>1- Check the wiring, in order to verify if LC coil is connected to the right connector pin and if it is not interrupted.</p> <p>2- If the alarm is still present, than the problem is inside the logic board; replace it.</p>
232	CONT. DRV. EV	AUX valve driver is not able to drive the load.	The device or its driving circuit is damaged. Replace the controller.
233	POWERMOS SHORTED	The DC-link voltage drops to zero when a high-side or low-side MOSFET is turned on.	<p>1- Check that motor phases are correctly connected.</p> <p>2- Check that there is no dispersion to ground for every motor phases.</p> <p>3- In case the problem is not solved, replace the controller.</p>
234	DRV. SHOR. EV	AUX valve driver is shorted.	<p>1- Check if there is a short circuit or a low impedance path between the negative terminal of the coils and -B.</p> <p>2- If the problem is not solved, replace the logic board.</p>
235	CTRAP THRESHOLD	it is a controller internal check fault	Check the parameter DUTY PWM CTRAP is correct. If the alarm is still, ask technician for assistance.
236	CURRENT GAIN		<p>The maximum current gain parameters are at the default values, which means that the maximum current adjustment procedure has not been carried out yet.</p>

Error	Error Message	Possible cause	Fault elimination
Error	Error text		
237	ANALOG INPUT	This alarm occurs when the A/D conversion of the analog inputs returns frozen values, on all the converted signals, for more than 400 ms. The goal of this diagnosis is to detect a failure in the A/D converter or a problem in the code flow that skips the refresh of the analog signal conversion.	If the problem occurs permanently, it is necessary to replace the logic board.
238	HW FAULT EV.	At start-up, the hardware circuit dedicated to enable and disable the EV drivers is found to be faulty. The hexadecimal value "XX" facilitates EP technicians debugging the problem.	This type of fault is not related to external components. Replace the logic board.
239	CONTROLLER MISIM.	The software is not compatible with the hardware. Each controller produced is "signed" at the end of line test with a specific code mark saved in EEPROM according to the customized part number. According with this "sign", only the customized firmware can be uploaded.	<p>1- Upload the correct firmware.</p> <p>2- Ask for assistance to a EP technician in order to verify that the firmware is correct.</p>
240	EVP DRIVER OPEN	The EVP driver is not able to drive the EVP coil. The device itself or its driving circuit is damaged.	This fault is not related to external components. Replace the logic board.
241	COIL SHOR. EVAUX		<p>1- Check the connections between the controller outputs and the loads.</p> <p>2- Collect information about characteristics of the coils connected to the drivers and ask for assistance to a EP technician in order to verify that the maximum current that can be supplied by the hardware is not exceeded. In case no failures/problems have been found, the problem is in the controller, which has to be replaced.</p>

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Error	Error Message	Possible cause	Fault elimination
Error	Error text	Error	Error text
242	OPEN COIL EV.	"This fault appears when no load is connected between one or more EV outputs and the positive terminal PEV (pin A3). For the meaning of code "XX", refer to paragraph 10.5 EVP1=BIT 0 EV1=BIT 1 EV2=BIT 2 EV3=BIT 3 EVP2=BIT 4 EV4=BIT 5 EV5=BIT 7 HORN=BIT 6"	1- Check the coils. 2- Check the wiring. 3- If the problem is not solved, replace the logic board.
243	THROTTLE PROG.	A wrong profile has been set in the throttle profile.	Set properly the throttle-related parameters
244	WARNING SLAVE	Warning on supervisor uc.	Connect the Console to the supervisor uc and check which alarm is present.
245	IQ MISMATCHED	The error between the Iq (q-axis current) setpoint and the estimated Iq is out of range.	Ask for assistance to a EP technician in order to do the correct adjustment of the motor parameters.
246	EB. DRIV.OPEN	The EB coil driver is not able to drive the load. The device itself or its driving circuit is damaged.	This type of fault is not related to external components. Replace the logic board.
247	DATA ACQUISITION	Controller in calibration state.	The alarm ends when the acquisition is done.
248	NO CAN MSG.	CANbus communication does not work properly. The hexadeciml value "XX" identifies the faulty node.	1- Verify the CANbus network (external issue). 2- Replace the logic board (internal issue).
249	CHECK UP NEEDED	This is a warning to point out that it is time for the programmed maintenance.	Turn on the CHECK UP DONE option after that the maintenance service.

Error	Error Message	Possible cause	Fault elimination
Error	Error text	Error	Error text
250	THERMIC SENS. KO	The output of the controller thermal sensor is out of range.	This kind of fault is not related to external components. Replace the controller.
251	WRONG SET BAT.	At start-up, the controller checks the battery voltage (measured at the KEY input A10) and it verifies that it is within a range of ±20% around the nominal value.	1- Check that the SET BATTERY parameter inside the ADJUSTMENTS list matches with the battery nominal voltage. 2- If the battery nominal voltage is not available for the SET BATTERY parameter inside the ADJUSTMENTS list, record the value stored as HARDWARE BATTERY RANGE parameter in the SPECIAL ADJUST. list and contact a EP technician. 3- Through the TESTER function, check that the KEY VOLTAGE reading shows the same value as the key voltage measured with a voltmeter on pin A10. If it does not match, then modify the ADJUST BATTERY parameter according to the value read by the voltmeter. 4- Replace the battery.
253	FIELD ORIENT. KO	The error between the Id (d-axis current) setpoint and the estimated Id is out of range.	Ask for assistance to a EP technician in order to do the correct adjustment of the motor parameters.
254	EB. DRIV.SHRT.	1- The EB driver is shorted. 2- The microcontroller detects a mismatch between the valve setpoint and the feedback at the EB output.	1- Check if there is a short or a low impedance path between the negative coil terminal and -B. 2- Check if the voltage applied is in accordance with the parameters settings 3- If the problem is not solved, replace the controller.

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8.9.2 Controller (ACE0+EPSAC0-SLAVE uc)

Error Message	Possible cause	Fault elimination
Error	Error text	
17 LOGIC FAILURE #3	A hardware problem in the logic board due to high currents (overload). An overcurrent condition is triggered even if the power bridge is not driven.	The failure lies in the controller hardware. Replace the controller.
19 LOGIC FAILURE #1	This fault is displayed when the controller detects an undervoltage condition at the KEY input. Undervoltage threshold depends on the nominal voltage of the controller	1-Fault can be caused by a key input signal characterized by pulses below the undervoltage threshold, possibly due to external loads like DC/DC converters starting-up, relays or contactors during switching periods, solenoids energizing or de-energizing. Consider removing such loads. 2-If no voltage transient is detected on the supply line and the alarm is present every time the key switches on, the failure probably lies in the controller hardware. Replace the logic board. 3-If the alarm occurs during motor acceleration or when there is a hydraulic-related request, check the battery charge, the battery health and power-cable connections.
195 WRONG CONFIG	wrong set of controller type and model type	1-check the parameter controller type in "special adjustment" menu 2-check the parameter model type in "special adjustment" menu
196 NO CAN TILL EP	the controller lost the communication with EP tiller at least once, when the truck is using	1-check the wiring of can cable 2-try to replace the EP tiller 3-replace the controller
197 NO CAN DISP EP	When the truck is running, if the DISPLAY TYPE=5, but the controller lose the communication with EP DISPLAY, this alarm occurs	1-check the communication wiring between EP DISPLAY and controller 2-check if the EP DISPLAY is broken

Error	Error text	Possible cause	Fault elimination
200 STEER SENSOR KO	The voltage read by the microcontroller at the steering-sensor input is not within the STEER RIGHT VOLT + STEER LEFT VOLT range, programmed through the STEER ACQUIRING function	The voltage read by the microcontroller at the steering-sensor input is not within the STEER RIGHT VOLT + STEER LEFT VOLT range, programmed through the STEER ACQUIRING function	1- Acquire the maximum and minimum values coming from the steering potentiometer through the STEER ACQUIRING function. If the alarm is still present, check the mechanical calibration and the functionality of the potentiometer. 2- If the problem is not solved, replace the logic board.
201 WRONG ENC SET	Mismatch between parameters ENCODER PULSES 1 and ENCODER PULSES 2	Set the two parameters with the same value, according to the adopted encoder	
202 VDC LINK OVERV.	Nominal voltage 24V 36/48V 72/80V 96V Overvoltage threshold 35V 65V 115V / 130V As soon as the fault occurs, power bridge and MC are opened. The condition is triggered using the same HW interrupt used for undervoltage detection, UC discerns between the two evaluating the voltage present across DC-link capacitors: - High voltage Overvoltage condition - Low/normal voltage Undervoltage condition	If the alarm happens during the brake release, check the line contactor contact and the battery powerable connection.	
208 EEPROM KO	the connection of the EEPROM is not ok	This type of fault is related to internal components. Replace the logic board.	

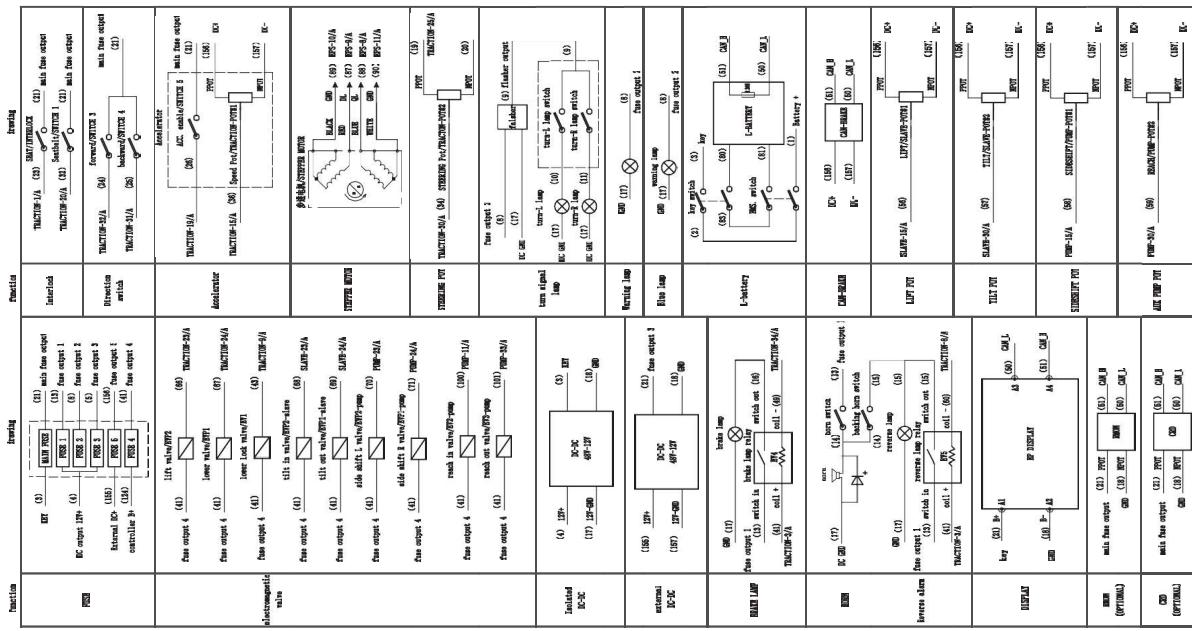
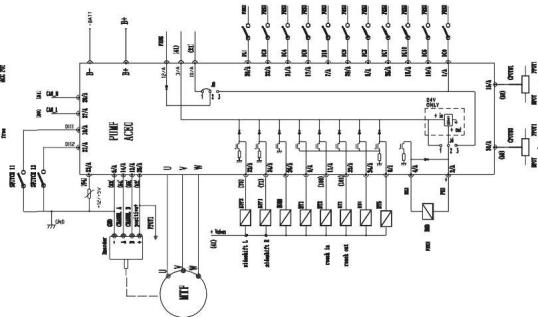
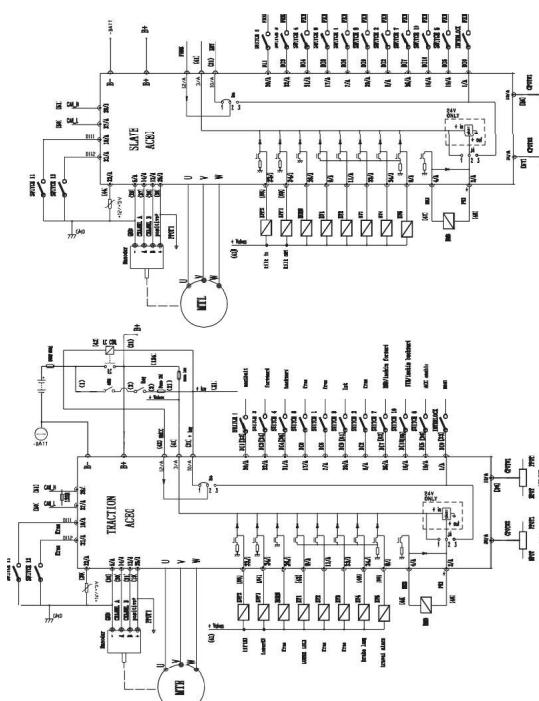
ELECTRICAL COMPONENTS

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Error Message		Possible cause		Fault elimination
Error	Error text	Error	Error text	
209 PARAM RESTORE		The controller has restored the default settings. If a CLEAR EEPROM has been made before the last key re-cycle, this warning informs you that EEPROM was correctly cleared.	1- A travel demand or a pump request does cancel the alarm. 2- If the alarm appears at key-on without any CLEAR EEPROM performed, replace the controller.	
210 WRONG RAM MEM.		The algorithm implemented to check the main RAM registers finds wrong contents. The register is "dirty". This alarm inhibits the machine operations.	Try to switch the key off and then on again, if the alarm is still present replace the logic board.	
212 W.SET. TG-EB		the slave controller find the status of the main contactor is different between hardware and CAN-BUS	This type of fault is related to internal components. Replace the logic board.	
213 INPUT MISMATCH XX		the slave controller find the status of the input is different between hardware and CAN-BUS	This type of fault is related to internal components. Replace the logic board.	
227 OUT MISMATCH XX		the slave controller find the status of the output is different between hardware and CAN-BUS	This type of fault is related to internal components. Replace the logic board.	
229 NO CAN WR MSG.XX		CANbus communication does not work properly. The hexadecimal value "XX" identifies the faulty node.	1- Verify the CANbus network (external issue). 2- Replace the logic board (internal issue).	
230 SOFTWARE ERROR		it means the software of the slave controller is wrong	This type of fault is related to internal components. Replace the logic board.	

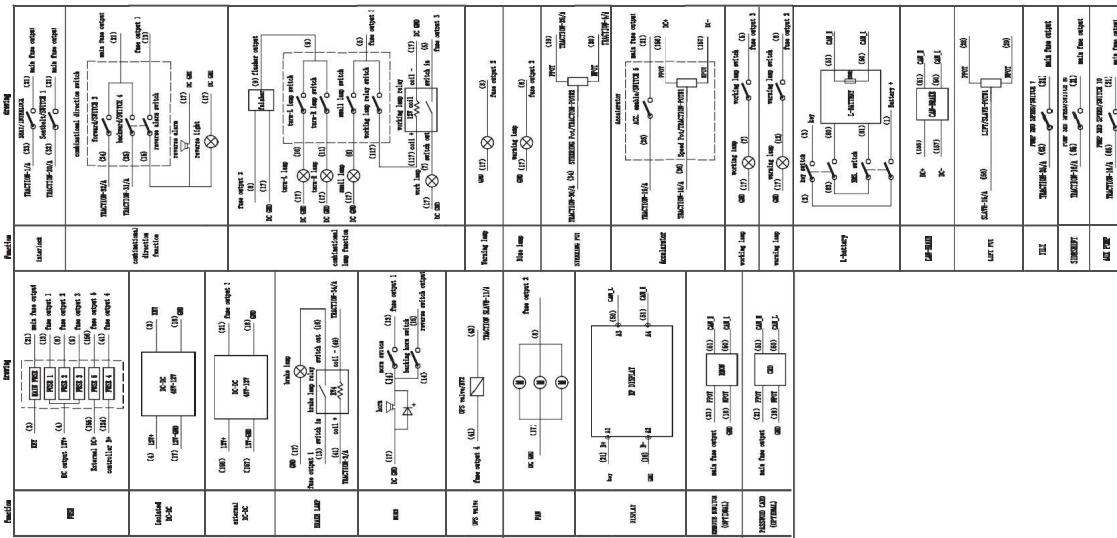
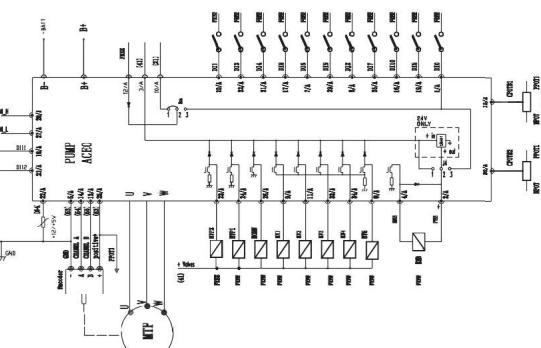
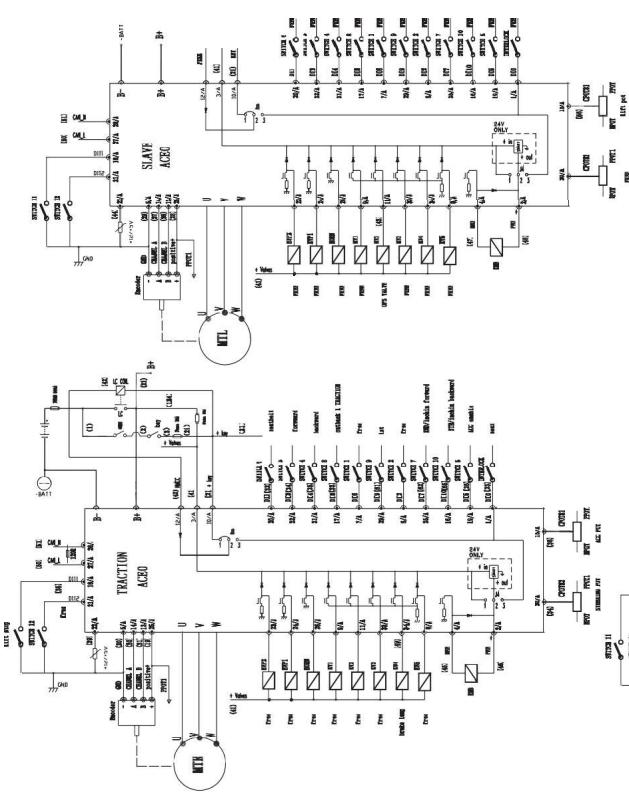
Error Message		Possible cause		Fault elimination
Error	Error text	Error	Error text	
		This alarm occurs when the A/D conversion of the analog inputs returns frozen values, on all the converted signals, for more than 400 ms. The goal of this diagnosis is to detect a failure in the A/D converter or a problem in the code flow that skips the refresh of the analog signal conversion.	If the problem occurs permanently it is necessary to replace the logic board.	
237 ANALOG INPUT		The software is not compatible with the hardware. Each controller produced is "signed" at the end of line test with a specific code mark saved in EEPROM according to the customized part number. According with this "sign", only the customized firmware can be uploaded.	1- Upload the correct firmware. 2- Ask for assistance to a EP technician in order to verify that the firmware is correct.	
239 CONTROLLER MISM.		This is a safety related test. Supervisor µC has detected that master µC is driving the pump motor in a wrong way (not corresponding to the operator request).	1- Checks the matching of the parameters between Master and Supervisor. 2- Ask for assistance to a EP technician. 3- If the problem is not solved, replace the logic board.	
240 OUT MISMATCH PU		This is a safety related test. The supervisor µC has detected a mismatch in the DC-pump speed setpoint with respect to the master µC.	1- Check the matching of the parameters between master and supervisor. 2- Ask for assistance to a EP technician. 3- If the problem is not solved, replace the logic board.	
241 SP MISMATCH PUMP		This is a safety related test. The supervisor µC has detected a mismatch in the speed setpoint with respect to the master µC.	1- Check the matching of the parameters between master and supervisor. 2- Ask for assistance to a EP technician. 3- If the problem is not solved, replace the logic board.	
242 SP MISMATCH XX		This is a safety related test. The supervisor µC has detected a mismatch in the speed setpoint with respect to the master µC. The hexadecimal value "XX" facilitates EP technicians debugging the problem.	1- Verify the CANbus network (external issue). 2- Replace the logic board.	
248 NO CAN MSG. XX		CANbus communication does not work properly. The hexadecimal value "XX" identifies the faulty node.	1- Verify the CANbus network (internal issue). 2- Replace the logic board.	

9.9.2 Electrical Schematic Diagrams-electromagnetic valve



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9.9.3 Electrical Schematic Diagrams-manual valve



9.9.4 Cable Wiring Diagrams

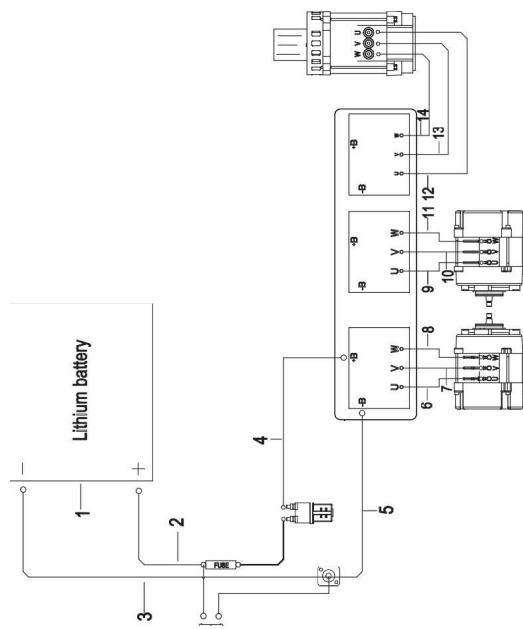
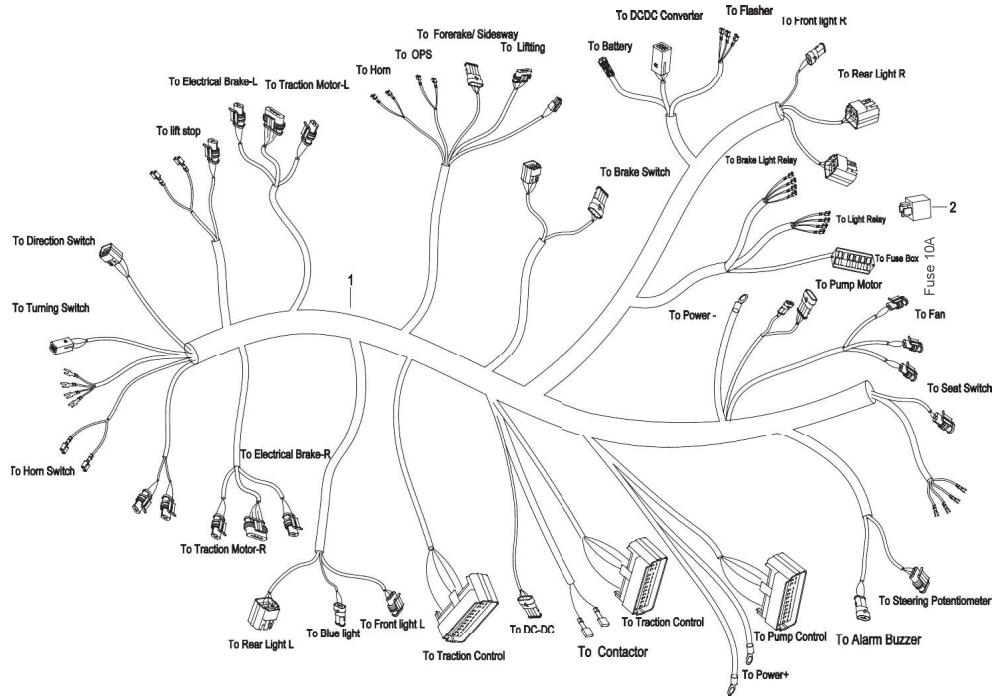


Fig3230-50039SM



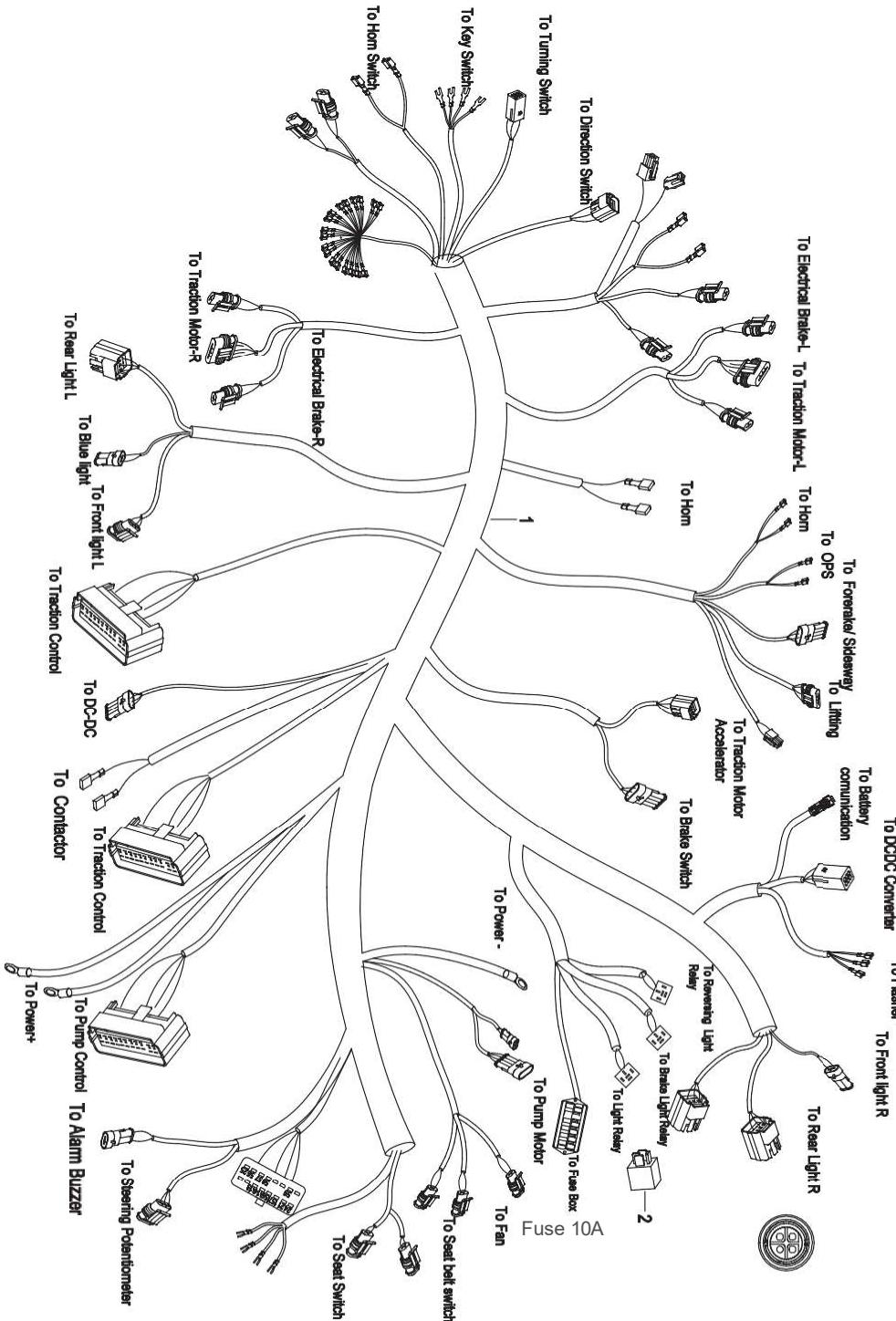
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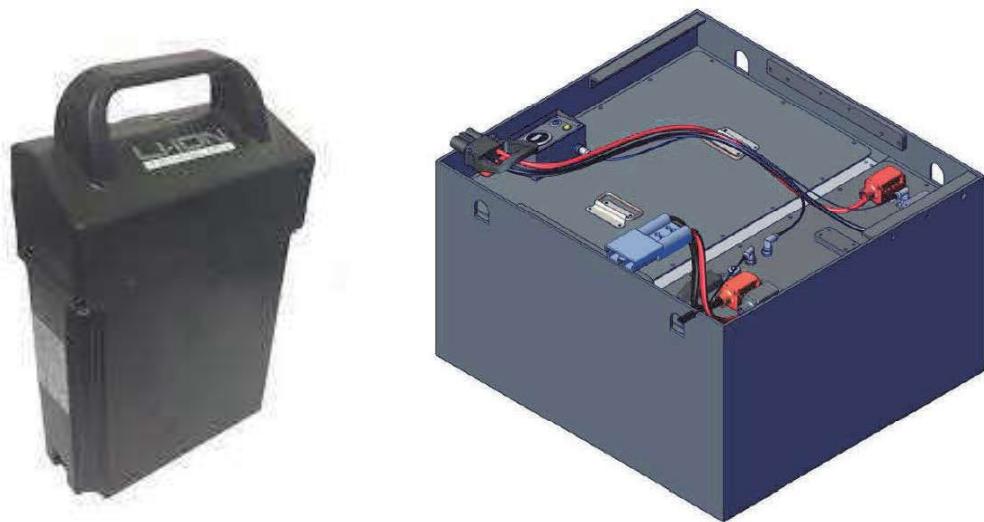
No.	Name
7	L-Drive Motor Cable V
8	L-Drive Motor Cable W
9	R-Drive Motor Cable U
10	R-Drive Motor Cable V
11	R-Drive Motor Cable W
12	Pump Motor Cable U
13	Pump Motor Cable V
14	Pump Motor Cable W

No.	Name
1	Battery
2	Battery Cable +
3	Battery cable -
4	Controller Cable +
5	Controller Cable -
6	L-Drive Motor Cable U

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Solenoid Valve





Operation Manual

Lithium-ion Battery

Version 2.0

6/21/2023

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Introduction

This manual is intended to provide information on correctly using the Li-ion battery and maximizing its productivity and longevity through preventive maintenance and safe operation. Operators should read through the manual before using the battery.

All the information, specifications, and illustrations in the manual are effective at time of print. The company maintains the right to modify the specification(s) or design(s) of the products at any time without prior notification.

Overview

Lithium-ion (Li-ion) batteries have many advantages over traditional lead acid and other types of batteries. Big Joe's Li-ion batteries are classified as LFP 'Lithium Iron Phosphate' or LiFePO4. When stored, handled, and used properly, they also have a longer service life, a higher power density, don't need a cooling down period, and can be opportunity charged.

Big Joe's priority is safety, and establishing the following safety procedures for storing, handling and use of these batteries will help prevent fires and explosions.

Companies training employees to recognize the hazards of Li-ion and other types of batteries as well as how to handle, store and manage them properly will help to avoid damage to the batteries resulting in possible fires and explosions.

This battery should not be used at a very low SOC (state of charge) status. To ensure the battery life, the operator should avoid the discharge depth of more than 80% of the rated capacity of the battery. Whether it is partially discharged or fully discharged, the battery should be immediately charged.

Lithium batteries have a special charger and may not be charged with other types of battery chargers.

NOTE: A new battery from the factory should be fully charged before its initial use.

Getting Started

The lithium-ion battery unit is composed of battery cells in series or in parallel. It is equipped with battery management system (BMS) for monitoring and protecting the lithium-ion battery. The truck's key switch can control power supply of the battery. The circular meter shows various data including SOC (State of Charge), error code, total voltage, and temperature.

Safety & Warnings

- Always wear personal protective equipment (PPE) (e.g., safety goggles and safety gloves) when working on cells and batteries.
- Abide by the operation manual.
- Check the battery for leakage and mechanical damage before use and charging.
- **NOTE: STOP** using the battery if leaking or is damaged and follow the recycling instructions found in section 8.3 in this manual. We recommend the battery be recycled within 3 days.
 - Inspect easy exchange batteries daily. See Appendix A for detailed daily inspection instructions for the pallet truck easy exchange batteries. If new or replacement visual inspection reminder decals are needed, they can be ordered via PN 056747.

WARNING

Visually inspect battery daily for cracks, bulges and leakage.
If damaged, remove from service and recycle immediately.
Refer to Li-Ion manual for further instructions.

- Check charger connectors and bracket for contamination daily, clean the bracket with a dry cloth if needed.
- All operations related to the battery must be implemented under the instruction of professionals.
- Do NOT smoke near the battery because it may cause fire.
- Do NOT place the battery near open flame, sparks, or energized wires as fire or explosion may occur.
- Avoid short-circuiting the battery, as fire or explosion is likely to occur.
- Keep the battery away from all fire sources, heat sources, and flammable or explosive materials.
- Don't knock over the battery, drop the battery, or expose it to abusive vibration applications.
- Use lifting and delivery devices as specified. Prevent the battery cell, interface, and connection cable from being damaged by the lifting hook.
- If the internal battery components start to leak out, do not inhale the fumes. Always wear PPE when in close contact with the battery.
- Wash hands after working on a battery.
- Use only insulated tools.
- Make sure the truck is turned off before connecting the battery.
- The metal part of the battery cell is electrified, don't place any external object or tool on the battery cell.

- Do NOT place the battery on top of conductive objects.
- Do NOT trample on the battery to prevent it from fierce shaking.
- Protect the battery from solar or other forms of heat radiation.
- Do NOT physically alter the battery, strike, crush, compress, notch, dent or modify it in any way.
- Do NOT open the battery without Big Joe Forklift's official authorization.
- Do NOT spray wash the battery with water.

Intended Use

- Discharge/Operational application temperatures: 32° F - 104° F
- Charging application temperatures: 41° F - 104° F.
- Humidity < 80%.
- The battery's maximum operation altitude is up to 6500ft (2000m).

NOTE:

- A high-rate recharging operation below 0°C may lead to battery damage, so the recommended charging temperature range is 41° F - 104° F.
- The discharging temperature range can be used in more extreme temperature conditions as follows -4° F - 131° F however, this isn't the recommended range for optimal life which is identified above. Also, the truck may not be rated for those extreme conditions or extended durations in a cold operating environment as that is truck and option dependent.
 - If used at low temperatures -4° F - 32° F, battery discharge capacity will be smaller compared with one in normal temperature conditions.
 - A battery used between 104° F - 131° F will accelerate the aging of the internal material which may shorten the service life of the battery, so is not recommended.

Battery Management System

The battery is permanently monitored by the Battery Management System (BMS). This provides communication with the truck.

The BMS continually monitors items such as the cell temperature, voltage, and charge status of the cells. It also functions as a safety cut-off device in case of overcharging, overcurrent, or overheating.

Potential Hazards

Hazards are not anticipated if the equipment is used correctly. Do not use the equipment for anything other than its intended purpose.

The following hazards can arise in the event of improper use:

Physical Damage:

This can occur if a battery falls or is deformed through pressure or high impact (e.g., truck forks penetrate the battery housing).

Physical damage includes cracks, breakage, splinters, or holes in the battery housing. This type of damage may be caused by a short circuit inside the battery, which may result in harmful materials leaking, fire or battery explosion.

Some physical damage may not show on the battery enclosure, but there may be damage to the internal cell pack, which could cause electrolyte leaking and short circuit. Always check for leakage before use and charging.

Short Circuits:

These may be caused by inadvertently creating a connection between the two battery terminals (e.g., battery immersed in water, battery leakage, contamination on the charger connector or battery connector).

Temperature Effects:

High temperatures caused by sunlight or being stored in warm locations (e.g., near ovens) can result in harmful material leakage and fire.

To avoid fire and leakage of harmful materials, a safe place for storing batteries must satisfy the following criteria:

- Do not store in places often frequented by personnel.
- Do not store in places where valuable objects (e.g., cars) are stored.
- Fire extinguishers must be available to put out any fires.
- Caution should be taken with fire or smoke detectors in the vicinity to ensure that an automatic fire detection system is only activated in the event of actual danger (e.g., naked flames).
- Small amounts of discharge from a single battery are not critical to the environment. Above-average natural ventilation is required in this case.
- No ventilation intake pipes should be in the vicinity, as discharged content could spread within a building.

Examples of where to store a non-functional battery:

- Covered area outdoors.
- Ventilated metal container.
- Covered box with pressure and smoke discharge option.

Fire Hazard

Physical damage, thermal effects, or incorrect storage in the event of a defect can result in fire. Please note that the battery materials can be flammable.

WARNING: Contact with combustion products can be hazardous. Fires produce combustion products. Combustion is a chemical process by which a flammable material combines with oxygen under heat and light (fire). The resulting combustion products can occur in the form of smoke, leaking fluids, escaping gases, debris, as well as decomposition products of certain chemicals. These combustion products are substances that enter the body through the respiratory tract and/or the skin and can cause serious health issues.

Avoid contact with combustion products and use personal protective equipment (PPE).

- Hydrogen fluoride (HF) Hydrofluoric acid = extremely corrosive
- Risk of toxic substances produced by pyrolysis
- Risk of highly flammable gas mixtures
- Other combustion products: Carbon monoxide & -dioxide, manganese, nickel, and cobalt oxides.

WARNING: If a lithium battery fire occurs, use a CO₂ (Class BC) or dry chemical (Class ABC) fire extinguisher. Lithium batteries do not have actual lithium metal so **DO NOT** use a Class D fire extinguisher.

Touch Voltage Hazard

Hazardous contact voltages only arise in the event of a technical or physical defect. The batteries are normally charged. There is still some residual voltage in a discharged battery. This must be considered a hazardous contact voltage.

Battery Storage

Proper storage prevents damage to batteries and prolongs their life expectancy. Follow these battery storage tips:

- Store in dry, well-ventilated areas
- Store in temperatures between 32° F and 104°F
- Store away from direct sunlight and heat sources
- Keep terminals covered when the battery is not in use
- Prevent terminals from touching each other
- Store separately from other types of batteries
- Keep the battery charged and do not store it for an extended period with a low state of charge (SOC) < 20%. It is recommended to maintain a charge level of 50% or greater.
- For long-term storage, the Li battery must be recharged every 2-3 months regardless of the SOC level. If a battery is stored longer than six months without charging, the cell may be damaged due to over-discharge. This can cause the cell to bulge and break the battery enclosure.

IMPORTANT: Monitor battery condition daily when in use and storage.

1.1 Battery Handling

Improper handling can cause damage to batteries, which may lead to overheating, fires, or explosions. Here are some tips for proper Li-ion battery handling:

- Remove batteries from devices that will not be used for an extended time.
- Keep batteries away from electromagnetic sources.
- Keep batteries intact.
- Keep batteries and charger in a clean location, do not expose battery or charger to water or other type of contaminations.
- Clean charger bracket and connector/pin with dry cloth if needed, since foreign material and contamination may accumulate in the bracket.
- DO NOT use batteries that show any signs of damage, they must be isolated.
- DO NOT modify the battery in any way.

WARNING: Damaged Li-ion batteries have the potential to leak electrolytes, so it's important to wear proper personal protective equipment (PPE) (goggles, gloves, apron, etc.) during handling.

Performance Data

Battery Nominal Data

Battery Cell

1	Cell material	LFP
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Battery System

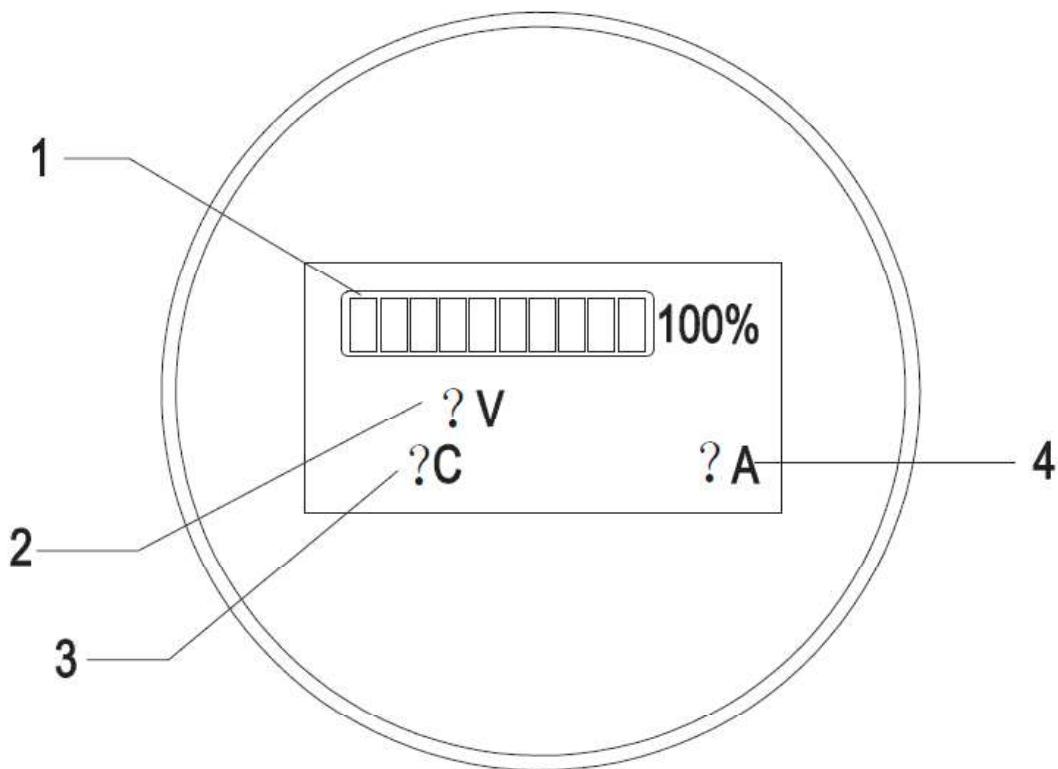
2	Burst mode	Parallel Circuit or Series Circuit
3	Ambient relative humidity	≤80%RH
4	Operational application temperature	32-104°F

BMS Nominal Data

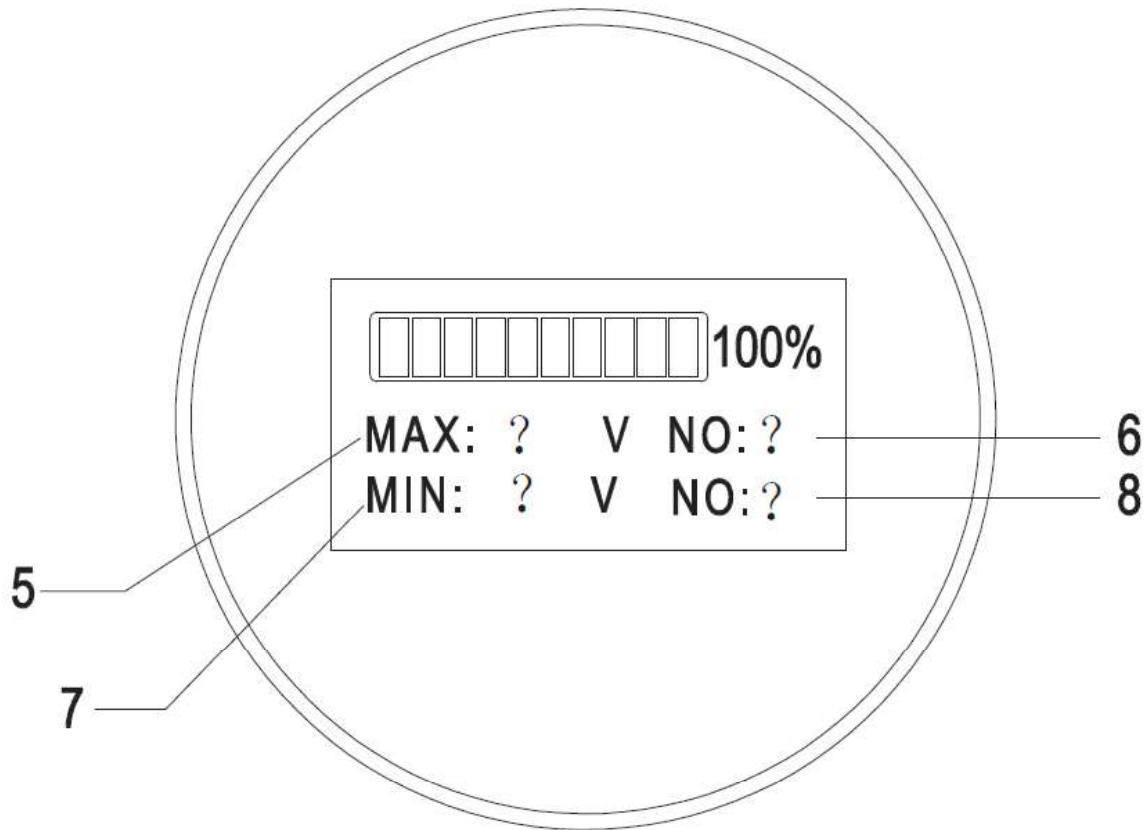
Battery Management System Function

No	Item	Function	Description
1	Inspection / Estimates	Monomer voltage detection	Accurate acquisition of all cell voltage data
2		Total voltage detection	Accurate acquisition of total voltage data
3		Temperature collecting	Accurate detection of battery temperature
4		Current inspection	Accurate detection of charge-discharge currents
5		SOC Estimate	Hall sensor is used to obtain the input and output current of the battery, and the SOC estimation of the battery is carried out by the method of ampere time integration
6	Communication Function	CAN communication	Communication and debugging
7	Protection Function	Short-circuit protection	Power circuit short circuit, contactor disconnect
8		Over current protection	Over-current occurs, contactor disconnect
9		Overcharging protection	Overcharge occurs, contactor disconnect
10		Over discharging protection	Over discharge occurs, contactor disconnect
11		Over temperature protection	Over temperature occurs, contactor disconnect
12	Sleep Wake	Sleep awakening function	Charge communication wake-up, Battery switch button wake-up

2. Battery Indicator



No	Name	Description
1	Energy Display	When the first cell and the second flash alternately, battery is low and must be charged. The battery remaining charge is displayed; "100%" indicates that the battery is fully charged.
2	Total Voltage	The sum of the total voltages of the lithium battery series
3	Temperature	Battery temperature
4	Charging Current	Current value when charging the lithium battery



No	Name	Description
5	Maximum Cell Voltage	Maximum value of cell voltage
6	Number of Cell	Identification number of the cell with maximum voltage
7	Minimum Cell Voltage	Minimum value of cell voltage
8	Cell Number of Minimum Cell Voltage	Identification number of the cell with minimum voltage

Transportation

Before transporting any lithium-ion battery, check the current regulations on the transport of dangerous goods. Comply with these when preparing the packaging and transport. Train authorized staff to dispatch lithium-ion batteries.

NOTE:

It is recommended that the original packaging is kept for any subsequent dispatch.

A lithium-ion battery is a special product.

Special precautions should be taken when:

- Transporting a truck equipped with a lithium-ion battery
- Transporting only the lithium battery

A class 9 danger label must be affixed to the packaging for transport.

Handling differs if the battery is transported on its own or in a truck. An example of a label appears in this supplement (see figure below). Refer to the latest current regulations before dispatch as the information might have changed since this manual was written.

Special documents must be sent with the battery. Refer to the applicable standards or regulations.

For UN3480	Lithium-ion Batteries	
For UN3481	Lithium-ion Batteries packed with Equipment or Lithium batteries built into Equipment	

Service

Lithium-ion batteries typically require no maintenance. If needed, only a certified technician should perform any service or maintenance.

Big Joe Forklifts recommends following the maintenance schedule below. Record all battery service, maintenance, and inspections to maximize the service life of your battery and lift truck.

No.	Maintenance Content	Method of Operation	Notes	Frequency
1	Check if battery capacity is too low	Check instrumentation SOC display	Make sure the battery is not stored without charge for a long period. If the battery system needs to be put on hold for a long period, keep the battery at a half power state and charge the battery every 3 months to ensure that the battery system remains in a half power state.	Everyday
2	The battery pack charge and discharge current	Check instrumentation display	Make sure battery pack charge and discharge current meet the operation manual requirements.	Everyday
3	Check connector pins at the bottom of the battery (if present)	Perform a visual inspection	If any ablation or deformation is found, replace the battery connector pins.	Everyday
4	Check if appearance is deformed, whether surface is oxidized, paint is peeling, the mounting position is offset or if cabinet is damaged	Perform a visual inspection	If deformed/damaged follow battery recycling procedure.	Everyday
5	Check the entire battery as well as the surface beneath it for signs of fluid leakage	Perform a visual inspection	If leaking, follow battery recycling procedure.	Everyday

No.	Maintenance Content	Method of Operation	Notes	Frequency
6	Check if battery and charger are clean	Perform a visual inspection Wear insulated gloves before performing cleaning	Clean the lithium battery and charger with a dry cloth or compressed air	Weekly

7	Check if external wiring harness has worn spots, imprints, creases, or exposed wire	Perform a visual inspection	Replace the wiring harness if damaged	Weekly
8	Check the surface of lithium-ion battery for cleanliness	No dust, water, corrosion, oxidation, rust, etc.	Clean the surface if dust, corrosion, oxidation, or rust is found. Use a dustless cloth or air compressor. Using water is strictly prohibited.	Weekly
9	Ensure outside battery screws are tight	Tighten screws if necessary		Weekly
10	Check for water or foreign material in the plug and socket. Check for rust or charring (if necessary)	Perform a visual inspection		Monthly
11	Check the cable for damages or loose joints (if necessary)	Perform a visual inspection		Monthly
12	Check the battery case for abnormalities such as cracks, deformation, and bulging	Perform a visual inspection	Stop using the battery if abnormalities are found	Monthly

NOTE: The manufacturer recommends using compressed air at less than 30psi (207kPa).

Troubleshooting & Recycling

During the use and maintenance of the lithium-ion battery, the battery or battery system may have one or more of the following abnormal conditions.

Only trained technicians are allowed to perform the necessary processing according to the instructions in this manual.

If there are any questions about the status or solutions, please contact Big Joe Forklifts dealers or after-sales service department of the company to obtain professional technical support.

- If the battery is found to have abnormal mechanical characteristics such as swelling, cracked casing, melted casing or distortion of the casing before and during installation, stop using the battery immediately, place it in open and well-ventilated space, and contact the after-sales service.
- If abnormalities such as looseness, cracks, cracks in the insulation layer, burn marks, etc. of the battery's pole pressing bolts, conductive strips, main circuit wires, and connectors are found before and during the installation, STOP using the battery immediately.
- If the polarity of the positive and negative terminals of the battery is found incorrect, STOP using the battery immediately and contact the after-sales service department to replace the battery or obtain other solutions.
- If the battery emits smoke; immediately STOP using the battery, use fire sand and an explosion-proof box for burial and isolation, wearing a respirator and fireproof gloves move the battery to a safe area, and notify the after-sales service department of the company for record and obtain technical support.

Damaged / Leaking Battery Handling

- Put on personal protective equipment (PPE), such as gloves, goggles/safety glasses, and a lab coat.
- Isolate and ventilate the area.
- Keep an appropriate fire extinguisher within reach.
- If batteries are showing evidence of overheating, use extreme care. Gases can be toxic and flammable.
- Disconnect the battery (if possible).
- Remove the battery from the equipment/device (if possible).
- Use inert, non-cellulose absorbents to clean up the spilled electrolyte.
- Place used absorbents and PPE in a sealed bag and contact your environmental or shipping container for proper disposal of the battery and absorbents.
- **DO NOT** place damaged batteries in regular trash or recycling containers.
- For safe storage while awaiting proper disposal, place the battery in a container of sand or another chemically inert cushioning material like vermiculite. There are damaged Li-ion battery kits commercially available for isolating a battery in a metal pail along with fire-proof media (such as sand, and vermiculite) to cover the battery with.

- If the electrolyte is leaking out, place the battery in a bucket of water for 7 days to effectively discharge the internal cells. This is the only time the battery should be exposed to water.
- Place the battery container away from combustibles.
- Contact the local fire department and ask for advice on how to proceed.

Charging

Designate a specific area for the purpose of charging lithium-ion batteries. When charging, make sure the battery charger is turned OFF before connecting the battery charging cables. Lithium-ion batteries allow for fast charging, if the battery does not charge completely in a normal period or if the battery management system (BMS) indicates a fault, then remove the battery from service. Big Joe Forklifts recommends the opportunity charge lithium-ion batteries. This is when the battery is recharged for short intervals during a shift period. It reduces or eliminates the need for long charging periods, changing batteries during a shift, and extending shift periods.

Please follow the guidelines below:

- Battery must be charged when the remaining charge is lower than 20%, avoid over-charging or over-discharging.
- Remaining charge should be higher than 60% during a short period of storage.
- Running the truck is prohibited in the case of a short circuit, low voltage, or high temperature.
- Perform charging, discharging test, and battery status inspection at least once per month, including total voltage, unit voltage, voltage difference, temperature, temperature difference, the value of insulation resistance, remaining charge, etc.
- Handle battery gently. DO NOT throw, roll, or allow to collide with other objects.

Recycling

Lithium-ion batteries must be disposed of according to the relevant environmental protection regulations. Big Joe Forklifts recommends researching battery recycling companies and choosing what is best for your situation. We have included two companies here with some information about each. This information is not guaranteed to be current, please contact the company for the most up-to-date information.

Note: The companies are not affiliated with Big Joe Forklifts and are considered third party.

Company:	<u>Battery Recyclers of America</u>	<u>Li-Cycle</u>
HQ:	Dallas TX	Toronto Canada
Years in Business: (as of 2023)	13 years	7 years
Recycling Process:	Smelting	Submerged
EPA Certified:	Yes	Yes
Refurb/Recycle:	Both	Recycle
Packaging Requirements:	Per DoT	Per DoT
Palletize Service:	Yes	No
Pickup:	Yes	Ship only
Logistics Support:	Yes	No
Min. Pickup Weight:	50 lbs.	N/A
Accept Mix of Lead and Li:	Yes	No

Appendix A: Daily Spot Check Record

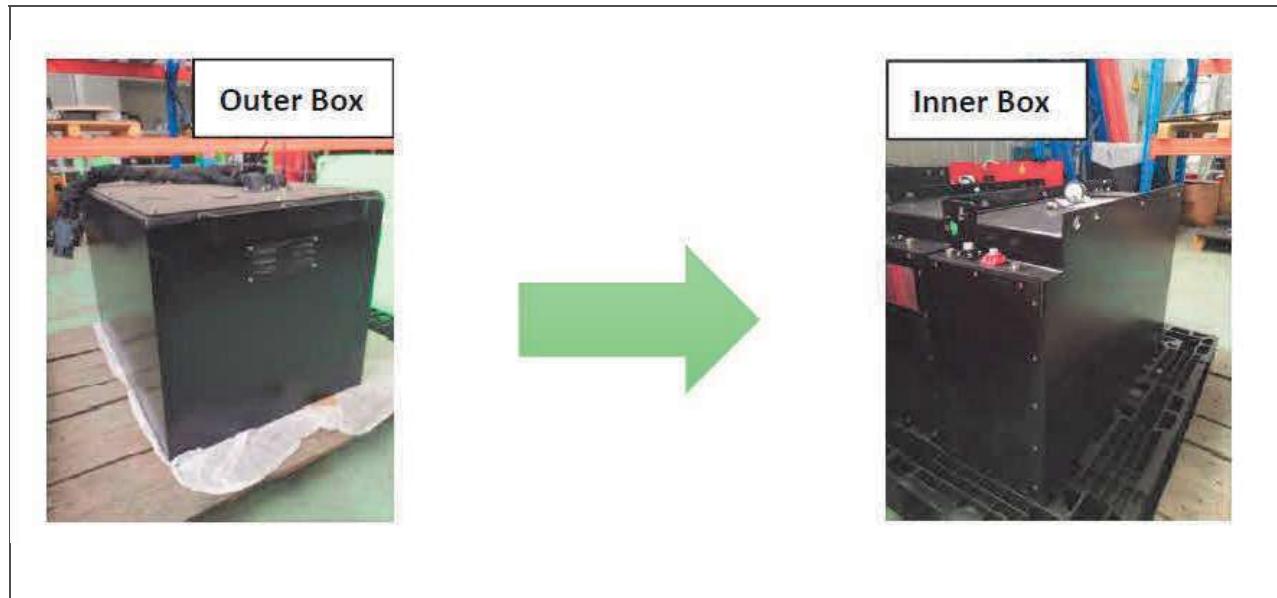
Daily Spot Check Record of Lithium Batteries (Easy Exchange)					
Routine Check Items	Leakage	Leakage	Box Damaged	Battery Bulge	Terminal Damage
Diagram of Routine Inspection Items					
Explanation	There is liquid leakage causing corrosion at the charging and discharging terminals on the bottom of the battery	There are traces of liquid leakage at the bottom of the battery, which caused stains around the positive and negative terminal ports	The box body is cracked and has pieces missing	The battery expands causing it to bulge	The terminal is deformed, discolored, blackened or there are traces of high temperature burning
Processing Method	Stop using, soak in water for 7 days to discharge and recycle according to local regulations	Stop using, soak in water for 7 days to discharge and recycle according to local regulations	Stop using and recycle according to local regulations	Stop using and recycle according to local regulations	Replace the terminal
Inspection Frequency	Daily	Daily	Daily	Daily	Daily
Inspection Method	Visual inspection	Visual inspection	Visual inspection	Visual inspection	Visual inspection
Date					
1					
2					
3					
4					
5					
6					
7					
8					
9					
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11					
12					
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31					

Note: All spot inspectors shall conduct a visual inspection prior to work every day. Mark "V" if they meet the requirements. If they do not meet the requirements, Mark "X" and report it to the proper personnel.

Place of use:	
Person in charge of spot inspection:	

Appendix B: Box Structure

Big Battery Box Structure – If equipped, only the inner box needs to be shipped with battery cells and BMS plate for repair/return.





Big Lift LLC