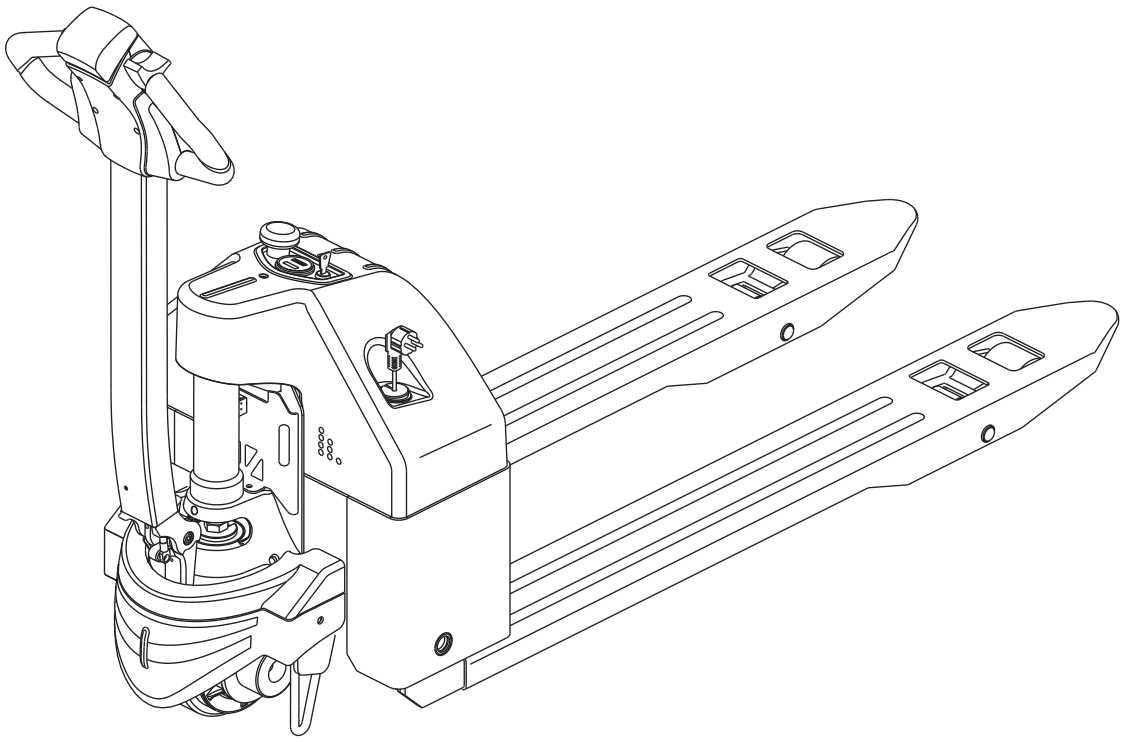
Service Manual

EPT20-15ET

EPT20-15ETL

Electric Pallet Truck



CE CERTIFICATE

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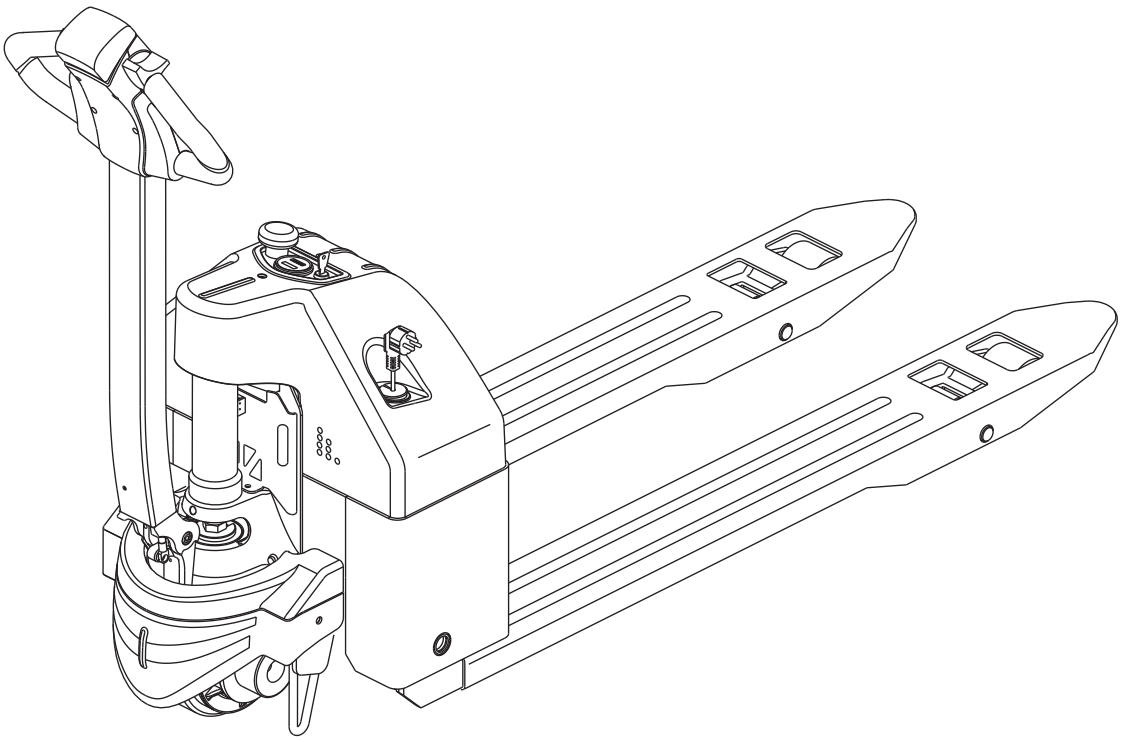

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Release Date	Version No.	Changes (Serial number)
2016-09-27	SM-1115 09.16	New Version

* If there are any changes, revised version will be published once every 12 months; if there is no change, please follow the most recent version.
* Please refer to the corresponding version of the service manual against the purchase time of your vehicle.
* If you need the latest versions of the manual, please contact our service department or dealer to obtain.

This manual applies to:

Model	Specifications
EPT20-15ET	1,500 kg Capacity
EPT20-15ETL	1,500 kg Capacity, Ultra-low Placement

Some sections of the manual only involve certain model, please refer to the manual according to the actual configuration of the vehicle.

FOREWORD

This Service Manual can help readers learn more about the truck system components, maintenance and troubleshooting, and other related information. The operation and maintenance personnel must read this Manual carefully before using the product. And when vehicle is in use, be sure to follow the complete operation and maintenance information in this Manual for vehicle maintenance.

Before using, please check if the pages of the Manual are clear and complete, so as not to affect your normal use because of incomplete information. If the contents of the Manual have been illegible or damaged, which may affect reading, please contact our company or dealer for replacement.

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.

Safety signs and instructions:


Please strictly adhere to these safety instructions to avoid personal injury.


Please pay attention to the important safety instructions.


Instructions.

EP Equipment Co., Ltd.

EP Industrial Park, Xiaquan Village,
Dipu Town, Anji County, Zhejiang Province

www.ep-zl.com

REV. SM-1115 09.16

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SAFETY WARNING

For your own safety and that of others, please observe the following safety instructions:

Thorough and normative maintenance is one of the most important prerequisites to ensure stable and reliable operation of truck. Neglecting regular maintenance could easily lead to the truck malfunction and failure, and potential threats to staff and operational safety. Therefore, there must be adequate maintenance equipment, professional maintenance personnel and a comprehensive maintenance plan in place.

Please perform the maintenance and inspections according to the following provisions:

1. To strictly enforce the truck maintenance, lubrication and inspection plans.
2. Truck maintenance, lubrication and inspection personnel must be approved by accredited certification or evaluation agency.
3. The following operations shall be performed before you leave the truck:
   - No parking on slopes.
   - Fully lower the forks.
   - Cut off the power supply.
   - Turn the switch lock to “STOP” and remove the key.
4. Prior to truck maintenance:
   - Raise the drive wheel off the ground, or cut off the power supply connection.
   - Use wooden wedges or other effective fixtures.
   - When performing maintenance underneath the vehicle, make sure that the lifting device or jack leg is secure.
   - Park your vehicle in a safe and secure area.
5. Never use an open flame to check level of electrolyte, other oils or fluids for leaks.
6. Keep the parking lot clean, well-ventilated and dry.
7. Regular checks and maintenance should be conducted to braking, steering, control, warning and safety devices to keep them in good condition.
8. All nameplates and safety signs on the truck should be cleaned regularly to make them clearly visible.
9. Regular checks and maintenance should be conducted to all the devices of lifting system to ensure them to be safe for use.
10. The hydraulic system should be checked regularly based on usage. Hydraulic cylinders, hydraulic valves and other hydraulic components should be ensured to be without leakage.
11. Regular checks and maintenance should be conducted to batteries, motors, controllers, limit switches, protective devices, wires and connectors, and so on. Please pay particular attention to the electrical insulation.
12. Park the truck in a clean environment to minimize the risk of fire.
13. Without the permission of the manufacturer, users are not allowed to change or increase the capacity of the truck. After having been changed under permission, the nameplates and safety signs on the truck should also be changed accordingly.

1. INFORMATION & SPECIFICATIONS

NOTE:

1.1 After-sales Service Platform

Claims/Replacement Parts Service Platform:

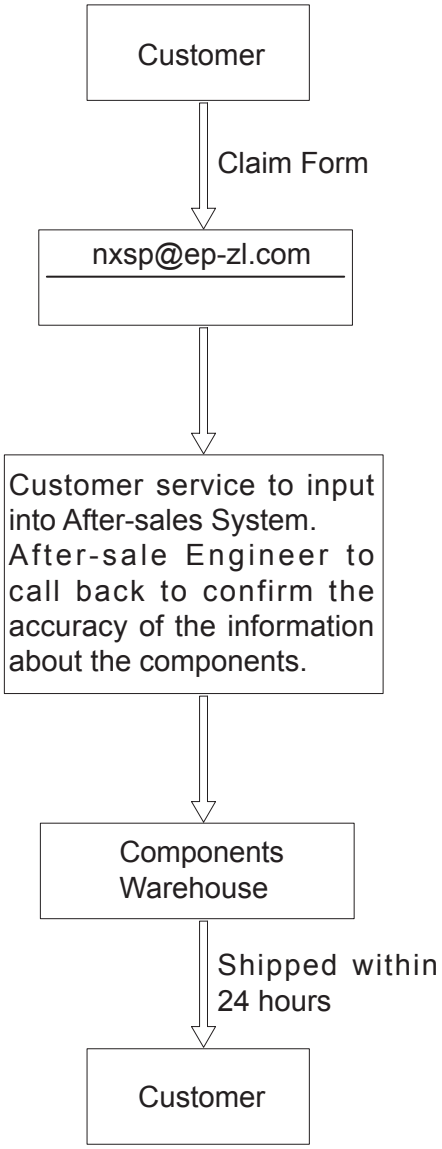


Figure 50004-1

After-sales Maintenance Service Platform:

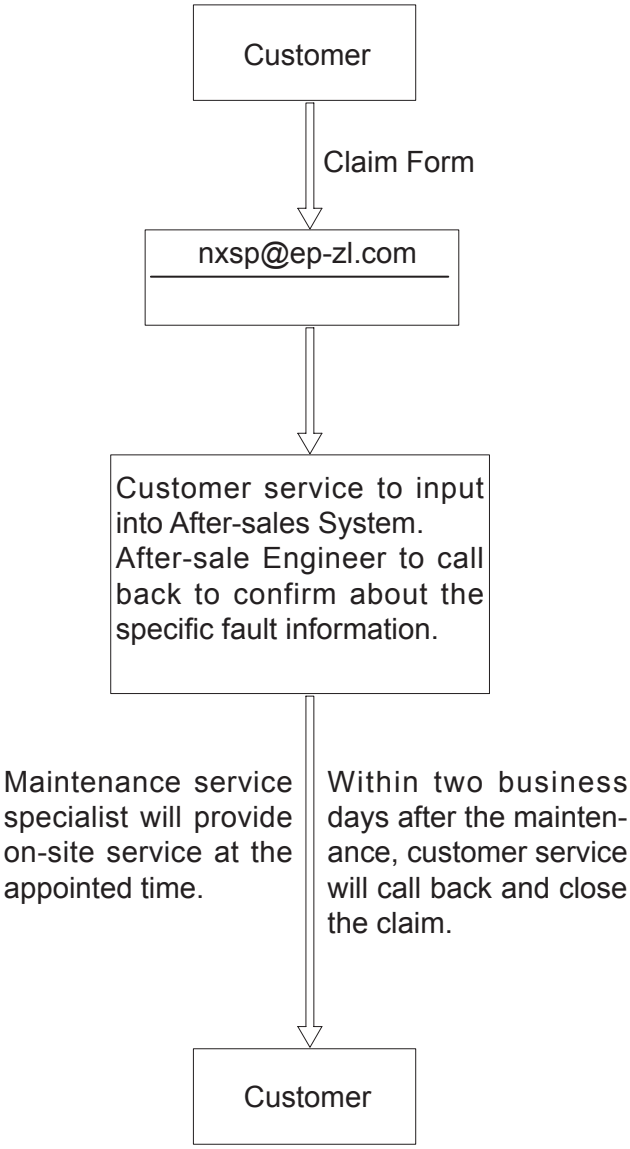


Figure 50005-1

NOTE

In order to provide you with a fast and efficient after-sales service, when you claim / order spare parts or after-sales service upon maintenance, please provide accurate truck model, vehicle body serial number and part number.

1.2 Introduction

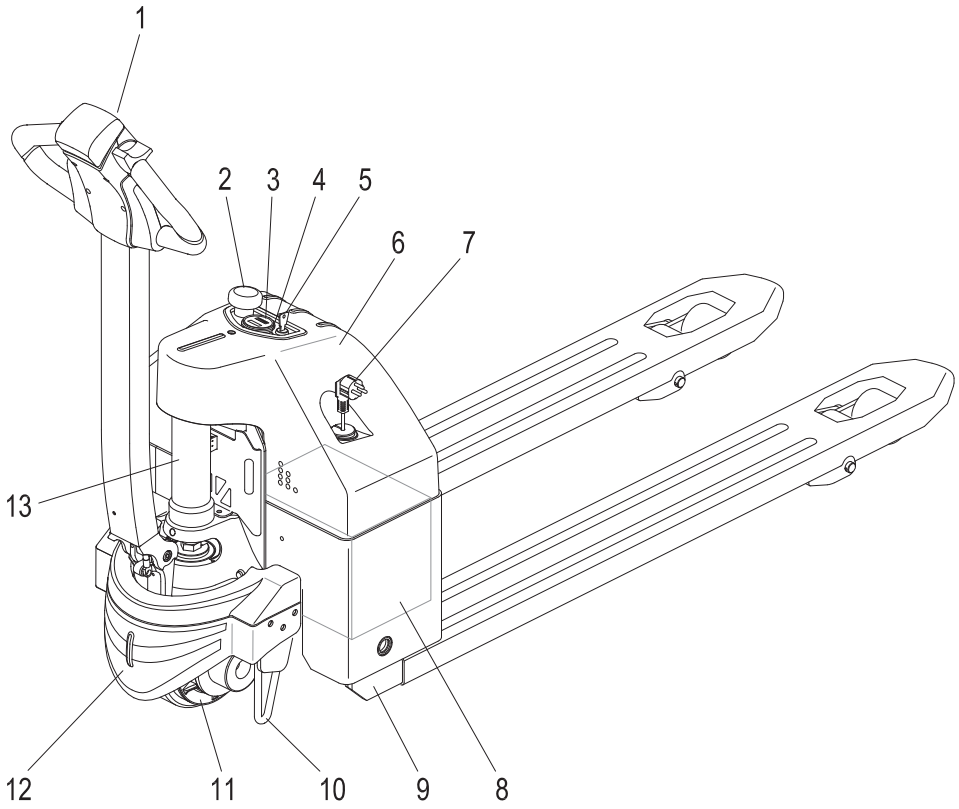


Figure 10001

No.	Name
1	Control Lever
2	Emergency Stop Switch
3	Charge Gauge
4	LED Charging Indicator
5	Key Switch
6	Upper Cover
7	Charging Plug

No.	Name
8	Battery
9	Chassis
10	Balance Stand / Caster Wheel
11	Drive Wheel
12	Lower Cover
13	Lift Cylinder

This series are electric pallet trucks. Its important structure is as shown in Figure 10001.

WARNING

- *Please refer to the nameplate for rated load capacity of the vehicle.*
- *The vehicle can only be used on the level ground indoors, never use it on mezzanine or balcony area.*

WARNING

Truck can only be operated by single operator; other personnel is forbidden from riding.

1.3 Common Tools

No.	Name	Remark
1	Hex Wrench	2#~14# One Set
2	Hex Head Socket Wrench	10#~27# One Set
3	Phillips Screwdriver	2# One Piece
4	Slotted Screwdriver	2# One Piece
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

1.4 General Tightening Torques

Screws or bolts used on the truck are of 8.8 grade or higher performance level.

When you are conducting truck maintenance, you can 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 grade	Low carbon steel	M6 ~ M48
	8.8 grade	Quenched and tempered medium carbon steel	M6 ~ M48
	10.9 grade	Quenched and tempered medium carbon alloy steel	M6 ~ M48
	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 the screws or bolts used on certain position are not marked with performance level, please select spare parts with performance level of at least 8.8 grade or higher level forreplacement.*

Table 1.4.2 Metric Screws/Bolts Tightening Torque Table (n•m)

Nominal Diameter (mm)	Performance Level			
	5.8	8.8	10.9	12.9
	Proof Stress (MPa)			
	380	600	830	970
M6	7~8	10~12	14~17	17~20
M8	16~18	25~30	34~41	41~48
M8×1	17~20	27~32	37~43	43~52
M10	31~36	49~59	68~81	81~96
M10×1	35~41	55~66	76~90	90~106
M12	55~64	86~103	119~141	141~167
M12×1.5	57~67	90~108	124~147	147~174
M14	87~103	137~164	189~224	224~265
M14×1.5	144~170	149~179	206~243	243~289
M16	136~160	214~256	295~350	350~414
M16×1.5	144~170	228~273	314~372	372~441
M18	186~219	294~353	406~481	481~570
M18×1.5	210~247	331~397	457~541	541~641
M20	264~312	417~500	576~683	683~808
M20×1.5	294~345	463~555	640~758	758~897
M22	360~431	568~680	786~941	918~1099
M22×1.5	395~473	624~747	803~1034	1009~1208
M24	457~547	722~864	998~1195	1167~1397
M24×2	497~595	785~940	1086~1300	1269~1520
M27	669~801	1056~1264	1461~1749	1707~2044
M27×2	723~865	1141~1366	1578~1890	1845~2208
M30	908~1087	1437~1717	1984~2375	2318~2775
M30×2	1005~1203	1587~1900	2196~2629	2566~3072
M36	1587~1900	2506~3000	3466~4150	4051~4850
M36×3	1680~2011	2653~3176	3670~4394	4289~5135
M42	2538~3039	4088~4798	5544~6637	6479~7757
M42×3	2731~3269	4312~5162	5965~7141	6921~8345
M48	3813~4564	6020~7207	8327~9969	9732~11651
M48×3	4152~4970	6556~7848	9069~10857	10598~12688

2. MAINTENANCE

NOTE:

2.1 Overview

Only by performing regular vehicle maintenance and repair, can ensure the continuous and reliable use of the truck.

Only specially trained and qualified personnel are capable of maintenance and repair operations of the equipment. If you want to perform the maintenance and repair on your own, it is recommended that on-site training should be conducted to your maintenance personnel by the service representative of the vendor.

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 the operations under the cabin, sufficiently strong chains or safety device must be used to secure the vehicle.

CAUTION

Without the supplier's consent, it is strictly forbidden to make modifications to truck, especially to the safety devices. It is strictly forbidden to change the various working speeds of the truck.

NOTE

- *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.*

2.2 Maintenance

2.2.1 Cleaning

- Do not use flammable liquids to clean the truck.
- Before starting to clean, all necessary security measures must be taken to prevent sparking (short circuit) during operation. If the truck is powered by battery, battery plug must be pulled out.
- When cleaning electrical and electronic components, you should use low-intensity suction gas or compressed dry air. Meanwhile, clean the dust on the surface of components with non-conductive and antistatic brush.
- Do not use vapor steam 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 per 7 days
250	At least once per 60 days
500	At least once per 90 days
1000	At least once every 6 months
2000	At least once per year

⚠ CAUTION

When the truck is at running-in phase (after approximately 100 hours of operation), the equipment user must check the fastening of wheel nuts and bolts and re-tighten them if necessary.

Regular inspection and maintenance under harsh conditions of use:

Under harsh working conditions, especially:
- Dusty environment
- Corrosive environment
- Cold storage environment

The maintenance intervals should be shortened by half.

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 interlock switch functions	A				
Check the emergency switch functions	A				
Check the cables for damage and if the terminals are secure		A			
Check the lifting limit switch functions	A				
Check and tighten the controllers and contactors					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 charge connector				A	
Check if the cable connections between battery monomers are secure, apply some grease to electrodes if necessary				A	
Check the position of various bearings for noise					A
Clean or add the gear grease					A / L
Check the gearbox for abnormal noise or leaks				A	
Check and lubricate the bearings between drive motor and gearbox		A / L			
Check the drive wheel and load wheel for worn or damage	A				
Check the wheel bearings and fixation			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.

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 bearing bridge for damage or crack			A		
Check the travel speed					A
Hydraulic System					
Check the functions of hydraulic system	A				
Check if the hoses, pipes and interfaces are fastened or sealed securely, and check if there is damage				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	
Clean or replace the hydraulic oil	Replace after 100 hours of early operation. Then replace once every 2000 hours				
Check the function of emergency pressure relief valve	A				
Check and clean oil tank air filter				A	
Replace the oil tank air filter and filter					A
Check the relief pressure					A
Breking System					
Check the braking functions of electromagnetic brake	A				
Check the air gap of electromagnetic brake				A	
Check the installation and connection of electromagnetic brake					A
Check the braking distance of electromagnetic brake					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.

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**
Lifting Mechanism					
Check the connecting rod mechanism for wear or damage				A	
Check whether the pin shaft is fixed securely				A	
Check and lubricate the moving parts of connecting rod mechanism		A / L			
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
Check the connections of bolts and nuts			A		
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.

2.2.3 Lubrication

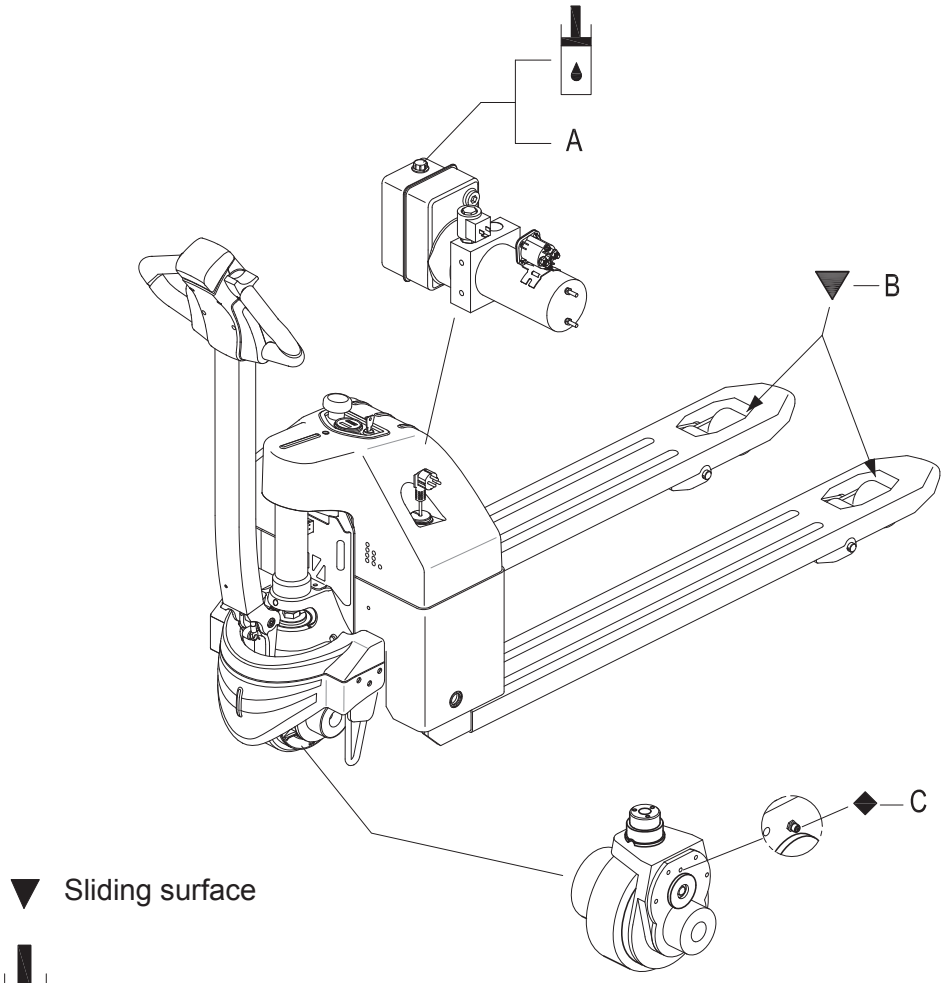
Lubricant

- Improper operations may constitute hazards to the operator's health and life, as well as to the surrounding environment.
- When storing or adding lubricant, use clean containers. It is strictly forbidden to mix different types and specifications of lubricants with each other (except for those can be mixed under clear statement).

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.



▼ Sliding surface

Hydraulic oil injection nozzle

◆ Gear oil injection nozzle

Figure 10002

Table 2.2 Lubricants				
Code	**Type**	**Specification**	**Amount**	**Position**
A	Anti-wear hydraulic oil	L-HM46	0.65 L	Hydraulic System
	Low temperature anti-wear hydraulic oil (cold storage)	L-HV32		
B	Multi-purpose grease	Polylub GA352P	Appropriate amount	Sliding surface (See Table 2.3)
C	Grease (MoS_2)	-	100 grams	Gearbox

Table 2.3 Sliding Surface Lubrication Table	
Code	**Position**
L1	Mounting Shaft
L2	Steering Bearing
L3	Drive Wheel
L4	Long Shaft
L5	Load Wheel

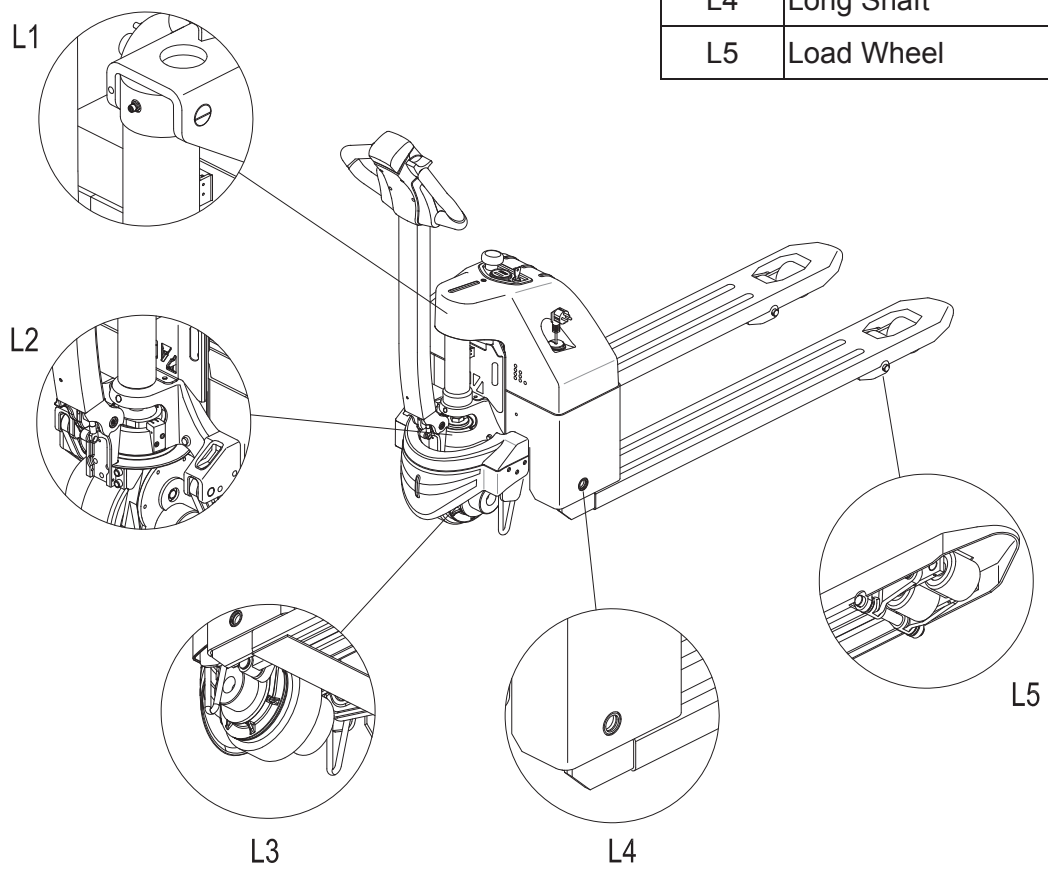


Figure 10003

3. STRUCTURE & FUNCTIONS

NOTE:

3.1 Structure & Functions

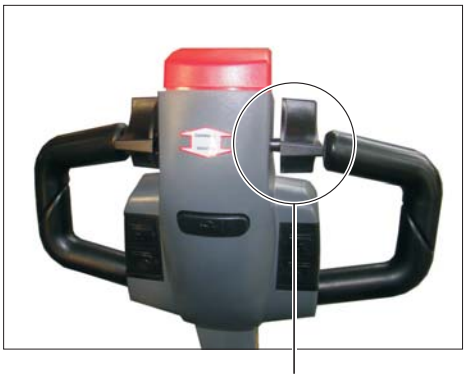
3.1.1 Travel Switch

Location: control lever;

Function: to output travel speed signal to the drive controller;

Description: when the vehicle is powered on, the travel switch is at Middle position;

Note: Unserviceable.



Travel Switch

3.1.2 Lifting/Lowering Switch

Location: control lever;

Function: to lift / lower the fork;

Description: the lifting/lowering switch is normally-open. When pressing, the switch is on; after release, the switch will automatically reset;

Note: Unserviceable.

Lifting/Lowering Switch

3.1.3 Emergency Reverse Switch

Location: control lever;

Function: press the switch, the vehicle will travel in reverse direction;

Description: reverse switch is normally-open. When pressing, the reverse switch is on; after release, the switch will automatically reset;

Note: Unserviceable.

Emergency Reverse Switch

3.1.4 Horn Switch

Location: control lever;

Function: to press the horn;

Description: the horn switch is normally-open. When pressing, the horn switch is on; after release, the switch will automatically reset;

Note: Unserviceable.

Horn Switch

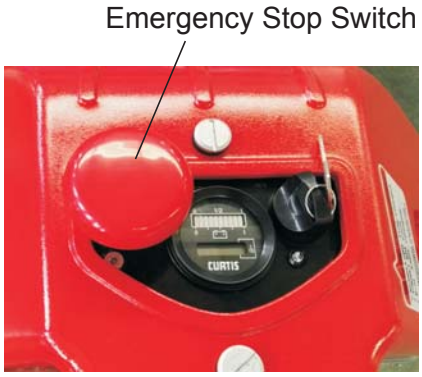
3.1.5 Emergency Stop Switch

Location: electrical mounting plate;

Function: to disconnect the circuit and switch off all electrical functions, achieving emergency braking;

Description: under normal circumstances, switch cover is at high position, and the circuit is connected, when pressing this switch, the circuit is disconnected;

Note: Unserviceable.



3.1.6 Key Switch

Location: electrical mounting plate;

Function: for operator to switch on or off the truck;

Description: remove the key to prevent operations to the truck by unauthorized operator;

Note: Unserviceable.

3.1.7 Charge Gauge

Location: electrical mounting plate;

Function: display battery power, working hours (this function is available on the component with timer function);

Description: 24V operating voltage;

Note: Unserviceable.

3.1.8 LED Charging Indicator

Location: electrical mounting plate;

Function: to determine the charging state by the color displayed;

Description: can display three colors, red, yellow and green;

Note: Unserviceable.

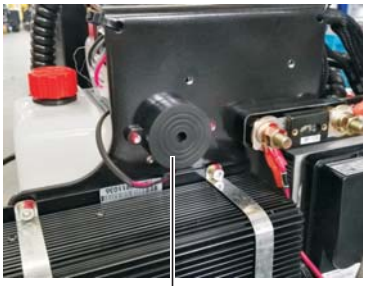
3.1.9 Buzzer

Location: electrical mounting plate;

Function: can provide sound alarm through the operation to horn switch operation;

Description: 24V operating voltage;

Note: Unserviceable.



Buzzer

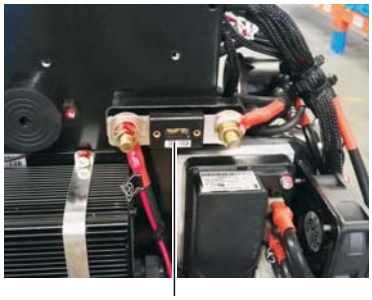
3.1.10 Fuse

Location: electrical mounting plate;

Function: overcurrent protection;

Description: fusing current is 100A;

Note: Unserviceable.



Fuse

3.1.11 Controller

Location: electrical mounting plate;

Function: to control the truck through the signal input ;

Description: 24V operating voltage, to control the circuit;

Note: Unserviceable.

Controller

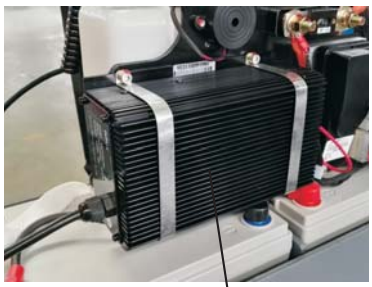
3.1.12 Charger

Location: electrical mounting plate;

Function: charge the battery;

Description: 100V~240V operating voltage,

Note: Unserviceable.



Charger

3.1.13 Lifting Limit Switch

Location: bracket;

Function: limit the lifting height of the fork;

Description: lifting limit switch is normally closed. When the fork is lifted in higher position (that is to trigger the limit switch to disconnect), lifting will be limited;

Note: Unserviceable.

Lifting Limit Switch

3.1.14 Interlock Switch

Location: at handle joint;

Function: the truck cannot be operated if the interlock switch is not closed;

Description: to prevent misuse of truck;

Note: Unserviceable.

Interlock Switch

3.1.15 Pump Motor

Location: electrical mounting plate;

Function: to provide power for gear pump for lifting the loading rack;

Description: upon receiving the signal input by control switch, traction controller to control the power transmission of pump motor;

Note: Unserviceable.

Pump and Motor Assembly

3.1.16 Gear Pump

Location: below the valve body;

Function: to provide pressure for hydraulic system of the entire vehicle;

Description: N/A;

Note: Unserviceable.

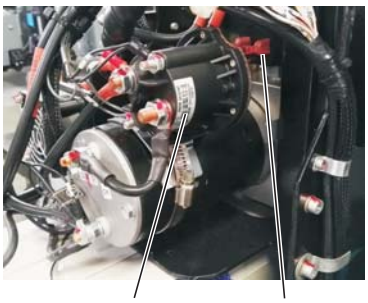
3.1.17 Pump Contactor

Location: outside of the pump motor;

Function: to connect and disconnect circuit of pump motor, and to control the power transmission of pump motor;

Description: the signal obtained by drive controller from lifting switch controls the ON/OFF of pump contactor;

Note: Unserviceable.



3.1.18 Solenoid Valve

Location: on valve body at pump and motor assembly;

Function: to realize the lowering of fork, controller gets signal from the lowering switch to control the absorption of solenoid valve, forming a hydraulic circuit;

Description: 24V operating voltage;

Note: Unserviceable.

4. CHASSIS SYSTEM

NOTE:

4.1 Load Wheel

4.1.1 Removal and Installation

Removal

- Lift the vehicle carefully with lifting equipment through the lifting holes at back;

WARNING

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

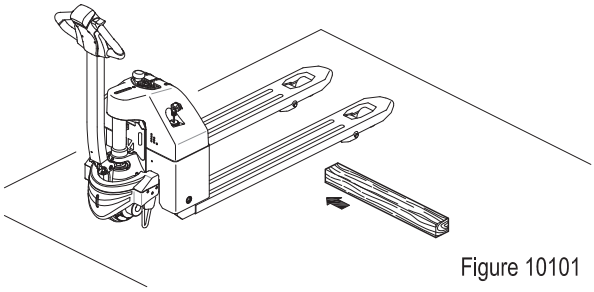


Figure 10101

- Place a wooden wedge under the chassis near load wheel, make the load wheel off the ground;

WARNING

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

Double Wheels (see Figure 10102)

- Remove the coiled elastic cylindrical pin (2) within the wheel bridge (1) with an ejector pin;
- Turn the wheel bridge to vertical direction, knock out the wheel pin shaft (3) from side, and remove the load wheel and bearing assembly;
- Remove the bearing (5) of load wheel (4) with hammer and jacking equipment.

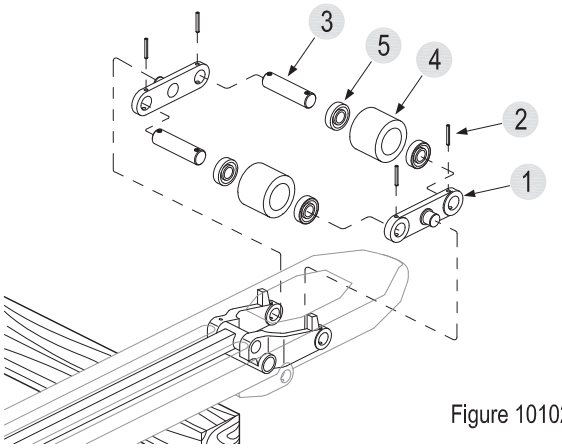


Figure 10102

Single Wheel (see Figure 10103)

- Remove the coiled elastic cylindrical pin (1) within the wheel bracket with an ejector pin;
- Knock out the wheel pin shaft (2) from side and remove load wheel and bearing assembly;
- Remove the bearing (3) of load wheel (4) with hammer and jacking equipment.

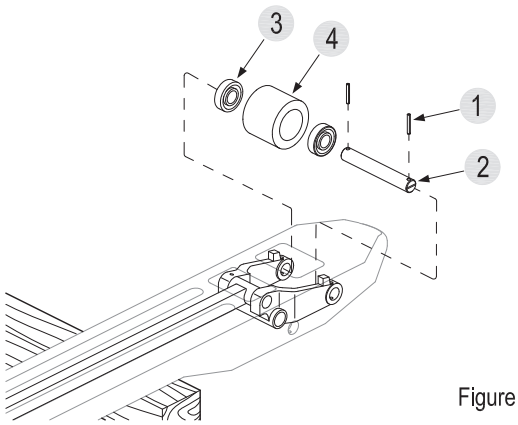


Figure 10103

Installation and Commissioning

- Install according to the reverse order of removal;
- Run the truck to see if the load wheel is functioning properly. If there is blocking or noise, please install again.

CAUTION

When installing, please apply appropriate amount of grease on the axle first.
(See Section 2.2.3 for specifications)

Quality of tyres directly affects the stability and driving performance of the device.

If you need to replace the factory-fitted tyres, please use original spare parts provided by the equipment manufacturer to reach the original design performance of the truck.

4.1.2 Faults and Causes

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

4.2 Cover

4.2.1 Removal and Installation

Removal

- Unscrew the two large flat-head screws (1), and pull out the upper cover (2);
- Unscrew the six screws (3) with a wrench and remove the upper drive cover (4) and the lower drive cover (5).

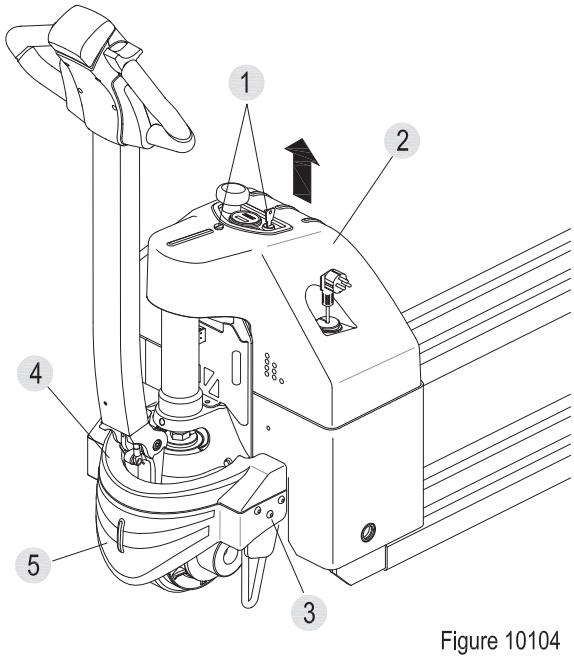


Figure 10104

CAUTION

The covers are all made of plastic materials, even force must be applied when pulling, be sure not to concentrate the force on one spot to prevent the covers from being damaged.

Installation

- Install according to the reverse order of removal.

4.3 Lifting Mechanism

4.3.1 Fork Inspection

Lower the forks completely down:

The truck is equipped with batteries, the height from fork surface at center of load wheel to the ground (h1):

- Single Wheel : 75 mm ~ 78 mm
- Double Wheels : 83 mm ~ 87 mm
- Ultra-low Placement : 42 mm

Lift the forks completely:

The truck is equipped with batteries, the height from fork surface at center of load wheel to the ground (h2):

- Single Wheel : 190 mm ~ 193 mm
- Double Wheels : 198 mm ~ 202 mm
- Ultra-low Placement : 117 mm

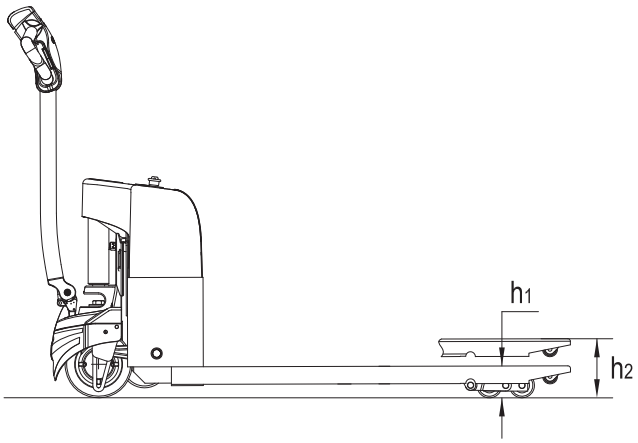


Figure 10105

4.3.2 Connecting Rod Adjustment

- Fully lower the forks and switch off the power supply;
- Lift the vehicle carefully with lifting equipment through the lifting holes at at front and back;

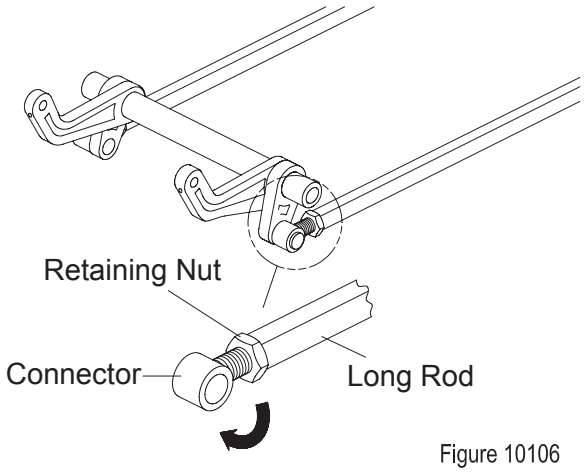


Figure 10106

WARNING

Make sure the lifting equipment is solid and secure, and the load capacity should be greater than the total weight of the vehicle.Lifting height of not more than 400mm, to prevent the hazards to the maintenance personnel working under the vehicle for connecting rod adjustment.

- Loosen the retaining nut, adjust the relative distance between long rod and connector;
- Turn the connector for 180° according to the arrow direction in the figure, the forks can then be lowered for 3 mm, whereas can be lifted for 3mm;
- Adjust the fork surface distance to standard value, tighten the retaining nut.

4.2.3 Removal and Installation

Removal

- Lift the vehicle carefully with lifting equipment through the lifting holes at at front and back;

WARNING

Make sure the lifting equipment is solid and secure, and the load capacity should be greater than the total weight of the vehicle.Lifting height of not more than 400mm, to prevent the hazards to the maintenance personnel working under the vehicle for connecting rod removal and installation.

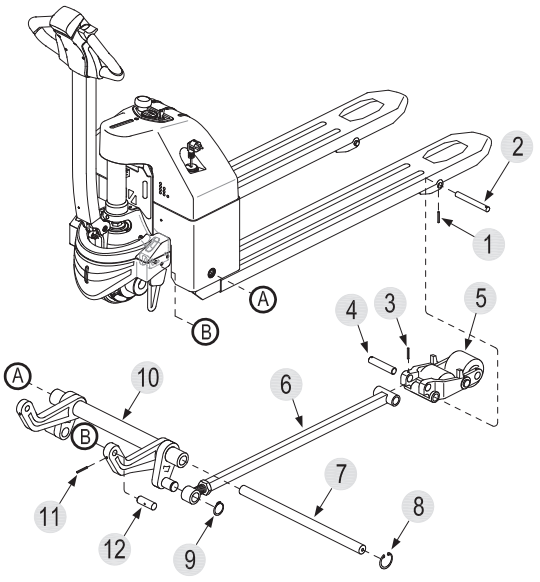


Figure 10107

CAUTION

Before going on with the next step, please fix the wheel bracket first. Be sure to avoid the falling of wheel bracket during removal, resulting in personal injury.

- Tap the coiled elastic cylinder (1) into the axle (2), and tap the axle (2) out from the side to separate the wheel frame from the front chassis;
- Remove the drive cover; (see Section 4.2)
- Tap the coiled elastic cylinder (11) into the short axis (12), and tap the short axis (12) out from the side to separate the lower connecting rod with the bearing bridge;
- Remove the circlip (8) from the holes at both sides of front chassis, tap out the support shaft (7) and remove the lower connecting rod (10);
- Remove the shaft circlip (9), and the adjustable long connecting rod can then be removed from the lower long connecting rod (6).
- Tap the coiled elastic cylinder (3) out, tap the long connecting rod pin shaft (4) out from the side, and remove the wheel frame assembly (5).

CAUTION

When replacing the long connecting rod, the connecting rod must be adjusted so that the fork surface height can reach the specified value.

Installation

- Install according to the reverse order of removal.

5. DRIVE SYSTEM

NOTE:

Drive System

No.	Name
1	Drive Assembly
2	Electromagnetic Brakes
3	Gear Cover
4	Gear Case
5	Drive Wheel
6	Drive Motor

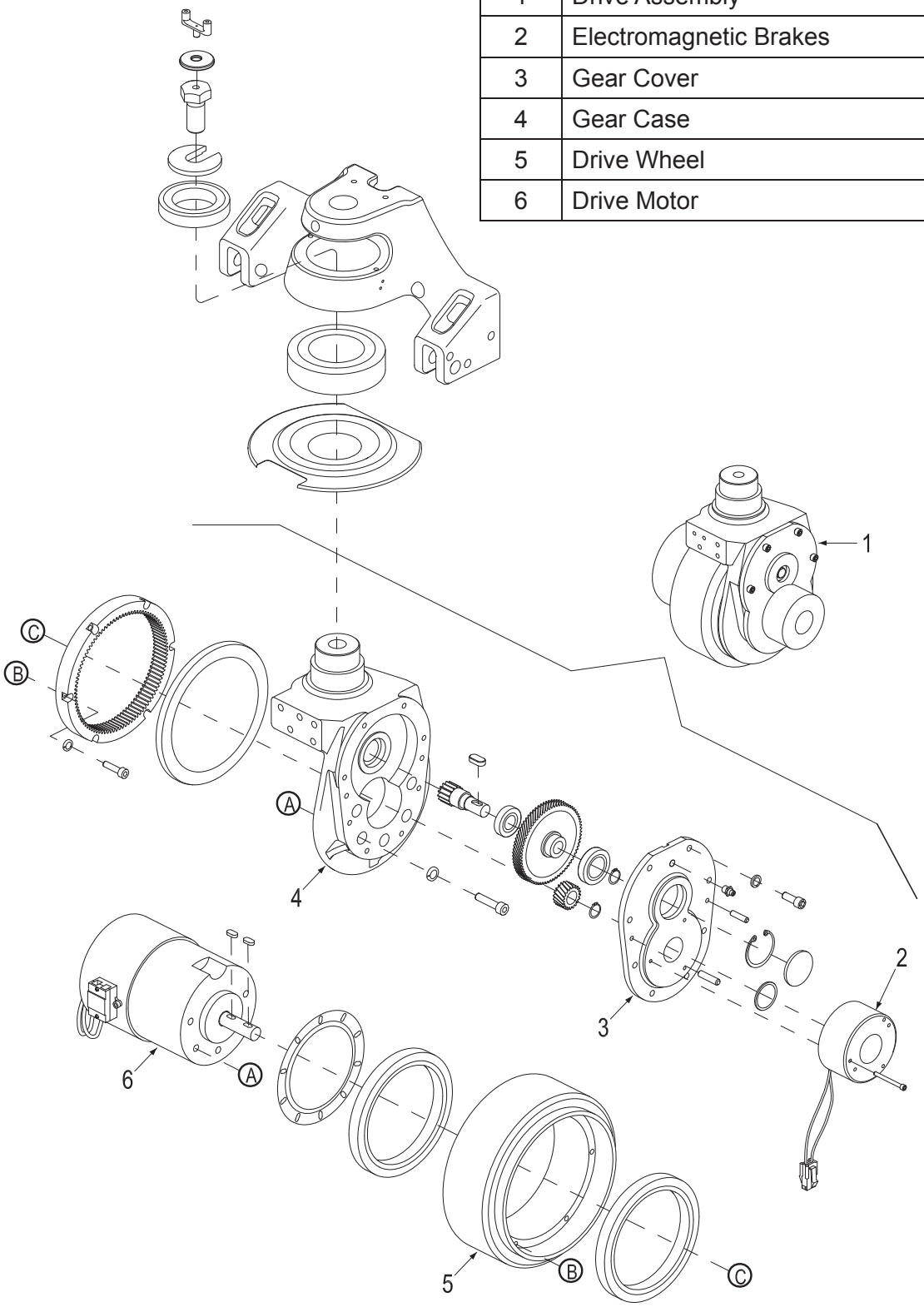


Figure 10201

5.1 Drive Assembly

5.1.1 Removal and Installation

Removal

- Remove the drive cover (see Section 4.2);
- Disconnect the connections between elbow wiring harness, interlock switch, positive and negative elec-trode cables of motor and the controller.
- Unscrew the five screws (4) with a wrench, and remove the handle assembly (5) off from the drive assembly (3);
- Unscrew the bolt (1) and knock the drive assembly (3) down with a hammer to remove it from the bearing bridge (2).

WARNING

When knocking, be sure to protect the wire harness cable from being damaged.

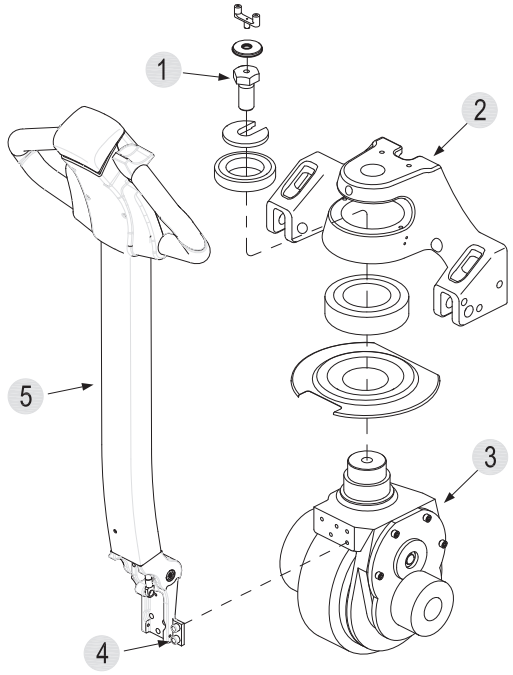


Figure 10202

Installation

- Install according to the reverse order of removal.

5.2 Electromagnetic Brakes

The truck is braked through electromagnetic brake. When the truck is powered off, the electromagnetic coil (6) doesn't absorb the pressure plate (8), the friction force generated between brake pads (2), pressure plate and friction plates (5) will prevent the drive motor from rotating, thus to brake the vehicle.

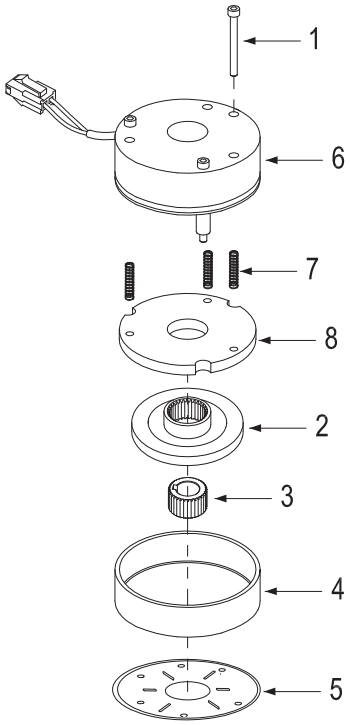


Figure 30203

No.	Name
1	Mounting screws
2	Brake pads
3	Brake gear
4	Dust cover
5	Friction plate
6	Electromagnetic coil
7	Spring
8	Pressure plate

5.2.1 Removal and Installation

Removal

The brake is installed on the drive motor. See Figure 30204

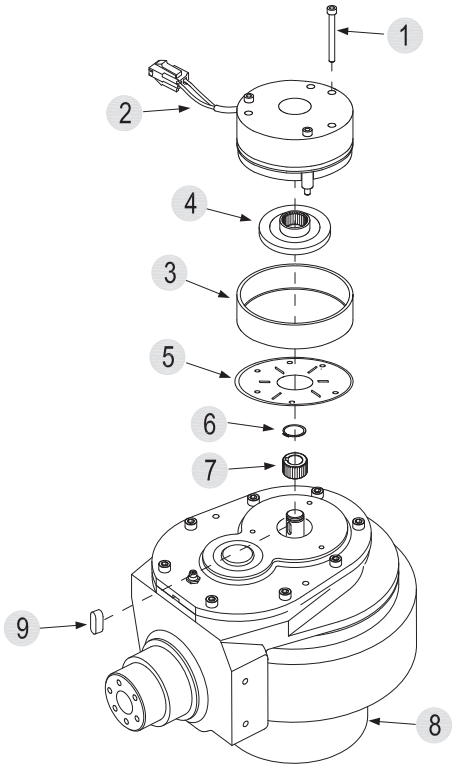


Figure 30204

- Switch off the truck power connections and pull out the brake connectors;
- Remove the drive cover;(see Section 4.2)
- Remove the three mounting screws (1) with wrench. Remove the electromagnetic coil (2) and dust cover (3);
- Remove the brake pads (4) and friction plates (5) by order;
- Remove the circlip (6) on the shaft with circlip pliers and remove the brake gear (7).

Installation

- Install according to the reverse order of removal.

CAUTION

When installing the brake gear (7), make sure the flat key is installed on the shaft of drive motor (8).

Adjustment

The electromagnetic brake used in this series of truck is an air gap adjustment-free brake. After the normal installation is completed, the air gap between electromagnetic coils and pressure plate should be standard gap distance.

As shown in the following table:

Air gap	Standard value	Maximum value
s	0.2 mm	0.4 mm

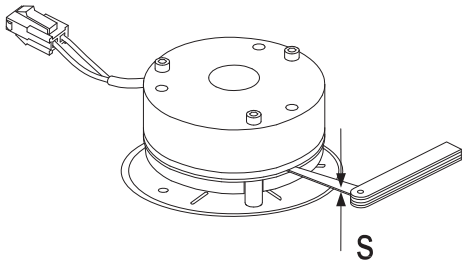


Figure 30205

CAUTION

When the air gap s exceeds 0.4mm, replace the brake pads (2, Figure 30203)

5.2.2 Faults and Causes

1	Fault	After the coil is energized, the pressure plate does not absorb
	Cause	a. Mechanical part failure; b. Foreign body blocking; c. Coil failure; d. Coil supply voltage less than 24V

2	Fault	After the coil is powered off, the pressure plate won't release
	Cause	Foreign body blocking
3	Fault	Abnormal noise after absorption
	Cause	a. Fully absorbed, but plate not flat. b. Mechanical resistance
4	Fault	Brake temperature is too high
	Cause	Pressure plate does not fully absorb, overcurrent of the coil, or energized too frequently

5.2.3 Checking and Testing

Electromagnetic Coil Checks

- Switch off the truck power connections and pull out the brake connectors;
- Check the resistance of the coil with a multimeter: measurement method is as shown in Figure 30206;

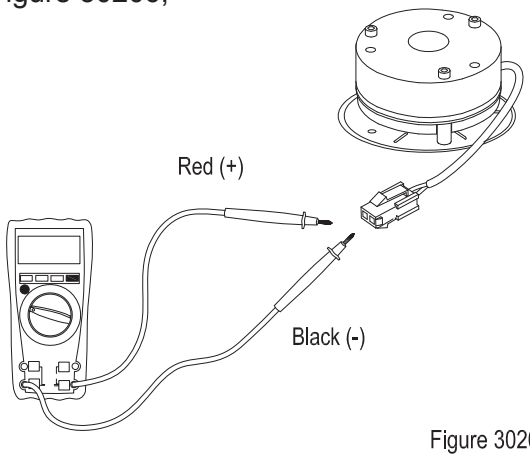


Figure 30206

- Identify if the electromagnetic coil is normal according to the readings of resistance on the multimeter.
  As shown in the following table:

Resistance Measurement	Judgment
Approx. 30 Ω	Normal
0 Ω	Coil shorting (replace the brake)
∞ Ω	Coil breaking (replace the brake)

Air Gap Checks

- Switch off the truck power connections and pull out the brake connectors;
- Check the air gap between electromagnetic coil and pressure plate with feeler gauge: measurement method is as shown in Figure 50208;
- Determine if the air gap is normal according to the gauge measurements.
  As shown in the following table:

Air gap distance	Judgment
0.2~0.4mm	Normal
> 0.4mm	The air gap is too large (replace brake pads)

NOTE

After a period of use, brake pads of the electromagnetic brake will wear. After being worn too much, the air gap between electromagnetic coil and pressure plate may exceed the predetermined maximum value, which may cause electromagnetic absorption failure.

Foreign Body Checks

Foreign bodies stuck in the brake may affect the normal absorption of pressure plates.

Check if there is foreign body in the air gap that may affect the absorption or bouncing off of the pressure plates.

Spring Checks

Deformation or foreign bodies stuck in the spring may affect the normal absorption of pressure plates.

Check if the distribution of the springs on the electromagnetic coil is correct, and check if there is foreign body in the spring hole.

NOTE

After a period of time of use, the springs may be deformed due to the effect of radial force, such case may result in abnormal air gap of the brake, and the spring must be replaced.

5.2.4 Control Circuit Troubleshooting

Brake Control Circuit (Figure 30207)

Check if the circuit is broken by using a multimeter:

- Set the multimeter to ON-OFF;
- Check if #6 circuit (circuit between brake and controller) is conducted;
- Check if #7 circuit (circuit between brake and controller) is conducted;

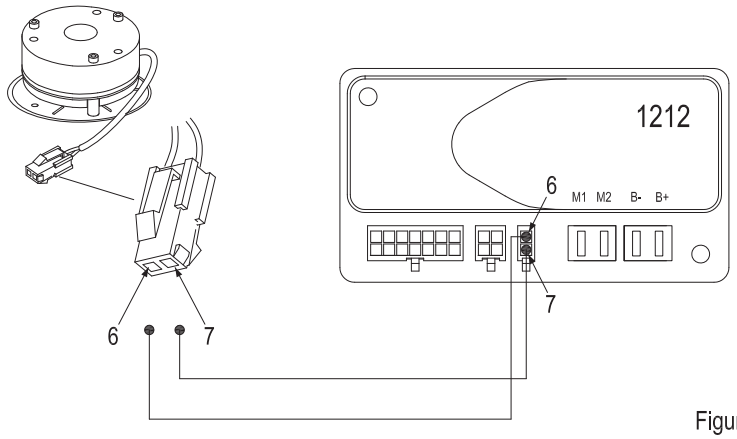


Figure 30207

5.3 Drive Wheel

5.3.1 Removal and Installation

Removal

- Remove the brake (see Section 5.2.1);

  (See Figure30208)

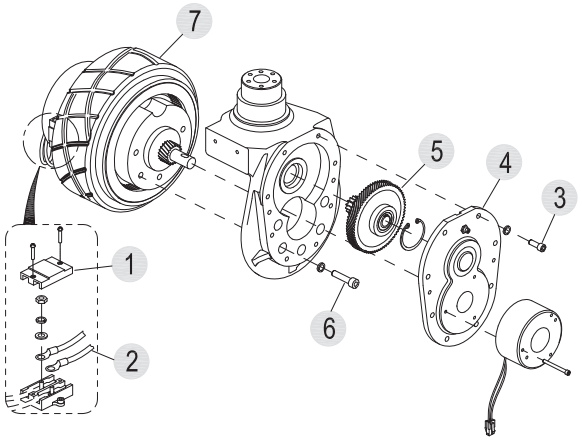


Figure 30208

- Dismantle the motor cable mounting base (1), and remove the motor cables (2);
- Loosen the eight screws (3) with a wrench, and remove the gearbox cover (4) and gear set (5);
- Unscrew the five screws (6) and knock out the assembly (7) from the gearbox;

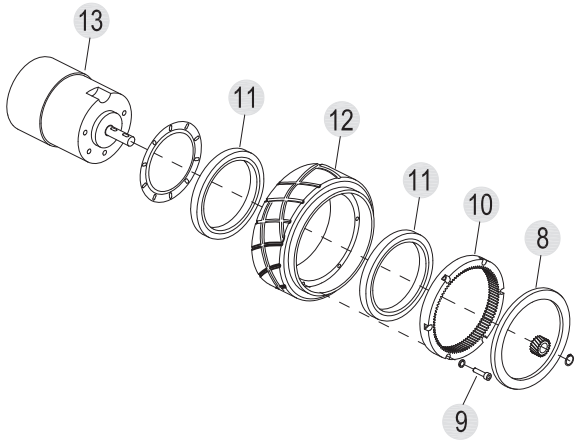


Figure 30209

(See Figure30209)

- Knock out the drive motor (13), and remove the oil seal (8);
- Loosen the six screws (9) with a wrench, and dismantle the large ring gear (10), bearing (11) and drive wheel (12) by order.

Installation

- Install according to the reverse order of removal.

CAUTION

Tyre wear can affect the stability of the truck, adjust the caster with minor wear on a regular basis, or replace the caster with heavy wear.

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

5.3.2 Faults and Causes

1	Fault	Drive wheel slipping or jumping
	Cause	Wear
2	Fault	Drive wheel cracking or degumming
	Cause	Improper use
3	Fault	Vehicle sways while running
	Cause	Drive wheel lock nut loosening

5.4 Drive Motor

This truck obtains drive force through DC motor.

5.4.1 Removal and Installation

Drive Motor

See Section 5.3.1 .

Carbon Brush

- Unscrew the three screws (1) and remove motor end cover (2) ;
- Unscrew the two screws (5) and remove the carbon brush (7) on the holder (6).
- Install according to the reverse order of removal.

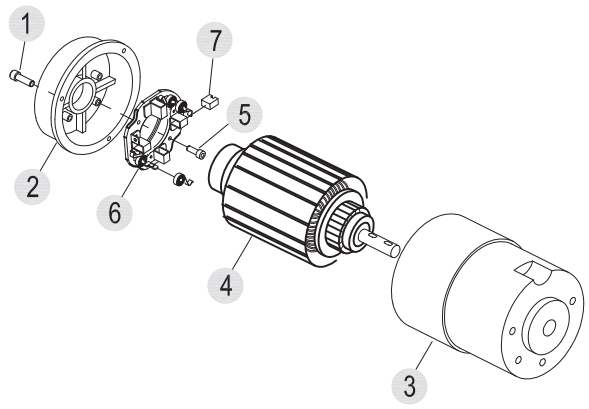


Figure 30210

CAUTION

When replacing the carbon brush, replace the complete set of carbon brushes.

WARNING

Due to magnetic force, the rotor and the stator may pull each other, therefore, when dismantling motor rotor, do not hold your hand between the rotor and the stator to avoid pinch hazard!

Adjustment

- After replacing the motor or carbon brush, conduction test must be carried out to the motor (see Section 5.4.3).
- After replacing carbon brush, running operation must be carried out to the carbon brush: By running the motor with repeated lifting, letting the carbon brush to be fully running, making its surface smooth to fit the rotor.

5.4.2 Faults and Causes

1	Fault	Motor does not rotate
	Cause	a. Negative electrode cable broken; b. Motor positive and negative electrode with loose terminals; c. Armature winding with broken circuits; d. Motor bearing damaged and blocked; e. Serious wearing of carbon brush.
2	Fault	Motor speed is turning slow
	Cause	a. Insufficient voltage of battery; b. Carbon brush worn or carbon brush spring pressure decreases; c. Bearing wear or lack of lubricating oil; d. Armature winding has short circuit elements; e. Carbon brush winding grounded.
3	Fault	Motor sometimes can start, sometimes cannot
	Cause	a. Motor positive and negative electrode with loose terminals and poor connection; b. Carbon brush wear and tear; c. Armature winding has circuit broken unit.
4	Fault	Motor with abnormal noise or vibration
	Cause	a. Uneven clearance between stator and rotor; b. Bearing failures; c. Loosening fixing screws on motor housing.

5	Fault	Motor smoking or burning smell
	Cause	Stator winding short circuit, motor burnt
6	Fault	Excessive temperature rise
	Cause	a. Stator winding short circuit; b. Motor positive and negative electrodes with surface oxidation, resistance increases and results in heating; c. Bearing failure, resulting in severe heating.

5.4.3 Checking and Testing

Checking

- Check if the drive motor and appearance of cables are in good condition, and if the plug connection is secure;
- Check if the circuit is connected.

Testing

- Remove the cables on the drive motor;
- Carry out ON/OFF test to motor positive and negative electrodes with a multimeter:
  If connected, the motor is normal;
  If not connected:
  1) Broken circuits in rotor coils (replace the motor);
  2) Carbon brush wearing, move on to the next step.
- Replace the carbon brush .
  (See Section 5.4.1)

CAUTION

When replacing the carbon brush, replace the complete set of carbon brushes.

Circuit of drive motor

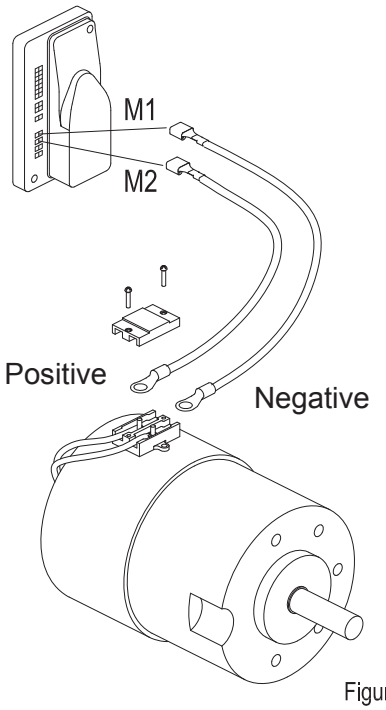


Figure 30211

5.5 Gearbox

5.5.1 Removal and Installation

See Section 5.3.1 .

CAUTION

Please add gear oil to the grease nipple on the gearbox cover (see Section 2.2.3 for specification and filling amount)

5.5.2 Faults and Causes

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

6. OPERATING SYSTEM

NOTE:

6.1 Control Lever

Control lever is used to control the travel, lifting, lowering, horn and emergency reverse of the vehicle.

Removal

Control lever is mounted on control arm (5, Figure 30301).

- Remove four screws (1) , lift up cap assembly (2);
- Disconnect control lever wiring harness from wiring harness;
- Unscrew two screws (4), remove the control lever (3).

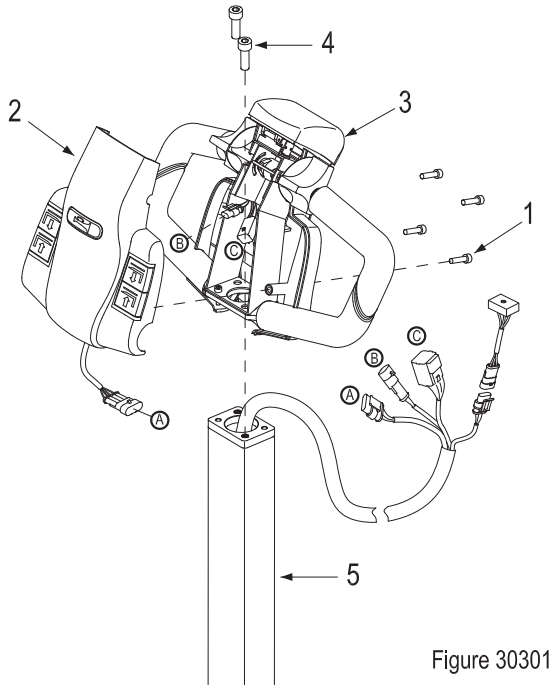


Figure 30301

Installation

- Install according to the reverse order of removal.

CAUTION

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

6.2 Button Switch

Push button switch is the switch that makes the dynamic and static contacts ON or OFF to achieve the switching of circuits through push-button drive mechanism. In the electrical control circuits of this truck, the push button switch is used for manual emitting of control signals to control the vehicle lifting, lowering, horn and emergency reverse.

By function:
- Lifting Button Switch
- Lowering Button Switch
- Horn Button Switch
- Emergency Reverse Switch

6.2.1 Removal and Installation

Lifting/Lowering/Horn Switch

(See Figure 30302)

- Remove pin (6&18) securing switches (16) ;
- Unscrew three screws (11), remove the wire clamps (12) and remove the lifting-lowering-horn switch wiring harness (15).
- Install according to the reverse order of removal.

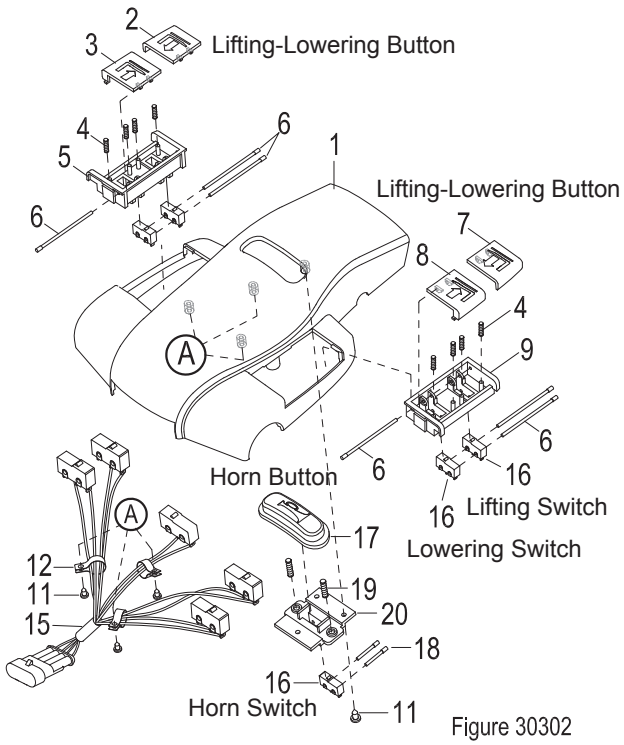


Figure 30302

Lifting/Lowering Button

(See Figure 30302)

- Remove switch assembly (5 or 9) form cap (1);
- Remove pin (6) securing buttons and remove the lifting button (2 or 7) , the lowering button (3 or 8) and springs (4).
- Install according to the reverse order of removal.

Horn Button

(See Figure 30302)

- Unscrew three screws (11) and remove bracket (20) and springs (19) and horn button (17).
- Install according to the reverse order of removal.

Emergency Reverse Switch

(See Figure 30303)

- Remove pin (5) securing button and remove the emergency reverse button (1) and springs (2) from bracket (4).
- Remove pin (3) and remove the emergency reverse switch (6).
- Install according to the reverse order of removal.

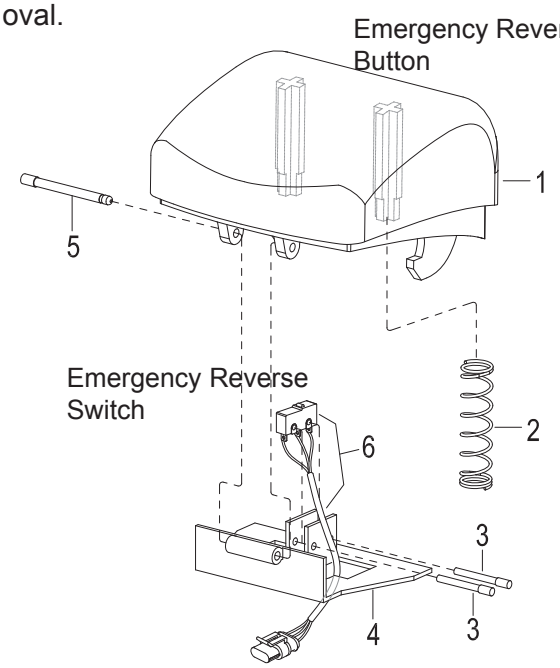


Figure 30303

6.2.2 Faults and Causes

1	Fault	Operate the push button switch, but the vehicle responds with no action
	Cause	a. Push button switch failure; b. Push button switch circuit not conducted.
2	Fault	Push button switch not operated, but the vehicle responds with action
	Cause	Pushbutton switch failure

6.2.3 Checking and Testing

Checking

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

Testing

- Check if the push button switch circuit is connected;
- Carry out ON/OFF test to the push button switch with a multimeter:

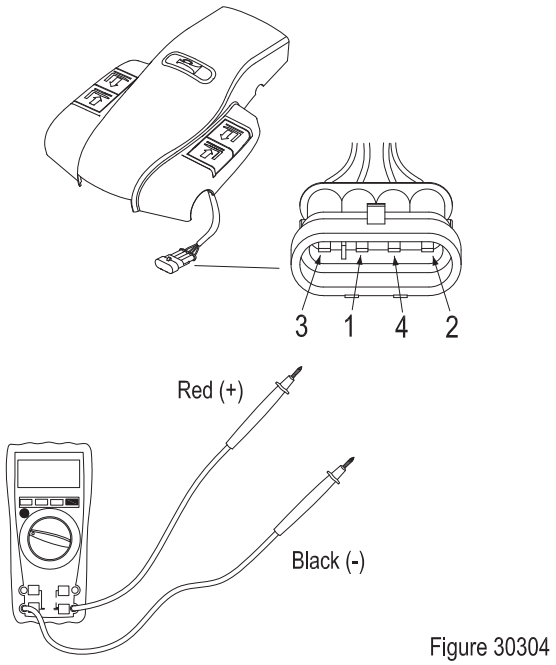


Figure 30304

Lifting Switch

(See Figure 30304)

- Carry out ON/OFF test to the circuit between #1 and #2 with a multimeter:
  push button switch at original position, broken circuit;
  press the button , the circuit is conducted.

Lowering Switch

(See Figure 30304)

- Carry out ON/OFF test to the circuit between #1 and #3 with a multimeter:
  push button switch at original position, broken circuit;
  press the button , the circuit is conducted.

Horn Switch

(See Figure 30304)

- Carry out ON/OFF test to the circuit between #1 and #4 with a multimeter:
  push button switch at original position, broken circuit;
  press the button , the circuit is conducted.

Emergency Reverse Switch

(See Figure 30308)

- Carry out ON/OFF test to the circuit with a multimeter:
  push button switch at original position:
  #1 - #12 : conducted
  #1 - #13 : broken
  #1 - #12 : broken

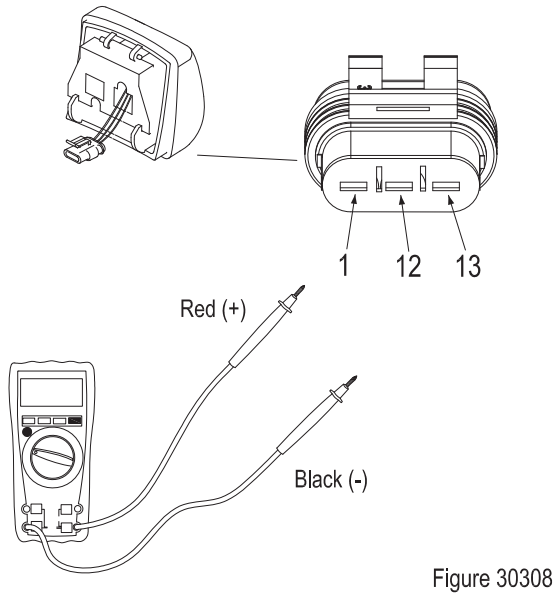


Figure 30308

press the button :
#1 - #12 : broken
#1 - #13 : conducted
#1 - #12 : broken

6

6.2.4 Control Circuit Troubleshooting

Lifting Switch Control Circuit (Figure 30305)

Check if the circuit is broken by using a multimeter:

- Set the multimeter to ON-OFF;
- Check if #1 circuit (circuit between lifting switch and key switch) is conducted;
- Check if #2 circuit (circuit between lifting switch and pump contactor) is conducted.

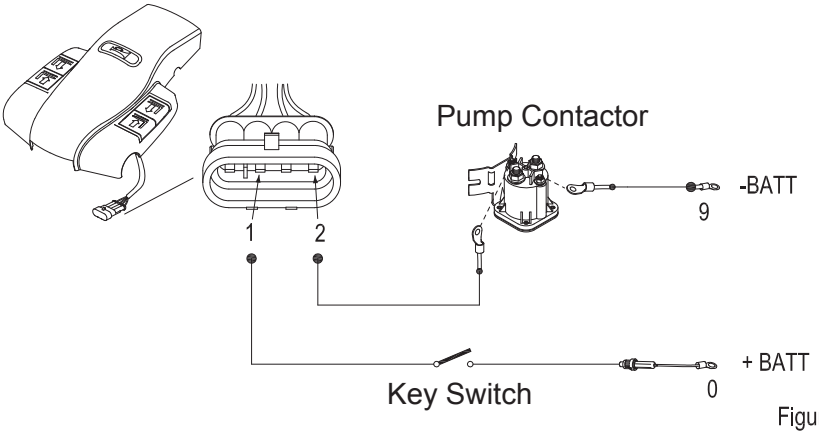


Figure 30305

Lowering Switch Control Circuit (Figure 30306)

Check if the circuit is broken by using a multimeter:

- Set the multimeter to ON-OFF;
- Check if #1 circuit (circuit between lowering switch and key switch) is conducted;
- Check if #3 circuit (circuit between lowering switch and solenoid valve) is conducted.

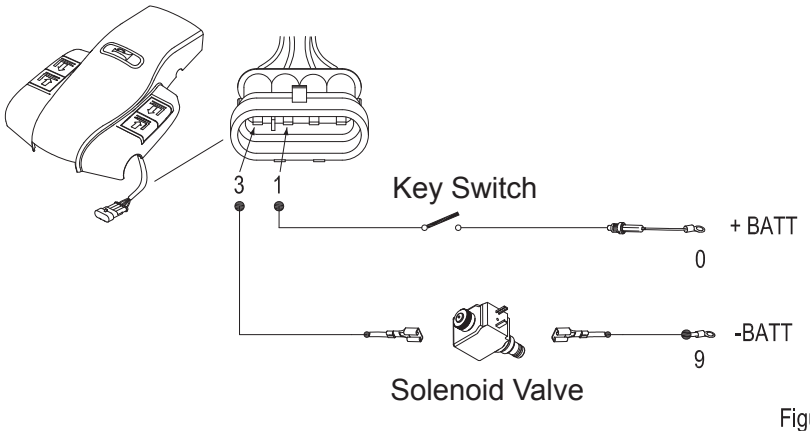


Figure 30306

Emergency Reverse Switch Control Circuit (Figure 30311)

See Section 6.3.4 .

6

Horn Switch Control Circuit (Figure 30307)

Check if the circuit is broken by using a multimeter:

- Set the multimeter to ON-OFF;
- Check if #1 circuit (circuit between horn switch and key switch) is conducted;
- Check if #4 circuit (circuit between horn switch and buzzer) is conducted.

Buzzer Checks

Energize the buzzer with a voltage of 24V:
Buzzer sounds, it is working properly;
Buzzer does not sound, it failure, needs to be replaced.

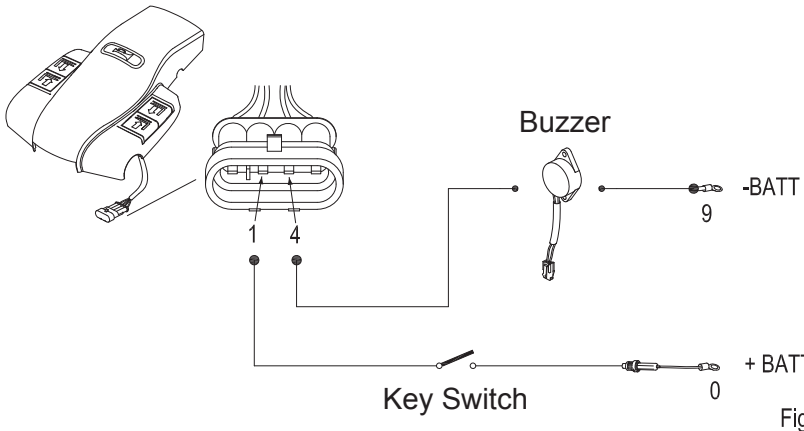


Figure 30307

6.3 Travel Switch

Travel switch provides forward or backward input signals for the vehicle.

6.3.1 Removal and Installation

Removal

(See Figure 30309)

- Remove four screws (1), lift up cap assembly (2);
- Remove the emergency reverse button;(See Section 6.2.1)
- Unscrew the screw(4 & 5) and remove the travel switch (9).

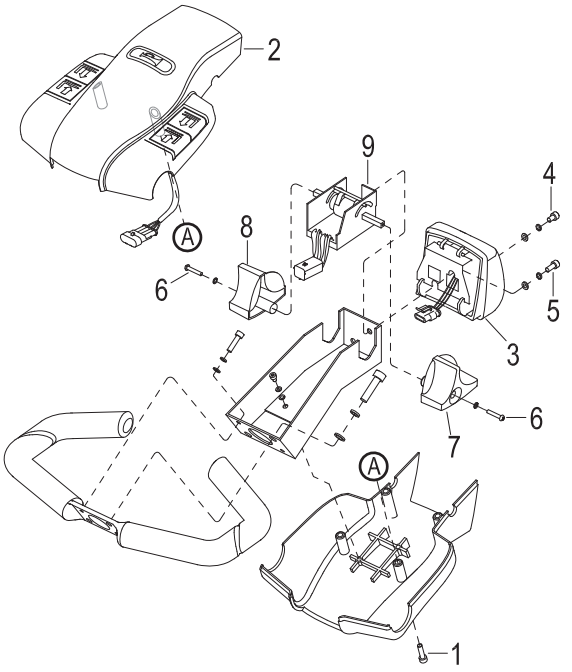


Figure 30309

Installation

- Install according to the reverse order of removal.

CAUTION

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

6.3.2 Faults and Causes

1	Fault	Operate travel switch, the vehicle cannot go forward or backward
	Cause	a. Travel switch failure; b. Travel switch circuit not conducted.
2	Fault	Travel switch not operated, the vehicle goes forward or backward automatically
	Cause	Travel switch failure;

6.3.3 Checking and Testing

Checking

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

Testing

- Enter Monitor Menu to check the status of the switch:
  "Throttle", toggle the switch forward / backward, if the display does not change, then it indicates the travel switch or its circuit failure;
- Turn off the vehicle to check the travel switch and its wiring harness. (See Figure 30310)
- Energize the travel switch with a voltage of 24V and check the voltage of each port with a multimeter;

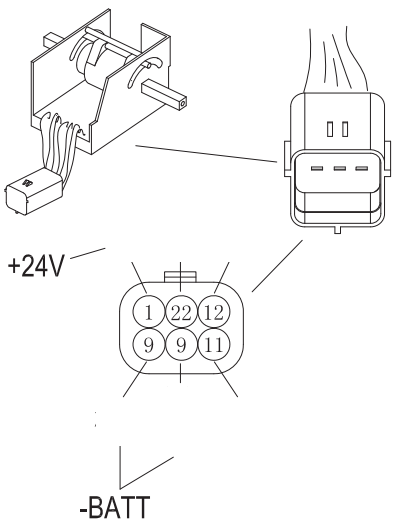


Figure 30310

- Place the travel switch at Middle position. Respectively, measure the voltage of pin (11), pin (12) and pin (22) of the travel switch:
  if the voltage is not 0, it indicates the travel switch failure, needs to be replaced;
  if the voltage is 0, indicating the switch is normal, move to the next step.
- Toggle the travel switch forward, measure the voltage of pin (11), pin (12) and pin (22) of the travel switch:
  Pin(11) : 24V . Normal
  Pin(12) : 0V . Normal
  Pin(22) : 0V~5V, the maximum value is 4V~5V. Normal
- Toggle the travel switch backward, measure the voltage of pin (11), pin (12) and pin (22) of the travel switch:
  Pin(11) : 0V . Normal
  Pin(12) : 24V . Normal
  Pin(22) : 0V~5V, the maximum value is 4V~5V. Normal

6.3.4 Control Circuit Troubleshooting

Travel Switch Control Circuit (Figure 30311)

Check if the circuit is broken by using a multimeter:

- Set the multimeter to ON-OFF;
- Check if #1/#9/#10/#11/#12 circuit (circuit between travel switch and controller) is conducted.

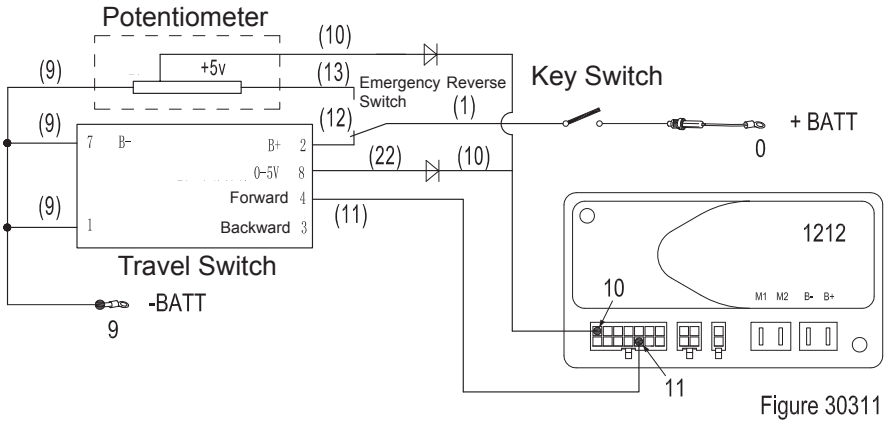


Figure 30311

7. HYDRAULIC SYSTEM

NOTE:

The system pressure of the entire hydraulic system pressure is provided by hydraulic power unit system, which is used for lifting. 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.

Solenoid valve on the valve body is used for the control of lowering. 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.

Hydraulic Schematic Diagram is as shown in Figure 10401;
See Section 7.8 for hydraulic symbol descriptions.

7.1 Overview

- Lower the fork 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 fork 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, please 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. Every time when replacing the cylinder, also replace the cylinder seals.

Hydraulic Oil

Hydraulic oil for truck:

Specifications: Anti-wear Hydraulic Oil L-HM46.

* For cold storage: Low Temperature Anti-wear Hydraulic Oil L-HV32.

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, pay attention to 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 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.

Where the hydraulic seals 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 first.

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

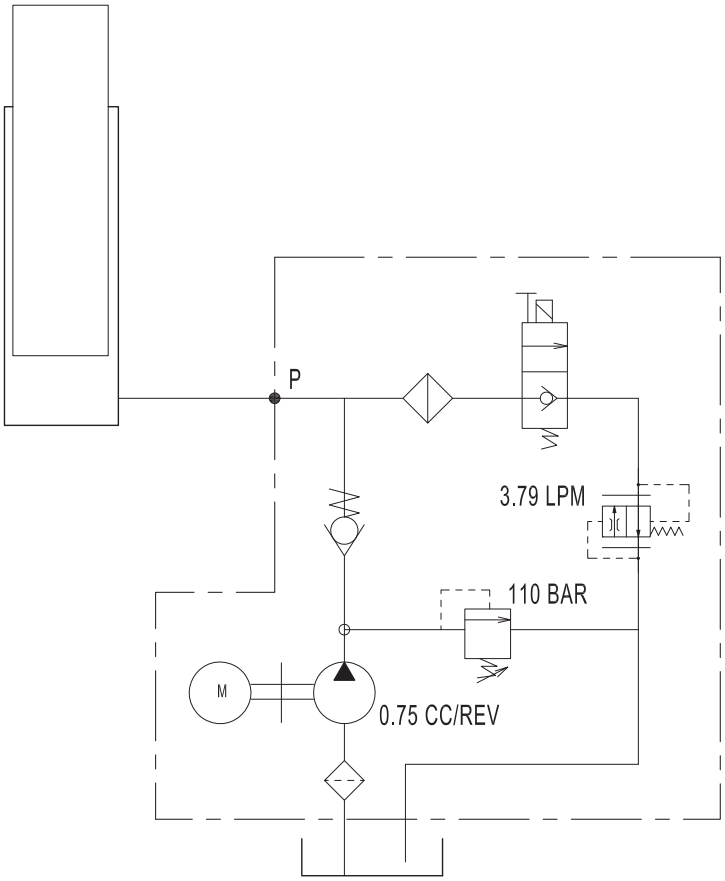


Figure 10401

7.2 Pump and Motor Assembly

7.2.1 Removal and Installation

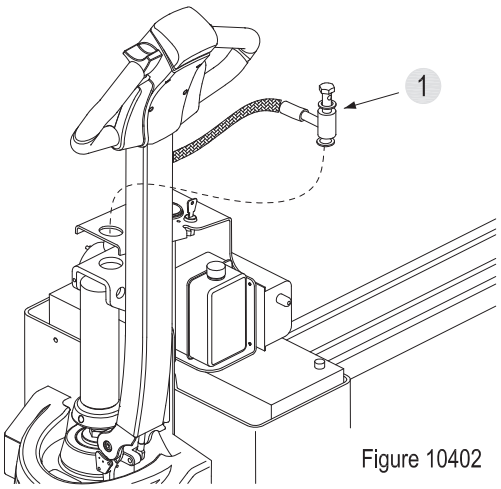


Figure 10402

Removal

- Remove the upper cover; (see Section 4.2)
- Unscrew the articulated joint (1) with a wrench and disconnect the connection between the tubing and the cylinder;
- Remove wiring harness and cables between electrical board assembly and the battery;
- Unscrew the four bolts (2) with wrench and remove the electrical board assembly from the chassis;

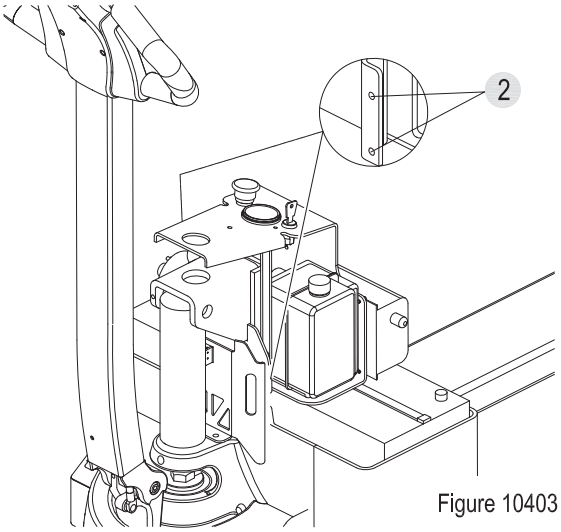


Figure 10403

- Remove the positive and negative electrode cables from the pump contactor and the wires from the solenoid valve;
- Unscrew the two screws (3) with a wrench and remove the hydraulic station from the electrical mounting plate.

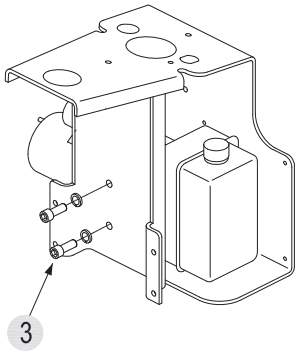


Figure 10404

Installation

- Install according to the reverse order of removal.

CAUTION

When removing the tubing and pump and motor assembly, the system will lose some hydraulic oil, please refer to Section 2.2.3 for supplementary adding of hydraulic oil.

7

7.2.2 Component

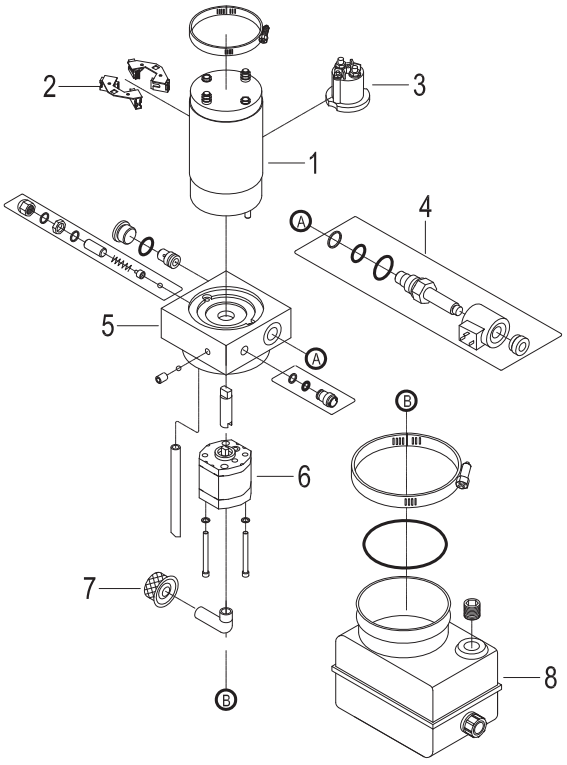


Figure 10405

No.	Name
1	Pump Motor
2	Carbon Brush
3	Pump Contactor
4	Solenoid Valve
5	Valve Body
6	Gear Pump
7	Filter
8	Tank

7.3 Pump Motor

7.3.1 Removal and Installation

Removal

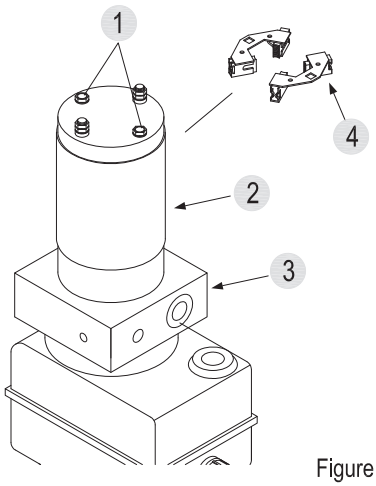


Figure 10406

- Remove the pump and motor assembly;
- Remove the 2 long screws (1) on the motor end cover, and remove the pump motor (2) from the valve block (3);
- If you need to replace carbon brush (4). Remove motor end cover, replace the carbon brush on the holder.

CAUTION

When replacing the carbon brush, replace the complete set of carbon brushes.

Installation

- Install according to the reverse order of removal.

CAUTION

When installing the pump motor, make sure the shaft and the coupling on motor rotor are mated in place. (Rotate the motor around to make the end surface of motor be in full contact with valve block).

WARNING

Due to magnetic force, the rotor and the stator may pull each other, therefore, when dismantling motor rotor, do not hold your hand between the rotor and the stator to avoid pinch hazard!

Adjustment

- After replacing the steering motor or carbon brush, conduction test must be carried out to the motor (see Section 7.3.3).
- After replacing carbon brush, running operation must be carried out to the carbon brush: By running the motor with repeated lifting, letting the carbon brush to be fully running, making its surface smooth to fit the rotor.

7.3.2 Faults and Causes

1	Fault	Motor does not rotate
	Cause	a. Negative electrode cable broken; b. Motor positive and negative electrode with loose terminals; c. Armature winding with broken circuits; d. Motor bearing damaged and blocked; e. Serious wearing of carbon brush.
2	Fault	Motor speed is turning slow
	Cause	a. Insufficient voltage of battery; b. Carbon brush worn or carbon brush spring pressure decreases; c. Bearing wear or lack of lubricating oil; d. Armature winding has short circuit elements; e. Carbon brush winding grounded.
3	Fault	Motor sometimes can start, sometimes cannot
	Cause	a. Motor positive and negative electrode with loose terminals and poor connection; b. Carbon brush wear and tear; c. Armature winding has circuit broken unit.
4	Fault	Motor with abnormal noise or vibration
	Cause	a. Uneven clearance between stator and rotor; b. Bearing failures; c. Loosening fixing screws on motor housing.
5	Fault	Motor smoking or burning smell
	Cause	Stator winding short circuit, motor burnt
6	Fault	Excessive temperature rise
	Cause	a. Stator winding short circuit; b. Motor positive and negative electrodes with surface oxidation, resistance increases and results in heating; c. Bearing failure, resulting in severe heating.

7.3.3 Checking and Testing

Checking

- Check if the pump motor and appearance of cables are in good condition, and if the plug connection is secure;
- Check if the circuit is connected.

Testing

- Remove the cables on the pump motor;
- Carry out ON/OFF test to motor positive and negative electrodes with a multimeter:
  If connected, the motor is normal;
  If not connected:
  1) Broken circuits in rotor coils (replace the motor);
  2) Carbon brush wearing, move on to the next step.
- Replace the carbon brush (See Section 7.3.1).

⚠ CAUTION

When replacing the carbon brush, replace the complete set of carbon brushes.

Circuit between pump motor and pump contactor

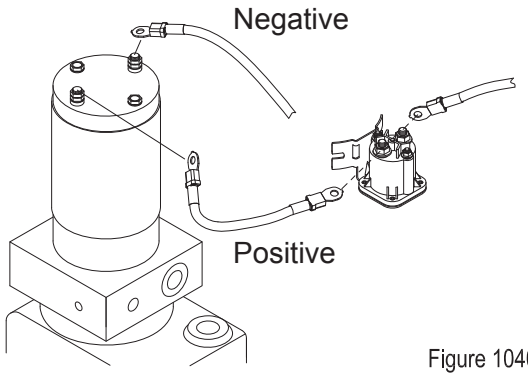


Figure 10407

7.4 Pump Contactor

This truck is using DC contactor with normally-open contacts. And the ON/OFF of the contactors is controlled through controller, thus to achieve the control of ON/OFF of the vehicle.

When the contactor coil (Between A and B) 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 (C and D) 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 (C and D) disconnected, so the circuit is disconnected.

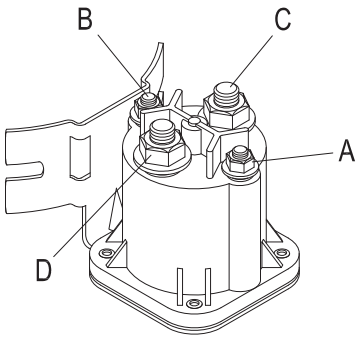


Figure 50406

7.4.1 Faults and Causes

1	Fault	Contact adhesion or slow release
	Cause	a. Contact fusion welding; b. Contact spring pressure is too low; c. Mechanical moving parts blocked, shaft rusted or crooked; d. Anti-force spring damaged.
2	Fault	Contact not absorbed or not fully absorbed
	Cause	a. Insufficient voltage of battery; b. Main contactor coil open circuit; c. Mechanical moving parts blocked, shaft rusted or crooked; d. Control contact poor contact.

7.4.2 Checking and Testing

Checking

- Check if the pump contactor and appearance of cables are in good condition, and if the plug connection is secure;

Testing

- Switch off the power supply of the vehicle;
- Carry out ON/OFF test to contacts of pump contactor with a multimeter:
  If connected, but with contactor adhesion, replace the contactor;
  If not connected, move on to the next step;

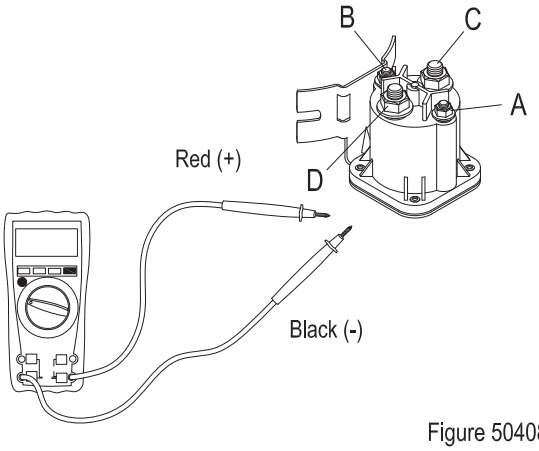


Figure 50408

- Measure the resistance between pump contactor coil end point A and B to identify if the coil is normal;
  As shown in the following table:

Resistance Measurement	Judgment
Approx. 22 Ω	Normal
0 Ω	Coil shorting (replace the contactor)
∞ Ω	Coil breaking (replace the contactor)

If the coil is normal, move on to the next step.

- Energize the contactor coil between end point A and B (24V):
  If the contact is not absorbed (without the sound of absorption), the contactor is having mechanical failure with its contact, replace the contactor;
  If the contact is absorbed (with the sound of absorption), and contact C and D are conducted, then the contactor is working properly.

7.4.3 Control Circuit Troubleshooting

Pump Contactor Control Circuit (Figure 10301)

Check if the circuit is broken by using a multimeter:

- Set the multimeter to ON-OFF;
- Check if #5/#9 circuit is conducted.

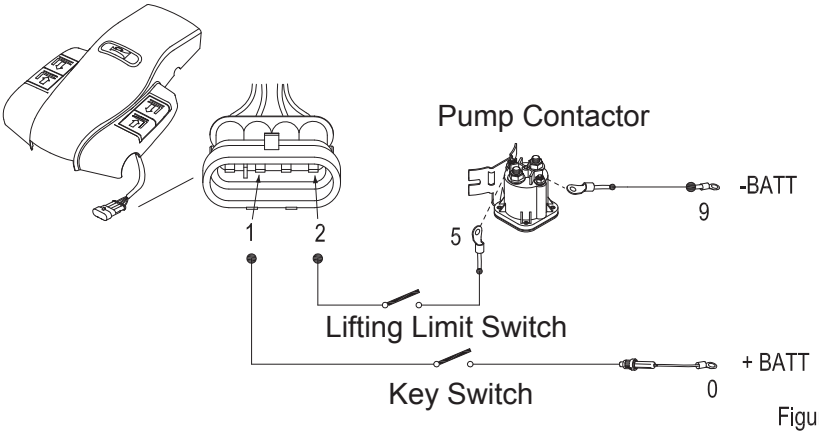


Figure 10301

7.5 Solenoid Valve

When solenoid valve coil is energized (there is voltage between coil end A and B), the electromagnetic coil generates electromagnetic force, and the spool will move, the valve will open, and the vehicle will be lowered.

When the contactor coil is de-energized, the closing part will be released under the effect of the released spring, the hydraulic oil cannot form a loop, thus the lifting mechanism cannot be lowered.

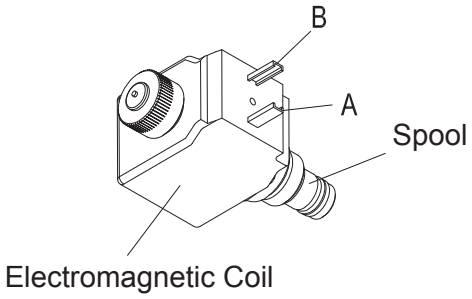


Figure 50410

7.5.1 Faults and Causes

1	Fault	Solenoid valve does not work after energized
	Cause	a. Different power supply circuits; b. Insufficient power supply voltage; c. Short circuit; d. Unsoldering coil (coil short circuit); e. Main spool and moving core of the solenoid valve blocked by impurities; f. High viscosity of hydraulic oil; g. High frequency of use, service life has expired already.
2	Fault	Solenoid valve cannot be closed
	Cause	a. Main spool or core seals broken or aged; b. Main spool and moving core of the solenoid valve blocked by impurities; c. Spring deformation; d. Balancing hole blocked by impurities; e. High frequency of use, service life has expired already.
3	Fault	Internal leakage
	Cause	Damaged seals or spring deformations
4	Fault	External leakage
	Cause	Loose connections or damaged seals
5	Fault	Noisy when energized
	Cause	a. Unstable supply voltage; b. Impurities on absorption surface or uneven surface of core, needs cleaning.

7.5.2 Checking and Testing

Checking

- Check the solenoid valve connector for loosening or poor connection of leads.

Testing

- Switch off the power supply of the vehicle;
- Measure the resistance between solenoid valve coil end point A and B to identify if the coil is normal;
  as shown in the following table:

Resistance Measurement	Judgment
Approx. 32 Ω	Normal
0 Ω	Coil shorting (replace the solenoid valve)
∞ Ω	Coil breaking (replace the solenoid valve)

If the coil is normal, move on to the next step.

- Check the solenoid valve for blocking:
  the fitting clearance between slide valve sleeve and spool is very small, when there is impurity entering or too less lubricant, it is easily blocked.

Handling method:

- Insert a steel wire from the small hole at valve end to make the spool rebound;

- Remove the solenoid valve, take out the spool and spool sleeve, clean with CCl4 to enhance the flexibility of the moving of spool within the spool sleeve. During disassembly, pay attention to the sequence of assembly and position of external wiring for correct re-assembly and wiring, also check the oil mist spray orifice for blockage and if the lubricant is sufficient.

CAUTION

If the solenoid valve is found with the above mechanical failures, it is recommended to re-place the solenoid valve directly.

7.5.3 Control Circuit Troubleshooting

Solenoid Valve Control Circuit (Figure 30306)

Check if the circuit is broken by using a multi-meter:

- Set the multimeter to ON-OFF;
- Check if #3/#9 circuit is conducted.

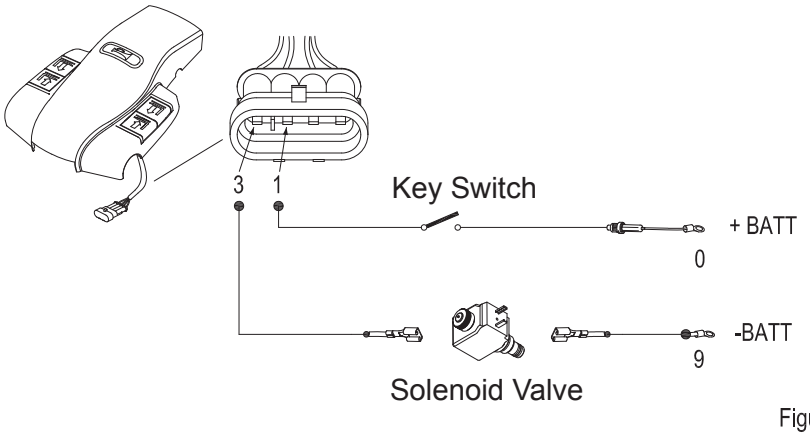


Figure 30306

7.6 Reach Cylinder

7.6.1 Cylinder Removal Precautions

- Before removing the cylinder, be sure to relieve the hydraulic circuit first, which is to lower the lifting mast to the bottom. Otherwise, when removing the tubing connected with the cylinder, the pressured hydraulic oil within the circuit may be sprayed out at high speed along with the tubing, and there is risk of causing personal injury.

  Turn off the power source, so that the entire hydraulic system will stop functioning, then the connecting tubing can be loosened; in order 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 hydraulic system. Therefore, before removing the cylinder from the equipment, the connection part must be supported with appropriate supporting to avoid personal injury or damage to the equipment;
- Cylinder is the powered actuator in hydraulic system. Therefore, before removing the cylinder from the equipment, the connection part must be supported with appropriate supporting to avoid personal injury or damage to the equipment;
- Upon disassembly of the cylinder, you should know the main structure of the cylinder to avoid sightless removal. Due to the different size, structure, purpose of use of the cylinders, the sequences and methods used for removal are also different;
- When removing each part, do not hammer forcefully, it such case cannot be avoided, please lay a copper rod to avoid damage to the parts; special tools must be used for the parts having such requirements, do not hammer forcefully or pry. Fine pitch threaded cylinder cap, after being shaken loose, loosen it with cylinder wrench with even force, copper rod can be used to hammer the part that cannot easily deform, do avoid violent shocks.
- Upon removal, the damage to cylinder threads, oil port threads, cylinder cap threads, piston rod surface and inner cylinder wall should be prevented.

  In order to prevent piston rod from bending or deformation, support it wooden block when placing.

  When removing seals, the use of sharp tools should be avoided, so as not to stab the seals. For the seals that are difficult to remove, soak them with boiled water, remove them when getting softened.

- Before removing, try to create conditions to prevent the cylinder parts from being contaminated by the surrounding dust and impurities. For example, try to disassemble the equipment in a clean environment; after the disassembly, all parts should be covered with plastic, do not cover with cotton cloth or other cloth used during operation;
- For the cylinder which is found with internal or external leakage during use, if the piston rod or cylinder tube is not scratched, such case may be due to wear or aged seals.

⚠ CAUTION

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

- For the cylinder which is found with internal or external leakage during use, if the piston rod or cylinder tube is not scratched, such case may be due to wear or aged seals (when replacing seals, replace 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 metallographic sandpaper.

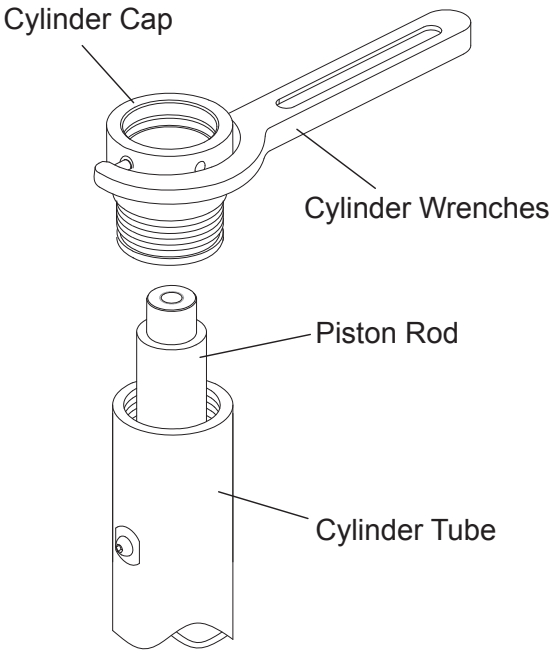


Figure 50402

7.6.2 Cylinder Installation Precautions

- All parts should be cleaned up before assembly, then to be 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.

  Where the hydraulic seals 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 first with hydraulic oil.

⚠ CAUTION

- *O-ring is quite flexible and easy to install, but it must not be pulled up to the extent of permanent deformation, nor scroll it while installing;*
- *Y-ring or X-ring needs to be identified if it is for shaft or hole to avoid misplacement;*
- *The removed O-rings and dust rings should be replaced with new ones.*

- Cylinder parts must not be arbitrarily replaced, the original products provided by the manufacturer should be used;
- After maintenance and assembly of the cylinder is completed, pressure leak testing must be carried out before it can be put operation once again.

  Before the testing, discharge the air within the cylinder, run the cylinder in a small range of movement for several times, and pay attention if it is moving without blocking and if there is uneven resistance during the moving. Upon the pressure testing, raise the pressure slowly and observe carefully for leaks.

7.6.3 Removal and Installation

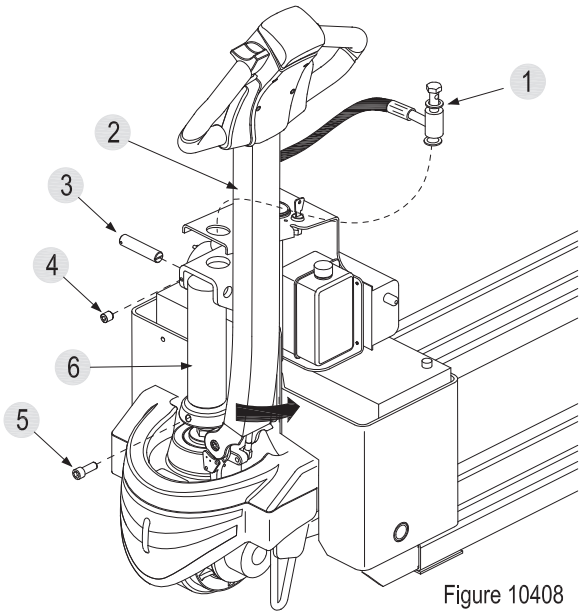


Figure 10408

- Lower the forks completely down, press the emergency stop switch and turn off the key switch;
- Remove the upper cover; (see Section 4.2.1)
- Turn the handle tube (2) to the right till the end;
- Unscrew the articulated joint (1) and remove the tubing from the cylinder;

CAUTION

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

- Unscrew two screws (4) and the screw (5);

CAUTION

Before going on with the next step, please fix the cylinder properly first. Be sure to avoid the falling of cylinder during removal, resulting in personal injury.

- Hold the cylinder (6) by hand, tap out the pin shaft (3) from the side and remove the cylinder;
- Install the cylinder according to the reverse order of removal ;
- 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 tubings and cylinder;
- Check the hydraulic oil level and make sure that the liquid is at standard level.

Cylinder Maintenance

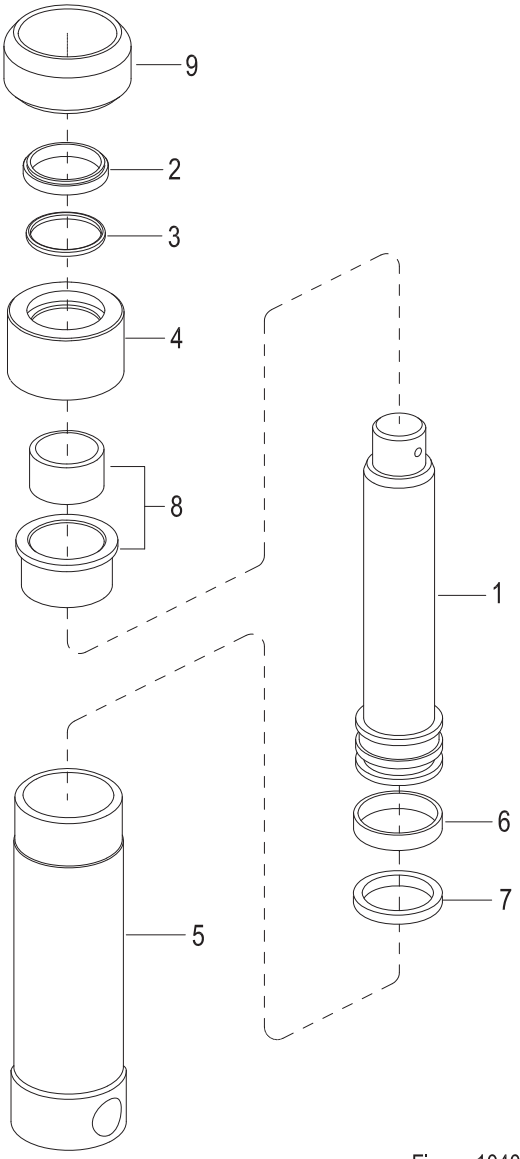


Figure 10409

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 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 cylinder cap (4, Figure 10409) with cylinder wrench;
- Remove the dust ring (2), O-ring (3) from the cylinder cap;
- Remove the guide bush (8) from the cylinder tube (5);
- Pull out the piston rod (1) from the cylinder tube;
- Remove the support ring (6) and seal (7) from the piston rod;
- Clean with hydraulic oil of the same specifications;
- Replace the problem parts and assembly in reverse steps.

CAUTION

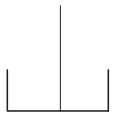
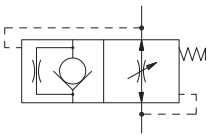
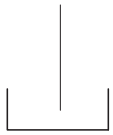
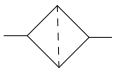
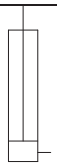
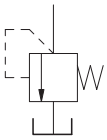
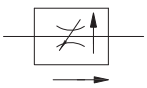
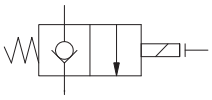
If the piston rode or cylinder tube is damaged, please replace the entire cylinder.

If the seals are aged or damaged, please replace the complete set of seals.

7.7 Hydraulic Troubleshooting

Fault Symptom		Failure Causes	Troubleshooting Measures
1	Noisy pump	a. Insufficient oil; b. High viscosity of oil; c. Oil suction pipe air leak; d. Filters clogged by impurities; e. 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.
2	Hydraulic oil with foam	a. Pump cavitation; b. 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.
3	Pump or oil temperature is too high	a. Oil is too thin; b. Pump cavitation; c. 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.
4	Low System Pressure	a. Insufficient oil; b. Relief valve failure. c. Pump wear, internal leakage.	1. Check the hydraulic oil level; 2. See Fault 6; 3. Replace the gear pump.
5	On load, declined	a. Solenoid valve failure.	1. Check and clean the solenoid valve spool.
6	Relief valve pressure unstable or too low	a. Pressure adjustment screw too loose; b. Relief valve spring breakage or deformation; c. 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.

7.8 Hydraulic Symbol

Symbol	Description	Symbol	Description
	Tank Pipe end below liquid level		Explosion-proof valve
	Tank Pipe end above liquid level		Check valve
	Filter		Cylinder Single-acting direction
	Service line (Supply line or return line)		Relief valve
	Control line (Drain line)		Throttle valve With pressure compensation device
	Connecting pipe		Solenoid Valve Two-way two-pass
	Port (Test port)		
	Motor		
	Hydraulic pump		

8. ELECTRICAL SYSTEM

NOTE:

8.1 Controller

8.1.1 Removal and Installation

Removal

- Remove the upper cover; (See Section 4.2.1)
- Remove the wiring harness and cables on the controller;
- Unscrew the two screws (1) with a wrench and remove the controller (2) and cooling fin (3);

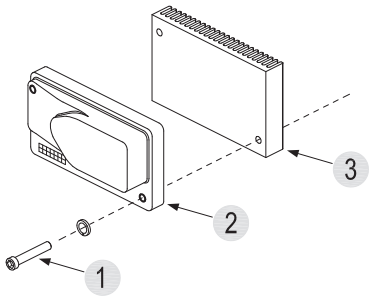


Figure 30501

Installation

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

8.1.2 Controller Interface Function

Traction Controller (1212)

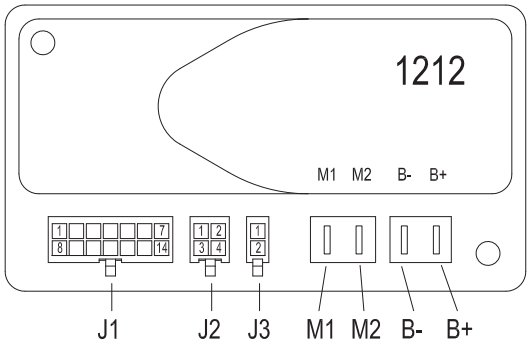
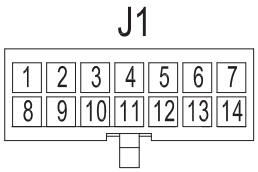


Figure 30502

J1 Interface



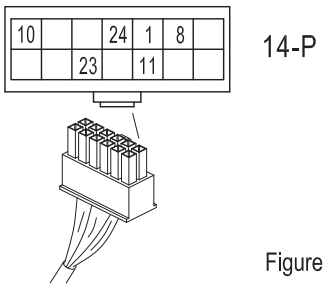


Figure 10501

J1 Interface	
Pin No.	**Description**
J1#1	Pot wiper
J1#2	-
J1#3	-
J1#4	Mode switch (open=M1,closed=M2)
J1#5	Keyswitch input (KSI)
J1#6	Speed inhibit
J1#7	-
J1#8	-
J1#9	-
J1#10	Status LED

J1 Interface - Continued	
Pin No.	**Description**
J1#11	-
J1#12	Reverse switch
J1#13	-
J1#14	-

J2 Interface
(Handheld unit communication interface)

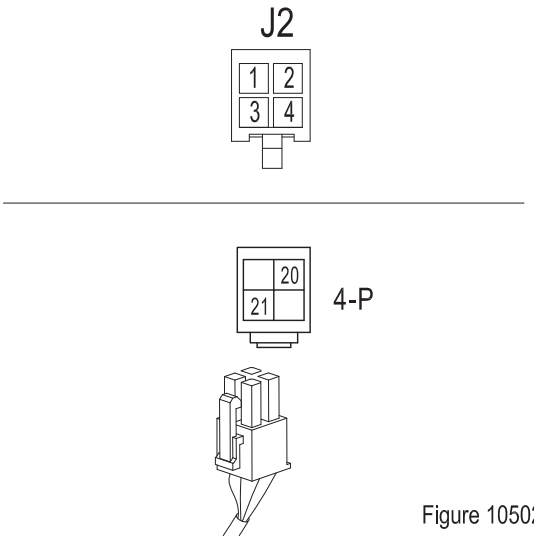


Figure 10502

J2 Interface	
Pin No.	**Description**
J2#1	Rx
J2#2	B-
J2#3	Tx / Charge inhibit
J2#4	Mode switch (open=M1,closed=M2)

J3 Interface

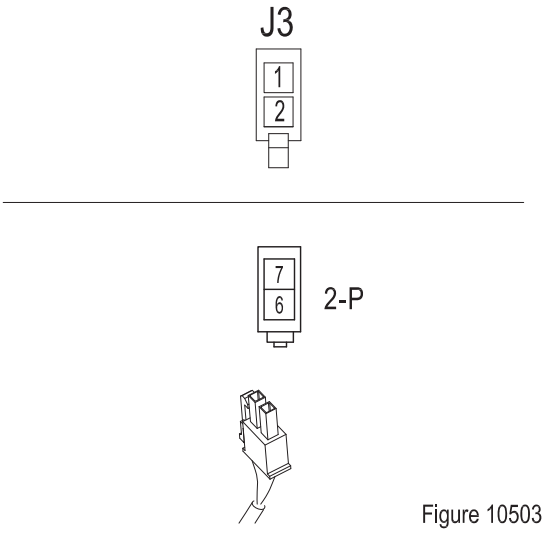


Figure 10503

J3 Interface	
Pin No.	**Description**
J3#1	Positive of electromechanical brake coil.
J3#2	Negative of electromechanical brake coil.

Terminal stud

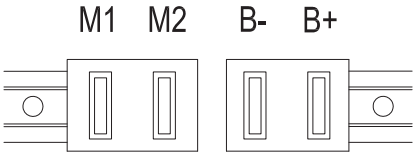


Figure 30506

Terminal stud	
Pin No.	**Description**
M1	Negative of the motor.
M2	Positive of the motor.
B-	- Batt.
B+	+Batt.

8.2 Fuse

The entire vehicle is installed with two 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 1 150A		×	O
Fuse 2 10A		O	×
1	Drive	×	×
2	Lifting / Lowering	×	×
3	Steering	O	O
4	Traction Controller	×	×
5	Charge Gauge	×	×
6	Horn	×	×

× : Failure
O : Normal

8.2.1 Location of Fuses

Fuse 1: installed on electrical mounting plate

Fuse 2: installed on main harness

★ Fuse position in electrical schematic diagram

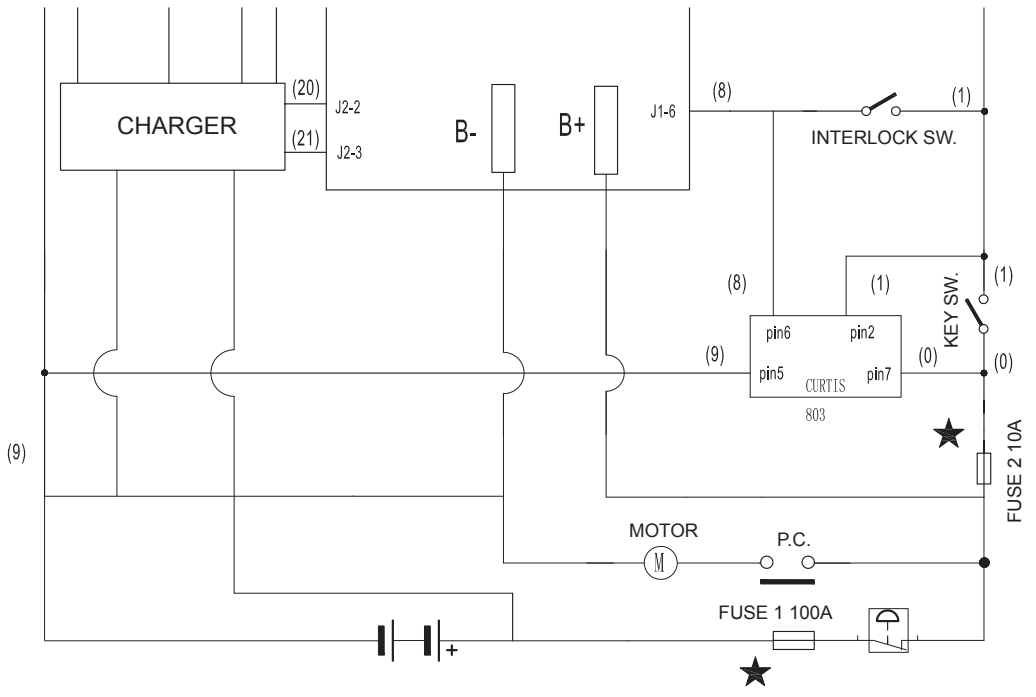


Figure 30508

8.2.2 Checking and Testing

Checking

- Check the fuses for damage, check the connectors at terminal lugs for loosening or poor connection of leads.

Testing

- Turn the key switch to "OFF", remove key; pull out the battery plug and disconnect the power supply.
- Set the multimeter to resistance measurement: with black probe (-) connected to one end of the fuse; red probe (+) connected to another end of the fuse.
- Identify if the fuse is normal according to the readings of resistance on the multimeter. As shown in the following table:

Resistance Measurement	Judgment
0 Ω	Normal
∞ Ω	Failure (replace the fuse)

8.3 Key Switch

Key switch is used to START / STOP the truck.

8.3.1 Removal and Installation

Removal

- Remove the upper cover ;(See Sention 4.2)

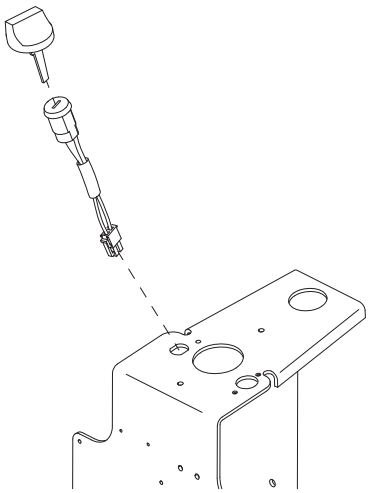


Figure 10505

- Disconnect the key switch connector from main wiring harness;
- Unscrew the nut and remove the key switch from the mounting plate.

Installation

- Install according to the reverse order of removal.

8.3.2 Faults and Causes

1	Fault	Turn the key switch to “ON”, the vehicle won’t start
	Cause	a. Key switch failure; b. Key switch circuit not conducted.
2	Fault	Turn the key switch to “OFF”, the vehicle won’t stop
	Cause	a. Key switch failure; b. Key switch shorted (short circuit)

8.3.3 Checking and Testing

Checking

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

Testing

- Check if the key switch circuit is conducted;
- Carry out ON/OFF test to the key switch with a multimeter:
  key switch at “OFF” position, open circuit; place the key switch at “ON” position, the circuit is conducted.

8.3.4 Control Circuit Troubleshooting

Key Switch Control Circuit (Figure 30517)

Check if the circuit is broken by using a multimeter:

- Set the multimeter to ON-OFF;
- Check if #0/#1 circuit is conducted.

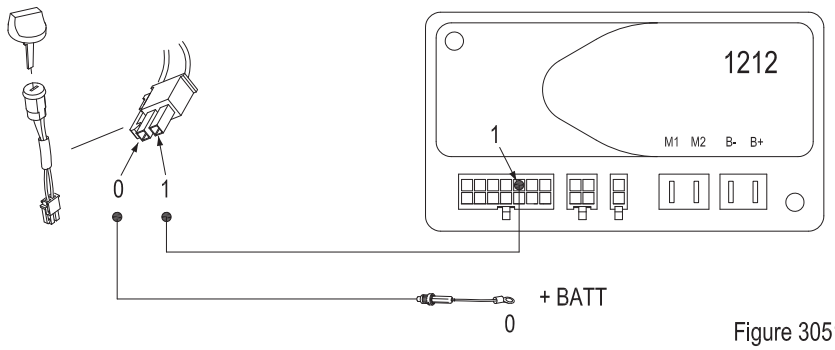


Figure 30517

8

8.4 Charge Gauge

Charge gauge is used to display remaining battery power of forklift, working hours (this function is available on the component with timer function).

8.4.1 Removal and Installation

Removal

- Remove the upper cover ;(See Sention 4.2)

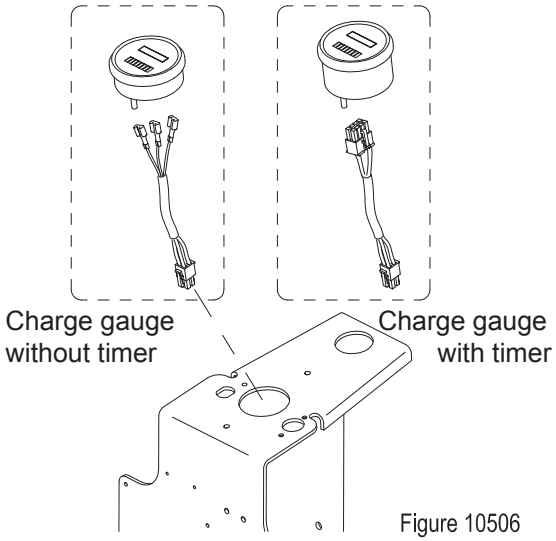


Figure 10506

- Disconnect the charge gauge connector from main wiring harness;
- Unscrew the nut and remove the charge gauge from the mounting plate.

Installation

- Install according to the reverse order of removal.

8.4.2 Faults and Causes

1	Fault	No display on the charge gauge
	Cause	a. Charge gauge failure; b. Charge gauge circuit not conducted.
2	Fault	Power capacity display not accurate
	Cause	a. Charge gauge wrong gear; b. Charge gauge failure.

8.4.3 Checking and Testing

Checking

- Check if the appearance of charge gauge its wiring harness are in good condition, and if the connectors are connected securely.
- Check if the charge gauge gear is in the correct position. (Charge gauge with timer)

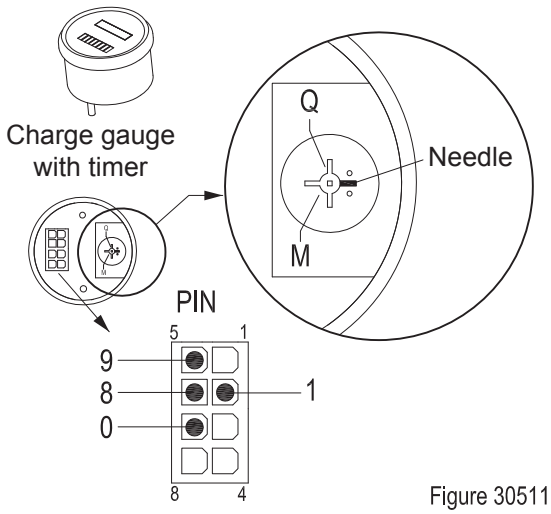


Figure 30511

M: for lead-acid battery
Q: for maintenance-free battery

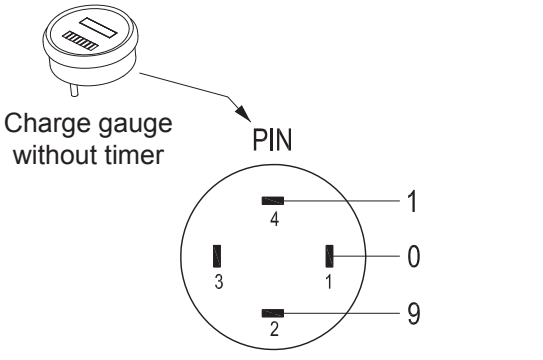


Figure 30518

8.4.4 Control Circuit Troubleshooting

Charge Gauge Control Circuit (See Electrical Schematic Diagrams)

Check if the circuit is broken by using a multimeter:

- Set the multimeter to ON-OFF;
- Check if #0/#1/#9/(#8) circuit is conducted.

8.5 LED Charging Indicator

LED charging indicator is used to display charge status, which can display in three colors: red, yellow and green.

Display	Description
Solid Red	Battery is charging
Solid Green	The charging is completed
Solid Yellow	Battery failure
Flashing Yellow	Charger failure
Flashing Red	No output current from the charger
NO Lighting	Charger failure

8.5.1 Removal and Installation

Removal

- Remove the upper cover ;(See Sention 4.2)
- Disconnect the LED charging indicator connector from main wiring harness;
- Remove the indicator (2) from the indicator holder (1) on mounting panel.

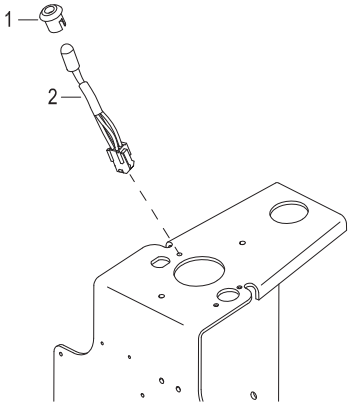


Figure 10507

Installation

- Install according to the reverse order of removal.

8.5.2 Faults and Causes

1	Fault	No display from indicator
	Cause	a. Indicator failure; b. Indicator circuit not connected; c. Charger failure.

8.5.3 Checking and Testing

Checking

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

Testing

- Check if LED charging indicator circuit is conducted;
- Energize the LED charging indicator with a voltage of 24V:
  If the light is on, then it is normal;
  if the light is not lit, then the light is faulty.

8.5.4 Control Circuit Troubleshooting

LED Charging Indicator Control Circuit (Figure 30513)

Check if the circuit is broken by using a multimeter:

- Set the multimeter to ON-OFF;
- Check if the circuit is conducted.

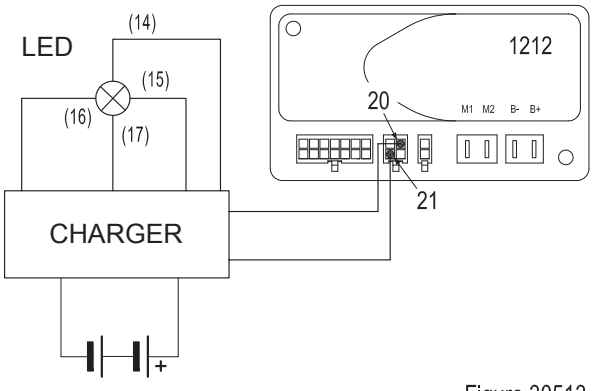


Figure 30513

8.6 Lifting Limit Switch

8.6.1 Removal and Installation

Removal

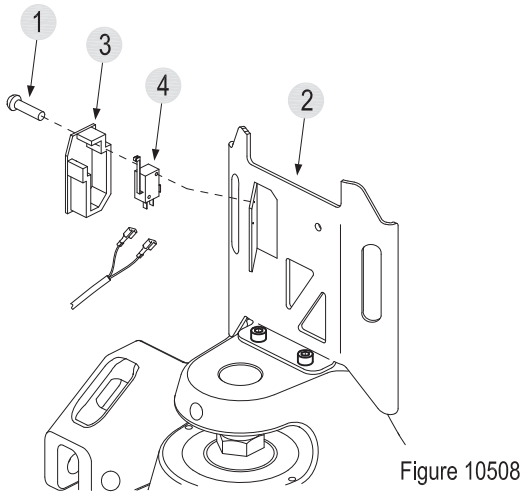


Figure 10508

- Unscrew the two screws (1) with a wrench, and remove the mounting plate (3) from the bracket (2);
- Remove the lifting limit switch (4) from the mounting plate (3);
- Disconnect the connection between lifting limit switch and drive wiring harness.

Installation

- Install according to the reverse order of removal.

8.6.2 Faults and Causes

1	Fault	Lifting mechanism cannot lift
	Cause	a. Lifting limit switch failure; b. Lifting limit switch with broken circuit.
2	Fault	Lifting limit switch pressed, lifting mechanism does not stop
	Cause	a. Lifting limit switch failure; b. Lifting limit switch shorted (short circuit).

8.6.3 Checking and Testing

Checking

- Check if the appearance of limit switch and its wiring harness are in good condition, and if the connectors are connected securely;
- Repeatedly press the limit switch to check if it can reset properly.
- Normally-closed (NC):

  Terminal (1) and Terminal (2) for connection of wiring harness connector.
  (see Figure 10509)

Testing

- Check if the limit switch circuit is conducted;
- Carry out ON/OFF test to limit switch with a multimeter:
  Reset the limit switch (original position), the circuit is connected;
  press the limit switch, the circuit is disconducted.

8.6.4 Control Circuit Troubleshooting

Lifting Limit Switch Control Circuit (Figure 10509)

Check if the circuit is broken by using a multimeter:

- Set the multimeter to ON-OFF;
- Check if #2/#5 circuit is conducted.

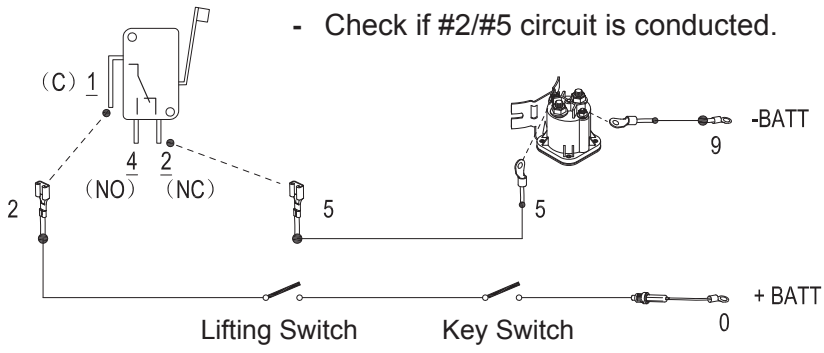


Figure 10509

8.7 Interlock Switch

8.7.1 Removal and Installation

Removal

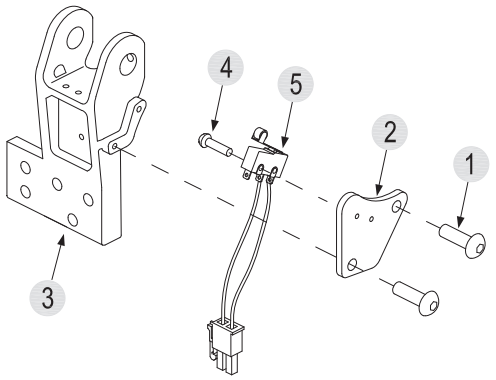


Figure 10510

- Disconnect the connection between interlock switch and main wiring harness;
- Unscrew the two screws (1) with a wrench, and remove the mounting plate (2) from the joint holder (3);
- Unscrew the two screws (4), and remove the interlock switch (5) from the mounting plate (2).

Installation

- Install according to the reverse order of removal.

8.7.2 Faults and Causes

1	Fault	Interlock switch not pressed, the vehicle can still travel
	Cause	a. Interlock switch failure; b. Interlock switch shorted (short circuit).
2	Fault	Interlock switch pressed, the vehicle cannot travel
	Cause	a. Interlock switch failure; b. Interlock switch with broken circuit.

8.7.3 Checking and Testing

Checking

- Check if the appearance of interlock switch and its wiring harness are in good condition, and if the connectors are connected securely;
- Repeatedly press the interlock switch to check if it can reset properly.

Testing

- Enter Monitor Menu to check the status of the switch: “Inhibit”, press the interlock switch, if the display does not change, then it indicates the interlock switch or its circuit failure; (see Section 8.9)
- Check if the interlock switch circuit is conducted;
- Carry out ON/OFF test to interlock switch with a multimeter:
  Reset the interlock switch (original position), the circuit is disconnected;
  press the interlock switch, the circuit is conducted.

8.7.4 Control Circuit Troubleshooting

Interlock Switch Control Circuit (Figure 30516)

Check if the circuit is broken by using a multimeter:

- Set the multimeter to ON-OFF;
- Check if #1/#8 circuit (circuit between interlock switch and controller) is conducted.

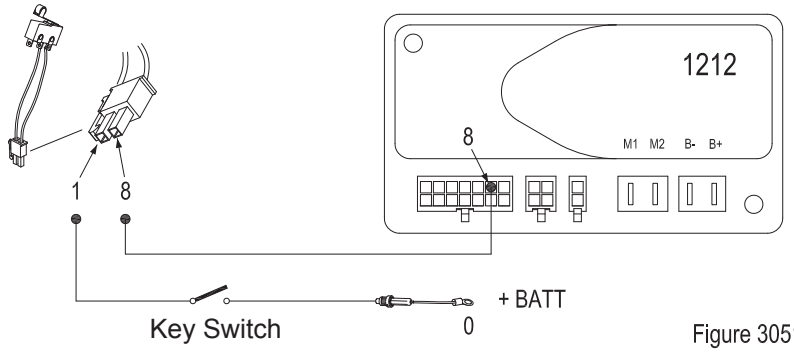


Figure 30516

8.8 Speed Mode Switch (Optional)

8.8.1 Removal and Installation

Removal

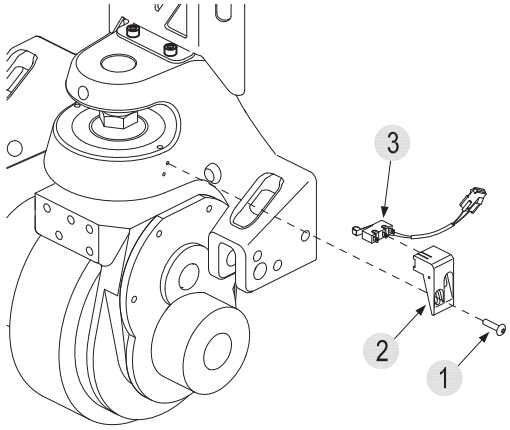


Figure 10511

- Unscrew the two screws (1) with a wrench, and remove the mounting plate (2) from the bearing bridge;
- Remove the speed mode switch (3) from the mounting plate (2);
- Disconnect the connection between speed mode switch and drive wiring harness.

Installation

- Install according to the reverse order of removal.

8.8.2 Connection Mode

Speed mode switch has 3 terminals.
The switch can be switched between open and close by toggling the roller lever to achieve the control of connection and disconnection of the circuit.

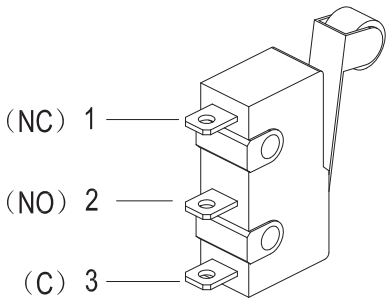


Figure 20312

Normally-opened (NO):

Terminal (2) and Terminal (3) for connection of wiring harness connector to switch base

8.8.3 Faults and Causes

1	Fault	When left or right steering angle ≥ 45°, but travel speed of forklift is not reduced
	Cause	a. Speed mode switch failure; b. Speed mode switch with broken circuit.
2	Fault	When speed mode switch is activated, the speed is not reduced
	Cause	a. Speed mode switch failure; b. Speed mode switch shorted (short circuit).

8.8.4 Checking and Testing

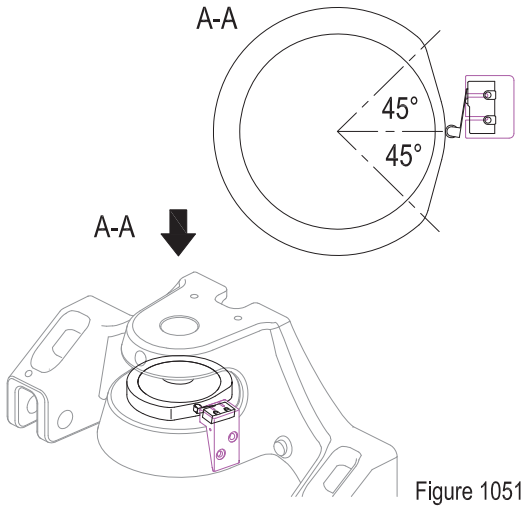


Figure 10512

Checking

- Check the switch for damage and check the roller for deformation;
- Check if the handwheel is working smoothly and if there is foreign body blockage.
- Check if the half-speed rail is in the initial position.(see Figure10512)

Testing

- Enter Monitor Menu to check the status of the switch:
  "Mode Input", press the switch, if the display does not change, then it indicates the switch or its circuit failure;
- Turn the key switch to "OFF", remove key; pull out the battery plug and switch off the power supply.
- Check the ON/OFF normally-opened (NO) terminal with a multimeter: with handwheel at natural position, Terminal (2) and (3) not conducted; toggle the handwheel, Terminal (2) and (3) conducted.
- Check the ON/OFF normally closed (NC) terminal with a multimeter: with handwheel at natural position, Terminal (1) and (3) conducted; toggle the handwheel, Terminal (1) and (3) not conducted.

8.8.5 Control Circuit Troubleshooting

Speed Mode Switch Control Circuit (Figure 10513)

Check if the circuit is broken by using a multimeter:

- Set the multimeter to ON-OFF;
- Check if #1/#24 circuit (circuit between switch and controller) is conducted.

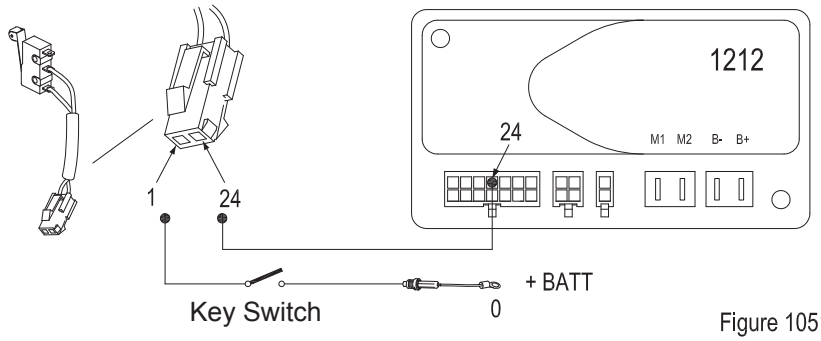


Figure 10513

8.9 Handheld Unit (Optional)

Handheld unit must be used together with controller, if necessary, it can be purchased from our company or dealer.

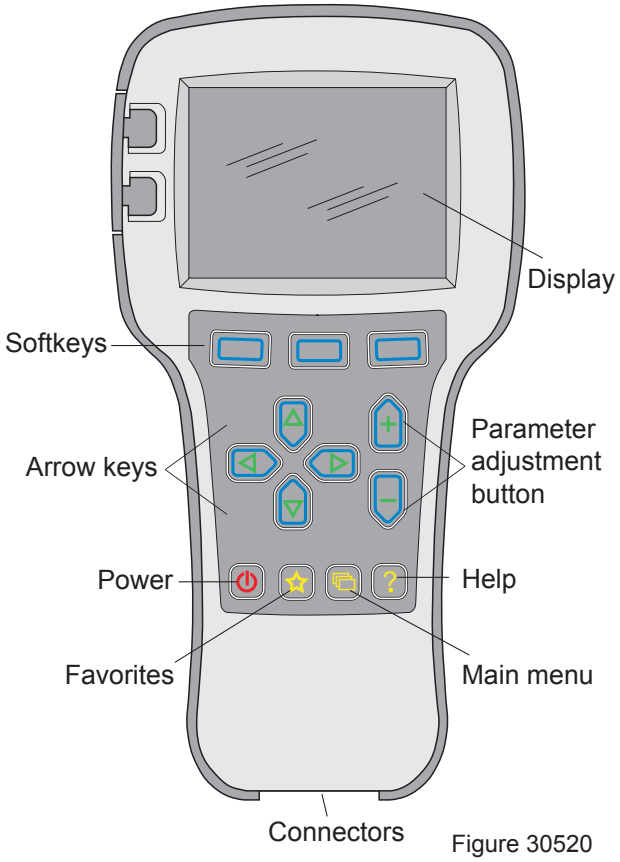
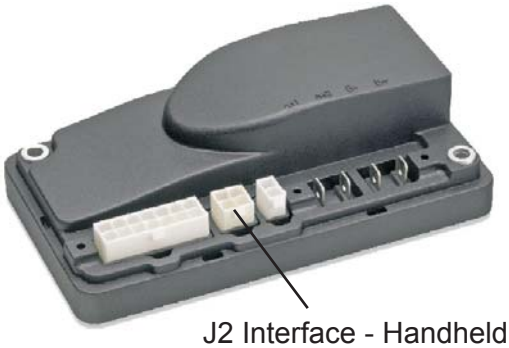


Figure 30520

8.9.1 Handheld Unit Connection

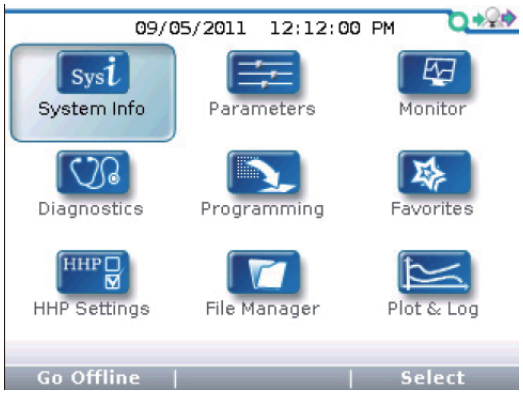
- Remove upper cover;(See Section 4.2)
- Plug the handheld unit communication cable into the handheld unit communication interface of the controller;



J2 Interface - Handheld unit communication interface

- Turn on the key switch, pull out emergency stop switch, the display of handheld unit will be flashing:
  if the connection is successful: The programmer automatically powers up, and displays this screen while it loads information from the controller.Once the programmer has uploaded the information from the controller, it displays the Main Menu.
  If the controller is not turned on when the programmer is connected, you can power up the programmer by pressing the Power key; the message “No System detected” will be displayed.

8.9.2 Handheld Unit Main Menu



- With Arrow keys (Figure 30520), you can carry out menu switching;
- “Select”, select ENTER the menu.

Parameters : parameter change
Monitor : vehicle running test
Diagnostics : error alrms

* See “Handheld Unit Operation Manual” for detailed operations

8.9.3 Parameter Settings

CAUTION

Without the written permission of equipment manufacturer or its agent, it is strictly prohibited to change any of the parameters in "PARAMETERS".

Traction Controller Parameter Settings

DRIVE MENU			
Paramete			Setting
1	Accel Max Speed		
2	Accel Min Speed		
3	Decel High Speed		
4	Decel Low Speed		
5	Rev Accel Max Speed		
6	Rev Accel Min Speed		
7	Rev Decel High Speed		
8	Rev Decel Low Speed		
9	Key off Decel		
10	E Stop Decel		
11	E Stop Pause		
12	Soft Start		
13	Gear Soften		
14	Creep Speed		
15	Soft Stop Speed		
16	Speed		
	Mode 1 (Full speed)	Max Speed	
		Min Speed	
		Rev Max Speed	
		Rev Min Speed	
	Mode 2 (Slow)	Max Speed	
		Min Speed	
		Rev Max Speed	
		Rev Min Speed	

THROTTLE MENU		
Paramete		Setting
1	Type	
2	Neutral Input	
3	PotHigh	
4	PotLow	
5	Neutral Deadband	
6	Throttle Max	
7	HPD	
8	Speed Limit Pot	
9	Throttle Map	
10	Tremor Suppression	
11	Calibration	

CURRENT MENU		
Paramete		Setting
1	Main Current Limit	
2	Braking Current Limit	
3	Boost Current	
4	Boost Time	

INHIBIT MENU		
Paramete		Setting
1	Type	
2	Speed	

BRAKE MENU		
Paramete		Setting
1	Delay	
2	Fault Check	
3	Hold Voltage	
4	Brake Light	

HORN MENU		
Paramete		Setting
1	Reverse Beep	
2	Beep Constant	

COMPENSATION MENU		
Paramete		Setting
1	IR Comp	
2	Anti-Rollback Comp	

MOTOR MENU		
Paramete		Setting
1	System Resistance	
2	Resistance Auto Comp	
3	Auto Comp Current Limit	
4	Speed Scaler	
5	Current Rating	
6	Max Current Time	
7	Cutback Gain	

EMERGENCY REVERSE MENU		
Paramete		Setting
1	Speed	
2	Time Limit	
3	Decel Rate	
4	Accel Rate	
5	Max Braking Current	
6	Switch Normally Closed	
7	EMR Interlock	

BDI MENU		
Paramete		Setting
1	Full Voltage	
2	Empty Voltage	
3	Full Charge Voltage	
4	Start Charge Voltage	
5	Reset Voltage	
6	Discharge Factor	
7	Charge Factor	
8	Low BDI Level	
9	Low BDI Max Speed	
10	External Lift Lockout	
11	Lift Lockout Enable	
12	Lift Lockout Threshold	
13	Lift Lockout Output Type	

MISCELLANEOUS MENU		
Paramete		Setting
1	Sleep	
2	Reset Drive Time	
3	Emergency Stop	
4	Pump SRO	

8.9.4 TESTER Menu

The parameters in Monitor Menu are real-time presentation of the running status of the equipment.

Traction Controller (1212)

Parameters	Description	Remark
Temp	Check the temperature of controller	Display the current temperature (℃)
Battery Voltage	Check the voltage of storage battery	Display the current voltage (V)
Motor Voltage	Check the voltage of motor	Display the current voltage (V)
Motor Thermal Cutback	Check the capacity of motor current	Display the current capacity (%)
Armature Current	Check the motor current	Display the current value (A)
Current Limit	Check the maximum limit current	Display the current value (A)
Resistance	Check the resistance of system	Display the current resistance (mΩ)
Throttle	Check the input of accelerator	Display the current capacity (%)
Speed Limit Pot	Check the input of limit speed	Display the current capacity (%)
Mode Input	Check the status of speed mode switch	If the function is triggered properly, the value will change
Reverse Input	Check the backward status of travel switch	If the function is triggered properly, the value will change
Inhibit	Check the status of interlock switch	If the function is triggered properly, the value will change
Push Input	Check the status of push switch	If the function is triggered properly, the value will change
Main Contactor	Check the status of main contactor	If the function is triggered properly, the value will change
Brake	Check the status of brake	If the function is triggered properly, the value will change
BDI	Check the capacity of battery	Display the current capacity (%)
Drive Time	Check the working time	Display the current working time (h)

8.10 Controller Error Message

The error message can be obtained in two ways:

1) By reading the appropriate display on the handheld unit ;
2) By observing the fault codes issued by the LED fault indicator.

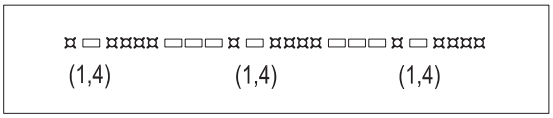
Handheld Unit Diagnostics

The fault information is shown in the Diagnostics menu of the handheld unit.

LED Fault Indicator Diagnostics

When the truck is in normal use, LED fault indicator is always going on; When any fault occurs to the vehicle, LED will twinkle and indicate the fault code; LED won't restore to the extinguishing state until the fault is eliminated.

LED indicates two digit codes: for example, digit code "1, 4" — UNDERVOLTAGE FAULT, the display mode is as follows:



¤ LED Blinks ▭ 1 Second Stop

Figure 30507

8.10.1 Traction Controller

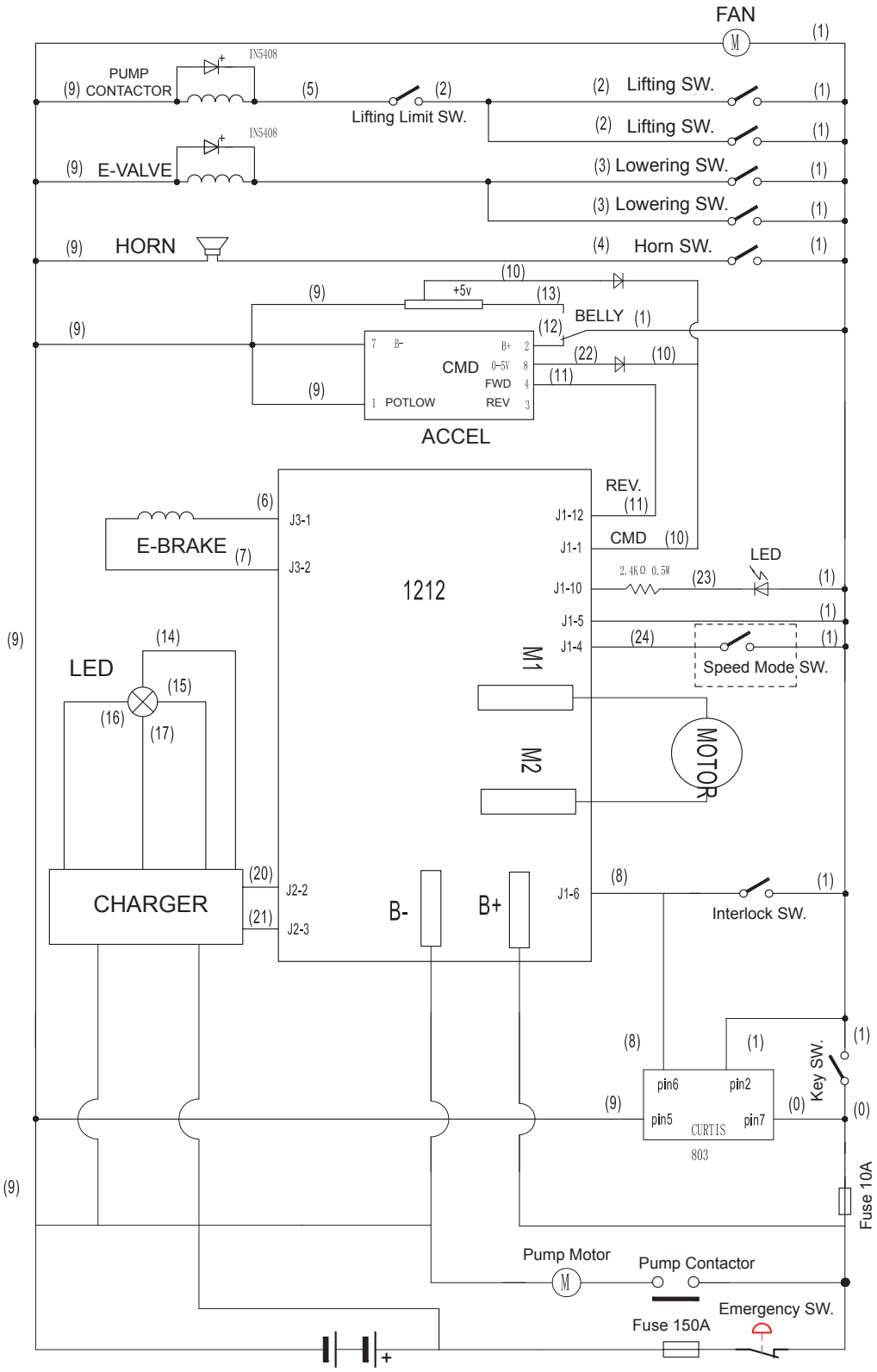
LED BLINKS digit 1	LED BLINKS digit 2	Error Message Error text	Explanation	Possible cause
1	1	THERMAL FAULT	over-/under-temperature cutback	1. Temperature >80°C or < -10°C. 2. Excessive load on vehicle. 3.Operation in extreme environments. 4.Electromagnetic brake not releasing.
1	2	THROTTLE FAULT	PotLow and/or PotWiper out of range	1.Throttle input wire open or shorted. 2.Throttle pot defective. 3.Wrong throttle type selected.
1	3	SPEED POT FAULT	speed limit pot wiper out of range	1.Speed limit pot wire(s) broken or shorted. 2. Broken speed limit pot.
1	4	UNDERVOLTAGE FAULT	battery voltage too low	1. Battery voltage <17 volts. 2. Bad connection at battery or controller.

LED BLINKS digit 1	LED BLINKS digit 2	Error Message Error text	EXPLANATION	Possible cause
1	5	OVERVOLTAGE FAULT	battery voltage too high	1. Battery voltage >31 volts. 2. Vehicle operating with charger attached. 3.Intermittent battery connection.
2	1	MAIN OFF FAULT	main contactor driver Off fault	1.Main contactor driver failed open.
2	3	MAIN FAULT	main contactor fault	1.Main contactor welded or stuck open. 2. Main contactor driver fault.
2	4	MAIN ON FAULT	main contactor driver On fault	1.Main contactor driver failed closed.
3	1	WIRING FAULT	HPD fault present >10 sec.	1.Misadjusted throttle. 2.Broken throttle pot or throttle mechanism.
3	2	BRAKE ON FAULT	brake On fault	1.Electromagnetic brake driver shorted. 2.Electromagnetic brake coil open.
3	3	PRECHARGE FAULT	precharge fault	1. Brake driver shorted. 2. Precharge circuit damaged. 3. MOSFET failure.
3	4	BRAKE OFF FAULT	brake Off fault	1.Electromagnetic brake driver open. 2.Electromagnetic brake coil shorted.
3	5	HPD FAULT	HPD (High Pedal Disable)	1. Improper sequence of throttle and KSI,push, or inhibit inputs. 2. Misadjusted throttle pot.
4	1	CURRENT SENSE FAULT	current sense out of range	1.Short in motor or in motor wiring. 2. Controller failure. ★

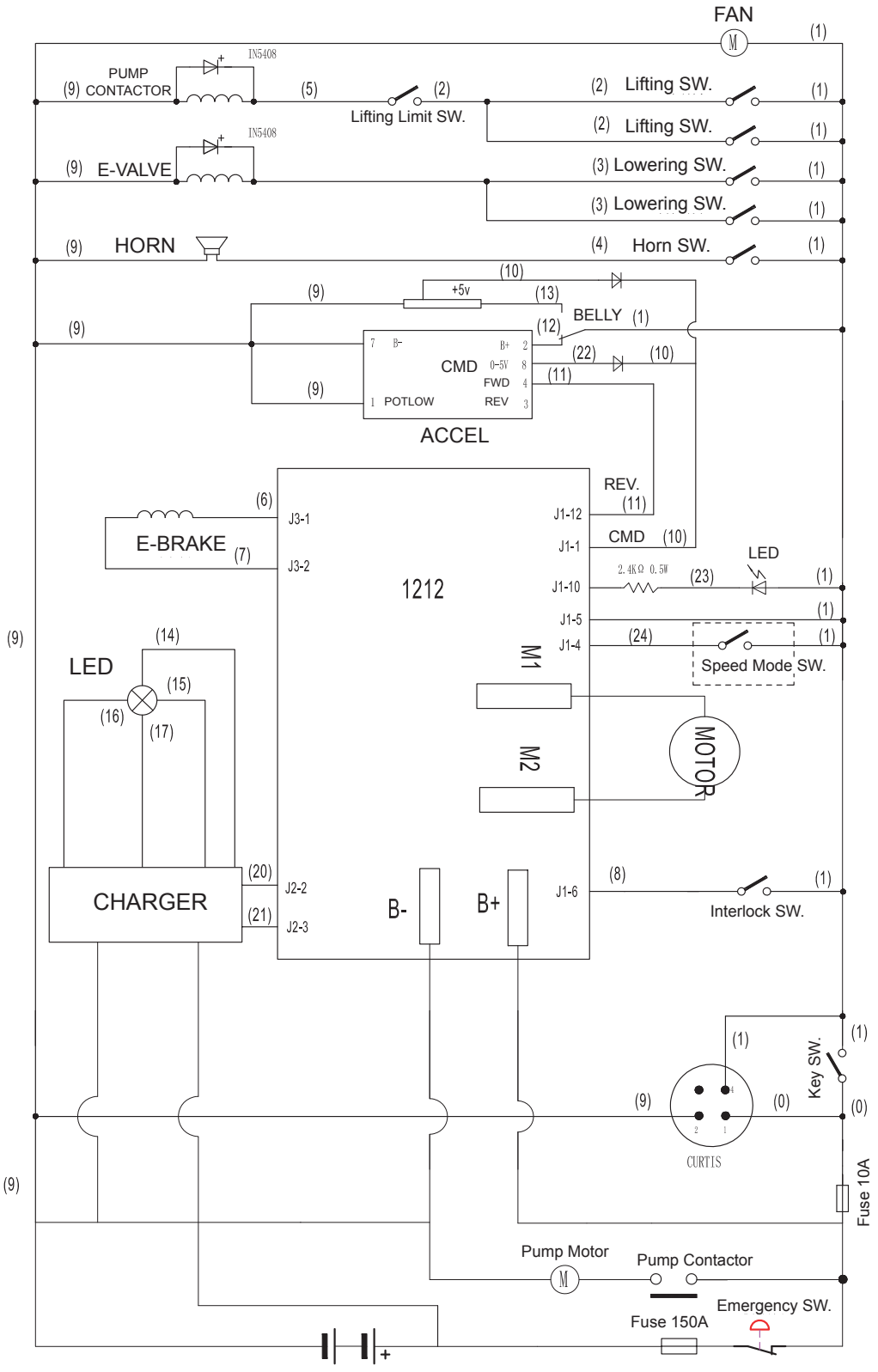
LED BLINKS digit 1	LED BLINKS digit 2	Error Message Error text	EXPLANATION	Possible cause
4	2	HARDWARE FAILSAFE	motor voltage out of range	1.Motor voltage does not correspond to throttle request. 2.Short in motor or in motor wiring. 3. Controller failure. ★
4	3	EE CHECKSUM FAULT	EEPROM fault	1. EEPROM failure or fault.
4	5	BATTERY DISCONNECT FAULT	battery disconnected	1. Battery not connected. 2.Poor connection to battery terminals.

8.11 Electrical Schematic Diagrams

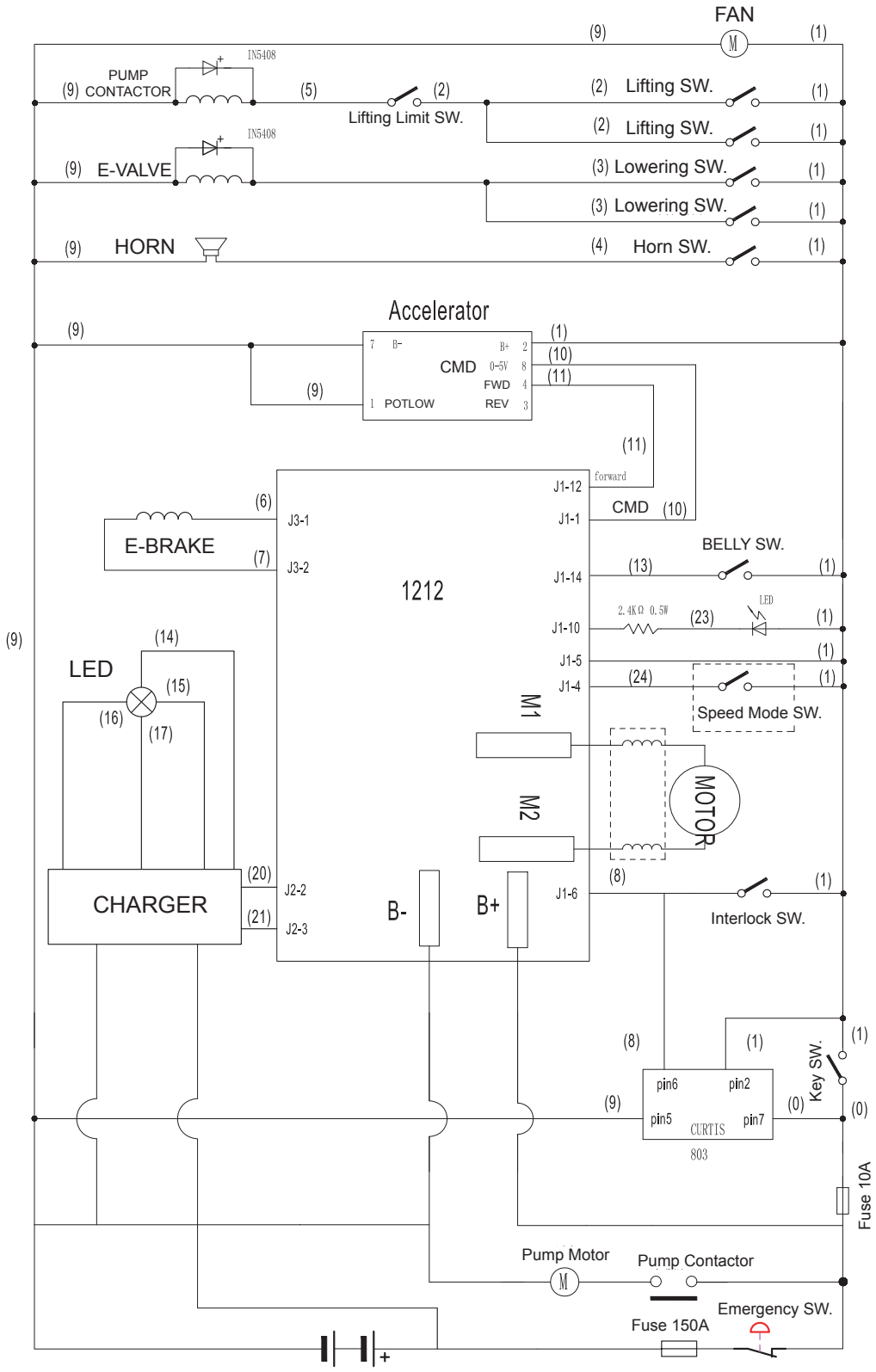
Charge Gauge with Timer + Emergency Reverse External Control



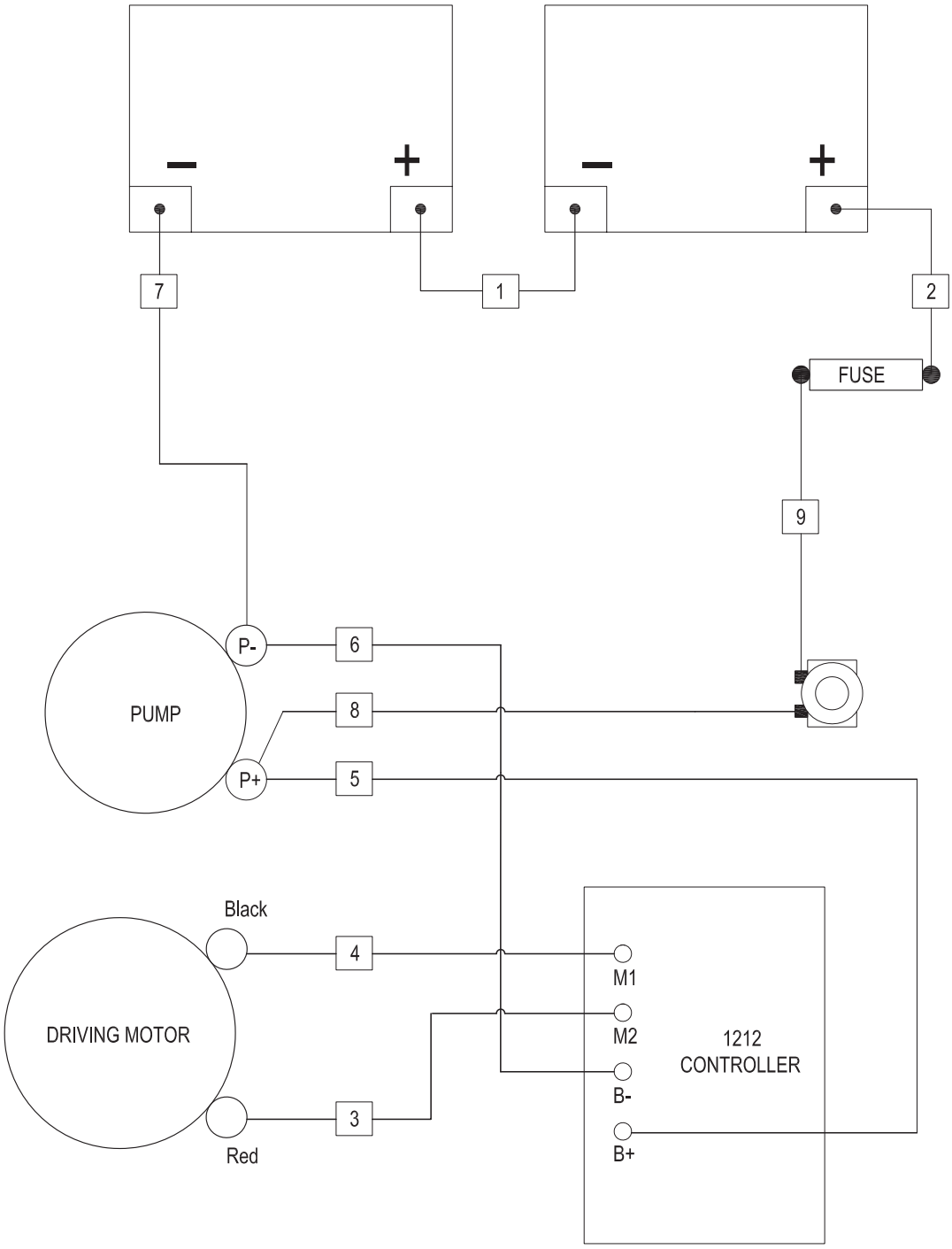
Charge Gauge without Timer + Emergency Reverse External Control



Charge Gauge with Timer + Emergency Reverse Internal Control



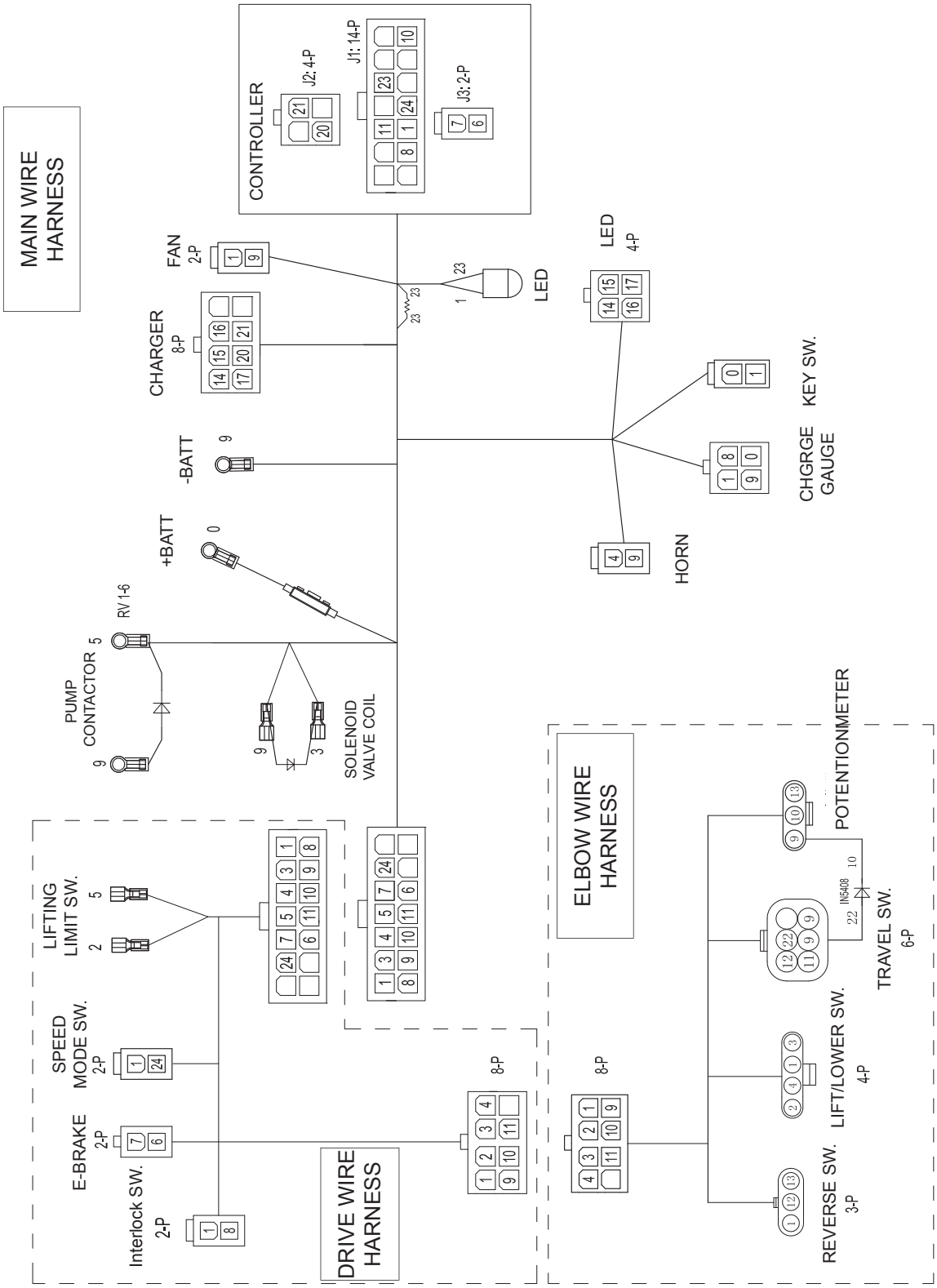
8.12 Cable Wiring Diagrams



No.	Name
1	Cable C2
2	Power Cable BATT+
3	Cable M2
4	Cable M1
5	Cable B+

No.	Name
6	Cable B-
7	Pump Motor Cable PA-
8	Pump Motor Cable PA+
9	Cable C3

8.13 Wiring Harness and Connectors



9. TROUBLESHOOTING

NOTE:

9.1 Preparation Before Troubleshooting

- Park the truck on level ground and block the wheels with wooden wedges;
- Fully lower the fork 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 battery plug has been unplugged and the electrical circuit is disconnected.*

9.1.1 Check the Voltage of Battery

- Unplug the battery plug;
- Measure the battery voltage with a multimeter: black probe (-) connected to (-) terminal of battery plug; red probe (+) connected to the (+) terminal of battery plug. Read the voltage reading on the meter.
- Identify if the battery voltage is normal according to the measured voltage.
  As shown in the following table:

Battery	Voltage	Judgment
24V	Greater than 24V	Normal
	Less than 24V	Needs to be charged

NOTE

Enter Monitor Menu to check the battery voltage.(see Section 8.9)

CAUTION

If the battery voltage is still abnormal after being charged: open the battery compartment, check the voltage of each battery and its connection circuit respectively:

1) Check if the voltage of single battery is normal;
   (See Service Manual : Maintenance-free Battery)
2) Check if the cables for connections between each battery are normal, check for open circuit and if the connection between connectors is secure.

- Battery leakage check: disconnect the battery connection, black probe (-) connected to (-) terminal of battery plug; red probe (+) connected to the chassis. Read the voltage reading on the meter.

  No voltage (0V): normal;
  With voltage: battery leakage (remove battery compartment, check each battery and cables)

9.2 Troubleshooting Solutions of Common Faults

Table 9.1 lists the common faults that may occur and handling methods. Mainly consists of the following items:

Table 9.1 Troubleshooting of Common Faults

Fault	Fault Symptom	Troubleshooting Order *	Troubleshooting Measures
Power supply failure	1. Whole vehicle power outrage	a. Power supply failure b. Fuse failure c. Emergency stop switch or circuit failure d. Key switch or circuit failure	1) Check the voltage of storage battery (see Section 9.1.1) 2) Check the fuses (see Section 8.2) 3) Check key switch and its circuit (see Section 8.3) 4) Check emergency stop switch and its circuit
Travel Fault	1. Forward and reverse moving failures of the vehicle, but other functions are normal	a. Interlock switch or its circuit connection failure b. Electromagnetic brake locked (Non-mechanical failure, the instrument will display fault code) c. Travel switch or its circuit connection failure d. Drive motor or its circuit connection failure e. Drive motor carbon brush failure f. Controller failure	Controller failure error, carry out troubleshooting according to the fault code information on the instrument (see Section 8.10). 1) Check if the interlock switch or the connection of its circuit is normal; (See Section 8.7) 2) Electromagnetic brake and its connecting circuit; (see Section 5.2) 3) Check the travel switch and its connection circuit; (see Section 6.3) 4) Check the drive motor and its connection circuit; (see Section 5.3) 5) Replace the controller.
	2. The vehicle can travel at low speed, but cannot travel at high speed	Failures due to external factors: a. Electromagnetic brake locked (Non-mechanical failure, the instrument will display fault code) b. Motor bearing blocked c. Gearbox bearing blocked Failures due to internal factors: a. Battery voltage deficiency b. Speed mode switch failure b. Controller failure	Controller failure error, carry out troubleshooting according to the fault code information on the instrument (see Section 8.10). 1) Check the voltage of storage battery (see Section 9.1.1) 1) Check if the motor rotation is normal; 2) Check the electromagnetic brake or its connection circuit (see Section 5.2) 3) Check speed mode switch and its connection circuit; (see Section 8.8) 4) Remove the gearbox, check if the gear rotation is smooth and if there is blocking; (see Section 5.5) 5) Replace the controller

***** Carry out trouble shooting in accordance with the order listed in the table, it can help you quickly identify problems and resolve accordingly.

Table 9.1 Troubleshooting of Common Faults (continued)

Fault	Fault Symptom	Troubleshooting Order *	Troubleshooting Measures
Hydraulic Failure	1. The vehicle cannot lift	1. Pump motor does not work: a. Pump motor or its circuit connection failure b. Pump contactor or its circuit connection failure c. Lifting switch or its circuit connection failure d. Lifting limit switch or its circuit connection failure	1. Pump motor does not work: 1) Check the pump motor and its connection circuit; (see Section 7.3) 2) Check the pump contactor and its connection circuit; (see Section 7.4) 3) Check the lifting switch and its connection circuit; (see Section 6.2) 4) Check the lifting limit switch and its connection circuit; (see Section 8.6)
		2. Pump motor works: a. Overload b. Insufficient hydraulic oil c. Hydraulic pipeline leakage d. Pump motor reverse rotation e. Cylinder failure (blocked) f. Solenoid valve blocked and cannot reset g. 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: 1) Refer to the rated capacity marked on the nameplate; 2) Lower the mast to the bottom, check if the amount of oil in the oil tank can meet the requirements (see Section 2.2.3); 3) Check the pipe and hydraulic components for oil leaks; 4) Check the pump motor wiring; 5) Check the cylinder for damage or deformation, remove the cylinder to check for wear or aged seals inside; (see Section 7.6) 6) Wash or replace the solenoid spool (see Section 7.5) 7) Wash or replace the valve body
	2. The vehicle cannot be lowered	a. Solenoid valve or its circuit connection failure b. Lowering switch or its circuit connection failure c. Valve failure; d. Cylinder deformation or blocked	1) Check the lowering button and its connection circuit; (see Section 6.2) 2) Check the solenoid valve and its connection circuit; (see Section 7.5) 3) Check the cylinder for deformation, remove the cylinder to check if the internal assembly is normal ; (see Section 7.6) 4) Clean or replace the valve;

***** Carry out trouble shooting in accordance with the order listed in the table, it can help you quickly identify problems and resolve accordingly.

Table 9.1 Troubleshooting of Common Faults (continued)

Fault	Fault Symptom	Troubleshooting Order *	Troubleshooting Measures
Lift Failure	3. Slow Lifting of Vehicle	a. Overload b. Hydraulic pipeline leakage c. 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
	4. Slow Lowering of Vehicle	a. Solenoid valve blocking b. Valve body failure: throttle valve failure or blocked	1) Wash or replace the solenoid spool (see Section 7.5) 2) Wash or replace the valve body
	5. Unstable Lifting / Lowering of Vehicle	a. Lifting mechanism loosening or wear; b. Poor lubrication of lifting mechanism;	1) Check if the lifting mechanism is normal; (see Section 4.3)
Other Failures	1. Horn does not sound	a. Horn switch or its circuit connection failure b. Horn failure	1) Check the horn button and its connection circuit; (see Section 6.2) 2) Check the horn and its connection circuit. (see Section 6.2)

***** Carry out trouble shooting in accordance with the order listed in the table, it can help you quickly identify problems and resolve accordingly.

APPENDIX

NOTE:

B SERVICE MANUAL - BATTERY

NOTE:

B1 Lead-acid Battery

B1-1 Safety and Warnings

- When operating on battery, you must wear protective glasses and protective clothing!
- Electrolyte contains sulfuric acid and is highly corrosive. If it accidentally comes into contact with the skin, wash immediately with plenty of water, if the situation is serious, immediately seek medical advice.
- The battery will produce hydrogen during charging, which may produce an explosive mixture. Smoking or ignition is prohibited near the battery that is being charged or just completes charging, there should not be flame or a hot wire, otherwise there may be fire or explosion hazards!

CAUTION

To avoid accumulation of hydrogen gas, keep the battery cover open during charging, charge the battery at a cool, well-ventilated place.

- To avoid short circuit. Metal parts of the battery cell are live; it is prohibited to place metal objects on the battery to avoid the occurrence of short circuit.
- Dumping of battery is prohibited. Only use proper lifting equipment to lift or transport the battery.

WARNING

- *It is necessary to add water regularly, otherwise may cause damage to the battery due to water loss.*
- *The water must be added after the battery is fully charged, adding water before charging can cause electrolyte overflow.*
- *The amount of water to be added must be strictly controlled, excessive adding of water may lead to electrolyte overflow.*
- *Only distilled water can be added, the adding of tap water or mineral water is prohibited.*

As for the decrease of battery capacity, or even damage to the battery due to failure to comply with the above provisions, the quality assurance will automatically void.

As for failure to comply with instructions for use, maintenance without using original parts, user corruption, or violation of provisions when adding electrolyte and other circumstances, the quality assurance will automatically void.

B

B1-2 Use of Battery

B1-2.1 Pre-use Checks

- Check if the battery status is normal and also check for mechanical failures;
- Connect the battery connectors, make sure the contact is solid, the electrodes are connected properly, otherwise may cause damage to the battery, truck or charger;
- Check if the electrode bolt of each battery interface is tightened;
- Check electrolyte fluid level. It must be ensured that the electrolyte level is higher than the upper edge of overflow outlet or separator;
- Charge the battery according to the instructions on the operation manual;
- Refill the electrolyte with distilled water to make the electrolyte level reach standard level.

B1-2.2 Discharging

- Do not close or cover the ventilation openings with objects;
- When connecting or disconnecting the battery connector (such as, plug), the power supply must be disconnected first;
- In order to meet or exceed the rated battery service life, the battery should avoid excessive discharge during runtime (capacity less than 20% of the rated capacity);
- Re-charge the battery immediately after discharging without delay.

B1-2.3 Charging

- When charging, only DC can be used. Connect the battery with proper charger for specification and size to avoid overload of circuit and interface, and to avoid electrolyte foaming or overflow from the cell;
- The charger purchased separately must be checked by the after-sales service department of our company before it can be used;
- When connecting the battery with the charger, the circuit switch should be at “OFF” position, make sure the connection is correct. It is prohibited to connect the battery with live charger.
- Before battery charging, make sure the electrolyte temperature is within the range of 10 ° C~ 45 ° C;
- When charging, the cover or cover plate of the battery compartment must be opened or removed to ensure that the gas generated during charging can be smoothly discharged.
- When the concentration of the electrolyte and battery voltage remain constant (for more than 2 hours), it indicates that the charging is completed.

B1-2.4 Temperature

- Rated temperature of electrolyte is 30 °C.
- If the temperature is too high, it will reduce the service life of the battery; too low may reduce the battery capacity.
- When the temperature reaches the limit temperature of 55 ° C, it is prohibited to run the battery.

B1-3 Maintenance & Care

B1-3.1 Daily Maintenance

- Charge the discharged battery;
- Visual inspection for excessive dirtiness and mechanical damage after the charging.

B1-3.2 Weekly Maintenance

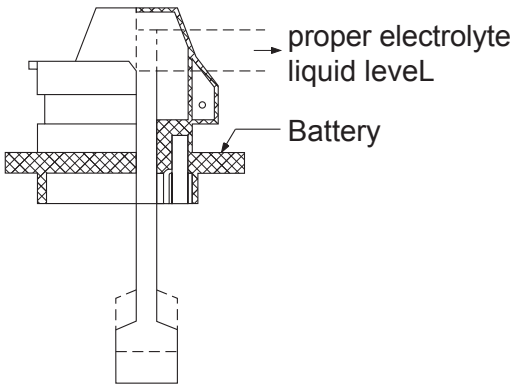
- Control the electrolyte fluid level. Check the electrolyte fluid level when the charging is about to complete. If necessary, add distilled water into the electrolyte when the charging is about to complete to make the fluid level reach the rated standard.

⚠ CAUTION

- *Lower fluid level may reduce the battery capacity, and thus reduce the service life of battery.*
- *Higher liquid level may lead to electrolyte overflow when charging, which may cause corrosion to the battery compartment or even the vehicle.*

There are two types of battery filler cap used on battery cell:

1) Filler cap with buoy



Add distilled water, red buoy will float until while rod appears under the red scale.

WARNING

- *Add only distilled water.*
- *Before adding distilled water, check if the buoy can move up and down properly to prevent the buoy from failing to float up and resulting in excessive filling.*

2) Filler cap without buoy

When adding water, stop filling when the electrolyte level is higher than the protective plate for 15~20 mm.

CAUTION

Please operate the electric watering device in accordance with its operating manual.

B1-3.3 Monthly Maintenance

- Before the charging is completed (while the charger is still energized), measure and record the voltage of battery cell the entire battery;
- After the charging is completed, measure and record the electrolyte concentration and temperature of the battery cell.

How to tell if the battery is normal?

- As for a normal set of fully charged batteries, the voltage of each of the battery cell should be around 2.08V, specific gravity of electrolyte should be around 1.28;

CAUTION

After being fully charged, if the voltage of battery cell is lower than 1.85V or the specific gravity of electrolyte is less than 1.05, then that battery cell has been damaged and needs to be replaced.

- As for a group of normal batteries, when the battery is discharged for 80% (the instrument alarms and prompts low battery, you should recharge in a timely manner), the open circuit voltage should be around 1.93V, specific gravity of electrolyte (under 30°C) should be around 1.14.

CAUTION

And you can identify if the battery is fully discharged according to the specific gravity of battery electrolyte when the instrument alarms, and identify if the capacity indicated on the instrument is accurate.

If there is fault, please notify service personnel for repairs.

B1-3.4 Care

1. Keep it clean

- Battery surface should be clean and dry to prevent the occurrence of leakage currents;
- Battery cables, terminals and connectors must be tightened and clean, a small amount of special grease should also be applied.

WARNING

- *Do not use a dry cloth or fabric to clean the surface of the battery, so that to prevent the occurrence of static electricity, resulting in explosion;*
- *Unplug the power plug;*
- *Wipe clean with a damp cloth;*
- *Please wear goggles, rubber boots and rubber gloves.*

2. Make sure that the cable insulation is not damaged and the connection layer has no signs of heating.

3. Make sure that the "+" and "-" output terminals are not sulfated (with white salt).

- Slight sulfation: clean top of the element with a damp cloth.
- Severe sulfation: the battery must be removed for powerful cleaning; the battery base should also be cleaned.
- Very severe sulfation (or a large amount of electrolyte overflow): please contact the after-sales service department as soon as possible.

DO NOT arbitrarily discharge acidic wastewater after cleaning, dispose such water in accordance with national laws and regulations!

B1-4 Storage

- When the battery is not used for a long time, the battery should be filled up and stored in a dry, frost-free space.
- Regular equalizing charge may help extend the service life of battery and ensure that the capacity won't be reduced.

B1-5 Troubleshooting

- Upon battery or charger failure, please promptly notify the after-sales service department.
- Refer to battery failure analysis to facilitate troubleshooting and elimination.

Battery Fault Analysis

Fault	Negative Phenomena	Cause	Handling Methods
Insufficient Battery Charge	1. Low static voltage 2. Low density, cannot meet the requirements after being charged 3. Short working time 4. When running, the instrument displays quick drop of capacity	1. Charger voltage and current are set too low 2. Insufficient initial charge 3. Charger failure	1. Adjust and repair the charger 2. Battery supplemental charge 3. Battery needs to be replaced in severe situations
Electrolyte has been improperly added to the battery	- In case of high intensity: 1. Electrolyte density is not less than 1.300g/cm3 after charging 2. Battery static voltage is higher 3. Initial capacity is good, but reduced after a period of use 4. Electrolyte is turbid - Low density: 1. Electrolyte density is still lower than the specified value after charging 2. Battery capacity is low - Adding impure liquid: 1. Battery capacity is low 2. Electrolyte is turbid and of abnormal color 3. Battery with severe self-discharge	1. Initial adding of electrolyte with excessive high or low density 2. Liquid level reduces, adding errors, failed to add pure water in accordance with provisions, but mistakenly adding dilute acid 3. Initial adding of liquid is impure (containing impurities and with odor)	1. Replace the battery electrolyte 2. Battery needs to be replaced in severe situations

Battery Fault Analysis

Fault	Negative Phenomena	Cause	Handling Methods
Electrode plate sulfation	1. Battery capacity drops during normal discharge 2. Density drops to be lower than normal value 3. Voltage drops quickly when discharging 4. Start charging under high voltage 5. Bubbles generated during charging 6. Coarse crystallization of PbSO4	1. Insufficient initial charge 2. Long time of storage under the state of discharge 3. Long-term insufficient charged 4. Electrolyte density is too high 5. Electrolyte level is too low, the upper part of electrode plate is exposed outside of the electrolyte 6. Impure electrolyte 7. Internal short circuit	1. Over-discharge method 2. Repeated charging method 3. Water treatment method
Excessive shedding of active substances	1. There is gray-brown substance rising from the bottom when charging 2. Battery capacity reduced	1. Brown precipitation is due to excessive large charging current 2. White sediment is due to over-discharge 3. Battery electrolyte is impure	1. Clean up the precipitation 2. Adjust the density 3. Battery needs to be replaced if necessary
Battery overcharged	1. Color of battery filling cap becomes yellow, and then red 2. Battery casing deformation 3. Battery spacers carbonization, deformation 4. Positive electrode corrosion, broken 5. Electrode pole rubber bushing raised, aged and cracked 6. Frequent water-adding, electrolytic turbidity during charging 7. Evenly shedding of active substances from electrode plate 8. Positive electrode plate detonation	1. Charger voltage and current are set too high 2. Charging time is too long 3. Frequent charging 4. Less discharging, but much charging 5. Charger failure	1. Adjust and repair the charger 2. Adjust the charging system 3. Battery needs to be replaced in severe situations
Battery Over-discharge	1. Low static voltage 2. Electrolyte density is still low after charging 3. Positive and negative electrode plates curved or fractured	1. Go on using the battery despite of insufficient charge 2. Battery pack short circuit 3. Small current long time discharge	1. Supplementary charging 2. Repair the vehicle 3. Battery needs to be replaced in severe situations

Battery Fault Analysis			
Fault	**Negative Phenomena**	**Cause**	**Handling Methods**
Battery Short Circuit	1. Low static voltage below 2V 2. Electrolyte density is too low 3. High temperature during charging 4. Truck is with short working time	1. Electrode plate deformed and short circuit 2. Spacer missing or broken during assembly 3. Positive electrode active substances shedding, short circuit at bottom	Battery needs to be replaced
Broken circuits	1. Abnormal and unstable voltage upon external connection with load 2. Current fails to input when charging	1. Poor welding during assembly of electrode pole or electrode plate 2. External short circuit 3. Large current discharge 4. Poor wiring connection or disconnected 5. Electrode plate corrosion	1. Battery needs to be repaired 2. Battery needs to be replaced if necessary
Battery Reverse Electrodes	1. Negative voltage values 2. Electrolyte density is lower than 1.20g/cm3 after charging 3. Positive and negative electrode lugs, colors of electrode plates are reversed	Wrong connections of positive and negative electrodes during charging	1. Reverse charging is allowable 2. Battery needs to be replaced in severe situations
Battery Leaks	1. Filling hole leaks 2. Leaks at sealing seams of tank and filling cap 3. Drainage 4. Marks of bumps on external surface of tank	1. Tank, filling cap with poor heat sealing 2. Electrode lug rubber ring problems 3. Sealing compound cracked 4 External impact due to negligence during use	1. Repair 2. Battery needs to be replaced if necessary

B2 Maintenance-free Battery

B2-1 Safety and Warnings

- The battery should be away from heat source and the place that is easy to produce sparks, the safety distance should be greater than 0.5m.
- The battery should avoid direct sunlight, and cannot be placed in the environment with large amount of radioactivity, infrared radiation, ultraviolet radiation, organic solvent gas and corrosive gases.
- Due to the high voltage of battery components, there is risk of electrical shock; therefore, insulated tools should be used when installing or removing the conductive straps, wear insulated gloves, aprons and protective goggles when installing or handling batteries. During installation or handling of the batteries, only non-metallic sling can be used, wire ropes cannot be used.
- Dirty strap or loose connection may cause battery ignition, or even damage the battery group, so double-check and remove the dirt on the strap when installing, and tighten the strap.
- DO NOT clean the battery case with organic solvent, DO NOT use carbon dioxide fire extinguisher to extinguish electrical fires, carbon tetrachloride fire extinguisher is available.
- When the battery is connected to the charger or the load, circuit switch should be at "OFF" position, and make sure the connection is correct: positive electrode of the battery is connected to the positive electrode of the charger, and negative electrodes are connected with each other.
- During the use of battery, be sure to tighten the bolts of the terminals, so as to avoid sparks and poor contact.

As for failure to comply with instructions for use, maintenance without using original parts, user corruption, or violation of provisions when adding electrolyte and other circumstances, the quality assurance will automatically void.

B2-2 Use of Battery

B2-2.1 Pre-use Checks

- Check if the fixing bolts on the bracket for the battery are tightened, insecure installation may cause damage to the case due to the shock during the travel of the vehicle.
  Metal objects should not be placed on the battery to prevent short circuits;
- Check if the poles and wiring connections are reliable from time to time. In order to prevent oxidation of terminals, you can apply Vaseline or other protective agents;
- DO NOT check the capacity of battery through direct ignition (short circuit test), such method may damage the battery;
- There will often be yellow white paste around the battery poles and cover, which is caused by the corrosion of sulfuric acid to the poles, wire clips and holders, etc. These substances are of very large resistance and must be removed in a timely manner;
- When you need to use two batteries in series, the capacities of the two batteries are preferably to be equal. Otherwise it will affect the service life of the battery.

B2-2.2 Discharging

- When connecting or disconnecting the battery connector (such as, plug), the power supply must be disconnected first;
- In order to meet or exceed the rated battery service life, the battery should avoid excessive discharge during runtime (the remaining capacity is less than 20% of the rated capacity);
- Re-charge the battery immediately after discharging without delay;
- The normal load voltage of battery is 20.8V ~24.4V, if the voltage is lower than this range, it indicates that the battery already has capacity loss, the circumstance of long time under load voltage may reduce the service life of the battery.

B2-2.3 Charging

- When charging, only DC can be used. Connect the battery with proper charger for specification and size to avoid overload of circuit and interface, and to avoid electrolyte foaming, leading to swollen battery;
- The charger purchased separately must be checked by the after-sales service department of our company before it can be used;
- When connecting the battery with the charger, the circuit switch should be at “OFF” position, make sure the connection is correct. It is prohibited to connect the battery with live charger.
- Before charging the battery, the charging space should be ensured with good ventilation without open flames and combustibles; when the temperature of electrolyte exceeds 40 degrees during charging, reduce the current or take physical cooling measures, the charging must be stopped when the temperature reaches 45 degrees;
- When the battery voltage remains constant (for more than 2 hours), and the load voltage of the battery is within the specified range between 20.8V~24.4V, it indicates that the charging is completed.

B2-3 Maintenance & Care

- Compared to lead-acid batteries, maintenance-free battery eliminates the maintenance to electrolyte.

Daily Maintenance

- Charge the discharged battery;
- Visual inspection for excessive dirtiness and mechanical damage after the charging.

Supplementary Charging

- If the vehicle is not used for more than two months, supplementary charging must be carried out to the battery to prevent permanent battery damage;
- Charging method is in accordance with the requirements of normal charging.

How to tell if the battery is normal?

General diagnostic method for the quality of battery is to fully charge the battery with good charger, and then measure the load voltage with a multimeter to check if the voltage is between 20.8V~24.4V.

C SCHEDULE

NOTE:

Operator's Daily Checklist

Date _____ Operator _____

Truck No. _____ No. _____

Department _____

Runtime
Meter Reading _____

Daily Check Items	O.K.(√)	Remark
Drive Wheel		
Load Wheel / Casters		
Horn		
Lifting / Lowering Control Functions		
Optional Features		
Forward / Reverse Control Functions		
Steering control functions		
Braking Functions		
Check hydraulic system for leaks: cylinders, fittings, tubings, oil tank, etc.		